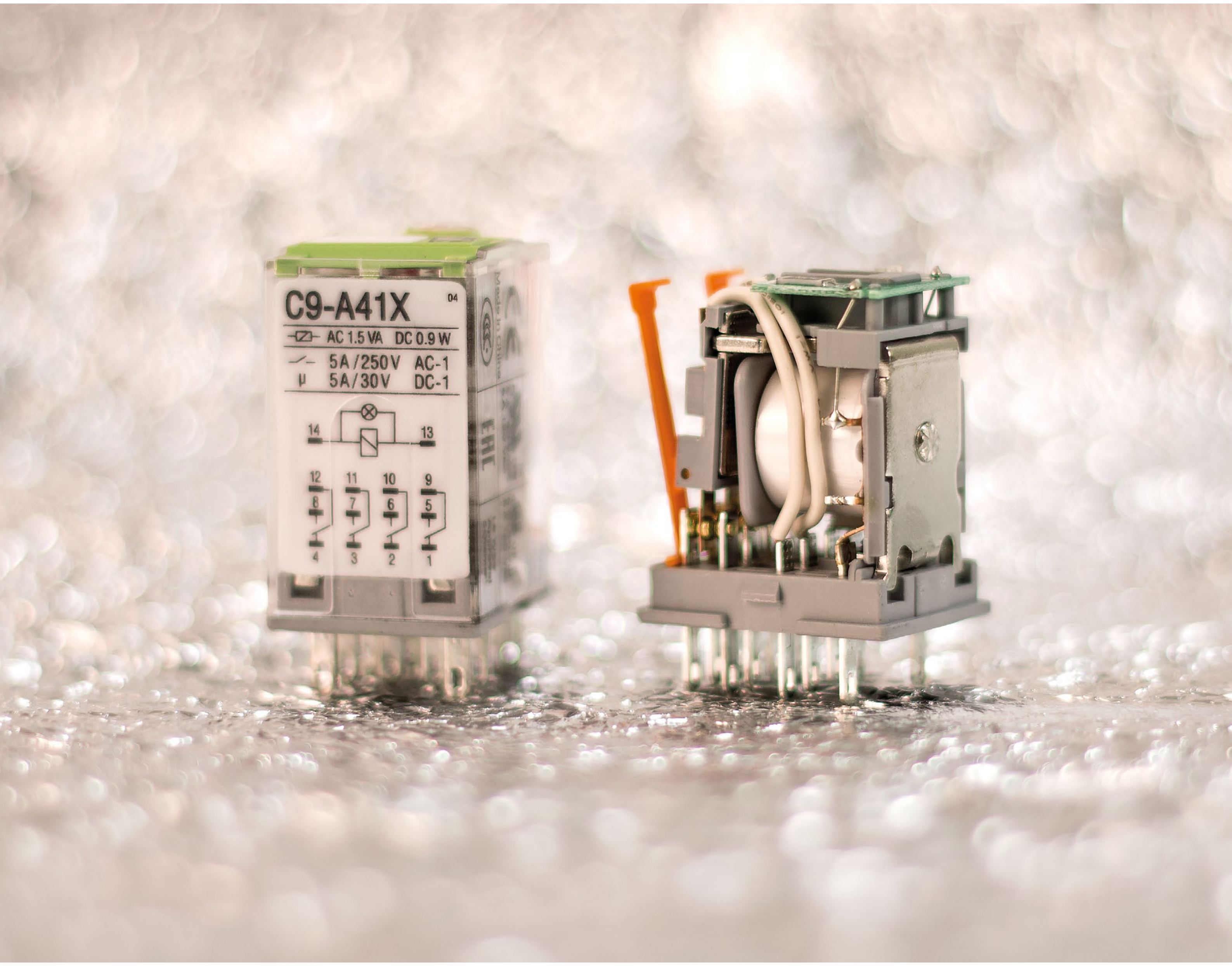
comat RELECO
WORLD OF RELAYS

Workshop

Industrial Relays



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01 INTRODUCTION

The electromechanical relay is the most frequently used switching element worldwide. Its roots can be traced back deep into the 19th century and originated in the era of telegraphy. Weakened signals were replenished by long lines in the relay station.
Current relays are electromechanical masterpieces of the highest precision and accomplish a wide range of tasks in all conceivable industrial areas in different versions.
The semiconductor technology (solid state) allows for the development of solid state relays, which, in contrast to electromechanical relays, do not contain any moving parts. The switching is purely electronic and therefore free of wear.
These solid state relays are increasingly replacing electromechanical relays in certain industrial sectors. This is especially the case for applications with a high number of switching cycles and high switching frequencies or for applications, where very rare yet very reliable switching is required. However, the versatility of electromechanical relays and their applications are so diverse that the market is still growing worldwide.
Regardless of which technology is used for a relay switching circuit, the properties of the application must be known. ComatReleco develops products from both technologies and puts itself forward as a competent partner for all industrial applications with relays.

We live in the "World of Relays".
We will use this workshop to demonstrate how relays and contactors are used. The properties of each application also involve corresponding requirements on the switching components. Knowing all about the application is essential for optimal dimensioning. It is not only important to know the voltage and current of the load, knowing whether the load is ohmic, inductive or capacitive is of equal importance. The switching frequency, switching rate and specific environmental conditions, such as the presence of sewer gases or dusts, but also the occurrence of temperature fluctuations, influence the selection of the relay. In practise – purely from the perspective of switching voltage and switching current – four fields of applications have become established, which can be characterized as follows.

Signal relay
Switching of micro and analogue signals (100 mV / 10uA … 5 V / 1mA)

Control relay
Switching of control signals (5V / 1 mA…30V / 100 mA)

Power relay
Switching of increased powers / loads (30V / 100 mA…250V / 16A)

High power relays
Switching of capacitive and inductive loads (12 V / 100 mA ... 400V / 63 A)

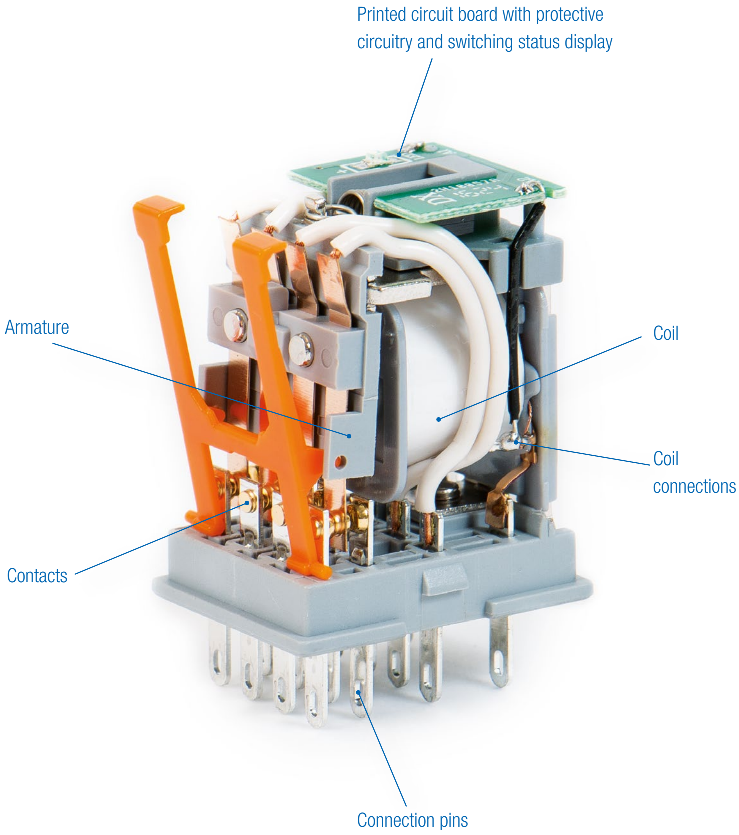
Furthermore, the factors already mentioned must also be considered. The utilization categories in accordance with IEC/EN 60947 help to characterize the application scenarios taking into account the operating conditions. An excerpt of this standardization can be found in this workshop for better understanding. You are more than welcome to contact us for further questions and clarifications at info@comat.ch or +41 (0)31 838 55 10.

02 OPERATION AND APPLICATION

Application

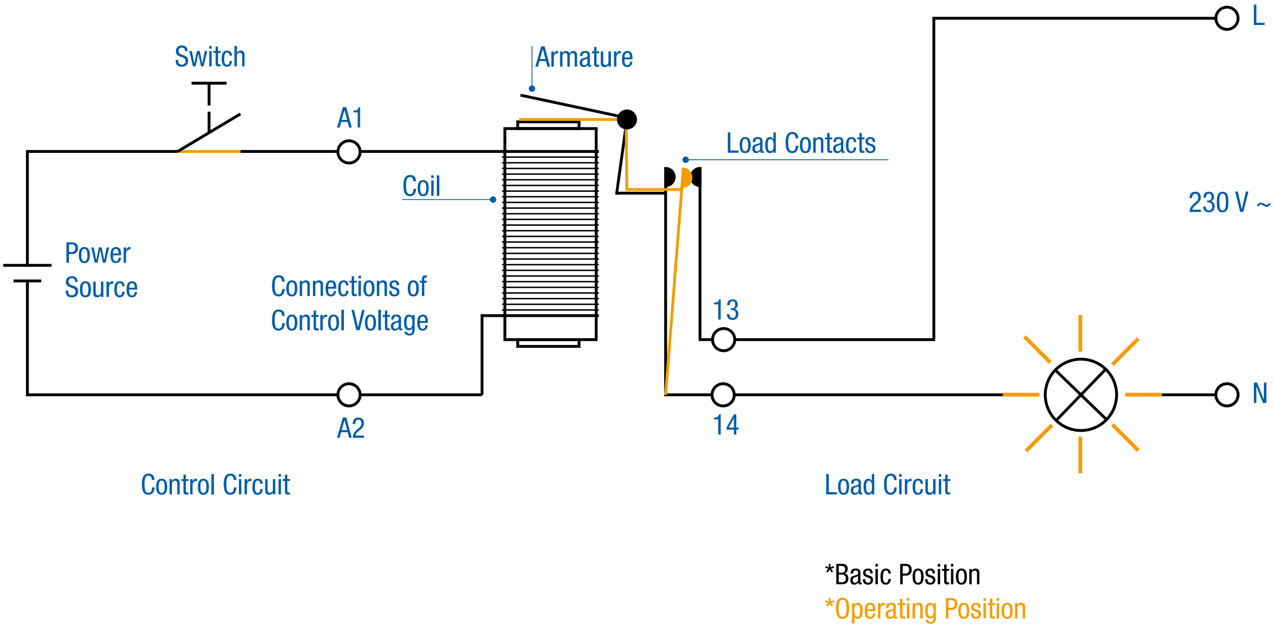
A relay is an electromechanical switch with two switching positions. Actuation is triggered via a control circuit. The control circuit uses a magnetic field to switch the contacts and thus the circuits to be switched. The main applications of relays include:

- Simultaneous interaction between several load circuits with a single control circuit
- Switching of large electrical loads with a low voltage control circuit
- Reducing of a higher voltage to the control voltage level
- Galvanic isolation of load circuit and control circuit



Functionality

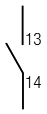
The electromechanical relay functions on the principle of an electromagnet. An electrical current in a coil generates a magnetic flux through the ferro-magnetic core. The resulting force is exerted on the armature, which moves the contacts into the working position from the idle position by means of mechanical transmission. The armature falls back into the idle position by the so-called de-energising of the coil.



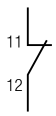
03 CONTACTS

Switch symbols

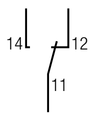
An electromechanical relay has mechanical contacts, which are designed as normally open, normally closed or change-over contacts.



Normally open contact
A contact is referred to as a closing, normally open or working contact if it is open when the armature is de-energised resp. the coil is de-energised. It closes when the coil is charged with current flow.



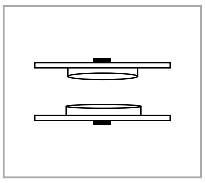
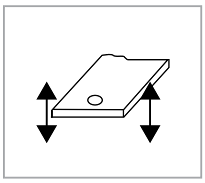
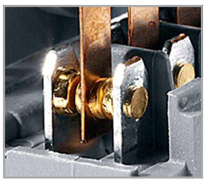
Normally closed contact
A contact that interrupts the circuit when the coil is activated is called opener, normally closed or break contact.



Change-over contact
A combination of normally closed and normally open contact is referred to as a changer, change-over or switch-over contact. The roots of the normally open and normally closed contacts are connected to each other. Therefore the change-over contact has three connections.

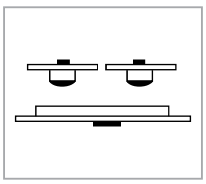
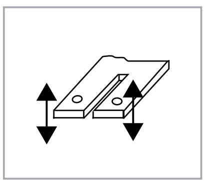
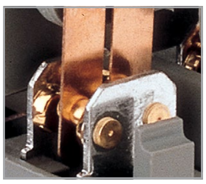
Contact types

Standard contact

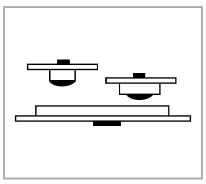
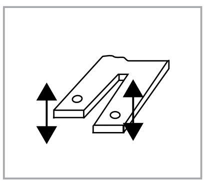
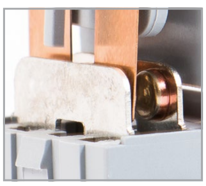
The standard contact consists of a pair of contact pills and, depending on the contact material, is predominantly used for control and power relays.

Double contact

The double contact has two pairs of contact pills. The contact reliability is increased by up to a factor of 100 as a result. It is used in signal and control relays.

Pre-run contact

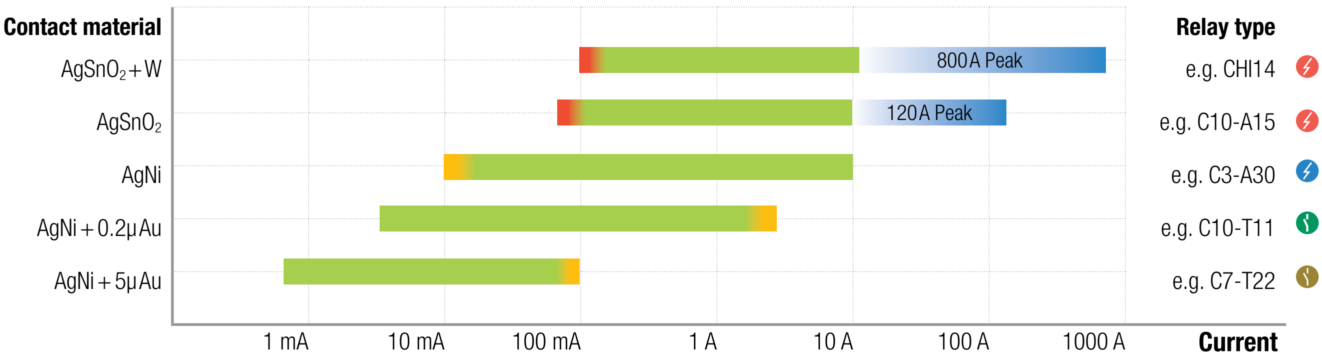
The pre-run contact consists of a contact fitted with a highly heat-resistant contact material and of a later closing contact consisting of a further contact material featuring good electrical conductivity at nominal load. This contact is mainly used for switching high inrush currents.

Contact materials

ComatReleco uses five different contact materials in its relays. The following table gives an overview of the switching capacity of the different materials. The actual switching capacity of the relay is also influenced by the contact geometry and other mechanical properties.

Material	Description
AgNi Silver-Nickel	Contact with good arc and oxidation resistance. Field of application: Typical values 10 mA / 12 V to 10 A / 250 V
AgNi + 0.2 µm Au AgNi with touch of gold plating	Same properties as AgNi contact. Higher oxidation resistance, well suited for long-term storage. Field of application: Typical values 5 mA / 12 V to 6 A / 250 V
AgNi + 5 µm Au AgNi with gold plating	Contact for the switching of small control signals, very good oxidation resistance. Field of application: Typical values 1 mA / 5 V to 100 mA / 30 V
$AgSnO_2$ + W AgNi tungsten pre-run contact	High arc resistance. Switching of high inrush currents up to 800 A. Field of application: Typical values 10 mA / 12 V to 16 A / 250 V
$AgSnO_2$ Silver-tin-oxide	Arc resistance. Switching of increased inrush currents up to 120 A. Field of application: Typical values 10 mA / 12 V to 10 A / 250 V

Working range of the contact materials



ComatReleco Quickfinder

The following Quickfinder can be used to quickly find the right relay for your application. All switching devices in our documentation are marked with pictograms, which correspond to the respective application field. The following four questions must also be answered for the appropriate dimensioning:

- How high are switching current and voltage of the application?

- Is direct voltage (DC) or alternating voltage (AC) switched?
- Is the load inductive or capacitive?
- How many switching cycles per unit of time are to be expected?

Application	Voltage	Current	Application	Type	Material
Signal relay	100 mV…5 V	10 uA…1 mA	Micro signals, Standard signals (0…10 V/4…20 mA)	Gold-plated Double contact	AgNi + Ag
Control relay	5 V…30 V	1 mA…100 mA	PLC inputs, Control circuits	Double contact	AgNi
				Gold-plated Standard contact	AgNi + Ag
			Frequent, rapid switching processes	Semiconductor	Mosfet (DC) Triac (AC)
Power relay	30 V…400 V	100 mA…16 A	Increased AC or DC loads	Standard contact	AgNi
			Electromagnets (Utilization cat. AC-15/DC-13)	Standard contact	$AgSnO_2$
			Frequent, rapid switching processes, high reliability, noiseless switching	Semiconductor	Mosfet (DC) Triac (AC)
High power relays	12 V…400 V	100 mA…16 A	Capacitive loads	Pre-run contact	AgNi + W $AgSnO_2$ + W
			High DC loads, inductive loads	Series contacts	AgNi $AgSnO_2$
			Frequent, rapid switching processes, high reliability, noiseless switching	Semiconductor	Mosfet (DC) Triac (AC)

Type designation code

C 10 - A 1 5 B X / U C 2 4 V

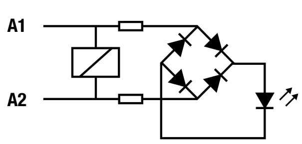
Family · Type · Number of contacts · Contact material · Circuitry · Voltage type · Control voltage

Type	A	Standard contact
	H	Relay with control and power contact
	M	Blow magnet relay with series contact
	R	Remanent relay
	T	Double contact
	W	Tungsten pre-run contact
Number of contacts	n	Number
Contact material	0	AgNi
	1/2/3/8/9	AgNi + Ag
	5	$AgSnO_2$
Circuitry	X	LED
	DX	Free-wheeling diode and LED
	FX	Polarity reversal protection, free-wheeling diode and LED
	BX	Bridge rectifier and LED
Voltage type	AC	Alternating voltage
	DC	Direct voltage
	UC	Direct and alternating voltage
Control voltage		…V

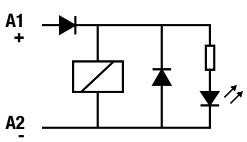
* This type designation code applies to pluggable industrial relays of the series C2-C18.

Circuitry

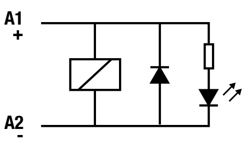
X



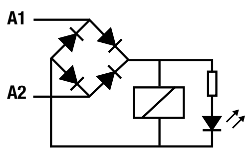
FX



DX



BX



Influencing factors

Depending on the application in question, individual parameters can be important or carry no significance at all and can have a differing effect on the service life of the switching device and thus the system. Two basic parameters that should always be observed for the correct dimensioning are the switching voltage and switching current parameters, as well as the type of the load to be switched. The switching frequency and the switching rate parameters, as well as the service life and maintenance cycle, are the other parameters, which will have to be considered for each application, yet vary considerably:

Example: "Switching frequency/switching rate"

The number of switching cycles which a relay can perform correctly is limited. It varies from 10,000 to 2,000,000, depending on the relay design, the contact material, the load and the environmental conditions. Some 10,000 processes a day are not uncommon in fast working machines and installations from the paper, packaging and textile industries.

⚠ The service life of an electromechanical relay may only amount to a few days in such cases. After that, the relay is mechanically worn and may fail.

ℹ Semiconductor relays or semiconductor contactors are suitable for such applications in the corresponding capacity range.

Example: “Switching of DC loads”

The switching of DC voltage loads, especially inductive loads such as valves, contactors or magnetic couplings, massively shortens the service life of the contacts due to burning. These loads have a lot of electromagnetic energy, which must be dissipated when switched off. Without countermeasures, such as free-wheeling diodes on the load, the energy is transformed into an arc as soon as the contact is opened. Unlike AC voltage, there is no zero crossing with DC voltage that automatically extinguishes the arc, placing a heavy load on the contacts.

⚠ All loads from the utilization category DC-13 as well as all DC loads of more than 30 V/1 A are problematic and limit the service life.

ℹ Semiconductor relays, semiconductor contactors or electromechanical relays or contactors with a blow magnet are ideal for this application. The service life of the relay can also be increased by connecting several contacts in series. The following products are suitable: C5-M10, RIC20-xxx-R4AD-C110V, CSS, CC.

Example: “Type of load to be switched”

A modern LED lighting system with switching power supply is to be switched with a relay. The lighting system is only switched on/off once a day. The values specified in the data sheet for the service life to be expected are only theoretically achieved in this manner after several years. However a high inrush current occurs due to the input capacity of the switching power supply, which causes an arc through the closing contact at the point of switching, which in turn can lead to welding of the contact if a relay is wrongly selected.

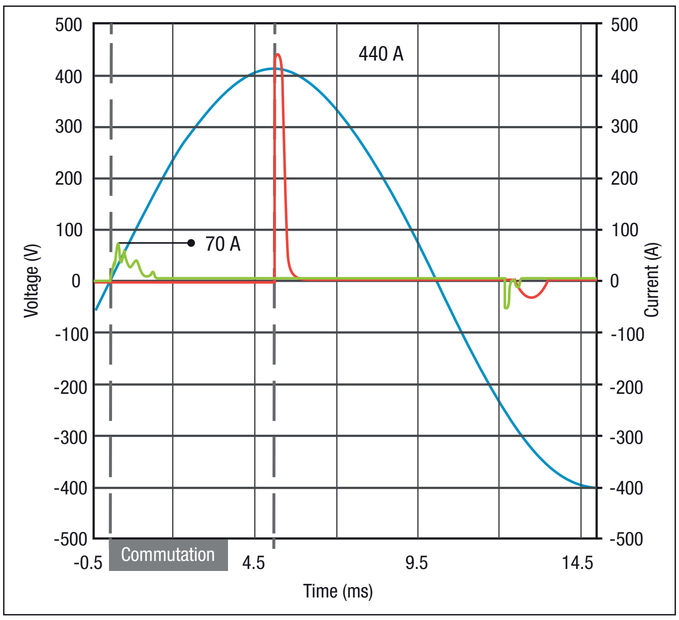
⚠ The relay used must be capable of switching inrush currents up to 250 times (!) the nominal current. The data sheet of the ballast must be observed here.

ℹ Relays with tungsten pre-run contact such as CHI14, CHI34, C7-W10 are suitable for applications with high inrush currents.
The following rule of thumb is used to calculate the number of ballasts per relay contact:

Example: Ballast 230 V / 90 W ($I_{nom} = 0.3\,A$) switched with CHI14 / CHI34 ($I_{inr} = 800\,A$)

$$n = \frac{I_{inr}}{200 \times I_{nenn}} = \frac{800\,A}{200 \times 0.3\,A} = 13$$

I_{inr}: Possible inrush current of the relay
I_{nom}: Nominal current per ballast
n: Number of ballasts, which can be switched via a relay contact



- **Fluorescent lamp with electronic ballast 40 × 24 W T5**
- Inrush currents with/without
- Zero voltage switching: 70 A/440 A

Utilization categories

The properties of the load to be switched affect the strain on the switching path of the open contacts of each switching device. The strains caused by the voltage and current when switching on and off are also important, since the switching behaviour of an ohmic load is fundamentally different to the behaviour of a capacitive load, for example, and thus places different requirements on the relay or on the contactors.

Classifying such applications into utilization categories makes the selection of the product and the dimensioning easier. We provide the respective data for switching current and switching voltage of the corresponding category. This data is ascertained by the test procedures defined in the norm: IEC/EN 60947 and is thus standardized. A detailed consideration of each application is still necessary, since additional parameters can influence the switching behaviour and the reliability in practice. The following table gives an overview of the most common utilization categories used for applications with relays and contactors.

Current type	Utilization category	Description	Application note
Alternating current	AC-1	Ohmic or slightly inductive load	Dimensioning in accordance with the nominal values for the corresponding utilisation category.
	AC-14	Small electromagnetic loads <72 VA	Dimensioning in accordance with the nominal values for the corresponding utilisation category.
	AC-15	Electromagnetic loads >72 VA	Dimensioning in accordance with the nominal values for the corresponding utilisation category.
	AC-3	Squirrel cage motors: Start-up, switch off during operation.	Application for industrial contactors. Dimensioning in accordance with the nominal values for the corresponding utilisation category.
Direct current	DC-1	Ohmic or slightly inductive load	Dimensioning in accordance with the load limit curve for the corresponding utilisation category.
	DC-3	Electromagnetic loads	Dimensioning in accordance with the load limit curve for the corresponding utilisation category.

Switching of different voltages with adjacent contacts

The switching of different voltages via a relay is the most commonly used application scenario in practise. The use of relays with a small contact distance for switching of 230 VAC and 24 VDC demonstrates that this entails certain risks. The following is used to show what must be observed in order to avoid incidents with consequential damages to the electrical equipment.

The theory behind the phenomenon!

Compact relays with a structural width of 22.5 mm or less must be equipped with up to four change-over contacts. In our example, a contact of a four-pole relay was loaded with a control voltage of 24 VDC and a maximum of 2 A while the adjacent contact set had to switch a voltage of 230 VAC and a maximum of 0.5 A – a contactor coil without protective circuit. This resulted in an arc and a short circuit between the adjacent contacts. The relay and the other surrounding components were destroyed as a consequence.

The phenomenon that causes this to happen can be explained by the laws of induction (Lenz's law): An induction voltage is generated that counteracts the control voltage due to the change in the magnetic flux upon both switching on and switching off a coil. Depending on the phase position at the point of switch-off, this induction voltage may well reach a level amounting to several kilovolts and can cause an arc to impact on the relay contact. Plasma can build-up as a result; the freed charge carriers in the air also transfer the arc to the adjacent contacts and lead to short-circuiting.

Explanation based on the norms

The norms: EN 60947 and EN 61810 are particularly applicable in relay technology. The norm: EN 60664 is referenced in EN 61810 and indicates that a basic insulation with a clearance of 3 mm is required for voltages above 150 VAC. This corresponds to a pulse test voltage of 4 kV. The clearance between adjacent contacts in compact relays often only amounts to 1.75 mm and the test voltage is given with 2 kV RMS. From the perspective of the norms, this explains why the use of this relay to switch 24 VDC and 230 VAC is not permissible in compact relays (22.5 mm).

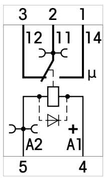
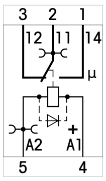
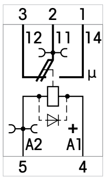
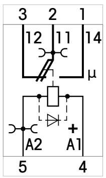
Remediation measure

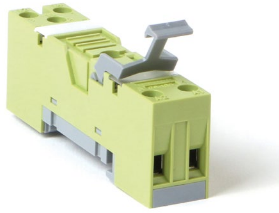
For this application, it is absolutely essential to switch the 24 VDC circuit and the 230 VAC circuit through two separate relays or to use one relay with larger contact distance (pulse test voltage ≥ 4 kV). One option is to use relays from the C5 series. These relays are pluggable and available in different versions. The contactors from the RIC, RAC, RSC or RMC series are also suitable. These can be fitted with an expansion module as an option. It has two double contacts and is therefore ideal to reliably switch small signals in the 24 VDC range.

Application errors

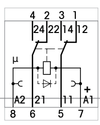
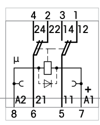
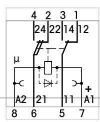
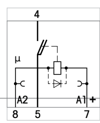
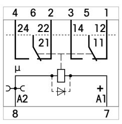
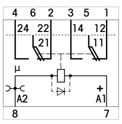
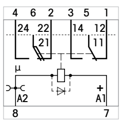
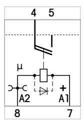
Load too small	The contacts of the relay close / appear closed when inspecting, but no current flows. The surface of the contacts is provided with an oxide coating that is often barely visible, which prevents clean contacting.	• Select relay from following categories: • Increase service interval, replace relay
Load too big	The contacts are welded and can only be released by external influence.	• Apply the relay according to the load.
DC load	Material is removed and transferred onto the other contact pill due to arc formation and the one-way movement of the electrons. The resulting surface geometry can lead to an increased contact resistance or the contact pills can be welded or mechanically interlock and no longer release.	• Use relay or contactor with blow magnet • Use semiconductor relay • Switch several contacts in series • Increase service interval, replace relay
	The contacts are welded and can only be released by external influence.	• Use relay or contactor with blow magnet • Use semiconductor relay • Switch several contacts in series • Increase service interval, replace relay
Capacitive load	Due to the high inrush current of capacitive loads, contacts may become welded after just a few switching cycles.	• Select relay from following category. Use a relay with tungsten pre-run contact:
Inductive load	The contacts are welded and can only be released by external influence.	• Select relay from following categories: Observe the special notes relating to the utilization category: DC-13, AC-15 or AC-3. • Apply protective circuitry on the load side (e.g. free-wheeling diodes)
Fast switching cycles	The signal transmission through the contacts is insufficient due to successive switching on and off that was too fast. The arc formation is occasionally increased.	• Use semiconductor relay
High number of switching cycles	The relay reaches the mechanical service life after just a short time (days, weeks) and drops out.	• Use semiconductor relay
Low number of switching cycles (1 × / year)	Particles of dirt may build up or corrosive deposits may form on the contacts during applications with a low number of switching cycles, since the contacts are not "cleaned" by continuous use. This can lead to poor signal transmission.	• Use semiconductor relay • Increase service interval, replace relay
Aggressive gases	The contacts of the relay close / appear closed when inspecting, but no current flows. The surface of the contacts is provided with an oxide coating, which is typically characterized as a black discolouration in appearance and prevents clean contacting.	• Select relay from following categories: • Use sealed relay • Increase service interval, replace relay • Improve ventilation
Dust in the environment	The contacts of the relay close / appear closed, but no current flows. The surface of the contacts is covered with non-conductive particles.	• Prevent the penetration of dust • Increase service interval, replace relay • Stabilise the temperature ("suck in" of dust due to temperature variations)
Long supply cables	The relay does not drop out even though the voltage on the coil has been withdrawn. A considerable voltage can still be measured at the connections A1 and A2, which is occasionally even higher than the operating voltage. This is due to capacitive coupling due to lines that are laid in parallel in the case of alternating voltage relays.	• Parallel connection of the coil with the suppressor module CEM01/UC24-240V

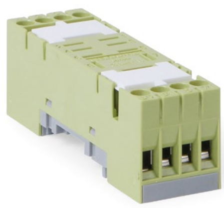
C10

Type	C10-A10	C10-A15	C10-T11	C10-T13
	Universal power relay 10A	High power relay for 120 A inrush current	Control relay with double contacts 6A	Signal relay with 5 μ gold plating
Contact material	AgNi	$AgSnO_2$	AgNi + 0,2 μ Au	AgNi + 5 μ Au
Recommended minimum load	10 mA / 10 V	10 mA / 10 V	5 mA / 5 V	1 mA / 5 V
Load AC-1	10 A / 250 VAC	10 A / 250 VAC	6 A / 250 VAC	6 A / 250 VAC
Load AC-15	2 A / 250 VAC	6 A / 250 VAC	–	–
Load DC-1	10 A / 30 VDC	10 A / 30 VDC	6 A / 30 VDC	6 A / 30 VDC
Inrush current	30 A (20 ms)	120 A (20 ms)	15 A (20 ms)	15 A (20 ms)
Operating voltage	0.8…1.2 U_N	0.8…1.2 U_N	0.8…1.2 U_N	0.8…1.2 U_N
Power consumption	1.1 VA / 0.7 W	1.1 VA / 0.7 W	1.1 VA / 0.7 W	1.1 VA / 0.7 W
Connection layout with socket CS-106				

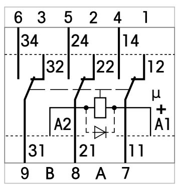
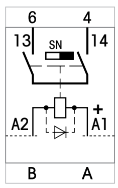


C7

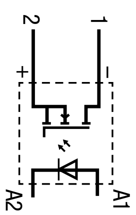
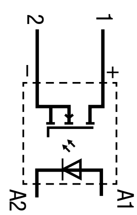
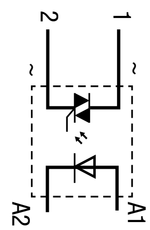
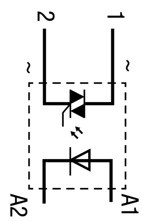
Type	C7-A20	C7-T21	C7-T22	C7-W10
	Universal power relay 10A	Control relay with double contacts 6A	Signal relay with 5μ gold plating	High power relay for 500A inrush current
Contact material	AgNi	AgNi + 0.2 μ Au	AgNi + 5 μ Au	AgNi + W
Recommended minimum load	10 mA / 10 V	5 mA / 5 V	1 mA / 5 V	10 mA / 10 V
Load AC-1	10 A / 250 VAC	6 A / 250 VAC	6 A / 250 VAC	10 A / 250 VAC
Load AC-15	6 A / 250 VAC	–	–	6 A / 250 VAC
Load DC-1	10 A / 30 VDC	6 A / 30 VDC	6 A / 30 VDC	10 A / 30 VDC
Inrush current	30 A (20 ms)	15 A (20 ms)	15 A (20 ms)	500 A (2.5 ms)
Operating voltage	0.8…1.2 U_N	0.8…1.2 U_N	0.8…1.2 U_N	0.8…1.2 U_N
Power consumption	1.5 VA / 0.9 W	1.5 VA / 0.9 W	1.5 VA / 0.9 W	1.5 VA / 0.9 W
Connection layout with socket CS-118				
Connection layout with socket CS-109				

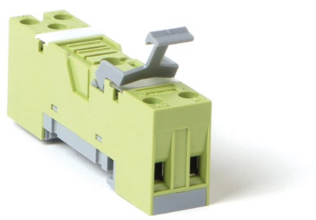


C5

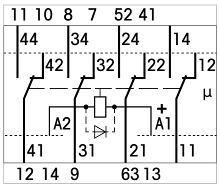
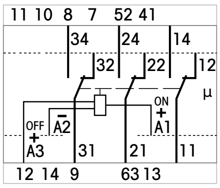
Type	C5-A30	C5-M10
	Universal power relay 16A	High power relay for DC load up to 10A 220V
Contact material	AgNi	AgNi
Recommended minimum load	10mA/10V	10mA/10V
Load AC-1	16A/400VAC	16A/400VAC
Load AC-15	8A/400VAC	–
Load DC-1	16A/30VDC	10A/220VDC
Inrush current	40A (20ms)	40A (20ms)
Operating voltage	0.8…1.2 U_N	0.8…1.2 U_N
Power consumption	2.4 VA/1.4W	2.4 VA/1.3W
Connection layout with socket CS-155		

CSS

Type	CSS-P13X	CSS-N13X	CSS-I12X	CSS-Z12X
	Power semiconductor relay for DC load	Power semiconductor relay for DC load	Power semiconductor relay for AC load, immediate switching	Power semiconductor relay for AC load, zero-voltage switching
Contact material	Semiconductor	Semiconductor	Semiconductor	Semiconductor
Recommended minimum load	1mA	1mA	1mA	1mA
Load AC-1	–	–	3A/240V	3A/240V
Load DC-1	6A/48V	6A/48V	–	–
Inrush current	40A (10ms)	40A (10ms)	150A (10ms)	150A (10ms)
Operating voltage	5…48V	5…48V	5…48V	5…48V
Power consumption	160mW	160mW	300mW	300mW
Connection layout with socket CS-106				



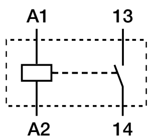
C4

Type	C4-A40	C4-R30
	Universal power relay	Remanent relay 10 A with AC or DC coil
Contact material	AgNi	AgNi
Recommended minimum load	10 mA / 10 V	10 mA / 10 V
Load AC-1	10 A / 250 VAC	10 A / 250 VAC
Load DC-1	10 A / 25 VDC	10 A / 25 VDC
Inrush current	30 A (20 ms)	30 A (20 ms)
Operating voltage	0.8…1.2 U_N	0.8…1.2 U_N
Power consumption	2.4 VA / 1.4 W	ON:1.5 VA / W OFF: 0.5 VA / W
Connection layout with socket CS-144		

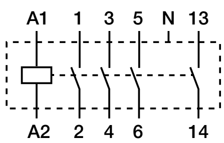
CHI14 / CHI34

Type	CHI14/UC24-240V	CHI34/UC24-240V
	High power relay with two contacts	High power relay with four contacts
Contact material	$AgSnO_2 + W$	$AgSnO_2 + W$
Number of contacts	1 NO	3 NO
Number of auxiliary contacts	–	1 NO
Recommended minimum load	100 mA / 12 V	100 mA / 12 V
Load AC-1	16 A / 250 V	16 A / 250 V
Inrush current	800 A / 200 µs 165 A / 20 ms	800 A / 200 µs 165 A / 20 ms
Electrical service life	5×10^6	5×10^6
Nominal operating voltage (V)	AC/DC 24…240 V	AC/DC 24…240 V
Operating voltage	AC/DC 16.8 V…250 V	AC/DC 16.8 V…250 V
Power consumption	AC: ≤1.2 VA DC: ≤430 mW	–

CHI14



CHI34



RIC20 / RIC25 – 63

RIC20 | RIC25-63	RIC20	RIC25	RIC40	RIC63
	RIC20-200/…V	RIC25-400/…V	RIC40-400/…V	RIC63-400/…V
	RIC20-110/…V	RIC25-220/…V	RIC40-220/…V	RIC63-220/…V
	RIC20-020/…V	RIC25-040/…V	RIC40-040/…V	–
	Contactor 20 A	Contactor 25 A	Contactor 40 A	Contactor 63 A
Contact material	AgNi	AgNi	$AgSnO_2$	$AgSnO_2$
Recommended minimum load	50 mA / 24 V	50 mA / 24 V	50 mA / 24 V	50 mA / 24 V
Load AC-1	4 kW / 230 V	16 kW / 400 V	26 kW / 400 V	40 kW / 400 V
Load AC-3	1.3 kW / 230 V	4 kW / 400 V	11 kW / 400 V	15 kW / 400 V
Inrush current	50 A / 180 ms	50 A / 280 ms	150 A / 970 ms	150 A / 1500 ms
Operating voltage	0.85…1.1 U_N	0.85…1.1 U_N	0.85…1.1 U_N	0.85…1.1 U_N
Power consumption	2.1 W	2.6 W	5 W	5 W

A

AC load switching

The relay can be operated when switching alternating voltage loads up to the maximum values, i.e. up to the level of the nominal voltage and nominal current. The arc generated during switch off is dependent on the level of voltage and current, but also on the phase position, and generally disappears by itself upon the next zero crossing of the load voltage.

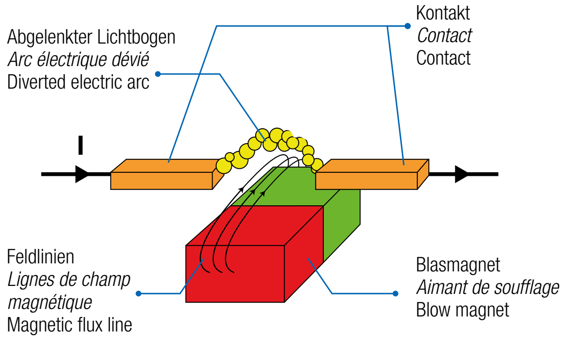
Aggressive environment

A hard gold coating of 5 µm prevents any transmission errors in signal and control circuits, which are caused by oxidation of the contacts under adverse environmental conditions, such as in sewage treatment plants, stables, chemical plants, in steel production or in road traffic, for example.

B

Blow magnet

The blow magnet is a magnet that is attached close to the contact pills, which "pushes away" the arc between the opening contacts by means of Lorentz force. As a result, the surface of the arc is increased, allowing it to cool down more quickly.



C

Capacitive load

The inrush current of a capacitive load increases up to 250 times the nominal current and then levels out to the nominal current. The high inrush current can lead to welding of the relay contacts.

Circuitry see page 09

Contact materials see page 07

Contact resistance

Typical values are in the range of 50 mΩ. The value changes by use.

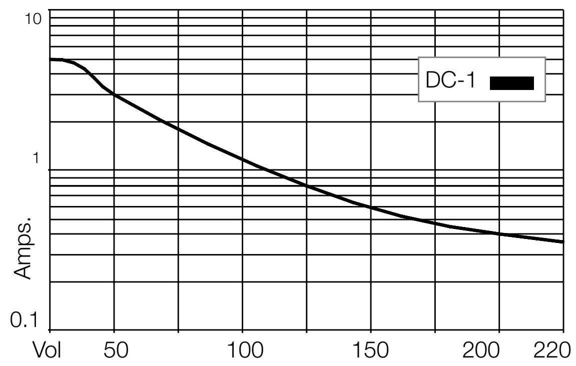
Control signals

Relays with double contacts are used for reliable transmission of control signals (see “Double contact”).

D

DC load switching

The switching capacity (switching current) decreases with increasing voltage in the case of DC loads. The load limit curve of the respective relay must therefore be observed during dimensioning. Relays or contactors with a higher contact distance or an internal series of contacts are used for DC loads in order to avoid increased contact burning. The same effect can be achieved with external connections of several contacts in series. The contacts of special relays for DC loads are additionally equipped with a blow magnet in order to accelerate cooling of the arc (see "Blow magnet").



Double contact

Has two parallel contact pills that increase the reliability for transmitting small currents in signal and control circuits by a factor of 10 to 100.

F

Fast, frequent switching processes

The wear caused by repetitive switching in second or minute intervals leads to electromechanical relays reaching their mechanical service life within days or weeks, therefore causing a resulting failure. Flasher or industrial relays with semiconductor output are recommended for such applications. These are wear-free due to the absence of moving parts and are therefore free of maintenance too.

H

High inrush currents

High inrush currents occur in the case of inductive loads, but especially with capacitive loads (see “Inductive load” and “Capacitive load”). Tungsten pre-run contacts have a higher melting point than silver alloys, making them resistant to rapidly rising currents which cause arc formation at the point of switch-on. This prevents welding of the contact pills.

I

Inductive load

The inrush current increases due to the build-up of the magnetic field of the inductor and then levels out to the nominal current (e.g. switching on a magnetic switch). A voltage of up to several 1,000 V may be induced upon switch off, which leads to an arc forming between the opening relay contacts. The arc breaks away due to the zero-crossing in the case of alternating voltage, whereas continuous arcing can result with direct voltage that immediately destroys the relay.

Installation position

The installation position of the relays is arbitrary when using a retaining clip or retaining bracket, unless different information is specified.

L

Low number of switching cycles

Particles of dirt may build up or corrosive deposits may form on the contacts during applications with a low number of switching cycles, since the contacts are not "cleaned" by continuous use. This can lead to poor signal transmission.

M

Minimum load

Recommended values for voltage and current under which a relay can function as expected under normal conditions such as an appropriate number of switching cycles per unit of time, minimum temperature surges, no extraordinary contamination or aggressive gases in the environmental air. Falling short of these values can lead to transmission errors and is therefore not recommended.

N

Nominal voltage

Nominal value of the coil voltage with which the relay can be supplied.

O

Ohmic load

The current flow remains constant from the switch-on point until the switch-off point.

P

Power circuits

Relays with contact distances of at least 3 mm allow for a safe isolation of different power circuits. The switching of circuits under different voltages via a relay is only recommended with certain relay series. (See page 11, article "Switching of…")

Pre-run contact

Normally open contact with two pairs of contact pills that are in quick succession, which are fitted with different contact materials. Is used to switch high inrush currents. The pair of contact pills to close first is fitted with tungsten that is resistant to high temperatures, which prevents the contact from welding during arc formation. The subsequent contact pair has contact pills made of a conductive silver alloy such as AgNi or $AgSnO_2$. Tungsten pre-run contacts can reliably switch inrush currents up to 800 A for 200 µs.

R

Remanent relay

Relay with two coil connections, which maintains its respective switching status without electrical energy being permanently applied. The connection A1 is used for activation and the connection A3 for deactivation of the relay via a pulse of >50 ms. Due to logic, A1 and A3 are not linked with each other. Simultaneous triggering of A1 and A3 is considered as "non-defined" and must intercepted by the higher-level control system.

S

Service interval

The stress burden on the switching path for electromechanical relays results in signs of wear over time. The relay should be replaced as required in order to maintain the availability of the system. Parameters such as switching voltage, switching current, utilization category and number of switching cycles per unit of time, but also corrosive environmental conditions and high temperature fluctuations, should be considered in order to determine the service interval. We would be happy to help you ascertain the service interval.

Small signals

Relays with double contacts are used for reliable transmission of small signals (see "Double contact"). A hard gold coating of 5 µm additionally prevents contact oxidation. A combination of both properties results in a reliable contact for switching micro signals and analogue circuits.

Step switch

Also bistable relay. Changes its switching status by applying a pulse at the input A1, maintaining this until the next pulse. Consequently, a step switch does not have to be permanently supplied with voltage, which has a positive effect on the energy consumption but also on the generation of heat with a large number of installed devices.

Switching cycle

The response and the ensuing release of the relay is referred to as a "switching cycle".

Switching capacity (maximum)

The maximum switching capacity corresponds to the product of the nominal current and nominal voltage of each utilisation category in the case of alternating voltage. The switching capacity should not be assumed for the dimensioning in the case of DC currents. The switching current, which the relay can safely isolate dependent on the switching voltage, shall be taken as a reference value here. Corresponding load limit curves provide further details. (See "Switching DC loads")

For technical queries, please do not hesitate to contact us at +41 (0)31 838 55 10 or support@comat.ch

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