FCC
Test Report
for
IEEE 802.15.4 wireless controller module
JN5148-001-M04

Report Number 07-362a/4011/1/09
Report Produced by: -

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1. Contents

2. Summary of Test Results

The IEEE 802.15.4 wireless controller module JN5148-001-M04 was tested to the following standards: -

FCC Part 15C (effective date October, 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: 1st July to 22nd July 2009

Test Engineer: Peter Finley — Digitally signed by Peter Finley DN: CN = Peter Finley, C = GB, O = RN Electronics Date: 2009.07.27 16:52:38 +01'00'

Approved By: Technical Director — Roger Ray — Digitally signed by Roger Ray DN: CN = Roger Ray, C = GB, O = RN Electronics Date: 2009.07.27 16:51:33 +01'00'

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
Manufacturer/Brand Name	Jennic Ltd
Full name of EUT	IEEE 802.15.4 wireless controller module
Model Number of EUT	JN5148-001-M04
Serial Number of EUT	#9
FCC ID (if applicable):	not stated
Date when equipment was received by RN Electronics Limited	1st July 2009
Date of test:	1st July to 22nd July 2009
Customer order number:	PO005383/CF
A visual description of EUT is as follows:	A small metal canned enclosure mounted on a PCB with an UFL connector for connecting a dedicated antenna. For the purpose of test the PCB was mounted onto a battery powered motherboard with an RS232 communications flying lead for programming purposes.
The main function of the EUT is: module.	A 2.4GHz(IEE802.15.4) wireless microcontroller
Antenna:	Dedicated Antenna connected to antenna port. 18dBi Aveslink Outdoor High Gain Directional Patch Antenna (Model #E-0360-AK) or 15dBi Aveslink Vertical Collinear Antenna (Model #E-1050-AK)

Equipment Under Test Information specification:

Height	6.9mm
Width	20mm
Depth	41mm
Weight	3g
Voltage	3V DC
Current required from above voltage source	130mA
Highest Frequencies used / generated	2.405 – 2.475GHz

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

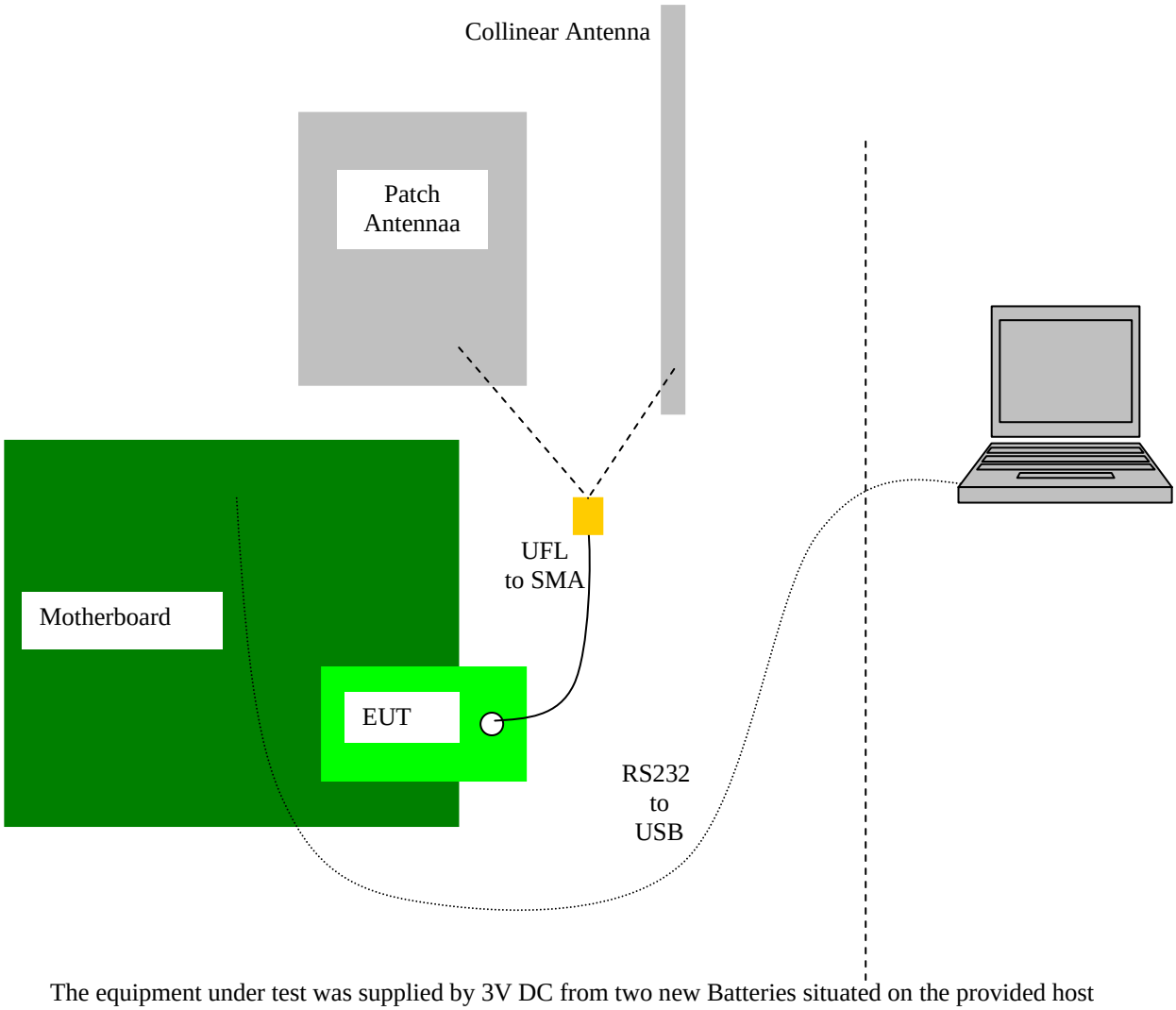
Modes of operation:

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 2.475GHz	Unit continuously transmitting on Top channel	YES

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

This report was printed on: 27 July 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 to allow the supplied High Gain and Co-Linear antennae 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. and would not normally be available to the user.

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 = 2.475GHz

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 Peter Finley 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. The transmitter was operated continuously to measure the emissions which would normally have a duty cycle <= 1%. Radiated Emissions testing was performed with a new battery. The EUT and antennae were rotated in all three orthogonal planes.

5.2.1.2 Test Procedure

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

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 1.5m above the ground in line with the EUT, which was rotated through 360° to record the worst case emissions.

Above 6.5GHz, the measurement antenna was moved to a distance of 1 metre.

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 &B

Test Environment:
M & B

Temperature: 20°C Humidity: 49-63%

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,TMS933,E268,E342,TMS79,TMS82,E429,E250,E251,E252,E235

See Section 10 for more details

5.3 Intentional Radiator Field Strength

5.3.1 Test Methods

Test Requirements FCC Part 15C, Reference (15.)

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

5.3.1.1 Configuration of EUT

The EUT was placed on a 1.5 metres high turntable. The front edge of the EUT was initially positioned facing the antenna. The EUT and antennae were rotated in all three orthogonal planes. The EUT was measured at a distance of 3 metres.

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: 20°C Humidity:63 %

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	122.34	118.84
2440	122.67	118.50
2475	121.50	117.17

Collinear Antenna results

Frequency (MHz)	Power (1MHz RBW) (dBuV/m @ 3 metres)	Power (100kHz RBW) (dBuV/m @ 3 metres)
2405	111.84	108.34
2440	114.84	111.67
2475	109.50	106.34

Conducted results

Frequency (MHz)	Power (dBm)
2405	17.12
2440	16.87
2475	16.49

Limits: 1Watt (+30dBm)
@3m 1Watt from an isotropic radiator would produce 125dBuV.
These results show that the EUT has **PASSED** this test.

5.3.2.1 Test Equipment used

E342, E268, E82, E250,E251,E252,E397,E290

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: 21°C

Frequency (MHz)	Peak Power (dBm/3kHz)
2405	-3.1
2440	-4.2
2475	-1.2

Limit: +8dBm/3kHz

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

5.4.2.1 Test Equipment used

E003, E005, E290, E397

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 and taking due consideration of the loss of the antenna port adaptor.

5.5.2 Test results

Tests were performed using Test Site A.

Temperature of test Environment: 24°C

Analyser plots for the 6dB bandwidth can be found in Section 6.4 of this report.

Frequency (MHz)	6dB Bandwidth (MHz)	Plot Reference
2405	1.5875	001
2440	1.6000	002
2475	1.6375	003

Limits: Must be >500kHz.

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

5.5.2.1 Test Equipment used

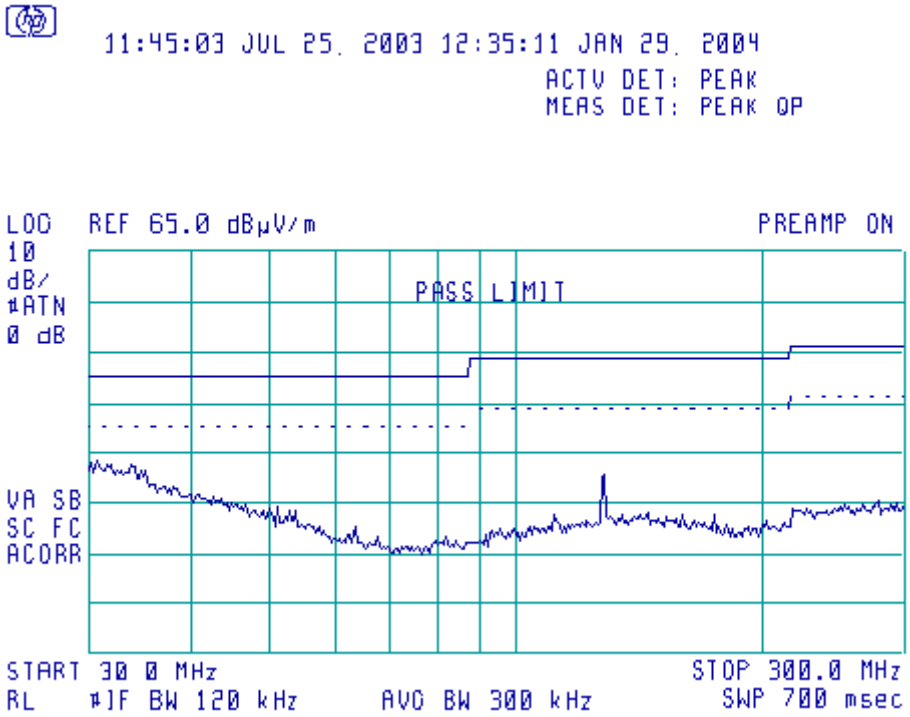
E003

See Section 10 for more details.

6. Plots and Results
6.1 Conducted Emissions

NONE - TEST NOT APPLICABLE

6.2 Radiated Emissions 30MHz – 1GHz



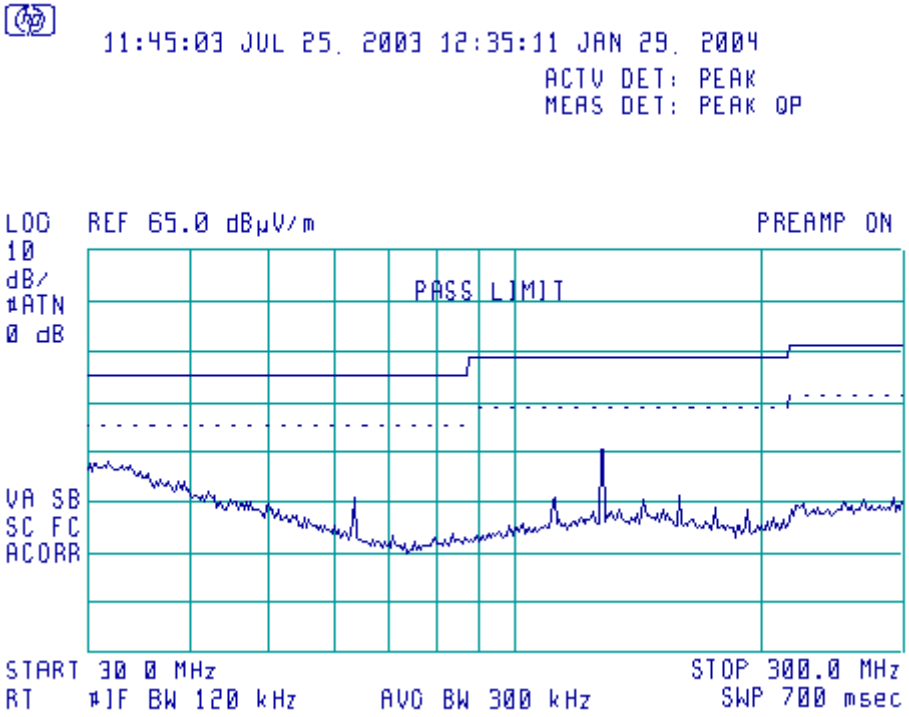
Collinear Antenna

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 table on following page of this report)



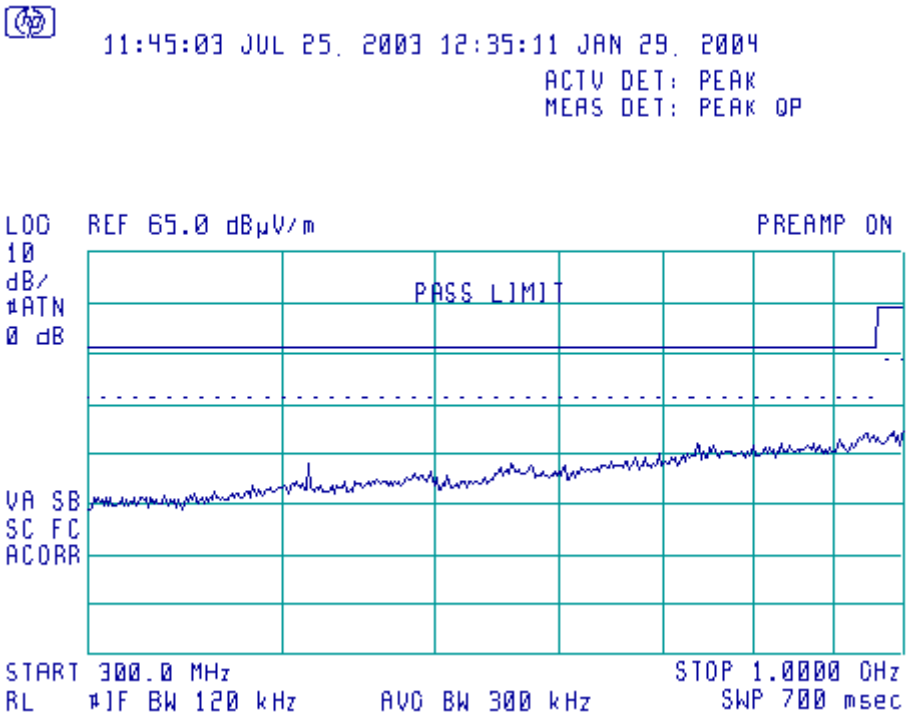
Collinear Antenna

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 table on following page of this report)



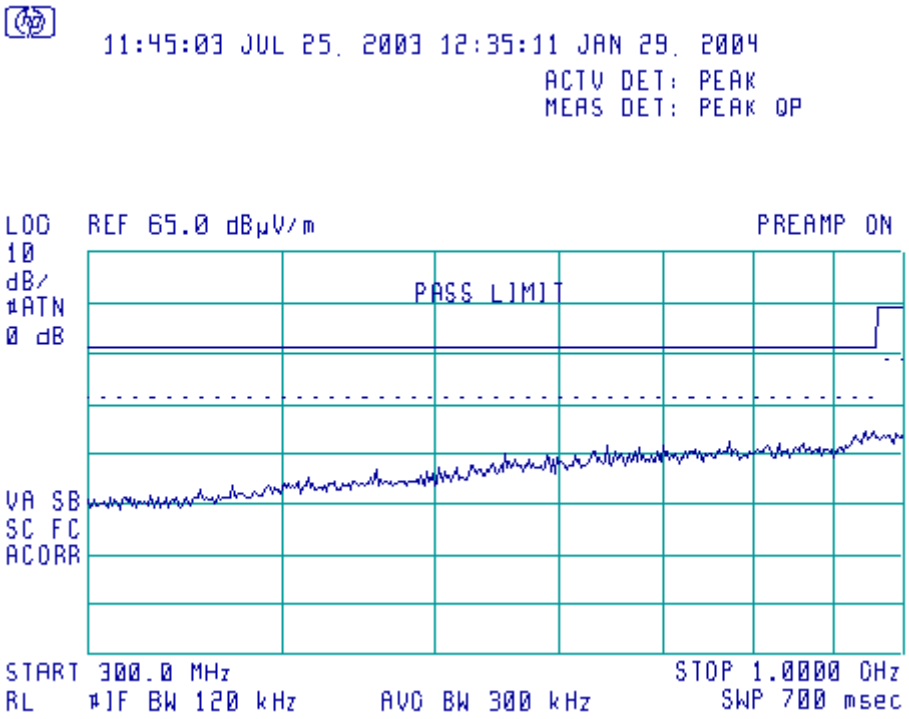
Collinear Antenna

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 table on following page of this report)



Collinear Antenna

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

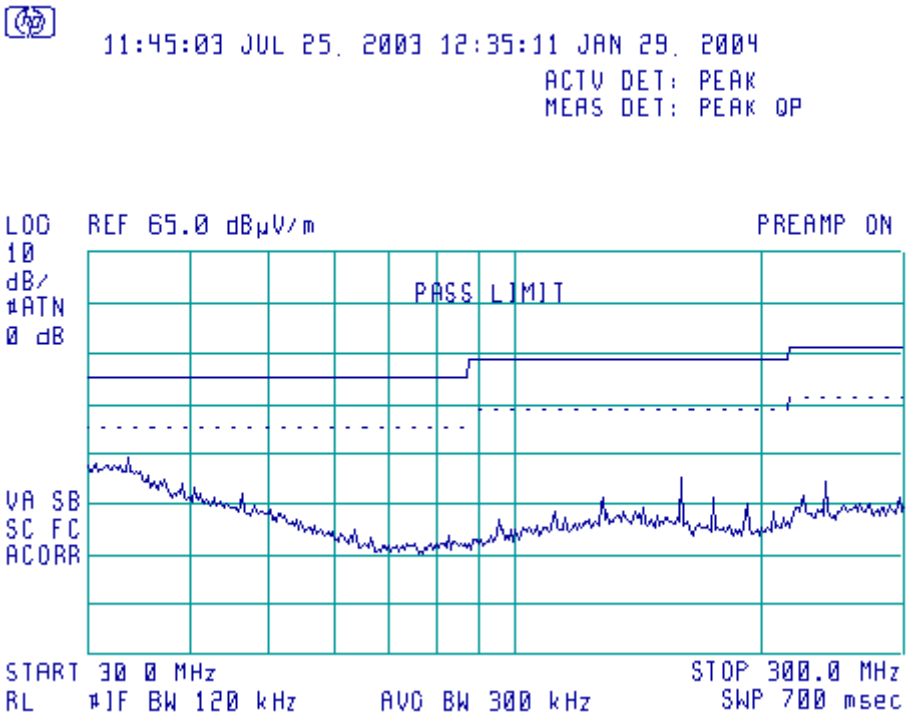
Vertical Polarisation

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 table on following page of this report)

Signal	Freq (MHz)	Peak Amp (dBuV/m)	Peak - Lim1 (dB)	QP Amp (dBuV/m)	QP - Lim1 (dB)
1	127.999988	27.29	-16.21	25.77	-17.73

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



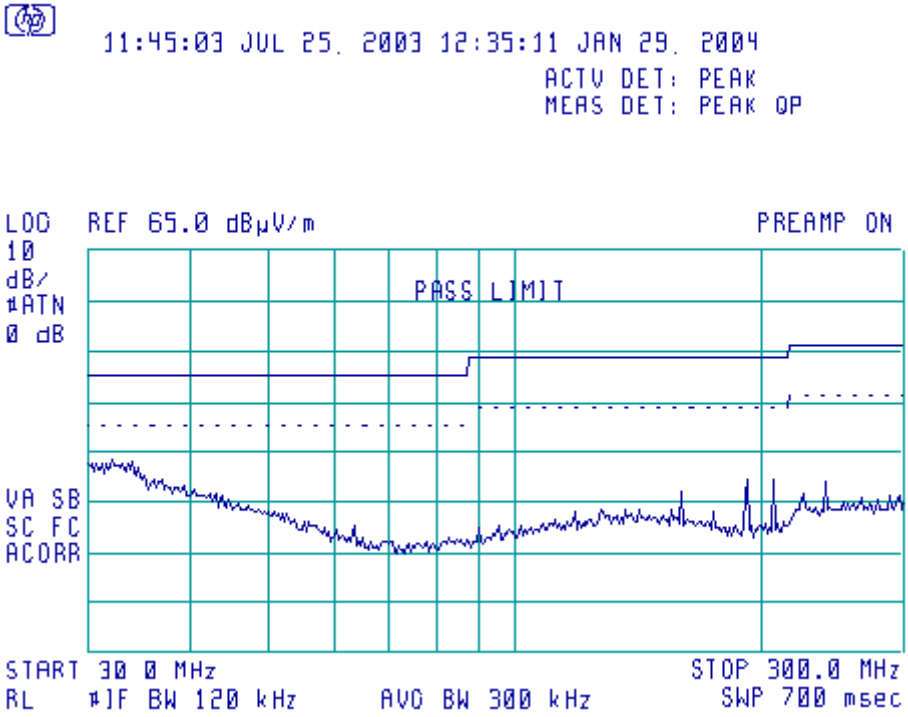
Patch Antenna

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 table on following page of this report)



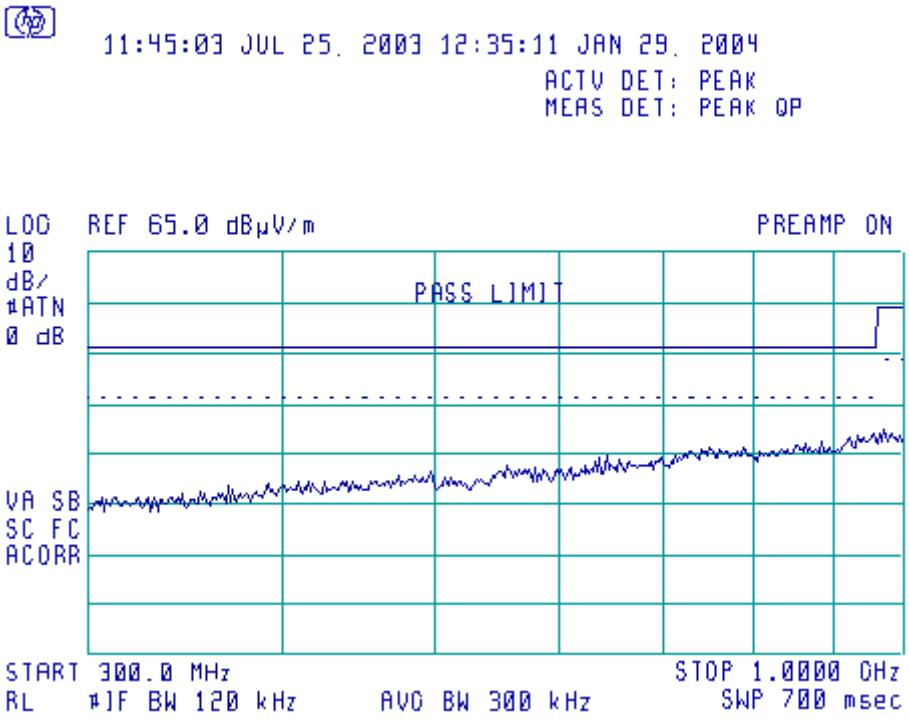
Patch Antenna

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 table on following page of this report)



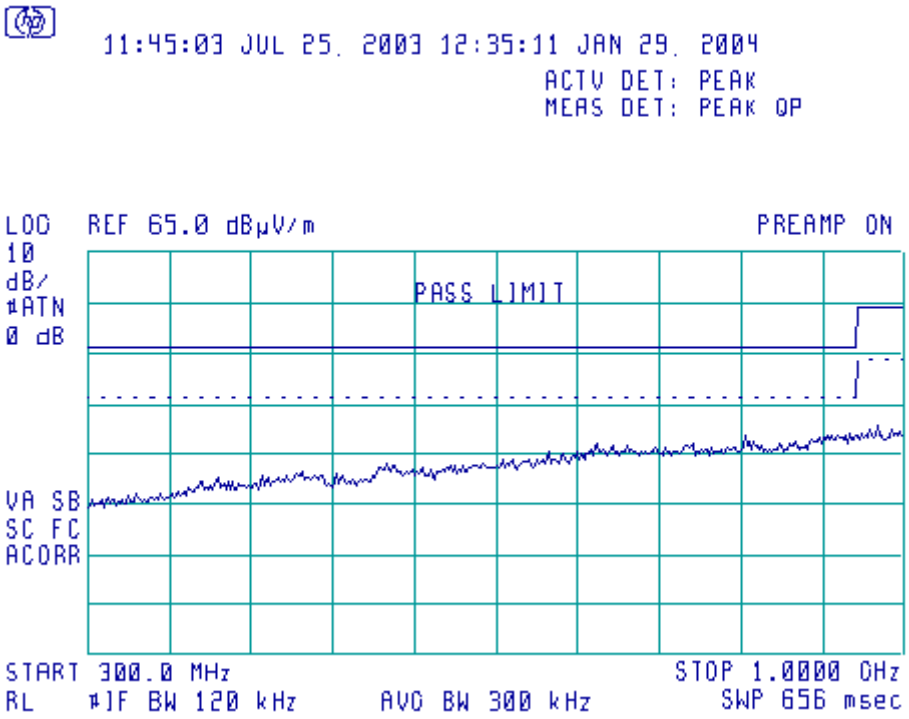
Patch Antenna

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 table on following page of this report)



Patch Antenna

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 table on following page of this report)

Tables of signals within 20dB of the limit line for Quasi-peak

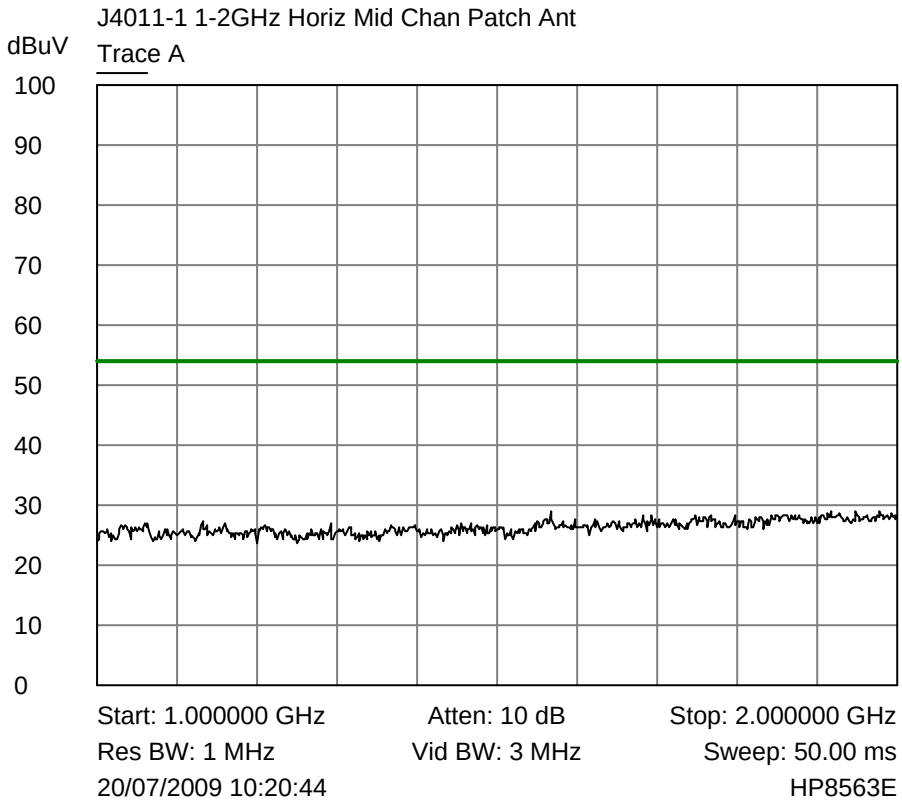
Top, Middle & Bottom Channels

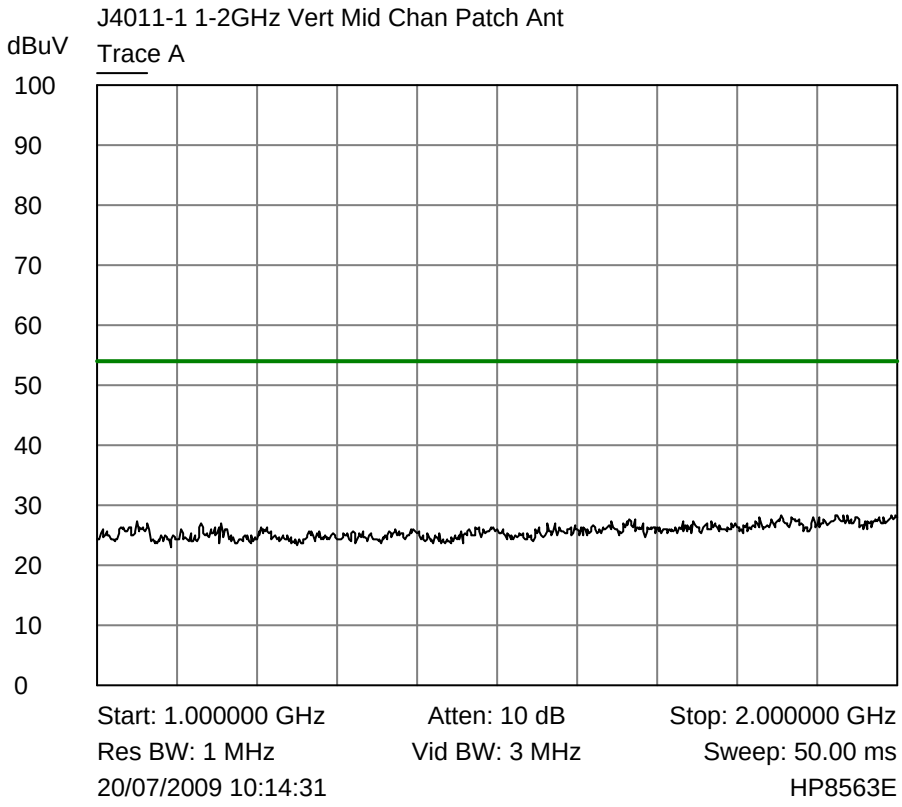
NONE

Measurement Uncertainty of ± 5.2dB Applies

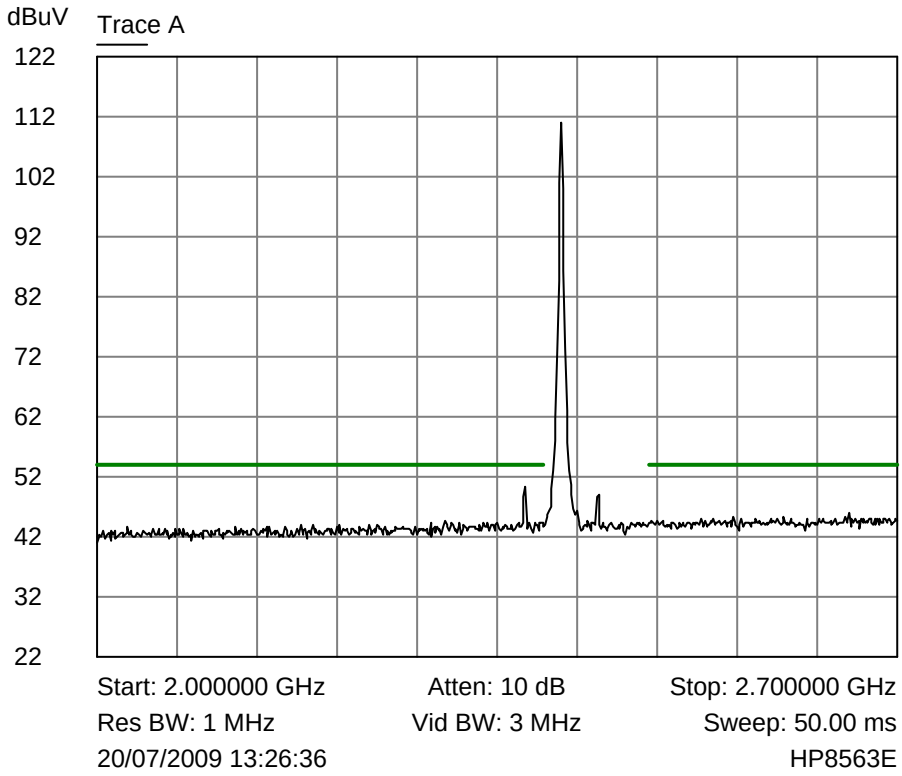
6.3 Radiated emissions 1GHz – 10th harmonic

6.3.1 Patch antenna plots



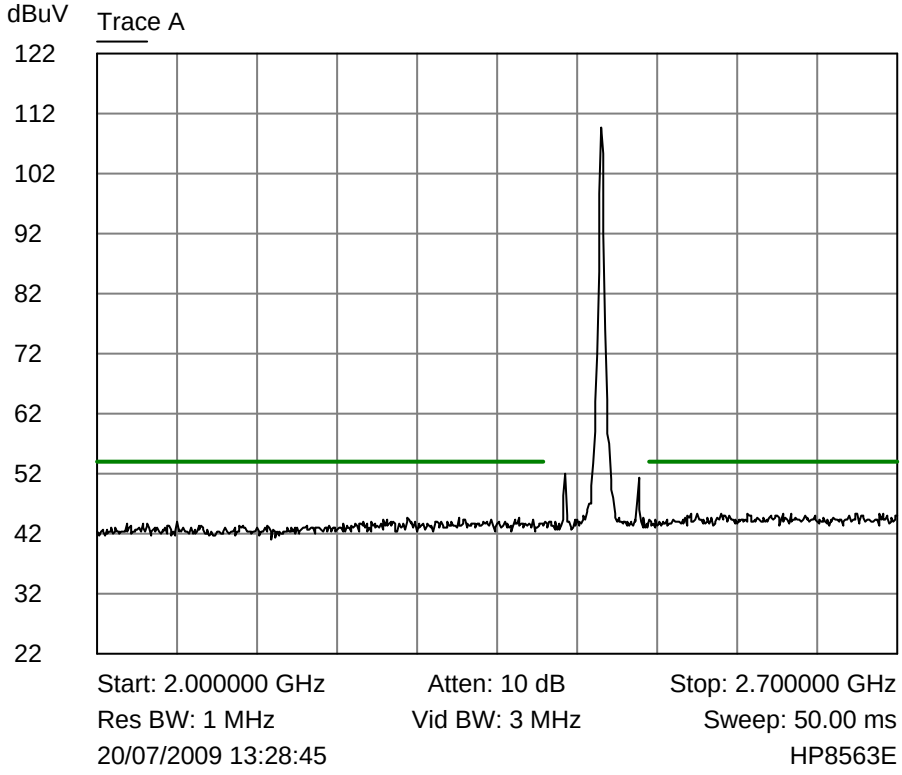


J4011-1 2-2.7GHz Horiz Bot Chan Patch Ant



Start: 2.000000 GHz Atten: 10 dB Stop: 2.700000 GHz
Res BW: 1 MHz Vid BW: 3 MHz Sweep: 50.00 ms
20/07/2009 13:26:36 HP8563E

J4011-1 2-2.7GHz Horiz Mid Chan Patch Ant



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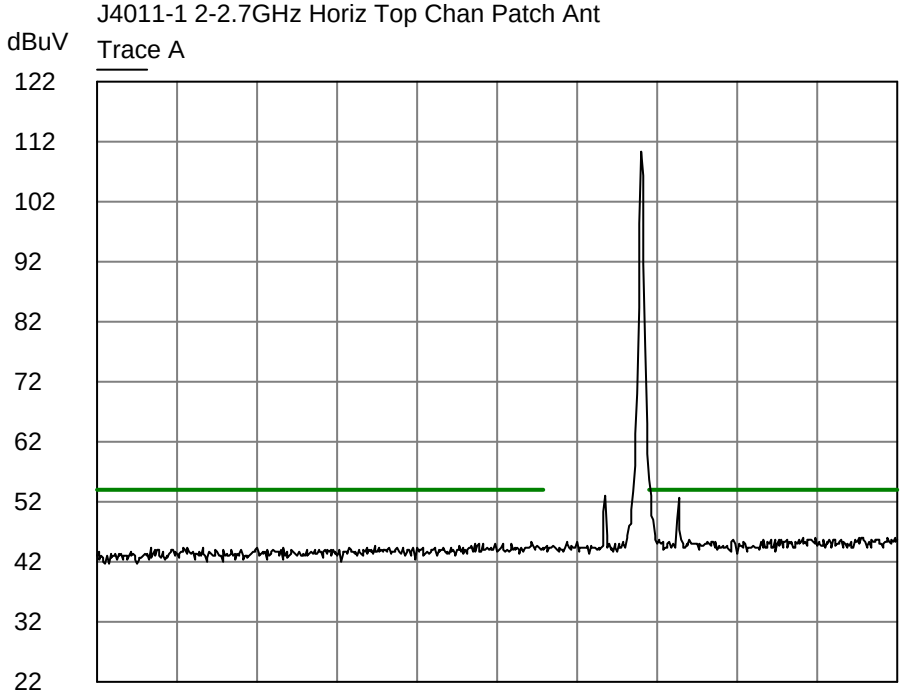
20/07/2009 13:28:45 HP8563E

J4011-1 2-2.7GHz Horiz Top Chan Patch Ant



Start: 2.000000 GHz Atten: 10 dB Stop: 2.700000 GHz
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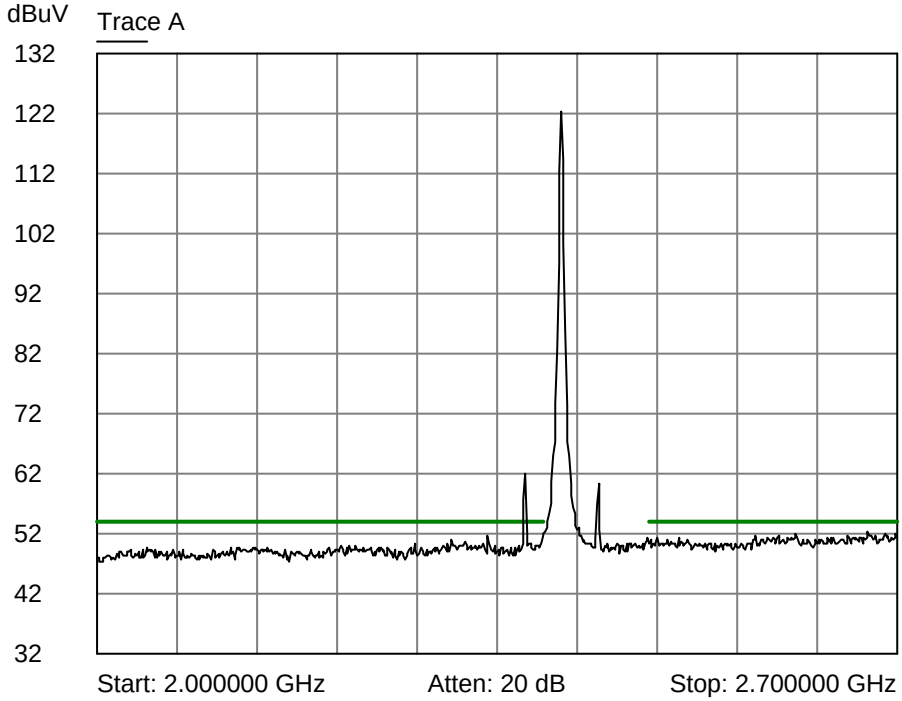
20/07/2009 13:43:04 HP8563E

J4011-1 2-2.7GHz Vert Bot Chan Patch Ant



Start: 2.000000 GHz Atten: 20 dB Stop: 2.700000 GHz
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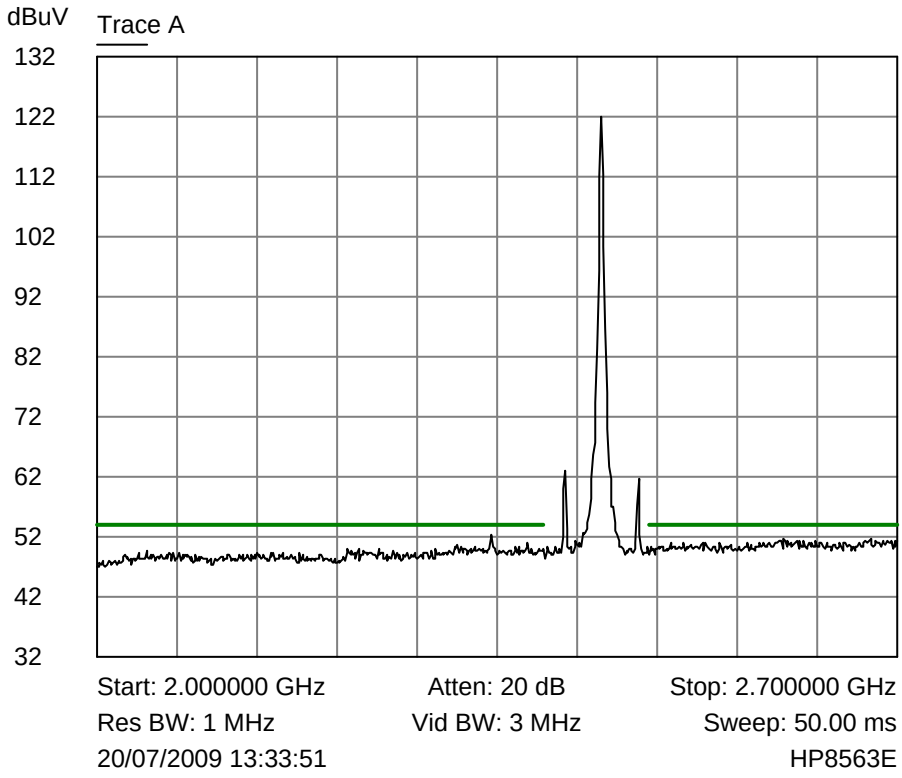
20/07/2009 13:24:54 HP8563E

J4011-1 2-2.7GHz Vert Mid Chan Patch Ant



Start: 2.000000 GHz Atten: 20 dB Stop: 2.700000 GHz
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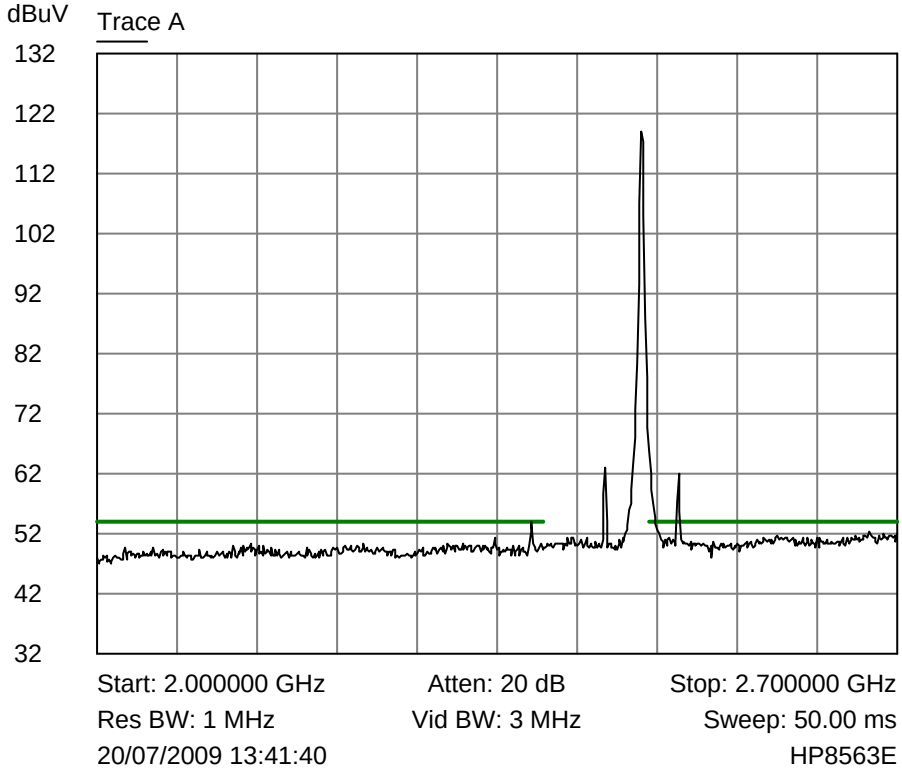
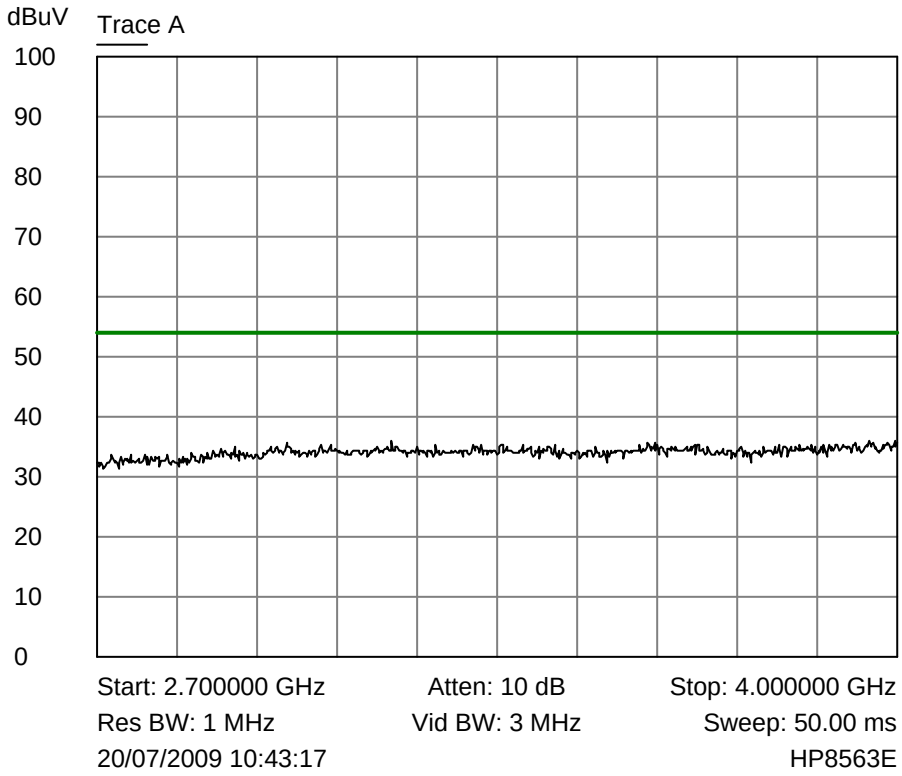
20/07/2009 13:33:51 HP8563E

J4011-1 2-2.7GHz Vert Top Chan Patch Ant



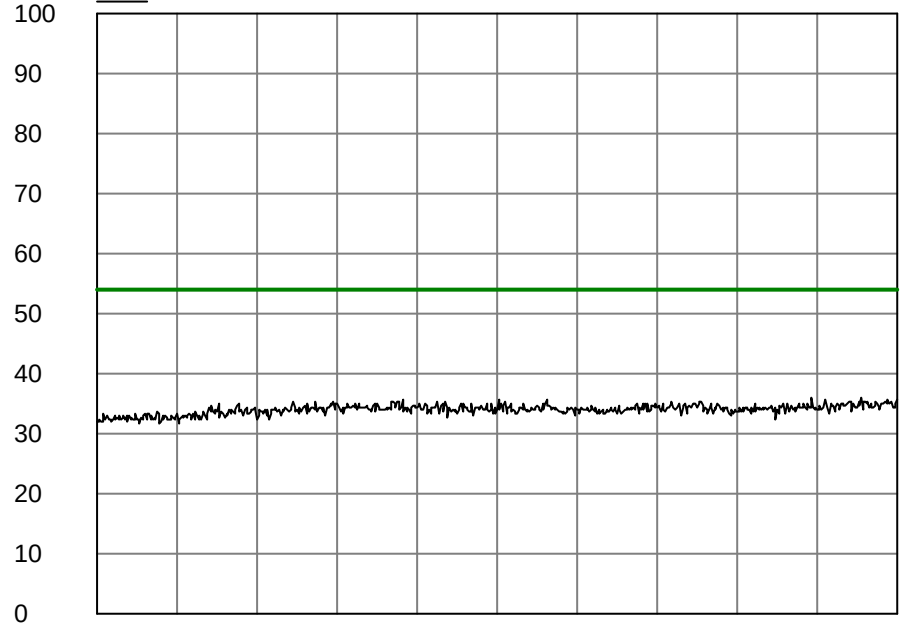
Start: 2.000000 GHz Atten: 20 dB Stop: 2.700000 GHz
Res BW: 1 MHz Vid BW: 3 MHz Sweep: 50.00 ms
20/07/2009 13:41:40 HP8563E

J4011-1 2.7-4GHz Horiz Mid Chan Patch Ant



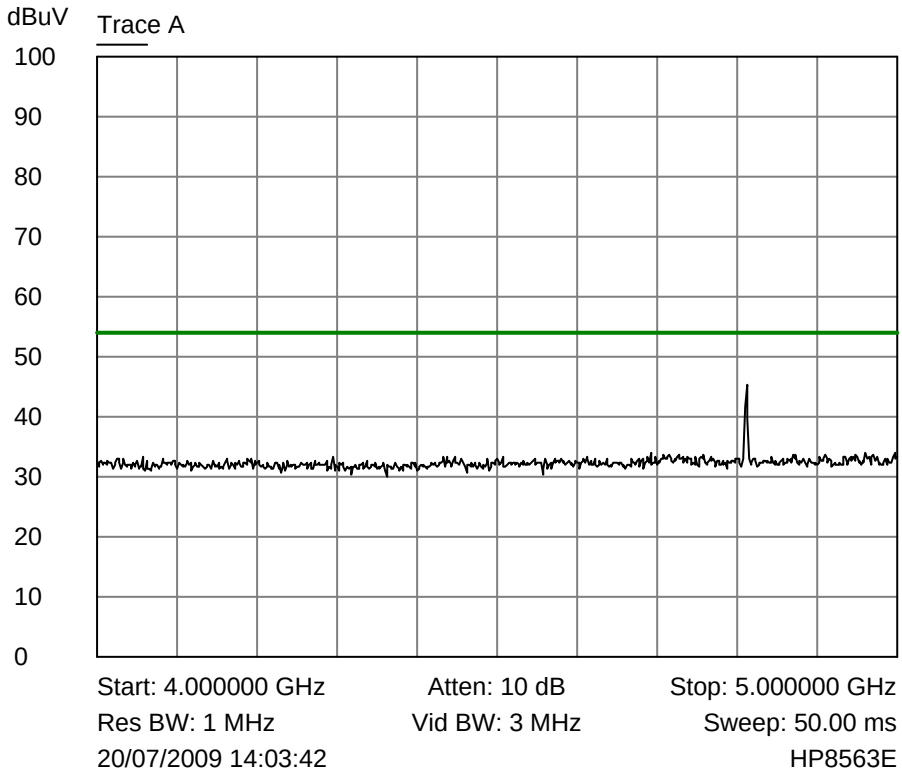
Start: 2.700000 GHz Atten: 10 dB Stop: 4.000000 GHz
Res BW: 1 MHz Vid BW: 3 MHz Sweep: 50.00 ms
20/07/2009 10:43:17 HP8563E

J4011-1 2.7-4GHz Vert Mid Chan Patch Ant



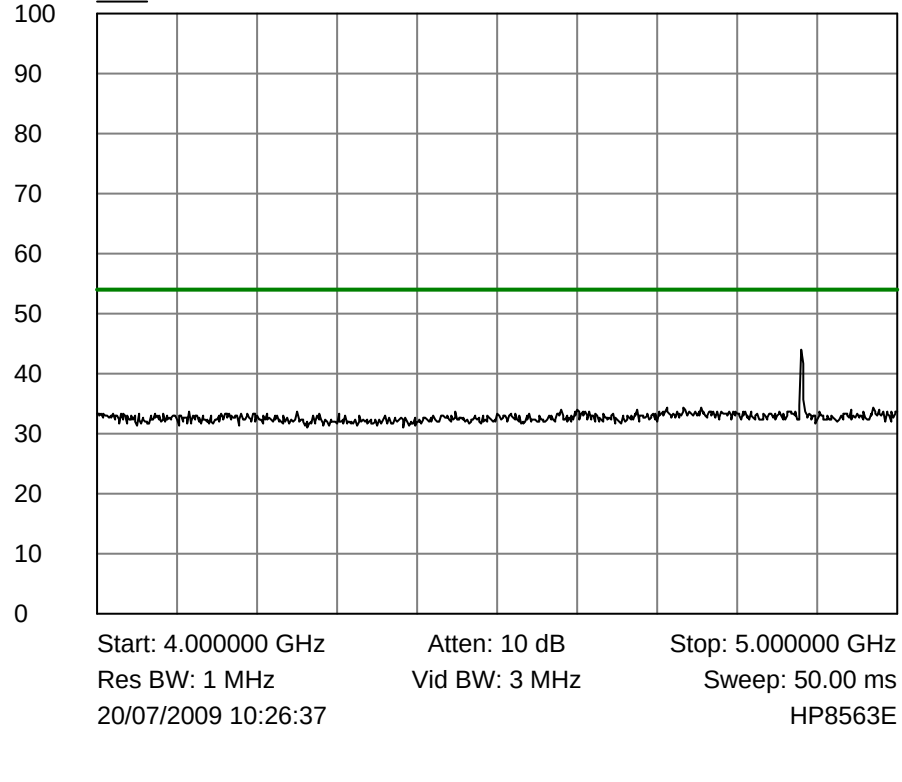
Start: 2.700000 GHz Atten: 10 dB Stop: 4.000000 GHz
Res BW: 1 MHz Vid BW: 3 MHz Sweep: 50.00 ms
20/07/2009 10:47:40 HP8563E

J4011-1 4-5GHz Horiz Bot Chan Patch Ant



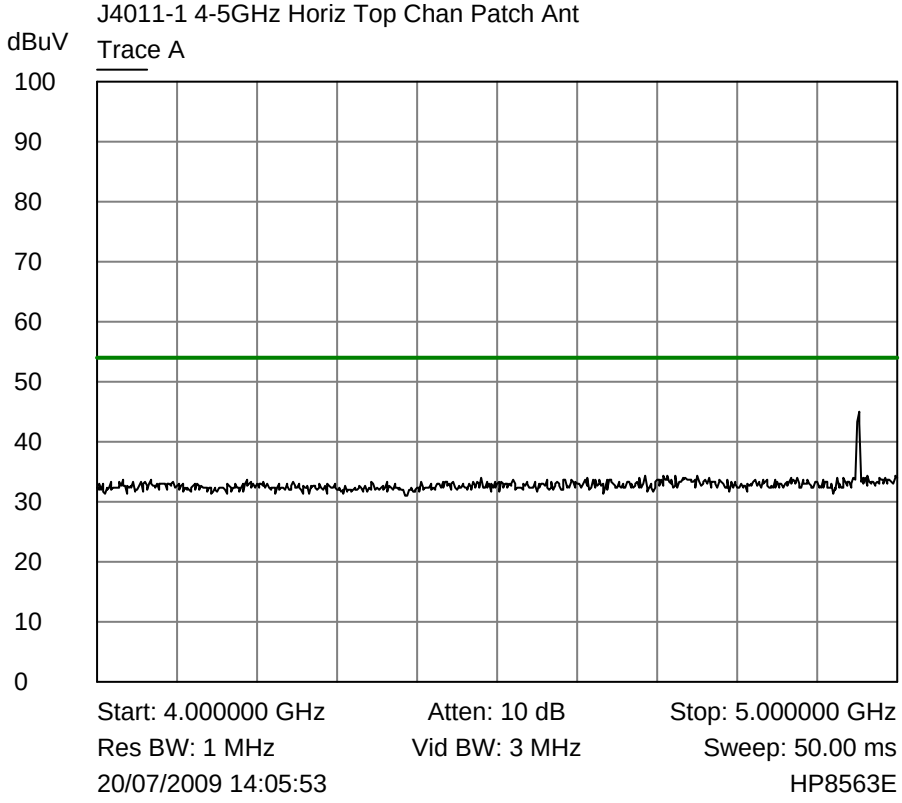
Start: 4.000000 GHz Atten: 10 dB Stop: 5.000000 GHz
Res BW: 1 MHz Vid BW: 3 MHz Sweep: 50.00 ms
20/07/2009 14:03:42 HP8563E

J4011-1 4-5GHz Horiz Mid Chan Patch Ant



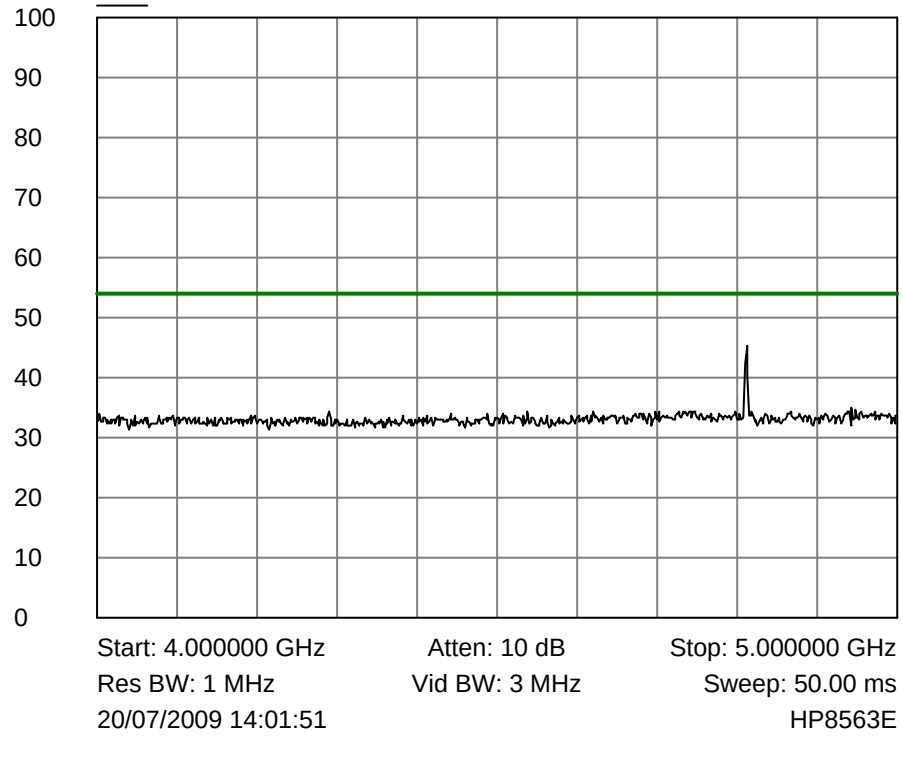
Start: 4.000000 GHz Atten: 10 dB Stop: 5.000000 GHz
Res BW: 1 MHz Vid BW: 3 MHz Sweep: 50.00 ms
20/07/2009 10:26:37 HP8563E

J4011-1 4-5GHz Horiz Top Chan Patch Ant



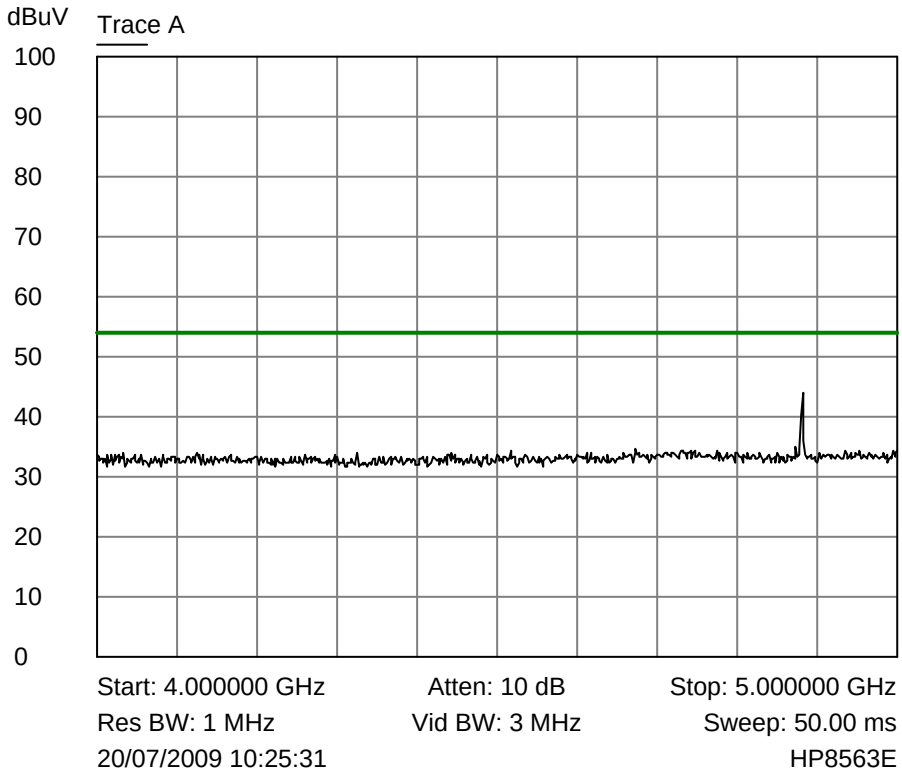
Start: 4.000000 GHz Atten: 10 dB Stop: 5.000000 GHz
Res BW: 1 MHz Vid BW: 3 MHz Sweep: 50.00 ms
20/07/2009 14:05:53 HP8563E

J4011-1 4-5GHz Vert Bot Chan Patch Ant



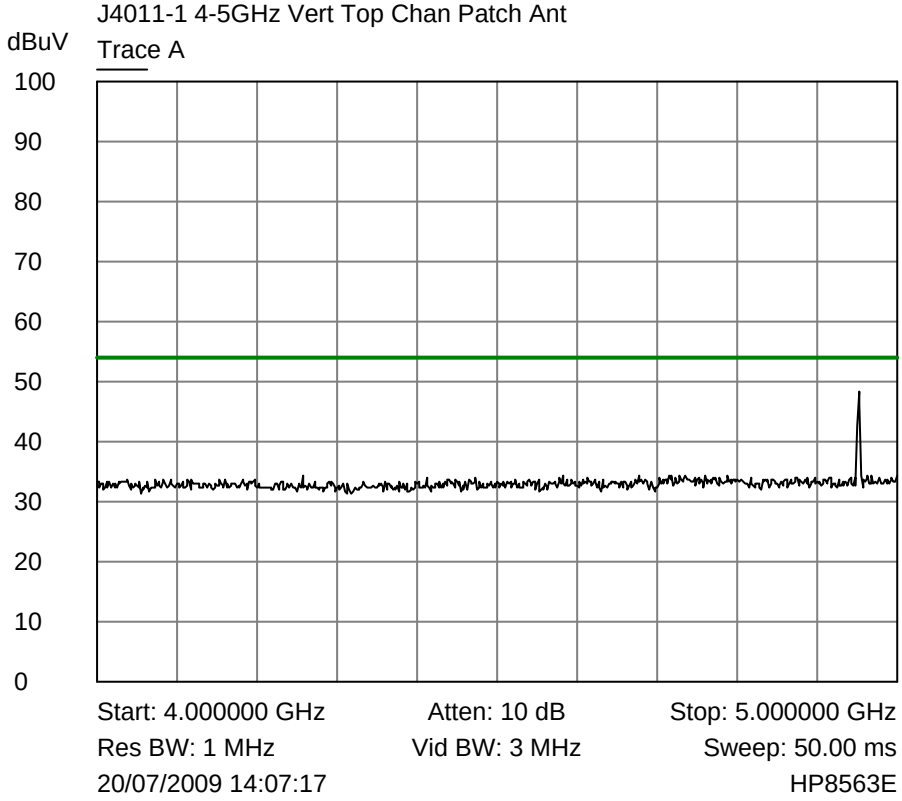
Start: 4.000000 GHz Atten: 10 dB Stop: 5.000000 GHz
Res BW: 1 MHz Vid BW: 3 MHz Sweep: 50.00 ms
20/07/2009 14:01:51 HP8563E

J4011-1 4-5GHz Vert Mid Chan Patch Ant



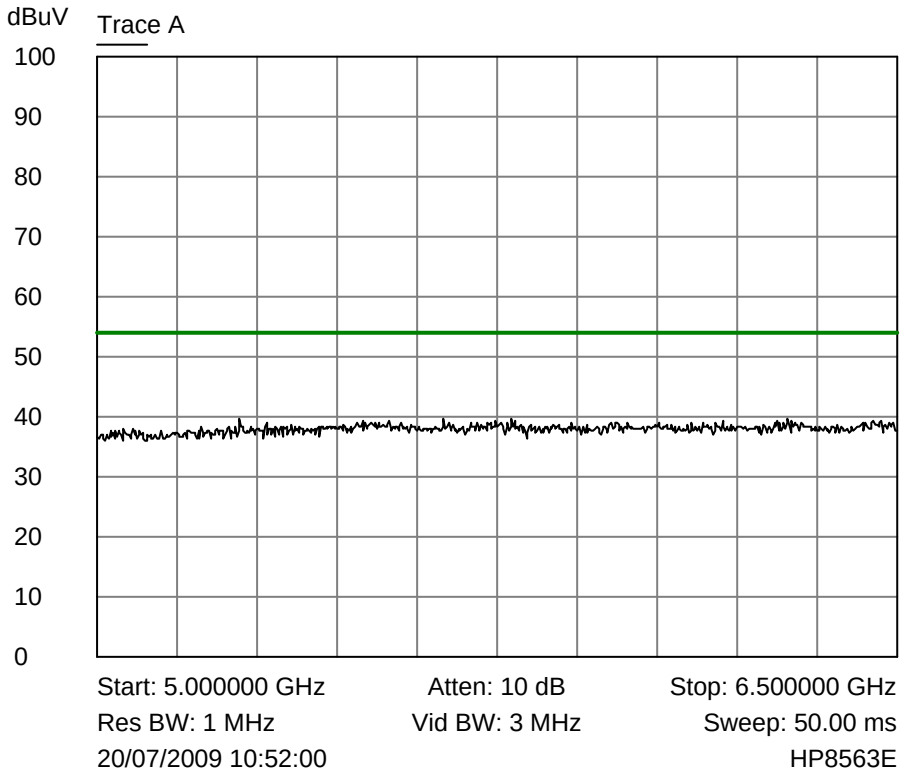
Start: 4.000000 GHz Atten: 10 dB Stop: 5.000000 GHz
Res BW: 1 MHz Vid BW: 3 MHz Sweep: 50.00 ms
20/07/2009 10:25:31 HP8563E

J4011-1 4-5GHz Vert Top Chan Patch Ant



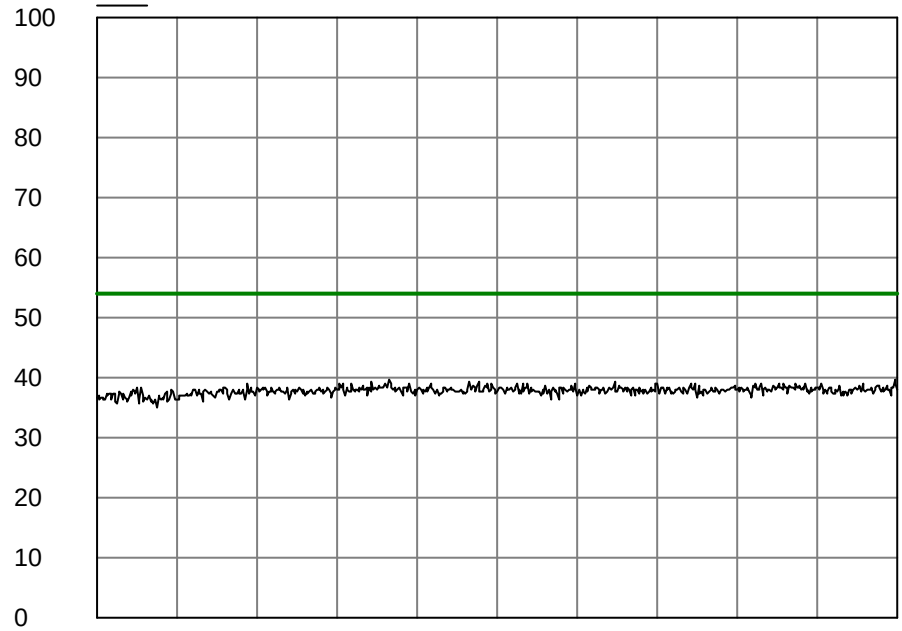
Start: 4.000000 GHz Atten: 10 dB Stop: 5.000000 GHz
Res BW: 1 MHz Vid BW: 3 MHz Sweep: 50.00 ms
20/07/2009 14:07:17 HP8563E

J4011-1 5-6.5GHz Horiz Mid Chan Patch Ant



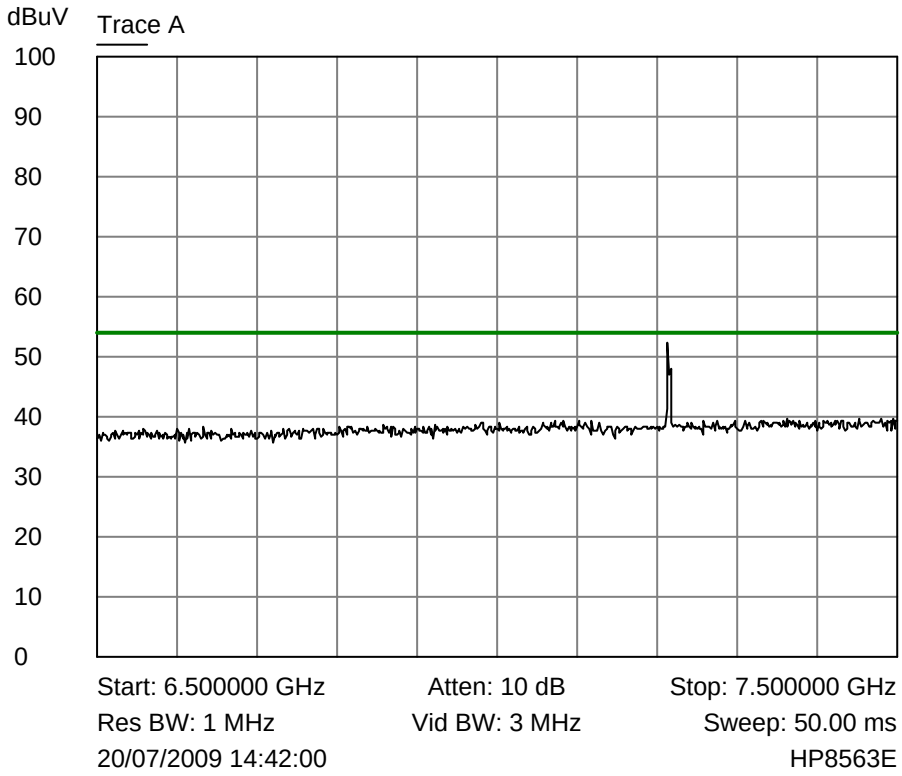
Start: 5.000000 GHz Atten: 10 dB Stop: 6.500000 GHz
Res BW: 1 MHz Vid BW: 3 MHz Sweep: 50.00 ms
20/07/2009 10:52:00 HP8563E

J4011-1 5-6.5GHz Vert Mid Chan Patch Ant

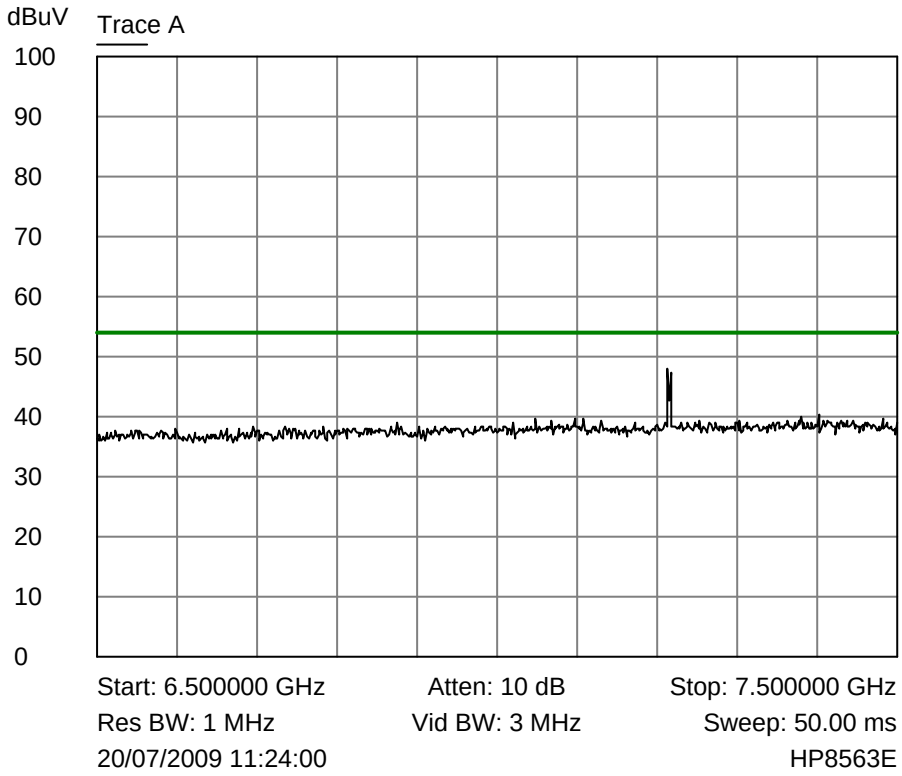


Start: 5.000000 GHz Atten: 10 dB Stop: 6.500000 GHz
Res BW: 1 MHz Vid BW: 3 MHz Sweep: 50.00 ms
20/07/2009 10:50:23 HP8563E

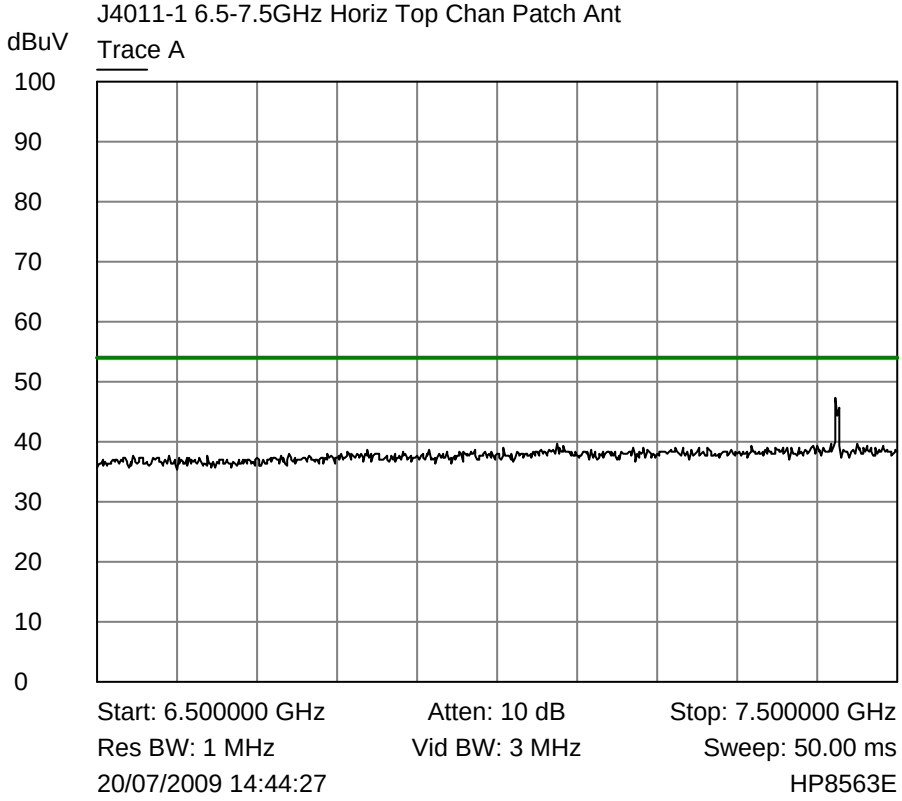
J4011-1 6.5-7.5GHz Horiz Bot Chan Patch Ant



J4011-1 6.5-7.5GHz Horiz Mid Chan Patch Ant

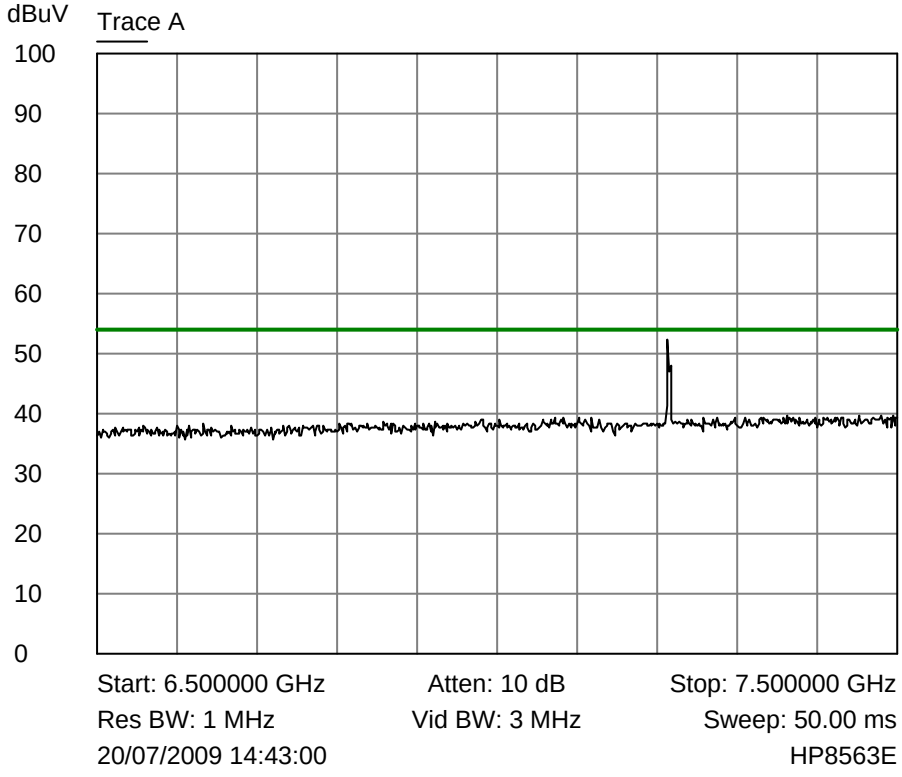


J4011-1 6.5-7.5GHz Horiz Top Chan Patch Ant



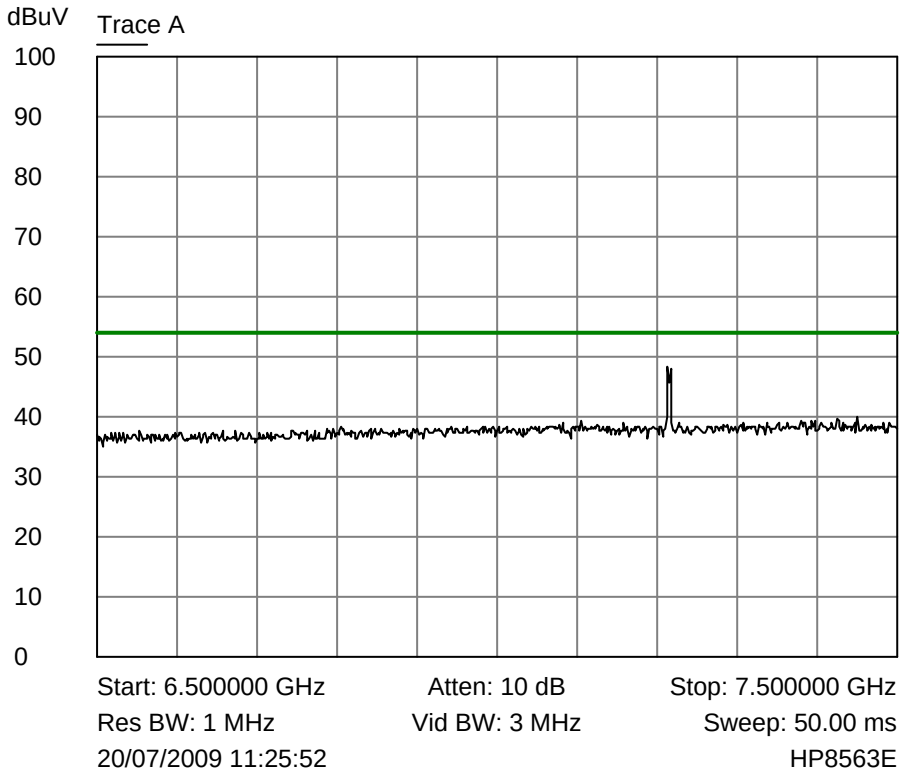
Start: 6.500000 GHz Atten: 10 dB Stop: 7.500000 GHz
Res BW: 1 MHz Vid BW: 3 MHz Sweep: 50.00 ms
20/07/2009 14:44:27 HP8563E

J4011-1 6.5-7.5GHz Vert Bot Chan Patch Ant

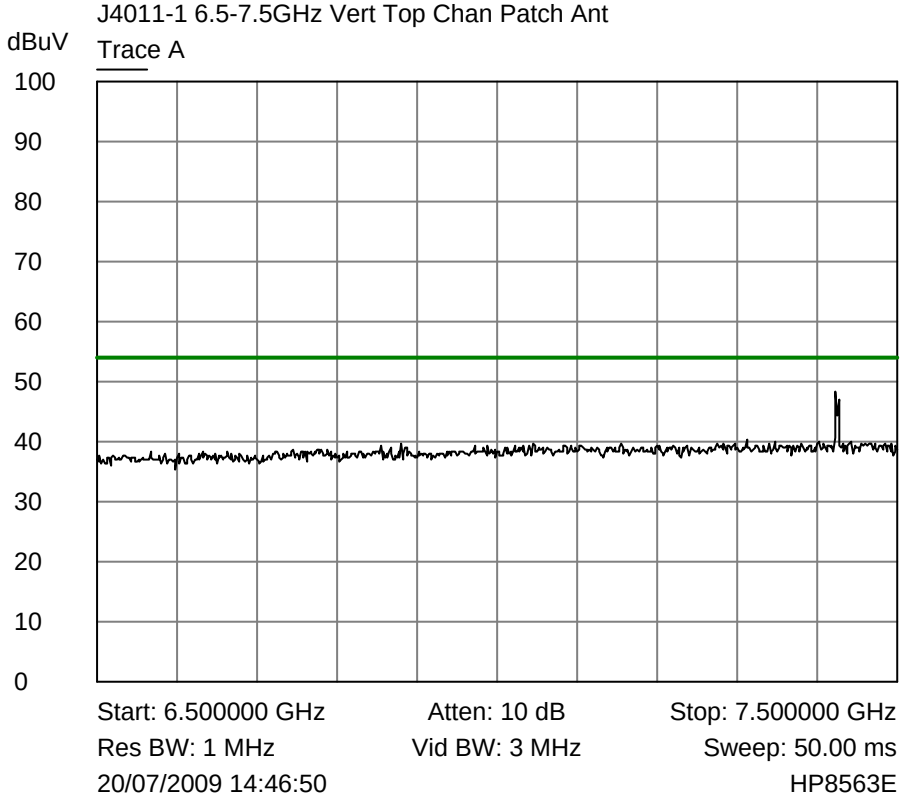


Start: 6.500000 GHz Atten: 10 dB Stop: 7.500000 GHz
Res BW: 1 MHz Vid BW: 3 MHz Sweep: 50.00 ms
20/07/2009 14:43:00 HP8563E

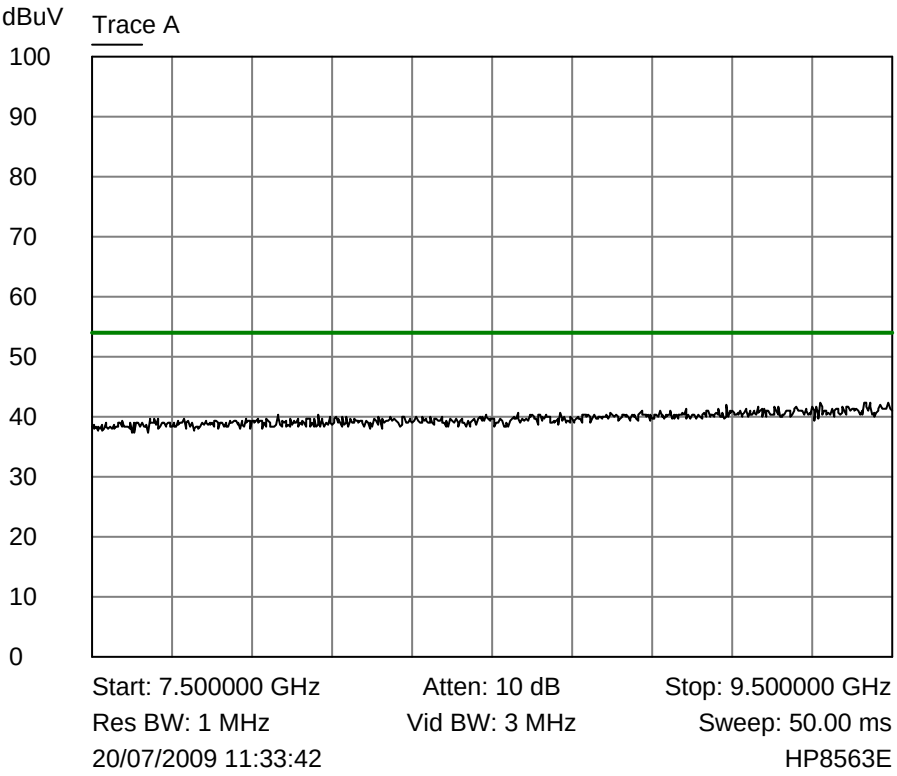
J4011-1 6.5-7.5GHz Vert Mid Chan Patch Ant



J4011-1 6.5-7.5GHz Vert Top Chan Patch Ant

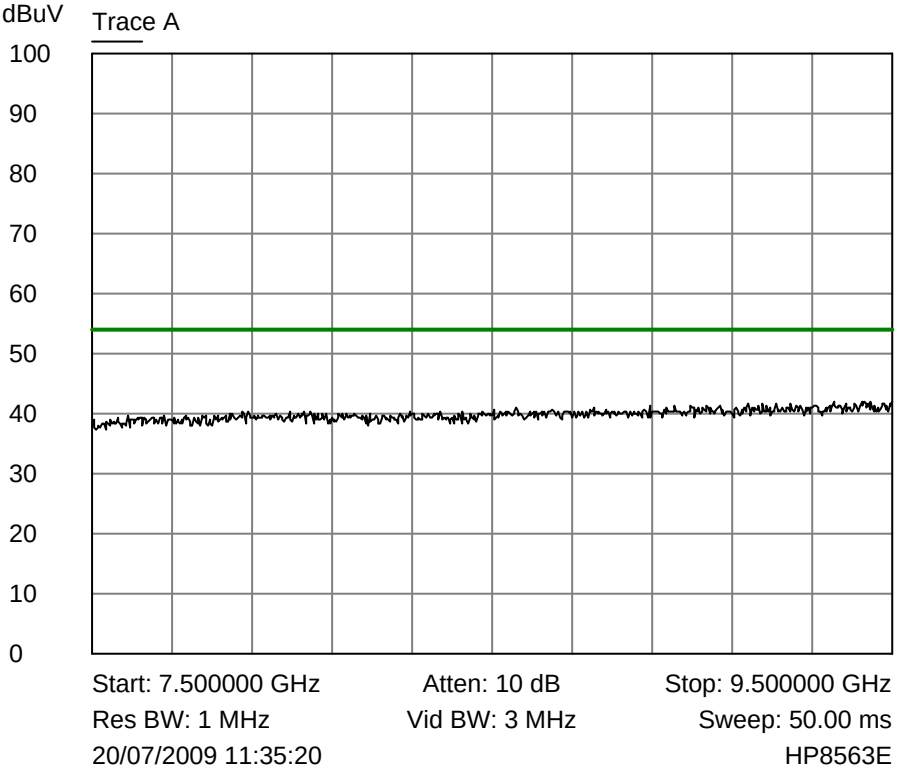


J4011-1 7.5-9.5GHz Horiz Mid Chan Patch Ant



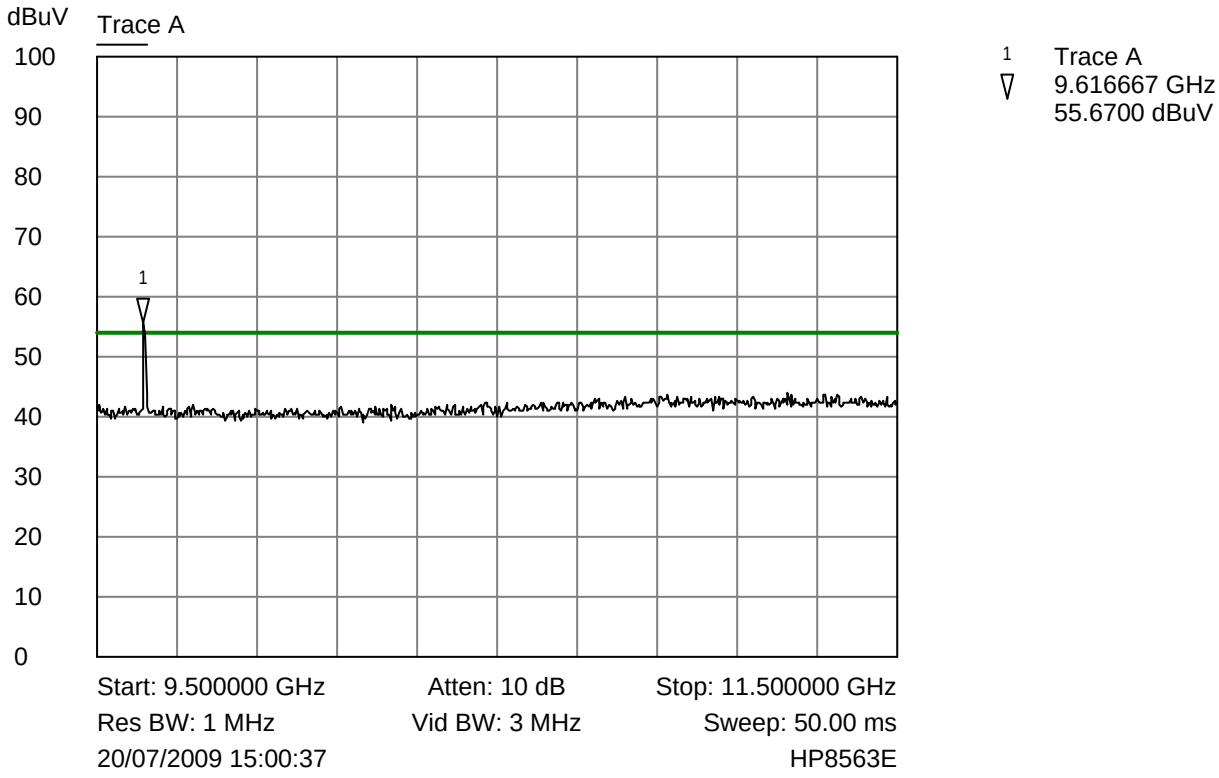
Start: 7.500000 GHz Atten: 10 dB Stop: 9.500000 GHz
Res BW: 1 MHz Vid BW: 3 MHz Sweep: 50.00 ms
20/07/2009 11:33:42 HP8563E

J4011-1 7.5-9.5GHz Vert Mid Chan Patch Ant

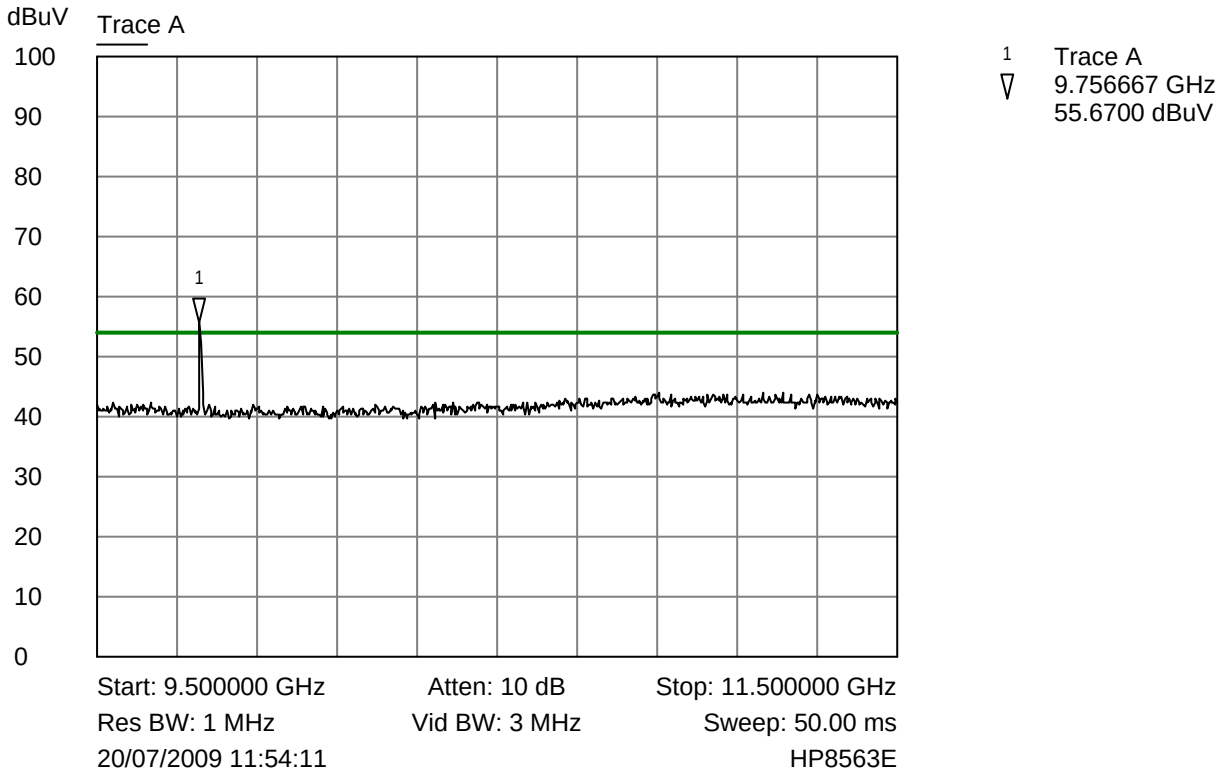


Start: 7.500000 GHz Atten: 10 dB Stop: 9.500000 GHz
Res BW: 1 MHz Vid BW: 3 MHz Sweep: 50.00 ms
20/07/2009 11:35:20 HP8563E

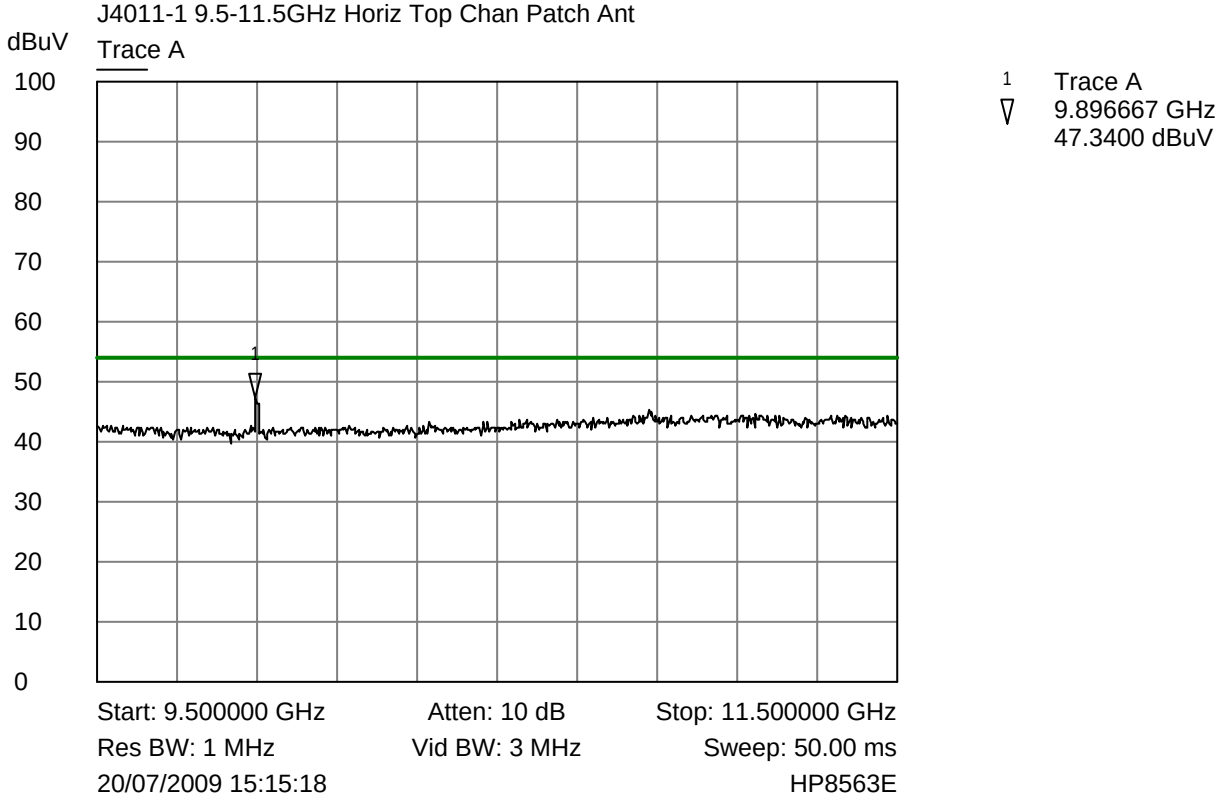
J4011-1 9.5-11.5GHz Horiz Bot Chan Patch Ant



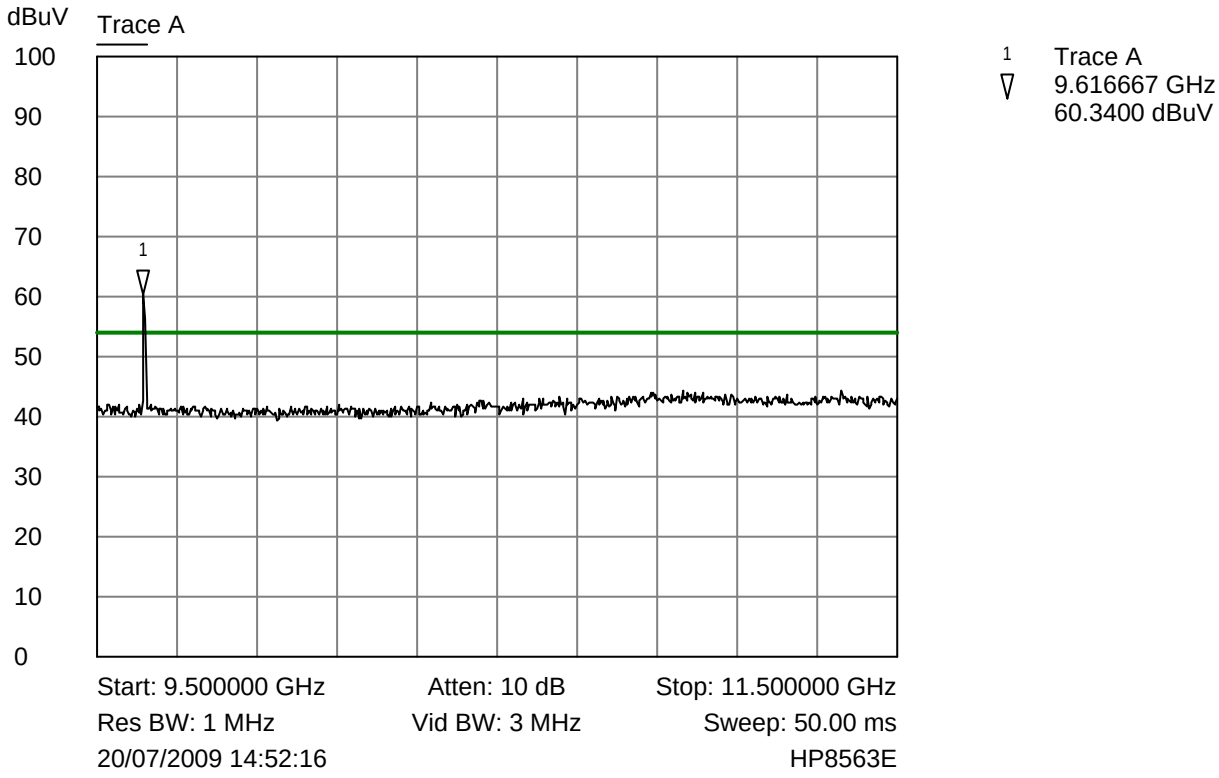
J4011-1 9.5-11.5GHz Horiz Mid Chan Patch Ant



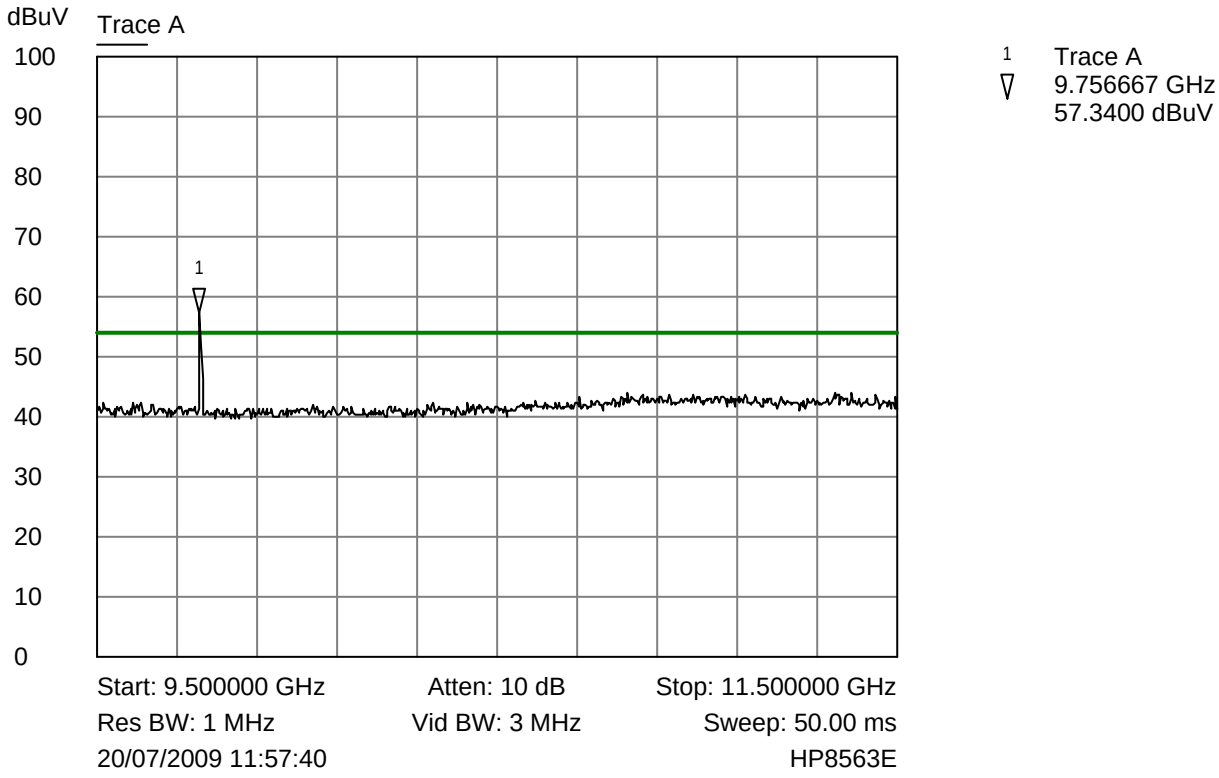
J4011-1 9.5-11.5GHz Horiz Top Chan Patch Ant



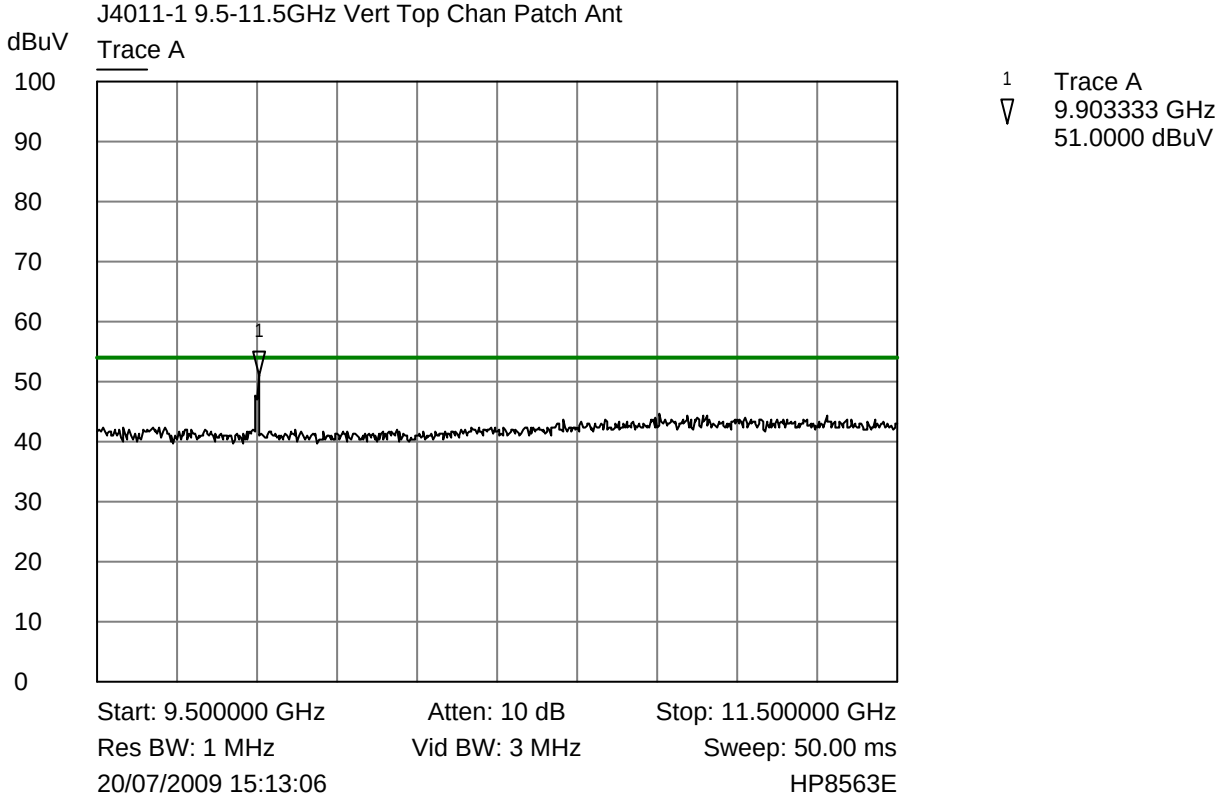
J4011-1 9.5-11.5GHz Vert Bot Chan Patch Ant



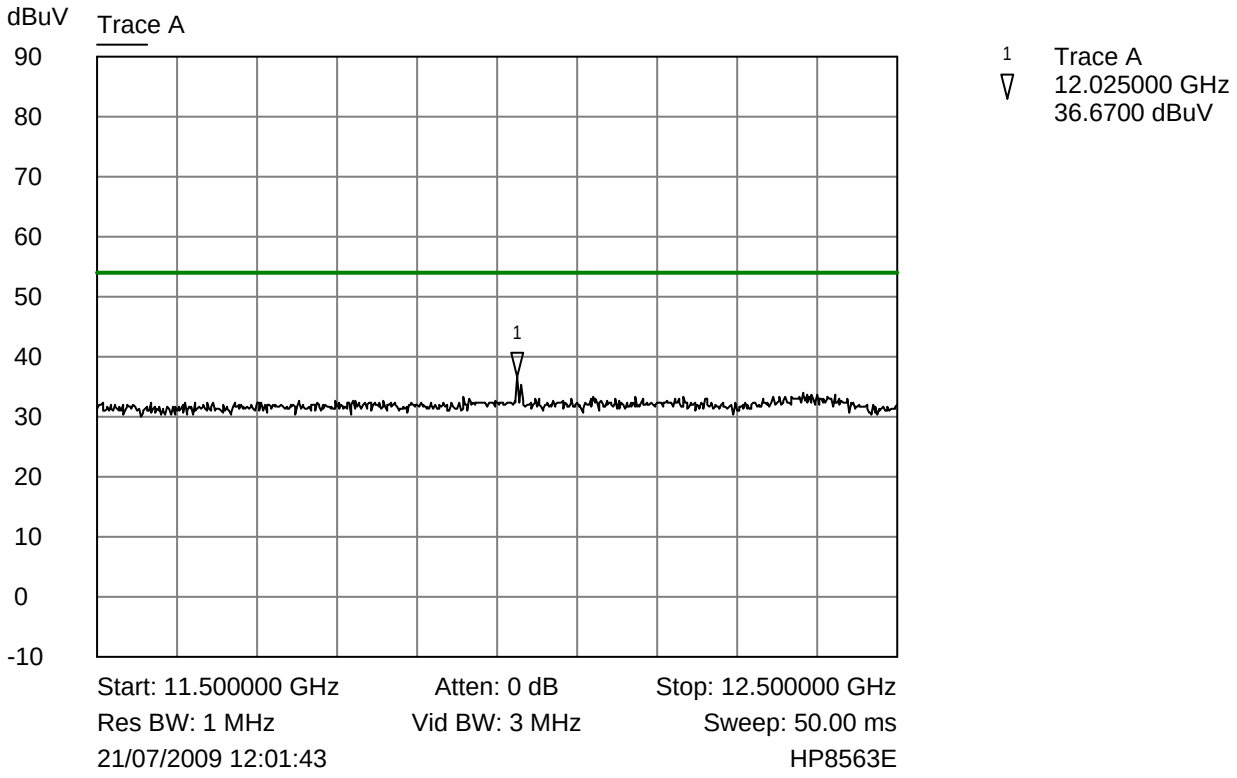
J4011-1 9.5-11.5GHz Vert Mid Chan Patch Ant



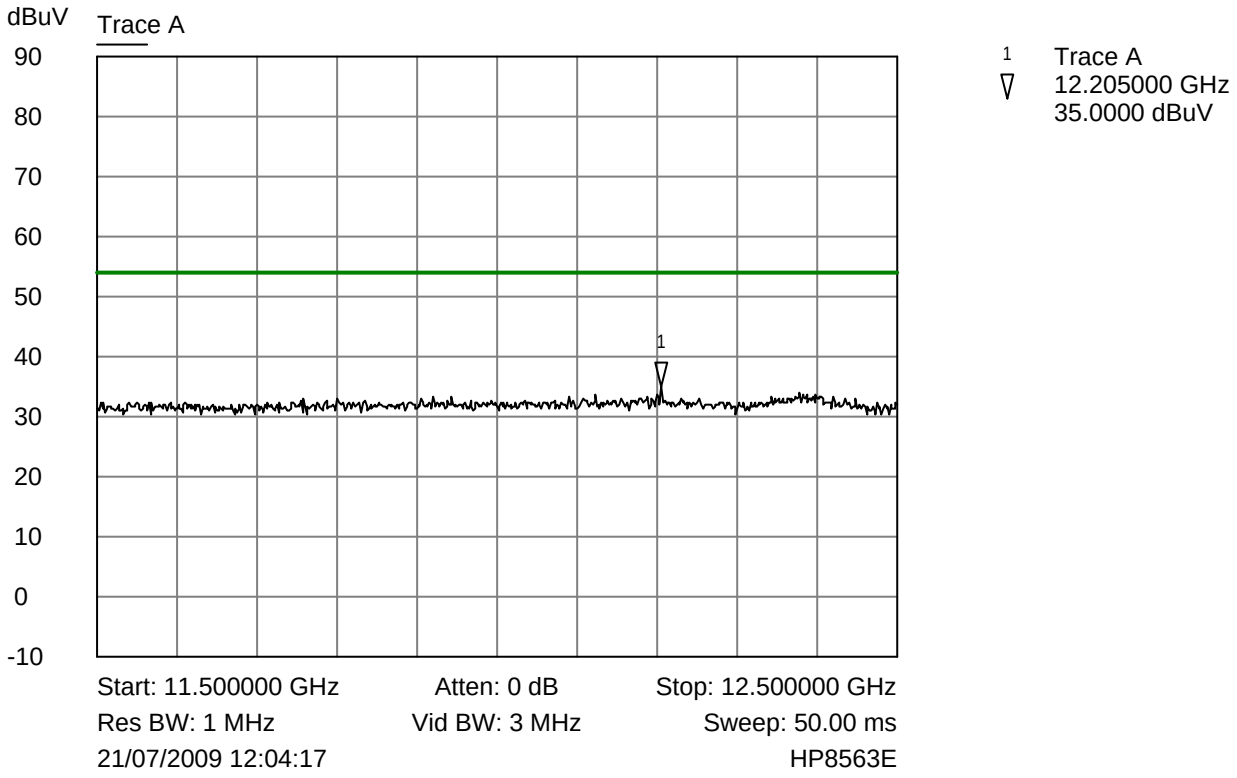
J4011-1 9.5-11.5GHz Vert Top Chan Patch Ant



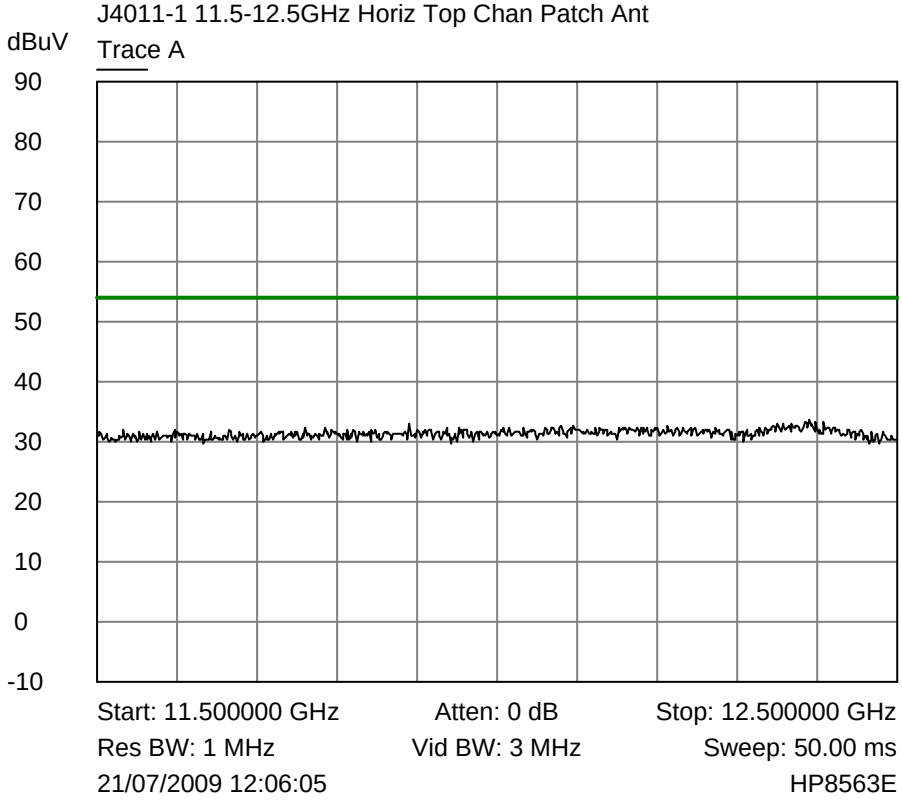
J4011-1 11.5-12.5GHz Horiz Bot Chan Patch Ant



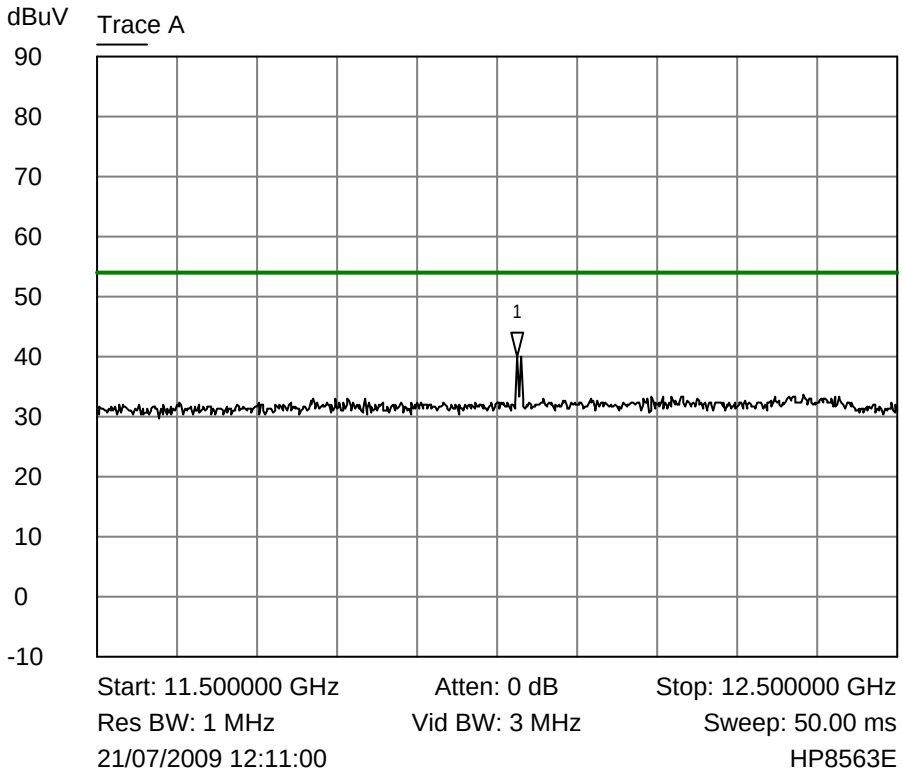
J4011-1 11.5-12.5GHz Horiz Mid Chan Patch Ant



J4011-1 11.5-12.5GHz Horiz Top Chan Patch Ant

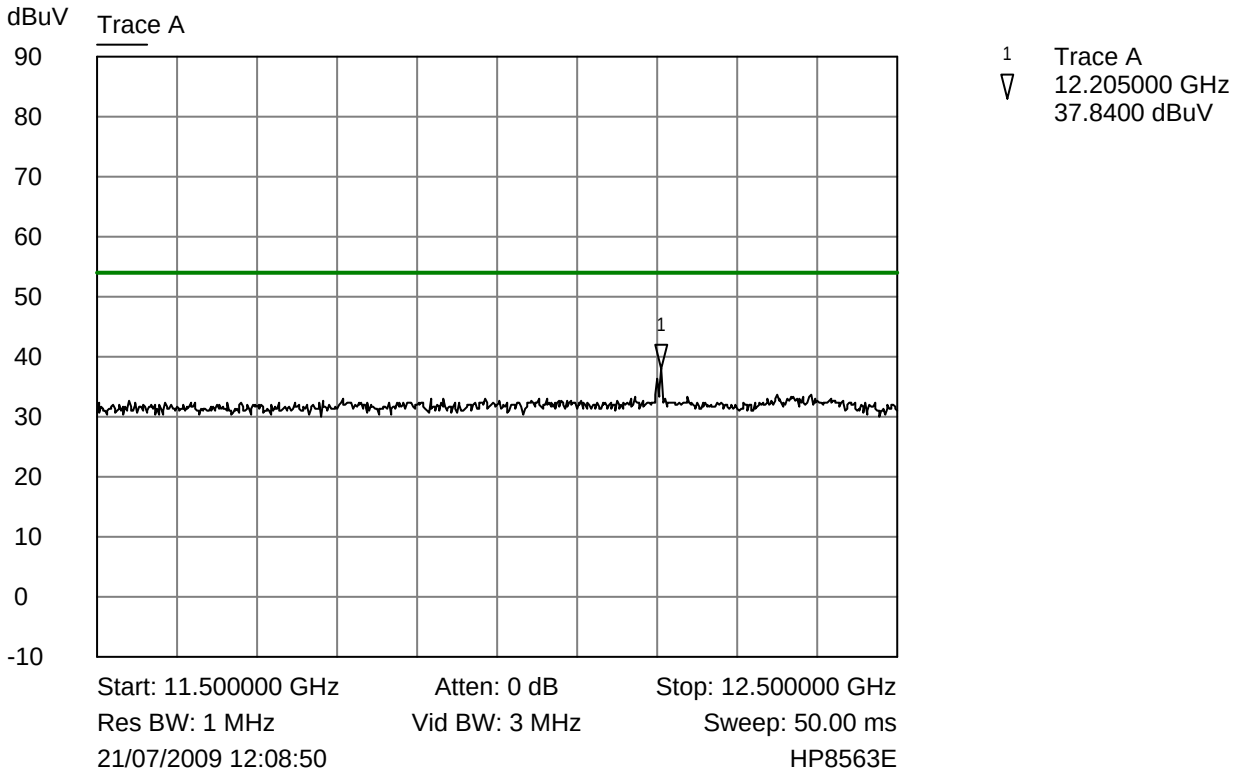


J4011-1 11.5-12.5GHz Vert Bot Chan Patch Ant

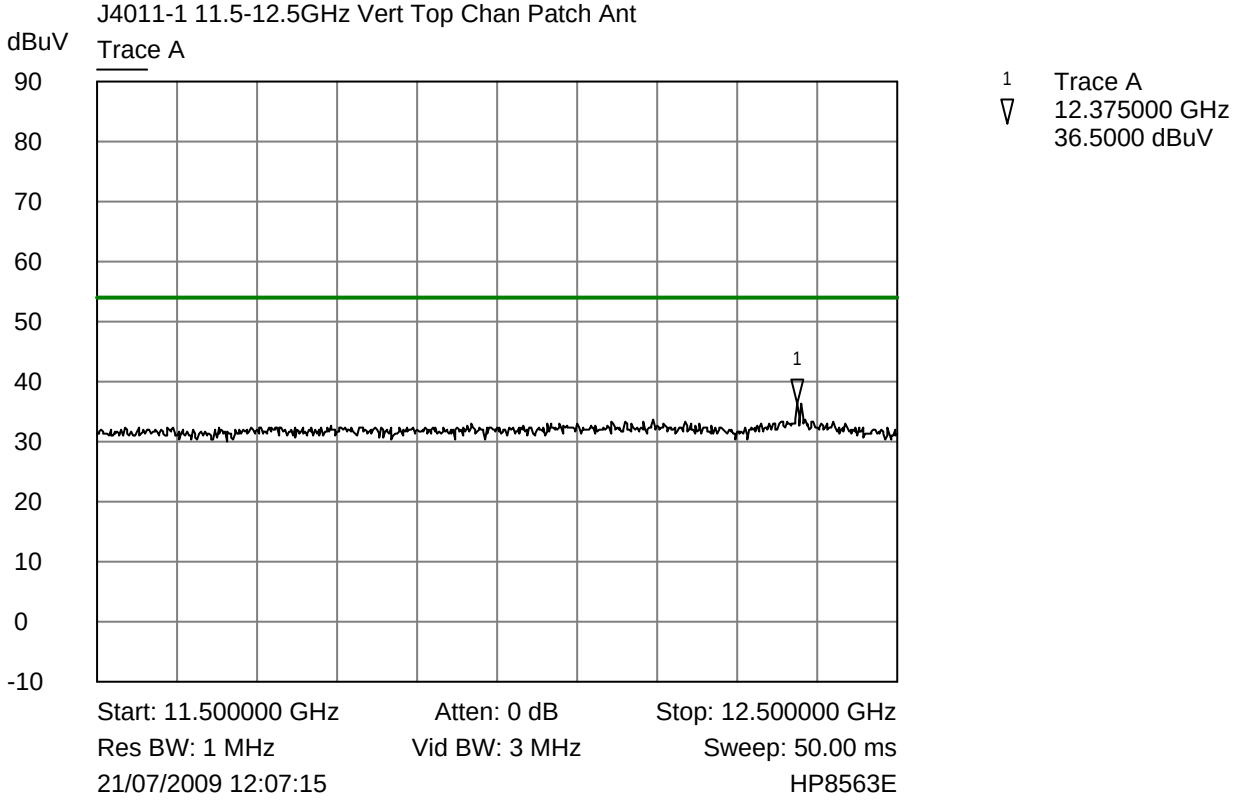


1 Trace A
12.025000 GHz
39.8400 dBuV

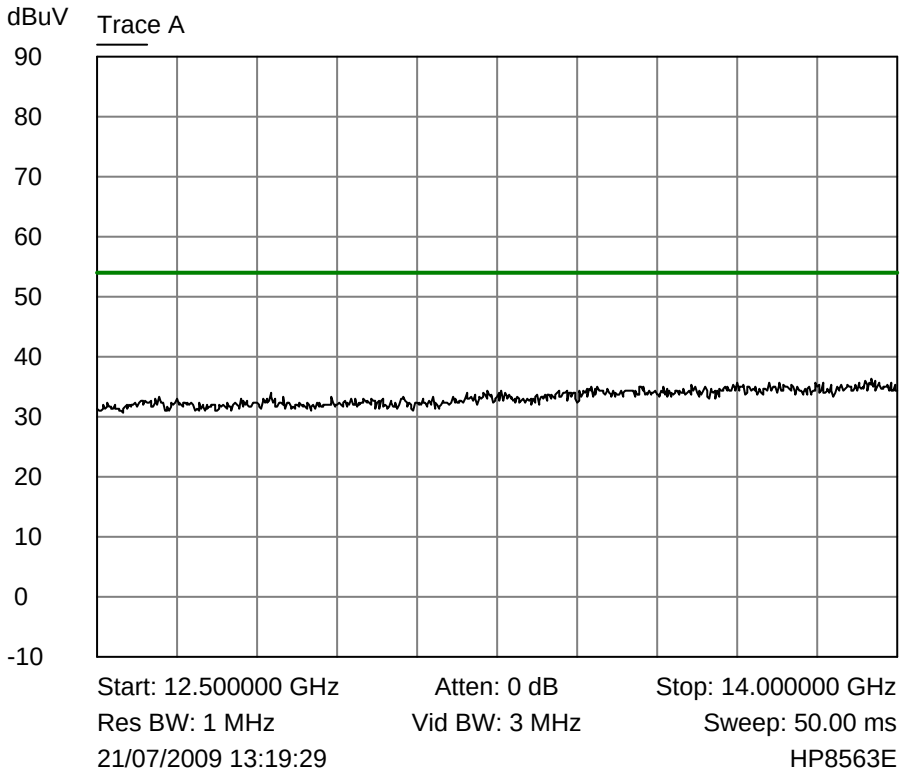
J4011-1 11.5-12.5GHz Vert Mid Chan Patch Ant



J4011-1 11.5-12.5GHz Vert Top Chan Patch Ant

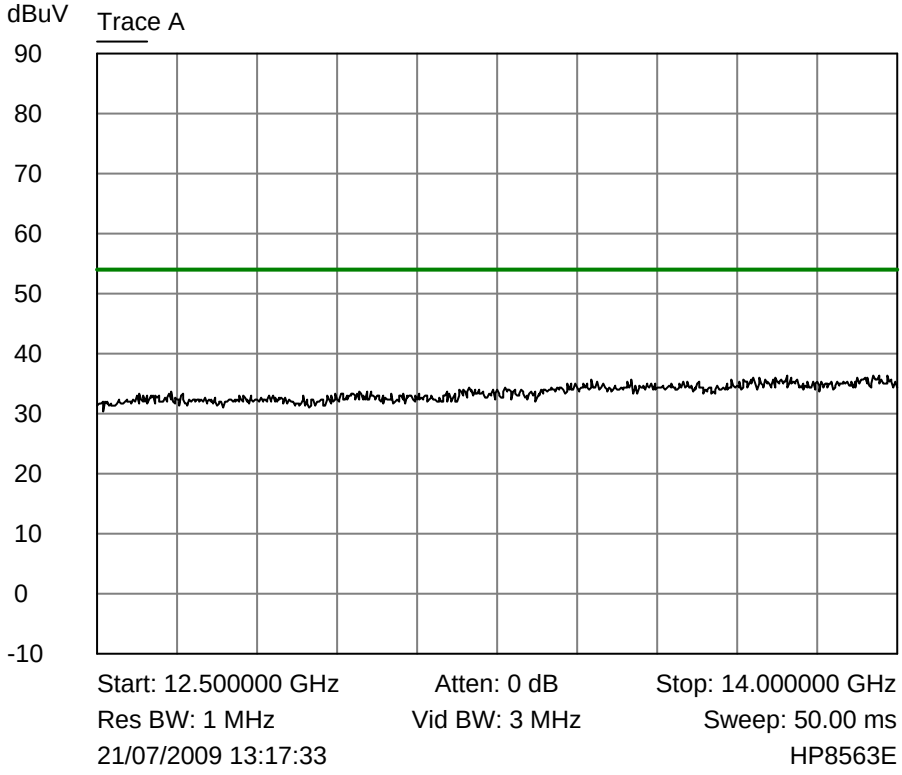


J4011-1 12.5-14GHz Horiz Mid Chan Patch Ant



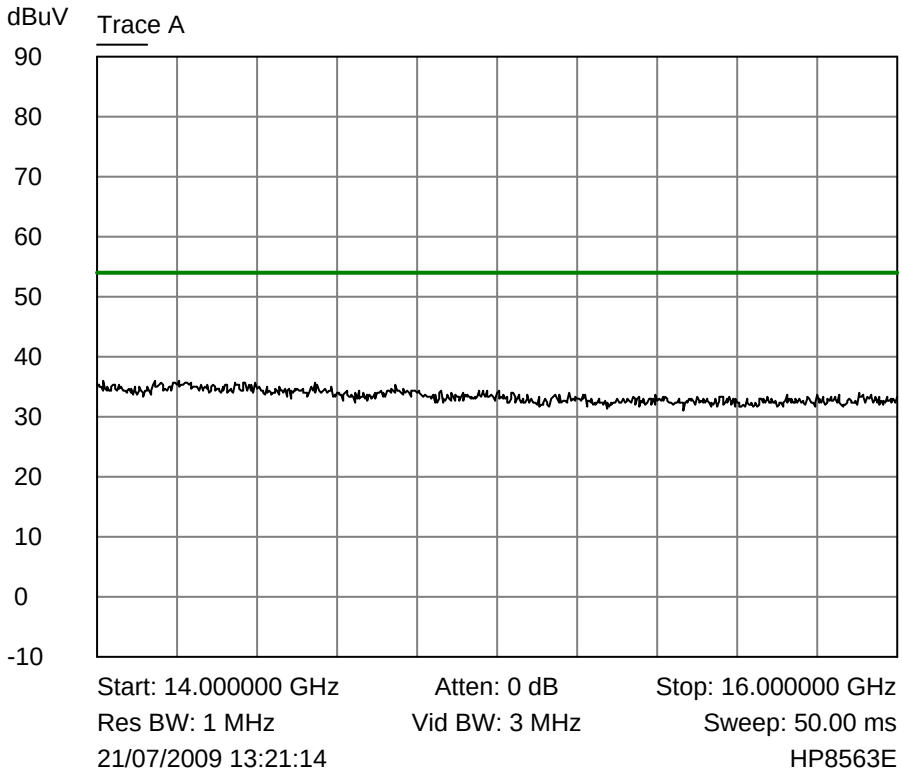
Start: 12.500000 GHz Atten: 0 dB Stop: 14.000000 GHz
Res BW: 1 MHz Vid BW: 3 MHz Sweep: 50.00 ms
21/07/2009 13:19:29 HP8563E

J4011-1 12.5-14GHz Vert Mid Chan Patch Ant



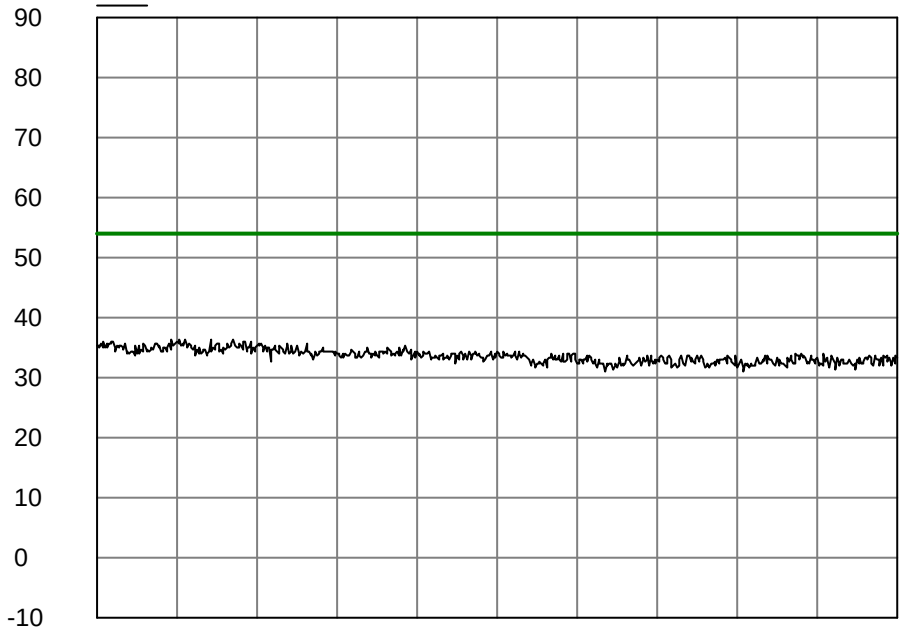
Start: 12.500000 GHz Atten: 0 dB Stop: 14.000000 GHz
Res BW: 1 MHz Vid BW: 3 MHz Sweep: 50.00 ms
21/07/2009 13:17:33 HP8563E

J4011-1 14-16GHz Horiz Mid Chan Patch Ant



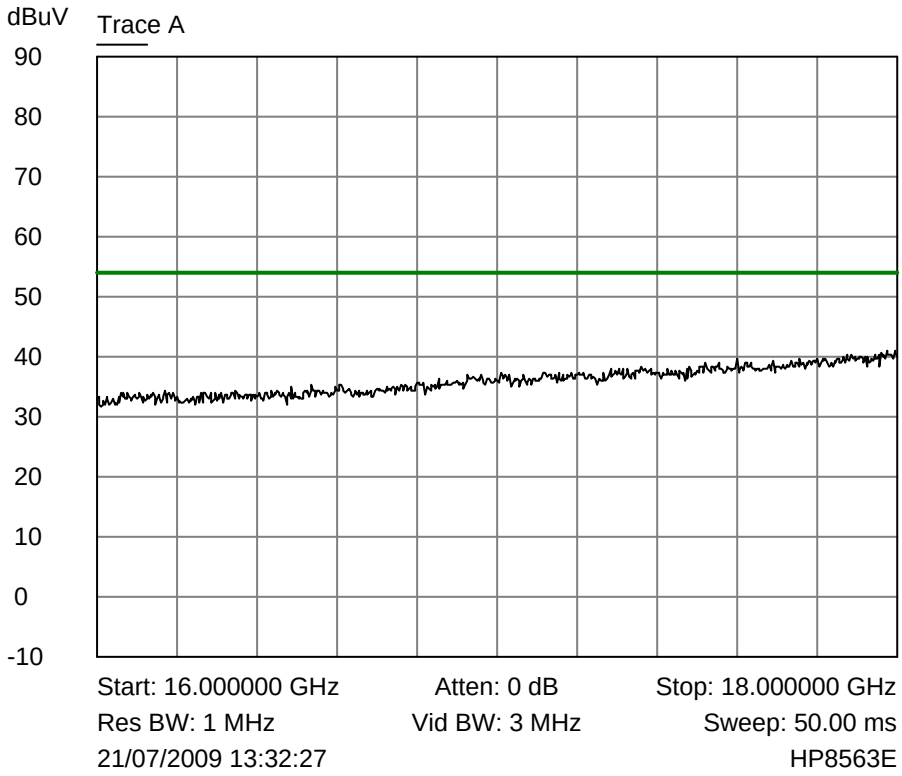
Start: 14.000000 GHz Atten: 0 dB Stop: 16.000000 GHz
Res BW: 1 MHz Vid BW: 3 MHz Sweep: 50.00 ms
21/07/2009 13:21:14 HP8563E

J4011-1 14-16GHz Vert Mid Chan Patch Ant



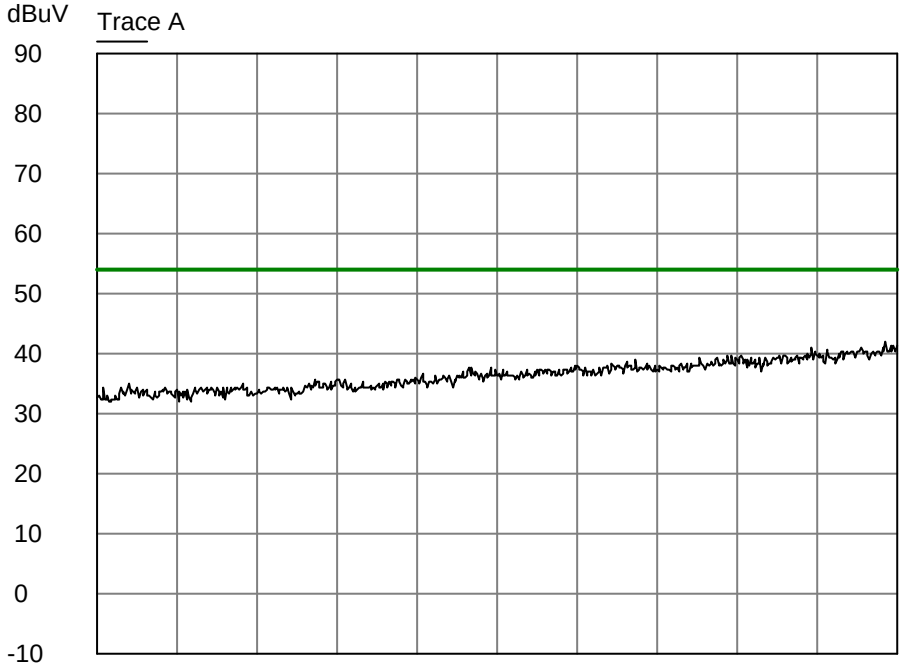
Start: 14.000000 GHz Atten: 0 dB Stop: 16.000000 GHz
Res BW: 1 MHz Vid BW: 3 MHz Sweep: 50.00 ms
21/07/2009 13:22:41 HP8563E

J4011-1 16-18GHz Horiz Mid Chan Patch Ant



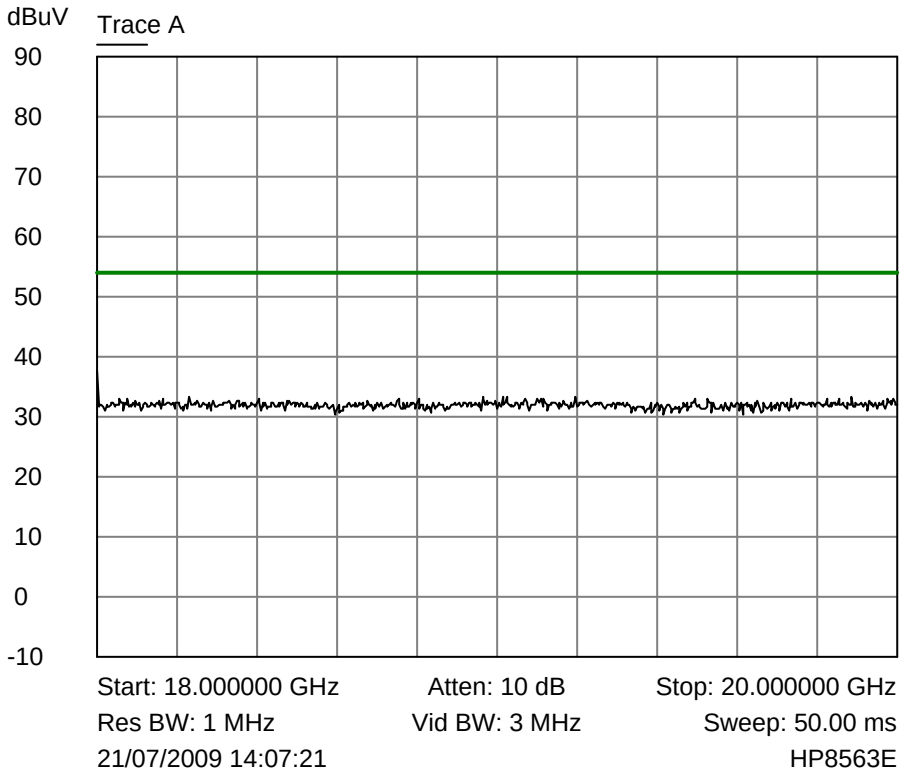
Start: 16.000000 GHz Atten: 0 dB Stop: 18.000000 GHz
Res BW: 1 MHz Vid BW: 3 MHz Sweep: 50.00 ms
21/07/2009 13:32:27 HP8563E

J4011-1 16-18GHz Vert Mid Chan Patch Ant



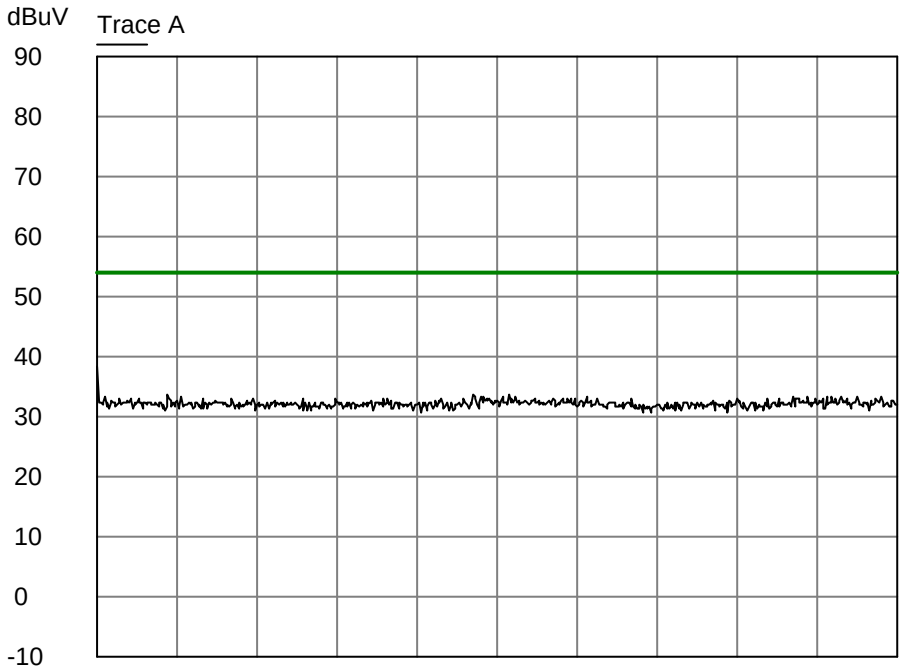
Start: 16.000000 GHz Atten: 0 dB Stop: 18.000000 GHz
Res BW: 1 MHz Vid BW: 3 MHz Sweep: 50.00 ms
21/07/2009 13:30:50 HP8563E

J4011-1 18-20GHz Horiz Mid Chan Patch Ant



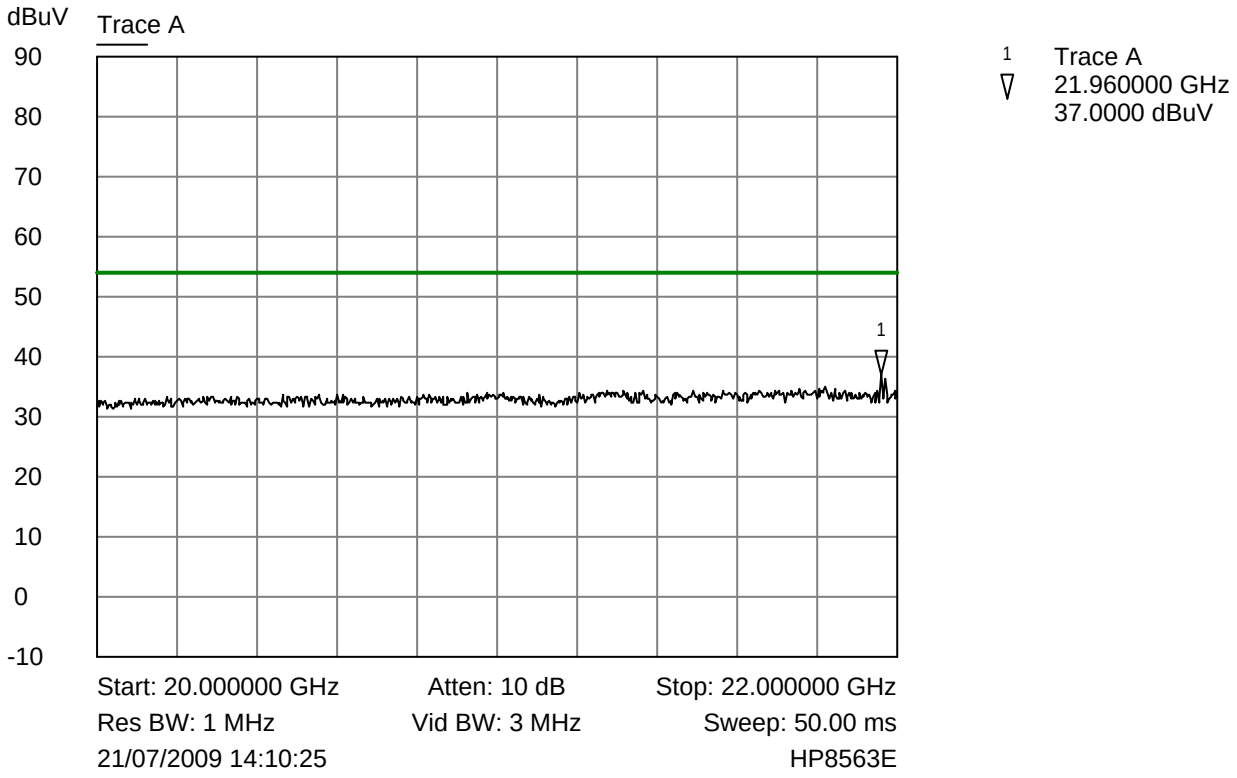
Start: 18.000000 GHz Atten: 10 dB Stop: 20.000000 GHz
Res BW: 1 MHz Vid BW: 3 MHz Sweep: 50.00 ms
21/07/2009 14:07:21 HP8563E

J4011-1 18-20GHz Vert Mid Chan Patch Ant

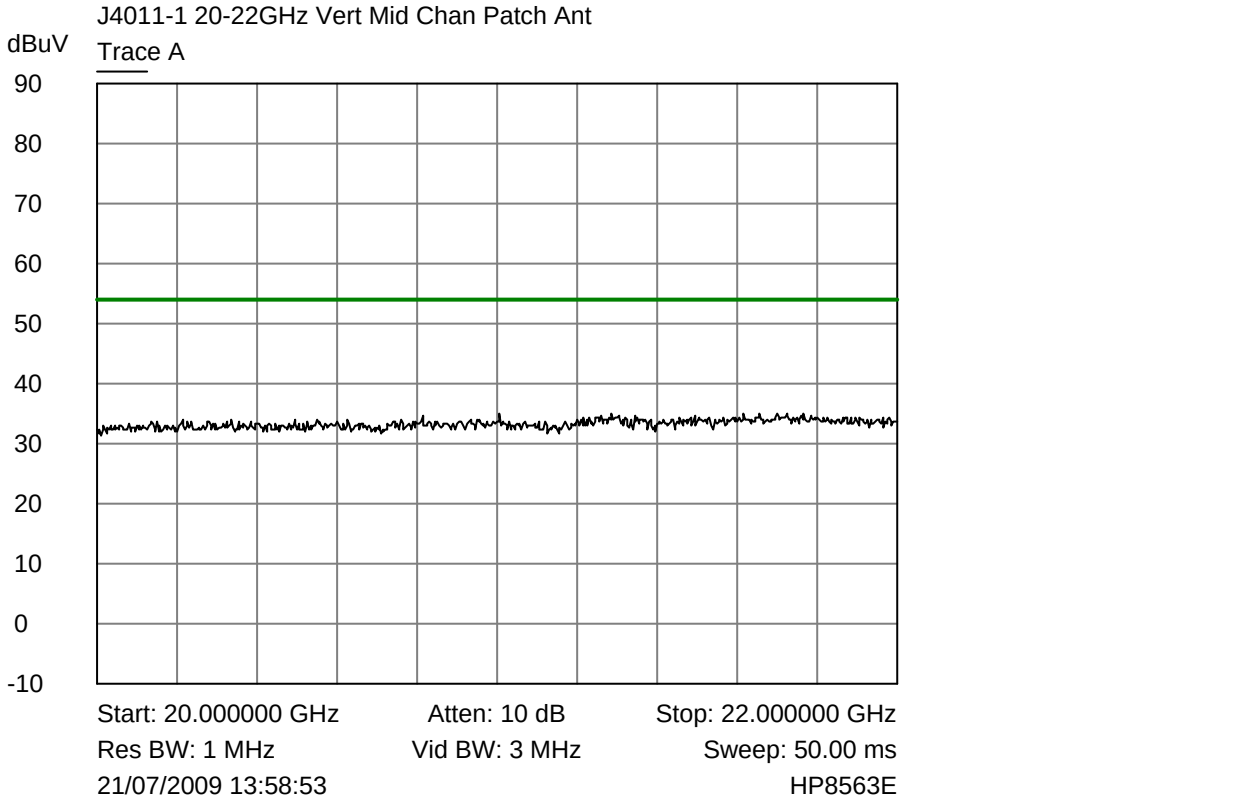


Start: 18.000000 GHz Atten: 10 dB Stop: 20.000000 GHz
Res BW: 1 MHz Vid BW: 3 MHz Sweep: 50.00 ms
21/07/2009 13:58:07 HP8563E

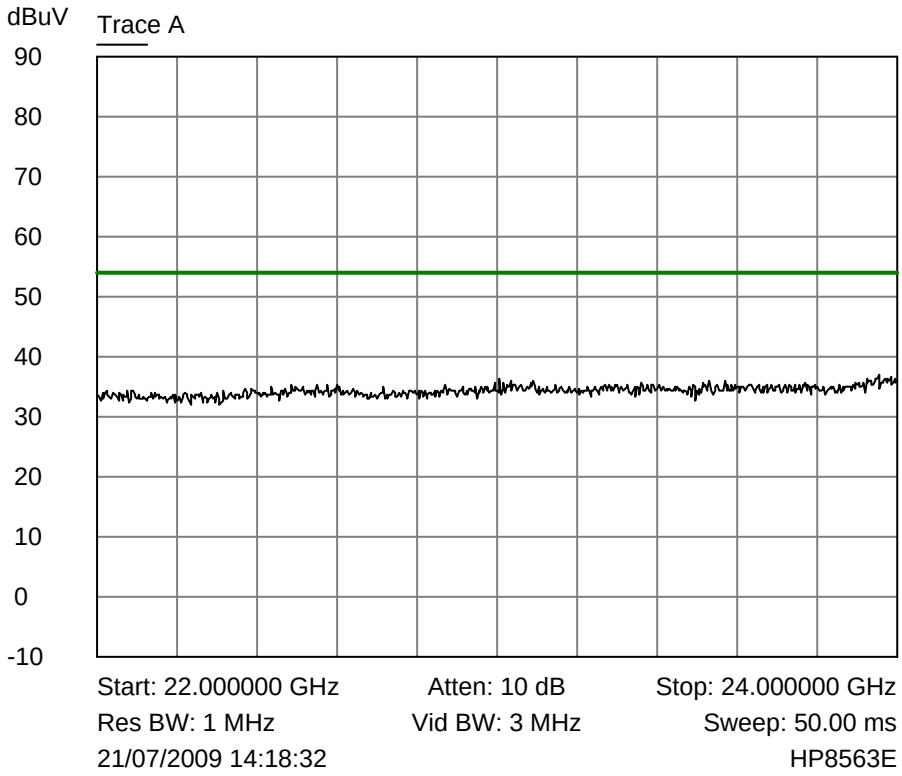
J4011-1 20-22GHz Horiz Mid Chan Patch Ant



J4011-1 20-22GHz Vert Mid Chan Patch Ant

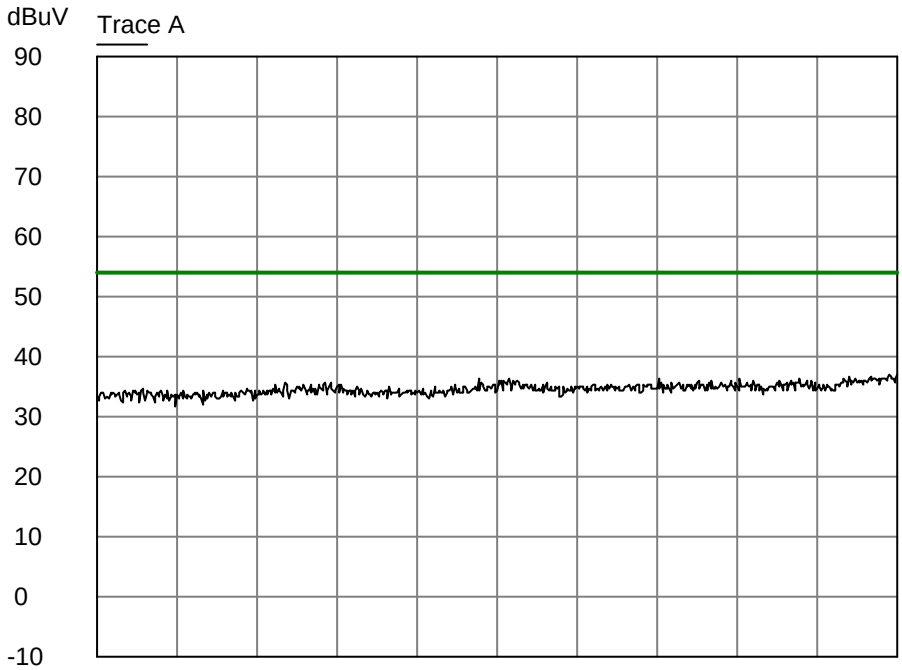


J4011-1 22-24GHz Horiz Mid Chan Patch Ant



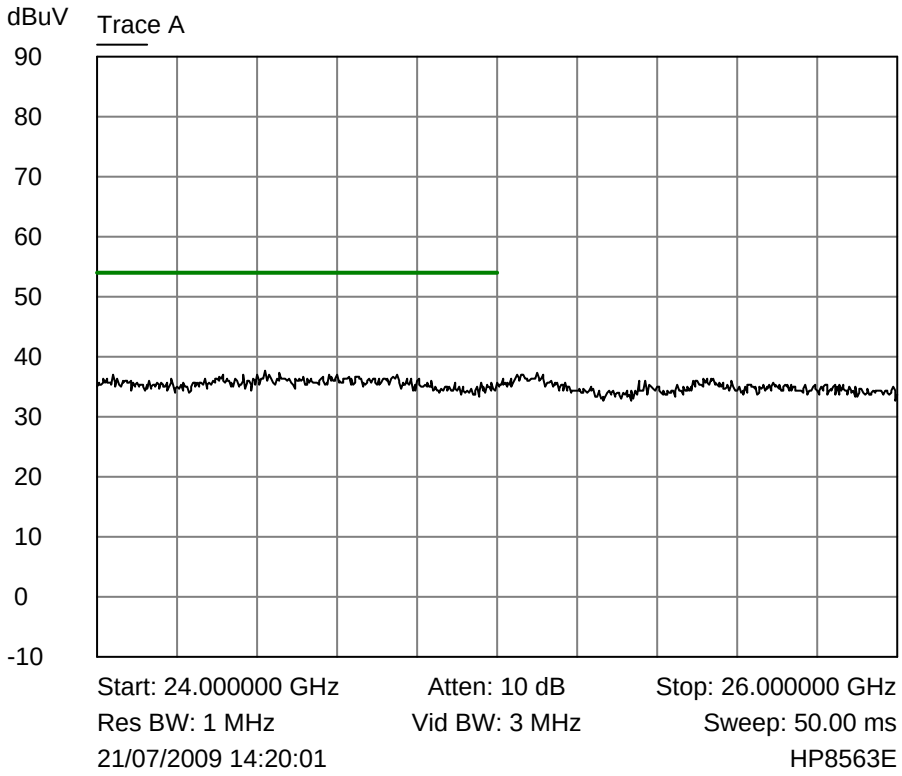
Start: 22.000000 GHz Atten: 10 dB Stop: 24.000000 GHz
Res BW: 1 MHz Vid BW: 3 MHz Sweep: 50.00 ms
21/07/2009 14:18:32 HP8563E

J4011-1 22-24GHz Vert Mid Chan Patch Ant



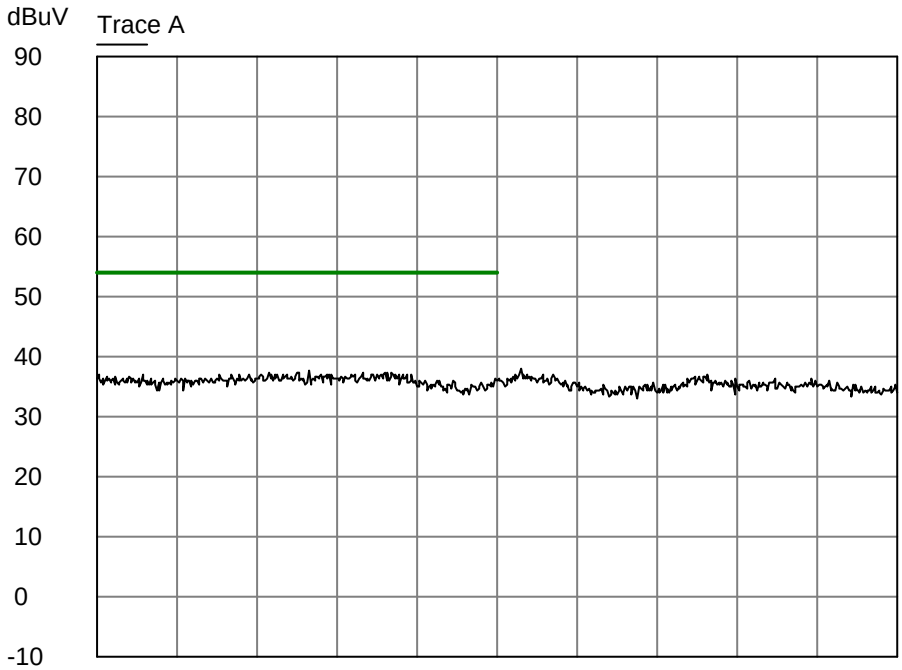
Start: 22.000000 GHz Atten: 10 dB Stop: 24.000000 GHz
Res BW: 1 MHz Vid BW: 3 MHz Sweep: 50.00 ms
21/07/2009 14:00:16 HP8563E

J4011-1 24-26GHz Horiz Mid Chan Patch Ant



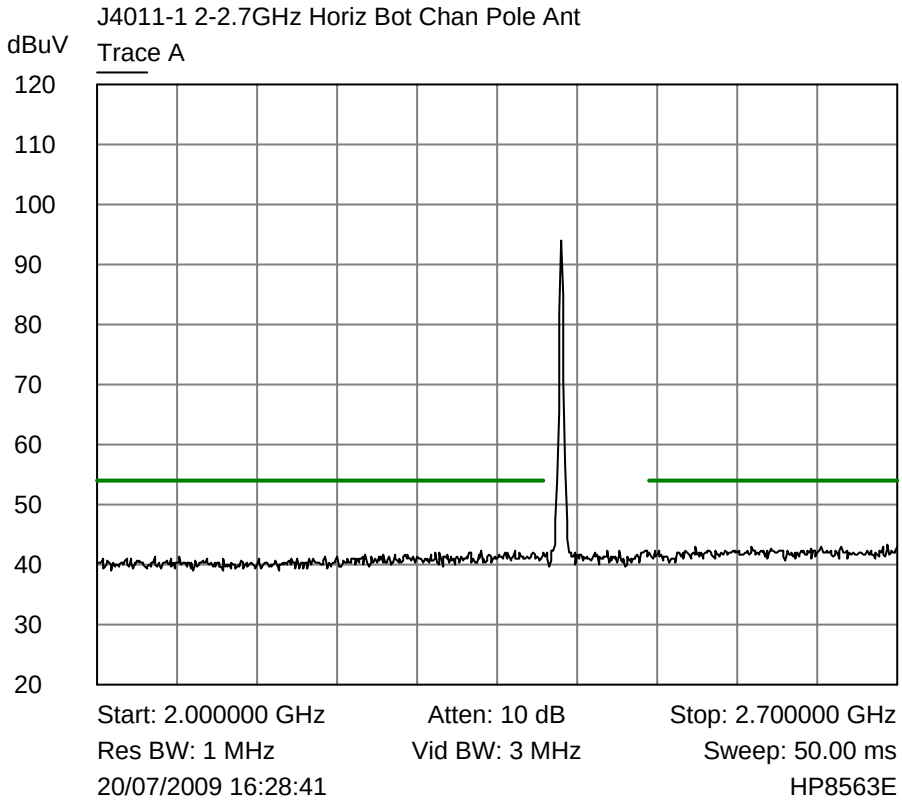
Start: 24.000000 GHz Atten: 10 dB Stop: 26.000000 GHz
Res BW: 1 MHz Vid BW: 3 MHz Sweep: 50.00 ms
21/07/2009 14:20:01 HP8563E

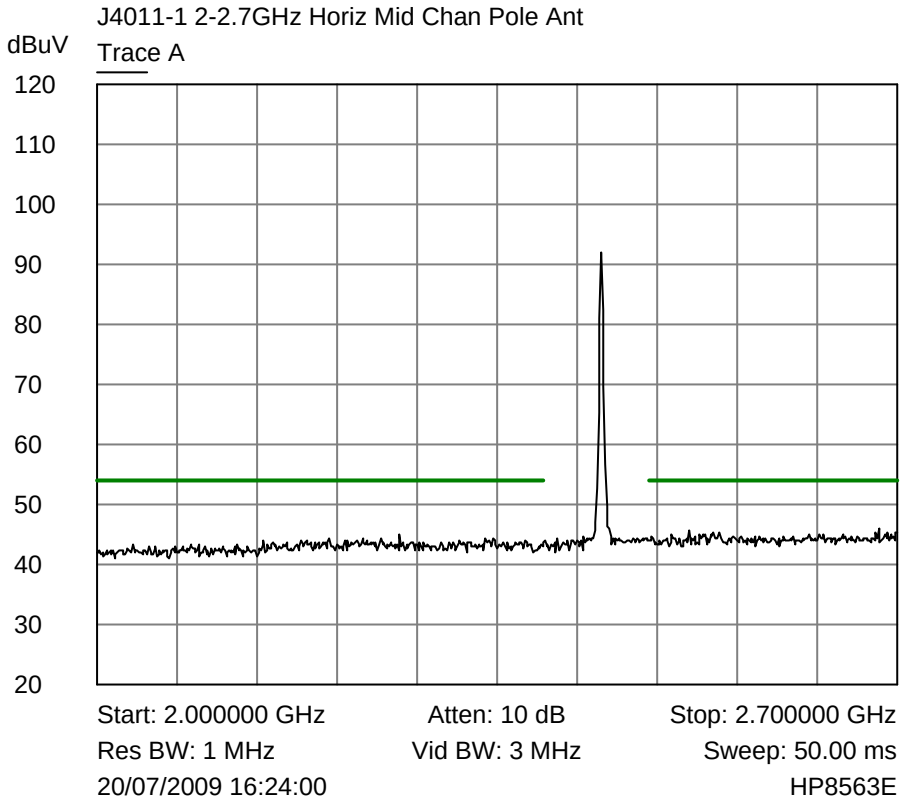
J4011-1 24-26GHz Vert Mid Chan Patch Ant



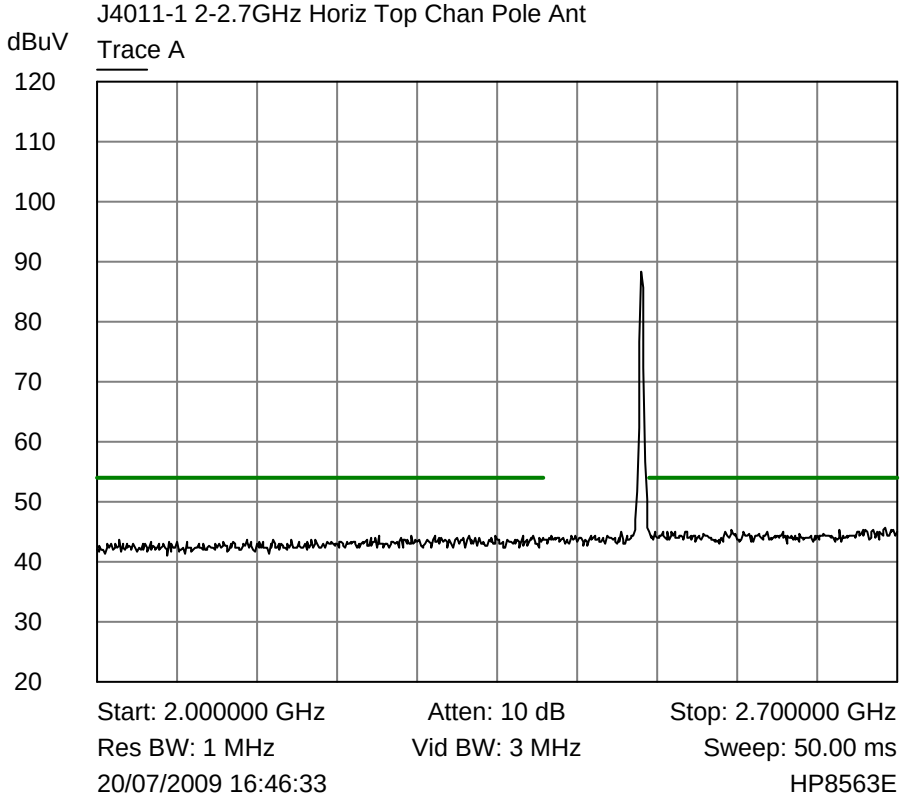
Start: 24.000000 GHz Atten: 10 dB Stop: 26.000000 GHz
Res BW: 1 MHz Vid BW: 3 MHz Sweep: 50.00 ms
21/07/2009 14:01:15 HP8563E

6.3.2 Additional colinear antenna plots



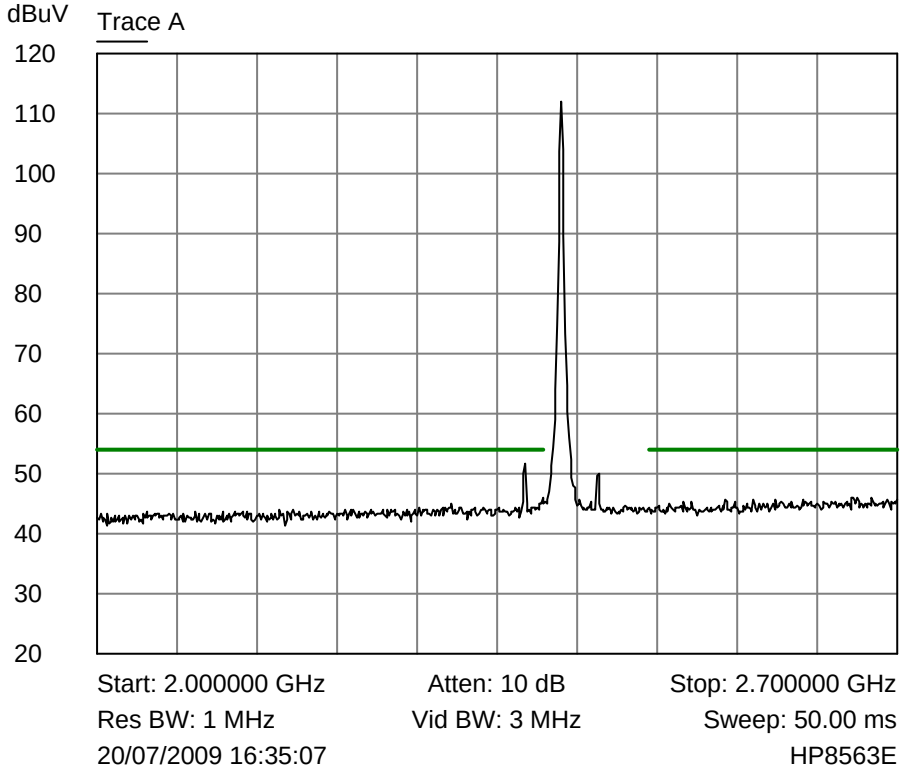


J4011-1 2-2.7GHz Horiz Top Chan Pole Ant



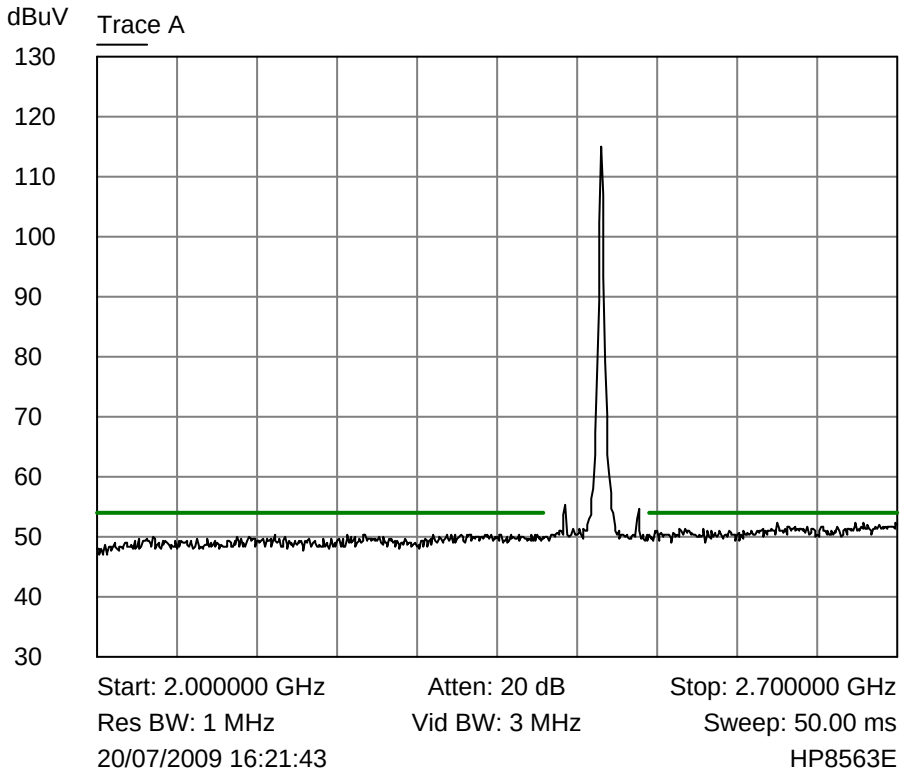
Start: 2.000000 GHz Atten: 10 dB Stop: 2.700000 GHz
Res BW: 1 MHz Vid BW: 3 MHz Sweep: 50.00 ms
20/07/2009 16:46:33 HP8563E

J4011-1 2-2.7GHz Vert Bot Chan Pole Ant



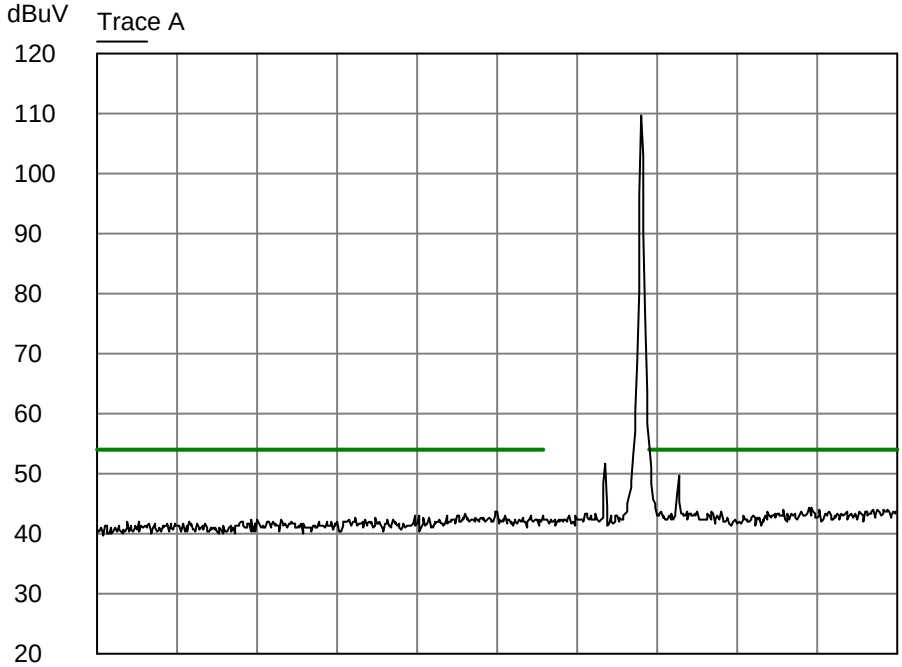
Start: 2.000000 GHz Atten: 10 dB Stop: 2.700000 GHz
Res BW: 1 MHz Vid BW: 3 MHz Sweep: 50.00 ms
20/07/2009 16:35:07 HP8563E

J4011-1 2-2.7GHz Vert Mid Chan Pole Ant



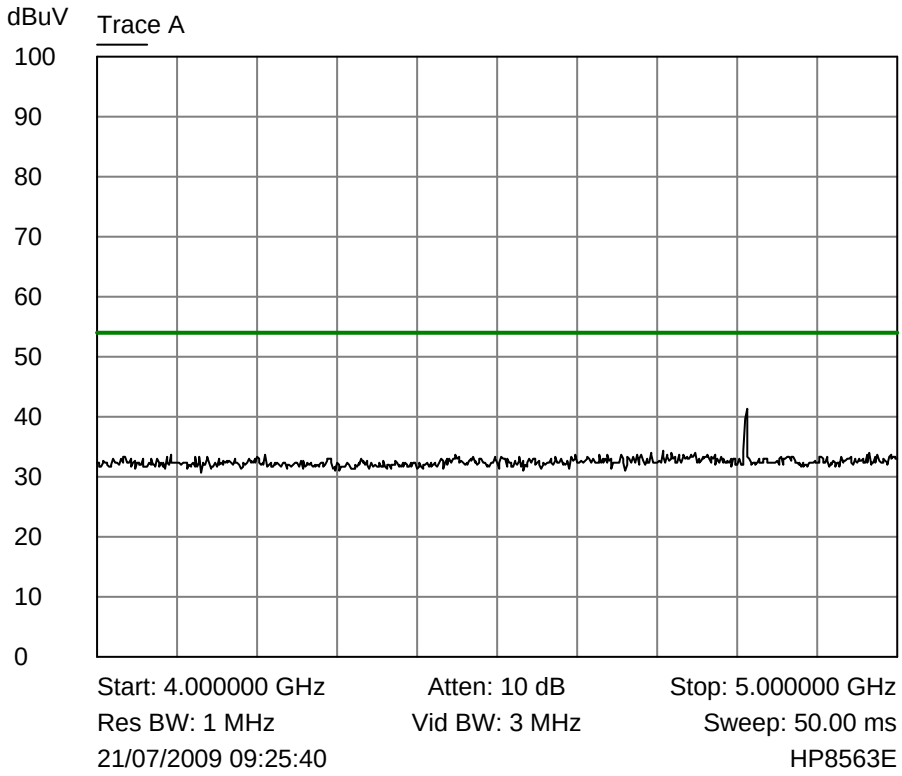
Start: 2.000000 GHz Atten: 20 dB Stop: 2.700000 GHz
Res BW: 1 MHz Vid BW: 3 MHz Sweep: 50.00 ms
20/07/2009 16:21:43 HP8563E

J4011-1 2-2.7GHz Vert Top Chan Pole Ant



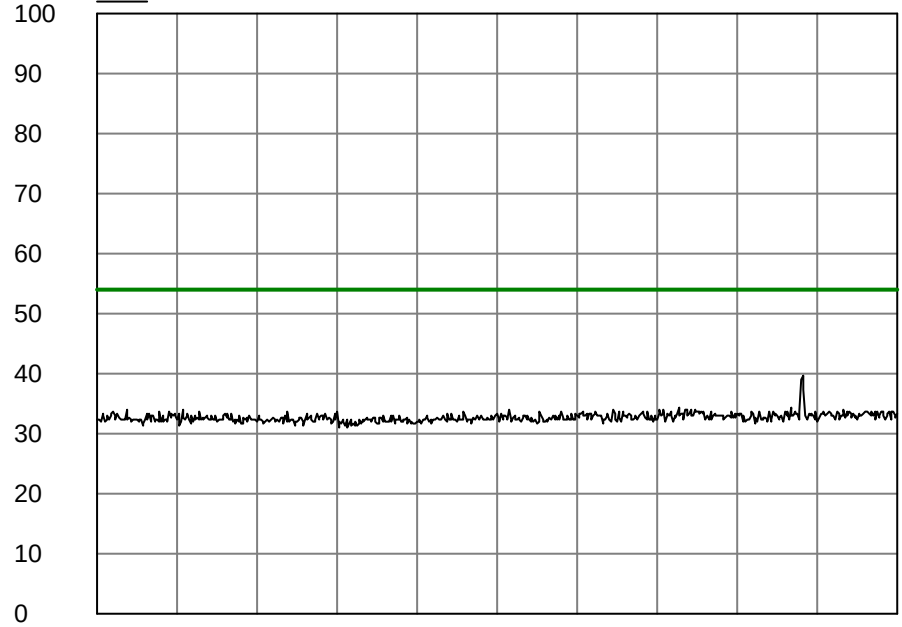
Start: 2.000000 GHz Atten: 10 dB Stop: 2.700000 GHz
Res BW: 1 MHz Vid BW: 3 MHz Sweep: 50.00 ms
20/07/2009 16:49:43 HP8563E

J4011-1 4-5GHz Horiz Bot Chan Pole Ant



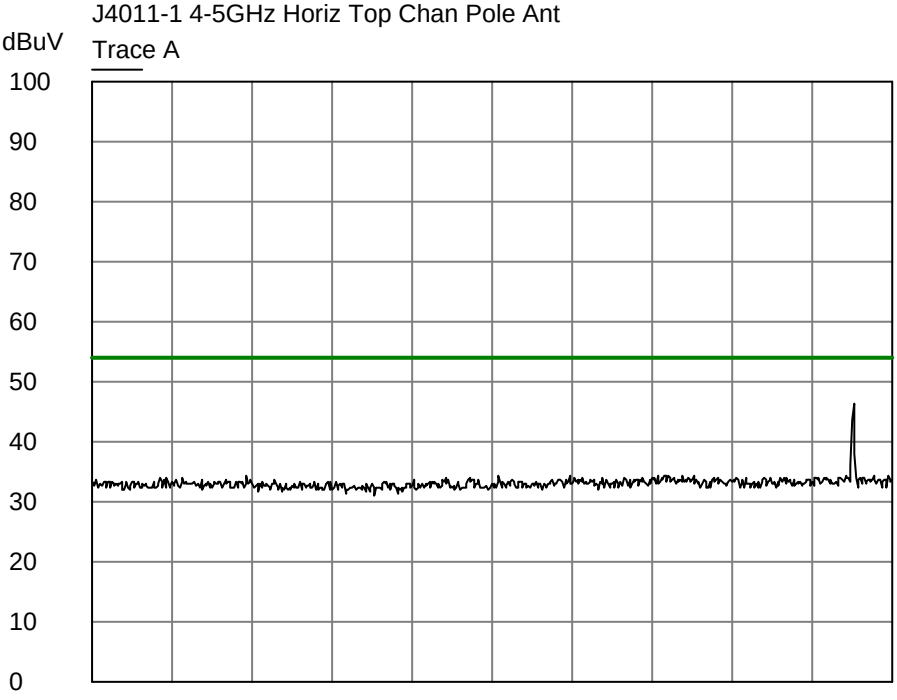
Start: 4.000000 GHz Atten: 10 dB Stop: 5.000000 GHz
Res BW: 1 MHz Vid BW: 3 MHz Sweep: 50.00 ms
21/07/2009 09:25:40 HP8563E

J4011-1 4-5GHz Horiz Mid Chan Pole Ant



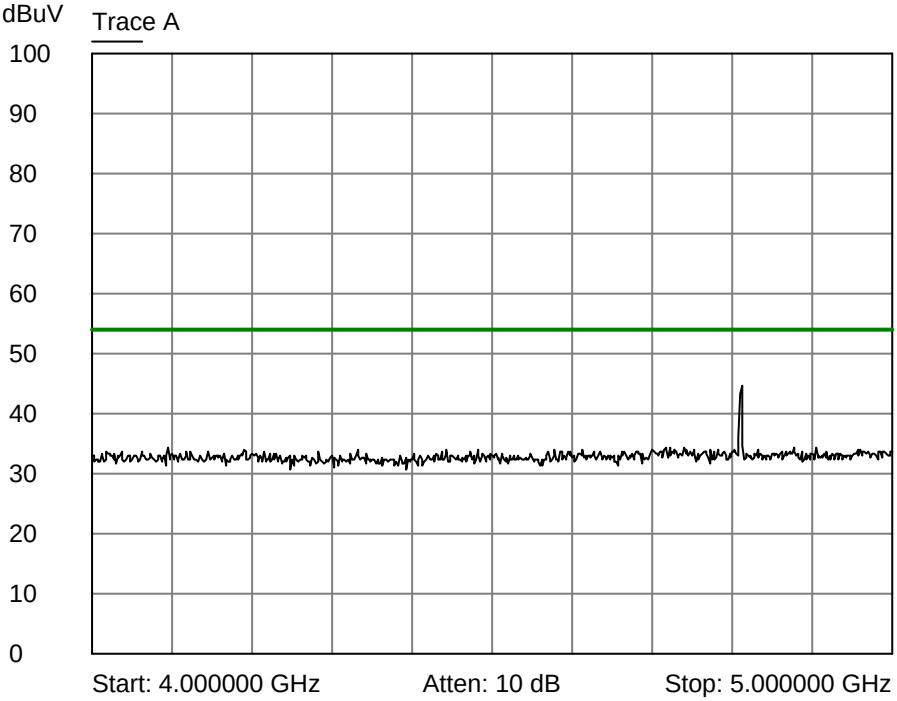
Start: 4.000000 GHz Atten: 10 dB Stop: 5.000000 GHz
Res BW: 1 MHz Vid BW: 3 MHz Sweep: 50.00 ms
21/07/2009 09:29:41 HP8563E

J4011-1 4-5GHz Horiz Top Chan Pole Ant
Trace A



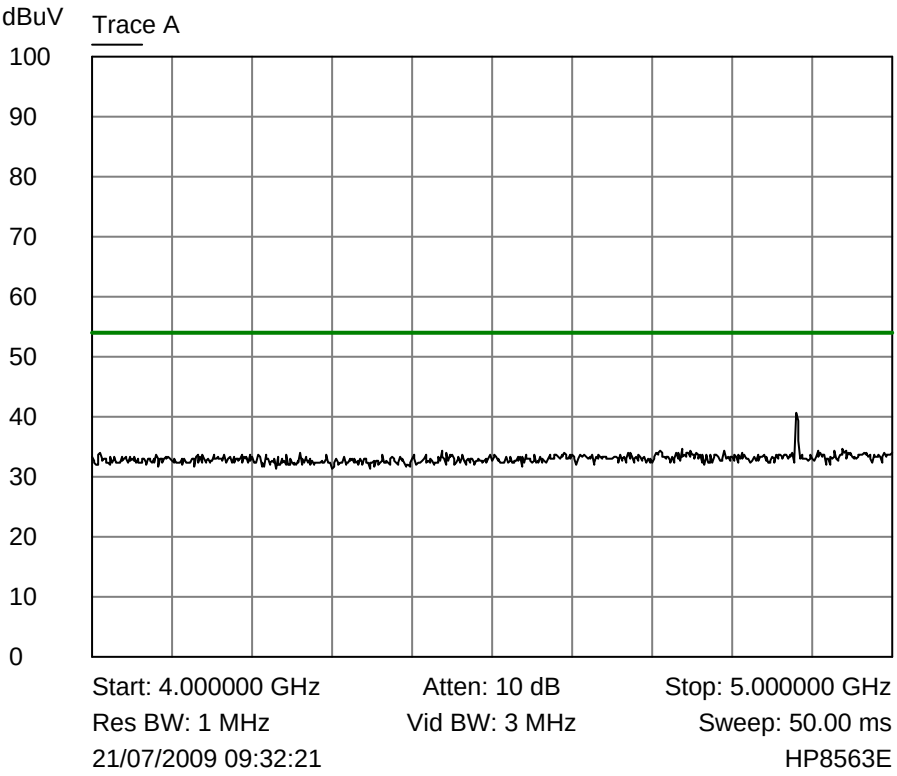
Start: 4.000000 GHz Atten: 10 dB Stop: 5.000000 GHz
Res BW: 1 MHz Vid BW: 3 MHz Sweep: 50.00 ms
21/07/2009 09:38:13 HP8563E

J4011-1 4-5GHz Vert Bot Chan Pole Ant
Trace A



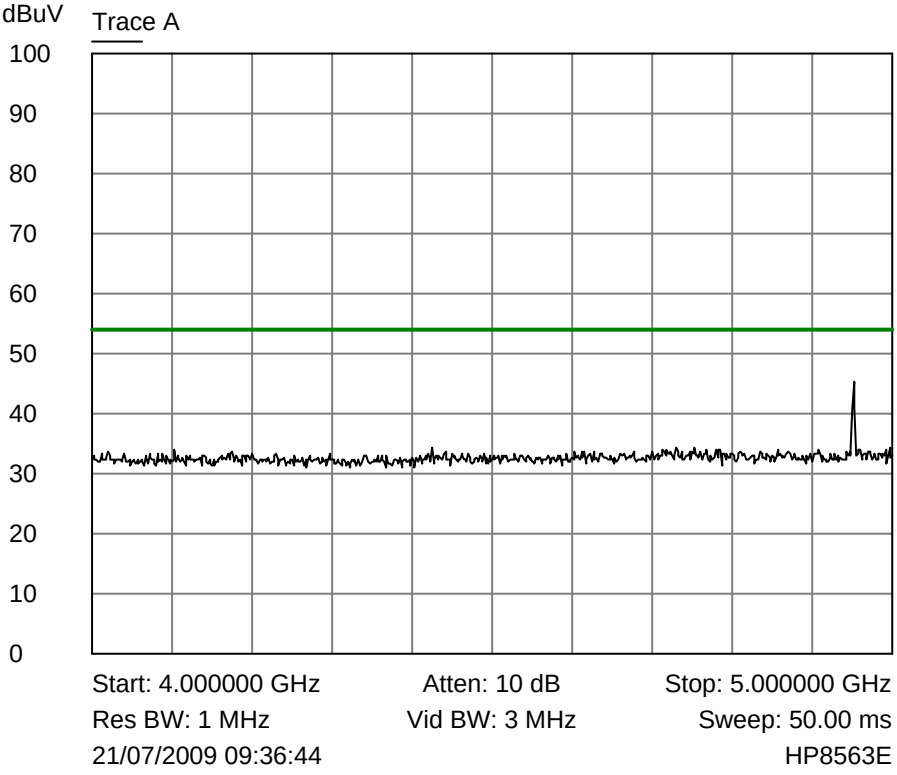
Start: 4.000000 GHz Atten: 10 dB Stop: 5.000000 GHz
Res BW: 1 MHz Vid BW: 3 MHz Sweep: 50.00 ms
21/07/2009 09:23:16 HP8563E

J4011-1 4-5GHz Vert Mid Chan Pole Ant



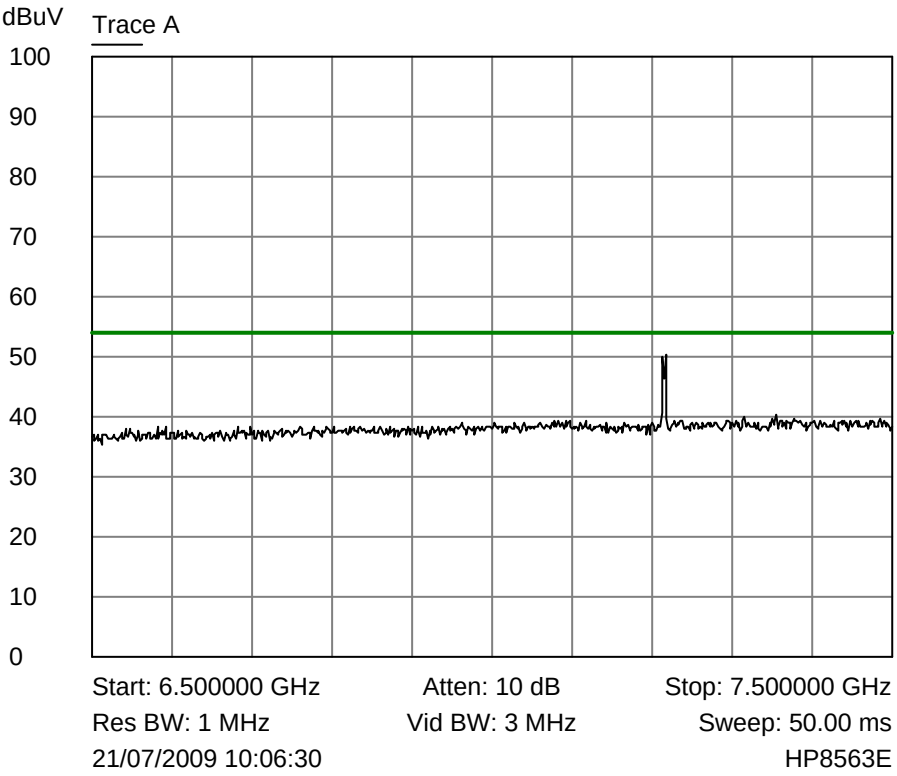
Start: 4.000000 GHz Atten: 10 dB Stop: 5.000000 GHz
Res BW: 1 MHz Vid BW: 3 MHz Sweep: 50.00 ms
21/07/2009 09:32:21 HP8563E

J4011-1 4-5GHz Vert Top Chan Pole Ant



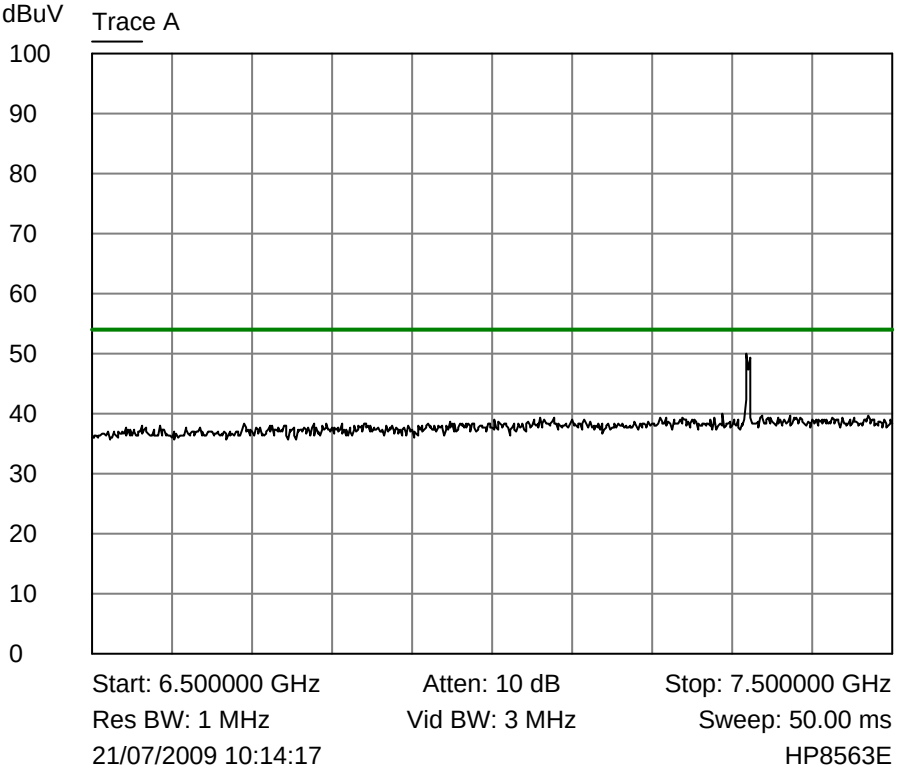
Start: 4.000000 GHz Atten: 10 dB Stop: 5.000000 GHz
Res BW: 1 MHz Vid BW: 3 MHz Sweep: 50.00 ms
21/07/2009 09:36:44 HP8563E

J4011-1 6.5-7.5GHz Horiz Bot Chan Pole Ant



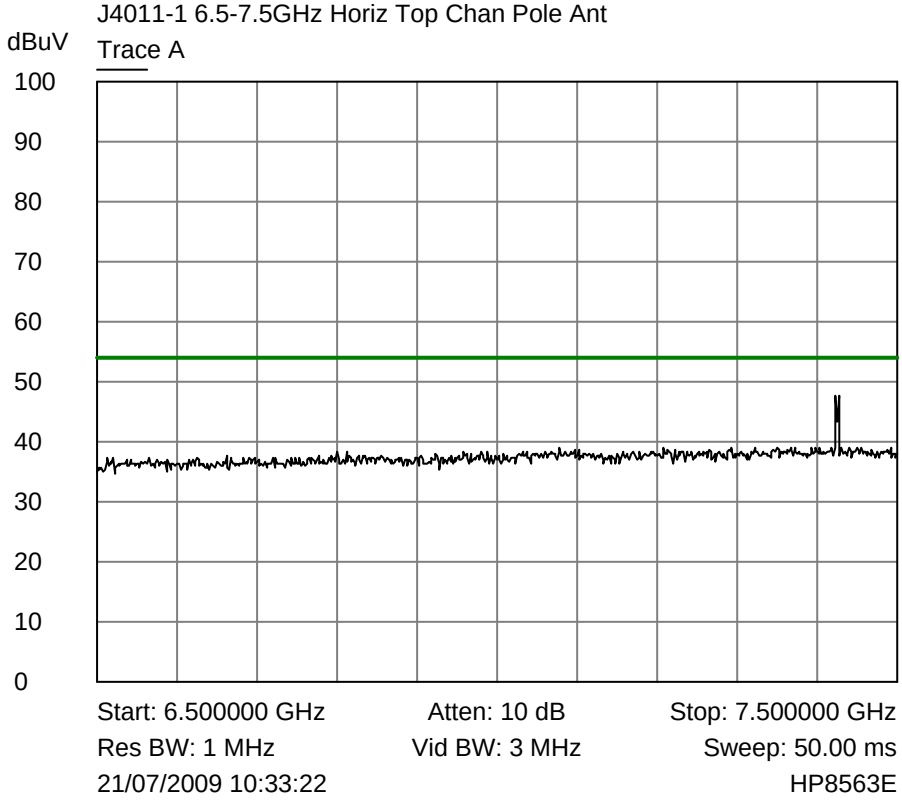
Start: 6.500000 GHz Atten: 10 dB Stop: 7.500000 GHz
Res BW: 1 MHz Vid BW: 3 MHz Sweep: 50.00 ms
21/07/2009 10:06:30 HP8563E

J4011-1 6.5-7.5GHz Horiz Mid Chan Pole Ant



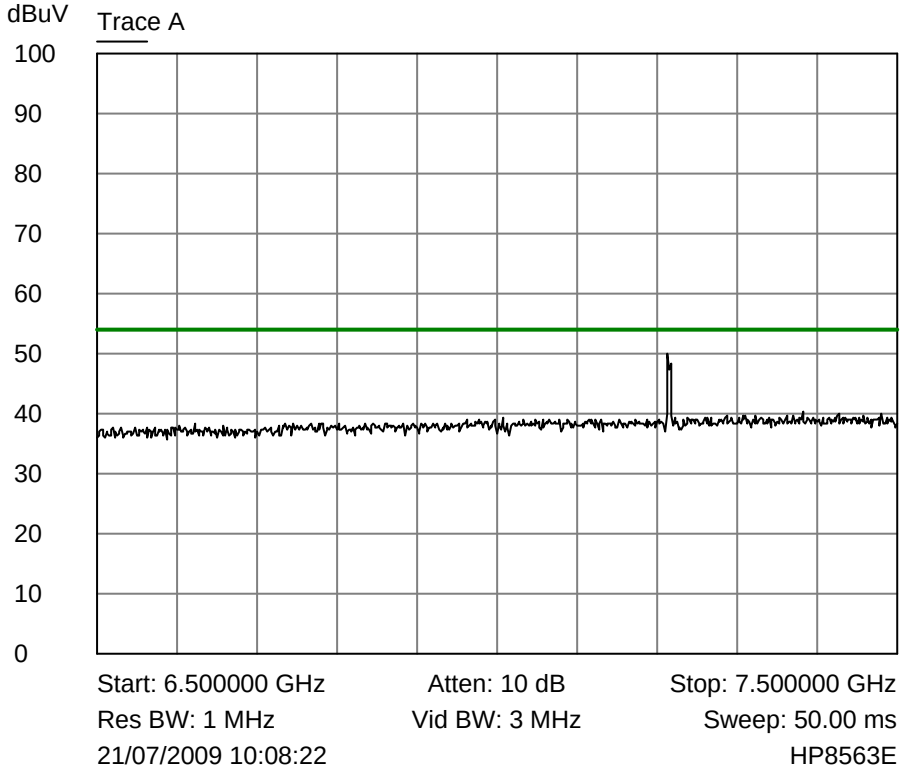
Start: 6.500000 GHz Atten: 10 dB Stop: 7.500000 GHz
Res BW: 1 MHz Vid BW: 3 MHz Sweep: 50.00 ms
21/07/2009 10:14:17 HP8563E

J4011-1 6.5-7.5GHz Horiz Top Chan Pole Ant



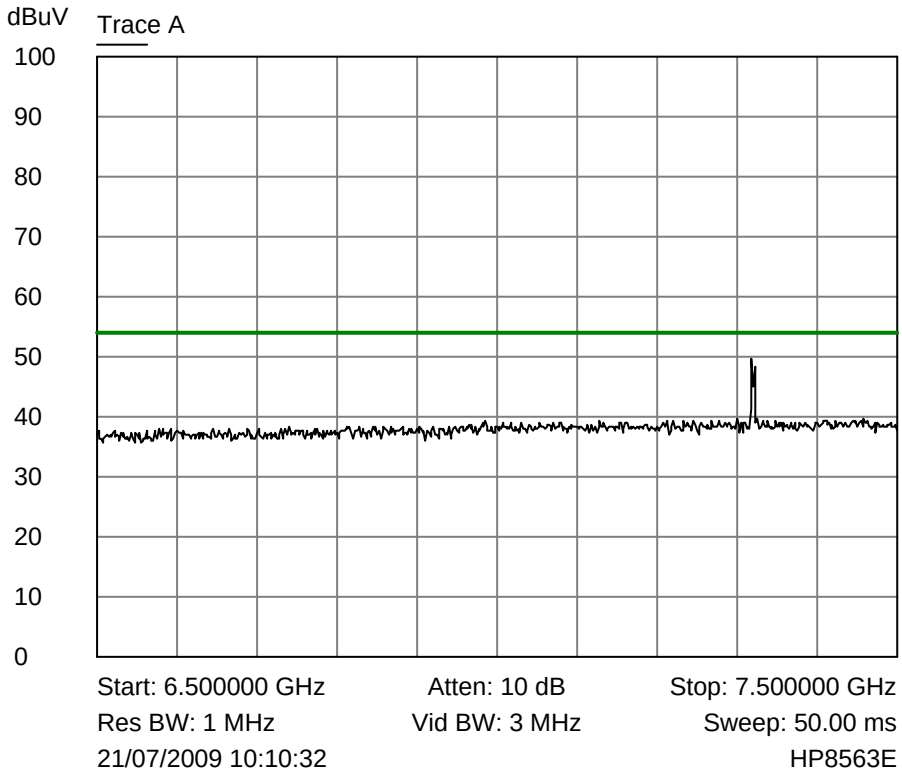
Start: 6.500000 GHz Atten: 10 dB Stop: 7.500000 GHz
Res BW: 1 MHz Vid BW: 3 MHz Sweep: 50.00 ms
21/07/2009 10:33:22 HP8563E

J4011-1 6.5-7.5GHz Vert Bot Chan Pole Ant



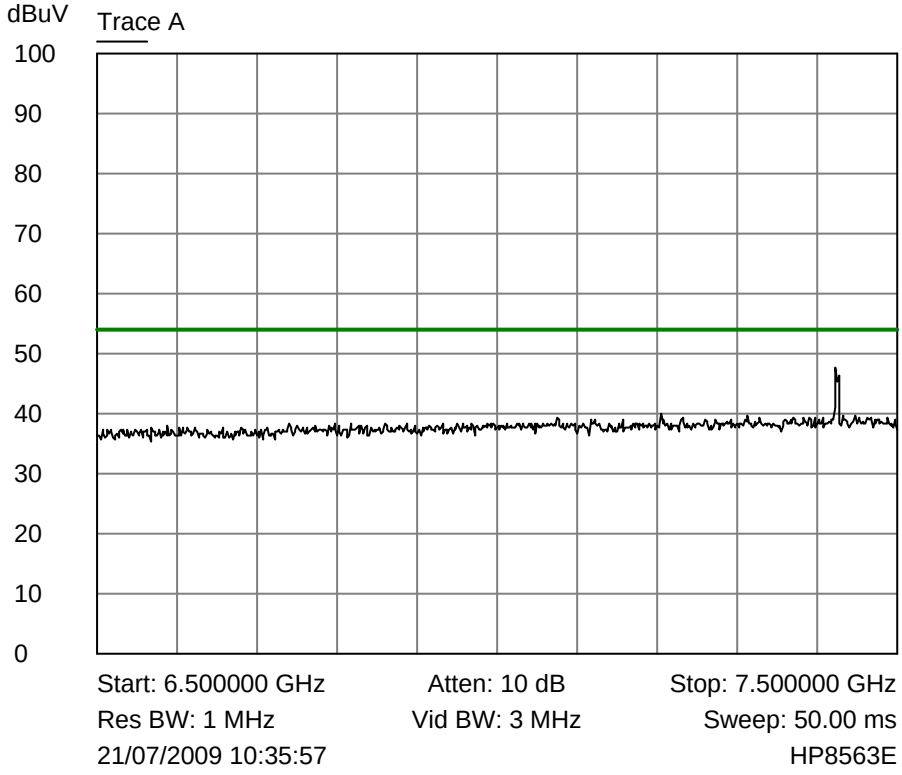
Start: 6.500000 GHz Atten: 10 dB Stop: 7.500000 GHz
Res BW: 1 MHz Vid BW: 3 MHz Sweep: 50.00 ms
21/07/2009 10:08:22 HP8563E

J4011-1 6.5-7.5GHz Vert Mid Chan Pole Ant



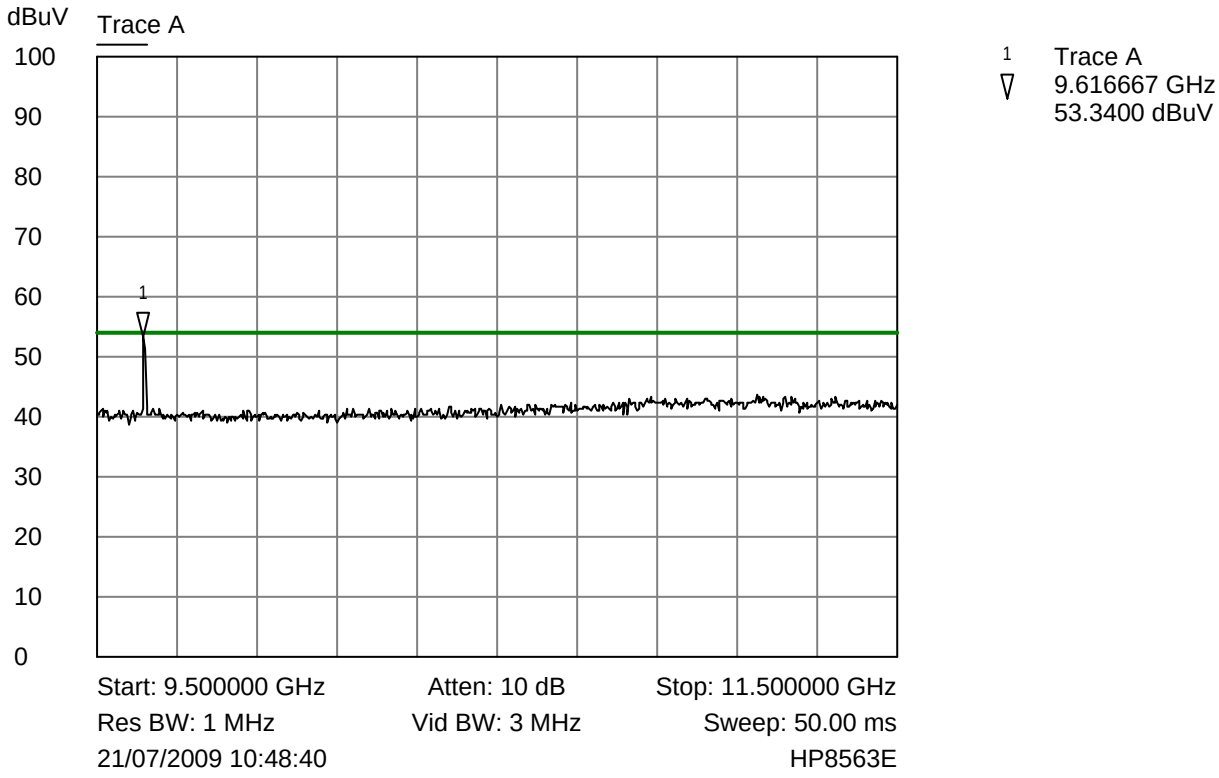
Start: 6.500000 GHz Atten: 10 dB Stop: 7.500000 GHz
Res BW: 1 MHz Vid BW: 3 MHz Sweep: 50.00 ms
21/07/2009 10:10:32 HP8563E

J4011-1 6.5-7.5GHz Vert Top Chan Pole Ant

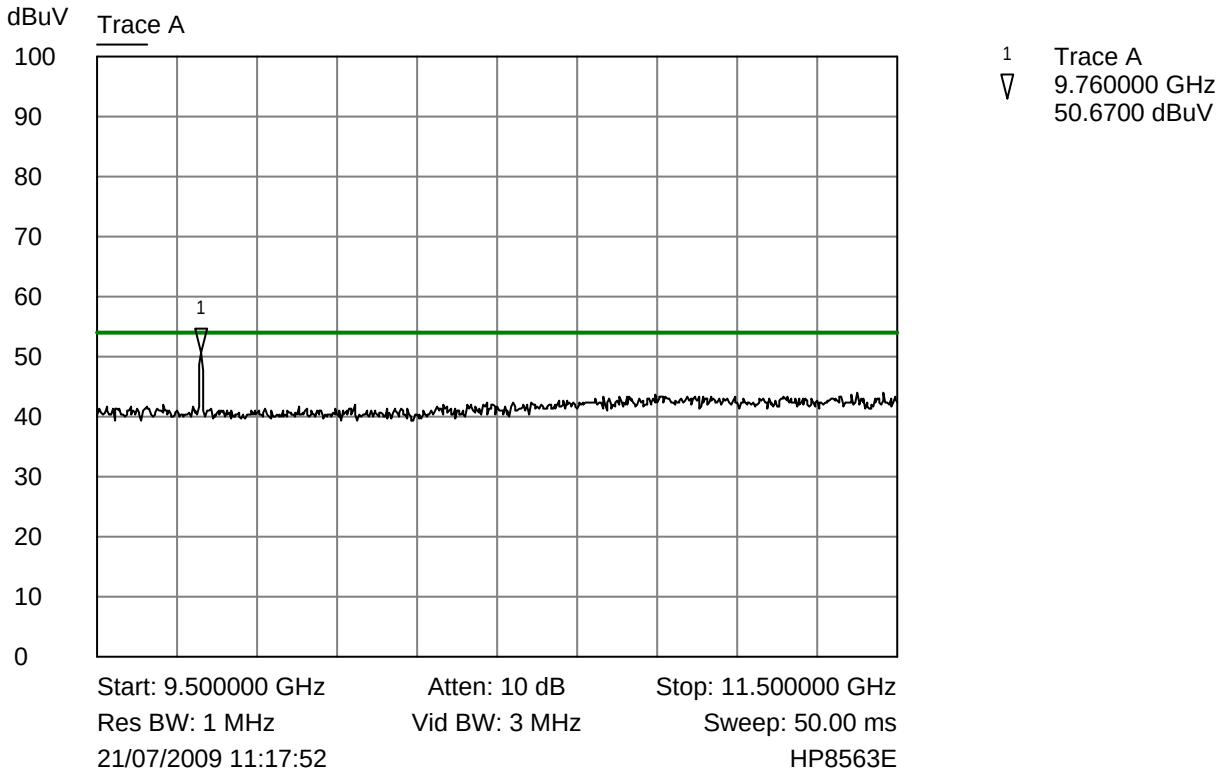


Start: 6.500000 GHz Atten: 10 dB Stop: 7.500000 GHz
Res BW: 1 MHz Vid BW: 3 MHz Sweep: 50.00 ms
21/07/2009 10:35:57 HP8563E

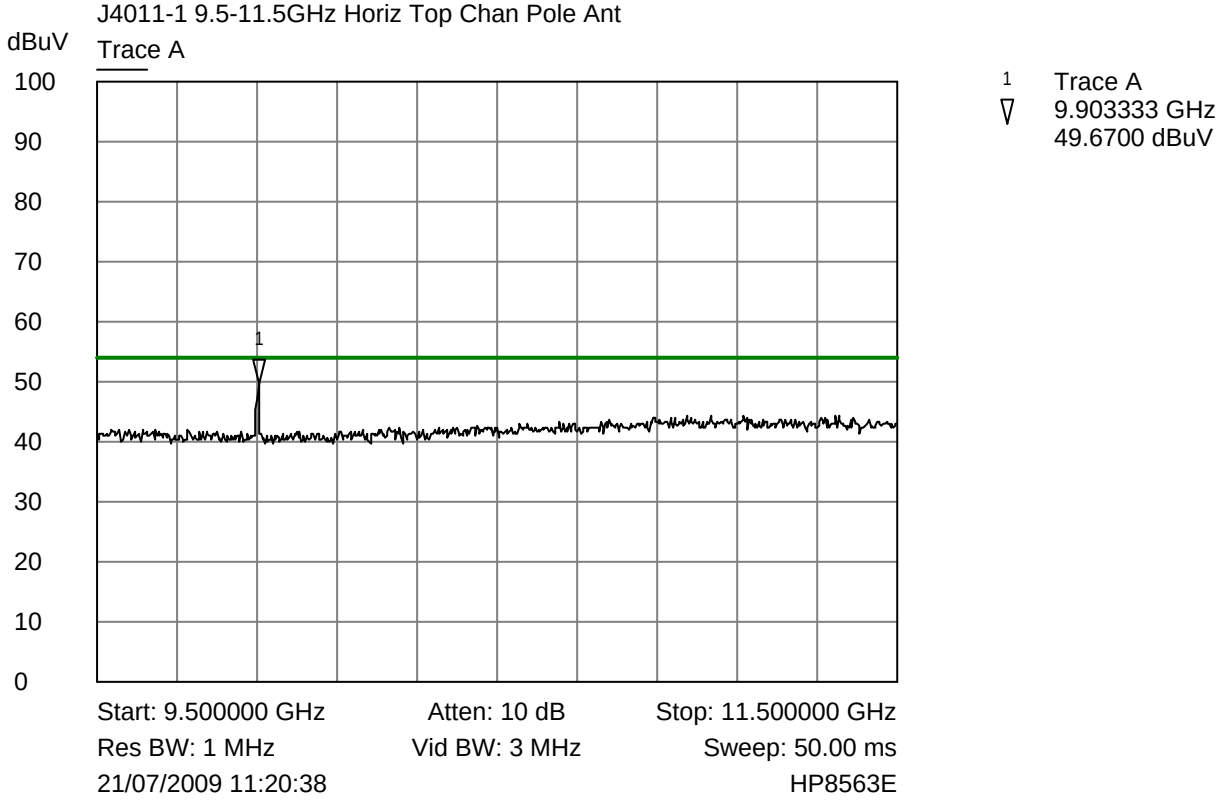
J4011-1 9.5-11.5GHz Horiz Bot Chan Pole Ant



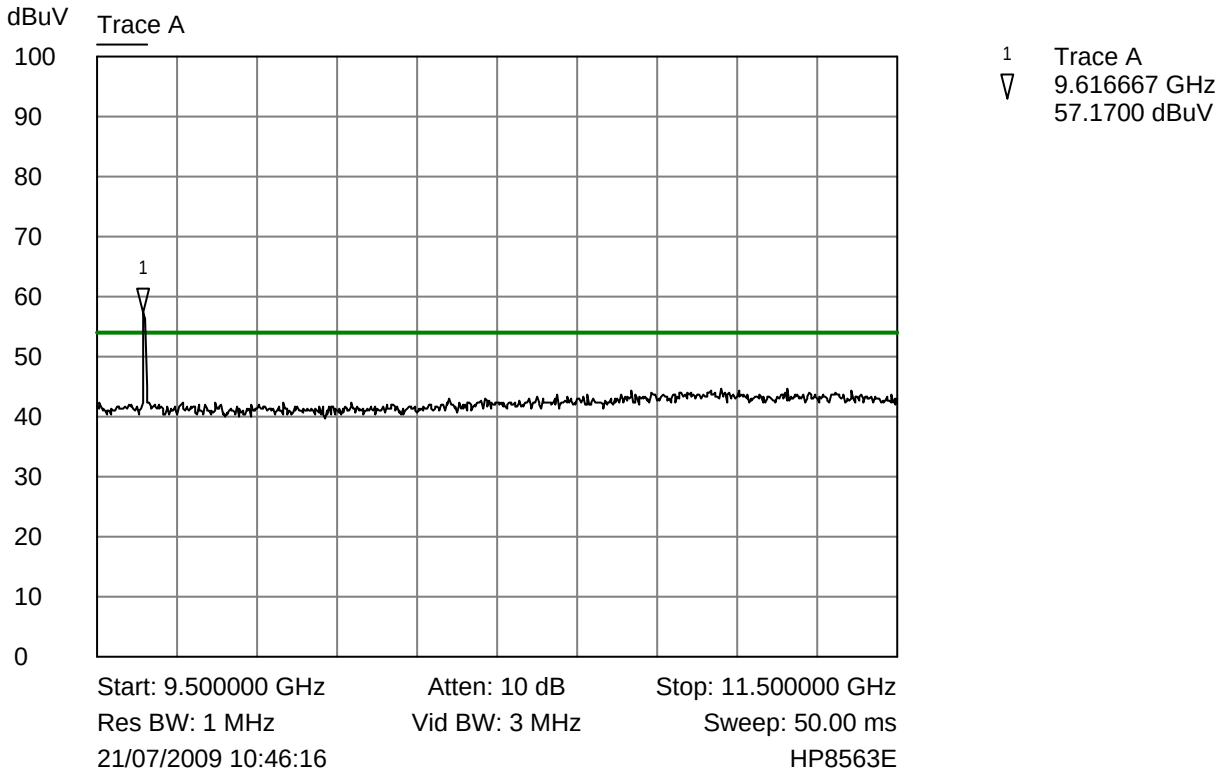
J4011-1 9.5-11.5GHz Horiz Mid Chan Pole Ant



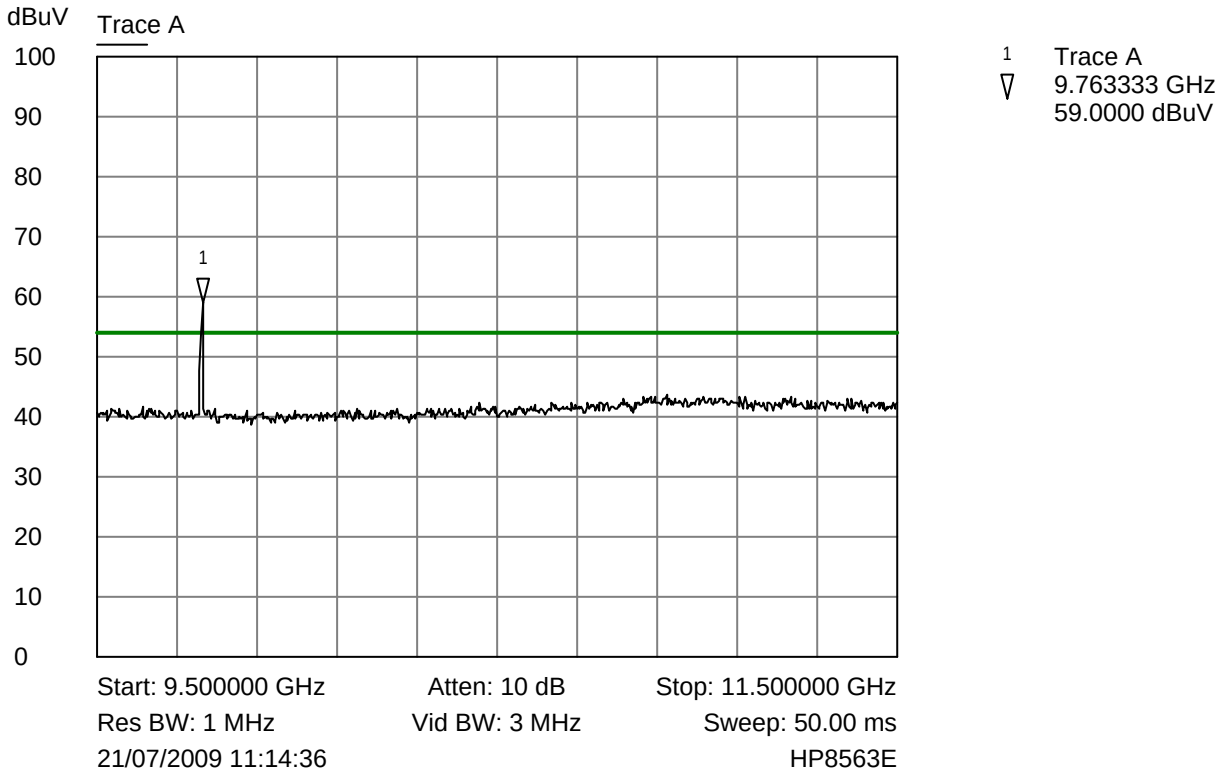
J4011-1 9.5-11.5GHz Horiz Top Chan Pole Ant



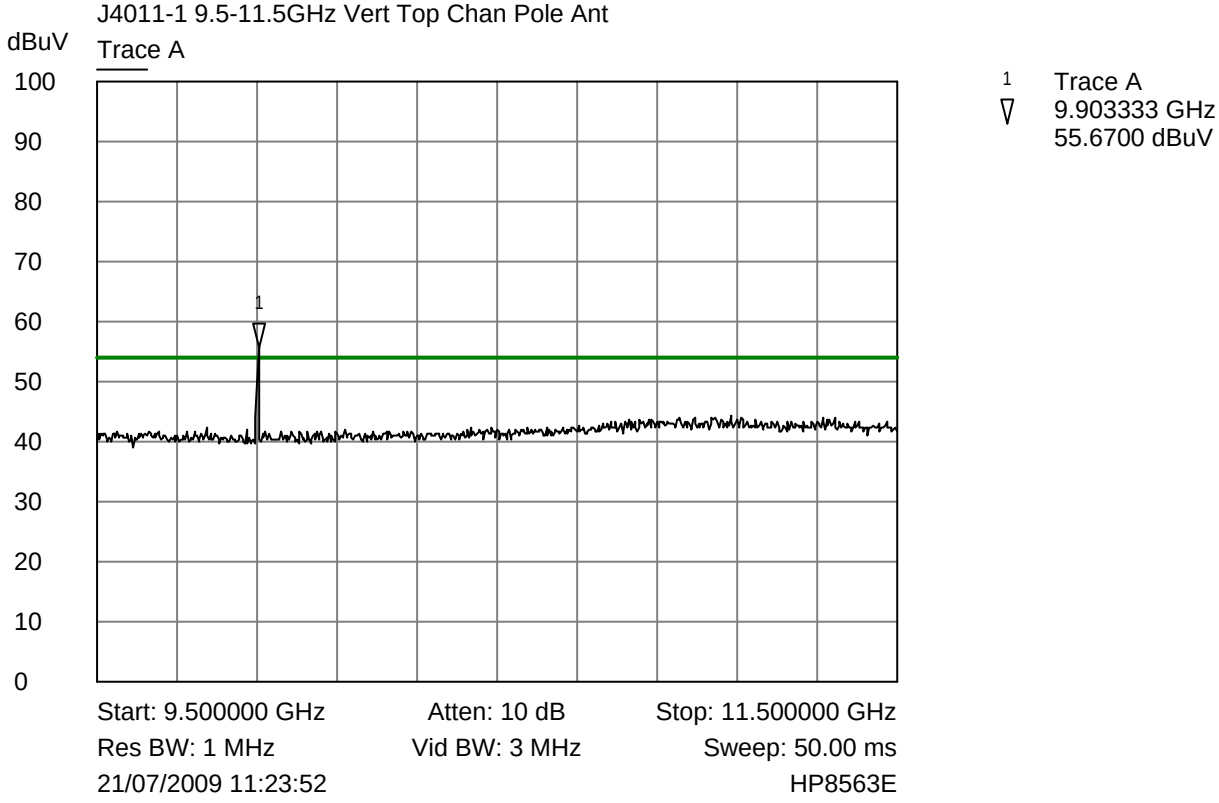
J4011-1 9.5-11.5GHz Vert Bot Chan Pole Ant



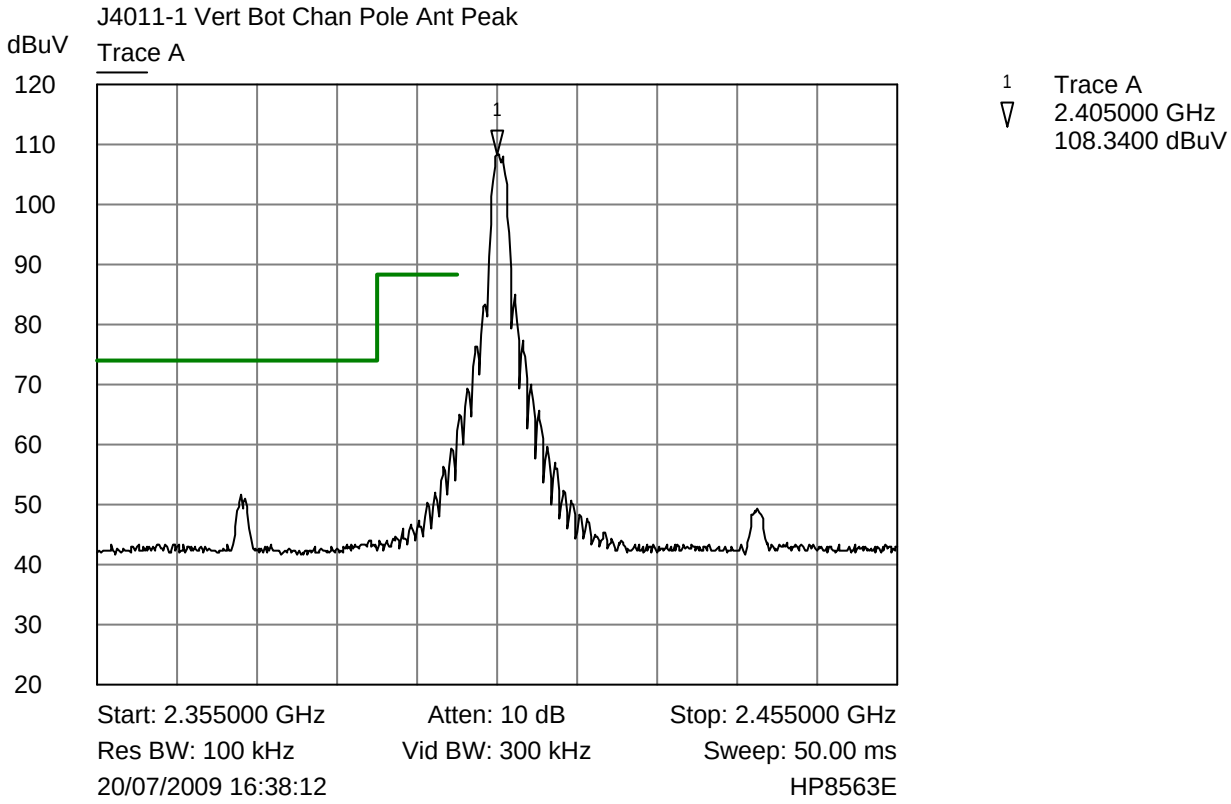
J4011-1 9.5-11.5GHz Vert Mid Chan Pole Ant

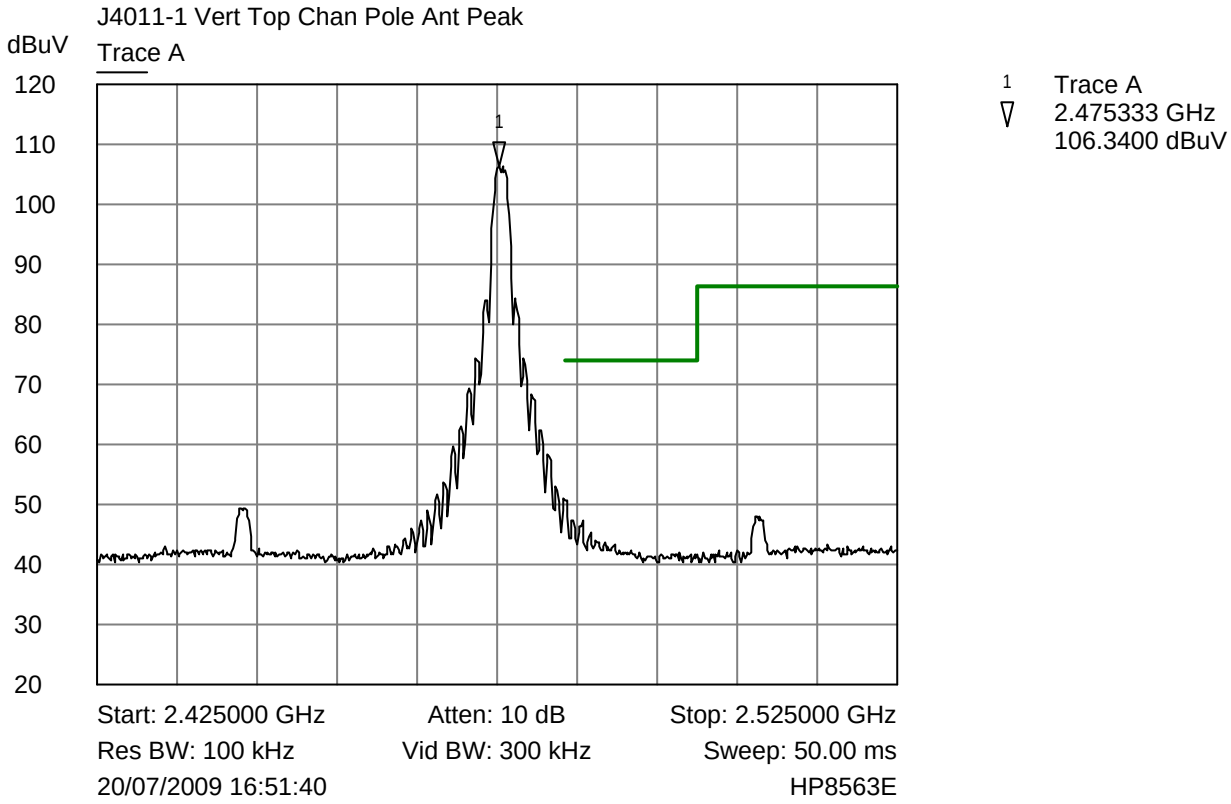


J4011-1 9.5-11.5GHz Vert Top Chan Pole Ant

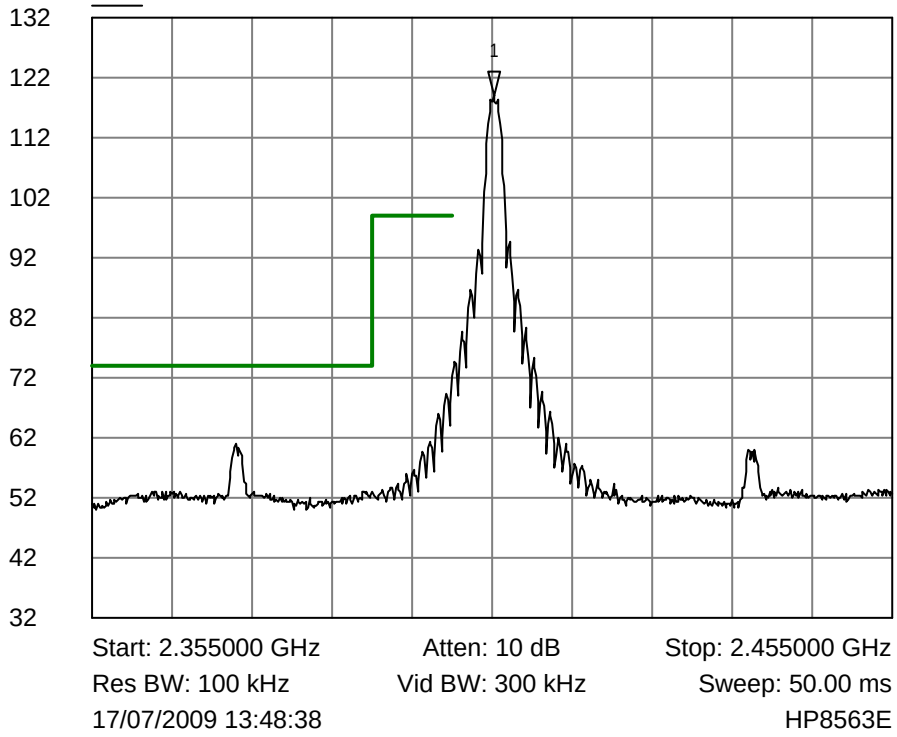


6.3.3 Band-edge





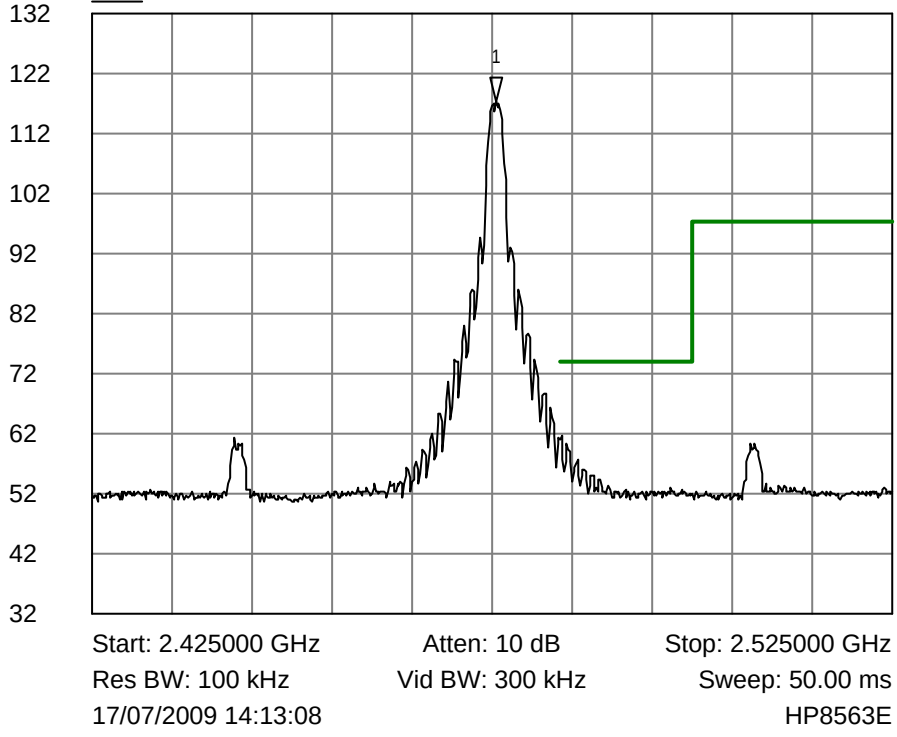
J4011-1 Bot Chan Patch Ant Vert Peak
Trace A



1 Trace A
2.405167 GHz
118.8400 dBuV

Start: 2.355000 GHz Atten: 10 dB Stop: 2.455000 GHz
Res BW: 100 kHz Vid BW: 300 kHz Sweep: 50.00 ms
17/07/2009 13:48:38 HP8563E

J4011-1 Top Chan Patch Ant Vert Peak
Trace A



1 Trace A
2.475500 GHz
117.1700 dBuV

Start: 2.425000 GHz Atten: 10 dB Stop: 2.525000 GHz
Res BW: 100 kHz Vid BW: 300 kHz Sweep: 50.00 ms
17/07/2009 14:13:08 HP8563E

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

All peak emissions were less than 3dB above average before duty cycle corrections.

Patch Antenna

EUT Transmitting on Low Channel

Signal	Freq (MHz)	Polaris-ation	Avg Amp (dBuV/m)	Avg –Limit[2] (dBuV/m)	Comments
1	2374.5	H	50.17	-3.83	
2	2374.5	V	62.00	8.00[3]	Before duty cycle correction
3	4810	H	45.34	-9.66	
4	4810	V	45.34	-9.66	
5	12025	V	39.84	-14.16	

Signal	Freq (MHz)	Polaris-ation	Avg Amp (dBuV/m)	Avg -Limit[4] (dBuV/m)	Comments
1	7215	H	52.17	-46.7	In-band peak was 118.84dBuV/m at 3m
2	7215	V	52.47	-46.4	
3	9620	H	63.00	-	
4	9620	V	64.50	-	

EUT Transmitting on Middle Channel

Signal	Freq (MHz)	Polaris-ation	Avg Amp (dBuV/m)	Avg –Limit[2] (dBuV/m)	Comments
1	4880	H	44.00	-10.00	
2	4880	V	43.84	-10.16	
3	7320	H	48.00	-6.00	
4	7320	V	48.50	-5.50	
5	12200	V	37.84	-16.16	

Signal	Freq (MHz)	Polaris-ation	Avg Amp (dBuV/m)	Avg -Limit[4] (dBuV/m)	Comments
1	9760	H	61.67	-36.8	In-band peak was 118.50dBuV/m at 3m
2	9760	V	64.17	-34.3	

[2] Limit for emissions within the restricted bands of 15.205 comes from 15.209 = 54dBuV/m at 3m.
[3] The values measured and tabulated are with the EUT operating in continuous transmit and are directly a result of the modulated signal (harmonics and products). 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.
[4] Limit for emissions outside the restricted bands of 15.205 comes from 15.247(d) = -20dB from highest in-band emission measured in 100kHz.

EUT Transmitting on High channel

Signal	Freq (MHz)	Polaris-ation	Avg Amp (dBuV/m)	Avg -Limit[2] (dBuV/m)	Comments
1	4950	H	45.00	-9.00	
2	4950	V	48.17	-5.83	
3	7425	H	47.34	-6.66	
4	7425	V	48.17	-5.83	

Signal	Freq (MHz)	Polaris-ation	Avg Amp (dBuV/m)	Avg -Limit[4] (dBuV/m)	Comments
1	2508.7	H	52.67	-44.5	In-band peak was 117.17dBuV/m at 3m
2	2508.7	V	61.84	-35.3	
3	9900	H	47.34	-49.8	
4	9900	V	51.00	-46.2	

Collinear Antenna

EUT Transmitting on Low Channel

Signal	Freq (MHz)	Polaris-ation	Avg Amp (dBuV/m)	Avg –Limit[2] (dBuV/m)	Comments
1	2374.5	V	51.67	-2.33	
2	4810	H	41.34	-12.66	
3	4810	V	44.67	-9.33	

Signal	Freq (MHz)	Polaris-ation	Avg Amp (dBuV/m)	Avg –Limit[4] (dBuV/m)	Comments
1	7215	H	50.17	-38.2	In-band peak was 108.34dBuV/m at 3m
2	7215	V	50.00	-38.3	
3	9620	H	53.34	-35.0	
4	9620	V	57.17	-31.2	

EUT Transmitting on Middle Channel

Signal	Freq (MHz)	Polaris-ation	Avg Amp (dBuV/m)	Avg -Limit[2] (dBuV/m)	Comments
1	4880	H	39.67	-14.33	
2	4880	V	40.67	-13.33	
3	7320	H	50.00	-4.00	
4	7320	V	49.50	-4.50	

Signal	Freq (MHz)	Polaris-ation	Avg Amp (dBuV/m)	Avg –Limit[4] (dBuV/m)	Comments
1	9760	H	50.67	-41.0	In-band peak was 111.67dBuV/m at 3m
2	9760	V	59.00	-32.7	

EUT Transmitting on High channel

Signal	Freq (MHz)	Polaris-ation	Avg Amp (dBuV/m)	Avg -Limit[2] (dBuV/m)	Comments
1	4950	H	46.17	-7.83	
2	4950	V	45.17	-8.83	
3	7425	H	47.67	-6.33	
4	7425	V	46.67	-7.33	

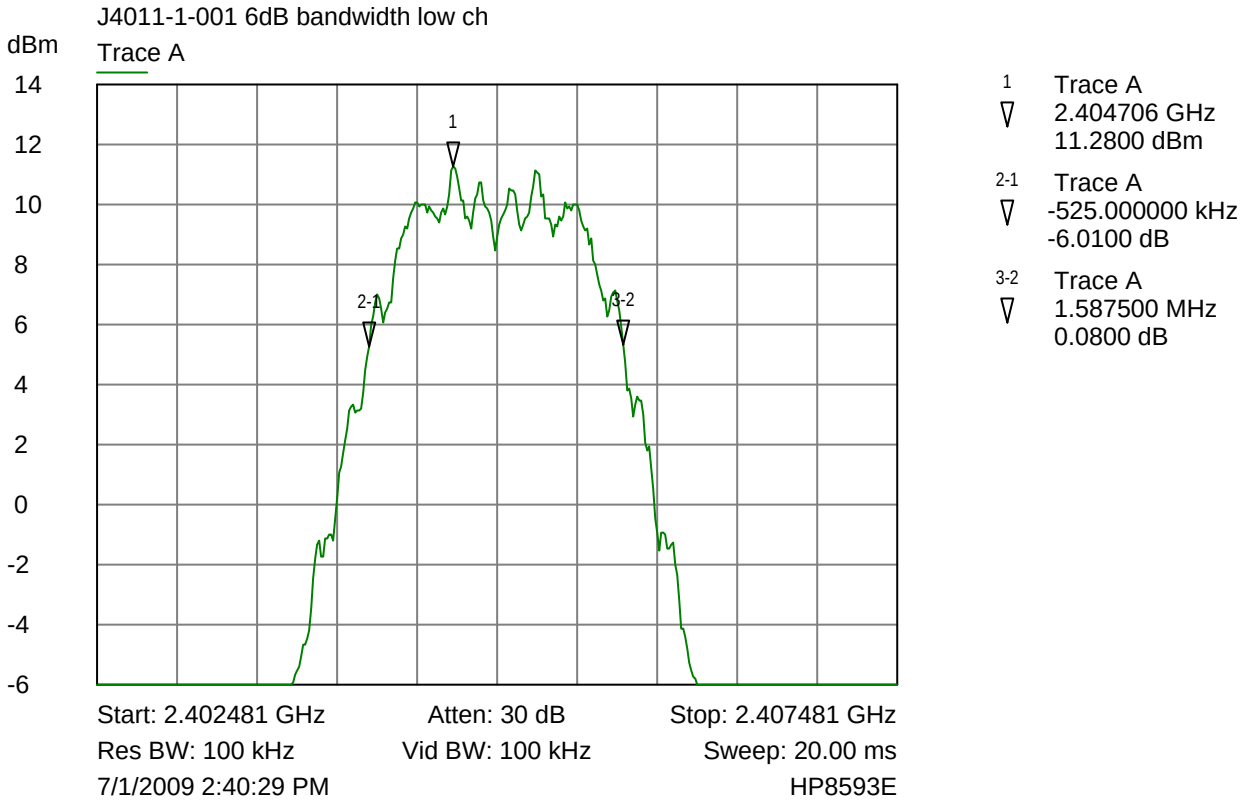
Signal	Freq (MHz)	Polaris-ation	Avg Amp (dBuV/m)	Avg –Limit[4] (dBuV/m)	Comments
1	2508.7	V	49.67	-36.67	In-band peak was 106.34dBuV/m at 3m
2	9900	H	49.67	-36.67	
3	9900	V	55.67	-30.67	

Duty Cycle Statements
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 250kb/s and down to 20kb/s). Typical applications for IEEE 802.15.4 devices are anticipated to run with low duty cycle rates (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 of 0.01472ms (40 data bytes) and for <10% duty cycle restrictions up to 6 packets per 100ms.

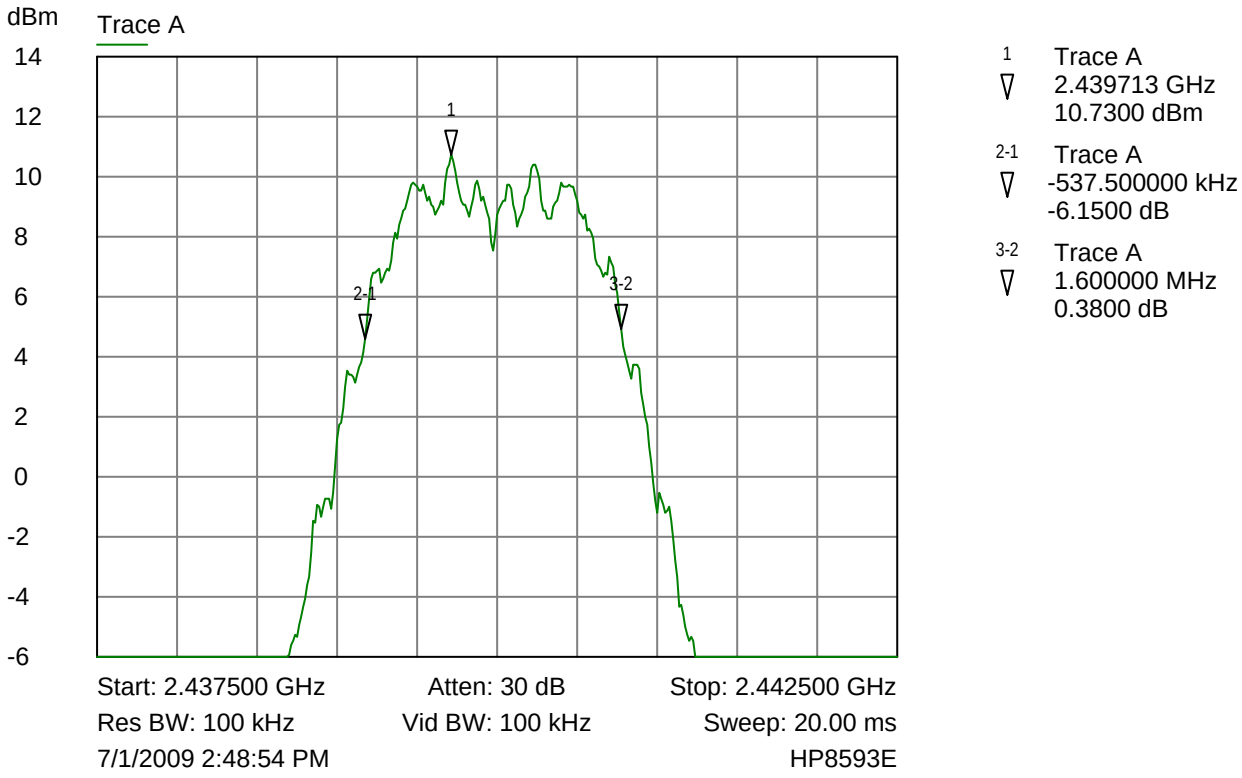
According to 15.35(c): when the radiated emission limits are expressed in terms of the average value of the emission, and pulsed operation is employed, the measurement field strength shall be determined by averaging over one complete pulse train, including blanking intervals, as long as the pulse train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

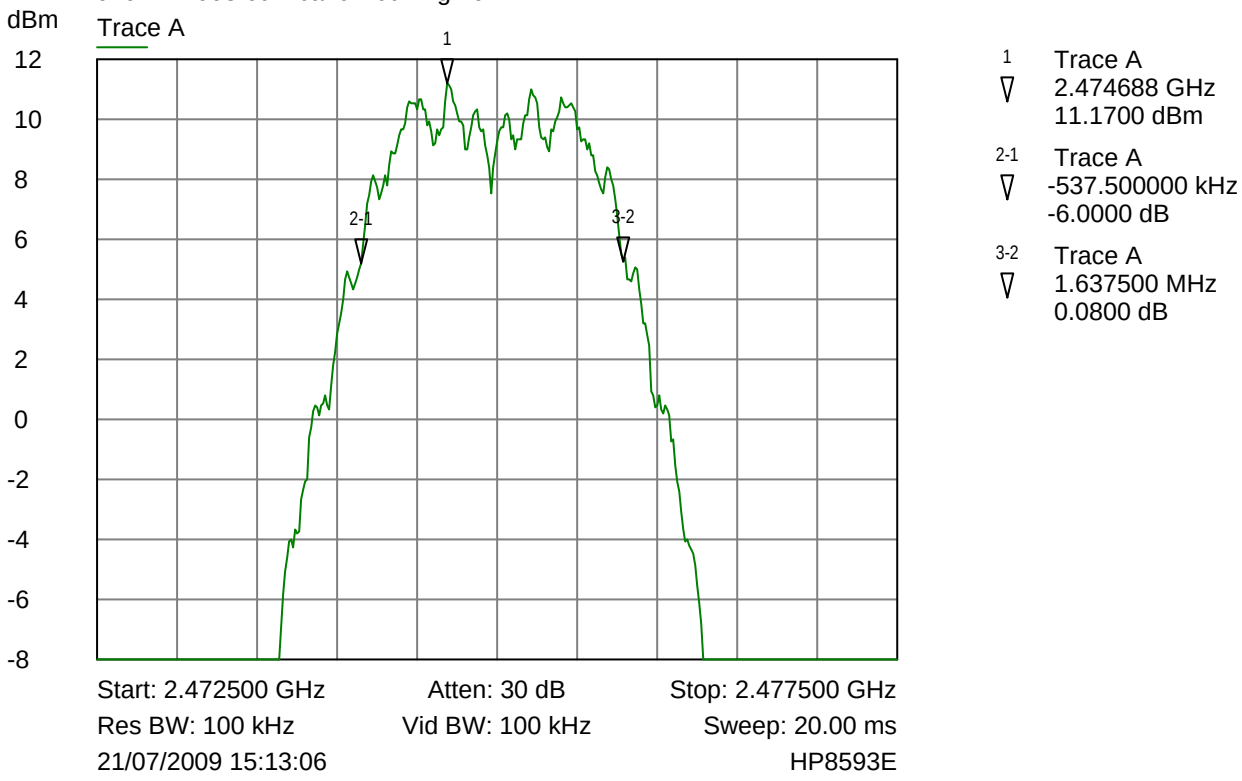
6.4 6dB Bandwidth



J4011-1-002 6dB bandwidth mid ch



J4011-1-003 6dB bandwidth high ch



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.

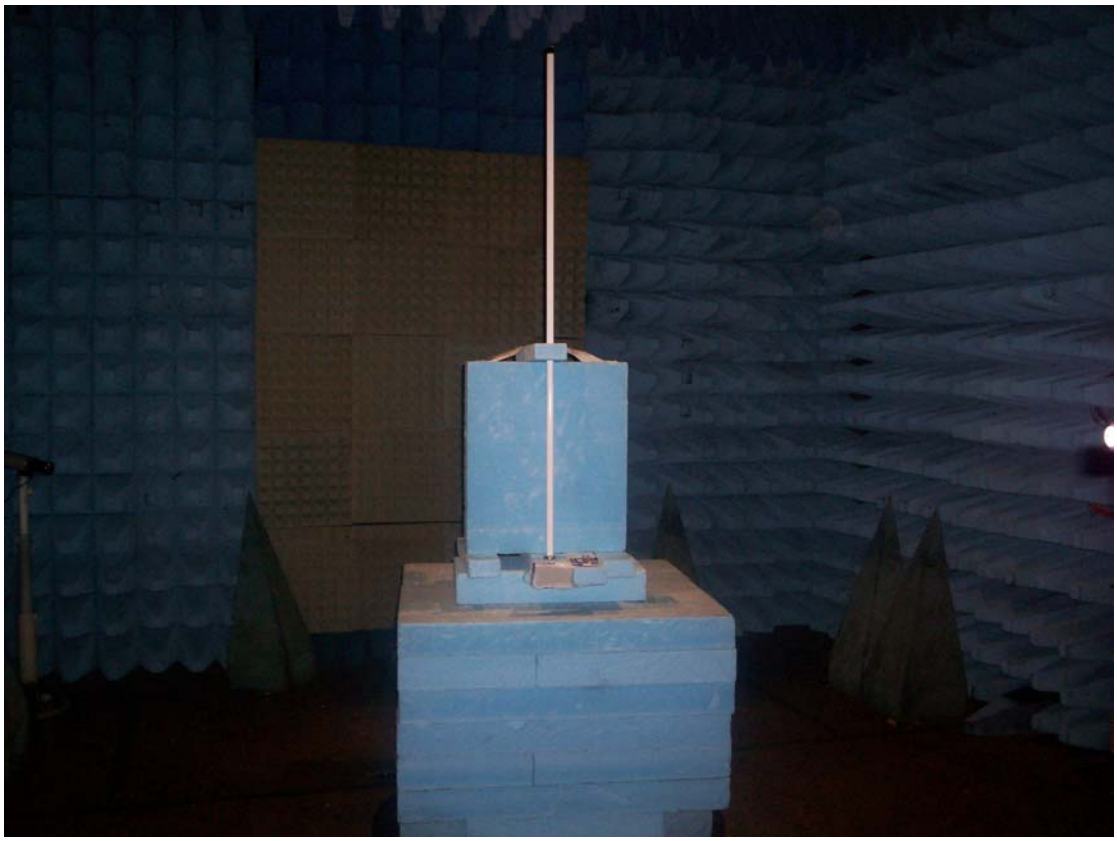
7.2 Explanation of limit line calculations for radiated measurements

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:

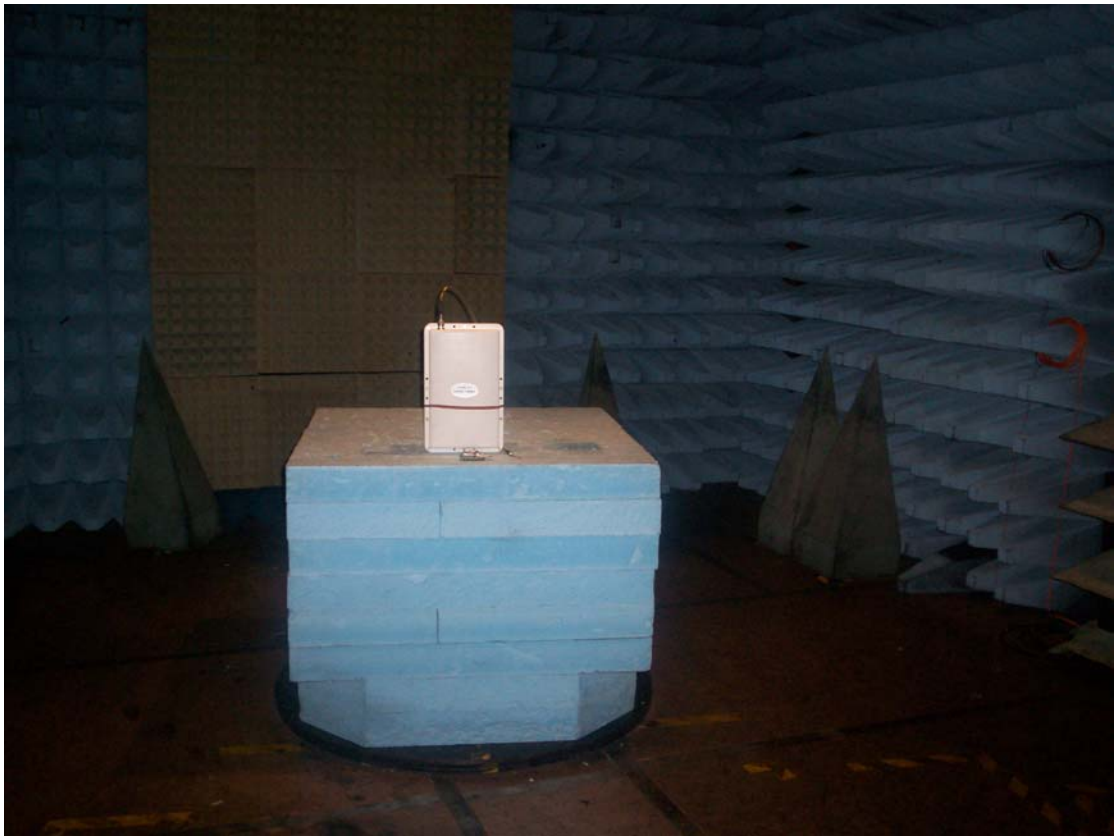
(a) limit of 500 µV/m equates to 20.log (500) = 54 dB µV/m.
(b) limit of 300 µV/m at 10m equates to 20.log (300 . 10/3) = 60 dB µV/m at 3m

N.b. the limit lines drawn on the plots are the general limits of 15.209, not the specific limits of 15.247 which are less stringent outside of the restricted bands of 15.205.

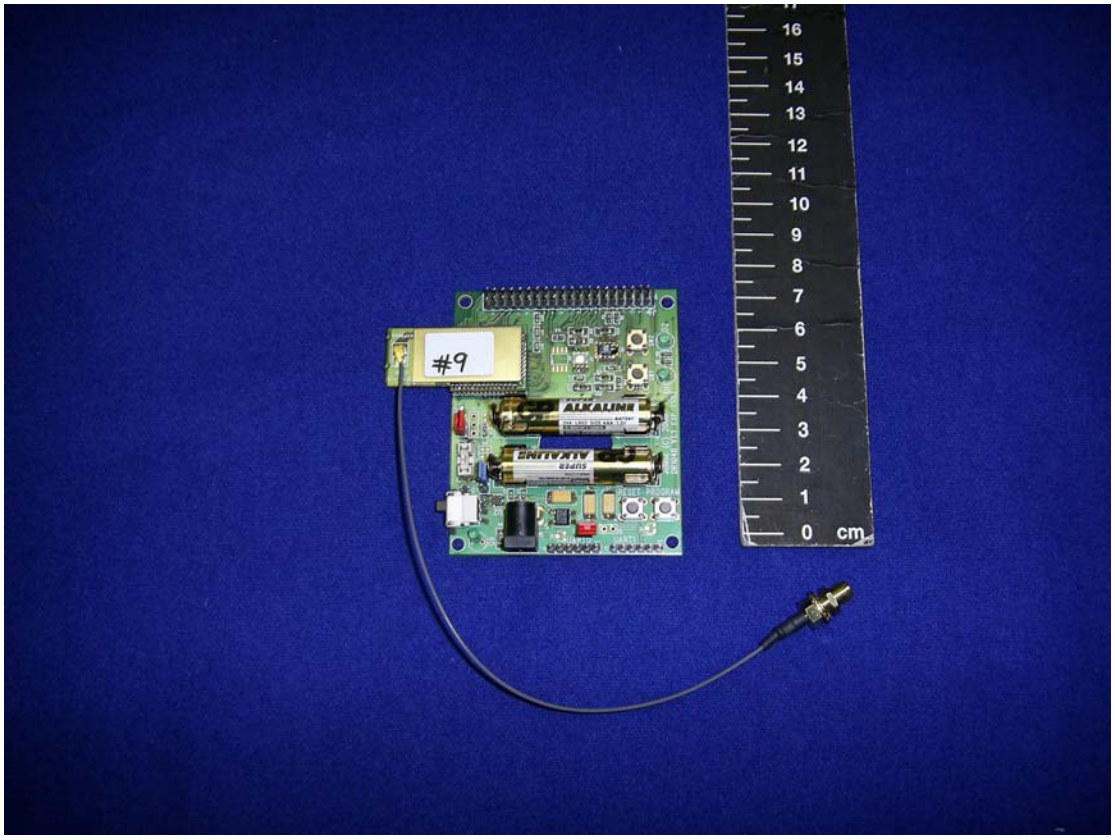
8. Photographs



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

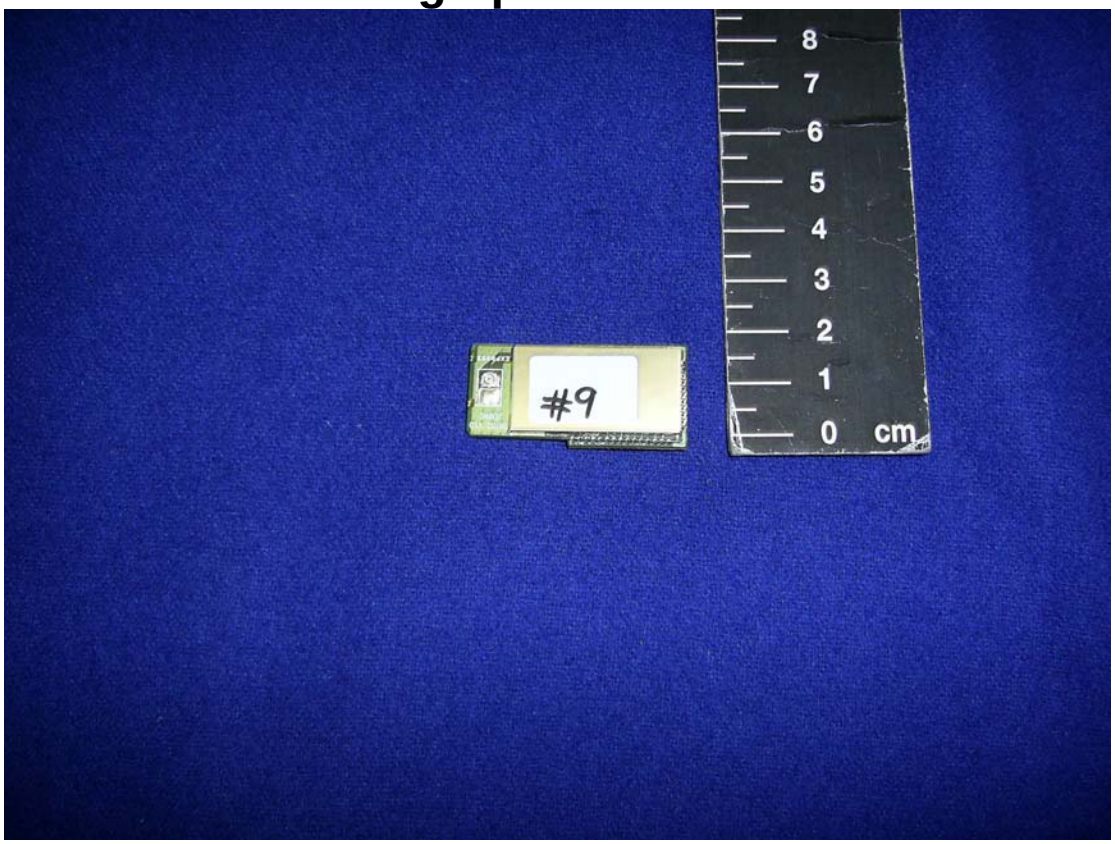


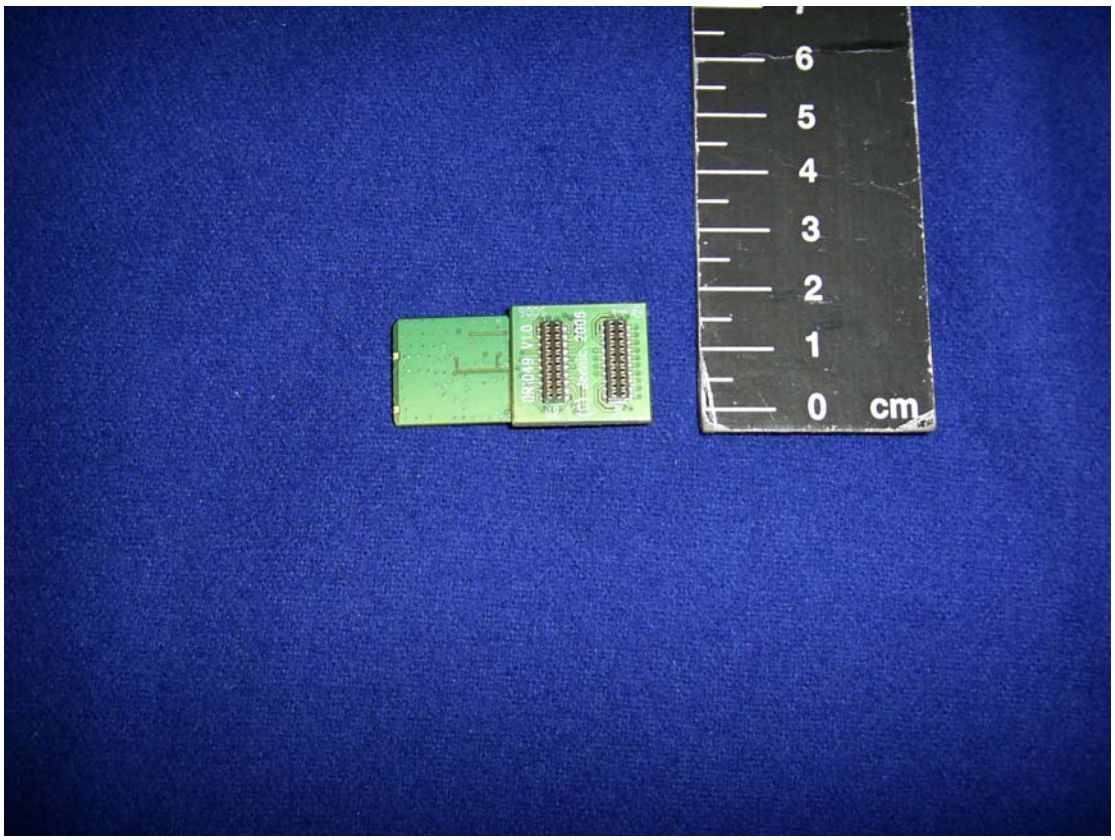
Photograph of the EUT with Patch antenna as viewed from in front of the antenna, site M.



Photograph of the EUT mounted on motherboard with antenna port adaptor.

Photographs of the EUT:





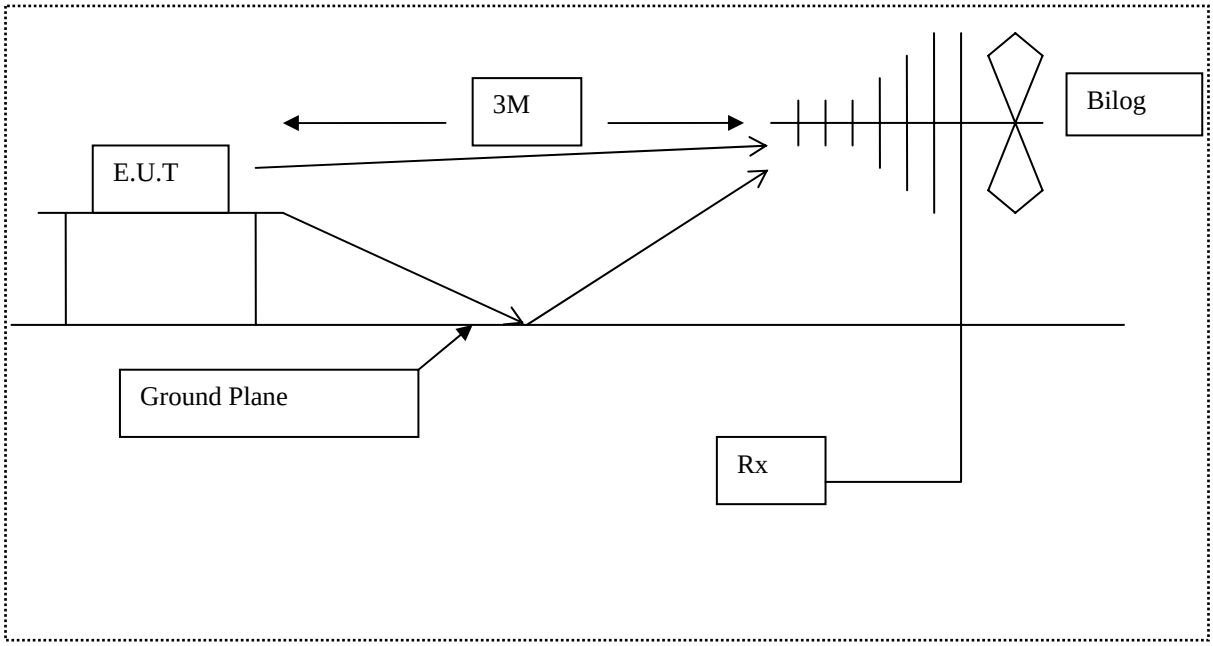


Diagram of the radiated emissions test setup.

9. Signal Leads

Port Name	Cable Type
Antenna	uFL connection to test jig / SMA adaptor with further coaxial lead to the antenna.

The EUT plugged directly into the test board.

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
E001	HP8542E	EMI Receiver & RF Filter	Hewlett Packard	19-Jan-09	6
E003	HP8593E	Spectrum Analyser	Hewlett Packard	10-Oct-08	24
E005	HP8447F	Pre-Amplifier	Hewlett Packard	09-Oct-08	12
E235	J2 7FV-15000/X6000	12-18 GHz BPF	K&L Microwave Inc.	N/A	N/A
E250	6806.19.A	6dB Attenuator	Hewlett Packard	16-Oct-08	12
E251	6806.19.A	6dB Attenuator	Suhner	16-Oct-08	12
E252	6810.19.A	10 dB Attenuator	Suhner	16-Oct-08	12
E256	44	10 dB Attenuator	Weinschel Engineering	08-Oct-08	12
E268	BHA 9118	1-18 GHz Horn Antenna	Schaffner	26-May-06	60
E290	6914	Power Sensor	Marconi Instruments	01-Jun-09	24
E342	8563E	Spectrum Analyser 26.5 GHz	HP	23-Feb-09	24
E351	54616C	500 MHz 2GSa/S Oscilloscope	HP (Agilent)	25-Jul-08	12
E397	6960B	RF Power Meter	Marconi Instruments	21-Nov-08	12
E429	-	5 Switch Filter Box 0.91 GHz - 16.3 GHz	RN Electronics	N/A	N/A
TMS73	0.083333333	Off Air Standard	Quartzlock	N/A	N/A
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	USB to RS232 Programming Lead	Not Available	Not Available
Jennic	PCB Motherboard	DR1048	Not Available
Jennic	PCB Carrier/Adaptor	DR1049	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.

NONE.

N.B. The settings of the device - continuous transmit, power level, frequency were set by test software not normally available to the user. The manufacturer should ensure that any OEM programming does not allow for alternative modes inconsistent with those tested.

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 controller module
Model Number(s):	JN5148-001-M04
Unique Serial Number(s):	#9
Manufacturer:	Jennic Ltd
Customer Purchase Order Number:	PO005383/CF
R.N. Electronics Limited Report Number:	07-362a/4011/1/09
Test Standards:	FCC Part 15C: effective date October 2008 Class DTS Intentional Radiator
Date:	1st July to 22nd July 2009

For and on behalf of
R.N. Electronics Limited

Signature: Roger Ray

Digitally signed by Roger Ray
DN: CN = Roger Ray, C = GB, O = RN Electronics
Date: 2009.07.27 16:51:43 +01'00'

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