

**ZETTLER**

NEW ENERGY SOLUTIONS



***SOLAR RELAYS***

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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** applications.

As solar and other alternative energy technologies continue to grow globally, ZETTLER **NEW ENERGY SOLUTIONS** is committed to supporting customers in renewable energy industries 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 components are designed for use in **solar inverters, electric vehicle charging devices, or any similar applications requiring high loads to be switched and carried.**

## 2. Solar Relays Overview

**Power inverters** are an integral part of any solar energy system, converting DC power output coming from solar panels into AC current that can be fed into a commercial electrical grid or into an off-grid local electrical network. In the interface to the power grid, electro **mechanical relays on the AC side of the inverter** play a critical role as switching devices and to provide necessary safety 'circuit-break' functions.

### The 'ZETTLER Advantage'

As photovoltaic (PV) power applications proliferate from micro-inverters, to string inverters, to commercial and even utility-scale PV systems, we have continually expanded our line of solar relays. These state-of-the-art ZETTLER components have been **successfully integrated** into many inverter applications by **market-leading manufacturers of PV systems** since many years.

Today, ZETTLERs product line of **AC circuit Solar relays** spans across an extended range of product characteristics:

- covering PV inverter applications from under 3 kVA to over 318 kVA,
- handling continuous currents from 12 A to as high as 200 A and
- max. switching currents ranging from 12 A to 200 A, and
- featuring min. contact gaps from 1.5 mm to 3.6 mm.

Since its inception, ZETTLER **NEW ENERGY SOLUTIONS** product design and engineering staff has proactively anticipated the PV inverter industry's desire to replace space and power consuming, relatively expensive contactors with increasingly smaller and more energy and cost efficient PCB relays.

ZETTLER Europe was one of the first companies to have successfully developed and produced a **35 A and 50 A PCB solar relay (AZSR235/250)** with a footprint of just 25mm x 40mm and the capability of handling 2 x 35A (50 A) at a holding power of < 100 mW (see below under **3.2** and **3.3**).

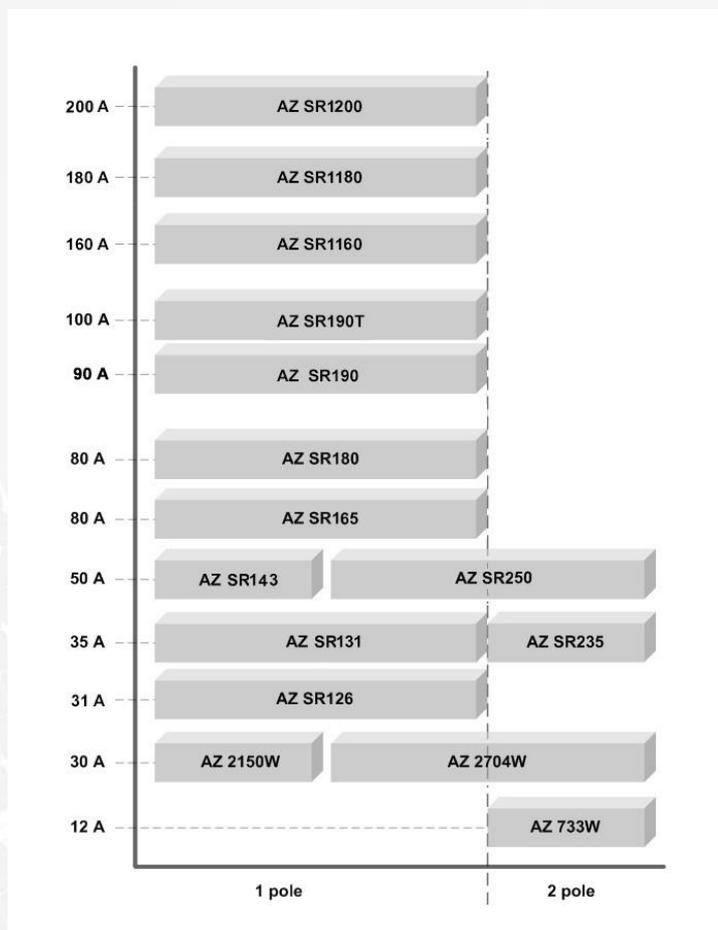


Figure 1: Relay overview

As pertinent safety standards such as IEC 62109, UL 62109 and DIN VDE V 0126-1-1 gradually evolved and internationally converged, additional capabilities of solar relays deployed in solar inverter applications became necessary to fulfil ever higher isolation requirements, which - in turn - continued to raise the bar, especially with respect to wider contact gaps.

For example, for inverters deployed at altitudes from 3000 m of up to 5000 m above sea level, contact gaps of at least 2.22 mm became a standard requirement.<sup>1</sup>

<sup>1</sup>All mentioned altitudes are based on a maximum system voltage of 849 DC, overvoltage category II and disconnection with two relays per phase according IEC 62109.

Equally importantly, as the **demand for higher kVA capacities** of solar inverters continues to expand, higher continuous and maximum switching currents need to be accommodated by relays used in these applications.

ZETTLER has remained at the forefront of these developments and has introduced, in close cooperation with its inverter producing customers, new **80 A, 90 A, 160 A, 180 A and 200 A** solar AC relay products (see below under **3.3** and **3.4**).

Some of these developments required completely **innovative design approaches**, as not all relays can be structurally modified to achieve widening contact gaps, while handling ever increasing current flows and also being capable of accommodating demanding, and sometimes arbitrary inverter-design driven specifications.

### 3. ZETTLER AC circuit Solar Relays for Inverters

#### 3.1 ZETTLER AC circuit Relays for Solar Inverters < 30 A

##### AZ733W

This **12 A** DPST miniature PCB power relay has been marketed by ZETTLER for more than 20 years. It is suitable for residential PV inverters up to 2.6kVA (single phase, 220V system) and deployments at up to 2000 m above sea level. The relay features a standard pin layout and a relatively small footprint with a contact gap of 1.5 mm.



Figure 2: AZ733W

- Dielectric strength 5000 Vrms
- Isolation spacing greater than 8 mm
- UL, CUR file E44211
- TÜV certificate R50129285

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## 3.2 ZETTLER AC circuit Relays for Solar Inverters $\geq 30$ A

### AZ2150W

This **30 A** SPST high power PCB relay is a modified version of a reliable relay which is about more than 30 years in the market. With its standard pin layout it is suitable for PV inverter applications of up to 6.6 kVA (single phase, 220V system) / 19.8 kVA (three phase, 380V system, 380V line voltage) and deployment levels of up to 3000 m above sea level, in residential and smaller commercial / roof-top solar systems.



Figure 3: AZ2150W

- $\geq 1.75$  mm contact gap
- High dielectric strength 4000 Vrms contact to coil
- All plastics PTI 250
- UL, CUR file E44211
- VDE certificate 40023154

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### AZ2704

This **30 A** DPST high power PCB relay is suitable for PV inverter applications of up to 6.6 kVA (single phase, 220V system) / 19.8 kVA (three phase, 380V system, 380V line voltage) and deployment levels of up to 7000 m (5000 m standard contact gap version) above sea level, in residential and smaller commercial / roof-top solar systems.



Figure 4: AZ2704

- 30 A AC7a approved
- 900 A short circuit current (carrying)
- Dielectric strength 4000 Vrms
- Standard ( $\geq 2.4$  mm) or wide contact gap ( $\geq 3.0$  mm) available
- UL, CUR file E44211
- TÜV certificate R50164753

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## AZSR126

This highly efficient **31 A** SPST miniature power relay has been on the market since about 10 years and features a **wider contact gap of 1.8 mm**. It is suitable for residential and small commercial / rooftop PV systems of up to 6.8 kVA (single phase, 220V system) / 20.4 kVA (three phase, 380V system, 380V line voltage) and deployment levels of up to 3000 m above sea level.



Figure 5: AZSR126

- Dielectric strength 4500 Vrms
- Clearance / creepage > 6.4 / 7.5 mm
- UL, CUR file E44211

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## AZSR131

This highly efficient **35 A** SPST miniature power relay is the result of consequent further development for higher requirements and features a **wider contact gap of 2.3 mm**. It is suitable for residential and small commercial / rooftop PV systems of up to 7.7 kVA (single phase, 220V system) / 23.1 kVA (three phase, 380V system, 380V line voltage) and deployment levels of up to 5000 m (3000 m standard contact gap version) above sea level.



Figure 6: AZSR131

- Dielectric strength 4500 Vrms
- Standard ( $\geq 1.8$  mm) or wide contact gap ( $\geq 2.3$  mm) available
- Clearance / creepage > 6.4 / 7.5 mm
- EN 60335-1 (GWT) approved version available
- UL, CUR file E365652
- TÜV certificate B0887930005

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## AZSR143

This highly efficient **50 A** SPST miniature power relay is the result of consequent further development for the requirement to switch high loads in a small package. Remarkable is, that the power loss at the coil is only 1.6 W, which is only half as high as that of comparable relays on the market. It is suitable for larger residential and midsize commercial PV systems up to 33 kVA (three phase, 380V system, 380V line voltage) and deployment levels of up to 3000 m above sea level. The AZSR143 and AZSR131 are also suitable for many EV charging applications.



Figure 7: AZSR143

- Dielectric strength 4500 Vrms
- Standard ( $\geq 1.8$  mm) or wide contact gap ( $\geq 2.0$  mm) available
- Clearance / creepage  $> 6.4 / 7.5$  mm
- UL, CUR file E365652
- TÜV certificate B0887930015

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## AZSR235

This **35 A** DPST high power PCB relay is part of the first group of ZETTLER relays that were **specifically developed for solar applications** and has been deployed in many PV inverters since eight years. It is suitable for larger residential and small to medium commercial / rooftop PV systems up to 7.7 kVA (single phase, 220V system) / 23.1 kVA (three phase, 380V system, 380V line voltage), features a wide contact gap of  $> 2.05$  mm making it suitable for deployment levels of up to 4000 m above sea level.



Figure 8: AZSR235

- Wide contact gap  $\geq 2.05$ mm
- Very low holding power  $< 100$  mW
- Dielectric strength 5000 Vrms

- 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

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### 3.3 ZETTLER AC circuit Relays for Solar Inverters $\geq 50$ A

#### AZSR250

A sibling to the AZSR235, this **50 A** DPST high power PCB relay is designed for deployment in solar inverters of up to 33 kVA (three phase, 380V system, 380V line voltage) - suitable for larger residential and midsize commercial PV systems, deployable at up to 3000 m above sea level. Key features of this relay are its very low holding power and a small footprint of just 10 cm<sup>2</sup>.

- Wide contact gap  $\geq 1.85$ mm
- Holding power < 100 mW
- Dielectric strength 5000 Vrms
- 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

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Figure 9: AZSR250

## AZSR165

The AZSR165 is the **65 A** economy version of the new AZSR190 series. Developed for PV applications of up to 42 kVA (three phase, 380V system, 380V line voltage) this relay is well suited for medium sized to larger roof top based / commercial systems, deployable up to 7000 m above sea level.

- Wide contact gap  $\geq 3.0$  mm ( $\geq 3.6$  mm available upon request)
- Dielectric strength 5000 Vrms
- Isolation spacing greater than 10 mm
- UL, CUR file E365652
- TÜV certificate B0887930008

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Figure 10: AZSR165

## AZSR180

The **80 A** high power PCB relay takes the AZSR235/250 series to the next logical level. Developed for PV applications of up to 52 kVA (three phase, 380V system, 380V line voltage) this relay is well suited for medium sized to larger roof top based / commercial systems, deployable up to 4000 m above sea level. It features a patent pending Thermal Bridge, designed to protect the parallel contacts from overheating as a result of uneven distribution of currents.

- Wide contact gap  $\geq 2.05$ mm
- Very low holding power < 100 mW
- Dielectric strength 5000 Vrms
- 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

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Figure 11: AZSR180

## AZSR190

This **90 A** standard version / **100 A** "T"-version high power PCB relay will close the gap between AZSR165 and AZSR1160. Developed for PV applications of up to 59.4 kVA (90A) / 66 kVA (100A) (three phase, 380V system, 380V line voltage) this relay is well suited for medium sized to larger roof top based / commercial systems, deployable up to 8000 m above sea level.



Figure 12: AZSR190

- Wide contact gap  $\geq 3.6\text{mm}$
- Dielectric strength 5000 Vrms
- Isolation spacing greater than 10 mm
- UL, CUR file E365652
- TÜV certificate B0887930008

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## 3.4 ZETTLER AC circuit Relays for Solar Inverters $\geq 100\text{ A}$

### AZSR1160

This **160 A** extreme high power PCB Relay has been designed for PV applications of up to 191 kVA (three phase, 690V system, 690V line voltage) – a highly attractive, small footprint substitute for conventional contactors. This relay is suitable for larger commercial PV systems and small commercial solar fields, deployable up to 7000 m above sea level and up to 8000m for 3.6mm gap option.



Figure 13: AZSR1160

- Wide contact gap  $\geq 3.2\text{mm}$ ,  $\geq 3.6\text{mm}$  available upon request
- Holding power  $< 480\text{ mW}$
- Dielectric strength 4000 Vrms
- Isolation spacing greater than 10 mm
- Contact rating: 160A, 690VAC
- UL, CUR file E365652

- TÜV certificate B0887930013

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### AZSR1180

This **180 A** extreme high power PCB Relay has been designed for PV applications of up to 286kVA (three phase, 920V system, 920V line voltage) – a highly attractive, small footprint substitute for conventional contactors. This relay is suitable for very large commercial PV systems, deployable up to 8000 m above sea level.

- Wide contact gap  $\geq 3.6$
- Holding power  $< 480$  mW
- Dielectric strength 4000 Vrms
- Isolation spacing greater than 10 mm
- Contact rating: 180A, 920VAC
- UL, CUR file E365652
- TÜV certificate B0887930013

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Figure 14: AZSR1180

### AZSR1200

This **200 A** extreme high power PCB Relay has been designed for PV applications of up to 318 kVA (three phase, 920V system, 920V line voltage) – a highly attractive, small footprint substitute for conventional contactors. This relay is suitable for very larger commercial PV systems, deployable up to 8000 m above sea level.

- Wide contact gap  $\geq 3.6$ mm
- Holding power  $< 480$  mW
- Dielectric strength 4000 Vrms
- Isolation spacing greater than 10 mm
- Contact rating: 200A, 920VAC
- UL, CUR file E365652



Figure 15: AZSR1200

- TÜV certificate B0887930013

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## 4. ZETTLER DC circuit Solar Relays

### AZDC6

This 12.5 A DPST relay for switching DC loads up to 600 V is designed to fulfill all requirements according 2017 NEC 690.12 for rapid shutdown systems for solar panels. The compact size of 33.9 x 30.6 x 16 mm allows a flatter design of certain RSS (Rapid Shutdown System) boxes. The relay can also be used as a pre-charge relay in battery-powered systems. To effectively reduce inrush current peaks the pre-charge circuit is switched on before the system is completely started in order to charge the capacitors in the controller and converter using a current limiting resistor.



Figure 16: AZDC6

- Blow magnet design
- Dielectric strength 4000 Vrms
- Dielectric strength between open contacts 2000 Vrms
- according to 2017 NEC 690.12
- cCSAus certificate 70204935

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## 5. ZETTLER Relay for Insulation Measuring in Solar Applications

### AZ742-2A-xxD(200)

As photovoltaic installations with transformerless solar inverters are not galvanically isolated, permanent measuring of the insulation is not possible when in operating mode, i.e. feeding energy into the grid. However, current safety standards for solar inverters and solar panels require that only systems with correct insulation can be grid-connected. Common switching components to connect the insulation measuring circuit with the inverter usually come in the form of relative expensive reed relays. ZETTLER's **solution** is a modified and **very cost effective** two-pole electromechanical relay meeting necessary standards.



Figure 17: AZ742-2A-xxD(200)

- Widened contact gap  $\geq 0.6$  mm
- Dielectric strength between open contacts 2000 Vrms for 60 sec.
- Isolation spacing greater than 10 mm
- Test conditions
  - Configuration: two contacts connected in series
  - Load: resistive 1000 VDC / 15.3 mA
  - Ambient temperature: 85°C
  - Duty cycle: 1.5 s On / 1.5 s Off
  - Electrical lifetime: 30k cycles
- UL, CUR file E43203
- VDE certificate 40012572

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