GEFRAN

G-START

MOTOR STARTER

CONFIGURATION AND PROGRAMMING MANUAL

CE

code: 81908C_MAN_GSTART_02-2024_ENG
Original instruction

81908B_MAN_G-START_02-2024_ENG

INDEX

1. GENERAL INFORMATION

Control device for motors up to 3KW, 7A at 500Vac, selection of the running rotation direction, overload protection by measuring the current absorbed by the motor (configurable) phase absence, current/phase imbalance protection, alarm reset (manual/automatic), relay alarm output, digital outputs for direction of travel indication

1.1. Profile

The Gefran G-Start motor starter is a device compact (width 22.5mm) for DIN bar coupling, for the functional start / stop command and selection of the gear rotation of asynchronous motors up to 500Vac- with a power not exceeding 3kW - 7A. Motor control is achieved through a combination of relays and power semiconductors (Triacs) that minimize thermal dissipation inside the electrical panel also guaranteeing great product reliability. Integrates motor overload protection with automatic management of shutdown and relative engine cooling time. Advanced diagnostics with recognition of internal faults and lack of phase.
On the front there is a selector to set the nominal current of the motor (tripping threshold of the overload protection) and 4 status LEDs for easy immediate diagnostics.
The alarms can be reset manually via the front button or digital input or by selecting the automatic mode.
PL e and SIL 3 certification guarantee the G-Start installation in applications where emergency stop is required.

1.2. Main applications

All direct starting of motors and remote reversers. In particular we point out:

- Small fans control
- Control of auger motors
- Hopper control
- Control of conveyor belts
- Pumps
- Oil mills
- Centrifugal pumps
- Blowers
- Compressors

1.3. Main Features

- Motor control up to 500Vac - 7A - 3 kW (3 product versions)
- Single-phase and Three-phase motor control
- PL e and SIL 3 certified
- Start / stop function
- Reverse rotation function (optional and available only for three-phase motors)
- Motor overload protection
- Phase absence protection
- 4 digital controls 24Vdc
- alarm relay output
- 2 digital outputs for motor running signaling
- Automatic or manual alarm reset (settable)
- Selection of nominal motor current with front-selector
- Module coupling to DIN bar.

2. TECHNICAL DATA

POWER SUPPLY
24 Vdc ±20% 50mA
Reverse voltage protection and overvoltage suppressor
LOGICAL INPUTS
N.4 command input 24Vdc - 5mA input
Voltage range 5-30V (max 5 mA) Safe voltage reading status “0” < 7 V Safe voltage reading status “1” > 10 V Input impedance15 KΩ
Type_1 Selection of: - Forward run / engine stop - Reverse run / motor stop (optional) - Automatic / Manual alarm reset selection - External reset command
DIGITAL OUTPUT
N. 2 digital outputs PNP 24Vdc max 40mA - Forward rotation motor signal - Reverse rotation motor signal
POWER INPUT
N.1 extractable connector for wiring to the power supply line max 500Vac / 50-60Hz
ALARM RELAY
N.1 output relay with NO / NC connection. Switching capacity according to IEC 60947-5-1: 3A (230V, AC15), 2A (24V, DC13)
MOTOR LOAD OUTPUT AC-3, AC53A, IEC60947-1
N.1 removable connector for wiring to the motor
THREE PRODUCT VERSIONS AVAILABLE
- I nominal = 0.6A / 500Vac - I nominal = 2.4A / 500Vac - I nominal = 7.0A / 500Vac
ENVIRONMENTAL CONDITIONS
Working temperature: -25...70°C, see derating curve
Storage temperature: -25 …80°C
Humidity: 20 … 90% UR non condensing
Degree of protection: IP 20
Degree of pollution: 2
INSULATION FEATURES
Rated insulation voltage: 500V
Rated surge voltage: Uimp 6kV

SAFETY FUNCTION (for models with Safety option only)

Safety Integrity Level (SIL, IEC 61508): up to **SIL 3**

Performance Level (ISO 13849): up to **PLe**

Parameter	Value	Measuring Unit
Type (EN IEC 62061)	B	--
Architecture (EN IEC 62061)	1oo2(D)	--
HFT (EN IEC 62061)	1	--
Category (EN ISO 13849-1/2)	3	--
β, β_D factor	2	%
CCF	>65	--
SFF (EN IEC 62061)	≥99	%
DC_{avg} (EN ISO 13849-1/2)	99	%
$MTTF_D$ (of each channel) (EN ISO 13849-1/2)	15020	years
PFH	1,52E-12	1/h
SIL (EN IEC 62061)	3	--
PL (EN ISO 13849-1/2)	e	--
Useful lifetime	20	years

Response time of the safety functions: <50 ms
NOTE: no fault exclusions applied.

NUMBER OF STARTING OPERATIONS

Permessible number of starting operations per hour 1/h				
Parameter: on-load factor = 50%				
Motor starter				
Max. rated operating current I		7A	2,4A	0,6A
Motor				
Starting Current	Starting Time [ms]	N° comm [1/h]	N° comm [1/h]	N° comm [1/h]
250%	100	1000	3300	3600
430%	100	1000	1000	1000
	300	400	400	400
	500	220	220	220
520%	100	750	750	750
	300	250	250	250
	500	100	100	100
630%	100	500	500	500
	300	150	150	150
	500	100	100	100
730%	100	360	360	360
	300	100	100	100
	500	60	60	60

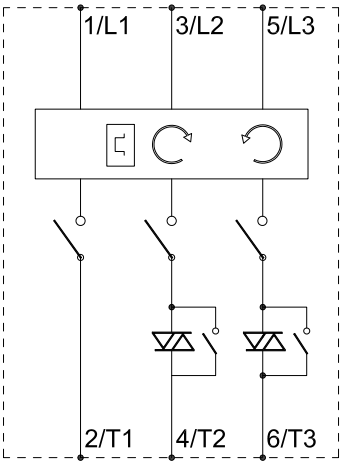
INSTALLATION

DIN mounting by quick spring coupling

FUNCTIONS / DIAGNOSTICS

- Engine start / stop
- Motor rotation selection
- Motor overload protection (settable current)
- Protection for the absence of a phase
- Current asymmetry / three-phase line unbalance protection
- Automatic engine shutdown and automatic management of the cooling time

Scheme



OPERATIONS TIME

Typical turn on time: 122ms
Typical turn off time: 80ms
Typical inversion time: 300ms

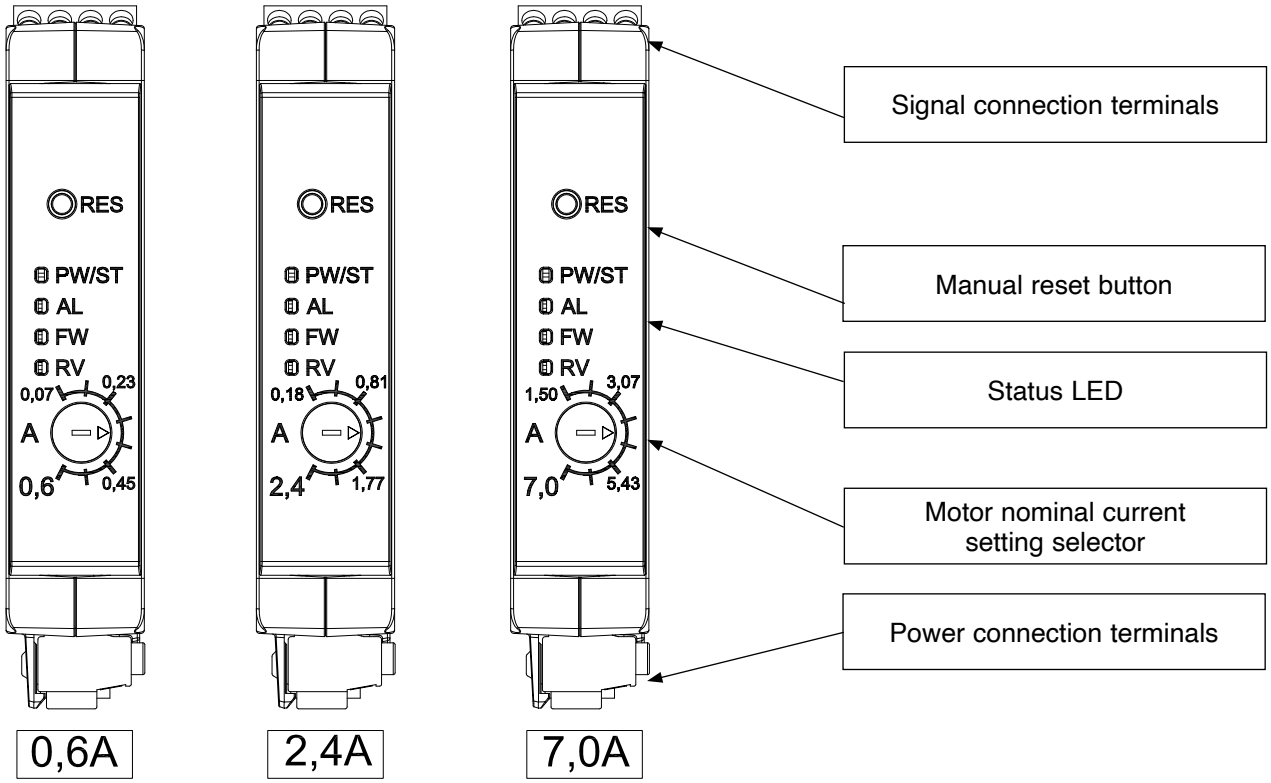
DURABILITY

Mechanical durability: 15 million cycles

CONNECTION DATA

Connection name	Control Circuits	Power Circuits
PINs	11 to 34	L1,L2,L3, T1,T2,T3
Conductor cross section, solid	0.2 mm2… 2.5 mm2	0.2 mm2… 2.5 mm2
Conductor cross section, flexible	0.2 mm2… 2.5 mm2	0.2 mm2… 2.5 mm2
Conductor cross section [AWG]	24…14	24…14
Tightening torque	0.5 Nm … 0.6 Nm	0.5 Nm … 0.6 Nm
Stripping length	8mm	8mm

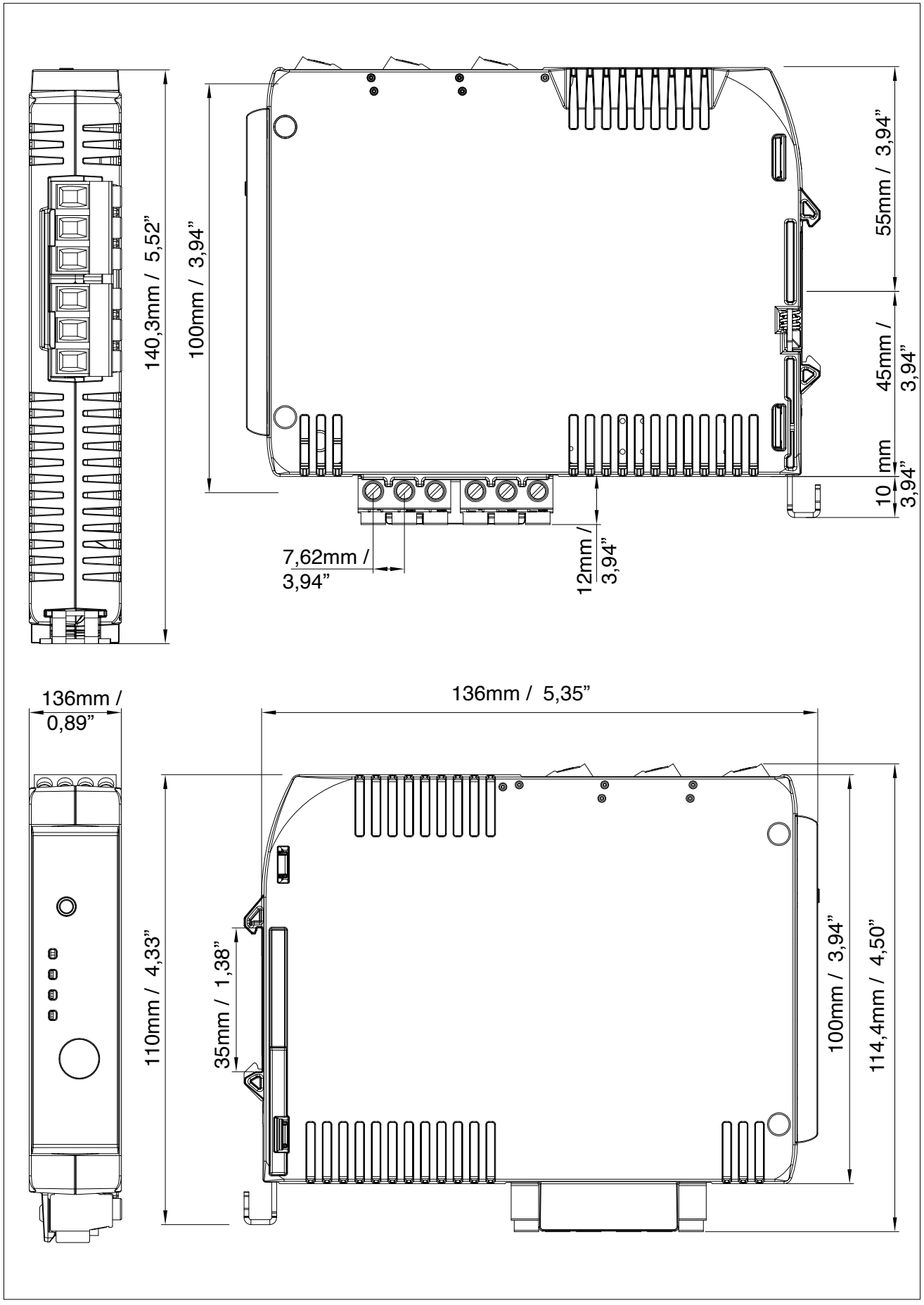
2.1. Front Description



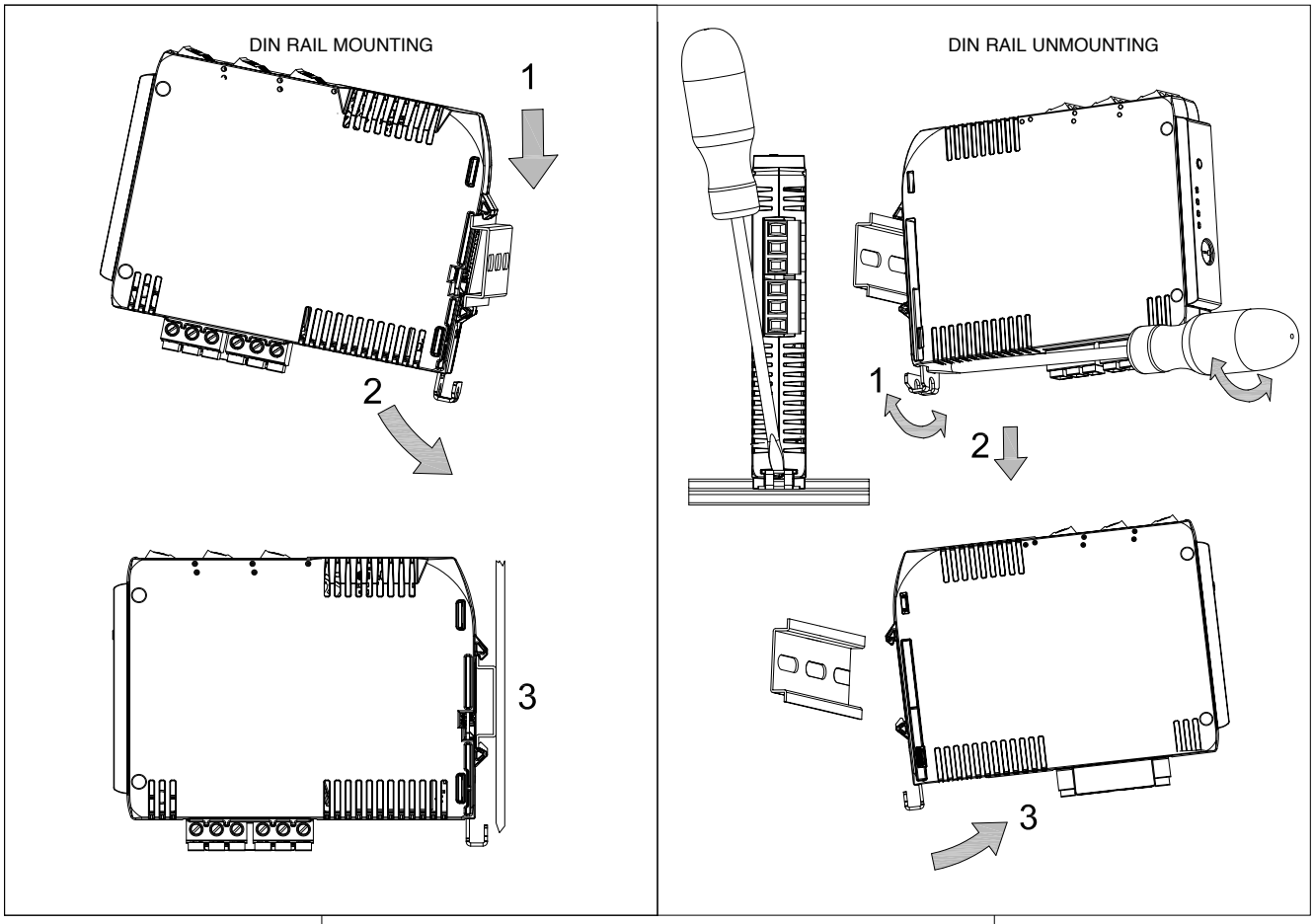
2.1.1. Status LED

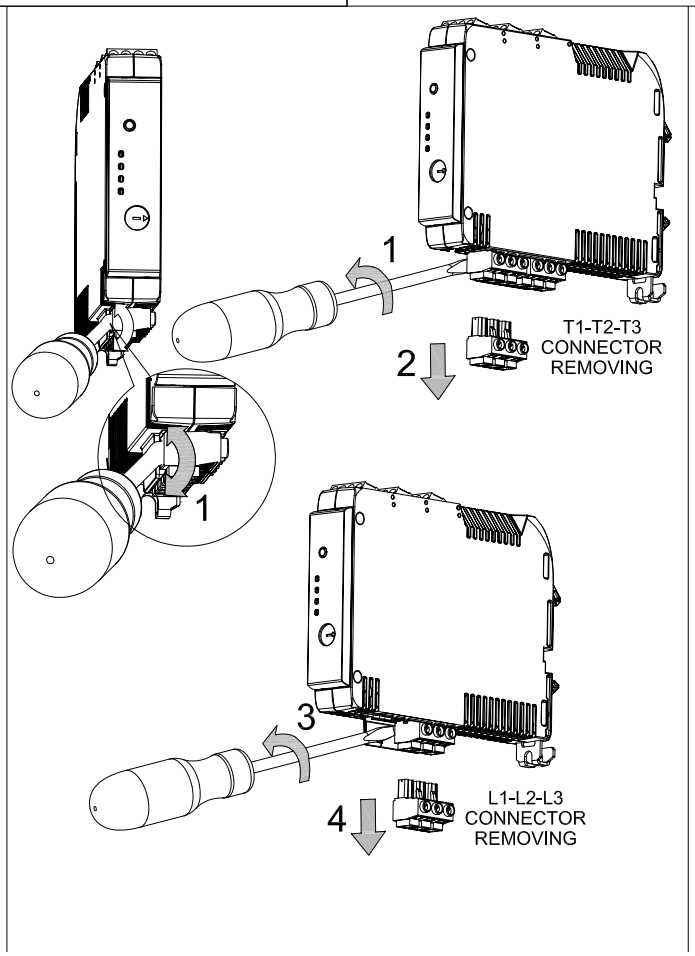
Led	*Color*	*Type of report*	*Meaning*
PW/ST	-	turned off	Module not powered
PW/ST	Green	Steady on	Module correctly powered. Manual reset selected
PW/ST	Yellow	Steady on	Module correctly powered. Automatic reset selected
PW/ST	Blu	Flashing	Confirmation of motor size selection. Once the movement of the rotary selector is finished, the blue LED flashes a number of times equal to the number of the selected position
PW/ST	Yellow	Flashing alternately with the AL led	System failure. Contact Gefran.
AL	Red	Turned off	No alarm indication
AL	Red	Flashing alternately with the PW / ST led	System failure. Contact Gefran
AL	Red	Steady on	Motor overload alarm
AL	Red	Fast flashing (10Hz)	Phase failure alarm or no load alarm
AL	Red	Slow flashing (1Hz)	Phase imbalance alarm
FW	Yellow	Turned off	The engine is not turning forward
FW	Yellow	Steady on	The engine is running and is turning forward
RV	Yellow	Turned off	The engine is not turning back
RV	Yellow	Steady on	The engine is running and is turning backwards

2.2. Dimensions and overall

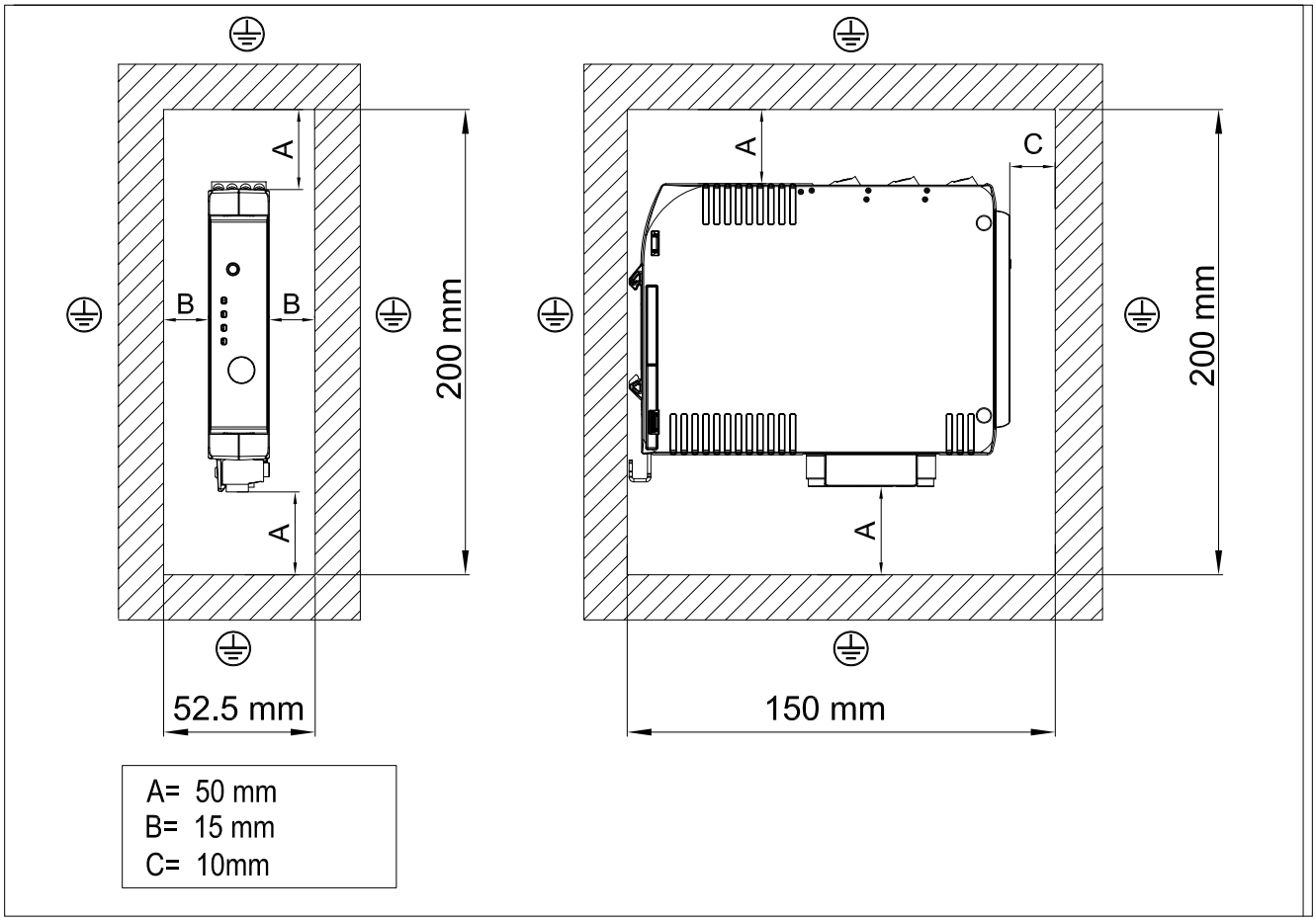


2.3. DIN rail mounting

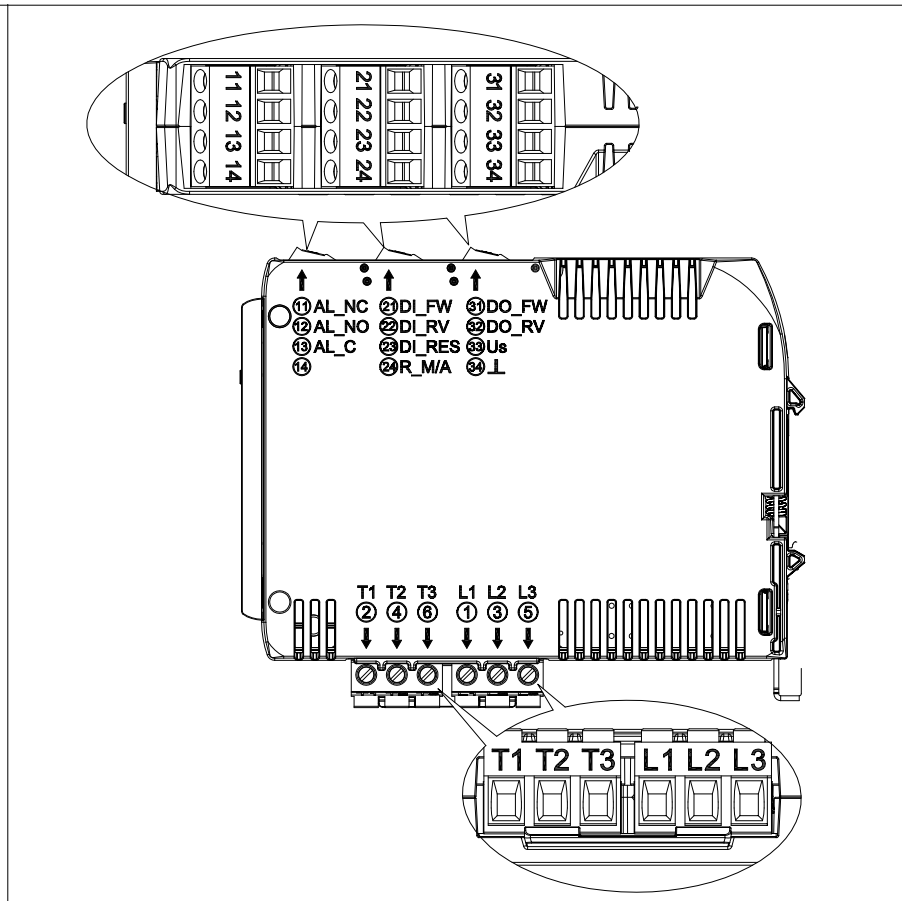




2.4. Installation



2.5. Terminals description

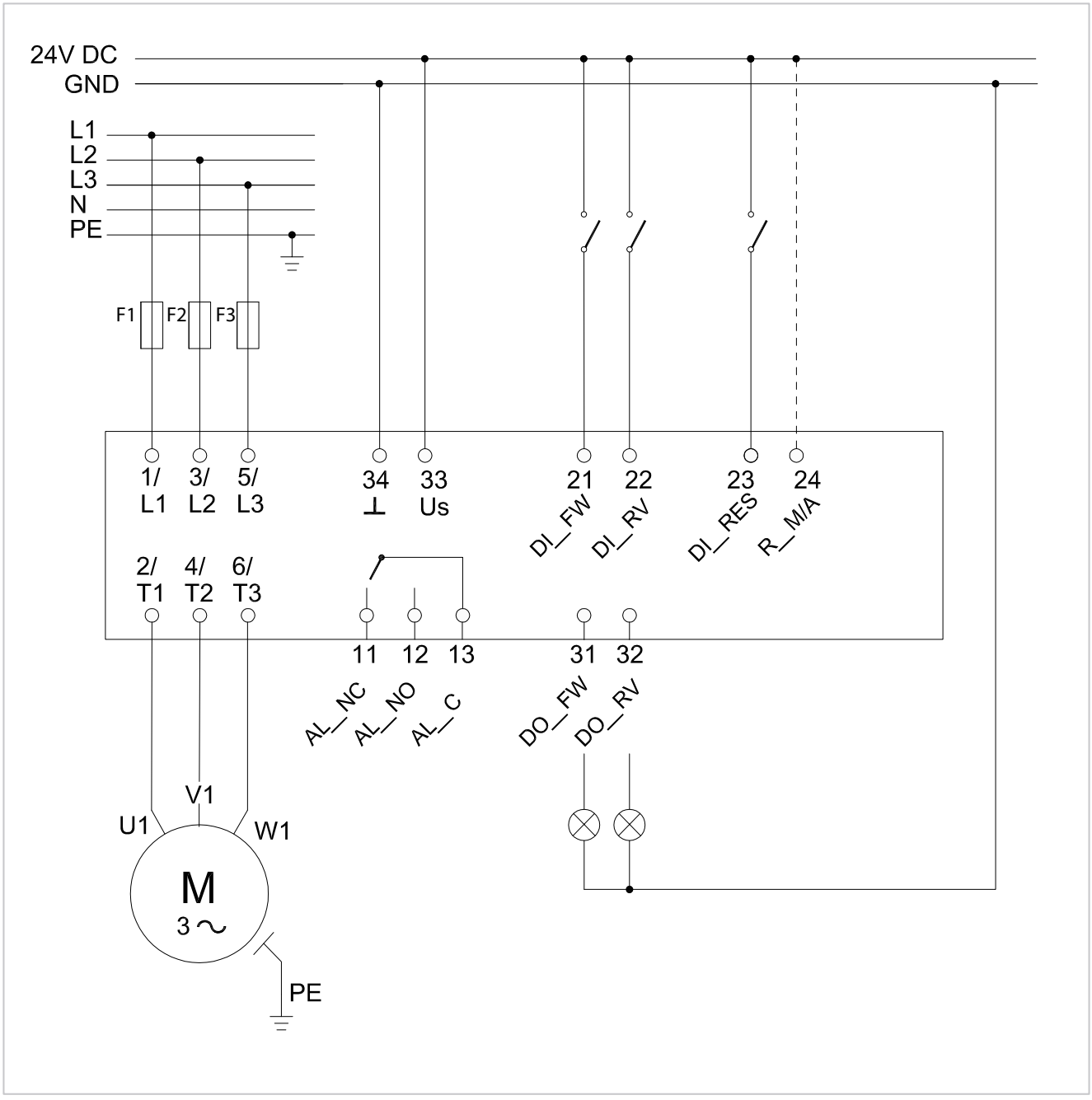


Signal connection		
Number	***Label***	
11	AL_NC	Changeover contact for alarm signaling: Normally Closed terminal
12	AL_NO	Changeover contact for alarm signaling: Normally Open terminal
13	AL_C	Changeover contact for alarm signaling: common terminal
14	-	Disconnect
21	DI_FW	Forward run command input
22	DI_RW	Reverse run command input
23	DI_RES	Reset command input
24	R_M/A	Manual/Automatic restart selection input
31	DO_FW	Forward running status signal output active
32	DI_RV	Reverse running status signal output active
33	Us	Device power supply + 24Vdc
34	⊥	Device power supply 0Vdc

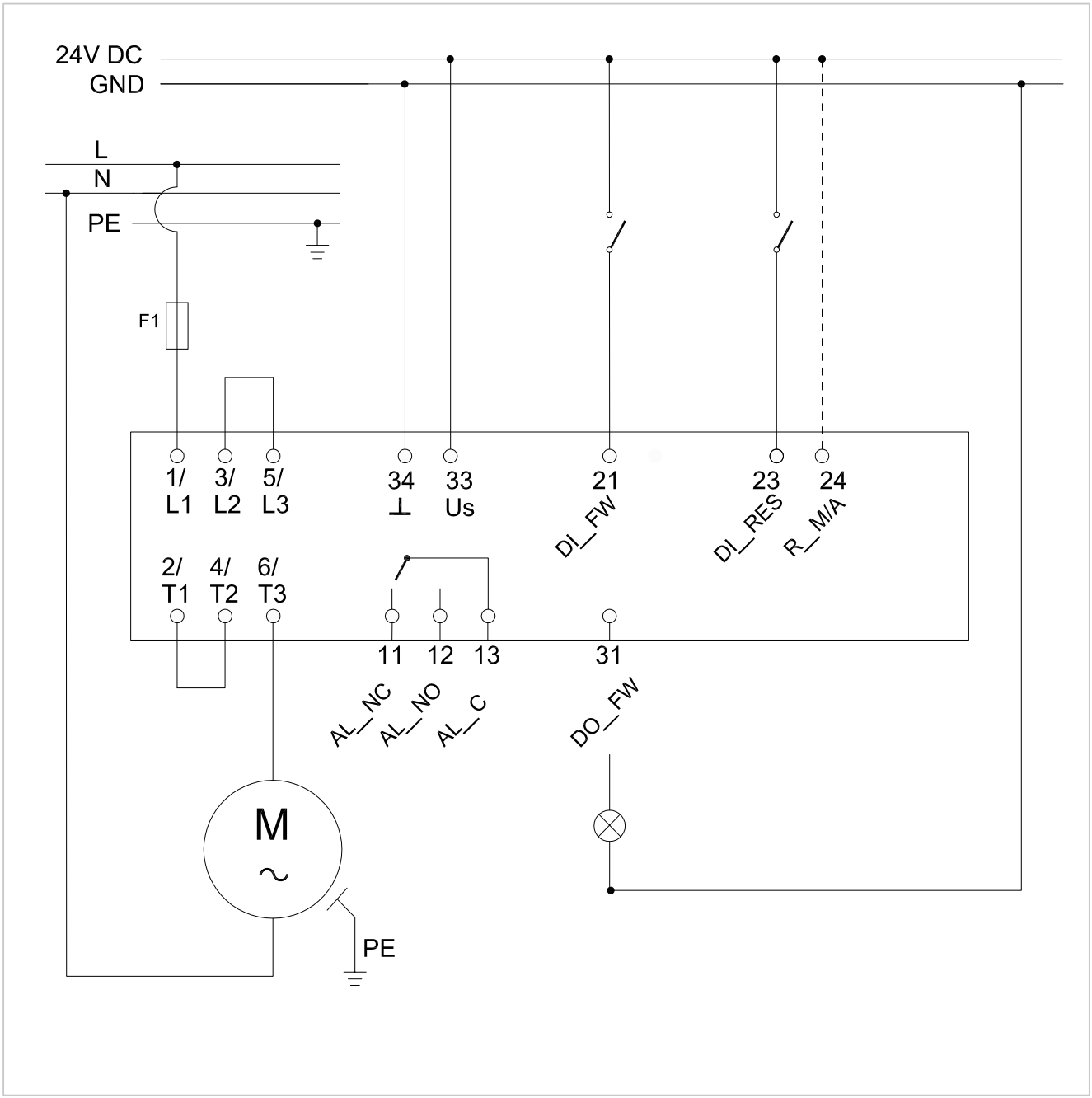
Power connection		
Number	***Label***	
2	T1	Phase motor connection 1
4	T2	Phase motor connection 2
6	T3	Phase motor connection 3
1	L1	Phase power line connection 1
3	L2	Phase power line connection 2
5	L3	Phase power line connection 3

2.6. Wiring schemes

2.6.1. Wiring scheme for three-phase motors

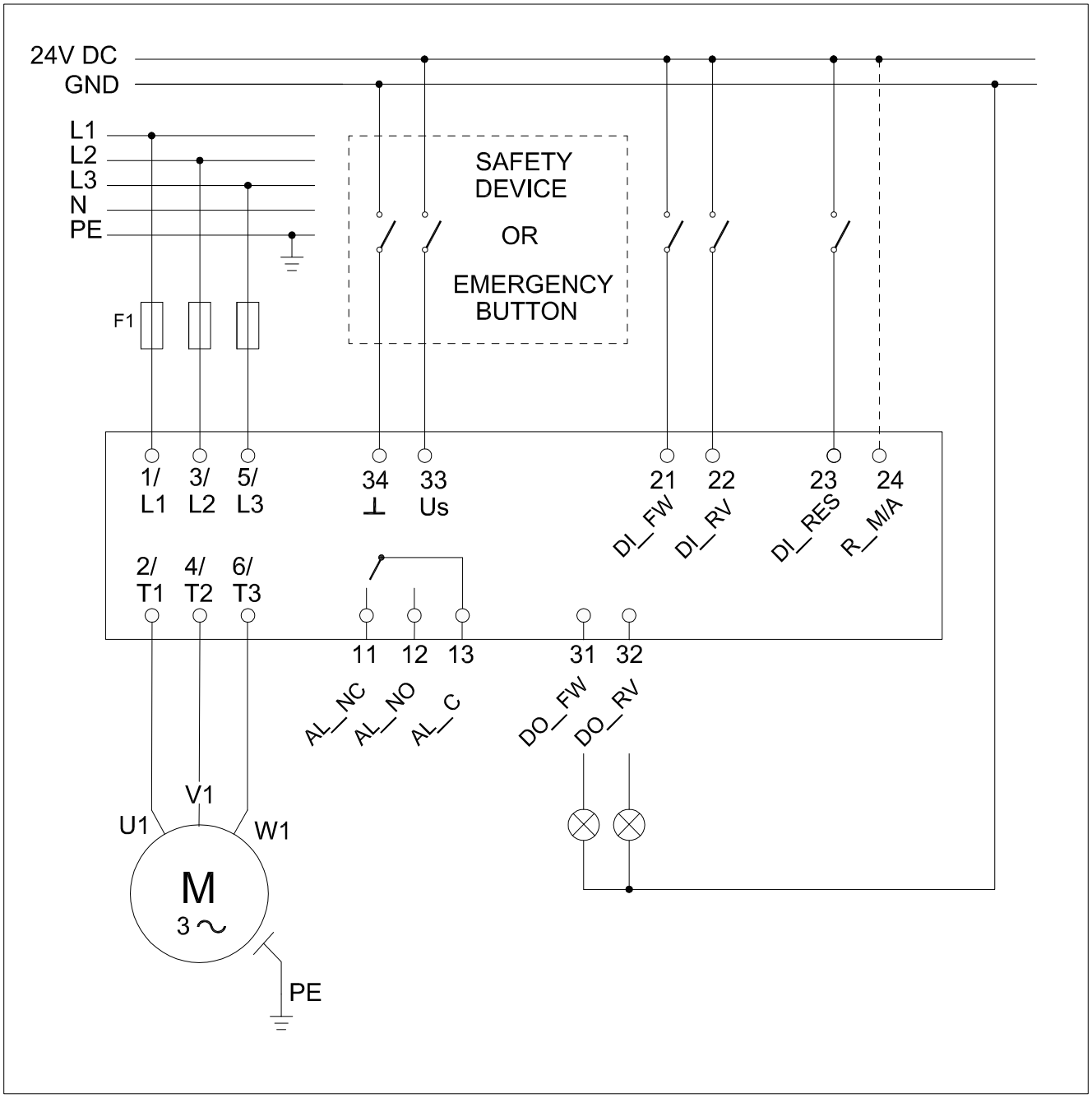


2.6.2. Wiring scheme for single-phase motors

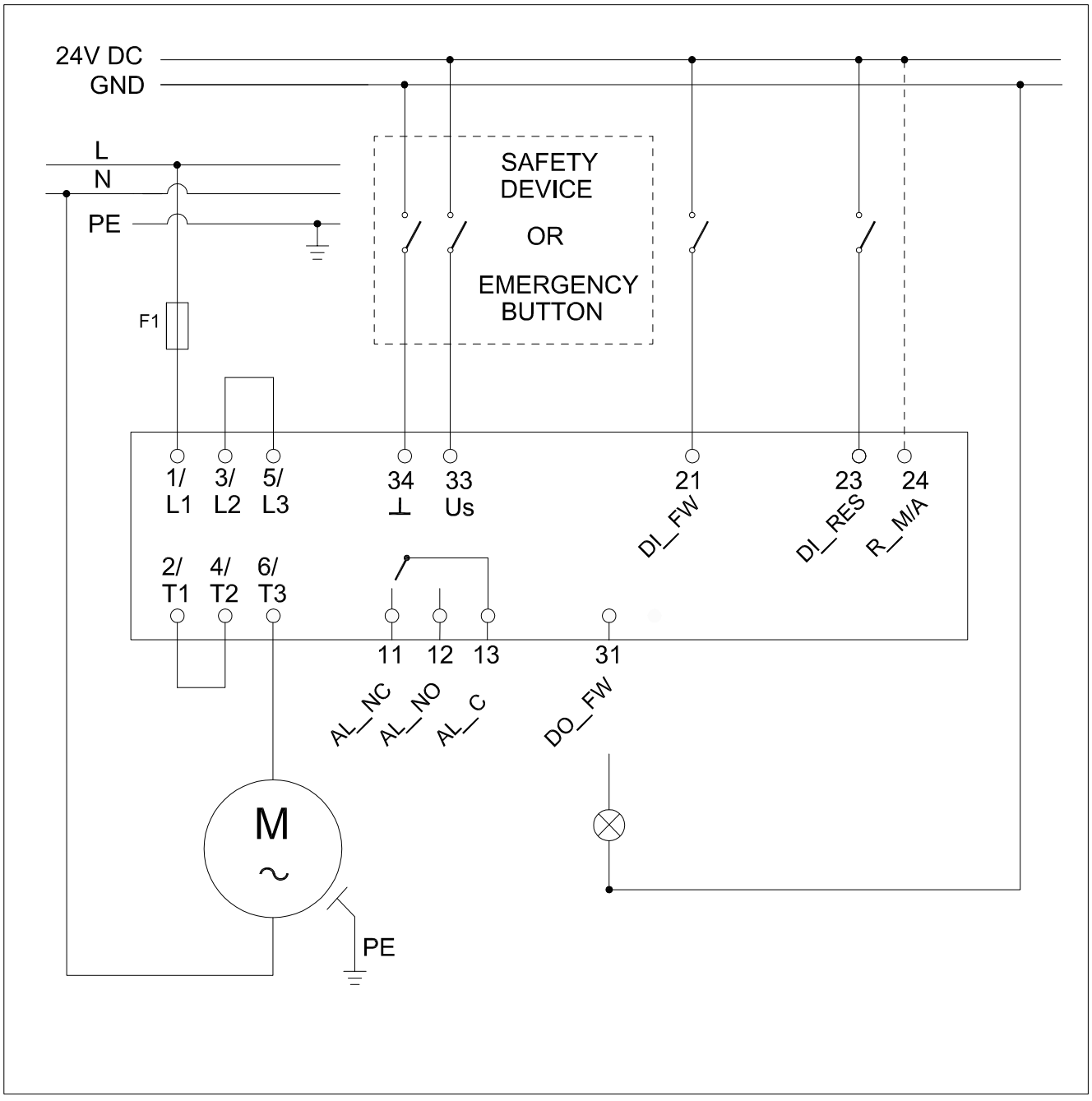


ATTENTION
The reverse rotation function can't be used for single-phase motors.

2.6.3. Wiring scheme for safety application three-phase motors



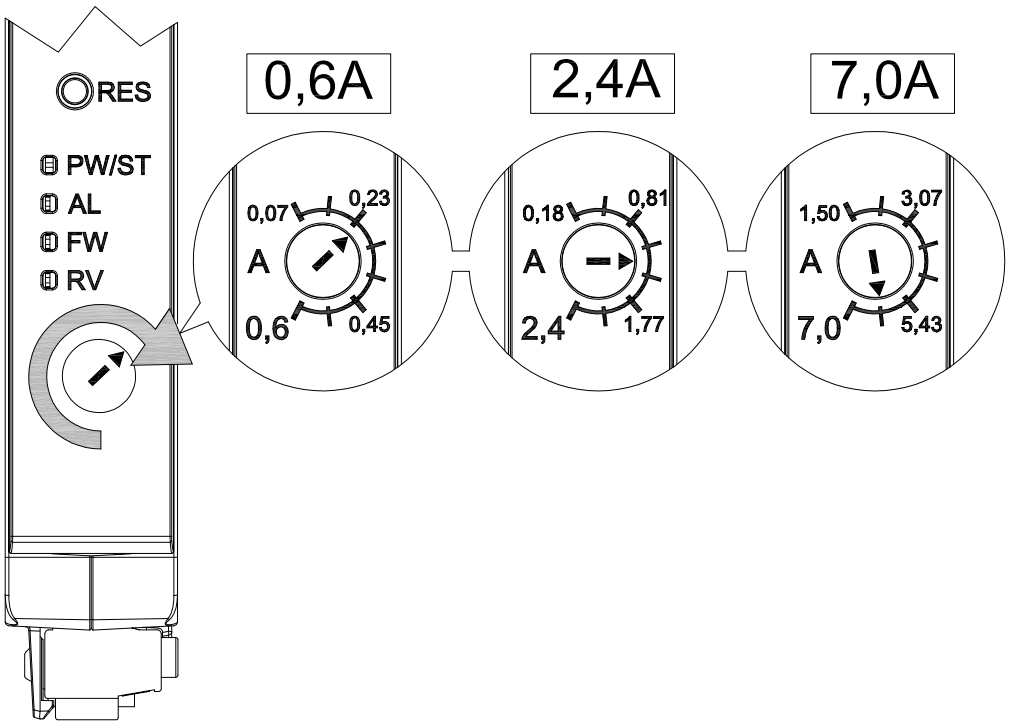
2.6.4. Wiring scheme for safety application single-phase motors



ATTENTION
The reverse rotation function can't be used for single-phase motors.

2.7. Nominal current calibration

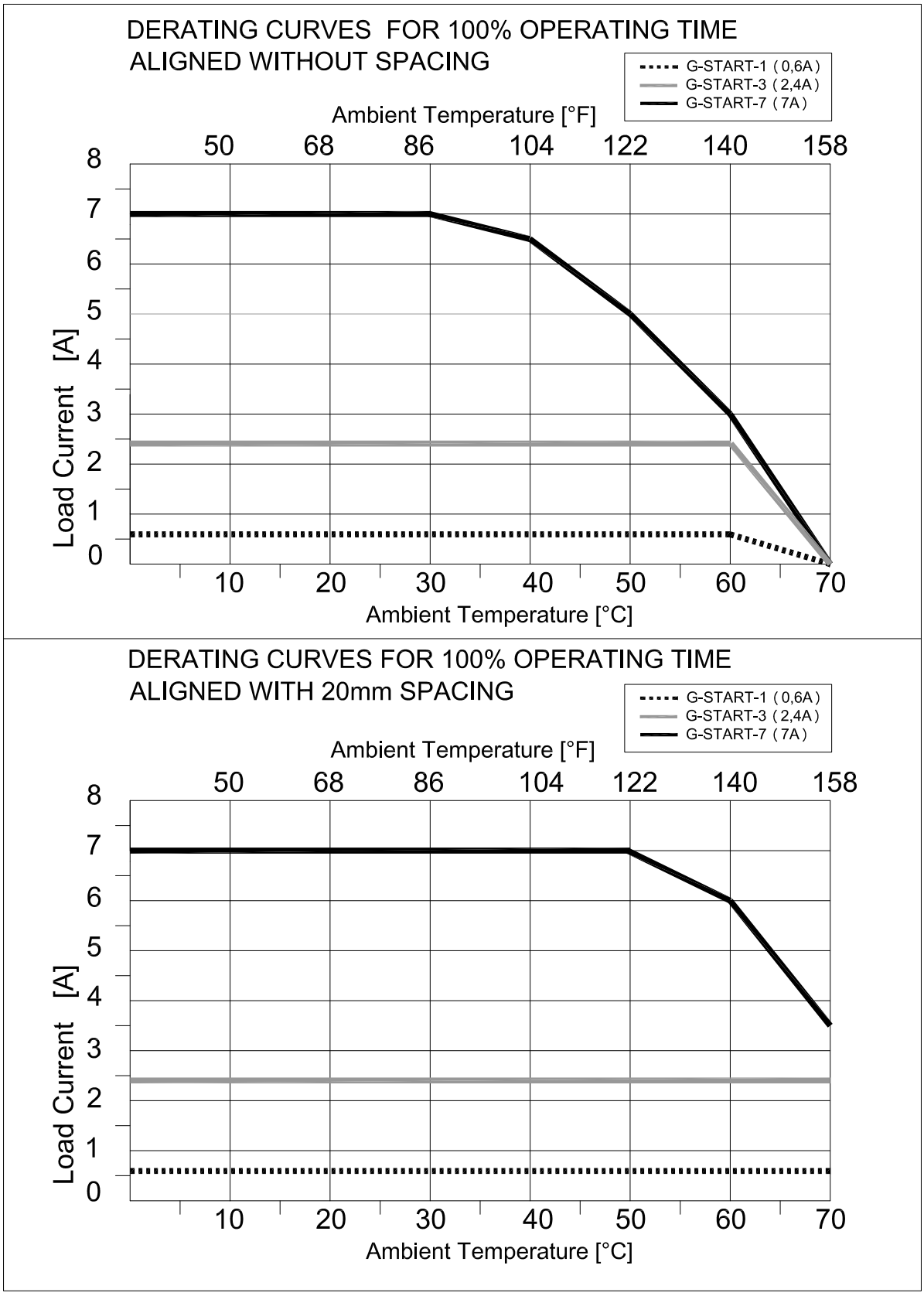
Rotate the selector by positioning it on one of the 8 preset positions according to the serigraphy indicated on the front.



Once the movement of the rotary selector is finished, the PW / ST LED will flash BLUE a number of times equal to the number of the selected position to confirm the selection of the motor size made

Calibration is also possible with the engine running. By pressing the RES button on the front for more than 3 seconds, it is possible to check the calibration by flashing the PW / ST LED

2.8. Derating Curve



2.9. Motor protection and diagnostic functions

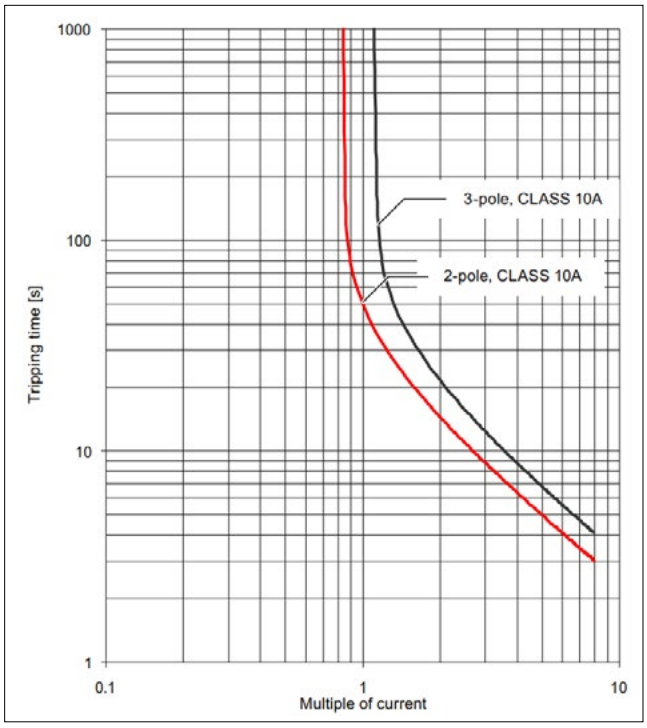
2.9.1. "Reverse protection" functions

If both DI_FW and DI_RV inputs are activated at the same time (simultaneous window of 50ms) the device does not activate the ignition sequence.
If, on the other hand, a gear is already in operation and the second gear is also activated, then the device ignores the second gear and keeps active the first gear that was already selected.

2.9.2. "Motor protection" Functions

2.9.2.1. *Motor overload alarm management*

During motor operation (forward or reverse running), if the motor exceeds the nominal absorption set with the front selector for a time that is a function of the percentage of over-current measured, the motor switches off and the red LED AL lights up.
The release time is defined by the Class10 curve shown below (e.g. with overload factor x8 it switches off after approx.2.5 s, with overload factor x2 it switches off after approx.18s)
Reactivation of the motor is not allowed for at least 3 minutes (cooling time)



If manual reset has been configured, the command from the button or from the digital input is performed only if it occurs after this cooling time.
If the Automatic reset has been configured after the cooling time of 20 minutes, the controller automatically exits the alarm condition and returns to normal operation. Therefore, if the run command is still active, the motor restarts

2.9.2.2. *Phase failure or no load alarm management*

During motor operation (forward or reverse running), if the absorption value of a phase falls below 6% of the nominal value for more than 2 seconds, the motor shutdown sequence is activated and the alarm LED AL lights up with a 10Hz flashing frequency.
In this case the cooling time is not considered.
In the case of manual reset, the motor restarts but if the fault persists it will be repeated as soon as it is detected.
In case of automatic reset, the motor does not restart.

2.9.2.3. *Phase imbalance alarm management*

During motor operation (forward or reverse running) if the absorption value of one of the three phases differs by more than +/- 20% with respect to the average value of the 3 currents, the device detects the current imbalance alarm and activates the shutdown sequence after 60s.
In this case the cooling time is not considered.
In the case of manual reset, the motor restarts but if the fault persists it will be repeated as soon as it is detected.
In case of automatic reset, the motor does not restart.

2.9.2.4. *Diagnostic test*

Through a series of internal tests during the ignition, shutdown and running phases, the device can detect a malfunction and activate the engine shutdown sequence. The fault will be signaled by the alternating flashing of the LEDs PW / ST and AL

2.10. Reset mode

The Reset mode can be automatic or manual.
The Automatic mode is selected by bringing the 24Vdc to terminal 24.
Manual alarm reset: In the event of an active alarm (engine off and red AL led on) by pressing the front button for at least 3 seconds or bringing the 24Vdc to terminal 23, the device resets the alarm condition and returns to normal operation.
Automatic alarm reset: In the event of an active alarm (engine off and red AL LED on), an alarm reset is performed after 20 minutes and is only available for the overload alarm.
However, the front manual reset button remains active.
(see paragraph "3.3. Warnings" on page 24")

2.11. MAINTENANCE AND PERIODIC INSPECTIONS

Periodic maintenance to carry-out in order to guarantee the justified exclusion of failures are:

Visual inspection of the status of the electrical and mechanical connections
The maintenance is designed to evaluate possible problems due to situations of incorrect mounting.
Frequency: every two years

Check the functionality of the safety function
The maintenance has the purpose to verify periodically the correct execution of the safety function and perform the output diagnostic test at least once per year.
Frequency: every year.

2.12. FAILURES AND TROUBLESHOOTING

In case of failures or malfunctions, in the following table you can find the most common failures and the means of appropriate search:

Failure	Possible cause	Troubleshooting
• LED AL (red): Fast flashing (10Hz) • Alarm relay: energized	• One of the phases of motor power supply is missing (L1, L2, L3) • One motor current is equal to zero	1- Power-off the motor starter 2- Check the stability of motor power supply 3- Turn-off the motor power supply 4- Check the connections on L1, L2, L3 and T1, T2, T3 5- Check possible Motor damages
• LED AL (red): Slow flashing (1Hz) • Alarm relay: energized	• Motor's power supply is unbalanced • The motor's currents are unbalanced	1- Power-off the motor starter 2- Check the stability of motor power supply 3- Turn-off the motor power supply 4- Check the connections on L1, L2, L3 and T1, T2, T3 5- Check possible Motor damages
• LED AL (red): ON • Alarm relay: energized	• Motor Overload	1- Power-off the motor starter 2- Check and remove the cause of motor overload/overheat Note: If the Automatic reset has been configured, after the cooling time of 20 minutes the controller automatically exits the alarm condition and returns to normal operation. Therefore, if the run command is still active, the motor restarts. **Power off the motor stater before checking for the cause of the motor overload!**
• LED AL (red): Flashing • LED PW / ST (Yellow): Flashing • Alarm relay: energized	• 24Vdc power supply over/undervoltage • Overtemperature • Program sequence error • System failure	1- Power-off the motor starter 2- Turn-off the motor power supply 3- Check the correct connection of the power supply 4- Check if the power supply level is within specification 5- Check voltage supply stability 6- Check possible housing overtemperatures. Remove the reasons, wait till cooling down and switch on the motor start 7- If the problem persists, send the device to factory for repair
• Power Supply (24Vdc) present • No LEDs on	• System failure	1- Power-off the motor starter 2- Turn-off the motor power supply 3- Check the correct connection of the power supply 4- Check if the power supply level is within specification 5- Check voltage supply stability 6- If the problem persists, send the device to factory for repair

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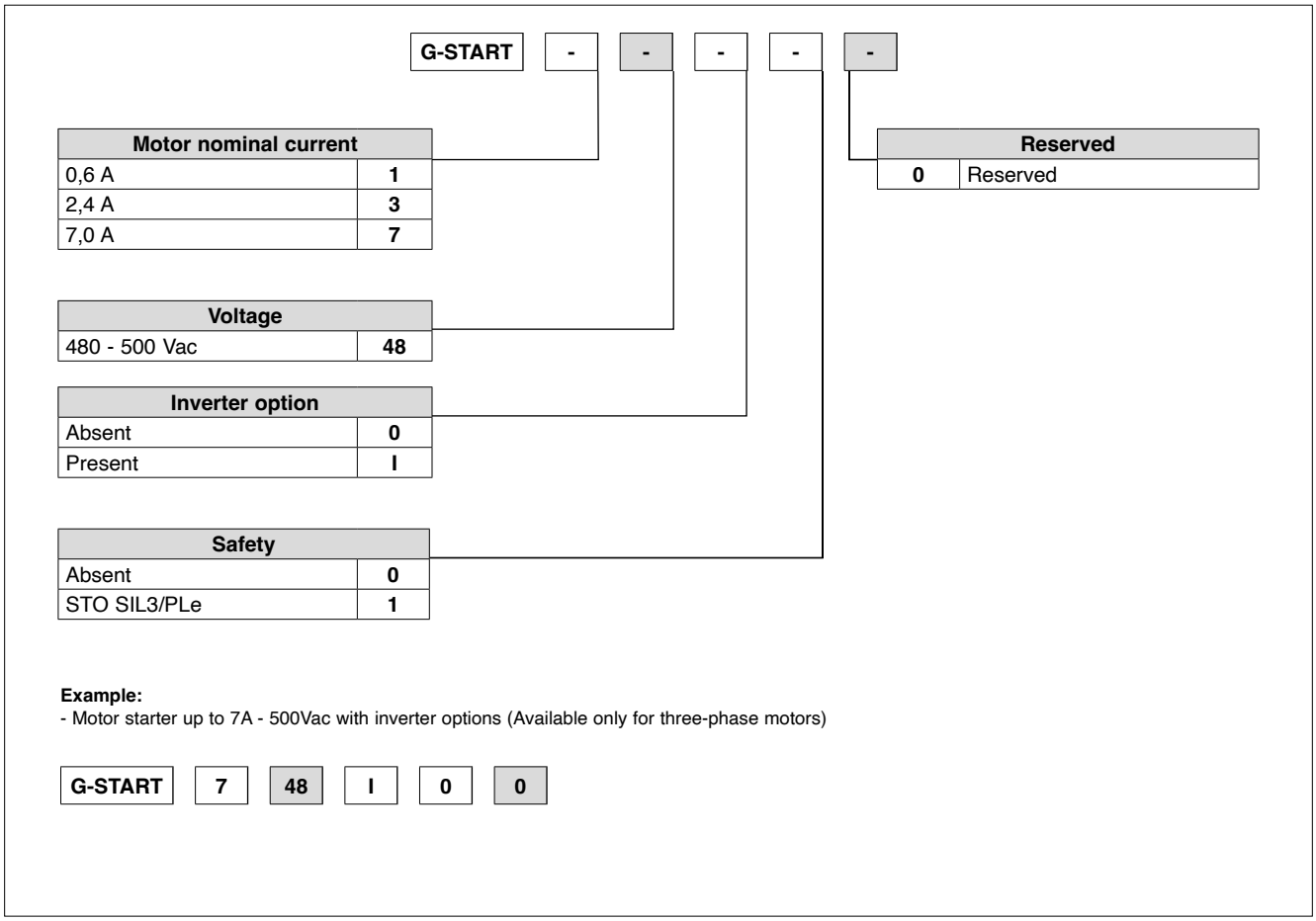
3. ORDER CODE

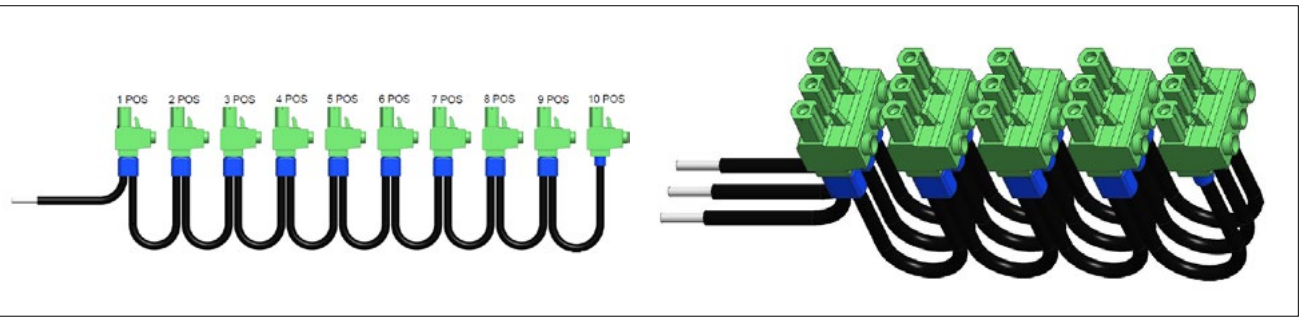


3.1. Order codes

Codice F	*Order Code*	*Description*
F090435	G-START-1-48-0-0-0	Size 0,6A without inversion
F090432	G-START-1-48-I-0-0	Size 0,6A with inversion
F090434	G-START-3-48-0-0-0	Size 2,4A without inversion
F090431	G-START-3-48-I-0-0	Size 2,4A with inversion
F090433	G-START-7-48-0-0-0	Size 7,0A without inversion
F089099	G-START-7-48-I-0-0	Size 7,0A with inversion
F097743	G-START-1-48-0-1-0	Size 0,6A without inversion. STO SIL3
F097744	G-START-1-48-I-1-0	Size 0,6A with inversion. STO SIL3
F097745	G-START-3-48-0-1-0	Size 2,4A without inversion. STO SIL3
F097746	G-START-3-48-I-1-0	Size 2,4A with inversion. STO SIL3
F097747	G-START-7-48-0-1-0	Size 7,0A without inversion. STO SIL3
F097748	G-START-7-48-I-1 -0	Size 7,0A with inversion. STO SIL3

3.2. Accessories

3.2.1. Cable kit G-START from 2 to 10 module



F code	*Order code*
F090808	G-START KIT BRIDGE 2
F090809	G-START KIT BRIDGE 3
F090810	G-START KIT BRIDGE 4
F090811	G-START KIT BRIDGE 5
F090812	G-START KIT BRIDGE 6
F090813	G-START KIT BRIDGE 7
F090814	G-START KIT BRIDGE 8
F090815	G-START KIT BRIDGE 9
F090816	G-START KIT BRIDGE 10

Cable section: 2,5mm2
Operating current ≤ 25A

3.2.2. FUSES

Coordination type 1:
- 25 A gG / 10 kA / 500 V
- 30 A CC / 30 kA / 500 V

Coordination type 2:
- FA 16 A (6,3 x 32 mm) / 1,5 kA / 500 V
- 16 A FF / gR (10 x 38 mm) / 10 kA / 500 V

Note
Type 1 and Type 2 coordination is a definition that applies to motor starters, set out in the IEC standard 60947-4-1. The coordination level relates to the level of resilience and protection in the event of a high current short-circuit fault. The differences between the two types can be summarised as follows.
TYPE 1
A motor starter incorporating type 1 protection will protect persons and surrounding equipment from harm in the event of a short circuit fault, but may not be suitable for further service. For example, the contactor may have welded contacts, or the overload may be destroyed. Replacement parts or repairs will generally be required to get the motor starter back into service.

TYPE 2
A motor starter incorporating type 2 coordination will again protect personnel and equipment from harm, but will also be suitable for further service without extensive repairs or replacements (though the standard does permit light welding of the contacts that can be separated easily with a screwdriver or similar). This allows the motor starter to continue use without the need for extensive maintenance or downtime.

3.3. Warnings

Commissioning, assembly and configurations must only be carried out by experienced and qualified personnel.
The motor connected to the circuit can start automatically if in the automatic restart position.
In case of emergency stops it is necessary to prevent automatic restart of the machine by a higher level controller.
Failure to follow these instructions can result in death, serious injury, or equipment damage.
When working on the device, observe the national safety and accident prevention regulations

Startup, mounting, modifications, should only be carried out after disconnecting the power to the module

During operation, parts of electrical switching devices carry hazardous voltages

The device is an associated item of equipment. Do not install the device in potentially explosive areas. When installing and operating associated equipment, the applicable safety directives must be observed.

If you use the “Automatic RESET” mode, the drive is switched on again after the cooling time has expired - if a control signal is still present. The cooling time is 20 minutes. For applications in the Ex-protection area, automatic restart is not permitted.

The device may not be exposed to mechanical or thermal influences that exceed the limits as described in the operating instructions

Install the device according to the instructions in the installation instructions. Access to circuits within the device is not permitted.

The operating equipment cannot be repaired by the user and must be replaced by an equivalent device. Repairs may only be carried out by the manufacturer.
Observe the safety information, conditions, and limits of use specified in the product documentation. Comply with them.

Secure the device during safety-related applications with an access protection

Observe the minimum permissible load current in safety-related applications:
G-START-1-... ≥ 70 mA
G-START-3-...: ≥ 180 mA
G-START-7-...: ≥ 1.5 A

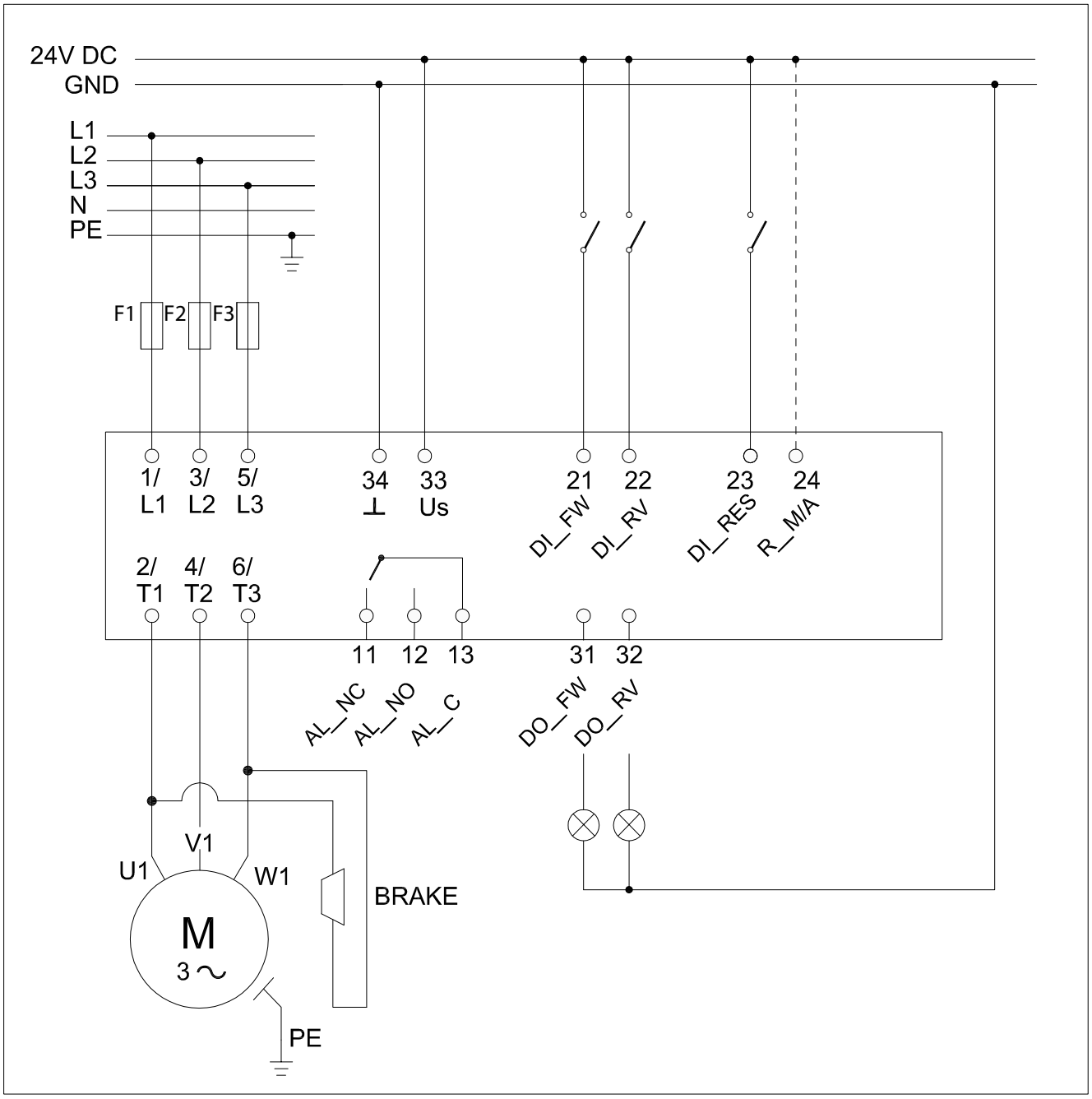
This is a product for environment A (industry). The device can cause unwanted radio interference if used in Class B environments (household). In this case, the user may be obligated to take the necessary precautionary measures.

Risk of electric shock and fire, the opening of the branch-circuit protective device may be an indication that a fault current has been interrupted. To reduce the risk of fire or electric shock, current carrying parts and the other components of the controller should be examined and replaced if damaged. Failure to follow instructions can result in death, serious injury, or equipment damage

3.4. Application notes

3.4.1. Motor with Brake 400 V AC BRAKE

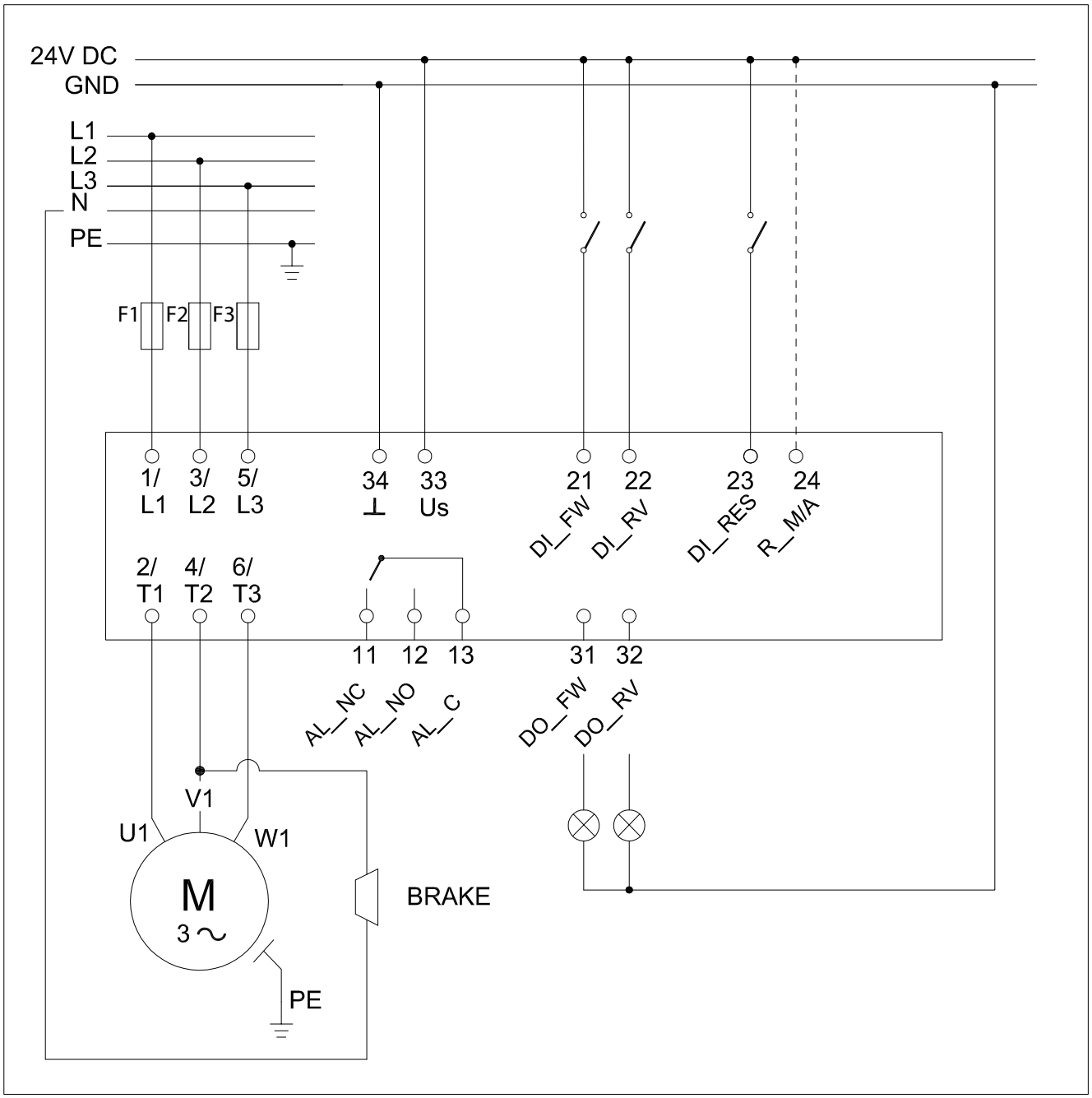
If a motor with brake (connection in the motor terminal block) is connected, the 400 V AC brake must be linked to the 2/T1 and 6/T3 terminals.



Note: Increase motor current to the sum of the nominal currents (motor + brake).

3.4.2. Motor with Brake 230 V AC BRAKE

If a motor with brake (connection in the motor terminal block) is connected, the 230 V AC brake must be connected to the 4/T2 terminals and the star point of the motor.



Note: Increase motor current to the sum of the nominal currents (motor + brake).

3.5. UL Note

3.5.1. Electrical Features

	3 Phase HP ratings Break all line 500 V	
	FLA (A)	LRA (A)
G-START-1	0.6	4.8
G-START-3	2.4	19.2
G-START-7	7.0	56

Control Circuit Power Supply: 24 Vdc, 50 mA
No.4 digital inputs: 5-30 Vdc, 5 mA

No.2 digital outputs: 24 Vdc, 40 mA

N.1 output relay with NO / NC connection. Switching capacity according to IEC 60947-5-1: 3A (230V, AC15), 2A (24V, DC13)

3.5.2. Wiring

“Use copper cables(CU) da 60/75°C”

Power Circuit Connections(L1,L2,L3,T1,T2,T3):
- AWG range: 30-12, stranded or solid
- Field wiring terminal Tightening torque: 5-7 lb-in
- Input, output, and auxiliary circuit connections (from 11 to 34):
- AWG range: 14-22, stranded or solid
- Field wiring terminal Tightening torque: 3,46 lb-in

3.5.3. SCCR

Suitable for use in a circuit capable of delivering no more than 5 kA symmetrical rms, maximum 500 Volts, when protected by a 20 A Class RK5 fuse (coordination type 1)

3.5.4. Enviromental ratings

- Ambient temperature: 50°C
- Rated surge voltage: Uimp 6kV
- Pollution degree: 2

3.6. Certification

The EC declaration of conformity is available on the website www.gefran.com

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