

Accessories

FOR CABLE INSTALLATION



ASIA PACIFIC PRODUCT SELECTION GUIDE 2009

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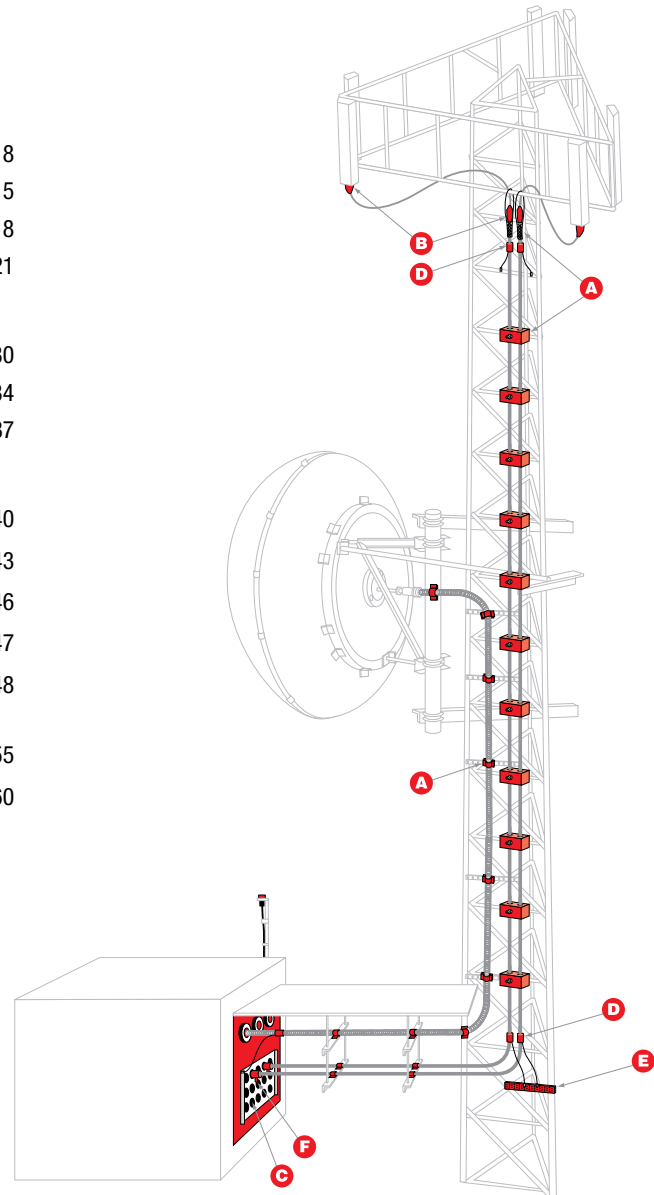
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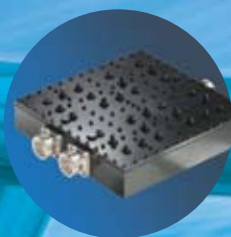
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Join the Evolution



Our evolution begins with you.

Whether you're a wireless network operator, original equipment manufacturer, distributor, integrator or installer, you need the right solutions—solutions that help you stay one step ahead of technology and the costs of keeping up. Solutions that help you stay ahead of the game. Andrew delivers those solutions for traditional wireless networks, third-generation technologies, triple-play (voice, data, video) services, as well as specialized applications for microwave communication systems.



The evolution of change.

Some technologies evolve in small increments; others evolve seemingly overnight. Andrew is always at the forefront, supporting the evolution on behalf of you, our customer. Over the years, Andrew has evolved too, from our humble beginnings in 1937 to our position today as a CommScope company and global leader.

Our evolution has come full circle today, as Andrew is committed to providing one complete source for managing the entire lifecycle of a wireless network. We design, manufacture, and deliver innovation for:

- Top-of-the-tower base station antennas
- Transmission line systems
- Microwave backhaul solutions
- Base transceiver station (BTS) radio equipment
- Coverage and capacity solutions
- Radio frequency (RF) signal distribution products
- Network optimization software
- Integrated cabinet solutions

We serve our customers from facilities in 35 countries, including multiple manufacturing plants in 10 countries. And many of our customer relationships span 25 years or more. It's a strong testament to what we can accomplish together.

Just look for the distinctive symbol that has been synonymous with advanced connectivity for more than 70 years: *the Andrew flash.*



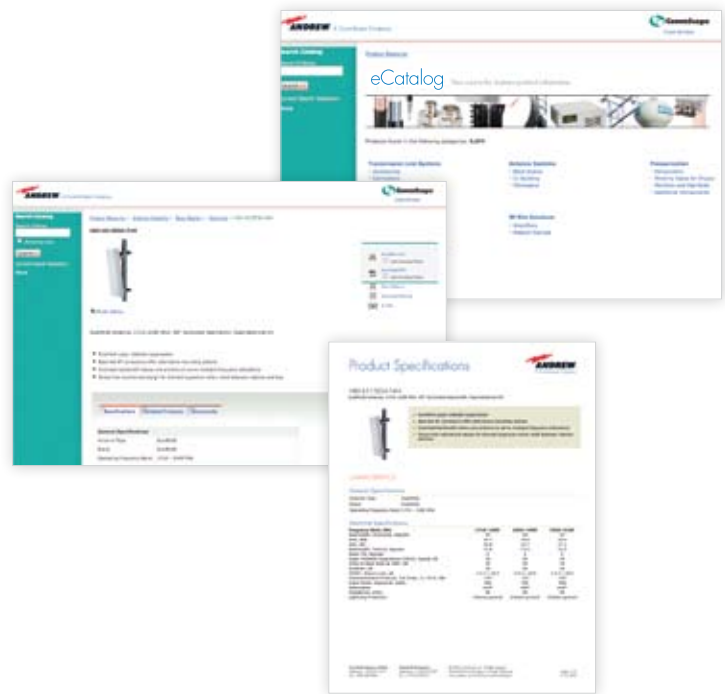
eCatalog

Your Source for Andrew Product Information

Visit the eCatalog at www.andrew.com for in-depth, up-to-the-minute information about Andrew products. The eCatalog provides detailed product specifications, images, installation instructions, links to related products, product comparisons, and more. It includes new products, information on discontinued products and their replacements, and easy-to-use calculators.

You decide how to view information—online, as a realtime customizable .pdf file, bundled .zip file, email link, or spreadsheet.

Visit the eCatalog often—it's your source for Andrew product information: <http://awapps.commscope.com/catalog/catalog.aspx>



OnePackSM Site Kits

The Answer for More Efficient System Build-outs

Today's global build-out demands new solutions that speed system deployment and simplify supply chain management. To help system managers better achieve these goals, Andrew offers kits for wireless RF communications systems sites. OnePack Site Kits provide the critical components in easy to order, easy to manage packages. System designers and managers can be confident of shortened project planning and execution cycles, improved efficiency, and dependable system performance.

Customer Support Center (CSC)

Service Around the Clock, Around the World

Contact the Andrew Customer Support Center for:

- Technical support
- Order status
- Coordinating product service, repairs, or replacement
- Product information
- Replacement materials

Call toll free from:

North America 1-800-255-1479
Fax 1-800-349-5444

International:

United Kingdom 0800-250055
Australia 1800-803 219
New Zealand 0800-441-747
Call from other areas: +1 708-873-2307



Andrew Institute provides technicians with the top-quality, specialized training they need to optimize communications systems performance and reliability.

- Comprehensive, hands-on instruction
- The latest Andrew products, installation methods, and theories
- Shared expertise
- Sharpen your skills, learn new techniques and see the latest product innovations
- 2-Year Certification after completed Andrew Institute coursework

Courses Offered

Teletilt® Systems — Remote Controlled Variable Electrical Downtilt Antennas

Covering topics from antenna fundamentals, hands-on installation of actuator, data cables, and control system, attendees will walk away with a better understanding of Andrew Base Station products.

HELIAX® Connector Attachment Training

Ideal for those who require assistance with fitting cables and connectors or would benefit from expanded technical training covering all aspects of HELIAX transmission line installation and latest techniques.

Terrestrial Microwave Systems Installation Training

Improve the efficiency and effectiveness of your Terrestrial Microwave (TMW) systems with specialized training on all aspects of installing and testing Andrew products.

VSWR Fundamentals

During the VSWR Fundamentals course attendees will learn definitions, testing guidelines, and plot/sweep interpretation.

For more information visit our Web site at: www.andrew.com

Registration is available online or call: +1-779-435-6231



Joliet, Illinois USA



Sorocaba, Brazil



Lochgelly, Scotland



Suzhou, China



Elements of a Cable Mounting and Protection System

Once you've selected the cable and connectors for your system, the cable mounting and protection system must be planned. Andrew offers a comprehensive line of installation accessories and lightning protection systems to help you realize your communications system's full potential.



Hoisting Grips

Select a hoisting grip to safely raise the cable and hold it during hanger attachment. In some cases, a hoisting grip must also be used with a calibrated clamp, available from Andrew, to provide permanent support for the cable.



Cable Entry

The final step in a base station installation is to bring the cable into the building or radio cabinet. Two basic types of cable entry systems are available: a standard building entry, and an integrated system that combines cable entry and lightning surge suppression into one efficient system.



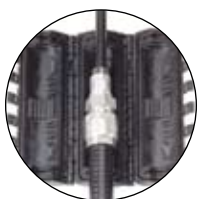
Hangers

The type or shape of the structure, the space available for cable attachment, the type of environment the system will be exposed to, and the ease of installation or maintenance are key considerations. Many hanger options are available, and many variables have tradeoffs that affect total hanger system cost. The table on page 14 will help you select the best hangers for your system and budget.



Grounding Kits

A grounding kit diverts transient currents from lightning off the transmission line to an earth grounding system to prevent damage to cable and radio equipment. A typical installation uses three grounding kits: near the top of the main feeder cable, at the bottom of the main feeder prior to the horizontal run, and just prior to the cable entering the building. Andrew offers three kit types to meet the requirements of your system and budget.



Weatherproofing

Weatherproofing keeps connector interfaces tight and adds an additional layer of protection against the environment. Andrew offers three types of weatherproofing. A standard weatherproofing kit provides universal coverage and uses butyl and vinyl tapes to wrap connector surfaces. Our 3M™ Cold Shrink™ weatherproofing kit uses a self-shrinking technology to reduce installation time. New WeatherShield™ enclosures seal and protect connectors for the environment in seconds.



Surge Arrestors

Andrew Arrestor Plus® surge arrestors provide the last stage of an effective lightning protection system. Install them to divert lightning transients off the inner conductor of your coaxial cable before they reach your radio equipment. Select from a variety of surge arrestors to meet your exact requirements.



- Cable Hoisting and Attachment
- Weatherproofing
- Cable Entry
- Installation Aids

Cable Installation Accessories

Cable Hoisting and Attachment

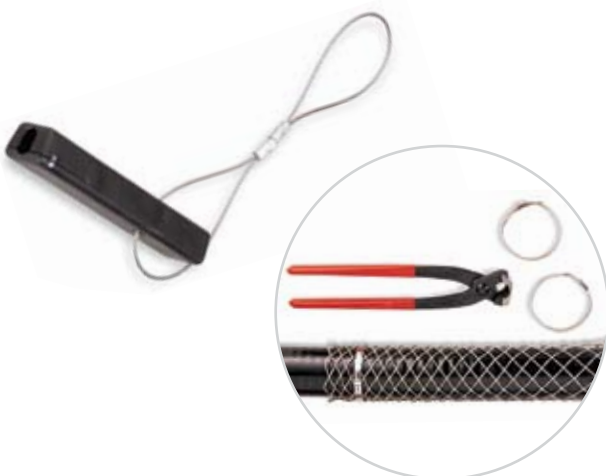
Support/Hoisting Grip

Safer, Faster Cable Hoisting

Lift and support cable in your monopole or on your tower faster and more safely and without the threat of slippage. Our one-piece grip and locking clamp speed and simplify installation by eliminating time consuming lacing.

Use at 200 ft (60 m) intervals to raise cable and provide permanent cable support. Basic kit includes one grip and one support clamp. Support clamps are also available in kits of 10. Installation tool is required.

Part Number	Part Number		
Support Grip	Support Clamp	Cable Size	Cable Type
F1SGRIP	F1SGRIP-1IK	1/4"	FSJ1
L1SGRIP	L1SGRIP-1IK	1/4"	LDF1
L2SGRIP	L2SGRIP-2IK	3/8"	LDF2, FXL-500
F2SGRIP	F2SGRIP-2IK	3/8"	FSJ2
C2SGRIP	C2SGRIP-2IK	3/8"	CNT-400
L4SGRIP	L4SGRIP-4IK	1/2"	LDF4, FXL-540
F4SGRIP	F4SGRIP-4IK	1/2"	FSJ4
L45SGRIP	L45SGRIP-45IK	5/8"	LDF4.5
L5SGRIP	L5SGRIP-5IK	7/8"	LDF5, VXL5, AVA5, FXL-780
L6SGRIP	L6SGRIP-6IK	1-1/4"	LDF6, VXL6, AVA6, FXL-1480
L7SGRIP	L7SGRIP-7IK	1-5/8"	LDF7, VXL7, AVA7, FXL-1873
L12SGRIP	L12SGRIP-12IK	2-1/4"	LDF12
3CCGRIP	—	—	RET cable
Part Number	Description		
SG-IT	Support Clamp Installation Tool		



TIP!

Use the support/hoisting grip whenever possible. Rely on the standard, lace up hoisting grip only when connectors are pre-attached or you have to place a grip in the middle of a cable run over 200 ft.

Standard Hoisting Grip

For Transmission Line Installation

Use at 200 ft (60 m) intervals to raise cable on tower. Use with additional support clamp to achieve optimum cable grip.

Part Number	Part Number	
Hoisting Grip	Optional Support Clamp	Cable Size
43094	L4SGRIP-4IK	1/2"
29958	L45SGRIP-45IK	5/8"
19256B	L5SGRIP-5IK	7/8"
29961	L6SGRIP-6IK	1-1/4"
24312A	L7SGRIP-7IK	1-5/8"
31535	L12SGRIP-12IK	2-1/4"
26985A	—	3"
34759	—	4"
31031-1	—	5"



Cable Installation Accessories

Cable Hoisting and Attachment

Click-On Hangers

Click-On Hangers—Install Cable with One Easy “Click”

Stackable click-on hangers install in just minutes and provide a perfect fit that gives your telecommunications system a compact, orderly cable installation, especially in confined spaces.

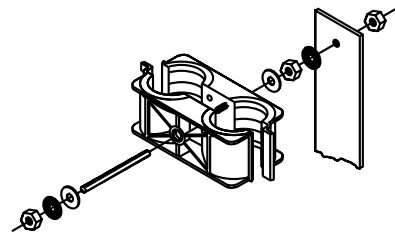
Available in either single or double versions, click-on hangers are manufactured of tough UV-resistant material and set the standard for durability, simplicity of installation, and cost effectiveness. They are attached with threaded rod (sold separately) and can be stacked up to three high. Fits corrugated and smoothwall cables.

United States Patent: 5794897.

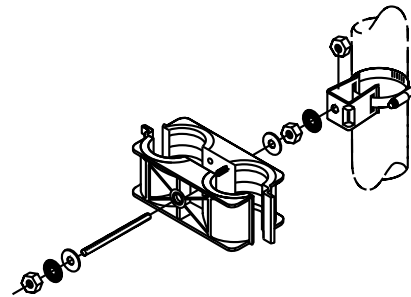
Double	Single	
Part Number	Part Number	Description
L4CLICK	L4SCCLICK	Click-on hanger for 1/2 in coaxial cable, kit of 10
L45CLICK	—	Click-on hanger for 5/8 in coaxial cable, kit of 10
L5CLICKB	L5SCCLICKB	Click-on hanger for 7/8 in coaxial cable, kit of 10
L6CLICK	L6SCCLICK	Click-on hanger for 1-1/4 in coaxial cable, kit of 10
L7CLICK	L7SCCLICK	Click-on hanger for 1-5/8 in coaxial cable, kit of 10



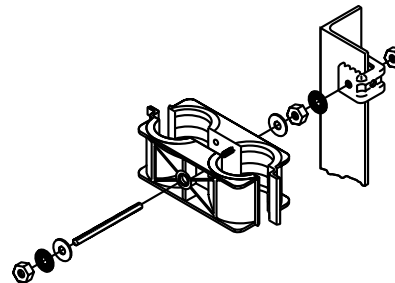
Part Number	Attachment Hardware
243684-M	Compact angle adapter, see page 12 for details
244350	Ceiling adapter, kit of 10
Round member adapter (various sizes) see page 12	



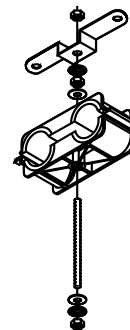
Flat Member Attachment



Round Member Attachment



Angle Adapter Attachment



Ceiling Adapter Attachment

Cable Installation Accessories

Cable Hoisting and Attachment

Click-On Hanger Hardware Kits

Click-on hanger attachment hardware is constructed of M10 stainless steel for durability. Select hardware length according to planned hanger stack height. Each kit contains 10 threaded rods, 30 nuts, 40 flat washers and 20 lock washers. **Note:** Click-on hangers accommodate two runs of cable and can be stacked up to three deep to handle up to six runs.

Part Number	Stack Height (# of hangers)	Cable Size	Rod Length in (mm)
Metric			
243095-11	1	1/2" or 7/8"	3.97 (101)
243095-7	2	1/2" or 7/8"	5.50 (141)
243095-3	3	1/2" or 7/8"	7.10 (181)
243095-12	1	1-1/4" or 1-5/8"	5.00 (126)
243095-8	2	1-1/4" or 1-5/8"	7.30 (186)
243095-4	3	1-1/4" or 1-5/8"	9.90 (251)



TIP!

Multi-run hangers are the best choice for installing cables where space is very limited on crowded towers.

Miniature Click-On Hangers

Fast, easy installation for small cables

Now installing small cables into hangers is accomplished in one easy click with miniature click-on hangers.

Each compact, miniature click-on hanger accommodates two runs of cable. Miniature click-on hangers are compact and stackable, making it easy to install several runs of cable in confined spaces.

Miniature click-on hangers are cost effective and durable. With flexible gripping ribs, the hanger provides secure support on a range of cable sizes, and indexing on the hanger body helps align cables during installation.

Specifically designed to accommodate small corrugated coaxial cables, elliptical waveguide, and braided cable runs, miniature click-on hangers provide a perfect fit for your installation. Hangers are packed in kits of 10. Attachment hardware, made of anti-corrosion coated metal for long service life, is sold separately in kits of 10.

United States Patent: 7,007,900.

Select hardware by intended hanger stack height.

Part Number	Description
68MCLICK	Click-on hangers for 6–8 mm cable; FSJ1A, CNT-240, CNT-300
912MCLICK	Click-on hangers for 9–12 mm cable; LDF1, EFX2, FSJ2, LDF2, CNT-400, EW380
1316MCLICK	Click-on hangers for 13–16 mm cable; FSJ4, LDF4-50A, CNT-500, CNT-600
Part Number	Description
252026-10KT	Mini angle adapters, M8 tap
252027-10KT	Single stack hardware for mini click-on hangers, M8 thread
252028-10KT	Double stack hardware for mini click-on hangers, M8 thread
252029-10KT	Triple stack hardware for mini click-on hangers, M8 thread



Cable Installation Accessories

Cable Hoisting and Attachment



Standard Hangers

Standard Hangers and Hardware—For Security and Flexibility

Standard hangers are designed to attach smoothwall and corrugated coaxial cables and waveguide securely to just about any type of support structure. The clamp locking bolt and nut are pre-assembled and captivated to minimize installation labor. They are drilled for 3/8 inch or M10 mounting hardware and feature slots for round member adapter clamps. See page 12 for accessories to adapt these hangers to most tower configurations.

Please refer to Appendix 5 for specific recommendations.

Hanger Part Number	Cable Size	Photo Reference
43211A	3/8"	A
43211A	1/2"	A
42396A-9	5/8"	B
42396A-5	7/8"	B
42396A-1	1-1/4"	B
42396A-2	1-5/8"	B
42396A-4	2-1/4"	B
31766A-11	3"	C
31766A-10	4"	C

Hanger Part Number	Waveguide Size	Photo Reference
31766A-9	EW17	C
31766A-10	EW20	C
31766A-11	EW28	C
42396A-4	EW37	B
42396A-16	EW43	B
42396A-8	EW52	B
42396A-7	EW63	B
42396A-1	EW64	B
42396A-11	EW77	B
42396A-5	EW85	B
42396A-5	EW90	B
42396A-9	EW127A	B
42396A-9	EW132	B
43211A	EW180	B
43211A	EW220	B
43211A	EW240	B

Hardware Sets, Kit of 10

Kits include 3/8 inch fillister-head bolts, lock washers, and nuts for attachment of standard hangers to drilled tower members. Not for use on 31768A-M and 243684-M angle adapters.

Part Number	Length
31769-5	3/4 in (19 mm)
31769-1	1 in (25 mm)



Additional Mounting Hardware

Threaded Rod Support Kit for Standard Hangers.

Use to mount hangers away from supporting structure, under cable bridge, and inside equipment room. Includes M10 stainless steel threaded rod, nuts, and washers. Attach to angle tower members with 31768A-M or 243684-M. Kit of 10.

Part Number	Rod Length, in (mm)
243095-4	9.9 (250)



Cable Installation Accessories

Cable Hoisting and Attachment

Compact Stainless Steel Angle Adapters

Compact, lightweight, high quality stainless steel angle adapters provide a cost saving option to standard adapters for many wireless systems that use HELIAX® coaxial cable. These compact angle adapters are suitable for use with single runs of HELIAX cable up to 2-1/4 inch in diameter. When used with our stackable click-on hangers, they can accommodate up to six runs of 1-5/8 inch cable or smaller cable. Includes M10 hanger attachment hardware, kit of 10.

Part Number	Description
243684-M	Compact angle adapter, M10 thread, kit of 10



Angle Adapter

Stainless steel, kit of 10. For mounting 1/2 inch to 4 inch cable hangers to angle tower members up to 7/8 in (22 mm) thick. Includes hanger attachment hardware.

Part Number	Description
31768A-M	Standard angle adapter, M10 thread, kit of 10



Round Member Adapter

Stainless steel clamps to mount 1/2 inch to 4 inch cable hangers to round support members. Two each are needed for 3 inch and 4 inch cable hangers, kit of 10.

Part Number	Member Diameter, in (mm)
31670-1	1-2 (25-50)
31670-2	2-3 (50-75)
31670-3	3-4 (75-100)
31670-4	4-5 (100-125)
31670-5	5-6 (125-150)
31670-6	6-8 (150-200)



Tower Standoff

Adapters with round member clamps and hardware for 1/2 inch to 4 inch hangers. They are prepunched for SnapStak hangers and include a 3/8 inch tapped insert to accept standard hangers. (Use hardware number 31769-5 for hanger attachment.) All parts are stainless steel, kit of 10.

Part Number	Member Diameter, in (mm)
TTS3-7515	0.75-1.5 (20-40)
TTS3-153	1.5-3.0 (40-75)
TTS3-34	3-4 (75-100)
TTS3-45	4-5 (100-125)
TTS3-56	5-6 (125-150)



Cable Installation Accessories

Cable Hoisting and Attachment

Clamp Head

Part Number	Description
MF39901-10	Clamp head, kit of 10



Nylon Cable Ties For Jumper Cable Attachment

Cable ties secure cable bundles where space is limited. They are an excellent choice for organizing jumper cables within and between radio cabinets and for bundling jumper cables. Nylon cable ties provide support for small diameter cable 1/4 inch to 1/2 inch. Typical applications include securing jumper cables in buildings and along horizontal antenna mounting arms.

Part Number	Description
40417	Nylon cable ties, 5/16 in wide 14.5 in long, kit of 50



Universal Snap-In Bracket

These galvanized steel brackets are designed to work on both angle and round members. They are pre-punched with 3/4 inch holes to hold snap-in hangers or standard hangers.

Part Number	Description
SS-TB2550	Universal snap-in bracket, for 1-1/2 in to 5-9/16 in round member 2-1/2 in to 5 in angle member. Accommodates six snap-in or standard hangers.
SS-TB6080	Universal snap-in bracket, for 6 in to 10-3/4 in round member 6 in to 8 in angle member. Accommodates six snap-in or standard hangers.



Cluster Support Bracket

The cluster support bracket is a versatile means to support multiple runs of coaxial cable in virtually any application. The oval design allows coaxial cable to be run inside and outside of the bracket, which maximizes its capacity. Each bracket features 3/4 inch holes to accommodate snap-in hangers and 3/8 inch holes for butterfly hangers using standard 3/8 inch hardware. The cluster support bracket supports seven runs of coaxial cable. Sold in units of one, U-bolt hardware sold separately.

Part Number	Description
CS-B	Cluster support bracket with U-bolt for 2-3/8 in round member attachment



Snap-In Adapter Bracket

This bracket is used in conjunction with WRAPLOCK® and is used on large, round members, water towers, or outside of a monopole. The brackets slide on the WRAPLOCK and hold up to six runs of coaxial cable. You can use multiple brackets for the number of runs required for your system. The galvanized steel bracket supports both standard hangers and snap-in hangers. Accommodates six runs of snap-in hangers and four runs of click-on hangers.

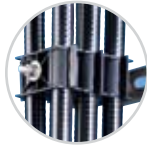
WRAPLOCK is a trademark of Hanler Corporation

Part Number	Description
RM-USBG 12395-1	Snap-in adapter bracket, kit of 10 Stainless steel WRAPLOCK, 100 ft, with fasteners



Cable Installation Accessories

Hanger Selection Guide



Click-On Single, Double, or Miniature Hangers



Standard Hangers



Support/Hoisting Grips*



Cable Ties**

Hanger Type	Click-On Single, Double, or Miniature Hangers	Standard Hangers	Support/Hoisting Grips*	Cable Ties**
Construction	Engineered plastic single or double	Stainless steel	Tin coated bronze	Nylon
Cable runs supported	2 to 6	1	1	1
Primary applications	Rooftops, water towers, and towers with limited space	Tower installations subject to high wind, high corrosion, and high ice	Monopole towers	Jumper cables and inter-rack cabling
Typical installation time (minutes)***	20	20	2	—
Key feature	Stackable up to three high	Stainless steel tensioning hardware	Calibrated clamp provides permanent cable support	Universal fastening
Benefits	- Attaches cables in compact six run bundles - Versatile and adaptable to almost any application - Easy to install click-on design - UV stable	- Impervious to environmental extremes - Adaptable to various tower configurations	- Quick installation - Monopole application - Accommodates single run of cable	- Fits most cable sizes and tower members - Quick installation - Inexpensive - Accommodates single run of lightweight cable
Attachment capability (Tower member type)	3/8" (M10) drilled hardware ladder - Various adapters (see page 11)	3/8" (M10) drilled cable ladder - Various adapters (see page 12)	All towers and monopoles	Round member, angle member, cable ladders
Additional parts needed	Threaded rod and hardware	Tower attachment hardware kit	None	None
Tower adapters (allows hanger attachment to various tower types)	- Round member adapter - Angle adapter	- Round member adapter - Angle adapter	None required	None required

Conditions

* Support grip or hoisting/support grip required with all cable installations

** Should only be used with 1/2 in cable and smaller

*** Installation time based on a 100 ft (30 m) run of 7/8 in cable with 3 ft (1 m) hanger spacing. Monopole application applied 200 ft intervals, 2 minutes.

Cable Installation Accessories

Weatherproofing

NEW! WeatherShield™ Reusable Connection Protection Enclosures

For In-Line Connectors, Antennas, and Tower Top Devices

Complete your transmission line installation with WeatherShield connection protection enclosures which seal and protect connectors from the environment.

This robust enclosure offers an additional measure of system protection by keeping connections clean, dry and tightly coupled.

The reusable enclosure contains an innovative trifold seal that provides complete moisture block for installed connectors. The ease of installation on hard-to-reach connections and the long-term protection provided by this enclosure makes it the most cost-effective solution available today. The WeatherShield connection protection enclosure takes just seconds to install. Simply place the housing around the connector and snap the tabs together.

No tapes, tools, or shrink tubes are required. The Andrew WeatherShield connection protection enclosures will accommodate Type N and 7-16 DIN connections and are compatible with Andrew HELIAX[®] cable, SureFlex[™] cable assemblies, and most brands of standard jumpers.

Part Number	Description
AWE-A12-C	Enclosure for 1/2 in antenna connection/device
AWE-7812	Enclosure for 7/8 in to 1/2 in connections
AWE-11412	Enclosure for 1-1/4 in to 1/2 in connections
AWE-15812	Enclosure for 1-5/8 in to 1/2 in connections



New compact version for jumper cables features slider bar closure method.

- 24% smaller profile
- Slide bar closure
- 100% reusable

More Information: See the installation video at <http://awapps.commscope.com/video/default.aspx>



Cable Installation Accessories

Weatherproofing

Weathertight Seal

Quickly Installs in Three Minutes

3M™ Cold Shrink™ weatherproofing seals and protects connectors and jumper-to-antenna interfaces from the environment.

Cold Shrink weatherproofing simply slips over the connection and compresses around the interface. No tapes or heat guns are required for sealing or shrinking. Simply place the Cold Shrink kit over the cable and connector, make the connection, and unwind the pull-tab applicator. Once it is collapsed, its continuous compression design forms a watertight seal around the cable.

Kits are available for transitions from larger to smaller diameter cable, such as 1-5/8 inch to 1/2 inch, or for same diameter cable, such as 1/2 inch to 1/2 inch. See the table for part numbers.

3M and Cold Shrink are trademarks of Minnesota Mining and Manufacturing Company



Part Number	Minimum Application Diameter, in (mm)*	Kit Coverage, Cable Size to Cable Size		
Connectors, 7-16 DIN or Type N				
245173	0.63–0.41 (16–10.0)	3/8" through 1/2"	to	3/8" through 1/2"
241475-13	0.80–0.29 (20–7.4)	5/8"	to	1/4" through 1/2"
245171	0.84–0.29 (2–7.4)	7/8"	to	1/4" through 1/2"
245172	1.20–0.29 (30–7.4)	1-5/8" or 1 1/4"	to	1/4" through 1/2"
245175	1.40–0.41 (36–10.0)	2-1/4"	to	1/4" through 1/2"
Antennas, filters, amplifiers, 7-16 DIN or Type N				
245174	0.84–0.29 (21–7.4)	1/2"–7/8" jumpers to antenna		

* Minimum application diameter is the fully compressed diameter of each tube in the kit.

Self-fusing Tape

Self-fusing and marking tape is a time saving alternative to traditional butyl rubber sealant tapes. The silicone tapes are produced from specially formulated UV-resistant silicone rubber. When applied to RF connectors, the tape wraps bond together giving the connection an additional layer of protection against water, dirt, and vibration. Compared to conventional tapes, self-fusing tape is both easy to apply and remove from connections.

Available in three colors options, self-fusing tape can also be used to color code tower top cable installations, making it easy to locate cables for monitoring purposes.

Part Number	Description	Quantity
FT-TB	Self-fusing tape, black .030" x 1.5" x 15'	2 rolls
FT-TR	Self-fusing tape, red .030" x 1.5" x 15'	2 rolls
FT-TW	Self-fusing tape, white .030" x 1.5" x 15'	2 rolls
FT-TC	Self-fusing tape, clear .030" x 1.5" x 15'	2 rolls



Cable Installation Accessories

Weatherproofing

Standard Weatherproofing Kit for Connectors and Antennas

The application of sealing materials to coaxial cable connections protects them from weather conditions. These include moisture penetration and loosening of connections from vibrations caused by strong winds. Andrew recommends weatherproofing these connections with standard weatherproofing tapes such as butyl and plastic electrical tapes.

- Main feeder cable-to-jumper cable connection
- Jumper cable-to-antenna connection

This kit provides an additional moisture seal and keeps connections free of dirt and tarnish from pollution. It also prevents loosening of connections from vibration or other external stresses, which would eventually allow moisture penetration. The sealed connection is suitable for typical exposed and buried cable applications.

Andrew 221213 Weatherproofing Kit contains:

- 2 rolls of 3/4 in x 66 ft black plastic tape
- 1 roll of 2 in x 20 ft black plastic tape
- 6 rolls of 2-1/2 in x 24 in butyl rubber tape

Weatherproofing Connections Per Kit

Connection Type	Applications Per Kit
2-1/4 in to 1/2 in (57 mm to 13 mm)	2
1-5/8 in to 1/2 in (41 mm to 13 mm)	2
1-1/4 in to 1/2 in (32 mm to 13 mm)	2
7/8 in to 1/2 in (22 mm to 13 mm)	4
1/2 in to 1/2 in (13 mm to 13 mm)	12
7/8 in to antenna, amplifier, device (22 mm to 13 mm)	12
1/2 in to antenna, amplifier, device (13 mm to 13 mm)	12

TIP!

- When applied, the tape must be above 32°F (0°C) to ensure adhesion. Keep tape warm by carrying in coat pockets.
- Do not stretch the tape. Apply only enough tension to provide a smooth wrap.
- Smooth each wrapped layer with your hands to ensure full adhesion.
- Do not pull the tape to tear tape—always cut it. (Pulled tape eventually unravels, decreasing protection.)
- Add extra final layers of tape in warmer climates where there will be long exposure to damaging ultra violet (UV) rays. Two or three extra layers of tape will provide additional UV protection.
- When wrapping tape, overlap the tape to half-width.
- Ensure vent or drain holes at the bottom of the antenna or device are not covered with weatherproofing tape.

Standard Weatherproofing Tape

Part Number	Description
221213	Complete kit, black
42615-10	2-1/2 in x 24 in butyl rubber roll
9905-41	3/4 in x 66 ft black plastic tape roll
9905-71	2 in x 20 ft black plastic tape roll



Colored Electrical Marking Tape

Colored tape is a convenient way to mark and code cable runs. Six different colors are available in 3/4 inch x 66 inch rolls. Sold in individual rolls.

Part Number	Description
CM-TB	Blue, 3/4 in x 66 ft (19.1 mm x 20.1 m)
CM-TBR	Brown, 3/4 in x 66 ft (19.1 mm x 20.1 m)
CM-TG	Green, 3/4 in x 66 ft (19.1 mm x 20.1 m)
CM-TR	Red, 3/4 in x 66 ft (19.1 mm x 20.1 m)
CM-TW	White, 3/4 in x 66 ft (19.1 mm x 20.1 m)
CM-TY	Yellow, 3/4 in x 66 ft (19.1 mm x 20.1 m)



Cable Entry

ArrestorPort™ II Integrated Transmission Line Entry/Ground System

The ArrestorPort II integrated building entry/ground system unifies the installation of entry ports, Arrestor Plus® surge protectors, and transmission line grounding into a single integrated entry/ground system.

The ArrestorPort™ II integrated wall entry/grounding system kit consists of a 4 port entry panel and a 1/8 inch tin plated copper ground bar assembly with punch-outs for 13 bulkhead mounted surge arrestors (7-16 DIN and Type N). Use with Arrestor Plus surge arrestors (pages 37 and 38, order separately) and SnapSeal cable boots (pages 19 and 20, order separately).

Part Number	Description
APOINT-13-4	Provides mounting positions for 13 bulkhead mount surge arrestors and includes four 4 inch holes for waveguide entry



Multiple Entrance Wall/Roof Feed-Thru Plate

Plate with one or more 4 inch holes. Weatherproof sealing caps included. Use with the corresponding size rubber cable boot (sold separately).

Part Number	Number of Openings	Height, in (mm)	Width in (mm)
4 in (102 mm) Entry Opening, Multiple Entrance Plate			
204673-1	1	7.0 (178.0)	7.0 (178)
204673-2	1	5.0 (127.0)	5.0 (127)
204673-2A	2	7.0 (178)	7.0 (178)
204673-3	3	9.5 (241)	20 (508)
204673-4	4	9.5 (241.3)	25.5 (648)
204673-6	6	17.5 (444.0)	23 (584)
204673-8	8	17.5 (444.0)	25.5 (648)
204673-9	9	23.0 (584.0)	23.0 (584)
204673-10	10	9.5 (241.3)	31.0 (787)
204673-12	12	25.5 (648.0)	25.5 (648)
204673-16	16	25.5 (648.0)	25.5 (648)
204673-18	18	25.5 (648.0)	39.5 (1003)
204673-20	20	28.8 (731.0)	31.0 (787)
204673-24	24	31.0 (787.0)	39.5 (1003)



Single Entrance Wall/Roof Feed-Thru Assembly

Includes rubber boot, clamp, and aluminum plate. Order from table.

Part Number	Cable Size
SCE-12	1/2"
SCE-58	5/8"
SCE-78	7/8"
SCE-114	1-1/4"
SCE-158	1-5/8"
SCE-214	2-1/4"



Cable Installation Accessories

Cable Entry

SnapSeal™ Cable Entry Cushion

The SnapSeal entry cushion provides a quick and easy method of entering cables into a wall/roof feed-thru plate with four inch openings.

Exclusively from Andrew, the SnapSeal entry cushion is a two piece cable entry device that snaps onto standard wall/roof feed-thru plates.

Using this system provides major advantages versus using standard bulky cable boots by greatly reducing the amount of space needed and labor required to install a complete cable entry system.

To install the SnapSeal entry cushion, remove the entry plug from the cushion, place the cushion around the cable, place the compression ring around the cushion, and push the device over the entry port opening until it snaps into place. The SnapSeal entry cushion is UV resistant and impervious to temperature, humidity extremes, and vibration.

Part Number	Description
SEC-614	SnapSeal entry cushion, 6 x 1/4 in, kit of one
SEC-638	SnapSeal entry cushion, 6 x 3/8 in, kit of one
SEC-412	SnapSeal entry cushion, 4 x 1/2 in, kit of one
SEC-358	SnapSeal entry cushion, 3 x 5/8 in, kit of one
SEC-378	SnapSeal entry cushion, 3 x 7/8 in, kit of one
SEC-1114	SnapSeal entry cushion, 1 x 1 1/4 in, kit of one
SEC-1158	SnapSeal entry cushion, 1 x 1 5/8 in, kit of one
SEC-1214	SnapSeal entry cushion, 1 x 2 1/4 in, kit of one

Standard Cable Entry Boots, 5 in (127 mm)

Part Number	Cable Size	Number of Holes in Boots
48939A-16	3/8" foam	3
48939A-6	1/2" foam	1
48939A-8	1/2" foam	3
48939A-7	1/2" air	1
48939A-5	1/2" air	3
48939A-17	1/2"	4
48939A-14	5/8"	1
48939A-15	5/8"	3
48939A-1	7/8"	1
48939A-2	7/8"	3
48939A-3	1-1/4"	1
48939A-4	1-5/8"	1
48939A-9	2-1/4"	1
48939A-10	3"	1
EP-CAP5	Blank cap	0

Hole Plugs

Part Number	Description
PLUG-12	Plug, 1/2 in, for unused cable boot holes, kit of 5
PLUG-78	Plug, 7/8 in, for unused cable boot holes, kit of 5
PLUG-114	Plug, 1-1/4 in, for unused cable boot holes, kit of 5
PLUG-158	Plug, 1-5/8 in, for unused cable boot holes, kit of 5



Cable Installation Accessories

Cable Entry

Elliptical Waveguide—Standard Cable Entry Wall and Roof Feed-Thru and Boots

- A Single entrance wall/roof feed-thru assembly. Includes rubber boot, clamp, and galvanized steel plate. Order from table below.
- B Single entrance wall/roof feed-thru assembly for EW37–EW240. Includes rubber boot, clamps, and aluminum plate.
- C Waveguide boot for use with 204673 and 48940 series multiple entrance wall/roof feed-thru plates. Boot diameter of 4 in or 5 in (102 or 127 mm) is available to match plate. Order individually from table below.

A, B Single Entrance Wall/Roof Feed-Thru Assemblies

Single Entrance For Waveguide Size

Photo Reference

Part Number

EW17	A	35849A-10
EW20	A	35849A-9
EW28	A	35849A-13
EW37	B	245314-37
EW43	B	245314-43
EW52	B	245314-52
EW63	B	245314-63
EW64	B	245314-64
EW77	B	245314-77
EW85	B	245314-85
EW90	B	245314-90
EW127A	B	245314-127A
EW132	B	245314-132
EW180	B	245314-180
EW220	B	245314-220
EW240	B	245314-240

C Waveguide Boots

For Waveguide Size

Part Number by Diameter

4 in (102 mm) 5 in (127 mm)

EW17	—	—
EW20	—	—
EW28	—	—
EW37	WGB4-37	WGB5-37
EW43	WGB4-43	WGB5-43
EW52	WGB4-52	WGB5-52
EW63	WGB4-63	WGB5-63
EW64	WGB4-64	WGB5-64
EW77	WGB4-77	WGB5-77
EW85	WGB4-85	WGB5-85
EW90	WGB4-90	WGB5-90
EW127A	WGB4-127	WGB5-122
EW132	WGB4-132	WGB5-132
EW180	WGB4-180	WGB5-180
EW220	WGB4-220	WGB5-220
EW240	WGB4-240	WGB5-240



A. Single Entrance
Wall/Roof Feed-Thru
Assembly for
EW17–EW28



B. Single Entrance
Wall/Roof Feed-Thru
Assembly for
EW37–EW240



C. Waveguide Boot

Cable Installation Accessories

Installation Aids

Better Connections Yield Superior System Performance

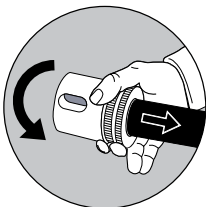
The connector interface is one of the most critical factors affecting transmission line operation. Even experienced technicians find the job more difficult when equipped with makeshift devices or an inadequate array of simple hand tools, and it only takes a single faulty connection to degrade performance and threaten your operation's revenues.

EZfit® Tools

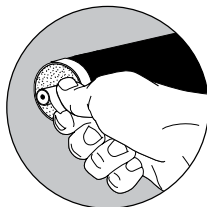
EZfit installation tools were co-designed with EZfit connectors to provide an integrated approach for better connectorization. These easy-to-use tools allow installers, contractors, and network operators to quickly and accurately core and prepare cables. By precisely controlling cutting and coring, EZfit tools help ensure that every connection, regardless of the technician, is exact and consistent from cable to cable.

The EZfit Series of hand prep tools includes a tool for each connector size to help ensure optimum electrical performance, mechanical reliability, and network uniformity.

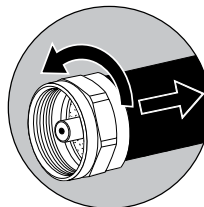
Choose from either drill driven tools for the greatest efficiency or economical hand prep tools to match the circumstances of your installation.



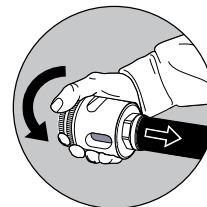
1. Core the cable



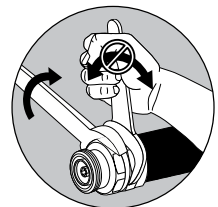
2. Expose the inner conductor



3. Fit the clamping nut



4. Flare the outer conductor



5. Tighten connector

Cable Installation Accessories

Installation Aids

EZPT Series Tools—Speed Connector Attachment

Andrew's automatic drill driven tools speed connector attachment by removing jacketing, coring foam, and flaring sheath. Supplied with a T-handle for hand use.

Cable Type	Part Number	Description
FXL Series		
SFX-500	SFX-EZPT	Automatic cable preparation tool for 1/2 in EZfit® connectors
FXL-540	540-EZPT	Automatic cable preparation tool for 1/2 in EZfit connectors
FXL-780	780-EZPT	Automatic cable preparation tool for 7/8 in EZfit connectors
FXL-1480	1480-PT	Automatic cable preparation tool for 1-1/4 in EZfit connectors
FXL-1873	FXL/CR1873-PT	Automatic cable preparation tool for 1-5/8 in EZfit connectors



Cable Type	Part Number	Description
AVA Series		
LDF4-50A	L4-EZPT	Automatic cable preparation tool for 1/2 in EZfit connectors
AVA5-50	A5-EZPT	Automatic cable preparation tool for 7/8 in EZfit connectors
AVA6-50	A6-EZPT	Automatic cable preparation tool for 1-1/4 in EZfit connectors
AVA7-50	A7-EZPT	Automatic cable preparation tool for 1-5/8 in EZfit connectors



HPT Series Tools—No Drill Required

The HPT manual cable preparation tool removes jacketing, cores foam and flares sheath for easy connector attachment. Includes bits for FXL-780 and AVA5 series cables. Drill not required.



Cable Type	Part Number	Description
FXL-540, LDF4-50A	12-HPT	Manual cable preparation tool for 1/2 in EZfit connectors
FXL-780, AVA5-50A	78-HPT	Manual cable preparation tool for 7/8 in EZfit connectors

Cable Installation Accessories

Installation Aids

EZfit® Tool Replacement Blade Kits

Part Number	Description
HPT-BK1278	Replacement blade kit for 1/2 in and 7/8 in HPT tools
EZPT-BKU12	Replacement jacket removal blade kit for L4 EZPT tools
EZPT-BKUA5	Replacement jacket removal blade kit for A5 EZPT tools
EZPT-BKUA6	Replacement jacket removal blade kit for A6 EZPT tools
EZPT-BKUA7	Replacement jacket removal blade kit for A7 EZPT tools
EZPT-BKU540	Replacement jacket removal blade kit for 540-EZPT tools
EZPT-BKU780	Replacement jacket removal blade kit for 780-EZPT tools
EZPT-BKU1480	Replacement jacket removal blade kit for 1480-PT tools
EZPT-BKU1873	Replacement jacket removal blade kit for FXL/CR 1873-PT

Saw Guides for EZfit Connectors

EZfit saw guides allow technicians to cut coaxial cable precisely at the crest of copper corrugations, at the exact distance required for attaching EZfit connectors.



Cable Type	Part Number	Description
LDF4-50A	L4-SG	Saw Guide for LDF4-50A EZfit connectors
AVA5-50	A5-SG	Saw Guide for AVA5-50 EZfit connectors
AVA6-50	A6-SG	Saw Guide for AVA6-50 EZfit connectors
AVA7-50	A7-SG	Saw Guide for AVA7-50 EZfit connectors

EASIAx® Plus Automated Cable Preparation Tool

For Positive Stop Connectors

Cable installers and system designers can dramatically reduce cable preparation time and expense while improving overall system performance with the EASIAx Plus automated cable preparation tool. Fit the EASIAx Plus tool to any standard power drill, and it removes the cable jacket, outer conductor, and foam, then cuts back and chamfers the inner conductor to the correct dimensions for connector attachment—all in less than 15 seconds. The EASIAx Plus automated method of cable preparation means cable connections that are more consistent, more reliable, and more repeatable.



Tool Part Number	Cable Type	Connector Type
CPT-E2L2N	LDF2-50	Type N connectors
CPT-E2L2DIN	LDF2-50	7-16 DIN connectors
CPT-F4	FSJ4-50B	FSJ4 version two connectors
CPT-L4ARC1	LDF4-50 HL4RP-50	7-16 DIN or Type N standard, RingFlare™, OnePiece™, or Positive Stop™ connectors
CPT-L45RC	LDF4.5-50	RingFlare connectors
CPT-78U	LDF5-50A AVA5-50 VXL5-50 AL5-50	7-16 DIN or Type N standard, RingFlare, OnePiece, or Positive Stop connectors
CPTL6	LDF6-50	7-16 DIN or Type N standard, RingFlare, OnePiece, or Positive Stop connectors
CPT-158U	LDF7-50 AVA7-50 VXL7-50 AL7-50	7-16 DIN or Type N standard, RingFlare, OnePiece, or Positive Stop connectors

Cable Installation Accessories

Installation Aids

EASIAx Replacement Blades

Tool	Replacement Blade Kit
Part Number	Part Number
CPT-F4	CPT-BK
CPT-L4ARC1	CPT-BKS1
CPT-L45RC	CPT-BKS1
CPTL6	CPT-BK6
CPT-158U	CPT-BK7
CPT-78U	CPT-BK5



TIP!

- Recommended drill size for tools for 1/4 in through 1/2 in cables is 3/8 in torque value with 12 volt minimum. Cordless drill 14.4 minimum voltage, 400–650 RPM.
- Recommended drill size for tools for 7/8 in through 1-5/8 in cable is 1/2 in. Cordless drill 15.4 minimum voltage, 400–650 RPM.
- For detailed information on cable preparation, see Special Publication SP50262.

EASIAx® Cable Preparation Tool

Cuts precisely at crest of copper corrugation at the exact distance required for easy connector attachment. Clean cut makes flaring easier than ever. Precise blade depth makes it impossible to cut inner conductor.



Cable Types	Cutting Tool		Replacement Blades
	Part Number	Description	Part Number, kit of 5
FSJ1, FSJ4, ETS1, RXL1* Series	MCPT-1412	Cuts jacketing and outer conductor	209874
FSJ2, FSJ4, ETS2 Series	MCPT-3812	Cuts jacketing and outer conductor	209874
LDF4, HL4RP-50A, RXL4** Series	MCPT-L4	Cuts outer conductor and scores jacketing	MCPT-BK4
LDF5, VXL5, AVA5, RXL5, AL5-50 Series	MCPT-78	Cuts outer conductor and inner conductor and scores jacketing	MCPT-BK5

* Except RXL1-1RNT

** Except RXL4-(1, 2 or 3) RNT

Cable Installation Accessories

Installation Aids

Connector Attachment Torque Wrenches

Preset torque to match connector size

Andrew torque wrenches for EZfit® connectors are designed with a mechanism to audibly alert the installer that the proper torque has been set and then release the pressure.

Cable Type	Part Number	Description
EZfit Series Connectors		
SFX-500	TW-SFX-EZFC	Torque wrench for 3/8 in EZfit connectors
FXL-540, LDF4-50A	TW-12-EZFC	Torque wrench for 1/2 in EZfit connectors
FXL-780, AVA5-50A	TW-78-EZFC	Torque wrench for 7/8 in EZfit connectors
FXL-1480, AVA6-50	TW-114-EZFC	Torque wrench for 1-1/4 in EZfit connectors
FXL-1873 AVA7-50	TW-158-EZFC	Torque wrench for 1-5/8 in EZfit connectors

Other Connector Designs

LDF4-50A	247696	Torque wrench for 1/2 in OnePiece™ connectors
LDF4-50A	245154	Torque wrench for 1/2 in RingFlare™ connectors

Connector Coupling Nuts

All	244379	Torque wrench for Type N coupling nut
All	244377	Torque wrench for 7-16 DIN coupling nut



Grounding Lug Crimping Tool

Used to attach crimp-on lugs for standard and SureGround™ series. Not required for kits with factory-attached lugs.

Part Number
207270



Combination and Open End Wrenches

Speed connector installation and improve performance with wrenches sized exactly per connector application. Each tool is made from high quality tool steel with black oxide finish.

Cable Size	Part number	Description
3/8", 1/2", 7/8"	EZW-7812	Combination wrench for SFX-500, FXL-540, and FXL-780 EZfit connectors
3/8", 1/2", 7/8"	CT-7812	Combination wrench for 1/2 in and 7/8 in Positive Stop™ connectors
7/8"	244459-5	1-1/4 in open end wrench for 7/8 in Positive Stop clamping nut
1-1/4"	1480-AW	45 mm open end wrench for 1-1/4 in EZfit connector clamping nut
1-1/4"	244459-6	1-7/8 in open end wrench for 1-1/4 in Positive Stop connector
1-5/8"	1873-AW	60 mm open end wrench for 1-5/8 in EZfit connector clamping nut
1-5/8"	244459-7	2-1/4 in open end wrench for 1-5/8 in Positive Stop connector



EZW-8412



CT-7812



1873-AW

Cable Installation Accessories

Installation Aids

Single Turn Grounding Kit Prep Tool

Now installers can prepare transmission line cable for grounding kit installation in one simple, precise step—and without using a knife! The Andrew aluminum grounding kit preparation tool takes just seconds to use: simply snap the tool in place around the cable and rotate. In one step the tool removes the exact amount of jacketing necessary to attach the grounding strap. The grounding kit preparation tool is a manually operated cutting device that quickly trims away a section of cable jacket for the purpose of grounding strap installation. The tool is ideal for use on cables mounted close to structures and other cable runs, and will not scrape or damage the cable's outer conductor.

Grounding Kit Prep Tools and Replacement Blades

Cable Type	Tool Number	Replacement Blade	Grounding Kit Type
FSJ4-50B	GKT-F4A	GKT-BKF4	Standard
LDF4-50A	GKT-L4A	GKT-BK512	CSGL and SGL series
	GKT-L4SG	GBK-SG1278*	SG series
7/8" corrugated	GKT-78A	GKT-BK512	CSGL and SGL series
	GKT-78SG	GBK-SG1278*	SG series
1-1/4" corrugated	GKT-114A	GKT-BK67	CSGL and SGL series
	GKT-114SG	GBK-SG114158*	SG series
1-5/8" corrugated	GKT-158A	GKT-BK67	CSGL and SGL series
	GKT-158SG	GBK-SG114158*	SG series

* Replacement blades for the SG series grounding kits may be used to retrofit GKT series tools. For example, blade kit number GBK-SG1278 may be installed to tool number GKT-78A to accommodate SG series grounding kits.

Multi Turn Jacket Stripping Tool

For FXL Series Cables

The multi turn jacket stripping tool removes the bonded jacket in preparation for grounding kit attachment. The tool is constructed of an aluminum body with a heat-treated cutting blade for years of dependable use.

Cable Type	Part Number	Description
SFX-500	SFX-MSS	Multi turn jacket stripping tool for SFX-500
FXL-540	540-MSS	Multi turn jacket stripping tool for FXL-540
FXL-780	780-MSS	Multi turn jacket stripping tool for FXL-780
FXL-1480	1480-MSS	Multi turn jacket stripping tool for FXL-1480
FXL-1873	1873-AMSS	Multi turn jacket stripping tool for FXL-1873



Jacket removal blade kit for SG series grounding kits

HELIAX® Hand Tool Kit

Part Number TB-COMP-KIT

The original collection of specialized hand tools remains available in this classic kit. Best suited for early generation connectors, contents include basic measuring, cutting and flaring tools as listed below.

Manual cable preparation tool for 1/4 inch FSJ1-50A cable
Manual cable preparation tool for 1/2 inch LDF4-50A cable.
Manual cable preparation tool for 7/8 inch corrugated cable.
Combination wrench for 1/2 inch and 7/8 inch PositiveStop connectors
Heavy duty safety knife
Precision wire snips
Plastic tipped hammer
Straight hammer tips, plastic
Tapered hammer tips, plastic
Pin depth gauge—Type N male connector
Pin depth gauge—Type N female connector
Pin depth gauge—7-16 DIN male connectors
Pin depth gauge—7-16 DIN female connectors
Acid brush
Emery cloth
Tapered drift punch
Connector pin straightening tool
Brass soldering pliers
Cut off guide—7/32 inch
Cut off guide—8/32 inch
Cut off guide—9/32 inch
Flare tool—LDF4 cable
Flare tool—LDF5 cable
Flare tool—LDF5 cable



Cable Installation Accessories

Installation Aids

Tool Selection Guide

Select the right tool for each cable size.

Cable Type	Description
------------	-------------

1/4 inch Coaxial Cable Tools

MCPT-1412	Manual cable preparation tool for 1/4 in FSJ1-50A cable
CPT-L1	Automated cable preparation tool for LDF1-50 cable

3/8 inch Coaxial Cable Tools

SFX-EZPT	Automated cable preparation tool for SFX-500 cable
EZW-7812	Combination tool for 3/8 in through 7/8 in EZfit® connectors
TW-SFX-EZFC	Torque wrench for 3/8 in EZfit connectors
MCPT-3812	Manual cable preparation tool for FSJ2-50 cable
SFX-MSS	Jacket stripping tool for SFX-500 cable

1/2 inch Coaxial Cable Tools

540-EZPT	EZfit Automated Cable Preparation Tool for FXL-540 cable
L4-EZPT	EZfit Automated Cable Preparation Tool for LDF4-50A cable
12-HPT	EZfit Manual Cable Preparation Tool for FXL-540 and LDF4-50A cable
EZPT-BKU540	Replacement jacket removal blade kit for 540-EZPT tools
EZPT-BKU12	Replacement jacket removal blade kit for L4-EZPT tools
HPT-BK1278	Replacement blade kit for 1/2 in and 7/8 in HPT tools
L4-SG	Saw guide for LDF4-50A EZfit connectors
EZW-7812	Combination tool for 3/8 in through 7/8 in EZfit connectors
TW-12-EZFC	Torque wrench for 1/2 in EZfit connectors
CPT-F4	Automated cable preparation tool for FSJ4-50B cable
CPT-L4ARC1	Automated cable preparation tool for LDF4-50A cable
MCPT-L4	Manual cable preparation tool for 1/2 in LDF4-50A cable
MCPT-1412	Manual cable preparation tool for 1/2 in FSJ4-50B cable
CT-7812	Combination tool for 1/2 in and 7/8 in Positive Stop™ connectors
241953	Chamfer tool for 1/2 in cable
GKT-L4A	Grounding kit preparation tool for LDF4-50A cable, SGL and CSGL series grounding kits
GKT-BK512	Replacement blade kit for GKT-L4A tool, SGL and CSGL series grounding kits
GKT-L4SG	Grounding kit preparation tool for LDF4-50A cable, SG series grounding kits
GBK-SG1278	Replacement blade kit for GKT-L4A and GKT-L4SG tools, SG series grounding kits
540-MSS	Jacket stripping tool for FXL-540 cable

7/8 inch Coaxial Cable Tools

780-EZPT	EZfit Automated Cable Preparation Tool for FXL-780 cable
A5-EZPT	EZfit Automated Cable Preparation Tool for AVA5-50A cable
78-HPT	EZfit Manual Cable Preparation Tool for FXL-780 and AVA5-50
EZPT-BKU780	Replacement jacket removal blade kit for 780-EZPT tools
EZPT-BKUA5	Replacement jacket removal blade kit for A5-EZPT tools
HPT-BK1278	Replacement blade kit for 1/2 in and 7/8 in HPT tools
A5-SG	Saw guide for AVA5-50A EZfit connectors
EZW-7812	Combination tool for 3/8 in through 7/8 in EZfit connectors
CPT-78U	Automated cable preparation tool for 7/8 in corrugated cable, Positive Stop connectors
MCPT-78	Manual cable preparation tool for 7/8 in corrugated cable, Positive Stop connectors

7/8 inch Coaxial Cable Tools (continued)

CT-7812	Combination tool for 1/2 in and 7/8 in Positive Stop connectors
244459-5	Open end wrench for 7/8 in Positive Stop connector, 1-1/4 in opening
TW-78-EZFC	Torque wrench for 7/8 in EZfit connectors
GKT-78A	Grounding kit preparation tool for 7/8 in corrugated cable, SGL and CSGL series grounding kits
GKT-BK512	Replacement blade kit for GKT-78A tool, SGL and CSGL series grounding kits
GKT-78SG	Grounding kit preparation tool for 7/8 in corrugated cable, SG series grounding kits
GBK-SG1278	Replacement blade kit for GKT-78U and GKT-78SG tools, SG series grounding kits
780-MSS	Jacket stripping tool for FXL-780 cable

1-1/4 inch Coaxial Cable Tools

1480-PT	EZfit Automated Cable Preparation Tool for FXL-1480 cable
A6-EZPT	EZfit Automated Cable Preparation Tool for AVA6-50 cable
EZPT-BKU1480	Replacement jacket removal blade kit for 1480-PT tools
EZPT-BKUA6	Replacement jacket removal blade kit for A6-EZPT tools
A6-SG	Saw guide for AVA6-50 EZfit connectors
1480-AW	Open end wrench for 1480 EZfit connectors, 1-3/4 in opening
TW-114-EZFC	Torque wrench for 1 1/4 in EZfit connectors
CPTL6	Automated cable preparation tool for 1-1/4 in corrugated cable
244459-6	1-7/8 in open end wrench for 1-1/4 in Positive Stop connector
GKT-114A	Grounding kit preparation tool for 1-1/4 in corrugated cable, SGL and CSGL series grounding kits
GKT-BK67	Replacement blade kit for GKT-114A tool, SGL and CSGL series grounding kits
GKT-114SG	Grounding kit preparation tool for 1-1/4 in corrugated cable, SG series grounding kits
GBK-SG114158	Replacement blade kit for GKT-114U and GKT-114SG tools, SG series grounding kits
1480-MSS	Jacket stripping tool for FXL-1480 cable

1-5/8 inch Coaxial Cable Tools

FXL/CR1873-PT	EZfit Automated Cable Preparation Tool for FXL-1873 coaxial cable
A7-EZPT	EZfit Automated Cable Preparation Tool for AVA7-50 coaxial cable
EZPT-BKU1873	Replacement jacket removal blade kit for FXL/CR1873-PT tool
EZPT-BKUA7	Replacement jacket removal blade kit for A7-EZPT tools
A7-SG	Saw guide for AVA7-50 EZfit connectors
1873-AW	Open end wrench for 1873 EZfit connectors, 2-3/8 in opening
TW-158-EZFC	Torque wrench for 1-5/8 in EZfit connectors
CPT-158U	Automated cable preparation tool for 1-5/8 in corrugated cable, Positive Stop connectors
244459-7	Open end wrench for 1-5/8 in Positive Stop connector, 2-1/4 in opening
GKT-158A	Grounding kit preparation tool for 1-5/8 in corrugated cable
GKT-BK67	Replacement blade kit for GKT-158A tool, SGL and CSGL series grounding kits
GKT-158SG	Grounding kit preparation tool for 1-5/8 in corrugated cable, SG series grounding kits
GBK-SG114158	Replacement blade kit for GKT-158U and GKT-158SG tools, SG series grounding kits
1873-AMSS	Jacket stripping tool for FXL-1873 cable

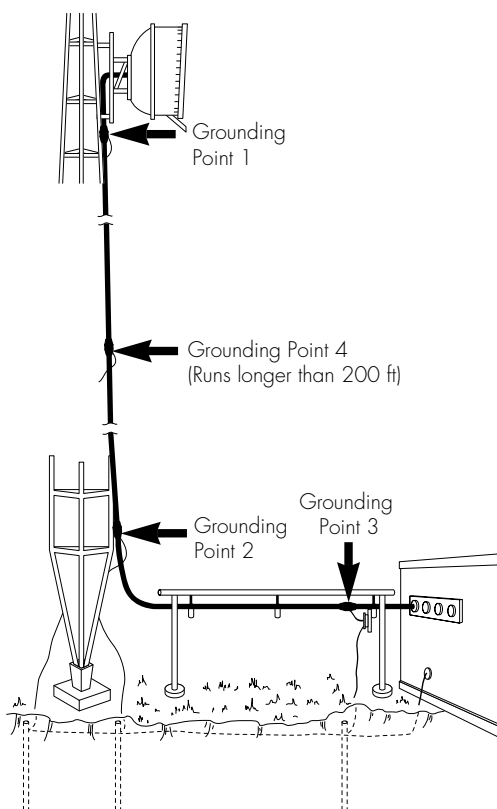




- Grounding Kits
- Grounding Bars
- Surge Arrestors

Transmission Line Grounding

A well designed system uses grounding kits to provide a bond between the cable and the tower/earth ground system. One grounding kit is recommended at tower top, tower bottom, at 200 ft (60 m) intervals (where applicable), and at the entrance to the equipment shelter. Andrew solid copper grounding kits have passed United States Air Force lightning simulation tests and meet MIL-STD-188-124A. The non-braided solid copper construction of all Andrew grounding kits eliminates corrosion caused by moisture retention and "wicking." A heat shrink tube protects the cable terminal connection.



Grounding Kit Selection

Several grounding kit options are available to meet the requirements of any transmission line grounding application.

- Compact SureGround™ grounding kits provide the fastest, easiest installation with the highest degree of lightning protection. Their self-sealing design clips and locks onto the cable in less than a minute.
- SureGround grounding kits, an industry favorite, offer clip on attachment with taped weatherproofing.
- Standard grounding kits provide the best grounding solution for elliptical waveguide. The copper grounding strap is coiled around the cable and weatherproofed with tape.
- Universal grounding kits can be applied to a broad range of coaxial or elliptical transmission lines.



● Compact SureGround™



● SureGround™



● Standard

Heavy Duty Ground Lead

Andrew grounding kits use heavy duty 6 gauge ground leads to maximize performance. The MIL-STD-188-124B compliant copper ground lead reduces dc resistance. The extremely pliable jacket provides protection and makes it easy to maneuver the lead into position for attachment to the down conductor.

- Solid copper construction for high current handling capability, compatibility with copper cable outer conductors
- Meets military standards at commercial prices.
- Provides certainty of continued operation, tested at an independent laboratory

Grounding Kit Selection Guide

	Compact SureGround	SureGround	Standard	Universal
Key Feature	Over-molded weatherproof design for easy, fast installation	Preformed clip-on strap	Wraparound grounding strap	Multiple cable size wraparound grounding strap
Benefits	Uniform installation compact design for bundled installation	Requires no tools for installation	Fits standard coaxial cable and elliptical waveguide	Breakaway design fits multiple sizes of coaxial cable and elliptical waveguide
Installation Time	Less than 1 minute	About 3 minutes	About 6 minutes	About 7 minutes
Construction	Preformed copper grounding strap Over-molded weatherproof boot, locking bail	Pre-tensioned copper grounding clip Standard weatherproofing	Copper grounding strap Standard weatherproofing	Copper grounding strap Standard weatherproofing

Lightning Protection

Grounding Kits

Compact SureGround™ Grounding Kits

Now wireless communications system installers and designers can protect their systems from the effects of lightning easier and at lower cost. The new Compact SureGround grounding kit, available only from Andrew, is a one-piece grounding assembly with the weatherproofing molded right into the grounding strap.

Compact SureGround grounding kit features:

Easy attachment

- Self-locking, self-sealing weatherproof enclosure eliminates loose hardware and taping
- Saves up to an hour of installation time per typical nine run site

Sure protection

- Largest surface contact area in the industry
- Provides surety of protection against even the most severe lightning strikes
- Waterproof to IEC529, IP68

Compact size

- "Clip and lock" installation ideal for tight cable bundles or crowded towers
- Exclusive universal grounding lug can be fitted to a one- or two-hole earthing attachment point.

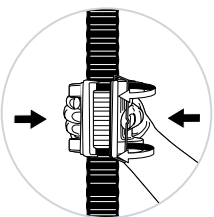
United States Patent: 6,548,762. Other patents pending.

More Information

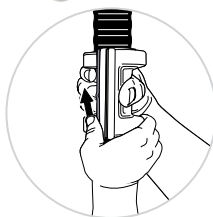
- See Compact SureGround ordering information on page 33
- See the installation video at <http://awapps.commscope.com/video/default.aspx>



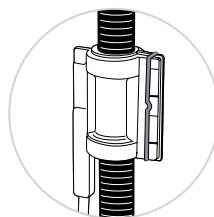
Easy Installation



Position Compact SureGround grounding kit



Clip and lock to seal



Completed

Universal SureGround™ Grounding Kits

Fast Installation, Complete Protection

Protect your equipment from the effects of lightning with SureGround Grounding Kits.

The SureGround clips in place and provides protection against lightning strikes in excess of 100 kA. The grounding kits are constructed with a tin-plated solid copper clip that ensures a low resistance, corrosion resistant connection to copper or aluminum coaxial cable. An insulated six-gauge stranded copper conductor with universal 1–2 hole attachment lug provides connection to the grounding system. Simply clip the SureGround onto your cable for fast, reliable, MIL spec compliant lightning protection.

SureGround Grounding Kits are compatible with smoothwall and corrugated coaxial cables with aluminum or copper outer conductors. Each kit includes a butyl tape weatherproofing system and stainless steel attachment hardware.

- Fits smoothwall and corrugated cable
- Compatible with aluminum and copper outer conductors
- Fast clip-on installation
- MIL-STD-188-124B compliant



TIP!

The Compact SureGround Kit with integrated weatherproofing is the choice for the speediest installation, best fit in tight locations, and long-term protection.

Lightning Protection

Grounding Kits

Standard Grounding Kits

Easy Installation for System Protection

Standard grounding kits are intended for elliptical waveguide installations. One grounding kit is recommended at the tower top, tower bottom, at 200 ft (60 m) intervals, and at the entrance to the equipment shelter. Standard grounding kits (204989 and 241088 series) require few steps to install and include easy-to-follow instructions. Proper tensioning is ensured by an expansion section that provides visual indication that the strap is secured.

Series 204989 and 241088 kits include a solid copper strap riveted to the grounding wire, coiling tool for proper tightening, universal grounding lug, tower attachment hardware, and a two-part tape weatherproofing system. Field-attachable, crimp-on grounding lugs require a crimping tool (not included).



Universal Grounding Kit

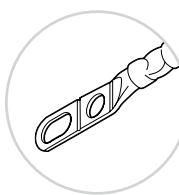
Part Number	Description
UG12158-15B4	1/2 in–1-5/8 in EW180–EW63 60 in field attached lug



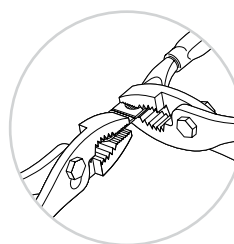
Universal Grounding Lugs

This grounding lug provides you with the option of a one-hole configuration or two-hole configuration. Just break away the bottom portion of the lug and this will give you your one-hole lug. This universal lug will fit common buss bar configurations with two-hole spacings of 0.750, 0.815, or 1.0 in. Designed to crimp on 6 gauge or 16 mm² grounding wire. Included on all grounding kits and available separately.

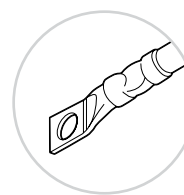
Part Number	Description
245529-10	Universal grounding lug, kit of 10
207136-3	Grounding lug hardware kit



For two bolt grounding



Snap off pre-scored
lug for one hole option



For one bolt grounding

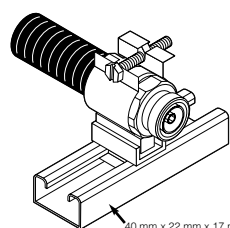
Crimping Tool for SureGround™ and Standard Grounding

The crimping tool is used to attach crimp-on lugs for standard and SureGround series grounding kits. Not required for kits with factory attached lugs.

Part Number	Description
207270	Crimping tool, quantity 1

Connector Grounding Kit for Mounting Rail

Part Number	Description
CGT12	Connector grounding kit fits all F4 and L4 (except OnePiece™) series connectors
CGT58	Connector grounding kit fits all L4.5 and L5 standard connectors
CGT78	Connector grounding kit fits all L5, V5, A5, OnePiece, and Positive Stop™ series connectors
CGT114	Connector grounding kit fits all L6 series connectors
CGT158	Connector grounding kit fits all L7 and V7 series connectors
CGT214	Connector grounding kit fits all L12 series connectors



Lightning Protection

Grounding Kits

Compact SureGround™

Size/Type	Part Number	Description
1/2" LDF4	CSGL4-06B2	Compact SureGround™ Grounding Kit for 1/2 in corrugated coaxial cable, 0.6 m (2 ft) lead, attached lug
7/8"	CSGL5-06B2-T	Compact SureGround™ Grounding Kit for 7/8 in corrugated coaxial cable, 0.6 m (2 ft) lead, attached lug
1-1/4"	CSGL6-06B2	Compact SureGround™ Grounding Kit for 1-1/4 in corrugated coaxial cable, 0.6 m (2 ft) lead, attached lug
1-5/8"	CSGL7-06B2-T	Compact SureGround™ Grounding Kit for 1-5/8 in corrugated coaxial cable, 0.6 m (2 ft) lead, attached lug

SureGround™

Size/Type	Part Number	Description
1/2 "	SG12-06B2A	SureGround Grounding Kit for 1/2 in coaxial cable, 0.6 m (2 ft) lead, attached lug, black
5/8 "	SG58-06B2A	SureGround Grounding Kit for 5/8 in coaxial cable, 0.6 m (2 ft) lead, attached lug, black
7/8 "	SG78-06B2A	SureGround Grounding Kit for 7/8 in coaxial cable, 0.6 m (2 ft) lead, attached lug, black
1-1/4 "	SG114-06B2A	SureGround Grounding Kit for 1-1/4 in coaxial cable, 0.6 m (2 ft) lead, attached lug, black
1-5/8 "	SG158-06B2A	SureGround Grounding Kit for 1-5/8 in coaxial cable, 0.6 m (2 ft) lead, attached lug, black
2-1/4 "	SG214-06B2A	SureGround Grounding Kit for 2-1/4 in coaxial cable, 0.6 m (2 ft) lead, attached lug, black

Standard Grounding Kit

Size/Type	Part Number	Description
1/4" and 3/8", EW240, EW380	223158-2	Standard Grounding Kit for 1/4 in and 3/8 in corrugated coaxial cable and elliptical waveguide 240 and 380, 0.6 m (2 ft) lead, attached lug
EW180, EW220	241088-1	Standard Grounding Kit for 1/2 in corrugated coaxial cable and elliptical waveguide 180 and 220, 0.6 m (2 ft) lead, attached lug
EW85, EW90, EW127A, EW132	241088-2	Standard Grounding Kit for 5/8 in and 7/8 in corrugated coaxial cable and elliptical waveguide 85, 90, 127A, and 132, 0.6 m (2 ft) lead, attached lug
EW64, EW77	241088-3	Standard Grounding Kit for 1-1/4 in corrugated coaxial cable and elliptical waveguide 64 and 77, 0.6 m (2 ft) lead, attached lug
EW52, EW63	241088-4	Standard Grounding Kit for 1-5/8 in corrugated coaxial cable and elliptical waveguide 52 and 63, 0.6 m (2 ft) lead, attached lug
EW43	204989-10	Standard Grounding Kit for elliptical waveguide 43, 0.6 m (2 ft) lead, attached lug
3", EW28, EW37	241088-5	Standard Grounding Kit for 2-1/4 in and 3 in corrugated coaxial cable and elliptical waveguide 28 and 37, 0.6 m (2 ft) lead, attached lug

Universal Grounding Kit

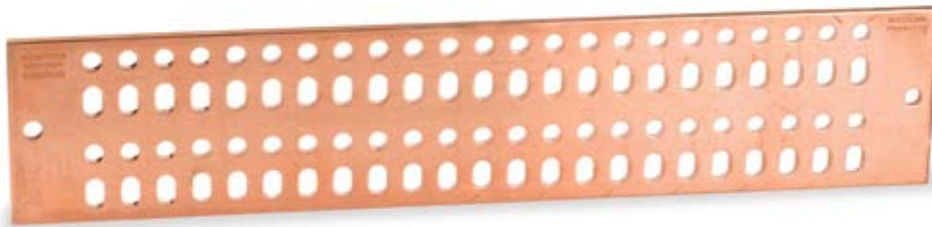
Size/Type	Part Number	Description
1/4"—5/8" coaxial cable and elliptical waveguide	GK-SUNV	Universal Grounding Kit for 1/4 in through 5/8 in corrugated coaxial cable

Universal Connector Grounding Kit

Size/Type	Part Number	Description
1/2"—1-5/8"	244495	Universal connector grounding kit

Universal Grounding Buss Bars

Andrew offers a complete range of grounding buss bar sizes and hole pattern configurations to accommodate just about any application. Each grounding bar is made from 1/4 inch solid copper bar stock and is available with optional tin plating. New theft deterrent features include stamped identification (see photo), versions made from 1/4 inch galvanized steel and optional theft proof hardware. Kits come complete with insulators, galvanized steel brackets, adapters, and hardware for mounting to a wall or tower.



UGBKIT-0420



TRH-38 Tamper
Resistant Hardware



UGBKIT-0420-T



GGBKIT-0420

Lightning Protection

Grounding Bars

2" Buss Bar Kits

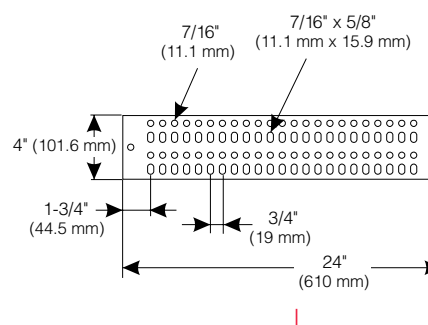
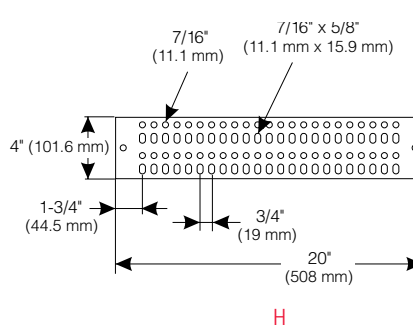
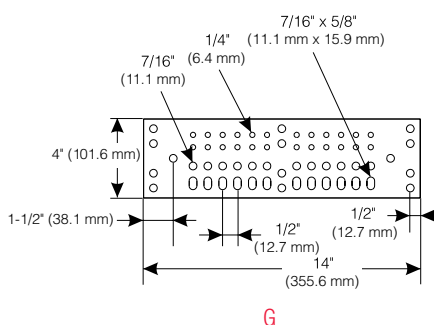
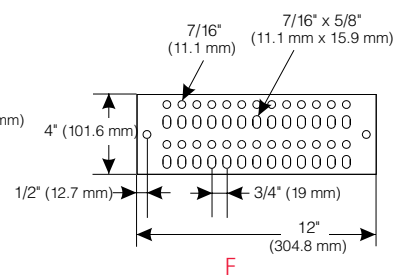
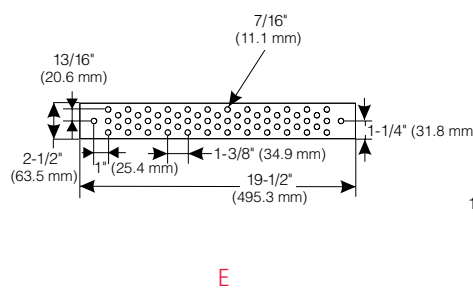
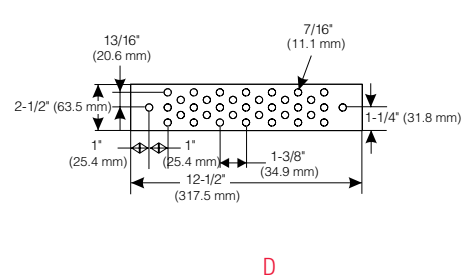
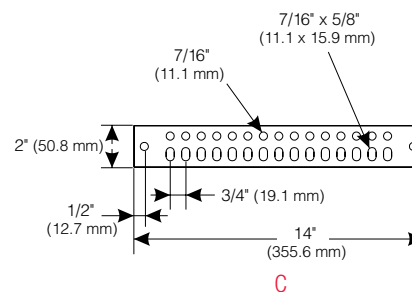
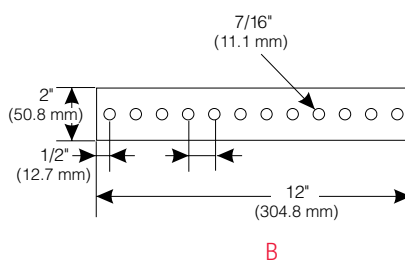
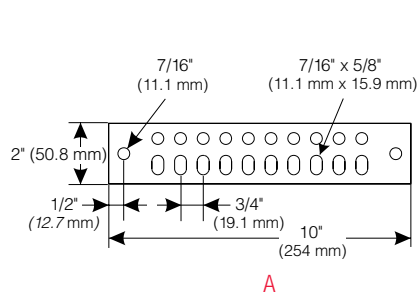
Part Number	Construction	Dimensions (inches)	Drawing
UGBKIT-0210	Solid copper	1/4 x 2 x 10	A
UGBKIT-0210-T	Tinned copper	1/4 x 2 x 10	A
UGBKIT-0212	Solid copper	1/4 x 2 x 12	B
UGBKIT-0212-T	Tinned copper	1/4 x 2 x 12	B
UGBKIT-0214	Solid copper	1/4 x 2 x 14	C
UGBKIT-0214-T	Tinned copper	1/4 x 2 x 14	C

2-1/2" Buss Bar Kits

Part Number	Construction	Dimensions (inches)	Drawing
UGBKIT-2	Solid copper	1/4 x 2-1/2 x 12-1/2	D
UGBKIT-2T	Tinned copper	1/4 x 2-1/2 x 12-1/2	D
UGBKIT	Solid copper	1/4 x 2-1/2 x 19-1/2	E
UGBKIT-T	Tinned copper	1/4 x 2-1/2 x 19-1/2	E

4" Buss Bar Kits

Part Number	Construction	Dimensions (inches)	Drawing
UGBKIT-0412	Solid copper	1/4 x 4 x 12	F
UGBKIT-0412-T	Tinned copper	1/4 x 4 x 12	F
GGBKIT-0412	Galvanized steel	1/4 x 4 x 12	F
UGBKIT-0414	Solid copper	1/4 x 4 x 14	G
UGBKIT-0414-T	Tinned copper	1/4 x 4 x 14	G
UGBKIT-0420	Solid copper	1/4 x 4 x 20	H
UGBKIT-0420-T	Tinned copper	1/4 x 4 x 20	H
GGBKIT-0420	Galvanized steel	1/4 x 4 x 20	H
UGBKIT-0424	Solid copper	1/4 x 4 x 24	I
UGBKIT-0424-T	Tinned copper	1/4 x 4 x 24	I
GGBKIT-0424	Galvanized steel	1/4 x 4 x 24	I



Grounding Bars

Universal Arrestor Ground Bar Assembly

This pre-punched solid copper ground bar assembly simplifies mounting and grounding of surge arrestors inside the building. Instead of relying on individual wires or field-fabricated trapeze setups, the Andrew universal arrestor ground bar assembly provides a uniform mounting and grounding point for surge arrestors and grounding leads. The 1/8 inch assembly uses three horizontal members that can be oriented flat or upright and adjusted vertically as needed to accommodate various surge arrestor types. Also included is a mounting kit that includes ceiling brackets, insulators, threaded rod, and hardware.

- Compatible with standard entry port sizes
- Height-adjustable bars
- Solid copper construction
- Accepts bulkhead or bolt grounded surge arrestors
- Accommodates one- and two-hole grounding lugs
- Eliminates need for internal buss bar

Part Number	Description
UGBA-DIN-36	Three 6-position ground bars punched for oversized 7-16 DIN mount arrestors (APTL and APT series) or bolt-grounded arrestors
UGBA-36	Three 6-position ground bars punched for most 7-16 DIN, Type N or bolt-grounded arrestors (Andrew APG and APM series arrestors)
UGBA-DIN-34	Three 4-position ground bars punched for oversized 7-16 DIN mount arrestors (APTL and APT series) or bolt-grounded arrestors
UGBA-34	Three 4-position ground bars punched for most 7-16 DIN, Type N, or bolt-grounded arrestors (Andrew APG and APM series arrestors)



Lightning Protection

Surge Arrestors

Arrestor Plus® Lightning Surge Arrestors

Add the final measure of protection to your equipment from lightning current traveling down the transmission line with Arrestor Plus surge arrestors. All designs are completely weatherproof and feature low return, insertion loss, and low intermodulation. Our wide range of surge arrestor types and configurations support most applications.



T-Series
Dual Band



dc Pass
Dual Band



Replaceable
Gas Tube



Integrated



Bias Tee



dc Block

T-Series Surge Arrestors

Arrestor Plus® T-series surge arrestors give engineers more flexibility when configuring lightning protection systems. This slim profile arrestor fits easily inside equipment enclosures, is bi-directional, and offers true multistrike protection. The arrestor plus bulkhead mount T-series features universal Type N and 7-16 DIN interfaces. The dc passing version allows current to travel to the top of the tower.



Replaceable Gas Tube Surge Arrestors

Offering broadband performance from 0–2200 MHz and excellent electrical characteristics, Arrestor Plus replaceable gas tube surge arrestors are easy to install, are bidirectional, and feature dc pass capability through the center conductor to the active tower top electronics. The unit's removable cap makes periodic maintenance fast and easy.

45–2200 MHz, 90 V

APG-BDFDF-090
APG-BDFDM-090
APG-BNFNF-090
APG-BNFNM-090

45–2200 MHz, 350 V

APG-BDFDF-350
APG-BDFDM-350
APG-BNFNF-350
APG-BNFNM-350



824–960 MHz and 1710–2170 MHz

APT-DFDF-DB
APT-DFDM-DB
APT-BDFDF-DB
APC-BDFDM-DB
APT-BDFDM-DB
APT-NFNF-DB
APT-NFNM-DB
APT-BNFNF-DB
APT-BNFNM-DB

824–960 MHz and 1710–2170 MHz dc Passing

APTDC-BDFDF-DB
APTDC-BDFDM-DB
APTDC-BNFNM-DB

380–520 MHz

APC-BDFDM-450A

675–825 MHz

APC-BDFDM-700A

2000–2800 MHz

APB-BNFNF-2400
APB-BNFNM-2400

Lightning Protection

Surge Arrestors

Integrated Surge Arrestor/Connector

The Arrestor Plus® integrated, T-series lightning surge arrestor is a one-piece surge arrestor/HELIAX® connector. It uniquely combines the reliability of quarterwave shorting stub technology with the proven performance of HELIAX connectors to deliver premium lightning protection in a single component.

824–960 MHz and 1710–2170 MHz

APTA5DC-BDF-DB
APTA7DC-BDF-DB



Bias Tee

Andrew bias tees are designed to protect equipment from damaging transients induced by lightning strikes. This product allows the injection of dc current to the center conductor of the feeder line, allowing current to travel to the top of the tower. Bias tees are unidirectional devices. Ports are clearly marked to show mounting direction with either "Antenna" or "Radio".

824–960 MHz and 1710–2170 MHz

ABT-DFDM-ADBH
ABT-DFDM-DB
ABT-DMDF-ADBH
ABT-DMDF-DB
ABT-NFNM-DB
ABT-NMNF-DB
ABT-DFDM-ADBA
ABT-DMDF-ADBA

Photo Reference

A
B
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A
A

AISG Compliant
AISG Compliant



A. Bias Tee
Standard Body
SMA Port



B. Bias Tee
Compact Cylindrical Body
SMA Port

dc Block

The dc block is designed to block dc signals from passing through the center conductor of a coaxial transmission line. The dc block is a bidirectional RF device. Either RF port may be connected to the equipment side or the antenna side of the transmission line interface to provide equivalent protection.

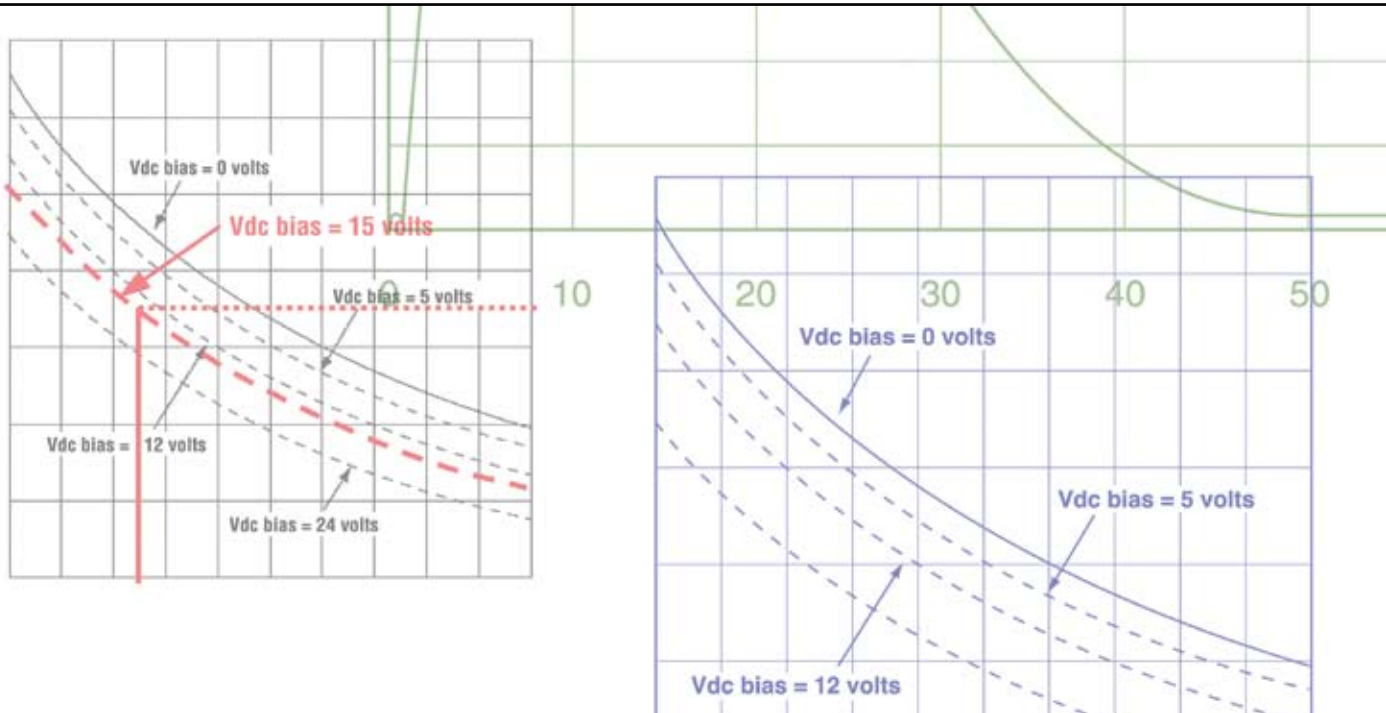
824–960 MHz and 1710–2170 MHz

ADCB-DFDM-DB



Surge Arrestor Accessories

Part Number	Description
GASTUBE-090	90 volt gas tube replacement, kit of 10
GASTUBE-350	350 volt gas tube replacement, kit of 10
243951	90 degree mounting/grounding bracket, Type N
243950	90 degree mounting/grounding bracket, 7–16 DIN
244847	Integrated surge arrestor/connector 90 degree mounting/grounding bracket, 7–16 DIN
DF-CAPKIT	Plated port sealing cap, 7–16 DIN (Fits onto DIN female connector), IP 66 and 68
DM-CAPKIT	Plated port sealing cap, 7–16 DIN (Fits onto 7–16 DIN male connector), IP 66 and 68.



Quarterwave Stub Surge Arrestors

Quarterwave Stub Surge Arrestors—Considerations and Selection

Quarterwave Stub (QWS) Surge Arrestor Technology

An understanding of the key concepts of quarterwave stub technology and its relationship to lightning transients can be of great benefit to transmission line system designers and operators. With this understanding, system designers and operators can more fully utilize lightning protection systems that use QWS technology as well as understand the critical role multistrike ability plays in lightning protection systems.

Arrestor Plus® T-series surge arrestors from Andrew Corporation employ QWS technology, a unique design that allows microwave signals to pass unattenuated while shunting the lower frequencies associated with lightning-induced transients to ground. This proven QWS technology is utilized in APT Arrestor Plus® Surge Arrestors.

To understand QWS technology, one needs to understand lightning. The lightning transient is characterized by a current waveform with an 8-microsecond rise time (time to reach 90% of the peak value) and a 20-microsecond decay time (time to decay to 50% of the peak value). Peak currents can reach excessive values, but 50% of all strikes will reach values of only 18 kA. It is important to remember that this is only a laboratory characterization of the lightning transient, but it facilitates standardized testing techniques for the industry. Figure 1 depicts an actual laboratory-generated 8/20 μ sec waveform that was used to evaluate Andrew surge arrestors. For more detailed information regarding laboratory generated surge waveforms, see IEC 60-2, ANSI-IEEE Std 4-1978, and ANSI C62.1-1984.

Laboratory generated 8 x 20 μ sec lightning surge current waveform.
Peak current: 21 kiloamperes

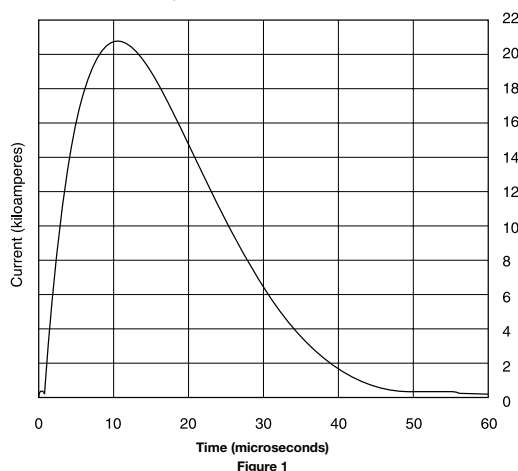


Figure 1

The substantial energy associated with lightning transients has frequency components near dc with components of decreasing value of energy extending through 160 kHz.

The effectiveness of surge arrestors is characterized by the throughput energy and the ability to withstand multiple surges. These characteristics are readily measurable in a laboratory equipped with the appropriate test equipment. Throughput energy is a measure of the amount of energy passed through the output of the device when the input of the device is subjected to a lightning transient waveform. The throughput energy can be calculated from the residual voltage waveform using the relationship:

$$\text{Throughput Energy (joules)} = \int_0^{\infty} \frac{V_{\text{RESIDUAL}}^2(t) dt}{R_{\text{LOAD}}}$$

Figure 2 shows the residual output voltage present when an APT Series Surge Arrestor was subjected to an actual 8/20 μ sec waveform with a peak current of 20 kA. In this case, the residual voltage was recorded across a 50 ohm load. The resulting throughput energy was 72 microjoules. The objective of the surge arrestor is to minimize the throughput energy to a manageable level. Most microwave transmitters and receivers used in today's wireless systems are capable of withstanding throughput energy levels of 10 millijoules or less.

Residual output voltage of an APT quarterwave stub surge arrestor when subjected to an 8 x 20 μ sec current surge with peak current of 20,000 amperes.

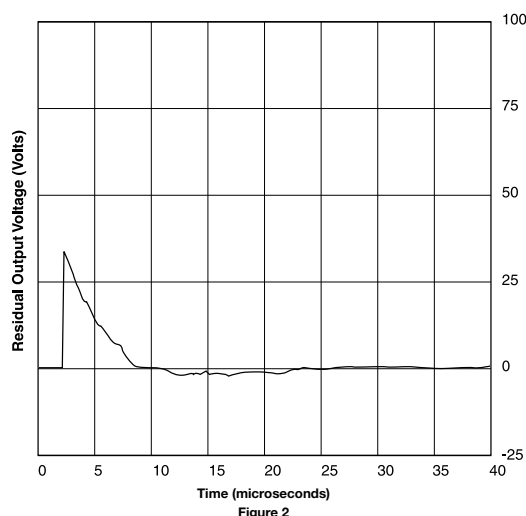


Figure 2

The ability to withstand multiple strikes is also an important measure of surge arrestor merit. Multistrike ability is measured by subjecting the QWS surge arrestors to repeated surges and observing if the arrestors continue to properly function or show

Appendix 1

Quarterwave Stub Surge Arrestors

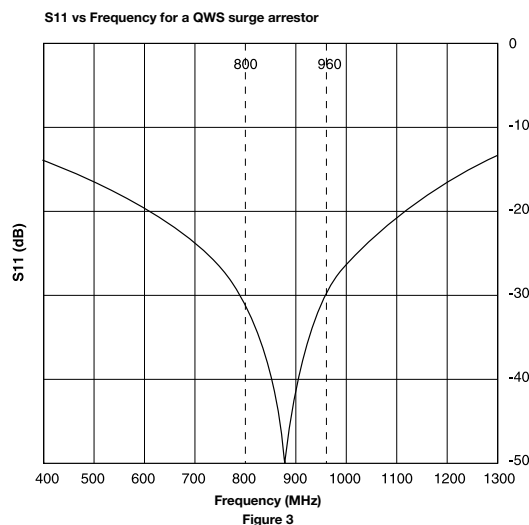
signs of degradation. No evidence of failure or degradation was observed after subjecting the Andrew Arrestor Plus® surge arrestors to over 100 strikes at 50 kA peak current using an 8/20 μ sec waveform. This level of reliability is essential in protecting today's telecommunications systems from the potential of damaging lightning transients.

Arrestor Plus QWS surge arrestors are carefully designed and tested to provide a low impedance path to ground for any lightning induced transient energy present on the center conductor of the transmission line. These surge arrestors are designed to withstand multiple strikes of the most severe surges. The unique attributes of QWS surge arrestors are made possible by careful design and selection of the geometry and cross-sectional area of the conductors that make up the shorting stub. QWS designs result in extremely low throughput energy devices with true multistrike ability.

When selecting a surge arrestor, the RF performance must be considered. Characteristics that describe RF performance are operating bandwidth, VSWR (return loss), insertion loss, maximum average power, and passive intermodulation distortion.

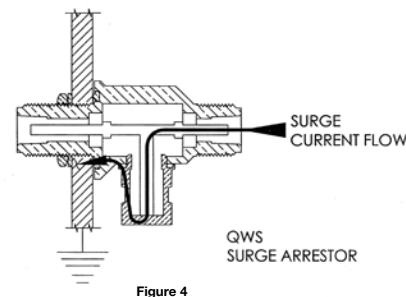
The operating bandwidth of quarterwave shorted stubs is limited, but Andrew Arrestor Plus QWS surge arrestors are designed to accommodate the operating bandwidth requirements of today's wireless telecommunications systems. Quarterwave shorted stubs can be designed to accommodate up to 20% bandwidth. The bandwidth characteristics of the surge arrestors is similar to that of a bandpass filter: RF signals at the center of the band pass unattenuated, while out-of-band signals (such as lightning transients) are diverted harmlessly to ground.

Figure 3 shows the measured wideband S11 (return loss) of a QWS surge arrestor. Note that in the band of interest, the S11 levels are typically -30 dB.



It is key to note that dc signals cannot be passed through the device. When dc passing is required, as is often the case for tower top active electronics, then it is strongly recommended to use Andrew APG gas tube series surge arrestors. For more information on APG gas tube series arrestors, see Appendix 2.

The lowest center frequency of operation is limited to approximately 400 MHz, while the highest center frequency is limited by the cutoff frequency of the coaxial cable being used. Figure 4 shows a cross-sectional view of a QWS surge arrestor. The lower operating frequency is limited due to the physical size of the shorting stub. When the shorting stub reaches too long of a physical length, the stub appears as an inductive load, resulting in excessive residual voltages. Quarterwave shorted stubs can be designed to accommodate systems operating as high as 12 GHz.

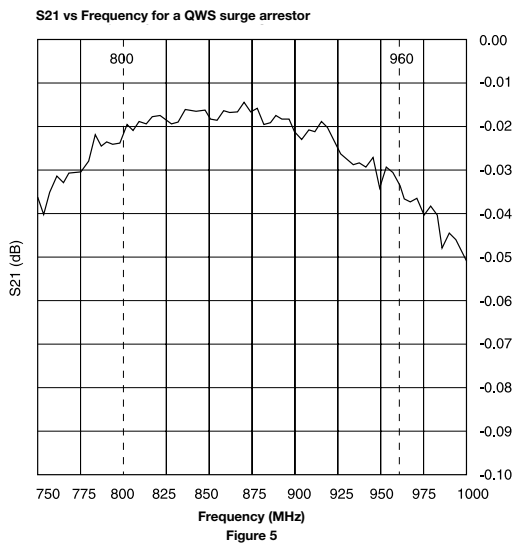


In the operating bandwidth of the Arrestor Plus® QWS surge arrestors, the RF performance characteristics are optimal. At the operating frequencies of the Arrestor Plus, the insertion loss is less than 0.1 dB, no more than adding a connector to the transmission line path. Figure 5 shows the measured S21 (insertion loss) performance of an APM type QWS surge arrestor. Note that in the band of interest, the S21 levels are better than -0.05 dB.

The maximum average operating power of the Arrestor Plus QWS surge arrestor is limited by the connector interface. The suggested maximum average operating power for Type N connectors is 600 watts at 900 MHz. The suggested maximum average operating power for 7-16 DIN connectors is 3000 watts at 900 MHz. Exceeding these values can result in excessive temperature rise and permanent damage to the device.

Intermodulation distortion (IMD) is a major concern in today's PCS, cellular, ESMR, and other wireless systems. IMD is caused by nonlinear effects within a device. For connectors, these nonlinear effects can be caused by poor contact between internal surfaces, plating with ferrous materials, such as nickel, or by oxide build up between contact surfaces.

Quarterwave Stub Surge Arrestors



Arrestor Plus® surge arrestors are designed with high pressure contacts, premium platings, and are compensated to offer the best possible IMD performance.

The functionality of Arrestor Plus QWS surge arrestors can be readily evaluated by using ordinary RF field test equipment. If there is no degradation of the VSWR or insertion loss of the arrester, then the surge arrester is reassuringly functioning as a transient lightning protection device. VSWR and insertion loss measurements can be made by using vector or scalar network analyzers as well as a variety of other readily available field test equipment. No other maintenance is required. As obvious as it may seem, surge arrestors should never be installed or tested when a storm is occurring or approaching.

System requirements often dictate outdoor installation of surge arrestors. Arrestor Plus surge arrestors are ideal for these applications and designed to withstand the harshest environments and are extensively tested to meet industry standard specifications for waterproofing, vibration, thermal cycling, mechanical shock, salt spray, fungus, and moisture resistance.

QWS surge arrestors are excellent choices for wireless base station applications where superior RF performance is required to ensure call quality and when protection against multiple lightning strikes is of primary importance.

Appendix 2

Gas Tube Surge Arrestors

Gas Tube Surge Arrestors—Considerations and Selection

Gas Tube Surge Arrestor Technology

To simplify selecting the appropriate gas tube surge arrestor for your system plots, maximum average power vs. VSWR have been compiled. Figures 1 and 2 show plots of maximum average power vs. VSWR for 90 and 350 volt gas tubes. Each graph shows different values of commonly used dc bias voltages. These graphs were established from extensive laboratory testing and include the appropriate safety factors to ensure proper gas tube selection. Using these graphs for selecting a gas tube will optimize the level of protection required for your system.

Gas tube elements are offered in various spark-over voltages. Andrew Corporation simplifies the selection process by limiting the choice to two options, 90 volt for GPS applications and 350 volt for many other wireless applications requiring a dc bias. Plots of maximum average power vs. VSWR have been compiled for the 90 and 350 volt gas tubes from extensive laboratory testing and have built-in safety factors to ensure proper selection. See figures 3 and 4. Each graph shows several different values of commonly used dc bias voltages. Using these graphs for selecting a gas tube will optimize the level of protection required for your system.

When working in today's environment of diplexed signals, overlaid networks, tower mounted amplifiers, and multiple carriers, it is necessary to verify that a system's maximum average power does not exceed that rating for the gas tube. The following example illustrates the process of using the voltage derating curves that follow.

Using the Maximum Average Power Derating Curves GSM Radio Operating Conditions:

1. Number of carriers = 2
2. Power of each carrier (dBm) = +42 dBm carriers at the output of a hybrid combiner (+45 dBm at combiner input)
3. VSWR = 1.25:1
4. dc Bias = 15 V
5. Nominal Impedance = 50 Ω

1. Calculate the peak instantaneous voltage of a single +42 dBm carrier for a 50 ohm based system

$$\text{Average Power per Carrier (watts)} = \frac{10 \text{ (average power per carrier in dBm/10)}}{1000}$$

$$V_{\text{rms per carrier (volts)}} = \sqrt{\text{average power per carrier (watts)} \cdot \text{Impedance (ohms)}}$$

$$V_{\text{rms per carrier (volts)}} = 28.284$$

$$V_{\text{peak per carrier (volts)}} = \sqrt{2} \cdot V_{\text{rms per carrier (volts)}}$$

$$V_{\text{peak per carrier (volts)}} = 40$$

Therefore, the peak instantaneous voltage of a single +42 dBm carrier is 40 volts.

2. Calculate the peak instantaneous voltage of a two, +42 dBm carrier, 50 ohm based system

$$\text{Peak instantaneous voltage (volts)} = V_{\text{peak per carrier (volts)}} \cdot \text{number of carriers (N)}$$

$$\text{Peak instantaneous voltage (volts)} = 80$$

Therefore, the peak instantaneous voltage of a two +42 dBm carriers is 80 volts.

3. Calculate the peak instantaneous power of two, +42 dBm carrier, 50 ohm based system

$$\text{Peak instantaneous power (watts)} = \frac{(\text{Peak instantaneous voltage (volts)})^2}{\text{Impedance (ohms)}}$$

$$\text{Peak instantaneous power (watts)} = 128$$

$$\text{Peak instantaneous power (dBm)} = 10 \cdot \log \left(\frac{\text{Peak instantaneous power (watts)}}{0.001} \right)$$

$$\text{Peak instantaneous power (dBm)} = 51.072$$

Therefore, the peak instantaneous voltage of two, +42 dBm carriers is 128 watts (+51 dBm).

4. The gas tube selection curves are specified as Maximum Average Power vs. VSWR. Therefore, it is required to calculate an estimate of the average (RMS) power from the peak instantaneous power. A reasonable calculation of this estimate is shown below:

$$\text{Peak instantaneous voltage (volts)} = 80$$

$$\text{RMS equivalent (volts)} = \frac{\text{Peak instantaneous voltage (volts)}}{\sqrt{2}}$$

$$\text{RMS equivalent (volts)} = 56.569$$

$$\text{RMS equal power (watts)} = \frac{(\text{RMS equivalent (volts)})^2}{\text{Impedance (ohms)}}$$

$$\text{RMS equal power (watts)} = 64$$

Therefore, to utilize the gas tube selection curves, an approximate value of 64 watts average power would provide a reasonable estimate.

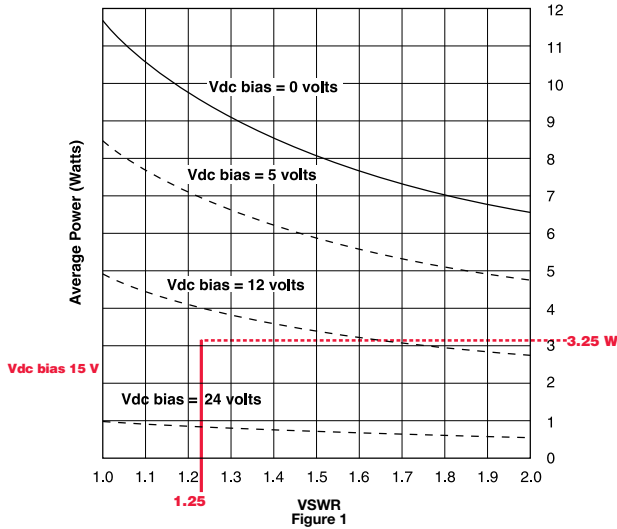
Note that for this calculation, the dc bias voltage was not specified and the VSWR was not specified. The gas tube selection curves provide a derating for both the VSWR and dc bias voltage.

5. Apply calculated information to the derating curves.

Appendix 2

Gas Tube Surge Arrestors

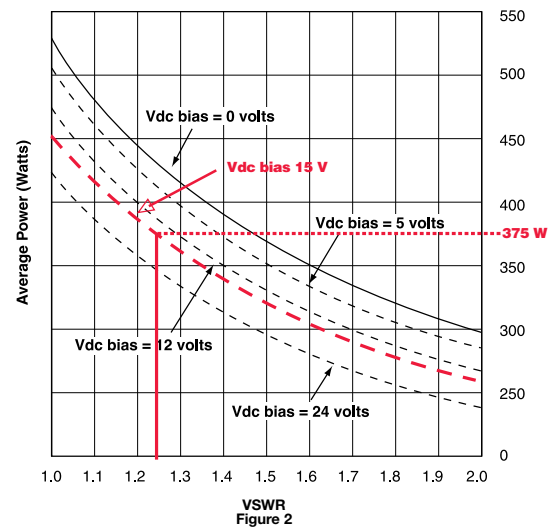
Derating of maximum average power due to VSWR and applied dc bias for APG Arrestor Plus® surge arrestors with 90 volt gas tubes



Steps

1. Apply system parameters to 90 V curves.
2. Estimate 15 V dc bias line
3. Find average power level at intersection with 1.25 VSWR
4. Average power = 3.25 W
5. 3.25 W is much less than 64 W therefore 90 V gas tube is not chosen for this application.
6. Move on to 350 V curve.

Derating of maximum average power due to VSWR and applied dc bias for APG Arrestor Plus® surge arrestors with 90 volt gas tubes



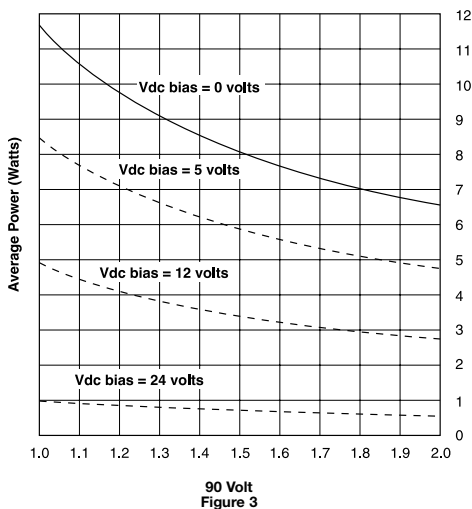
Steps

1. Locate maximum average power for system with VSWR = 1.25 and Vdc = 15 V as before.
2. Maximum average power (est.) = 375 W (+55.74 dBm)
3. Estimated average power (from calculation) = 64 W (+48.06 dBm)
4. Resulting safety margin is 7.68 dB.
5. 350 V gas tube is chosen due to acceptable safety margin.

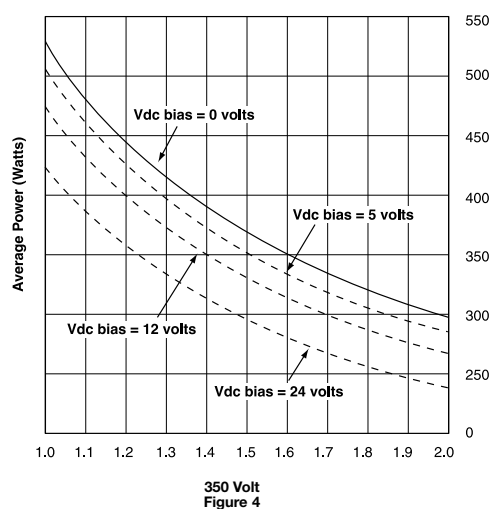
The APTDC line of dc passing surge arrestors should be used for those cases where the intersection of VSWR and Maximum Average Power lie above the 0 volt dc offset curve.

Gas Tube Derating Curves

Derating of maximum average power due to VSWR and applied dc bias for APG Arrestor Plus® surge arrestors with 90 volt gas tubes



Derating of maximum average power due to VSWR and applied dc bias for APG Arrestor Plus® surge arrestors with 350 volt gas tubes



Appendix 2

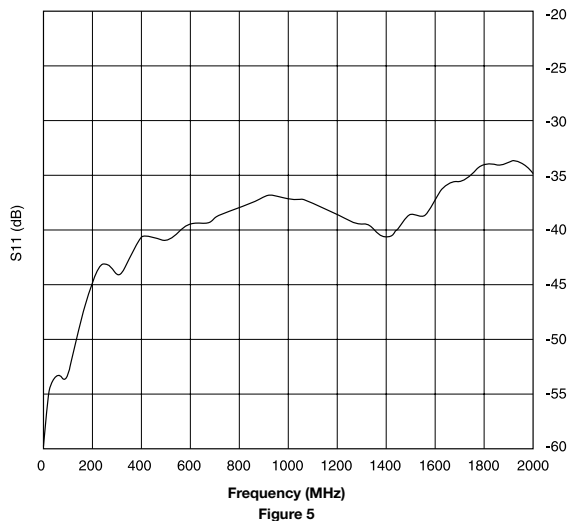
Gas Tube Surge Arrestors

Andrew Arrestor Plus® gas tube surge arrestors allow field replacement of gas tube elements. Gas tubes can be replaced by simply removing the nut and replacing the element. A gas tube element may not always show outward signs of failure or degradation, therefore, routine maintenance and inspection is suggested. If the number of storms in an area is high, gas tube elements should be replaced more frequently. Gas tube degradation is dependent on the number as well as the intensity of the lightning strikes. As obvious as it may seem, gas tube elements should never be replaced when a storm is occurring or approaching.

When selecting a surge arrestor, the RF performance must be considered. Characteristics that describe RF performance are operating bandwidth, VSWR (return loss), insertion loss, and maximum average power.

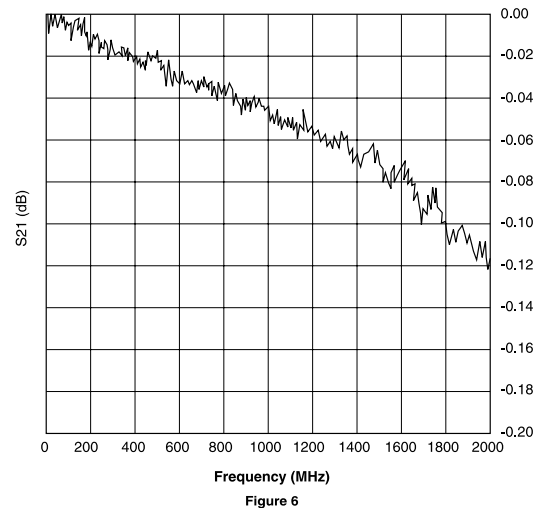
Arrestor Plus gas tube arrestors offer the widest bandwidth available of any gas tube surge arrestors on the market. Unlike quarterwave stub arrestors, Andrew APG gas tube arrestors can be used for applications under 400 MHz. A single unit can be used for broadband applications over the full frequency range of 0–2000 MHz. Figure 5 shows the measured wideband S11 return loss plot of a gas tube surge arrestor. Note that in the commonly used 800–960 MHz and 1700–2000 MHz bands, the S11 levels are typically better than -30 dB.

S11 vs Frequency for an APG gas tube surge arrestor



Over the operating frequencies of the Arrestor Plus surge arrestor, the insertion loss is less than 0.1 dB, no more than adding a connector to the transmission line path. Figure 6 shows the measured S21 (insertion loss) performance for a typical APG family arrestor. Note that in the commonly used 800–960 MHz and 1700–2000 MHz bands, the S21 levels are typically -0.05 dB and -0.12 dB, respectively.

S21 vs Frequency for an APG gas tube surge arrestor



Unlike QWS arrestors, a gas tube arrestor can pass dc current along the center conductor, as is often required for today's wireless communication systems incorporating tower top active electronics.

VSWR and insertion loss measurement of APG gas tube surge arrestors can be made by using vector or scalar network analyzers as well as a variety of other readily available types of field test equipment. The arrestors are dc passing broadband devices and can therefore be used with time domain reflect meters or fault location equipment.

System requirements often dictate that surge arrestors will be installed outdoors. The Arrestor Plus APG series surge arrestors from Andrew are ideal for these applications and are designed to withstand the harshest environment. They are extensively tested to meet industry standard specifications for waterproofing, vibration, thermal cycling, mechanical shock, salt spray, fungus, and moisture resistance.

Andrew Arrestor Plus gas tube surge arrestors are an excellent choice for broadband frequency applications or when a dc bias is required for providing power to tower top devices. Please visit our website at www.andrew.com for more information.

dc Passing T-Series Surge Arrestors

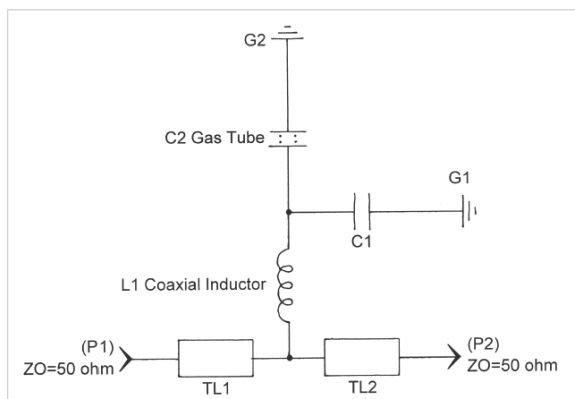
dc Passing T-Series Surge Arrestors

Andrew Arrestor Plus® dc passing surge arrestors (US patent pending) are true broadband RF devices that are capable of allowing a dc bias to pass along the center while shorting the lower frequencies associated with lightning induced transients to the outer conductor and to earth ground. By removing the gas tube from the RF path, they allow dc voltage to pass and greatly enhance power handling capability.

Arrestor Plus® dc passing wideband surge arrestors are the same general shape and size as a typical quarterwave surge arrestors. The arrestor is comprised of two coaxial connector interfaces joined by a center conductor passing through a coaxial arrestor body. A shorting stub connects to the center conductor on an axis perpendicular to the center conductor through a port in the arrestor body. A gas discharge tube sits directly on top of the RF shorting stub, under constant pressure applied by the gas tube spring clip. The shorting stub, RF shorting stub, gas tube, and gas tube spring clip are sealed inside of the shorting stub sleeve and arrestor body by compressing an o-ring between the screw-in gas cap and the shorting stub sleeve.

The function of the various elements in the dc passing T-series surge arrestor described above are best understood if modeled as a simple electronic circuit as shown in figure 1, below.

Figure 1
Electronic circuit diagram of
dc-passing wideband surge arrestor



The two coaxial connector interfaces, ports P1 and P2, provide coupling to coaxial cables that run between the output of the radio equipment and the surge arrestor and the surge arrestor and the antenna. This cable is indicated as having a nominal impedance (Z_0) of 50 Ω . The center conductor sections that are between the coaxial connector interfaces and the shorting stub are modeled as transmission lines TL1 and TL2. The shorting stub is modeled as an inductor (L1) that connects to the center conductor between TL1 and TL2. The outer surface of the RF shorting stub is coated with a dielectric material to create a series capacitance (C1) between the end of the helical shorting stub and the shorting stub sleeve, which is a ground (G1). A gas discharge tube with capacitance (C2) sits in parallel with capacitor C1 and ground (G2). The inductance, L1, of the helical shorting stub and the effective capacitance of parallel capacitors C1 and C2 tune the surge arrestor giving it a broadband frequency response.

Under normal operating conditions, the RF signal will pass straight from P1 to P2 since the inductor, L1, appears as an open circuit. When a dc bias voltage is applied at either P1 or P2, it will also pass straight through the device. The dc bias voltage is prevented from shorting to either earth grounds, G1 or G2, by capacitors, C1 and C2, because these capacitors appear as open circuits to low current dc bias voltages typically applied to power tower mounted amplifiers or active antennas. The gas in the gas discharge tube will ionize under lightning strikes or other high voltage conditions allowing the transient to go from the center conductor to the outer conductor or ground (G2). For purposes of effective grounding, the surge arrestor can either be mounted to ground through a bulkhead interface or by mounting the surge arrestor to a copper grounding buss bar via threaded mounting hardware that is provided with the surge arrestor or ordered separately.

Appendix 4

Lightning Strike Probability

Lightning Strikes—Statistics and Definitions

Statistics on the probability of a lightning strike to towers of various heights in various locations on Earth

Location	Isokeraunic Level	Latitude	Flash Density	Ground Flash Density	Strikes per Year: 50-foot tower	100-foot tower	200-foot tower
Chicago, IL	41	42	33.60	9.95	0.041	0.153	0.591
Arlington, TX	48	33	46.10	9.85	0.040	0.151	0.585
Atlanta, GA	50	34	50.00	11.30	0.046	0.173	0.671
Tampa, FL	100	28	200.00	35.00	0.143	0.537	2.081
York, UK	9	53	1.62	0.67	0.003	0.010	0.039
Taiwan	20	23	8.00	1.27	0.005	0.019	0.075
Hong Kong	30	23	18.00	2.85	0.012	0.043	0.170
Singapore	140	2	392.00	39.30	0.160	0.604	2.340
Rio de Janeiro	60	23	72.00	11.40	0.046	0.175	0.679

Definitions and Comments

Isokeraunic Level: The isokeraunic level is a measure of the number of thunderstorm days per year. A thunderstorm day is defined as a day on which thunder is heard. For example, the city of Chicago averages 41 thunderstorm days per year. The isokeraunic level is expressed as:

$$T_i = \text{Isokeraunic Levels}$$

Total Flash Density: The total flash density is a measure of the number of flashes per year per square kilometer. For example, the city of Chicago averages 33 flashes per year per square kilometer. Total flash density includes intracloud flashes, intercloud flashes, and cloud-to-ground flashes. Total flash density can be expressed as DT. The expression for total flash density is an empirically determined value based on many years of observation and can be approximated as follows:

$$P_{\text{fraction}} D_T \approx 0.02 \times T_i^2 \quad P_{\text{fraction}}$$

Ground Flash Density: The ground flash density is a measure of the number of flashes that reach the ground (as opposed to intercloud and intracloud type flashes). Flashes that reach the ground are the ones that are threatening to us. For example, the city of Chicago averages 9.9 ground flashes per year per square kilometer. The expression for ground flash density is an empirically determined value based on many years of observation and can be expressed as follows:

$$D_{\text{Ground Flash}} = P_{\text{fraction}} \times D_T$$

is the fraction of total flashes that reach the ground. The value is related to the latitude as expressed in the following equation:

$$P_{\text{fraction}} = 0.1 \times \left[1 + \left(\frac{\text{latitude}}{10} \right)^2 \right]$$

Area of Attraction of a Structure: A structure has a defined attraction area that is strongly dependent on the height and less dependent on its width and length. For a structure of height H, length L, and width W, the area of attraction (sometimes referred to as "area of collection") can be estimated by using the following equation. All units are in meters. Note that if the structure has a small length or small width as compared to the height, such as a communications tower or pole, then the equation is dominated by the height.

$$\text{Area}_c = L W = 4.4 H (L + W) + \pi (2.2 H)^2$$

Average Number of Strikes per Year to a Tower: The average number of strikes per year for an arbitrary tower of height H, length L and width W, can be estimated by multiplying the Area of Attraction, Area C, by the Ground Flash Density, D Ground Flash. Since the Area of Attraction, is expressed in square meters and the Ground Flash Density is expressed in square kilometers, a factor of 10⁻⁶ must be included.

$$S_y \approx \text{Area}_c \times D_{\text{Ground Flash}} \times H^2 \times 10^6$$

Strikes per Year, 50 foot tower: As an example, a 50-foot tower in the Chicago area will average 0.040 strikes per year (or this can be interpreted as 1 strike every 24.6 years). The calculations were based on a 50-foot (15.24 meters) height, 3.5-meter width, 3.5-meter length, latitude of 42 degrees, and an isokeraunic level of 41 thunderstorm days per year.

Strikes per Year, 100 foot tower: As an example, a 100-foot tower in the Chicago area will average 0.153 strikes per year (or this can be interpreted as 1 strike every 6.5 years). The calculations were based on a 100-foot (30.48 meters) height, 3.5-meter width, 3.5-meter length, latitude of 42 degrees, and an isokeraunic level of 41 thunderstorm days per year.

Strikes per Year, 200 foot tower: As an example, a 200-foot tower in the Chicago area will average 0.591 strikes per year (or this can be interpreted as 1 strike every 1.7 years). The calculations were based on a 200-foot (60.96 meters) height, 3.5-meter width, 3.5-meter length, latitude of 42 degrees, and an isokeraunic level of 41 thunderstorm days per year.

It is important to remember that these are statistical calculations based on many years of observation. When lightning strikes within even a few kilometers of the tower, damaging transients can be coupled and carried on any transmission lines, data lines, and power lines in the vicinity and cause damaging effects within the area of the tower.

References

- 1 IEC 1312-1, Protection Against Lightning Electromagnetic Impulse
- 2 IEEE C62.41-1991, IEEE Recommended Practice on Surge Voltages in Low-Voltage ac Power Circuits
- 3 MIL-STD-188-124A, Military Standard for Grounding, Bonding and Shielding
- 4 MIL-HDBK-419A, Military Handbook for the Theory of Grounding, Bonding and Shielding of Communications Electronics. Volume 1 (Basic Theory), Volume 2 (Applications)
- 5 MIL-STD-1757A, Lightning Qualification Test Techniques for Aerospace Vehicles and Hardware
- 6 National Electric Code 1993, Article 280
- 7 IEC 1024-1, Protection of Structures Against Lightning.
- 8 BS 6651, 1992 Code of Practice for Protection of Structures Against Lightning
- 9 Aleksa, J. and Stockman, C., "A Flash of Beauty or a Force for Destruction?", South African Wireless Communications, Aug 1997
- 10 Fisher, F.A. and Plumer, J.A., Lightning Protection of Aircraft, Lightning Technologies, 1990

Appendix 5

Hangar Spacing Guidelines

HELIAX® Coaxial Cable

Recommended maximum hanger spacings are tabulated below for various wind speed and ice conditions. The recommendations are based on guidelines stated in EIA Standard RS-222 and new wind tunnel and vibration tests. They supersede those in previous Andrew catalogs. Please refer to Andrew publication number TP-101619-EN.

These spacing recommendations assume that all hangers are properly installed and tightened.

Installations in Typical Climates

Use the 125 mph (200 km/h), 1/2" in ice conditions, highlighted in red.

Severe or Mild Climates

Use the wind speed and ice conditions that most closely approximate the expected worst case conditions for the local climate.

Standard Hanger—Maximum Hanger Spacing

Cable Size	Cable Type	Hanger Part Number	Recommended Maximum Hanger Spacing, feet (meters)					
Wind Speed			85 mph (137 km/h)			100 mph (160 km/h)		
Radial Ice			No Ice	1/2" (13 mm)	1" (25 mm)	No Ice	1/2" (13 mm)	1" (25 mm)
1/2"	Corrugated	43211A	5 (1.5)	4 (1.2)	3 (0.9)	5 (1.5)	4 (1.2)	3 (0.9)
1/2"	Smoothwall	43211A	5 (1.5)	4 (1.2)	3 (0.9)	5 (1.5)	4 (1.2)	3 (0.9)
5/8"	Corrugated	42396A-9	5 (1.5)	5 (1.5)	4 (1.2)	5 (1.5)	5 (1.5)	4 (1.2)
7/8"	Corrugated	42396A-5	5 (1.5)	5 (1.5)	4 (1.2)	5 (1.5)	5 (1.5)	4 (1.2)
7/8"	Smoothwall	42396A-5	5 (1.5)	5 (1.5)	4 (1.2)	5 (1.5)	5 (1.5)	4 (1.2)
1-1/4"	Corrugated	42396A-1	4 (1.2)	4 (1.2)	4 (1.2)	4 (1.2)	4 (1.2)	3 (0.9)
1-1/4"	Smoothwall	42396A-2	4 (1.2)	4 (1.2)	4 (1.2)	4 (1.2)	3 (0.9)	3 (0.9)
1-5/8"	Corrugated	42396A-2	4 (1.2)	4 (1.2)	4 (1.2)	4 (1.2)	3 (0.9)	3 (0.9)
1-5/8"	Smoothwall	42396A-2	4 (1.2)	4 (1.2)	4 (1.2)	4 (1.2)	3 (0.9)	3 (0.9)

Definitions and Assumptions 1. Per EIA-222 Standard: Coefficient of drag for coaxial cable is 1.2 (cylindrical members). Ice forms completely around member (360 degrees). Combined wind and ice loading is reduced by 25% to reflect lower probability of wind and ice occurring simultaneously. 2. Wind speeds are maximum, which includes gust factors and exposure factors. Note: Standard tower configuration spacing is 3 to 4 ft.

Standard Hanger—Maximum Hanger Spacing

Cable Size	Cable Part Number	Hanger Part Number	Recommended Maximum Hanger Spacing, feet (meters)					
Wind Speed			85 mph (137 km/h)			100 mph (160 km/h)		
Radial Ice			No Ice	1/2" (13 mm)	1" (25 mm)	No Ice	1/2" (13 mm)	1" (25 mm)
2-1/4"	LDF12-50A	42395A-4	4 (1.2)	4 (1.2)	4 (1.2)	4 (1.2)	3 (0.9)	3 (0.9)
2-1/4"	HJ12-50	42396A-4	4 (1.2)	4 (1.2)	4 (1.2)	4 (1.2)	3 (0.9)	3 (0.9)
3"	HJ8-50B	31766A-11	5 (1.5)	5 (1.5)	5 (1.5)	5 (1.5)	5 (1.5)	5 (1.5)
4"	HJ11-50B	31766A-10	5 (1.5)	5 (1.5)	5 (1.5)	5 (1.5)	5 (1.5)	5 (1.5)
5"	HJ9HP-50	33598-5	5 (1.5)	5 (1.5)	5 (1.5)	5 (1.5)	5 (1.5)	5 (1.5)
5"	HJ9-50	33598-5	5 (1.5)	5 (1.5)	5 (1.5)	5 (1.5)	5 (1.5)	5 (1.5)

Note: Standard tower configuration spacing is 3 to 4 ft.

Appendix 5

Hanger Spacing Guidelines

Standard Hanger—Maximum Hanger Spacing

Cable Size	Cable Part Number	Hanger Part Number	Recommended Maximum Hanger Spacing, feet (meters)					
Wind Speed			125 mph (200 km/h)			150 mph (240 km/h)		
Radial Ice			No Ice	1/2" (13 mm)	1" (25 mm)	No Ice	1/2" (13 mm)	1" (25 mm)
1/2"	Corrugated	43211A	4 (1.2)	3 (0.9)	2 (0.6)	3 (0.9)	2 (0.6)	1 (0.3)
1/2"	Smoothwall	43211A	4 (1.2)	3 (0.9)	2 (0.6)	3 (0.9)	2 (0.6)	1 (0.3)
5/8"	Corrugated	42396A-9	5 (1.5)	4 (1.2)	3 (0.9)	4 (1.2)	3 (0.9)	3 (0.9)
7/8"	Corrugated	42396A-5	5 (1.5)	4 (1.2)	3 (0.9)	4 (1.2)	3 (0.9)	2 (0.6)
7/8"	Smoothwall	42396A-5	5 (1.5)	4 (1.2)	3 (0.9)	4 (1.2)	3 (0.9)	2 (0.6)
1-1/4"	Corrugated	42396A-1	4 (1.2)	4 (1.2)	3 (0.9)	3 (0.9)	3 (0.9)	3 (0.9)
1-1/4"	Smoothwall	42396A-2	3 (0.9)	3 (0.9)	3 (0.9)	3 (0.9)	3 (0.9)	2 (0.6)
1-5/8"	Corrugated	42396A-2	3 (0.9)	3 (0.9)	3 (0.9)	3 (0.9)	3 (0.9)	2 (0.6)
1-5/8"	Smoothwall	42396A-2	3 (0.9)	3 (0.9)	3 (0.9)	3 (0.9)	3 (0.9)	2 (0.6)
2-1/4"	LDF12-50	42395A-4	3 (0.9)	3 (0.9)	3 (0.9)	3 (0.9)	3 (0.9)	3 (0.9)
2-1/4"	HJ12-50	42396A-4	3 (0.9)	3 (0.9)	3 (0.9)	3 (0.9)	3 (0.9)	3 (0.9)
3"	HJ8-50B	31766A-11	5 (1.5)	5 (1.5)	5 (1.5)	5 (1.5)	5 (1.5)	5 (1.5)
4"	HJ11-50B	31766A-10	5 (1.5)	5 (1.5)	5 (1.5)	5 (1.5)	5 (1.5)	5 (1.5)
5"	HJ9HP-50	33598-5	5 (1.5)	5 (1.5)	5 (1.5)	5 (1.5)	5 (1.5)	5 (1.5)
5"	HJ9-50	33598-5	5 (1.5)	5 (1.5)	5 (1.5)	5 (1.5)	5 (1.5)	5 (1.5)

Note: Standard tower configuration spacing is 3 to 4 ft.

Snap-In Hanger—Recommended Maximum Hanger Spacing

Cable Size	Cable Part Number	Hanger Part Number	Recommended Maximum Hanger Spacing, feet (meters)					
Wind Speed			85 mph (137 km/h)			100 mph (160 km/h)		
Radial Ice			No Ice	1/2" (13 mm)	1" (25 mm)	No Ice	1/2" (13 mm)	1" (25 mm)
1/2"	Corrugated	SSH-12	4 (1.2)	4 (1.2)	3 (0.9)	4 (1.2)	3 (0.9)	2 (0.6)
1/2"	Smoothwall	SSH-12	4 (1.2)	4 (1.2)	3 (0.9)	4 (1.2)	3 (0.9)	2 (0.6)
5/8"	Corrugated	206706A-6	4 (1.2)	4 (1.2)	3 (0.9)	4 (1.2)	3 (0.9)	2 (0.6)
7/8"	Corrugated	SSH-78	4 (1.2)	3 (0.9)	3 (0.9)	3 (0.9)	3 (0.9)	2 (0.6)
7/8"	Smoothwall	SSH-78	4 (1.2)	3 (0.9)	3 (0.9)	3 (0.9)	3 (0.9)	2 (0.6)
1-1/4"	Corrugated	SSH-114	3 (0.9)	3 (0.9)	3 (0.9)	3 (0.9)	3 (0.9)	2 (0.6)
1-1/4"	Smoothwall	SSH-158	3 (0.9)	3 (0.9)	3 (0.9)	3 (0.9)	3 (0.9)	2 (0.6)
1-5/8"	Corrugated	SSH-158	3 (0.9)	3 (0.9)	3 (0.9)	3 (0.9)	3 (0.9)	2 (0.6)
1-5/8"	Smoothwall	SSH-158	3 (0.9)	3 (0.9)	3 (0.9)	3 (0.9)	3 (0.9)	2 (0.6)
2-1/4"	LDF12-50	206706A-6	3 (0.9)	3 (0.9)	3 (0.9)	3 (0.9)	2 (0.6)	2 (0.6)
2-1/4"	HJ12-50	206706A-6	3 (0.9)	3 (0.9)	3 (0.9)	3 (0.9)	2 (0.6)	2 (0.6)

Definitions and Assumptions 1. Per EIA-222 Standard: Coefficient of drag for coaxial cable is 1.2 (cylindrical members). Ice forms completely around member (360 degrees). Combined wind and ice loading is reduced by 25% to reflect lower probability of wind and ice occurring simultaneously. 2. Wind speeds are maximum, which includes gust factors and exposure factors. Note: Standard tower configuration spacing is 3 to 4 ft.

Appendix 5

Hanger Spacing Guidelines

Snap-In Hanger—Recommended Maximum Hanger Spacing

Cable Size	Cable Part Number	Hanger Part Number	Recommended Maximum Hanger Spacing, feet (meters)					
Wind Speed			125 mph (200 km/h)			150 mph (240 km/h)		
Radial Ice			No Ice	1/2" (13 mm)	1" (25 mm)	No Ice	1/2" (13 mm)	1" (25 mm)
1/2"	Corrugated	SSH-12	3 (0.9)	3 (0.9)	2 (0.6)	3 (0.9)	2 (0.6)	1 (0.3)
1/2"	Smoothwall	SSH-12	3 (0.9)	3 (0.9)	2 (0.6)	3 (0.9)	2 (0.6)	1 (0.3)
5/8"	Corrugated	206706A-6	3 (0.9)	3 (0.9)	2 (0.6)	2 (0.6)	2 (0.6)	1 (0.3)
7/8"	Corrugated	SSH-78	3 (0.9)	3 (0.9)	2 (0.6)	2 (0.6)	1 (0.3)	1 (0.3)
7/8"	Smoothwall	SSH-78	3 (0.9)	3 (0.9)	2 (0.6)	2 (0.6)	1 (0.3)	1 (0.3)
1-1/4"	Corrugated	SSH-114	3 (0.9)	3 (0.9)	2 (0.6)	2 (0.6)	1 (0.3)	1 (0.3)
1-1/4"	Smoothwall	SSH-158	3 (0.9)	3 (0.9)	2 (0.6)	2 (0.6)	1 (0.3)	1 (0.3)
1-5/8"	Corrugated	SSH-158	3 (0.9)	3 (0.9)	2 (0.6)	2 (0.6)	1 (0.3)	1 (0.3)
1-5/8"	Smoothwall	SSH-158	3 (0.9)	3 (0.9)	2 (0.6)	2 (0.6)	1 (0.3)	1 (0.3)
2-1/4"	LDF12-50	206706A-6	3 (0.9)	3 (0.9)	2 (0.6)	2 (0.6)	1 (0.3)	1 (0.3)
2-1/4"	HJ12-50	206706A-6	2 (0.6)	2 (0.6)	1 (0.3)	2 (0.6)	1 (0.3)	1 (0.3)

Definitions and Assumptions 1. Per EIA-222 Standard: Coefficient of drag for coaxial cable is 1.2 (cylindrical members). Ice forms completely around member (360 degrees). Combined wind and ice loading is reduced by 25% to reflect lower probability of wind and ice occurring simultaneously. 2. Wind speeds are maximum, which includes gust factors and exposure factors. Note: Standard tower configuration spacing is 3 to 4 ft.

Appendix 5

Hanger Spacing Guidelines

Click-On Hanger—Recommended Maximum Hanger Spacing

Cable Size	Cable Part Number	Hanger Part Number	Recommended Maximum Hanger Spacing, feet (meters)					
Wind Speed			85 mph (137 km/h)			100 mph (160 km/h)		
Radial Ice			No Ice	1/2" (13 mm)	1" (25 mm)	No Ice	1/2" (13 mm)	1" (25 mm)
1/2"	Corrugated, Smoothwall	L4CLICK, 1 Stack	3 (0.9)	3 (0.9)	3 (0.9)	3 (0.9)	3 (0.9)	3 (0.9)
1/2"	Corrugated, Smoothwall	L4CLICK, 2 Stack	3 (0.9)	3 (0.9)	3 (0.9)	3 (0.9)	3 (0.9)	3 (0.9)
1/2"	Corrugated, Smoothwall	L4CLICK, 3 Stack	3 (0.9)	3 (0.9)	3 (0.9)	3 (0.9)	3 (0.9)	3 (0.9)
Note: These same hanger spacing recommendations apply for the other following 1/2 in cable types: LDF4-75A, HL4RP-50, HLT4-50, HS4RP-50, HST4-50, HT4-50, HJ4-50								
5/8"	Corrugated	L45CLICK, 1 Stack	3 (0.9)	3 (0.9)	3 (0.9)	3 (0.9)	3 (0.9)	3 (0.9)
5/8"	Corrugated	L45CLICK, 2 Stack	3 (0.9)	3 (0.9)	3 (0.9)	3 (0.9)	3 (0.9)	3 (0.9)
5/8"	Corrugated	L45CLICK, 3 Stack	3 (0.9)	3 (0.9)	3 (0.9)	3 (0.9)	3 (0.9)	3 (0.9)
Note: These same hanger spacing recommendations apply for the other following 5/8 in cable types: HJ4.5-50								
7/8"	Corrugated, Smoothwall	L5CLICK, 1 Stack	4 (1.2)	4 (1.2)	4 (1.2)	3 (0.9)	3 (0.9)	3 (0.9)
7/8"	Corrugated, Smoothwall	L5CLICK, 2 Stack	4 (1.2)	4 (1.2)	4 (1.2)	3 (0.9)	3 (0.9)	3 (0.9)
7/8"	Corrugated, Smoothwall	L5CLICK, 3 Stack	4 (1.2)	4 (1.2)	4 (1.2)	3 (0.9)	3 (0.9)	3 (0.9)
Note: These same hanger spacing recommendations apply for the other following 7/8 in cable types: AVA5-50, VXL5-50, AL5-50, HJ5-50, HJ5-75, HT5-5								
1-1/4"	Corrugated, Smoothwall	L6CLICK, 1 Stack	4 (1.2)	4 (1.2)	4 (1.2)	3 (0.9)	3 (0.9)	3 (0.9)
1-1/4"	Corrugated, Smoothwall	L6CLICK, 2 Stack	4 (1.2)	4 (1.2)	4 (1.2)	3 (0.9)	3 (0.9)	3 (0.9)
1-1/4"	Corrugated, Smoothwall	L6CLICK, 3 Stack	3 (0.9)	3 (0.9)	3 (0.9)	3 (0.9)	3 (0.9)	3 (0.9)
1-5/8"	Corrugated, Smoothwall	L7CLICK, 1 Stack	4 (1.2)	4 (1.2)	4 (1.2)	3 (0.9)	3 (0.9)	3 (0.9)
1-5/8"	Corrugated, Smoothwall	L7CLICK, 2 Stack	3 (0.9)	3 (0.9)	3 (0.9)	3 (0.9)	3 (0.9)	3 (0.9)
1-5/8"	Corrugated, Smoothwall	L7CLICK, 3 Stack	3 (0.9)	3 (0.9)	3 (0.9)	3 (0.9)	3 (0.9)	3 (0.9)

Note: These same hanger spacing recommendations apply for the other following 1 5/8 in cable types: HJ7-50A, AVA7-50, AL7-50

* These hanger spacings have been specified based on using the Click-On Hangers with Andrew specified hardware kits.

(Note: Standard tower configuration spacing is 3 to 4 ft)

Definitions and Assumptions 1. Per EIA-222 Standard: Coefficient of drag for coaxial cable is 1.2 (cylindrical members). Ice forms completely around member (360 degrees). Combined wind and ice loading is reduced by 25% to reflect lower probability of wind and ice occurring simultaneously. 2. Wind speeds are maximum, which includes gust factors and exposure factors.

Appendix 5

Hangar Spacing Guidelines

Click-On Hanger—Recommended Maximum Hanger Spacing

Cable Size	Cable Part Number	Hanger Part Number	Recommended Maximum Hanger Spacing, feet (meters)					
Wind Speed			125 mph (200 km/h)			150 mph (240 km/h)		
Radial Ice			No Ice	1/2" (13 mm)	1" (25 mm)	No Ice	1/2" (13 mm)	1" (25 mm)
1/2"	Corrugated, Smoothwall	L4CLICK, 1 Stack	3 (0.9)	3 (0.9)	3 (0.9)	2 (0.6)	2 (0.6)	2 (0.6)
1/2"	Corrugated, Smoothwall	L4CLICK, 2 Stack	3 (0.9)	3 (0.9)	3 (0.9)	2 (0.6)	2 (0.6)	2 (0.6)
1/2"	Corrugated, Smoothwall	L4CLICK, 3 Stack	3 (0.9)	3 (0.9)	3 (0.9)	2 (0.6)	2 (0.6)	2 (0.6)

Note: These hanger spacing recommendations are also applicable for these 1/2 in cable types: LDF4-75A, HL4RP-50, HLT4-50, HS4RP-50, HST4-50, HT4-50, HJ4-50

5/8"	Corrugated	L45CLICK, 1 Stack	3 (0.9)	3 (0.9)	3 (0.9)	2 (0.6)	2 (0.6)	2 (0.6)
5/8"	Corrugated	L45CLICK, 2 Stack	3 (0.9)	3 (0.9)	3 (0.9)	2 (0.6)	2 (0.6)	2 (0.6)
5/8"	Corrugated	L45CLICK, 3 Stack	2 (0.6)	2 (0.6)	2 (0.6)	2 (0.6)	2 (0.6)	2 (0.6)

Note: These hanger spacing recommendations are also applicable for this 5/8 in cable type: HJ4.5-50

7/8"	Corrugated, Smoothwall	L5CLICK, 1 Stack	3 (0.9)	3 (0.9)	3 (0.9)	2 (0.6)	2 (0.6)	2 (0.6)
7/8"	Corrugated, Smoothwall	L5CLICK, 2 Stack	3 (0.9)	3 (0.9)	3 (0.9)	2 (0.6)	2 (0.6)	2 (0.6)
7/8"	Corrugated, Smoothwall	L5CLICK, 3 Stack	2 (0.6)	2 (0.6)	2 (0.6)	2 (0.6)	2 (0.6)	2 (0.6)

Note: These hanger spacing recommendations are also applicable for these 7/8 in cable types: AVA5-50, VXL5-50, AL5-50, HJ5-50, HJ5-75, HT5-5

1-1/4"	Corrugated, Smoothwall	L6CLICK, 1 Stack	3 (0.9)	3 (0.9)	3 (0.9)	2 (0.6)	2 (0.6)	2 (0.6)
1-1/4"	Corrugated, Smoothwall	L6CLICK, 2 Stack	3 (0.9)	3 (0.9)	3 (0.9)	2 (0.6)	2 (0.6)	2 (0.6)
1-1/4"	Corrugated, Smoothwall	L6CLICK, 3 Stack	2 (0.6)	2 (0.6)	2 (0.6)	2 (0.6)	2 (0.6)	2 (0.6)
1-5/8"	Corrugated, Smoothwall	L7CLICK, 1 Stack	3 (0.9)	3 (0.9)	3 (0.9)	2 (0.6)	2 (0.6)	2 (0.6)
1-5/8"	Corrugated, Smoothwall	L7CLICK, 2 Stack	2 (0.6)	2 (0.6)	2 (0.6)	2 (0.6)	2 (0.6)	2 (0.6)
1-5/8"	Corrugated, Smoothwall	L7CLICK, 3 Stack	2 (0.6)	2 (0.6)	2 (0.6)	2 (0.6)	2 (0.6)	2 (0.6)

Note: These hanger spacing recommendations are also applicable for these 1 5/8 in cable types: HJ7-50A, AVA7-50, AL7-50

(Note: Standard tower configuration spacing is 3 to 4 ft)

Mini Click-On Hanger—Recommended Maximum Hanger Spacing

Cable Size	Cable Part Number	Hanger Part Number	125 mph (200 km/h)		
Radial Ice			No Ice	1/2" (13 mm)	1" (25 mm)
6 mm–8mm	CNT-240, CNT-300, FSJ1 series	68MCLICK, 1 Stack	1.5 (0.61)	1.5 (0.61)	1.5 (0.61)
6 mm–8mm	CNT-240, CNT-300, FSJ1 series	68MCLICK, 2 Stack	1.5 (0.61)	1.5 (0.61)	1.5 (0.61)
6 mm–8mm	CNT-240, CNT-300, FSJ1 series	68MCLICK, 3 Stack	1.5 (0.61)	1.5 (0.61)	1.5 (0.61)
9 mm–12 mm	CNT-400, LDF1, FSJ2, LDF2, SFX series	912MCLICK, 1 Stack	3.0 (0.90)	3.0 (0.90)	3.0 (0.90)
9 mm–12 mm	CNT-400, LDF1, FSJ2, LDF2, SFX series	912MCLICK, 2 Stack	3.0 (0.90)	3.0 (0.90)	3.0 (0.90)
9 mm–12 mm	CNT-400, LDF1, FSJ2, LDF2, SFX series	912MCLICK, 3 Stack	2.0 (0.60)	2.0 (0.60)	2.0 (0.60)
13 mm–16 mm	CNT-500, CNT-600, FSJ4, LDF4, FXL-540	1316MCLICK, 1 Stack	3.0 (0.90)	3.0 (0.90)	3.0 (0.90)
13 mm–16 mm	CNT-500, CNT-600, FSJ4, LDF4, FXL-540	1316MCLICK, 2 Stack	3.0 (0.90)	3.0 (0.90)	3.0 (0.90)
13 mm–16 mm	CNT-500, CNT-600, FSJ4, LDF4, FXL-540	1316MCLICK, 3 Stack	2.0 (0.60)	2.0 (0.60)	2.0 (0.60)

Definitions and Assumptions 1. Per EIA-222 Standard: Coefficient of drag for coaxial cable is 1.2 (cylindrical members). Ice forms completely around member (360 degrees).

Combined wind and ice loading is reduced by 25% to reflect lower probability of wind and ice occurring simultaneously. 2. Wind speeds are maximum, which includes gust factors and exposure factors. Note: Standard tower configuration spacing is 3 to 4 ft.

Appendix 5

Hanger Spacing Guidelines

HELIAX® Elliptical Waveguide

Recommended maximum hanger spacings are tabulated below for various wind speed and ice conditions. The recommendations are based on guidelines stated in EIA Standard RS-222 and new wind tunnel and vibration tests. They supersede those in previous Andrew catalogs.

Installations in Typical Climates

Use the 125 mph (200 km/h), 1/2" in ice conditions, highlighted in red.

Severe or Mild Climates

Use the wind speed and ice conditions that most closely approximate the expected worst case conditions for the local climate.

Standard Hanger for HELIAX® Elliptical Waveguide—Recommended Maximum Hanger Spacing

Waveguide Type	Hanger Part Number	Recommended Maximum Hanger Spacing, feet (meters)					
		85 mph (137 km/h)			100 mph (160 km/h)		
Wind Speed							
Radial Ice		No Ice	1/2" (13 mm)	1" (25 mm)	No Ice	1/2" (13 mm)	1" (25 mm)
EW17	31766A-9	6.0 (1.80)	6.0 (1.80)	6.0 (1.80)	6.0 (1.80)	6.0 (1.80)	6.0 (1.80)
EW20	31766A-10	6.0 (1.80)	6.0 (1.80)	6.0 (1.80)	6.0 (1.80)	6.0 (1.80)	6.0 (1.80)
EW28	31766A-11	6.0 (1.80)	6.0 (1.80)	6.0 (1.80)	6.0 (1.80)	6.0 (1.80)	5.5 (1.68)
EW37	42396A-4	6.0 (1.80)	6.0 (1.80)	5.5 (1.68)	5.5 (1.68)	5.5 (1.68)	5.0 (1.50)
EW43	42396A-16	6.0 (1.80)	6.0 (1.80)	5.5 (1.68)	5.0 (1.50)	5.0 (1.50)	4.5 (1.37)
EW52	42396A-8	5.5 (1.68)	5.0 (1.50)	4.5 (1.37)	4.5 (1.37)	4.5 (1.37)	4.0 (1.20)
EW63	42396A-7	5.0 (1.50)	4.5 (1.37)	4.0 (1.20)	4.0 (1.20)	4.0 (1.20)	3.5 (1.07)
EW64	42396A-1	5.0 (1.50)	6.0 (1.80)	4.0 (1.20)	4.5 (1.37)	4.0 (1.20)	3.5 (1.07)
EW77	42396A-11	5.0 (1.50)	6.0 (1.80)	4.0 (1.20)	4.5 (1.37)	4.0 (1.20)	3.5 (1.07)
EW85	42396A-5	5.5 (1.68)	6.0 (1.80)	4.0 (1.20)	4.5 (1.37)	4.0 (1.20)	3.5 (1.07)
EW90	42396A-5	5.5 (1.68)	4.5 (1.37)	4.0 (1.20)	4.5 (1.37)	4.0 (1.20)	3.0 (0.90)
EW127A	42396A-9	5.5 (1.68)	4.5 (1.37)	3.5 (1.07)	4.5 (1.37)	4.0 (1.20)	3.0 (0.90)
EW132	42396A-9	5.5 (1.68)	4.5 (1.37)	3.5 (1.07)	5.0 (1.20)	4.0 (1.20)	3.0 (0.90)
EW180	43211A	6.0 (1.80)	4.5 (1.37)	3.5 (1.07)	5.0 (1.20)	4.0 (1.20)	3.0 (0.90)
EW220	43211A	6.0 (1.80)	4.5 (1.37)	3.5 (1.07)	5.0 (1.20)	4.0 (1.20)	3.0 (0.90)
EW240	43211A	6.0 (1.80)	4.5 (1.37)	3.5 (1.07)	5.0 (1.20)	4.0 (1.20)	3.0 (0.90)
EW380	43211A	6.0 (1.80)	4.5 (1.37)	3.5 (1.07)	5.0 (1.20)	4.0 (1.20)	3.0 (0.90)

Note: Standard tower configuration spacing is 3 to 4 ft.

Appendix 5

Hanger Spacing Guidelines

Standard Hanger for HELIAX® Elliptical Waveguide—Recommended Maximum Hanger Spacing

Waveguide Type	Hanger Part Number	Recommended Maximum Hanger Spacing, feet (meters)					
Wind Speed		125 mph (200 km/h)			150 mph (240 km/h)		
Radial Ice		No Ice	1/2" (13 mm)	1" (25 mm)	No Ice	1/2" (13 mm)	1" (25 mm)
EW17	31766A-9	6.0 (1.80)	6.0 (1.80)	5.5 (1.68)	5.0 (1.50)	5.0 (1.50)	4.5 (1.37)
EW20	31766A-10	5.5 (1.68)	5.5 (1.68)	5.0 (1.50)	4.5 (1.37)	4.5 (1.37)	4.0 (1.20)
EW28	31766A-11	5.0 (1.50)	5.0 (1.50)	4.5 (1.37)	4.0 (1.20)	4.0 (1.20)	3.5 (1.07)
EW37	42396A-4	4.5 (1.37)	4.5 (1.37)	4.0 (1.20)	3.5 (1.07)	3.5 (1.07)	3.0 (.090)
EW43	42396A-16	4.0 (1.20)	4.0 (1.20)	3.5 (1.07)	3.5 (1.07)	3.5 (1.07)	3.0 (.090)
EW52	42396A-8	3.5 (1.07)	3.5 (1.07)	3.0 (.090)	3.0 (.090)	3.0 (.090)	2.5 (0.76)
EW63	42396A-7	3.5 (1.07)	3.0 (.090)	2.5 (0.76)	2.5 (0.76)	2.5 (0.76)	2.0 (0.60)
EW64	42396A-1	3.5 (1.07)	3.0 (.090)	2.5 (0.76)	3.0 (.090)	2.5 (0.76)	2.0 (0.60)
EW77	42396A-11	3.5 (1.07)	3.0 (.090)	2.5 (0.76)	3.0 (.090)	2.5 (0.76)	2.0 (0.60)
EW85	42396A-5	3.5 (1.07)	3.0 (.090)	2.5 (0.76)	3.0 (.090)	2.5 (0.76)	2.0 (0.60)
EW90	42396A-5	3.5 (1.07)	3.0 (.090)	2.5 (0.76)	3.0 (.090)	2.5 (0.76)	2.0 (0.60)
EW127A	42396A-9	3.5 (1.07)	3.0 (.090)	2.5 (0.76)	3.0 (.090)	2.5 (0.76)	2.0 (0.60)
EW132	42396A-9	4.0 (1.20)	3.0 (.090)	2.5 (0.76)	3.0 (.090)	2.5 (0.76)	2.0 (0.60)
EW180	43211A	4.0 (1.20)	3.0 (.090)	2.5 (0.76)	3.5 (1.07)	2.5 (0.76)	2.0 (0.60)
EW220	43211A	4.0 (1.20)	3.0 (.090)	2.5 (0.76)	3.5 (1.07)	2.5 (0.76)	2.0 (0.60)
EW240	43211A	4.0 (1.20)	3.0 (.090)	2.5 (0.76)	3.5 (1.07)	2.5 (0.76)	2.0 (0.60)

Definitions and Assumptions 1. Per EIA-222 Standard: Coefficient of drag for coaxial cable is 1.2 (cylindrical members). Ice forms completely around member (360 degrees). Combined wind and ice loading is reduced by 25% to reflect lower probability of wind and ice occurring simultaneously. 2. Wind speeds are maximum, which includes gust factors and exposure factors. Note: Standard tower configuration spacing is 3 to 4 ft.

* These hanger spacing recommendations have been specified using the click-on hangers with Andrew specified hardware kits.

Appendix 6

Hardware and Accessory Consolidation Cross Reference

Discontinued Part	Replacement	Description
1070-BCH	42396A-5	Butterfly Hanger for 7/8 in coaxial cable and elliptical waveguide 85 and 90
1070-BCH-NH	42396A-5	Butterfly Hanger for 7/8 in coaxial cable and elliptical waveguide 85 and 90
1070-CS	245171	Andrew 3M™ Cold Shrink™ Kit for 7/8 in to 1/4 in through 1/2 in connections
1480-BA4	SEC-1114	SnapSeal™ Entry Cushion with 1 hole for 1-1/4 in corrugated coaxial cable
1480-BA5	48939A-3	Boot Assembly, 5 in, for 1-1/4 in corrugated coaxial cable
1480-BCH	42396A-1	Butterfly Hanger for 1-1/4 in coaxial cable and elliptical waveguide 64
1480-BCH-NH	42396A-1	Butterfly Hanger for 1-1/4 in coaxial cable and elliptical waveguide 64
1480-CP	PLUG-114	Cushion Plugs for 1-1/4 in corrugated coaxial cable
1480-CS	245172	Andrew 3M™ Cold Shrink™ Kit for 1-5/8 in or 1/4 in to 1/4 in through 1/2 in connections
1480-DHK	L6CLICK	Double Click-on Hanger for 1-1/4 in coaxial cable
1480-EZC	SSH-114	SnapStak™ Hanger for 1-1/4 in coaxial cable
1480-EZSNS	SSH-114	SnapStak™ Hanger for 1-1/4 in coaxial cable
1480-HG	29961	Lace-up Hoisting Grip for 1-1/4 in coaxial cable and elliptical waveguide 64
1480-HG-NL	L6SGRIP	Support Hoisting Grip for 1-1/4 in coaxial cable
1480-SEK	SG114-12B2U	SureGround™ Grounding Kit for 1-1/4 in coaxial cable
1480/1873-CS	245172	Andrew 3M™ Cold Shrink™ Kit for 1-5/8 in or 1/4 in to 1/4 in through 1/2 in connections
1873-BA4	SEC-1158	SnapSeal™ Entry Cushion with 1 hole for 1-5/8 in corrugated coaxial cable
1873-BCH	42396A-2	Butterfly Hanger for 1-5/8 in coaxial cable
1873-BCH-NH	42396A-2	Butterfly Hanger for 1-5/8 in coaxial cable
1873-CP	PLUG-158	Cushion Plugs for 1-5/8 in corrugated coaxial cable
1873-CS	245172	Andrew 3M™ Cold Shrink™ Kit for 1-5/8 in or 1/4 in to 1/4 in through 1/2 in connections
1873-DHK	L7CLICK	Double Click-on Hanger for 1-5/8 in coaxial cable
1873-EZS	SSH-158	SnapStak™ Hanger for 1-5/8 in coaxial cable
1873-EZSNS	SSH-158	SnapStak™ Hanger for 1-5/8 in coaxial cable
1873-HG	24312A	Lace-up Hoisting Grip for 1-5/8 in coaxial cable and elliptical waveguide 44, 52, and 63
1873-HG-NL	L7SGRIP	Support Hoisting Grip for 1-5/8 in coaxial cable
1873-SEK	SG158-12B2U	SureGround™ Grounding Kit for 1-5/8 in coaxial cable
1873-SEK-G	SG158-12S2U	SureGround™ Grounding Kit for 1-5/8 in coaxial cable
1873-SPC	No replacement	Cushion Insert with 1 hole for 1-5/8 in coaxial cable
540-BA4	SEC-412	SnapSeal™ Entry Cushion with 4 holes for 1/2 in corrugated coaxial cable
540-BA4-3	SEC-412	SnapSeal™ Entry Cushion with 4 holes for 1/2 in corrugated coaxial cable
540-BA5	48939A-6	Boot Assembly, 5 in, for 1/2 in corrugated coaxial cable
540-BA5-3	48939A-8	Boot Assembly, 5 in, for 1/2 in corrugated coaxial cable
540-BCH	43211A	Butterfly Hanger for 1/2 in coaxial cable and elliptical waveguide 180, 220, and 240
540-BCH-NH	43211A	Butterfly Hanger for 1/2 in coaxial cable and elliptical waveguide 180, 220, and 240
540-CP	PLUG-12	Cushion Plugs for 1/2 in corrugated coaxial cable
540-CS	245173	Andrew 3M™ Cold Shrink™ Kit for 3/8 in through 1/2 in to 3/8 in through 1/2 in connections
540-DHK	L4CLICK	Double Click-on Hanger for 1/2 in coaxial cable
540-EZC	SSH-12	SnapStak™ Hanger for 1/2 in coaxial cable
540-EZSNS	SSH-12	SnapStak™ Hanger for 1/2 in coaxial cable
540-HG	43094	Lace-up Hoisting Grip for 1/2 in coaxial cable and elliptical waveguide 180 and 220
540-HG-NL	L4SGRIP	Support Hoisting Grip for 1/2 in coaxial cable
540-SEK	SG12-12B2U	SureGround™ Grounding Kit for 1/2 in coaxial cable
540-SEK-G	SG12-12S2U	SureGround™ Grounding Kit for 1/2 in coaxial cable
540-SPC-3	No replacement	Cushion Insert with 3 holes for 1/2 in CR-540 and FXL-540 cable
780-BA4	SEC-378	SnapSeal™ Entry Cushion with 3 holes for 7/8 in corrugated coaxial cable
780-BA4-3	SEC-378	SnapSeal™ Entry Cushion with 3 holes for 7/8 in corrugated coaxial cable
780-BA5	48939A-1	Boot Assembly, 5 in, for 7/8 in corrugated coaxial cable
780-BA5-3	48939A-2	Boot Assembly, 5 in, for 7/8 in corrugated coaxial cable
780-BCH	42396A-5	Butterfly Hanger for 7/8 in coaxial cable and elliptical waveguide 85 and 90
780-BCH-NH	42396A-5	Butterfly Hanger for 7/8 in coaxial cable and elliptical waveguide 85 and 90
780-CP	PLUG-78	Cushion Plugs for 7/8 in corrugated coaxial cable
780-CS	245171	Andrew 3M™ Cold Shrink™ Kit for 7/8 in to 1/4 in through 1/2 in connections

Appendix 6

Hardware and Accessory Consolidation Cross Reference

Discontinued Part	Replacement	Description
780-DHK	L5CLICKB	Double Click-on Hanger for 7/8 in coaxial cable
780-EZC	SSH-78	SnapStak™ Hanger for 7/8 in coaxial cable
780-EZSNS	SSH-78	SnapStak™ Hanger for 7/8 in coaxial cable
780-HG	19256B	Lace-up Hoisting Grip for 7/8 in coaxial cable and elliptical waveguide 77
780-HG-NL	L5SGRIP	Support Hoisting Grip for 7/8 in coaxial cable
A1480-BEK	SG114-06B2A	SureGround™ Grounding Kit for 1-1/4 in coaxial cable
A1480-SEK	SG114-12B2U	SureGround™ Grounding Kit for 1-1/4 in coaxial cable
A1873-BEK	SG158-06B2A	SureGround™ Grounding Kit for 1-5/8 in coaxial cable
A1873-SEK	SG158-12B2U	SureGround™ Grounding Kit for 1-5/8 in coaxial cable
A540-BEK	SG12-06B2A	SureGround™ Grounding Kit for 1/2 in coaxial cable
A540-SEK	SG12-12B2U	SureGround™ Grounding Kit for 1/2 in coaxial cable
A780-BEK	SG78-06B2A	SureGround™ Grounding Kit for 7/8 in coaxial cable
A780-SEK	SG78-12B2U	SureGround™ Grounding Kit for 7/8 in coaxial cable
A780-SEK-2HM8	SG78-06B2A	SureGround™ Grounding Kit for 7/8 in coaxial cable
AA-38S	31768A	Angle Adapter, standard, 3/8 in tapped hole
AA-SH	UA-3	Angle Adapter, universal, snap-in, 3/4 in through hole
AAU	UA-3 and UAAI	Angle Adapter, universal, snap-in, 3/4 in through hole
AEP4-11	204673-1	Single Entrance Panel
AEP4-12	204673-2A	2 Port Entrance Panel, 1 x 2
AEP4-13	204673-3	3 Port Entrance Panel, 1 x 3
AEP4-14	204673-4	4 Port Entrance Panel, 1 x 4
AEP4-22	No replacement	4 Port Entrance Panel, 2 x 2
AEP4-23	204673-6	6 Port Entrance Panel, 2 x 3
AEP4-24	204673-8	8 Port Entrance Panel, 2 x 4
AEP4-25	204673-10	10 Port Entrance Panel, 2 x 5
AEP4-26	No replacement	12 Port Entrance Panel, 2 x 6
AEP4-33	204673-9	9 Port Entrance Panel, 3 x 3
AEP4-34	204673-12	12 Port Entrance Panel, 3 x 4
AEP4-36	204673-18	18 Port Entrance Panel, 3 x 6
AEP4-44	204673-16	16 Port Entrance Panel, 4 x 4
AEP4-46	204673-24	24 Port Entrance Panel, 4 x 6
AEP5-11	No replacement	Single Entrance Panel, 1 x 1
AEP5-12	No replacement	2 Port Entrance Panel, 1 x 2
AEP5-22	No replacement	4 Port Entrance Panel, 2 x 2
AEP5-23	No replacement	6 Port Entrance Panel, 2 x 3
AEP5-24	No replacement	8 Port Entrance Panel, 2 x 4
AEP5-33	No replacement	9 Port Entrance Panel, 3 x 3
BT	MT-644	C-2 Banding Tool
CMT-Blue	CM-TB	Blue 3/4 in PVC Tape, 66 ft
CMT-Brown	CM-TBR	Brown 3/4 in PVC Tape, 66 ft
CMT-Green	CM-TG	Green 3/4 in PVC Tape, 66 ft
CMT-Red	CM-TR	Red 3/4 in PVC Tape, 66 ft
CMT-White	CM-TW	White 3/4 in PVC Tape, 66 ft
CMT-Yellow	CM-TY	Yellow 3/4 in PVC Tape, 66 ft
GB-HK-U	No replacement	Universal Buss Bar Hardware Kit
HK-10M	243684-MH	Hardware Kit for Standard Hangers, includes M10 bolts and hardware
HK-1873-1	243095-10	Hardware Kit for 1-1/4 in or 1-5/8 in Double Click-on Hangers, includes 3/8 in bolts and hardware
HK-1873-2	243095-6	Hardware Kit for 1-1/4 in or 1-5/8 in Double Click-on Hangers, includes 3/8 in bolts and hardware
HK-1873-3	243095-2	Hardware Kit for 1-1/4 in or 1-5/8 in Double Click-on Hangers, includes 3/8 in bolts and hardware
HK-1DHK	243095-9	Hardware Kit for 1/2 in or 7/8 in Double Click-on Hangers, includes 3/8 in bolts and hardware
HK-2DHK	243095-5	Hardware Kit for 1/2 in or 7/8 in Double Click-on Hangers, includes 3/8 in bolts and hardware
HK-381	31769-1	Hardware Kit for Standard Hangers, includes 3/8 in fillister head bolts and hardware
HK-3834	31769-5	Hardware Kit for Standard Hangers, includes 3/8 in fillister head bolts and hardware

Appendix 6

Hardware and Accessory Consolidation Cross Reference

Discontinued Part	Replacement	Description
HK-3DHK	243095-1	Hardware Kit for 1/2 in or 7/8 in Double Click-on Hangers, includes 3/8 in bolts and hardware
MT	FT-TB	Black Self-fusing Tape, 15 ft
RMA-1000	31670-1	Round Member Adapter, for 1–2 in round members
RMA-2000	31670-2	Round Member Adapter, for 2–3 in round members
RMA-3000	31670-3	Round Member Adapter, for 3–4 in round members
RMA-4000	31670-4	Round Member Adapter, for 4–5 in round members
RMB-USBG	RM-USBG	Universal Round Member Support Bracket for 6 runs
SFX-BA4	SEC-638	SnapSeal™ Entry Cushion with 6 holes for 3/8 in corrugated coaxial cable
SFX-BA4-3	SEC-638	SnapSeal™ Entry Cushion with 6 holes for 3/8 in corrugated coaxial cable
SFX-BA5	No replacement	Boot Assembly, 5 in, single hole, for 1/2 in SFX-500 cable
SFX-BA5-3	No replacement	Boot Assembly, 5 in, three-hole, for 1/2 in SFX-500 cable
SFX-CP	No replacement	Cushion Plugs for SFX-500 cable
SFX-HG-NL	L2SGRIP	Support Hoisting Grip for 3/8 in coaxial cable
SFX-SPC	No replacement	Cushion Insert with 1 hole for SFX-500 cable
SFX-SPC-9	No replacement	Cushion Insert with 9 holes for SFX-500 cable
SGL12-06B2	SG214-06B2A	SureGround™ Grounding Kit for 2-1/4 in coaxial cable
SGL12-06S2	SG214-06S2A	SureGround™ Grounding Kit for 2-1/4 in coaxial cable
SGL12-15B4	SG214-12B2U	SureGround™ Grounding Kit for 2-1/4 in coaxial cable
SGL12-15S4	SG214-12S2U	SureGround™ Grounding Kit for 2-1/4 in coaxial cable
SGL12-30B4	No replacement	SureGround™ Grounding Kit for 2-1/4 in coaxial cable
SGL4-06B2	SG12-06B2A	SureGround™ Grounding Kit for 1/2 in coaxial cable
SGL4-06S2	SG12-06S2A	SureGround™ Grounding Kit for 1/2 in coaxial cable
SGL4-15B4	SG12-12B2U	SureGround™ Grounding Kit for 1/2 in coaxial cable
SGL4-15S4	SG12-12S2U	SureGround™ Grounding Kit for 1/2 in coaxial cable
SGL4-30B4	No replacement	SureGround™ Grounding Kit for 1/2 in coaxial cable
SGL45-06B2	SG58-06B2A	SureGround™ Grounding Kit for 5/8 in coaxial cable
SGL45-06S2	SG58-06S2A	SureGround™ Grounding Kit for 5/8 in coaxial cable
SGL45-15B4	SG58-12B2U	SureGround™ Grounding Kit for 5/8 in coaxial cable
SGL45-15S4	SG58-12S2U	SureGround™ Grounding Kit for 5/8 in coaxial cable
SGL45-30B4	No replacement	SureGround™ Grounding Kit for 5/8 in coaxial cable
SGL5-06B2	SG78-06B2A	SureGround™ Grounding Kit for 7/8 in coaxial cable
SGL5-06B2-T	SG78-06B2A	SureGround™ Grounding Kit for 7/8 in coaxial cable
SGL5-06S2	SG78-06S2A	SureGround™ Grounding Kit for 7/8 in coaxial cable
SGL5-15B4	SG78-12B2U	SureGround™ Grounding Kit for 7/8 in coaxial cable
SGL5-15B4-T	SG78-12B2U	SureGround™ Grounding Kit for 7/8 in coaxial cable
SGL5-15S4	SG78-12S2U	SureGround™ Grounding Kit for 7/8 in coaxial cable
SGL5-30B4	No replacement	SureGround™ Grounding Kit for 7/8 in coaxial cable
SGL5-50G5	No replacement	SureGround™ Grounding Kit for 7/8 in coaxial cable
SGL6-06B2	SG114-06B2A	SureGround™ Grounding Kit for 1-1/4 in coaxial cable
SGL6-06S2	SG114-06S2A	SureGround™ Grounding Kit for 1-1/4 in coaxial cable
SGL6-15B4	SG114-12B2U	SureGround™ Grounding Kit for 1-1/4 in coaxial cable
SGL6-15S4	SG114-12S2U	SureGround™ Grounding Kit for 1-1/4 in coaxial cable
SGL6-30B4	No replacement	SureGround™ Grounding Kit for 1-1/4 in coaxial cable
SGL7-06B2	SG158-06B2A	SureGround™ Grounding Kit for 1-5/8 in coaxial cable
SGL7-06B2-T	SG158-06B2A	SureGround™ Grounding Kit for 1-5/8 in coaxial cable
SGL7-06S2	SG158-06S2A	SureGround™ Grounding Kit for 1-5/8 in coaxial cable
SGL7-15B4	SG158-12B2U	SureGround™ Grounding Kit for 1-5/8 in coaxial cable
SGL7-15B4-T	SG158-12B2U	SureGround™ Grounding Kit for 1-5/8 in coaxial cable
SGL7-15S4	SG158-12S2U	SureGround™ Grounding Kit for 1-5/8 in coaxial cable
SGL7-30B4	No replacement	SureGround™ Grounding Kit for 1-5/8 in coaxial cable
SSB	MT-640	1/2 in Stainless Steel Banding, 100 ft roll
SSBC	MT-641	Stainless Buckle Clamps, 1/2 in

Hardware and Accessory Consolidation Cross Reference

Discontinued Part	Replacement	Description
TW	40417	Nylon Cable Tie, 14.5 in
UGB-0212	UGBKIT-0212	Copper Ground Buss Bar, 1/4 in x 2 in x 12 in
UGB-0414	UGBKIT-0414	Copper Ground Buss Bar, 1/4 in x 4 in x 14 in
USA-38S	SA-38 and UAAI	Universal Stand-off Adapter
USA-38S1000	TTS3-7515	Three-way Stand-off Adapter for 0.75–1.5 in round members
USA-38S2000	TTS3-153	Three-way Stand-off Adapter for 1.5–3 in round members
USA-38S3000	TTS3-34	Three-way Stand-off Adapter for 3–4 in round members
USA-38S4000	TTS3-45	Three-way Stand-off Adapter for 4–5 in round members
USA-SS	SA-38	Universal Stand-off Adapter
USA-SS1000	STS3-12	Three-way Snap-in Stand-off Adapter for 1–2 in round members
USA-SS2000	STS3-23	Three-way Snap-in Stand-off Adapter for 2–3 in round members
USA-SS3000	STS3-34	Three-way Snap-in Stand-off Adapter for 3–4 in round members
USA-SS4000	STS3-45	Three-way Snap-in Stand-off Adapter for 4–5 in round members
USK-A	221213	Weatherproofing Kit for Connectors and Splices, includes butyl rubber and PVC tape
UTLS-TB2550	SS-TB2550	Star Support Tee Bracket for 1-1/2 in to 5-9/16 in OD round members and 2-1/2 in to 5 in angle members
UTLS-TB6080	SS-TB6080	Star Support Tee Bracket for 4 in to 10-3/4 in OD round members and 4 in to 8 in angle members
USK-A	221213	Weatherproofing Kit for Connectors and Splices, includes butyl rubber and PVC tape
VT-10	9905-71	Black 2 in PVC Tape, 20 ft



12-HPT	22	244459-7	25	42396A-2	11
12395-1	13	244495	33	42396A-4	11
1316MCLICK	10	244847	38	42396A-5	11
1480-AW	25	245154	25	42396A-7	11
1480-MSS	26	245171	16	42396A-8	11
1480-PT	22	245172	16	42396A-9	11
1873-AMSS	26	245173	16	42615-10	17
1873-AW	25	245174	16	43094	8
19256B	8	245175	16	43211A	11
204673-1	18	245314-127A	20	48939A-1	19
204673-10	18	245314-132	20	48939A-10	19
204673-12	18	245314-180	20	48939A-14	19
204673-16	18	245314-220	20	48939A-15	19
204673-18	18	245314-240	20	48939A-16	19
204673-2	18	245314-37	20	48939A-17	19
204673-20	18	245314-43	20	48939A-2	19
204673-24	18	245314-52	20	48939A-3	19
204673-2A	18	245314-63	20	48939A-4	19
204673-3	18	245314-64	20	48939A-5	19
204673-4	18	245314-77	20	48939A-6	19
204673-6	18	245314-85	20	48939A-7	19
204673-8	18	245314-90	20	48939A-8	19
204673-9	18	245529-10	32	48939A-9	19
204989-10	33	247696	25	540-EZPT	22
207136-3	32	252026-10KT	10	540-MSS	26
207270	25	252027-10KT	10	68MCLICK	10
207270	32	252028-10KT	10	78-HPT	22
209874	24	252029-10KT	10	780-EZPT	22
221213	17	26985A	8	780-MSS	26
221213-S	17	29958	8	912MCLICK	10
223158-2	33	29961	8	9905-41	17
241088-1	33	31031-1	8	9905-71	17
241088-2	33	31535	8	A5-EZPT	22
241088-3	33	31670-1	12	A5-SG	23
241088-4	33	31670-2	12	A6-EZPT	22
241088-5	33	31670-3	12	A6-SG	23
241475-13	16	31670-4	12	A7-EZPT	22
243095-3	10	31670-5	12	A7-SG	23
243095-4	10	31670-6	12	ABT-DFDM-ADBA	38
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243095-7	10	31766A-11	11	ABT-DFDM-DB	38
243095-8	10	31766A-9	11	ABT-DMDF-ADBA	38
243095-11	10	31768A-M	12	ABT-DMDF-ADBH	38
243095-12	10	31769-1	11	ABT-DMDF-DB	38
24312A	8	31769-5	11	ABT-NFNM-DB	38
243684-M	12	34759	8	ABT-NMNF-DB	38
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243950	38	35849A-13	20	APB-BNFNF-2400	37
243951	38	35849A-9	20	APB-BNFNF-2400	37
244350	9	3CCGRIP	8	APC-BDFDM-450A	37
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244379	25	42396A-1	11	APC-BDFDM-DB	37
244459-5	25	42396A-11	11	APG-BDFDF-090	37
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