B015 Dynamic Brake
Technical Manual

Part Number 4201-211 Revision B

IMPORTANT

Read and understand the procedures described in this manual before attempting to install or commission your unit.

If in doubt, before proceeding, please contact Bardac Drives at:

410-604-3400

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IMPORTANT NOTES

The DB-15 operates a **HIGH POWER DC CIRCUIT AT LETHAL VOLTAGES**. Great care **MUST** be taken in the application and protection of the DB-15 and the load resistors.

The heat generated by the resistors connected to a single DB-15 operating under full power of **FAULT CONDITIONS** can exceed 11kW. The design of the system must include **FAIL-SAFE** protection to prevent a **FIRE HAZARD** under all conditions.

The DB-15 operates at **RECTIFIED MAINS POTENTIAL**. 600Vdc is present whenever the mains supply is present. Be absolutely sure all voltage is **ISOLATED** and has **DISCHARGED** before working on the DB-15.

The DB-15 provides functional braking. It is not a safety brake and should not be employed as such. A separate mechanical safety brake must be used where necessary.

SECTION 1: INTRODUCTION

The DB-15 is a stand-alone 15A Dynamic Brake consisting of a dynamic brake control module with a 50 Ohm internal resistor.

The dynamic braking system provides the Xtravert (or Elite Series) with the ability to cope with short term regeneration of the motor such as may be experienced during the deceleration of a high inertia load. The effect of this action is that the mechanical energy in the load is converted to heat in the dynamic brake resistor and the motor is rapidly decelerated. Up to 11kW of regenerated power may be switched by each DB-15.

The DB-15 can be controlled by an external trigger signal or by the built in voltage sensing circuit. An output is provided for slaving multiple DB-15 to provide extra braking capability. A fail-safe fault relay indicates fault status. Provision is made for the connection of an external resistor.

The DB-15 is fitted in the same size enclosure as the Xtravert (models 9A and larger). This compact bookshelf style enclosure offers the advantage of reduced installation space, allowing for easy installation.

Plug-in control terminals allow for speedy change-over should the unit require relocation or service.

SECTION 2: ELECTRICAL SPECIFICATIONS & TECHNICAL DATA

Dynamic brake switching voltage (switch selectable)	390Vdc or 735Vdc
Internal resistor value	50 Ohm
Maximum switch current	15A
Maximum ambient temperature	50°C
Maximum internal resistor dissipation	600W at 20°C
linearly decreasing to	300W at 50°C
Internal resistor time constant	300s
Internal resistor continuous duty cycle at 50°C	2.8% at 735V 10% at 390V

PROTECTION:

Missing Resistor	Trip when switching into open-circuit resistor
IGBT desat trip	Trip when switching into short circuit

Note: There is no internal resistor protection. Never exceed the power rating of the internal resistor.

BRAKE VOLTAGE CONTROL:

Mode selection	Slave (by external controller) or Master (internal sensing circuit)
Voltage selection	390Vdc / 735Vdc

OUTPUTS:

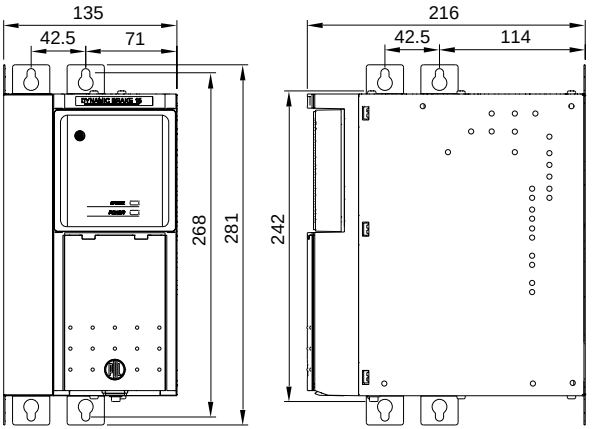
Fail Safe Fault relay	Normally closed, 250Vac/30Vac, 1A
Slave DB control	13mA current output
External Resistor Connection	

ENVIRONMENTAL SPECIFICATION:

IP20

DIMENSIONS

(h x w x d):
281 X 135 X 216mm



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SECTION 3: APPLICATION RECOMMENDATIONS

The most common application for the DB-15 is to aid in the rapid braking of high inertia loads such as a fly-wheel or a centrifuge.

In this application when the drive begins to stop or slow down the load, the slip speed of the motor can become negative. This causes the motor to regenerate which pumps up the DC bus voltage. The dynamic brake is turned on when the DC bus voltage is too high.

The brake voltage can be controlled externally by the Xtravert or Elite Series or by the internal voltage sensor.

The DB-15 switches the dynamic brake resistor across the DC bus thus dissipating the regenerated energy and controlling the DC bus voltage. Figure 3.1 shows the configuration for the brake system.

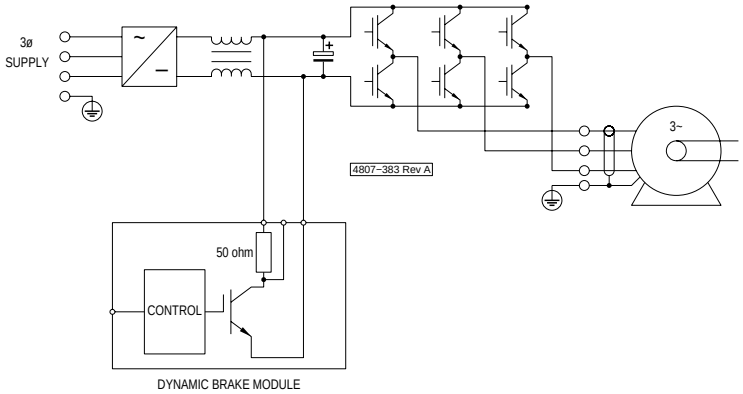

Figure 3.1: DB-15 Operational Schematic

The effect of this action is that the mechanical energy in the load is converted to heat in the brake resistor and the motor is brought to a rapid halt.

If the level of regeneration exceeds the capability of the dynamic brake system the DC bus voltage will continue to rise. This will cause the drive to hardware voltage limit or trigger a **HIGH VDC** fault. In either case, the drive will have lost control of the motor.

If higher average levels of braking power are required other dynamic braking options are available. Contact your PDL Electronics representative for details.

In determining whether the DB-15 dynamic module meets your application requirements, three power rating figures must be considered as follows:

3.1 PEAK INSTANTANEOUS REGENERATED POWER (PRPK)

This is the absolute maximum peak power the brake resistor can absorb. If this power is exceeded, the DC bus voltage will continue to rise during regeneration and the drive will voltage limit or trip. The peak instantaneous regenerated power of DB-15 is **11kW** (for 400Vac rated drives) or **3kW** (for 230Vac rated drives).

3.2 SHORT TERM REGENERATED POWER (PRAV)

The actual power dissipated by the brake resistor is

$P_{R_{AV}} = P_{R_{PK}}$ X Duty Cycle(%) / 100

The short term regenerated power is the power limit resulting from the short term power absorption rating of the brake resistor. To determine if the application is within these limits, the regenerated power and regenerative time must be known. The brake duty cycle can be calculated from the following equation:

Duty Cycle(%) = $P_{R_{AV}} / P_{R_{PK}}$

Knowing the brake duty cycle, the maximum regenerative time can be read from the graph of Figure 3.2.

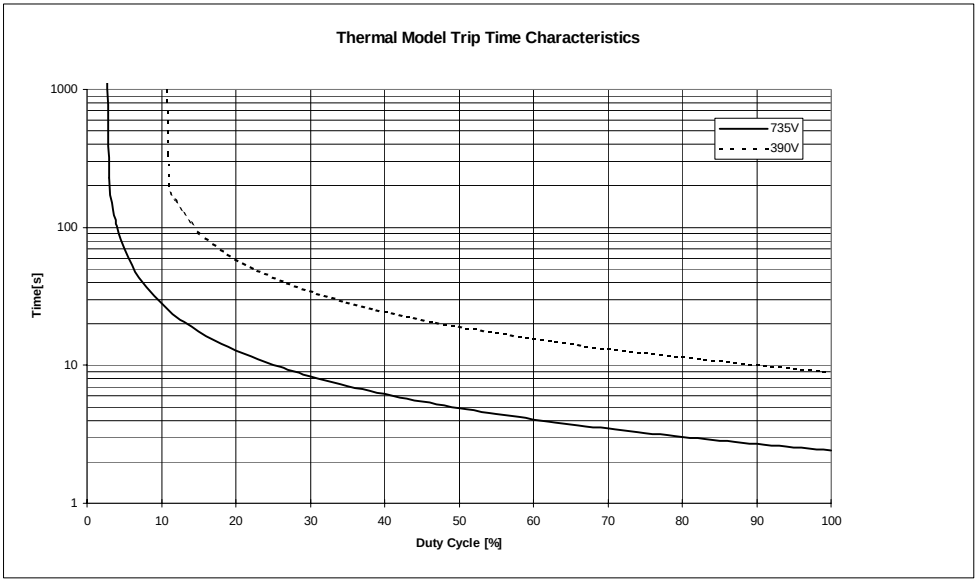

Figure 3.2 : Thermal Model Trip Time Characteristics

3.3 AVERAGE LONG TERM REGENERATED POWER

The average long term regenerated power of DB-15 versus ambient temperature is as shown in Figure 3.3.

The DB-15 dissipates the motor's regenerated energy into the heatsink. If the average level of regeneration is too high, the heatsink and the resistor will get too hot, damaging the resistor.

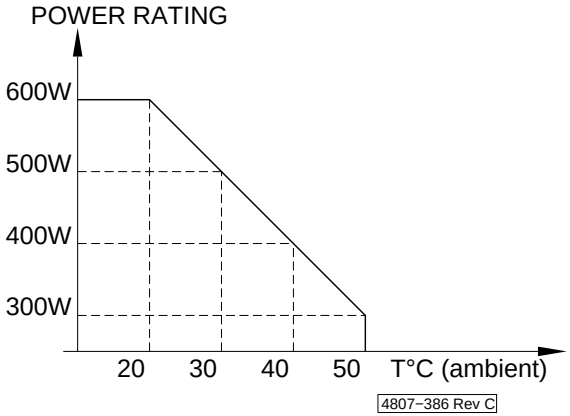

Figure 3.3 : Thermal Model Trip Time Characteristics

SECTION 4: INSTALLATION

4.1 GENERAL CONSIDERATIONS

The DB-15 must be mounted vertically to ensure proper cooling. Do not mount the DB-15 closer than 150mm from other equipment or the localised maximum ambient air temperature may exceed specifications of 50°C. Avoid mounting the DB-15 immediately above other units. Ensure that the airflow from the fan is not obstructed. If the DB-15 is mounted in a cabinet, ensure that sufficient cooling is available to prevent the localised air ambient exceeding specifications of 50°C.

Due to the high switching speed and current of the DB-15, special wiring practices must be observed. A multicore cable for the power input and optional resistor output is recommended. Alternatively, two separate cables, securely cable tied together at 200mm intervals without any gaps between them, may be used for each of the input and resistor output connections. This minimises the cable inductance.

Do not run power and the control wiring together, but separate by at least 300mm.

The external resistor must be of non-inductive construction.

The wiring between the drive and the DB-15 should be kept as short as possible (no more than two meters).

The maximum cable length allowed between the DB-15 and the external resistor is 20 meters.

Some applications will require a mechanical brake as a safety measure in the event of dynamic brake failure. The output of the fault relay can be used to operate the mechanical brake.

Thermal fuses or thermostats fitted to the resistor bank and connected to the coil of a contactor in the drive supply will provide a second level of protection.

4.2 WIRING THE DB-15 TO THE DC BUS

WARNING: Isolate the drive used and allow stored charge to dissipate before proceeding.

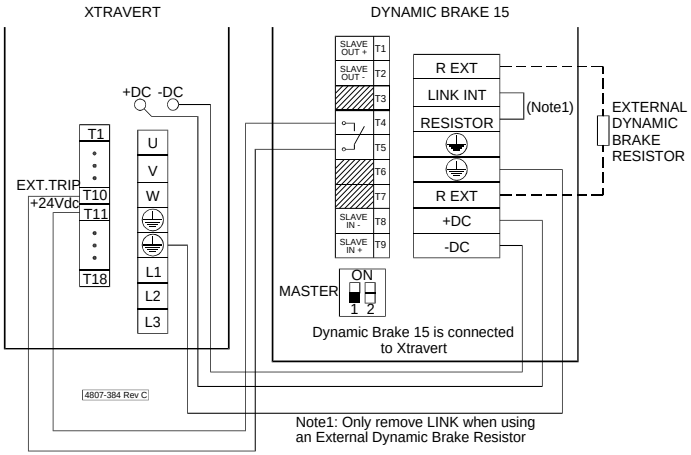

Figure 4.1: Details of the Xtravert to DB-15 wiring.

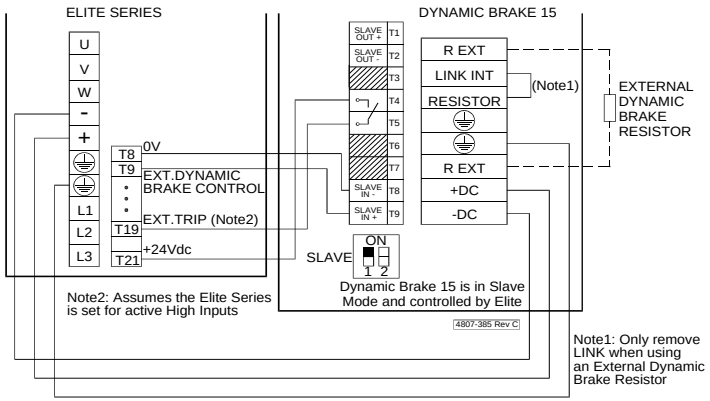

Figure 4.2: Details of the Elite Series to DB-15 wiring.

Connect the drive DC bus terminals to the DB-15 terminals, labelled **+DC** and **-DC,** using a low inductance cable of shortest possible length (less than two meters). Be careful to observe correct polarity.

4.3 EARTHING THE DB-15

Connect an earth conductor to the DB-15 earth terminal ((⏚)).

4.4 WIRING THE DB-15 TO AN EXTERNAL RESISTOR

The DB-15 can be used with either the internal resistor or an external resistor. Do not use the internal resistor and an external resistor.

An external resistor may be used when the regenerated power exceeds the capability of the internal resistor.

The internal resistor is connected in the circuit as a factory default. When the internal resistor is not required, the link labelled **LINK FOR INT R** must be removed.

The external resistor is connected to the terminals labelled **R EXT**. The maximum cable length permitted is 20 meters.

4.5 CONTROL INPUT/OUTPUT WIRING

4.5.1 MASTER/SLAVE CONTROL

When the DB-15 is connected to an Elite, connect the dynamic brake output of the drive (Elite T8 and T9) to the DB-15 control input (T8 and T9), as shown in Figure 4.2 . Set the **DB CONTROL** switch to the **SLAVE** position. In this mode the position of the **SENSE VOLTS** switch is immaterial.

When the DB-15 is used with an Xtravert set the **DB CONTROL** switch to the **MASTER** position. In addition, set the **SENSE VOLTS** switch as follows;

XTRAVERT RATED VOLTAGE	SWITCH POSITION
230V (models X302 to X309 and X502 to X516)	390Vac
400V (models X702 to X716)	725Vdc

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4.5.2 MULTIPLE DB-15

Multiple DB-15 can be connected if the application requires dynamic braking such that either the power rating of the resistor or the current rating of the switch of a single DB-15 would be exceeded.

The first DB-15 is configured as described in 4.5.1. All other DB-15 are configured as **SLAVE**.

The **SLAVE IN-(Terminal T8) and the SLAVE IN+ (Terminal T9)** input terminals of the slave DB-15 are connected to the **SLAVE OUT+ (Terminal T1) and the SLAVE OUT- (Terminal T2)** output terminals of the preceding DB-15. When external resistors are used, each DB-15 must have a separate resistor, that is, the **R EXT** terminals must **NOT** be connected together.

4.5.3 FAIL-SAFE FAULT RELAY CONNECTION

The DB-15 fail-safe fault relay is closed during normal operation. The relay contacts open when the power is removed or a fault has occurred. The terminals are labelled with the relay symbol. The following faults are signalled:

- Desaturation of the IGBT, possible cause: resistor short circuit, faulty wiring.
- IGBT overtemperature, possible cause: output current exceeded, insufficient cooling.
- Resistor open circuit, possible cause: faulty resistor or resistor wiring.

The relay should be connected to the external trip circuit of the Elite (Terminal T19) or Xtravert (Terminal T10). When multiple DB-15 are used the individual fault relays must be connected in series.

The DB-15 automatically resets the fault condition after 32 seconds if the fault has been removed. There is no external reset and the fault is not latched.

SECTION 5: ELECTROMAGNETIC COMPATIBILITY (EMC) AND SAFETY

5.1 CONTROL CABLES

The Dynamic Brake 15 has the ability to be controlled from an external source (i.e., Slave Mode). When configured to do so, screened control cables must be used for the connection between the Dynamic Brake 15 and the external controller to comply with EMC regulations. The screen should be connected to 0V on the control board of the external controller (irrespective of whether the control board is earthed or floating) as a radio frequency (RF) return. Avoid using long twisted leads (pigtails) for the screen connection as this twisting increases the RF impedance (reducing the effectiveness of the screen).

The Dynamic Brake 15 has an optically isolated input for external control. This prevents earth loops in the control wiring. An example of where this is useful is where multiple Dynamic Brake 15 are controlled using the same signal source.

Avoid running control cables in parallel with power cables with a spacing less than 300mm. Cross control cables at right angles to power cables to avoid magnetically induced interference.

5.2 DC BUS CABLES

DC bus connections between the Xtravert and the Dynamic Brake 15 may use unscreened cable. If screened cable is used, connect the screen at both the Xtravert and the Dynamic Brake 15 to provide an RF return path. This prevents the Dynamic Brake 15 cabinet becoming a RF source, coupling into the local metalwork and the earthing system. Connect all earths (input, output and cabinet) together at one star point.

Local regulations may require that a separate earth be run to the resistor for safety requirements. It is recommended that three-core cable plus screen is used in these applications.

5.3 RESISTOR CABLES

Screened output power cables to any external resistor must be used for the Dynamic Brake 15 to comply with EMC regulations. Connect the screen at both the Dynamic Brake 15 and resistor ends to provide an RF return path. This prevents the resistor frame becoming a RF source, coupling into the local metalwork and the earthing system. Avoid using long twisted leads (pigtails) for the screen connection as this twisting increases the RF impedance (reducing the effectiveness of the screen). Connect all earths (input, output and cabinet) together at one star point.

Local regulations may require that a separate earth be run to the resistor for safety requirements. It is recommended that three-core cable plus screen is used in these applications.

Screened cables to the resistor prevent high speed switching noise from being radiated to the environment. Generally, it is better to keep resistor cables as short as possible to reduce capacitive charging currents due to cable capacitance and limit the peak voltage at the resistor terminals.

If unscreened cables to any external resistor are used, EMC regulations may not be complied with.

EC Declaration of Conformity

Manufacturer:	PDL Electronics Ltd. 81 Austin Street, Napier, New Zealand
Authorised Representative:	PDL Elektronik Vertrieb Deutschland GmbH Industriestraße 13A, D-90592, Schwarzenbruck, Deutschland
Details of Equipment:	Dynamic Brake
Model Number(s):	B015
Description:	Dyamic Brake 15
Directives this equipment complies with:	LVD 73/23/EEC, EMC 89/336/EEC

Standards applied in order to verify compliance with directives:

BS EN61010-1:1993.
Safety requirements for electrical equipment for measurement, control, and laboratory use, part 1: General requirements. Sicherheitsbestimmungen für elektrische Meß-, Steuer-, Regel- und Laborgeräte - Allgemeine Anforderrungen.

BS EN61800-3:1996.
Adjustable speed electrical power drive systems, part 3: EMC product standard including specific test methods. Drehzahlveränderbare elektrische Antriebe - EMV - Produktnorm einschließlich spezieller Prüfverfahren.

BS EN55011:1991.
Limits and methods of measurement of radio disturbance characteristics of industrial, scientific and medical (ISM) radio-frequency equipment. Grenzwerte und Meßverfahren für Funkstörungen von industriellen, wissenschaftlichen und medizinischen Hochfrequenzgeräten (ISM - Geräten).

BS EN61000-4-2:1995.
Electrostatic discharge immunity. Prüfung der Störfestigkeit gegen die Entladung statischer Elektrizität.

BS EN61000-4-3:1995.
Radiated, radio-frequency, electromagnetic field immunity. Prüfung der Störfestigkeit gegen hochfrequente elektromagnetische Felder.

BS EN61000-4-4:1995.
Electrical fast transient/burst immunity. Prüfung und Störfestigkeit gegen schnelle transiente elektrische Störgrößen/Burst.

Year of affixing CE mark: 1998

	Authorised Signatory: Manufacturer	EU Authorised Representative
		
Name:	Ian Hickey	Günter Gassner
Title:	Research & Development Manager	Market Development Manager
Date of Issue:	2nd February 1998	
Place of Issue:	Napier, New Zealand	

SECTION 6: COMMISSIONING INSTRUCTIONS

Before applying power, double check that all connections are correctly made. Any incorrect connection can result in extensive damage and danger to personnel!

When the internal voltage sensing circuit is used, check that the correct activation voltage is selected.

On power up, the **POWER** LED should light and the fan should turn on. The **BRAKE** LED should remain off.

6.1 CONFIGURING THE XTRAVERT

Xtravert screen **X8** selects the regeneration mode. **Select X8 REGEN=D-BRAKE** for proper operation.

6.2 CONFIGURING THE ELITE

Elite screens **D1** and **D2** allow the dynamic brake to be configured. Refer to the Elite manual for a detailed description. When the internal resistor is used, select **D1 DB TIME= 250s** and **D2 DB DUTY= 3%**. When an external resistor is used, select values appropriate for that resistor.

SECTION 7: PROTECTION

The likely effects resulting from a failure in any part of the circuit must be considered.

7.1 LOSS OF DYNAMIC BRAKE PERFORMANCE

If the DB-15 trips out for any reason, the dynamic braking effect will be lost. Under this circumstance, certain loads may require additional or back up mechanical braking. The contact of the fault relay may be used to trigger the mechanical brake.

7.2 FIRE HAZARD

A failure of the DB-15 may cause the resistors to be turned ON permanently. Unless preventative action is taken, the power generated could easily lead to the destruction of low duty cycle resistors or fire. Thermal protection would typically take the form of thermal fuses or thermostats mounted in the near vicinity of the resistors. These should control the coil of a contactor wired into the AC input of the drive concerned. If the load is of the continuous regeneration type, the contactor must be placed in series with the resistor. This resistor contactor must be a DC type, **NEVER** substitute an AC contactor!

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