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Protecting Charging Infrastructures and Electric Vehicles

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Overview

Electric vehicles are changing the way we move. The future of transportation pushes for the replacement of fossil-fuel vehicles by electric vehicles because of global warming due to carbon emissions. Long distance travel has been a barrier to electric vehicles (EV) adoption due to vehicle range limitations. Government funding and incentives, given to the manufacturers, leads to a growing market for electric vehicles and nationwide charging opportunities.

As more consumers recognize that a cleaner future begins with one vehicle at a time, the future of the electric vehicles will be growing rapidly. With more EVs on the road, the fast-charging network demand is increasing and evolving. In the consumer electronic industry, there is an increasing interest and demand for a convenient and safe way to power electronic vehicles. This paper will cover recommendations on how surge protection devices (SPD) protect electric vehicles and charging field devices.

Introduction

The general public has previously relied on at-home wall sockets, which output 120VAC, to provide electrical power to electric car chargers. AC charging is simpler in nature and is the most commonly available charging infrastructure, as it is able to connect directly to the existing power infrastructure of a home or business. It can safely deliver AC power from the electrical grid into the vehicle. Outlets are everywhere and 80 percent of electric vehicle owners' recharge from the socket at home. An AC charger provides power to the on-board charger of the vehicle, converting that AC power to DC in order to charge the battery. The grid transmits power in AC form, and energy stored in the onboard battery is in DC, therefore a charger is required to do the conversion job. That means, depending on your vehicle it can take anywhere from four or six hours to overnight to fully charge an EV.

DC fast charging is a new level of consumer electronics. DC fast charging bypasses all of the limitations of the on-board charger and required conversion, instead providing DC power directly to the battery, as shown on Fig. 1.

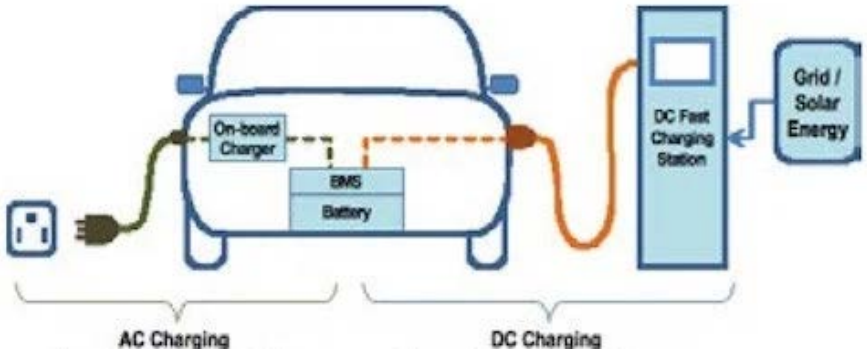


Figure 1 [4]. AC charging vs DC charging

Charging speed has the potential to be greatly increased. DC Fast Charging (DCFC) method shortens charging time from hours to minutes. The emergence of DC fast charging stations is a game changer for electric vehicle drivers looking to charge quickly, as shown on Figure 2.

Figure 2. Fast Charging Stations

Surge Protection Device (SPD)

Charging stations must be available at all times. The supercharger network currently provides a power level up to 250 kW, while most other installed DCFC stations are currently rated at 50 kW. There are initial concerns focused on overload protection, risk of electric shock, and making sure that cars with a high voltage electric power train, such as electric vehicles, are as safe as a gas-powered vehicle.

In an effort to reduce the risk of injury and potential damage to electrical systems and buildings, it will require the installation of surge protective devices. To appropriately protect the charging infrastructures and electric vehicles against lightning strikes and transients, surge protection devices should be permanently installed in every distribution substation, charging station, and wall box. Maida recommends the following surge protection devices (SPDs) below for these applications.

Thermally Protected High Energy (TPHE) Series

TPHE Series Surge Protective Device (SPD) line is available in through hole or DIN-Rail construction. TPHE Series is designed to withstand the rigors of UL 1449 4th Edition Type 1 and 2 applications. Maida has 3 TPHE designs with operating voltage range from 150VAC to 680VAC.

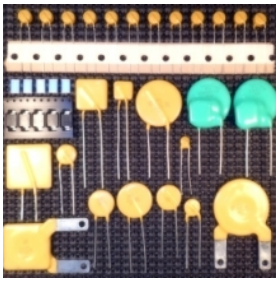
MPD Series

The MPD Series is a modular surge protective device (SPD), featuring an IP65 enclosure rating and available with operating voltages of: 120VAC, 277VAC, 347VAC and 480VAC. MPD Series is UL 1449 – Type 4CA recognized and can be connected in series and parallel with the load.

MPDS Series

The MPDS Series is a smaller form factor of our MPD Series, featuring an IP65 enclosure rating. The MPDS Series utilizes metal oxide varistors to provide a protection package for use in many applications. A metal oxide varistor will divert, absorb and dissipate the energy of a transient. MPDS Series is UL 1449 – Type 4CA/Type5 recognized and can be connected in series and parallel. The MPDS Series is available with operating voltages of: 120VAC, 277VAC, 347VAC, and 480VAC.

Other SPDs



Suppression of transient surges is achieved by the use of metal oxide varistors (MOV), installed in shunt (or “parallel”) with the AC power lines. Maida has numerous products with high energy dissipation, that can be used to suppress lightning and other high-energy transients found in AC power-line applications. They are equipped to withstand large amounts of energy and divert this potentially destructive energy away from sensitive devices located downstream. Maida’s products, which are also used in DC circuits, come in a variety of forms.

Conclusion

Experts predict commercial installation of charging station for electric cars will grow exponentially. Charging infrastructure equipment is exposed to a variety of elements, from weather events, and climate extremes to seismic activity. The best way to minimize the risk of severe damage by transients is to install SPDs to the electrical distribution network as SPDs are intended to limit transients, divert surge current, or both. In the simplest terms, an effective SPD will divert damaging transients harmlessly away from the sensitive load, with a goal of preventing equipment damage and downtime due to transient voltage surges reaching the devices they protect. Using components designed to limit catastrophic conditions caused by random events like lightning strikes or climate extremes will ultimately protect critical applications. This solution can prevent unanticipated voltage fluctuations while the device is in operation.

References

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