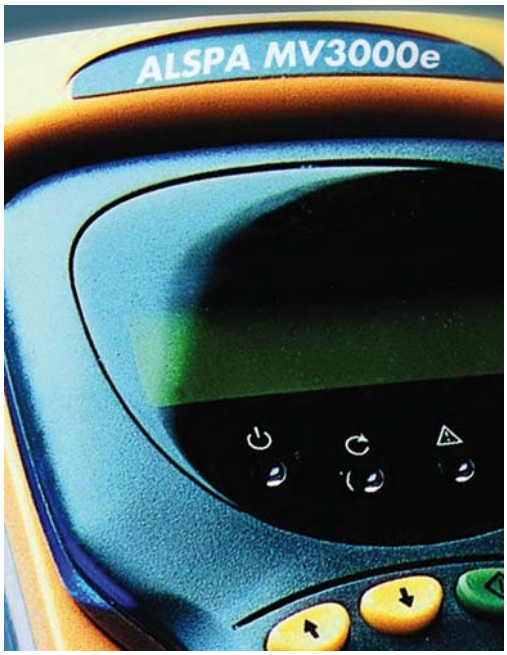


ALSPA MV3000e

Dynamic Braking Units MV3DB Series

Publication No. T1684EN Rev. 0005 (07/06)

Dynamic Braking

CONVERTEAM
THE POWER CONVERSION COMPANY

SAFETY INSTRUCTIONS

Care has been taken with the design of this product to ensure that it is safe. However, in common with all products of this type, misuse can result in injury or death. Therefore, it is very important that the instructions in this manual and on the product are observed during transportation, commissioning, operation, maintenance and disposal.

This technical manual should be regarded as part of the product. It should be stored with the product and passed on to any subsequent owner or user.

Local safety laws and regulations must always be observed.

Persons working on the product must be suitably skilled and should have been trained in that work for these products.

The product is a component designed for incorporation in installations, apparatus and machines.

The product must not be used as a single item safety system. In applications where maloperation of the product could cause danger, additional means must be used to prevent danger to persons.

Product approvals and certifications will be invalidated if the product is transported, used or stored outside its ratings or if the instructions in this manual are not observed.

Third party approvals to safety standards UL 508C and CSA C22.2 No 14 are marked on the product.

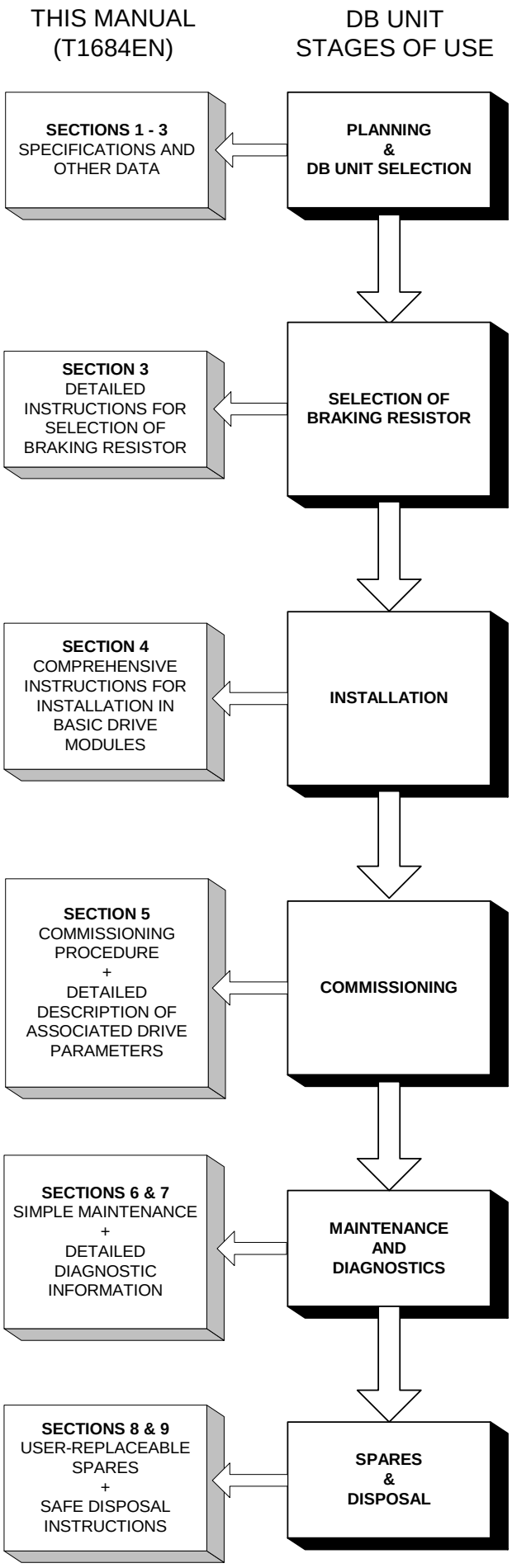
In the European Union:

- Products within the scope of the Low Voltage Directive, 73/23/EEC as amended are CE marked.
- The product complies with the essential protection requirements of the EMC directive 89/336/EEC as amended, when installed and used as described in this manual. The requirements of the EMC Directive should be established before any installation, apparatus or machine which incorporates the product is taken into service.
- A machine should not be taken into service until the machine has been declared in conformity with the provisions of the Machinery (Safety) Directive, 98/37/EEC.

CHANGES FROM PREVIOUS EDITION

Revision 0004	Warning texts revised. References to other manuals revised.
Revision 0005	Company Name change

Publication No. T1684EN Rev.0005 (07/06)


THIS MANUAL
(T1684EN)
DB UNIT
STAGES OF USE
SECTIONS 1 - 3
SPECIFICATIONS AND
OTHER DATA
PLANNING
&
DB UNIT SELECTION
SECTION 3
DETAILED
INSTRUCTIONS FOR
SELECTION OF
BRAKING RESISTOR
SELECTION OF
BRAKING RESISTOR
SECTION 4
COMPREHENSIVE
INSTRUCTIONS FOR
INSTALLATION IN
BASIC DRIVE
MODULES
INSTALLATION
SECTION 5
COMMISSIONING
PROCEDURE
+
DETAILED
DESCRIPTION OF
ASSOCIATED DRIVE
PARAMETERS
COMMISSIONING
SECTIONS 6 & 7
SIMPLE MAINTENANCE
+
DETAILED
DIAGNOSTIC
INFORMATION
MAINTENANCE
AND
DIAGNOSTICS
SECTIONS 8 & 9
USER-REPLACEABLE
SPARES
+
SAFE DISPOSAL
INSTRUCTIONS
SPARES
&
DISPOSAL

OVERVIEW

TABLE OF CONTENTS

1. Introduction

1.1 About this Manual

This Dynamic Braking Manual provides a competent user trained in electrical installation practice with sufficient information to safely install, commission, maintain and dispose of an ALSPA MV3000e Dynamic Braking (DB) Unit. The manual should be read in conjunction with the relevant ALSPA MV3000e Getting Started Manual.

This manual should be regarded as part of the ALSPA MV3000e DB Unit. It should be retained for the life of the product and should be passed on to any subsequent owner or user.

To use a ALSPA MV3000e DELTA system configured with a DB Unit, refer to T1689, the Technical Manual for MV3000e DELTA.

1.2 About the ALSPA MV3000e Dynamic Braking Unit

The DB Units described in this manual are intended only to be used when installed within the associated ALSPA MV3000e MicroCubicle™- style drive and must not be used in any other manner.

The DB Unit is used in conjunction with an externally mounted braking resistor, to dissipate kinetic energy stored in a motor and its load. This is regenerated into the ALSPA MV3000e drive during deceleration or when the load is overhauling. The drive monitors the DC link voltage and uses the DB Unit to switch the braking resistor into circuit when the voltage exceeds a pre-set level.

All DB Units are mounted within the MicroCubicle™, and are powered and controlled by the drive. Braking functions may be configured using parameters which are described in Section 5 (Commissioning).

A typical DB Unit is illustrated in Figure 1-1.

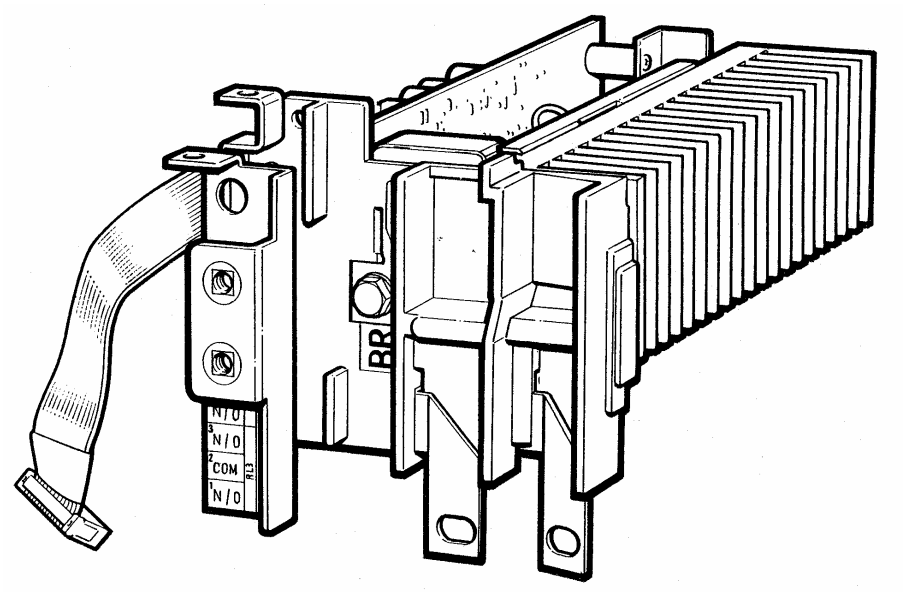


Figure 1-1 A typical DB Unit

1.3 Range of DB Units covered by this Manual

Table 1-1 shows the full range of DB Units available for MV3000e drives. There is one DB Unit for each frame size at each available supply voltage rating. Electrical data, dimensions and weights are provided in Section 2.

Table 1-1 – Range of DB Units available

Drive Frame Size	Drive Supply Voltage		
	380 V – 440 V	460 V – 525 V	575 V – 690 V
3	MV3DB045S5	MV3DB045S5	N/A
4	MV3DB092S5	MV3DB092S5	MV3DB061S6
6	MV3DB247S5	MV3DB247S5	MV3DB185S6
7	MV3DB391S5	MV3DB391S5	MV3DB246S6

1.4 Range of Standard Braking Resistors supplied by Converteam

Converteam produces a range of standard braking resistors designed to allow each internal DB Unit to produce the maximum possible braking effort. Section 2.1 shows the braking resistor model number associated with each DB Unit. The maximum permitted sizes of resistor connecting cables are given in Section 3.7.

Instruction Sheet T1947 provides detailed installation instructions for these resistors.

1.5 Identity Codes

The code used to identify DB Units is explained in Figure 1-2 below. The figure shows the code for a standard duty DB Unit rated at 92 Amps and with a maximum supply voltage of 525 V.

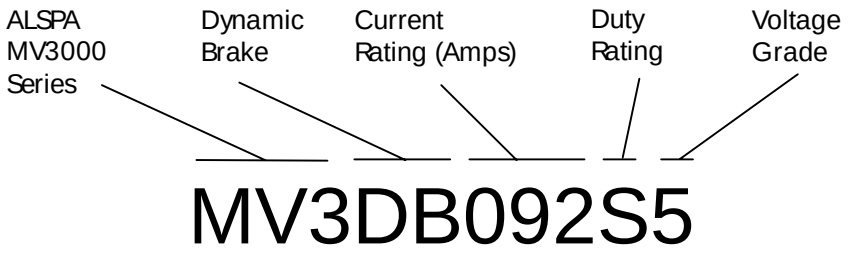


Figure 1-2 DB Unit identity code

1.6 Use of Metric Units

The ALSPA MV3DB range of DB Units has been designed to IEC standards using SI units. In this manual approximate values for inches, lb and hp are also included for convenience.

1.7 Customer Support and Training

Converteam provides comprehensive telephone technical support, application planning, service and customer training.

Contact **Converteam** at the address and telephone numbers shown at the end of this manual.

1.8 Associated Publications

Various ALSPA MV3000e Getting Started Manuals for Converteam MicroCubicle™ Drives

These manuals provide competent users trained in electrical installation practice with sufficient information to safely install, commission, operate, maintain and dispose of simple MicroCubicle™ drive installations.

T1679 ALSPA MV3000e Software Technical Manual

This manual contains detailed technical information to enable a competent user trained in drives to safely configure the ALSPA MV3000e drives for specific applications. It includes full descriptions of the menu structure and parameters, also the serial communications systems.

T1947 ALSPA MV3DBR Series Braking Resistors

This Instruction Sheet provides detailed instructions for installing braking resistors produced by **Converteam**.

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2. Specifications

2.1 Electrical Specification of DB Units and Standard Braking Resistors

General specifications for the DB Units and standard braking resistors are given in Table 2-1. Default values for the braking voltage – the voltage at which the DB Unit switches the resistor into circuit – are given in Table 2-2.

Table 2-1 – Electrical specifications for the DB Unit and the required standard braking resistor

DB Unit				Suitable Braking Resistor*				
Model	Used with drives		Nominal Current	Nominal Power during 18 seconds ON time	Resistance		Standard Resistor from Converteam	
	Frame size	Nominal ac voltage grade			Minimum	Maximum (to achieve nominal power)	Name	Resistance
		Volts	Amps	kW	Ohms	Ohms		Ohms
MV3DB045S5	3	400	45	28.10	13.6	16.6	MV3DBR045S4	13.6
"	3	480	38	28.30	15.3	23.6	MV3DBR038S5	15.3
MV3DB092S5	4	400	92	57.00	6.8	8.21	MV3DBR092S4	6.8
"	4	480	76	56.70	7.6	11.8	MV3DBR076S5	7.6
MV3DB061S6	4	690	61	56.70	11.0	20.3	MV3DBR061S6	11.0
MV3DB247S5	6	400	247	153.30	1.6	3.1	MV3DBR247S4	2.6
"	6	480	231	171.70	1.8	3.9	MV3DBR231S5	3.3
MV3DB185S6	6	690	185	171.70	3.7	6.7	MV3DBR185S6	5.1
MV3DB391S5	7	400	391	241.9	1.6	1.9	MV3DBR391S4	1.6
"	7	480	308	228.9	1.8	2.9	MV3DBR308S5	1.8
MV3DB246S6	7	690	246	228.9	3.7	5.0	MV3DBR246S6	3.7

* The chosen resistor must not be less than the minimum resistor value given in Table 2-1, including its manufacturing and temperature related tolerances. If the rated braking power given in Table 2-1 is required, the chosen resistor should not exceed the maximum resistance value given in Table 2-1, including its manufacturing and temperature related tolerances.

If the application does not require the full nominal power of the DB Unit, a braking resistor may be used which has a higher ohmic value.

Notes: 1. Refer to Section 3 (System Design) for notes on the calculation of the braking power and for a typical application.

2. Physical dimensions of **Converteam** resistors are provided with the product.

Table 2-2 Default braking voltage

Nominal ac voltage grade of drive	Default * braking voltage
Volts	Volts
400	732
480	846
600/690	1118

* Drive dependent. Can be adjusted in drive Menu 23.

2.2 Duty Cycle

The rated Duty Cycle is 18 seconds ON per 3 minutes. This is illustrated in Figure 2-1.

During the 18 sec ON time, Nominal kW quoted in Table 2-1 should not be exceeded.

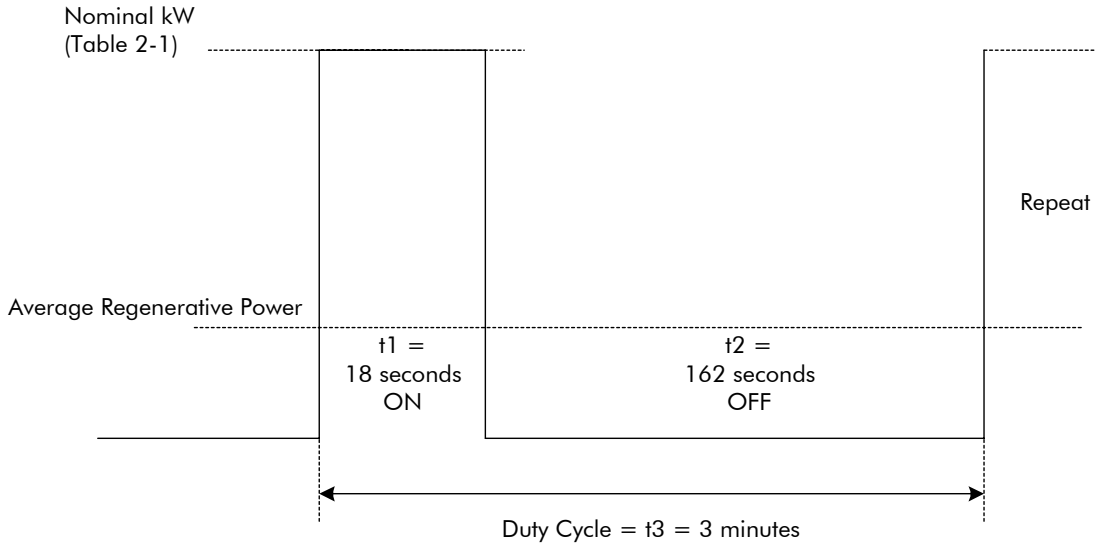

Figure 2-1 Rated braking duty cycle

2.3 Data Common to all DB Units

Table 2-3 Environment

Storage	Altitude (maximum)	3000 m
	Temperature range	–25°C to +55°C (–13°F to +130°F)
	Relative humidity	5% to 95%, non-condensing
Transport	Altitude (maximum)	Overland 3000 m. Withstands air transport pressurised to ≡ 3000 m (maximum)
	Temperature range	–25°C to +70°C (–13°F to +158°F)
	Relative humidity	≤ 95%, non-condensing
	Vibration, drop	IEC 60721-3-2 Class 2M1
Operating	Altitude (maximum)	1000 m, 1000 m to 2000 m with derating
	Temperature range	0°C to 40°C (+32°F to +104°F); 40°C to 50°C (+104°F to +122°F) with derating 2.5% per °C. Refer to Table 2-1.
	Relative humidity	5% to 95%, non-condensing
	Vibration	IEC 60721-3-3 Class 3M1 & EN50178
	Cooling air	As per drive
	Ingress protection	IP20 when fitted
	Resistor acoustic noise	< 70 dB(A)

Table 2-4 Common electrical data

Nominal Supply Voltage	400 V, 480 V, 600/690 V 3-phase, as selected	
Rated Duty	18 seconds at nominal power, repeating every 3 minutes	
Switching Frequency	Automatic, load dependent, 1.5 kHz max.	
Rated Lifetime	200,000 cycles at rated duty.	
Protection	Output short circuit protection + Indication* Thermal overload protection + Indication* * Provided via Drive parameters Current overload protection (in the event of fitting an unsuitable resistor) Configurable I^2T protection for braking resistor	
Status Signals	DB Unit Fitted	Status Flag 54
	DB Resistor OK	Status Flag 55
	DB Resistor I^2T Remaining	Drive parameter 23.07
	DB Resistor Overtemperature Warning	Warning Code 104
	DB Resistor Overtemperature Trip	Trip Code 67
	DB Unit Trip	Trip Code 151
	DB Unit Overtemperature	Trip Code 152

Table 2-5 Weights (unboxed)

Frame Size	3	4	6	7
Weight kg (lb)	1.5 (3)	3.5 (7.5)	6.5 (14.5)	6.5 (14.5)

2.4 Safety Standards

The DB Unit is designed to comply with the requirements of the following:

EN 50178 Electronic equipment for use in power installations.

ANSI/UL 508C Power conversion equipment, as marked on unit.

CAN/CSA C22.2-14 Industrial equipment, Industrial products.

2.5 Illustration of Ratings

This section illustrates the ability of the DB Units to absorb the energy from inertial loads during deceleration to zero speed. For speed reductions from one speed to another (not zero) refer to Section 3.4.

Figures 2-2 to 2-4 show the time taken to brake a given inertia from a typical speed of 1500 r/min to zero speed, for DB Units operating at 400 V, 480 V and 690 V nominal supply volts, using the standard **Converteam** braking resistors shown in Table 2-1. It is assumed that the braking torque during deceleration is constant.

- If the initial speed is not 1500 r/min, the braking time to zero can be found by using the graph to find the braking time t_{graph} for 1500 r/min and scaling by the following formula:

$$t_1 = t_{graph} \times \frac{N_2^2}{1500^2}$$

where t_1 = actual braking time

N_2 = initial speed

- Inertia is shown in kg m^2.

1 kg m^2 = 23.73 lb ft^2.

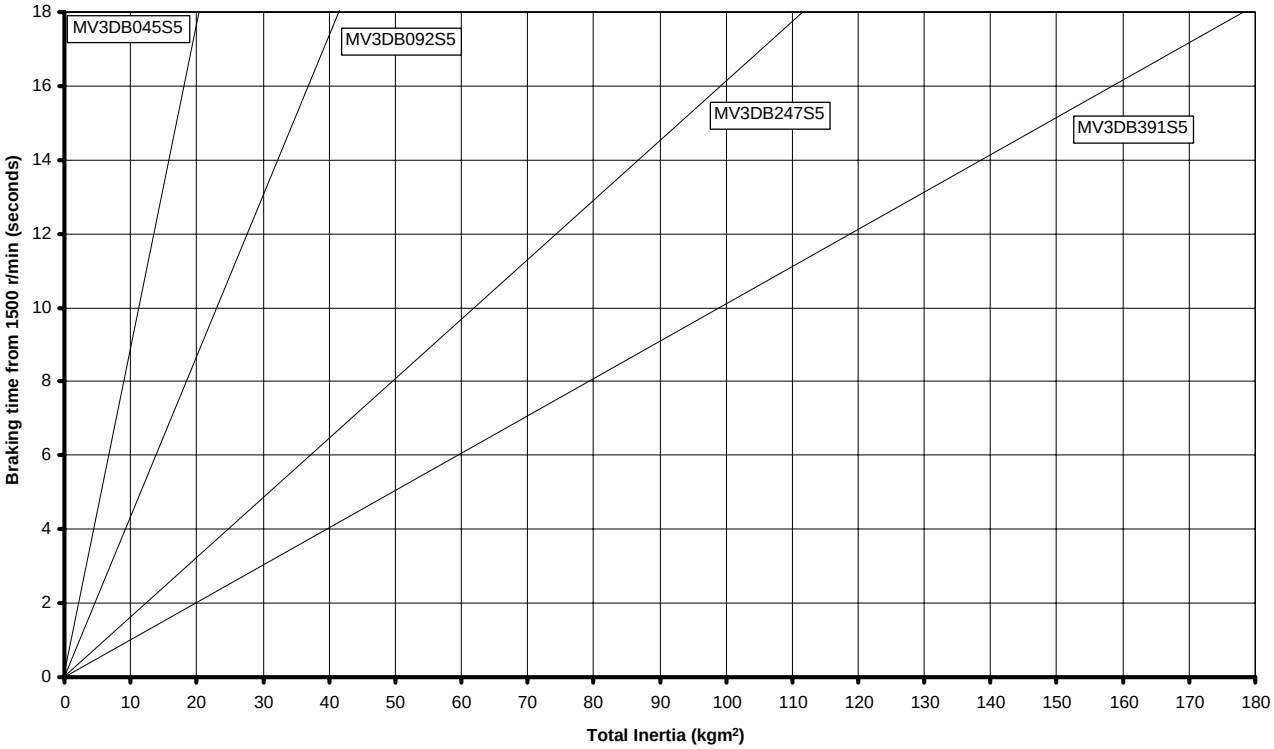

Figure 2-2 Stopping times from 1500 r/min at 400 V supply voltage

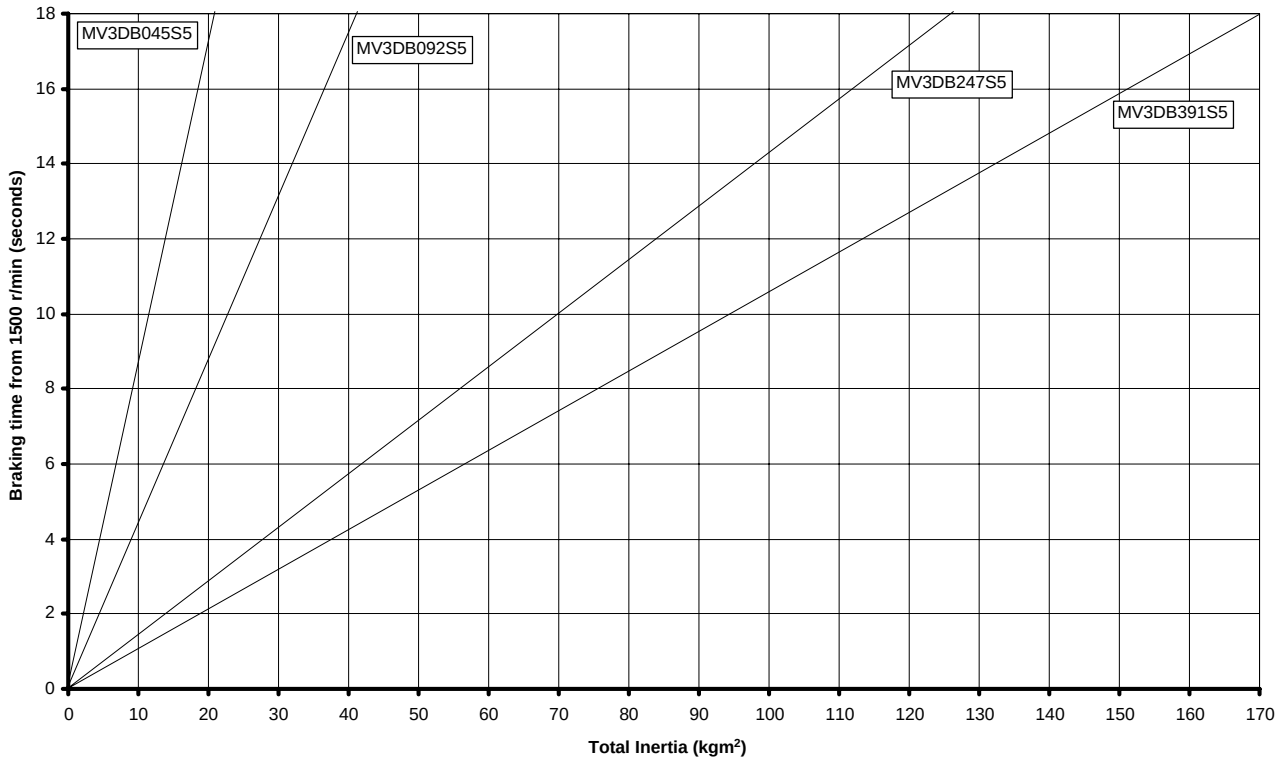

Figure 2-3 Stopping times from 1500 r/min at 480 V supply voltage

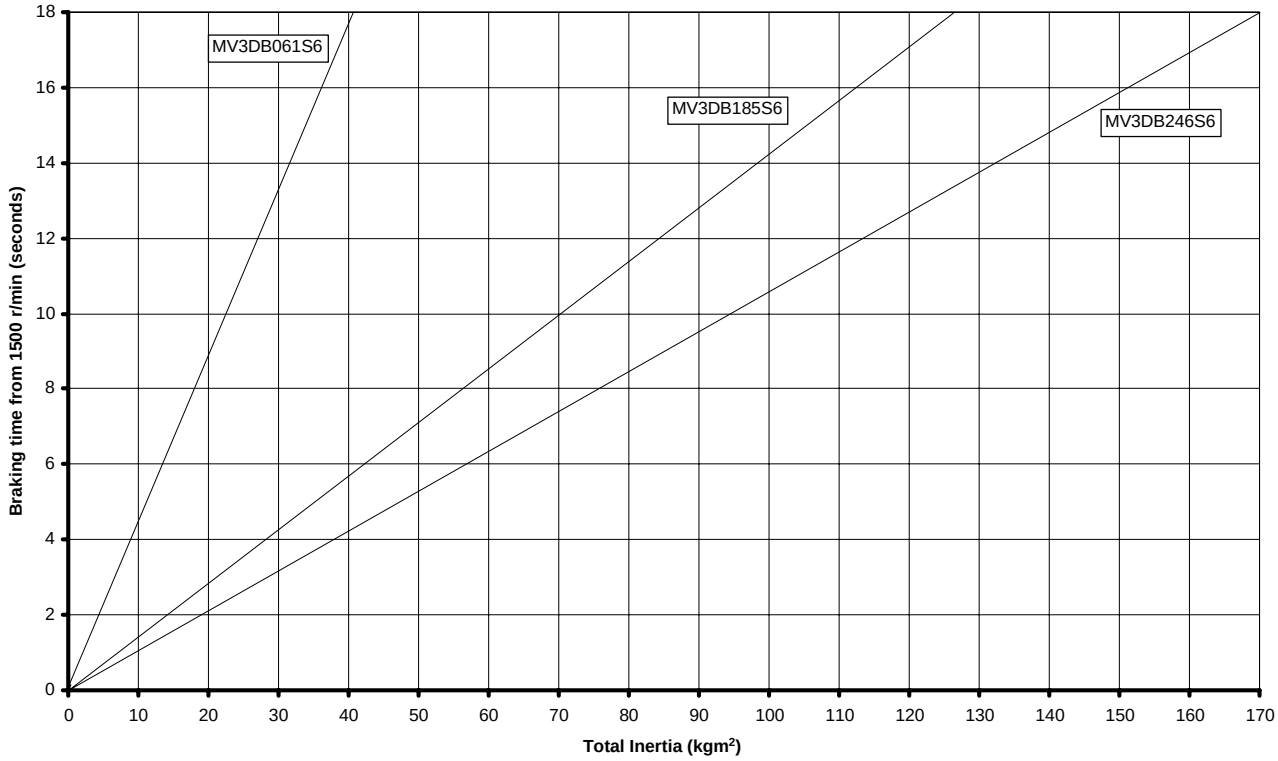

Figure 2-4 Stopping times from 1500 r/min at 690 V supply voltage

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3. System Design

3.1 Introduction

This section contains a functional description of the ALSPA MV3000e DB Unit and application specific information to assist with system design.

3.2 Functional Description

Under motor braking conditions, the rotational energy of the motor is transferred back to the drive causing the internal DC link voltage to rise. Therefore the rate of deceleration of the motor is limited by the amount of energy that the drive can absorb. By fitting a DB Unit and braking resistor as shown in Figure 3-1, the drive will be able to dissipate excess energy from the DC link and hence greatly increase the maximum rate of motor deceleration.

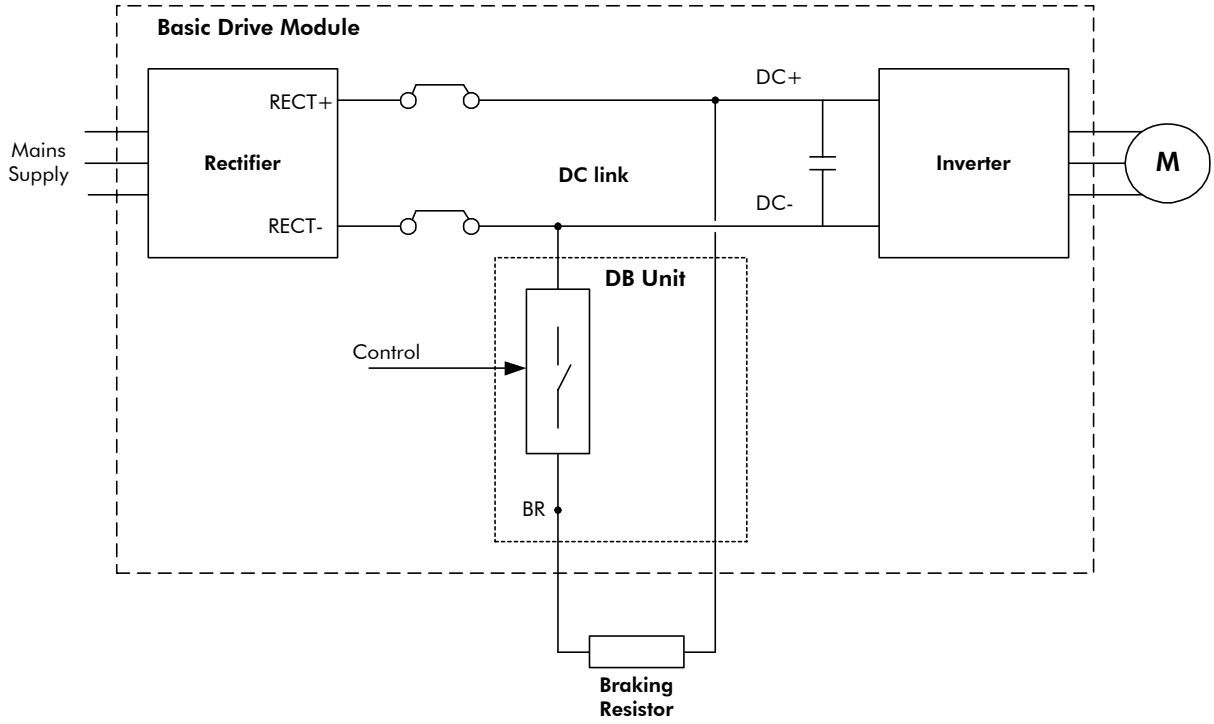

Figure 3-1 DB Unit function

The ALSPA MV3000e DB Unit is fitted within the drive and is controlled by the same microprocessor that controls the inverter, allowing the MV3000e to produce the maximum possible dynamic motor performance. Additionally, the internal interface between the DB Unit and the microprocessor provides automatic DB Unit detection, full fault diagnostics and allows simple software set-up for advanced features such as braking resistor protection.

3.3 Standard Braking Resistor Selection

Converteam produces a range of standard braking resistors designed to allow each internal DB Unit to produce the maximum possible braking effort. Section 2.1 shows the braking resistor model number associated with each DB Unit. The maximum permitted sizes of resistor connecting cables are given in Section 3.7.

If the braking effort provided by the standard resistor is not sufficient, the user may need to select an external DB Unit with a higher rating or an Active Front End product – refer to **Converteam**.

3.4 Alternative Braking Resistor Selection

If the braking duty required is less than that given by the standard resistor (shown in Figures 2-2 to 2-4), an alternative resistor may be selected. The following points should be noted:

1. The energy regenerated into the ac drive from the motor(s) and its load is limited to a rate based on the drive's capability. The drive overload current limit applies when motoring or regenerating.

2. The resistor value in ohms is usually determined by the DB unit current capability and the maximum voltage at which it operates.

3.5 Calculation for Alternative Resistors

Where it is required to use a braking resistor other than a standard **Converteam** resistor as shown in Table 2-1, the following procedure should be used. Two methods are given, one based on a known power and the other upon a known inertia.

3.5.1 Calculation Based on Power

If the power being returned to the drive is known (e.g. overhauling load), the resistor may be calculated as follows:

Resistance, $R = \frac{V_{DB}^2}{P_p} \Omega$

where V_{DB} = DB operating voltage (see Table 2-2).

P_p = Peak power during braking.

Alternatively, a resistor whose resistance is lower than this calculated value may be used, in which case the DB unit will cycle on and off. However, the resistance value must not be less than that given in Table 2-1.

The resistor should have a peak power capability equal to the power during braking and be able to withstand this power for the braking time t_1.

It should also have an average power capability given by:

Long term average power = Average power during braking $\times \frac{t_1}{t_3}$

where t_1 = braking time

and t_3 = total on/off cycle time.

This is illustrated in Figure 3-2.

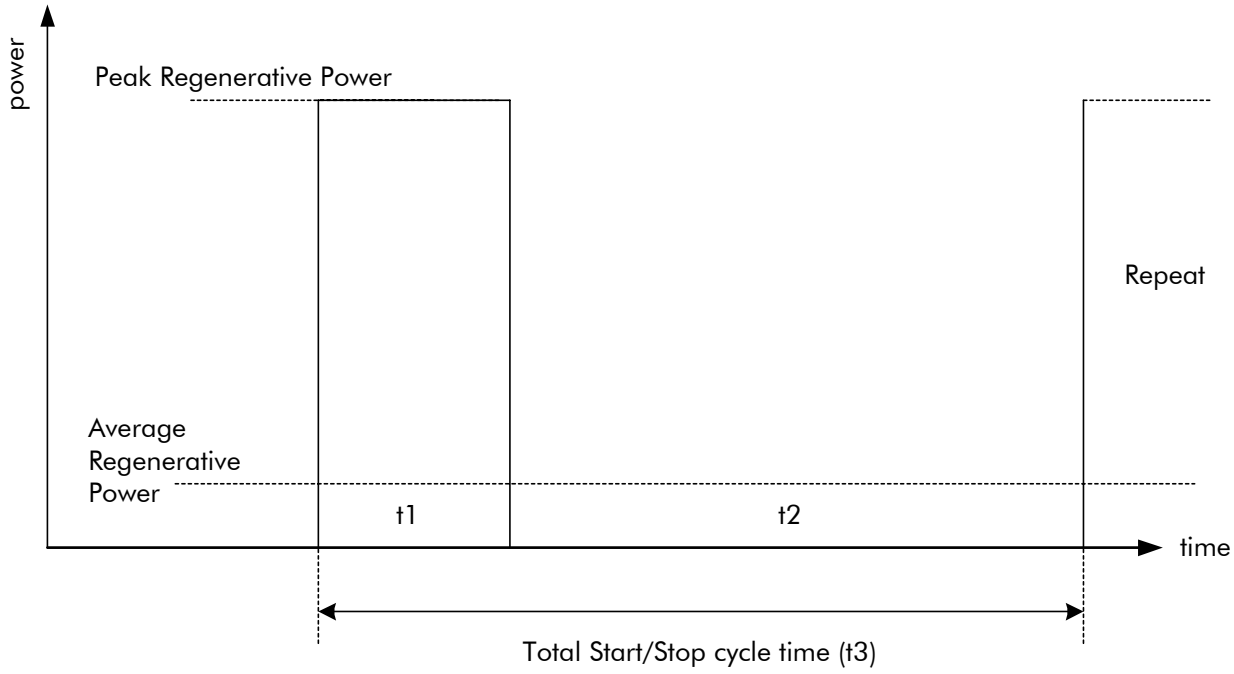

Figure 3-2 DB resistor power dissipation

3.5.2 Calculation Based on Inertia

If the regenerative power is not known, but the inertia of the load is known, the resistance and power rating may be calculated as follows:

Resistance, $R = \dfrac{91.2V_{DB}^2 t_1}{JN_2(N_2 - N_1)}\Omega$

where V_{DB} = DB operating voltage (see Table 2-2 in Section 2 "Specifications")

J = system inertia (kgm^2)

t_1 = braking time (seconds)

N_2 = initial speed (r/min)

N_1 = final speed (r/min)

Note: $J = J_{motor} + (J_{load} \times 1/(gear\ box\ ratio)^2)$.

If there is no gear box, $gear\ box\ ratio$ = 1.

Inertia of the motor and load to be determined from the respective suppliers.

Peak power (at start of braking) = $P_P = \dfrac{J(N_2 - N_1)N_2}{91.2t_1}$

The resistor should have a peak power capability equal to the power during braking and be able to withstand this power for the braking time t_1.

It should also have an average power capability given by:

Long term average power $= \dfrac{energy}{total\ \ cycle\ \ time}$

$= \dfrac{J(N_2^2 - N_1^2)}{182.4t_3}$

where t_3 = total stop-start cycle time in seconds.

Example:

Suppose we have an inertia of 0.9 kgm^2, a top speed of 3000 r/min and we require to brake to zero speed in 2 seconds repeated every 100 seconds.
Assume DB switching voltage is 732 V.

$R = \dfrac{91.2V_{DB}^2 t_1}{JN_2(N_2 - N_1)} = \dfrac{91.2 \times 732^2 \times 2}{0.9 \times 3000 \times (3000 - 0)}$ = 12.07 Ω

Peak power $= \dfrac{J(N_2 - N_1)N_2}{91.2t_1} = \dfrac{0.9 \times (3000 - 0) \times 3000}{91.2 \times 2}$

= 44408 Watts or 44.4 kW

Long term average power = $\dfrac{J(N_2^2 - N_1^2)}{182.4t_3} = \dfrac{0.9 \times (3000^2 - 0)}{182.4 \times 100}$ = 444 Watts

Current in resistor $= \dfrac{V_{DB}}{R} = \dfrac{732}{12.07}$ = 60.6 A

Hence MV3DB092S5 in frame size 4 will achieve this duty.

3.6 Equivalence of Duty Cycles

Ratings in Table 2-1 are given for a braking time of 18 seconds.

3.6.1 For braking times longer than 18 seconds:

- The graph shown in Figure 3-3 can be used to find the derating factor for the peak power.
- The long term average power must not exceed 10% of the “Nominal Power during 18 seconds ON time” given in Table 2-1.

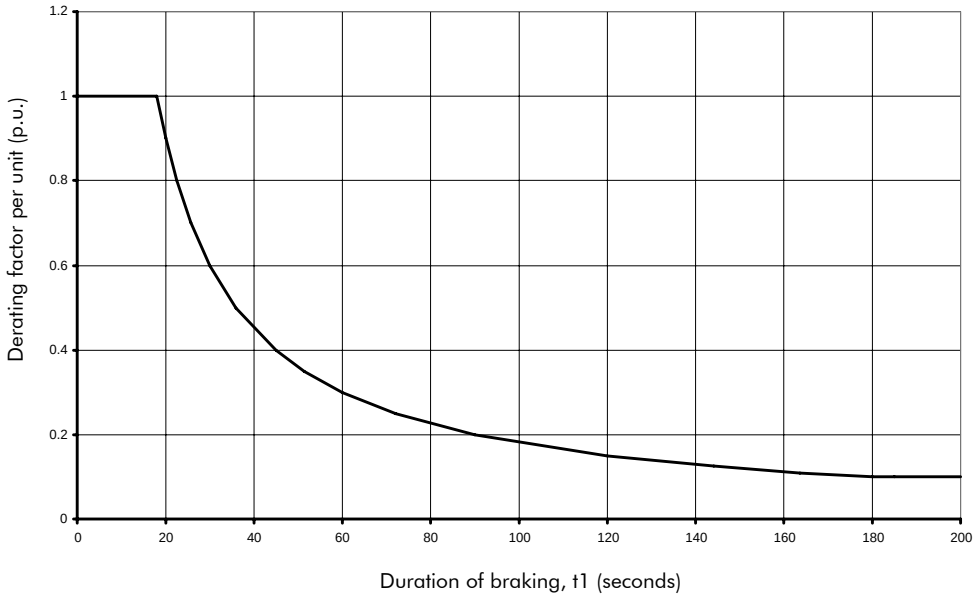

Figure 3-3 Derating factor

3.6.2 For braking times less than 18 seconds:

- the peak power given in the Specification section must not be exceeded;
- the total cycle time t_3 can be reduced but the long term average power must not exceed 10% of the "Nominal Power during 18 seconds ON time" given in Table 2-1.

3.7 Braking Resistor Cable Selection

The cables must conform to local wiring regulations. Cables rated less than the peak current rating of the DB Unit in Table 2-1 should not be used unless they are protected against overload by means external to the drive.

The maximum sizes of cable which can be connected to the optional dynamic braking resistors are shown in Table 3-1.

Temperature Limitations

1. Cables connected to the resistor terminals inside the resistor casing must be capable of withstanding a local air temperature up to 80 ˚C (176 ˚F). The conductor temperature at this end of the cable must not be allowed to exceed 160 ˚C (320 ˚F).

2. Cables connected to the drive terminals must be capable of withstanding a temperature of 70 ˚C (158 ˚F), (60 ˚C (158 ˚F) on drives rated at less than 100 A mains or motor current). The conductor temperature must not be allowed to exceed 120 ˚C (248 ˚F).

Table 3-1 Optional braking resistors and associated maximum cable sizes

DB Unit	Optional Braking Resistor	Cable Size (Maximum)	
		Metric Sizes mm^2	AWG Sizes
MV3DB045S5	MV3DBR045S4	6	10
MV3DB045S5	MV3DBR038S5	6	10
MV3DB092S5	MV3DBR092S4	16	6
MV3DB092S5	MV3DBR076S5	16	6
MV3DB061S6	MV3DBR061S6	16	6
MV3DB247S5	MV3DBR247S4	50	1/0
MV3DB247S5	MV3DBR231S5	50	1/0
MV3DB185S6	MV3DBR185S6	50	1/0
MV3DB391S5	MV3DBR391S4	120	4/0
MV3DB391S5	MV3DBR308S5	120	4/0
MV3DB246S6	MV3DBR246S6	120	4/0

Outside the cabinet the braking resistor cables must be segregated from other cables by at least 300 mm (12 in).

To avoid EMC problems the resistor cables outside the cabinet should be screened (e.g. NYCWY according to VDE 0276-603 or steel wire armoured) or fully enclosed in metallic trunking. The screen or metallic trunking must be continuous throughout its length and be connected directly to, or glanded to, both the cabinet and the resistor casing.

3.8 Resistor Protection

3.8.1 Internal Protection

The drive monitors the power being dissipated by the braking resistor to avoid the resistor overheating. Figure 3-2 shows a typical stop/start cycle. If a braking resistor other than a standard **Converteam** resistor is used, it should be chosen to comply with the requirements of Sections 2 or 3.4.

The following aspects of the braking resistor's power capability are entered in the drive's parameters:

- Average power capability over total stop/start cycle (P23.01)
- Peak power capability (P23.02)
- Time at peak power (P23.03)

The drive uses these parameters to model the resistor temperature. See Section 5.3 for further information.

3.8.2 External Protection

Note: All braking resistors supplied by **Converteam** are fitted with an over-temperature thermostat. The thermostat is isolated from the DC link voltage, but for safety reasons the thermostat output should never be connected directly to the drive. It should always be connected indirectly, typically as shown in this section.

In the unlikely event of failure of the DB Unit, it is possible for the braking resistor to be switched continuously across the DC link. **Converteam** therefore recommend that protection circuits should be included such as those shown in Figures 3-4 or 3-5.

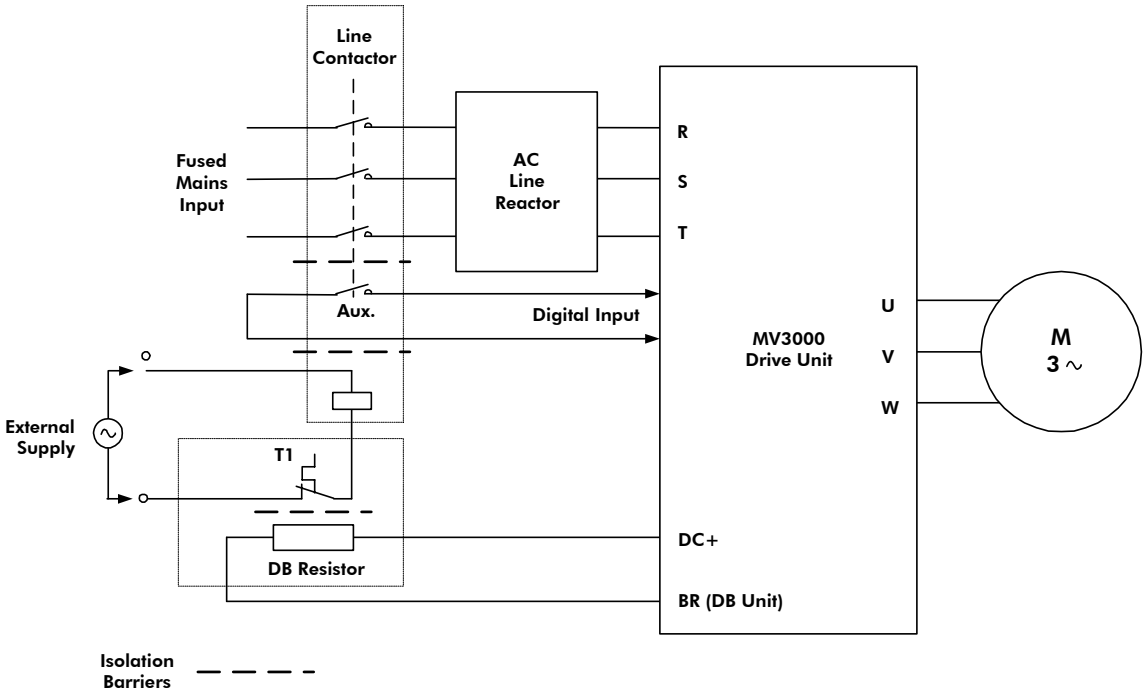

Figure 3-4 DB resistor protection by removing supply from the drive

In Figure 3-4 protection is provided by thermostat T1. If the resistor temperature exceeds its maximum rated value, T1 operates to open the line contactor and remove the mains supply. An auxiliary contact is used to trip the drive via a digital input and control flag CF111 (parameter P23.09). The line contactor and thermostat T1 are fed by an external supply; the contacts of thermostats fitted to **Converteam** braking resistor assemblies are rated up to 240 V rms at 10 A and are isolated from the resistor.
The auxiliary contact of the contactor must be rated for double or re-inforced insulation to prevent dangerous voltages being transmitted to the drive control terminals.
The contact must also be suitable for handling currents as low as 1.6 mA at 24 V d.c.

As shown in Figures 3-4 and 3-5, **Converteam** braking resistors are fitted with isolation barriers to fully isolate the thermostat from the resistor. If the resistor is obtained from an alternative source, ensure that the temperature sensing device is isolated from the resistor using double or re-inforced insulation.

An alternative method of protection is shown in Figure 3-5. The external supply energises the DC rated contactor, which completes the circuit to the braking resistor. If the resistor overheats, the thermostat opens and the contactor breaks the resistor supply. The drive continues to operate but regenerative braking is no longer available and the drive will trip on overvolts if a rapid deceleration is performed.

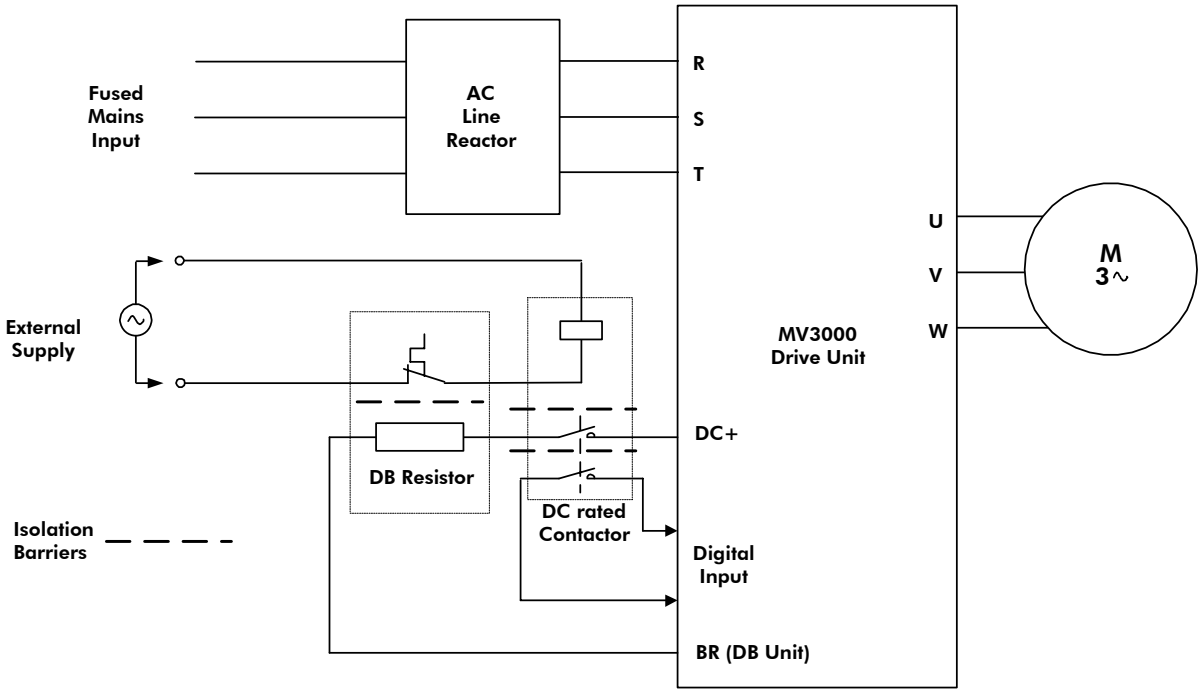

Figure 3-5 DB resistor protection by disconnection

For the method shown in Figure 3-5, if it is required to warn the drive when the DB resistor has been disconnected, one possible solution would be to use a contactor having a volts-free auxiliary contact and connect this to activate a drive digital input to flag a warning. Alternatively a lower rated thermostat could be used to warn of imminent disconnection. In either case, the contact connected to the digital input must be rated for double or re-inforced insulation to prevent dangerous voltages being transmitted to the drive control terminals. Control wiring must be segregated from power wiring as shown in Section 3.9 and in Section 3 of the drive Getting Started Manual.

3.9 Cabinet layout and EMC

Figure 3-6 shows a typical layout and EMC segregation requirements for a braking resistor mounted on top of the drive cabinet.

To minimise radiated noise emissions, the braking resistor should be mounted in a suitably ventilated metal enclosure. Power cables between the resistor and the cabinet should be overall screened (shielded), with the screens bonded to both enclosures.

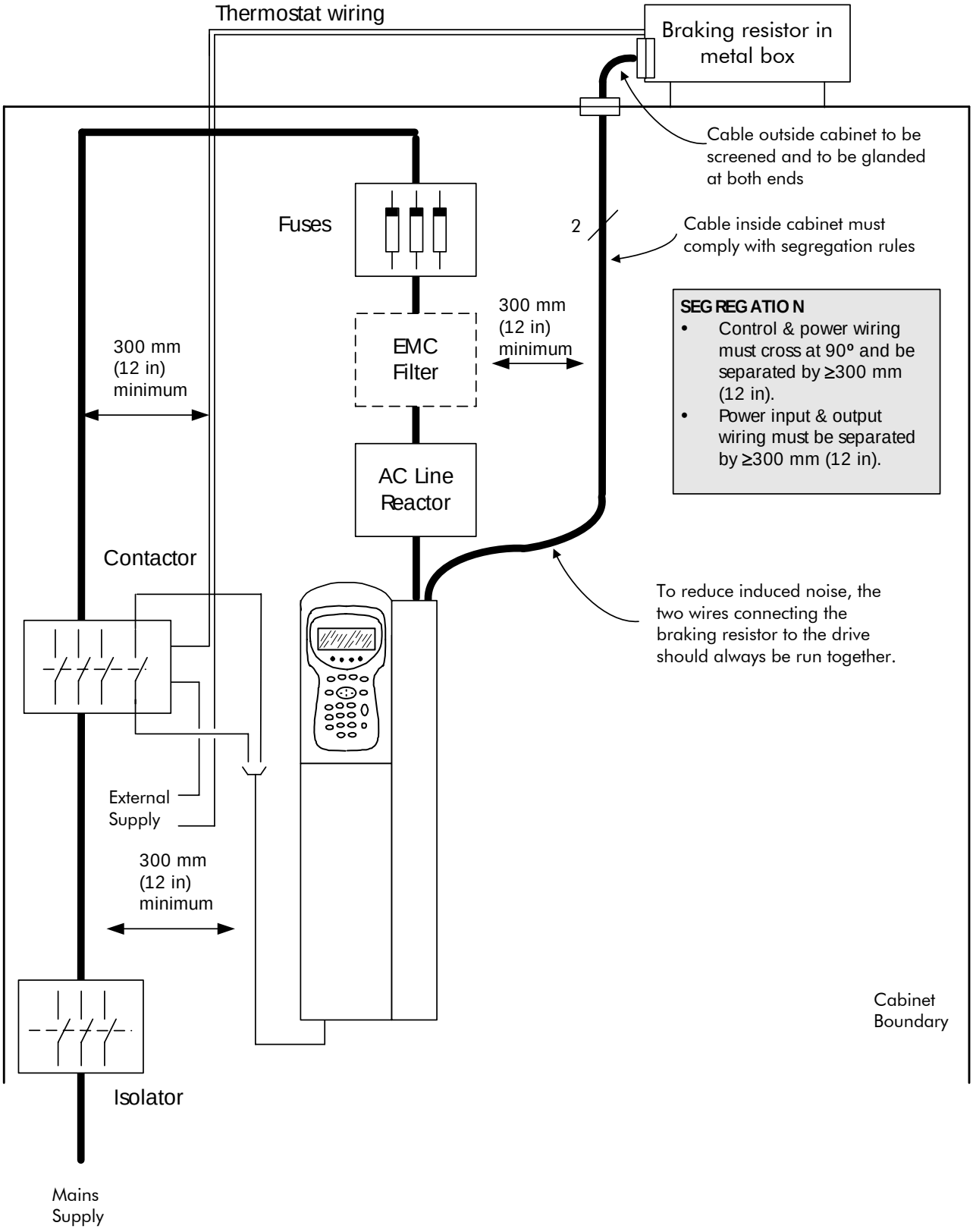

Figure 3-6 EMC considerations

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4. Installation

4.1 Introduction

This section provides comprehensive procedures for installing MV3DB Series DB Units into ALSPA MV3000e MicroCubicle™- style drives.

4.2 Receipt of Equipment

4.2.1 Inspection

Check the contents of the consignment against the Delivery Note for any damage, shortages or loss in transit. If any item is found to be damaged or missing, contact **Converteam** at the address/telephone number shown on the rear cover, quoting the following details:

- List of damaged or missing items with names and part numbers.
- Description of damage.
- Delivery Note numbers and dates, and order and item numbers.

4.2.2 Storage

If the DB Unit is not to be installed immediately:

- Re-pack it in its original packaging material. If this is not possible it should be enclosed in polythene sheet to protect it from the ingress of dust.
- Store it in a clean, dry atmosphere, preferably at room temperature, ensuring that the storage environment meets the requirements of Section 2.
- If the DB Unit is unpacked in a warm environment condensation may occur.
  Should condensation be seen, the DB Unit should not be used until its temperature has stabilised to that of the working environment.

4.2.3 Handling

CAUTION

This equipment contains solid state devices which may be affected by electrostatic discharge. Observe static handling precautions.

Because DB Units contain static-sensitive devices, they should be handled carefully without touching components or connectors, and should preferably be kept in the supplied conductive bag until required for use.

Take care to protect exposed printed circuit board components from physical damage.

4.3 Installing the DB Unit

WARNING

- **Wait at least 5 minutes after isolating supplies and check that voltage between DC+ and DC- has reduced to a safe level before working on this equipment.**
- **This equipment may be connected to more than one live circuit. Disconnect all supplies before working on the equipment.**
- **All items exposing high voltage must be placed in a suitable enclosure with restricted access.**
- **Air used to cool the product is unfiltered. Air ejected from the product may contain foreign particles. Air outlets should deflect the air away from the eyes.**

- **Surfaces on dynamic braking resistors can reach high temperatures and remain hot for some time after power has been removed.**
- **The combined audible noise emitted by fans in an installation can be greater than 70 dB(A), dependent on the air flow path.**

  Measure the audible noise level in the installation.

  When the audible noise level exceeds 70 dB(A), appropriate warning notices should be displayed.

CAUTION

Ensure that all conductors connected to this equipment are mechanically restrained.

4.3.1 Cable Lugs and Recommended Torque Settings

Copper or plated copper cable lugs may be used. Table 4-1 shows the size of drive studs and recommended connector lugs/torque settings.

Table 4-1 Drive stud sizes, cable lugs and torque settings

Drive Frame Size	Stud Size	Use Lug Size	Torque Settings	
			Nm	lbf in
3	M6	M6 or 1/4 in.	8	70
4	M8	M8 or 5/16 in.	15	130
6	M10	M10 or 3/8 in.	30	265
7	M12	M12 or 1/2 in.	45	400

4.3.2 Access to Drive Components

(Refer to Figure 4-1)

1. Ensure that the drive is upright as shown.
2. Open the left plastic door (the "Control" door) under the Keypad harbour (1) by carefully pulling the bottom of the door and/or the depression at the top.
3. Open the right door (the "Power" door) by releasing the two screws (2) securing it to the drive chassis.

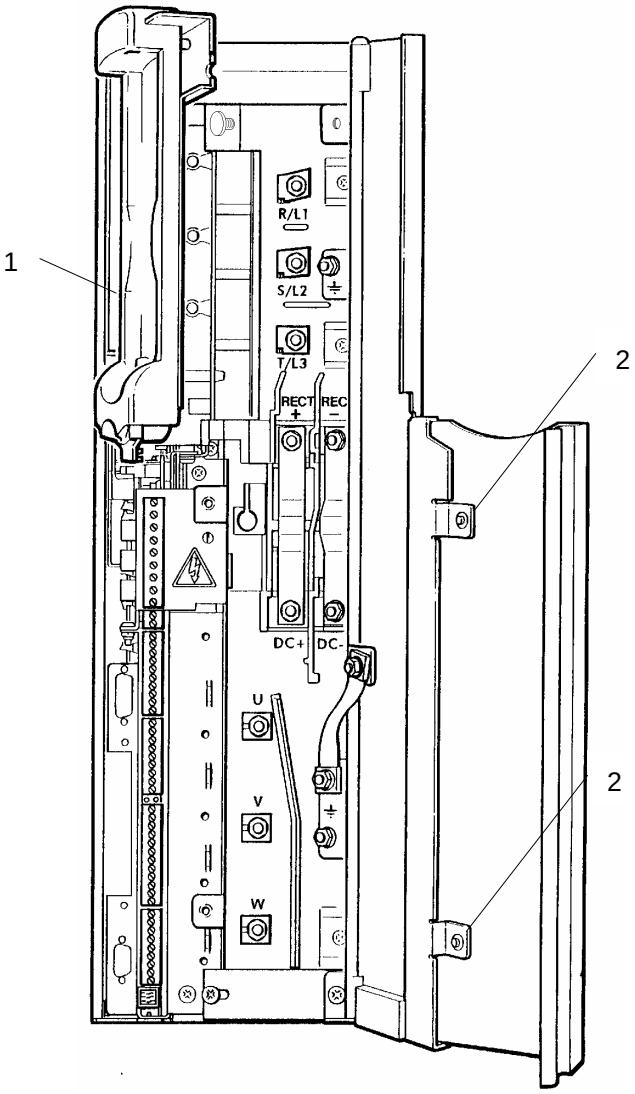


Figure 4-1 Access to drive interior

4.3.3 Installation to Frame Size 3 Drives

Frame Size 3 Preparation
(Refer to Figure 4-2)

1. Gain access as described in Section 4.3.2.
2. Release the M5 captive screw securing the Keypad harbour and swing it open.
3. Locate the link (6) between the RECT+ and DC+ studs, and link (7) between the RECT– and DC– studs. Remove the push-on covers from the M6 retaining nuts (8), remove the nuts, washers and the two links.
4. Open the hinged plastic shroud protecting TB1 on the control board, by releasing the M5 captive screw (1).
5. Remove two M5 screws (2), (3) and spring washers securing the DB blanking plate (5) to the drive chassis.
6. Remove the M5 screw (9) and spring washer securing the control board to the drive chassis.
7. Slide the control board forward by approximately 50 mm (2 inches) and disconnect the Keypad ribbon cable from connector PL2 on the board.
8. Withdraw the control board enough to allow access to connectors PL4, PL10 and PL11. Disconnect the cables and release them from retaining clips, then remove the control board, putting it somewhere safe.
9. Release the M5 screw (4) securing the DB blanking plate to the rectifier terminal assembly.
10. Withdraw the DB blanking plate from the drive chassis.

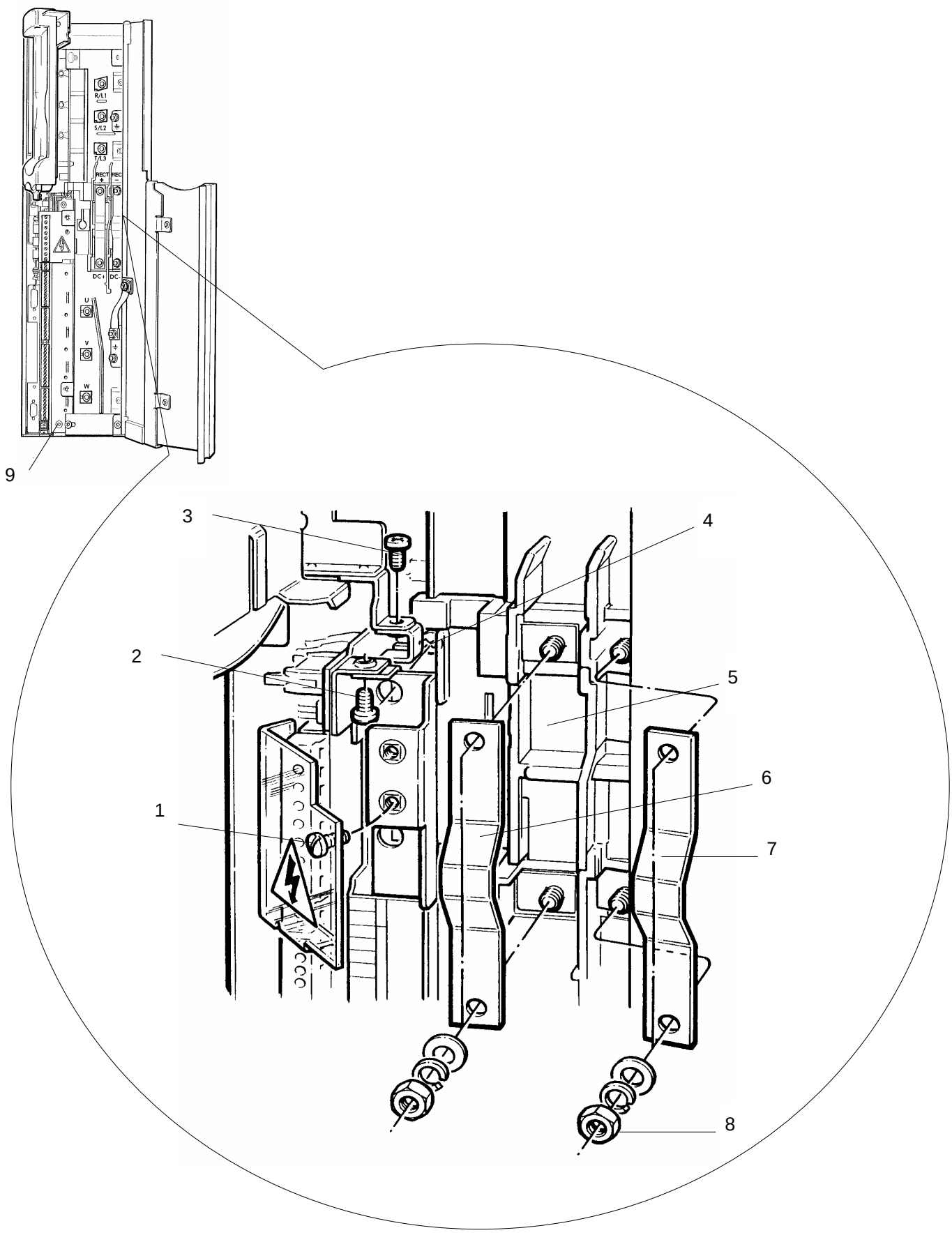


Figure 4-2 Frame size 3 – preparation

Frame Size 3 Installation
(Refer to Figures 4-1 through 4-6)

Note: Torque all M6 nuts and screws to 8 Nm (70 lbf in).

1. Offer the DB Unit to the drive and carefully slide towards the rear right hand side of the drive chassis, ensuring that :
   - the PCB is not damaged by steelwork.
   - wiring on the DB Unit does not snag.
   - the holes in the DB Unit busbars align with the DC+ and DC– studs on the drive (Figure 4-4 (2)). The busbars may have to be gently pushed towards the right to pass the insulation barriers in the moulding.

2. When the moulding at the front of the DB Unit has just passed the door hinge, push the DB Unit to the right, to align the plastic tab on the DB Unit (Figure 4-5 (1)) with the slot in the rectifier moulding – follow the dashed line! Ensure that the back of the DB Unit is as far to the right as possible. Push the DB Unit home and check that the back is not loose i.e. that the locating pegs at the rear of the DB Unit have located in the slots (Figure 4-4 (1)) in the drive chassis.

3. Secure the DB unit to the rectifier terminal assembly using the retained M5 screw (Figure 4-2 (4)), and secure to the SMPS mounting plate using one M5 x 10 mm screw and spring washer (Figure 4-2 (3)).

4. Offer the control board to the drive and connect ribbon cables, as shown in Figure 4-3, to connectors PL4, PL10 and PL11 on the board, using the indicated sequence A to E.

A. Connect ribbon to PL4.
B. Insert ribbon into clip, folding it as shown.
C. Insert retractile into clip.
D. Connect retractile to PL10.
E. Connect retractile to PL11.

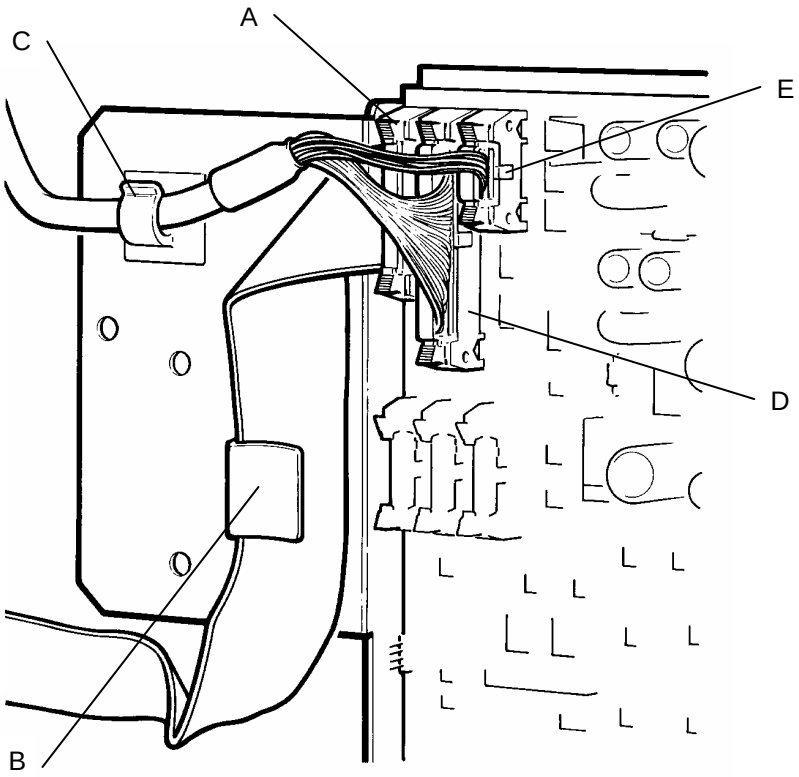


Figure 4-3 Control board ribbon connection detail

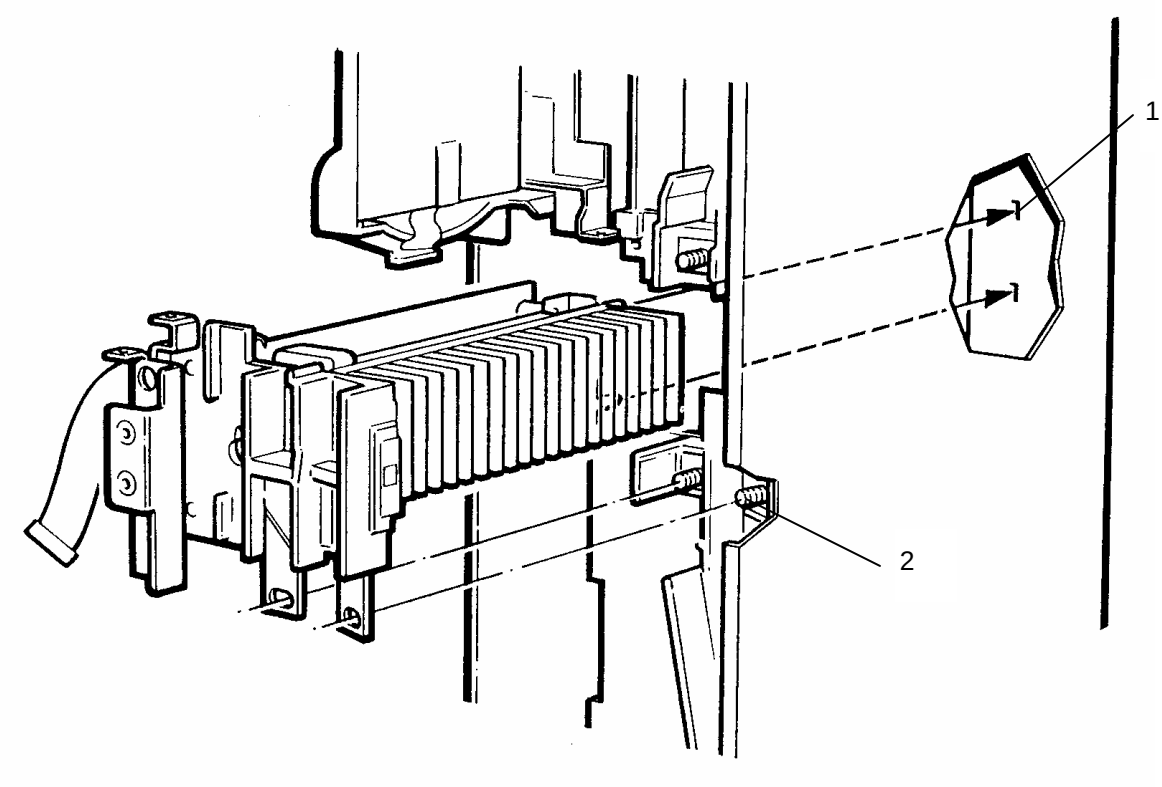


Figure 4-4 Locating the DB Unit

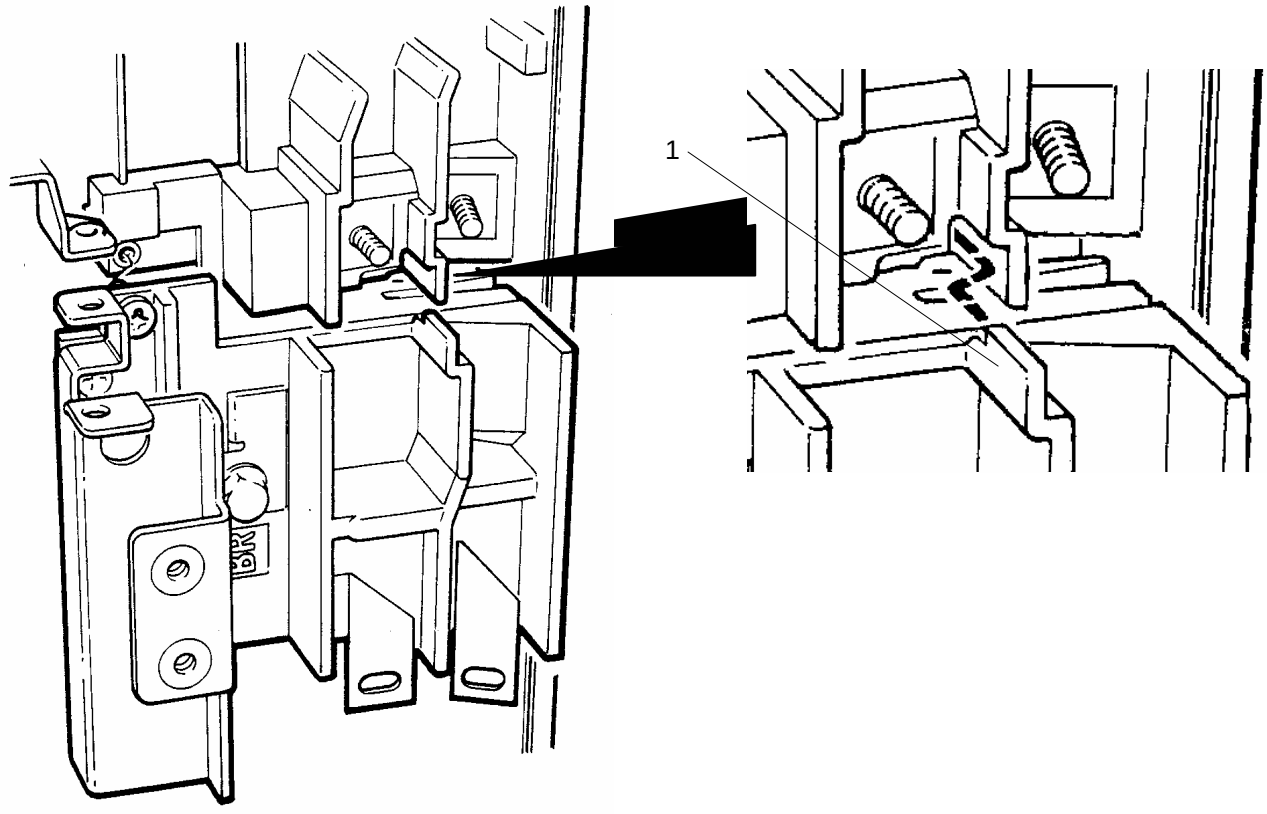


Figure 4-5 Frame size 3 – installation detail

5. Slide the control board partially into the drive, ensuring that it slides between top and bottom runners and taking care not to snag cables. With the board approximately 75 mm (3 in) out from the drive, connect Keypad cable to ribbon connector PL2 and DB Unit cable to connector PL8 as shown in **Error! Reference source not found.**. Take care to route the ribbon cable as shown, not over the top of the steelwork. Push the board fully into the drive and secure using two M5 screws and washers, see Figure 4-2 (2) and (9).

Note: If the control board fit is very tight, temporarily release M5 screw (Figure 4-2 (3)) to ease entry of the board.

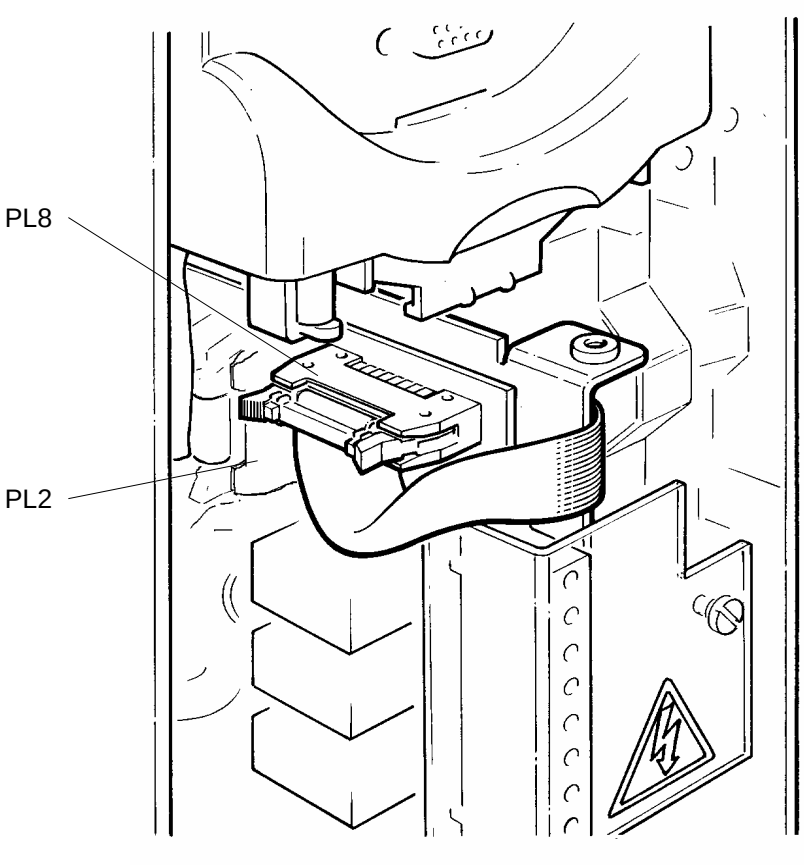


Figure 4-6 Keypad and DB Unit cable connection detail

6. Close the plastic shroud over TB1 on the control board and secure using the retained M5 screw.

7. Fit busbar links between the RECT+ and DC+ studs, and between the RECT– and DC– studs. Connect braking resistor cable crimp to the DC+ stud. Secure using M6 nuts, spring washers and flat washers. Torque as shown above.

8. Connect braking resistor cable crimp to the BR terminal on the DB Unit and secure using the supplied M6 hex head screw, spring washer and flat washer. Torque as shown above.

9. Route the braking resistor high voltage wiring through the plastic fingerguard at the top of the drive.

10. Close the Keypad harbour and secure with the M5 captive screw.

11. Mount the self-adhesive label in the “Options Fitted” area inside the Control door.

12. Close the power door and secure using two M5 captive screws.

Note: If it is difficult to secure the lower M5 captive screw, temporarily release the lower M5 screw retaining the control board, see Figure 4-2 (9).

13. Close the Control door.

14. External cables must be secured as close as possible to the drive.

4.3.4 Installation to Frame Size 4 Drives

Frame Size 4 Preparation
(Refer to Figure 4-7)

1. Gain access as described in Section 4.3.2.
2. Locate the link (4) between the RECT+ and DC+ studs, and the insulated link (7) between the RECT– and DC– studs. Remove the M8 nuts (8) and washers retaining the two links and remove the links.
3. Open the hinged plastic shroud on the control board by releasing the M5 captive screw (1).
4. Release the DB Blanking plate as follows:
   i. Remove the M5 screw and washer (2) securing the DB blanking plate to the control board.
   ii. Remove the two M4 taptite screws (6) on the right hand side of the DB blanking plate.
   iii. Remove the M4 taptite screw (3) to the left hand side of the DB blanking plate – see the inset in Figure 4-7 to remove the correct screw.
5. Remove the M5 screw (5) securing the bottom of the control board to the chassis.

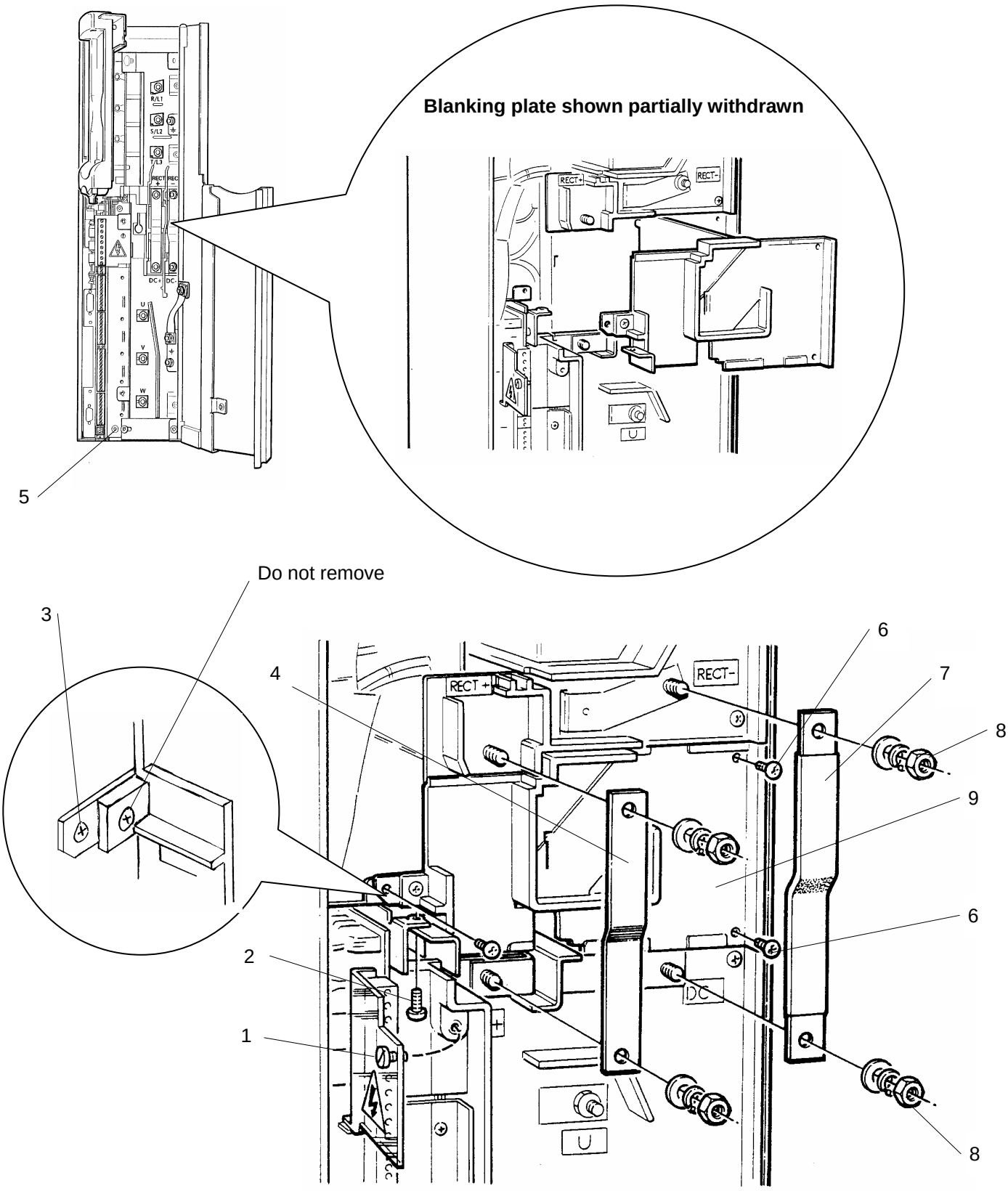


Figure 4-7 Frame size 4 – preparation

Frame Size 4 Installation
(Refer to Figure 4-8)

Note: Torque all M8 nuts to 15 Nm (130 lbf in).

1. Push the DB Unit approximately 50 mm (2 in) into the hole vacated by the DB Unit blanking plate. The rear of the DB Unit will now be supported by the transistor assembly.

2. Carefully slide the DB Unit towards the rear of the drive, keeping the DB Unit to the right hand side of the drive as follows:

   i. After the DB Unit has been inserted by approximately 60 mm (2.4 in) ensure that the capacitor (4) does not hit the rectifier moulding.

   ii. When the moulding on the front of the DB Unit reaches the drive door push the DB Unit slightly to the left to clear the door.

   iii. After the front of the DB Unit clears the door flange, push the DB Unit to the right and into the drive.

   iv. Check that the two DB Unit busbars (5) are aligned onto the studs (2) at the front of the unit.

3. With the back of the DB Unit as far to the right as possible, push the DB Unit home. Check that the back is not loose i.e. that the two tabs at the rear of the DB Unit have located in the slots (3) in the drive chassis.

4. Slide the control board forward by approximately 100 mm (4 in). Connect the DB Unit ribbon cable to connector PL8 (9) on the control board. Slide the control board back into place and re-fit its bottom M5 screw.

5. Secure the DB Unit to the chassis using two M4 x 12 mm taptite screws (13), one M4 x 6 mm taptite screw (8), and to the control board by one M5 screw (7).

6. Fit the non-insulated link (15) between the RECT+ stud (10) and the DC+ stud, and fit the insulated link (16) between the RECT– stud (12) and the DC– stud, taking care to fit them with orientation of the step as shown. Note that this orientation is different from that when the links were fitted over the blanking plate. Secure the busbar links to the RECT+, RECT– and DC– studs using M8 nuts, spring and flat washers (14). Torque as shown above.

7. Fit DB resistor cables as follows :–

   i. Release the M5 captive screw (1) securing the Keypad harbour and swing it open.

   ii. At the top of the drive, cut out fingerguards to allow cable entry.

   iii. Connect braking resistor cables to the BR stud (11) on the DB Unit and to the DC+ stud (2) on the drive. Secure the crimps with M8 nuts, spring and flat washers, and torque as shown above.

   iv. Close the Keypad harbour and secure with the M5 captive screw.

8. Close the hinged plastic shroud on the control board and secure with the M5 captive screw (6).

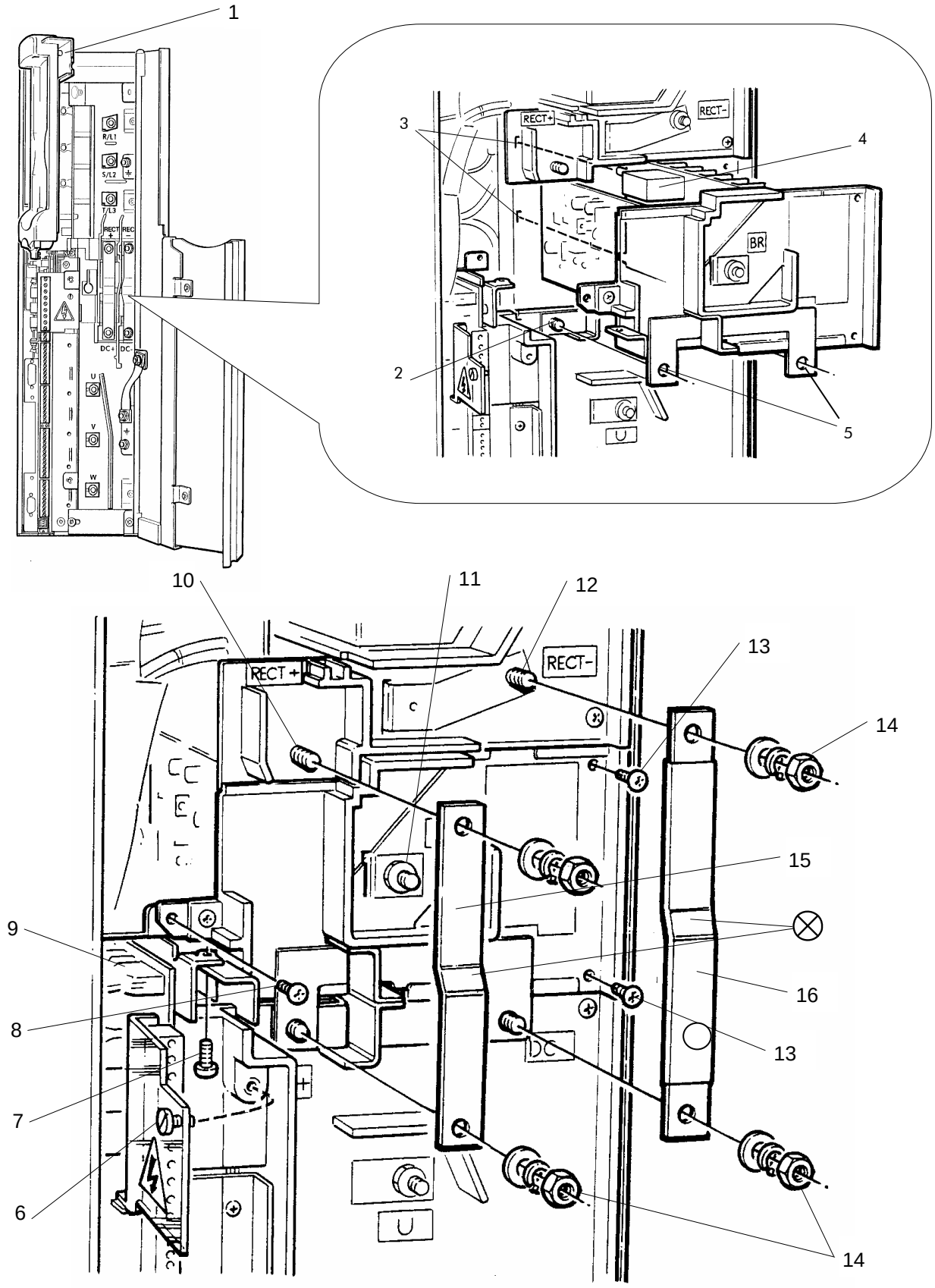


Figure 4-8 Frame size 4 – installation

9. Mount the self-adhesive label in the “Options Fitted” area inside the Control door.

10. Close and secure the Power door, close the Control door.

11. External cables must be secured as close as possible to the drive.

4.3.5 Installation to Frame Size 6 Drives

Frame Size 6 Preparation
(Refer to Figure 4-9)

1. Remove the M5 taptite screw (4) securing the blanking plate to the top of the drive casing.

2. Remove eight M5 taptite screws (5) securing the fan access plate (6) to the chassis and remove the plate. Do not remove the fan securing screw ⊗.

3. Slide the blanking plate (7) out of the drive and store.

4. Remove two M10 nuts, spring washers and flat washers (10) securing the link (9) to the DC+ and RECT+ studs. Remove the link.

5. Remove the M10 hex head screw and washers (if fitted) from the top of the DC+ busbar (2).

6. Remove the M10 nut and washers from the DC– stud (3).

7. Remove three M5 taptite screws (1) securing the transparent plastic shroud (8) to the DC– busbar. Remove the shroud.

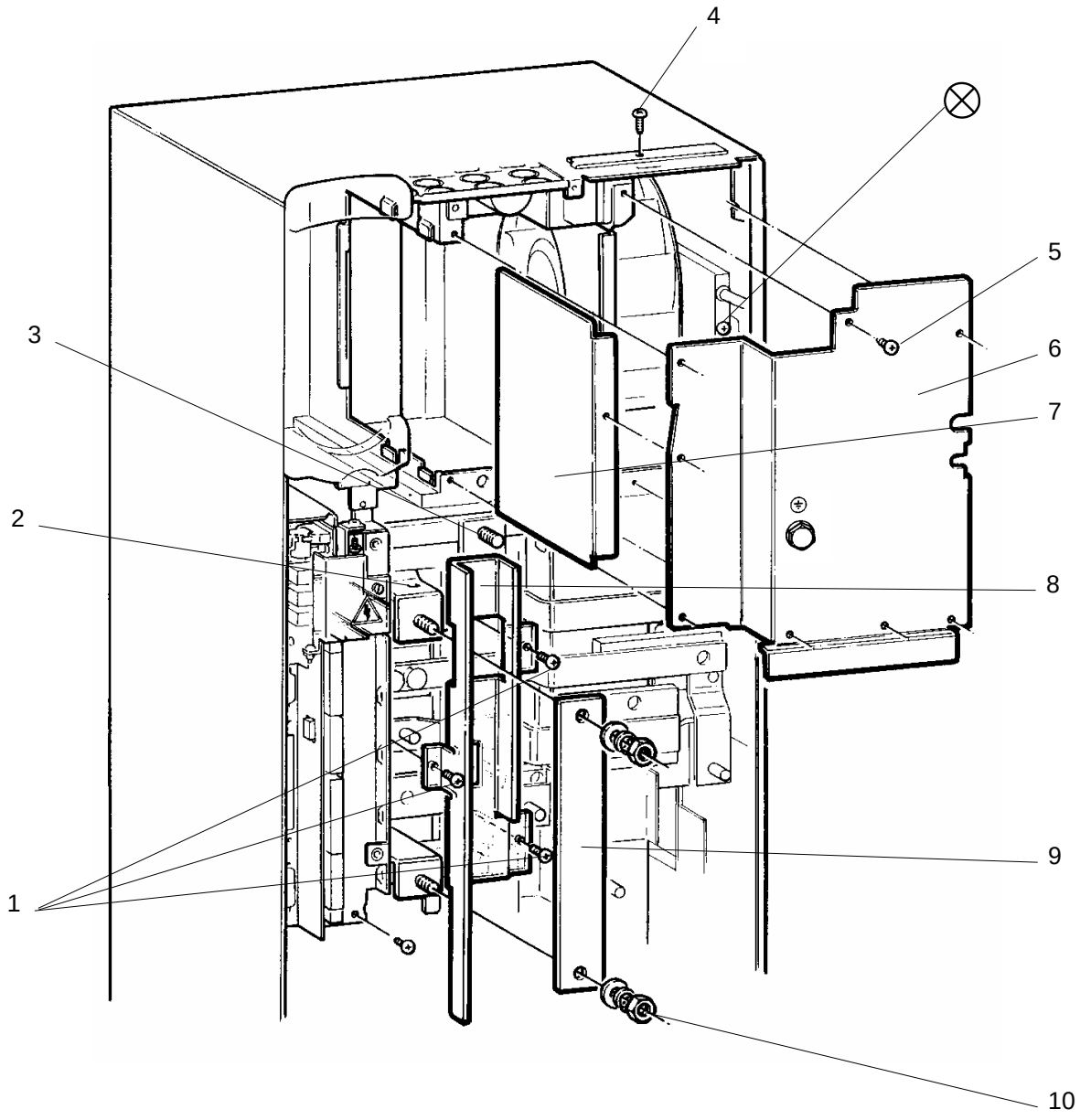


Figure 4-9 Fitting to frame size 6 – preparation

Frame Size 6 Installation
(Refer to Figure 4-10)

Note: Torque all M10 nuts and bolts to 30 Nm (265 lbf in).

1. The ribbon cable has been folded inside the DB Unit for transportation purposes. Release the free end of the ribbon cable so that it hangs out of the front of the DB Unit. Slide the DB Unit into the drive chassis, ensuring that the top and bottom edges of the DB Unit are located correctly in the guides (2) as shown in Figure 4-10 (A). Ease the bottom busbar (3) over the DC– stud (17) and slide fully into position.

2. Release the control board as follows:

   i. Open the hinged plastic shroud (7) by releasing the retained M5 screw (8).

   ii. Remove the M5 screw and spring washer (5) securing the bottom of the control board to the drive chassis.

   iii. Remove the M5 screw and spring washer (9) securing the top of the control board to the drive chassis.

   iv. Withdraw the control board approximately 25 mm (1 in).

3. Run the DB Unit ribbon cable (11) through the clip (10) on the drive chassis. If the clip is missing, fit the clip supplied with the DB Unit. The location of the clip is shown in Figure 4-10 (B). Connect the ribbon to PL8 (1) on the control board.

4. Re-fit the control board into the drive, using the procedure in step 2 (i) to (iv) in reverse order.

5. Secure the DB Unit to the DC+ busbar, using an M10 hex head bolt, spring and flat washers (16) (supplied in the DB Unit kit). Torque as shown above.

6. Secure the DB Unit to the DC– stud (17), using an M10 nut, spring and flat washers (18). Torque as shown above.

7. Re-fit the fan access panel (15) into position, easing it past the BR stud (12) and the DC– busbar (17). Check that the panel does not trap cables at the top or bottom. Secure with eight M5 taptite screws (14), starting with the centre screw on the left edge.

8. Re-fit the M5 taptite screw securing the blanking plate to the top of the drive.

9. Re-fit the transparent plastic shroud (4), using three M5 taptite screws (20).

10. Position the link (21) between the RECT+ stud (6) and the DC+ stud (19). Secure the link to the RECT+ stud (braking resistor cable to be fitted to the DC+ stud later), using an M10 nut, spring and flat washers (22).

11. At the top of the drive, cut open plastic fingerguard (13) to allow the braking resistor cables to enter the drive.

12. Secure the crimp of one DB resistor cable to the DC+ stud (19), using an M10 nut, spring and flat washers. Torque as shown above.

13. Secure the crimp of the other DB resistor cable to the BR stud (12) on the DB Unit, using an M10 nut, spring and flat washers. Torque as shown above.

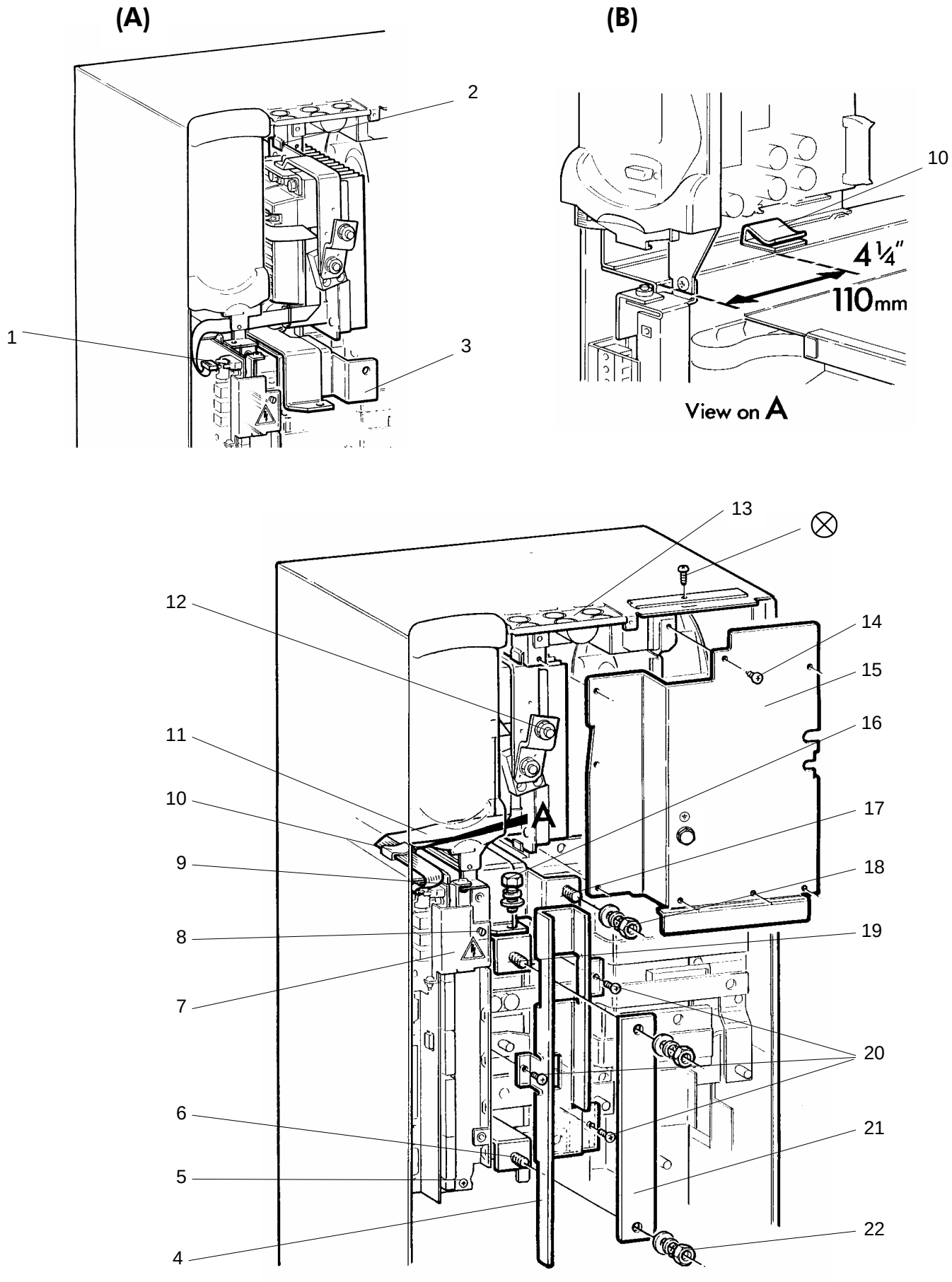


Figure 4-10 Frame size 6 - installing the DB Unit

14. Mount the self-adhesive label in the “Options Fitted” area inside the Control door.

15. Close and secure the Power door, close the Control door.

16. External cables must be secured as close as possible to the drive.

4.3.6 Installation to Frame Size 7 Drives

Frame Size 7 Preparation
(Refer to Figures 4-11 and 4-12)

1. Referring to Figure 4-11, release the two captive M5 screws (1) securing the keypad harbour and swing it open.

2. Remove seven M5 cross-head screws securing the fan access plate (4) to the chassis, also remove the M8 bolt and spring washer (6) securing the plate to the transistor-transistor unit chassis. Do not remove earthing screw (7) or fan securing screw ⊗. Carefully manoeuvre the top of the access plate past the fan cable (5) and fan terminal blocks, then lift the plate clear of the DC+ busbar (2).

3. Remove the M12 nuts, spring washers and plain washers from the DC+ stud (9) and the DC– stud (8).

4. Remove the securing panel (3), and remove and retain all the fingerguards.

5. Referring to Figure 4-12, remove the blanking panel (5) by sliding it out from the chassis guides (3).

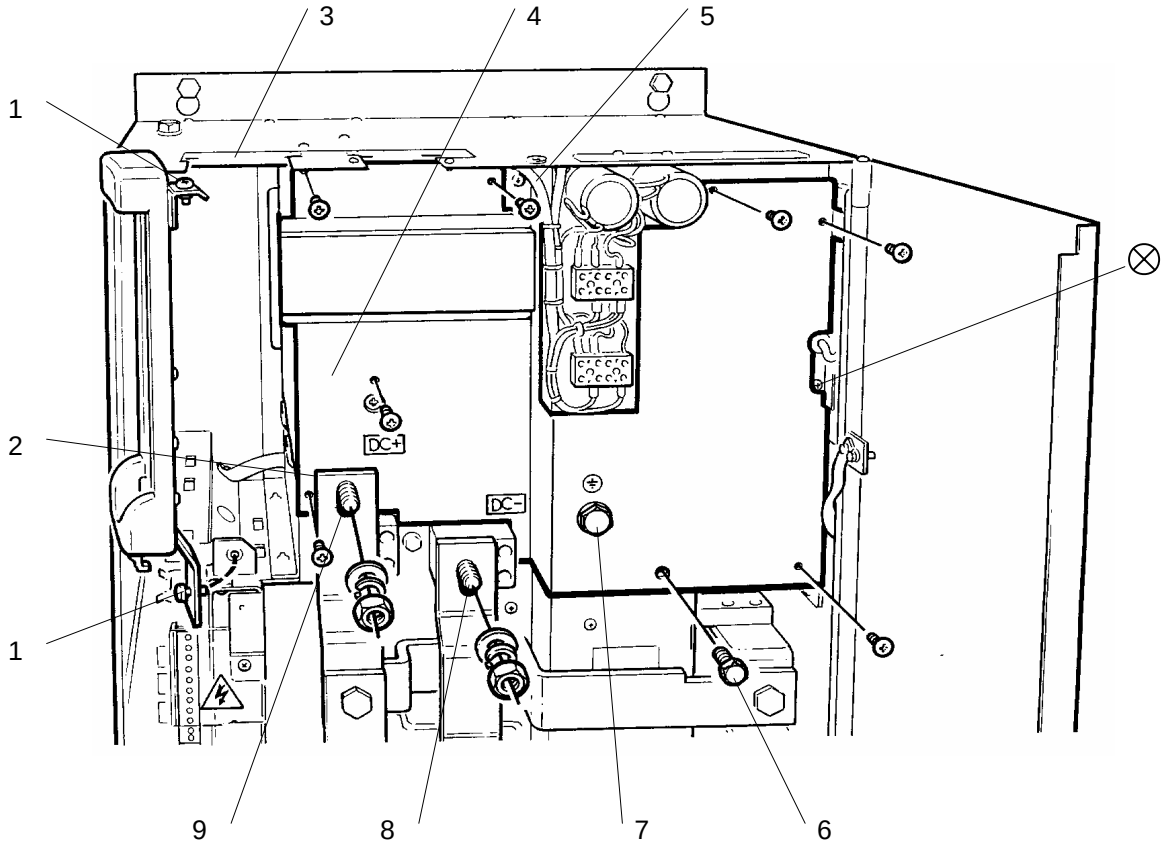


Figure 4-11 Fitting to frame size 7 – preparation

Frame Size 7 Installation
(Refer to Figures 4-11 and 4-12)

Notes: 1. Torque all M12 nuts and bolts to 45 Nm (400 lbf in).

2. The preferred routing of DB cables to the braking resistor is via the top of the drive, though bottom access may be used.

1. The DB Unit ribbon cable has been folded inside the unit for transportation purposes. Release the free end of the ribbon cable so that it hangs out of the front of the DB Unit.

2. Referring to Figure 4-12, slide the DB Unit into the drive chassis, ensuring that the top and bottom edges of the DB Unit are located correctly in the guides (3) as shown in Figure 4-12. Ease the busbars (1) over the DC+ stud (2) and DC– stud (4), and slide fully into position.

3. Secure the DB Unit negative busbar to the DC– stud, using an M12 nut, spring washer and flat washer (9) (supplied in the DB Unit kit). Torque as shown above.

4. Connect the DB Unit ribbon cable connector to PL8 (6) on the control board. This is shown in greater detail in Figure 4-6.

5. Referring to Figure 4-11, re-fit the fan access panel (4) by placing the bottom behind the DC+ busbar (2) and easing the top past the fan cable and the fan terminal blocks. Secure the panel to the drive chassis with seven M5 screws and secure to the transistor-transistor chassis with an M8 bolt and spring washer (7).

6. At the top of the chassis, fit the plastic fingerguard and secure with panel (3). Cut away sufficient fingerguard to allow the braking resistor cables to enter the drive.

7. Secure the crimp of one DB resistor cable to the DC+ stud (9), using an M12 nut, spring washer and flat washer. Torque as shown above.

8. Referring to Figure 4-12, secure the crimp of the other DB resistor cable to the BR stud (7), using an M12 nut, spring washer and flat washer. Torque as shown above.

9. Referring to Figure 4-11, close the keypad harbour and secure with the two captive screws (1).

10. Mount the self-adhesive label in the "Options Fitted" area inside the Control door.

11. Close and secure the Power door, close the Control door.

12. External cables must be secured as close as possible to the drive.

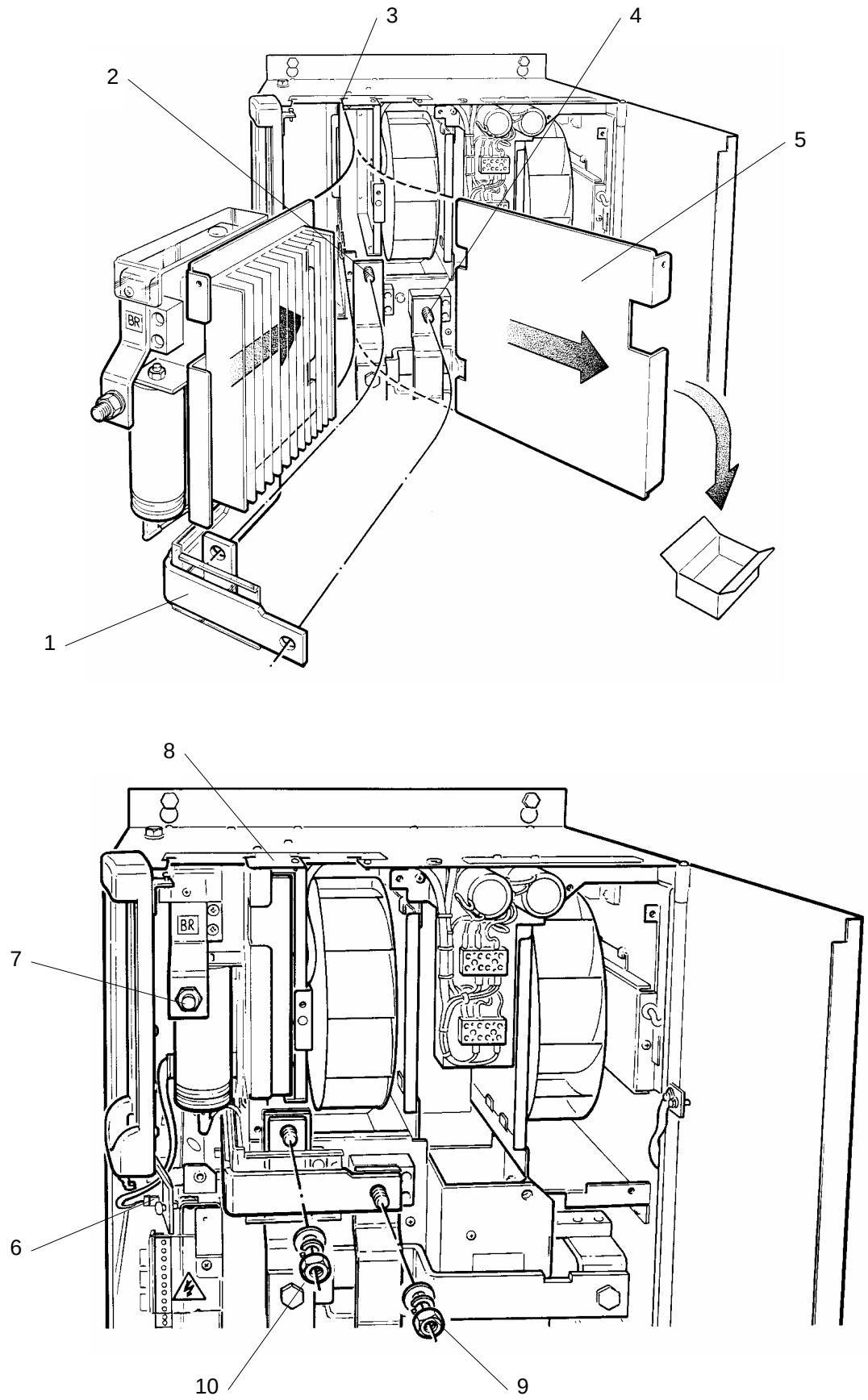


Figure 4-12 Frame size 7 – installing the DB Unit

4.4 Installing the Braking Resistor

WARNING
Surfaces on braking resistors can reach high temperatures and remain hot for some time after power has been removed.

The following points must be considered:

- The braking resistor should be positioned so as to avoid the accidental touching of hot surfaces.
- The resistor must be located so as to allow adequate cooling airflow.
- Cabling to the resistor must comply with the requirements of Section 3.7.
- The resistor enclosure must be earthed (grounded).

Where the drive is installed in a cabinet, the braking resistor assembly must always be mounted outside the cabinet, typically fixed to the top of the cabinet. The resistor assembly must be protected from dripping liquids by use of a protective canopy (available from **Converteam**).

Specifications and installation instructions for the ALSPA MV3DBR series braking resistors are provided in Instruction Sheet T1947, available from **Converteam** and provided with braking resistors.

5. Commissioning

WARNING

- **Wait at least 5 minutes after isolating supplies and check that voltage between DC+ and DC- has reduced to a safe level before working on this equipment.**
- **All items exposing high voltage must be placed in a suitable enclosure with restricted access.**
- **This equipment may be connected to more than one live circuit. Disconnect all supplies before working on the equipment.**
- **Do not use mobile phones or walkie talkies within 2 metres (6 feet) of the equipment.**
- **Surfaces on braking resistors can reach high temperatures and remain hot for some time after power has been removed.**
- **The combined audible noise emitted by fans in an installation can be greater than 70 dB(A), dependent on the air flow path.**
  Measure the audible noise level in the installation.
  When the audible noise level exceeds 70 dB(A), appropriate warning notices should be displayed.

CAUTION

High voltage insulation tests can damage this equipment. Cables/external components to be insulation tested must be disconnected from this equipment.

5.1 Installation Assumptions

The commissioning procedure assumes that the DB Unit and the braking resistor have been correctly installed as described in Section 4.

5.2 Commissioning Procedure

Note: The drive parameters associated with the DB Unit and braking resistor, and which are required for commissioning, are contained in Section 5.3.

5.2.1 Mechanical Checks

Check that the DB Unit has been installed in accordance with the instructions given in Section 4.

5.2.2 Power Connections

Ensure the drive is fully serviceable before installing the DB Unit.

Check that the correct DB Unit is fitted – see **Error! Reference source not found.**.

Ensure that:

- The cabling between the DB Unit and the braking resistor is adequate for the duty – see Section 3.7 .
- The connected braking resistor is within the range detailed in Section 2.1 (Specifications).

5.2.3 Procedure

Apply power to the drive but do not enable the output (i.e. do not run the motor).

- Check that current does not flow in the DB Unit output cables.

- Check the drive accepts that the DB Unit is connected. This is done by using Drive Data Manager™ (Keypad) or a PC using ALSPA Drive Coach™, to monitor parameter P11.33 and checking that bit 6 of the displayed binary string (Status Flag 54) is set to 1.
- Check the drive accepts that the braking resistor is “healthy” i.e. not too hot. This is done by monitoring Parameter P11.33 and checking that bit 7 of the displayed binary string (Status Flag 55) is set to 1.
- Using a Keypad or a suitable PC, configure the relevant drive parameters to operate the drive with DB Unit, as described in Section 5.3.

Run the drive.

- Check that on motor deceleration, the DB Unit switches on/off when the requested deceleration rate is faster than the free-wheel deceleration rate of the motor.

After commissioning the drive system, check that the duty cycle of the DB Unit is within the limits detailed in Section 2 (Specifications).

5.3 Drive Parameters

Several ALSPA MV3000e drive parameters must be configured to allow correct operation of the DB Unit with a drive. Access to menus and parameters is described in the relevant ALSPA MV3000e Getting Started Manual. The drive is set up using a Keypad, or using a suitable PC and appropriate software such as ALSPA Drive Coach.

The values to be entered for these parameters allow the drive to safely operate the dynamic brake and associated braking resistor.

Parameter 23.00 - DB Resistor Value

Enter the resistance of the fitted braking resistor.

Permitted values:

0.1 Ω to 1000.0 Ω

Parameter 23.01 - DB Resistor Average Power

Enter the average value of the power to be dissipated by the braking resistor, this being a measure of its continuous capability. The default value is drive dependent.

Permitted values:

0.1kW to 3000.0 kW

If a resistor listed in **Error! Reference source not found.** is used, P23.01 should be set to 10% of the “Nominal Power during 18 seconds ON time” given in that table.

Parameter 23.02 - DB Resistor Maximum Power

Enter the maximum value of the power to be dissipated by the braking resistor. This parameter, in conjunction with P23.03, is a measure of its overload capability. The default value is drive dependent. Range of permitted values:

From value in P23.01 to 3000.0 kW

If a resistor listed in Table 2-1 is used, P23.01 should be set equal to the “Nominal Power during 18 seconds ON time” given in that table.

Parameter 23.03 - Duration of DB Resistor Maximum Power

Enter a value for the maximum permitted duration of dissipating maximum power by the braking resistor (P23.02). The default value is 18 seconds.

Permitted values:

0.1 s to 1800 s

Parameter 23.04 - DB Voltage Threshold

The DC link voltage will increase due to regenerative braking. Enter the value of DC link voltage at which the DB Unit will switch in.
In general, the default value for the given drive size is suitable. The drive determines this value for itself when powering up.

Permitted values:

Minimum: Drive dependent
Maximum: 1500 V

Parameter 23.05 - Motor Regenerative Power Limit

This is the peak power which the drive will regenerate from the motor.
If this value is greater than the instantaneous peak power which the DB Unit can dissipate, i.e. $(P23.04)^2/P23.00$, then the drive may still trip on overvoltage. P23.05 should be used to limit the regenerative capability of the drive to match that of the DB Unit. This parameter is a repeat of P4.12 in the Start/Stop menu.

Permitted values:

–0.1 kW to 3000.0 kW

(–0.1 means NO LIMIT, the energy is to be absorbed by the dynamic brake.)

Parameter 23.06 - Action on DB Resistor Overload

This parameter defines the action to be taken by the drive on DB resistor overload. If the DB Unit is healthy (i.e. no warning or trip), status flag SF55 is set.

Permitted values:

0 = No action

1 = Warning (104) at 25% I^2T remaining

2 = Warning (104) at 25% I^2T remaining, Trip (67) at 0% I^2T remaining

3 = Reduce regenerative power limit to DB average power, issue Warning (104) at 25% I^2T remaining, Trip (67) at 0% I^2T remaining

Note: For options 0 and 1 the drive will trip if any DB function is required when P23.07 Resistor I^2t Remaining = 0% because at this point the DB unit is effectively disabled and thus the drive will now trip on overvolts.

Parameter 23.07 - Resistor I^2T Remaining

This read-only parameter shows the remaining overload capacity of the braking resistor.

Permitted values:

0% to 100%

Parameter 23.08 - Control Flag 110 - DB Enable

When CF110 is set, the DB Unit is enabled.

P23.08 selects the source for CF110.
The default value of P23.08 is 2.008 (= Status Flag 8, Drive Output Enabled) so the DB Unit is enabled whenever the drive is running.

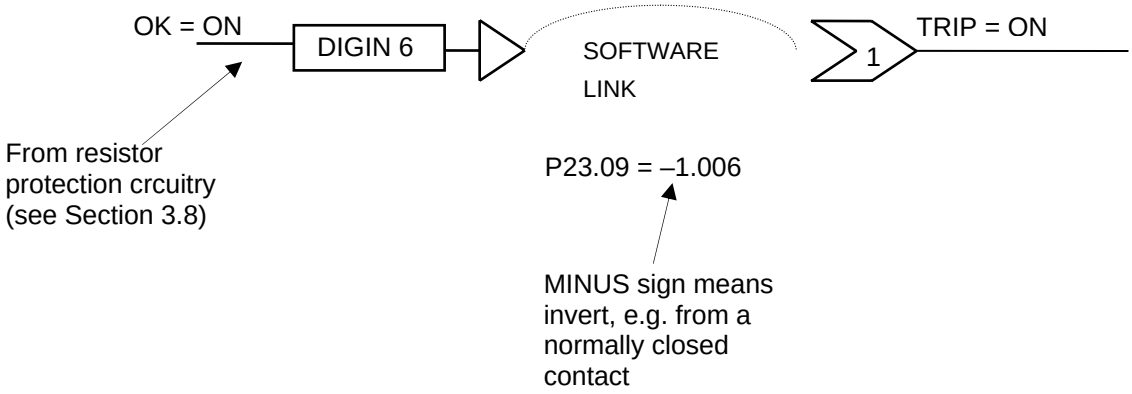
Parameter 23.09 - Control Flag 111 - DB Resistor Thermostat

P23.09 configures Control Flag 111.

CF111 is intended to be “connected”, via one of the Drive’s digital inputs, to the DB resistor’s thermostat thus providing additional over-temperature protection.

When CF111 is “ON” the DB unit is disabled, P23.07 (remaining I^2T) is forced to 0% and the action specified by P23.06 occurs. The default value of P23.06 will cause a “DB Resistor Trip”.

P23.09 can be used to “connect” one of the digital inputs to CF111. The value “1.001” selects Digital Input 1, “1.002” selects Digital Input 2 etc. Note that preceding the value with a “–” sign inverts the sense of the signal and will allow a normally closed thermostat or auxiliary contact to be used. An example is shown below, using Digital Input 6.



The default value for P23.09 is 0 i.e. CF111 is inactive.

See Section 3.8 for essential resistor protection information - and the relevant drive Getting Started Manual or T1679 for further information about Control Flags.

5.4 Dynamic Brake Status Flags

For the status of the DB Unit see Status Flag 54.

For the status of the braking resistor see Status Flag 55.

6. Preventive Maintenance

WARNING

- **Wait at least 5 minutes after isolating supplies and check that voltage between DC+ and DC- has reduced to a safe level before working on this equipment.**
- **This equipment may be connected to more than one live circuit. Disconnect all supplies before working on the equipment.**
- **Surfaces on braking resistors can reach high temperatures and remain hot for some time after power has been removed.**

6.1 Tools and Equipment Required

Torque wrench, suitable size for power terminals, for range of torques as follows:

M6 (1/4 in) to M12 (1/2 in), range 8 - 45 Nm (70 - 400 lbf in)

Flat blade screwdriver, suitable for opening the power door (RH door).

Vacuum cleaner having soft (e.g. rubber) nozzle.

6.2 Maintenance Schedules

Note: It is suggested that these schedules be integrated with those for the drive unit.

6.2.1 Access to Equipment

1. Switch off the drive and isolate it from the electrical supply. Comply with the Warning at the top of this page.

2. Gain access to the drive interior by opening the doors as shown in Section 4.3.2.

6.2.2 Monthly Servicing

1. Ensure all braking resistor ventilation louvres are unobstructed.

2. Examine DB Unit connections to the DC link terminals DC+ and DC–, also to the braking resistor terminal BR, for signs of overheating (discolouration and/or damaged insulation).

6.2.3 Annual Servicing

1. Carry out the Monthly schedule as above.

2. Use the vacuum cleaner to remove dust etc. from the braking resistor enclosure.

3. Check all DB Unit and braking resistor terminations are secure, refer to Table 4-1 in Section 4.3.1 for torque settings.

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7. Diagnostics

7.1 Fault monitoring

The drive continuously monitors the performance of the DB Unit and braking resistor. A malfunction of the dynamic brake will result in the drive indicating a warning or a trip, depending on the nature of the fault.

To aid fault diagnosis the drive keeps a log of warnings and trips, which are entered as warning or trip fault codes. Use of the log is explained in Section 6 of the Getting Started Manual, which also shows how to view the fault codes and what action to take in the event of a warning or trip. This section also explains how to reset a trip.

7.2 Warnings

The drive illuminates the WARNING indicator if a fault occurs which is not sufficiently serious to trip the drive. Warnings are not latched, so that if the reason for the warning is cleared the WARNING indicator will extinguish, though a record may be maintained in the History Log to aid possible further diagnosis (if configured by the user).

The warning fault code and possible diagnosis is given in Table 7-1.

Table 7-1 Warning diagnosis

Warning Code	Description	Possible Fault
104	**DB resistor.** There is <25% power dissipation capability remaining.	If this warning occurs often: 1. Use a higher rated braking resistor. 2. Power data may be incorrect. Review calculations in Section 3.

7.3 Trips

The drive flashes the TRIPPED indicator if a serious fault has caused it to trip. Trips are latched and the drive cannot be used until the fault is cleared and the drive is reset as described in the Getting Started Manual.

A list of trip fault codes and possible diagnosis is given in Table 7-2.

Table 7-2 Trip diagnosis

Trip Code	Description	Possible Fault
3	**DC overvolts.** The DC Link voltage has exceeded the maximum permitted value when the load is decelerating.	1. DB Unit not enabled. Check status of CF110 (P23.08). 2. Peak braking power capability of DB Unit/resistor is insufficient for the application. 3. Braking resistor open circuit. 4. Loose termination or break in wiring to resistor. 5. Malfunction of DB Unit.
6	**Overtemperature.** Drive or DB Unit temperature has exceeded its maximum safe level.	1. Excessive use of dynamic brake. 2. Possible obstruction of airflow through drive. 3. Ambient temperature too high.
67	**DB resistor trip.** The drive estimates (from data) that the braking resistor is too hot.	1. Application requires more braking effort than the resistor can absorb. Use a higher rated resistor. 2. Incorrect data entered for the braking resistor in use.

(continued)

Trip Code	Description	Possible Fault
151	**DB trip.** The drive has detected a trip from the DB Unit caused by either an overcurrent or heatsink overtemperature.	1. Ohmic value of braking resistor too low. 2. Resistor has shorted turns. 3. Wiring fault from DB Unit to resistor. 4. Excessive use of dynamic brake. 5. Possible obstruction of airflow through drive.
152	**DB overtemperature.** Heatsink overtemperature.	1. Excessive use of dynamic brake. 2. Possible obstruction of airflow through drive. 3. Ambient temperature too high.

8. Spare Parts

The DB Unit contains no user-replaceable parts.

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9. Disposal

This equipment or any part of the equipment should be disposed of in accordance with the laws of the country of use.

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INDEX

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