1.6 High Inrush Relays

Application	Types	Contacts	AC ratings	Socket
Power relay for high inrush current	C7-W1x		10 A / 250 V	S7
Hum-free installation contactor	RIC20		20 A / 400 V	DIN
Universal time relay for high inrush currents	CIM14		16 A / 250 V	DIN
Power relay for high inrush currents	CHI14		16 A / 250 V	DIN

OFTEN UNDERESTIMATED:
HIGH INRUSH CURRENTS IN LIGHTING TECHNOLOGY

Lighting technology has been changing for some years now. Traditional light bulbs are rapidly being replaced with energy-efficient light sources such as fluorescent lamps and LEDs. All of these lamps have one thing in common: they require electronic control gear (ECG). The contacts on conventional relays wear out very quickly if used for triggering these devices.

Pre-devices such as relays and contactors are placed under an increased strain when switching ECGs and energy-saving lamps with integrated ECGs. This has to be taken into consideration when planning a new system. Even when refitting the lighting technology in an existing system, the new features have to be accounted for by adapting switching components to suit the new consumers. Be aware, however, that this issue affects more than just light sources. The structure of modern switching power supplies in many devices means that this problem is also found in other areas of electronics and installation. Modern devices require a low operating current but a very high inrush current, which has to be taken into account when designing switching devices.

ECG inrush processes

ECGs and switching power supplies allow for the inrush current to peak at the exact point the device is switched on. High inrush currents are created by the capacitors used in ECGs after the rectifier for smoothing out the current and as an energy store. If a capacitor is entirely discharged, a charging current, similar to an electrical short, may occur during the first micro-seconds of the inrush process.

Our example of an ECG for 2 × 24 W T5 fluorescent lamps shows that peak currents of more than 22 A – measured during the phase maximum – and a half-life of 305 µs may easily occur. During normal operation, this ECG absorbs a current of merely 220 mA. The inrush current is therefore 100 times higher than the nominal current in this example. The data sheets of renowned ECG manufacturers show, however, that inrush currents as high as 60 A may occur – with a lamp output of just 100 W. In daily life, complete lighting groups are most commonly switched on together, thus cumulating the effect of the high inrush current even further.

Great demand placed on relay performance

Common relay types use silver alloys such as silver-nickel (AgNi) for their contacts. They are not designed for inrush currents that are much higher than the nominal current. The thermic loads could weld the contacts shut after just a few switching-cycles. The result: the consumer can no longer be switched off.

An arc is created at the point the contact blades of a relay near each other during the switching process. The contact bounce found in mechanical contacts increases this arc even further. This effect is primarily influenced by the level and half-life of the inrush current. The temperatures created during the process can easily exceed the melting point of the contact alloy, thus leading to the contact blades being welded together.

The information provided in the data sheets of relay and consumer manufacturers is a first point of reference when calculating the correct specifications of a relay. They often disclose the inrush currents and peak times.

Disproportionately high inrush currents create an exceptionally high risk of welding, which is the reason why the contact material must be able to meet increased demands.

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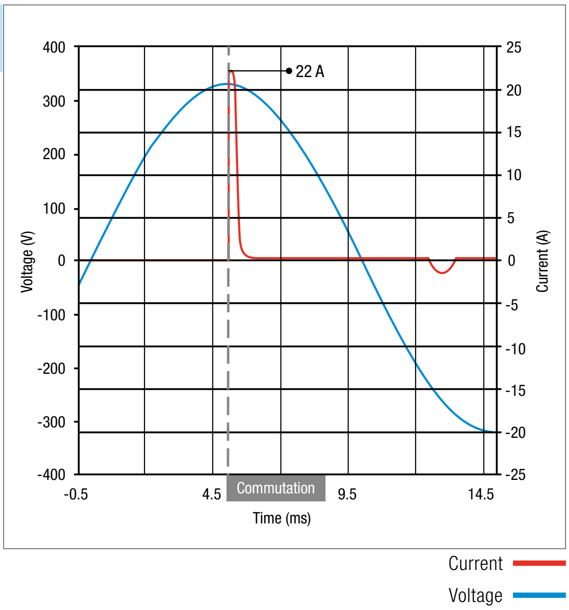
Relays for high inrush currents up to 800 A

Comat developed the high power relay CHI14 especially for inrush currents up to 800 A.
The CHI14 has a tungsten (W/$AgSnO_2$) pre-contact with a higher melting point than ordinary silver alloys. This facilitates the switching of currents up to 800 A for 200 µs and 165 A for 20 ms. The switching during zero flow is another special feature of this high-tech product.
This significantly reduces the inrush current. The 2 × 24 W T5 ECG is an impressive example: Fig. 1 shows a inrush current without zero flow switching of 22 A. Thanks to the zero flow switching at almost 3.5 A, the inrush current is 85 % lower in Fig. 2.
With a 16 A nominal current and a DIN housing with one module width, the CHI14 is suitable for installation in distributors and upgrading existing installations. It is also ideal for use in living areas as its switching process is almost entirely noiseless.
The multi-function time relay CIM14 of similar build features an additional 10 time functions such as stepping switches and automatic light switches in hallways.
The RIC series contactors have large-surface contacts that disconnect twice. Thanks to $AgSnO_2$ contacts, the RIC 40 and RIC63 types can switch currents up to 150 A for 100 ms. The RAC versions with on-off function and the RBC stepping switches are also interesting options for installation.
The movable relay C7-W10 is ideal for industrial applications. The tungsten (W/$AgSnO_2$) pre-contact makes it possible to handle inrush currents up to 500 A for 2.5 ms.

1



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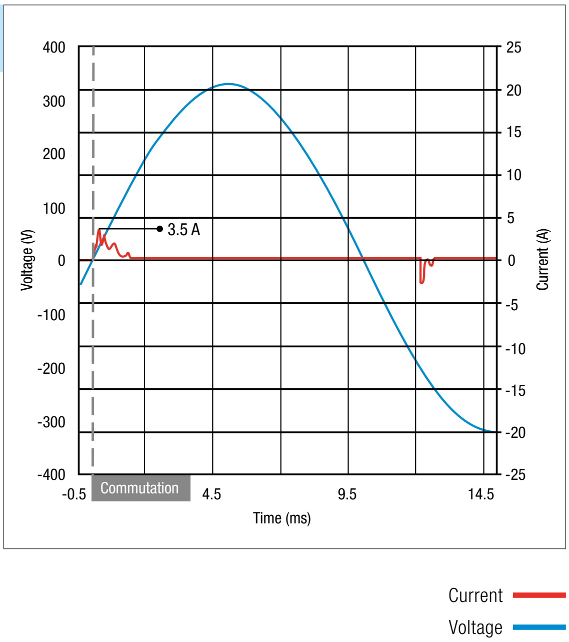

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C7-W1x

4-pin, miniature relay, 1-pole, tungsten contact, faston

Type:	**C7-W1x/ ... V** Power relay for high inrush current 1 pole normally open	
Maximum contact load:	**10 A/250 V AC**	**6 A/250 V AC5a/b**
Recommended minimum contact load:	**10 mA/10 V**	

Contacts

Material Standard Code 0	AgNi/W
Rated current	10 A
Switch-on current max. (2,5 ms)	500 A
Switching voltage max.	250 V
AC load (Fig 1)	2,5 kVA
DC load	see fig. 2

Coil

Coil resistance	see table; tolerance ± 10 %
Pick-up voltage	≤ 0,8 x U_N
Release voltage	≥ 0,1 x U_N
Nominal power	1,5 VA (AC)/1,5 W (DC)

Coil table

VAC	Ω	mA	VDC	Ω	mA
24	153	62	12	99	121
48	611	31	24	388	61
115	3K6	13	48	1K5	32
230	14K5	6,5	110	8K	14

Insulation

	Volt rms, 1 min
Contact open	1000 V
Contact/coil	2,5 kV
Insulation resistance at 500 V	≥1 GΩ
Insulation, IEC 61810-1	2,5 kV

Specifications

Ambient temperature operation/storage	-40 (no ice)….60 °C /-40 ... 80 °C
Pick-up time/bounce time	20 ms/≤ 3 ms
Release time/bounce time	10 ms/≤ 1 ms
Mechanical life ops	AC: 10 Mill./DC: 20 Mill.
DC voltage endurance at rated load	≥100000 switching cycles
Switching frequency at rated load	≤ 1200/h
Protection class	IP40
Weight	43 g

Standard types

VAC 50 Hz/60 Hz: 24, 48, 115 (120), 230 (240)	**C7-W10/AC ... V**
LED	**C7-W10X/AC ... V**
VDC 12, 24, 48, 110	**C7-W10/DC ... V**
LED	**C7-W10X/DC ... V**
Free wheeling diode	**C7-W10DX/DC ... V**
Polarity and free wheeling diode	**C7-W10FX/DC ... V**
AC/DC bridge rectifier 24 V, 48 V, 60 V	**C7-W10BX/UC ... V**

"..." Enter the voltage for full type designation

Accessories

Socket:	**S7-M, S7-I/O, S7-L, S7-P, S7-P0**
Optional accessories (blanking plug):	**S9-NP, S9-OP**

Connection diagram

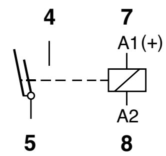


Fig. 1 AC voltage endurance

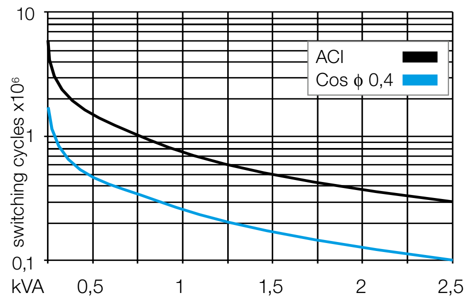
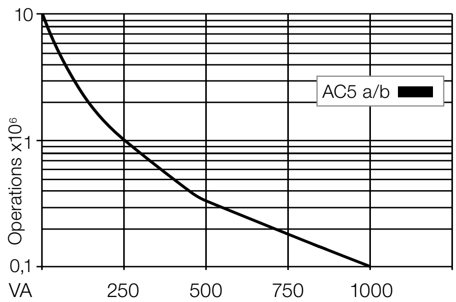
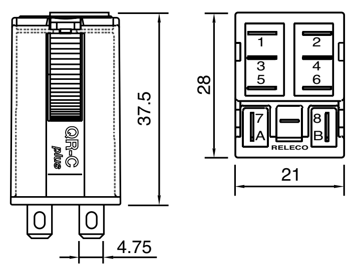


Fig. 2 AC voltage endurance



Dimensions [mm]



Technical approvals, conformities

IEC 61810; EN 60947

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RIC20

20 A, AC/DC control voltage, silent operation
DIN rail mounting according to DIN 43 880

Type: RIC20-xxx/ …V
Hum-free installation contactor, 2 contacts, 2 NO, 1 NO-1 NC, 2 NC types available

Rated operational power	**4 kW / 230 V AC-1, 0.5 A / 220 V DC-1**
Recommended minimum contact load	**10 mA / 24 V**

Contacts

Material		AgNi
Rated operational current		20 A
Max. inrush current (100ms)		50 A
Max. switching voltage		400 V
Max. AC load	AC-1, AC-7a	4 kW / 230 V
	AC-3	1.3 kW /230 V (NO contact only)
Max. DC load 24 V / 220 V DC-1 (Fig. 1)		480 W / 130 W

Control input V_n =	**UC 24 V**	**UC 36 V**	**UC 230 V**
Operating voltage range [V]	20.4 … 26.4	30.6 … 39.6	195 … 253
Typ. pic up voltage [V]	17	25	160
Typ. release voltage [V]	7	11	70
Power consumption [W]	≤ 2.5	≤ 2.5	≤ 2.5
Inductive turn-off voltage	None	None	None
Surge immunity EN 6100-4-5	2 kV	2 kV	2 kV

Insulation

Rated insulation voltage	230 V
Rated impulse withstand voltage	4 kV
Min. clearance of open contact	3.6 mm

General Specifications

Ambient temperature	
storage	-30 … 80 °C
operation, Spacer after 2 contactors side by side	-5 … 55 °C
operation, Spacer after 3 contactors side by side	-5 … 40 °C
Pick-up time	15 … 45 ms
Release time	20 … 50 ms
Mechanical life	≥ 3 x 10^6 operations
AC voltage endurance at rated load AC-3, AC-7b	≥ 3 x 10^5 operations
DC voltage endurance at rated load DC-1	10^5 operations
Operating frequency at rated load DC-1	≤ 300 operations / h
Operating frequency at rated load AC-1	≤ 600 operations / h
Conductor cross section coil /contacts	Stranded wire 2.5 mm^2 / 6 mm^2
Max. Screw torque coil /contacts	0.6 Nm / 1.2 Nm
Ingress protection degree	IP 20
Weight	140 g

Standard types

UC (AC / DC) 50 / 60 Hz, 24, 36, 230	**2NO**	**RIC20-200/UC …V**
	1NO + 1NC	**RIC20-110/UC …V**
"…" enter the voltage for full type designation	**2NC**	**RIC20-020/UC …V**

Accessories

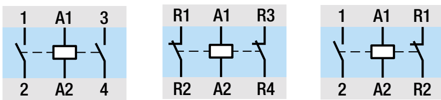
Sealing cover:	**RIC-SEAL 20**
Spacer:	**RIC-DIST**

Samples of lamp loads	**Number of lamps**
Incandescent lamps 230 V / 100 W	20
Fluorescent lamps not corrected 230 V / 36 W	17
Fluorescent lamps electronic ballast units 36 W	15

Find more information about RIC, RAC, RBC series on pages 117 – 127.

Mounting information
If multiple contactors are mounted side by side, spacers (RIC DIST) have to be inserted for the purpose of heat dissipation.
Example: Ambient temperature up to 40°C: 1 spacer after 3 RIC // 40…55°C: 1 spacer after 2 RIC.

Connection diagram



2xNO RIC20-200 | 2xNC RIC20-020 | 1xNO + 1xNC RIC20-110

Coil circuit

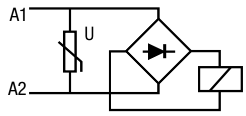
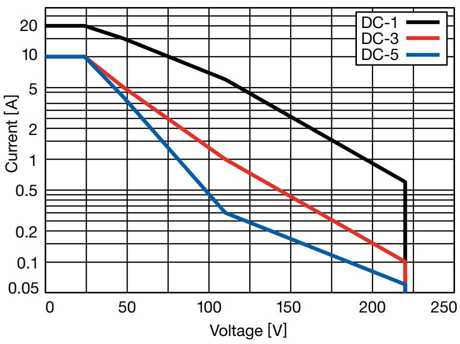
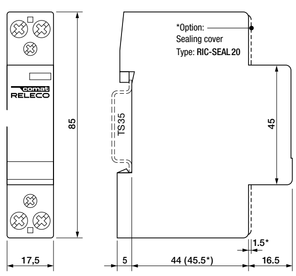


Fig. 1 DC load limit curve DC1



Dimensions [mm]



Technical approvals, conformities

IEC/EN 60947-4-1, VDE 0660
IEC/EN 60947-5-1
IEC/EN 61095, VDE 0637

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CIM14

Time relay with NO contact for high inrush currents up to 800 A
8 time functions + stepping function, ON-OFF switch, 50 ms … 60 h, DIN Rail mounting according to DIN 43 880

comat RELECO
WORLD OF RELAYS

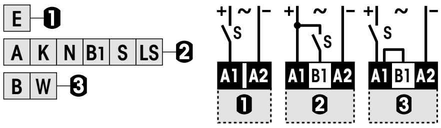
Type: CIM14/UC24-240V

Sophisticated multifunction time relay, 1 NO power contact for high inrush currents up to 800 A with zero crossing switching (50/60 Hz), 8 time functions, stepping function and service function ON/OFF, time ranges: 50 ms … 60 h, multifunction LED state indicator, suitable for any time-control application and also staircase lighting, Light-switch neon lamp current absorption on input B1, Manual switching function for maintenance, emergency, etc., 16.6 Hz power supply applications. Railway version available.

Maximum contact load	**16 A / 250 V AC-1 384 W DC-1**
Recommended minimum contact load	**100 mA / 12 V**

Time functions and related connection diagrams (Function diagrams: refer to page 152)

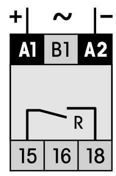
The functions are selectable by rotary switch



LED function table:

LED	Relay	Time run
OFF	OFF	NO
Continuous ON	ON	NO
Short blinking	OFF	YES
Long blinking	ON	YES

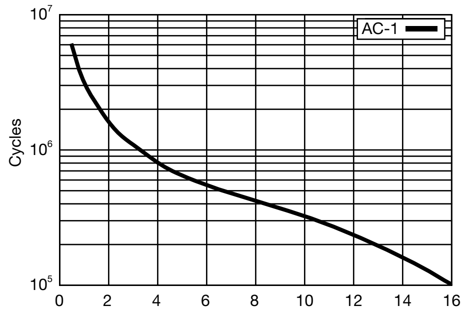
Connection diagram



Time data

7 partial time ranges, t_{max} (rotary switch)	0.6, 6, 60 s / 6, 60 min / 6, 60 h
Fine adjustment range (rotary knob)	t_{min} … t_{max}, 0.5 … 6
Time range tolerance	t_{min}: -5 % … +0 % / t_{max}: -0 % … +5 %
Repetition accuracy	± 0.1 % or DC: 2 ms / AC: 10 ms
Response time, power on, on A1	≤ 45 ms
Min. trigger pulse on B1	20 ms (AC / DC)
Reset time B1 (AC/DC)	≤ 30 ms
Voltage failure buffering (50 / 60 Hz)	≥ 20 ms

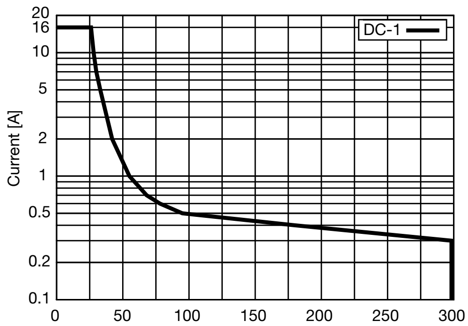
Fig.1 AC voltage endurance



Contacts

Material	W / $AgSnO_2$
Rated operational current at 40 °C / 60 °C	16 A / 13 A
Max. inrush current	165 A / 20 ms
	800 A / 200 µs
Max. switching voltage AC-1	250 V
Max. AC load AC-1 (Fig.1)	4 kVA
Max. DC load DC-1 24 V	384 W

Fig. 2 DC load limit curve



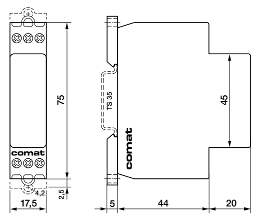
Power supply- and control input

Nominal voltage (A1, B1)	**UC 24-240 V (UC = AC / DC)**
Operating voltage range	16.8 … 250 V
Power consumption	1.2 VA / 0.43 W
Frequency range	16 … 60 Hz
Allowed DC residual current into B1	≤ 0.5 mA
AC Neon lamp residual current into B1	≤ 10 mA
Trigger threshold voltage on B1, AC / DC	15 / 17 V

Insulation

Test voltage open contact	1 kVrms 1 minute
Test voltage between contacts and control input	2.5 kVrms 1 minute

Dimensions [mm]



General Specifications

Ambient temperature storage /operation	-40 … 85 °C / -40 …60 °C
Mechanical life of contact	5 x 10^6 operations
Conductor cross section	Stranded wire 2.5 mm^2, 2 x 1.5 mm^2
Ingress protection degree	IP 20
Max. Screw torque	0.4 Nm
Housing material / weight	Lexan / 70 g

Technical approvals, conformities

EN 50155, EN 60730 cULus CE RoHS

Standard types

UC (AC/DC) 15...60 Hz	**CIM14/UC24-240V**

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CHI14

Power relay for high inrush currents up to 800 A
DIN Rail mounting according to DIN 43 880

Type: CHI14/UC24-240V

The CHI14 is a power relay for all applications effecting high inrush currents up to 800 A such as electronic control gears of energy saving lamps, power supplies of the latest LED lights and switching supplies of industrial components. These loads show an inrush current up to 250 times of their nominal current.

The CHI14 is equipped with a low noise operating NO contact with a nominal current up to 16 A and complies with the applicable DIN standards 43880 with installation dimension of 17.5 mm (1 module width).

Maximum contact load	**16 A / 250 V AC-1 384 W DC-1**
Recommended minimum contact load	**100 mA / 12 V**

Contacts

Material	W / $AgSnO_2$
Rated operational current at 40 °C / 60 °C	16 A / 13 A
Max. inrush current	165 A / 20 ms
	800 A / 200 µs
Max. switching voltage AC-1	250 V
Max. AC load AC-1 (Fig.1)	4 kVA
Max. DC load DC-1 24 V /	384 W

Power supply- and control input

Nominal voltage (A1, B1)	**UC 24-240 V (UC = AC / DC)**
Operating voltage range	16.8 … 250 V
Power consumption	1.2 VA / 0.43 W
Frequency range	16 … 60 Hz

Insulation

Test voltage open contact	1 kVrms 1 minute
Test voltage between contacts and control input	2.5 kVrms 1 minute

General Specifications

Ambient temperature storage /operation	-40 … 85 °C / -40 …60 °C
Mechanical life of contact	5 x 10^6 operations
Conductor cross section	Stranded wire 2.5 mm^2, 2 x 1.5 mm^2
Ingress protection degree	IP 20
Max. Screw torque	0.4 Nm
Housing material / weight	Lexan / 70 g

Standard types

UC (AC/DC) 15…60 Hz	**CHI14/UC24-240V**

Connection diagram

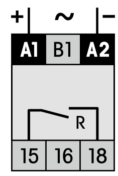


Fig.1 AC voltage endurance

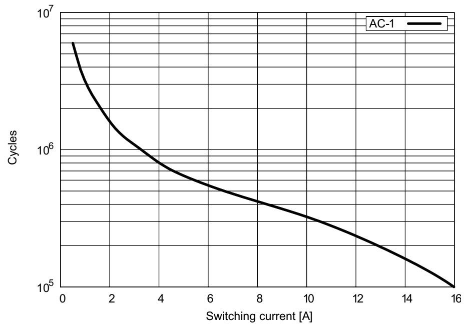
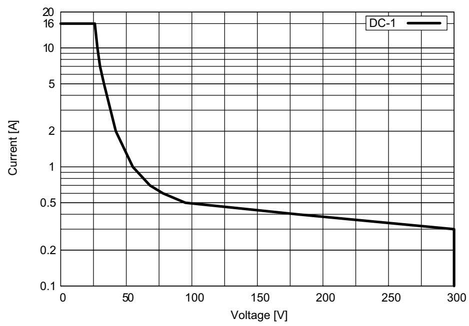
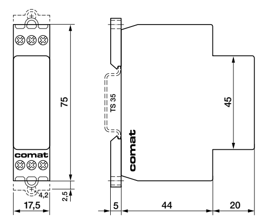


Fig. 2 DC load limit curve



Dimensions [mm]



Technical approvals, conformities

EN 50155, EN 60730

Notes

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