Technical Support
Bulletin Nr. 2 - Outputs

Contents

- **Relays**
- **Selection criteria**
- **Configuration (LX controllers)**
- **Mode, Control, Operating**
- **TRIAC and on-off control**
- **Relay summary table**
- **ID relay table**
- **IC relay table**

Relays

Relays are installed on all our controllers. They are used for connecting, cutting off and switching between electrical circuits using special signals. This is very important when directly operating the loads (users) used for control (e.g. compressor) or "energizing" (relay output used as control signal for an external relay).

The relay opens or closes the output contact (towards load) according to the low voltage signal sent to the winding by the controller logic. The magnetic force developed by the winding moves a rocker arm fitted with a spring in order to obtain electrical continuity between the rocker arm and the contact. See fig. 1.

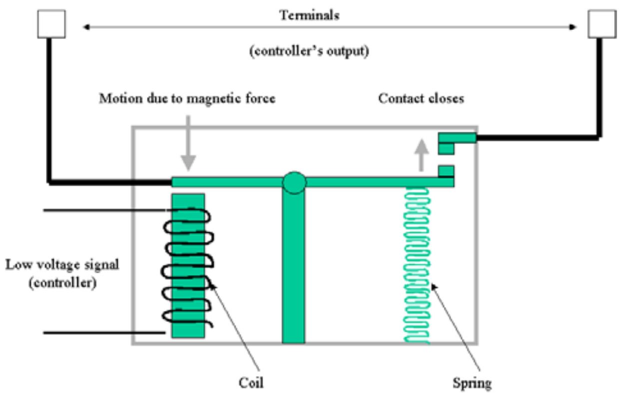

fig. 1

It is a good idea to classify the relays according to their physical configuration or number of poles and paths (output contacts): for our instruments **SPST** (single pole single throw - 1 pole and 1 path) and **SPDT** (single pole double throw - 1 pole and 2 paths) configurations are used. This is important for correct wiring of the loads (e.g. if exchange between two different loads takes place on the same SPDT relay). See fig. 2.

As far as the physical configuration is concerned, polarity is frequently referred to as "**normally open**" (the contact is open when there is no voltage on the winding) and the opposite "**normally closed**".

Relays are also classified according to the maximum voltage and current values allowed on the load side; the maximum voltage (V) is generally 250VAC for our applications; for current (A), we must consider:

- **the type of application (control of a load vs. simple "control")**
- **the type of control performed by the relay (e.g. resistive vs. inductive load)**
- **nominal absorption of load**

- **type of electrical connection** between the controller and the load with "shared" contacts, if present.

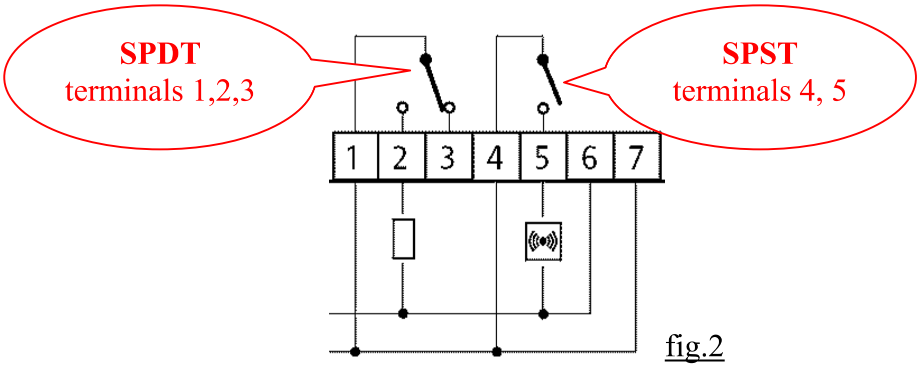

fig.2

Relay selection criteria

The above has an effect on the maximum power that the load can produce; this is expressed in W (or kW or even, in the past, HP). This has led to the expression "1HP" or "2HP" relay that is an interesting feature of some versions of the **ID, IC, IW** and **EWDR** instruments**.** High power (or current) is obviously advantageous because it avoids buying and installing external relays that can withstand the required power.

Classification according to power (HP) depends on the supply voltage of the load (it therefore varies – it is approximately halved – if the voltage is 115 VAC as in North America).

Classification according to current (A) does not change when the voltage changes since it is established when the circuit is sized in accordance with relevant regulations.

Loads are not all the same; for example, the current that flows on an electric motor is subjected to inductive behaviour and inertia; for this reason, an "**inductive**" (or even "reactive") value that is always less than the current reference value is declared.

In other words, for a specific relay, reference is made to a maximum limit that is obtained:

- constantly, with total absorption by the load (by dissipation, for example, **electrical resistance**), or
- variably (consider motor start-up) and with absorption affected by the reactance of the load itself for the loads described below. With regard to this limit, the operating current has a lower value ("inductive") that is therefore used as a reference for these loads: e.g. operating a **motor (compressor, fan, pump).**

The same difference between current values at start-up and during operating also exists for different reasons on lamps and devices with electrical winding (e.g. solenoid valve, although it has limited absorption).

Swings above these values caused by start-up or circuit characteristics are linked to the respective duration (different amplitude "peaks" and duration have different effects).

The electrical, mechanical and thermal stresses caused by this affect the service life of the relay (number of cycles); this is important for UL or other voluntary body approval; for more information, contact Technical Support.

For our applications, the values should be expressed in pairs, for example: **8(3)A, i.e. 8 A resistive and 3 inductive.**

These values are linked by cosφ (characteristic of electrical circuit of load equal to 1 if resistive, between 0.35 and 0.65 for motors) or, alternatively, are defined according to the categories of use (AC1, AC2... according to IEC coding).

The maximum current values also depend on the **type of connection**, i.e. on a condition that is not related to the relay but is part of the instrument: e.g. screw connectors (max 16 A), removable connectors (max 12 A), fast-ons, etc.

Sometimes a more restrictive value for the cumulative current that flows on a “shared” contact, if present, may be used when space is limited (fig. 3).

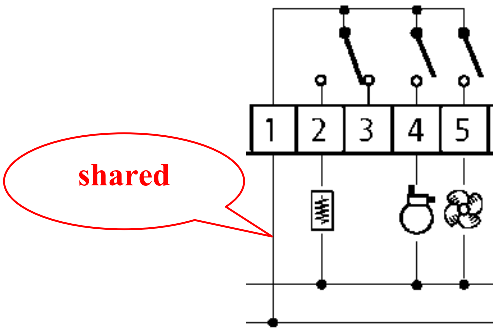

fig. 3

Configuration (LX controllers)

It is important to mention the possibility of configuring the outputs on LX models, i.e. assign a specific function to each relay using parameters that are always accessible. The possibilities for ID and IC are:

•**control of temperature (or other input)**, for example. compressor...
•defrosting
•evaporator fan
•alarm
•auxiliary
•light
•duty cycle
the relay can also be associated with the status of the on-off controller

Mode, Control, Operating

Control is performed in **“cool” mode** (ID) whereas for all the ICs the **mode** can be selected (cool/heat or more generally, direct/reverse), see fig. 4.

Relay operating has to be on-off, as can be seen in the diagram; this depends on the type of control that is generally based on two points (enabling or disabling of relay), and the status of the specific output is permanently active or not depending on the control variables (temperature or input value, set point, differential).

This applies to most of our instruments.

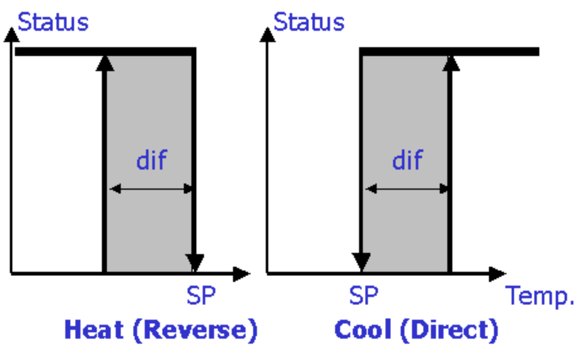

fig. 4

In some applications, more precise control that does however use relays is useful. Here are some examples that will be examined in more detail in the next bulletin:

- Soft Start (automatic rise of set point, usually during heating processes. e.g. IC LXs)
- Dynamic set point (change depending on external analogue signal; e.g.. ECHs, ERTs, IC 915 Ds)
- PID (control based on proportional, integral and derivative calculation usually during heating processes. e.g.. IC 917s, EWTQs, EWTNs and some EWTRs)

Sometimes, different outputs from those described here are used (modulation outputs, for example); these will also be discussed shortly.

TRIAC and on-off control

In addition to relays that are passive components, active (semiconductor) components are also present, so-called because of their ability to supply high value power for a applied signal with lower power.

Of the many types of semiconductor (diode) components, we will mention the **Triac** (bi-directional SCR diode or alternate current triode), that is used on some instruments, the FanCoilBasicom, for example.

Advantages and disadvantages: the relay can operate at any voltage within the maximum value (therefore also with no-load) and this allows simple wiring – the Triac operates at a specific voltage with limitations, use of the external relay, for example; the relay, on the other hand, contains moving parts and is therefore subjected to wear and tear and is noisy whereas the Triac is not subjected to wear and tear and is very quiet.

This demonstrates how useful this solution is in fan coil applications in hotels and offices where a low noise level and high number of cycles (step fan with auto setting) are decisive factors with reduced loads involved.

The Triac is also used on other controllers (EWCM 412s and most ECH/ERT 200s) to supply variable voltage (to check condensation).

It can sometimes be used externally on some of our instruments; this is a solution adopted, although not strictly necessary, in **PID control** and will be discussed in a separate Technical Support Bulletin.

Relay summary table

(used on IDs and ICs; for other products, contact Technical Support).

current, A referring to component	current, A referring to controller		power, HP
	screw terminal, fixed	screw terminal, removable	
5	5(2)	5(2)	1/4
8	8(3)	8(3)	1/2
16	15(8)	12(8)	1
30	**16(-)**	**12(-)**	2

ID relay table

(Opt.= the option present at produced code level, in fourth place e.g.. ID2**3**...)

Mod.	Opt.	Relay and current (A) referring to controller, fixed screw connector (all: 250VAC)			
ID961/ ID961LX	**1**		8(3)A, SPDT		
	6		15(8)A, SPDT		
	7		16(-)A, SPST		
ID961A total current on shared contact: 15 A max	**A**		8(3)A, SPDT		8(3)A, SPST
	B		8(3)A, SPDT		15(8)A, SPST
ID970/ ID970LX	**2**	8(3)A, SPDT	8(3)A, SPST		
	8	8(3)A, SPDT	15(8)A, SPST		
	9	8(3)A, SPDT	16(-)A, SPST		
ID971/ ID971LX	**2**	8(3)A, SPDT	8(3)A, SPST		
	8	8(3)A, SPDT	15(8)A, SPST		
	9	8(3)A, SPDT	16(-)A, SPST		
ID974/ ID974LX total current on shared contact: 15 A max	**3**	8(3)A, SPDT	8(3)A, SPST	5(2)A, SPST	
	C	8(3)A, SPDT	15(8)A, SPST	8(3)A, SPST	
ID975LX	**4**	8(3)A, SPST	8(3)A, SPST	5(2)A, SPST	5(2)A, SPST
ID985LX (983)	**4 (2)**	8(3)A, SPDT	8(3)A, SPST	8(3)A, SPST	5(2)A, SPST

IC relay table
(Opt.= the option present at produced code level, in fourth position, see above)

Mod.	**Opt.**	**Relay and current (A) referring to controller, fixed screw connector (all: 250VAC)**		
IC901 IC901/A	**1**	8(3)A, SPDT		
	6	15(8)A, SPDT		
	7	16(-)A, SPST		
	A	8(3)A, SPDT		8(3)A, SPST
	B	8(3)A, SPDT		15(8)A, SPST
IC902	**1**	8(3)A, SPDT		
	6	15(8)A, SPDT		
	7	16(-)A, SPST		
IC912 IC912LX (PTC/NTC/PT100-TCJ/K)	**1**	8(3)A, SPDT		
	6	15(8)A, SPDT		
	7	16(-)A, SPST		
	A	8(3)A, SPDT		8(3)A, SPST
IC912 IC912LX (V-I-Pressure, RH%)	**1**	8(3)A, SPDT		
IC915 IC915LX (PTC/NTC)	**2**	8(3)A, SPDT	8(3)A, SPST	
	D	8(3)A, SPDT	8(3)A, SPDT	
IC915 IC915LX (PT100-TCJ/K)	**2**	8(3)A, SPST	8(3)A, SPST	
IC915 IC915LX (V-I-Pressure-RH%)	**2**	8(3)A, SPDT	8(3)A, SPST	
IC917 IC917LX (PTC/NTC)	**2**	8(3)A, SPDT	8(3)A, SPST	
IC917 IC917LX (PT100-TCJ/K)	**2**	8(3)A, SPST	8(3)A, SPST	
IC974, IC974LX (PTC/NTC)	**4**	8(3)A, SPST	8(3)A, SPST	8(3)A, SPDT (defrost) & 5(2)A, SPST

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