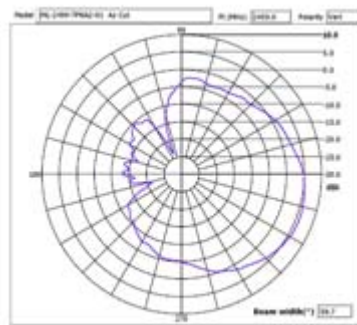
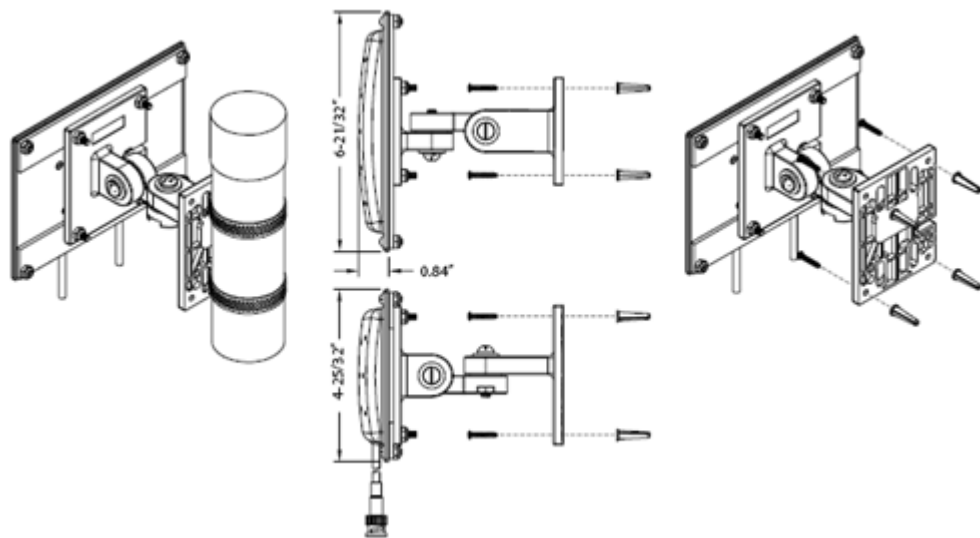
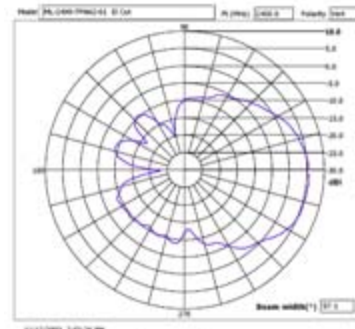


Enterprise Wireless LAN Antenna

Specification Guide



Azimuth Cut



Elevation Cut

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Appendix A. Technical Support

About This Guide

Introduction

This guide provides the RF Engineer a catalog of antenna parts and accessories to complete a customized RF environment. This guide specifically addresses the antennas used for 802.11a, .11b, and .11g implementations for Wireless Local Area Networks (WLANs).

It is important to understand that antenna and accessory selection should be qualified by on-site testing with the actual components used. Signal attenuation is cumulative with each connection and component added between the antenna and the radio, so careful study should verify the given arrangement delivers the expected results.



NOTE: Illustrations displayed in this guide are samples and can differ from the actual antenna.

Document Conventions

The following conventions are used in this document to draw your attention to important information:



NOTE: Indicate tips or special requirements.



CAUTION: Indicates conditions that can cause equipment damage or data loss.



WARNING! Indicates a condition or procedure that could result in personal injury or equipment damage.

Notational Conventions

The following additional notational conventions are used in this document:

- *Italics* are used to highlight the following:
 - Chapters and sections in this and related documents
 - Dialog box, window and screen names
 - Drop-down list and list box names
 - Check box and radio button names
 - Icons on a screen.
- **GUI** text is used to highlight the following:
 - Screen names
 - Menu items
 - Button names on a screen.
- bullets (•) indicate:
 - Action items
 - Lists of alternatives
 - Lists of required steps that are not necessarily sequential
- Sequential lists (those that describe step-by-step procedures) appear as numbered lists.

Antenna Selection and Description

1.1 Antenna Selection

While several antennas may work in a given environment, some will provide better coverage than others. Using the right antenna in the right location will maximize both the performance and coverage of your network. Understanding the key characteristics that describe how an antenna sends and receives radio frequency signals is critical to finding the ideal antenna for your deployment. This guide supports the antennas used for an AP-5131 or AP-5181 model access point and an AP300 (non-integrated antenna) model access port.

Motorola Enterprise Wireless LAN products operate in the 2.4 GHz and 5 GHz ISM bands allocated for unlicensed use. Access point and access port products available today support either the 802.11b/g or the 802.11a standard, or both. Wireless devices conforming to the 802.11b/g standard operate in the 2.4 GHz ISM band, while 802.11a devices operate in the 5 GHz band. The antennas in this guide are grouped according to the frequency band they support. Some antennas are designed to operate on either band. These antennas (described as "Dual-band") may be connected to radios operating in either the 2.4 or 5 GHz bands, although a single antenna may not be connected to two radios at the same time.

1.1.1 Access Points and Access Ports Supported

The antennas and accessories referenced in this guide are intended to customize the radiated signal lobes of Motorola's WLAN product suite.

The *access port* (AP) supported is the AP300 (Part No. WSAP-5100-100-WWR). This access port has no integrated antennas and some antenna must be added to the device. The AP300 supports both 5 GHz (802.11a) and 2.4 GHz (802.11b/g). The AP300 has two sets of antenna connectors providing diversity (for each spectrum supported).

The two 5 GHz connectors on the AP300 are - **RPSMA-Female**

The two 2.4 GHz connectors on the AP300 are - **RPBNC-Female**

The AP-5131 and AP-5181 access points are also addressed in this document. For an AP-5131, there are several different part number configurations unrelated to the actual antenna connections. An AP-5131 and AP-5181 supports both 5 GHz (802.11a) and 2.4 GHz (802.11b/g). Valid AP-5131 part numbers include:

The AP-5131 supports both 5 GHz and 2.4 GHz spectrums, but the antenna connectors implemented on the AP provide dual spectrum capability - both spectrums on one physical connector.

The connectors on the AP-5131 are **RP-SMA-Female**.

The AP-5181 is used outdoors and only one part number is currently available (AP-5181-13040-WWR). Since this device is intended to be mounted outside in unpredictable weather, lightning protection is integrated into the device design. As such, no additional lightning protection is required.

The connectors on the AP-5181 are **N-Type-Female**.

1.1.2 Connector Types and Definitions

There are combinations of antenna types and cables required to provide a satisfactory connection to the AP. One confusing factor is "reverse polarity". Reverse polarity is the FCC's requirement for each WLAN manufacturer to have unique access point connectors. Motorola (Symbol) had previously standardized our offerings for access points/ports:

- 2.4 GHz is Reverse polarity BNC female (RP-BNC-F)
- 5 GHz is reverse polarity SMA female (RP-SMA-F)
- Dual Band is reverse polarity SMA female (for AP-5131), and N-Female (for AP-5181).



NOTE: Reverse polarity presents confusion because of a lack of a standardized definition from connector manufactures. Reverse polarity provides a center element, which should not be confused with a male connector. A male connector is defined by the outer jacket of the connector rather than the center element .

The following displays the connectors used within this antenna specification guide:



Figure 1.1 RP-BNC-F



Figure 1.2 RP-BNC-M



Figure 1.3 RP-SMA-F



Figure 1.4 RP-SMA-M

Additionally, antennas deployed outdoors and industry standard accessories like lightening arrestors use N-Type connectors (as displayed below). Therefore, with the combinations devices required (access points/ports, antennas, cable extensions, and lightening arrestors), various adapter cables are required to connect an antenna to an access point/port.



Figure 1.5 N-Type-F



Figure 1.6 N-Type-M

1.1.3 Indoor and Outdoor Antennas

One important aspect of an antenna is whether it is weather sealed to protect it from the environment. Because of this extra protection, outdoor antennas are typically more expensive than those rated for indoor use. Outdoor antennas can be used for indoor applications, such as freezers and cooler where moisture is common. Outdoor antennas can be used for indoor applications, but indoor applications should not be used in outdoor applications.

One common distinction of outdoor antennas is the connector. Since lightning protection is always advised for outdoor antennas, these antennas typically have N-type-Male to directly attach the lightning arrestor. This is true of the 2.4 GHz, 5 GHz, and the dual-band outdoor antennas.

1.1.4 Spectrum and Part Number Designations

The antennas listed in this document are ultimately referenced by part number. A numerical sequence is used within each antenna's part number to identify the spectrum supported by the antennas.

- The antenna part numbers with a 2499 indicates a 2.4 GHz antenna. For more information on the 2.4 GHz antenna suite, see [802.11b/g Antenna Suite on page 3-1](#).
- The antenna part numbers with a 5299 indicates a 5 GHz antenna. For more information on the 5 GHz antenna suite, see [802.11a Antenna Suite on page 4-1](#).
- The antenna part numbers with a 2452 indicates a dual band antenna (2.4GHz and 5 GHz). For more information on the 2.4 GHz antenna suite, see [2.4GHz - 5.2GHz Dual Band Antenna Suite on page 5-1](#).

1.1.5 Extended AP to Antenna Cable Lengths

Most indoor antennas are intended to be mounted directly to the AP's connectors. Some mounting arrangements call for positioning the AP a significant distance away from the antenna due to serviceability or other reason. In these situations, various adapters and cable extensions are required.

In these situations be mindful of:

- The connector on the AP
- The connector on the Antenna
- The spectrum being implemented
- Signal loss due to multiple connectors and long cable lengths

Combinations of these attributes present different parts required to complete the connection. The Product Compatibility matrix in addresses the parts required to make a proper connection. For more information, see [Product Compatibility on page 2-1](#).

1.2 Antenna Selection Criteria

In addition to antenna frequency, there is other criteria to consider when selecting an antenna for the AP-5131, AP-5181 or AP300 (non-integrated antenna) model access port.

1.2.1 Antenna Pattern

1.2.1.1 Omni-Directional

Signal radiates from the antenna in all directions on the horizontal plane.

1.2.1.2 Directional

Signal radiates in a specific direction, typically described as a beam of given width, expressed in degrees in the horizontal and vertical plane. For more information, see [Azimuth 3dB Beamwidth on page 1-8](#) and [Elevation 3dB Beamwidth on page 1-8](#).

1.2.2 Antenna Type

1.2.2.1 Panel

A panel antenna is a flat antenna mounted to a wall or other vertical surface and radiates RF energy (radio waves) directionally away from the wall. They usually have gain greater than 5 dBi and are not suitable for omni-directional situations. Ideally suited for long hallways.

1.2.2.2 Patch

A patch antenna is a flat antenna mounted on the ceiling but whose pattern is omni-directional. Most of the energy goes out horizontally to the sides of the antenna and equal in all directions.

1.2.2.3 Dipole

A dipole antenna is a tubular antenna that can be either a pipe shape, a straight flexible rod or a paddle. This antenna has an omni-directional pattern when placed in a vertical position. It usually has 2 dBi of gain.

1.2.2.4 Dipole Array

Essentially a dipole, a dipole array is two or more dipoles that are placed one on top of the other, requiring a longer tube to hold them. The advantage of a dipole array is that it has higher gain.

1.2.2.5 Parabolic Grid

A parabolic grid antenna is a very directional, dish-like antenna. Its parabolic reflector focuses the RF energy like a flashlight. Most of the time the radiating element is a dipole, but when combined with the dish, it becomes very directional with gain up to 24 dBi. Usually used in long point-to-point systems.

1.2.2.6 Yagi

A yagi antenna is an antenna that has an internal structure resembling that of typical antennas used for TV reception (a series of rods perpendicular to a main rod, making a triangular shape). This is a directional antenna with less gain than the PGA, typically around 13 dBi. It may be used in either point-to-point situations, or to cover a very long, narrow area in point-to-multi-point situations.

1.2.3 Antenna Performance Characteristics

1.2.3.1 Frequency

The frequency band within which the antenna performs at the stated specifications

1.2.3.2 Gain (dBi)

The relative amplification of the antenna with respect to an equivalent isotropic antenna, expressed on the decibel logarithmic scale.

1.2.3.3 Cable loss (dB)

The signal strength loss introduced by the cable connected to the antenna expressed on the decibel logarithmic scale.

1.2.3.4 Net gain (dBi)

The resulting amplification of the antenna paired with its cable.

1.2.3.5 Polarization

The orientation of the electrical field which the antenna is optimized to receive. If the transmitting and receiving antennas are both linear polarized, then turning one 90° so that they are cross polarized will reduce the range significantly.

1.2.3.6 VSWR

Voltage Standing Wave Ratio (VSWR) is the ratio of maximum voltage to minimum voltage along the line. Expresses the degree of match between the transmission line and the terminating element (antenna). When VSWR is 1:1 the match is perfect, a VSWR of 1.5:1 corresponds to 96% power efficiency.

1.2.3.7 Azimuth 3dB Beamwidth

Width of the antenna beam on the horizontal plane expressed in degrees.

1.2.3.8 Elevation 3dB Beamwidth

Height of the antenna beam on the vertical plane expressed in degrees.

1.3 Antenna Accessories for Motorola Enterprise WLANs

Motorola offers a complete selection of antennas and accessories to ensure optimal coverage and performance for 802.11a/b/g wireless LANs. Regardless of the size or layout of your environment, from a small office or storefront to campus-wide, multiple-site, indoor and outdoor deployments, Motorola offers the antennas, cables and accessories designed to fit your needs.

By combining this portfolio with a broad line of wireless switches, access ports, access points, client connectivity cards, ruggedized mobile voice/data devices and network management software, as well as wireless mobility planning and deployment services, Motorola offers comprehensive end-to-end wireless enterprise LAN solutions, giving you secure, reliable access to your critical business data and applications at the point of activity. For more information on Motorola's wireless products, visit

www.motorola.com.

1.3.1 Choosing the Right Antenna and accessories for your WLAN

It is important to consider a number of factors when choosing an antenna and accessories for your Motorola enterprise WLAN. To choose the right components, you'll need to know:

- Where is the antenna to be installed, and what type of coverage is required. Knowing the intended radio band is central. Determine if the intended radio coverage area supports dual 2.4/5.2 band traffic. Has the attenuation of the coverage been discerned in respect to known barriers.
- In which band (802.11b/g or 802.11a) your network operates
- Which Motorola AP to use
- Whether you will be deploying the network indoors or outdoors
- The distance between AP and antenna, to determine extender cable length, if any
- the serviceability requirement for each AP and antenna deployment

Review the [Product Compatibility](#) chart to determine which antennas suit your needs. Using the part numbers provided, determine which of the antennas will work with your hardware in your environment.

Product Compatibility

To find the right antenna and accessories for your AP-5131, AP-5181 or AP300 (non-integrated antenna) deployment:

- Find your Motorola access point or access point model at the top of the chart (refer to the chart on the following page). Follow that column down to find the antennas, cables and lightning arrestors compatible with that model access port or access point. Write those part numbers down.
- Follow the row antenna across the table to the columns for the lightning arrestors and cables you wrote down to confirm that they compatible with the antenna you've chosen and determine if an adaptor is required to connect the two selected parts.

		AP Radios						Cables					LAs			
		AP300 A	AP300 B/G	AP-5131 A	AP-5131 B/G	AP-5181 A	AP-5181 B/G	ML-1499-100JK-01R	ML-1499-10JK-01R	ML-1499-25JK-01R	ML-1499-50JK-01R	ML-1499-72PJ-01R	ML-1499-LAK1-01R	ML-1499-LAK2-01R	ML-2452-LAK1-01R	
Antennas	2.4 GHz	ML-2499-11PNA2-01R	X *	X 3	X X	X X	X X	1	1	1	1	*	2	2	2	
		ML-2499-5PNL-72-N	X 8	X 7	X *	X *	X *	A	A	A	A	X	*	*	*	
		ML-2499-7PNA2-01R	X *	X 3	X X	X X	X X	X X	1	1	1	1	*	2	2	2
		ML-2499-APA2-01	X *	X X	X X	X X	X X	X X	X	X	X	X	X	X	X	X
		ML-2499-BPNA3-01R	X 9	X 6	X X	X X	X X	X X	*	*	*	*	X	X	*	X
		ML-2499-BYGA2-01R	X 9	X 6	X X	X X	X X	X X	*	*	*	*	X	X	*	X
		ML-2499-FHPA5-01R	X X	X X	X X	X X	X *	X *	A	A	A	A	X			
		ML-2499-FHPA9-01R	X X	X X	X X	X X	X *	X *	A	A	A	A	X			
		ML-2499-HPA3-01R	X *	X *	X X	X X	X X	X X	1	1	1	1	*	2	2	2
		ML-2499-PNAHD-01R	X *	X 3	X X	X X	X X	X X	1	1	1	1	*	2	2	2
	ML-2499-SD3-01R	X *	X 3	X X	X X	X X	X X	1	1	1	1	*	2	2	2	
	5 GHz	ML-5299-APA1-01R	* X	* X	X X	X X	X X	X X	X X	X X	X X	X X	X X	X X	X X	X X
		ML-5299-FHPA10-01R	X X	X X	X X	X X	X X	X X	A	A	A	A	X			
		ML-5299-FHPA6-01R	X X	X X	X X	X X	X X	X X	A	A	A	A	X			
		ML-5299-HPA1-01R	* X	* X	X X	X X	X X	X X	4	4	4	4	X	5	5	5
		ML-5299-PTA1-01R	* X	* X	X X	X X	X X	X X	4	4	4	4	X	5	5	5
		ML-5299-WPNA1-01R	* X	* X	X X	X X	X X	X X	4	4	4	4	X	5	5	5
	Dual	ML-2452-APA2-01	* X	* X	X X	X X	X X	X X	X X	X X	X X	X X	X X	X X	X X	X X
		ML-2452-PNA5-01R	X X	X X	X X	X X	X X	X X	A	A	A	A	X			
		ML-2452-PNA7-01R	X X	X X	X X	X X	X X	X X	A	A	A	A	X			
LAs	ML-1499-LAK1-01R	X *	X X					*	*	*	*	*				
	ML-1499-LAK2-01R	X X	X X					*	*	*	*	X				
	ML-2452-LAK1-01R	* X	* X					*	*	*	*	X				
Cables	ML-1499-100JK-01R	7	X	7	7	*	*									
	ML-1499-10JK-01R	7	X	7	7	*	*									
	ML-1499-25JK-01R	7	X	7	7	*	*									
	ML-1499-50JK-01R	7	X	7	7	*	*									
	ML-1499-72PJ-01R	X	*	X	X	X	X									
1	ML-1499-RBNCA1-01R															
2	ML-1499-RBNCA2-01R															
3	25-72178-01															
4	25-90262-01R															
5	25-90263-01R															
6	25-85391-01R															
7	25-85392-01R															
8	must use ML-1499-LAK1-01R															
9	25-97261-01R															
A	25-99175-01R															
*	Compatible															
X	Not compatible															
	Not required															

802.11b/g Antenna Suite

3.1 Supported 802.11b/g/n Antenna Suite

Motorola supports numerous single-band 2.4 GHz 802.11b/g/n antennas to suit the requirements of your unique AP-5131, AP-5181 or AP 300 (non-integrated antenna) deployment. Check the Motorola Web site periodically, as newly supported 802.11b/g/n antennas will be added to this document as they are released. For more information, go to <http://support.symbol.com/support/product/manuals.do>.

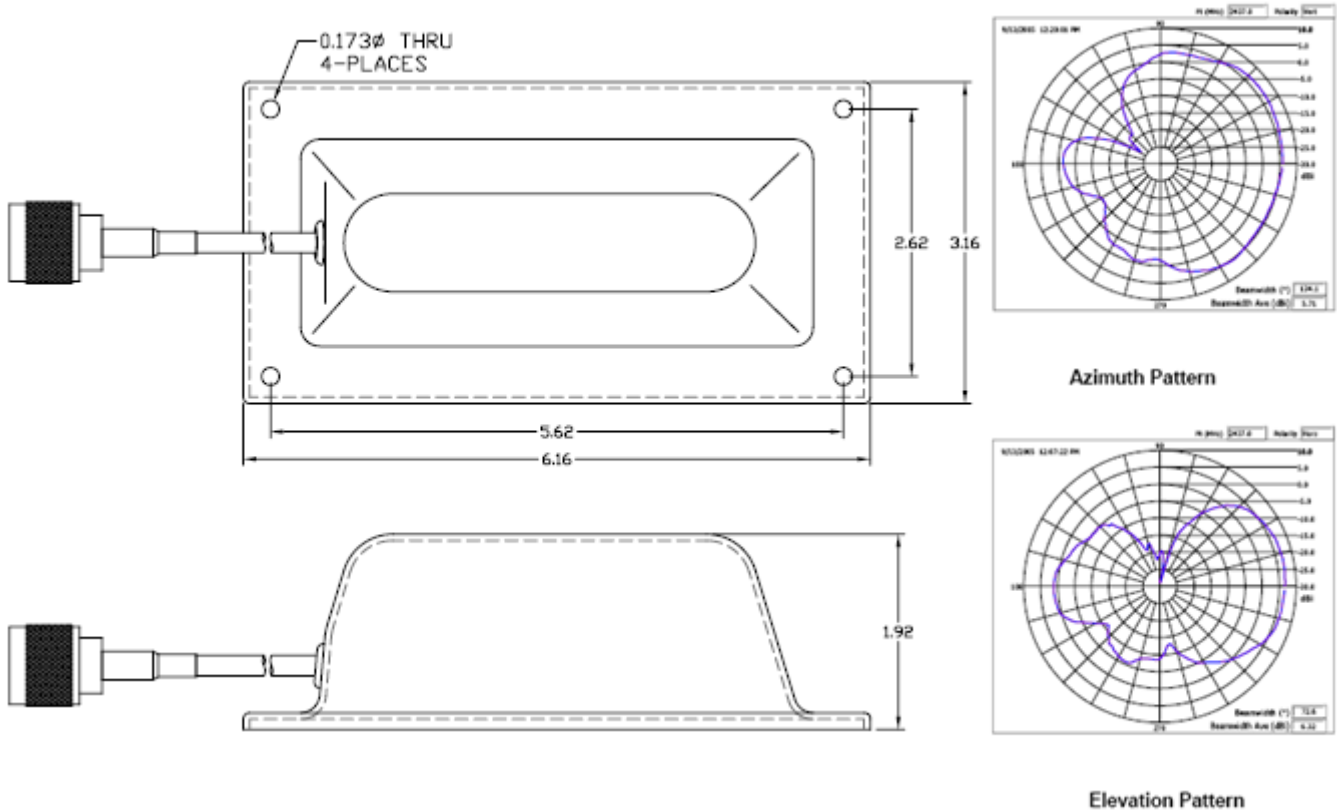
For detailed information on supported 802.11b/g/n antenna models, refer to:

- *ML-2499-5PNL-72-N High Performance 135 Degree Panel Antenna - 5.5 dBi; N Male Connector*
- *ML-2499-7PNA2-01R 65 Degree H-Plane Diversity Directional Panel - 7 dBi, RP-BNC Male*
- *ML-2499-11PNA2-01R High-Gain 97 Degree H-Plane Directional Panel - 11 dBi, RP-BNC Male*
- *ML-2499-APA2-01R High Performance Omni-Directional 'Fixed Point' Dipole - 3.5 dBi, RP-BNC Male*
- *ML-2499-BPDA1-01R Heavy-Duty 35 Degree High-Gain Directional Panel - 14.5 dBi, N Female*
- *ML-2499-BPNA3-01R Heavy-Duty 35 Degree High-Gain Directional Panel - 14.5 dBi, Type N - Female*
- *ML-2499-BYGA2-01R Heavy-Duty 35 Degree High-Gain Directional Yagi - 15 dBi, N Female*
- *ML-2499-HPA3-01R High Performance Omni-Directional "Pipe" Antenna - 5 dBi, RP-BNC Male*
- *ML-2499-PNAHD-01R Heavy-Duty 65 Degree H-Plane Directional Panel - 6.3 dBi, RP-BNC Male*
- *ML-2499-SD3-01R Low Profile Ceiling/Surface Mount Omni-Directional - 3.5 dBi, RP-BNC Male*
- *ML-2499-FHPA5-01R Omni-Directional "Pipe" Antenna - 7.7 dBi, N Male Connector*
- *ML-2499-FHPA9-01R High Performance Fixed Point Dipole - 9 dBi, Male Connector*



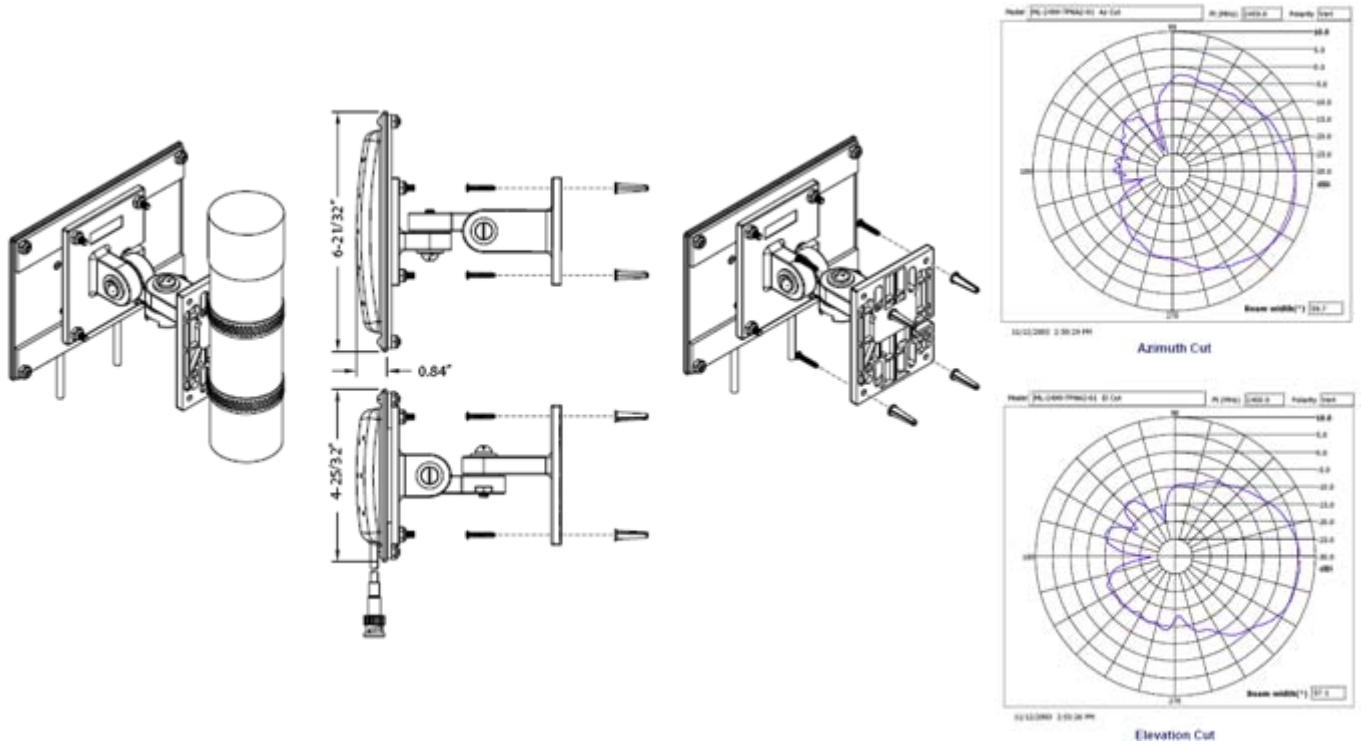
NOTE: For examples on how various antenna and connectors are deployed in a 2.4 GHz AP-5131 installation, see [2.4 GHz AP-5131 Antenna Connections](#).

3.1.1 ML-2499-5PNL-72-N High Performance 135 Degree Panel Antenna - 5.5 dBi; N Male Connector



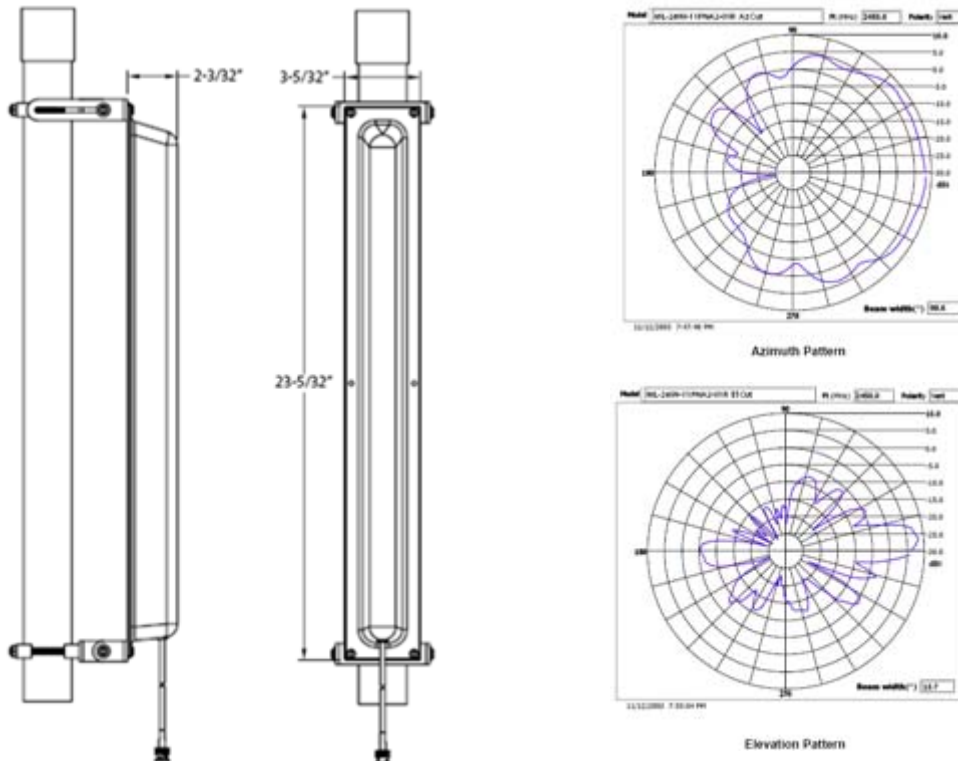
Type	Panel (Outdoor)
Frequency	2400-2500 MHz
Gain (dBi)	7.5
Net Gain (dBi)	5.5
Cable Loss (dB)	2
Polarization	Linear, Vertical
VSWR	1.7:1
Azimuth	3dB Beamwidth: 135°
Elevation	3dB Beamwidth: 56°
Cable Length (in.)	72
Cable Attenuation (dB/100 ft.)	33.5
Cable Type	RG-58 Ultralink
Connector Type	Type N - Male
Power	25 W
Weight	5 lb

3.1.2 ML-2499-7PNA2-01R 65 Degree H-Plane Diversity Directional Panel - 7 dBi, RP-BNC Male



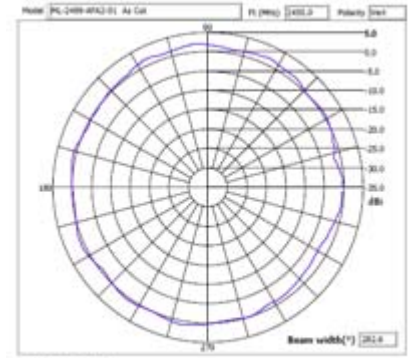
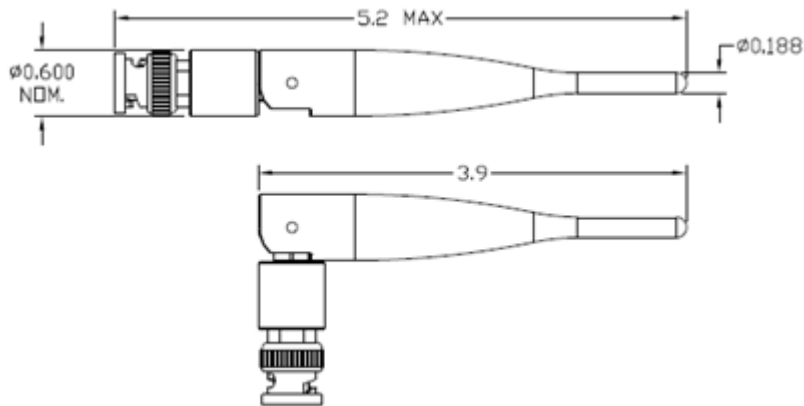
Type	Panel (Indoor)
Frequency	2400-2500 MHz
Gain (dBi)	7.6
Net Gain (dBi)	6.3
Cable Loss (dB)	1.3
Polarization	Linear, Vertical
VSWR	1.7:1 Typical
Azimuth	3dB Beamwidth: 60°
Elevation	3dB Beamwidth: 60°
Cable Length (in.)	48
Cable Attenuation (dB/100 ft.)	33.5
Cable Type	RG-58 Ultralink
Connector Type	RP-BNC Male
Power	10 W
Weight	9.6 oz

3.1.3 ML-2499-11PNA2-01R High-Gain 97 Degree H-Plane Directional Panel - 11 dBi, RP-BNC Male

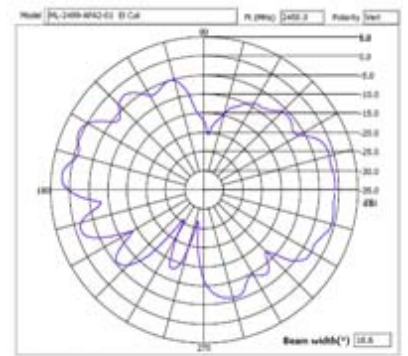


Type	Panel (Indoor)
Frequency	2400-1500 MHz
Gain (dBi)	11.2
Net Gain (dBi)	8.5
Cable Loss (dB)	2.7
Polarization	Linear, Vertical
VSWR	1.7:1 Typical
Azimuth	3dB Beamwidth: 97°
Elevation	3dB Beamwidth: 14°
Cable Length (in.)	96
Cable Attenuation (dB/100 ft.)	33.5
Cable Type	RG-58 Ultralink
Connector Type	RP-BNC Male
Power	50 W
Weight	1.5 lb

3.1.4 ML-2499-APA2-01R High Performance Omni-Directional 'Fixed Point' Dipole - 3.5 dBi, RP-BNC Male



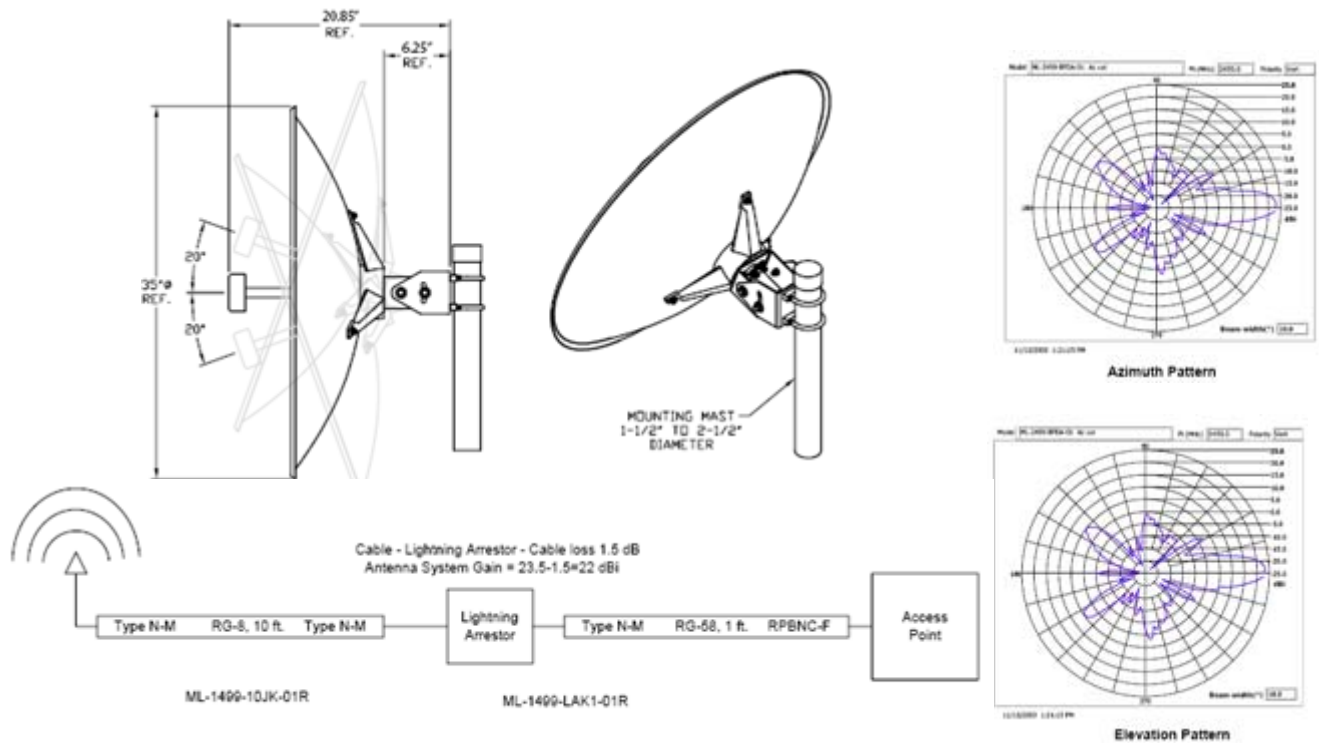
Azimuth Pattern



Elevation Pattern

Type	Dipole (Indoor)
Frequency	2400-2500 MHz
Gain (dBi)	2
Net Gain (dBi)	2
Cable Loss (dB)	0
Polarization	Linear, Vertical
VSWR	1.7:1 Typical
Azimuth	3dB Beamwidth: 360°
Elevation	3dB Beamwidth: 60°
Cable Length (in.)	0
Cable Attenuation (dB/100 ft.)	N/A
Cable Type	N/A
Connector Type	RP-BNC Male
Power	2 W
Weight	1.2 oz

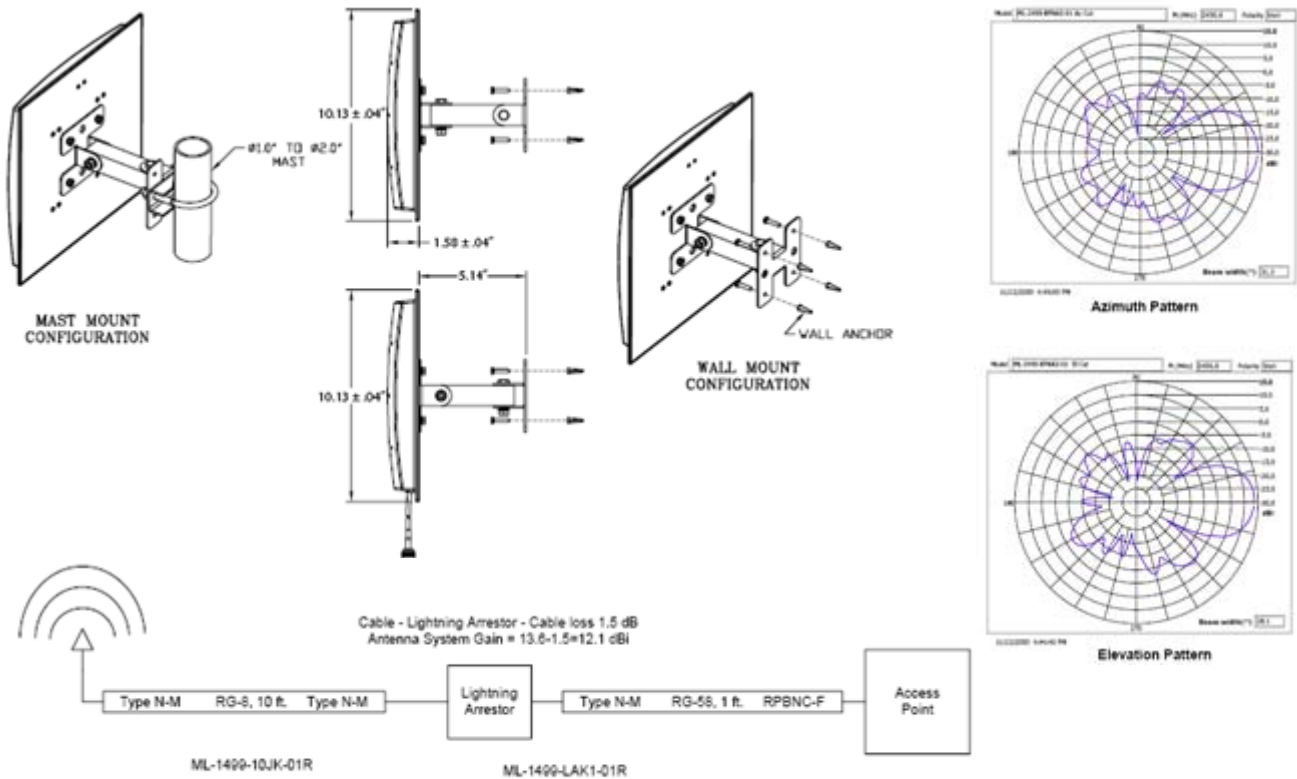
3.1.5 ML-2499-BPDA1-01R Heavy-Duty 35 Degree High-Gain Directional Panel - 14.5 dBi, N Female



Minimum Cabling Configuration

Type	Parabolic Dish (Outdoor)
Frequency	2400-2500 MHz
Gain (dBi)	23.5
Net Gain (dBi)	23.5
Cable Loss (dB)	0
Polarization	Linear, Vertical
VSWR	1.7:1 Typical
Azimuth	3dB Beamwidth: 10°
Elevation	3dB Beamwidth: 11°
Cable Length (in.)	0
Cable Attenuation (dB/100 ft.)	N/A
Cable Type	N/A
Connector Type	Type N - Female
Power	50 W
Weight	13 lb

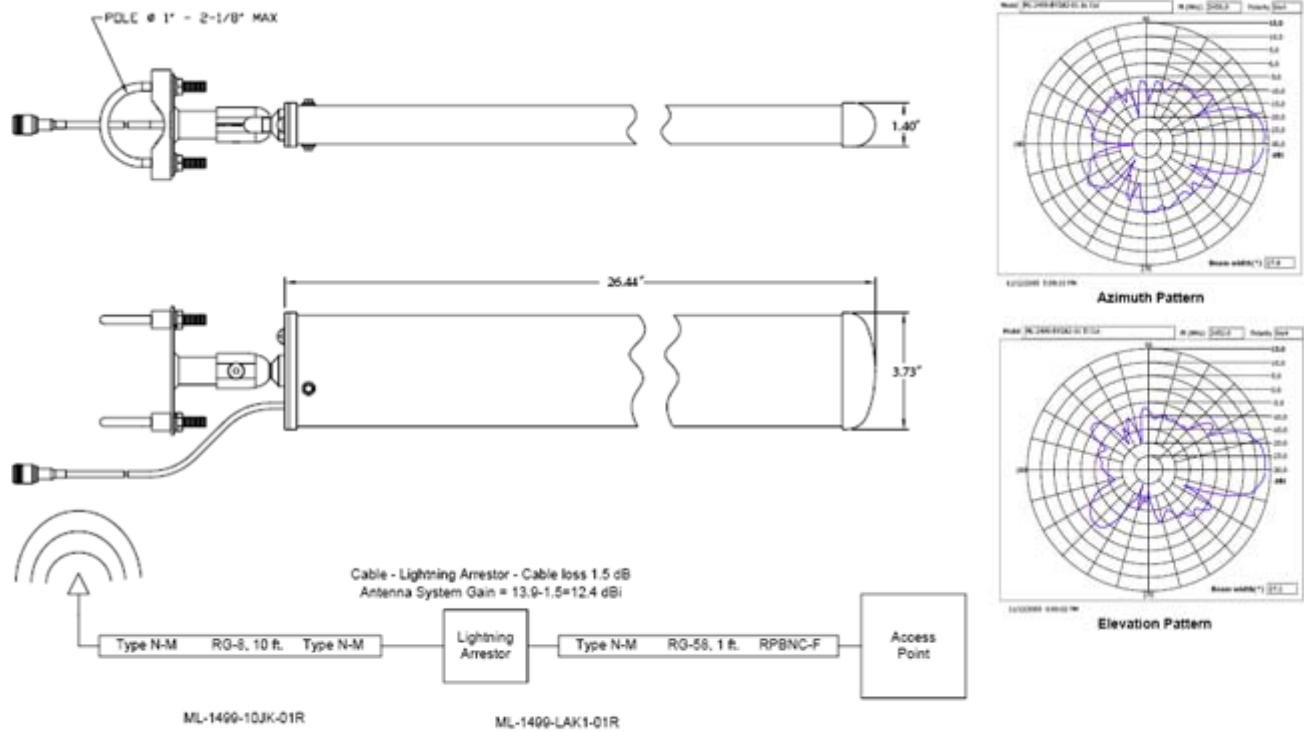
3.1.6 ML-2499-BPNA3-01R Heavy-Duty 35 Degree High-Gain Directional Panel - 14.5 dBi, Type N - Female



Minimum Cabling Configuration

Type	Panel (Outdoor)
Frequency	2400-2500 MHz
Gain (dBi)	13.9
Net Gain (dBi)	13.6
Cable Loss (dB)	3
Polarization	Linear, Vertical
VSWR	1.5:1
Azimuth	3dB Beamwidth: 31°
Elevation	3dB Beamwidth: 28°
Cable Length (in.)	12
Cable Attenuation (dB/100 ft.)	33.5
Cable Type	RG-58 Ultralink
Connector Type	Type N - Female
Power	50 W
Weight	1.5 lb

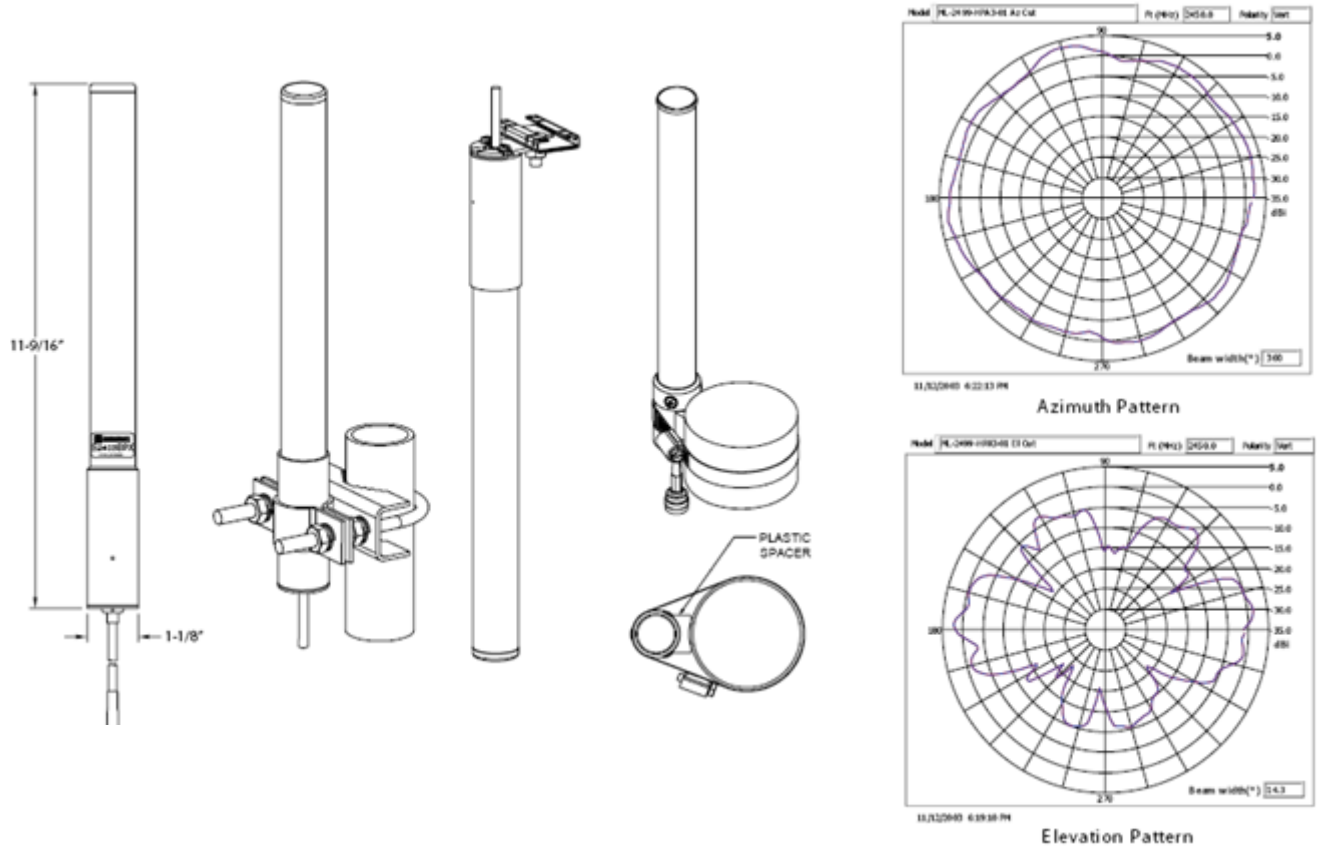
3.1.7 ML-2499-BYGA2-01R Heavy-Duty 35 Degree High-Gain Directional Yagi - 15 dBi, N Female



Minimum Cabling Configuration

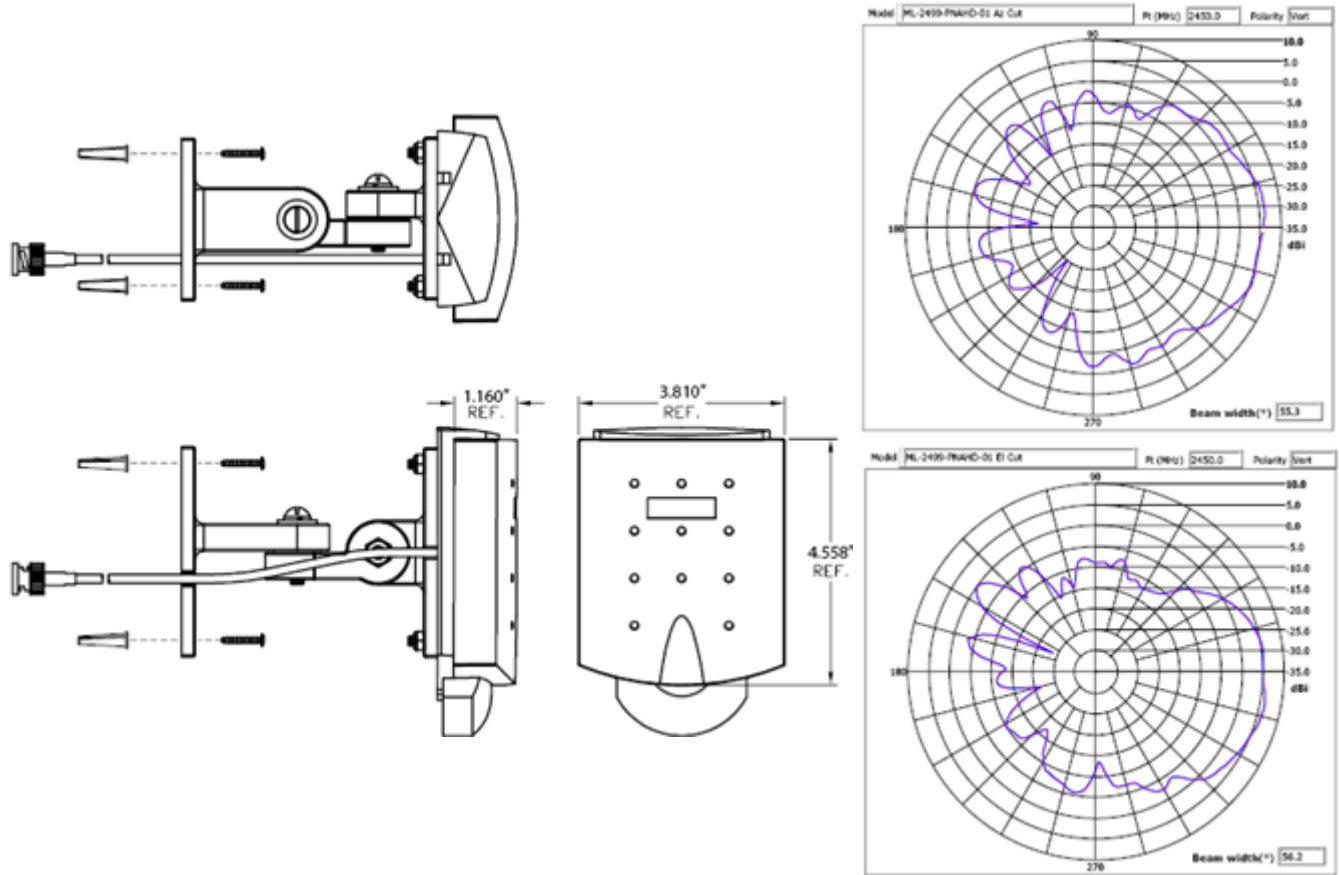
Type	Yagi (Outdoor)
Frequency	2400-2500 MHz
Gain (dBi)	14.1
Net Gain (dBi)	13.9
Cable Loss (dB)	3
Polarization	Linear, Vertical
VSWR	1.5:1 Typical
Azimuth	3dB Beamwidth: 34°
Elevation	3dB Beamwidth: 30°
Cable Length (in.)	12
Cable Attenuation (dB/100 ft.)	33.5
Cable Type	RG-58 Ultralink
Connector Type	Type N - Female
Power	50 W
Weight	1.25 lb

3.1.8 ML-2499-HPA3-01R High Performance Omni-Directional "Pipe" Antenna - 5 dBi, RP-BNC Male



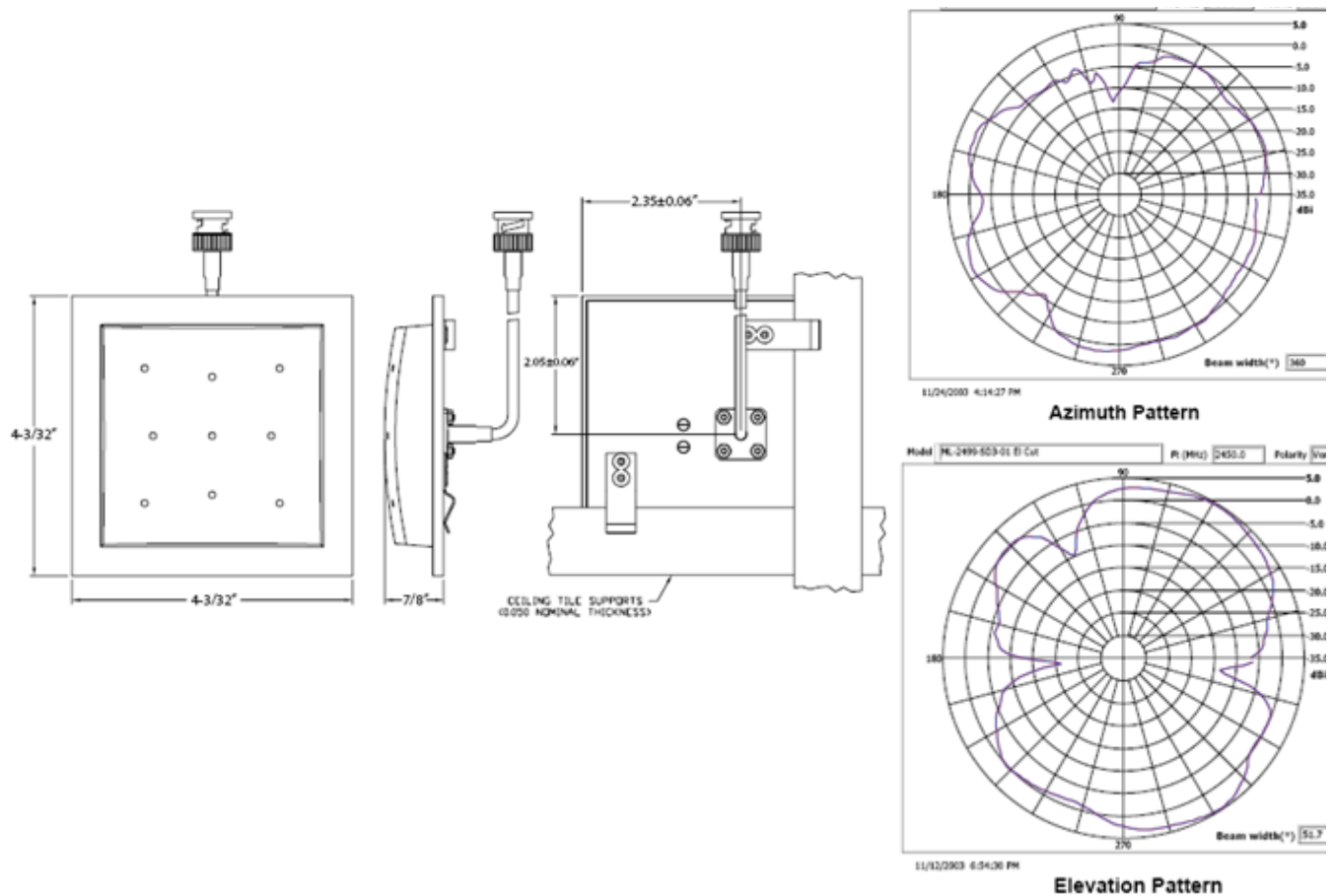
Type	Dipole Array (Indoor)
Frequency	2400-2500 mHz
Gain (dBi)	4.6
Net Gain (dBi)	3.3
Cable Loss (dB)	1.3
Polarization	Linear, Vertical
VSWR	1.7:1
Azimuth	3dB Beamwidth: 360°
Elevation	3dB Beamwidth: 31°
Cable Length (in.)	48
Cable Attenuation (dB/100 ft.)	33.5
Cable Type	RG-58 Ultralink
Connector Type	RP-BNC Male
Power	50 W
Weight	.03 lb

3.1.9 ML-2499-PNAHD-01R Heavy-Duty 65 Degree H-Plane Directional Panel - 6.3 dBi, RP-BNC Male



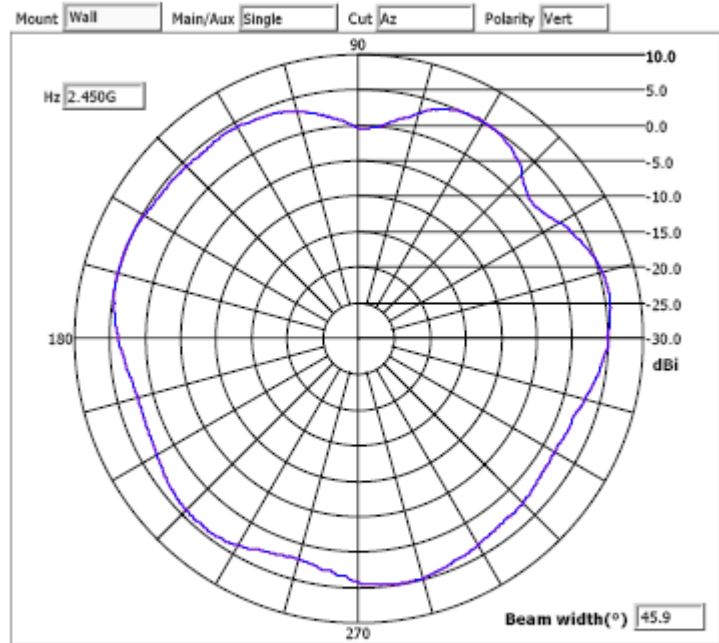
Type	Panel (Indoor)
Frequency	2400-2500 Mhz
Gain (dBi)	7.6
Net Gain (dBi)	6.3
Cable Loss (dB)	1.3
Polarization	Linear, Vertical
VSWR	1.7:1
Azimuth	3dB Beamwidth: 55°
Elevation	3dB Beamwidth: 56°
Cable Length (in.)	48
Cable Attenuation (dB/100 ft.)	33.5
Cable Type	RG-58 Ultralink
Connector Type	RP-BNC Male
Power	50 W
Weight	.5 lb

3.1.10 ML-2499-SD3-01R Low Profile Ceiling/Surface Mount Omni-Directional - 3.5 dBi, RP-BNC Male



Type	Panel (Indoor)
Frequency	2400-2500 MHz
Gain (dBi)	4.8
Net Gain (dBi)	3.5
Cable Loss (dB)	1.3
Polarization	Linear, Vertical
VSWR	1.7:1
Azimuth	3dB Beamwidth: 360°
Elevation	3dB Beamwidth: 52°
Cable Length (in.)	48
Cable Attenuation (dB/100 ft.)	33.5
Cable Type	RG-58 Ultralink
Connector Type	RP-BNC Male
Power	10 W
Weight	3.2 oz

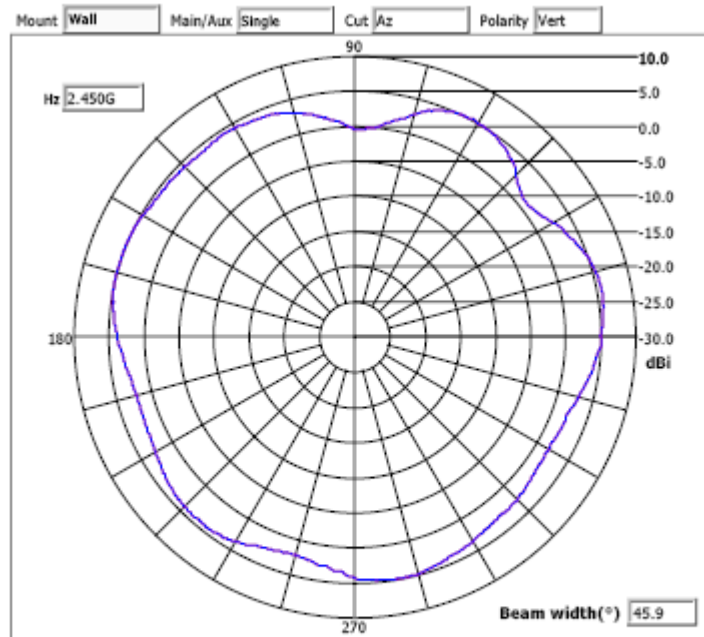
3.1.11 ML-2499-FHPA5-01R Omni-Directional "Pipe" Antenna - 7.7 dBi, N Male Connector



Azimuth Pattern 2450 MHz

Type	Dipole Array (Outdoor)
Frequency	2400-2500 MHz
Gain (dBi)	7.7
Net Gain (dBi)	7.7
Cable Loss (dB)	0.0
Polarization	Linear, Vertical
VSWR	2:1
Azimuth	3dB Beamwidth: 360°
Elevation	3dB Beamwidth: 25°
Cable Length (in.)	N/A
Cable Attenuation (dB/100 ft.)	N/A
Cable Type	N/A
Connector Type	Type N - Male
Power	10 W
Weight	.7 (.3)

3.1.12 ML-2499-FHPA9-01R High Performance Fixed Point Dipole - 9 dBi, Male Connector



Azimuth Pattern 2450 MHz

Type	Dipole Array (Outdoor)
Frequency	2400-2500 MHz
Gain (dBi)	9.0
Net Gain (dBi)	9.0
Cable Loss (dB)	0.0
Polarization	Linear, Vertical
VSWR	2:1
Azimuth	3dB Beamwidth: 360°
Elevation	3dB Beamwidth: 14°
Cable Length (in.)	N/A
Cable Attenuation (dB/100 ft.)	N/A
Cable Type	N/A
Connector Type	Type N - Male
Power	10 W
Weight	1.1 (.5)

802.11a Antenna Suite

4.1 Supported 802.11a Antenna Suite

Motorola supports numerous 802.11a antennas to suit the requirements of your unique AP-5131, AP-5181 or AP 300 (non-integrated antenna) deployment. Check the Motorola Web site periodically, as newly supported 802.11a antennas will be added to this document as they are released. For more information, go to <http://support.symbol.com/support/product/manuals.do>.

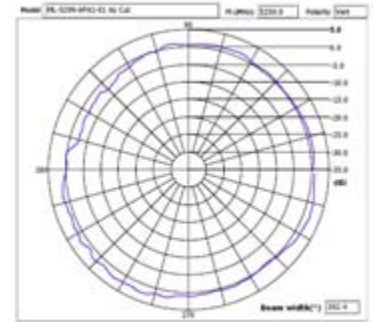
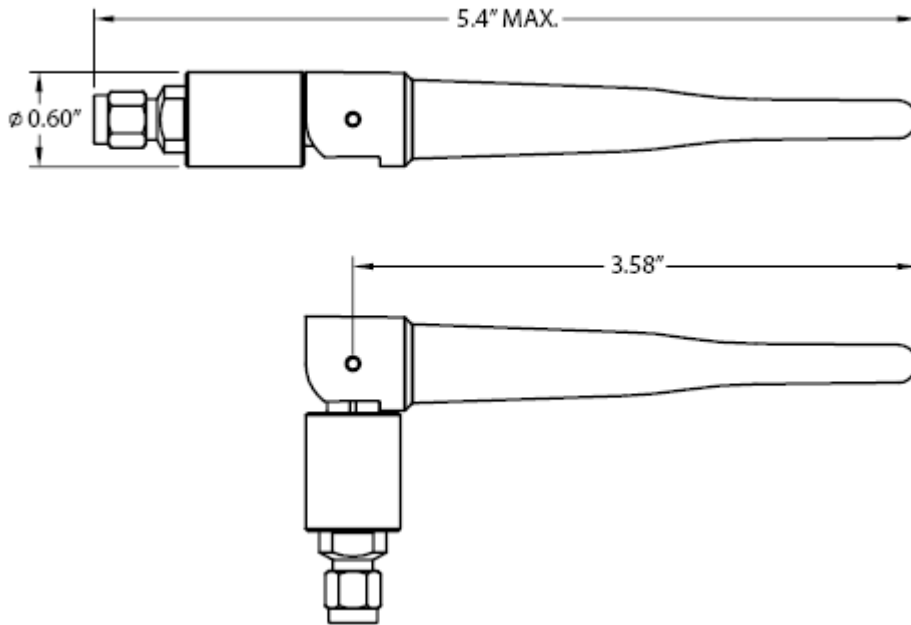
For detailed information on supported 802.11a antenna models, refer to:

- *ML-5299-APA1-01R High Performance Fixed Point Dipole - 2 dBi, RP-SMA Male Connector*
- *ML-5299-HPA1-01R High Performance Omni-Directional Antenna - 5 dBi, RP-SMA Male Connector*
- *ML-5299-PTA1-01R Low Profile Ceiling-Tile Mount Panel - 2 dBi, RP-SMA Male Connector*
- *ML-5299-WPNA1-01R Wall Mount Panel Antenna w/Articulating Mount - 13 dBi, RP-SMA Male*
- *ML-5299-FHPA10-01R Omni-Directional "Pipe" Antenna, 10 dBi, N-Male Connector*
- *ML-5299-FHPA6-01R Omni-Directional "Pipe" Antenna, 8 dBi, N-Male Connector*

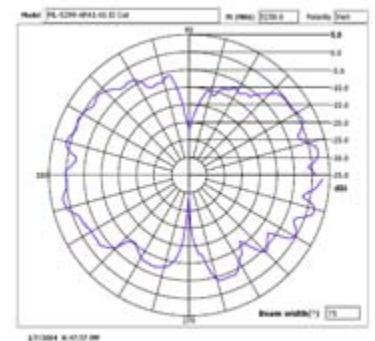


NOTE: For examples on how various antenna and connectors are deployed in a 5 GHz AP-5131 installation, see *5 GHz AP-5131 Antenna Connections*.

4.1.1 ML-5299-APA1-01R High Performance Fixed Point Dipole - 2 dBi, RP-SMA Male Connector



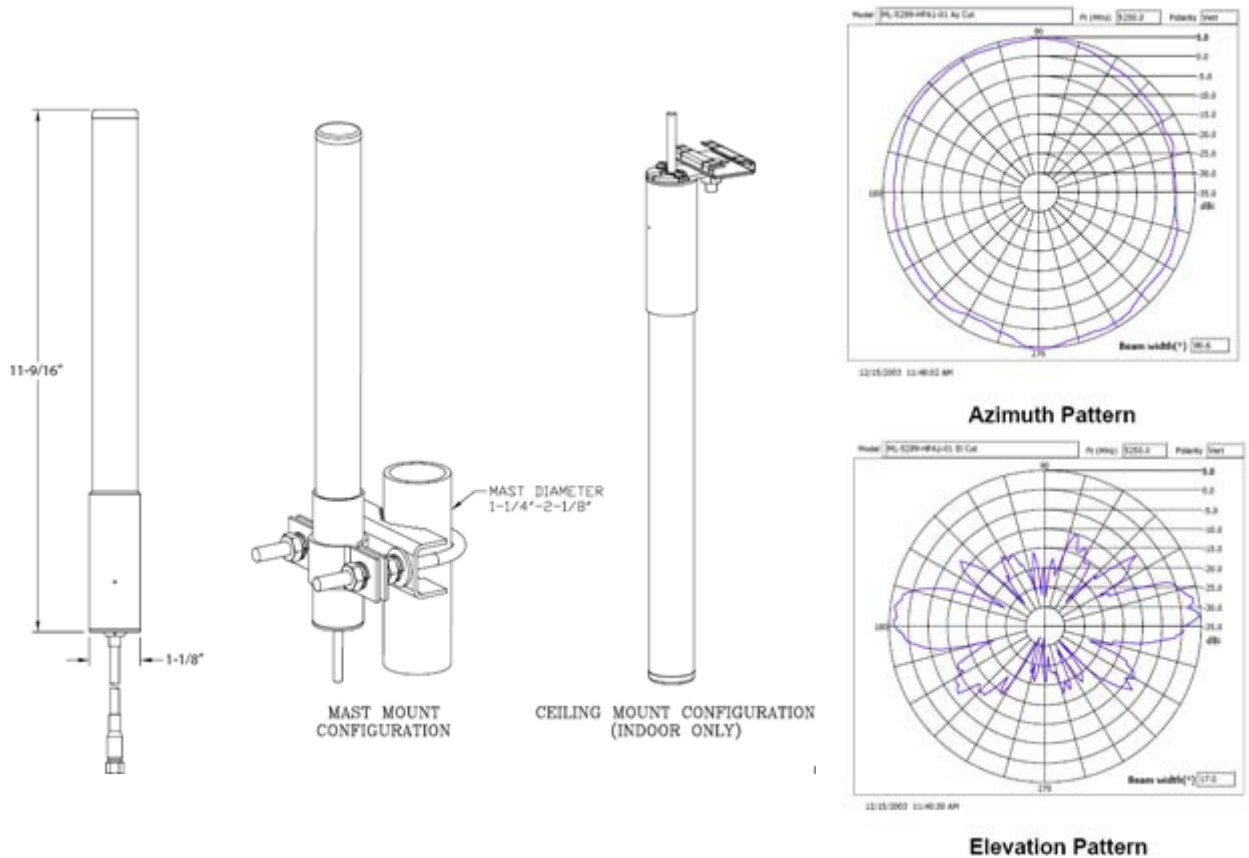
Azimuth Pattern



Elevation Pattern

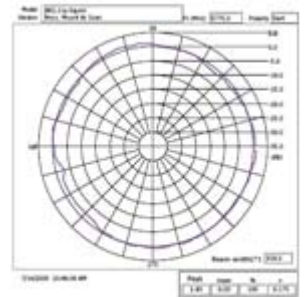
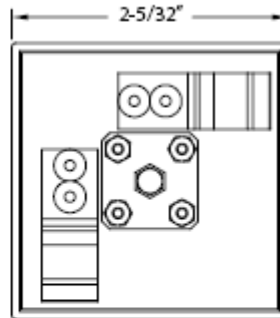
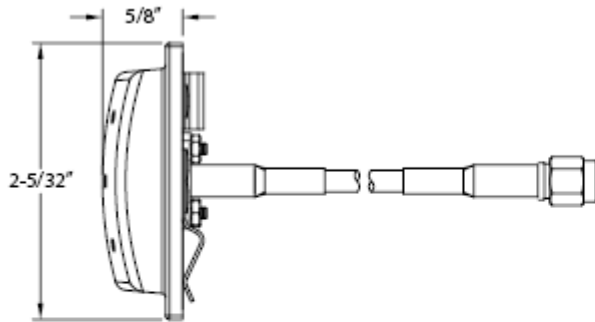
Type	Dipole (Indoor)
Frequency	4900-5875 MHz
Gain (dBi)	2.0/2.0
Net Gain (dBi)	2.0/2.0
Cable Loss (dB)	N/A
Polarization	Linear, Vertical
VSWR	1.5:1
Azimuth	3dB Beamwidth: 360°
Elevation	3dB Beamwidth: 75°
Cable Length (in.)	N/A
Cable Attenuation (dB/100 ft.)	N/A
Cable Type	N/A
Connector Type	RP-SMA Male
Power	1 W
Weight	1 oz

4.1.2 ML-5299-HPA1-01R High Performance Omni-Directional Antenna - 5 dBi, RP-SMA Male Connector

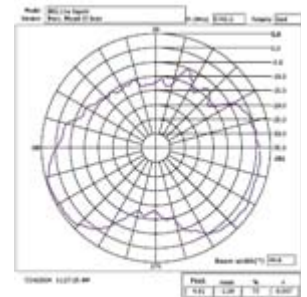


Type	Dipole Array (Indoor)
Frequency	4900-5875 MHz
Gain (dBi)	5.9
Net Gain (dBi)	5
Cable Loss (dB)	84
Polarization	Linear, Vertical
VSWR	2:1
Azimuth	3dB Beamwidth: 360°
Elevation	3dB Beamwidth: 17°
Cable Length (in.)	36
Cable Attenuation (dB/100 ft.)	28
Cable Type	LMR195
Connector Type	RP-SMA Male
Power	5 W
Weight	0.3 lb.

4.1.3 ML-5299-PTA1-01R Low Profile Ceiling-Tile Mount Panel - 2 dBi, RP-SMA Male Connector



Azimuth Pattern



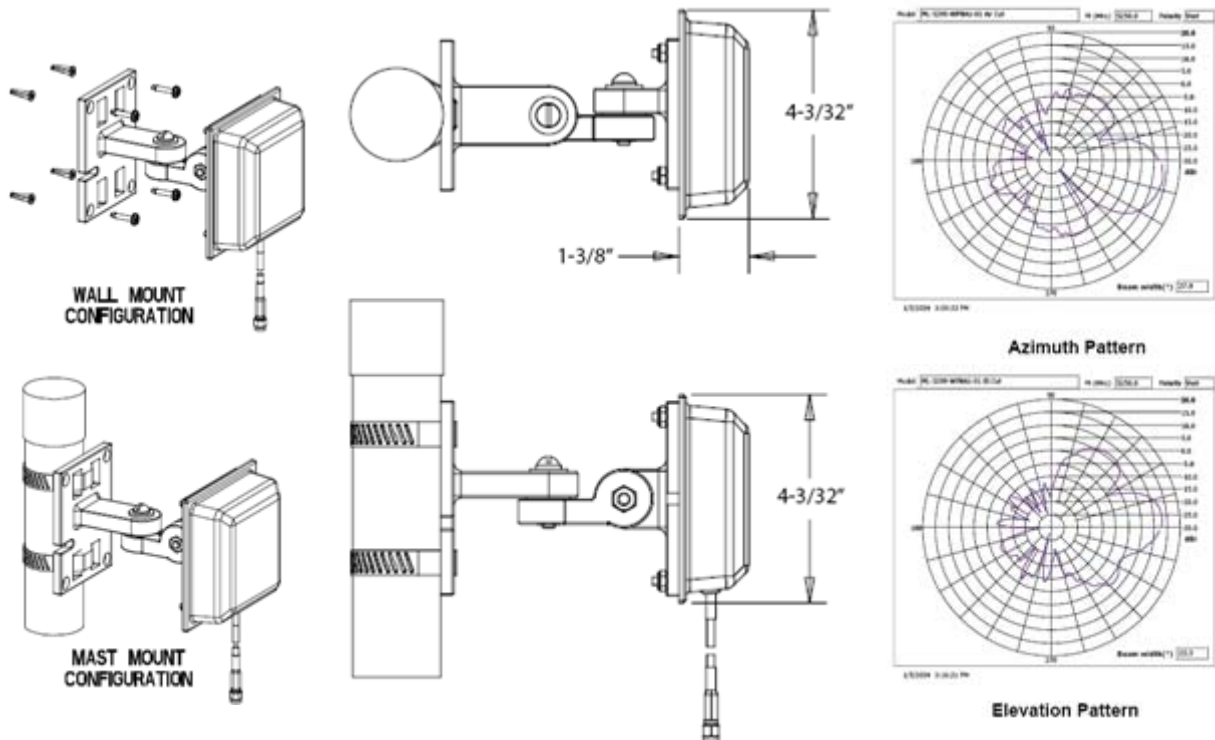
Elevation Pattern

MOUNTING HARDWARE

QTY	Description	
2	RECESSED TILE ADAPTER CLIP	

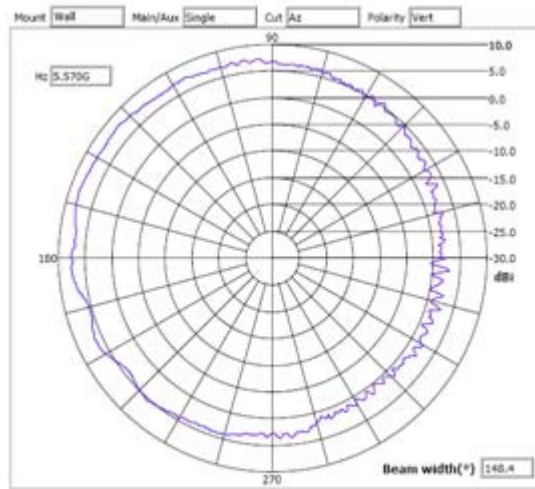
Type	Patch (Indoor)
Frequency	4900-5875 MHz
Gain (dBi)	6.5/2.0
Net Gain (dBi)	4.5/0
Cable Loss (dB)	2
Polarization	Linear, Vertical
VSWR	1.5:1
Azimuth	3dB Beamwidth: 360°
Elevation	3dB Beamwidth: 45°
Cable Length (in.)	36
Cable Attenuation (dB/100 ft.)	2.15
Cable Type	RG-58
Connector Type	RP-SMA Male
Power	2 W
Weight	2.4 lb.

4.1.4 ML-5299-WPNA1-01R Wall Mount Panel Antenna w/Articulating Mount - 13 dBi, RP-SMA Male



Type	Panel (Indoor)
Frequency	4900-5875 MHz
Gain (dBi)	14.2
Net Gain (dBi)	13
Cable Loss (dB)	1.2
Polarization	Linear, Vertical
VSWR	2:1
Azimuth	3dB Beamwidth: 31°
Elevation	3dB Beamwidth: 27°
Cable Length (in.)	36
Cable Attenuation (dB/100 ft.)	40
Cable Type	RG-303
Connector Type	RP-SMA Male
Power	10 W
Weight	0.7 lb.

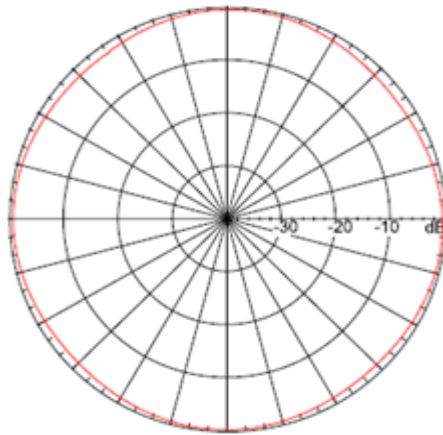
4.1.5 ML-5299-FHPA10-01R Omni-Directional "Pipe" Antenna, 10 dBi, N-Male Connector



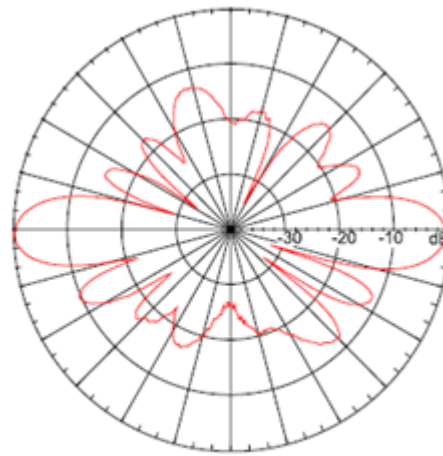
Azimuth Pattern 5570 MHz

Type	Dipole (Outdoor)
Frequency	4900-5850 MHz
Gain (dBi)	10.0
Net Gain (dBi)	10.0
Cable Loss (dB)	0.0
Polarization	Linear, Vertical
VSWR	2:1
Azimuth	3dB Beamwidth: 360°
Elevation	3dB Beamwidth: 13
Cable Length (in.)	N/A
Cable Attenuation (dB/100 ft.)	N/A
Cable Type	N/A
Connector Type	Type N Male
Power	5 W
Weight	.37 (.17)

4.1.6 ML-5299-FHPA6-01R Omni-Directional "Pipe" Antenna, 8 dBi, N-Male Connector



Azimuth Pattern 5500 MHz



Elevation Pattern 5500MHz

Type	Array (Outdoor)
Frequency	4900-5850
Gain (dBi)	8.0
Net Gain (dBi)	8.0
Cable Loss (dB)	0.0
Polarization	Linear, Vertical
VSWR	2:1
Azimuth	3dB Beamwidth: 360°
Elevation	3dB Beamwidth: 16°
Cable Length (in.)	N/A
Cable Attenuation (dB/100 ft.)	N/A
Cable Type	N/A
Connector Type	Type N Male
Power	5 W
Weight	.37 (.17)

2.4GHz - 5.2GHz Dual Band Antenna Suite

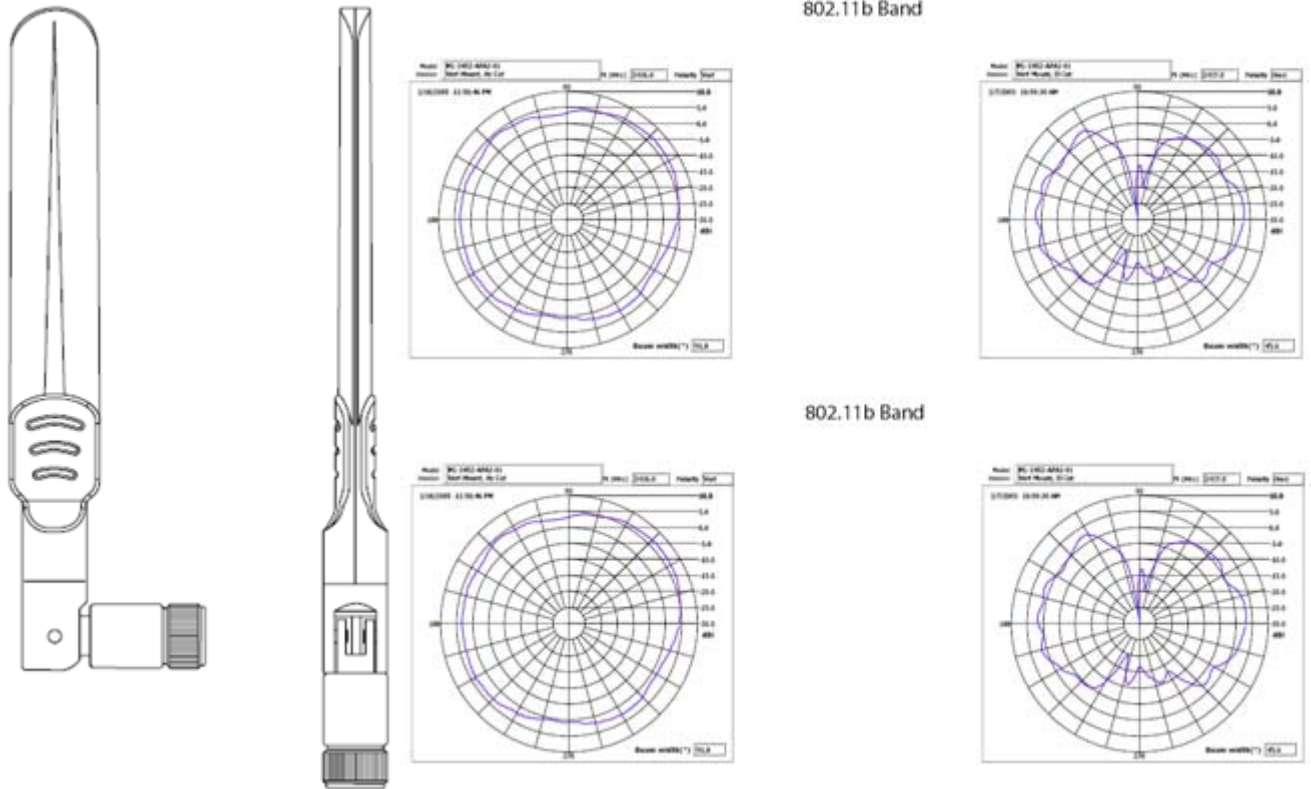
5.1 Supported 2.4GHz - 5.2GHz Dual Band Antennas

Motorola supports several 2.4GHz - 5.2GHz Dual Band antennas to suit the requirements of your unique AP-5131, AP-5181 or AP 300 (integrated antenna) deployment. Check the Motorola Web site periodically, as newly supported 2.4GHz - 5.2GHz Dual Band antennas will be added to this document as they are released. For more information, go to <http://support.symbol.com/support/product/manuals.do>.

For detailed information on supported 2.4GHz - 5.2GHz Dual Band antenna models, refer to:

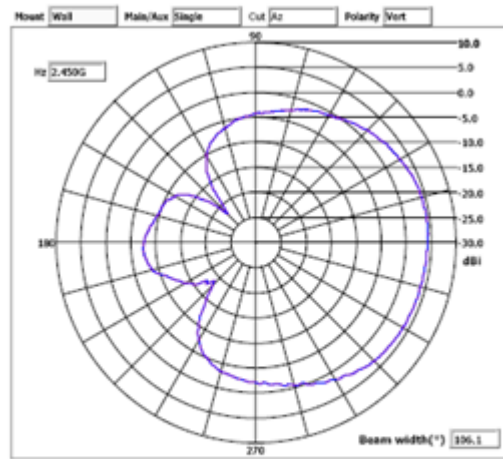
- *ML-2452-APA2-01 High Performance Dual Band Fixed Point Dipole - 3 dBi/4 dBi, RP-SMA Male*
- *ML-2452-PNA5-01R Dual Band Panel, 5 dBi, Connector Type N-Male*
- *ML-2452-PNA7-01R Dual Band Panel, 7 dBi, Connector Type N-Male*

5.1.1 ML-2452-APA2-01 High Performance Dual Band Fixed Point Dipole - 3 dBi/4 dBi, RP-SMA Male

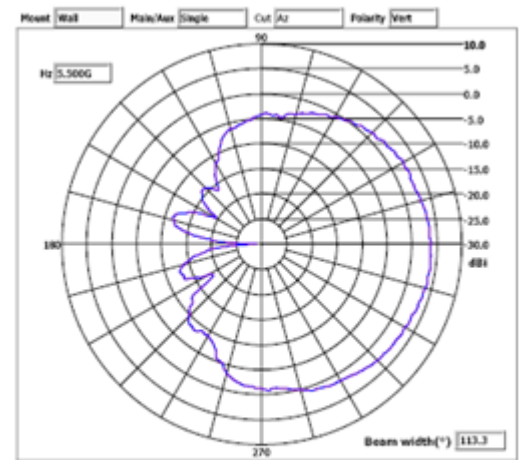


Type	Dipole (Indoor)
Frequency	2400-2500/5150-5850 MHz
Gain (dBi)	3.4
Net Gain (dBi)	3.4
Cable Loss (dB)	N/A
Polarization	Linear, Vertical
VSWR	1.92:1
Azimuth	3dB Beamwidth: 360°
Elevation	3dB Beamwidth: 35°
Cable Length (in.)	N/A
Cable Attenuation (dB/100 ft.)	N/A
Cable Type	N/A
Connector Type	RP-SMA Male
Power	10 W
Weight	0.7 oz

5.1.2 ML-2452-PNA5-01R Dual Band Panel, 5 dBi, Connector Type N-Male



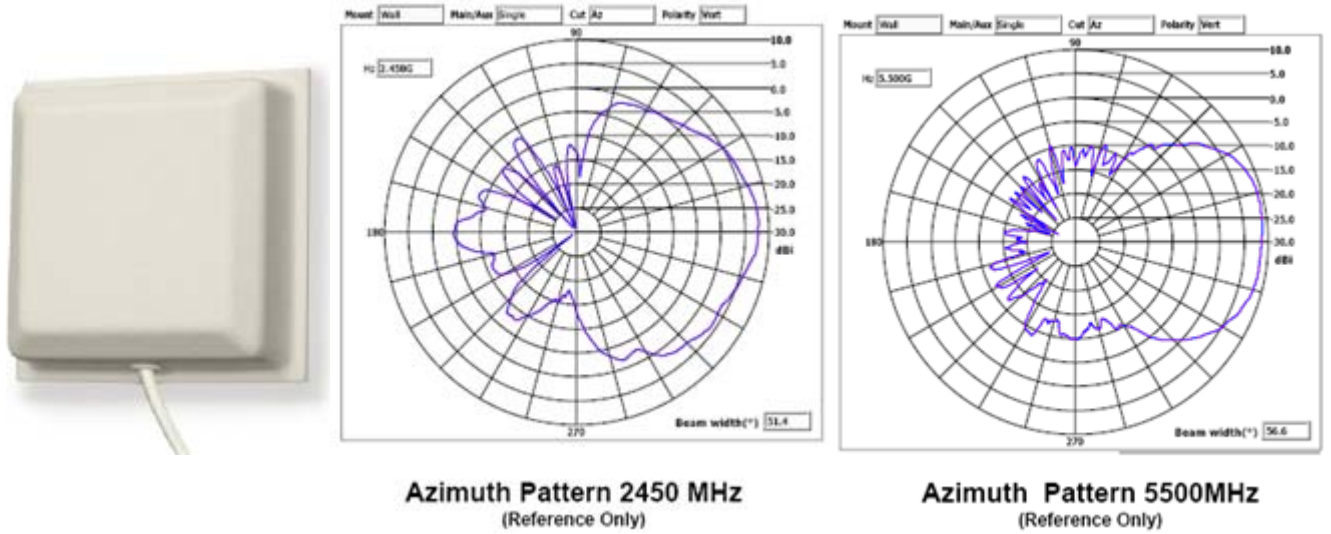
Azimuth Pattern 2450 MHz
(Reference Only)



Azimuth Pattern 5500MHz
(Reference Only)

Type	Panel (Outdoor)
Frequency	2400-2500/4900-5900 MHz
Gain (dBi)	4.5 (2400-2500); 5.0 (4900-5250); 7.5 (5250-5900)
Net Gain (dBi)	N/A
Cable Loss (dB)	N/A
Polarization	Linear, Vertical
VSWR	2:1
Azimuth	3dB Beamwidth: 120°
Elevation	3dB Beamwidth: 65°
Cable Length (in.)	12
Cable Attenuation (dB/100 ft.)	1.01/1.96
Cable Type	RG-58 Ultralink
Connector Type	Type N Male
Power	5 W
Weight	.2 (.09)

5.1.3 ML-2452-PNA7-01R Dual Band Panel, 7 dBi, Connector Type N-Male



Type	Panel (Outdoor)
Frequency	2400-2500/4900-5900 MHz
Gain (dBi)	7.8 (2400-2500); 7.0 (4900-5250); 10.7 (5250-5900)
Net Gain (dBi)	N/A
Cable Loss (dB)	0.3/0.7
Polarization	Linear, Vertical
VSWR	2:1
Azimuth	3dB Beamwidth: 68° / 52°
Elevation	3dB Beamwidth: 66° / 60°
Cable Length (in.)	12
Cable Attenuation (dB/100 ft.)	1.01/1.96
Cable Type	RG-58 Ultralink
Connector Type	Type N Male
Power	10 W
Weight	.5 (.23)

Antenna Cables

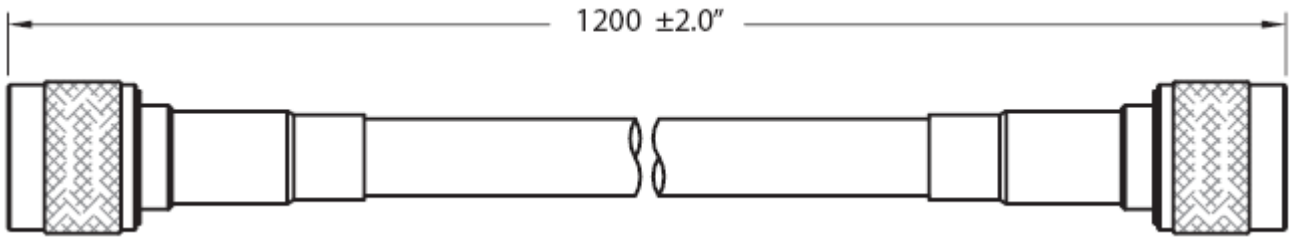
6.1 Supported Antenna Cables

Motorola supports numerous cables to suit your unique AP-5131, AP-5181 or AP 300 (non-integrated antenna) deployment. Check the Motorola Web site periodically, as new cables will be added to this document as they are released. For more information, go to <http://support.symbol.com/support/product/manuals.do>.

For detailed information on supported cables, refer to:

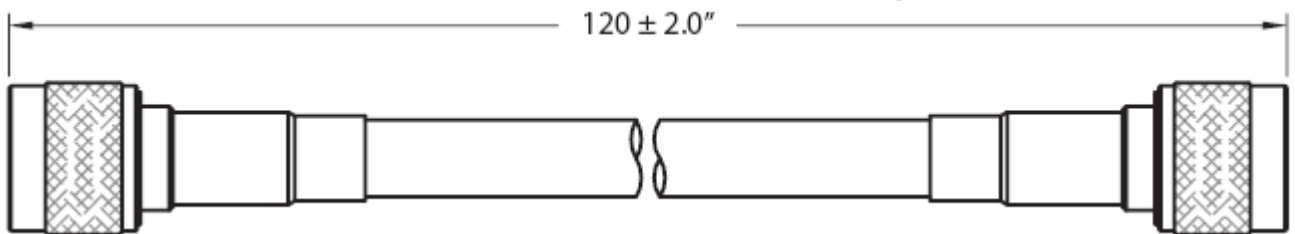
- *ML-1499-100JK-01R 100 ft. Low-Loss Coaxial Cable Jumper: N Male to N Male with 2 Connector Seal Kits*
- *ML-1499-10JK-01R 10 ft. Low-Loss Coaxial Cable Jumper: N Male to N Male*
- *ML-1499-25JK-01R 25 ft. Low-Loss Coaxial Cable Jumper: N Male to N Male with 2 Connector Seal Kits*
- *ML-1499-50JK-01R 50 ft. Low-Loss Coaxial Cable Jumper: N Male to N Male with 2 Connector Seal Kits*
- *ML-1499-72PJ-01R 6 ft. BNC Female to RP BNC Male Plenum Coaxial Jumper*

6.1.1 ML-1499-100JK-01R 100 ft. Low-Loss Coaxial Cable Jumper: N Male to N Male with 2 Connector Seal Kits



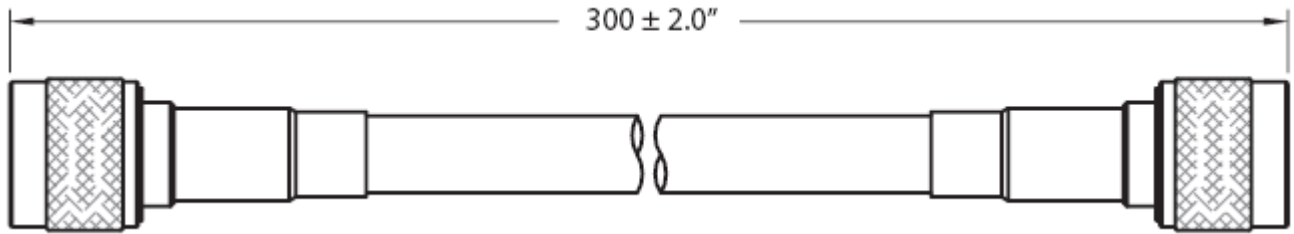
Type	Ultralink TL 93605
RF Connectors	N (m) to N (m)
Cable Attenuation (dB)	10.6 @ 2.4 GHz; 15.5 @ 5.8 GHz
Frequency	2400-2500 Mhz

6.1.2 ML-1499-10JK-01R 10 ft. Low-Loss Coaxial Cable Jumper: N Male to N Male



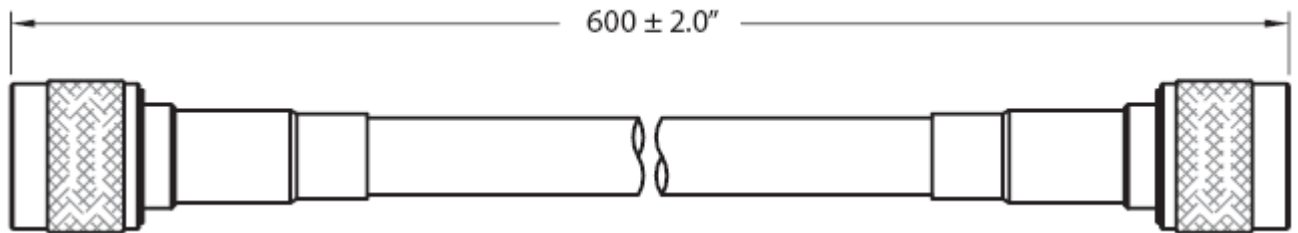
Type	Ultralink TL 93605
RF Connectors	N (m) to N (m)
Cable Attenuation (dB)	2.0 @ 2.4 GHz; 2.9 @ 5.8 GHz
Frequency	2400-2500 Mhz

6.1.3 ML-1499-25JK-01R 25 ft. Low-Loss Coaxial Cable Jumper: N Male to N Male with 2 Connector Seal Kits



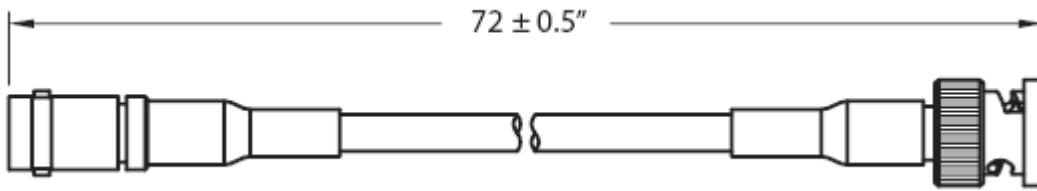
Type	Ultralink TL 93605
RF Connectors	N (m) to N (m)
Cable Attenuation (dB)	2.5 @ 2.4 GHz; 4.0 @ 5.8 GHz
Frequency	2400-2500 Mhz

6.1.4 ML-1499-50JK-01R 50 ft. Low-Loss Coaxial Cable Jumper: N Male to N Male with 2 Connector Seal Kits



Type	Ultralink TL 93605
RF Connectors	N (m) to N (m)
Cable Attenuation (dB)	4.5 @ 2.4 GHz; 7.0 @ 5.8 GHz
Frequency	2400-2500 Mhz

6.1.5 ML-1499-72PJ-01R 6 ft. BNC Female to RP BNC Male Plenum Coaxial Jumper



<i>Type</i>	CMP Plenum, RG-58
<i>RF Connectors</i>	BNC (f) to RP. BNC (m)
<i>Cable Attenuation (dB)</i>	9 dB
<i>Frequency</i>	2400-2500 Mhz

Supported Antenna Adapters

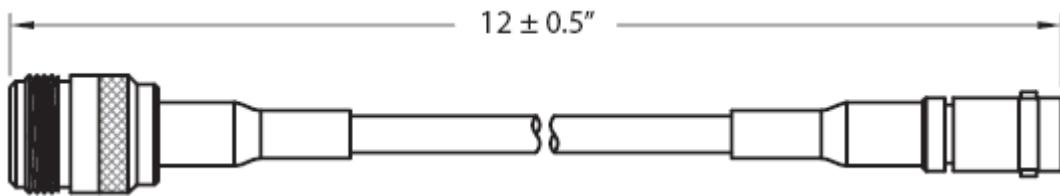
7.1 Supported Adapters

Motorola supports many adapters to suit your unique AP-5131, AP-5181 or AP 300 (non-integrated antenna) deployment. Check the Motorola Web site periodically, as new adapters will be added to this document as they are released. For more information, go to <http://support.symbol.com/support/product/manuals.do>.

For detailed information on supported antenna adapters, refer to:

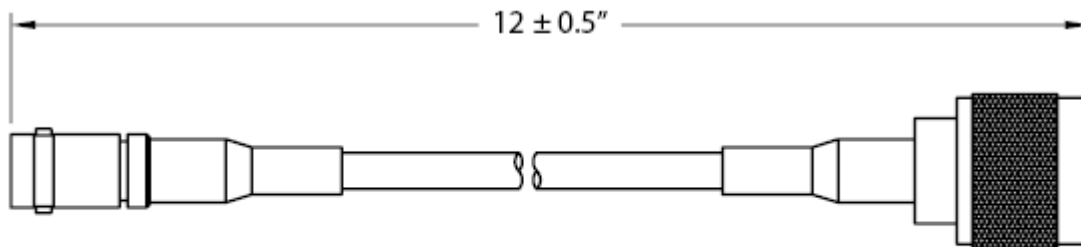
- *ML-1499-RBNCA1-01R 1 ft. N Female to RP BNC Female Cable Adapter with Connector Seal Kit*
- *ML-1499-RBNCA2-01R 1 ft. N Male to RP BNC Female Cable Adapter with Connector Seal Kit*
- *25-85391-01R 3.5 in. Jumper Cable, RP-SMA (Female) to Type N (Male) Adaptor*
- *25-72178-01 Jumper, RP-SMA(M) to RP-BNC(F)*
- *25-90262-01R RP-SMA (Female) to Type N (Female) Adapter*
- *25-90263-01R Type N (Male) to RP-SMA (Female) Bulkhead Adapter*

7.1.1 ML-1499-RBNCA1-01R 1 ft. N Female to RP BNC Female Cable Adapter with Connector Seal Kit



Type	Black, Ultralink, RG-58
RF Connectors	N (f) to RP. BNC (f)
Frequency	2400-2500 MHz
Attenuation	.2 dB

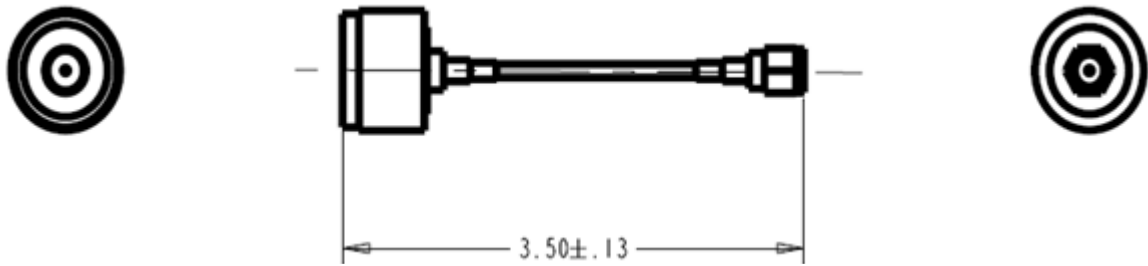
7.1.2 ML-1499-RBNCA2-01R 1 ft. N Male to RP BNC Female Cable Adapter with Connector Seal Kit



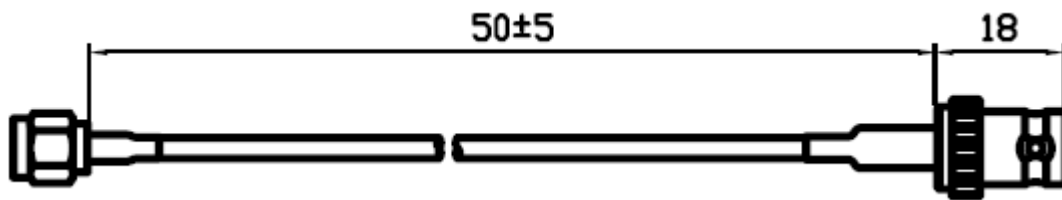
CONNECTOR 2

CONNECTOR 1

Type	RG-58
Frequency	2400-2500 MHz
Cable Loss (dB)	85
Cable Length (in.)	12
Connector 1	N - Male
Connector 2	RP-BNC-F
Color	Black

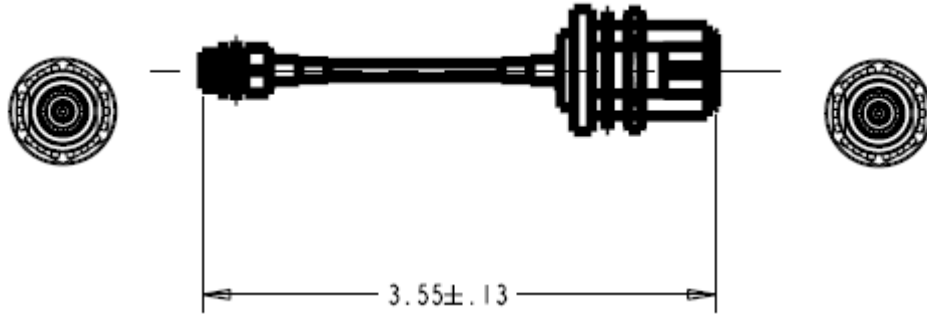
7.1.3 25-85391-01R 3.5 in. Jumper Cable, RP-SMA (Female) to Type N (Male) Adaptor

Type	Clear Jacket, RG-316
Connector 1	RP-SMA, Female
Connector 2	Type N, Male
Insertion Loss	2.4 GHz: 0.2 dB MIN
Insertion Loss	5.2 GHz: 0.3 dB MIN

7.1.4 25-72178-01 Jumper, RP-SMA(M) to RP-BNC(F)

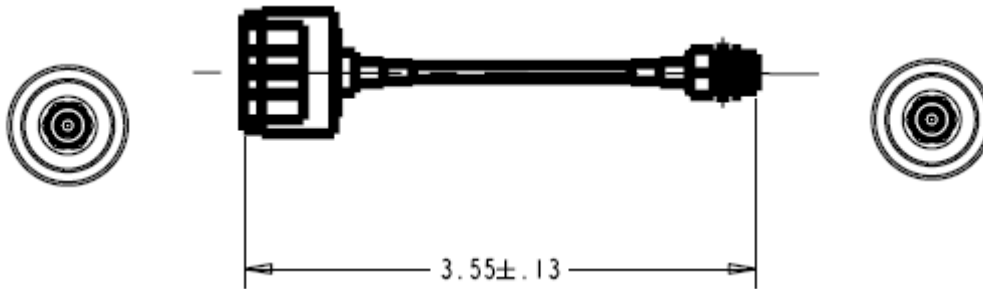
Type	RG-316
Connector 1	RP-SMA, Male
Connector 2	RP-BNC, Female
Insertion Loss	2.4 GHz: .2 dB
Insertion Loss	5.2 GHz: .3 dB

7.1.5 25-90262-01R RP-SMA (Female) to Type N (Female) Adapter



Type	RG-316
Connector 1	RP-SMA, Female
Connector 2	Type N, Female
Insertion Loss	2.4 GHz: .3 dB
Insertion Loss	5.2 GHz: .4 dB

7.1.6 25-90263-01R Type N (Male) to RP-SMA (Female) Bulkhead Adapter



Type	RG-316
Connector 1	Type N, Male
Connector 2	RP-SMA, Female, bulkhead
Insertion Loss	2.4 GHz: 0.2 dB MIN
Insertion Loss	5.2 GHz: 0.2 dB MIN

Supported Lightning Arrestors

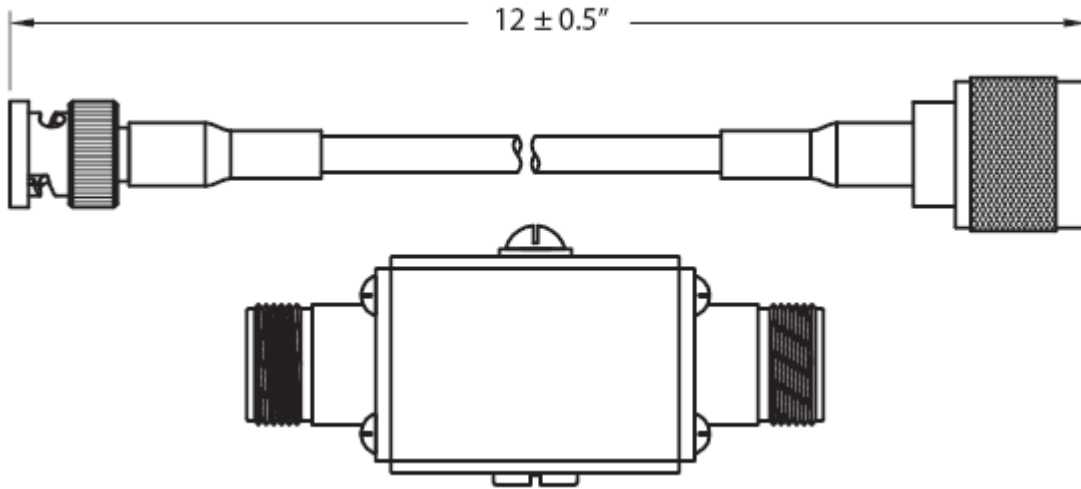
8.1 Lightning Arrestors

Motorola supports several lightning arrestors to support your unique AP-5131, AP-5181 or AP 300 (non-integrated antenna) deployment safety requirements. Check the Motorola Web site periodically, as new lightning arrestors will be added to this document as they are released. For more information, go to <http://support.symbol.com/support/product/manuals.do>.

For detailed information on supported lightning arrestors refer to:

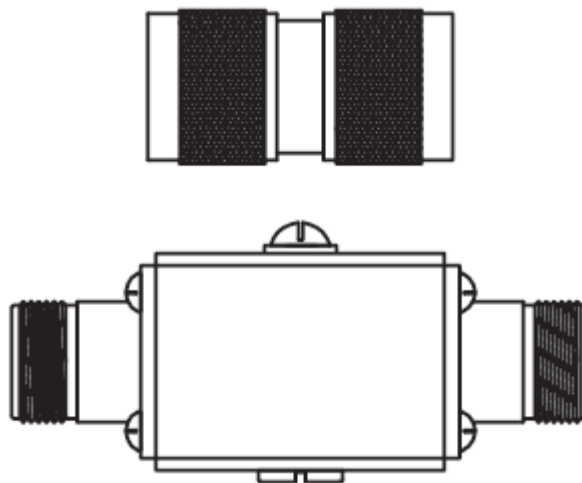
- *ML-1499-LAK1-01R 1 ft. N Male to RP BNC Male Lightning Arrestor with Connector Seal Kit*
- *ML-1499-LAK2-01R Lightning Arrestor Kit with N Male to N Male Barrel Adapter*
- *ML-2452-LAK1-01R Lightning Arrestor (N Female to N Female) with N Male to RP-SMA Male Adapter*

8.1.1 ML-1499-LAK1-01R 1 ft. N Male to RP BNC Male Lightning Arrestor with Connector Seal Kit



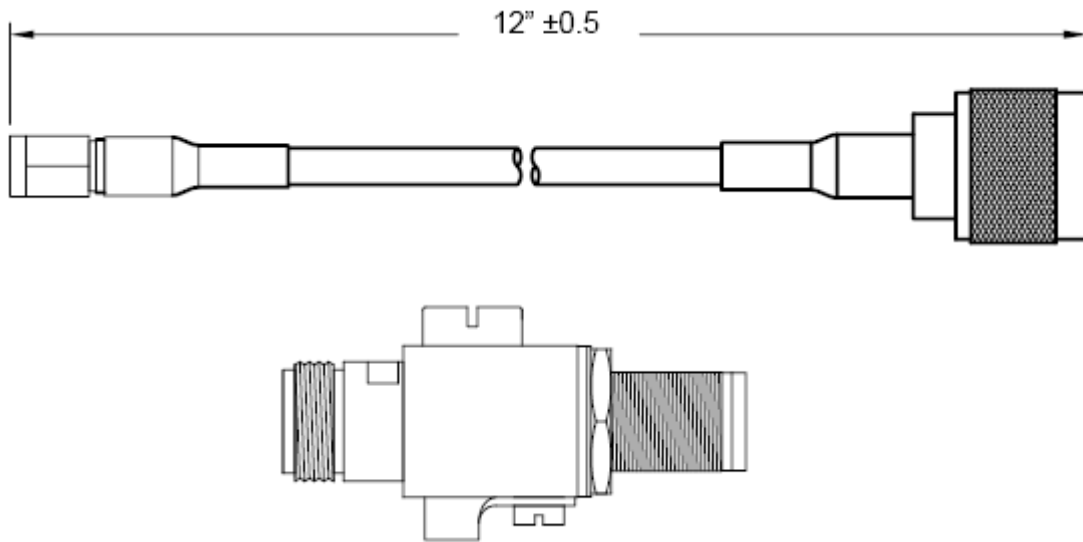
<i>Cable</i>	Black, Ultralink, RG-58
<i>RF Connectors</i>	N (m) to RP BNC (m)
<i>Arrestor RF Connectors</i>	N (f) to N (f)
<i>Frequency</i>	2400-2500 MHz
<i>Insertion Loss</i>	0.25 dB

8.1.2 ML-1499-LAK2-01R Lightning Arrestor Kit with N Male to N Male Barrel Adapter



<i>RF Connectors</i>	N (m) to N (m)
<i>Arrestor RF Connectors</i>	N (f) to N (f)
<i>Frequency</i>	2400-2500 MHz
<i>Maximum RF Power</i>	100 W
<i>Insertion Loss</i>	0.25 dB

8.1.3 ML-2452-LAK1-01R Lightning Arrestor (N Female to N Female) with N Male to RP-SMA Male Adapter



<i>Cable</i>	Black, Ultralink, RG-58
<i>RF Connectors</i>	N (m) to RP. SMA (m)
<i>Frequency</i>	100-6000 MHz
<i>Maximum RF Power</i>	200 W
<i>VSWR (50 ohm)</i>	1.4:1 dB Max
<i>Insertion Loss</i>	0.4 dB Max
<i>Insulation Resistance</i>	50 M-ohms
<i>Connectors</i>	Type N (f) to N (f)
<i>Weight</i>	4.5 oz
<i>Operating Temperature</i>	- 40° to 85°C

Mounting Kits

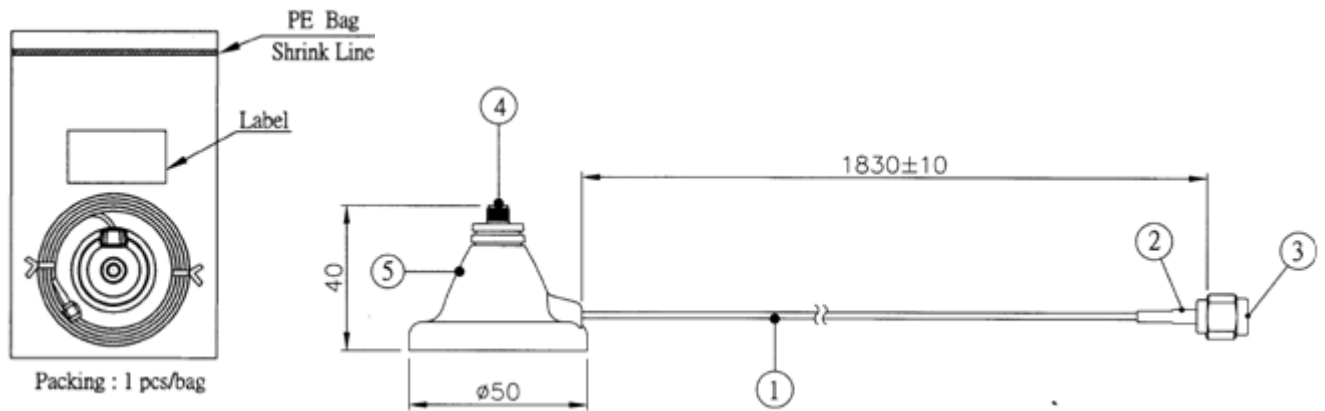
9.1 Mounting Kit Support

Motorola supports mounting kits to support your unique AP-5131, AP-5181 or AP 300 (non-integrated antenna) deployment. Check the Motorola Web site periodically, as new kits will be added to this document as they are released. For more information, go to <http://support.symbol.com/support/product/manuals.do>.

For detailed information on supported mounting kits refer to:

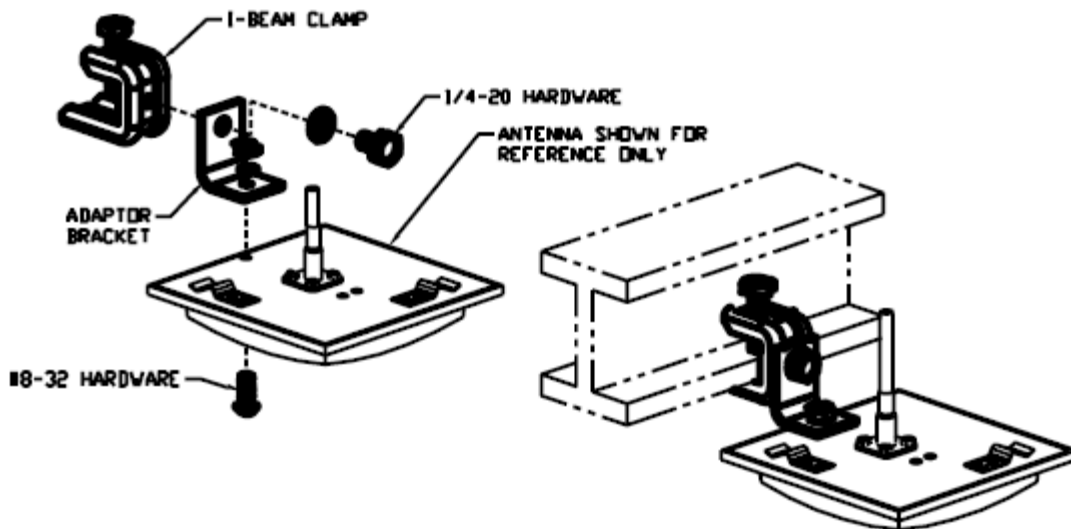
- *ML-1499-APAMK-01R Magnetic Base for ML-2452-APA2-01 with 6 Ft. Cable RP-SMA (Male)*
- *ML-1499-SD3MK-01R Articulating I-Beam Mount Kit for ML-2499-SD3-01 Omni Antenna*

9.1.1 ML-1499-APAMK-01R Magnetic Base for ML-2452-APA2-01 with 6 Ft. Cable RP-SMA (Male)



Cable	RG-178
Connector 1	RP-SMA, Male
Connector 2	RP-SMA, Female
Attenuation (dB)	2.6 @ 2.4 GHz; 4.6 @ 5.5 Ghz

9.1.2 ML-1499-SD3MK-01R Articulating I-Beam Mount Kit for ML-2499-SD3-01 Omni Antenna



Functionality	Mounts Part No. ML-2499-SD3-01 to an I-beam.
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Connecting 2.4 and 5 GHz Antennas to an AP-5131

This chapter describes how the 2.4 and 5 GHz antennas described within this guide are physically connected to an AP-5131 model access point. Central in this discussion are descriptions of the single and dual-band antennas supported, their supported connector models and how lightning arrestors are supported for specific antenna and connector combinations.

For more information, see:

- [*2.4 GHz AP-5131 Antenna Connections*](#)
- [*5 GHz AP-5131 Antenna Connections*](#)

10.1 2.4 GHz AP-5131 Antenna Connections

This section describes how the components described within this guide are used collectively in the following AP-5131 installation scenarios supporting the 2.4 GHz band:

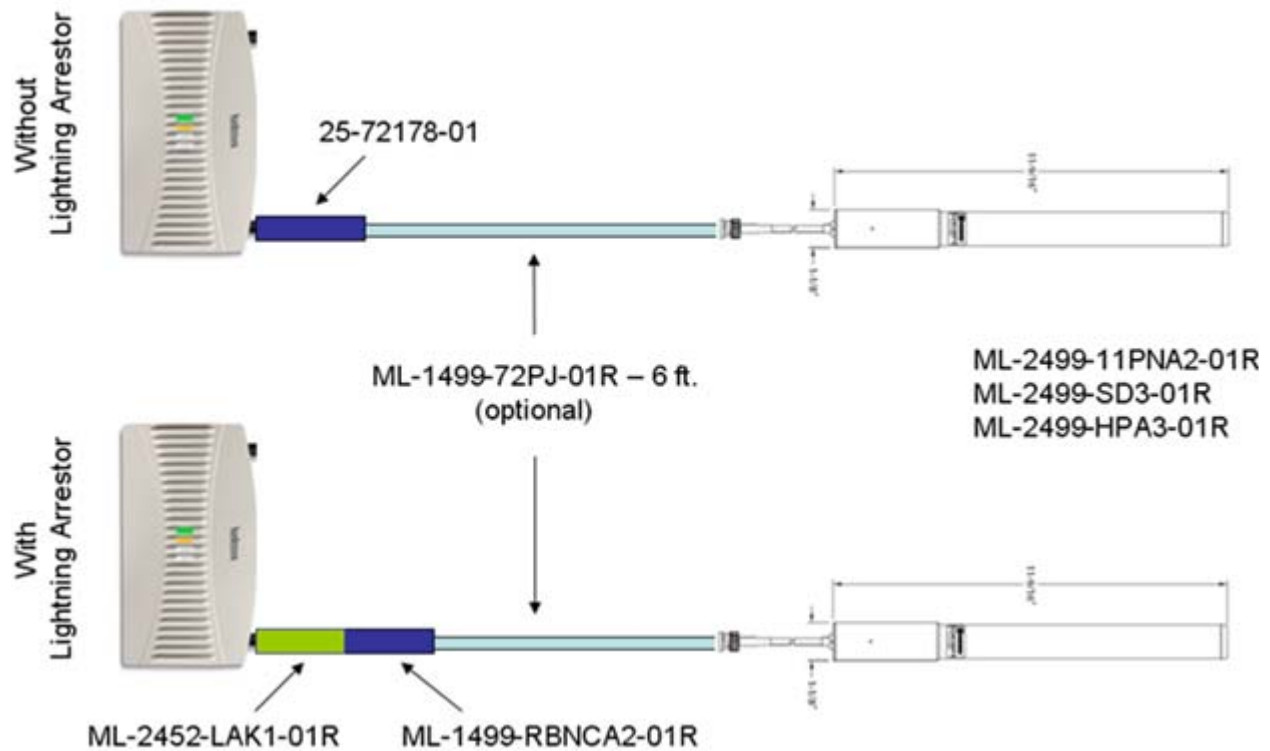
- [RP-BNC Male Antenna Installation](#)
- [Type N Female Connector Installation](#)
- [Type N Male Connector Installation](#)



NOTE: For information on the individual 2.4 GHz antennas approved for use with an AP-5131, see [802.11b/g Antenna Suite](#).

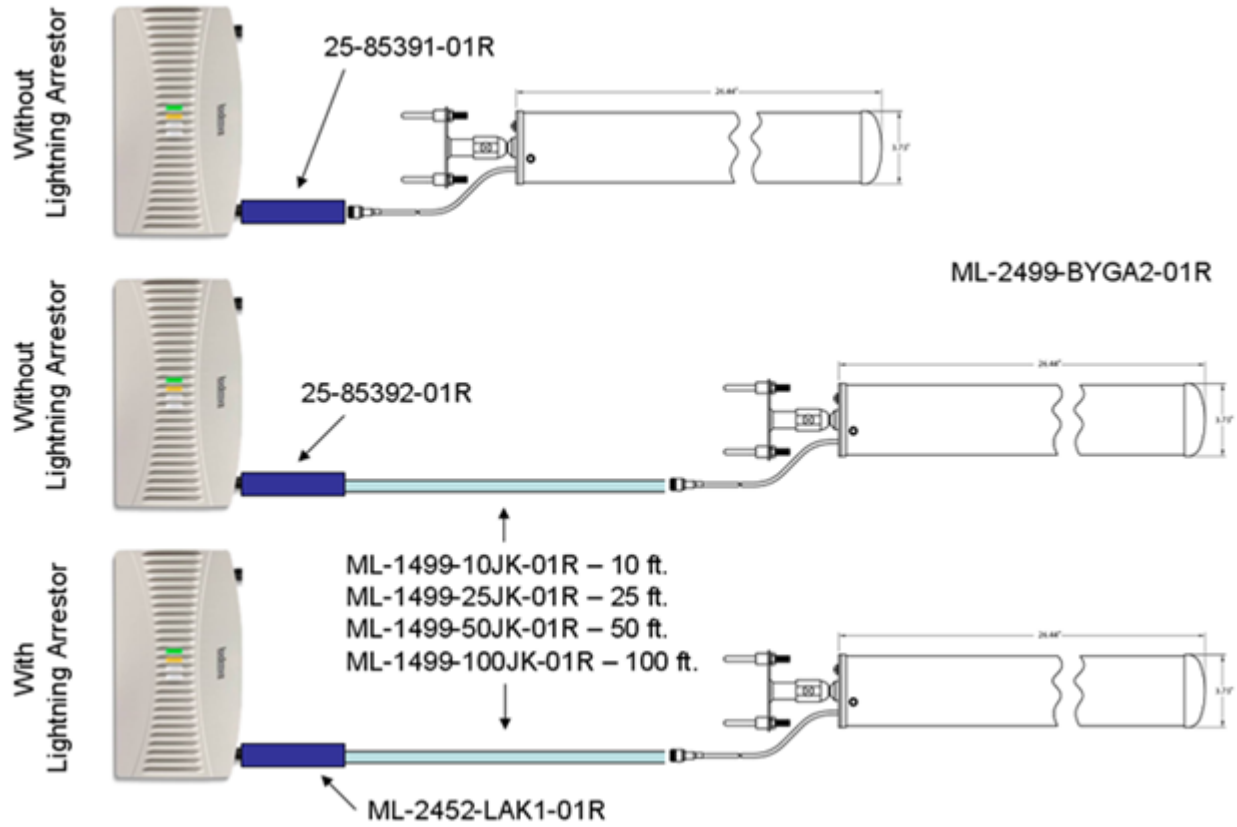
10.1.1 RP-BNC Male Antenna Installation

Refer to the following for a graphical depiction of the parts and connection options available for cabling an AP-5131 model access point using RP-BNC Male Antennas:



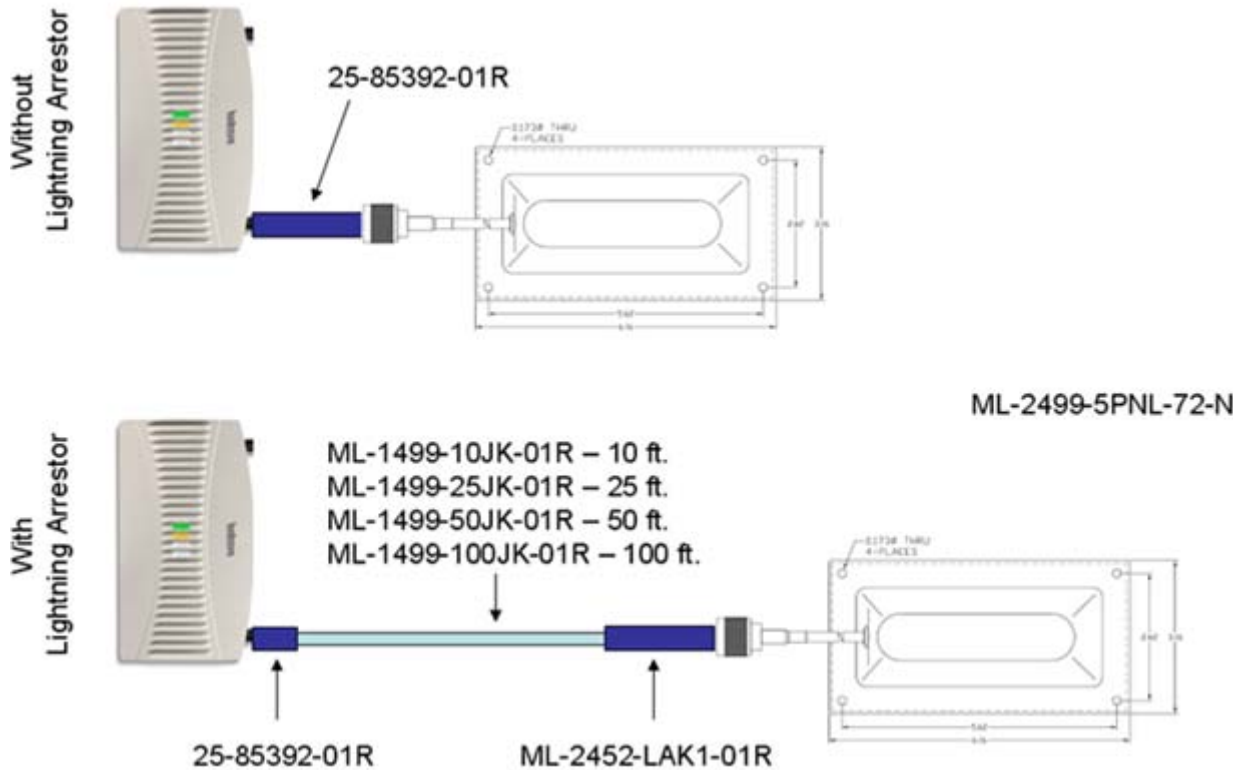
10.1.2 Type N Female Connector Installation

Refer to the following for a graphical depiction of the parts and connection options available for cabling an 2.4 GHz AP-5131 model access point using Type N Female Connectors:



10.1.3 Type N Male Connector Installation

Refer to the following for a graphical depiction of the parts and connection options available for cabling an 2.4 GHz AP-5131 model access point using Type N Male Connectors:



10.2 5 GHz AP-5131 Antenna Connections

This section describes how the components described within this guide are used collectively in the following AP-5131 installation scenarios supporting the 5 GHz band:

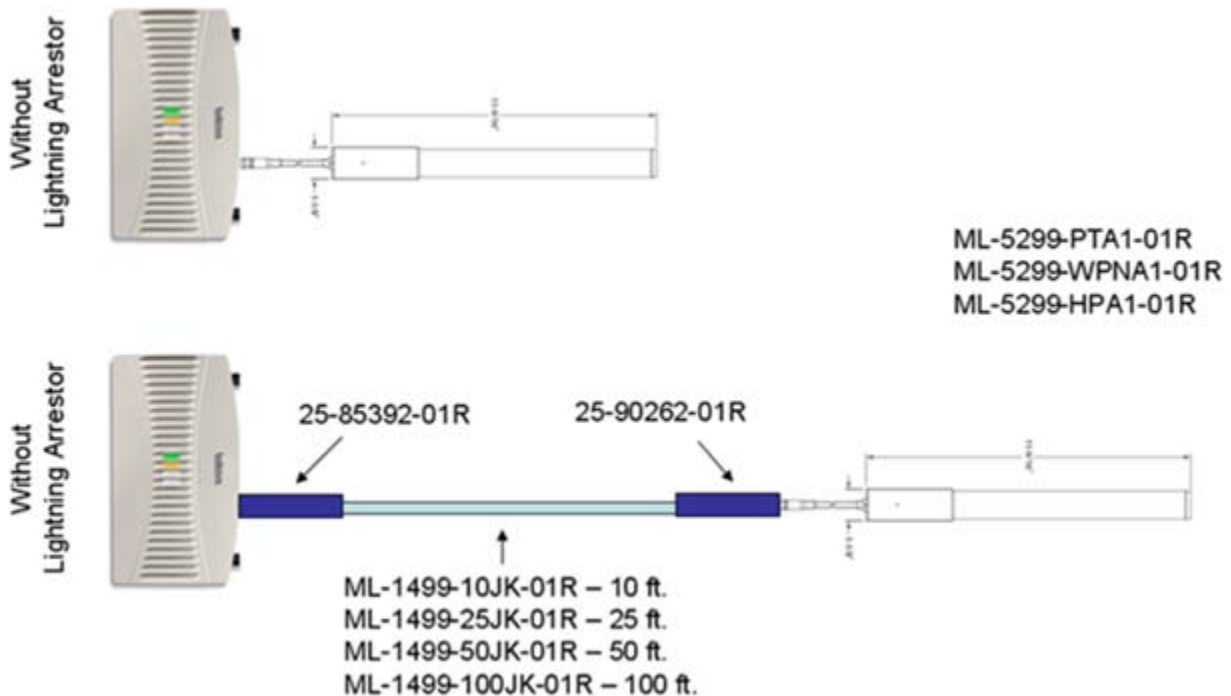
- [RP-SMA Male Antenna Installation - No Lightning Arrestor](#)
- [RP-SMA Male Antenna Installation - With Lightning Arrestor](#)



NOTE: For information on the individual 5 GHz antennas approved for use with an AP-5131, see [802.11a Antenna Suite](#).

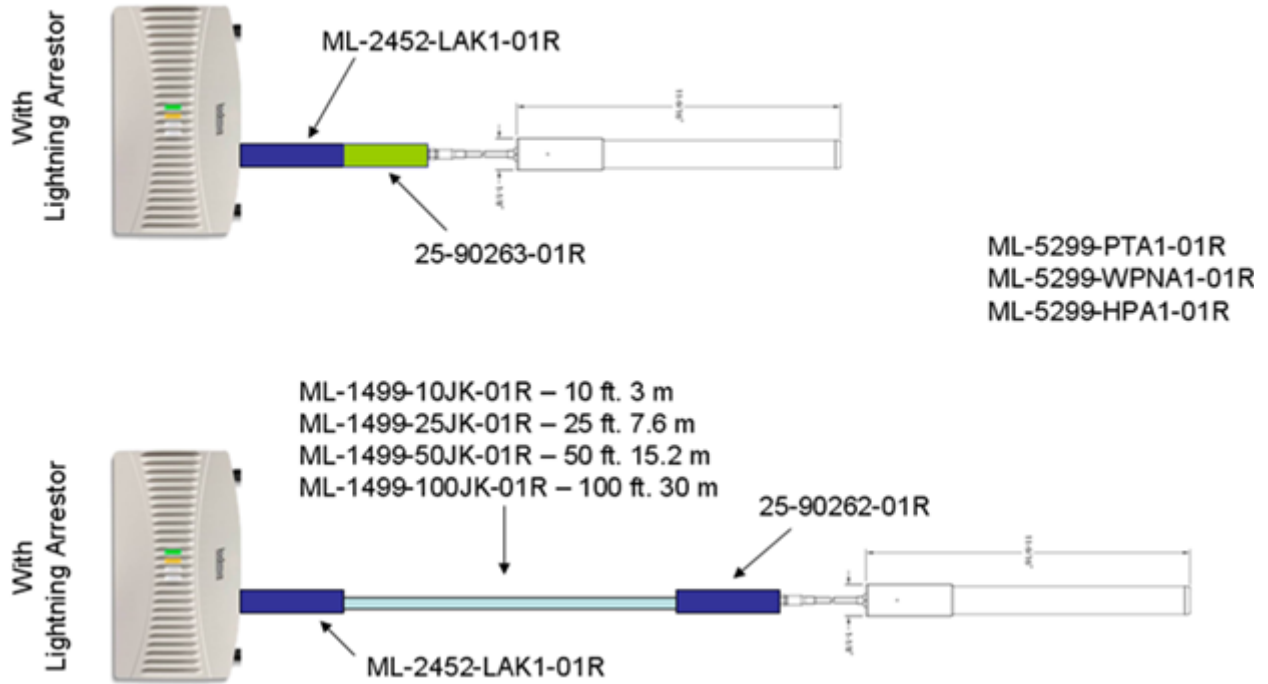
10.2.1 RP-SMA Male Antenna Installation - No Lightning Arrestor

Refer to the following for a graphical depiction of the parts and connection options available for cabling an 5 GHz AP-5131 model access point using a RP-SMA Male Antenna (with no lightning arrestor):



10.2.2 RP-SMA Male Antenna Installation - With Lightning Arrestor

Refer to the following for a graphical depiction of the parts and connection options available for cabling an 5 GHz AP-5131 model access point using a RP-SMA Male Antenna (with a lightning arrestor):





Technical Support

Comprehensive on-line support is available at the Support Central site at <http://www.symbol.com/support/>. Support Central provides our customers with a wealth of information and online assistance including developer tools, software downloads, product manuals and online repair requests.

When contacting the Motorola Support Center, please provide the following information:

- *serial number of unit*
- *model number or product name*
- *software type and version number.*

North American Contacts

Support (for warranty and service information):

telephone: 1-800-653-5350

fax: (631) 738-5410

Email: emb.support@motorola.com

International Contacts

Outside North America:

Motorola, inc.

Symbol Place

Winnersh Triangle, Berkshire, RG41 5TP

United Kingdom

0800-328-2424 (Inside UK)

+44 118 945 7529 (Outside UK)

Web Support Sites

Product Downloads

<http://www.symbol.com/downloads>

Manuals

<http://support.symbol.com/support/product/manuals.do>

Additional Information

Obtain additional information by contacting Motorola at:

1-800-722-6234, inside North America

+1-516-738-5200, in/outside North America

<http://www.motorola.com/>



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