

# Solid State Relays

## Industrial, 1-Phase ZS w. LED and Built-in Varistor

### Types RA 23, RA 40, RA 48, RA 60

CARLO GAVAZZI



- Zero switching AC Solid State Relay
- Direct copper bonding (DCB) technology
- LED indication
- Built-in varistor
- Input range: 5 - 32 VDC
- Rated operational current: 10, 25, 50, 90 and 110 AACrms
- Rated operational voltage: 230, 400, 480 and 600 VACrms
- Non-repetitive voltage: Up to 1600 V<sub>p</sub>
- Opto-insulation: > 4000 VACrms
- Cover for touch protection

## Product Description

The zero switching relay with antiparallel thyristor output is the most widely used industrial SSR due to its multiple application possibilities. The relay can be used for resistive, inductive and capacitive loads. The zero switching relay switches ON when the sinusoidal curve crosses zero

and switches OFF when the current crosses zero. The built-in varistor secure transient protection for the heavy industrial applications and the LED indicates the status of the control input. The cover is securing touch protection.

## Ordering Key

**RA 23 25 -D 06 D**

Solid State Relay \_\_\_\_\_  
 Switching mode \_\_\_\_\_  
 Rated operational voltage \_\_\_\_\_  
 Rated operational current \_\_\_\_\_  
 Control voltage \_\_\_\_\_  
 Non-rep. peak voltage \_\_\_\_\_  
 LED indication \_\_\_\_\_

## Type Selection

| Switching mode    | Rated operational voltage                                            | Rated operational current                                                           | Control voltage | Non-rep. voltage                                                                                       |
|-------------------|----------------------------------------------------------------------|-------------------------------------------------------------------------------------|-----------------|--------------------------------------------------------------------------------------------------------|
| A: Zero Switching | 23: 230 VACrms<br>40: 400 VACrms<br>48: 480 VACrms<br>60: 600 VACrms | 10: 10 AACrms<br>25: 25 AACrms<br>50: 50 AACrms<br>90: 90 AACrms<br>110: 110 AACrms | -D: 5 to 32 VDC | 06: 650 V <sub>p</sub><br>08: 850 V <sub>p</sub><br>12: 1200 V <sub>p</sub><br>16: 1600 V <sub>p</sub> |

## Selection Guide

| Rated operational voltage | Non-rep. voltage    | Control voltage | Rated operational current 10 AAC | 25 AAC             | 50 AAC             | 90 AAC             | 110 AAC             |
|---------------------------|---------------------|-----------------|----------------------------------|--------------------|--------------------|--------------------|---------------------|
| 230 VACrms                | 650 V <sub>p</sub>  | 5 - 32 VDC      | <b>RA2310-D06D</b>               | <b>RA2325-D06D</b> | <b>RA2350-D06D</b> | <b>RA2390-D06D</b> | <b>RA23110-D06D</b> |
| 400 VACrms                | 850 V <sub>p</sub>  | 5 - 32 VDC      | <b>RA4010-D08D</b>               | <b>RA4025-D08D</b> | <b>RA4050-D08D</b> | <b>RA4090-D08D</b> | <b>RA40110-D08D</b> |
| 480 VACrms                | 1200 V <sub>p</sub> | 5 - 32 VDC      | <b>RA4810-D12D</b>               | <b>RA4825-D12D</b> | <b>RA4850-D12D</b> | <b>RA4890-D12D</b> | <b>RA48110-D12D</b> |
| 600 VACrms                | 1600 V <sub>p</sub> | 5 - 32 VDC      | -                                | -                  | <b>RA6050-D16D</b> | <b>RA6090-D16D</b> | <b>RA60110-D16D</b> |

## General Specifications

|                             | RA 23... -D06D     | RA 40... -D08D     | RA 48...-D12D       | RA 60... -D16D      |
|-----------------------------|--------------------|--------------------|---------------------|---------------------|
| Operational voltage range   | 24 to 280 VACrms   | 42 to 440 VACrms   | 42 to 530 VACrms    | 42 to 660 VACrms    |
| Non-rep. peak voltage       | 650 V <sub>p</sub> | 850 V <sub>p</sub> | 1200 V <sub>p</sub> | 1600 V <sub>p</sub> |
| Varistor voltage            | 275 VACrms         | 420 VACrms         | 510 VACrms          | 680 VACrms          |
| Zero voltage turn-on        | < 20 V             | < 20 V             | < 20 V              | < 20 V              |
| Operational frequency range | 45 to 65 Hz        | 45 to 65 Hz        | 45 to 65 Hz         | 45 to 65 Hz         |
| Power factor                | > 0.5              | > 0.5              | > 0.5               | > 0.5               |
| CE-marking                  | Yes                | Yes                | Yes                 | Yes                 |
| Norm fulfilled              | EN 50082-2         | EN 50082-2         | EN 50082-2          | EN 50082-2          |



Input Specifications

|                                         |             |                        |         |
|-----------------------------------------|-------------|------------------------|---------|
| Control voltage range<br>(-10% to +10%) | 5 to 32 VDC | Input current @ 24 VDC | < 10 mA |
| Pick-up voltage                         | 4.5 VDC     | Response time pick-up  | < 10 ms |
| Drop-out voltage                        | 1 VDC       | Response time drop-out | < 20 ms |
|                                         |             | Green LED indication   | Yes     |

Output Specifications

|                                                             | RA ..10 -D..D        | RA ..25 -D..D        | RA ..50 -D..D         | RA ..90 -D..D         | RA ..110 -D..D         |
|-------------------------------------------------------------|----------------------|----------------------|-----------------------|-----------------------|------------------------|
| Rated operational current AC1                               | 10 AACrms            | 25 AACrms            | 50 AACrms             | 90 AACrms             | 110 AACrms             |
| AC3                                                         | 3 AACrms             | 5 AACrms             | 15 AACrms             | 20 AACrms             | 30 AACrms              |
| Minimum operational current                                 | 200 mA               | 200 mA               | 200 mA                | 200 mA                | 200 mA                 |
| Rep. overload current (t = 1 s)                             | < 35 AACrms          | < 55 AACrms          | < 125 AACrms          | < 150 AACrms          | < 200 AACrms           |
| Non-rep surge current (t = 20 ms)                           | 160 A <sub>p</sub>   | 250 A <sub>p</sub>   | 600 A <sub>p</sub>    | 1000 A <sub>p</sub>   | 1500 A <sub>p</sub>    |
| Off-state leakage current at<br>rated voltage and frequency | < 6 mA               | < 6 mA               | < 6 mA                | < 6 mA                | < 6 mA                 |
| I <sup>2</sup> t for fusing (t = 10 ms)                     | 130 A <sup>2</sup> s | 310 A <sup>2</sup> s | 1800 A <sup>2</sup> s | 5000 A <sup>2</sup> s | 11250 A <sup>2</sup> s |
| Critical di/dt                                              | 100 A/μs             | 100 A/μs             | 100 A/μs              | 100 A/μs              | 100 A/μs               |
| On-state voltage drop<br>at rated current                   | < 1.6 Vrms           | < 1.6 Vrms           | < 1.6 Vrms            | < 1.6 Vrms            | < 1.6 Vrms             |
| Critical dv/dt                                              | 500 V/μs             | 500 V/μs             | 500 V/μs              | 500 V/μs              | 500 V/μs               |
| Zero crossing detection                                     | Yes                  | Yes                  | Yes                   | Yes                   | Yes                    |

Thermal Specifications

|                                     | RA ..10 -D..D                     | RA ..25 -D..D                     | RA ..50 -D..D                     | RA ..90 -D..D                     | RA ..110 -D..D                    |
|-------------------------------------|-----------------------------------|-----------------------------------|-----------------------------------|-----------------------------------|-----------------------------------|
| Operating temperature range         | -20° to +70°C<br>(-4 to +158°F)   | -20° to +70°C<br>(-4 to +158°F)   | -20° to +70°C<br>(-4 to +158°F)   | -20° to +70°C<br>(-4 to +158°F)   | -20° to +70°C<br>(-4 to +158°F)   |
| Storage temperature range           | -40° to +100°C<br>(-40 to +212°F) | -40° to +100°C<br>(-40 to +212°F) | -40° to +100°C<br>(-40 to +212°F) | -40° to +100°C<br>(-40 to +212°F) | -40° to +100°C<br>(-40 to +212°F) |
| Junction temperature                | < 125°C (< 257°F)                 | < 125°C (< 257°F)                 | < 125°C (< 257°F)                 | < 125°C (< 257°F)                 | < 125°C (< 257°F)                 |
| R <sub>th</sub> junction to case    | 2.0 K/W                           | 1.25 K/W                          | 0.65 K/W                          | 0.35 K/W                          | 0.30 K/W                          |
| R <sub>th</sub> junction to ambient | 12 K/W                            | 12 K/W                            | 12 K/W                            | 12 K/W                            | 12 K/W                            |

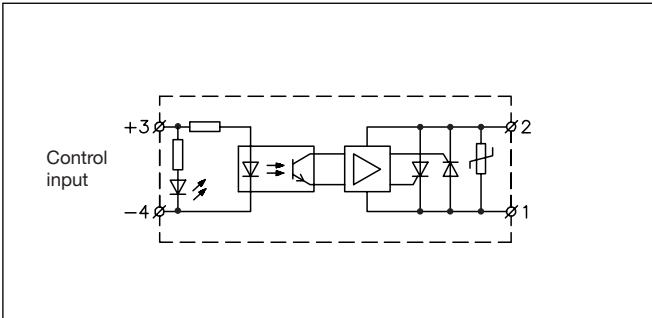
Insulation

|                                             |               |
|---------------------------------------------|---------------|
| Rated insulation voltage<br>Input to output | ≥ 4000 VACrms |
| Rated insulation voltage<br>Output to case  | ≥ 4000 VACrms |

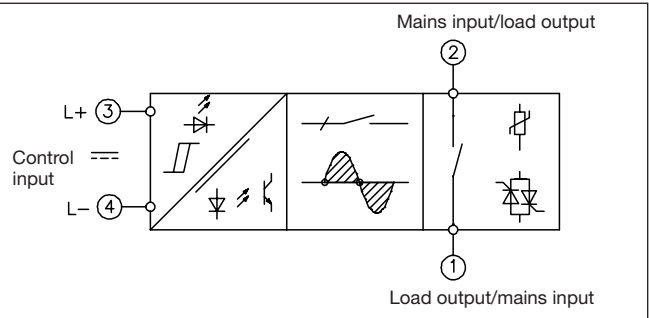
Accessories

|                  |                               |
|------------------|-------------------------------|
| Heatsinks        | For further information refer |
| DIN-rail adapter | to "General Accessories".     |
| Fuses            |                               |

Wiring Diagram

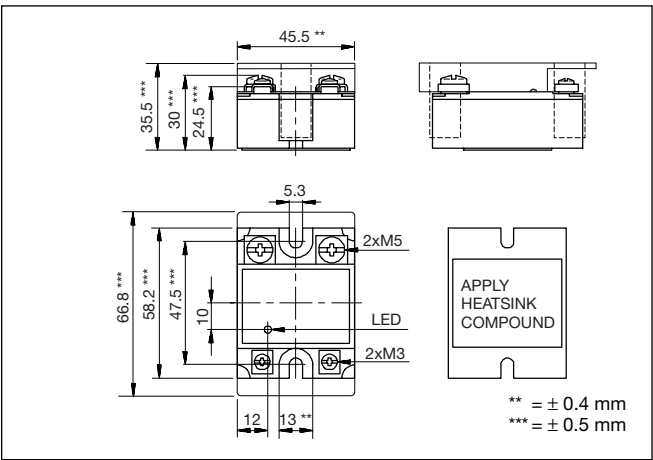


Functional Diagram





Dimensions



Housing Specifications

|                  |                                 |
|------------------|---------------------------------|
| Weight           | Approx. 110 g                   |
| Housing material | Noryl GFN 1, black              |
| Base plate       | 10 A, 25 A, 50 A<br>90 A, 110 A |
| Potting compound | Polyurethane                    |
| Relay            |                                 |
| Mounting screws  | M5                              |
| Mounting torque  | 1.5 Nm                          |
| Control terminal |                                 |
| Mounting screws  | M3 x 6                          |
| Mounting torque  | 0.5 Nm                          |
| Power terminal   |                                 |
| Mounting screws  | M5 x 6                          |
| Mounting torque  | 2.4 Nm                          |

Applications

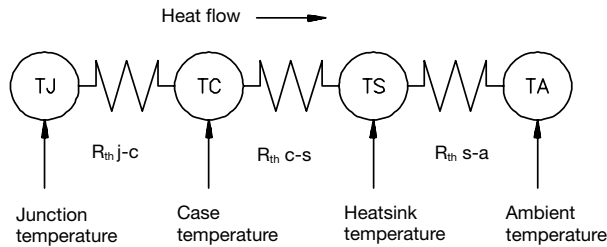
This relay is designed for use in applications in which it is exposed to high surge conditions. Care must be taken to ensure proper heatsinking when the relay is to be used at high sustained currents. Adequate electrical connection between relay terminals and cable must be ensured.

Thermal characteristics

The thermal design of Solid State Relays is very impor-

tant. It is essential that the user makes sure that cooling is adequate and that the maximum junction temperature of the relay is not exceeded.

If the heatsink is placed in a small closed room, control panel or the like, the power dissipation can cause the ambient temperature to rise. The heatsink is to be calculated on the basis of the ambient temperature and the increase in temperature.



Thermal resistance:  
 $R_{th\ j-c}$  = junction to case  
 $R_{th\ c-s}$  = case to heatsink  
 $R_{th\ s-a}$  = heatsink to ambient

Direct bonding

In the design of the output power semiconductor direct bonding of the copper layer and the ceramic substrate has been applied. This is to ensure uninhibited heat transfer and high thermal fatigue strength.

The relay has been designed for applications requiring large numbers of load cycles.

Power dissipation

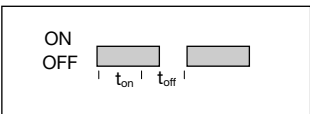
The power dissipation for intermittent use is calculated according to the following formula:

$$I_{rms} = \sqrt{\frac{I_{ON}^2 \times t_{ON}}{t_{ON} + t_{OFF}}}$$

Ex: RA 23 50 -D 06D:  
Load current = 45 A  
 $t_{ON} = 30\ s$   
 $t_{OFF} = 15\ s$

$$I_{rms} = \sqrt{\frac{45^2 \times 30}{30 + 15}}$$

The rms current will be 36.7 A.





Heatsink Dimensions (load current versus ambient temperature)

RA ..10 -D..D

| Load current [A]                 | Thermal resistance [K/W] |      |      |      |      |      | Power dissipation [W] |
|----------------------------------|--------------------------|------|------|------|------|------|-----------------------|
| 16                               | 2.7                      | 2.2  | 1.8  | 1.3  | 0.87 | 0.41 | 22                    |
| 15                               | 3.1                      | 2.6  | 2.1  | 1.7  | 1.2  | 0.65 | 20                    |
| 14                               | 3.7                      | 3.1  | 2.6  | 2    | 1.5  | 0.92 | 18                    |
| 13                               | 4.3                      | 3.7  | 3.1  | 2.5  | 1.9  | 1.2  | 16                    |
| 12                               | 5                        | 4.3  | 3.7  | 3    | 2.3  | 1.6  | 15                    |
| 11                               | 5.9                      | 5.1  | 4.4  | 3.6  | 2.8  | 2.1  | 13                    |
| 10                               | 6.9                      | 6    | 5.2  | 4.3  | 3.5  | 2.6  | 12                    |
| 9                                | 7.9                      | 6.9  | 5.9  | 4.9  | 4    | 3    | 10                    |
| 7                                | 10.8                     | 9.5  | 8.1  | 6.8  | 5.4  | 4.1  | 7                     |
| 5                                | -                        | 14.2 | 12.2 | 10.2 | 8.1  | 6.1  | 5                     |
| 3                                | -                        | -    | -    | -    | 14.6 | 10.9 | 3                     |
| 20 30 40 50 60 70 T <sub>A</sub> |                          |      |      |      |      |      |                       |
| Ambient temp. [°C]               |                          |      |      |      |      |      |                       |

RA ..50 -D..D

| Load current [A]                 | Thermal resistance [K/W] |      |      |      |      |      | Power dissipation [W] |
|----------------------------------|--------------------------|------|------|------|------|------|-----------------------|
| 50                               | 0.92                     | 0.76 | 0.60 | 0.45 | 0.29 | -    | 63                    |
| 45                               | 1.2                      | 0.99 | 0.80 | 0.62 | 0.44 | 0.26 | 55                    |
| 40                               | 1.5                      | 1.3  | 1.1  | 0.85 | 0.63 | 0.42 | 47                    |
| 35                               | 1.9                      | 1.6  | 1.4  | 1.1  | 0.89 | 0.63 | 40                    |
| 30                               | 2.4                      | 2.1  | 1.8  | 1.5  | 1.2  | 0.91 | 33                    |
| 25                               | 3                        | 2.7  | 2.3  | 1.9  | 1.5  | 1.1  | 26                    |
| 20                               | 3.9                      | 3.5  | 3    | 2.5  | 2    | 1.5  | 20                    |
| 15                               | 5.5                      | 4.8  | 4.1  | 3.4  | 2.7  | 2.1  | 15                    |
| 10                               | 8.6                      | 7.5  | 6.4  | 5.4  | 4.3  | 3.2  | 9                     |
| 5                                | 17.9                     | 15.6 | 13.4 | 11.2 | 8.9  | 6.7  | 4                     |
| 20 30 40 50 60 70 T <sub>A</sub> |                          |      |      |      |      |      |                       |
| Ambient temp. [°C]               |                          |      |      |      |      |      |                       |

RA ..25 -D..D

| Load current [A]                 | Thermal resistance [K/W] |      |      |      |      |      | Power dissipation [W] |
|----------------------------------|--------------------------|------|------|------|------|------|-----------------------|
| 25                               | 2                        | 1.7  | 1.4  | 1    | 0.71 | 0.40 | 32                    |
| 22.5                             | 2.5                      | 2.1  | 1.8  | 1.4  | 1    | 0.66 | 27                    |
| 20                               | 3.1                      | 2.7  | 2.3  | 1.9  | 1.4  | 1    | 23                    |
| 17.5                             | 4                        | 3.5  | 3    | 2.5  | 2    | 1.4  | 20                    |
| 15                               | 4.9                      | 4.3  | 3.7  | 3.1  | 2.5  | 1.9  | 16                    |
| 12.5                             | 6.2                      | 5.4  | 4.6  | 3.9  | 3.1  | 2.3  | 13                    |
| 10                               | 8.1                      | 7.1  | 6.1  | 5.1  | 4    | 3    | 10                    |
| 7.5                              | 11.3                     | 9.9  | 8.5  | 7.1  | 5.6  | 4.2  | 7                     |
| 5                                | -                        | 15.6 | 13.3 | 11.1 | 8.9  | 6.7  | 5                     |
| 2.5                              | -                        | -    | -    | -    | 18.7 | 14   | 2                     |
| 20 30 40 50 60 70 T <sub>A</sub> |                          |      |      |      |      |      |                       |
| Ambient temp. [°C]               |                          |      |      |      |      |      |                       |

RA ..90 -D..D

| Load current [A]                 | Thermal resistance [K/W] |      |      |      |      |      | Power dissipation [W] |
|----------------------------------|--------------------------|------|------|------|------|------|-----------------------|
| 90                               | 0.63                     | 0.53 | 0.42 | 0.32 | -    | -    | 97                    |
| 80                               | 0.81                     | 0.69 | 0.57 | 0.45 | 0.33 | -    | 84                    |
| 70                               | 1                        | 0.89 | 0.75 | 0.61 | 0.47 | 0.33 | 71                    |
| 60                               | 1.3                      | 1.2  | 1    | 0.83 | 0.66 | 0.49 | 59                    |
| 50                               | 1.7                      | 1.5  | 1.3  | 1.1  | 0.85 | 0.64 | 47                    |
| 40                               | 2.2                      | 1.9  | 1.7  | 1.4  | 1.1  | 0.83 | 36                    |
| 30                               | 3.1                      | 2.7  | 2.3  | 1.9  | 1.5  | 1.2  | 26                    |
| 20                               | 4.8                      | 4.2  | 3.6  | 3    | 2.4  | 1.8  | 17                    |
| 10                               | 10                       | 8.8  | 7.5  | 6.3  | 5    | 3.8  | 8                     |
| 20 30 40 50 60 70 T <sub>A</sub> |                          |      |      |      |      |      |                       |
| Ambient temp. [°C]               |                          |      |      |      |      |      |                       |

RA ..110 -D..D

| Load current [A]                 | Thermal resistance [K/W] |      |      |      |      |      | Power dissipation [W] |
|----------------------------------|--------------------------|------|------|------|------|------|-----------------------|
| 110                              | 0.43                     | 0.35 | 0.27 | -    | -    | -    | 126                   |
| 90                               | 0.63                     | 0.53 | 0.42 | 0.32 | -    | -    | 97                    |
| 80                               | 0.81                     | 0.69 | 0.57 | 0.45 | 0.33 | -    | 84                    |
| 70                               | 1                        | 0.89 | 0.75 | 0.61 | 0.47 | 0.33 | 71                    |
| 60                               | 1.3                      | 1.2  | 1    | 0.83 | 0.66 | 0.49 | 59                    |
| 50                               | 1.7                      | 1.5  | 1.3  | 1.1  | 0.85 | 0.64 | 47                    |
| 40                               | 2.2                      | 1.9  | 1.7  | 1.4  | 1.1  | 0.83 | 36                    |
| 30                               | 3.1                      | 2.7  | 2.3  | 1.9  | 1.5  | 1.2  | 26                    |
| 20                               | 4.8                      | 4.2  | 3.6  | 3    | 2.4  | 1.8  | 17                    |
| 10                               | 10                       | 8.8  | 7.5  | 6.3  | 5    | 3.8  | 8                     |
| 20 30 40 50 60 70 T <sub>A</sub> |                          |      |      |      |      |      |                       |
| Ambient temp. [°C]               |                          |      |      |      |      |      |                       |

Heatsink Selection

| Carlo Gavazzi Heatsink<br>(see Accessories) | Thermal resistance        |
|---------------------------------------------|---------------------------|
| No heatsink required                        | $R_{th\ s-a} > 12.5\ K/W$ |
| RHS 100 Assy                                | 3.0 K/W                   |
| RHS 301 Assy                                | 0.8 K/W                   |
| RHS 301 F Assy                              | 0.25 K/W                  |
| Consult your distributor                    | $< 0.25\ K/W$             |

Compare the value found in the current versus temperature chart with the standard heatsink values and select the heat-sink with the next lower value.