



ESB and EN installation contactors

Application handbook

Content

1 Basic function of installation contactors	4
2 Modular DIN rail components	5
3 ESB/EN Installation contactors	6
4 Technical requirements	9
5 Utilization categories	12
5.1 AC-1	15
5.2 AC-3	16
5.3 AC-5a	17
5.4 AC-5b	18
5.5 AC-7a/AC-7b	18
5.6 Summary of the utilization categories	20
6 Applications	21
6.1 Motors	21
6.2 Lighting	22
6.3 Mixed Loads	24
6.4 Heating	25
6.5 E-mobility	26
6.6 Solar power systems	27

1 Basic function of installation contactors

Contactors are electromagnetically operated switches. The functional principle can be described as follows: when control power flows through the magnet coil of a contactor, the resulting magnetic field attracts the mechanical contact carrier. By interruption of the coil control circuit the mechanical contact carrier returns to the starting position.

Installation contactors belong to the class of air-break contactors. If coil power is removed, an arc is created as the contacts open. Air-break contactors extinguish the arc by separating the contacts by a sufficient distance. Air-break contactors are more economic, because the price and the maintenance costs are lower than with other classes of contactors (e.g. oil immersed, vacuum).

Figure 1 shows the basic construction of a contactor. This contactor consists of a normally closed and normally open contact. Current is drawn into the coil when an energy supply is connected to coil connections (3). This current causes the coil to produce electromagnetic forces which draw the anchor (5) downward, opening the normally closed contact (2), and closing the normally open contact (1). When the magnetic circuit is interrupted, the contact spring (4) returns the contacts to their normal state.

The following chapters describe modular DIN rail components and the requirements for installation contactors.

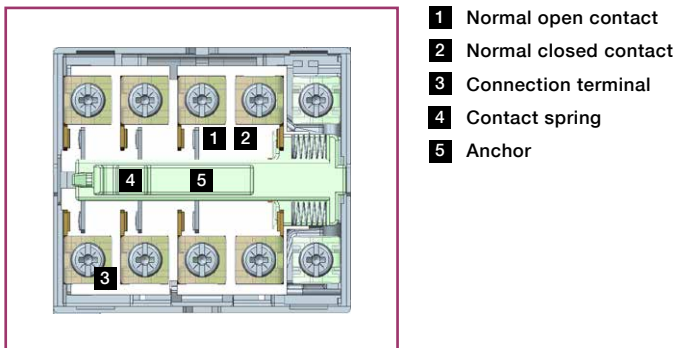


Figure 1: Construction of a contactor

2 Modular DIN rail components

Modular DIN rail components (MDRC) are devices designed to be used with a mounting rail. The mounting rail consists of metal and is standardized for electrical engineering. The term is derived from the original specifications published by the German Institute for Standardization (DIN) in Germany, which have since been adopted as European (EN) and international (ISO) standards. The mounting rail is specified by the DIN Norm EN 50022 with the dimensions 35 mm x 7.5 mm, seen in the Figure 2. Figure 2 shows several standardized mounting rail designs. Today, the standards for mounting rails are summarized in DIN EN 60715.

Modular DIN rail components are designed for a high degree of safety and finger protection. Their compact construction saves space and increases customer benefits in building installations. All MDRC products are designed using the concept of modular width, and are either a fraction of, or multiples of, a single “module”, which is standardized at 17.5 mm. These devices can be installed on mounting rails, and include products such as control relays, impulse relays, time switch relays, circuit breakers, series terminals and installation contactors. Installation enclosures include distribution panels, switchboards and distribution boxes. A distribution panel is shown in Figure 3.

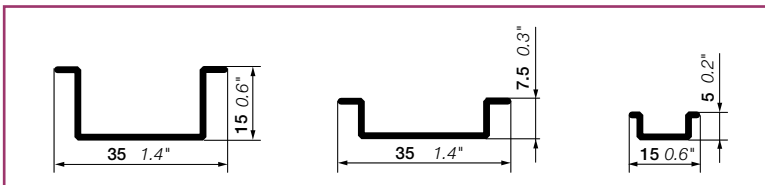


Figure 2: Mounting-rail designs



Figure 3: Distribution panel

3 ESB/EN Installation contactors

Introduction

ABB offers a complete range of equipment for controlling and protecting electrical installations in buildings such as hotels, hospitals, shopping centers, office centers and residences.

ESB and EN installation contactors are designed to match the Modular DIN rail components (MDRC) for use in dedicated panels providing high safety and finger protection.

The range

The ESB range includes 4 ratings from 20 A to 63 A in 2 to 4-pole versions. The EN contactor range offers 3 types from 20 A to 40 A with an additional manual switch on the front.

Features and benefits

Flexible use for many applications

ESB20 ... ESB63 can be used for both installation-type and industrial applications:

- Resistive loads such as electric heaters, water heaters, etc.
- Motors, pumps
- Lamp switching and controls

High comfort due to hum-free operation

The installation contactor types ESB24/EN24...ESB63 operate free from vibration, due to their DC coil technology. This feature has high value in building installations where hum-free and silent operations are important for peoples' wellbeing.

High protection against overvoltages and current peaks

- Built-in surge protection for ESB24 ... ESB63
- ABB tested lamp table is compensated to allow for more secure planning

Approvals available

Certificates for CE, CCC, UL/CSA, GOST, as well as household and ship approvals are available. Other approvals on request.

Compact and optimized design

Installation contactors with the MDRC design have a very compact size. A powerful ESB63, with a maximum operating current of 63 A, fits in a small enclosure with only 60 mm depth.

Cost savings

- Low power consumption of DC coils (ESB24, ESB40, ESB63)
- Better logistics, because an AC/DC coil supply requires less variants
- Significantly reduced space compared to industrial contactors

Higher functionality with EN types

EN types also include a special hand operating function.

This provides customers with the following features:

- Manual control in case of failure
- Easier and faster commissioning
- Time savings on maintenance and testing of equipment



O = OFF

Automatic run

I = ON

Functions:

- Switch in position „AUTO“: standard control
- Switch in position „0“: Supply to coil interrupted
- Switch in position „I“: Manually switched on (a trigger signal to the coil terminal initiates the switch moving into „AUTO“ position)

3 ESB/EN Installation contactors

Product overview and technical data



Contactor types		ESB20	ESB24	ESB40	ESB63
Remote controlled		EN20	EN24	EN40	-
Remote and manually controlled		EN20	EN24	EN40	-
Module width	mm	18	36	54	54
coil types		AC operated	AC / DC operated	AC / DC operated	AC / DC operated

Main Pole - Utilization Characteristics according to IEC

Rated operational voltage U_e max.	V	AC: 250, DC: 220	AC: 400, DC: 220		
Utilization category AC-1 / AC-7a for air temperature close to contactor < 55 °C					
Max. rated operational current I_e AC-1 / AC-7a					
N.O.	A	20	24	40	63
N.C.	A	20	24	30	30
Utilization category AC-3 / AC-7b for air temperature close to contactor < 55 °C					
Max. rated operational current I_e AC-3 / AC-7b					
230 V - 1 phase	A	9	9	22	30
400 V - 3 phases	A	-	9	22	30
Rated operational power AC-3					
230 V - 1 phase	kW	1.1	1.3	3.7	5
400 V - 3 phases	kW	-	4	11	15

Accessories

	Aux. switches	2 NO	-	EH04-20	
		1 NO + 1 NC	-	EH04-11	
	Distance piece		-	ESB-DIS	
	Sealing covers		-	ESB-PLK 24	ESB-PLK 40/63

4 Technical requirements

The technical requirements for switching devices, including installation contactors, are based on the fact that electric circuits require the possibility for interruption. The contacts of the installation contactors consist of metallic, conductive materials. These contacts must fulfil two duties: the opening and closing of the circuit (moving contact), and the transference of the electric energy as freely of loss as possible (fixed contact). The demands for the fixed contact include a low voltage drop and, for the moving contact, a light and low-wear operation. In the following section the temperature requirements of the contacts, which is fixed in the norm IEC 60947-1, will be explained.

Temperature

A technical requirement on switching devices includes the temperature of the touchable parts and connections. The temperature development which is fixed after the norm IEC 60947-1 is dependent on the surrounding ambient temperature. The range of the surrounding temperature in which the installation contactor were tested includes from -25 to +55 °C, with an air humidity of max. 95 %.

The heating of the installation contactor is a result not only of the surrounding ambient temperature, but also of the connected load, which must be added to the surrounding temperature. The temperature of the installation contactor can be influenced by ventilation and cooling, so that the temperature can be reduced by heat removal. If no sufficient heat removal exists, as the material heats up a steady increase in the resistance of the contact results. The increased resistance of the contact and also of the installation contactor increases the temperature.

The maximum allowed temperatures of the surfaces and connections is fixed in the norm IEC 60947-1. The temperature-rise limits of the terminals is shown for different materials in the Table 1. Table 2 contains the temperature-rise limits of different accessible parts. The surface temperature is measured directly on the product. The surrounding ambient temperature (air) is measured around the product, and does not correspond to the product surface temperature.

4 Technical requirements

Table 1: Temperature-rise limits of terminals

Terminal materials	Temperature-rise limits ^{a, c}
	K
Bare copper	60
Bare brass	65
Tin plated copper or brass	65
Silver plated or nickel plated copper or brass	70
Other metals	^b

- ^a The use in service of connected conductors significantly smaller than those listed in Tables 9 and 10 could result in higher terminals and internal part temperatures and such conductors should not be used without the manufacturer's consent since higher temperatures could lead to equipment failure.
- ^b Temperature-rise limits to be based on service experience or life tests but not to exceed 65 K.
- ^c Different values may be prescribed by product standards for different test conditions and for devices of small dimensions, but not exceeding by more than 10 K the values of this table.

Copyright © 2007 IEC Geneva, Switzerland. www.iec.ch

Table 2: Temperature-rise limits of accessible parts

Accessible parts	Temperature-rise limits ^a
	K
Manuel operating means:	
Metallic	15
Non-metallic	25
Parts intended to be touched but not hand-held:	
Metallic	30
Non-metallic	40
Parts which need not be touched during normal operation ^b:	
Exteriors of enclosures adjacent to cable entries:	
Metallic	40
Non-metallic	50
Exterior of enclosures for resistors	200 ^b
Air issuing from ventilation openings of enclosures for resistors	200 ^b

- ^a Different values may be prescribed by product standards for different test conditions and for devices of small dimensions but not exceeding by more than 10 K the values of this table.
- ^b The equipment shall be protected against contact with combustible materials or accidental contact with personnel. The limit of 200 K may be exceeded if so stated by the manufacturer. Guarding and location to prevent danger is the responsibility of the installer. The manufacturer shall provide appropriate information, in accordance with 5.3.

Copyright © 2007 IEC Geneva, Switzerland. www.iec.ch

The maximum temperatures are calculated as follows:

temperature rise + ambient air temperature = maximum temperature limit

Example:

- the air temperature is 30 °C
- the temperature rise of the terminal is 50 °C
- the temperature rise of the accessible parts is 40 °C
- the terminal material is bare copper
- the accessible part is the product surface, which need not be touched for normal operation and is non-metallic

Temperature of the terminal:

$$50\text{ °C} + 30\text{ °C} = 80\text{ °C}$$

Temperature limit of the terminal:

$$65\text{ °C} + 30\text{ °C} = 95\text{ °C}$$

Result: The terminal temperature of 80 °C is under the temperature limit of 95 °C and is therefore acceptable.

Temperature of the product surface:

$$40\text{ °C} + 30\text{ °C} = 70\text{ °C}$$

Temperature limit of the product surface:

$$50\text{ °C} + 30\text{ °C} = 80\text{ °C}$$

Result: The product surface temperature of 70 °C is under the temperature limit of 80 °C and is therefore acceptable.

5 Utilization categories

Utilization categories characterize the requirements for electric switching devices under different switching conditions. Generally, the utilization categories are standardized for low-voltage switching devices in the norm IEC 60947-1 and for the installation contactors in IEC 60947-4-1. The utilization categories are shown in Table 3.

Table 3: Utilization categories

Kind of current	Utilization categories	Additional category designation	Typical applications
AC	AC-1	General use	Non-inductive or slightly inductive loads, resistance furnaces
	AC-2		Slip-ring motors: starting, switching off
	AC-3		Squirrel-cage motors: starting, switching off motors during running ^a
	AC-4		Squirrel-cage motors: starting, plugging, inching
	AC-5a	Ballast	Switching of electric discharge lamp controls
	AC-5b	Incandescent	Switching of incandescent lamps
	AC-6a		Switching of transformers
	AC-6b		Switching of capacitor banks
	AC-7a ^c		Slightly inductive loads in household appliances and similar applications
	AC-7b ^c		Motor-loads for household applications
	AC-8a		Hermetic refrigerant compressor motor ^b control with manual resetting of overload releases
DC	DC-1		Non-inductive or slightly inductive loads, resistance furnaces
	DC-3		Shunt-motors: starting, plugging, inching Dynamic breaking of d.c. motors
	DC-5		Series-motors: starting, plugging, inching Dynamic breaking of d.c. motors
	DC-6	Incandescent	Switching of incandescent lamps

^a AC-3 category may be used for occasional inching (jogging) or plugging for limited time periods such as machine set-up; during such limited time periods, the number of such operations should not exceed five per minute or more than ten in a 10-min period.

^b A hermetic refrigerant compressor motor is a combination consisting of a compressor and a motor, both of which are enclosed in the same housing, with no external shaft or shaft seals, the motor operating in the refrigerant.

^c For AC-7a and AC-7b, see IEC 61095.

The requirements for the installation contactors are fixed by the characteristics of the loads to be controlled, along with the application conditions. The making and breaking currents also have high importance.

The making and breaking capacity of an installation contactor must comply with the requirements for the utilization category. These categories outline the conditions and number of operations over which the making and breaking currents must be switched without failure of the device. Furthermore the conventional operational performance of the installation contactors must correspond to the conditions according to Table 4. The load test, which shows the circuit behavior under normal use, covers conventional operational performance. The installation contactor must be able to switch on and switch off under agreed conventional conditions and an agreed number of cycles without failure of the device.

In the following section, the utilization categories for the typical loads and applications for installation contactors are described. Switching devices must always be selected based on the loads to be controlled, which differ in regards to making and breaking currents.

5 Utilization categories

Table 4: Conventional operational performance – Making and breaking conditions according to utilization category

Utilization category	Make and break test conditions					
	I_c/I_e	U_r/U_e	$\cos \varphi$	On-time s	Off-time s	Number of operating cycles
AC-1	1.0	1.05	0.80	0.05 ^b	c	6 000 ⁱ
AC-2	2.0	1.05	0.65	0.05 ^b	c	6 000 ⁱ
AC-3	2.0	1.05	a	0.05 ^b	c	6 000 ⁱ
AC-4	6.0	1.05	a	0.05 ^b	c	6 000 ⁱ
AC-5a	2.0	1.05	0.45	0.05 ^b	c	6 000 ⁱ
AC-5b	1.0 ^e	1.05	e	0.05 ^b	60	6 000 ⁱ
AC-6	g	g	g	g	g	g
AC-8a	1.0	1.05	0.80	0.05 ^b	c	30 000
AC-8b ^{h j}	6.0	1.05	a	1 10	g 90 ^d	5 900 100
Utilization category	I_c/I_e	U_r/U_e	L/R ms	On-time s	Off-time s	Number of operating cycles
DC-1	1.0	1.05	1.0	0.05 ^b	c	6 000 ^f
DC-3	2.5	1.05	2.0	0.05 ^b	c	6 000 ^f
DC-5	2.5	1.05	7.5	0.05 ^b	c	6 000 ^f
DC-6	1.0 ^e	1.05	e	0.05 ^b	60	6 000 ^f

I_c = Current made or broken. Except for AC-5b, AC-6 or DC-6 categories, the making current is expressed in d.c. or a.c. r.m.s. symmetrical values but it is understood that for a.c. the actual peak value during the making operation may assume a higher value than the symmetrical peak value.

I_e = Rated operational current

U_r = Power frequency or d.c. recovery voltage

U_e = Rated operational voltage

^a $\cos \varphi = 0.45$ for $I_e \leq 100$ A; 0.35 for $I_e > 100$ A

^b The time may be less than 0.05 s, provided that contacts are allowed to become properly seated before reopening.

^c These off-times shall be not greater than the values specified in Table 8

^d The manufacturer may choose any value for the Off-time up 200 s.

^e Tests to be carried out with an incandescent light load.

^f 3 000 operating cycles with one polarity and 3 000 operating cycles with reverse polarity.

^g Under consideration.

^h Tests for category AC-8b shall be accompanied by tests for category AC-8a. The tests may be made on different samples.

ⁱ For manually operated switching devices, the number of operating cycles shall be 1 000 on-load, followed by 5 000 off-load.

^j A lower ratio of I_c/I_e (locked rotor to full load current) may be used if specified by the manufacturer.

Copyright © 2007 IEC Geneva, Switzerland. www.iec.ch

5.1 AC-1

A typical application for the utilization category AC-1 is electric heating. Utilization category AC-1 covers all non-inductive and slightly inductive loads.

For this utilization category, the inrush current and the nominal current are the same, shown in Figure 5. This utilization category can cause installation contactors to generate excess heat, which can limit their rated capacity.

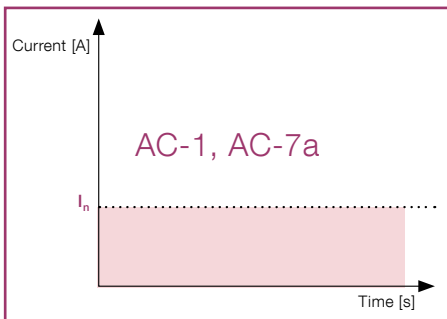


Figure 5: Inrush current of resistive loads

5 Utilization categories

5.2 AC-3

Utilization category AC-3 covers the starting and stopping of squirrel cage motors.

The inrush current can reach ten times the value of the nominal current. The typical inrush current of a squirrel cage motor is shown in Figure 6.

Squirrel cage motors are used to drive pumps, conveyor belts, tool machines and fans in rooms and air shafts.

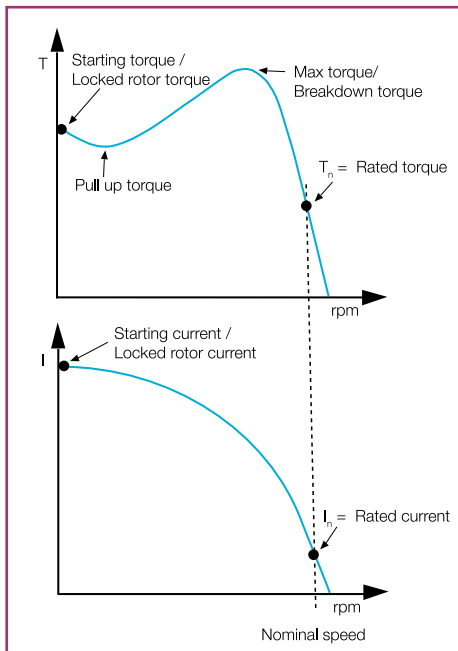


Figure 6: Torque and current diagram of a squirrel cage motor

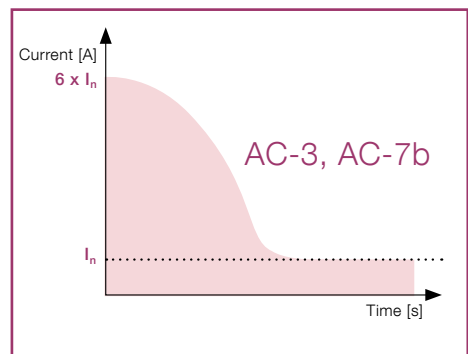


Figure 7: Inrush current of the utilization categories AC-3 and AC-7b

5.3 AC-5a

Utilization category AC-5a covers glow-discharge lamps. This includes high-pressure discharge lamps, halogen metal vapor lamps, fluorescent lamps with EVG (Electronic ballast) and LEDs with EVG.

A sodium vapor high-pressure lamp has a starting current of approx. 25 % above the nominal current, which can last for a period of 6 to 10 minutes. The start process is shown in Figure 8.

A mercury vapor high-pressure lamp has a similar approach behavior, however, this approach lasts about 5 minutes and has a starting current of approx. 40 % above the nominal current. Figure 9 shows this approach behavior.

Halogen metal vapor lamps have a similar approach behavior with a 3 to 5 minute duration and a 40 % inrush peak.

The activation behavior of a fluorescent lamp with EVG and a compact fluorescent lamp are similar, and consist of an inrush current peak up to the 10 times the nominal current. This inrush current peak is a result of the memory condenser of the EVGs.

LEDs also utilize an EVG, and have similar making and breaking capacities to fluorescent lamps.

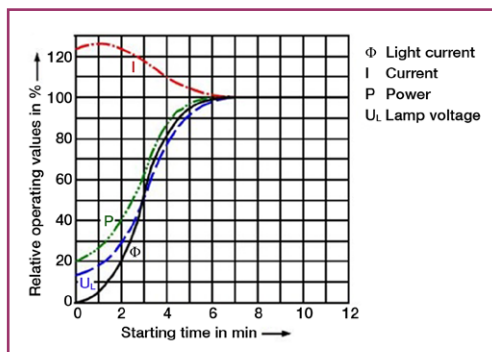


Figure 8: Starting diagram of a high-pressure sodium lamp

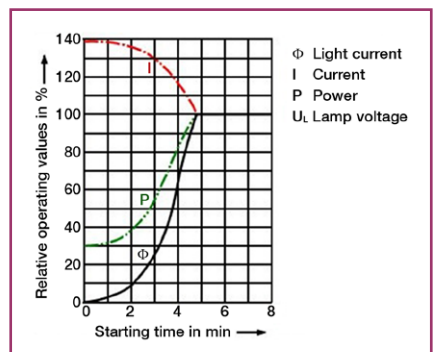


Figure 9: Starting diagram of a high-pressure mercury lamp

5 Utilization categories

The switching of lamps covered by utilization category AC-5a can be difficult due to the high inrush current putting burden on the switching devices. In addition to the higher inrush currents, the approach times for high-pressure discharge lamps must also be taken into consideration.

5.4 AC-5b

Utilization category AC-5b covers electric light bulbs, halogen electric light bulbs and mixed lamps.

The load is highest at start for electric light bulbs, because in their cold state the glow filament has a very small ohmic resistance, leading to an inrush current peak. This inrush current peak can equate to the 15 times the nominal current, but fades within milliseconds back to the nominal current.

A mixed light lamp behaves similar to an electric light bulb, again caused by small ohmic resistance causing a high inrush current peak.

The difference between utilization category AC-5b and utilization category AC-5a is based on the fact that the loads under the utilization category AC-5b have inrush currents lasting only a few milliseconds, making the requirements for the switching devices lower than for the utilization category AC-5a. Utilization category AC-5a requires, in addition to the higher inrush current, a longer starting duration of up to 10 minutes, during which the starting current can amount to a value of 40 % above the nominal current.

5.5 AC-7a/AC-7b

The norms of the utilization categories AC-7a and AC-7b are standardized in IEC 61095. The definitions of these utilization categories are shown in Table 5.

IEC 61095 applies to electromechanical air break contactors for household and similar purposes provided with main contacts intended to be connected to circuits the rated voltage of which does not exceed 440 V a.c. (between phases) and with rated operational currents less than or equal to 63 A for utilization category AC-7a and 32 A for utilization categories AC-7b and AC-7c, and rated conditional short-circuit current less than or equal to 6 kA.

Table 5: Utilization categories

Utilization categories ^a	Typical applications
AC-7a	Slightly inductive loads
AC-7b	Motor loads ^b
AC-7c	Switching of compensated electric discharge lamp control ^c

^a Contactors may have other utilization categories, in which case they shall comply with the requirements of IEC 60947-4-1 for such categories.

^b The AC-7b category may be used for occasional inching (jogging) or plugging for limited time periods: during such limited time periods the number of operations should not exceed 5/min or more than 10 in a 10-minute period.

^c This category is similar to a capacitive switching category AC-6b as defined in IEC 60947-4-1 for the switching of capacitor banks, the characteristic being very dependant on the capacitance value of the lamp circuit.

Copyright © 2007 IEC Geneva, Switzerland. www.iec.ch

For the conventional operational performance, the requirements for the installation contactor are shown in Table 6.

Table 6: Conventional operational performance – Making and breaking conditions corresponding to the utilization categories

Categories	Making and breaking conditions					
	I_c/I_e	U_r/U_e	$\cos \varphi$	On-time ^a s	Off-time s	Number of operating cycles
AC-7 a	1,0	1,05	0,80	0,05	^b	30 000
AC-7b	^d	^c	0,45	0,05	^b	30 000
AC-7c ^e	1,0	1,05	0,90	0,05	^b	30 000

I_c is the current made and broken, expressed in r.m.s. symmetrical values, but it is understood that the actual peak value in the making operation may assume a higher value than the symmetrical peak value

I_e is the rated operational current

U_r is the power frequency recovery voltage

U_e is the rated operational voltage

$\cos \varphi$ is the power factor of the test circuit

^a Time may be less than 0,05 s provided that contacts are allowed to become properly seated before re-opening.

^b These OFF times shall be not greater than the values specified in Table 8.

^c $U_r/U_e = 1,0$ for making and $U_r/U_e = 0,17$ for breaking.

^d $I_c/I_e = 6,0$ for making and $I_c/I_e = 1,0$ for breaking.

^e The test shall be done on a specific test circuit (see 9.3.3.5.2, item d) 2)).

Copyright © 2007 IEC Geneva, Switzerland. www.iec.ch

5 Utilization categories

The utilization category AC-7a can be compared to the utilization category AC-1, but the slightly inductive loads find their use in household conditions, and the switching devices must therefore conform to the standards of the IEC 61095. The motor loads, which are covered under the utilization category AC-7b, correspond to motors covered under the utilization category AC-3, but under household conditions.

5.6 Summary of the utilization categories

A complete overview of the above mentioned utilization categories and their inrush current is shown in Table 7.

Table 7: Overview of the inrush currents of the utilization categories

Summary of the utilization categories and inrush currents:			
Utilization category		Inrush current value	Inrush time
AC-1	Resistive loads AC-1	Inrush current = operating current	
AC-2	Slip-ring motors, plugging, inching	Multiple 6...7 of operating current	4...6 s
AC-3	Squirrel-cage motor loads		
	standard motors	Multiple 6...7 of operating current	4...6 s
	high performance motors	Multiple 8 of operating current	
	high efficiency motors	Multiple 10...14 of operating current	
AC-5a	Switching of lamp loads fluorescent lamps, sodium vapor lamps etc.	Multiple 3...6 of operating current	
AC-5b	Switching of lamp loads incandescent lamps	Multiple 15...20 of operating current	
AC-6A	Transformer switching	Multiple 15...20 of operating current	
AC-7a	Resistive and slightly inductive loads for household	Inrush current = operating current	
AC-7b	Motor loads for household	Multiple 6...7 of operating current	

6 Applications

In the following chapters the different loads and applications are described and explained. In addition to the connection possibilities, information about the different application examples is also introduced.

6.1 Motors

Motors are a common application for the installation contactors. The switching of motor loads are covered under the utilization categories AC-2, AC-3 and AC-4. The difficulty with all motor loads are the high inrush currents which can amount to 6-10 times the nominal current. Besides, inductive loads tend to build electric arcs during shut off, especially with direct current motors.

Motors applications include pumps, compressors and lifts. Motors are also commonly used for air-conditioners. Applications include:

- Pumps
- Air-conditioning systems
- Ventilators
- Elevators

The following circuit diagrams show the most common connections of motors for single-phase and three-phase systems.

The direct starting of three-phase current asynchronous motors is the simplest kind of starting. Nevertheless, it is the most intensive load type for installation contactors. The inrush current can be reduced by different starting procedures, such as a star-delta starter, softstarter or frequency converter.

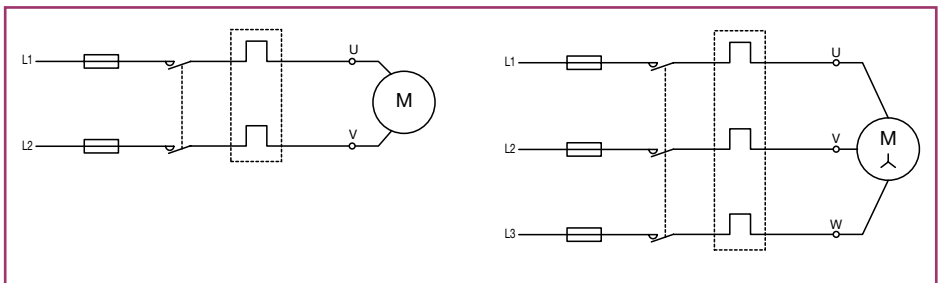


Figure 10: Circuit diagrams for motors

6 Applications

6.2 Lighting

Another common application for installation contactors is the switching of lamps. These lamps are covered by utilization categories AC-5a and AC-5b.

Table 9: Lamp table for ESB/EN installation contactors

		ESB20/EN20	ESB/EN24	ESB/EN40	ESB63
Permitted compensating capacity per phase	C_{max} [μF]	75	100	350	500
Lamp types		Maximum load of the current paths during switching of electric lamps I_e [A]			
Incandescent and halogen lamps (230 V)	I_e [A]	6	7	20	30
Mixing lamps without ballast	I_e [A]	6	7	20	30
Fluorescent lamps with conventional ballast					
single lamp uncompensated	I_e [A]	9	22	36	56
single lamp parallel compensated	I_e [A]	3	3.5	10	15
series compensation, duo circuit	I_e [A]	9	22	36	56
Fluorescent lamps with electronic ballast or CFL	I_e [A]	3	7	20	30
LED lamps	I_e [A]	3 ¹⁾	7	20	30
High pressure mercury-vapor lamps					
single lamp without compensation	I_e [A]	9	11	18	28
single lamp with parallel compensation	I_e [A]	3	3.5	10	15
Halogen metal-vapor lamps					
single lamp without compensation	I_e [A]	9	11	18	28
single lamp with parallel compensation	I_e [A]	3	3.5	10	15
High pressure sodium-vapor lamps					
single lamp without compensation	I_e [A]	9	11	18	28
single lamp with parallel compensation	I_e [A]	3	3.5	10	15
Low pressure sodium-vapor lamps					
single lamp without compensation	I_e [A]	9	11	18	28
single lamp with parallel compensation	I_e [A]	3	3.5	10	15
Electronic ballast devices	I_e [A]	3	7	20	30

¹⁾ Valid for max. inrush of 50 x I_e

Switching lamps is a capacitive load application where high inrush current peaks can occur. These are influenced by the length and cross section of the wire, as well as the type of power supply unit and the specifications of the individual lamp brand.

For example, long cables can increase the possible number of lamps per pole. Table 9 shows the allowed maximum current for 1 pole, already compensating for the differing startup current peaks.

The selection table 9 shows the current values and the maximum switchable capacitor load for compensated lamps.

These two limits have to be considered in the selection of contactors.

Due to many varieties of lamps and ballasts, it is advised to take the load current as the basis for reference.

The lamp table already considers the inrush peaks and other lamp parameters. The formula $I=P/U$ can be used for calculation if only the voltage and power is known.

Please see the following examples for a reliable project lamp calculation:

- Fluorescent lamp with conventional ballast, uncompensated, the lamp operating current $I = 1.5 \text{ A}$, voltage $U = 230 \text{ V}$
 - 1 pole of ESB24 can be loaded with max. 22 A, see lamp table $\Rightarrow 22 \text{ A} / 1.5 \text{ A} = 14.66 \Rightarrow 14$ lamps
 - 1 pole of ESB20 can be loaded with max. 9 A, see lamp table $\Rightarrow 9 \text{ A} / 1.5 \text{ A} = 6 \Rightarrow 6$ lamps

Please use the referring value in the table stated above and divide it with the current stated on the lamp. This will lead into the number of lamps which can be switched.

E.g.: ESB24 used for LED lamps: $7 \text{ A} (= 7000 \text{ mA}) / 85 \text{ mA} = 82.23 \Rightarrow 82$ lamps



6 Applications

6.3 Mixed Loads

The switching of mixed loads entails that multiple requirements for the installation contactors are met, and are typically required for houses and flats. The application of installation contactors in households follows special standards, so here the requirements for the utilization categories AC-7a and AC-7b must be respected. A more specialized application includes installation on a ship. Mixed loads include a variety of different inrush currents. As all loads are centrally controlled in the switch cabinet, the switching devices should be of the same design. This is offered by the installation contactors, because these are built in the MDRC design.

The installation contactors also offers the possibility to be integrated into the existing power supply system of a house, because they are tested with a voltage of 230 V. The number of contacts, and therefore the connection possibilities, also plays an important role.

The range of products System pro *M* compact

The product range System pro *M* compact offers the possibility to integrate other products of the ABB product family into the existing electric installation. One possibility would be to combine the circuit of the installation contactor with a time relay.

The possible application are:

- Key-Card opening system
- Load shedding apartments, houses
- Off-peak storage heating
- Load shedding yachts
- Protection of sensitive equipment

6.4 Heating

Off-peak storage heating was one of the major applications for which installation contactors were developed. The connected load falls under the utilization category AC-1 and therefore has no special requirements for the installation contactor. An example of the connection to a heater is shown in Figure 11.

Example of application:

- Off-peak storage heating

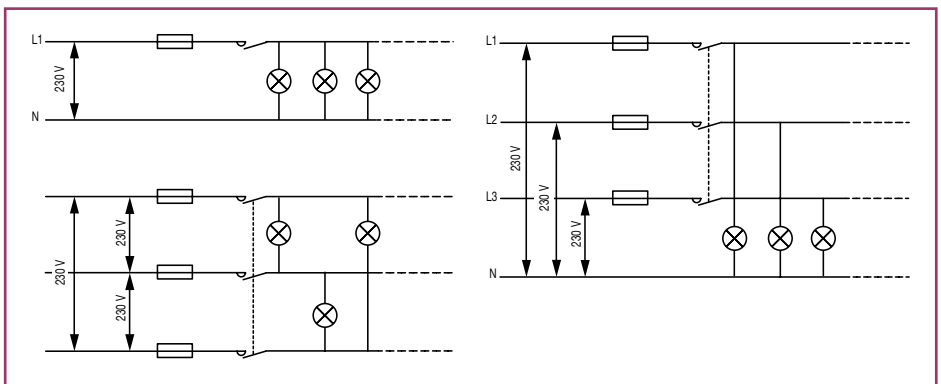


Figure 11: Wiring diagrams for resistive loads as heaters

6 Applications

6.5 E-mobility

E-mobility has no major requirements in regards to the complexity of the circuit, as the load to be switched falls under the utilization category AC-1. The loads are usually purely resistive or slightly inductive loads. The special requirements which are made to the installation contactors are the compact construction method and the design. These requirements are based on the need for the installation contactor to be integrated in the loading columns or loading stations, which can be seen in Figure 12.

Operating frequency is also an important consideration for this application.

Example of application:

- Charging stations



Figure 12: Charging station

6.6 Solar power systems

Renewable energy is becoming more and more important, especially solar power. Worldwide, solar power systems totaling up to more than 150 GW have already been installed (07/2014). By comparison, the installed total in 2005 was 5 GW. The installed total is expected to rise globally to 200 GW by the end of 2014.

In small solar power systems, the installation contactors are used on the AC side. ESBs feature the MDRC design and therefore are well-suited for the application of power distribution. The products offer a direct current magnet system, hence, are absolutely hum-free and switch very quietly. In addition to common standards, additional norms and directives have been developed to cover solar power systems.

The installation contactors are used for the protective equipment of the solar power system.

Example of application:

- Solar inverters



Figure 13: Solar power system

The author thanks the International Electrotechnical Commission (IEC) for permission to reproduce Information from its International Standards IEC 60947-1 ed.5.0 (2007), IEC 60947-4-1 ed.3.0 (2009), and IEC 61095 ed.2.0 (2009). All such extracts are copyright of IEC, Geneva, Switzerland. All rights reserved. Further information on the IEC is available from www.iec.ch. IEC has no responsibility for the placement and context in which the extracts and contents are reproduced by the author, nor is IEC in any way responsible for the other content or accuracy therein.

Contact us

ABB STOTZ-KONTAKT GmbH

Eppelheimer Straße 82

69123 Heidelberg, Germany

Phone: +49 (0) 6221 701-0

Fax: +49 (0) 6221 701-1325

E-Mail: info.desto@de.abb.com

www.abb.com

**You can find the address of your local
sales organization on the ABB home page
<http://www.abb.com/contacts>
-> Low-voltage products**

Note:

We reserve the right to make technical changes or modify the contents of this document without prior notice. With regard to purchase orders, the agreed particulars shall prevail. ABB AG does not accept any responsibility whatsoever for potential errors or possible lack of information in this document.

We reserve all rights in this document and in the subject matter and illustrations contained therein. Any reproduction, disclosure to third parties or utilization of its contents – in whole or in parts – is forbidden without prior written consent of ABB AG.

Copyright © 2015 ABB
All rights reserved