Product note – ACS580-07 with brake chopper option +D150

Contents of this product note

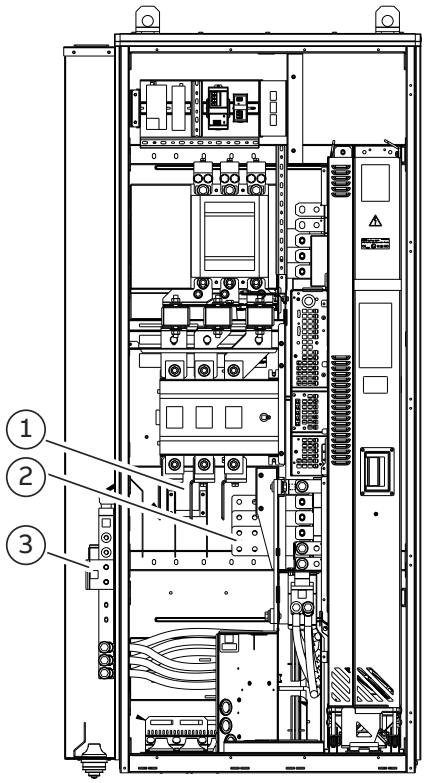
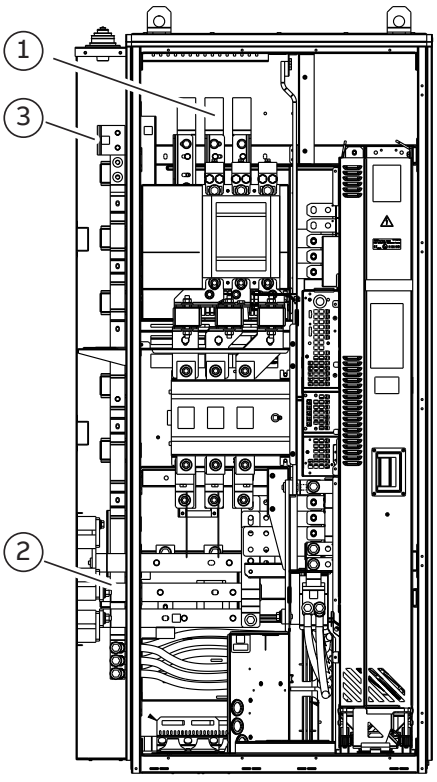
This product note contains information on the brake chopper (option +D150) for ACS580-07 drives. The information is valid for the R10 and R11 frame sizes, that is, for drive types types -0505A-4 …-0880A-04.

Operation principle and hardware description

You can order the drive with a built-in brake chopper (option +D150). Brake resistors are available as add-on kits.

Layout

For the brake chopper option, ABB adds a side box onto left side of the cabinet. The side box contains the terminals for the resistor cable, and the resistor cable entries. The grounding terminals (PE) are inside the main cubicle.

Bottom cable entry and exit	Top cable entry and exit (options +H351 and +H353)
	
1. Input power cable terminals	
2. Motor cable terminals	
3. Brake resistor cable terminals	

Operation principle

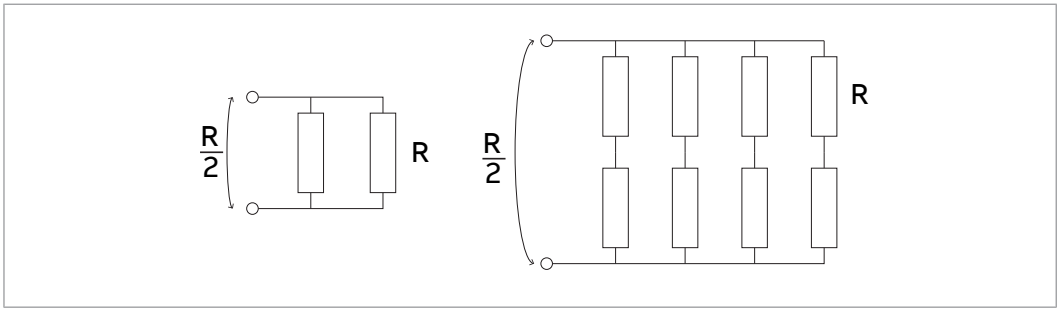
The brake chopper handles the extra energy generated by motor during a quick deceleration. The extra energy increases the drive DC link voltage. The chopper connects the brake resistor to the DC link whenever the voltage is greater than the limit defined by the control program. Energy consumption by the resistor losses lowers the voltage until the resistor can be disconnected.

Planning the braking system

Selecting the drive, brake chopper and brake resistor

For the ratings of the brake choppers and resistors, refer to the resistor braking technical data.

1. Define the basic data: maximum power generated by the motor during the braking (P_{br}), braking time (t_{br}) and braking cycle time (T).
2. Select the drive. Take its resistor braking capacity into account. The power rating of the drive and brake chopper (P_{brmax}) must be greater than or equal to P_{br}.
3. Make sure that the ABB default brake resistor assembly can dissipate the braking energy. The energy generated by the motor during one resistor heat dissipation period (400 s) must be equal to or smaller than the heat dissipation capacity (E_R) of the resistor assembly. If it is not, you cannot use the default ABB resistor assembly. These alternatives are possible:
   - If it is possible, decrease the braking power or braking time, or prolong the braking cycle time.
   - Select a custom brake resistor with high enough heat dissipation capacity. The resistance may not be smaller than the minimum value defined for the chopper.
   - Use multiple of the ABB default brake resistors. Make sure that the total resistance seen from the brake chopper terminals remains unchanged. An example connection is shown below. The connection of an ABB default brake resistor assembly is on the left (two resistors). The equivalent multiple resistor connection is on the right (8 resistors). The heat dissipation capacity is four times bigger.



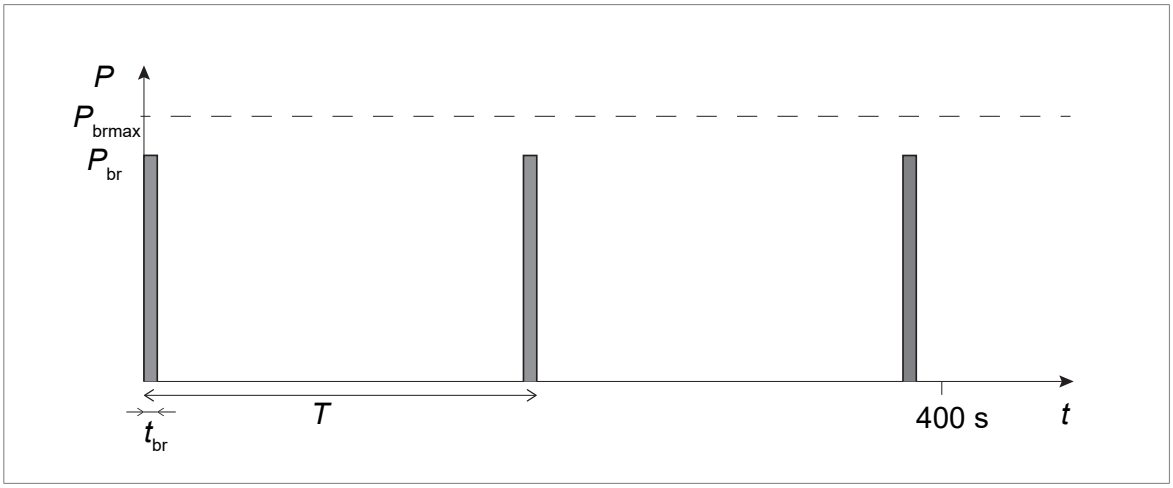
Selection example

In this example, motor generates 300 kW power during the braking. Braking time is 15 s every third minute.

1. Define the basic data:
   P_{br} = 300 kW, t_{br}= 15 s and T = 180 s.
2. Select the drive, brake chopper and default resistor combination:

P_{brmax} value for the drive size …-585A-4 is 315 kW. Since it is greater than P_{br}, this drive type is suitable for the application.

3. Make sure that the ABB default brake resistor assembly can dissipate the braking energy:
   - The ABB default resistor heat dissipation value (E_R) is 10800 kJ during a 400 s period.
   - Braking energy per each braking cycle is: 300 kW × 15 s = 4500 kJ.
   - Number of braking cycles during one resistor heat dissipation period is: 400 s / 180 s = 2.2 cycles.
   - The sum energy generated by the motor during the resistor heat dissipation period is: 2.2 × 4500 kJ = 9900 kJ. This value is lower than the ABB default resistor assembly E_R value. Thus, the ABB default brake resistor can be used.



Selecting the brake resistor cable

ABB recommends a cable which is identical with the drive input power cable (size, type, ratings). Refer also to Protecting the resistor cable against short-circuits.

Maximum brake resistor cable length

The maximum length for the resistor cable(s) is 10 m (33 ft).

Protecting the brake resistor and the resistor cable in short-circuits

If the brake resistor cable is identical with the drive input power cable (size, type, ratings), the short-circuit protections of the input power cable and the drive protect also the brake resistor and the resistor cable in short-circuit situations.

Protecting the system against thermal overload

Implement the brake resistor overload protection with a resistor thermal model of the drive. For the parameters setting, refer to Start-up (Page 7).

In addition to the thermal model, it is a good practise to monitor the brake resistor actual temperature with a temperature sensor, and stop the drive in case of an overtemperature. Connect the sensor to a digital input of the drive. Configure the input to cause a fault trip or turn off the run enable signal if the sensor gives an overtemperature indication. For the parameters settings, refer to Start-up (Page 7).

Selecting the installation location for the brake resistors

Protect the open (IP00) brake resistors against contact. Install the brake resistor in a place where it cools effectively. Arrange the cooling of the resistor so that:

- no danger of overheating is caused to the resistor or nearby materials, and
- the temperature of the space that the resistor is in does not go above the allowed maximum value.

WARNING!
The materials near the brake resistor must be non-flammable. The surface temperature of the resistor is high. Air flowing from the resistor is of hundreds of degrees Celsius. If the exhaust vents are connected to a ventilation system, make sure that the material withstands high temperatures. Protect the resistor against contact.

Selecting the temperature sensor cable

Specification: Twisted pair, shielding recommended, voltage rating ≥ 750 V, insulation test voltage > 2.5 kV.

Minimizing electromagnetic interference

Make sure that the installation is compliant with the EMC requirements. Obey these rules in order to minimize electromagnetic interference caused by the rapid voltage and current changes in the resistor cables:

- Shield the brake resistor cable. Use shielded cable or a metallic enclosure. If you use unshielded single-core cables, route them inside a cabinet that efficiently suppresses the radiated emissions.
- Install the cables away from other cable routes.
- Avoid long parallel runs with other cables. The minimum parallel cabling separation distance is 0.3 meters (1 ft).
- Cross the other cables at 90° angles.
- Keep the cable as short as possible in order to minimize the radiated emissions and stress on the brake chopper. The longer the cable the greater the radiated emissions, inductive load and voltage peaks over the IGBT semiconductors of the brake chopper.

Mechanical installation of brake resistors

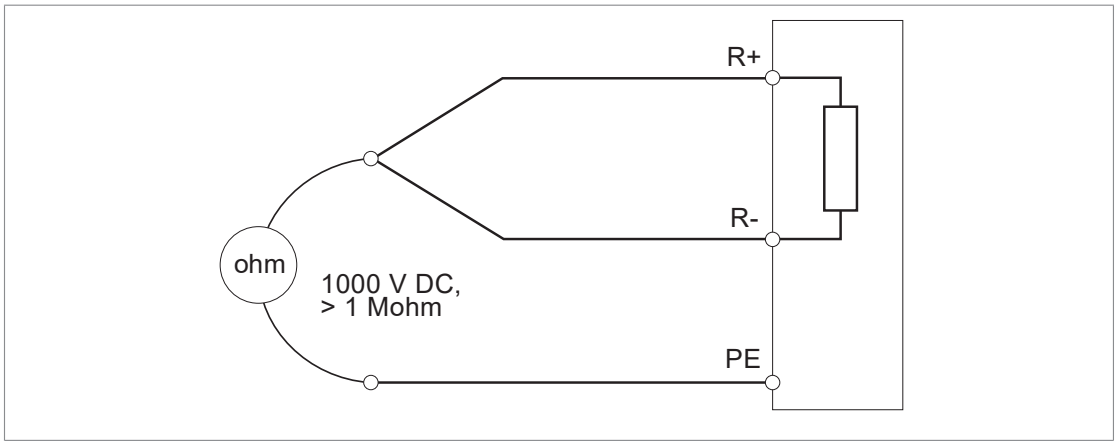
Install brake resistors outside the drive cabinet. Obey the resistor installation instructions.

Electrical installation of brake resistor cables

Measuring the insulation resistance of the brake resistor circuit

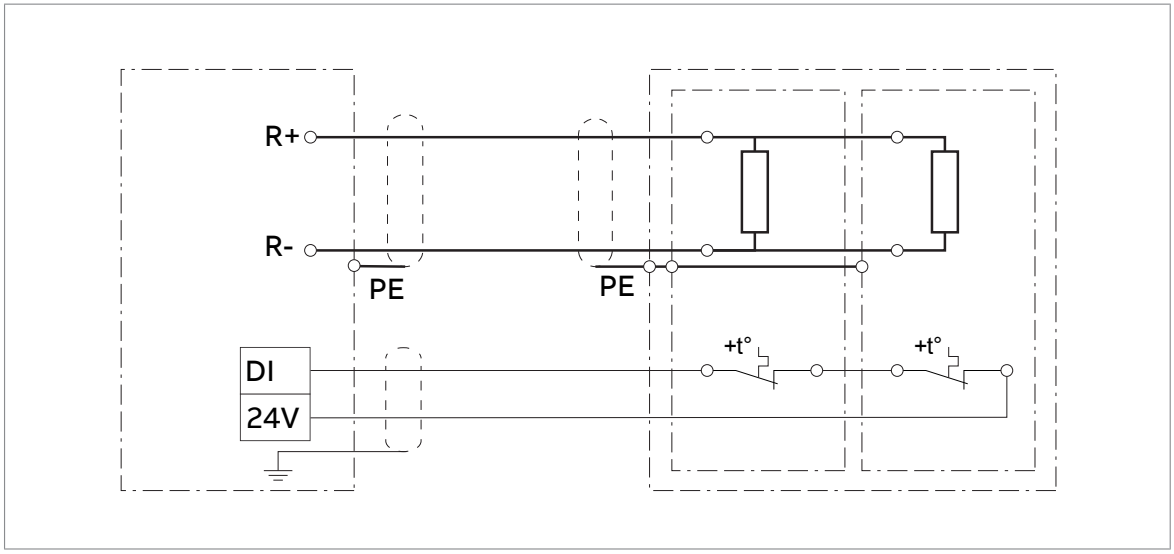
WARNING!
Obey the safety instructions of the drive. If you ignore them, injury or death, or damage to the equipment can occur. If you are not a qualified electrical professional, do not do installation, commissioning or maintenance work.

1. Stop the drive and do the steps in section *Electrical safety precautions* before you start the work.
2. Make sure that the resistor cable is connected to the resistor and disconnected from the drive output terminals.
3. At the drive end, connect the R+ and R- conductors of the resistor cable together. Measure the insulation resistance between the conductors and the PE conductor with a measuring voltage of 1000 V DC. The insulation resistance must be more than 1 Mohm.



Connection diagram

This diagram shows the connections of the brake resistor cable and the resistor temperature sensor cable. This is applicable when the brake resistor assembly consist of two parallel-connected resistors.



Connection procedure

WARNING!
Obey the safety instructions of the drive. If you ignore them, injury or death, or damage to the equipment can occur. If you are not a qualified electrical professional, do not do installation, commissioning or maintenance work.

1. Stop the drive and do the steps in section *Electrical safety precautions* before you start the work.
2. Prepare the resistor cable and put it inside the cabinet. Refer to the drive power cabling instructions. Use the resistor cable entry in the side box.
3. Twist the cable shield, attach a cable lug to it and connect it to the PE terminal. Tighten to specified torque. Refer to the technical data. Mark the PE conductor with yellow-green tape or shrink tube.
4. Attach cable lugs to phase conductors and connect them to R+ and R- terminals. Tighten to specified torque. Refer to the technical data.
5. If the resistor temperature sensor cable is in use: Connect the cable to an applicable digital input of the drive. Tighten to the specified torque. Refer to the instructions on connecting the control cables to the drive.
6. Connect the brake resistor cable, grounding, and the temperature sensor cable (if in use) at the resistor end. Tighten to specified torque. Refer to the resistor manufacturer's instructions.

Start-up

WARNING!
Make sure that there is sufficient ventilation. New brake resistors can have a protective grease coating. When the resistor warms up for the first time, the grease burns off and can produce some smoke.

WARNING!
If you disable the brake chopper by parameter, also disconnect the brake resistor cable from the drive. Otherwise, there is a risk of resistor overheating and damage.

Parameter settings

This section describes the parameter settings for an example application in which:

- Drive uses brake resistor thermal model for the resistor overload protection.
- The brake resistor has a temperature sensor. The drive monitors the sensor status via a digital input. An overtemperature indication causes a fault trip.

Set parameters in the example application as follows:

- Set parameter 30.30 to value Disable. This disables the overvoltage control of the drive DC link. the brake chopper operation is possible.
- Set parameter 43.06 to Enabled with thermal model. This enables the brake chopper operation and activates the brake resistor overload protection function with the thermal model.
- Set parameters 43.08, 43.09 and 43.10 according to the brake resistor data. These parameters define the thermal time constant, continuous power rating and resistance for the brake resistor thermal model.
- Set parameters 43.11 and 43.12 to suitable values. They define the warning and fault resistor temperature limits for the brake resistor thermal model.
- Set parameter 31.01 to point to the digital input to which the brake resistor temperature sensor is connected. This defines the source for the external event 1 function.
- Set parameter 31.02 to Fault. This defines fault as the event type for the external event 1 function.

Technical data

Ratings

ACS580-07-...	Internal brake chopper		ABB default brake resistor			
	P_{brcont}	R_{min}	No. of parallel resistors × type	R	E_R	P_{Rcont}
	kW	ohm		ohm	kJ	kW
U_n = 400 V						
0505A-4	250	2.0	2×SAFUR125F500	2.0	7200	18
0584A-4	315	1.3	2×SAFUR200F500	1.3	10800	27
0650A-4	315	1.3	2×SAFUR200F500	1.3	10800	27
0725A-4	400	0.7	3×SAFUR200F500	0.9	16200	40
820A-4	400	0.7	3×SAFUR200F500	0.9	16200	40
880A-4	400	0.7	3×SAFUR200F500	0.9	16200	40

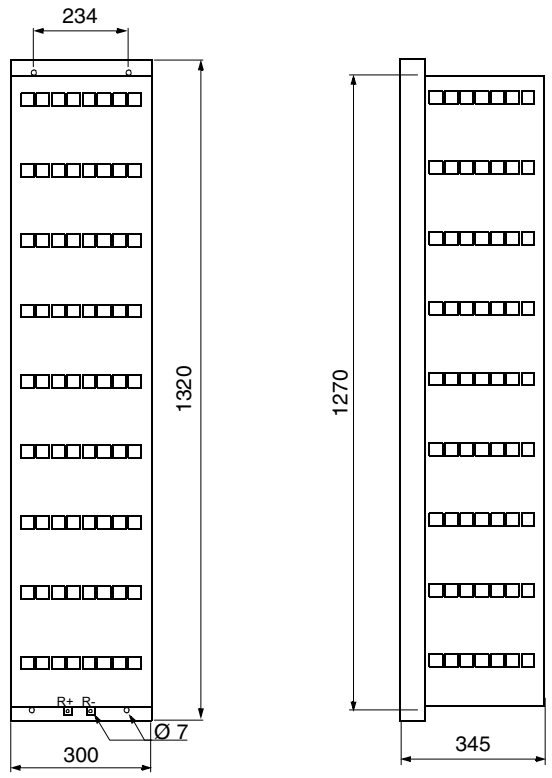
P_{brcont}	Maximum continuous braking power. The braking is considered continuous if the braking time exceeds 30 seconds.
R_{min}	Minimum permitted resistance value for the brake resistor
R	Resistance value of the ABB default brake resistor
E_R	Energy pulse that the ABB default brake resistor withstands and can dissipate every 400 seconds
P_{Rrcont}	Continuous heat dissipation capacity (power) of the resistor when placed correctly

The ratings apply at an ambient temperature of 40 °C (104 °F).

SAFUR resistor data

These features are common to all SAFUR resistors:

- Degree of protection: IP00 (open)
- Resistor cable tightening torque: 9 N·m
- Thermal time constant: 555 s
- In-built overheat temperature sensor
- Not UL listed.



Brake resistor type	*R* [ohm]	E_r [kJ]	P_{Rcont} [kW]	Weight	ABB ordering code
SAFUR125F500	4.0	3600	9	25 kg (55 lb)	68759285
SAFUR200F500	2.7	5400	13.5	30 kg (66 b)	68759340

R Resistance

E_R Energy pulse that the ABB default brake resistor withstands during a 400 s duty cycle. This energy will heat the resistor element from 40 °C to the maximum allowable temperature.

P_{Rcont} Continuous heat dissipation capacity (power) of the resistor when placed correctly

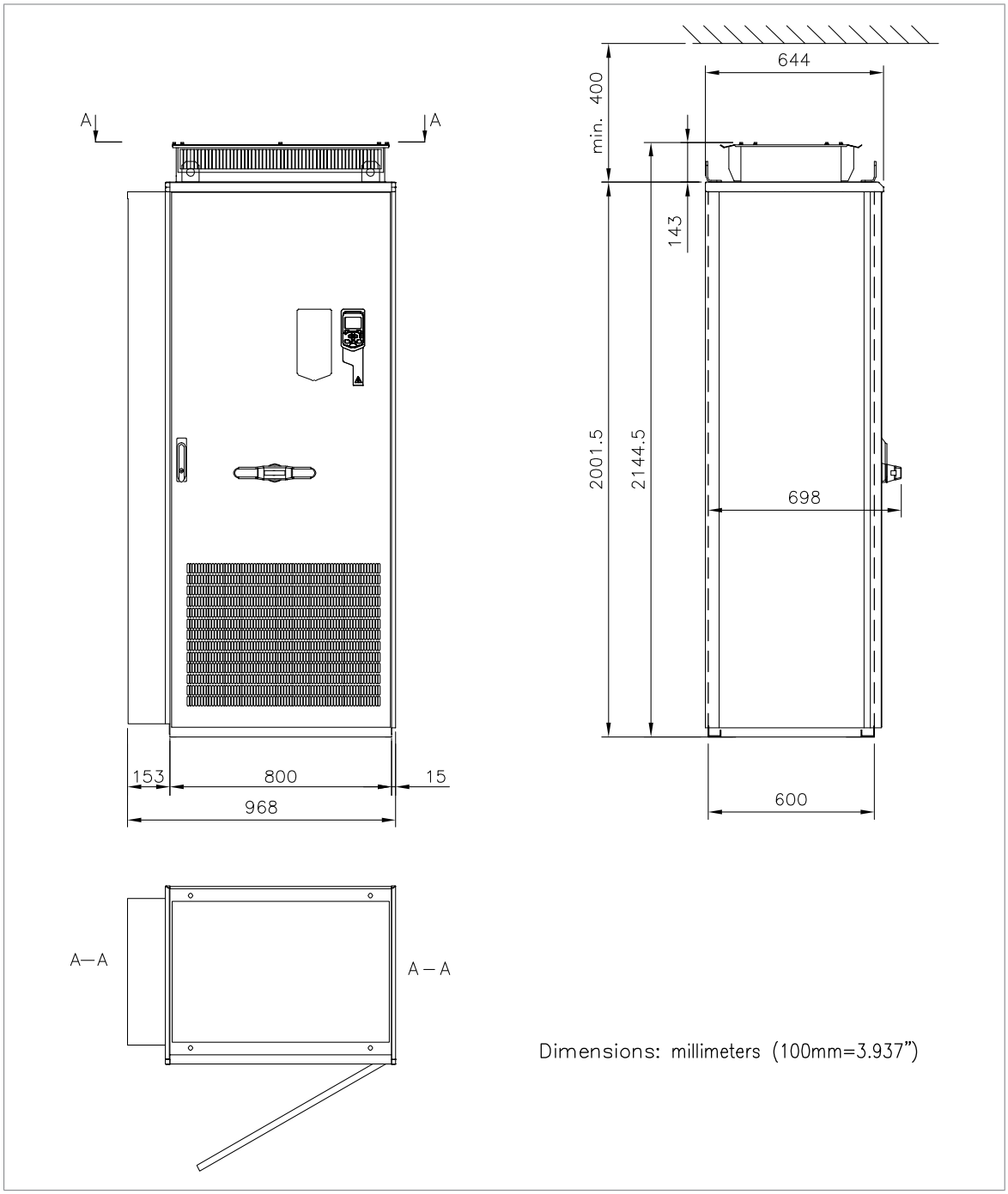
Brake resistor cable terminals and cable entry

Frame size	Brake resistor cable terminals R+, R-			PE (grounding) terminals	
	Max. cable size mm²	Bolt size	Tightening torque N·m	Bolt size mm²	Tightening torque N·m
R10	2×(3×150)	M12	50…75	M12	50…75
R11	2×(3×240)	M12	50…75	M12	50…75

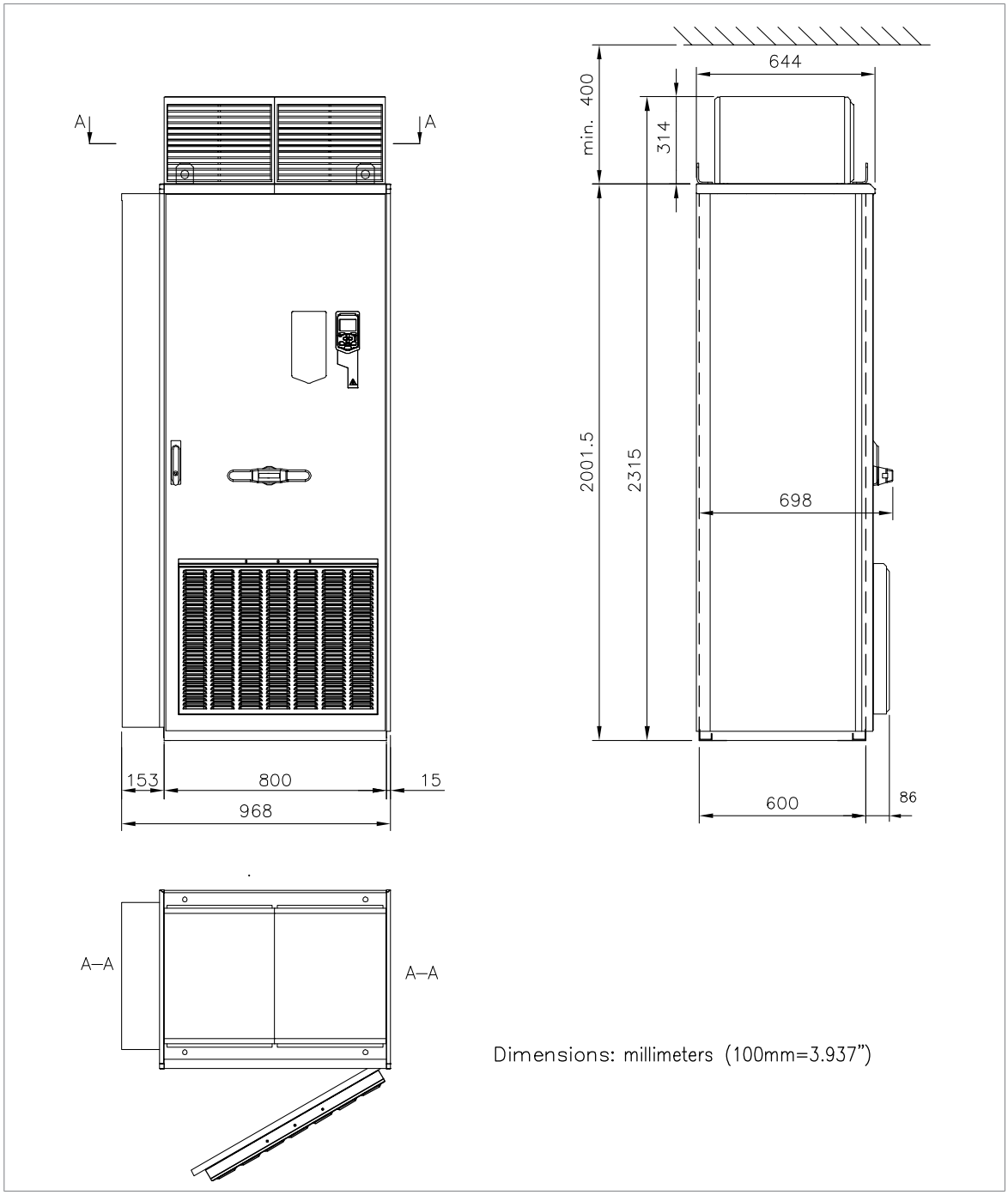
For more information, refer to Dimension drawings – Drive with the brake chopper (option +D150) (Page 10).

Dimension drawings – Drive with the brake chopper (option +D150)

IP21 enclosure

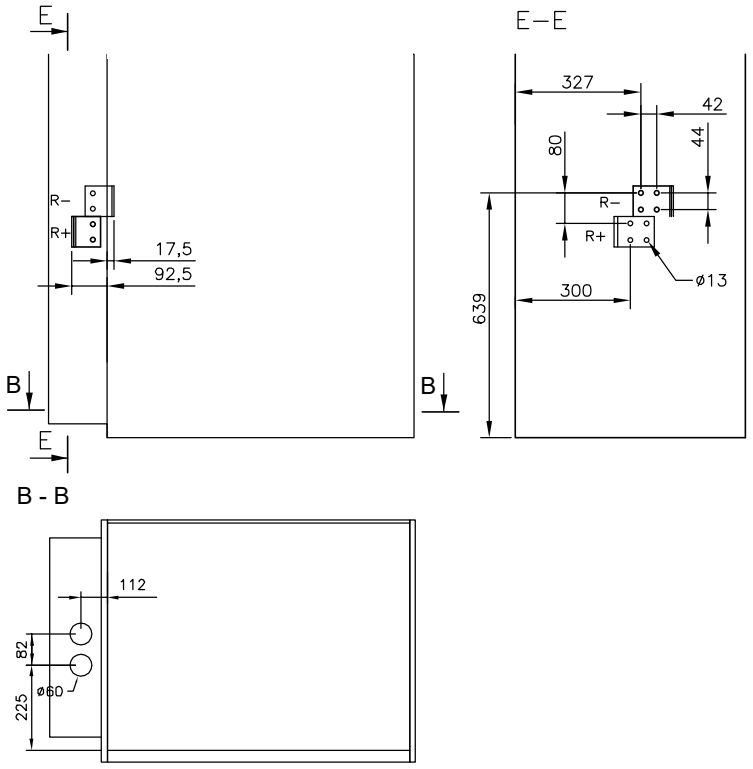


IP54 enclosure

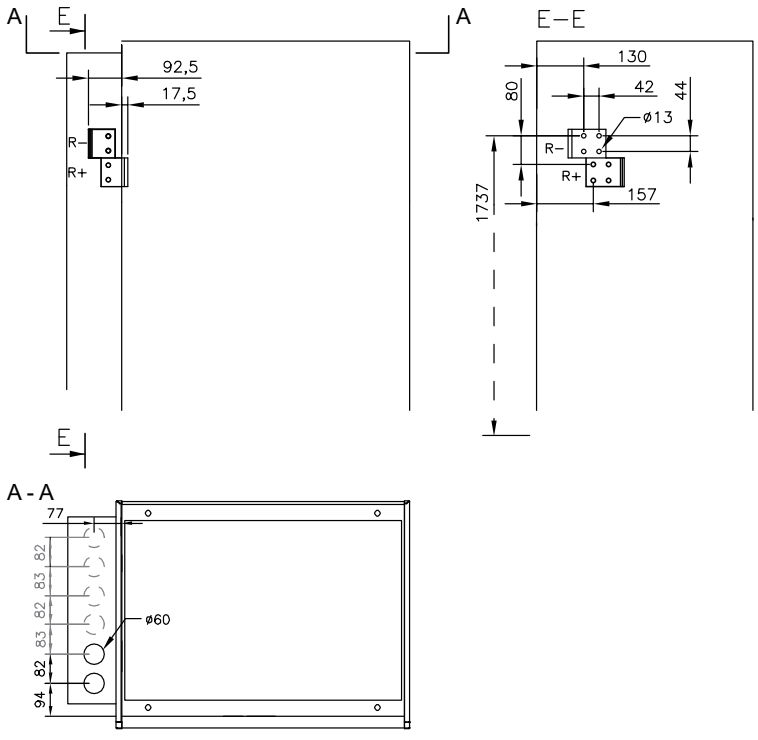


Brake resistor cable exits and terminals

Bottom cable exit (standard)



Top cable exit (option +H353)



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