Control Wiring

General wiring diagrams for the 620 are provided in Chapter 2.

Control cables should be 0.75mm^2 (18AWG) minimum. It is recommended that screened cable is used, with the screen connected at the drive end only. Control wiring should be kept separate from power and motor wiring.

For normal speed control operation, the speed demand signals are connected to the speed inputs (control board terminals C3, C4 and F2) as required. Terminal C2 or F1 may be used for the 0V connection associated with the SPEED SETPOINT and DIRECT INPUT signals. The maximum speed, and other associated parameters, are set from the MMI.

The START signal to the 620 Vector drive is provided by connecting a single holding contact between control board terminal B7 (START) and terminal B9 (+24V). When the contact is open, the motor stops. When the contact is closed and both COAST STOP and FAST STOP are at +24V, the motor will run.

A digital output indicating that the drive is healthy is provided on terminals E7 of the 620 Vector drive. Any alarm which causes the drive healthy output to de-activate is internally latched by the drive until both START and JOG go low (0V or open circuit). The cause of the alarm is displayed by the MMI. Once latched, such an alarm can be cleared only by removing and re-applying the START or JOG signal.

DYNAMIC BRAKING

Introduction

During deceleration, or with an overhauling load, the motor acts as a generator. Energy flows back from the motor into the DC link capacitors within the drive. This causes the DC link voltage to rise. If the DC link voltage exceeds 810V for the 400V build (or 420V for the 230V build) then the drive will trip to protect the capacitors and the inverter power devices. The amount of energy that can be absorbed in the capacitors is relatively small; typically more than 20% braking torque will cause the drive to trip on overvoltage. Dynamic braking increases the braking capability of the drive by dissipating the excess energy in a high power resistor connected across the DC link (refer to Figure 3.2).

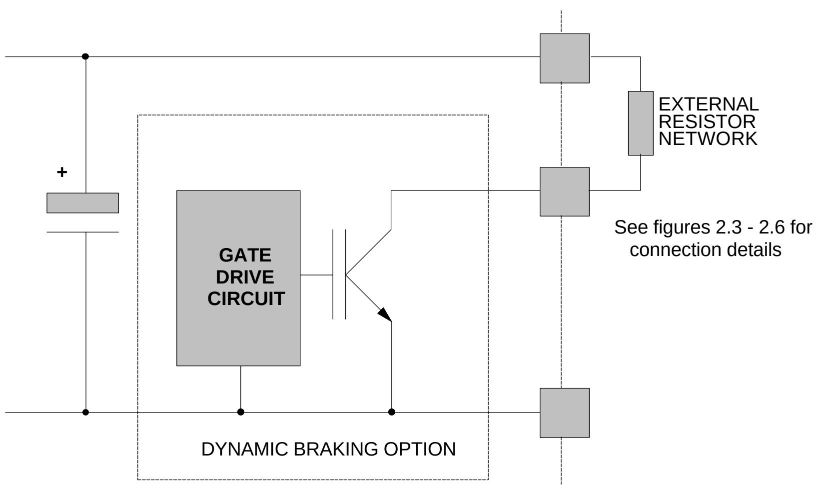


Figure 3.2 - The Dynamic Braking Option

The dynamic braking option is a PCB with an extra IGBT power device fitted. This is fitted inside the drive package and is connected to the negative side of the DC link as shown in Figure 3.2.

When the DC link voltage rises above 750V for the 400V build (385V for the 230V build), the brake unit switches the external resistor network across the DC link. The brake unit switches off again when the DC link voltage falls below the threshold level. The amount of energy produced by the motor during regeneration depends upon the RAMP DOWN TIME parameter and the inertia of the load.

> Note: The dynamic braking option is designed to cope with short term stopping or braking only. It is not rated for a continuously overhauling load.

All 620 units are supplied without braking resistors by default. The following paragraphs should be used as a guide to calculate the braking requirements of the system.

WARNING!

Connecting a brake resistor to a drive not fitted with brake option (see product code) will result in damage to this unit. In the case when an internal brake option is not present the DBR terminal may be used to connect an external braking unit

Brake Resistor Selection

Brake resistor assemblies must be rated to absorb both peak braking power during deceleration and the average power over the complete cycle.

$$\text{Peak braking power} = \frac{0.0055J \times (n_1^2 - n_2^2)}{t_b} \quad (W)$$

$$\text{Average braking power } P_{av} = \frac{P_{pk}}{t_c} \text{ x } t_b$$

J	- total inertia (kgm^2)
n_1	- initial speed (rpm)
n_2	- final speed (rpm)
t_b	- braking time (s)
t_c	- cycle time (s)

Information on the peak power rating and the average power rating of the resistors must be obtained from the resistor manufacturer. Alternatively if this information is not available then a large safety margin must be incorporated to ensure that the resistors are not overloaded. Eurotherm Drives can supply suitable brake resistor assemblies as detailed over.

By connecting these resistors in series and in parallel the braking capacity can be selected for the application.

The minimum resistance of the combination should not be less than that specified in Table 3.2.

The resistor(s) must be specified to the maximum DC link voltage (810V for the 400V build, 420V for the 230V build).

Brake Resistor Specification

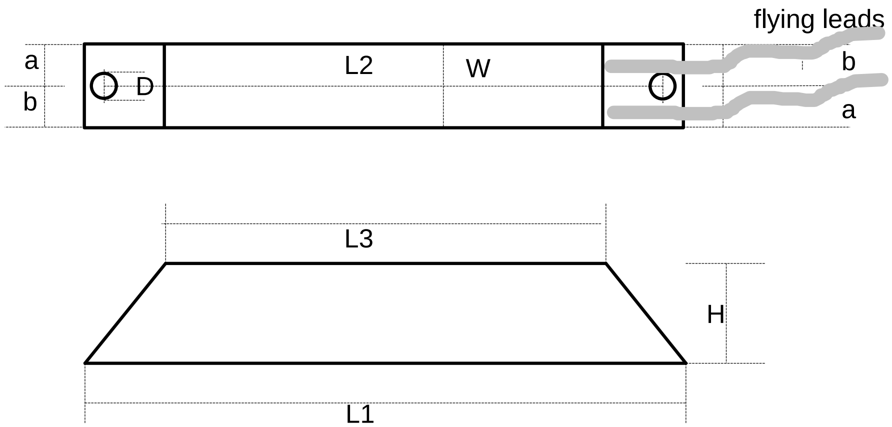
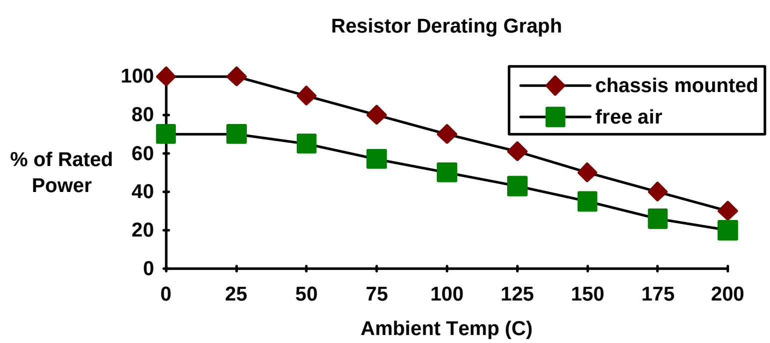


Figure 3.3 Mechanical outline of default brake resistors.

Part number	CZ388397	CZ388396
Resistance	56ohms	36ohms
Max Wattage	200W	500W
5 second rating	500%	500%
3 second rating	833%	833%
1 second rating	2500%	2500%
Dimensions L1 (mm)	165	335
L2 (mm)	146	316
L3 (mm)	125	295
W (mm)	30	30
H (mm)	60	60
D (mm)	5.3	5.3
a (mm)	13	13
b (mm)	17	17
Flying lead length (mm)	500	500
Electrical Connection	M5 spade	M5 ring



These resistor should be mounted on a heatsink (back panel) and covered to prevent injury from burning.

Specification of the Dynamic Braking Switch

Chassis type 4		
Typical motor rating	(380 - 460 Volts)	0.75kW to 7.5kW
Typical motor rating	(208 - 240 Volts)	0.75kW to 4.0kW
Current rating	(20s max)	15A
Max duty cycle		30%
Min resistor value	(380 - 460 Volts)	50Ω
Min resistor value	(208 - 240 Volts)	25Ω

Chassis type 5		
Typical motor rating	(380 - 460 Volts)	11kW to 15kW
Typical motor rating	(208 - 240 Volts)	5.5kW to 7.5kW
Current rating	(20s max)	30A
Max duty cycle		30%
Min resistor value	(380 - 460 Volts)	25Ω
Min resistor value	(208 - 240 Volts)	12.5Ω

Chassis type 6					
Typical motor rating	(380 - 460 Volts)	18kW	22kW	30kW	37kW
Typical motor rating	(208 - 240 Volts)	-	11kW	15Kw	18kW
Current rating	(20s max)	45A	45A	65A	75A
Max duty cycle		30%	30%	30%	30%
Min resistor value	(380 - 460 Volts)	17Ω	17Ω	11.5Ω	10Ω
Min resistor value	(208 - 240 Volts)	-	8.5Ω	6Ω	5Ω

Chassis type 7				
Typical motor rating	(380 - 460 Volts)	45kW	55kW	75kW
Typical motor rating	(208 - 240 Volts)	22kW	30kW	37kW
Current rating	(20s max)	90A	110A	150A
Max duty cycle		30%	30%	30%
Min resistor value	(380 - 460 Volts)	8.3Ω	6.9Ω	5.0Ω
Min resistor value	(208 - 240 Volts)	4.2Ω	3.5Ω	2.6Ω

Table 3.2 Dynamic Braking Switch Ratings

Brake Resistor Selection - Further notes.

There are several criteria which must be fulfilled when selecting a braking resistor for safe and proper operation. These include peak and average power dissipation, resistance and voltage rating. This section describes how to select the right resistor for the application.

When the motor is decelerating a load, the amount of power it creates is determined by the inertia of the load and the time the change in speed takes. The rate of change is determined by the MMI parameter **RAMP DOWN TIME**.

Calculating Power Dissipation

The power dissipation of the resistor needs to be calculated for both peak and average power. The relationship between these two figures is shown in Figure 3.4.

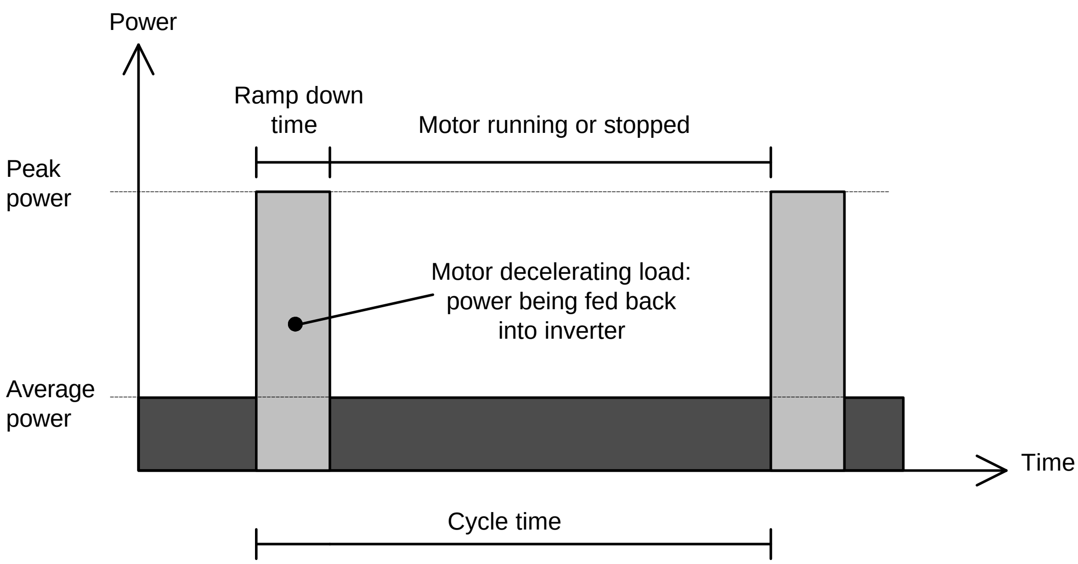


Figure 3.4 Peak and Average power

The peak power dissipation depends on the change in motor rotational speed, how quickly the change is achieved, and the inertia of the load. This is calculated as follows:

$$\text{Peak power dissipation (in W)} = \frac{0.0055 \text{ x total inertia } \left(\text{in kgm}^2\right) \text{ x } \left(\text{initial RPM}^2 - \text{final RPM}^2\right)}{\text{ramp down time}}$$

or,

$$P_{pk} = \frac{0.0055 \text{ x J x } \left(N_1^2 - N_2^2\right)}{t_b}$$

where J = total inertia in kgm^2, N_1 is the initial motor speed in RPM, N_2 is the final speed and t_b is the braking time in seconds.

The average power dissipation calculated as follows:

$$\text{Average power (W)} = \frac{\text{peak power in W} \times \text{ramp down time}}{\text{cycle time in seconds}}$$

or,

$$P_{av} = \frac{P_{pk}}{t_c} \times t_b$$

where t_c is the cycle time in seconds (refer to Figure 3.4)

For example, for a system with a total inertia of 1 kgm^2 decelerating from 1500 RPM to 500 RPM in 10 seconds and a cycle time of 110 seconds, the calculations are:

$$\text{Peak power (W)} = \frac{0.0055 \times 1 \times \left(1500^2 - 500^2\right)}{10}$$
$$= \frac{0.0055 \times (2250000 - 250000)}{10}$$
$$= \frac{0.0055 \times (2000000)}{10}$$
$$= \frac{11000}{10}$$
$$= 1100\text{W (1.1kW) Peak for 10 Seconds}$$

$$\text{Average power (W)} = \frac{\text{peak power}}{\text{cycle time in seconds}} \times \text{braking time in seconds}$$
$$= \frac{1100}{110} \times 10$$
$$= 100\text{W}$$

The brake resistor must be rated to cope with both the peak and average power. For the above example, a resistor capable of dissipating 1100W peak for 10 seconds and an average power of 100W will be required.

Information on the peak power rating and the average power rating of resistors must be obtained from the resistor manufacturer. Alternatively if this information is not available then a large safety margin must be incorporated to ensure that the resistors are not overloaded.

The resistance of the resistor is an important factor. Each of the 620 Vector drives has a specified minimum load resistance. Under no circumstances must a resistor of lower value be used, as this will cause serious damage to the electronic switch. The minimum resistor values and the maximum permissible peak power dissipation for a maximum of 20 seconds are listed in Table 3.1.

If the power dissipation is to be significantly less than half the maximum allowable, a higher resistance value may be used if this is convenient, up to a maximum of five times the minimum resistance. A rule of thumb calculation for this is as follows:

$$\text{Maximum resistance } (\Omega) = R_{max} = R_{min} \times \frac{P_{max}}{2 \times P_{pk}} \quad \text{but note: } R_{max} \leq 5 \times R_{min}$$

No damage will be caused if any resistance between this value and the minimum specified in Table 3.1 is used. Always use a lower resistance rather than a higher resistance if the calculated value is not available.

Series/parallel Networks

In order to obtain the necessary power rating, it will usually be necessary to build up a series/parallel network of resistors, as shown in Figure 3.5.

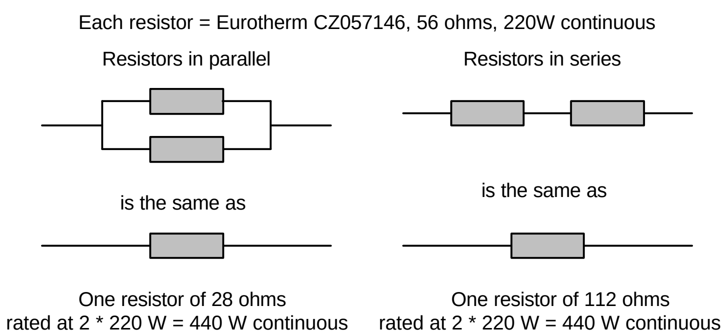


Figure 3.5 Example parallel and series networks

By connecting resistors in series and in parallel the braking capacity can be selected for the application. **Always use identical resistors in series/parallel combinations for braking applications.**

The formula to calculate the effects of series and parallel combinations are as follows.

Resistors in series: Total resistance = the sum of all the resistances (i.e. R1 + R2 + R3 +R4 etc.).

Resistors in parallel : Total resistance $= \dfrac{\text{resistor value}}{\text{total number of resistors}}$

Power dissipation: the number of resistors times the individual power dissipation of each resistor.

For example, four Eurotherm CZ057146 56 Ω 220W continuous resistors in series:

Total resistance = 56 Ω + 56 Ω + 56 Ω + 56 Ω = 224 Ω

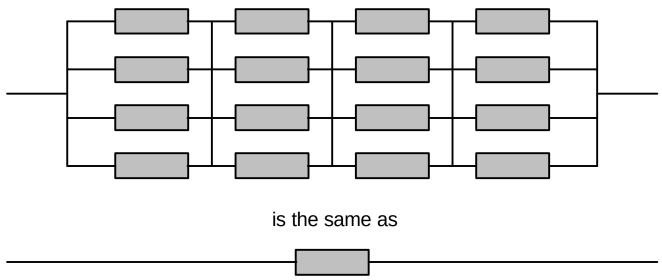
Four Eurotherm CZ057146 56 Ω 220W continuous resistors in parallel:

Total resistance $= \dfrac{56\ \text{W}}{4} = 14\ \text{W}$

Continuous power ratings in both cases are 880W (four times 220W). Peak powers are similarly multiplied by four.

Series and parallel networks can be combined as shown in Figure 3-5. The calculations are then simply combined: add up the series resistances first, then calculate the effect of having the appropriate numbers in parallel.

Each resistor = Eurotherm CZ057146, 56 ohms, 220W continuous



One resistor of 56 ohms rated at 16 * 220 W = 3.25 kW continuous

Figure 3.6 Series/parallel network

A special case is for 'square' series/parallel networks where the number of series elements is the same as the number of parallel elements, as in Figure 3.6. In such an array the total resistance is always the same as one resistor; the power rating is the rating of one resistor multiplied by the number of resistors.

Resistor Voltage Ratings

The resistor(s) must be specified for the maximum DC link voltage (800V for the 380-460V version, 405V for the 208-240V version).