Lightning Protectors for Amateur Radio

LP-HBR-U Series 1.8-100 MHz

Covers 160 – 6 Meter Ham Radio Bands

- *DC Blocked for Best Surge Protection*
- *2kW Average Power*
- *<0.1 dB Insertion Loss*
- *<1.06:1 VSWR / -30dB*
- *Multi Strike Capability*
- *Weatherized Housing*
- *Built in Weatherization Gasket at Connector*
- *Bulkhead or Supplied Bracket Mount*

LP HBR-UFF
UHF female connectors on surge and protected sides

LP HBR-UMP
UHF female connector on surge side with UHF male connector on protected side

LP HBR-UMS
UHF male connector on surge side with UHF female on protected side

Electrical Specifications	
Impedance	50 Ohm
Frequency Range	1.8 MHz – 100 MHz
Maximum VSWR/Return Loss	<1.06:1 / <-30dB
Insertion Loss	< 0.1dB
Power Handling - Average	2000 Watts
Maximum Peak RF Voltage	4400 Volts
Maximum Surge Current	20 kA Single Strike
Multiple Strikes	10 kA (8x20µs waveform)
Energy Throughput Rating	<12 mJ
Impulse Spark-over Voltage	2000 Volts Nominal
DC Turn on Voltage	1400 Volts Nominal
Protection Circuit	DC Blocked, Uni-directional

Also available with Type N connectors
Applications: Amateur Radio, Government, Military, and Others in the 1.8 – 100 MHz spectrum

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LP- HBX-N Filter Type Protector from 100 –700 MHz
Covers 144 MHz, 222 MHz, and 420 MHz Ham Radio Bands

Electrical Specifications	
Impedance	50 Ω
Frequency Range	100-700 MHz
VSWR/Return Loss	<1.15:1 / <-23dB
Insertion Loss	< 0.1dB
Impulse Discharge Current	20KA multiple (8x20µs wave-form)
Residual Pulse Voltage	<5V@6kV/3kA (8x20µs wave-form)
Energy Throughput Rating	<1.4µJ (6kV/3kA 1.2x50/8x20µs wave-form)
Power Handling	750 Watts
Protection Circuit	DC Blocked

The HBX-N series is a high performance, low throughput energy, 750 watt rated filter type protector. It is weatherized to IP 65 standards and can be installed outdoors. A high pass filter is used to pass the V/UHF signal while the dc and lower frequency lightning transients are passed through an inductor, to the protector body. A low resistance / inductance protector ground connection is essential using a grounded entry panel or ground bar with optional LP-BFDN-CW bracket.

LP-STRH-N Filter Type Protector from 700 – 2700 MHz
Covers 902 MHz, 1240 MHz, and Authorized Bands up to 2450 MHz

Electrical Specifications	
Impedance	50 Ω
Frequency Range	700-2700 MHz
VSWR/Return Loss	< 1.2:1 / <-24dB (700-840MHz) < 1.1:1 / <-26dB (840-2700MHz)
Insertion Loss	< 0.1dB
Average Power	500 Watts
PIM	<-160 dBc
Maximum Surge Current	50kA (8x20µs wave-form)
Residual Pulse Voltage	< 100V (50kA 8x20µs wave-form)
Residual Pulse Voltage	< 1V (4kV/2kA 1.2x50/8x20µs wave-form)
Energy Throughput Rating	< 1nJ (4kV/2kA 1.2x50/8x20µs wave-form)
Protection Circuit	DC Blocked

The STRH-N series is a high performance, low throughput energy, 500 watt rated filter type protector. It is weatherized to IP 65 standards and can be installed outdoors. A high pass filter is used to pass the UHF signal to equipment, while the dc and lower frequency lightning transients are passed through an inductor to the protector body. The STRLH-N series also has a very low PIM (Passive Intermodulation) rating and can be used at multi-transmitter sites with confidence. A low resistance/inductance protector ground connection is essential using a grounded entry panel or ground bar with optional LP-BFDN-CW bracket.

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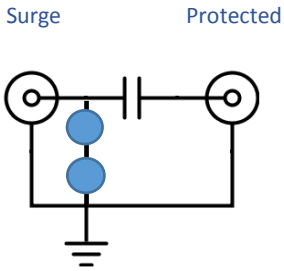
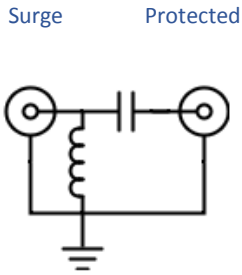
LP-HBR-U Series 1.8-100 MHz
Schematic and Technical Discussion



The LP-HBR-U uses two gas tubes connected in series from the center pin of the "surge" connector to the protector body, and a capacitor from the "surge" connector center pin to the "protected" connector center pin. The capacitor blocks dc current flow to the RF input coupling loop in the protected equipment's antenna connector long enough for the gas tubes to "turn on". The gas tubes equalize the center conductor to shield potential. With center conductor and shield at the same potential, there is no current flow through the circuitry connected across the antenna connector center pin and shield, and the equipment is undamaged. Dc blocking allows a very low throughput to the equipment. A dc blocked protector will have a *specified frequency range* to maintain an impedance match through the protector. It must be connected to a verifiable low "resistance" ground system.

LP-HBX-N 100-700MHz and LP-STRH-N 700-2700 MHz
Schematics and Technical Discussion



A high pass filter has a high current rated inductor connected from the center pin of the "surge" connector to the protector body. A conductor from the top of the inductor is continued to a series capacitor to the center pin of the "protected" connector. This forms a high pass filter with dc and low frequency lightning transient currents passing through the inductor to the protector body, while allowing < 0.1 dB insertion loss at its RF bandpass frequency. An RF high pass filter will have a *specified frequency range* to maintain an impedance match through the protector. It must be connected to a verifiable low "resistance" ground system. *or with optional LP-BFDN-CW bracket.*

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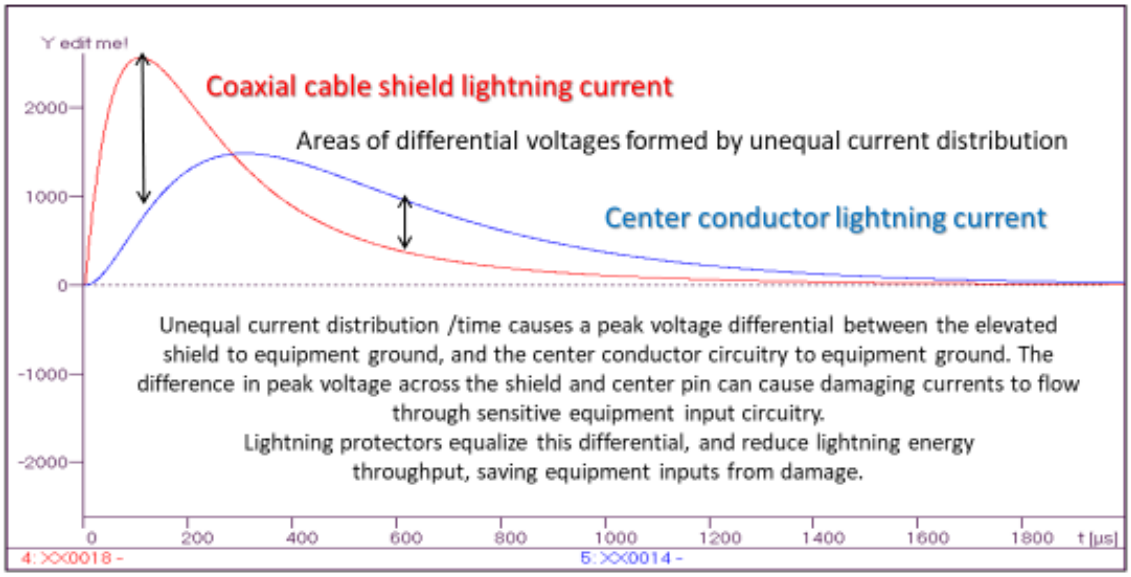
Why Lightning Damage Occurs to Equipment Inputs/Outputs



Velocity of Propagation on Shield vs. Center Conductor

Coaxial cable is known as "unbalanced cable" since the shield has a greater circumference than the center conductor. Radio signals and lightning transients will travel toward equipment faster on the shield than the center conductor. Most coaxial cables have a center conductor "Velocity Factor" of ~ 86-88% referenced to the speed of light. Older RG/ type coaxial cables are ~ 66%. The coaxial cable center conductor current arrival time is generally based on the cable length and center conductor Velocity Factor. The above graph (black arrows) indicates the area between the blue and red lines where the differential voltage between shield and center conductor occurs. The two current pulses and resulting differential voltages are common to all coaxial cables, and is what drives damaging lightning current through a transceiver's antenna input.

A dc blocked gas tube protector *equalizes this differential by elevating the center conductor potential to shield potential at the same "time", effectively protecting the antenna input circuitry. The capacitor lets through the RF signal and a very small pulse resulting from the rapid change in current as the center conductor is equalized. A gas tube protector must be used for HF frequencies. A high pass filter at 1.8 MHz could still let through LF lightning energy. The protector body must be properly grounded either at entry panel or with included bracket.*

A high pass filter protector *(>100 MHz) sends dc/ low frequency lightning transients through an inductor to the protector body, while passing the V/UHF RF signal though the coupling capacitor to the transceiver's antenna connector. Residual let though energy is very low. During a strike, the protector body would pass combined shield and center conductor currents on through to the equipment if the protector was not grounded either at entry panel or with optional LP-BFDN-CW bracket.*

About Grounding A lightning pulse on the coax shield will arrive at your equipment bringing large potential driven currents that can only be reduced by grounding the shield at the base of the tower *and* at the entrance to the equipment room. Protector operation sends shield and center conductor current to the protector body. *It must be grounded*. A conductive plate mounted on an outside wall, and bonded to a low "resistance" ground system, makes a good entrance bulkhead and provides a "single point" ground that can be extended to the transceiver's operating position. Protectors can also be mounted to a ground bar with a bracket (see above).

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