FCC
Test Report
for
IEEE 802.15.4 Wireless microcontroller module
JN5139-T01-C13

Report Number 02-323/3876/1/09a
This report supersedes report 02-323/3876/1/09
Report Produced by: -

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1. Contents

2. Summary of Test Results

The IEEE 802.15.4 Wireless microcontroller moduleJN5139-T01-C13 was tested to the following standards: -

FCC Part 15C (effective date October 1, 2008); 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)	PASSED
5. Power Spectral Density	FCC Part 15C §15.247(e)	PASSED

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: 5th - 16th February 2009

Test Engineer: Daniel Sims — Digitally signed by Daniel Sims DN: CN = Daniel Sims, C = GB, O = RN Electronics Date: 2009.03.26 13:10:09 Z

Approved By: Roger Ray — Digitally signed by Roger Ray DN: CN = Roger Ray, C = GB, O = RN Electronics Date: 2009.03.26 13:15:19 Z

Customer Representative:

[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".

3. Information about Equipment Under Test
3.1 Equipment Specification

Applicant	Jennic Ltd Furnival Street Sheffield S1 4QT UK
Manufacturer/Brand Name	Jennic Ltd
Full name of EUT	IEEE 802.15.4 Wireless microcontroller module
Model Number of EUT	JN5139-T01-C13
Serial Number of EUT	#03
FCC ID (if applicable):	
Date when equipment was received by RN Electronics Limited	3rd February 2009
Date of test:	5th - 16th February 2009
Customer order number:	PO 005126/CF
A visual description of EUT is as follows:	A canned IC on small PCB with a UFL type antenna connector port. For purposes of test mounted on a UFL to SMA test jig & motherboard with battery/ DC voltage input and RS232 communications fly lead (For programming).
The main function of the EUT is:	2.4GHz (IEEE 802.15.4) wireless microcontroller module
Antennas: 15dBi	18dBi Aveslink Outdoor High Gain Directional Patch Antenna (Model #E-0360-AK) and a Aveslink Vertical Colinear Antenna (Model #E-1050-AK).

Equipment Under Test Information specification:

Height	6.9mm
Width	20mm
Depth	30.8mm
Weight	0.01kg
Voltage	3V DC
Current required from above voltage source	0.05A
Highest Frequencies used / generated	2.405-2.480 GHz

Purpose of Test:	To demonstrate compliance with FCC OET regulations for intentional radiators.

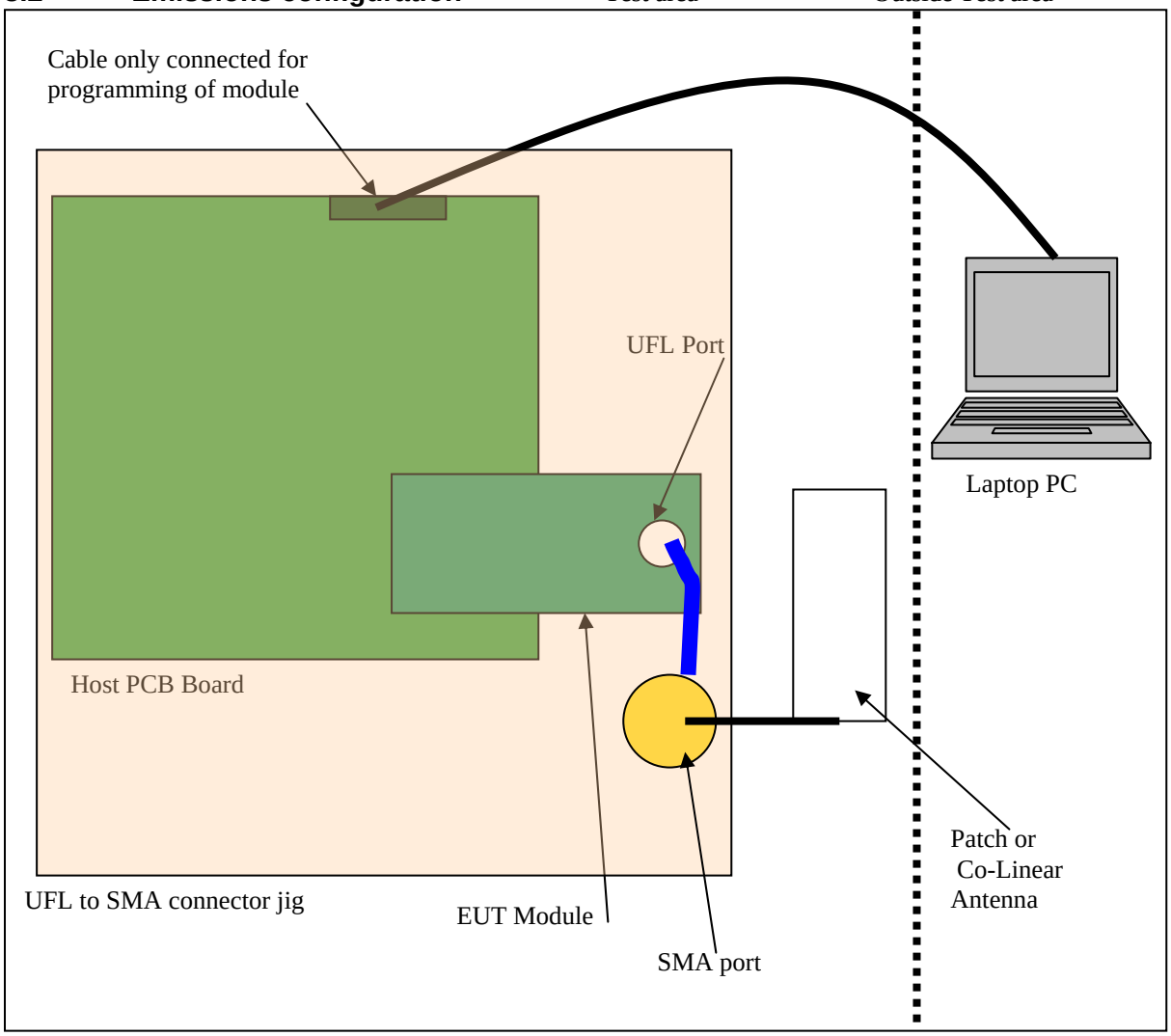
Modes of operation:

Mode	Description of mode	Used for Testing
Continuous TX 2.405GHz	Unit continuously transmitting on bottom channel	YES
Continuous TX 2.440GHz	Unit continuously transmitting on Middle channel	YES
Continuous TX 2.480GHz	Unit continuously transmitting on Top channel	YES
Conrinuous RX 2.405GHz	Unit continuously receiving on bottom channel	YES
Conrinuous RX 2.440GHz	Unit continuously receiving on Middle channel	YES
Conrinuous RX 2.480GHz	Unit continuously receiving on Top channel	YES

Any modifications made to the **EUT**, whilst under test, can be found in Section 12.

This report was printed on: 26 March 2009

3.2 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. The unit was provided with a UFL to SMA connector jig to allow the supplied Patch & Co-Linear antennas to be connected and tested. 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 Jennic Ltd. A laptop provided by RN Electronics was used to program the modules.

For radiated emissions the support equipment was situated outside the chamber.

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

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.

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:	FCC Part 15C, Reference (15.209)

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. Radiated Emissions testing was performed with a new battery.

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 or OATS**.**

Test Environment:
M or OATS

Temperature: 8-22°C Humidity: 32-46%

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.

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

5.2.2.1 Test Equipment used

E001, TMS81, TMS933, E268, TMS79, TMS82

See Section 10 for more details

5.3 Intentional Radiator Field Strength

5.3.1 Test Methods

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

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

5.3.1.1 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 antenna was scanned 1-4m in height in both Horizontal and Vertical polarisations. The EUT was rotated in all three orthogonal planes.

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.
Both the equipment and the antenna were rotated 360° to record the maximised emission.

5.3.2 Test results

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

Test Environment: Temperature: 8-21°C Humidity: 32-46 %

The maximised field strength measured was:-
Patch Antenna results

Frequency (MHz)	Power (1MHz RBW) (dBuV/m @ 3 metres)	Power (100kHz RBW) (dBuV/m @ 3 metres)
2405	107.2	103.4
2440	108.2	105.4
2480	107.4	103.7

CO-Linear Antenna results

Frequency (MHz)	Power (1MHz RBW) (dBuV/m @ 3 metres)	Power (100kHz RBW) (dBuV/m @ 3 metres)
2405	99.6	95.5
2440	98.7	96.7
2480	99.1	95.7

Conducted results

Frequency (MHz)	Power (dBm)
2405	0.7
2440	1.0
2480	1.0

Limits: 1Watt.

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

5.3.2.1 Test Equipment used

E268, E412, TMS82

See Section 10 for more details

5.4 Maximum Spectral Power Density

5.4.1 Test Methods

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

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

5.4.1.1 Configuration of EUT

A test jig was provided with an SMA 50ohm coaxial connector which was checked for maximum conducted power at the antenna port.

5.4.1.2 Test Procedure

Tests were made in accordance with FCC Part 15 using the measuring equipment noted below and taking due consideration of the loss of the antenna port adaptor.

5.4.2 Test results

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

Temperature of test Environment: 22°C

Frequency (MHz)	Peak Power (dBm/3kHz)
2405	-17.4
2440	-17.2
2480	-17.5

Limit: +8dBm/3kHz

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

5.4.2.1 Test Equipment used

C031, C032, E005, E266, E002, E003

See Section 10 for more details.

5.5 6dB Bandwidth

5.5.1 Test Methods

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

Test Method: FCC Part 15C, Reference (15.215)

5.5.1.1 Configuration of EUT

A test jig was provided with an SMA 50ohm coaxial connector which was used to measure the 6dB Bandwidth.

5.5.1.2 Test Procedure

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

5.5.2 Test results

Tests were performed using Test Site A.

Temperature of test Environment: 22°C

Analyser plots for the 6dB bandwidth can be found in Section 6.6 of this report.

Frequency (MHz)	6dB Bandwidth (MHz)	Plot Reference
2405	1.6375	Plot 001
2440	1.6250	Plot 002
2480	1.6250	Plot 003

Limits: Must be >500kHz.

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

5.5.2.1 Test Equipment used

E002, E003

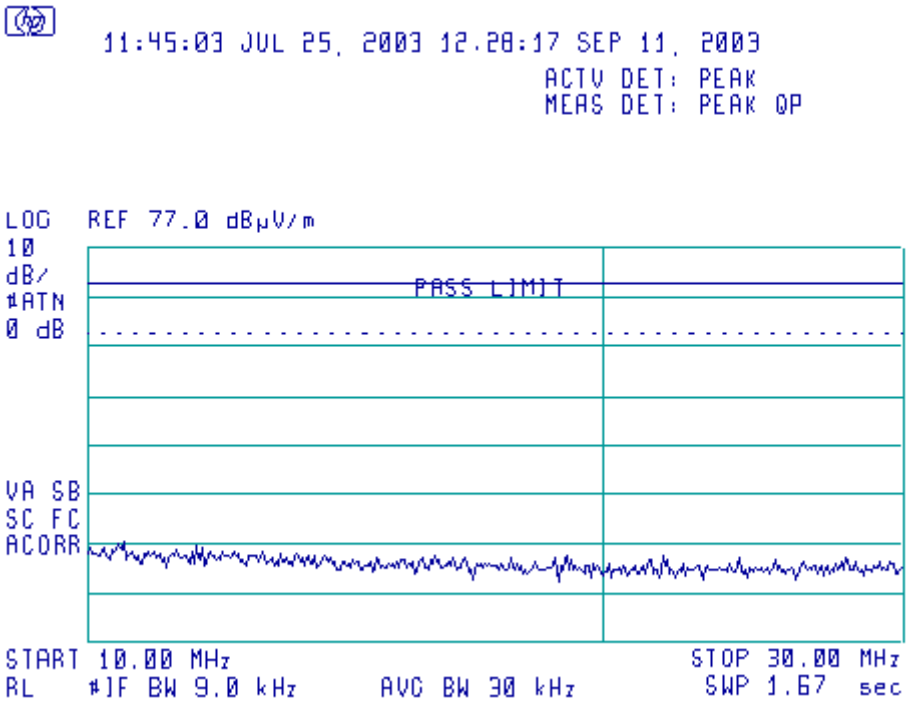
See Section 10 for more details.

6. Plots and Results
6.1 Conducted Emissions

NONE - TEST NOT APPLICABLE

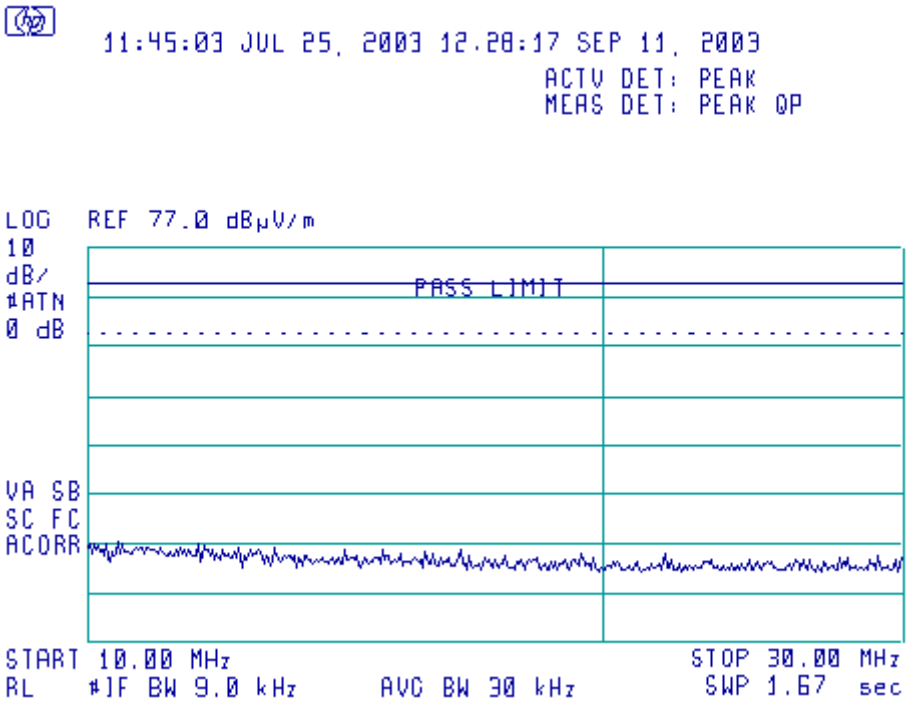
6.2 Radiated Emissions

Top, Middle & Bottom Channels were tested. However whilst all spurious signals have been reported for each channel, only middle channel plots are shown within this report.



Quasi-Peak Values 10MHz to 30MHz Parallel Patch & Co-linear Antennas.

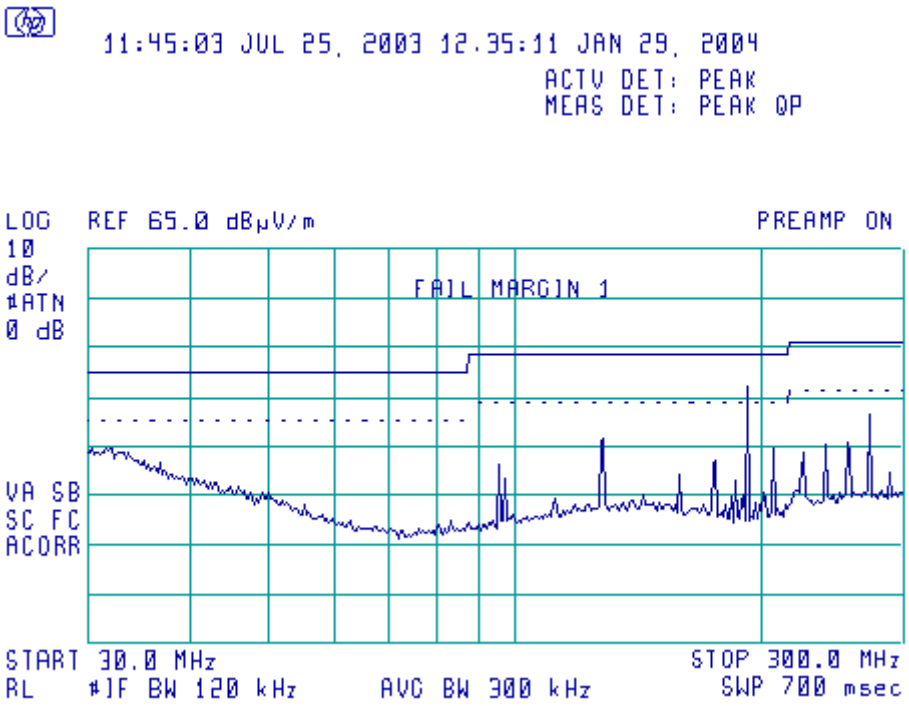
The plot shows a swept response of peak values using the quasi-peak limit line



Quasi-Peak Values 10MHz to 30MHz Perpendicular Patch & Co-linear Antennas.

The plot shows a swept response of peak values using the quasi-peak limit line

PATCH ANTENNA RESULTS

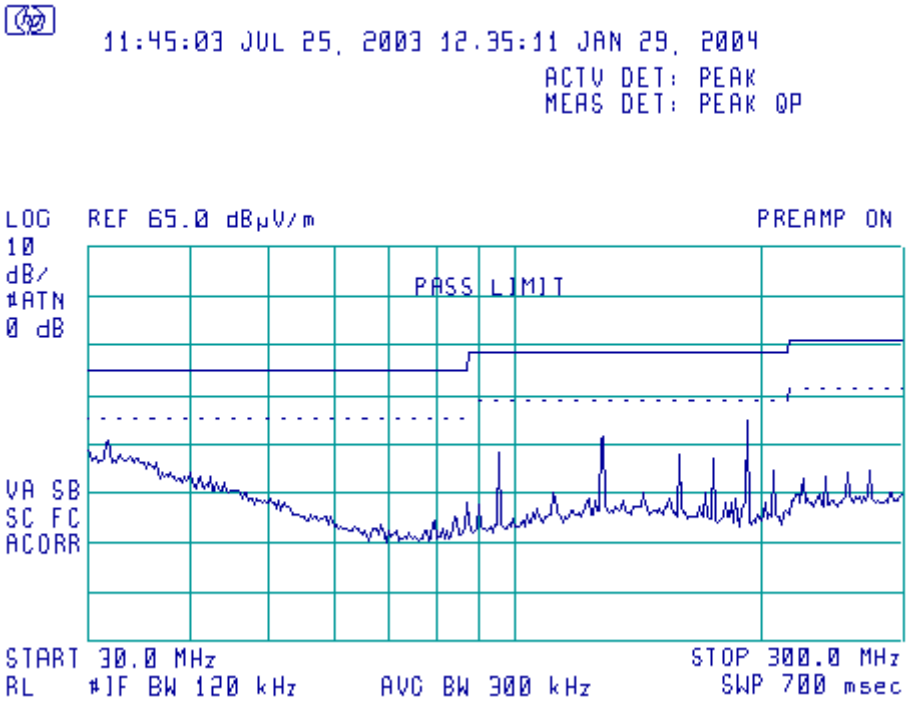


Quasi-Peak Values of 30 MHz. to 300 MHz.

Horizontal Polarisation

The plot shows a swept response of peak values using the quasi-peak limit line

(Any peaks within 20dB of the limit line have been calculated and appear in the tables following)

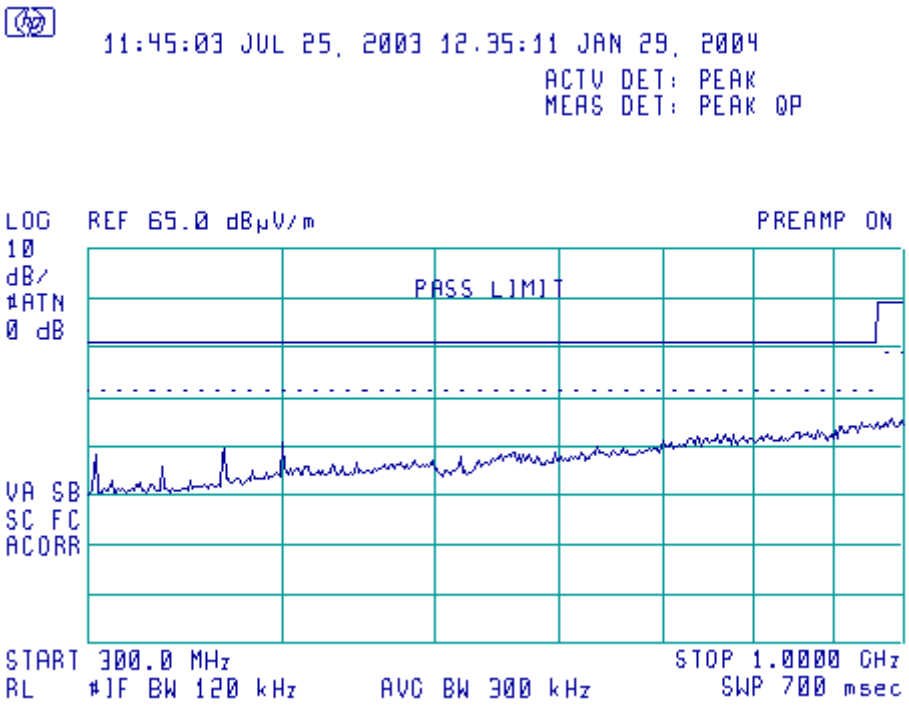


Quasi-Peak Values of 30 MHz. to 300 MHz.

Vertical Polarisation

The plot shows a swept response of peak values using the quasi-peak limit line

(Any peaks within 20dB of the limit line have been calculated and appear in the tables following)

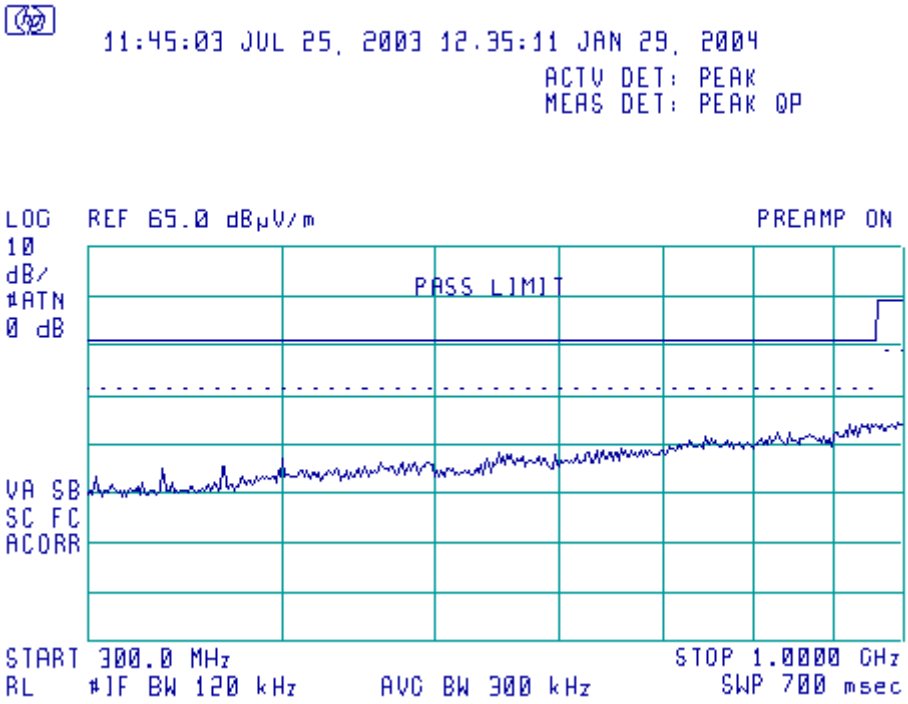


Quasi-Peak Values of 300 MHz. to 1 GHz.

Horizontal Polarisation

The plot shows a swept response of peak values using the quasi-peak limit line

(Any peaks within 20dB of the limit line have been calculated and appear in the tables following)



Quasi-Peak Values of 300 MHz. to 1 GHz.

Vertical Polarisation

The plot shows a swept response of peak values using the quasi-peak limit line

(Any peaks within 20dB of the limit line have been calculated and appear in the tables following)

Tables of signals within 20dB of the limit line for Quasi-peak Top, Middle & Bottom Channels Patch Antenna

Bottom Channel
Horizontal

Signal	Freq (MHz)	QP Amp (dBuV/m)	QP - Lim1 (dB)	Peak Amp (dBuV/m)	Peak - Lim1 (dB)
1	128.007938	27.16	-16.34	28.34	-15.16
2	192.005625	36.86	-6.64	37.26	-6.24
3	208.000913	24.94	-18.56	26.09	-17.41
4	272.003175	31.65	-14.35	32.67	-13.33
5	400.018688	25.17	-20.83	28.06	-17.94

Vertical

Signal	Freq (MHz)	QP Amp (dBuV/m)	QP - Lim1 (dB)	Peak Amp (dBuV/m)	Peak - Lim1 (dB)
1	192.005813	30.35	-13.15	31.06	-12.44
2	127.997400	26.20	-17.30	27.43	-16.07
3	96.012225	23.55	-19.95	24.86	-18.64

Middle Channel
Horizontal

Signal	Freq (MHz)	QP Amp (dBuV/m)	QP - Lim1 (dB)	Peak Amp (dBuV/m)	Peak - Lim1 (dB)
1	127.995800	25.87	-17.63	27.32	-16.18
2	191.997500	38.04	-5.46	38.37	-5.13
3	208.011800	24.33	-19.17	25.73	-17.77
4	239.994450	25.33	-20.67	26.94	-19.06
5	256.024300	24.92	-21.08	26.90	-19.10
6	272.007700	31.42	-14.58	32.68	-13.32
7	400.002350	27.37	-18.63	29.58	-16.42

Vertical

Signal	Freq (MHz)	QP Amp (dBuV/m)	QP - Lim1 (dB)	Peak Amp (dBuV/m)	Peak - Lim1 (dB)
1	96.015525	23.35	-20.15	24.74	-18.76
2	128.010075	26.18	-17.32	27.43	-16.07
3	191.997525	30.36	-13.14	31.20	-12.30

Top Channel
Horizontal

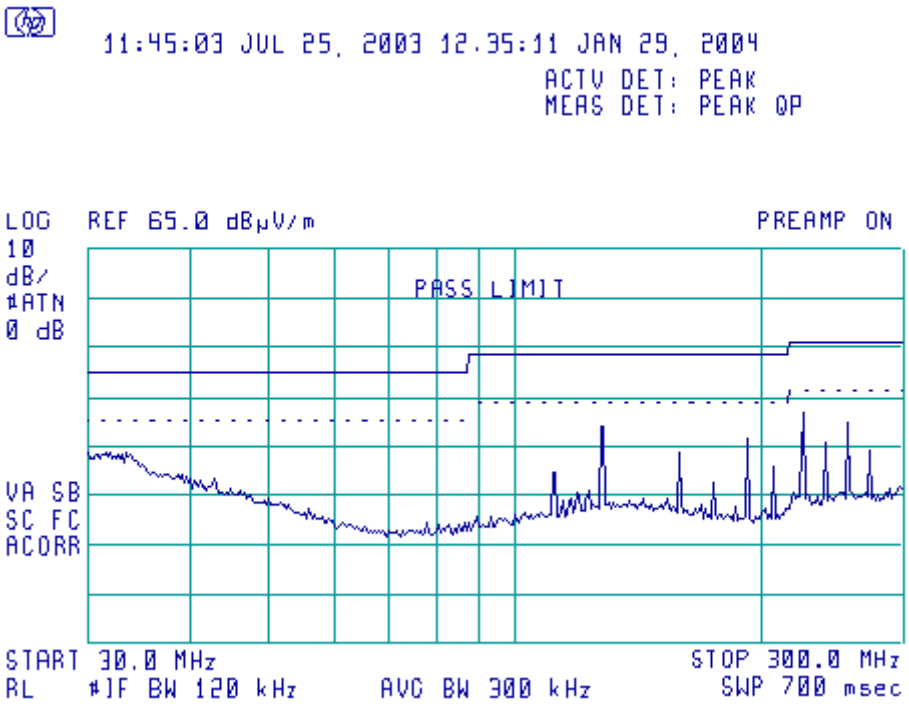
Signal	Freq (MHz)	QP Amp (dBuV/m)	QP - Lim1 (dB)	Peak Amp (dBuV/m)	Peak - Lim1 (dB)
1	128.006400	27.18	-16.32	28.29	-15.21
2	191.997250	36.83	-6.67	37.21	-6.29
3	207.996250	25.13	-18.37	26.66	-16.84
4	256.016750	26.17	-19.83	27.95	-18.05
5	272.007550	31.01	-14.99	32.03	-13.97

Vertical

Signal	Freq (MHz)	QP Amp (dBuV/m)	QP - Lim1 (dB)	Peak Amp (dBuV/m)	Peak - Lim1 (dB)
1	128.006588	27.18	-16.32	28.58	-14.92
2	191.996000	31.99	-11.51	32.63	-10.87
3	272.007800	25.84	-20.16	27.56	-18.44

Measurement Uncertainty of ± 5.2dB Applies

CO-LINEAR ANTENNA RESULTS

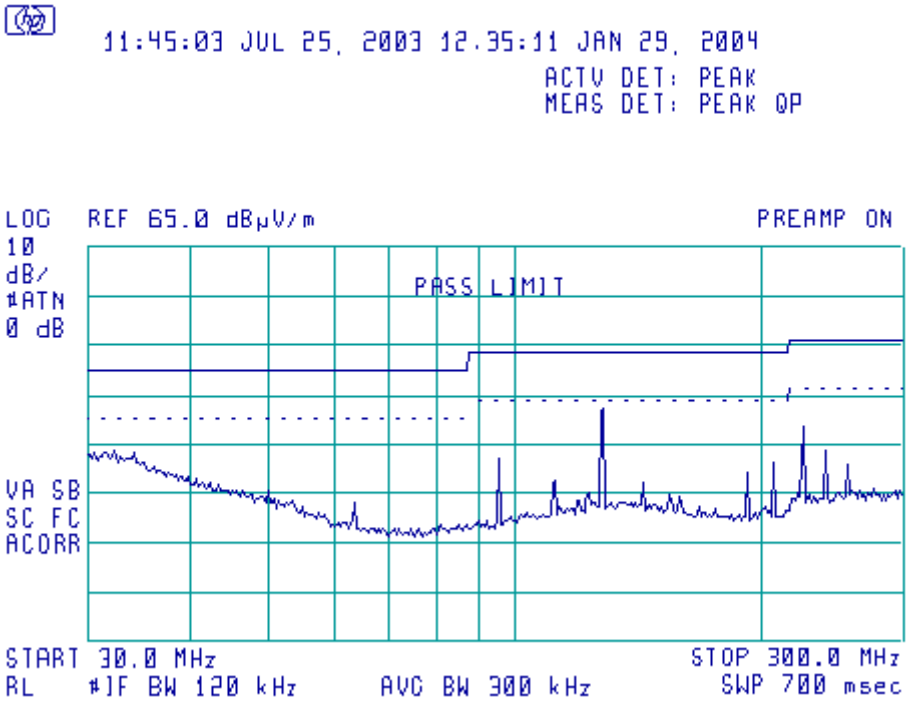


Quasi-Peak Values of 30 MHz. to 300 MHz.

Horizontal Polarisation

The plot shows a swept response of peak values using the quasi-peak limit line

(Any peaks within 20dB of the limit line have been calculated and appear in the tables following)

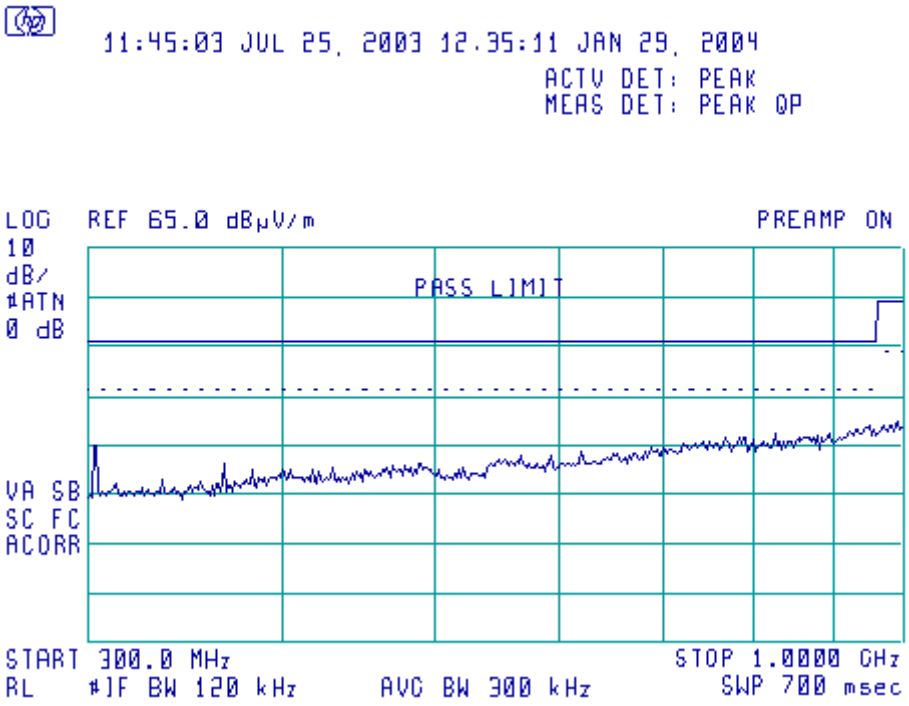


Quasi-Peak Values of 30 MHz. to 300 MHz.

Vertical Polarisation

The plot shows a swept response of peak values using the quasi-peak limit line

(Any peaks within 20dB of the limit line have been calculated and appear in the tables following)

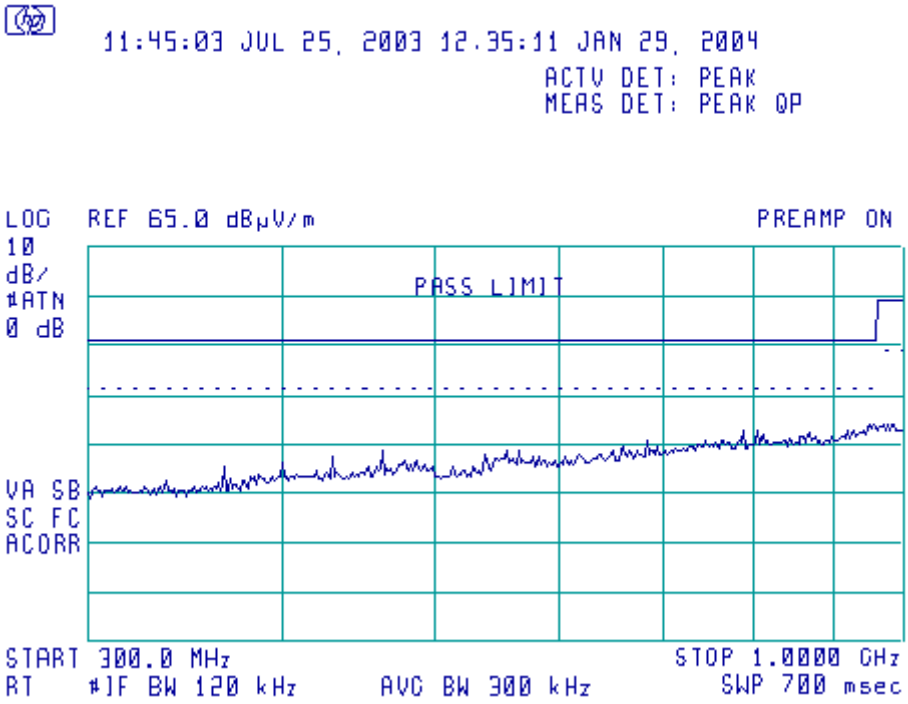


Quasi-Peak Values of 300 MHz. to 1 GHz.

Horizontal Polarisation

The plot shows a swept response of peak values using the quasi-peak limit line

(Any peaks within 20dB of the limit line have been calculated and appear in the tables following)



Quasi-Peak Values of 300 MHz. to 1 GHz.

Vertical Polarisation

The plot shows a swept response of peak values using the quasi-peak limit line

(Any peaks within 20dB of the limit line have been calculated and appear in the tables following)

Tables of signals within 20dB of the limit line for Quasi-peak Top, Middle & Bottom Channels Co-Linear Antenna

Bottom Channel
Vertical

Signal	Freq (MHz)	QP Amp (dBuV/m)	QP - Lim1 (dB)	Peak Amp (dBuV/m)	Peak - Lim1 (dB)
1	128.011275	34.39	-9.11	34.92	-8.58
2	160.012913	24.69	-18.81	26.14	-17.36
3	192.012825	24.22	-19.28	25.50	-18.00
4	224.002425	28.37	-17.63	29.97	-16.03

Horizontal

Signal	Freq (MHz)	QP Amp (dBuV/m)	QP - Lim1 (dB)	Peak Amp (dBuV/m)	Peak - Lim1 (dB)
1	128.006063	29.45	-14.05	30.40	-13.10
2	191.995575	26.18	-17.32	27.23	-16.27
3	224.007300	31.30	-14.70	32.47	-13.53
4	256.001250	28.83	-17.17	30.16	-15.84

Middle Channel
Vertical

Signal	Freq (MHz)	QP Amp (dBuV/m)	QP - Lim1 (dB)	Peak Amp (dBuV/m)	Peak - Lim1 (dB)
1	128.005425	32.42	-11.08	33.24	-10.26
2	223.992750	28.30	-17.70	29.55	-16.45

Horizontal

Signal	Freq (MHz)	QP Amp (dBuV/m)	QP - Lim1 (dB)	Peak Amp (dBuV/m)	Peak - Lim1 (dB)
1	128.007300	28.94	-14.56	30.01	-13.49
2	191.997225	26.29	-17.21	27.28	-16.22
3	224.009400	30.96	-15.04	31.94	-14.06
4	256.009425	29.18	-16.82	30.55	-15.45

Top Channel
Vertical

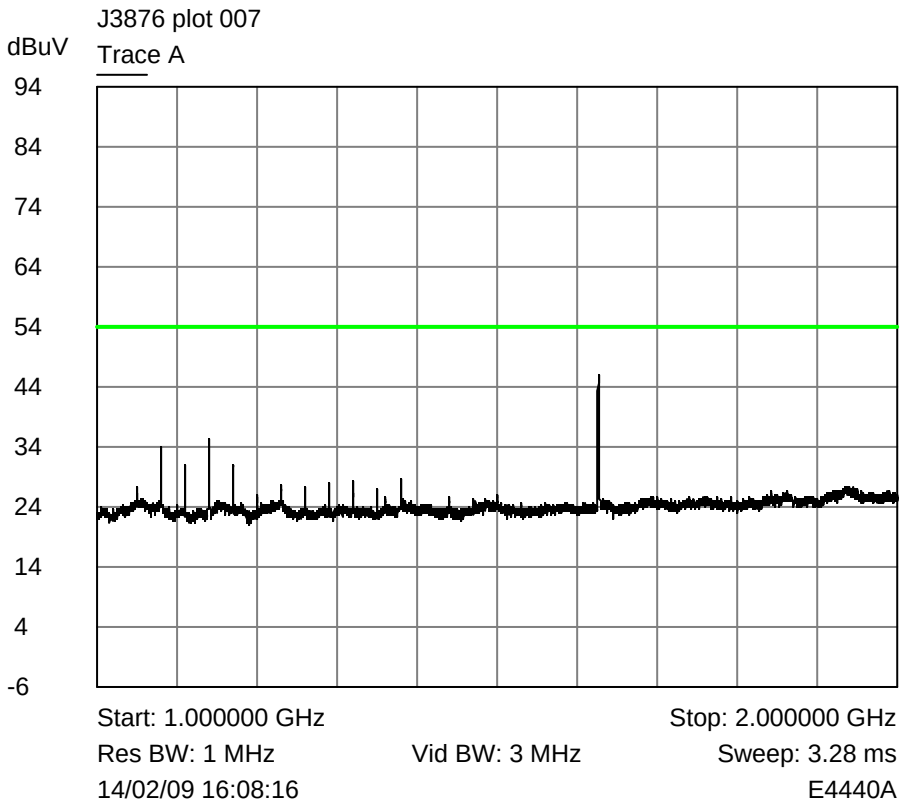
Signal	Freq (MHz)	QP Amp (dBuV/m)	QP - Lim1 (dB)	Peak Amp (dBuV/m)	Peak - Lim1 (dB)
1	127.998713	36.05	-7.45	36.57	-6.93
2	160.005450	27.04	-16.46	28.19	-15.31
3	192.008100	22.41	-21.09	23.80	-19.70
4	224.003813	30.05	-15.95	31.42	-14.58
5	255.993188	27.01	-18.99	28.87	-17.13
6	367.992991	25.50	-20.50	27.69	-18.31

Horizontal

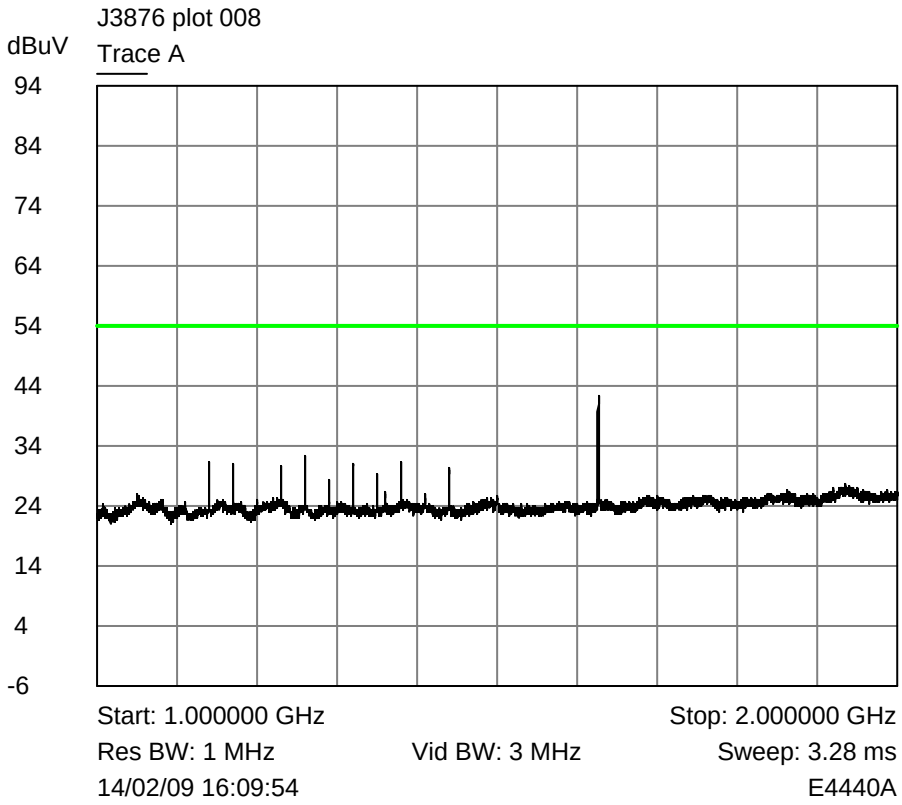
Signal	Freq (MHz)	QP Amp (dBuV/m)	QP - Lim1 (dB)	Peak Amp (dBuV/m)	Peak - Lim1 (dB)
1	128.006063	31.19	-12.31	32.04	-11.46
2	159.999788	20.61	-22.89	22.82	-20.68
3	192.004350	26.76	-16.74	28.00	-15.50
4	224.009025	28.31	-17.69	29.72	-16.28
5	255.995400	30.98	-15.02	32.42	-13.58

Measurement Uncertainty of ± 5.2dB Applies

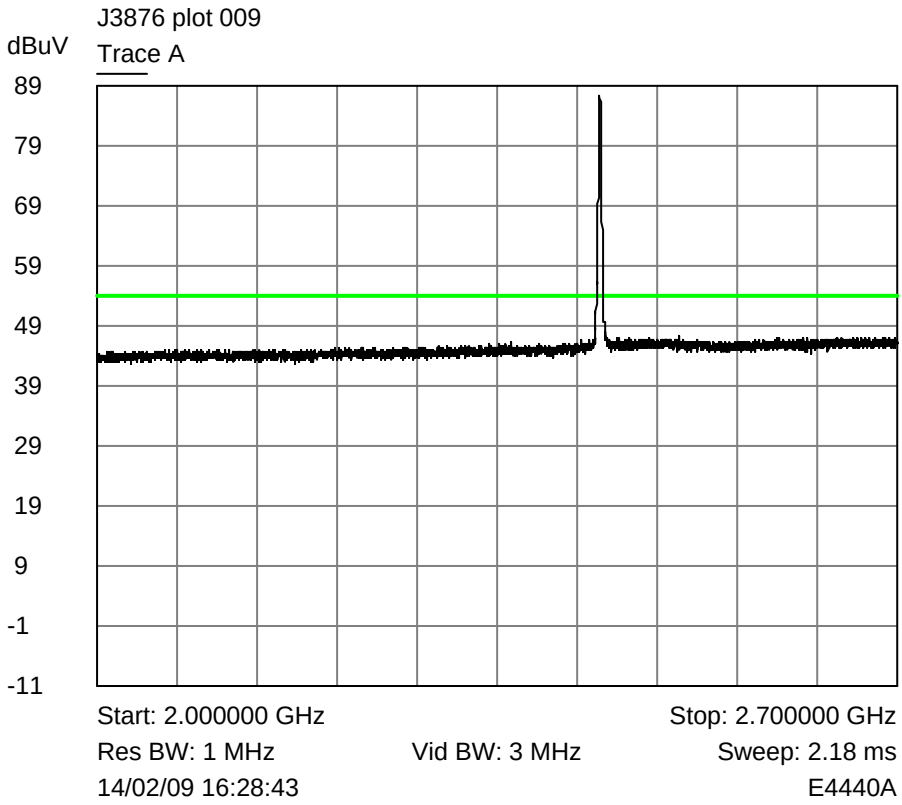
Patch Antenna Plots Above 1GHz.



Average Values of 1 – 2 GHz.
Vertical Polarisation

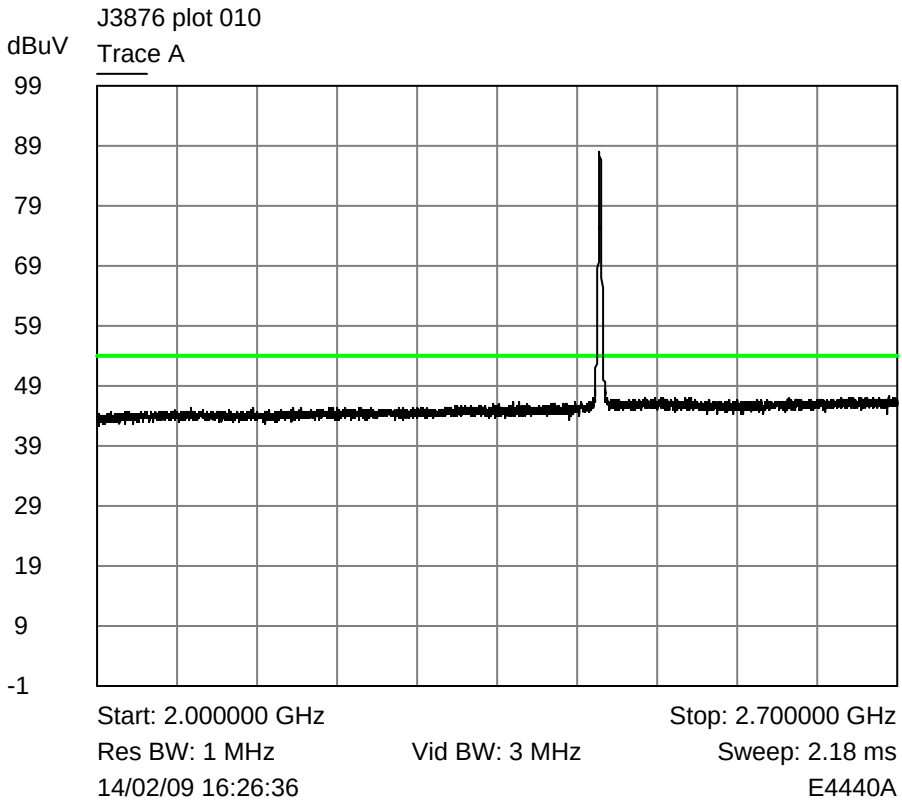


Average Values of 1 – 2 GHz.
Horizontal Polarisation

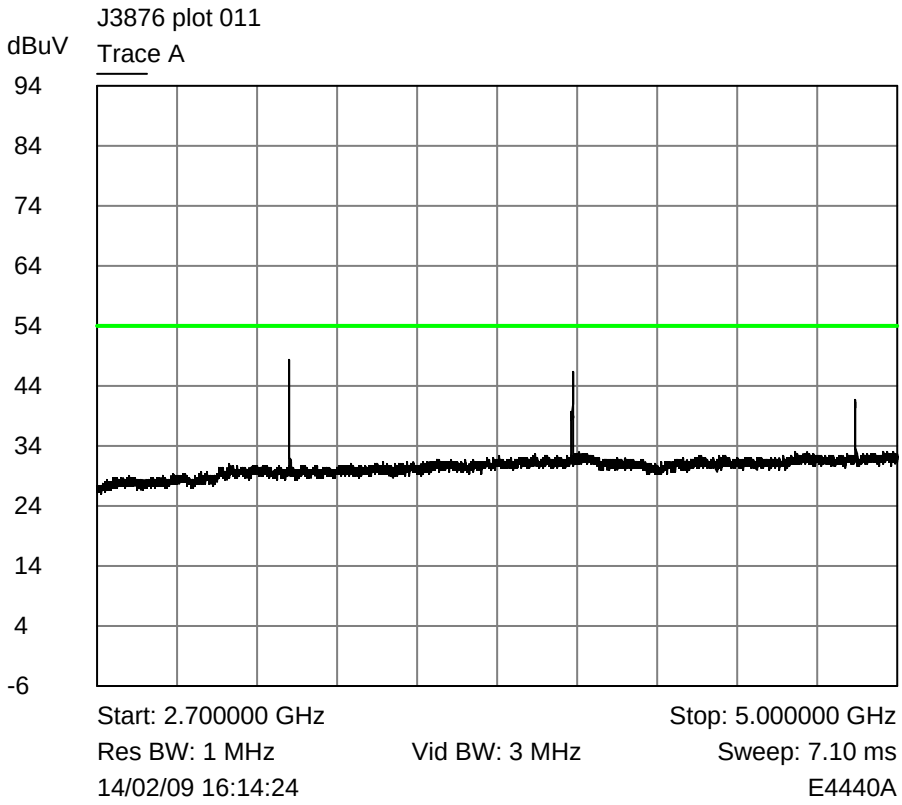


Average Values of 2 – 2.7 GHz.

Horizontal Polarisation

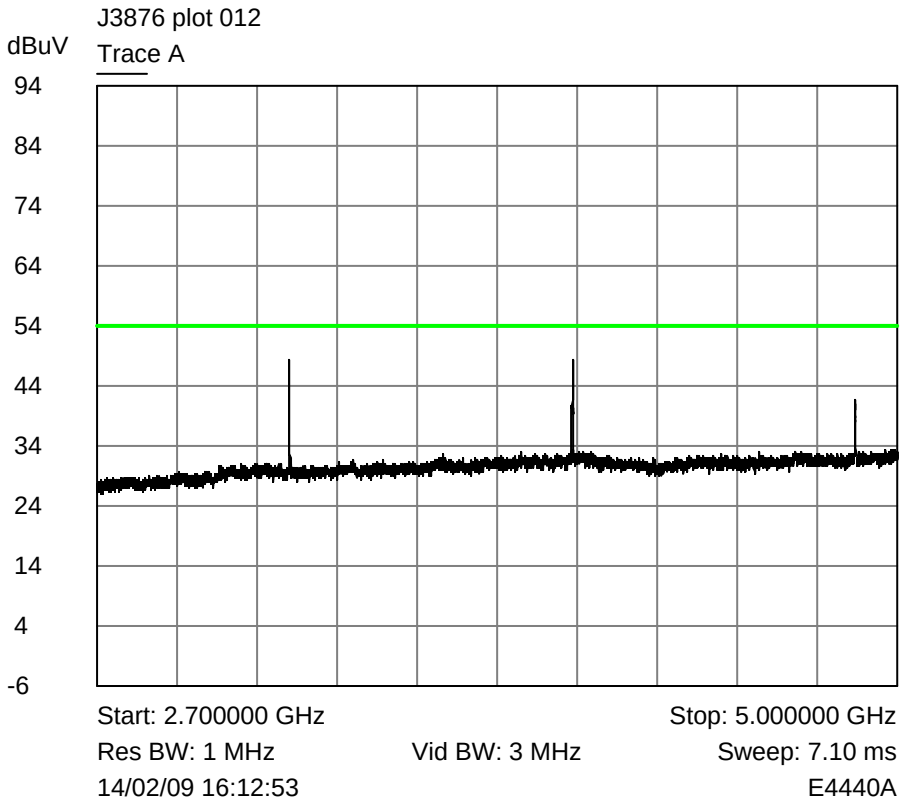


Average Values of 2 – 2.7 GHz.
Vertical Polarisation



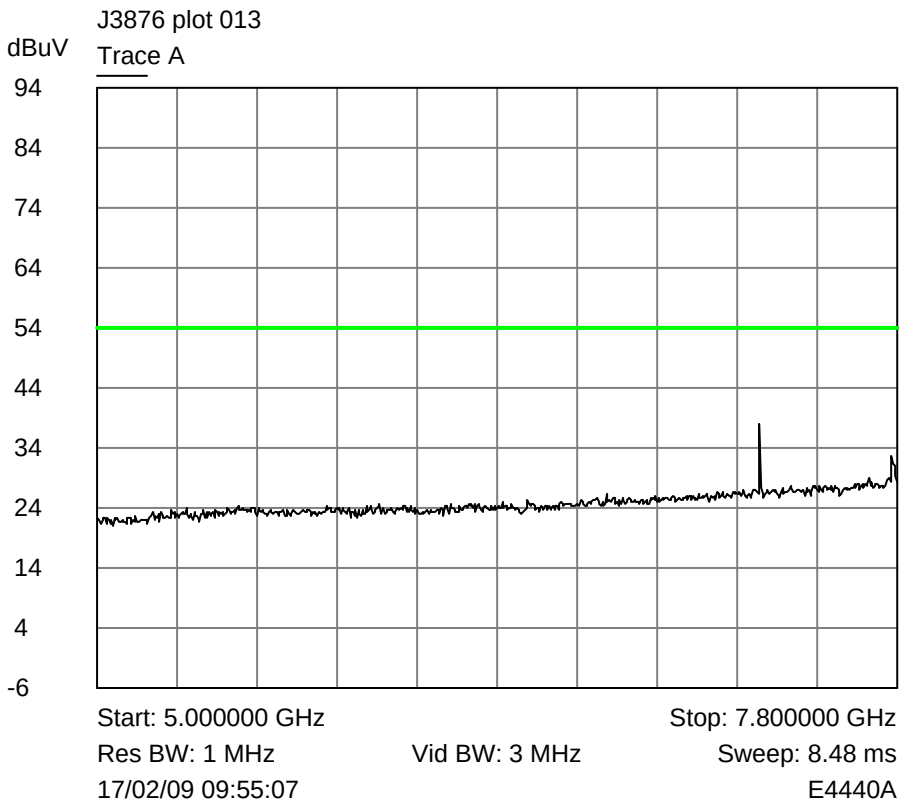
Average Values of 2.7 – 5 GHz.

Horizontal Polarisation



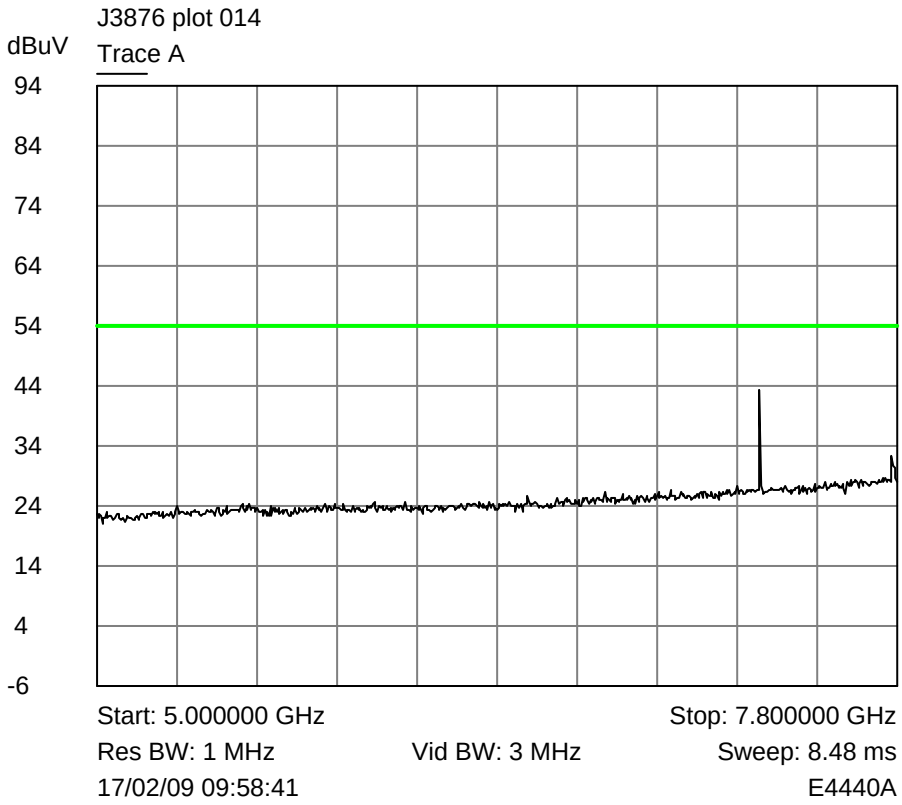
Average Values of 2.7 – 5 GHz.

Vertical Polarisation



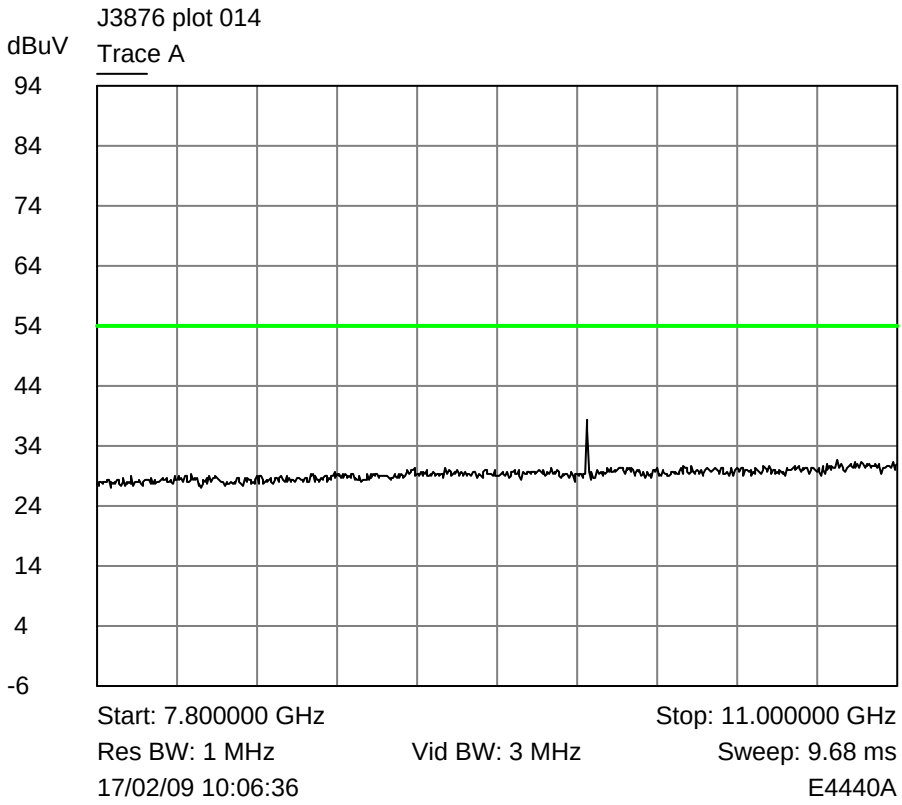
Average Values of 5 – 7.8 GHz.

Horizontal Polarisation



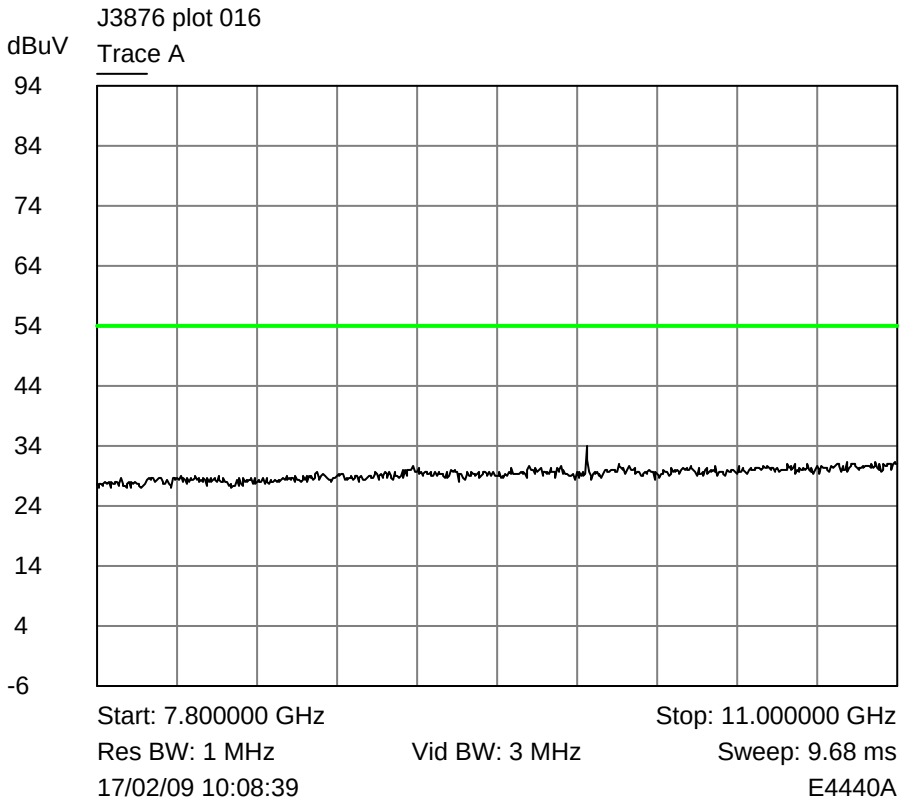
Average Values of 5 – 7.8 GHz.

Vertical Polarisation



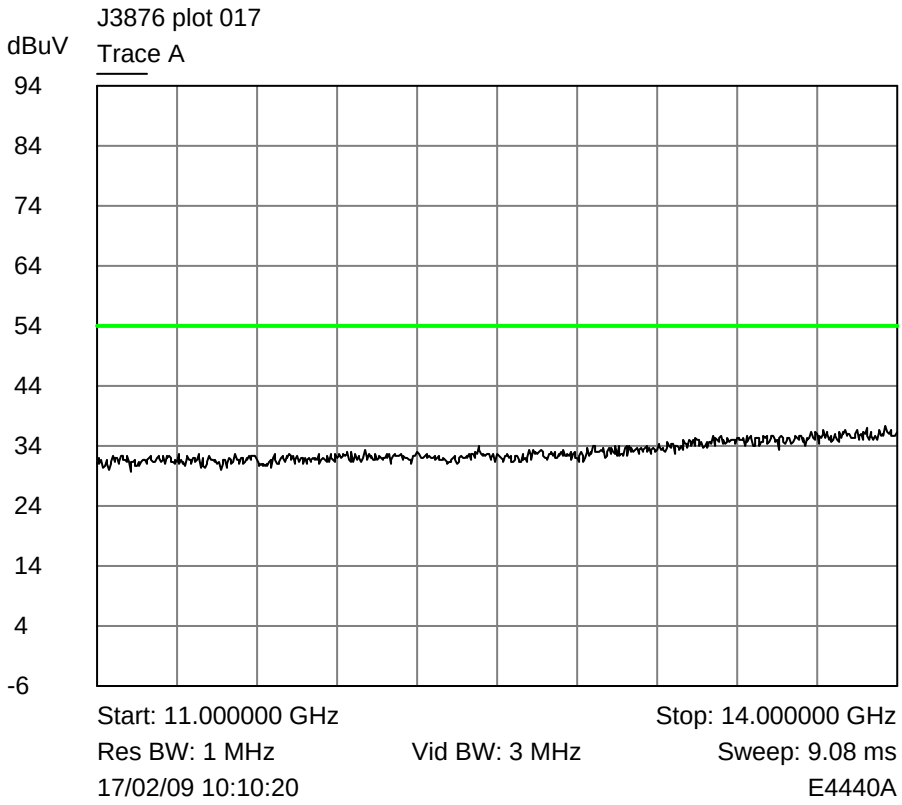
Average Values of 7.8 – 11 GHz.

Vertical Polarisation

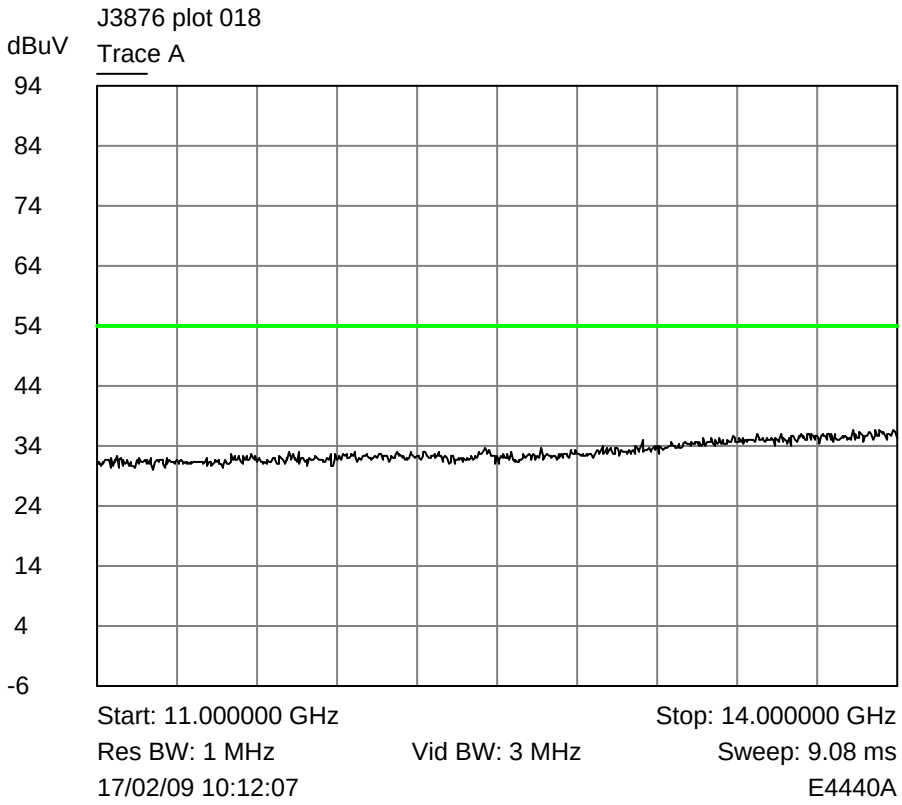


Average Values of 7.8 – 11 GHz.

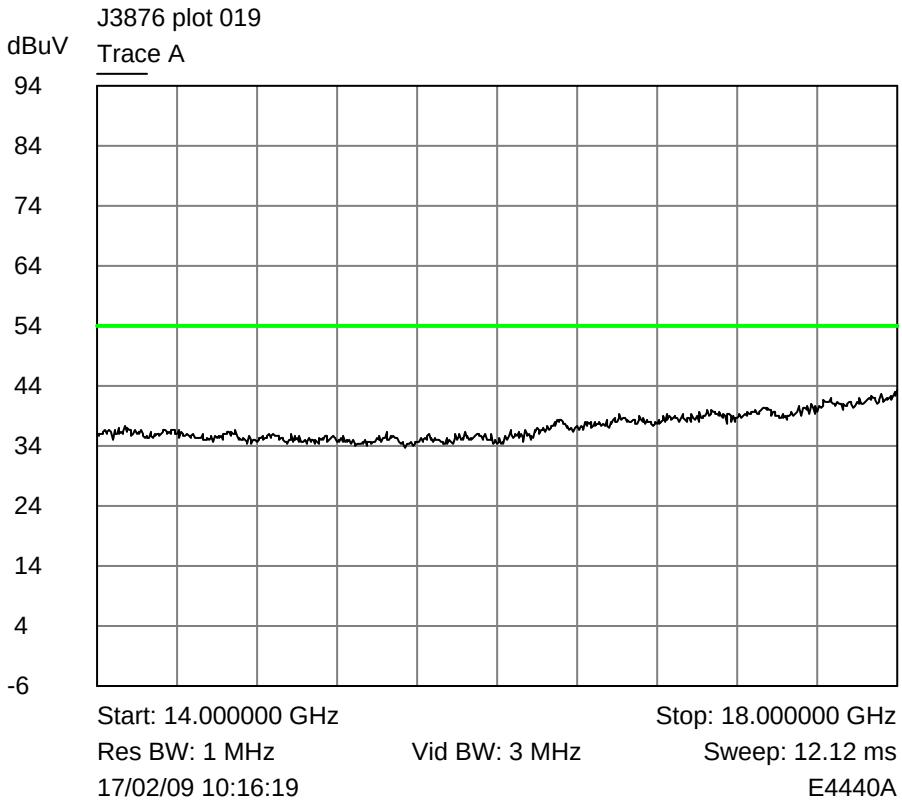
Horizontal Polarisation



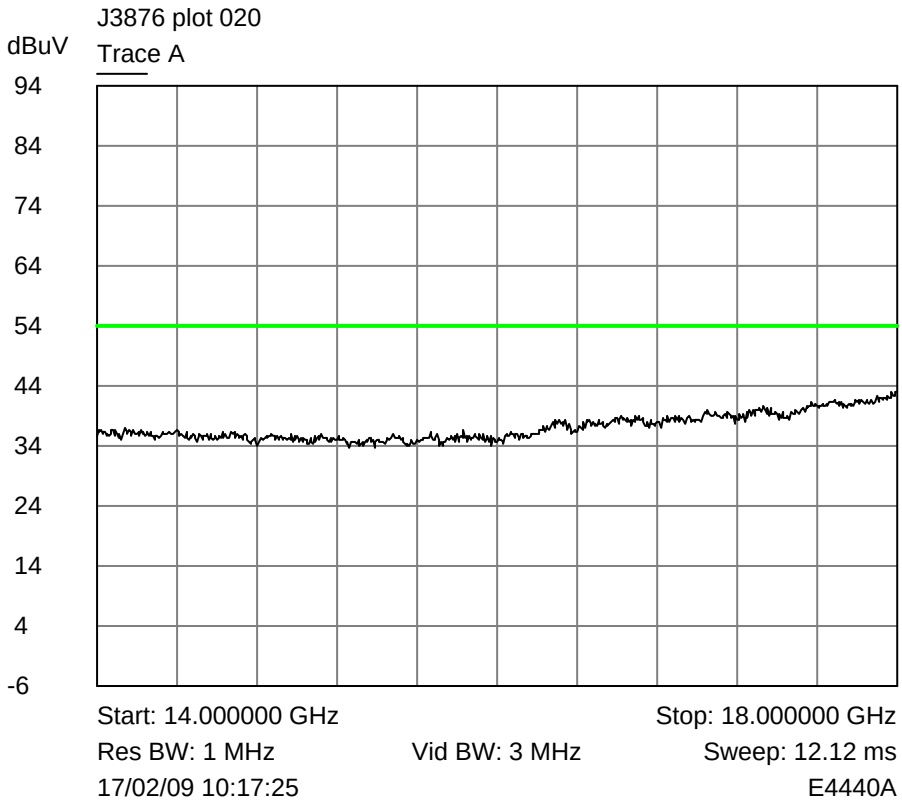
Average Values of 11 – 14 GHz.
Horizontal Polarisation



Average Values of 11 – 14 GHz.
Vertical Polarisation

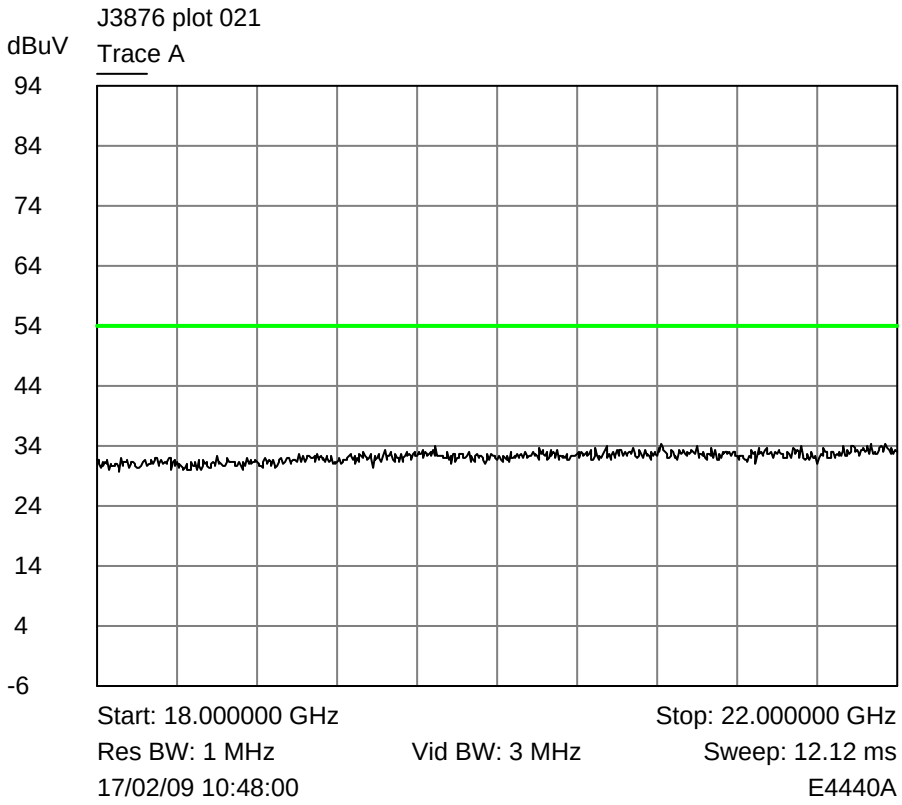


Average Values of 14 – 18 GHz.
Vertical Polarisation

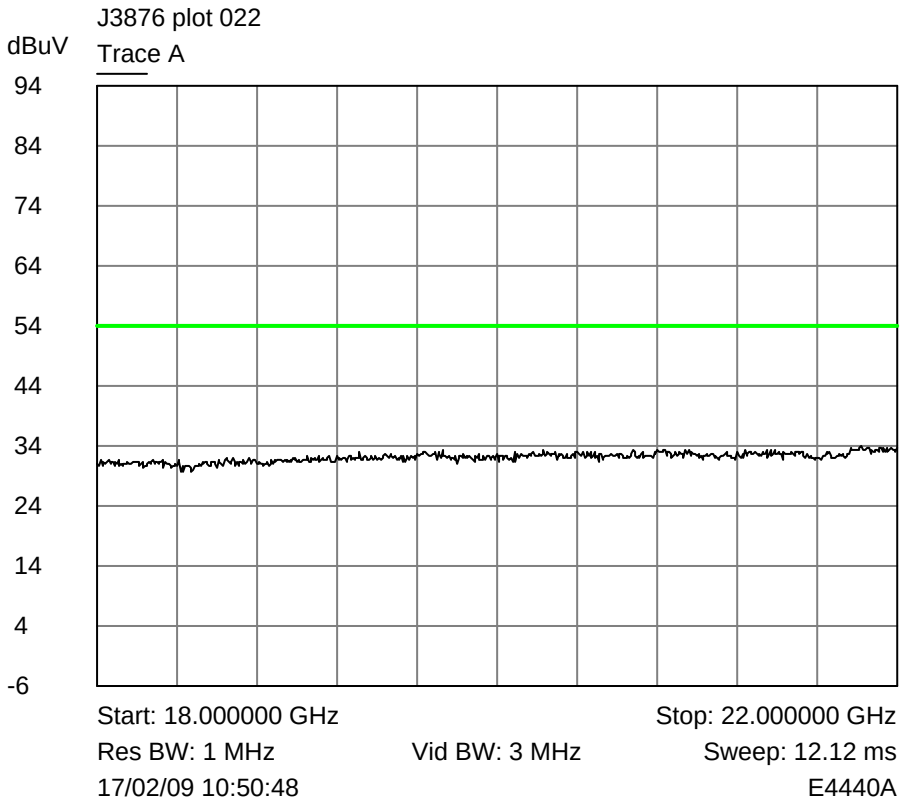


Average Values of 14 – 18 GHz.

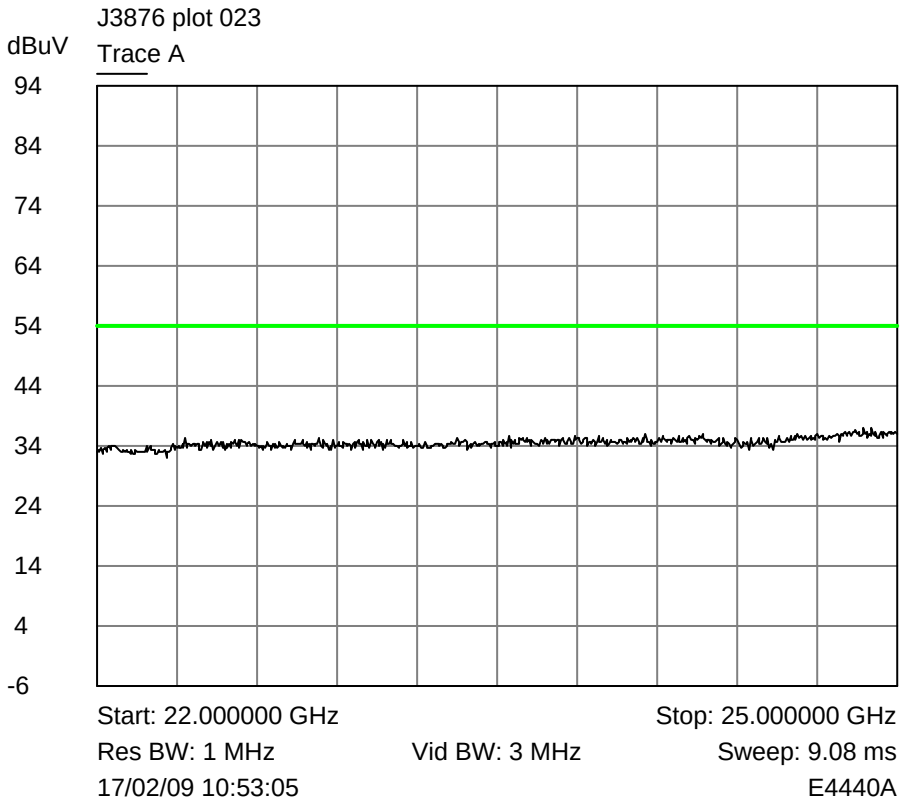
Horizontal Polarisation



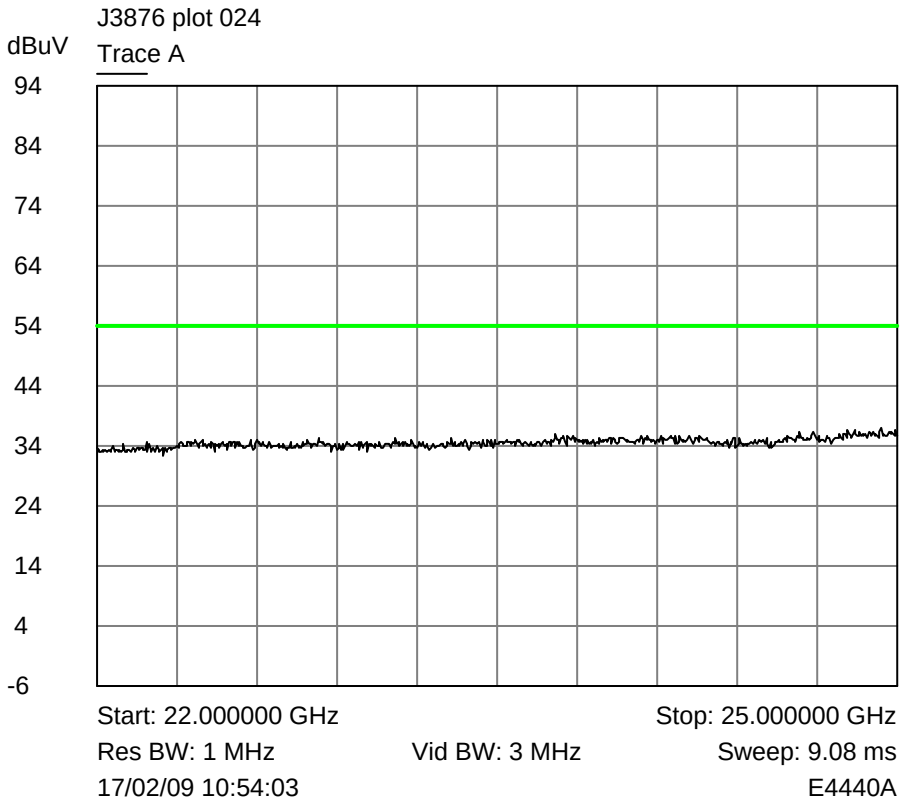
Average Values of 18 – 22 GHz.
Horizontal Polarisation



Average Values of 18 – 22 GHz.
Vertical Polarisation



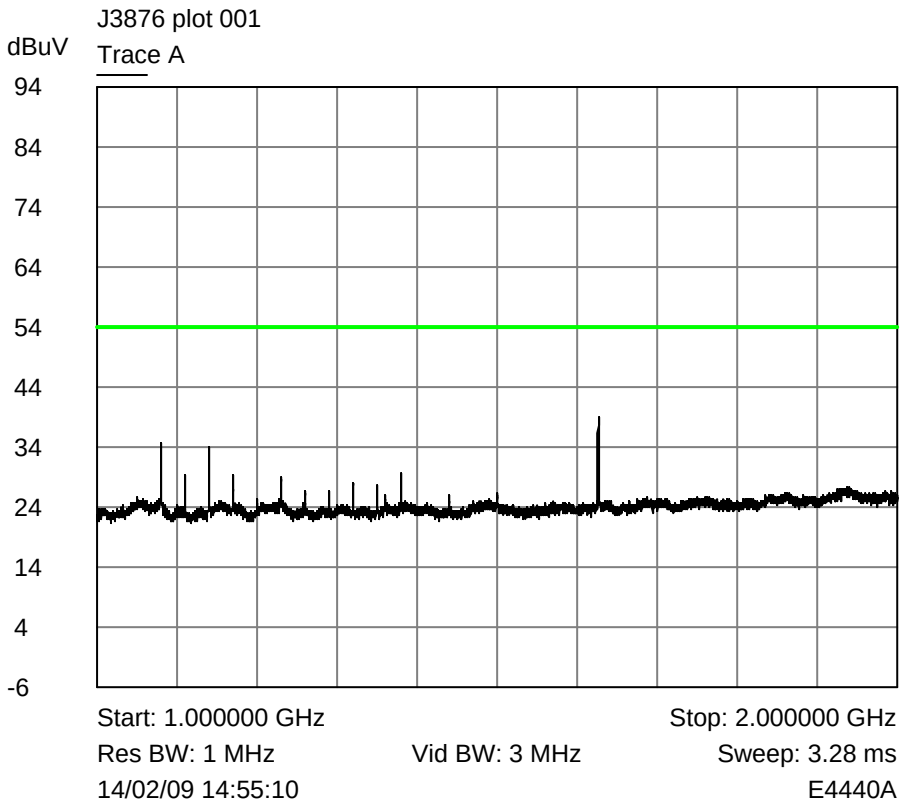
Average Values of 22 – 25 GHz.
Vertical Polarisation



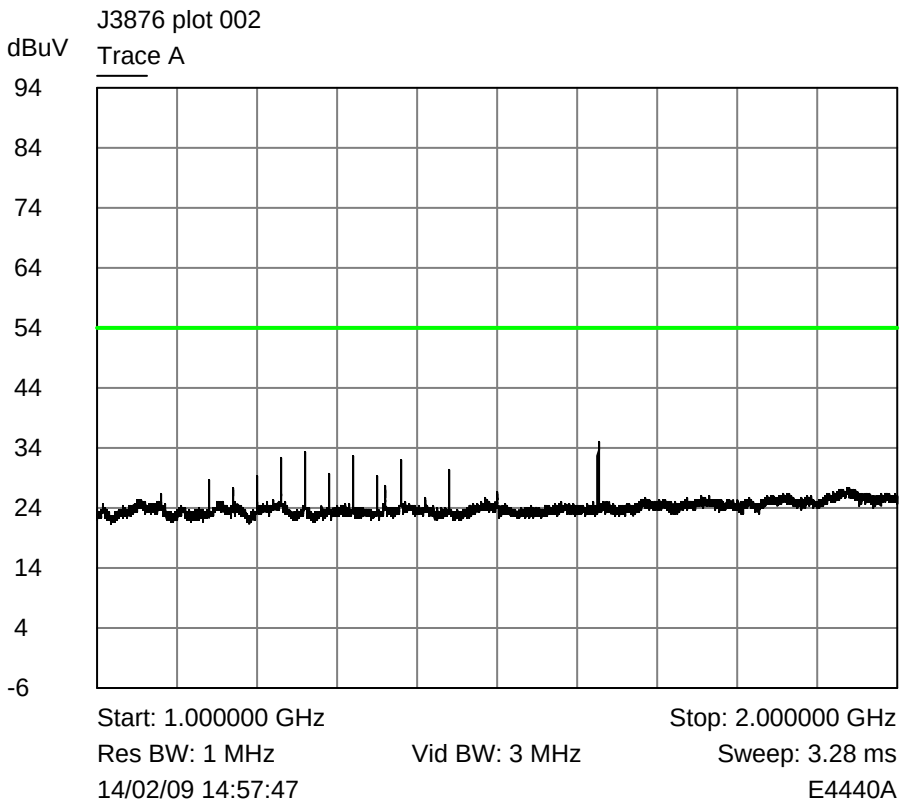
Average Values of 22 – 25 GHz.

Horizontal Polarisation

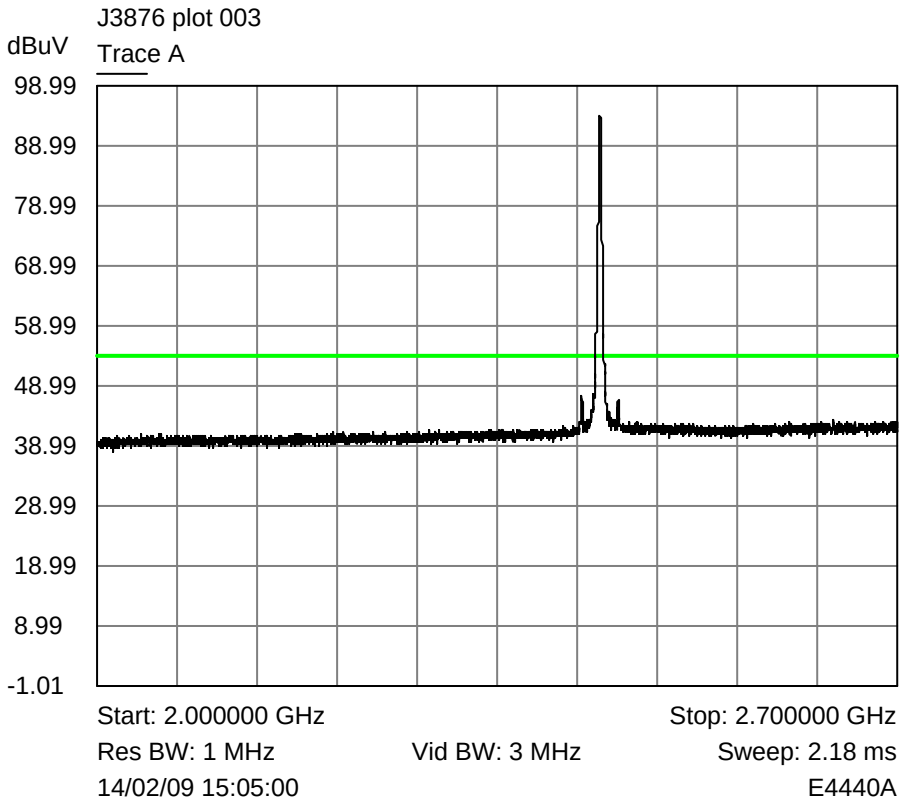
CO-Linear Antenna Plots Above 1GHz.



Average Values of 1 – 2 GHz.
Vertical Polarisation

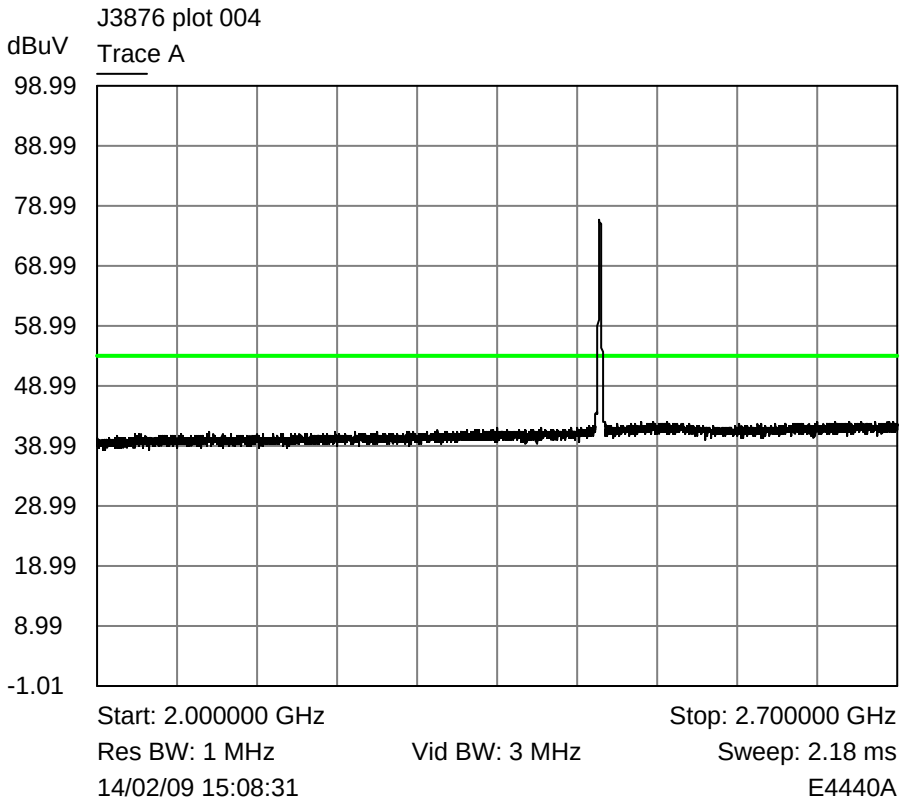


Average Values of 1 – 2 GHz.
Horizontal Polarisation



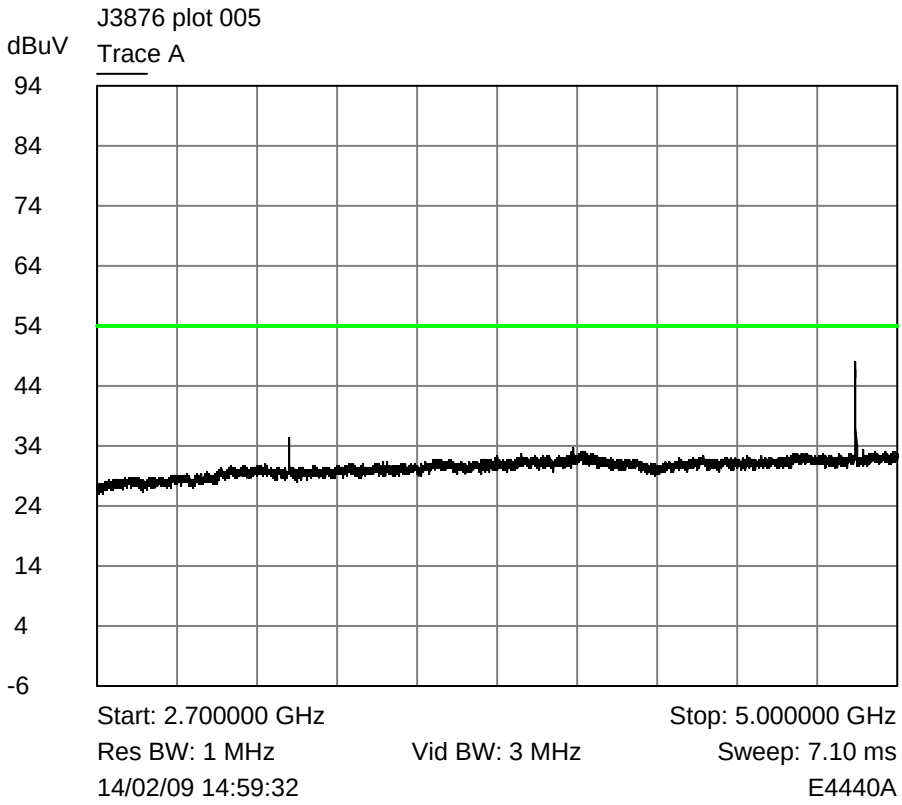
Average Values of 2 – 2.7 GHz.

Horizontal Polarisation

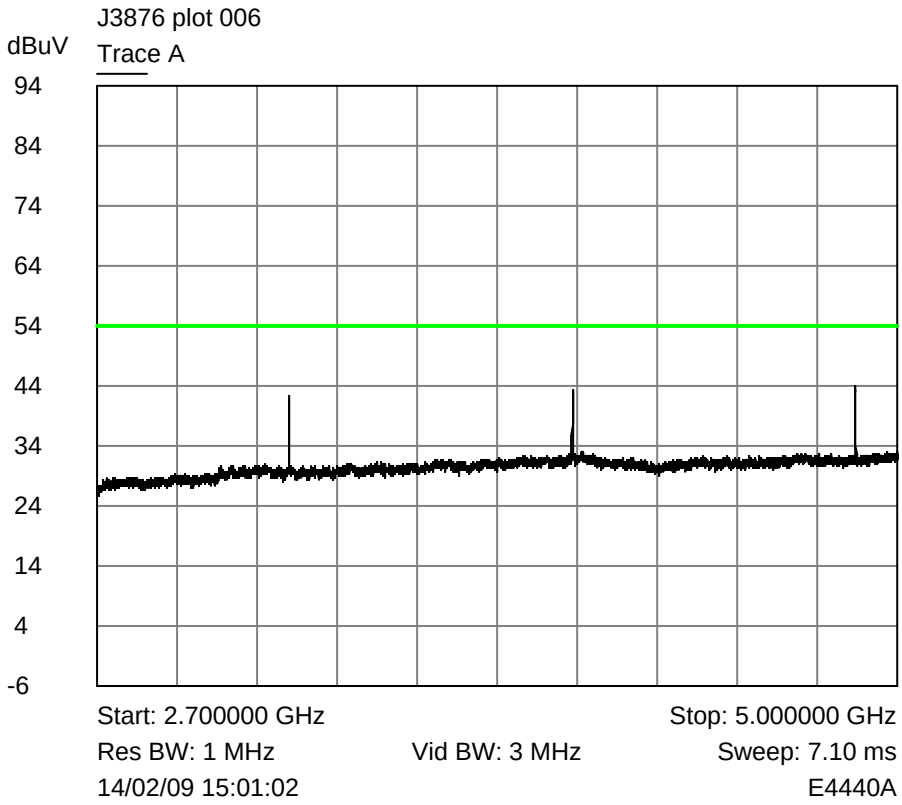


Average Values of 2 – 2.7 GHz.

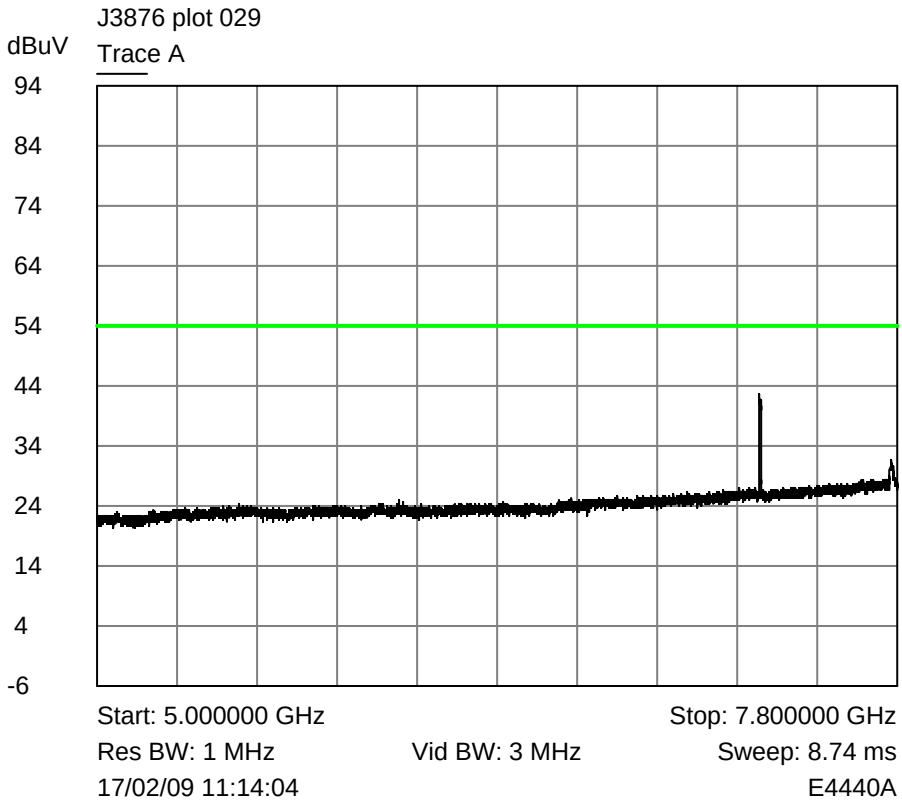
Vertical Polarisation



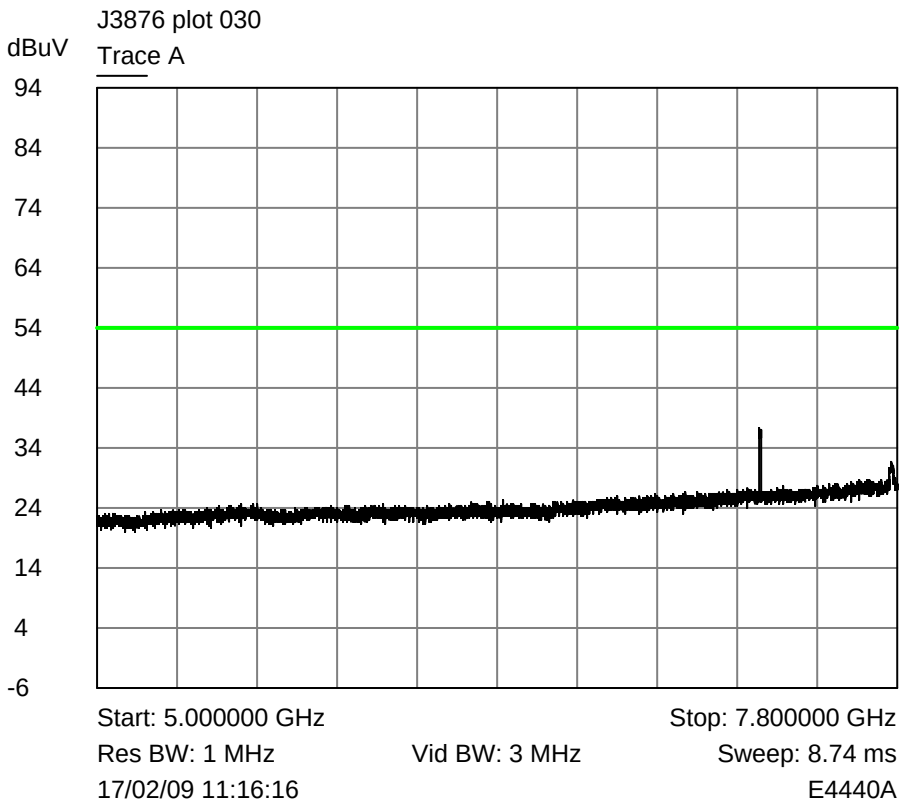
Average Values of 2.7 – 5 GHz.
Horizontal Polarisation



Average Values of 2.7 – 5 GHz.
Vertical Polarisation

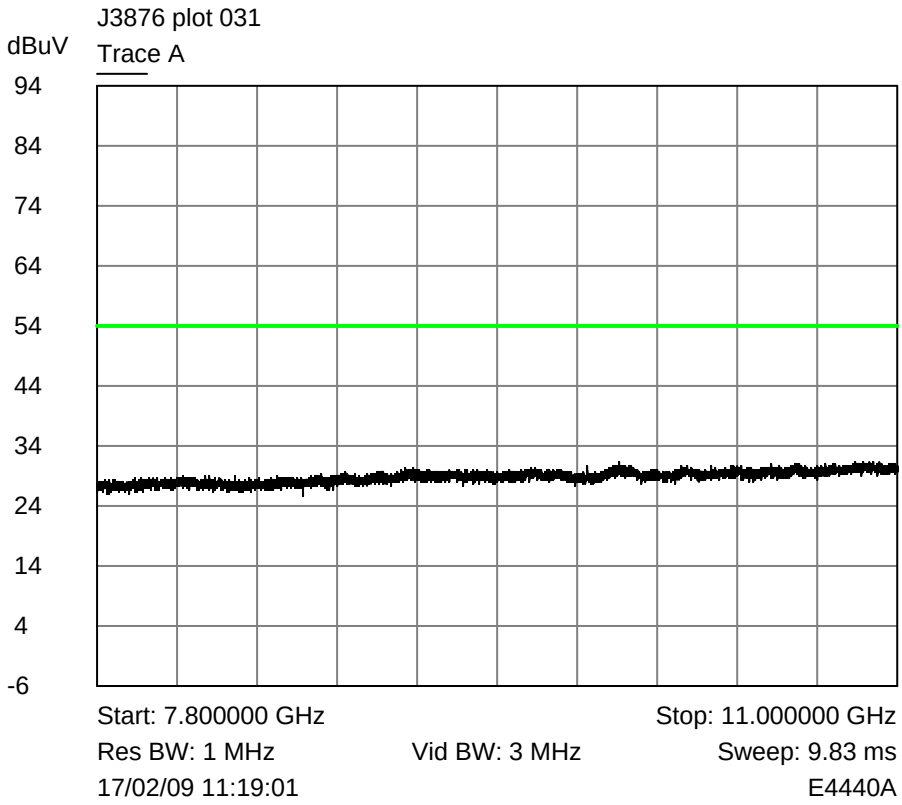


Average Values of 5 – 7.8 GHz.
Vertical Polarisation



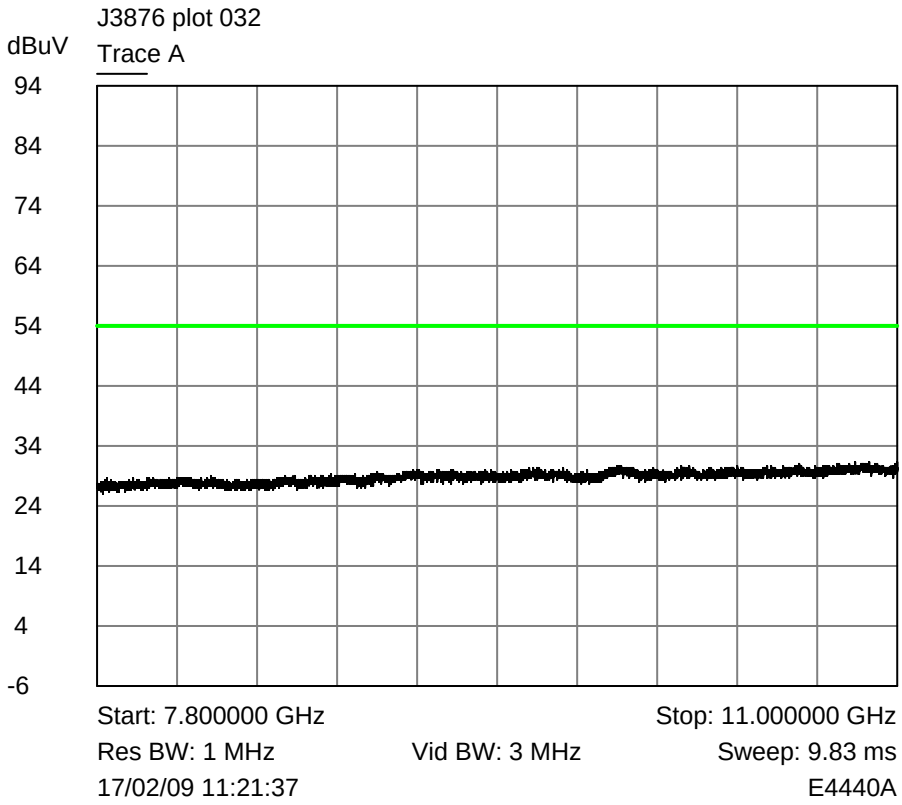
Average Values of 5 – 7.8 GHz.

Horizontal Polarisation

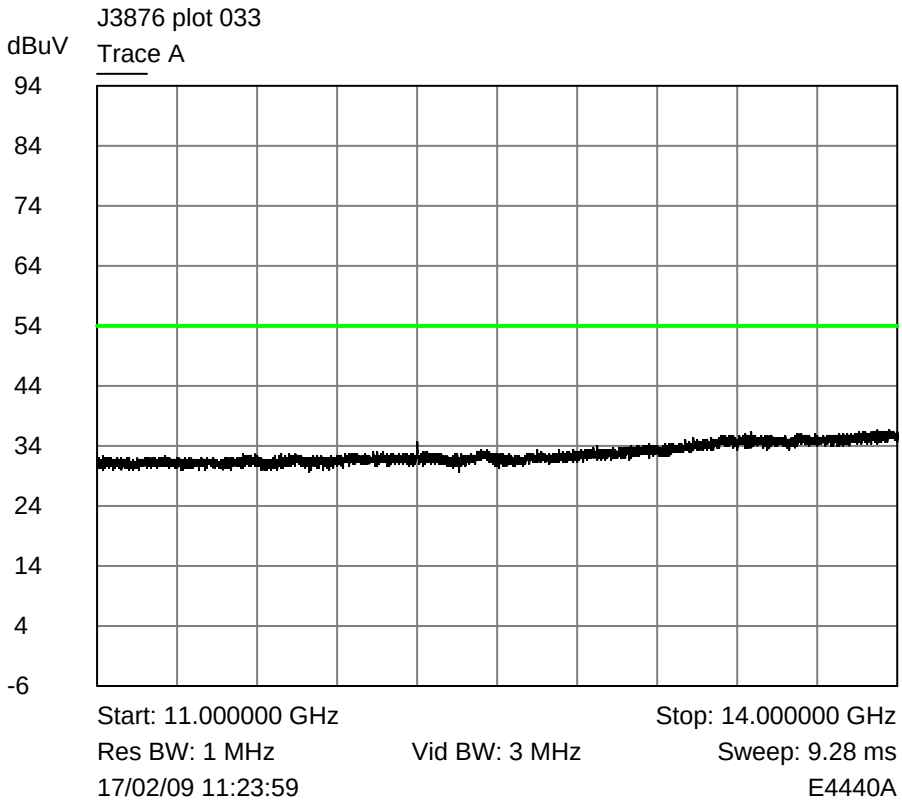


Average Values of 7.8 – 11 GHz.

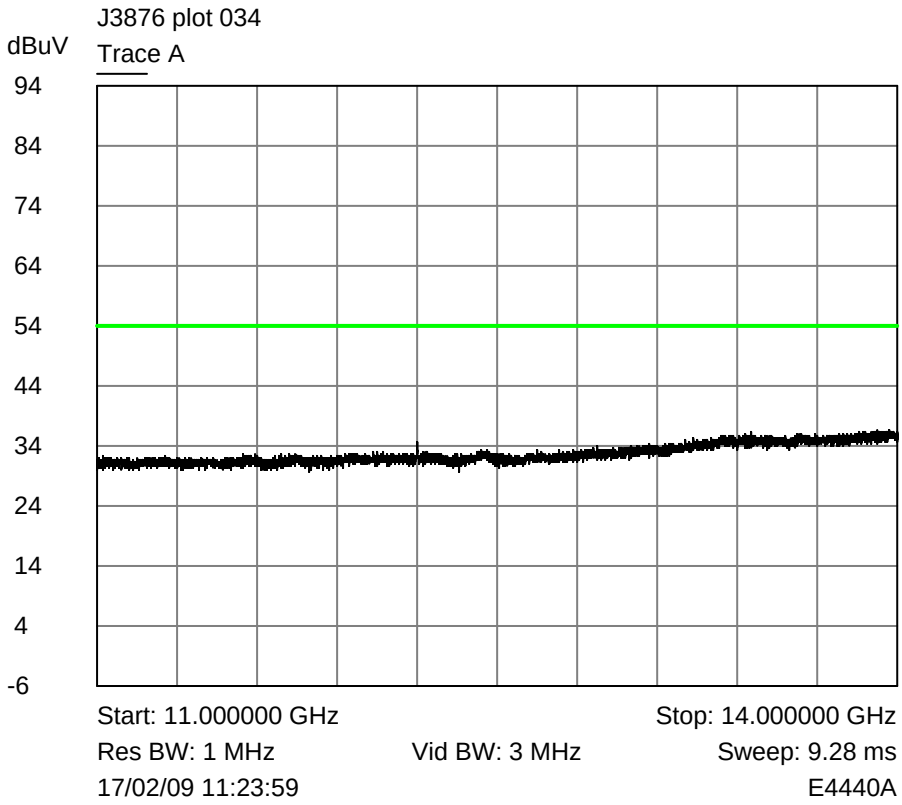
Horizontal Polarisation



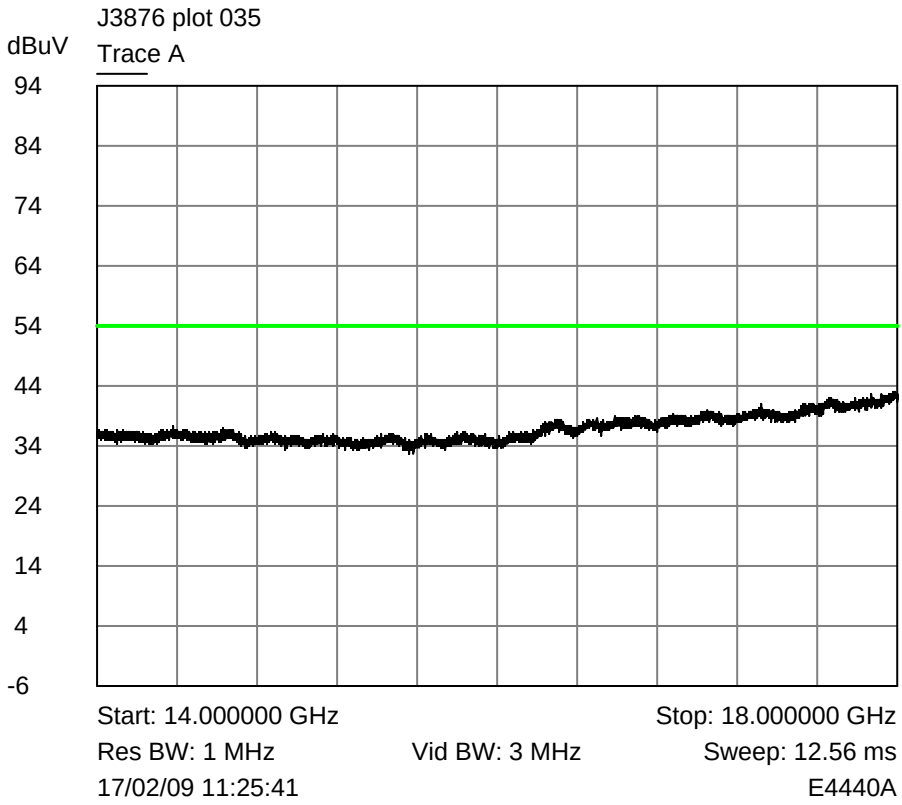
Average Values of 7.8 – 11 GHz.
Vertical Polarisation



Average Values of 11 – 14 GHz.
Vertical Polarisation

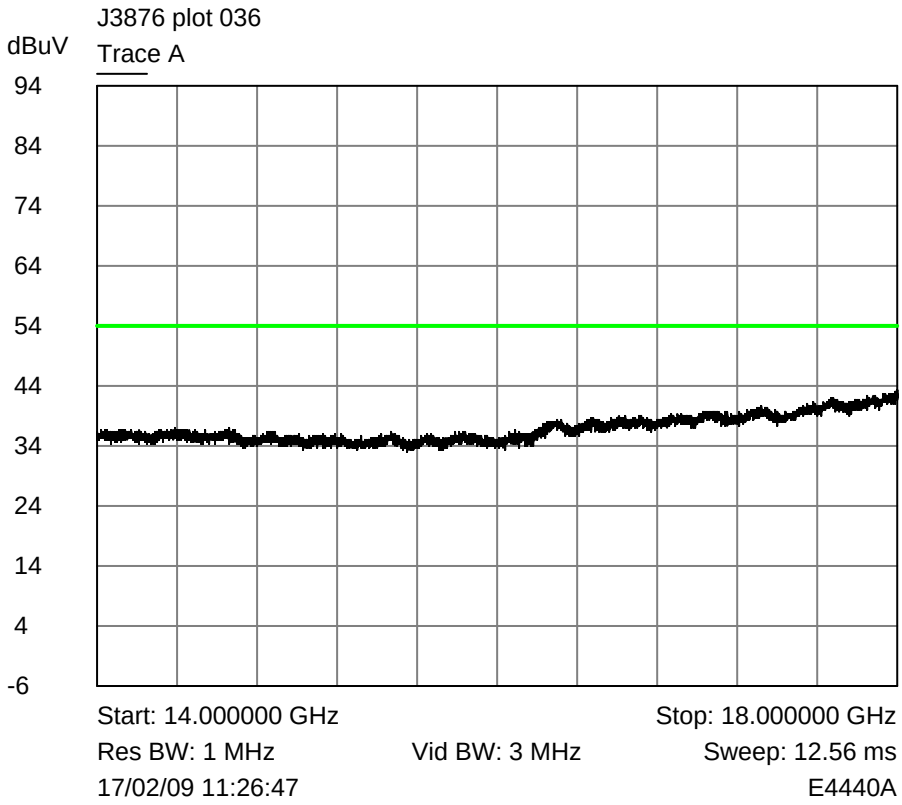


Average Values of 11 – 14 GHz.
Horizontal Polarisation

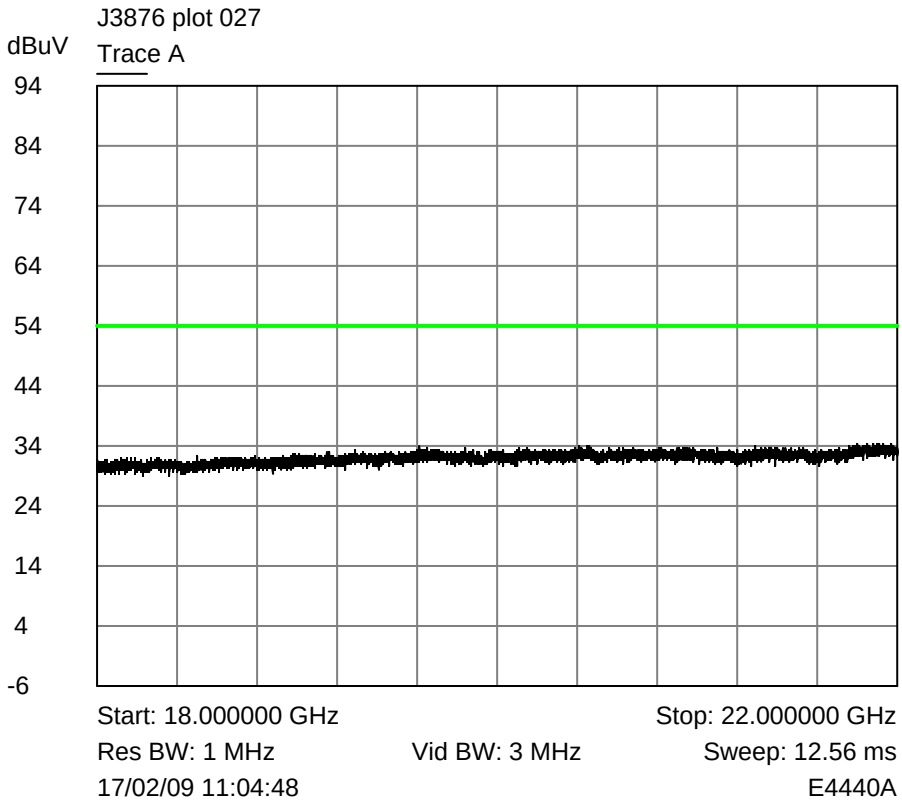


Average Values of 14 – 18 GHz.

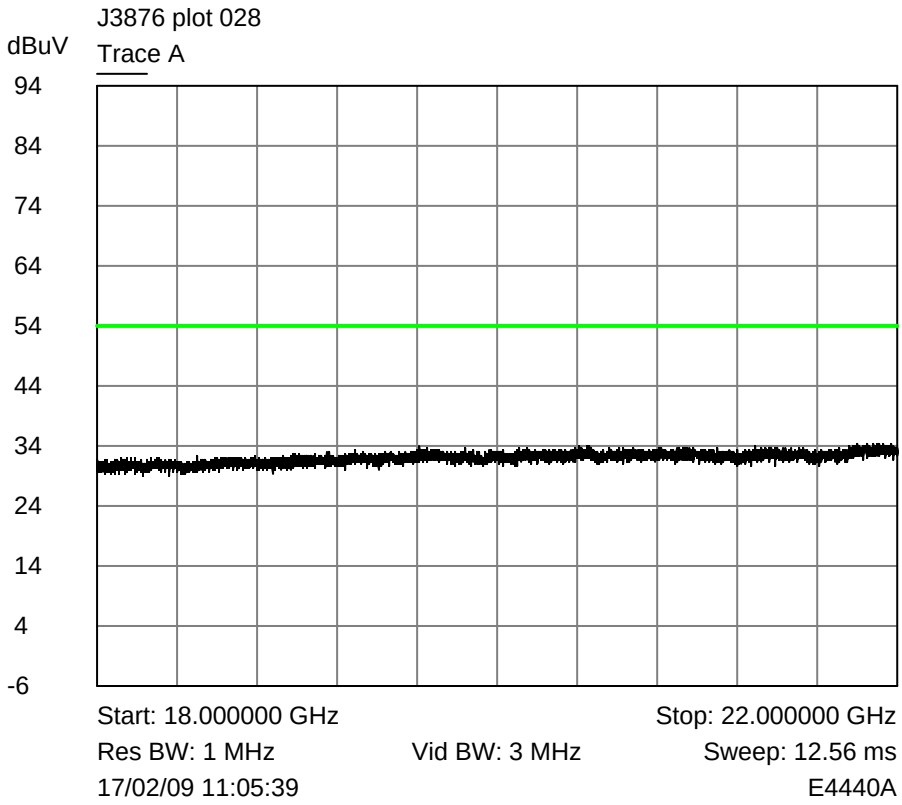
Horizontal Polarisation



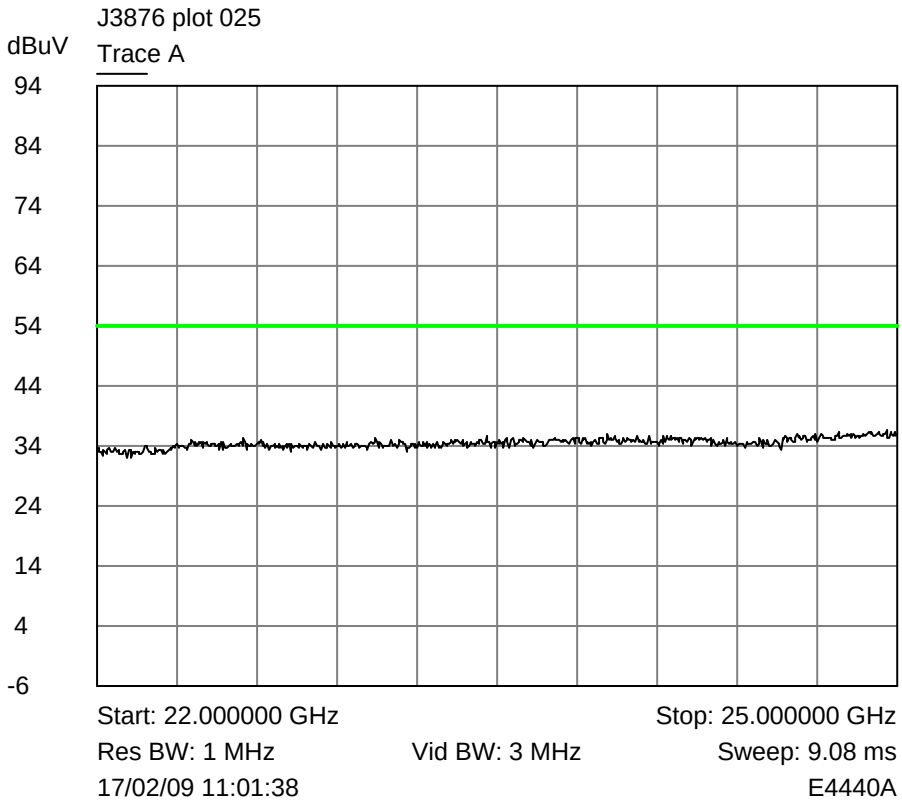
Average Values of 14 – 18 GHz.
Vertical Polarisation



Average Values of 18 – 22 GHz.
Vertical Polarisation

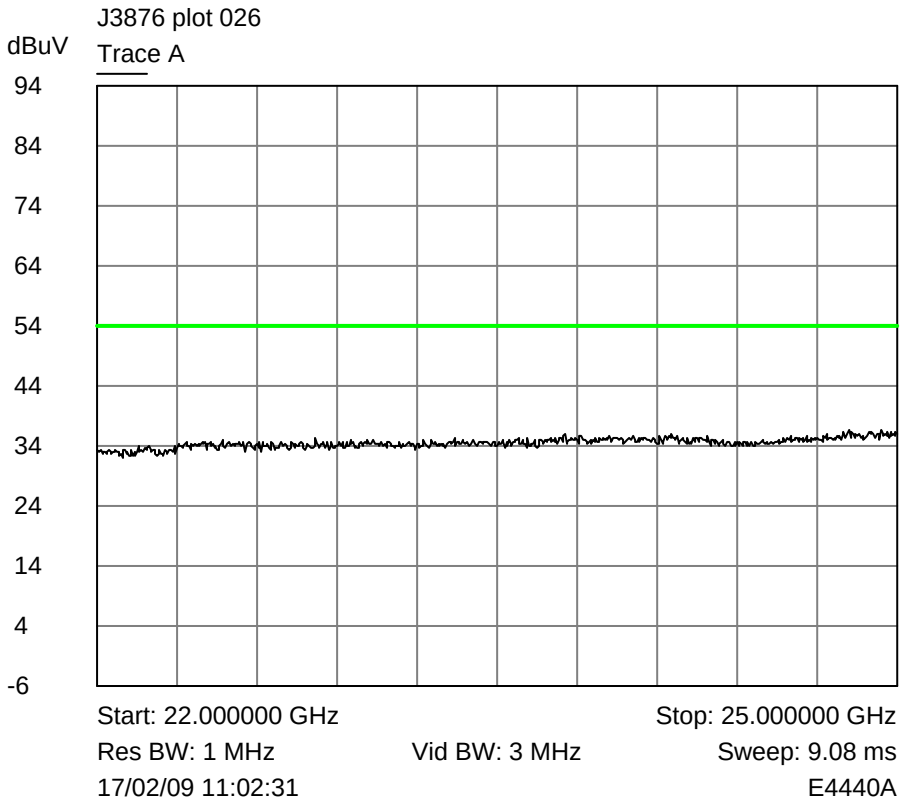


Average Values of 18 – 22 GHz.
Horizontal Polarisation



Average Values of 22 – 25 GHz.

Horizontal Polarisation



Average Values of 22 – 25 GHz.

Vertical Polarisation

Tables of signals within 20dB of the limit line for 1GHz - 25GHz Patch Antenna

EUT Transmitting on Low Channel

Signal	Freq (MHz)	Polaris-ation	Avg Amp (dBuV/m)	Avg -Limit[1] (dBuV/m)	Comments
1	1603	Vertical	47.9	-6.1	
2	1603	Horizontal	47.0	-7.0	
3	3206	Vertical	49.7	-4.3	
4	4008	Vertical	48.5	-5.5	
5	4008	Horizontal	42.0	-12.0	
6	4810	Vertical	48.2	-5.8	
7	4810	Horizontal	45.0	-9.0	
8	7215	Vertical	38.6	-15.4	
9	7215	Horizontal	41.5	-12.5	
10	9620	Vertical	38.7	-15.3	

Signal	Freq (MHz)	Polaris-ation	Avg Amp (dBuV/m)	Avg -Limit[2] (dBuV/m)	Comments
11	3206	Horizontal	*56.5	-26.9	

*Measured in 100kHz RBW and referenced to -20dB of highest in band emission

EUT Transmitting on Middle Channel

Signal	Freq (MHz)	Polaris-ation	Avg Amp (dBuV/m)	Avg -Limit[1] (dBuV/m)	Comments
1	1140	Vertical	35.1	-18.9	
2	1626	Vertical	45.3	-8.7	
3	1626	Horizontal	44.5	-9.5	
4	3253	Vertical	51.2	-2.8	See below†
5	3253	Horizontal	51.7	-2.3	See below†
6	4066	Vertical	47.8	-6.2	
7	4066	Horizontal	46.3	-7.7	
8	4880	Vertical	49.5	-4.5	
9	4880	Horizontal	46.8	-8.2	
10	7320	Vertical	44.8	-9.2	
11	7320	Horizontal	39.0	-15.0	

EUT Transmitting on High channel

Signal	Freq (MHz)	Polaris-ation	Avg Amp (dBuV/m)	Avg -Limit[1] (dBuV/m)	Comments
1	1653	Vertical	49.7	-4.3	
2	1653	Horizontal	45.2	-8.8	
3	1822	Vertical	36.0	-18.0	
4	3306	Vertical	47.2	-6.8	
5	3306	Horizontal	48.0	-6.0	
6	4133	Vertical	50.3	-3.7	
7	4133	Horizontal	48.2	-5.8	
8	4960	Vertical	50.1	-3.9	
9	4960	Horizontal	46.8	-6.2	
10	7440	Vertical	36.0	-18.0	
11	7440	Horizontal	34.1	-19.9	

In all the above measurements the fundamental signal was continuously on, and in no case were the peak emissions more than 10dB above the average.

[1]Limit for emissions within the restricted bands of 15.205 comes from 15.209 = 54dBuV/m at 3m.

[2]Limit for emissions outside the restricted bands of 15.205 comes from 15.247(d) = -20dB from highest in-band emission measured in 100kHz.

Highest in-band emissions measured in 100kHz bandwidth, per 15.209(d):

Channel	Frequency (MHz)	Field (dBuV/m)
Low	2405	103.4
Middle	2440	105.4
High	2480	103.7

†Continuous emissions observed comparable to the limit:

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.

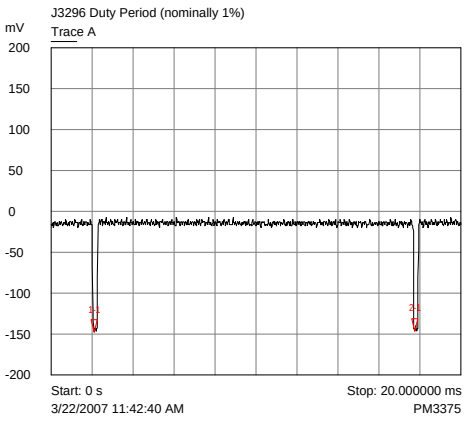
As peak emissions were no more than 10dB above the average emissions measured and the worst case average emission measured is -1.0dB below the permitted average emission limit then the condition for peak emissions is met.

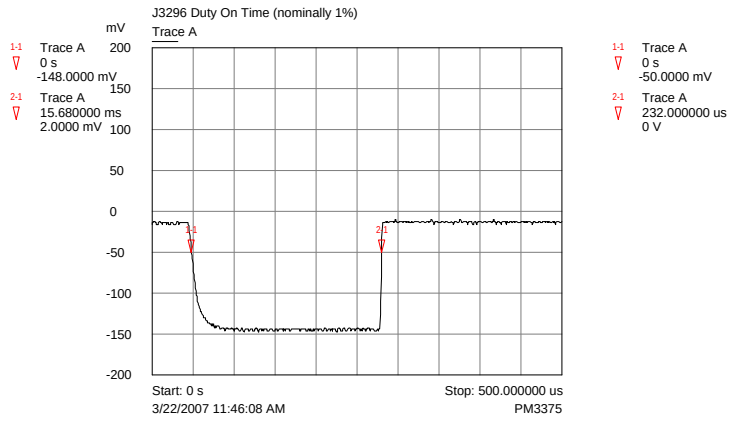
According to 15.35(c): when the radiated emission limits are expressed in terms of the average value of the emission, and pulsed operation is employed, the measurement field strength shall be determined by averaging over one complete pulse train, including blanking intervals, as long as the pulse train 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 below.

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





Tables of signals within 20dB of the limit line for 1GHz - 25GHz

CO-Linear Antenna

EUT Transmitting on Low Channel

Signal	Freq (MHz)	Polaris-ation	Avg Amp (dBuV/m)	Avg -Limit[1] (dBuV/m)	Comments
1	1603	Vertical	42.0	-12.0	
2	1603	Horizontal	39.0	-15.0	
3	2388.87	Vertical	48.1	-5.9	Sideband
4	2420.89	Vertical	46.7	-7.3	Sideband
5	3206	Vertical	48.2	-5.8	
6	3206	Horizontal	38.6	-15.4	
7	4008	Vertical	44.0	-10.0	
8	4810	Vertical	53.0	-1.0	See Above†
9	4810	Horizontal	46.8	-7.2	
10	7215	Vertical	35.9	-18.1	

EUT Transmitting on Middle Channel

Signal	Freq (MHz)	Polaris-ation	Avg Amp (dBuV/m)	Avg -Limit[1] (dBuV/m)	Comments
1	1626	Vertical	42.4	-11.6	
2	2423.923	Vertical	47.7	-6.3	Sideband
3	2455.775	Vertical	45.1	-8.9	Sideband
4	3253	Vertical	46.9	-7.1	
5	3253	Horizontal	40.6	-13.4	
6	4066	Vertical	43.0	-11.0	
7	4880	Vertical	50.6	-3.4	
8	4880	Horizontal	47.7	-6.3	
9	7320	Vertical	38.1	-17.9	
10	7320	Horizontal	43.2	-10.8	
11	9760	Vertical	35.1	-18.9	

EUT Transmitting on High channel

Signal	Freq (MHz)	Polaris-ation	Avg Amp (dBuV/m)	Avg -Limit[1] (dBuV/m)	Comments
1	1653	Vertical	41.1	-12.9	
2	1653	Horizontal	34.2	-19.8	
3	2463.866	Vertical	47.3	-6.7	Sideband
4	2495.926	Vertical	50.2	-3.8	Sideband
5	3306	Vertical	36.0	-18.0	
6	3306	Horizontal	46.5	-7.5	
7	4133	Vertical	39.1	-14.9	
8	4960	Vertical	45.1	-8.9	
9	4960	Horizontal	43.2	-10.8	
10	7440	Vertical	40.5	-13.5	
11	7440	Horizontal	39.5	-14.5	
12	9920	Vertical	38.0	-16.0	

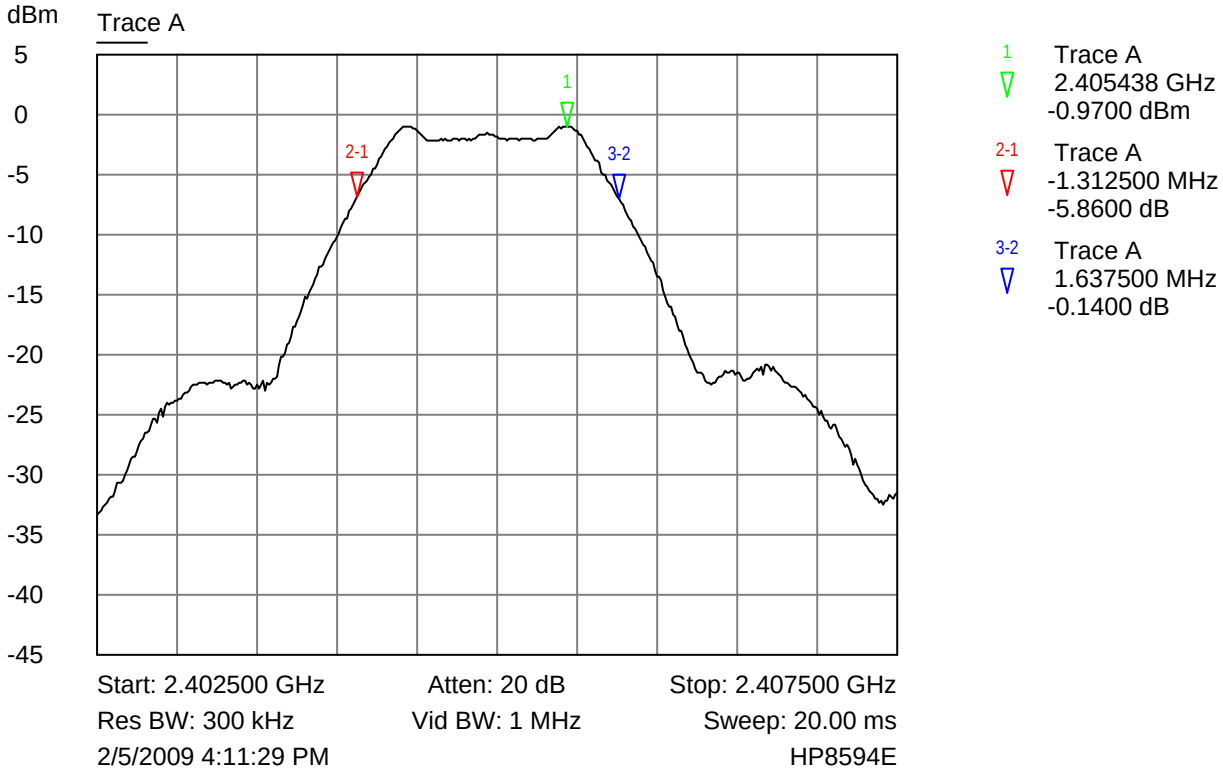
In all the above measurements the fundamental signal was continuously on, and in no case were the peak emissions more than 10dB above the average.

[1]Limit for emissions within the restricted bands of 15.205 comes from 15.209 = 54dBuV/m at 3m.

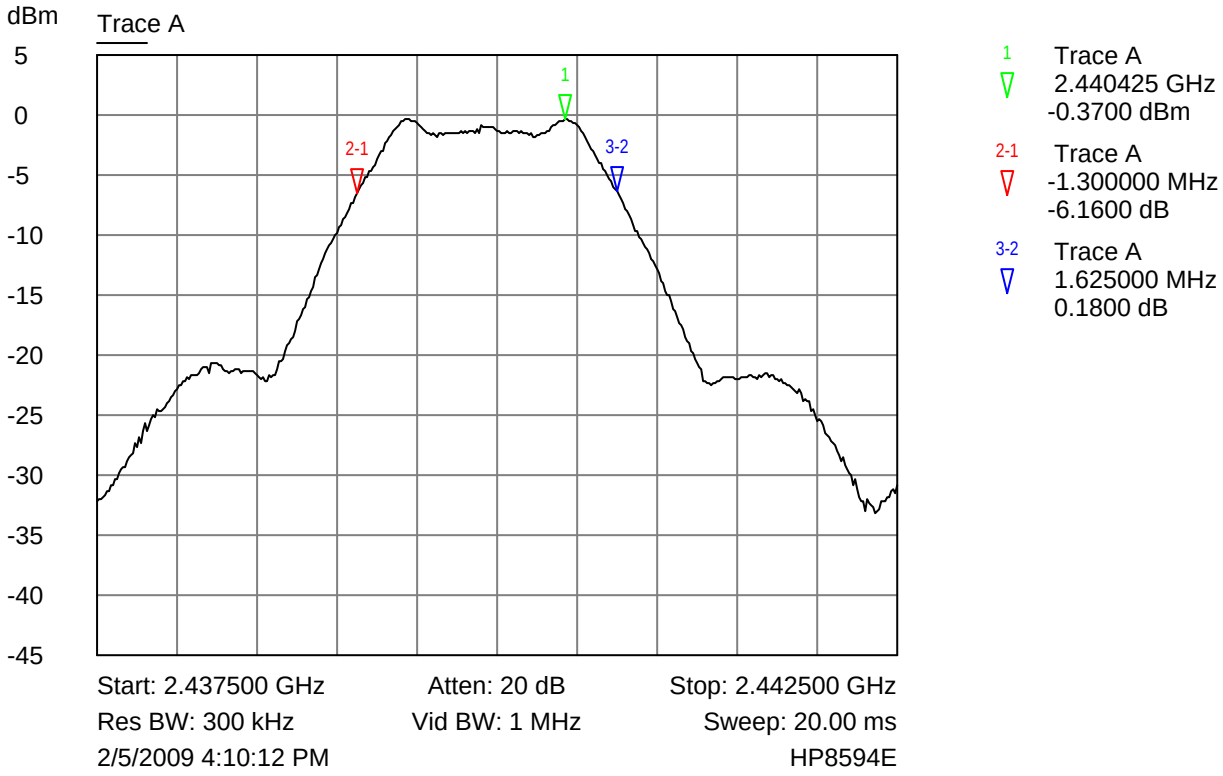
[2]Limit for emissions outside the restricted bands of 15.205 comes from 15.247(d) = -20dB from highest in-band emission measured in 100kHz. However, all spurious found using the CO-Linear antenna were within the tighter limits of 15.209 and are thus referenced to this limit.

6.3 6dB Bandwidth

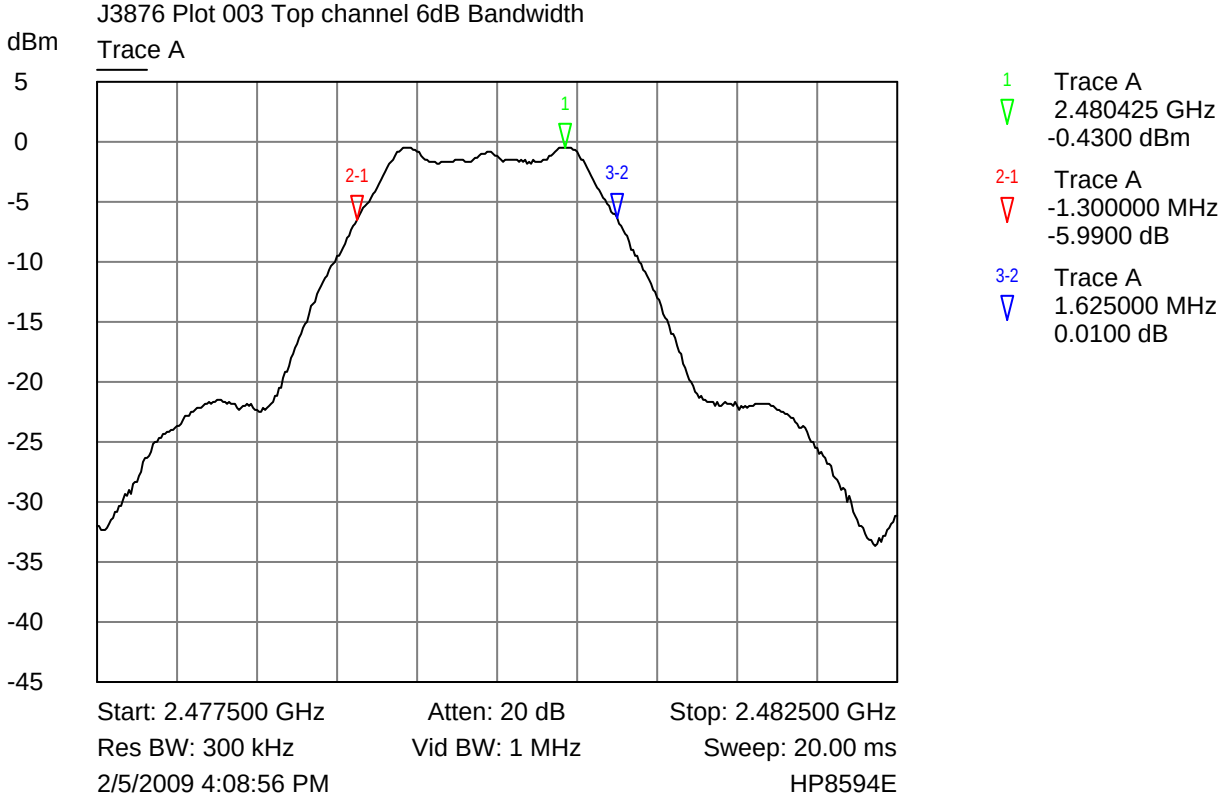
J3876 Plot 001 Bottom channel 6dB Bandwidth



J3876 Plot 002 Mid channel 6dB Bandwidth



J3876 Plot 003 Top channel 6dB Bandwidth



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.

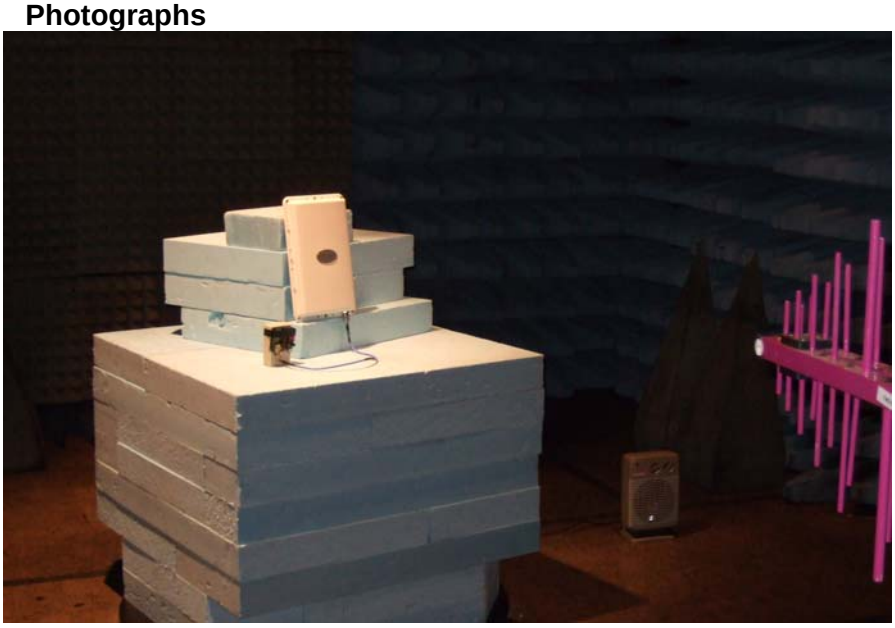
7.2 Explanation of limit line calculations for radiated measurements

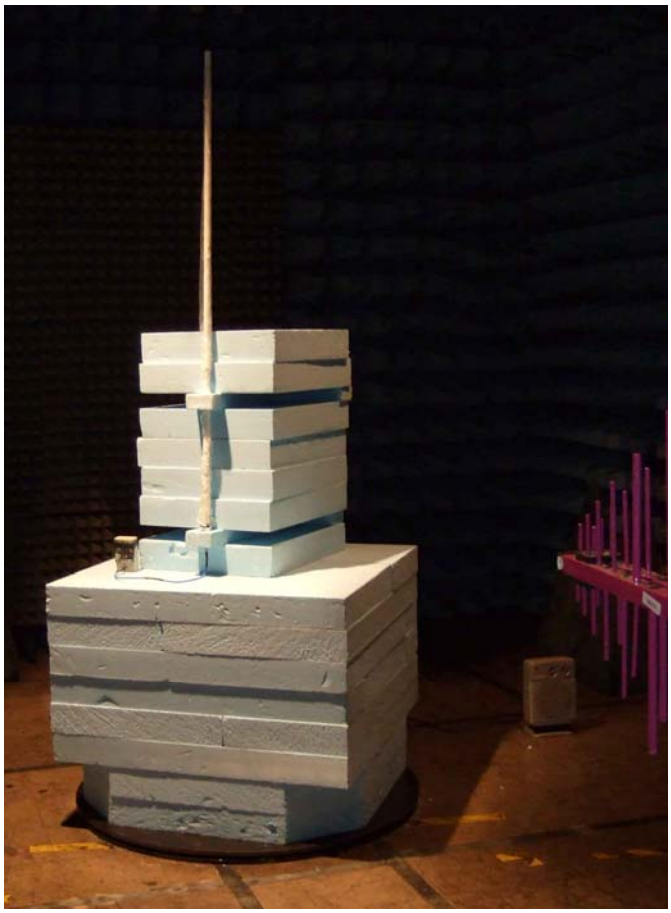
The limits given in the test standard are normally expressed as absolute values (e.g. in µV/m at a specified distance), whereas the measured values are expressed as peak, quasi peak or average values in dBµV/m referenced to the measuring instrument inputs. RN Electronics calibrate the test set-up to 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.

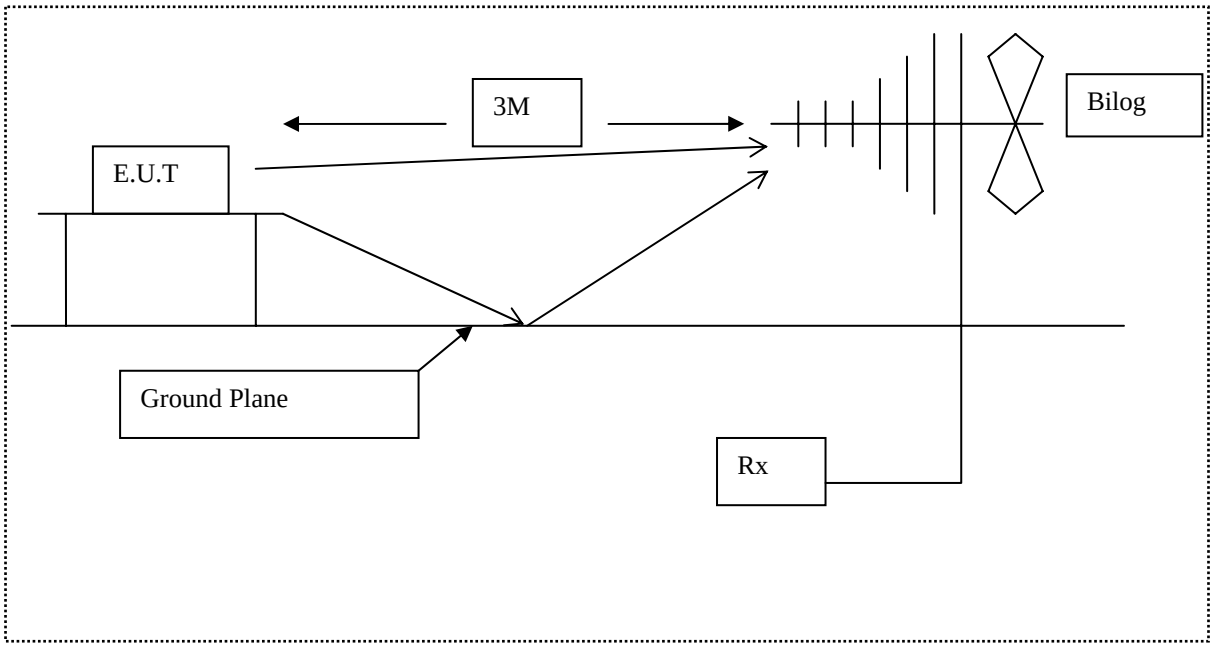
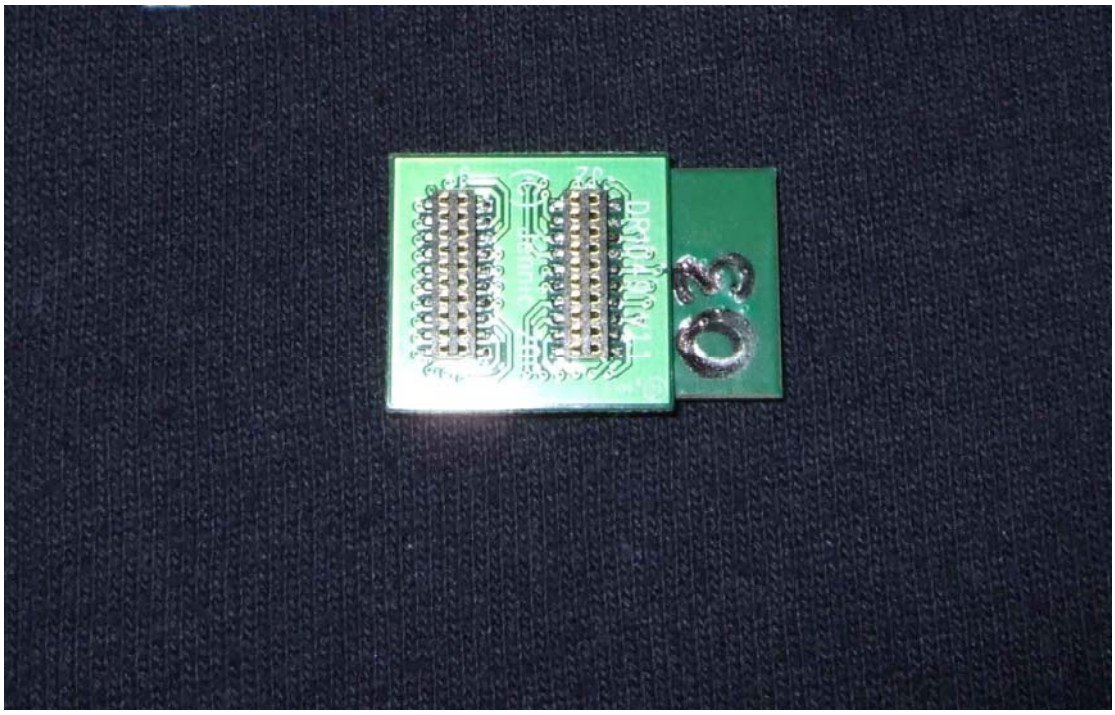
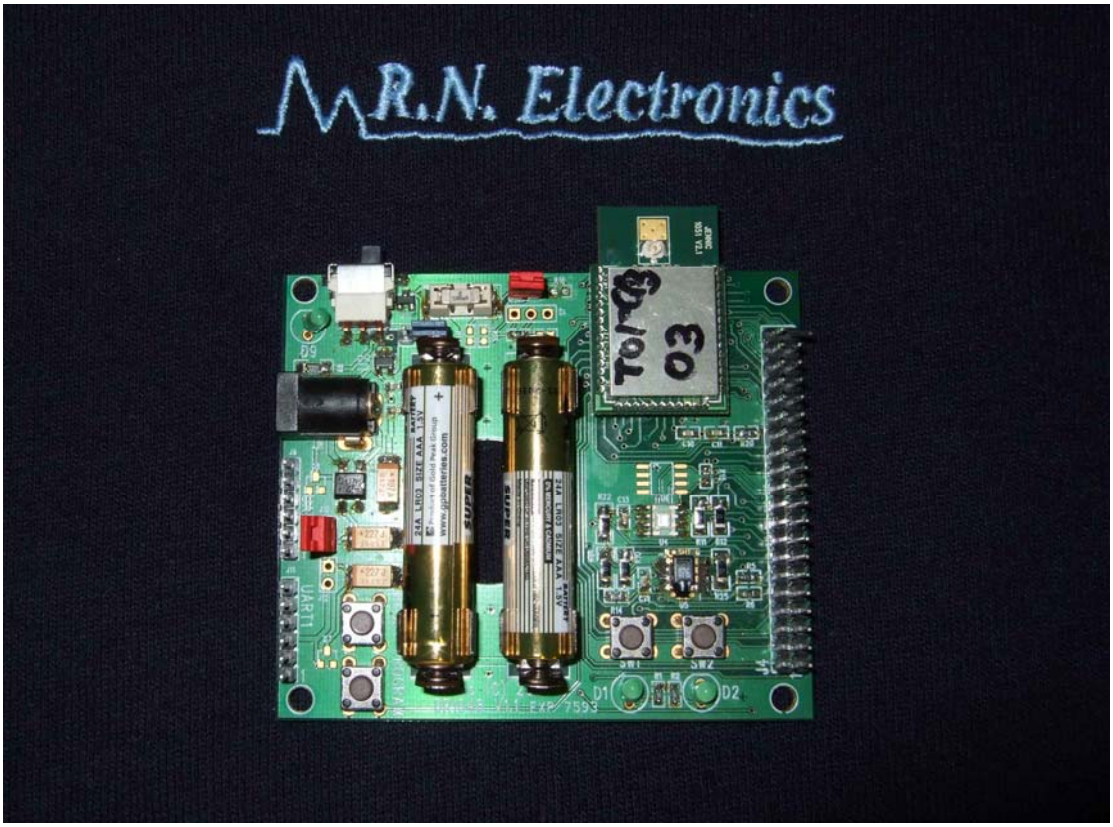


Diagram of the radiated emissions test setup.

8.2 EUT



8.3 EUT in Test Board



9. Signal Leads

None. EUT Battery powered.

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
C031	437B	Power Meter	Hewlett Packard	14-Oct-08	12
C032	8482A	Power Sensor	Hewlett Packard	16-Oct-08	12
E001	HP8542E	EMI Receiver & RF Filter	Hewlett Packard	13-Nov-07	18
E002	HP8594E	Spectrum Analyser + EMC S/ware	Hewlett Packard	N/A	N/A
E003	HP8593E	Spectrum Analyser	Hewlett Packard	10-Oct-08	24
E005	HP8447F	Pre-Amplifier	Hewlett Packard	09-Oct-08	12
E266	2032	5.4GHz Signal Generator	Marconi Instruments	27-Mar-08	24
E268	BHA 9118	1-18 GHz Horn Antenna	Schaffner	26-May-06	26-May-06
E412	E4440A	3 Hz - 26.5 GHz PSA Spectrum Analyzer	Agilent	01-Oct-08	12
TMS79	460451	Std Gain Horn Antenna 18-26.5 GHz	ETS Systems	26-May-06	26-May-06
TMS81	6502	Active Loop Antenna	EMCO	11-Dec-07	24
TMS82	8449B	Pre Amplifier 1 - 26 GHz	Agilent	28-Oct-08	12
TMS933	CBL6141A	Bilog Antenna 30MHz - 2GHz	York EMC	10-Sep-07	36

11. Auxiliary equipment

11.1 Auxiliary equipment supplied by Jennic Ltd

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

Manufacturer	Description	Model Number	Serial Number
Jennic Ltd	Motherboard PCB	DR1048 V1.1	7593
Jennic Ltd	Test Jig (UFL to SMA)	-	-

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 Numb	Manufacturer	Description	Model Number	Serial Number
I005	HP	Laptop	NX9010	CNF3512U85

12. Modifications

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

NONE.

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.

RN Electronics
EMC & RADIO TEST SERVICES

Certificate of Test

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

This certificate relates to the equipment, 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 microcontroller module
Model Number(s):	JN5139-T01-C13
Unique Serial Number(s):	#03
Manufacturer:	Jennic Ltd
Customer Purchase Order Number:	PO 005126/CF
R.N. Electronics Limited Report Number:	02-323/3876/1/09a
Test Standards:	FCC Part 15C: effective date October 1, 2008 Class DTS Intentional Radiator
Date:	5th - 16th February 2009
For and on behalf of R.N. Electronics Limited	
Signature:	

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