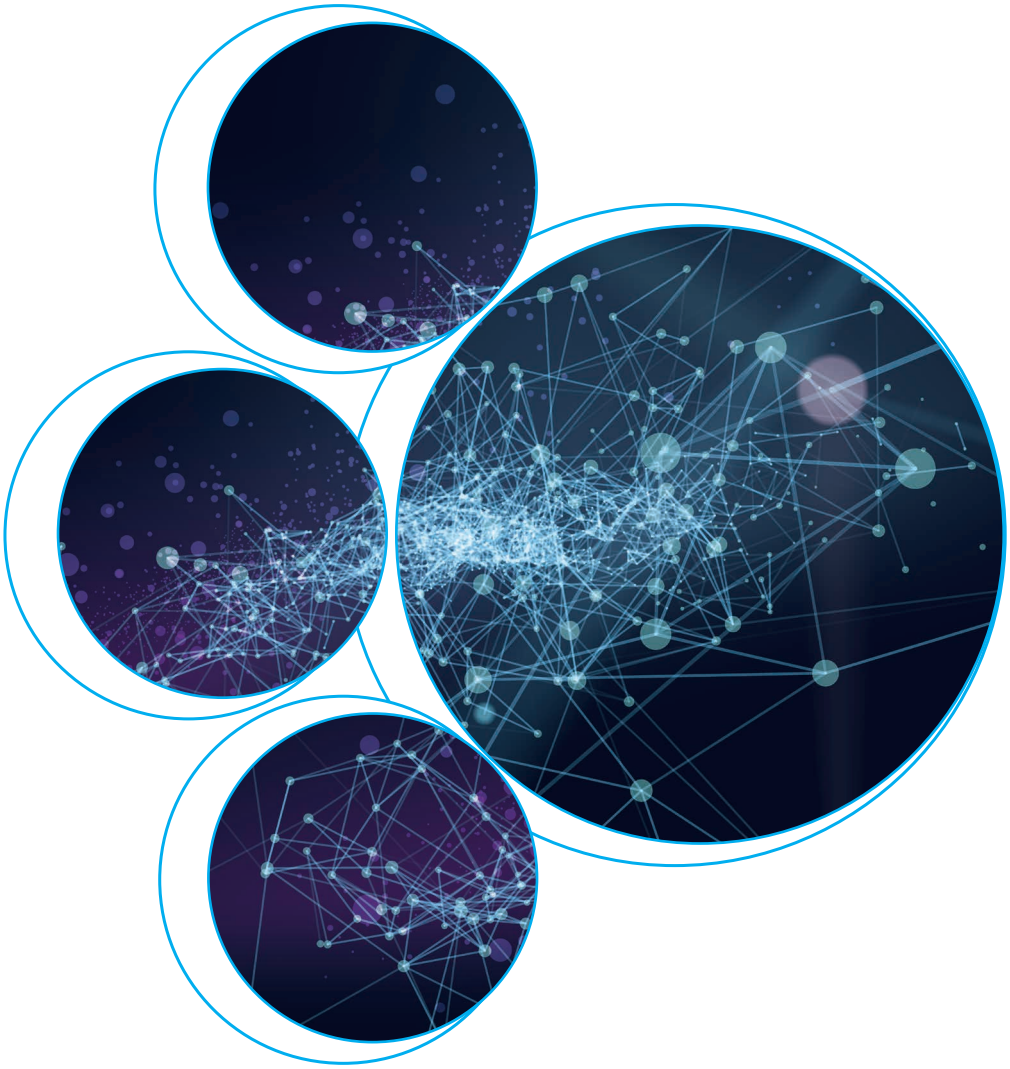
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SWITCH TO THE FUTURE

Index - General technical information



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Reference standards

Unless expressly indicated otherwise, the products shown in this catalogue are designed and manufactured according to the requirements of the following European and International Standards:
- **EN 61810-1**, **EN 61810-2**, **EN 61810-7** for electromechanical elementary relays
- **EN 61810-3** for relays with forcibly guided contacts
- **EN 61812-1** for timers
- **EN 60669-1** and **EN 60669-2-2** for electromechanical step relays
- **EN 60669-1** and **EN 60669-2-1** for light-dependent relays, electronic step relays, light dimmers, staircase switches, time switches, movement detectors and monitoring relays.

Other important standards, often used as reference for specific applications, are:
- **EN 60335-1** and **EN 60730-1** for domestic appliances
- **EN 50178** for industrial electronic equipments

Reference values and tolerances

Unless expressly indicated otherwise, all technical data is specified under the following environmental conditions:
- ambient temperature: 23 °C ± 5 K
- pressure: 96 ± 10 kPa
- humidity: 50 ± 25%
- altitude: from sea level to 2000 m. Higher altitudes will not affect current or temperature ratings, but will require a de-rating of the rated impulse voltage - which must be reduced by 14% at 3000 m, 29% at 4000 m, 48% at 5000 m

The following tolerances apply:
- coil resistance, rated consumption and rated power: ± 10%
- frequency: ± 2%
- dimensions indicated in the mechanical drawings: ± 0.1 mm

Regulations for storage and handling of goods

All Finder products are packaged individually and / or in multiple packages and boxes that are designed to facilitate warehousing, identification, storage and handling.
To ensure optimum performance and quality over time, the following regulations must be adhered to:
- ALWAYS move pallets by forklift and / or other suitable equipment for moving and handling goods.
- Handle products with caution, avoiding dropping, falling or other violent mechanical stress (such as shock, compression and abrasion) that could compromise their integrity and functionality.
- Store the product in dry areas, in accordance with the "storage temperature range" guidelines.
- Maintain in the vertical position the packages and boxes, which have been designed to protect the contents more effectively this way.
- To simplify the identification and traceability of products, store them in their original packaging until they are used.
- Keep the original packaging closed, in order to avoid the accumulation of dust on the products; and to reduce their exposure to direct sunlight.
- In cases such as e-commerce, when and where necessary, use additional packaging to avoid potential damage from automatic sorting systems.
- Avoid using products found in packaging with visible signs of damage or tampering.

Operating & installation conditions

Coil operating range
In general, Finder relays will operate over the full specified temperature range, according to:
• Class 1 - 80% to 110% of nominal coil voltage, or
• Class 2 - 85% to 110% of nominal coil voltage.
Outside the above Classes, coil operation is permitted according to the limits shown in the appropriate "R" chart.
Unless expressly indicated otherwise, all relays are suitable for 100% Duty Cycle (continuous energisation) and all AC coil relays are suitable for 50 and 60 Hz frequency.

Excessive peak voltage limiting
Overvoltage protection (varistor for AC, diode for DC) is recommended in parallel with the coil for nominal voltages ≥ 110 V for the relays of 40, 41, 44, 46 series. LED + Varistor (for AC) or LED + diode (for DC) 99 series modules are perfectly suitable for this purpose.

Residual current
When AC relay coils are controlled via a proximity switch, or via cables having length > 10 m, the use of a 99 series "residual current bypass" module is recommended, or alternatively, fit a resistor of 62 kOhm/1 watt in parallel with the coil.

Ambient temperature
The Ambient temperature as specified in the relevant specification and "R" chart relates to the immediate environment in which the component is situated, as this may be greater than the ambient temperature in which the equipment is located. Refer to page XIV for more detail.

Condensation
Environmental conditions causing condensation or ice formation in the relay are not permitted.

Installed orientation
The component's specification is unaffected (unless expressly stated otherwise) by its orientation, (provided it is properly retained, eg by a retaining clip in the case of socket mounted relays).

RC contact suppression
If a resistor/capacitor network is placed across a contact to suppress arcing, it should be ensured that when the contact is open, the leakage current through the RC network does not give rise to a residual voltage across the load (typically the coil of another relay or solenoid) any greater than 10% of the load's nominal voltage - otherwise, the load may hum or vibrate, and reliability can be affected. Also, the use of an RC network across the contact will destroy the isolation normally afforded by the contact (in the open position).

Guidelines for automatic flow solder processes

In general, an automatic flow solder process consists of the following stages:

Relay mounting
Ensure that the relay terminals are straight and enter the PC board perpendicular to the PC board. For each relay, the catalogue illustrates the necessary PC board hole pattern (copper side view). Because of the weight of the relay, a plated through hole printed circuit board is recommended to ensure a secure fixation.

Flux application
This is a particularly delicate process. If the relay is not RT II or RT III rated (see page XIV), flux may penetrate the relay due to capillary forces, changing its performance and functionality.
Whether using foam or spray fluxing methods, ensure that flux is applied sparingly and evenly and does not flood through to the component side of the PC board.
By following the above precautions, and assuming the use of alcohol or water based fluxes, it is possible to satisfactorily use relays with protection category RT II or RT III.

Preheating
Set the preheat time and heat to just achieve the effective evaporation of the flux, taking care not to exceed a component side temperature of 120 °C (248 °F).

Soldering
Set the height of the molten solder wave such that the PC board is not flooded with solder. Ensure the solder temperature and time are kept to 260 °C (500 °F) and 5 seconds maximum.

Cleaning
The use of modern "no-clean" flux avoids the necessity of washing the PC boards.

In special cases, where the PC board must be washed, the use of wash-tight relays (option xxx1 - RT III) is mandatory.

In such case, after the soldering and before starting any cleaning process, it is necessary to assure an appropriate cooling of the assemblies, in order to reduce thermal stress and avoid pressure difference between relay interior and ambient, both conditions which could cause cracking of the sealing.

Ultrasonic cleaning is generally not allowed. Aggressive solvents must be avoided: the user should establish compatibility between his cleaning fluid and the relay plastics. In washing cycles, the solvent temperature must not be higher than 50 °C, and the difference of the temperature of cleaning and rinsing liquids must not exceed 10 °C.

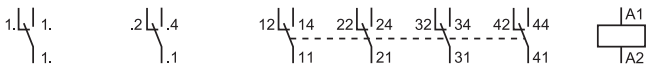
After cleaning it is suggested to break the pin on the relay cover. This is necessary to guarantee the electrical life at maximum load as quoted in the catalogue; otherwise ozone generated inside the relay (dependent on the switching load and frequency) will significantly reduce the electrical life.

Terminology & definitions

All the following terms used in the catalogue are commonly used in technical language. However, occasionally, National, European or International Standards may prescribe the use of different terms, in which case these will be mentioned in the appropriate descriptions that follow.

Terminal marking

European Standard EN 50005 recommends the following numbering for the marking of relay terminals:
- .1 for common contact terminals (e.g. 11, 21, 31…)
- .2 for NC contact terminals (e.g. 12, 22, 32…)
- .4 for NO contact terminals (e.g. 14, 24, 34…)
- A1 and A2 for coil terminals
- B1, B2, B3 etc. for Signal inputs
- Z1 & Z2 for potentiometer or sensor connection



Pole Number | Contact configuration Number | Example: Relay with 4 poles

For delayed contacts of timers the numbering will be:
- .5 for common contact terminals (e.g. 15, 25,…)
- .6 for NC contact terminals (e.g. 16, 26,…)
- .8 for NO contact terminals (e.g. 18, 28,…)

American standards prescribes:
progressive numbering for terminals (1,2,3,…13,14,…) and sometimes A and B for coil terminals.

Contact specification

Symbol	Configuration	EU	D	GB	USA
	Make contact (Normally Open)	NO	S	A	SPST-NO DPST-NO nPST-NO
	Break contact (Normally Closed)	NC	Ö	B	SPST-NC DPST-NC nPST-NC
	Changeover	CO	W	C	SPDT DPDT nPDT

n = number of poles (3,4,…), S = 1 and D = 2

Contact Set
The contact set comprises all the contacts within a relay.

Single contact
A contact with only one point of contact.

Twin/Bifurcated contact
A contact with two points of contact, which are effectively in parallel with each other. Very effective for switching small contact loads such as analogue, transducer, low signal or PLC input circuits.

Double break contact
A contact comprising two points of contact in series with each other. Particularly effective for switching DC loads. The same effect can be achieved by wiring two single contacts in series.

Micro interruption
Interruption of a circuit, without any specific requirements for distance or dielectric strength across the contact gap. All Finder relays comply or exceed this.

Micro disconnection
Adequate contact separation in at least one contact so as to provide functional safety. A dielectric strength requirement must be achieved across the contact gap. All Finder relays comply with this class of disconnection.

Full disconnection
Contact separation for the disconnection of conductors so as to provide the equivalent of basic insulation between those parts intended to be disconnected. There are requirements for both the dielectric strength and the dimensioning of the contact gap. Several Finder relays comply with this category of disconnection.

Rated current
This coincides with the *Limiting continuous current* - the highest current that a contact can continuously carry within the prescribed temperature limits. It also coincides with the *Limiting cycling capacity*, i.e. the maximum current that a contact is capable of making and breaking under specified conditions. In virtually all cases the Rated current is also the current that, when associated with the Rated switching voltage, gives rise to the Rated load (AC1). (The exception being the 30 series relay).

Maximum peak current
The highest value of inrush current (≤ 0.5 seconds) that a contact can make and cycle (duty cycle ≤ 0.1) without undergoing any permanent degradation of its characteristics due to generated heat. It also coincides with the *Limiting making capacity*.

Rated switching voltage
This is the switching voltage that when associated with the Rated current gives rise to the Rated load (AC1). The Rated load is used as the reference load for electrical life tests.

Maximum switching voltage
This represents the maximum nominal voltage that the contacts are able to switch and for the relay to meet the insulation and design requirements called for by the insulation coordination standards.

Rated load AC1

The maximum AC resistive load (in VA) that a contact can make, carry and break repeatedly, according to classification AC1 (see Table 1). It is the product of rated current and rated voltage, and is used as the reference load for electrical life tests.

Rated load AC15

The maximum AC inductive load (in VA) that a contact can make, carry and break repeatedly, according to classification AC15 (see Table 1), called "AC inductive load" in EN 61810-1, Annex B.

Single-phase motor rating

The nominal value of motor power that a relay can switch.
(The figures are given in kW; the horsepower rating can be calculated by multiplying the kW value by 1.34 i.e. 0.37 kW = 0.5 HP).
Note: "inching" or "plugging" is not permitted.
If reversing motor direction, always allow an intermediate break of > 300 ms, otherwise an excessive inrush peak current (caused from change of polarity of motor capacitor) may occur, causing contact welding.

Nominal lamp ratings

Lamp ratings for 230 V AC supply for:
- Incandescent (or halogen) lamps
- Fluorescent lamps with electronic or electromechanical ballast
- CFL (Compact Fluorescent Lamps) or LED lamps
- LV (Low voltage) halogen or LED lamps with electronic or electromechanical ballast

Breaking capacity DC1

The maximum value of DC resistive current that a contact can make, carry and break repeatedly, according to classification DC1 (see Table 1).

Minimum switching load

The minimum values of power, voltage and current that a contact can reliably switch. For example, if minimum values are 300 mW, 5 V/5 mA:
- with 5 V the current must be at least 60 mA;
- with 24 V the current must be at least 12.5 mA;
- with 5 mA the voltage must be at least 60 V.

For gold contact variants, loads no less than 50 mW, 5 V/2 mA are suggested. With 2 gold contacts in parallel, it is possible to switch 1 mW, 0.1 V/1 mA.

Test conditions for contact data and charts

Unless otherwise specified, the following test conditions apply:
- Tests performed at the maximum ambient temperature.
- Relay coil (AC or DC) energised at rated voltage.
- Load test applied to the NO contacts; generally the rated AC1 current for the NC contacts is the same, but the electrical life and/or the other ratings (AC15, DC, motor, lamp) can be lower, information on request. For a CO contact, the rated values and third-party life tests are based on a single load being controlled by either the NO or the NC side, but a "secondary" load ≤10% of the rated load is generally acceptable on the other side of the CO.
- Switching frequency for elementary relays: 900 cycles/h with 50% duty cycle (can be 25% or less for relays with rated current ≥16 A).
- Switching frequency for step relays: 900 cycles/h for the coil, 450 cycles/h for the contact, 50% duty cycle.
- Electrical life expectancy values and ratings other than AC1 (AC15, DC, motor, lamp) are generally valid for relays with standard contact material; data for optional materials are available on request.

Electric life tests

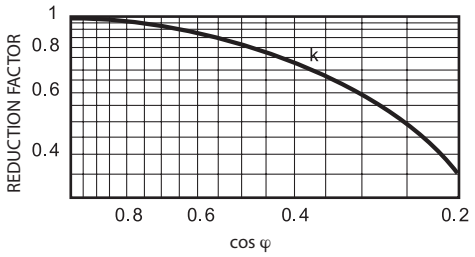
The Electrical life at rated load AC1, as specified in the Technical data, represents the life expectancy for an AC resistive load at rated current and 250 V.
(This value can be used as the relay B_{10} Value; see "Electrical life "F-chart" and "Reliability" sections).

Electrical life "F-chart"

The "Electrical life (AC) v contact current" chart indicates the life expectancy for an AC resistive load for different values of contact current. Some charts also indicate the results of electrical life tests for inductive AC loads
In general, the reference load voltage applicable to these life expectancy charts is Un = 250 V AC. However, the life indicated can also be assumed to be approximately valid for voltages between 125 V to 277 V. Where the life expectancy chart shows a curve for 440 V, the life indicated can also be assumed to be approximately valid for voltages up to 480 V.
Note: Life, or number of cycles, from these charts can be taken as indicating the B_{10} statistical value for the purposes of reliability calculations. And, this value multiplied by 1.4 could be taken as an approximation to the related MCTF (Mean Cycles To Failure) figure. (Failure, in this case, refers to the contact "wear-out" mechanism that occurs at relatively high contact loads.)
Predicting life expectancy at voltages lower than 125 V:
For load voltages < 125 V (i.e. 110 or 24 V AC), the electrical life will rise significantly with decreasing voltage. (A rough estimate can be made using a multiplying factor of 250/2Un and applying it to the life expectancy appropriate to the 250 V load voltage).
Estimating switching current at voltages greater than 250 V:
For load voltages higher than 250 V (but less than the maximum switching voltage specified for the relay), the maximum contact current should be limited to the Rated load AC1 divided by the voltage being considered. For example, a relay with rated current and rated load AC1 of 16 A and 4000 VA respectively, is able to switch a maximum current of 10 A at 400 V AC: the corresponding electrical life will be approximately the same as that at 16 A/250 V.

Load reduction factor versus Cos φ

The load current for AC loads which comprise both an inductive and resistive component can be estimated by applying a reduction factor (k) to the resistive contact current (according to the load's Cos φ). Such loads should not be taken as appropriate for electric motors or fluorescent lamps, where specific ratings are quoted. They are however, appropriate for inductive loads where the current and Cos φ are substantially the same at "make" and "break", and are also widely specified by international relay standards as reference loads for performance verification and comparison.



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TABLE 1 ***Contact load classifications***

(related to the utilization categories defined in EN 60947-4-1 and EN 60947-5-1)

Load classification	Supply type	Application	Switching with relay
AC1	AC single-phase AC three-phase	Resistive or slightly Inductive AC loads.	Work within the relay data.
AC3	AC single-phase AC three-phase	Starting and stopping of Squirrel cage motors. Reversing direction of rotation only after motor has stopped rotating. Three-phase: Motor reversal is only permitted if there is a guaranteed break of 50 ms between energisation in one direction and energisation in the other. Single-phase: Provision of 300 ms "dead break" time when neither relay contacts are closed - during which time the capacitor discharges harmlessly through the motor windings.	For single-phase: keep to the relay data. For three-phase: see "Three-phase motors" section.
AC4	AC three-phase	Starting, Stopping and Reversing direction of rotation of Squirrel cage motors. Jogging (Inching). Regenerative braking (Plugging).	Not possible using relays. Since, when reversing a phase connection, severe contact arcing will occur.
AC14	AC single-phase	Control of small electromagnetic loads (< 72 VA), power contactors, magnetic solenoid valves, and electromagnets.	Assume a peak inrush current of approx. 6-times rated current, and keep this within the the specified "Maximum peak current" for the relay.
AC15	AC single-phase	Control of small electromagnetic loads (> 72 VA), power contactors, magnetic solenoid valves, and electromagnets.	Assume a peak inrush current of approx. 10-times rated current, and keep this within specified "Maximum peak current" for the relay.
DC1	DC	Resistive loads or slightly inductive DC loads. (The switching voltage at the same current can be doubled by wiring 2 contacts in series).	Work within relay data (see the diagram "Maximum DC1 breaking capacity").
DC13	DC	Inductive DC loads such as contactor coils, electrovalves, electromagnets	This assumes no inrush current, although the switch off over-voltage can be up to 15 times the rated voltage. An approximation of the relay rating on a DC inductive load with 40 ms L/R can be made using 50% of the DC1 rating. If a freewheeling diode is wired in parallel to the load, it can be considered the same value as DC1. See the diagram "Maximum DC1 breaking capacity"

TABLE 2.1 *Certified products ratings*

R = Resistive / GP = General Purpose / GU = General Use / SB = Standard Ballast /I = Inductive (cosφ 0.4) / B = Ballast / NO = N.O. type

Type	UL file No.	Ratings				Open Type Devices	Pollution degree	Max Surrounding Air Temperature
		AC/DC	"Motor Load" Single phase		Pilot Duty			
			110-120	220-240				
34.51	E106390	6 A – 250 Vac (GP)			B300 – R300	Yes	2	40 °C
34.81.7.XXX.7048	E106390	0.1 A – 48 Vdc (GU)	/	/	/	Yes	1	70 °C
34.81.7.XXX.7220	E106390	0.2 A – 220 Vdc (GU)	/	/	/	Yes	1	70 °C
34.81.7.XXX. 8240	E106390	2 A – 277 Vac (GU)	/	/	1.25 A-120 Vac 0.63 A-240 Vac	Yes	1	50 °C
34.81.7.XXX.9024	E106390	6 A – 24 Vdc (GU)	/	/	1.5 A – 24 Vdc	Yes	1	70 °C
40.31 – 40.51	E81856	10 A – 250 Vac (R)		1/3 Hp (250 V)	/	Yes	/	85 °C
40.52	E81856	8 A – 250 Vac (R) 8 A – 277 Vac (GP) 8 A – 30 Vdc (GP)	1/6 Hp (4.4 FLA)	1/3 Hp (3.6 FLA)	R300	Yes	/	85 °C
40.61	E81856	15 A – 250 Vac (R)		½ Hp (250 V)	/	Yes	/	85 °C
40.31 – 40.51 NEW	E81856	12 A – 277 Vac (GU) 12 A – 30 Vdc (GU)	1/3 Hp (7.2 FLA/43.2 LRA)	¾ Hp (6.9 FLA/41.4 LRA)	B300	Yes	2 or 3	85 °C
40.52 NEW	E81856	8 A – 250 Vac (R) 8 A – 277 Vac (GP) 8 A – 30 Vdc (GP)	1/4 Hp	1/2 Hp	B300	Yes	2 or 3	85 °C
40.61 NEW	E81856	16 A – 277 Vac (GU) 16 A – 30 Vdc (GU) (AgCdO) 12 A – 30 Vdc (GU) (AgNi) 16 A – 24 Vdc (GU) ($AgSnO_2$)	1/3 Hp (7.2 FLA/43.2 LRA)	¾ Hp (6.9 FLA/41.4 LRA)	B300	Yes	2 or 3	85 °C
40.62	E81856	10 A – 277 Vac (GU) 10 A – 24 Vdc (GU)	¼ Hp (only NO)	½ Hp (AgNi) (Only NO) ¾ Hp ($AgSnO_2$) (Only NO)	B300 (Only NO) 1 A – 30 Vdc (Only NO)	Yes	2 or 3	85 °C
40.11 – 40.41	E81856	10 A – 240 Vac (R) 5 A – 240 Vac (I) 10 A – 250 Vac (GP) 8 A – 24 Vdc 0.5 A – 60 Vdc 0.2 A – 110 Vdc 0.12 A – 250 Vdc	/	½ Hp (250 V)	/	Yes	/	70 °C
41.31	E81856	12 A – 277 Vac (GU) 12 A – 277 Vac (R)	1/4 Hp (5.8 FLA)	½ Hp (4.9 FLA)	B300 – R300	Yes	2 or 3	40 or 70 °C with a minimum distance among relay of 5 mm
41.61	E81856	16 A – 277 Vac (GU-R) 8 A – 277 Vac (B)	¼ Hp (5.8 FLA)	½ Hp (4.9 FLA)	B300 – R300	Yes	2 or 3	40 or 70 °C with a minimum distance among relay of 5 mm
41.52	E81856	8 A – 277 Vac (GU-R) 8 A – 30 Vdc (GU; NO)		½ Hp (277 V) (4.1 FLA)	B300	Yes	2 or 3	40 or 70 °C with a minimum distance among relay of 5 mm
43.41	E81856	10 A – 250 Vac (GU-R) 4 A – 30 Vdc (R)	¼ Hp (5.8 FLA)	½ Hp (4.9 FLA)	B300 – R300	Yes	2 or 3	40 or 85 °C
43.61	E81856	10 A – 250 Vac (GU-R) (AgCdO) 16 A – 250 Vac (GU) (AgNi) 16 A – 250 Vac (R) (AgCdO)	¼ Hp (5.8 FLA) (AgCdO) 1/3 Hp (7.2 FLA) (AgNi)	½ Hp (4.9 FLA) (AgCdO) ¾ Hp (6.9 FLA) (AgNi)	B300 – R300	Yes	2 or 3	40 or 85 °C
44.52	E81856	6 A – 277 Vac (R)	1/8 Hp (3.8 FLA)	1/3 Hp (3.6 FLA)	/	Yes	/	85°C
44.62	E81856	10 A – 277 Vac (R)	¼ Hp (5.8 FLA)	¾ Hp (6.9 FLA)	/	Yes	/	85°C
45.31	E81856	16 A – 277 Vac (GU)(AgNi) 16 A – 30 Vdc (GU)(AgNi)	1/3 Hp (7.2 FLA) (AgNi; NO)	1 Hp (8 FLA) (AgNi)	/	Yes	2 or 3	105 or 125 °C with a minimum distance among relay of 10 mm
45.71	E81856	16 A – 240 Vac (GU) 16 A – 30 Vdc (GU) (AgCdO) 16 A – 277 Vac (GU) 16 A – 30 Vdc (NO-GU) 12 A – 30 Vdc (NC-GU) (AgNi)	½ Hp (9.8 FLA) (AgCdO) 1/3 Hp (7.2 FLA) (AgNi; NO)	1 Hp (8 FLA) (AgNi)	/	Yes	2 or 3	105 or 125 °C with a minimum distance among relay of 10 mm
45.91	E81856	16 A – 277 Vac (GU)(AgNi) 16 A – 30 Vdc (GU)(AgNi)	1/6 Hp (4.4 FLA)	½ Hp (4.9 FLA)	/	Yes	2 or 3	105 or 125 °C with a minimum distance among relay of 10 mm
46.52	E81856	8 A – 277 Vac (GU) 6 A – 30 Vdc (R)	¼ Hp (5.8 FLA/34.8 LRA)	½ Hp (4.9 FLA/29.4 LRA)	B300 – R300	Yes	2 or 3	70 °C
46.61	E81856	16 A – 277 Vac 12 A(NO)-10 A (NC) 30 Vdc (AgNi) 10 A(NO)-8 A(NC) 30 Vdc ($AgSnO_2$)	1/3 Hp (7.2 FLA/43.2 LRA)	¾ Hp (6.9 FLA/41.4 LRA)	B300 – R300 (AgNi) A300 – R300 ($AgSnO_2$)	Yes	2 or 3	70 °C

TABLE 2.1 cULus *Certified products ratings*

R = Resistive / GP = General Purpose / GU = General Use / SB = Standard Ballast /I = Inductive (cosφ 0.4) / B = Ballast / NO = N.O. type

Type	UL file No.	Ratings				Open Type Devices	Pollution degree	Max Surrounding Air Temperature
		AC/DC	"Motor Load" Single phase		Pilot Duty			
			110-120	220-240				
50	E81856	8 A – 277 Vac (GU) 8 A – 30 Vdc (GU)	1/3 Hp (7.2 FLA/43.2 LRA) (Only NO)	½ Hp (4.9 FLA/29.4 LRA) (Only NO)	B300 (NO only)	Yes	2 or 3	70 °C with a minimum distance among relay of 5 mm
55.X2 – 55.X3	E106390	10 A – 277 Vac (R) 10 A – 24 Vdc (R) (55.X2) 5 A – 24 Vdc (R) (55.X3)	1/3 Hp (7.2 FLA)	¾ Hp (6.9 FLA)	R300 (2 CO only)	Yes	/	40 °C
55.X4	E106390	7 A – 277 Vac (GP) 7 A – 30 Vdc (GP) (Std/Au contact) 5 A – 277 Vac (R) 5 A – 24 Vdc (R) (AgCdO contact)	1/8 Hp (3.8 FLA)	1/3 Hp (3.6 FLA)	R300	Yes	/	55°C
56	E81856	12 A – 277 Vac (GU) 12 A – 30 Vdc (GU) (AgNi; NO) 8 A – 30 Vdc (GU) (AgNi; NC) 12 A – 30 Vdc (GU) (AgCdO) 10 A – 30 Vdc (GU) ($AgSnO_2$; NO) 8 A – 30 Vdc (GU) ($AgSnO_2$; NC)	½ Hp (9.8 FLA)	1 Hp (8 FLA)	B300	Yes	2 or 3	40 or 70 °C
60	E81856	10 A – 277 Vac (R) 10 A – 30 Vdc (GU)	1/3 Hp (7.2 FLA)	1 Hp (8 FLA)	B300 (AgNi only) R300	Yes	/	40 °C
62	E81856	15 A – 277 Vac (GU) 10 A – 400 Vac (GU) 8 A – 480 Vac (GU) 15 A – 30 Vdc (GU)	¾ Hp (13.8 FLA)	2 Hp (12 FLA) 1 Hp (480 Vac - 3 Ø) (2.1 FLA) (NO)	B300 (AgCdO) R300	Yes	2 or 3	40 or 70 °C
62.XX.9.XXX.X2XXS	E81856	16 A – 277 Vac (GU) 16 A – 30 Vdc (GU) 1.6 A – 110 Vdc (GU)	/	/	/	Yes	2 or 3	85 °C
62.31.9.XXX.4800	E81856	12 A – 240 Vdc (GU) 16 A – 125 Vdc (GU) 16 A – 30 Vdc (GU)	/	/	/	Yes	2 or 3	70 °C
62.32.9.XXX.4800	E81856	6 A – 240 Vdc (GU) 12 A – 125 Vdc (GU) 16 A – 30 Vdc (GU)	/	/	/	Yes	2 or 3	70 °C
65.31 65.61	E81856	20 A – 277 Vac (GU)	3/4 Hp (13.6 FLA)	2 Hp (12.0 FLA)	/	Yes	/	70 °C
65.31 NO 65.61 NO		30 A – 277 Vac (GU)						
65.31-S 65.61-S (DC coil and NO type only)		35 A – 277 Vac (GU)	/	/				85 °C
66	E81856	30 A – 277 Vac (GU) (NO) 10 A – 277 Vac (GU) (NC) 24 A – 30 Vdc (GU) (NO) 30 A – 30 Vdc (GU) (X6XX type only)	1 Hp (16.0 FLA/96 LRA) (AgCdO, NO only) ½ Hp (9.8 FLA/58.8 LRA) (AgNi, NO only)	2 Hp (12.0 FLA/72 LRA) (NO only)	/	Yes	2 or 3	70 °C with a minimum distance among relay of 20 mm
67	E81856	50 A – 277 Vac (GU) 50 A – 480 Vac (GU) (three phases)	/	/	/	Yes	3	85 °C (60 °C – x50x)
67 1301-1501	E81856	50 A – 277 Vac (GU) 50 A – 480 Vac (GU) (three phases)	1 ½ Hp (20 FLA/120 LRA)	3 Hp (17 FLA/102 LRA) 15 Hp – 480 Vac – 3 Ø (21 FLA/116 LRA)	/	Yes	3	60°C (GU) or 40 °C
67 4301-4501	E81856	50 A – 277 Vac (GU) 50 A – 480 Vac (GU) (three phases)	1 ½ Hp (20 FLA/120 LRA)	3 Hp (17 FLA/102 LRA) 10 Hp – 480 Vac – 3 Ø (14 FLA/81 LRA)	/	Yes	3	60°C (GU) or 40 °C
20	E81856	16 A – 277 Vac (R) 1000 W Tung. 120 V 2000 W Tung. 277 V	½ Hp (9.8 FLA)	/	/	Yes	/	40 °C
85.02 – 85.03	E106390	10 A – 277 Vac (R) 10 A – 24 Vdc (R) (55.X2) 5 A – 24 Vdc (R) (55.X3)	1/3 Hp (7.2 FLA)	¾ Hp (6.9 FLA)	R300 (2 CO only)	Yes	/	40 °C
85.04	E106390	7 A – 277 Vac (GP) 7 A – 30 Vdc (GP) (Std/Au contact) 5 A – 277 Vac (R) 5 A – 24 Vdc (R) (AgCdO contact)	1/8 Hp (3.8 FLA)	1/3 Hp (3.6 FLA)	R300	Yes	/	55°C
86	E106390	/	/	/	/	Yes	2	35 or 50 °C
99	E106390	/	/	/	/	Yes	2 or 3	50 °C
7T.81…2301 7T.81…2401	E337851	10 A – 250 Vac (R)		1 ½ Hp (250 Vac) (10 FLA)	/	Yes	2	–20 / +40 °C
7T.81…2303 7T.81…2403	E337851	10 A – 250 Vac (R)		1 ½ Hp (250 Vac) (10 FLA)	/	Yes	2	0 / +60 °C

TABLE 2.2 c UL us *Certified products ratings*

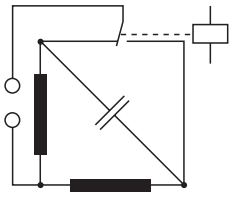
R = Resistive / GP = General Purpose / GU = General Use / SB = Standard Ballast /I = Inductive (cosφ 0.4) / B = Ballast / NO = N.O. type

Type	UL file No.	Ratings				Open Type Devices	Pollution degree	Max Surrounding Air Temperature
		AC/DC	"Motor Load" Single phase		Pilot Duty			
			110-120	220-240				
19.21	E81856	10 A – 250 Vac (GU)	¼ Hp	½ Hp	B300 – R300	Yes		50 °C
22.32 – 22.34	E81856	25 – 277 Vac (GU) 25 A – 30 Vdc (GU) 20 A – 277 Vac (B)	3/4 Hp (13.8 FLA / 82.8 LRA) (AgNi ; N.O.) 1/2 Hp (9.8 FLA / 5.8 LRA) ($AgSnO_2$; N.O.)	2 Hp (12 FLA / 72 LRA) (AgNi ; N.O.) 1.5 Hp (10 FLA / 60 LRA) ($AgSnO_2$; N.O.) Three phase (22.34 N.O. only) 3 Hp (9.6 FLA / 64 LRA)	A300	Yes	2	50 °C
0.22.33 – 0.22.35	E81856	5 A – 277 Vac (GU)			B300	Yes	2	50 °C
70.61	E106390	6 A – 250 Vac (R) 6 A – 24 Vdc (R)	/	/	/	Yes	2	50 °C
72.01 – 72.11	E81856	15 A – 250 Vac (R)	/	½ Hp (250 Vac) (4.9 FLA)	/	Yes	2 or 3	50 °C
77.01.0-.8	E359047	5 A – 240 Vac (GU) 3 A – 277 Vac (SB)	1/10 Hp			Yes	2	50 °C
77.01.9.024.9024	E359047	12 A – 24 Vdc (GU)	5 A FLA/50 A LRA 24 Vdc			Yes	2	50 °C
77.01.9.024.9125	E359047	6 A – 120 Vdc (GU)	1/6 Hp - 120 Vdc			Yes	2	50 °C
77.11	E359047	15 A – 277 Vac (GU-B)	¾ Hp	1 Hp	/	Yes	2	45 °C
77.31	E359047	30 A – 400 Vac (GU) 30 A – 277 Vac (B)	¾ Hp	1 Hp ½ Hp (480 Vac)	/	Yes	2	40 °C
80.01-11-21-41-51-91…X(0 or P)XXX	E172124	10 A – 250 (R)		¾ Hp (250 Vac) (NO only)	B300 (NO only)	Yes	2	40 °C
80.61	E172124	8 A – 250 (GU;R)	/	1/3 Hp (250 Vac) (3.6 FLA)	R300	Yes	2	40 °C
80.82	E172124	6 A – 250 Vac (GU;R)	/	/	B300 – R300	Yes	2	40 °C
83.X1 – 83.X2	E81856	12 A – 250 Vac (GU)	/	/	/	Yes	2	50 °C
83.62	E81856	8 A – 250 Vac (GU)	/	/	/	Yes	2	50 °C
84	E81856	10A – 277 Vac 10 A – 30 Vdc	1/3 Hp (7.2 FLA/43.2 LRA)	¾ Hp (6.9 FLA/41.4 LRA)	B300 (NO only)	Yes	2	50 °C
7S	E172124	6 A – 250 Vac (GU same polarity) 6 A – 24 Vdc (GU)	/	/	B300 (NO only)	Yes	/	70 °C
7S.23	E172124	10 A – 250 Vac (GU same polarity) 6 A – 24 Vdc (GU)	/	/	B300 (NO only)	Yes	/	70 °C
78.1D – 78.1C	E361251	5 A – 24 Vdc (120 W)	/	/	/	Yes	2	40 °C
78.1B	E361251	4.5 A – 24 Vdc (108 W)	/	/	/	Yes	2	40 °C
78.2E	E361251	10 A – 24 Vdc (240 W)	/	/	/	Yes	2	40 °C

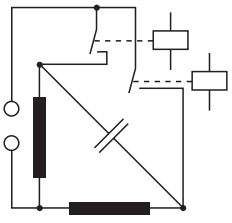
Capacitor start motors

Single phase 230 V AC capacitor start motors have a starting current of about 120% of the rated current. However, damaging currents can result from an instantaneous reversal of the direction of rotation. In the first diagram, high circulating currents can cause severe arcing across the contact gap, as the changeover contacts make an almost instantaneous reversal of polarity to the capacitor. Measurements have shown a peak current of 250 A for a 50 Watt motor, and up to 900 A for a 500 Watt motor. This inevitably leads to welding of the contacts.

Reversing the direction of such motors should therefore use two relays, as the second diagram shows, whereby in the control to the relay coils a "dead break" of approximately 300 ms is provided. The delay can either be provided by another control component such as a Timer, or through the Microprocessor etc., or by connecting a suitable NTC resistance in series with each relay coil. Cross interlocking the coil circuits of both relays will not produce the required delay! Moreover, the use of anti-weld contact material will not solve the problem.



Incorrect AC motor reversal:
Contact is in the intermediate state for less than 10 ms – insufficient time to allow the energy in the capacitor to dissipate before the electrical connection is remade to the opposite polarity.



Correct AC motor reversal:
Provision of 300 ms "dead break" time when neither relay contacts are closed - during which time the capacitor discharges harmlessly through the motor windings.

TABLE 2.3 *Certified sockets ratings*

Socket type	UL ratings	CSA ratings	Open Type Devices	Pollution degree (Installation environment)	Max Surrounding Air Temperature	System Overvoltage Category (max peak Voltage impulse)	Conductors to be used	Wire size (AWG)	Terminal tightening torque
90.02/03	10A-300V(60°C) 8A-300V(70°C)	10A 300V (max 20A Total Load)			70°C				
90.14/15	10A 300V	10A 300V max20A TL							
90.20/21/26/27	10A 300V	10A 250V							
90.82.3	10A 300V	10A 300V			70 °C			14-20 stranded and solid	7.08 lb.in. (0.8 Nm)
90.83.3	10A 300V	10A 300V			65 °C			14-20 stranded and solid	7.08 lb.in. (0.8 Nm)
92.03	16A 300V	10A 250V (max 20A Total Load)			70°C		75°C Cu only	10-24, stranded or solid	7.08 lb.in. (0.8 Nm)
92.13/33	16A 300V	10A 300V max20A TL							
93.01/51	6A 300V	6A 250V			60°C		75°C Cu only	14-24, stranded or solid	
93.02/52	2x10A 300V (60°C) 2x8A 300V (70°C)	2x10A 300V (60°C) 2x8A 300V (70°C)	Yes	2	60 or 70°C	II (2.5 kV)	75°C Cu only (CSA)		
93.11	6A 300V	6A 300V			70°C				
93.21	6A 300V	/	Yes	2	70°C				
93.60/65/ 66/67/69	6A 300V (40°C) 4A 300V (70°C)	6A 300V (40°C) 4A 300V (70°C)			40 or 70°C		75°C Cu only	14-24, stranded or solid	
93.61/62/ 63/64/68	6A 300V (40°C) 4A 300V (70°C)	6A 300V (40°C) 4A 300V (70°C)			40 or 70°C		75°C Cu only	14-24, stranded or solid	4.43 lb.in. (0.5 Nm)
09368141	100mA 24V	100mA 24V			70°C				
94.02/03/04	10A 300V	10A 250V (max 20A Total Load)			70°C		75°C Cu only	10-24 stranded, 12-24 solid	4.43 lb.in. (0.5 Nm)
94.12/13/14	10A 300V (4 pole: 5A 300V)	10A 300V max20A TL							
94.22/23/24	10A 300V	10A 250V							
94.33/34	10A 300V (4 pole: 5A 300V)	10A 300V max20A TL							
94.54	10A 300V		Yes		70 °C		Copper only	14-18-24 stranded and solid	
94.62/64	10A 300V	10A 250V							
94.72/73/74	10A 300V	10A 250V (94.74: max 20A Total Load)							
94.82	10A 300V	10A 250V							
94.82.3/92.3	10A 300V		Yes		70 °C				
94.84.3/94.3	10A 300V		Yes		55 °C				
94.82.2	10A 300V		Yes		50 °C				
94.84.2	7 A 300 V		Yes		50 °C				
94.P2/P3	10A 300V	10A 300V	Yes		70°C			14-26 stranded and solid	
94.P4	7A 300V	7A 300V	Yes		70°C			14-26 stranded and solid	
95.03/05	10A 300V	10A 250V (max 20A Total Load)			70°C		75°C Cu only	10-24 stranded, 12-24 solid	4.43 lb.in. (0.5 Nm)
95.13.2	12A 300V	10A 300V (max 20A Total Load)	Yes		70 °C with a minimum distance of 5 mm				
95.15.2	10A 300V	10A 300V (max 20A Total Load)	Yes		70 °C with a minimum distance of 5 mm				
95.55/55.3	10A 300V (40°C) 8A 300V (70°C)	10A 300V (40 °C) 8A 300V (70 °C)	Yes		40 or 70°C			14-24 stranded and solid	
95.23	10A 300V	10A 250V							
95.63/65	10A 300V	10A 250V							
95.75	10A 300V	10A 250V (max 20A TL)							
95.83.3/85.3/ 93.3/95.3	12A 300V		Yes		85 °C			14-18, stranded or solid	7.08 lb. in. (0.8 Nm)
95.P3/P5	10A 300V	10A 300V	Yes		70°C			14-26 stranded and solid	
96.02/04	12A 300V (50°C) 10A 300V (70°C)	12A 300V (50°C) 10A 300V (70°C)	Yes		50 or 70°C	III (4.0 kV)	60/75°C Cu only 75°C Cu only (CSA)	10-14, stranded or solid	7.08 lb.in. (0.8 Nm)
96.12/14	12A 300V	15A 250V							
96.72	16A 300V	10A 250V (max 20A Total Load)							
96.74	15A 300V	10A 250V (max 20A Total Load)							
97.01	16A 300V (50°C) 12A 300V (70°C)	16A 300V (50°C) 12A 300V (70°C)	Yes		50 or 70°C		75°C Cu only (CSA)		
97.02	2x8A 300V	2x8A 300V	Yes		70°C		75°C Cu only (CSA)		
97.11	16A 300V (50°C) 12A 300V (70°C)	/	Yes		50 or 70 °C with a minimum distance of 5 mm				
97.12	2x8A 300V	/	Yes		70 °C with a minimum distance of 5 mm				
97.51 - 97.51.3	15A 300V (40°C) (2-wires/per pole) 10A 300V (70°C)	15A 300V (40 °C) 10A 300V (70 °C)	Yes		40 or 70°C			14-24 stranded and solid	
97.52 - 97.52.3	10A 300V (40°C) 8A 300V (70°C)	8A 300V	Yes		70°C			14-24 stranded and solid	
97.P1/P2	10A 300V	10A 300V	Yes		70°C			14-26 stranded and solid	

Three-phase alternating current loads

Larger three-phase alternating current loads should preferably be switched with contactors according to EN 60947-4-1 Electromechanical contactors and motor starters. Contactors are similar to relays but they have their own characteristics; typically compared to relays:

- They can normally switch different phases at the same time.
- They are physically much larger.
- Their design and construction usually features double break contacts.
- They can withstand certain short-circuit conditions.

There is nevertheless, some overlap between relays and contactors regarding switching characteristics and applications.

However, when switching three-phase alternating current with relays, consider and take into account:

- The isolation co-ordination, i.e. the voltage stress and the degree of pollution between the contacts according to the insulation rated voltage.
- And, avoid the use of the NO relay versions with 3 mm contact gaps, unless the isolation afforded by the contact gap is specifically required.

Three-phase motors

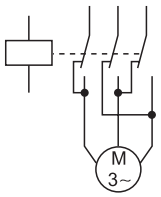
Higher power three-phase motors are often switched by a 3-pole contactor, where there is high isolation/separation between phases. However, for space, size and other reasons, relays are also called upon to switch 3-phase motors.

TABLE 3 ***Motor ratings v relay series***

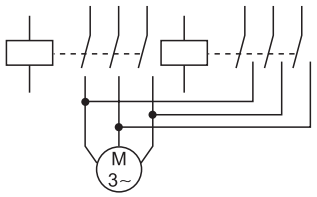
Relay series	Motor Power (400 V 3 phase)		Permissible degree of pollution	Impulse voltage
	kW	PS(hp)		
55.33, 55.13	0.37	0.50	2	4
56.34, 56.44	0.80	1.10	2	4
60.13, 60.63	0.80	1.10	2	3.6
62.23, 62.33, 62.83	1.50	2.00	3	4
67.23	11	15	3	6

62 series relay is also capable to switch 1 hp 480 V 3 phase motors

Reversing the motor: Take particular care if it is required to change the motor direction by reversing two of the supply phases applied to the motor terminals, as this will result in severe damage unless there is a "dead time" between the changeover. Therefore, use one relay for the forward direction and another for the reverse direction (as the following diagram). And, most importantly, ensure that there is a "dead time" of no less than 50 ms - when neither relay coil is energised. Simple cross interlocking of the relay coils will not produce a Time delay! However, choosing a tougher, anti-weld contact material may further improve the reliability and performance, and is advised.



Incorrect three-phase motor reversal: The electrical stress of opposing phase voltages across the contact gap, together with contact arcing can result in a phase to phase short-circuit.



Correct three-phase motor reversal: "Dead break" time of > 50 ms, during which time neither the Forward nor the Reverse relay contacts are closed.

Notes:

1 - For AC3 category (starting and switching off) - motor reversal is only permitted if there is a guaranteed break of 50 ms between energisation in one direction and energisation in the other. Observe the maximum starts per hour, according to the motor manufacturer's recommendation.

2 - AC4 category (starting, plugging, reversing and inching/jogging) is not possible with relays or small contactors. In particular, the direct reversing of phase connections for "plugging" will result in severe contact arcing leading to a short-circuit within the relay or contactor.

3 - Under certain circumstances it may be preferable to use three single pole relays to control each phase individually, and so achieve greater separation between the phases. (Any relatively small time difference between the operation times of the three relays is insignificant compared to the much slower operation of contactors.)

Switching different voltages within a relay

Switching different voltages in a relay e.g. 230 V AC with one contact and 24 V DC with a neighboring contact is possible - provided that the Insulation type between adjacent contacts is at least of Basic level. However, note that the equipment standard might demand a higher level that is not possible using adjacent contacts on the same relay. The possibility of using more than one relay could be considered.

Contact resistance

Measured, according to Application Category (Table 4), at the external terminals of the relay. It is a final test value, not necessarily reproducible subsequently. It has little effect on relay reliability for most applications since a typical value would be < 50 mΩ (measured with 24 V 100 mA).

Contact categories according to EN 61810-7

The effectiveness with which a relay contact can make an electrical circuit depends on several factors, such as the material used for the contact, its exposure to environmental pollution and its design etc. Therefore, for reliable operation, it is necessary to specify a Contact Category, which is defined in terms of the characteristics of the load. The appropriate Contact Category will also define the voltage and current levels used to measure the contact resistance. All Finder relays are category CC2.

TABLE 4 ***Contact categories***

Contact category	Load characteristic	Contact Resistance Measurement	
CC0	Dry circuit	30 mV	10 mA
CC1	Low load without arcing	10 V	100 mA
CC2	High load with arcing	30 V	1 A

TABLE 5 ***Contact materials characteristics***

Material	Property	Typical application
AgNi + Au (Silver Nickel Gold plated)	- Silver-nickel base with a galvanic hard gold plating - Gold is not attacked by industrial atmospheres - With small loads, contact resistance is lower and more consistent compared to other materials. **NOTE:** hard gold plating is completely different to 0.2 µm gold flashing, which allows only protection in storing, but no better performance in use.	Wide range applications: - Small load range (where gold plating erodes very little) from 50 mW (5 V - 2 mA) up to 1.5 W/24 V (resistive load). - Middle load range where gold plating erodes after several operations and the property of basic AgNi becomes dominant. **NOTE:** for switching lower load, typically 1 mW (0.1 V - 1 mA), (for example in measuring instruments), it is recommended to connect 2 contacts in parallel.
AgNi (Silver Nickel)	- Standard contact material for most relay applications - High wear resistance - Medium resistance to welding	- Resistive and slightly inductive loads
AgCdO (Silver Cadmium Oxide)	- High wear resistance with higher AC loads - Good resistance to welding	- Inductive and motor loads
$AgSnO_2$ (Silver Tin Oxide)	- Excellent resistance to welding	- Lamp and capacitive loads - Very high Inrush current loads

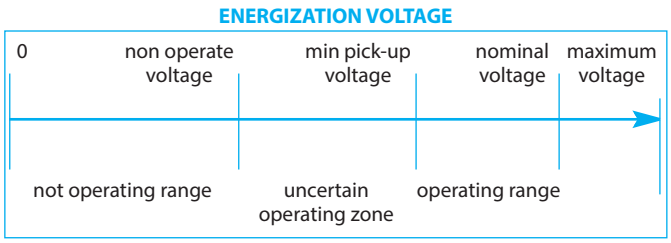
Coil specification

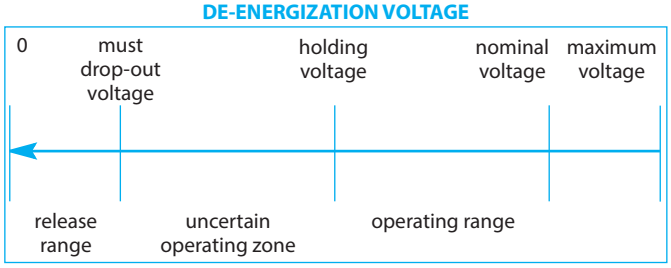
Nominal voltage
The nominal value of coil voltage for which the relay has been designed, and for which operation is intended. The operating and performance characteristics are with respect to the coil at nominal voltage.

Rated power
The DC power value (W) or the apparent AC power value (VA with closed armature) which is absorbed by the coil at 23 °C and at rated voltage.

Operating range
The range of input voltage, in nominal voltage applications, in which the relay works in the whole range of ambient temperatures, according to operating class:
- class 1: (0.8…1.1)U_N
- class 2: (0.85…1.1)U_N

In application where the coil voltage doesn't meet the tolerances of nominal voltage, the diagrams "R" shows the relation of maximum coil voltage permitted and pick-up voltage (without pre-energisation) versus ambient temperature.





Non-operate voltage
The highest value of input voltage at which the relay will not operate (not specified in the catalogue).

Minimum Pick-up voltage (Operate voltage)
The lowest value of applied voltage at which the relay will operate.

Maximum permitted voltage
The highest applied coil voltage that the relay can continuously withstand, dependent on ambient temperature (see "R" diagrams).

Holding voltage (Non-release voltage)
The lowest value of coil voltage at which the relay (which has previously been energised with a voltage within the operating range) will not drop-out.

Must drop-out voltage (Must release voltage)
The highest value of coil voltage at which the relay (having previously been energised with a voltage within the operating range) will definitely drop-out. The same "per unit" value can be applied to the nominal coil current value to give an indication of the maximum leakage current that may be permitted in the coil circuit, before problems with relay release might be expected.

Coil Resistance
The nominal value of the coil resistance under the standard prescribed condition of 23 °C ambient. Tolerance is ± 10%.

Rated coil consumption
The nominal value of coil current, when energized at nominal voltage (and at 50 Hz for AC coils).

Thermal tests
Calculation of the coil temperature rise (ΔT) is made by measuring the coil resistance in a temperature controlled oven (not ventilated) until a stable value is reached (no less than 0.5 K variation in 10 minutes).
That is: $\Delta T = (R2 - R1)/R1 \times (234.5 + t1) - (t2 - t1)$
where:
R1 = initial resistance
R2 = final resistance
t1 = initial temperature
t2 = final temperature

Monostable relay
An electrical relay which, having responded to coil energisation by changing contact state, returns to the previous contact state when the coil energisation is removed.

Bistable relay
An electrical relay, which, having responded to coil energisation by changing contact state, retains that contact state after the coil energisation has been removed. A further energisation of the coil is necessary to cause the contact state to revert.

Latching relay
A bistable relay, where the contacts retain their state due to a mechanical latching mechanism. Subsequent applications of coil energisation causes the contacts to "toggle" open and closed.

Remanence relay
A bistable relay, where the contacts retain their operated (or Set) state due to remanent magnetism in the relay iron circuit caused by the application of a DC current through the coil. Resetting the contact state is achieved by passing a smaller DC current through the coil in the opposite direction. For AC excitation, magnetization takes place via a diode to produce a DC set current, and demagnetising is achieved by applying an AC coil current of lower magnitude.

Insulation

Relay function and Isolation
One of the main functions of a relay is to connect and disconnect different electric circuits, and usually, to maintain a high level of electrical separation between the various circuits. It is therefore necessary to consider the level of isolation appropriate to the application and the task to be performed - and to relate this to the relay's specification. In the case of electromechanical relays the areas of isolation generally considered are:
- Isolation between coil and all contacts (the "contact set").
  Catalogue data - "Insulation between coil and contact set".
- Isolation between physically adjacent, but electrically separate, contacts of a multi-pole relay. Catalogue data - "Insulation between adjacent contacts".
- Isolation between the open contacts (applies to the NO contact, and the NC contact when the coil is energised).
  Catalogue data - "Insulation between open contacts".

Specifying isolation levels
There are several ways of specifying or describing the level of isolation offered by, or demanded of, a relay. These include:

Insulation coordination, which focuses on the levels of impulse voltage likely to be seen on the supply lines of the application equipment and the cleanliness of the immediate surroundings of the relay in the equipment. And, as a consequence, it demands appropriate levels of separation between circuits, in terms of isolating distances and quality of insulating material used etc. (see additional information under "Insulation coordination").

Type of insulation; For both equipment and components such as a relay, there are several types (or levels) of insulation that might be demanded between the various circuits. The appropriate type will depend on the specific function being performed, the voltage levels involved, and the associated safety consequences. The various types of insulation are listed below, and those appropriate to each relay series are stated within the relay data; Specifically, within the table under the section entitled Technical data, sub-heading; Insulation.

Functional insulation; Insulation between conductive parts, which is necessary only for the proper functioning of the relay.
Basic insulation; Insulation applied to live parts to provide basic protection against electric shock.
Supplementary insulation; Independent insulation applied in addition to basic insulation, in order to provide protection against electric shock in the event of a failure of basic insulation.
Double insulation; Insulation comprising both basic insulation and supplementary insulation.
Reinforced insulation; A single insulation system applied to live parts, which provides a degree of protection against electric shock equivalent to double insulation.
(Usually, the decision as to the appropriate type of insulation will have already been made by the equipment standard.)

Dielectric strength, and high voltage impulse tests; These are either, final inspection or Type tests, which prove the level of isolation in terms of the minimum voltage stress that can be withstood, between the various specified electrical circuits. As the only method of specifying and checking for adequate isolation, this tends to be the more historical approach. However, there are still some dielectric strength requirements to be found within both the Insulation coordination approach and the Level of Insulation approach.

Insulation coordination
In accordance with EN 61810-1 and IEC 60664-1, the Insulation characteristics offered by a relay can be described by just two characteristic parameters – the Rated Impulse Voltage and the Pollution Degree.
To ensure the correct Insulation Coordination between the relay and the application, the equipment designer (relay user) should establish the Rated Impulse Voltage appropriate to his application, and the Pollution Degree for the microenvironment in which the relay is situated. He should then match (or coordinate) these two figures with the corresponding values given in the appropriate relay data, under the section entitled Technical data, sub-heading; Insulation.
Rated Impulse Voltage; To establish the appropriate Rated Impulse Voltage refer to the appropriate Equipment Standard which may specify mandatory values for equipment being designed. Alternatively, using the Rated Impulse Voltage table (Table 6) with knowledge of the Nominal Voltage of the Supply System and knowledge of the Overvoltage Category, determine the appropriate Rated Impulse Voltage.
Overvoltage Category; this is described in IEC 60664-1, but is also summarised in the footnotes to Rated Impulse Voltage table. Alternatively, it may be specified in the equipment standard.
Pollution Degree; determine this by considering the immediate surroundings of the relay (refer to Pollution Degree table 7). Then check that the relay specification offers the appropriate (or better) Rated Impulse Voltage and Rated Insulation Voltage, for that Pollution Degree.

Nominal voltage of supply system
This effectively describes the source of the power supply system, so 230/400 V AC indicates that this would be (or is likely to be) a three-phase sub-station transformer with a Neutral connection. Being aware of the source of the supply system is important since (in conjunction with the Overvoltage category) it determines the typical levels of impulse voltage likely to be seen on the supply lines, and this has to be taken into account in the designing of the relay. However, it does not necessarily follow that the relay will be rated by the manufacturer for use at the highest voltage of the supply system. It is the declared Rated Insulation Voltage that confirms this aspect.

Rated Insulation Voltage
This is a notional value of voltage that indicates the relay's insulation as being suitable for handling voltages up to this level. Note that this notional Rated Insulation Voltage is selected from a list of preferred values. For Finder relays, 250 V and 400 V are two such preferred values, and of course they will cover respectively, the 230 V L-N and 400 V L-L voltages commonly encountered in practice.

TABLE 6 ***Rated impulse voltage***

Nominal voltage of the supply system(1) V		Rated insulation voltage V	Rated impulse voltage kV			
Three-phase systems	Single-phase systems		Overvoltage category			
			I	II	III	IV
	120 to 240	125 to 250	0.8	1.5	2.5	4
230/400		250/400	1.5	2.5	4	6
277/480		320/500	1.5	2.5	4	6

(1) In accordance with IEC 60038.

Remark: The descriptions of overvoltage categories below are for information. The actual overvoltage category to be considered has to be taken from the product standard defining the application of the relay.
Overvoltage category I Applies to equipment intended for connection to fixed installations of buildings, but where measures have been taken (either in the fixed installation or in the equipment) to limit transient overvoltages to the level indicated.
Overvoltage category II Applies to equipment intended for connection to fixed installations of buildings.
Overvoltage category III Applies to equipment in fixed installations, and for cases where a higher degree of availability of the equipment is expected.
Overvoltage category IV Applies to equipment intended for use at or near the origin of the installation, from the main distributor towards the supply mains.

TABLE 7 ***Pollution degree***

Pollution degree	Immediate surroundings of relay
1	No pollution or only dry, non-conductive pollution occurs. The pollution has no influence.
2	Only non-conductive pollution occurs, except that occasionally a temporary conductivity caused by condensation is to be expected.
3	Conductive pollution occurs or dry, non-conductive pollution occurs which becomes conductive due to condensation, which is to be expected.

Dependent on the product standard, pollution degree 2 and 3 are commonly prescribed for equipment. For example, EN 50178 (electronics for use in power installations) prescribes, under normal circumstances, contamination level 2.

Dielectric strength
This can be described in terms of an AC voltage test, or in terms of an Impulse (1.2/50 µs) voltage test. (The correspondence between the AC test and Impulse voltage test is listed in IEC 60664-1 Annex A, Table A.1).
All Finder relays receive a 100% final inspection AC (50 Hz) dielectric strength test; applied between all contacts and coil, between adjacent contacts, and across open contacts. The leakage current must be less than 3 mA.
For Type testing, both AC and Impulse voltage dielectric strength tests are applied.

Insulation Group

This was the older Insulation Group classification (such as C 250), which was according to the VDE 0110 standard. They have largely been replaced with the more recent way of specifying insulation properties, according to Insulation Coordination.

SELV, PELV and Safe separation

Insulation Coordination as described earlier ensures the isolation of hazardous voltages from other circuits to a safe engineering level, but may not be adequate on its own if the design of the equipment permits the LV circuit to be accessible and therefore able to be touched directly or, where the nature and location of the electrics presents extra dangers.

Therefore, for these extra dangerous applications (such as swimming pool lighting or bathroom electrics) there can be a need for a special low voltage supply system (SELV or PELV), that is inherently safe and highly secure, working at low voltage and with much higher levels of physical isolation and integrity between it and other hazardous circuits.

The SELV system

The SELV system (Separated Extra Low Voltage) is achieved by designing with double or reinforced insulation and by ensuring "safe separation" from hazardous circuits in accordance with regulations for SELV circuits. The SELV voltage (which is isolated from Ground) must be derived via a safety transformer meeting double or reinforced isolation between the windings, as well as other safety requirements demanded by the appropriate standard.

Note: The value for the "safe voltage" can differ slightly dependent upon the particular application or end product regulation.

There are specific requirements for keeping SELV circuits and wiring separate from other hazardous circuits, and it is this aspect concerning the separation of the coil to contacts that is met by several Finder relays as standard, and as a special version of the 62 series of relays - where an additional barrier is a special option.

The PELV system

The PELV system (Protected Extra Low Voltage), like the SELV system, requires a design that guarantees a low risk of accidental contact with a high voltage, but in contrast, it has a protective earth (ground) connection. Like SELV, the transformer can have windings separated by double or reinforced isolation, or by a conductive shield with a protected earth connection.

Consider a common situation, where the mains voltage of 230 V and a low voltage circuit both appear within a relay; all the following requirements must be met by the relay - and also applied to the connections/wiring to it.

- The low voltage and the 230 V must be separated by double or reinforced insulation. This means that between the two electrical circuits there must be guaranteed a dielectric strength of 6 kV (1.2/50 µs), an air distance of 5.5 mm and, depending on the pollution degree and on material used, an appropriate tracking distance.
- The electrical circuits within the relay must be protected against any possibility of bridging, caused for instance by a loose metal part. This is achieved by the physical separation of circuits into isolated chambers within the relay.
- The different voltage wiring connected to the relay must also be physically separated from each other. This is normally achieved by using separate cable channels.
- For relays mounted on printed circuit boards the appropriate distance between the tracks connected to low voltage and the tracks connected to other voltages must be achieved. Alternatively, earth barriers can be interposed between hazardous and safe parts of the circuitry.

Although this appears quite complex, with the SELV capability/options offered by some Finder relays, the user only needs to address the two last points. And, when using a socket where the coil and contact connections are on opposite sides, the separation of wiring into different cable channels is greatly facilitated.

General technical data

Cycle

The operate and subsequent release of a relay. Over a cycle, the coil is energised and de-energised, and a (NO) contact will have progressed through a cycle of making circuit, through to breaking the circuit, back to the point at which it is just about to re-make the circuit.

Period

The time taken by one cycle.

Duty factor (DF)

During cyclic operation, the Duty Factor is the ratio between the time the relay is energized, to the time taken for one cycle (i.e. the Period). For continuous duty, the DF = 1.

Continuous operation

This would represent the condition where the coil is permanently energized, or is energized for at least sufficient time for the relay to reach thermal equilibrium.

Mechanical life

This is derived from a test performed by energising the coils of several relays at 5 to 10 cycles per second without any load applied to the contacts. It establishes the ultimate durability of the relay where electrical wear of the contacts is not an issue. The maximum Electrical Life may therefore approach the Mechanical Life where the electrical loading of the contacts is very small.

Operate time

The typical time (average of values measured supplying the relay coil with the nominal DC voltage) for the NO contact to close, from the point of coil energisation. It does not include the bounce time (see following pattern).

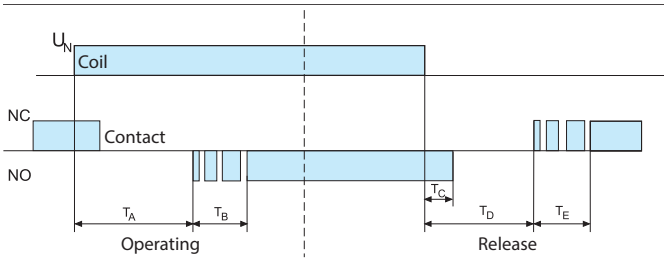
Release time

- For CO relays: The typical time (average of values measured removing from the coil the DC voltage) for the NC contact to close, from the point of coil de-energisation. It does not include the bounce time.
- For NO relays: The typical time (average of values measured removing from the coil the DC voltage) for the NO contact to open, from the point of coil de-energisation.

Note: The release time will increase if a suppression diode in parallel with the coil is employed (either in the form of; a coil protection module; integrated option within the relay; or mounted directly on the PCB).

Bounce time

The typical time duration (average of values measured) while closing contacts bounce, before attaining a stable closed state. Different values generally apply to NO and NC contacts.



T_A Operate time
T_B Bounce time for NO contact
T_C Release Time (NO relays)
T_D Release Time (CO relays)
T_E Bounce time for NC contact

For each relay type, the catalogue data-sheet states the operate and release time on the main page, and the bounce times are shown in the "Technical data" section that follows the "Ordering information" section. All these values must be considered as "average" values, such that an individual relay can show times differing by about ± 3 ms from the stated value. For relays with AC coil such differences can reach 10 ms.

Ambient temperature
The temperature of the immediate area where the relay is located. It will not necessarily correspond to the ambient temperature either within, or external to, the enclosure in which the relay is located. To accurately measure the ambient temperature with respect to the relay, remove the relay from its location whilst maintaining the worst-case energisation of all the other relays and components within the enclosure or panel. Measuring the temperature at the position vacated by the relay will give the true ambient temperature in which the relay is working.

Ambient temperature range
The temperature range over which, operation of the relay is guaranteed (under prescribed conditions).

Storage temperature range
This can be taken as the ambient temperature range, with the upper and lower limits extended by 10 °C.

Environmental protection
According to EN 61810-1. The RT categories describe the degree of sealing of the relay case:

Environmental protection category		Protection
RT 0	Unenclosed relay	Relay not provided with a protective case.
RT I	Dust protected relay	Relay provided with a case, which protects its mechanism from dust.
RT II	Flux proof relay	Relay capable of being automatically soldered without allowing the migration of solder fluxes beyond the intended.
RT III	Wash tight relay	Relay capable of being automatically soldered and subsequently undergoing a washing process to remove flux residues without allowing the ingress of flux or washing solvents.
Special application categories		
RT IV	Sealed relay	Relay provided with a case which has no venting to the outside atmosphere.
RT V	Hermetically sealed relay	Sealed relay having an enhanced level of sealing.

Protection category
According to EN 60529. The first digit is related to the protection against the intrusion of solid foreign objects into the relay, and also against access to hazardous parts. The second digit relates to the protection against ingress of water. The IP category relates to the relay, when used normally in relay sockets or PC boards.
For sockets, IP 20 signifies that the socket is "finger-safe" (VDE 0106).
IP Examples:
IP 00 = Not protected.
IP 20 = Protected against solid foreign objects of 12.5 mm Ø and greater. Not protected against water.
IP 40 = Protected against solid foreign objects of 1 mm Ø and greater. Not protected against water.
IP 50 = Protected against powder (ingress of dust is not totally prevented, but dust shall not penetrate in a quantity to interfere with satisfactory operation of the relay). Not protected against water.
IP 51 = As IP 50, but with protection against vertically falling drops of water.
IP 54 = As IP 50, but with protection against spayed from all directions - limited ingress permitted.
IP 67 = Totally protected against powder (dust-tight) and protected against the effects of temporary immersion in water.

Vibration resistance
The maximum level of sinusoidal vibration, over the specified frequency range, which can be applied to the relay in the X-axis without the opening (for more than 10 µs) of the NO contact (if the coil is energised) or NC contact (if the coil is not energised). (The X-axis is the axis through the plane of the relay face containing the relay terminals). The vibration resistance is usually higher in the energised state, than in the non-energised state. Data for other axes and frequency ranges, on request. The level of vibration is given in terms of the maximum acceleration of the sinusoidal vibration, "g" (where g = 9.81 m/s^2). But note: the normal testing procedure according to IEC 60068-2-6 prescribes to limit the maximum peak-to-peak displacement in the lower range of frequencies.

Shock resistance
The maximum mechanical shock (half-sine 11 ms waveform) permitted in the X-axis without contact opening > 10 µs.
Data for other axes on request.

Installed orientation
The component's specification is unaffected (unless expressly stated otherwise) by its orientation, (provided it is properly retained, eg by a retaining clip in the case of socket mounted relays.)

Power lost to the environment
The value of the power lost from the relay with the coil energised (without contact current, or with full rated current through all NO contacts). This may be used in the thermal design and regulation of the control panel.

Recommended distance between relays mounted on printed circuit boards
This is the minimum mounting distance suggested when several relays are mounted on the same PC board. Care and consideration shall be given to ensure that other components mounted on the PC board do not heat the relay and raise its microenvironment beyond the permitted maximum ambient temperature.

Torque
The maximum value of torque that can be used for tightening terminal screws, according to EN 60999, is 0.4 Nm for M2.5 screws, 0.5 Nm for M3 screws, 0.8 Nm for M3.5 screws, 1.2 Nm for M4 screws. The test torque is indicated in the catalogue. Normally a 20% increase of this value is acceptable.
Both slot-head and cross-head screwdrivers can be used.

Minimum Wire size
If not otherwise indicated, for screw terminals a minimum cross-section of 0.5 mm^2 is permitted.

Max. wire size
Maximum cross-section of cables (solid or stranded wire, without ferrules) that can be connected to each terminal. For use with ferrules, the wire cross-section has to be reduced (e.g. from 4 to 2.5 mm^2, from 2.5 to 1.5 mm^2, from 1.5 to 1 mm^2).

Terminating more than one wire
EN 60204-1 permits 2 or more wires to be terminated in the same terminal. All Finder products are designed in such a way that each terminal can accept 2 or more wires, except screwless and push-in terminals.

Box clamp
Wires are terminated within a box shaped clamp.
Effective retention of solid, stranded and "bootlace" wires, but not suitable for wires terminated with "fork" style terminations.

Plate clamp
Wires are terminated under the pressure of a clamp plate. Effective for "fork" terminated wires and solid wire, but less so for stranded wire.

Screwless terminal (Spring clamp)
Wires are terminated under the pressure of a spring clamp. The clamp being temporarily held open by the insertion of a tool, while the wire is inserted.

Push-in terminal
Similarly to spring clamp terminals, wires are terminated under the pressure of a spring clamp. Solid wires or ferrules can be quickly connected by their simple insertion into the terminal. For stranded wires insertion, and for each wire type extraction, it is necessary first to open the terminal by pushing down on the push-button.

Jumper link
Jumper links are accessories intended to simplify wiring and are typically used in the connection of the common side of multiple coils.
Attention must be paid to the total current that they can carry, if used to interconnect contact circuits, and to the stability of their mechanical and electrical connection (for example, their use is not recommended in applications where continuous vibration is expected).

SSR - Solid State Relay

SSR Solid State Relay
A relay utilising semiconductor technology, rather than electromechanical. In particular, the load is switched by a semiconductor and consequently these relays are not subject to burning of contacts and there is no migration of contact material.
SSRs are capable of very high speed switching and virtual unlimited life. However, SSRs for switching DC are polarity sensitive and consideration must given to the maximum permitted blocking voltage.

Opto-coupler
For all SSR relays in the catalogue, the electrical isolation between Input and Output circuits is provided by the use of an opto-coupler.

Switching voltage range
The minimum to maximum range for the load voltage.

Minimum switching current
The minimum value of load current necessary to ensure correct switch-on and switch-off action.

Control current
The nominal value of input current, at 23 °C and with rated voltage applied.

Maximum blocking voltage
The maximum level of output (load) voltage that the SSR can withstand.

Relay with forcibly guided (mechanically linked) contacts, or safety relay

A relay with forcibly guided contacts is a special type of relay which must satisfy the requirements of a very specific safety EN standard.
Such relays are used within safety systems to guarantee their operational safety and reliability, contributing to a safe working environment.
Such relays must have at least one NO and one NC forcibly guided contact. These contacts must be mechanically linked, such that if one of the contacts fails to open, the other is prevented from closing (and vice versa). This requirement is fundamental in order to identify with certainty the non-correct operation of a circuit. For example, a failure of a NO contact to open (for example, by welding closed) is identified by the failure of the NC from closing, thereby signaling an operational anomaly. Under such circumstances, the standard requires a guaranteed contact gap of 0.5 mm to be maintained.

EN 61810-3 (which replaced former EN 50205) is the standard that establishes the requirements for relays with forcibly guided contacts, and it describes two types:
- Type A: where all the contacts are forcibly guided
- Type B: where only some contacts are forcibly guided

According to EN 61810-3, in a relay with changeover contacts, only the NO of one pole and the NC of the other pole can be considered as forcibly guided contacts. In the case of the 50.12 type relay this means the remaining poles cannot be considered as forcibly guided and therefore this relay is categorised as "Type B".
However, since the other 50 series relay types and all the relays of 7S series offer only NO and NC contacts, they can be categorized as "Type A".

Monitoring and Measuring relays

Supply voltage monitoring
The supply voltage being monitored also provides the operating power for the unit, so an auxiliary supply is not necessary.

3-phase asymmetry monitoring

In a 3-phase system, asymmetry is present if at least one of the three L - L voltage vectors fails to be at 120° with respect to the other L - L voltage vectors.

Detection level
For monitoring relays, this represents, either fixed or adjustable level(s) of voltage, current or phase asymmetry, which define the acceptable limits of operation. Values outside acceptable limits will cause the output relay NO contact to open (after any intentional delay).

Switch-on lock-out time
For over and under voltage monitoring relays this is a selectable time delay to ensure that the output relay cannot re-energise too quickly (following a trip and the re-establishment of healthy conditions). Protects equipment where a quick succession of restarts might cause overheating and damage. Same delay applies immediately following "power-on".

Trip on-delay
Similar in effect to the switch-off delay, this delays the "trip" signal that would result in the output relay switching off. The term is used primarily for monitoring relays which monitor and act according to several parameters. But the effect is the same, and momentary or short-term excursions of the measured/monitored values outside of limits are ignored.

Run-on time
With liquid level control relays the pump motor can be turned on (or off) within 0.5 to 1 second of the liquid reaching or departing the level of the electrode. Depending on model, this delay can be increased up to 7 seconds, which will have the effect of the liquid level running past the electrode level. This can help prevent "hunting" of the motor, which might otherwise have happened due to ripples, or foam, on the surface of the liquid.

Reaction time
For monitoring relays, this is the maximum time taken by the electronics to respond to changes in the monitored value.

Fault memory
For monitoring relays; selecting this function will inhibit the automatic reset following clearing of fault condition. Reset can only be made by positive intervention.

Fault memory - status retained on power down
As above but the fault memory status will be retained during power down.

Thermistor temperature sensing
Over-temperature monitoring via a PTC resistance sensor, with in-built checking for sensor open or short circuit faults.

Level control relay
Detects the level of conductive liquids by measuring and evaluating the resistance between either 2 or 3 level electrodes.

Electrode voltage
For level control relays, this is the nominal voltage between electrodes. Note: this voltage is an alternating voltage, so as to avoid the effects of electrolytic corrosion.

Electrode current
For level control relays, this is the nominal (AC) electrode current.

Max. sensitivity
For level control relays: the maximum sensitivity is the maximum resistance between the electrodes that will be recognised as indicating the presence of liquid. This may be fixed, or adjustable over a range - according to type.

Sensitivity, fixed or adjustable
The resistance value between the electrodes B1-B3 and B2-B3 is used to determine if there is a conductive liquid between the electrodes. The sensitivity is either a fixed level (type 72.11) or an adjustable value (type 72.01). The latter is useful for "tuning out" any false detection of the fluid level arising from detecting surface foam (or head), rather than the liquid itself.

Positive safety logic
Positive logic means that the make contact is closed, if the level or parameter which is being monitored lies within the target range. The make contact opens, after a delay if appropriate, if the level falls outside of the target range, or level.

Timers

Specified time range
The minimum and maximum limits of, one or more time ranges, over which it is possible to set the desired time.

Repeatability
The difference between the upper and lower limits of a range of values taken from several time measurements of a specified time relay under identical stated conditions. Usually repeatability is indicated as a percentage of the mean value of all measured values.

Recovery time
The minimum time necessary before re-starting the timer function - in order to maintain the defined timing accuracy.

Minimum control impulse
The minimum duration of a control impulse (Terminal B1) necessary to ensure the complete and proper time function.

Setting accuracy
The difference between the measured value of the specified time and the reference value set on the scale.

Light dependent relays

Threshold setting
The ambient light level setting, measured in lux (lx), at which the output relay switches on (following the elapse of the ON Delay time). This is adjustable over the range specified in the specification.
The relay will switch off, dependent upon the type of Light dependent relay used, at either the same or a higher brightness value (following the elapse of the OFF Delay time).

Delay time
Switching ON/OFF For light-dependent relays this is an intentional delay in the response of the output relay, following a change of state within the electronic light sensitive circuit (usually indicated by change of state of an LED).
This is to eliminate the possibility of the output relay unnecessarily responding to a momentary change in ambient light level.

Time switches

1 or 2 pole output types
The 2 pole output type (12.62, 12.A2 and 12.B2) can have both contacts programmed independently of each other.

Type of time switch
Daily Same program every day.
Weekly Different program possible for each of the 7 days of the week.

Programs
For electronic digital time switches, this is the maximum number of switching times that can be stored in memory. A switching time can be used for more than one day (ie. It could apply to Mon, Tues, Wed, Thurs and Friday), but will only use one memory location.
For mechanical daily time switches, this is the maximum number of switching points during the day that can be set.

Minimum interval setting
For time switches, this it is the minimum time interval that can be programmed.

Power back-up
The time, following a power failure, over which the time switch will retain the stored programs and the elapsed time information.

Step relays and staircase timers

Minimum/Maximum impulse duration
For step relays there is a minimum and a maximum time period for coil energisation. The former is necessary to ensure a full and complete mechanical step action, while exceeding the latter would result in coil overheating and damage.
With the electronic staircase timer, there is no limit to the maximum time for impulse duration.

Max. number of illuminated push-buttons
For step relays and staircase switches, this is the maximum number of illuminated push-buttons (having current absorption < 1 mA @ 230 V AC) that can be connected without causing problems. If the push-button consumption is higher than 1 mA, the maximum number of push-buttons allowed is proportionally reduced. (i.e. 15 push-buttons x 1 mA is equivalent to 10 push-buttons x 1.5 mA).

Glow wire conformity according to EN 60335-1

European standard EN 60335-1, "Household and similar electrical appliances - Safety - Part 1: General requirements"; clause 30 prescribes that insulated parts supporting connections that carry current exceeding 0.2 A (and the insulated parts within a distance of 3 mm from them), must comply with the following 2 requirements with respect to resistance to fire:

1 - GWFI (Glow Wire Flammability Index) of 850 °C - Compliance with glow wire flammability test at 850 °C (according to EN 60695-2-12).

2 - GWIT (Glow Wire Ignition Temperature) of 775 °C according to EN 60695-2-13 - This requirement can be verified with a GWT (Glow Wire Test according to EN 60695-2-11) at a value of 750 °C with a flame extinction within 2 seconds.

The following Finder products comply with the above mentioned requirements:
- electromechanical relays of series **34, 40, 41, 43, 44, 45, 46, 50, 55, 56, 60, 62, 65, 66, 67**;
- PCB or DIN Rail sockets in special versions **9x.xx.7**

Important note: Whilst EN 60335-1 permits the application of an alternative needle flame test (if the flame during test no. 2 burns longer than 2 seconds) this can result in some limitation in the relay's mounting position. Finder products however, have no such limitations, since the materials used do not require the alternative test method to be performed.

EMC (ElectroMagnetic Compatibility) Standards

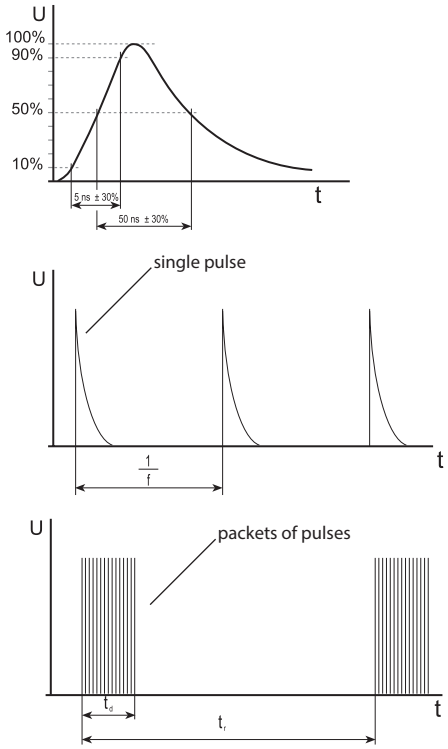
Type of test	Reference standard
Electrostatic discharge	EN 61000-4-2
Radio-frequency electromagnetic field (80 ÷ 1000 MHz)	EN 61000-4-3
Fast transients (burst) (5-50 ns, 5 kHz)	EN 61000-4-4
Surges (1.2/50 µs)	EN 61000-4-5
Radio-frequency common mode disturbances (0.15…80 MHz)	EN 61000-4-6
Power-frequency magnetic field (50 Hz)	EN 61000-4-8
Radiated and conducted emission	EN 55011/55014/55022

In panel installations, the most frequent and, particularly, more dangerous type of electrical disturbances are the following:

Burst (fast transients)

These are packets of **5/50 ns** pulses, having high peak voltage level but low energy since individual pulses are very short - 5 ns rise time (5 x 10^{-9} seconds) and 50 ns fall time.

They simulate the disturbances that can spread along the cables as a consequence of commutation transients from relays, contactors or motors. Usually they are not destructive, but they can affect the correct working of electronic devices.

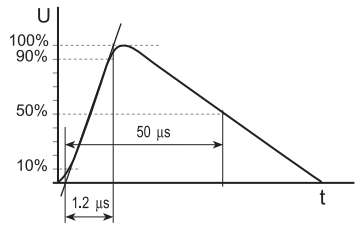


Surge (voltage pulses)

These are single **1.2/50 µs** pulses, with energy much higher than bursts since the duration is considerably longer - 1.2 µs rise time (1.2 x 10^{-6} seconds) and 50 µs fall time.

For this reason they are very often destructive. The Surge test typically simulates disturbances caused by the propagation of atmospheric electrical storm discharges along electrical lines, but often the switching of power contacts (such as the opening of highly inductive loads) can cause disturbances that are very similar, and equally destructive. The test levels V (peak values of the single pulses) are prescribed in appropriate product standards:

- **EN 61812-1** for electronic timers;
- **EN 60669-2-1** for electronic relays and switches;



- **EN 61000-6-2** (generic standard for immunity in the industrial environment) for other electronic products for industrial application;
- **EN 61000-6-1** (generic standard for immunity in the domestic environment) for other electronic products for domestic application.

Finder electronic products are in accordance with European EMC Directive **2014/30/EU** and indeed, have immunity capabilities often higher than the levels prescribed in the above mentioned standards. Nevertheless, it is not impossible that some working environments may impose levels of disturbances far in excess of the guaranteed levels, such that the product could be immediately destroyed!

It is therefore necessary to consider Finder products as not being indestructible under all circumstances. The user should pay attention to the disturbances in electrical systems and reduce as much as possible these disturbances. For example, employ arc suppression circuits on the contacts of switches, relays or contactors which otherwise might produce over-voltages when opening electrical circuits (particularly highly inductive or DC loads). Attention should also be paid to the placement of components and cables in such a way as to limit disturbances and their propagation.

EMC rules

Require that it is the equipment designer who must ensure that the emissions from panels or equipment does not exceed the limits stated in EN 61000-6-3 (generic standard for emission in the domestic environment) or 61000-6-4 (generic standard for emission in the industrial environment) or any product specific harmonised EMC standard.

Reliability (MTTF & MTBF for equipment)

MTBF, MTTF and MCTF

Relays are generally considered to be non-repairable items and consequently require replacement following failure. Consequently, if a worn relay within equipment is replaced, its MTTF (Mean Time To Failure) value is appropriate in calculating the MTBF (Mean Time Between Failure) for the equipment. The predominant failure mode for elementary relays is attributable to the wear-out mechanism affecting the relay contacts. This can be expressed in terms of MCTF (Mean Cycles To Failure). With knowledge of the frequency of operation f (cycling rate, expressed in cycles/hour) of the relay within the equipment, the number of cycles can be simply transformed, using the relation MTTF = MCTF / f, into a respective time (expressed in hours), giving the effective MTTF value for the relay in that application.

MCTF, B_{10} and B_{10d} for Finder relays

The electrical contact life for a Finder relay, as indicated by its associated "F" chart in the relay data-sheet, can be taken as the relay B_{10} figure, which is the statistical 10% fractile of lifetime (or, more simply, the expected time at which 10% of the population will have failed).

For Finder relays it is possible to estimate a relationship between it and the MCTF value, using the rough approximation MCTF = 1.5 x B_{10}.

The B_{10d} value refers to dangerous failures, and is derived from the B_{10} value from the relationship: $B_{10d} = B_{10} \times 10/N_d$, where N_d is the number of registered dangerous failures on 10 tested relays.

For a precise value it is of course necessary to test at least 10 relays, however for Finder relays it is possible to estimate using the rough approximation $B_{10d} = 2 \times B_{10}$.

Example 40.31 relay, switching a 10 A current on a resistive load, at 250 V AC, with a frequency of operation of 10 cycles per hour:

- from the chart "F40.1" we can see the electrical life value to be 200 000 cycles and can take it to represent the B_{10} value;
- this value, multiplied by 1.5 gives an MCTF value of about 300 000 cycles;
- this 300 000, divided by the cycling rate (10 cycles/hour), gives a MTTF value of 30 000 hours;
- the B_{10d} value can then be estimated (multiplying by 2 the B_{10} value) as 400 000 cycles.

RoHS, REACH & WEEE directives

Recent directives approved by the European Union aim to reduce potentially hazardous substances contained in electrical and electronic equipment - minimising risks to health and the environment, and guaranteeing the safe reuse, recycling or ultimate disposal of equipment.

Finder products comply with the relevant requirements of these Directives. Details and updated references can be found on the Finder website.

CADMIUM

Following the European Commission decision 2005/747/EC dated 21st October 2005, cadmium and its compounds are still permitted in electrical contacts. Consequently, relays with AgCdO contacts are acceptable in all applications. However, if required, the majority of Finder relays are currently available in "Cadmium-free" versions (for example, AgNi or $AgSnO_2$). But, it should be noted that AgCdO achieves a particularly good balance between the electrical life and the switching capacity of, for example, solenoids and inductive loads in general (particularly DC loads), motor loads and higher power resistive loads.

Alternative materials such as AgNi and $AgSnO_2$, do not always offer the same performance for electrical life as AgCdO, although this depends on both the type of load and application (see Table 5 under Contact specification section).

S I L and P L categories

S I L and P L categories relate to the statistical reliability of Safety Related Electrical Control Systems (SRECS). They are defined, respectively, in the following standards: EN 62061 (sector standard deriving from EN/IEC 61508 and listed as a Harmonized standard under the EU Machinery Directive) and EN ISO 13489-1 (which replaces EN 954-1 and is specifically intended to cover machines and process plant).

From the point of view of a user who is implementing safety controls using electrical / electronic / programmable systems, there is no clear distinction as to which standard should be used for any particular application, whether EN 62061 or ISO 13849-1. Either standard can be used as guidance for both hardware and application software for systems up to the highest integrity or performance as identified by the standard. Some of the considerations that might influence the choice of standard are:

- Customer requirements to demonstrate the safety integrity of a machine control system in terms of a Safety Integrity Level (SIL) may mean the use of IEC 62061 is more appropriate;
- Control systems of machinery used in, for example, process industries where other safety related systems (such as safety instrumented systems in accordance with IEC 61511) are characterised in terms of SILs may mean the use of IEC 62061 is more appropriate;
- Control system based upon media other than electrical may mean that the use of ISO 13849-1 is more appropriate.

Both standards use the concept of functional safety which means specifying the safety requirements in terms of the functional requirements (for example: "WHEN THE GUARD IS OPENED HAZARDOUS MOVEMENT MUST BE STOPPED"), and the amount of risk reduction required. EN 62061 uses Safety Integrity Levels (SIL), EN 13849-1 uses Performance Levels (PL). Both standards require the user to follow essentially the same series of steps:

- Access the Risks
- Allocate the Safety measures
- Design Architecture
- Validate

Both standards have a recommended risk assessment method to help establish the risk reduction that is required from a particular safety function; although the methods are quite different the outcomes should be the same (or very similar) for any given function.

S I L Classes - according to EN 62061

The severity of possible harm is assessed as one of four levels. The probability of the hazardous event occurring is then assessed by considering 3 further parameters in a range of point scores, these scores are summed to give the class (Cl). The class is then plotted against the severity in a simple matrix to establish the target SIL for the function.

The S I L (Safety Integrity Level) classifies, as one of 4 classes (SIL 0 to SIL 3), the dangers and risks that would be consequential to a particular application malfunctioning. This in turn generates the need for any associated SRECS to perform with an appropriate level of reliability. Applications, where the consequences of a failure of the control system are assessed as low (SIL 0) can tolerate a relatively high statistical probability of a control system failure occurring. Conversely, applications where the dangerous consequences of a failure of the control system are assessed as very high (SIL 3), cannot tolerate anything other than a control system with the highest (statistically assured) reliability. The reliability of the (overall) control system is specified in terms of the "Statistical probability of a dangerous system failure per hour".

P L Classes - according to EN ISO 13849-1

The risk assessment methodology given in EN ISO 13849-1 is in the form of a qualitative risk graph which is an enhanced version of the well-known risk graph that was in EN 954-1.

The output of the risk graph indicates a required performance level of a, b, c, d, e and clearly the greater the risk exposure to a hazard, the higher the performance of the safety related control needs to be.

Points of commonality between EN 62061 and EN ISO 13849-1

There is clearly correspondence between the SIL required according to EN 62061 and the PL required according to EN ISO 13849-1 because the numeric values for the "statistical probability of a dangerous fault per hour" are to a large extent the same for EN 62061 and EN ISO 13849-1.

SIL 1 corresponds to PL b & c, SIL 2 corresponds to PL d and SIL 3 corresponds to PL e.

Both standards define the statistical probability of a SERCS failure, and not the failure of a component. It is the responsibility of the system designer to ensure that a failure of a component does not compromise the required safety integrity of the system.

IEC EN 62061 (Safety Integrity Level)	"Statistical probability of a dangerous system failure per hour"	**EN ISO 13849-1** (Performance Level)
No special safety requirements	$\geq 10^{-5} \ldots < 10^{-4}$	a
1	$\geq 3 \times 10^{-6} \ldots < 10^{-5}$	b
	$\geq 10^{-6} \ldots < 3 \times 10^{-6}$	c
2	$\geq 10^{-7} \ldots < 10^{-6}$	d
3	$\geq 10^{-8} \ldots < 10^{-7}$	e

Component reliability

The safety control system designer needs to take into account the reliability of components. Accordingly, the most predictable failure for a relay is contact wear-out at moderate to high contact loading. But, as relay reliability standard EN 61810-2 emphasises, relays are not repairable, and this in particular needs to be taken into account when estimating the "statistical probability of a dangerous system failure per hour". See Reliability section.

For relays, the number of switching cycles before failure is predominantly determined by the life of the contacts, and consequently is dependent upon contact loading. The F-diagrams in the Finder catalogue can be regarded as indicating the B_{10} Value of a Weibull type distribution of electrical life (for a 230 V AC1 load); from which the MCTF can be derived and used ultimately in calculating the "statistical probability of a dangerous system failure per hour" for the safety control system.

Certifications and Quality Approvals

CE		**CE**	**EU**	
UKCA	UK Conformity Assessed	**UKCA**	United Kingdom	
Ex		**ATEX**	**EU**	
IECEx		**IECEx**	**World**	
UL HazLoc		**UL HazLoc**	**USA**	
ANCE	Asociación de Normalización y Certificación, A.C.	ANCE	Mexico	
CCC	China quality Certification Centre	CCC	China	
CSA	Canadian Standards Association	CSA	Canada	
EAC	EurAsian Conformity	EAC	Russia, Belarus, Kazakhstan, Armenia and Kyrgyzstan	
ENEC	European Norms Electrical Certification	ENEC	Europe	
IMQ	Istituto Italiano del Marchio di Qualità	IMQ	Italy	
NF	Laboratoire Central des Industries Electriques	LCIE	France	
LR	Lloyd's Register of Shipping	Lloyd's Register	United Kingdom	
RINA	Registro Italiano Navale	RINA	Italy	
RCM	Regulatory Compliance Mark	RCM	Australia	
TÜV	TÜV Rheinland TÜV SÜD	TUV	Germany	
UL	Underwriters Laboratories	UL	USA	
cULus	Underwriters Laboratories	UL	USA Canada	
VDE	VDE Prüf- und Zertifizierungsinstitut Zeichengenehmigung	VDE	Germany	
SM	Servimeetrs	SM	Colombia	
RMRS	Russian Maritime Register of Shipping	RMRS	Russia	