



Farnell

AN AVNET COMPANY

ELECTRIC VEHICLE CHARGING

A Comprehensive Guide



A brief guide
on building a EV
charging solution



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1. INTRODUCTION

What is an Electric Vehicle (EV) charger? It's a device that supplies electric power to recharge EV batteries. This comprehensive guide for EV charging solutions is your ultimate resource for EV charger design. It covers various charging technologies, differences between AC and DC charging architectures, and types of charges, ranging from level 1 to level 3, encompassing slow to fast charging. It breaks down and helps you understand essential components such as power management, control systems, communication protocols, and security measures, providing insights on planning and deploying EV charging infrastructure. Additionally, it offers curated solutions and product recommendations from industry-leading suppliers for building and enhancing EV charging infrastructure, ultimately aiding in navigating the future of mobility.

2. EV CHARGING INFRASTRUCTURE

The EV charging infrastructure is a collection of residential and commercial EV supply equipment (EVSE). A robust EVSE that serves both urban and rural areas is essential for promoting the global uptake of EVs.

Any successful fleet electrification program must:

- Prepare for the placement of the EVSE to best support the EVs. The placement must be based on demand, visible, easily accessed, and near all needed amenities.
- Identify the charger types that can be used.
- Assess the electrical capacity of the site. Such an assessment is needed to accommodate the charging infrastructure.
- Determine the number of charging stations and their placement.
- Execute network connectivity and power management,
- Integrate renewable energy sources like solar power while ensuring regulatory compliance,
- Focus on user experience and establish a maintenance plan,
- Collaborate with stakeholders.

There is no one-size-fits-all formula for determining the number of charging stations needed. It would be best to establish a maintenance plan for regular check-ups, repairs, and support services to keep the charging infrastructure operational.

2.1. Types of EV Chargers (AC/DC types)

One can charge EVs using Alternating Current (AC) or Direct Current (DC). AC charging is the most common method, with the onboard charger being the main converter. As shown in Figure 1, power fed into the vehicle must be converted to DC to charge the battery. This conversion must occur within the vehicle using an Onboard Charger (OBC) or inside the charge station.

AC chargers are smaller in size and charge slowly. They are ideal for overnight charging and are used in homes. AC chargers are more affordable than DC chargers, where the charging process involves connecting the EV to AC power, 120V or 240V, and converting the AC power to DC.

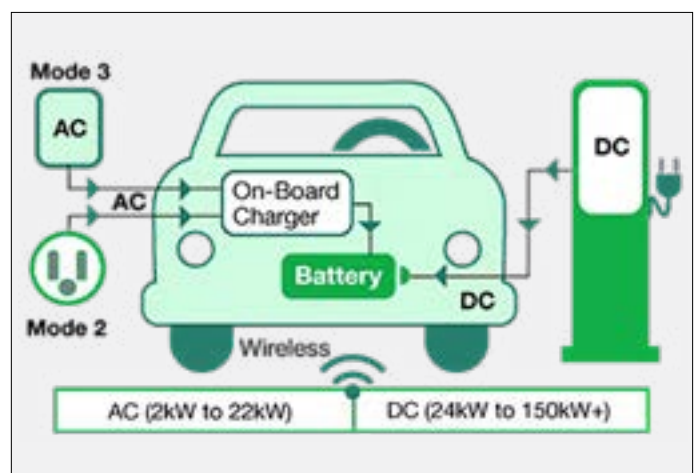


Figure 1: AC and DC Charging in an Electric Vehicle

On the other hand, DC charging can feed power directly to the car’s battery, and there is no need for an onboard charger. This is possible as DC charging has a converter inside the charger itself. DC fast charging bypasses the limitations of the onboard charger and provides DC power directly to the battery, increasing charging speed. DC chargers are faster than AC charging, bigger in size, and used for fast charging.

2.2. Different Level Types of Chargers

EVs can be charged using AC or DC methods. AC charging offers two options: slow or fast, while DC provides rapid charging. The charging times depend on the type of EV charger. There are three types of EV charging: Level 1, which is slow with 5 km of range per hour; Level 2, which offers 30 to 50 km of range per hour; and Level 3, which offers up to 20 miles per minute. Level 1 and Level 2 are AC chargers, while Level 3 is a DC charger. As the charging level increases, the charging speed decreases.

Power level Types	Charger Location	Typical Use	Energy Supply Interface	Expected Power Level	Charging Time
Level 1 (Slow)	On-board 1-phase (AC charging)	Charging at home or office	Convenience outlet	1.4kW (12A) 1.9kW (20A)	11-36 hours 4-11 hours
Level 2 (Intermediate or slow)	On-board 1- or 3-phase (AC charging)	Charging at private or public outlets	Dedicated power connector	4Kw (17A) 8kW (32A) 19.2kW (80A)	2- 6 hours 2-3 hours 1-4 hours
Level 3 (Fast/less than 1 hour)	Off-board 3-phases (DC charging)	Commercial, same as gas station	Dedicated power connector	50kW 100kW 250kW 350kW	0.4-1 hours 0.2-0.5 hours

Table 1: Levels of EV charger (source: Avnet)

The vehicle’s onboard converter converts AC to DC in Levels 1 and 2. At the same time, DC power is supplied directly to the battery in Level 3 charging, where the conversion occurs outside the vehicle and in the charging station. This rapid charging method eliminates the slow onboard conversion process, resulting in higher power outputs and faster charging times.

The slower rate of AC Level 2 charging is best for people who don’t mind waiting a few hours for their cars to recharge. Many workplaces and homes are equipped with AC Level 2 chargers.

3. EXPLAINING DIFFERENT KINDS OF EV CHARGER

3.1. Level 1: Vehicle On-board Charger (OBC)

The increasing demand for fast charging with low system costs is a strong driver for using OBC solutions. The OBC system in EVs recharges the high-voltage main battery from the AC grid while parked. Recharge occurs from the home AC mains plug or private/public outlets (AC charging station). The system optimizes EV battery management, supports various conversion topologies, and features high power density, low switching losses, integrated isolation, and high-performance 32-bit microcontrollers. The OBC uses discrete high-voltage components where the typical AC power charging level goes from 3.6 kW (single Phase) to 22 kW (three Phase). Electric components’ battery capacity and energy efficiency determine whether one can achieve the desired driving range.

An OBC is of a four-stage design: EMI filter/input stage, power factor correction stage, DC-DC conversion stage, and output filtering stage, as shown in Figure 2. The EMI filter is an essential part of the OBC, where it removes undesirable noise from AC sine waves and filters AC power. It improves system efficiency and dependability by

reducing potentially harmful voltage and current spikes. Common mode chokes, AC harmonic filter capacitors, and X & Y safety capacitors are a few parts that make up the filter, and they function as an effective barrier against unauthorized electrical disruptions. The filter's efficiency can be found by comparing the waveform before and after the EMI filter's intervention.

The **Power Factor Correction (PFC)** stage ensures efficient power and prevents grid issues. It is crucial to OBC design. The PFC inhibits component damage due to displacement or distortion and minimizes user-related challenges. A PFC stage can be implemented through active or passive methods to rectify these losses. Active correction involves switching to convert the incoming waveform into a DC waveform, enhancing the power factor and ensuring efficient power utilization. Passive correction uses capacitors and inductors to smooth abrupt switching patterns, creating a balanced waveform and mitigating ripple voltage.

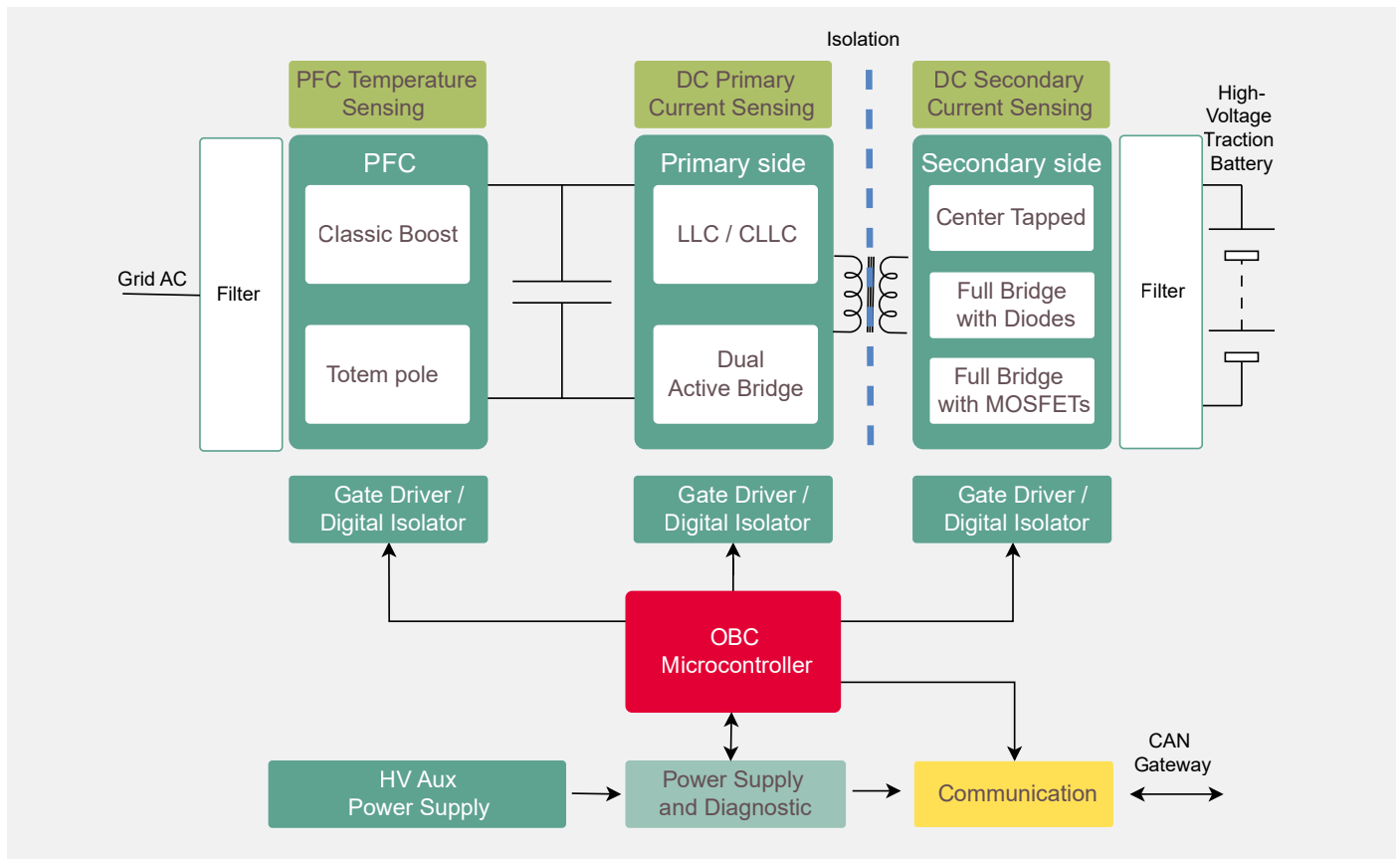


Figure 2: Block diagram of the OBC (Source Infineon)

In an OBC design, the vital **DC-DC converter** stage converts AC power from the PFC stage to DC as per the requirements of the battery system. The converter input is the DC power generated by the PFC stage. The transformer is the central stage and facilitates the step-up or step-down voltage transformation. Active devices surrounding the transformer work together to fine-tune the power factor, mitigating power factor corrections and optimizing the voltage conversion process.

In the final stage of the OBC, an **output filter** is placed to remove the remaining harmonics. This is done using a simple RLC circuit in a passive context. The adjusted power charges the battery used in an EV. Components like power resistors, high-voltage capacitors, and high-power inductors are designed to withstand extreme power conditions and the device's physical characteristics. Engineers consider vibration resistance, temperature and humidity requirements, and space constraints when selecting components for an OBC.

Farnell provides a complete product portfolio including Si and SiC power MOSFETs, IGBTs, silicon and SiC diodes, protections, SCR thyristors, MEMS, connectivity ICs, gate drivers, and microcontrollers, in accordance with AEC-Q100 and AEC-Q101 standards.

3.2. Level 1 & 2 Chargers: Wall Box Chargers

Level 1 (slow) charging is an onboard 1-phase AC charging method used primarily at home or the office. It uses a standard convenience outlet with a power rating ranging from 1.4 kW (12A) to 1.9 kW (20A). The charging duration varies significantly, with estimated times ranging from 11 to 36 hours. This method is characterized by simplicity and convenience, making it suitable for overnight or extended parking scenarios. However, it may not be ideal for rapid recharging and is often used when the vehicle is parked for extended periods, such as overnight or during the workday.

The simplest and slowest way to charge an EV involves the AC 'wall box,' typically found in homes, offices, or street-side installations. This approach directs the mains AC to the vehicle's onboard AC-DC charger, enabling up to 8 kW charge rate from single-phase supplies or, rarely, about 20 kW from three-phase sources. Cars that can take three-phase AC are uncommon; even if they can, the automobile may have a restriction, such as 11 kW for the Tesla Model 3. For home or workplace charges, billing capability is optional. Authentication technologies such as RFID or key functionalities can be used for essential user identification.



Figure 3: AC wall box charger

3.2.1. Architecture of AC wall box EV charger

The architecture of the AC wall box EV charger is shown in Figure 4. The charger consists of 50/60Hz T1 and T2 current transformers operating under various conditions. The line current is measured by T1, which can be tens of amps under fault conditions. Energy use is measured, and over-current and short circuits are detected, if any. Resistive sensing can also be used, but it may cause high losses and is not isolated from AC mains. Hall effect sensors provide isolation but are expensive, non-linear, and suffer from poor temperature stability and offset errors. Current transformers are a suitable solution for AC.

The Ground Fault Current Indicator (GFCI) is shown as T2 that cancels normal line and neutral currents, generating a secondary voltage when there's a difference between line and neutral currents, indicating an extra fault current to the ground. This makes the part smaller than T1 and typically requires additional winding for testing. The relay performs the disconnect function under fault conditions or for scheduled connection. The isolated auxiliary supply provides a few watts for the control and monitoring functions.

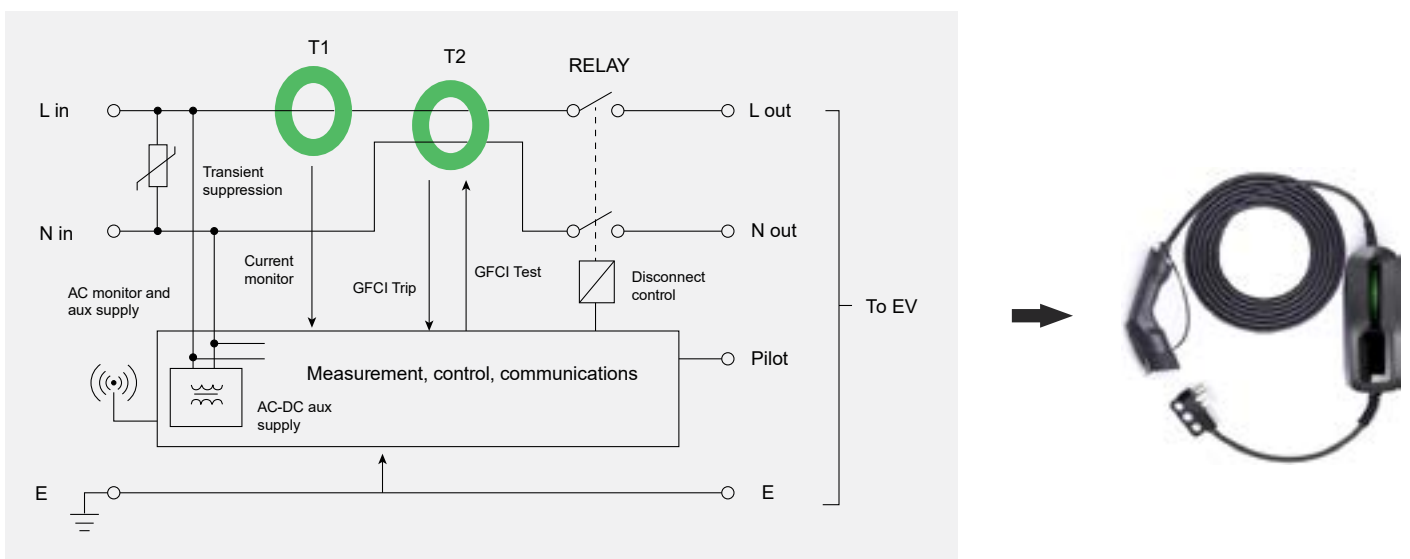


Figure 4: AC wall box EV charger (Source: Avnet)

A large inverter or transformer is needed if the AC wall box comes without galvanic isolation between the AC supply and EV connection. Mechanical disconnection is necessary, with relay contacts in line and neutral, opening when overload, short circuit, or ground fault is detected. Current transformers can sense these conditions. The disconnect function can be used for scheduled charging and controlled remotely via wireless or powerline communications along the AC supply. The control unit/wall box interface or powerline communication can be used for scheduled charging. Three-phase AC wall boxes for domestic installation will typically operate from nominal 380/400VAC and be designed for over-voltage category III and IEC 61581. One transformer can be used for ground fault detection.

Below is the list of AC wall box EV chargers from Farnell.

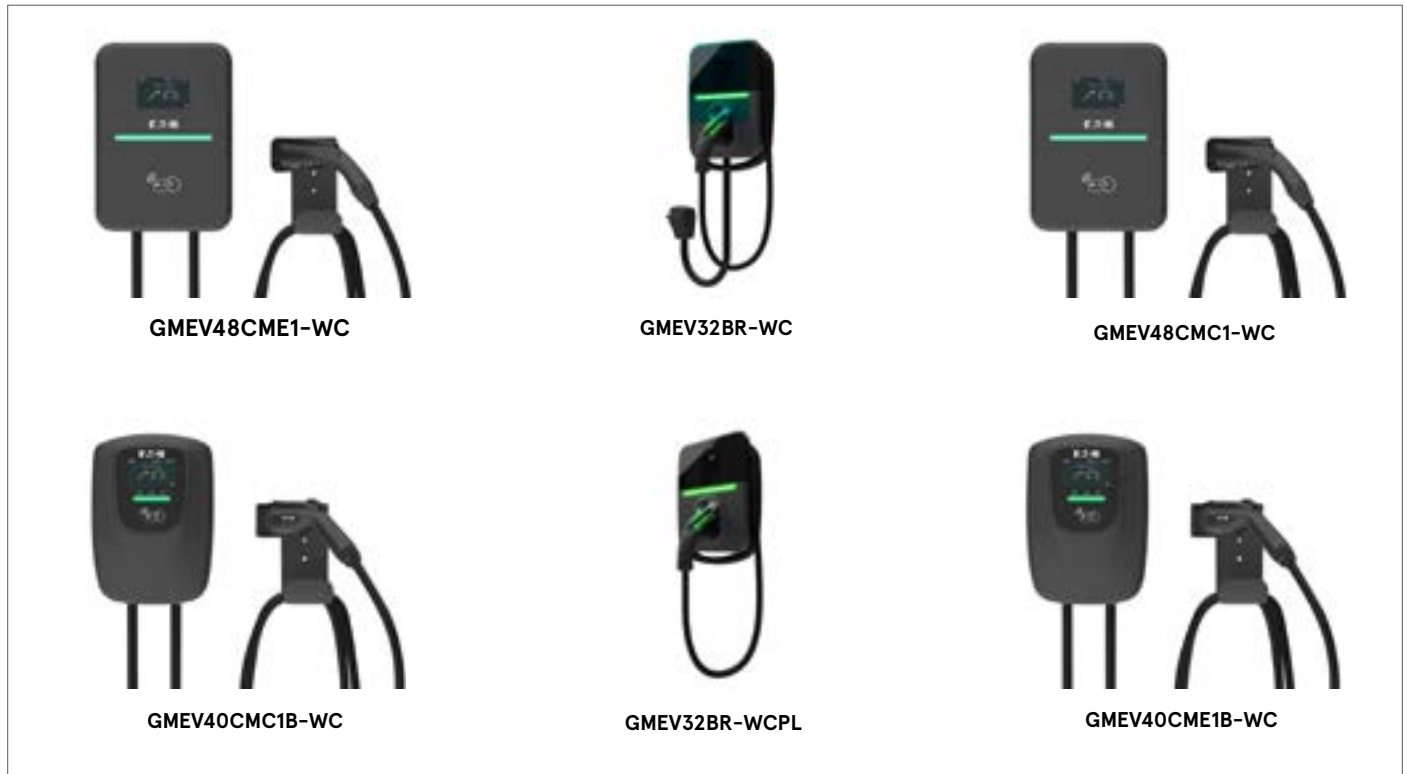


Figure 5: EV Charging

3.3. Level-3 EV charging solution

A DC charging station is a Level 3 charger with a high-power level of over 350 kW, using modular converters that can be stacked outside the vehicle. These converters directly interface with the vehicle's battery, bypassing the onboard charger. The power module in a DC charging station consists of AC/DC and DC/DC power stages, where each has its own power stage, power switches, gate driver, current and voltage sensing, and controller. In the first stage, it converts incoming 3-phase AC into a fixed DC voltage of around 800 V, while in the next stage, the DC/DC converter sets the output to match the needs of the battery integrated into the vehicle.

DC EV chargers have revolutionized the charging industry by combining power, speed, and scalability. With a higher power rating than AC chargers, DC chargers operate in the 11 kW–22 kW range and are expected to reach the 30 kW to 50 kW spectrum in the near future. When multiple DC charger sub-units work in parallel, the power rating of charging piles can be increased from 120 kW to 360 kW, enhancing user convenience. DC charging also has the advantage of recharging EV batteries to 80 percent capacity in less than half an hour, transforming the charging experience and aligning with modern EV users' fast-paced lifestyles.

3.3.1. Architecture of Three-phase EV DC charger

The power stage includes gate drivers for MOSFETs, current and voltage sensor blocks, and individual controllers for processing analog data and providing fast control action. It also has temperature sensing blocks, interfaces for CAN, Ethernet, and RS-485, and isolated and non-isolated DC/DC converters for powering auxiliary circuits like fans

and amplifiers. The topology for AC/DC and DC/DC power conversion stages is a prime factor, as it determines the system's efficiency. Each power stage has its controller responsible for processing analog data and providing rapid control reactions.

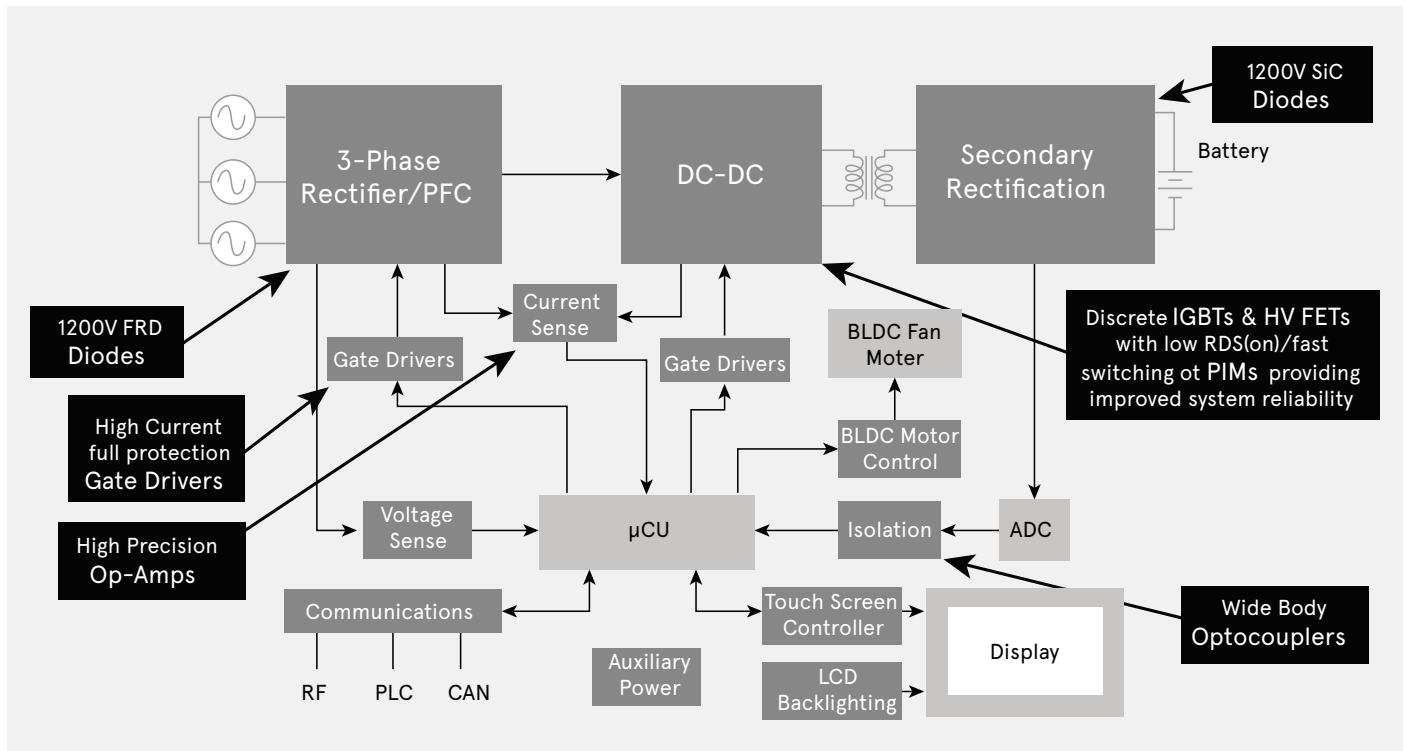


Figure 6: Three-phase EV DC charger outline (Source Onsemi)

Three-phase Power Factor Correction (PFC) topologies are critical for efficient and fast DC charging. By incorporating Silicon Carbide (SiC) power semiconductors into your three-phase PFC topologies, you can address the usually conflicting challenge of reducing power losses and increasing power density. Implementing the frontend three-phase PFC boost stage in multiple topologies is possible; several may fulfill the exact electrical requirements.

The AC-DC converter in an offboard charger is a frontend rectifier before the DC-DC conversion stage in an EV fast charging station. Various topologies convert AC power from the utility grid to DC power, handling high power fed directly to the battery. Due to advancements in semiconductor technology, active PFCs are increasingly used in EV charging stations. Single-phase and three-phase topologies are used depending on power levels, with single-phase used for power levels less than 3.3 kW and three-phase used for higher power levels. The AC/DC converter in an EV typically uses a three-phase high-power rectifier for fast charging. Topologies for AC-DC conversion include a three-phase buck type rectifier, Swiss rectifier, Vienna rectifier, and three-phase boost type rectifier.

DC-DC conversion stages employ three main isolated topologies: the full-bridge LLC resonant converter, the full-bridge phase-shift Dual Active Bridge (DAB) Zero Voltage Transition (ZVT) converter, and the full-bridge phase-shift ZVT converter.

3.3.2. EV charger and their components

1) Input Protection

EV chargers have various protection mechanisms to ensure safety and prevent potential hazards. Overvoltage protection disconnects the power if the voltage exceeds the maximum rating, averting damage to the charging system. Ground Fault Circuit Interrupter monitors the current flow and disconnects the circuit in case of a ground fault, minimizing the risk of electric shocks. Surge Protection Devices (SPDS) are needed for all new electrical circuits to protect against voltage surges, protecting electronic components and infrastructure from damage.

SM15T6V8A – TVS DIODE



TVS Diode, SM15T, Unidirectional, 5.8 V, 13.4 V, DO-214AB (SMC), 2 Pins



Order Code
9885820

SMF05C – TVS DIODE



TVS Diode, TRANSZORB SMCJ, Unidirectional, 5 V, 12.5 V, SOT-323, 6 Pins



Order Code
2059033RL

SMBJ24A-E3/52 – TVS DIODE



TVS Diode, Transil SMBJ, Unidirectional, 24 V, 38.9 V, DO-214AA (SMB), 2 Pins



Order Code
9551026

PTVS15VS1UR,115 – TVS DIODE



TVS Diode, PTVS, Unidirectional, 15 V, 24.4 V, SOD-123, 2 Pins



Order Code
1829240RL

SMAJ30A-TR – TVS DIODE



TVS Diode, TRANSZORB SMAJ, Unidirectional, 30 V, 64.3 V, DO-214AC (SMA), 2 Pins



Order Code
2252452

SMBJ43A – TVS DIODE



TVS Diode, Transil SMBJ, Unidirectional, 43 V, 69.4 V, DO-214AA (SMB), 2 Pins



Order Code
2295713

FLLD31K0APV11 – POWER LINE FILTER



Power Line Filter, General Purpose, 520 VAC, one kA, Three Phase, 2 Stage, Chassis Mount



Order Code
2902085

FLLD3075AMHT5 – POWER LINE FILTER



Power Line Filter, General Purpose, 530 VAC, 75 A, Three Phase, 1 Stage, Chassis Mount



Order Code
2767080

6609048-1 – POWER LINE FILTER



Power Line Filter, Installation, General Purpose, 250 VAC, 3 A, Single Phase, 2 Stage



Order Code
9586210

BNX012-01 – POWER LINE FILTER



Power Line Filter, 50 V, 15 A, 1 Stage, Through Hole



Order Code
1828968

B84111F0000B060 – POWER LINE FILTER



Power Line Filter, Chassis, General Purpose, 250 VAC, 6 A, Single Phase, 1 Stage, Chassis Mount



Order Code
1467059

FN3258-30-33 – POWER LINE FILTER



Power Line Filter, Chassis, General Purpose, 480 VAC, 30 A, Three Phase, 1 Stage, Chassis Mount



Order Code
2134571

5500.204 – POWER LINE FILTER



Power Line Filter, Chassis, General Purpose, 250 VAC, 3 A, Single Phase, 1 Stage, Chassis Mount



Order Code
1162772

TBU-CA065-200-WH – INPUT PROTECTION



Surge Protector, High Speed, Single, Bidirectional, 1 Pole, 300 VAC, PCB – Surface Mount



Order Code
1833393

MPSM34S471P2NBA – INPUT PROTECTION



Surge Protector, Surge Protector, 20 kA, 300 VAC, PCB – Through Hole



Order Code
4263740

OVR T1-T2 N 50-275S C QS – INPUT PROTECTION



Surge Protector, 1 Pole, Mains Surge Protector, 1 Pole, Type 1 & 2, 80 kA, 275 VAC, DIN Rail



Order Code
2914202

F202F-63/0.03 – INPUT PROTECTION



Circuit Breaker, F200, 230 V, 63 A, 2 Pole



Order Code
2991162

5SV3342-6 – INPUT PROTECTION



Circuit Breaker, SENTRON, 400 V, 25 A, 4 Pole, 800 A



Order Code
3529834

2) Current Sensing Transformer

Current transformers are instrument transformers designed to produce an alternating current in its secondary coil proportional to the primary circuit or primary load. They reduce high voltage at lower levels, providing a safe and accurate method to measure electrical current flow through alternating transmission lines. These transformers have low power impedances, making them operate in short circuits. The current in the secondary turns winding depends on the current flow in the primary generating winding rather than directionally dependent on loads. The primary side present relies on the secondary current side circuit conditions in the potential transformer. Zero-phase current transformers are widely used for the electrical safety module of EV charging devices, providing electrical utility safety for EV charging devices. Various solutions using different current transformers are available to ensure safety in EV charging devices.

CST2010-040LD – CURRENT SENSING TRANSFORMER

Current Sensing Transformer, AEC-Q200, 1:40, 1.36 mH, 40 A, 101.6 Vµs, 5kHz to 1MHz, 0.56 ohm



Order Code
2836756

LA12-50V21 – CURRENT SENSING TRANSFORMER

Current Sensing Transformer, 50 A



Order Code
2985767

B82801A1135A125 – CURRENT SENSING TRANSFORMER

Current Sensing Transformer, 1:125, 1.28 mH, 7 A, 36 Vµs, 50kHz to 1MHz, 15 ohm



Order Code
3414896RL

749252150 – CURRENT SENSING TRANSFORMER

Current Sensing Transformer, 1:150, 1.8 mH, 7 A, 67.5 Vµs, 1MHz, 21 ohm



Order Code
3584457

For a complete list of product offerings, refer to the Appendix.

3) Relay

Relays are crucial in EV charging stations, as they switch power to the EV and manage potential hazards like ground faults or creepage currents. A control module within the EVSE controls the main relay, activated only after safety conditions are met. The relay then switches power to the high-voltage terminals of the charging cable, initiating the charging cycle. When disengaged, the control module deactivates the main relay to prevent terminal arcing. Relays must withstand high inrush and short circuit currents and voltage spikes of 10kV or more, handling high currents for sustained periods and repeatedly switching high voltages. Level 1 or 2 chargers need relays to take 16A at 250V AC.

AHES3193 – POWER RELAY

Power Relay, DPST-NO, 48 VDC, 40 A, HE-S Series, Through Hole, Non-Latching



Order Code
3881338

T92S7D12-24. – POWER RELAY

General Purpose Relay, T92 Series, Power, Non-Latching, DPST-NO, 24 VDC, 40 A



Order Code
1608379

RPF2ABD – POWER RELAY

Power Relay, DPST-NO, 24 VDC, 30 A, Zelio RPF, DIN Rail, Panel



Order Code
2780445

668290000000 – POWER RELAY

Power Relay, DPST-NO, 24 VDC, 30 A, 66 Series, Panel Mount



Order Code
3050910

G7L-2A-X-SI-DC12 – POWER RELAY

Power Relay, DPST-NO, 12 VDC, 30 A, G7L-X Series, Through Hole, Non-Latching



Order Code
4216035

MGN2A-AC120 – POWER RELAY

RELAY, DPST-NO, 240VAC, 28VDC, 30A















Order Code
7270185

4) SiC MOSFET and driver

The choice of semiconductor devices is crucial for optimizing the efficiency of rectifier and PFC circuits. Silicon Carbide (SiC) MOSFETs and Insulated Gate Bipolar Transistors (IGBTs) have advantages, such as high-speed switching and reduced

inductor size. SiC MOSFETs are voltage-controlled devices made with silicon carbide, offering conveniences such as higher breakdown voltages, better cooling and temperature endurance, smaller size, 10x higher dielectric breakdown field strength, 2x higher electron saturation velocity, 3x higher energy bandgap, and 3x higher thermal conductivity. They are used in high-power and voltage devices, reducing the size of components like inductors, capacitors, filters, and transformers.

<p>A1F25M12W2-F1 – SIC MOSFET MODULE</p>  <p>Silicon Carbide MOSFET, FourPack, Four N Channel, 50 A, 1.2 kV, 0.025 ohm, ACEPACK 1</p> <p>Order Code 4229252</p>	<p>FS45MR12W1M1B1BO-MA1 – SIC MOSFET MODULE</p>  <p>Silicon Carbide MOSFET, Full Bridge, Six N Channel, 25 A, 1.2 kV, 0.045 ohm, Module</p> <p>Order Code 2986380</p>	<p>SCTH35N65G2V-7AG – SIC MOSFET</p>  <p>Silicon Carbide MOSFET, Single, N Channel, 45 A, 650 V, 0.045 ohm, H2PAK</p> <p>Order Code 3764233RL</p>
<p>SCTL35N65G2V – SIC MOSFET</p>  <p>Silicon Carbide MOSFET, Single, N Channel, 40 A, 650 V, 0.045 ohm, PowerFLAT HV</p> <p>Order Code 3764234RL</p>	<p>SCT20N120 – SIC MOSFET</p>  <p>Silicon Carbide MOSFET, Single, N Channel, 20 A, 1.2 kV, 0.169 ohm, HIP247</p> <p>Order Code 2807234</p>	<p>SCT3030KLG11 – SIC MOSFET</p>  <p>Silicon Carbide Power MOSFET, N Channel, 72 A, 1.2 kV, 0.03 ohm, 18 V, 5.6 V</p> <p>Order Code 2678784</p>
<p>NTBG160N120SC1 – SIC MOSFET</p>  <p>Silicon Carbide MOSFET, EliteSiC, Single, N Channel, 19.5 A, 1.2 kV, 0.16 ohm, TO-263HV (D2PAK)</p> <p>Order Code 3528497RL</p>	<p>IMBG120R350M1HXTMA1 – SIC MOSFET</p>  <p>Silicon Carbide MOSFET, Single, N Channel, 4.7 A, 1.2 kV, 0.35 ohm, TO-263 (D2PAK)</p> <p>Order Code 3582467</p>	<p>LSIC1M0120G0040 – SIC MOSFET</p>  <p>Silicon Carbide MOSFET, Single, N Channel, 70 A, 1.2 kV, 0.04 ohm, TO-247</p> <p>Order Code 3996617</p>
<p>LSIC1M0120G0025 – SIC MOSFET</p>  <p>Silicon Carbide MOSFET, Single, N Channel, 100 A, 1.2 kV, 0.025 ohms, TO-247</p> <p>Order Code 3996616</p>	<p>MSC040SMA120B – SIC MOSFET</p>  <p>Silicon Carbide MOSFET, Single, N Channel, 66 A, 1.2 kV, 0.04 ohm, TO-247</p> <p>Order Code 3929950</p>	<p>MSC080SMA120S – SIC MOSFET</p>  <p>Silicon Carbide MOSFET, Single, N Channel, 35 A, 1.2 kV, 0.08 ohm, TO-268 (D3PAK)</p> <p>Order Code 3929951</p>

5) MOSFET Driver

A MOSFET gate driver is a specialized circuit that efficiently drives the gate of power MOSFETs in high-speed switching applications. It is a power amplifier that accepts a low-power input from a controller IC and produces a high-current drive input for the gate of a high-power transistor, such as an IGBT or power MOSFET. Gate drivers can be provided on-chip or as a discrete module. A voltage higher than the rated gate threshold must be applied to turn on a MOSFET. The MOSFET gate drive consumes no power in a steady on or off state. Factors such as compatibility, isolation, protection, and integration must be considered when selecting an appropriate gate driver. The gate driver should align with the controller's input signal characteristics, the circuit's supply voltage, and the specific MOSFET gate voltage and current requirements.

<p>STGAP2HSMTR – MOSFET DRIVER</p>  <p>MOSFET Driver, Half Bridge, 9.6 V to 26 V Supply, -40 °C to 125 °C, 75 ns Delay, WSOIC-8</p> <p>Order Code 3581054</p>	<p>HIP4082IBZ – MOSFET DRIVER</p>  <p>MOSFET Driver IC, Full Bridge, 8.5V-15V Supply, 1.4A Out, 25ns Delay, SOIC-16</p> <p>Order Code 1561948</p>	<p>IRS2453DSTRPBF – MOSFET DRIVER</p>  <p>MOSFET Driver, Full Bridge, 10 V to 16.6 V supply, 180 mA /260 mA out, 15.6 V Clamp, NSOIC-14</p> <p>Order Code 2780833</p>
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LT1162CSW#PBF – MOSFET DRIVER



Gate Driver, 4 Channels, Full Bridge, MOSFET, 24 Pins, WSOIC



Order Code
4018519

NCP81062MNTWG – MOSFET DRIVER



MOSFET Driver, High Side, and Low Side, 4.5 V to 13.2 V supply, 25 ns Propagation delay, DFN-8



Order Code
2724059

6) Power MOSFET

A power MOSFET is a three-terminal silicon device that switches large amounts of current due to its low gate drive power, fast charging speed, and superior paralleling capability. It is widely used due to its ability to operate at low voltages, offer high switching speed, and optimize efficiency.

STB45N30M5 – POWER MOSFET



Power MOSFET, N Channel, 300 V, 53 A, 0.037 ohms, TO-263 (D2PAK), Surface Mount



Order Code
2984364

SPA11N65C3XKSA1 – POWER MOSFET



Power MOSFET, N Channel, 650 V, 11 A, 0.34 ohm, TO-220F, Through Hole



Order Code
1471771

NTHL125N65S3H – POWER MOSFET



Power MOSFET, N Channel, 650 V, 24 A, 0.108 ohms, TO-247, Through Hole



Order Code
3677723

IXTP4N65X2 – POWER MOSFET



Power MOSFET, X2-Class, N Channel, 650 V, 4 A, 0.85 ohms, TO-220, Through Hole



Order Code
2674789

R6511ENJTL – POWER MOSFET



Power MOSFET, N Channel, 650 V, 11 A, 0.36 ohm, TO-263S, Surface Mount



Order Code
3213692

IXFP12N65X2 – POWER MOSFET



Power MOSFET, X2 Cls, N Channel, 650 V, 12 A, 0.31 ohm, TO-220, Through Hole



Order Code
3438390

SIHG73N60E-GE3 – POWER MOSFET



Power MOSFET, N Channel, 650 V, 73 A, 0.032 ohms, TO-247AC, Through Hole



Order Code
2283634

IXTP6N100D2 – POWER MOSFET



Power MOSFET, N Channel, 1 kV, 6 A, 2.2 ohm, TO-220AB, Through Hole



Order Code
3930296

TK14G65W,RQ(S) – POWER MOSFET



Power MOSFET, N Channel, 650 V, 13.7 A, 0.22 ohm, D2PAK, Surface Mount



Order Code
4173015

TK065U65Z,RQ(S) – POWER MOSFET



Power MOSFET, N Channel, 650 V, 38 A, 0.051 ohm, TO-LL, Surface Mount



Order Code
3977662

7) IGBT

Insulated-Gate Bipolar Transistors (IGBTs) are essential components in EV charging systems. They are semiconductor-switching devices that convert DC and AC in the charging process. IGBTs are known for their high efficiency, ensuring minimal energy losses during the charging cycle. They are robust and reliable, contributing to the longevity and stability of EV charging systems. Their fast-switching capabilities enable precise control over the flow of electrical currents, optimizing the charging process.

STGYA50H120DF2 – IGBT



IGBT, 100 A, 2.1 V, 535 W, 1.2 kV, MAX-247, 3 Pins



Order Code
3972507

IXGH32N120A3 – IGBT



IGBT, 75 A, 2.35 V, 300 W, 1.2 kV, TO-247, 3 Pins



Order Code
3930552

IXYK120N120C3 – IGBT



TRANSISTOR, IGBT, 1.2KV, 240A, TO-264



Order Code
3775981

HGTG11N120CND – IGBT



IGBT, 43 A, 2.4 V, 298 W, 1.2 kV, TO-247, 3 Pins



Order Code
1611490

STGWA30M65DF2 – IGBT



IGBT, 60 A, 1.55 V, 258 W, 650 V, TO-247, 3 Pins



Order Code
2490225

RGTH00TK65GC11 – IGBT



IGBT, 35 A, 1.6 V, 72 W, 650 V, TO-3PFM, 3 Pins



Order Code
3132336

DG50X07T2 – IGBT



IGBT, 100 A, 1.45 V, 714 W, 650 V, TO-247, 3 Pins



Order Code
3790235

8) Bridge rectifier and rectifier diodes

Bridge rectifiers transform incoming AC voltage into DC form in EV chargers. The selection criteria include packaging, inrush current ratings, quality and reliability, voltage drop, recovery options, and voltage withstanding. High conduction, switching losses, and heating issues are common during rectification. The rectifier's ability to handle inrush currents during initial power-up is essential for sustained and stable operation.

SMT5012GW – BRIDGE RECTIFIER



Bridge Rectifier, Three Phase, 1.2 kV, 50 A, Module, 5 Pins, 1.1 V



Order Code
2750976

GUO40-12NO1 – BRIDGE RECTIFIER



Bridge Rectifier, Three Phase, 1.2 kV, 40 A, GUPF, 5 Pins, 1.28 V



Order Code
3438360

STTH30RQ06G2-TR – FAST & ULTRAFAST RECOVERY RECTIFIER DIODES



Fast / Ultrafast Diode, 600 V, 30 A, Single, 2.95 V, 55 ns, 180 A



Order Code
3105991

VS-E5TX3012-M3 – FAST & ULTRAFAST RECOVERY RECTIFIER DIODES



Fast / Ultrafast Diode, 1.2 kV, 30 A, Single, 3.3 V, 80 ns, 190 A



Order Code
3639221

DSEP29-12A – FAST & ULTRAFAST RECOVERY RECTIFIER DIODES



Fast / Ultrafast Diode, 1.2 kV, 30 A, Single, 1.81 V, 40 ns, 200 A



Order Code
1427266

IDW30C65D1XKSA1 – FAST & ULTRAFAST RECOVERY RECTIFIER DIODES



Fast / Ultrafast Diode, 650 V, 30 A, Dual Common Cathode, 1.7 V, 71 ns, 120 A



Order Code
2780783

RURG3060 – FAST & ULTRAFAST RECOVERY RECTIFIER DIODES



Fast / Ultrafast Diode, Soft, 600 V, 30 A, Single, 1.5 V, 60 ns, 325 A



Order Code
1076353

IDW80C65D2XKSA1 – FAST & ULTRAFAST RECOVERY RECTIFIER DIODES



Fast / Ultrafast Diode, 650 V, 80 A, Dual Common Cathode, 2.2 V, 36 ns, 250 A



Order Code
2780786

FERD40H100SG-TR – RECTIFIER DIODES



Standard Recovery Diode, 100 V, 40 A, Single, 675 mV, 440 A



Order Code
2579641

DNA30EM2200PZ-TRL – RECTIFIER DIODES



RECTIFIER, 2.2KV, 30A, TO-263



Order Code
3771219

DSI30-12AS-TRL – RECTIFIER DIODES



Standard Recovery Diode, 1.2 kV, 30 A, Single Dual Anode, 1.29 V, 325 A



Order Code
4060190RL

IDB30E120ATMA1 – RECTIFIER DIODES



Standard Recovery Diode, 1.2 kV, 50 A, Single, 2.15 V, 243 ns, 102 A



Order Code
2212799

STTH30L06GY-TR – RECTIFIER DIODES



Standard Recovery Diode, 600 V, 30 A, Single, 1.55 V, 90 ns, 300 A



Order Code
2806744RL

9) SiC Schottky diode

Silicon carbide (SiC) Schottky diodes play an essential role in EVs and hybrid vehicles (HEVs), improving efficiency and extending range. They have low turn-on voltage, fast recovery time, low-loss energy, high voltage tolerance, high power density, low on-state resistance, and excellent thermal conductivity. SiC Schottky diodes can increase efficiency, reduce DC-DC converter size and cost, improve operating temperature, provide better conduction losses, lower leakage currents, and offer higher surge capacity and max voltage ratings.

STPSC20H12G2-TR – SIC SCHOTTKY DIODE



Silicon Carbide Schottky Diode, Single, 1.2 kV, 20 A, 129 nC, D2PAK-HV



Order Code
3766511

STPSC15H12G2-TR – SIC SCHOTTKY DIODE



Silicon Carbide Schottky Diode, Single, 1.2 kV, 15 A, 94 nC, D2PAK-HV



Order Code
3748726RL

LSIC2SD065D20A – SIC SCHOTTKY DIODE



Silicon Carbide Schottky Diode, Single, 650 V, 48 A, 63 nC, TO-263



Order Code
3996577

IDWD30G120C5XKSA1 – SIC SCHOTTKY DIODE



Silicon Carbide Schottky Diode, CoolSiC 5G 1200V, Single, 1.2 kV, 87 A, 154 nC, TO-247



Order Code
3051958

AIDW30S65C5XKSA1 – SIC SCHOTTKY DIODE



Silicon Carbide Schottky Diode, CoolSiC 5G 650V, Single, 650 V, 30 A, 43 nC, TO-247



Order Code
3014238

10) Thyristor SCR

Thyristors, also known as SCRs, are crucial in electric vehicle chargers for their variable DC output, which can be adjusted by changing the pulse on their gates. They are particularly useful in applications involving high currents and voltages, controlling alternating currents, and automatically switching off.

TN4050HP-12G2YTR – THYRISTOR SCR



1200 V, 40 A Automotive Grade AEC-Q101 SCR Thyristor in D2PAK HV package



Order Code
3993616

STTD6050H-12M2Y – THYRISTOR SCR



60 A 1200 V half-controlled bridge rectifier in ACEPACK SMIT module



Order Code
3775638

CS19-12HO1S-TRL – THYRISTOR SCR



Thyristor, 1.2 kV, 28 mA, 20 A, 31 A, TO-263 (D2PAK), 3 Pins



Order Code
3930319

16TTS12SPBF – THYRISTOR SCR

Thyristor, 1.2 kV, 35 mA, 10 A, 16 A, TO-220AB, 3 Pins



Order Code
9104380

PGH100N16 – THYRISTOR SCR

Thyristor Diode Module, Three Phase – SCR / Diode, 100A Itav, 1.6kV Vdrm, 1.2kA Itsm



Order Code
4036911

11) DC-DC controller

DC-DC converters in electric vehicle systems have diverse topologies, including isolated and non-isolated configurations. The bidirectional non-isolated topologies emerge as especially well-suited for interfacing with battery electric cars. These topologies exhibit a variety of benefits that make them beneficial compared to other solutions. The following table mentions a few components.

L3751PUR – DC/DC CONTROLLER

DC/DC Controller, Synchronous Buck, 6 V to 75 V in, 1 Output, 99% Duty Cycle, 1 MHz, QFN-EP-20



Order Code
4067513RL

LT3748IMS#PBF – DC/DC CONTROLLER

DC/DC Controller, Isolated Flyback, 5V to 100V Supply, 1 Output, MSOP-16



Order Code
4026242

TLE63893GV50XUMA2 – DC/DC CONTROLLER

DC/DC Controller, Buck, 5 V to 60 V Supply, 1 Output, 360 kHz, SOIC-14



Order Code
3703518

MCP1650S-E/MS – DC/DC CONTROLLER

DC/DC Controller, 2.7V to 5.5V, 1 Output, Boost, 850kHz, MSOP-8



Order Code
1863920

MP6005GK-P – DC/DC CONTROLLER

DC/DC Controller, Flyback, 8V to 80V Supply, 1 Output, 70% Duty Cycle, 250 kHz, MSOP-10



Order Code
3869183RL

ISL95870AHRUZ-T – DC/DC CONTROLLER

DC/DC Controller, Synchronous Buck (Step Down), 3.3V to 25V Supply, 1 Output, 1MHz, µTQFN-20



Order Code
2983665






12) EV Charging controller module (PLC)

The EV charging controllers are a vital component of a sustainable and intelligent mode in electric car charging Infrastructure, featuring comprehensive features and interfaces in a compact, modular housing and equipped with an



Figure 7: PLC-based EV controller

open Linux platform. Higher-power DC chargers are typically built modularly, stacking power blocks of 15 to 75 kW (and above) in a single cabinet. They are programmable charging controller for DC and AC charging of EVs in accordance with IEC 61851-1,-23, DIN SPEC 70121, and CHAdeMO, with an integrated cellular modem.

<p>1622452 – CHARGE CONTROLLER</p> <p>AC CHARGER, EV-CC-AC1-M3-CBC-SER-HS</p>  <p>Order Code 2926901</p>	<p>1622453 – CHARGE CONTROLLER</p> <p>AC CHARGER, EV-CC-AC1-M3-CBC-SER-PCB</p>  <p>Order Code 2926902</p>	<p>1622460 – CHARGE CONTROLLER</p> <p>AC CHARGER, EV-CC-AC1-M3-CC-SER-PCB</p>  <p>Order Code 2926904</p>
<p>1018701 – CHARGE CONTROLLER</p> <p>AC CHARGER, EV-CC-AC1-M3-CBC-RCM-ETH</p>  <p>Order Code 2926900</p>	<p>1622459 – CHARGE CONTROLLER</p> <p>AC CHARGER, EV-CC-AC1-M3-CC-SER-HS</p>  <p>Order Code 2926903</p>	

13) EV charging connector

Charging cables have two connectors – one for the charge point socket and the other for the electric car. EVs have a type 1 or, more commonly, type 2 socket for slow/fast charging and CHAdeMO or CCS for DC rapid charging.

CHAdeMO, or “Charge de Move,” is a standard used by carmakers, primarily in Japan, for charging EVs. The Combined Charging System (CCS) connector is an open industry standard commonly associated with North American and European automakers. All newly manufactured passenger EVs (except Tesla) in North America use the CCS connector. Tesla connectors are exclusively found in Tesla cars, and EVgo is the first public fast-charging network to offer native compatibility with Tesla vehicles. Tesla also designs its connectors, including adaptors for AC Level 1 and 2 (J1772) and a CHAdeMO to Tesla Adaptor for DC charging. The SAE J1772 connector, or “J Plug,” is used for Level 1 and Level 2 AC charging, which are slower than DC Fast Charging and primarily for short-term use.

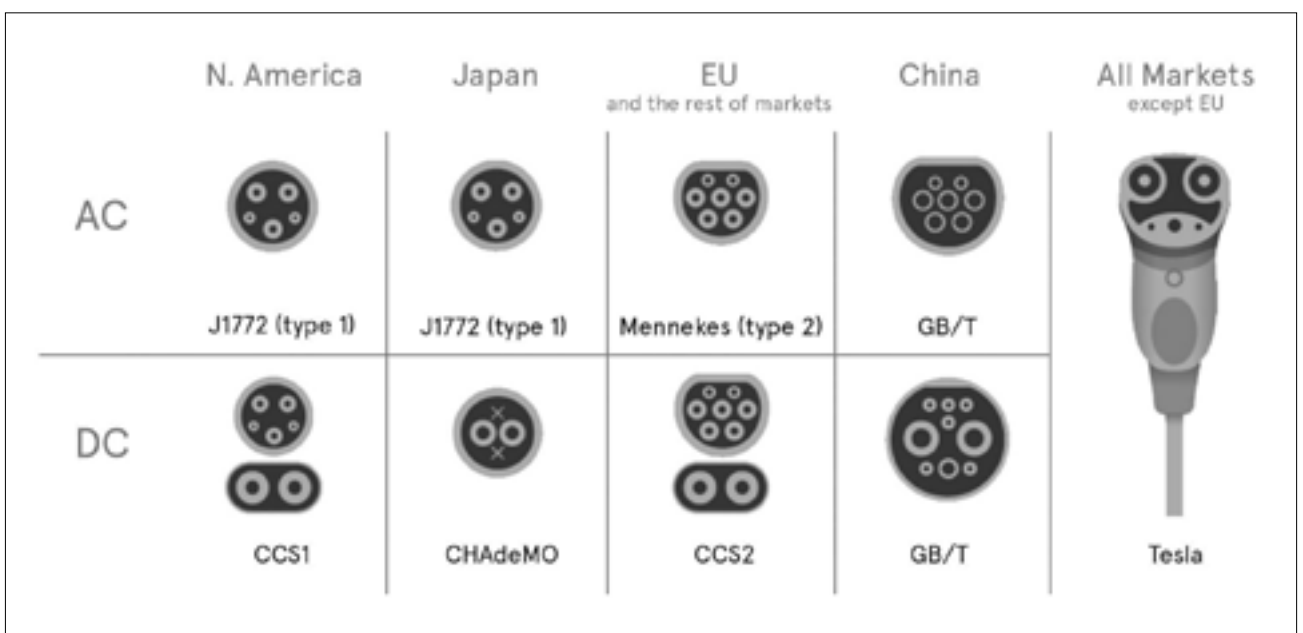


Figure 8: EV charging connector types

MP006852 – EV CHARGING CONNECTORS & CABLES **multicomp^{PRO}**

EV Charging Cable, IEC 62196-2 Type 2 to IEC 62196-2 Type 2, 5 m (16.4 ft), 250 VAC/32 A, Black



Order Code
3650596

08914090301A0 – EV CHARGING CONNECTORS & CABLES

CHARGING CBLE, IEC 62196-2 RCPT-PLUG, 5M



Order Code
3780083



EV-T1G3K-1AC20A-5,0M2,5ESBK01 – EV CHARGING CONNECTORS & CABLES

AC CHARGING CABLE, 5M, 250VAC, 20A, BLK



Order Code
3293131



35622691 – EV CHARGING CONNECTORS & CABLES **• A P T I V •**

EV Charging Cable, IEC 62196-2 Type 2 Plug to Free End, 3 Positions, 250 VAC, 5 m



Order Code
4062674

AU10169534-J24CBLF – EV CHARGING CONNECTORS & CABLES

EV Charging Cable, Plug to Free End, 3 Signal + 2 Power, 120 VDC, 200 mm



Order Code
4149923



2-2208877-5 – EV CHARGING CONNECTORS & CABLES

EV Charging Cable, IEC 62196-2 Type 1 Receptacle to Free End, 5 Positions, 250 VAC, 5 m, HV Series



Order Code
4142161



14) Energy Measurement

Energy measurement in EV charging manages and optimizes energy usage. It helps determine the percentage of total energy usage derived from EV chargers by measuring the amount of energy transferred from the charging station to the EV during a charging session. The standard procedure involves using a meter installed within the charging station. The meter records the amount of electrical energy consumed during the charging session in kilowatt-hours (kWh), which is then used to calculate the charging session cost based on the charging station operator's rate per kWh.



Figure 9: Energy meter for EV charging

EM340DINAV23XO1X – ENERGY METER

Energy Meter, EM340 Series, DIN Rail, Three Phase, Pulse Output, 400 Vac



Order Code
2672861



A44 213-100 – ENERGY METER

Energy Meter, Modular, DIN Rail, Three Phase, 6 A, 57.7 to 500 Vac, Class B, Pulse Output, Modbus



Order Code
2829460



METSEPM5560 – ENERGY METER

Power Meter, PowerLogic PM5000 Series, Three Phase, 100Vac to 480Vac, Serial, Ethernet, Modbus, TCP



Order Code
2835418



MCP3905A-I/SS - ENERGY METERING



AEC-Q100, Single Phase Energy Metering, 4.5 V to 5.5 V, SSOP-24



Order Code
1439398

STPM33TR - ENERGY METERING



Single Phase Energy Metering, 2.95 V to 3.65 V in, QFN-32



Order Code
2435571

ATM90E26-YU-R - ENERGY METERING



Single-Phase Active and Apparent Energy Metering IC, 2.8 V to 3.6 V, SSOP-28, -40 °C to 85 °C



Order Code
2851658

STPM34TR - ENERGY METERING



Three Phase Energy Metering, 2.95 V to 3.65 V in, QFN-32



Order Code
2435572

15) Microcontroller

The MCU/MPU will play a key role in enabling a scalable future for EV charging, acting as a combination of system monitors for data quality and charging levels while providing a secure gateway for insights into payment and vehicle data. The EV charging station controller ensures high efficiency, accuracy, and security by connecting a simulated EVSE to a cloud-based application. The controller supports device-to-cloud and cloud-to-device communications, accurate energy billing, and one-tap NFC authentication. It connects to the cloud over Ethernet or WiFi. The controller board uses security and external communications blocks for high-level communications and protocol stacks. It may also include contactless communication for cashless payments and installation, commissioning, and maintenance.

TC377TX96F300SABKX-UMA1 - MCU/MPU



32 Bit Microcontroller, AURIX Family TC3xx Series Microcontrollers, TriCore, 32-bit, 300 MHz



Order Code
3625283

TC332LP32F300FAAKXU-MA1 - MCU/MPU



32 Bit Microcontroller, AURIX Family TC33X Series Microcontrollers, TriCore, 32-bit, 300 MHz



Order Code
3779678RL

TC365DP64F300WAAKX-UMA1 - MCU/MPU



32 Bit Microcontroller, AURIX Family TC3xx Series Microcontrollers, TriCore, 32-bit, 300 MHz



Order Code
3625287

NCH-RSL15-512-101Q40-ACG - MCU/MPU



32 Bit Microcontroller, RSL15 Series Microcontrollers, ARM Cortex-M33, 32 bit, 48 MHz, 512 KB



Order Code
3879388

NCH-RSL15-284-101Q40-ACG - MCU/MPU



32 Bit Microcontroller, RSL15 Series Microcontrollers, ARM Cortex-M33, 32 bit, 48 MHz, 284 KB



Order Code
3879387

K32W041AZ - MCU/MPU



MCU, 32BIT, 48MHZ, HVQFN-40 ROHS COMPLIANT: YES



Order Code
40AJ7313

SE050E2HQ1/Z01Z3Z - MCU/MPU



IOT Plug and Trust Secure Element, 1.62 to 3.6V Supply, HX2QFN-20, -40 to 105°C



Order Code
4235985

SE050C2HQ1/Z01SDZ - MCU/MPU



IOT Plug & Trust Secure Element, 1.62 V to 3.6 V, -40 to 105 °C, HX2QFN-20



Order Code
3955231RL

3.4. Charger Connectivity Modules

Charging connectivity is crucial for an emission-free future, enabling efficient electricity distribution between vehicles and the power grid. This requires communication between the vehicle, charging unit, and the power grid, and connecting the vehicle to a smart home for comfort. Bi-directional charging requires deeper interaction within the vehicle, consumer, and energy provider. The current battery state, user, or smart home requirements must align with the available energy source and energy provider, possibly including automated billing features.

Figure 10 depicts Infineon’s charging connectivity solution; its product portfolio enables customers to develop solutions that meet ISO15118 requirements and beyond. Critical elements for creating a Charging Connectivity module include the TPM module, AURIX Microcontrollers family, WiFi/BT module, and CAN transceiver. These elements ensure secure communication, local storage and memory data updating, and vehicle network connection.



Figure 10: EV charging gun

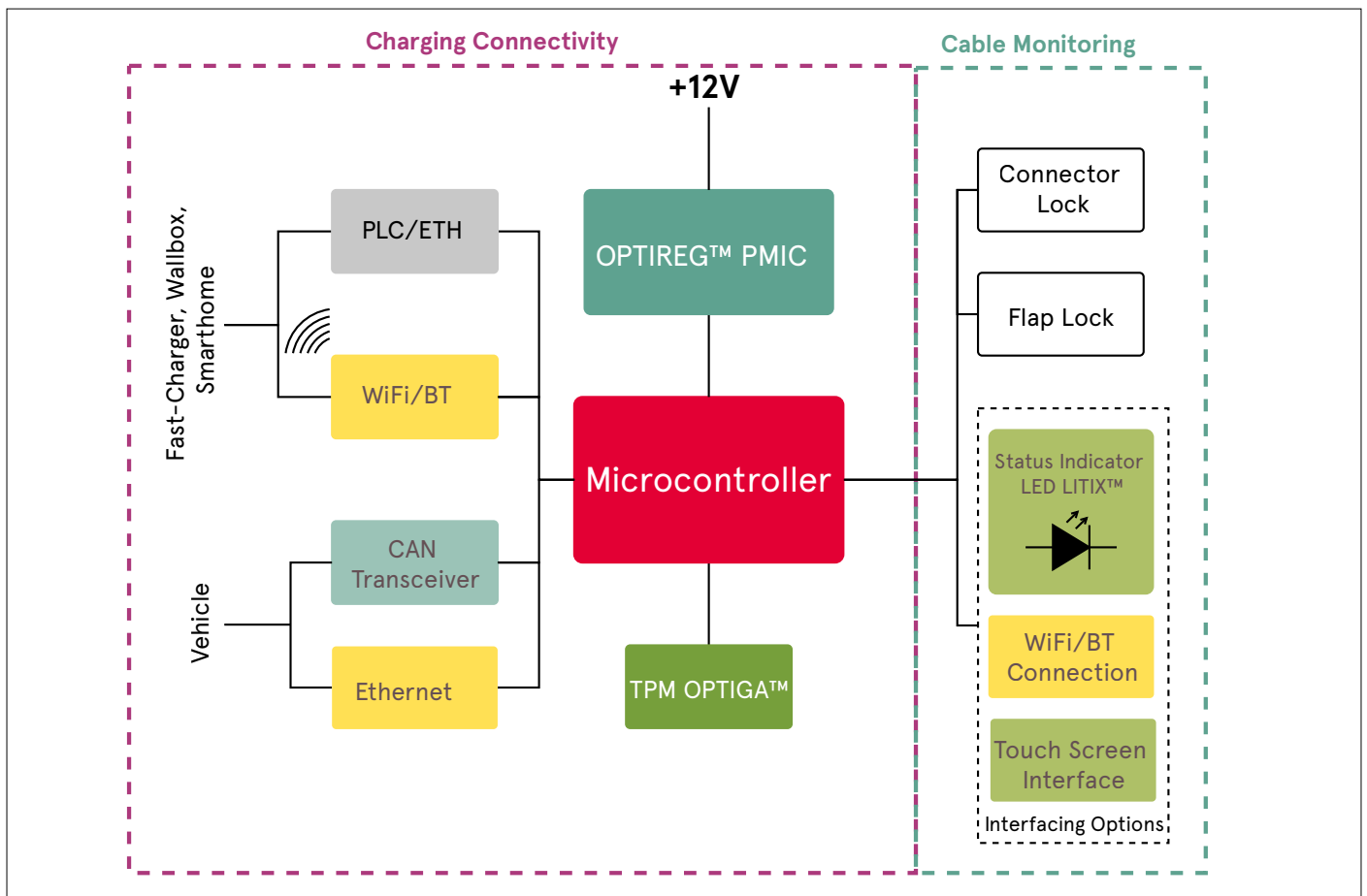


Figure 11: Charging connectivity block diagram

The charger cable is a critical component in e-mobility, serving as a core element of the charging infrastructure, forming the physical link between the charging station or wall box and the electric vehicle. It directly impacts EV owners’ user experience and satisfaction with its ease of use, durability, and performance. The charger cables are engineered with safety features to mitigate risks associated with charging. These cables are designed to withstand diverse environmental conditions, including temperature variations and exposure to elements, ensuring the reliability of assessing operations in different scenarios. Compatibility and standards are essential for charging cables, as they adhere to specific standards, promoting interoperability and broadening the accessibility of charging Infrastructure.

3.5. Charger Communication Protocol

All DC chargers extensively communicate using the pilot connection between the EV and charger. Such communication is needed for correct and complete mating, the initial state of charge, appropriate charge rate, and a cut-off when completed or if a fault occurs, such as battery temperature becoming too high.

1) Wired communication

ST3222BTR – WIRED CONNECTIVITY



RS232 Transceiver, 2 Drivers, 2 Receivers, 3V to 3.6V Supply, TSSOP-20



Order Code
2849903

MAX3075EAPA+ – WIRED CONNECTIVITY



Transceiver, RS422, RS485, 1 Driver, 3 V to 3.6 V Supply, DIP-8



Order Code
2765038

MAX3462ESA+ – WIRED CONNECTIVITY



Transceiver RS422, RS485, 4.75V-5.25V supply, 1 Driver, NSOIC-8



Order Code
2511457

MC1489ADG – WIRED CONNECTIVITY



QUAD RECEIVER RS-232 14-PIN SOIC N RAIL



Order Code
4185843

FT2311D-32L1C-R – WIRED CONNECTIVITY



USB Interface, USB Host Controller / Android Host, USB 1.1, 2.0, 2.97 V, 3.63 V, LQFP, 32 Pins



Order Code
2285511

FT231XQ-R – WIRED CONNECTIVITY



USB Interface, USB-UART Converter, USB 2.0, 2.97 V, 5.5 V, QFN, 20 Pins



Order Code
2081330

UPD720202K8-701-BAA-A – WIRED CONNECTIVITY



USB Interface, USB Host Controller, USB 3.0, 3 V, 3.6 V, QFN, 48 Pins



Order Code
3213721

L9616 – WIRED CONNECTIVITY



CAN Interface, CAN Transceiver, 1 Mbaud, 4.5 V, 5.5 V, SOIC, 8 Pins



Order Code
2807108

BD41041FJ-CE2 – WIRED CONNECTIVITY



CAN Interface, CAN Transceiver, 1 Mbps, 4.75 V, 5.25 V, SOP-J, 8 Pins



Order Code
3011368

BD41044FJ-CE2 – WIRED CONNECTIVITY



CAN Interface, CAN FD Transceiver, 5 Mbps, 4.75 V, 5.25 V, SOP-J, 8 Pins



Order Code
3010877RL

NCV7356D1R2G – WIRED CONNECTIVITY



CAN Interface, J2411, CAN Transceiver, 100 Kbps, 5 V, 27 V, SOIC, 8 Pins



Order Code
2531204

MAX3100EPD+ – WIRED CONNECTIVITY



UART Interface, Serial UART, 1 Channels, 230 Kbaud, 2.7 V, 5.5 V, DIP



Order Code
2518788

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SC16IS741AIPWJ – WIRED CONNECTIVITY



UART Interface, Serial UART, 1 Channels, 5 Mbps, 3 V, 3.6 V, TSSOP

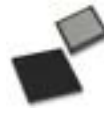


Order Code
2776220

FT2232HQ-REEL – WIRED CONNECTIVITY



UART Interface, Serial to Parallel UART, 2 Channels, 480 Mbps, 1.62 V, 1.98 V, QFN



Order Code
1697462

IS82C52Z – WIRED CONNECTIVITY



UART Interface, Serial UART, 1 Channels, 1 Mbaud, 4.5 V, 5.5 V, LCC



Order Code
3381528

L99PM62GXPTX – WIRED CONNECTIVITY



POWER MANAGEMENT IC W/ LIN/CAN, 150DEG C



Order Code
3367206

MAX20340EWL+ – WIRED CONNECTIVITY



Bidirectional DC Powerline Communication Management IC, 3.4 V to 5.5 V Supply, WLP-9



Order Code
3291111

2) Wireless communication

BLUENRG-232 – WIRELESS COMMUNICATION



RF Transceiver, Bluetooth, 2400 MHz to 2483.5 MHz, GFSK, 2Mbps, 8dBm out, 1.7V to 3.6V, VFQFPN-32



Order Code
2771347

BLUENRG-345AT – WIRELESS COMMUNICATION



RF Transceiver, 2.4 to 2.4835 GHz, 2 Mbps, -97 dBm, QFN-32, -40 °C to 105 °C



Order Code
3678915

BLUENRG-M2SP – WIRELESS COMMUNICATION



BLUETOOTH MODULE, BLE 5.0, 2.4835GHZ



Order Code
3387323

BGM210PB32JIA2 – WIRELESS COMMUNICATION



Bluetooth Module, BLE 5.1, 2 Mbps, -94.1 dBm, 1.71 V to 3.8 V, -40 °C to 125 °C



Order Code
3625368

BGM111A256V2 – WIRELESS COMMUNICATION



Blue Gecko Bluetooth® v4.2 Module, 2.4GHz, 1MBPS, 200M



Order Code
2687541

BGM220SC22HNA2 – WIRELESS COMMUNICATION



Bluetooth Module, V5.2, 2Mbps, -98.6dBm, 1.8 V to 3.8 V, -40 °C to 105 °C



Order Code
3566128

ENW89854A1KF – WIRELESS COMMUNICATION



Bluetooth Module, Bluetooth LE 5.1, 2.45GHz, IEEE 802.15.4, 1.7V to 5.5V



Order Code
3359898

2611011024000 – WIRELESS COMMUNICATION



Bluetooth Module, Proteus-III, V5.1, 2.402 GHz to 2.48 GHz, 2 Mbps, -92 dBm, 1.8 V to 3.6 V



Order Code
3499988

2608011024010 – WIRELESS COMMUNICATION



Bluetooth Module, V5.0, Proteus-II, 2.402 GHz to 2.48 GHz, 2 Mbps, -91 dBm, 1.8 V to 3.6 V



Order Code
3499950

2611011024000 – WIRELESS COMMUNICATION



Bluetooth Module, Proteus-III, V5.1, 2.402 GHz to 2.48 GHz, 2 Mbps, -92 dBm, 1.8 V to 3.6 V



Order Code
3499988RL

ZETA-NEP-LTE4 (EU) STARTER KIT – WIRELESS COMMUNICATION



Modem, EDGE, GPRS, GSM, LTE, UMTS, WCDMA, RS232/USB, 150 Mbps, 33 dBm



Order Code
3497812

GSM2C2R – WIRELESS COMMUNICATION



GSM Monitoring Module, Compact, Quad Band



Order Code
3287165

261501136000
- WIRELESS COMMUNICATION
 GPS Receiver, ADC/I2C/SPI/UART, 1.5 m, 2.3 V to 4.3 V, WIRL-CLTI Adrastea-I Series



Order Code
4009257RL

ENW49C02A3KF
- WIRELESS COMMUNICATION
 Wi-Fi Embedded b/g/n Module, 2x UART, 3V to 3.6V Supply, 1Mbps, -97dBm Sensitivity



Order Code
2783826

453-00047C
- WIRELESS COMMUNICATION
 WLAN Module, Wi-Fi+Bluetooth, Dual-Band 2.4GHz & 5GHz, SDIO, UART, Sterling LWB5+, Trace Pin



Order Code
3577641

DA16600MOD-AAC4WA32 - WIRELESS COMMUNICATION
 WLAN Module, Wi-Fi+Bluetooth, RF 2.4GHz, I2C, SPI, UART, -40 °C to 85 °C



Order Code
3703742

RN171XVW-I/RM - WIRELESS COMMUNICATION
 Wireless LAN Module, 802.11 b/g, Onboard TCP/IP Stack, Wire Antenna



Order Code
2144011

ST25DV04K-JFR8D3 - WIRELESS COMMUNICATION
 RFID, READ/WRITE, 13.567MHZ, UFDFPN-12



Order Code
3364972

PN7150B0HN/C11002Y - WIRELESS COMMUNICATION
 RFID, NFC Controller, Read, Write, 13.56 MHz, 1.65 V to 1.95 V, HVQFN-40



Order Code
2663167

NLM0010XTSA1 - WIRELESS COMMUNICATION
 RFID, Read, Write, 13.56 MHz, 3 V to 5.5 V, SOT-23-5



Order Code
3226924

N24RF04DTP3G - WIRELESS COMMUNICATION
 RFID, Read, Write, 13.563MHz to 13.567MHz, 4Kbit Memory, 1.8V to 5.5V Supply, TSSOP-8



Order Code
298117RL

CLRC66302HN,151 - WIRELESS COMMUNICATION
 RFID, NFC Frontend, Multi-Protocol, Read, Write, 13.56 MHz, 8 KB, 3 V to 5.5 V, HVQFN-32



Order Code
2400511

M24LR64E-RMC6T/2 - WIRELESS COMMUNICATION
 RFID, Dynamic NFC Tag, Read, Write, 13.567 MHz, 64 Kbit, 1.8 V to 5.5 V, UFDFPN-8



Order Code
2762693

3.6. Charger User Interface

The user interface is a crucial part of an EV charging station, allowing users to input information and control the charging process. Common types include touchscreen interfaces, that display charging status, time remaining, and cost; mobile app interfaces, that allow users to control the charging process using a smartphone or tablet; and RFID card reader interfaces, that enable users to initiate a charging session by swiping an RFID card or fob. These interfaces can be integrated or connected to a separate device, providing real-time information about the charging process. EV charging stations can also incorporate or connect the user interface to a different device, providing flexibility in design and functionality.



Figure 12: User interface touchscreen panel

1) Display Interface

MAX7219EWG+T - DISPLAY INTERFACE



Display Driver, LED, 8 Digits, 7 Segment, 4 to 5.5 V, 4 Wire, Serial, -40 to 85 °C, WSOIC-24



Order Code
3404632

MAX25221ATJ/V+ - DISPLAY INTERFACE



TFT-LCD Power Supply w/ VCOM Buffer, 4-Channel, 2.65 V to 5.5 V Supply, TQFN-EP-32



Order Code
3501511

AY0438-I/L - DISPLAY INTERFACE



Display Driver, LCD, 32 Segments, 3 V to 8.5 V, CMOS & TTL, Serial Interface, LCC-44



Order Code
1467690

LC75874EHS-E - DISPLAY INTERFACE



Display Driver, LCD, Serial, 264 Segments, 2.7 to 6 V, -40 to 85 °C, QFP-80



Order Code
4193569

BU9797FUV-ME2 - DISPLAY INTERFACE



Display Driver, LCD 144 Segment, Multi-function, 2.5 V to 5.5 V, Serial Interface, TSSOP-48



Order Code
2546589

PTN3816EWY - DISPLAY INTERFACE



Interface, HDMI, I2C, Linear Redriver, HWFLGA-36, -20 °C to 85 °C



Order Code
3912102

MAX3814CHJ+T - DISPLAY INTERFACE



Display Interface, FR-4 & Cable Equalizer/Driver, DVI, HDMI, 3 V to 3.6 V Supply, TQFP-32



Order Code
2517394

PI3HDX412BDZBE - DISPLAY INTERFACE



Interface, HDMI, 1:2 Splitter/ Demux, I2C, TQFN-56, -40 °C to 85 °C



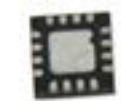
Order Code
3755386

2) Touchscreen controller

AD7879-1ACPZ-500R7 - TOUCH SCREEN CONTROLLER



Touch Screen Controller, I2C Interface, 12 Bit, 2 Channel, 3.6 V, -40 to 85 °C, LFCSP-EP-16



Order Code
4026118

AD7843ARUZ-REEL7 - TOUCH SCREEN CONTROLLER



Touch Screen Digitizer, Serial, 12 Bit, 4 Channel, 2.2 to 5.25 V, -40 to 85 °C, TSSOP-16



Order Code
4026115RL

CY8CMBR2016-24LQXI - TOUCH SCREEN CONTROLLER



Touch Screen Controller IC, 16 Buttons, CapSense Express, Serial Interface, 1.71 V to 5.5 V, QFN-48



Order Code
2630767

CAP1298-1-A4-TR - TOUCH SCREEN CONTROLLER



Touch Screen/Proximity Controller, 8-CH Capacitive, I2C, SMBus Interface, 3V or 5.5V Supply, QFN-16



Order Code
2373292

4. CONCLUSION

This EV charging solution e-book is an in-depth resource for understanding EV charging systems. It covers various charging technologies, from slow to fast, and offers insights into planning and deployment. The e-book explores key components like EMI filters, power factor correction stages, and DC-DC converters. It also presents a curated product selection from Farnell and its channel partners, addressing current needs and paving the way for clean, efficient mobility.

For more resources on EV charging from Farnell, click on the below links:



[e-techjournal](#)



[ev-charging](#)



[Communication network for electric vehicle charging](#)



[Design Considerations for High-Efficiency EV Chargers](#)



[EV Charging and Battery Management System](#)



[EV charging and renewable energy for sustainable transportation](#)



[EV Charging Standards: Ensuring Compatibility and Safety in the Charging Process](#)



[How SPI isolated communication helps BMS in EVs](#)



[How to boost Level-3 EV charging with the proper connectivity](#)



[How to design a Bidirectional Buck-Boost Converter for EV Application](#)



[Implementing Inter-Module Communications in EV Battery Systems](#)



[Powering Up with Safety and Ease: The Art of EV Charger Design](#)



[The benefits and challenges of electric vehicles](#)



[Wireless Power Transfer: A Convenient and Efficient Solution for EV Charging](#)

Appendix – Associated Product Categories: Farnell – EV Charging Solution Product Portfolio Offering

[Silicon Carbide Schottky Diodes](#)

[Electronic Circuit Breakers](#)

[Thermal Magnetic Circuit Breakers](#)

[RCBO, RCD, GFCI, AFDD Circuit Breakers](#)

[Silicon Carbide \(SiC\) MOSFET](#)

[Fast & Ultrafast Recovery Rectifier Diodes](#)

[Standard Recovery Rectifier Diodes](#)

[DC / DC Controllers](#)

[MOSFET Solid State Relays](#)

[Isolated Gate Drive](#)

[Current sensing transformer](#)

[Power Relay](#)

[Single IGBTs](#)

[TVS Diode](#)

[TVS Thyristors](#)

[TVS Varistors](#)

[Surge Protectors](#)

[Gate Drivers](#)

[CAN Interfaces](#)

[Special function interface IC](#)

[Serial Communications RS232, RS485, RS422](#)

[USB Interfaces](#)

[UART Interfaces](#)

[HDMI / DVI / Display Port Interfaces](#)

[Display Drivers](#)

[Human Machine Interface - HMI](#)

[Touch Screen Controllers](#)

[Bluetooth Modules & Adaptors](#)

[WLAN Modules & USB Adaptors](#)

[GSM, GPRS, CDMA & HSPA Modules & Modems](#)

[Ethernet Modules & POE](#)

[RFID](#)

[Motor Drivers / Controllers](#)

[EMC / RFI Suppression](#)

[Power Line Filters](#)

[EV charging connectors & cables](#)

[Energy Meters](#)

[Digital Panel Meters](#)

[EV Charging Stations](#)

[Charging Technology Sets](#)

[Fans & Blowers](#)

[Safety switches](#)

[Enclosures, Rack & cabinet accessories](#)

[Microcontroller](#)

[Microprocessors](#)

[Single Board Computer](#)

[Programmable Logic Controller](#)

