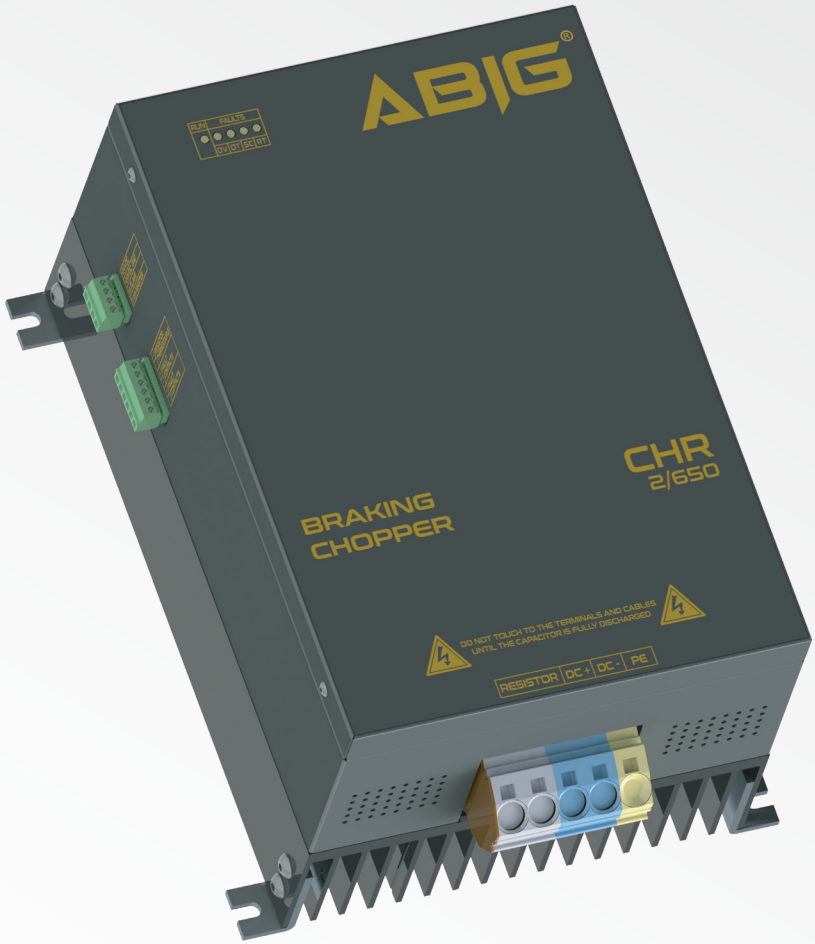
PRODUCT MANUAL

BRAKING CHOPPER

CHR 2/650



Hilkar

RECORD OF REVISION

Product Code	Hardware Version	Operating Instructions	Release Date
ABIG CHR 2/650	V1.5	Edition 1.4	05/11/2025
ABIG CHR 2/650	V1.5	Edition 1.5	16/02/2026

Liability

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Scope

This product manual describes the operation of the ABIG CHR 2/650 braking chopper, including mounting instructions and critical safety precautions for installation and maintenance. This manual is intended solely for qualified technical personnel responsible for the installation, commissioning, and servicing of the braking chopper.

Disclaimer

Technical Changes

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This section outlines safety instructions that must be strictly followed during the installation, operation, and maintenance of the braking chopper. Read and understand this section thoroughly before attempting any work on the device.

All electrical installation and maintenance work on the ABIG CHR 2/650 braking chopper must be performed only by qualified technical personnel who exercise maximum care and adhere to all instructions.

Figure 1 WARNING Symbol

The warning symbol on the braking chopper indicates the presence of high voltage on terminals and cables, which poses a risk of severe physical injury, death, and/or damage to the equipment.

Before energizing the braking chopper, ensure the Protective Earth (PE) terminal is securely connected to a reliable earth ground. Do not touch the module while the braking chopper is energized, even if the earth ground is connected. Do not touch the module or perform any operations until the unit is completely de-energized and the internal capacitors are fully discharged. Failure to observe these warnings may result in physical injury, death, and/or equipment damage.

DANGER: RISK OF ELECTRIC SHOCK

Do not perform any work on the braking chopper while the system is energized. Before starting any installation, maintenance, or disconnection:

1. Isolate All Power Sources: Disconnect the unit from the host system. Ensure all primary power sources such as AC mains for motor drivers, DC bus connections for battery storage, or any other energy supply/storage systems are completely switched off and isolated.
2. Prevent Residual Energy Feed: Ensure that no regenerative energy is being generated (e.g., motor is at a complete standstill) and that no external DC sources are actively feeding the DC link.
3. Wait for Discharge: Wait at least **5 minutes** for the internal capacitors of the entire system and the braking chopper to discharge to safe levels.

4. Verify with Measurement: It is mandatory to measure the voltage between all terminals (DC+, DC-, and Resistor terminals) using a properly rated voltage-indicating instrument.
5. Safe Working Limit: Work may only begin once the measured voltage is confirmed to be below **25 VDC**.

Failure to comply with these instructions will result in death or serious injury.

ATTENTION: DO NOT OPEN THE COVER

Product Integrity and Warranty:

- No Internal Serviceable Parts: For safety reasons and to maintain the technical integrity of the device, the cover of the braking chopper must never be opened.
- Warranty Void: Any unauthorized opening of the cover, tampering with the internal circuitry, or replacement of internal components by unauthorized personnel will **void the product warranty**.
- Exclusive Manufacturer Service: All internal inspections and repairs must be performed exclusively by the manufacturer.

The braking chopper is designed to limit the DC link voltage of a frequency converter-based motor drive. When an induction motor decelerates, it acts as a generator, feeding energy back into the converter and subsequently the DC link. The braking chopper transmits this braking energy to a resistor, where it is dissipated as heat. An IGBT is used as a power transistor switch to control high braking energy and maintain the DC link voltage within maximum and minimum limits. The braking resistor is connected externally to the ABIG CHR 2/650.

The connection diagrams for the braking chopper are provided in Figure 2 and Figure 3. When mains power is applied to the R, S, T terminals of the motor driver, the power terminals of the braking chopper (DC+, DC-, R1, and R2) are energized at high voltage.

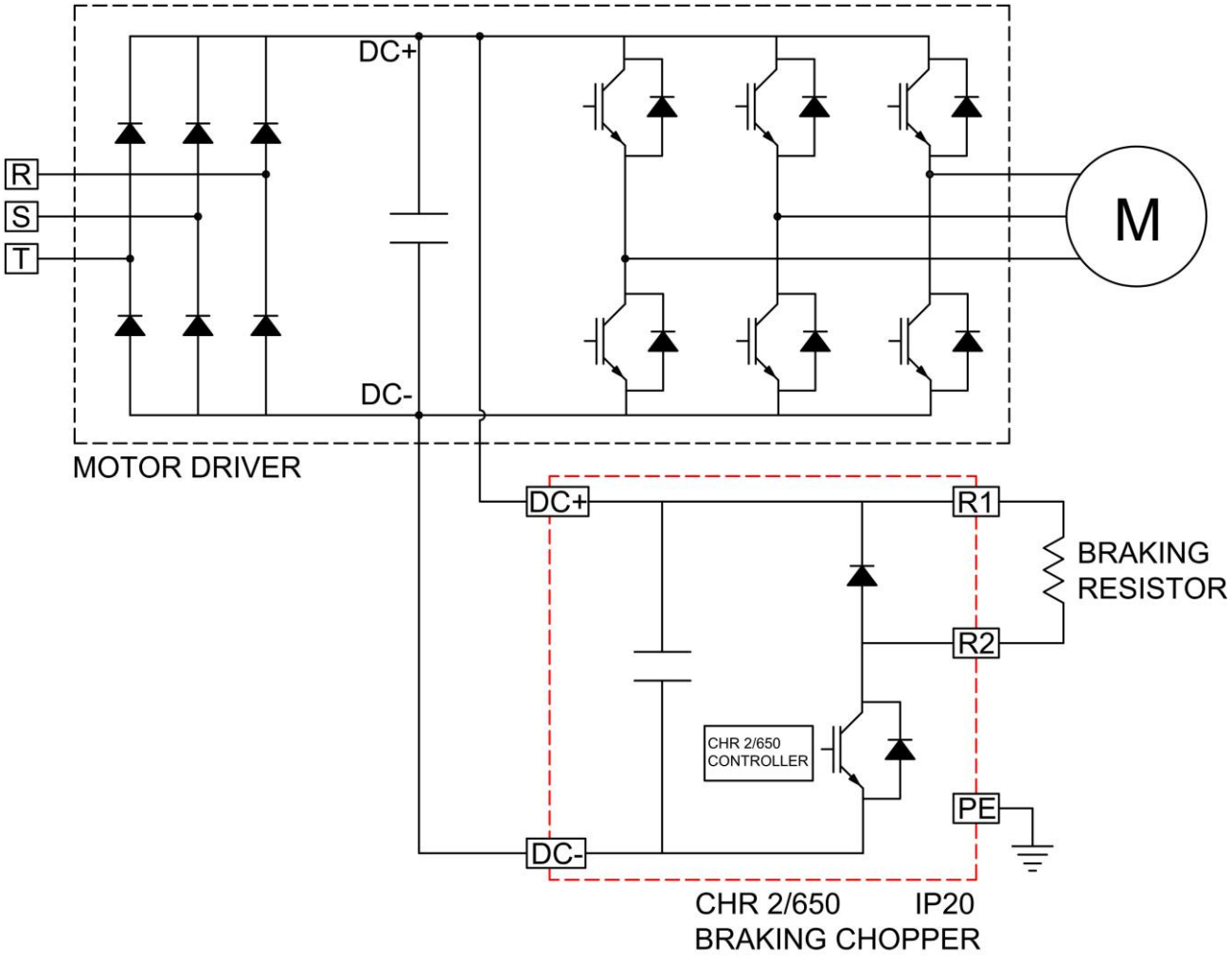

Figure 2 Connection Diagram-1

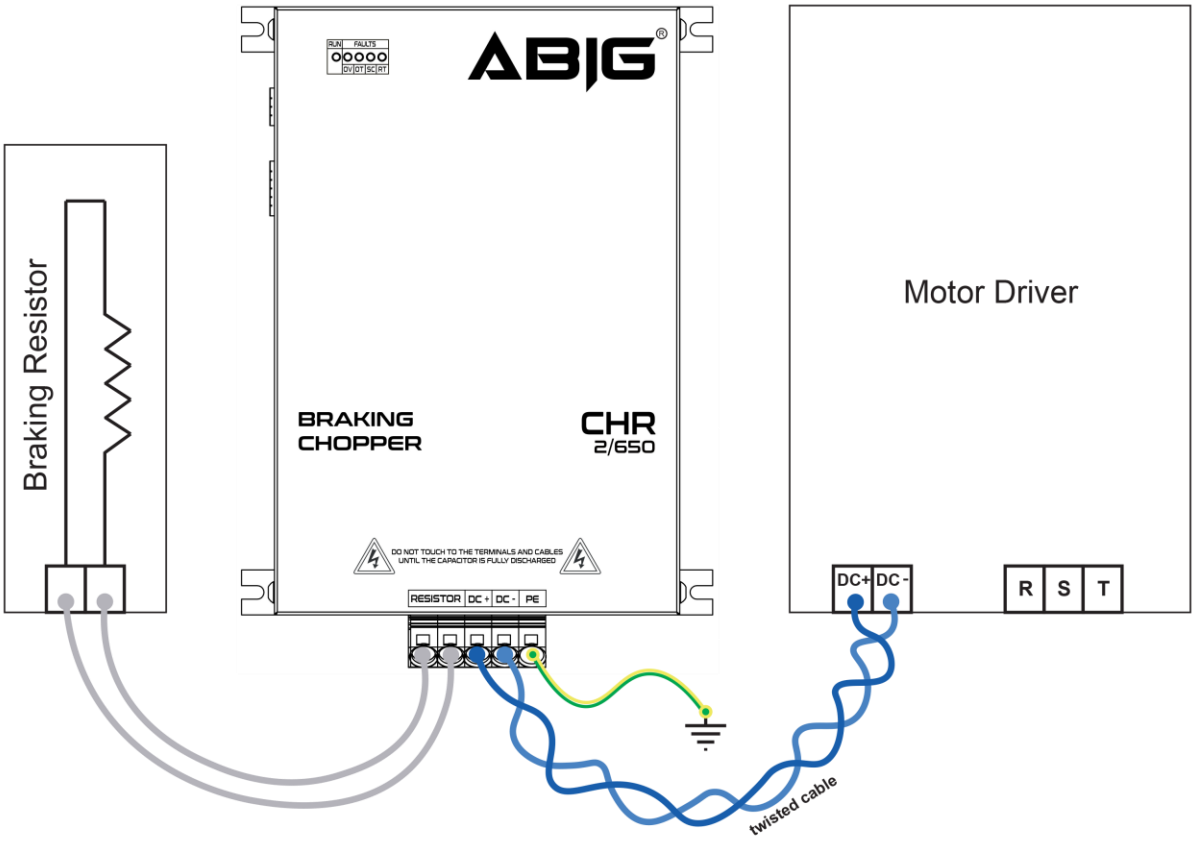

Figure 3 Connection Diagram-2

ABSOLUTE MAXIMUM RATINGS

Stresses beyond those listed under 'Absolute Maximum Ratings' may cause permanent damage to the device. These are stress ratings only and functional operation of the device at these or any other conditions beyond those indicated in the operational sections of the specification is not implied. Exposure to absolute maximum rating conditions for extended periods may affect device reliability.

Table 1 Absolute Maximum Ratings

Ratings	Min	Typ.	Max	Unit
Input DC Voltage	200		1000	VDC
Ambient Temperature	-20		50	°C
Storage Temperature	-25		70	°C
Peak Braking Current @5% Duty Cycle			250	A
Auxiliary Supply Voltage			26	V
Altitude (non-derating)			2000	m
Parallel Operation		Up to 7 modules		

RECOMMENDED OPERATION CONDITIONS

Table 2 Recommended Operation Conditions

Ratings	Min	Typ.	Max	Unit
Brake Voltage Threshold (Factory set)	250	660	850	VDC
Power Up Voltage		100		VDC
Minimum Braking Resistance @ Input Voltage	1.2	3.1	4	Ω
Peak Braking Current @10% Duty Cycle			210	A
Peak Braking Power @10% Duty Cycle			178.5	kW
Rated Continuous Current			40	A
Rated Continuous Power			34	kW
Auxiliary Supply Voltage	22.8	24	25.2	V
Auxiliary Supply Current		0.2		A
Ambient Temperature	-10		40	°C

INPUT and OUTPUT CHARACTERISTICS

Table 3 Input and Output Characteristics

Ratings	Min	Typ.	Max	Unit
Voltage of Digital Inputs		24		VDC
Current of Digital Inputs		8		mA
Current of Digital Outputs			1	A

It is recommended to mount the ABIG CHR 2/650 as shown in Figure 4. The top of the braking chopper is indicated with an arrow. When mounting the unit on a wall or a panel plate, power terminals should be positioned at the bottom, and signal terminals on the left. This orientation ensures that the LED indicators on the front are clearly visible. Do not cover the ABIG CHR 2/650 with any object. Ensure sufficient lighting inside the panel or room so that labels can be read clearly to prevent wiring errors.

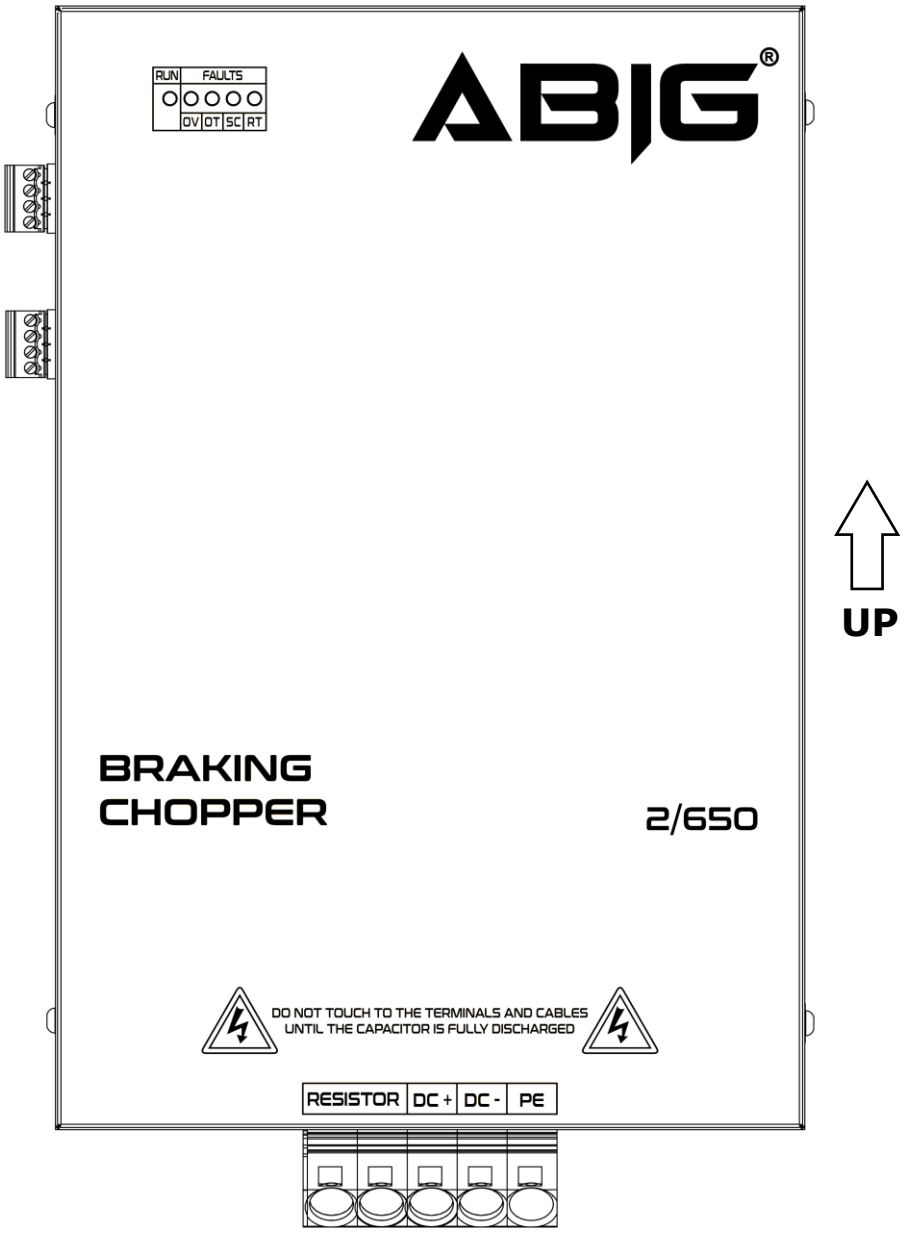

Figure 4 Braking Chopper Front View

The dimensions of the ABIG CHR 2/650 are provided in Figure 5 and Table 4.

Table 4 Specifications of Chopper Module

Width x Height x Depth	209,2mm x 293,4mm x 146,9mm
Mounting holes	195,2mm x 250mm
Weight	4 kg
Protection degree	IP20 as per EN 60529

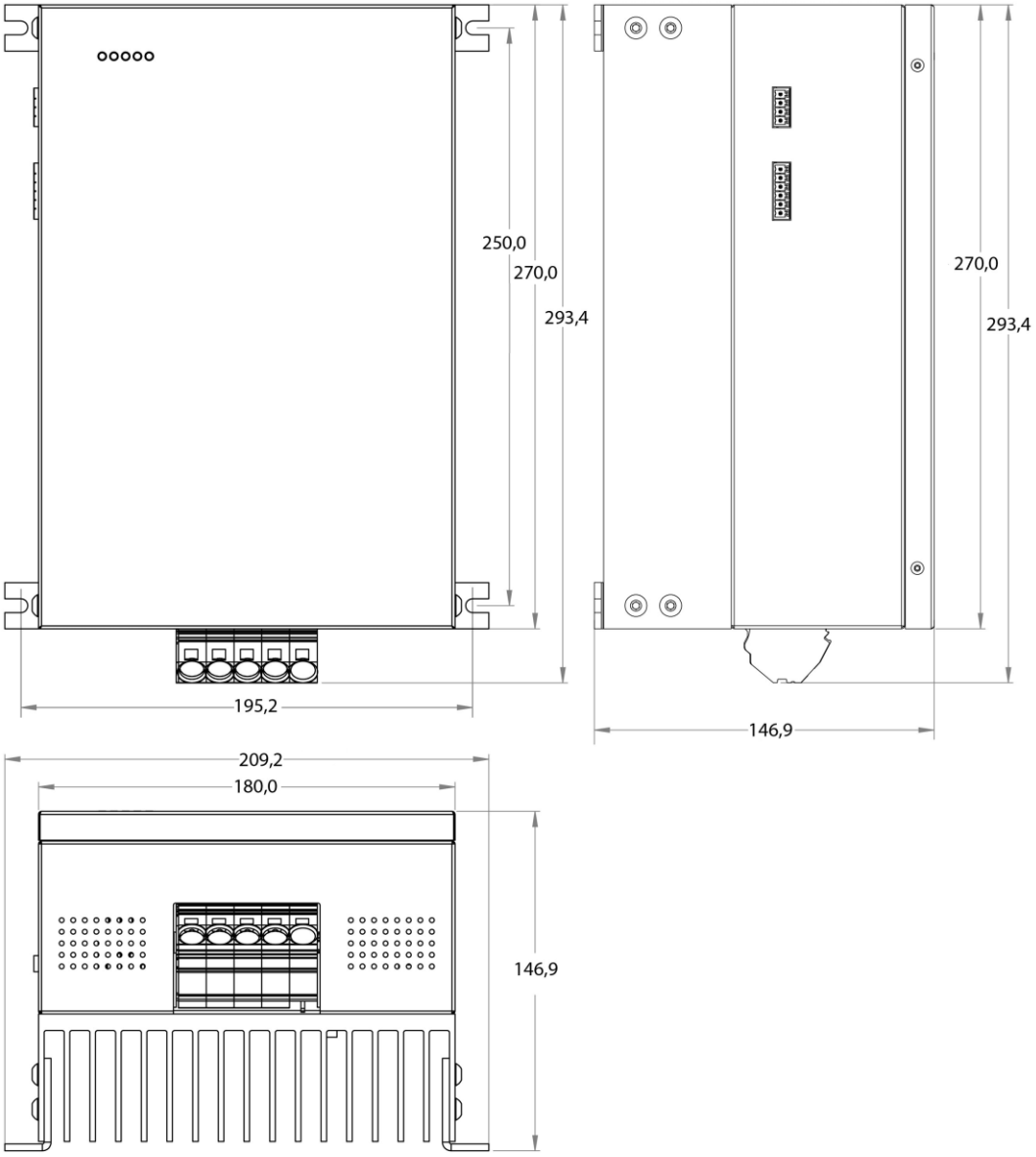

Figure 5 Braking Chopper Dimensions

Use M5x20 pan head machine screws, M5 spring washers, and M5 flat washers to mount the ABIG CHR 2/650 on the panel mounting plate, as shown in Figure 6. Tighten the mounting screws to a torque of **6 Nm**.

The center coordinates for the four mounting holes form a 195.2 mm by 250 mm rectangle (see Figure 5). For proper mounting, ensure sufficient clearance around the device to allow for manual intervention and cable connections during installation and maintenance.

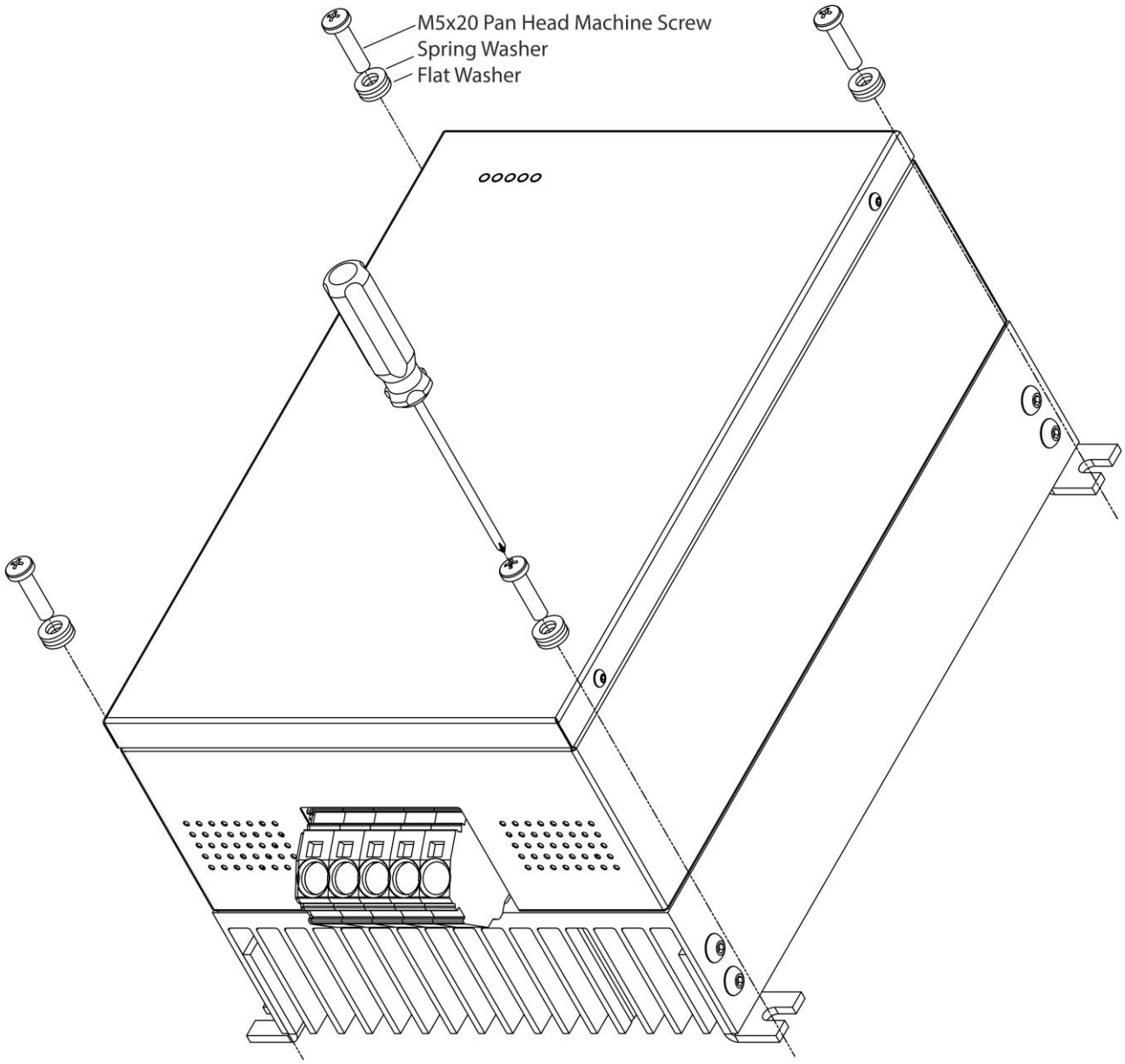

Figure 6 Mounting Instructions

The ABIG CHR 2/650 utilizes natural convection cooling. As shown in Figure 7, fresh air enters from the bottom and heated air dissipates through the top. To ensure proper cooling and optimum air circulation, maintain a minimum clearance of 30 cm above and below the device.

When installing single or multiple chopper units, select a well-ventilated panel where the internal temperature does not exceed 40°C. Do not mount heat-generating devices or braking resistors inside the same panel. If unavoidable, install such devices on top of the panel to minimize heat transfer. For multiple ABIG CHR 2/650 installations within the same panel (see Figure 7), leave approximately 15 cm of space between units for signal cabling and mechanical mounting.

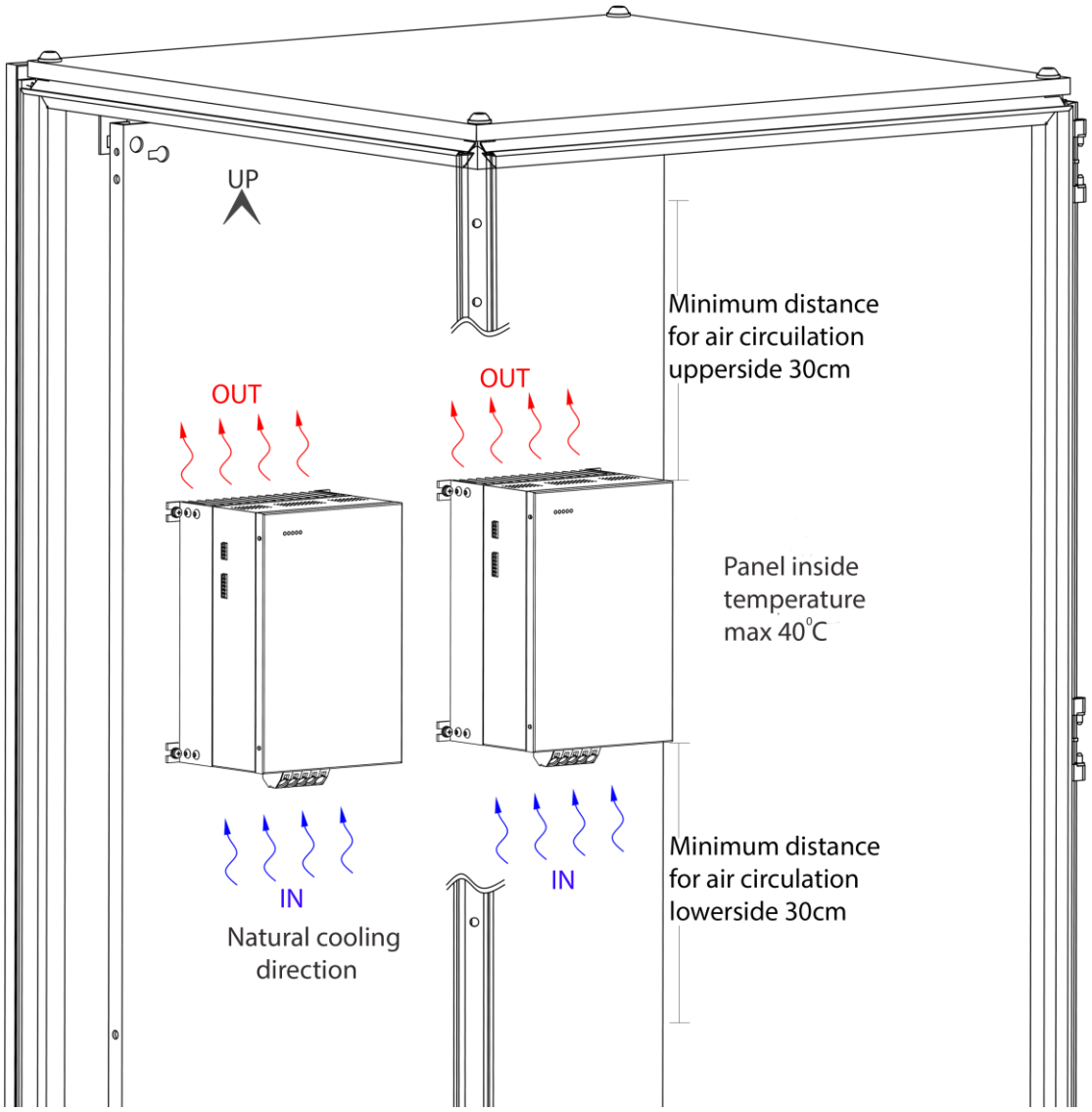

Figure 7 Natural Cooling Inside Panel

The ABIG CHR 2/650 features power terminals, signal terminals, and LED indicators.

- **Power Terminals:** Designed for 16 mm² stranded copper cables without ferrules. Wires are connected by pushing them into the terminals using a screwdriver.
- **Signal Terminals:** Designed for 1–1.5 mm² stranded copper cables, with or without ferrules.
- **LED Indicators:** Provide status information and fault signals during operation.

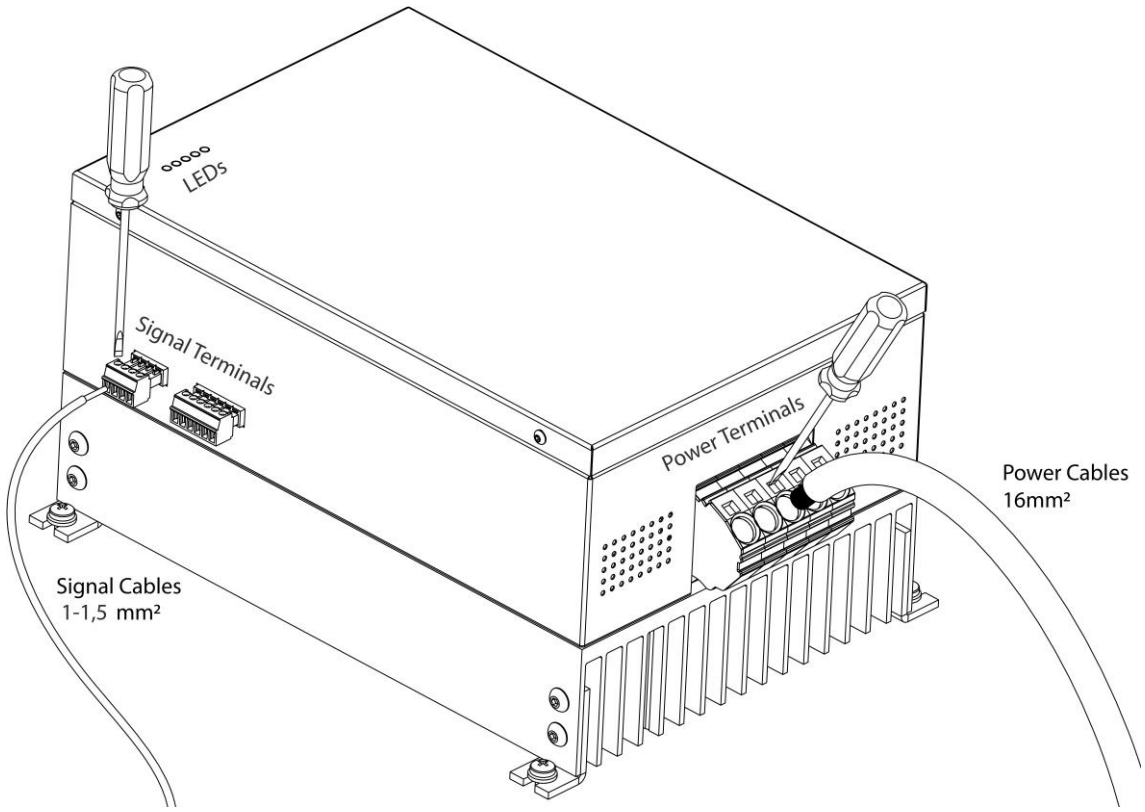

Figure 8 General View of Braking Chopper

CAUTION-1: Do not connect or disconnect DC-Link voltage cables at the Power Terminals while voltage is present.

CAUTION-2: The braking chopper is not equipped with reverse polarity protection. Correct connection of DC+ and DC- is critical. Incorrect polarity will damage the device. Using different colored cables for DC+ and DC- is highly recommended.

CAUTION-3: Do not plug or unplug Signal Terminals while voltage is present on the signal wires. Hot-plugging or disconnecting terminals under load is strictly prohibited.

All power terminals are identical push-in type terminals accepting a conductor cross-sectional area of 16 mm². Connect cables without ferrules. To open the clamp for wiring, insert a flat screwdriver vertically as shown in Figure 9.

Figure 9 displays the power terminal labels:

- **Braking Resistor Terminals:** The first two grey terminals. These have no polarity. The maximum recommended cable length is **20 meters**. Use a braking resistor with a minimum ohmic value of **3.1Ω** for operation at 660 VDC. (Consult the factory for optimum values at other voltages).

- **DC Link Terminals (DC+ and DC-):** Blue-coloured terminals. **Warning:** Improper polarity connection will cause device failure. The maximum recommended length for DC+ and DC- cables is **5 meters** each. Install these cables as twisted pairs or adjacent to each other.

- **PE (Protective Earth) Terminal:** Marked in yellow and green. This connection is **mandatory** to ensure user and device safety against faults (e.g., IGBT insulation failure). Connect to the nearest grounding stud within the same panel using a cable no longer than **5 meters**.

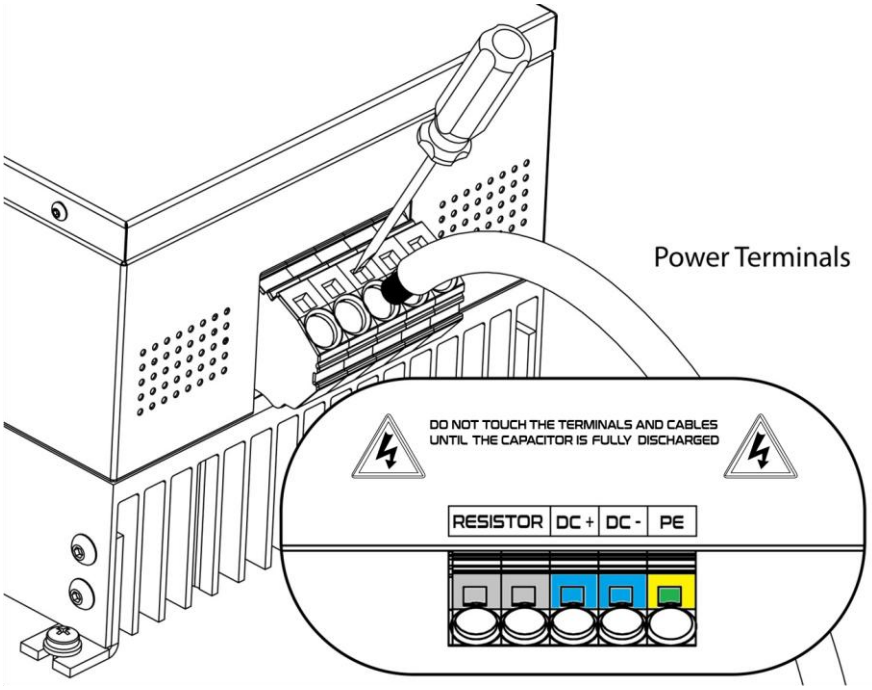

Figure 9 Power Terminals

All signal terminals are identical screw-type terminals accepting a conductor cross-sectional area of 1–1.5 mm². Connections can be made with or without ferrules. Tighten terminal screws to **0.25 Nm**.

Figure 10 illustrates the signal terminal labels. The first connector includes: "+24VDC", "+24VDC_GND", "to SLAVE" and "from MASTER".

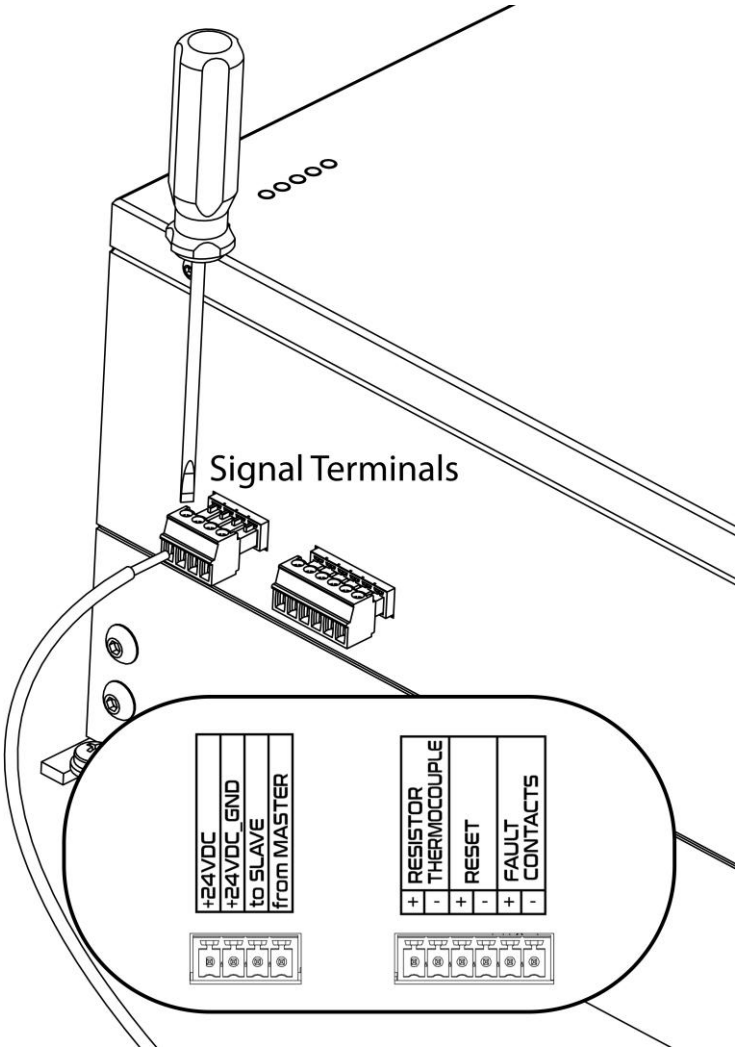

Figure 10 Signal Terminals

"to SLAVE" is a digital output and "from MASTER" is digital input. Electronic circuits connected to these terminals are isolated from the high-voltage side but require an external +24VDC power supply. If no signal terminals are used, the +24VDC connection is not mandatory, as the braking chopper draws operating power from the DC link.

The "**from MASTER**" and "**to SLAVE**" terminals are utilized specifically for the parallel operating mode. **Up to seven (7) braking choppers** can be connected in parallel to provide higher total braking power. For this configuration, an external power supply of 24 VDC ±5% is required; ensure that the +24VDC and +24VDC_GND cables are properly connected for each individual braking chopper in the system.

Figure 11 illustrates the master and slave cable connections required for the parallel operation of the braking choppers. This specific connection strategy is referred to as a "daisy chain" topology. In this configuration, the master-slave signal terminals of all parallel-connected braking choppers are linked in a continuous chain.

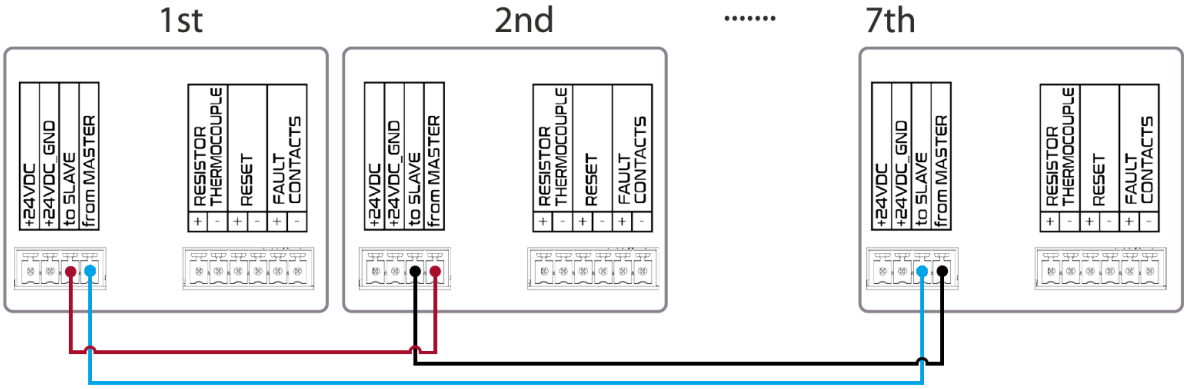

Figure 11 Master Slave Connections

The second signal connector, illustrated in Figure 10, features three signal interfaces: two inputs and one output.

The **"RESISTOR_THERMOCOUPLE"** input is designed for the thermal protection of the braking resistor. A Normally Closed (NC) thermostat is recommended for this function. If the thermal threshold is exceeded, the contact opens, signaling excessive temperature in the resistor. To operate this, +24VDC must be supplied and the thermostat wired to the terminals as shown in Figure 12. If thermal protection is not required, or if the braking resistor is used without a thermostat, connect +24VDC directly to the thermostat input terminal to bypass this feature while taking into consideration of the voltage polarities.

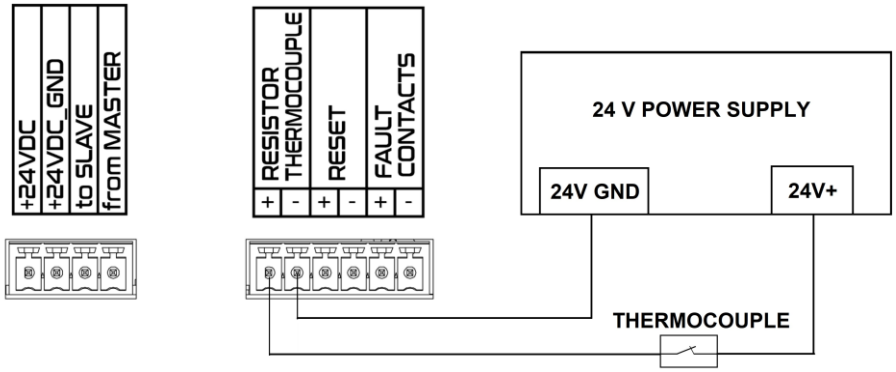

Figure 12 Resistor thermocouple contact connections

The braking chopper is equipped with High Voltage, High Temperature, and Short Circuit (SC) protection. Upon detecting any of these faults, the device ceases operation and enters a fault state, which is indicated via its LEDs and the "FAULT CONTACTS" output. Generally, the system automatically clears the fault state once the underlying cause is resolved. However, a Short Circuit (SC) fault is not cleared automatically. Following an SC fault, the issue must be resolved, and an external RESET signal must be applied to the "**RESET**" terminal. A reset button should be connected as depicted in Figure 13, using twisted-pair cables with a maximum length of 20 meters.

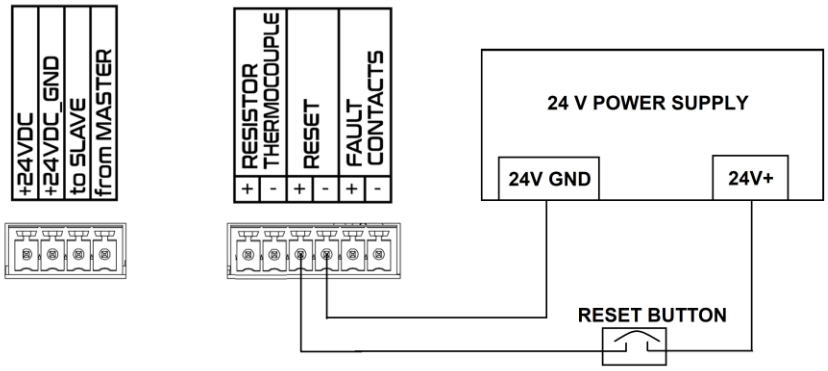

Figure 13 Reset contact connections

The **"FAULT CONTACTS"** interface on the ABIG CHR 2/650 consists of two terminals connected to an internal relay, providing a fail-safe signal for monitoring the operational health of the equipment. This output is designed to be integrated into the control or safety circuits of the host system, such as motor drivers, battery storage systems, or other DC power applications. During normal operation (no fault), the internal relay is energized and the contact between the two terminals is closed. In this state, a reference voltage (e.g., 24 VDC) applied to one terminal will be conducted through to the second terminal. If the braking chopper encounters a fault condition or if the auxiliary power supply is interrupted, the relay de-energizes and the contact becomes open (floating).

In the event of a fault, the braking chopper will cease operation and will no longer be able to regulate the DC link voltage. Therefore, to protect the host system and connected equipment against overvoltage, the FAULT CONTACTS signal must be incorporated into the system's safety chain to trigger an external action, such as disconnecting the primary power source or the DC link via a circuit breaker. The internal relay contact is rated for a maximum of 230 VAC or 30 VDC at 1 A. To ensure signal integrity and minimize electromagnetic interference (EMI), twisted-pair cabling must be used for the connection, and the total cable length must not exceed 20 meters.

The ABIG CHR 2/650 braking chopper features five LED indicators on the front panel to provide real-time status information and diagnostic feedback. These LEDs allow the user to monitor the operational health of the unit and quickly identify specific fault conditions.

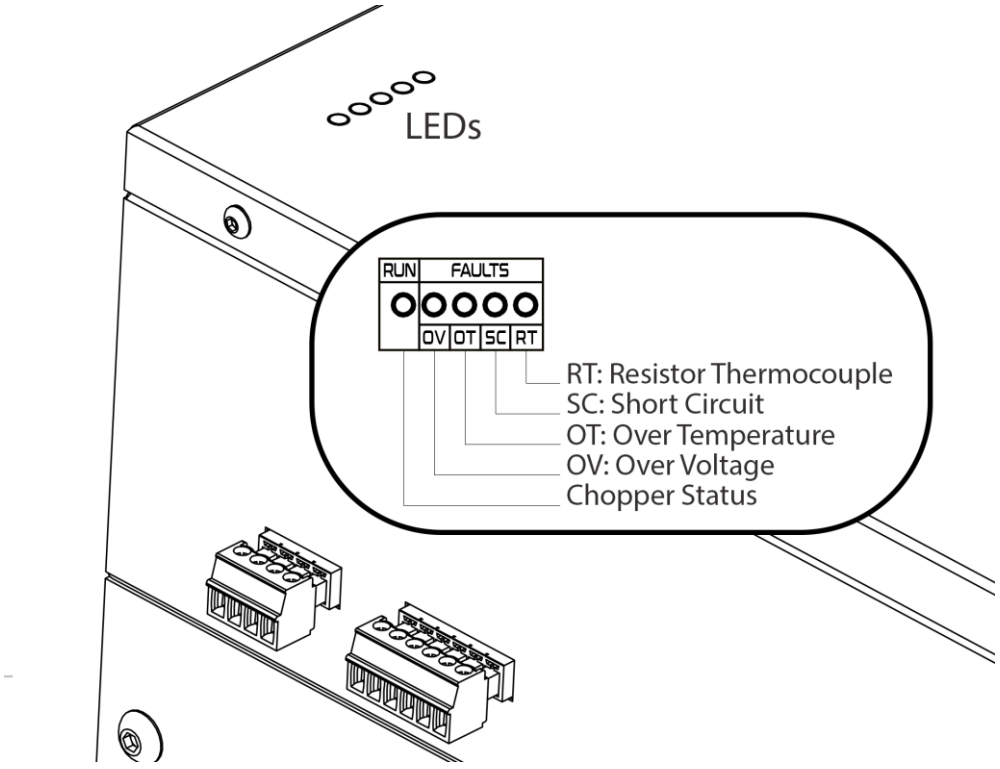

Figure 14 LEDs

Table 5 below summarizes the function of each LED, followed by a detailed description of their behavior and flash codes.

Table 5 LED Indicators

Symbol	Colour	Function	Description
RUN	Blue	System Status	Indicates power is on and braking is active.
OV	Red	Overvoltage	Lights up when DC Link voltage is too high.
OT	Red	Internal Overtemperature	Indicates that the IGBT is overheating.
SC	Red	Short Circuit	Indicates a critical short-circuit fault (Latched).
RT	Red	Resistor Overtemperature	Indicates that the external braking resistor is overheating.

Detailed Description of Indicators

1. RUN (System Status): The blue RUN LED serves as the primary heartbeat of the system.

- Continuous ON: Indicates that the device is energized (DC Link voltage is present) and ready for operation.
- Blinking: When the braking chopper starts discharging energy (braking), this LED blinks (0.25s ON / 0.25s OFF). To ensure visibility, the blinking signal persists for a minimum of 2 seconds once activated.

2. OV (Overvoltage): The red OV LED alerts the user when the DC Link voltage exceeds the configured safety threshold.

- Behaviour: Turns ON immediately when the threshold is exceeded.
- Reset Logic: Automatically turns OFF approximately 3 seconds after the voltage returns to safe levels.

3. OT (Internal Overtemperature): The red OT LED monitors the internal thermal health of the braking chopper.

- Behaviour: Turns ON if the IGBT junction is overheated.
- Reset Logic: Clears automatically once the system cools down to safe operating margins.

4. SC (Short Circuit): The red SC LED indicates that the unit has detected a short circuit condition. This specific fault triggers when the current exceeds the hardware limits immediately.

- Cause: This usually indicates a short circuit across the braking resistor terminals, a wiring fault in the resistor cables, or a failure of the internal IGBT module.
- Behaviour: The braking chopper stops operation instantly to prevent further damage.
- Reset Logic: This is a latched fault, meaning it does not clear automatically even if the condition disappears. The user must first inspect the braking resistor and cabling. Once the physical issue is resolved, the specific reset procedure below must be followed.

5. RT (Resistor Overtemperature): The red RT LED is dedicated to monitoring the temperature of the external braking resistor via the thermocouple input.

- Behaviour: Turns ON when the temperature value of the braking resistor exceeds the limit temperature.
- Reset Logic: Clears automatically once the resistor cools down to nominal temperature levels.

To clear the SC fault, a rising edge signal (transition from 0V to +24VDC) must be applied to the "RESET" terminals, as shown in Figure 15.

Please observe the following operational requirements:

1. The system detects the transition of the voltage. Therefore, applying a continuous +24VDC voltage to the reset terminals will not be sensed as a valid RESET command. The signal must toggle from Low to High.

2. Upon detecting a valid rising edge signal, the chopper initiates a mandatory safety sequence. The device will wait for 30 seconds before resuming normal operation.

WARNING: PERSISTENT FAULT If the SCP LED remains lit or the fault immediately repeats after the 30-second reset period, **DO NOT ATTEMPT TO OPERATE THE CHOPPER UNIT ANYMORE.** This indicates a permanent internal failure or unresolved short circuit. Disconnect the power immediately and contact the maintenance service.

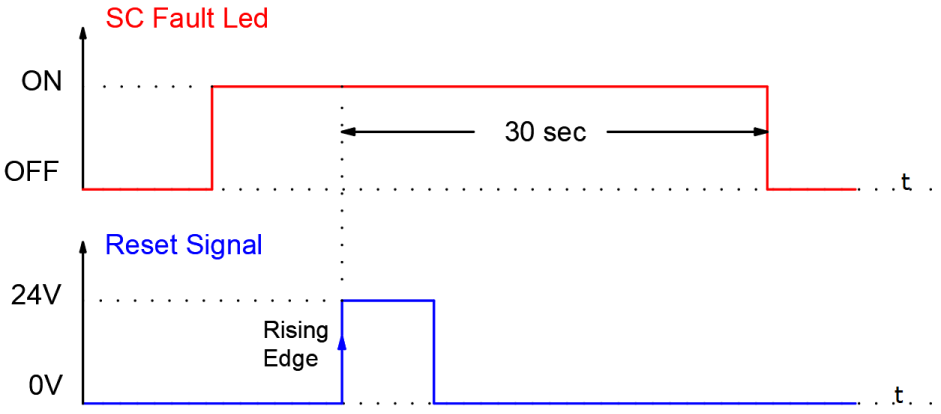

Figure 15 Resetting SC Fault

Proper cable selection and routing are critical for the safe and efficient operation of the braking chopper. The tables below outline the recommended cable types, cross-sectional areas, and maximum allowable lengths for both power and signal connections.

Table 6 Cable list for power terminals

Terminal Name	Cable Type	Max. Length(m)
Resistor Terminals	2x16mm^2 stranded Cu cable	20
DC Link Terminals	2x16mm^2 stranded Cu cable (twisted)	5
Protective Earth Terminal	16mm^2 stranded Cu cable	5

Table 7 Cable list for signal terminals

Terminal Name	Cable Type	Recommended Length(m)
+24VDC Inputs	2x1,5mm^2 stranded Cu cable	20
from Master Input	1,5mm^2 stranded Cu cable	20
to Slave Output	1,5mm^2 stranded Cu cable	20
Resistor Thermocouple Inputs	1,5mm^2 stranded Cu cable	20
Reset Inputs	1,5mm^2 stranded Cu cable	20
Fault Contacts Outputs	1,5mm^2 stranded Cu cable	20

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