ZETTLER

NEW ENERGY SOLUTIONS

SOLUTIONS FOR

E-MOBILITY DEMANDS

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1 Introduction

Innovation and leading-edge product development have always been a hallmark of ZETTLER Group's engineering competence. During recent years, this has been particularly evident by our leadership role in providing component solutions in the field of **Alternative and Renewable Energy** and by developing special electromechanical switching devices for these types of applications.

As electro mobility and other alternative transportation technologies continue to grow globally, ZETTLERs **NEW ENERGY SOLUTIONS** division is committed to supporting customers in electro mobility sectors around the world, with first-class engineering and new product design, and by leveraging ZETTLER Groups worldwide production and distribution resources.

ZETTLERs industry-leading electromechanical 'new energy' components are designed for use in **electric vehicle charging devices, electric drive trains or any similar applications requiring high loads to be switched and carried.**

2 E-mobility charging – IEC61851 modes and SAE J1772 levels

There are two standards governing EV charging. In the U.S. there is the SAE J1772 standard, while in Europe and China the IEC61851 standard is used. The IEC standard was derived from the SAE standard and thus has similar requirements, adapted for the European and Asian AC line voltages. Most terminology differences are small. While the SAE standard describes METHODS and LEVELS, the IEC standard talks about MODES, which are virtually the same.

The charging of electro vehicles may take place in different manners, either with 1 or 3 phase household level AC voltages and respective currents, or by use of DC quick charging at voltages of 200 to 600V at currents up to 400A.

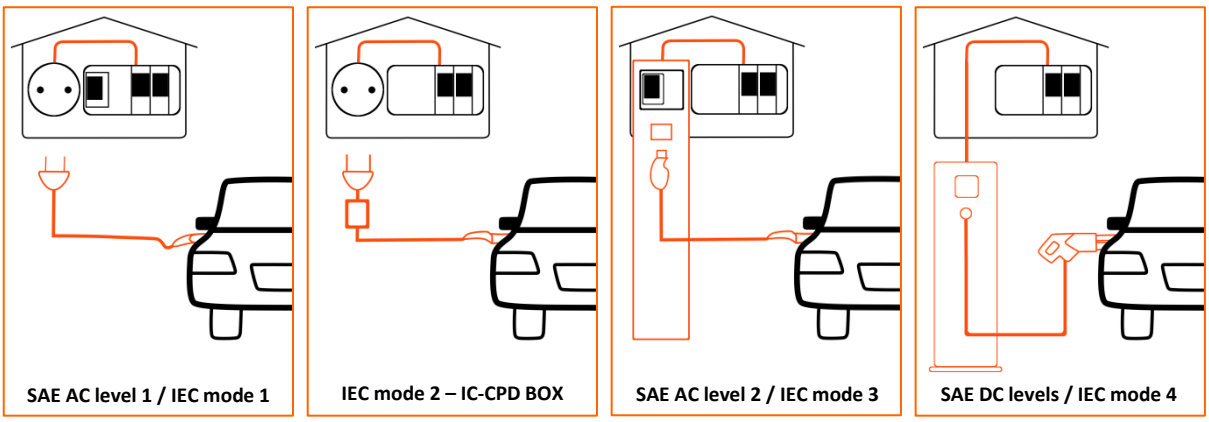

Figure 1: SAE charging levels

SAE AC level 1: Level 1 Charging utilizes a direct cable connection between the EV and a standard 1 phase 120V AC wall outlet. The outlet has to be protected by a circuit breaker and ground fault interrupter (GFI)/residual current detector (RCD). Charging power of 1.9 kW can be achieved.

SAE AC level 2: This is charging with 1 or 3 phase AC by use of a stationary charging station which is protected by a circuit breaker and GFI/RCD. The charging station and the vehicle communicate to each other to control the charging process. With a peak current of 80A, the maximum delivered power can be nearly up to 20kW. The SAE's level 2 is comparable to the IEC's mode 3.

SAE DC levels: SAE J1772 also defines charging at DC voltages with high currents of some 100 amperes and voltages up to 400V and above. Due to the high amount of electrical power, DC charging allows minimizing charging time and is generally referred to as DC quick charging.

IEC mode 1: Similar to SAE AC level 1 charging, this is charging with AC on a typical household wall outlet, either 1 or 3 phase with currents up to 16A. In this mode there is no communication between the energy source/grid and the vehicle. It must be ensured that some GFI/RCD protective device is installed on the infrastructure side.

IEC mode 2: The difference to mode 1 is basically that there are higher currents and a control and protection equipment integrated into the charger cable (In-Cable Control and Protection Device – IC-CPD). The IC-CPD protects from electrical hazards in case of isolation failures and is defined in IEC62752. In its newest edition the IEC62752:2016 requires a peak current I_p of up to 1.5kA in case of short circuits. ZETTLERs newest developments are tailored to fulfil this challenging demand

IEC mode 3: In this mode charging with AC takes place through a dedicated charging outlet which is connected to a stationary charger (or wallbox). Charging is controlled via communication between charging unit and the vehicle. IEC mode 3 charging is based on a special purpose infrastructure to deliver the necessary power.

IEC mode 4: This is charging similar to the SAE's DC levels. Charging with DC is useful when charging with a high amount of power. In IEC mode 4 there is a dedicated wallbox with fixed charging cable and a dedicated DC charging plug.

The 'ZETTLER Advantage'

As electro vehicles will have a significant impact in future personal mobility and public transportation, we have continually expanded our line of relays and contactors. These state-of-the-art ZETTLER components have been successfully integrated by manufacturers of charging equipment.

Charging modes	Switching	Sensing	Visualizing
IEC mode 1 **SAE AC level 1** Direct Connection	Not applicable	Not applicable	Not applicable
IEC mode 2 IC-CPD BOX	✓ Available - and new products under development	✓ Available by ZETTLER	✓ Available by ZETTLER
IEC mode 3 **SAE AC level 2** Stationary AC Charger	✓ Available by ZETTLER	✓ Available by ZETTLER	✓ Available by ZETTLER
IEC mode 4 **SAE DC levels** Stationary DC Charger	Intended	✓ Available by ZETTLER	✓ Available by ZETTLER

Figure 2: IEC charging mode solutions

Today, ZETTLER's product line of **AC circuit Relays and Contactors** spans across an extended range of product characteristics which make them suitable for many demands in EV charging. These products are accompanied by AC current sensing transformers and HMI solutions of our AZ Displays subsidiary.

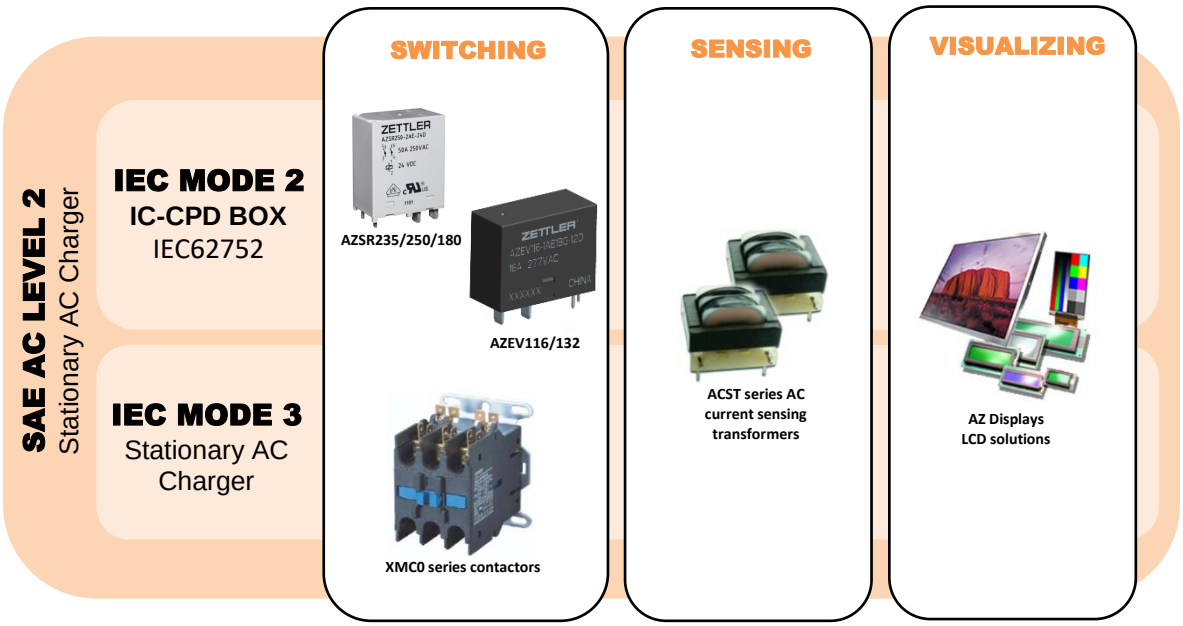

Figure 3: SAE AC LEVEL 2 solutions

Withstand highest momentary currents with special contact arrangements

In the AZEV116/132 series the conventional contact spring arrangement is replaced by a patent pending[1)] solution to survive highest momentary currents, as they may occur on short circuits. Through this special arrangement the contact performance even increases due to magnetic force; thus ensuring an outstanding reliability without contact welding.

For the AZEV132 this approach allows 32 Amp switching current, and up to 1500 Amp of short circuit current (carrying) without welding. With its low holding power of only 400mW (also suitable for PWM), this PCB relay has entered a dimension that was hardly imaginable just a few years ago.

Fulfilling safety and supervisory demands with contact monitoring

Additionally, the AZEV116/132 features a potential free N.C. (1 Form B) monitoring supervisory contact as required by IEC62752:2016, thus making these types of relays ideally suited for applications with high security and safety demands. Contact welding or malfunction can thus be easily detected and indicated.

1) German patent application pending (DE10 2014 106 957.9)

3 ZETTLER Relays and Contactors

3.1 ZETTLER Relays for SAE AC level 1 charging

AZ27XX Series

These **30A** relays feature double make contacts allowing for up to a 3mm contact gap. The AZ27XX relay series comes in multiple package and termination styles (panel mount, plug-in, PCB), and has an optional UL Class F (155^{0}C) insulation system.

Figure 4: AZ2705 and AZ2704

- **SPST-NO-DM (1 form X) or DPST-NO-DM (2 form X)**
- **Contact gaps of 2.4mm or 3.0mm**
- **Dielectric strength 4000VRMS**
- **AC and DC coils**
- **UL, cUR file E44211**
- **TUV certificate R50164753**

3.2 ZETTLER Relays for SAE AC level 2 and IEC mode 2 – Generation 1 charging

AZSR131

The AZSR131 miniature power relay series are capable of switching up to 35 A at 277 VAC and meet IEC 61810-1 for the use in low voltage equipment and UL 508 for industrial control panels. Versions compliant to IEC-60335-1 (GWT-Glow Wire Testing) for household appliances are also available. In the standard version the AZ SR131 has a contact gap of 1.8 mm and a dielectric strength of 2.5 kV between open contacts. A wide contact gap version (2.3 mm) is also available, with dielectric strength of 3.5 kV between open contacts. With TÜV approved ratings up to 50k cycles it fulfills the required lifetime according IEC61851 and IEC62752.

Figure 5: AZSR131

- **Dielectric strength 4500V_{RMS}**
- **Creepage distance <7.5mm**
- **Wide contact gap > 1.8mm (standard), >2.3mm (wide version)**
- **Glow wire approved version available**
- **UL, cUR file E365652**
- **TÜV certificate B0887930005**

AZ2800

Figure 6: AZ2800

The double pole AZ2800 and AZ2850 series of relays come with a **40A@277VAC** rating, thus meeting the requirements of UL2202 Level 2 charging with branch circuit protection. Coming in both panel mount (AZ2800) and PCB (AZ2850) configurations, the relays are ideally suited to portable and fixed EVSE units. DPST-NO and DPDT versions are available. The lower capacity (3A) NC contacts can be used as part of a contact position monitoring and supervisory circuit.

- **Dielectric strength 4000V_{RMS}**
- **Creepage distance <8mm**
- **AC and DC coils**
- **UL, cUR file E44211**
- **VDE certificate 40023442**

AZSR250

Figure 7: AZSR250

This **50 A** DPST high power PCB relay is part of the first series of Zettler relays that were specifically developed for alternative energy applications and has been deployed in many various applications for years.

It is suitable for charging equipment of up to 12.5 kVA (single phase) / 35 kVA (three phase). Key features of this relay are its very low holding power and a small footprint of just 10 cm^2. This relay is also available as AZSR235. It is a cost effective solution for applications where a switching capacity of up to 35 A is sufficient.

- **Wide contact gap: AZSR250 > 1.85mm, AZSR235 > 2.05mm**
- **Holding power <100 mW**
- **Dielectric strength 5000 V_{RMS}**
- **Isolation spacing greater than 10 mm**
- **Reinforced insulation, EN 60730-1 (VDE 0631, part 1), EN 60335-1 (VDE 0700, part 1)**
- **UL, cUR file E44211**
- **VDE certificate 40033251**

AZSR180

This **80 A** SPST high power PCB relay takes the well-known AZSR235/250 series to the next logical level. Developed for applications of up to 20 kVA (single phase) / 55 kVA (three phase). It features a patent pending[2)] Thermal Bridge, designed to protect the paralleled contacts from overheating as a result of uneven distribution of currents. It is part of a series of Zettler relays that were specifically developed for alternative energy applications.

Figure 8: AZSR180

- **Wide contact gap > 2.05mm**
- **Very low holding power <100 mW**
- **Dielectric strength 5000 V_{RMS}**
- **Isolation spacing greater than 10 mm**
- **Reinforced insulation, EN 60730-1 (VDE 0631, part 1), EN 60335-1 (VDE 0700, part 1)**
- **UL, cUR file E44211**
- **VDE certificate 40044305**

2) International patent application pending (PCT/EP2015/076187)

3.3 ZETTLER AC circuit Relays for IEC mode 2 – Generation 2 charging

AZEV116

In development for 2019. The AZEV116 is the entry level member of the AZEV116/132 series of SPST power PCB relay.

With its specially formed contact set it is especially designed to withstand extreme short circuit currents without contact welding.

Additionally, it features a potential free N.C. (1 Form B) monitoring supervisory contact as required by IEC62752:2016, thus making these types of relays ideally suited for applications with high security demands.

Figure 9: AZEV116

- **16 Amp switching**
- **Potential free N.C. signal contact for monitoring purposes**
- **1500 Amp short circuit current (carrying)**
- **Wide contact gap > 2.25 mm**
- **Holding power < 400 mW**
- **Dielectric strength 4000 V_{RMS} (between Form A contact and coil)**

AZEV132

In development for 2019. The AZEV132 is the midrange member of the AZEV116/132 series of SPST power PCB relay.

With its unique contact set arrangement it is especially designed to withstand extreme short circuit currents without contact welding.

Additionally it features a potential free N.C. (1 Form B) monitoring supervisory contact as required by IEC62752:2016, thus making these types of relays ideally suited for applications with high security demands.

Figure 10: AZEV132

- **32 Amp switching**
- **Potential free N.C. signal contact for monitoring purposes**
- **1500 Amp short circuit current (carrying)**
- **Wide contact gap > 2.25 mm**
- **Holding power < 400 mW**
- **Dielectric strength 4000 V_{RMS} (between Form A contact and coil)**

3.4 ZETTLER Contactors for SAE AC level 2 and IEC mode 3 charging

XMC0 Series

The XMC0 series of Definite Purpose Contactors are electromechanical switching devices designed ideally for stationary quick chargers.

With its high breaking capacity, this contactor is used for safety cutoff of the charger circuit from the grid (power network) to prevent abnormal currents

XMC0 contactors are built to the ARI 780/790 standard in our ISO 9001 manufacturing facility for high performance and great reliability. The XMC0 is available in various pole configurations and load ratings up to 90 amps.

Figure 11: XMC0 Series Contactor

- **A variety of termination options for specific application requirements**
- **Universal mounting plate**
- **Heavy-duty contacts ensure long electrical life**
- **EE lamination (magnetic assembly) provides optimum performance while reducing power consumption**
- **Dust-free internal construction**
- **UL, cUR file no. E222994**

4 ZETTLER Magnetics – Current Sense Transformers

ACST-200 Series

These AC-Current-Sense-Transformers (ACST) are used in control and monitoring applications, at protective circuits or load detection systems with purpose to confirm that the designated current actually flows, or whether the current differs significantly due to an overload, construction damage, or other failure. The main applications are in 50 Hz- or 60 Hz-systems.

Figure 12: ACST-262

The primary winding is integrated in the sensor; this saves assembling time and results in a clear defined compact component with outside dimensions of just 20.5 x 17.5 x 16.4 mm.

The measurement signal is isolated from the primary AC side, thus the sensor can be implemented at any point within the electrical circuit.

The magnitude of the sensor's output voltage may be adapted to the specific application by selecting an appropriate R_L value.

For the ACST-262 and a load resistor of up to 200 Ω it is linear in the whole measurement range up to 30 A_{RMS}.

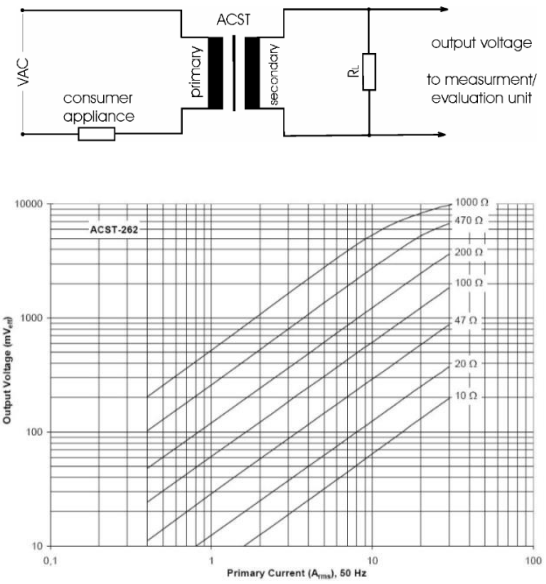

Figure 13: Typical application and sensitivity of ACST-262

- **Primary Current Range 0.4 to 30 A_{RMS}**
- **Dielectric Strength 4000 V_{RMS}**
- **Split bobbin design for 5.5 mm or 8.0 mm creepage and clearance**
- **Low profile (16 mm height)**
- **UL approved Class B materials**

5 AZ Displays – a ZETTLER Group company

Competence in Displays (www.azdisplays.com)

AZ Displays is a leading developer and marketer of customized LCD solutions for existing and future markets, combining leading-edge screen and electronic technologies.

AZ Displays is a 100 % member of the ZETTLER group. Since many years AZ Displays is offering to its customers various Displays and HMI solutions including TFT, OLED, and PM LCD solutions.

Figure 14: AZ Displays product range

TFT LCD

- PCAP Touch panel or Resistive Touch available
- Dimensions from 3.5“ to 15“
- Various Interfaces: Parallel RGB, LVDS, UART, MCU
- TN, MVA, IPS Technologies
- Display-Controller and Driving-Boards available
- High Brightness for advanced readability

OLED

- Active/Passive Matrix
- Dimensions from 1.46“ to 3.5“

Passive Matrix

- Graphical and Character mode displays
- Technologies: COB, COG, TAB
- TN, HTN, STN, FSTN, FFSTN glasses
- Industry standard parallel interfacing

6 ZETTLER Contacts

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