

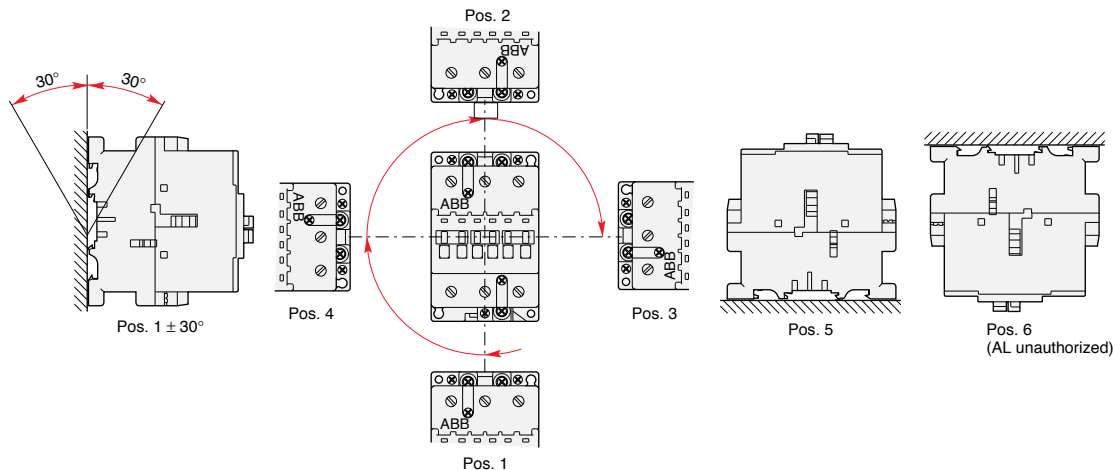
UL & CSA Technical data

A/AE9 – A/AE/AF110, AL9 – AL40

AC & DC operated

| ABB contactor frame size | | A/AE/AL 9 | A/AE/AL 12 | A/AE/AL 16 | A/AE/AL 26 | A/AE/AL 30 | A/AE/AL 40 | A/AE/AF 45 | A/AE/AF 50 | A/AE/AF 63 | A/AE/AF 75 | A/AE/AF 95 | A/AE/AF 110 |
|--------------------------------------|--|--------------|---------------|---------------|---------------|---------------|---------------|---------------|---------------|---------------|---------------|---------------|----------------|
| NEMA size | | 00 | — | 0 | 1 | 1P | — | — | 2 | — | 3 | — | — |
| Number of poles | | 3 OR 4 | 3 | 3 OR 4 | 3 OR 4 | 3 | 3 | 4 | 3 OR 4 | 3 | 3 OR 4 | 3 | 3 |
| AC rating information | | | | | | | | | | | | | |
| NEMA cont. amp rating | | 9 | — | 18 | 27 | 36 | — | — | 45 | — | 90 | — | — |
| NEMA maximum H.P. ratings | | | | | | | | | | | | | |
| 115 VAC | | 1/3 | — | 1 | 2 | 3 | — | — | 3 | — | — | — | — |
| 230 VAC | | 1 | — | 2 | 3 | 5 | — | — | 7.5 | — | — | — | — |
| NEMA maximum H.P. ratings | | | | | | | | | | | | | |
| 200 VAC | | 1.5 | — | 3 | 7.5 | — | — | — | 10 | — | 25 | — | — |
| 230 VAC | | 1.5 | — | 3 | 7.5 | — | — | — | 15 | — | 30 | — | — |
| 460/575 VAC | | 2 | — | 5 | 10 | — | — | — | 25 | — | 50 | — | — |
| U.L. general purpose current | | 21 | 25 | 30 | 40 | 50 | 60 | 65 | 80 | 90 | 105 | 125 | 140 |
| Max. 3 Ph Switching motor loads | | 9 | 11 | 17 | 28 | 34 | 42 | — | 54 | 65 | 80 | 95 | 110 |
| U.L. maximum H.P. ratings | | | | | | | | | | | | | |
| 115 VAC | | 1/2 | 3/4 | 2HP, 24A | 2 | 3 | 3 | — | 3 | 5 | 7.5 | 7.5 | 10 |
| 230 VAC | | 2 | 2 | 3 | 5 | 7.5 | 7.5 | — | 7.5 | 10 | 15 | 20 | 25 |
| U.L. maximum H.P. ratings | | | | | | | | | | | | | |
| 200-208 VAC | | 2 | 3 | 5 | 7.5 | 10 | 10 | — | 15 | 20 | 25 | 30 | 30 |
| 220-240 VAC | | 2 | 3 | 5 | 10 | 10 | 15 | — | 20 | 25 | 30 | 30 | 40 |
| 440-480 VAC | | 5 | 7.5 | 10 | 20 | 25 | 30 | — | 40 | 50 | 60 | 60 | 75 |
| 550-600 VAC | | 7.5 | 10 | 15 | 25 | 30 | 40 | — | 50 | 60 | 75 | 75 | 100 |
| U.L. maximum H.P. ratings | | | | | | | | | | | | | |
| 120 VDC | | 1 | 1.5 | 2 | 3 | 3 | 5 | — | 7.5 | 10 | 10 | — | — |
| 240 VDC | | 2 | 3 | 3 | 5 | 7.5 | 10 | — | 15 | 20 | 25 | — | — |
| Lighting — ballast and incandescent | | 15 | 15 | 20 ① | 35 | 50 | 60 | 65 | 65 | 85 | 105 | 120 | — |
| Resistive heating applications | | 15 | 15 | 20 | 35 | 50 | 60 | 65 | 65 | 85 | 105 | — | — |
| CSA Elevator ratings | | | | | | | | | | | | | |
| 220 – 240VAC | | — | — | 5 | — | — | 10 | — | 15 | — | 20 | 20 | — |
| 440 – 480VAC | | — | — | 10 | — | — | 20 | — | 30 | — | 30 | 40 | — |
| 550 – 600VAC | | — | — | 10 | — | — | 20 | — | 30 | — | 40 | 50 | — |
| 230VAC | | — | — | 2 | — | — | 5 | — | 7.5 | — | 10 | 10 | — |
| Auxiliary contacts | | | | | | | | | | | | | |
| NEMA rating | | A600 | A600 | A600 | A600 | A600 | A600 | — | A600 | A600 | A600 | A600 | A600 |
| AC rated voltage | | 600 | 600 | 600 | 600 | 600 | 600 | — | 600 | 600 | 600 | 600 | 600 |
| AC thermal rated current | | 10 | 10 | 10 | 10 | 10 | 10 | — | 10 | 10 | 10 | 10 | 10 |
| AC maximum volt-ampere making | | 7200 | 7200 | 7200 | 7200 | 7200 | 7200 | — | 7200 | 7200 | 7200 | 7200 | 7200 |
| AC maximum volt-ampere breaking | | 720 | 720 | 720 | 720 | 720 | 720 | — | 720 | 720 | 720 | 720 | 720 |
| NEMA rating | | P600 | P600 | P600 | P600 | P600 | P600 | — | P600 | P600 | P600 | P600 | P600 |
| DC rated voltage | | 600 | 600 | 600 | 600 | 600 | 600 | — | 600 | 600 | 600 | 600 | 600 |
| DC thermal rated current | | 5 | 5 | 5 | 5 | 5 | 5 | — | 5 | 5 | 5 | 5 | 5 |
| DC Maximum make-break | | 0.2 | 0.2 | 0.2 | 0.2 | 0.2 | 0.2 | — | 0.2 | 0.2 | 0.2 | 0.2 | 0.2 |
| Approximate weight | | | | | | | | | | | | | |
| Contactor | | 0.7 | 0.7 | 0.7 | 1.01 | 1.2 | 2.25 | 2.25 | 2.25 | 2.25 | 2.25 | 3.5 | 5 |
| Starter | | 1.04 | 1.04 | 1.04 | 1.35 | 1.54 | 3 | — | 3 | 3 | 3 | 6 | 7 |
| Terminal wire range | | | | | | | | | | | | | |
| Number of wires per phase | | 18-10 | 18-10 | 18-10 | 12-8 | 8-4 | 8-4 | 8-1 | 8-1 | 8-1 | 8-1 | 6-2/0 | 6-2/0 |
| | | 2 | 2 | 2 | 2 | 2 | 2 | 1 | 1 | 1 | 1 | 1 | 1 |
| Maximum short circuit ratings | | | | | | | | | | | | | |
| MCCB,MCP, Amps/kA | | 50/35 | 50/35 | 50/35 | 100/35 | 150/65 | 150/65 | — | 150/85 | 250/85 | 250/85 | 250/85 | 250/85 |
| MCCB,MCP, Amps/kA | | 10/35 | 10/35 | 10/35 | 100/35 | 150/25 | 150/25 | — | — | — | — | 250/35 | 250/35 |
| Fuse,Amps — type/kA | | 30J/200 | 30J/200 | 30J/200 | 60J/200 | 60J/200 | 100J/200 | — | 100J/200 | 200J/200 | 200J/200 | 200J/200 | 200J/200 |

Mounting positions



UL & CSA Technical data

A/AF145 – AF750

AC & DC operated

Across the line
contactors

1

| ABB contactor frame size | | A/AF 145 | A/AF 185 | A/AF 210 | A/AF 260 | A/AF 300 | AF 400 | AF 460 | AF 580 | AF 750 |
|--------------------------------------|-------------|--------------------|--------------------|-------------|-------------|-------------|------------|------------|------------|------------|
| NEMA size | | 4 | — | — | 5 | — | — | 6 | — | 7 |
| Number of poles | | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 3 |
| AC rating information | | | | | | | | | | |
| NEMA maximum H.P. ratings | | | | | | | | | | |
| 200 | 3 phase VAC | 40 | — | — | 75 | — | — | 150 | — | — |
| 230 | VAC | 50 | — | — | 100 | — | — | 200 | — | 300 |
| 460/575 | V | 100 | — | — | 200 | — | — | 400 | — | 600 |
| U.L. general purpose current | | | | | | | | | | |
| 40°C | | 230 | 250 | 300 | 350 | 400 | 550 | 650 | 750 | 900 |
| Max. 3 Ph switching motor loads | | | | | | | | | | |
| | Amps | 130 | 156 | 192 | 248 | 302 | 414 | 480 | 590 | 720 |
| U.L. maximum H.P. ratings | | | | | | | | | | |
| 115 | 1 phase VAC | 10 | 15 | — | — | — | — | — | — | — |
| 230 | VAC | 25 | 30 | 40 | 50 | — | — | — | — | — |
| U.L. maximum H.P. ratings | | | | | | | | | | |
| 200–208 | 3 phase VAC | 40 | 50 | 60 | 75 | 100 | 125 | 150 | 200 | 250 |
| 220–240 | VAC | 50 | 60 | 75 | 100 | 100 | 150 | 200 | 250 | 300 |
| 440–480 | VAC | 100 | 125 | 150 | 200 | 250 | 350 | 400 | 500 | 600 |
| 550–600 | VAC | 125 | 150 | 200 | 250 | 300 | 400 | 500 | 600 | 700 |
| Lighting – ballast and incandescent | | | | | | | | | | |
| | 600VAC | 200 | — | 300 | — | 400 | — | — | — | — |
| CSA Elevator ratings | | | | | | | | | | |
| 220 – 240VAC | 3 phase | | | 40 | 50 | 60 | — | — | — | — |
| 240 – 480VAC | 3 phase | Consult factory | Consult factory | 75 | 100 | 125 | — | — | — | — |
| 550 - 600VAC | 3 phase | | | 100 | 125 | 150 | — | — | — | — |
| 230VAC | 1 phase | | | — | — | — | — | — | — | — |
| Auxiliary contacts | | | | | | | | | | |
| NEMA rating | AC | A600 | A600 | A600 | A600 | A600 | A600 | A600 | A600 | A600 |
| AC rated voltage | VAC | 600 | 600 | 600 | 600 | 600 | 600 | 600 | 600 | 600 |
| AC thermal rated current | A | 10 | 10 | 10 | 10 | 10 | 10 | 10 | 10 | 10 |
| AC maximum volt—ampere making | VA | 7200 | 7200 | 7200 | 7200 | 7200 | 7200 | 7200 | 7200 | 7200 |
| AC maximum volt—ampere breaking | VA | 720 | 720 | 720 | 720 | 720 | 720 | 720 | 720 | 720 |
| NEMA rating | DC | P600 | P600 | P600 | P600 | P600 | P600 | P600 | P600 | P600 |
| DC rated voltage | VDC | 600 | 600 | 600 | 600 | 600 | 600 | 600 | 600 | 600 |
| DC thermal rated current | A | 5 | 5 | 5 | 5 | 5 | 5 | 5 | 5 | 5 |
| DC Maximum make—break | A | 0.2 | 0.2 | 0.2 | 0.2 | 0.2 | 0.2 | 0.2 | 0.2 | 0.2 |
| Approximate weight | | | | | | | | | | |
| Contactor | lbs. | 7.1 | 7.1 | 13 | 13 | 13 | 26 | 26 | 33 | 33 |
| Starter | lbs. | 9.11 | 9.11 | 17.67 | 17.67 | 17.67 | 35 | 35 | 45 | 45 |
| Terminal wire range | | | | | | | | | | |
| | AWG | 6-250MCM | 6-250MCM | 4-400MCM | 4-400MCM | 4-500MCM | 250-500MCM | 250-500MCM | 2/0-500MCM | 2/0-500MCM |
| Number of wires per phase | | 1 | 1 | 1 | 1 | 2 | 2 | 2 | 2 | 3 |
| Maximum short circuit ratings | | | | | | | | | | |
| MCCB,MCP,amps/kA | 480VAC | 400/85 | 400/85 | 800/85 | 800/85 | 800/85 | 800/80 | 800/80 | 1200/42 | 1200/42 |
| MCCB,MCP,amps/kA | 600VAC | 400/35 | 400/35 | 800/35 | 800/35 | 800/35 | 800/42 | 800/42 | — | — |
| Fuse, amps—Type/kA | 600VAC | 400J/200 | 400J/200 | 600J/200 | 600J/200 | 600J/200 | 1000L/80 | 1000L/80 | 1200L/80 | 1200L/80 |

UL & CSA Technical data

AF1350 – AF1650

AC & DC operated

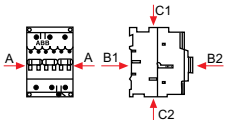
| ABB contactor frame size | | AF 1350 | AF 1650 |
|--------------------------------------|---------|-------------|-------------|
| NEMA size | | — | 8 |
| Number of poles | | 3 | 3 |
| AC rating information | | | |
| NEMA maximum H.P. ratings | 3 phase | | |
| 200 | VAC | — | — |
| 230 | VAC | — | 450 |
| 460/575 | V | — | 900 |
| U.L. general purpose current | | | |
| | 40°C | 1350 | 1650 |
| Max. 3 Ph switching motor loads | | Amps | 960 |
| U.L. maximum H.P. ratings | | 1 phase | |
| 115 | VAC | — | — |
| 230 | VAC | — | — |
| U.L. maximum H.P. ratings | | 3 phase | |
| 200—208 | VAC | — | — |
| 220—240 | VAC | 400 | 450 |
| 440—480 | VAC | 800 | 900 |
| 550—600 | VAC | 900 | 1000 |
| Auxiliary contacts | | | |
| NEMA rating | AC | A600 | A600 |
| AC rated voltage | VAC | 600 | 600 |
| AC thermal rated current | A | 10 | 10 |
| AC maximum volt—ampere making | VA | 7200 | 7200 |
| AC maximum volt—ampere breaking | VA | 720 | 720 |
| NEMA rating | DC | P600 | P600 |
| DC rated voltage | VDC | 600 | 600 |
| DC thermal rated current | A | 5 | 5 |
| DC Maximum make—break | A | 0.2 | 0.2 |
| Approximate weight | | | |
| Contactor | lbs. | 75 | 75 |
| Starter | lbs. | — | — |
| Terminal wire range | | | |
| | AWG | 1/0-750 MCM | 1/0-750 MCM |
| Number of wires per phase | | 4 | 6 |
| Maximum short circuit ratings | | | |
| MCCB,MCP,amps/kA | 480VAC | 2000/42 | 2000/42 |
| MCCB,MCP,amps/kA | 600VAC | — | — |
| Fuse, amps—Type/kA | 600VAC | 1600L/82 | 2000L/82 |

UL/CSA & IEC Technical data

A/AE9 – A/AE/AF/TAE110

Across the line
contactors

1

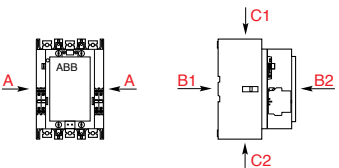
| Contactor types: A..., AE... AF..., TAE... | 9 | 12 | 16 | 26 | 30 | 40 | 45 | 50 | 63 | 75 | 95 | 110 | | | | | | | | | | | | | | | | | | |
|---|---|-------------------|----|----|----|----|----|----|----|----|----|---------------------------------|-----------------|-----------------|-------------------|---|------|------|----|------|-------|----|--------|--------|----|------|------|----|------|------|
| Rated insulation voltage U_i according to IEC 60947-4-1 | - | - | - | - | - | - | 45 | 50 | 63 | 75 | 95 | 110 | | | | | | | | | | | | | | | | | | |
| according to UL/CSA | - | - | - | - | - | - | 45 | 50 | 63 | 75 | 95 | 110 | | | | | | | | | | | | | | | | | | |
| Rated impulse withstand voltage $U_{imp.}$ | 8 | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| Standards | Devices complying with international standards IEC 60947-1 / 60947-4-1 and European standards EN 60947-1 / 60947-4-1 | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| Air temperature close to contactor | see "Conditions for use" page 1.50, for control voltage limits and authorized mounting positions | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| - fitted with thermal O/L relay | -25 to +55 | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| - without thermal O/L relay | -40 to +70 (55 max. for TAE... contactors) | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| - for storage | -60 to +80 | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| Climatic withstand 68-2-30 | acc. to IEC 60068-2-30 and 60068-2-11 - UTE C 63-100 specification II | | | | | | | | | | | acc. to IEC | | | | | | | | | | | | | | | | | | |
| Operating altitude | m | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| Shock withstand acc. IEC 60068-2-27 and EN 60068-2-27 Mounting position 1 (see page 1.50) | <p>1/2 sinusoidal shock for 11 ms: no change in contact position</p> <table border="1"> <thead> <tr> <th>Shock direction</th> <th>Making position</th> <th>Breaking position</th> </tr> </thead> <tbody> <tr> <td>A</td> <td>20 g</td> <td>20 g</td> </tr> <tr> <td>B1</td> <td>10 g</td> <td>5 g ①</td> </tr> <tr> <td>B2</td> <td>15 g ②</td> <td>15 g ②</td> </tr> <tr> <td>C1</td> <td>20 g</td> <td>20 g</td> </tr> <tr> <td>C2</td> <td>20 g</td> <td>20 g</td> </tr> </tbody> </table> | | | | | | | | | | | | Shock direction | Making position | Breaking position | A | 20 g | 20 g | B1 | 10 g | 5 g ① | B2 | 15 g ② | 15 g ② | C1 | 20 g | 20 g | C2 | 20 g | 20 g |
| Shock direction | Making position | Breaking position | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| A | 20 g | 20 g | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| B1 | 10 g | 5 g ① | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| B2 | 15 g ② | 15 g ② | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| C1 | 20 g | 20 g | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| C2 | 20 g | 20 g | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
|  | | | | | | | | | | | | Not valid for DIN-rail mounting | | | | | | | | | | | | | | | | | | |

① 3 g for AF 45-22, AE 45-22, AF 75-22 and AE 75-22.
② 10 g for AF 45-22, AE 45-22, AF 75-22 and AE 75-22.

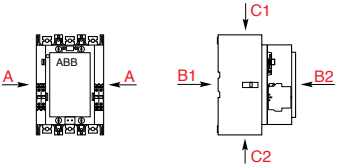
UL/CSA & IEC Technical data

A/AF145 – AF1650

A/AF145 – AF750

| Contactor types: | A... | 145 | 185 | 210 | 260 | 300 | - | - | - | - |
|---|-------|---|-----|-----|-----|--------------|-----|-----|-----|-----|
| | AF... | 145 | 185 | 210 | 260 | 300 | 400 | 460 | 580 | 750 |
| Rated insulation voltage U_i according to IEC 60947-4-1 according to UL/CSA | V | | | | | 1000 V600 | | | | |
| Rated impulse withstand voltage U_{imp} . Standards | kV | | | | | 8 | | | | |
| | | Devices complying with international standards IEC 60947-1 / 60947-4-1 and European standards EN 60947-1 / 60947-4-1 | | | | | | | | |
| Air temperature close to contactor – fitted with thermal O/L relay | °C | see "Conditions for use" page 1.51 , for control voltage limits and authorized mounting positions | | | | | | | | |
| – without thermal O/L relay | °C | -25 to +55 | | | | | | | | |
| – for storage | °C | -40 to +70 | | | | | | | | |
| Climatic withstand | | acc. to IEC 60068-2-30 | | | | | | | | |
| Operating altitude | m | ≤ 3000 | | | | | | | | |
| Shock withstand acc. IEC 60068-2-27 and EN 60068-2-27 Mounting position 1 (see page 1.51) | | 1/2 sinusoidal shock for 30 ms: no change in contact position 5 g in all directions (A, B1, B2, C1, C2) | | | | | | | | |
|  | | | | | | | | | | |

AF1350 – AF1650

| Contactor types: | AF... | 1350 | 1650 |
|---|-------|---|-------------|
| Rated insulation voltage U_i according to IEC 60947-4-1 according to UL/CSA | V | | 1000 600 |
| Rated impulse withstand voltage U_{imp} . Standards | kV | | 8 |
| | | Devices complying with international standards IEC 60947-1 / 60947-4-1 and European standards EN 60947-1 / 60947-4-1 | |
| Air temperature close to contactor – fitted with thermal O/L relay | | see "Conditions for use" page 1.51 , for control voltage limits and authorized mounting positions | |
| – without thermal O/L relay | | °C-25 to +55 | |
| – for storage | | °C-40 to +70 | |
| Climatic withstand | | acc. to IEC 60068-2-30 | |
| Operating altitude | m | ≤ 3000 | |
| Shock withstand acc. IEC 60068-2-27 and EN 60068-2-27 Mounting position 1 (See page 1.51) | | 1/2 sinusoidal shock for 30 ms: no change in contact position 5 g in all directions (A, B1, B2, C1, C2) | |
|  | | | |

IEC Technical data




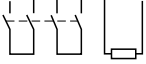








A/AE9 – GAE75

DC circuit switching

General

The arc switching on d.c. is more difficult than on a.c.

- For selecting a contactor it is essential to determine the current, the voltage and the L/R time constant of the controlled load.
- For information, typical time constant values are quoted hereafter: non-inductive loads such as resistance furnaces ($L/R \approx 1$ ms), inductive loads such as shunt motors ($L/R \approx 2$ ms) or series motors ($L/R \approx 7.5$ ms).
- The addition of a resistor in parallel with an inductive winding helps in the elimination of the arcs.
- All the poles required for breaking must be connected in series between the load and the source polarity not linked to earth (or chassis).

| a.c. operated contactors a.c. / d.c. operated (electronic coil interface) d.c. operated contactors | A9 - AE9 | A12 - AE12 | A16 - AE16 | A26 - AE26 | A30 - AE30 | A40 - AE40 | A45 AF45 AE45 | A50 AF50 AE50 | A63 AF63 AE63 | A75 AF75 AE75 | GA75 - GAE75 | |
|--|----------------|------------------|------------------|------------------|------------------|------------------|---------------------|---------------------|---------------------|---------------------|--------------------|-----|
| Utilization category DC-1, $L/R \leq 1$ ms | | | | | | | | | | | | |
|  | ≤ 72 V | A | 25 | 27 | 30 | 45 | 55 | 60 | 70 | 100 | 110 | 120 |
| | 110 V | A | 10 | 15 | 20 | - | - | - | - | - | - | 120 |
| | 220 V | A | - | - | - | - | - | - | - | - | - | 120 |
| | 440 V | A | - | - | - | - | - | - | - | - | - | 100 |
| | 600 V | A | - | - | - | - | - | - | - | - | - | 75 |
|  | ≤ 72 V | A | 25 | 27 | 30 | 45 | 55 | 60 | 70 | 100 | 110 | 120 |
| | 110 V | A | 25 | 27 | 30 | 45 | 55 | 60 | 70 | 100 | 110 | 120 |
| | 220 V | A | 10 | 15 | 20 | - | - | - | - | - | - | - |
|  | ≤ 72 V | A | 25 | 27 | 30 | 45 | 55 | 60 | 70 | 100 | 110 | 120 |
| | 110 V | A | 25 | 27 | 30 | 45 | 55 | 60 | 70 | 100 | 110 | 120 |
| | 220 V | A | 25 | 27 | 30 | 45 | 55 | 60 | 70 | 100 | 110 | 120 |
|  | ≤ 72 V | A | 25 | 27 | 30 | 45 | - | - | 70 | 100 | - | 120 |
| | 110 V | A | 25 | 27 | 30 | 45 | - | - | 70 | 100 | - | 120 |
| | 220 V | A | 25 | 27 | 30 | 45 | - | - | 70 | 100 | - | 120 |
| | 440 V | A | 10 | 15 | 20 | - | - | - | - | - | - | - |
| Utilization category DC-3, $L/R \leq 2$ ms | | | | | | | | | | | | |
|  | ≤ 72 V | A | 25 | 27 | 30 | 45 | 55 | 60 | 70 | 100 | 110 | 120 |
| | 110 V | A | 6 | 7 | 8 | - | - | - | - | - | - | 120 |
| | 220 V | A | - | - | - | - | - | - | - | - | - | 100 |
| | 440 V | A | - | - | - | - | - | - | - | - | - | 85 |
|  | ≤ 72 V | A | 25 | 27 | 30 | 45 | 55 | 60 | 70 | 100 | 110 | 120 |
| | 110 V | A | 25 | 27 | 30 | 45 | 55 | 60 | 70 | 100 | 110 | 120 |
| | 220 V | A | 6 | 7 | 8 | - | - | - | - | - | - | - |
|  | ≤ 72 V | A | 25 | 27 | 30 | 45 | 55 | 60 | 70 | 100 | 110 | 120 |
| | 110 V | A | 25 | 27 | 30 | 45 | 55 | 60 | 70 | 100 | 110 | 120 |
| | 220 V | A | 25 | 27 | 30 | 45 | 55 | 60 | 70 | 100 | 110 | 120 |
|  | ≤ 72 V | A | 25 | 27 | 30 | 45 | - | - | 70 | 100 | - | 120 |
| | 110 V | A | 25 | 27 | 30 | 45 | - | - | 70 | 100 | - | 120 |
| | 220 V | A | 25 | 27 | 30 | 45 | - | - | 70 | 100 | - | 120 |
| | 440 V | A | 6 | 7 | 8 | - | - | - | - | - | - | - |
| Utilization category DC-5, $L/R \leq 7.5$ ms | | | | | | | | | | | | |
|  | ≤ 72 V | A | 9 | 12 | 16 | 25 | 30 | 40 | 50 | 50 | 63 | 75 |
| | 110 V | A | 4 | 4 | 4 | - | - | - | - | - | - | 85 |
| | 220 V | A | - | - | - | - | - | - | - | - | - | 85 |
| | 440 V | A | - | - | - | - | - | - | - | - | - | 35 |
|  | ≤ 72 V | A | 25 | 27 | 30 | 45 | 55 | 60 | 70 | 100 | 110 | 120 |
| | 110 V | A | 10 | 15 | 20 | 30 | 45 | 50 | 70 | 80 | 90 | 100 |
| | 220 V | A | 4 | 4 | 4 | - | - | - | - | - | - | - |
|  | ≤ 72 V | A | 25 | 27 | 30 | 45 | 55 | 60 | 70 | 100 | 110 | 120 |
| | 110 V | A | 25 | 27 | 30 | 45 | 55 | 60 | 70 | 100 | 110 | 120 |
| | 220 V | A | 9 | 12 | 16 | 25 | 30 | 40 | 50 | 50 | 63 | 75 |
|  | ≤ 72 V | A | 25 | 27 | 30 | 45 | - | - | 70 | 100 | - | 120 |
| | 110 V | A | 25 | 27 | 30 | 45 | - | - | 70 | 100 | - | 120 |
| | 220 V | A | 10 | 15 | 20 | 30 | - | - | 70 | 70 | - | 100 |
| | 440 V | A | 4 | 4 | 4 | - | - | - | - | - | - | - |










IEC Technical data

A/AF/AE95 – AF750

DC circuit switching

Technical Data

- The tables indicate for the standard contactors the I_g max. operating currents depending on: the utilization category (i.e. L/R) DC-1, DC-3, DC-5 as defined in the IEC 60947-4-1 publication, the operating voltage U_g and the pole coupling details. See page 1.81.
Ampere values quoted in the tables below are valid for a -25 ... +70 °C temperature close to the contactors, as long as the AC-1 Ampere values (see pages 1.45 - 146) for the corresponding ambient temperature are not exceeded.
 - Max. switching frequency: 300 ops/h.
 - For switching higher d.c. ratings, we recommend the use of bar mounted contactors, R series (63 ... 2000 A).
- The selection table for AE 50 ... AE 110 contactors can be used for the TAE 50 ... TAE 110 types.

| a.c. operated contactors | | | A95 | A110 | A145 | A185 | A210 | A260 | A300 | - | - | - | - |
|---|--------|---|------|-------|-------|-------|-------|-------|-------|-------|-------|-------|-------|
| a.c. / d.c. operated (electronic coil interface) | | | AF95 | AF110 | AF145 | AF185 | AF210 | AF260 | AF300 | AF400 | AF460 | AF580 | AF750 |
| d.c. operated contactors | | | AE95 | AE110 | - | - | - | - | - | - | - | - | - |
| Utilization category DC-1, L/R ≤ 1 ms | | | | | | | | | | | | | |
|  | ≤110 V | A | - | - | - | - | - | - | - | 600 | 700 | 800 | 1050 |
|  | ≤110 V | A | 145 | 160 | 250 | 275 | 350 | 400 | 450 | 600 | 700 | 800 | 1050 |
| | 220 V | A | - | - | - | - | - | - | - | 600 | 700 | 800 | 1050 |
|  | ≤110 V | A | 145 | 160 | 250 | 275 | 350 | 400 | 450 | 600 | 700 | 800 | 1050 |
| | 220 V | A | 145 | 160 | 250 | 275 | 350 | 400 | 450 | 600 | 700 | 800 | 1050 |
| | 440 V | A | - | - | - | - | - | - | - | 600 | 700 | 800 | 1050 |
| | 600 V | A | - | - | - | - | - | - | - | 600 | 700 | 800 | 1050 |
| Utilization category DC-3, L/R ≤ 2.5 ms | | | | | | | | | | | | | |
|  | ≤110 V | A | - | - | - | - | - | - | - | 600 | 700 | 800 | 1050 |
|  | ≤110 V | A | 145 | 160 | 250 | 275 | 350 | 400 | 450 | 600 | 700 | 800 | 1050 |
| | 220 V | A | - | - | - | - | - | - | - | 600 | 700 | 800 | 1050 |
|  | ≤110 V | A | 145 | 160 | 250 | 275 | 350 | 400 | 450 | 600 | 700 | 800 | 1050 |
| | 220 V | A | 145 | 160 | 250 | 275 | 350 | 400 | 450 | 600 | 700 | 800 | 1050 |
| | 440 V | A | - | - | - | - | - | - | - | 600 | 700 | 800 | 1050 |
| | 600 V | A | - | - | - | - | - | - | - | 600 | 700 | 800 | 1050 |
| Utilization category DC-5, L/R ≤ 15 ms | | | | | | | | | | | | | |
|  | ≤110 V | A | - | - | - | - | - | - | - | 600 | 700 | 800 | 1050 |
|  | ≤110 V | A | 145 | 160 | 250 | 275 | 350 | 400 | 450 | 600 | 700 | 800 | 1050 |
| | 220 V | A | - | - | - | - | - | - | - | 600 | 700 | 800 | 1050 |
|  | ≤110 V | A | 145 | 160 | 250 | 275 | 350 | 400 | 450 | 600 | 700 | 800 | 1050 |
| | 220 V | A | 145 | 160 | 250 | 275 | 350 | 400 | 450 | 600 | 700 | 800 | 1050 |
| | 440 V | A | - | - | - | - | - | - | - | 600 | 700 | 800 | 1050 |
| | 600 V | A | - | - | - | - | - | - | - | 600 | 700 | 800 | 1050 |

IEC Technical data




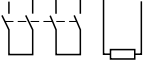








AL9 – AL40

DC circuit switching

General

The arc switching on d.c. is more difficult than on a.c.

- For selecting a contactor it is essential to determine the current, the voltage and the L/R time constant of the controlled load.
- For information, typical time constant values are quoted hereafter: non inductive loads such as resistance furnaces ($L/R \approx 1$ ms), inductive loads such as shunt motors ($L/R \approx 2$ ms) or series motors ($L/R \approx 7.5$ ms).
- The addition of a resistor in parallel with an inductive winding helps in the elimination of the arcs.
- All the poles required for breaking must be connected in series between the load and the source polarity not linked to earth (or chassis).

| A.C. operated contactors | | AL9 | AL12 | AL16 | AL26 | AL30 | AL40 | |
|---|-------------|-----|------|------|------|------|------|----|
| Utilization category DC-1, $L/R \leq 1$ ms | | | | | | | | |
|  | ≤ 72 V | A | 25 | 27 | 30 | 45 | 55 | 60 |
| | 110 V | A | 10 | 15 | 20 | – | – | – |
| | 220 V | A | – | – | – | – | – | – |
| | 440 V | A | – | – | – | – | – | – |
| | 600 V | A | – | – | – | – | – | – |
|  | ≤ 72 V | A | 25 | 27 | 30 | 45 | 55 | 60 |
| | 110 V | A | 25 | 27 | 30 | 45 | 55 | 60 |
| | 220 V | A | 10 | 15 | 20 | – | – | – |
|  | ≤ 72 V | A | 25 | 27 | 30 | 45 | 55 | 60 |
| | 110 V | A | 25 | 27 | 30 | 45 | 55 | 60 |
| | 220 V | A | 25 | 27 | 30 | 45 | 55 | 60 |
|  | ≤ 72 V | A | 25 | 27 | 30 | 45 | – | – |
| | 110 V | A | 25 | 27 | 30 | 45 | – | – |
| | 220 V | A | 25 | 27 | 30 | 45 | – | – |
| | 440 V | A | 10 | 15 | 20 | – | – | – |
| Utilization category DC-3, $L/R \leq 2$ ms | | | | | | | | |
|  | ≤ 72 V | A | 25 | 27 | 30 | 45 | 55 | 60 |
| | 110 V | A | 6 | 7 | 8 | – | – | – |
| | 220 V | A | – | – | – | – | – | – |
| | 440 V | A | – | – | – | – | – | – |
|  | ≤ 72 V | A | 25 | 27 | 30 | 45 | 55 | 60 |
| | 110 V | A | 25 | 27 | 30 | 45 | 55 | 60 |
| | 220 V | A | 6 | 7 | 8 | – | – | – |
|  | ≤ 72 V | A | 25 | 27 | 30 | 45 | 55 | 60 |
| | 110 V | A | 25 | 27 | 30 | 45 | 55 | 60 |
| | 220 V | A | 25 | 27 | 30 | 45 | 55 | 60 |
|  | ≤ 72 V | A | 25 | 27 | 30 | 45 | – | – |
| | 110 V | A | 25 | 27 | 30 | 45 | – | – |
| | 220 V | A | 25 | 27 | 30 | 45 | – | – |
| | 440 V | A | 6 | 7 | 8 | – | – | – |
| Utilization category DC-5, $L/R \leq 7.5$ ms | | | | | | | | |
|  | ≤ 72 V | A | 9 | 12 | 16 | 25 | 30 | 40 |
| | 110 V | A | 4 | 4 | 4 | – | – | – |
| | 220 V | A | – | – | – | – | – | – |
| | 440 V | A | – | – | – | – | – | – |
|  | ≤ 72 V | A | 25 | 27 | 30 | 45 | 55 | 60 |
| | 110 V | A | 10 | 15 | 20 | 30 | 45 | 50 |
| | 220 V | A | 4 | 4 | 4 | – | – | – |
|  | ≤ 72 V | A | 25 | 27 | 30 | 45 | 55 | 60 |
| | 110 V | A | 25 | 27 | 30 | 45 | 55 | 60 |
| | 220 V | A | 9 | 12 | 16 | 25 | 30 | 40 |
|  | ≤ 72 V | A | 25 | 27 | 30 | 45 | – | – |
| | 110 V | A | 25 | 27 | 30 | 45 | – | – |
| | 220 V | A | 10 | 15 | 20 | 30 | – | – |
| | 440 V | A | 4 | 4 | 4 | – | – | – |

IEC Technical data

EK110 – EK1000

DC circuit switching

General

The arc switching on d.c. is more difficult than on a.c.












- For selecting a contactor it is essential to determine the current, the voltage and the L/R time constant of the controlled load.
- For information, typical time constant values are quoted hereafter: non inductive loads such as resistance furnaces ($L/R \approx 1$ ms), inductive loads such as shunt motors ($L/R \approx 2$ ms) or series motors ($L/R \approx 7.5$ ms).
- The addition of a resistor in parallel with an inductive winding helps in the elimination of the arcs.
- All the poles required for breaking must be connected in series between the load and the source polarity not linked to earth (or chassis).

Technical Data

- The tables indicate for the standard contactors the I_b max. operating currents depending on: the utilization category (i.e. L/R) DC-1, DC-3, DC-5 as defined in the IEC 60947-4-1 publication (see page 1.75 for more details), the operating voltage U_b and the pole coupling details. Ampere values quoted in the tables below are valid for a $-25 \dots +70$ °C temperature close to the contactors, as long as the AC-1 Ampere values (see page 1.61) for the corresponding ambient temperature are not exceeded.
- Max. switching frequency: 300 ops/h.
- For switching higher d.c. ratings, we recommend the use of bar mounted contactors, R series (63 ... 2000 A).

Selection Table

a.c. / d.c. operated contactors

| | | | EK110 | EK150 | EK175 | EK210 | EK370 | EK550 | EK1000 |
|---|-------------|---|-------|-------|-------|-------|-------|-------|--------|
| Utilization category DC-1, L/R ≤ 1 ms | | | | | | | | | |
|  | ≤ 72 V | A | 120 | 145 | 210 | 210 | 370 | 550 | - |
| | 110 V | A | 120 | 145 | 210 | 210 | 370 | 550 | - |
|  | ≤ 72 V | A | 200 | 200 | 300 | 300 | 550 | 800 | - |
| | 110 V | A | 200 | 200 | 300 | 300 | 550 | 800 | - |
| | 220 V | A | 200 | 200 | 300 | 300 | 550 | 800 | - |
|  | ≤ 72 V | A | 200 | 200 | 300 | 300 | 550 | 800 | - |
| | 110 V | A | 200 | 200 | 300 | 300 | 550 | 800 | - |
| | 220 V | A | 200 | 200 | 300 | 300 | 550 | 800 | - |
| | 440 V | A | - | - | 210 | 210 | 450 | 650 | - |
| | 600 V | A | - | - | - | - | 450 | 650 | - |
|  | ≤ 72 V | A | 200 | 200 | 300 | 300 | 550 | 800 | - |
| | 110 V | A | 200 | 200 | 300 | 300 | 550 | 800 | - |
| | 220 V | A | 200 | 200 | 300 | 300 | 550 | 800 | - |
| | 440 V | A | 200 | 200 | 260 | 300 | 450 | 650 | - |
| | 600 V | A | - | - | 260 | 300 | 450 | 650 | - |
| Utilization category DC-3, L/R ≤ 2 ms | | | | | | | | | |
|  | ≤ 72 V | A | 120 | 145 | 210 | 210 | 370 | 550 | - |
| | ≤ 72 V | A | 135 | 145 | 210 | 210 | 450 | 650 | - |
|  | 110 V | A | 135 | 135 | 210 | 210 | 450 | 650 | - |
| | 220 V | A | 135 | 135 | 210 | 210 | 450 | 650 | - |
| | ≤ 72 V | A | 135 | 145 | 210 | 210 | 450 | 650 | - |
|  | 110 V | A | 135 | 135 | 210 | 210 | 450 | 650 | - |
| | 220 V | A | 135 | 135 | 210 | 210 | 450 | 650 | - |
| | 440 V | A | - | - | 210 | 210 | 450 | 650 | - |
| | 600 V | A | - | - | - | - | 450 | 650 | - |
| | ≤ 72 V | A | 135 | 145 | 210 | 210 | 450 | 650 | - |
|  | 110 V | A | 135 | 135 | 210 | 210 | 450 | 650 | - |
| | 220 V | A | 135 | 135 | 210 | 210 | 450 | 650 | - |
| | 440 V | A | 135 | 135 | 210 | 210 | 450 | 650 | - |
| | 600 V | A | - | - | 170 | 210 | 450 | 650 | - |
| | ≤ 72 V | A | 135 | 145 | 210 | 210 | 450 | 650 | - |
| Utilization category DC-5, L/R ≤ 7.5 ms | | | | | | | | | |
|  | ≤ 72 V | A | 135 | 145 | 210 | 210 | 450 | 650 | - |
| | 110 V | A | 135 | 135 | 210 | 210 | 450 | 650 | - |
| | 220 V | A | 135 | 135 | 210 | 210 | 450 | 650 | - |
|  | ≤ 72 V | A | 135 | 145 | 210 | 210 | 450 | 650 | - |
| | 110 V | A | 135 | 135 | 210 | 210 | 450 | 650 | - |
| | 220 V | A | 135 | 135 | 210 | 210 | 450 | 650 | - |
| | 440 V | A | - | - | 210 | 210 | 450 | 650 | - |
| | 600 V | A | - | - | - | - | 450 | 650 | - |
|  | ≤ 72 V | A | 135 | 145 | 210 | 210 | 450 | 650 | - |
| | 110 V | A | 135 | 135 | 210 | 210 | 450 | 650 | - |
| | 220 V | A | 135 | 135 | 210 | 210 | 450 | 650 | - |
| | 440 V | A | 135 | 135 | 210 | 210 | 450 | 650 | - |
| | 600 V | A | - | - | 170 | 210 | 450 | 650 | - |

IEC Technical data

A/AE9 – A/AE/AF/TAE110

Across the line
contactors

1

Main Pole - Utilization Characteristics

| Contactor types: | A..., AE... | 9 | 12 | 16 | 26 | 30 | 40 | 45 | 50 | 63 | 75 | 95 | 110 | | |
|--|----------------------------------|--|-----|------|-----|-----|------|-----------------------------------|------|------|------|------|------|------|------|
| | AF..., TAE... | - | - | - | - | - | - | 45 | 50 | 63 | 75 | 95 | 110 | | |
| Rated operational voltage U_e max. | V | 690 | | | | | | 1000 (690 for AF... contactors) | | | | | | | |
| Rated frequency limits | Hz | 25-400 | | | | | | | | | | | | | |
| Conventional free-air thermal current I_{th} acc. to IEC 60947-4-1, open contactors $\theta \leq 40^\circ\text{C}$ | A | 26 | 28 | 30 | 45 | 65 | 65 | 100 | 100 | 125 | 125 | 145 | 160 | | |
| with conductor cross-sectional area mm^2 | 4 | 4 | 4 | 6 | 16 | 16 | 35 | 35 | 50 | 50 | 50 | 70 | | | |
| Rated operational current I_e / AC-1 for air temperature close to contactor | | | | | | | | | | | | | | | |
| U_e max. 690 V | $\theta \leq 40^\circ\text{C}$ | A | 25 | 27 | 30 | 45 | 55 | 60 | 70 | 100 | 115 | 125 | 145 | 160 | |
| | $\theta \leq 55^\circ\text{C}$ | A | 22 | 25 | 27 | 40 | 55 | 60 | 60 | 85 | 95 | 105 | 135 | 145 | |
| | $\theta \leq 70^\circ\text{C}$ ③ | A | 18 | 20 | 23 | 32 | 39 | 42 | 50 | 70 | 80 | 85 | 115 | 130 | |
| with conductor cross-sectional area | mm^2 | 2.5 | 4 | 4 | 6 | 10 | 16 | 25 | 35 | 50 | 50 | 50 | 70 | | |
| Utilization categorie AC-3 | | | | | | | | | | | | | | | |
| for air temperature close to contactor $\leq 55^\circ\text{C}$ | | | | | | | | | | | | | | | |
| Rated operational current I_e AC-3 ① | | | | | | | | | | | | | | | |
| 3-phase motors | 220-230-240 V | V | A | 9 | 12 | 17 | 26 | 33 | 40 | 40 | 53 | 65 | 75 | 96 | 110 |
| | 380-400 V | V | A | 9 | 12 | 17 | 26 | 32 | 37 | 37 | 50 | 65 | 75 | 96 | 110 |
| | 415 V | V | A | 9 | 12 | 17 | 26 | 32 | 37 | 37 | 50 | 65 | 72 | 96 | 110 |
| | 440 V | V | A | 9 | 12 | 16 | 26 | 32 | 37 | 37 | 45 | 65 | 70 | 93 | 100 |
| | 500 V | V | A | 9 | 12 | 14 | 22 | 28 | 33 | 33 | 45 | 55 | 65 | 80 | 100 |
| | 690 V | V | A | 7 | 9 | 10 | 17 | 21 | 25 | 25 | 35 | 43 | 46 | 65 | 82 |
| | 1000 V | V | A | - | - | - | - | - | - | - | 23 ② | 25 ② | 28 ② | 30 ② | 30 ② |
| Rated operational power AC-3 ① | | | | | | | | | | | | | | | |
| 1500 r.p.m. 50 Hz 1800 r.p.m. 60 Hz 3-phase motors | 220-230-240 V | V | kW | 2.2 | 3 | 4 | 6.5 | 9 | 11 | 11 | 15 | 18.5 | 22 | 25 | 30 |
| | 380-400 V | V | kW | 4 | 5.5 | 7.5 | 11 | 15 | 18.5 | 18.5 | 22 | 30 | 37 | 45 | 55 |
| | 415 V | V | kW | 4 | 5.5 | 9 | 11 | 15 | 18.5 | 18.5 | 25 | 37 | 40 | 55 | 59 |
| | 440 V | V | kW | 4 | 5.5 | 9 | 15 | 18.5 | 22 | 22 | 25 | 37 | 40 | 55 | 59 |
| | 500 V | V | kW | 5.5 | 7.5 | 9 | 15 | 18.5 | 22 | 22 | 30 | 37 | 45 | 55 | 59 |
| | 690 V | V | kW | 5.5 | 7.5 | 9 | 15 | 18.5 | 22 | 22 | 30 | 37 | 40 | 55 | 75 |
| | 1000 V | V | kW | - | - | - | - | - | - | - | 30 ② | 33 ② | 37 ② | 40 ② | 40 ② |
| Rated making capacity AC-3 according to IEC 60947-4-1 | | | | | | | | | | | | | | | |
| 10 x I_e AC-3 | | | | | | | | | | | | | | | |
| Rated breaking capacity AC-3 according to IEC 60947-4-1 | | | | | | | | | | | | | | | |
| 8 x I_e AC-3 | | | | | | | | | | | | | | | |
| Short-circuit protection for contactors without thermal O/L relay - Motor protection excluded | | | | | | | | | | | | | | | |
| $U_e \leq 500$ V a.c. - gG type fuse | A | 25 | 32 | 32 | 50 | 63 | 80 | 100 | 125 | 160 | 160 | 200 | | | |
| Rated short-time withstand current I_{cw} at 40°C ambient temp., in free air, from a cold state | | | | | | | | | | | | | | | |
| 1 s | A | 250 | 280 | 300 | 400 | 600 | 1000 | | | | | 1320 | 1320 | | |
| 10 s | A | 100 | 120 | 140 | 210 | 400 | 650 | | | | | 800 | 800 | | |
| 30 s | A | 60 | 70 | 80 | 110 | 225 | 370 | | | | | 500 | 500 | | |
| 1 min | A | 50 | 55 | 60 | 90 | 150 | 250 | | | | | 350 | 350 | | |
| 15 min | A | 26 | 28 | 30 | 45 | 65 | 110 | 110 | 135 | 135 | | 160 | 175 | | |
| Maximum breaking capacity | | | | | | | | | | | | | | | |
| $\cos \phi = 0.45$ ($\cos \phi = 0.35$ for $I_e > 100$ A) | | | | | | | | | | | | | | | |
| at 440 V | A | 250 | | | 420 | 820 | 900 | 1300 | | | | 1160 | | | |
| at 690 V | A | 90 | | | 170 | 340 | 490 | 630 | | | | 800 | | | |
| Heat dissipation per pole | | | | | | | | | | | | | | | |
| I_e / AC-1 | W | 0.8 | 1 | 1.2 | 1.8 | 2.5 | 3 | 2.5 | 5 | 6.5 | 7 | 6.5 | 7.5 | | |
| I_e / AC-3 | W | 0.1 | 0.2 | 0.35 | 0.6 | 0.9 | 1.3 | 0.65 | 1.3 | 1.5 | 2 | 2.7 | 3.6 | | |
| Max. electrical switching frequency | | | | | | | | | | | | | | | |
| - for AC-1 | cycles/h | 600 | | | | | | 600 (300 for AF..., AE... TAE...) | | | | | 300 | | |
| - for AC-3 | cycles/h | 1200 (600 for AE...) | | | | | | 600 (300 for AF..., AE... TAE...) | | | | | 300 | | |
| - for AC-2, AC-4 | cycles/h | 300 | | | | | | 150 | | | | | 150 | | |
| Electrical durability | | | | | | | | | | | | | | | |
| see pages 1.70 - 1.73 | | | | | | | | | | | | | | | |
| Mechanical durability | | | | | | | | | | | | | | | |
| - millions of operating cycles | | 10 (5 for AE... and TAE... contactors) | | | | | | | | | | | | | |
| - max. mechanical switching frequency | cycles/h | 3600 (300 for AF... contactors) | | | | | | | | | | | | | |

① For the corresponding hp/A values of 1500 r.p.m., 50Hz, 3-phase motors, see page 1.76.

② AF... contactors excluded

③ Unauthorized for TAE... contactors.

IEC Technical data

A/AF145 – AF750

Main Pole - Utilization Characteristics

| Contactor types: | A... | 145 | 185 | 210 | 260 | 300 | - | - | - | - | |
|--|---|------------|-----|-----|-----|-------|---------|---------|---------|--------------|------|
| | AF... | 145 | 185 | 210 | 260 | 300 | 400 | 460 | 580 | 750 | |
| Rated operational voltage U_e max. | V | 690 | | | | | | | | | |
| Rated frequency limits | Hz | 25 ... 400 | | | | | | | | | |
| Conventional free-air thermal current I_{th} acc. to IEC 60947-4-1, | | | | | | | | | | | |
| open contactors $\varnothing \leq 40^\circ\text{C}$ | A | 250 | 275 | 350 | 400 | 500 | 600 | 700 | 800 | 1050 | |
| with conductor cross-sectional area ① | mm ² | 120 | 150 | 185 | 240 | 300 ③ | 2 x 185 | 2 x 240 | 2 x 240 | 2 x 80 x 5 ② | |
| Rated operational current I_e / AC-1 for air temperature close to contactor | | | | | | | | | | | |
| U_e max. 690 V | $\varnothing \leq 40^\circ\text{C}$ $\varnothing \leq 55^\circ\text{C}$ $\varnothing \leq 70^\circ\text{C}$ | A | 250 | 275 | 350 | 400 | 500 | 600 | 700 | 800 | 1050 |
| | | A | 230 | 250 | 300 | 350 | 400 | 500 | 600 | 700 | 800 |
| | | A | 180 | 180 | 240 | 290 | 325 | 400 | 480 | 580 | 720 |
| with conductor cross-sectional area | mm ² | 120 | 150 | 185 | 240 | 300 ③ | 2 x 185 | 2 x 240 | 2 x 240 | 2 x 80 x 5 ② | |

Utilization categorie AC-3

for air temperature close to contactor $\leq 55^\circ\text{C}$

Rated operational current I_e AC-3

| | | A | 145 | 185 | 210 | 260 | 305 | 400 | 460 | 580 | 750 |
|----------------|---------------|---|-----|-----|-----|-----|-----|-----|-----|-----|-----|
| 3-phase motors | 220-230-240 V | A | 145 | 185 | 210 | 260 | 305 | 400 | 460 | 580 | 750 |
| | 380-400 V | A | 145 | 185 | 210 | 260 | 305 | 400 | 460 | 580 | 750 |
| | 415 V | A | 145 | 185 | 210 | 260 | 300 | 400 | 460 | 580 | 750 |
| | 440 V | A | 145 | 185 | 210 | 240 | 280 | 400 | 460 | 580 | 750 |
| | 500 V | A | 145 | 170 | 210 | 240 | 280 | 400 | 460 | 580 | 750 |
| | 690 V | A | 120 | 170 | 210 | 220 | 280 | 350 | 400 | 500 | 650 |
| | 1000 V | A | - | - | - | - | - | - | - | - | - |



Rated operational power AC-3

| | | kW | 45 | 55 | 59 | 80 | 90 | 110 | 132 | 160 | 220 |
|--|---------------|----|-----|-----|-----|-----|-----|-----|-----|-----|-----|
| 1500 r.p.m. 50 Hz 1800 r.p.m. 60 Hz 3-phase motors | 220-230-240 V | kW | 45 | 55 | 59 | 80 | 90 | 110 | 132 | 160 | 220 |
| | 380-400 V | kW | 75 | 90 | 110 | 140 | 160 | 200 | 250 | 315 | 400 |
| | 415 V | kW | 75 | 90 | 110 | 140 | 160 | 220 | 250 | 355 | 425 |
| | 440 V | kW | 75 | 90 | 110 | 140 | 160 | 220 | 250 | 355 | 450 |
| | 500 V | kW | 90 | 110 | 132 | 180 | 200 | 250 | 315 | 400 | 520 |
| | 690 V | kW | 110 | 132 | 160 | 200 | 250 | 315 | 355 | 500 | 600 |
| | 1000 V | kW | - | - | - | - | - | - | - | - | - |



Rated making capacity AC-3

according to IEC 60947-4-1

10 x I_e AC-3

Rated breaking capacity AC-3

according to IEC 60947-4-1

8 x I_e AC-3

Short-circuit protection for contactors

without thermal O/L relay - Motor protection excluded

$U_e \leq 500$ V a.c. - gG type fuse

A 315 355 400 500 630 800 1000

Rated short-time withstand current I_{cw}

at 40°C ambient temp., in free air,

from a cold state

| | | A | 1800 | 2000 | 2500 | 3500 | 4600 | 7000 |
|--------|---|------|------|------|------|------|------|------|
| 1 s | A | 1800 | 2000 | 2500 | 3500 | 4600 | 7000 | |
| 10 s | A | 1200 | 1500 | 1700 | 2400 | 4400 | 6400 | |
| 30 s | A | 800 | 1000 | 1200 | 1500 | 3100 | 4500 | |
| 1 min | A | 600 | 800 | 1000 | 1100 | 2500 | 3500 | |
| 15 min | A | 280 | 320 | 400 | 500 | 840 | 1300 | |

Maximum breaking capacity

$\cos \varphi = 0.45$ ($\cos \varphi = 0.35$ for $I_e > 100$ A)

at 440 V

at 690 V

A 1500 2000 2300 2600 3000 4000 5000 6000 7500
A 1200 1600 2000 2400 2500 3500 4500 5000 7000

Heat dissipation per pole

I_e / AC-1

I_e / AC-3

W 13 16 18 25 32 30 42 32 50
W 5 8 9 14 18 16 21 17 28

Max. electrical switching frequency

- for AC-1

cycles/h

300

300

300

300

- for AC-3

cycles/h

300

300

300

- for AC-2, AC-4

cycles/h

150

150

60

60

Electrical durability

see pages 1.65 ... 1.69

Mechanical durability

- millions of operating cycles

5

3

- max. mechanical switching

frequency

cycles/h

3600 (300 for AF... contactors)

300

① Conductors with preparation.



② Dimensions of the bars (in mm).

③ For currents above 450A, use terminal extension / enlargement pieces LX 300 / LW 300 see page 1.31).

IEC Technical data

AF1350 – AF1650

Main Pole - Utilization Characteristics

| Contactor types: AF.. | | 1350 | 1650 |
|--|---------------------------------------|---|-------------------------|
| Rated operational voltage U_e max. | V | 1000 | 1000 |
| Rated frequency limits | Hz | 25-400 | 25-400 |
| Conventional free-air thermal current I_{th} acc. to IEC 60947-4-1, open contactors $\varnothing \leq 40^\circ\text{C}$ | A | 1350 | 1650 |
| with conductor cross-sectional area ^⓪ | mm ² | 2/100x5 | 3/100x5 |
| Rated operational current I_e / AC-1 for air temperature close to contactor | | | |
| U_e max. 690 V | $\varnothing \leq 40^\circ\text{C}$ A | 1350 | 1650 |
| | $\varnothing \leq 55^\circ\text{C}$ A | 1150 | 1450 |
| | $\varnothing \leq 70^\circ\text{C}$ A | 1000 | 1270 |
| with conductor cross-sectional area | mm ² | 2 x 80 x 5 ^⓪ | 2 x 80 x 5 ^⓪ |
| Utilization categorie AC-3 | | | |
| for air temperature close to contactor $\leq 55^\circ\text{C}$ | | | |
| Rated operational current I_e AC-3 | | | |
| | 220-230-240 V A | 860 | 1050 |
| 3-phase motors | 380-400 V A | 860 | 1050 |
| | 415 V A | 860 | 1050 |
| | 440 V A | 860 | 1050 |
| | 500 V A | — | — |
| | 690 V A | — | — |
| | 1000 V A | — | — |
|  | | | |
| Rated operational power AC-3 | | | |
| | 220-230-240 V kW | 257 | 315 |
| 1500 r.p.m. 50 Hz | 380-400 V kW | 475 | 560 |
| 1800 r.p.m. 60 Hz | 415 V kW | 500 | 600 |
| 3-phase motors | 440 V kW | 560 | 670 |
| | 500 V kW | — | — |
| | 690 V kW | — | — |
| | 1000 V kW | — | — |
|  | | | |
| Rated making capacity AC-3 according to IEC 60947-4-1 | | 10 x I_e , AC-3 | |
| Rated breaking capacity AC-3 according to IEC 60947-4-1 | | 8 x I_e , AC-3 | |
| Short-circuit protection for contactors without thermal O/L relay - Motor protection excluded $U_e \leq 500$ V a.c. - gG type fuse A | | Product coordination with ABB circuit breaker Consult factory | |
| Rated short-time withstand current I_{cw} at 40°C ambient temp., in free air, from a cold state | | | |
| | 1 s A | 10,000 | 12,000 |
| | 10 s A | 8000 | 10,000 |
| | 30 s A | 6000 | 7500 |
| | 1 min A | 4500 | 5500 |
| | 15 min A | 1600 | 2200 |
| Maximum breaking capacity $\cos \varphi = 0.45$ ($\cos \varphi = 0.35$ for $I_e > 100$ A) | | | |
| | at 440 V A | 10,000 | 12,000 |
| | at 690 V A | — | — |
| Max. electrical switching frequency | | | |
| - for AC-1 | cycles/h | 60 | 60 |
| - for AC-3 | cycles/h | | |
| - for AC-2, AC-4 | cycles/h | | |
| Electrical durability | | 50,000 | 50,000 |
| Mechanical durability | | | |
| - millions of operating cycles | | 500,000 | 500,000 |
| - max. mechanical switching frequency | cycles/h | 60 | 60 |

⓪ Dimensions of the bars (in mm).

IEC Technical data

A/AF9 – AF110

Magnet System Characteristics for A... Contactors

| Contactor types: | A... | 9 | 12 | 16 | 26 | 30 | 40 | 45 | 50 | 63 | 75 | 95 | 110 |
|--|------------|-------------------------------|-------|----------|---------|----------|---------|-----------|---------|----|----|-------------------------------|-----|
| Rated control circuit voltage U_c | | | | | | | | | | | | | |
| - at 50 Hz | V | 20 ... 690 | | | | | | | | | | | |
| - at 60 Hz | V | 24 ... 600 | | | | | | | | | | | |
| Coil operating limits according to IEC 60947-4-1 | | | | | | | | | | | | | |
| | | $\vartheta \leq 55\text{ °C}$ | | | | | | | | | | $\vartheta \leq 70\text{ °C}$ | |
| | | 0.85 ... 1.1 x U_c | | | | | | | | | | | |
| Drop-out voltage in % of U_c | | | | | | | | | | | | | |
| roughly 40 ... 65 % | | | | | | | | | | | | | |
| Coil consumption | | | | | | | | | | | | | |
| Average pull-in value | | | | | | | | | | | | | |
| | 50 Hz | VA | 70 | | 120 | | 180 | | 350 | | | | |
| | 60 Hz | VA | 80 | | 140 | | 210 | | 450 | | | | |
| | 50/60 Hz ① | VA/VA | 74/70 | | 125/120 | | 190/180 | | 410/365 | | | | |
| Average holding value | | | | | | | | | | | | | |
| | 50 Hz | VA/W | 8/2 | | 12/3 | | 18/5.5 | | 22/6.5 | | | | |
| | 60 Hz | VA/W | 8/2 | | 12/3 | | 18/5.5 | | 26/8 | | | | |
| | 50/60 Hz ① | VA/W | 8/2 | | 12/3 | | 18/5.5 | | 27/7.5 | | | | |
| Operating time | | | | | | | | | | | | | |
| between coil energization and: | | | | | | | | | | | | | |
| - N.O. contact closing | ms | 10 ... 26 | | 8 ... 21 | | 8 ... 27 | | 10 ... 25 | | | | | |
| - N.C. contact opening | ms | 7 ... 21 | | 6 ... 18 | | 7 ... 22 | | 7 ... 22 | | | | | |
| between coil de-energization and: | | | | | | | | | | | | | |
| - N.O. contact opening | ms | 4 ... 11 | | 4 ... 11 | | 4 ... 11 | | 7 ... 15 | | | | | |
| - N.C. contact closing | ms | 9 ... 16 | | 7 ... 14 | | 7 ... 14 | | 10 ... 18 | | | | | |

Magnet System Characteristics for AF... Contactors

| Contactor types: | AF.. | - | - | - | - | - | - | 45 | 50 | 63 | 75 | 95 | 110 | |
|--|-------|-------------------------------|-------|---|---|---|---|----|----|----|----|----|-----|--|
| Rated control circuit voltage U_c | | | | | | | | | | | | | | |
| - at 50 Hz | V | 48 ... 250 | | | | | | | | | | | | |
| - at 60 Hz | V | 48 ... 250 | | | | | | | | | | | | |
| - d.c. | V | 20 ... 250 | | | | | | | | | | | | |
| Coil operating limits according to IEC 60947-4-1 | | | | | | | | | | | | | | |
| | | $\vartheta \leq 70\text{ °C}$ | | | | | | | | | | | | |
| | | 0.85 ... 1.1 x U_c | | | | | | | | | | | | |
| Drop-out voltage in % of U_c | | | | | | | | | | | | | | |
| 55 % | | | | | | | | | | | | | | |
| Coil consumption | | | | | | | | | | | | | | |
| Average pull-in value | | | | | | | | | | | | | | |
| | 50 Hz | VA | 210 | | | | | | | | | | | |
| | 60 Hz | VA | 210 | | | | | | | | | | | |
| | d.c. | W | 190 | | | | | | | | | | | |
| Average holding value | | | | | | | | | | | | | | |
| | 50 Hz | VA/W | 7/2.8 | | | | | | | | | | | |
| | 60 Hz | VA/W | 7/2.8 | | | | | | | | | | | |
| | d.c. | W | 2.8 | | | | | | | | | | | |
| Operating time | | | | | | | | | | | | | | |
| between coil energization and: | | | | | | | | | | | | | | |
| - N.O. contact closing | ms | 30 ... 100 | | | | | | | | | | | | |
| - N.C. contact opening | ms | 27 ... 95 | | | | | | | | | | | | |
| between coil de-energization and: | | | | | | | | | | | | | | |
| - N.O. contact opening | ms | 30 ... 110 | | | | | | | | | | | | |
| - N.C. contact closing | ms | 35 ... 115 | | | | | | | | | | | | |

① 50/60 Hz coils: voltage codes 8 0 to 8 8. see page 1.28.

IEC Technical data

A145 – AF750

Across the line
contactors

1

Magnet System Characteristics for A... Contactors

| Contactor types: | A... | 145 | 185 | 210 | 260 | 300 | - | - | - | - | |
|--|------------|--|-----------|-----|-----------|-----|---|---|---|---|--|
| Rated control circuit voltage U_c | | | | | | | | | | | |
| - at 50 Hz | V | 24 ... 690 | | | | | | | | | |
| - at 60 Hz | V | 24 ... 690 | | | | | | | | | |
| Coil operating limits according to IEC 60947-4-1 | | $\sigma \leq 70^\circ\text{C}$ 0.85 ... 1.1 x U_c | | | | | | | | | |
| Drop-out voltage in % of U_c | | roughly 25 ... 65 % | | | | | | | | | |
| Coil consumption | | | | | | | | | | | |
| Average pull-in value | 50 Hz | VA | 550 | | 1350 | | | | | | |
| | 60 Hz | VA | 600 | | 1550 | | | | | | |
| | 50/60 Hz ① | VA/VA | 700/650 | | 1700/1550 | | | | | | |
| Average holding value | 50 Hz | VA/W | 35/11 | | 60/16 | | | | | | |
| | 60 Hz | VA/W | 40/12 | | 65/19 | | | | | | |
| | 50/60 Hz ① | VA/W | 44/13 | | 80/21 | | | | | | |
| Operating time | | | | | | | | | | | |
| between coil energization and: | | | | | | | | | | | |
| - N.O. contact closing | ms | | 13 ... 27 | | 17 ... 35 | | | | | | |
| - N.C. contact opening | ms | | 8 ... 22 | | 12 ... 30 | | | | | | |
| between coil de-energization and | | | | | | | | | | | |
| - N.O. contact opening | ms | | 5 ... 10 | | 7 ... 13 | | | | | | |
| - N.C. contact closing | ms | | 9 ... 13 | | 10 ... 16 | | | | | | |

Magnet System Characteristics for AF... Contactors

| Contactor types: | AF... | 145 | 185 | 210 | 260 | 300 | 400 | 460 | 580 | 750 | |
|--|-------|--|------------|-----|--------|-----|------------|-----|--------|-----|--|
| Rated control circuit voltage U_c | | | | | | | | | | | |
| - at 50 Hz | V | 48 ... 250 | | | | | | | | | |
| - at 60 Hz | V | 48 ... 250 | | | | | | | | | |
| - d.c. | V | 24 ... 250 | | | | | | | | | |
| Coil operating limits according to IEC 60947-4-1 | | $\sigma \leq 70^\circ\text{C}$ 0.85 ... 1.1 x U_c | | | | | | | | | |
| Drop-out voltage in % of U_c | | 55 % | | | | | | | | | |
| Coil consumption | | | | | | | | | | | |
| Average pull-in value | 50 Hz | VA | 430 | | 470 | | 890 | | 850 | | |
| | 60 Hz | VA | 430 | | 470 | | 890 | | 850 | | |
| | d.c. | W | 500 | | 520 | | 990 | | 950 | | |
| Average holding value | 50 Hz | VA/W | 12/3.5 | | 10/2.5 | | 12/4 | | 12/4.5 | | |
| | 60 Hz | VA/W | 12/3.5 | | 10/2.5 | | 12/4 | | 12/4.5 | | |
| | d.c. | W | 2 | | 2 | | 4 | | 4.5 | | |
| Operating time | | | | | | | | | | | |
| between coil energization and: | | | | | | | | | | | |
| - N.O. contact closing | ms | | 30 ... 115 | | | | 50 ... 120 | | | | |
| - N.C. contact opening | ms | | 30 ... 115 | | | | 50 ... 120 | | | | |
| between coil de-energization and | | | | | | | | | | | |
| - N.O. contact opening | ms | | 25 ... 80 | | | | 40 ... 70 | | | | |
| - N.C. contact closing | ms | | 25 ... 80 | | | | 40 ... 70 | | | | |

① 50/60 Hz coils: voltage codes 8 0 to 8 8. see page 1.28.

IEC Technical data

AF1350 – AF1650

Magnet System Characteristics for AF... Contactors

| Contactor types: AF... | | 1350 | 1650 |
|--|------|---|---------|
| Rated control circuit voltage U_c | | | |
| – at 50 Hz | V | 100 - 250 | |
| – at 60 Hz | V | 100 - 250 | |
| – d.c. | V | 100 - 250 | |
| Coil operating limits according to IEC 60947-4-1 | | $\vartheta \leq 70\text{ °C}$ 0.85 ... 1.1 x U_c | |
| Drop-out voltage in % of U_c | | 55 % | |
| Coil consumption | | | |
| Average pull-in value | | | |
| 50 Hz | VA | 1900 | |
| 60 Hz | VA | 1900 | |
| d.c. | W | 1700 | |
| Average holding value | | | |
| 50 Hz | VA/W | 48/17 | |
| 60 Hz | VA/W | 48/17 | |
| d.c. | W | 16 | |
| Operating time | | | |
| between coil energization and: | | | |
| – N.O. contact closing | ms | 50 - 80 | |
| – N.C. contact opening | | ms | 50 - 80 |
| between coil de-energization and | | | |
| – N.O. contact opening | | ms | 35 - 55 |
| – N.C. contact closing | ms | 35 - 55 | |
| With PLC | | | |
| between coil energization and | | | |
| – N.O. contact opening | | ms | 40 - 65 |
| – N.C. contact closing | ms | 40 - 65 | |
| between coil de-energization and | | | |
| – N.O. contact opening | | ms | 10 - 30 |
| – N.C. contact closing | ms | 10 - 30 | |

① 50/60 Hz coils: voltage codes 8 0 to 8 8. see page 1.28.

IEC Technical data

AE9 – AE110

TAE45 – TAE110

Across the line
contactors

1

Magnet System Characteristics for AE... Contactors

| Contactor types: | AE... | 9 | 12 | 16 | 26 | 30 | 40 | 45 | 50 | 63 | 75 | 95 | 110 |
|--|--------|---|----|----|------------|----|----|---------------------|----|-----------|-------------|-------------------------------------|-----|
| Rated control circuit voltage U_c | V d.c. | 12 ... 250 | | | | | | | | | | | |
| Coil operating limits according to IEC 60947-4-1 | | $\varnothing \leq 55^\circ\text{C}$ 0.85 ... 1.1 x U_c | | | | | | | | | | $\varnothing \leq 70^\circ\text{C}$ | |
| Drop-out voltage in % of U_c | | roughly 10 ... 30 % | | | | | | roughly 15 ... 40 % | | | | | |
| Coil consumption - Average values | | | | | | | | | | | | | |
| - pull-in value | W | 90 | | | 110 | | | 200 | | | 400 | | |
| - holding value | W | 2 | | | 2.5 | | | 4 | | | 2.4 | | |
| Coil time constant | | | | | | | | | | | | | |
| - open | L/R | ms | | 2 | | 3 | | 3 | | 6 | | | |
| - closed | L/R | ms | | 9 | | 16 | | 15 | | 30 ... 40 | | | |
| Operating time between coil energization and: | | | | | | | | | | | | | |
| - N.O. contact closing | ms | 10 ... 16 | | | 13 ... 21 | | | 13 ... 30 | | | 15 ... 25 | | |
| - N.C. contact opening | ms | 8 ... 12 | | | 11 ... 16 | | | 10 ... 27 | | | 12 ... 22 | | |
| Operating time between coil de-energization and: | | | | | | | | | | | | | |
| - N.O. contact opening | ms | 5 ... 14 ① | | | 6 ... 12 ① | | | 5 ... 15 ① | | | 15 ... 20 ① | | |
| - N.C. contact closing | ms | 11 ... 17 ① | | | 8 ... 16 ① | | | 8 ... 18 ① | | | 18 ... 23 ① | | |

Magnet System Characteristics for TAE... Contactors

| Contactor types: | TAE... | - | - | - | - | - | - | 45 | 50 | - | 75 | 95 | 110 |
|---|--------|--|---|---|---|---|---|-------------|----|----|--------------|----|-----|
| Rated control circuit voltage U_c | V d.c. | 17 ... 264 | | | | | | | | | | | |
| Coil operating limits according to IEC 60947-4-1 | | $\varnothing \leq 55^\circ\text{C}$ U_c min. ... U_c max. | | | | | | | | | | | |
| Drop-out voltage in % of U_c max. | | roughly 20 ... 35 % | | | | | | | | | | | |
| Coil consumption values for U_c min. ... U_c max. | | | | | | | | | | | | | |
| - pull-in value | W | | | | | | | 120 ... 250 | | | 300 ... 1000 | | |
| - holding value | W | | | | | | | 1.7 ... 6.5 | | | 2 ... 7 | | |
| Coil time constant | | | | | | | | | | | | | |
| - open | L/R | ms | | | | | | 3 | | 6 | | | |
| - closed | L/R | ms | | | | | | 15 | | 40 | | | |
| Operating time between coil energization and: | | | | | | | | | | | | | |
| - N.O. contact closing | ms | | | | | | | 13 ... 30 | | | 15 ... 25 | | |
| - N.C. contact opening | ms | | | | | | | 10 ... 27 | | | 12 ... 22 | | |
| Operating time between coil de-energization and: | | | | | | | | | | | | | |
| - N.O. contact opening | ms | | | | | | | 5 ... 15 ② | | | 15 ... 20 ② | | |
| - N.C. contact closing | ms | | | | | | | 8 ... 18 ② | | | 18 ... 23 ② | | |

① The use of surge suppressors increases the opening time on a scale of 1.1 to 1.5 for a varistor suppressor and on a scale of 4 to 8 for a diode suppressor. AE 9 ... AE 40 contactors and $U_c \geq 110$ V: table values for contactors with RV 5 surge suppressor (factory mounted).

② The use of surge suppressors increases the opening time on a scale of 1.1 to 1.5 for a varistor suppressor and on a scale of 4 to 8 for a diode suppressor.

IEC Technical data

A9 – A110

Built-in Auxiliary Contacts - Utilization Characteristics

| Contactor types: A... | | 9 | 12 | 16 | 26 | 30 | 40 | 45 | 50 | 63 | 75 | 95 | 110 |
|--|--------|--------------------|----|----|----|----|----|----|----|----|----|----|-----|
| Rated operational voltage U_e max. | V | 690 | | | | | | - | - | - | - | - | - |
| Conventional free air thermal current I_{th} - $\theta \leq 40$ °C | A | 16 | | | | | | - | - | - | - | - | - |
| Rated frequency limits | Hz | 25 ... 400 | | | | | - | - | - | - | - | - | - |
| Rated operational current I_e / AC-15 according to IEC 60947-5-1 | | | | | | | | | | | | | |
| 24-127 V 50/60 Hz | A | 6 | | | | | | - | - | - | - | - | - |
| 220-240 V 50/60 Hz | A | 4 | | | | | | - | - | - | - | - | - |
| 380-440 V 50/60 Hz | A | 3 | | | | | | - | - | - | - | - | - |
| 500 V 50/60 Hz | A | 2 | | | | | | - | - | - | - | - | - |
| 690 V 50/60 Hz | A | 2 | | | | | | - | - | - | - | - | - |
| Rated operational current I_e / DC-13 according to IEC 60947-5-1 | | | | | | | | | | | | | |
| 24 V d.c. | A / W | 6 / 144 | | | | | | - | - | - | - | - | - |
| 48 V d.c. | A / W | 2.8 / 134 | | | | | | - | - | - | - | - | - |
| 72 V d.c. | A / W | 2 / 144 | | | | | | - | - | - | - | - | - |
| 125 V d.c. | A / W | 1.1 / 138 | | | | | | - | - | - | - | - | - |
| 250 V d.c. | A / W | 0.55 / 138 | | | | | - | - | - | - | - | - | - |
| Rated making capacity acc. to IEC 60947-5-1 | | 10 x I_e / AC-15 | | | | | | - | - | - | - | - | - |
| Rated breaking capacity acc. to IEC 60947-5-1 | | 10 x I_e / AC-15 | | | | | | - | - | - | - | - | - |
| Short-circuit protection gG type fuse | A | 10 | | | | | | - | - | - | - | - | - |
| Rated short-time withstand current I_{cw} for 1.0 s | A | 100 | | | | | | - | - | - | - | - | - |
| for 0.1 s | A | 140 | | | | | | - | - | - | - | - | - |
| Minimum switching capacity | V / mA | 17 / 5 | | | | | | - | - | - | - | - | - |
| Non-overlapping time between N.O. and N.C. contacts | ms | ≥ 2 | | | | | | - | - | - | - | - | - |
| Insulating resistance at 500 V d.c. after durability test | MOhm | 5 | | | | | | - | - | - | - | - | - |
| Heat dissipation per pole at 6 A | W | 0.10 | | | | | | - | - | - | - | - | - |

IEC Technical data

A/AE9 – AF/TAE110

Mounting characteristics

| | | | | | | | | | | | | | |
|--|--|----------|-----------|-----------|-----------|-----------|-----------|------------|------------|-----------|-----------|-----------|------------|
| Contactor types: | A..., AE... | 9 | 12 | 16 | 26 | 30 | 40 | 45 | 50 | 63 | 75 | 95 | 110 |
| | AF..., TAE... | - | - | - | - | - | - | 45 | 50 | 63 | 75 | 95 | 110 |
| Mounting positions | see "Conditions for use" | | | | | | | | | | | | |
| Mounting distances | The contactors can be assembled side by side | | | | | | | | | | | | |
| Mounting | | | | | | | | | | | | | |
| on DIN rail | 35 x 7.5 mm | | | | | | | 35 x 15 mm | | | | | |
| according to IEC 715 and EN 50022 / EN 50023 | 35 x 15 mm | | | | | | | 75 x 25 mm | 75 x 25 mm | | | | |
| by screws (not supplied) | 2 x M4 | | | | | | | 2 x M6 | | | | | |

Conditions for Use

Sustainable utilization conditions for contactors involving at the same time the Mounting position, Ambient temperature and Control voltage operating limits are summarized in the table below.

| Contactors | Mounting position | Ambient temperature | Control voltage |
|--------------------------------|------------------------|----------------------|--|
| A 9 ... A 110, AE 9 ... AE 110 | 1, 1 ± 30°, 2, 3, 4, 5 | ≤ 55 °C | 0.85 ... 1.1 x U _c |
| | 6 | 55 ... 70 °C | U _c |
| AF 45 ... AF 110 | 1, 1 ± 30°, 2, 3, 4, 5 | ≤ 55 °C | 0.95 ... 1.1 x U _c |
| | 6 unauthorized | > 55 °C unauthorized | - |
| TAE 45 ... TAE 110 | 1, 1 ± 30°, 2, 3, 4, 5 | ≤ 70 °C | 0.85 U _c min. ... 1.1 x U _c max. |
| | 6 unauthorized | ≤ 55 °C | U _c min. ... U _c max. |
| | | > 55 °C unauthorized | - |
| | 6 unauthorized | - | - |

Notes for 4-pole contactors

Whatever the coil voltage: Pos. 5 unauthorized for A 45-22-00, AE 45-22-00, A 75-22-00, AE 75-22-00 contactors.

For 60 Hz coil voltage: (only for devices fitted with CA 5-.. and CAL 5-11 auxiliary contacts or TP timer)

- A 45-40-00, A 50-40-00 and A 75-40-00 contactors

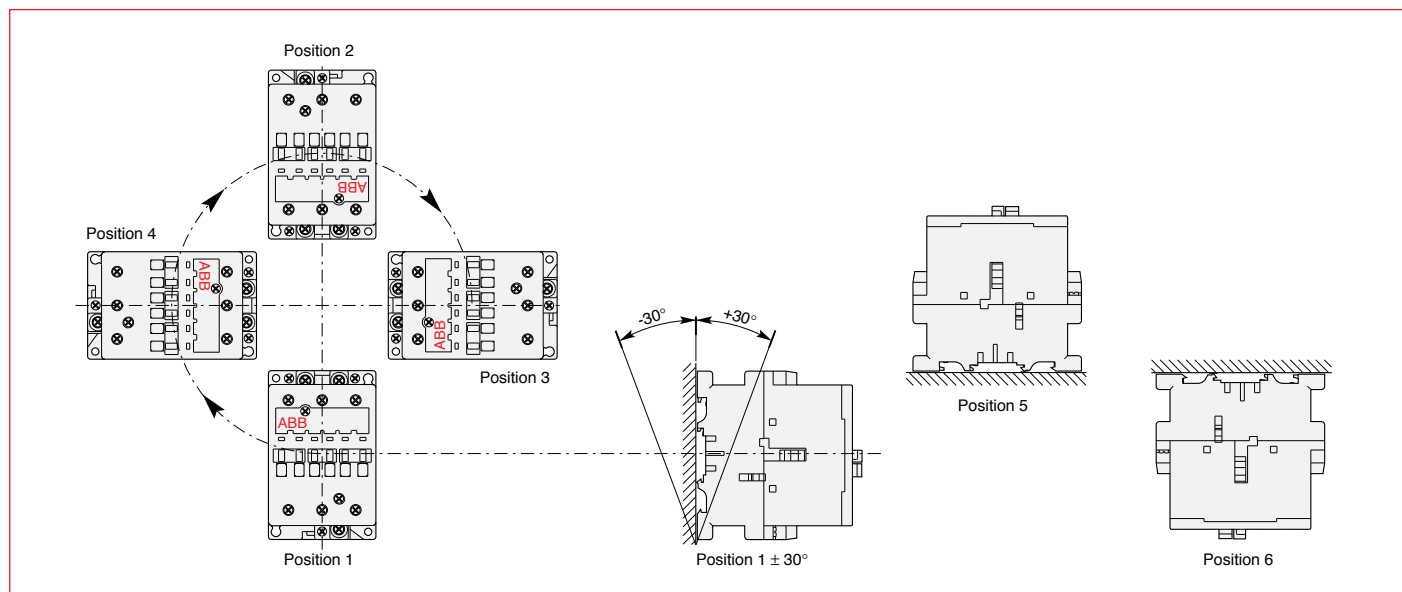
Mounting positions 1 to 5 and ambient temperature ≤ 55 °C: tolerance reduced to 0.9 ... 1.1 U_c (instead of 0.85 ... 1.1 U_c) for coil voltage codes 7 □ and 8 □.

- A 45-22-00 and A 75-22-00 contactors

Mounting positions 1 to 4 (pos. 5 unauthorized) and ambient temperature ≤ 55 °C: tolerance reduced to 0.9 ... 1.1 U_c (instead of 0.85 ... 1.1 U_c) for coil voltage codes 7 □ and 8 □.

For mounting position 6 or ambient temperature of 55 to 70 °C the information given on this page remains applicable.

Mounting Positions (see the above table for authorized positions)



IEC Technical data

A/AF145 – AF1650

Mounting Characteristics – A/AF145 – AF750

| | | | | | | | | | | |
|---|--|------------|------------|------------|------------|------------|------------|------------|------------|------------|
| Contactor types: | A... | 145 | 185 | 210 | 260 | 300 | – | – | – | – |
| | AF... | 145 | 185 | 210 | 260 | 300 | 400 | 460 | 580 | 750 |
| Mounting positions | see "Condition for use" | | | | | | | | | |
| Mounting distances | The contactors can be assembled side by side | | | | | | | | | |
| Fixing | | | | | | | | | | |
| on DIN rail according to IEC 715 and EN 50022 / EN 50023 | – – – – – – – – – – | | | | | | | | | |
| by screws (not supplied) | 4 x M5 | | | | | | | | 4 x M6 | |

Mounting Characteristics – AF1350 – AF1650

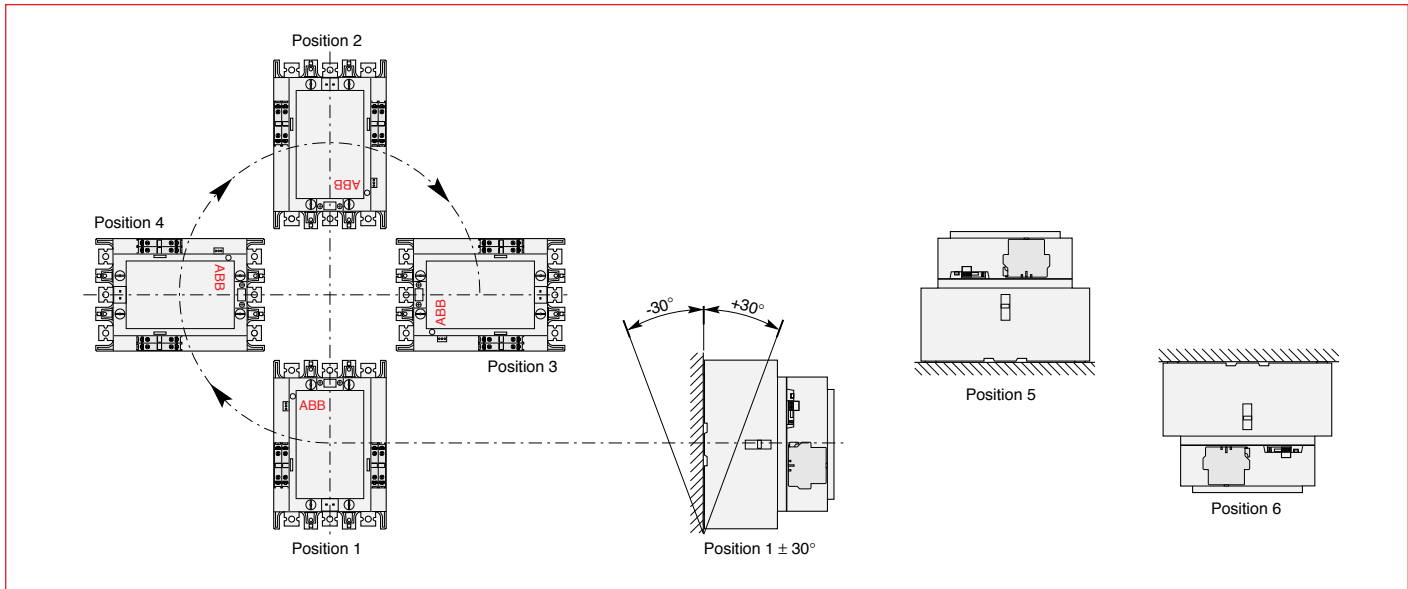
| | | | |
|---|--|-------------|-------------|
| Contactor types: | AF | 1350 | 1650 |
| Mounting positions | see "Condition for use" | | |
| Mounting distances | The contactors can be assembled side by side | | |
| Fixing | | | |
| on DIN rail according to IEC 715 and EN 50022 / EN 50023 | – – | | |
| by screws (not supplied) | 4 x M8 | | |

Conditions for Use

Sustainable utilization conditions for contactors involving at the same time the Mounting position, Ambient temperature and Control voltage operating limits are summarized in the table below.

| Contactors | Mounting position | Ambient temperature | Control voltage |
|-------------------|------------------------|---------------------|--|
| A 145 ... A 300 | 1, 1 ± 30°, 2, 3, 4, 5 | ≤ 70 °C | 0.85 ... 1.1 x U _c |
| | 6 unauthorized | – | – |
| AF 145 ... AF 750 | 1, 1 ± 30°, 2, 3, 4, 5 | ≤ 70 °C | 0.85 x U _c min. ... 1.1 x U _c max. |
| | 6 unauthorized | – | – |

Mounting Positions (see the above table for authorized positions)



IEC Technical data

A/AE9 – AF/TAE110


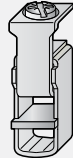
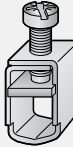
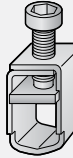
Across the line
contactors

1

Connecting Characteristics










| | | | | | | | | | | | | |
|------------------------------|---|----|----|----|----|----|----|----|----|----|----|-----|
| Contactor types: A..., AE... | 9 | 12 | 16 | 26 | 30 | 40 | 45 | 50 | 63 | 75 | 95 | 110 |
| AF..., TAE... | - | - | - | - | - | - | 45 | 50 | 63 | 75 | 95 | 110 |

Main terminals

| | | | |
|---|---|---|---|
|  |  |  |  |
| with cable clamp | with double connector 2 x (5.6 x 6.5 mm) | with single connector (13 x 10 mm) | with single connector (14 x 14 mm) |







Connecting capacity (min. ... max.)

Main conductors (poles)

| | | | | | | |
|--|---|--------------|------------|------------|----------|-----------------|
| Rigid: solid ($\leq 4 \text{ mm}^2$) |  1 x mm ² | 1 ... 4 | 1.5 ... 6 | 2.5 ... 16 | 6 ... 50 | 10 ... 95 |
| stranded ($\geq 6 \text{ mm}^2$) |  2 x mm ² | 1 ... 4 | 1.5 ... 6 | 2.5 ... 16 | 6 ... 16 | 6 ... 35 |
| Rigid with connector | | - | - | - | - | - |
| single for Cu cable |  | - | - | - | - | - |
| single for Al/Cu cable |  | - | - | - | - | - |
| double for Al/Cu cable |  | - | - | - | - | - |
| Flexible with cable end |  1 x mm ² | 0.75 ... 2.5 | 0.75 ... 4 | 2.5 ... 10 | 6 ... 35 | 10 ... 70 |
| |  2 x mm ² | 0.75 ... 2.5 | 0.75 ... 4 | 2.5 ... 10 | 6 ... 25 | 6 ... 35 |
| Bars or lugs |  L mm \leq | 8 | 10 | - | - | 30 [Ⓜ] |
| |  l mm $>$ | 3.7 | 4.2 | - | - | 6 |

Auxiliary conductors

(built-in auxiliary terminals + coil terminals)

| | | | | | | |
|-------------------------|---|--------------|---|-----|-----------|--------------|
| Rigid solid |  1 x mm ² | 1 ... 4 | | | | 0.75 ... 2.5 |
| |  2 x mm ² | 1 ... 4 | | | | 0.75 ... 2.5 |
| Flexible with cable end |  1 x mm ² | 0.75 ... 2.5 | | | 1 ... 2.5 | 0.75 ... 2.5 |
| |  2 x mm ² | 0.75 ... 2.5 | | | | |
| Lugs |  L mm \leq | 8 | Ⓜ | 8 | | |
| |  l mm $>$ | 3.7 | Ⓜ | 3.7 | | |

Degree of protection acc. to IEC 60947-1 / EN 60947-1 and IEC 60529 / EN 60529

Protection against direct contact acc. to VDE 0106 - Part. 100

| | | | | | | |
|--------------------------------|-------|--|--|--|--|-------|
| - Main terminals | IP 20 | | | | | IP 10 |
| - Coil terminals | IP 20 | | | | | |
| - Built-in auxiliary terminals | IP 20 | | | | | |

Screw terminals

(delivered in open position, screws of unused terminals must be tightened)

| | | | | | | |
|------------------------------|---|----|----|----|--|----------------|
| Main terminals | (+,-) pozidriv 2 screws | | | | | hexagon socket |
| | M3.5 | M4 | M5 | M6 | | M8 (s = 4 mm) |
| Coil terminals | M3.5 (+,-) pozidriv 2 screws with cable clamp | | | | | |
| Built-in auxiliary terminals | (+,-) pozidriv 2 screws with cable clamp | | | | | |
| | M3.5 | M4 | M5 | | | |

Tightening torque

| | | | | | | |
|------------------------------|------------|----------|----------|-----------|-----------|-----------|
| Main pole terminals | | | | | | |
| - recommended | Nm / lb.in | 1.00 / 9 | 1.7 / 15 | 2.30 / 20 | 4.00 / 35 | 6.00 / 53 |
| - max. | Nm | 1.20 | 2.20 | 2.60 | 4.50 | 6.50 |
| Coil terminals | | | | | | |
| - recommended | Nm / lb.in | 1.00 / 9 | | | | |
| - max. | Nm | 1.20 | | | | |
| Built-in auxiliary terminals | | | | | | |
| - recommended | Nm / lb.in | 1.00 / 9 | 1.7 / 15 | 1.00 / 9 | | |
| - max. | Nm | 1.20 | 2.20 | 1.20 | | |

Terminal marking and positioning

see pages 1.34

Ⓜ L \leq 8 and l $>$ 3.7 for coil terminal - L \leq 10 and l $>$ 4.2 for built-in auxiliary terminals.
[Ⓜ] With LW 110 enlargement piece. See page 1.31.

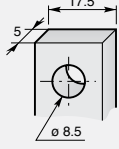
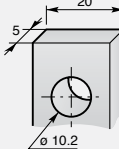
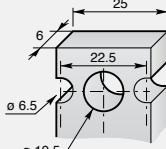
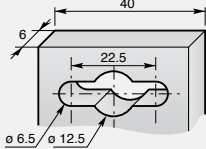
IEC Technical data

A/AF145 – AF750

Connecting Characteristics










| Contactor types: | A... | 145 | 185 | 210 | 260 | 300 | - | - | - | - |
|------------------|-------|-----|-----|-----|-----|-----|-----|-----|-----|-----|
| | AF... | 145 | 185 | 210 | 260 | 300 | 400 | 460 | 580 | 750 |

Main terminals






| Flat type |  |  |  |  |
|-----------|---|---|--|---|
|-----------|---|---|--|---|

Connecting capacity (min. ... max.)

Main conductors (poles)

| | | | | | | | | | | |
|------------------------|---|---------------------|------------|----------------|---|---|---------------|---|---------------|---|
| Rigid: |  | 1 x mm ² | - | - | - | - | - | - | - | - |
| |  | 2 x mm ² | - | - | - | - | - | - | - | - |
| Rigid with connector |  | mm ² | 6 ... 185 | 16 ... 240 | | | 240 | | 300 | |
| single for Cu cable |  | mm ² | 25 ... 150 | 120 ... 240 | | | 240 | | 300 | |
| single for Al/Cu cable |  | mm ² | - | 2 x 95 ... 120 | | | 2 x 240 | | 3 x 185 | |
| double for Al/Cu cable |  | mm ² | - | - | | | - | | - | |
| Flexible |  | 1 x mm ² | - | - | - | - | - | - | - | - |
| |  | 2 x mm ² | - | - | - | - | - | - | - | - |
| Bars or lugs |  | L mm ≤ Ø mm > | 24 8 | 32 10 | | | 47 / 45 10 | | 52 / 50 12 | |

Auxiliary conductors (coil terminals)

| | | | | | | | | | | |
|-------------------------|---|---------------------|--------------|--|--|--|--|--|--|--|
| Rigid solid |  | 1 x mm ² | 1 ... 4 | | | | | | | |
| |  | 2 x mm ² | 1 ... 4 | | | | | | | |
| Flexible with cable end |  | 1 x mm ² | 0.75 ... 2.5 | | | | | | | |
| |  | 2 x mm ² | 0.75 ... 2.5 | | | | | | | |
| Lugs |  | L mm ≤ l mm > | 8 3.7 | | | | | | | |

Degree of protection acc. to IEC 60947-1 / EN 60947-1 and IEC 60529 / EN 60529

| | |
|--------------------------------|-------|
| - Main terminals | IP 00 |
| - Coil terminals | IP 20 |
| - Built-in auxiliary terminals | - |

Screw terminals

| | | | | | |
|---|---|----|-----|-----|-----|
| Main terminals | Screws and bolts | M8 | M10 | M10 | M12 |
| Coil terminals (delivered in open position) | M3.5 (+,-) pozidriv 2 screws with cable clamp | | | | |
| Built-in auxiliary terminals | - | - | - | - | - |

Tightening torque

| | | | | | |
|------------------------------|------------|----------|----------|----------|----------|
| Main pole terminals | | | | | |
| - recommended | Nm / lb.in | 18 / 160 | 28 / 240 | 40 / 354 | 45 / 443 |
| - max. | Nm | 20 | 30 | 44 | 49 |
| Coil terminals | | | | | |
| - recommended | Nm / lb.in | 1.00 / 9 | | | |
| - max. | Nm | 1.20 | | | |
| Built-in auxiliary terminals | | | | | |
| - recommended | Nm / lb.in | - | - | - | - |
| - max. | Nm | - | - | - | - |

Terminal marking and positioning

see pages 1.36 & 1.37














IEC Technical data

AF1350 – AF1650

Across the line
contactors

1

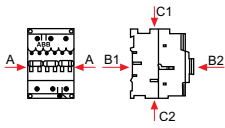
Connecting Characteristics

| Contactor types: | AF... | 1350 | 1650 |
|---|---|---|------------|
| Main terminals | | | |
| Flat type | | | |
| Connecting capacity (min. ... max.) | | | |
| Main conductors (poles) | | | |
| Rigid: |  1 x mm ² | - | - |
| |  2 x mm ² | - | - |
| Rigid with connector | | | |
| single for Cu cable |  mm ² | - | - |
| single for Al/Cu cable |  mm ² | - | - |
| double for Al/Cu cable |  mm ² | - | - |
| Flexible | | | |
| |  1 x mm ² | - | - |
| |  2 x mm ² | - | - |
| Bars or lugs |  L mm ≤ Ø mm > | 100 12 | 100 12 |
| Auxiliary conductors (coil terminals) | | | |
| Rigid solid | | | |
| |  1 x mm ² | 1...4 | 1...4 |
| |  2 x mm ² | 1...4 | 1...4 |
| Flexible with cable end | | | |
| |  1 x mm ² | 0.75...2.5 | 0.75...2.5 |
| |  2 x mm ² | 0.75...2.5 | 0.75...2.5 |
| Lugs |  L mm ≤ l mm > | 8 3.7 | 8 3.7 |
| Degree of protection acc. to IEC 60947-1 / EN 60947-1 and IEC 60529 / EN 60529 | | | |
| - Main terminals | | IP 00 | IP 00 |
| - Coil terminals | | IP 20 | IP 20 |
| - Built-in auxiliary terminals | | | |
| Screw terminals | | Screw and bolts M12 | |
| Main terminals | | | |
| Coil terminals (delivered in open position) | | M3.5 (+,-) pozidriv 2 screws with cable clamp | |
| Built-in auxiliary terminals | | - | - |
| Tightening torque | | | |
| Main pole terminals | | | |
| - recommended | Nm / lb.in | 45/443 | 45/443 |
| - max. | Nm | 49 | 49 |
| Coil terminals | | | |
| - recommended | Nm / lb.in | 1.00 / 9 | 1.00 / 9 |
| - max. | Nm | 1.20 | 1.20 |
| Built-in auxiliary terminals | | | |
| - recommended | Nm / lb.in | - | - |
| - max. | Nm | - | - |

UL/CSA & IEC Technical data

AL9 – AL40

| Contactor types: | AL | AL9 | AL12 | AL16 | AL26 | AL30 | AL40 |
|---|----|---|-----------------|-------------------|------|------|------|
| Rated insulation voltage U_i according to IEC 60947-4-1 | V | | | | 1000 | | |
| according to UL/CSA | V | | | | 600 | | |
| Rated impulse withstand voltage U_{imp} | kV | | | | 8 | | |
| Standards | | Devices complying with international standards IEC 60947-1 / 60947-4-1 and European standards EN 60947-1 / 60947-4-1 | | | | | |
| Air temperature close to contactor – fitted with thermal O/L relay | °C | see "Conditions for use" page 1.50, for control voltage limits and authorized mounting positions | | | | | |
| – without thermal O/L relay | °C | -25 to +55 | | | | | |
| – for storage | °C | -40 to +70 (55 max. for TAE... contactors) | | | | | |
| Climatic withstand | | -60 to +80 | | | | | |
| Climatic withstand | | acc. to IEC 60068-2-30 and 60068-2-11 - UTE C 63-100 specification II | | | | | |
| Operating altitude | m | ≤ 3000 | | | | | |
| Shock withstand acc. IEC 60068-2-27 and EN 60068-2-27 Mounting position 1 (see page 1.50) | | 1/2 sinusoidal shock for 11 ms: no change in contact position | | | | | |
| | | Shock direction | Making position | Breaking position | | | |
| | | A | 20 g | 20 g | | | |
| | | B1 | 10 g | 5 g | | | |
| | | B2 | 15 g | 15 g | | | |
| | | C1 | 20 g | 20 g | | | |
| | | C2 | 20 g | 20 g | | | |





IEC Technical data

AL9 – AL40

Across the line
1

Main Pole - Utilization Characteristics

| Contactor types: | AL | AL9 | AL12 | AL16 | AL26 | AL30 | AL40 | |
|--|---------------------------------------|--------|----------------------|------|------|------|------|------|
| Rated operational voltage U_o max. | V | 690 | | | | | | |
| Rated frequency limits | Hz | 25-400 | | | | | | |
| Conventional free-air thermal current I_{th} acc. to IEC 60947-4-1, open contactors $\varnothing \leq 40^\circ\text{C}$ | A | 26 | 28 | 30 | 45 | 65 | 65 | |
| with conductor cross-sectional area mm^2 | 4 | 4 | 4 | 6 | 16 | 16 | 35 | |
| Rated operational current I_o / AC-1 for air temperature close to contactor | | | | | | | | |
| U_o max. 690 V | $\varnothing \leq 40^\circ\text{C}$ | A | 25 | 27 | 30 | 45 | 55 | 60 |
| | $\varnothing \leq 55^\circ\text{C}$ | A | 22 | 25 | 27 | 40 | 55 | 60 |
| | $\varnothing \leq 70^\circ\text{C}$ ③ | A | 18 | 20 | 23 | 32 | 39 | 42 |
| with conductor cross-sectional area | mm^2 | 2.5 | 4 | 4 | 6 | 10 | 16 | |
| Utilization categorie AC-3 | | | | | | | | |
| for air temperature close to contactor $\leq 55^\circ\text{C}$ | | | | | | | | |
| Rated operational current I_o AC-3 ① | | | | | | | | |
| 220-230-240 V | V | A | 9 | 12 | 17 | 26 | 33 | 40 |
| 380-400 V | V | A | 9 | 12 | 17 | 26 | 32 | 37 |
| 415 V | V | A | 9 | 12 | 17 | 26 | 32 | 37 |
| 440 V | V | A | 9 | 12 | 16 | 26 | 32 | 37 |
| 500 V | V | A | 9 | 12 | 14 | 22 | 28 | 33 |
| 690 V | V | A | 7 | 9 | 10 | 17 | 21 | 25 |
| 1000 V | V | A | – | – | – | – | – | – |
| 3-phase motors | | | | | | | | |
|  | | | | | | | | |
| Rated operational power AC-3 ① | | | | | | | | |
| 220-230-240 V | V | kW | 2.2 | 3 | 4 | 6.5 | 9 | 11 |
| 380-400 V | V | kW | 4 | 5.5 | 7.5 | 11 | 15 | 18.5 |
| 415 V | V | kW | 4 | 5.5 | 9 | 11 | 15 | 18.5 |
| 440 V | V | kW | 4 | 5.5 | 9 | 15 | 18.5 | 22 |
| 500 V | V | kW | 5.5 | 7.5 | 9 | 15 | 18.5 | 22 |
| 690 V | V | kW | 5.5 | 7.5 | 9 | 15 | 18.5 | 22 |
| 1000 V | V | kW | – | – | – | – | – | – |
| 1500 r.p.m. 50 Hz 1800 r.p.m. 60 Hz 3-phase motors | | | | | | | | |
|  | | | | | | | | |
| Rated making capacity AC-3 according to IEC 60947-4-1 | | | $10 \times I_o$ AC-3 | | | | | |
| Rated breaking capacity AC-3 according to IEC 60947-4-1 | | | $8 \times I_o$ AC-3 | | | | | |
| Short-circuit protection for contactors without thermal O/L relay - Motor protection excluded $U_o \leq 500$ V a.c. - gG type fuse | A | 25 | 32 | 32 | 50 | 63 | | |
| Rated short-time withstand current I_{cw} at 40°C ambient temp., in free air, from a cold state | | | | | | | | |
| 1 s | A | 250 | 280 | 300 | 400 | 600 | | |
| 10 s | A | 100 | 120 | 140 | 210 | 400 | | |
| 30 s | A | 60 | 70 | 80 | 110 | 225 | | |
| 1 min | A | 50 | 55 | 60 | 90 | 150 | | |
| 15 min | A | 26 | 28 | 30 | 45 | 65 | | |
| Maximum breaking capacity $\cos \varnothing = 0.45$ ($\cos \varnothing = 0.35$ for $I_o > 100$ A) | | | | | | | | |
| at 440 V | A | 250 | – | – | 420 | 820 | | |
| at 690 V | A | 90 | – | – | 170 | 340 | | |
| Heat dissipation per pole | | | | | | | | |
| I_o / AC-1 | W | 0.8 | 1 | 1.2 | 1.8 | 2.5 | | |
| I_o / AC-3 | W | 0.1 | 0.2 | 0.35 | 0.6 | 0.9 | | |
| Max. electrical switching frequency | | | | | | | | |
| – for AC-1 | cycles/h | 600 | | | | | | |
| – for AC-3 | cycles/h | 1200 | | | | | | |
| – for AC-2, AC-4 | cycles/h | 300 | | | | | | |
| Mechanical durability | | | | | | | | |
| – millions of operating cycles | | 10 | | | | | | |
| – max. mechanical switching frequency | cycles/h | 3600 | | | | | | |

IEC Technical data

AL9 – AL40, TAL9 – TAL40

Magnet system characteristics for AL contactors

| Contactor types: | AL | AL9 | AL12 | 16 | 26 | 30 | 40 |
|--|---|--------------------------|------|----|-----|----|----|
| Rated control circuit voltage U_c | V d.c. 12 ... 240 (24V & 48V for AL...Z) | | | | | | |
| Coil operating limits according to IEC 60947-4-1 | $\vartheta \leq 55^\circ\text{C}$ 0.85 ... 1.1 x U_c | | | | | | |
| Drop-out voltage in % of U_c | roughly 15 ... 30 % | | | | | | |
| Coil consumption - Average values | | | | | | | |
| - pull-in value | W | 3 (2.4 for AL9Z - AL16Z) | | | 3.5 | | |
| - holding value | W | 3 (2.4 for AL9Z - AL16Z) | | | 3.5 | | |
| Coil time constant | | | | | | | |
| - open | L/R | ms | 40 | | | | |
| - closed | L/R | ms | 90 | | | | |
| Operating time | | | | | | | |
| between coil energization and: | | | | | | | |
| - N.O. contact closing | ms | 50 ... 75 | | | | | |
| - N.C. contact opening | ms | 45 ... 70 | | | | | |
| between coil de-energization and | | | | | | | |
| - N.O. contact opening | ms | 15 ... 30 | | | | | |
| - N.C. contact closing | ms | 17 ... 32 | | | | | |

Magnet System Characteristics for TAL... Contactors

| Contactor types: | TAL | TAL9 | TAL12 | TAL16 | TAL26 | TAL30 | TAL40 |
|--|---|-------------|-------|-------|-------|-------|-------|
| Rated control circuit voltage U_c | V d.c. 9 ... 264 | | | | | | |
| Coil operating limits according to IEC 60947-4-1 | $\vartheta \leq 55^\circ\text{C}$ 0.85 ... 1.1 x U_c | | | | | | |
| Drop-out voltage in % of U_c max. | roughly 20... 35 % | | | | | | |
| Coil consumption values for U_c max. and 20 °C | | | | | | | |
| - U_c max. DC | W | 8.5 | | | 9 | | |
| - U_c min. DC | W | 2.5 | | | 2.7 | | |
| - U_c DC | W | 5 | | | 5.4 | | |
| Operating time | | | | | | | |
| between coil energization and: | | | | | | | |
| - N.O. contact closing | ms | 50 ... 100 | | | | | |
| - N.C. contact opening | ms | 20 ... 70 | | | | | |
| between coil de-energization and | | | | | | | |
| - N.O. contact opening | ms | 10 ... 17 ① | | | | | |
| - N.C. contact closing | ms | 16 ... 27 ① | | | | | |

① The use of surge suppressors increases the opening time on a scale of 1.1 to 1.5 for a varistor suppressor and on a scale of 4 to 8 for a diode suppressor.

IEC Technical data

AL9 – AL40

Across the line
contactors

1

Built-in Auxiliary Contacts - Utilization Characteristics

| Contactor types: AL | AL9 | AL12 | AL16 | AL26 | AL30 | AL40 |
|--|-----|------|--------------------|------|------|------|
| Rated operational voltage U_o max. V | | | 690 | | | |
| Conventional free air thermal current I_{th} - $\theta \leq 40$ °C A | | | 16 | | | |
| Rated frequency limits Hz | | | 25 ... 400 | | | |
| Rated operational current I_o / AC-15 according to IEC 60947-5-1 | | | | | | |
| 24-127 V 50/60 Hz A | | | 6 | | | |
| 220-240 V 50/60 Hz A | | | 4 | | | |
| 380-440 V 50/60 Hz A | | | 3 | | | |
| 500 V 50/60 Hz A | | | 2 | | | |
| 690 V 50/60 Hz A | | | 2 | | | |
| Rated operational current I_o / DC-13 according to IEC 60947-5-1 | | | | | | |
| 24 V d.c. A / W | | | 6 / 144 | | | |
| 48 V d.c. A / W | | | 2.8 / 134 | | | |
| 72 V d.c. A / W | | | 2 / 144 | | | |
| 125 V d.c. A / W | | | 1.1 / 138 | | | |
| 250 V d.c. A / W | | | 0.55 / 138 | | | |
| Rated making capacity acc. to IEC 60947-5-1 | | | 10 x I_o / AC-15 | | | |
| Rated breaking capacity acc. to IEC 60947-5-1 | | | 10 x I_o / AC-15 | | | |
| Short-circuit protection gG type fuse A | | | 10 | | | |
| Rated short-time withstand current I_{cw} | | | | | | |
| for 1.0 s A | | | 100 | | | |
| for 0.1 s A | | | 140 | | | |
| Minimum switching capacity V / mA | | | 17 / 5 | | | |
| Non-overlapping time between N.O. and N.C. contacts ms | | | ≥ 2 | | | |
| Insulating resistance at 500 V d.c. after durability test MOhm | | | 5 | | | |
| Heat dissipation per pole at 6 A W | | | 0.10 | | | |

IEC Technical data

AL9 – AL40

Mounting characteristics

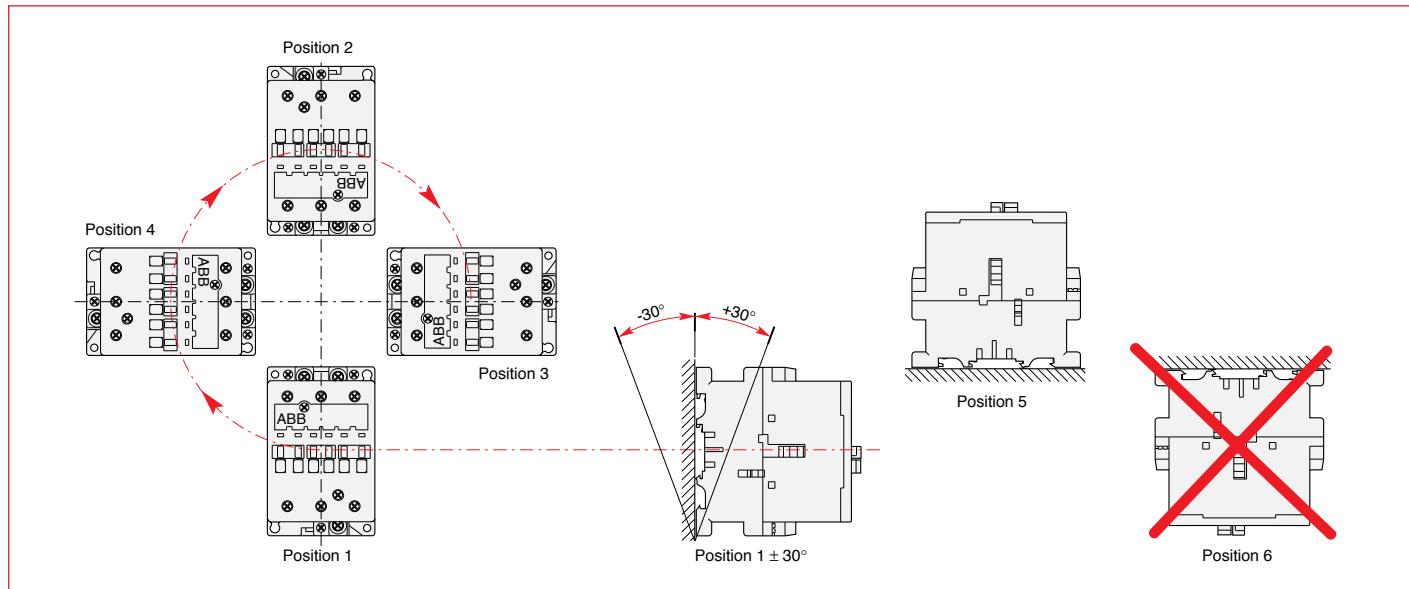
| | |
|--|--|
| Contactor types: AL | AL9 AL12 AL16 AL26 AL30 AL40 |
| Mounting positions | see "Conditions for use" |
| Mounting distances | The contactors can be assembled side by side |
| Mounting | |
| on DIN rail | 35 x 7.5 mm |
| according to IEC 715 and EN 50022 / EN 50023 | 35 x 15 mm |
| by screws (not supplied) | 2 x M4 |

Conditions for Use

Sustainable utilization conditions for contactors involving at the same time the Mounting position, Ambient temperature and Control voltage operating limits are summarized in the table below.

| Contactors | Mounting position | Ambient temperature | Control voltage |
|------------|------------------------|---------------------|-------------------------------|
| AL9 – AL40 | 1, 1 ± 30°, 2, 3, 4, 5 | ≤ 55 °C | 0.85 ... 1.1 x U _c |
| | 6 (Unauthorized) | 55 ... 70 °C | U _c |
| | | | |

Mounting Positions (see the above table for authorized positions)



IEC Technical data

AL9 – AL40

Across the line
1

Connecting Characteristics

Contactor types: **AL** **AL9** **AL12** **AL16** **AL26** **AL30** **AL40**

Main terminals



Connecting capacity (min. ... max.)

Main conductors (poles)

| | | | | | | |
|--|--|---------------------|--------------|---|------------|------------|
| Rigid: solid ($\leq 4 \text{ mm}^2$) | | 1 x mm ² | 1 ... 4 | | 1.5 ... 6 | 2.5 ... 16 |
| | | 2 x mm ² | 1 ... 4 | | 1.5 ... 6 | 2.5 ... 16 |
| Rigid with connector | | mm ² | - | - | - | - |
| single for Cu cable | | mm ² | - | - | - | - |
| single for Al/Cu cable | | mm ² | - | - | - | - |
| double for Al/Cu cable | | mm ² | - | - | - | - |
| Flexible with cable end | | 1 x mm ² | 0.75 ... 2.5 | | 0.75 ... 4 | 2.5 ... 10 |
| | | 2 x mm ² | 0.75 ... 2.5 | | 0.75 ... 4 | 2.5 ... 10 |
| Bars or lugs | | L mm \leq | 8 | | 10 | - |
| | | l mm $>$ | 3.7 | | 4.2 | - |

Auxiliary conductors

(built-in auxiliary terminals + coil terminals)

| | | | | | | |
|-------------------------|--|---------------------|--------------|--|-------|--|
| Rigid solid | | 1 x mm ² | 1 ... 4 | | | |
| | | 2 x mm ² | 1 ... 4 | | | |
| Flexible with cable end | | 1 x mm ² | 0.75 ... 2.5 | | | |
| | | 2 x mm ² | 0.75 ... 2.5 | | | |
| Lugs | | L mm \leq | 8 | | ① 8 | |
| | | l mm $>$ | 3.7 | | ① 3.7 | |

Degree of protection acc. to IEC 60947-1 / EN 60947-1 and IEC 60529 / EN 60529

Protection against direct contact acc. to VDE 0106 - Part. 100

| | |
|--------------------------------|---|
| - Main terminals | IP 20 |
| - Coil terminals | IP 20 |
| - Built-in auxiliary terminals | IP 20 |
| Screw terminals | (delivered in open position, screws of unused terminals must be tightened) |
| Main terminals | (+,-) pozidriv 2 screws M3.5 M4 M5 |
| Coil terminals | M3.5 (+,-) pozidriv 2 screws with cable clamp |
| Built-in auxiliary terminals | (+,-) pozidriv 2 screws with cable clamp M3.5 M4 M5 |

Tightening torque

| | | | | |
|------------------------------|------------|----------|----------|-----------|
| Main pole terminals | | | | |
| - recommended | Nm / lb.in | 1.00 / 9 | 1.7 / 15 | 2.30 / 20 |
| - max. | Nm | 1.20 | 2.20 | 2.60 |
| Coil terminals | | | | |
| - recommended | Nm / lb.in | 1.00 / 9 | | |
| - max. | Nm | 1.20 | | |
| Built-in auxiliary terminals | | | | |
| - recommended | Nm / lb.in | 1.00 / 9 | 1.7 / 15 | 1.00 / 9 |
| - max. | Nm | 1.20 | 2.20 | 1.20 |

Terminal marking and positioning see pages 1.35

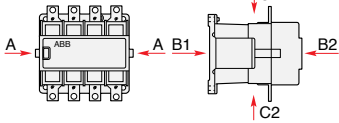
① $L \leq 8$ and $l > 3.7$ for coil terminal - $L \leq 10$ and $l > 4.2$ for built-in auxiliary terminals.
② With LW 110 enlargement piece. See page 1.31.

IEC Technical data

EK110 – EK1000

General Technical Data

| Contactor types: EK... | | 110 | 150 | 175 | 210 | 370 | 550 | 1000 |
|---|----|--|-----|-----|-----|-----|-----|------|
| Rated insulation voltage U_i according to IEC 60947-4-1 | V | 1000 | | | | | | |
| according to UL/CSA | V | 600 | | | | | | |
| Rated impulse withstand voltage U_{imp} | kV | 8 | | | | | | |
| Standards | | Devices complying with international standards IEC 60947-1 / 60947-4-1 and European standards EN 60947-1 / 60947-4-1 | | | | | | |
| Air temperature close to contactor – fitted with thermal O/L relay | °C | see "Conditions for use" page 1.63, for control voltage limits and authorized mounting positions | | | | | | |
| – without thermal O/L relay | °C | -25 to +55 | | | | | | |
| – for storage | °C | -40 to +70 | | | | | | |
| Climatic withstand | | acc. to IEC 60068-2-30 | | | | | | |
| Operating altitude | m | ≤ 3000 | | | | | | |
| Shock withstand acc. IEC 60068-2-27 and EN 60068-2-27 | | 1/2 sinusoidal shock for 15 ms: no change in contact position | | | | | | |
| Mounting position 1 (see page 1.63) | | Contactor in making or breaking position | | | | | | |
| | | Shock direction: A, C1, C2: 10 g | | | | | | |
| | | B1: 10 g | | | | | | |
| | | B2: 10 g | | | | | | |





IEC Technical data

EK110 – EK1000

Across the line
contactors

1

Main Pole - Utilization Characteristics

| Contactor types: | EK... | 110 | 150 | 175 | 210 | 370 | 550 | 1000 | |
|--|--------------------------------|----------------|----------------------|------|-----|---------|---------|---------|------|
| Rated operational voltage U_o max. | V | 1000 | | | | | | 690 | |
| Rated frequency limits | Hz | 25 ... 400 | | | | | | | |
| Conventional free-air thermal current I_{th} acc. to IEC 60947-4-1, open contactors $\theta \leq 40^\circ\text{C}$ | A | 200 | 250 | 300 | 350 | 550 | 800 | 1000 | |
| with conductor cross-sectional area | mm ² | 95 | 150 | 185 | 240 | 2 x 185 | 2 x 240 | 2 x 300 | |
| Rated operational current I_o / AC-1 for air temperature close to contactor | | | | | | | | | |
| U_o max. 690 V | $\theta \leq 40^\circ\text{C}$ | A | 200 | 250 | 300 | 350 | 550 | 800 | 1000 |
| | $\theta \leq 55^\circ\text{C}$ | A | 180 | 230 | 270 | 310 | 470 | 650 | 800 |
| | $\theta \leq 70^\circ\text{C}$ | A | 155 | 200 | 215 | 250 | 400 | 575 | 720 |
| with conductor cross-sectional area | mm ² | 95 | 150 | 185 | 240 | 2 x 185 | 2 x 240 | 2 x 300 | |
| Utilization categorie AC-3 | | | | | | | | | |
| for air temperature close to contactor $\leq 55^\circ\text{C}$ | | | | | | | | | |
| Rated operational current I_o AC-3 | | | | | | | | | |
| 3-phase motors  | 220-230-240 V | A | 120 | 145 | 210 | 400 | 550 | – | |
| | 380-400 V | A | 120 | 145 | 210 | 400 | 550 | – | |
| | 415 V | A | 120 | 145 | 210 | 400 | 550 | – | |
| | 440 V | A | 120 | 145 | 210 | 370 | 550 | – | |
| | 500 V | A | 120 | 145 | 210 | 370 | 550 | – | |
| | 690 V | A | 120 | 120 | 210 | 370 | 550 | – | |
| | 1000 V | A | 64 | 80 | 113 | 155 | 175 | – | |
| Rated operational power AC-3 | | | | | | | | | |
| 1500 r.p.m. 50 Hz | 220-230-240 V | kW | 30 | 45 | 59 | 110 | 160 | – | |
| 1800 r.p.m. 60 Hz | 380-400 V | kW | 55 | 75 | 110 | 200 | 280 | – | |
| 3-phase motors  | 415 V | kW | 55 | 75 | 110 | 220 | 315 | – | |
| | 440 V | kW | 59 | 75 | 110 | 220 | 315 | – | |
| | 500 V | kW | 75 | 90 | 132 | 250 | 400 | – | |
| | 690 V | kW | 110 | 110 | 160 | 355 | 500 | – | |
| | 1000 V | kW | 90 | 110 | 160 | 220 | 250 | – | |
| Rated making capacity AC-3 according to IEC 60947-4-1 | | | | | | | | | |
| | | | $10 \times I_o$ AC-3 | | | | | – | |
| Rated breaking capacity AC-3 according to IEC 60947-4-1 | | | | | | | | | |
| | | | $8 \times I_o$ AC-3 | | | | | – | |
| Short-circuit protection for contactors without thermal O/L relay - Motor protection excluded | | | | | | | | | |
| $U_o \leq 500$ V a.c. - gG type fuse | A | 250 | | 355 | | 630 | 800 | 1000 | |
| Rated short-time withstand current I_{cw} at 40°C ambient temp., in free air, from a cold state | | | | | | | | | |
| 1 s | A | 1700 | 1800 | 2300 | | 5500 | | 6800 | |
| 10 s | A | 900 | 1200 | 1680 | | 5300 | | 6400 | |
| 30 s | A | 600 | 700 | 1000 | | 3700 | | 4400 | |
| 1 min | A | 450 | 550 | 800 | | 3000 | | 3400 | |
| 15 min | A | 210 | 250 | 320 | | 1000 | | 1200 | |
| Maximum breaking capacity | | | | | | | | | |
| cos $\phi = 0.45$ (cos $\phi = 0.35$ for $I_o > 100$ A) | | | | | | | | | |
| at 440 V | A | 1400 | 1500 | 2000 | | 5000 | 5400 | – | |
| at 690 V | A | 1100 | 1200 | 1700 | | 5000 | 5400 | – | |
| Heat dissipation per pole | | | | | | | | | |
| I_o / AC-1 | W | 10 | 13 | 18 | | 40 | 60 | 80 | |
| I_o / AC-3 | W | 3 | 5 | 9 | | 15 | 25 | – | |
| Max. electrical switching frequency | | | | | | | | | |
| – for AC-1 | cycles/h | 300 | | | | | | 300 | |
| – for AC-3 | cycles/h | 300 | | | | | | – | |
| – for AC-2, AC-4 | cycles/h | 150 | | 120 | | | | – | |
| Electrical durability | | | | | | | | | |
| | | see pages 1.75 | | | | | | | |
| Mechanical durability | | | | | | | | | |
| – millions of operating cycles | | 10 | | | | 5 | | | |
| – max. mechanical switching frequency | cycles/h | 3600 | | | | 3600 | | | |

IEC Technical data

EK110 – EK1000

Magnet System Characteristics for EK... Contactors - a.c. Operated

| Contactor types: | EK... | 110 | 150 | 175 | 210 | 370 | 550 | 1000 |
|--|-----------------------------|---|-----|---------|-----|-------------|-----|------|
| Rated control circuit voltage U_c | | | | | | | | |
| – at 50 Hz | V | 24 ... 500 | | | | 48 ... 500 | | |
| – at 60 Hz | V | 24 ... 600 | | | | 110 ... 600 | | |
| Coil operating limits according to IEC 60947-4-1 | | $\vartheta \leq 70\text{ °C}$ 0.85 ... 1.1 x U_c | | | | | | |
| Drop-out voltage in % of U_c | | roughly 45 ... 65 % | | | | | | |
| Coil consumption | | | | | | | | |
| Average pull-in value | 50 Hz ^① VA | 800 | | 1100 | | 3500 | | |
| | 60 Hz ^① VA | 900 | | 1200 | | 4000 | | |
| | 50/60 Hz ^② VA/VA | 500/500 | | 630/630 | | 3800/3400 | | |
| Average holding value | 50 Hz ^① VA/W | 44/15 | | 52/18 | | 125/50 | | |
| | 60 Hz ^① VA/W | 52/18 | | 65/22 | | 140/60 | | |
| | 50/60 Hz ^② VA/W | 2.5/2.5 | | 2.5/2.5 | | 140/60 | | |
| Operating time | | | | | | | | |
| between coil energization and: | | | | | | | | |
| – N.O. contact closing | ms | 20 ... 40 ^① / 30 ... 50 ^② | | | | 30 ... 60 | | |
| – N.C. contact opening | ms | 15 ... 35 ^① / 25 ... 45 ^② | | | | 25 ... 55 | | |
| between coil de-energization and: | | | | | | | | |
| – N.O. contact opening | ms | 7.5 ... 15 ^① / 95 ... 120 ^② | | | | 10 ... 20 | | |
| – N.C. contact closing | ms | 10 ... 18 ^① / 100 ... 125 ^② | | | | 13 ... 23 | | |

Magnet System Characteristics for EK... Contactors - d.c. Operated

| Contactor types: | EK... | 110 | 150 | 175 | 210 | 370 | 550 | 1000 |
|--|--------|---|-----|-----|-----|------------|-----|------|
| Rated control circuit voltage U_c | V d.c. | 12 ... 220 | | | | 24 ... 220 | | |
| Coil operating limits according to IEC 60947-4-1 | | $\vartheta \leq 70\text{ °C}$ 0.85 ... 1.1 x U_c | | | | | | |
| Drop-out voltage in % of U_c | | roughly 15 ... 50 % | | | | | | |
| Coil consumption - Average values | | | | | | | | |
| – pull-in value | W | 500 | | 630 | | 1100 | | |
| – holding value | W | 2.5 | | 2.5 | | 20 | | |
| Coil time constant | | | | | | | | |
| – open | L/R | ms | 8 | | | 12 | | |
| – closed | L/R | ms | 50 | | | 60 | | |
| Operating time | | | | | | | | |
| between coil energization and: | | | | | | | | |
| – N.O. contact closing | ms | 30 ... 50 | | | | 60 ... 80 | | |
| – N.C. contact opening | ms | 27 ... 47 | | | | 55 ... 75 | | |
| between coil de-energization and: | | | | | | | | |
| – N.O. contact opening | ms | 10 ... 35 | | | | | | |
| – N.C. contact closing | ms | 13 ... 38 | | | | | | |

① "A" coil voltage codes see page 1.29.

② 50/60 Hz "E" coil voltage codes see page 1.29.

IEC Technical data

EK110 — EK1000

Across the line
contactors

1

Mounting Characteristics

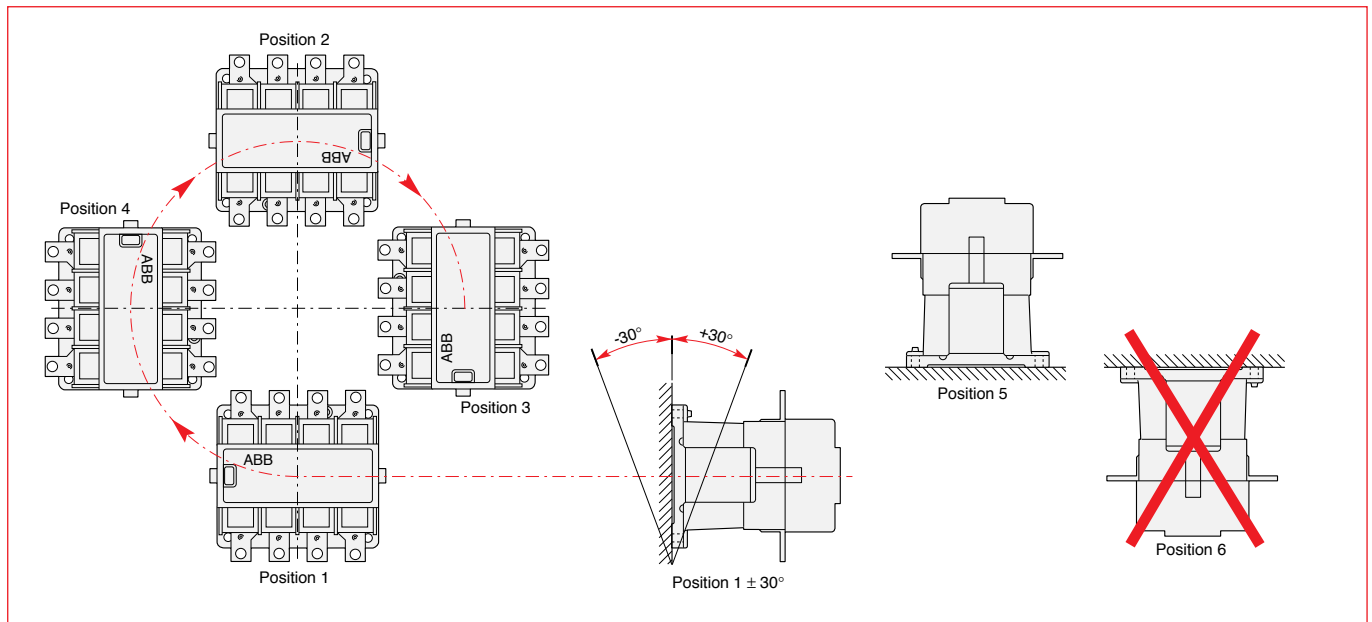
| Contactor types: | EK... | 110 | 150 | 175 | 210 | 370 | 550 | 1000 |
|-----------------------------|--------------------------|-----|-----|-----|-----|------------|-----|------|
| Mounting positions | see "Conditions for use" | | | | | | | |
| Fixing by screws (supplied) | 4 x M6 | | | | | 4 x M6 (1) | | |

Conditions for Use

Sustainable utilization conditions for contactors involving at the same time the Mounting position, Ambient temperature and Control voltage operating limits are summarized in the table below.

| Contactors | Mounting position | Ambient temperature | Control voltage |
|-----------------|--|-------------------------|-----------------------------|
| E110 ... EK210 | 1, $1 \pm 30^\circ$, 3, 4, 5 2, 6 unauthorized | $\leq 70^\circ\text{C}$ | $0.85 \dots 1.1 \times U_c$ |
| E370 ... EK1000 | 1, $1 \pm 30^\circ$, 2, 3, 4, 5 6 unauthorized | $\leq 70^\circ\text{C}$ | $0.85 \dots 1.1 \times U_c$ |

Mounting Positions (see the above table for authorized positions)



① Damping elements are supplied

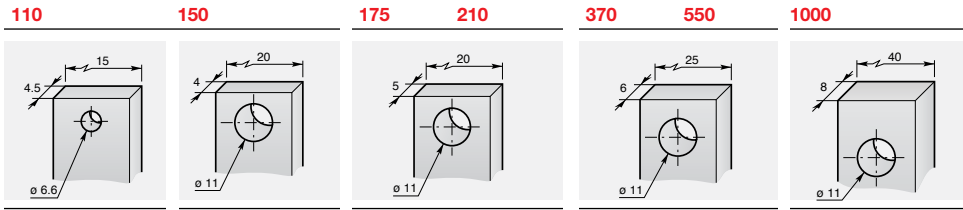
IEC Technical data

EK110 – EK1000

Connecting Characteristics

Contactor types: EK...

Main terminals
Flat type



Connecting capacity (min. ... max.)

Main conductors (poles)

| | | 110 | 150 | 175 | 210 | 370 | 550 | 1000 |
|----------------------|--|------------|------------|-----|------------|----------------|-----|----------------|
| Rigid: | 1 x mm ² | - | - | - | - | - | - | - |
| | 2 x mm ² | - | - | - | - | - | - | - |
| Rigid with connector | single for Cu cable mm ² | 25 ... 185 | | | 70 ... 300 | | - | |
| | single for Al/Cu cable mm ² | 10 ... 70 | 35 ... 120 | | | 70 ... 300 | | 95 ... 300 |
| | double for Al/Cu cable mm ² | - | - | | | 2 x 35 ... 185 | | 2 x 95 ... 300 |
| Flexible | 1 x mm ² | - | - | - | - | - | - | - |
| | 2 x mm ² | - | - | - | - | - | - | - |
| Bars or lugs | L mm ≤ | 30 | 30 | 33 | | 55 | | |
| | Ø mm > | 6 | 10 | 10 | | 10 | | |

Auxiliary conductors
(coil terminals)

| | | | | | | | | |
|-------------------------|---------------------|-------------|--|--|--|--|--|--|
| Rigid solid | 1 x mm ² | 0.5 ... 2.5 | | | | | | |
| | 2 x mm ² | 0.5 ... 2.5 | | | | | | |
| Flexible with cable end | 1 x mm ² | 0.5 ... 2.5 | | | | | | |
| | 2 x mm ² | 0.5 ... 2.5 | | | | | | |
| Lugs | L mm ≤ | 8 | | | | | | |
| | l mm > | 3.7 | | | | | | |

Degree of protection acc. to IEC 60947-1 / EN 60947-1 and IEC 60529 / EN 60529

- Main terminals
- Coil terminals

Protection against direct contact acc. to VDE 0106 - Part. 100

IP 00
IP 20

Screw terminals

Main terminals

Screws and bolts

M6 M10

Coil terminals (delivered in open position)

M3.5 (+,-) pozidriv 2 screws with cable clamp

Tightening torque

Main pole terminals

- recommended Nm / lb.in
- max. Nm

5 / 44 18 / 160
6 22

Coil terminals

- recommended Nm / lb.in
- max. Nm

1.00 / 9
1.20

IEC Technical data

Contactor electrical durability and Utilization categories

General

Utilization categories determine the current making and breaking conditions relating to the characteristics of the loads to be controlled by the contactors. International standard IEC 60947-4-1 and European standard EN 60947-4-1 are the standards to be referred to.

If I_c is the current to be broken by the contactor and I_o the rated operational current normally drawn by the load, then:

- Categories AC-1 and AC-3: $I_c = I_o$
- Category AC-2: $I_c = 2.5 \times I_o$
- Category AC-4: $I_c = 6 \times I_o$

Generally speaking $I_c = m \times I_o$ where m is a multiple of the load operational current.

On pages 1.66 - 1.71, the curves corresponding to categories AC-1, AC-2, AC-3 and AC-4 represent the electrical durability variation of standard contactors in relation to the breaking current I_c .

Electrical durability is expressed in millions of operating cycles.

These curves have been plotted for 400 V - 50 Hz 3-phase currents but remain valid up to 690 V - 40 ... 60 Hz provided that a check is carried out to make sure that at the operational voltage U_o , the current I_o normally drawn by the load does not exceed the value of the contactor rated operational current: I_o / AC-1 for category AC-1 and I_o / AC-3 for categories AC-3 and AC-4. The values are given for each type of contactor in pages 1.44, 1.45, 1.54, and 1.61 (Technical Data).

Curve Utilization Mode

Electrical durability forecast and contactor selection for categories AC-1, AC-2, AC-3 or AC-4

- Note the characteristics of the load to be controlled:
 - Operational voltage U_o
 - Current normally drawn I_o (U_o / I_o / kW relation for motors, + page 0/0).
 - Utilization category AC-1, AC-2, AC-3 or AC-4
 - Breaking current $I_c = I_o$ for AC-1 and for AC-3 ; $I_c = 2.5 \times I_o$ for AC-2 ; $I_c = 6 \times I_o$ for AC-4
- Define the number of operating cycles N required.
- On the diagram corresponding to the operational category, select the contactor with the curve immediately above the intersection point (I_c ; N).

Electrical durability forecast and contactor selection for mixed duty motor control: AC-3 ($I_c = I_o$) type switching off while "motor running" and, occasionally, AC-4 ($I_c = 6 \times I_o$) type switching off while "motor accelerating".

- Note the characteristics of the motor to be controlled:
 - Operational voltage U_o
 - Current normally drawn while "motor running" I_o (U_o / I_o / kW relation for motors, + 0/0).
 - Breaking current for AC-3 $I_c = I_o$
 - Breaking current for AC-4 while "motor accelerating" $I_c = 6 \times I_o$
 - Percentage of AC-4 operations K (on the basis of the total number of operating cycles)
- Define the total number of operating cycles N required.
- Note the smallest contactor rating compatible for AC-3 (U_o / I_o) on pages 2/62, 2/63, 2/73, and 2/79.
- For the selected contactor make a note of the following in relation to the voltage using diagram AC-3 page 2/85 and AC-4 page 2/86 or 2/87:
 - The number of operating cycles A for $I_c = I_o$ (AC-3)
 - The number of operating cycles B for $I_c = 6 \times I_o$ (AC-4)
- Calculate the estimated number of cycles N' (N' is always below A)

$$N' = \frac{A}{1 + 0.01 K (A/B - 1)}$$

- If N' is too low in relation to the target N , calculate the estimated number of cycles for a higher contactor rating.

Case of uninterrupted duty.

Among the different utilization categories, the uninterrupted duty implies the following remark. The combined effect of environmental conditions and the proper temperature of the product may require some disposals. As a matter of fact, for this duty, the use duration prevails over the number of operating cycles.

For long term service, some verifications of preventing maintenance are needed to check the functionality of the concerned product (consult us).

Over a duration of five years, in these conditions the contactor might present high internal resistance. We recommend to change the contactor or change the contacts.

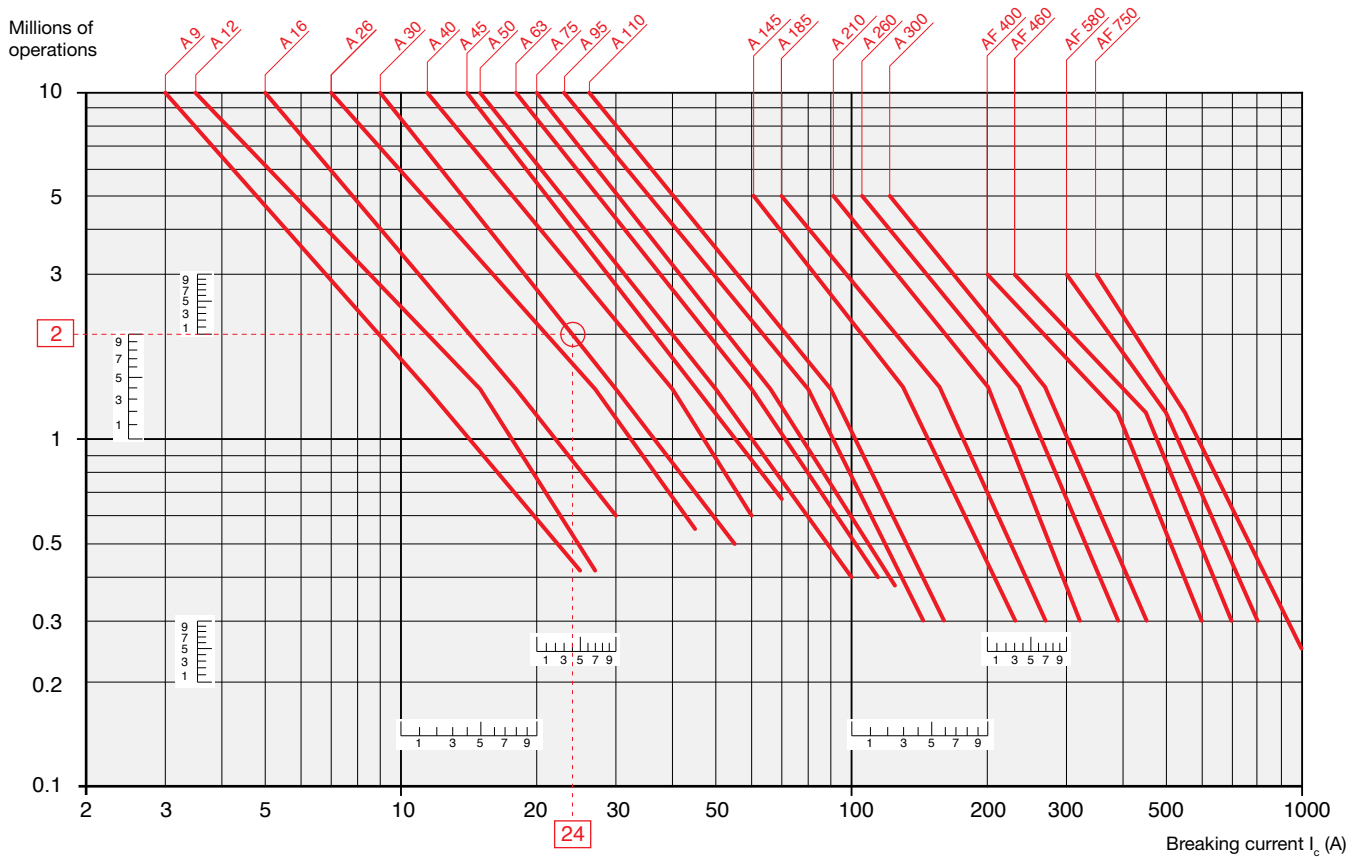
IEC Technical data

A9 – AF750

Electrical durability

Electrical Durability for AC-1 Utilization Category. Ambient Temperature $\leq 55\text{ }^{\circ}\text{C}$

Switching non-inductive or slightly inductive loads. The breaking current I_c for AC-1 is equal to the rated operational current of the load.



Example:

$I_c / \text{AC-1} = 24\text{ A}$ – Electrical durability required = 2 million operations.

Using the AC-1 curves above select the A 30 contactor at intersection "O" (24 A / 2 million operations).

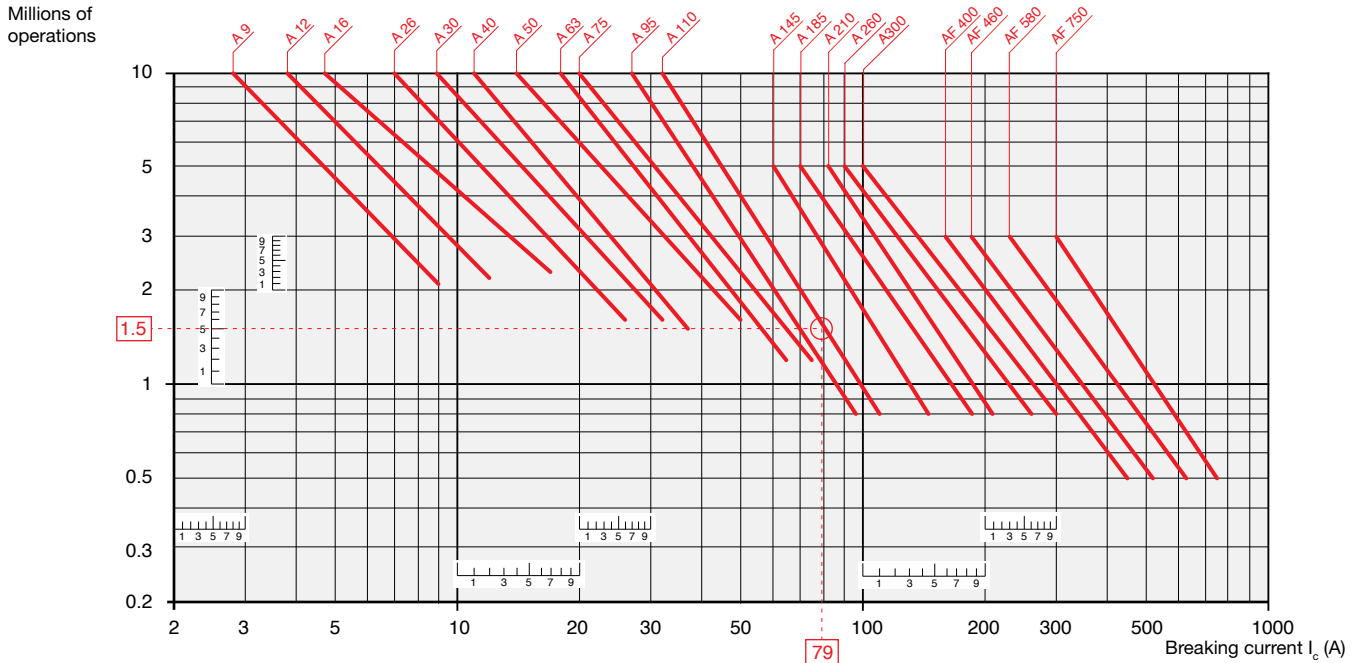
IEC Technical data

A9 – AF750

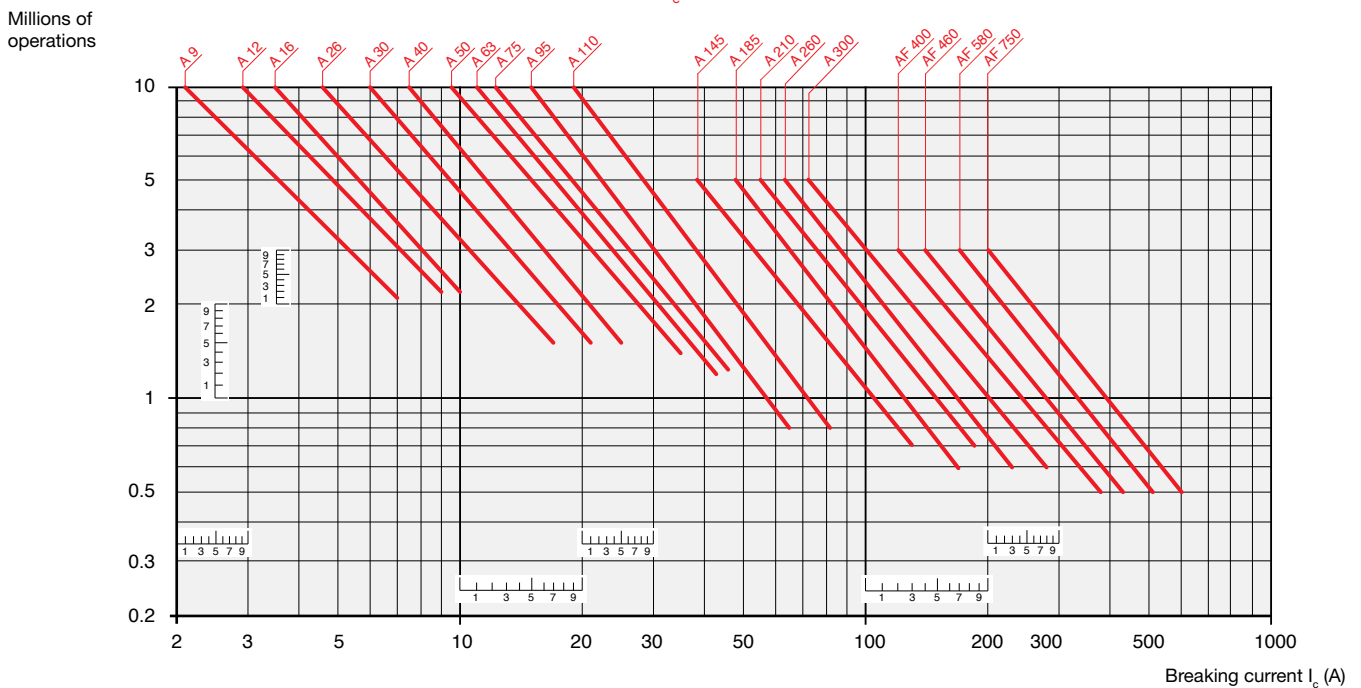
Electrical durability

Switching cage motors: starting and switching off running motors. The breaking current I_c for AC-3 is equal to the rated operational current I_o (I_o = motor full load current).

Electrical Durability for AC-3 Utilization Category - $U_e \leq 440$ V. Ambient Temperature ≤ 55 °C



Electrical Durability for AC-3 Utilization Category - 440 V < $U_e \leq 690$ V. Ambient Temperature ≤ 55 °C



Example:

Motor power 40 kW for AC-3 - $U_e = 400$ V utilization – Electrical durability required = 1.5 million operations.

40 kW, 400 V corresponds to $I_o = 79$ A. For AC-3: $I_c = I_o$. Select the A 110 contactor at intersection "O" (79 A / 1.5 million operations) on the curves (AC-3 - $U_e \leq 440$ V).

IEC Technical data

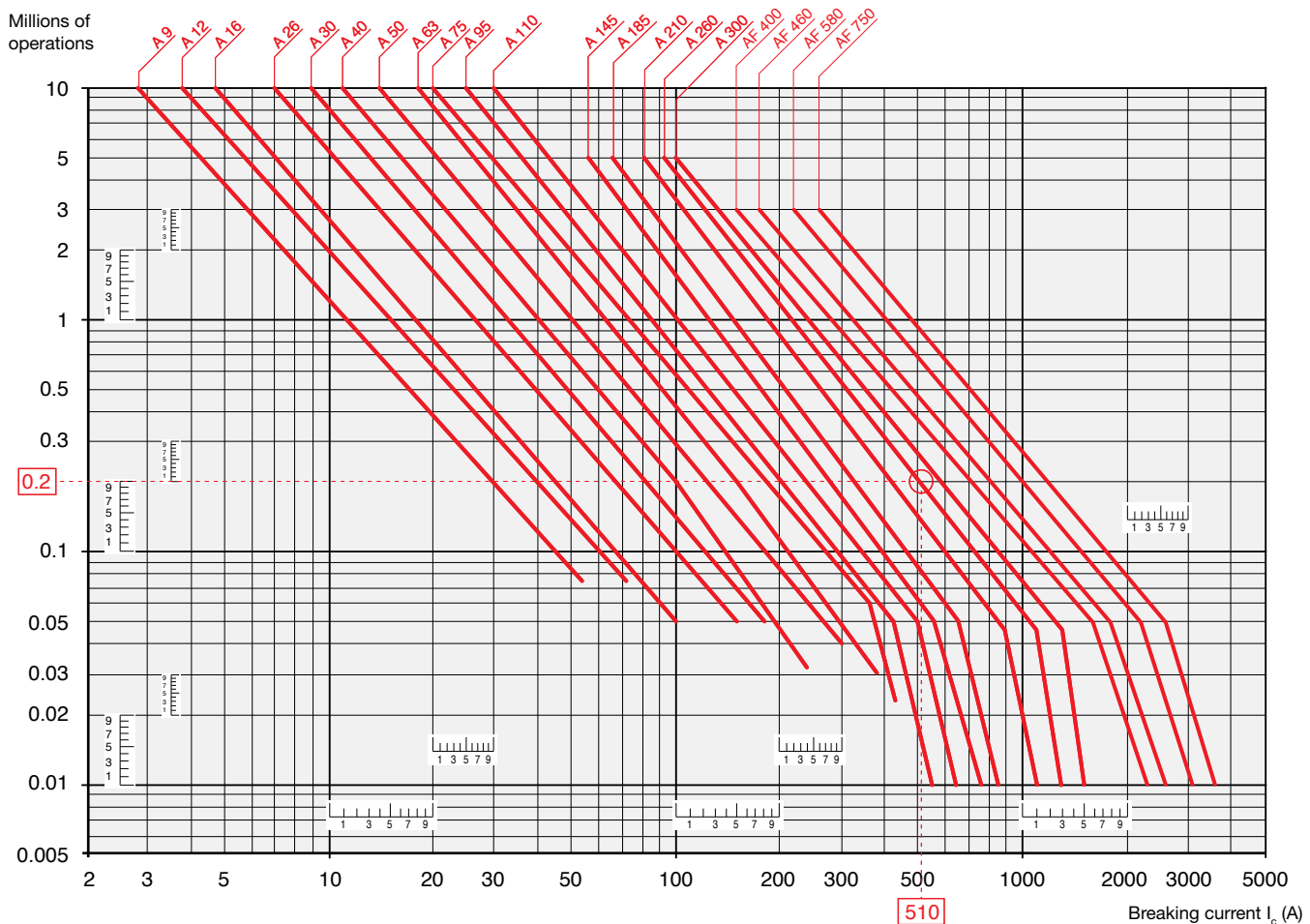
A9 – AF750

Electrical durability

Electrical Durability for AC-2 or AC-4 Utilization Category - $U_e \leq 440$ V. Ambient Temperature ≤ 55 °C

Maximum number of AC-2 or AC-4 operations: 300 per hour for A 9 ... A 40 contactors,
150 per hour for A 50 ... A 300 contactors.

Switching cage motors: starting, reverse operation and step-by-step operation. The breaking current I_c is equal to $2.5 \times I_e$ for AC-2 and $6 \times I_e$ for AC-4, keeping in mind that I_e is the motor rated operational current (I_e = motor full-load current).



Example:

Motor power 45 kW for AC-4 - $U_e = 400$ V utilization - Electrical durability required = 0.2 million operations.
45 kW, 400 V corresponds to $I_e = 85$ A.

For AC-4: $I_c = 6 \times I_e = 510$ A - Select the A 260 contactor at intersection "O" (510 A / 0.2 million operations) on the curves (AC-4 - $U_e \leq 440$ V).

IEC Technical data

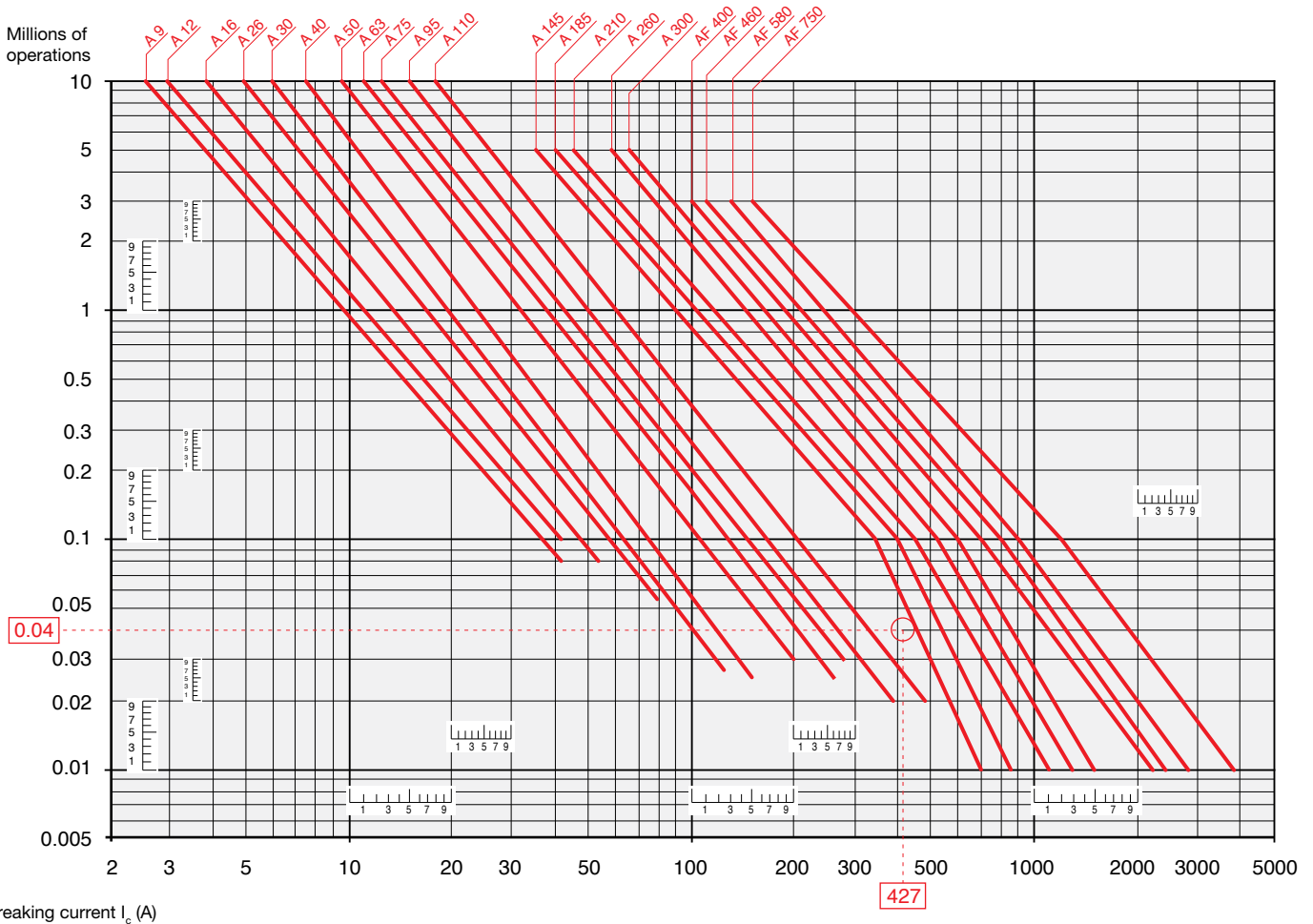
A9 – AF750

Electrical durability

Electrical Durability for AC-2 or AC-4 Utilization Category - $440\text{ V} < U_e \leq 690\text{ V}$. Ambient Temperature $\leq 55\text{ }^\circ\text{C}$

Maximum number of AC-2 or AC-4 operations: 300 per hour for A 9 ... A 40 contactors,
150 per hour for A 50 ... A 300 contactors.

Switching cage motors: starting, reverse operation and step-by-step operation. The breaking current I_c is equal to $2.5 \times I_e$ for AC-2 and $6 \times I_e$ for AC-4, keeping in mind that I_e is the motor rated operational current (I_e = motor full-load current).



Breaking current I_c (A)

Example:

Motor power 59 kW for AC-4 - $U_e = 600\text{ V}$ utilization – Electrical durability required = 0.04 million operations.

As stated on page 0/0: 59 kW, 600 V corresponds to $I_e = 71.1\text{ A}$.

For AC-4: $I_c = 6 \times I_e = 426.6\text{ A}$ - Select the A 145 contactor at intersection "O" (427 A / 0.04 million operations) on the curves (AC-4 - $440\text{ V} < U_e \leq 690\text{ V}$).

IEC Technical data

AL9 – AL40

Electrical durability

Consult
factory

IEC Technical data

EK110 – EK1000

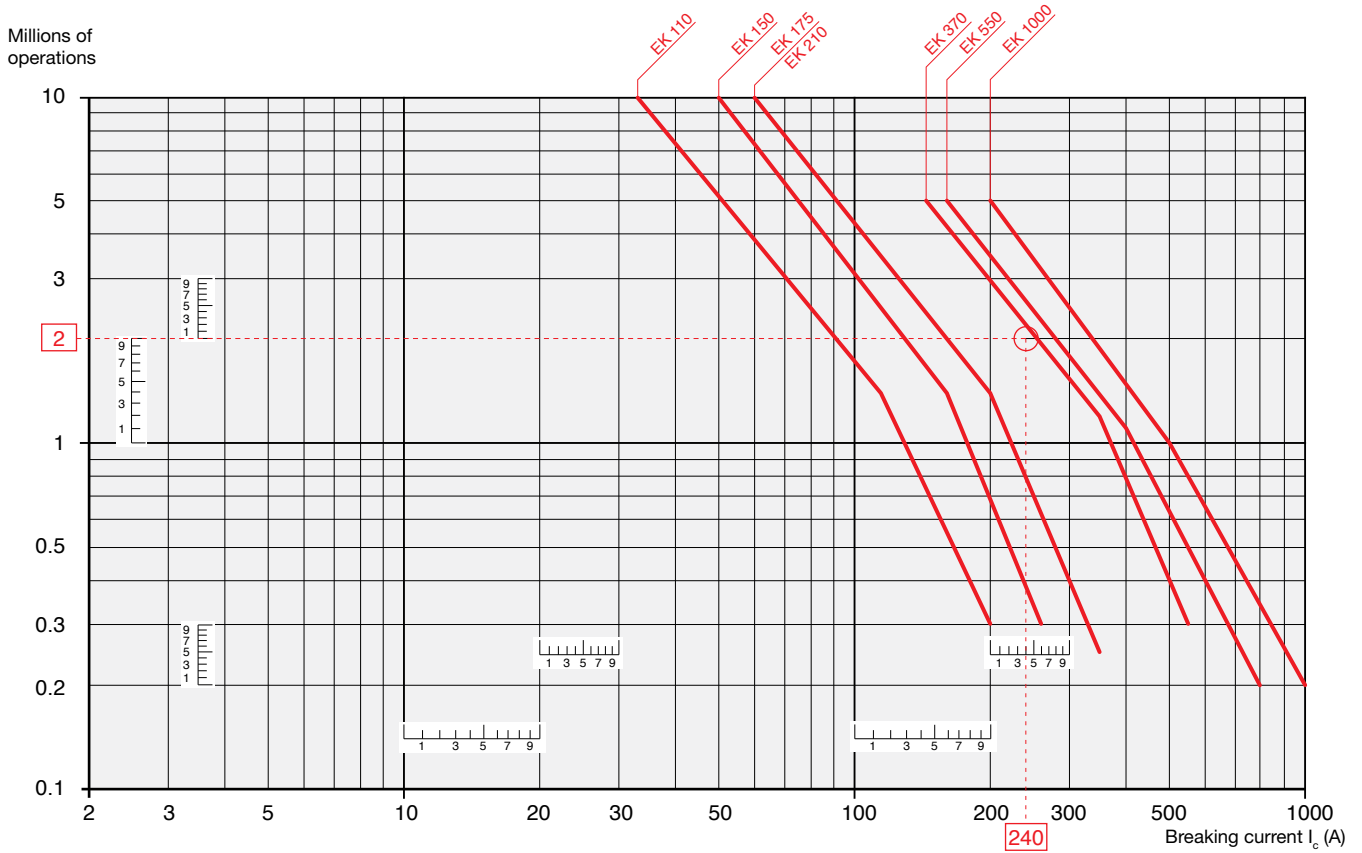
Electrical durability

Across the line
contactors

1

Electrical Durability for AC-1 Utilization Category. Ambient Temperature $\leq 55\text{ }^{\circ}\text{C}$

Switching non-inductive or slightly inductive loads. The breaking current I_c for AC-1 is equal to the rated operational current of the load.



Example:

$I_c / \text{AC-1} = 240\text{ A}$ – Electrical durability required = 2 million operations.

Using the AC-1 curves above select the EK 370 contactor at intersection "O" (240 A / 2 million operations).

IEC Technical data

Influence of the length of conductors used in contactor control circuits



A 50-30-00



AF 460-30-11

Under certain conditions the excessive length of the control circuit conductors may prevent the contactor from carrying out closing and opening orders.

- no closing: due to excessive voltage drop (in a.c. or d.c.).
- no opening: due to excessive capacitance (in a.c.).

Contactor Closing (contactor with a.c. or d.c. fed control circuit)

The voltage drop is due to the pull-in current (pull-in power) and to the resistance of the control circuit conductors.

The table and graph below can be used to determine the single length of line feeders (distance between the control device and the contactor coil) in relation to:

- I the coil pull-in consumption.
- I the supply voltage.
- I the connecting wire cross-sectional area.

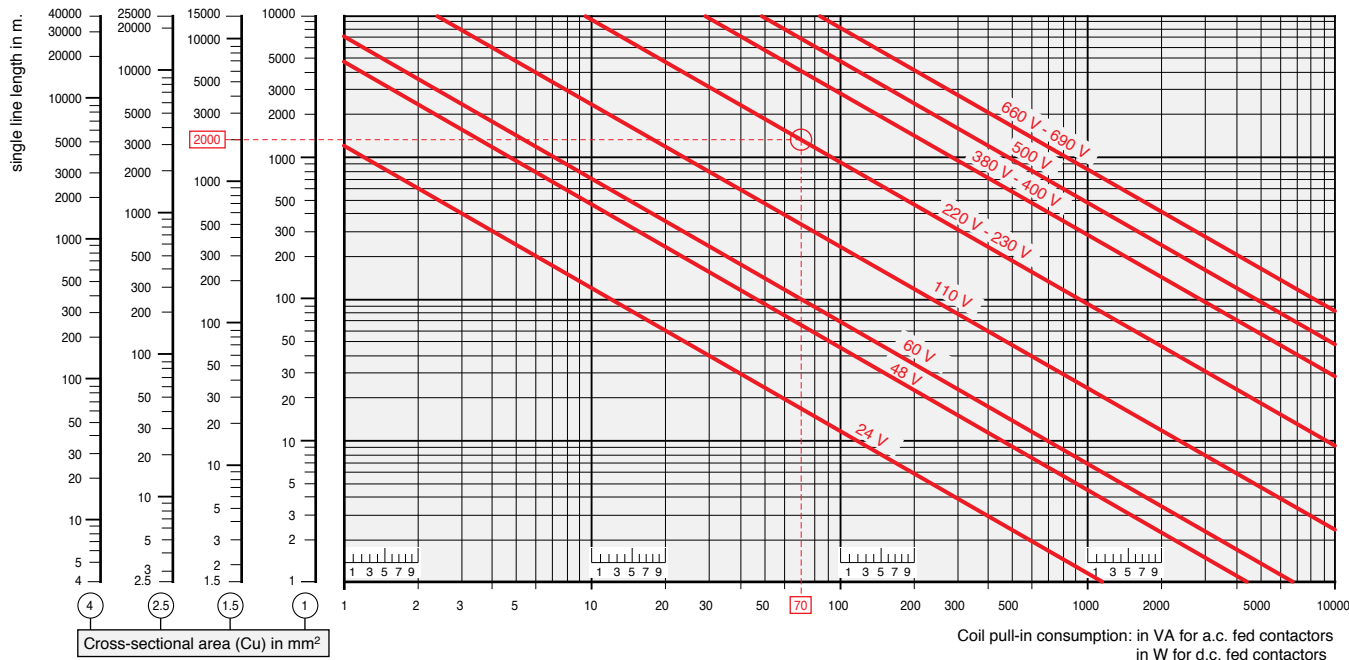
The graph has been drawn for a max. line voltage drop of 5 %.

Coil pull-in consumption (average value)

| Contactors | a.c. control circuit 50 Hz | Contactors | d.c. control circuit |
|-------------------|-------------------------------|----------------------|----------------------|
| A 9, 12, 16 | 70 VA | AE 9, 12, 16 | 90 W |
| A 26, 30, 40 | 120 VA | AE 26, 30, 40 | 110 W |
| A 45, 50, 63, 75 | 180 VA | AE 45, 50, 63, 75 | 200 W |
| A 95, 110 | 450 VA | AE 95, 110 | 400 W |
| A 145, 185 | 700 VA | BC 9, 16, 18, 25, 30 | 7 W |
| A 210, 260, 300 | 1700 VA | | |
| AF 45, 50, 63, 75 | 210 VA | AF 45, 50, 63, 75 | 190 W |
| AF 95, 110 | 350 VA | AF 95, 110 | 400 W |
| AF 145, 185 | 430 VA | AF 145, 185 | 500 W |
| AF 210, 260, 300 | 470 VA | AF 210, 260, 300 | 520 W |
| AF 400, 460 | 890 VA | AF 400, 460 | 990 W |
| AF 580, 750 | 850 VA | AF 580, 750 | 950 W |

Permissible single length for the control circuit conductors on contactor closing:

Depending on the coil pull-in power consumption on the supply voltage and on the control circuit conductor cross-sectional area.



Example:

A 9 contactor

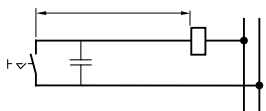
Coil voltage: 230 V 50 Hz, contactor coil pull-in power consumption: 70 VA, control circuit conductor cross-sectional area: Cu 1.5 mm².

Max. permissible length: 2000 m.

IEC Technical data

Influence of the length of conductors used in contactor control circuits

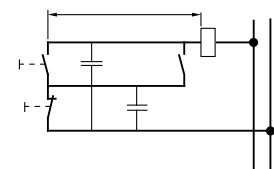
Single control line length



Wiring diagram A

Via maintained pushbutton and 2-core cable (with a capacity of 0.2 μF/km, for example).

Single control line length



Wiring diagram B

Via momentary pushbutton plus hold-in contact and 3-core cable (with a capacity of 2 x 0.2 = 0.4 μF/km, for example).

Contactor Opening (contactor with a.c. fed control circuit)

Under certain conditions, an a.c. operated contactor does not open when the control circuit is de-energized.

This is due to a critical capacity of the excessively long control circuit line and the type of contactor coil control layout (see diagrams A and B opposite).

This may be caused by the following factors:

- high control voltage.
- low coil holding consumption.
- low contactor drop-out voltage (according to IEC 60947-4-1: 0.2 to 0.75 x U_c).

If lines longer than those indicated are required, the following measures must be taken:

- select a contactor with a higher rating.
- select a lower control voltage.
- connect "R_p" impedances in parallel with the contactor coil:

$$\text{sizing of parallel resistor: } R_p = \frac{10^3}{C} \quad (\text{with } C \text{ in } \mu\text{F})$$

The table and graph below can be used to determine the single length of line feeders (distance between the control device and the contactor coil) in relation to:

- the coil holding consumption VA.
- the supply voltage.
- the capacity in μF/km (depending on the control layout).

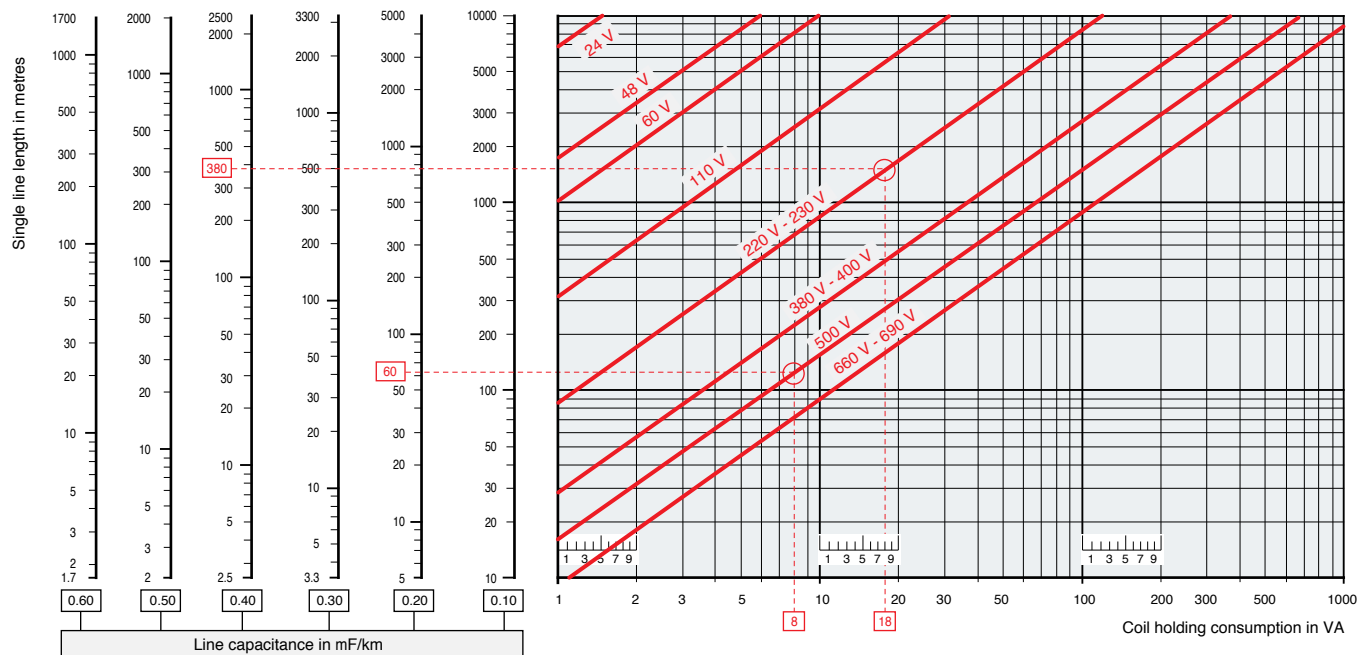
Wiring diagrams A and B opposite show two supply and coil control wiring examples.

Coil holding consumption (average value)

| Contactors | a.c. control circuit 50 Hz | Contactors | a.c. control circuit 50 Hz |
|------------------|-------------------------------|-------------------|-------------------------------|
| A 9, 12, 16 | 8 VA | AF 45, 50, 63, 75 | 7 VA |
| A 26, 30, 40 | 12 VA | AF 95, 110, | 7 VA |
| A 45, 50, 63, 75 | 18 VA | AF 145, 185, | 12 VA |
| A 95, 110 | 22 VA | AF 210, 260, 300 | 10 VA |
| A 145, 185 | 35 VA | AF 400, 460 | 12 VA |
| A 210, 260, 300 | 60 VA | AF 580, 750 | 12 VA |

Permissible single length for the control circuit conductors on contactor opening:

Depending on the coil holding power consumption, on the supply voltage and on the control circuit conductor capacity.



Examples:

A 16 contactor

Coil voltage U_c = 500 V, 50 Hz, 8 VA contactor coil holding consumption, control type: diagram A, via maintained pushbutton, and 2-core cable with a capacity of 0.2 μF/km.

Max. permissible length: 60 m.

A 50 contactor

Coil voltage U_c = 230 V, 50 Hz, 18 VA contactor coil holding consumption, control type: diagram B via momentary pushbutton, hold-in contact and 3-core cable with a capacity of 2 x 0.2 μF/km = 0.4 μF/km.

Max. permissible length: 380 m.

IEC Technical data

Parallel connection of main poles

Parallel Connection of Main Poles

Purpose: Increasing the a.c. resistive load.

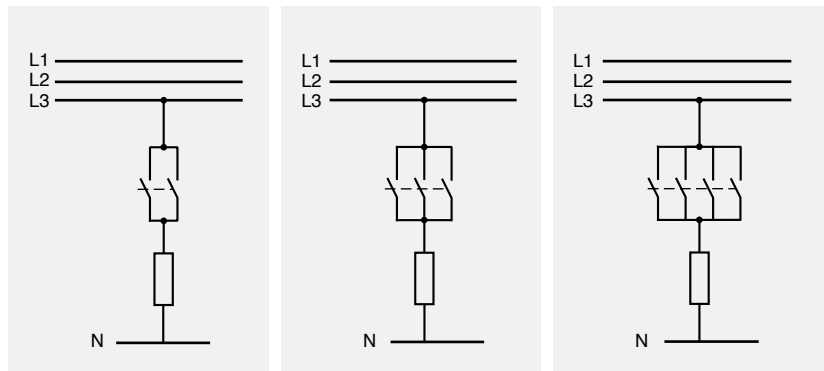
Remarks:

- Parallel connection of main poles to increase the d.c. resistive load is not acceptable.
- Parallel connection of main poles does'nt increase the breaking capacity.

Means: The poles can be connected in parallel via shorting bars. See page 1.30.

- LP and LH for parallel connection of 2 poles,
- LY and LF for parallel connection of 3 poles,

The table below shows the uprating factor for $I_g / AC-1$ max. in relation to the number of poles in parallel and for a max. switching frequency.



2 poles in //

3 poles in //

4 poles in //

| Contactors | | | Factor to be applied to the rated operational current $I_g / AC-1$ to obtain the permissible current $I_g / AC-1$ with "n" poles in parallel. | | | | | |
|--------------------------|-----------------|----------------|---|-----|--|-----|-----|-----|
| a.c. Operated | d.c. Operated | Cycles / h | | | | | | |
| 3-pole contactors | | | | | | | | |
| A 9 ... A 75 | AF 50 ... AF 75 | | | | | | | |
| AF 50 ... AF 75 | AE..., TAE... | 600 | 1.6 | 2.2 | | | | |
| | AL... | A 95 ... A 300 | AF 145 ... AF 750 | 300 | | 1.6 | 2.2 | - |
| AF 145 ... AF 750 | | | | | | | | |
| 4-pole contactors | | | | | | | | |
| A 9 ... A 75 | AF 45 ... AF 75 | | | | | | | |
| AF 45 ... AF 75 | AE..., TAE... | 600 | 1.6 | 2.2 | | 2.6 | | |
| | AL... | EK... | EK... | 300 | | 1.6 | 2.2 | 2.8 |

IEC Technical data

Temporary or intermittent duty

Across the line
contactors

1

Utilization of Contactors for Temporary / Intermittent Duty

The table below shows the factor to be applied to the rated operational current $I_o / AC-1$ to obtain the permissible operational current $I_o / AC-1$ in relation to the switching frequency and the current flow time per cycle.

| Operating cycles per hour | 120 | 60 | 20 | 6 | 2 | 1 |
|---|---|-----|-----|-----|-----|-----|
| Current flow time per cycle in seconds. | Factor to be applied to the rated operational current $I_o / AC-1$ max. to obtain the permissible current $I_o / AC-1$ for temporary / intermittent duty. | | | | | |
| 5 | 2.8 | 3.4 | 4 | 4.7 | 5 | 5.2 |
| 10 | 2.2 | 2.6 | 3 | 3.4 | 3.7 | 3.8 |
| 20 | 1.6 | 2 | 2.4 | 2.6 | 2.7 | 2.8 |
| 30 | – | 1.7 | 2.1 | 2.2 | 2.3 | 2.4 |
| 40 | – | 1.5 | 1.9 | 2.0 | 2.1 | 2.2 |
| 60 | – | – | 1.7 | 1.8 | 1.8 | 1.9 |

Example:

A 9 contactor (intermittent duty, resistive load)

Rated operational current $I_o / AC-1$ at 55 °C (see page 1.42)

22 A

Switching frequency

2 operations/h

Current flow time per cycle

20 s

Factor to be applied to the current $I_o / AC-1$

2.7

Permissible current: $2.7 \times 22 =$

59 A

Technical data

Technical terms and definitions

Altitude

Refers to the height of the site where the equipment is located, expressed in meters above the sea level.

Ambient temperature

Temperature of the air surrounding the unit.

Circuits

• Auxiliary circuit

All the conducting parts of a contactor, intended to be included in a circuit different from the main circuit and the control circuit of the contactor e.g. signalization, interlocking circuits etc ...

• Control circuit

All the conducting parts of a contactor (other than the main circuit) included in a circuit used for the closing operation, or opening operation, or both, of the contactor.

• Main circuit

All the conducting parts of a contactor included in the circuit which it is designed to close or open.

Coil operating range

Expressed as a multiple of the rated control circuit voltage U_c for the lower and upper limits.

Cycle duration

Total time of the on-load + off-load period.

Endurance / durability

• Electrical endurance

Number of on-load operating cycles (i.e. with current on the main contacts) a contactor can achieve, varies depending on the utilization category.

• Mechanical endurance

Number of off-load operating cycles (i.e. without current on the main contacts) a contactor can achieve.

Inching

Energizing a motor once or repeatedly for short periods to obtain small movements of the driven mechanism.

Insulation class according to the VDE 0110 and NFC 20-040

Characterizes contactors suitability in accordance with environment and utilization conditions. A contactor can be classified depending on its own clearance and creepage distances in the insulation classes A, B, C, D which correspond to different insulation voltage values.

The insulation class C is applicable to most of the industrial applications. Equipment described in this catalogue correspond to insulation class C.

Intermittent duty

Duty in which the main contacts of a contactor remain closed for periods of time insufficient to allow the contactor to reach thermal equilibrium, the current-carrying periods being separated by off-load periods of sufficient duration to restore equality of temperature with the cooling medium.

Mounting positions

Stated by the manufacturer. Please note restrictions when applicable.

On-load factor

Ratio of the current flow time to the total time of the cycle x 100.

Plugging

Stopping or reversing a motor quickly by interchanging two supply leads whilst the motor is running.

Rated breaking capacity; Rated making capacity

Value of r.m.s current a contactor can break or make at a fixed voltage value, within the conditions specified by the standards, depending on the utilization category.

Rated control circuit voltage U_c

Control voltage value for which the control circuit of the unit is sized.

Rated insulation voltage U_i

Voltage value which designates the unit and to which dielectric tests, clearance and creepage distances are referred.

Rated impulse withstand voltage U_{imp}

The highest peak value of an impulse voltage of prescribed form 1.2/50, which does not cause breakdown under specified conditions of test.

Rated operating current I_e

Current value stated by the manufacturer and taking into account the rated operating voltage U_e , the rated frequency, the rated duty, the utilization category, the electrical contact life and the type of the protective enclosure.

Rated operating voltage U_e

Voltage value to which utilization characteristics of the contactor are referred, i.e. phase to phase voltage in 3 phase circuits.

Conventional thermal current I_{th}

Value of current the contactor can withstand with poles in closed position, in free air for an eight hour duty, without the temperature rise of its various parts exceeding the limits specified by the standards.

Resistance to shocks

Requirements applicable for instance to vehicles, crane operation or switchgear slide-in module systems.

At the quoted permissible «g» values, contactors must not undergo a change in switching state and O/L relays must not trip.

Resistance to vibrations

Requirements applicable to all the vehicles, vessels and other similar transport systems. At the quoted amplitude and vibration frequency values, the unit must be capable to achieve the required duty.

Short-circuit protection coordination

Achieved by using back-up protection devices such as circuit-breakers, H.R.C. fuses or standard fuses.

Co-ordination types a, b, c are defined in IEC 292-1 publication, VDE 0660, NFC 63-650 standards. Co-ordination types "1" and "2" are defined in IEC 947-4-1.

• Type 1 co-ordination

There has been no discharge of parts beyond the enclosure. Damage to the contactor and the overload relay is acceptable.

• Type 2 co-ordination

No damage to the overload relay or other parts has occurred, except that welding of contactor or starter contacts is permitted, if they are easily separated.

Switching frequency

Number of operating cycles per hour.

Time

• Closing time

Time between energization of the coil until the moment the contacts of the first current path to be closed actually close.

• Opening time

Time from the beginning of state causing breaking until the moment when the contacts of the last current path to be opened are open.

• Minimal operation time

Shortest control duration to ensure complete closing or opening of a contactor.

• Short time current permissible

Value of current which the contactor can withstand in closed position for a short time period and within specified conditions.

• Time constant

Ratio of inductance to the resistance : $L/R = \text{mH}/\text{Ohm} = \text{ms}$.

Standards

- IEC standards 158-1: "Contactors" and series IEC 292 :

"Motor-starters" have been revised and replaced by the new IEC 947-4-1 (1990-05): "Contactors and Motor-starters" referring to IEC 947-1 (1988): "General rules"
The new standards will constitute the basis of the future European and National standards, not yet revised.

Therefore the ratings indicated in this catalog are established according to the former and the future standards.

- Main changes and additions in the new standards are:

- Revision and extension of the utilization categories (see hereafter)
- Replacement of the coordination classes types a, b, c by new types: "1" (approximately equivalent to former class "a") and "2" (approximately equivalent to former class "c") with additional requirements.
- Classification of the thermal overload relays in tripping classes: 10 A; 10; 20 and 30 depending on their tripping times, at 1.5 and 7.2 times their setting current, in order to cover motor applications depending on their starting times. Class 10 A is adapted for motors according to IEC 34-1.
- Introduction of tests to verify the connecting capability and the mechanical strength of terminals.

Utilization categories

A contactor duty is characterized by the utilization category plus indication of the rated operating voltage and the rated operating current (see at Rated ...), or the motor characteristics.

Utilization categories for contactors according to IEC 947-4-1

| | | |
|----------------------|--|--|
| Alternating current: | AC-1 | Non-inductive or slightly inductive loads, resistance furnaces. Power factor 0.7 - 0.8 (slightly inductive). |
| | AC-2 | Slip-ring motors: starting, switching-off. |
| | AC-3 | Squirrel-cage motors: starting, switching-off motors during running. Power factor 0.4 - 0.5 (AC-3). |
| | AC-4 | Squirrel-cage motors: starting, plugging, inching. |
| | AC-5a | Switching of electric discharge lamp controls. |
| | AC-5b | Switching of incandescent lamps. |
| | AC-6a | Switching of transformers. |
| | AC-6b | Switching of capacitor banks |
| | AC-8a | Hermetic refrigerant compressor motor control with manual resetting of overload releases |
| AC-8b | Hermetic refrigerant compressor motor control with automatic resetting of overload releases. | |
| Direct current: | 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 | Switching of incandescent lamps |

Utilization categories for contactor relays according to IEC 947-5-1

| | | |
|----------------------|-------|---|
| Alternating current: | AC-12 | Control of resistive loads and solid state loads with isolation by opto couplers. |
| | AC-13 | Control of solid state loads with transformer isolation. |
| | AC-14 | Control of small electromagnetic loads (≤ 72 VA). |
| | AC-15 | Control of electromagnetic loads (> 72 VA). |
| Direct current: | DC-12 | Control of resistive loads and solid state loads with isolation by opto couplers. |
| | DC-13 | Control of electromagnets. |
| | DC-14 | Control of electromagnetic loads having economy resistors in circuit. |

Utilization categories AC-1, AC-2, AC-3, AC-4 and DC-1, DC-3, DC-5 are maintained with slightly more severe tests.

Other categories have been added in order to standardize specific applications. In fact some contactor applications and the specific criteria characterizing the types of load controlled can modify the recommended utilization characteristics. These major applications are, for example :

Switching of capacitor banks

This application is characterized by high current peaks when switching-on the contactor and presence of harmonic currents on uninterrupted duty. For this application, IEC 947-4-1 has defined an utilization category AC-6b. Practical ratings have to be defined according to tests or, in absence of tests, by a calculation indicated in IEC 947-4-1.

Switching of transformers

This application is characterized by high current peaks on contactor closing due to magnetization phenomena. The corresponding utilization category according to IEC 947-4-1 is AC-6a. Ratings are derived from test-values for AC-3 or AC-4 according to formula given in IEC 947-4-1.

Switching of lighting circuits

The current peaks on contactor closing and power factor vary depending on the type of lamps, the switching method used and if compensation systems are fitted or not.

IEC 947-4-1 contains two standard utilization categories

- AC-5a for switching of the electric discharge lamps.
- AC-5b for switching of incandescent lamp.

UL/CSA Technical data

Motor data

Ampere ratings of 3 phase, AC induction motors

| Horse power | 110 – 120V | | | 200 – 208V | | | 220 – 240V | | | 380 – 415V ^① | | 440 – 480V | | | 550 – 600V | | |
|-------------|--------------|-----------|-------------|--------------|-----------|-------------|--------------|-----------|-------------|-------------------------|-------------|--------------|-----------|-------------|--------------|-----------|-------------|
| | Single phase | Two phase | Three phase | Single phase | Two phase | Three phase | Single phase | Two phase | Three phase | Single phase | Three phase | Single phase | Two phase | Three phase | Single phase | Two phase | Three phase |
| 1/10 | 3.0 | — | — | 1.65 | — | — | 1.5 | — | — | 1.0 | — | — | — | — | — | — | — |
| 1/8 | 3.8 | — | — | 2.1 | — | — | 1.9 | — | — | 1.2 | — | — | — | — | — | — | — |
| 1/6 | 4.4 | — | — | 2.4 | — | — | 2.2 | — | — | 1.4 | — | — | — | — | — | — | — |
| 1/4 | 5.8 | — | — | 3.2 | — | — | 2.9 | — | — | 1.8 | — | — | — | — | — | — | — |
| 1/3 | 7.2 | — | — | 4.0 | — | — | 3.6 | — | — | 2.3 | — | — | — | — | — | — | — |
| 1/2 | 9.8 | 4.0 | 4.4 | 5.4 | 2.2 | 2.4 | 4.9 | 2.0 | 2.2 | 3.2 | 1.3 | 2.5 | 1.0 | 1.1 | 2.0 | 0.8 | 0.9 |
| 3/4 | 13.8 | 4.8 | 6.4 | 7.6 | 2.6 | 3.5 | 6.9 | 2.4 | 3.2 | 4.5 | 1.8 | 3.5 | 1.2 | 1.6 | 2.8 | 1.0 | 1.3 |
| 1 | 16.0 | 6.4 | 8.4 | 8.8 | 3.6 | 4.6 | 8.0 | 3.2 | 4.2 | 5.1 | 2.3 | 4.0 | 1.6 | 2.1 | 3.2 | 1.3 | 1.7 |
| 1 1/2 | 20.0 | 9.0 | 12.0 | 11.0 | 5.0 | 6.6 | 10.0 | 4.5 | 6.0 | 6.4 | 3.3 | 5.0 | 2.3 | 3.0 | 4.0 | 1.8 | 2.4 |
| 2 | 24.0 | 11.8 | 13.6 | 13.2 | 6.5 | 7.5 | 12.0 | 5.9 | 6.8 | 7.7 | 4.3 | 6.0 | 3.0 | 3.4 | 4.8 | 2.4 | 2.7 |
| 3 | 34.0 | 16.6 | 19.2 | 18.7 | 9.2 | 10.6 | 17.0 | 8.3 | 9.6 | 10.9 | 6.1 | 8.5 | 4.2 | 4.8 | 6.8 | 3.3 | 3.9 |
| 5 | 56.0 | 26.4 | 30.4 | 30.8 | 14.5 | 16.8 | 28.0 | 13.2 | 15.2 | 17.9 | 9.7 | 14.0 | 6.6 | 7.6 | 11.2 | 5.3 | 6.1 |
| 7 1/2 | 80.0 | 38.0 | 44.0 | 44.0 | 21.0 | 24.2 | 40.0 | 19.0 | 22.0 | 27.0 | 14.0 | 21.0 | 9.0 | 11.0 | 16.0 | 8.0 | 9.0 |
| 10 | 100.0 | 48.0 | 56.0 | 55.0 | 26.4 | 30.8 | 50.0 | 24.0 | 28.0 | 33.0 | 18.0 | 26.0 | 12.0 | 14.0 | 20.0 | 10.0 | 11.0 |
| 15 | 135.0 | 72.0 | 84.0 | 75.0 | 39.6 | 46.2 | 68.0 | 36.0 | 42.0 | 44.0 | 27.0 | 34.0 | 18.0 | 21.0 | 27.0 | 14.0 | 17.0 |
| 20 | — | 94.0 | 108.0 | 96.8 | 52.0 | 60.0 | 88.0 | 47.0 | 54.0 | 56.0 | 34.0 | 44.0 | 23.0 | 27.0 | 35.0 | 19.0 | 22.0 |
| 25 | — | 118.0 | 136.0 | 121.0 | 65.0 | 75.0 | 110.0 | 59.0 | 68.0 | 70.0 | 44.0 | 55.0 | 29.0 | 34.0 | 44.0 | 24.0 | 27.0 |
| 30 | — | 138.0 | 160.0 | 150.0 | 76.0 | 88.0 | 136.0 | 69.0 | 80.0 | 87.0 | 51.0 | 68.0 | 35.0 | 40.0 | 54.0 | 28.0 | 32.0 |
| 40 | — | 180.0 | 208.0 | 194.0 | 100.0 | 115.0 | 176.0 | 90.0 | 104.0 | 112.0 | 66.0 | 88.0 | 45.0 | 52.0 | 70.0 | 36.0 | 41.0 |
| 50 | — | 226.0 | 260.0 | 238.0 | 125.0 | 143.0 | 216.0 | 113.0 | 130.0 | 139.0 | 83.0 | 108.0 | 56.0 | 65.0 | 86.0 | 45.0 | 52.0 |
| 60 | — | — | — | — | 147.0 | 160.0 | — | 133.0 | 154.0 | — | 103.0 | — | 67.0 | 77.0 | — | 53.0 | 62.0 |
| 75 | — | — | — | — | 183.0 | 212.0 | — | 166.0 | 192.0 | — | 128.0 | — | 83.0 | 96.0 | — | 66.0 | 77.0 |
| 100 | — | — | — | — | 240.0 | 273.0 | — | 218.0 | 248.0 | — | 165.0 | — | 109.0 | 124.0 | — | 87.0 | 99.0 |
| 125 | — | — | — | — | — | 344.0 | — | — | 312.0 | — | 208.0 | — | 135.0 | 156.0 | — | 108.0 | 125.0 |
| 150 | — | — | — | — | — | 396.0 | — | — | 360.0 | — | 240.0 | — | 156.0 | 180.0 | — | 125.0 | 144.0 |
| 200 | — | — | — | — | — | 528.0 | — | — | 480.0 | — | 320.0 | — | 208.0 | 240.0 | — | 167.0 | 192.0 |
| 250 | — | — | — | — | — | 663.0 | — | — | 602.0 | — | 403.0 | — | — | 302.0 | — | — | 242.0 |
| 300 | — | — | — | — | — | — | — | — | — | — | 482.0 | — | — | 361.0 | — | — | 289.0 |
| 350 | — | — | — | — | — | — | — | — | — | — | 560.0 | — | — | 414.0 | — | — | 336.0 |
| 400 | — | — | — | — | — | — | — | — | — | — | 636.0 | — | — | 477.0 | — | — | 382.0 |
| 500 | — | — | — | — | — | — | — | — | — | — | 786.0 | — | — | 590.0 | — | — | 472.0 |

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