Life Is On | Schneider Electric

Monitoring SPD Condition

White Paper

UNDERSTANDING INDICATION FEATURES IS KEY TO AVOIDING DAMAGES FROM SURGES

Surge protective devices (SPDs) are available with a wide range of features that indicate whether they may be providing protection from transient overvoltages. This paper surveys the range of indication features that may be offered on SPDs today.

BACKGROUND INFORMATION

Surge protective devices play an important role in protecting electrical equipment from the damaging effects of transient overvoltages. As designed, SPDs routinely shunt transient overvoltages that typically occur and decay in microseconds. However, SPDs can be exposed to transient overvoltages that exceed their rated capacity. In addition, SPDs will shunt current whenever line voltages exceed their Maximum Continuous Operating Voltage, a condition that continuously generates heat. Over time, SPD components can degrade or fail with continued exposure to these conditions.

Following installation, users need to know that SPDs are working properly and whether they are delivering all of the protection they were designed to provide. To convey this information, SPDs are available with a range of features that provide feedback to users.

SPD MONITORING DEVICES

The range of features for indicating the status of SPDs is shown in Figure 1. The following narrative describes these features with their respective advantages and disadvantages.

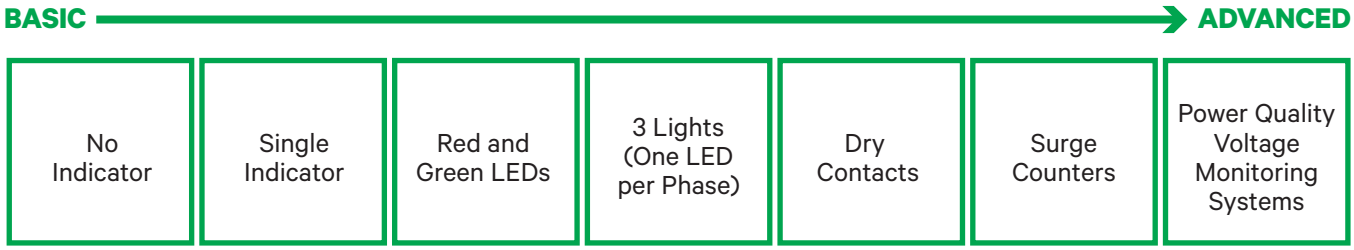

Figure 1: Range of SPD Indication

No Indication

The simplest SPDs do not feature mechanisms that monitor the condition of the devices. Without these features, users cannot reliably assess whether an installed SPD is continuing to protect against overvoltage transients. Consequently, users must arbitrarily decide when to replace these units. As a result, users could incur higher costs by (1) unnecessarily replacing properly functioning SPDs, or (2) repairing or replacing equipment damaged by transient overvoltages following SPD failure.

Single and Dual Indicators

The simplest indicators are most often LEDs that signal when an SPD may no longer be providing full protection. Manufacturers typically place these indicators on the exterior of an SPD, where they can be readily seen (Figure 2). These indicators may signal whether the SPD is fully protecting, partially protecting, or not protecting the circuit it serves. Some units use a single green LED and a single red LED to show when the unit is functioning properly and when replacement is needed. Before purchasing an SPD with one or more indicators, be sure to understand exactly what information the indicators represent.

For many applications, it is important to specify SPDs that are equipped with integral audible alarms. In general, these alarms sound when one or more SPD components may be failing.

Three Lights (One Light per Phase)

Some models provide one LED for each phase of 3-phase ac power, as shown in Figure 3. These can aid in diagnosing which SPD components have failed, or whether a thermal protection device on a specific phase has opened. If an indicator shows a problem on one phase, protection remains for the other phases. Nevertheless, the SPD should be replaced when indicators show that protection has been reduced on any phase.

Figure 2: The ASCO Model 420 uses a single LED to indicate whether all phases are functioning properly.

Figure 3: The Square D Type XDSE uses separate LEDs to indicate proper functioning of each phase.

Dry Contacts

Regardless of whether SPDs feature indicator lights, they may be equipped with dry contacts. These are used to connect an SPD to an annunciator, a power or building management system, or other equipment that can display signals and sound alarms when an SPD may have been compromised. This capability enables remote annunciation. For instance, if an SPD is located in a noisy or unattended area, a local alarm may go unnoticed, leaving equipment at risk for surge-related damage. Providing remote annunciation to an attended area can help ensure that alarms will be noticed. ASCO offers annunciators for local or remote monitoring and notification. ASCO's Critical Power Management System can provide real-time notifications for SPD failure via email and other media.

Surge Counters

Some SPDs are equipped with surge counters that quantify transient overvoltages that have been detected by the units. When considering counters, it is important to understand that the integrity of an SPD cannot be assessed solely from the quantity of transient overvoltages to which it has been exposed. This is because there is no way of knowing how many surges an SPD can withstand. Rather, the value of the information lies in comparing surge counts before and after events such as lightning storms to understand temporal surge activity. An SPD featuring a surge counter is shown in Figure 4.

Some SPDs are equipped with dual counters that monitor different parameters. One counter may register overvoltage transients that occur and decay quickly, and the other may monitor swells, which are overvoltages that occur over a longer time-frame. Some models allow users to set a counter's sensitivity to overvoltage events. Other models quantify line-to-ground and line-to-neutral surges separately. At service entrances and separately-derived systems, the resulting information can indicate problems in bonds between neutral and grounding conductors.

Figure 4: The ASCO Model 450 SPD indicates the quantity of surges that have been diverted by the unit and displays the status of protection on each phase.

Surge counters may be resettable, which enables users to track the quantity of surges that occur over consecutive periods. Where multiple counter-equipped SPDs are used in the same electrical system, resettable counters also allow comparison of the occurrence of surges at different locations during the same time-frame.

Figure 5: The ASCO Model 460 SPD indicates the quantity of surges that have reached the unit and displays the status of protection on each phase.

Test Mode Indication

The role of indicators in SPD testing varies from model to model. Before purchasing SPDs, buyers should understand the functions that are tested as well as the meaning of the information that is displayed on the unit. For instance, placing some ASCO models in test mode changes the status of the LEDs, alarms, and contacts to show how indicators would appear when a failure is detected. Other models test various SPD functions to evaluate whether protection has been reduced or has failed. Shown in Figure 5, the ASCO Model 460 is an example of a unit that demonstrates failure mode indication.

On sophisticated models, test modes can offer valuable information. For instance the ASCO Model 560 and Model 570 SPDs feature modular components that include multiple redundant metal oxide varistors, which are the components that shunt excess voltage in common SPD designs. These models feature a test mode that indicates when protection has been reduced. When two or more varistors fail, the units also trigger an alarm that is indicated by both an LED and alarm contacts. The remaining varistors continue to provide protection and the alarm prompts replacement of individual modules to restore full protection.

Figure 6: The ASCO Active Surge Monitoring System provides comprehensive voltage information for tracking surge events.

Power Quality Voltage Monitoring Systems

To prevent costly downtime and protect high-value equipment, the most comprehensive SPD monitoring solutions involve installing one or more power quality voltage monitoring systems. These systems monitor, count, and record transient overvoltages at every connected panel or device. The resulting event logs provide time-stamped records that show when transients occurred and identify the phases on which they were measured. Data from multiple units can be compared to evaluate the occurrence of voltage and phase imbalances, surges and swells, and harmonic distortion. The magnitude of overvoltages attained during surge events can be estimated using the recorded let-through voltage.

With these systems, personnel do not have to be present to learn of power events, power conditions, and equipment malfunctions. Power quality voltage monitors continually record voltage data and events, and can send the information to a web page or a building monitoring system. The event logs provide information that can be evaluated to reactively and proactively discern power events and power quality issues. The components of a power quality monitoring system are shown in Figure 6.

A key attribute of surge monitoring systems is the sampling frequency used to record voltage measurements. For instance, most of the energy associated with lightning–induced transient overvoltages may occur and decay within a few microseconds. If the sampling rate is too slow, the data may have insufficient resolution to capture evidence of transient overvoltage events. For example, the ASCO Active Surge Monitor samples voltage more than 250,000 times per second to capture and evaluate even the fastest transient overvoltages.

REPLACING SPDs

When SPDs fail, equipment may be unprotected from damaging transient overvoltages. Low-cost models without indicators cannot provide evidence that SPDs are working properly. ASCO recommends using SPDs equipped with indicators that are suited to the application. When SPDs indicate a potential malfunction, replacement of the unit or any replaceable modules is the only way to restore full protection.

UPGRADING SURGE PROTECTION

As facilities change, equipment may be added together with new circuits and power distribution equipment. Technological advances may drive replacement of older electromechanical equipment with new electronically controlled devices, which can be more susceptible to damage from transient overvoltages. Existing equipment may also be retrofitted with upgraded monitoring and control devices, including those that connect to the Internet. For these reasons, a reassessment of transient overvoltage risks could show that upgraded surge protection is needed. Likewise, periodic review could show that surge protection equipment featuring the latest advances could enhance reliability, ease regulatory compliance, and reduce surge-related costs.

SUMMARY

The condition of SPDs should be monitored because components may degrade with continued exposure to overvoltages. Their condition should also be monitored to ensure that valuable electrical equipment will be protected from damaging transient overvoltages. Key features that indicate SPD function or condition range widely, and are summarized in the table on the following page.

INDICATION	DESCRIPTION	ADVANTAGES	DISADVANTAGES
None	An SPD without indicators	Simple	No detection
			No diagnostics
		Low cost	No failure indication
Audible Alarm	An option on many SPDs, an audible alarm sounds to indicate component failure. Most SPDs that have audible alarms also have LED indicators.	Audible alarms draw attention to compromised SPDs	In loud or remote environments, alarms may not be heard
Single Indicator	SPDs may be equipped with one green LED indicator that illuminates when the unit is providing protection	Provides visual indication	Does not indicate phase-specific issues
		LED is easily seen	
Red and Green LEDs	A green indicator signals proper function	Positive indication of status of each phase	Does not indicate phase-specific issues
	A red indicator signals when replacement is needed		
Three Lights (One LED per Phase)	One LED per phase provides greater understanding of phase-specific protection	Provides visual indication LEDs are easily seen	No active surge monitoring
	Red and green indicators for each phase provide even greater detail	Monitors individual phases	
Dry Contacts	Dry contacts allow SPDs to be monitored from a remote location according to user-defined protocols.	SPD status is viewable on annunciators, the ASCO CPMS, or building management systems	No active surge monitoring
		Customizable indicator logic	
		Can eliminate need for SPD inspection	
		Can monitor individual phases	
Surge Counters	A single counter quantifies transient overvoltages exceeding a specified threshold on a particular phase.	Indicates quantity of detected surges	Counters do not show the transient voltage or duration
	Twin counters can quantify surges at different thresholds or different modes (L-N, L-G).	Counts allow for comparisons of surge activity across time and between locations	Counters that do not use EPROM memory may retain counts for only a limited time when power fails
Power Quality Voltage Monitoring	Power quality voltage monitoring systems record and assess ac voltage sine waves	Provide continuous remote monitoring	More costly than SPDs
		Information can be shared with ASCO's Critical Power Management System and other monitoring systems to notify users of power quality issues.	

Because the type and configuration of indicators vary by manufacturer and model, users should evaluate product documentation to fully understand both the parameters that are monitored by the device and the messaging associated with its indicators. Regardless of the type of indication selected, SPDs should be repaired or replaced when indicators show potential degradation or malfunction. ASCO recommends reassessing surge protection needs when electrical systems are modified or load equipment is added to SPD-protected circuits.

Life Is On | Schneider Electric

Schneider Electric
14550 58th Street North
Clearwater, Florida 33760

se.com/us/en/work/support
1-888-778-2733

WP-50017 RevA 02/2021