HEDY

HD700 Technical Data Manual

（0.4kW~500kW）

(V1.0)

Foreword

General information

Thank you for using HD700 AC drives made by HEDY Industry Automation Control Co., Ltd.
This manual introduces HD700 drives technical data in detail. The manufacturer accepts no liability for any consequences resulting from inappropriate, negligent or incorrectinstallation or adjustment of the optional parameters of the equipment or from mismatching the variable speed drive with the motor.
The contents of this manual are believed to be correct at the time of printing. In the interests of commitment to a policy of continuous development and improvement, the manufacturer reserves the right to change the specification of the product or its performance, or the content of the manual without notice.

Drive software version

This product is supplied with the latest version of software. If this product is to be used in a new or existing system with other drives, there may be some differences between their software and the software in this product. These differences may cause this product to function differently.

Contents

1 Technical specification

1.1 Model reference

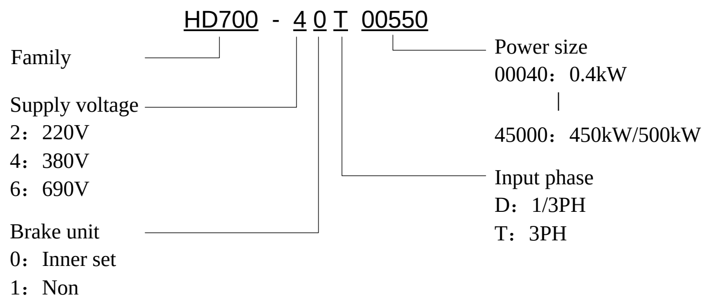

Figure1-1 HD700 model description

1.2 Rating label

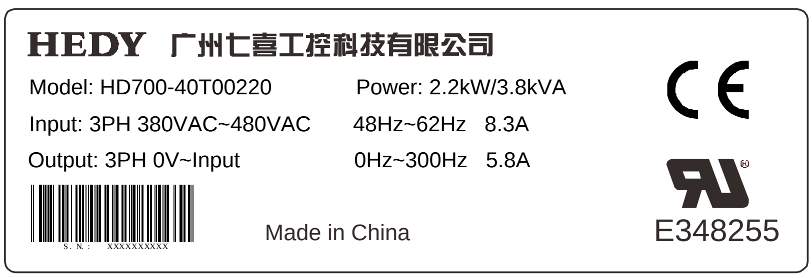

Figure1-2 HD700 Rating label (SizeA, B, C)

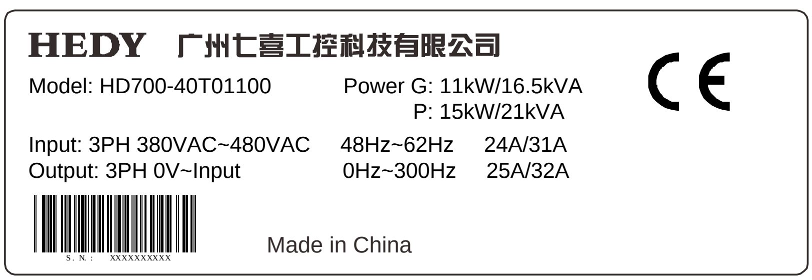

Figure1-3 HD700 Rating label (SizeD, E)

1.3 Technical data

Power size of HD700 is refered to the standard 4 poles inductionmotor at rated voltage.

HD700 size D and above products have two power allocations (G type and P type). Selecting what kind of power allocation depends on motor rated current value.

G: Heavy duty

P: Normal duty

Overload of G type: 132kW and below, 150% rated output current, 1 minute

160kW and above, 130% rated output current, 1 minute

Overload of P type: 110% rated output current, 1 minute

1.3.1 220V size A to C

Table 1-1 Ratings

Model	HD700								
	20D00040		20D00075		20D00150		20D00220		20T00400
	1PH	3PH	1PH	3PH	1PH	3PH	1PH	3PH	3PH
Size	A						B		C
AC supply voltage and frequency	200V to 240V ±10%, 48Hz to 62Hz								
Nominal motor power (kW)	0.4	0.4	0.75	0.75	1.5	1.5	2.2	2.2	4.0
Output voltage and frequency	0V to 220V, 0Hz to 300Hz								
Rated output current (A)	2.8	2.8	5.0	5.0	8.0	8.0	11.0	11.0	17.6
Overload current for 60s (A)	4.2	4.2	7.5	7.5	12.0	12.0	16.5	16.5	26.4
Rated input current (A)	7.1	4.0	12.8	7.1	20.5	11.3	24.0	14.5	13.2
Typical inrush current (A) (<10ms)	5.6		2.8		2.8		18.0		11.3
Weight (kg)	1.4		1.4		1.4		2.2		4.5
Internal EMC filter	Yes		Yes		Yes		Yes		Yes
Fan acoustic noise (dB)	59.9		59.9		59.9		55.6		60.1

Table 1-2 Brake resistor

Model	HD700								
	20D00040		20D00075		20D00150		20D00220		20T00400
	1PH	3PH	1PH	3PH	1PH	3PH	1PH	3PH	3PH
Minimum brake resistor value (Ω) ±10%	41	41	41	41	41	41	20	20	12
Resistor peak power rating (kW)	4.15	4.15	4.15	4.15	4.15	4.15	8.48	8.48	14.30
Maximum brake current (A)	10	10	10	10	10	10	21	21	35
Recommended brake resistor value (Ω)	200		150		100		50		30

NOTE:

About the calculation of brake resistor value and power, see section 3.4.2 *brake resistor calculation* for details.

1.3.2 400V size A to C

Table 1-3 Ratings

Model	HD700					
	40T00075	40T00150	40T00220	40T00400	40T00550	40T00750
Size	A		B		C	
AC supply voltage and frequency	380V to 480V ±10%, 48Hz to 62Hz					
Nominal motor power (kW)	0.75	1.5	2.2	4.0	5.5	7.5
Output voltage and frequency	0V to 380V, 0Hz to 300Hz					
Rated output current (A)	2.5	4.2	5.8	9.5	13.0	17.0
Overload current for 60s (A)	3.8	6.3	8.7	14.3	19.5	25.5
Rated input current (A)	3.6	5.7	8.3	13.2	12.4	16.1
Typical inrush current (A) (<10ms)	5.6	5.6	11.3	11.3	11.3	11.3
Weight (kg)	1.4	1.4	2.2	2.2	4.5	4.5
Internal EMC filter	Yes	Yes	Yes	Yes	Yes	Yes
Fan acoustic noise (dB)	59.9	59.9	55.6	55.6	60.1	60.1

Table 1-4 Brake resistor

Model	HD700					
	40T00075	40T00150	40T00220	40T00400	40T00550	40T00750
Minimum brake resistor value (Ω) ±10%	120	120	65	50	24	24
Resistor peak power rating (kW)	5.67	5.67	10.40	13.50	28.70	28.70
Maximum brake current (A)	7	7	13	17	35	35
Recommended brake resistor value (Ω)	300	300	150	100	80	55

1.3.3 400V size D, E

Table 1-5 Ratings

Model	HD700			
	40T01100	40T01500	40T01850	40T02200
Size	D		E	
AC supply voltage and frequency	380V to 480V±10%, 48Hz to 62Hz			
Output voltage and frequency	0V to 380V, 0Hz to 300Hz			
P				
Nominal motor power (kW)	15	18.5	22	30
Rated output current (A)	32.0	38.0	46.0	60.0
G				
Nominal motor power (kW)	11	15	18.5	22
Rated output current (A)	25.0	32.0	38.0	46.0
Overload output current for 60s (A)	37.5	48.0	57.0	69.0
Rated input current (A)	24.0	31.0	36.0	44.0
Typical inrush current (A)	49.8	49.8	49.8	49.8
Weight (kg)	8.8	8.8	12.1	12.1
Internal EMC filter	Yes	Yes	Yes	Yes
Fan acoustic noise (dB)	65.8	65.8	69.0	69.0

Table 1-6 Brake resistor

Model	HD700			
	40T01100	40T01500	40T01850	40T02200
Minimum brake resistor value (Ω) ±10%	24	17	17	17
Resistor peak power rating (kW)	28	40	40	40
Maximum brake current (A)	35	50	50	50
Recommended brake resistor value (Ω)	50	35	29	29

NOTE:

1) **All drives with a cooling fan except HD700-20D00040.**

2) **Size F and above product data will be released in the next version manual.**

1.3.5 General technical data

Table 1-7 General technical spec.

Input power	**Input voltage U_{in}**	200V (−10%) to 240V (+10%) 1/3 PH 380V (−10%) to 480V (+10%) 3PH 500V (−10%) to 690V (+10%) 3PH
	Input Frequency	48Hz to 62Hz
	Maximum supply imbalance	≤3%
Power output	**Output voltage**	0V to U_{in}
	Output frequency	0Hz to 300Hz
Main performance function	**Voltage control**	V/F, open loop vector control
	Switching frequency	1kHz to 15kHz
	Adjust	Open loop vector - 1:100, V/Fmode -1:50
	Start torque	Open loop vector - 0.5Hz: 100%, 1Hz: 150%
	Torque accurancy	≤2%
	Torque ripple	≤2%
	Speed accurancy	≤1%n_0 (rated condictions)
	Reference resolution	Digital - 0.01Hz, analogue - 0.1% ×max. frequency
	Acce. & Dece. rate	0.1s to 3600min
	Voltage boost	0.1% to 30.0%
	Overload	G type: 132kW and below, 150% rated output current, 1 minute 160kW and above, 130% rated output current, 1 minute P type: 110% rated output current, 1 minute
	V/F	4 types: V/F (user can program) and ramp (2.0 power, 1.7 power, 1.2 power)
	DC braking	Injection frequency: 0.0% to 20.0% Max. frequency Injection current: 0.0% to 100.0% rated current Injection time: 0.0s to 60.0s
	Dynamic brake	Brake rate: 0.0% to 100.0%
	Jog	Jog frequency: 0.00Hz to 50.00Hz Jog acceleration rate: 0.1s to 60.0s Jog interval time: 0.1s to 60.0s
	Preset	16 preset speeds (decided by control terminals)
	AVR	Maintain the rated output voltage when the input power supply voltage changed

Special function	**Textile**	For textile machine control
	Simple PLC	Onboard PLC
	Length control	Winding control
	PID control	Process control (reference close loop control)
	Advanced function blocks	2 logic control blocks, 1 binary selector, 2 threshold control blocks, 3 variable selectors
Control terminal	**Reference source**	Digit: Keypad, motorized pot (E-Pot), pulse, comms.
		Analogue: AI1: 0V to 10V, 0(4) mA to 20mA AI2: 0V to 10V
	Operation mode	Keypad, Control terminal, Serial comms.
	Digital input terminals	DI1 to DI7: Programmable terminals and DI6 can be set as pulse input, 0Hz to 60Hz; DI7 can be high frequency pulse input (0.1KHz to 50.0kHz) or PTC thermistor input
	Digital output terminals	DO1 to DO2: Programmable terminals, Max. output current: 50mA, DO2can be the terminal to output pulse (0.1kHz to 50.0kHz), and output PWM
	Analogue output terminal	AO1: programmable terminal, 0V to 10V
	Status relay	2 programmable relays, contactor data: AC250V/2A(COSφ=1) AC250V/1A(COSφ=0.4) DC30V/1A
Comms.	**Connector**	2 terminals (A&B) and RJ45 port
	Protocol	Modbus RTU
Environment	**Altitude**	1000m rated 1000m～3000m,1% rated current derating per 100m
	Operating temperature	−10°C to +40°C
	Max. humidity	≤90%RH, no-condensing
	vibration	≤5.9m/s^2 (0.6g)
	Storage temperature	−40°C to +70°C
	Running environment	Indoor, non-flammable, corrosive gasses, no contamination with electrically conductive material, avoide dust which may restrict the fan
Options		LCD Keypad, HDOM-232、HDOM-USB、Profibus module、Keypad pallet、HDSOFT (PCTools), etc.
Protection		Output shortage, over current, over load, over voltage, under Voltage, Phase loosing, over heat (heatsink and junction), external trip, etc.
Efficiency		1.5kW and below: ≥89% 2.2kW to 22kW: ≥93% 30kW and above: ≥95%
Mounting method		Surface mounting, through hole, cubicle standing
Enclosure		IP20, IP21 (by adding option device)
Cooling method		220V/ 0.4kW model is nature cool, others are forced air cool

2 Derating curves, losses and overload protection curves

The derating curves are based on the results of heatruns that are carried out to measure temperatures of various components and at various key points within the drive at different switching frequencies, different loads and different ambient temperatures. The key components/points are:

- Heatsink
- Bridge rectifier
- IGBTs
- DC bus capacitors
- Various electrolytic capacitors
- Various resistors
- Various semiconductor components

It is not always the heatsink temperature that is the limiting factor for the de-rating curves.

At 3 and 6kHz, the limiting factor tends to be the capacitor temperatures. Operating outside the derating curves will cause some of the capacitors within the drive to run outside of their maximum operating temperature and this could lead to the drives design lifetime being reduced.

At 12 and 15kHz (15kHz where applicable), the limiting factor tends to be the heatsink temperatures. Operating outside the de-rating curves will cause the heatsink temperature to increase and may cause the drive to trip on F009.

If the auto-switching frequency change is enabled (P10.11 = 1 [by default]), the drive will automatically decrease the switching frequency.

2.1 Size A

2.1.1 Derating curves

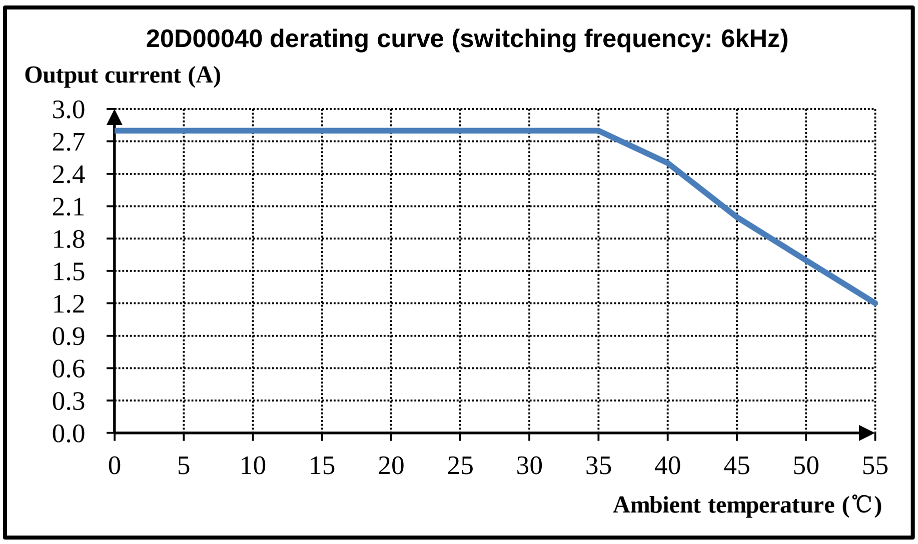

Figure 2-1 HD700-20D00040 derating curve

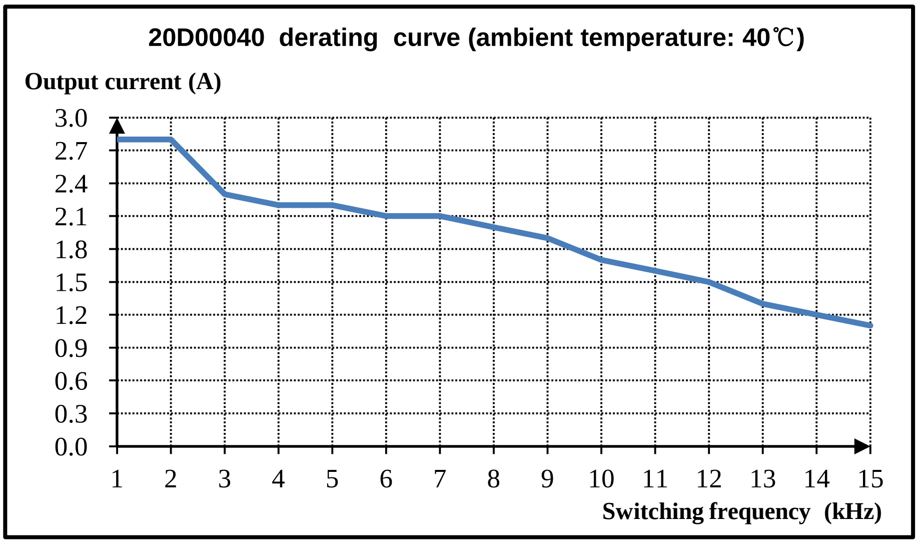

Figure 2-2 HD700-20D00040 derating curve

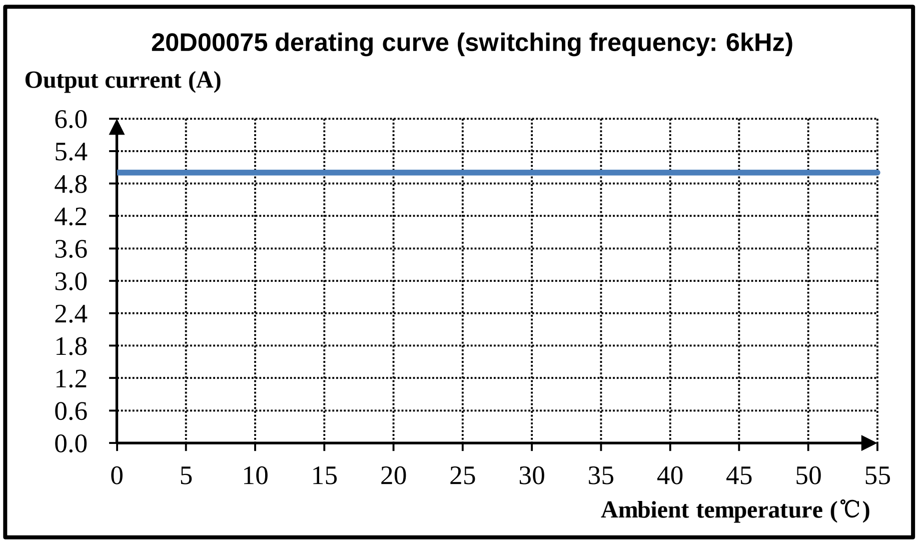

Figure 2-3 HD700-20D00075 derating curve

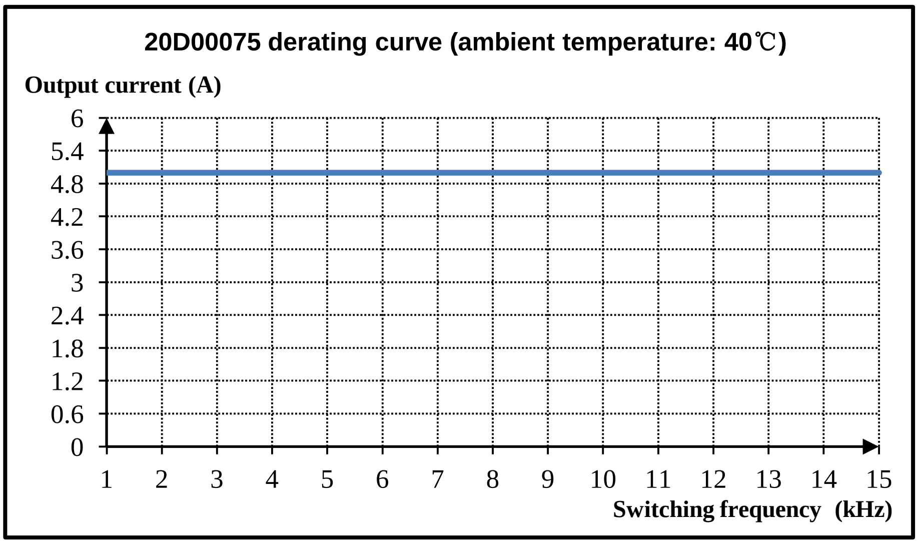

Figure 2-4 HD700-20D00075 derating curve

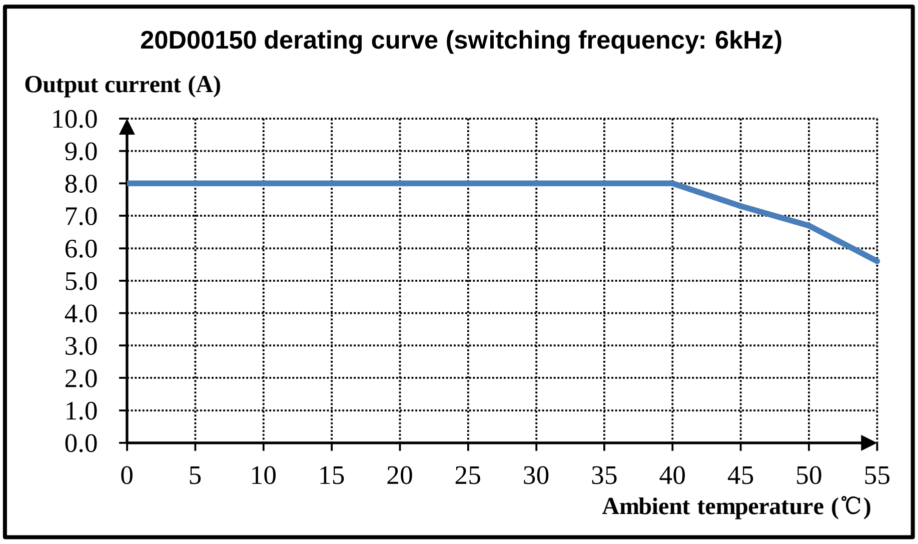

Figure 2-5 HD700-20D00150 derating curve

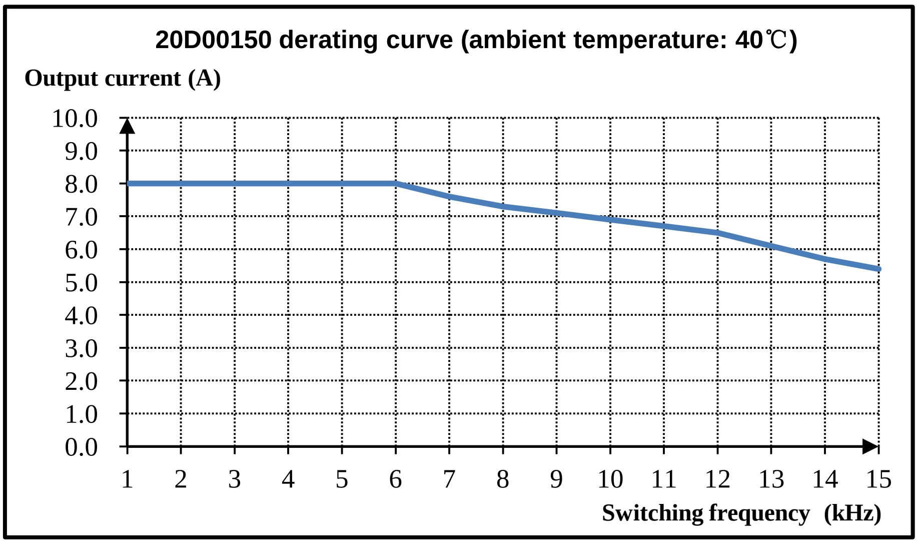

Figure 2-6 HD700-20D00150 derating curve

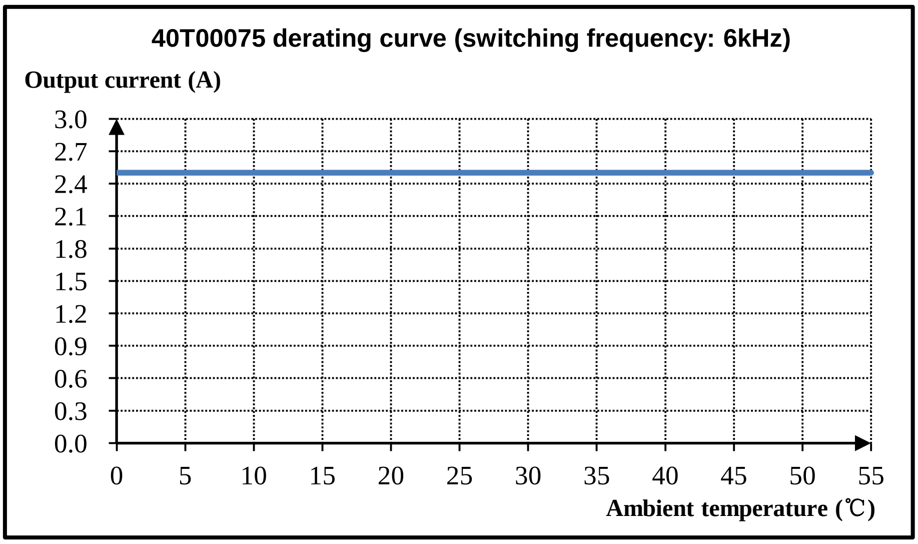

Figure 2-7 HD700-40T00075 derating curve

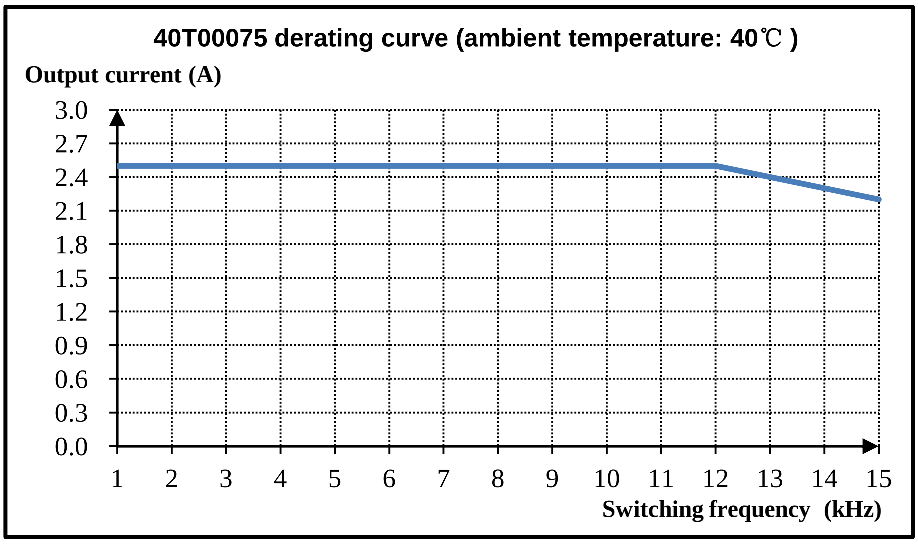

Figure 2-8 HD700-40T00075 derating curve

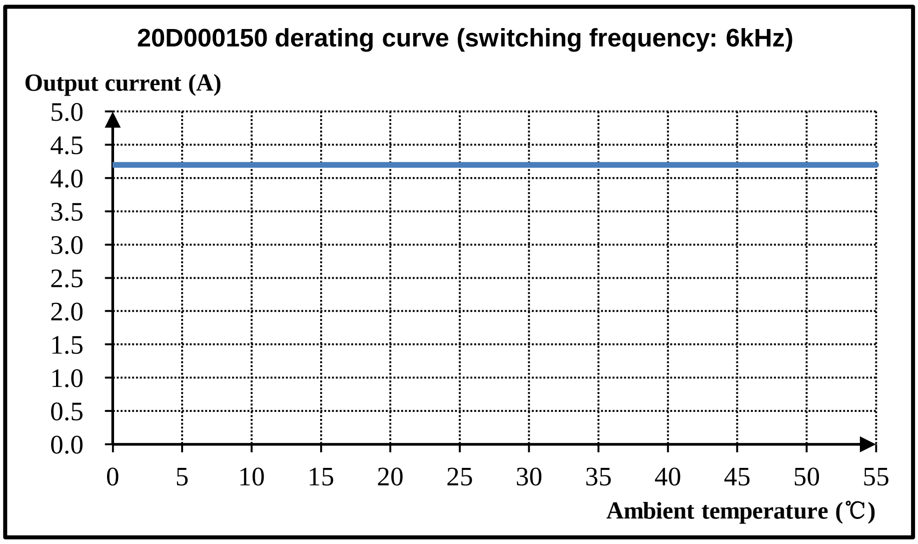

Figure 2-9 HD700-40T00015 derating curve

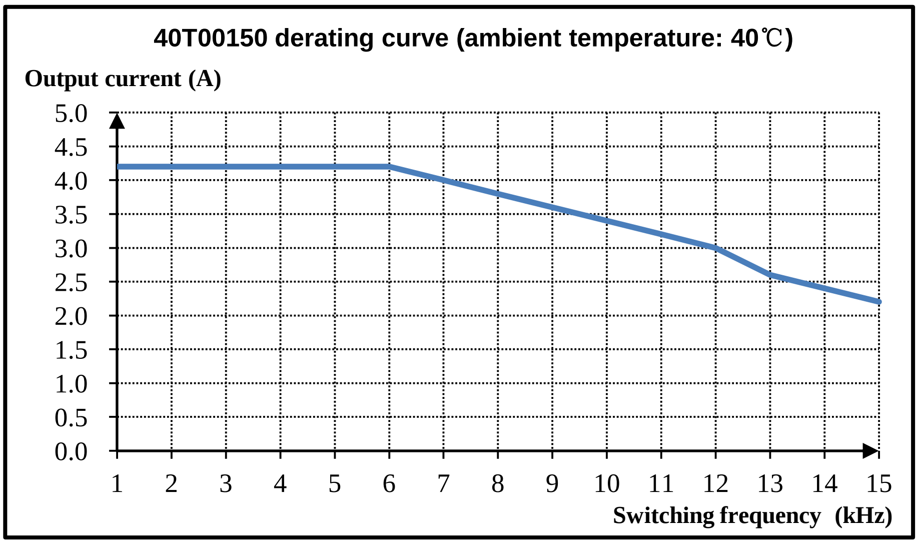

Figure 2-10 HD700-40T00150 derating curve

2.1.2 Drive losses

The following table indicates the losses at 40℃ ambient temperature and 6kHz switching frequency for HD700 size A drives.

Table 2-1 HD700 size A drive losses

Voltage rating (V)	200			400	
Power (kW)	0.40	0.75	1.50	0.75	1.50
Loss (kW)	0.029	0.07	0.118	0.03	0.049

2.2 Size B

2.2.1 Derating curves

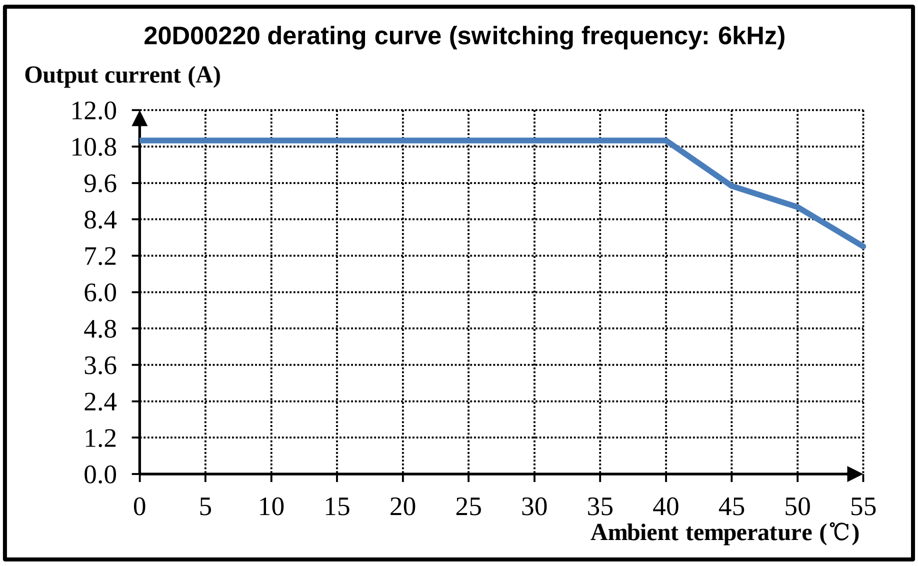

Figure 2-11 HD700-20D00220 derating curve

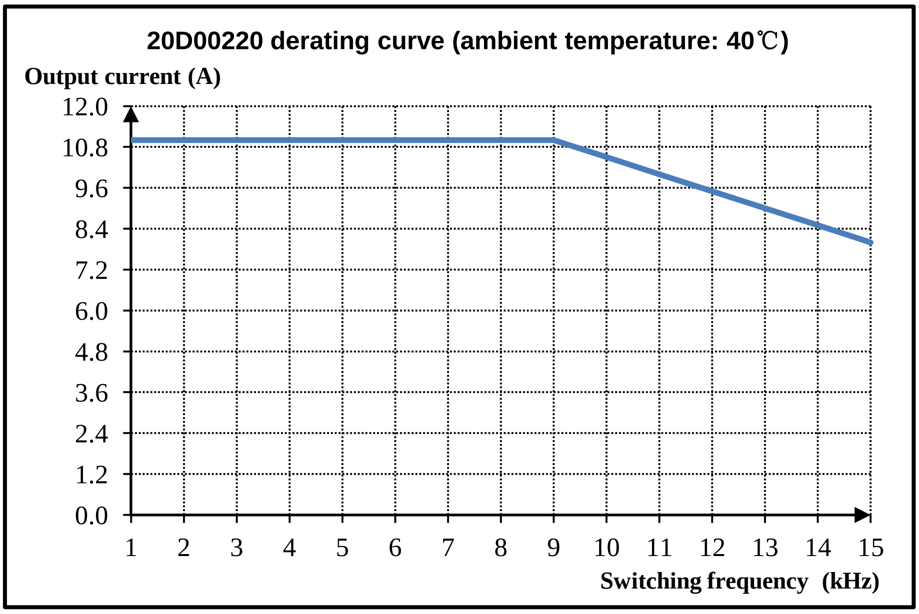

Figure 2-12 HD700-D00220 derating curve

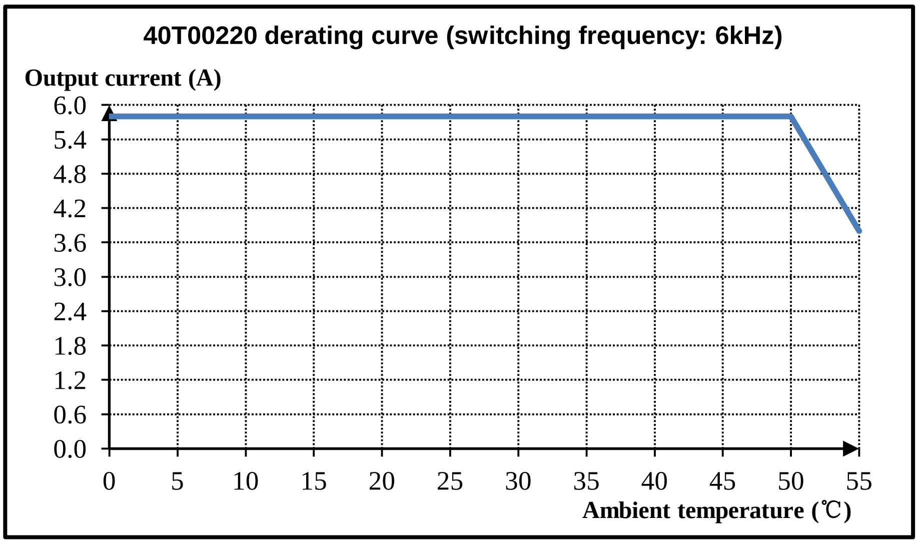

Figure 2-13 HD700-40T00220 derating curve

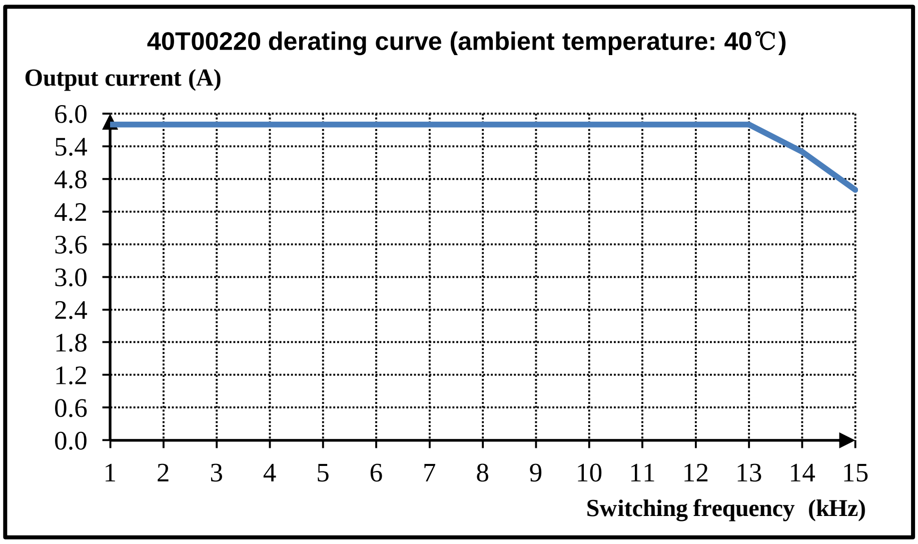

Figure 2-14 HD700-40T00220 derating curve

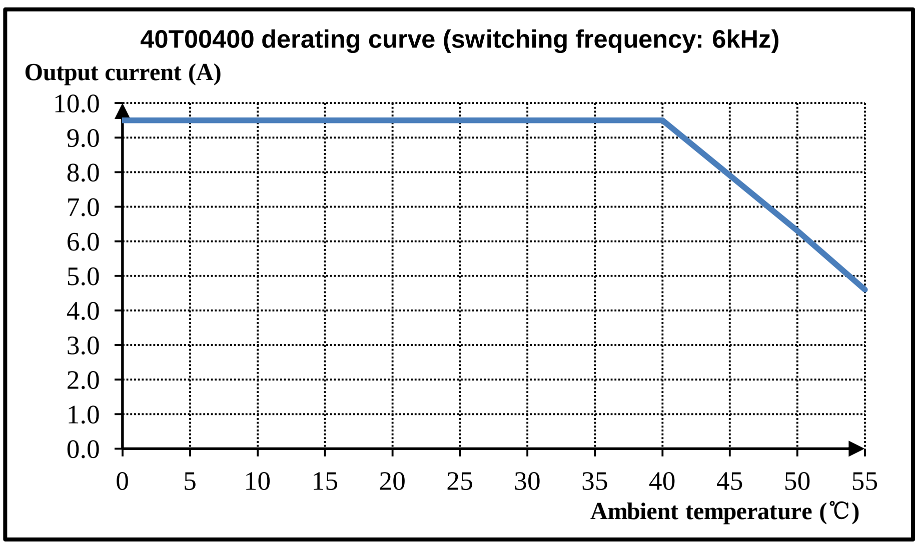

Figure 2-15 HD700-40T00400 derating curve

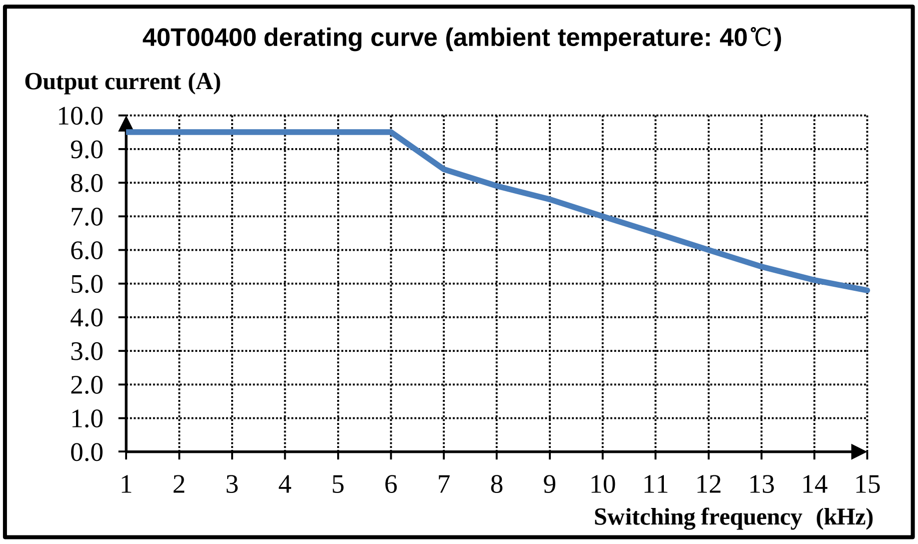

Figure 2-16 HD700-40T00400 derating curve

2.2.2 Drive losses

The following table indicates the losses at 40℃ ambient temperature and 6kHz switching frequency for HD700 size B drives.

Table 2-2 HD700 size B drive losses

Voltage rating (V)	200	400	
Power (kW)	2.2	2.2	4.0
Loss (kW)	0.11	0.13	0.16

2.3 Size C

2.3.1 Derating curves

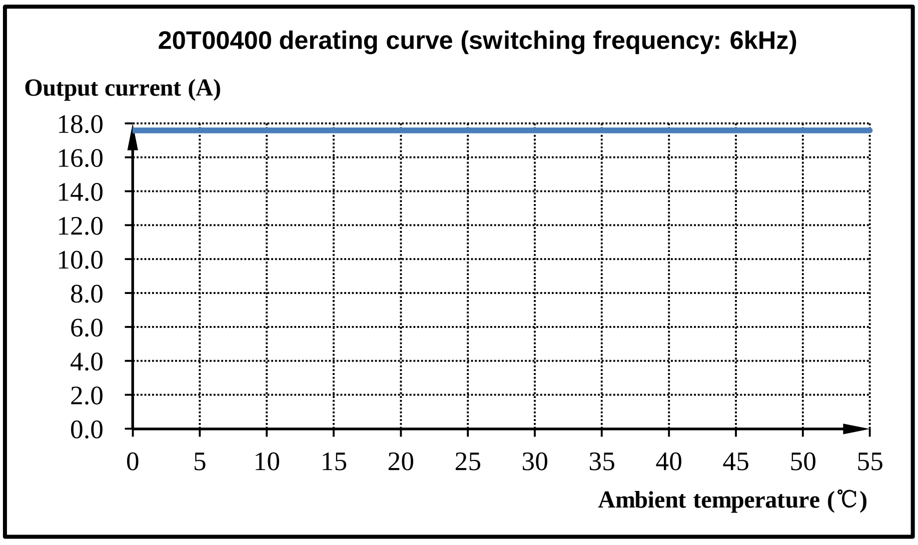

Figure 2-17 HD700-20T00400 derating curve

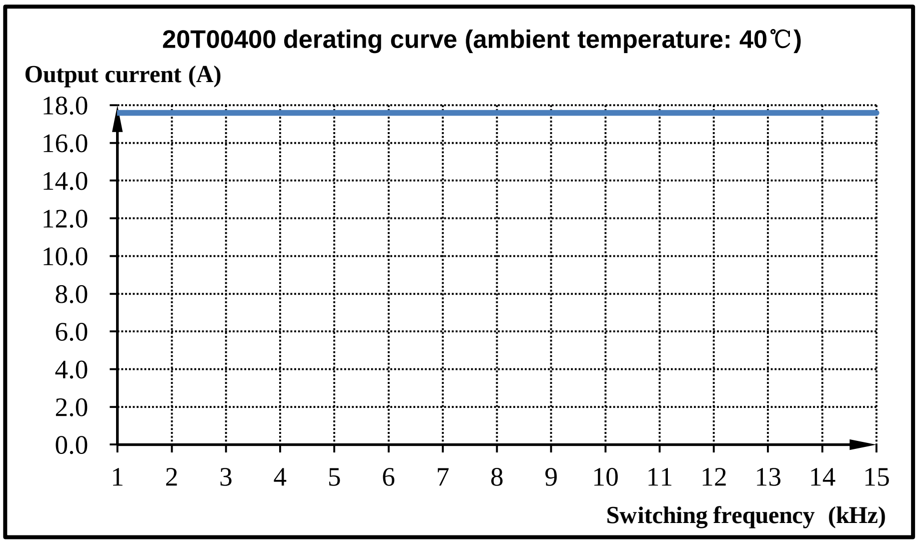

Figure 2-18 HD700-20T00400 derating curve

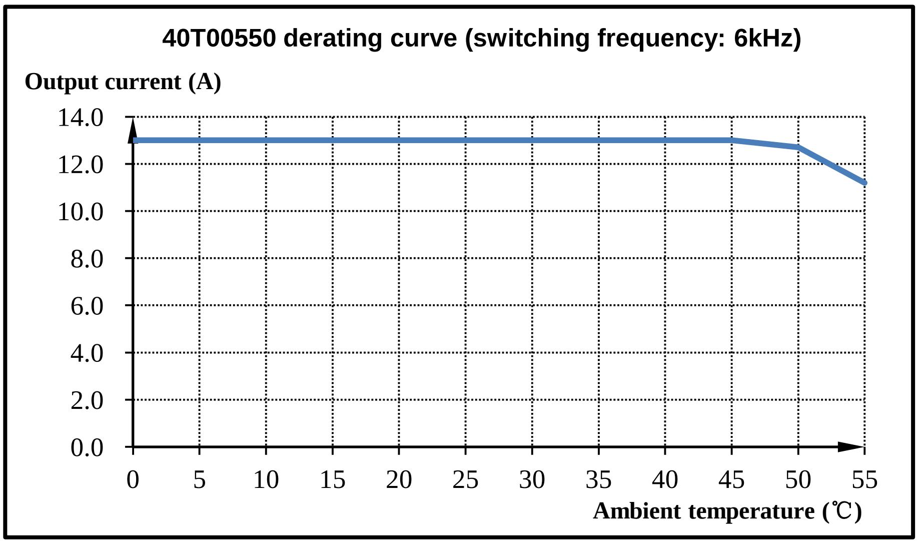

Figure 2-19 HD700-40T00550 derating curve

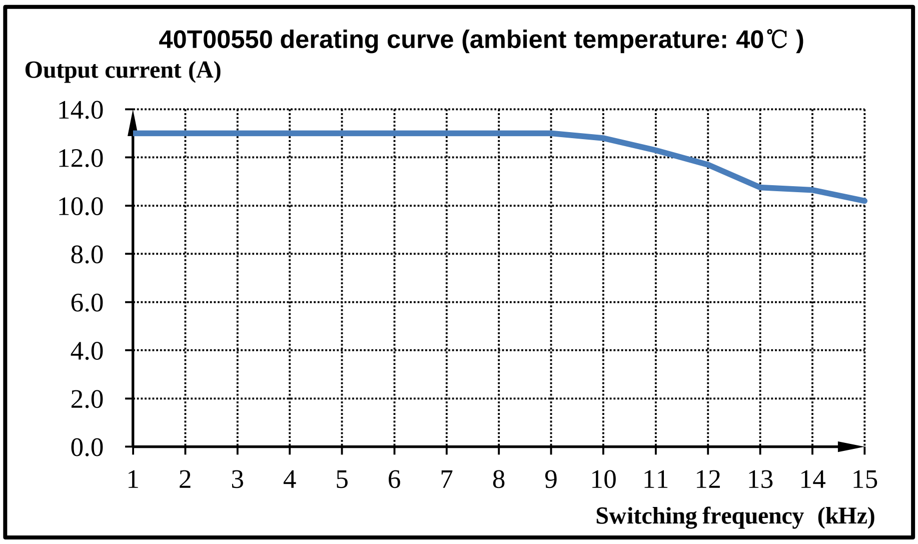

Figure 2-20 HD700-40T00550 derating curve

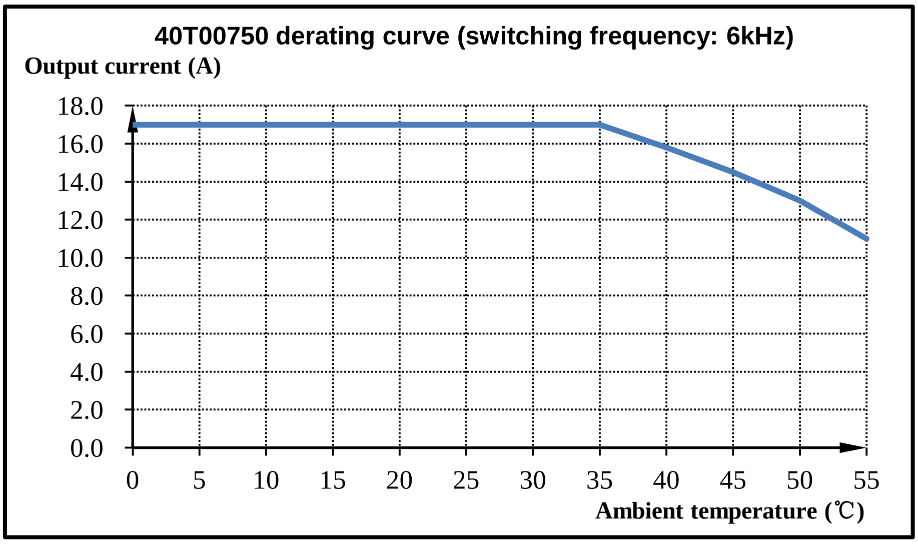

Figure 2-21 HD700-40T00750 derating curve

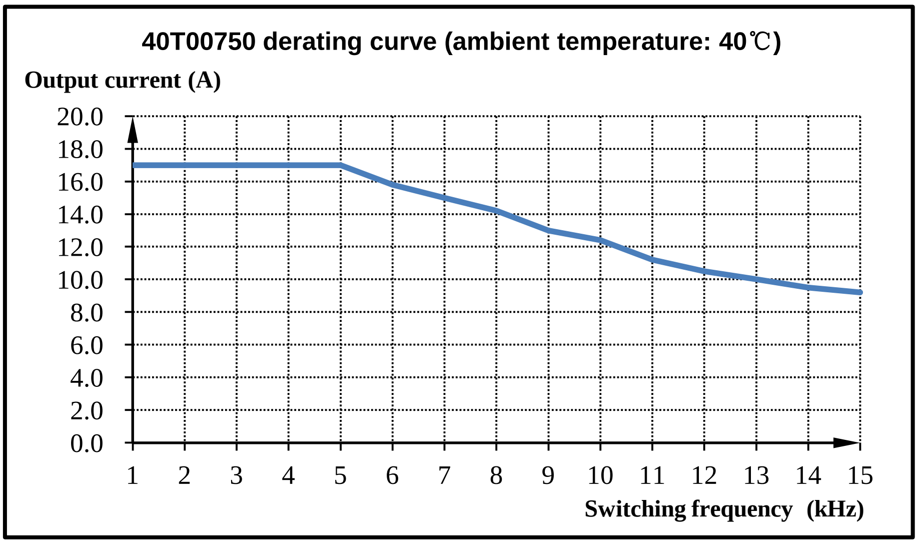

Figure 2-22 HD700-40T00750 derating curve

2.3.2 Drive losses

Table 2-3 HD700 size C drive losses

Voltage rating (V)	200	400	
Power (kW)	4.0	5.5	7.5
Loss (kW)	0.23	0.34	0.40

2.4 Size D

2.4.1 Derating curves

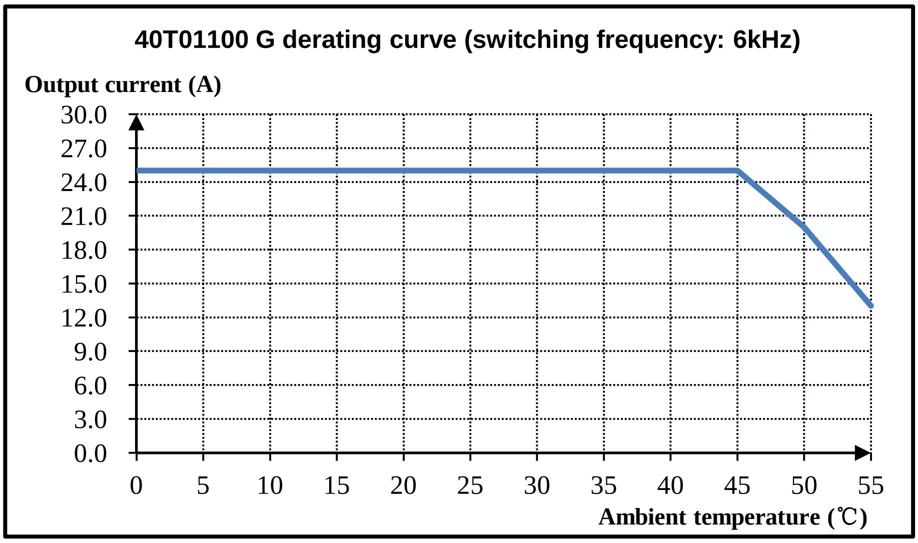

Figure 2-23 HD700-40T01100 G type derating curve

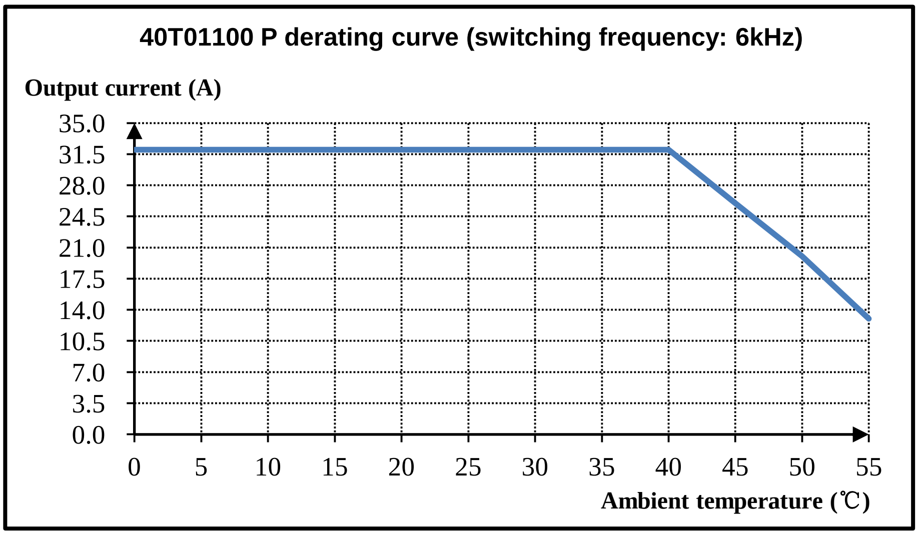

Figure 2-24 HD700 -40T01100 P type derating curve

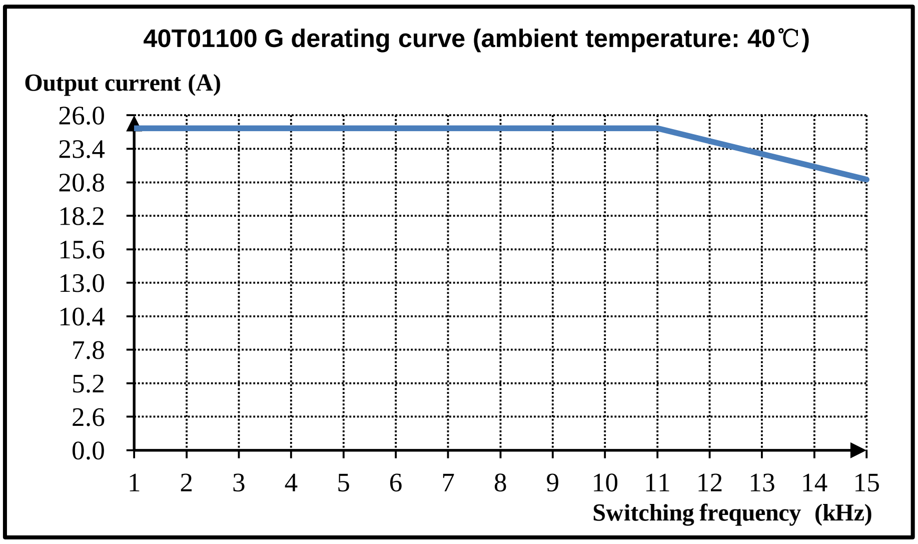

Figure 2-25 HD700 -40T01100 G type derating curve

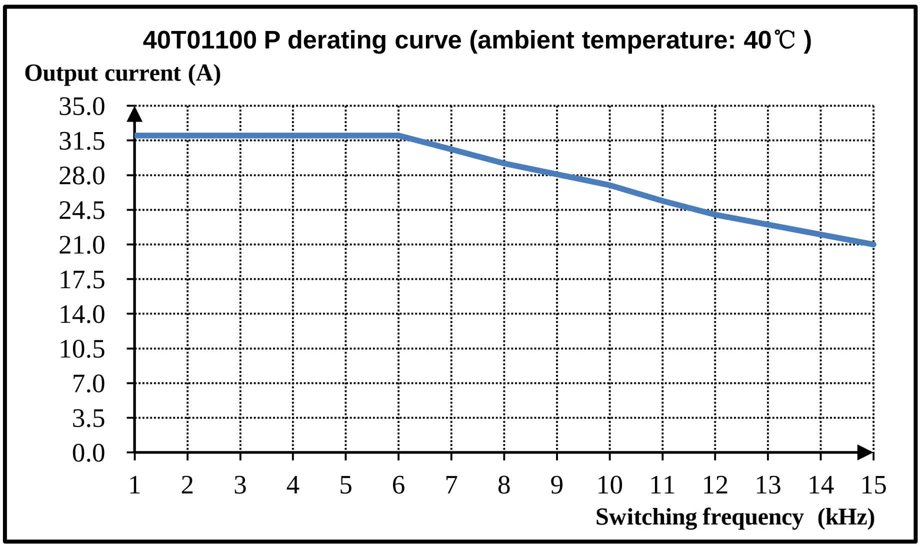

Figure 2-26 HD700-40T01100 P type derating curve

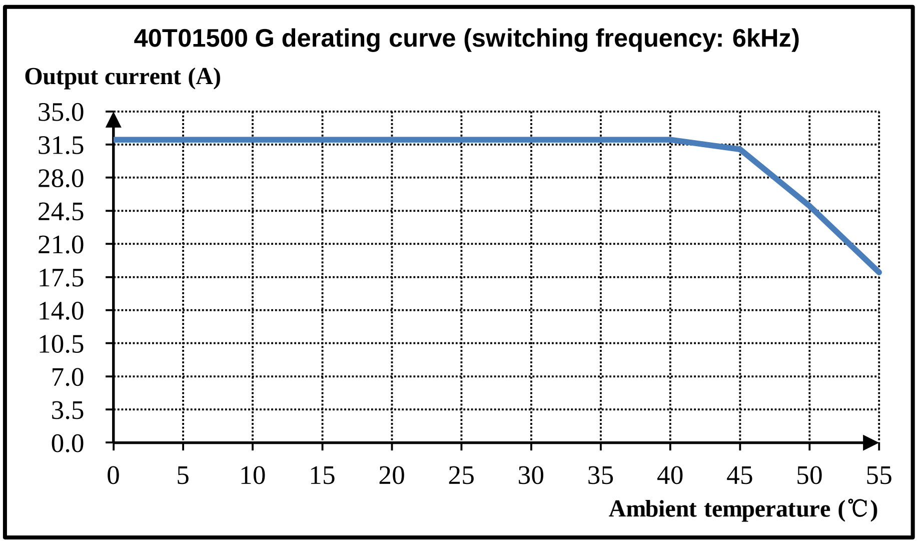

Figure 2-27 HD700-40T01500 G type derating curve

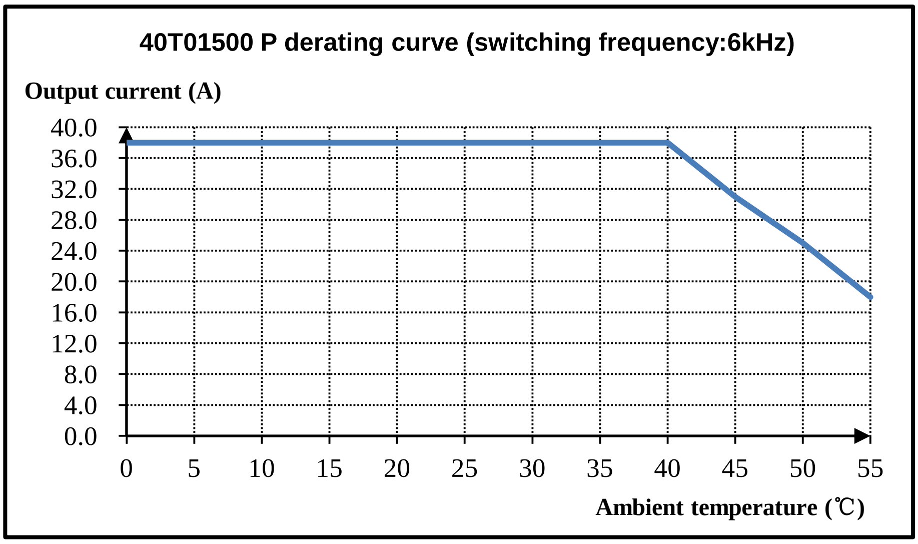

Figure 2-28 HD700-40T01500 P type derating curve

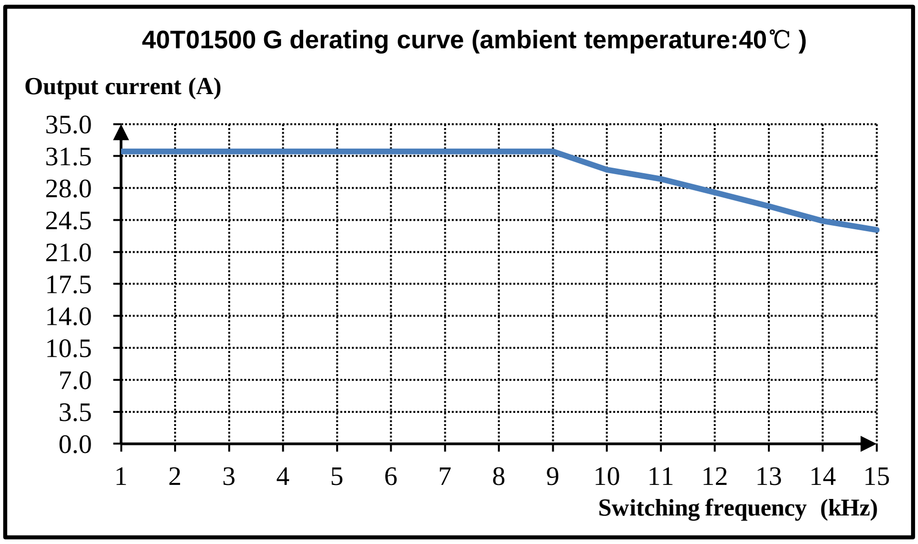

Figure 2-29 HD700-40T01500 G type derating curve

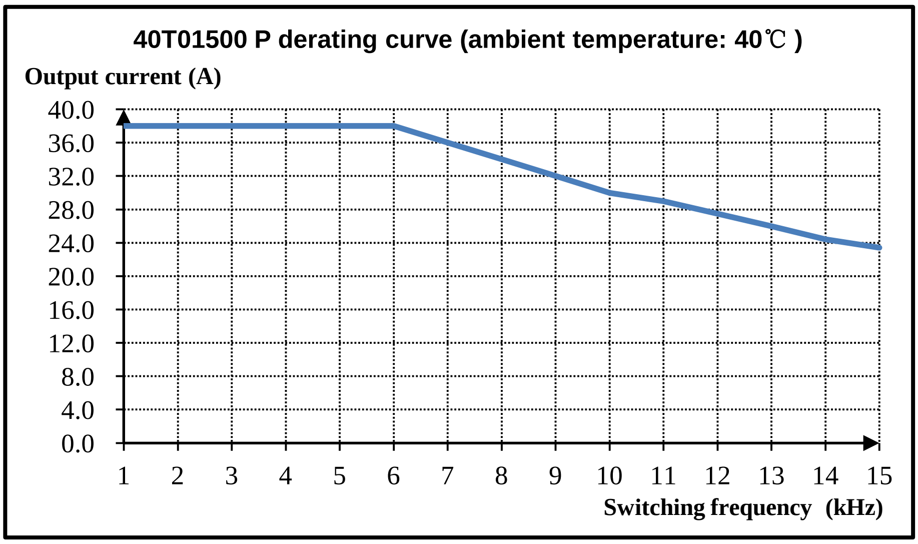

Figure 2-30 HD700-40T01500 P type derating curve

2.4.2 Drive losses

Table 2-4 HD700 size D drive losses

Voltage rating (V)	400			
Power (kW)	11G	15P	15G	18.5P
Loss (kW)	0.45	0.50	0.55	0.60

2.5 Size E

2.5.1 Derating curves

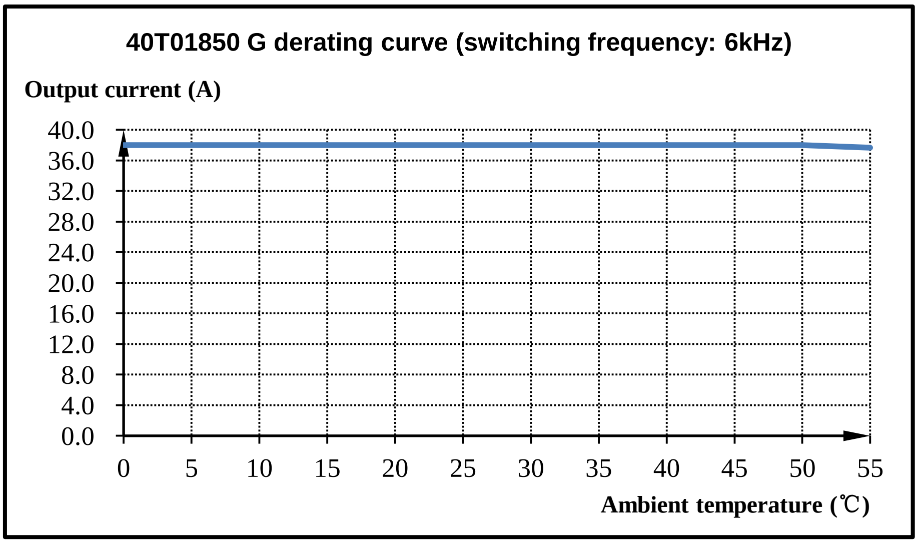

Figure 2-31 HD700-40T01850 G type derating curve

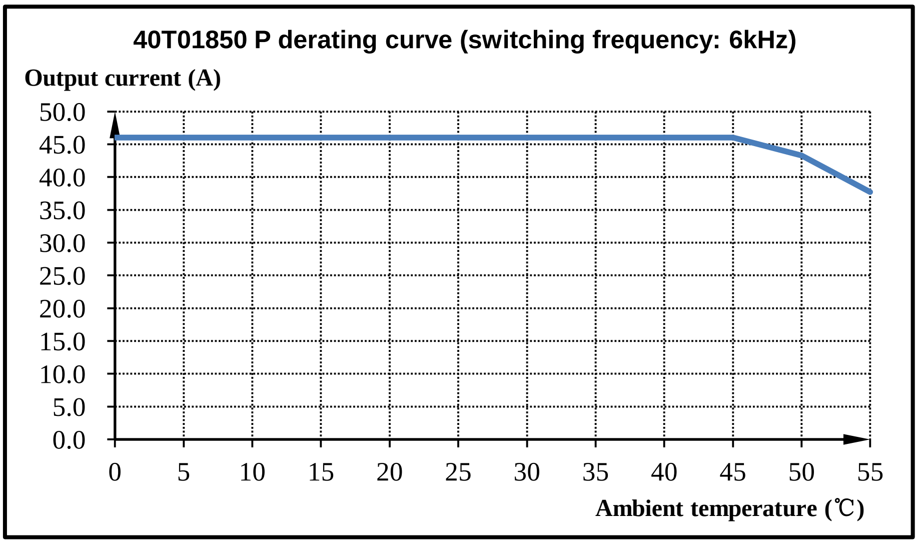

Figure 2-32 HD700-40T01850 P type derating curve

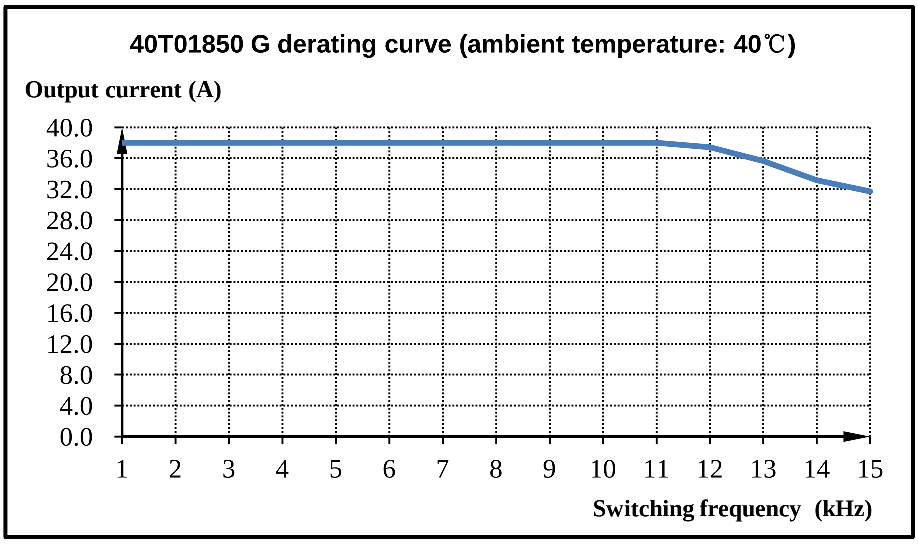

Figure 2-33 HD700-40T01850 G type derating curve

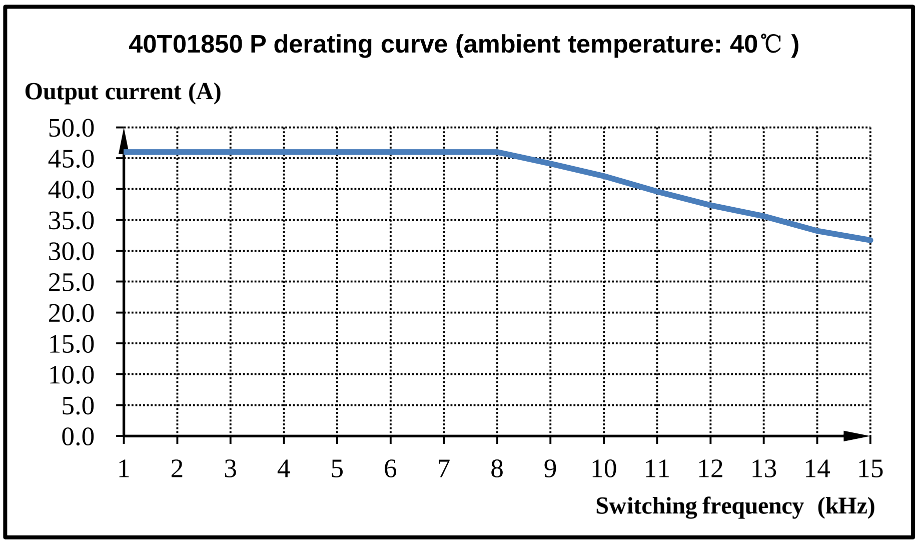

Figure 2-34 HD700-40T01850 P type derating curve

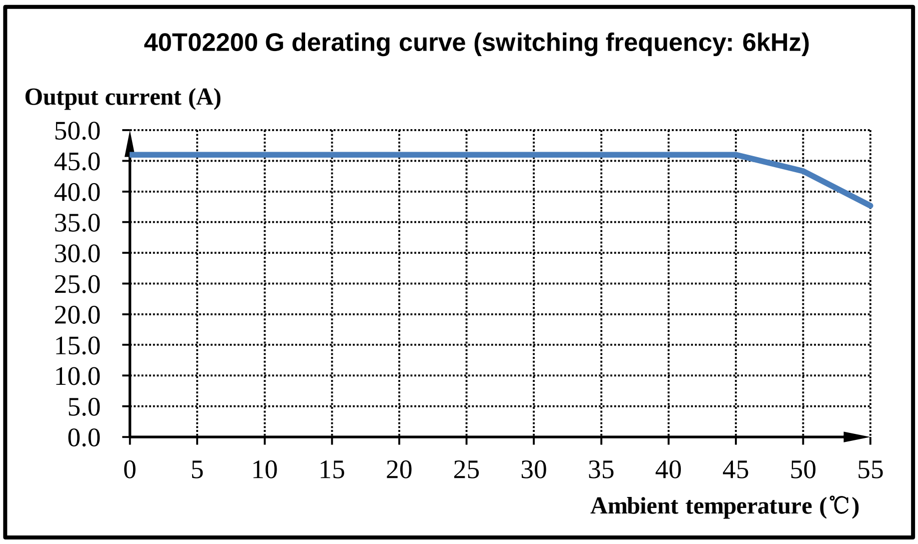

Figure 2-35 HD700-40T02200 G type derating curve

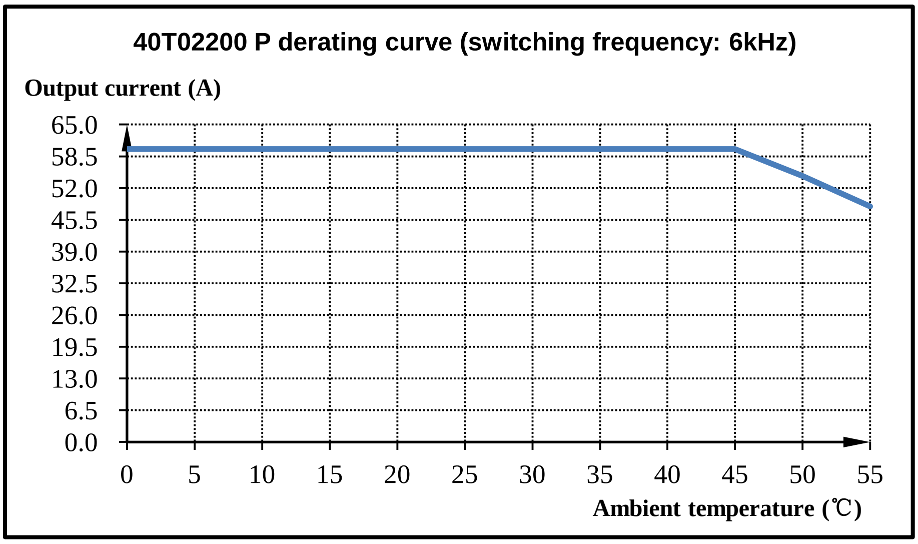

Figure 2-36 HD700-40T02200 P type derating curve

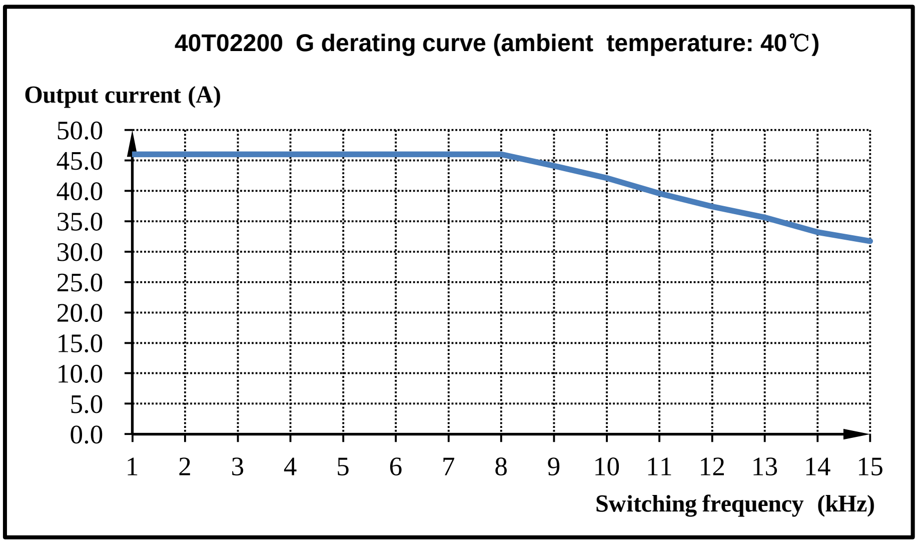

Figure 2-37 HD700-40T02200 G type derating curve

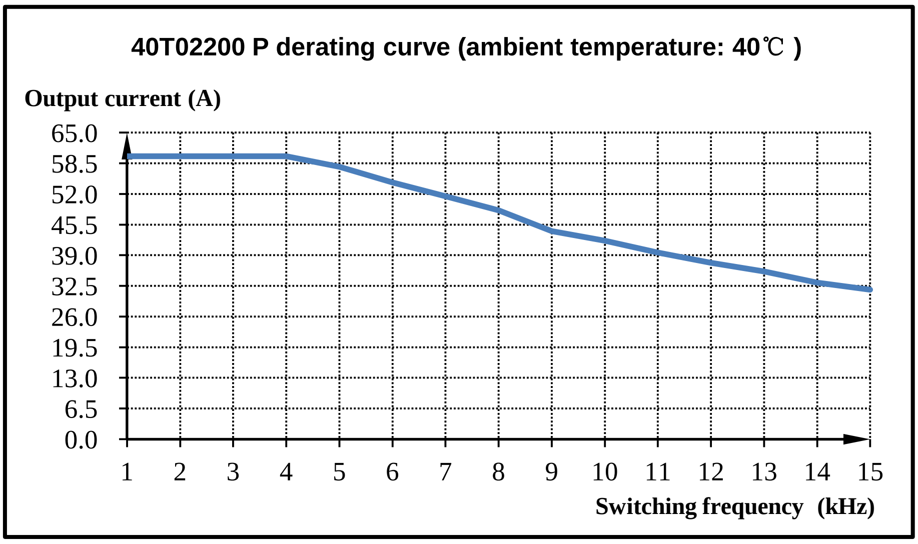

Figure 2-38 HD700-40T02200 P type derating curve

2.5.2 Drive losses

Table 2-5 HD700 size E drive losses

Voltage rating (V)	400			
Power (kW)	18.5G	22P	22G	30P
Loss (kW)	0.61	0.67	0.67	0.73

2.6 Derating due to altitude

Derating must be considered when the drive is installed at high altitude, greater than 1000m. This is because the cooling effect of Drive is deteriorated due to the thin air, as shown in Figure 2-39 that indicates the relationship between the altitude and rated current of the Drive.

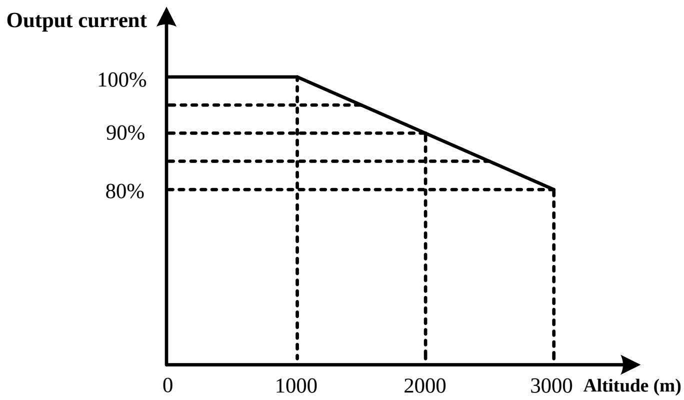

Figure 2-39 Drive derating at different altitude

2.7 Overload protection curve

Overload:
G type: 132kW and below, 150% rated output current, 1 minute
160kW and above, 130% rated output current, 1 minute
P type: 110% rated output current, 1 minute.

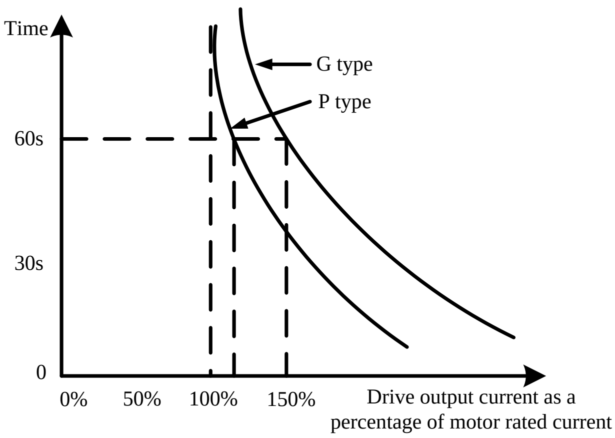

Figure 2-40 Overload protection curve

3 Installation and cabling

3.1 Installation

3.1.1 Diagram of mounting

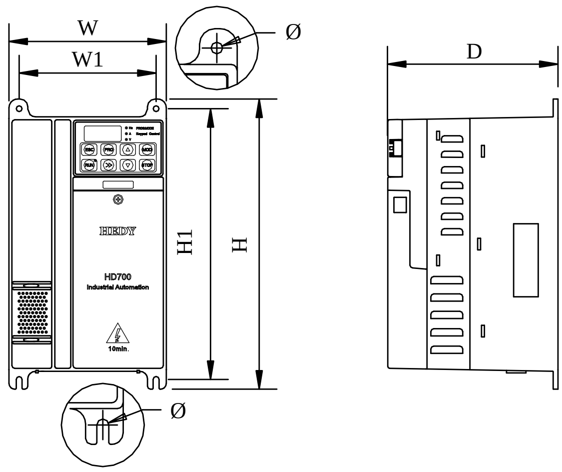

Figure 3-1 Mechanical dimensions and mounting (size A, B, C)

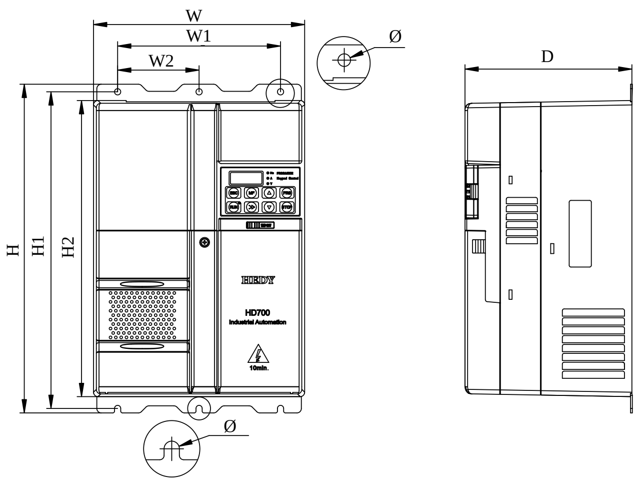

Figure 3-2 Mechanical dimensions and mounting (size D, E)

Table 3-1 Mechanical dimensions

Size	Model name	W (mm)	W1 (mm)	W2 (mm)	H (mm)	H1 (mm)	H2 (mm)	D (mm)	Mounting hole Ø (mm)	Weight (kg)
A	HD700-20D00040	97.4	80	—	202.4	190	—	148.8	5	1.4
	HD700-20D00075									
	HD700-20D00150									
	HD700-40T00075									
	HD700-40T00150									

Size	Model name	W (mm)	W1 (mm)	W2 (mm)	H (mm)	H1 (mm)	H2 (mm)	D (mm)	Mounting hole Ø (mm)	Weight (kg)
B	HD700-20D00220	142.4	123.5	—	220.4	208	—	155.5	5	2.2
	HD700-40T00220									
	HD700-40T00400									
C	HD700-20T00400	163.1	142	—	300	280	—	176.8	6	4.7
	HD700-40T00550									
	HD700-40T00750									
D	HD700-40T01100	238.8	184	92	370	356.5	333.4	189	7	8.7
	HD700-40T01500									
E	HD700-40T01850	238.8	184	92	435.5	422	403.8	200.3	7	11.3
	HD700-40T02200									

NOTE: Mechanical dimensions of size F to L are to be decided.

3.1.3 Keypad pallet

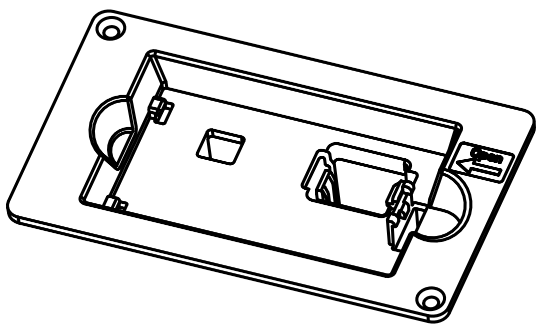

Figure 3-3 Outlook of keypad pallet

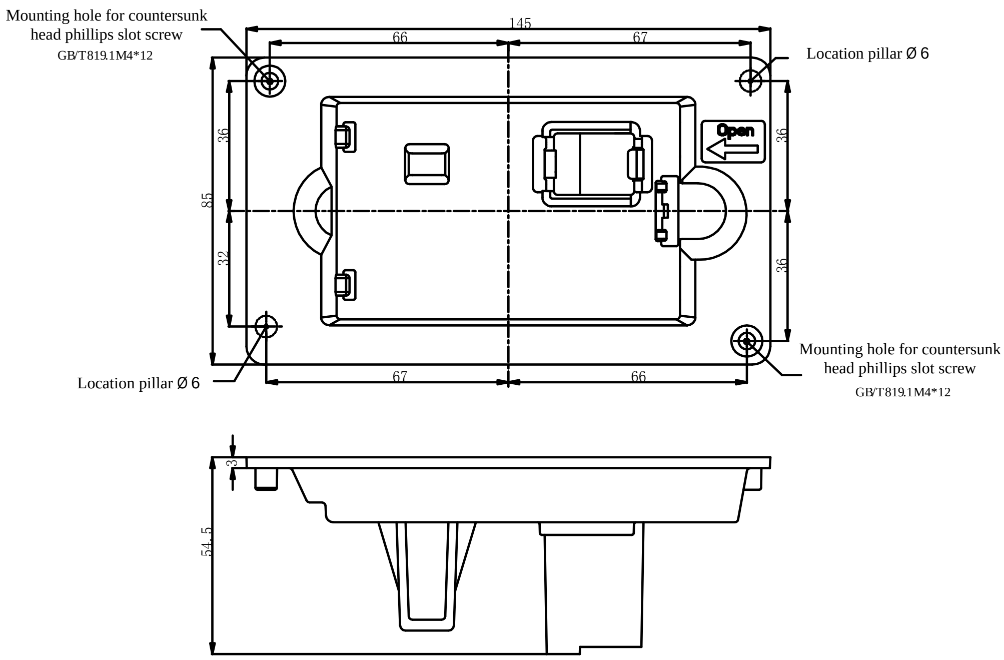

Figure 3-4 Outlook dimensions of pallet

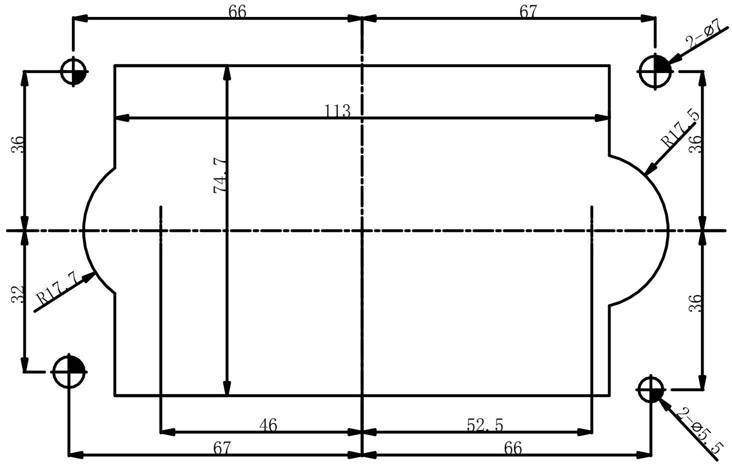

Figure 3-5 Pallet mounting dimensions

In order to reduce the difficulty of the keypad installation, recommend the mounting dimensions as shown bellow:

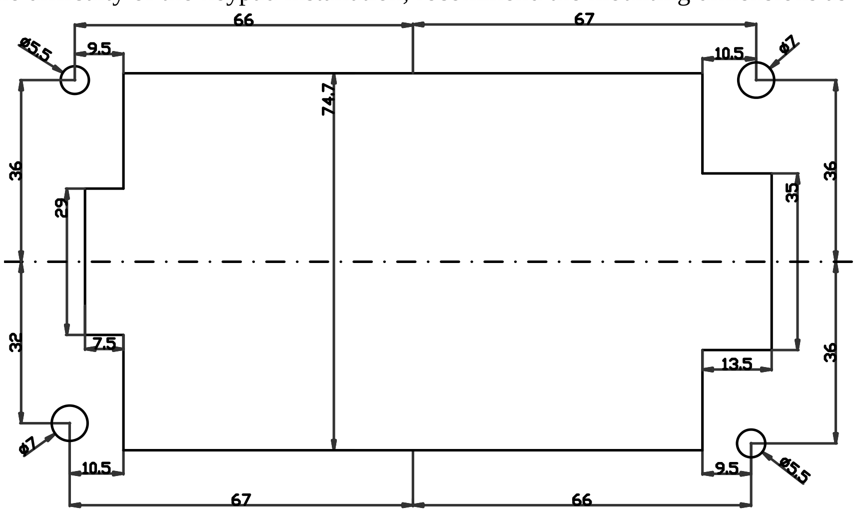

Figure 3-6 Recommended pallet mounting dimensions

3.1.4 Simple keypad pallet

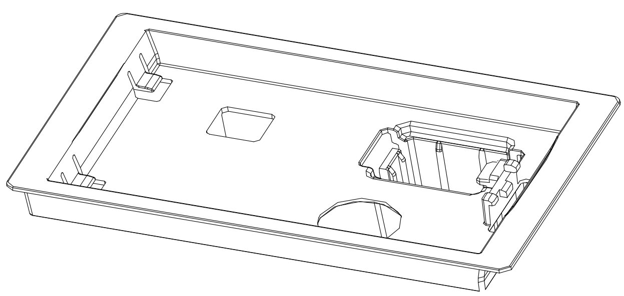

Figure 3-7 Outlook of simple keypad pallet

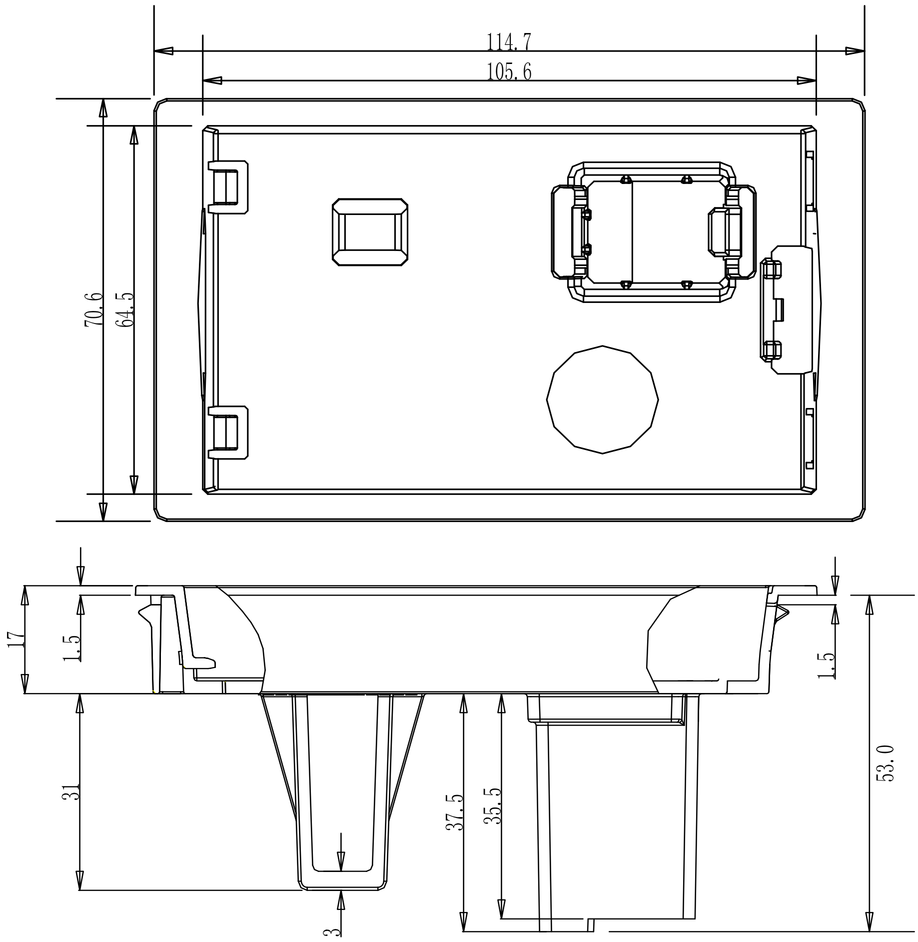

Figure 3-8 Outlook dimensions of simple keypad pallet

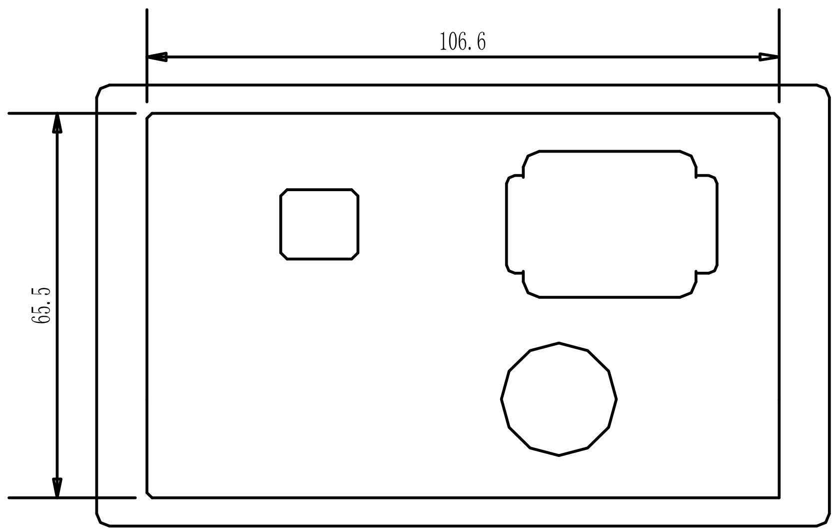

Figure 3-9 Simple keypad pallet mounting dimensions

3.2 Mechanical installation

3.2.1 Drive installation diagram

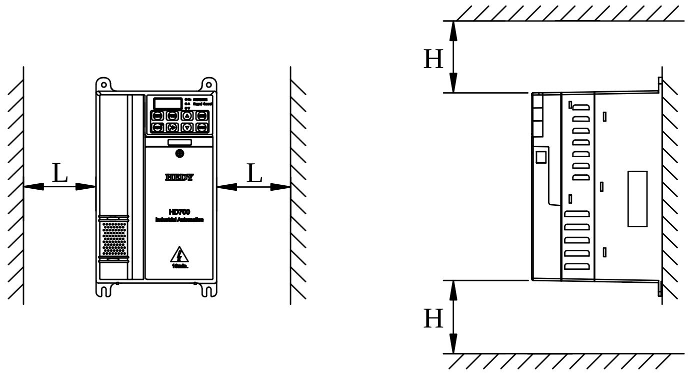

Figure 3-10 Single drive installation

Recommend: L ≥ 50mm，H ≥ 50mm

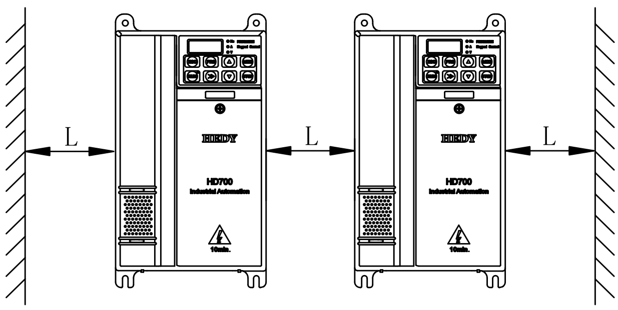

Figure 3-11 Multi drives installation

Recommend: L ≥ 50mm

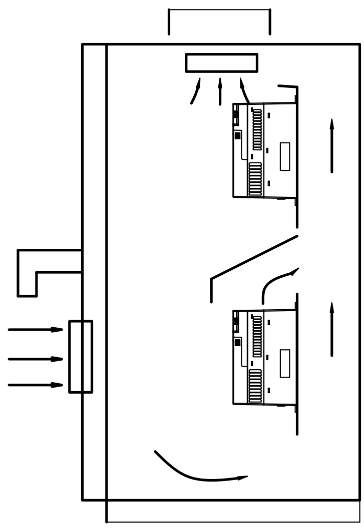

Figure 3-12 Multi drives vertical installation

3.2.2 Fitting and removing terminal cover

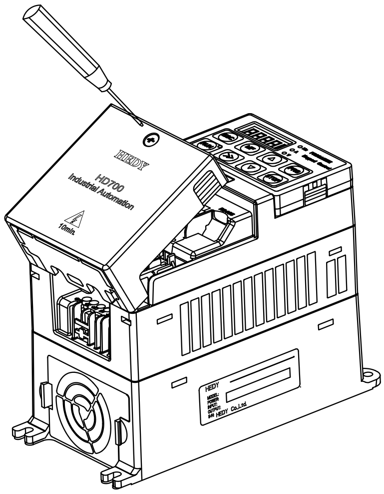

Figure 3-13 Fit and remove the terminal cover

Remove: Untighten the screw, loose the clip then take off the cover.

Fit: By a suitable angle, put the clips into the slots on the middle cover, push the cover on, tighten the screw M4×10 (Torque 1N m).

3.2.3 On and off the keypad

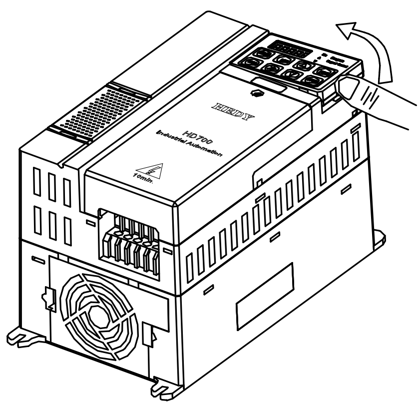

Figure 3-14 Diagram of the keypad fitting

Off: Push the spring clip, and then pull up the Keypad.

On: Fit the left two clips (correct angle) into the slots on the control pod, and then push down the Keypad.

HD700 keypad is removable, through a standard net cable can link the keypad and the drive, and show as below:

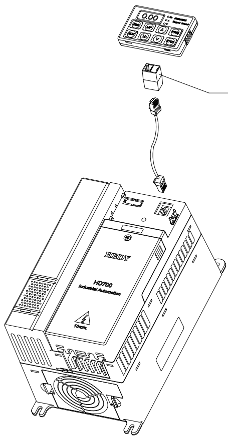

Figure 3-15 Keypad cable link

NOTE: maximum length of cable is 10cm.

3.3 Electrical installation

3.3.1 Power terminals

1. Models of Size A, B, C: HD700-20D00040～HD700-40T00750

L1	**L2**	**L3/N**	**U**	**V**	**W**
PE	**+DC**	**+DC1**	**BR**	**−DC**	**PE**

Figure 3-16 Size A, B Power terminals

L1	**L2**	**L3**	**U**	**V**	**W**
PE	**+DC**		**BR**	**−DC**	**PE**

Figure 3-17 Size C power terminals

Table 3-2 Power terminal of Size A, B, C

Terminals	Function
L1, L2, L3/N	AC power supply. For single phase supply, suggest to use L1, L3/N
+DC, +DC1	For DC choke, linked by busbar factory set
BR	Brake resistor, another end is +DC1
−DC	Minus DC bus
U, V, W	Output terminals (Motor terminals)
PE	Protective earth terminal

NOTE:

1) Size C has DC Choke inside, +DC1is not used.

2) For Size C, the brake resistor is connected to BR and +DC.

2. Models of Size D, E: HD700-40T01100～HD700-40T02200

+DC	BR	−DC	L1	L2	L3	PE	PE	U	V	W

Figure 3-18 Size D, E power terminals

Table 3-3 Power terminals of Size D, E

Terminals	Function
L1, L2, L3	AC power supply
+DC, −DC	Plus and minus DC bus
BR	Brake resistor, another end is +DC1.
U, V, W	Output terminals (Motor terminals)
PE	Protective earth terminal

3. Models of Size F, G: HD700-41T03000～HD700-41T05500

L1	L2	L3	PE			
			Size F, G			
U	V	W	PE	+DC	BR	−DC

Figure 3-19 Power terminals of Size F, G

Table 3-4 Power terminal of Size F, G

Terminals	Function
L1, L2, L3	AC power supply
+DC, −DC	Plus and minus DC bus
BR	Brake resistor, another end is +DC1
U, V, W	Output terminals (Motor terminals)
PE	Protective earth terminal

4. Models of size H, I: HD700-41T07500～HD700-41T13200

L1	L2	L3	PE	+DC1	BR	
			Size H, I			
U	V	W	PE	+DC	+DC1	−DC

Figure 3-20 Power terminals of Size H, I

Table 3-5 Power terminals functions of Size H, I

Terminals	Function
L1, L2, L3	AC power supply
+DC, +DC1	DC choke terminals
BR	Brake resistor, another end is +DC1
−DC	Minus DC bus
U, V, W	Output terminals (Motor terminals)
PE	Protective earth terminal

3.3.2 Power connection

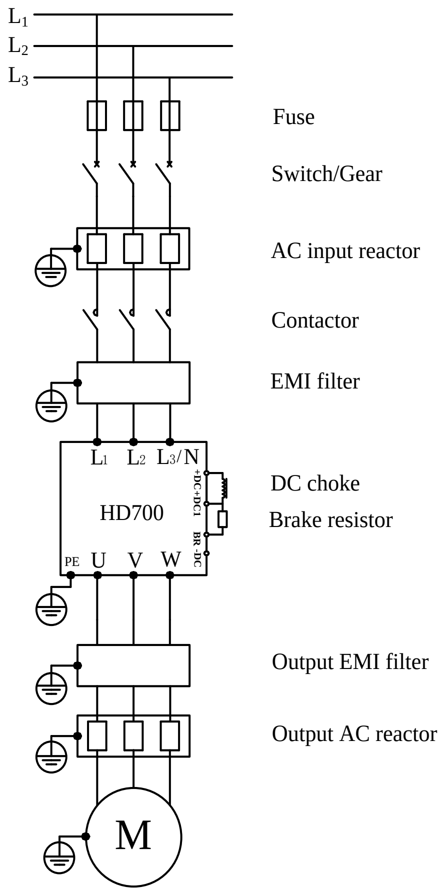

Figure 3-21 typical power connection

NOTE:

1. **The selection of fuse and switch refers to table 3-6.**
2. **Do not suggest using the power contactor to control the RUN/STOP of the drive.**
3. **When the motor cable is longer than 100m, recommend to use output AC reactor.**
4. **For safety, Drive and Motor must be earthed, and the earth contacting resistance must be less than 10Ω, the earthing conductor must meet the requirements in table 3-7.**

Table 3-6 Recommended switch, fuse, power cable and control cable

Model name	Input				Power				Control cable (mm²)
	Switch (A)		Fuse (A)		Input current (A)	Supply cable (mm²)		Motor cable (mm²)	
	1 PH	3 PH	1 PH	3 PH	1/3 PH	1 PH	3 PH	3 PH	
HD700-20D00040	16	10	10	6	7.1/4	1.0	1.0	1.0	≥0.5
HD700-20D00075	25	25	16	16	12.8/7.1	1.5	1.0	1.0	≥0.5
HD700-20D00150	32	25	20	16	20.5/11.3	2.5	1.5	1.0	≥0.5
HD700-20D00220	50	32	32	20	24/14.5	4.0	2.5	1.5	≥0.5
HD700-20T00400	32		20		16.5	2.5		2.5	≥0.5
HD700-40T00075	10		6		3.6	1.0		1.0	≥0.5
HD700-40T00150	16		10		5.7	1.0		1.0	≥0.5
HD700-40T00220	25		16		8.3	1.5		1.0	≥0.5
HD700-40T00400	32		20		13.2	2.5		1.5	≥0.5
HD700-40T00550	25		16		12.4	2.5		2.5	≥0.5
HD700-40T00750	32		20		16.1	2.5		2.5	≥0.5
HD700-40T01100	40		25		24	4.0		4.0	≥0.5
HD700-40T01500	50		32		31	6.0		6.0	≥0.5
HD700-40T01850	60		40		36	10		10	≥0.5
HD700-40T02200	80		50		44	16		16	≥0.5
HD700-40T03000	100		63		58	25		25	≥0.5
HD700-40T03700	120		80		72	25		25	≥0.5
HD700-40T04500	180		110		93	35		35	≥0.5
HD700-40T05500	200		125		121	70		70	≥0.5
HD700-40T07500	320		200		151	95		95	≥0.5
HD700-40T09000	400		250		175	120		120	≥0.5
HD700-40T11000	400		250		204	150		150	≥0.5
HD700-40T13200	500		315		248	240		240	≥0.5
HD700-60T03000	100		63		36	10		10	≥0.5
HD700-60T03700	100		63		43	16		16	≥0.5
HD700-60T04500	100		63		52	16		16	≥0.5
HD700-60T05500	120		80		61	25		25	≥0.5
HD700-60T07500	200		125		83	35		35	≥0.5
HD700-60T09000	200		125		97	50		50	≥0.5
HD700-60T11000	250		160		127	120		120	≥0.5
HD700-60T13200	250		160		145	120		120	≥0.5

NOTE:

1. **Data of 160kW and above are to be decided.**
2. **The current value of fuse is recommended for G type drives. About current value of fuse for P type drives, please refer to the rated input current of P type.**

Table 3-7 Earth conductor cross sectional area

Power cable cross sectional area-S (mm^2)	Earth conductor cross sectional area-Sp (mm^2)
$S \leq 16$	S
$16 < S \leq 35$	16
$35 < S$	S/2

NOTE:

The data in the table 3-7 is base on that they are same metal material; otherwise the area value should be modified by the conductor factor between the different metal material.

3.4 Brake resistor

3.4.1 Brake resistor rating

The actual resistance on the site application is decided by the motor power, system inertia, deceleration rate, etc. The user can design the brake resistance according to the actual situation.

Table 3-8 Brake resistor draft rating

Spec. / Model	Min.resistance (Ω)	Max. brake current (A)	Peak power (kW)	60s average power (kW)
HD700-20D00040	41	10	4.15	1.9
HD700-20D00075	41	10	4.15	1.9
HD700-20D00150	41	10	4.15	1.9
HD700-40T00075	120	7	5.67	2.67
HD700-40T00150	120	7	5.67	2.67
HD700-20D00220	20	21	8.48	4
HD700-40T00220	65	13	10.4	4.9
HD700-40T00400	50	17	13.5	6.4
HD700-20T00400	12	35	14.3	6.7
HD700-40T00550	24	35	28.7	13.5
HD700-40T00750	24	35	28.7	13.5
HD700-40T01100	24	35	28	13.5
HD700-40T01500	17	50	40	19
HD700-40T01850	17	50	40	19
HD700-40T02200	17	50	40	19

NOTE:

When choose HD700-40T/60T models (above 30kW), please contact with the supplier if brake resistors required.

3.4.2 Sizing a braking resistor

The size and rating of the resistor are calculated with respect to the energy to be absorbed, the rate at which the power is delivered and the time between successive decelerations.

Kinetic energy of the motor and the driven machine = 0.5 $\mathbf{J} \boldsymbol{\omega}^2$

Where:

$\boldsymbol{\omega}$ = angular velocity in radians s^{-1}

$$\boldsymbol{\omega} = \frac{2\pi \times n}{60}$$

Where: **n** = motor speed in RPM

J = total moment of inertia (kg m^2) of the motor and driven machine.

As energy is proportional to the square of the angular velocity, most of the energy is concentrated at the higher operating speeds. If the motor is operated above base speed, the power delivered to the resistor is constant until the speed falls below base speed.

Example

The information required to calculate the size of the braking resistor is as below:

Inertia	**J**	1.5kg m^2
Braking cycle		10 seconds in every 60 seconds
Time required decelerating to stop	$\mathbf{t_b}$	10 seconds
Motor size		2.2kW
Drive size		2.2kW
Motor nominal torque		16 N m
Motor rated speed	**n**	1430RPM
Braking transistor operating voltage	**V**	780VDC

The first stage is to determine the maximum braking torque (**M**) available.

M = 150% × nominal motor torque

= 1.5 × 16

= 24N m

Now calculate the minimum deceleration time possible to ensure that the time required is within specification.

$\mathbf{M} = \mathbf{J} \times \boldsymbol{\alpha}$

Where:

$\boldsymbol{\alpha}$ = angular acceleration (rad / s^2)

J = moment of inertia (kg m^2)

$$\boldsymbol{\alpha} = \frac{\boldsymbol{\omega}}{t_b}$$

$$\mathbf{M} = \mathbf{J} \times \frac{\boldsymbol{\omega}}{t_b}$$

Where:

$\boldsymbol{\omega}$ = angular velocity (rad / s)

$\mathbf{t_b}$ = minimum deceleration time (s)

$$\boldsymbol{\omega} = \frac{2\pi \times n}{60}$$

n = motor speed RPM

$$\mathbf{M} = \mathbf{J} \times \frac{\boldsymbol{\omega}}{t_b} = \mathbf{J} \times \frac{2 \times \pi \times n}{60 \times t_b}$$

$$= \frac{1.5 \times \pi \times 1430}{30 \times t_b}$$

$$24 = \frac{1.5 \times \pi \times 1430}{30 \times t_b}$$

$$\mathbf{t_b} = \frac{1.5 \times \pi \times 1430}{30 \times 24}$$

$$\mathbf{t_b} = 9.35s$$

The minimum time for deceleration is 9.35 seconds. The required deceleration time is 10 seconds and is therefore within the specification for the drive.

Now using the required deceleration time of 10 seconds, calculate the required braking torque:

$$\mathbf{M_b} = \frac{1.5 \times 2 \times \pi \times 1430}{60 \times 10}$$

$$\mathbf{M_b} = 22.45 \text{ N m}$$

Now calculate the braking power:

$$\mathbf{P_b} = \mathbf{M_b} \times \boldsymbol{\omega}$$

$$= \frac{22.45 \times \pi \times 1430}{30 \times 10^3}$$

$$= 3.36kW$$

So calculate the value of the braking resistor:

$$\mathbf{R_b} = \frac{(\mathbf{V_R})^2}{\mathbf{P_b}} = \frac{780^2}{3.36 \times 10^3} = 181\Omega$$

Since braking occurs intermittently, the resistor can be rated for intermittent rather than continuous power dissipation so that the overload factor of the resistor can be used. This factor can be obtained from the cooling curves for resistor type that is being used. The cooling curves are provided by the brake resistor producer. For this example, the overload factor = 2, so calculate the required power rating of the resistor: $\mathbf{P_R} = \frac{\mathbf{P_b}}{2} = \frac{3.36kW}{2} = 1.68kW$.

In practice, use a resistor having a preferred value close to and lower than the calculated value. This is because the calculated value would cause the braking transistor to be switched on almost continuously during braking. In this case, the drive will not have full control of the DC Bus voltage. A lower value of braking resistor will cause the braking transistor to act as a chopper which will then allow the drive to control the DC Bus voltage more accurately.

This reduction in value does not increase the power dissipation since the average voltage across the resistor is reduced by the braking transistor operating as a chopper.

3.5 Line reactors

Input line reactors reduce the risk of damage to the drive resulting from poor phase balance or severe disturbances on the supply network.

Where line reactors are to be used, reactance values of approximately 2% are recommended. Higher values may be used if necessary, but may result in a loss of drive output (reduced torque at high speed) because of the voltage drop.

For all drive ratings, 2% line reactors permit drives to be used with a supply imbalance of up to 3.5% negative phase sequence (equivalent to 5% voltage imbalance between phases).

Severe disturbances may be caused by the following factors, for example:

- Power factor correction equipment connected close to the drive.
- Direct-on-line started motor(s) connected to the supply such that when any of these motors are started, the voltage dip exceeds 20%. Large
- Large DC drives having no or inadequate line reactors connected to the supply.

Such disturbances may cause excessive peak currents to flow in the input power circuit of the drive. This may cause nuisance tripping, or in extreme cases, failure of the drive.

Drives of low power rating may also be susceptible to disturbance when connected to supplies with a high rated capacity.

Reactor current ratings

Continuous current:

Not less than the continuous input current rating of the drive.

Repetitive peak current rating:

Not less than twice the continuous input current rating of the drive.

Input Inductor calculation

To calculate the inductance required (at **Y**%), use the following equation:

$$L=\frac{Y}{100}\times\frac{V}{\sqrt{3}}\times\frac{1}{2\pi fI}$$

Where:

L = inductance (H)

I = drive rated input current (A)

f = supply frequency (Hz)

V = voltage between lines

Y = percentage of voltage drop

Table 3-9 AC line reactor values

Drive model \ Reactor data	Input phases	Inductance (mH)	Continuous rms current (A)	Peak current (A)
HD700-20D00040	1	8.1	3.0	6.0
	3	4.7	1.7	3.4
HD700-20D00075	1	4.3	5.6	11.2
	3	2.5	3.2	6.5
HD700-20D00150	1	2.3	11.2	22.4
	3	1.3	6.5	12.9
HD700-20D00220	1	1.5	16.4	32.8
	3	0.9	9.5	18.9
HD700-20T00400	3	0.5	15.0	30.0
HD700-40T00075	3	7.4	1.9	3.8
HD700-40T00150	3	3.8	3.7	7.4
HD700-40T00220	3	2.5	5.5	11.0
HD700-40T00400	3	1.6	8.7	17.4
HD700-40T00550	3	1.2	12.0	24.0
HD700-40T00750	3	0.9	16.4	32.8
HD700-40T01100	3	0.6	23.1	46.2

Drive model \ Reactor data	Input phases	Inductance (mH)	Continuous rms current (A)	Peak current (A)
HD700-40T01500	3	0.5	31.1	62.2
HD700-40T01850	3	0.4	38.0	76.0
HD700-40T02200	3	0.3	45.0	90.0

3.6 Cables and fuses

3.6.1 Cables

Recommended cable sizes are given in table 3-10 as below. They are only a guide; refer to local wiring regulations for correct size of cables. In some cases, a larger cable size is required to avoid excessive voltage drop.

Motor cables

The recommended output cable sizes assume that the motor maximum current matches that of the drive. Where a motor of reduced rating is used, the cable rating may be chosen to match that of the motor. To ensure that the motor and cable are protected against overload, the drive must be programmed with the correct motor rated current.

Table 3-10 Recommended diameter of copper conductor cables

Model		Recommended supply cable (mm^2)	Recommended motor cable (mm^2)	Recommended brake resistor cable (mm^2)	Control cable (mm^2)
HD700-20D00040	Single phase	1.0	1.0	1.0	≥0.5
	Three phase	1.0	1.0	1.0	≥0.5
HD700-20D00075	Single phase	1.5	1.0	1.0	≥0.5
	Three phase	1.0	1.0	1.0	≥0.5
HD700-20D00150	Single phase	2.5	1.0	1.0	≥0.5
	Three phase	1.5	1.0	1.0	≥0.5
HD700-20D00220	Single phase	4.0	1.5	1.5	≥0.5
	Three phase	2.5	1.5	1.5	≥0.5
HD700-20D00400		2.5	2.5	2.5	≥0.5
HD700-40T00075		1.0	1.0	1.5	≥0.5
HD700-40T00150		1.0	1.0	1.5	≥0.5
HD700-40T00220		1.5	1.0	1.5	≥0.5
HD700-40T00400		2.5	1.5	1.5	≥0.5
HD700-40T00550		2.5	2.5	2.5	≥0.5
HD700-40T00750		2.5	2.5	2.5	≥0.5
HD700-40T01100		4.0	4.0	4.0	≥0.5
HD700-40T01500		6.0	6.0	6.0	≥0.5
HD700-40T01850		10	10	10	≥0.5
HD700-40T02200		16	16	16	≥0.5
HD700-40T03000		25	25	25	≥0.5
HD700-40T03700		25	25	25	≥0.5
HD700-40T04500		35	35	35	≥0.5
HD700-40T05500		70	70	70	≥0.5

Model	Recommended supply cable (mm^2)	Recommended motor cable (mm^2)	Recommended brake resistor cable (mm^2)	Control cable (mm^2)
HD700-40T07500	95	95	95	≥0.5
HD700-40T09000	120	120	120	≥0.5
HD700-40T11000	150	150	150	≥0.5
HD700-40T13200	240	240	240	≥0.5
HD700-60T03000	10	10	10	≥0.5
HD700-60T03700	16	16	16	≥0.5
HD700-60T04500	16	16	16	≥0.5
HD700-60T05500	25	25	25	≥0.5
HD700-60T07500	35	35	35	≥0.5
HD700-60T09000	50	50	50	≥0.5
HD700-60T11000	120	120	120	≥0.5
HD700-60T13200	120	120	120	≥0.5

3.6.2 Fuses

The AC supply to the drive must be fitted with suitable protection against overload and short circuits. Failure to observe this requirement will cause risk of fire.

A fuse or other protection device must be included in all live connectors to the AC supply.

An MCB (miniature circuit breaker) or MCCB (moulded case circuit breaker) with type C tripping characteristics maybe used in place of fuses as long as the fault clearing capacity is sufficient for the installation. The current value of fuses cannot be lower than the data in Ttable 3-11.

NOTE:

The tripping current of the MCB/MCCB of type C is (5 to 10) In. It is suitable for the distribution circuit, lighting circuit and motor circuit.

Table 3-11 Recommended fuses

Drive model		Recommended input fuses (A)		
		IECgG	ClassCC	ClassJ
HD700-20D00040	Single phase	10	10	—
	Three phase	6	5	—
HD700-20D00075	Single phase	16	15	—
	Three phase	16	15	—
HD700-20D00150	Single phase	20	20	—
	Three phase	16	15	—
HD700-20D00220	Single phase	32	—	30
	Three phase	20	15	—
HD700-20D00400		20	20	—
HD700-40T00075		6	5	—
HD700-40T00150		10	10	—
HD700-40T00220		16	15	—
HD700-40T00400		20	20	—

Drive model	Recommended input fuses (A)		
	IECgG	ClassCC	ClassJ
HD700-40T00550	16	15	—
HD700-40T00750	20	20	—
HD700-40T01100	32	—	—
HD700-40T01500	40	—	—
HD700-40T01850	50	—	—
HD700-40T02200	63	—	—
HD700-40T03000	63	—	—
HD700-40T03700	80	—	—
HD700-40T04500	110	—	—
HD700-40T05500	125	—	—
HD700-40T07500	200	—	—
HD700-40T09000	250	—	—
HD700-40T11000	250	—	—
HD700-40T13200	315	—	—
HD700-60T03000	63	—	—
HD700-60T03700	63	—	—
HD700-60T04500	63	—	—
HD700-60T05500	80	—	—
HD700-60T07500	125	—	—
HD700-60T09000	125	—	—
HD700-60T11000	160	—	—
HD700-60T13200	160	—	—

NOTE:

The current value of fuse is recommended for G type drives. For P type drives, please refer to the rated input current of P type.

3.7 Supply network

There are three supply types: **TT, TN, IT** system. **TN** system is divided into **TN-C, TN-S, TN-C-S** system.

The first letter relates to the connection between earth and the source of power supply, i.e. generator or transformer; and the second relates to the connection between earth and the electrical device the power is supplying; with each letter meaning as follows:

- **T** = Direct connection of a point with earth (Latin: terra).
- **N** = Neutral. Connection to earth via the supply network.
- **S** = Separate.
- **C** = Combined.
- **I** = Isolated. No connection with earth, unless through a high impedance.

In an **IT** network, the electrical distribution system has no connection to earth at all, or it has only a high impedance connection.

A **TT** system has a direct connection to the supply source to earth and a direct connection of the installation metalwork to earth.

In a **TN** earthing system, one of the points in the generator or transformer is connected with earth, usually the star point in a three-phase system. The body of the electrical device is connected with earth via this earth connection at the transformer. The conductor that connects the exposed metallic parts of the consumer's electrical installation is called protective earth (PE). The conductor that connects to the star point in a three-phase system, or that carries the return current in a single-phase system, is called neutral (N).

A **TN-S** system has the supply source directly connected to earth, the installation metalwork connected to the neutral of the supply source via the lead sheath of the supply cable, and the neutral and protective conductors throughout the whole system performing separate functions.

A **TN-C-S** system is as the TN-S but the supply cable sheath is also the neutral, i.e. it forms a combined earth/neutral conductor known as a PEN (protective earthed neutral) conductor.

The installation earth and neutral are separate conductors.

This system is also known as PME (protective multiple earthing).

In a **TN-C** earthing system, a combined PEN conductor fulfills the functions of both a PE and an N conductor. Rarely used.

HD700 drives are suitable for use with TN and TT system.

4 EMC

4.1 Ground leakage current

The ground leakage current depends upon the internal EMC filter being fitted. The drive is supplied with the filter fitted. Instructions for removal of the internal EMC filter are given in the *HD700 User Manual*. The ground leakage currents with internal EMC filter fitted or removed are shown as below:

Table 4-1 HD700 ground leakage current data

Model	Voltage class	With internal EMC filter fitted (mA)	With internal EMC filter removed (mA)
SizeA	200V	10	0.1
	400V	9	0.1
SizeB	200V	11	0.1
	400V	7	0.1
SizeC	200V	8	0.0
	400V	18	0.3
SizeD	400V	17	0.1
SizeE	400V	18	0.1

NOTE:

1) **The test condition of the Table 4-1 is no motor load.**
2) **When a ground leakage protecting contactor is used for front power supply, the internal EMC filter should be removed.**
3) **When the internal EMC filter is fitted, the leakage current is high. In this case, a permanent fixed ground connection must be provided using two independent conductors each with a cross-section equal to or exceeding that of the supply conductors. The drive is provided with two earth terminals to facilitate this. The purpose is to prevent a safety hazard occurring if the connection is lost.**

4.2 Internal EMC filter

The internal EMC filter reduces radio-frequency emissions into the mains supply. Where the motor cable length is short, it permits the requirements of EN61800-3 to be met for the second environment. For longer motor cables, the filter continues to provide a useful reduction in emission level, and when used with any length of shielded motor cable up to the limit for the drive, it is unlikely that nearby industrial equipment will be disturbed. It is recommended that the filter be used in all applications unless the instructions given above require it to be removed or the ground leakage current of 28mA is unacceptable.

There is a metal tab between the ground and EMC filter as show in the following figures. It is recommended that the internal EMC filter be kept in place unless there is a specific reason for removing it.

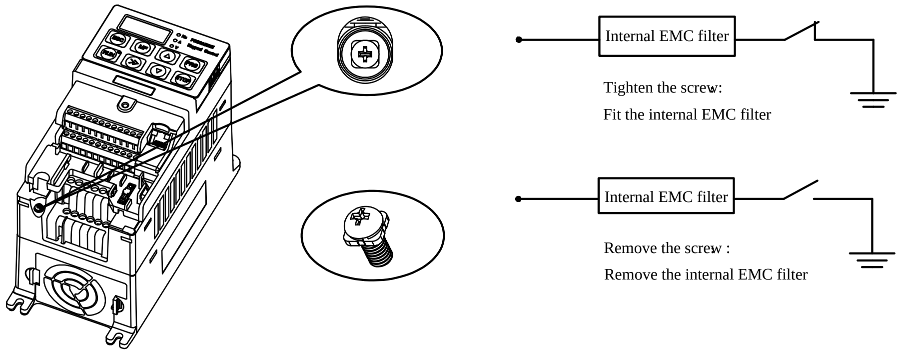

Figure 4-1 Fitting and removal of internal EMC filter (size A)

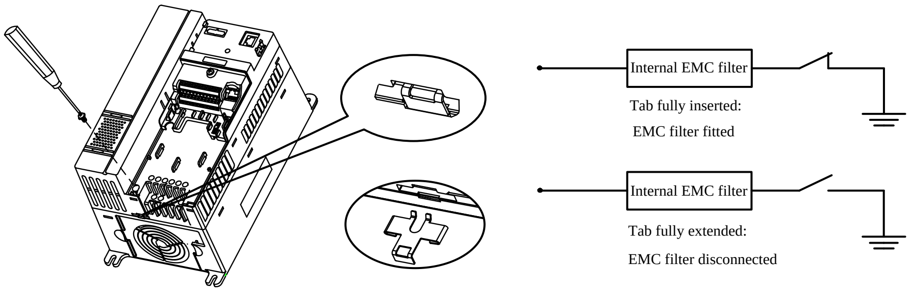

Figure 4-2 Fitting and removal of internal EMC filter (size B, C)

NOTE: After removing the tab of EMC filter, please keep the tab for re-fitting the EMC filter.

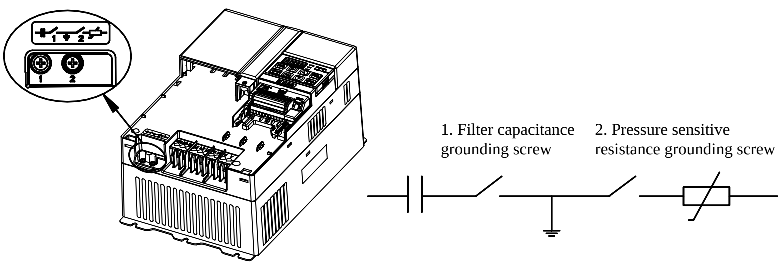

Figure 4-3 Fitting and removal of internal EMC filter (size D, E)

Tighten the filter capacitance screw up and the inner EMC filter is fitted.

Loosen and remove the filter capacitance screw, the inner EMC fliter is disconnected.

NOTE: When disconnecting thermistor is required, please loosen the screw and remove.

4.3 Electromagnetic compatibility (EMC)

4.3.1 EMC overview

Electromagnetic compatibility (EMC) is the branch of electrical sciences which studies the unintentional generation, propagation and reception of electromagnetic energy with reference to the unwanted effects (Electromagnetic interference, or EMI) that such energy may induce. EMC aims to ensure that equipment items or systems will not interfere with or prevent each other's correct operation through spurious emission and absorption of EMI.

While electromagnetic interference (EMI) is a phenomenon-the radiation emitted and its effects-electromagnetic compatibility (EMC) is an equipment characteristic or property-to not behave unacceptably in the EMI environment. EMC ensures the correct operation, in the same electromagnetic environment, of different equipment items which use or respond to electromagnetic phenomena, and the avoidance of any interference effects.

An electrical equipment can be an interference source and may also be a victim.

Electrical transmission equipments are limited by EN61800-3. EN61800-3 (part 3) is the EMC product standard of adjustable speed electrical power drive systems (PDS). According to this standard, the industrial power supply networks do not need to observe all the EMC requirements, but it is necessary to take specific EMC solutions according to the actual environment. Immunity is the ability of the receptor or victim equipment to operate correctly in the presence of electromagnetic disturbances. EN61800-3 defines limits and requirements of equipment running conditions in industry application. HD700 series drive is designed for industrial application. In an electrical power drive system, just like other electrical control equipments (such as contactor, switch), it is a component of the system. It must observe this standard for correct drive installation.

4.3.2 General requirements for EMC

The drive is usually mounted in the electrical control enclosure. When designing and mounting the drive, please observe the following EMC installation guide to ensure meet EMC requirements in bad electrical environment.

Ground (earth) connections

The grounding arrangements should be in accordance with Figure 4-4, which shows a single drive on a back-plate with or without an additional enclosure. Figure 4-4 shows how to manage EMC when using an unshielded motor cable. However a shielded cable is preferable.

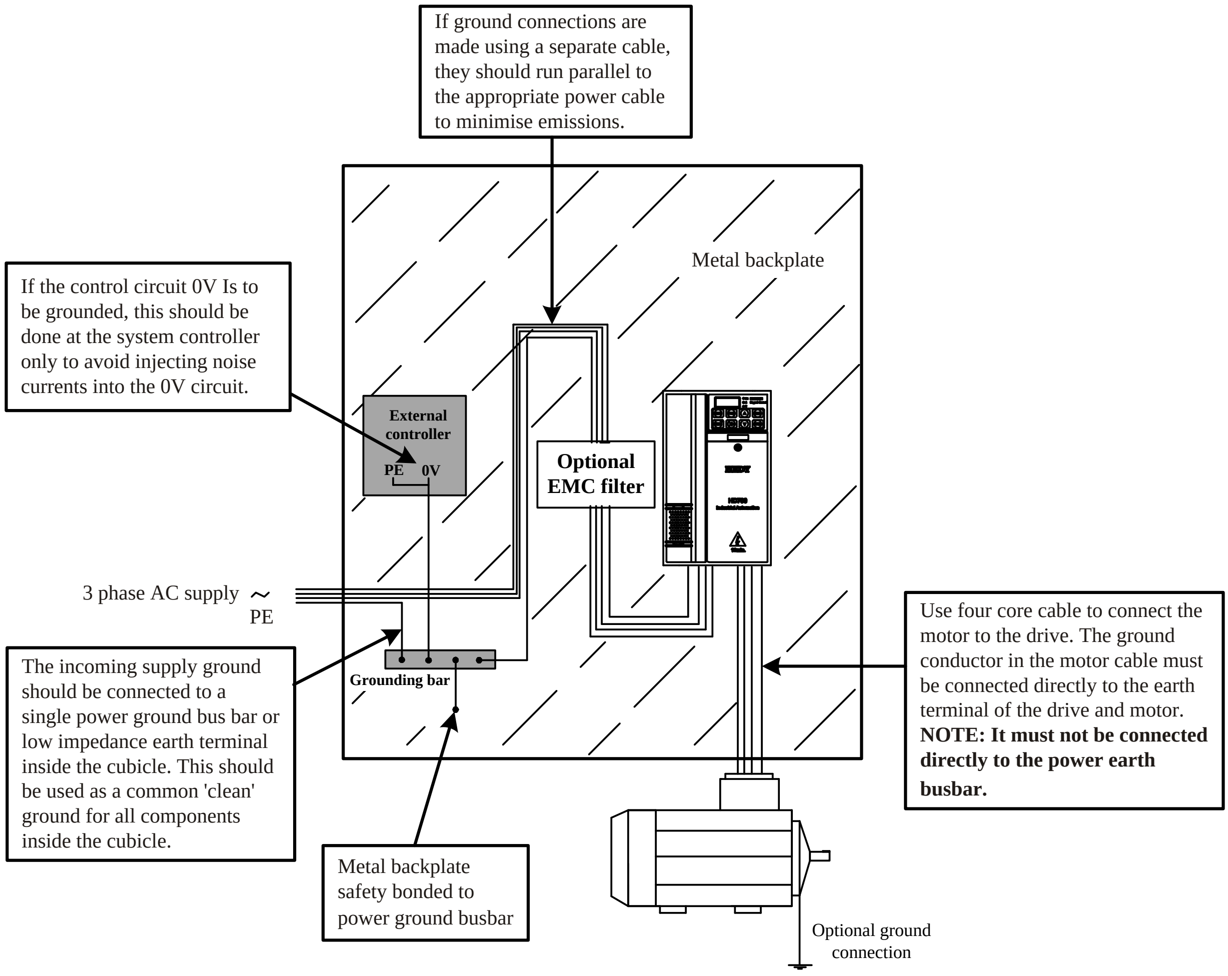

Figure 4-4 General EMC enclosure layout showing ground connections

NOTE:

1) **All devices in the enclosure must be connected to the grounding bar using short and thick ground cables.**
2) **The ground cable from the motor must be connected to the PE terminal of the drive.**
3) **All hardwares in the enclosure must be connected to each other by the biggest surface (any paint must be removed).**
4) **Components with control coil in the enclosure such as contactor, raly, electromagnetic valve and etc. should be derectly installed with absorber (i.e. RC, varistor, diode) on the coil.**

Cable layout

Figure 4-4 indicates the clearances which should be observed around the drive and related 'noisy' power cables by all sensitive control signals/ equipments.

Signal and power cables must be separately laid out and keep the distance as far as possible to avoid coupling interference, if they must cross each other, should take 90 degrees right-angle crossing.

Tow ends of the screen of signal cables must be earthed.

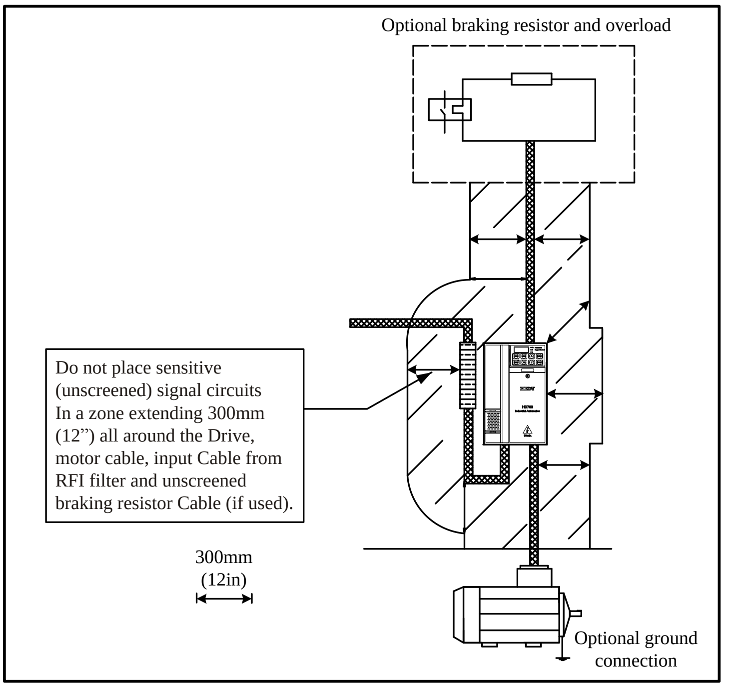

Figure 4-5 Drive cable clearances

NOTE:

Any signal cables which are carried inside the motor cable (i.e. motor thermistor, motor brake) will pick up large pulse currents via the cable capacitance. The screen of these signal cables must be connected to round close to the motor cable, to avoid this noise current spreading through the control system.

Ensure good EMC grounding.

4.3.3 General radiation standard

Use the recommended filter and shielded motor cable. Observe the layout rules given in Figure 4-6. Ensure the AC supply and ground cables are at least 100mm from the power module and motor cable.

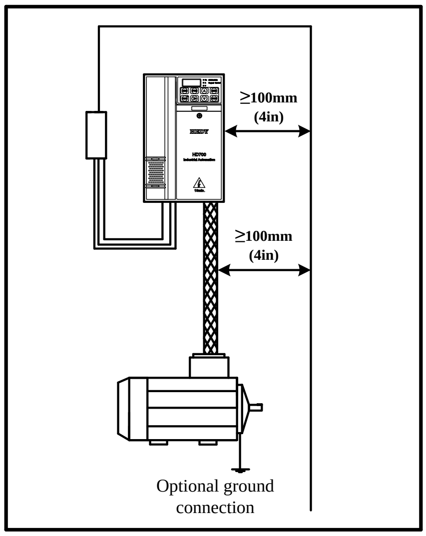

Figure 4-6 Supply and ground cable clearance

Avoid placing sensitive signal circuits in a zone 300mm (12in) all around the power module.

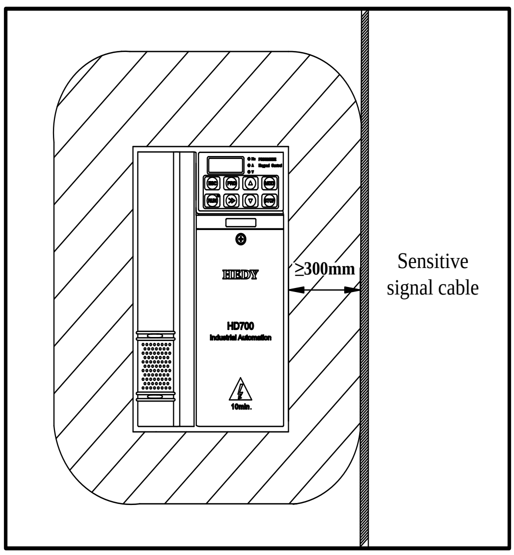

Figure 4-7 Sensitive signal circuit clearance

Ensure good EMC grounding.

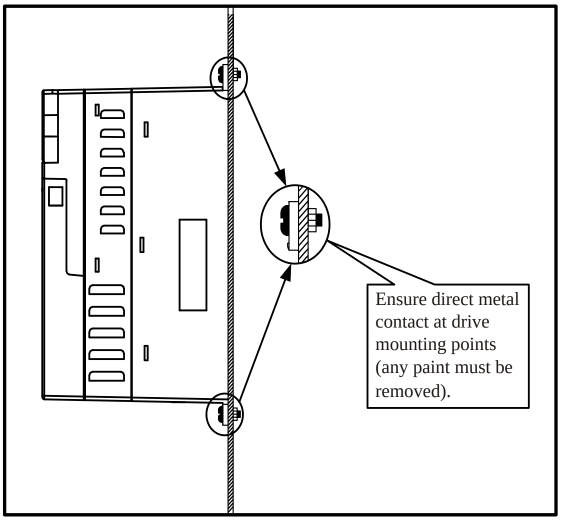

Figure 4-8 Grounding the drive

Connect the shield of the motor cable to the ground terminal of the motor frame using a link that is as short as possible and not exceeding 50mm (2in) long. A full 360∘termination of the shield to the terminal housing of the motor is beneficial.

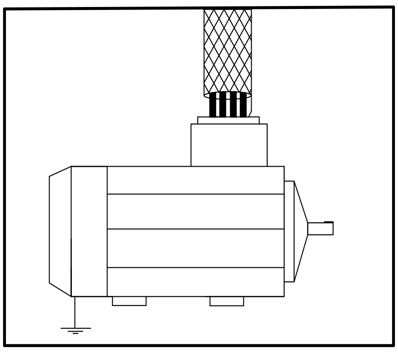

Figure 4-9 Grounding the motor cable shield

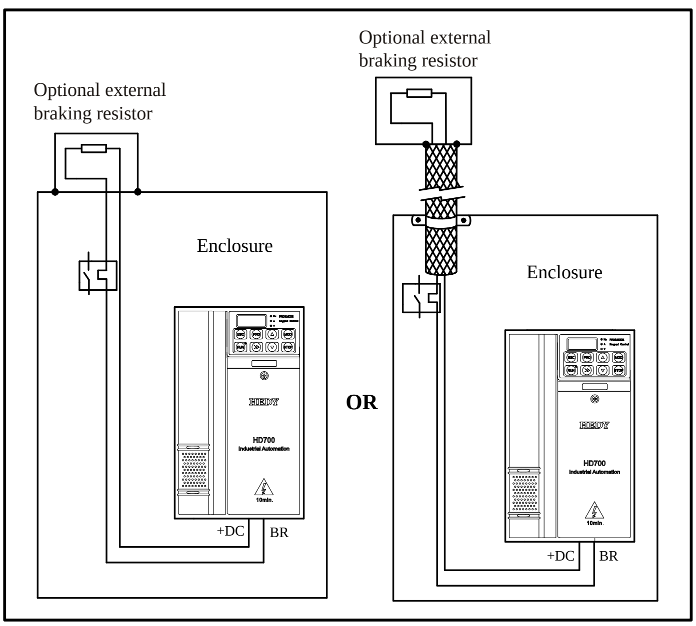

Figure 4-10 Shielding requirements of optional external braking resistor

4.3.4 Variations in the EMC wiring

Interruptions to the motor cable

The motor cable should ideally be a single length of shielded or armoured cable having no interruptions. In some situations it may be necessary to interrupt the cable, as in the following examples:

- Connecting the motor cable to a terminal block in the drive enclosure
- Fitting a motor isolator switch for safety when work is done on the motor

In these cases the following guidelines should be followed.

Terminal block in the enclosure

The motor cable shields should be bonded to the back-plate using uninsulated metal cable-clamps which should be positioned as close as possible to the terminal block. Keep the length of power conductors to a minimum and ensure that all sensitive equipment and circuits are at least 0.3m (12 in) away from the terminal block.

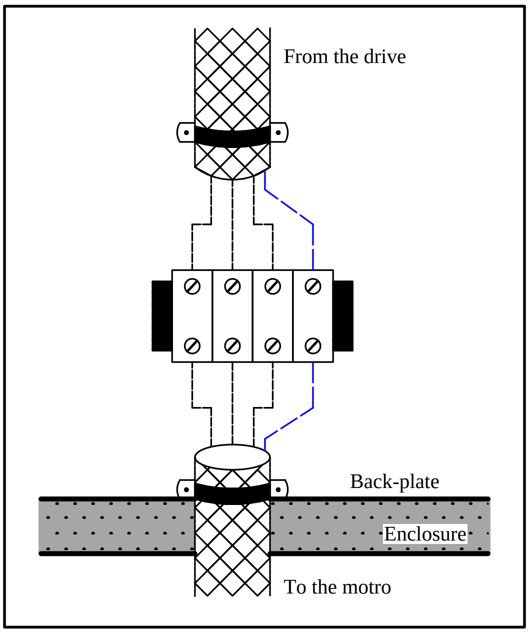

Figure 4-11 Connecting the motor cable to a terminal block in the enclosure

Using a motor isolator-switch

The motor cable shields should be connected by a very short conductor having a low inductance. The use of a flat metal coupling-bar is recommended; conventional wire is not suitable.

The shields should be bonded directly to the coupling-bar using uninsulated metal cable-clamps. Keep the length of the exposed power conductors to a minimum and ensure that all sensitive equipment and circuits are at least 0.3m (12 in) away.

The coupling-bar may be grounded to a known low-impedance ground nearby, for example a large metallic structure which is connected closely to the drive ground.

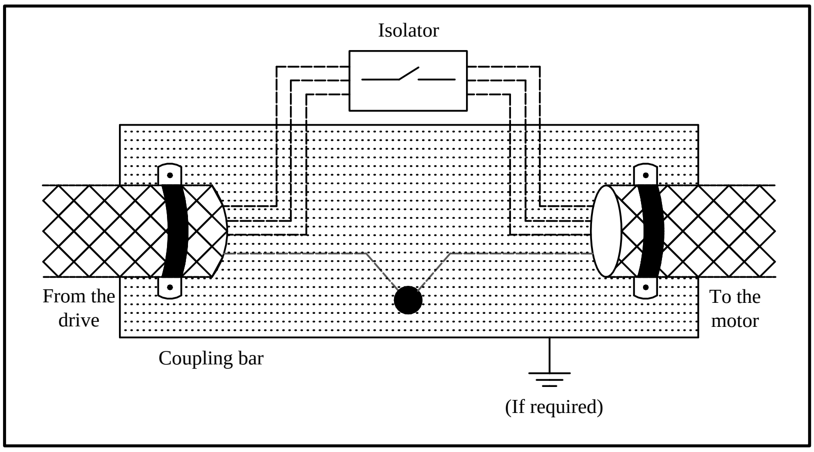

Figure 4-12 Connecting the motor cable to an isolator switch

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