

DATE: 06 July 2011

I.T.L. (PRODUCT TESTING) LTD.

FCC Radio Test Report

for

ConnectOne Ltd.

Equipment under test:

**Nano WiREACH SMT Module With On-Board Antenna
and External Antenna**

- 1. BRD-Nano-SMT-Ant; P/NL iW-SM2144SMT-OB**
- 2. BRD-Nano-SMT-UFL; P/NL iW-SM2144SMT-EX**

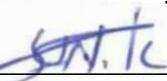
Written by:



D. Shidlovsky

D. Shidlovsky, Documentation

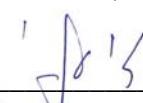
Approved by:



A. Moses

A. Moses, Test Engineer

Approved by:



I. Raz

I. Raz, EMC Laboratory Manager

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This report relates only to items tested.

Measurement/Technical Report for ConnectOne Ltd.

Nano WiREACH SMT Module With On-Board Antenna and External Antenna

1. BRD-Nano-SMT-Ant; P/NL iW-SM2144SMT-OB
2. BRD-Nano-SMT-UFL; P/NL iW-SM2144SMT-EX

FCC ID: XM5-SM2144SMT

This report concerns: Original Grant: X

Class I Change:

Class II Change:

Equipment type: Digital Transmission System

Limits used:

47CFR15 Section 15.247

Measurement procedure used is ANSI C63.4-2003.

Application for Certification

prepared by:

Ishaishou Raz

ITL (Product Testing) Ltd.

Kfar Bin Nun

D.N. Shimshon 99780

Israel

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Applicant for this device:

(different from "prepared by")

Avi Provizor

ConnectOne Ltd.

20 Atir Yeda St.

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e-mail: avip@connectone.com

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1. General Information

1.1 Administrative Information

Manufacturer:	ConnectOne Ltd.
Manufacturer's Address:	20 Atir Yeda St., Kfar Saba, 44643, Israel Tel: +972-9-766-0456 Fax: +972-9-766-0461
Manufacturer's Representative:	Avi Provizor
Equipment Under Test (E.U.T):	Nano WiREACH SMT Module With On-Board Antenna and External Antenna
Equipment Model No.:	1. BRD-Nano-SMT-Ant; P/NL iW-SM2144SMT-OB 2. BRD-Nano-SMT-UFL; P/NL iW-SM2144SMT-EX
Equipment Serial No.:	Not Designated
Date of Receipt of E.U.T:	15.05.11
Start of Test:	15.05.11
End of Test:	22.05.11
Test Laboratory Location:	I.T.L (Product Testing) Ltd. Kfar Bin Nun, ISRAEL 99780
Test Specifications:	FCC Part 15, Subpart C

1.2 List of Accreditations

The EMC laboratory of I.T.L. is accredited by the following bodies:

1. The American Association for Laboratory Accreditation (A2LA) (U.S.A.), Certificate No. 1152.01.
2. The Federal Communications Commission (FCC) (U.S.A.), Registration No. 90715.
3. The Israel Ministry of the Environment (Israel), Registration No. 1104/01.
4. The Voluntary Control Council for Interference by Information Technology Equipment (VCCI) (Japan), Registration Numbers: C-1350, R-1285.
5. Industry Canada (Canada), IC File No.: 46405-4025; Site No. IC 4025B-1.
6. TUV Product Services, England, ASLLAS No. 97201.

I.T.L. Product Testing Ltd. is accredited by the American Association for Laboratory Accreditation (A2LA) and the results shown in this test report have been determined in accordance with I.T.L.'s terms of accreditation unless stated otherwise in the report.

1.3 ***Product Description***

BRD-Nano-SMT (both types, BRD-Nano-SMT-Ant; BRD-Nano-SMT-UFL) is a secure serial-to-Wireless LAN device server module that also acts as a bridge to connect serial devices to 802.11b/g Wireless LANs. It includes the iChip™ CO2144 IP Communication Controller™ chip and Marvell 88W8686 WiFi chipset. It is packaged in RoHS-compliant ultra-slim form factor and uses an industry standard pin-out.

BRD-Nano-SMT offers much more than many other device servers on the market. It acts as a security gap between the application and the network; supports up to 10 simultaneous TCP/UDP sockets; two listening sockets; a web server with two websites; SMTP and POP3 clients; MIME attachments; FTP and TELNET clients, and SerialNET™ mode for serial-to-IP bridging.

BRD-Nano-SMT supports the SSL3/TLS1 protocol for secure sockets, HTTPS and FTPS, WEP, WPA and WPA2 WiFi encryption.

BRD-Nano-SMT minimizes the need to redesign the host device hardware. It easily inserts into headers on the host PCB and connects to an external antenna(BRD-Nano-SMT-Ant) or internal antenna (BRD-Nano-SMT-UFL) . Minimal or no software configuration is needed for BRD-Nano-SMT to access the Wireless LAN.

Connect One's high-level AT+i™ API eliminates the need to add WiFi drivers, security and networking protocols and tasks to the host application. The AT+i SerialNET operating mode offers a true plug-and-play mode that eliminates any changes to the host application.

BRD-Nano-SMT firmware – the IP stack and Internet configuration parameters – are stored in an external flash memory. The module is power-efficient: the core operates at 1.2V, while I/Os operate at 3.3V. Power Save mode further reduces power consumption.

1.4 *Test Methodology*

Both conducted and radiated testing were performed according to the procedures in ANSI C63.4: 2003. Radiated testing was performed at an antenna to EUT distance of 3 meters.

1.5 *Test Facility*

The radiated emissions tests were performed at I.T.L.'s testing facility at Kfar Bin-Nun, Israel. This site is a FCC listed test laboratory (FCC Registration No. 90715, date of listing September 3, 2009). I.T.L.'s EMC Laboratory is also accredited by A2LA, certificate No. 1152.01.

1.6 *Measurement Uncertainty*

Radiated Emission

Radiated Emission (CISPR 11, EN 55011, CISPR 22, EN 55022, ANSI C63.4) for open site 30-1000MHz:

Expanded Uncertainty (95% Confidence, K=2):

± 4.96 dB

2. System Test Configuration

2.1 ***Justification***

The E.U.T. was placed in an evaluation board powered from 9 VDC in order to perform the tests. The E.U.T. transmitted continuously.

The evaluation board was placed in a typical position on the table.

The E.U.T was tested with both an on-board antenna and an external antenna.

2.2 ***EUT Exercise Software***

iChip Config (ConnetOne's utility), and Hyper terminal was used.

2.3 ***Special Accessories***

No special accessories were needed to achieve compliance.

2.4 ***Equipment Modifications***

No modifications were necessary in order to achieve compliance.

2.5 Configuration of Tested System

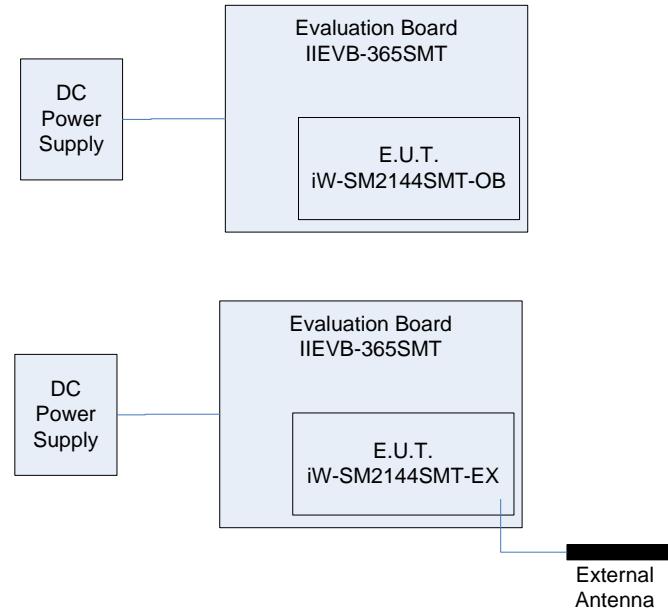


Figure 1. Configuration of Tested System

3. Conducted and Radiated Measurement Test Set-up Photo



Figure 2. Conducted Emission From Antenna Port Test



Figure 3. Radiated Emission Test External Antenna



Figure 4. Radiated Emission Test Internal Antenna

4. 6 dB Minimum Bandwidth

4.1 Test procedure

The E.U.T. was set to the applicable test frequency. The E.U.T. antenna terminal was connected to the spectrum analyzer through an external attenuator (20 dB) and an appropriate coaxial cable (cable loss = 1 dB). The spectrum analyzer was set to 100 kHz resolution BW. The spectrum bandwidth of the E.U.T. at the point of 6 dB below maximum peak power was measured and recorded.

The E.U.T. was tested at 2412, 2437, and 2462 MHz with the following modulations: 1 Mbps, 6 Mbps, 11 Mbps and 54 Mbps.

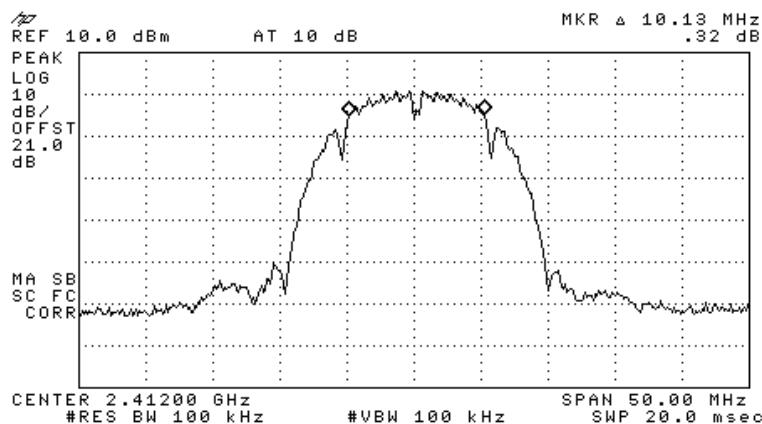


Figure 5 — Channel 1, 1 Mbps

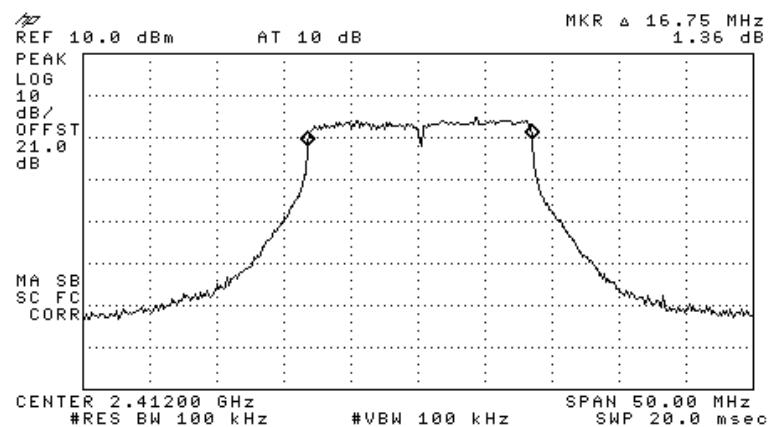


Figure 6 — Channel 1, 6 Mbps

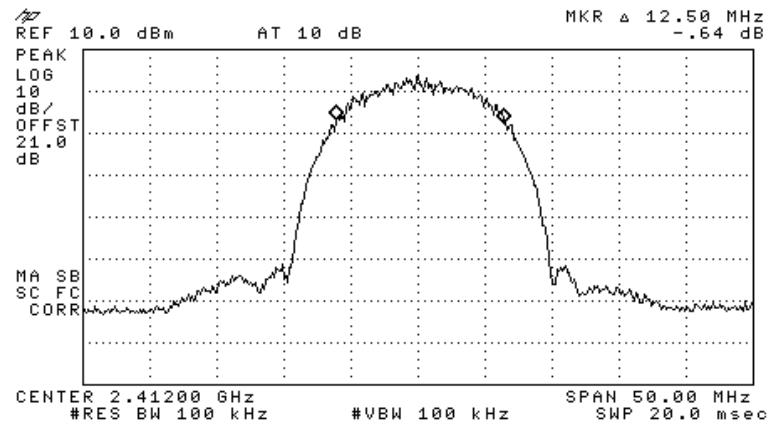


Figure 7 — Channel 1, 11 Mbps

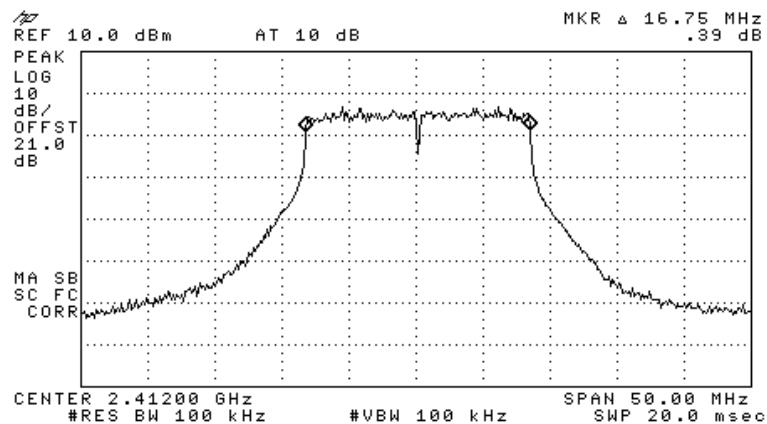


Figure 8 — Channel 1, 54 Mbps

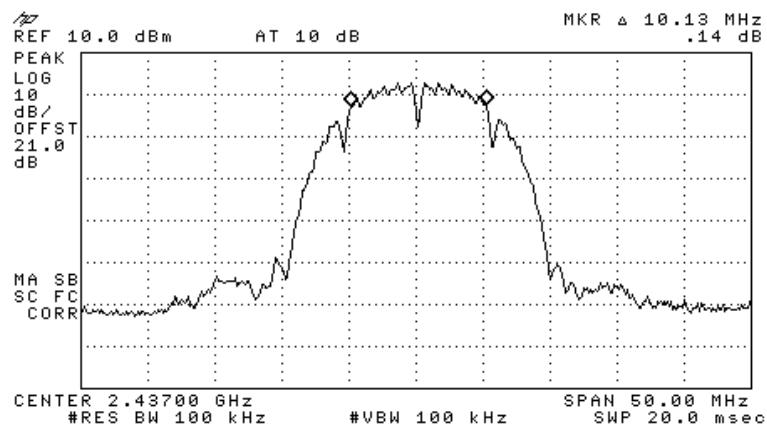


Figure 9 — Channel 6, 1 Mbps

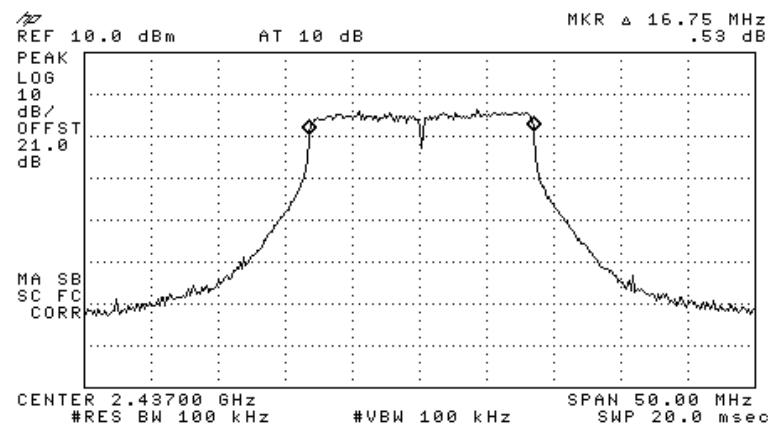


Figure 10 — Channel 6, 6 Mbps

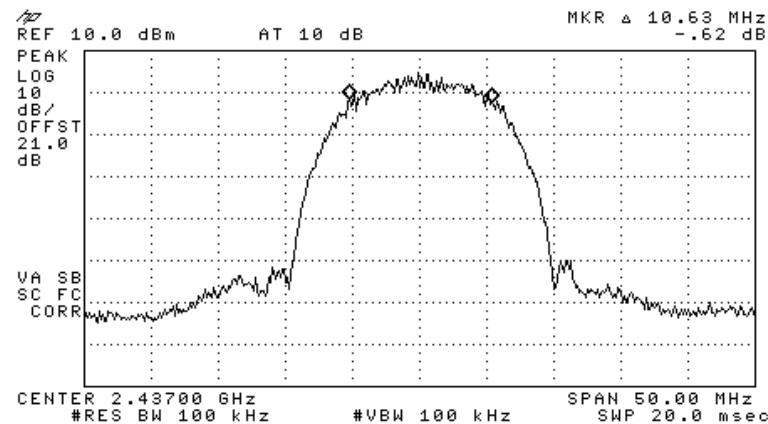


Figure 11 — Channel 6, 11 Mbps

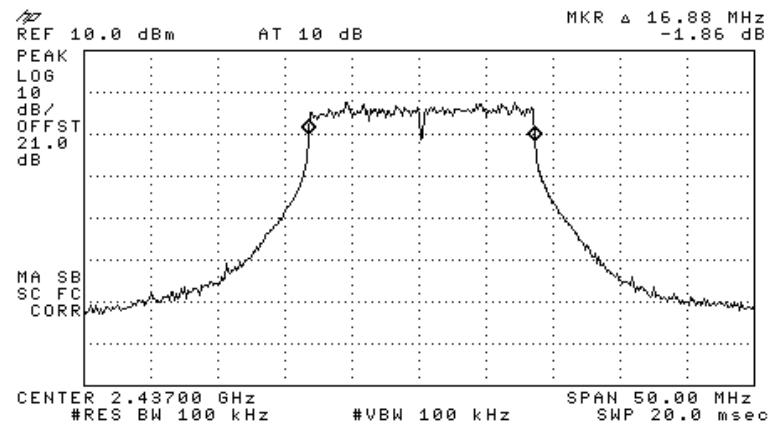


Figure 12 — Channel 6, 54 Mbps

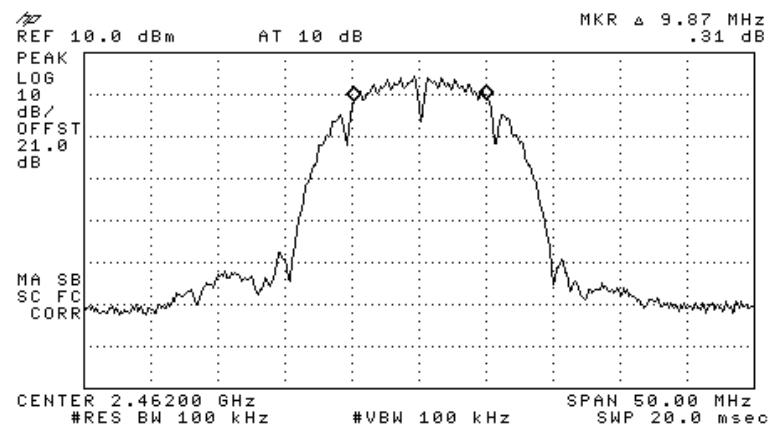


Figure 13 — Channel 11, 1 Mbps

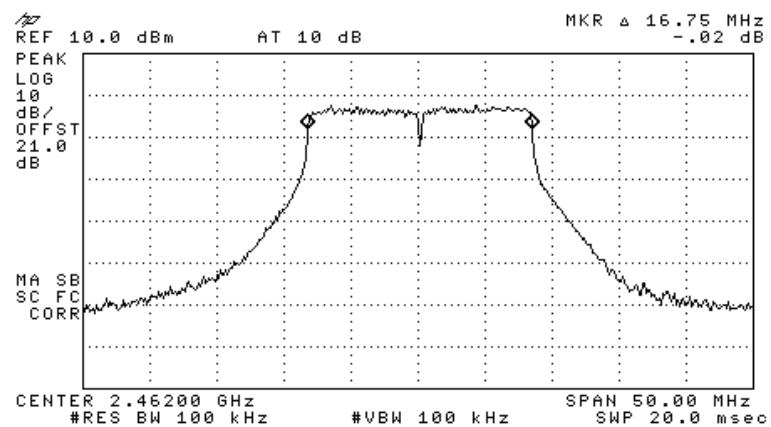


Figure 14 — Channel 11, 6 Mbps

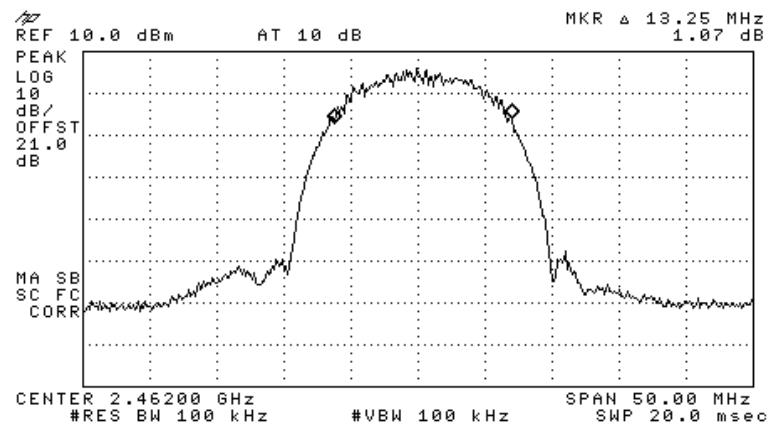


Figure 15 — Channel 11, 11 Mbps

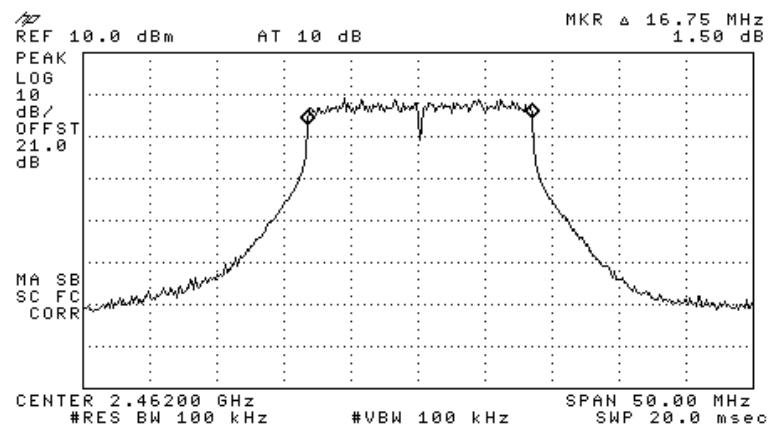


Figure 16 — Channel 11, 54 Mbps

4.2 Results table

E.U.T Description: Nano WiREACH SMT Module With On-Board Antenna and External Antenna

Model No.: 1. BRD-Nano-SMT-Ant; P/NL iW-SM2144SMT-OB
2. BRD-Nano-SMT-UFL; P/NL iW-SM2144SMT-EX

Serial Number: Not Designated

Specification: F.C.C. Part 15, Subpart C: (15.247-a2)

Operation Frequency (MHz)	Modulation (Mbps)	Reading (MHz)	Specification (MHz)
2412	1	10.13	0.5
	6	16.75	0.5
	11	12.50	0.5
	54	16.75	0.5
2437	1	10.13	0.5
	6	16.75	0.5
	11	10.63	0.5
	54	16.88	0.5
2462	1	9.87	0.5
	6	16.75	0.5
	11	13.25	0.5
	54	16.75	0.5

Figure 17 6 dB Minimum Bandwidth

JUDGEMENT: Passed

TEST PERSONNEL:

Tester Signature:  Date: 06.07.11

Typed/Printed Name: A. Moses

4.3 **Test Equipment Used.**

6 dB Minimum Bandwidth

Instrument	Manufacturer	Model	Serial/Part Number	Calibration	
				Last Calibration	Period
Spectrum Analyzer	HP	8592L	3826A01204	February 21, 2011	1 year
Attenuator	Jyebao	-	FAT-AM5AF5G6G2W20	January 04, 2011	1 year
Cable	Rhophase	KPS-5000-KPS	A1674	January 04, 2011	1 year

Figure 18 Test Equipment Used

5. 26 dB Minimum Bandwidth

5.1 *Test procedure*

The E.U.T. was set to the applicable test frequency. The E.U.T. antenna terminal was connected to the spectrum analyzer through an external attenuator (20 dB) and an appropriate coaxial cable (cable loss = 1 dB). The spectrum analyzer was set to 100 kHz resolution BW. The spectrum bandwidth of the E.U.T. at the point of 26 dB below maximum peak power was measured and recorded.

The E.U.T. was tested at 2412, 2437, and 2462 MHz with the following modulations: 1 Mbps, 6 Mbps, 11 Mbps, and 54 Mbps.

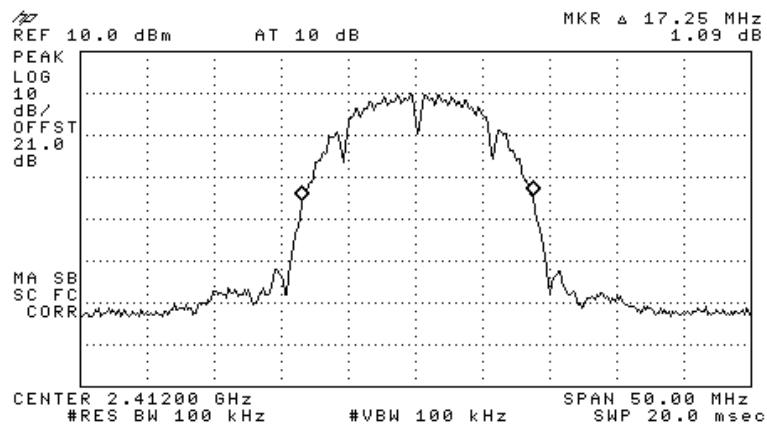


Figure 19 — Channel 1, 1 Mbps

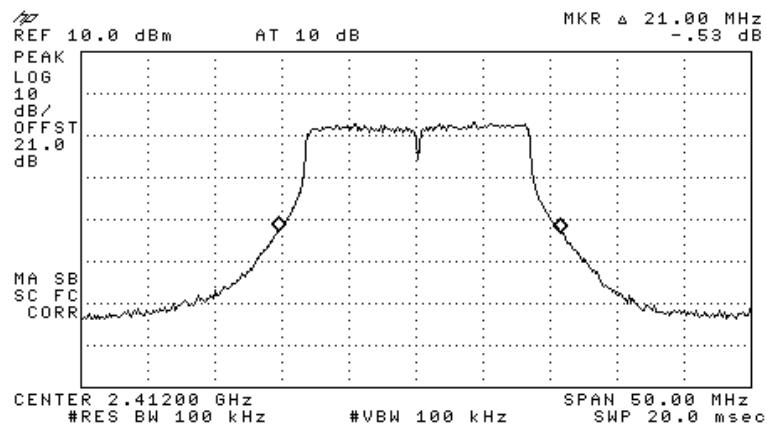


Figure 20 — Channel 1, 6 Mbps

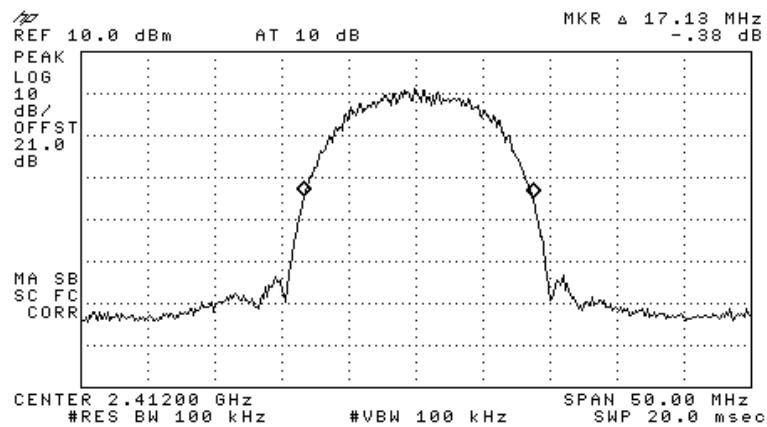


Figure 21 — Channel 1, 11 Mbps

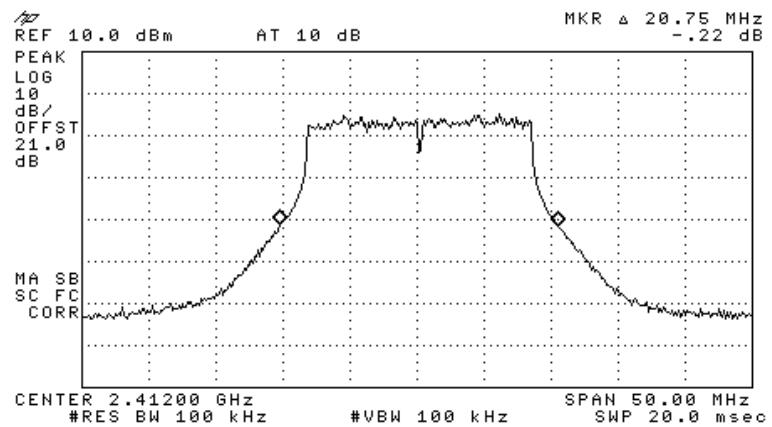


Figure 22 — Channel 1, 54 Mbps

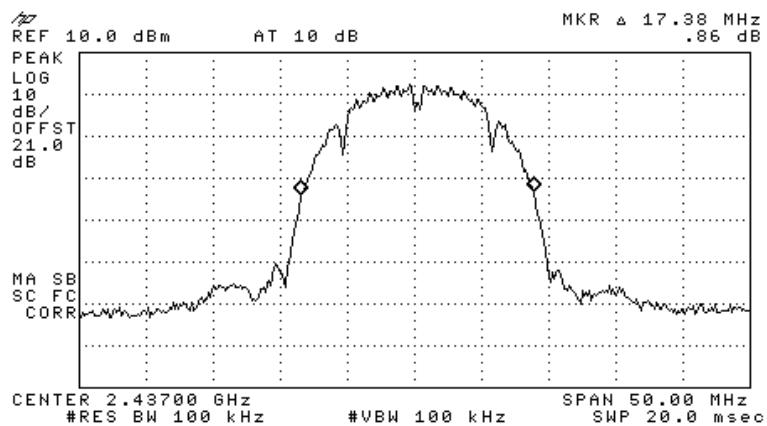


Figure 23 — Channel 6, 1 Mbps

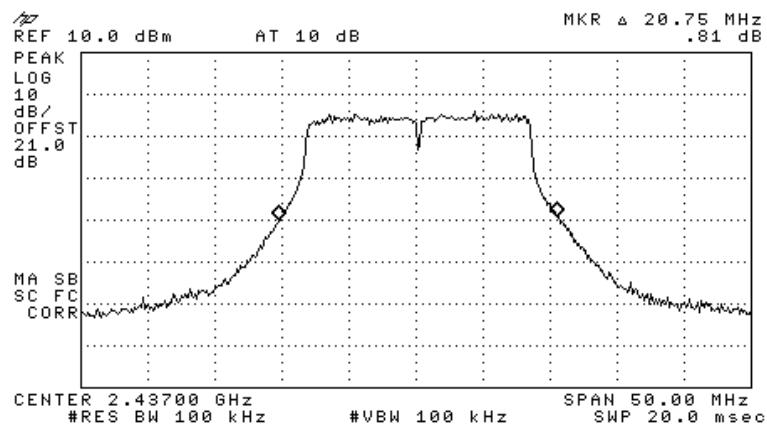


Figure 24 — Channel 6, 6 Mbps

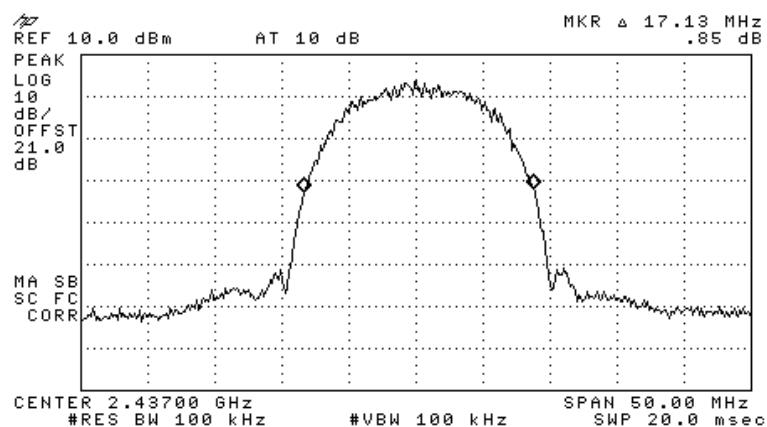


Figure 25 — Channel 6, 11 Mbps

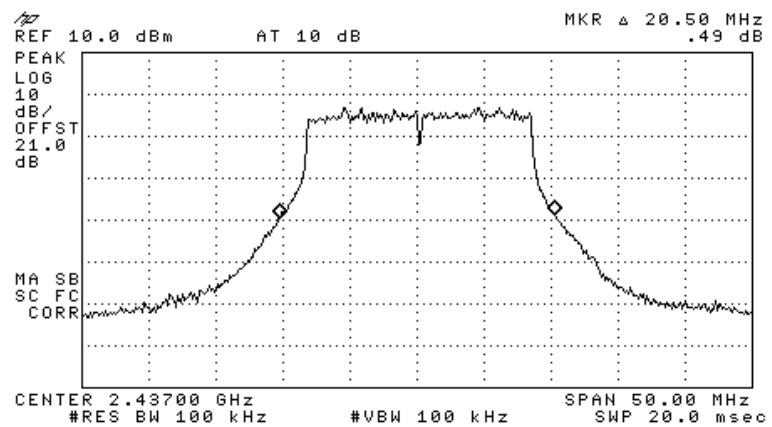


Figure 26 — Channel 6, 54 Mbps

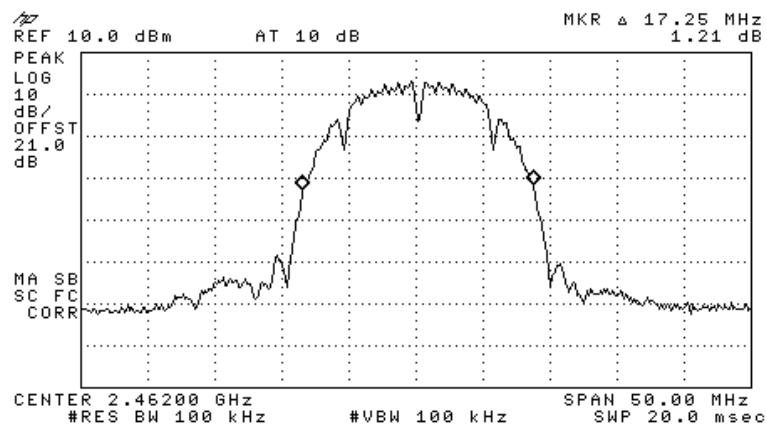


Figure 27 — Channel 11, 1 Mbps

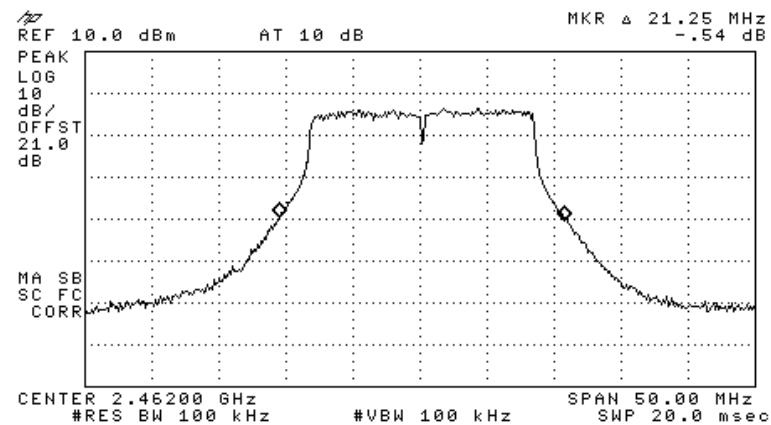


Figure 28 — Channel 11, 6 Mbps

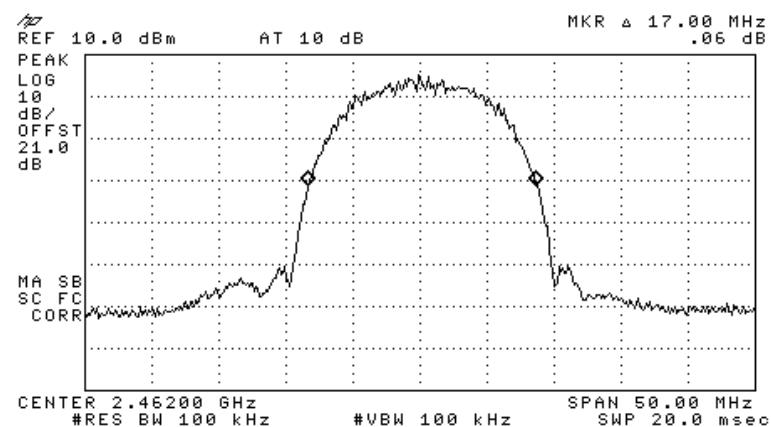


Figure 29 — Channel 11, 11 Mbps

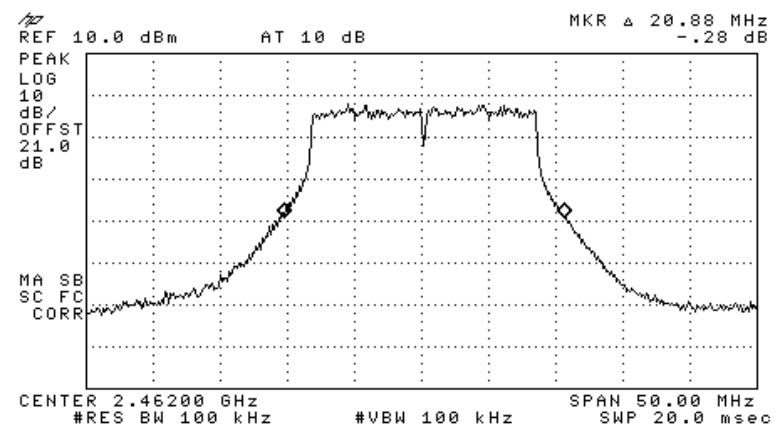


Figure 30 — Channel 11, 54 Mbps

5.2 Results table

E.U.T Description: Nano WiREACH SMT Module With On-Board Antenna and External Antenna

Model No.: 1. BRD-Nano-SMT-Ant; P/NL iW-SM2144SMT-OB
2. BRD-Nano-SMT-UFL; P/NL iW-SM2144SMT-EX

Serial Number: Not Designated

Specification: F.C.C. Part 15, Subpart C: (15.247-a2)

Operation Frequency (MHz)	Modulation (Mbps)	Reading (MHz)	Specification (MHz)
2412	1	17.25	0.5
	6	21.00	0.5
	11	17.13	0.5
	54	20.75	0.5
2437	1	17.38	0.5
	6	2075	0.5
	11	17.13	0.5
	54	20.50	0.5
2462	1	17.25	0.5
	6	21.25	0.5
	11	17.00	0.5
	54	20.88	0.5

Figure 31 26 dB Minimum Bandwidth

JUDGEMENT: Passed

TEST PERSONNEL:

Tester Signature:  Date: 06.07.11

Typed/Printed Name: A. Moses

5.3 **Test Equipment Used.**

26 dB Minimum Bandwidth

Instrument	Manufacturer	Model	Serial/Part Number	Calibration	
				Last Calibration	Period
Spectrum Analyzer	HP	8592L	3826A01204	February 21, 2011	1 year
Attenuator	Jyebao	-	FAT-AM5AF5G6G2W20	January 04, 2011	1 year
Cable	Rhophase	KPS-5000-KPS	A1674	January 04, 2011	1 year

Figure 32 Test Equipment Used

6. Maximum Transmitted Peak Power Output

6.1 Test procedure

The E.U.T. antenna terminal was connected to the Spectrum Analyzer through an external attenuator (20 dB) and an appropriate coaxial cable (cable loss = 1 dB). The Spectrum Analyzer was set to 1.0 MHz resolution BW. Peak power level was measured at selected operation frequencies.

The E.U.T. was tested at 2412, 2437, and 2462 MHz with the following modulations: 1 Mbps, 6 Mbps, 11 Mbps, and 54 Mbps .

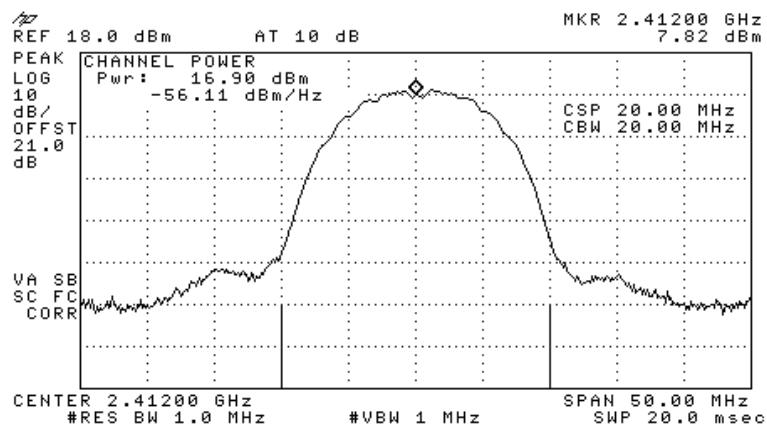


Figure 33 Channel 1, 1 Mbps

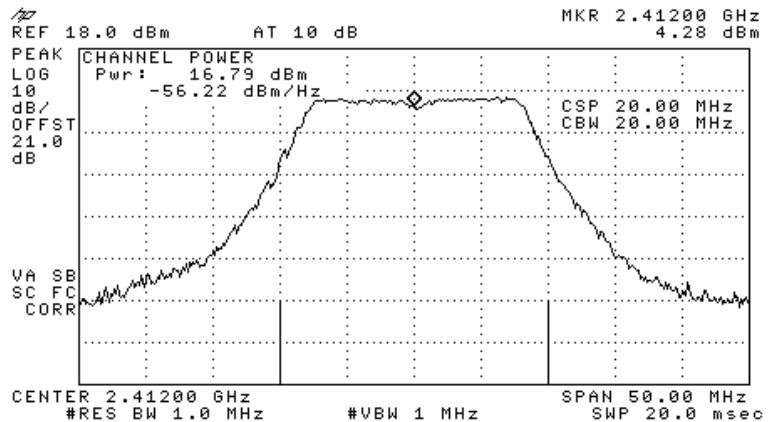


Figure 34 Channel 1, 6 Mbps

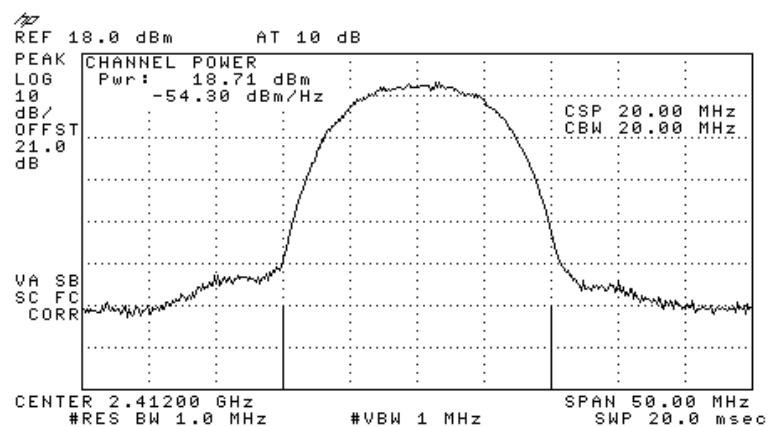


Figure 35 Channel 1, 11 Mbps

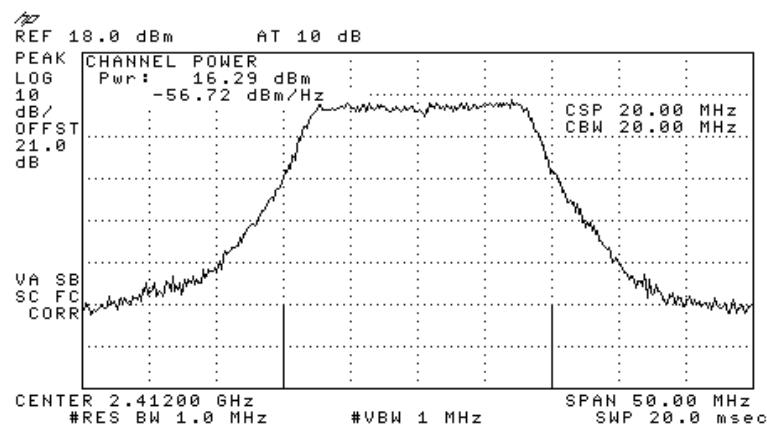


Figure 36 Channel 1, 54 Mbps

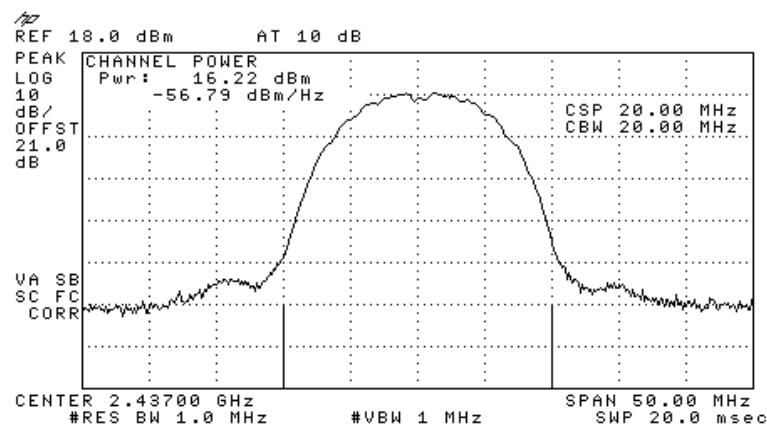


Figure 37 Channel 6, 1 Mbps

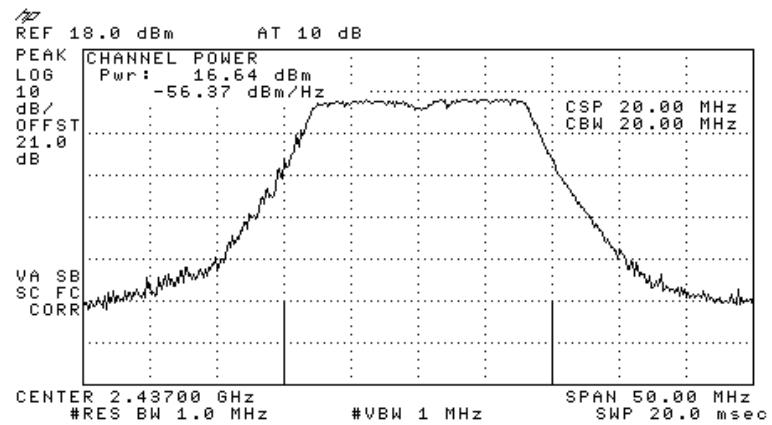


Figure 38 Channel 6, 6 Mbps

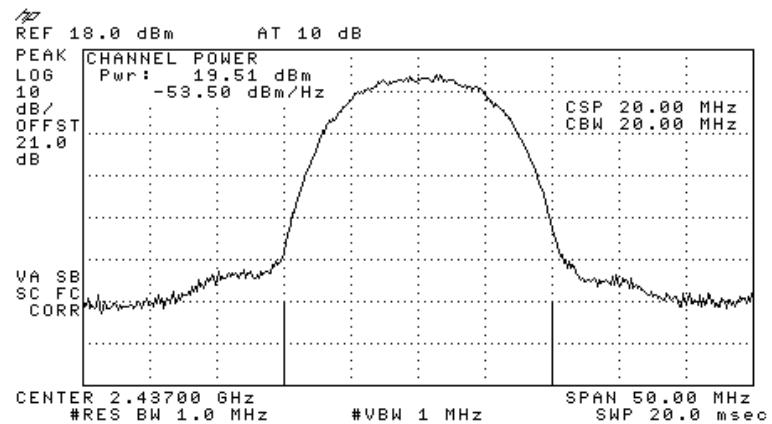


Figure 39 Channel 6, 11 Mbps

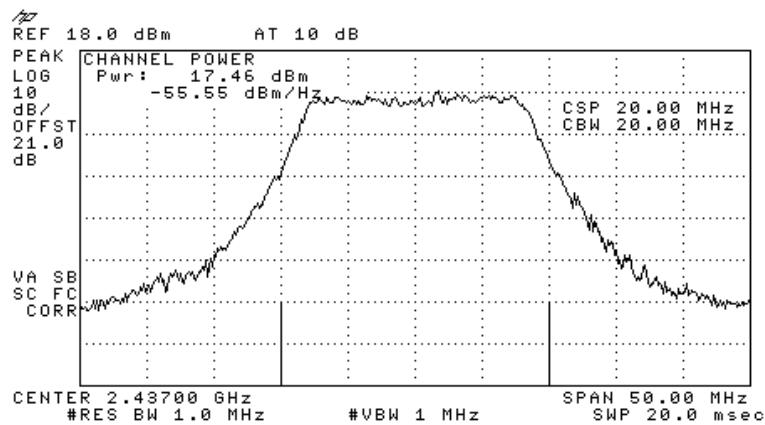


Figure 40 Channel 6, 54 Mbps

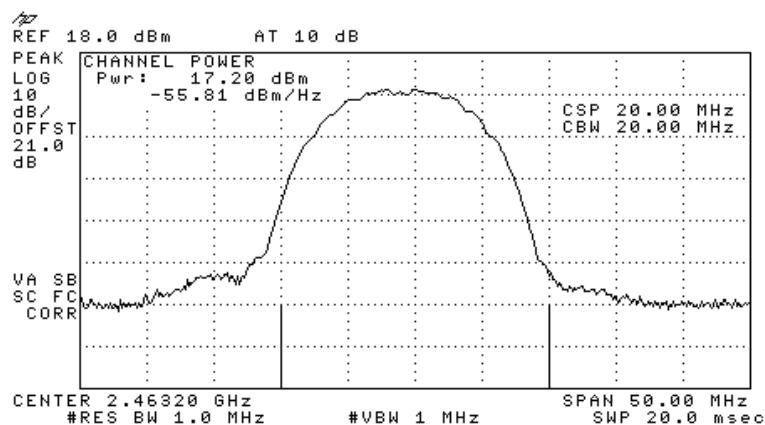


Figure 41 Channel 11, 1 Mbps

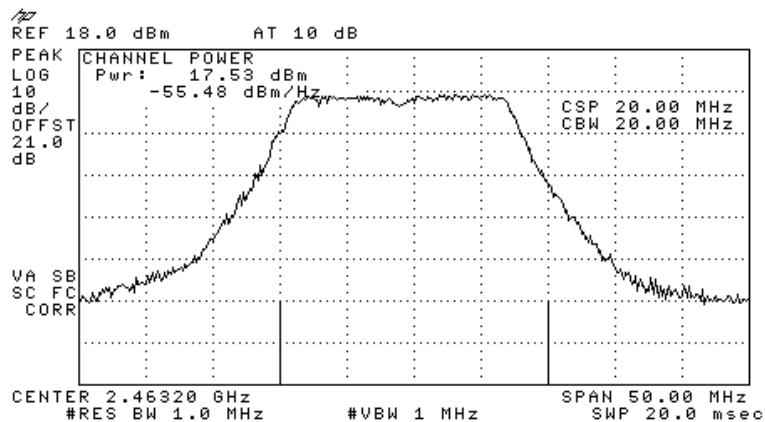


Figure 42 Channel 11, 6 Mbps

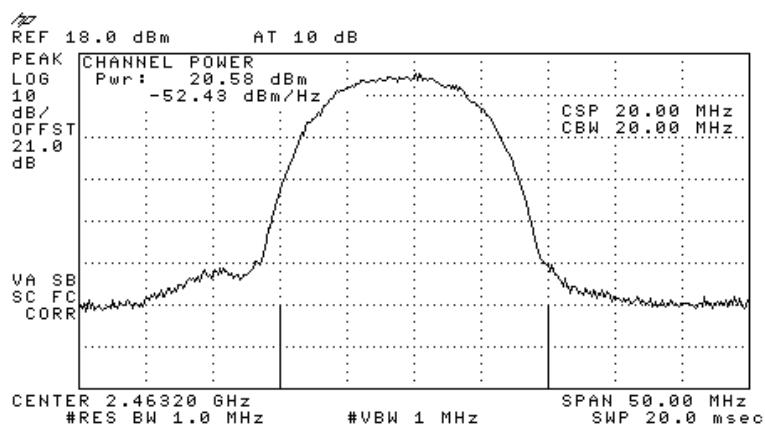


Figure 43 Channel 11, 11 Mbps

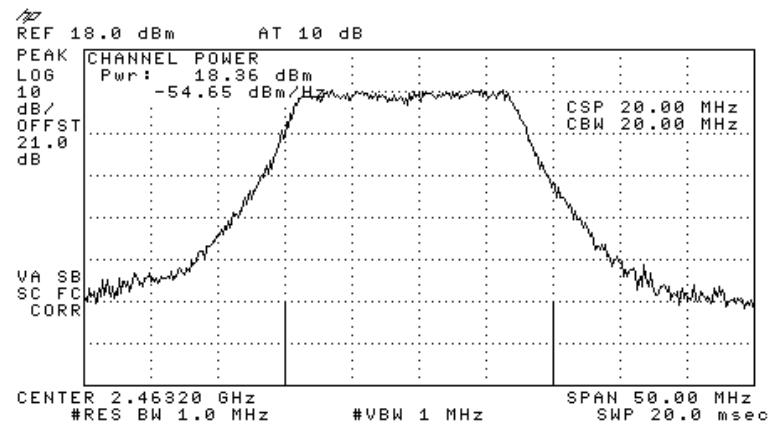


Figure 44 Channel 11, 54 Mbps

6.2 Results table

E.U.T. Description: Nano WiREACH SMT Module With On-Board Antenna and External Antenna
 Model No.: 1. BRD-Nano-SMT-Ant; P/NL iW-SM2144SMT-OB
 2. BRD-Nano-SMT-UFL; P/NL iW-SM2144SMT-EX
 Serial Number: Not Designated
 Specification: F.C.C. Part 15, Subpart C Section 15.247(b)

Operation Frequency (MHz)	Modulation (Mbps)	Reading (dBm)	Specification (dBm)	Margin (dB)
2412	1	16.90	30.0	-13.10
	6	16.79	30.0	-13.21
	11	18.71	30.0	-11.29
	54	16.29	30.0	-13.71
2437	1	16.22	30.0	-13.78
	6	16.64	30.0	-13.36
	11	19.51	30.0	-10.49
	54	17.46	30.0	-12.54
2462	1	17.20	30.0	-12.80
	6	17.53	30.0	-12.47
	11	20.58	30.0	-9.42
	54	18.36	30.0	-11.64

Figure 45 Maximum Peak Power Output

JUDGEMENT: Passed by 9.42 dB

TEST PERSONNEL:

Tester Signature:  Date: 06.07.11

Typed/Printed Name: A. Moses

6.3 **Test Equipment Used.**

Peak Power Output

Instrument	Manufacturer	Model	Serial/Part Number	Calibration	
				Last Calibration	Period
Spectrum Analyzer	HP	8592L	3826A01204	February 21, 2011	1 year
Attenuator	Jyebao	-	FAT-AM5AF5G6G2W20	January 04, 2011	1 year
Cable	Rhophase	KPS-5000-KPS	A1674	January 04, 2011	1 year

Figure 46 Test Equipment Used

7. Peak Power Output Out of 2400-2483.5 MHz Band

7.1 *Test procedure*

The E.U.T. antenna terminal was connected to the spectrum analyzer through an external attenuator (20 dB) and an appropriate coaxial cable (cable loss = 1 dB). The spectrum analyzer was set to 100 kHz resolution BW except for the frequency range

9 kHz-150 kHz where the RBW was set to 1kHz and the frequency range 150 kHz-10 MHz where the RBW was set to 10kHz. The frequency range from 9 kHz to 25 GHz was scanned. Level of spectrum components out of the 2400-2483.5 MHz was measured at the selected operation frequencies.

The E.U.T. was tested at 2412, 2437, and 2462 MHz with the following modulations: 1 Mbps, 6 Mbps, 11 Mbps and 54 Mbps.

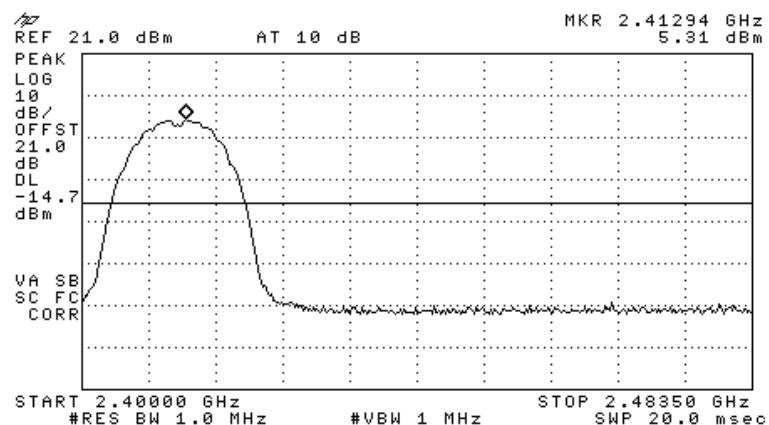


Figure 47 — Channel 1, 1 Mbps

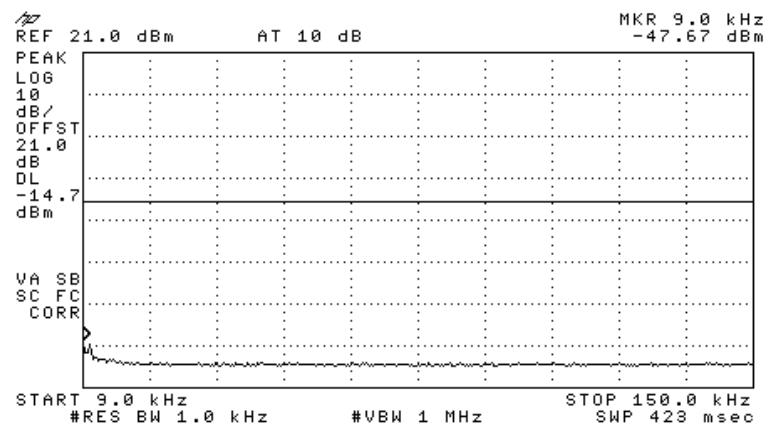


Figure 48 — Channel 1, 1 Mbps

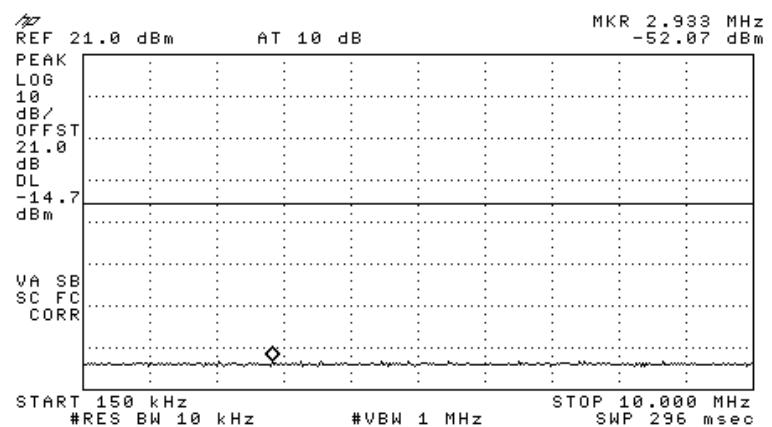


Figure 49 — Channel 1, 1 Mbps

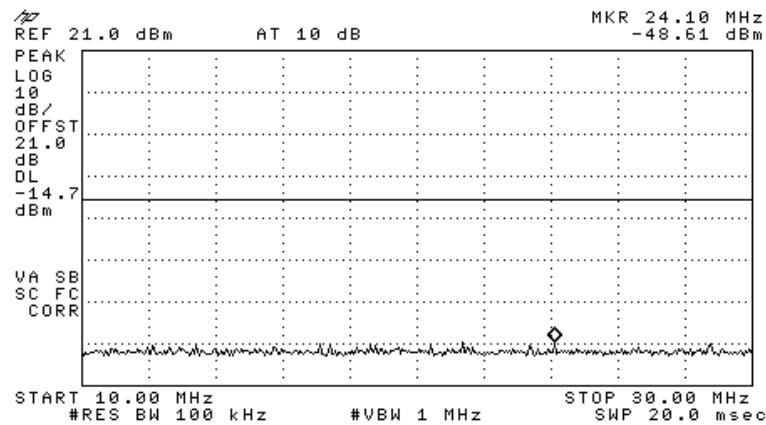


Figure 50 — Channel 1, 1 Mbps

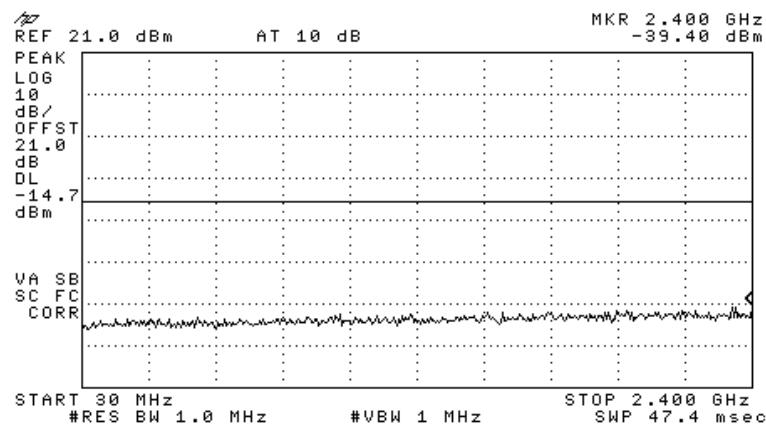


Figure 51 — Channel 1, 1 Mbps

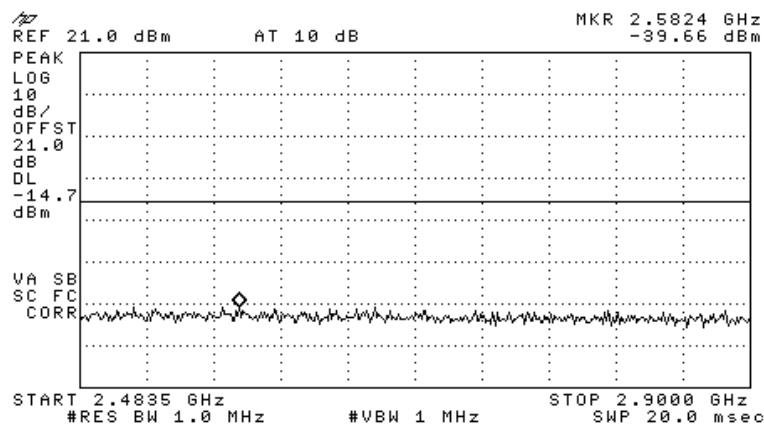


Figure 52 — Channel 1, 1 Mbps

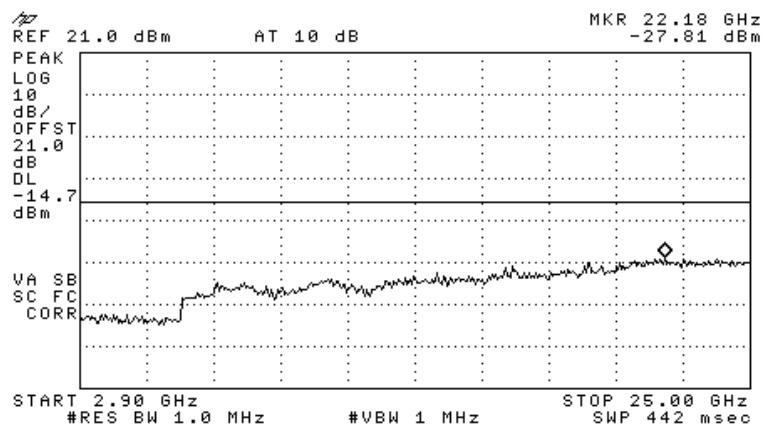


Figure 53 — Channel 1, 1 Mbps

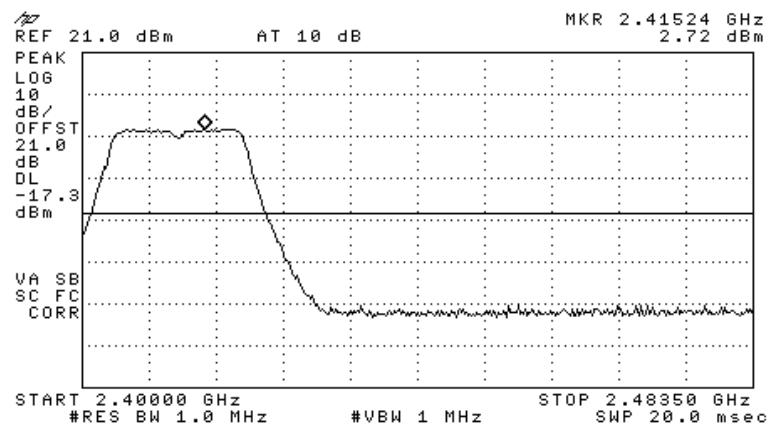


Figure 54 — Channel 1, 6 Mbps

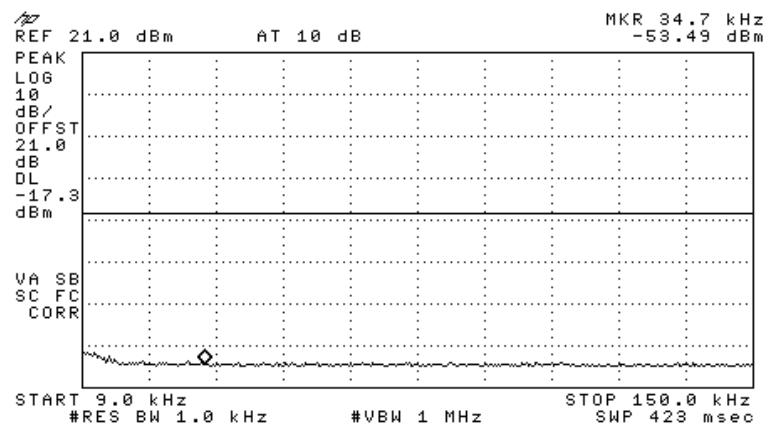


Figure 55 — Channel 1, 6 Mbps

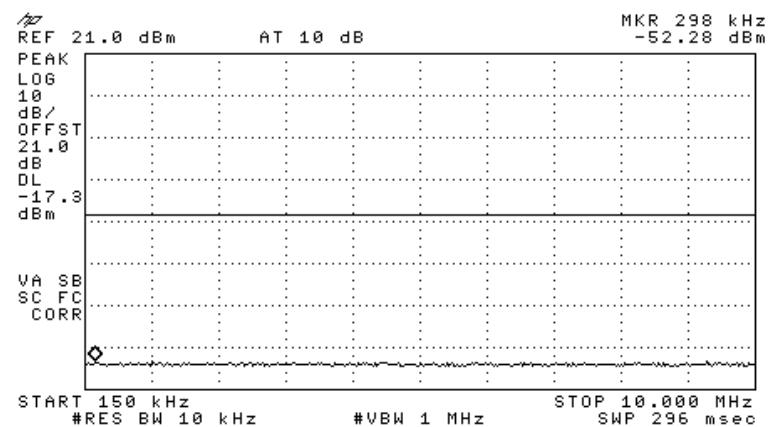


Figure 56 — Channel 1, 6 Mbps

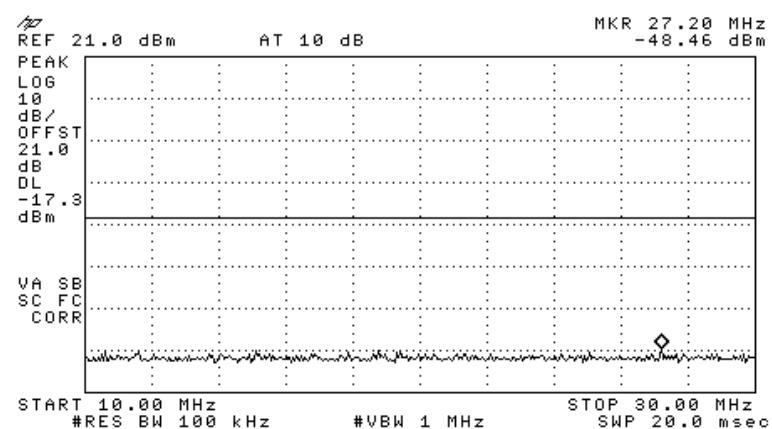


Figure 57 — Channel 1, 6 Mbps

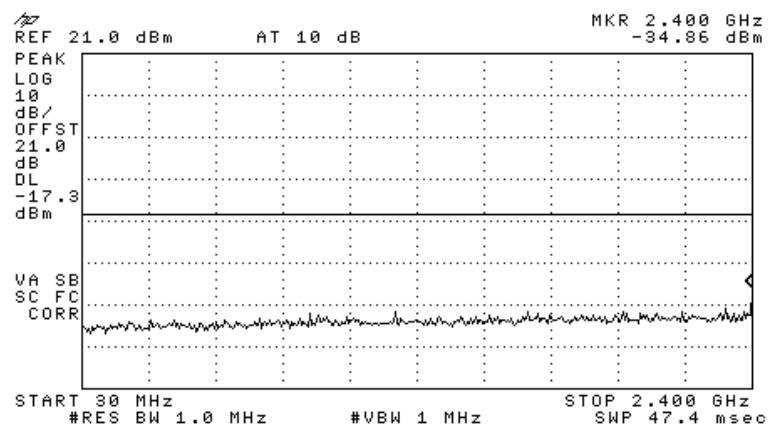


Figure 58 — Channel 1, 6 Mbps

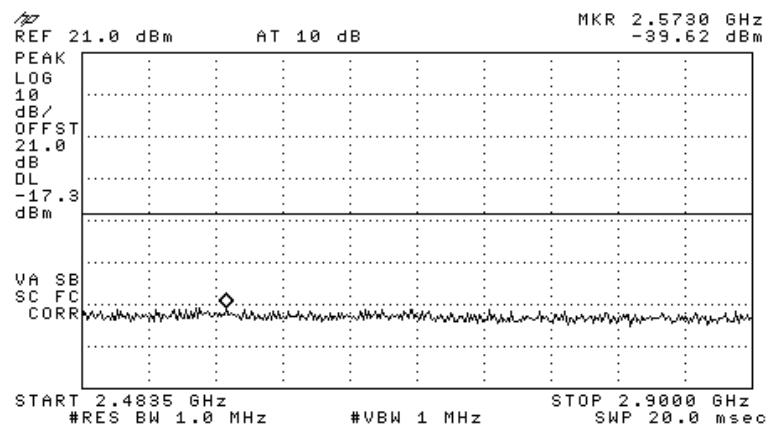


Figure 59 — Channel 1, 6 Mbps

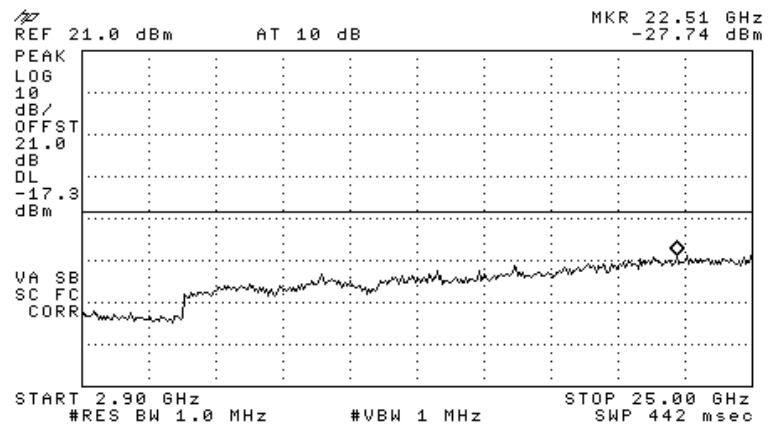


Figure 60 — Channel 1, 6 Mbps

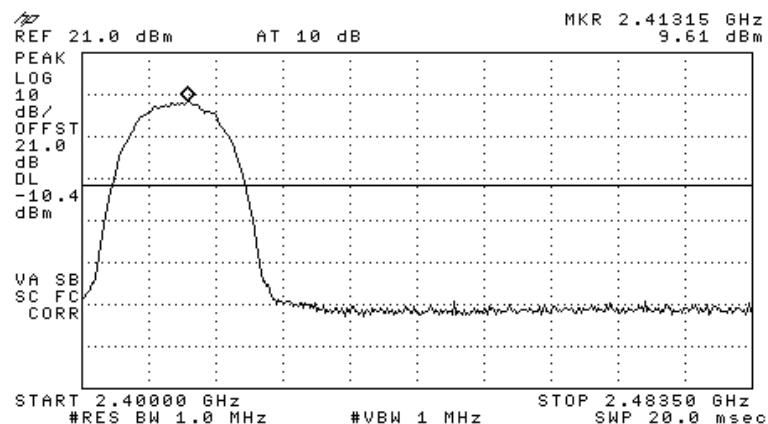


Figure 61 — Channel 1, 11 Mbps

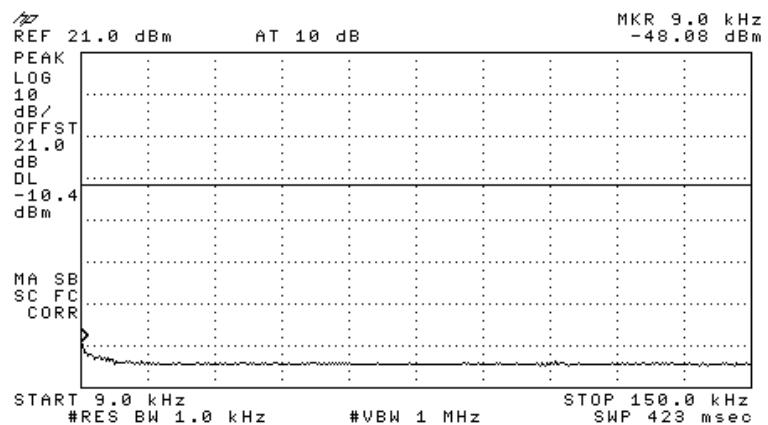


Figure 62 — Channel 1, 11 Mbps

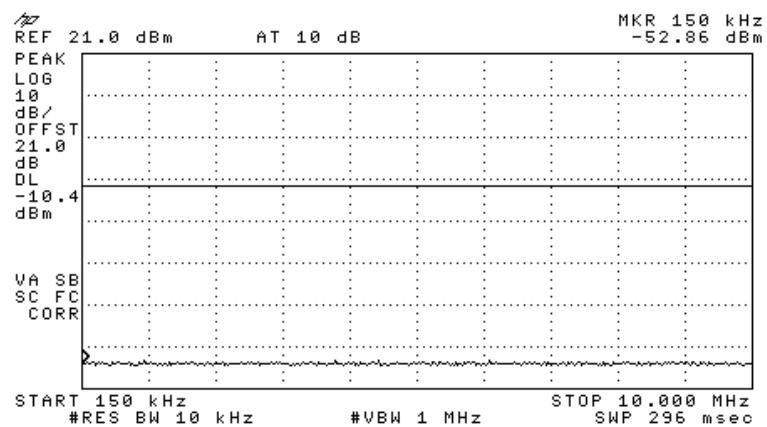


Figure 63 — Channel 1, 11 Mbps

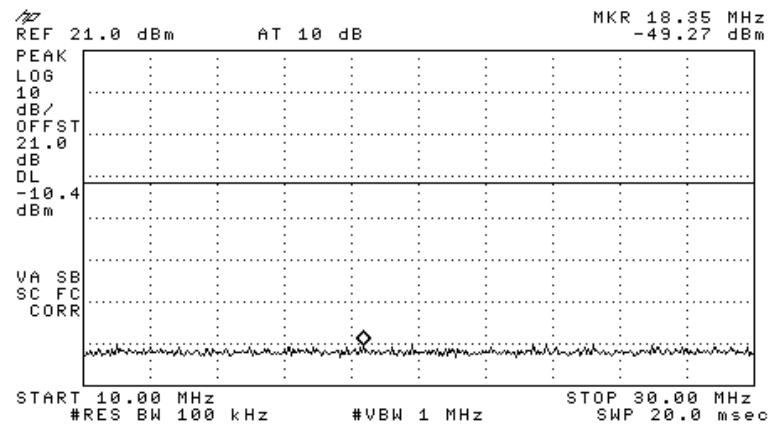


Figure 64 — Channel 1, 11 Mbps

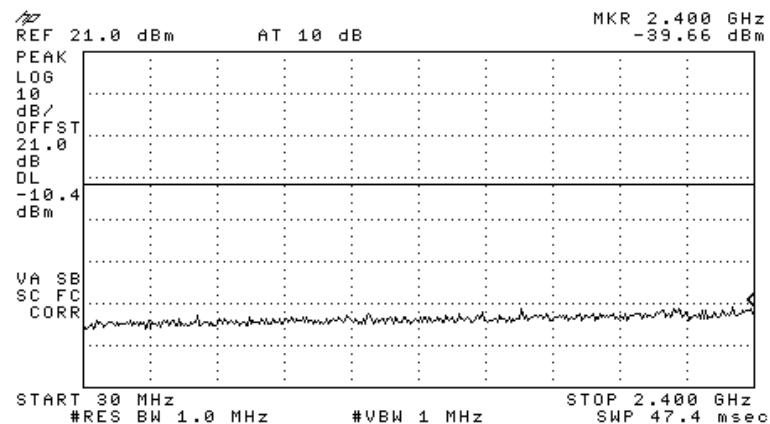


Figure 65 — Channel 1, 11 Mbps

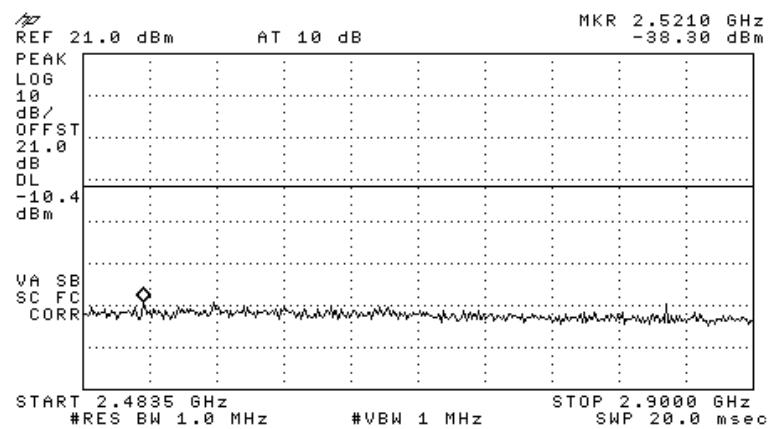


Figure 66 — Channel 1, 11 Mbps

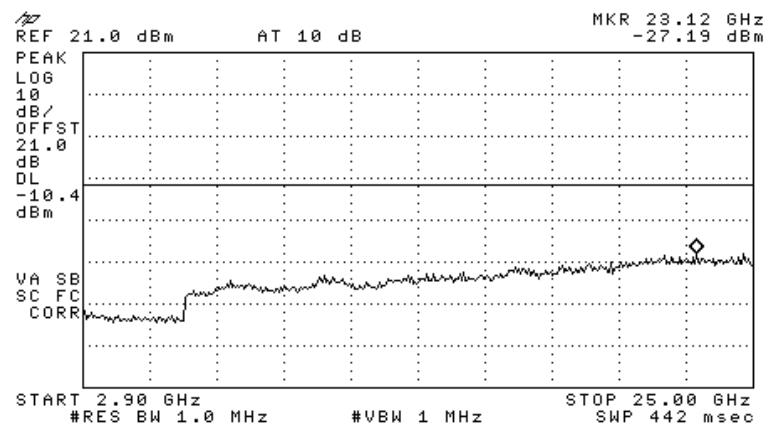


Figure 67 — Channel 1, 11 Mbps

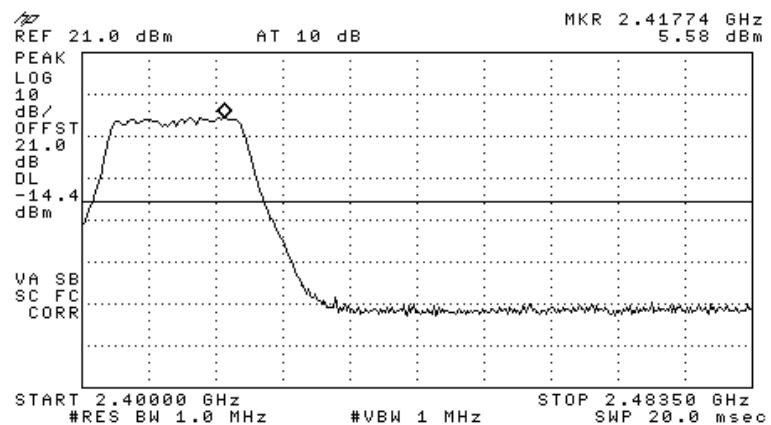


Figure 68 — Channel 1, 54 Mbps

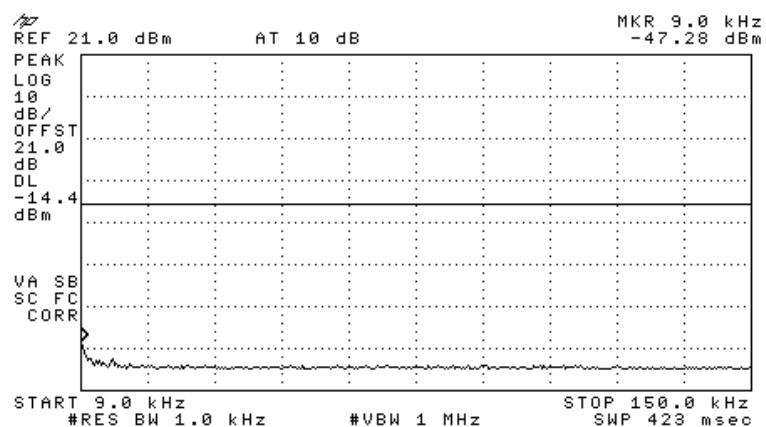


Figure 69 — Channel 1, 54 Mbps

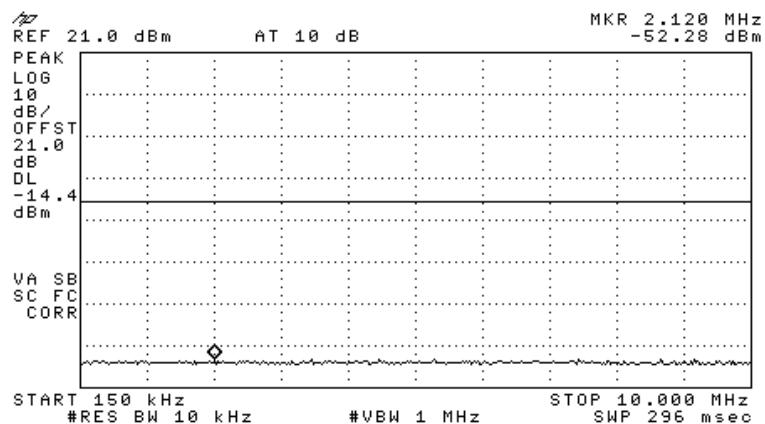


Figure 70 — Channel 1, 54 Mbps

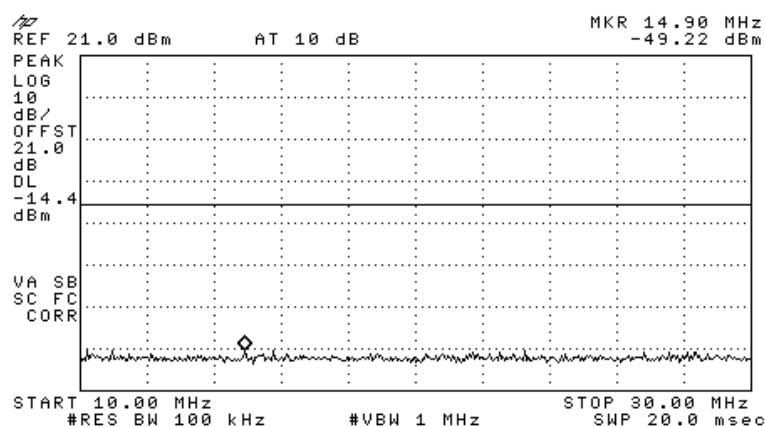


Figure 71 — Channel 1, 54 Mbps

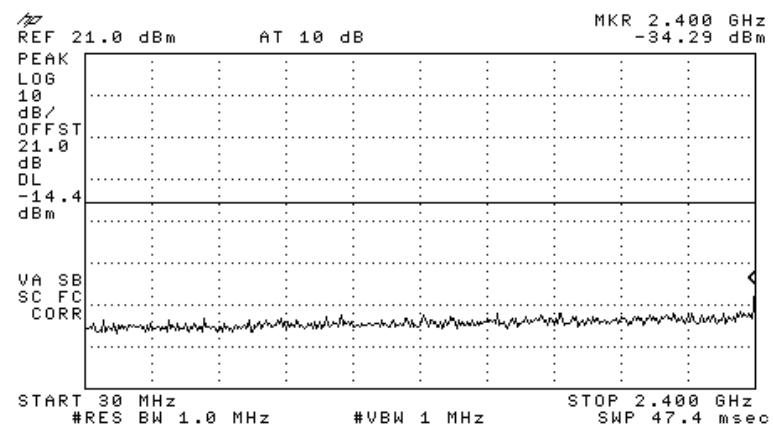


Figure 72 — Channel 1, 54 Mbps

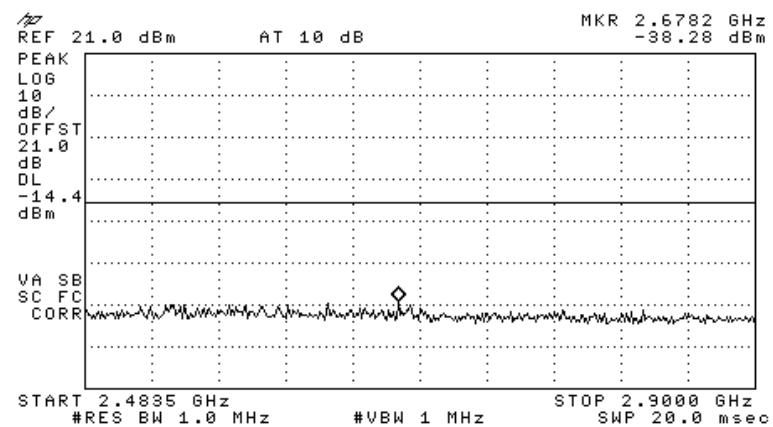


Figure 73 — Channel 1, 54 Mbps

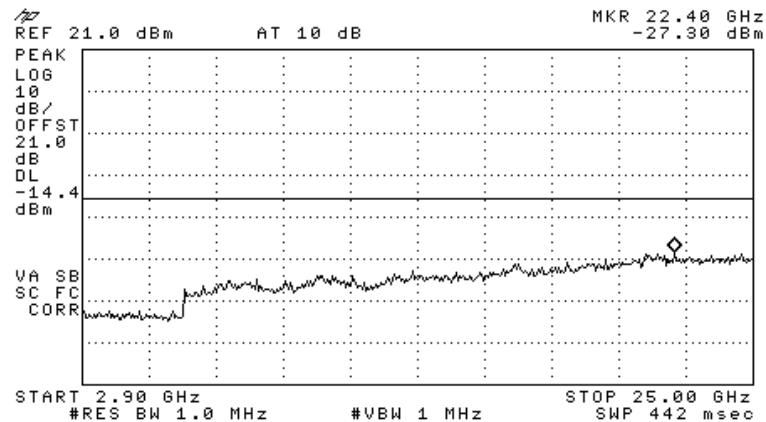


Figure 74 — Channel 1, 54 Mbps

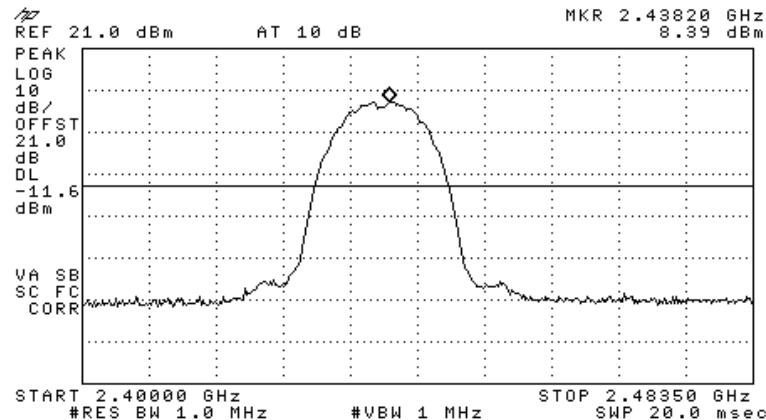


Figure 75 — Channel 6, 1 Mbps

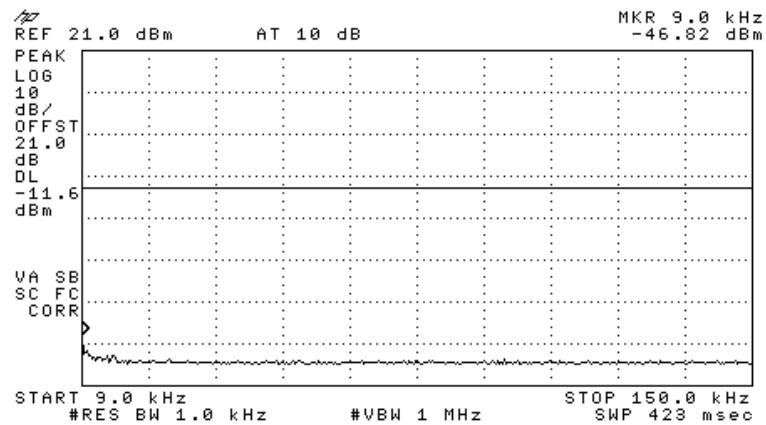


Figure 76 — Channel 6, 1 Mbps

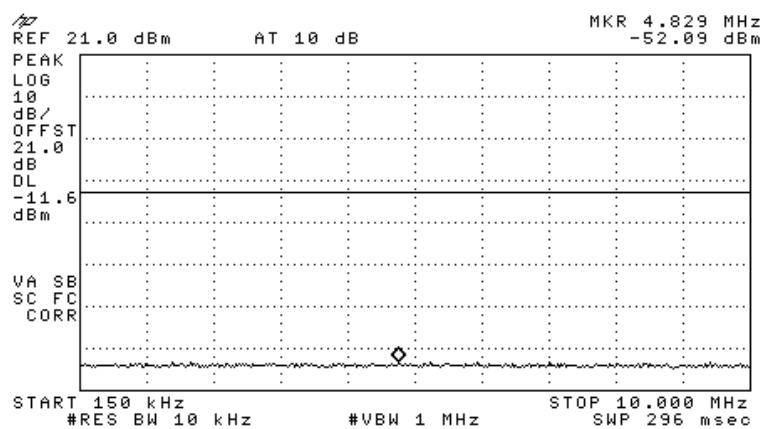


Figure 77 — Channel 6, 1 Mbps

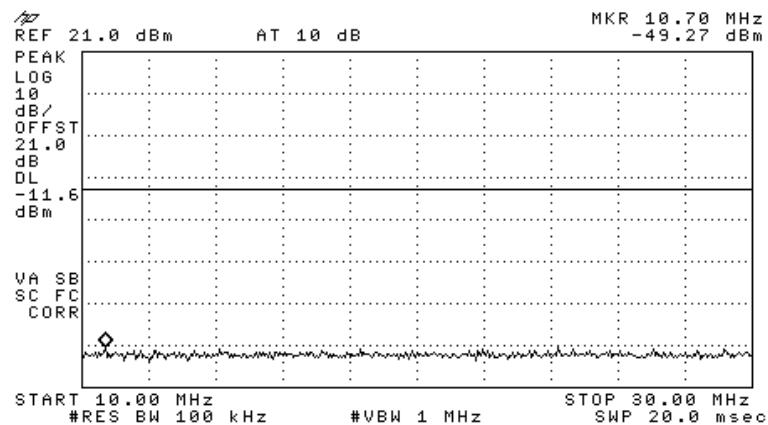


Figure 78 — Channel 6, 1 Mbps

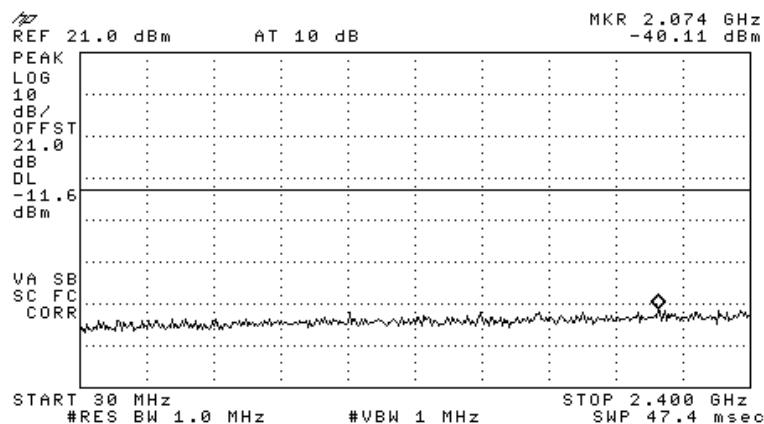


Figure 79 — Channel 6, 1 Mbps

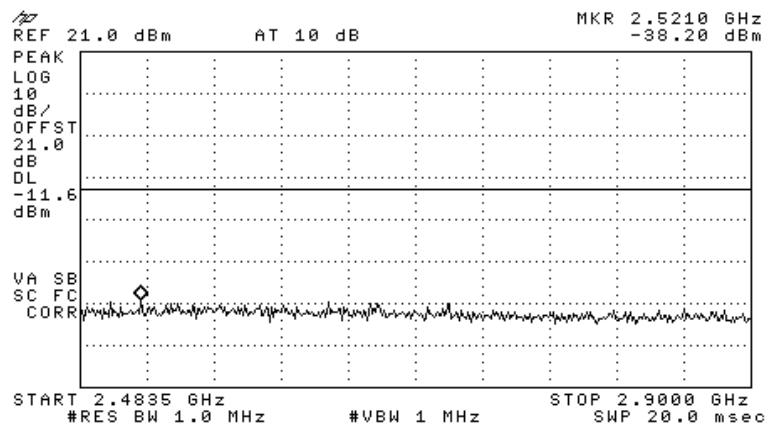


Figure 80 — Channel 6, 1 Mbps

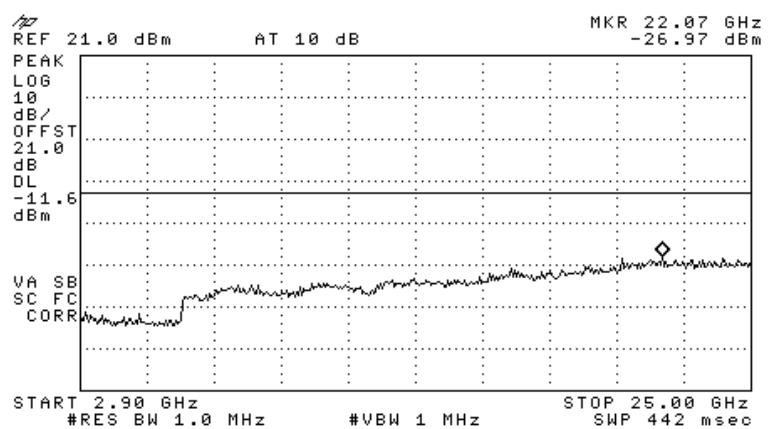


Figure 81 — Channel 6, 1 Mbps

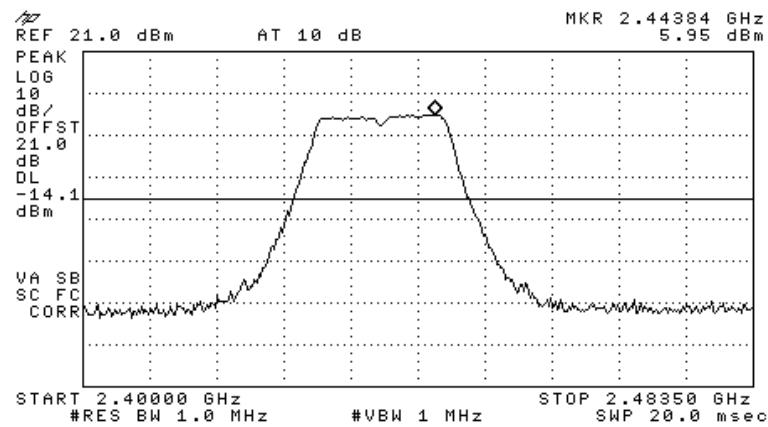


Figure 82 — Channel 6, 6 Mbps

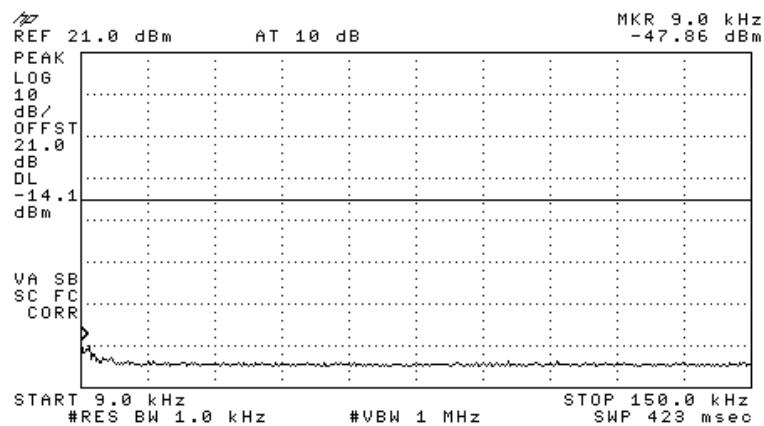


Figure 83 — Channel 6, 6 Mbps

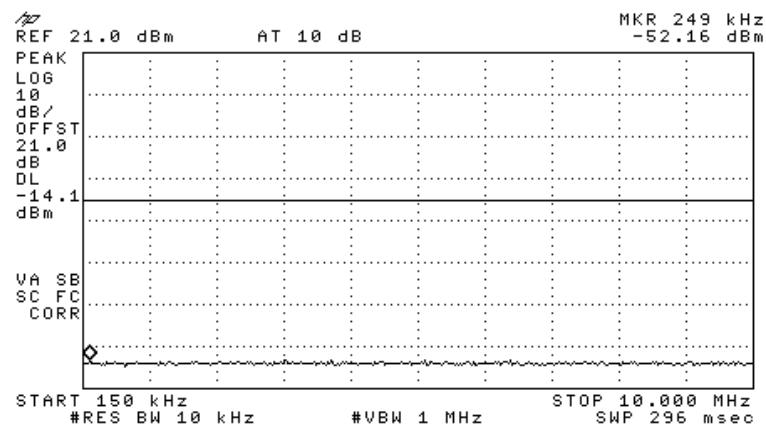


Figure 84 — Channel 6, 6 Mbps

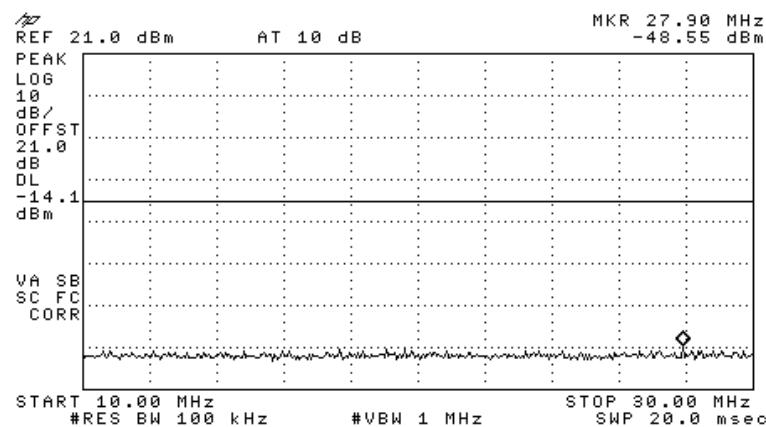


Figure 85 — Channel 6, 6 Mbps

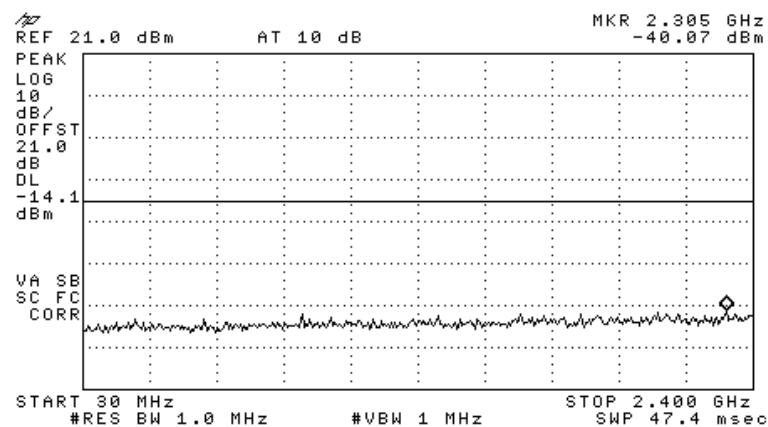


Figure 86 — Channel 6, 6 Mbps

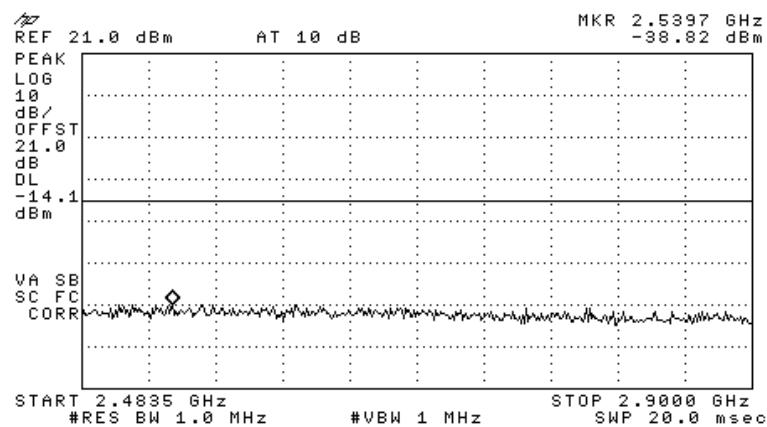


Figure 87 — Channel 6, 6 Mbps

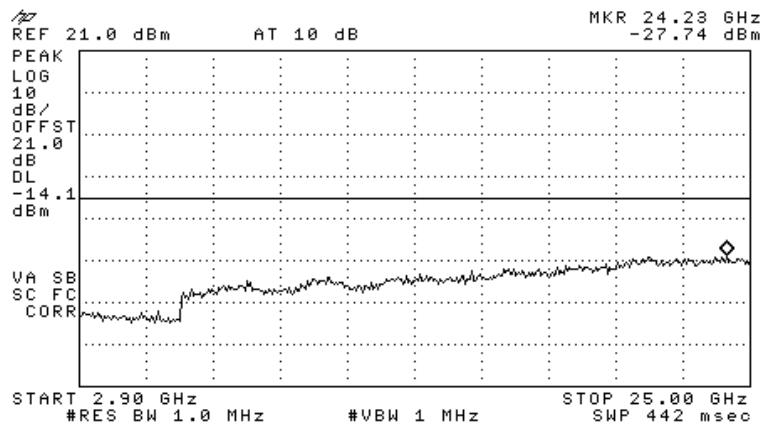


Figure 88 — Channel 6, 6 Mbps

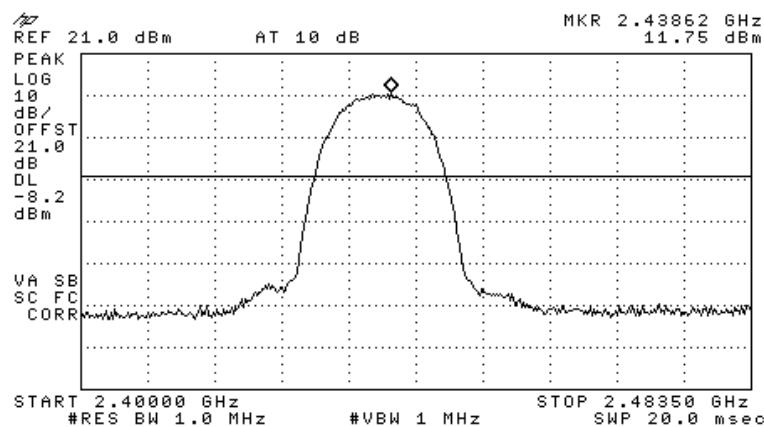


Figure 89 — Channel 6, 11 Mbps

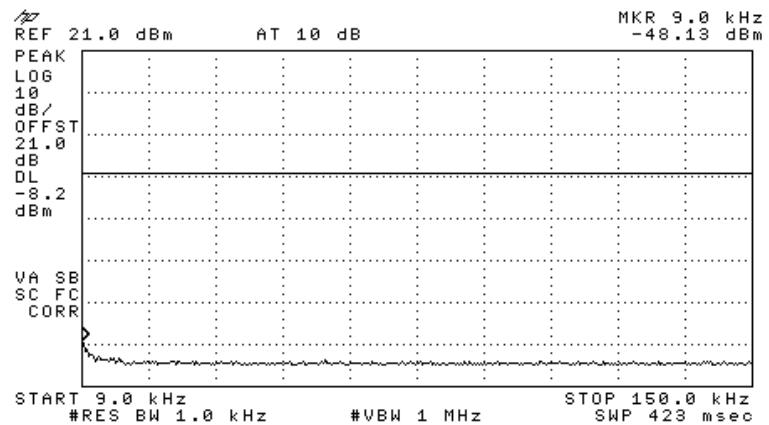


Figure 90 — Channel 6, 11 Mbps

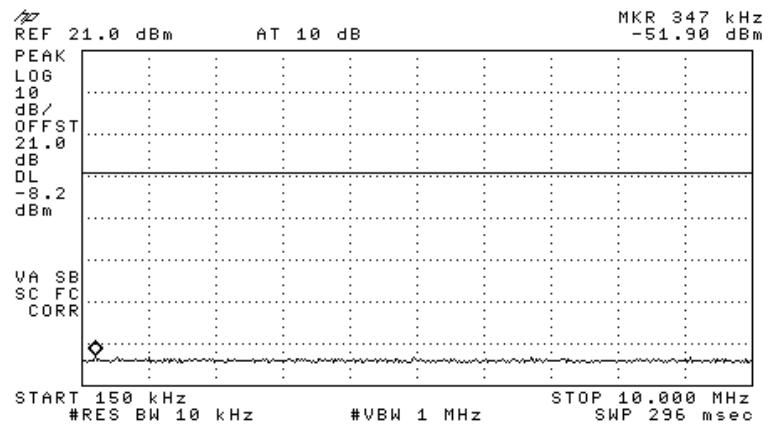


Figure 91 — Channel 6, 11 Mbps

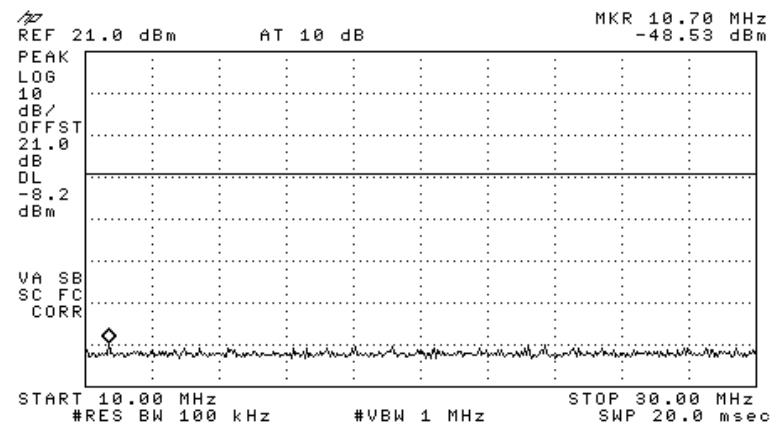


Figure 92 — Channel 6, 11 Mbps

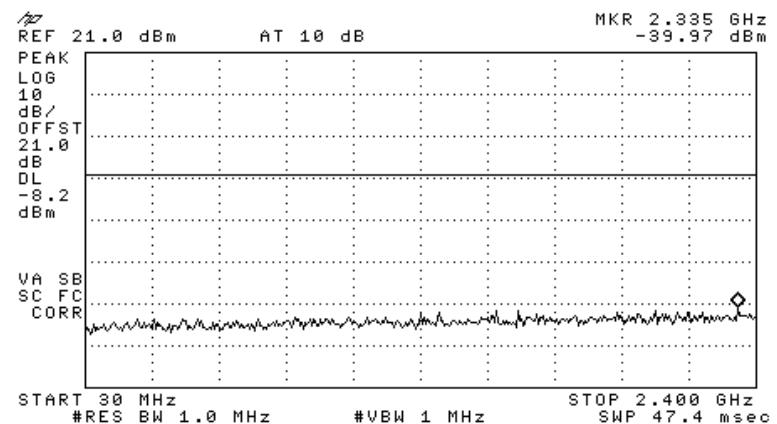


Figure 93 — Channel 6, 11 Mbps

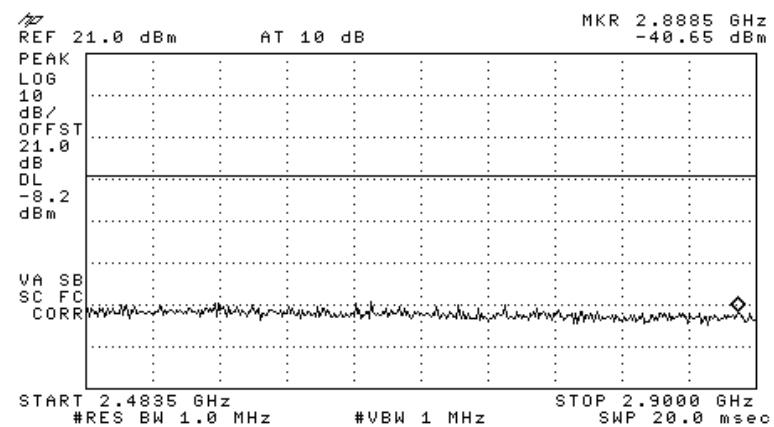


Figure 94 — Channel 6, 11 Mbps

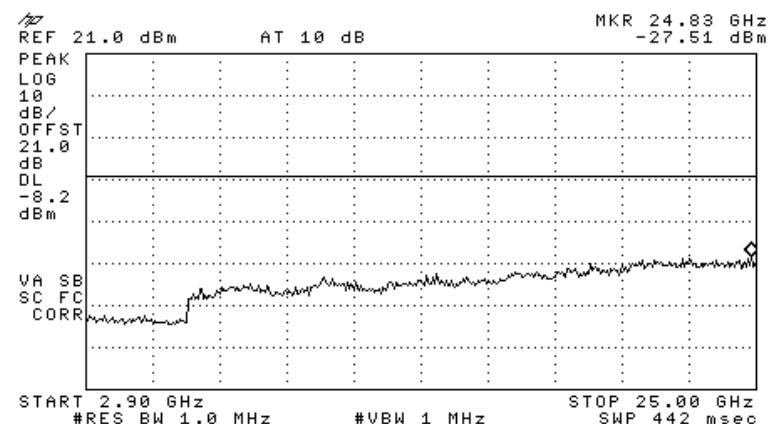


Figure 95 — Channel 6, 11 Mbps

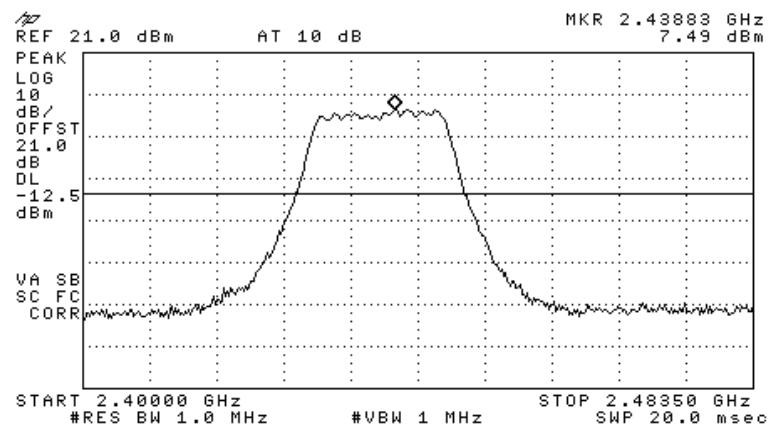


Figure 96 — Channel 6, 54 Mbps

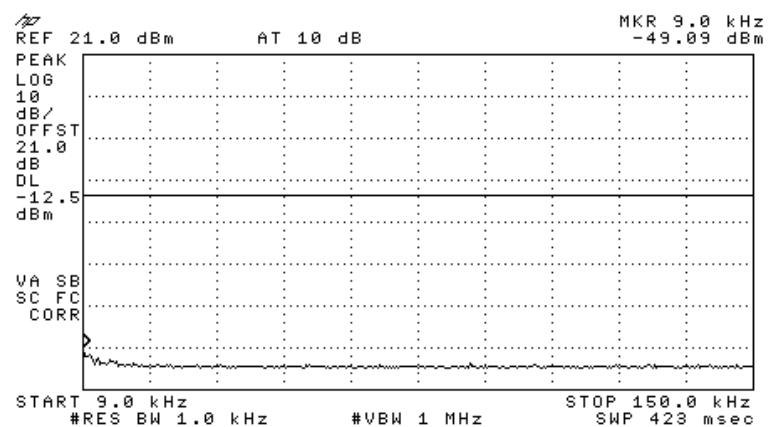


Figure 97 — Channel 6, 54 Mbps

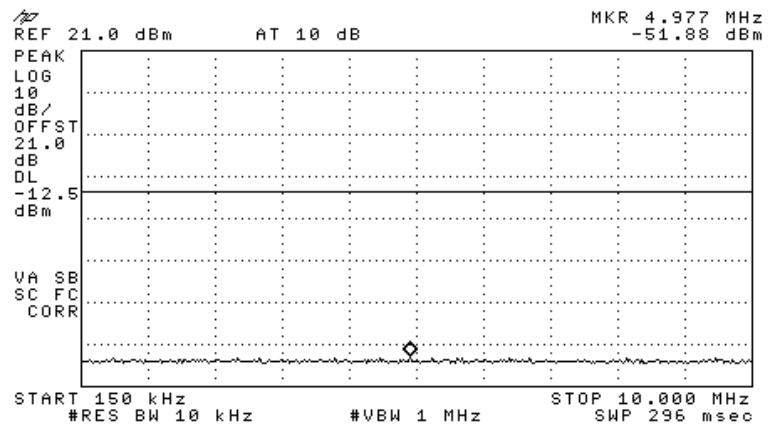


Figure 98 — Channel 6, 54 Mbps

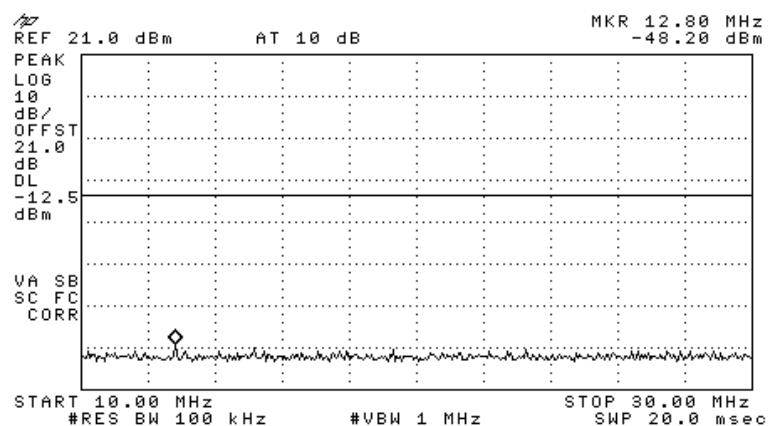


Figure 99 — Channel 6, 54 Mbps

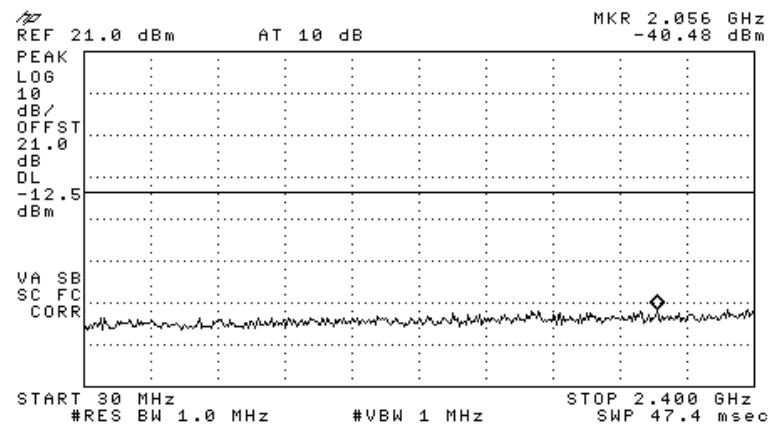


Figure 100 — Channel 6, 54 Mbps

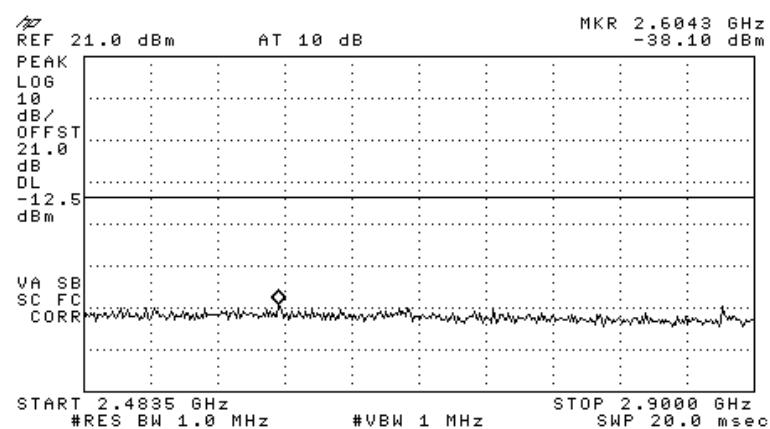


Figure 101 — Channel 6, 54 Mbps

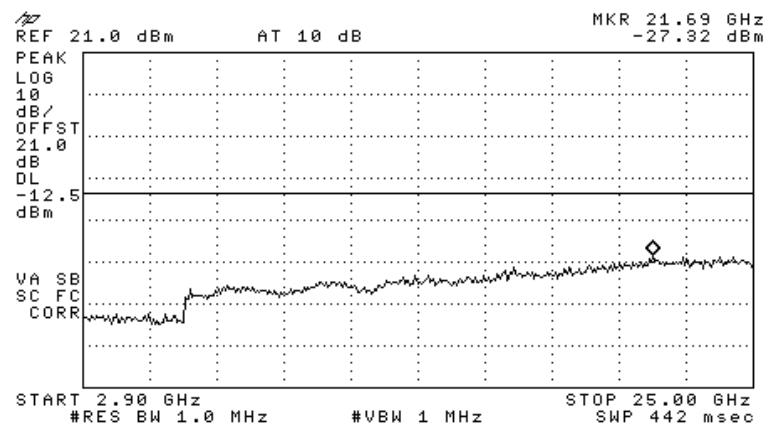


Figure 102 — Channel 6, 54 Mbps

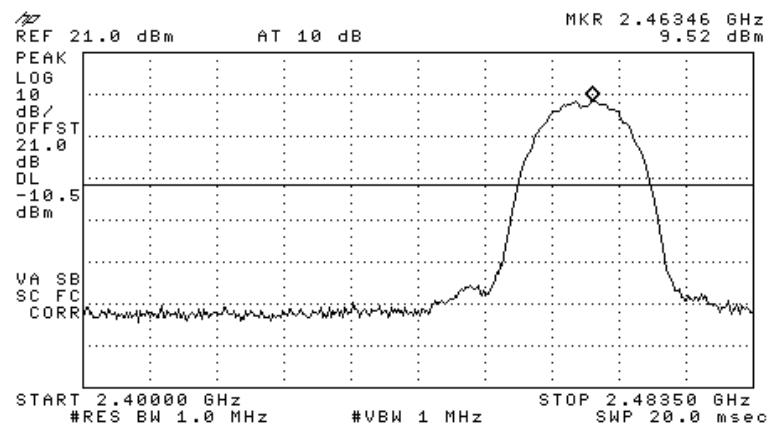


Figure 103 — Channel 11, 1 Mbps

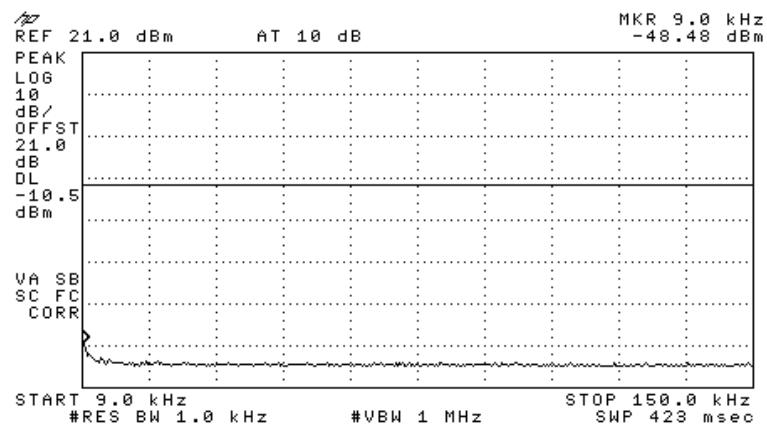


Figure 104 — Channel 11, 1 Mbps

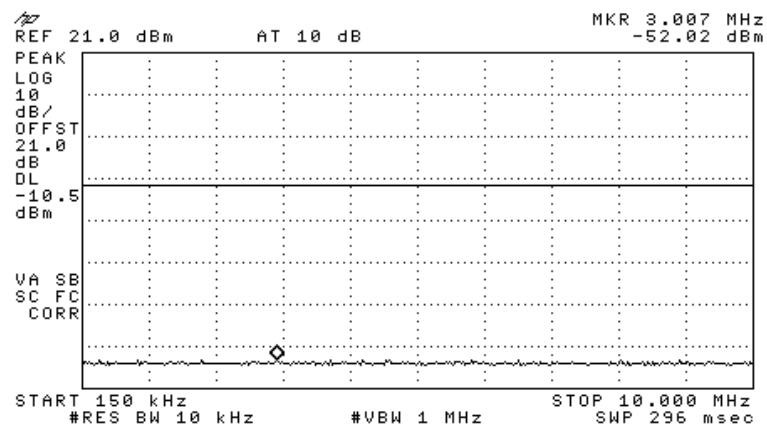


Figure 105 — Channel 11, 1 Mbps

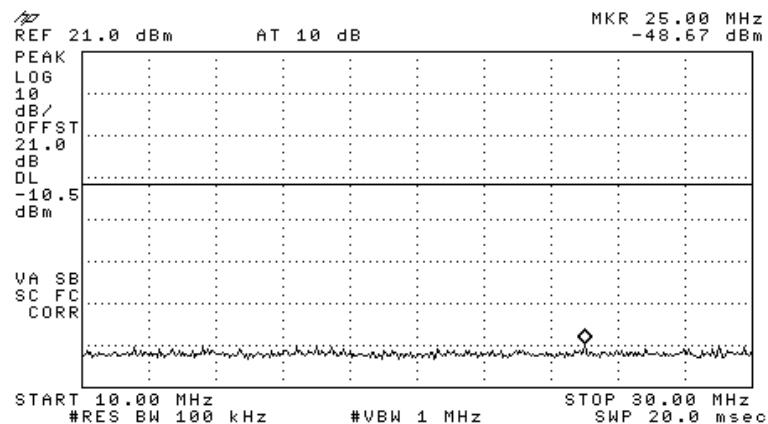


Figure 106 — Channel 11, 1 Mbps

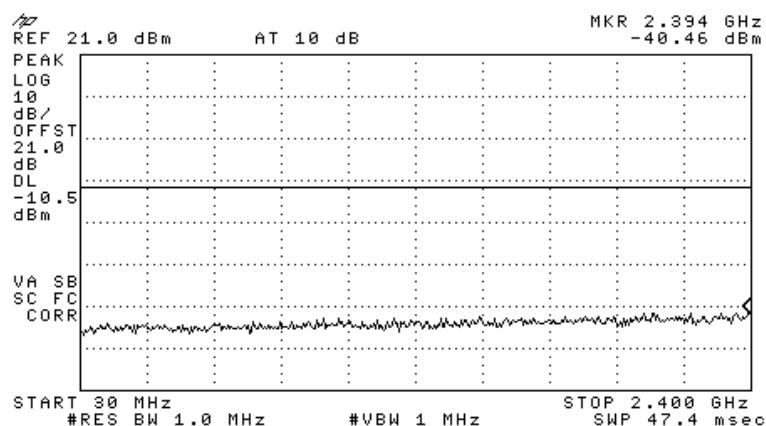


Figure 107 — Channel 11, 1 Mbps

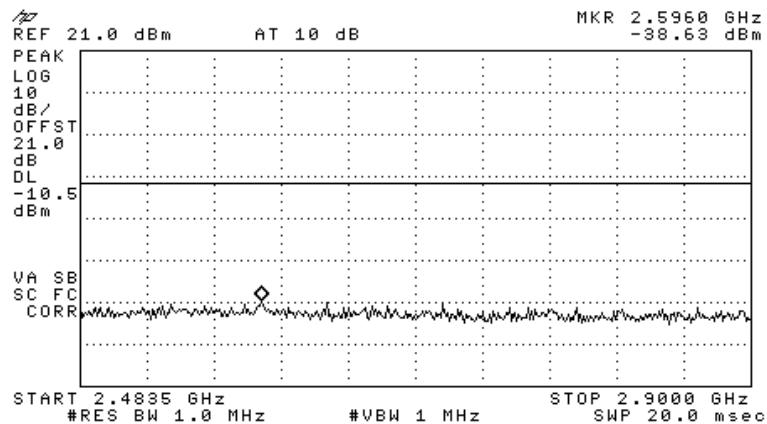


Figure 108 — Channel 11, 1 Mbps

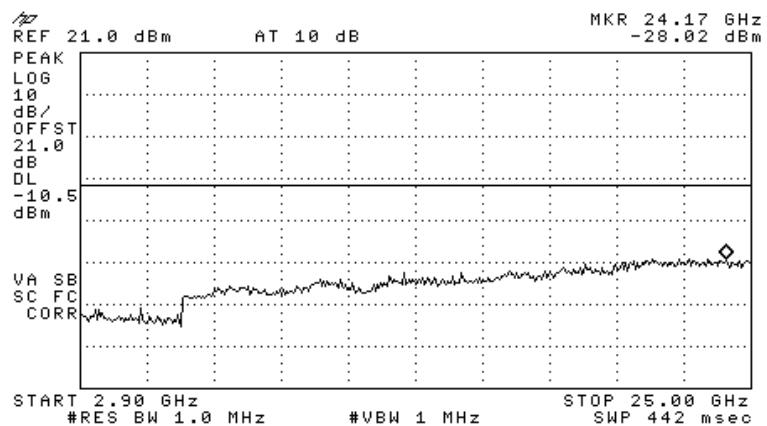


Figure 109 — Channel 11, 1 Mbps

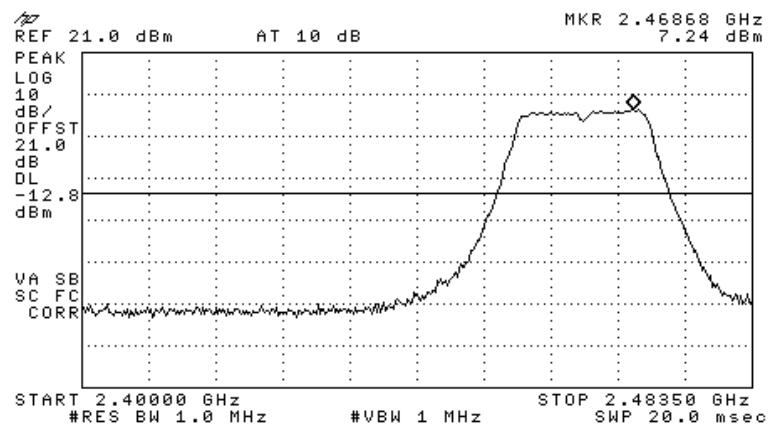


Figure 110 — Channel 11, 6 Mbps

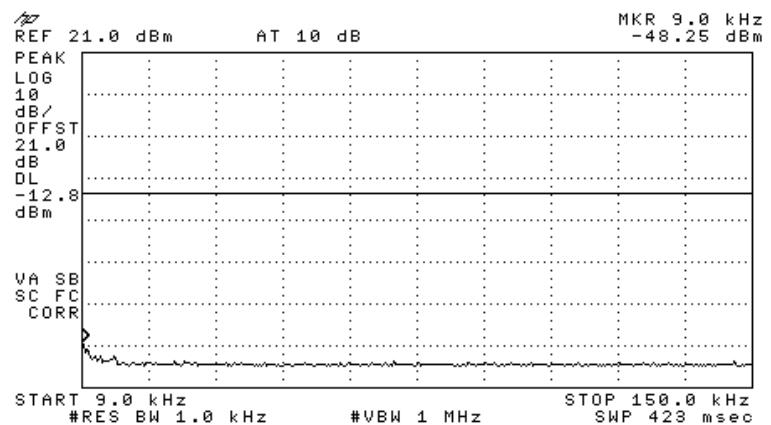


Figure 111 — Channel 11, 6 Mbps

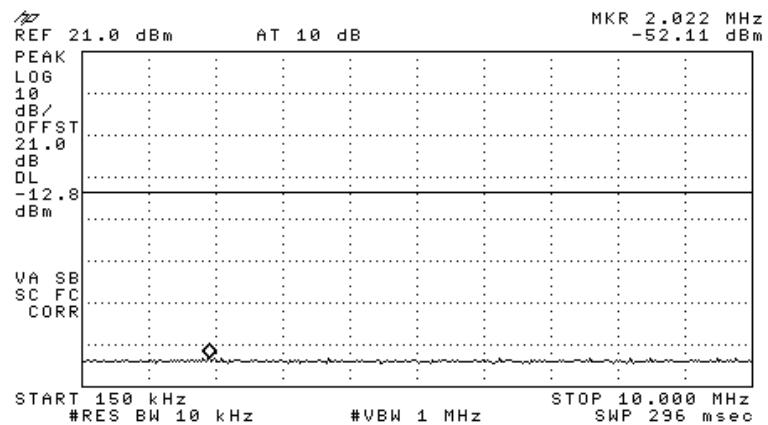


Figure 112 — Channel 11, 6 Mbps

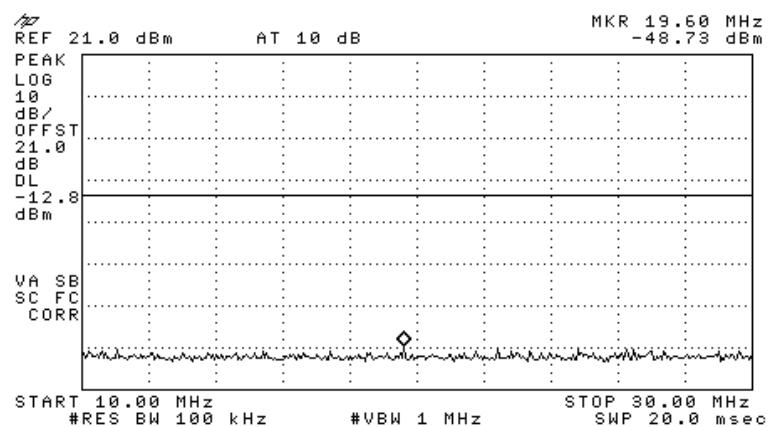


Figure 113 — Channel 11, 6 Mbps

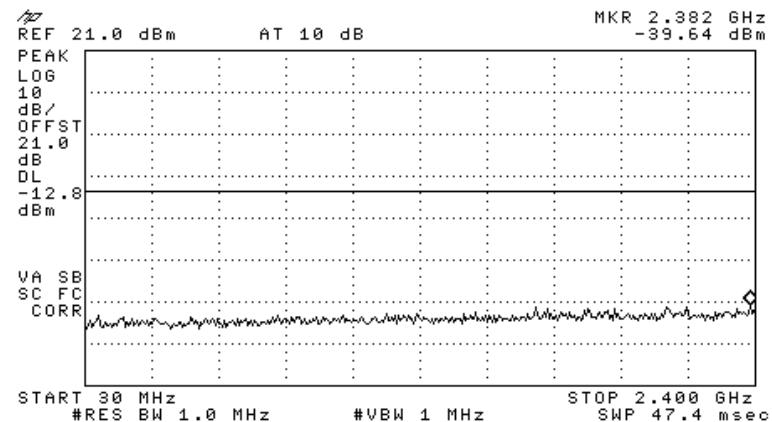


Figure 114 — Channel 11, 6 Mbps

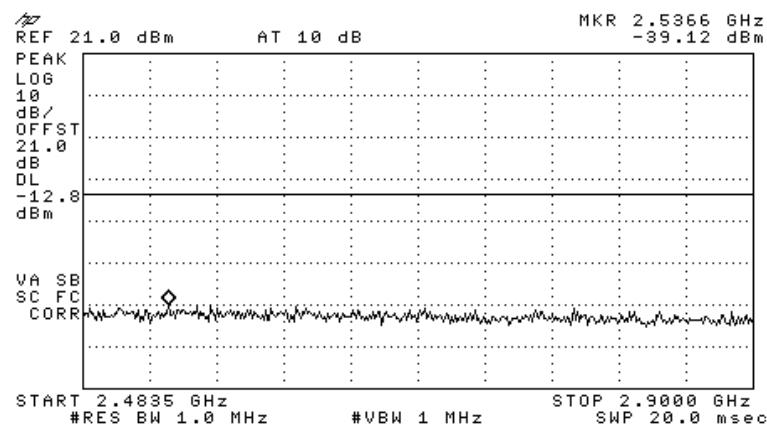


Figure 115 — Channel 11, 6 Mbps

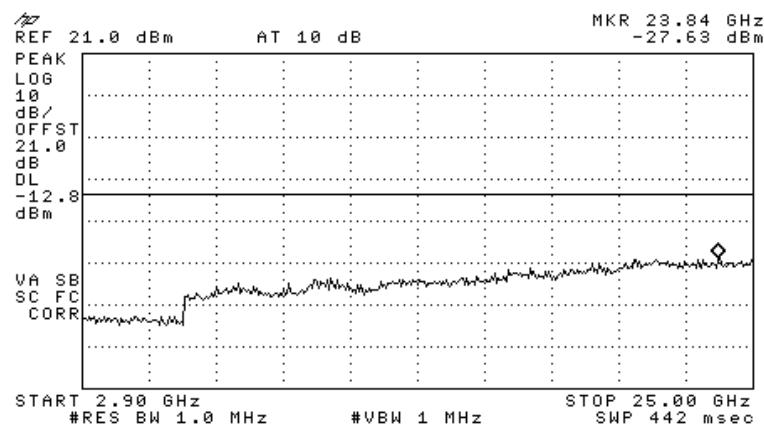


Figure 116 — Channel 11, 6 Mbps

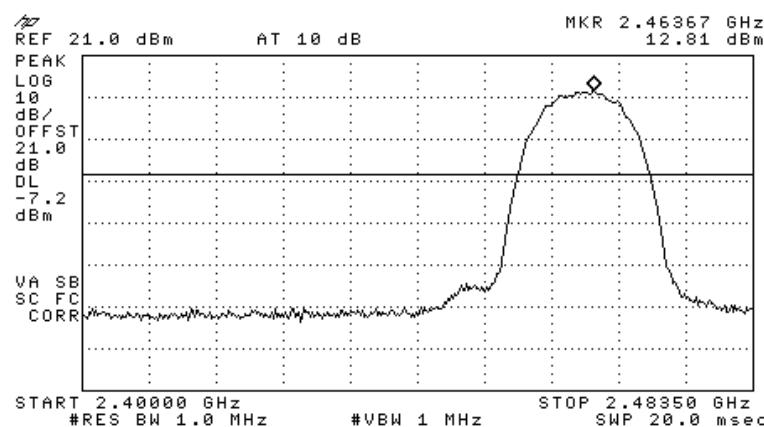


Figure 117 — Channel 11, 11 Mbps

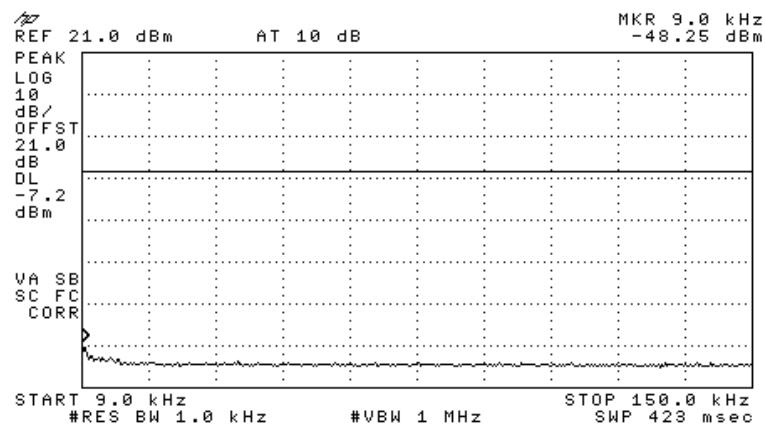


Figure 118 — Channel 11, 11 Mbps

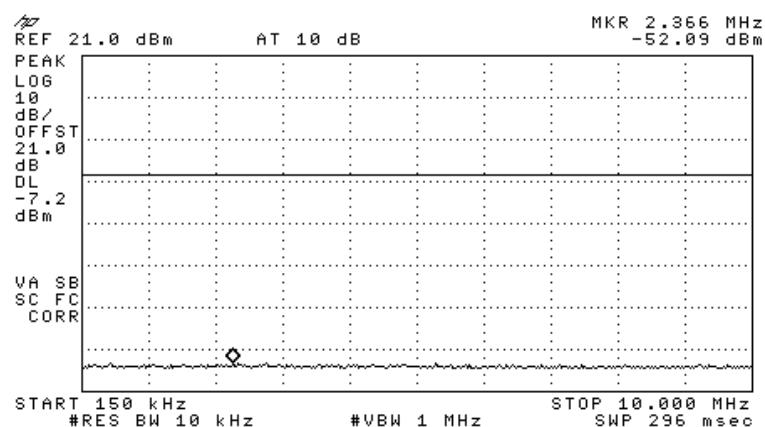


Figure 119 — Channel 11, 11 Mbps

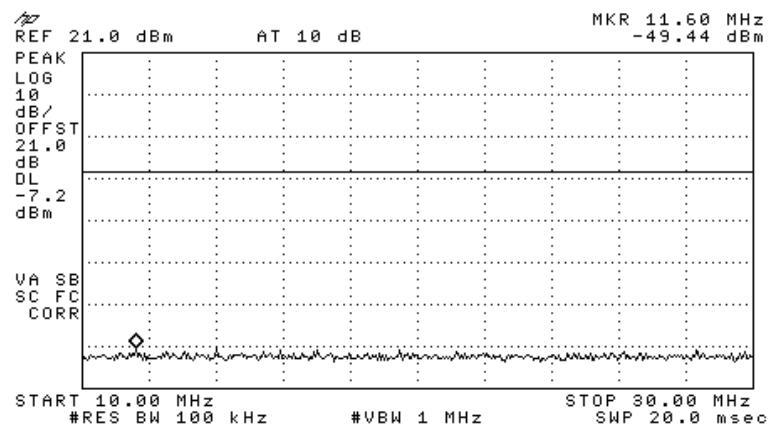


Figure 120 — Channel 11, 11 Mbps

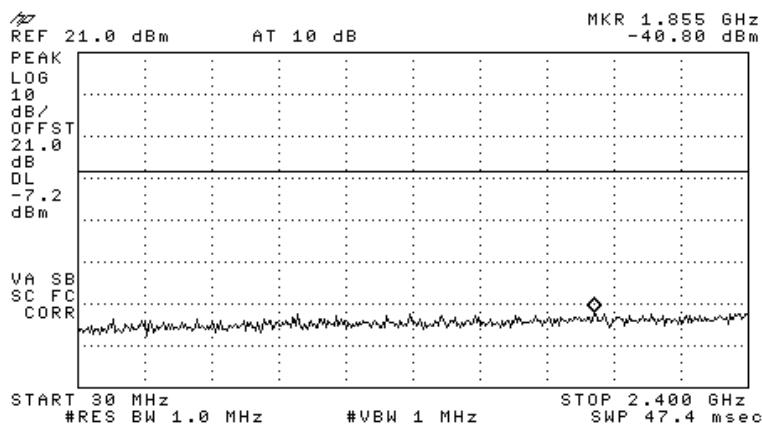


Figure 121 — Channel 11, 11 Mbps

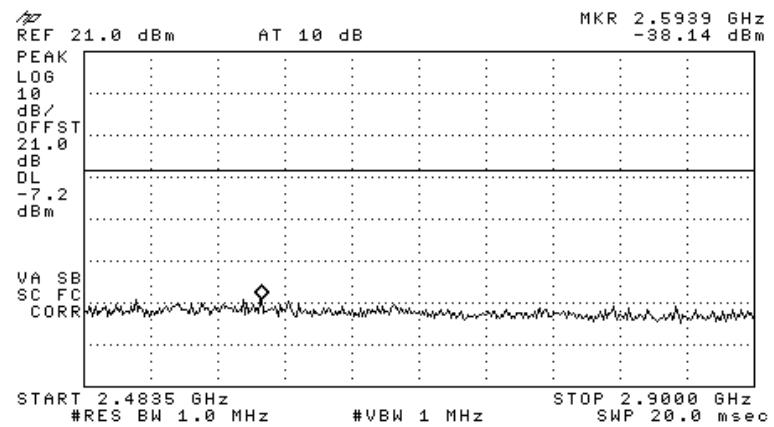


Figure 122 — Channel 11, 11 Mbps

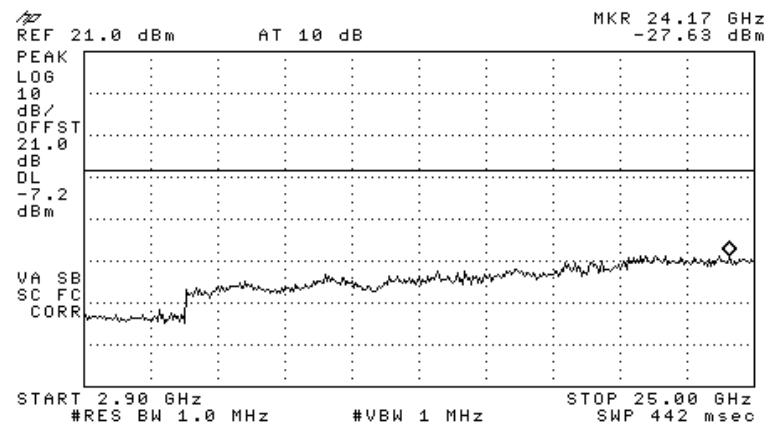


Figure 123 — Channel 11, 11 Mbps

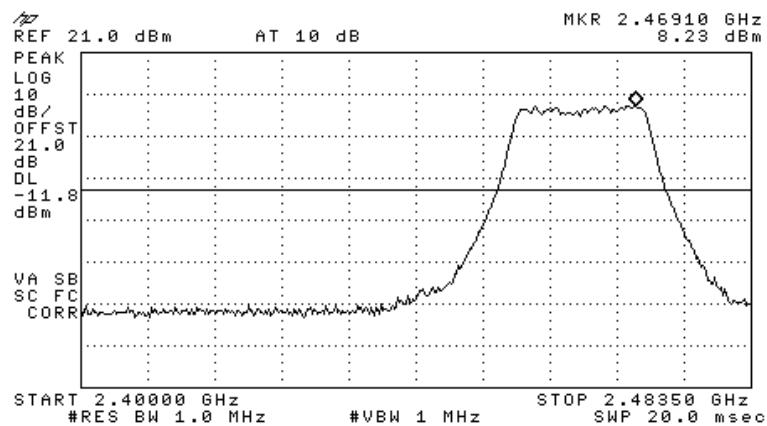


Figure 124 — Channel 11, 54 Mbps

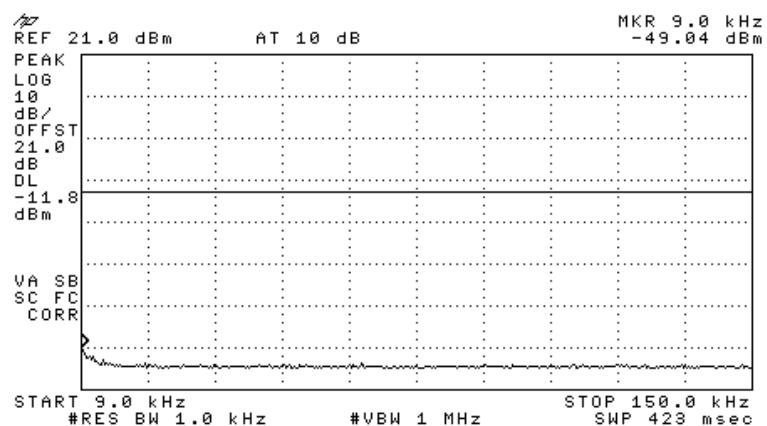


Figure 125 — Channel 11, 54 Mbps

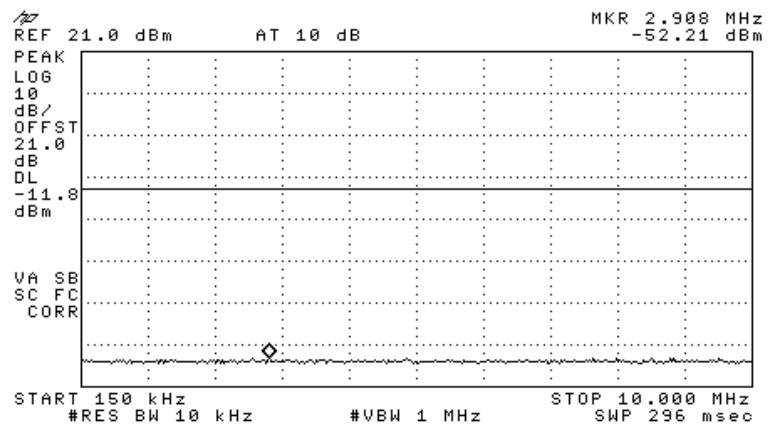


Figure 126 — Channel 11, 54 Mbps

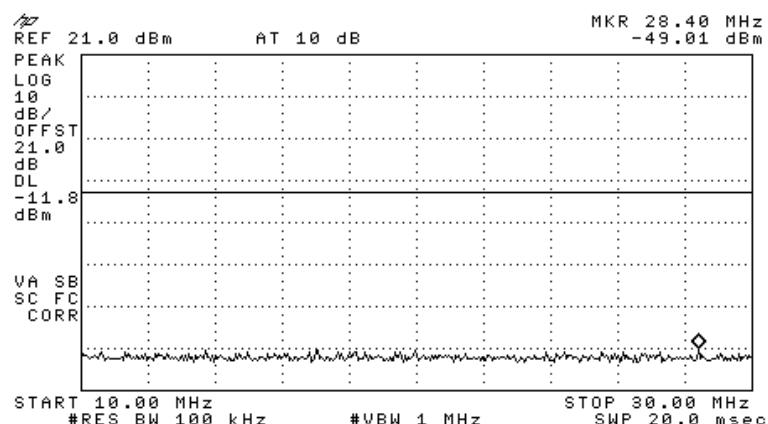


Figure 127 — Channel 11, 54 Mbps

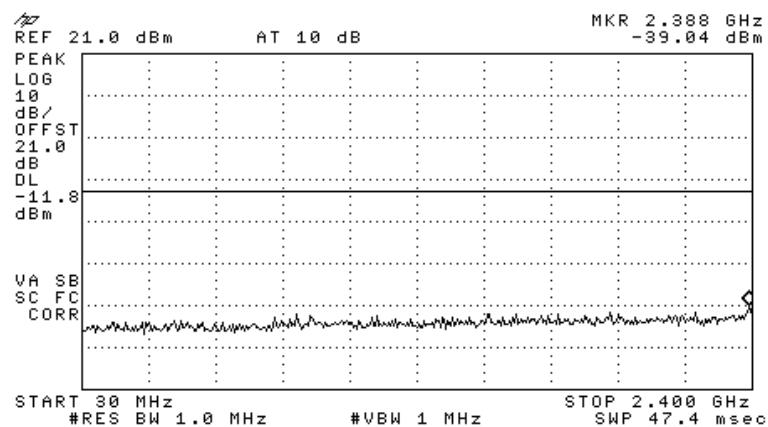


Figure 128 — Channel 11, 54 Mbps

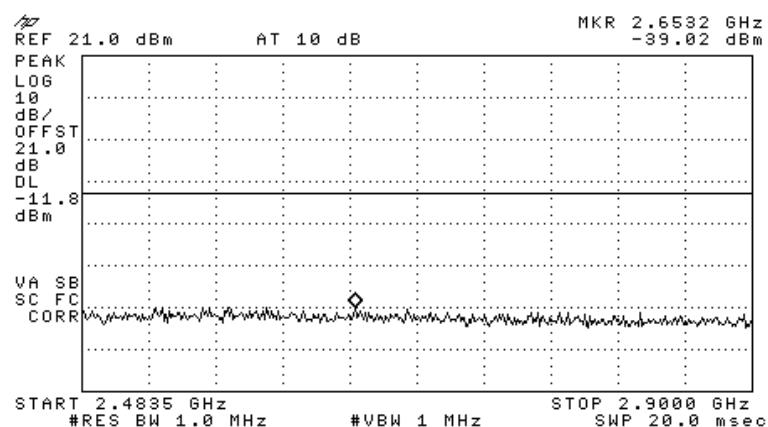


Figure 129 — Channel 11, 54 Mbps

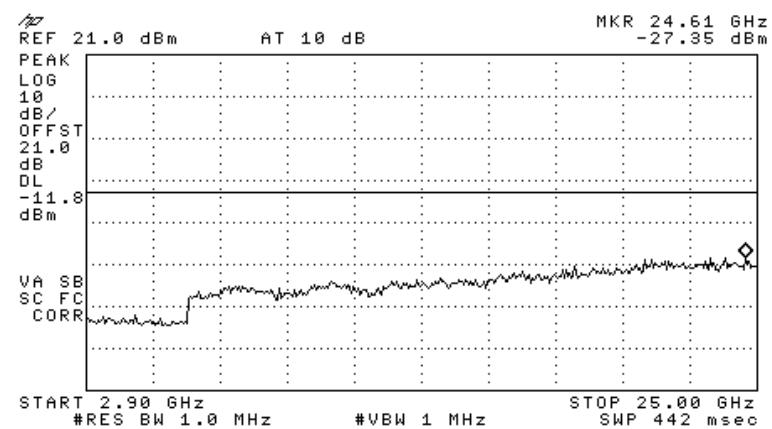


Figure 130 — Channel 11, 54 Mbps

7.2 Results table

E.U.T Description: Nano WiREACH SMT Module With On-Board Antenna and External Antenna

Model No.: 1. BRD-Nano-SMT-Ant; P/NL iW-SM2144SMT-OB
2. BRD-Nano-SMT-UFL; P/NL iW-SM2144SMT-EX

Serial Number: Not Designated

Specification: F.C.C. Part 15, Subpart C (15.247)

Operation Frequency (MHz)	Modulation (Mbps)	Reading (dBm)	Specification (dBm)	Margin (dB)
2412	1	-27.81	-14.7	-13.11
	6	-27.74	-17.3	-10.44
	11	-27.19	-10.4	-16.79
	54	-27.30	-14.4	-12.90
2437	1	-26.97	-11.6	-15.37
	6	-27.74	-14.1	-13.64
	11	-27.51	-8.2	-19.31
	54	-27.82	-12.5	-15.32
2462	1	-28.02	-10.5	-17.52
	6	-27.63	-12.8	-14.83
	11	-27.63	-7.2	-20.43
	54	-27.35	-11.8	-15.55

Figure 131 Peak Power Output of 2400-2483.5 MHz Band

JUDGEMENT: Passed by 10.44 dB

TEST PERSONNEL:

Tester Signature:  Date: 06.07.11

Typed/Printed Name: A. Moses

7.3 **Test Equipment Used.**

Peak Power Output of 2400-2438.5 MHz Band

Instrument	Manufacturer	Model	Serial/Part Number	Calibration	
				Last Calibration	Period
Spectrum Analyzer	HP	8592L	3826A01204	February 21, 2011	1 year
Attenuator	Jyebao	-	FAT-AM5AF5G6G2W20	January 04, 2011	1 year
Cable	Rhophase	KPS-5000-KPS	A1674	January 04, 2011	1 year

Figure 132 Test Equipment Used

8. Band Edge Spectrum

[In Accordance with section 15.247(c)]

8.1 Test procedure

The E.U.T. antenna terminal was connected to the spectrum analyzer through an external attenuator (20 dB) and an appropriate coaxial cable (cable loss = 1 dB). The spectrum analyzer was set to 100 kHz resolution BW. Maximum power level below 2400 MHz and above 2483.5 MHz was measured relative to power level at MHz, and MHz correspondingly.

The E.U.T. was tested using the following modulations: , , and .

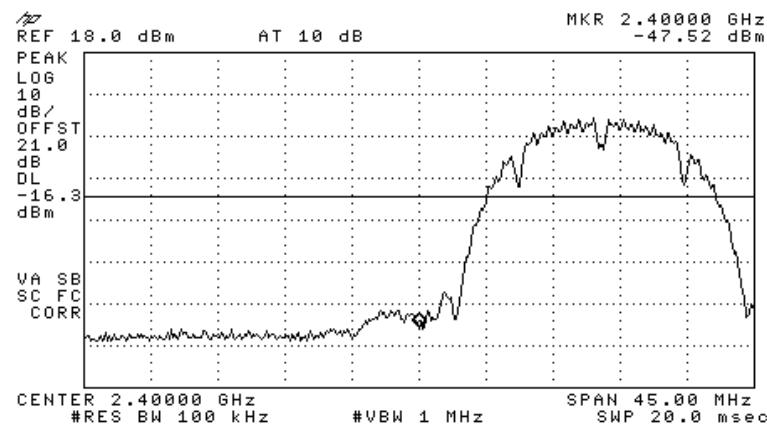


Figure 133 — Channel 1, 1 Mbps

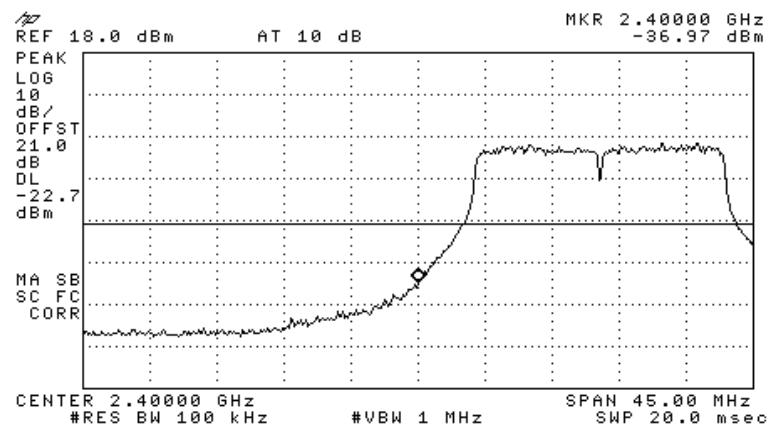


Figure 134 — Channel 1, 6 Mbps

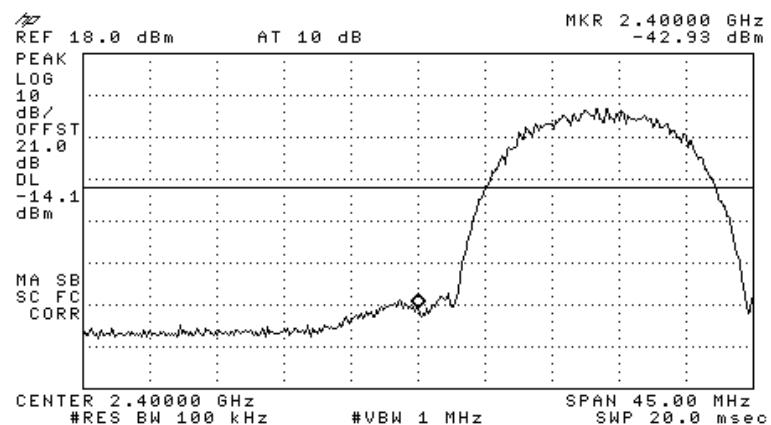


Figure 135 — Channel 1, 11 Mbps

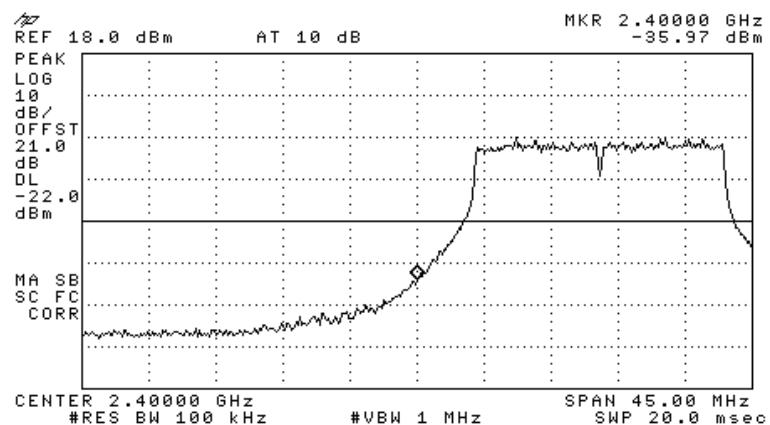


Figure 136 — Channel 1, 54 Mbps

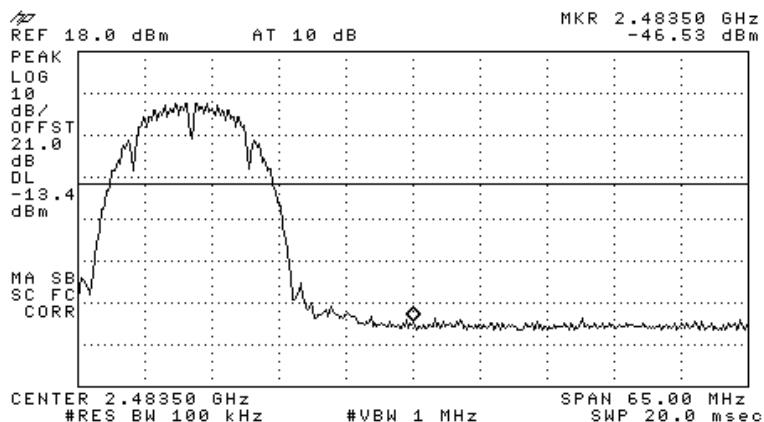


Figure 137 — Channel 11, 1 Mbps

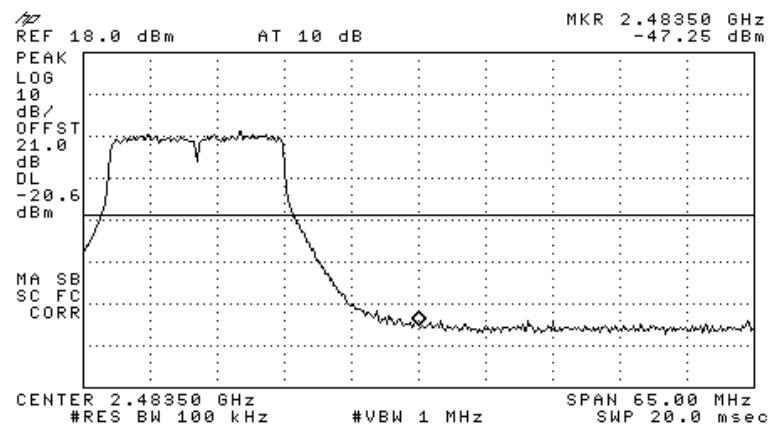


Figure 138 — Channel 11, 6 Mbps

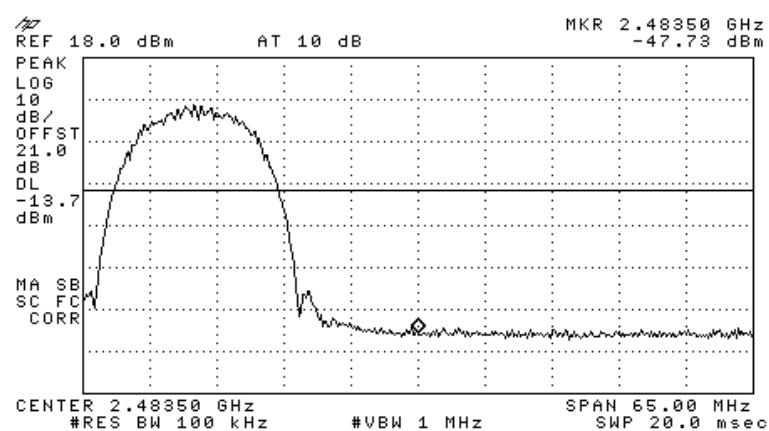


Figure 139 — Channel 11, 11 Mbps

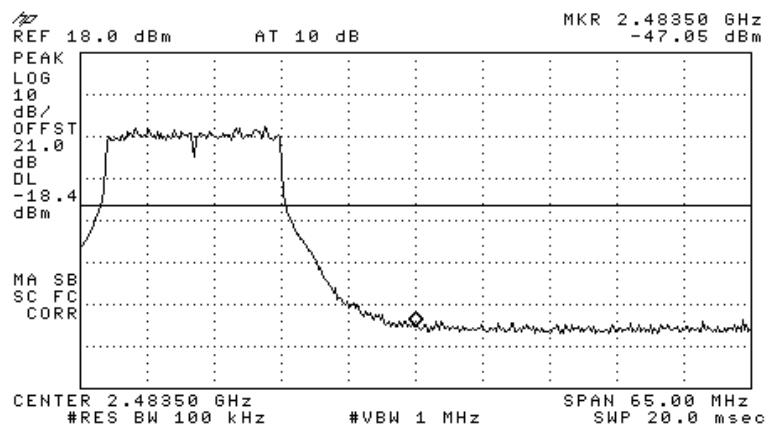


Figure 140 — Channel 11, 54 Mbps

8.2 Results table

E.U.T. Description: Nano WiREACH SMT Module With On-Board Antenna and External Antenna

Model No.: 1. BRD-Nano-SMT-Ant; P/NL iW-SM2144SMT-OB
2. BRD-Nano-SMT-UFL; P/NL iW-SM2144SMT-EX

Serial Number: Not Designated

Specification: F.C.C. Part 15, Subpart C (15.247)

Operation Frequency (MHz)	Modulation (Mbps)	Band Edge Frequency (MHz)	Reading (dBm)	Specification (dBm)	Margin (dB)
2412	1	2400.00	-47.52	-16.3	-31.22
	6	2400.00	-36.97	-22.7	-14.27
	11	2400.00	-42.93	-14.1	-28.83
	54	2400.00	-35.97	-22.0	-13.97
2462	1	2483.50	-46.53	-13.4	-33.13
	6	2483.50	-47.25	-20.6	-26.65
	11	2483.50	-47.73	-13.7	-34.03
	54	2483.50	-47.05	-18.4	-28.65

Figure 141 Band Edge Spectrum

JUDGEMENT: Passed by 13.97 dB

TEST PERSONNEL:

Tester Signature:  Date: 06.07.11

Typed/Printed Name: A. Moses

8.3 **Test Equipment Used.**

Band edge Spectrum

Instrument	Manufacturer	Model	Serial/Part Number	Calibration	
				Last Calibration	Period
Spectrum Analyzer	HP	8592L	3826A01204	February 21, 2011	1 year
Attenuator	Jyebao	-	FAT-AM5AF5G6G2W20	January 04, 2011	1 year
Cable	Rhophase	KPS-5000-KPS	A1674	January 04, 2011	1 year

Figure 142 Test Equipment Used

9. Radiated Emission, 9 kHz – 30 MHz

9.1 **Test Specification**

9 kHz-30 MHz, FCC, Part 15, Subpart C, Section 209

9.2 **Test Procedure**

The E.U.T. operation mode and test set-up are as described in Section 3.

A preliminary measurement to characterize the E.U.T was performed inside the shielded room at a distance of 3 meters, using peak detection mode and broadband antennas. The preliminary measurements produced a list of the highest emissions. The E.U.T was then transferred to the open site, and placed on a remote-controlled turntable. The E.U.T was placed on a non-metallic table, 0.8 meters above the ground. The configuration tested is shown in Figure 3.1.

The frequency range 9 kHz-30 MHz was scanned.

The emissions were measured using a computerized EMI receiver complying to CISPR 16 requirements. The specification limits and applicable correction factors are loaded to the receiver via a 3.5" floppy disk.

In the frequency range 9 kHz-30MHz, the loop antenna was rotated on its vertical axis. The antenna height (center of loop) was 1 meter at a distance of 3 meters.

The E.U.T. was tested at 2412, 2437, and 2462 MHz with the following modulations: 1, 11, 6 and 54 Mbps.

These frequencies were measured using a peak detector.

9.3 **Measured Data**

JUDGEMENT: Passed

The EUT met the requirements of the F.C.C. Part 15, Subpart C, Section 209 specification.

The results for all 3 operation frequencies and modulations were the same.

No signals were detected in the frequency range of 9 kHz – 30 Mhz.

TEST PERSONNEL:

Tester Signature: 

Date: 06.07.11

Typed/Printed Name: A. Moses

9.4 **Test Instrumentation Used, Radiated Measurements**

Instrument	Manufacturer	Model	Serial Number	Calibration	Period
EMI Receiver	HP	85422E	3906A00276	November 24, 2010	1 year
RF Section	HP	85420E	3705A00248	November 24, 2010	1 year
Active Loop Antenna	EMCO	6502	9506-2950	October 19, 2010	1 year
Antenna Mast	ARA	AAM-4A	1001	N/A	N/A
Turntable	ARA	ART-1001/4	1001	N/A	N/A
Mast & Table Controller	ARA	ACU-2/5	1001	N/A	N/A
Printer	HP	LaserJet 2200	JPKGC19982	N/A	N/A

9.5 **Field Strength Calculation**

The field strength is calculated directly by the EMI Receiver software, and a "Correction Factors" data disk, using the following equation:

$$FS = RA + AF + CF$$

FS: Field Strength [dB μ V/m]
 RA: Receiver Amplitude [dB μ V]
 AF: Receiving Antenna Correction Factor [dB/m]
 CF: Cable Attenuation Factor [dB]

Example: $FS = 30.7 \text{ dB}\mu\text{V (RA)} + 14.0 \text{ dB (AF)} + 0.9 \text{ dB (CF)} = 45.6 \text{ dB}\mu\text{V}$

No external pre-amplifiers are used.

10. Spurious Radiated Emission 30 MHz – 25 GHz External Antenna

10.1 ***Test Specification***

30 MHz-25000 MHz, F.C.C., Part 15, Subpart C

10.2 ***Test Procedure***

The E.U.T. operation mode and test set-up are as described in Section 3.

See Section 3.1 Justification of the System Test Configuration concerning the E.U.T. orientation for this test.

A preliminary measurement to characterize the E.U.T was performed inside the shielded room at a distance of 3 meters, using peak detection mode and broadband antennas. The preliminary measurements produced a list of the highest emissions. The E.U.T was then transferred to the open site, and placed on a remote-controlled turntable. The E.U.T was placed on a non-metallic table, 0.8 meters above the ground. The configuration tested is shown in Figure 1.

The frequency range 30 MHz-25000 MHz was scanned, and the list of the highest emissions was verified and updated accordingly.

The levels of the emissions within the frequency ranges of the restricted bands (Section 15.205 of FCC Part 15) were compared to the limits of the table in Section 15.209 (a), General Requirements.

In the frequency range of 30 MHz – 2.9 GHz, the emissions were measured using a computerized EMI receiver complying to CISPR 16 requirements. The specification limits and applicable correction factors are loaded to the receiver via a 3.5" floppy disk.

In the frequency range 2.9 - 25 GHz, a spectrum analyzer including a low noise amplifier was used. During peak measurements, the I.F. bandwidth was 1 MHz, and video bandwidth 3 MHz. During average measurements, the I.F. bandwidth was 1 MHz and video bandwidth was 100 Hz.

The readings were maximized by adjusting the antenna height between 1-4 meters, the turntable azimuth between 0-360°, and the antenna polarization. Verification of the E.U.T emissions was based on the following methods: turning the E.U.T on and off; using a frequency span less than 10 MHz; observation of the signal level during turntable rotation. (Background noise is not affected by the rotation of the E.U.T.)

Verification of the E.U.T emissions was based on the following methods:

Turning the E.U.T on and off.

Using a frequency span less than 10 MHz.

Observation of the signal level during turntable rotation. Background noise is not affected by the rotation of the E.U.T.

The test distance was 3 meters

The E.U.T. was tested at 2412, 2437, and 2462 MHz with the following modulations: 1, 11, 6 and 54 Mbps.

10.3 Test Data

JUDGEMENT: Passed by 8.1 dB

The EUT met the requirements of the F.C.C. Part 15, Subpart C, specification.

For the operation frequency of 2412 MHz, the margin between the emission level and the specification limit is 9.3 dB in the worst case at the frequency of 2390.00 MHz, vertical polarization.

For the operation frequency of 2437 MHz, the margin between the emission level and the specification limit is 13.3 dB in the worst case at the frequency of 4783.00 MHz, vertical polarization.

For the operation frequency of 2462 MHz, the margin between the emission level and the specification limit is 8.1 dB in the worst case at the frequency of 2483.50 MHz, vertical polarization.

The results for all modulations were the same.

The details of the highest emissions are given in *Figure 143* to *Figure 148*.

TEST PERSONNEL:

Tester Signature:  Date: 06.07.11

Typed/Printed Name: A. Moses

Radiated Emission 30 MHz – 25 GHz

E.U.T Description Nano WiREACH SMT Module With On-Board
 Antenna and External Antenna
 Type 1. BRD-Nano-SMT-Ant; P/NL iW-SM2144SMT-OB
 2. BRD-Nano-SMT-UFL; P/NL iW-SM2144SMT-EX
 Serial Number: Not Designated

Specification: FCC, Part 15, Subpart C

Antenna Polarization: Horizontal/Vertical Frequency range: 1.0 GHz to 25.0 GHz
 Test Distance: 3 meters Detector: Peak
 Operation Frequency: 2412 MHz

Frequency (MHz)	Polarity (H/V)	Peak Reading (dB μ V/m)	Peak. Specification (dB μ V/m)	Peak. Margin (dB)
2390.0	H	53.9**	74.0	-20.1
2390.0	V	54.7**	74.0	-19.3
4824.0	H	50.2*	74.0	-23.8
4824.0	V	54.0*	74.0	-20.0

**Figure 143. Radiated Emission. Antenna Polarization: HORIZONTAL / VERTICAL.
Detector: Peak**

Margin refers to the test results obtained minus specified requirement; thus a positive number indicates failure, and a negative result indicates that the product passes the test.

“Peak Reading” includes correction factor.

* “Correction Factor” = Antenna Factor + Cable Loss- Low Noise Amplifier Gain

** “Correction Factor” = Antenna Factor + Cable Loss

Radiated Emission 30 MHz – 25 GHz

E.U.T Description Nano WiREACH SMT Module With On-Board
 Antenna and External Antenna
 Type 1. BRD-Nano-SMT-Ant; P/NL iW-SM2144SMT-OB
 2. BRD-Nano-SMT-UFL; P/NL iW-SM2144SMT-EX
 Serial Number: Not Designated

Specification: FCC, Part 15, Subpart C

Antenna Polarization: Horizontal/Vertical Frequency range: 1.0 GHz to 25.0 GHz
 Test Distance: 3 meters Detector: Average
 Operation Frequency: 2412 MHz

Frequency (MHz)	Polarity (H/V)	Average Reading (dB μ V/m)	Average Specification (dB μ V/m)	Peak. Margin (dB)
2390.00	H	44.4**	54.0	-9.6
2390.00	V	44.7**	54.0	-9.3
4824.00	H	40.1*	54.0	-13.9
4824.00	V	41.9*	54.0	-12.1

**Figure 144. Radiated Emission. Antenna Polarization: HORIZONTAL / VERTICAL.
Detector: Average**

Notes:

Margin refers to the test results obtained minus specified requirement; thus a positive number indicates failure, and a negative result indicates that the product passes the test.

“Average Reading” includes correction factor.

* Correction Factor = Antenna Factor + Cable Loss- Low Noise Amplifier Gain

** “Correction Factor” = Antenna Factor + Cable Loss

Radiated Emission 30 MHz – 25 GHz

E.U.T Description Nano WiREACH SMT Module With On-Board
 Antenna and External Antenna
 Type 1. BRD-Nano-SMT-Ant; P/NL iW-SM2144SMT-OB
 2. BRD-Nano-SMT-UFL; P/NL iW-SM2144SMT-EX
 Serial Number: Not Designated

Specification: FCC, Part 15, Subpart C

Antenna Polarization: Horizontal/Vertical Frequency range: 1.0 GHz to 25.0 GHz
 Test Distance: 3 meters Detector: Peak
 Operation Frequency: 2437 MHz

Frequency (MHz)	Polarity (H/V)	Peak Reading (dB μ V/m)	Peak. Specification (dB μ V/m)	Peak. Margin (dB)
4783.00	H	52.0*	74.0	-22.0
4783.00	V	52.1*	74.0	-21.9

**Figure 145. Radiated Emission. Antenna Polarization: HORIZONTAL / VERTICAL.
Detector: Peak**

Margin refers to the test results obtained minus specified requirement; thus a positive number indicates failure, and a negative result indicates that the product passes the test.

“Peak Reading” includes correction factor.

* “Correction Factor” = Antenna Factor + Cable Loss- Low Noise Amplifier Gain

Radiated Emission 30 MHz – 25 GHz

E.U.T Description Nano WiREACH SMT Module With On-Board
 Antenna and External Antenna
 Type 1. BRD-Nano-SMT-Ant; P/NL iW-SM2144SMT-OB
 2. BRD-Nano-SMT-UFL; P/NL iW-SM2144SMT-EX
 Serial Number: Not Designated

Specification: FCC, Part 15, Subpart C

Antenna Polarization: Horizontal/Vertical Frequency range: 1.0 GHz to 25.0 GHz
 Test Distance: 3 meters Detector: Average
 Operation Frequency: 2437 MHz

Frequency (MHz)	Polarity (H/V)	Average Reading (dB μ V/m)	Average Specification (dB μ V/m)	Peak. Margin (dB)
4783.00	H	40.2*	54.0	-13.8
4783.00	V	40.7*	54.0	-13.3

**Figure 146. Radiated Emission. Antenna Polarization: HORIZONTAL / VERTICAL.
Detector: Average**

Notes:

Margin refers to the test results obtained minus specified requirement; thus a positive number indicates failure, and a negative result indicates that the product passes the test.

“Average Reading” includes correction factor.

* Correction Factor = Antenna Factor + Cable Loss- Low Noise Amplifier Gain

Radiated Emission 30 MHz – 25 GHz

E.U.T Description: Nano WiREACH SMT Module With On-Board Antenna and External Antenna
 Type: 1. BRD-Nano-SMT-Ant; P/NL iW-SM2144SMT-OB
 2. BRD-Nano-SMT-UFL; P/NL iW-SM2144SMT-EX
 Serial Number: Not Designated

Specification: FCC, Part 15, Subpart C

Antenna Polarization: Horizontal/Vertical Frequency range: 1.0 GHz to 25.0 GHz
 Test Distance: 3 meters Detector: Peak
 Operation Frequency: 2462 MHz

Frequency (MHz)	Polarity (H/V)	Peak Reading (dB μ V/m)	Peak. Specification (dB μ V/m)	Peak. Margin (dB)
2483.50	H	55.2**	74.0	-18.8
2483.50	V	54.8**	74.0	-19.2
4924.00	H	51.8*	74.0	-22.2
4924.00	V	51.5*	74.0	-22.5

**Figure 147. Radiated Emission. Antenna Polarization: HORIZONTAL / VERTICAL.
Detector: Peak**

Margin refers to the test results obtained minus specified requirement; thus a positive number indicates failure, and a negative result indicates that the product passes the test.

“Peak Reading” includes correction factor.

* “Correction Factor” = Antenna Factor + Cable Loss- Low Noise Amplifier Gain

**“Correction Factor” = Antenna Factor + Cable Loss

Radiated Emission Above 1 GHz

E.U.T Description Nano WiREACH SMT Module With On-Board Antenna and External Antenna

Type 1. BRD-Nano-SMT-Ant; P/NL iW-SM2144SMT-OB
 2. BRD-Nano-SMT-UFL; P/NL iW-SM2144SMT-EX

Serial Number: Not Designated

Specification: FCC, Part 15, Subpart C

Antenna Polarization: Horizontal/Vertical Frequency range: 1.0 GHz to 25.0 GHz
 Test Distance: 3 meters Detector: Average
 Operation Frequency: 2462 MHz

Frequency (MHz)	Polarity (H/V)	Average Reading (dB μ V/m)	Average Specification (dB μ V/m)	Peak. Margin (dB)
2483.50	H	45.0**	54.0	-9.0
2483.50	V	45.9**	54.0	-8.1
4924.00	H	40.3*	54.0	-13.7
4924.00	V	40.5*	54.0	-13.5

**Figure 148. Radiated Emission. Antenna Polarization: HORIZONTAL / VERTICAL.
Detector: Average**

Notes:

Margin refers to the test results obtained minus specified requirement; thus a positive number indicates failure, and a negative result indicates that the product passes the test.

“Average Reading” includes correction factor.

* Correction Factor = Antenna Factor + Cable Loss- Low Noise Amplifier Gain

**“Correction Factor” = Antenna Factor + Cable Loss

10.4 **Field Strength Calculation below 1 GHz**

The field strength is calculated directly by the EMI Receiver software, and a "Correction Factors" data disk, using the following equation:

$$[\text{dB}\mu\text{v}/\text{m}] \text{ FS} = \text{RA} + \text{AF} + \text{CF}$$

FS: Field Strength [dB μ v/m]

RA: Receiver Amplitude [dB μ v]

AF: Receiving Antenna Correction Factor [dB/m]

CF: Cable Attenuation Factor [dB]

Example: FS = 30.7 dB μ V (RA) + 14.0 dB (AF) + 0.9 dB (CF) = 45.6 dB μ V

No external pre-amplifiers are used.

**10.5 Test Instrumentation Used, Radiated Measurements
30 MHz -25 GHz**

Instrument	Manufacturer	Model	Serial No.	Last Calibration Date	Period
EMI Receiver	HP	85422E	3906A00276	November 24, 2010	1 Year
RF Filter Section	HP	85420E	3705A00248	November 24, 2010	1 Year
Antenna Biconical	ARA	BCD 235/B	1041	August 1, 2010	1 Year
Antenna Log Periodic	ARA	LPD-2010/A	1038	March 23, 2011	1 Year
Antenna Log Periodic	A.H. Systems	SAS-200/511	253	January 27, 2011	2 Years
Double Ridged Waveguide Horn Antenna	EMCO	3115	29845	March 14, 2010	2 Years
Horn Antenna	ARA	SWH-28	1008	January 26, 2011	2 Years
Low Noise Amplifier	DBS MICROWAVE	LNA-DBS-0411N313	013	November 5, 2010	1 Year
Low Noise Amplifier	Sophia Wireless	LNA 28-B	232	January 4, 2011	1 Year
Spectrum Analyzer	HP	8592L	3826A01204	February 21, 2011	1 Year
Spectrum Analyzer	HP	8546E	3442A00275	January 11, 2011	1 Year
Antenna Mast	ARA	AAM-4A	1001	N/A	N/A
Turntable	ARA	ART-1001/4	1001	N/A	N/A
Mast & Table Controller	ARA	ACU-2/5	1001	N/A	N/A
Printer	HP	LaserJet 2200	JPKG C19982	N/A	N/A

11. Spurious Radiated Emission 30 MHz – 25 GHz Internal Antenna

11.1 ***Test Specification***

30 MHz-25000 MHz, F.C.C., Part 15, Subpart C

11.2 ***Test Procedure***

The E.U.T. operation mode and test set-up are as described in Section 3.

See Section 3.1 Justification of the System Test Configuration concerning the E.U.T. orientation for this test.

A preliminary measurement to characterize the E.U.T was performed inside the shielded room at a distance of 3 meters, using peak detection mode and broadband antennas. The preliminary measurements produced a list of the highest emissions. The E.U.T was then transferred to the open site, and placed on a remote-controlled turntable. The E.U.T was placed on a non-metallic table, 0.8 meters above the ground. The configuration tested is shown in Figure 1.

The frequency range 30 MHz-25000 MHz was scanned, and the list of the highest emissions was verified and updated accordingly.

The levels of the emissions within the frequency ranges of the restricted bands (Section 15.205 of FCC Part 15) were compared to the limits of the table in Section 15.209 (a), General Requirements.

In the frequency range of 30 MHz – 2.9 GHz, the emissions were measured using a computerized EMI receiver complying to CISPR 16 requirements. The specification limits and applicable correction factors are loaded to the receiver via a 3.5" floppy disk.

In the frequency range 2.9 - 25 GHz, a spectrum analyzer including a low noise amplifier was used. During peak measurements, the I.F. bandwidth was 1 MHz, and video bandwidth 3 MHz. During average measurements, the I.F. bandwidth was 1 MHz and video bandwidth was 100 Hz.

The readings were maximized by adjusting the antenna height between 1-4 meters, the turntable azimuth between 0-360°, and the antenna polarization. Verification of the E.U.T emissions was based on the following methods: turning the E.U.T on and off; using a frequency span less than 10 MHz; observation of the signal level during turntable rotation. (Background noise is not affected by the rotation of the E.U.T.)

Verification of the E.U.T emissions was based on the following methods:

Turning the E.U.T on and off.

Using a frequency span less than 10 MHz.

Observation of the signal level during turntable rotation. Background noise is not affected by the rotation of the E.U.T.

The test distance was 3 meters

The E.U.T. was tested at 2412, 2437, and 2462 MHz with the following modulations: 1, 11, 6 and 54 Mbps.

11.3 **Test Data**

JUDGEMENT: Passed by 8.9 dB

The EUT met the requirements of the F.C.C. Part 15, Subpart C, specification.

For the operation frequency of 2412 MHz, the margin between the emission level and the specification limit is 9.3 dB in the worst case at the frequency of 2390.00 MHz, vertical polarization.

For the operation frequency of 2437 MHz, the margin between the emission level and the specification limit is 13.8 dB in the worst case at the frequency of 4783.00 MHz, vertical polarization.

For the operation frequency of 2462 MHz, the margin between the emission level and the specification limit is 8.9 dB in the worst case at the frequency of 2483.00 MHz, horizontal polarization.

The results for all modulations were the same.

The details of the highest emissions are given in *Figure 149* to *Figure 154*.

TEST PERSONNEL:

Tester Signature:  Date: 06.07.11

Typed/Printed Name: A. Moses

Radiated Emission 30 MHz – 25 GHz

E.U.T Description Nano WiREACH SMT Module With On-Board
 Antenna and External Antenna
 Type 1. BRD-Nano-SMT-Ant; P/NL iW-SM2144SMT-OB
 2. BRD-Nano-SMT-UFL; P/NL iW-SM2144SMT-EX
 Serial Number: Not Designated

Specification: FCC, Part 15, Subpart C

Antenna Polarization: Horizontal/Vertical Frequency range: 1.0 GHz to 25.0 GHz
 Test Distance: 3 meters Detector: Peak
 Operation Frequency: 2412 MHz

Frequency (MHz)	Polarity (H/V)	Peak Reading (dB μ V/m)	Peak. Specification (dB μ V/m)	Peak. Margin (dB)
2390.00	H	54.5**	74.0	-19.5
2390.00	V	54.6**	74.0	-19.4
4824.00	H	51.5*	74.0	-22.5
4824.00	V	52.0*	74.0	-22.0

**Figure 149. Radiated Emission. Antenna Polarization: HORIZONTAL / VERTICAL.
Detector: Peak**

Margin refers to the test results obtained minus specified requirement; thus a positive number indicates failure, and a negative result indicates that the product passes the test.

“Peak Reading” includes correction factor.

* “Correction Factor” = Antenna Factor + Cable Loss- Low Noise Amplifier Gain

** “Correction Factor” = Antenna Factor + Cable Loss

Radiated Emission 30 MHz – 25 GHz

E.U.T Description Nano WiREACH SMT Module With On-Board
 Antenna and External Antenna
 Type 1. BRD-Nano-SMT-Ant; P/NL iW-SM2144SMT-OB
 2. BRD-Nano-SMT-UFL; P/NL iW-SM2144SMT-EX
 Serial Number: Not Designated

Specification: FCC, Part 15, Subpart C

Antenna Polarization: Horizontal/Vertical Frequency range: 1.0 GHz to 25.0 GHz
 Test Distance: 3 meters Detector: Average
 Operation Frequency: 2412 MHz

Frequency (MHz)	Polarity (H/V)	Average Reading (dB μ V/m)	Average Specification (dB μ V/m)	Peak. Margin (dB)
2390.00	H	44.3**	54.0	-9.7
2390.00	V	44.7**	54.0	-9.3
4824.00	H	40.0*	54.0	-14.0
4824.00	V	40.2*	54.0	-13.8

**Figure 150. Radiated Emission. Antenna Polarization: HORIZONTAL / VERTICAL.
Detector: Average**

Notes:

Margin refers to the test results obtained minus specified requirement; thus a positive number indicates failure, and a negative result indicates that the product passes the test.

“Average Reading” includes correction factor.

* Correction Factor = Antenna Factor + Cable Loss- Low Noise Amplifier Gain

** “Correction Factor” = Antenna Factor + Cable Loss

Radiated Emission 30 MHz – 25 GHz

E.U.T Description Nano WiREACH SMT Module With On-Board
 Antenna and External Antenna
 Type 1. BRD-Nano-SMT-Ant; P/NL iW-SM2144SMT-OB
 2. BRD-Nano-SMT-UFL; P/NL iW-SM2144SMT-EX
 Serial Number: Not Designated

Specification: FCC, Part 15, Subpart C

Antenna Polarization: Horizontal/Vertical Frequency range: 1.0 GHz to 25.0 GHz
 Test Distance: 3 meters Detector: Peak
 Operation Frequency: 2437 MHz

Frequency (MHz)	Polarity (H/V)	Peak Reading (dB μ V/m)	Peak. Specification (dB μ V/m)	Peak. Margin (dB)
4783.00	H	51.5*	74.0	-22.5
4783.00	V	51.6*	74.0	-22.4

**Figure 151. Radiated Emission. Antenna Polarization: HORIZONTAL / VERTICAL.
Detector: Peak**

Margin refers to the test results obtained minus specified requirement; thus a positive number indicates failure, and a negative result indicates that the product passes the test.

“Peak Reading” includes correction factor.

* “Correction Factor” = Antenna Factor + Cable Loss- Low Noise Amplifier Gain

Radiated Emission 30 MHz – 25 GHz

E.U.T Description Nano WiREACH SMT Module With On-Board
 Antenna and External Antenna
 Type 1. BRD-Nano-SMT-Ant; P/NL iW-SM2144SMT-OB
 2. BRD-Nano-SMT-UFL; P/NL iW-SM2144SMT-EX
 Serial Number: Not Designated

Specification: FCC, Part 15, Subpart C

Antenna Polarization: Horizontal/Vertical Frequency range: 1.0 GHz to 25.0 GHz
 Test Distance: 3 meters Detector: Average
 Operation Frequency: 2437 MHz

Frequency (MHz)	Polarity (H/V)	Average Reading (dB μ V/m)	Average Specification (dB μ V/m)	Peak. Margin (dB)
4783.00	H	40.1*	54.0	-13.9
4783.00	V	40.2*	54.0	-13.8

**Figure 152. Radiated Emission. Antenna Polarization: HORIZONTAL / VERTICAL.
Detector: Average**

Notes:

Margin refers to the test results obtained minus specified requirement; thus a positive number indicates failure, and a negative result indicates that the product passes the test.

“Average Reading” includes correction factor.

* Correction Factor = Antenna Factor + Cable Loss- Low Noise Amplifier Gain

Radiated Emission 30 MHz – 25 GHz

E.U.T Description Nano WiREACH SMT Module With On-Board
 Antenna and External Antenna
 Type 1. BRD-Nano-SMT-Ant; P/NL iW-SM2144SMT-OB
 2. BRD-Nano-SMT-UFL; P/NL iW-SM2144SMT-EX
 Serial Number: Not Designated

Specification: FCC, Part 15, Subpart C

Antenna Polarization: Horizontal/Vertical Frequency range: 1.0 GHz to 25.0 GHz
 Test Distance: 3 meters Detector: Peak
 Operation Frequency: 2462 MHz

Frequency (MHz)	Polarity (H/V)	Peak Reading (dB μ V/m)	Peak. Specification (dB μ V/m)	Peak. Margin (dB)
2483.50	H	55.8**	74.0	-18.2
2483.50	V	54.6**	74.0	-19.4
4924.00	H	52.5*	74.0	-21.5
4924.00	V	51.2*	74.0	-22.8

**Figure 153. Radiated Emission. Antenna Polarization: HORIZONTAL / VERTICAL.
Detector: Peak**

Margin refers to the test results obtained minus specified requirement; thus a positive number indicates failure, and a negative result indicates that the product passes the test.

“Peak Reading” includes correction factor.

* “Correction Factor” = Antenna Factor + Cable Loss- Low Noise Amplifier Gain

**“Correction Factor” = Antenna Factor + Cable Loss

Radiated Emission Above 1 GHz

E.U.T Description Nano WiREACH SMT Module With On-Board
 Antenna and External Antenna
 Type 1. BRD-Nano-SMT-Ant; P/NL iW-SM2144SMT-OB
 2. BRD-Nano-SMT-UFL; P/NL iW-SM2144SMT-EX
 Serial Number: Not Designated

Specification: FCC, Part 15, Subpart C

Antenna Polarization: Horizontal/Vertical Frequency range: 1.0 GHz to 25.0 GHz
 Test Distance: 3 meters Detector: Average
 Operation Frequency: 2462 MHz

Frequency (MHz)	Polarity (H/V)	Average Reading (dB μ V/m)	Average Specification (dB μ V/m)	Peak. Margin (dB)
2483.50	H	45.1**	54.0	-8.9
2483.50	V	44.9**	54.0	-9.1
4924.00	H	40.4*	54.0	-13.6
4924.00	V	40.2*	54.0	-13.8

**Figure 154. Radiated Emission. Antenna Polarization: HORIZONTAL / VERTICAL.
Detector: Average**

Notes:

Margin refers to the test results obtained minus specified requirement; thus a positive number indicates failure, and a negative result indicates that the product passes the test.

“Average Reading” includes correction factor.

* Correction Factor = Antenna Factor + Cable Loss- Low Noise Amplifier Gain

**“Correction Factor” = Antenna Factor + Cable Loss

11.4 **Field Strength Calculation below 1 GHz**

The field strength is calculated directly by the EMI Receiver software, and a "Correction Factors" data disk, using the following equation:

$$[\text{dB}\mu\text{v}/\text{m}] \text{ FS} = \text{RA} + \text{AF} + \text{CF}$$

FS: Field Strength [dB μ v/m]

RA: Receiver Amplitude [dB μ v]

AF: Receiving Antenna Correction Factor [dB/m]

CF: Cable Attenuation Factor [dB]

Example: FS = 30.7 dB μ V (RA) + 14.0 dB (AF) + 0.9 dB (CF) = 45.6 dB μ V

No external pre-amplifiers are used.

**11.5 Test Instrumentation Used, Radiated Measurements
30 MHz -25 GHz**

Instrument	Manufacturer	Model	Serial No.	Last Calibration Date	Period
EMI Receiver	HP	85422E	3906A00276	November 24, 2010	1 Year
RF Filter Section	HP	85420E	3705A00248	November 24, 2010	1 Year
Antenna Biconical	ARA	BCD 235/B	1041	August 1, 2010	1 Year
Antenna Log Periodic	ARA	LPD-2010/A	1038	March 23, 2011	1 Year
Antenna Log Periodic	A.H. Systems	SAS-200/511	253	January 27, 2011	2 Years
Double Ridged Waveguide Horn Antenna	EMCO	3115	29845	March 14, 2010	2 Years
Horn Antenna	ARA	SWH-28	1008	January 26, 2011	2 Years
Low Noise Amplifier	DBS MICROWAVE	LNA-DBS-0411N313	013	November 5, 2010	1 Year
Low Noise Amplifier	Sophia Wireless	LNA 28-B	232	January 4, 2011	1 Year
Spectrum Analyzer	HP	8592L	3826A01204	February 21, 2011	1 Year
Spectrum Analyzer	HP	8546E	3442A00275	January 11, 2011	1 Year
Antenna Mast	ARA	AAM-4A	1001	N/A	N/A
Turntable	ARA	ART-1001/4	1001	N/A	N/A
Mast & Table Controller	ARA	ACU-2/5	1001	N/A	N/A
Printer	HP	LaserJet 2200	JPKG C19982	N/A	N/A

12. Transmitted Power Density

[In accordance with section 15.247(d)]

12.1 Test procedure

The E.U.T. antenna terminal was connected to the spectrum analyzer through an external attenuator (30dB) and an appropriate coaxial cable (cable loss = 1 dB). The spectrum analyzer was set to 3 kHz resolution BW. and sweep time of 1 second for each 3 kHz “window”. The spectrum peaks were located at each of the 3 operating frequencies.

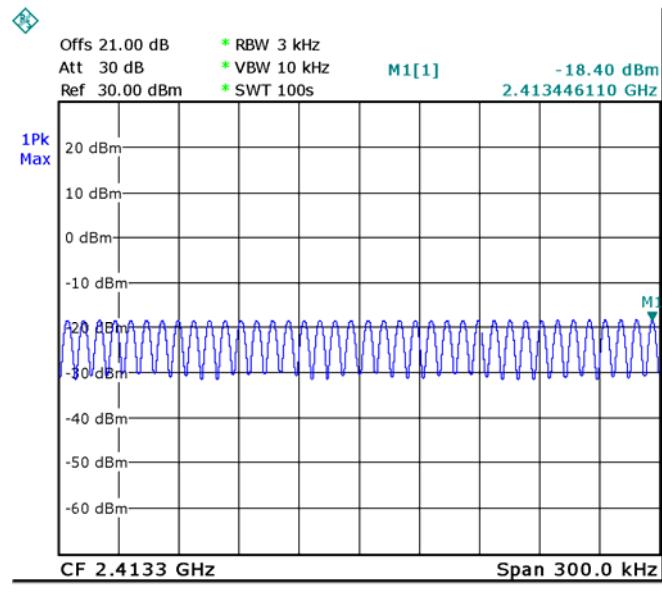
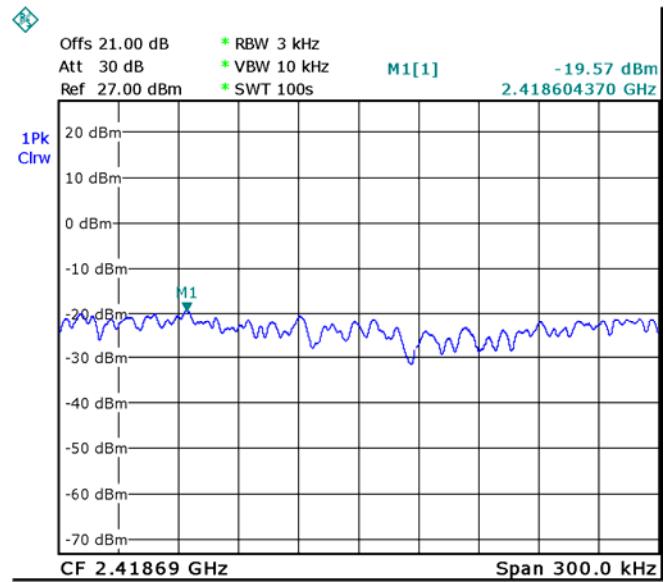
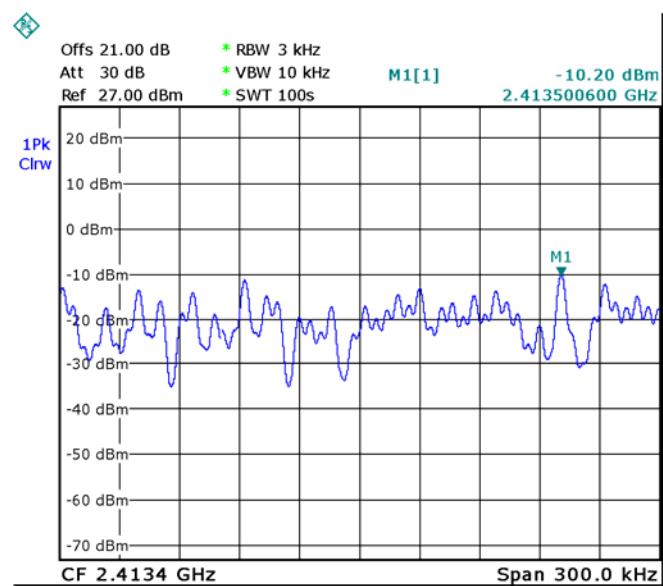


Figure 155 — Channel 1, 1 Mbps



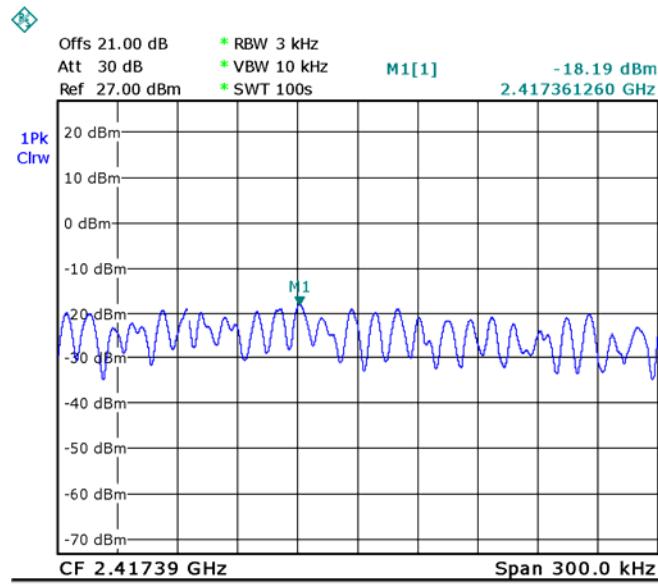
Date: 18.MAY.2011 13:34:06

Figure 156 — Channel 1, 6 Mbps



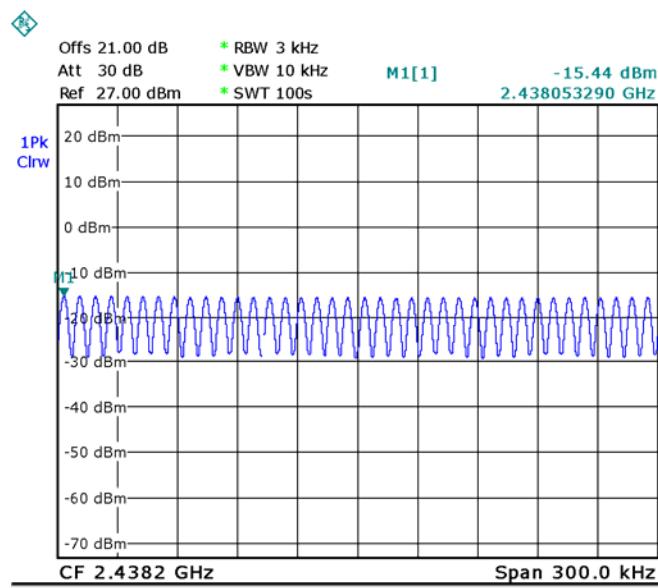
Date: 18.MAY.2011 13:37:38

Figure 157 — Channel 1, 11 Mbps



Date: 18.MAY.2011 13:41:20

Figure 158 — Channel 1, 54 Mbps



Date: 18.MAY.2011 13:48:16

Figure 159 — Channel 6, 1 Mbps

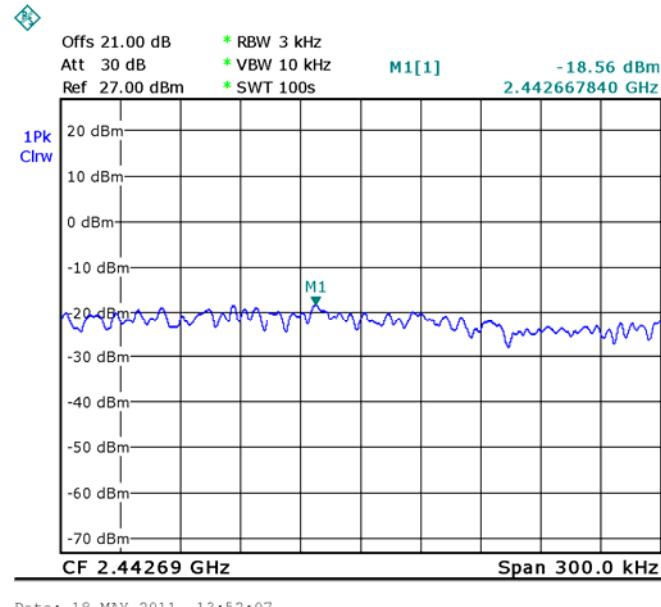


Figure 160 — Channel 6, 6 Mbps

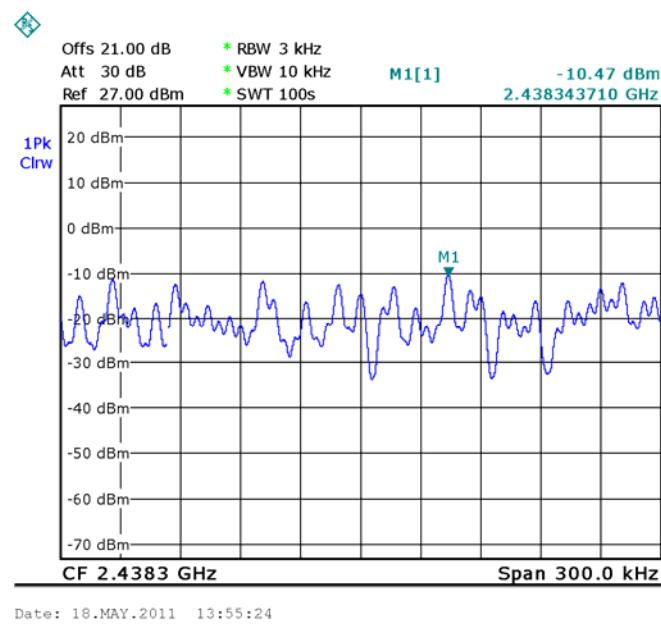
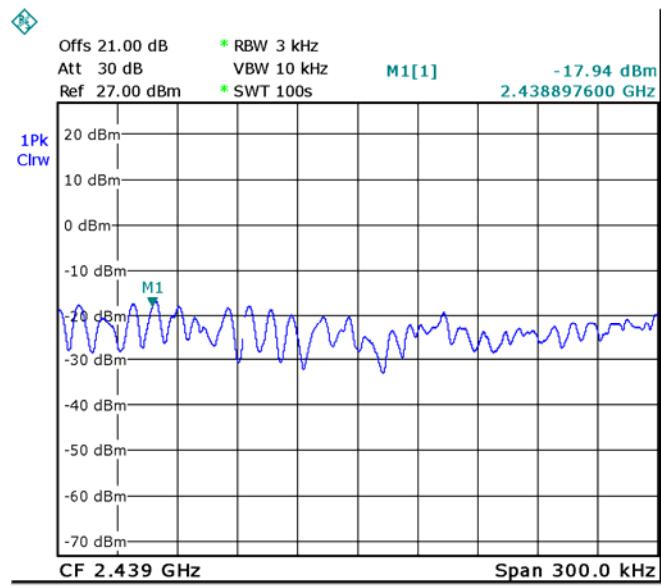
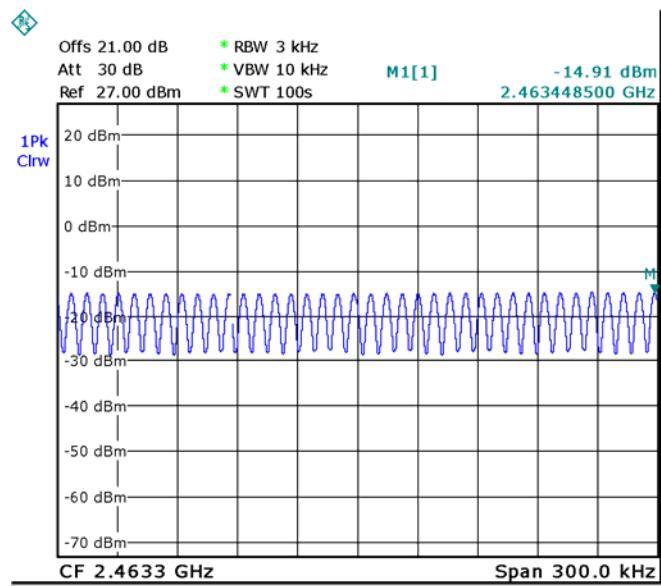


Figure 161 — Channel 6, 11 Mbps



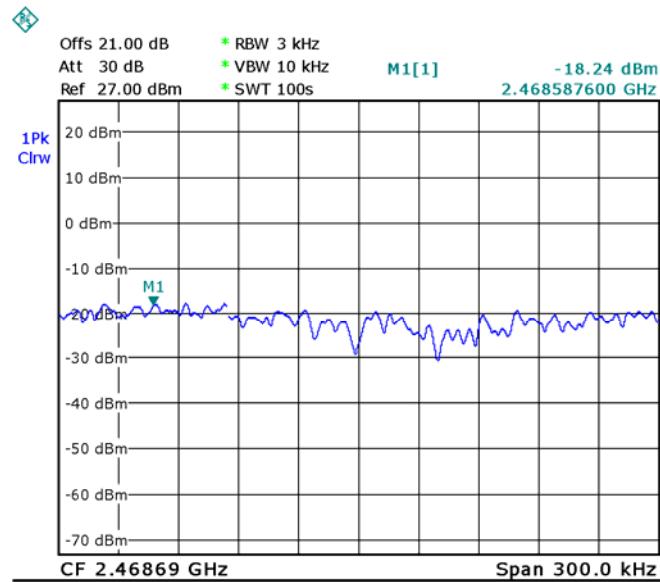
Date: 18.MAY.2011 13:58:42

Figure 162 — Channel 6, 54 Mbps



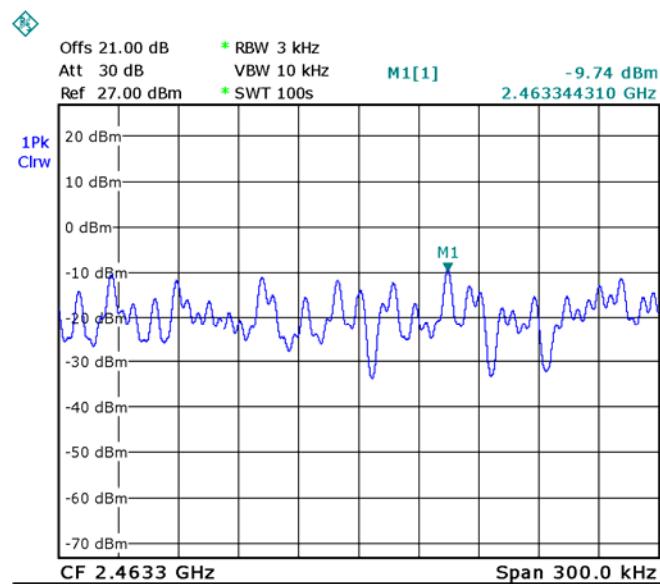
Date: 18.MAY.2011 14:02:22

Figure 163 — Channel 11, 1 Mbps



Date: 18.MAY.2011 14:05:49

Figure 164 — Channel 11, 6 Mbps



Date: 18.MAY.2011 14:08:54

Figure 165 — Channel 11, 11 Mbps

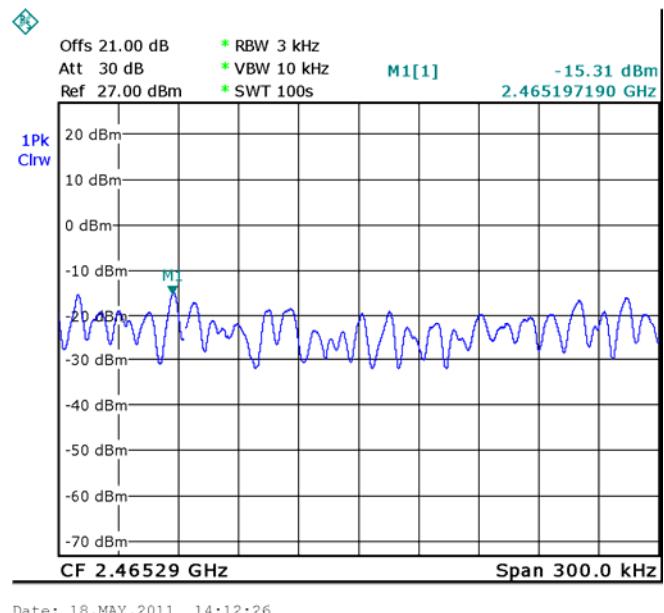


Figure 166 — Channel 11, 54 Mbps

12.2 Results table

E.U.T. Description: Nano WiREACH SMT Module With On-Board Antenna and External Antenna

Model No.: 1. BRD-Nano-SMT-Ant; P/NL iW-SM2144SMT-OB
2. BRD-Nano-SMT-UFL; P/NL iW-SM2144SMT-EX

Serial Number: Not Designated

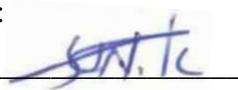
Specification: F.C.C. Part 15, Subpart C (15.247)

Operation Frequency (MHz)	Modulation (Mbps)	Reading (dBm)	Specification (dBm)	Margin (dB)
2412	1	-18.40	8.0	-26.40
	6	-19.57	8.0	-27.57
	11	-10.20	8.0	-18.20
	54	-18.19	8.0	-26.19
2437	1	-15.44	8.0	-23.44
	6	-18.56	8.0	-26.56
	11	-10.47	8.0	-18.47
	54	-17.94	8.0	-25.94
2462	1	-14.91	8.0	-22.91
	6	-18.24	8.0	-26.24
	11	-9.74	8.0	-17.74
	54	-15.31	8.0	-23.31

Figure 167 Test Results

JUDGEMENT: Passed by 17.74 dB

TEST PERSONNEL:

Tester Signature:  Date: 06.07.11

Typed/Printed Name: A. Moses

12.3 **Test Equipment Used.**

Transmitted Power Density

Instrument	Manufacturer	Model	Serial/Part Number	Calibration	
				Last Calibr.	Period
Spectrum Analyzer	RHODE&SCHWARZ	FSL6	100194	July 22, 2010	1 year
Attenuator	Bird	8304-N30DB	-	December 9, 2010	1 year
Cable	Mini-Circuits	30091		February 10, 2011	1 year

Figure 168 Test Equipment Used

13. Antenna Gain/Information

The external antenna gain is 2 dBi.

The On-board antenna gain is 2.1 dBi.

14. R.F Exposure/Safety

The typical placement of the E.U.T. is on an OEM board. The typical distance between the E.U.T. and the user in the worst case application, is >10 cm .

Calculation of Maximum Permissible Exposure (MPE)

Based on Section 1.1307(b)(1) Requirements

(a) FCC limits at 2437 MHz is: $1 \frac{mW}{cm^2}$

Using table 1 of Section 1.1310 limit for general population/uncontrolled exposures, the above level is an average over 30 minutes.

(b) The power density produced by the E.U.T. is

$$S = \frac{P_t G_t}{4\pi R^2}$$

P_t- Transmitted Power 20.58 dBm (Peak) = 114.3 mw

G_T- External Antenna Gain, 2 dBi = 1.58 numeric

G_T- External Antenna Gain, 2.1 dBi = 1.62

R- Distance from Transmitter using 10 cm worst case

(c) The peak power density using the external antenna is :

$$S_p = \frac{114.3 \times 1.58}{4\pi(100)^2} = 0.144 \frac{mW}{cm^2}$$

(d) The peak power density using the internal antenna is :

$$S_p = \frac{114.3 \times 1.62}{4\pi(100)^2} = 0.147 \frac{mW}{cm^2}$$

(e) This is below the FCC limit.

15. APPENDIX A - CORRECTION FACTORS

**15.1 Correction factors for CABLE
from EMI receiver
to test antenna
at 3 meter range.**

FREQUENCY (MHz)	CORRECTION FACTOR (dB)	FREQUENCY (MHz)	CORRECTION FACTOR (dB)
10.0	0.3	1200.0	7.3
20.0	0.6	1400.0	7.8
30.0	0.8	1600.0	8.4
40.0	0.9	1800.0	9.1
50.0	1.1	2000.0	9.9
60.0	1.2	2300.0	11.2
70.0	1.3	2600.0	12.2
80.0	1.4	2900.0	13.0
90.0	1.6		
100.0	1.7		
150.0	2.0		
200.0	2.3		
250.0	2.7		
300.0	3.1		
350.0	3.4		
400.0	3.7		
450.0	4.0		
500.0	4.3		
600.0	4.7		
700.0	5.3		
800.0	5.9		
900.0	6.3		
1000.0	6.7		

NOTES:

1. The cable type is RG-214.
2. The overall length of the cable is 27 meters.
3. The above data is located in file 27MO3MO.CBL on the disk marked "Radiated Emission Tests EMI Receiver".

15.2 Correction factors for

CABLE

from EMI receiver
to test antenna
at 3 meter range.

FREQUENCY (GHz)	CORRECTION FACTOR (dB)
1.0	1.2
2.0	1.6
3.0	2.0
4.0	2.4
5.0	3.0
6.0	3.4
7.0	3.8
8.0	4.2
9.0	4.6
10.0	5.0
12.0	5.8

NOTES:

1. The cable type is RG-8.
2. The overall length of the cable is 10 meters.

15.3 Correction factors for

CABLE from spectrum analyzer to test antenna above 2.9 GHz

FREQUENCY (GHz)	CORRECTION FACTOR (dB)	FREQUENCY (GHz)	CORRECTION FACTOR (dB)
1.0	1.9	14.0	9.1
2.0	2.7	15.0	9.5
3.0	3.5	16.0	9.9
4.0	4.2	17.0	10.2
5.0	4.9	18.0	10.4
6.0	5.5	19.0	10.7
7.0	6.0	20.0	10.9
8.0	6.5	21.0	11.2
9.0	7.0	22.0	11.6
10.0	7.5	23.0	11.9
11.0	7.9	24.0	12.3
12.0	8.3	25.0	12.6
13.0	8.7	26.0	13.0

NOTES:

1. The cable type is SUCOFLEX 104 E manufactured by SUHNER.
2. The cable is used for measurements above 2.9 GHz.
3. The overall length of the cable is 10 meters.

12.6 Correction factors for LOG PERIODIC ANTENNA

Type LPD 2010/A
at 3 and 10 meter ranges.

Distance of 3 meters

FREQUENCY (MHz)	AFE (dB/m)
200.0	9.1
250.0	10.2
300.0	12.5
400.0	15.4
500.0	16.1
600.0	19.2
700.0	19.4
800.0	19.9
900.0	21.2
1000.0	23.5

Distance of 10 meters

FREQUENCY (MHz)	AFE (dB/m)
200.0	9.0
250.0	10.1
300.0	11.8
400.0	15.3
500.0	15.6
600.0	18.7
700.0	19.1
800.0	20.2
900.0	21.1
1000.0	23.2

NOTES:

1. Antenna serial number is 1038.
2. The above lists are located in file number 38M30.ANT for a 3 meter range, and file number 38M100.ANT for a 10 meter range.
3. The files mentioned above are located on the disk marked "Radiated Emission Test EMI Receiver".

15.4 Correction factors for

LOG PERIODIC ANTENNA

Type SAS-200/511
at 3 meter range.

FREQUENCY (GHz)	ANTENNA FACTOR (dB)
1.0	24.9
1.5	27.8
2.0	29.9
2.5	31.2
3.0	32.8
3.5	33.6
4.0	34.3
4.5	35.2
5.0	36.2
5.5	36.7
6.0	37.2
6.5	38.1

FREQUENCY (GHz)	ANTENNA FACTOR (dB)
7.0	38.6
7.5	39.2
8.0	39.9
8.5	40.4
9.0	40.8
9.5	41.1
10.0	41.7
10.5	42.4
11.0	42.5
11.5	43.1
12.0	43.4
12.5	44.4
13.0	44.6

NOTES:

1. Antenna serial number is 253.
2. The above lists are located in file number SAS3M0.ANT for a 3 meter range.
3. The files mentioned above are located on the disk marked "Antenna Factors".

15.5 Correction factors for

BICONICAL ANTENNA

**Type BCD-235/B,
at 3 meter range**

FREQUENCY (MHz)	AFE (dB/m)
20.0	19.4
30.0	14.8
40.0	11.9
50.0	10.2
60.0	9.1
70.0	8.5
80.0	8.9
90.0	9.6
100.0	10.3
110.0	11.0
120.0	11.5
130.0	11.7
140.0	12.1
150.0	12.6
160.0	12.8
170.0	13.0
180.0	13.5
190.0	14.0
200.0	14.8
210.0	15.3
220.0	15.8
230.0	16.2
240.0	16.6
250.0	17.6
260.0	18.2
270.0	18.4
280.0	18.7
290.0	19.2
300.0	19.9
310	20.7
320	21.9
330	23.4
340	25.1
350	27.0

NOTES:

1. Antenna serial number is 1041.
2. The above list is located in file 19BC10M1.ANT on the disk marked "Radiated Emissions Tests EMI Receiver".

15.6 Correction factors for Double-Ridged Waveguide Horn

**Model: 3115, S/N 29845
at 3 meter range.**

FREQUENCY (GHz)	ANTENNA FACTOR (dB 1/m)	ANTENN A Gain (dBi)	FREQUENCY (GHz)	ANTENNA FACTOR (dB 1/m)	ANTENNA Gain (dBi)
1.0	24.8	5.4	10.0	38.8	11.4
1.5	26.1	7.6	10.5	38.9	11.8
2.0	28.6	7.7	11.0	39.0	12.1
2.5	29.8	8.4	11.5	39.6	11.8
3.0	31.4	8.4	12.0	39.8	12.0
3.5	32.4	8.7	12.5	39.6	12.5
4.0	33.7	8.6	13.0	40.0	12.5
4.5	33.4	9.9	13.5	39.8	13.0
5.0	34.5	9.7	14.0	40.2	13.0
5.5	35.1	9.9	14.5	40.6	12.9
6.0	35.4	10.4	15.0	41.3	12.4
6.5	35.6	10.8	15.5	39.5	14.6
7.0	36.2	10.9	16.0	38.8	15.5
7.5	37.3	10.4	16.5	40.0	14.6
8.0	37.7	10.6	17.0	41.4	13.4
8.5	38.3	10.5	17.5	44.8	10.3
9.0	38.5	10.8	18.0	47.2	8.1
9.5	38.7	11.1			

15.7 Correction factors for

Horn Antenna

**Model: SWH-28
at 1 meter range.**

FREQUENCY (GHz)	AFE (dB /m)	Gain (dB1)
18.0	40.3	16.1
19.0	40.3	16.3
20.0	40.3	16.1
21.0	40.3	16.3
22.0	40.4	16.8
23.0	40.5	16.4
24.0	40.5	16.6
25.0	40.5	16.7
26.0	40.6	16.4

15.8 Correction factors for ACTIVE LOOP ANTENNA

**Model 6502
S/N 9506-2950**

FREQUENCY (MHz)	Magnetic Antenna Factor (dB)	Electric Antenna Factor (dB)
.009	-35.1	16.4
.010	-35.7	15.8
.020	-38.5	13.0
.050	-39.6	11.9
.075	-39.8	11.8
.100	-40.0	11.6
.150	-40.0	11.5
.250	-40.0	11.6
.500	-40.0	11.5
.750	-40.1	11.5
1.000	-39.9	11.7
2.000	-39.5	12.0
3.000	-39.4	12.1
4.000	-39.7	11.9
5.000	-39.7	11.8
10.000	40.2	11.3
15.000	-40.7	10.8
20.000	-40.5	11.0
25.000	-41.3	10.2
30.000	42.3	9.2