Danfoss offers a complete range of brake resistors for VLT frequency converters, types 5001-5250.

Description of the brake system

When the speed reference of a frequency converter is reduced, the motor acts as a generator and brakes. When a motor acts as a generator, it supplies energy to the frequency converter which is collected in the intermediate circuit. The function of the brake resistor is to provide a load on the intermediate circuit during braking, thereby ensuring that the braking power is absorbed by the brake resistor.
If a brake resistor was not used, the intermediate circuit voltage of the frequency converter would continue to increase, until it cuts out for protection. The advantage of using a brake resistor is it enables braking of a heavy load quickly, e.g. on a conveyor belt. In addition, VLT 5000 incorporates brake monitoring to ensure that the average power dissipated to the brake resistor does not exceed a given limit.

Danfoss has chosen a solution in which the brake resistor does not form an integral part of the frequency converter.
This offers the user the following advantages:

- The resistor time cycle can be selected as required
- The heat developed during braking can be conveyed beyond the panel cabinet to allow the energy to be used
- There is no overheating of the electronic components, even if the brake resistor is overloaded

Knowledge of the system

If the right brake resistor is to be selected, it is necessary to know how often and by how much the motors are to brake.

In the following, some examples are given of calculations of the required braking for a conveyor belt and a centrifuge, respectively:

Example 1 - Conveyor belt

Fig. 1 shows the relation between the braking power and the acceleration/braking of a conveyor belt.
As can be seen, the motor power during braking is negative, since the torque on the motor shaft is negative. The braking power, i.e. the power to be dissipated to the brake resistor, corresponds almost to the negative motor power, taking the losses in the motor and the VLT frequency converter into account. The example also shows that the motor power is time-dependent.

Kinetic energy (E) in conveyor belt + motor:

$$\boxed{E = \tfrac{1}{2} \times m \times v^2 + \tfrac{1}{2} \times j \times \omega^2 \ \text{[Ws]}}$$

m = mass with linear movement [kg]
v = speed of mass with linear movement [m/s]
j = inertia of motor and gear box (kgm²]

$$\omega = \text{motor speed} = \frac{n \times 2\pi}{60} \ \text{[rad/s]}$$

This formula may also be expressed as follows:

$$\boxed{E = \tfrac{1}{2} \times m \times v^2 + 0.0055 \times j \times n^2 \ \text{[Ws]}}$$

However, not all of the energy is to be dissipated to the brake resistor. The friction of the conveyor belt and the power loss of the motor also contribute to the braking function. Consequently, the formula for energy dissipation (E_b) to the brake resistor is as follows:

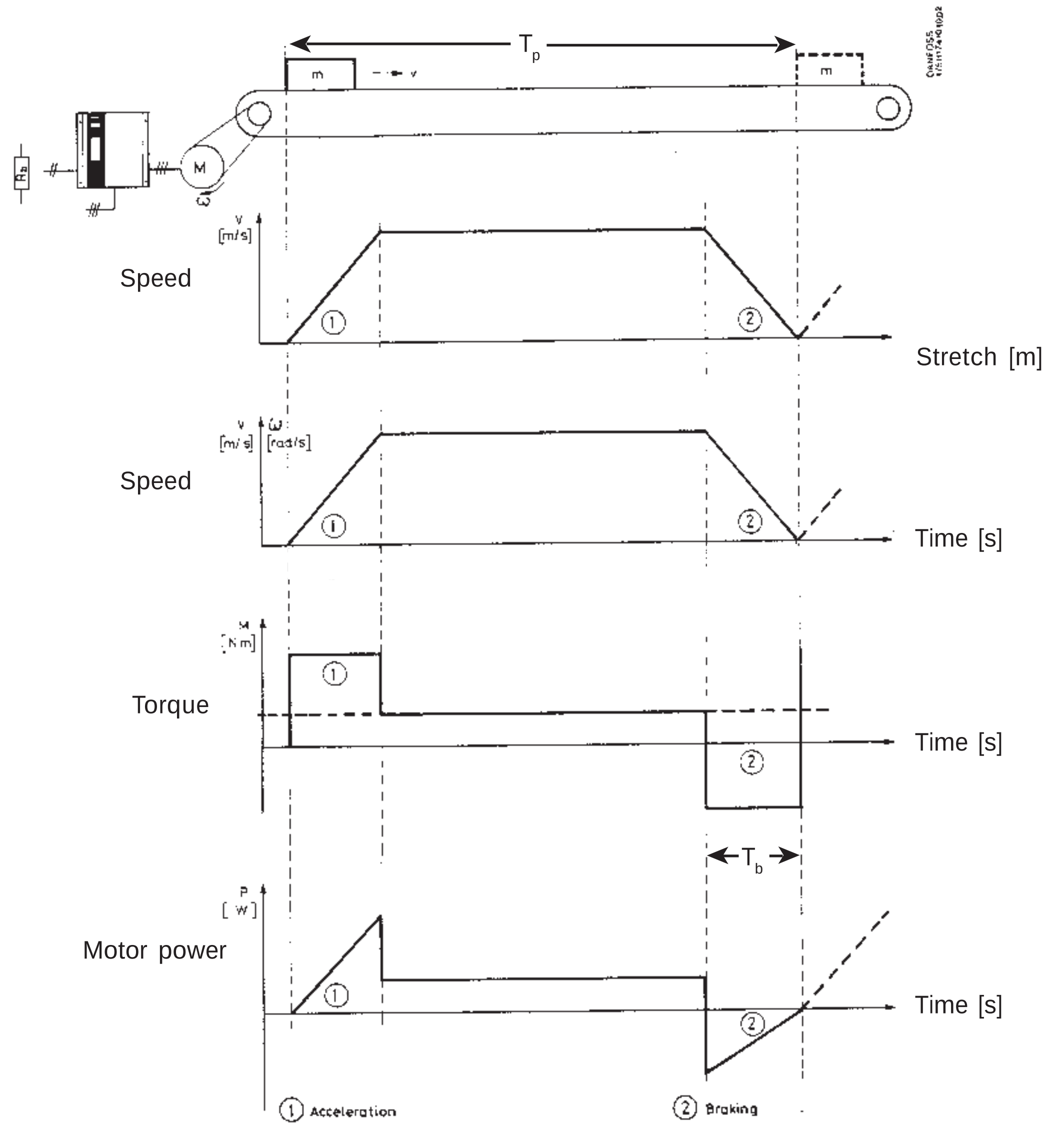
$$\boxed{E_b = (\tfrac{1}{2} \times m \times v^2 + \tfrac{1}{2} \times j \times \omega^2 - \tfrac{1}{2} \times M_f \times \omega) \times \eta_{motor} \ \text{[Ws]}}$$

M_f = Friction torque [Nm]
η_M = Motor efficiency

When $\omega = \frac{n \times 2\pi}{60}$ is inserted, the result is as follows:

$$\boxed{E_b = (\tfrac{1}{2} \times m \times v^2 + 0.0055 \times j \times n^2 - 0.052 \times n \times M_f) \times \eta_M \ \text{[Ws]}}$$

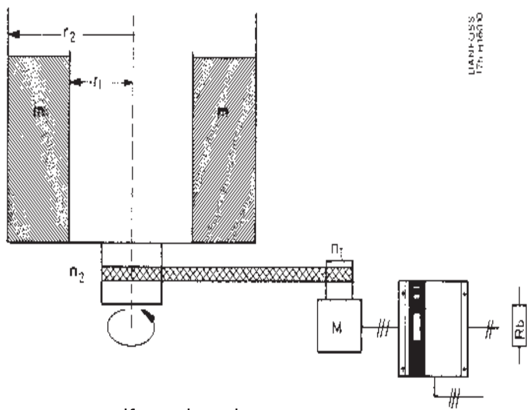
■ **Fig. 1**
The relation between braking power and acceleration/braking of a conveyor belt.



T_p = Process period time.
T_b = Braking time.

Example 2 - Centrifuge

Another typical application in which braking can be required on centrifuges. The weight of the centrifuge content is m.



j_C	=	centrifuge inertia = ½ × m × (r_1^2 + r_2^2) [kgm^2]
j_M	=	Gear motor inertia [kgm^2]
η_M	=	Gear motor efficiency
n_1	=	max. motor speed [rpm]
n_2	=	max. centrifuge speed [rpm]

$$\boxed{E_b = (0.0055 \times j_c \times n_2^2 + 0.0055 \times j_M \times n_1^2) \times \eta_M \ \ [Ws]}$$

Brake set-up

Fig. 2 shows a brake set-up using a VLT 5000 Series.

The following sections use expressions and abbreviations with respect to a brake set-up that can be seen from fig. 2.

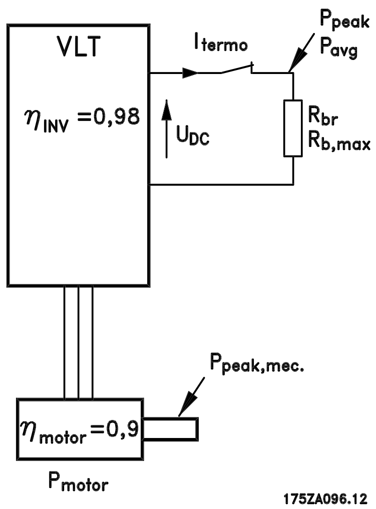


Fig. 2

Calculation of brake resistor values

The following example and formula apply to VLT 5000 Series only.

To keep the VLT frequency converter from cutting out for protection when the motor brakes, the resistor values are to be selected on the basis of the peak braking power and the intermediate circuit voltage:

$$R_{br} = \frac{Udc^2}{P_{peak}} \qquad [\Omega]$$

As can be seen, the brake resistor depends on the intermediate circuit voltage (Udc).

With a VLT 5000 frequency converter that has a mains voltage of 3 x 380-500 Volts, the brake is activated at 822* Volts (Udc); if the mains voltage is 3 x 200-240 Volts, the brake is activated at 397* Volts (Udc).

Another option is to use the brake resistor recommended by Danfoss (R_{rec}). This guarantees that the frequency converter is able to brake at the highest braking torque (M_{br}), i.e. 160%*. See the tables on pages 12 and 13.

1) $$R_{rec} = \frac{Udc^2 \times 100}{P_{motor} \times M_{BR(\%)} \times \eta_{motor} \times \eta_{vlt}} \qquad [\Omega]$$

NB!:
Remember to check whether your brake resistor is able to handle a voltage of 850 Volts or 430 Volts if you do not use Danfoss brake resistors.

η_{motor} is typically 0.90, while η_{VLT} is typically 0.98. For 500 Volt and 200 Volt frequency converters, R_{rec} at 160%* braking torque can be expressed as follows:

500 Volt*: $$R_{rec} = \frac{478801}{P_{motor}} \qquad [\Omega]$$

200 Volt*: $$R_{rec} = \frac{111684}{P_{motor}} \qquad [\Omega]$$

NB!:
Choose a brake resistor which is max. 10% below the value recommended by Danfoss.

If a bigger brake resistor is selected, 160%* braking torque cannot be obtained, and there is a risk that VLT 5000 Series will cut out for protection.

If braking is only e.g. at 80% torque, it is possible to install a bigger brake resistor, the size of which can be calculated using the formula R_{rec}, no. 1.

* U_{dc} for VLT 5001-5052/380-500 V = 822 V	U_{dc} for VLT 5032-5052/200-240 V = 390 V
U_{dc} for VLT 5001-5027/200-240 V = 397 V	U_{dc} for VLT 5060-5250/380-500 V = 795 V
Max. braking torque 160%	Max. braking torque 150%

■ Calculation of braking power

When calculating the braking power, it is to be ensured that the brake resistor is able to handle the average power as well as the peak power.
The average power is determined by the process period time, i.e. the length of the braking time in relation to the process period time.
The peak power is determined by the braking torque, which means that as braking progresses, the brake resistor must be able to dissipate the energy input.
Fig. 3 shows the relation between the average power and the peak power.

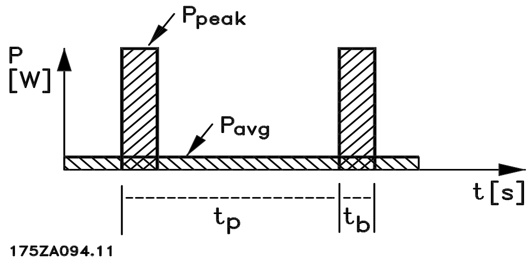


Fig. 3

■ Calculation of the brake resistor peak power

$P_{peak, mec}$ is the peak power by which the motor brakes on the motor shaft. It is calculated as follows:

$$P_{peak, mec} = P_{motor} \times M_{BR(\%)} \quad [W]$$

P_{peak} is the name used for the braking power dissipated to the brake resistor when the motor brakes.
P_{peak} is lower than $P_{peak,mec}$ since the power is reduced by the efficiencies of the motor and the VLT frequency converter.
The peak power is calculated as follows:

$$P_{peak} = P_{motor} \times M_{BR(\%)} \times \eta_{motor} \times \eta_{vlt} \quad [W]$$

If the brake resistor recommended by Danfoss is selected (R_{rec}) on the basis of the tables on pages 11 and 12, the brake resistor will be certain to provide a braking torque of 160%* on the motor shaft.

■ Calculation of the brake resistor average power

The average power is determined by the process period time, i.e. the length of the braking time in relation to the process period time.

If the amount of kinetic energy (E_b) transferred to the resistor in each braking sequence (see examples 1 and 2) is known, the average power of the resistor can be calculated as follows:

$$P_{avg} = \frac{E_b}{T_p} \quad [W]$$

T_p = period time in seconds (see drawing on page 3).

If the amount of kinetic energy transferred to the resistor in each braking sequence is not known, the average power can be calculated on the basis of the process period time and the braking time.

The duty-cycle for the braking sequence is calculated as follows:

$$\text{Duty-cycle} = \frac{T_b \times 100}{T_p} \quad [\%]$$

T_p = process period time in seconds.
T_b = braking time in seconds.

Danfoss offers brake resistors with a duty-cycle of max. 10% and 40%, respectively (VLT 5060-5250 200V and VLT 5032-5052 200V are only available with a duty cycle of max. 10%). If a 10% duty-cycle is applied, the brake resistors are able to absorb Ppeak for 10% of the period time. The remaining 90% of the period time will be used on deflecting excess heat.
The average power with 10% duty-cycle can be calculated as follows:

$$P_{avg} = \frac{P_{peak}}{10} \quad [W]$$

The average power with 40% duty-cycle can be calculated as follows:

$$P_{avg} = \frac{P_{peak}}{2,5} \quad [W]$$

The calculations made for VLT 5001-5052 apply to intermittent braking using a period time of 120 seconds.

NB!:
Longer period times than 120 seconds may result in overheating of the resistor.

* U_{dc} for VLT 5001-5052/380-500 V = 822 V U_{dc} for VLT 5001-5027/200-240 V = 397 V Max. braking torque: 160%	U_{dc} for VLT 5032-5052/200-240 V = 390 V U_{dc} for VLT 5060-5250/380-500 V = 795 V Max. braking torque: 150%

Braking of inertia

In the case of braking of high inertia values on the motor shaft, the brake resistor values can be based on the inertia, $\Delta\,\omega$, Δ t. See fig. 4.

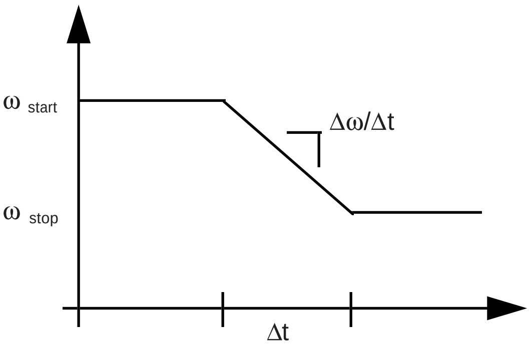


Fig. 4

Δt is determined by the ramp-down time in parameter 208.

NB!:
The ramp-down time goes from the rated motor frequency in parameter 104 to 0 Hz.

P_{peak} can be calculated as:

$$P_{peak} = \eta_{motor} \times \eta_{VLT} \times \omega_{start} \times j \times \frac{\Delta\omega}{\Delta t}$$

$$P_{peak} = \eta_{motor} \times \eta_{VLT} \times n_{start} \times j \times \left(\frac{2 \times \pi}{60}\right)^2 \times \frac{\Delta n}{\Delta t}$$

j is the inertia of the motor shaft.
Calculate the value on the brake resistor as described under the preceding paragraphs.

Continuous braking

For continuous braking, select a brake resistor in which the constant braking power does not exceed the average power P_{avg} of the brake resistor.

NB!:
Please contact your Danfoss distributor for further information.

Optimum braking

Dynamic braking is useful from max. speed down to about 8% of the rated speed. Below 8% speed, DC braking is to be applied as required.
The most efficient way of doing this is to change over from dynamic to DC braking. See fig. 5.

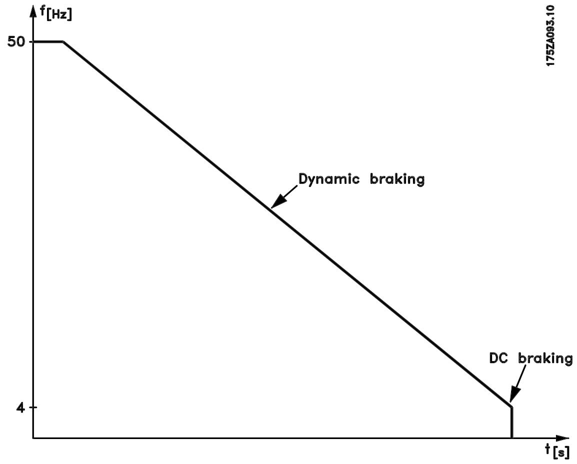


Fig. 5

Brake cable

Max. length [m]: 20 m

The connection cable to the brake resistor is to be screened/armoured. Connect the screen/armouring to the conductive back plate at the VLT frequency converter and to the brake resistor metal cabinet by means of cable clamps.

NB!:
If Danfoss brake resistors are not used, make sure that the brake resistors used are induction-free.

■ Protective functions during installation

When installing a brake resistor, every measure should be taken to avoid the risk of overloading, since a fire hazard may arise owing to the heat generated in the heat resistor.

NB!:
The brake resistor is to be fitted on a non-flammable material.

For protection of the installation, a thermal relay should be fitted that cuts off the frequency converter if the brake current becomes too high.

Calculate the brake current setting of the thermal relay as follows:

$$I_{thermo} = \sqrt{\frac{P_{avg}}{R_{br}}}$$

R_{br} is the current brake resistor value calculated in the section on "Calculation of brake resistor values". Fig. 6 shows an installation with a thermal relay.

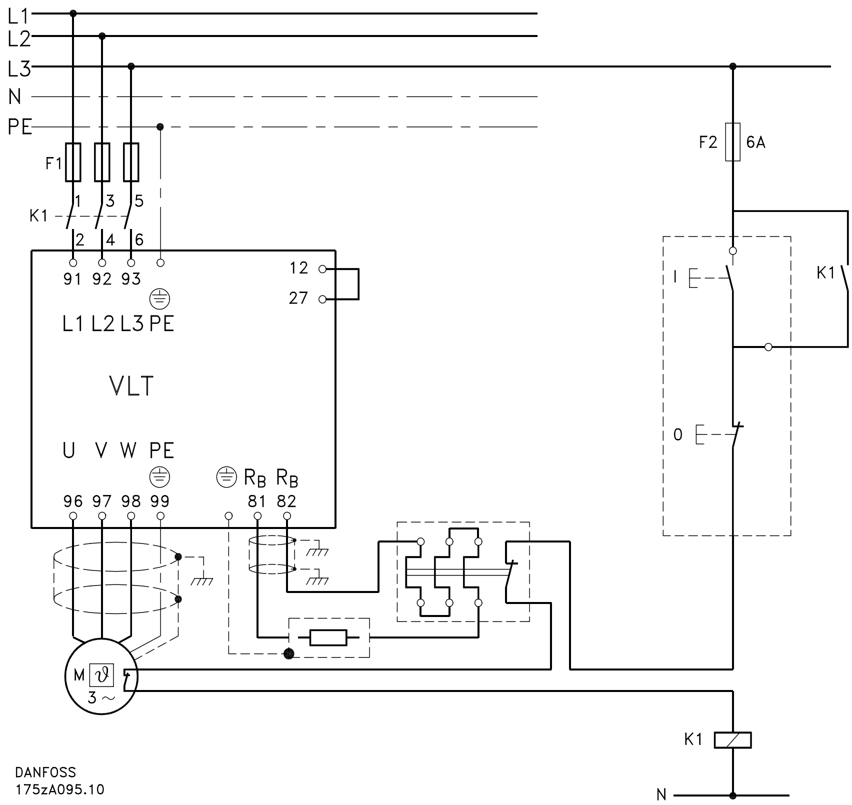


Fig. 6

■ Description of VLT 5000 brake

Danfoss VLT 5000 Series enables activation of an integral brake monitor to guarantee that the braking power does not exceed a given limit.
The power is calculated on the basis of the resistor ohm value (parameter 401), the intermediate circuit voltage and the resistor running time.
For further information, see page 10.

NB!:
The brake power monitoring system is not a protective device. For protection, use a thermal switch as shown in fig. 6.

Via the digital/relay outputs, it is possible to get a status message concerning the brake, e.g. indicating brake faults. Furthermore, VLT 5000 Series features an integral function to check whether the brake resistor has been connected/is intact at the time of power-up.
Additionally, the brake is protected against short-circuiting by the brake resistor.
The brake circuit is not earthing proof.

Parameter description for VLT 5000 Series brake

The following is a decription of parameters for the VLT 5000 Series which are important for the dynamic brake and the DC brake.

009-012
Display lines (DISPLAY LINE 2)

Value:

Brake effect/2 min. [KW] (BRAKE ENERGY/2 min)	[23]
Brake effect/sec. [kW] (BRAKE ENERGY/s)	[24]

Function:

This parameter allows a choice of the data value to be displayed in line 2 of the display.

Description of choice:

Brake effect/2 min. [KW] states the brake effect transferred to an external brake resistor. The mean power is calculated continuously for the latest 120 seconds.
It is assumed that a resistor value has been entered in parameter 401.
Brake effect/sec. [kW] states the present brake effect transferred to an external brake resistor. Stated as an instantaneous value.
It is assumed that a resistor value has been entered in parameter 401.

---

125 DC braking current
(DC BRAKE CURRENT)

Value:

0 (OFF) - $\frac{I_{VLT,MAX}}{I_{M,N}}$ x 100 % ✭ 50 %

The maximum value depends on the rated motor current.

If the DC braking current is active, the VLT frequency converter has a switching frequency of 4 kHz.

Function:

This parameter is used for setting the DC brake current that is activated upon a stop when the DC brake frequency set in parameter 127 has been reached, or if the DC brake inverse is active via digital terminal 27 or via a serial communication port. The DC braking current will be active for the duration of the DC braking time set in parameter 126.

Description of choice:

To be set as a percentage value of the rated motor current $I_{M,N}$ set in parameter 105.
100% DC braking current corresponds to $I_{M,N}$.

Warning: 100 % supply for too long may damage the motor.

---

126 DC braking time
(DC BRAKING TIME)

Value:

0.0 (OFF) - 60.0 sec. ✭ 10.0 sec.

Function:

This parameter is for setting the DC braking time for which the DC braking current (parameter 125) is to be active.

Description of choice:

Set the desired time.

---

127 DC brake cut-in frequency
(DC BRAKE CUT-IN)

Value:

0.0 - parameter 202 ✭ 0.0 Hz (OFF)

Function:

This parameter is for setting the DC brake cut-in frequency at which the DC braking current (parameter 125) is to be active, in connection with a stop command.

Description of choice:

Set the desired frequency.

✭ = factory setting. ( ) = display text [ ] = value for use in communication via serial communication port

222 Torque limit for generating operation (TORQ LIMIT GENER)

Value:

0.0 % - xxx.x % of $T_{M,N}$ ★ 160 %

The max. torque depends on the unit and the motor size selected.

Function:

This function is relevant for all application configurations; speed, process and torque regulation.
This is where to set the torque limit for generating operation. The torque limiter is active in the frequency range up to the rated motor frequency (parameter 104). In the oversynchronous range, where the frequency is higher than the rated motor frequency, this function acts as a current limiter.
See fig. for parameter 221.

Description of choice:

If *Resistor brake* [1] has been selected in parameter 400, the torque limit is changed to 1.6 x the rated motor torque.

400 Brake function/overvoltage control (BRAKE FUNCTION)

Value:

★ Off (OFF)	[0]
Resistor brake (RESISTOR)	[1]
Overvoltage control (OVERVOLTAGE CONTROL)	[2]
Overvoltage control and stop (OVERVOLT CTRL. & STOP)	[3]

Function:

The factory setting is *Off* [0] for VLT 5001-5052 380-500 V and 5001-5027 200-240 V. For VLT 5060-5250 380-500 V and 5032-5052 200-240 V the factory setting is *Overvoltage control* [2].
Resistor brake [1] is used for programming the VLT frequency converter for connection of a brake resistor. The connection of a brake resistor allows a higher intermediate circuit voltage during braking (generating operation).

The *Resistor brake* [1] function is only active in units with an integral dynamic brake (SB and EB units).

Overvoltage control (excl. brake resistor) can be selected as an alternative. This function is active for all units (ST, SB and EB).

The function ensures that a trip can be avoided if the intermediate circuit voltage increases. This is done by increasing the output frequency so as to use the energy from the intermediate circuit. This is a very useful function, e.g. if the ramp-down time is too short, since tripping of the VLT frequency converter is avoided. In this situation, the ramp-down time is extended.

NB!
Please note that the ramp-down time is extended in the case of overvoltage control, which in some applications may not be appropriate.

Description of choice:

Select *Resistor brake* [1] if a brake resistor is part of the system.
Select *Overvoltage control* [2] if the overvoltage control function is required in all cases - also if stop is pressed. The VLT frequency converter will not stop in the case of a stop command when the overvoltage control is active.
Select *Overvoltage control and stop* [3] if the overvoltage control function is not required during ramp-down after stop has been pressed.

Warning: If *Overvoltage control* [2] is used at the same time as the supply voltage to the VLT frequency converter is close to or above the maximum limit, there is a risk that the motor frequency will increase and that, consequently, the VLT frequency converter will not stop the motor when stop is pressed. If the supply voltage is higher than 264 V for 200-240 V units or higher than 550 V for 380-500 V units, *Overvoltage control and stop* [3] should be selected so that the motor can be stopped.

401 Brake resistor, ohm (BRAKE RES. (OHM))

Value:

Depends on the unit ★ Depends on the unit

Function:

This parameter gives the ohmic value of the brake resistor. This value is used for monitoring the power to the brake resistor provided this function has been selected in parameter 403.

Description of choice:

Set the present resistor value.

402 Brake power limit, kW (BR.POWER. LIM.KW)

Value:

Depends on the unit ★ Depends on the unit

Function:

This parameter gives the monitoring limit of the power transmitted to the brake resistor.

Description of choice:

The monitoring limit is determined as a product of the maximum duty cycle (120 sec.) that will occur and the maximum power of the brake resistor at that duty cycle.

★ = factory setting. ( ) = display text [ ] = value for use in communication via serial communication port

403 Power monitoring (POWER MONITORING)

Value:

	Off (OFF)	[0]
★	Warning (WARNING)	[1]
	Trip (TRIP)	[2]

Function:

This parameter allows monitoring of the power transmitted to the brake resistor. The power is calculated on the basis of the resistor ohm value (parameter 401), the intermediate circuit voltage and the resistor running time. If the power transmitted over 120 sec. exceeds 100% of the monitoring limit (parameter 402) and *Warning* [1] has been selected, a warning will come up on the display. The warning will disappear if the power goes below 80%. If the calculated power exceeds 100% of the monitoring limit and *Trip* [2] has been selected in parameter 403 *Power monitoring*, the VLT frequency converter will cut out while giving an alarm. If power monitoring has been selected as *Off* [0] or *Warning* [1], the brake function will remain active, even if the monitoring limit has been exceeded.This may lead to thermal overload of the resistor. It is also possible to have a warning via the relay/digital outputs.
The typical measuring accuracy of the power monitoring depends on the accuracy of the resistor ohmic value (better than ± 20%).

NB!
The power dissipation during quick discharge does not form part of the power monitoring function.

Description of choice:

Select whether this function is to be active (*Warning/Alarm*) or inactive (*Off*).

404 Brake check (BRAKE TEST)

Value:

★	Off (OFF)	[0]
	Warning (WARNING)	[1]
	Trip (TRIP)	[2]

Function:

In this parameter a testing and monitoring function can be integrated which will give a warning or an alarm. On power-up it will be tested whether the brake resistor is disconnected. The test of whether the brake resistor is disconnected is carried out during braking, while the test of whether the IGBT is disconnected is carried out when there is no braking. A warning or trip disconnects the brake function.
The testing sequence is as follows:

1. If the intermediate circuit voltage is higher than the brake starting voltage, discontinue the brake check.
2. If the intermediate circuit voltage is unstable, discontinue the brake check.
3. Carry out a brake test.
4. If the intermediate circuit voltage is lower than the starting voltage, discontinue the brake check.
5. If the intermediate circuit voltage is unstable, discontinue the brake check.
6. If the braking power is higher than 100%, discontinue the brake check.
7. If the intermediate circuit voltage is higher than the intermediate circuit voltage -2% before the brake test, discontinue the brake check and give off a warning or alarm.
8. Brake check OK.

Description of choice:

If *Off* [0] is selected, this function will still monitor whether the brake resistor and the brake IGBT short-circuit during operation, in which case it will give off a warning.
If *Warning* [1] is selected, the brake resistor and brake IGBT will be monitored with respect to short-circuiting. In addition, on power-up it will be checked whether the brake resistor has been disconnected.

NB!:
A warning in connection with *Off* [0] or *Warning* [1] can only be removed by disconnecting the mains supply and turning it back on, provided the fault has been corrected. Please note that in connection with *Off* [0] or *Warning* [1] the VLT frequency converter will continue even if a fault has been found.

In the case of *Trip* [2], the VLT frequency converter will cut out while giving an alarm (trip locked) if the brake resistor has short-circuited or been disconnected or if the brake IGBT has short-circuited.

★ = factory setting. ( ) = display text [ ] = value for use in communication via serial communication port

Outputs	Terminal No.	42	45	01 (relay)	04 (relay)
	parameter	319	321	323	326
Value:					
Brake, no warning (BRAKE NO WARNING)		[28]	[28]	[28]	[28]
Brake ready, no fault (BRAKE) (RDY(NO FAULT))		[29]	[29]	[29]	[29]
Brake fault (BRAKE FAULT (IGBT))		[30]	[30]	[30]	[30]

Function:

Digital outputs 42 and 45 can be set to show status or warnings on the brake using a pull-down resistor (min. 600 Ω). Used as a digital output, 24 V DC is generated.
Relay outputs 01 and 04 can also be used for indicating status or warnings. The relay is activated when the conditions for the data value have been fulfilled.
See fig. 7 and fig. 8 concerning relay connections.

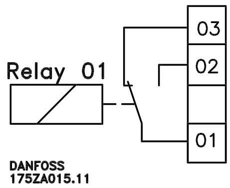


Fig. 7
Relay connection to relay 01.

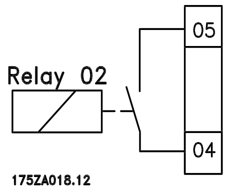


Fig. 8
Relay connection to relay 04.

Description of choice:

Brake, no warning - the brake is now active and there is no warning.

Brake ready, no fault - no faults have been found in the brake check in parameter 404.

Brake fault - there is a fault on the brake. This can be because the monitoring limit is higher than 100% or that the brake transistor has short-circuited, or that a fault has been found in the brake check (parameter 404).

✭ = factory setting. ( ) = display text [ ] = value for use in communication via serial communication port

Brake resistor for VLT 5001-5500 (200-500 V) 10% duty-cycle

Table 1

VLT Type	Pmotor [kW]	Rmin [W]	Rrec [W]	Ppeak [kW]	Ppeak mec [kW]	Pb, max [kW]	Therm.relay [Amp]	Code number 175U0xxx
F001 (200V)	0,75	130	145	1,0	1,2	0,065	0,7	820*
F002 (200V)	1,1	81	90	1,7	1,9	0,095	1	821*
F003 (200V)	1,5	58	65	2,3	2,7	0,25	2	822*
F004 (200V)	2,2	45	50	3,0	3,5	0,285	2,4	823*
F005 (200V)	3,0	31	35	4,4	4,9	0,43	2,5	824*
F006 (200V)	4,0	22	25	6,1	6,9	0,8	5,7	825*
F008 (200V)	5,5	18	20	7,6	8,6	1	7,1	826*
F011 (200V)	7,5	13	15	10,1	11,5	1,8	11	827*
F016 (200V)	11	9,0	10	15,2	17,2	2,8	17	828**
F022 (200V)	15	6,3	7,0	21,2	24,0	4	24	829**
F027 (200V)	18,5	5,2	6	26,1	29,6	4,8	28	830**
F032 (200V)	22	4,2	4,7	31,7	35,2	6	36	954**
F045 (200V)	30	3,0	3,3	43,2	48,0	8	49	955**
F052 (200V)	37	2,4	2,7	53,3	59,2	10	61	956**
F001 (500V)	0,75	557	620	1,0	1,2	0,065	0,3	840*
F002 (500V)	1,1	382	425	1,5	1,7	0,095	0,5	841*
F003 (500V)	1,5	279	310	2,1	2,4	0,25	0,9	842*
F004 (500V)	2,2	189	210	3,1	3,5	0,285	1,2	843*
F005 (500V)	3,0	135	150	4,4	4,9	0,43	1,7	844*
F006 (500V)	4,0	99	110	6,0	6,8	0,6	2,3	845*
F008 (500V)	5,5	72	80	8,2	9,3	0,85	3,3	846*
F011 (500V)	7,5	58,5	65	11,7	13,3	1	3,9	847*
F016 (500V)	11	36	40	16,4	18,6	1,8	6,7	848**
F022 (500V)	15	27	30	21,9	24,8	2,8	9,7	849**
F027 (500V)	18,5	22	25	26,2	29,8	3,5	12	850**
F032 (500V)	22	18	20	32,8	37,2	4	14	851**
F042 (500V)	30	13	15	43,7	49,6	4,8	18	852**
F052 (500V)	37	10,8	12	54,7	61,9	5,5	21	853**
F060 (500V)	45	7,0	7,8	60,8	67,5	12	39	957**
F075 (500V)	55	5,1	5,7	74,3	82,5	14	50	958**
F100 (500V)	75	4,2	4,7	101,3	112,5	18	62	959**
F125 (500V)	90	3,4	3,8	121,5	135,0	22	76,1	960**
F150 (500V)	110,0	2,9	3,2	148,5	165,0	27	92	961**
F200 (500V)	132,0	2,3	2,6	178,2	198,0	32	111	962**
F250 (200V)	160,0	1,9	2,1	216,0	240,0	39	136	963**

Pmotor:	Rated motor size for VLT type.
Rmin:	Minimum permissible brake resistor.
Rrec:	Recommended brake resistor (Danfoss).
Ppeak:	Braking power dissipated to the brake resistor at 160%*** braking torque on the motor shaft.
Ppeak,mec:	Braking power on the motor shaft.
Pb, max:	Brake resistor rated power as stated by supplier.
Therm. relay:	Brake current setting of thermal relay.
Order no.:	Order numbers for Danfoss brake resistors.

*) Max. resistor surface temp.: 200-250°C
Max. housing temp.: 120-135°C
Max. term. box temp.: 50°C

**) Max. resistor surface temp.: 250-300°C
Max. housing temp.: 150-235°C

***) VLT 5001-5027, 200V and
VLT 5001-5052, 500V:
Max. braking torque = 160%

VLT 5032-5052, 200V and
VLT 5060-5250, 500V:
Max. braking torque = 150%

Brake resistor for VLT 5001-5500 (200-500 V) 40% duty-cycle

Table 2

VLT Type	Pmotor [kW]	Rmin [Ω]	Rrec [Ω]	Ppeak [kW]	Ppeak mec [kW]	Pb, max [kW]	Therm. relay [Amp]	Code number 175U0xxx
5001 (200V)	0,75	130	145	1,0	1,2	0,3	1,3	920*
5002 (200V)	1,10	81	90	1,7	1,9	0,4	2,2	921*
5003 (200V)	1,50	58	65	2,3	2,7	0,8	3,5	922*
5004 (200V)	2,20	45	50	3,0	3,5	1,0	4,5	923*
5005 (200V)	3,00	31	35	4,4	4,9	1,4	6,2	924*
5006 (200V)	4,00	22	25	6,1	6,9	3,0	11,0	925**
5008 (200V)	5,50	18	20	7,6	8,6	3,5	13,0	926**
5011 (200V)	7,50	13	15	10,1	11,5	5,0	18,0	927**
5016 (200V)	11,00	9	10	15,2	17,2	9,0	30,0	928**
5022 (200V)	15,00	6,5	7	21,2	24,0	10,0	38,0	929**
5027 (200V)	18,50	5,2	6	26,1	29,6	12,7	46,0	930**
5001 (500V)	0,8	557,0	620,0	1,0	1,2	0,3	0,6	940*
5002 (500V)	1,1	382,0	425,0	1,5	1,7	0,4	1,0	941*
5003 (500V)	1,5	279,0	310,0	2,1	2,4	0,8	1,6	942*
5004 (500V)	2,2	189	210	3,1	3,5	1,4	2,5	943*
5005 (500V)	3,0	135	150	4,4	4,9	2,0	3,7	944*
5006 (500V)	4,0	99	110	6,0	6,8	2,4	4,7	945*
5008 (500V)	5,5	72	80	8,2	9,3	3,0	6,1	946**
5011 (500V)	7,5	59	65	11,7	13,3	4,5	8,3	947**
5016 (500V)	11,0	36	40	16,4	18,6	5,0	11,0	948**
5022 (500V)	15,0	27	30	21,9	24,8	9,3	18,0	949**
5027 (500V)	18,5	22	25	26,2	29,8	12,7	23,0	950**
5032 (500V)	22,0	18	20	32,8	37,2	13,0	25,0	951**
5042 (500V)	30,0	14	15	43,7	49,6	15,6	32,0	952**
5052 (500V)	37,0	10	12	54,7	61,9	19,0	40,0	953**

Pmotor:	Rated motor size for VLT type.
Rmin:	Minimum permissible brake resistor.
Rrec:	Recommended brake resistor (Danfoss).
Ppeak:	Max. braking power at 160% braking torque.
Ppeak, mec:	Braking power on the motor shaft.
Pb, max:	Brake resistor rated power as stated by supplier.
Therm. relay:	Brake current setting of thermal relay.
Order no.:	Order numbers for Danfoss brake resistors.

*)	Max. resistor surface temp.:	200-250°C
	Max. housing temp.:	120-135°C
	Max. term. box temp.:	50°C
**)	Max. resistor surface temp.:	250-300°C
	Max. housing temp.:	150-235°C

■ Sizing and weights

Table 3

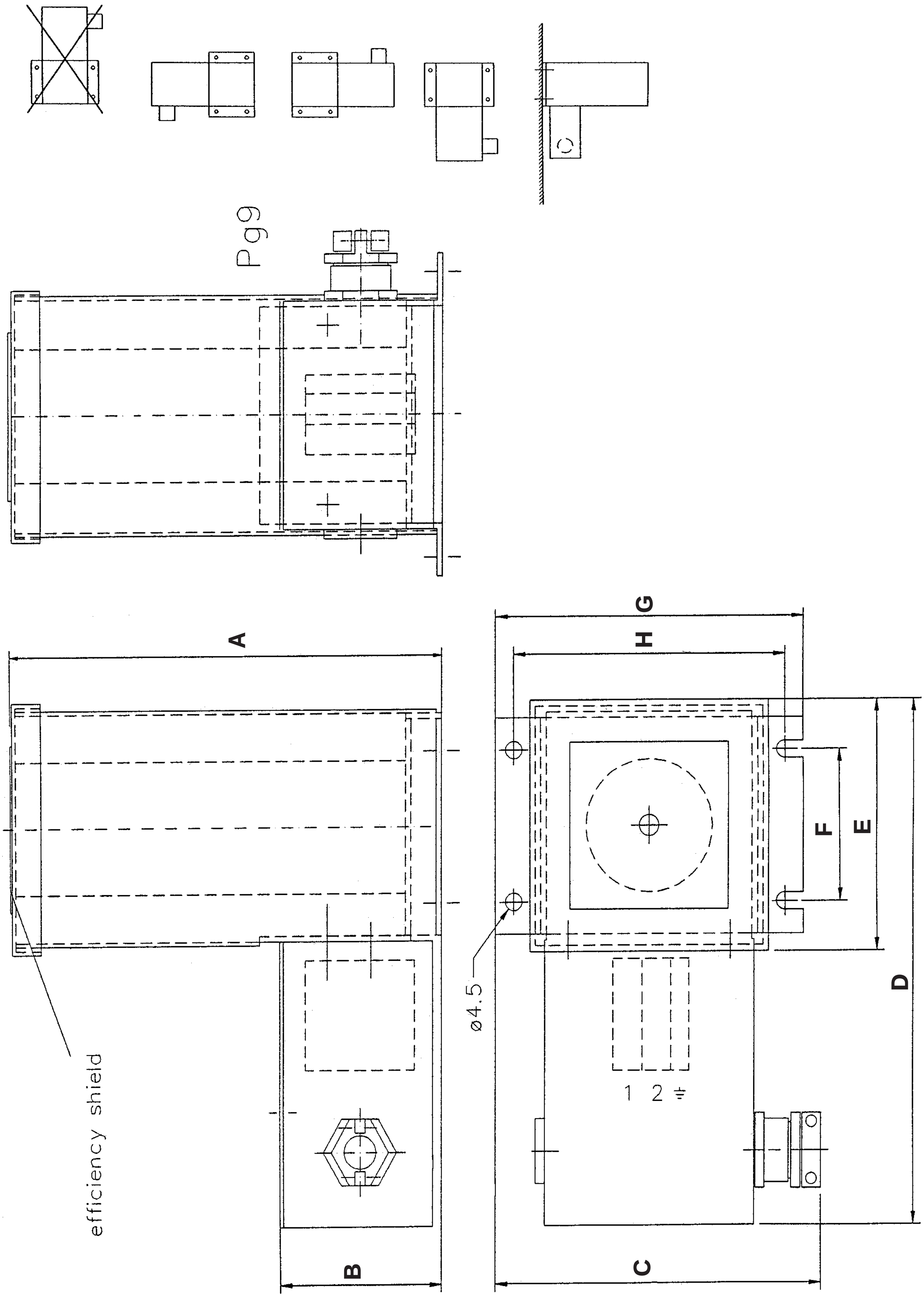
Code number 175U0xxx	Drawing no.	A [mm]	B [mm]	C [mm]	D [mm]	E [mm]	F [mm]	G [mm]	H [mm]	Weight [kg]	Cablegland PG
820	1	135	44	90	138	66	40	85	75	0,5	see drawing
821	1	165	44	90	138	66	40	85	75	0,6	see drawing
822	2	430	400	44	90	95	90	35	70	1,2	see drawing
823	3	400	50	120	95	90	325	70		1,8	see drawing
824	3	400	50	120	95	90	325	70		3,0	see drawing
825	3	600	50	120	95	90	525	70		4,0	see drawing
826	3	700	50	120	95	90	625	70		4,5	see drawing
827	4	700	50	120	180	625	140			9,0	see drawing
828	5	485	380	340	330	300	305	300	380	13,5	21
829	5	485	380	340	330	300	305	300	380	15,0	21
830	5	485	380	340	330	300	305	300	380	16,5	21
840	1	135	44	90	138	66	40	85	75	0,5	see drawing
841	1	165	44	90	138	66	40	85	75	0,6	see drawing
842	2	430	400	44	90	95	90	35	70	1,8	see drawing
843	3	400	50	120	95	90	325	70		1,8	see drawing
844	3	400	50	120	95	90	325	70		3,0	see drawing
845	3	500	50	120	95	90	425	70		3,5	see drawing
846	3	600	50	120	95	90	525	70		4,0	see drawing
847	3	700	50	120	95	90	625	70		4,5	see drawing
848	4	700	50	120	180	625	140			9,0	see drawing
849	5	485	380	330	330	300	305	300	380	13,5	16
850	5	485	380	330	330	300	305	300	380	15,0	16
851	5	485	380	330	330	300	305	300	380	15,0	16
852	5	485	380	340	330	300	305	300	380	16,5	21
853	5	485	380	340	330	300	305	300	380	19,0	21
920	2	430	400	44	90	95	90	35	70	1,2	see drawing
921	3	400	50	120	95	90	325	70		3,0	see drawing
922	3	600	50	120	95	90	525	70		4,0	see drawing
923	3	700	50	120	95	90	625	70		4,5	see drawing
924	4	700	50	145	120	625	80			5,5	see drawing
925	5	485	380	330	330	300	305	300	380	13,5	16
926	5	485	380	330	330	300	305	300	380	15,0	16
927	5	485	380	340	330	300	305	300	380	16,5	21
928	5	485	380	540	530	500	305	500	380	25,0	21
929	5	485	380	540	530	500	305	500	380	25,0	21
930	5	485	380	750	740	710	305	710	380	32,0	21
940	2	430	400	44	90	95	90	35	70	1,2	see drawing
941	3	400	50	120	95	90	325	70		3,0	see drawing
942	3	600	50	120	95	90	525	70		4,0	see drawing
943	4	700	50	145	120	625	80			5,5	see drawing
944	4	700	50	120	180	625	140			9,0	see drawing
945	4	700	50	145	240	625	200			10,0	see drawing
946	4	700	50	120	270	625	230			12,0	see drawing
947	5	485	380	330	330	300	305	300	380	19,0	16
948	5	485	380	330	330	300	305	300	380	16,5	16
949	5	485	380	540	530	500	305	500	380	25,0	21
950	5	485	380	750	740	710	305	710	380	32,0	21
951	5	485	380	750	740	710	305	710	380	34,0	21
952	5	485	380	750	740	710	305	710	380	35,0	21
953	6	485	380	540	530	500	605	500	380	47,0	29

Sizing and weights (continued)

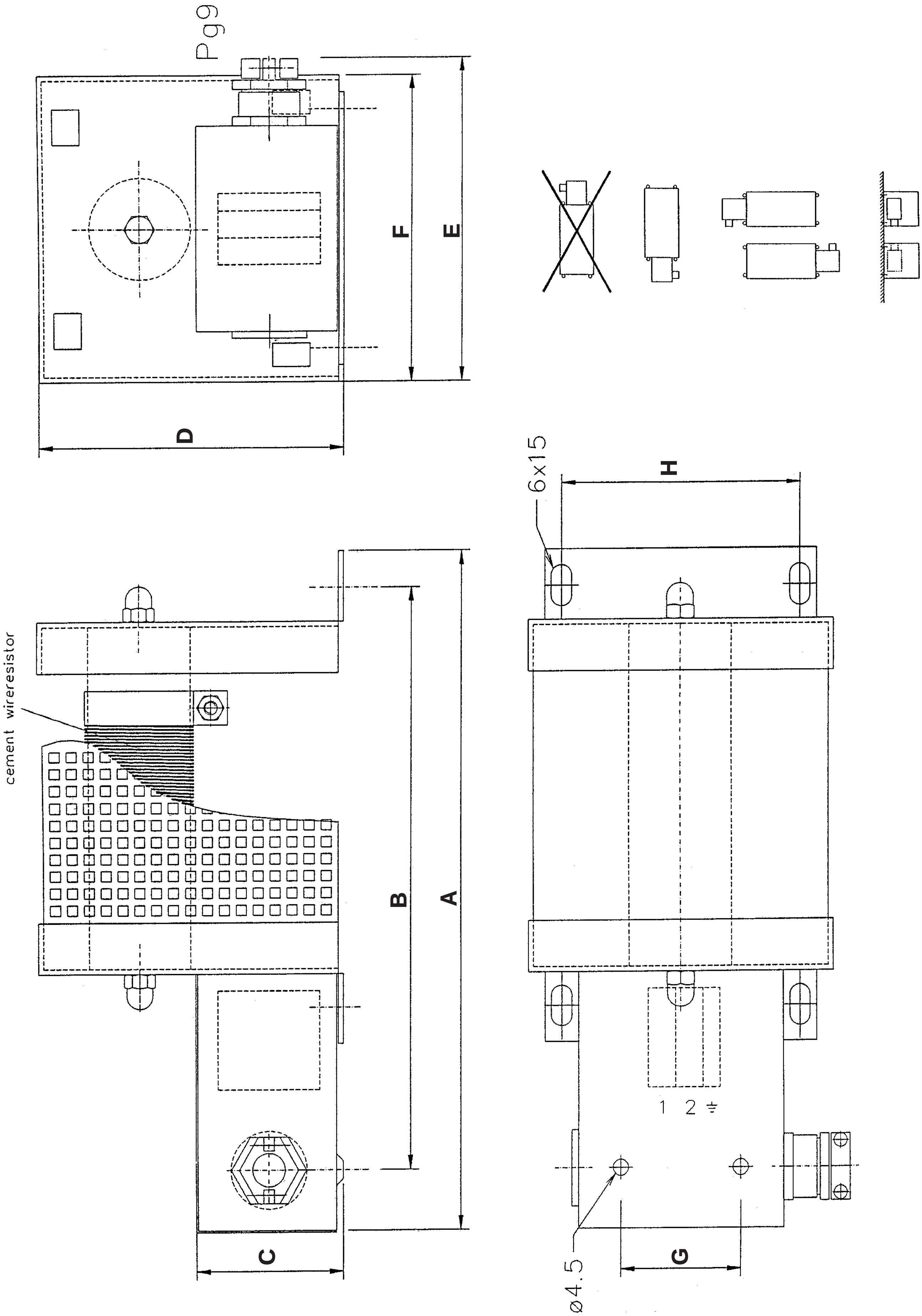
Table 3

Code number 175U0xxx	Drawing no.	A [mm]	B [mm]	C [mm]	D [mm]	E [mm]	F [mm]	G [mm]	H [mm]	Weight [kg]	Cablegland PG	Bolt M
954	9	380	485	305	300	330	340	300	380	19	21	6
955	9	380	485	305	400	430	440	400	380	20	21	6
956	9	380	485	305	500	530	540	500	380	25	21	8
957	9	380	485	305	500	530	540	500	380	26	21	6
958	9	380	485	305	710	740	750	710	380	34	21	6
959	9	380	485	305	710	740	750	710	380	40	21	8
960	7	380	485	605	500	530	540	500	380	50	29	8
961	7	380	485	605	710	740	750	710	380	55	29	8
962	7	380	485	605	710	740	750	710	380	60	36	10
963	8	380	485	1025	800	710	740	710	380	95	36	10

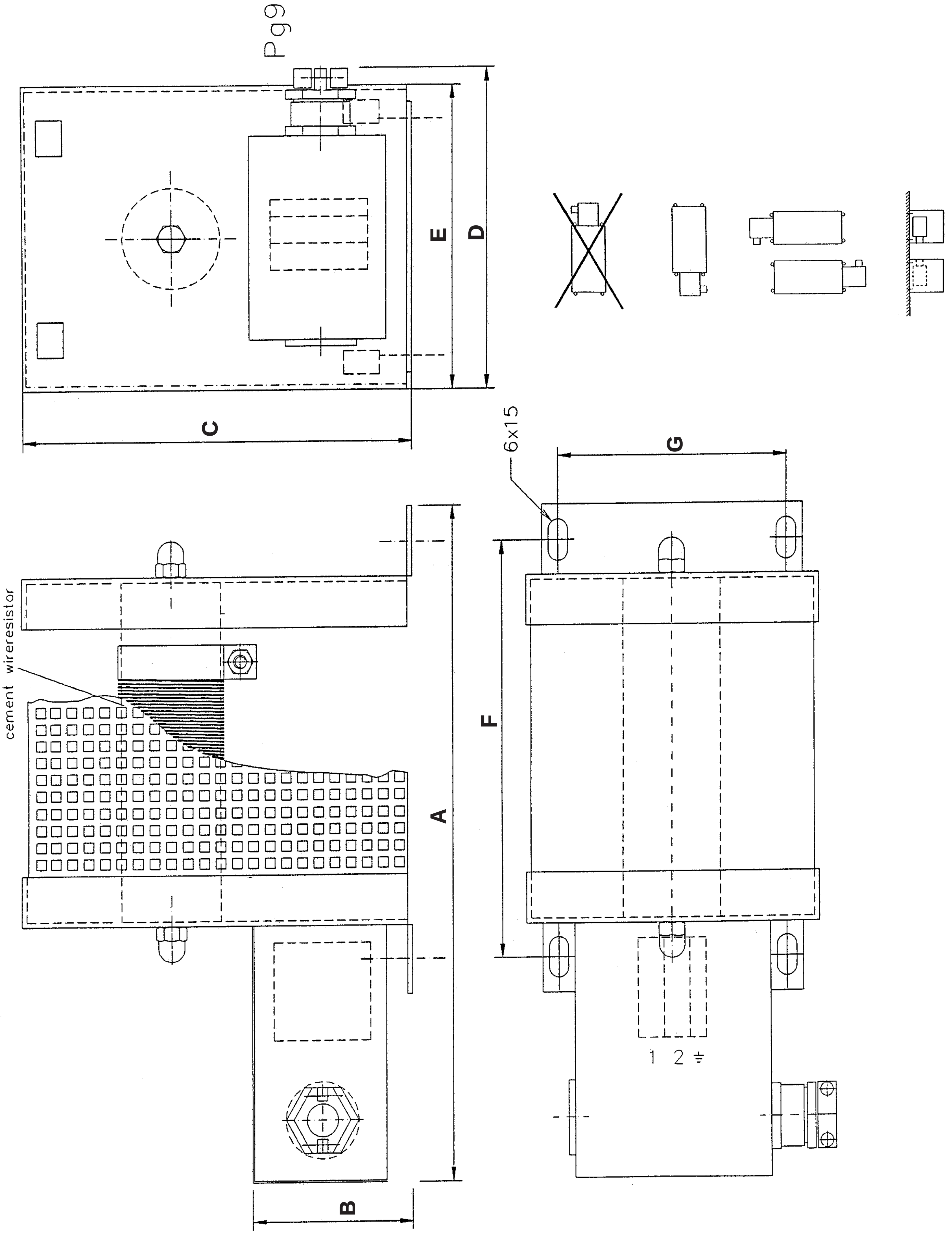
■ Drawing no. 1



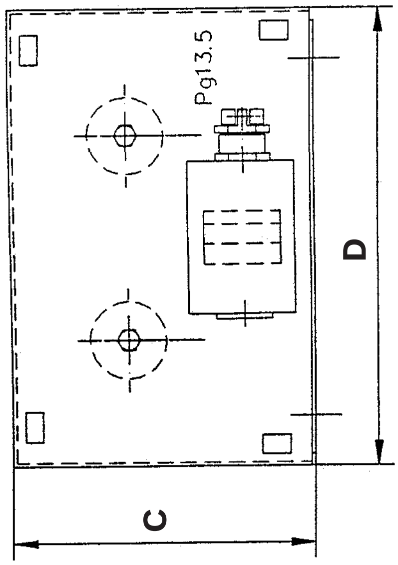
■ Drawing no. 2

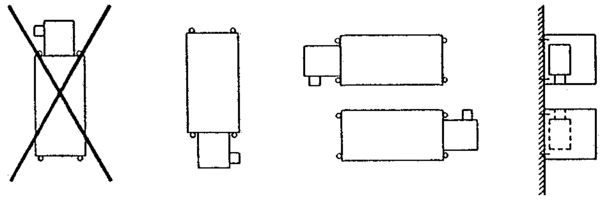


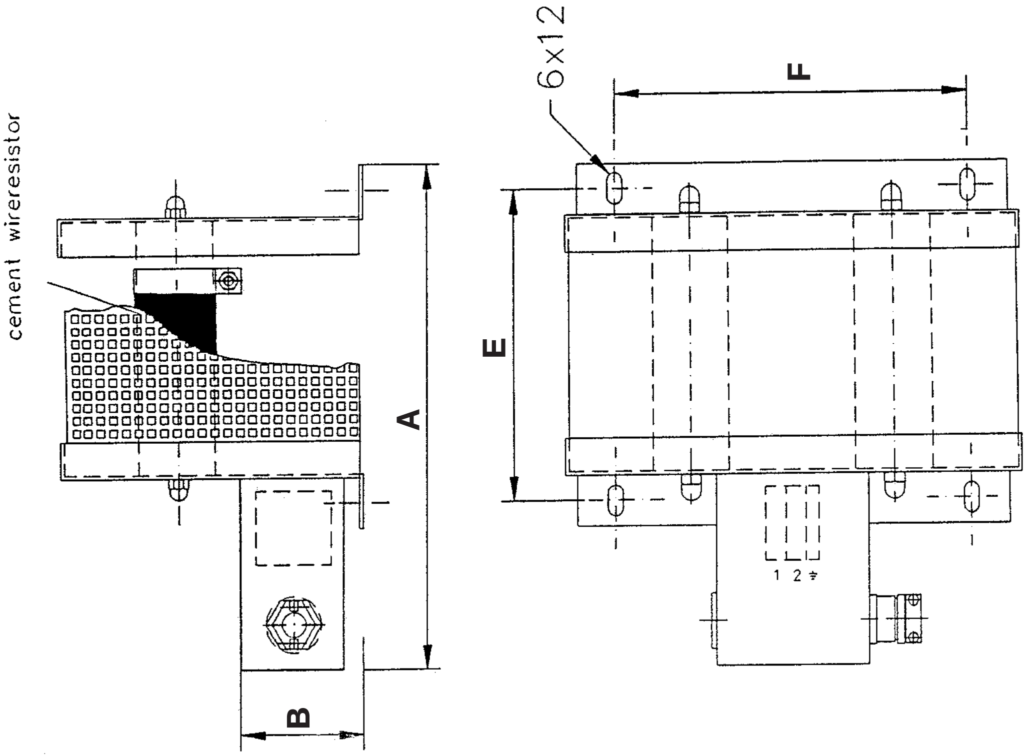
■ **Drawing no. 3**



Drawing no. 4

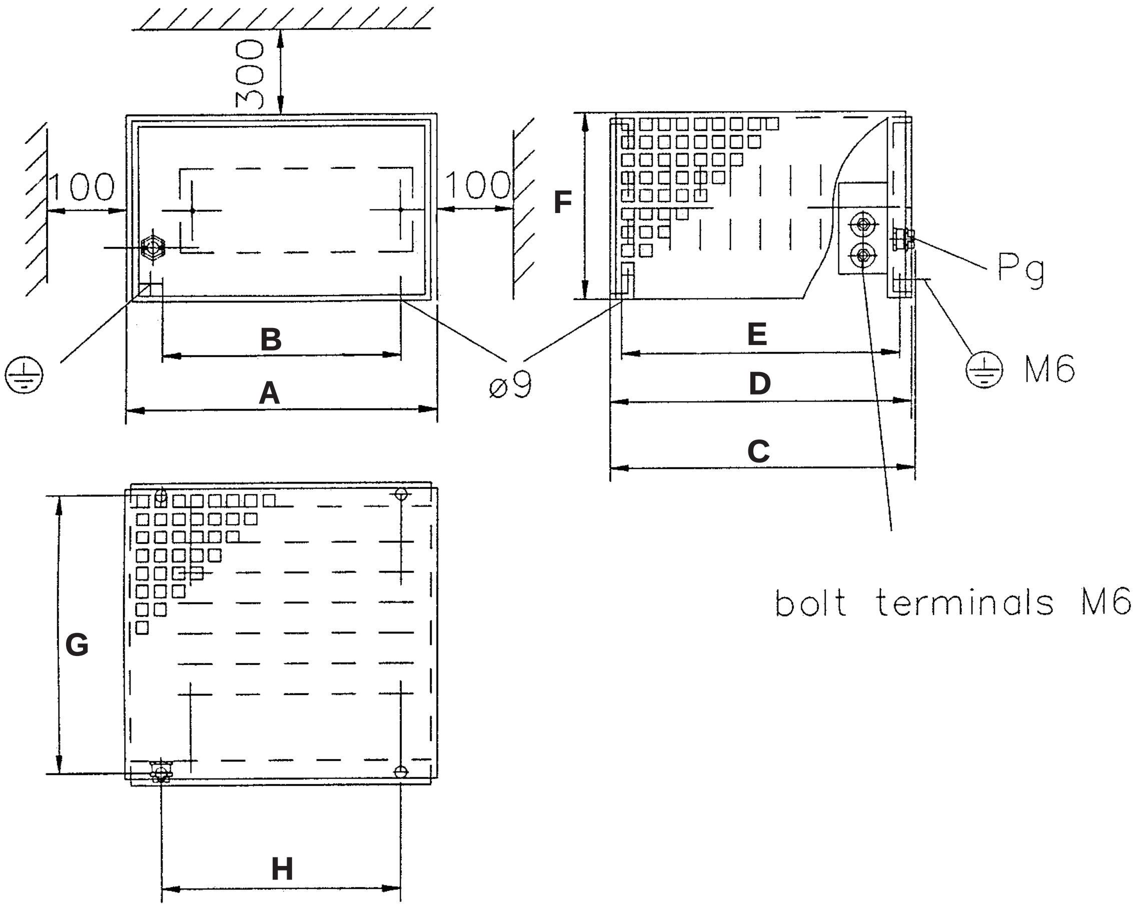




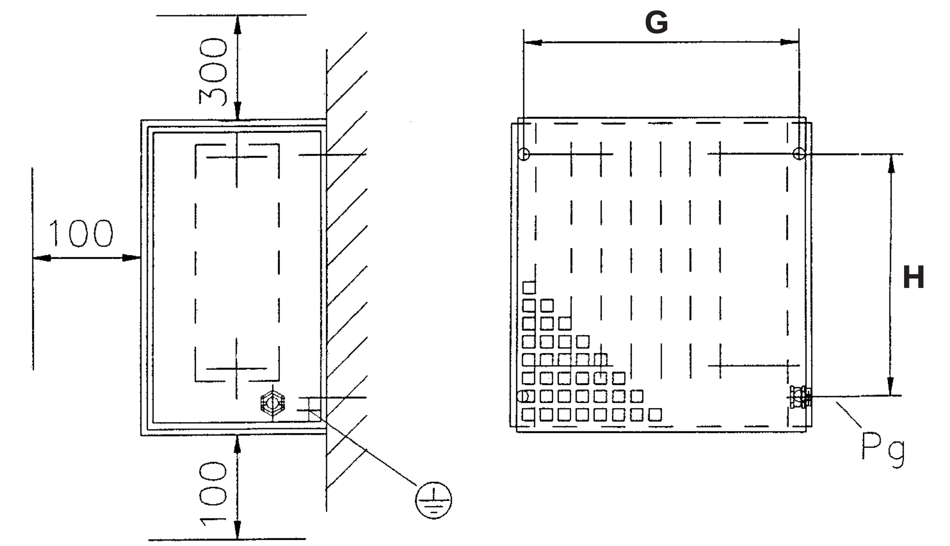


■ Drawing no. 5

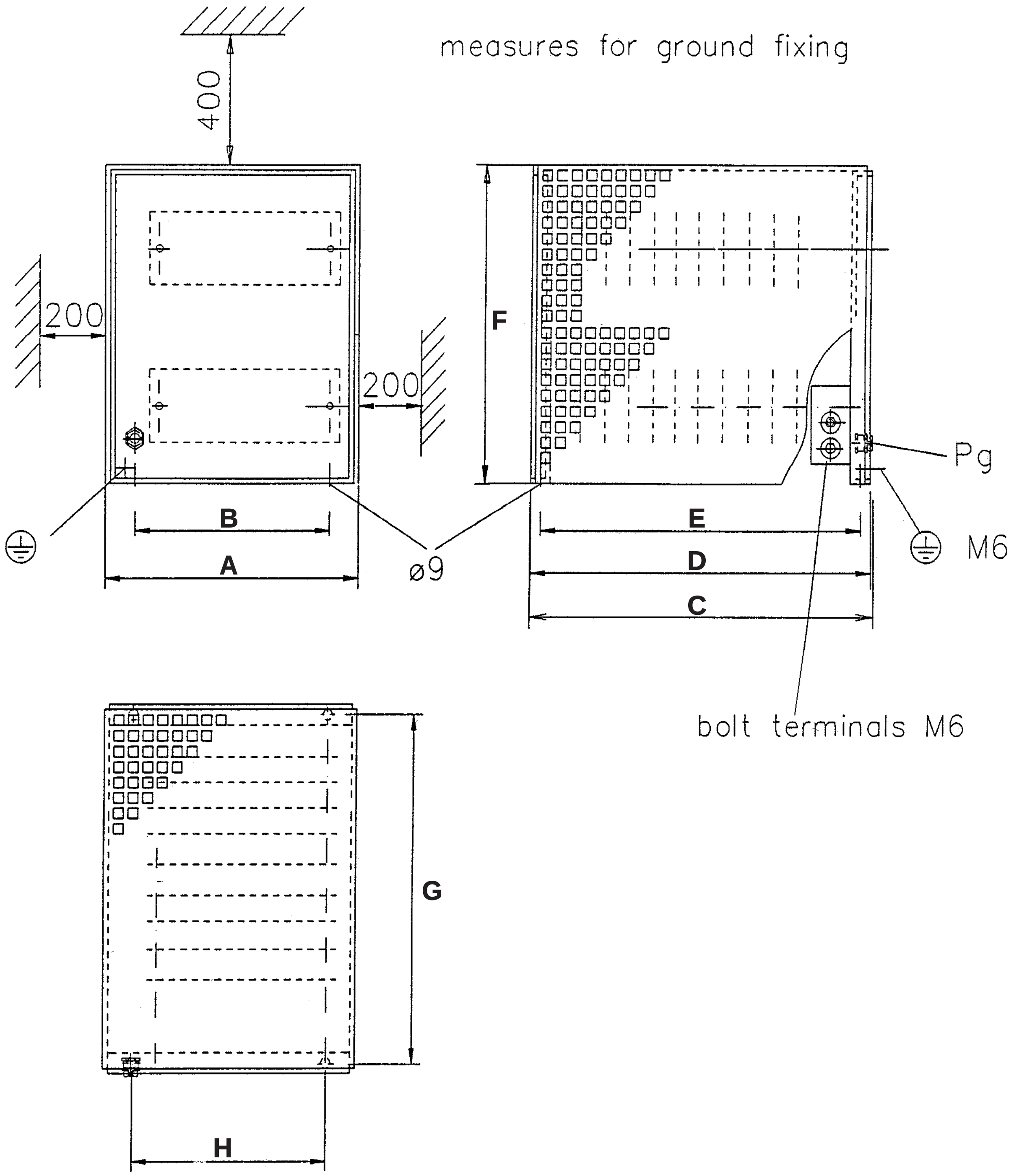
measures for ground fixing



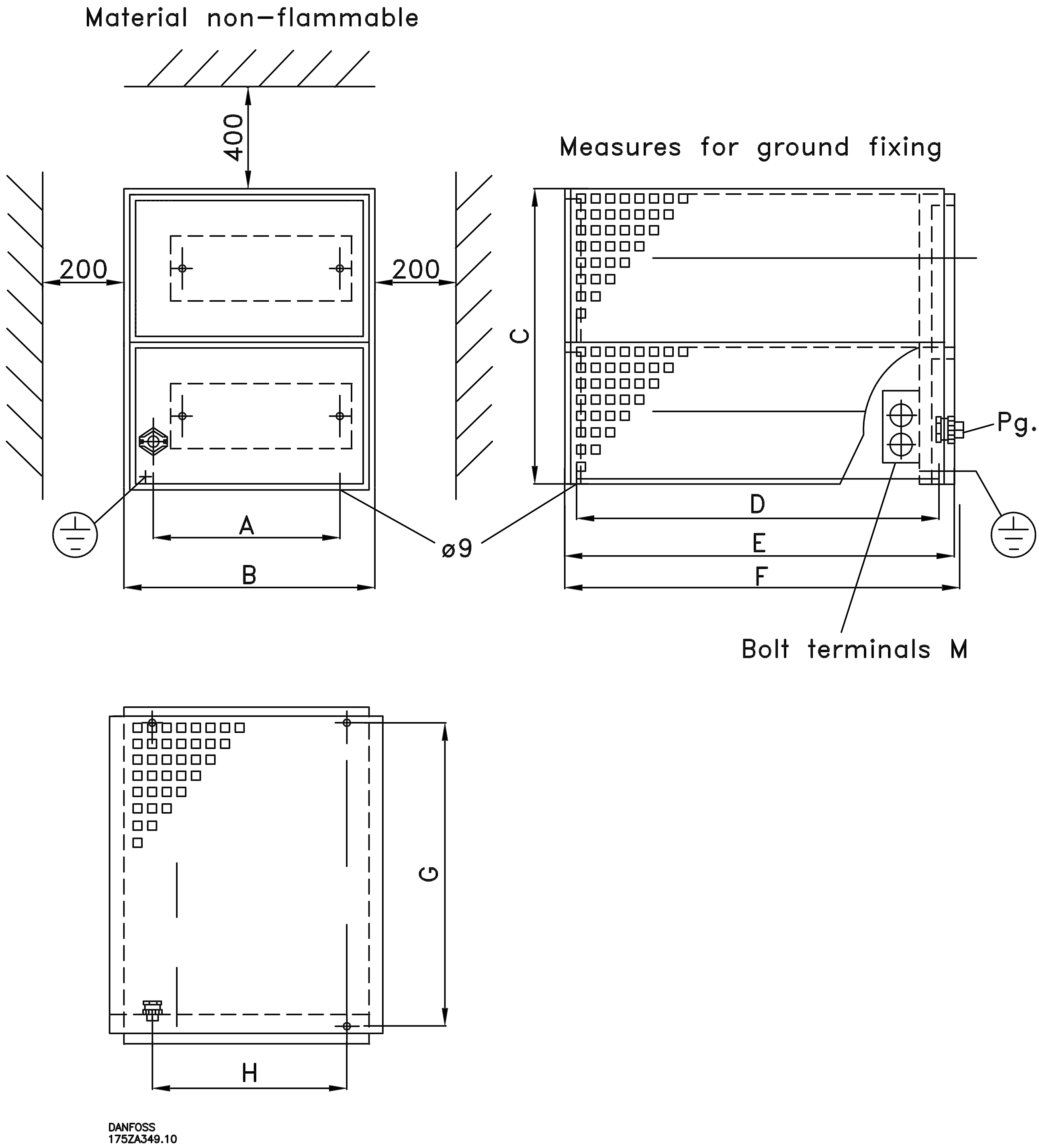
side installation



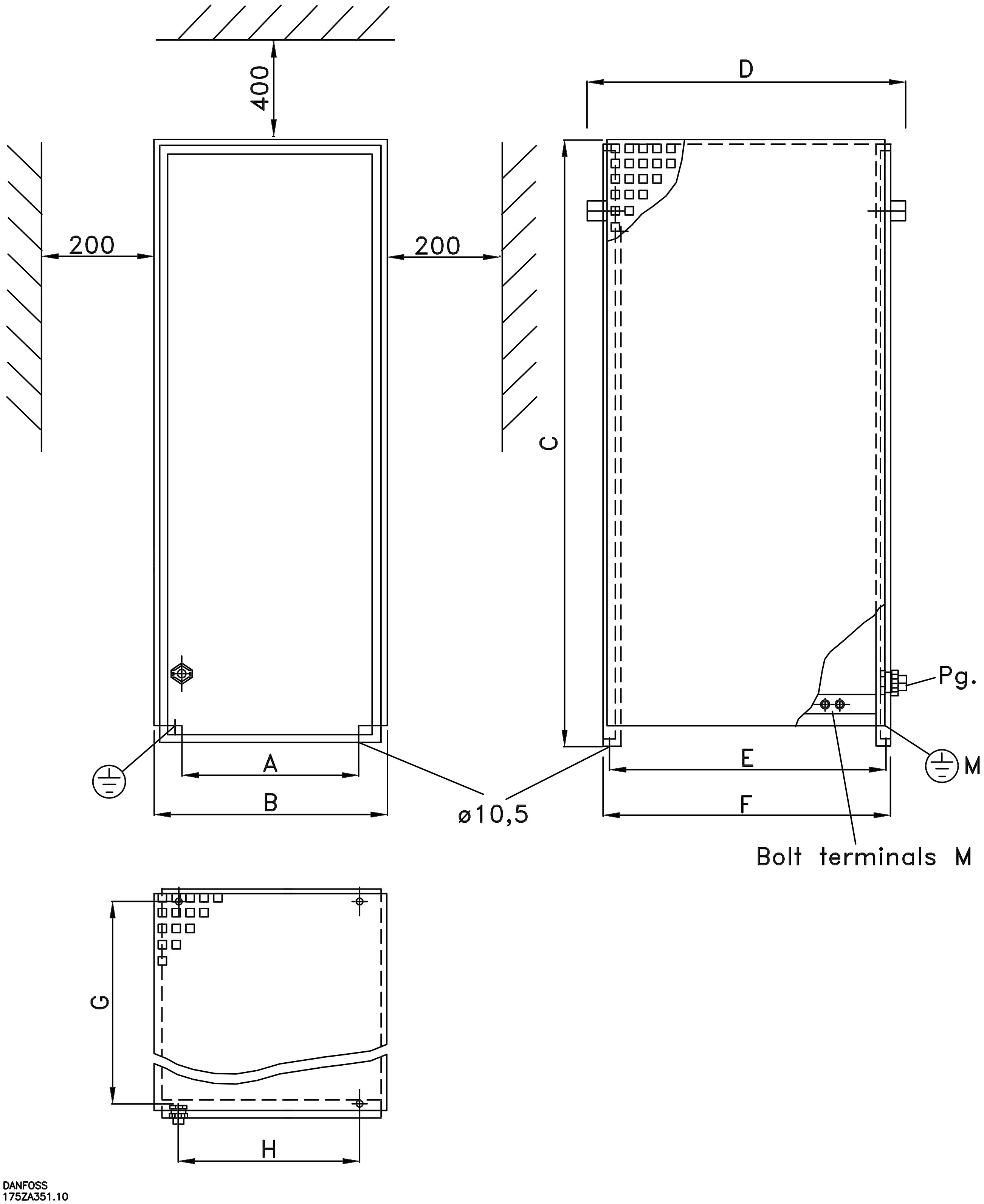
■ **Drawing no. 6**


measures for ground fixing
400
200
200
F
B
A
E
D
C
ø9
Pg
M6
bolt terminals M6
G
H

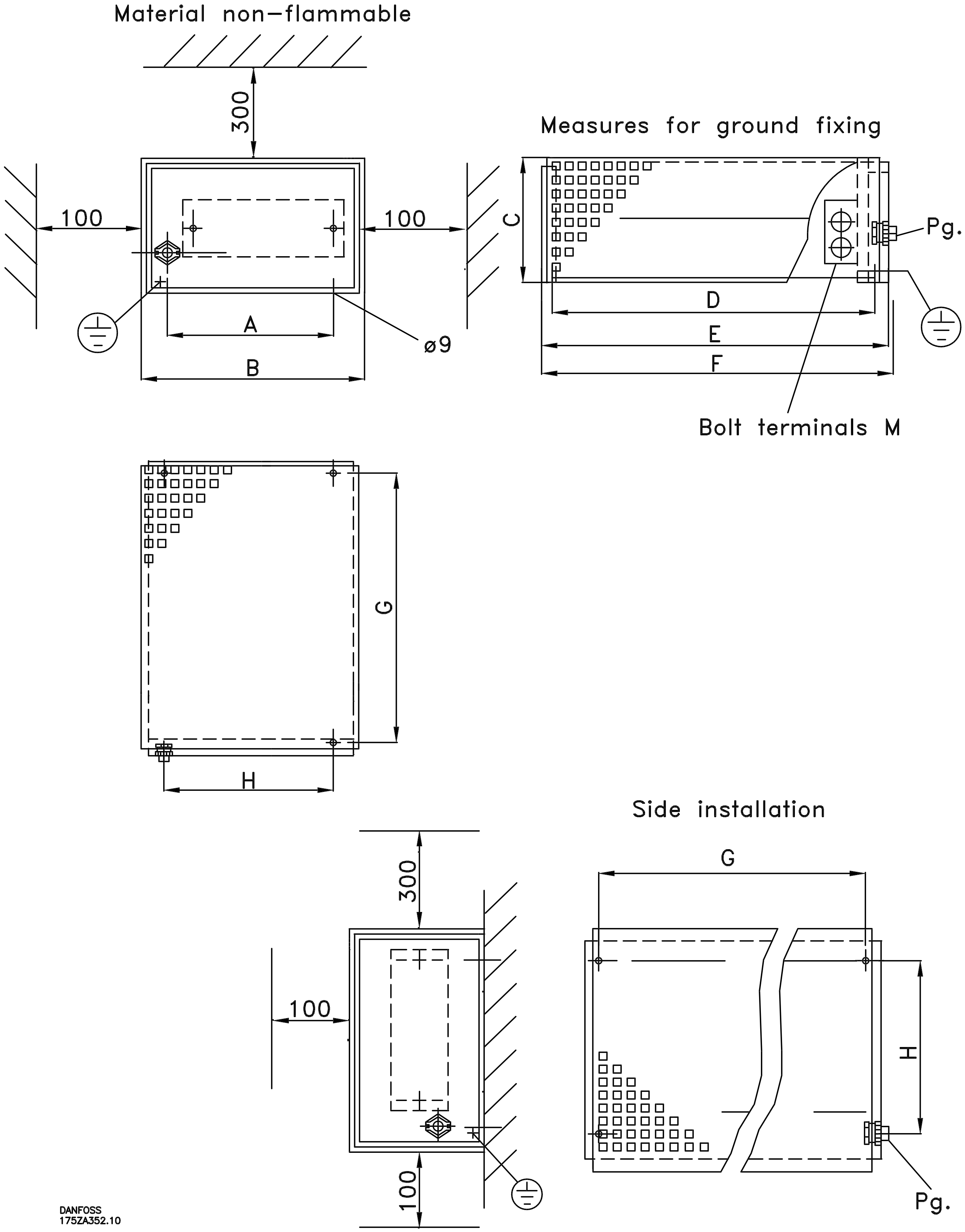
■ **Drawing no. 7**


Material non-flammable
400
200
200
A
B
ø9
Measures for ground fixing
C
Pg.
D
E
F
Bolt terminals M
G
H
DANFOSS
175ZA349.10

■ Drawing no. 8


400
200
200
D
C
Pg.
M
A
B
ø10,5
E
F
Bolt terminals M
G
H
DANFOSS
175ZA351.10

■ **Drawing no. 9**


Material non-flammable
300
100
100
A
B
ø9
Measures for ground fixing
C
Pg.
D
E
F
Bolt terminals M
G
H
Side installation
G
300
100
H
100
Pg.
DANFOSS
175ZA352.10

