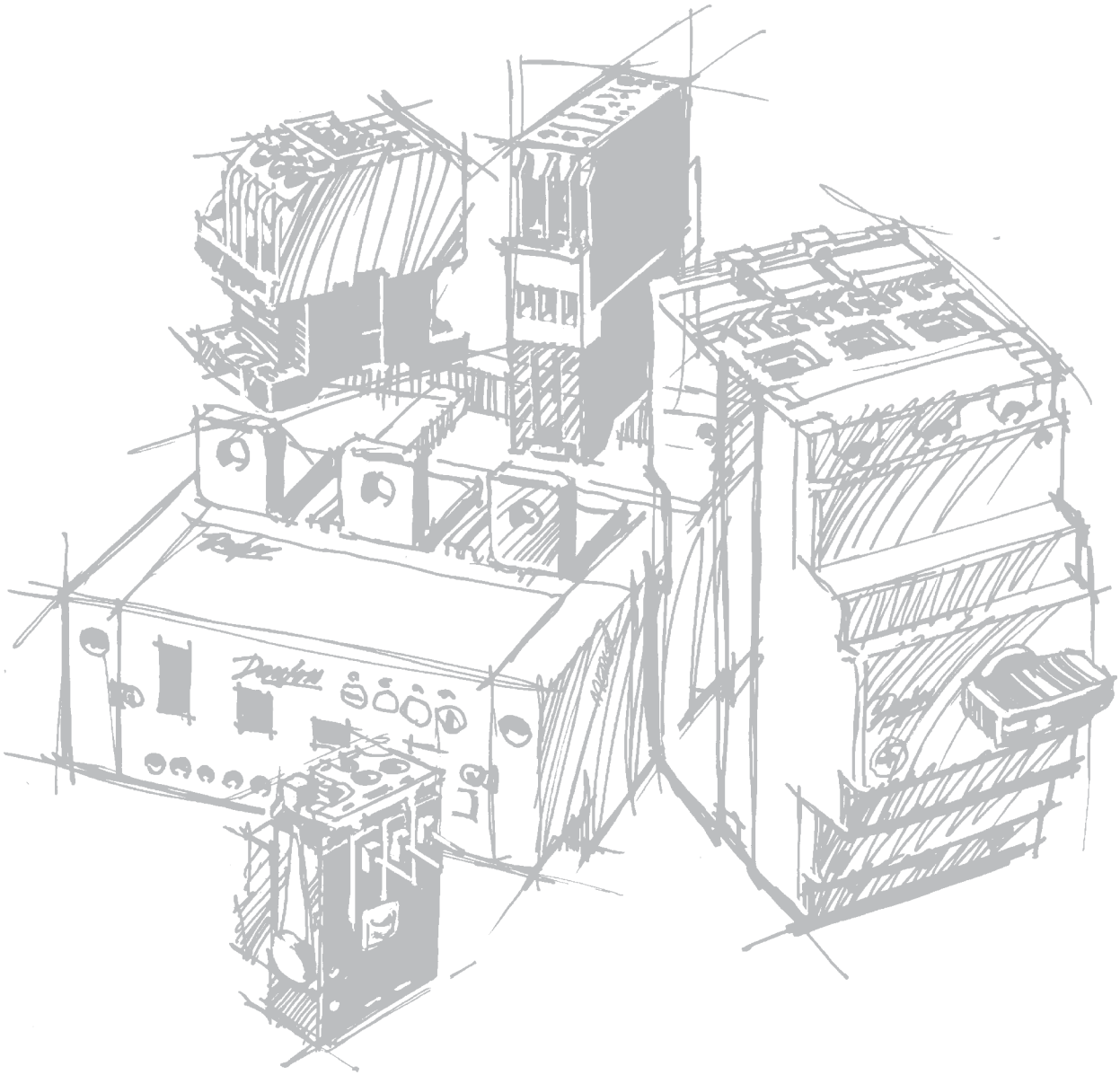
Data sheet



CI-TI ™ Contactors and Motor Starters

Mini Contactors CI 4-

September 2002

DKACT.PD.C00.E2.02
520B1334

Introduction

CI 4 minicontactors cover the power range 1.5 to 5.9 kW and are available for a.c. and d.c. coil voltages. Characteristic of the minicontactors is that they are compact. With add-on auxiliary contact blocks and a timer they offer high flexibility.
The CI 4- range includes low-power d.c. coils, especially for PC and PLC control.
The CI 4- range is particularly suitable for applications where space is at a premium.
In addition, the CI 4- range also includes thermal overload relays for the protection of squirrel-cage motors.

Ordering

Minicontactors CI 4-, for a.c. coil voltage

Main circuit						Built-in auxiliary contacts Number/ Function	**Code no.** [1]	Type
AC-3 load			I_{th} [2])	I_{the} [3])	Main			
220-240 V kW	U_e **380-500 V kW**	**U_e** A	I_e Open A	(AC-1) Encl. A	(AC-1) (make) Number			
1.1	**1.5**	3.7	16	12	-	4 NO	**037H3210**	CI 4-2 [2])
1.1	**1.5**	3.7	16	12	-	2 NO, 2 NC	**037H3211**	CI 4-2 [2])
1.5	**2.2**	5.3	20	16	3	1 NO	**037H3114**	CI 4-5
1.5	**2.2**	5.3	20	16	3	1 NC	**037H3115**	CI 4-5
3.0	**4.0**	9	20	16	3	1 NO	**037H3116**	CI 4-9
3.0	**4.0**	9	20	16	3	1 NC	**037H3117**	CI 4-9
3.0	**4.0**	9	20	16	4	-	**037H3118**	CI 4-9
3.3	**5.9**	12	20	16	3	1 NO	**037H3457**	CI 4-12
3.3	**5.9**	12	20	16	3	1 NC	**037H3458**	CI 4-12

[1]) Coil voltage/frequency or Suffix no. (see table below) must be added to the Danfoss code no.
[2]) The thermal current value I_{th} gives the maximum load at 40°C, which corresponds to installing the contactor in air (open).
[3]) The thermal current value I_{the} gives the maximum load at 60°C, corresponding installing the contactor inside an enclosure.

a.c. coil voltages for CI 4-

Coil voltage [1])	Suffix no.
24 V, 50/60 Hz	13
48 V, 50/60 Hz	15
110 V, 50 Hz 110 - 120 V, 60 Hz	23
220-230 V, 50 Hz 230-240 V, 60 Hz	32
240 V, 50/60 Hz	33
380-400 V, 50 Hz 400-415 V, 60 Hz	37

[1]) Standard coil voltage tolerance -15%, +10%

Correct ordering of contactors
Example: CI 4-5 with NC auxiliary contact and 24 V, 50/60 Hz coil voltage.
Select one of the following two forms of ordering:
1. Danfoss code no. + Suffix no.:
   037H3115.13
   or
2. Danfoss code no. + coil voltage/frequency:
   037H3115, 24 V/50 Hz

Ordering

Minicontactors CI 4-, for d.c. coil voltage

Main circuit						Built-in auxiliary contacts Number/ Function	**Code no.** [1]	Type
AC-3 load			I_{th} [2]) (AC-1) Open A	I_{the} [3]) (AC-1) Encl. A	Main contacts (make) Number			
U_e 220-240 V kW	**U_e 380-500 V kW**	I_e A						
1.1	**1.5**	3.7	16	12	-	4 NO	**037H3212**	CI 4-2 [2])
1.1	**1.5**	3.7	16	12	-	2 NO, 2 NC	**037H3213**	CI 4-2 [2])
1.5	**2.2**	5.3	20	16	3	1/NO	**037H3143**	CI 4-5
1.5	**2.2**	5.3	20	16	3	1/NC	**037H3144**	CI 4-5
3.0	**4.0**	9	20	16	3	1/NO	**037H3145**	CI 4-9
3.0	**4.0**	9	20	16	3	1/NC	**037H3146**	CI 4-9
3.0	**4.0**	9	20	16	4	-	**037H3147**	CI 4-9
4.0	**5.9**	12	20	16	3	1 NO	**037H3459**	CI 4-12
4.0	**5.9**	12	20	16	3	1 NC	**037H3460**	CI 4-12

[1]) Coil voltage/frequency or Suffix no. (see table below) must be added to the Danfoss code no.
[2]) The thermal current value I_{th} gives the maximum load at 40 °C, which corresponds to installing the contactor in air (open).
[3]) The thermal current value I_{the} gives the maximum load at 60°C, corresponding installing the contactor inside an enclosure.

d.c. coil voltages for CI 4-

Coil voltage [1])	Suffix no.
* 12 V, d.c.	01
24 V, d.c.	02
** 48 V, d.c.	04
* 110 V d.c.	06

[1]) Standard coil voltage tolerance –15%, +10%
* Code no. 037H3145 only
** Code no. 037H3145 and 037H3146 only

Auxiliary contact CBM-

Auxiliary contact blocks CBM for CI 4-

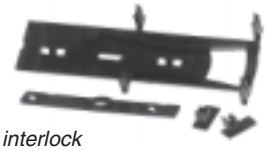
Contact function	Load				**Code no.**	Type
	I_e (AC - 15) A	I_{th}*) (AC-1) Open A	I_{the}*) (AC-1 Encl. A	U_e V		
4 make (NO)	2	10	6	500	**037H3149**	CBM-40
2 break (NC)	2	10	6	500	**037H3150**	CBM-02
1 make (NO) + 1 break (NC)	2	10	6	500	**037H3151**	CBM-11
2 make (NO) + 2 break (NC)	2	10	6	500	**037H3152**	CBM-22
4 break (NC)	2	10	6	500	**037H3369**	CBM-04

*) I_{th} and I_{the} are defined and specified under Technical data.

Built-in auxiliary contacts and auxiliary contacts CBM- are force-actuated and suitable for safety switching.

The silver tips on the moveable auxiliary contact CBM- are cross stamped and PLC-compatible. Min. load 24 V, 10 mA.

Accessories for minicontactors CI 4-



Mech. interlock

Diode element DIM 250

RC element RCM

Clip-on timer ETM-ON

Clip-on markers

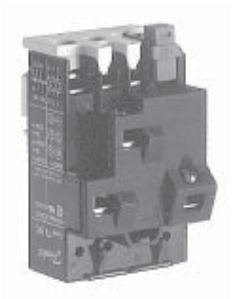
Base for ETM-ON

3-pole jumper

Loop terminal

Description	Comments		Code no.
Mech. interlock	Mech. interlock can be established between pairs (Applies only to versions with a.c. coils)		**037H3157**
Diode element	Reduces overvoltage on de-energization of coils Type DIM 250 (12-250 V, d.c.)		**037H3148**
RC Element	Reduces overvoltage on de-energization of coils Type RCM 48 (24-48 V, 50/60 Hz)		**037H3155**
	Type RCM 280 (110-280 V, 50/60 Hz)		**037H3156**
Clip-on timer	Clip-on timer (On-delay) Time range 1-30 s, voltage range 110-250 V a.c./d.c. Type ETM-ON		**037H3153**
Clip-on markers	Rating plate with cover (100-off)		**037H3142**
DIN-rail base for ETM-ON	For DIN rail mounting of clip-on timer ETM-ON, suitable for 35 mm DIN rail and 32 mm C rail		**037H3154**
3-pole jumper	For single-phase loads and star point connection (50-off)		**037H0169**
Loop terminal	Neutral terminal (16 mm2) for screw fixing - can be mounted on side of CI4-		**037H3158**

Introduction



Thermal overload relays TI 9C and 12C are used with minicontactors CI 4- for protection of squirrel-cage motors where compactness is required.
The relays have single-phase protection, i.e. accelerated release if phase drop-out occurs. This is particularly important for motors with delta-connected windings.
Other features of TI 9C and 12C:

- stop/reset button
- manual/automatic reset
- test button
- double scale for direct start or Y/D start
- galvanically isolated signal contact

Ordering

Thermal overload relays TI 9C and 12C, for minicontactors CI 4-

Range		Max. fuse [1]				HRC[2]	Code no.	Type
Motor starter	Y/D-starter	gl, gL, gG		BS 88, type T		Form II		
		type 1	type 2	type 1	type 2			
A	A	A	A	A	A	A		
0.13 - 0.20	-	25	-	32	-	1	**047H3060**	TI 9C
0.19 - 0.29	-	25	-	32	2	1	**047H3061**	
0.27 - 0.42	-	25	2	32	2	1	**047H3062**	
0.4 - 0.62	-	25	2	32	4	1	**047H3063**	
0.6 - 0.92	-	25	4	32	6	3	**047H3064**	
0.85 - 1.3	-	25	4	32	6	3	**047H3065**	
1.2 - 1.9	-	25	6	32	10	6	**047H3066**	
1.8 - 2.8	3.2 - 4.8	25	6	32	10	15	**047H3067**	
2.7 - 4.2	4.7 - 7.3	25	16	32	20	15	**047H3068**	
4.0 - 6.2	6.9 - 10.7	35	20	40	25	15	**047H3069**	
6.0 - 9.2	10 - 16	50	20	50	25	35	**047H3070**	
8.0 - 12	13 - 20.8	63	25	63	32	35	**047H3071**	TI 12C

1) To IEC 947-4 coordination types 1 and 2:
Coordination type 1: Any type of damage to the motor starter is permissible. If the motor starter is in an enclosure, no external damage to the enclosure is permissible. After a short-circuit the thermal overload relay shall be partially or wholly replaced.
Coordination type 2: No damage to the motor starter is permissible, but slight contact burning and welding is permissible.

2) In accordance with HRC form II, TI 9C and 12C is suitable for operation in Canada and the USA.

Selection of thermal overload relay
The selection of a thermal overload relay must be based on the motor full load current and the method of starting:
- With direct start the range for motor starter is used.
- With star-delta start the range for Y/Dstarter is used.

Example:
Full load current: 12 A
- With direct start, the suitable motor starter range is 8.0-12 A, i.e. thermal overload relay **047H3071**.
- With Y/D - start, the the suitable motor starter range is 10-16A, i.e. thermal overload relay **047H3070.**

Accessories for thermal overload relays TI 9C and TI 12C.

Description	Comments	Code no.
Clip-on marker	To be mounted on thermal overload relays TI 12C (250-off)	**037H0105**
Push button extension	For thermal overload relays TI 12C (3mm)	**047L0406**

Construction standards

Contactors, thermal overload relays and accessories are designed and tested in accordance with IEC 947/EN 60947.

Pulse voltage

Type	U_{imp}
CI 4-	8 kV

Environment
Temperate climate
Tested and passed in accordance with DIN 50 016 and 40 046 part 38 and IEC 68
Max. installation height: 2000 NN, in accordance with IEC 947

Ambient temperature

Type	Ambient temperature	
	Operation	Storage/Transport
CI 4-	–50 °C ··· +60 °C	–55 °C ··· +80 °C

Vibration and shock
Tested and passed in accordance with IEC 68-2-6

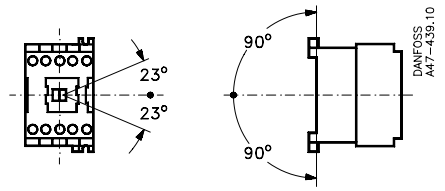
Type	Vibration[1])	Shock[2])
CI 4-	3 g, 10-300 Hz	5 g i 12 ms

1) Operating conditions: All directions with de-energized coil.
2) Operating conditions: Parallel with armature and with de-energized coil

Environment

Type	Temperature compensated	Ambient temperature	Vibration	Shock perpendicular to contact system	Max. operations per hour
TI 9C-12C	-5 to +40 °C	-50 to +60 °C	2 g at 200 Hz	9 g for 7.5 ms	30

Mounting direction



CI 4 - with a.c. coil
No restriction for CI 4- with d.c. coil

Rated life

Type	Mechanical life AC-3 load Operations	Electrical life AC-3 load Operations	Switching per hour AC-3 load Operations
CI 4-	10×10^6 [1])	0.7×10^6	600

1) Direct current version: 20 million operations.

Approvals

Approval authority / Product type	CE EN 60947	CSA UL-listed CSA, Canada	UL UL-listed USA	Lloyds Register of Shipping, UK	Germanischer Lloyd, Germany	Bureau Veritas France
CI 4-	●	●	●	●	●	●
TI 9C	●	●[1])	●[1])	●	□	□
TI 12C	●	●[1])	●[1])	□	□	□

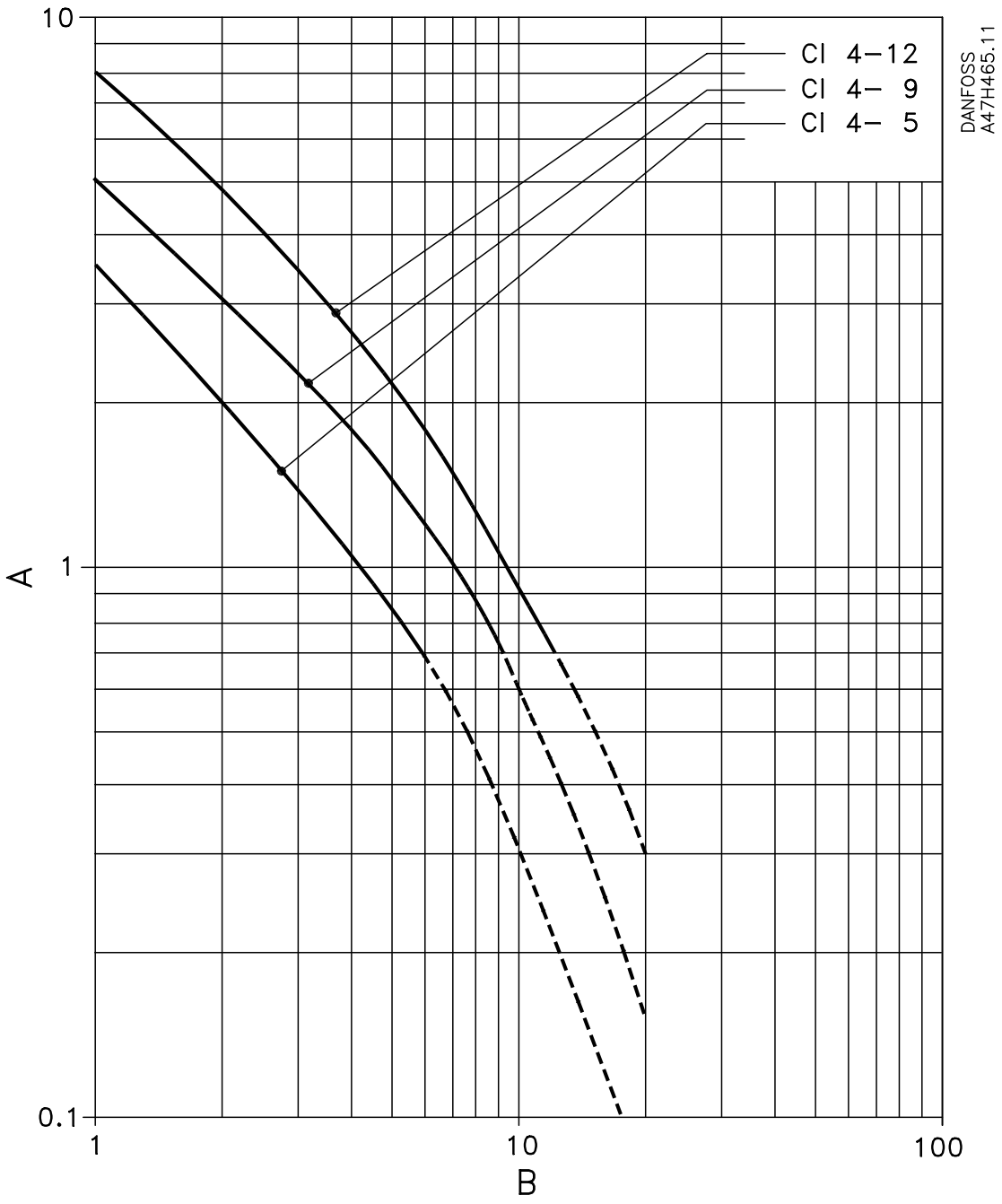
● Approved

□ Not applied for

1) c UL

Electrical life curve

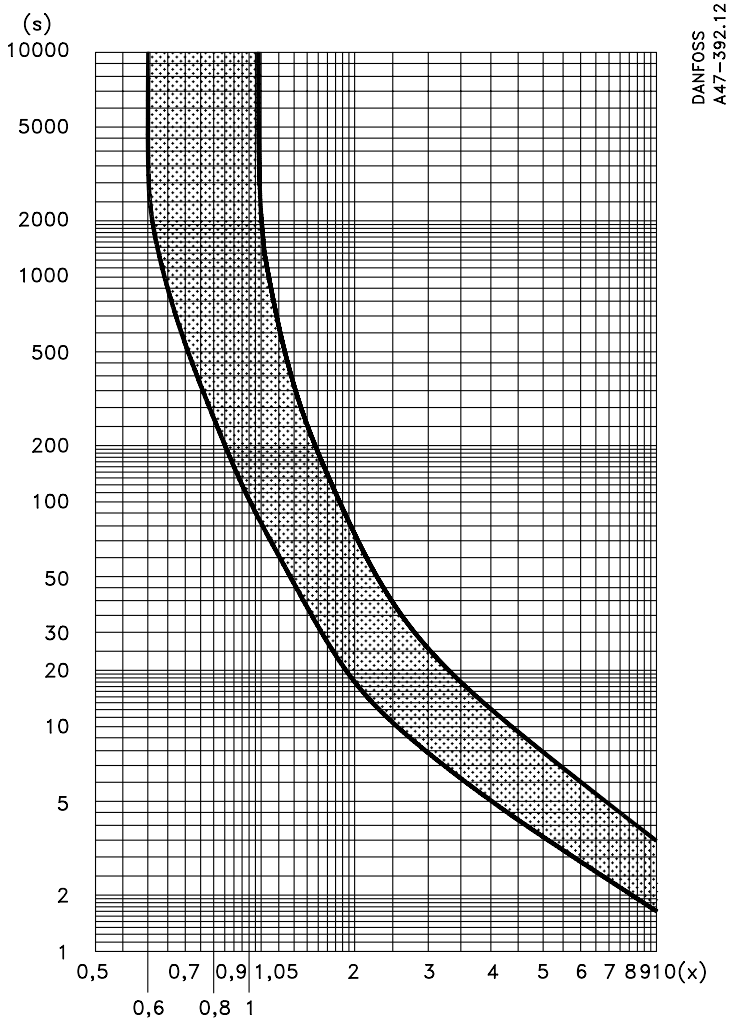
Minicontactor CI 4-5, CI 4-9 and CI 4-12, load categories AC-1, AC-2 and AC-3



A: Electrical life in millions of make/break operations
B: Breaking current (A)

Tripping graphs

TI 9C, TI 12C



3-phase overload

1) Measure overload current
2) Find the overload factor (x) by dividing the measured value by the set value of the thermal overload relay (motor full load current).
3) Find (x) on the horizontal axis and follow a line vertically up until it intersects the upper curve.
4) From the intersection point, follow a horizontal line to the left and read off on the vertical axis the time that will elapse before the thermal overload relay cuts out the motor.

Explanation of graphs
Mean value curves
Upper curve: 3-phase tripping and asymmetric load tripping at min. setting.
Lower curve: Asymmetric load tripping at max. setting.

When tripping from the operationally warm condition, the tripping times are approx. 30% of the values shown.
These values apply at an ambient temperature = 20°C.

3-phase tripping: $x = \frac{\text{measured current}}{\text{rated motor current}}$

Asymmetric load tripping: $x = \frac{\text{measured current}}{\text{max. scale value on overload relay}}$

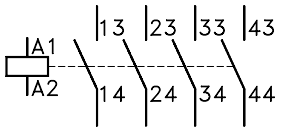
Tripping time $2 < T_p$ 10 s at 7.2 x I_e class 10 A
Note! In general, the thermal overload relay is always set on motor full load current.

Asymmetric load tripping

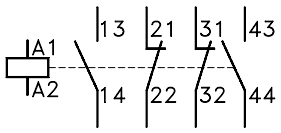
1) Measure the current the motor draws from one of the intact phases.
2) Find the overload factor (x) by dividing the measured value by the maximum scale value of the thermal overload relay.
3) Find (x) on the horizontal axis and follow a line vertically up until it intersects the lower curve.
4) From the intersection point, follow a horizontal line to the left and read off on the vertical axis the time that will elapse before the thermal overload relay switch off the motor.

Contact symbols and control relays terminal markings

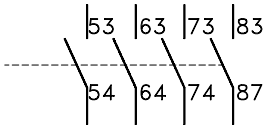
Auxiliary contacts



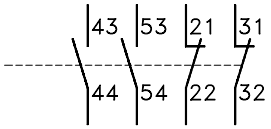
Control relay (4 NO)
CI 4-2 40E



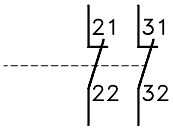
Control relay (2 NO + 2 NC)
CI 4-2 22E



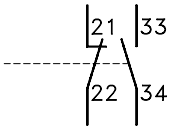
Auxiliary contact (4 NO)
CBM-40



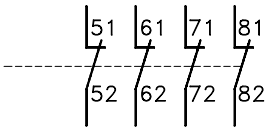
Auxiliary contact (2 NO + 2 NC)
CBM-22



Auxiliary contact (2 NO)
CBM-02

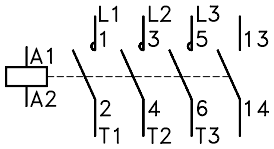


Auxiliary contact (1 NO + 1 NC)
CBM-11

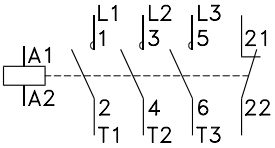


Auxiliary contact (4 NC)
CBM-04

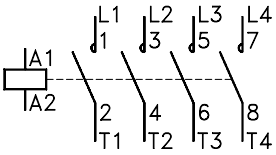
Contactors



Contactor
CI 4-5, CI 4-9, CI 4-12

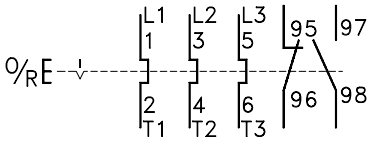


Contactor
CI 4-5, CI 4-9, CI 4-12



Contactors
CI 4-9

Thermal overload relay



Thermal overload relay
TI 9C, TI 12C

Main circuit

Connections, main contacts

Type	Connection method	EN 60947			Recom-mended Tightening torque [Nm]
		Single core [mm²]	Multi core without terminal sleeve [mm²]	Multi core with terminal sleeve [mm²]	
CI 4-	Screw and clamp washer	0.75 - 2.5	1-2.5	0.75-1.5	1-1.5
TI 9C - 12C	Screw and clamp washer	0.75 - 4	0.75 - 4	1 - 4	0.8 - 2

Direct start, load categories AC-2, AC-3, AC-4

Type		Rated loads at 50-60 Hz				
		220-230 V	240 V	380-400 V	415 V	500 V
CI 4-2	A	5.0	5.0	3.7	3.7	2.8
	kW	1.3	1.3	1.7	1.7	1.6
CI 4-5	A	6.5	6.0	5.3	4.8	4.0
	kW	1.5	1.5	2.2	2.2	2.2
CI 4-9	A	12.0	11.0	9.0	8.2	7.0
	kW	3.0	3.0	4.0	4.0	4.0
CI 4-12	A	12.0	12.0	12.0[1])	12.0[1])	7.0
	kW	3.3	3.4	5.9	6.1	4.2

[1]) Not AC-4

Star-delta start, load category AC-3

Type		Rated loads at 50-60 Hz				
		220-230 V	240 V	380-400 V	415 V	500 V
CI 4-9	A	15.0	14.0	16.0	14.0	12.0
	kW	4.0	4.0	7.5	7.5	7.5
CI 4-12	A	21.0	21.0	16.0	16.0	12.0
	kW	5.8	6.3	10.8	11.2	7.7

Three phase ohmic load, load category AC-1

Type		Operating temperature max. 40°C (Open condition)				
		220-230 V	240 V	380-400 V	415 V	500 V
CI 4-2	A	16.0	16.0	16.0	16.0	16.0
	kW	6.0	6.0	10.0	11.0	13.0
CI 4-5/CI 4-9	A	20.0	20.0	20.0	20.0	20.0
CI 4-12	kW	8.0	8.3	14.0	14.0	17.0x

Three phase ohmic load, load category AC-1

Type		Operating temperature max. 60°C (Enclosed condition)				
		220-230 V	240 V	380-400 V	415 V	500 V
CI 4-2	A	12.0	12.0	12.0	12.0	12.0
	kW	4.5	5.0	7.0	8.0	9.0
CI 4-5/CI 4-9/	A	16.0	16.0	16.0	16.0	16.0
CI 4-12	kW	6.4	6.7	11.0	12.0	14.0

Switching lighting

Type	Incandescent lamps	Fluorescent lamps, individually compensated			
	Max. operating current A	Max. operating current [A] at operating temp. [1]) 40 °C	60 °C	Max. capacitor [µF] at I_{cc} = 10 kA	20 kA
CI 4-2. -5. -9. -12	9.3	18	14.5	750	400

[1]) 40 °C is defined as non-enclosed condition
60 °C is defined as enclosed condition

Short time withstand current I_{cw}

Type	Current transfer time in sec.							Min. cooling in min.
	1	4	10	15	60	240	900	
	Short time withstand current in Amps (I_{cw})							
CI 4-5, CI 4-9	110	85	60	50	30	20	20	3
CI 4-12	144	113	96	78	40	20	20	3

Main circuit

Switching direct current load
Load categories DC-3 and DC-5, contacts connected in series

Type	Max. operating current [A]								
	DC-3, 3 pole in series					DC-5, 3 pole in series			
	24 V	48 V	110 V	220 V	440 V	24 V	48 V	110 V	220 V
CI 4-5	5	4	2	0.8	0.15	5	2	0.6	0.1
CI 4-9	9	6	3	1.2	0.2	9	3	1	0.1
CI 4-12	9	6	3	1.2	0.2	9	3	1	0.1

1) 40 °C is defined as non-enclosed condition
60 °C is defined as enclosed condition

Switching direct current load
Load categories DC-1, contacts connected in series

Type	Max. operating current [A]														
	24 V			48 V			110 V			220 V			440 V		
	1-pole	2-pole	3-pole	1-pole	2-pole	3-pole	1-pole	2-pole	3-pole	1-pole	2-pole	3-pole	1-pole	2-pole	3-pole
CI 4-5	6	6	6	4	6	6	0.6	4	6	0.2	0.8	3	0.08	0.2	0.4
CI 4-9/CI 4-12	9	9	9	6	8	9	1	6	9	0.3	1.2	4	0.1	0.3	0.6

Power loss

Contact resistance and power losses

Type	Typical impedance per pole mΩ	Power losses all 3 poles AC-3 W	Power losses all 3 poles AC-1 W	Coil consumption a.c. W	Total power losses AC-3 W	Total power losses AC-1 W
CI 4-2	5.5	0.25	4.2	1.4	1.65	5.6
CI 4-5	5.5	0.4	6.6	1.4	1.8	8.0
CI 4-9	5.5	1.3	6.6	1.4	2.7	8.0
CI 4-12	5.5	2.4	6.6	1.4	3.8	8.0

Type	Average power	
	Min. setting	Max. setting
TI 9C, TI 12C	typically 2.15 W	typically 4.87 W

Control circuit

Connections, auxiliary contacts

Type/Application		Connection method	Single core [mm²]	Multi core without terminal sleeve [mm²]	Multi core with terminal sleeve [mm²]	Tightening torque [Nm]
CI 4-	built in	Screw and clamp washer	0.75 - 2.5	1 - 2.5	0.75 - 1.5	1 - 1.5
CBM	for CI 4-	Screw and clamp washer	0.75 - 2.5	1 - 2.5	0.75 - 1.5	1 - 1.5
TI 9C - 12C		Screw and clamp washer	0.75 - 2.5	0.75 - 1.5	0.75 - 1.5	0.78 - 1

Auxiliary contacts, load categories AC-15 and AC-1

Type	Comments	Max. operating current [A]						
		AC-15					AC-1	
		220-230 V	240	380-400 V	415 V	500 V	40 °C [1])	60 °C [1])
CI 4-	Built into contactor	6	5	2.5	2	1.25	16	12
CBM	For contactor CI 4-	2	2	1	1	0.6	10	6

[1]) 40 °C is defined as non-enclosed condition
60 °C is defined as enclosed condition

Auxiliary contacts, load categories DC-12, DC-13, DC-14

Type	Comments	Max. driftstrøm [A]														
		DC-12					DC-13					DC-14				
		24 V	48 V	110 V	220 V	440 V	24 V	48 V	110 V	220 V	440 V	24 V	48 V	110 V	220 V	440 V
CI 4-		6	4	0.6	0.2	0.08	5	0.6	0.45	0.25	0.04	4	2.5	0.4	0.12	0.05
CBM		6	2	0.6	0.2	0.08	2	0.6	0.45	0.1	0.04	4	1.2	0.4	0.12	0.05

Coil consumption and operating times

Type	Inrush power			Holding power			Pull-in voltage		Drop-out voltage		Make time		Break time	
	a.c.		d.c.	a.c.		d.c.	a.c.	d.c.	a.c.	d.c.	a.c.	d.c.	a.c.	d.c.
	VA	W	W	VA	W	W	V	V	V	V	ms	ms	ms	ms
CI 4-	22	20	2.5	4	1.4	2.5	$(0.85\text{-}1.1) \times U_s$	$(0.85\text{-}1.1) \times U_s$	$(0.35\text{-}0.65) \times U_s$	$(0.1\text{-}0.25) \times U_s$	15-40	18-40	15-25	6-12

RC Element (charge suppressor)

Type	Comments	Overvoltage factor $n = \frac{U_{max}}{U_n}$
RCM	Suitable for contactors CI 4	1-2.5

Max. load control circuit (contact system)

Type	Load		Max fuse	
	AC-15	DC-13	gI, gL, gG	BS 88 type T
TI 9C - 12C	500 V 2 A 200 VA	250 V 2 A 20 W	4 A	6 A

UL/CSA specications

UL/CSA approved loads

Type	Motor load (AC-3) [hp]							Other loads (AC-1) [A]			
	1-phase		3-phase					UL		CSA	
	115 V	230 V	115 V	200 V	240 V	460 V	575 V	40 °C [1])	60°C [1])	40 °C [1])	60 °C [1])
CI 4-5	0.5	1	1	1.5	1.5	3	3	12	12	12	12
CI 4-9	0.5	1.5	2	2	2	5	5	12	12	12	12
CI 4-12	0.5	2	3	3	3	7.5	10	12	12	12	12

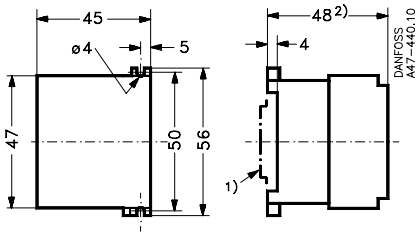
[1]) 40 °C is defined as non-enclosed condition
60 °C is defined as enclosed condition

Auxiliary contacts, UL/CSA approved loads

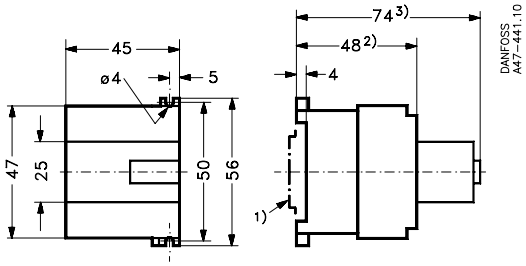
Type	Comments	Load capacity			
		a.c.		d.c.	
		Category	VA	Category	W
CI 4-	Built into contactor	A600	720	Q600	69
CBM	For contactor CI 4-	A600	720	Q600	69

Dimensions

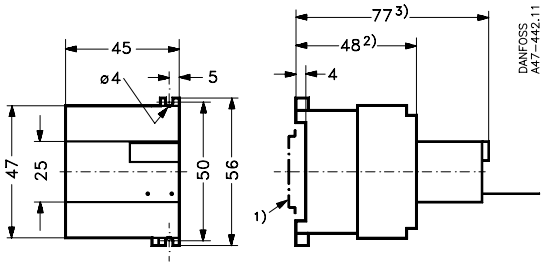
Contactor CI 4-



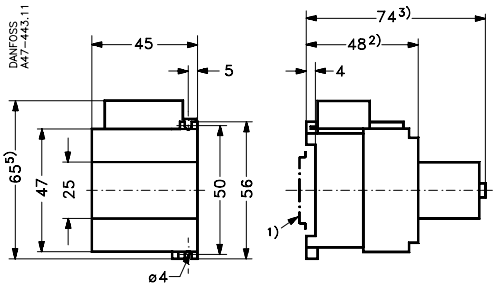
Contactor CI 4-
with auxiliary contact block CBM



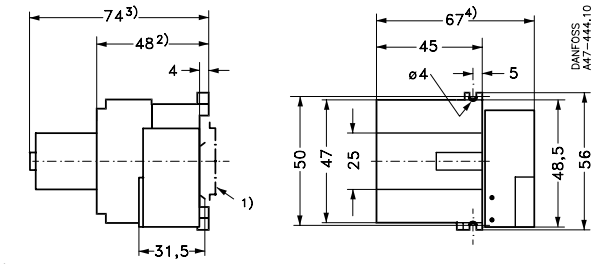
Contactor CI 4-
with clip-on timer ETM



Contactor CI 4-
with auxiliary contact block
CBM and RC Element with
RCM or with diode elememt
DIM 250



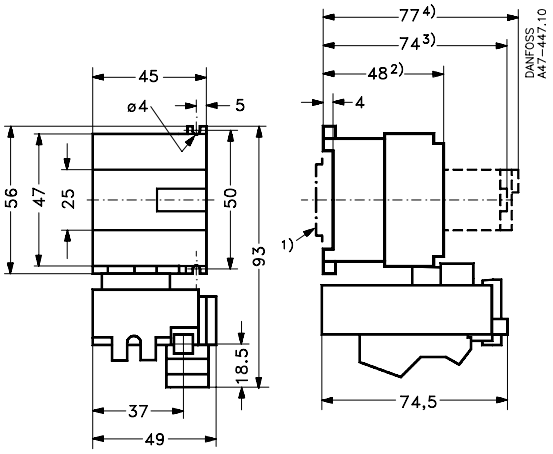
Contactor CI 4- with auxiliary
contact CBM in front
and clip-on timer ETM on side



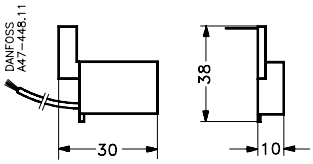
Footnotes, see next page

Dimensions
Accessories

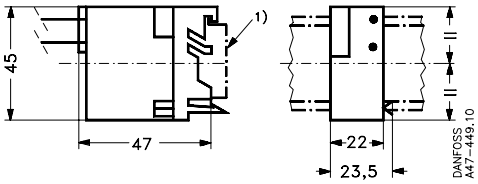
Motor starter CI 4-9C/12C + TI 12C



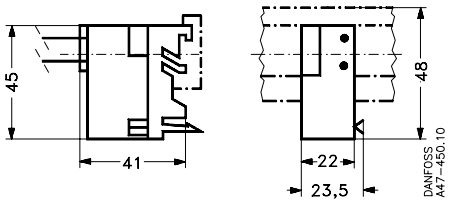
RC element, type RCM
Diode element DIM



Clip-on timer ETM
with adapter on DIN rail
EN 50022-35



Clip-on timer ETM
with adapter on DIN rail



1) Fixing possibilities on DIN rail EN 50022-35
2) Basic unit without accessories
3) With auxiliary contact block CBM
4) With Clip-on timer ETM
5) With RC Element RCM or diode element DIM

