

Powering an Electric Vehicle Charging Station

Electric Vehicles have proven to be quite a disruptive force for the automotive industry. This new mode of transportation is overtaking internal combustion equivalents due to the many benefits it offers over its counterpart such as lowering emissions, cheaper operating costs and significantly reduced maintenance requirements.

The electric vehicle in its current form still faces several challenges before it can be adopted as a preferred choice of transportation by the masses. The foremost challenge is the accessibility to an electric vehicle charging network that is both reliable and readily available.

Various countries around the globe have identified the need for an enhanced public charging network and have set up aggressive targets to meet them. The EU, for example, has estimated a need for 2 million EV chargers by 2025.

These high demands for a public electric charging network are in direct response to the current and future volume of electric vehicles sold. Looking at the USA, just in the state of California, a goal has been set to have 5 million electric vehicles on the roads by 2030. China, which is turning out to be one of the largest electric car markets has seen sales of over 2 million electric cars in 2018. These numbers indicate a strong need for an Electric vehicle charging network which is expected to keep rising as more electric vehicles are sold.

The current number of charging stations in India is estimated to be below 200. Recognizing the need for more stations, through the FAME II scheme, the government of India has approved the installation of 2600 EV chargers in 62 cities. The goal is to set up one charging station every three km in cities and every 25 km on highways. Efforts have been made at both the state and central government levels to create policies to accelerate the construction of the electric vehicle charging infrastructure. These initiatives provide opportunities for local industries to design and develop expertise in this global challenge to meet electric vehicle charging demands.

These chargers have been classified in many ways, but to make things simple we will broadly classify them into the following 3 main categories based on charging rate and output voltage type:

- 1] Portable AC chargers: These electric vehicle chargers are designed to be small, lightweight and draw power directly from the wall socket. These portable chargers are widely used as it provides a cost-effective solution that is a necessity due to the current unavailability of faster public charging stations.
- 2] AC charging stations: These charging stations can charge an electric vehicle faster than the portable AC chargers by delivering higher current with more protective safety features and complicated UI, making them safer and cheaper to install than DC charging stations.
- 3] DC charging stations: This is the fastest charging station. Unlike the previous two types that simply deliver AC to the EVs and let the onboard charger handle the AC to DC conversion, the DC charging station converts AC to DC within the station and feeds the DC power directly to the EV battery. This way, the charging speed is not limited by the onboard charger and is significantly faster than the AC charging rate.

Designing power supplies to power different modules of an electric vehicle charger is a challenging proposition. Luckily Aimtec provides off the shelf solutions to help ease the challenge and reduce time to market.

Portable Electric Vehicle Chargers:

These chargers use a PWM and $\pm 12\text{V}$ volt pilot signal to communicate with the EVs. The power converters used to provide power to the many auxiliary circuits need to be able to generate positive 12V and negative 12V. The +12V is also used to drive the contactor and various electronics. Below is a typical block diagram of the portable electric vehicle charger.

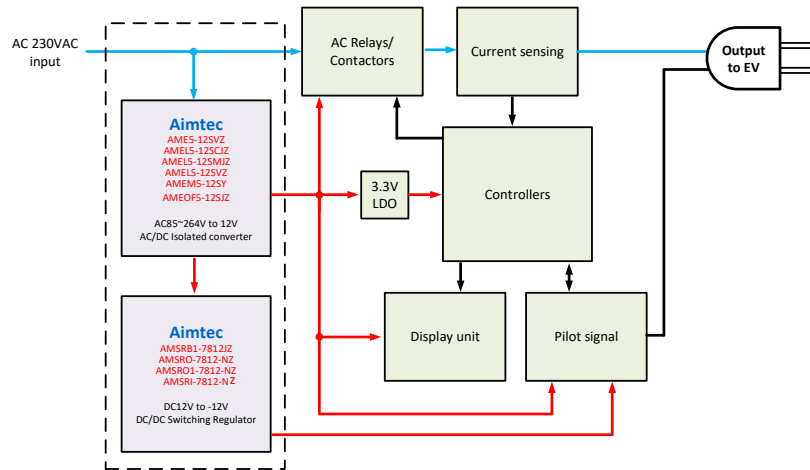


Figure 1. Portable AC charger

To further reduce the size of the portable AC charger, Aiptec offers the AME5-512T277NZ, an AC-DC converter that features triple outputs and can satisfy the power needs of a portable AC charger in just one converter. AME5-512T277NZ outputs +5, +12 and -12V. The +5V output can power the device's electronics while the +12V drives the contactor, UI and -12V output is dedicated to the pilot signal. Utilizing the AME5-512T277NZ in the design of a portable AC charger can significantly reduce the BOM and simplify the design. Below is a block diagram of how the AME5-512T277NZ can be implemented.

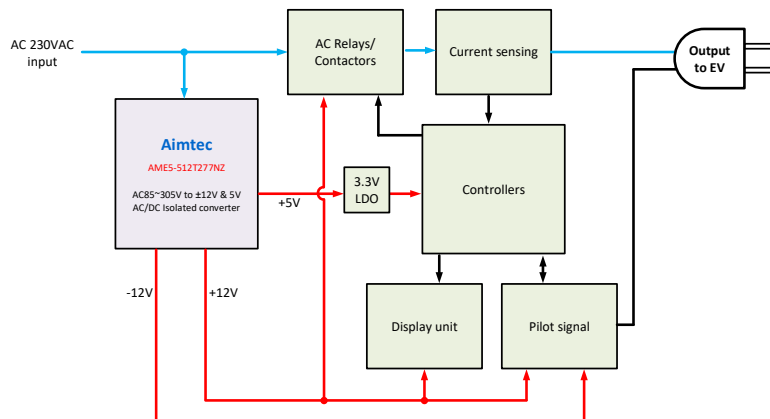


Figure 2. Portable AC charger with AME5-512T277NZ

AC Charging station:

Below is a simplified block diagram that shows the basic construction of an AC charging station. The design uses a higher wattage AC-DC converter that can accept an input of 90 to 528VAC in case 3 phase power is used. As the communication device consumes more power, we added a 12V to 5V converter to power the device electronics.

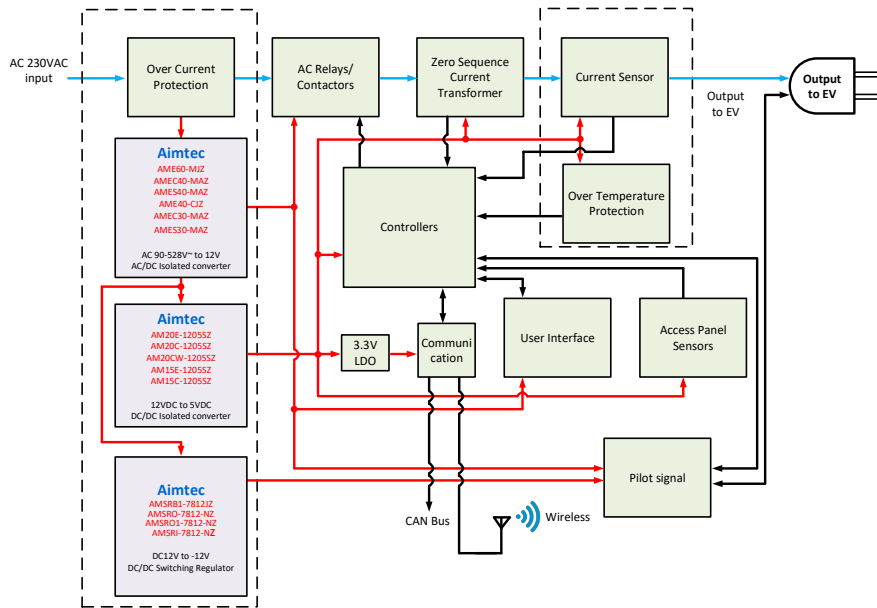


Figure 3. AC charging station

DC Charging station:

The DC charging stations do not use pilot signals to communicate with the electric vehicles, thus eliminating the need for -12V converters. Instead, it relies on a more complicated CAN bus communication, therefore an additional isolated 5V DC-DC converter is used to ensure the quality of the CAN bus commutation.

The power rating for DC charging stations can be over 100kW, hence more protective devices are required and a higher power rated AC-DC converter is recommended. Typical DC charging stations use a resonance circuit to bring the output voltage to the desired level and is usually done by IGBTs. Aimtec's isolated dual asymmetrical IGBT drivers can be utilized to generate the required positive and negative voltages to drive the IGBTs while providing an extra layer of protection. The below block diagram provides an overview of a DC charging station.

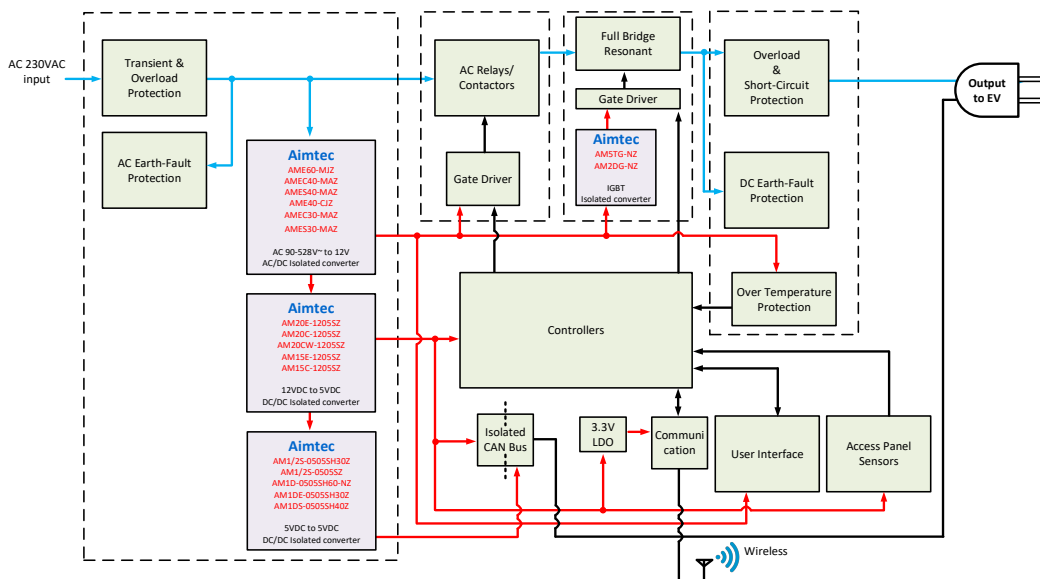


Figure 4. DC charging station

Portable EV power bank:

In addition, there is an opportunity for a new type of electric vehicle charger that can provide roadside assistance when electric vehicles run out of charge. Below is a simplified block diagram of an EV power bank. The system consists of one or many high voltage battery packs connected to a charger module.

Each battery pack requires a battery management system, contactors, and a CAN communication system. As the battery management system needs to be able to work independently without other power sources, Aimtec's 100-1000V to 12V isolated DC-DC converter can help power the device electronics which operate at much lower voltages.

The charger module has an additional auxiliary battery to power its electronics and auxiliary circuits independently when the charger does not receive power from the high voltage battery.

DC voltage is used to quickly charge the Electric vehicle from the high voltage battery using the CAN bus as a communication link with the EV.

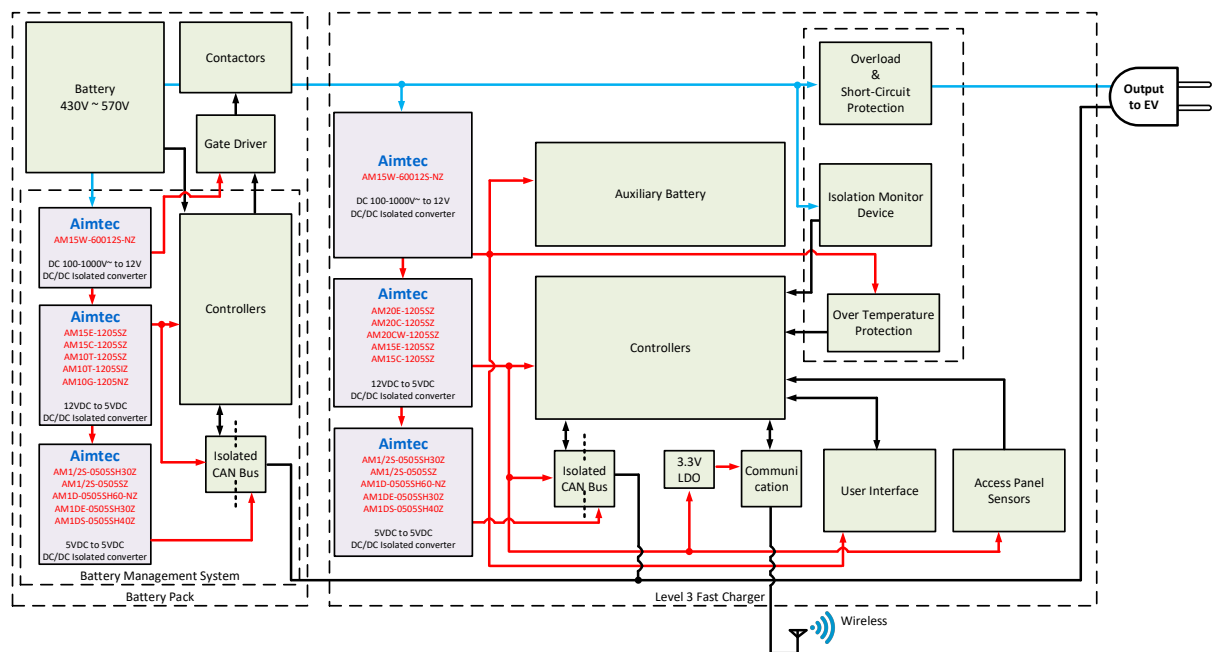


Figure 5. EV power bank

With the rise in electric vehicle demand, there is a greater need for a robust and vast charging infrastructure. This need has been identified by many governing bodies as well as private companies and an electrification race has begun. This environment creates a unique opportunity to develop expertise in this new market segment that can be applicable on a global scale.

The future of the Indian charging network will be determined by how quickly a solution can be developed and deployed to meet the rising demand using either public monies or large private investments in the sector.

Aimtec's power solutions offer proven off the shelf solutions that are adapted for the EV charging network by offering efficient and versatile solutions as described above. Integrating our components into your designs will simplify your BOM, reduce certification time and decrease your time to market!

Aimtec AC/DC Converters

Series	Power	Input	Output	Operating Temperature (°C)	Isolation	Dimensions	Features	Safety
AME5-VZ	5	85-264	3.3, 5, 9, 12, 15, 24	-40 to +85	4k	1.9 x 1.4"	OCP, OVP, CSP	UL
AMEL5-CJZ	5	85-264	3.3, 5, 9, 12, 15, 24	-25 to +70	4k	2 x 1"	OCP, OVP, CSP	UL
AMEL5-MJZ	5	85-264	5, 12, 15, 24	-25 to +70	4k	2.12 x 1.13"	OCP, OVP, CSP	UL
AMEL5-VZ	5	85-264	3.3, 5, 9, 12, 15, 24	-40 to +70	4k	1.46 x 0.96"	OCP, OVP, CSP	UL
AMEM5-Y	5	85-264	3.3, 5, 9, 12, 15, 24, 36, 48	-25 to +70	4k	1 x 1"	OCP, OVP, CSP	CE, UL
AMEOF5-BJZ	5	90-528	3.3, 9, 12, 15, 24	-40 to +85	4K	Open Frame SIP	OCP, CSP	CE, UL
AMEC30-MAZ	30	90-264	3.3, 5, 12, 15, 24	-40 to +85	4k	Enclosed 4.92 x 2.56"	OCP, OVP, CSP	CE, UL, CB
AMES30-MAZ	30	90-264	3.3, 5, 12, 15, 24	-40 to +85	4k	Enclosed 4.92 x 2.56"	OCP, OVP, CSP	CE, UL, CB
AMEC40-MAZ	40	90-264	3.3, 5, 12, 15, 24	-40 to +85	4k	Enclosed 4.92 x 2.56"	OCP, OVP, CSP	CE, UL, CB
AMES40-MAZ	40	90-264	3.3, 5, 12, 15, 24	-40 to +85	4k	Enclosed 4.92 x 2.56"	OCP, OVP, CSP	CE, UL, CB
AME40-VZ	40	85-264	3.3, 5, 9, 12, 15, 24, 48	-40 to +70	4k	3.5 x 2.5"	OCP, OVP, CSP	CE
AME60-VZ	60	85-264	5, 9, 12, 15, 24, 48	-40 to +70	4k	4.29 x 2.3"	OCP, OVP, CSP	CE
AME60-MJZ	60	90-264	5, 9, 12, 15, 24, 48	-40 to +70	4k	4.3 x 2.3"	OCP, OVP, CSP	CE, UL
AME3-BJZ	3	90-528	3.3, 5, 9, 12, 15, 24	-40 to +80	3k	2 x 1	CSP	CE, UL
AME10-BJZ	10	90-528	3.3, 5, 9, 12, 15, 24	-40 to +70	4k	2.44 x 1.77	CSP	CE
AME20-BJZ	20	90-528	3.3, 5, 9, 12, 15, 24	-40 to +70	4k	2.76 x 1.89	CSP	CE
AME3-BJZ	3	90-528	3.3, 5, 9, 12, 15, 24	-40 to +80	3k	2 x 1	CSP	CE, UL
AME10-BJZ	10	90-528	3.3, 5, 9, 12, 15, 24	-40 to +70	4k	2.44 x 1.77	CSP	CE
AME20-BJZ	20	90-528	3.3, 5, 9, 12, 15, 24	-40 to +70	4k	2.76 x 1.89	CSP	CE

Aimtec DC/DC Converters

Series	Power	Input	Output	Operating Temperature (°C)	Isolation	Case	Features	Safety
AM1/2S-Z	0.5	2.97-52.8	3.3, 5, 7.2, 9, 12, 15, 18, 24	-40 to +85	1K or 3K	SIP4	MSP	CE
AM1DM-NZ AM2DM-NZ	1 & 2	3-26.4	5, 9, 12, 15, ±5, ±9, ±12, ±15	-40 to +85	6K	SIP7	MSP	CE, UL
AM1DE-Z	1	4.6-26.4	5, 12, 15, ±5, ±12, ±15	-40 to +105	1.5K or 3K	SIP7	CSP	CE
AM1DS-Z	1	4.5-26.4	5, 7.2, 9, 12, 15, 18, 24, ±5, ±7.2, ±9, ±12, ±15	-40 to +85	1K-6K	SIP7	CSP	
AM20E-Z	2	9-75	3.3, 5, 12, 15, ±12, ±15	-40 to +85	1.6K	2 x 1"	OCP, OVP, CSP	CE
AM20C-Z	20	9-75	3.3, 5, 12, 15, ±12, ±15	-40 to +75	1.6K	1 x 1"	OCP, OVP, CSP	CE
AM20CW-NZ	20	9-75	3.3, 5, 12, 15, 24, ±5 ±12, ±15, ±24	-40 to +95	1.5K	1 x 1"	OCP, OVP, CSP	CE
AM15E-Z	15	9-72	3.3, 5, 7.2, 9, 12, 15, 18, 24, ±3.3, ±5, ±7.2, ±9, ±12, ±15, ±18, ±24	-40 to +85	1.5K	2 x 1"	CSP	CE, UL
AM15C-NZ	15	9-75	3.3, 5, 12, 15, 24, ±5 ±12, ±15, ±24	-40 to +95	1.5K	1 x 1"	OCP, OVP, CSP	CE, UL

Aimtec Switching Regulators

Series	Current	Input	Output	Operating Temperature (°C)	Dimensions	Features	Safety
AMSRB1-78JZ	Up to 1A	6-36	3.3, ±5, 9, ±12, ±15	-40 to +85	SIP3	CSP	-
AMSRO-78-NZ	Up to 0.5A	4.75-36	3.3, ±5, ±12, ±15	-40 to +85	SIP3	CSP	UL
AMSRO1-78-NZ	Up to 1A	6-36	3.3, ±5, ±12, ±15	-40 to +85	SIP3	CSP	UL
AMSRI-78-NZ	Up to 1A	6-36	3.3, ±5, 9, ±12, ±15	-40 to +85	SIP3	CSP	UL

About Aimtec:

Founded in 2002, Aimtec is a global designer and manufacturer of modular AC/DC and DC/DC switching power supplies. The company's standard products include DC/DC converters up to 200 W, AC/DC converters and LED drivers reaching 250 W.

Aimtec converters assist customers worldwide in reducing engineering design time and expenses while facilitating miniaturization and performance enhancements of their end products.

For more information, please visit Aimtec at www.Aimtec.com