

# Contactors for capacitor switching

## AC-6b utilization category according to IEC 60947-4-1

### Capacitor transient conditions

In Low Voltage industrial installations, capacitors are mainly used for reactive energy correction (raising the power factor). When these capacitors are energized, overcurrents of high amplitude and high frequencies (3 to 15 kHz) occur during the transient period (1 to 2 ms).

The amplitude of these current peaks, also known as "inrush current peaks", depends on the following factors:

- The network inductances.
- The transformer power and short-circuit voltage.
- The type of power factor correction.

There are 2 types of power factor correction: fixed or automatic.

**Fixed power factor correction** consists of inserting, in parallel on the network, a capacitor bank whose total power is provided by the assembly of capacitors of identical or different ratings.

The bank is energized by a contactor that simultaneously supplies all the capacitors (a single step).

The inrush current peak, in the case of fixed correction, can reach 30 times the nominal current of the capacitor bank.

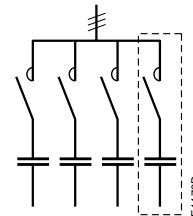


**Single-step capacitor bank scheme**  
Use the A/AF... contactor ranges.

**An automatic power factor correction system**, on the other hand, consists of several capacitor banks of identical or different ratings (several steps), energized separately according to the value of the power factor to be corrected.

An electronic device automatically determines the power of the steps to be energized and activates the relevant contactors.

The inrush current peak, in the case of automatic correction, depends on the power of the steps already on duty, and can reach 100 times the nominal current of the step to be energized.



**Multi-step capacitor bank scheme**  
Use the UA... or UA..RA contactor ranges.

### Steady state condition data

The presence of harmonics and the network's voltage tolerance lead to a current, estimated to be 1.3 times the nominal current  $I_n$  of the capacitor, permanently circulating in the circuit.

Taking into account the manufacturing tolerances, the exact power of a capacitor can reach 1.15 times its nominal power.

Standard IEC 60831-1 Edition 2002 specifies that the capacitor must therefore have a maximum thermal current  $I_T$  of:

$$I_T = 1.3 \times 1.15 \times I_n = 1.5 \times I_n$$

### Consequences for the contactors

To avoid malfunctions (welding of main poles, abnormal temperature rise, etc.), contactors for capacitor bank switching must be sized to withstand:

- A permanent current that can reach 1.5 times the nominal current of the capacitor bank.
- The short but high peak current on pole closing (maximum permissible peak current  $\hat{I}$ ).

### Contactor selection tool for capacitor switching

In a given application, if the user does not know the value of the inrush current peak, this value can be approximately calculated using the formulas given on the pages "Calculation and dimensioning".

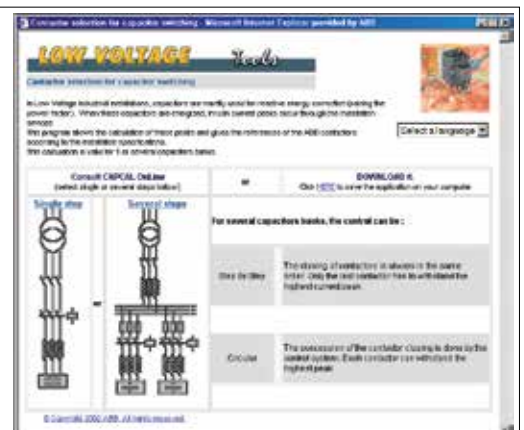
Alternatively by the **CAPCAL selection tool**, available on the ABB Website.

right hand side menu

search: "Online product selection tools"

select: "Contactors: AC-6b capacitor switching"

This program allows the calculation of these peaks and gives the references of the ABB contactors according to the installation specifications. This calculation is valid for one or several capacitor banks.



# Contactors for capacitor switching

## The ABB solutions

ABB offers 2 contactor versions according to the value of the inrush current peak and the power of the capacitor bank.

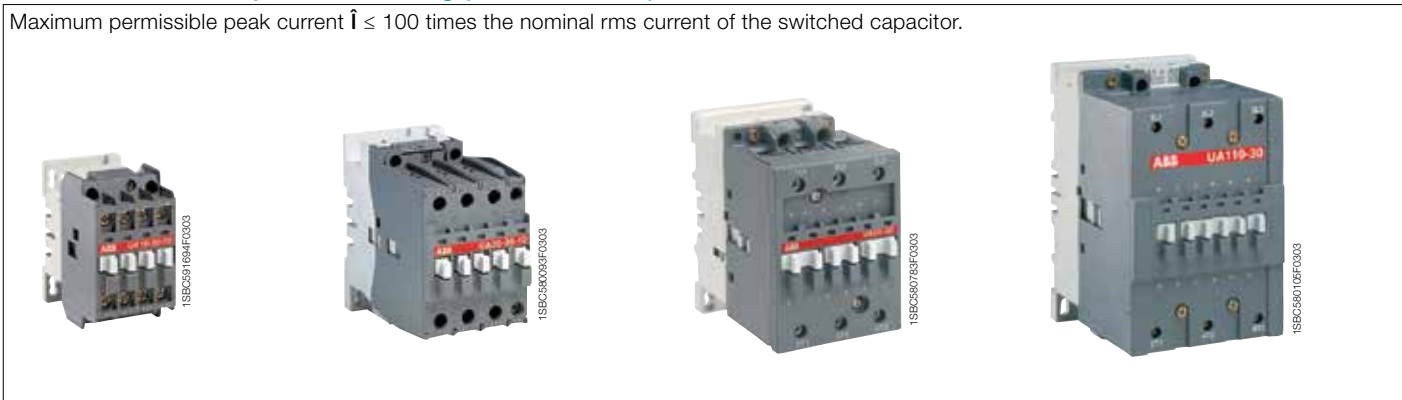
### UA..RA contactors for capacitor switching (UA16..RA to UA110..RA) with insertion of damping resistors

The insertion of damping resistors protects the contactor and the capacitor from the highest inrush currents.



### UA contactors for capacitor switching (UA16 to UA110)

Maximum permissible peak current  $\hat{I} \leq 100$  times the nominal rms current of the switched capacitor.



# UA16..RA ... UA30..RA 3-pole contactors for capacitor switching 12.5 to 30 kvar - Unlimited peak current $\hat{I}$ AC operated



UA16-30-10RA

1SBC87794FC001



UA30-30-10RA

1SBC87774FC001

## Description

UA..RA contactors for capacitor switching can be used for installations in which the peak current far exceeds 100 times nominal rms current. The contactors are delivered complete with their damping resistors and must be used without additional inductances.

The capacitors must be discharged (maximum residual voltage at terminals  $\leq 50$  V) before being re-energized when the contactors are making.

These contactors are of the block type design with:

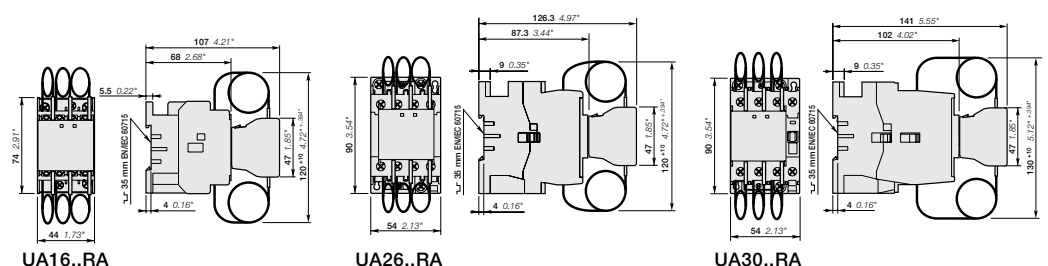
- 3 main poles and 1 built-in auxiliary contact
- the UA..RA contactors are fitted with a special front-mounted block, which ensures the serial insertion of 3 damping resistors into the circuit to limit the current peak on energization of the capacitor bank
- their connection also ensures capacitor precharging in order to limit the second current peak occurring upon making of the main poles
- the insertion of resistors allows to damp the highest current peak of the capacitor when switching on, whatever its level.
- control circuit: AC operated
- add-on auxiliary contact blocks for side mounting and a wide range of accessories.

## Ordering details

IEC Rated operational power $\theta \leq 40^\circ\text{C}$ 400 V AC-6b kvar	UL/CSA Rated operational power $\theta \leq 40^\circ\text{C}$ 480 V kvar	Rated control circuit voltage $U_c$ (1)		Auxiliary contacts fitted	Type	Order code	Weight Pkg (1 pce) kg
		V 50 Hz	V 60 Hz				
12.5	16	24	24	1 0	UA16-30-10RA	1SBL181024R8110	0.460
		48	48	1 0	UA16-30-10RA	1SBL181024R8310	0.460
		110	110...120	1 0	UA16-30-10RA	1SBL181024R8410	0.460
		220...230	230...240	1 0	UA16-30-10RA	1SBL181024R8010	0.460
		230...240	240...260	1 0	UA16-30-10RA	1SBL181024R8810	0.460
		380...400	400...415	1 0	UA16-30-10RA	1SBL181024R8510	0.460
		400...415	415...440	1 0	UA16-30-10RA	1SBL181024R8610	0.460
		22	22	24	24	1 0	UA26-30-10RA
48	48			1 0	UA26-30-10RA	1SBL241024R8310	0.710
110	110...120			1 0	UA26-30-10RA	1SBL241024R8410	0.710
220...230	230...240			1 0	UA26-30-10RA	1SBL241024R8010	0.710
230...240	240...260			1 0	UA26-30-10RA	1SBL241024R8810	0.710
380...400	400...415			1 0	UA26-30-10RA	1SBL241024R8510	0.710
400...415	415...440			1 0	UA26-30-10RA	1SBL241024R8610	0.710
30	28			24	24	1 0	UA30-30-10RA
		48	48	1 0	UA30-30-10RA	1SBL281024R8310	0.810
		110	110...120	1 0	UA30-30-10RA	1SBL281024R8410	0.810
		220...230	230...240	1 0	UA30-30-10RA	1SBL281024R8010	0.810
		230...240	240...260	1 0	UA30-30-10RA	1SBL281024R8810	0.810
		380...400	400...415	1 0	UA30-30-10RA	1SBL281024R8510	0.810
		400...415	415...440	1 0	UA30-30-10RA	1SBL281024R8610	0.810

(1) Other control voltages see voltage code table.

## Main dimensions mm, inches



1SBC101507S0201

# UA50..RA ... UA75..RA 3-pole contactors for capacitor switching 40 to 60 kvar - Unlimited peak current $\hat{I}$ AC operated



UA75-30-00 RA

## Description

UA..RA contactors for capacitor switching can be used for installations in which the peak current far exceeds 100 times nominal rms current. The contactors are delivered complete with their damping resistors and must be used without additional inductances.

The capacitors must be discharged (maximum residual voltage at terminals  $\leq 50$  V) before being re-energized when the contactors are making.

These contactors are of the block type design with:

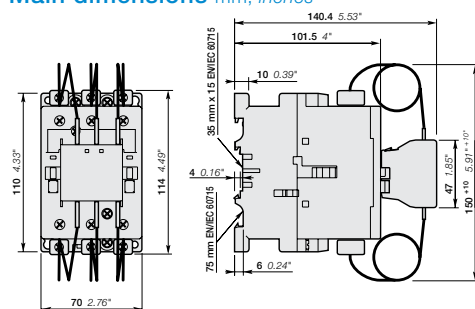
- 3 main poles
- the UA..RA contactors are fitted with a special front-mounted block, which ensures the serial insertion of 3 damping resistors into the circuit to limit the current peak on energization of the capacitor bank
  - their connection also ensures capacitor precharging in order to limit the second current peak occurring upon making of the main poles
  - the insertion of resistors allows to damp the highest current peak of the capacitor when switching on, whatever its level.
- control circuit: AC operated
- add-on auxiliary contact blocks for side mounting and a wide range of accessories.

## Ordering details

IEC Rated operational power $\theta \leq 40^\circ\text{C}$ 400 V AC-6b kvar	UL/CSA Rated operational power $\theta \leq 40^\circ\text{C}$ 480 V kvar	Rated control circuit voltage Uc (1)		Auxiliary contacts fitted	Type	Order code	Weight Pkg (1 pce) kg
		V 50 Hz	V 60 Hz				
40	50	24	24	0 0	UA50-30-00RA	1SBL351024R8100	1.350
		48	48	0 0	UA50-30-00RA	1SBL351024R8300	1.350
		110	110...120	0 0	UA50-30-00RA	1SBL351024R8400	1.350
		220...230	230...240	0 0	UA50-30-00RA	1SBL351024R8000	1.350
		230...240	240...260	0 0	UA50-30-00RA	1SBL351024R8800	1.350
		380...400	400...415	0 0	UA50-30-00RA	1SBL351024R8500	1.350
		400...415	415...440	0 0	UA50-30-00RA	1SBL351024R8600	1.350
50	55	24	24	0 0	UA63-30-00RA	1SBL371024R8100	1.350
		48	48	0 0	UA63-30-00RA	1SBL371024R8300	1.350
		110	110...120	0 0	UA63-30-00RA	1SBL371024R8400	1.350
		220...230	230...240	0 0	UA63-30-00RA	1SBL371024R8000	1.350
		230...240	240...260	0 0	UA63-30-00RA	1SBL371024R8800	1.350
		380...400	400...415	0 0	UA63-30-00RA	1SBL371024R8500	1.350
		400...415	415...440	0 0	UA63-30-00RA	1SBL371024R8600	1.350
60	64	24	24	0 0	UA75-30-00RA	1SBL411024R8100	1.350
		48	48	0 0	UA75-30-00RA	1SBL411024R8300	1.350
		110	110...120	0 0	UA75-30-00RA	1SBL411024R8400	1.350
		220...230	230...240	0 0	UA75-30-00RA	1SBL411024R8000	1.350
		230...240	240...260	0 0	UA75-30-00RA	1SBL411024R8800	1.350
		380...400	400...415	0 0	UA75-30-00RA	1SBL411024R8500	1.350
		400...415	415...440	0 0	UA75-30-00RA	1SBL411024R8600	1.350

(1) Other control voltages see voltage code table.

## Main dimensions mm, inches



UA50..RA, UA63..RA, UA75..RA

# UA95..RA ... UA110..RA 3-pole contactors for capacitor switching 70 to 80 kvar - Unlimited peak current $\hat{I}$ AC operated



UA110-30-00 RA

1SBC391444F0002

## Description


UA..RA contactors for capacitor switching can be used for installations in which the peak current far exceeds 100 times nominal rms current. The contactors are delivered complete with their damping resistors and must be used without additional inductances.

The capacitors must be discharged (maximum residual voltage at terminals  $\leq 50$  V) before being re-energized when the contactors are making.

These contactors are of the block type design with:

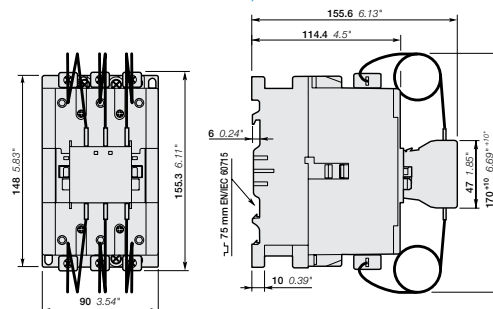
- 3 main poles
- the UA..RA contactors are fitted with a special front-mounted block, which ensures the serial insertion of 3 damping resistors into the circuit to limit the current peak on energization of the capacitor bank
- their connection also ensures capacitor precharging in order to limit the second current peak occurring upon making of the main poles
- the insertion of resistors allows to damp the highest current peak of the capacitor when switching on, whatever its level.
- control circuit: AC operated
- add-on auxiliary contact blocks for side mounting and a wide range of accessories.

## Ordering details

IEC Rated operational power $\theta \leq 40^\circ\text{C}$ 400 V AC-6b	UL/CSA Rated operational power $\theta \leq 40^\circ\text{C}$ 480 V	Rated control circuit voltage Uc (1)		Auxiliary contacts fitted 	Type	Order code	Weight Pkg (1 pce) kg
		V 50 Hz	V 60 Hz				
70	80	24	24	0 0	UA95-30-00RA	1SFL431024R8100	2.000
		48	48	0 0	UA95-30-00RA	1SFL431024R8300	2.000
		110	110...120	0 0	UA95-30-00RA	1SFL431024R8400	2.000
		220...230	230...240	0 0	UA95-30-00RA	1SFL431024R8000	2.000
		230...240	240...260	0 0	UA95-30-00RA	1SFL431024R8800	2.000
		380...400	400...415	0 0	UA95-30-00RA	1SFL431024R8500	2.000
		400...415	415...440	0 0	UA95-30-00RA	1SFL431024R8600	2.000
80	95	24	24	0 0	UA110-30-00RA	1SFL451024R8100	2.000
		48	48	0 0	UA110-30-00RA	1SFL451024R8300	2.000
		110	110...120	0 0	UA110-30-00RA	1SFL451024R8400	2.000
		220...230	230...240	0 0	UA110-30-00RA	1SFL451024R8000	2.000
		230...240	240...260	0 0	UA110-30-00RA	1SFL451024R8800	2.000
		380...400	400...415	0 0	UA110-30-00RA	1SFL451024R8500	2.000
		400...415	415...440	0 0	UA110-30-00RA	1SFL451024R8600	2.000

(1) Other control voltages see voltage code table.

## Main dimensions mm, inches







UA95..RA, UA100..RA

# UA..RA 3-pole contactors for capacitor switching

## Unlimited peak current $\hat{I}$

### Main accessory fitting details

Many configurations of accessories are possible depending on whether these are front-mounted or side-mounted.

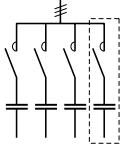
Contactor types	Main poles		Available auxiliary contacts		Front-mounted accessories	Side-mounted accessories
					Auxiliary contact blocks	Auxiliary contact blocks
					1-pole CA5-...	2-pole CAL...
UA16-30-10RA	3	0	1	0	-	1 x CAL5-11
UA26-30-10RA	3	0	1	0	-	1 to 2 x CAL5-11
UA30-30-10RA	3	0	1	0	1 x CA5-...	+ 1 to 2 x CAL5-11
UA50-30-00RA	3	0	0	0	1 to 2 x CA5-...	+ 1 to 2 x CAL5-11
UA63-30-00RA	3	0	0	0		
UA75-30-00RA	3	0	0	0		
UA95-30-00RA	3	0	0	0	1 to 2 x CA5-...	+ 1 to 2 x CAL18-11
UA110-30-00RA	3	0	0	0		

# UA16..RA ... UA110..RA 3-pole contactors for capacitor switching

## Unlimited peak current $\hat{I}$

### Technical data

#### Main pole - Utilization characteristics according to IEC

Contactor types	AC operated	UA16..RA	UA26..RA	UA30..RA	UA50..RA	UA63..RA	UA75..RA	UA95..RA	UA110..RA	
Standards		IEC 60947-1 / 60947-4-1 and EN 60947-1 / 60947-4-1								
Rated operational voltage $U_e$ max.		690 V								
Rated frequency (without derating)		50 / 60 Hz								
AC-6b Utilization category										
<b>Rated operational power AC-6b</b>										
For air temperature close to contactor	$\theta \leq 40^\circ\text{C}$	230-240 V	8 kvar	12.5 kvar	16 kvar	25 kvar	30 kvar	35 kvar	40 kvar	45 kvar
		400-415 V	12.5 kvar	22 kvar	30 kvar	40 kvar	50 kvar	60 kvar	70 kvar	80 kvar
	$\theta \leq 55^\circ\text{C}$	440 V	15 kvar	24 kvar	32 kvar	50 kvar	55 kvar	65 kvar	75 kvar	85 kvar
		500-550 V	18 kvar	30 kvar	34 kvar	55 kvar	65 kvar	75 kvar	85 kvar	95 kvar
		690 V	22 kvar	35 kvar	45 kvar	72 kvar	80 kvar	100 kvar	120 kvar	130 kvar
$\theta \leq 70^\circ\text{C}$	230-240 V	7.5 kvar	11.5 kvar	16 kvar	24 kvar	27 kvar	30 kvar	35 kvar	40 kvar	
	400-415 V	12.5 kvar	20 kvar	27.5 kvar	40 kvar	45 kvar	50 kvar	60 kvar	70 kvar	
	440 V	13 kvar	20 kvar	30 kvar	43 kvar	48 kvar	53 kvar	65 kvar	75 kvar	
	500-550 V	16 kvar	25 kvar	34 kvar	50 kvar	60 kvar	65 kvar	75 kvar	82 kvar	
$\theta \leq 70^\circ\text{C}$	690 V	21 kvar	31 kvar	45 kvar	65 kvar	75 kvar	80 kvar	105 kvar	110 kvar	
	230-240 V	6 kvar	9 kvar	11 kvar	20 kvar	23 kvar	25 kvar	30 kvar	35 kvar	
	400-415 V	10 kvar	15.5 kvar	19.5 kvar	35 kvar	39 kvar	41 kvar	53 kvar	60 kvar	
	440 V	11 kvar	17 kvar	20.5 kvar	37 kvar	42.5 kvar	45 kvar	58 kvar	70 kvar	
$\theta \leq 70^\circ\text{C}$	500-550 V	12.5 kvar	20 kvar	25 kvar	46 kvar	50 kvar	55 kvar	70 kvar	78 kvar	
	690 V	17 kvar	26 kvar	32 kvar	60 kvar	65 kvar	70 kvar	85 kvar	100 kvar	
Max. permissible peak current $\hat{I}$		Unlimited								
Short-circuit protection device for contactors		80 A		125 A	200 A	250 A				
gG type fuse (1)		80 A		125 A	200 A	250 A				
Max. electrical switching frequency		240 cycles/h								
Electrical durability AC-6b	$U_e \leq 440\text{ V}$	250 000 operating cycles								
	$500\text{ V} \leq U_e \leq 690\text{ V}$	100 000 operating cycles								

(1) The fuse ratings given represent the maximum ratings ensuring type 1 coordination according to the definition of standard IEC 60947-4-1.

#### Main pole - Utilization characteristics according to UL / CSA

Contactor types	AC operated	UA16..RA	UA26..RA	UA30..RA	UA50..RA	UA63..RA	UA75..RA	UA95..RA	UA110..RA	
<b>Power - 60 Hz</b>										
For air temperature close to contactor	$\theta \leq 40^\circ\text{C}$	240 V	8 kvar	11 kvar	14 kvar	25 kvar	27.5 kvar	32 kvar	40 kvar	45 kvar
		480 V	16 kvar	22 kvar	28 kvar	50 kvar	55 kvar	64 kvar	80 kvar	95 kvar
		600 V	20 kvar	27 kvar	35 kvar	62 kvar	70 kvar	80 kvar	100 kvar	120 kvar
Max. permissible peak Current $\hat{I}$		Unlimited								

#### Operating principle

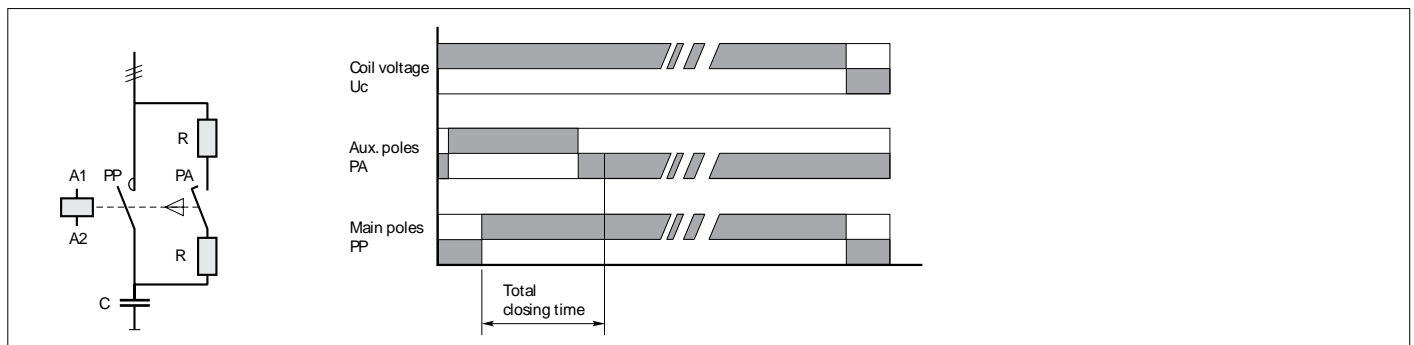
The front-mounted block mechanism of the UA..RA contactors ensures:

- early making of the auxiliary "PA" poles with respect to the main "PP" poles
- automatic return to the open position of the auxiliary "PA" poles after the main poles are closed.

**When the coil is energized**, the early making auxiliary poles connect the capacitor to the network via the set of 3 resistors. The damping resistors attenuate the first current peak and the second inrush current when the main contacts begin to make. Once the main poles are in the closed position, the auxiliary poles automatically break.

**When the coil is de-energized**, the main poles break ensuring the breaking of the capacitor bank.

The contactor can then begin a new cycle.









The insertion of resistors allows to damp the highest current peak of the capacitor when switching on, whatever its level.

# UA16..RA ... UA110..RA 3-pole contactors for capacitor switching

## Unlimited peak current $\hat{I}$

### Technical data

#### Connecting characteristics

Contactor types	AC operated	UA16..RA	UA26..RA	UA30..RA	UA50..RA UA63..RA UA75..RA	UA95..RA UA110..RA
<b>Connection capacity (min. ... max.)</b>						
<b>Main conductors (poles)</b>						
 Rigid	Solid ( $\leq 4 \text{ mm}^2$ )	1 x 1...4 mm <sup>2</sup>	1.5...6 mm <sup>2</sup>	2.5...16 mm <sup>2</sup>	6...50 mm <sup>2</sup>	10...95 mm <sup>2</sup>
	Stranded ( $\geq 6 \text{ mm}^2$ )	2 x -	-	2.5...16 + 2.5...6 mm <sup>2</sup>	6...25 + 6...16 mm <sup>2</sup>	6...35 mm <sup>2</sup>
 Flexible with ferrule		1 x 0.75...2.5 mm <sup>2</sup>	1.5...4 mm <sup>2</sup>	2.5...10 mm <sup>2</sup>	6...35 mm <sup>2</sup>	10...70 mm <sup>2</sup>
		2 x -	-	2.5...10 + 2.5...4 mm <sup>2</sup>	6...16 + 6...10 mm <sup>2</sup>	6...35 mm <sup>2</sup>
 Bars or lugs		L $\leq$ 7.7 mm	10 mm	-	-	-
		I $>$ 3.7 mm	4.2 mm	-	-	-
Connection capacity acc. to UL/CSA		1 or 2 x AWG 18...10	AWG 12...8	AWG 8...4	AWG 8...1	AWG 6...2/0
Tightening torque						
	Recommended	1 Nm / 9 lb.in	1.7 Nm / 15 lb.in	2.3 Nm / 20 lb.in	4 Nm / 35 lb.in	8 Nm / 53 lb.in
	Max.	1.2 Nm	2.2 Nm	2.6 Nm	4.5 Nm	9 Nm
<b>Auxiliary conductors</b> (built-in auxiliary terminals + coil terminals)						
 Rigid solid		1 x 1...4 mm <sup>2</sup>				0.75...2.5 mm <sup>2</sup>
		2 x 1...4 mm <sup>2</sup>				0.75...2.5 mm <sup>2</sup>
 Flexible with ferrule		1 x 0.75...2.5 mm <sup>2</sup>			1...2.5 mm <sup>2</sup>	0.75...2.5 mm <sup>2</sup>
		2 x 0.75...2.5 mm <sup>2</sup>				
 Lugs	Coil terminals	L $\leq$ 8 mm				
		I $>$ 3.7 mm				
	Built-in auxiliary terminals	L $\leq$ 7.7 mm	10 mm	8 mm	-	-
		I $>$ 3.7 mm	4.2 mm	3.7 mm	-	-
Connection capacity acc. to UL/CSA		1 or 2 x AWG 18...14				
Tightening torque						
	Coil terminals					
	Recommended	1 Nm / 9 lb.in				
	Max.	1.2 Nm				
	Built-in auxiliary terminals					
	Recommended	1 Nm / 9 lb.in				
	Max.	1.2 Nm				
<b>Degree of protection</b> acc. to IEC 60947-1 / EN 60947-1 and IEC 60529 / EN 60529						
Main terminals		IP20		IP10		
Coil terminals		IP20				
Built-in auxiliary terminals		IP20				
<b>Screw terminals</b>						
Main terminals		Delivered in open position, screws of unused terminals must be tightened				
		M 3.5	M 4	M 5	M 6	M 8
	Screwdriver type	Flat $\varnothing$ 5.5 / Pozidriv 2		Flat $\varnothing$ 6.5 / Pozidriv 2		Hexagon socket (s = 4 mm)
Coil terminals		M 3.5				
	Screwdriver type	Flat $\varnothing$ 5.5 / Pozidriv 2				
Built-in auxiliary terminals		M 3.5	M 4	M 3.5	-	-
	Screwdriver type	Flat $\varnothing$ 5.5 / Pozidriv 2		-	-	-

Other technical characteristics are the same as those of standard A contactors.

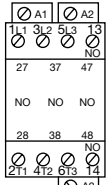


# UA..RA contactors

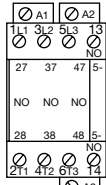
## Terminal marking and positioning

### UA..RA contactors - AC operated

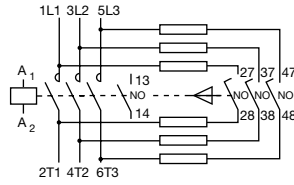
Standard devices without addition of auxiliary contacts



UA16-30-10 RA  
UA26-30-10 RA

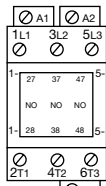


UA30-30-10 RA

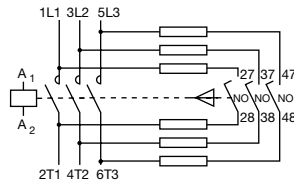


UA16 ... 30-30-10 RA

5



UA50 ... 110-30-00 RA

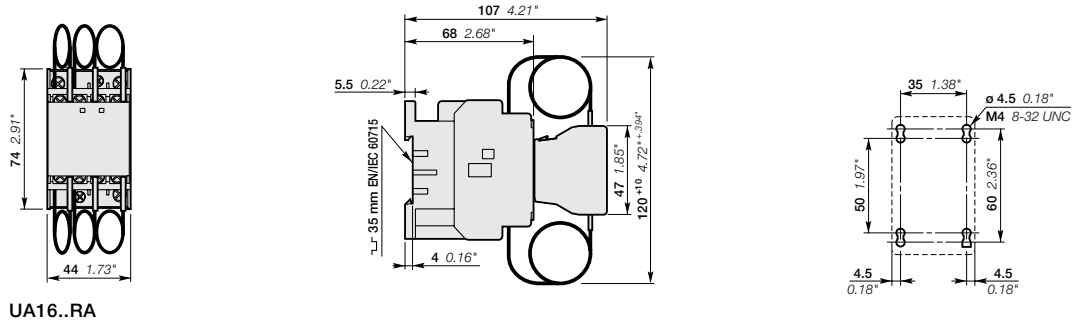


UA50 ... 110-30-00 RA

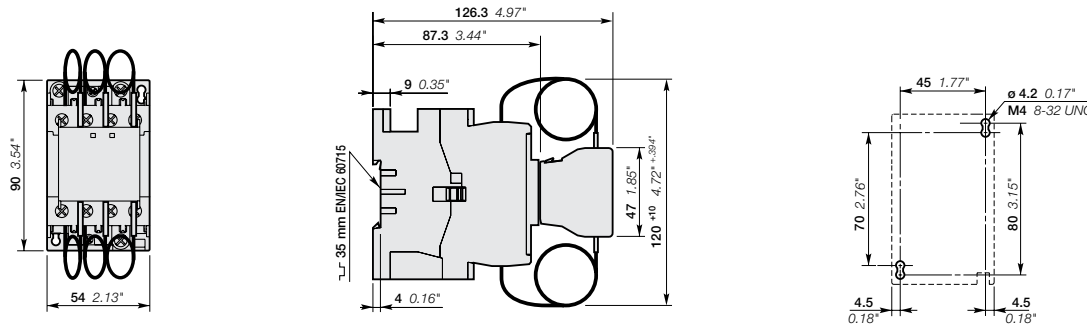
# UA..RA 3-pole contactors for capacitor switching

## Unlimited peak current $\hat{I}$

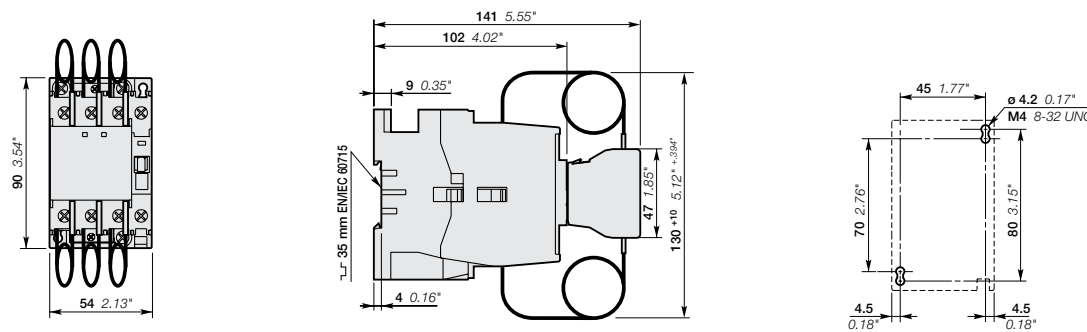
### Main dimensions mm, inches



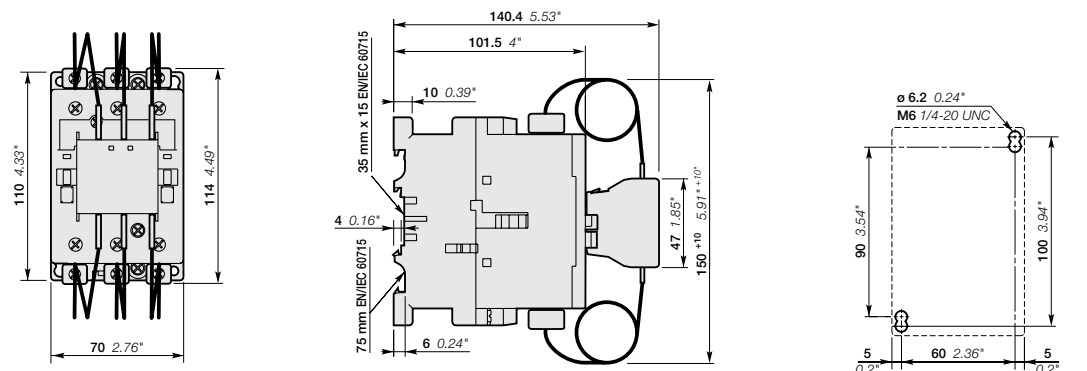
UA16..RA



UA26..RA



UA30..RA

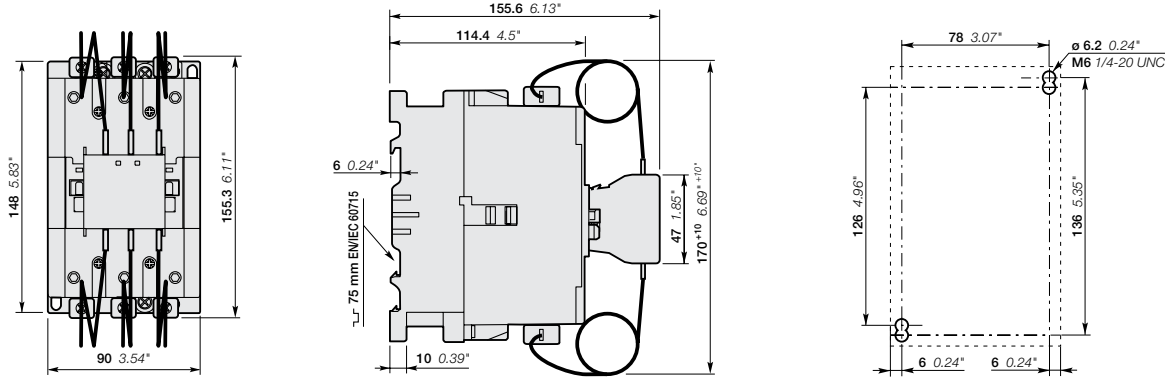


UA50..RA, UA63..RA, UA75..RA

# UA..RA 3-pole contactors for capacitor switching

## Unlimited peak current $\hat{I}$

Main dimensions mm, inches



UA95..RA, UA110..RA