

APPLICATION NOTE

Overload relays with current transformers

Electronic and thermal overload relays with CTxL current transformers



With a history spanning more than 130 years, ABB is a pioneering technology leader in electrification products, robotics and motion, and industrial automation, serving customers in utilities, industry and transport and infrastructure globally.

ABB offers a wide range of solutions to control and protect electrical motors. Especially in highly standardized applications, the usage of overload relays in combination with current transformers brings several advantages. This application note provides information to aid in the proper use of overload relays in combination with CTxL current transformers.

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Foreword

This application note is written as a general guide for people working with lowvoltage switchgear and controlgear applications. We suggest to follow the recommendations described in this document for the use of electronic and thermal overload relays with CTxL current transformers.

This document cannot claim to contain all detailed information of this product and cannot consider every possible application of the products. Further information and data are obtainable from the catalogs and data sheets of this product, from the local ABB sales organizations as well as on the ABB homepage abb.com/low-voltage.

More information on motor starting products as well as other ABB products is available at: <https://new.abb.com/low-voltage/products/motor-protection>

1. Principles

Application description

Current transformers (CT) convert a primary alternating current into a secondary alternating current, thereby influencing the magnitude of the current. This makes it possible to use overload relays in the secondary circuit to protect the higher currents in the primary circuit.

It is possible to combine current transformers with thermal and electronic overload relays. For ABB's thermal overload relays, the usage of current transformers is the only solution for applications with currents above 200 A. In addition, the use of overload relays in combination with current transformers has further advantages, especially in highly standardized applications such as in motor control centers:



Reduced complexity of variants

Reduced number of type-tested standard module variants as well as space reduction within those modules.



Efficient operation

The use of current transformers in combination with smaller thermal or electronic overload relays allows to reduce the heat dissipation.



Optimized testing procedures

Simplification of tests since a smaller power source can be used to generate test currents. The costs of tests and validation are reduced due to the standardization of variants (leading to a reduced number of combinations to be tested).



Customizable installation

With the ability to spatially separate current transformers and overload relays, the combination allows for greater configurability and optimized use of space.

Safety requirements

The installation and the operation of this device and any maintenance must be carried out by a qualified person in accordance with specific local standards and safety regulations. Before installing this device, read the respective installation instructions carefully. For use in potentially explosive areas please refer to operating instructions for thermal overload relays 2CDC106076M6801 or electronic overload relays 2CDC107043M6801.

2. Theoretical foundations

External current transformers convert the primary current according to their transformation ratio into a smaller secondary current, which can be detected by an overload relay. The setting of the overload relay must be done according to the secondary current. The secondary current is depending on the ratio of the used current transformer and the number of windings at the current transformer:

$$I_{SN} = I_{PN} \times \frac{N}{R}$$

I_{SN} = Secondary Current
 I_{PN} = Primary Current
 N = Number of Windings
 R = Ratio of Current Transformer

3. Overview

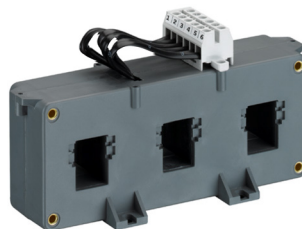
3.1 Thermal overload relays



T16 + DB16



T42 + DB42



CT4L...



CT5L...

Features

- Economic overload protection with separate mounting
- Motor applications from 106 A up to 850 A
- For single and three phase motors
- Automatic and manual reset
- RESET, TEST, and STOP functions
- Trip Class 10
- ATEX/IECEx certification for TF42 thermal overload relays with current transformers

Customer values

- Standardized design: Freedom of variation
 - Less complexity due to reduced number of type-tested standard module variants
 - Reduced costs of tests and validation
- CTs in the electrical distribution – overload relays in the operating area
- Suitability for ATEX / IECEx applications (with TF42 only)
- Usage of ABB's thermal overload relays in applications above 200 A



BVS 13 ATEX E 002

IECEx BVS 17.0073

[Ex]

Components which can be used for this application

- Single mounting kits DB16 for T16 or DB42 for TF42
- Current transformers CTCT4L185R/4, CT4L310R/4, CT5L500R/4, CT5L850R/4
- Thermal overload relays T16-2.3, T16-3.1, T16-4.2, TF42-2.3, TF42-6.1, TF42-4.2

3.2 Electronic overload relays



EF19 + DB19EF



CT4L...



CT5L...

Features

- Economic overload protection with separate mounting
- Motor applications from 40 A up to 850 A
- For three phase motors
- Automatic and manual reset
- RESET, TEST, and STOP functions
- Trip Class 10E, 20E, 30E
- ATEX/IECEx certification for EF19 electronic overload relays with current transformers

Customer values

- Standardized design: Freedom of variation
 - Less complexity due to reduced number of type-tested standard module variants
 - Reduced costs of tests and validation
- CTs in the electrical distribution - overload relays in the operating area
- Suitability for ATEX / IECEx applications



II (2) G [Ex eb Gb] [Ex db Gb] [Ex pxb Gb]
 II (2) D [Ex tb Db] [Ex pxb Db]

BVS 15 ATEX F 001

IECEx BVS 17.0016

[Ex]

Components which can be used for this application

- Single mounting kit DB19EF for EF19
- Current transformers CT4L185R/4, CT4L310R/4, CT5L500R/4, CT5L850R/4
- Electronic overload relays EF19-2.7, EF19-6.3

4. Product data

4.1 Thermal overload relays with current transformers

Order data

	Type	Order code	Setting Range
Thermal overload relays	T16-3.1	1SAZ711201R1033	2.30 ... 3.10 A
	T16-4.2	1SAZ711201R1035	3.10 ... 4.20 A
	TF42-3.1	1SAZ721201R1033	2.30 ... 3.10 A
	TF42-4.2	1SAZ721201R1035	3.10 ... 4.20 A
Single mounting kits	DB16	1SAZ701901R0001	
	DB42	1SAZ701902R0001	
Current transformers			Rated primary current range I_e
	CT4L185R/4	1SAJ929500R0185	60 ... 185 A AC
	CT4L310R/4	1SAJ929500R0310	150 ... 310 A AC
	CT5L500R/4	1SAJ929501R0500	200 ... 500 A AC
	CT5L850R/4	1SAJ929501R0850	400 ... 850 A AC

Current ranges (A) for CT with T16

Type	Ration	CT with T16-3.1		CT with T16-4.2	
		Lower Current Setting (in A)	Upper Current Setting (in A)	Lower Current Setting (in A)	Upper Current Setting (in A)
CT4L185R/4	46.5	106.95	144.15	144.15	195.3
CT4L310R/4	77.5	178.25	240.25	240.25	325.5
CT5L500R/4	125	287.5	387.5	387.5	525
CT5L850R/4	212.5	488.75	658.75	658.75	892.5

Current ranges (A) for CT with TF42

Type	Ration	CT with TF42-3.1		CT with TF42-4.2*	
		Lower Current Setting (in A)	Upper Current Setting (in A)	Lower Current Setting (in A)	Upper Current Setting (in A)
CT4L185R/4	46.5	106.95	144.15	144.15	186
CT4L310R/4	77.5	178.25	240.25	240.25	310
CT5L500R/4	125	287.5	387.5	387.5	500
CT5L850R/4	212.5	488.75	658.75	658.75	850

* TF42-4.2 used up to 4 A setting max.

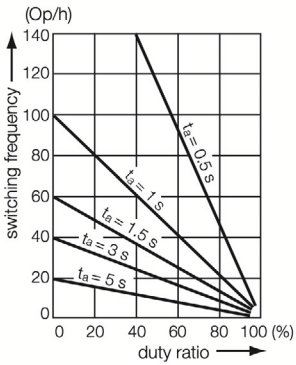
Accuracy of combination (CT + DB + T16/TF42)	The current transformer increases the tolerance of the tripping time for currents between 3 ... 8 the current setting by 3%
Wire size connection: Current transformer – Overload relay	2.5 mm ²
Max. cable length between: Current transformer – Overload relay	2 m
Max impedance connection: Current transformer – Overload relay	60 mΩ per pole

Short-circuit coordination

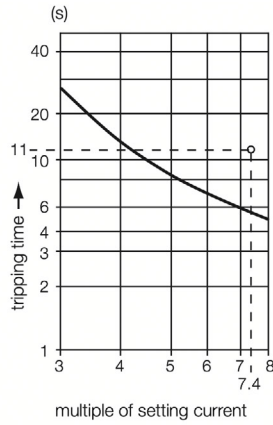
For other tables please refer to ABB „Coordination tables for motor protection“

<https://www.lowvoltage-tools.abb.com/soc/>

Technical diagrams

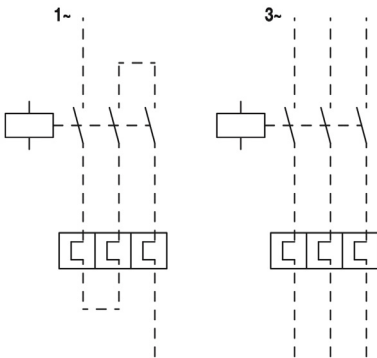


Intermittent periodic duty, t_a : motor starting time

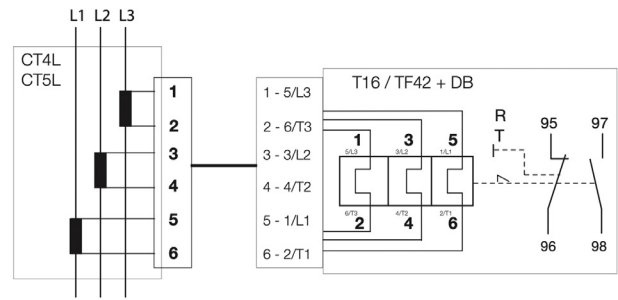


Example of a tripping curve, starting from cold state

Wiring diagrams



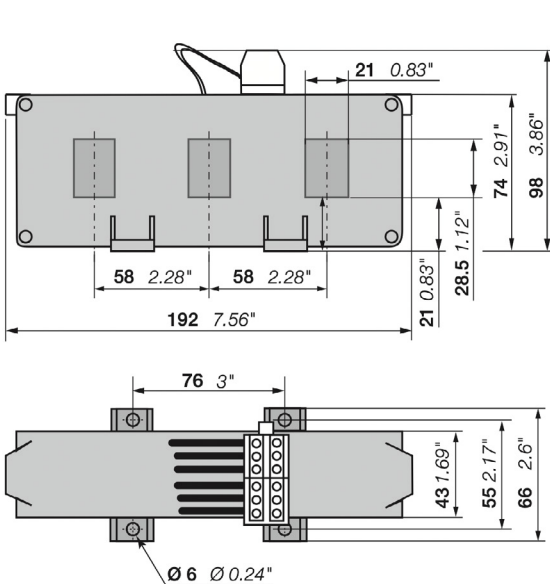
Operation mode 1-phase / 3-phase



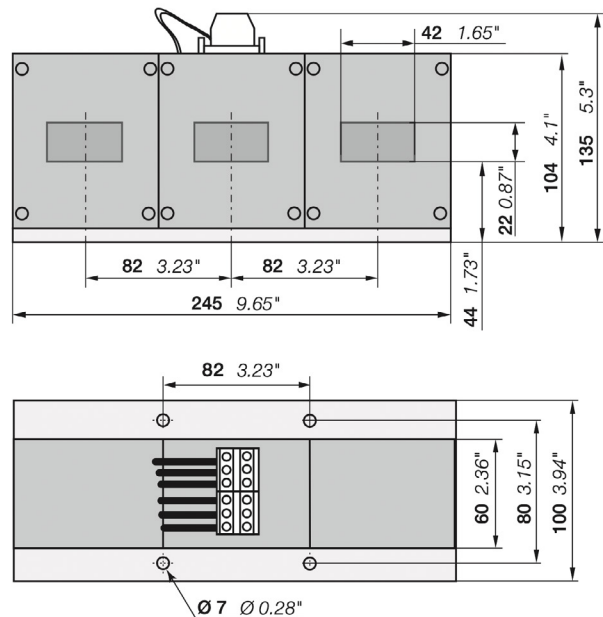
External current transformer CTxL with T16 / TF42

Dimensions

in mm and inches



CT4L185R/4, CT4L310R/4



CT5L500R/4, CT5L850R/4

Technical data

Main circuit – Utilization characteristics according to IEC/EN

Type	T16, TF42 + DB + CT
Standards	IEC/EN 60947-4-1, IEC/EN 60947-5-1, IEC/EN 60947-1
Rated operational voltage U _e	1000 V AC
Rated frequency	50/60 Hz
Trip class	10
Number of poles	3
Duty time	100 %
Operating frequency without early tripping	Up to 15 operations/h, see „Technical diagram – Intermittent periodic duty“
Rated impulse withstand voltage U _{imp}	8 kV
Rated insulation voltage U _i	1000 V AC
Short-circuit protection	Refer to short-circuit coordination https://www.lowvoltage-tools.abb.com/soc/

For further technical data please refer the product data sheets for thermal overload relays

T16: 2CDC106020D0201

TF42: 2CDC106020D0202

4.2 Electronic overload relays with current transformers

Order data

	Type	Order code	Setting Range
Electronic overload relays	EF19-2.7	1SAX111001R1103	0.8 ... 2.7 A
	EF19-6.3	1SAX111001R1104	1.9 ... 6.3 A
Single mounting kits	DB19EF	1SAX101910R1001	
Current transformers			Rated primary current range I_e
	CT4L185R/4	1SAJ929500R0185	60 ... 185 A AC
	CT4L310R/4	1SAJ929500R0310	150 ... 310 A AC
	CT5L500R/4	1SAJ929501R0500	200 ... 500 A AC
	CT5L850R/4	1SAJ929501R0850	400 ... 850 A AC

Current ranges (A)

Type	Ration	CT with EF19-2.7			CT with EF19-6.3*	
		Lower Current Setting (in A)	Upper Current Setting (in A)	Min Setting (in A)	Lower Current Setting (in A)	Upper Current Setting (in A)
CT4L185R/4	46.5	60	125.55	1.2	88.35	186
CT4L310R/4	77.5	147.25	209.25	1.9	147.25	310
CT5L500R/4	125	200	337.5	1.6	237.5	500
CT5L850R/4	212.5	400	573.75	1.8	403.75	850

* EF19-6.3 used up to 4 A setting max.

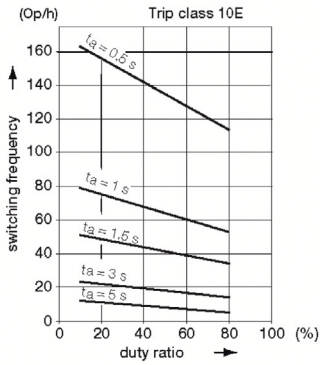
Accuracy of combination (CT + DB + EF19)	The current transformer increases the tolerance of the tripping time for currents between 3 ... 8 the current setting by 3 %
Wire size connection: Current transformer – Overload relay	1.5 mm ²
Max. cable length between: Current transformer – Overload relay	10 m
Max impedance connection: Current transformer – Overload relay	120 mΩ per pole

Short-circuit coordination

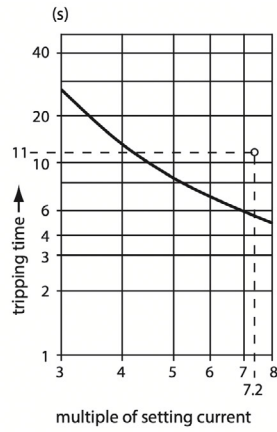
For other tables please refer to ABB „Coordination tables for motor protection“

<https://www.lowvoltage-tools.abb.com/soc/>

Technical diagrams

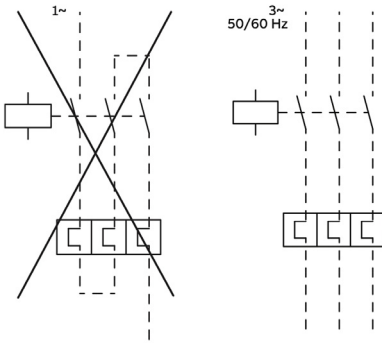


Intermittent periodic duty, t_a: motor starting time

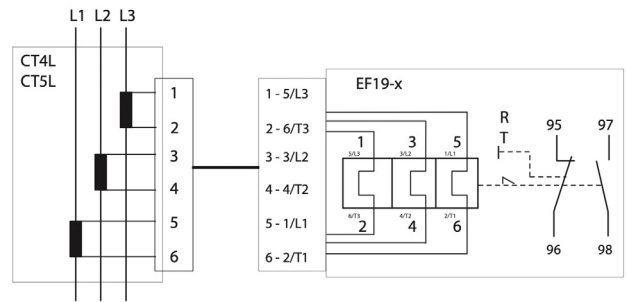


Example of a tripping curve, starting from cold state

Wiring diagrams



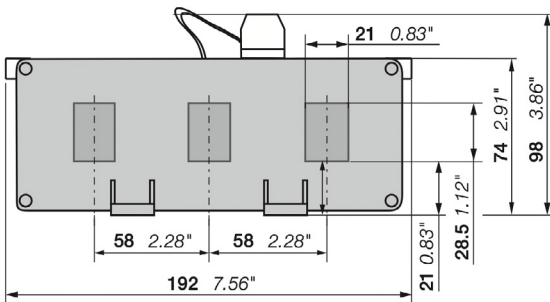
Operation mode 1-phase / 3-phase



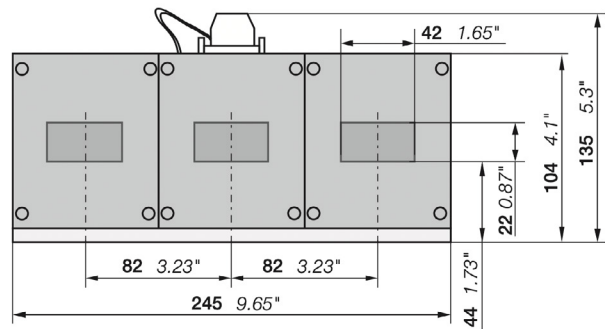
External current transformer CTxL with T16 / TF42

Dimensions

in mm and inches



CT4L185R/4, CT4L310R/4



CT5L500R/4, CT5L850R/4

Technical data

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Main circuit – Utilization characteristics according to IEC/EN

Type	EF + DB + CT
Standards	IEC/EN 60947-4-1, IEC/EN 60947-5-1, IEC/EN 60947-1
Rated operational voltage U_e	1000 V AC
Rated frequency	50/60 Hz
Trip class	10 E, 20 E, 30 E
Number of poles	3
Rated impulse withstand voltage U_{imp}	8 kV
Rated insulation voltage U_i	1000 V AC
Short-circuit protection	Refer to short-circuit coordination https://www.lowvoltage-tools.abb.com/soc/

For further technical data please refer the product data sheets for electronic overload relays
EF19: 2CDC107025D0201

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**You can find the address of your local
sales organization on the ABB homepage**

abb.com/lowvoltage



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