

# CONTACTORS



IEC / EN 60947-4-1  
CE

**Mounting Position** : Front face downwards  
**Altitude** : 2000 m (max)  
**Relative Humidity** : 90% (55°C)  
**Ambient Temperature** : between -25°C and +60°C  
**Pollution Degree** : III

All these given information are general. We have always right to change them.

## Power Contactors (AC - DC)



**FC06M**  
**FC09M**



**FC115D**  
**FC150D**



**FC09D**  
**FC12D**  
**FC18D**



**FC220D**  
**FC260D**  
**FC300D**



**FC25D**  
**FC32D**  
**FC38D**



**FC400D**  
**FC475D**



**FC40D**  
**FC50D**  
**FC65D**



**FC580D**  
**FC650D**  
**FC750D**



**FC80D**  
**FC95D**

## Contactors for Capacitor Switching



**FC09DK**  
**FC12DK**  
**FC18DK**



**FC40DK**  
**FC50DK**  
**FC65DK**



**FC25DK**



**FC80DK**  
**FC95DK**



**FC32DK**



**FC115DK**  
**FC150DK**













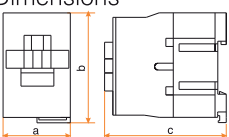









**FC38DK**

## High Current Contactors



**EC300 ... EC2500**

# CONTACTORS





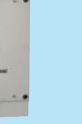













|   |                          |    |  |    |   |    |  |    |  |  |  |
|---|--------------------------|---|---|---|--|---|---|---|---|---|---|
| Type  |                          | FC06M   | FC09M   | FC09D   | FC12D  | FC18D   | FC25D   | FC32D   | FC38D   | FC40D   | FC50D   |
| Number of Poles   | A                        | 3   | 3   | 3 - 4   | 3 - 4  | 3 - 4   | 3 - 4   | 3 - 4   | 3   | 3 - 4   | 3 - 4   |
| Utilization Class - Ie<br>(£440V) A   | AC-3                     | 6   | 9   | 9   | 12   | 18  | 25  | 32  | 38  | 40  | 50  |
|   | AC-5a                    | 8   | 10  | 12  | 16   | 25  | 35  | 45  | 50  | 55  | 70  |
|   | AC-1                     | 16  | 16  | 25  | 25   | 32  | 40  | 50  | 55  | 60  | 80  |
| Rated Thermal Current - Ith £ 55°C  | A                        | 16  | 16  | 25  | 25   | 32  | 40  | 50  | 55  | 60  | 80  |
| Rated Insulation Voltage-Ui 50-60Hz   | V                        | 800   | 800   | 800   | 800  | 800   | 800   | 800   | 800   | 800   | 800   |
| Rated Impulse Withstand Voltage-Uimp  | kV                       | 8   | 8   | 8   | 8  | 8   | 8   | 8   | 8   | 8   | 8   |
| Motor Control<br>3 ~ AC3<br>Driving<br>Stopping<br>kW   | 230 V                    | 1,5   | 2,2   | 2,2   | 3  | 4   | 5,5   | 7,5   | 9   | 11  | 15  |
|   | 400 V                    | 2,2   | 4   | 4   | 5,5  | 7,5   | 11  | 15  | 18,5  | 18,5  | 22  |
|   | 440 V                    | 2,2   | 4   | 4   | 5,5  | 9   | 11  | 15  | 18,5  | 22  | 25  |
|   | 500 V                    | 3   | 4   | 5,5   | 7,5  | 10  | 15  | 18,5  | 18,5  | 22  | 30  |
|   | 690 V                    | 3   | 4   | 5,5   | 7,5  | 10  | 15  | 18,5  | 18,5  | 30  | 33  |
| Weight  | kg. 3 pole               | 0,16  | 0,16  | 0,33  | 0,33   | 0,33  | 0,345   | 0,52  | 0,55  | 1,14  | 1,14  |
|   | 4 pole                   | -   | -   | 0,33  | 0,33   | 0,33  | 0,59  | 0,59  | -   | 1,29  | 1,29  |
| Number of Auxiliary Contacts  | 3 pole                   | 1 NO<br>or 1 NC   | 1 NO<br>or 1 NC   | 1 NO<br>or 1 NC   | 1 NO<br>or 1 NC  | 1 NO<br>or 1 NC   | 1 NO<br>or 1 NC   | 1 NO<br>or 1 NC   | 1 NO<br>or 1 NC   | 1 NO<br>+ 1 NC  | 1 NO<br>+ 1 NC  |
|   | 4 pole                   | -   | -   | -   | -  | -   | -   | -   | -   | -   | -   |
| Coil Power<br>Consumption<br>(VA)   | AC Coil Holding          | 7   | 7   | 9,5   | 9,5  | 9,5   | 9,5   | 11  | 11  | 30  | 30  |
|   | AC Coil Pull             | 50  | 50  | 75  | 75   | 75  | 75  | 110   | 110   | 225   | 225   |
|   | DC Coil                  | -   | -   | 9   | 9  | 9   | 9   | 11  | 11  | 20  | 20  |
| Power Loss Per Pole   | (AC-3) W                 | 0,15  | 0,33  | 0,30  | 0,50   | 1,2   | 2,1   | 2,3   | 2,9   | 2,8   | 4,1   |
| Max. - min. Tightening Torque   | Nm                       | 1-1,5   | 1-1,5   | 1-1,5   | 1-1,5  | 1-1,5   | 1-1,5   | 1,2-2   | 1,5-2,5   | 3,5-4,5   | 3,5-4,5   |
| Dimensions<br>                        | a (width) (mm)           | 45,5  | 45,5  | 47/47   | 47/47  | 47/47   | 47/57   | 57 / 57   | 57  | 77/85   | 77/85   |
|   | b (height) (mm)          | 58  | 58  | 76/76   | 76/76  | 76/76   | 76/86   | 86 / 86   | 86  | 129/129   | 129/129   |
|   | c (depth) (mm)           | 57  | 57  | 82/82   | 82/82  | 82/82   | 87/95   | 95 / 95   | 100   | 115/115   | 115/115   |
|   | DC Coiled c (depth) (mm) | -   | -   | 116/116   | 116/116  | 116/116   | 120/130   | 130/130   | 135   | 175/174   | 175/174   |
| Easily replaced coils   |                          |  |   |  |  |  |   |  |   |   |   |
| Auxiliary contact blocks (Side assembly)<br>1st figure is number of NO contacts<br>2nd figure is number of NC contacts  |                          |   |   |   |  |   |   |  |   |   |   |
| Auxiliary contact blocks (Front assembly)<br>1st figure is number of NO contacts<br>2nd figure is number of NC contacts |                          |   |   |   |   |   |   |  |   |   |   |
| Mechanical Lock   |                          |   |   |   |  |   |   |  |   |   |   |

**Note:** Auxiliary contact blocks are assembled on front face of the contactor

**NO** : Normally open contact

**NC** : Normally closed contact

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|    |                |    |         |    |         |      |         |    |         |  |         |  |  |  |  |  |  |
|---|----------------|---|---------|---|---------|---|---------|---|---------|--|---------|---|--|---|--|---|--|
| FC65D   | FC80D          | FC95D   | FC115D  | FC150D  | FC220D  | FC260D  | FC300D  | FC400D  | FC475D  | FC580D   | FC650D  | FC750D  |  |   |  |   |  |
| 3 - 4   | 3 - 4          | 3 - 4   | 3 - 4   | 3 - 4   | 3 - 4   | 3 - 4   | 3 - 4   | 3 - 4   | 3 - 4   | 3 - 4  | 3 - 4   | 3 - 4   |  |   |  |   |  |
| 65  | 80             | 95  | 115     | 150   | 220     | 260   | 300     | 400   | 475     | 580  | 650     | 750   |  |   |  |   |  |
| 80  | 100            | 115   | 140     | 180   | 260     | 300   | 350     | 470   | 560     | 680  | 760     | 880   |  |   |  |   |  |
| 80  | 125            | 125   | 200     | 200   | 300     | 315   | 400     | 600   | 650     | 750  | 850     | 1000  |  |   |  |   |  |
| 80  | 125            | 125   | 200     | 200   | 300     | 315   | 400     | 600   | 650     | 750  | 850     | 1000  |  |   |  |   |  |
| 800   | 800            | 800   | 1000    | 1000  | 1000    | 1000  | 1000    | 1000  | 1000    | 1000   | 1000    | 1000  |  |   |  |   |  |
| 8   | 8              | 8   | 8       | 8   | 8       | 8   | 8       | 8   | 8       | 8  | 8       | 8   |  |   |  |   |  |
| 18,5  | 22             | 25  | 30      | 40  | 60      | 80  | 90      | 110   | 140     | 180  | 200     | 220   |  |   |  |   |  |
| 30  | 37             | 45  | 55      | 75  | 110     | 140   | 160     | 200   | 250     | 315  | 355     | 400   |  |   |  |   |  |
| 37  | 45             | 45  | 59      | 80  | 129     | 150   | 160     | 220   | 250     | 315  | 355     | 450   |  |   |  |   |  |
| 37  | 55             | 55  | 75      | 90  | 132     | 180   | 200     | 257   | 290     | 360  | 410     | 470   |  |   |  |   |  |
| 37  | 45             | 45  | 80      | 100   | 160     | 200   | 250     | 280   | 375     | 470  | 530     | 650   |  |   |  |   |  |
| 1,14  | 1,38           | 1,38  | 2,1     | 2,1   | 4,7     | 4,7   | 8,5     | 8,5   | 10,8    | 17,4   | 17,5    | 19  |  |   |  |   |  |
| 1,29  | 1,54           | 1,54  | 4,3     | 4,5   | 5,7     | 5,7   | 10      | 10  | 12,9    | 20,5   | 20,5    | 22,4  |  |   |  |   |  |
| 1 NO<br>+ 1 NC  | 1 NO<br>+ 1 NC | 1 NO<br>+ 1 NC  | -       | -   | -       | -   | -       | -   | -       | -  | -       | -   |  |   |  |   |  |
| -   | -              | -   | -       | -   | -       | -   | -       | -   | -       | -  | -       | -   |  |   |  |   |  |
| 30  | 30             | 30  | 22/55   | 22/55   | 55      | 55  | 13      | 20  | 24      | 22   | 22      | 22  |  |   |  |   |  |
| 225   | 225            | 225   | 300     | 300   | 750     | 750   | 1100    | 1100  | 1250    | 1600   | 1600    | 1600  |  |   |  |   |  |
| 20  | 20             | 20  | -       | -   | -       | -   | -       | -   | -       | -  | -       | -   |  |   |  |   |  |
| 6   | 7,7            | 10,9  | 10      | 17  | 24      | 33  | 35      | 44  | 37      | 37   | 46      | 62  |  |   |  |   |  |
| 3,5-4,5   | 6-10           | 6-10  | 8-12    | 8-12  | 15-20   | 15-20   | 20-25   | 20-25   | 20-25   | 30-40  | 30-40   | 30-40   |  |   |  |   |  |
| 77/85   | 87/97          | 87/97   | 120/204 | 120/204   | 170/211 | 170/211   | 218/261 | 215/261   | 235/288 | 310/389  | 310/389 | 310/389   |  |   |  |   |  |
| 129/129   | 129/129        | 129/129   | 154/163 | 154/171   | 175/175 | 175/175   | 210/210 | 210/210   | 240/240 | 304/304  | 304/304 | 304/304   |  |   |  |   |  |
| 115/115   | 127/127        | 127/127   | 121/172 | 121/172   | 183/183 | 183/183   | 223/223 | 223/223   | 235/235 | 257/257  | 257/257 | 257/257   |  |   |  |   |  |
| 175/174   | 183/180        | 183/180   | -       | -   | -       | -   | -       | -   | -       | -  | -       | -   |  |   |  |   |  |
|  |                |  |         |  |         |  |         |   |         |  |         |   |  |   |  |   |  |
| FCC-D6  |                | FCC-D8  |         | FCC-D10   |         | FCC-D12   |         |   |         |  |         |   |  |   |  |   |  |
|  |                |   |         | FCBS-F11<br>FCBS-F20<br>FCBS-F02  |         |   |         |   |         |  |         |   |  |   |  |   |  |
|  |                |   |         | FCB-F20<br>FCB-F02<br>FCB-F11   |         |   |         |  |         |  |         |   |  |   |  |   |  |
|  |                |   |         | FCB-F20<br>FCB-F02<br>FCB-F11   |         |   |         | FCB-F40<br>FCB-F31<br>FCB-F22<br>FCB-F13<br>FCB-F04                                 |         |  |         |   |  |   |  |   |  |
|  |                |   |         |   |         |   |         |   |         |  |         |   |  |   |  |   |  |

Give coil voltages of the contactors in accordance with the table below

| <input type="checkbox"/> | 24V | 42V | 48V | 110V | 220V | 230V | 240V | 380V | 415V | 440V | 500V |
|--------------------------|-----|-----|-----|------|------|------|------|------|------|------|------|
| AC                       | A   | D   | E   | H    | K    | N    | R    | S    | T    | U    | V    |
| DC                       | A6  |     | E6  | H6   | K6   |      |      |      |      | U6   |      |

Example: 9DD-A5013-0018 means 24V coil voltage 18A (AC3) 1NC contactors.

Contactors allow remote-control of electrical facilities such as compensation, heating etc. and in particular, electrical motors via a cable. When they are used with thermal relays, they protect devices and facilities against overload currents. Federal contactors are manufactured in accordance with international IEC 60947-4-1, TS EN60947-4-1 standards and CE. Coil and auxiliary contact blocks can be easily mounted and demounted with primary and auxiliary contacts. FC-type contacts have three-end coil. In this way, connection flexibility is provided. Coils of the contactors can be controlled safety between 0.8 and 1.1 times more of rated coil voltage. They operate with full efficiency between ambient temperatures of -5°C and +55°C. Contactors' capability of being assembled on rail provides great ease during installation. They can resist 1000V voltage in terms of their material composition.

### Major features of the contactor:

**1-** The contactor should bear high current values without being subject to any corrosion or boiling. This depends on quality of contactors (contact surface technology and resource technology). Contactor selection is very important especially in AC-3 class and capacitor control.

**2-** While the contractor is closed, the current flowing over the contacts causes heating. This heating is limited in standards. According to IEC 60947-4-1, when continuous thermal current ( $I_{th}$ ) passes through primary contacts for 8 hours, maximum heat increase in contactor terminals should not exceed 65K.

**3-** When the contactor breaks the current, it forms an electrical arc between separating contacts. The arc is the electron and ion current detaching from the contact material as a result of thermal impact. Arc temperature reaches thousands of degrees and this is higher than the temperature born by metals and conductors used in manufacture of breaking cells and contacts. Therefore, arc should be terminated as soon as possible. For this purpose, separators are used in contactors.

### Acceptable continuous thermal current $I_{th}$ :

Acceptable thermal current is the highest value of the test current to be used in heat increase test to be carried out in accordance with IEC 60947-4-1. This test is based on applying current to contact terminals through PVC-insulated copper conductors for 8 hours. In this case, heat change in contactor terminals should not exceed ( $\Delta Q$ ) 65 K.

### Closing capacity:

The closing capacity is the current value,

which the contactor can successfully close without any damage in contacts. Power factor and frequency of closing are factors affecting the closing capacity. In IEC60947-4-1, for AC3 utilization class; if  $I_e$  is the maximum motor operating current; the closing capacity should be  $10 \times I_e$ .

### Breaking capacity:

The breaking capacity is the current value, which the contactor can successfully break without any damage in contacts and arc extinction cells. As the voltage value increases, the breaking capacity decreases. In IEC60947-4-1, for AC3 utilization class; if  $I_e$  is the maximum motor operating current; the closing capacity should be  $8 \times I_e$ .

### Mechanical life:

Maximum number of openings + closings, which can be performed without any maintenance operation by supplying the coil only without passing any current through main poles of the contactor, determines mechanical resistance of the contactor.

### Electrical life:

Electrical resistance is the maximum number of openings + closings without any maintenance operation while load current passes through poles of the contactor. Electrical resistance is determined as a result of tests carried out on typical currents specified for various utilization classes.

AC1: Resistive load,  
Closing current=breaking current= $I_e$

AC3: Squirrel cage asynchronous motors,  
Closing current =  $6 I_e$  (drive)  
Breaking current =  $I_e$  ( $I_e=I_n$ )

AC4: Discrete operation of squirrel cage or ring asynchronous motor and current breaking applications,  
Closing current=breaking current= $6 I_e$ .

### Contactor Selection According to Utilization Classes

One of the most important points in contactor selection is to understand the load well and to determine instant load characteristic sizes well.

### Important selection parameters:

Operating voltage ( $U_e$ ), operating current ( $I_e$ ), Coil voltage, current to be broken ( $I_c$ ), utilization class, operating type and contact life.

### Contactor selection for motors:

Important selection parameters in contactor selection for motors;

- Operating voltage ( $U_e$ ),
- Breaking current while motor is operating = Operating current ( $I_e$ ),
- Motor start-up current ( $I_c=m \times I_e$ ),

- Start-up frequency (K),
- Operation number.

### a. Cage asynchronous motors:

Motor rated power (kW), operating voltage and motor operating type (continuous, discrete, short-term etc.) are taken into consideration. While contactor is selected for motors operated at low power due to reasons such as high environmental temperature or increased safety, danger zone etc., motor operating current should be taken into consideration.

### b. Ring asynchronous motors:

Separate selections are made for stator and rotor circuits. Selection of stator contactor is made according to  $I_{th}$  thermal current. Important criteria for selection in rotor circuit are operating status (start-up, adjustment), insulation (there is grounding or not), application type (intermediate contactor or final contactor).

### c. Contactor selection in driving AC motors:

In direct driving; selection is made in AC3 utilization category according to motor nominal power. In unloaded star-triangle drives, since 1/3 of the motor nominal current shall pass through star contactor, the star contactor is selected at 1/3 of the nominal motor power according to AC3 utilization category. Since energy and triangle contactor is serially connected to motor coils, motor coil current passes through these contactors during operation. Therefore, these contactors are selected at 0.58 times more that is  $1/\sqrt{3}$  of the motor nominal power according to AC3 category. All the contactors are selected at 0.58 times more that is  $1/\sqrt{3}$  of the motor nominal power according to AC3 category in star-triangle drive of motors under load.

### d. Contactor selection for DC current:

Extinction of arc in direct current is more difficult than alternative current. In this selection, time constant L/R of the load is a size as important as load voltage and current. Load constant (L/R) is approximately 1 ms in non-inductive loads, 7.5 ms in shunt motors, 10 ms in serial motors and 300 ms in electromagnets. Important parameters in inductive DC load switching are voltage, load type (Ohmic or inductive) and switching frequency.

### e. Ohmic loads:

Ohmic loads are the most problem-free loads for enablement and disablement; because only rated current passes through the contactor. Closing current is equal to breaking current. It should be considered that the heat to be produced shall be higher as the switching

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| Contactor selection in driving cage asynchronous motors |  |
|---|--|
| Direct drive  | Primary contactor current = $I_e$  |
| Normal star-delta drive                                 | Primary contactor : $0,58 I_e$<br>Delta contactor : $0,58 I_e$<br>Star contactor : $0,58 I_e$<br>Transition contactor : $0,30 I_e$ |
| Impedance drive   | Primary contactor : $I_e$<br>Start-up contactor : $0,7 I_e$  |
| Auto transformer drive                                  | Primary contactor : $I_e$<br>Transformer contactor : $I_e$<br>Star contactor : $0,5 I_e$   |

## Contactor selection in direct driving squirrel cage asynchronous motors:

| Threephase 380/400V |        | Thermal relay adjustment area (A) | Suitable FEDERAL Contactor |
|---------------------|--------|-----------------------------------|----------------------------|
| kW                  | In (A) |                                   |                            |
| 0,37                | 1,03   | 1 - 1,6                           | FC09D                      |
| 0,55                | 1,6    | 1,25 - 2                          | FC09D                      |
| 0,75                | 2      | 1,6 - 2,5                         | FC09D                      |
| 1,1                 | 2,6    | 2,5 - 4                           | FC09D                      |
| 1,5                 | 3,5    | 2,8 - 4                           | FC09D                      |
| 2,2                 | 5      | 4,5 - 6,3                         | FC09D                      |
| 3                   | 6,6    | 5,5 - 8                           | FC09D                      |
| 4                   | 8,5    | 7 - 10                            | FC09D                      |
| 5,5                 | 11,5   | 9 - 12,5                          | FC12D                      |
| 7,5                 | 15,5   | 14 - 20                           | FC18D                      |
| 9                   | 18,5   | 17 - 22                           | FC25D                      |
| 11                  | 22     | 20 - 25                           | FC25D                      |
| 15                  | 30     | 23 - 32                           | FC32D                      |
| 18,5                | 37     | 30 - 40                           | FC40D                      |
| 22                  | 44     | 37 - 50                           | FC50D                      |
| 30                  | 60     | 55 - 70                           | FC65D                      |
| 37                  | 72     | 63 - 80                           | FC80D                      |
| 45                  | 85     | 75 - 105                          | FC95D                      |
| 55                  | 105    | 95 - 125                          | FC115D                     |
| 75                  | 138    | 100 - 160                         | FC150D                     |
| 90                  | 170    | 125 - 200                         | FC220D                     |
| 110                 | 205    | 200 - 315                         | FC260D                     |
| 132                 | 245    | 200 - 315                         | FC260D                     |
| 160                 | 300    | 250 - 400                         | FC300D                     |

## Contactor selection in star-triangle driving squirrel cage asynchronous motors:

| 380/400V |        | Thermal relay adjustment area (A) | Suitable FEDERAL Contactor |        |        |
|----------|--------|-----------------------------------|----------------------------|--------|--------|
| kW       | In (A) |                                   | Line                       | Star   | Delta  |
| 7,5      | 15,5   | 7-10                              | FC12D                      | FC12D  | FC09D  |
| 9        | 18,5   | 9-12,5                            | FC12D                      | FC12D  | FC09D  |
| 11       | 22     | 11-16                             | FC12D                      | FC12D  | FC09D  |
| 15       | 30     | 14-20                             | FC18D                      | FC18D  | FC09D  |
| 18,5     | 37     | 20-25                             | FC18D                      | FC18D  | FC09D  |
| 22       | 44     | 23-32                             | FC32D                      | FC32D  | FC18D  |
| 30       | 60     | 30-40                             | FC50D                      | FC40D  | FC25D  |
| 37       | 72     | 38-50                             | FC50D                      | FC50D  | FC32D  |
| 45       | 85     | 48-57                             | FC50D                      | FC50D  | FC32D  |
| 55       | 105    | 57-66                             | FC65D                      | FC65D  | FC50D  |
| 75       | 138    | 63-80                             | FC80D                      | FC80D  | FC50D  |
| 90       | 170    | 75-105                            | FC150D                     | FC150D | FC80D  |
| 110      | 205    | 100-160                           | FC150D                     | FC150D | FC80D  |
| 132      | 245    | 100-160                           | FC220D                     | FC220D | FC150D |
| 160      | 300    | 125-200                           | FC220D                     | FC220D | FC150D |
| 200      | 370    | 200-315                           | FC260D                     | FC260D | FC220D |
| 220      | 408    | 200-315                           | FC260D                     | FC260D | FC220D |

frequency increases and calculation should be made by assuming lower rated current of the contactors selected according to AC1. 2 or 3 poles of 3-phase contactors, which are used for supplying heating circuits that are usually mono-phased, are connected serially. If two poles are serial, rated operating current should be calculated as  $1,6I_e$ ; if three poles are serial, it should be calculated as  $2I_e$ .

### f. Compensation applications:

Capacitors cause high frequency (1...5kHz) and high value temporary currents in the circuits they are connected to during start up. Switching of a single capacitor or a capacitor within a group of capacitors has different characteristics. Gradual start-up in group of capacitors is more difficult for the contactor. Because, while the capacitors in group of capacitors start up gradually, a circulating current is formed between parallel capacitor, in addition to drawing current of the battery and it forces the contactor. Therefore, special contactors and combinations have been developed for compensation applications. Where required, shock coil is used to limit the current. Contactors developed for controlling tri-phase capacitors have been developed with limit resistant transition contact blocks limiting the current value at start-up.

### g. Illumination facility applications:

Impact voltages and currents, which occur in illumination applications from time to time, may force the contactor. It has been classified in terms of type behavior and closing-breaking operation for selection. While contactor is selected for illumination circuits, important factors are bulb type, connection, whether there is compensation or not, start-up and operating current and power factor. While the contactor is loaded up to 15 times of the lamp rated current during closing in filament lamps, breaking current is equal to rated current. Compensation is very important in discharge and florescent lamps. In high pressure mercury vapor lamps, a current occurs at two times of the operating current during pre-heating period (approximately 5 minutes). This regime period is about 10 minutes in halogen lamps and sodium vapor lamps.

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## Utilization classes of contactor:

Accurate determination of the utilization class and selection in accordance with this class is the most important point for healthy operation of the contactor. The reason of many failures encountered in application is the failure to make the right selection according to utilization class of contactors.

### AC1 class:

It covers the alternative current loads with a power factor at least 0,95. The most common example of this is heating applications.

### AC3 class:

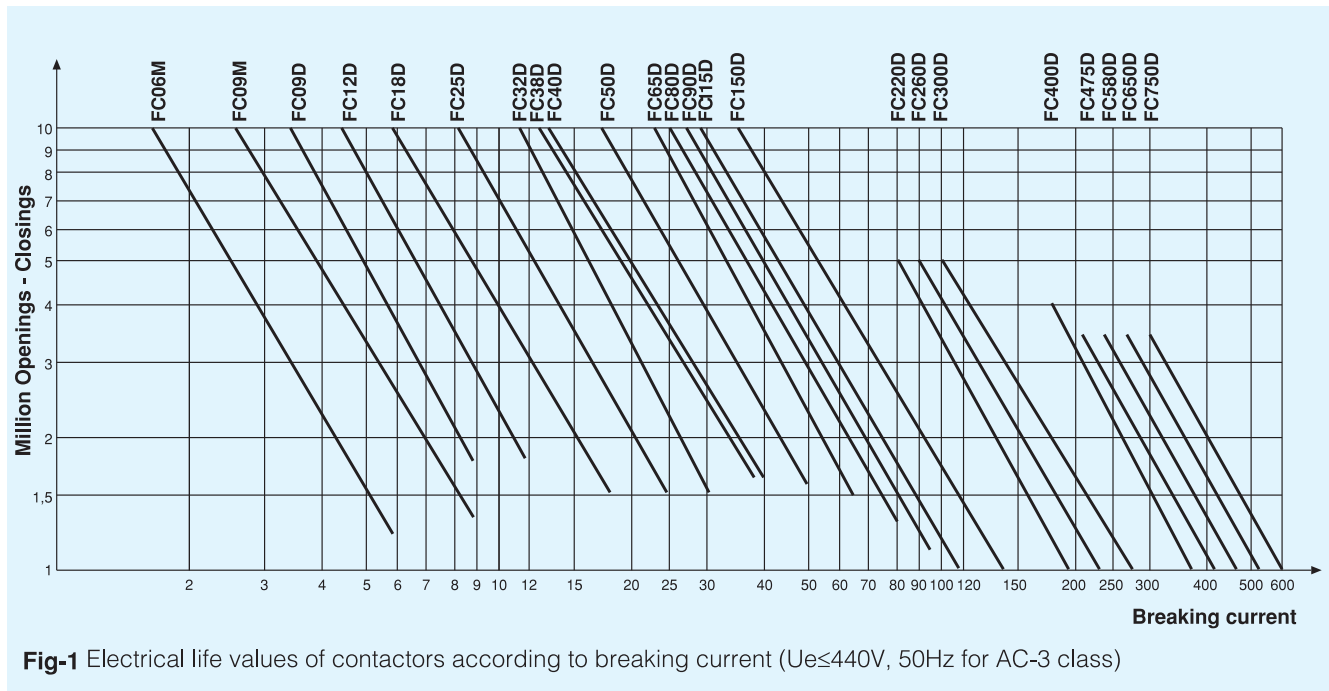
This is the most common application class. It covers cage asynchronous motors disabled while in operation after driving. At closing, motor start-up current, which is 5...7 times more than rated current of the motor, passes through the contactor contacts. At start-up, the contactor shall break the rated current drawn by the motor. At that time, the voltage between contactor poles is about 20% of the nominal voltage. This is an easy breaking situation. Examples of this class are stator and stator control of all standard squirrel cage motors and ring asynchronous motors, elevators, escalators, conveyors, pumps, ventilators, mixers, air-conditioning devices, coolers and valves.

### AC4 class:

This is related to discrete operation and reverse-current braking applications of cage or ring motors. Contactor opens and closes at driving current, which is 5...7 times more than rated current of the motor. Breaking is difficult at low speeds. Sample applications are pressing machines, wire and cable machines, discrete operating machine tools, metallurgy, lifting, electro valves, couplers etc.

## a. Contactor utilization classes according to IEC 60947-4-1:

| Current type        | Class   | Area of utilization  |
|---------------------|---------|--|
| Alternative current | AC - 1  | Non-inductive or low-inductive loads, resistance furnaces              |
|                     | AC - 3  | Squirrel cage motors, driving, motor stop in operation                 |
|                     | AC - 4  | Squirrel cage motors, driving, reversing operation, stepping operation |
|                     | AC - 5a | Electrical discharge lamp control mechanism switching                  |
|                     | AC - 6b | Switching of capacitor groups  |



**Fig-1** Electrical life values of contactors according to breaking current ( $U_e \leq 440V$ , 50Hz for AC-3 class)

# CONTACTORS

## Contactor failures and impacts:

If the contactors are not used in accordance with the technical data present in the catalogues or if there are failures in the supply network, failures may occur.

## Possible disablement reasons of contactors:

In general, contactors are actually devices which are not subject to failures quite easily. If selection has been made correct and if operating conditions are accurate, a contactor may perform millions of safe openings - closings. Below are the failures frequently encountered in contactors and reasons and solutions of these failures.

- Too long control (coil) circuit cables may cause some problems. Whereas significant voltage decrease throughout long cables makes closing difficult, too big section cable capacitance hinders opening. If control cable is longer than the recommended value, it is recommended to utilize a lower coil voltage or to connect a parallel resistance or inductive impedance to the coil.
- Existence of dust or foreign objects in

the contactor, severe atmosphere conditions and corrosion may hinder closing of the contactor especially with remote-control. When such a fault is encountered, the contactor should be cleaned with a strong clean air flow against dust and dirt, housing should be made more closed and protected, the circuit should be checked and any factor corrupting conductivity should be eliminated.

- The contactor coil may burn due to low or high voltage. Voltage regulator should be used in cases where network voltage fluctuates too much. Moreover, dust and foreign objects in air gap facilitate it. When coil is burnt, first voltage and frequency should be checked and a stable control voltage should be ensured.
- Another incident hindering opening other than the capacitive impact is adherence of the contacts. Reason of this adherence might be switching in high current, short circuit or fault in star-delta transition. If there is a short circuit, first of all reason of the short circuit should be found out.
- Incidents causing noisy operation of the contactor are presence of foreign

objects such as dust etc. in the air gap, failure of nucleus surface due to long-time operation and inappropriate voltage and frequency. In order to avoid them, nucleus surface should be kept clean and coil should be replaced according to voltage and frequency if required.

## Coil replacement:




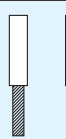

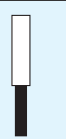
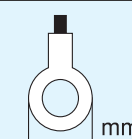


















Screws on both sides of the contactor are removed, top parts are separated, coil in the bottom is pulled out of its slot and new coil is mounted. Top part is placed and contactor is closed. However, attention should be paid to secure the spring during assembly.

## Contact life depending on opening current:

Contact melting loss at a particular switch device generally depends on opening current and contact lives are given in diagrams.

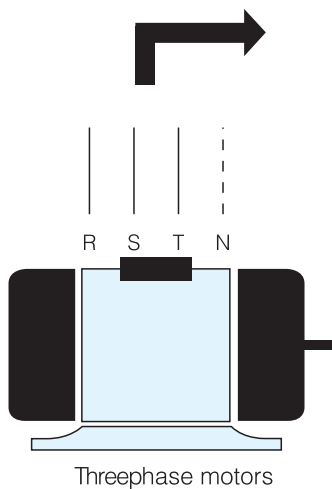
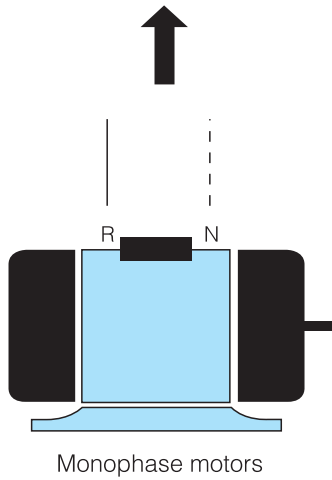
The most common area of utilization of the contactors is operation of motors. Different operating types of the motors are classified in IEC 60947-4-1.

## Connection sections:

| Min. and max. connection sections (mm <sup>2</sup> ) |  Primary contact |  Auxiliary contact |  mm <sup>2</sup> |  mm <sup>2</sup> |  mm <sup>2</sup> |  mm <sup>2</sup> |  mm |
|--|---|---|---|---|---|---|--|
| FC09D, FC12D, FC18D                                  |                  |                    | 1...4   | 1...4+1...4   | 1...6   | 1...6+1...6   | 8  |
| FC25D  |                  |                    | 1...2,5   | 1...2,5+1...2,5   | 1...2,5   | 1...2,5+1...2,5   | 8  |
|  |                  |   | 1,5...6   | 1,5...6+1,5...6   | 1,5...6   | 1,5...6+1,5...6   | 10   |
| FC32D  |                  |                    | 1,5...10  | 1,5...6+1,5...6   | 1,5...10  | 1,5...6+1,5...6   | 10   |
| FC38D  |   |                    | 1...2,5   | 1...2,5+1...2,5   | 1...2,5   | 1...2,5+1...2,5   | 8  |
|  |                  |   | 2,5...10  | 4...10+4...10   | 2,5...10  | 2,5...10+2,5...10   | 12   |
| FC40D, FC50D, FC65D                                  |   |                    | 1...2,5   | 1...2,5+1...2,5   | 1...2,5   | 1...2,5+1...2,5   | 8  |
|  |                  |   | 2,5...2,5   | 2,5...16+2,5...16   | 2,5...2,5   | 4...16+4...16   | —  |
| FC80D, FC95D   |   |                    | 1...2,5   | 1...2,5+1...2,5   | 1...2,5   | 1...2,5+1...2,5   | 8  |
|  |                  |   | 4...50  | 4...35+4...35   | 4...50  | 6...35+6...35   | —  |
| FC115D, FC150D                                       |                  |   | —   | —   | —   | —   | 20   |
| FC220D, FC260D                                       |                  |   | —   | —   | —   | —   | 25   |
| FC300D, FC400D                                       |                  |   | —   | —   | —   | —   | 25   |
| FC475D   |                  |   | —   | —   | —   | —   | 30   |
| FC580D, FC630D, FC750D                               |                  |   | —   | —   | —   | —   | 40   |

# CONTACTORS

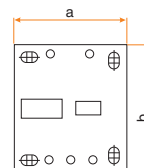
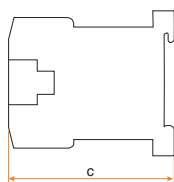
| Mono-phase motors |      |         |         | Threephase motors |      |             |         |         |         |         |         |          |
|-------------------|------|---------|---------|-------------------|------|-------------|---------|---------|---------|---------|---------|----------|
| kW                | HP   | 220 V A | 240 V A | kW                | HP   | 220-240 V A | 380 V A | 415 V A | 440 V A | 500 V A | 660 V A | 1000 V A |
| 0,37              | 0,5  | 3,9     | 3,6     | 0,37              | 0,5  | 1,8         | 1,03    | —       | 0,99    | 1       | 0,6     | 0,4      |
| 0,55              | 0,75 | 5,2     | 4,8     | 0,55              | 0,75 | 2,75        | 1,6     | —       | 1,36    | 1,21    | 0,9     | 0,6      |
| 0,75              | 1    | 6,6     | 6,1     | 0,75              | 1    | 3,5         | 2       | 2       | 1,68    | 1,5     | 1,1     | 0,75     |
| 1,1               | 1,5  | 9,6     | 8,8     | 1,1               | 1,5  | 4,4         | 2,6     | 2,5     | 2,37    | 2       | 1,5     | 1        |
| 1,5               | 2    | 12,7    | 11,7    | 1,5               | 2    | 6,1         | 3,5     | 3,5     | 3,06    | 2,6     | 2       | 1,3      |
| 1,8               | 2,5  | 15,7    | 14,4    | 2,2               | 3    | 8,7         | 5       | 5       | 4,42    | 3,8     | 2,8     | 1,9      |
| 2,2               | 3    | 18,6    | 17,1    | 3                 | 4    | 11,5        | 6,6     | 6,5     | 5,77    | 5       | 3,8     | 2,5      |
| 3                 | 4    | 24,3    | 22,2    | 3,7               | 5    | 13,5        | 7,7     | 7,5     | 7,1     | 5,9     | 4,4     | 3        |
| 4                 | 5    | 29,6    | 27,1    | 4                 | 5,5  | 14,5        | 8,5     | 8,4     | 7,9     | 6,5     | 4,9     | 3,3      |
| 4,4               | 6    | 34,7    | 31,8    | 5,5               | 7,5  | 20          | 11,5    | 11      | 10,4    | 9       | 6,6     | 4,5      |
| 5,2               | 7    | 39,8    | 36,5    | 7,5               | 10   | 27          | 15,5    | 14      | 13,7    | 12      | 8,9     | 6        |
| 5,5               | 7,5  | 42,2    | 38,7    | 9                 | 12   | 32          | 18,5    | 17      | 16,9    | 13,9    | 10,6    | 7        |
| 6                 | 8    | 44,5    | 40,8    | 10                | 13,5 | 35          | 20      | —       | —       | 15      | 11,5    | 7,5      |
| 7                 | 9    | 49,5    | 45,4    | 11                | 15   | 39          | 22      | 21      | 20,1    | 18,4    | 14      | 9        |
| 7,5               | 10   | 54,4    | 50      | 15                | 20   | 52          | 30      | 28      | 26,5    | 23      | 17,3    | 12       |
| 18,5              | 25   | 64      | 37      | 35                | 32,8 | 28,5        | 21,3    | 14,5    |         |         |         |          |
| 22                | 30   | 75      | 44      | 40                | 39   | 33          | 25,4    | 17      |         |         |         |          |
| 25                | 35   | 85      | 52      | 47                | 45,3 | 39,4        | 30,3    | 20      |         |         |         |          |
| 30                | 40   | 103     | 60      | 55                | 51,5 | 45          | 34,6    | 23      |         |         |         |          |
| 33                | 45   | 113     | 68      | 60                | 58   | 50          | 39      | 25      |         |         |         |          |
| 37                | 50   | 126     | 72      | 66                | 64   | 55          | 42      | 28      |         |         |         |          |
| 40                | 54   | 134     | 79      | 71                | 67   | 60          | 44      | 30      |         |         |         |          |
| 45                | 60   | 150     | 85      | 80                | 76   | 65          | 49      | 33      |         |         |         |          |
| 51                | 70   | 170     | 98      | 90                | 83   | 75          | 57      | 38      |         |         |         |          |
| 55                | 75   | 182     | 105     | 100               | 90   | 80          | 61      | 40      |         |         |         |          |
| 59                | 80   | 195     | 112     | 105               | 97   | 85          | 66      | 43      |         |         |         |          |
| 63                | 85   | 203     | 117     | 115               | 109  | 89          | 69      | 45      |         |         |         |          |
| 75                | 100  | 240     | 138     | 135               | 125  | 105         | 82      | 53      |         |         |         |          |
| 80                | 110  | 260     | 147     | 138               | 131  | 112         | 86      | 57      |         |         |         |          |
| 90                | 125  | 295     | 170     | 165               | 146  | 129         | 98      | 65      |         |         |         |          |
| 100               | 136  | 325     | 188     | 182               | 162  | 143         | 107     | 71      |         |         |         |          |
| 110               | 150  | 356     | 205     | 200               | 178  | 156         | 118     | 78      |         |         |         |          |
| 129               | 175  | 420     | 242     | 230               | 209  | 184         | 135     | 85      |         |         |         |          |
| 132               | 180  | 425     | 245     | 240               | 215  | 187         | 140     | 90      |         |         |         |          |
| 140               | 190  | 450     | 260     | 250               | 227  | 200         | 145     | 95      |         |         |         |          |
| 147               | 200  | 472     | 273     | 260               | 236  | 207         | 152     | 100     |         |         |         |          |
| 150               | 205  | 483     | 280     | 270               | 246  | 210         | 159     | 102     |         |         |         |          |
| 160               | 220  | 520     | 300     | 280               | 256  | 220         | 170     | 115     |         |         |         |          |
| 180               | 245  | 578     | 333     | 320               | 289  | 254         | 190     | 135     |         |         |         |          |
| 185               | 250  | 595     | 342     | 325               | 295  | 263         | 200     | 138     |         |         |         |          |
| 200               | 270  | 626     | 370     | 340               | 321  | 281         | 215     | 150     |         |         |         |          |
| 220               | 300  | 700     | 408     | 385               | 353  | 310         | 235     | 160     |         |         |         |          |
| 250               | 340  | 800     | 460     | 425               | 401  | 360         | 274     | 200     |         |         |         |          |
| 257               | 350  | 826     | 475     | 450               | 412  | 365         | 280     | 203     |         |         |         |          |
| 280               | 380  | 900     | 510     | 475               | 450  | 400         | 305     | 220     |         |         |         |          |
| 295               | 400  | 948     | 546     | 500               | 473  | 416         | 320     | 227     |         |         |         |          |
| 300               | 410  | 980     | 565     | 510               | 481  | 420         | 325     | 230     |         |         |         |          |
| 315               | 430  | 990     | 584     | 535               | 505  | 445         | 337     | 239     |         |         |         |          |
| 335               | 450  | 1100    | 620     | 550               | 518  | 472         | 355     | 250     |         |         |         |          |
| 355               | 480  | 1150    | 636     | 580               | 549  | 500         | 370     | 262     |         |         |         |          |
| 375               | 500  | 1180    | 670     | 610               | 575  | 527         | 395     | 273     |         |         |         |          |
| 400               | 545  | 1250    | 710     | 650               | 611  | 540         | 410     | 288     |         |         |         |          |
| 425               | 580  | —       | 760     | 690               | 650  | 574         | 445     | 302     |         |         |         |          |
| 445               | 600  | —       | 790     | 730               | 680  | 595         | 455     | 317     |         |         |         |          |
| 450               | 610  | —       | 800     | 740               | 690  | 608         | 460     | 320     |         |         |         |          |
| 175               | 645  | —       | 850     | 780               | 730  | 645         | 485     | 335     |         |         |         |          |
| 500               | 680  | —       | 900     | 820               | 780  | 680         | 515     | 350     |         |         |         |          |



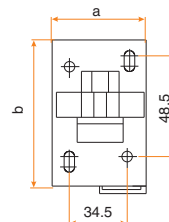
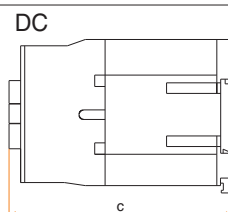
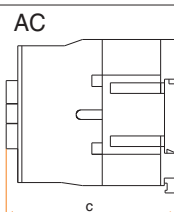


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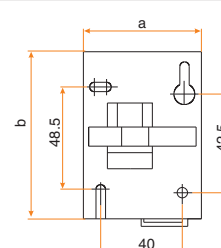
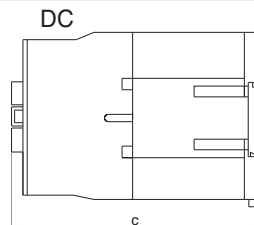
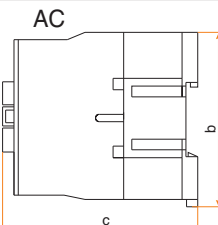
| Type  | a    | b  | c  |
|-------|------|----|----|
| FC06M | 45.5 | 58 | 57 |
| FC09M | 45.5 | 58 | 57 |



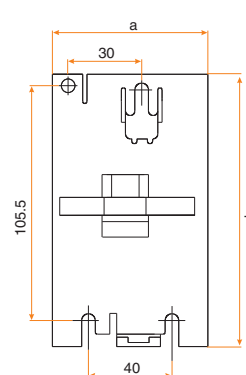
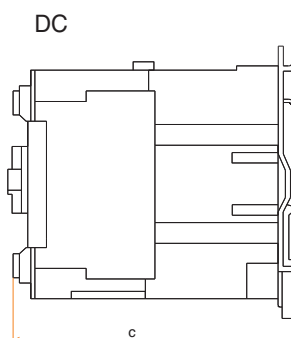
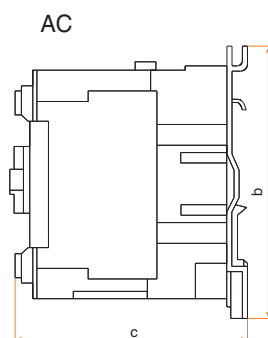
| Type  | Pole | a  | b  | c  |     |
|-------|------|----|----|----|-----|
|       |      |    |    | AC | DC  |
| FC09D | 3    | 47 | 76 | 82 | 116 |
| FC09D | 4    | 47 | 76 | 82 | 116 |
| FC12D | 3    | 47 | 76 | 82 | 116 |
| FC12D | 4    | 47 | 76 | 82 | 116 |
| FC18D | 3    | 47 | 76 | 82 | 116 |
| FC18D | 4    | 47 | 76 | 82 | 116 |



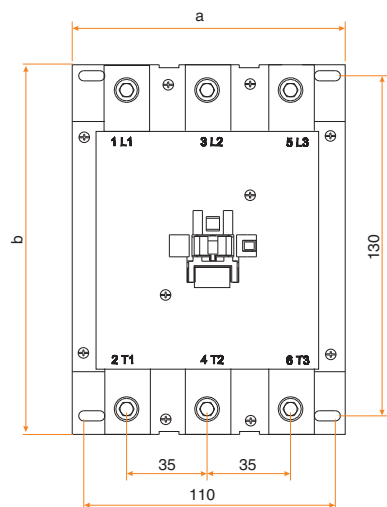
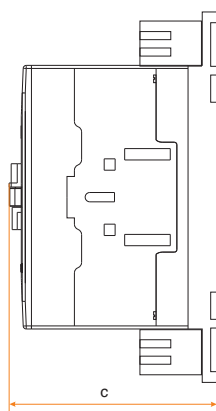
| Type  | Pole | a  | b  | c   |     |
|-------|------|----|----|-----|-----|
|       |      |    |    | AC  | DC  |
| FC25D | 3    | 47 | 76 | 87  | 120 |
| FC25D | 4    | 57 | 86 | 95  | 130 |
| FC32D | 3    | 57 | 86 | 95  | 130 |
| FC32D | 4    | 57 | 86 | 95  | 130 |
| FC38D | 3    | 57 | 86 | 100 | 135 |



| Type  | Pole | a  | b   | c   |     |
|-------|------|----|-----|-----|-----|
|       |      |    |     | AC  | DC  |
| FC40D | 3    | 77 | 129 | 115 | 175 |
| FC40D | 4    | 85 | 129 | 115 | 174 |
| FC50D | 3    | 77 | 129 | 115 | 175 |
| FC50D | 4    | 85 | 129 | 115 | 174 |
| FC65D | 3    | 77 | 129 | 115 | 175 |
| FC65D | 4    | 85 | 129 | 115 | 174 |
| FC80D | 3    | 87 | 129 | 127 | 183 |
| FC80D | 4    | 97 | 129 | 127 | 180 |
| FC95D | 3    | 87 | 129 | 127 | 183 |
| FC95D | 4    | 97 | 129 | 127 | 180 |

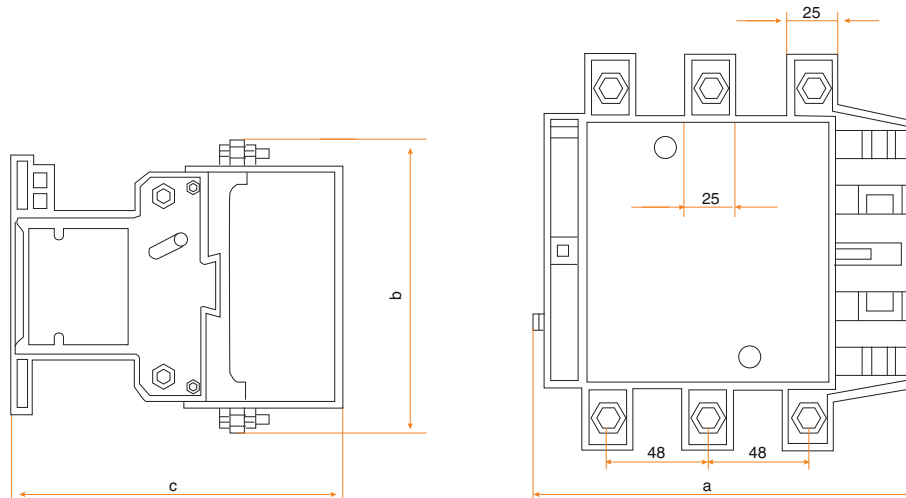


| Type   | Pole | a   | b   | c   |
|--------|------|-----|-----|-----|
| FC115D | 3    | 120 | 154 | 124 |
| FC115D | 4    | 204 | 163 | 172 |
| FC150D | 3    | 120 | 154 | 124 |
| FC150D | 4    | 204 | 171 | 172 |

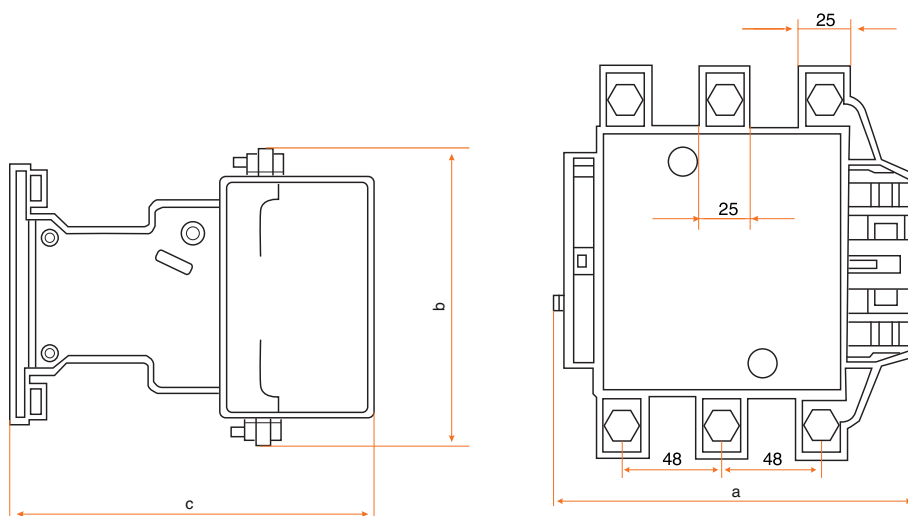


# CONTACTORS

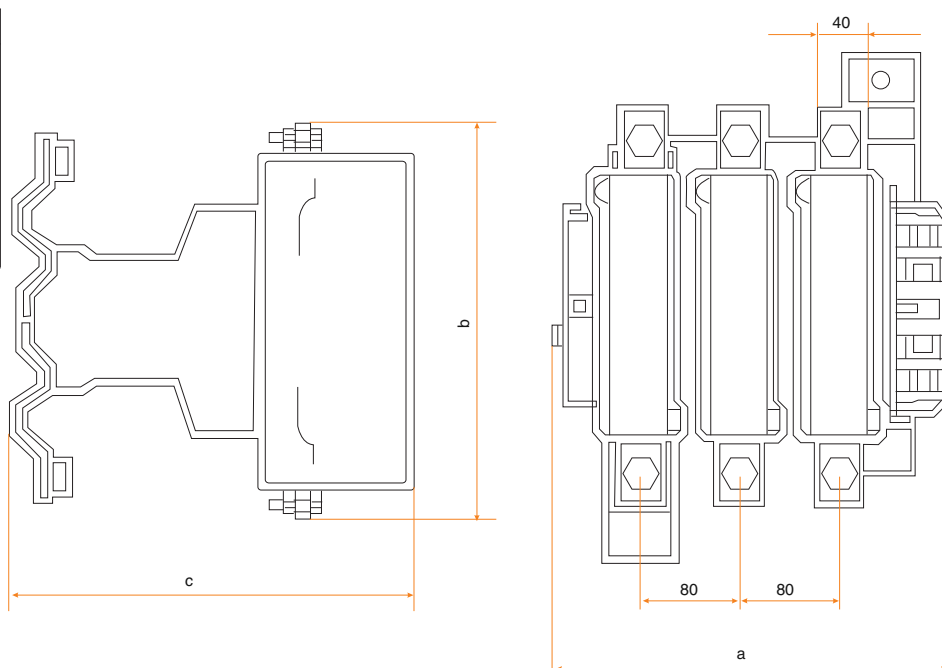
| Type   | Pole | a   | b   | c   |
|--------|------|-----|-----|-----|
| FC220D | 3    | 170 | 175 | 183 |
| FC220D | 4    | 211 | 175 | 183 |
| FC260D | 3    | 170 | 175 | 183 |
| FC260D | 4    | 211 | 175 | 183 |
| FC300D | 3    | 218 | 210 | 223 |
| FC300D | 4    | 261 | 210 | 223 |



| Type   | Pole | a   | b   | c   |
|--------|------|-----|-----|-----|
| FC400D | 3    | 218 | 210 | 223 |
| FC400D | 4    | 261 | 210 | 223 |
| FC475D | 3    | 235 | 240 | 235 |
| FC475D | 4    | 288 | 240 | 235 |

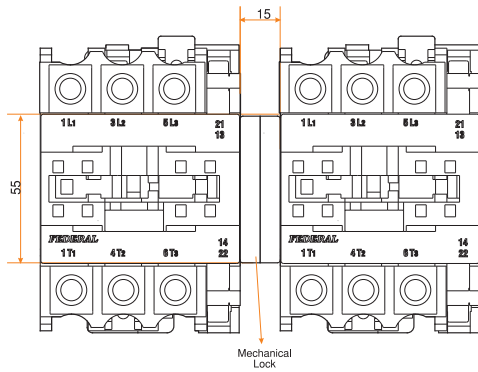


| Type   | Pole | a   | b   | c   |
|--------|------|-----|-----|-----|
| FC580D | 3    | 310 | 304 | 257 |
| FC580D | 4    | 389 | 304 | 257 |
| FC650D | 3    | 310 | 304 | 257 |
| FC650D | 4    | 389 | 304 | 257 |
| FC750D | 3    | 310 | 304 | 257 |
| FC750D | 4    | 389 | 304 | 257 |

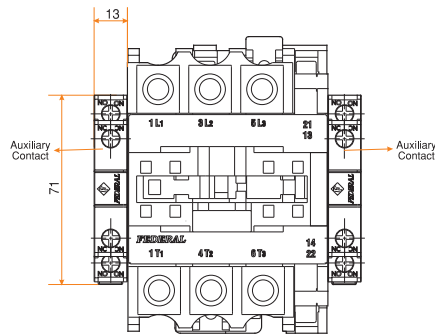


# CONTACTORS

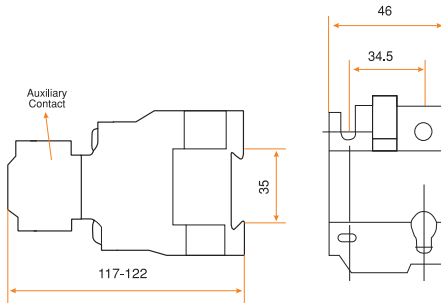
## Mechanical lock



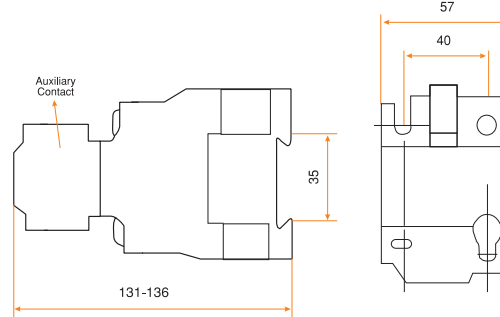
## Side assembled contact block



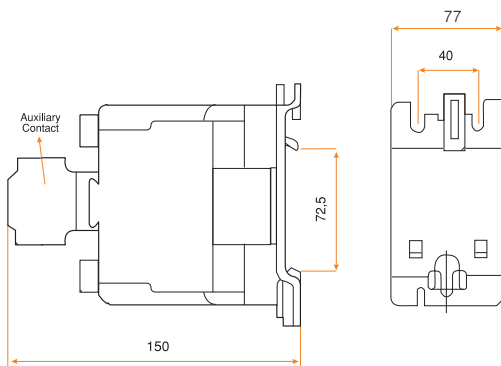
## FC12D / FC18D Front Assembling One Assembly Auxiliary Contact Block :



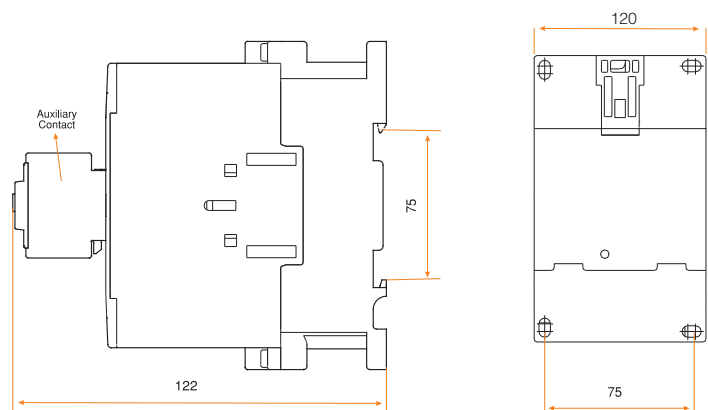
## FC25D / FC32D / FC38D Front Assembling One Assembly Auxiliary Contact Block :



## FC40D / FC50D / FC65D / FC80D / FC95D Front Assembling One Assembly Auxiliary Contact Bloc:



## FC115D / FC150D Front Assembling One Assembly Auxiliary Contact Block:



# CONTACTORS

## Order codes of auxiliary contact blocks

| Top Assembly Type | Order code     |
|-------------------|----------------|
| FCB-F20           | 8DD-A0020-0000 |
| FCB-F11           | 8DD-A0011-0000 |
| FCB-F02           | 8DD-A0002-0000 |
| FCB-F40           | 8DD-A0040-0000 |
| FCB-F31           | 8DD-A0031-0000 |
| FCB-F22           | 8DD-A0022-0000 |
| FCB-F13           | 8DD-A0013-0000 |
| FCB-F04           | 8DD-A0004-0000 |

| Side Assembly Type | Order code     |
|--------------------|----------------|
| FCAB-F11           | 8DD-B0011-0000 |
| FCAB-F20           | 8DD-B0020-0000 |
| FCAB-F02           | 8DD-B0002-0000 |

## Order codes of spare coils:

| Type    | Order code     |
|---------|----------------|
| FCC-D2  | 8DD-C□□20-0000 |
| FCC-D4  | 8DD-C□□30-0000 |
| FCC-D6  | 8DD-C□□40-0000 |
| FCC-D8  | 8DD-C□□50-0000 |
| FCC-D10 | 8DD-C□□60-0000 |
| FCC-D12 | 8DD-C□□70-0000 |

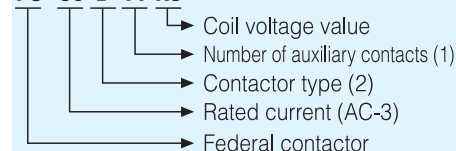
□□ Indicates coil operating voltage

## Order codes of spare primary contact sets:

| Type    | Order code    |
|---------|---------------|
| FC09 D  | 8DD-0000-0009 |
| FC12 D  | 8DD-0000-0012 |
| FC18 D  | 8DD-0000-0018 |
| FC25 D  | 8DD-0000-0025 |
| FC32 D  | 8DD-0000-0032 |
| FC38 D  | 8DD-0000-0038 |
| FC40 D  | 8DD-0000-0040 |
| FC50 D  | 8DD-0000-0050 |
| FC65 D  | 8DD-0000-0065 |
| FC80 D  | 8DD-0000-0080 |
| FC95 D  | 8DD-0000-0095 |
| FC115 D | 8DD-0000-0115 |
| FC150 D | 8DD-0000-0150 |
| FC200 D | 8DD-0000-0200 |
| FC260 D | 8DD-0000-0260 |
| FC300 D | 8DD-0000-0300 |
| FC400 D | 8DD-0000-0400 |
| FC475 D | 8DD-0000-0475 |
| FC580 D | 8DD-0000-0580 |
| FC650 D | 8DD-0000-0650 |
| FC750 D | 8DD-0000-0750 |

## Descriptions of contactor type codes:

**FC- 50 D 11 K5** (Sample contactor type)



(1) First figure indicates number of normally open (NO) contacts and second figure indicates number of normally closed (NC) contacts.

Sample

11=1NO + 1NC

(2) M: Mini contactor

D: Standard contactor

DK: Compensation contactor

## Order codes of contactors :

| Type     | AC-3 Ie (A) | kW 400 V | Standard auxiliary contact | Order code                           |
|----------|-------------|----------|----------------------------|--------------------------------------|
| FC06M22* | 6           | 2.2      | 2 NO + 2 NC                | 9DM -K3 223-0006                     |
| FC06M    | 6           | 2.2      | 1 NO<br>1 NC               | 9DM -□□ 103-0006<br>9DM -□□ 013-0006 |
| FC09M    | 9           | 4        | 1 NO<br>1 NC               | 9DM -□□ 103-0009<br>9DM -□□ 013-0009 |
| FC09D    | 9           | 4        | 1 NO<br>1 NC               | 9DD -□□ 103-0009<br>9DD -□□ 013-0009 |
| FC12D    | 12          | 5,5      | 1 NO<br>1 NC               | 9DD -□□ 103-0012<br>9DD -□□ 013-0012 |
| FC18D    | 18          | 7,5      | 1 NO<br>1 NC               | 9DD -□□ 103-0018<br>9DD -□□ 013-0018 |
| FC25D    | 25          | 11       | 1 NO<br>1 NC               | 9DD -□□ 103-0025<br>9DD -□□ 013-0025 |
| FC32D    | 32          | 15       | 1 NO<br>1 NC               | 9DD -□□ 103-0032<br>9DD -□□ 013-0032 |
| FC38D    | 38          | 18,5     | 1 NO<br>1 NC               | 9DD -□□ 103-0038<br>9DD -□□ 013-0038 |
| FC40D    | 40          | 18,5     | 1 NO + 1 NC                | 9DD -□□ 113-0040                     |
| FC50D    | 50          | 22       | 1 NO + 1 NC                | 9DD -□□ 113-0050                     |
| FC65D    | 65          | 30       | 1 NO + 1 NC                | 9DD -□□ 113-0065                     |
| FC80D    | 80          | 37       | 1 NO + 1 NC                | 9DD -□□ 113-0080                     |
| FC95D    | 95          | 45       | 1 NO + 1 NC                | 9DD -□□ 113-0095                     |
| FC115D   | 115         | 55       | -                          | 9DD -□□ 003-0115                     |
| FC150D   | 150         | 75       | -                          | 9DD -□□ 003-0150                     |
| FC220D   | 220         | 110      | -                          | 9DD -□□ 003-0220                     |
| FC260D   | 260         | 140      | -                          | 9DD -□□ 003-0260                     |
| FC300D   | 300         | 160      | -                          | 9DD -□□ 003-0300                     |
| FC400D   | 400         | 200      | -                          | 9DD -□□ 003-0400                     |
| FC475D   | 475         | 250      | -                          | 9DD -□□ 003-0475                     |
| FC580D   | 580         | 315      | -                          | 9DD -□□ 003-0580                     |
| FC650D   | 650         | 355      | -                          | 9DD -□□ 003-0650                     |
| FC750D   | 750         | 400      | -                          | 9DD -□□ 003-0750                     |

□□ Indicates coil operating voltage. \*Auxiliary contactor.

## Order codes of mechanical locks :

| Type          | Order code     |
|---------------|----------------|
| FC09D...FC38D | 8DD-MK000-0001 |
| FC40D...FC95D | 8DD-MK000-0002 |

## Coil voltages :

Give coil voltages of the contactors in accordance with the table below.

| □□ | 24V | 42V | 48V | 110V | 220V | 230V | 240V | 380V | 415V | 440V | 500V |
|----|-----|-----|-----|------|------|------|------|------|------|------|------|
| AC | A5  | D5  | E5  | H5   | K5   | N5   | R5   | S5   | T5   | U5   | V5   |
| DC | A6  |     | E6  | H6   | K6   |      |      |      |      | U6   |      |

Sample1: For 220 V, 50/60 Hz coil voltage; K5.

Sample2: For AC3 class 32 A, normally closed, coil voltage 48 V 50/60 Hz contactor: FC - 32DO1 E5.

Sample3: For AC3 class 95 A, normally 3 closed and 1 open auxiliary contacts, coil voltage 220 V 50/60 Hz contactor

FC - 95D11K5 + FCB-F02 (Contactor and 1 FCB - F02 contact block shall be adequate.)

# CONTACTORS

## Contactor for capacitor switching:

Contactor for capacitor switching have been designed to switch capacitors and can be safely utilized in compensation circuits thanks to their special design. Contactors limit start-up currents of the capacitors thanks to limiting contact blocks. In this way, life of either capacitors or circuit protective devices is extended. The only difference of FEDERAL contactor for capacitor switching from normal contactors is the transition block with current limiting resistances connected parallel to primary contacts on the contactor.

## Reasons for use of compensation contactor:

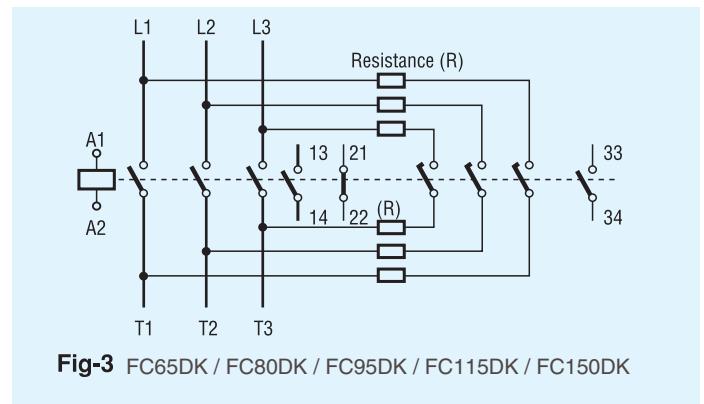
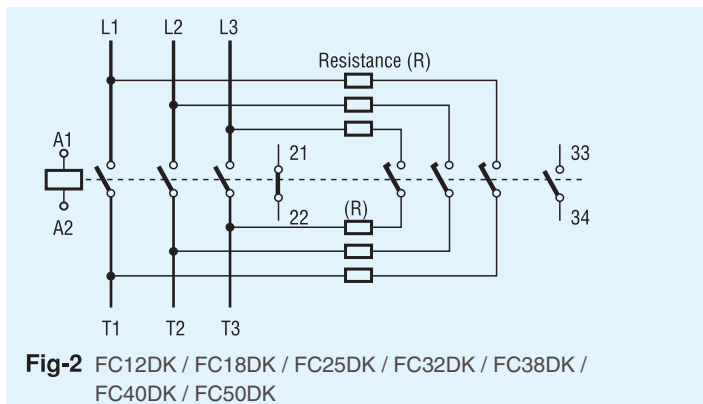
As it is known, capacitors cause high frequencies between 1 and 15 kHz and very short-time high currents that can be ten times more than the rated current during initial start-up. Inductance (shock coil) may be added to each three phases which the capacitor is connected to. However, as this transaction is difficult in practice, contactor for capacitor switching designed only for this purpose are utilized. In this way, life of the contactor shall extend by 100% when compared to normal contactors. To given an example, if electrical life of normal

contactors at maximum load is 100,000, life of contactor for capacitor switching is 200,000.

## Principles of operation:

Contactor for capacitor switching' principle of operation is as follows. When contactor coil receives energy, first contacts of the transition block are closed. Approximately 3,5 ms after first start-up current of the capacitor passes through these contactors, contacts of the transition block are opened and nominal current of the capacitors are carried by primary contacts.

## Circuit diagram:



| Contactor Type (DK)                    | FC09      | FC12    | FC18  | FC25  | FC32  | FC38  | FC40    | FC50    | FC65    | FC80    | FC95 | FC115     | FC150 |  |
|--|-----------|---------|-------|-------|-------|-------|---------|---------|---------|---------|------|-----------|-------|--|
| Number of Poles                        | 3         | 3       | 3     | 3     | 3     | 3     | 3       | 3       | 3       | 3       | 3    | 3         | 3     |  |
| Utilization Class AC-6b Ie max 440V    | A 13      | 16      | 20    | 22    | 26    | 33    | 44      | 52      | 59      | 79      | 85   | 92        | 105   |  |
| Rated Thermal Current - Ith            | A 25      | 25      | 32    | 40    | 50    | 55    | 60      | 80      | 80      | 125     | 125  | 200       | 200   |  |
| Rated Insulation Voltage - Ui 50-60 Hz | V 630     | 630     | 630   | 630   | 630   | 630   | 630     | 630     | 630     | 630     | 630  | 630       | 630   |  |
| Rated Impulse Withstand Voltage        | kV 8      | 8       | 8     | 8     | 8     | 8     | 8       | 8       | 8       | 8       | 8    | 8         | 8     |  |
| Rated Power                            | 220/240 V | 5       | 7     | 8     | 9     | 10    | 15      | 20      | 25      | 25      | 35   | 40        | 45    |  |
| 3 ~ AC-6b                              | 400/440 V | 10      | 12,5  | 15    | 16,7  | 20    | 25      | 33,3    | 40      | 45      | 60   | 65        | 70    |  |
| 55°C - kVAr                            | 480/525 V | 12,5    | 15    | 16,7  | 20    | 24    | 25      | 36      | 45      | 45      | 60   | 65        | 70    |  |
| Weight                                 | kg        | 0,39    | 0,39  | 0,39  | 0,4   | 0,58  | 0,6     | 1,2     | 1,2     | 1,2     | 1,5  | 1,5       | 2,2   |  |
| Number of Auxiliary Contacts           |           | 1NO+1NC |       |       |       |       |         | 2NO+1NC |         |         |      | 1NO / 1NC |       |  |
| Coil Power Consumption (holding)       | VA        | 9,5     | 9,5   | 9,5   | 9,5   | 11    | 11      | 30      | 30      | 30      | 30   | 30        | 22    |  |
| Power Loss Per Pole (AC-6b)            | W         | 0,6     | 1     | 1,4   | 1,7   | 2,5   | 3,9     | 3,4     | 4,5     | 5       | 7,5  | 8,8       | 6,5   |  |
| Min-Max Tightening Torque              | Nm        | 1-1,5   | 1-1,5 | 1-1,5 | 1-1,5 | 1,2-2 | 1,5-2,5 | 3,5-4,5 | 3,5-4,5 | 3,5-4,5 | 6-10 | 6-10      | 8-12  |  |
| Dimensions                             |           |         |       |       |       |       |         |         |         |         |      |           |       |  |
|  | a (mm)    | 47      | 47    | 47    | 47    | 57    | 57      | 77      | 77      | 77      | 87   | 87        | 120   |  |
|  | b (mm)    | 76      | 76    | 76    | 76    | 86    | 86      | 129     | 129     | 129     | 129  | 129       | 154   |  |
|  | c (mm)    | 117     | 117   | 117   | 122   | 131   | 136     | 150     | 150     | 150     | 158  | 158       | 158   |  |

# CONTACTORS

## Order codes of contactor for capacitor switching

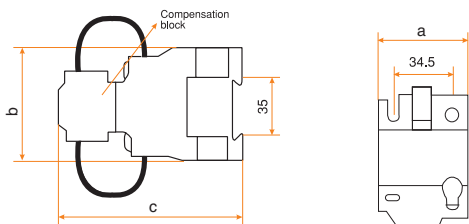
| Type     | AC-6b Ie (A) | kVAr 200/240 V | kVAr 400/440 V | Standard auxiliary contact | Order code      |
|----------|--------------|----------------|----------------|----------------------------|-----------------|
| FC09DK   | 13           | 5              | 10             | 1 NO + 1 NC                | 9DK-□□ 113-0009 |
| FC12DK   | 16           | 7              | 12,5           | 1 NO + 1 NC                | 9DK-□□ 113-0012 |
| FC18DK   | 20           | 8              | 15             | 1 NO + 1 NC                | 9DK-□□ 113-0018 |
| FC25DK   | 22           | 9              | 16,7           | 1 NO + 1 NC                | 9DK-□□ 113-0025 |
| FC32DK   | 26           | 10             | 20             | 1 NO + 1 NC                | 9DK-□□ 113-0032 |
| FC38DK   | 33           | 15             | 25             | 1 NO + 1 NC                | 9DK-□□ 113-0038 |
| FC40DK   | 44           | 20             | 33,3           | 1 NO + 1 NC                | 9DK-□□ 213-0040 |
| FC50DK   | 52           | 25             | 40             | 2 NO + 1 NC                | 9DK-□□ 213-0050 |
| FC65DK   | 59           | 25             | 45             | 2 NO + 1 NC                | 9DK-□□ 213-0065 |
| FC80DK   | 79           | 35             | 60             | 2 NO + 1 NC                | 9DK-□□ 213-0080 |
| FC95DK   | 85           | 40             | 65             | 2 NO + 1 NC                | 9DK-□□ 213-0095 |
| FC115DK  | 92           | 45             | 70             | 1 NO                       | 9DK-□□ 103-0115 |
|          |              |                |                | 1 NC                       | 9DK-□□ 013-0115 |
| FC-150DK | 105          | 50             | 80             | 1 NO                       | 9DK-□□ 103-0150 |
|          |              |                |                | 1 NC                       | 9DK-□□ 013-0150 |

## Order codes of contactor for capacitor switching accessories :

| Type                          | Order code   |
|-------------------------------|--------------|
| Compensation resistance block | 8DK-D21-0□□□ |
| Compensation block            | 8DK-D21-1□□□ |

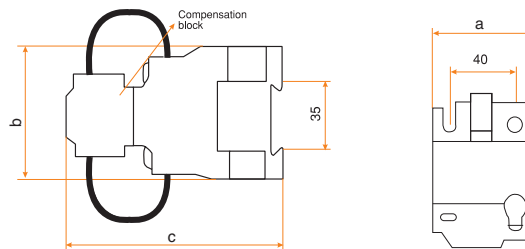
□□□ Contactor type

### FC09DK / FC12DK / FC18DK



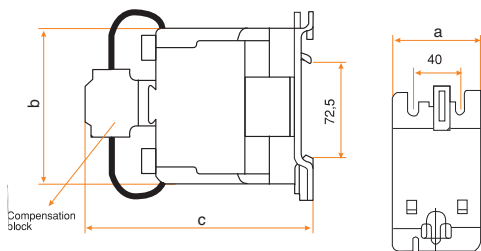
| Type   | a  | b  | c   |
|--------|----|----|-----|
| FC09DK | 47 | 76 | 117 |
| FC12DK | 47 | 76 | 117 |
| FC18DK | 47 | 76 | 117 |

### FC25DK / FC32DK / FC38DK



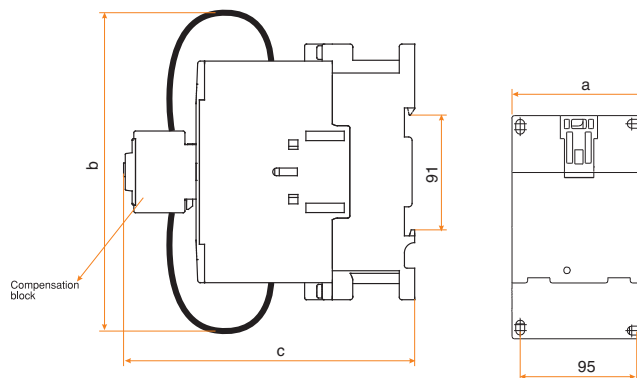
| Type   | a  | b  | c   |
|--------|----|----|-----|
| FC25DK | 47 | 76 | 122 |
| FC32DK | 57 | 86 | 131 |
| FC38DK | 57 | 86 | 136 |

### FC40DK / FC50DK / FC65DK / FC80DK / FC95DK



| Type   | a  | b   | c   |
|--------|----|-----|-----|
| FC40DK | 77 | 129 | 150 |
| FC50DK | 77 | 129 | 150 |
| FC65DK | 77 | 129 | 150 |
| FC80DK | 87 | 129 | 158 |
| FC95DK | 87 | 129 | 158 |

### FC115DK / FC150DK



| Type    | a   | b   | c   |
|---------|-----|-----|-----|
| FC115DK | 120 | 154 | 158 |
| FC150DK | 120 | 154 | 158 |

# CONTACTORS

## Federal High Current Contactors:

They are used safely in Ohmic, inductive and capacitive, AC and DC circuits, network-transformer inverter systems. Contactors comply with EN 60947-4-1 standard. Contactors, which have 3 poles normally, are manufactured with 1, 2 and 4 poles upon order. Federal contactors are designed to break DC current. Since arc extinction is more difficult in DC than AC, Federal contactors can be utilized in AC circuits safely for a long time. Selection of contactors for various utilization classes and voltages is shown in the technical values table.

## Advantages:

- As there are arc contacts, primary contacts are not damaged in starting and breaking currents.
- Large arc separators can be safely used in severe conditions, to which compact contactors cannot resist, thanks to magnetic blow and special contact system.
- Heating of coil nucleus is avoided at high frequencies. Thanks to this feature, it is suitable for utilization in induction furnaces.
- There is no noise while contactor is in operation.
- Power consumption is very low.
- It is not affected from voltage fluctuations.
- There is adequate number of auxiliary contacts. (Number of auxiliary contacts may be increased if required.)
- There is no spare part problem.
- There is mechanical lock option as well as electrical lock.

- As well as these advantages, economic characteristic provides another advantage.

- It has long electrical life as they have double contacts.

## Coil circuit:

AC control supply voltage is converted into DC via a bridge diode and applied to contactor coil. As it can be seen in the connection diagram, starting button is placed on AC circuit; stopping button and thermal relay opening contact is placed on DC circuit. Contactor is not opened due to voltage fluctuations. For example, voltage should go below 55V ( $0.25 \times U_s$ ) for the contactor to open in a network with control supply voltage as ( $U_s$ ) 220V. When contactor is enabled initially, it draws a maximum current of 4A and while it is in operation, it draws maximum 180mA. As it can be understood here, power consumption of Federal contactors is very low. There is no noise problem in the contactor due to dirt or rust on nucleus plates in coil circuit.

## Contact system:

There are arc and primary contacts in main circuit of the contactor. First of all, arc contacts close the circuit in case of closing and instant driving currents on the nominal current are taken over by this contact. After that, primary contacts are closed to provide full contact. Thanks to this closing mechanism, damage of primary contacts due to crash and wearing

due to arcs is avoided. In case of opening, first primary contacts and then arc contacts are opened with spring force as soon as after coil voltage is broken. In this way, primary contacts are not damaged due to arc.

## Auxiliary contacts:

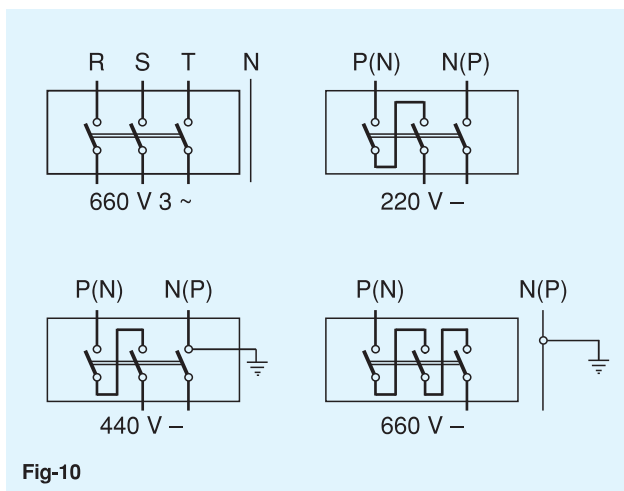
There are 4 open and 4 closed auxiliary contacts on the contactor. 2 open and 2 closed contacts of them have been used in coil circuit. Other 4 contacts (2 open and 2 closed) are kept as spares. 2 open and 2 closed contacts can be added to them if required.

## Arc Chamber:

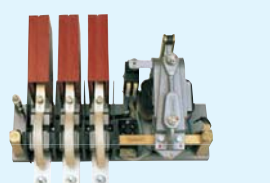
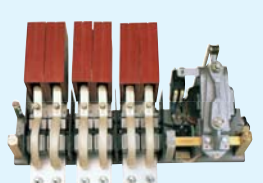
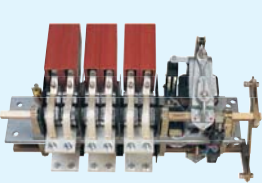
The arc formed during opening with the electromagnetic blow in the contactor is pushed into the arc chambers and arc chambers in the chamber separate the arc and extinct it. Therefore, contactors should not be opened and closed under voltage without assembling arc chambers.

## Connection types in AC and DC circuits:

Connection type of contactors for AC and various DC voltages is given in Figure-10. However, opening spring size and distance is different in AC and DC contactors. This fact should be taken into consideration in orders. In order to let electromagnetic blow push the arc into separators, energy to the contactor should be supplied through top terminals, where separators are present.



# CONTACTORS

|  |               |         |  |         |         |         |  |         |  |         |
|--|---------------|---------|---|---------|---------|---------|--|---------|---|---------|
| Type   |               |         | EC 300  | EC 400  | EC 630  | EC 800  | EC 1250  | EC 1600 | EC 2000   | EC 2500 |
| Utilization class (Ith)<br>Ie max                      | AC1<br>≤ 40°C | A       | 300   | 400     | 630     | 800     | 1250   | 1600    | 2000  | 2500    |
| Number of poles *                                      |               |         | 1,2,3,4   | 1,2,3,4 | 1,2,3,4 | 1,2,3,4 | 1,2,3  | 1,2,3   | 1,2,3   | 1,2,3   |
| Rated impulse withstand voltage                        |               | kV      | 8   | 8       | 8       | 8       | 8  | 8       | 8   | 8       |
| For motor control<br>(Squirrel cage motors)<br>3 ~ AC3 | 220 / 230 V   | kW      | 75  | 110     | 160     | 200     | 370  | 470     | 580   | 730     |
|  | 380 / 400 V   | kW      | 132   | 200     | 280     | 335     | 630  | 790     | 980   | 1230    |
|  | 500 V         | kW      | 180   | 257     | 355     | 450     | 740  | 960     | 1190  | 1490    |
| In compensation circuits                               | 380 / 400 V   | kVAr    | 150   | 200     | 250     | 300     | 450  | 525     | 655   | 820     |
| Rated insulation voltage                               |               | Ui ~ V  | 690   | 690     | 690     | 690     | 690  | 690     | 690   | 690     |
| Coil voltage   | Us (AC)       | ~ V     | 24, 48, 110, 220, 240, 380, 415   |         |         |         |  |         |   |         |
|  | Us (DC)       | - V     | 24, 48, 110, 220, 240, 380, 415   |         |         |         |  |         |   |         |
| Coil voltage operating interval                        |               | xUs ~ V | 0,72 - 1,1  |         |         |         |  |         |   |         |
| Auxiliary contacts                                     | NA (10A)      | Ad      | 2   | 2       | 2       | 2       | 2  | 2       | 4   | 4       |
|  | NK (10A)      | Ad      | 2   | 2       | 2       | 2       | 2  | 2       | 4   | 4       |
| Coil power consumption                                 | pulling       | W       | 800   | 800     | 800     | 800     | 880  | 880     | 1760  | 1760    |
|  | holding       | W       | 26  | 26      | 26      | 26      | 35   | 35      | 70  | 70      |
| Mechanical life  | Operation     |         | 50000   | 50000   | 50000   | 50000   | 50000  | 50000   | 50000   | 50000   |
| Dimensions   | depth         | mm      | 245   | 245     | 245     | 245     | 245  | 245     | 500   | 500     |
|  | wideness      | mm      | 462   | 462     | 462     | 462     | 577  | 577     | 710   | 710     |
|  | height        | mm      | 370   | 370     | 370     | 370     | 370  | 370     | 370   | 370     |
| Weight   |               | kg      | 28,6  | 29,2    | 29,8    | 30,4    | 44,2   | 44,8    | 88,4  | 89,6    |
| Power loss per pole                                    |               | W       | 6   | 11      | 26      | 42      | 52   | 85      | 80  | 125     |

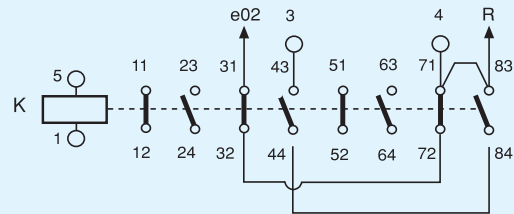
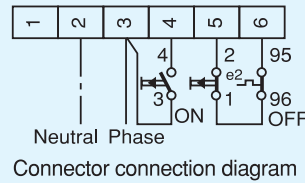
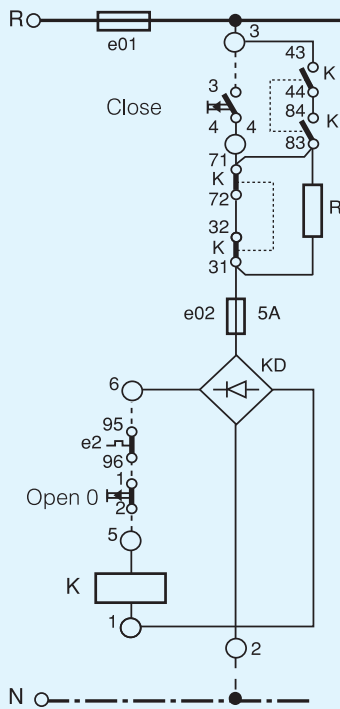
**Us:**Control supply voltage.

\* High Current Contactors are manufactured with 3 poles as a standard.



# CONTACTORS

Connection diagram :



- e01 : 6A fuse
- e02 : 5A fuse
- e2 Thermal relay contact (Depends on user request)
- : Connections to be made by user (Stop mechanism)
- R : Voltage separator resistance (2200 Ω - 75 W)
- KD : Bridge diode
- K : Coil

Fig-11

-○ : Sequence connectors - V<sub>RN</sub>=220 V for R<sub>1</sub>=(2200±%5)Ω-75W

- Place stop button in DC circuit as shown in the diagram, otherwise there shall be a delay in opening.

- Connectors no 5 and 6 are subject to short circuit for test. User should pay attention to this fact and make the connection according to the diagram.

Mechanical lock connection diagram:

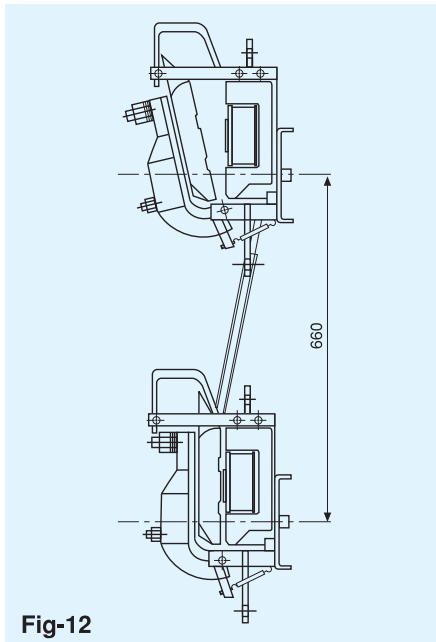


Fig-12

Order codes of high current contactors :

| Type    | AC-3 I <sub>e</sub> (A) | kW 400 V | Standard Auxiliary Contact | Order code       |
|---------|-------------------------|----------|----------------------------|------------------|
| EC 300  | 300                     | 132      | 4 NO + 4 NC                | 9DY-□□ 22 Δ-0300 |
| EC 400  | 400                     | 200      | 4 NO + 4 NC                | 9DY-□□ 22 Δ-0400 |
| EC 630  | 630                     | 280      | 4 NO + 4 NC                | 9DY-□□ 22 Δ-0630 |
| EC 800  | 800                     | 325      | 4 NO + 4 NC                | 9DY-□□ 22 Δ-0800 |
| EC 1250 | 1250                    | 630      | 4 NO + 4 NC                | 9DY-□□ 22 Δ-1250 |
| EC 1600 | 1600                    | 790      | 4 NO + 4 NC                | 9DY-□□ 22 Δ-1600 |
| EC 2000 | 2000                    | 980      | 4 NO + 4 NC                | 9DY-□□ 22 Δ-2000 |
| EC 2500 | 2500                    | 1230     | 4 NO + 4 NC                | 9DY-□□ 22 Δ-2500 |

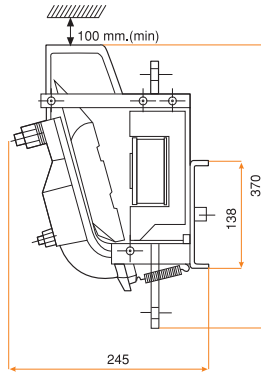
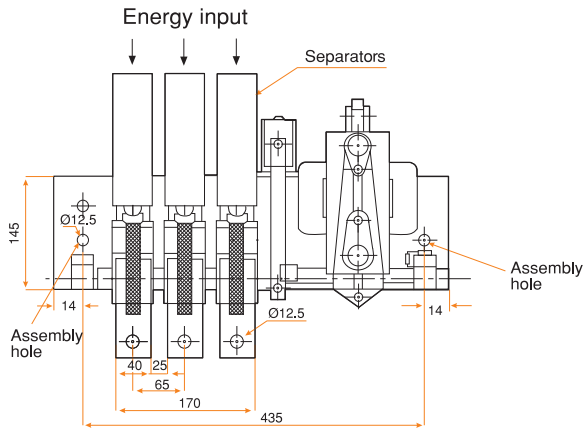
Coil voltages :

|          | 24 V | 48 V | 110 V | 220 V | 240 V | 380 V | 415 V |
|----------|------|------|-------|-------|-------|-------|-------|
| 50/60 Hz | A5   | E5   | H5    | K5    | R5    | S5    | T5    |
| DC       | A6   | E6   | H6    | K6    | R6    | S6    | T6    |

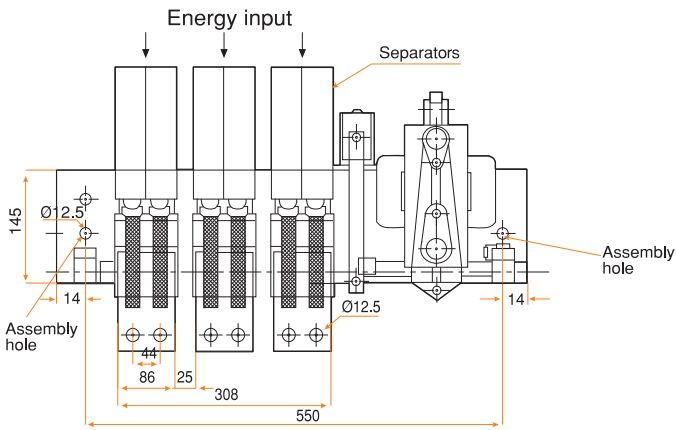
□□ : Coil operating voltages Δ : Number of poles ((1, 2, 3, 4))

# CONTACTORS

## EC300-EC400-EC630-EC800:



## EC1250 - EC1600:



## EC2000 - EC2500:

