FCC 47CFR part 15C
Test Report
For
IEEE 802.15.4 wireless controller module
JN5148-T01-M00

Reference Standard: FCC 47CFR part 15C
Manufacturer: NXP Laboratories UK Ltd
For type of equipment and serial number, refer to section 3
Report Number: 05-480/4715/1/11
Report Produced by: -

R.N. Electronics Ltd.
1 Arnolds Court
Arnolds Farm Lane
Mountnessing
Essex
CM13 1UT
U.K.

www.RNelectronics.com

Telephone +44 (0) 1277 352219
Facsimile +44 (0) 1277 352968

1. Contents

2. Summary of Test Results

The IEEE 802.15.4 wireless controller module JN5148-T01-M00 was tested to the following standards: -

FCC 47CFR Part 15C (effective date October 1st, 2010); Class DTS Intentional Radiator

Any compliance statements are made reliant on the modes of operation as instructed to us by the Manufacturer based on their specific knowledge of the application and functionality of the equipment tested. Whilst every effort is made to assure quality of testing, type tests are not exhaustive and although no non-conformances may be found, this doesn't exclude the possibility of equipment not meeting the intentions of the standard, particularly under different conditions to those during testing.

Title	Reference	Results
1. Conducted Emissions	FCC Part 15C §15.207	NOT APPLICABLE[1]
2. Radiated Emissions	FCC Part 15C §15.205, §15.209 & §15.247(d)	PASSED
3. Modulation Bandwidth	FCC Part 15C §15.215(c), §15.247(a)(2)	PASSED
4. Intentional Radiator Field Strength	FCC Part 15C §15.247(b)(3)	PASSED
5. Power Spectral Density	FCC Part 15C §15.247(e)	PASSED
6. Band Edge Compliance	FCC Part 15C §15.205, §15.209 & §15.247	PASSED

Notes:
[1] The digital device tested is intended to be powered from 3V dc supply (battery) and intended for modular approval. Any third party device it is incorporated into with a connection to the AC power line will require demonstration of compliance with the limits. Refer to §15.207(c) "Measurements to demonstrate compliance with the conducted limits are not required for devices which only employ battery power for operation and which do not operate from the AC power lines or contain provisions for operation while connected to AC power lines".

This report relates to the equipment tested as identified by a unique serial number and at the time it was tested. It does not relate to any other similar equipment and performance of the product before or after the test cannot be guaranteed.

Date of Test: 24th to 27th May 2011

Test Engineer: Digitally signed by: Daniel Sims
DN: CN = Daniel Sims C = GB O = RN Electronics
Date: 2011.06.07 16:49:52 Z

Approved By:
Technical Director

Customer Representative:

3. Equipment Under Test (EUT)

3.1 Equipment Specification

Applicant	NXP Laboratories UK Ltd Furnival Street Sheffield S1 4QT
Manufacturer of EUT	NXP Laboratories UK Ltd
Brand name of EUT	NXP Labs (UK) Ltd
Model Number of EUT	JN5148-T01-M00
Serial Number of EUT	1111000065
Date when equipment was received by RN Electronics	19th May 2011
Date of test:	24th to 27th May 2011
Customer order number:	GB628200012562
Visual description of EUT:	A small metal canned enclosure mounted on a PCB with an integral track antenna. For the purpose of test the PCB was mounted onto a battery powered motherboard.
Main function of the EUT:	A 2.4GHz (IEE802.15.4) wireless microcontroller module.
Height	6.9 mm
Width	20 mm
Depth	30.8 mm
Weight	0.01 kg
Voltage	3 V DC battery powered via test board pcb
Current required from above voltage source	0.05 A

3.2 EUT Configurations for testing

Frequency range	2.405 - 2.480 GHz
Normal use position	Not specified
Normal test signals	Internally generated OQPSK - 1M65G1D
Declared Power Level	+2.5dBm
Declared Channel Bandwidth	2MHz
Highest Frequencies generated/used	2.480GHz

3.3 EUT Modes

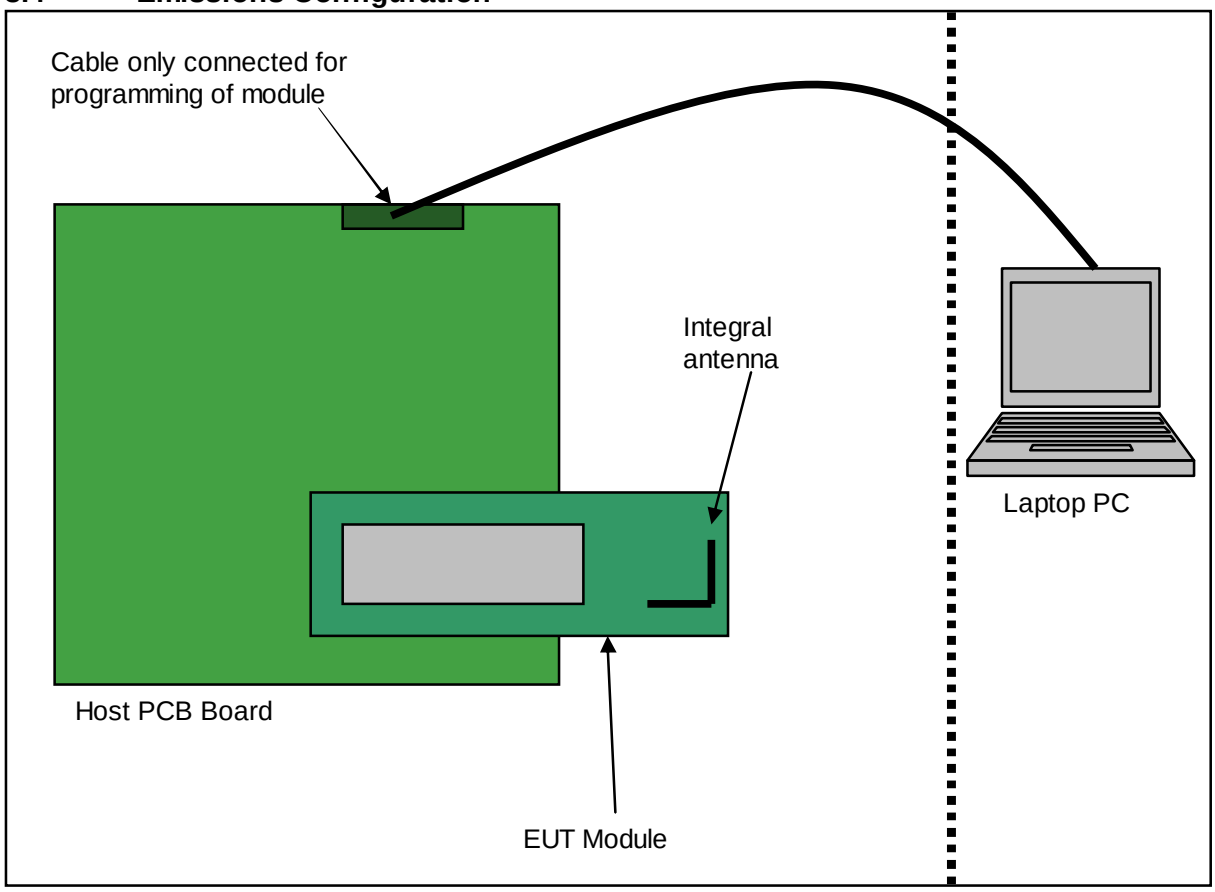
Mode	Description of mode	Used for Testing
Transmit CW 2.405GHz	Unit in constant transmit with no mod @ 2.405GHz	YES
Transmit CW 2.440GHz	Unit in constant transmit with no mod @ 2.440GHz	YES
Transmit CW 2.480GHz	Unit in constant transmit with no mod @ 2.480GHz	YES
Transmit Mod 2.405GHz	Unit in constant transmit with mod @ 2.405GHz	YES
Transmit Mod 2.440GHz	Unit in constant transmit with mod @ 2.440GHz	YES
Transmit Mod 2.480GHz	Unit in constant transmit with mod @ 2.480GHz	YES
Receive 2.405GHz	Unit in receive mode @2.405 GHz	YES
Receive 2.440GHz	Unit in receive mode @2.440 GHz	YES
Receive 2.480GHz	Unit in receive mode @2.480 GHz	YES
Transmit 1% duty cycle	Unit transmitting system modulation 1% duty cycle	YES

Description of ancillary equipment connected to the equipment under test, for the purpose of tests, can be found in Section 10.

Any modifications made to the EUT, whilst under test, can be found in Section 11.

This report was printed on: 07 June 2011

3.4 Emissions Configuration



The equipment under test was supplied by 3V DC from two new Batteries situated on the provided host PCB board. The battery levels were monitored throughout tests to ensure the levels did not drop below the +/- 10% required. To change channels and select the correct modes for test a programming lead was connected and the unit programmed. The programming lead was removed for tests. Application programming software was provided by NXP Laboratories UK Ltd. A laptop provided by RN Electronics was used to program the modules.

For radiated emissions the support equipment was situated outside the chamber and the programming lead removed after each channel/mode change.

Top, Middle & Bottom channels were checked/ tested in both Transmit and Receive modes using the 16MHz clock option. All power levels were left at maximum (default setting).

Bottom channel = 2.405GHz
Middle channel = 2.440GHz
Top channel = 2.480GHz

All test were performed using the unit marked s/n 1111000065, except for conducted power, for which, a second unit s/n 1111601272 was provided.

Description of ancillary equipment connected to the equipment under test, for the purpose of tests, can be found in Section 11.

4. Specifications

The tests were performed by RN Electronics Engineer Daniel Sims who set up the tests, the test equipment, and operated it in accordance with the ***R.N. Electronics Ltd*** procedures manual, FCC Part 15 and those specifications incorporated by reference into 47CFR15 (e.g. ANSI C63.4-2003).

R.N. Electronics Ltd sites M and OATS are listed with the FCC. Registration Number 293246

4.1 Deviations

None.

4.2 Tests at Extremes of Temperature & Voltage

☒ A permanent integral antenna was used for testing.
☐ A test fixture was used for testing.
☐ A temporary RF port was created for testing.
☒ The equipment external RF port was used for testing.

4.3 Measurement Uncertainties

Parameter	Uncertainty
Transmitter Tests	
Conducted RF power	<± 1.0 dB
Spectral power density	<± 1.5 dB
Bandwidth	<± 1.9 %
Radiated RF Power	<± 3.5 dB
Radiated Spurious Emissions	<± 3.4 dB
H-Field Emissions	<± 2.8 dB

5. Tests, Methods and Results

5.1 Conducted Emissions

NOT APPLICABLE.
The digital device tested is intended to be powered from 3V DC supply (battery) and intended for modular approval. Any third party device it is incorporated into with a connection to the AC power line will require demonstration of compliance with the limits. Refer to §15.207(c) "Measurements to demonstrate compliance with the conducted limits are not required for devices which only employ battery power for operation and which do not operate from the AC power lines or contain provisions for operation while connected to AC power lines"

5.2 Radiated Emissions

5.2.1 Test Methods

Test Requirements	FCC Part 15C, Reference (15.209)
Test Method:	ANSI C63.4, Reference (8.)

5.2.1.1 Configuration of EUT

The EUT was placed on a 0.8 metres high turntable. The front edge of the EUT was initially positioned facing the antenna. The EUT was measured at a distance of 3 metres. The EUT was rotated in all three orthogonal planes. Radiated Emissions testing was performed with new batteries.

5.2.1.2 Test Procedure

Tests were made in accordance with FCC Part 15 using the measuring equipment noted below.

Below 30MHz, measurements were made in a semi-anechoic chamber (pre-scan) with final measurements on an OATS without a ground plane. The antenna was placed 1m above the ground. The equipment and the antenna were rotated 360° to record the worst case emissions.

30MHz - 1GHz, measurements were made on a site listed with the FCC. The equipment was rotated 360° and the antenna scanned 1 – 4 metres in both horizontal and vertical polarisations to record the worst case emissions.

Above 1GHz, measurements were made in a semi-anechoic chamber with appropriate absorbing material for use in this range. The antenna was placed 1m above the ground in line with the EUT, which was rotated through 360° to record the worst case emissions.

At least 6 signals within 20dB and all signals within 10dB of the limit were investigated.

5.2.2 Test results

Tests were performed using Test Site M**.**

Test Environment: Temperature: 17-20°C Humidity: 35-38%

Analyser plots for the Quasi-Peak / Average values as applicable and any table of signals within 20dB of the limit line can be found in Section 6.2 of this report. Band Edge Compliance plots can be found in section 6.6 of this report.

These show that the **EUT** has **PASSED** this test.

5.2.2.1 Test Equipment used

E410, E411, E412, TMS933, E268, E428, TMS78, TMS79, TMS82

See Section 10 for more details

5.3 Intentional Radiator Field Strength & Peak Conducted Power

5.3.1 Test Methods

Test Requirements: FCC Part 15C, Reference (15.247)

Test Method: FCC Part 15C, Reference (15.247)
ANSI C63.10, Reference (6.10.2.1 a))

5.3.1.1 Configuration of EUT

The Integral antenna EUT was placed on a 0.8 metres high turntable. The front edge of the EUT was initially positioned facing the antenna. The EUT was measured at a distance of 3 metres. The antenna was scanned 1-4m in height in both Horizontal and Vertical polarisations. The EUT was rotated in all three orthogonal planes. The conducted EUT was measured on a bench using a spectrum analyser connected to the RF port.

5.3.1.2 Test Procedure

Tests were made in accordance with FCC Part 15 using the measuring equipment noted below.

Measurements were made in a semi-anechoic chamber and on a test bench.

The integral antenna unit was rotated 360° to record the maximised emission.

5.3.2 Test results

Test Environment: Temperature: 17-25°C Humidity: 32-46 %

Any Analyser plots can be found in Section 6.3 of this report.

The maximised field strength measured was:-

Integral Antenna results

Frequency (MHz)	Power (3MHz RBW) (dBuV/m @ 3 metres)	Power (100kHz RBW) (dBuV/m @ 3 metres)
2405	94.8	91.4
2440	95.0	91.7
2480	93.6	89.9

Conducted unit results

Frequency (MHz)	Power (dBm) (3MHz RBW)
2405	+1.5
2440	+1.7
2480	+1.5

Limits: 1Watt (+30dBm).

These results show that the EUT has **PASSED** this test.

5.3.2.1 Test Equipment used

TMS82, E268, E367, E410, E411, E412

See Section 10 for more details

5.4 Duty Cycle

Test not applicable. However, a basic duty cycle measurement was made in order to ascertain any duty cycle corrections required to be applied to the test results.

According to 15.35(b): the limit on peak radio frequency emissions is 20 dB above the maximum permitted average emission limit applicable to the equipment under test.

As peak emissions (upper restricted band edge – see page 43) were no more than 9.3dB above the average emissions measured and the worst case average emission measured is -4.0dB below the permitted average emission limit then the condition for peak emissions is met.

According to 15.35(c): when the radiated emission limits are expressed in terms of the average value of the emission, and pulsed operation is employed, the measurement field strength shall be determined by averaging over one complete pulse train, including blanking intervals, as long as the pulse train does not exceed 0.1 seconds.

For purposes of test the equipment was operated with the transmitter continuously on. For a 1% duty cycle, the power measured would be reduced by 20 log (0.01) = 40dB. For a 10% duty cycle, the power measured would be reduced by 20 log (0.10) = 20dB. According to the declared duty cycle, therefore, the emissions observed are well below the limit after averaging for pulse rate.

Duty Cycle
In normal operation the equipment employs pulsing at a variable rate, depending on the application. The manufacturer has declared a duty cycle of 1% and quotes IEEE 802.15.4: "The specifications of IEEE Std 802.15.4-2003 are tailored for applications with low power and low data rates (a maximum of 250 kb/s and down to 20 kb/s). Typical applications for IEEE 802.15.4 devices are anticipated to run with low duty cycles (under 1%). This will make IEEE 802.15.4 devices less likely to cause interference to other standards".
IEEE 802.15.4 also quotes a nominal packet length of 0.01472ms (40 data bytes) and for <10% duty cycle restrictions up to 6 packets per 100ms.
A measurement of the EUT operating at the nominal 1% rate is shown in the plots section **6.4.**

5.6 Maximum Spectral Power Density

5.6.1 Test Methods

Test Requirements	FCC Part 15C, Reference (15.247)
Test Method:	FCC Part 15C, Reference (15.247) KDB558074, PSD Option 1

5.6.1.1 Configuration of EUT

The Conducted EUT was tested on a bench via the RF port.

5.6.1.2 Test Procedure

Tests were made in accordance with FCC Part 15 using the measuring equipment noted below. The peak of the power envelope was found and zoomed in on; the spectrum analyser was then set to measure at a slow sweep, per KDB558074, in 3kHz bandwidth.

5.6.2 Test results

Tests were performed using Test Site **A.**

Temperature of test Environment: 19°C

Channel	Duty cycle	Result (dBm/3kHz)
Bottom	100%	-9.2
Middle	100%	-9.2
Top	100%	-9.8

Limits: +8dBm/3kHz.

These results show that the **EUT** has **PASSED** this test.

5.6.2.1 Test Equipment used

E342, E367, E434

See Section 10 for more details.

5.7 6 dB Bandwidth

5.7.1 Test Methods

Test Requirements	FCC Part 15C, Reference (15.247)
Test Method:	FCC Part 15C, Reference (15.247) ANSI C63.10, Reference (6.9.1)

5.7.1.1 Configuration of EUT

The Conducted EUT was tested on a bench via the RF port.

5.7.1.2 Test Procedure

Tests were made in accordance with FCC Part 15 using the measuring equipment noted below.

5.7.2 Test results

Tests were performed using Test Site **K**.

Temperature of test Environment: 21°C

Analyser plots for the 6dB bandwidth can be found in Section 6.5 of this report.

Channel	Result	Plot reference
Bottom	1.53MHz	J4715-1, Bottom channel 6dB BW (OBW) 100k rbw
Middle	1.56MHz	J4715-1, Middle channel 6dB BW (OBW) 100k rbw
Top	1.62MHz	J4715-1, Top channel 6dB BW (OBW) 100k rbw

Limits: > 500kHz BW.

These results show that the **EUT** has **PASSED** this test.

5.7.2.1 Test Equipment used

E412, E313

See Section 10 for more details.

5.8 Band Edge Compliance

5.8.1 Test Methods

Test Requirements: FCC Part 15C, Reference (15.215 and 15.247)

Test Method: FCC Part 15C, Reference (15.215)
ANSI C63.10, Reference (6.9.2)

5.8.1.1 Configuration of EUT

The EUT was placed on a 0.8 metres high turntable. The front edge of the EUT was initially positioned facing the antenna. The EUT was measured at a distance of 3 metres.

5.8.1.2 Test Procedure

Tests were made in accordance with FCC Part 15 using the measuring equipment noted below.

5.8.2 Test results

Tests were performed using Test Site **B**.

Temperature of test Environment: 22°C

Analyser plots for the Band Edge Compliance can be found in Section 6.5 and 6.6 of this report. These show the 20dBc requirement of 15.247(d) are met at the band edges of 2400 and 2483.5 MHz.

The following tables list the field strengths observed in the adjacent restricted bands, which are required to meet the tighter 15.209 limits:

Channel	Band edge PK reading (dBuV/m)	Band edge AV reading (dBuV/m)	Plot reference
Bottom	44.2	35.3	J4715-1, bot chan Horiz band edge 1M rbw AV
Top	63.3	50.0	J4715-1, Top chan Horiz band edge 1M rbw AV

The band edge readings were performed with a peak detector (max held plot) and with the EUT set in a constant 100% transmit state.

Limits: AV = 54dBuV/m at band edges
PK = 74dBuV/m at band edges

These results show that the **EUT** has **PASSED** this test.

5.8.2.1 Test Equipment used

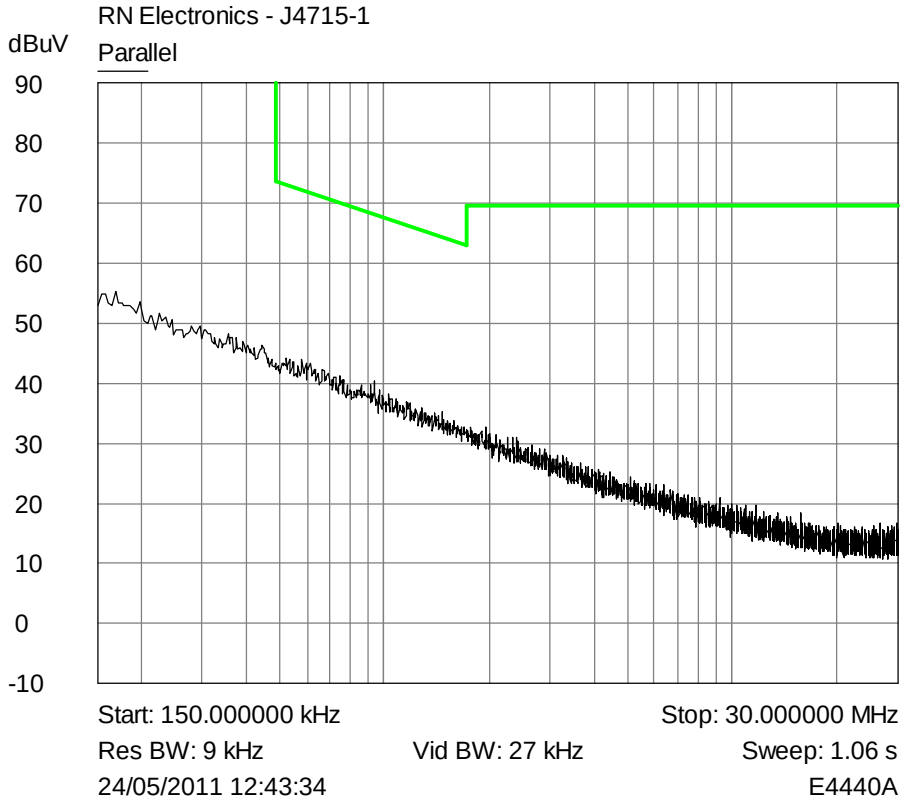
E412, E342, TMS82, E268,

See Section 10 for more details.

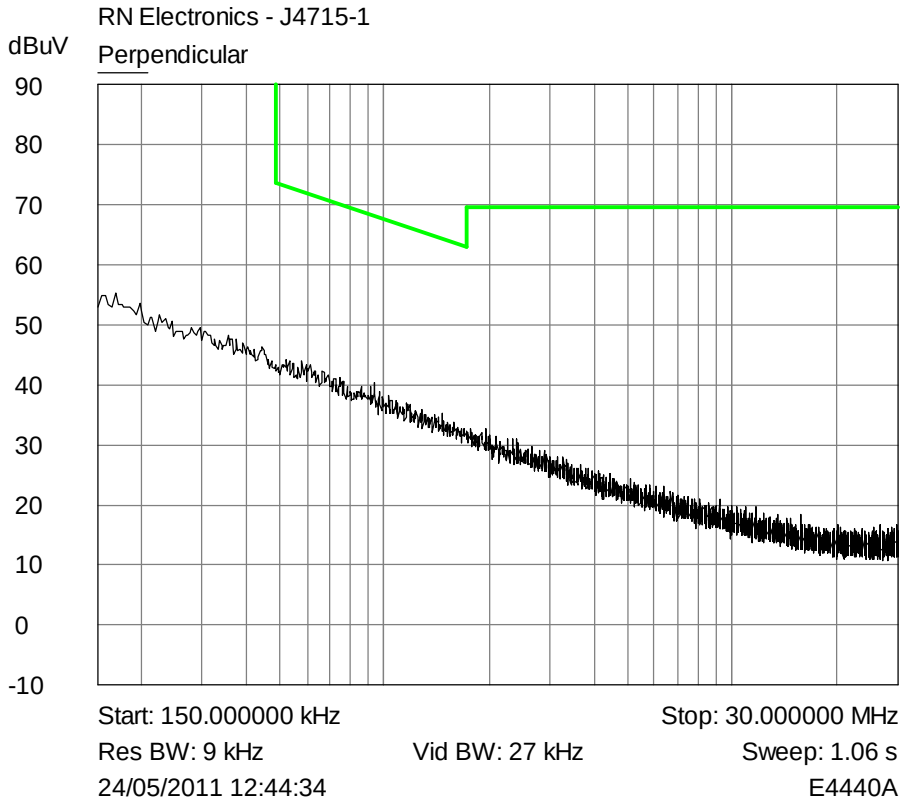
6. Plots and Results
6.1 Conducted Emissions

Test not applicable.
The digital device tested is intended to be powered from 3V DC supply (battery) and intended for modular approval. Any third party device it is incorporated into with a connection to the AC power line will require demonstration of compliance with the limits. Refer to §15.207(c) "Measurements to demonstrate compliance with the conducted limits are not required for devices which only employ battery power for operation and which do not operate from the AC power lines or contain provisions for operation while connected to AC power lines"

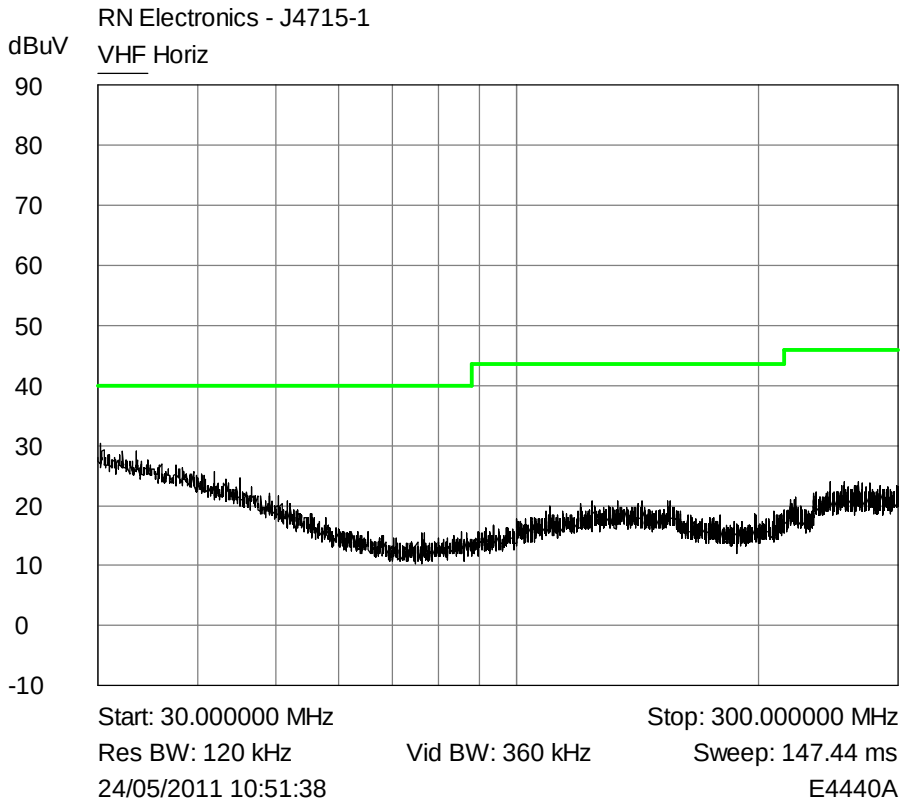
6.2 Radiated Emissions



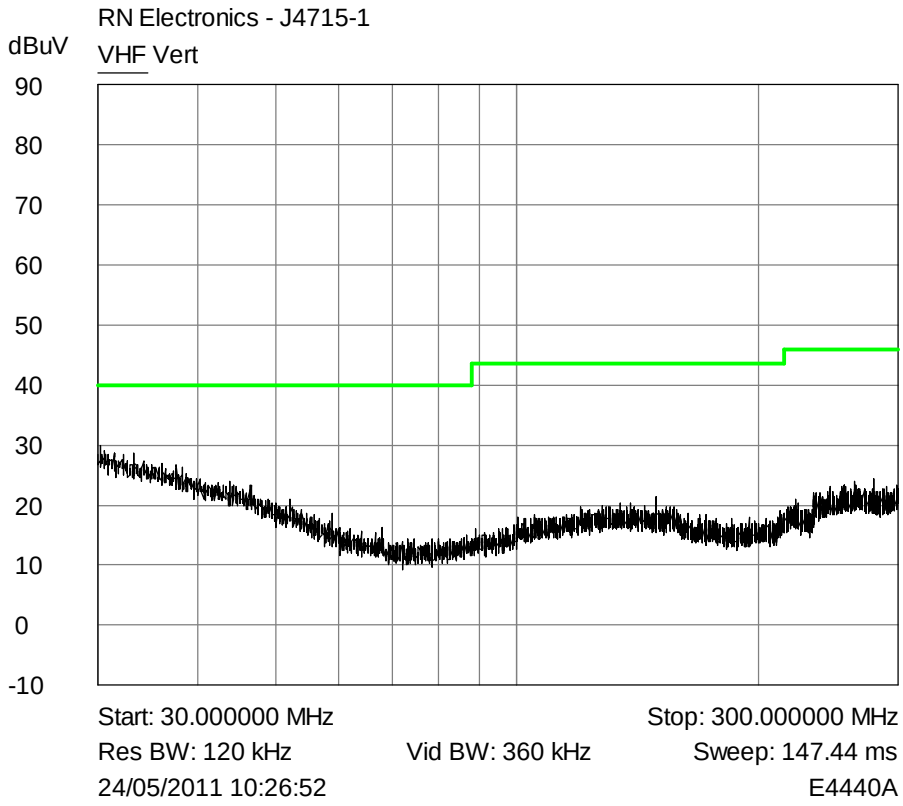
Plot of peak Parallel emissions 150kHz - 30MHz against the quasi-peak limit line.



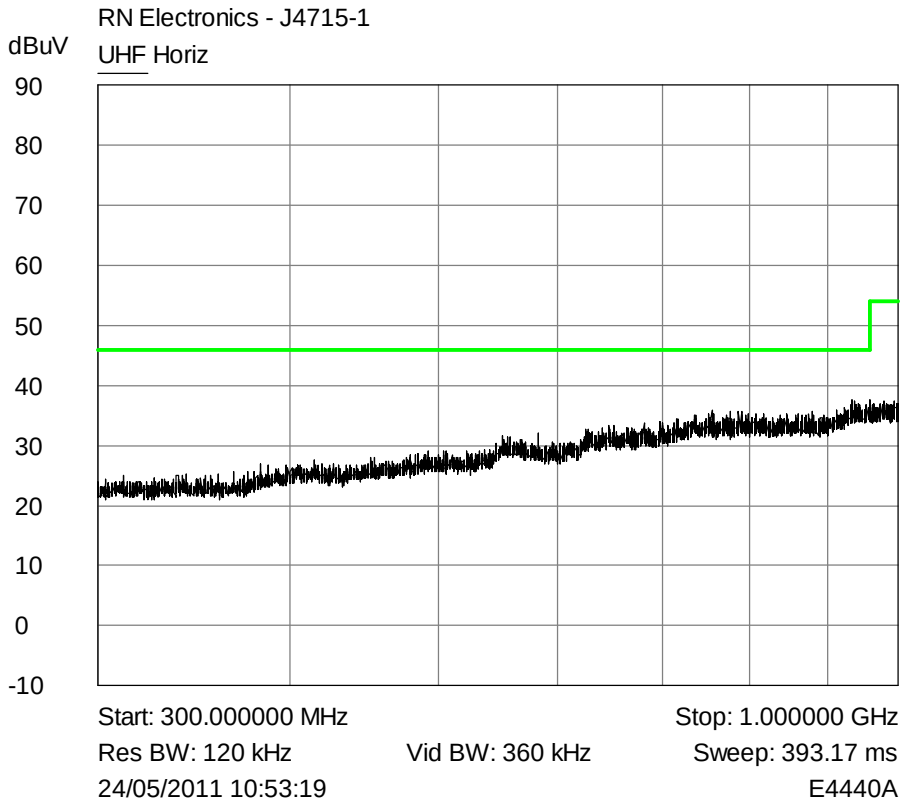
Plot of peak Perpendicular emissions 150kHz - 30MHz against the quasi-peak limit line.



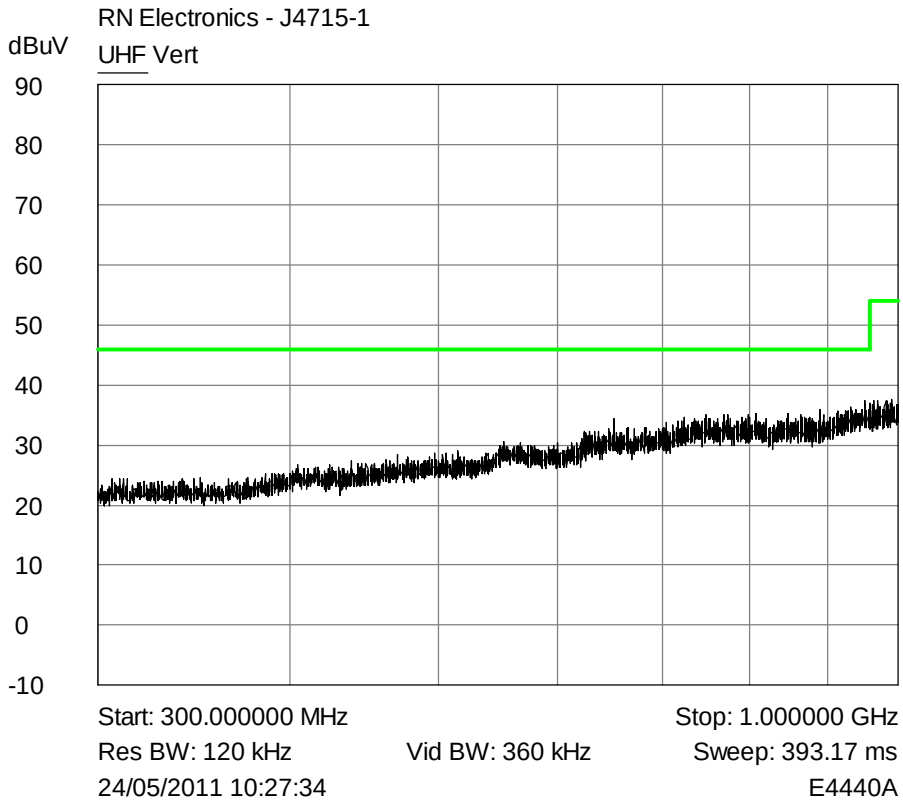
Plot of peak horizontal emissions 30MHz - 300MHz against the quasi-peak limit line.



Plot of peak vertical emissions 30MHz - 300MHz against the quasi-peak limit line.



Plot of peak horizontal emissions 300MHz - 1GHz against the quasi-peak limit line.



Plot of peak vertical emissions 300MHz - 1GHz against the quasi-peak limit line.

Table of signals measured below 1GHz.

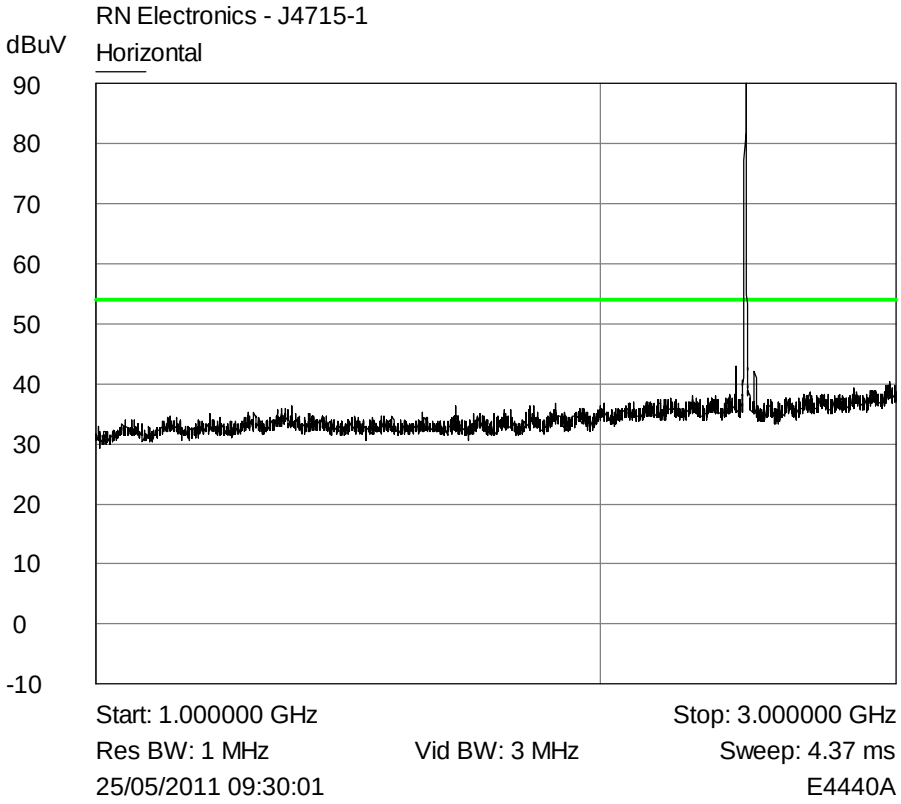
Horizontal

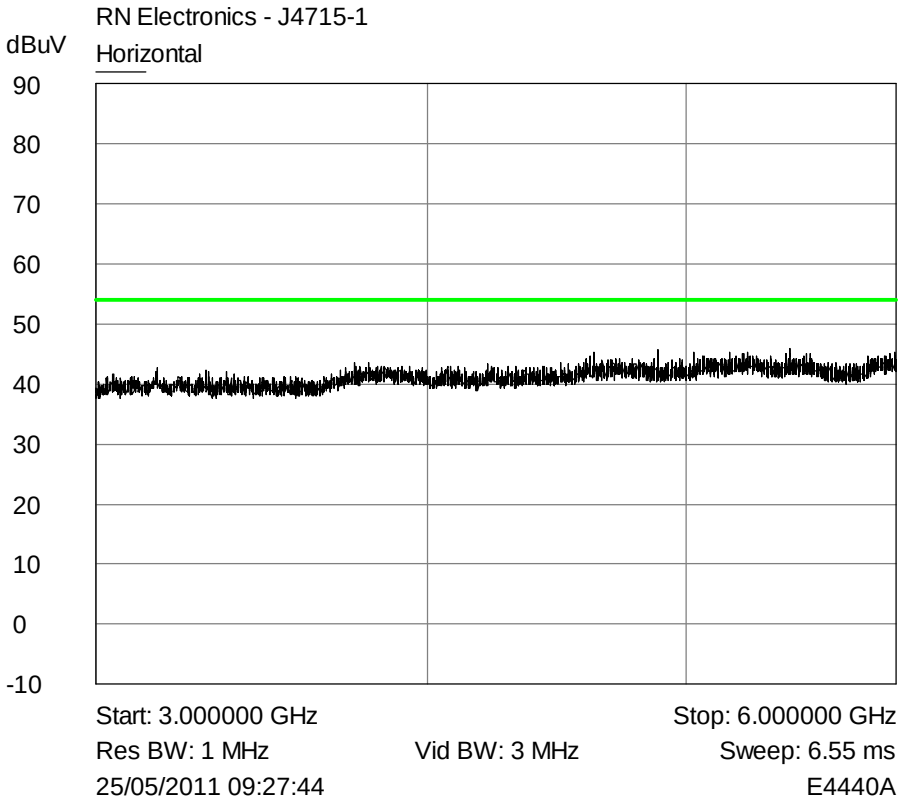
No signals within 20dB.

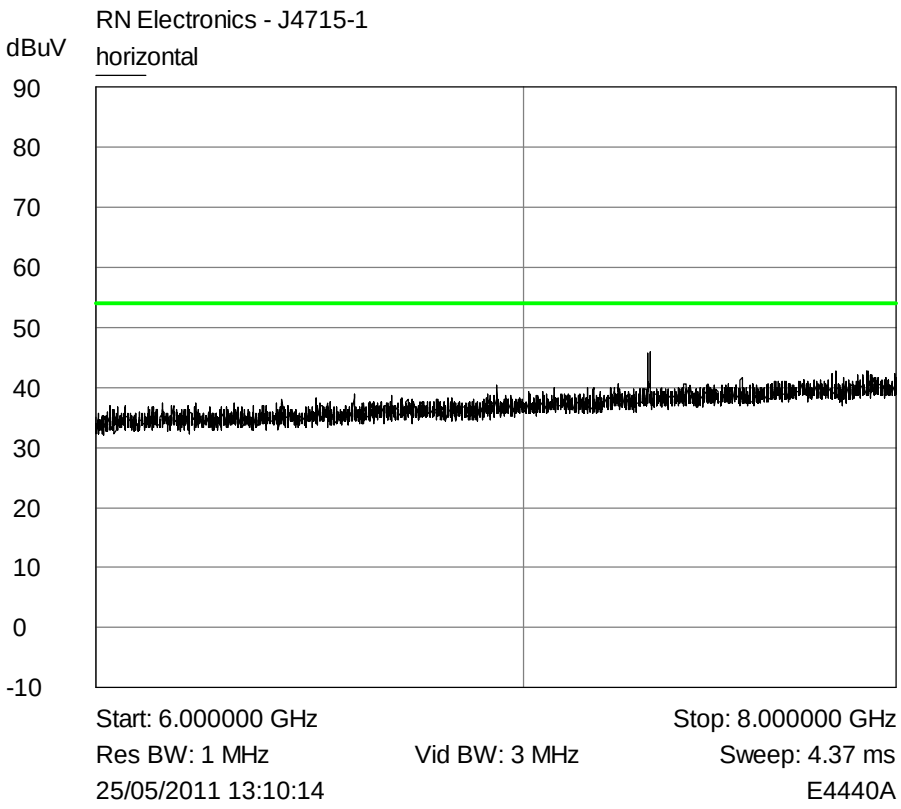
Vertical

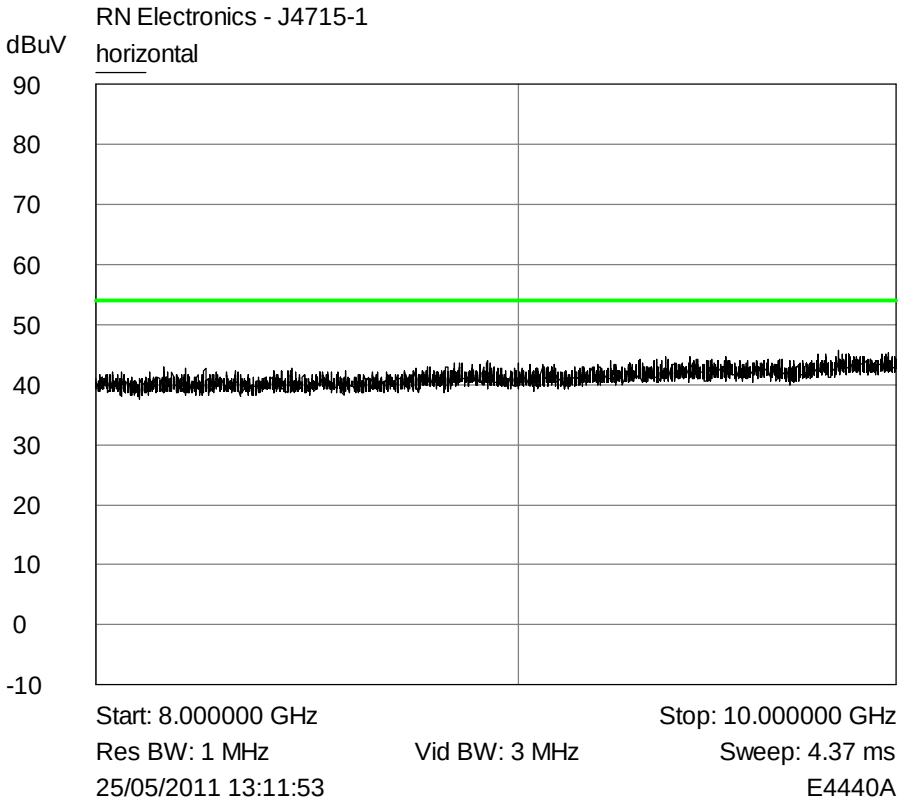
No signals within 20dB.

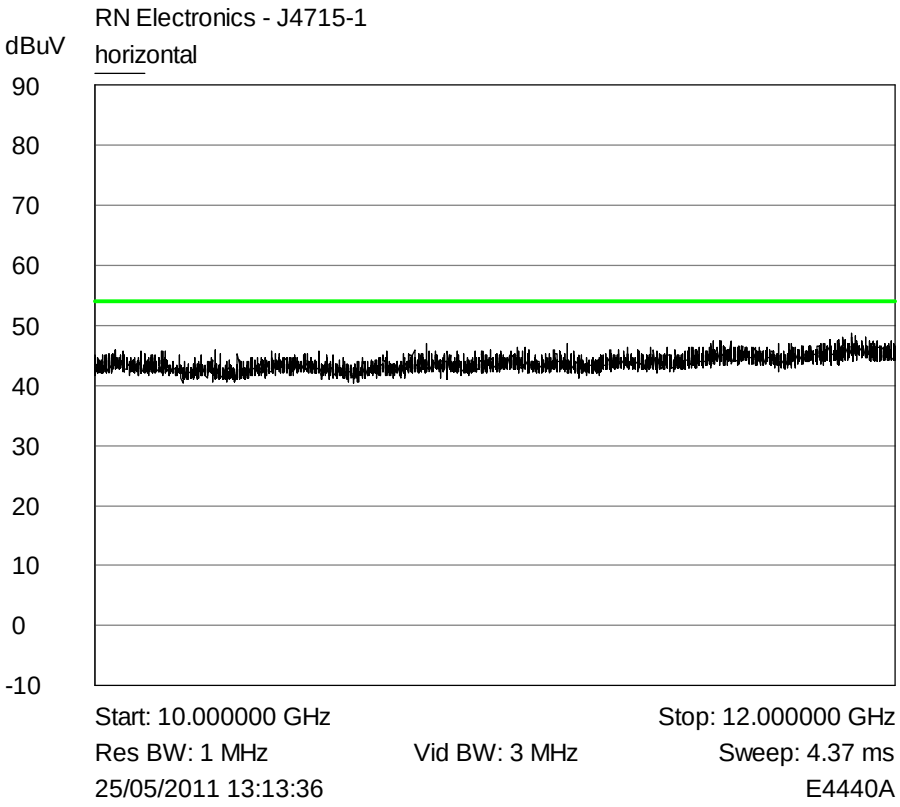
Plots of Average horizontal emissions 1GHz - 25GHz against the Average limit line.

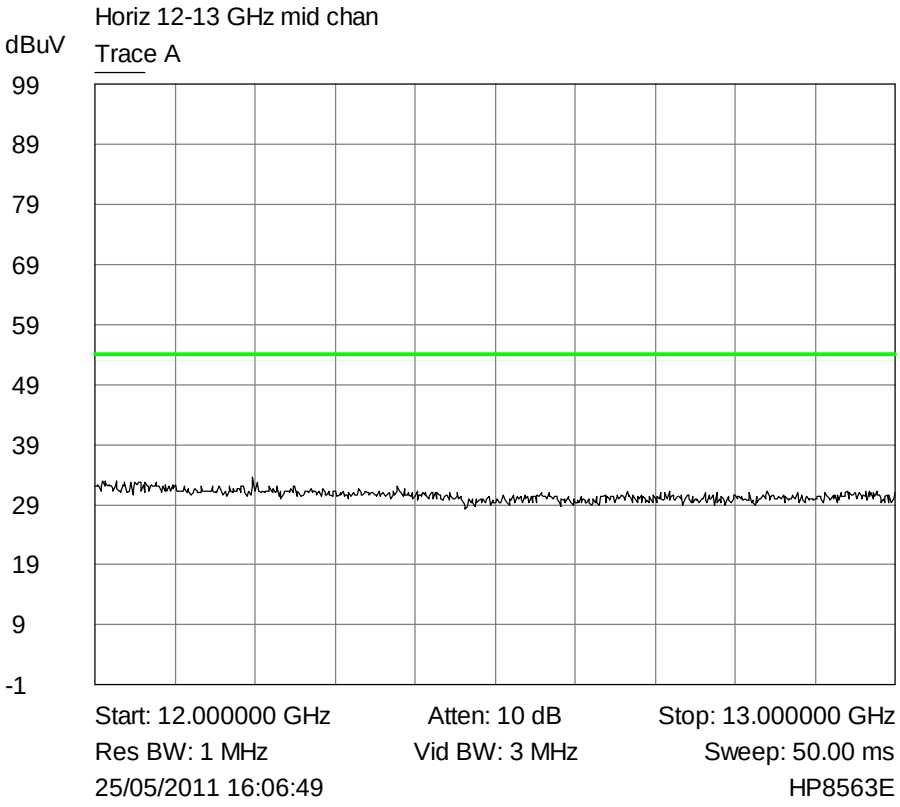




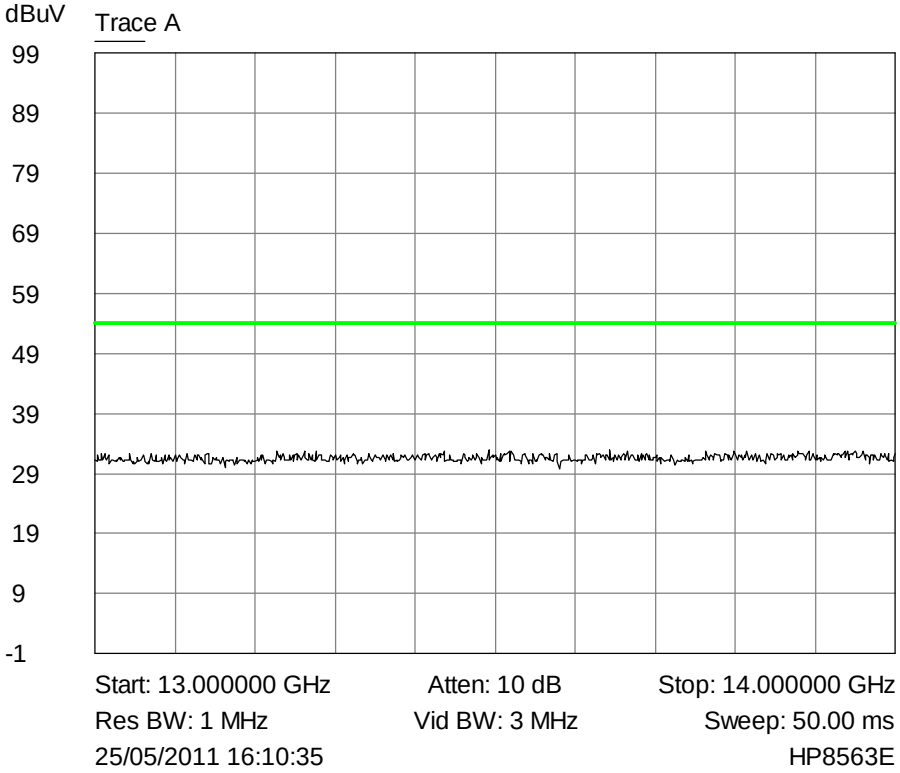





RN Electronics - J4715-1
horizontal
dBuV
90
80
70
60
50
40
30
20
10
0
-10
Start: 10.000000 GHz
Stop: 12.000000 GHz
Res BW: 1 MHz
Vid BW: 3 MHz
Sweep: 4.37 ms
25/05/2011 13:13:36
E4440A

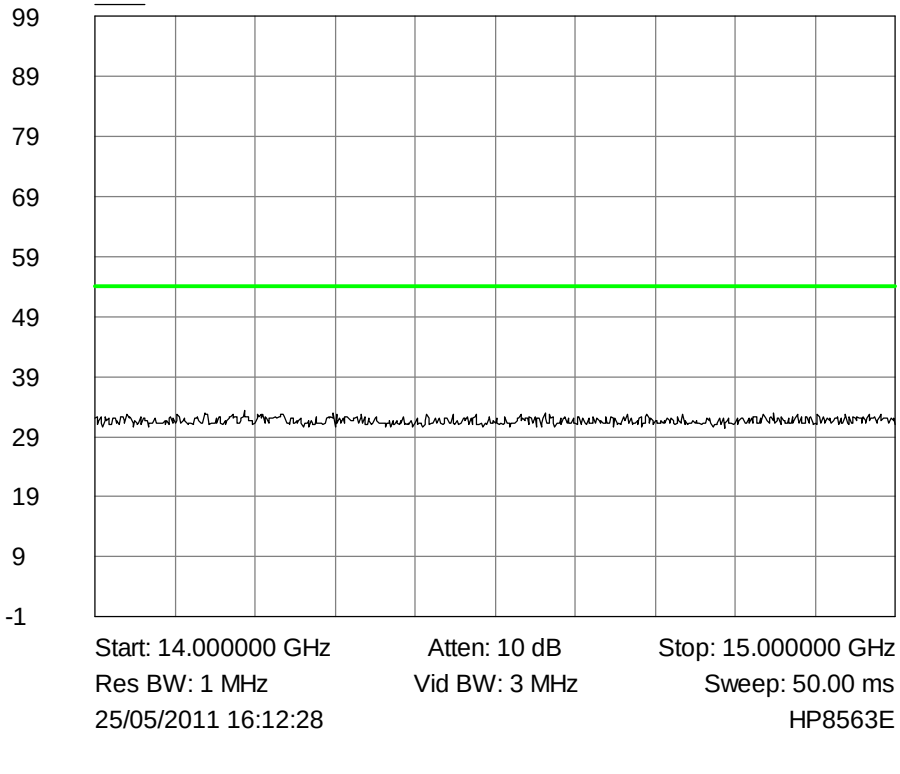

Horiz 12-13 GHz mid chan
Trace A
dBuV
99
89
79
69
59
49
39
29
19
9
-1
Start: 12.000000 GHz
Atten: 10 dB
Stop: 13.000000 GHz
Res BW: 1 MHz
Vid BW: 3 MHz
Sweep: 50.00 ms
25/05/2011 16:06:49
HP8563E

Horiz 13-14 GHz mid chan



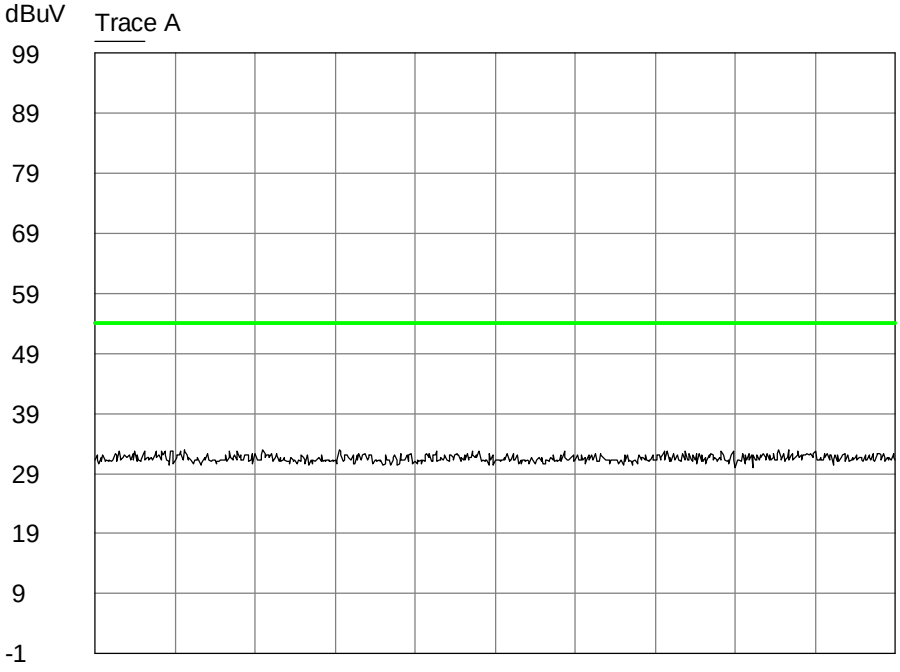
Start: 13.000000 GHz Atten: 10 dB Stop: 14.000000 GHz
Res BW: 1 MHz Vid BW: 3 MHz Sweep: 50.00 ms
25/05/2011 16:10:35 HP8563E

Horiz 14-15 GHz mid chan



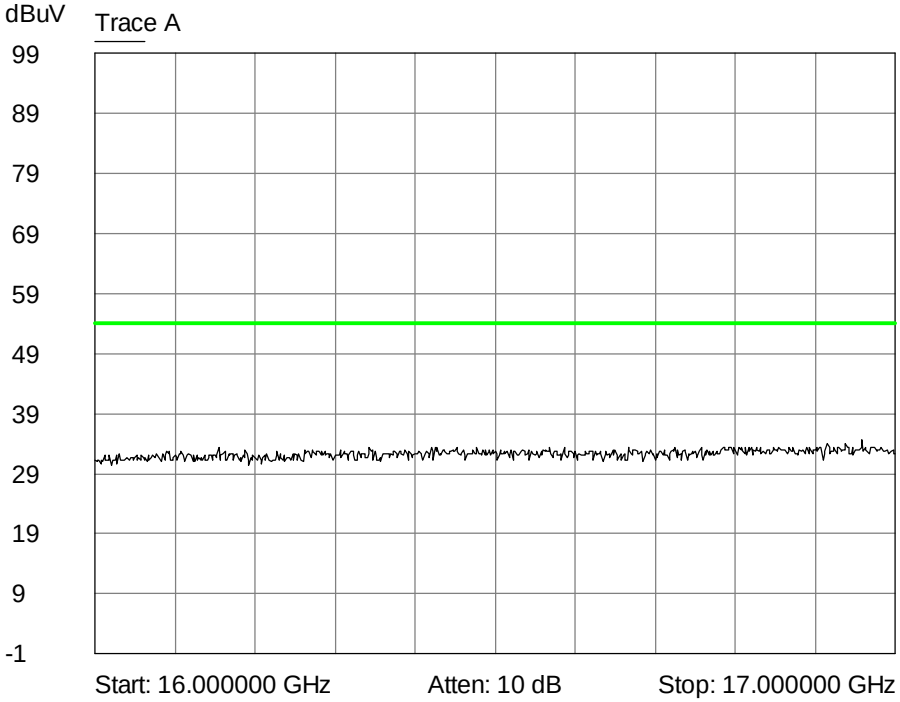
Start: 14.000000 GHz Atten: 10 dB Stop: 15.000000 GHz
Res BW: 1 MHz Vid BW: 3 MHz Sweep: 50.00 ms
25/05/2011 16:12:28 HP8563E

Horiz 15-16 GHz mid chan



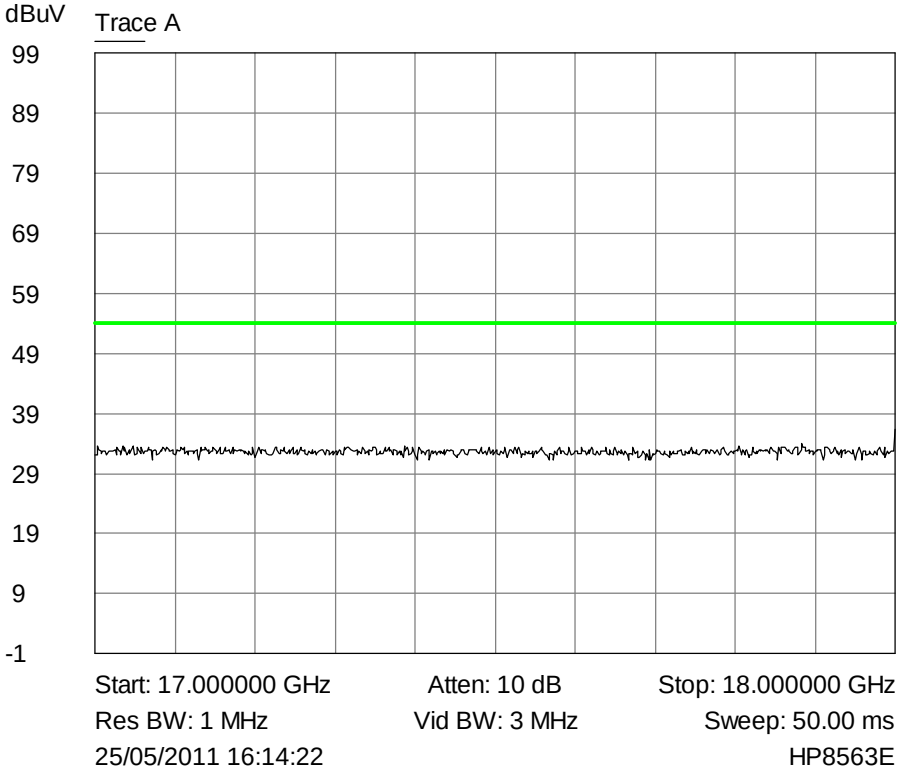
Start: 15.000000 GHz Atten: 10 dB Stop: 16.000000 GHz
Res BW: 1 MHz Vid BW: 3 MHz Sweep: 50.00 ms
25/05/2011 16:13:05 HP8563E

Horiz 16-17 GHz mid chan



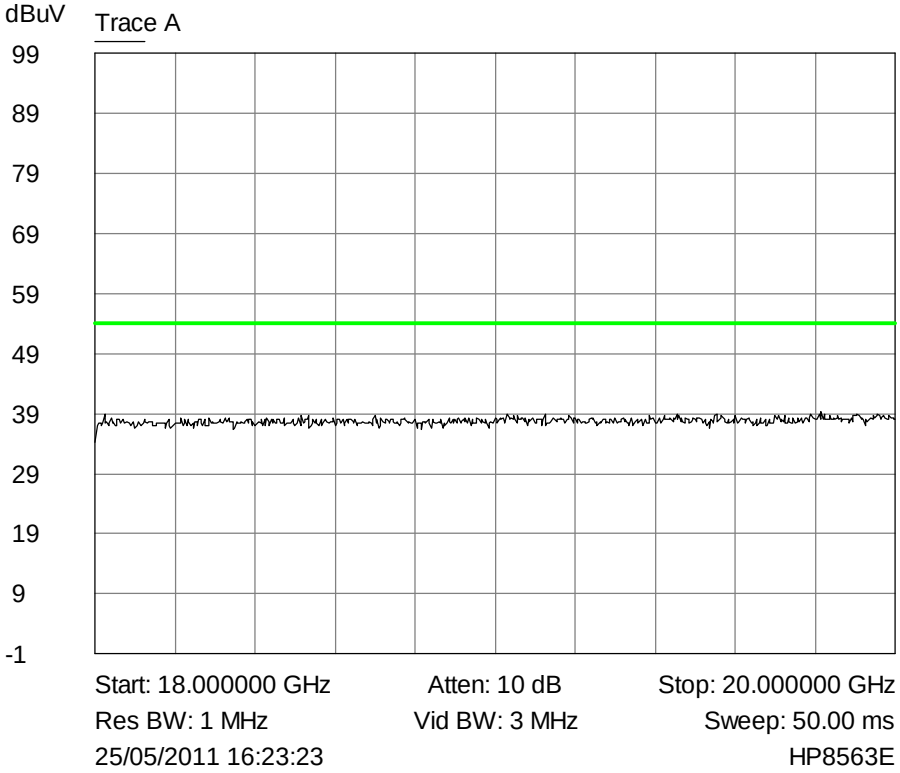
Start: 16.000000 GHz Atten: 10 dB Stop: 17.000000 GHz
Res BW: 1 MHz Vid BW: 3 MHz Sweep: 50.00 ms
25/05/2011 16:13:42 HP8563E

Horiz 17-18 GHz mid chan



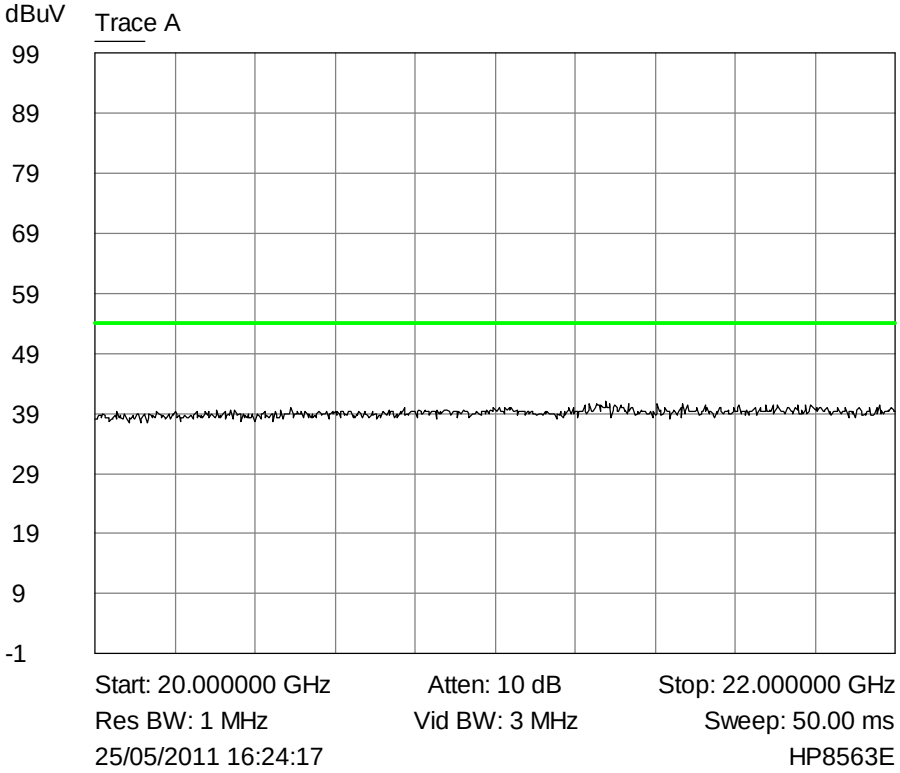
Start: 17.000000 GHz Atten: 10 dB Stop: 18.000000 GHz
Res BW: 1 MHz Vid BW: 3 MHz Sweep: 50.00 ms
25/05/2011 16:14:22 HP8563E

Horiz & Vert 18-20 GHz mid chan



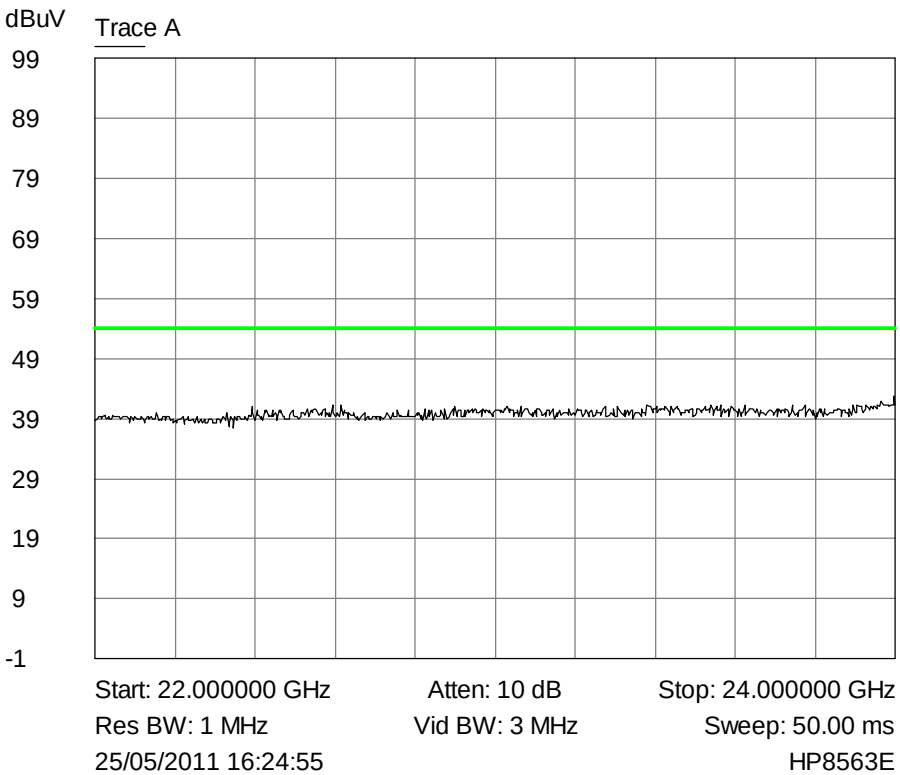
Start: 18.000000 GHz Atten: 10 dB Stop: 20.000000 GHz
Res BW: 1 MHz Vid BW: 3 MHz Sweep: 50.00 ms
25/05/2011 16:23:23 HP8563E

Horiz & Vert 20-22 GHz mid chan

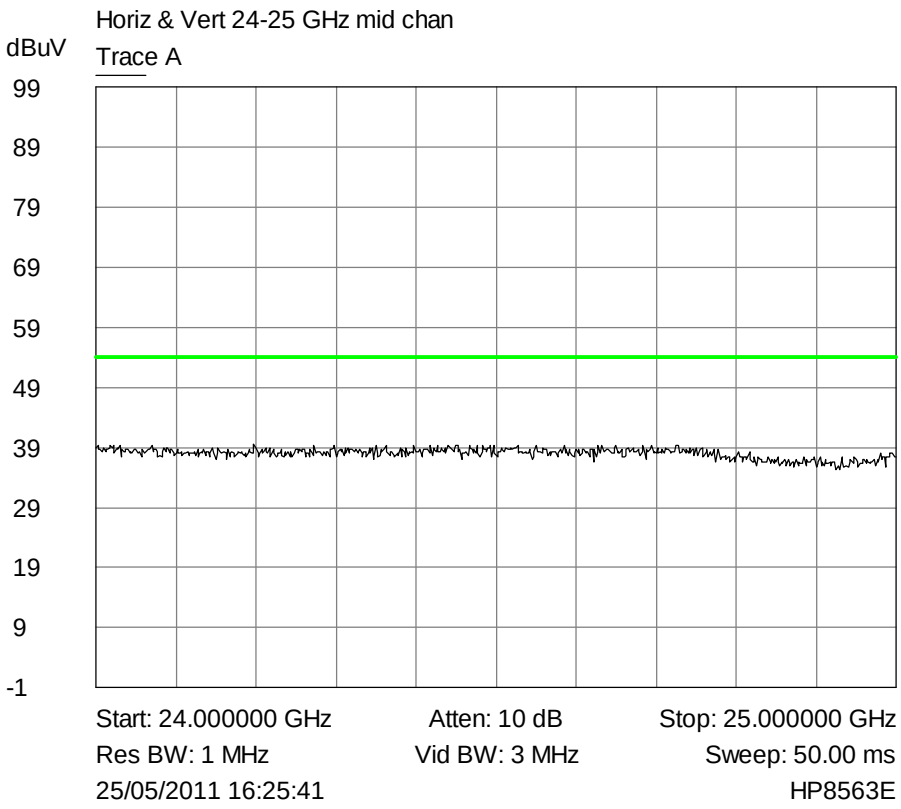


Start: 20.000000 GHz Atten: 10 dB Stop: 22.000000 GHz
Res BW: 1 MHz Vid BW: 3 MHz Sweep: 50.00 ms
25/05/2011 16:24:17 HP8563E

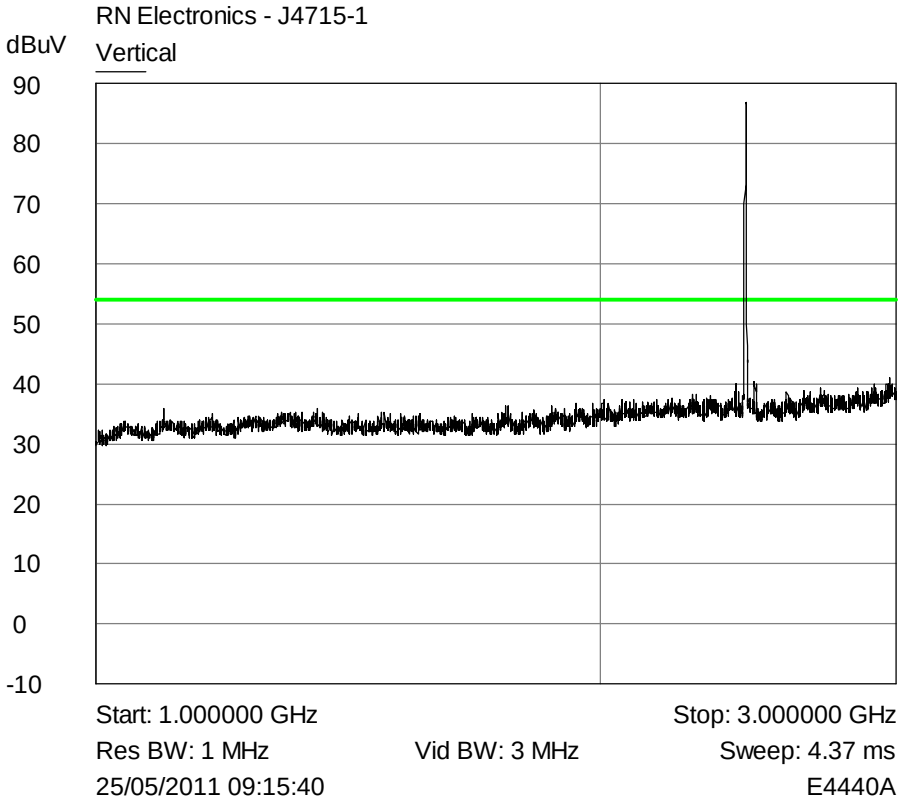
Horiz & Vert 22-24 GHz mid chan

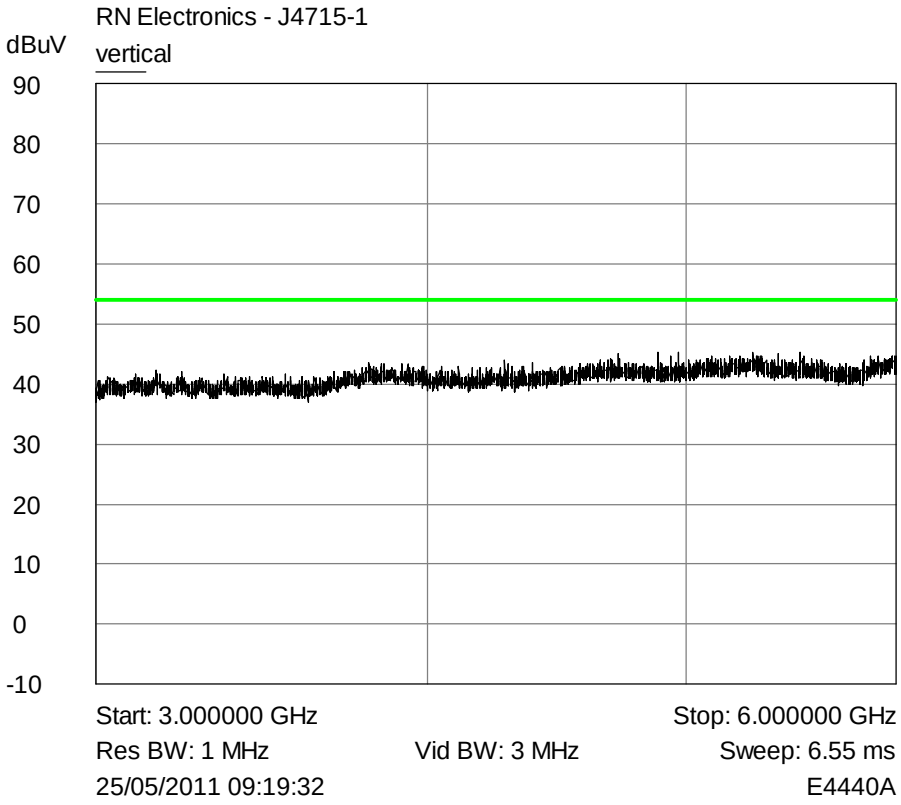


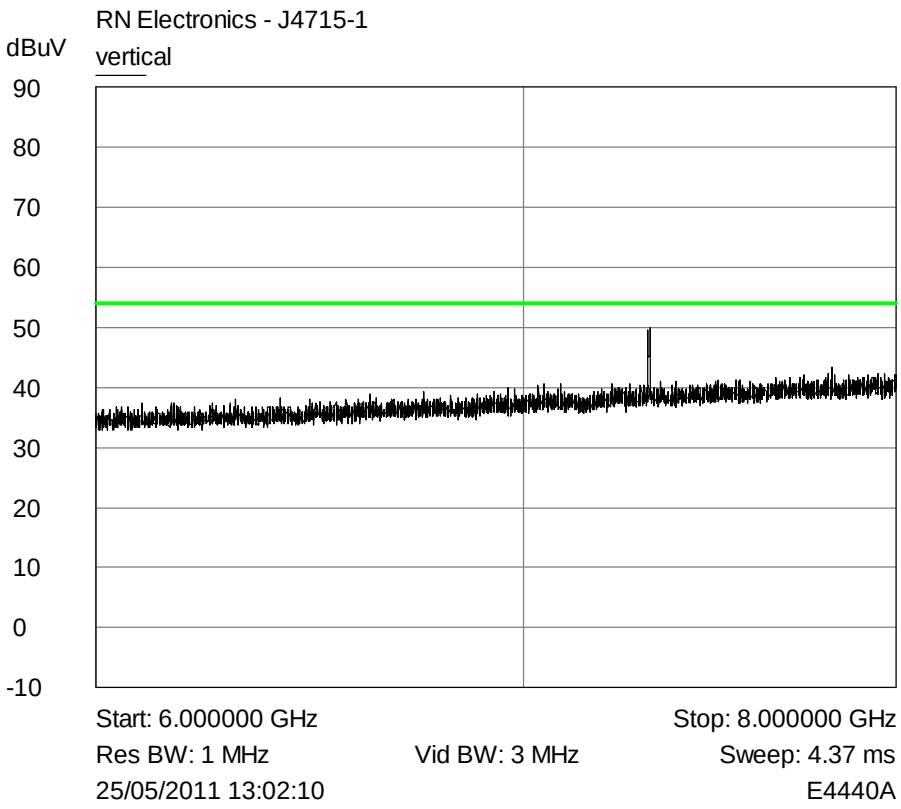
Start: 22.000000 GHz Atten: 10 dB Stop: 24.000000 GHz
Res BW: 1 MHz Vid BW: 3 MHz Sweep: 50.00 ms
25/05/2011 16:24:55 HP8563E

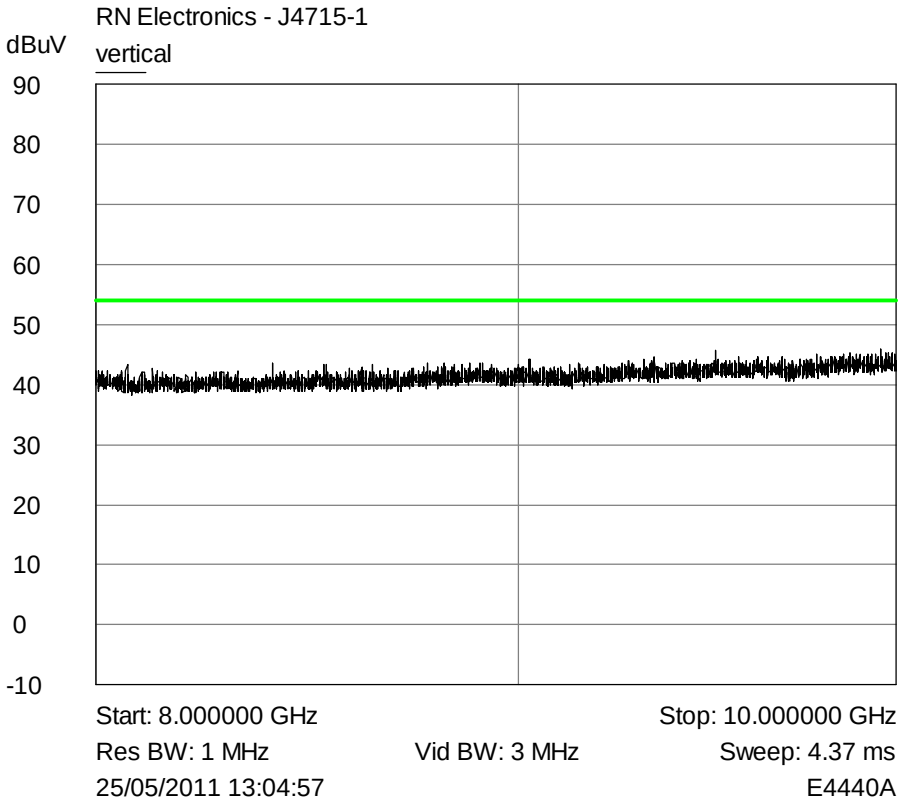

Horiz & Vert 24-25 GHz mid chan
dBuV
Trace A
99
89
79
69
59
49
39
29
19
9
-1
Start: 24.000000 GHz
Atten: 10 dB
Stop: 25.000000 GHz
Res BW: 1 MHz
Vid BW: 3 MHz
Sweep: 50.00 ms
25/05/2011 16:25:41
HP8563E

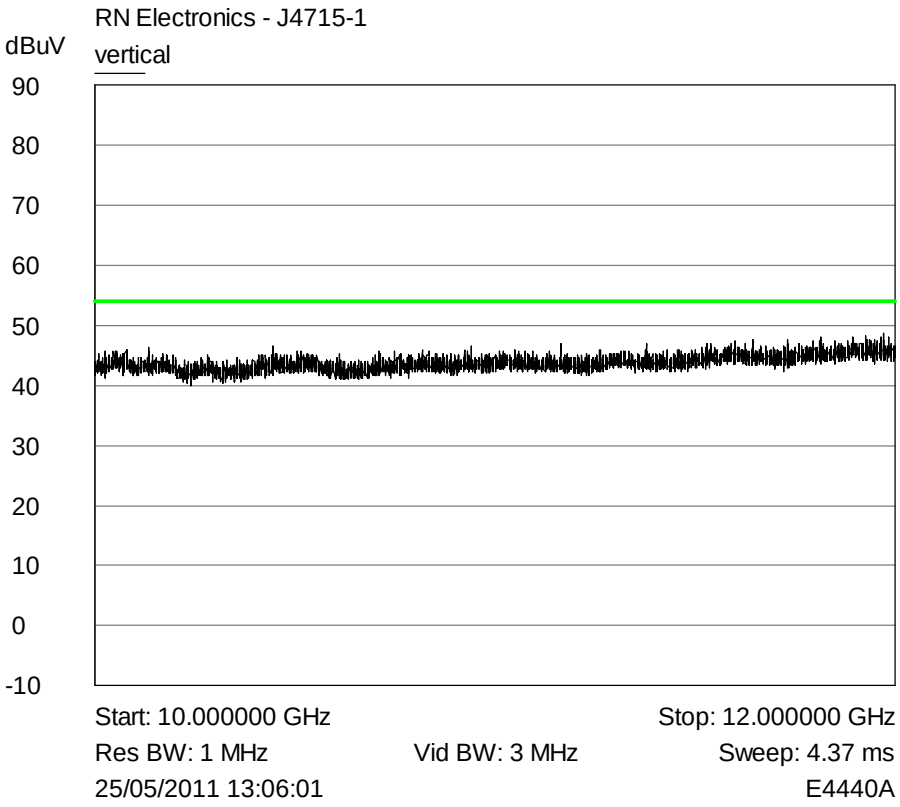
Plot of Average Vertical emissions 1GHz - 25GHz against the Average limit line.

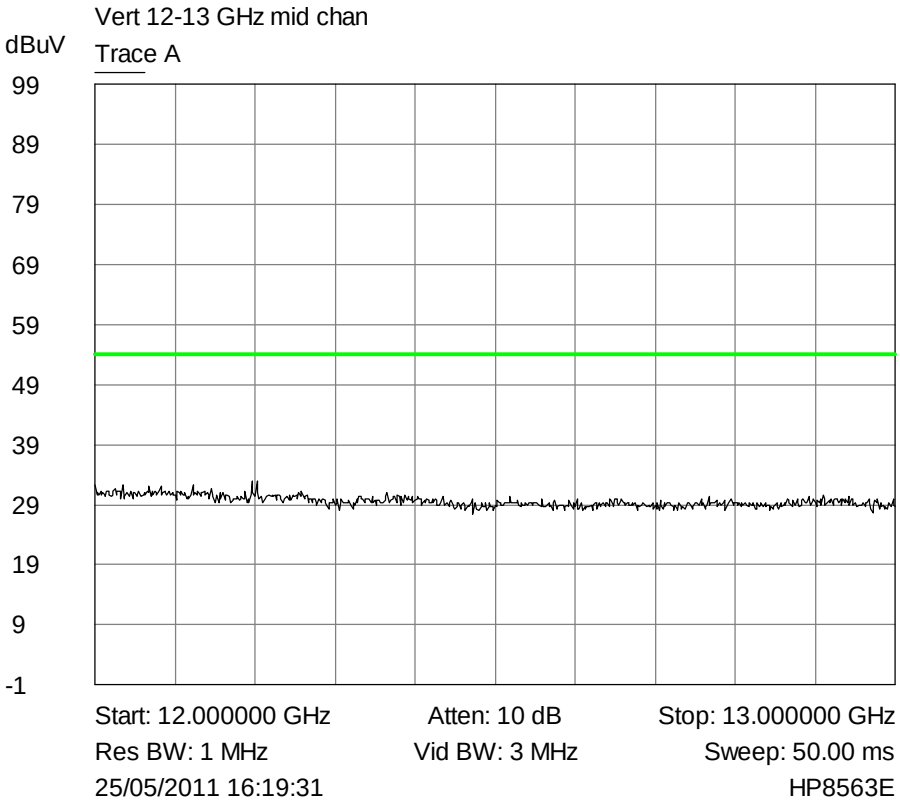




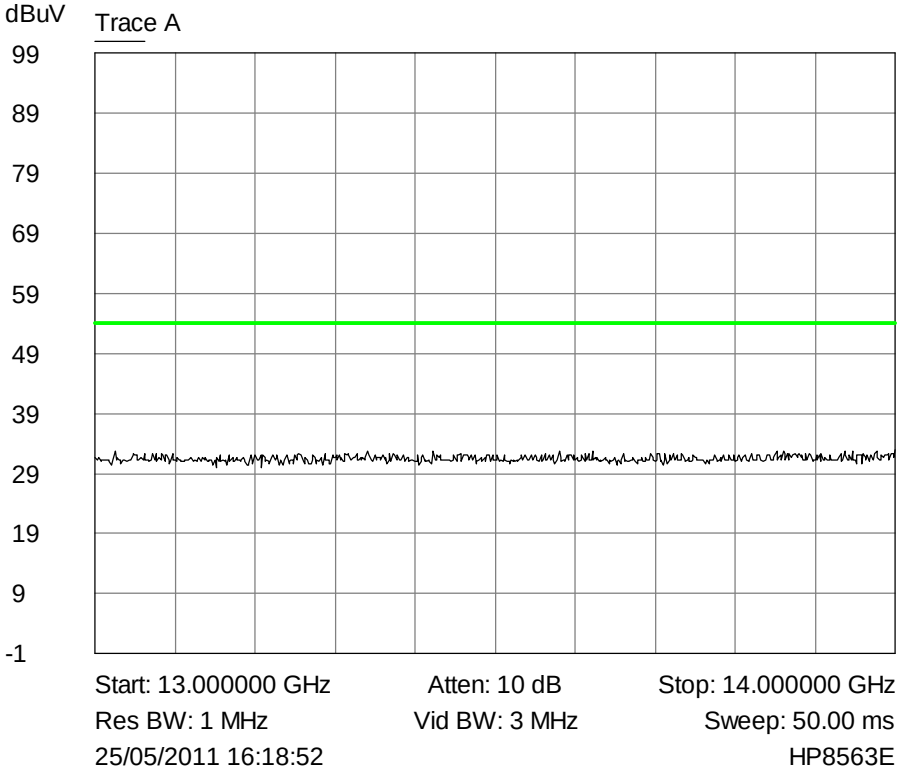





RN Electronics - J4715-1
vertical
dBuV
90
80
70
60
50
40
30
20
10
0
-10
Start: 10.000000 GHz
Stop: 12.000000 GHz
Res BW: 1 MHz
Vid BW: 3 MHz
Sweep: 4.37 ms
25/05/2011 13:06:01
E4440A

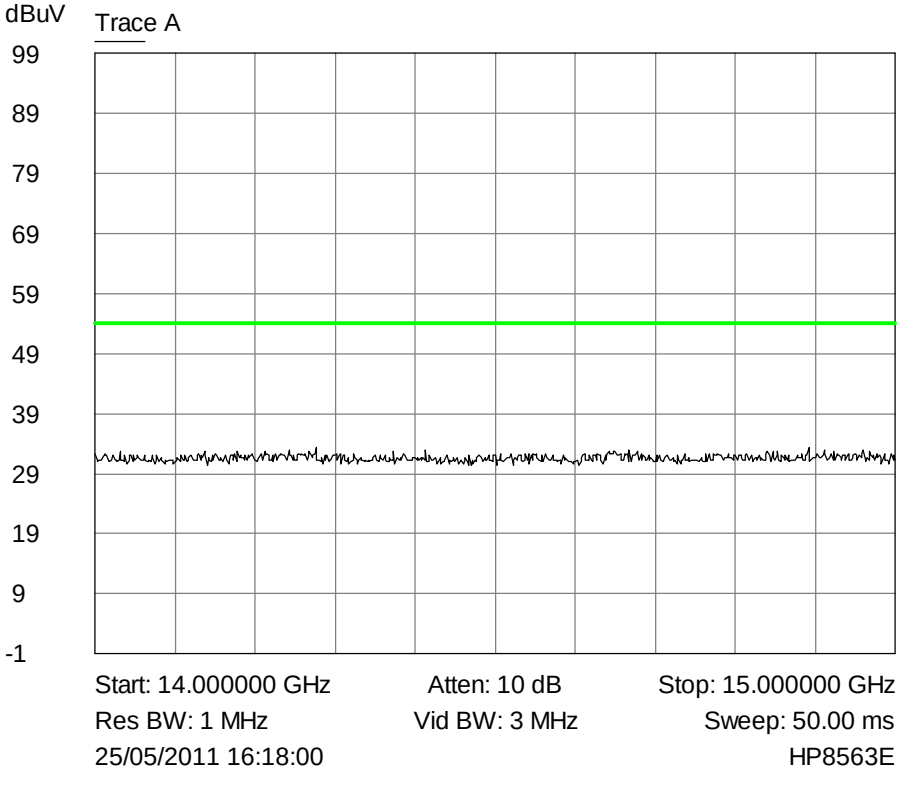

Vert 12-13 GHz mid chan
Trace A
dBuV
99
89
79
69
59
49
39
29
19
9
-1
Start: 12.000000 GHz
Atten: 10 dB
Stop: 13.000000 GHz
Res BW: 1 MHz
Vid BW: 3 MHz
Sweep: 50.00 ms
25/05/2011 16:19:31
HP8563E

Vert 13-14 GHz mid chan



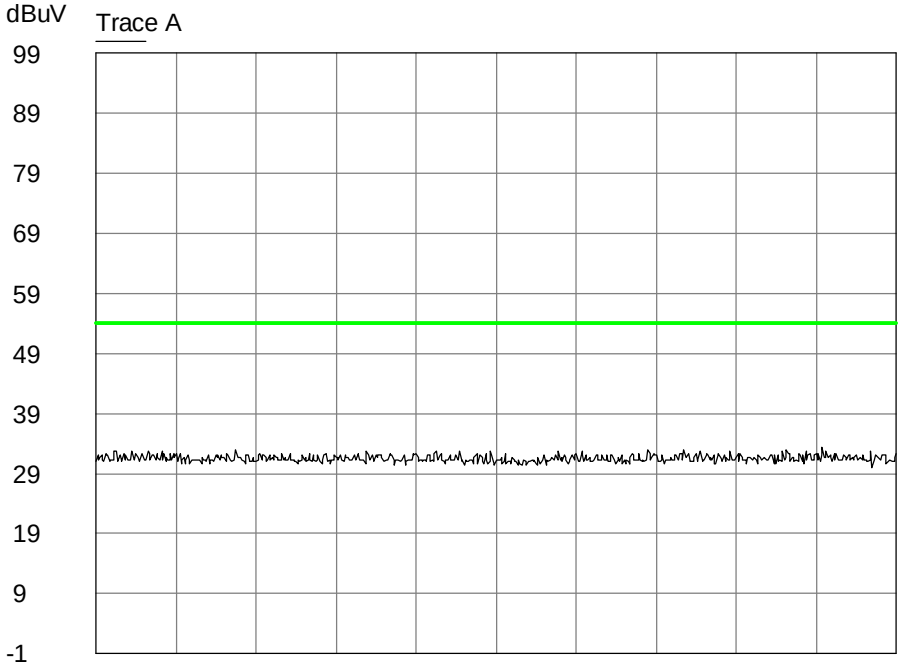
Start: 13.000000 GHz Atten: 10 dB Stop: 14.000000 GHz
Res BW: 1 MHz Vid BW: 3 MHz Sweep: 50.00 ms
25/05/2011 16:18:52 HP8563E

Vert 14-15 GHz mid chan



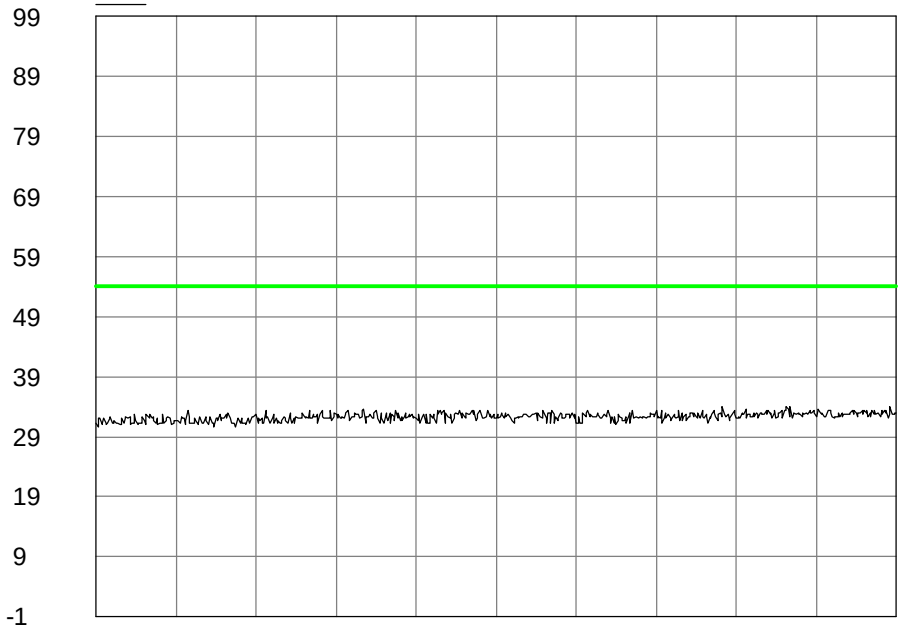
Start: 14.000000 GHz Atten: 10 dB Stop: 15.000000 GHz
Res BW: 1 MHz Vid BW: 3 MHz Sweep: 50.00 ms
25/05/2011 16:18:00 HP8563E

Vert 15-16 GHz mid chan



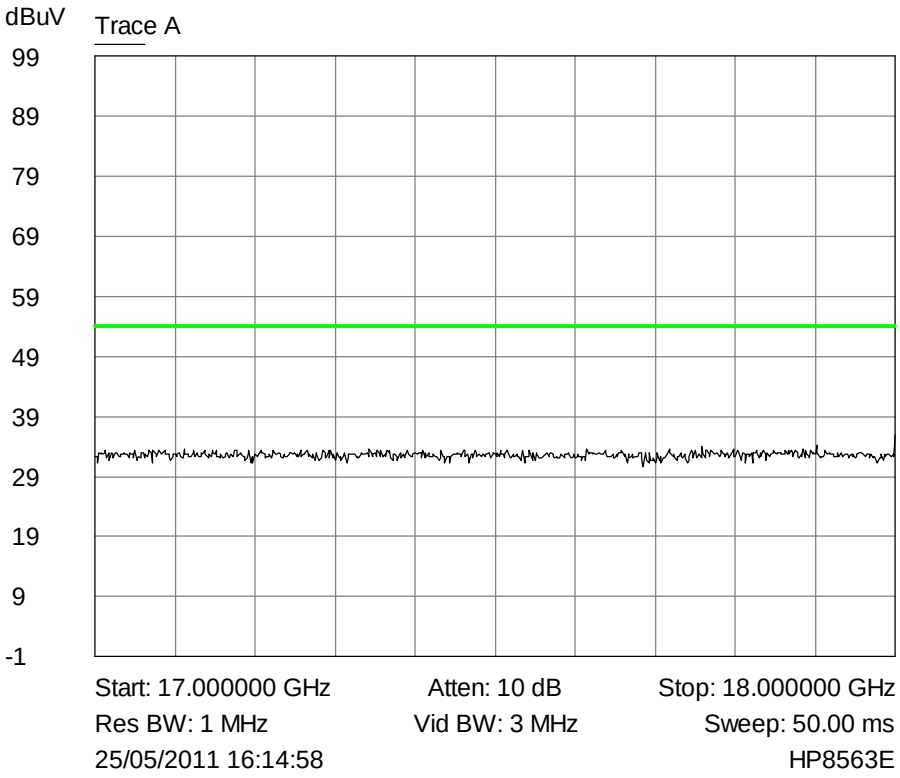
Start: 15.000000 GHz Atten: 10 dB Stop: 16.000000 GHz
Res BW: 1 MHz Vid BW: 3 MHz Sweep: 50.00 ms
25/05/2011 16:17:21 HP8563E

Vert 16-17 GHz mid chan



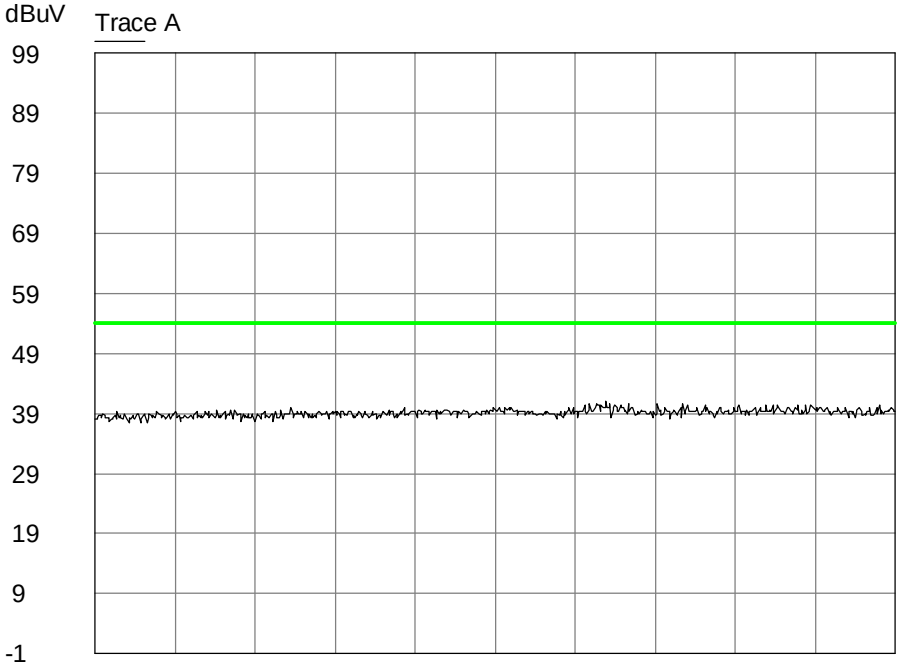
Start: 16.000000 GHz Atten: 10 dB Stop: 17.000000 GHz
Res BW: 1 MHz Vid BW: 3 MHz Sweep: 50.00 ms
25/05/2011 16:15:56 HP8563E

Vert 17-18 GHz mid chan



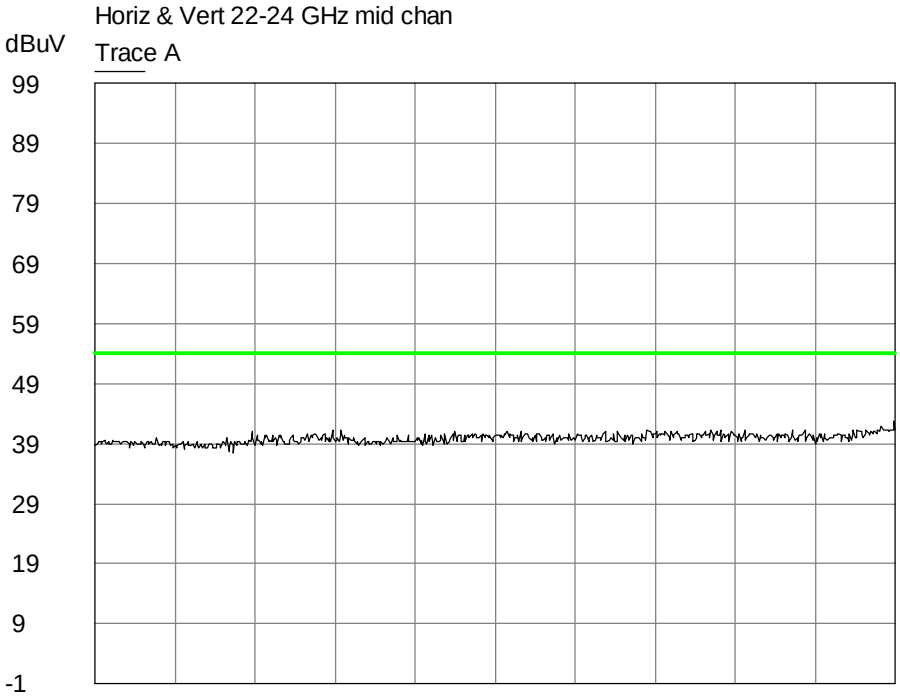
Horiz & Vert 18-20 GHz mid chan

Horiz & Vert 20-22 GHz mid chan



Start: 20.000000 GHz Atten: 10 dB Stop: 22.000000 GHz
Res BW: 1 MHz Vid BW: 3 MHz Sweep: 50.00 ms
25/05/2011 16:24:17 HP8563E

Horiz & Vert 22-24 GHz mid chan



Start: 22.000000 GHz Atten: 10 dB Stop: 24.000000 GHz
Res BW: 1 MHz Vid BW: 3 MHz Sweep: 50.00 ms
25/05/2011 16:24:55 HP8563E

Horiz & Vert 24-25 GHz mid chan

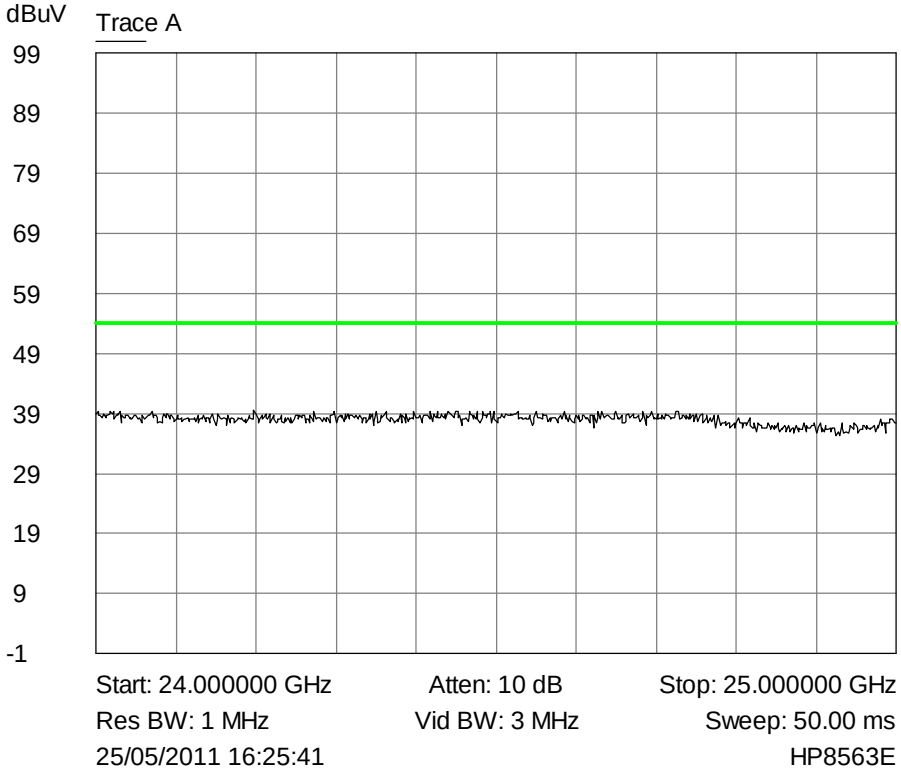


Table of signals measured above 1GHz.

Note: The values measured and tabulated below are with the EUT operating in continuous transmit and are directly a result of the modulated signal (harmonics). According to 15.35(c) the duty cycle should be taken into consideration when calculating the average value of the emission. Therefore these values will actually be reduced in practice. Refer to the manufacturer's statement regarding actual duty cycle.

Horizontal

Bottom Channel

Signal No.	Freq (MHz)	Peak Amp (dBuV)	AV Amp (dBuV)	AV - Lim1 (dB)
1	2372.378	43.7	33.7	-20.3
2	2437.300	43.1	34.7	-19.3
3	4810.941	51.2	41.1	-12.9
4	7216.068	46.3	37.5	-16.5

Middle Channel

Signal No.	Freq (MHz)	Peak Amp (dBuV)	AV Amp (dBuV)	AV - Lim1 (dB)
1	2407.805	44.1	37.3	-16.7
2	2471.757	42.6	35.0	-19.0
3	4881.017	47.3	35.1	-18.9
4	7321.225	47.9	38.8	-15.2

Top Channel

Signal No.	Freq (MHz)	Peak Amp (dBuV)	AV Amp (dBuV)	AV - Lim1 (dB)
1	2448.410	42.8	33.3	-20.7
2	2511.535	42.2	32.5	-21.5
3	7441.552	48.0	38.2	-15.8

Vertical

Bottom Channel

Signal No.	Freq (MHz)	Peak Amp (dBuV)	AV Amp (dBuV)	AV - Lim1 (dB)
1	4809.966	49.0	41.5	-12.5
2	7216.069	43.9	34.1	-19.9

Middle Channel

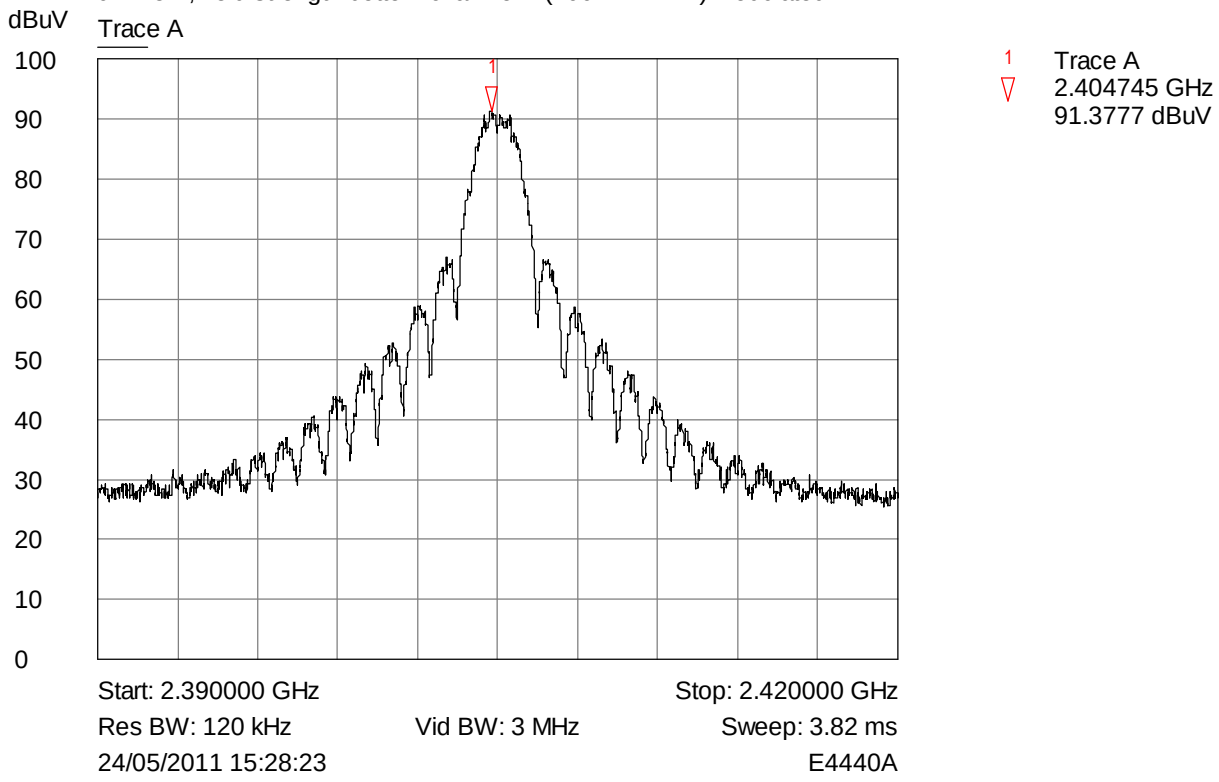
Signal No.	Freq (MHz)	Peak Amp (dBuV)	AV Amp (dBuV)	AV - Lim1 (dB)
1	2408.273	42.9	32.5	-21.5
2	2471.251	41.3	30.1	-23.9
3	4881.093	46.9	35.4	-18.6
4	7318.728	50.3	42.4	-11.6

Top Channel

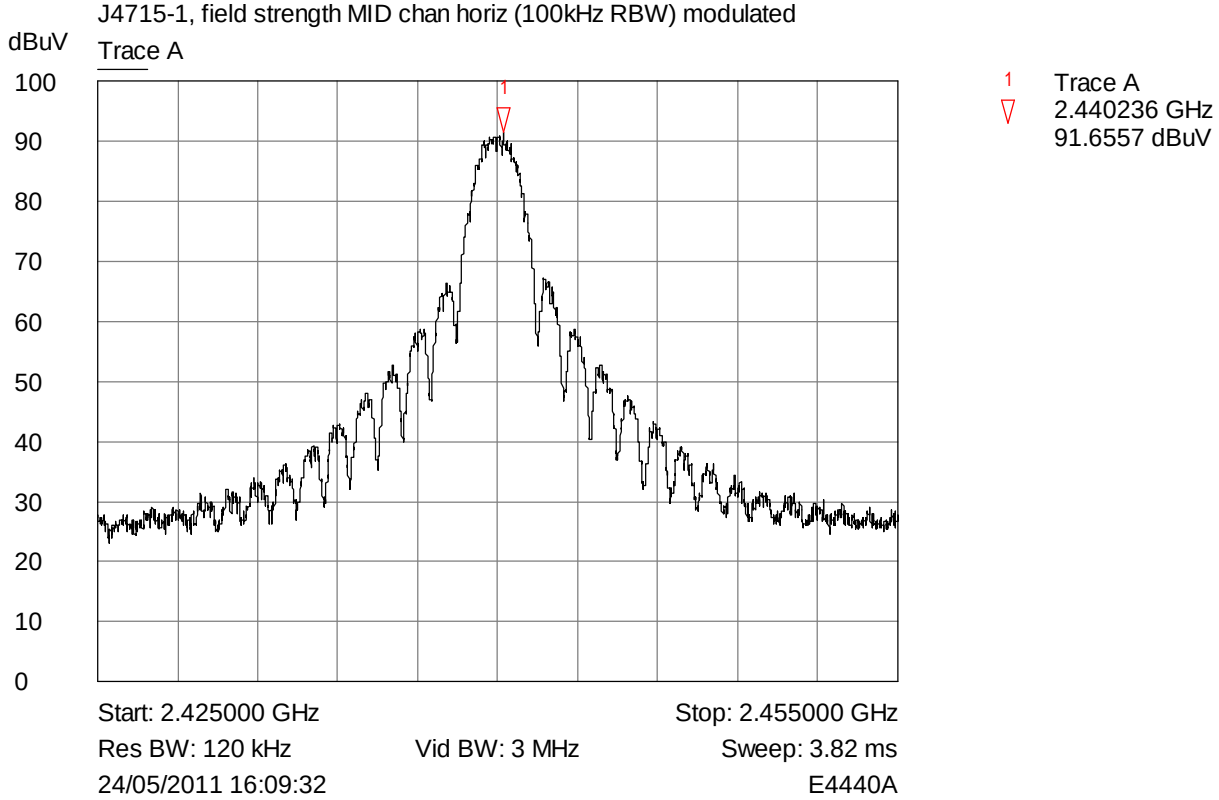
Signal No.	Freq (MHz)	Peak Amp (dBuV)	AV Amp (dBuV)	AV - Lim1 (dB)
1	2448.667	40.4	29.3	-24.7
2	2511.539	40.7	30.2	-23.8
3	7441.560	53.6	45.4	-8.6

6.3 Fundamental Emissions

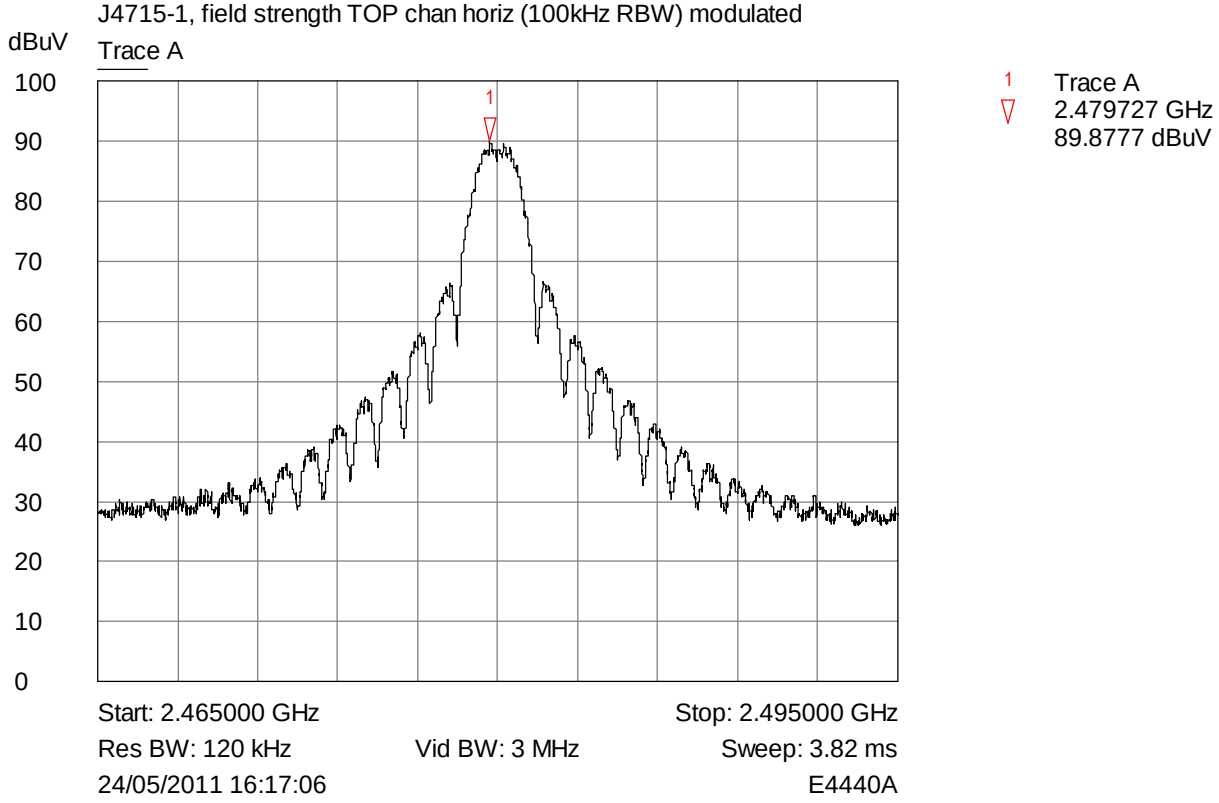
J4715-1, field strength bottom chan horiz (100kHz RBW) modulated



J4715-1, field strength MID chan horiz (100kHz RBW) modulated

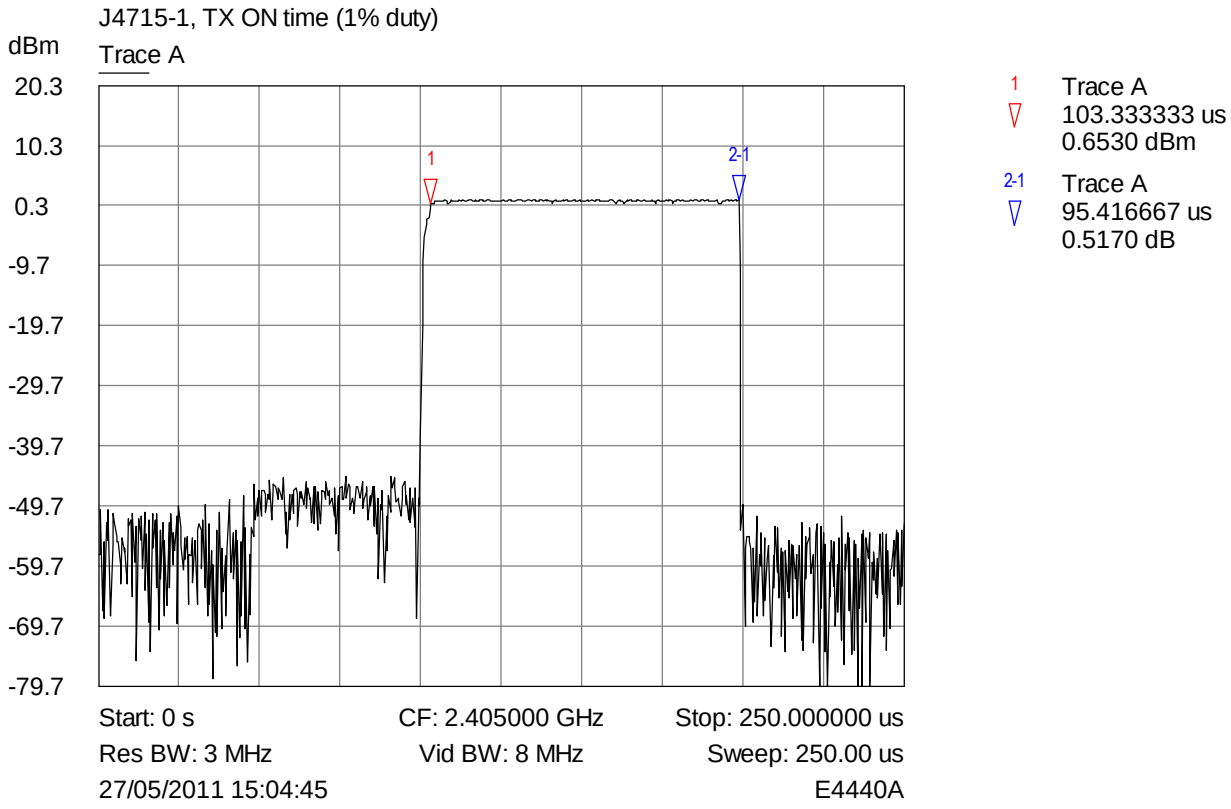


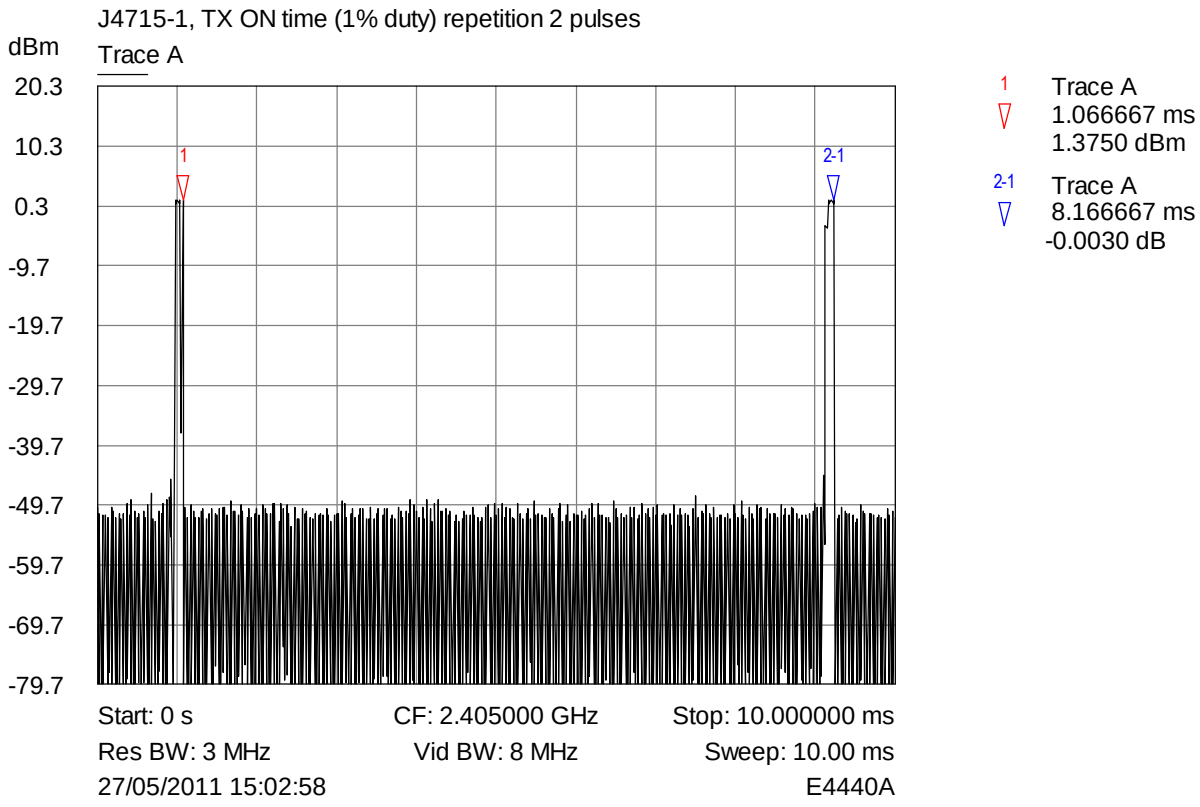
J4715-1, field strength TOP chan horiz (100kHz RBW) modulated



6.4 Duty Cycle

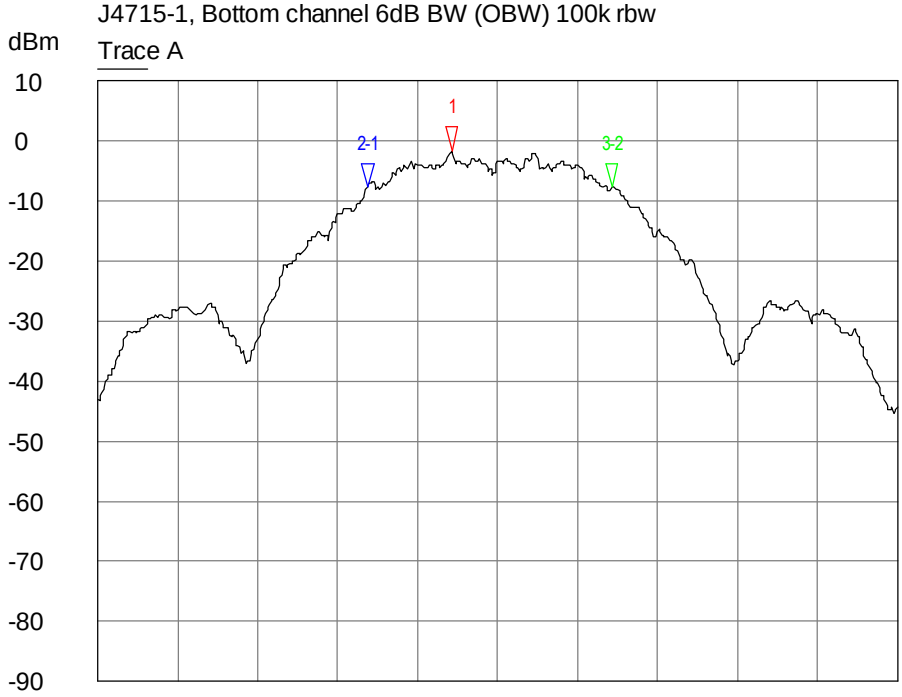
Plots of duty cycle period and pulse width (nominally 1%):





6.5 6dB Bandwidth

J4715-1, Bottom channel 6dB BW (OBW) 100k rbw



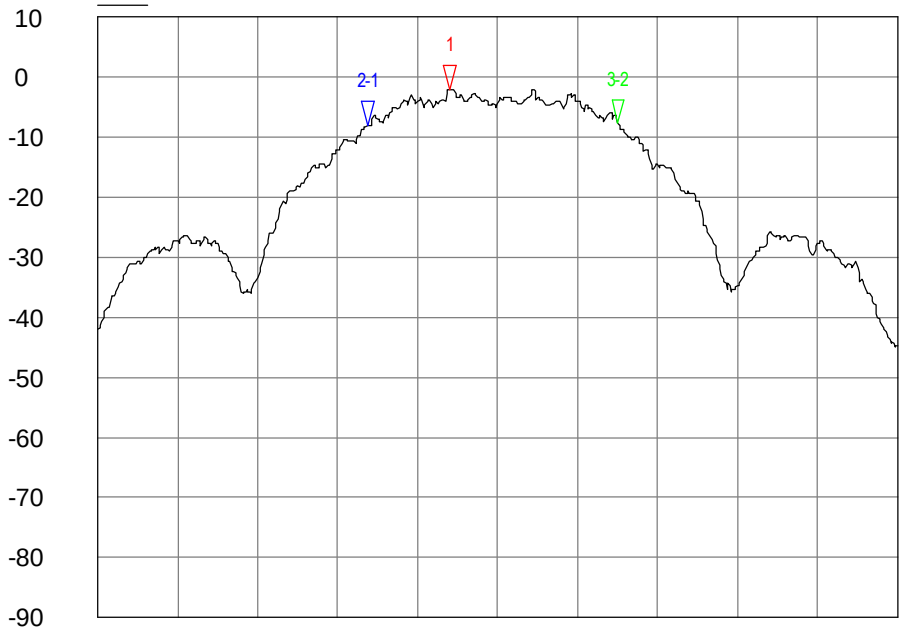
1 Trace A
2.404708 GHz
-1.7540 dBm

2-1 Trace A
-525.000000 kHz
-6.0020 dB

3-2 Trace A
1.533333 MHz
0.1860 dB

Start: 2.402500 GHz Stop: 2.407500 GHz
Res BW: 100 kHz Vid BW: 300 kHz Sweep: 1.00 ms
24/05/2011 14:37:18 E4440A

J4715-1, Middle channel 6dB BW (OBW) 100k rbw



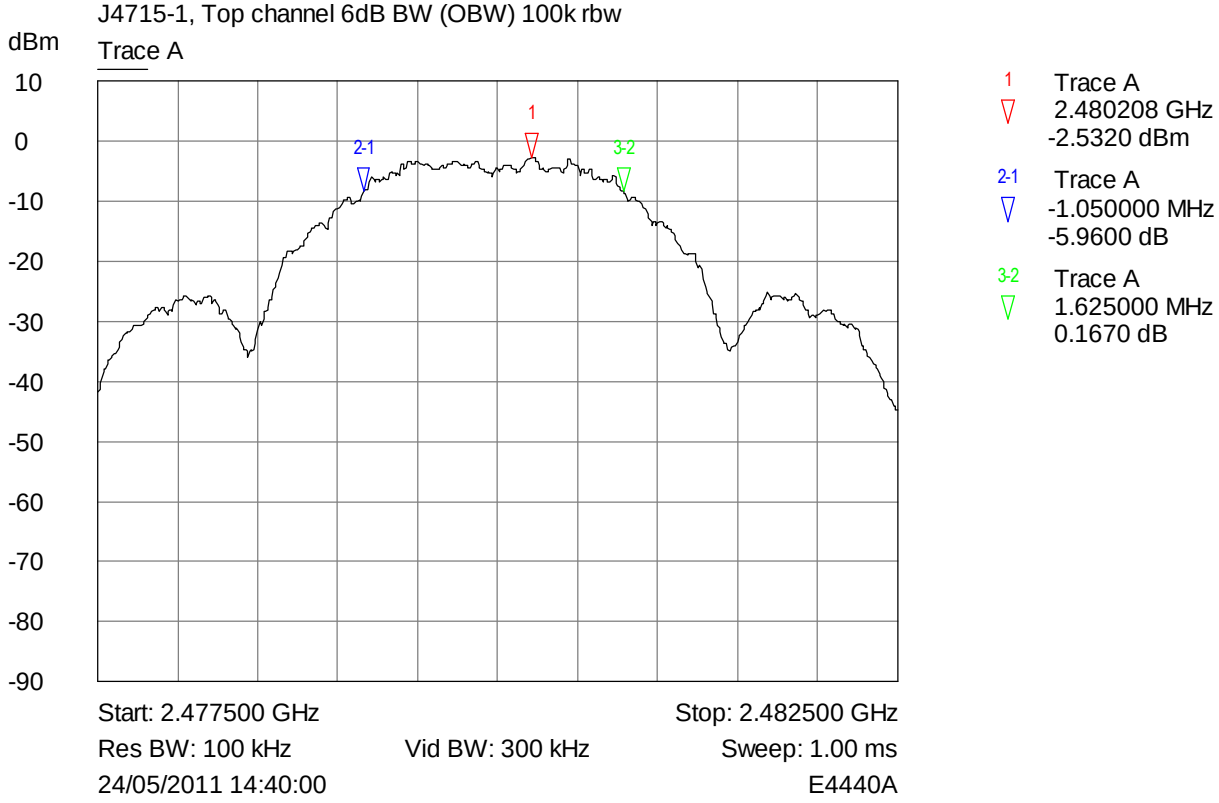
1 Trace A
2.439700 GHz
-1.8840 dBm

2-1 Trace A
-508.333332 kHz
-5.9820 dB

3-2 Trace A
1.558333 MHz
0.1380 dB

Start: 2.437500 GHz Stop: 2.442500 GHz
Res BW: 100 kHz Vid BW: 300 kHz Sweep: 1.00 ms
24/05/2011 14:37:59 E4440A

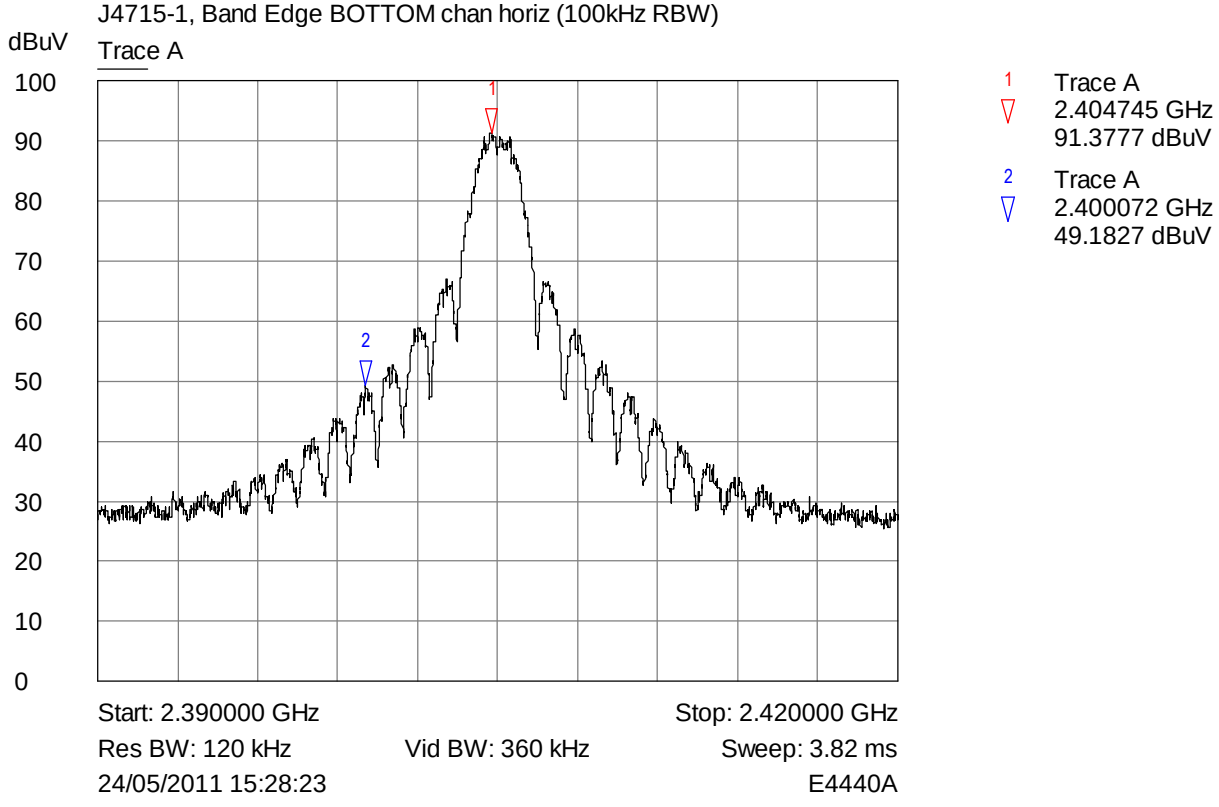
J4715-1, Top channel 6dB BW (OBW) 100k rbw



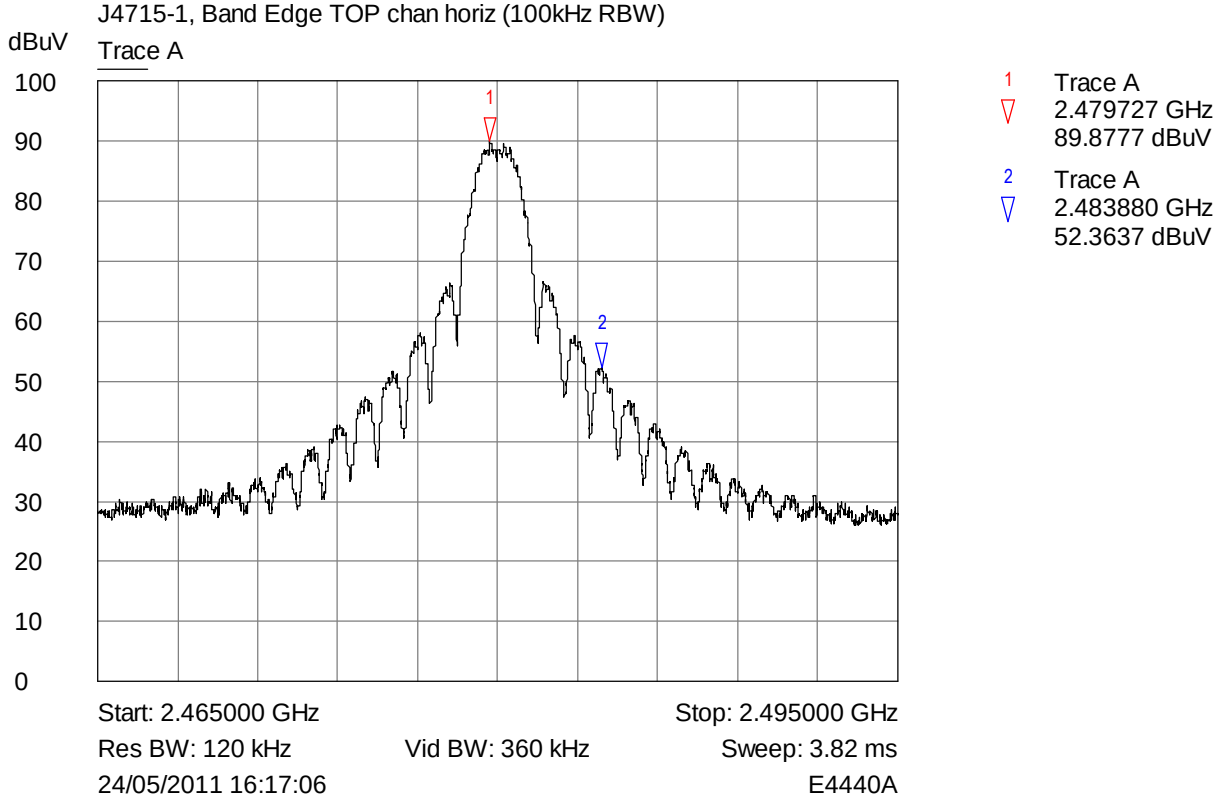
6.6 Band Edge Compliance

Band Edge.

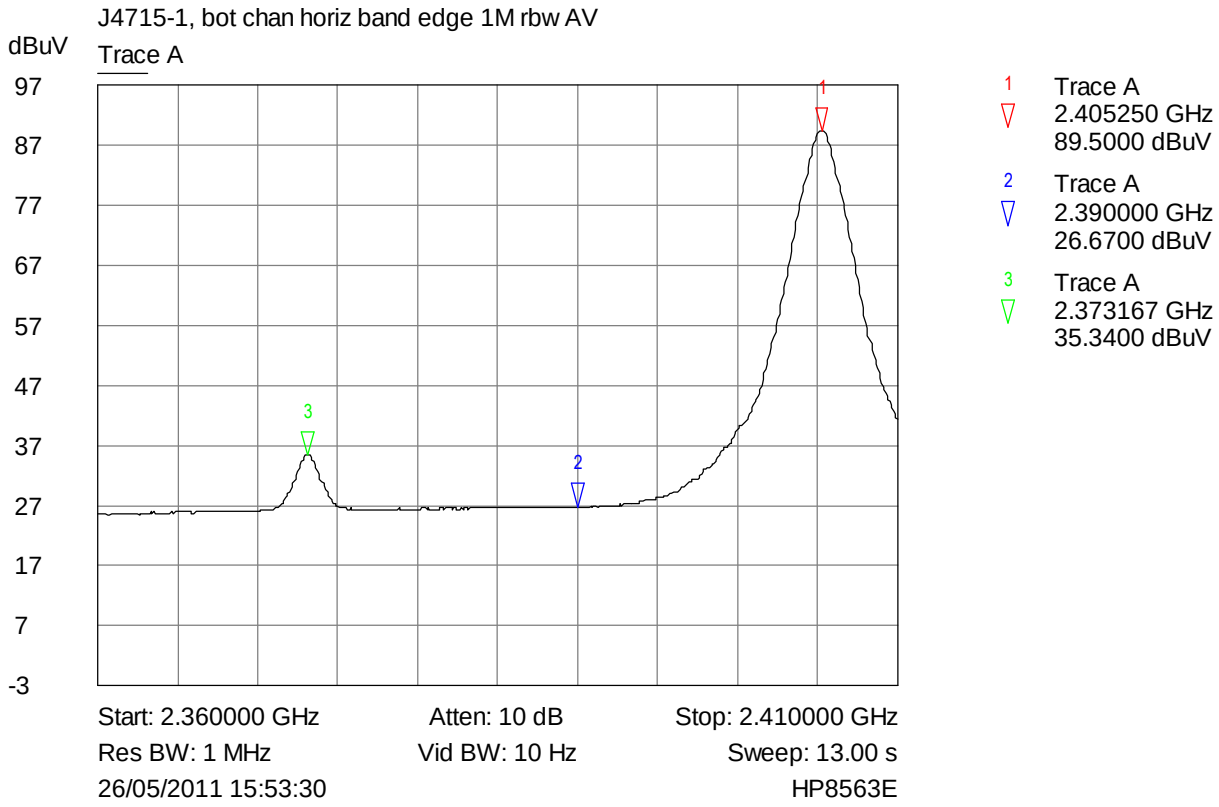
J4715-1, Band Edge BOTTOM chan horiz (100kHz RBW)

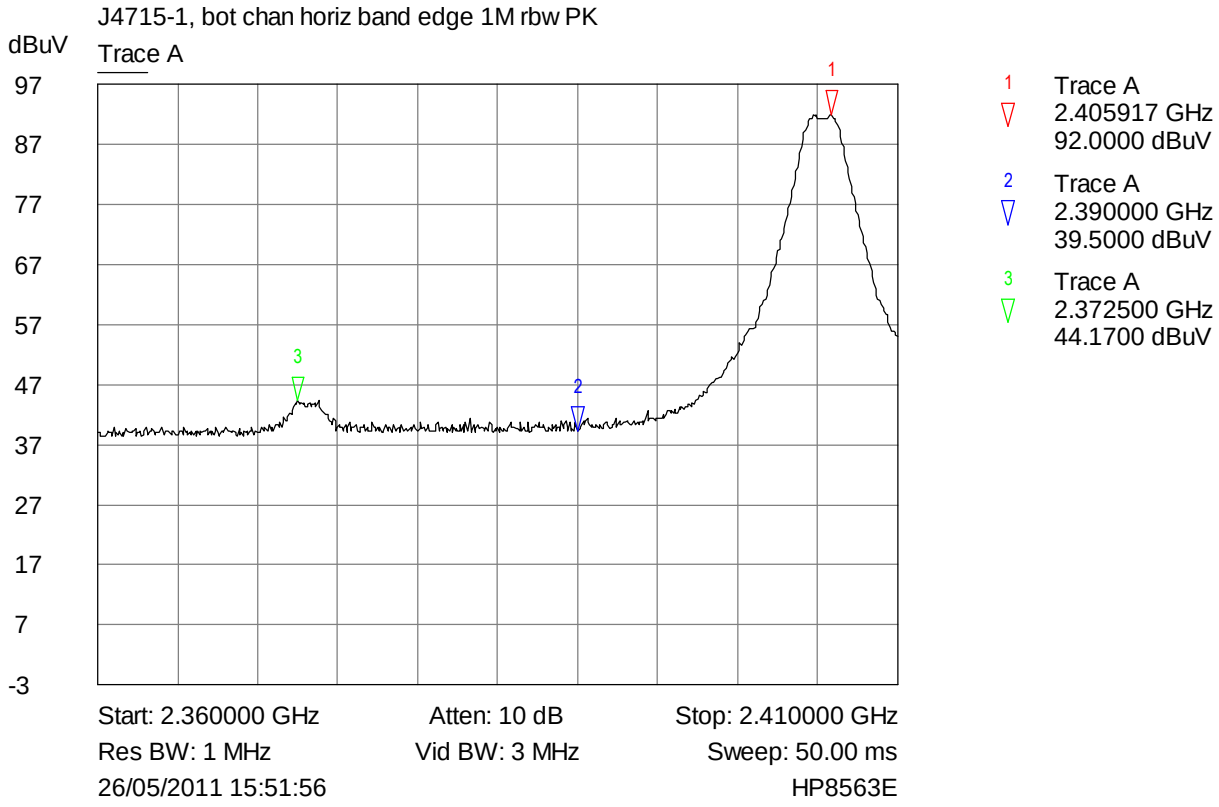


J4715-1, Band Edge TOP chan horiz (100kHz RBW)

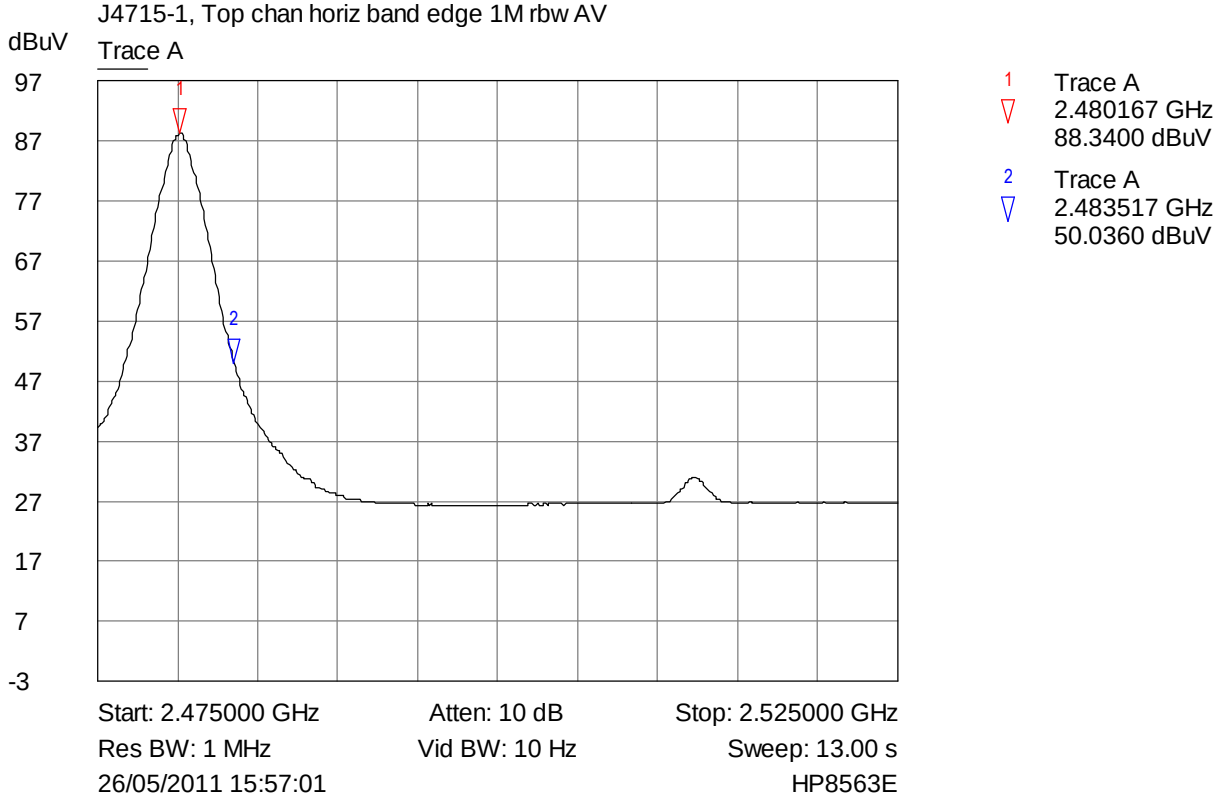


Restricted band edge.





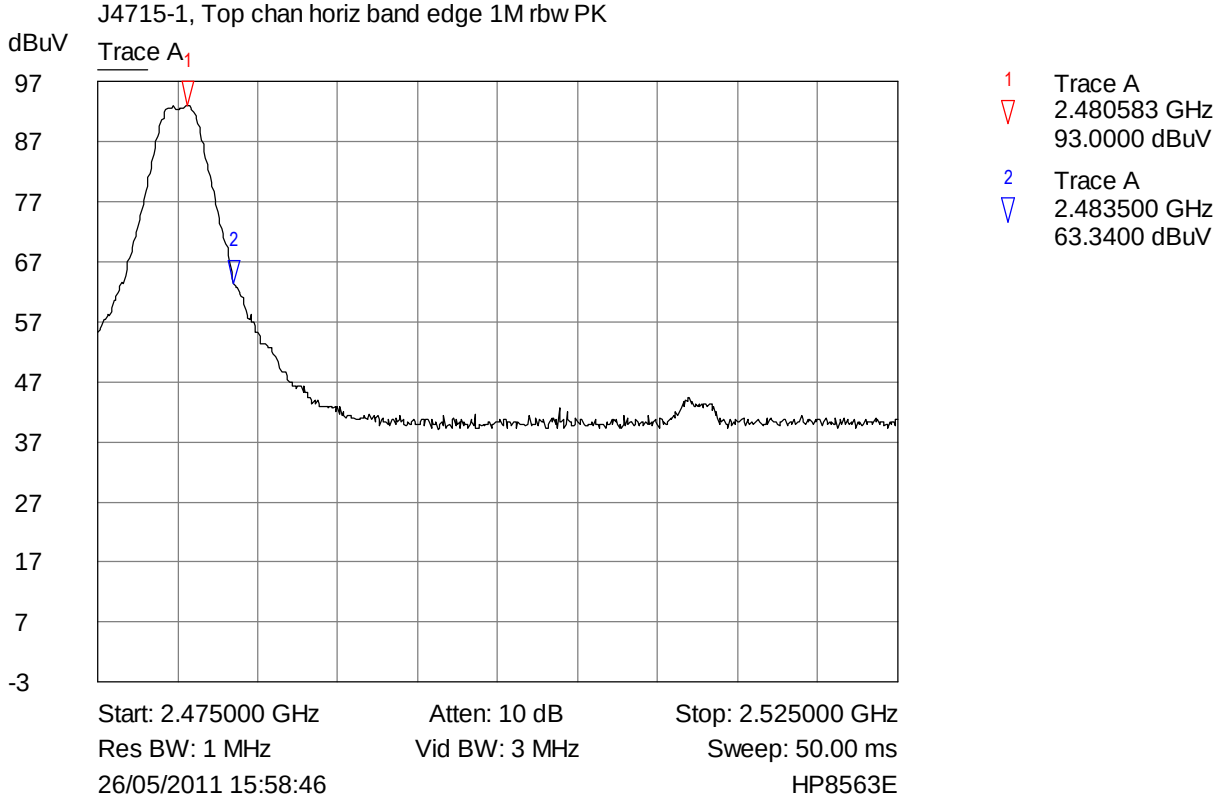
J4715-1, Top chan horiz band edge 1M rbw AV



1 Trace A
2.480167 GHz
88.3400 dBuV

2 Trace A
2.483517 GHz
50.0360 dBuV

J4715-1, Top chan horiz band edge 1M rbw PK



1 Trace A
2.480583 GHz
93.0000 dBuV

2 Trace A
2.483500 GHz
63.3400 dBuV

7 Explanatory Notes

7.1 Explanation of FAIL LIMIT 1 Statement

The **FAIL MARGIN 1** statement(s) may appear on the graphical plots when the receiver used to measure your equipment detects a signal that exceeds the dashed line. This does not mean that the **EUT** has failed the test, only that the 10 dB calculation margin set, has been exceeded on a peak measurement.

Following the indication that the margin has been exceeded, measurements are made at the frequency (ies) of the peaks. These peaks have been calculated to either Quasi Peak or Average Peak dependant on the test. A table of results has been printed on the reverse of the page. This table looks similar to the one illustrated below: -

Signal Number	Frequency (MHz)	Peak (dBμV)	PK Delta L 1 (dB)	Avg (dBμV)	Av Delta L 1 (dB)
1	12345.0000	12.9	-2.5	10.2	-5.2

The First column, labelled Signal Number, is a number that the receiver has given to each signal, which has been calculated.

Column Two, labelled Frequency (MHz), is the frequency of the signal received.

Column Three, labelled Peak (dBμV), (can also be labelled, in the case of Quasi Peak, Peak dBμV/m) is the Level that was received at peak amount in dB above 1μV.

Column Four, labelled PK Delta L1 (dB), is the same level as Column three but is given in a level relative to the limit line required.

Column Five, labelled AVG (dBμV), (can also be labelled, in the case of Quasi Peak, QP dBμV/m) when undertaking a Quasi peak test, This is the Average or Quasi peak calculation results given in dBμV or dBμV/m above 1μV.

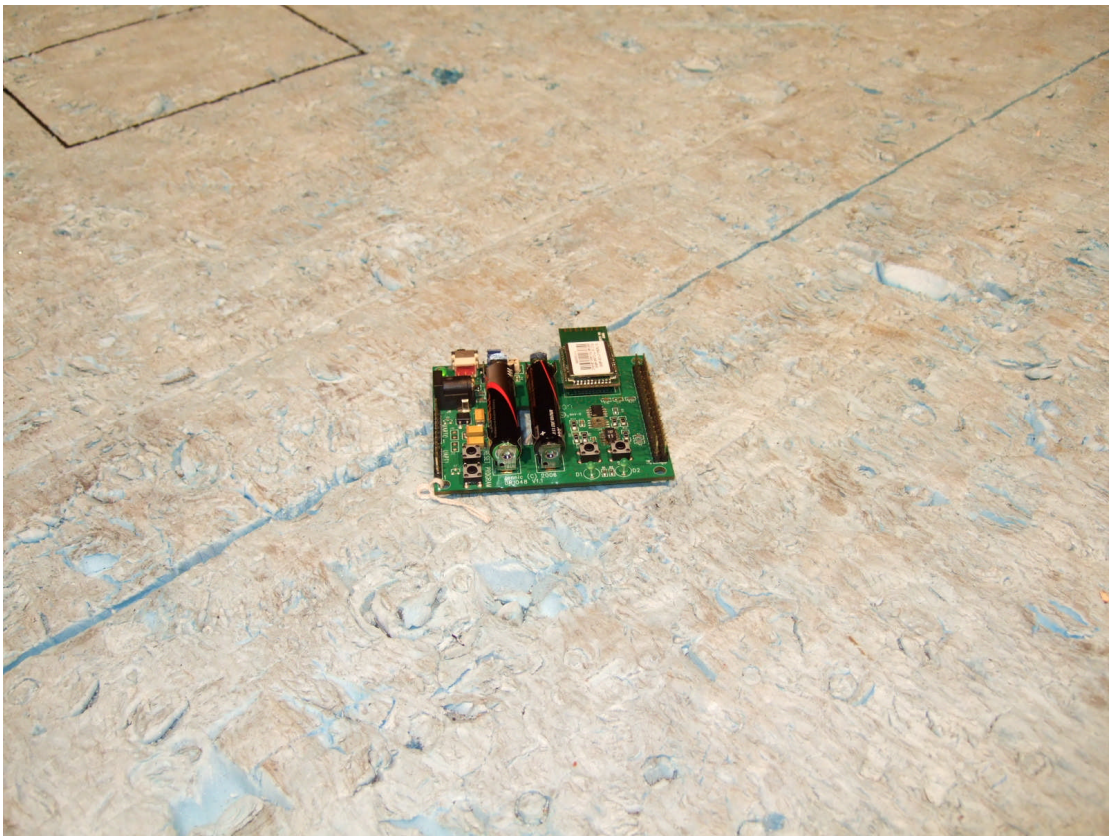
Column Six, labelled AV Delta L 1 (dB), (can also be labelled, in the case of Quasi Peak, QP Delta L 1 (dB)) is the Average or Quasi Peak calculation relevant to the limit line. The results entered in this column indicate the signal level relative to the compliance limit required. Negative numbers indicate that the product is compliant.

7.2 Explanation of limit line calculations for radiated measurements

The limits given in the test standard are normally expressed as absolute values (e.g. in μV/m at a specified distance), whereas the measured values are expressed as peak, quasi peak or average values in dBμV/m referenced to the measuring instrument inputs. RN Electronics calibrate the test set-up to account for any path losses, antenna gains, etc. so that the value read at the receiver relates directly to the absolute value required, except that it is expressed in dB relative to one microVolt and may need to take account of any alternative measuring distance used. Examples:

(a) limit of 500 μV/m equates to 20.log (500) = 54 dB μV/m.
(b) limit of 300 μV/m at 10m equates to 20.log (300 . 10/3) = 60 dB μV/m at 3m

8. Photographs



Photograph of the EUT as viewed from in front of the antenna, site M.

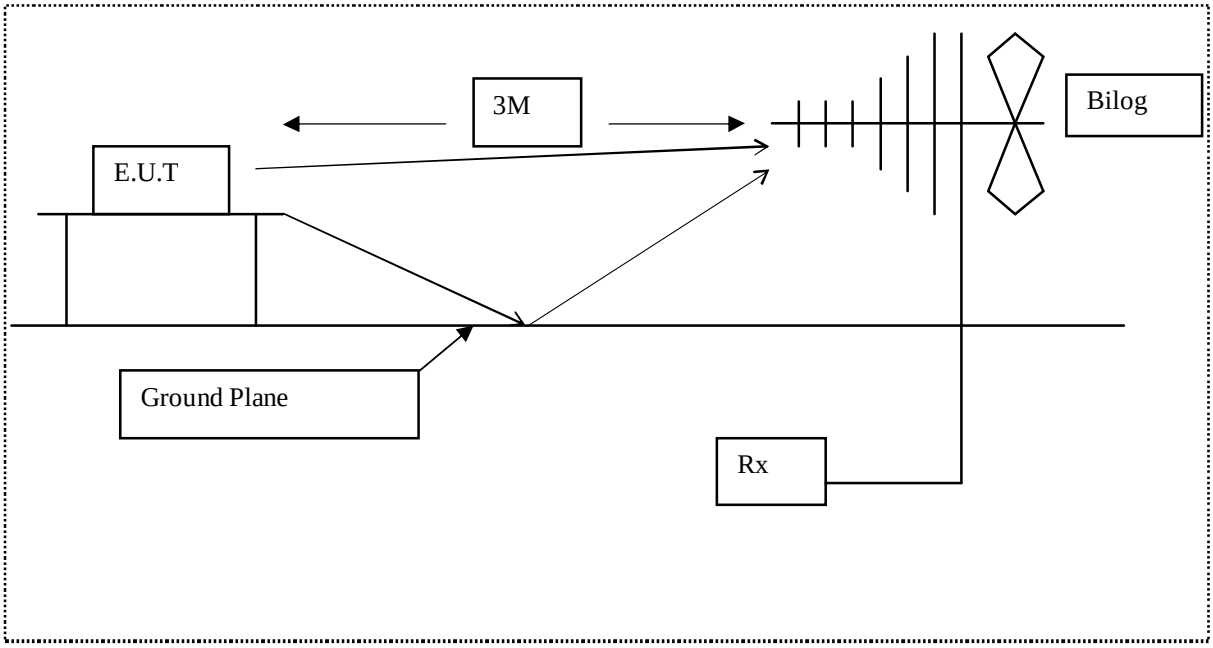


Diagram of the radiated emissions test setup.

Photograph of the EUT as viewed from screened room (conducted emissions)

Test not applicable. The digital device tested is intended to be powered from 3V DC supply (battery) and intended for modular approval. Any third party device it is incorporated into with a connection to the AC power line will require demonstration of compliance with the limits. Refer to §15.207(c) "Measurements to demonstrate compliance with the conducted limits are not required for devices which only employ battery power for operation and which do not operate from the AC power lines or contain provisions for operation while connected to AC power lines"

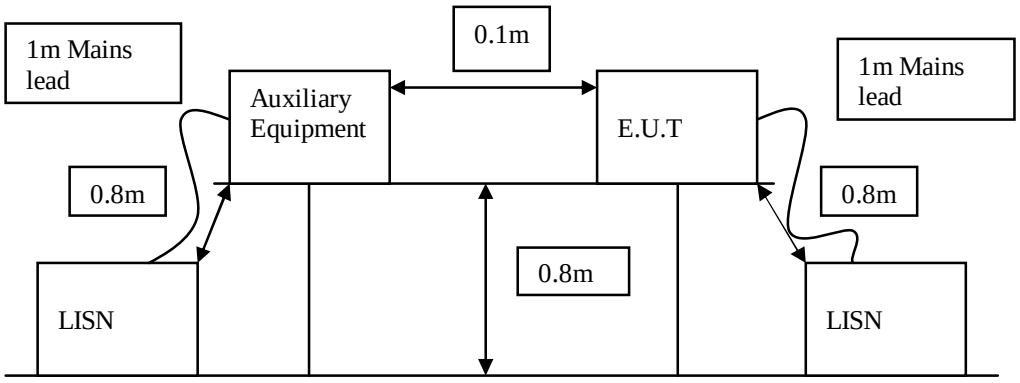
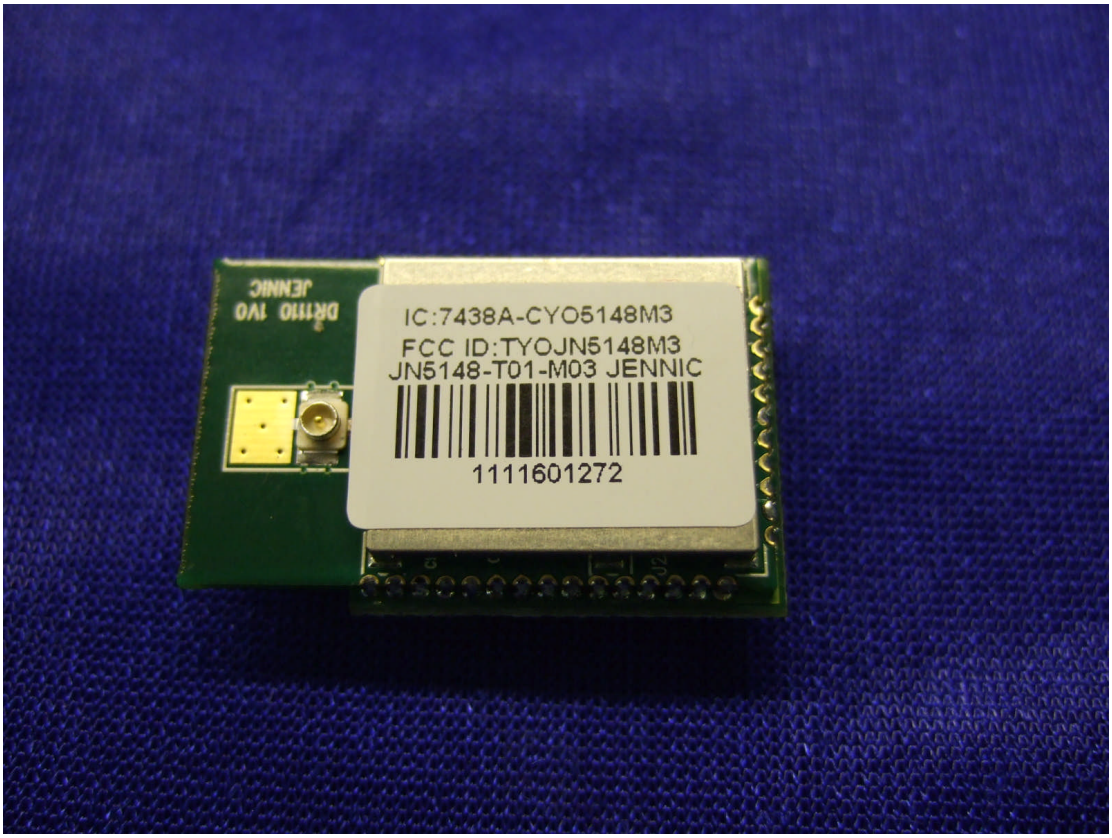


Diagram of the conducted emissions test setup.

Identifying Photographs of the EUT

Integral Antenna unit

Conducted unit



9. Signal Leads

Integral antenna unit had no ports.

Conducted unit.

Port Name	Cable Type
RF Port	Coaxial

10. Test Equipment Calibration list

The following table lists the test equipment used, last calibration date and calibration interval. All test equipment used has been maintained within the calibration requirements of ***R.N. Electronics Ltd.*** test facility quality system. Calibration intervals are regularly reviewed dependent on equipment manufacturer's recommendations and actual usage of the equipment.

RNNo	Model	Description	Manufacturer	Date Calibrated	Period
E268	BHA 9118	1-18 GHz Horn Antenna	Schaffner	02-Mar-09	60
E313	777C	30dB Attenuator	Narda	30-Jun-10	12
E342	8563E	Spectrum Analyser 26.5 GHz	HP	29-Mar-11	24
E367	1692626	20dB Attenuator	Marconi Instruments	15-Jan-11	12
E410	N5181A	3 GHz MXG Signal Generator	Agilent Technologies	06-Oct-10	12
E411	N9039A	9 kHz - 1 GHz RF Filter Section	Agilent Technologies	05-Oct-10	12
E412	E4440A	3 Hz - 26.5 GHz PSA	Agilent Technologies	05-Oct-10	12
E428	HF906	1-18 GHz Horn Antenna	Rhode & Schwarz	23-Oct-09	36
E434	G3RUH	10 MHz GPS Oscillator	James Miller	N/A	N/A
TMS78	460420	Std Gain Horn Antenna 12.4-18 GHz	ETS Systems	03-Nov-10	24
TMS79	460451	Std Gain Horn Antenna 18-26.5 GHz	ETS Systems	03-Nov-10	24
TMS81	6502	Active Loop Antenna	EMCO	13-Apr-10	24
TMS82	8449B	Pre Amplifier 1 - 26 GHz	Agilent	29-Oct-10	12
TMS933	CBL6141A	Bilog Antenna 30MHz - 2GHz	York EMC	09-Sep-10	36

11. Auxiliary equipment

11.1 Auxiliary equipment supplied by NXP Semiconductors

Auxiliary equipment used for the purpose of test supplied by the above has been listed below

Manufacturer	Description	Model Number	Serial Number
NXP Semiconductor	short RF lead	not available	not available
NXP Semiconductor	PCB Motherboard	DR1048	not available
NXP Semiconductor	USB to RS232 Programming Lead	not available	not available

11.2 Auxiliary equipment supplied by RN Electronics Limited

Auxiliary equipment used for the purpose of test supplied by the above has been listed below

RN Number	Manufacturer	Description	Model Number	Serial Number
I017	DELL	Laptop PC	Inspiron 5150	CN-0W0940-12961-44J-2047

12. Modifications

In order for the EUT to produce the results shown within this report the following modifications, if any, were implemented.

12.1 Modifications before test

There were no modifications made by R.N. Electronics Ltd before testing commenced.

12.2 Modifications during test

There were no modifications made by R.N. Electronics Ltd during testing.

n.b. The settings of the device - continuous transmit, power level & frequency were set by test software not normally available to the user.

13. Compliance information

Products subject to the Declaration of Conformity procedure are required to be supplied with a compliance information statement. A copy of this statement may be included here:

NOT APPLICABLE - Device to be Certified.

14 Description of Test Sites

Site A	Radio / Calibration Laboratory and anechoic chamber
Site B	Semi-anechoic chamber
Site B1	Control Room for Site B
Site C	Transient Laboratory
Site D	Screened Room (Conducted Immunity)
Site E	Screened Room (Control Room for Site D)
Site F	Screened Room (Conducted Emissions) VCCI Registration No. C-2823
Site K	Screened Room (Control Room for Site M)
Site M	3m Semi-anechoic chamber (indoor OATS) FCC Registration No. 293246
Site Q	Fully-anechoic chamber
Site OATS	3m and 10m Open Area Test Site FCC Registration No. 293246 IC Registration No. 5612A-1 VCCI Registration No. R-2580

15 Abbreviations and Units

%	Percent
µA/m	microAmps per metre
µV	microVolts
µW	microWatts
AC	Alternating Current
ALSE	Absorber Lined Screened Enclosure
AM	Amplitude Modulation
Amb	Ambient
ATPC	Automatic Transmit Power Control
BER	Bit Error Rate
ºC	Degrees Celsius
C/I	Carrier / Interferer
CEPT	European Conference of Postal and Telecommunications Administrations
COFDM	Coherent OFDM
CS	Channel Spacing
CW	Continuous Wave
dB	deciBels
dBµA/m	deciBels relative to 1µA/m
dBµV	deciBels relative to 1µV
dBc	deciBels relative to Carrier
dBm	deciBels relative to 1mW
DC	Direct Current
DTA	Digital Transmission Analyser
EIRP	Equivalent Isotropic Radiated Power
ERP	Effective Radiated Power
EU	European Union
EUT	Equipment Under Test
FM	Frequency Modulation
FSK	Frequency Shift Keying
g	Grams
GHz	GigaHertz
Hz	Hertz
IF	Intermediate Frequency
kHz	kiloHertz
LBT	Listen Before Talk
LO	Local Oscillator
mA	milliAmps
max	maximum
mbar	milliBars
Mbit/s	MegaBits per second
MHz	MegaHertz
mic	Microphone
min	minimum
mm	milliMetres
ms	milliSeconds
mW	milliWatts
NA	Not Applicable
nom	Nominal
nW	nanoWatt
OATS	Open Area Test Site
OFDM	Orthogonal Frequency Division Multiplexing
ppm	Parts per million
PRBS	Pseudo Random Bit Sequence
QAM	Quadrature Amplitude Modulation
QPSK	Quadrature Phase Shift Keying
R&TTE	Radio and Telecommunication Terminal Equipment
Ref	Reference
RF	Radio Frequency
RFC	Remote Frequency Control
RSL	Received Signal Level
RTP	Room Temperature and Pressure
RTPC	Remote Transmit Power Control
Rx	Receiver
s	Seconds
SINAD	SIgnal to Noise And Distortion
Tx	Transmitter
V	Volts

RN Electronics
EMC & RADIO TEST SERVICES

Certificate of Test 4715/1

The equipment noted below has been tested by ***R.N. Electronics Limited*** and conforms with the relevant subpart of FCC 47CFR part 15, subject to deviations as detailed in this report.

This certificate relates to the unit, as identified by unique serial number(s) and further detailed in the referenced report, in the condition(s) at the time it was tested. It does not relate to any other similar equipment and performance of the product before or after the test cannot be guaranteed. Furthermore, this is a certificate of test only and should not be confused with an equipment authorisation.

Equipment:	IEEE 802.15.4 wireless controller module
Model Number(s):	JN5148-T01-M00
Unique Serial Number(s):	1111000065 Integral Ant unit 1111601272 Conducted unit
Manufacturer:	NXP Labs UK Ltd Furnival Street Sheffield S1 4QT
Customer Purchase Order Number:	GB628200012562
R.N. Electronics Limited Report Number:	05-480/4715/1/11
Test Standards:	FCC 47CFR Part 15C: Effective date **October 1st 2010,** Class DTS Intentional Radiator
Date:	24th to 27th May 2011
For and on behalf of R.N. Electronics Limited	
Signature:	
Notes:	

RN Electronics Ltd www.RNelectronics.com
Arnolds Court, Arnolds Farm Lane, Mountnessing, Brentwood, Essex CM13 1UT
Tel: +44 1277 352219 E-mail: sales@RNelectronics.com Fax: +44 1277 352968