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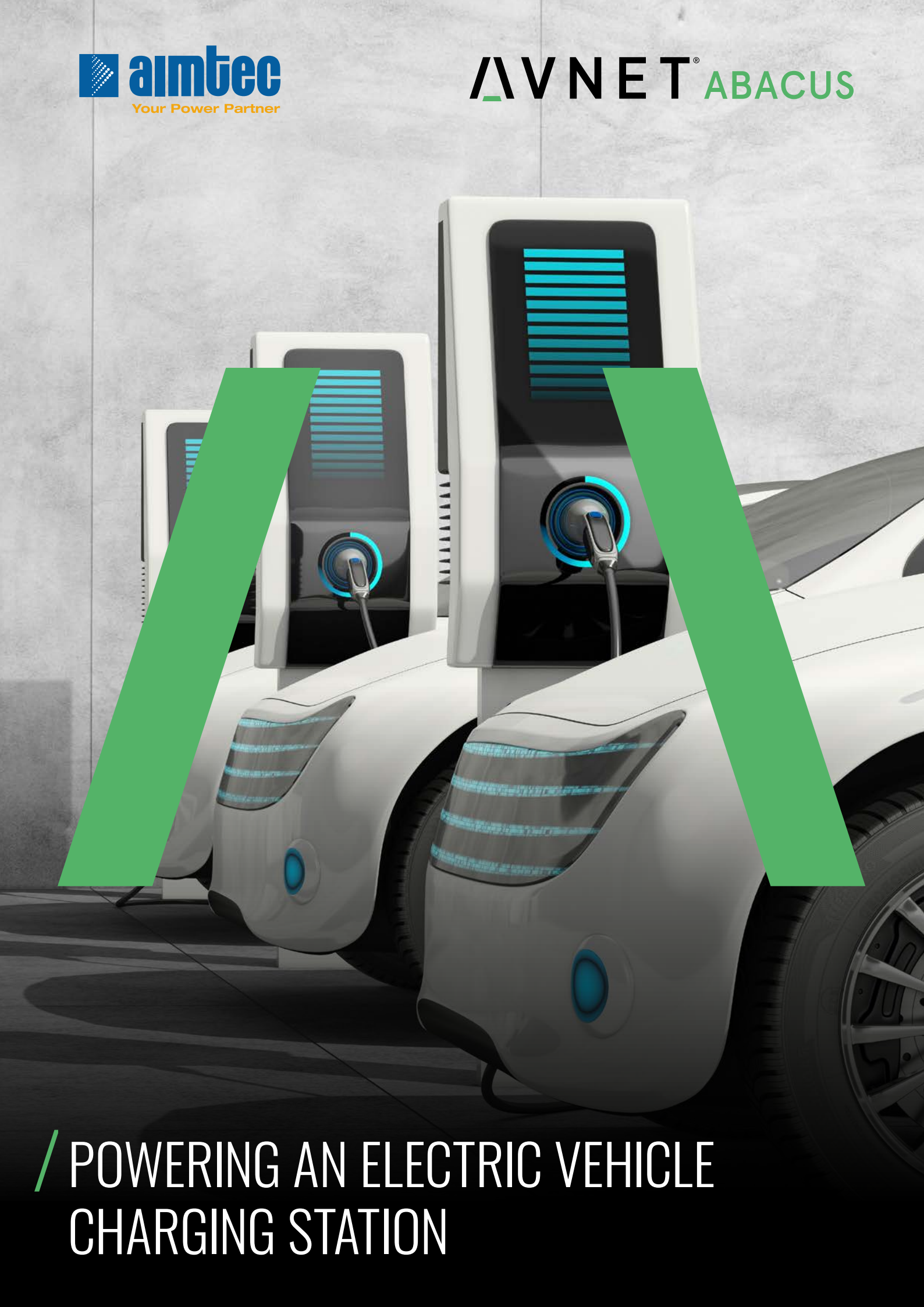

/ POWERING AN ELECTRIC VEHICLE CHARGING STATION

CONTENT

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POWERING AN ELECTRIC VEHICLE CHARGING STATION

INTRODUCTION

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.

In the current EV charging infrastructure landscape, there are various ways that chargers a classified, 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 ±12V 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.

To further reduce the size of the portable AC charger, Aimtec 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.

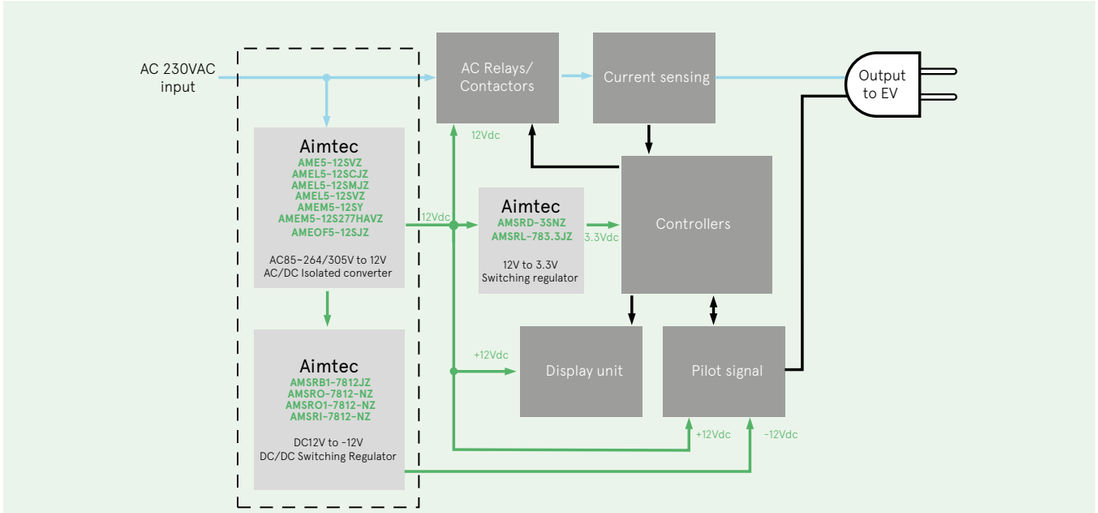

Figure 1. Portable AC charger

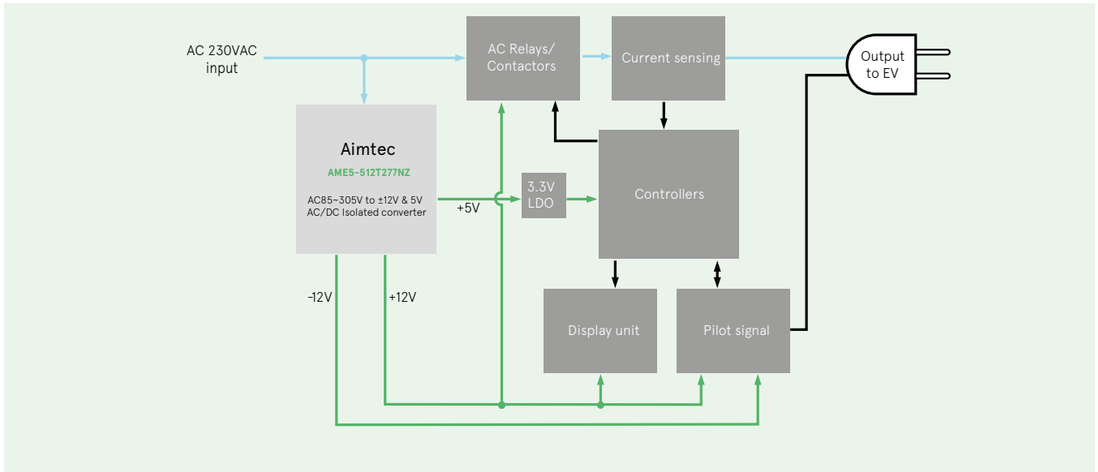

Figure 2. Portable AC charger with AME5-512T277NZ

AC CHARGING STATIONS

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.

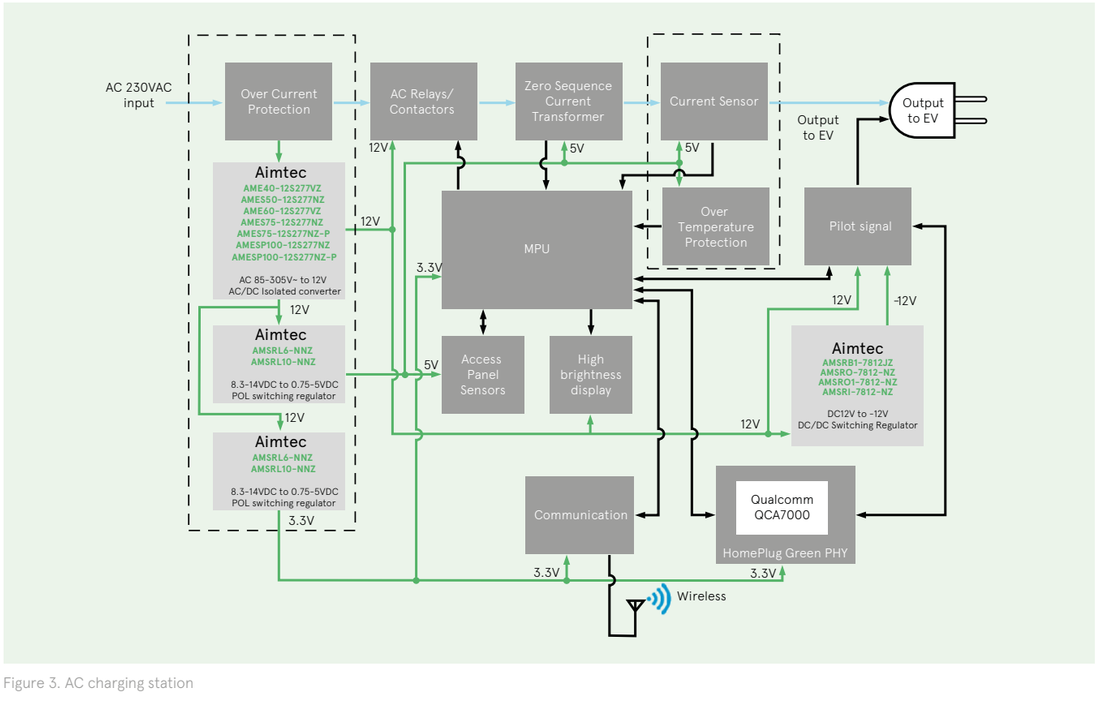

Figure 3. AC charging station

DC CHARGING STATIONS

The DC charging stations does 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 station 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.

SAE J2931 requires that all DC chargers with CCS plug uses HomePlug Green PHY for high level communication. It uses the same pin as the control pilot signal, so it is backward compatible. The HPGP features higher data rate than CAN bus and is capable of transmitting more information like payment and billing information. As it is designed for smart grid and smart appliance, the HPGP is compatible with HomePlug AV, HomePlug AV2 and IEEE 1901 specification. This allows higher degree of integration with other smart devices like smart meter and realize smart building. The below block diagram provides a DC charging station with integrated HomePlug Green PHY solution.

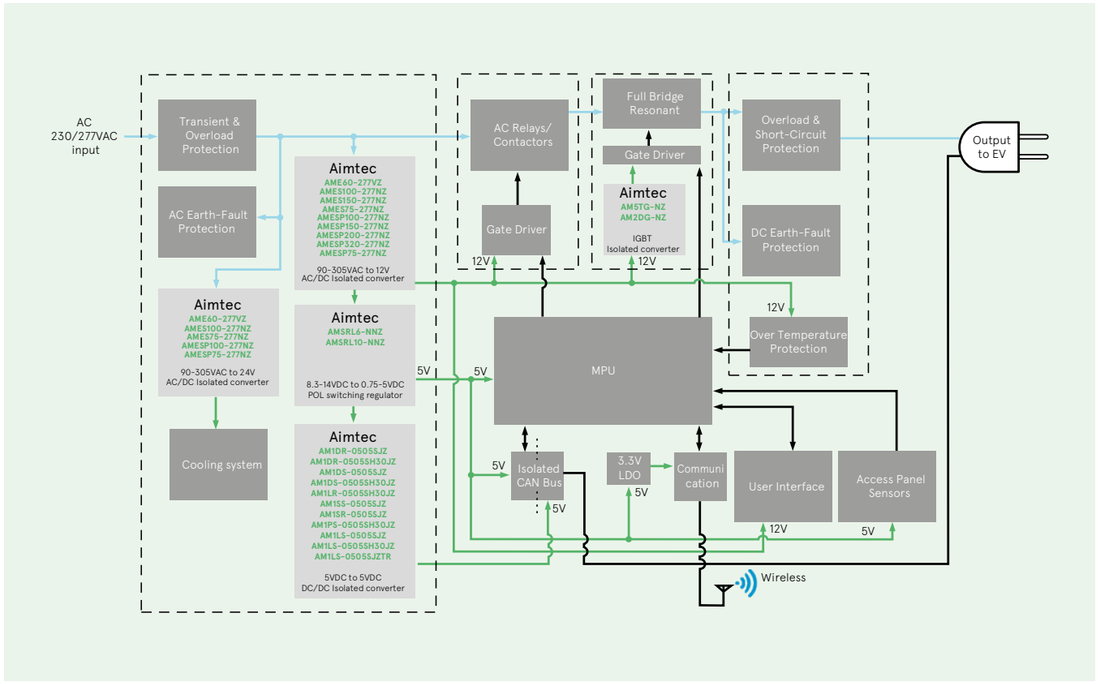

Figure 4. DC charging station

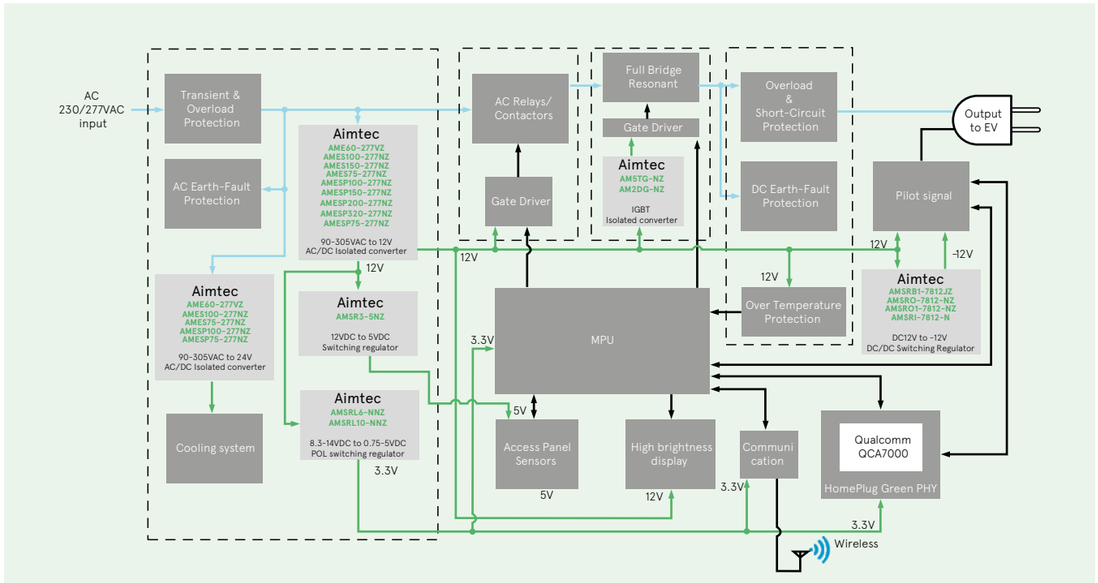

Figure 5. DC charging station with HPGP

PORTABLE EV POWER BANKS

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.

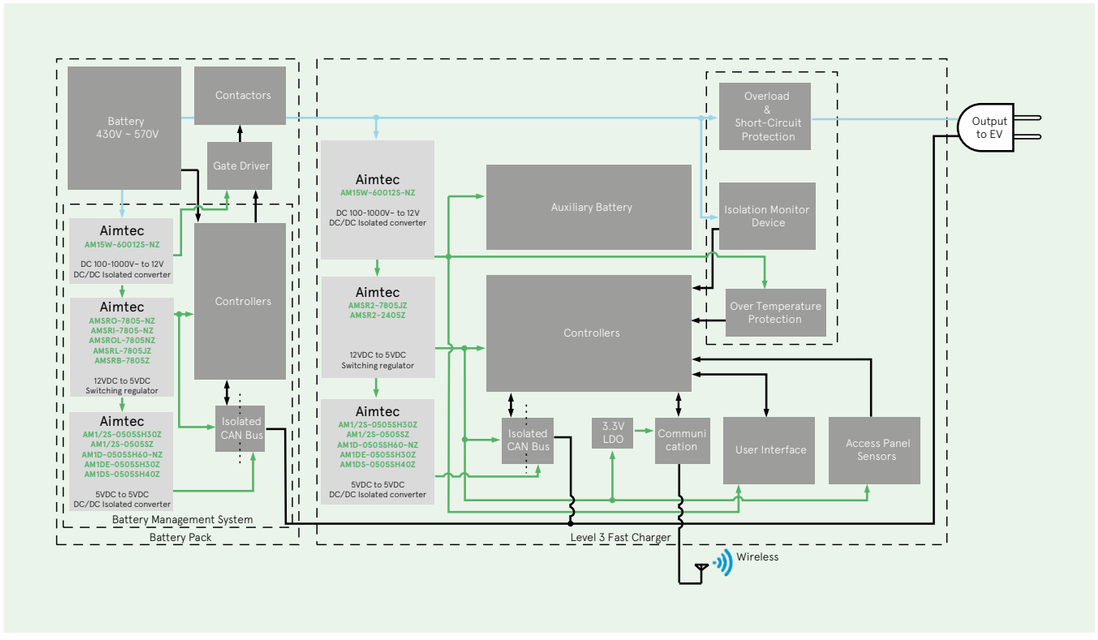

Figure 6. EV power bank

CONCLUSION

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.

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 Aimtec components into your designs will simplify your BOM, reduce certification time and decrease your time to market.

Avnet Abacus works with Aimtec to provide the highest level of engineering support for your designs. Explore Aimtec's solutions for EV charging infrastructure below, or if you're ready to take the next step, get in touch at Avnet-abacus.eu/ask-an-expert

Whether you're designing EV charging stations for the ground up or taking a modular approach, you can simplify design and shorten time to market with end-to-end EV charging solutions from Avnet Abacus and EBV. Visit www.ev-chargi.ng to find out more.

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						

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

ABOUT AVNET ABACUS

Avnet Abacus is a pan-European demand creation distributor specialising in interconnect, passive, electromechanical, power supply and battery products. Avnet Abacus' extensive product range and exceptional line card is supported by a team of over 50 product specialists based across Europe, delivering technical expertise and technology focused initiatives. Avnet Abacus is a regional business unit of Avnet, (NASDAQ:AVT), with European headquarters in Belgium (Avnet Europe Comm. VA).

For more information, visit: www.avnet-abacus.eu or follow us on http://www.twitter.com/Avnet_Abacus

ENGINEERING SERVICES – ASK AN EXPERT

Have a question?
Avnet Abacus' regional technical specialists are on hand to help

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