

On Site Testing of Lightning Protection Devices

After a severe thunderstorm with multiple tower strikes, how is a technician to know if the coaxial lightning protectors are still operating properly? There are some obvious visual indications of damage such as arcing / discoloration and melted / welded connectors, while the Return Loss / VSWR and Insertion Loss in the transmission line system could provide some indication of *impending* failure. But until now, there has been no simple field test to assure the protectors meet specifications.



The Times Protect LP-SPT Surge Protection Tester is designed to test all coaxial cable RF Lightning Protection products offered by Times Microwave. Other LP products based on transient protection devices such as GDT, MOVS, TVS and SIDACs and mechanical filter designs can be tested. Moreover the LP-SPT is suitable for testing discrete transient devices as well.

The LP-SPT consists of a battery operated high voltage DC power supply providing an output up to 1000 Volts at approximately 1-1.5mA. This output level provides enough voltage to cause breakdown of the transient device to occur without over-driving the device

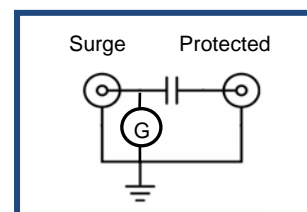
with excessive current; providing a reliable and valid method for measuring peak breakdown voltages of transient suppression devices. Although the test voltage is applied at a rise time rate of approximately 10kV/S, it is slow enough to facilitate valid testing of the device's rated "dc" breakdown voltage within the tolerance specified by the device manufacturer while staying within the 1000 Volt operating range.

The LP-SPT is a rugged, simple to use handheld test instrument. The LP-SPT has a 3.5 digit LCD that displays device under test peak breakdown voltage to a resolution of one Volt. Two type-N connectors (male and female) at the top of the LP-SPT provide direct connection of an RF LP device to the tester. An on-off switch and LED backlit "TEST" button facilitate operation and testing.

Coaxial protector product types and IS-SPT test readings

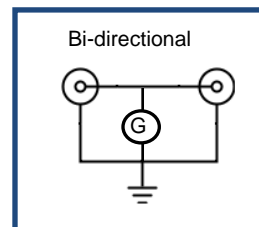
Gas Tube Type- Dc blocked, or non dc blocked "straight-through" permanent or replaceable gas tube.

A **dc blocked protector** uses a gas tube connected from the center pin of the "surge" connector to the protector body and a discrete component capacitor in series from the top of the gas tube to the "protected" connector center pin. The capacitor blocks dc current flow to a resistive component (rf coupling loop) long enough for the gas tube to "turn on" and equalize the center conductor to local ground potential. With center conductor and shield at the same potential, there is no current flow through the protected equipment input, and the equipment is undamaged. Dc blocking allows a very low energy pass-through to equipment. A dc blocked protector will have a *specified frequency range* to maintain proper impedance match through the device. **LP-SPT test - from surge side connector, read 480 to 720 Volts with 600 Volt gas tube (e.g. LP-BTR/W series). Protected side connector, read high (800-900 Volts) open.**



On Site Testing with Times Protect LP-SPT Surge Protection Tester (TechDoc)

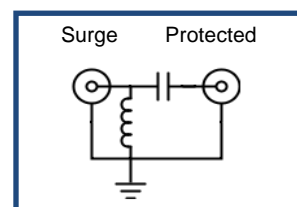
A **non-dc blocked protector** (“straight-through”) will share the incoming current with a resistive component (rf coupling loop). The gas tube will turn on when the current through the resistive component in the equipment input rises enough to create a voltage drop reflected back to the protector’s gas tube. A longer coax jumper cable from the protector to the equipment might produce a di/dt drop to forward bias and facilitate the gas tube turn on, reducing the required current flow through the protected equipment input. A non-dc blocked protector is bi-directional and can have a *very wide frequency range*, as much as dc to 7 GHz (Times Protect product), but will pass through more energy to the equipment than a dc blocked protector. Dc to tower top equipment can be passed through a non dc blocked protector with gas tube turn on rated as close as possible to the required dc voltage. **LP-SPT test – from either connector, read installed gas tube turn on voltage (as specified) +/- 20%**



Note: Readout could “jitter” when the test button is continuously activated while testing a gas tube. The LP-SPT is designed to provide an activation voltage with just enough current (approximately 1-1.5mA) to keep the gas tube ionized for “turn on” measurement without damage. Since there is not enough available current for a “hard turn on”, the gas tube could be in an unstable condition during measurement. The range of “jitter” could be *approximately* the minimum and maximum acceptable Voltage limit on the Test Reference guide supplied with the instrument.

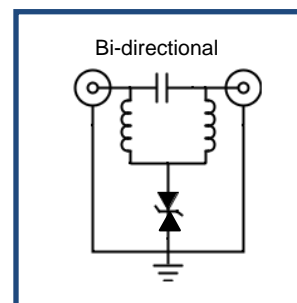
Dc blocked mechanical filters (no gas tube) - Blocks dc and low frequency transient energy present during lightning strike. *Instantaneous protection, no activation time.*

A **dc blocked mechanical filter** has a high current rated inductor connected from the center pin of the “surge” connector to the protector body. A conductor is continued from the top of the inductor to a mechanical capacitor in series to the center pin of the “protected” connector. This forms a high pass filter with a sharp low frequency cut off and an extended high frequency band pass. As with any dc blocked protector there is a *specified frequency range* to maintain proper impedance match through the device. Dc blocking in a mechanical filter allows an extremely low energy pass-through to equipment. **LP-SPT test - surge side connector and read very low approximately (0 – 2 Volts) shorted. Test protected side and read very high (800-900 Volts) open.**



Bi-Polar Diode Type - DC blocking in the RF path. RF decoupled / re-coupled solid state DC pass/protect circuit for tower mounted preamp. Monitors peak voltage occurrence during lightning strike.

The solid state dc pass/protect protector, with a dc blocking capacitor in the rf path from connector to connector, is bi-directional, and includes an rf isolated high current bi-polar diode. The diode is rf decoupled with an inductor from each connector center pin. The two inductors are connected together at the top of the diode, and the diode is bonded back to the protector body. The diode turns on when the voltage exceeds approximately 5 Volts (see Times Protect LP-GPX-05 specifications). All incoming differential voltages are limited to 5-7 Volts with a short 12 Volt residual pulse. **LP-SPT test - will display the lowest turn on transient device in a hybrid multi-component, dc pass/protect protector (read 5-7 Volts from either connector with LP-GPX-05)**



On Site Testing with Times Protect LP-SPT Surge Protection Tester (TechDoc)

On site testing of coaxial rf lightning protectors

Testing lightning protectors is most accurate and reliable when the protector is out of circuit and attached directly to the LP-SPT. If a coax jumper is used for convenience, "**know thy jumper**". It must be tested and reliable!



A **dc blocked protector** must be tested with the **surge side connector** attached to the LP-SPT. The protector can remain physically mounted with the equipment jumper attached. *Turn off equipment!*

A **non-dc blocked protector** must be disconnected at both ends. The protector can remain physically mounted. Test at either end.

A **dc blocked mechanical filter** must be tested with the **surge side connector** attached to the LP-SPT. It can remain physically mounted with the equipment jumper attached. *Turn off equipment!*

The **solid state dc pass/protect protector**, with dc blocking in the rf path from connector to connector, must be disconnected at both ends. The protector can remain physically mounted. Test at either end.

Note: When removing and replacing site coax feeders or equipment jumpers during LP-SPT test procedure, make sure connectors are properly seated and equipment is operating normally before leaving site.

On site testing of ac power lightning / surge protectors

Ac power protection *must be disconnected from power source and load.* For 240 Volt Bi-phase devices, connect supplied alligator clip adapter to ac power input terminals

1. Connect alligator clips to neutral and ground, test and note results.
2. Connect alligator clips from each 120 Volt terminal to neutral, test and note results.
3. Connect alligator clips to both 120 Volt terminals (240 Volts), test and note results.

Test results should agree with manufacturer's turn-on specifications +/- 20%.

Testing telephone interfaces and individual surge protection components.

Telephone interface Disconnect line in and line out.

1. Connect alligator clips to line input tip terminal and ground, test and note results.
2. Connect alligator clips to line input ring terminal and ground, test and note results.
3. Connect alligator clips to tip and ring terminals, test and note results.

Test results should agree with manufacturer's specifications +/- 20% for type of supplied service (POTS, DSL, etc).

Individual components A simple alligator clip connection to individual surge components is all that's necessary for testing. Some components could be polarity sensitive. Reverse connection to component if test reading is suspect.

Ken Rand – Times Microwave Systems, Senior Consultant – Protection Technologies