Installation Data

Allen-Bradley
1336/1336VT/1336 PLUS/PLUS II/IMPACT
1336 FORCE Drives
Dynamic Braking

Series D Cat. No. 1336-MOD-KA005, KB005 and KC005
Series D Cat. No. 1336-MOD-KA010, KB010 and KC010
Series D Cat. No. 1336-MOD-KB050 and KC050

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What This Option Provides

The Heavy Duty Dynamic Braking Option provides a self contained NEMA Type 1 enclosed assembly that is wired to a 1336 AC Drive. Dynamic braking can increase the braking torque capability of a drive up to 100%.

Where This Option Is Used

B003-B250 and C003-C250 1336 Drives
B003-B250 1336VT Drives
AQF05-A010, BRF05-B250 and C007-C250 1336 PLUS and 1336 FORCE Drives

Catalog Number Description

1336 MOD K B005
1336/1336VT/1336 PLUS/1336 FORCE Heavy Duty Dynamic Braking
Voltage Rating
A = 230V AC
B = 380/415/460V AC
C = 500/575V AC
Brake Kit Code
005 = Drive Ratings 003-005/F05-F50
010 = Drive Ratings 007-010
050 = Drive Ratings 040-060

What These Instructions Contain

These instructions describe Dynamic Brake Module operation and explain how to calculate the data needed to correctly select, configure and install a Heavy Duty Dynamic Brake Module. By completing How to Select a Dynamic Brake Module first, you will be able to determine:

1. Whether or not Heavy Duty Dynamic Braking is required for your application.
2. If Heavy Duty Dynamic Braking is required, the rating and quantity of brakes required.

How Dynamic Braking Works

When an induction motor’s rotor is turning slower than the synchronous speed set by the drive’s output power, the motor is transforming electrical energy obtained from the drive into mechanical energy available at the drive shaft of the motor. This process is referred to as motoring. When the rotor is turning faster than the synchronous speed set by the drive’s output power, the motor is transforming mechanical energy available at the drive shaft of the motor into electrical energy that can be transferred back into the utility grid. This process is referred to as regeneration.

Most AC PWM drives convert AC power from the fixed frequency utility grid into DC power by means of a diode rectifier bridge or controlled SCR bridge before it is inverted into variable frequency AC power. Diode and SCR bridges are cost effective, but can only handle power in the motoring direction. Therefore, if the motor is regenerating, the bridge cannot conduct the necessary negative DC current, the DC bus voltage will increase and cause a Bus Overvoltage trip at the drive.
Expensive bridge configurations use SCRs or transistors that can transform DC regenerative electrical energy into fixed frequency utility electrical energy. A more cost effective solution is to provide a Transistor Chopper on the DC Bus of the AC PWM drive that feeds a power resistor which transforms the regenerative electrical energy into thermal energy. This is generally referred to as Dynamic Braking.

A Dynamic Brake Module consists of a Chopper Module (a chopper transistor and related control components) and a Dynamic Brake Resistor. Figure 1 shows a simplified schematic of a Dynamic Brake Module. The Chopper Module is shown connected to the positive and negative DC Bus conductors of an AC PWM Drive. The two series connected Bus Caps are part of the DC Bus filter of the AC Drive.

A Chopper Module contains five significant power components:

- **Protective fuses** are sized to work in conjunction with a *Crowbar SCR*. Sensing circuitry within the Chopper Transistor Voltage Control determines if an abnormal condition exists within the Chopper Module, such as a shorted Chopper Transistor or open Dynamic Brake Resistor. When an abnormal condition is sensed, the Chopper Transistor Voltage Control will fire the Crowbar SCR, shorting the DC Bus and melting the fuse link. This action isolates the Chopper Module from the DC Bus until the problem can be resolved.

- The **Chopper Transistor** is an Insulated Gate Bipolar Transistor (IGBT). The Chopper Transistor is either ON or OFF, connecting the Dynamic Brake Resistor to the DC Bus and dissipating power, or isolating the resistor from the DC Bus. There are several transistor ratings that are used in the various Dynamic Brake Module ratings. The most important rating is the collector current rating of the Chopper Transistor that helps to determine the minimum ohmic value used for the Dynamic Brake Resistor.

- **Chopper Transistor Voltage Control** regulates the voltage of the DC Bus during regeneration. The average values of DC Bus voltages are:
  - 375V DC (for 230V AC input)
  - 750 V DC (for 460V AC input)
  - 937.5V DC (for 575V AC input)

  Voltage dividers reduce the DC Bus voltage to a value that is usable in signal circuit isolation and control. The DC Bus feedback voltage from the voltage dividers is compared to a reference voltage to actuate the Chopper Transistor.

- The **Frewheel Diode** (FWD), in parallel with the Dynamic Brake Resistor, allows any magnetic energy stored in the parasitic inductance of that circuit to be safely dissipated during turn off of the Chopper Transistor.
Dynamic Brake Modules are designed to be applied in parallel if the current rating is insufficient for the application. One Dynamic Brake Module is the designated Master Dynamic Brake Module, while any other Modules are the designated Follower Modules.

Two lights are provided on the front of the enclosure to indicate operation.

- **DC Power** light illuminates when DC power has been applied to the Dynamic Brake Module.
- **Brake On** light flickers when the Chopper Module is operating or chopping.
How to Select a Dynamic Brake Module

As a rule, a Dynamic Brake Module can be specified when regenerative energy is dissipated on an occasional or periodic basis. In general, the motor power rating, speed, torque, and details regarding the regenerative mode of operation will be needed in order to estimate what Dynamic Brake Module rating to use. When a drive is consistently operating in the regenerative mode of operation, serious consideration should be given to equipment that will transform the electrical energy back to the fixed frequency utility.

The peak regenerative power of the drive must be calculated in order to determine the maximum ohmic value of the Dynamic Brake Resistor of the Dynamic Brake Module. Once the maximum ohmic value of the Dynamic Brake Resistor current rating is known, the required rating and number of Dynamic Brake Modules can be determined. If a Dynamic Brake Resistance value greater than the minimum imposed by the choice of the peak regenerative power is made and applied, the drive can trip off due to transient DC Bus overvoltage problems. Once the approximate ohmic value of the Dynamic Brake Resistor is determined, the necessary power rating of the Dynamic Brake Resistor can be calculated.

The wattage rating of the Dynamic Brake Resistor is estimated by applying what is known about the drive’s motoring and regenerating modes of operation. The average power dissipation of the regenerative mode must be estimated and the wattage of the Dynamic Brake Resistor chosen to be greater than the average regenerative power dissipation of the drive. If the Dynamic Brake Resistor has a large thermodynamic heat capacity, then the resistor element will be able to absorb a large amount of energy without the temperature of the resistor element exceeding the operational temperature rating. Thermal time constants in the order of 50 seconds and higher satisfy the criteria of large heat capacities for these applications. If a resistor has a small heat capacity, defined as thermal time constants less than 5 seconds, the temperature of the resistor element could exceed maximum temperature limits during the application of pulse power to the element and could exceed the safe temperature limits of the resistor. The resistors used in the Dynamic Brake Modules have thermodynamic time constants of less than 5 seconds. This means restrictions must be imposed upon the application of the Dynamic Brake Modules.

Peak regenerative power can be calculated as:

- Horsepower (English units)
- Watts (The International System of Units, SI)
- Per Unit System (pu) which is dimensionless

The final number must be in watts of power to estimate the ohmic value of the Dynamic Brake Resistor. The following calculations are demonstrated in SI units.
How to Select a Dynamic Brake Module

Gather the following information:

- Power rating from motor nameplate in watts, kilowatts, or horsepower
- Speed rating from motor nameplate in rpm or rps (radians per second)
- Motor inertia and load inertia in kg-m² or lb-ft²
- Gear ratio (GR) if a gear is present between the motor and load
- Motor shaft speed, torque, and power profile of the drive application

Figure 2 shows the speed, torque, and power profiles of the drive as a function of time for a particular cyclic application that is periodic over $t_4$ seconds. The desired time to decelerate is known or calculable and is within the drive performance limits. In Figure 2, the following variables are defined:

\[ \omega(t) = \text{Motor shaft speed in radians per second (rps)} \]

\[ \omega = \frac{2\pi N}{60} \]

\[ N(t) = \text{Motor shaft speed in Revolutions Per Minute (RPM)} \]

\[ T(t) = \text{Motor shaft torque in Newton-meters} \]

\[ 1.0 \text{ lb-ft} = 1.355818 \text{ N-m} \]

\[ P(t) = \text{Motor shaft power in watts} \]

\[ 1.0 \text{ HP} = 746 \text{ watts} \]

\[ \omega_b = \text{Rated angular rotational speed} \]

\[ \text{Rad/s} \]

\[ \omega_o = \text{Angular rotational speed less than } \omega_b \text{ (can equal 0)} \]

\[ \text{Rad/s} \]

\[-P_b = \text{Motor shaft peak regenerative power in watts} \]
Figure 2
Application Speed, Torque and Power Profiles
Step 1 — Determine the Total Inertia

\[ J_T = J_m + (GR^2 \times J_L) \]

1.0 lb-ft\(^2 = 0.04214011\) kg-m\(^2\)

- \( J_T \) = Total inertia reflected to the motor shaft (kg-m\(^2\))
- \( J_m \) = Motor inertia (kg-m\(^2\))
- \( GR \) = Gear ratio for any gear between motor and load (dimensionless)

Note: For 2:1 gear ratio, \( GR = 0.5 \).

- \( J_L \) = Load inertia (kg-m\(^2\))

\[ JT = \begin{pmatrix} \text{Total inertia reflected to the motor shaft (kg-m}^2) \\ \text{Jm} \\ \text{GR}^2 \times J_L \end{pmatrix} \]

\[ JT = \begin{pmatrix} \text{Jm} \\ \text{GR}^2 \times J_L \end{pmatrix} \]

\[ JT = \begin{pmatrix} \text{Jm} \\ \text{GR}^2 \times J_L \end{pmatrix} \]

Step 2 — Calculate the Peak Braking Power

\[ P_b = \frac{J_T \times \omega_b (\omega_b - \omega_o)}{t_3 - t_2} \]

- \( J_T \) = Total inertia reflected to the motor shaft (kg-m\(^2\))
- \( \omega_b \) = Rated angular rotational speed (Rad / s = \( 2\pi N_b / 60 \))
- \( \omega_o \) = Angular rotational speed, less than rated speed down to zero (Rad / s)
- \( N_b \) = Rated motor speed (RPM)
- \( t_3 - t_2 \) = Deceleration time from \( \omega_b \) to \( \omega_o \) (seconds)
- \( P_b \) = Peak braking power (watts)

\[ P_b = \frac{J_T \times \omega_b (\omega_b - \omega_o)}{t_3 - t_2} \]

\[ P_b = \frac{J_T \times \omega_b (\omega_b - \omega_o)}{t_3 - t_2} \]

\[ P_b = \frac{J_T \times \omega_b (\omega_b - \omega_o)}{t_3 - t_2} \]

Compare the peak braking power to that of the rated motor power. If the peak braking power is greater that 1.5 times that of the motor, then the deceleration time \( (t_3 - t_2) \) needs to be increased so that the drive does not go into current limit. (This is assuming that 150% of motor power is less than or equal to 150% drive capacity.)
Step 3 — Calculate the Maximum Dynamic Brake Resistance Value

\[
R_{db1} = \frac{0.9 \times V_d^2}{P_b} \quad V_d = \text{DC Bus voltage the chopper module regulates to} \quad (375\text{V DC}, 750\text{V DC}, \text{or} 937.5\text{V DC})
\]

\[
P_b = \text{Peak braking power calculated in Step 2 (watts)}
\]

\[
R_{db1} = \text{Maximum allowable value for the dynamic brake resistor (ohms)}
\]

\[
R_{db1} = \left[ \frac{V_d}{P_b} \right] \quad R_{db1} = \text{ohms}
\]

The choice of the Dynamic Brake resistance value should be less than the value calculated in Step 3. If the resistance value is greater than the value calculated in Step 3, the drive can trip on DC Bus overvoltage. Do not reduce \(P_b\) by any ratio because of estimated losses in the motor and inverter. This has been accounted for by an offsetting increase in the manufacturing tolerance of the resistance value and the increase in resistance value due to the temperature coefficient of resistor element.

Step 4 — Choose the Correct Dynamic Brake Module

Go to Table 1a, 2a, or 3a in this publication and choose the correct Dynamic Brake Module based upon the resistance value being less than the maximum value of resistance calculated in Step 3. If the Dynamic Brake Resistor value of one Dynamic Brake Module is not sufficiently low, consider using up to three Dynamic Brake Modules in parallel, such that the parallel Dynamic Brake resistance is less than \(R_{db1}\) calculated in Step 3. If the parallel combination of Dynamic Brake Modules becomes too complicated for the application, consider using a Brake Chopper Module with a separately specified Dynamic Brake Resistor.

Step 5 — Estimate the Minimum Wattage Requirements for the Dynamic Brake Resistors

It is assumed that the application exhibits a periodic function of acceleration and deceleration. If \((t_3 - t_2)\) equals the time in seconds necessary for deceleration from rated speed to \(\omega_0\) speed, and \(t_4\) is the time in seconds before the process repeats itself, then the average duty cycle is \((t_3 - t_2)/t_4\).

The power as a function of time is a linearly decreasing function from a value equal to the peak regenerative power to some lesser value after \((t_3 - t_2)\) seconds have elapsed. The average power regenerated over the interval of \((t_3 - t_2)\) seconds is:

\[
P_b \left( \frac{\omega_b + \omega_0}{\omega_b} \right)
\]
The average power in watts regenerated over the period $t_4$ is:

\[ P_{av} = \frac{[t_3 - t_2]}{t_4} \times \frac{P_b}{2} \left( \frac{\omega_o - \omega_b}{\omega_b} \right) \]

- $P_{av} = \text{Average dynamic brake resistor dissipation (watts)}$
- $t_3 - t_2 = \text{Deceleration time from } \omega_b \text{ to } \omega_o \text{ (seconds)}$
- $t_4 = \text{Total cycle time or period of process (seconds)}$
- $P_b = \text{Peak braking power (watts)}$
- $\omega_b = \text{Rated motor speed (Rad / s)}$
- $\omega_o = \text{A lower motor speed (Rad / s)}$

\[ P_{av} = \frac{[t_3 - t_2]}{t_4} \times \frac{P_b}{2} \left( \frac{\omega_o - \omega_b}{\omega_b} \right) \]

The Dynamic Brake Resistor power rating of the Dynamic Brake Module (singly or two in parallel) that will be chosen must be greater than the value calculated in Step 5. If it is not, then a Brake Chopper Module with the suitable Dynamic Brake Resistor must be specified for the application.

**Step 6 — Calculate the Percent Average Load of the Dynamic Brake Resistor**

\[ AL = \frac{P_{av}}{P_{db}} \times 100 \]

- $AL = \text{Average load in percent of Dynamic Brake Resistor}$
- $P_{av} = \text{Average dynamic brake resistor dissipation calculated in Step 5 (watts)}$
- $P_{db} = \text{Steady state power dissipation capacity of dynamic brake resistors obtained from Table 1a, 2a, or 3a (watts)}$

\[ AL = \frac{P_{av}}{P_{db}} \times 100 \]

The calculation of $AL$ is the Dynamic Brake Resistor load expressed as a percent. $P_{db}$ is the sum of the Dynamic Brake Module dissipation capacity and is obtained from Table 1a, 2a, or 3a. This will give a data point for a line to be drawn on the curve in Figure 3. The number calculated for $AL$ must be less than 100%. If $AL$ is greater than 100%, an error was made in a calculation or the wrong Dynamic Brake Module was selected.
Step 7 — Calculate the Percent Peak Load of the Dynamic Brake Resistor

The calculation of PL in percent gives the percentage of the instantaneous power dissipated by the Dynamic Brake Resistors relative to the steady state power dissipation capacity of the resistors. This will give a data point to be drawn on the curve of Figure 3. The number calculated for PL will commonly fall between 300% and 600%. A calculated number for PL of less than 100% indicates that the Dynamic Brake Resistor has a higher steady state power dissipation capacity than is necessary.

Step 8 — Plot the Steady State and Transient Power Curves on Figure 3

Draw a horizontal line equal to the value of AL (Average Load) in percent as calculated in Step 6. This value must be less than 100%.

Pick a point on the vertical axis equal to the value of PL (Peak Load) in percent as calculated in Step 7. This value should be greater the 100%.

Draw a vertical line at (t3 - t2) seconds such that the line intersects the AL line at right angles. Label the intersection point “Point 1”.

Draw a straight line from PL on the vertical axis to Point 1 on the AL line. This line is the power curve described by the motor as it decelerates to minimum speed.

Figure 3
Plot Your Power Curve
If the line you drew lies to the left of the constant temperature power curve of the Dynamic Brake Resistor, then there will be no application problem.

If any portion of the line lies to the right of the constant temperature power curve of the Dynamic Brake Resistor, then there is an application problem. The application problem is that the Dynamic Brake Resistor is exceeding its rated temperature during the interval that the transient power curve is to the right of the resistor power curve capacity. It would be prudent to parallel another Dynamic Brake Module or apply a Brake Chopper Module with a separate Dynamic Brake Resistor.

ATTENTION: The heavy duty dynamic brake unit contains a thermostat to guard against overheating and component damage. If the thermostat sensed excessive ambient temperature associated with a high duty cycle, torque setting, or overload condition, the thermostat will open and disable the brake until components cool to rated temperature. During the cooling period, no brake operation is available.

If reduced braking torque represents a potential hazard to personnel, auxiliary stopping methods must be considered in the machine and/or control circuit design.
Example Calculation

A 50 HP, 4 Pole, 460 Volt motor and drive is accelerating and decelerating as depicted in Figure 2.

- Cycle period \( (t_4) \) is 60 seconds
- Rated speed is 1785 RPM and is to be decelerated to 0 speed in 6.0 seconds
- Motor load can be considered purely as an inertia, and all power expended or absorbed by the motor is absorbed by the motor and load inertia
- Load inertia is directly coupled to the motor
- Motor inertia plus load inertia is given as 9.61 kg-m²

Calculate the necessary values to choose an acceptable Dynamic Brake Module.

**Rated Power** = 50 HP \( \times \) 746 = 37.3 kW

This information was given and must be known before the calculation process begins. This can be given in HP, but must be converted to watts before it can be used in the equations.

**Rated Speed** = 1785 RPM = \( 2\pi \times 1785/60 = 186.93 \) Rad/s = \( \omega_b \)

This information was given and must be known before the calculation process begins. This can be given in RPM, but must be converted to radians per second before it can be used in the equations.

\( \omega_o = 0 \) RPM = 0 Rad/s

**Total Inertia** = 9.61 kg-m² = \( J_T \)

This value can be in lb-ft² or Wk², but must be converted into kg-m² before it can be used in the equations.

**Deceleration Time** = \( (t_3 - t_2) = 6.0 \) seconds.

**Period of Cycle** = \( t_4 = 60 \) seconds.

**V_d = 750 Volts**

This was known because the drive is rated at 460 Volts rms. If the drive were rated 230 Volts rms, then \( V_d = 375 \) Volts, and if the drive were rated at 575 Volts rms, then \( V_d = 937.5 \) Volts.

All of the preceding data and calculations were made from knowledge of the application under consideration. The total inertia was given and did not need further calculations as outlined in Step 1.

\[
\text{Peak Braking Power} = P_b = \frac{J_T \times \omega_b(\omega_b - \omega_o)}{(t_3 - t_2)} = 55.95 \text{ kW}
\]

This is 150% rated power and is equal to the maximum drive limit of 150% current limit. This calculation is the result of Step 2 and determines the peak power that must be dissipated by the Dynamic Brake Resistor.
$R_{db1} = 0.9V_d^2/P_b = 9.05\ \text{ohms}$

This calculation is the result of Step 3 and determines the maximum ohmic value of the Dynamic Brake Resistor. Note that a choice of $V_d = 750$ Volts DC was made based on the premise that the drive is rated at 460 Volts.

The most cost-effective combination of Dynamic Brake Modules chosen in Step 4 is one 1336-MOD-KB050 and one 1336-MOD-KB010 operated in parallel. This results in an equivalent Dynamic Brake Resistance of 8.76 ohms.

By comparison, a KB050 paralleled with a KB005 results in an equivalent Dynamic Brake Resistance of 9.57 ohms, which is greater than the maximum allowable value of 9.05 ohms. If two KB050 Dynamic Brake Modules are paralleled, the equivalent resistance would be 5.25 ohms, which will satisfy the resistance criteria set by Step 3, but is not cost effective.

$P_{av} = \frac{(t_3 - t_2)}{t_4} \times \frac{P_b}{2} \left( \frac{\omega_b + \omega_o}{\omega_o} \right) = 2.8 \text{ kW}$

This is the result of calculating the average power dissipation as outlined in Step 5. Verify that the sum of the power ratings of the Dynamic Brake Resistors chosen in Step 4 is greater than the value calculated in Step 5.

$AL = 100 \times P_{av}/P_{db} = 32\%$

This is the result of the calculation outlined in Step 6 and is less than 100%.

Draw AL as a dotted line on Figure 4.

$PL = 100 \times P_b/P_{db} = 617\%$

This is the result of the calculation outlined in Step 7 and should always be greater than 100%.
Figure 4 is the result of Step 8. Note that a portion of the motor power curve lies to the right of the constant temperature power curve of the Dynamic Brake Resistor. This means that the resistor element temperature is exceeding the operating temperature limit. This could mean a shorter Dynamic Brake Resistor life than expected. To alleviate this possibility, use two KB050 Dynamic Brake Modules in parallel and recalculate.

AL = 20%

PL = 400%

Figure 5 is the result of Step 8 using two KB050 Dynamic Brake Modules in parallel and the graph indicates that the resistive element temperature will not exceed the operational limit.
### Table 1a
**Maximum Ratings for 230V AC Drives, 375 Volts Turn-on Voltage**

<table>
<thead>
<tr>
<th>Dynamic Brake Module Catalog No. 1336-MOD-</th>
<th>Resistance Value of Dynamic Brake Resistor (Ohms)</th>
<th>Average Wattage Dissipation of Dynamic Brake Resistor (Watts)</th>
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<tbody>
<tr>
<td>KA 005</td>
<td>28.0</td>
<td>666</td>
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<td>KA 010</td>
<td>13.2</td>
<td>1650</td>
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### Table 2a
**Maximum Ratings for 380-460V AC Drives, 750 Volts Turn-on Voltage**

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<th>Dynamic Brake Module Catalog No. 1336-MOD-</th>
<th>Resistance Value of Dynamic Brake Resistor (Ohms)</th>
<th>Average Wattage Dissipation of Dynamic Brake Resistor (Watts)</th>
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<tbody>
<tr>
<td>KB 005</td>
<td>108.0</td>
<td>1500</td>
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<td>KB 010</td>
<td>52.7</td>
<td>2063</td>
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<td>KB 050</td>
<td>10.5</td>
<td>7000</td>
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### Table 3a
**Maximum Ratings for 575V AC Drives, 937.5 Volts Turn-on Voltage**

<table>
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<tr>
<th>Dynamic Brake Module Catalog No. 1336-MOD-</th>
<th>Resistance Value of Dynamic Brake Resistor (Ohms)</th>
<th>Average Wattage Dissipation of Dynamic Brake Resistor (Watts)</th>
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<tr>
<td>KC 005</td>
<td>108.0</td>
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<tr>
<td>KC 010</td>
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<td>2063</td>
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<td>KC 050</td>
<td>15.8</td>
<td>8000</td>
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KA005-KA010, KB005-KB010 and KC005-KC010
Dimensions, Weights and Conduit Entry Locations

Dimensions and Weights in Millimeters (Inches) and Kilograms (Pounds)

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<tr>
<th>Option Code</th>
<th>A</th>
<th>B</th>
<th>C</th>
<th>D</th>
<th>E</th>
<th>F</th>
<th>G</th>
<th>H</th>
<th>I</th>
<th>J</th>
<th>K</th>
<th>R1 Dia.</th>
<th>R2 Dia.</th>
<th>Weight</th>
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<td>193.5</td>
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<td>133.4</td>
<td>425.4</td>
<td>30.0</td>
<td>6.4</td>
<td>9.7</td>
<td>50.8</td>
<td>46.0</td>
<td>50.8</td>
<td>7.1</td>
<td>14.3</td>
<td>6.8</td>
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<tr>
<td>KB005-KB010</td>
<td>(7.62)</td>
<td>(17.38)</td>
<td>(6.87)</td>
<td>(5.25)</td>
<td>(16.75)</td>
<td>(1.18)</td>
<td>(0.25)</td>
<td>(0.38)</td>
<td>(2.00)</td>
<td>(1.81)</td>
<td>(16.75)</td>
<td>(0.28)</td>
<td>(0.56)</td>
<td>(15.00)</td>
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<tr>
<td>KC005-KC010</td>
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## KB050 and KC050
### Dimensions, Weights and Conduit Entry Locations

![Diagram of KB050 and KC050 dimensions](image)

**Conduit Entry**
- 28.5mm (1.12") Dia.

### Dimensions and Weights in Millimeters (Inches) and Kilograms (Pounds)

<table>
<thead>
<tr>
<th>Option Code</th>
<th>A</th>
<th>B</th>
<th>C</th>
<th>D</th>
<th>E1</th>
<th>E2</th>
<th>F</th>
<th>G</th>
<th>H</th>
<th>I</th>
<th>J</th>
<th>K</th>
<th>R1 Dia.</th>
<th>R2 Dia.</th>
<th>Weight</th>
</tr>
</thead>
<tbody>
<tr>
<td>KB050</td>
<td>406.4 (16.00)</td>
<td>609.6 (24.00)</td>
<td>247.7 (9.75)</td>
<td>381.0 (15.00)</td>
<td>304.8 (12.00)</td>
<td>592.3 (23.32)</td>
<td>12.7 (0.50)</td>
<td>17.3 (0.68)</td>
<td>19.1 (0.75)</td>
<td>50.8 (2.00)</td>
<td>152.4 (6.00)</td>
<td>79.3 (3.12)</td>
<td>8.4 (0.33)</td>
<td>14.3 (0.56)</td>
<td>33.8 (75.00)</td>
</tr>
<tr>
<td>and KC050</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

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Specifications

<table>
<thead>
<tr>
<th>Specification</th>
<th>Details</th>
</tr>
</thead>
<tbody>
<tr>
<td>Braking Torque</td>
<td>100% torque for 20 seconds (typical).</td>
</tr>
<tr>
<td>Duty Cycle</td>
<td>20% (typical).</td>
</tr>
<tr>
<td>Input Power</td>
<td>DC power supplied from DC Bus.</td>
</tr>
<tr>
<td></td>
<td>Customer supplied 115V AC, 1Ø, 50/60 Hz required for KB050 &amp; KC050 brake operation.</td>
</tr>
<tr>
<td>Enable Signal</td>
<td>50 mA</td>
</tr>
<tr>
<td>Fan Power</td>
<td>600 mA</td>
</tr>
<tr>
<td>Optional Brake Fault Contact</td>
<td>(1) N.O. contact, TTL compatible, closed when 115V AC is applied, open when a brake fault or loss of power occurs.</td>
</tr>
<tr>
<td></td>
<td>Customer supplied 115V AC, 50 mA required for KA005, KB005, KC005, KA010, KB010 &amp; KC010 optional brake fault contact monitoring.</td>
</tr>
<tr>
<td>UL/CSA Rating</td>
<td>0.6 Amps, 125VAC.</td>
</tr>
<tr>
<td></td>
<td>0.6 Amps, 110VAC.</td>
</tr>
<tr>
<td></td>
<td>2.0 Amps, 30VAC.</td>
</tr>
<tr>
<td>Initial Contact Resistance</td>
<td>50mΩ maximum.</td>
</tr>
<tr>
<td>Temperature</td>
<td>-10°C to 50°C (14°F to 122°F).</td>
</tr>
<tr>
<td>Humidity</td>
<td>5% to 95% non-condensing.</td>
</tr>
<tr>
<td>Atmosphere</td>
<td>NEMA Type 1 — Cannot be used in atmospheres having corrosive or hazardous dust, vapor or gas.</td>
</tr>
<tr>
<td>Altitude Derating</td>
<td>1,000 meters (3,300 feet) maximum without derating.</td>
</tr>
<tr>
<td>Enclosure Type</td>
<td>KA005, KB005, KC005 — IP20 (NEMA Type 1)</td>
</tr>
<tr>
<td></td>
<td>KA010, KB010, KC010 — IP20 (NEMA Type 1)</td>
</tr>
<tr>
<td></td>
<td>KB050, KC050 — IP00 (Open)</td>
</tr>
</tbody>
</table>

Installation Requirements

ATTENTION: Electric Shock can cause injury or death. Remove all power before working on this product.

For all Dynamic Brake ratings, DC brake power is supplied from the drive DC Bus. In addition:

1. Dynamic Brakes KB050 and KC050 have fans and an enable circuit that requires a 115V AC user power supply.
2. Optional brake fault contact monitoring also requires a 115V AC user power supply. For KB050 and KC050 brakes, the same AC power supply may be used.

Hazards of electrical shock exist if accidental contact is made with parts carrying bus voltage. A bus charged indicator on the brake enclosures provides visual indication that bus voltage is present. Before proceeding with any installation or troubleshooting activity, allow at least one minute after input power has been removed for the bus circuit to discharge. Bus voltage should be verified by using a voltmeter to measure the voltage between the +DC and -DC terminals on the drive power terminal block. Do not attempt any servicing until bus charged indicating lights have extinguished and bus voltage has diminished to zero volts.
Mounting Requirements

Dynamic brake enclosures must only be installed in the vertical position. Select a location using the guidelines below and information provided in the Recommended Brake Configurations section.

- Each dynamic brake enclosure must be mounted outside of any other enclosure or cabinet and exposed to unrestricted circulating air for proper heat dissipation. Allow a minimum of 304.8 mm (12 in.) between brake enclosures and all other enclosure or cabinets including the drive.
- Each enclosure must be mounted in an area where the environment does not exceed the values listed in the specification section of this publication.
- If only one dynamic brake enclosure is required, the enclosure must be mounted within 3.0 m (10 ft.) of the drive.
- If more than one KB050 or KC050 brake enclosure is required, a separate user supplied terminal block must be mounted within 3.0 m (10 ft.) of the drive. Allow a maximum distance of 1.5 m (5 ft.) between each brake enclosure and the terminal block.
- If more than one KA005-KA010, KB005-KB010 or KC005-KC010 brake enclosure is required, the first enclosure must be mounted within 3.0 m (10 ft.) of the drive. Allow a maximum distance of 1.5 m (5 ft.) between each remaining brake enclosure.
- Separate conduit must be provided for the control connections between multiple brake enclosures.
- Separate conduit must be provided for the DC power connections between brake enclosures, the terminal block (if required) and the drive. For AC power connection and conduit requirements, refer to your 1336, 1336VT, 1336 PLUS II, or 1336 FORCE User Manual.

IMPORTANT: The National Electrical Codes (NEC) and local regulations govern the installation and wiring of the Heavy Duty Dynamic Brake. DC power wiring, AC power wiring, control wiring and conduit must be sized and installed in accordance with these codes and the information supplied on the following pages.
Recommended Brake Configurations

Single Brake Enclosure

KA050, KB050 and KC050
Multiple Brake Enclosures

KA005-KA010, KB005-KB010 and KC005-KC010
Multiple Brake Enclosures
Brake Fault Contact Monitoring
For all brake ratings a fault contact has been provided to provide a remote output signal to an Allen-Bradley 1336-MOD-L3, L6 or PLC. Should a brake fuse fail, the brake thermostat trip (or for KB050 & KC050 units the brake enable signal be lost), the brake fault contact will open. Interconnection wiring for remote brake monitoring is provided in the Wiring Schemes.

Brake Fuses
All dynamic brakes are internally fused to protect brake components. When replacing brake fuses, use only the type and size specified below.

<table>
<thead>
<tr>
<th>Dynamic Brake</th>
<th>Fuse</th>
<th>Type</th>
<th>Rating</th>
</tr>
</thead>
<tbody>
<tr>
<td>KA005</td>
<td>F1</td>
<td>A50P10 or Equivalent</td>
<td>10A, 500V</td>
</tr>
<tr>
<td>KB005</td>
<td>F1</td>
<td>A60Q or Equivalent</td>
<td>5A, 600V</td>
</tr>
<tr>
<td>KC005</td>
<td>F1</td>
<td>FWP-5 or Equivalent</td>
<td>5A, 700V</td>
</tr>
<tr>
<td>KA010</td>
<td>F1</td>
<td>A50P20 or Equivalent</td>
<td>20A, 500V</td>
</tr>
<tr>
<td>KB010</td>
<td>F1</td>
<td>A60Q or Equivalent</td>
<td>10A, 600V</td>
</tr>
<tr>
<td>KC010</td>
<td>F1</td>
<td>FWP-10 or Equivalent</td>
<td>10A, 700V</td>
</tr>
<tr>
<td>KB050</td>
<td>F1 &amp; F2</td>
<td>A70QS35 or Equivalent</td>
<td>35A, 700V</td>
</tr>
<tr>
<td>KC050</td>
<td>F1 &amp; F2</td>
<td>A70QS35 or Equivalent</td>
<td>35A, 700V</td>
</tr>
</tbody>
</table>

Brake Module Jumper Settings
For the Recommended Brake Configurations shown on the previous page as well as the interconnection diagrams shown on the following pages, there can be only one master brake to control dynamic braking. When multiple brakes are used, only one brake can serve as the master brake to control the remaining slave brakes.

Master Brake Module Jumper Settings
For the master brake, leave slave/master jumper W1 factory set to master — Between jumper positions 2 & 3.

Slave Brake Module Jumper Settings
In each slave enclosure, reset jumper W1 to slave — Between jumper positions 1 & 2

Input Voltage Jumper Settings
For KB brakes, remember to set jumper W2 in all enclosures to correspond to the nominal drive input voltage. Setting the jumper between positions 1 & 2 will select an input voltage of 415/460 volts. Setting the jumper between positions 2 & 3 will select an input voltage of 380 volts.
KA and KC brakes do not have input voltage jumpers.
KA005-KA010, KB005-KB010 and KC005-KC010
Terminal Block, Fuse and Jumper Locations

Side View

Front View

Brake Fault Contact Terminal Block TB3

Brake Module Board

Relay Option Board

Power and Control Terminal Block TB1

Brake Chassis Ground Screw

Slave/Master Jumper W1

Input Voltage Select Jumper W2

KB005-KB010 Units Only

Fuse F1

KA005-KA010 and KC005-KC010 Units Only

DC Power ON Light

Brake ON Light

Fuse F1

KB005-KB010 Units Only
KB050 and KC050
Terminal Block, Fuse and Jumper Locations
KA005-KA010, KB005-KB010 and KC005-KC010

Wiring Scheme

**Important:** Series A 1336 PLUS (A4 frames) 380-480V, 5.5-7.5 kW/7.5-10 HP, do not use the -DC terminal for brake connection. A separate -BRK terminal is supplied for proper brake connection.

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**Brake Power Wiring**

All DC Brake Power Wiring must be twisted pair and run in conduit separate from Control Wiring. Minimum required DC Brake Power Wiring sizes are listed in tables 1b, 2b and 3b.

**Control Wiring**

All Control Wiring must be twisted pair and run in conduit separate from DC Brake Power Wiring. Interconnection Control Wiring between the brake terminals must be twisted pair, 1 mm² (18 AWG) minimum.

**Optional Brake Fault Contact Wiring**

A separate 115V AC power supply is required if the brake fault contacts are to be monitored. Refer to your 1336, 1336VT, 1336 PLUS, or 1336 FORCE User Manual for wire selection and installation details.


2. The MASTER OUT terminals are factory jumpered and must remain jumpered for single brake applications. For multiple brake applications, remove the jumpers in all but the last enclosure.

3. Contact is shown in a de-energized state. Contact is closed when 115V AC power is applied to TB3 and pilot relay is energized. Loss of power or a brake malfunction will open contact.

4. Connect the brake frame to earth ground. Refer to the connected drive's User Manual for grounding instructions.
All DC Brake Power Wiring must be twisted pair and run in conduit separate from Control Wiring. Minimum required DC Brake Power Wiring sizes are listed in tables 1b, 2b, 3b.

Control Wiring
All Control Wiring must be twisted pair and run in conduit separate from DC Brake Power Wiring. Interconnection Control Wiring between the brake terminals must be twisted pair, 1 mm² (18 AWG) minimum.

Optional Brake Fault Contact Wiring
A separate 115V AC power supply is required if the brake fault contacts are to be monitored. Refer to your 1336, 1336VT, 1336 PLUS, or 1336 FORCE User Manual for wire selection and installation details.

2. When more than KB050 or KC050 brake is required, a separate user supplied Auxiliary Term Block is also required — A-B Catalog Number 1492-PDM3141 or equivalent.
3. A separate 115V AC power supply is required to operate fans and enable the brake.
4. The MASTER OUT terminals are factory jumpered and must remain jumpered for single brake applications. For multiple brake applications, remove the jumpers in all but the last enclosure.
5. Contact is shown in a de-energized state. Contact is closed when 115V AC power is applied to TB3 and pilot relay is energized. Loss of power or a brake malfunction will open contact.
6. Connect the brake frame to earth ground. Refer to the connected drive’s User Manual for grounding instructions.
**DC Power Wiring Tables**

Required Minimum DC Power Wiring Sizes in mm² and (AWG)

### Table 1b — DC Brake Power Wiring for 200-240V AC Drives

<table>
<thead>
<tr>
<th>for drive rating</th>
<th>with</th>
<th>Drive – Master or Auxiliary Term Block</th>
<th>Auxiliary Term Block - Master</th>
<th>Master – Slave</th>
<th>Slave – Slave</th>
</tr>
</thead>
<tbody>
<tr>
<td>AQF05-AQF50</td>
<td>(1) KA005</td>
<td>—</td>
<td>6 (10)</td>
<td>—</td>
<td>—</td>
</tr>
<tr>
<td>A007-A010</td>
<td>(1) KA010</td>
<td>—</td>
<td>6 (10)</td>
<td>—</td>
<td>—</td>
</tr>
<tr>
<td>A015</td>
<td>(1) KA005 + (1) KA010</td>
<td>—</td>
<td>6 (10)</td>
<td>6 (10)</td>
<td>—</td>
</tr>
<tr>
<td>A020</td>
<td>(2) KA010</td>
<td>—</td>
<td>6 (10)</td>
<td>6 (10)</td>
<td>—</td>
</tr>
</tbody>
</table>

### Table 2b — DC Brake Power Wiring for 380-480V AC Drives

<table>
<thead>
<tr>
<th>for drive rating</th>
<th>with</th>
<th>Drive – Master or Auxiliary Term Block</th>
<th>Auxiliary Term Block - Master</th>
<th>Master – Slave</th>
<th>Slave – Slave</th>
</tr>
</thead>
<tbody>
<tr>
<td>BRF05-BRF50</td>
<td>(1) KB005</td>
<td>—</td>
<td>4 (12)</td>
<td>—</td>
<td>—</td>
</tr>
<tr>
<td>B003-B005</td>
<td>(1) KB010</td>
<td>—</td>
<td>4 (12)</td>
<td>—</td>
<td>—</td>
</tr>
<tr>
<td>B015</td>
<td>(1) KB005 + (1) KB010</td>
<td>—</td>
<td>4 (12)</td>
<td>4 (12)</td>
<td>—</td>
</tr>
<tr>
<td>B020</td>
<td>(2) KB010</td>
<td>—</td>
<td>4 (12)</td>
<td>4 (12)</td>
<td>—</td>
</tr>
<tr>
<td>BX040</td>
<td>(1) KB050</td>
<td>—</td>
<td>6 (10)</td>
<td>—</td>
<td>—</td>
</tr>
<tr>
<td>BX060</td>
<td>(1) KB050</td>
<td>—</td>
<td>6 (10)</td>
<td>—</td>
<td>—</td>
</tr>
<tr>
<td>B040-B060</td>
<td>(2) KB050</td>
<td>16 (6)</td>
<td>6 (10)</td>
<td>—</td>
<td>—</td>
</tr>
</tbody>
</table>

### Table 3b — DC Brake Power Wiring for 500-600V AC Drives

<table>
<thead>
<tr>
<th>for drive rating</th>
<th>with</th>
<th>Drive – Master or Auxiliary Term Block</th>
<th>Auxiliary Term Block - Master</th>
<th>Master – Slave</th>
<th>Slave – Slave</th>
</tr>
</thead>
<tbody>
<tr>
<td>C003-C005</td>
<td>(1) KC005</td>
<td>—</td>
<td>4 (12)</td>
<td>—</td>
<td>—</td>
</tr>
<tr>
<td>C007-C010</td>
<td>(1) KC010</td>
<td>—</td>
<td>4 (12)</td>
<td>—</td>
<td>—</td>
</tr>
<tr>
<td>C015</td>
<td>(1) KC005 + (1) KC010</td>
<td>—</td>
<td>4 (12)</td>
<td>4 (12)</td>
<td>—</td>
</tr>
<tr>
<td>C020</td>
<td>(2) KC010</td>
<td>—</td>
<td>4 (12)</td>
<td>4 (12)</td>
<td>—</td>
</tr>
<tr>
<td>C040-C060</td>
<td>(1) KC050</td>
<td>—</td>
<td>6 (10)</td>
<td>—</td>
<td>—</td>
</tr>
<tr>
<td>C075-C100</td>
<td>(2) KC050</td>
<td>16 (6)</td>
<td>6 (10)</td>
<td>—</td>
<td>—</td>
</tr>
</tbody>
</table>