

Application & Guidance Notes

Motor Control Gear



General Information

IMO Motor Control Gear is built and tested to decisive national and international specifications. All devices suit all important specifications without any test obligation, like VDE 0660 and BS EN 60947-4-1. This is the reason why IMO Motor Control Gear is used all over the world. In order to provide special versions there are sometimes limitations to the max. voltage, currents and power ratings or special markings necessary.

Test Authorities, Registration Mark, Duty of Approval

| Country | Canada | USA | Switzerland | Denmark | Norway | Sweden | Finland |
|--|---------------------------------------|------------------------------------|---|---|--|---|---|
| State deputy or private examination board (state admitted) | CSA Canadian Standards Association | UL Underwriter's Laboratories | SEV Schweizerischer Elektrotechnischer Verein | DEMKO Danmarks Elektriske Materielkontrol | NEMKO Norges Elektriske Materielkontrol | SEMKO Svenska Elektriske Materielkontrollanstalten | SETI Electrical Inspectorate |
| Label marking of examination boards | | | | | | | |
| Duty of approval | All switchgear | Approval of switchgear recommended | For devices with applications in security or protection function with voltages >42V and currents >2A for retail | Approval of switchgear up to 63A for retail use | Switchgear up to 32A for retail | Motor- circuit switches up to 25A for retail | Switchgear up to 63A, motor-circuit switches up to 25A for retail |

IMO Motor Control Gear is also suitable for applications in ship equipment. It's classified in "Lloyd's Register of Shipping" and in the "Register of the USSR". The "American Bureau of Shipping" does not claim a general approval for single components, the complete electrical equipment on board has to be approved. These devices should have UL- and CSA-approval. Further information for approved values and also Guide-No. and File-No. (CSA, UL) is available on request.

Suffix for control voltage and frequency

For contactor-type **MR07, MB09, 12**, standard voltages in bold type letter

| Rated control voltage at 50Hz V | | Suffix to contactor-type e.g: MB09-S-10 24 | Rated control voltage at 50Hz V | | Suffix to contactor-type e.g: MB09-S-10 230 | Rated control voltage at 50Hz V | | Suffix to contactor-type e.g: MB09-S-01 400 |
|---------------------------------|-----------|---|---------------------------------|------------|--|---------------------------------|------------|--|
| 24 | 24 | 24 | 110 | 120 | 110 | 380-400 | 440 | 400 |
| 42 | 42 | 42 | 220-230 | 240 | 220 | 400-415 | 440-460 | 415 |
| 100 | 110-115 | 100 | 230-240 | 240-250 | 240 | | | |

For contactor-type **MC10 to MC74**, standard voltages in bold type letter

| Rated control voltage at 50Hz V | | Suffix to contactor-type e.g: MC32-S-00 24 | Rated control voltage at 50Hz V | | Suffix to contactor-type e.g: MC32-S-00 230 | Rated control voltage at 50Hz V | | Suffix to contactor-type e.g: MC32-S-00 400 |
|---------------------------------|-----------|---|---------------------------------|----------------|--|---------------------------------|----------------|--|
| 24 | 24 | 24 | 60 | - | 60 | 254 | 277 | 254 |
| 32 | 36 | 32 | 110 | 110-120 | 110 | 345 | 380-415 | 345 |
| 36 | - | 36 | 115 | 125 | 115 | 380-415 | 415-440 | 400 |
| 38 | 42 | 38 | 127 | - | 127 | 415-440 | 440-480 | 415 |
| 42 | 48 | 42 | 180-210 | 200-230 | 180 | 440-480 | 480-500 | 440 |
| 48 | - | 48 | 200-220 | 220-240 | 200 | 500-550 | 550-600 | 500 |
| 55 | 60 | 55 | 220-240 | 240 | 230 | | | |

For contactor-type **K85 to K110**, standard voltages in bold type letter

| Rated control voltage at 50Hz V | | Suffix to contactor-type e.g: K85A22 24 | Rated control voltage at 50Hz V | | Suffix to contactor-type e.g: K85A22 180 | Rated control voltage at 50Hz V | | Suffix to contactor-type e.g: K110A22 400 |
|---------------------------------|-----------|--|---------------------------------|----------------|---|---------------------------------|----------------|--|
| 20 | 24 | 20 | 48 | 60 | 48 | 220-240 | 277 | 230 |
| 24 | - | 24 | 60 | - | 60 | 320 | 380-415 | 320 |
| 24 | 24 | 24FR | 90 | 110-120 | 90 | 345 | 415-440 | 345 |
| 32 | 36 | 32 | 110 | 110 | 110FR | 380-415 | 460-480 | 400 |
| 36 | 42 | 36 | 110-120 | - | 110 | 415-440 | 480-500 | 415 |
| 38 | 48 | 38 | 180-200 | 208-240 | 180 | 440-480 | 550-575 | 440 |
| 42 | - | 42 | 220 | 220 | 220FR | 500-550 | 600-660 | 500 |

Operating range of magnet-coils: 0,85 x Us (min. value of rated control voltage) up to 1,1 x Us (max. value of rated control voltage)

Order control voltages not included in table as follows, e.g.: K85A22 12V 50Hz. Maximum control voltage 600V AC, 50-60HZ.

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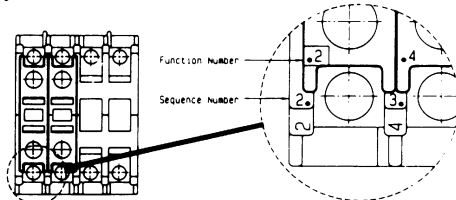


Motor Control Gear (continued)

Terminal markings

Auxiliary contacts of AC contactors and contacts of contactor relays and thermal overload relays are specially numbered. In addition, terminal covers (contactor relays and auxiliary contacts up to type MC74) and actuators (auxiliary contact blocks and contact blocks of control units) are colour coded, green for normally-open contacts, red for normally-closed contacts.

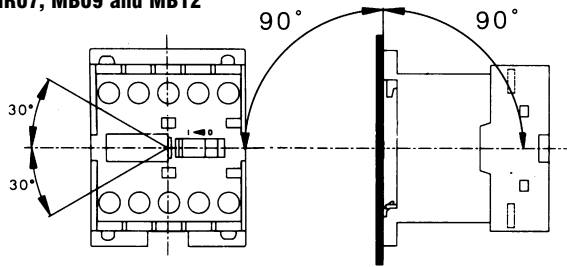
The figure below illustrates the determination of terminal markings for contactors with auxiliary contact blocks.



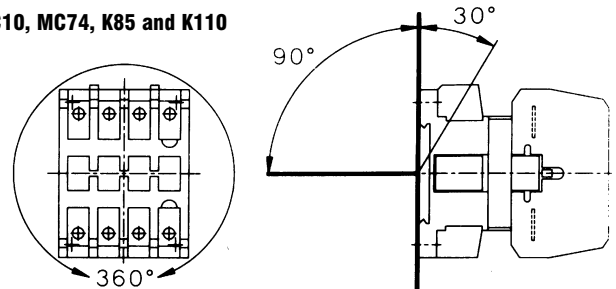
The complete terminal marking according to DIN EN 50011 and DIN EN 50012 results from the sequence numbers on the contactor relay or AC contactor (e.g. 2., 3.) and the function numbers on the auxiliary contact blocks (.1,2 or .3.,4).

Mounting positions of contactors

MR07, MB09 and MB12



MC10, MC74, K85 and K110



Terminal screws in relation to screwdriver sizes and tightening torques

| Terminal screws version | Size | Pozidriv | Philips | Screw driver | Tightening torque Nm | lb. inch |
|----------------------------------|------|----------|---------|--------------|----------------------|----------|
| Screw with Pozidriv and slot | M3 | Pz 1 | No 1 | Size 1 | 0,6 - 1,2 | 5 - 11 |
| | M3,5 | Pz 2 | No 2 | Size 2, 3 | 0,8 - 1,4 | 7 - 12 |
| | M4 | Pz 2 | No 2 | Size 3, 4 | 1,2 - 1,8 | 11 - 16 |
| | M5 | Pz 2 | No 2 | Size 3, 4, 5 | 2 - 2,5 | 18 - 22 |
| | M6 | Pz 3 | No 3 | Size 4, 5 | 2,5 - 3 | 22 - 26 |
| Screw or nut with hexagonal-head | M8 | - | - | - | 6 - 10 | 53 - 88 |
| | M10 | - | - | - | 10 - 16 | 88 - 140 |

Full load current - typical values

| Motor Rating | | | | 3 Phase Motor F.L.C. at Line Volts | | | | | | Single Phase |
|--------------|------|-------|---------------|------------------------------------|---------|---------|---------|---------|---------|--------------|
| HP | kW | % EEF | PF Cos ϕ | 220V AC | 240V AC | 380V AC | 415V AC | 500V AC | 230V AC | |
| 0.25 | 0.19 | 60 | 0.7 | 1.24 | 1.2 | 0.8 | 0.7 | 0.5 | 2.8 | |
| 0.5 | 0.37 | 65 | 0.7 | 2.4 | 2.2 | 1.3 | 1.2 | 1.0 | 3.5 | |
| 0.75 | 0.56 | 70 | 0.7 | 3.0 | 2.8 | 1.7 | 1.6 | 1.3 | 4.8 | |
| 1 | 0.75 | 75 | 0.8 | 3.5 | 3.2 | 2.0 | 1.8 | 1.5 | 6.2 | |
| 1.5 | 1.1 | 76 | 0.8 | 5.0 | 4.5 | 2.8 | 2.6 | 2.2 | 8.7 | |
| 2 | 1.5 | 77 | 0.8 | 6.4 | 5.8 | 3.7 | 3.5 | 2.8 | 11.8 | |
| 3 | 2.2 | 78 | 0.8 | 9.5 | 8.7 | 5.5 | 5.0 | 3.9 | 17.5 | |
| 4 | 3.0 | 80 | 0.82 | 11.8 | 10.9 | 6.6 | 6.2 | 5.3 | 20.0 | |
| 5 | 3.7 | 83 | 0.82 | 14.6 | 13.4 | 8.5 | 7.5 | 6.5 | 24.0 | |
| 7.5 | 5.6 | 86 | 0.83 | 21 | 19 | 11.5 | 11 | 10 | 36.0 | |
| 10 | 7.5 | 86 | 0.83 | 27.5 | 25 | 15.5 | 14 | 12.5 | 47.0 | |
| 12.5 | 9.3 | 87 | 0.83 | 34.5 | 31.5 | 20 | 18 | 15.5 | 59.0 | |
| 15 | 11.2 | 87 | 0.83 | 41 | 37 | 22.5 | 21 | 18.5 | 70.0 | |
| 20 | 15 | 89 | 0.84 | 54 | 50 | 30 | 28 | 24 | 91.0 | |
| 25 | 18.6 | 90 | 0.85 | 65 | 61 | 38 | 35 | 30 | - | |
| 30 | 22.4 | 90 | 0.85 | 76 | 70 | 43 | 40 | 34 | - | |
| 40 | 30 | 90 | 0.85 | 99 | 91 | 57 | 53 | 45 | - | |
| 50 | 37 | 91 | 0.85 | 120 | 107 | 72 | 66 | 57 | - | |
| 60 | 45 | 91 | 0.85 | 147 | 133 | 85 | 80 | 67 | - | |
| 70 | 52 | 91 | 0.85 | 165 | 150 | 100 | 95 | 78 | - | |
| 80 | 60 | 91 | 0.86 | 195 | 178 | 112 | 107 | 89 | - | |
| 90 | 67 | 92 | 0.86 | 217 | 198 | 127 | 121 | 99 | - | |
| 100 | 75 | 92 | 0.86 | 240 | 219 | 142 | 135 | 112 | - | |

Marking of auxiliary contacts

At several points in CSA- and UL-data there are two voltages for auxiliary contacts mentioned (e.g.: 600 volts at same potential, 150 volts at different potentials). This means, if the voltage is higher than 150 volts, the control voltage applied to input terminals must be at the same potential.

Motor Control Gear for auxiliary circuits (e.g. contactor relays, control units, auxiliary contacts in general) is usually approved for "Heavy Duty" or "Standard Duty" of CSA and UL and in addition are marked with the admissible max. voltage or with short codes (see table).

Please refer to IMO for ratings to UL and CSA approvals.

| Marking of auxiliary contacts according to CSA and UL | Max. rated values per pole | | | | Contact Rating Code Designation |
|---|----------------------------|------------------------|---------|----------------------|---------------------------------|
| | Voltage V | Maximum Current Make A | Break A | Continuous Current A | |
| Heavy Duty (HD or HVY DTY) | 110-120~ | 60 | 6 | 10 | A150 |
| | 220-240~ | 30 | 3 | 10 | A300 |
| | 440-480~ | 15 | 1,5 | 10 | A600 |
| | 550-600~ | 12 | 1,2 | 10 | A600 |

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Motor Control Gear (continued)

Utilization Categories

| Category | Typical applications | Rated operational current | Test conditions for the number of on-load operating cycles | | | | | | Test conditions for making and breaking capacities | | | | | |
|---------------------|---|--|--|------------------|----------|--------------------------------------|--------------------------------|----------|--|------------------|----------|--------------------------------------|--------------------------------|----------|
| | | | Make | | | Break | | | Make | | | Break | | |
| Alternating current | | | I/I _e | U/U _e | cosφ | I _c /I _e | U _r /U _e | cosφ | I/I _e | U/U _e | cosφ | I _c /I _e | U _r /U _e | cosφ |
| AC1 | Non-inductive or slightly inductive loads resistance furnaces | all values | 1 | 1 | 0,95 | 1 | 1 | 0,95 | 1,5 | 1,05 | 0,8 | 1,5 | 1,05 | 0,8 |
| AC2 | Slip-ring motors; starting, switching off | all values | 2,5 | 1 | 0,65 | 2,5 | 1 | 0,65 | 4 | 1,05 | 0,65 | 4 | 1,05 | 0,65 |
| AC3 | Squirrel-cage motors: starting, switching off motors during running | I _e ≤ 17A | 6 | 1 | 0,65 | 1 | 0,17 | 0,65 | 10 | 1,05 | 0,45 | 8 | 1,05 | 0,45 |
| | | 17A < I _e ≤ 100A | 6 | 1 | 0,35 | 1 | 0,17 | 0,35 | 10 | 1,05 | 0,45 | 8 | 1,05 | 0,45 |
| | | I _e > 100A | 6 | 1 | 0,35 | 1 | 0,17 | 0,35 | 10 | 1,05 | 0,35 | 8 | 1,05 | 0,35 |
| AC4 | Squirrel-cage motors: starting, plugging,* inching† | I _e ≤ 17A | 6 | 1 | 0,65 | 6 | 1 | 0,65 | 12 | 1,05 | 0,45 | 10 | 1,05 | 0,45 |
| | | 17A < I _e ≤ 100A | 6 | 1 | 0,35 | 6 | 1 | 0,35 | 12 | 1,05 | 0,45 | 10 | 1,05 | 0,45 |
| | | I _e > 100A | 6 | 1 | 0,35 | 6 | 1 | 0,35 | 12 | 1,05 | 0,35 | 10 | 1,05 | 0,35 |
| AC5a | Switching of electric discharge lamp controls | all values | - | - | - | - | - | - | 3 | 1,05 | 0,45 | 3 | 1,05 | 0,45 |
| AC5b | Switching of incandescent lamps | all values | - | - | - | - | - | - | 1,5 | 1,05 | 1) | 4 | 1,05 | 1) |
| AC6a | Switching of transformers | I _e ≤ 100A | - | - | - | - | - | - | 4,5 | 1,05 | 0,45 | 3,6 | 1,05 | 0,45 |
| | | I _e > 100A | - | - | - | - | - | - | 4,5 | 1,05 | 0,35 | 3,6 | 1,05 | 0,35 |
| AC6b | Switching of capacitor banks | - | - | - | - | - | - | - | 2) | | | 2) | | |
| AC7a | Slightly inductive loads in household appliances and similar applications | all values | - | - | - | - | - | - | 1,5 | 1,05 | 0,8 | 1,5 | 1,05 | 0,8 |
| AC7b | Motor loads for household applications | I _e ≤ 100A | - | - | - | - | - | - | 8 | 1,05 | 0,45 | 6 | 1,05 | 0,45 |
| | | I _e > 100A | - | - | - | - | - | - | 8 | 1,05 | 0,35 | 6 | 1,05 | 0,35 |
| AC8a | Hermetic refrigerant compressor motor control with manual resetting of overload releases | I _e ≤ 100A I _e > 100A | - | - | - | - | - | - | 6 | 1,05 | 0,45 | 6 | 1,05 | 0,45 |
| AC8b | Hermetic refrigerant compressor motor control with automatic resetting of overload releases | I _e ≤ 100A I _e > 100A | - | - | - | - | - | - | 6 | 1,05 | 0,45 | 6 | 1,05 | 0,45 |
| AC12 | Control of resistive loads and solid state loads with isolation by opto couplers | all values | - | - | - | - | - | - | 1 | 1 | 0,9 | 1 | 1 | 0,9 |
| AC13 | Control of solid state loads with transformer isolation | all values | - | - | - | - | - | - | 10 | 1,1 | 0,65 | 1,1 | 1,1 | 0,65 |
| AC14 | Control of small electromagnetic loads (≤ 72VA) | - | - | - | - | - | - | - | 6 | 1,1 | 0,7 | 6 | 1,1 | 0,7 |
| AC15 | Control of electromagnetic load (>72VA) | - | 10 | 1 | 0,7 | 1 | 1 | 0,4 | 10 | 1,1 | 0,3 | 10 | 1,1 | 0,3 |
| Direct current | | | Make I/I _e | U/U _e | L/R [ms] | Break I _c /I _e | U _r /U _e | L/R [ms] | Make I/I _e | U/U _e | L/R [ms] | Break I _c /I _e | U _r /U _e | L/R [ms] |
| DC1 | Non-inductive or slightly inductive loads resistance furnaces | all values | 1 | 1 | 1 | 1 | 1 | 1 | 1,5 | 1,05 | 1 | 1,5 | 1,05 | 1 |
| DC3 | Shunt-motors: starting, plugging*, inching† Dynamic breaking of d.c. motors | all values | 2,5 | 1 | 2 | 2,5 | 1 | 2 | 4 | 1,05 | 2,5 | 4 | 1,05 | 2,5 |
| DC5 | Series-motors: starting, plugging*, inching† Dynamic breaking of d.c. motors | all values | 2,5 | 1 | 7,5 | 2,5 | 1 | 7,5 | 4 | 1,05 | 15 | 4 | 1,05 | 15 |
| DC6 | Switching of incandescent lamps | all values | - | - | - | - | - | - | 1,5 | 1,05 | 1) | 4 | 1,05 | 1) |
| DC12 | Control of resistive loads and solid state loads with isolation by opto couplers | all values | - | - | - | - | - | - | 1 | 1 | 1 | 1 | 1 | 1 |
| DC13 | Control of electromagnets | all values | 1 | 1 | ≤ 300 | 1 | 1 | ≤ 300 | 1,1 | 1,1 | ≤ 300 | 1,1 | 1,1 | ≤ 300 |
| DC14 | Control of electromagnetic loads having economy resistors in circuit | all values | - | - | - | - | - | - | 10 | 1,1 | 15 | 10 | 1,1 | 15 |

U_e Rated operational voltage, U Voltage before make, U_r Recovery voltage, I_e Rated operational current, I Current make, I_c Current broken

1) Test with incandescent lamps 2) Test conditions according to standard

* Plugging is defined as the rapid reversal of the direction of rotation of a motor by interchanging the primary connections whilst the motor is running.

† inching is defined as supplying a motor with current for a brief period, either once or repeatedly in order to achieve small movements.