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PolyPhaser®
CORPORATION

The Industry's

Finest

Coaxial Cable

And

Assemblies

8

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Note: All dimensions shown in catalog are for reference only and are subject to change without notice.

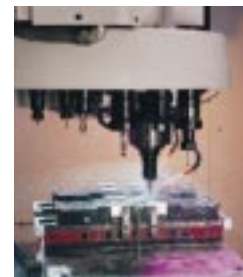
This is PolyPhaser!

Situated in Carson Valley and just minutes from Lake Tahoe, PolyPhaser Corporation, a subsidiary of Smiths Industries plc of London, maintains its headquarters in Minden, Nevada, USA. PolyPhaser provides world class lightning/electromagnetic pulse and

grounding solutions for the communications industry. Founded in 1979, the company

designs and manufactures more than 2,500 models of coax, power and twisted-pair protectors.

PolyPhaser's numerous products divert lightning from communications equipment through the proper installation of its full line of lightning protection and grounding solution products, including coax entrance panels, cellular and PCS protectors, in-line power mains, global positioning system (GPS) coaxial protectors, shunt-type power mains, rack panel components and power-supply protectors.



Smiths Industries

Smiths Industries is a London based company which has grown substantially from the family clock and watch-making business started by Samuel Smith in 1851. It now operates 50 different businesses around the world

and is organized into three distinct activities: specialized industrial products, aerospace electronics and medical systems.

PolyPhaser was acquired by Smiths on June 1, 1997 and is part of the Industrial Group. This group is the fastest growing part of Smiths Industries and has tripled in size over the past five years. Times Microwave Systems in Wallingford, Connecticut is also a member of the Industrial

Group. They design and manufacture coaxial cables for wireless telecommunications as well as civil and military aircraft.

Smiths has achieved a strong record of growth through investment in research and development, new manufacturing technology and closely focused marketing.





The Industry's

Finest

Lightning

Protection

Products

Setting the Standard

PolyPhaser continues to define industry standards on lightning protection and grounding. The company recently introduced a line



of protection products based on a revolutionary filter design. With its unique, small footprint design,

the microwave filter series of protectors has the industry's best performance, including the lowest throughput energy.

To further safeguard communications equipment, PolyPhaser also offers complete technical support, testing, training and consulting. Customers may also receive the company's catalog, view its tutorial video or read PolyPhaser's book on lightning protection, "The 'Grounds' for Lightning and EMP Protection." Preview PolyPhaser's capabilities at its web site: www.polyphaser.com.



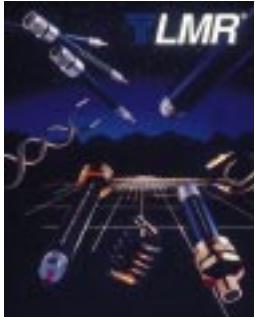
Times Microwave Systems, founded in 1948 and formerly known as Times Wire and Cable, is the industry leader in the development and

manufacture of coaxial cable and assemblies.

The expertise that provided cable solutions for the demanding require-

ments of airborne Electronic Warfare systems, and led the way in the development of low smoke cables for shipboard applications is now yielding high performance cables to meet the needs of the wireless communications market.

The innovative LMR product line provides a better alternative to corrugated copper cables for antenna feeders and system interconnects. Compared to corrugated copper cables, LMR cables offer better flexibility, resistance to kinking, comparable attenuation and easier connector attachment at a lower cost.





PCS MICRO FILTER PROTECTION

SX SERIES

Revolutionary lightning protection from PolyPhaser is now available in a unique patent pending design. The SX Series is dc blocked for the ultimate in equipment protection. Comprehensive testing proved the industry's finest RF and surge performance characteristics. The ultra compact footprint incorporates a fully integrated connector

housing that is completely weatherized, contains no gas tubes and is available in various connector configurations. The SX Series for Personal Communications Services is maintenance-free and recommended for single or multi-channel transmitters as well as receivers. (See page 80 for ordering information.)

**WEATHERIZED DC PATH PCS PROTECTION****IS-MR50MDZ SERIES**

Wireless communications require optimal performance. PolyPhaser introduces an innovative product to protect your equipment investment from lightning surges. Our newest microwave protector series is designed for systems up to 300 watts maximum continuous power and still provides protected ac/dc for in-line amplifiers or Global

Positioning Systems (GPS) receivers. The fully tested protector provides the industry's best VSWR and insertion loss performance in the 1.2 to 2.0GHz pass-band. The IS-MR50MDZ Series is fully weatherized and is available in several dc voltages with currents to 2 amps. (See page 86 for ordering information.)



MICRO LIGHTNING BLOCK PROTECTOR

IS-MF50LD

Revolutionary designs in lightning protection continue with PolyPhaser's microwave filter protector for the 1.7 to 2.2GHz frequency range. The maintenance-free device exhibits the industry's best RF and surge performance with ultra low

insertion loss and VSWR over the bandwidth. The IS-MF50LD is a non-gas tube protector which has a fully weatherized, small footprint housing. The dc blocked protector provides maximum equipment protection. (See page 84 for ordering information.)



MEDIUM POWER LIGHTNING FILTER

IS-MF50HD SERIES

Protect your communications equipment and keep your valuable wireless customers connected with PolyPhaser's newest microwave filter protectors. These protectors are engineered for systems requiring up to 300 watts maximum continuous power including Cellular, Paging and Personal Communications Services bands.

The fully weatherized IS-MF50HD Series protectors feature compact integrated connector housings and are dc blocked. With an innovative non-gas tube design, this series provides the ultimate equipment protection while continuing to maintain the industry's best passband VSWR and extremely low insertion loss. (See page 85 for ordering information.)



MICRO LIGHTNING BLOCK PROTECTOR

IS - MF50LN

A revolutionary design in lightning protection, the Micro Lightning Block Protector (Model IS-MF50LN) was engineered as a non-gas tube, single broadband device for the 980MHz to 2.6GHz bandwidth. It fulfills the customers needs in the in the Personal Communications Services (PCS) field as well as other sectors of the microwave market. The maintenance-free protector exhibits the industry's best RF and surge performance in a fully

weatherproof, small footprint. Comprehensive testing proved ultra low surge throughput measuring significantly less than $0.5\mu\text{J}$ at 3kA 8/20 μs waveform. Providing both positive and reverse voltage protection, the Micro Lightning Block Protector exhibits low insertion loss ($\leq 0.1\text{dB}$) over the large bandwidth. The dc blocked protector provides the maximum equipment protection. (See page 84 for ordering information.)

**CELLULAR LIGHTNING BLOCK PROTECTOR****IS-CLF50HN**

PolyPhaser's lightning filter protection products include weatherized devices for transmit- and receive-only applications in the 800MHz to 1.0GHz frequency range. The non-gas tube, maintenance-free protectors exhibit the industry's best RF and surge performance. The Micro Lightning Filter Series is dc blocked for maxi-

mum equipment protection, and is available in various connector configurations. The devices protect single or multi-channel transmitters and receivers in such markets as Specialized Mobile Radio (SMR), Personal Communications Services (PCS), paging and cellular services. (See page 81 for ordering information.)



PAGING COMBINER PROTECTOR

IS-PF50HN

High power paging applications require sturdy designs with lightning protection to match. PolyPhaser has engineered a Paging Filter Series to protect single or multi-channel transmitters in the 890 to 980MHz bandwidth. The

Paging Filter Series is a non-gas tube, dc blocked protector which exhibits the industry's best surge and RF performance characteristics. The series is available in various connector configurations. (See page 83 for ordering information.)

**CELLULAR COMBINER PROTECTOR****IS-CF50HN**

Today's cellular market demands the industry's finest high power, multi-channel, dc blocked coax lightning protection. PolyPhaser has met this challenge with the introduction of the Cellular Filter Series providing the industry's best RF and surge performance. Used for combined

transmit/receive applications in the 800 to 900MHz frequency range, with up to 750 watts continuous power and no gas tube, the maintenance-free protector is available in various connector configurations. (See page 82 for ordering information.)

**GROUNDING SYSTEM INTERNAL TO EXTERNAL KIT****GSIE SERIES**

Single point grounding is essential for communications site protection. PolyPhaser's patent pending grounding retrofit kit known as the GSIE (Grounding System Internal to External) is uniquely designed to provide a high quality, low inductance path to ground for existing sites as well as new construction. This system assures

that surge protectors, as well as the coax or waveguide, are properly grounded. The GSIE Series can be used with multi-port entry panel systems and includes copper straps and ground bars which attach to the existing perimeter ground system.

(See page 47 for ordering information.)

**POLYPHASER ENTRANCE PANEL****8PEP**

Incorporating earthed copper entrance panels for coaxial lines is your best defense against the damaging effects of lightning. PolyPhaser Entrance Panels are designed to divert lightning energy to earth and provide built-in single point grounding for up to eight coaxial cables from

1/2" to 1" diameter. This compact, high density entrance panel is complete with cone shaped weather boots and multiple copper strap-down conductors terminating to a buried sandwich ground bar.

(See page 44 for ordering information.)

Custom Manufacturing



Comprehensive testing in our engineering labs ensures PolyPhaser products maintain the industry's highest standards.

New products are developed as a result of customer inquiry and industry needs. Custom protectors are routinely designed, tested and produced as specials. Innovative engineering, state-of-the-art technology, sophisticated testing equipment and extensive experience result in application-specific products that meet or exceed performance requirements. Our Technical Consultants are ready to address specific needs and applications.

Order: CUSTOM

(see page 107 for Custom Product Order Form)

Training Programs



Professionals from throughout the telecommunications industry attend PolyPhaser training courses to learn proven lightning protection and grounding techniques.

At our corporate training center, specialists will guide you from lightning theory and protection techniques to practical application. PolyPhaser can provide the latest information to assist in developing and maintaining the best in lightning protection. Video clips from worldwide consultations supplement classroom experience. Specialized training and/or off-site seminars are quoted separately. Call PolyPhaser with your requirements.

Order: TRAINING (limited dates available)

Consulting Services



An on-site visit to your communications installation by one of our engineers will provide you with the specific information required for lightning protection and grounding.

Highly qualified engineers provide expertise to assess the effectiveness of your site grounding and lightning protection system.

- Evaluate plans for new or existing site
- Review protection standards
- Design an optimal package for specific requirements
- Create custom products to enhance your systems

- Prepare an engineering analysis of your site complete with video and written comments
- Work with your engineers, subcontractors and construction firms to assure equipment protection

Consulting contracts are tailored to your requirements including state, county and local regulations, or military specifications. Programs are provided to match your schedule and budget to assure complete equipment protection. Ongoing consultation services continue after project completion.

*Consulting Options**

A. On-Site Visit Consulting Package:

Engineering site visit includes technical analysis by engineering staff with written follow-up report and recommendations.

B. Customer Provided Video for Analysis:

A comprehensive checklist is provided to each customer so a site can be videotaped and the tape forwarded to PolyPhaser for engineering analysis.

C. Testing and Standards Review and Recommendations Package:

Customers may want to include product testing in conjunction with a written review of customer lightning protection standards.

**Options will be quoted separately to accommodate customer requirements.*

Order: Consult-A

Consult-B

Consult-C

Educational Information



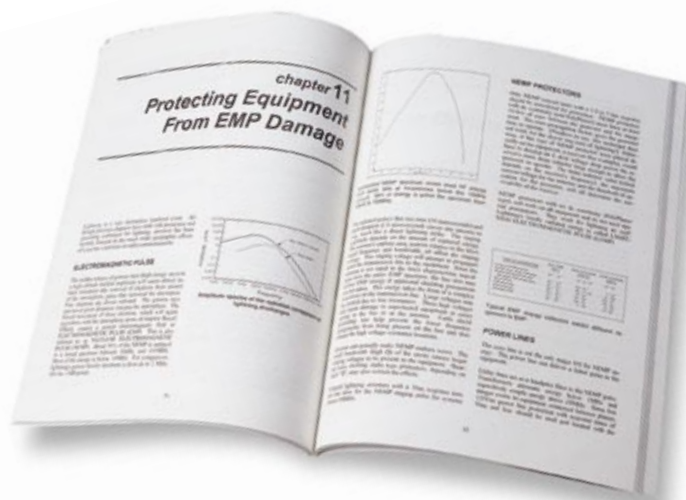
GROUNDING VIDEO TAPES

This hour long overview of grounding, covers types of lightning, why damage occurs, grounding types and materials, measuring, protectors and their placement, and tying it all together.

- One hour w/charts, graphs, pictures and drawings
- Available in VHS: NTSC, PAL, N PAL, M PAL, SECAM, and MESECAM, TV formats

Order: **GROUNDING - An Overview**

Note: export orders - please give TV format desired



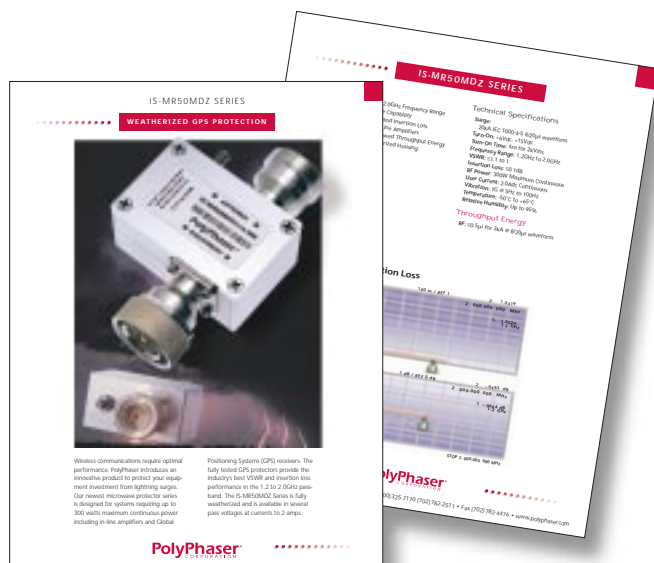
THE "GROUNDS" FOR LIGHTNING & EMP PROTECTION, SECOND EDITION

This often cited book contains important information analyzing proper techniques for grounding and protection against destructive lightning and nuclear electromagnetic pulse (EMP) energy. Drawings help illustrate the concepts in this 100+page comprehensive analysis applicable to all types of communications equipment. This publication contains simple math with many easy to follow explanations. Additional topics address telephone, central offices, computers, Local Area Networks, cable TV, television receive only (TVRO), and security cameras.

Order: **GLEP/E** for English version
(ISBN 0-9644493-1-5)

GLEP/S for Spanish version
(ISBN 0-9644493-2-1)

Educational Information



POLYPHASER PRODUCT LITERATURE

PolyPhaser's new product flyers showcase our innovative product line. Each flyer features two photographic views of the product with a description of key features. The reverse side presents each product's features, technical specifications, throughput energy, let-through voltage, environmental test data and VSWR and insertion loss plots.

Order: **STRIKING NEWS** for free tutorial newsletter

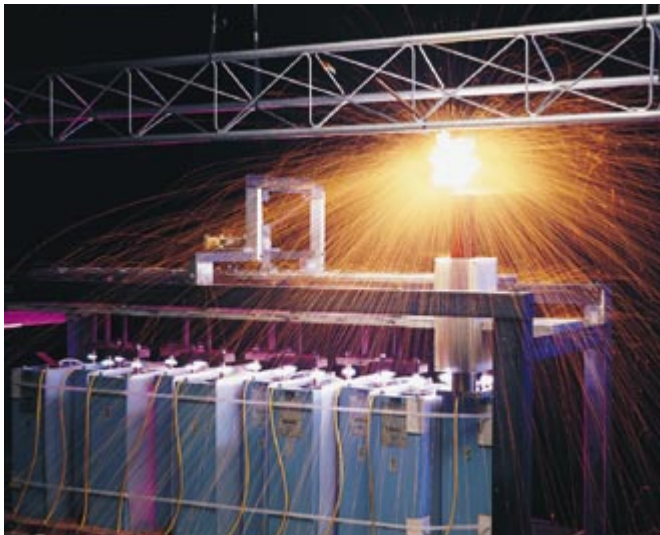


INTERNET

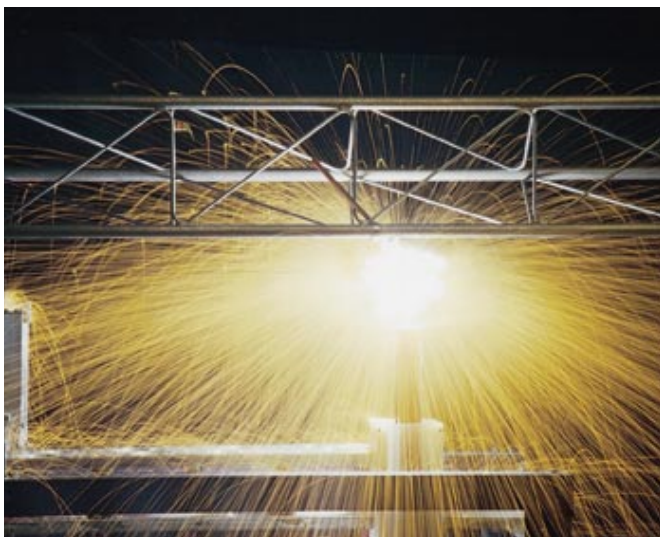
Access PolyPhaser 24 hours a day on the Internet. Browse our on-line catalog, locate an International Distributor, refer to the PolyPhaser Answer Center for technical information, review current employment opportunities or e-mail us with your questions or comments. Our web address is: **www.polyphaser.com**.

If you don't have access to the World Wide Web, but do have internet electronic mail, you can send questions or comments to: **info@polyphaser.com**.

Product Testing Capabilities



Big Bertha, PolyPhaser's lightning simulator, tests a dissipation brush with a 100kV, 65,000 ampere strike.



Big Bertha strikes again! This lightning simulator is used to test PolyPhaser products and customer's communications equipment.

One of the more difficult tasks facing original equipment manufacturers (OEMs) is determining what will happen to their product or system when lightning strikes. PolyPhaser has the capability to conduct extensive destructive testing with results measured on the latest 4 giga-sample, 1.1GHz bandwidth digital oscilloscope.

Customer equipment/system testing is also available on any one of three lightning simulators. Each has its own attributes including long duration pulses, high currents greater than 100,000 amperes and high energy surges. The largest simulator consists of high density capacitors which can generate 100kV with 65kA and 100k Joules of energy in a traditional 8/20 μ s pulse. Customers can witness the tests or tests can be videotaped.

Customer Considerations:

- Item to be tested, item size and weight, and type of test information required.
- Specify defined waveforms or standards which may include current peak, duration, open circuit voltage or source resistance, and number of strikes.
- Additional tests may include network analyzer measurements of RF, dc, ac and resistance measured at intervals between strikes to determine failures.

Order: TESTING (call for quote)

Product Applications

ac Power Protectors: Use at ac mains, subpanels and extension outlets throughout the building. The PSP model can be mounted inside the device to be protected.

dc Power Protectors: Use in solar power systems and other dc current systems. The open circuit voltage of the battery must be less than the turn-on voltage value of the protector.

Grounding Solutions: Everything for grounding applications except the ground rods. PEPs, PEEPs and PBs come with everything necessary for a complete installation: boots, copper straps, hardware, etc. Use PEPs and PEEPs for "thinwall" buildings and PBs for "thickwall" (cinderblock and concrete) structures.

Test Equipment: Use of a Lightning Strike Counter will record the number of strikes and how many times your PolyPhasers® have protected your equipment.

Twisted Pair/Cable Protectors: Available for twisted pair telephone wiring carrying data and voice for both discrete and punchdown block configurations; alarm circuits (current loop); and rotor control lines.

RF Coupled Shield/dc Blocked: Provides the ultimate in protection. Both the center conductor *and* the shield are dc-blocked. Especially useful when the capability of the ground system to handle the surge is either inadequate or questionable. Also prevents ground loops and achieves the proper single point ground.

dc Blocked Filter: Use with passive (no pre-amp) antennas. These will NOT pass the dc (or 60Hz ac) voltage(s) diplexed onto the center conductor. They provide maintenance-free service and the industry's lowest throughput energy.

dc Blocked/Gas Tube: Use with passive (no pre-amp) antennas. These will NOT pass the dc (or 60Hz ac) voltage(s) diplexed onto the center conductor for feeding pre-amps, relays or sequencers. Use in single transmitter situations only. If combiners are used, a combiner protector should be specified.

dc Injector/dc Path: Protects active antennas, pre-amps or other situations requiring a dc (or ac) voltage on the center conductor. The dc and RF paths (RF is dc-blocked) are separated, individually protected, and recombined. Also bias-T models for injecting the dc onto the center conductor or picking off the dc to feed the powered device. The bias-T models are receive only.

Combiner Protectors: For multi-channel or multi-transmitter applications. Refer to formula in APPENDIX 'B' to ensure that the total voltage does not exceed the "Vt" rating of the protector, or call for technical assistance.

dc Type & Isolated Shield: For coax-based baseband LANs (e.g. 10 BASE T), closed circuit television (CCTV) security monitors, and HF Receive only. To prevent hum bars due to ground loops, use the IGA-90V to isolate the shield of the camera-mounted protector from earth ground.

Grounding Components:

- **Rack Isolation Kit:** Isolates the rack from conductive floors (concrete). Eliminates a current path through sensitive equipment.
- **Bulkhead to Flange Adapter:** Adapts most PolyPhaser bulkhead-mounted protectors to mount on a single point grounding panel or similar flat surface. The connector on the antenna (surge) side must be female; i.e. will not work with the -MA versions.
- **Low Inductance Copper Grounding Strap:** To achieve a low inductance ground system. Copper strap has a larger surface area and lower inductance per foot than equivalent cross section circular wire.
- **Copper Strap Bonding Clamps:** To bond copper strap without building up the joint for an exothermic weld. Use for connecting the copper strap radial to the ground rod; to transition from copper strap to wire [sizes: #6AWG to #4/OAWG]; and bonding different widths of copper strap to each other.

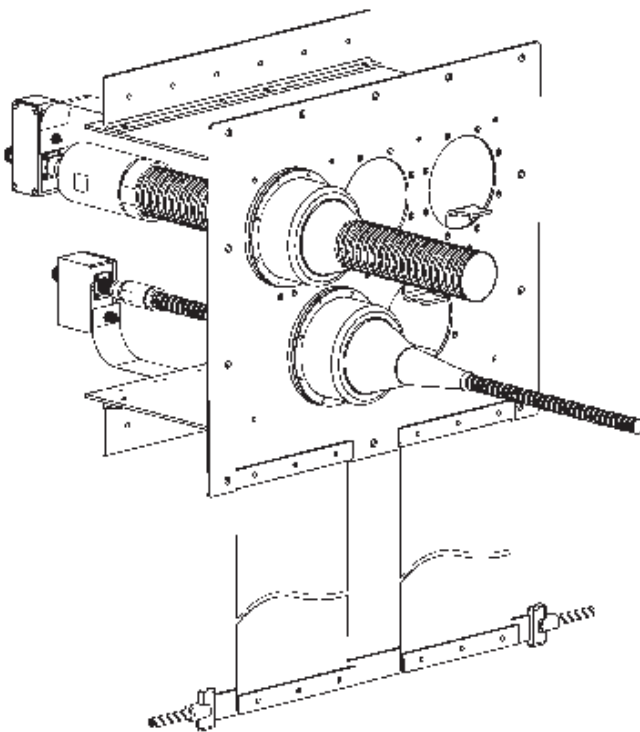
Product Applications (continued)

- **Copper to Tower Leg Corrosion Free Grounding Clamps:** Use for attaching copper strap to a galvanized tower leg. Maximizes the contact surface area and prevents corrosion due to dissimilar metals. Eliminates the need for exothermic welding to the tower.
- **Wire/Copper Rod Transition Clamps:** Bonds the copper strap radial to the (copper-plated) ground rod without building up the joint for an exothermic weld.
- **Copper Cleaning Kit and Copper Primer Kit:** For best results, the copper should be brought down to "white metal" before bonding and weather sealing. To paint the copper straps and entrance panels use our copper primer kit.

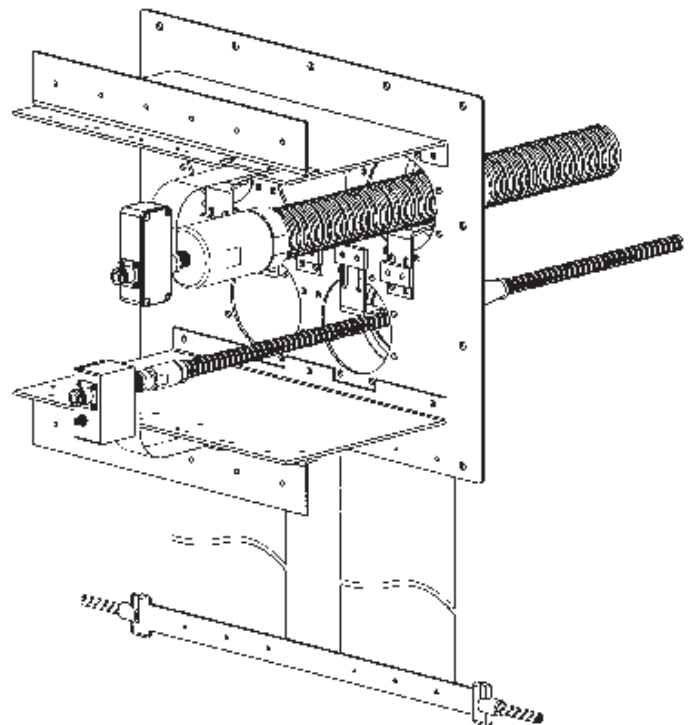
- **Weather Proofing Kit:** When a PolyPhaser model designed for inside use must be mounted outdoors and unprotected, use the weather proofing kit to prevent moisture ingress. The kit can easily handle extreme temperatures, and is unaffected by the sun's ultra-violet (UV) rays.

Tower Accessory Protectors: Often forgotten and therefore a "sneak path" for the lightning surge energy, the wiring associated with the tower lights or obstruction strobe lamps should be protected.

Entrance Panels



Typical Installation of an entrance panel (front view)



Typical Installation of an entrance panel (back view)

Coax Protection

To determine the proper protector application, the following should be considered.

IMPEDANCE

50 and 75 ohm protectors are standard. Other impedance available as custom product.

SPEED

Primarily for lightning protection or for defined lightning and Nuclear Electro Magnetic Pulse (NEMP) threats. Most of the protectors do well for both, but for some military applications high speed protection may be necessary.

FREQUENCY RANGE

There are broad coverage and single band gas tube or filter models. Most of lightning's energy is in the lower frequency range of dc to 1.0MHz. The further away from this range, the less the amount of energy that will get through to the equipment (throughput energy). Always choose the lowest throughput energy for the desired frequency range.

TRANSMIT (XMIT), TRANSCEIVE (XCV) OR RECEIVE ONLY (RO)

If multiple transmitters are combined, the number of XMIT signals is important. Gas tube protectors are voltage sensitive and multi-XMIT signals are voltage additive. Two 100 watt XMIT signals combined equal 200 watts of heating power but the additive voltages have peaks of 200V, which equate to a single 400 watt signal. Therefore, multi-channel simultaneous XMIT systems must have a higher turn-on voltage and be designed to handle higher peak instantaneous RF currents. This peak turn-on voltage calculation is not required for filter type protectors (no gas tube). (See "Section 4 - COMBINER PROTECTORS.")

TRANSMIT POWER (CONTINUOUS AND/OR PEAK)

As the frequency is increased in a gas tube type protector, the power handling is reduced. This is done to be sure the protector will turn off after a lightning strike or EMP firing and not be "kept alive" in a glow mode by the presence of the RF transmit energy. The turn-on voltage is determined by the protector power rating. Since most PolyPhaser units do not have dc continuity, little protection is lost by going to a higher turn-on voltage unit especially if XMIT combining is planned in the future. This is not a concern with filter type units (no gas tube).

PRESENCE OF AC OR DC POWER WITH THE RF SIGNALS

Usually for receive only situations such as tower top preamps and down converters. However, there are units available for cellular and P.C.S. ranges to accommodate the higher current requirements of tower top transmit amplifiers. Units are listed for dc injector/pickoff and for protecting already injected coax lines (pickor model).

MOUNTING

Bulkhead panels are recommended. (Bulkhead panel systems are listed as grounding components.) Flange style may be mounted on a bus bar or a single point ground panel shown on pages 42-47. A ground strap larger than the total sum of all the circumferences of the coax shields should be used to connect to a low inductance ground system. For more on grounding, see our listed book, *The 'Grounds' for Lightning & EMP Protection*.

CONNECTOR TYPE AND SEX

Type N connectors are standard. DIN, TNC, BNC, SMA, F, LC, and EIA male and female are stocked connectors. These and others are available for some models at an additional cost. The connector sex can be chosen for male and/or female combinations (except for some microwave models). The male is always the one with the outside moveable shell and solid center pin. (See page 100 for connector pictorials.)

Data/Phone Line Protection

Telephone central offices and computer rooms have many things in common. Both have computers connected to data or phone lines, local area networks (LAN), and phone channel banks (T-carrier). All are interconnected to the "outside world" with twisted pair, coaxial cable, or fibre optic interfaces.

Telephone line protectors supplied by the phone company are a first line of defense, but are not always connected to a high current capacity, fast transient response ground system. PolyPhaser offers a series of data and telco protectors when a higher level of protection is required.

LAN and T-carriers require protectors that have wide bandwidths for high frequency data with tightly controlled surge energy specifications. If our catalog products do not match your requirement, PolyPhaser can supply a custom designed product for your application.

Other special protectors are available for telco span line and repeater current loop lines. Please contact our customer service department.

Power Line Protection

For lightning and EMP, shunt type protectors will limit the voltages to a safe level for most non-electronic equipment. In-line type protectors are preferred for electronic equipment survival. In-line units should be mounted/grounded close to the protected equipment. For mainframe computers and broadcast equipment, in-line power mains protectors are listed which provide single or polyphase protection with EMI/RFI filtering.

For power line protector selection, the voltages, number of phases, configuration, current usage (in-line only), will pinpoint the model. Voltages to 480Vac are listed for single to three phase applications. All models (except IS-PSP-120 and IS-PSP-240) have built in end-of-life protection. Replacement modules and breakers are sold separately for most models. The 100/200A in-line, 120/208/240 shunt, and both PSP models are NRTL or CSA listed.

Grounding

Grounding is so important that we wrote a book about it (*The 'Grounds' for Lightning & EMP Protection*). Proper grounding is necessary to disperse lightning energy into the earth, away from electronic equipment as quickly as possible.

One low inductance connection to earth should be made with all other ground conductors from equipment attached to that point ("single point ground"). The ground system must have large surface area conductors in contact with the soil and be capable of dispersing high peak currents into the earth in the shortest possible time.

The ground system needs to be integrated with proper lightning protectors for your application. PolyPhaser provides the products, knowledge, and consulting services to help design and maintain your lightning protection system.

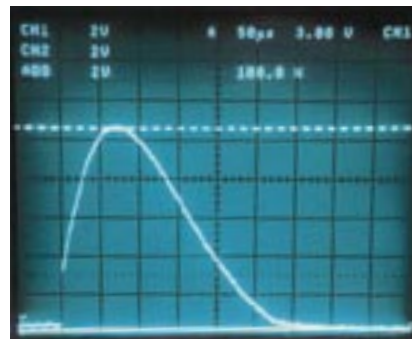
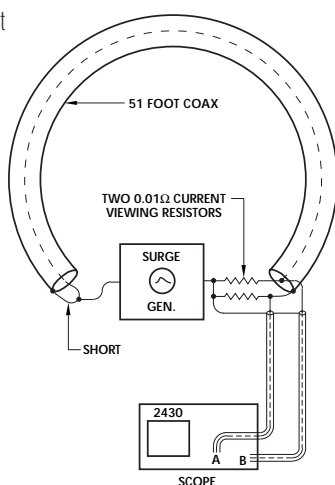
The Need for Coax Protection

Skin effect is a physical phenomenon that relates to the limited penetration into a conductor of an RF signal according to its frequency. Coax uses this effect to keep the RF signal inside its shield and any external coupling interference on its outside surface. This effect begins to degrade as the frequency is lowered (transfer impedance). The RF penetration, which is a gradient, begins to mix the shield's outside interference energy with the desired inside energy. A ground loop, which imparts 60Hz onto a desired signal, is due to dissimilar grounds causing ac current flow between points via the coax shield, coupling unwanted energy to the center conductor.

With lightning, the main frequency range is dc to 1MHz. This is in the range that affects the coax transfer impedance. The thicker the coax shield material, the less the effect of these low frequency currents.

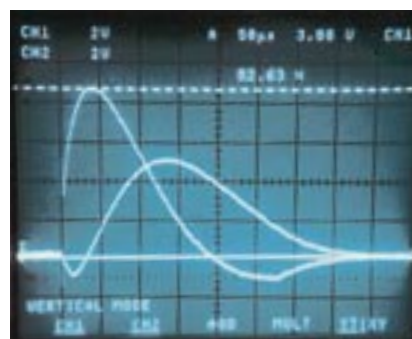
A simulated lightning test was performed on 51 feet of 1/2" hard line. The center conductor was connected to the shield on one end simulating a shunt-fed antenna. For the test, 1050 amperes of current was pulsed to individual 0.01 ohm resistors at the far end. The voltage drop across the current viewing resistors went to separate channels on a digital storage scope. Due to a lower inductance, the shield pulse arrived first. The center conductor had more inductance so the pulse was spread out in time. The energy (area under the curves) was exactly the same for both the shield and the center conductor.

Since the pulses arrive at different times, a differential voltage occurs that must be equalized and prevented from reaching the equipment input. This is precisely what the patented PolyPhaser products do to provide the ultimate protection.



The above pulse was used on a 51 foot long 1/2" hard line. One end was shorted to simulate a shunt-fed antenna, while the other end went to separate 0.01 ohm current viewing resistors.

NOTE: This pulse is the algebraic summation and its peak 1050 Amps is referenced to 100%.



SHIELD
The voltage across each 0.01 ohm resistor. Here the shield has 82.63% relative to the total pulse.



CENTER
Here the center conductor's peak is only 48.89% of the total. Note that the area under both waveforms is nearly equal. Each has 50% of the total surge energy.

PolyPhaser's Coaxial Impulse Suppressors

THE POLYPHASER DIFFERENCE

PolyPhaser Corporation's coaxial impulse suppressors are a unique line of patented products. Hermetically sealed voltage sensitive gas tubes are used on most models with additional components to assure that surge voltages and currents formed differentially on the coax are not conducted to the equipment input. There is no dc continuity from center pin to center pin on our dc blocked protectors.

Other gas tube protectors have dc continuity through their center pins and share the energy with the equipment before the gas tube turns on. If the equipment has an inductor to ground as the first component, the differential voltage must first propagate through the coax jumper to the equipment, then create enough inductive voltage drop across the combined inductances (coax cable jumper and input inductor) to turn on the gas tube.

Since the gas tube turn on voltage must be rated above transmitter power ($E_p = 1.414 \sqrt{PZ}$), a considerable inductive voltage drop ($E = L di/dt$) must occur for the gas tube to fire. The voltage required to fire the gas tube is directly related to pulse rise time and current flow through the combined inductances to ground. Typically, 10,000 amps (peak) through the equipment input circuitry to ground is required to develop the $L di/dt$ voltage needed to fire the gas tube in a dc continuity coax protector. *The equipment is subject to a 10,000 amp pulse before the protector can turn on!*

Quarter wave stub protectors are also dc coupled devices. There is dc continuity between center pins. However, instead of a broad band voltage sensitive device (gas tube), quarter wave stub protectors are a tuned band pass filter. A grounded quarter wave matching section in the device presents a high impedance to the center conductor at the designed operating band and a low impedance to ground for all other frequencies. Since most of lightning's energy is at dc or frequencies up to 1MHz, these type of protectors would appear to be ideal.

Antennas are a tuned circuit and will ring at their operating frequency when hit with a fast rise time voltage pulse (lightning). This on frequency ringing voltage will propagate

down the coax with other lower lightning frequencies. The quarter wave stub will, at best, divide the lower frequency energies, sending most to ground. Some of the lower frequency energy and all of the on frequency energy will go to the equipment input. A gas tube protector is voltage sensitive, regardless of frequency, and will conduct the ringing voltage to ground.

A PolyPhaser dc blocked protector only lets through our rated specification (low milli-, or microjoules). Peak voltage let-through is also significantly less than dc continuity protectors. PolyPhaser's measured let-through energy and voltage are the industry's lowest.

PolyPhaser's new dc blocked, non gas tube, weather resistant impulse suppressors continue our tradition of superior RF and surge performance. These new "*Microwave Filter*" devices with band passes from 800MHz up, represent the best protection available for CELLULAR through PCS (and above) equipment. Unlike quarter wave stubs, our filter protectors exhibit a wide flat band pass with very low VSWR and insertion loss. With average power level capabilities up to 750 watts, they are the best choice for critical high power applications.

Since PolyPhaser's *Microwave Filters* are dc blocked (quarter wave stub filters are not), the PolyPhaser filter does not "share" lightning energy with the equipment input. Detailed let-through voltage and energy specifications are published in this catalog.

Peak current ratings on coaxial protectors vary with different manufacturers. A higher peak current rating does not always mean a better protector. For example, consider a self supporting tower with 9 antennas and one microwave downlink for a total of 10 coaxial cables. An average strike would be 20kA. However, let's calculate a 100kA strike (less than 1 percent of all strikes). The tower would conduct 70kA to ground. The remaining 30kA is divided between 10 coax cables, or 3kA on each cable. Since most of the peak current is on the shield, about 1kA would be on the center conductor. When applying the above current division principle to a tower system, it is easy to see why PolyPhaser's 20kA rating is more than adequate.

[illegible]

**** Available soon**

ac Power Protectors

POWER MAINS INFORMATION

There are several ways in which your equipment can be damaged via the power line. One is a strike elsewhere on the power line inducing a surge that travels to your equipment. However, a strike to your tower or a coupled surge to the phone lines can also damage equipment since the power line can provide an alternate path to ground. To ensure survival, all inputs and outputs (I/Os) must not only be protected but must be bonded in common via a common low inductance conductor to an earth ground. All grounds should be bonded in the earth to form a single earth system.

Power mains protectors are to be placed at the entrance panels, transfer switches or distribution panels. They should have a low inductance path to the earth system and be installed with the minimal lead inductance (short with gradual bends). For best protection, have an additional in-line power protector at or very near the sensitive equipment. This should not be a protector that uses only the wall outlet safety ground. It should be a protector that can be mounted/grounded (like the IS-PLDO or IS-MSRP) to your main earth system.

TYPES OF POWER MAINS CONFIGURATIONS

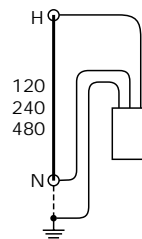
Power mains come in several different configurations. The three basic ones are single, bi-phase and three phase. Three phase is sometimes called polyphase and has further divisional classes using the letters "Y", (written "Wye", and "Δ", the Greek letter Delta).

SINGLE PHASE

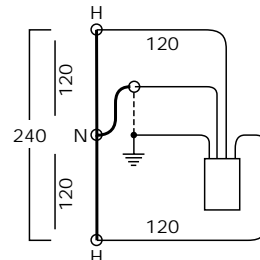
This is the simplest. It has a live or hot feed, a return called a neutral and a safety ground. This is commonly used for secondary wiring for a normal outlet. It may be any worldwide standard voltage. For the U.S.A., it is 120Vac (see drawing).

BI-PHASE

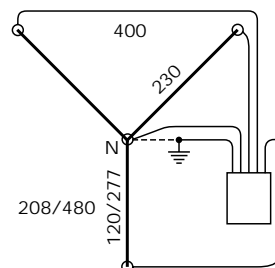
This is a common feed configuration. It may be obtained by either a single transformer, center tapped or by grounding one phase of a three phase delta. The former is often called single phase in the U.S.A. since it often uses a single, center tapped transformer fed from one of three



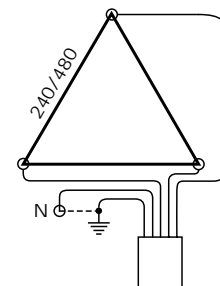
SINGLE PHASE (SP)
120, 240 or 480VAC



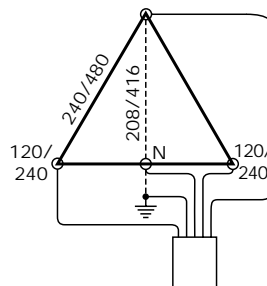
BI-PHASE (North American Only)



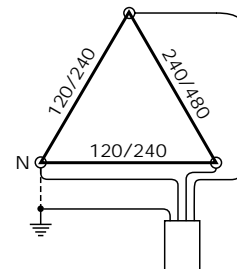
120/208 230/400 277/480 WYE (Y)



240 or 480 DELTA (D)



240 or 480 OPEN DELTA (O)



240 or 480 GROUNDED DELTA

high line phases. These phases are 180 degrees from each other so 120Vac is available as well as 240Vac. This is typical for most houses in the U.S.A. (see drawing).

POLYPHASE OR THREE PHASE

This is the feed for large facilities. The phases are 120 degrees apart. The Wye configuration normally always has a neutral/return which is grounded. The true delta (called a closed delta) normally does not have a ground. There is an open delta where a high leg (red lead) has a higher voltage to ground than the rest and there is a ground lead. A grounded delta has one leg grounded (see drawings).

ac Power Protectors

VOLTAGES AVAILABLE AND WHERE USED

Voltages to 480Vac are used for normal feeds. The voltages will depend on the type of feed and your country. Measure the phase to phase voltages and the phase to ground voltages to determine the type of service, then check the current rating on the (largest) cut-off breaker.

CONNECTIONS FOR PROTECTORS

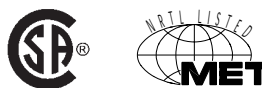
The connections for the protectors are given for each model and service type. Only the voltages change. The wires are properly color coded for identification.

SHUNT OR IN-LINE AND WHERE TO USE EACH

In-line protectors are load bearing; shunt types are not. In-lines are presently available up to 200A. These have redundancy, better surge limiting and provide filtering. Shunt types have no real load current limit however the larger the load, the larger the wires, and the more the surge energy will follow the conductors with the largest surface area. This means that more than one protector should be used. Two shunt protectors separated by twenty feet of wiring in steel conduit almost equal a single in-line protector. Both types have alarm contacts and field replaceable surge components.

NRTL UL 1449 APPROVAL

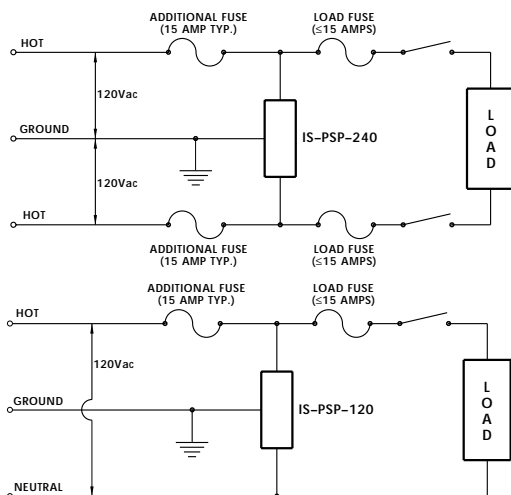
PolyPhaser employs the services of CSA and MET Laboratories, Inc. to test and certify its products. These Nationally Recognized Testing Laboratories (NRTL) are approved by OSHA in the U.S.A. CSA is also approved by Federal, State, City and Municipal jurisdictions throughout the U.S.A. Both agencies test to all applicable standards including UL, ANSI, IEEE, NFPA, etc. Both agencies are approved by the National Institute of Standards and Technology (NIST) through the National Voluntary Laboratory Accreditation Program (NVLAP) and are a National Certified Body in the IECEE Scheme. CSA and MET labels are accepted throughout the U.S.A. and in most countries.



ac Power Protectors - Component Protectors



Models shown: IS-PSP-120 (left) , IS-PSP-240 (right)



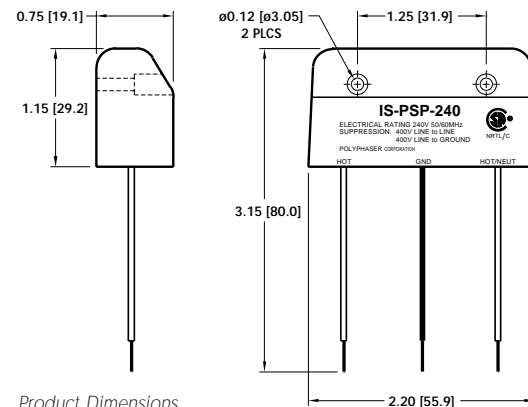
Recommended installation for IS-PSP-240 (top) and IS-PSP-120 (bottom).

HARDWARE POWER SUPPLY SHUNT PROTECTOR

APPLICATION:

Used for commercial and military equipment protection — incorporated within the equipment and properly fused or breakered.

- Low cost
- Superior because it is referenced to your equipment
- High speed MOV & high current gas tube combination
- Long life
- Must be locally fused/breakered (15A)
- Soldered in place
- 1-3/4" long #20AWG leads
- NRTL/C - LR#106164-4



Product Dimensions

SPECIFICATIONS:

Surge: 35kA IEC 1000-4-5 8/20μs waveform 875 Joules

Turn-on: IS-PSP-120 ±400Vdc L to N
±400Vdc L to G
IS-PSP-240 ±400Vdc L to L
±400Vdc L to G

Turn-on Time: 2ns L to L, 10ns L to G for 2kV/ns

Temperature: -40°C to +85°C Storage/Operating

ORDER INFORMATION:

IS-PSP-120 for 120Vac (single phase)*

IS-PSP-240 for 240Vac (two phase)*

*NRTL/C, must be locally fused/breakered @ 15A

ac Power Protectors - Component Protectors



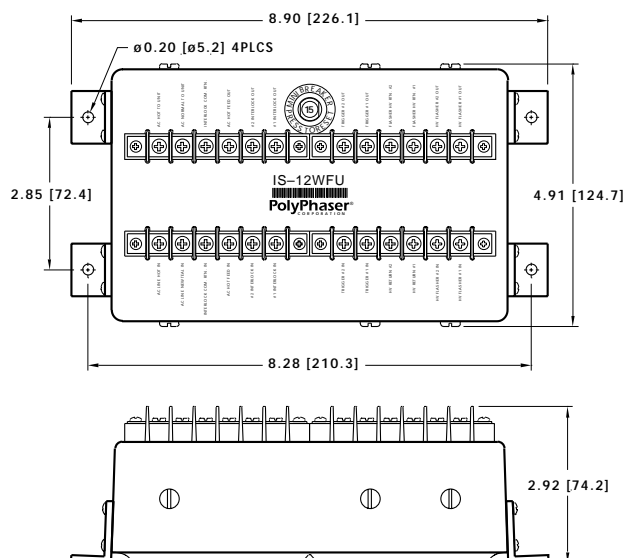
Model shown: IS-7VWFU, flange mount

DROP-IN TOWER STROBE FLASHER PROTECTOR

APPLICATION:

To prevent lightning energy from damaging strobe flasher and entering building power lines.

- Single or double strobe flasher models
- In-line protector for ac, HV, HV return, trigger and interlock lines
- Housed use only — fits inside some control boxes



Product Dimensions, model shown IS-12WVFU

SPECIFICATIONS:

Hook-up	Surge:*	Turn-on:	Usage:
ac	15kA	200Vdc	120Vac@15A
HV & return	6.5kA	2000Vdc	2000Vdc
trigger & return	10kA	400Vdc	350Vdc
interlock	15kA	200Vdc	120Vac

*IEC 1000-4-5 8/20 μ s waveform

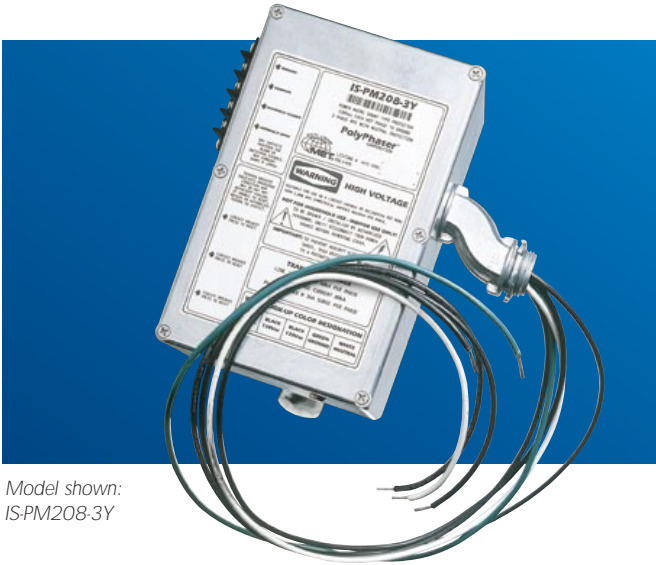
Temperature: -40°C to +85°C Storage/Operating

ORDER INFORMATION:

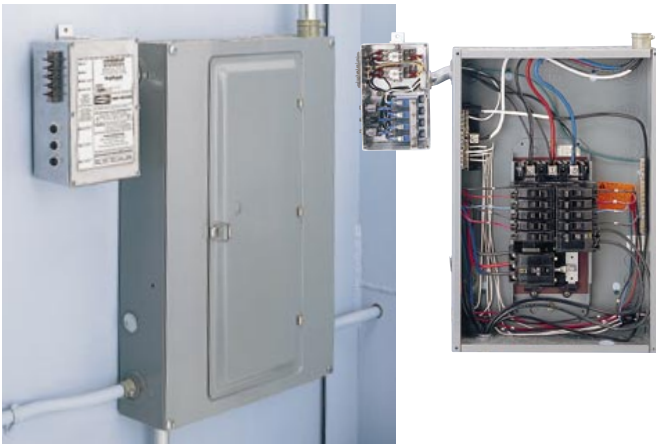
IS-7WVFU for single (7 wire) flasher unit

IS-12WVFU for dual (12 wire) flasher unit

ac Power Protectors



Model shown:
IS-PM208-3Y



Typical Installation: external view (left) and internal view (right)

POWER MAINS SHUNT TYPE LINE PROTECTOR

APPLICATION:

For building service entrances where lightning energy may be shunted to an outside ground before it enters the building. The distance between the entrance and a sensitive electronic load should not be more than 10 feet unless another (in-line) protector is also being used on a single point ground.

- NRTL UL 1449 MET approved (120, 208 & 240Vac only)
- Single, bi and three phase
- 120, 208, 240, 400 and 480Vac
- Surge energy is shunted to earth, not to neutral
- Neutral protection for single earthed neutral sites
- Remote/local status dry contacts
- Protectors individually circuit breakered — will not interrupt load power
- Field replaceable protection blocks

Mil Specs: Many — call with requirements

SPECIFICATIONS:

Surge: 40kA per phase IEC 1000-4-5 8/20 μ s waveform

Turn-on Time: ≤ 25 ns for full lead length 2kV/ns

Temperature: +5°C to +40°C Storage/Operating

ORDER INFORMATION:

	AC Voltage	Phase Type	Total Unit Surge Current**	Peak dc Volts@3kA Phase to Gnd** (No-Load) Surge	Turn-on Phase to Gnd dc (ac)***
IS-PM120-SP*	120	Single	80kA	400V	205 (145)
IS-PM208-3Y*	208	Three	160kA	400V	205 (145)
IS-PM240-SP*	240	Single	80kA	700V	360 (255)
IS-PM240-BP*	240	Two (US only)	80kA	400V	205 (145)
IS-PM400-3Y	400	Three	160kA	700V	360 (255)
IS-PM480-3Y	480	Three	160kA	850V	425 (300)

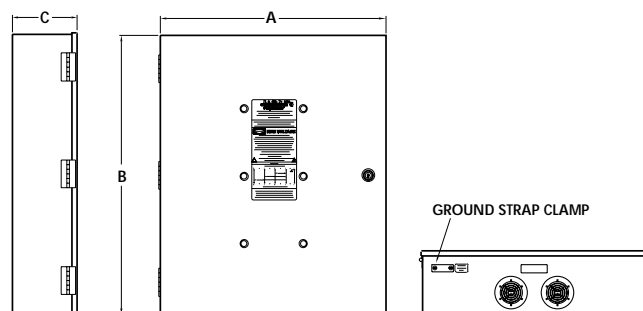
* NRTL/MET Listed to UL 1449

**Based on 8/20 μ s waveform

***Phase to Phase = 2 times

ac Power Protectors

Model shown: IS-IL400-3Y-100A front (left), inside (right)



DIMENSIONS (inches [mm])				SHIPPING WEIGHT	
UNIT	A	B	C	100A	200A
IS-IL120-SP 100A & 200A	16.235 [412.37]	24.160 [613.66]	6.620 [168.15]	42 LBS	46 LBS
IS-IL240-SP 100A & 200A	16.235 [412.37]	24.160 [613.66]	6.620 [168.15]	42 LBS	46 LBS
IS-IL240-BP 100A & 200A	24.000 [609.60]	24.000 [609.60]	6.620 [168.15]	70 LBS	75 LBS
IS-IL208-3Y 100A & 200A	24.000 [609.60]	30.000 [762.00]	7.000 [177.80]	99 LBS	107 LBS
IS-IL400-3Y 100A & 200A	24.000 [609.60]	30.000 [762.00]	7.000 [177.80]	99 LBS	107 LBS
IS-IL480-3Y 100A & 200A	24.000 [609.60]	30.000 [762.00]	7.000 [177.80]	99 LBS	107 LBS

Product Dimensions

POWER MAINS IN-LINE TYPE LINE PROTECTOR**APPLICATION:**

Where outside originating line surges are a problem and they must be shunted and filtered to protect sensitive electronic equipment.

- Single, bi and three phase
- 120, 208, 240, 400 and 480Vac
- Built-in redundancy - dual stages per phase with pi-network, low pass filtering
- Surge energy is shunted to ground, not to neutral
- Neutral protection for single earthed neutral sites
- Front panel circuit breaker indicators
- Remote/local status dry contacts
- 100 and 200A load currents per phase
- Protectors individually circuit breakered — won't interrupt load power
- Field replaceable protection blocks/circuit breakers if needed
- NRTL UL 1449 listed NRTL/C LR#106164-3
- Not weather resistant

SPECIFICATIONS:

Surge: 45kA per phase IEC 1000-4-5 8/20μs waveform

Turn-on Time: Not defined due to filtering

EMI/RFI Filtering: (MIL-STD-220)

-30dB 1.2MHz, -30dB 8MHz, -31.4dB 10MHz

Temperature: -20°C to +40°C Storage/Operating

ORDER INFORMATION:

	AC Voltage	Phase Type	Total Unit Surge Current**	Peak dc Volts@3kA Phase to Gnd** (No-Load) Surge	Turn-on Phase to Gnd dc (ac)***
IS-IL120-SP*	120	Single	90kA	400V	205 (145)
IS-IL208-3Y*	208	Three	175kA	400V	205 (145)
IS-IL240-SP*	240	Single	90kA	700V	360 (255)
IS-IL240-BP*	240	Two (US only)	130kA	400V	205 (145)
IS-IL400-3Y*	400	Three	175kA	700V	360 (255)
IS-IL480-3Y*	480	Three	175kA	850V	425 (300)

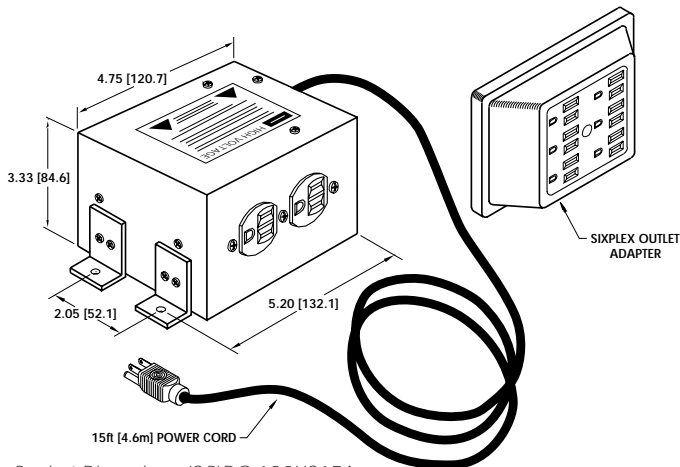
* You must add desired Power Per Phase (-100A or -200A) to product number when ordering (i.e. IS-IL120-SP-100A)

Based on 8/20μs waveform *Phase to Phase = 2 times

ac Power Protectors



Model shown IS-PLDO-120US15A



Product Dimensions: IS-PLDO-120US15A

Order: **SIXPLEX** - six outlet adapter for 120Vac US15A

POWER LINE EXTENSION PROTECTORS - 120/240Vac

APPLICATION:

Where equipment requires power line protection for surges/lightning. This unit will provide proper protection, filtering and grounding since it has an all metal grounded enclosure.

- NRTL listed – UL #1449 (Domestic only)
- In-line multi-stage (EMP rated) protectors
- All aluminum grounded enclosure/panel for lower inductance
- Multi-strike capability
- Circuit breakered for added protection
- Master on/off switch
- Can be mounted/grounded to a Copper Single Point Ground Panel (See page 42)
- Crimped and soldered terminal construction for reliability
- Duplex outlet adaptable to six outlets (Domestic)
- IS-PLDO models are duplex outlets
- IS-PLSO models are single outlets

SPECIFICATIONS:

Surge: 20kA IEC 1000-4-5 8/20 μ s waveform 800J (120Vac) 1.4kJ (240Vac)

Turn-on: 200Vdc (120Vac), 370Vdc (240Vac)

Turn-on Time: Not defined due to filtering

EMI/RFI Filtering: (Measured to MIL-STD-220)
-50dB @ 5MHz, -55dB @ 70MHz, -45dB @ 140MHz

Surge Let-Through Voltage: 6kV/3kA 8/20 μ s waveform
400Vp to 10kA, 600Vp to 20kA (120Vac)
700Vp to 10kA, 1000Vp to 20kA (240Vac)

Temperature: +5°C to +40°C Storage/Operating

ORDER INFORMATION:

IS-PLDO-120US15A for 120Vac with 15' cord, 15 Amps

IS-PLDO-120US20A for 120Vac with 6' cord, 20 Amps

IS-PLDO-240US15A for 240Vac with 10' cord, 15 Amps

IS-PLDO-240AU10A for 240Vac with 2.5m cord, 10 Amps

IS-PLSO-240CE15A for 240Vac with 2.5m cord, 15 Amps

IS-PLSO-240IN15A for 240Vac with 2.5m cord, 15 Amps

IS-PLSO-240IS15A for 240Vac with 2.5m cord, 15 Amps

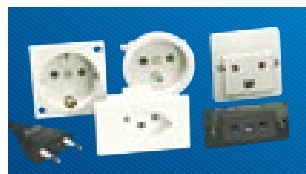
IS-PLSO-240UK10A for 240Vac with 2.5m cord, 10 Amps

Other international plug styles available. The International Plug Patterns are printed on page 39. Call for more information.

ac Power Protectors - Worldwide Plug/Socket Patterns



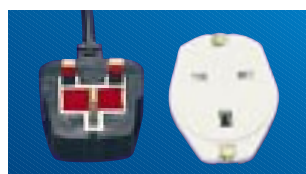
Cont. Europe
CEE 7



Europlug
CEE 7/16 (2.5A max.)



Australia/Mainland China



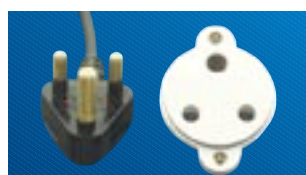
United Kingdom/Hong Kong



Denmark



France/Belgium



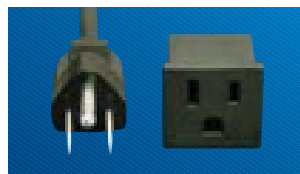
India (Old. Brit.)



Israel



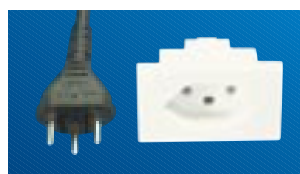
Italy



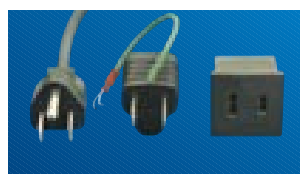
Japan



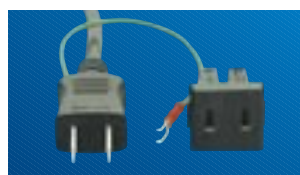
North America/Taiwan
Brazil (special order)
(NEMA 5-15)



Switzerland



Japan
(Polarized) Non-grounded



Flat blade
(Unpolarized) Non-grounded



North America
(NEMA 5-20)



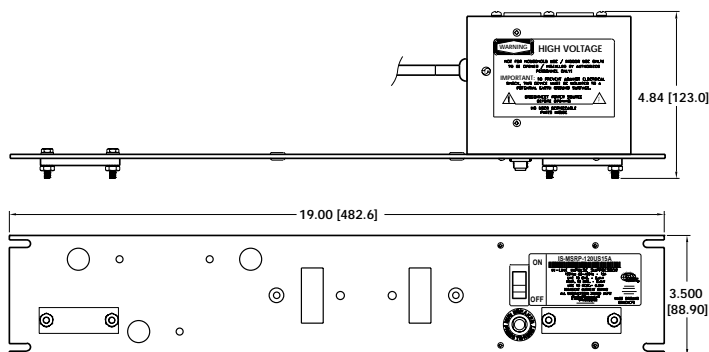
North America
(NEMA 6-15)

Information provided by Panel Components Corporation

ac Power Protectors



Model shown: IS-MSRP-120US20A back view (top), front view (bottom)



Product Dimensions: IS-MSRP-120US20A

MULTI-SUPPRESSOR RACK PANEL WITH BUILT-IN POWER LINE PROTECTOR

APPLICATION:

Where a bulkhead panel can't be installed and an equipment rack must be protected. All inputs and outputs should have protection and be grounded in common with the rack.

- Provides a low inductance, single point grounding location
- Standard 19" rack size by 3.5" high and 1/8" aluminum
- Has IS-PLDO built on the panel (See page 38)
- Copper blocks sandwich 1-1/2" x 20' copper strap for grounding
- Mounts up to three coaxial protectors
- Mounts either single or dual twisted pair protectors (See pages 57 & 58)
- U.S. 15A models NRTL listed UL #1449

You may mount any three models from Group A or any two models from Group A and one model from Group B or any two models from Group B with any one model from Group A. Female connectors only.

GROUP A: IS-B50 Series, IS-NEMP

GROUP B: Any Small Box Type, Aluminum Enclosure Protector

NOTE: You may *not* have all three models from Group B.

SPECIFICATIONS:

Surge: 20kA IEC 1000-4-5 8/20μs waveform 800J (120Vac) 1.4kJ (240Vac)

Turn-on: 200Vdc (120Vac), 370Vdc (240Vac)

Turn-on Time: Not defined due to filtering

EMI/RFI Filtering: (Measured to MIL-STD-220)

-50dB @ 5MHz, -55dB @ 70MHz, -45dB @ 140MHz

Surge Let-Through Voltage: 6kV/3kA 8/20μs waveform

400Vp to 10kA, 600Vp to 20kA (120Vac)

700Vp to 10kA, 1000Vp to 20kA (240Vac)

Temperature: +5°C to +40°C Storage/Operating

ORDER INFORMATION:

IS-MSRP-120US15A* 120Vac with 15' cord, 15A, Duplex

IS-MSRP-120US20A 120Vac with 6' cord, 20A, Duplex

IS-MSRP-240US15A 240Vac with 10' cord, 15A, Duplex

IS-MSRP-240AU10A 240Vac with 2.5m cord, 10A, Duplex

IS-MSRP-240CE15A 240Vac with 2.5m cord, 15A, Single

IS-MSRP-240UK10A 240Vac with 2.5m cord, 10A, Single

IS-MSRP-240IN15A 240Vac with 2.5m cord, 15A, Single

IS-MSRP-240IS15A 240Vac with 2.5m cord, 15A, Single

*Sixplex outlet adapter available for 120Vac US 15A (see page 38).

Other international plug styles available (see page 39).

dc Power Protectors



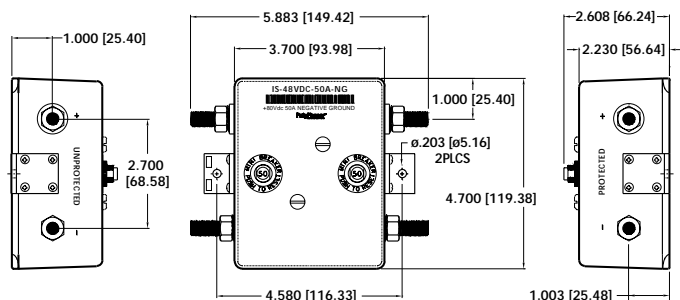
Models shown: IS-24VDC-30A-FG (left) and IS-12VDC-50A-NG (right)

DC BATTERY POWER PROTECTORS

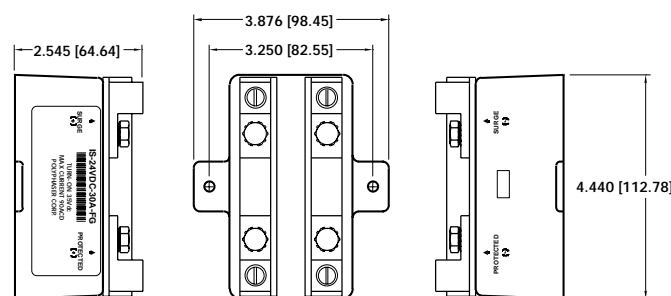
APPLICATION:

Solar panels can capture large amounts of nearby strike energy due to their large area. The protectors prevent energy from entering the building and damaging the regulator.

- Protects series pass and relay type regulators for 30A and 50A
- Has head room for open circuit arrays and battery surface charge
- Positive, negative and floating grounds
- Low resistance/voltage drop
- Aluminum enclosure
- 18-8 stainless steel hardware



Product Dimensions: IS-48VDC-50A-NG



Product Dimensions: IS-24VDC-30A-FG

SPECIFICATIONS:

Surge Per Pair: 18kA IEC 1000-4-5 8/20μs waveform

Turn-on: 18Vdc for IS-12VDC 27Vdc for IS-17VDC
35Vdc for IS-24VDC 53Vdc for IS-35VDC
80Vdc for IS-48VDC 100Vdc for IS-60VDC

Temperature: -40°C to +65°C Storage/Operating +50°C

Turn-on Time: <2ns

Resistance: 0.02Ω

Throughput Surge: 30A - <420mJ 6kV 3kA 8/20μs waveform
50A - <420mJ 6kV 3kA 8/20μs waveform

ORDER INFORMATION:

IS-12VDC -30A or -50A -NG (Negative Ground)

IS-17VDC -30A or -50A -PG (Positive Ground)

IS-24VDC -30A or -50A -FG (Floating Ground)

IS-35VDC

IS-48VDC

IS-60VDC

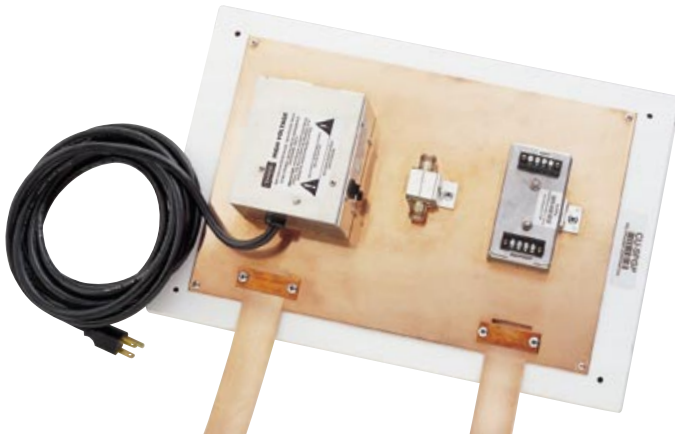
Part number example: IS-12VDC-30A-NG

Connections: 30A - 14 to 1/0 AWG, Compression Lug
50A - 3/8-24 SS Studs

Grounding Solutions



Model shown: CU-SPGP



Typical Mounting

Note: Mounted PolyPhaser products not included, but are available.

COPPER GROUNDING PANEL

APPLICATION:

Where a grounded entrance panel cannot be installed due to ownership, etc. and it is desired to provide proper and effective protection to a small group or rack(s) of equipment, this panel may be used to mount/ground protectors and to establish a single point grounding location for grounding the racks/chassis of equipment.

- Simple to install
- Fits 16" on center stud construction
- Copper plate 0.062"
- Melamine covered particle board
- Mount products at desired location on plate

Option: 20" Center Stud Mounting

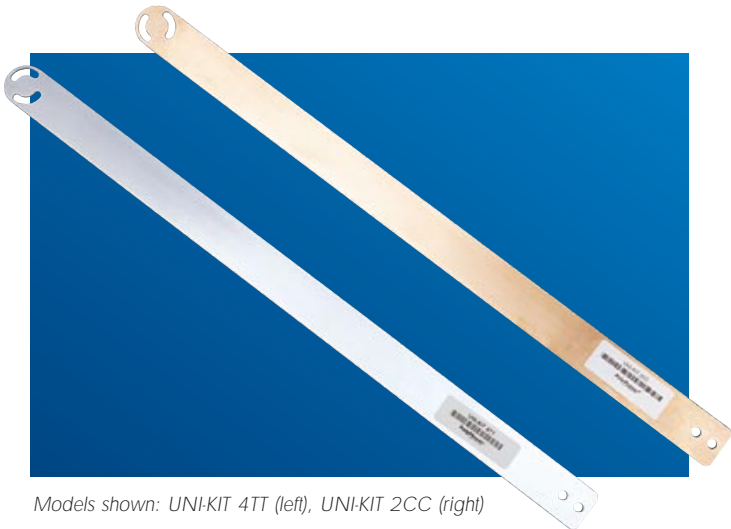


Includes CU-SPGP Accessories

ORDER INFORMATION:

CU-SPGP Copper Single Point Ground Panel with:
 4 concrete anchors
 10 mounting screws
 2 rolls 10' x 1-1/2" copper strap
 2 copper sandwich bars

Grounding Solutions



Models shown: UNI-KIT 4TT (left), UNI-KIT 2CC (right)



Installed UNI-KIT (see page 104 for detailed installation steps)

CABLE GROUNDING KIT SERIES
UNI-KIT 2 & UNI-KIT 4

APPLICATION:

Coaxial shield grounding is required to provide an effective ground path to prevent energy from reaching equipment. Integrating copper strap as a conductor provides an improved surface area connection to the cable shield, thus reducing inductance.

- UNI-KIT 4 fits 2-1/8" to 4" diameter and elliptical waveguides up to EW20
- UNI-KIT 2 fits cables from 1/4" to 2-1/8" diameter and elliptical waveguides up to EW44
- Lower resistance and inductance than wire pigtailed
- 24" copper tail is weather protected to prevent tower corrosion damage
- Provides a high current ground path; tested to 50kA
- Eight models with specially coated ends for no dissimilar metal connections
- Two NEMA-spaced tail grounding holes provided with stainless (1/4-20x3/4) hardware
- Quick installation
- Adjustable strap to cable angle
- Traditional weatherizing materials included

SPECIFICATIONS:

Resistance: 680μΩ

Inductance: 0.3μH

Surge Current: 50kA

Total Voltage Drop: 763V (based on 20kA 8/20μs strike)

ORDER INFORMATION:

	Type of metal to be grounded (top clamping end)	Grounding to (bottom end)	Diameter
UNI-KIT 2CT	Copper or Brass	Aluminum, Tin or Galvanized	1/4" - 2-1/8"
UNI-KIT 4CT	Copper or Brass	Aluminum, Tin or Galvanized	2-1/8" - 4"
UNI-KIT 2CC	Copper or Brass	Copper or Brass	1/4" - 2-1/8"
UNI-KIT 4CC	Copper or Brass	Copper or Brass	2-1/8" - 4"
UNI-KIT 2TT*	Aluminum, Tin or Galvanized	Aluminum, Tin or Galvanized	1/4" - 2-1/8"
UNI-KIT 4TT	Aluminum, Tin or Galvanized	Aluminum, Tin or Galvanized	2-1/8" - 4"
UNI-KIT 2TC*	Aluminum, Tin or Galvanized	Copper or Brass	1/4" - 2-1/8"
UNI-KIT 4TC	Aluminum, Tin or Galvanized	Copper or Brass	2-1/8" - 4"

*Can also be used for grounding a galvanized tower leg.

Grounding Solutions - Cable Entrance Panels



Model Shown: 8PEP



Typical Installation - back view

POLYPHASER ENTRANCE PANEL (PEP)

APPLICATION:

Where coaxial cables enter a facility and both grounding of the outside shield and coaxial protectors are desired to protect electronic equipment as well as for establishing a central single point ground location.

- Made of special hardness copper allowing threaded holes to provide extra surface area interconnections
- Accommodates cable from 1/2" to 1" diameter
- Weather-boot protected cable grounding kit
- 6" wide 15' long copper straps provide low inductance, large surface area conductors with sandwich bar connection and joint compound for system lug or exothermic interconnection to the perimeter ground cable
- Boot made of EPDM +300, -60°F, excellent UV and atmospheric stability, expands to 200% to fit over cable
- Inside horizontal plates provide sandwich connections to flexible copper straps for grounding the coaxial protectors
- Design allows for various length cable connections to the protectors and accommodates cable entry
- Horizontal plates have hole locations for bolting other equipment grounding cables to form a single point facility ground

SPECIFICATIONS:

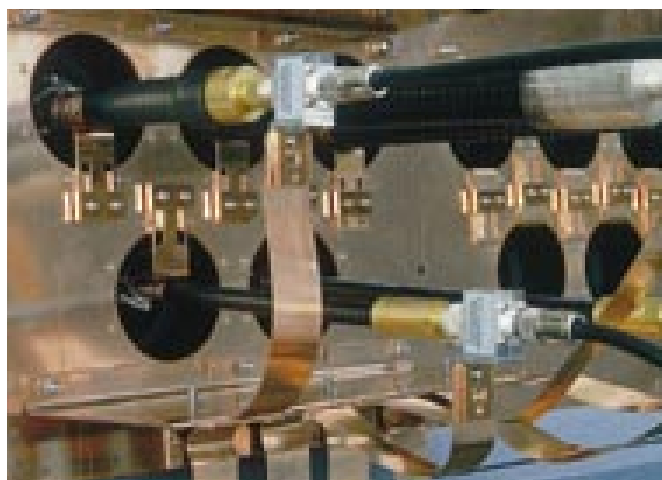
Material: C110 half hard copper

Hardware: Stainless steel and brass

Boots: UV & weather resistant EPDM rubber

ORDER INFORMATION:

8PEP 8 port entrance system

Grounding Solutions - Cable Entrance Panels*Model Shown: 3 PEEP**Typical Installation***POLYPHASER EARTHED ENTRANCE PANELS (PEEP)****APPLICATION:**

Where coaxial cables enter a facility and both grounding of the outside shield and coaxial protectors are desired to protect electronic equipment as well as for establishing a central single point ground location.

- Accommodates up to 3-1/8" rigid line (without EIA flange) and up to EW28 type elliptical line (without flange) including coaxial cables
- Weather-boot protected cable grounding kit
- 6" wide 15' long copper straps provide low inductance, large surface area conductors with sandwich bar connection and joint compound for system lug or exothermic interconnection to the perimeter ground cable
- Boot made of EPDM +300, -60°F, excellent UV and atmospheric stability, expands to 200% to fit over cable
- Inside horizontal plates provide sandwich connections to flexible copper straps for grounding the coaxial protectors
- Design allows for various length cable connections to the protectors and accommodates cable entry
- Horizontal plates have hole locations for bolting other equipment grounding cables to form a single point facility ground

SPECIFICATIONS:

Material: C110 half hard copper

Hardware: Stainless steel and brass

Boots: UV & weather resistant EPDM rubber

ORDER INFORMATION:

3PEEP 3 port system, two 6" wide straps

5PEEP 5 port system, two 6" wide straps

8PEEP 8 port system, two 6" wide straps

10PEEP 10 port system, four 6" wide straps (two-5PEEP)

16PEEP 16 port system, four 6" wide straps (two-8PEEP)

24PEEP 24 port system, four 6" wide straps (three-8PEEP)

Grounding Solutions - Cable Entrance Panels



Model Shown: 10PB



Typical Installation - back view

BULKHEAD PANELS (PB)

APPLICATION:

Where coaxial cables enter a facility and both grounding of the outside shield and coaxial protectors are desired to protect electronic equipment as well as for establishing a central single point ground location.

- Accommodates cable from 1/2" to 3-1/8" diameter
- Weather-boot protected cable grounding kit
- 6" wide 15' long copper straps provide low inductance, large surface area conductors with sandwich bar connection and joint compound for system lug or exothermic interconnection to the perimeter ground cable
- 18-8 stainless steel hardware & 300 series stainless clamps
- Boot made of EPDM +300, -60°F, excellent UV and atmospheric stability, expands to 200% to fit over cable
- Removable universal pre-punched protector mounting plates on U-panel allow for easy installation and for rigid or elliptical line penetrations
- U-panel allows for indoor access only to the coax connections for a safe, dry and reliable installation
- U-panel provides a low inductance grounding means for the coaxial protectors and can be used as a central single point ground for the entire facility

SPECIFICATIONS:

Material: C110 half hard copper

Hardware: Stainless steel and brass

Boots: UV & weather resistant EPDM rubber

ORDER INFORMATION:

3PB 3 port system, two 6" wide straps

5PB 5 port system, two 6" wide straps

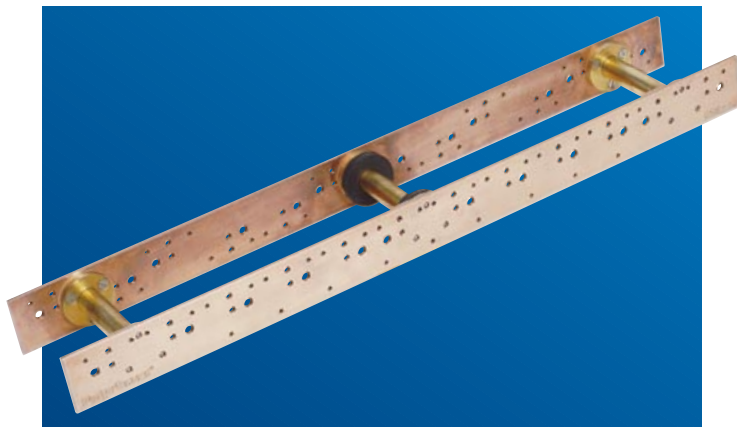
8PB 8 port system, two 6" wide straps

10PB 10 port system, four 6" wide straps (two-5PB)

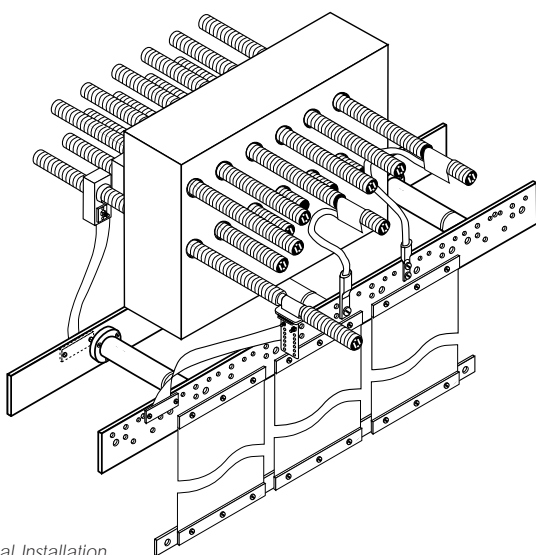
16PB 16 port system, four 6" wide straps (two-8PB)

24PB 24 port system, four 6" wide straps (three-8PB)

Grounding Solutions



Model Shown: GSIE-12



Typical Installation

GROUNDING SYSTEM INTERNAL TO EXTERNAL KIT

APPLICATION:

The Grounding System Internal to External (GSIE) is uniquely designed to provide a high quality, low inductance path to ground for existing sites as well as new construction. This system assures that surge protectors, as well as the coax or wave guide, are properly grounded. The GSIE Series can be used with multi-port entry panel systems and features copper straps and ground bars which attach to the existing perimeter ground system.

- Offers ease of installation to utilize grounding kits and surge protectors
- Quality copper construction provides low inductance path to ground
- Single point grounding capability tied to perimeter grounding system
- Accommodates existing and new shelter construction (wall thickness of 5" to 8")
- Diverts lightning energy to earth prior to reaching equipment
- Assembly access hardware is internal to shelter (tamper resistant)
- Weathertight seals included
- Accessory options: GSIE KIT 1, GSIE KIT 2 and UNI-KIT

Patent Pending

ORDER INFORMATION:

GSIE-8 21.4" x 2.5"

GSIE-12 31.6" x 2.5"

Grounding Solutions



Cu Primer Kit



CCK

COPPER PRIMER KIT

APPLICATION:

Some customers wish to paint the copper straps and entrance panels for aesthetic or other reasons. Our copper primer kit suitably prepares the copper for painting.

- Prevents the paint from cracking and peeling off of the copper
- After exterior paint is applied on primed surface, the entrance panel and straps meld with the building
- Primer color is light gray

COPPER CLEANING KIT

APPLICATION:

Provides a means to clean copper and weather seal connections from moisture and corrosion.

- Nylon abrasive scrub pad
- Silicone based copper joint compound
- Finger towelettes for clean up
- MSDS information and instructions included

ORDER INFORMATION:

Cu PRIMER KIT Copper Primer Kit contents:
19 oz. can self-etch primer*
1 pair of gloves
2 cleaning pads
2 tack cloths*
9 finger cleaning packets*

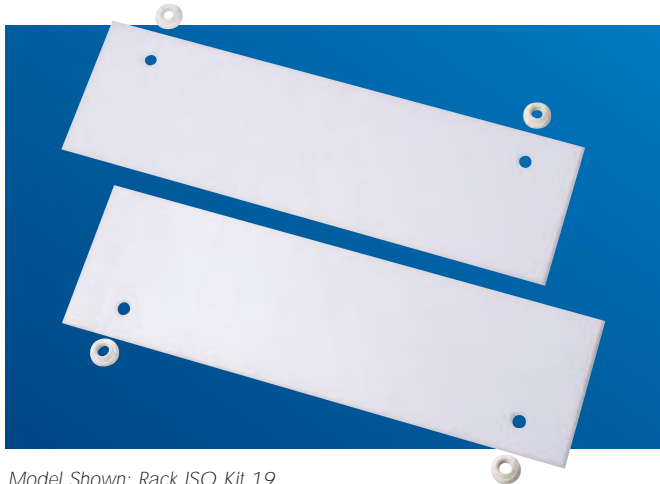
CCK Copper Cleaning Kit contents:
1.4 oz. copper joint compound*
1 cleaning pad
9 finger cleaning packets*

*Includes MSDS Sheet

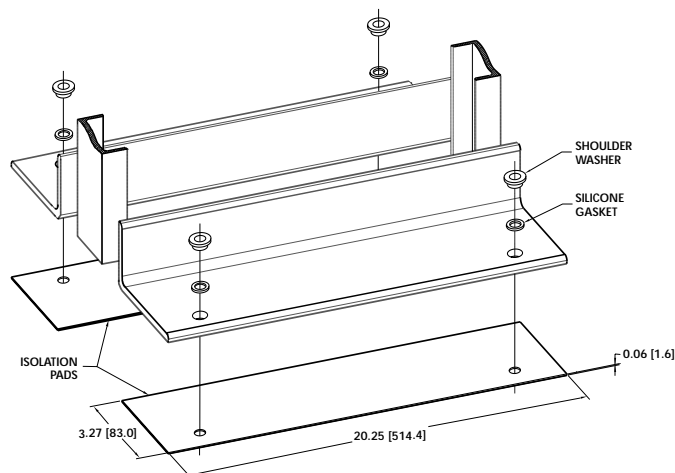


Typical Application

Grounding Components



Model Shown: Rack ISO Kit 19



Product Dimensions: RACK ISO KIT 19

RACK ISOLATION KIT

APPLICATION:

Isolate equipment racks from conductive flooring to prevent multiple ground paths. Kit can be utilized on existing racks, new installations, concrete floors or structures, and metal floors and enclosures.

- Isolation pads made of high dielectric polypropylene
- Easy installation
- Designed for new installations as well as existing racks
- Mounts with standard 1/2" or 3/8" diameter hardware

SPECIFICATIONS:

Breakdown Voltage: 6kV

Compression Strength: 1200 psi - Isolation Pad
5000 psi - Washers

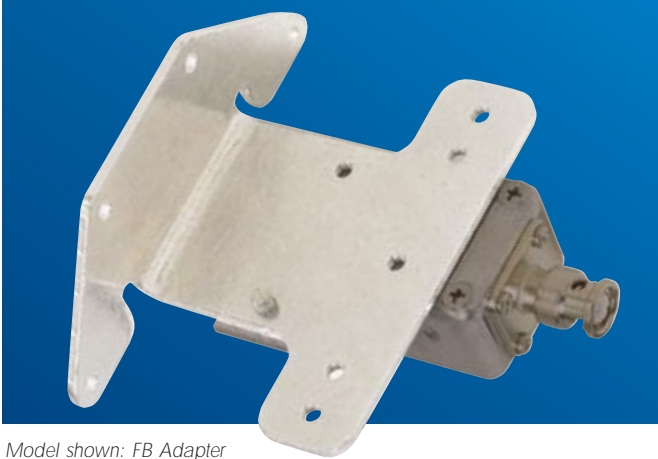
Mounting Hardware: 1/2" or 3/8" dia. (not included)

ORDER INFORMATION:

RACK ISO KIT 19 with 19" rack width

RACK ISO KIT 23 with 23" rack width

Grounding Components



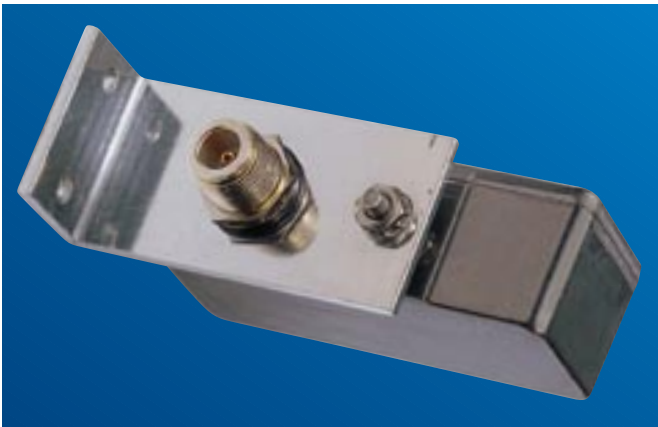
Model shown: FB Adapter

FLANGE TO BULKHEAD ADAPTER

APPLICATION:

FB ADAPTER adapts PolyPhaser flange mountable protector to a bulkhead panel.

- Provides a low inductance, large surface area connection
- Designed to mount to any PolyPhaser Bulkhead, PEEP or PEP entrance panel
- Designed to accommodate most PolyPhaser flange mountable design



Model shown: BF Adapter

BULKHEAD TO FLANGE ADAPTER

APPLICATION:

BF ADAPTER adapts PolyPhaser bulkhead mountable protector to a single grounding panel or other flat surface.

- Provides a low inductance, large surface area connection
- Designed for female connectors handling most bulkhead protectors

ORDER INFORMATION:

FB ADAPTER Flange to Bulkhead Adapter

BF ADAPTER Bulkhead to Flange Adapter

Note: Protectors not included with adapters.

Grounding Components



Model Shown: CS6-25

LOW INDUCTANCE COPPER GROUNDING STRAP

APPLICATION:

Where any wire ground path is used, the copper strap will have lower inductance. Radials on bare mountain tops — the strap's sharp edge will allow a lower voltage side flashing to the bare rock than wire.

- Lower inductance than wire
- Easy to work with (cut, solder, etc.)
- Sold in increments of 25', 50', 75' & 100'
- Can not be fused open by lightning
- Above or in ground usage
- Can be sandwiched for exothermic welding
- Can be used with TK series clamps (see page 53)
- 1-1/2" can be used with strap connector clamps (see page 52)
- Shipped in rolls

Options: 200, 300, 400 and 500 foot lengths available.

SPECIFICATIONS:	1.5" STRAP*	3.0" STRAP*	6.0" STRAP*
Cross-sectional area in square inches:	0.0239	0.0478	0.0956
Closest stranded wire size to the above area:	#6 AWG (0.02062)	#3 AWG (0.04134)	#2/0 AWG (0.1045)
Inductance of wire (8'):	3.362μH	3.194μH	2.961μH
Inductance of strap (8'):	2.58μH	2.22μH	1.9μH
% decrease of inductance of strap over wire (8'):	23.2%	30.5%	35.8%

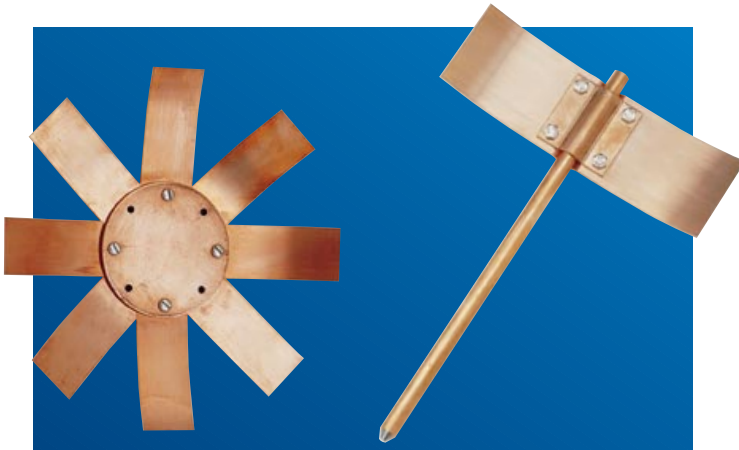
*Gage/Thickness = 26 AWG (0.0159)

Note: 1.5" strap has lower inductance than #2/0 AWG cable.

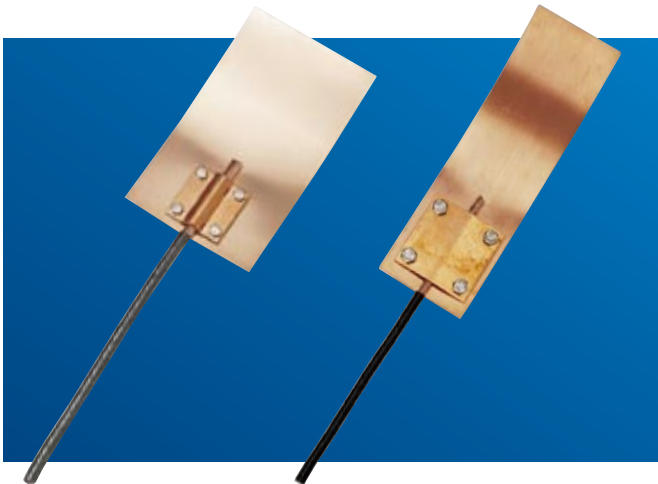
ORDER INFORMATION:

CS112-25	1.5" width, 25' length
CS112-50	1.5" width, 50' length
CS112-75	1.5" width, 75' length
CS112-100	1.5" width, 100' length
CS3-25	3" width, 25' length
CS3-50	3" width, 50' length
CS3-75	3" width, 75' length
CS3-100	3" width, 100' length
CS6-25	6" width, 25' length
CS6-50	6" width, 50' length
CS6-75	6" width, 75' length
CS6-100	6" width, 100' length

Grounding Components



Models Shown: MSC-3 (left), 58R-112S (right)
(strap and ground rod not included)



Models Shown: 10C-112S (left), 1C-112S (right)
(strap and cable not included)

COPPER STRAP BONDING CLAMPS

APPLICATION:

To bond copper strap without building up the joint for an exothermic weld.

- Faster installation than exothermic welding
- Copper to copper will not corrode
- Less than 100 $\mu\Omega$ resistance
- All copper sandwich with 18-8 stainless steel hardware
- Large contact surface which locks the strap into place
- Can be used for 1-1/2" to 6" copper strap
- Use CCK for cleaning copper before installation

SPECIFICATIONS:

Material: C110 half hard copper

Hardware: Stainless steel

ORDER INFORMATION:

1C-112S 6 to 1 AWG Cable to 1-1/2" Copper Strap

10C-112S 1/0 AWG to 6/0 AWG Cable to 1-1/2" Copper Strap

58R-112S 5/8" Ground Rod to 1-1/2" Copper Strap

MSC-3 1-1/2" or 3" Multi Copper Strap

Note: Typical contact resistance of copper strap: 0.0001 Ω

Grounding Components



Models Shown: TK-1, TK-2, TK-3, TK-4



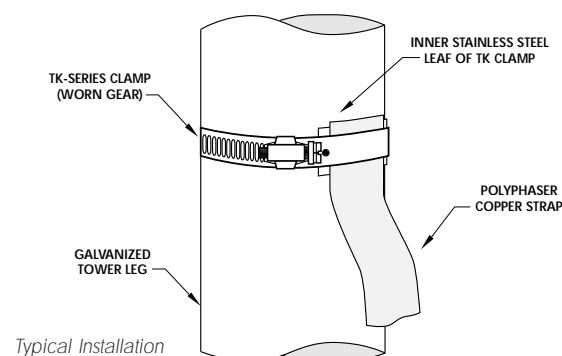
Typical Application

COPPER TO TOWER LEG CORROSION FREE GROUND CLAMPS

APPLICATION:

To provide a good copper to galvanized tower leg connection, without any corrosion or exothermic welding to your tower structure.

- Less than 1 milliohm typical contact resistance
- Marine quality 100% 300 series stainless steel
- Clamps copper wire or strap
- No dissimilar metal corrosion
- Less expensive than bronze clamps
- 4 models from 5/8" to 5"
- Can be joined together for even larger sizes
- CCK for cleaning copper before installing



Typical Installation

ORDER INFORMATION:

- | | | |
|-------------|------------------|---|
| TK-1 | 5/8" to 1-1/4" | 1-1/2" (tapered) strap to ground rod |
| TK-2 | 1-1/4" to 2-1/4" | 1-1/2" strap to Rohn 25, 45 and 65 tower legs |
| TK-3 | 2-1/4" to 3-3/4" | 1-1/2" strap to water mains |
| TK-4 | 3-1/2" to 5" | 3" strap to fire raisers/tower legs |

Note: Typical contact resistance: <0.0001Ω

Grounding Components



Models Shown: J-1, J-2

WIRE/COPPER ROD TRANSITION CLAMPS

APPLICATION:

Can be used to bond wire to ground rods, fire risers, etc.

- Two adjustable sizes
- Cast bronze
- 18-8 stainless screws
- For wire sizes #2 stranded to #10 solid



Model Shown: WK-1

WEATHER PROOFING KIT

APPLICATION:

Where a weather tight seal is needed with an extreme temperature range and exposed to UV.

- Non-conductive
- Withstands -65°F to +180°F without cracking
- Paintable — latex or solvent based paints
- Water impermeable (MIL-S-19653A)
- Exceptional UV and salt spray resistance
- Non-irritating to skin
- Hand applied and self adhering

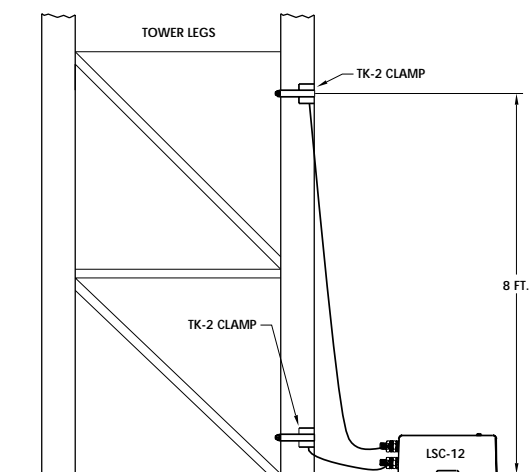
ORDER INFORMATION:

- J-1** Transition clamp for 1/2" to 1-1/3" diameters
- J-2** Transition clamp for 1-1/2" to 2-1/4" diameters
- WK-1** Weather proofing kit: 2-1/2" x 6" x 1/8", black (includes 1 roll black electrical tape)

Test Equipment



Model Shown: LSC-12 Lightning Strike Counter



Typical Installation

LIGHTNING STRIKE COUNTERS

APPLICATION:

To show tower hits, and how many times PolyPhasers® have protected your equipment.

- Internally protected
- Counts to 999,999 before resetting
- Uses the tower, etc. as an inductive shunt; voltage drop across the shunt triggers the counter
- Requires an electrical connection spaced 6' to 10' for Rohn 25 larger spacing for larger towers. The larger the lead separation the greater the counter's sensitivity.
- Use a #14 or larger wire gauge for connections with TK clamps (see page 53) and CCK (see page 48) for corrosion free joints
- Momentary test with either polarity battery from 9V to 50V
- Can be made weather resistant with WK-1 (see page 54)
- LSC-13 provides dry contacts for computer monitoring with contact closure time proportional to strike energy

ORDER INFORMATION:

LSC-12 Lightning Strike Counter -
1/4-20 stud w/nut and ext. tooth washer,
flange mounting

LSC-13 Lightning Strike Counter with Contact Closure -
1/4-20 stud w/nut and ext. tooth washer,
analog signal monitoring, flange mounting,
(9V battery included)

Note: Lightning strike counters are available for Phone Lines and Plug-in Power Lines upon request.

Test Equipment



SPT pH Soil Test Kit



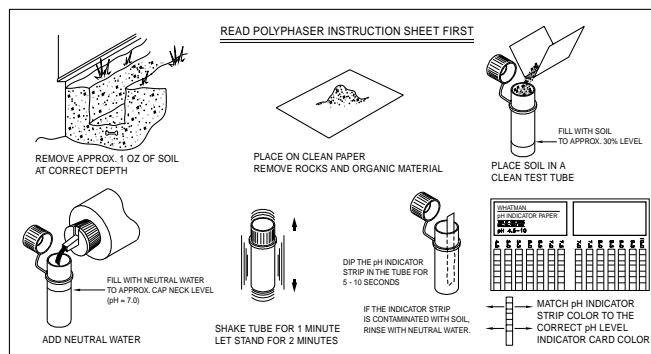
Matching the pH indicator strip color to the correct pH level indicator card color (see page 105 for detailed instructions)

pH SOIL TEST KIT

APPLICATION:

Before installing a ground system, the pH of the soil should be measured. This measurement will determine the best material to use to maximize its longevity.

- Measure the pH of the soil at the depth the grounding radial system will be placed.
- The pH value will determine whether copper is the best material. Copper works best in an alkaline environment (pH of 7 or higher). Aluminum, tin and/or galvanized metal work best in an acidic environment (pH of 7 or lower).



pH Soil Test Kit Instruction Sheet

ORDER INFORMATION:

SPT pH Soil Test Kit (contains 100 test strips)

Twisted Pair/Cable Protectors



Models shown: IS-3T1, IS-6PTL

IN-LINE TWISTED PAIR PROTECTORS

APPLICATION:

For T1, data, current loop for measurement and control, extension lines, telephone trunk lines, and high speed data: Single, Double and Six Pair Protectors suppressing surges up to 40kA.

- Multi-stage protectors
- Large data bandwidths
- Low resistance on current loops and data protectors
- Fast response times: <2ns, EMP rated
- Low let-through voltages
- Easy — positive floating plate screw connections
- Convenient ground stud for cable shield grounding
- Single and Dual pair interfaces to IS-MSRP panel (see page 40)
- Flange mounting/grounding
- 18-8 stainless steel hardware
- Temperature: -40°C to +85°C Storage/Operating +50°C
- T1: -12dB minimum common mode attenuation of EMP pulse

Mil Specs: Many — call with requirements

TEN YEAR WARRANTY



Models shown: IS-DPXL, IS-CLSP, and IS-SPTV

SPECIFICATIONS & ORDER INFORMATION:

Order Number (# wires)	Typical Application	Surge	Turn-on @10mA	R	C	Energy	Let-through*	-3dB (600Ω) BW
IS-T1 (4), IS-3T1 (12),	T1 Data	36kA	±7Vdc	1Ω	30pF	425J	17Vp	120MHz**
IS-SPDDL (2), IS-DPDDL (4),	RS232/562 Data	36kA	±20Vdc	1Ω	30pF	425J	24Vp	120MHz**
IS-6PDDL (12)								
IS-SPHSD (2), IS-DPHSD (4),	RS422/423/485 Data	36kA	+2.8/-0.6Vdc	1Ω	30pF	425J	<+10/-1Vp	95MHz
IS-6PHSD (12)								
IS-CLSP(2), IS-CLDP(4), IS-CL6P(12)	Current Loops	36kA	±27Vdc	<0.1Ω	30nF	425J	35Vp	65kHz
IS-SPXL(2), IS-DPXL(4), IS-6PXL(12)	Extension Lines	40kA	±75Vdc	20Ω±1%	11nF	550J	100Vp	30kHz
IS-SPTL(2), IS-DPTL(4), IS-6PTL(12)	Telco Trunks (Handles standard ring voltages to 105Vrms)	40kA	±200Vdc	20Ω±1%	2.4nF	550J	300Vp	250kHz
IS-SPTV (2)	CCTV Power	18kA	±39Vdc	<0.1Ω	20nF	425J		50/60Hz

*Peak open circuit voltage at max current (wires vaporized) **Measured across 110Ω system.

Twisted Pair/Cable Protectors



Model shown: IS-MPT-200



Typical Mounting on a Ground Bus for 66 block, model 25P10GB

MULTI-LINE SOLID STATE TWISTED PAIR PROTECTORS

APPLICATION:

For more than 6 pair on 66 blocks, these protectors replace gas tubes and have many advantages.

- Fast response time
- Balanced turn-on voltage
- Three voltage ratings for 66 type punch down blocks
- Lower differential voltage than 3 element gas tubes
- Lower harmonic energy than gas tube
- Clamps surges
- No fast dv/dt slew like crow bar tube action
- Fails in shorted mode like gas tubes
- Easily replaced if necessary
- Balanced MOV type common mode protector
- One unit = one pair protector
- Stagger mount on 66 block for >8 lines (66 block not included)
- Adjustable ground bus for 66 block available

SPECIFICATIONS:

Application:	Surge: (per pair)	Operating Voltage	C (L to G)
T1 Data	4kA (60 Joules)	±17	27nF*
RS232 Data	4kA (60 Joules)	±24	27nF*
Extension Lines	4kA (72 Joules)	±75	5nF
Telco Trunks	13kA (100 Joules)	±200	1.6nF

Turn-on Time: 2.5ns for 2kV/ns

Temperature: -25°C to +25°C Storage/Operating

ORDER INFORMATION:

IS-MPT-17*

IS-MPT-24*

IS-MPT-75 for Extension Lines on 66 blocks

IS-MPT-200 for Telco Trunks on 66 blocks

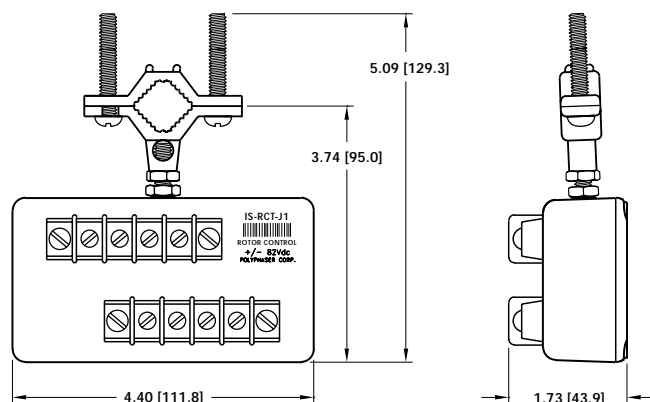
25P10GB Ground Bus for 25 pair 10" 66 block adjustable for 66 blocks with & without stands

**Call factory for bandwidth and application information.*

Twisted Pair/Cable Protectors



Model shown: IS-RCT-J1



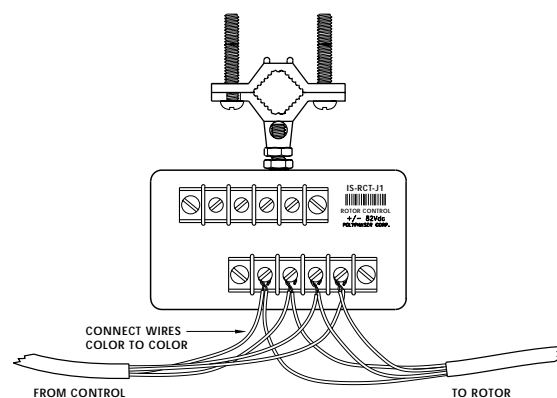
Product Dimensions: IS-RCT-J1

ROTOR CONTROL 8 LINE PROTECTOR

APPLICATION:

For protecting up to 8 line rotor controllers, helps protect motors, control box and other nearby equipment from damage by preventing strike energy from entering room.

- EMP rated
- Faster than gas tubes
- Lower turn-on than gas tubes
- Shunt type device for up to 8 lines
- Aluminum enclosure
- Screw terminals
- 16 crimp/solder lugs
- Stainless steel mounting stud
- Available with bronze clamps for mounting on ground rods and tower legs



Typical Installation

SPECIFICATIONS:

Surge: 6500A (each line)
IEC 1000-4-5 8/20μs waveform 72 Joules

Turn-on: 82Vdc ±10%

Turn-on Time: <4ns

Temperature: -40°C to +85°C Storage/Operating +50°C

ORDER INFORMATION:

IS-RCT for protector with 1/4-20 x 13/16" mounting studs

IS-RCT-J1 for unit mounting 1/2" to 1-1/3" diameters

IS-RCT-J2 for unit mounting 1-1/2" to 2-1/4" diameters

dc Injector /dc Path



Model shown: IS-MR50LNZ+6, bulkhead mount



Model shown: IS-MR50LNZ+15, bulkhead mount

GLOBAL POSITIONING SYSTEM AND PCS TOWER TOP PRE-AMP PROTECTORS

APPLICATION:

Lightning protection for GPS receivers with active antennas and tower top preamplifiers.

- 50Ω models; 1.2GHz to 2.0GHz
- Protects in-line amplifiers and GPS receivers
- Provides positive and reverse voltage protection
- Low loss and low VSWR
- Multi-strike capability
- Low strike throughput energy
- Not weather resistant
- Weatherize using WK-1 (see page 54)
- 18-8 stainless steel hardware
- N silver shell and gold center pin
- Bulkhead mounting/grounding (flange mount adapter, page 50)

Options: Weatherized version available

Mil Specs: Many — call with requirements

TEN YEAR WARRANTY

SPECIFICATIONS:

Surge: 20kA IEC 1000-4-5 8/20μs waveform

Turn-on: +7, -1Vdc for IS-MR50LNZ+6
+17, -1Vdc for IS-MR50LNZ+15

Turn-on Time: 4ns for 2kV/ns

User Current: 2.0A dc continuous

VSWR: ≤1.1 to 1 over frequency range

Insertion Loss: ≤0.1dB

Temperature: -45°C to +85°C Storage/Operating +50°C

Vibration: 1G up to 100Hz

ORDER INFORMATION:

IS-MR50LNZ+6 N connectors, Bulkhead mounting*
Frequency Range: 1.2GHz to 2.0GHz
Throughput Energy (typical): 58.0μJ

IS-MR50LNZ+6/W N connectors, Bulkhead mounting*
Frequency Range: 1.2GHz to 2.0GHz
Throughput Energy (typical): 58.0μJ

IS-MR50LNZ+15 N connectors, Bulkhead mounting*
Frequency Range: 1.2GHz to 2.0GHz
Throughput Energy (typical): 58.0μJ

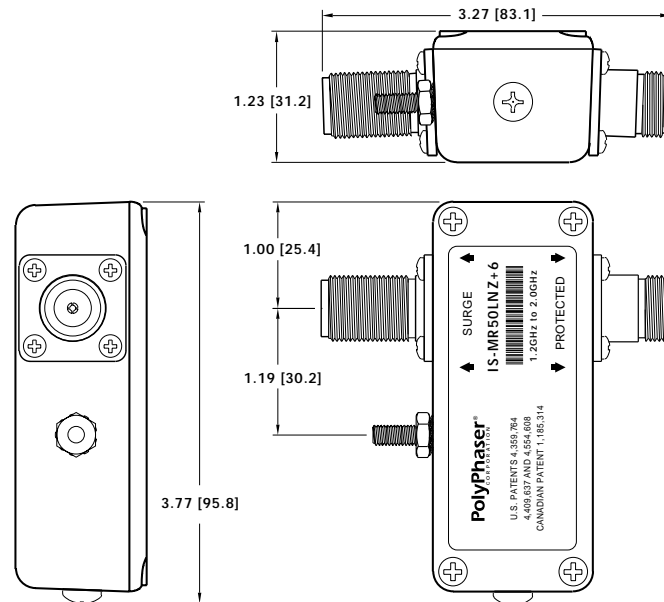
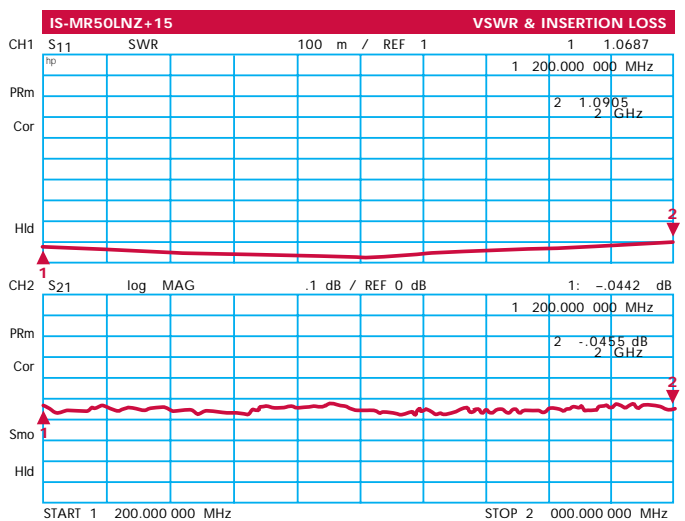
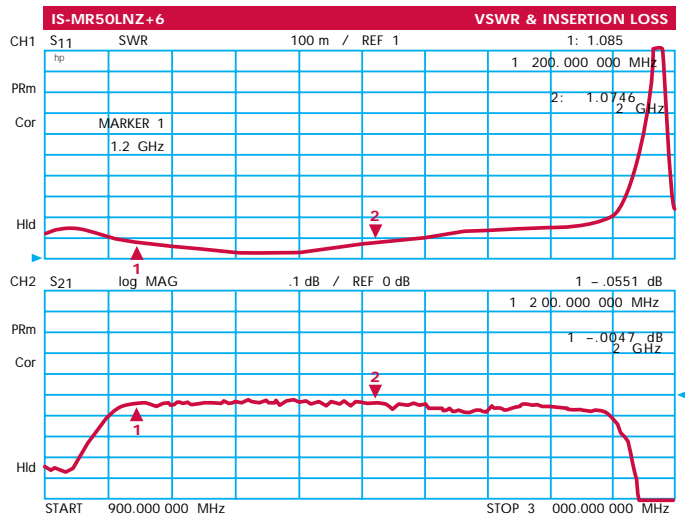
Add suffix: **-MA** for male antenna port connector

-ME for male equipment port connector

*Flange Mount Adapter available (see page 50)

(W) Weatherized version. Energy based on 6kV/3kA 8/20μs waveform.

dc Injector/dc Path - VSWR & Insertion Loss Graphs



Product Dimensions: IS-MR50LNZ+6

dc Injector / dc Path



Model shown: IS-DC50LNZ+15, bulkhead mount

DC INJECTOR/PICKOFF/PICKOR COAXIAL PROTECTORS

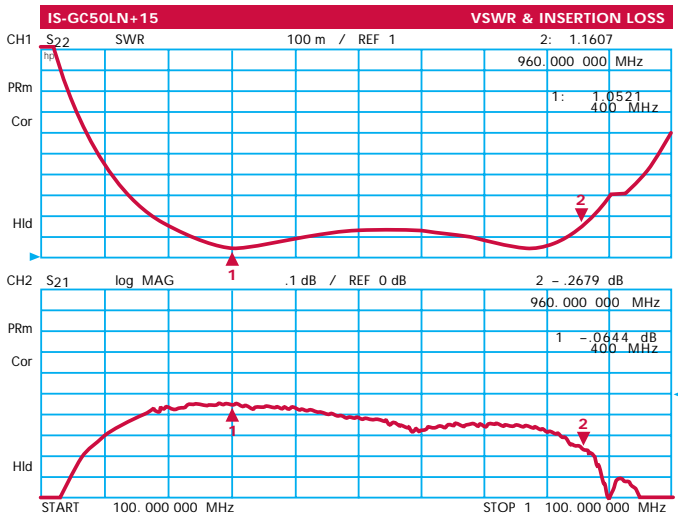
APPLICATION:

To supply or control remote equipment by injecting an ac or dc voltage onto the coax line and picking it off. A "pickor" is a contraction of pickoff and injector. It is transparent to supply voltages. It protects optimally by separating the supply voltage and the RF, protecting each, then re-injecting the supply voltage onto the coax. Ideal for bulkhead locations to prevent the surge from getting into the facility.

- Multi-stage patented design
- Multi-strike capability
- Low throughput energy
- Receive only (Transmit units available)
- Bulkhead mounting/grounding
(flange mount adapter, page 50)
- Weatherize using WK-1 (see page 54)
or use MR50MDZ (see page 86)
- Aluminum enclosure
- 18-8 stainless steel hardware
- N silver shell and gold center pin

Mil Specs: Many — call with requirements

TEN YEAR WARRANTY



SPECIFICATIONS:

Surge: 18kA IEC 1000-4-5 8/20μs waveform 110 Joules

Turn-on: ≈15% above model voltage

Turn-on Time: <4ns for 2kV/ns

Frequency Range: 400MHz to 960MHz

VSWR: ≤1.2 to 1 over the frequency range

Insertion Loss: ≤0.3dB over the frequency range

User Current: 2.0A dc continuous

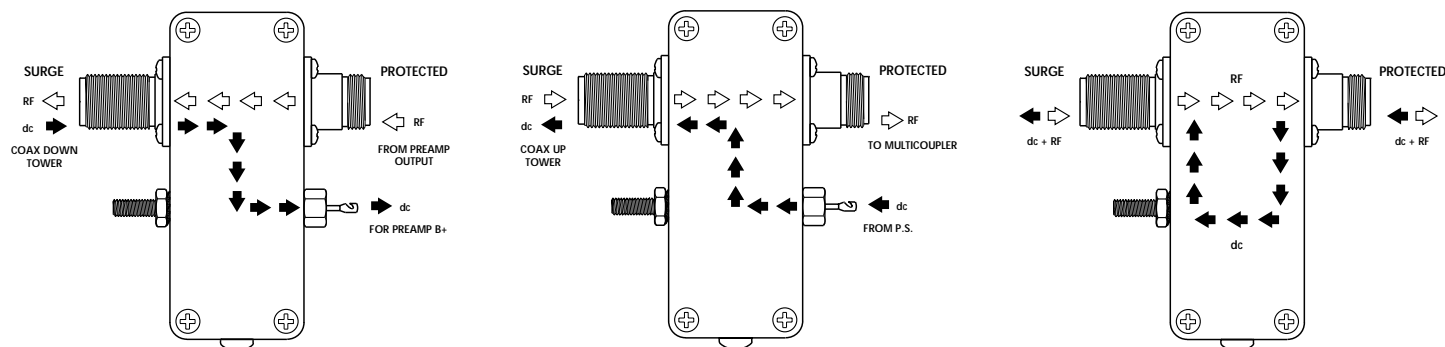
Temperature: -40°C to +85°C Storage/Operating +50°C

Vibration: 1G up to 100Hz

ORDER INFORMATION:

- | | |
|---------------------|---|
| IS-DC50LN+15 | Injector (N connectors, bulkhead mount*)
Throughput Energy: RF: 49.0nJ, DC: 730μJ** |
| IS-DC50LN+20 | Injector (N connectors, bulkhead mount*)
Throughput Energy: RF: 1.76μJ, DC: 348μJ** |
| IS-DC50LN+26 | Injector (N connectors, bulkhead mount*)
Throughput Energy: RF: 1.95μJ, DC: 1.42mJ** |
| IS-DC50LN+30 | Injector (N connectors, bulkhead mount*)
Throughput Energy: RF: 1.60μJ, DC: 509μJ** |
| IS-DC50LN+36 | Injector (N connectors, bulkhead mount*)
Throughput Energy: RF: 0.94μJ, DC: 762μJ** |

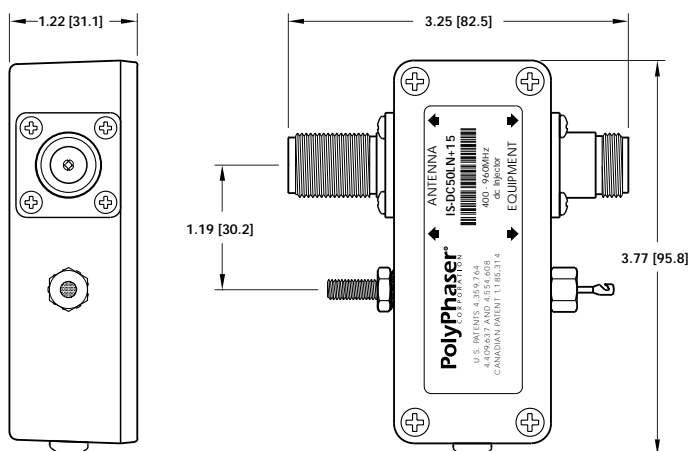
dc Injector/dc Path



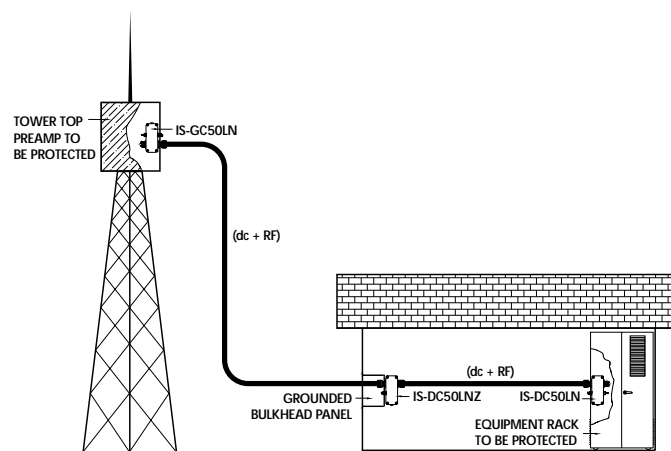
dc PICKOFF: Pick off dc but optimized for opposite RF passage

dc INJECTOR: Injects dc onto the coax

dc PICKOR: Pick off dc and re-injects for optimal protection for bulkhead panel users



Product Dimensions: IS-DC50LN+15



Typical Application

- IS-DC50LNZ+15** Pickoff (N connectors, bulkhead mount*)
Throughput Energy: RF: 294μJ**
- IS-DC50LNZ+20** Pickoff (N connectors, bulkhead mount*)
Throughput Energy: RF: 255μJ**
- IS-DC50LNZ+26** Pickoff (N connectors, bulkhead mount*)
Throughput Energy: RF: 644μJ**
- IS-DC50LNZ+30** Pickoff (N connectors, bulkhead mount*)
Throughput Energy: RF: 498μJ**
- IS-DC50LNZ+36** Pickoff (N connectors, bulkhead mount*)
Throughput Energy: RF: 900μJ**
- IS-GC50LN+15** Pickoff (N connectors, bulkhead mount*)
Throughput Energy: RF: 5.50μJ, DC: 20.0μJ**

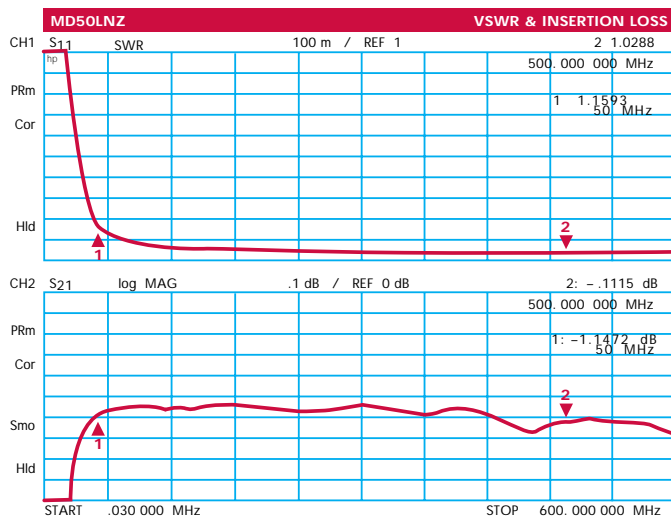
- IS-GC50LN+20** Pickoff (N connectors, bulkhead mount*)
Throughput Energy: RF: 19.5μJ, DC: 900μJ**
- IS-GC50LN+26** Pickoff (N connectors, bulkhead mount*)
Throughput Energy: RF: 4.0μJ, DC: 576μJ**
- IS-GC50LN+30** Pickoff (N connectors, bulkhead mount*)
Throughput Energy: RF: 1.60μJ, DC: 460μJ**
- IS-GC50LN+36** Pickoff (N connectors, bulkhead mount*)
Throughput Energy: RF: 0.78μJ, DC: 2.14mJ**

Add suffix: **-MA** for male antenna port connector
-ME for male equipment port connector
* Flange Mount Adapter available (see page 50)
** Typical
Energy based on 6kV/3kA 8/20μs waveform.

dc Injector / dc Path



Model shown: IS-MD50LNZ, bulkhead mount



DC PATH-MW DOWNCONVERTED COAXIAL PROTECTORS

APPLICATION:

18GHz and up Microwave Systems that use Gunnplexers and have 50 to 500MHz If frequencies with power and/or data or error signals in the dc to 0.5MHz band. Two are required for complete protection - one inside the tower top unit and one inside the hut at the bulkhead panel.

- Employs UL497B listed gas tube
- Transceive bi-directional to signals
- Isolates and protects standard telco battery power on coax
- Patented design separates the dc from the RF, protects each optimally and recombines them
- Bulkhead mounting/grounding (*flange mount adapter, page 50*)
- Lower throughput energy than dc continuity protectors (*dc type protectors with a gas tube will not handle the voltage and current for this application without the tube staying on and destroying itself with the first strike*)
- Not weather resistant
- Weatherize using WK-1 (*page 54*)
- Multi-strike capability
- NEMP rated
- Aluminum enclosure
- 18-8 stainless steel hardware
- N silver shell and gold center pin

Mil Specs: Many — call with requirements

TEN YEAR WARRANTY

SPECIFICATIONS:

Surge: 20kA IEC 1000-4-5 8/20μs waveform 138 Joules

Turn-on: -66Vdc, 2Vdc ±10%

Turn-on Time: 4ns for 2kV/ns

VSWR: ≤1.2 to 1 over frequency range

Insertion Loss: ≤0.3dB

Usage Current: 2.0A dc continuous

Frequency Range: dc to 0.5MHz and 50MHz to 500MHz

Temperature: -45°C to +85°C Storage/Operating +50°C

Vibration: 1G up to 100Hz

ORDER INFORMATION:

IS-MD50LNZ (N connectors only, bulkhead mount*)
Throughput Energy (typical): 313μJ

Add suffix: **-MA** for male antenna port connector
-ME for male equipment port connector

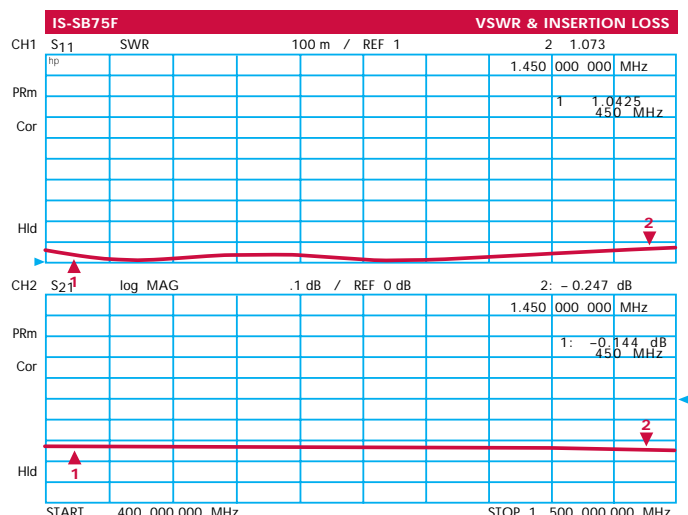
*Flange Mount Adapter available (see page 50)

Energy based on 6kV/3kA 8/20μs waveform.

dc Injector / dc Path



Model shown: IS-DB75F, flange mount



SPECIFICATIONS:

Surge: 18kA IEC 1000-4-5 8/20μs waveform 110 Joules

Turn-on: 26Vdc, -1Vdc ±5%

Turn-on Time: 6ns for 2kV/ns

VSWR: 1.5 to 1 over the frequency range

Insertion Loss: ≤0.3dB over the frequency range

Frequency Range: 450MHz to 1450MHz

Temperature: -25°C to +85°C Storage/Operating +50°C

BROADBAND DC PATH 75 OHM COAXIAL PROTECTOR

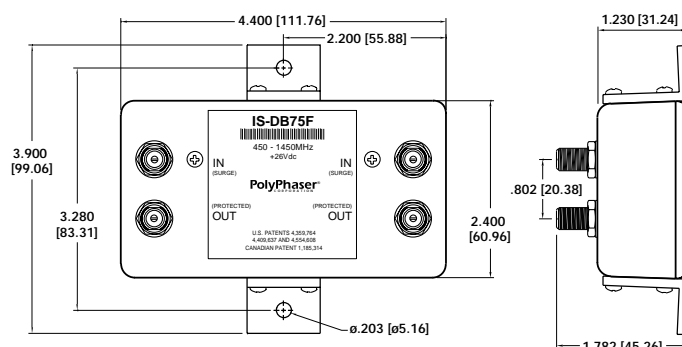
APPLICATION:

Satellite dish receivers where the LNB(s) is powered via the coax line from the receiver. Simplex RF LAN operation with switched antenna preamp.

- Single and dual LNB models
- Two-stage patented design
- Multi-strike capability
- Housed use only — mounts into IS-TVRO
- Aluminum enclosure • 18-8 stainless steel hardware
- Not weather resistant • Weatherize using WK-1 (page 54)

Mil Specs: Many — call with requirements

TEN YEAR WARRANTY



ORDER INFORMATION:

IS-SB75F for single protector
F females standard, flange mount
Throughput Energy (typical): 580μJ

IS-DB75F for dual protector
F females standard, flange mount
Throughput Energy (typical): 580μJ

Energy based on 6kV/3kA 8/20μs waveform.

dc Type

Model shown: IS-50BB/6, flange mount

50/75 OHM BASEBAND COAXIAL PROTECTORS**APPLICATION:**

VLF/HF receive only, LAN, closed circuit video.

- Complies with IEEE 802.3 (50Ω)
- Broadband — low VSWR and loss
- Multi-strike capability
- Low voltage thresholds
- Low throughput energy
- Not weather resistant
- Weatherize using WK-1 (see page 54)
- Aluminum enclosure
- 18-8 stainless steel hardware
- Flange mount (bulkhead mount adapter, page 50)

TEN YEAR WARRANTY**SPECIFICATIONS:**

Surge: 18kA IEC 1000-4-5 8/20μs waveform 110 Joules

Turn-on Time: 4ns for 2kV/ns

VSWR: ≤1.1 to 1 over frequency range

Insertion Loss: ≤0.3dB over frequency range

User Current: 2.0A_{dc} continuous

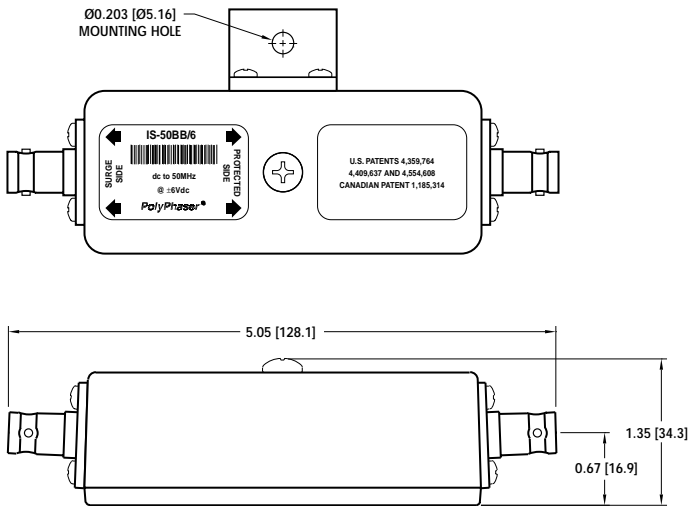
Temperature: -45°C to +85°C Storage/Operating +45°C

Vibration: 1G up to 100Hz

ORDER INFORMATION:

- | | |
|--------------------|---|
| IS-75UB/(*) | Frequency Range: dc to 30MHz
UHF female connectors
Throughput Energy (typical): 103μJ |
| IS-50UB/(*) | Frequency Range: dc to 50MHz
Tuned for 50 Ohm
UHF female connectors
Throughput Energy (typical): 153μJ |
| IS-50BB/(*) | Frequency Range: dc to 50MHz
Tuned for 50 Ohm
BNC female connectors
Throughput Energy (typical): 153μJ |

dc Type



Product Dimensions: IS-50BB/6

Typical Application	Impedance	Operating Voltage
Closed Circuit Video	75Ω	1.5
VLF/HF Receive Only	50Ω	6
LAN*	50Ω	18

* 10 M bits per second Max Baud Rate

IS-50NB/(*)	Frequency Range: dc to 50MHz Tuned for 50 Ohm N female connectors Throughput Energy (typical): 153μJ
IS-50TB/(*)	Frequency Range: dc to 50MHz Tuned for 50 Ohm TNC female connectors Throughput Energy (typical): 153μJ
IS-75BB/(*)	Frequency Range: dc to 30MHz BNC (50 Ohm) female connectors Throughput Energy (typical): 103μJ

IS-75FB/(*)	Frequency Range: dc to 30MHz F female connectors Throughput Energy (typical): 103μJ
IS-75NB/(*)	Frequency Range: dc to 30MHz N (70 Ohm) female connectors Throughput Energy (typical): 103μJ

*Add operation voltage: **1.5** or **6** or **18** (for example: **IS-50NB/1.5**)
Add suffix: **-MA** for male antenna port connector
-ME for male equipment port connector
Energy based on 6kV/3kA 8/20μs waveform.

dc Type



Model shown: IGA-90V, flange mount



IGA-90V attached to a PolyPhaser suppressor

Note: PolyPhaser suppressor not included, but available (see page 66)

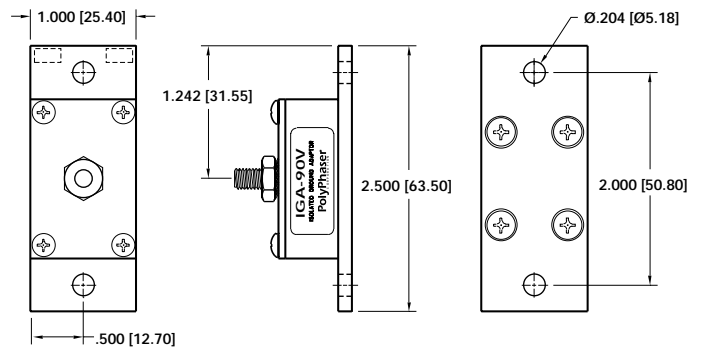
ISOLATED GROUND ADAPTER FOR PROTECTORS

APPLICATION:

Provides ground isolation to 90Vdc to prevent noise and reduce ground loop/hum problems on lines running between buildings.

- Multi-strike capability
- Copper mounting plate
- PVC insulator
- When used with 50/75 ohm baseband protectors, replaces IE50 & IE75 series

TEN YEAR WARRANTY



Product Dimensions: IGA-90V

SPECIFICATIONS:

Surge: 18kA IEC 1000-4-5 8/20µs waveform 110 Joules

Turn-on: 90Vdc

Temperature: -40°C to +85°C Storage/Operating

ORDER INFORMATION:

IGA-90V 10/32 stud mounting unit*, surface ground**

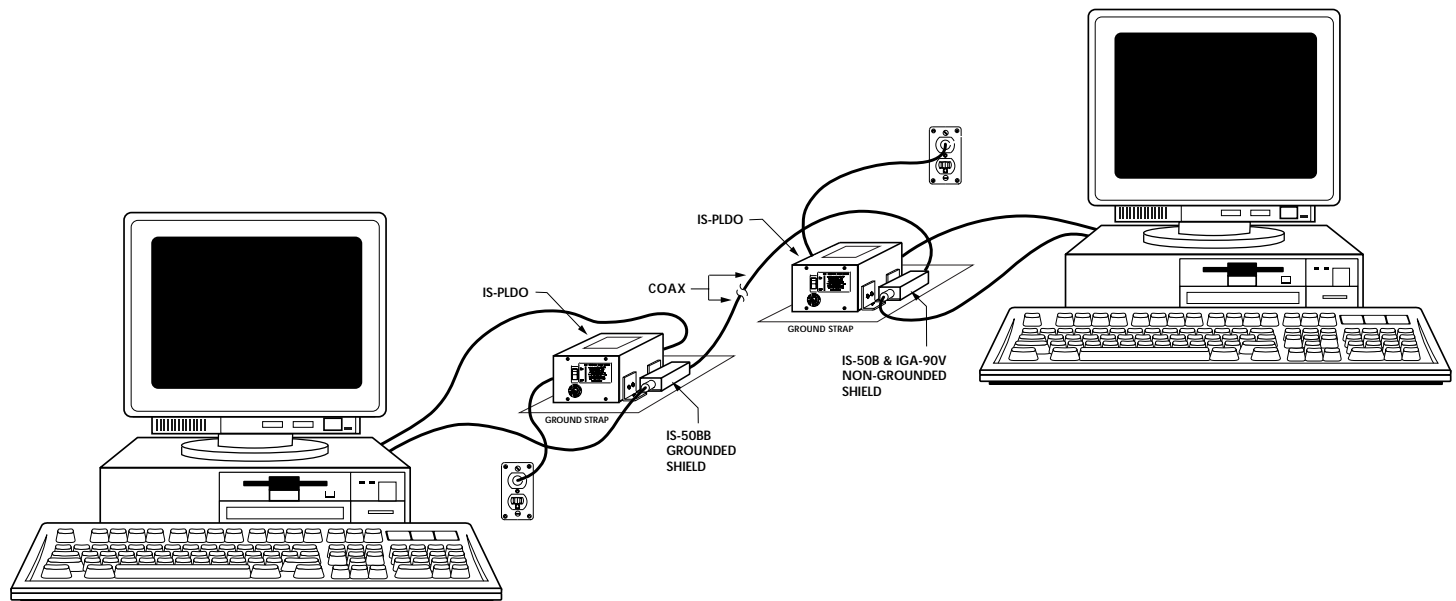
*Installation nut torque 30 lb. force x inch

**Ground to a low impedance system

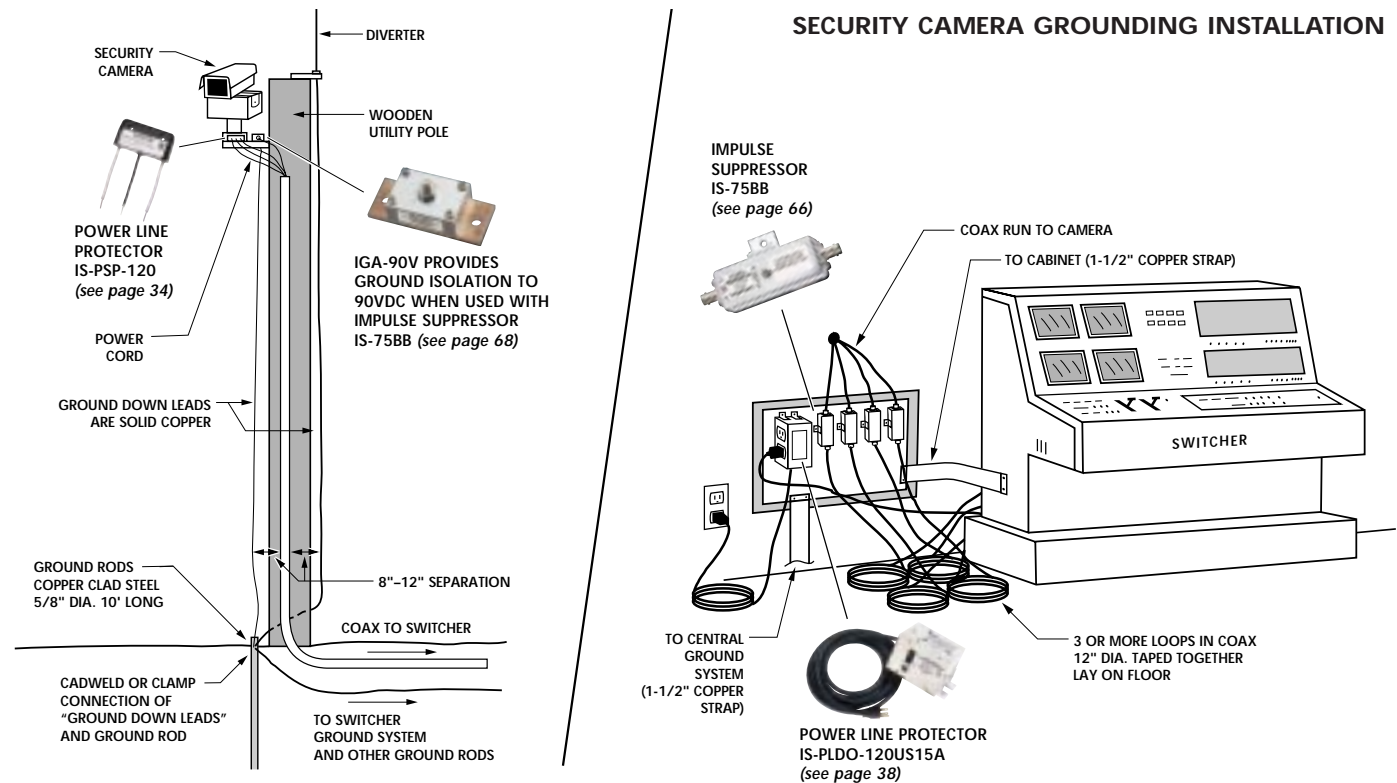
For good ground continuity, apply a metal anti-oxidant joint compound between metal surfaces

dc Type - Typical Application

LOCAL AREA NETWORK GROUNDING INSTALLATION



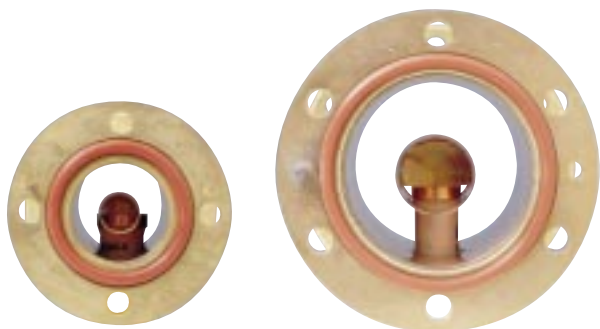
SECURITY CAMERA GROUNDING INSTALLATION



dc Type



Models shown: IS-158E (left) IS-318E (right)



Inside View: IS-158E (left) IS-318E (right)

HIGH POWER COAXIAL PROTECTOR

APPLICATION:

25kW high powered HF.

- EMP and lightning
- EIA flanges: 1-5/8" and 3-1/8"
- dc to 220MHz typical bandwidths
- Fast <25ns turn-on time
- Unique PolyPhaser® gas tube design for fast response and fast restoration
- Field replaceable gas tubes available
- Air tight "through" for dry air or N pressure (15#psi)
- Stainless steel hardware and gasket

SPECIFICATIONS:

Surge: 100kA IEC 1000-4-5 8/20µs waveform 1000 Joules

Turn-on: Varies with power requirements custom gas tube

Turn-on Time: <25ns for 2kV/ns

Frequency Range: dc to 220MHz (May vary with requirements.)

Maximum Power: HF 25kW

(Call factory with power & VSWR antenna line measurements.)

Temperature: -55°C to +85°C Storage/Operating

ORDER INFORMATION:

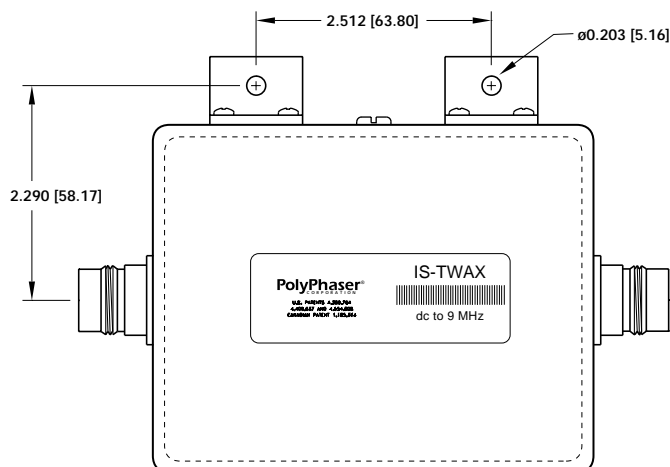
IS-318E with 3-1/8" EIA connector, flange mount

IS-158E with 1-5/8" EIA connector, flange mount

Note: Gas tube must be ordered separately.
See Appendix B for gas tube formula.

dc Type

Model shown: IS-TWAX



Product Dimensions: IS-TWAX

IBM® TWINAX SERIES**APPLICATION:**

Where Twinax Cable/Data require specialized coax protection.

- For IBM® System 34, 36, 38 or 400
- Extra wide bandwidth (dc to 9MHz)
- EMP rated
- Multi-strike capability
- Not weather resistant
- Weatherize using two WK-1s (see page 54)
- All 18-8 stainless steel hardware

TEN YEAR WARRANTY**SPECIFICATIONS:**

Surge: 18kA IEC 1000-4-5 8/20μs waveform

Turn-on Vdc: ±7.6Vdc line-to-line and each line-to-ground

Turn-on Time: 2ns after voltage wavefront reaches dc threshold (Based on 1kV/ns waveform)

Impedance: 100Ω balanced, 50Ω unbalanced

Throughput Energy: 1.60mJ (typical) for 6kV/3kA 8/20μs waveform

VSWR: ≤1.2 to 1 over frequency range

Insertion Loss: ≤0.1dB over frequency range

Temperature: -45°C to +85°C Storage/Operating +50°C

IBM® is a registered trademark of International Business Machines Corporation.

ORDER INFORMATION:

IS-TWAX Twinax (AMP 82-5590) connectors, flange mount
Frequency Range: dc to 9MHz

Energy based on 6kV/3kA 8/20μs waveform

Combiner Protectors

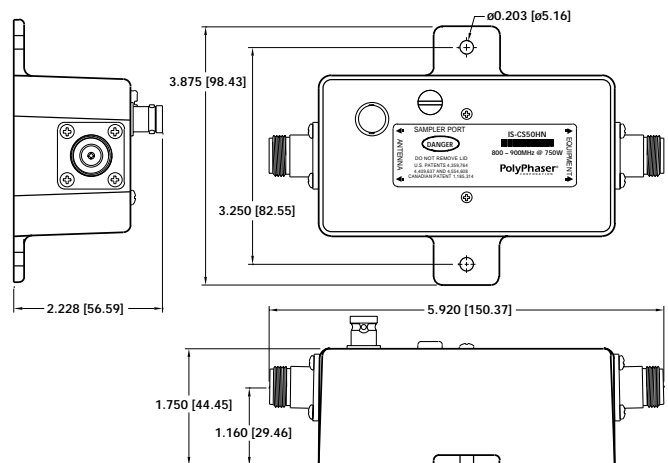
PolyPhaser developed the Combiner Series to eliminate the sharing of center pin surge current common to 1/4 wave stubs and other dc continuity protectors. The patented PolyPhaser protectors have center pin dc blocking and have as much as 60dB more attenuation of lightning frequencies than 1/4 wave devices.

UNDERSTANDING THE SAMPLER PORT

A number of protectors are sold on the premise that they will reduce the number of connectors needed in the cable system. At some time it will become necessary to sweep or TDR test your cable or antenna. This can not be accomplished with a 1/4 wave filter in line. An RF sweep will be colored by the 1/4 wave and will not show the true frequency versus return loss (or VSWR). A TDR pulse will not pass through the 1/4 wave.

With PolyPhaser's Sampler Port Series, preventive maintenance and troubleshooting can be accomplished without removing the protectors. The Sampler Port with its BNC connector coupled to the antenna line permitting the port to be used for "on-air" relative spectrum analysis (signal strength at discrete frequencies can be noted for future comparisons), TDR testing, power monitoring, RF sweeps, and protector testing.

The port is buffered by a parallel tuned circuit which provides a minimum of 20dB (typically 30dB) attenuation of the transmit signals. The inductance will show on a low resolution TDR response as a small discontinuity but the location will be obvious. For a 2ns TDR pulse, the total pulse loss is -3dB, round trip.



Product Dimensions: IS-CS50HN

SPECIFICATIONS:

Surge: 20kA IEC 1000-4-5 8/20µs waveform 138 Joules

Turn-on: 1200Vdc $V_t = 1800V$

Turn-on Time: 7.0ns for 2kV/ns

VSWR: ≤ 1.1 to 1 over frequency range

Insertion Loss: ≤ 0.1 dB over frequency range

Max. Power: 750W single channel

(See Appendix B for Multi-Channel Capability)

Temperature: -25°C to +50°C Storage/Operating

Vibration: 1G up to 100Hz

ORDER INFORMATION:

IS-CS50HD Frequency Range: 800 to 900MHz,
DIN 7/16 female connectors, flange mount
Throughput Energy (typical): 6.5nJ

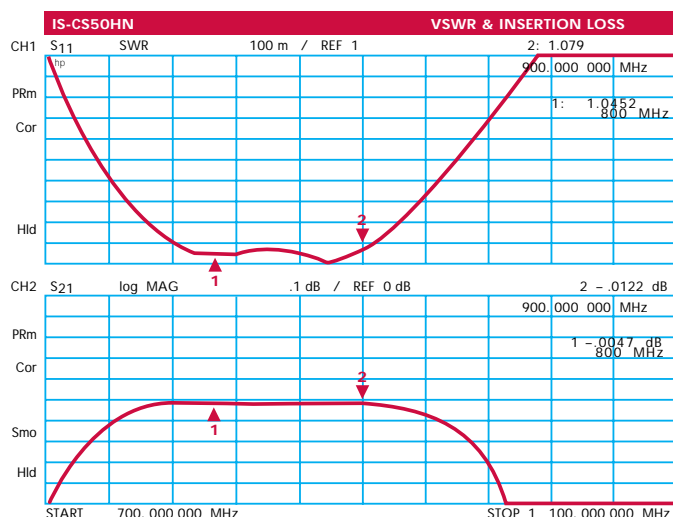
IS-CS50HD-B Frequency Range: 800 to 900MHz,
DIN 7/16 female connectors, bulkhead mount
Throughput Energy (typical): 6.5nJ

IS-CS50HN Frequency Range: 800 to 900MHz,
N female connectors, flange mount
Throughput Energy (typical): 6.5nJ

Combiner Protectors



Model shown: IS-CS50HN, flange mount



SAMPLER PORT CELLULAR/PAGING COMBINER COAXIAL PROTECTOR

APPLICATION:

Designed for 800 to 980MHz bands with multi-channel or combined transmitters. Sampler Port provides access for on-air spectrum analysis without removing the protector.

- Employs UL497B listed gas tube
- Built-in sampler port with BNC connector
- Ideal for combined transmit/receive applications
- Multi-strike capability
- EMP rated protectors
- Sampler port is coupled to the antenna connector
- Flange mounting/grounding (*bulkhead mount adapter, page 50*)
- Not weather resistant
- Weatherize using two WK-1s (*see page 54*)
- Aluminum enclosure
- 18-8 stainless steel hardware

Mil Specs: Many — call with requirements

TEN YEAR WARRANTY

IS-CS50HN-B Frequency Range: 800 to 900MHz,
N female connectors, bulkhead mount
Throughput Energy (typical): 6.5nJ

IS-PS50HN Frequency Range: 890 to 980MHz,
N female connectors, flange mount
Throughput Energy (typical): 6.5nJ

IS-PS50HN-B Frequency Range: 890 to 980MHz,
N female connectors, bulkhead mount
Throughput Energy (typical): 6.5nJ

IS-PS50HD Frequency Range: 890 to 980MHz,
DIN 7/16 female connectors, flange mount
Throughput Energy (typical): 6.5nJ

IS-PS50HD-B Frequency Range: 890 to 980MHz,
DIN 7/16 female connectors, bulkhead mount
Throughput Energy (typical): 6.5nJ

Add suffix: **-MA** for male antenna port connector
-ME for male equipment port connector
Energy based on 6kV/3kA 8/20μs waveform.

Combiner Protectors



Model shown: IS-CT50HD, flange mount

CELLULAR/PAGING COMBINER COAXIAL PROTECTOR

APPLICATION:

For the 800 to 980MHz bands where multi-transmitters are combined, excellent receive only protector, Broadcast STL links.

- Employs UL497B listed gas tube
- Multi-strike capability
- Unique dc blocked air strip line design
- Very low throughput energy
- High number and power of combined channels handled
(See Appendix B for formula) 750W single channel
- Bulkhead mounting/grounding to 1/4" panels for type N connectors
- Not weather resistant
- Weatherize using WK-1 (see page 54)
- 18-8 stainless steel hardware
- N silver shell and gold center pin

Mil Specs: Many — call with requirements

SPECIFICATIONS:

Surge: 20kA IEC 1000-4-5 8/20μs waveform 138 Joules

Turn-on: 1200Vdc $V_t = 1800V$

Turn-on Time: 7.0ns for 2kV/ns

VSWR: ≤ 1.1 to 1 over frequency range

Insertion Loss: ≤ 0.1 dB over frequency range

Throughput Energy: 15nJ typical for 3kA @ 8/20μs waveform

Max. Power: 750W single channel

(See Appendix B for Multi-Channel Capability)

Temperature: -25°C to +50°C Storage/Operating

Vibration: 1G up to 100Hz

ORDER INFORMATION:

IS-CT50HN Frequency Range: 800 to 900MHz
N female connectors, flange mount

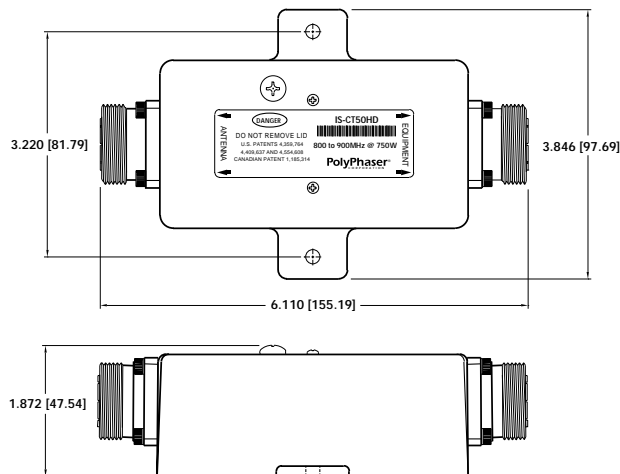
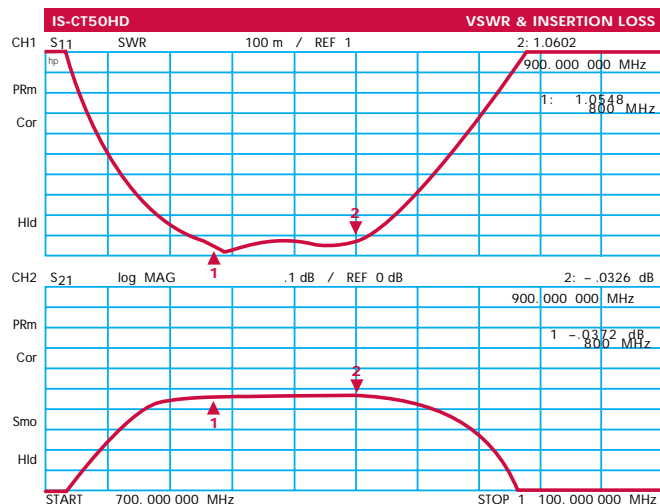
IS-CT50HN-B Frequency Range: 800 to 900MHz
N female connectors, bulkhead mount

IS-CT50HD Frequency Range: 800 to 900MHz
DIN 7/16 female connectors, flange mount

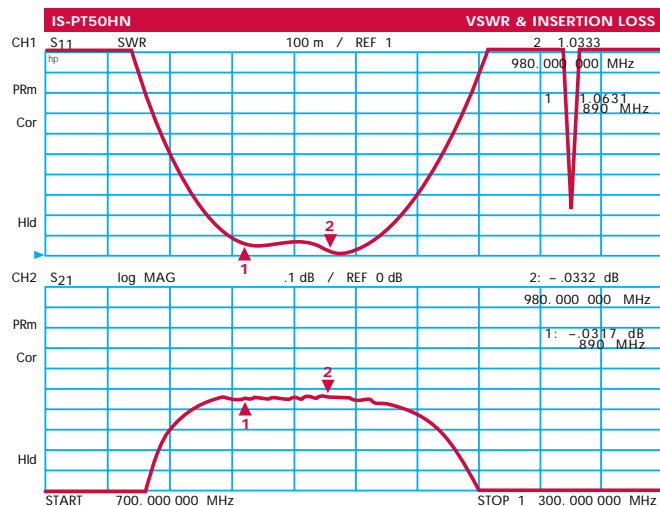
IS-CT50HD-B Frequency Range: 800 to 900MHz
DIN 7/16 female connectors, bulkhead mount

IS-PT50HN Frequency Range: 890 to 980MHz
N female connectors, flange mount

Combiner Protectors



Product Dimensions: IS-CT50HD



IS-PT50HN-B Frequency Range: 890 to 980MHz
N female connectors, bulkhead mount

IS-PT50HD Frequency Range: 890 to 980MHz
DIN 7/16 female connectors, flange mount

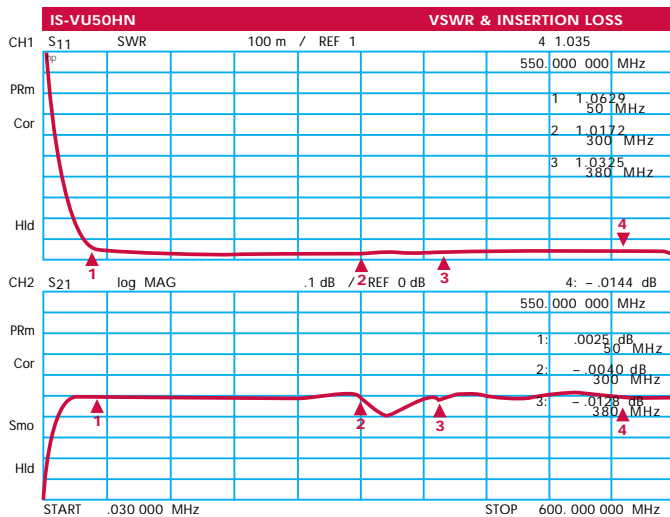
IS-PT50HD-B Frequency Range: 890 to 980MHz
DIN 7/16 female connectors, bulkhead mount

Add suffix: **-MA** for male antenna port connector
-ME for male equipment port connector

Combiner Protectors



Model shown: IS-VU50HN, bulkhead mount



VHF/UHF CROSS BAND COMBINER COAXIAL PROTECTORS

APPLICATION:

Where multi-band transmit channels are combined to save transmission line expense and then re-separated for individual band antennas.

- High number of combined channels handled
- High turn-on for clean peak voltage handling
- High channel power handling
- dc blocked design
- Low throughput energy
- Multi-strike capability
- Bulkhead mounting/grounding
(flange mount adapter, page 50)
- Not weather resistant
- Weatherize using WK-1 (see page 54)
- Aluminum enclosure
- 18-8 stainless steel hardware
- N silver shell and gold center pin

Mil Specs: Many — call with requirements

SPECIFICATIONS:

Surge: 50kA IEC 1000-4-5 8/20μs waveform 500 Joules

Turn-on: IS-VU50HN: 1800Vdc $V_t = 1200V$
IS-CU50HN: 1200Vdc $V_t = 1200V$

Turn-on Time: IS-VU50HN: 15ns
IS-CU50HN: 7ns

VSWR: ≤ 1.1 to 1 over frequency range

Insertion Loss: ≤ 0.1 dB over frequency range

Temperature: -25°C to +50°C Storage/Operating

Vibration: 1G up to 100Hz

ORDER INFORMATION:

IS-VU50HN Throughput Energy: 2.23mJ (typical)
Frequency Range: 50 to 550MHz
N female connector, bulkhead mounting
Max. Power: 750W single channel*

IS-CU50HN Throughput Energy: 2.23mJ (typical)
Frequency Range: 450 to 900MHz
N female connector, bulkhead mounting
Max. Power: 250W single channel*

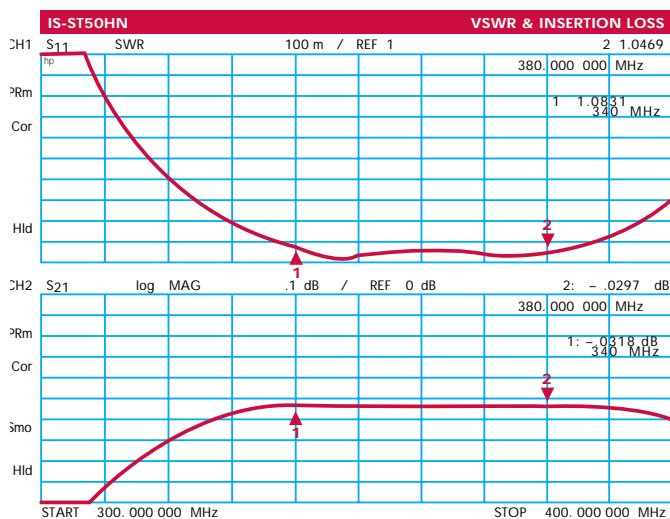
Add suffix: **-MA** for male antenna port connector
-ME for male equipment port connector

*See Appendix B for Multi-Channel Capability
Energy based on 6kV/3kA 8/20μs waveform.

Combiner Protectors



Model shown: IS-TT50HN, flange mount



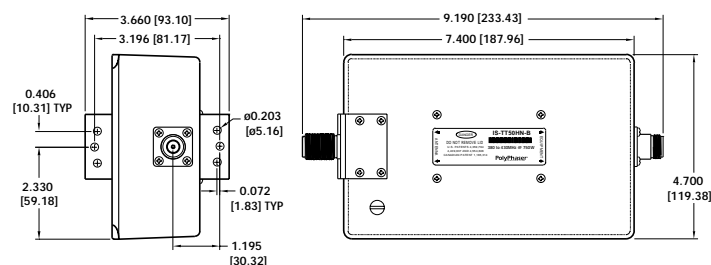
UHF COMBINER COAXIAL PROTECTOR

APPLICATION:

For the UHF 340MHz to 512MHz bands where multi-transmitters are combined, excellent receive only protector.

- Employs UL497B listed gas tube
- Multi-strike capability
- Unique dc blocked air strip line design
- Very low throughput energy
- High number and power of combined channels handled (see Appendix B for formula) 750W single channel
- Weatherize using WK-1 (see page 54)
- Aluminum enclosure
- 18-8 stainless steel hardware
- N silver shell and gold center pin

Mil Specs: Many — call with requirements



Product Dimensions: IS-TT50HN-B

SPECIFICATIONS:

Surge: 20kA IEC 1000-4-5 8/20μs waveform 130 Joules

Turn-on: 1200 Vdc Vt= 1200V

Turn-on Time: 7ns for 2kV/ns

VSWR: ≤1.1 to 1 over frequency range

Insertion Loss: ≤0.1dB over frequency range

Temperature: -25°C to +50°C Storage/Operating

Max. Power: 750W single channel

(See Appendix B for Multi-Channel Capability)

Vibration: 1G up to 100Hz

ORDER INFORMATION:

IS-ST50HN 340 to 380MHz, Throughput Energy: 44.0μJ*

IS-ST50HN-B 340 to 380MHz, Throughput Energy: 44.0μJ*

IS-TT50HN 380 to 430MHz, Throughput Energy: 34.0nJ*

IS-TT50HN-B 380 to 430MHz, Throughput Energy: 34.0nJ*

IS-UT50HN 450 to 512MHz, Throughput Energy: 250nJ*

IS-UT50HN-B 450 to 512MHz, Throughput Energy: 250nJ*

Add suffix: **-MA** for male antenna port connector

-ME for male equipment port connector

*Typical

All models have N female connectors standard.

Models with **-B** are bulkhead mount, without are flange mount.

Energy based on 6kV/3kA 8/20μs waveform.

RF Coupled Shield/dc Blocked



Model shown: IS-IEML50LN



Model shown: IS-IE50LN-C2

ISOLATED EQUIPMENT PORT COAXIAL PROTECTORS

APPLICATION: Where the best protection is a must. This unique PolyPhaser® is one that not only has a dc block for the center conductor but also blocks the shield's surge energy from going to your equipment chassis. This is the ultimate in protection and prevents ground loops for proper single point grounding.

- RF coupled shield with >2kVdc breakdown
- Large bandwidths
- Transceive but not for combiner output
- Bulkhead mounting/grounding
(flange mount adapter, page 54)
- Multi-strike capability
- Low throughput energy
- Housed use only — aluminum enclosure
- Not weather resistant
- Weatherize using WK-1 (see page 50)
- 18-8 stainless steel hardware
- N silver shell and gold center pin

Mil Specs: Many — call with requirements

TEN YEAR WARRANTY

SPECIFICATIONS:

Surge: 50kA IEC 1000-4-5 8/20μs waveform 500 Joules
20kA for IE-ML series

Turn-on: 600Vdc ±20% L models
1200Vdc ±20% H models

Turn-on Time: 2.5ns L; 7ns H; for 2kV/ns

VSWR: ≤1.1 to 1 over frequency range

Insertion Loss: ≤0.1dB over frequency range

Temperature: -50°C to +85°C Storage/Operating +50°C

Vibration: 1G up to 100Hz

ORDER INFORMATION: UHF CONNECTORS (Female)

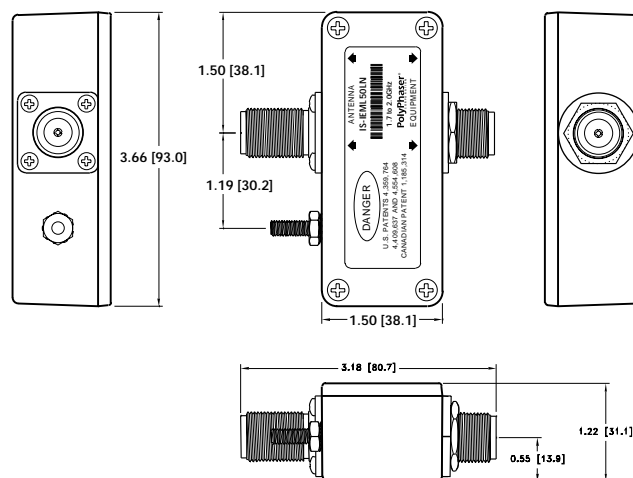
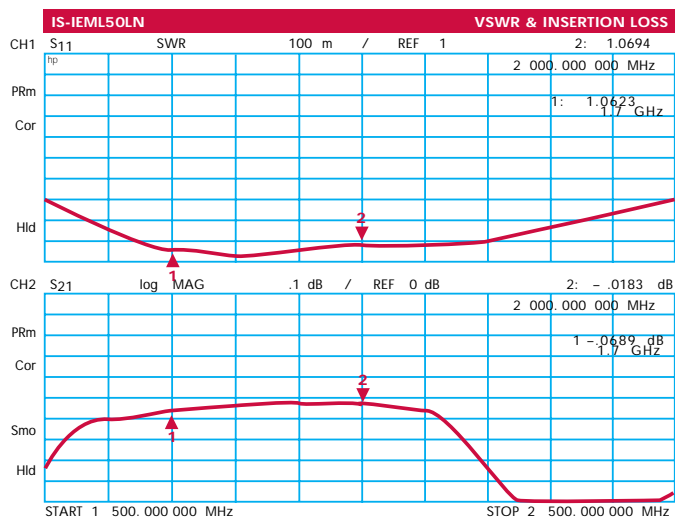
IS-IE50LU-C0 Throughput Energy (typical): 4.70mJ
Frequency Range: 1.5MHz to 400MHz
Max. Power: HF 2kW, VHF 375W, UHF 125W

IS-IE50HU-C0 Throughput Energy (typical): 4.70mJ
Frequency Range: 1.5MHz to 400MHz
Max. Power: HF 3kW, VHF 500W, UHF 250W

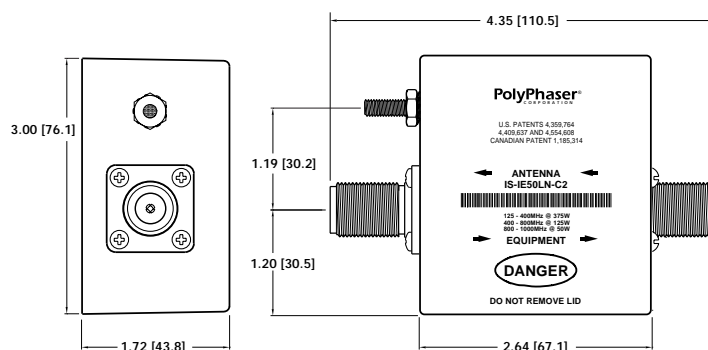
IS-IE50LU-C1 Throughput Energy (typical): 1.10mJ
Frequency Range: 50MHz to 500MHz
Max. Power: VHF 375W, UHF 125W

IS-IE50HU-C1 Throughput Energy (typical): 1.10mJ
Frequency Range: 50MHz to 500MHz
Max. Power: VHF 500W, UHF 250W

RF Coupled Shield/dc Blocked



Product Dimensions: IS-IEML50LN



Product Dimensions: IS-IE50LN-C2

ORDER INFORMATION: N CONNECTORS (Female)

IS-IE50LN-C0 Throughput Energy (typical): 4.70mJ
Frequency Range: 1.5MHz to 400MHz
Max. Power: HF 2kW, VHF 375W, UHF 125W

IS-IE50HN-C0 Throughput Energy (typical): 4.70mJ
Frequency Range: 1.5MHz to 400MHz
Max. Power: HF 3kW, VHF 500W, UHF 250W

IS-IE50LN-C1 Throughput Energy (typical): 1.10mJ
Frequency Range: 50MHz to 700MHz
Max. Power: VHF 375W, UHF 125W

IS-IE50HN-C1 Throughput Energy (typical): 1.10mJ
Frequency Range: 50MHz to 700MHz
Max. Power: VHF 500W, UHF 250W

IS-IE50LN-C2 Throughput Energy (typical): 137μJ
Frequency Range: 125MHz to 1GHz
Max. Power: VHF 375W, UHF_(low) 125W, 800MHz to 1GHz 50W

IS-IE50HN-C2 Throughput Energy (typical): 854μJ
Frequency Range: 125MHz to 1GHz
Max. Power: VHF 500W, UHF_(low) 250W, 800MHz to 1GHz 125W

IS-IEML50LN Throughput Energy (typical): 0.20μJ
Frequency Range: 1.7GHz to 2.0GHz
Max. Power: 100W

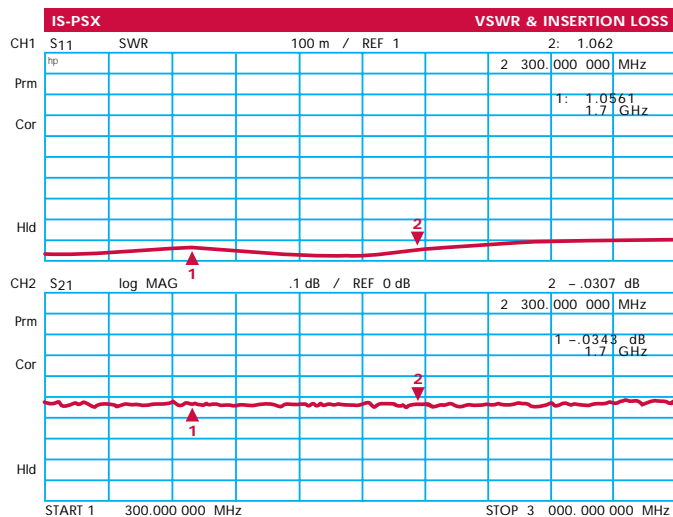
IS-IEMH50LN Throughput Energy (typical): 59.0nJ
Frequency Range: 2.0GHz to 2.3GHz
Max. Power: 100W

Choose lowest throughput energy for desired frequency.
Energy based on 8/20μs waveform. Add suffix: **-MA** for male connector.

dc Blocked Filter



Model shown: PSX



PCS MICRO FILTER PROTECTOR

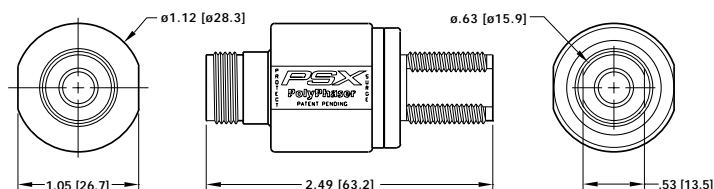
APPLICATION:

The Micro PSX is dc blocked for the ultimate in equipment protection. Comprehensive testing proved the industry's finest RF and surge performance characteristics. The ultra compact footprint incorporates a fully integrated connector housing that is completely weatherized, contains no gas tubes and will be available in various connector configurations.

- Industry's best RF performance
- Compact, integrated connector housing
- Industry's lowest throughput energy
- dc blocked
- Small footprint
- Multi-strike capability
- No gas tubes
- Fully weatherized
- Maintenance free

Patent Pending

TEN YEAR WARRANTY



Product Dimensions: PSX

SPECIFICATIONS:

Surge: 20kA IEC 1000-4-5 8/20μs waveform

Frequency Range: 1.2 to 2.8GHz

VSWR: ≤1.1 to 1 over frequency range

Insertion Loss: <0.1dB **Power:** 300W continuous

Throughput Energy: ≤0.5μJ for 3kA @ 8/20μs waveform

Let-Through Voltage: ≤±3V for 3kA @ 8/20μs waveform

Temperature: -40°C to +85°C Storage/Operating

Relative Humidity: to 95%

Vibration: 1G up to 100Hz

ORDER INFORMATION:

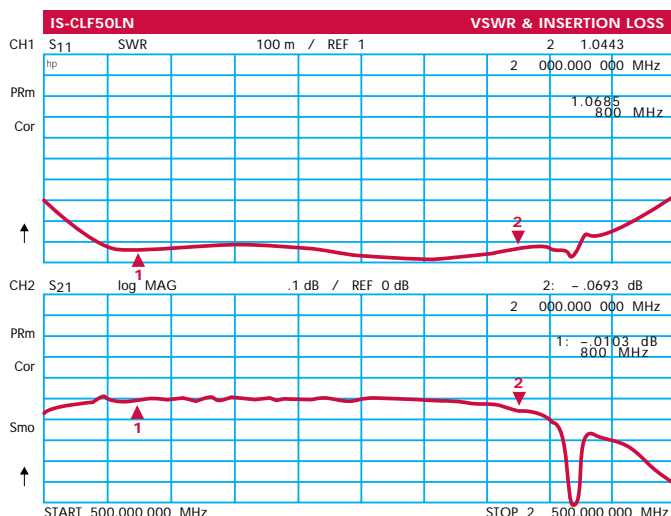
PSX Bulkhead mounted, N connector (female) on surge side and N connector (female) on protected side.

CSX, LSX and other frequency and connector combinations to be developed. Contact factory for availability.

dc Blocked Filter



Model shown: IS-CLF50LN



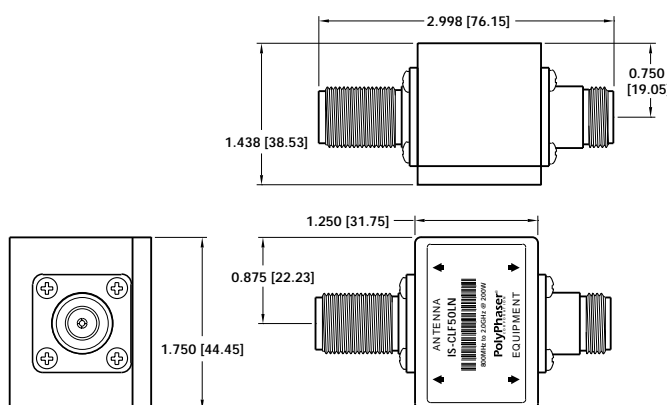
CELLULAR LIGHTNING BLOCK PROTECTOR

APPLICATION:

Weatherized unit for transmit and/or receive only.

- Industry's best RF performance
- Wide bandwidth
- Small footprints and fully weatherized housing
- Industry's lowest throughput energy
- Maintenance free
- Multi-strike capability
- No gas tubes

TEN YEAR WARRANTY



Product Dimensions: IS-CLF50LN

SPECIFICATIONS:

Surge: 20kA IEC 1000-4-5 8/20μs waveform

Frequency Range: 800MHz to 1.0GHz
800MHz to 2.0GHz (CLF50LN only)

VSWR: ≤1.1 to 1 over frequency range

Insertion Loss: <0.05dB typical, ≤0.1dB maximum

Power: 200W for L, 500W for H

Throughput Energy: ≤0.5μJ for 3kA @ 8/20μs waveform

Temperature: -40°C to +85°C Storage/Operating

Relative Humidity: to 95%

Vibration: 1G up to 100Hz

ORDER INFORMATION:

IS-CLF50LN N connector (female), surface/bulkhead mounting

IS-CLF50HN N connector (female)

IS-CLF50HD DIN connector (female)

IS-CLF50LD DIN connector (female)

Add suffix: **-MA** for male antenna port connector

-ME for male equipment port connector

dc Blocked Filter



Model shown: IS-CF50HN

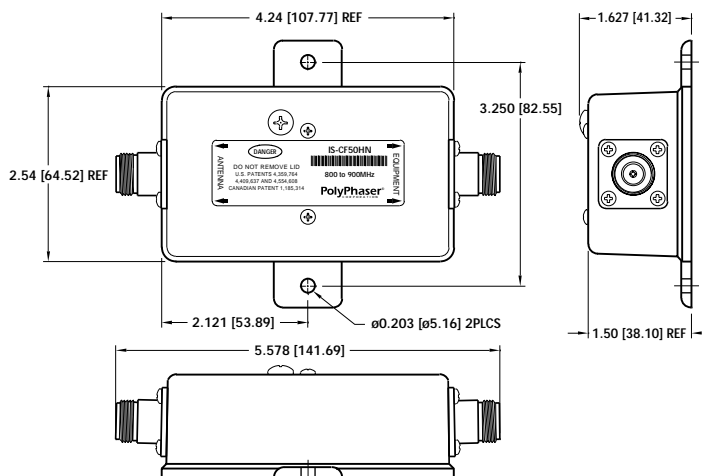
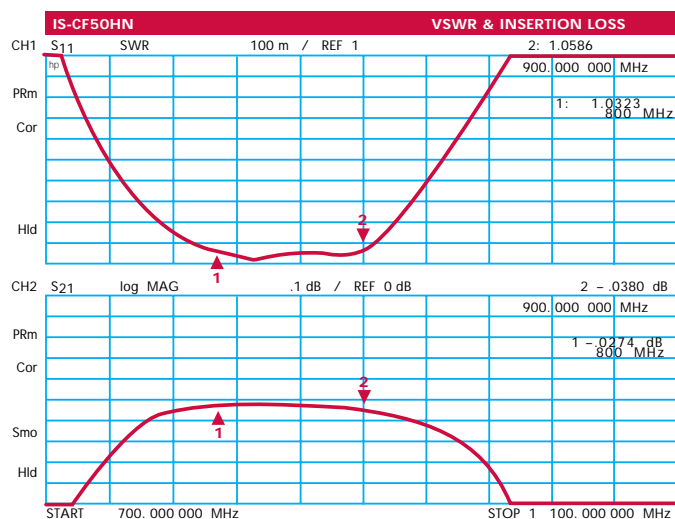
CELLULAR COMBINER PROTECTOR

APPLICATION:

Combiner transmit and/or receive only.

- Multi-channel transmit, 750W max single channel
- Industry's lowest throughput energy
- Maintenance free
- Multi-strike capability
- No gas tubes/dc blocked

TEN YEAR WARRANTY



Product Dimensions: IS-CF50HN

SPECIFICATIONS:

Surge: 20kA IEC 1000-4-5 8/20μs waveform 138 Joules

Frequency Range: 800MHz to 900MHz

VSWR: ≤1.1 to 1 over frequency range

Insertion Loss: <0.05dB typical, ≤0.1dB maximum

Power: 750W single channel

Throughput Energy: ≤5pJ typical for 3kA @ 8/20μs waveform

Temperature: -40°C to +85°C Storage/Operating

Vibration: 1G up to 100Hz

ORDER INFORMATION:

IS-CF50HN N connector (female), surface mounting

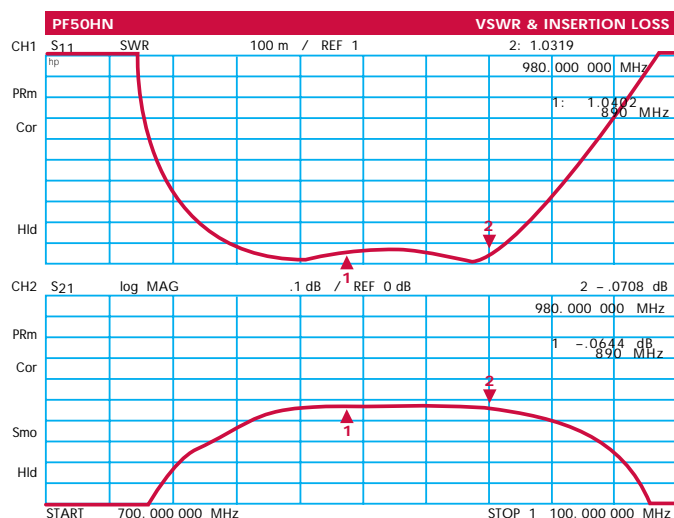
IS-CF50HD DIN connector (female), surface mounting

Add suffix: **-MA** for male antenna port connector
-ME for male equipment port connector

dc Blocked Filter



Model shown: IS-PF50HN



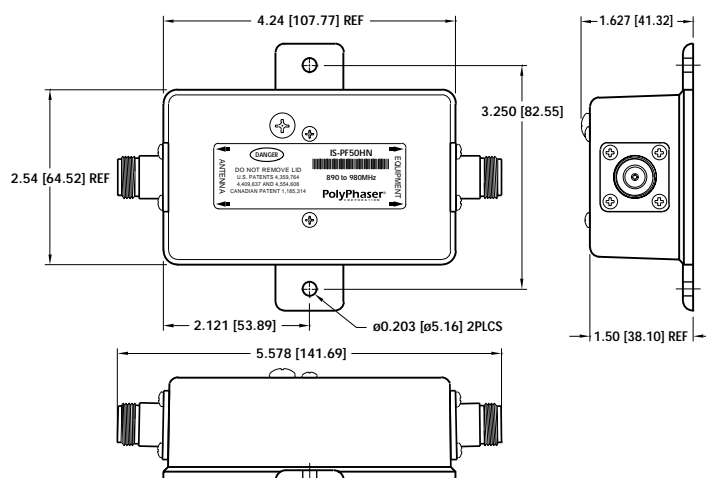
PAGING COMBINER PROTECTOR

APPLICATION:

Combiner transmit and/or receive only.

- Multi-channel transmit, 750W max single channel
- Industry's lowest throughput energy
- Maintenance free
- Multi-strike capability
- No gas tubes/dc blocked

TEN YEAR WARRANTY



Product Dimensions: IS-PF50HN

SPECIFICATIONS:

Surge: 20kA IEC 1000-4-5 8/20μs waveform 138Joules

Frequency Range: 890MHz to 980MHz

VSWR: ≤1.1 to 1

Insertion Loss: <0.05dB typical, ≤0.1dB maximum

Power: 750W single channel

Throughput Energy: ≤5pJ typical for 3kA @ 8/20μs waveform

Temperature: -40°C to +85°C operating/storage

Vibration: 1G up to 100Hz

ORDER INFORMATION:

IS-PF50HN N connector (female), surface mounting

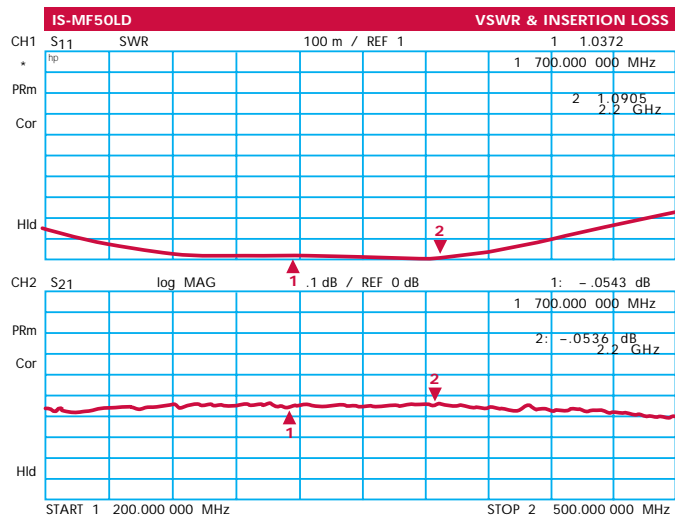
IS-PF50HD DIN connector (female), surface mounting

Add suffix: **-MA** for male antenna port connector
-ME for male equipment port connector

dc Blocked Filter



Model shown: IS-MF50LD



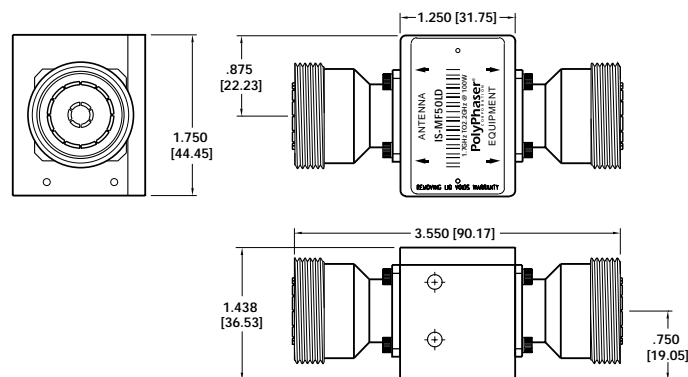
MICRO LIGHTNING BLOCK PROTECTOR

APPLICATION:

Weathertight unit for transmit and/or receive only.

- Industry's best RF performance
- Small footprint & fully weatherized housing
- Industry's lowest throughput energy
- Maintenance free
- Multi-strike capability
- No gas tubes/dc blocked

TEN YEAR WARRANTY



Product Dimensions: IS-MF50LD

SPECIFICATIONS:

Surge: 20kA IEC 1000-4-5 8/20μs waveform

Frequency Range: IS-MF50LD: 1.7GHz to 2.2GHz
IS-MF50LN: 980MHz to 2.6GHz

VSWR: ≤1.1 to 1

Insertion Loss: ≤0.1dB

Power: 100W

Throughput Energy: ≤0.5μJ for 3kA @ 8/20μs waveform

Temperature: -40°C to +85°C Storage/Operating

Vibration: 1G up to 100Hz

ORDER INFORMATION:

IS-MF50LD DIN connector, 1.7GHz to 2.2GHz freq.

IS-MF50LN N connector, 980MHz to 2.6GHz freq.

IS-MF50LN-MA N connector, 1.7GHz to 2.2GHz freq.

IS-MF50LN-ME N connector, 1.7GHz to 2.2GHz freq.

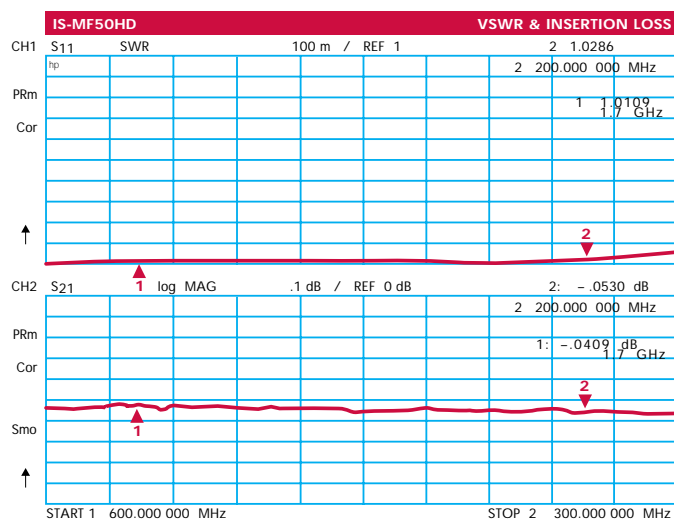
Add suffix: **-MA** for male antenna port connector

-ME for male equipment port connector

dc Blocked Filter



Model shown: IS-MF50HD



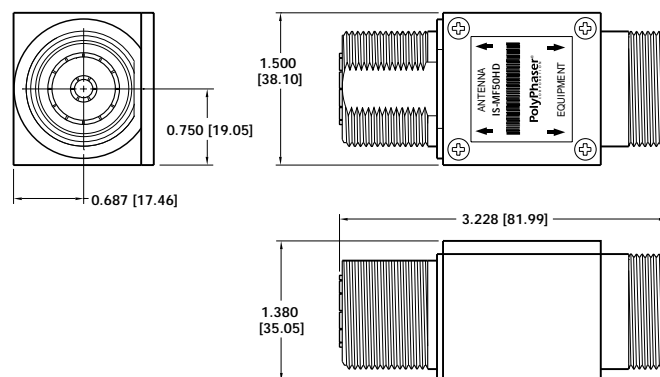
MEDIUM POWER LIGHTNING FILTER

APPLICATION:

Weathertight unit for transmit and/or receive only.

- New UniBody construction
- Small footprints and fully weatherized housing
- Industry's lowest throughput energy
- Maintenance free
- Multi-strike capability
- No gas tubes/dc blocked
- Elongated DIN with "D" hole mounting

TEN YEAR WARRANTY



Product Dimensions: IS-MF50HD

SPECIFICATIONS:

Surge: 20kA IEC 1000-4-5 8/20μs waveform

Frequency Range: 1.7GHz to 2.2GHz

VSWR: ≤1.1 to 1

Insertion Loss: ≤0.1dB typical

Power: 300W maximum continuous

Throughput Energy: ≤10μJ for 3kA @ 8/20μs waveform

Temperature: -40°C to +85°C Storage/Operating

Vibration: 1G up to 100Hz

ORDER INFORMATION:

IS-MF50HD DIN connector (female), surface/bulkhead mounting

Add suffix: **-ME** for male equipment port connector

dc Blocked Filter



Model shown: IS-MR50MDZ+6-ME

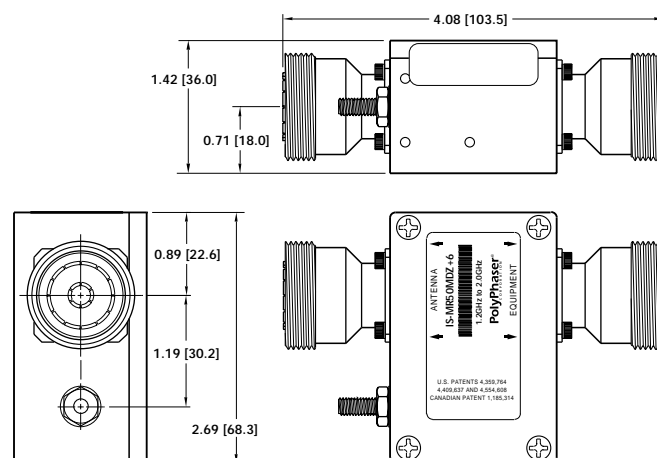
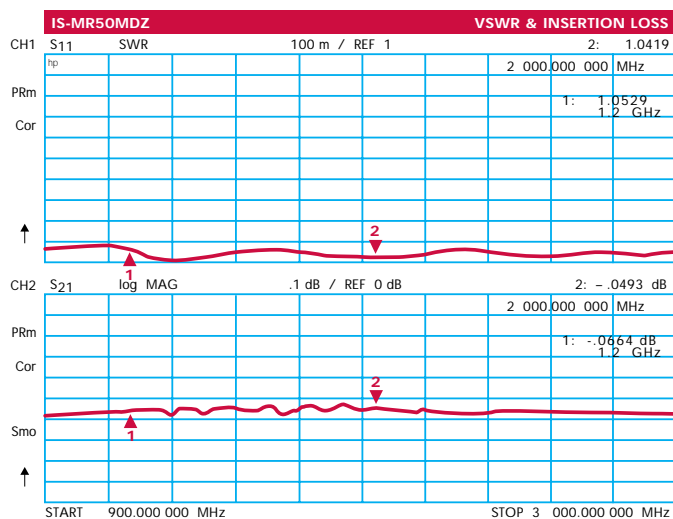
WEATHERIZED GPS PROTECTION

APPLICATION:

Weathertight unit for transmit and/or receive only.

- 1.2GHz to 2.0GHz frequency range
- Multi-strike capability
- Low VSWR and insertion loss
- Protects in-line amplifiers
- Industry's lowest throughput energy
- Fully weatherized housing

TEN YEAR WARRANTY



Product Dimensions: IS-MR50MDZ+6

SPECIFICATIONS:

Surge: 20kA IEC 1000-4-5 8/20μs waveform

Turn-on: ≈15% above model voltage

Frequency Range: 1.2GHz to 2.0GHz

VSWR: ≤1.1 to 1

Insertion Loss: ≤0.1dB

RF Power: 300W maximum continuous

Throughput Energy: 350μJ typical for 3kA @ 8/20μs waveform

Temperature: -50°C to +85°C Storage/Operating +65°C

Vibration: 1G up to 100Hz

ORDER INFORMATION:

IS-MR50MDZ+6 +6Vdc, DIN connector (female)
surface/bulkhead mounting

IS-MR50MDZ+15 +15Vdc, DIN connector (female)
surface/bulkhead mounting

IS-MR50MNZ+6 +6Vdc, N connector (female)
surface/bulkhead mounting

IS-MR50MNZ+15 +15Vdc, N connector (female)
surface/bulkhead mounting

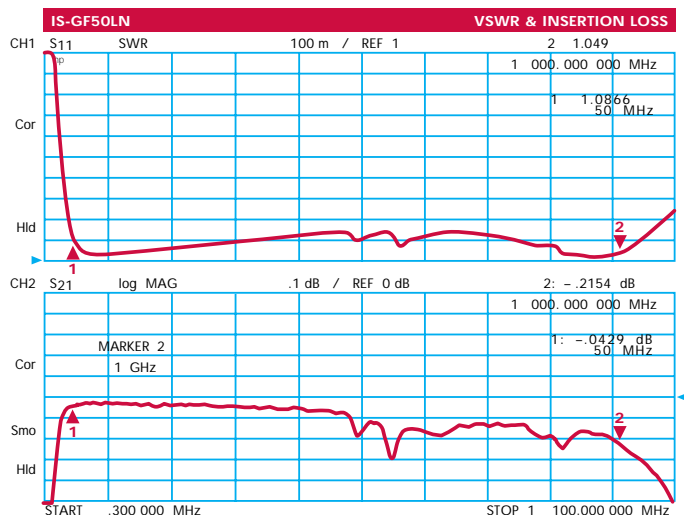
Add suffix: **-MA** for male antenna port connector
-ME for male equipment port connector

Energy based on 6kV/3kA 8/20μs waveform.

dc Blocked



Model shown: IS-GF50LN

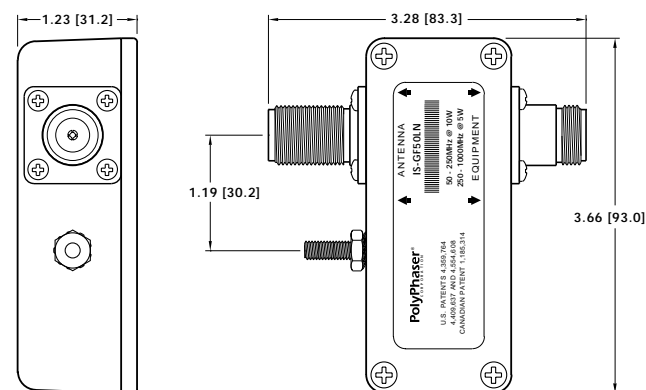


FILTERED AND GROUNDED COAXIAL PROTECTORS

APPLICATION:

GaAs FET receivers and low powered transmitters from 20MHz to 1GHz.

- Four pole filter further attenuates strike energy
- dc grounded on equipment port for less strike noise
- Wide bandwidths
- Multi-strike capability
- Housed use only
- Ultra-low throughput energy
- Bulkhead mounting/grounding
(flange mount adapter, page 50)
- Weatherized using WK-1 (see page 54)
- Aluminum enclosure, 18-8 stainless steel hardware
- N silver shell and gold center pin



Product Dimensions: IS-GF50LN

SPECIFICATIONS:

Surge: 18kA IEC 1000-4-5 8/20μs waveform 110 Joules

Turn-on: 90V ±20%

Turn-on Time: 4ns for 2kV/ns

VSWR: ≤1.2 to 1 over frequency range

Insertion Loss: ≤0.2dB throughout most of the frequency range

Temperature: -40°C to +85°C Storage/Operating +50°C

ORDER INFORMATION: N CONNECTORS (Female)

IS-LR50LN Throughput Energy (typical): ≤700μJ
Frequency Range: 20MHz to 300MHz
Max. Power: HF 25W, VHF 10W

IS-GF50LN Throughput Energy (typical): ≤150pJ
Frequency Range: 80MHz to 900MHz
at ≤1.2 to 1 VSWR
(50MHz to 1GHz at ≤1.2 to 1 VSWR)
Max. Power: HF 10W, VHF 5W

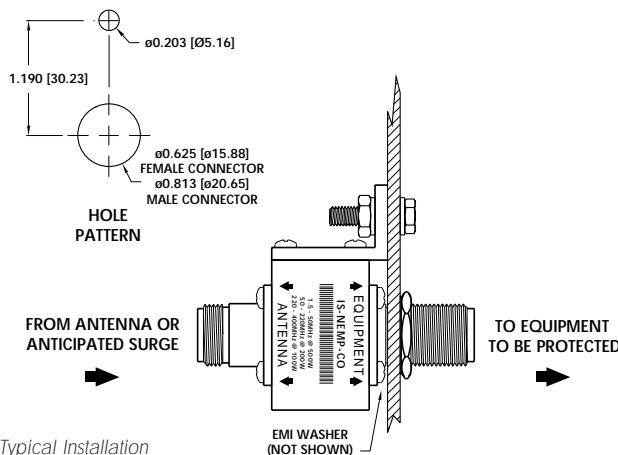
Add suffix: **-MA** for male antenna port connector
-ME for male equipment port connector

Energy based on 6kV/3kA 8/20μs waveform.

dc Blocked



Model shown: IS-NEMP-C0, bulkhead mount



Typical Installation

NUCLEAR EMP COAXIAL PROTECTOR

APPLICATION:

Military, government (FEMA and NCA), protection of emergency radio communications equipment.

- Weatherize using WK-1 (see page 54)
- Employs UL497B listed gas tube
- Patented technology
- Ultra-fast response
- Low throughput energy
- High surge current handling
- Aluminum enclosure
- 18-8 stainless steel hardware
- Bulkhead mountable up to 1/4" thick panels (flange mount adapter, page 50)
- N silver shell and gold center pin
- Highest pulse attenuation (30.14dB for IS-NEMP-C0) of all models tested by NCS (TIB 85-10 document)
- Mounts outside screen room penetration panel or equipment housing for best skin effect and pulse attenuation
- EMI/RFI weather washer for low impedance no drip penetration

Mil Specs: Many — call with requirements

SPECIFICATIONS:

Surge: 50kA IEC 1000-4-5 8/20μs waveform 500 Joules

Turn-on: 330Vdc ±20%

Turn-on Time: 1.5ns for 2kV/ns

VSWR: (see plots on page 89)

- C0: 1.5 to 2MHz is 1.2 to 1 & 2 to 400MHz is 1.1 to 1
- C1: 50 to 60MHz is 1.2 to 1 & 60 to 700MHz is 1.1 to 1
- C2: 125 to 1000MHz is 1.1 to 1

Insertion Loss: ≤0.1dB over frequency range

Temperature: -45°C to +85°C Storage/Operating +50°C

Vibration: 1G up to 100Hz

ORDER INFORMATION: N CONNECTORS (Female)

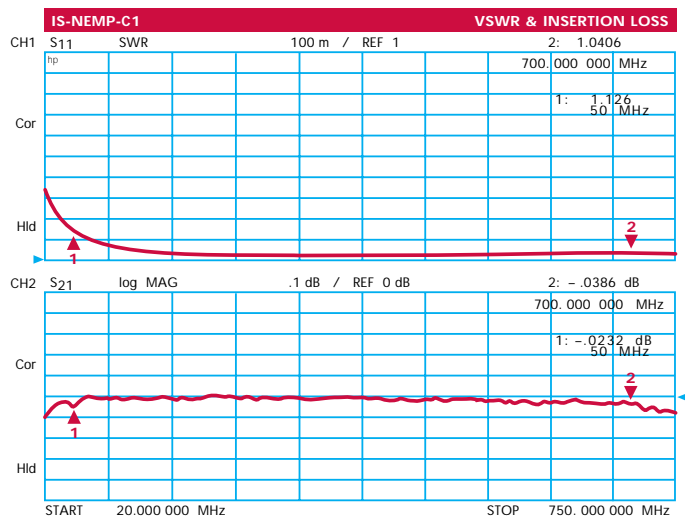
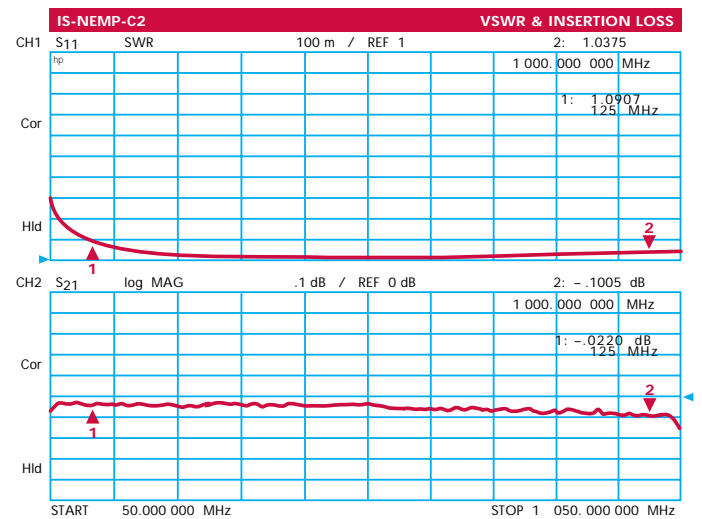
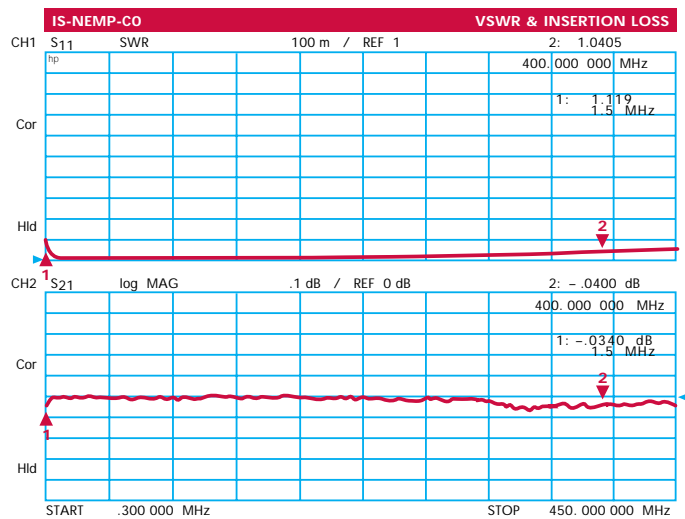
IS-NEMP-C0 Throughput Energy: 1.10mJ typical
Frequency Range: 1.5MHz to 400MHz
Max. Power: HF 500W, VHF 200W, UHF 100W

IS-NEMP-C1 Throughput Energy: 313μJ typical
Frequency Range: 50MHz to 700MHz
Max. Power: VHF 200W, UHF 100W

IS-NEMP-C2 Throughput Energy: 250mJ typical
Frequency Range: 125MHz to 1000MHz
Max. Power: VHF 200W, UHF (low) 100W
800MHz to 1GHz 50W

Add suffix: -MA for male antenna port connector
Energy based on 6kV/3kA 8/20μs waveform.
Choose lowest throughput energy for desired frequency.

dc Blocked - VSWR & Insertion Loss Graphs



dc Blocked

Model shown: IS-50NX-C0, flange mount



Model shown: IS-B50LN-C2, bulkhead mount

BROADBAND HF/VHF/UHF COAXIAL PROTECTORS**APPLICATION:**

For general radio use; surface or bulkhead mountable options, NOT where transmitter combining is performed.

- Utilizes UL497B listed gas tube
- Models from 1.5MHz to 1000MHz
- Multi-strike capability
- Low strike throughput energy
- Flange mount and bulkhead mount options
- Not weather resistant
- Weatherize using WK-1 (see page 54)
- Aluminum enclosure
- 18-8 stainless steel hardware
- UHF nickel shell silver center, TFE
- N silver shell and gold center pin

Mil Specs: Meets 6' all angle drop test, Op to 70,000'; MIL-STD-202, 170F Cond. B -65°C to 125°C, rainproof option meets many Mil specs under 202 and 810 for vibration, shock (both), fungus, etc. UHF & N connectors MIL-C-39012, QQ-S-365, QQ-B-626, QQ-C-530 and MIL-G-45204, follows MIL-STD-454J, Solder QQ-S-571 Sn62

SPECIFICATIONS:

Surge: 50kA IEC 1000-4-5 8/20μs waveform 500 Joules

Turn-on: 600Vdc ±20% 2.5ns for 2kV/ns L models

1200Vdc ±20% 7ns for 2kV/ns H models

VSWR:

-C0: 1.5 to 2MHz is 1.2 to 1 & 2 to 400MHz is 1.1 to 1

-C1: 50 to 60MHz is 1.2 to 1 & 60 to 700MHz is 1.1 to 1

-C2: 125 to 100MHz is ≤1.1 to 1 type N,

≤1.2 to 1 type F & UHF

Insertion Loss: ≤0.1dB over frequency range

Temperature: -45°C to +85°C Storage/Operating +50°C

Vibration: 1G up to 100Hz

ORDER INFORMATION: (Female)

IS-B50LU-C0 Throughput Energy: ≤10mJ* (UHF Connector/Bulkhead)
Frequency Range: 1.5MHz to 400MHz
Max. Power: HF 2kW, VHF 375W, UHF 125W

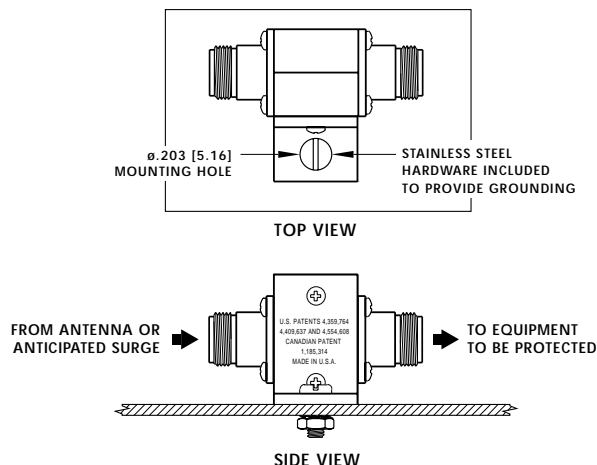
IS-B50HU-C0 Throughput Energy: ≤20mJ* (UHF Connector/Bulkhead)
Frequency Range: 1.5MHz to 400MHz
Max. Power: HF 3kW, VHF 500W, UHF 250W

IS-B50LU-C1 Throughput Energy: ≤600μJ* (UHF Connector/Bulkhead)
Frequency Range: 50MHz to 700MHz
Max. Power: VHF 375W, UHF 125W

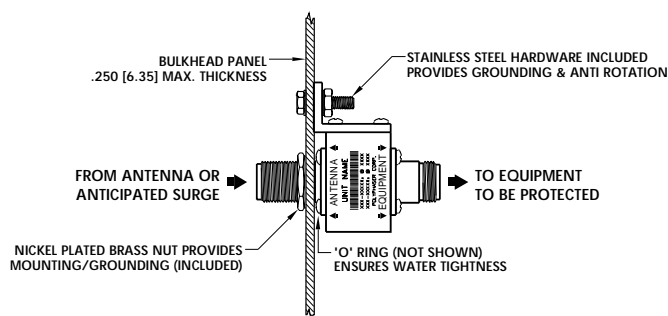
IS-B50HU-C1 Throughput Energy: ≤1mJ* (UHF Connector/Bulkhead)
Frequency Range: 50MHz to 700MHz
Max. Power: VHF 500W, UHF 250W

IS-B50LN-C0 Throughput Energy: ≤10mJ* (N Connector/Bulkhead)
Frequency Range: 1.5MHz to 400MHz
Max. Power: HF 2kW, VHF 375W, UHF 125W

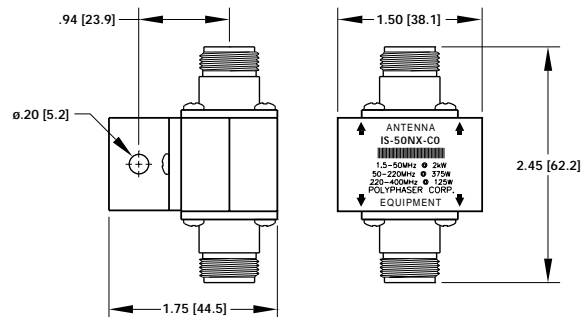
dc Blocked



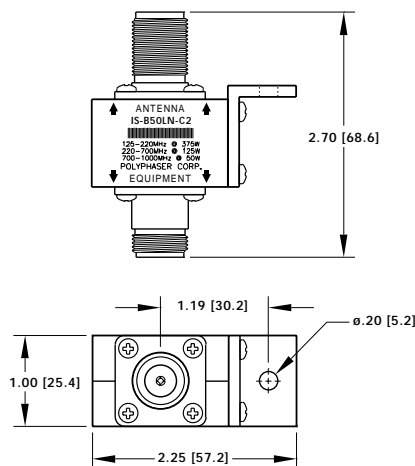
Mounting Configuration: flange mount models



Mounting Configuration: bulkhead mount models



Product Dimensions: IS-50NX-C0, flange mount



Product Dimensions: IS-B50LN-C2, bulkhead mount

IS-B50HN-C0 Throughput Energy: $\leq 20\text{mJ}^*$ (N Connector/Bulkhead)
Frequency Range: 1.5MHz to 400MHz
Max. Power: HF 3kW, VHF 500W, UHF 250W

IS-B50LN-C1 Throughput Energy: $\leq 600\mu\text{J}^*$ (N Connector/Bulkhead)
Frequency Range: 50MHz to 700MHz
Max. Power: VHF 375W, UHF 125W

IS-B50HN-C1 Throughput Energy: $\leq 1\text{mJ}^*$ (N Connector/Bulkhead)
Frequency Range: 50MHz to 700MHz
Max. Power: VHF 500W, UHF 250W

IS-B50LN-C2 Throughput Energy: $\leq 220\mu\text{J}^*$ (N Connector/Bulkhead)
Frequency Range: 125MHz to 1000MHz
Max. Power: VHF 375W, UHF (low) 125W
800MHz to 1GHz 50W

IS-B50HN-C2 Throughput Energy: $\leq 800\mu\text{J}^*$ (N Connector/Bulkhead)
Frequency Range: 125MHz to 1000MHz
Max. Power: VHF 500W, UHF (low) 250W
800MHz to 1GHz 125W

IS-50UX-C0 Throughput Energy: $\leq 10\text{mJ}^*$ (UHF Connector/Surface)
Frequency Range: 1.5MHz to 400MHz
Max. Power: HF 2kW, VHF 375W, UHF 125W

IS-50UX-C1 Throughput Energy: $\leq 600\mu\text{J}^*$ (UHF Connector/Surface)
Frequency Range: 50MHz to 700MHz
Max. Power: VHF 375W, UHF 125W

IS-50NX-C0 Throughput Energy: $\leq 10\text{mJ}^*$ (N Connector/Surface)
Frequency Range: 1.5MHz to 400MHz
Max. Power: HF 2kW, VHF 375W, UHF 125W

IS-50NX-C1 Throughput Energy: $\leq 600\mu\text{J}^*$ (N Connector/Surface)
Frequency Range: 50MHz to 700MHz
Max. Power: VHF 375W, UHF 125W

IS-50NX-C2 Throughput Energy: $\leq 220\mu\text{J}^*$ (N Connector/Surface)
Frequency Range: 125MHz to 1000MHz
Max. Power: VHF 375W, UHF (low) 125W
800MHz to 1GHz 50W

IS-75F-C1 Throughput Energy: $\leq 1\text{mJ}^*$ (F Connector/Surface)
Frequency Range: 4MHz to 900MHz VSWR $\leq 1.2:1$
Max. Power: HF 100W, VHF 100W, UHF 25W

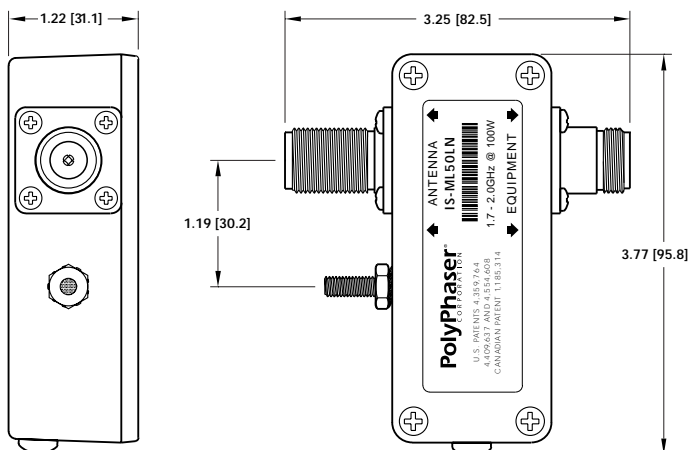
Add suffix: **-MA** for male antenna port connector
-ME for male equipment port connector

*Typical
Choose lowest throughput energy for desired frequency.
Energy based on 6kV/3kA 8/20 μs waveform.

dc Blocked



Model shown: IS-ML50LN, bulkhead mount



Product Dimensions: IS-ML50LN

MICROWAVE COAXIAL PROTECTORS

APPLICATION:

Lightning/NEMP protection for any frequency range from 1GHz to 3GHz for point to point links receive/transmit and broadcast to 100W.

- 50Ω models; 1GHz to 3GHz
- Multi-strike capability
- Low strike throughput energy
- Bulkhead mounting/grounding
(flange mount adapter, page 50)
- Not weather resistant
- Weatherize using WK-1 (see page 54)
- 18-8 stainless steel hardware
- N silver shell and gold center pin

Mil Specs: Many — call with requirements

SPECIFICATIONS:

Surge: 20kA IEC 1000-4-5 8/20μs waveform 138 Joules

Turn-on: 600Vdc ±20%

Turn-on Time: 2.5ns for 2kV/ns

Insertion Loss: ≤0.1dB **VSWR:** ≤1.1 to 1 **Power:** 100W

NEMP Peak Throughput Voltage: 56Vp typical for 3/250ns waveform

Temperature: -45°C to +85°C Storage/Operating +50°C

Vibration: 1G up to 100Hz

ORDER INFORMATION: N CONNECTORS/BULKHEAD

IS-MR50LN for 980MHz to 1.8GHz, Throughput Energy: 4.0μJ*

IS-ML50LN for 1.7GHz to 2.0GHz, Throughput Energy: 15.0μJ*

IS-MH50LN for 2.0GHz to 2.3GHz, Throughput Energy: 4.0nJ*

IS-MT50LN for 2.1GHz to 2.6GHz, Throughput Energy: 4.0nJ*

IS-MU50LN for 2.4GHz to 3.0GHz, Throughput Energy: 32.0nJ*

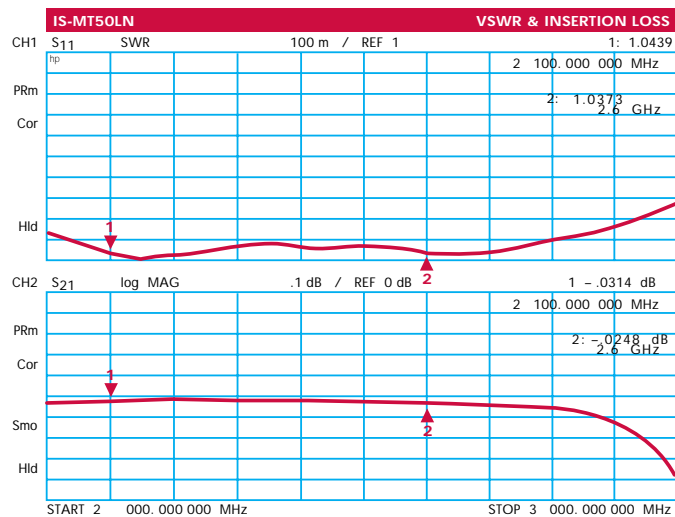
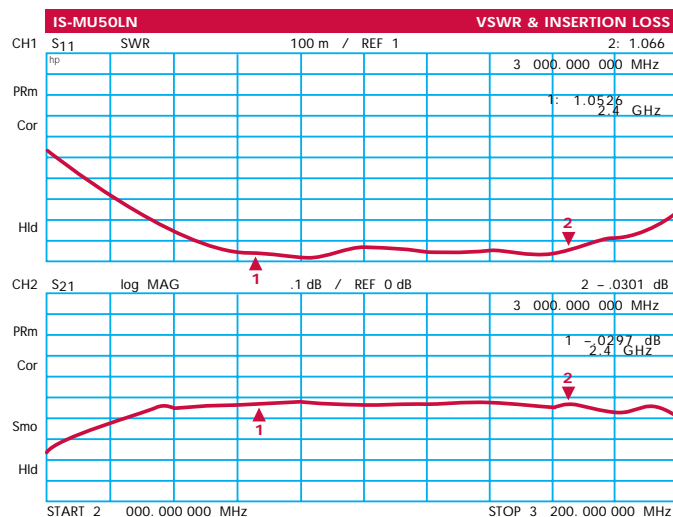
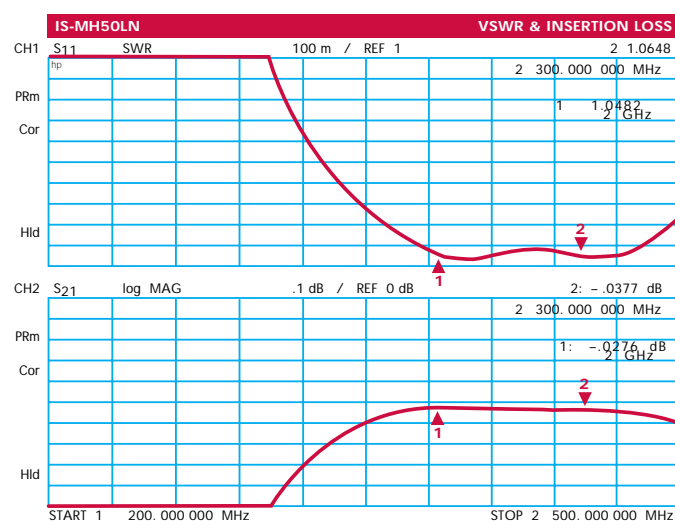
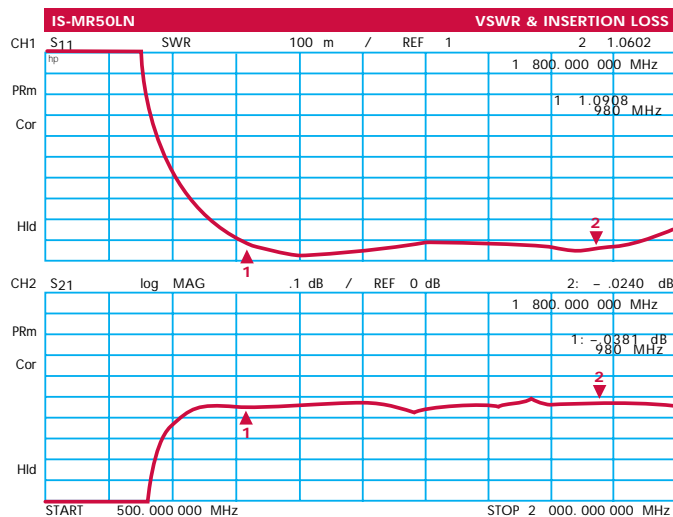
Add suffix: **-MA** for male antenna port connector

-ME for male equipment port connector

* Typical

Energy based on 6kV/3kA 8/20μs waveform.

dc Blocked - VSWR & Insertion Loss Graphs



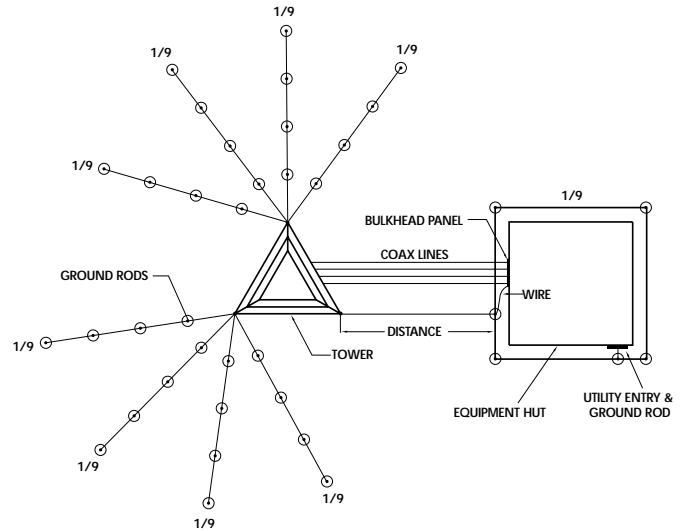
Lightning Protection Information

GROUNDING OVERVIEW

The severity of a lightning strike is a statistically predictable event. An economically designed protection/grounding (P/G) system should take into account a typical-to-large strike. The P/G system should be maintained on a monthly or at least yearly basis. This should include testing protectors, measuring the ground system, pulling on ground rods, and cleaning/inspecting connections for corrosion and tightness. It should also involve a re-evaluation of the overall system design each time new equipment is installed, moved, or modified.

A lightning strike starts with a local breakdown of the atmosphere (step leader) and steps about 150 feet in $1\mu\text{s}$ time increments every $50\mu\text{s}$. During each of the $49\mu\text{s}$ dormant stages, an imaginary hemisphere of 150' radius can be used to determine the next jumping distance. Any object which penetrates this hemisphere, can be chosen as the point of attachment for the return stroke (lightning strike). Since this is a hemisphere, the geometry of a horizontal strike to a tower can occur anywhere above the 150' point over average terrain (side mounted antennas above this height are vulnerable). This has led to the 150' radius rolling ball concept, where an imaginary ball is rolled along the ground in all directions. Each touch point of the ball with any ground mounted object is subject to an attachment point (hit). Coax grounding kits should be installed every 75' above the 150' point. Install additional kits below 150' at the middle, bottom, and prior to the building entry bulkhead.

Lightning will take the path of least impedance which is both resistance and inductance. The larger the conductive surface, the lower the inductance. Bends add inductance — a coil is the continuous bending of a wire. Ground wires should be large and run straight for minimum inductance and voltage drop. They also should be separated from all other conductors by 6" to 8" and should not be run inside or through a conductor unless they are bonded to it. In conduit, ground wires should be bonded at both the entrance and the exit. When working with a metal wall, bond the ground wires to both sides. Do not go through the wall.



Your tower will be the point of impact like a pebble going into a still pond. The rings will be equipotential waves as they diffuse into the surrounding soil. The ground wires in the soil still have inductance. This inductance, shunted by the soil resistance, sets up a time constant or velocity of propagation (since capacitance is present also). The "ripples" will propagate faster with larger surface area wire and better conductive soil. The doping of soil with MgSO_4 salts can help increase soil conductivity and help retain water.

It is not necessary to run interconnecting rings around a tower. Self-support towers will equalize the surge current to each leg (the coax leg may have slightly more current). Guyed towers should not have rings, even if the rings are to act as a collector for the radials. If each radial is interconnected directly to the tower base or leg, the inductance would be less than having only one or two connections going to a ground ring. Rings further out would be connecting radial ground rods that will have the same potential at the same point in time, thus little current will flow as compared to taking the same material and effort and running another radial from the tower base.

Lightning Protection Information

Guy anchors should be grounded with no dissimilar metals (see our book *The 'Grounds' for Lightning and EMP Protection*, Second Edition, Page 24). In poor soil conditions, radials can be used together with ground rods to ground the anchors. A ground system can be obtained in many ways, but the most economical is with radials and ground rods. Radials of less than 100' will disperse the tower base or guy wire energy outward while the ground rods can help take it to lower, more conductive soil layers. If the surge is not leaked or launched into the soil in the radial section(s), the ground rods, if lower soil conductivity can't be found, will develop high E fields and can arc in the soil to spread the charge outward. (This arcing is less likely in soils with higher conductivity.)

Arcing can cause glassification around the rod starting at the tip and working upward. The hot plasma fuses the silica sand into a glass which is a good insulator since water is boiled out in the process and can no longer re-penetrate the hardened glass. This is why, as a routine maintenance, a tug on the rod which produces easy movement, is a possible indication of glassification.

The whole practice of lightning protection is to control the discharge path and not have it randomly disperse in any direction. In normally conductive soil, two rods should be spaced the sum of their lengths. One long deep rod or well casing will not be as effective as an array of radials and ground rods. Even if the one deep rod measures a low resistance, the inductance is usually much greater. In conductive upper layer soil conditions, saturation can occur which can cause eddy currents and additional inductance.

Unlike the radials, ground rod diameter size will have little effect on impedance unless the rod is very long. It is not always imperative to reach the water table, since this may be too far for the rod to be effective. It may be easier to salt dope the rod or use a chemical ground rod that collects precipitation. In poor soil conditions, the spacing of ground rods should be closer. Poor ground conductivity will not shunt the radials' inductance, thus more ground rods will help by either reaching more conductive soil or arcing to relieve the voltage potential. If not quickly dispersed, the voltage will build up at the tower and attempt to go another, perhaps unwanted, path.

All radials should be run away from the equipment building. The more radials there are, the more the current is divided. A perimeter ground system (ring) around the building will help form an equipotential plane. If this ring is approximately equal (in length) to each radial and if eight radials are used, each will have 1/9 the total surge energy. This will leave only 1/9 the strike energy to the equipment building perimeter ground. The perimeter should only have one interconnection to the tower base and should be just below the coax cable runs. For mountain tops, where no conductive soil exists and only radials can be used, wide copper strap, 1-1/2" to 3" wide, should be used to minimize inductance.

The re-bar in the concrete tower base should be used to augment the grounding system. Concrete is conductive because of retained moisture and alkalinity. Tower J bolts or anchor bolts embedded in a conductive concrete tower base will couple strike energy to the concrete. The surface area interface between bolt and concrete will conduct high current levels during a strike. If the ground system is not adequate, the current density could be high enough to cause arcing at the bolt/concrete interface. When the re-bar is interconnected with the bolts, there is additional surface area interface with the concrete, reducing current density. With more surface area and less current density, arcing in the concrete is less likely to occur. If the ground system is not adequate, the current density will be high enough to cause arcing at the bolts. By interconnecting the re-bar, the current density will be reduced and arcing will be less likely to occur. To learn more on designing with the re-bar, consult the book, *The 'Grounds' for Lightning & EMP Protection*, Second Edition.

It is not necessary to route a single copper ground wire up a large galvanized steel tower. The difference in resistance between copper and galvanized steel is lost when compared to the inductive voltage drop due to surface area (skin effect). Placing a lightning rod at the tower top and using the copper cable and tying it to ground is ineffective. The inductive voltage drop of the wire (>100kV) will cause it to jump (arc) to the tower, unless it is at least 24" from the tower. In fact, the use of bare copper cable can cause a corrosion problem to the tower and should not be

Lightning Protection Information

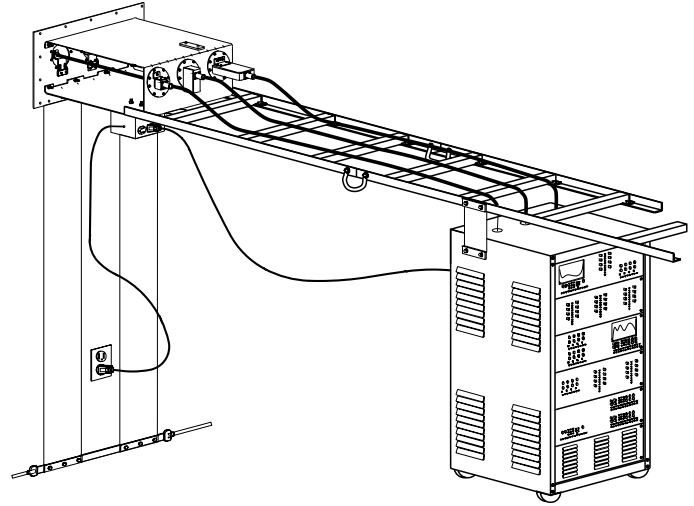
used unless covered. Copper should never come in contact with galvanized steel. Tinned copper wire should not be used in the ground together with copper ground rods since the tinning will be leached into the soil very quickly.

Increasing the distance between the tower and the coax cable entry provides additional propagational time for the tower ground to absorb the strike energy. At the building entry bulkhead panel, coax protectors should be used in addition to another set of coax grounding kits. This bulkhead panel should have ground connectors connecting it to the perimeter ground with the same circumferences as the combined circumferences of the coax cables. Tower lighting protectors should also be included and grounded at this same point.

In a P/G system design, one should also think of system noise reduction and EMI/RFI (Tempest) shielding. This can be accomplished with a single point grounding system. Sometimes the use of a single ground bus (called the Principal Ground Window or PGW) can act as your single point. All your equipment chassis should be grounded to this bus. It should be a large surface area connection to the ground system such as a PolyPhaser Bulkhead Panel, PEEP or PEP.

Typically, the plasma column of the lightning strike (return stroke) can have a voltage rise time of 20-50 nanoseconds. If it hits a tower, the tower will handle the majority of the current pulse to ground. The tower will also radiate the RF energy of the strike. The near field (high magnetic or H field) will penetrate equipment interconnecting wires and induce surge energy. A Faraday cage can reduce this energy. A halo ground system with multiple down conductors to the outside perimeter ground loop can act as a quasi-Faraday cage and give some low frequency shielding. Properly bonded metal building panels can act as a more effective cage. Double-walled screen rooms offer the greatest isolation.

Tower flasher lines, both strobe and conventional, should have protectors to prevent surge entry into the building on the power lines as well as nuisance damage to strobe PC boards.



To ensure survival of the building equipment, all Inputs/Outputs (I/Os) must have protection and they should all be ideally located at the principal ground window or bulkhead panel. If these I/Os (power, telco, etc.) enter elsewhere, protect them first at the entry point (ground protector to perimeter) next run to Perimeter Ground Window (PGW) then protect it again before distribution by the cable trays. (Note: All trays should be grounded to the PGW or bulkhead panel.)

TYPES OF PROTECTORS

The best type of protector is an in-line type. It can better clamp and protect, while preventing the sharing of surge voltage and current with equipment. For telco lines, the best protector is needed when just a few lines are used. Every ground system will momentarily saturate or elevate with respect to the surrounding area until the surge can propagate and dissipate into the soil. The evaluated site ground system can force "on" protectors (power and telco) and dump surge energy onto outbound lines. The greater the number of telco lines, the more the surge is divided as it is distributed over these pairs. The single pair needs the world's best protector to ensure equipment survivability from overvoltage stress as larger surge energy is diverted to this single outbound pair.

Lightning Protection Information

LOCAL AREA NETWORKS

When coax or twisted pairs are used in LAN or WAN systems, a problem between different local grounds can occur. This can cause protectors, which protect in differential mode (wire to wire) as well as common mode (wire to ground), to see a voltage over the turn-on threshold between wires and grounds and clip, induce a hum, or not allow the system to operate. This is not the fault of the protector, but the system design. Grounds should be in common, or on an isolated ground adapter.

POWER LINE

Lightning and surge protectors are no substitute for an Uninterruptible Power Supply (UPS). However, many UPS units do not have adequate surge protection. In-line protectors can offer filtering of the line; however, many protectors use ferrite core material which will saturate on major surges and be useless. Air core type indicators may not offer as low a cut off frequency or as much filter attenuation and are physically larger, but they will not change with surge current or become less effective due to ferrite core magnetic orientation. (PolyPhaser uses only air core inductors). If your equipment is sensitive and critical, it should be on a UPS, which will buffer any line noise from your system since the ac power is regenerated. (Filters do not absorb or dissipate energy, but merely shunt or reflect it back to its source.)

Power line protectors that cover the wall outlet when they plug in are only good for stand-alone equipment with no other I/Os. This is because other I/Os can input a surge to the equipment. A power line protector, which is far away on the end of an inductive cord, will not limit the overvoltage due to the inductance of the cord's safety ground wire. Protectors should be in common with (by a short interconnection) the chassis of the equipment that is to be protected and not at the end of a long equipment power cord. This may be hard or impossible to do with consumer type protectors in plastic enclosures, but not with PolyPhaser's conductive aluminum case.

Semiconductors, whether silicon based or Metal Oxide Varistors (MOV), will fail in a shorted mode when they are at the end of life, or when over powered beyond their designed capabilities. However, if subjected to power levels in excess of the fusing levels of the wire leads, the unit may fuse open.

Gas tubes normally fail in a shorted mode. Once shorted, another large strike can explode the gas tube creating an open circuit. Lab test levels show that our IS-NEMP, IS-B50 and IS-50 series models will vent the gas tubes at 89kA and above using the IEEE 8/20 μ s waveform.

This is just an overview of proper grounding and protector installation. For a more in-depth study, the 100+ page book *The 'Grounds' for Lightning and EMP Protection* will provide additional information and is available for order on page 22.

Lightning Protection Information

TESTING AND CUSTOM PRODUCTS

Testing can be done on any product. Please indicate the type of testing that you need. Testing results to Mil specs such as MIL-STD-462 or equal can be obtained in writing only. Some results may be considered proprietary and may not be released. Custom products designed for customers, can at our discretion, be sold to others (including foreign governments) unless we are notified in writing.



The Haefely PSURG6.1 surge generator tests another PolyPhaser[®] to determine let-through energy.

SURGE LET-THROUGH ENERGY TESTING OF POLYPHASER PRODUCTS

The let-through energy for PolyPhaser products is determined by testing the products with a Haefely PSURG6.1 surge generator equipped with a Hybrid Network input module, which will output a surge waveform compatible with IEC 1000-4-5 requirements for coaxial products. The surge generator is capable of a 6kV by 3kA combined waveform.

Products are connected to the surge generator through antenna or surge side connector of the device under test (DUT). The surge let-through energy is measured by capturing the voltage waveform on the equipment or protected side of the DUT with an H.P. 54522C oscilloscope through a length of line which has the specific impedance compatible with the DUT (50 ohm coaxial line, twisted pair line, etc.).

The digitized captured waveform is then mathematically processed to determine the let-through energy.

Our largest surge generator can produce up to 100kV and 65kA 8/20 μ s waveform IEC 1000-4-5.

Formulas

MULTI-CHANNEL COMBINING

Combining consists of summing multiple channels together to feed onto a common cable. Low frequencies and higher frequencies will in time reach a peak voltage together of the same polarity. This voltage summation peak can have more peak power than the sum of their RMS powers. Since gas tube protectors are voltage sensitive, they must be designed to handle combiner outputs or turn-on RF voltage peaks can result. This can cause major problems at other frequencies (intermod, spurs, interference, etc.). Each protector designed for combiners is listed as to its total voltage peak (V_T) that it can handle without RF turn-on. This total is the summation of all the voltage peaks for each channel being combined.

$$V_T = V_{p1} + V_{p2} + V_{p3} \dots + V_{pn}$$

where $V_p = 1.414 \cdot X \cdot \sqrt{P_{ch} \cdot 50}$

(P_{ch} = channel power out of combiner)

and for a	VSWR	X =
	1.1 to 1	1.05
	1.2 to 1	1.09
	1.3 to 1	1.13
	1.4 to 1	1.17
	1.5 to 1	1.2
	1.86 to 1	1.3

CALCULATING INDUCTANCE:

Copper Wire:

$$L(\text{in } \mu\text{H}) = 0.508I [2.303 \log_{10} (4I/d) - 0.75] \times 10^{-2}$$

Copper Strap:

$$L(\text{in } \mu\text{H}) = 0.508I [2.303 \log_{10} (2I/(w+t)) + 0.5 + 0.2235 (w+t)/I] \times 10^{-2}$$

Where: I = length in inches
 d = diameter in inches
 w = width in inches
 t = thickness in inches

IS-158E & 318E HIGH POWER GAS TUBE SELECTION:

$$V_p = 1.414 \cdot X \cdot \sqrt{P_{ch} \cdot 50}$$

V_p = Voltage peak
 P_{ch} = Power per channel
 X = VSWR (same as Multi-Channel Combining)

Standard Connectors

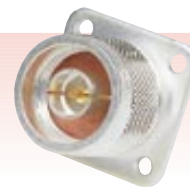
N



Standard Female



Elongated Female



Male

UHF



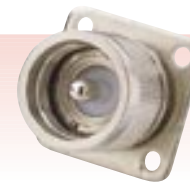
Mini Female



Standard Female



Elongated Female



Male

BNC



Female



Male

F



Female



Male

SMA

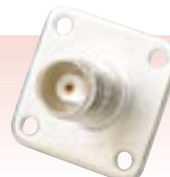


Female

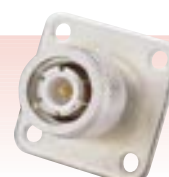


Male

TNC



Female



Male

7/16 DIN



Female



Male

LC



Female

EIA



Front View



Side View

Definition of Terms

PRODUCT RELATED DEFINITIONS

AMPERE

An ampere (current) is a (coulomb/second).

BANDWIDTH

Difference in frequency between the upper and lower 3dB down response frequencies.

BI-PHASE

Found as a power feed to most U.S. homes. Derived from a center tapped transformer, it contains two hot phases (180°) with a center tap neutral return. Normally supplied as two 120 volt single phases with 240 volts available across both phases. The neutral return is usually earth grounded.

CAPACITANCE

Measured at 1.0kHz unless otherwise stated.

CLAMP

To clip. To hold turn-on voltage as current is increased. Turn-on voltage is the same, or nearly the same, as "on" voltage drop.

CLAMPING RATIO

The ratio of voltage drop at a given current to the turn-on voltage.

CLAMPING SPEED

Measured with full lead length using a 1kV/ns waveform in a 50Ω system, with ≥300MHz or larger bandwidth.

COMBINER

The summation of multiple transmitters into one transmission line. The peak voltage from each signal will be additive and will be higher than the sum of the power would indicate.

COMMON-MODE

Pertaining to signals or signal components referenced to ground.

COULOMB

Measurement of charge. Often used to indicate the amount of transferred charge through a gas tube to determine gas tube life. "Q" abbreviation. A coulomb is (current x time).

CROWBAR

To turn-on and clamp close to ground level. Having a high turn-on trigger voltage and a low "on" voltage.

DIFFERENTIAL MODE

Referenced only between conductors (not referenced to ground).

DIPLEXER

(TV Broadcasting). The combining of two transmitters into one transmission line. TV visual and aural.

DUPLEXER

Simultaneous receive and transmit on one transmission line. Where a T connector splits/combines the signals to two groups of filters. The receiver filter passes the receive frequency while rejecting (band stop) the transmitter's frequency. The transmitter filter passes its frequency while attenuating the Class C transmit noise at the receive frequency.

EMI/RFI

Electro Magnetic Interference/Radio Frequency Interference. Broad spectrum noise or interfering signals.

EMP

Electro Magnetic Pulse, usually referred to as the man-made generation by detonation of a nuclear bomb at a high altitude, which generates a very fast pulse (RF) which can be captured by antennas and long unshielded lines. Sometimes referred to as NEMP, HEMP, etc. Lightning can also generate an EMP near the event. Referred to as LEMP.

EMP RATED

Rated as having a fast enough turn-on time or filtering to protect against the effects of an EMP event.

FARADAY SHIELD

An electrostatic (E field) shield made up of a conductive or partially conductive material or grid. A Faraday cage or screen room is effective for protecting inside equipment from outside radiated RF energies.

FILTERING (EMI/RFI)

Measured in a 50Ω system — loaded. As per MIL-STD-220.

FREQUENCY RANGE

The bandwidth over which both the listed maximum VSWR and Insertion Loss specifications are valid.

Definition of Terms

GROUND IMPEDANCE

The ground resistance and the inductance/capacitance value of the grounding system. Also called dynamic surge ground impedance.

GROUND LOOP

An undesired potential EMI condition formed when two or more pieces of equipment are interconnected and earthed for shock safety hazard prevention purposes.

GROUND RESISTANCE

The resistance value of a given ground rod or grounding system as measured, usually by a fall of potential (3 stake) method, using a 100Hz signal source.

HF

High Frequency – normally from 3 to 30MHz, however in this catalog it covers from 1.5 to 30MHz.

HOUSED USE ONLY

For indoor use, or must be further enclosed or rain-proofed for outdoor usage.

IMPEDANCE

Nominal impedance of the device. The variation of this impedance with frequency is measured as VSWR.

IN-LINE

Power or signal passage through unit. In series with line. Usually a multi-stage protector. Best protection method.

INSERTION LOSS

Loss of a device across the stated frequency range. This type of loss is due to the insertion of the unit in series with a signal path.

JOULES

A unit of energy. One joule for one second is equal to one watt of power. Joules is (current x time x voltage).

LEAKAGE CURRENT

Usually measured at 50 or 60Hz with 120, 240 or 480 volts ac. However, it can be ac or dc at a specific voltage and frequency.

LOOP RESISTANCE

Total resistance as measured across the input with the output shorted.

MAXIMUM PEAK LET-THROUGH VOLTAGE

Measured at a given surge current using a given waveform, and using $\geq 300\text{MHz}$ bandwidth across a 50Ω impedance. (Note: this 50Ω impedance may be dc blocked [large bandwidth compared to the surge frequencies present] and 50Ω resistive load [termination]).

MAXIMUM POWER

Maximum Continuous Wave (CW) transmit power, without unit degradation.

MAXIMUM SURGE

The maximum single surge current and specified waveform that can be handled by a device without failure during the conduction of that waveform and which ends the life of the device for conducting successive waveforms, but does not allow any generation of outward projectiles.

MULTI-STRIKE CAPABILITY

In most applications current sharing will occur, and in a direct strike event the unit will survive to work again.

POWER

Power is (voltage x current) or a (coulomb/second).

RECEIVER MULTICOUPLER

Sometimes with an amplifier, this device has one antenna line and multiple outlets.

RF

Radio Frequencies — any and all frequencies that can be radiated as an electromagnetic wave (plane wave).

SAFETY GROUND

The local earth ground. The earth ground which grounds the neutral return. The wire may be green or bare and can be through a metal conduit. It may be earth grounded as many times as needed. (Neutral must only be grounded once at the entry location).

SHF

Super High Frequency – from 3000MHz to 30GHz.

SHUNT PROTECTOR

Line-to-ground. No power or signal passage through unit. Not in-series with line.

Definition of Terms

SINGLE PHASE

A true single phase supply. Usually a two-wire system with one hot phase and a neutral return. A safety earth ground is also present.

SKIN EFFECT

The gradient conduction and propagation of RF or RF components of a surge on the outer surfaces of conductors.

TEMPERATURE

The extremes of operating or storage that the unit or unit parts have been tested to under MIL-STD-202 for thermal shock.

THREE PHASE

It consists of sinusoids 120° apart on at least three wires (Delta) and often four wires (Wye). The fourth wire is a grounded neutral return. In a Delta system there is no reference to ground and thus it is more susceptible to lightning problems.

THROUGHPUT ENERGY

The total energy that will be let through the device using the indicated surge waveform.

TOTAL SURGE ENERGY

Total sum of surge energy for all lines of a protector unit. Measured in joules. The minimum total energy which results in the failure of the unit.

TRANSFER IMPEDANCE

Referring to coax, is the impedance to transfer into or outside the coax at various frequencies usually below 1MHz. Due to loss of skin effect attenuation or shielding at these low frequencies, coax can be susceptible to interference and noise as well as the radiation of such signals.

TURN-ON TIME – GAS TUBE

The amount of time that exists in the period that occurs when the ramp voltage barely exceeds the turn-on voltage of the device, and the point at which 50% of the peak voltage is achieved during the turn-on (crowbar) process. Measured in a 50Ω system with ≥300MHz bandwidth.

TURN-ON Vac

The maximum ac sine wave voltage that can be passed with the peaks just at the turn-on Vdc level.

TURN-ON Vdc

Turn-on voltage at 1mA dc with a ramp of 100V/ms typical.

UHF

Ultra-High Frequency – normally from 300 to 3000MHz, however in this catalog we breakout 800 to 1000MHz separately even though it is within this category.

VHF

Very High Frequency – from 30 to 300MHz.

VLF

Very Low Frequency – from 300Hz to 3kHz.

VOLT

A volt is a (joule/coulomb).

VSWR

Voltage Standing Wave Ratio (VSWR) of the device across the stated frequency range. VSWR is the amount of reflected signal due to an impedance mismatch.

VT MAX

The max peak voltage of all combined waveforms. V_{total} is used for multi-coupled or combined transmit signals.

Product Applications - UNI-KIT Installation



1. First, locate a suitable grounding point on the coax cable and place the rectangular slot at the grounding point of the top clamping end on the coax cable using it as a guide to mark two inches of insulation on the coax cable.



5. Before tightening all the bolts and nuts, make sure the bottom end of the strap is in the proper position to be mounted on the tower leg and insert the provided 1/4 - 20 hardware. Now the hardware at the top clamping end of the grounding strap can be tightened.



2. Take the flat perforated strap and wrap it around the exposed outer shield of the coax cable. Keep the holes of the strap aligned. In order to ensure optimum grounding contact, make sure the perforated strap is completely contacting the exposed outer shield of the coax cable.



6. Torque down the 1/4 - 20 hardware on the bottom end of the grounding strap to the tower leg at 35 to 50 inch pounds.



3. Fold both perforated strap tails together and pull these through the rectangular slot. Pull hard on the tails while pushing the rectangular slot towards the coax cable.



7. Fold the perforated strap tails together in the same direction, back towards the coax cable.



4. Place the rounded end of the grounding strap, with the kidney shaped holes between the perforated strap tails. Then place the angle bracket with the threaded studs through the holes of the perforated strap tails while passing through the kidney shaped holes of the grounding strap.

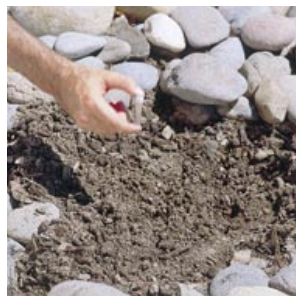


8. Using the black electrical tape, completely cover the assembly, then cover with black mastic weatherizing material and apply black electrical tape again to fully weatherproof the assembly.

Note: Coax cable courtesy of Times Microwave Systems.

Product Applications - pH Soil Test Kit

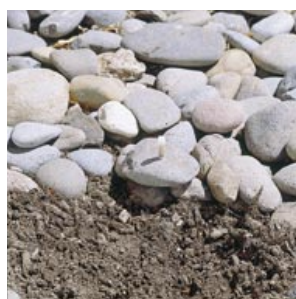
1. To test your site's soil, dig to the level at which you intend to install your grounding system or if installed, carefully dig to the conductors and scoop 1 oz. or a small teaspoon of soil. ***Do not touch the sample.***



5. Place the test tube cap on tightly and shake by hand for one minute.



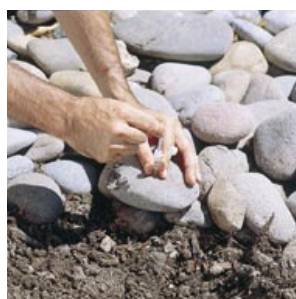
2. Place the sample on clean paper and remove all foreign material. Crush the sample if necessary to fit it into the test tube.



6. Let it settle for 2 minutes or more...



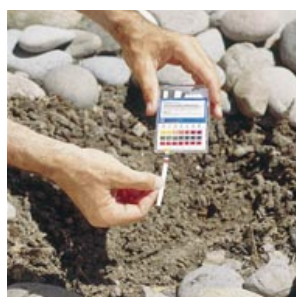
3. Add enough soil to cover the bottom 1/3 of the test tube. Lift the nozzle on the dispensing bottle of distilled water.



7. ...and then dip the colored end of the sensor strip into the water, covering all the color squares in a flow of distilled water for better visibility.



4. Squeezing the bottle, slowly add distilled water up to the test tube cap neck level.



8. Compare the color squares to the color chart for the correct pH value. You should be able to match the colors to the nearest 1/2 pH value. This is extremely accurate.

Order Forms**QUESTIONS SPECIFICALLY FOR RF PRODUCTS/CATALOG ITEMS**

- ☐ Frequency Range(s) or Center Frequency(ies) and Bandwidth(s) _____
- ☐ Impedance (usually 50 Ω ; 75 Ω for video) _____
- ☐ Connectors _____
Most common for 50 Ω systems: N and UHF. UHF are *nominally* 50 Ω .
Most common for 75 Ω systems: N, F and BNC.
- ☐ Males required? _____ Antenna (MA) or Equipment (ME) side? _____
- ☐ dc Blocked. Normal status unless powering pre-amp, etc. _____
☐ If not, working voltage: _____ Vdc (_____ Vac @ _____ Hz)
Current: _____ Adc (_____ Aac)
☐ _____ INJECTOR _____ PICKOFF _____ PICKOR
- ☐ Insertion Loss Required: _____
- ☐ VSWR Required: _____
If transmit, need:
☐ Worst case VSWR of system _____
- ☐ Transmit (Tx) or Receive Only (RO) _____
If transmit, need:
☐ Single or Multi-channel (=Frequency) _____
☐ If Multi-channel, how many channels and spacing between them? _____
☐ Transmit Power (after combiner, if multi-channel) _____
Recommend obtaining Power/Channel
If value after combiner unknown, get transmitter power and dB loss through combiner.
☐ Modulation type (AM, FM, SSB, Pulse, Other [Specify]): _____
☐ Duty Cycle: _____ % On-Time Day: _____
- ☐ Special Handling Requirements: (Define) _____

Order Forms

CUSTOM PRODUCTS ORDER FORM	
SPECIFICATIONS	CUSTOMER SPECS
SURGE (MAX SURGE):	
(L) LIGHTNING (E) EMP (LE) BOTH:	
EMI/RFI WASHER	
TYPE OF CONNECTOR & Z	
SEX-ANT OR SURGE:	
SEX-EQ OR PROTECTED:	
dc BLOCKED:	
*RF TURN-ON VOLTAGE:	
INSERTION LOSS:	
VSWR: TEST @ Z	
BULKHEAD OR FLANGE MOUNT:	
DIFFERENT MNTG. HRDWR. OR CONFIG.:	
FREQUENCY RANGE:	
Tx POWER OR RECEIVE ONLY:	
Tx ONLY: WORST CASE SYSTEM VSWR	
MULTI-CHANNEL Tx:	
CONFIG: INJECTOR, PICKOFF, PICKOR	
MAX VOLTAGE, dc OR ac @ ____ Hz	
MAX CURRENT, dc OR ac @ A	
*Vdc TURN-ON VOLTAGE	
MAX SERIES PATH RESISTANCE @Ω	
AIRTIGHT/RAINPROOF:	
ISOLATED:	
LIMITATION ON PHYSICAL SIZE:	
MIL SPECS:	
WHERE IS UNIT PHYSICALLY LOCATED:	
TEMPERATURE RANGE:	

APPLICATION:
COMMENTS:

CONTACT NAME:	PHONE:	FAX:
COMPANY:		
ADDRESS:		
CITY:	STATE:	ZIP: COUNTRY:

Terms and Conditions of Sale

1. **ORDERING GOODS.** All orders for goods must be made or confirmed in writing. PolyPhaser's acceptance of any order shall occur only after receipt of Purchaser's written order or confirmation and delivery of PolyPhaser's written confirmation to Purchaser.

2. **PRICES.** Unless otherwise quoted in a firm offer, all prices shall be as described in PolyPhaser's price list last published before PolyPhaser's receipt of Purchaser's written order or confirmation. PolyPhaser shall provide firm quotes only in writing. Unless otherwise specified, all firm quotes shall expire thirty (30) days from date of issuance. Prices are subject to change at any time without notice. Prices do not include federal, state or local taxes, freight or insurance.

3. **TERMS.** Domestic sales on account are net thirty (30) days upon previously approved credit only. All other sales shall be Cash, Discover, MasterCard, Visa, Prepaid (before shipping) or COD. International sales shall be prepaid or payment guaranteed by Irrevocable Letter of Credit, all bank charges paid by Purchaser. Purchaser may purchase goods on account or credit only after approval by PolyPhaser's Credit Department.

4. **DELIVERY AND SHIPPING.** Unless otherwise requested in writing before shipment:

- (1) All domestic orders shall be shipped (a) prepaid, insured FOB destination, UPS Ground Service; or (b) COD or on account, FOB PolyPhaser's factory, Minden, Nevada; and
- (2) All international orders shall be shipped insured air delivery freight collect via carriers serving Reno/Tahoe International Airport. All freight and insurance charges shall be payable by Purchaser (in addition to the purchase price for the goods) in accordance with Section 3 TERMS above. Except goods shipped FOB destination, Purchaser bears the risk of all loss or damage to goods in transit, and must make any claim for damage or loss during shipment directly with the carrier. Identification of goods shall occur when PolyPhaser places the goods in the custody of carrier for shipment.

5. **INSPECTION AND ACCEPTANCE.** All claims for damages, errors, shortages or non-conformance of goods must be made to PolyPhaser in writing within thirty (30) days of Purchaser's receipt of the goods. Purchaser's failure to make such claim within the time permitted shall constitute Purchaser's irrevocable acceptance of the goods.

6. **MODIFICATIONS.** PolyPhaser reserves the right to modify and change specifications with respect to any goods without notice, and to substitute such modified goods to the extent that they meet or exceed the performance specifications of the goods ordered by Purchaser.

7. **RETURNS AND ALLOWANCES.** Goods rejected by Purchaser for damage (other than during shipping) or non-conformance must be returned to PolyPhaser within thirty (30) days of Purchaser's timely rejection thereof. All other returns, whether for warranty or otherwise, may be returned only after written notice given by Purchaser to PolyPhaser and written authorization and acceptance by PolyPhaser. Purchaser shall ship all returned goods insured freight collect by carrier designated by PolyPhaser. Credit or adjustment for returned goods shall be subject to inspection and acceptance by PolyPhaser at PolyPhaser's factory, Minden, Nevada. Non-standard catalog items and items specially manufactured for Purchaser are non-cancelable, non-returnable, non-refundable except as to warranty defects and non-conformance to manufacturing specifications.

8. **LIMITED WARRANTY.** POLYPHASER WARRANTS THAT AT THE TIME OF SHIPMENT THE GOODS SHALL MEET OR EXCEED ALL OF POLYPHASER'S PUBLISHED SPECIFICATIONS FOR SUCH GOODS AND SHALL BE AND REMAIN FREE OF DEFECTS IN WORKMANSHIP AND MATERIALS FOR A PERIOD OF UP TO TEN (10) YEARS AFTER THE DATE OF SHIPMENT OF THE GOODS TO PURCHASER. PURCHASER AGREES THAT THE GOODS ARE DESIGNED ACCORDING TO SPECIFICATIONS SUITABLE FOR PURCHASER'S PURPOSES, AND THAT, EXCEPT AS SET FORTH IN THIS LIMITED WARRANTY, POLYPHASER DISCLAIMS ANY WARRANTY OF ANY KIND, EXPRESS OR IMPLIED, INCLUDING WITHOUT LIMITATION, ANY WARRANTY AS TO THE DESIGN, FITNESS, CONDITION, MERCHANTABILITY OR DESCRIPTION OF OR AS TO THE QUALITY OF THE MATERIAL OR WORKMANSHIP IN THE GOODS, OR AS TO THEIR FITNESS FOR ANY PARTICULAR PURPOSE FOR ANY TRADE OR BUSINESS, OR ANY OTHER REPRESENTATION OR WARRANTY WHATSOEVER. Also excluded from this limited warranty are goods covered by other written manufacturer or supplier warranties, damage resulting from ordinary wear and tear, abusive use or lack of proper maintenance, work not done by PolyPhaser or PolyPhaser's contractor or agents, or loss or injury caused by the elements or during shipment to or from Purchaser. Purchaser agrees to notify PolyPhaser in writing within thirty (30) days of Purchaser's discovery of any problem with any goods subject to this limited warranty. Goods determined to be defective in materials or workmanship within the time described in this Limited Warranty shall be repaired, replaced, or price fully refunded at PolyPhaser's sole discretion, and only after Purchaser's full compliance with the terms of RETURNS AND ALLOWANCES above, PolyPhaser's written approval for return, and examination by PolyPhaser at PolyPhaser's factory. PolyPhaser shall notify Purchaser of its decision to repair, replace, refund the purchase price, or to deny liability under this Limited Warranty within sixty (60) days of PolyPhaser's receipt of the returned goods. The warranties contained in this Limited Warranty are personal to Purchaser and are not assignable by Purchaser to any transferee of the goods.

9. **LIMITATION OF LIABILITY.** PolyPhaser shall not under any circumstances (a) be liable to Purchaser for any warranty claim relating to the goods or components that Purchaser asserts more than ten (10) years after the date of shipment of the goods to Purchaser; (b) be liable to Purchaser for any damages in excess of the amount actually paid by Purchaser to PolyPhaser for the goods as to which Purchaser makes a warranty claim or the cost of repair or replacement, whichever is the smaller amount; (3) be liable to Purchaser for any loss of use or profits or other special or consequential damages; or (4) be responsible for any personal injury, or property damage alleged to arise as a result of Purchaser's or any third party's use of the goods. Purchaser expressly assumes the risk of and the responsibility for any and all damages for personal injury, property damage, loss of use or profits or other special or consequential damages relating in any way to the goods or use thereof. The above limitation shall apply even though it may be alleged that PolyPhaser or its agents have been actively or passively negligent.

10. **VENUE AND JURISDICTION.** The sole and exclusive forum for the resolution of any disputes arising between Purchaser and PolyPhaser shall be the Ninth Judicial District Court in the State of Nevada, in and for Douglas County, or, upon proper legal basis, the United States District Court for the District of Nevada, Northern Nevada Division, and Purchaser and PolyPhaser each confers jurisdiction over the resolution of such disputes upon these courts.

