Environmental Potentials

Power Quality For The Digital Age

SWITCHING TRANSIENTS

An Environmental Potentials White Paper

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Introduction

Facility managers are usually required to keep the facility powered up 24 hours a day, seven days a week. This increases energy consumption and adds unnecessary miles to expensive equipment. However, facility managers cannot shut down the facility's power unless they want to risk burning control boards and damaging expensive equipment. This is because fuse and protection relays generate large switching transients.

Fuse and protection relays are specialized devices that increase safety and prevent damage from various types of faults. The most common applications for fuse and protection relays include protection against overcurrents, short circuits, overvoltage and undervoltage. Sustained overcurrent can damage conductors, equipment, or the source of supply.

A short circuit can melt a conductor, resulting in arcing and even fire. The high electromechanical forces associated with a short circuit will cause mechanical stress which can severely damage equipment. A heavy short circuit can even cause an explosion. Rapid disconnection of overcurrents and short circuits is therefore vital safety component.

Switching Transients

In general, relays operate in the event of a fault by closing a set of contacts. This results in the closure of a trip-coil circuit in the circuit breaker which then disconnects the fault. The presence of the fault is detected by current transformers, voltage transformers or bimetal strips. This process is similar to turning a switch on and off.

Although fuse and protection relays are a necessary safety component, both fuse and protection relays generate switching transients when the relays/breakers are turned on and off. A typical switching transient can create voltage peaks up to 20kV with a duration of 10-100usec. This can cause arcing faults and static discharge. A typical industrial facility will use hundreds of fuse and protection relays most of which are turned on and off several times each day. This translates into multiple switching transients each day and some are large enough in magnitude to cause load failure.

The following readings demonstrate a switching transient generated by a relay.

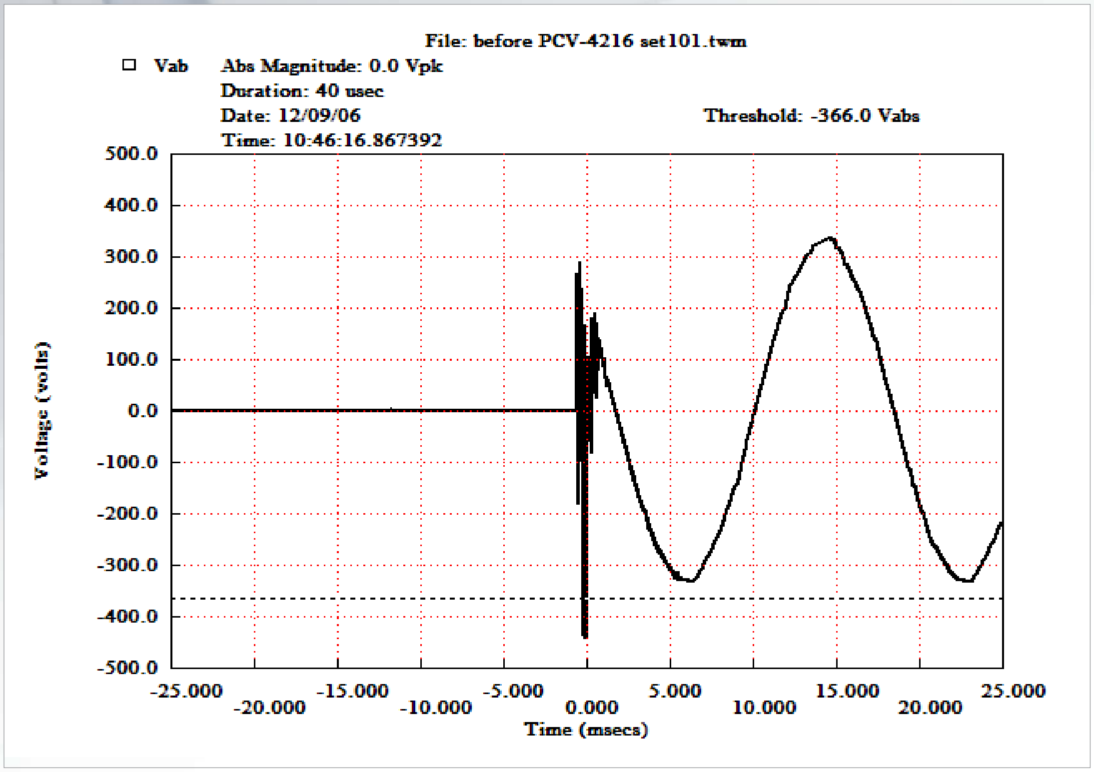

Figure 1: Response of magnetic relay switch on voltage waveform when it's turned on.

Figure 1 measures voltage as the magnetic relay switch is turned on. The relay is turned on at 0.0 msec on the time scale. Under ideal conditions, at this time point of 0.0msec, the voltage value of the waveform should be less than peak voltage (320V). However, the negative peak reaches approximately 430V while the positive peak is close to 300V. This means, as the magnetic replay switch is turned on, it creates voltage transients and noise on the waveform. This amount of noise can easily cause equipment malfunctions. Therefore, when this signal is transmitted to an electronic load, it may behave erratically for a few milliseconds until the transient dissipates. Prolonged exposure of sensitive electronic load to this waveform will degrade the digital components.

Transients this size and duration can cause premature failure of circuit boards and shorten the lifespan of sensitive equipment. This is why experienced facility managers will not power down the facility when it is not in use. They will not risk losing sensitive equipment to switching transients so facilities stay powered on 24 hours a day, seven days a week.

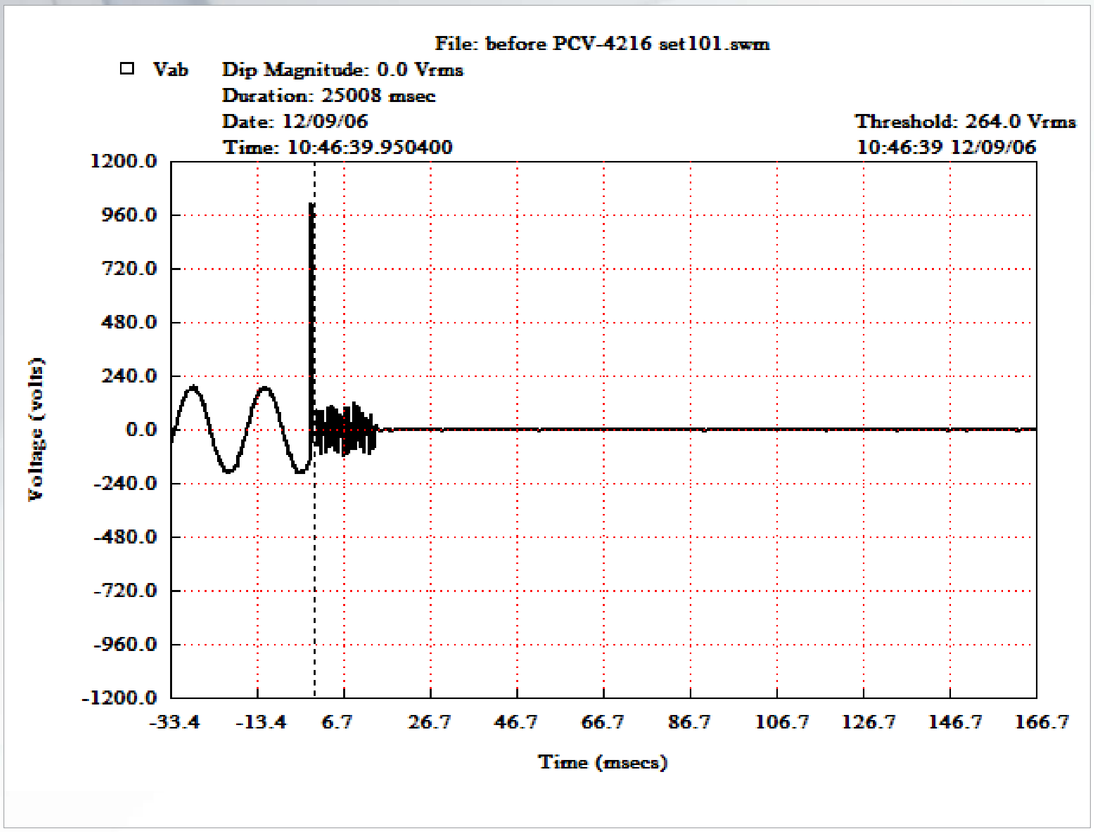

Figure 2: Response of magnetic relay switch on voltage waveform when its turned off.

Figure 2 was taken as the magnetic relay is turned off. Technically the value of voltage starting from the dashed vertical line point should be zero since the replay interrupted the power supply. However, the voltage reaches approximately 980V and there is a significant amount of noise for approximately 20 more milliseconds. Theoretically, the value of the voltage after the dashed line should be zero (straight line) since the power is completely turned off at this point of time. However, the relay generated a massive voltage transient and noise before completely shutting off the voltage. This massive amount of voltage (980v) can cause equipment malfunctions and even equipment failure.

This massive surge is the main reason why facility managers cannot risk powering off the facility overnight or over the weekends or holidays. Even as facilities explore every option to lower energy consumption, facility managers cannot risk generating 1000V transients. Therefore facilities stay powered up and consume needless energy.

The EP Solution

Environmental Potentials' waveform correction technology absorbs and dissipates switching noise generated by the turning on and off of magnetic relays. This is an extremely important leap in power quality technology and cannot be overstated.

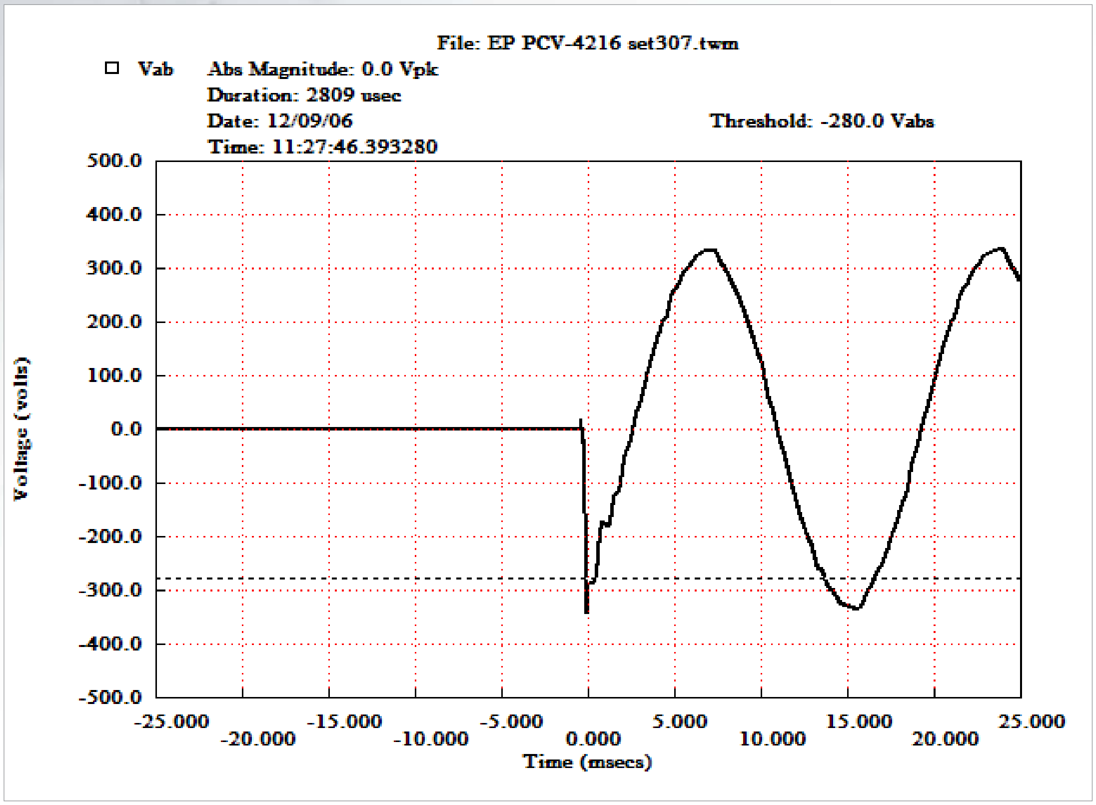

Figure 3: Response of magnetic relay switch on voltage waveform when its turned on after installing EP.

This measurement was taken at the same switch relay after installing EP unit. The switching transient generated is completely removed. There is no noise on the voltage waveform and there are no transients. This means that the voltage waveform is maintaining its sinusoidal nature at the time the relay is turned on. Removing transients and noise will protect the load from malfunction and erratic behavior. Environmental Potentials' waveform correction technology clipped the voltage, removed the noise and completely dissipated it within the EP tank circuit. The sinusoidal nature of the wave is maintained.

Facility managers can confidently power on and off facilities without fear of burning control boards or damaging sensitive equipment.

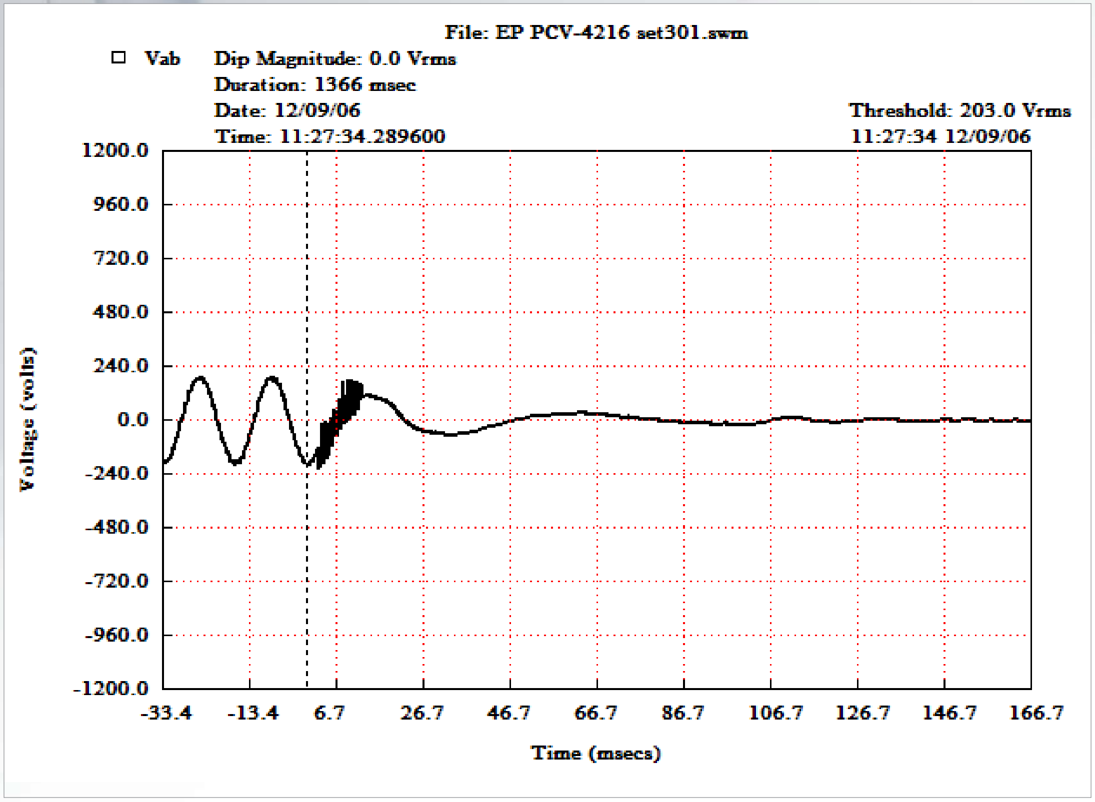

Figure 4: Response of magnetic relay switch on voltage waveform when its turned off after installing EP

Figure 4 was taken at the switch relay after installing EP. This reading was taken while the switch relay was being turned off. There are no voltage transients unlike the previous measurement. Environmental Potentials' waveform correction technology clipped the voltage, removed the noise and converted it into heat in the EP unit. This waveform will not damage or harm the load. After installing EP, the magnetic relay is performing its function as it was designed to do, turning off the supply without generating any transients.

Conclusion

Magnetic relays are protective devices that are widely used in the electrical distribution system in order to protect the electrical loads from transients and over voltages. However, these devices generate switching transients and noise during normal operation. These switching transients can be high enough in magnitude to damage equipment and cause equipment malfunctions. The modern facility uses hundreds of relays during the course of daily operation. These relays generate massive voltage transients. These voltage transients can harm an idle load and also degrade sensitive electronic and computerized loads.

Environmental Potentials' waveform correction technology will remove electrical noise and suppress voltage transients generated from turning relays on and off. This is an exciting development in power quality devices. This allows facility managers to power on and power off without fear of burning control boards. This leap in technology allows facility managers to shut down the facility during weekends without fear that control boards will fail on Monday morning. This will extend the lifecycle of expensive assets and protect sensitive electronic and computerized equipment.

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