

# Heat Pumps: Protection from Surges



**NYSERDA**  
New York State Energy Research  
and Development Authority

Modern heat pumps rely on sophisticated electronics featuring circuit boards equipped with power-control circuits. These circuits convert alternating current (AC) into variable-frequency direct current (DC) signals, enabling compressors to adjust speed according to heating or cooling demands. Sensors and microprocessors manage the behavior of the compressor, fans, and refrigerant metering valves. This coordination optimizes system performance.









The advanced microprocessors and circuit boards integral to cold-climate heat pump operation are susceptible to electrical surges from the grid or household appliances. Whether through a catastrophic event or a series of low-level surges over time, electrical surges can render the system either partially impaired or completely inoperable. In such cases, a damaged circuit board cannot be repaired and must be replaced. Install a surge protector to protect your customer's investment and reduce your time spent on call backs.

## Electrical Surges

An electrical surge, also known as a transient, refers to sudden fluctuations in voltage, current, or transferred energy within an electrical circuit. These surges typically occur when the flow of electricity is abruptly interrupted and restarted, or when electrical energy is sent back into the system from an external source.



## WHERE ELECTRICAL SURGES COME FROM:

-  Faulty wiring/short circuits
-  Overloaded circuits/tripped circuit breakers
-  Downed power lines/power outages
-  Power transients in other large equipment (refrigerator or air conditioner) on the same circuit
-  Malfunctions caused by power providers
-  Electrical storms/lightning strikes
-  Electromagnetic pulses
-  Inductive spikes

## Surge Protectors

Surge protectors can safeguard against electrical surges to protect equipment and reduce callbacks. When a surge exceeds the maximum rated voltage of a surge protector, the device either limits or removes voltage to the protected equipment, effectively shutting it down, akin to a circuit breaker tripping.

It's important to note that while surge protectors are effective against transient spikes in voltage, they have limitations. No device available can protect against a direct lightning strike. Surge protectors are not equipped to handle or regulate continuous overvoltage resulting from a poorly regulated grid or an aging electrical distribution system within a home. When a 208/230-volt heat pump circuit is asked to handle more than 253 volts continuously, it can lead to circuit boards overheating and failing. Addressing issues with overvoltage is best handled by engaging with the utility provider or utilizing other devices specifically designed to regulate a home's voltage within acceptable parameters.

## Whole-Home Protection

Whole-home surge protection systems are designed to detect irregularities in electrical currents, ranging from lightning strikes to minor fluctuations in voltage. When such irregularities are sensed, these systems swiftly divert excessive voltage into the ground before it can reach a home's electronics, thereby safeguarding them from damaging spikes.

Notably, the 2023 National Electrical Code (NEC 230.67) mandates the installation of whole-home surge protection systems in new homes and when electrical service equipment is upgraded or replaced. Additionally, all outdoor HVAC equipment must be protected by a ground fault circuit interrupter (GFCI) breaker starting September 1st, 2026. Contact the manufacturer for details about compatibility.

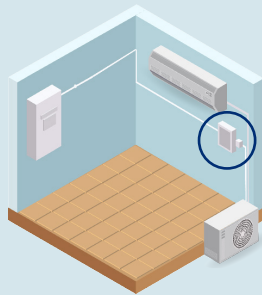


Figure 1: Whole-home surge protector

## Surge Protection Best Practices

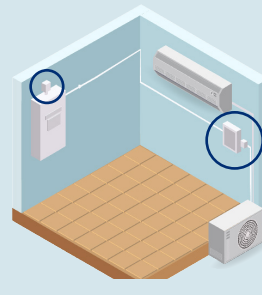
### Better

Always protect the heat pumps directly with component protection.



### Best

Protect against surges from the grid and surges from within, with both whole-home and component protection.



## Component Protection

While main panel surge protection helps against external surges, it may not cover internal surges. In contrast, component surge protection is installed directly at a specific location along the heat pump's circuitry – typically at the electrical disconnect, but also possibly at the main panel – to protect the heat pump directly from all forms of surge. Some electrical disconnect boxes come with surge protection integrated within, others can be paired with a component surge protector at the disconnect.

*Note – this is different from GFCI breakers to trip, which may also be included in the electrical disconnect but does not protect from line surges.*

Component surge protectors, starting at \$50, will help prevent thousands of dollars in damage and time spent on call backs repairing a heat pump. Protect your customer's investment, protect your callback and warranty response budget. Talk to your distributor about what they recommend, and offer surge protection devices with all your heat pump installations.



Figure 2: Integrated electrical disconnect with surge protector



Figure 3: External surge protector

## Component Surge Protection Costs:

- ✓ **Component Surge Protector:** \$50-\$150
- ✓ **Integrated Electrical Disconnect and Surge Protector:** \$150-\$300
- ✓ **Surge Protector Breaker:** \$50-\$250