# APPLICATION OF SOLID STATE RELAYS

## 1- Most frequent types of loads : Reference to IEC/EN 947-x-x standards

| Type of current | Category of use | Characteristics applications | Precautions for use |
|---|---|---|---|
| alternating current<br><br>POWER | AC-51 | non-inductive loads or hardly inductive resistance furnaces,.... | For on-off relays, use zero cross relays. In the case of heating elements with wound resistor, the switched current can be up to 1.4 times the assigned current.<br>Refer to the selection guides AC-51 : solutions in single phase, two phase and three phase<br>Use proportional full wave pulse control relays for the variation in power : control in 0-10V or 4-20mA. |
| | AC-53 | Squirrel cage motors : starting, switching motors started | The starting currents can reach 8 times the assigned current for a duration of 1.6 seconds. The relays specified in AC-53 account for these surges. Voltage surges generated by the motor can appear on opening of the relay.<br>**celduc** proposes on/off control products (SVT , SGT) and SOFT-START starters ( SMCW).<br>Refer to the selection guides AC-53. |
| | AC-4 | Squirrel cage motors : starting, reversal of operation, single stroke operation | The stresses are quick close to the applications in AC-53, however with even greater surges on the reversal.<br>Performing reversals of the rotation direction with solid state relays calls for very high immunity products, a control logic integrating a locking of controls and a time delay on each reversal.<br>**celduc** proposes suitable products : SG9/SV9/SW9<br>Refer to the selection guides : AC-53 and AC-4. |
| | AC-55a | Control of discharge lamps | -->Fluorescent lamps without power factor corrector (AC-55a) carry currents which can reach twice the assigned current for a short instant.<br>--> Parallel compensated fluorescent lamps (AC-56b) , can carry inrush current 20 times the assigned current and generator significant surges on opening.<br>--> Electronic ballast fluorescent lamps can have current peaks 10 times the assigned current.<br>--> High pressure mercury vapour lamps and metallic halogenide lamps without power factor corrector are switched via ballast units of the serial inductance type and using arcing devices. During the starting period, a mainly inductive current is made. As this current can be twice the assigned current, it must be supported by the solid state relay (AC-55a)<br>--> High pressure sodium vapour lamps also carry an inductive current from 1.7 to 2.2 times the assigned current.<br>--> High pressure mercury vapour lamps and metallic halogenide and sodium vapour lamps with power corrector factor carry significant capacitive inrush currents and generate surges on opening AC-56b).<br>The general rule is to use the zero cross relays adapted to the current surges (warning : to check the resistance of these repetitive currents --> see the curve : repetitive Itsm = f(t) )<br>AC-55a = 10 In for 20ms / 6In for 200ms / 3In for 10 s / 2In for 1 minute<br>AC-56b = 30 In for 20ms / 1.4In for 200ms / 1,1In for 1 s : see §AC56b (capacitor batteries) and voltage surges on opening using relays of 400VAC on the 230VAC network. |

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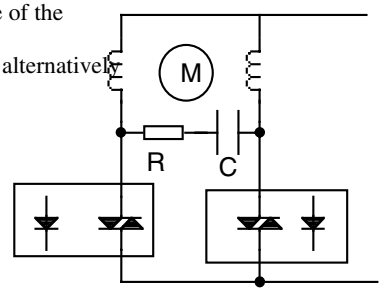
| alternating current<br>POWER | AC-55b | Control of incandescent lamps | The cold starting of an incandescent lamp produces significant current surges. The filaments of these lamps have very low resistances cold, it is advantageous to zero cross switch them.<br>The current surge is reduced which greatly increases the lifetime of the lamp.<br>The general rule is to use zero cross relays adapted to the current surges (repetitive):<br>AC55b = 10 In for 20ms / 6In for 200ms / 1.2In for 1 s / 1.1In for 10 s<br>At the end of the lifetime of these lamps, short-circuits between coils can produce strong current surges which can be considered as short-circuits.<br>The coordination between the semiconductor relay and the device for protection against short-circuits must be accounted for.<br>For the variation in power of these loads, it is also possible to use random relays with an adapted control or relays (SG4) allowing for the variation of the PHASE ANGLE (CONTROLLER) according to an isolated 0-10V or 4-20mA analog input. |
| | AC-56a | Control of transformers | This is a special type of control of the load. The saturation of the magnetic circuit must be avoided.<br>If a conventional solid state relay is used, it must be oversized.<br>The magnetising current of a transformer can reach 100 times the nominal current.<br>Use oversized random relays or special transformer control relays : special application note. |
| | AC-56b | Control of capacitor batteries | Mainly power factor correctors but also loads with filters by capacitor at the input (see certain discharge lamps). Mainly 2 problems :<br>--> current surge on closing<br>--> voltage surge on opening<br>**celduc** has developed a range of relays dedicated to these applications with high Itsm (up to 20 000 A/20ms and 1600 volts) with a special application note |
| | AC-7a | Control of slightly inductive loads for household appliances and similar applications | Same specifications as AC-51 adhering to the current and voltage limits of the relays. |
| | AC-7b | Motor for domestic applications | <u>Single phase motor with collector or universal motors.</u><br>Preferably use random relays. The brushes generate microcuts generating voltage surges. It is highly advised to protect the relay by a varistor.<br>The variation in speed of these motors can be performed with SG4 type CONTROLLER relays.<br><u>Asynchronous single phase motor with capacitor</u><br>These motors are used in a great deal of mechanisms requiring a change of the rotation direction.<br>The control is provided by two alternatively switched relays for each change of rotation.<br>  |

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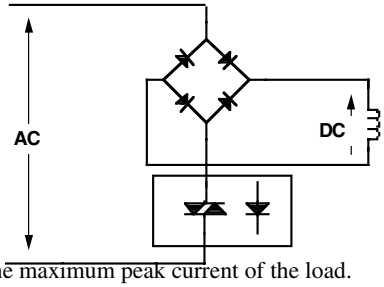
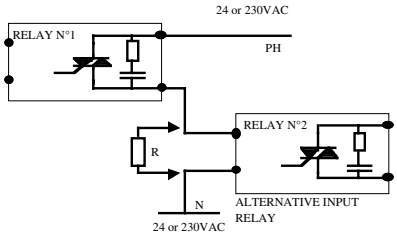
| **alternating current**<br><br>**POWER** | **AC-7b ( suite)** | **Motors for domestic applications** | Asynchronous single phase motors with capacity (contd.)<br>The relays must be controlled with a short time delay (50 to 100ms ) to ensure the breaking of one before the other.<br>In the case of simultaneous operation, provide for a serial resistor R with dephasing capacitor. The value of this resistor must be: Vmax capacitor/ Itsm of relay. Provide a wound power resistor P= R x Inominal motor x Inominal motor.<br>It is also to be pointed out that the voltage across the terminals of the open relay the voltage across the terminals of the capacitor C. This is typically ϖ2 times the mains voltage and can be greater if the voltages on the windings are not exactly quadrature .<br>Consequently, use 400VAC relays on 230V network.<br>It is also possible to vary the speed of these asynchronous single phase motors by adjusting the slipping, i.e. the power supply voltage. SG4 type CONTROLLER relays can be used. However, precautions must be taken with regard to heating of these motors. Please consult us. |
| | **AC-8 (a et b)** | **Control of hermetic refrigeration compressors** | Quite similar to a start in AC-53 , with starting currents capable of reaching 8 to 10 times the assigned current.<br>Refer to the AC-53 currents allowing for a small extra margin. |
| | **other loads** | **DC loads suppied from an AC mains** | DC loads supplied from an alternating mains<br><br>This type of load has the inconvenience of switching a practically rectangular current which may be a problem for relays using standard triacs.<br>The **celduc** relays are fully suited to this type of load by oversizing the current of the relay with that of the maximum peak current of the load.<br>  |
| **alternating current**<br><br>**INTERFACE** | **AC-12** | **Control of ohmic loads and loads insulated by optocoupler current** | Ohmic load : refer to the characteristics in AC-51.<br><br>Loads insulated by optocoupler.<br><br>example : Solid state relay pilot controlling another alternating control solid state relay capable of operating with 1.5mA (eg : regulators which pilot control a solid state relay). You must make sure that the leakage current in blocked state of relay N°1 does not allow for the control of relay N°2 .<br>A parallel impedance on the input of relay N°2 may be required to ensure a voltage lower than the non-operating voltage of the relay.<br>  |

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| alternative current<br><br>INTERFACE | AC-13 | Control of static loads insulated by transformers | Check the compatibility with the magnetising current of the transformer. |
| | AC-14 | Control of electromagnetic loads (contactors, etc) Low loads : < 72VA | This is typically the case for solenoid valves, contactor control coils, small servocontrol motors, etc.<br>Although it is preferable to use random relays, the **celduc** zero cross relays are fully suited to this type of load.<br>Solid state relays with a reduced leakage current must be used to avoid these loads being kept supplied in the blocked state. The **celduc** interface relays are very well suited to this type of load. |
| | AC-15 | Control of electromagnetic loads (contactors, etc) High loads : > 72 VA | Oversize if there is a risk of saturation of the load and preferably use random relays. The **celduc** zero cross relays are also suitable. |
| direct current | DC-1 | non inductive or hardly inductive loads, resistor furnaces, etc. | In DC , as in AC , the rules are as follows :<br><br>--> Adhere to the currents and voltages.<br>--> account for inrush currents of the different loads ( DC-3 ; DC-5 ; DC-6 )<br>--> Account for any voltage surges ==> Place a free wheel diode on the inductive loads ( DC-13 ; DC-14 ; DC-3 ; DC-5)<br><br>Use the following relays of the **celduc** range :<br>* SKD 3A 60VDC / 1A 200VDC control 3-30VDC<br>* XKD 3A 60VDC / 1A 200VDC control 3-30VDC or models with control in AC<br>* SCC 5A 60VDC /15A 60VDC<br>* SGC 20A 200VDC<br>* SGD 30 and 60A in 50 and 100VDC |
| | DC-12 | control of ohmic loads or static loads insulated by photocoupler | |
| | DC-13 | control of electromagnets | |
| | DC-14 | control of electromagnets with economy resistors | |
| | DC-3 | shunt motors : starting, reversal, etc | |
| | DC-5 | serial motors : starting and reversal | |
| | DC-6 | Control of incandescent lamps | |