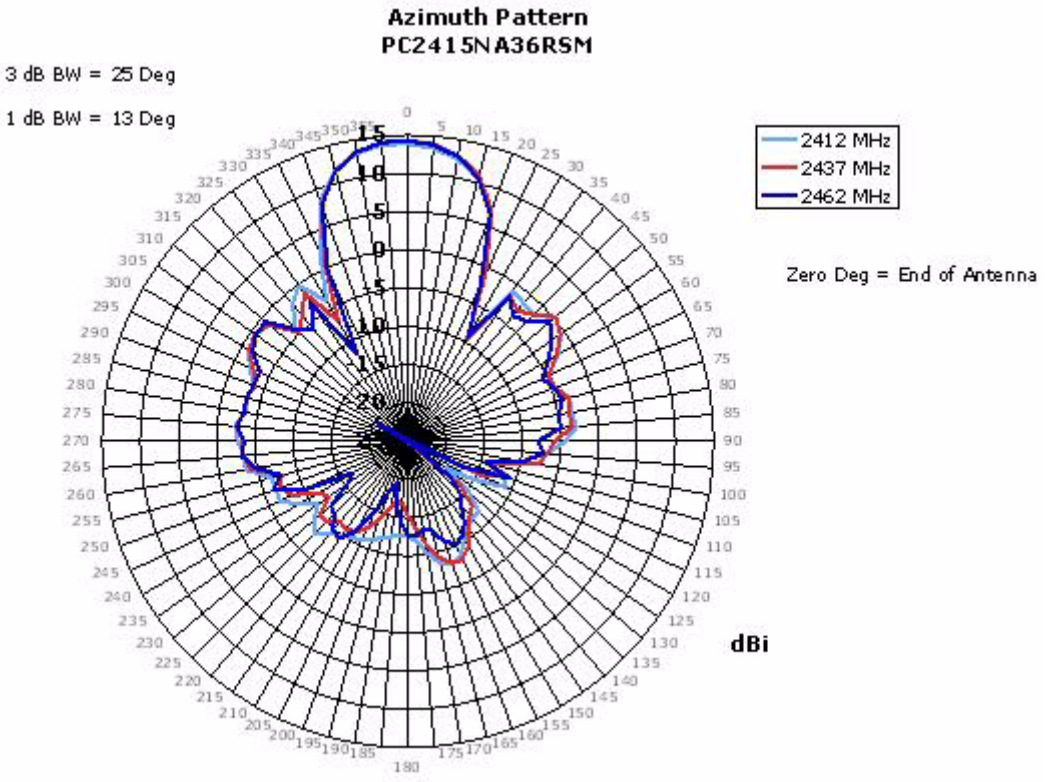
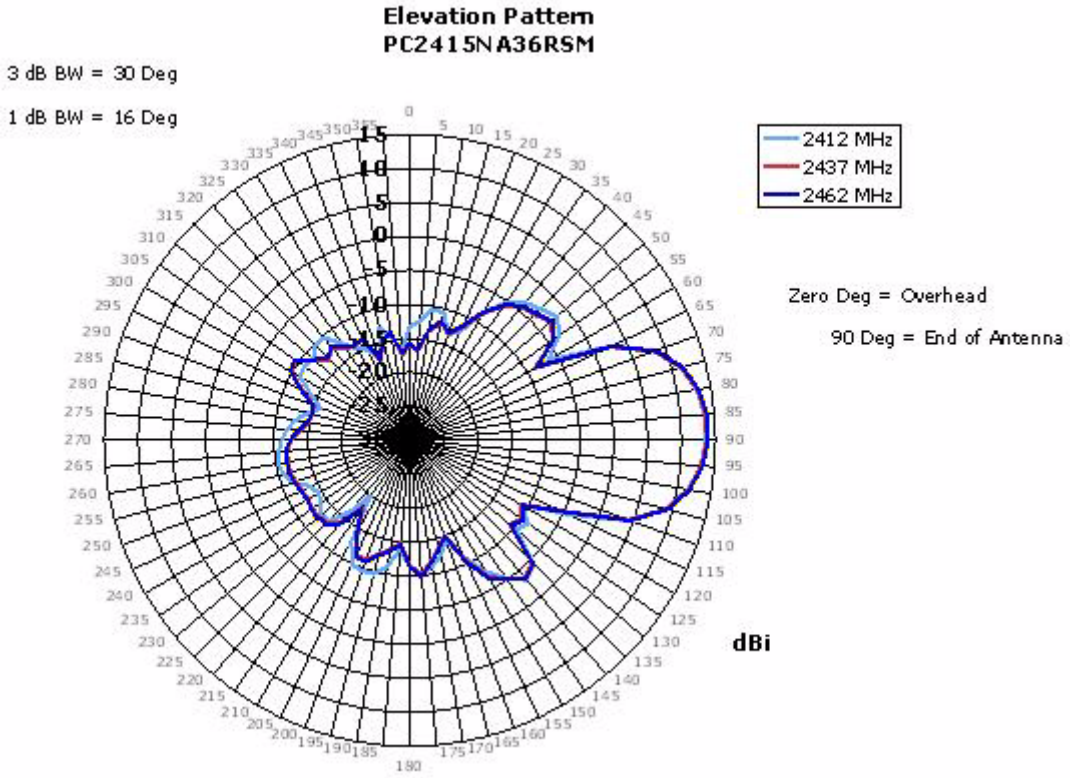
9 Directional Yagi Antenna

Nortel Order Number: DR4000077E6

- Cushcraft Model PC2415NA36RSM
- 2.4 - 2.5 GHz, 14.1 dBi Peak Gain
- Articulating mount for precise direction pointing
- Good for long and narrow zones like tunnels
- 3-foot cable
- Measures 26.5” x 3.75” x 1.5”

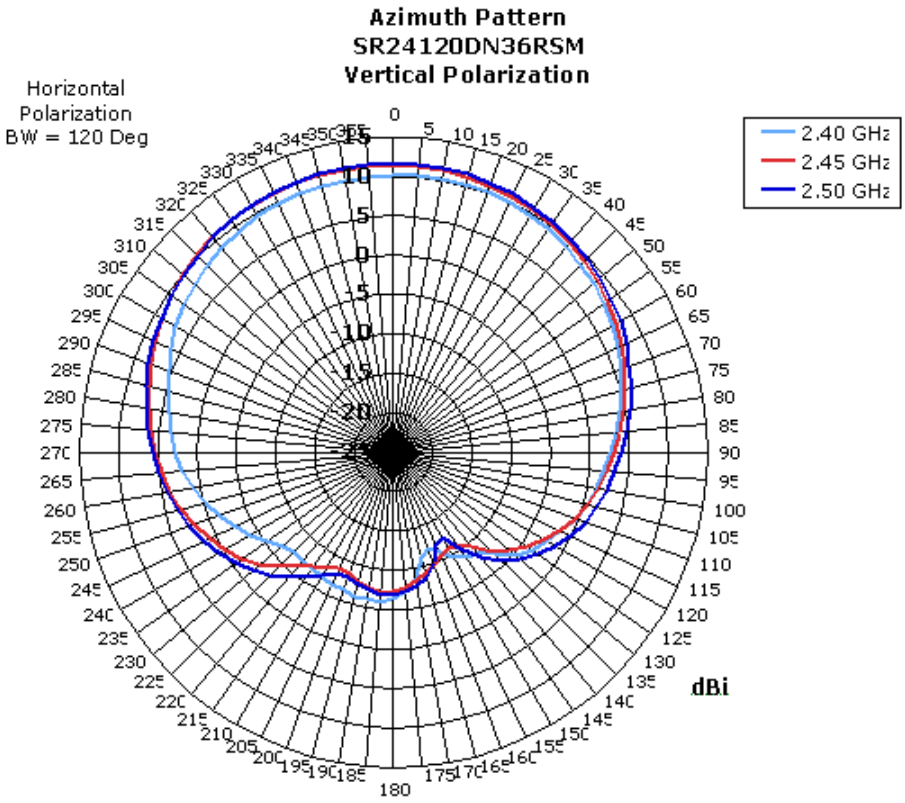

Azimuth Pattern
PC2415NA36RSM
3 dB BW = 25 Deg
1 dB BW = 13 Deg
2412 MHz
2437 MHz
2462 MHz
Zero Deg = End of Antenna
dBi

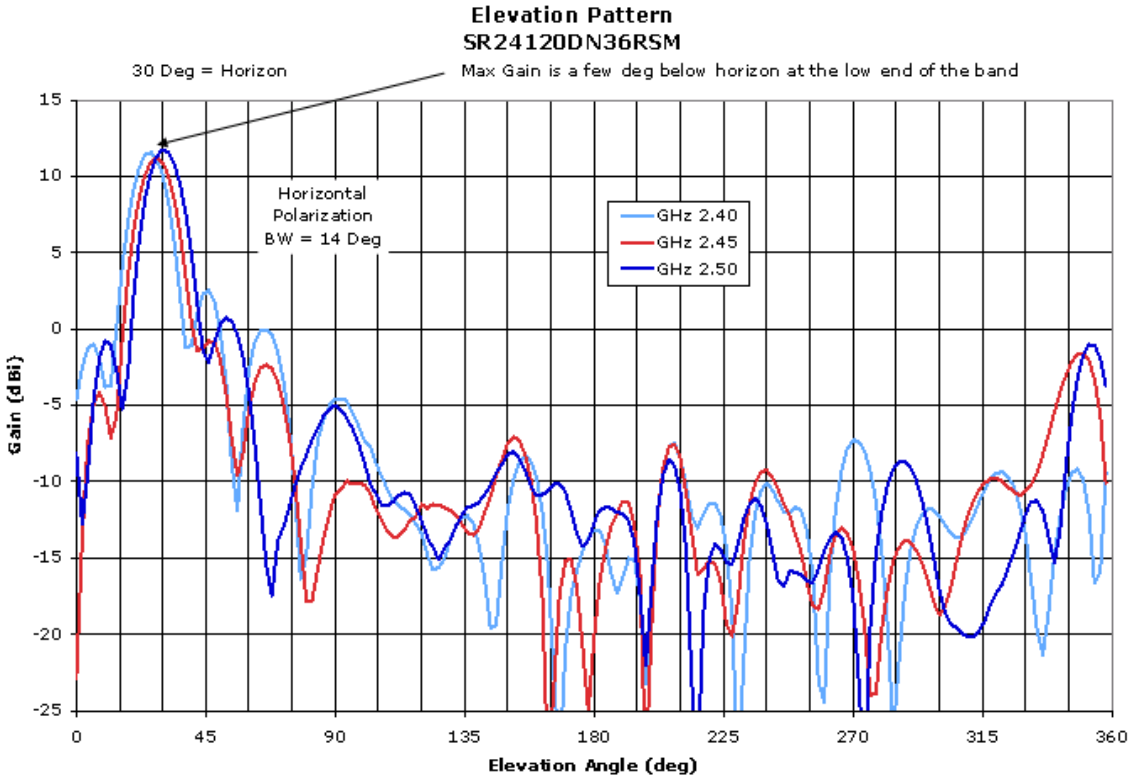

Elevation Pattern
PC2415NA36RSM
3 dB BW = 30 Deg
1 dB BW = 16 Deg
2412 MHz
2437 MHz
2462 MHz
Zero Deg = Overhead
90 Deg = End of Antenna
dBi

10 Directional Patch Panel Antenna

Nortel Order Number: DR4000087E6

- Cushcraft Model SR24120DN36RSM
- 2.4 - 2.5 GHz, 11 dBi Peak Gain
- Uniform 120 degree H-plane and 14 degree E-plane pattern
- Tilt-mount available for precise direction pointing
- Designed for long, wide coverage environments
- 3-foot cable
- Measures 23" x 3" x 2"


Azimuth Pattern
SR24120DN36RSM
Vertical Polarization
Horizontal
Polarization
BW = 120 Deg
2.40 GHz
2.45 GHz
2.50 GHz
dBi

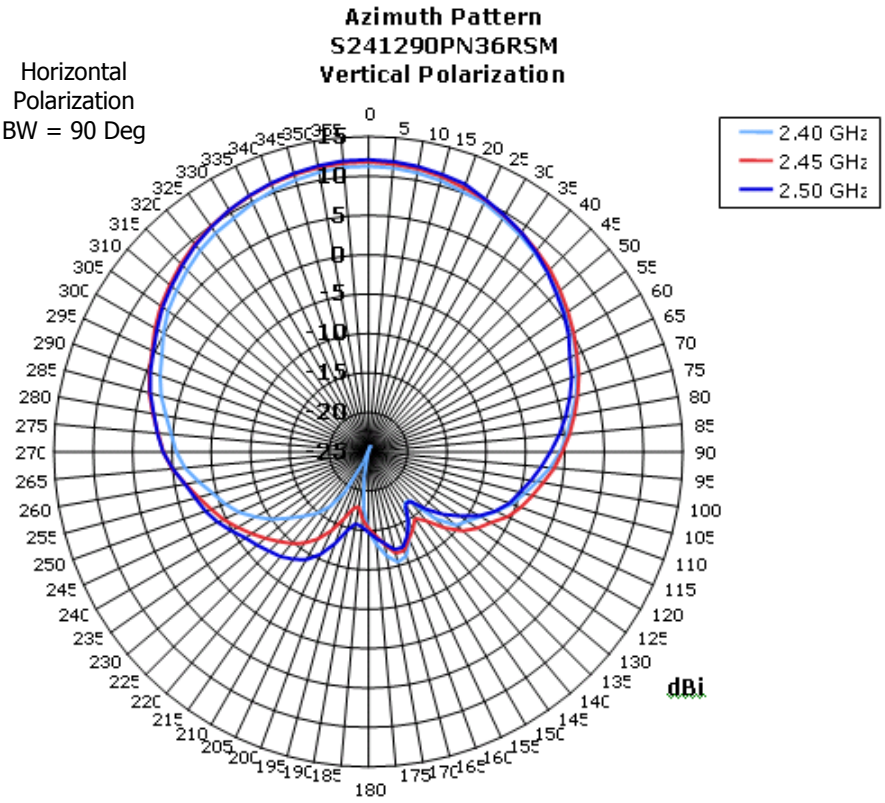

Elevation Pattern
SR24120DN36RSM
30 Deg = Horizon
Max Gain is a few deg below horizon at the low end of the band
Horizontal
Polarization
BW = 14 Deg
GHz 2.40
GHz 2.45
GHz 2.50
Gain (dBi)
15
10
5
0
-5
-10
-15
-20
-25
0
45
90
135
180
225
270
315
360
Elevation Angle (deg)

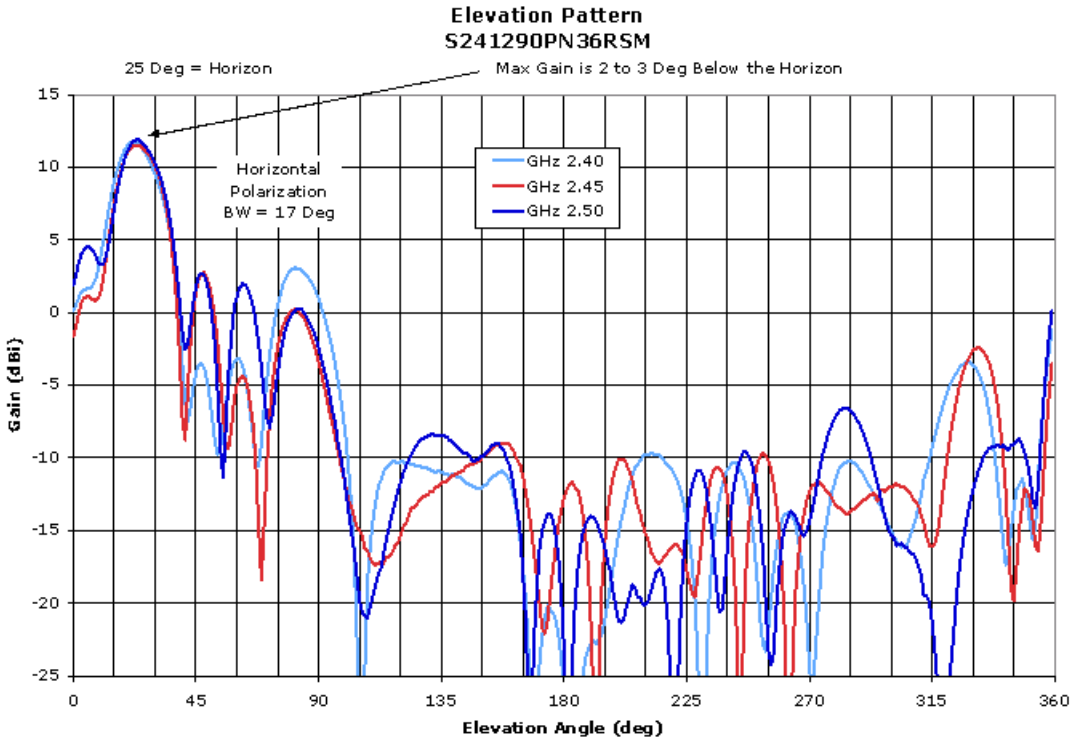
11 Directional Patch Panel Antenna

Nortel Order Number: DR4000086E6

- Cushcraft Model S241290PN36RSM
- 2.4 - 2.5 GHz, 12 dBi Peak Gain
- Uniform 90 degree H-plane and 17 degree E-plane pattern
- Tilt-mount available for precise direction pointing(shown)
- Designed for long, wide coverage environments
- 3-foot cable
- Measures 26" x 3" x 1"

Horizontal
Polarization
BW = 90 Deg




Elevation Pattern
S241290PN36RSM
25 Deg = Horizon
Max Gain is 2 to 3 Deg Below the Horizon
Horizontal
Polarization
BW = 17 Deg
GHz 2.40
GHz 2.45
GHz 2.50
Gain (dBi)
15
10
5
0
-5
-10
-15
-20
-25
0
45
90
135
180
225
270
315
360
Elevation Angle (deg)

2.4/5.0 GHz Dual antenna

12 Dual-band, Tri-mode 802.11a/b/g Spatial Diversity Antenna

Nortel Order Number: DR4000078E6

- Cushcraft Model S24493DSN36RSM
- 2.4 - 2.5 GHz, 3.0 dBi Peak Gain
- 4.90 - 5.15 GHz, 4.0 dBi Peak Gain
- 5.15 - 5.25 GHz, 3.9 dBi Peak Gain

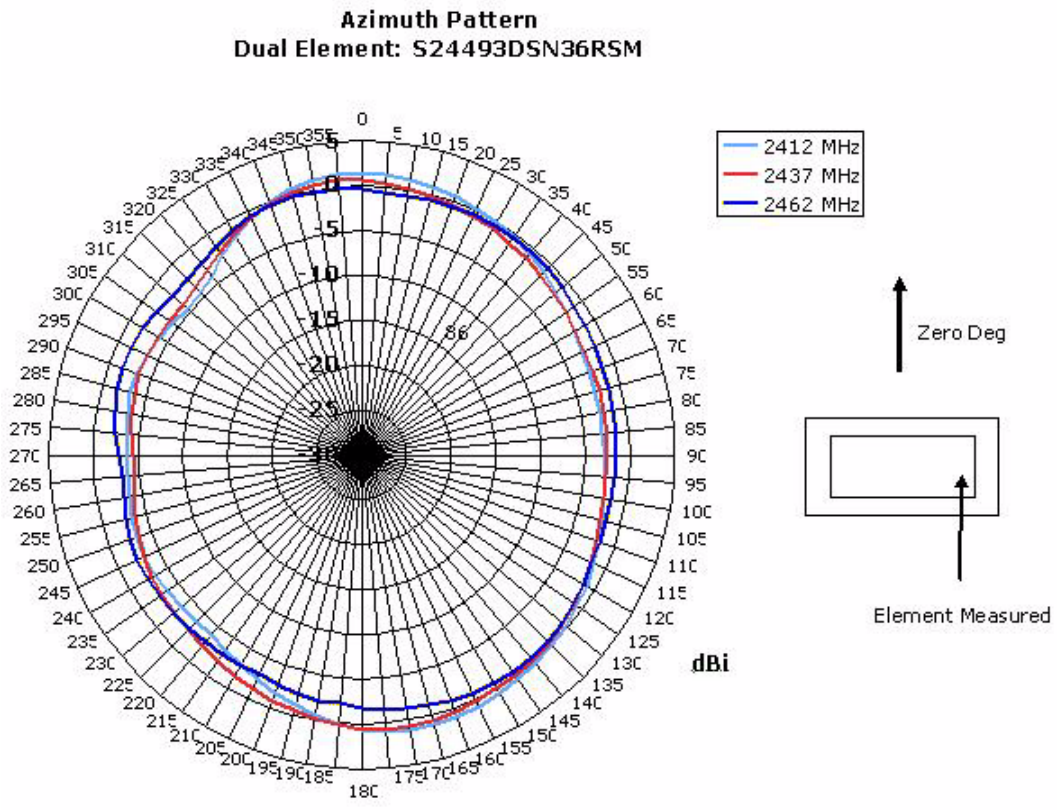
5.25 - 5.35 GHz, 3.2 dBi Peak Gain

5.470 - 5.725 GHz, 2.9 dBi Peak Gain

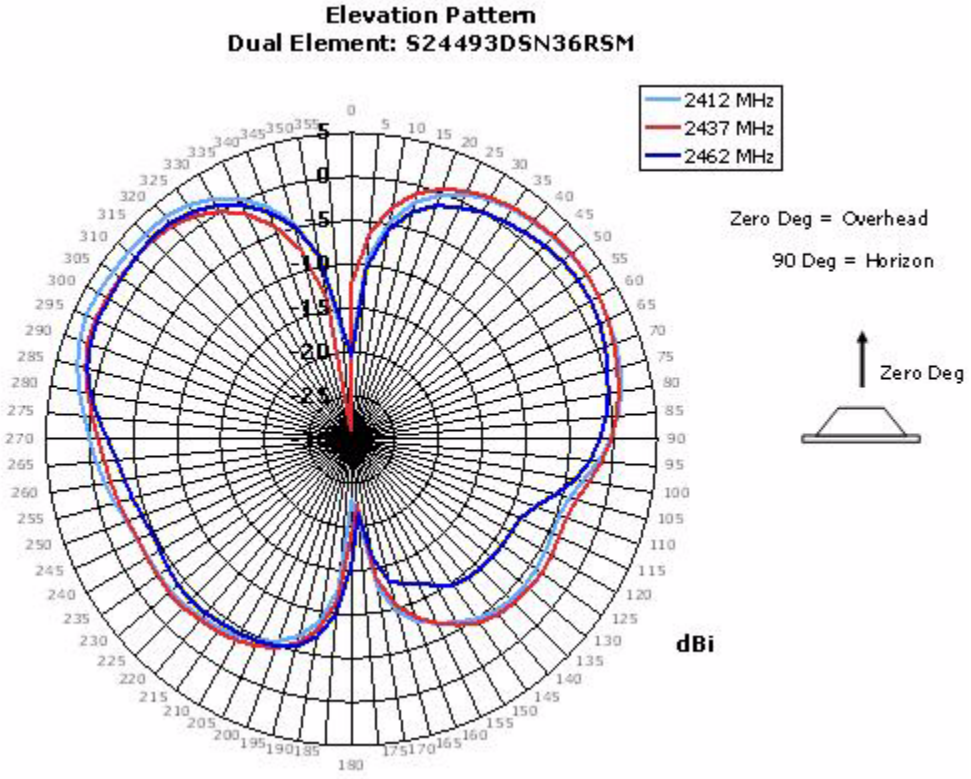
5.725 - 5.85 GHz, 2.6 dBi Peak Gain

- Each antenna port can be used individually for simultaneous 802.11a and 802.11b/g
- Well-suited for high data rate office applications
- 3-foot cable
- Measures 6.16” x .89” x 3.66”

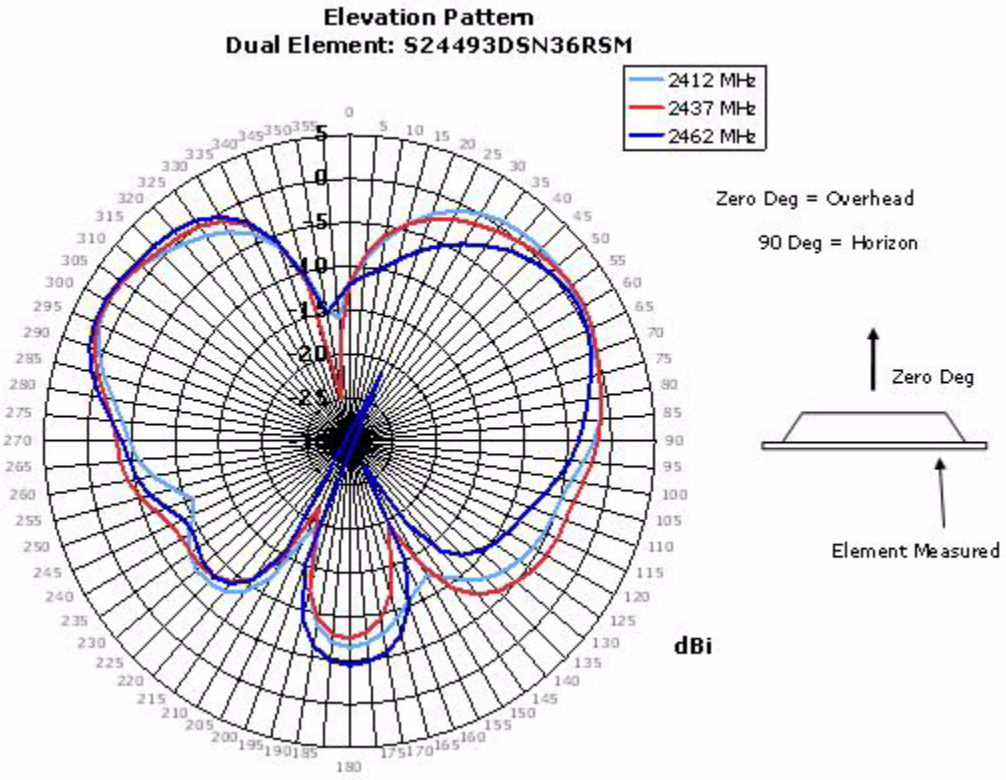
Azimuth Pattern for 2.4 GHz



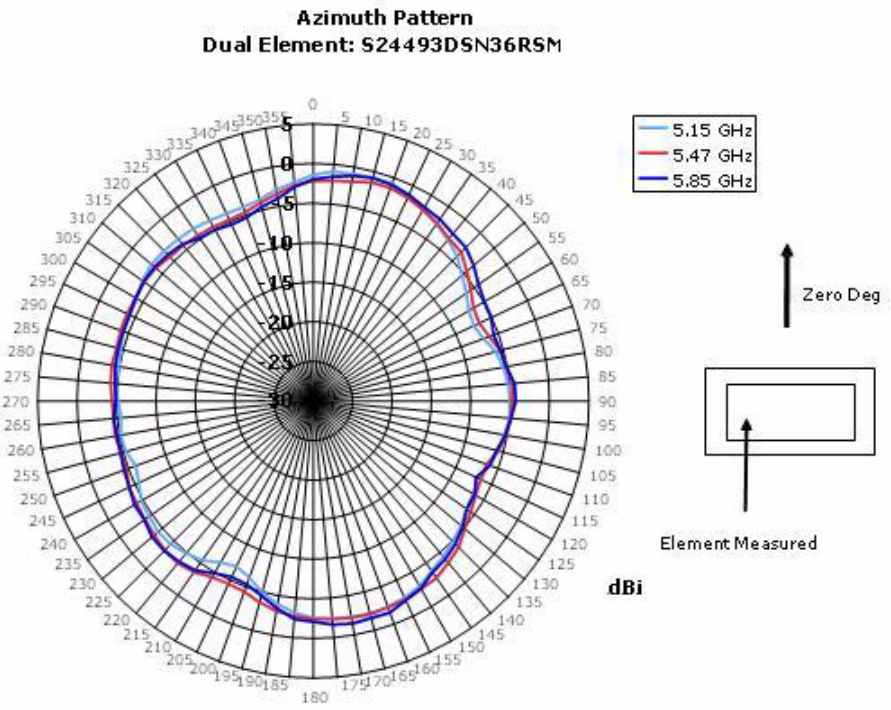
Elevation Pattern 1 for 2.4 GHz



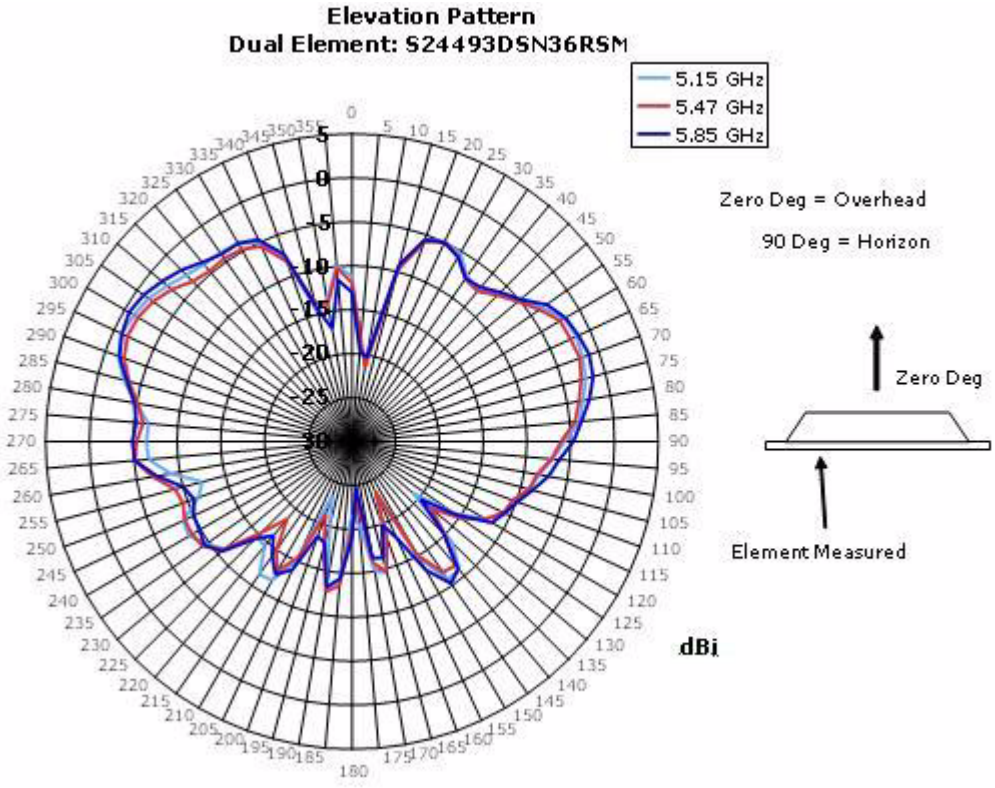
Elevation Pattern 2 for 2.4 GHz



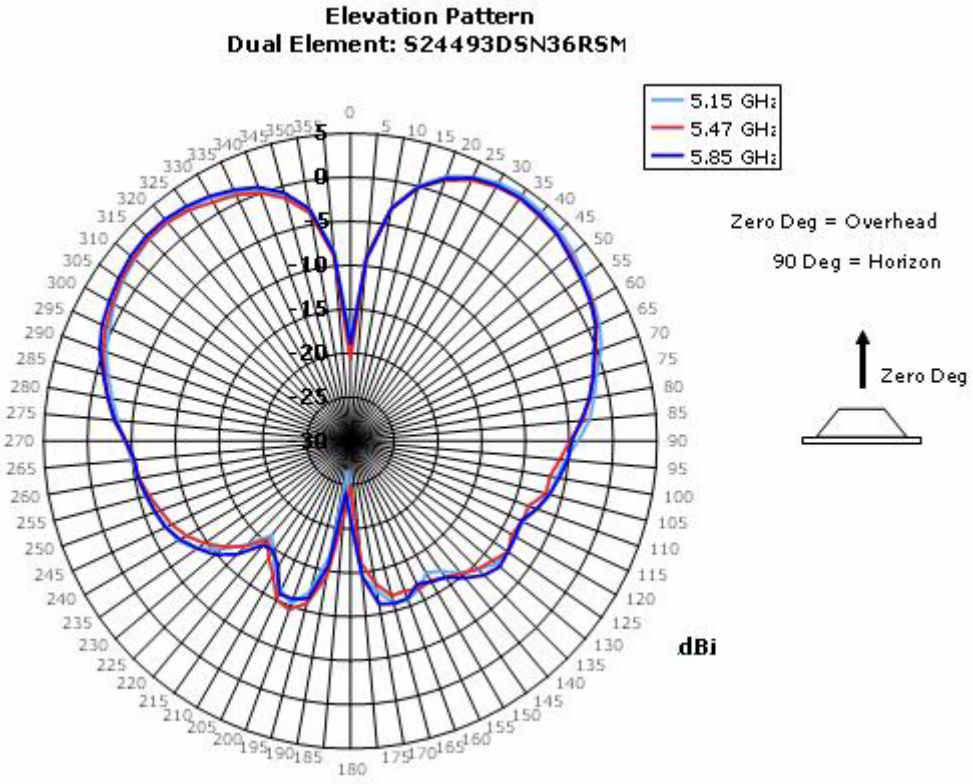
Azimuth Pattern for 5.0 GHz



Elevation Pattern 1 for 5.0 GHz



Elevation Pattern 2 for 5.0 GHz



Glossary of common antenna terminology

The following glossary includes basic antenna terminology that can help in the selection and/or recommendation of a particular antenna. These terms are used throughout the remainder of the document:

Omnidirectional (Omni) – Refers to the antenna coverage pattern. An omnidirectional antenna creates a uniform coverage pattern. Most omnidirectional antennas are weakest directly above and directly below their endpoints – this characteristic creates the familiar dual-lobe pattern shown on the E-plane graphs. Nulls are typically related to the orientation of the dipole/monopole antenna relative to the horizontal or vertical planes. The lobes grow and shrink depending upon the ground plane effects and cancellation/addition of the radiating signal. Omnidirectional antennas are suitable for most general deployments.

Directional – Refers to the antenna coverage pattern. A directional antenna focuses its lobe or radiated energy in a particular direction. In general, as the gain of a directional antenna increases, the radiating beamwidth or lobe decreases. This design increases the transmitted power and communication distance in a specific direction at the expense of uniform coverage, as compared to an omnidirectional antenna. A directional antenna must be “aimed” at the intended coverage zone.

Gain – Expressed in dBi, indicates the relative increase in radiated power over an isotropic point radiating source with a reference gain of 1.0.

Each 3 dB increment in power effectively doubles the radiated energy. For example, an antenna with a gain of 9 dBi increases the transmit power 8 times more than an isotropic point radiating source. For example:

12.5 mW = 11 dBm

11 dBm + 9dBi = 20 dBm

20 dBm = 100 mW

100mw/12.5 mW = 8 times more power

E-Plane graph – The elevation plane graph shows the radiated antenna coverage pattern as a vertical cross section - as if looking directly at the antenna from the side.

H-Plane graph – The horizontal plane graph shows the radiated antenna coverage pattern as a horizontal cross section - as if looking directly at the antenna from above.

AP troubleshooting

After you insert the Cat-5 cable into an AP's port connector and enable PoE on the cable, observe the device's health or LINK LED to determine the status of the connection with the WSS.

- If the LED is green and is glowing steadily, the AP was booted successfully by the WSS and is ready for operation.
- If the LED is not steadily glowing green, see Table 5.

(For descriptions of all the LEDs, see "Status LEDs" on page 28.)

Table 5: Health LED States (2332 Series)

Health or LINK LED Appearance	Diagnosis	Remedy
Not solid green	AP radio needs to be enabled.	Enable at least one of the radios. If the LED is still not solid green, try the remedy listed in this table based on the LED's appearance.
Unlit	AP is not receiving power.	Check the Cat-5 cable connection(s). For a direct connection to a WSS: • Set the port type on the WSS to an AP port. • Verify that Power over Ethernet (PoE) is enabled on the WSS port connected to the AP. For an indirect connection through the network: • Configure a AP connection on a WSS. • Verify that a Nortel-approved PoE source is supplying power to the AP.
Slowly alternating green and amber	AP is booting with an image received from a WSS.	Wait a few seconds for the boot process to complete. If this LED appearance persists, enable a radio or place a radio in sentry mode.
Solid amber	AP is waiting to receive boot instructions and a configuration file from a WSS.	Wait a few seconds for the boot process to begin. If the LED remains amber, try the remedies for the other health LED appearances. If the LED still remains amber, make sure the AP is securely connected to its PoE source and to the network or WSS.

AP technical specifications

This appendix lists the technical specifications for the Nortel 2332 Series access points. Table 6 lists the mechanical and compliance specifications. Table 7 on page 110, Table 8 on page 111, and Table 9 on page 111 list the radio specifications. Table 10 on page 112 lists the MAC address allocation scheme.

(For specifications for the WSS, see the *Nortel WLAN-Security Switch 2300 Series Configuration Guide*.)

Note. The 2332 Series access points are designed and approved to be used only with Nortel WLAN—Security Switch (WSS) models 2360/2361, and 2350. (The 2380 and 2382 does not directly connect to the AP.)

Note. The AP radios are disabled by default and can be enabled only by the system administrator using the WLAN Management softwareapplication or the WSS's command-line interface (CLI).

Note. The radio frequency band, operating channels, and transmit power depend on the country of operation specified by the system administrator using WLAN Management software or the WSS's CLI.

Table 6: AP Mechanical and Compliance Specifications

Specification	Description
Size	Diameter: 16.76 cm (6.6 inches) Height: 6.1 cm (2.4 inches)
Weight	Without mounting bracket: 0.45 kg (16 ounces) With mounting bracket: 0.5 kg (17.5 ounces)
Operating Temperature	0° C to +50° C (32° F to 122° F)
Storage Temperature	-20° C to +70° C (-4° F to +158° F)
Humidity	10% to 95% noncondensing
Power over Ethernet (PoE)	42 VDC to 57 VDC (46 VDC nominal) IEEE 802.3af
Status indicators	Health/WSS and radio LEDs (For descriptions of the LEDs, see "Status LEDs" on page 28.)
Wired network ports	Two RJ-45 ports for 10/100BASE-T Ethernet and Power over Ethernet (PoE) for the 2332 Series only.

Table 6: AP Mechanical and Compliance Specifications (continued)

Specification	Description
Standards compliance	IEEE 802.11 IEEE 802.11a IEEE 802.11b IEEE 802.11g IEEE 802.3af
Safety and electromagnetic compliance	FCC Part 15, UL 60950 IC Part 15, CSA 22.2 N0-950, RSS-139-1 and RSS-210 ETS 300-328 (2.4 GHz) and 301-893 (5 GHz), EN 301-489-17 R&TTE Directive 1999/5/EC TELEC, ARIB T66 GBT-15941-1995, GBT-16841-1997 LP0002
Encryption	Wi-Fi Protected Access (WPA) Advanced Encryption Standard (AES) 40-bit/104-bit Wired-Equivalent Privacy (WEP)
General	Power-save mode supported Transmit power control in 1 dB increments Supports up to 250 clients per radio

Table 7: 802.11a Radio Specifications

Specification	Description
Antenna type	Integrated omnidirectional with (2) radiating elements to allow for the use of diversity
Antenna gain	Internal: 5.15 - 5.35 GHz = 2.0 dBi peak, 5.470 - 5.725 GHz = 2.48 dBi peak and 5.725 - 5.850 GHz = 0.65 dBi peak
Frequency band	5.15 - 5.25 GHz, 5.25 - 5.35 GHz, 5.470 - 5.725 GHz and 5.725 - 5.85 GHz, based on country regulations
Operating channels	Based on the country of operation specified by the system administrator
Association rates	54 Mbps, 48 Mbps, 36 Mbps, 24 Mbps, 18 Mbps, 12 Mbps, 9 Mbps, and 6 Mbps, with automatic fallback
Modulation	Orthogonal frequency division multiplexing (OFDM)
Transmit power	Based on the country of operation specified by the system administrator

Table 8: 802.11b Radio Specifications

Specification	Description
Antenna type	Integrated omnidirectional with (2) radiating elements to allow for the use of diversity
Antenna gain	Internal: 2.48 dBi peak
Frequency band	2.4 GHz to 2.4835 GHz based on country regulations
Operating channels	Based on the country of operation specified by the system administrator
Association rates	11 Mbps, 5.5 Mbps, 2 Mbps, and 1 Mbps, with automatic fallback
Modulation	BPSK, QPSK, CCK
Transmit power	Based on the country of operation specified by the system administrator

Table 9: 802.11g Radio Specifications

Specification	Description
Antenna type	Integrated omnidirectional with (2) radiating elements to allow for the use of diversity
Antenna gain	Internal: 2.48 dBi peak
Frequency band	2.4 GHz to 2.4835 GHz based on country regulations
Operating channels	Based on the country of operation specified by the system administrator
Association rates	54 Mbps, 48 Mbps, 36 Mbps, 24 Mbps, 18 Mbps, 12 Mbps, 9 Mbps, and 6 Mbps, with automatic fallback
Modulation	Orthogonal frequency division multiplexing (OFDM)
Transmit power	Based on the country of operation specified by the system administrator

MAC addresses

Each 2332 Series is assigned a unique block of 64 MAC addresses. Each radio has 32 MAC addresses and can therefore support up to 32 SSIDs, with one MAC address assigned to each SSID as its BSSID.

An AP's MAC address block is listed on a label on the back of the AP. If the AP is already deployed and running on the network, you can display the MAC address assignments by using the **show {ap | dap} status** command.

All MAC addresses on an AP are assigned based on the AP's base MAC address, as described in Table 9 on page 111.

Table 10: MAC Address Allocations on an 2332 Series

AP base MAC Address	• The AP has a base MAC address. All the other addresses are assigned based on this address.
Ethernet Port MAC Addresses	• Ethernet port 1 equals the AP base MAC address. • Ethernet port 2 equals the AP base MAC address + 1.
802.11a Radio and SSID MAC Addresses	• The 802.11a radio equals the AP base MAC address + 1. • The BSSIDs for the SSIDs configured on the 802.11a radio end in odd numbers. The first BSSID is equal to the AP's base MAC address + 1. The next BSSID is equal to the AP's base MAC address + 3, and so on.
802.11b/g Radio and SSID MAC Addresses	• The 802.11b/g radio equals the AP base MAC address. • The BSSIDs for the SSIDs configured on the 802.11b/g radio end in even numbers. The first BSSID is equal to the AP's base MAC address. The next BSSID is equal to the AP's base MAC address + 2, and so on.

Translated caution statement, warning conventions and warning messages

The following caution statement, warning conventions, and warning messages apply to this manual.

Caution! The 2332 Series radios are disabled by default and can be enabled only by a system administrator using the WSS.

Warnen Sie! Die 2332 Series-Radios werden von Versäumnis außer Betrieb gesetzt und werden von nur einem Systemverwalter ermöglicht, der den WSS benutzt.

Avise! Las radios de 2332 Series son por defecto inválidas y sólo pueden ser habilitadas por un administrador del sistema que usa el WSS.

Avertissez! Les radios 2332 Series sont desactivées par défaut et peuvent être permises seulement par un administrateur du système qui utilise le WSS.

Acautele! Os rádios de 2332 Series são inválidos através de falta e só podem ser habilitados por um administrador de sistema que usa o WSS.

Avverta! Le radio di 2332 Series sono disabilitate per difetto e possono essere abilitate solamente da un amministratore di sistema che usa il WSS.

Warning conventions

Warning! This situation or condition can cause injury.

Warnung! Diese Situation oder dieser Zustand kann zu Verletzungen führen.

Aviso! Esta situación o condición puede causar lesiones.

Avertissement! Cette situation ou cette condition peuvent provoquer des blessures.

Advertindo! Esta situação ou condição podem causar dano.

Avvertendo! Questa situazione o la condizione possono provocare danno.

Warning! High voltage. This situation or condition can cause injury due to electric shock.

Warnung! Hochspannung. Diese Situation oder dieser Zustand kann einen Elektroschock verursachen.

Aviso! Alta tensión. Esta situación o condición puede causar lesiones por descarga eléctrica.

Avertissement! Haute tension. Cette situation ou cette condition peuvent provoquer des blessures dues à des décharges électriques.

Advertindo! Voltagem alta. Esta situação ou condição podem causar dano devido a choque elétrico.

Avvertendo! Tensione alta. Questa situazione o la condizione possono provocare danno a causa di colpo elettrico.

Qualified service personnel warning

Warning! Installation must be performed by qualified service personnel only. Read and follow all warning notices and instructions marked on the product or included in the documentation.

Warnung! Die Installation darf nur von einem qualifizierten Kundendienstmitarbeiter vorgenommen werden. Lesen Sie alle Warnhinweise und Anweisungen auf dem Produkt oder in der Dokumentation und befolgen Sie sie.

Aviso! Sólo puede realizar la instalación personal cualificado de asistencia técnica. Lea y siga todas las notas de advertencia e instrucciones indicadas en el producto o incluidas en la documentación.

Avertissement! L'installation doit être effectuée uniquement par des techniciens qualifiés. Lisez et suivez toutes les notices d'avertissement et les instructions figurant sur le produit ou comprises dans la documentation.

Advertindo! Instalação só deve ser executada através de pessoal de serviço qualificado. Leia e siga toda a advertência nota e instruções marcaram no produto ou incluíram na documentação.

Avvertendo! L'installazione deve essere compiuta solamente da personale di servizio qualificato. Legga e segua ogni avvertimento nota e le istruzioni marcarono sul prodotto o incluso nella documentazione.

Radio safety warnings

Warning! Install this device in such a manner as to maintain a minimum of 20 cm (7.9 inches) separation distance between the radiating element(s) and all persons. This safety warning conforms with FCC radio frequency exposure limits.

Warnung! Installieren Sie dieses Gerät auf so eine Weise, um ein Minimum von 20 beizubehalten cm (7.9 Zoll) Trennungsentfernung zwischen dem ausstrahlenden Element (s) und allen Personen. Diese Sicherheitswarnung richtet sich nach FCC Radio Häufigkeit Aussetzung Grenzen.

Aviso! Instale este dispositivo de tal una manera acerca de mantenga un mínimo de 20 distancia de separación de centímetro (7.9 pulgadas) entre los elementos radiando y todas las personas. Este seguridad advirtiendo conforma con FCC radio frecuencia exposición límites.

Avertissement! Installez cet appareil dans une telle manière comme pour maintenir un minimum de distance de la séparation de 20 centimètres (7.9 pouces) entre le ou les éléments rayonnant et toutes les personnes. Ce sécurité prévenir se conforme avec FCC envoyez par radio des limites de l'exposition de la fréquence.

Advertindo! Instale este dispositivo de tal uma maneira sobre mantenha um mínimo de 20 cm (7.9 polegadas) distância de separação entre o elemento radiando e todas as pessoas. Este segurança advertindo conforma com FCC rádio freqüência exposição limites.

Avvertendo! Installi questa apparecchiatura in tale maniera come mantenere un minimo di 20 distanza di separazione di cm (7.9 pollici) tra l'elemento che irradia e tutte le persone. Questo sicurezza avvertendo adatta con FCC radio frequenza esposizione limiti.

Warning! Do not operate access point near unshielded blasting caps or in an otherwise explosive environment unless the device has been modified for such use by qualified personnel.

Warnung! Die Zugriffspunkte sollten nicht neben ungeschirmten Sprengkapseln betrieben oder in einer explosiven Umgebung eingesetzt werden. Für einen solchen Einsatz muss das Gerät von einem qualifizierten Kundendienstmitarbeiter entsprechend angepasst werden.

Aviso! No utilice el punto de acceso de cerca de detonadores no blindados ni en un entorno explosivo, a menos que haya sido modificado el dispositivo con ese fin por personal cualificado.

Avertissement! Le point d'accès ne doit pas fonctionner près de détonateurs non blindés ou dans un autre environnement qui présent un risque d'explosion, à moins que cet appareil n'ait été adapté en vue d'une telle utilisation par du personnel qualifié.

Advertindo! Não opere ponto de acesso próximo unshielded que dinamita bonés ou em um caso contrário ambiente explosivo a menos que o dispositivo fosse modificado para tal uso através de pessoal qualificado.

Avvertendo! Non azioni punto di accesso vicino ad unshielded che danneggia berretti o in un altrimenti ambiente esplosivo a meno che l'apparecchiatura è stata cambiata per tale uso da personale qualificato.

Warning! Do not touch or move the access point when the antennas are transmitting or receiving.

Warnung! Berühren oder bewegen Sie den Zugriffspunkt nicht, während die Antennen senden oder empfangen.

Aviso! No toque ni mueva el punto de acceso de cuando las antenas estén transmitiendo o recibiendo señales.

Avertissement! Ne touchez ni ne déplacez le point d'accès lorsque les antennes sont en cours de transmission ou de réception.

Advertindo! Não toque ou mova o ponto de acesso quando as antenas estiverem transmitindo ou estão recebendo..

Avvertendo! Non tocchi o trasporti il punto di accesso quando le antenne stanno emettendo o stanno ricevendo..

Warning! Before using a wireless device in a hazardous location, consult the local codes, national codes, and safety directors of the location for usage constraints.

Warnung! Bevor Sie drahtlose Geräte an einem gefährlichen Standort einsetzen, sollten Sie die lokalen und nationalen Regelungen und Sicherheitsbestimmungen des Standorts auf Nutzungsbeschränkungen überprüfen.

Aviso! Antes de utilizar un dispositivo inalámbrico en una ubicación peligrosa, consulte los códigos locales y nacionales y a los responsables de seguridad de la ubicación para conocer las restricciones de uso.

Avertissement! Avant d'utiliser un appareil sans fil dans un endroit dangereux, consultez la réglementation locale et nationale ainsi que les responsables de la sécurité de l'endroit concerné pour obtenir des informations relatives aux conditions et aux limites d'utilisation de cet appareil.

Advertindo! Antes de usar um dispositivo sem fios em um local perigoso, consulte os códigos locais, códigos nacionais, e diretores de segurança do local para constrangimentos de uso.

Avvertendo! Prima di usare un'apparecchiatura senza fili in un'ubicazione azzardata, consulti i codici locali, codici nazionali, e direttori di sicurezza dell'ubicazione per costrizioni di uso.

Warning! Intentional radiators, such as the Nortel WLAN 2332 Series are not intended to be operated with any antenna(s) other than those furnished by Nortel. An intentional radiator may only be operated with the antenna(s) with which it is authorized. For a complete listing of the authorized antennas for use with this product, visit http://www.nortel.com/support

Warnung! Absichtliche Heizkörper, wie der Nortel WLAN Zugangspunkt 2332 Series sollen nicht mit irgendeinem antenna(s) anders als die bearbeitet werden versorgt worden von Nortel. Ein absichtlicher Heizkörper kann mit dem antenna(s) nur bearbeitet werden,mit dem er autorisiert wird. Für eine komplette Auflistung der autorisierten Antennen für Gebrauch mit diesem Produkt, Besuch http://www.nortel.com/support.

Aviso! Os radiadores intencionais, tais como o ponto de acesso 2332 Series de Nortel WLAN não são pretendidos ser operados com nenhum antenna(s) à excepção daqueles fornecido por Nortel. Um radiador intencional pode somente ser operado com o antenna(s) com que é autorizado. Para uma lista completa das antenas autorizadas para o uso com este produto, visita http://www.nortel.com/support

Avertissement! Des radiateurs intentionnels, tels que le point d'accès de Nortel WLAN 2332 Series ne sont pas prévus pour n'être actionnés avec aucun antenna(s) autre que ceux meublé par Nortel. Un radiateur intentionnel peut seulement être actionné avec l'antenna(s) avec lequel il est autorisé. Pour une liste complète des antennes autorisées pour l'usage avec ce produit, visite http://www.nortel.com/support

¡Advertencia! Los radiadores intencionales, tales como el punto de acceso de Nortel WLAN 2332 Series no se piensan para ser funcionados con ningún antenna(s) con excepción de ésos equipado por Nortel. Un radiador intencional se puede funcionar solamente con el antenna(s) con el cual se autoriza. Para un listado completo de las antenas autorizadas para el uso con este producto, visita http://www.nortel.com/support.

Avvertimento! I radiatori intenzionali, quale il punto di accesso di Nortel WLAN 2332 Series non sono intesi per essere funzionati con alcun antenna(s) tranne quelli ammobiliato da Nortel. Un radiatore intenzionale può essere funzionato soltanto con il antenna(s) con cui è autorizzato. Per un elenco completo delle antenne autorizzate per uso con questo prodotto, chiamata http://www.nortel.com/support.

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