EV Charging Solutions

Wireless Modules
Passive & Emech components
Thermal management
PANASONIC EV CHARGING SOLUTIONS

EV Charging Types and Requirements

Emech
Thermal solutions
Wireless modules
Relays
Passives

Safe, fast & reliable charging – the key driver for successful e-mobility

E-mobility is a core DNA of Panasonic. For decades we develop and supply solutions for all kind of xEVs. To succeed in the mass market, the new technology must be reliable. Customers will not accept failures, neither during driving nor during charging.

This zero failure mindset motivates us to engineer best in class components & devices for safe, fast & reliable charging technology.

<table>
<thead>
<tr>
<th>Mode 2</th>
<th>Mode 3</th>
<th>Mode 4</th>
</tr>
</thead>
<tbody>
<tr>
<td>AC charging cable</td>
<td>AC wallbox or charging station – AC to EV</td>
<td>DC wallbox or charging station – DC to EV</td>
</tr>
<tr>
<td>Input: 120V AC 1-phase</td>
<td>Input: 208–240V AC 1-phase</td>
<td>Input: 380–600V AC 3-phase</td>
</tr>
</tbody>
</table>
The PAN902x Series perfectly connects the charging station with mobile devices or a cloud.

For commissioning and displaying usage data by a smartphone or a similar handset, wireless modules serve as access points or clients. With its combination of Wi-Fi and Bluetooth® function, the PAN902x Series provides the highest flexibility for connectivity, depending on which data rates or ranges are required for an EV charger application. The PAN9026, a dual band 2.4/5 GHz 802.11 a/b/g/n Wi-Fi radio module with integrated Bluetooth® BDR/EDR/LE is specifically designed for highly integrated and cost effective applications, whereas the PAN9028 is targeted for more sophisticated use cases where higher data rates (802.11ac) are needed. The PAN902x can act as a client to connect the charging station to a network, in order to upload data to a cloud.

**Load Balancing**

<table>
<thead>
<tr>
<th>Private Wallbox</th>
<th>Professional DC Charging Station</th>
</tr>
</thead>
<tbody>
<tr>
<td>Usage data</td>
<td></td>
</tr>
<tr>
<td>Uploading usage data to a cloud</td>
<td>Uploading commercial data to a cloud</td>
</tr>
<tr>
<td>Monitoring</td>
<td></td>
</tr>
<tr>
<td>Tracking of vehicle’s state of charge or storage capacity</td>
<td>Tracking of vehicle’s state of charge or storage capacity, occupancy and expected availability of the various charging stations</td>
</tr>
<tr>
<td>Maintenance</td>
<td></td>
</tr>
<tr>
<td>No technical staff needed locally for maintenance</td>
<td>On site technician can access maintenance data remotely, thus saving material costs</td>
</tr>
<tr>
<td>Smart charging</td>
<td></td>
</tr>
<tr>
<td>No smart charging needed</td>
<td>Load Balancing by taking storage capacity, occupancy and vehicles’ state of charges into account thus saving you from costs of expensive grid upgrades.</td>
</tr>
</tbody>
</table>
**WIRELESS MODULES**

*Bluetooth® LE Solution*

Just integrate PAN178x series in a meshed network and easily access charging station data.

PAN178x are Bluetooth® Low Energy modules based on Nordic Semiconductor chipsets, particularly suitable for low-power transmission of smaller data rates. The wireless modules differ only in memory size and number of GPIOs to meet various application requirements.

In commercial DC charging stations, the PAN178x modules can be integrated into a meshed network, which not only allows customers to connect easily, but also gives the operator an overview of the individual charging stations in terms of occupation. The SoC offers a qualified Bluetooth mesh stack with all mandatory and optional features in addition to a wide range of applications.

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**PAN178x**

- **IP Core:** Cortex M4(F) with 64 MHz
- **Temperature Range:** -40 to 85
- **Size:** 15.6x8.7x2mm
- **Up to 48 General Purpose I/Os (depending on module version)**

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<table>
<thead>
<tr>
<th>PAN1781</th>
<th>PAN1782</th>
<th>PAN1780</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>less</strong></td>
<td><strong>more</strong></td>
<td></td>
</tr>
<tr>
<td>256 kB Flash</td>
<td>512 kB Flash</td>
<td>1 MB Flash</td>
</tr>
<tr>
<td>32 kB RAM</td>
<td>128 kB RAM</td>
<td>256 kB RAM</td>
</tr>
<tr>
<td>64 MHz</td>
<td>64 MHz</td>
<td>64 MHz</td>
</tr>
</tbody>
</table>

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Under development. Contact us: wireless.connectivity@eu.panasonic.com
POLYMER CAPACITORS
Perfect for AC/DC and DC/DC Converters

Tough against temperature fluctuations, perfect for outdoor installations.

These advanced capacitors use conductive polymers to form the electrolyte, or the conductive polymers can be used in conjunction with a liquid electrolyte in a design known as a hybrid capacitor. Either way, these polymer-based capacitors fulfill the high endurance and temperature requirements of EV charging stations. In addition, due to polymerization and having high conductivity, such applications benefit from a very low ESR which is needed for power stabilization.

Temperature Range

- Ultra-low ESR for power stabilization (down to 3mΩ)
- Long endurance at high temperature, 20,000h @105°
- High reliability for outdoor usage
- AEC-Q200 compliant
- High temperature resistance up to 150°C
FILM CAPACITORS
High Safety by Integrated Fuse Function

Zero risk for safety and high resistance against moisture.

The outstanding feature of Panasonic’s film capacitors is the integrated safety function. An original in-house patterned metallization process is the basis of a special structure serving as a fuse mechanism function that prevents from short mode failure. Additionally, it achieves a very stable capacitance level over the capacitor’s lifetime and therefore guarantees a high reliability. Furthermore, long lifetime is realized by high temperature & moisture resistance using originally developed sealing technology.

» Rated voltage 275VAC to 310VAC (EMI suppression), 600VDC to 1,100VDC (DC smoothing)
» 0.0082μF to 10μF (EMI suppression), 3μF to 110μF (DC smoothing)
» -40°C to 110°C
» AEC-Q200 compliant (Automotive part numbers only)
» Built-in fuse function
» High moisture resistance
» Flame retardant plastic (case and sealing resin)
Space saving high-tech with zero failures.“

Best-in-class reliability for the automotive industry market the metal composite power inductors ETQP-series. The monolithic core and innovative terminal structure guarantee high resistance against thermal stress and vibrations. Unique is the magnetic core material which provides none hard saturation characteristics against D.C. bias current for high peak current capability, and also can reduce D.C. Resistance and A.C. Resistance for low power loss. This in turn supports higher power efficiency in DC-DC converters and input filter circuits, as well as a possible space reduction of up to 50% against ferrite inductors.

» Variety of inductance range from 0.33µH to 100µH
» Package size from 5x5mm to 12x12mm
» Up to 85A saturation, 53A rated / 0.33µH
» Operation temp. -55°C to +155°C, up to +180°C in short time
» 50% space saving vs Ferrite inductor
» Vibration resistance from 10G to 30G
» AEC-Q200 compliant
Our mission: Zero solder joint cracks

Panasonic offers a wide range of resistors, designed and tested to be used in a variety of applications. All of Panasonic resistors use soft termination technology. This means that by using a soft resin, the solder joint experiences less stress in temperature cycles and therefore, ensures minimum risk of solder joint cracks.

**EV Charging – recommended series**

» High temperature thick film chip resistors (ERJH series)
» Anti-surge thick film chip resistors (ERJP series)
» High power wide terminal thick film chip resistors (ERJB and ERJD series)

Without soft resin  With soft resin (Panasonic)

Risk of solder crack because of high stress  Less risk of crack because of soft termination → high solder-joint reliability

» Soft termination technology for highest solder-joint reliability
» Resistance values from 1 mΩ to 10 MΩ
» High precision by tolerance as low as 0.05% and TCR as low as 10 ppm/K
» High temperature up to 175°C
» AEC-Q200, RoHS, and REACH compliant
» Anti-pulse and anti-sulfur types available
RELAYS AS A MAIN SWITCHING ELEMENT

Handle up to 22kW of Charging Power Directly on the PCB

New HE-R relay is the first 3 phase switching solution for direct PCB mounting.

AC switching elements are a crucial part of safety and protection function in charging stations and cables. Key parts of the HE line-up are the 35A HE-S with two contacts and 40A HE-R relay with four contacts. Both types are available with a mirror contact according to IEC 69947-4-1 and VDE / UL approvals. They can be used in the latest generation of wallboxes which fulfill either IEC 61851-1 or the recent IEC 62955 norm.

<table>
<thead>
<tr>
<th>Series</th>
<th>HE-S</th>
<th>HE-R</th>
</tr>
</thead>
<tbody>
<tr>
<td>Switching current</td>
<td>35A AC</td>
<td>40A AC</td>
</tr>
<tr>
<td>Contact configuration</td>
<td>2a, 2a1b</td>
<td>4a, 4a1b</td>
</tr>
<tr>
<td>Dimensions</td>
<td>30x36x40mm</td>
<td>35x58x47mm</td>
</tr>
<tr>
<td>Holding power*</td>
<td>170mW</td>
<td>490mW</td>
</tr>
<tr>
<td>Contact gap</td>
<td>3.2mm</td>
<td>3.6mm</td>
</tr>
</tbody>
</table>

Feedback contact construction: HE-S relay

With a gap between normally open contacts of 3.2mm, the HE-S exceeds mandatory regulations.
Realize an isolation of 1,500V in a small SOP6 housing.

Beside the power line, charging stations include a lot of systems for communication, system control, safety functions and HMI. Wherever switching must be electrically separated from the control circuit, electromechanical or optocoupled semiconductor PhotoMOS® relays are used. AQY series, for example, is used in charging station battery storage systems to isolate internal from external signals. Contact us directly to find the perfect fit for your need quickly – and save hours of internet investigation.

PhotoMOS® relays realize galvanic isolation by an LED that emits light through an isolator to a solar cell. The solar cell drives the MOSFET output.

<table>
<thead>
<tr>
<th>Feature</th>
<th>PhotoMOS</th>
<th>Signal Relay</th>
</tr>
</thead>
<tbody>
<tr>
<td>Signal transfer</td>
<td>++</td>
<td>++</td>
</tr>
<tr>
<td>I/O Galvanic Isolation</td>
<td>++</td>
<td>+</td>
</tr>
<tr>
<td>Output Separation</td>
<td>0</td>
<td>++</td>
</tr>
<tr>
<td>AC/ DC Switching</td>
<td>+</td>
<td>+</td>
</tr>
<tr>
<td>Control Power</td>
<td>++</td>
<td>0</td>
</tr>
<tr>
<td>Load Voltage</td>
<td>++</td>
<td>+</td>
</tr>
<tr>
<td>Load Current</td>
<td>+</td>
<td>+</td>
</tr>
<tr>
<td>Stable On Resistance</td>
<td>++</td>
<td>0</td>
</tr>
<tr>
<td>Overload withstand</td>
<td>0</td>
<td>+</td>
</tr>
<tr>
<td>Switching noise</td>
<td>++</td>
<td>0</td>
</tr>
<tr>
<td>Size</td>
<td>++</td>
<td>0</td>
</tr>
</tbody>
</table>
Just apply and benefit the long term reliability effect.

GraphiteTIM, a Panasonic exclusive material using highly crystallized graphite, transfers heat generated from a power device to a heat sink with excellent thermal conductivity. In addition, the high compressibility effectively fills the voids between the heating and the cooling device to achieve even lower low thermal resistance. Compared to grease, GraphiteTIM has a stable heat dissipation for a long period of time due to no deterioration and pump out effect.

High reliability (power cycle test)
Junction temperature remain stable for a long period of time.

> Low thermal resistance (ASTM D5470 at 0.6MPa) 0.2 K • cm²/W*
> High Compressibility (ASTM D5470 at 0.6MPa) 40%*
> High reliability (stable junction temperature)
> Operating temperature -55 to +400 °C
> Easy handling and easy to install

* Measuring device TIM Tester ANALYSIS TECH, ASTM D5470 compliant)
New ASQMR series integrates resistor-based detection of lead wire break and short circuit.

Safety is an important requirement in EV applications. ASQM switches are used e.g. to detect if a lid or cover plate of the high voltage part is open. The control of the charging station can use this signal to prevent the system of an unintended activation or perform an emergency shutdown for protection against accidental contact.

An even higher grade of safety and reliability offers ASQMR series. By integrated chip resistors, failure modes like lead wire break and short circuit can easily be detected.

Comparison of detection results between conventional and resistor installed switches.

**Without Resistor**

- **Switch OFF** (Open)
  - **V out (V)**
  - Same
  - Not detectable

- **Switch ON** (Short)
  - **V out (V)**
  - Same
  - Not detectable

**Resistor installed**

- **Switch OFF** (Open)
  - **V out (V)**
  - Not the same
  - Detectable

- **Switch ON** (Short)
  - **V out (V)**
  - Not the same
  - Detectable

**ASQM series:**
- Contact form SPST
- Soldering or fork terminal
- Silent operation with sliding contact
- Long stroke
- Excellent shock and vibration resistance
- Waterproof – IP67 degree of protection
- Insertion lever with high reset force

**Additional features ASQMR diagnostic series:**
- 2012 chip resistor (0.5W 70°C)
- Smallest diagnostic switch on the market
CF1/CF2 directly connects BMS without relay harnessing.

To increase the charging speed and relieve the power grid, future charging stations will re-use EV car battery packs. CF1/CF2 series of Board to FPC connectors give a smart & robust connection in battery management systems with only two parts, a plug and a receptacle. This saves time, money and space.

For connecting displays with keyboard or touch function with the control board, Y5B Series as FPC and FFC connector can be used. The low profile typ enables slim product designs which is especially requested for private wall boxes. To reduce production time and efforts, Y5B is delivered with opened levers.

Comparison of connection methods of board and FPC in Battery systems

» For Automotive applications, 125 °C heat resistance
» Contact reliability is preserved by double-sided contact structure
» Weight and process cost reduction
» ‘Anti-misoperation bridge structure’ prevents unintended operation of mating lock
» Inertia lock construction prevents half-mating