POWEROHM RESISTORS INC.

Braking Resistors
Brake Modules
VBR Load Analyzer

Manufactured for

GE Fuji Drives

(800) 838-4694
www.powerohm.com

POWEROHM RESISTORS, INC.

PO Box 537 Katy, TX 77492
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POWEROHM HAS CLOSED THE LOOP

CHOPPERS

DRIVES

BRAKE RESISTORS

SIZING

On Braking Resistors

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Powerohm Resistors is pleased to offer the first printing of the Powerohm Braking Resistor catalog for Fuji Drives. In addition to the comprehensive Dynamic Braking Resistor selection list, we have sections for the Powerohm Resistors new line of stand alone **DB Modules/Choppers** and the exciting new **VBR,** a diagnostic tool, which facilitates the proper selection and takes the mystery out of sizing Dynamic Braking Resistors.

This comprehensive guide also offers complete information on all the resistor selections including the panel mounted type CR case style resistors, to rugged style type screened or louvered enclosed units. All units are covered, and conveniently listed under the appropriate section by Voltage, HP, Duty Cycle.

Once your part number is selected, additional technical information such as ohms, watts, dimensions, weight and the list price of the unit may be found on page 19.

Powerohm's new DB Module/Chopper is listed on page 11. Models are available in continuous amp ratings of 50, 115, 450, and 600.

Powerohm's VBR takes the mystery out of sizing DB resistors. The light compact, portable unit will assist in sizing the proper DB Resistor for any of the Fuji Drives series. The unit may be purchased or rented from Powerohm Resistors Inc. A complete description of the unit's operation is available on pages 12 thru 13, purchasing and rental information is available on page 20.

Finally, additional product information such as Installation and Mounting instructions is included as well as other product information pages and useful Application and Engineering Notes.

Feel free to call Powerohm Resistors Inc. toll free at 1-800-838-4694 if you have any questions.

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230V Fuji Drive

Standard Enclosed Resistors

Volts	Motor HP	G11S Inverter	Motor HP	P11S Inverter	Ohms	Q'ty	Powerohm P/N	G11S % Torque	P11S % Torque
230	1/4	FRNF25G11S-2UX	-	-	100	1	PRDB0.75-2	150	-
230	1/2	FRNF50G11S-2UX	-	-	100	1	PRDB0.75-2	150	-
230	1	FRN001G11S-2UX	-	-	40	1	PRDB0.75-2	150	-
230	2	FRN002G11S-2UX	-	-	40	1	PRDB2.2-2	150	-
230	3	FRN003G11S-2UX	-	-	33	1	PRDB2.2-2	150	-
230	5	FRN005G11S-2UX	7.5	FRN007P11S-2UX	33	1	PRDB3.7-2	150	100
230	7.5	FRN007G11S-2UX	10	FRN010P11S-2UX	20	1	PRDB5.5-2	150	100
230	10	FRN010G11S-2UX	15	FRN015P11S-2UX	15	1	PRDB7.5-2	150	100
230	15	FRN015G11S-2UX	20	FRN020P11S-2UX	10	1	PRDB11-2	150	100
230	20	FRN020G11S-2UX	25	FRN025P11S-2UX	8.6	1	PRDB15-2	150	100
230	25	FRN025G11S-2UX	30	FRN030P11S-2UX	6.8	1	PRDB18.5-2	150	100
230	30	FRN030G11S-2UX	40	FRN040P11S-2UX	5.8	1	PRDB22-2	150	100
230	40	FRN040G11S-2UX	50	FRN050P11S-2UX	4	1	PRDB30-2C	100	75
230	50	FRN050G11S-2UX	60	FRN060P11S-2UX	3	1	PRDB37-2C	100	75
230	60	FRN060G11S-2UX	75	FRN075P11S-2UX	2.5	1	PRDB45-2C	100	75
230	75	FRN075G11S-2UX	100	FRN100P11S-2UX	2	1	PRDB55-2C	100	75
230	100	FRN100G11S-2UX	125	FRN125P11S-2UX	1.5	1	PRDB75-2C	100	75
230	125	FRN125G11S-2UX	150	FRN150P11S-2UX	1.2	1	PRDB90-2C	100	75

CONSTRUCTION NOTES:

Enclosures have a mill galvanized finish.
Resistance values have a +/- 10% tolerance.
All enclosures include a terminal block for customer connections and a normally closed thermal switch.

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460V Fuji Drive

Standard Enclosed Resistors

Volts	Motor HP	G11S Inverter	Motor HP	P11S Inverter	Ohms	Q'ty	Powerohm P/N	G11S % Torque	P11S % Torque
460	1/2	FRNF50G11S-4UX	-	-	200	1	PRDB0.75-4	150	-
460	1	FRN001G11S-4UX	-	-	200	1	PRDB0.75-4	150	-
460	2	FRN002G11S-4UX	-	-	160	1	PRDB2.2-4	150	-
460	3	FRN003G11S-4UX	-	-	160	1	PRDB2.2-4	150	-
460	5	FRN005G11S-4UX	7.5	FRN007P11S-4UX	130	1	PRDB3.7-4	150	100
460	7.5	FRN007G11S-4UX	10	FRN010P11S-4UX	80	1	PRDB5.5-4	150	100
460	10	FRN010G11S-4UX	15	FRN015P11S-4UX	60	1	PRDB7.5-4	150	100
460	15	FRN015G11S-4UX	20	FRN020P11S-4UX	40	1	PRDB11-4	150	100
460	20	FRN020G11S-4UX	25	FRN025P11S-4UX	34.4	1	PRDB15-4	150	100
460	25	FRN025G11S-4UX	30	FRN030P11S-4UX	27	1	PRDB18.5-4	150	100
460	30	FRN030G11S-4UX	40	FRN040P11S-4UX	22	1	PRDB22-4	150	100
460	40	FRN040G11S-4UX	50	FRN050P11S-4UX	15	1	PRDB30-4C	100	75
460	50	FRN050G11S-4UX	60	FRN060P11S-4UX	12	1	PRDB37-4C	100	75
460	60	FRN060G11S-4UX	75	FRN075P11S-4UX	10	1	PRDB45-4C	100	75
460	75	FRN075G11S-4UX	100	FRN100P11S-4UX	7.5	1	PRDB55-4C	100	75
460	100	FRN100G11S-4UX	125	FRN125P11S-4UX	6.5	1	PRDB75-4C	100	75
460	125	FRN125G11S-4UX	150	FRN150P11S-4UX	4.7	1	PRDB110-4C	100	75
460	150	FRN150G11S-4UX	200	FRN200P11S-4UX	4.7	1	PRDB110-4C	100	75
460	200	FRN200G11S-4UX	250	FRN250P11S-4UX	3.9	1	PRDB132-4C	100	75
460	250	FRN250G11S-4UX	300	FRN300P11S-4UX	3.2	1	PRDB160-4C	100	75
460	300	FRN300G11S-4UX	350	FRN350P11S-4UX	2.6	1	PRDB200-4C	100	75
460	350	FRN350G11S-4UX	400	FRN400P11S-4UX	2.2	1	PRDB220-4C	100	75
460	400	FRN400G11S-4UX	450	FRN450P11S-4UX	3.2	2	PRDB160-4C	100	75
460	450	FRN450G11S-4UX	500	FRN500P11S-4UX	3.2	2	PRDB160-4C	100	75
460	500	FRN500G11S-4UX	600	FRN600P11S-4UX	2.6	2	PRDB200-4C	100	75
460	600	FRN600G11S-4UX	700	FRN700P11S-4UX	2.6	2	PRDB200-4C	100	75
460	-	-	800	FRN800P11S-4UX	2.6	2	PRDB200-4C	100	75

CONSTRUCTION NOTES:
Enclosures have a mill galvanized finish.
Resistance values have a +/- 10% tolerance.
All enclosures include a terminal block for customer connections and a normally closed thermal switch.

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SIZING AND DESIGN CONSIDERATIONS FOR POWER RESISTORS USED IN DYNAMIC BRAKING APPLICATIONS ON VARIABLE FREQUENCY DRIVES

Abstract

VFD's operated in Constant Torque applications often employ the use of dynamic braking resistors to allow faster process and product cycle times that otherwise would be unattainable. For safety code reasons, including personnel and equipment, particular processes may need to have a quick stop feature so the process is terminated quickly.

This paper will examine the design considerations for braking resistors when used in both of the above applications. The paper also examines and suggests the proper element type that might be used as well as other options. Increasing the throughput rates of processes (increased efficiency) and safety considerations (quick process stops) for equipment and personnel, will also be examined.

The Problem Described

Efficiency and flow through rates may sometimes seem to be at a fixed upper end speed range. Increasing these maximum speeds without giving consideration to the inertia may cause nuisance tripping of the VFD and thus the process. Simply by decreasing the deceleration time to increase the overall process time, may not be possible without a resistive load due to the inertia present in the system.

Secondly, quickly terminating and shutting down a process for equipment and personnel safety and code considerations may also be desired.

The choice of the proper dynamic braking resistor would provide the solution for both of these situations.

Constant Torque Processes

Some constant torque processes may be operated in speed/torque quadrants that oppose one another. Figure 1 shows a typical four quadrant graph of a drive. In Quadrants I and II, regeneration of energy from the load (a counter emf) is generated back through the motor. The motor, in essence, becomes a generator. This regenerated energy looks to the connected Drive for the opportunity to dissipate itself. The Drive is able to absorb some of this energy in the bus capacitors but is unable to sustain this condition for large loads or long periods without the need to rid itself of this over-voltage situation.

Concurrently, when processes need to be quickly terminated for the safety of personnel and equipment, the inertia in the system may cause an over-voltage fault in the drive if decelerated too quickly. Many applications, by safety code, must be terminated in a predetermined period. Also, when retrofitting or installing a VFD in place of an existing mechanical or DC system, it is very important to obtain the total inertia that would affect the desired braking time.

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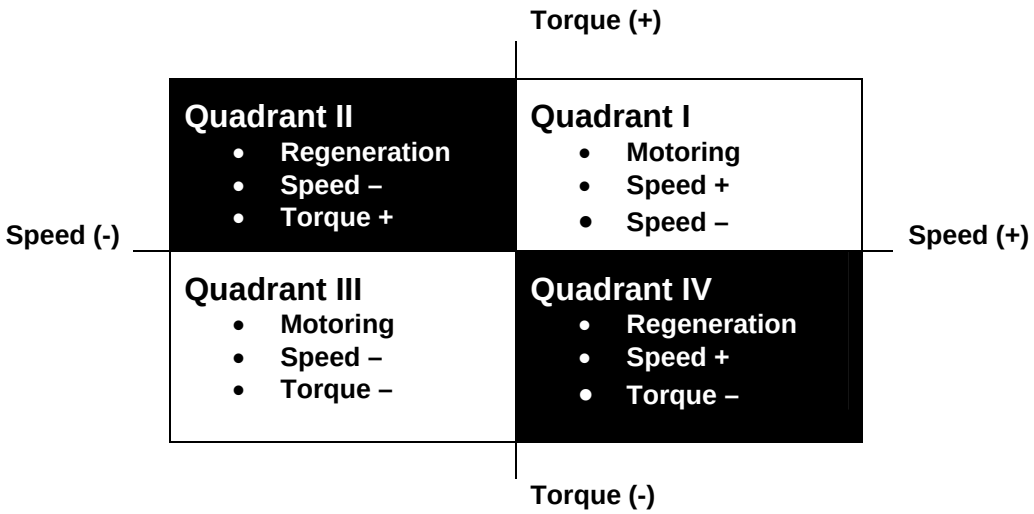

Figure 1

Resistor Element Type Options

The type of resistor element to be used in a braking resistor application is a function of braking current and the duty cycle. The continuous current rating of the braking resistor is derived from calculations based on the duty cycle along with considerations of the Brake IGBT built in the drive or the IGBT in the external brake chopper.

The proper ohm value is chosen based on the torque requirements of the application along with considerations of the current rating of the IGBT. The selected resistance value must be greater than the minimum resistance specified for the drive. Installing a braking resistor with too low of a resistance value may violate the maximum current rating of the IGBT and cause permanent damage to the drive.

There are many types of element options available for selection. The proper selection is important to insure performance and reliability as well as to provide the most compact and economical package. Note that the ohm value and continuous amp rating of the resistor is inversely proportional to one another. In other words, in a typical family of element types while maintaining the same approximate overall size, the higher the ohm rating of given resistor element, the lower the current rating.

The following element selection chart provides an approximate guide to use for the proper selection of natural convection cooled resistors. This example is for a 460 volt VFD.

HP	Duty Cycle Range	Element type
1-25	up to 10%	Case style, Smoothwound or Wirewound
1-25	above 10%	Wirewound or Edgewound
30-75	up to 10%	Wirewound or Edgewound
30-75	above 10%	Wirewound, Edgewound or Grid
100 and up	up to 10%	Edgewound, Grid or Ribbon
100 and up	above 10%	Edgewound, Grid or Ribbon

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Series Connections Versus Parallel Connections

According to Ohm's Law, the same total ohm value of a braking resistor circuit can be obtained using either a series or a parallel connection of elements. However, the thermal mass (active element weight) of the series connection is much greater than the equivalent parallel connection because the series connected resistors feature a larger cross-sectional element to manage its higher current rating.

Figure 2 shows a pair of 50 ohm resistors connected in series for an equivalent resistance of 100 ohms. Figure 3 shows a pair of 200 ohm resistors connected in parallel for an equivalent resistance of 100 ohms. Both configurations have the same equivalent resistance, however, are the configurations equal when applied in a VFD cyclic braking application? The answer is absolutely not!

To demonstrate more clearly, we shall examine the test results for both the series connected resistor configuration with the parallel connected resistor configuration while subjected to a repeat cycle as well as a single shot or quick stop.

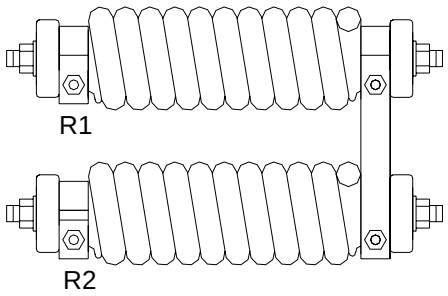

Figure 2

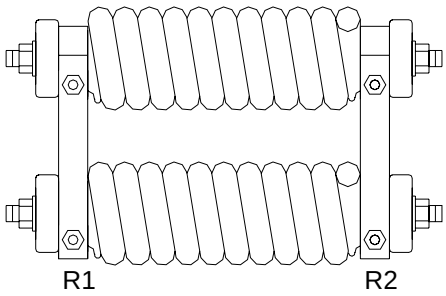

Figure 3

Repeat Cycle Applications involve a duty cycle. Typically, the resistor is overloaded for a few seconds and then allowed to cool for several more seconds. This cycle of on time and off time repeats indefinitely. After multiple cycles, the resistor stabilizes between two temperatures. The highest temperature occurs at the end of the on (or heating) cycle and the lowest temperature occurs at the end of the off (or cooling) cycle. The off time is typically longer than the on time for most repeat cycle applications such as motor control.

Single Shot or Quick Stop Applications involve absorbing large amounts of energy in a short period of time and then allowing the resistor to completely cool down to ambient temperature. A good example is an emergency stop application.

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Repeat Cycle Test Comparison

Figure 4 illustrates the corresponding element temperatures for a 50% duty cycle application, (5 seconds on/ 5 seconds off), for both the series and parallel connection while subjected to the same voltage and overall current flow. As noted, both circuits equal 100 ohms total, but the active element weight of the series connection is 3 times greater than the parallel connection giving it an advantage. Why is this important? The answer is the watt second capability of the resistor unit. Notice the element temperature rise of the series circuit is operating much lower than the equivalent parallel circuit. The total element mass of the series connected unit has a watt second rating equivalent to approximately 3 times the parallel unit in this given example. The higher the watt second rating of a resistor assembly, the lower temperature rise, the longer the life expectancy.

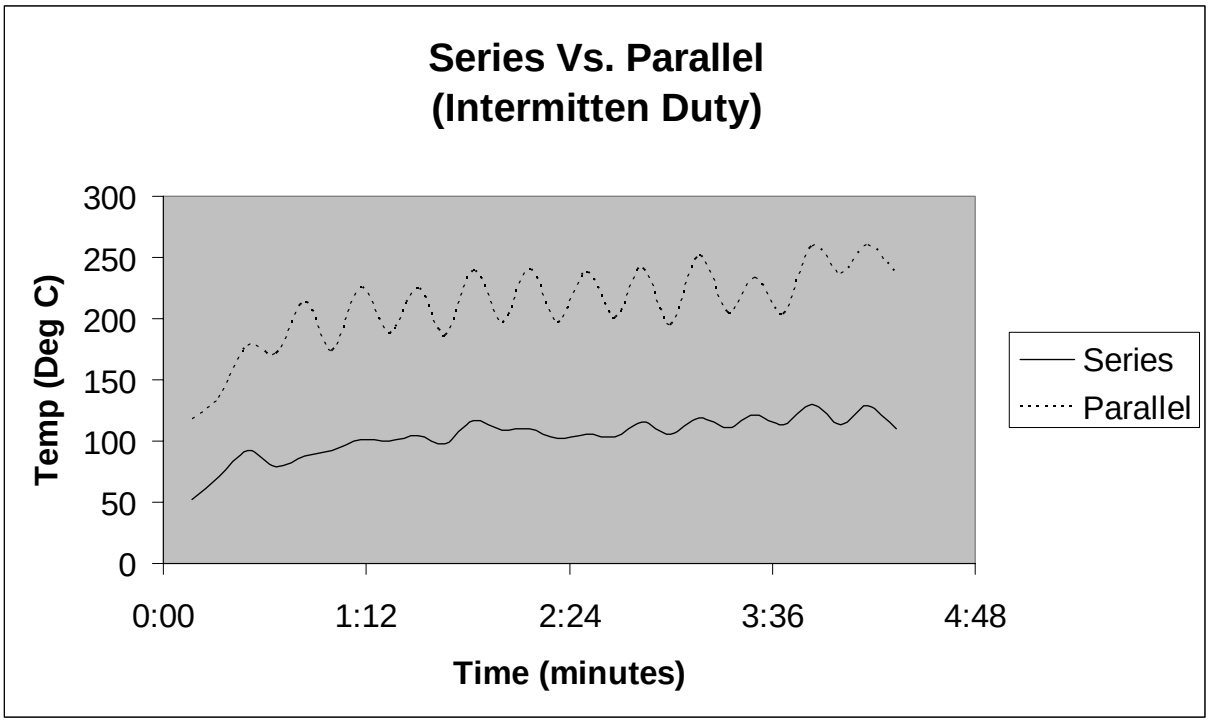

Figure 4

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One Shot Cycle Test Comparison

Figure 5 illustrates the corresponding element temperatures for a single shot application. The graph shows the temperature comparisons for both the series and parallel configurations while subjected to the same overall current flow and the same ON time. The test was stopped once the parallel configuration reached its full temperature rise of 375 degrees Celsius. As noted, both circuits equal 100 ohms total, but the active element weight of the series connection is 3 times greater than the parallel connection giving it an advantage. As you can see from the graph the series configuration's temperature rise was much lower than the equivalent parallel circuit. The total element mass of the series connected unit has a watt second rating equivalent to approximately 3 times the parallel unit in this given example. Once again, the higher the watt second rating of a resistor assembly, the lower temperature rise, the better the reliability.

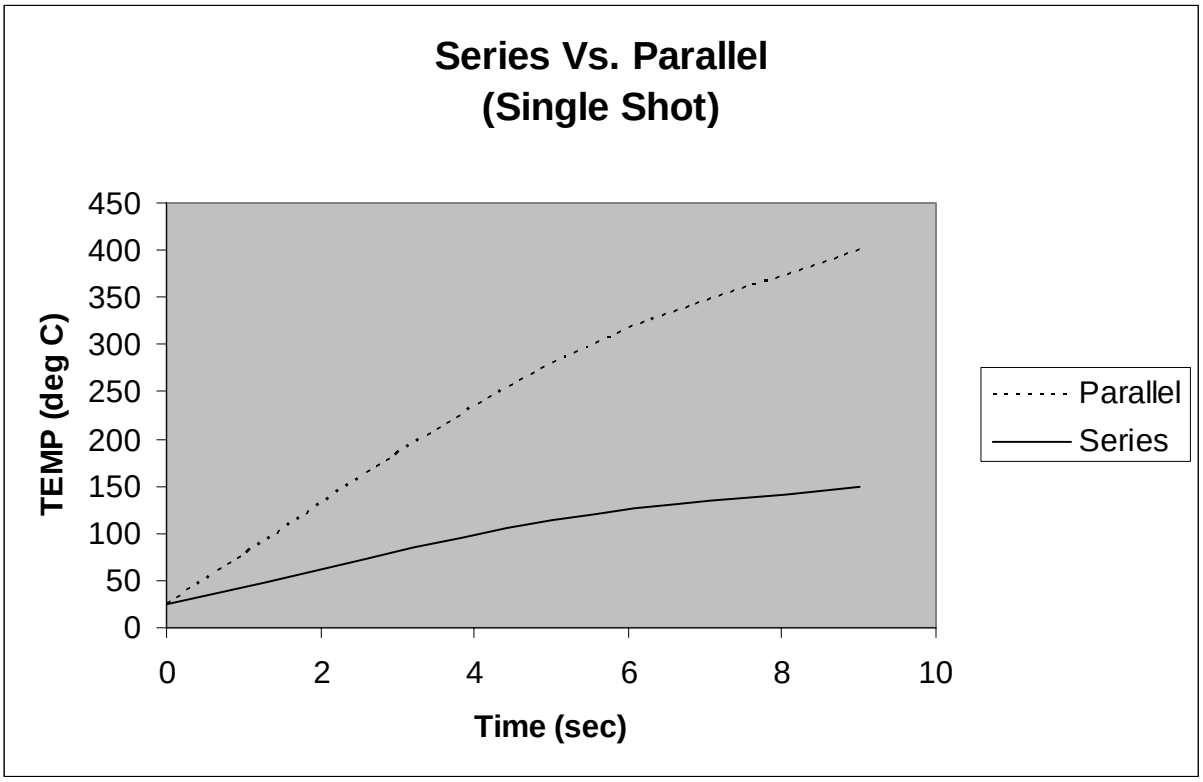

Figure 5

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Powerohm Type BM Braking Modules

PRODUCT OVERVIEW

Powerohm Type BM Braking Modules can be used in conjunction with any AC drive to monitor the DC bus of the drive and activate external braking resistor as needed not only to avoid over-voltage trips, but to greatly improve the performance of the drive system. The use of Braking Modules and resistors increase the braking torque capability of a variable frequency drive, allowing faster and more controlled deceleration times.

To accommodate system horsepower requirements beyond the capability of a single Module, the Modules are all Master/Slave programmable. This allows an arrangement of multiple Modules to effectively function as a single higher rated module.

Pricing for the Brake Modules appears on page 20, while the pricing for the resistors may be found in the resistor index page 19.

GENERAL SPECIFICATIONS

The Powerohm Type BM Braking Module is available in three different voltage classes including 240, 480 and 600 volts.

Powerohm Part No.	Nominal AC Line Voltage	RMS Continuous Load Current	Turn ON Voltage	Max Peak Current
BM2-50	240	50	390	200
BM2-115	240	115	390	200
BM240-450	240	450	390	600
BM240-600	240	600	390	900
BM4-50	480	50	775	200
BM4-115	480	115	775	200
BM480-450	480	450	775	600
BM480-600	480	600	775	900
BM6-50	600	50	970	200
BM6-115	600	115	970	200
BM600-450	600	450	970	600
BM600-600	600	600	970	900

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VBR

Variable Braking Resistor Analyzer

Available for Rent or Purchase

With the VBR you can:

- Correctly size the OHMS and WATTS for any application
- Quickly provide a DB Resistor Sizing Service for your customers
- Provide a temporary DB solution while the permanent is on its way
- Validate the existing resistor size being employed as the optimum choice
- Provide OEM's and Integrator's with a portable / adjustable diagnostic tool for sizing braking resistors.

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VBR Operation

Figure 1.

Figure 2.

Figure 3.

CAUTION: Reference the Drive Manual and the Powerohm Braking Resistor Manual when selecting the proper resistance value. Do not select resistance values below the minimum values listed for the drive. Selecting a resistance value below the minimum will result in failure of the brake IGBT and/or drive.

Step 1. Secure the VBR unit in place and plug in supplied power cord to a 120VAC source before connecting load leads to drive or braking module. Attach the supplied load lead cables to the drive by connecting the red lead to DC+ and the black lead to DC-. **Warning:** Drive power and DC bus must be OFF before connecting the loads leads.

Step 2. Turn power selector switch to the ON position to activate the VBR unit. (Fig 1.) The selector switch should illuminate green and blowers should function when ON. Insure that there is a minimum clearance of 24 inches beyond the exhaust to any non-flammable surfaces.

Step 3. If the drive has an existing braking resistor installed, it is important to not press the "Braking Enable" pushbutton. Enabling a selected resistor value may push the equivalent resistance below the minimum allowed. Note that the VBR can be used to analyze an existing braking resistor to determine if a more effective resistor could be used for the installation (skip to Step 5 if this is the case).

Step 4. Select a desired resistance value and press "Braking Enable" to activate the resistive load. (Fig 2.) It is critical that the resistance value selected is greater than the minimum resistance value specified by the drive or braking module manufacturer. Selecting a resistance value lower than the minimum may cause permanent damage to the drive or braking module. The VBR is now ready to monitor your braking cycle.

Step 5. Start and run the Drive at full load, through its entire motoring and braking cycles for a minimum of 30 minutes. To prevent under sizing the resistor, be sure to operate at maximum load in combination with the most sever duty cycle. During the cycling of the Drive you will notice that "VBR Reading" will begin to register a readout from 1 to 135. (Fig 3.)

Step 6. It is important to run the Drive a minimum of 30 minutes so that the proper watt selection of the resistor is realized. At this time the "VBR Reading" should have reached its maximum value and you are you are ready to record the peak "VBR Reading." Lift off the small cover below the digital readout to access the programming keys. Press the up arrow key, which is the second key from the left. This blinking number displayed is the peak readout that will be used in sizing your braking resistor.

Step 7. With the resistance value you selected in Step 4 (or the value of an existing braking resistor) and the peak "VBR Reading" you recorded from Step 6, you can now properly select a fixed resistor for your application. Go to the VBR resistor selection chart to obtain the correct braking resistor part number.

Step 8. The VBR unit must remain ON a minimum of 5 minutes after the drive is powered down to allow the unit to cool. Do not remove load leads until the Drive and DC bus have been powered down. Use caution when handling the VBR unit as the exhaust area surface may be HOT!

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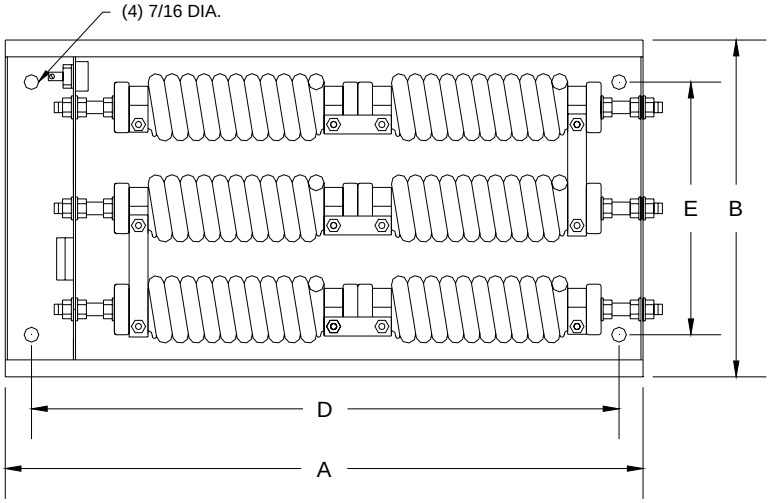
Type GCE Enclosures

These heavy gage screened enclosures feature a solid bottom and a built-in compartment separated from the resistor assembly. The resistors are factory wired to a terminal block mounted in this compartment using high temperature Teflon or silicone wire. The terminal compartment also houses a normally closed thermal switch used for detecting resistor temperature overloads. During installation, standard 90ºC rated wire is routed into the compartment through the removable 1/2 inch conduit knockouts and connected to the factory wired terminal block.

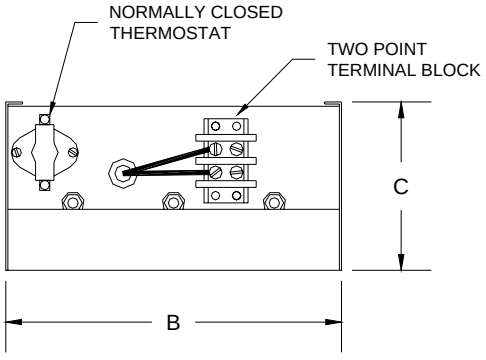
Our standard unit includes a screened cover which is CNC punched to obtain maximum cooling and professional aesthetics. Mounting holes are located inside the enclosure and can be easily accessed by removing the cover. Resistor coils are interconnected using stainless steel bus bars, producing a corrosion resistant current path to withstand nearly any harsh industrial environment. The standard finish is galvanized, but an optional ANSI 61 powder coated finish is available upon request. As shown in the table below, the size of the enclosure will vary depending on the number of resistor coils required for your application. Please do not hesitate to call the factory if you need assistance. Units are available with louvered covers; add "-W" to the part number and note that the 'A' and 'B' dimensions will increase by 2 inches and the ‘C’ dimension will increase by 1 inch.

GCE ENCLOSURE DIMENSIONS AND COIL OPTIONS							
PART	MAX. NO.	MAX NO.	DIMENSIONS IN INCHES				
NUMBER	WR COLS	SXR,VR or ER	A	B	C	D	E
GCE1	1	(1) Size 2	12	5	5	10-1/2	---
GCE2	2	(2) Size 2	12	7	5	10-1/2	4-1/2
GCE3	3	(3) Size 2	12	10	5	10-1/2	7-1/2
GCE4	4	(4) Size 2	12	13	5	10-1/2	10-1/2
GCE5	5	(5) Size 2	12	16	5	10-1/2	13-1/2
GCE6	6	(3) Size 5	19	10	5	17-1/2	7-1/2
GCE8	8	(4) Size 5	19	13	5	17-1/2	10-1/2
GCE9	9	(3) Size 7	26-1/2	10	5	25	7-1/2
GCE10	10	(5) Size 5	19	16	5	17-1/2	13-1/2
GCE12	12	(4) Size 7	26-1/2	13	5	25	10-1/2
GCE15	15	(5) Size 7	26-1/2	16	5	25	13-1/2
GCE18	18	(6) Size 7	28	10	10	26-1/2	7-1/2
GCE24	24	(8) Size 7	28	13	10	26-1/2	10-1/2
GCE30	30	(10) Size 7	28	16	10	26-1/2	13-1/2

TOP VIEW



LEFT SIDE VIEW



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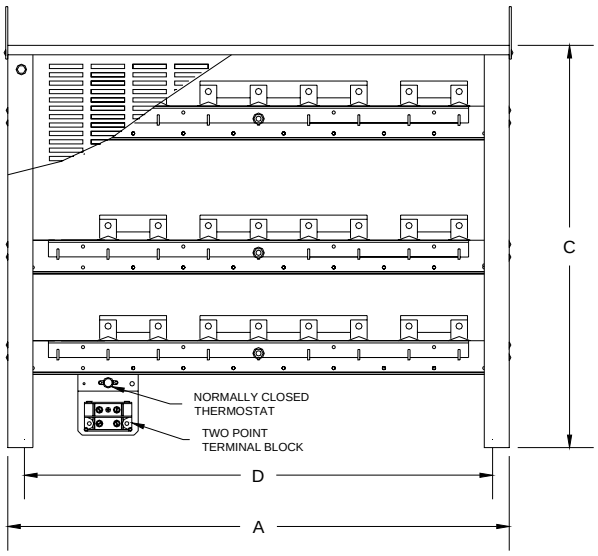
Type ED Enclosures

The Type ED enclosure is designed for applications requiring a large number of Type SXR, WR, VR and/or ER resistor coils. In addition to the large capacity, these units are supplied with terminal connections up to 400 amps continuous located on a terminal plate in the bottom of the enclosure. These factory wired connections allow standard 90ºC rated wire to be used if routed along the enclosure bottom. If installing without the optional terminal connections, always use 200ºC rated silicone or Teflon wire when attaching directly to resistors. A normally closed thermal switch is also provided, which is used to detect resistor temperature overloads.

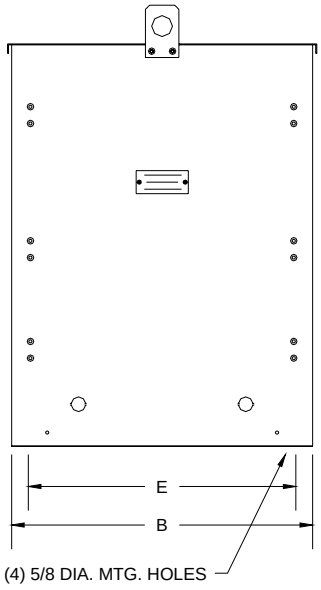
These rigid enclosures include a screened top and removable front and back screened covers. The enclosure sides are solid and the bottom is open and furnished with two lifting eyes. Mounting holes are located inside the enclosure and can be easily accessed by removing the front or rear cover. Resistor coils are interconnected using all stainless steel bus bars, producing a corrosion resistant current path to withstand nearly any harsh industrial environment. The standard finish is galvanized, but an optional ANSI 61 powder coated finish is available upon request. As shown in the table below, the size of the enclosure will vary depending on the number of resistor coils required for your application. Units are available with louvered covers; add "-W" to the part number and note that the 'A' and 'B' dimensions will increase by 4 inches and the 'C' dimensions will increase by 1-1/2 inches.

ED ENCLOSURE DIMENSIONS AND COIL OPTIONS							
PART	MAX. NO.	MAX NO.	DIMENSIONS IN INCHES				
NUMBER	WR COLS	SXR,VR or ER	A	B	C	D	E
ED1	18	(9) Size 5	30	18	10	26	16
ED2	36	(18) Size 5	30	18	16	26	16
ED3	54	(27) Size 5	30	18	24	26	16
ED4	72	(36) Size 5	30	18	32	26	16
ED5	90	(45) Size 5	30	18	40	26	16
ED6	108	(54) Size 5	30	18	48	26	16
ED7	126	(63) Size 5	30	18	56	26	16
ED8	144	(72) Size 5	30	18	64	26	16
ED9	162	(81) Size 5	30	18	72	26	16
ED10	180	(90) Size 5	30	18	80	26	16

FRONT VIEW



SIDE VIEW



POWEROHM RESISTORS, INC.

PO Box 537 Katy, TX 77492
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Installation Instructions

Construction: Powerohm braking resistors consists of smoothwound, wirewound or edgewound type resistor coils mounted in ventilated enclosures. All current carrying components used to manufacture our resistor coils including the elements and terminals are stainless steel for maximum corrosion resistance. Standard enclosures will be mill galvanized with terminals factory wired to a terminal block and normally closed thermal switch. Braking resistors are available with a variety of options such as special enclosure finishes and outdoor ratings.

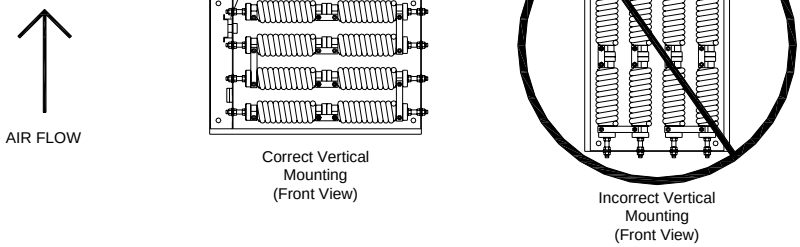
INSPECTION: Upon receipt of your Powerohm Braking Resistor, be sure to inspect the unit carefully for any shipping damage. After unpacking, check the unit for loose, broken, bent or otherwise damaged parts due to shipping. Report any shipping damage immediately to the freight carrier. Be sure to verify that the part number and ratings listed on the nameplate conform to the order specification. The ohm rating listed on the nameplate is critical (too low of an ohm value may cause damage to the drive).

INSTALLATION:

IMPORTANT: The National Electric Code (NEC) and local regulations govern the installation and wiring of electrical equipment such as braking resistors. DC power wiring, AC power wiring, control wiring and conduit must be installed in accordance with these codes.

Powerohm braking assemblies cool by natural convection causing hot air to rise vertically from the enclosure. Braking resistors should be mounted in a well ventilated location free of any combustible materials or equipment affected by heat. Units should be installed with at least 24 inches of free space above the enclosure top and 6 inches of free space surrounding the enclosure sides. If necessary, units can be mounted on spacers or channels to limit heat from conducting from the resistor enclosure to its mounting surface.

Braking resistor enclosures 28 inches or less in width, can be mounted vertically or horizontally. If the unit is mounted vertically, it is important that the resistor coils remain in a horizontal position. Also, if a thermal switch is included with the unit, position the equipment so the switch remains near the top of the enclosure. See below for vertical mounting details.



To install the unit, first remove the ventilated cover. Units 28 inches or less in width require a 5/16 inch wrench, while larger units require a 7/16 inch wrench to remove the cover hardware. Mounting holes can be found on the inside of the braking resistor enclosure. Mounting dimensions are listed on pages 25-36. Units that are 28 inches or smaller have 7/16 inch diameter mounting holes designed for 3/8 inch hardware. 30 inch wide units have 5/8 inch diameter mounting holes designed for 1/2 inch hardware. Be sure to fasten the unit securely in place.

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Smaller 28 inch wide enclosures have convenient conduit knockouts for easy connection. Remove the proper knockout after determining a suitable entry point. Larger units may require field punching for conduit entry. It is preferable to route conduit near the bottom of the resistor enclosure. After attaching conduit, pull wiring into the enclosure for connection to resistor. If connecting directly to the terminals on the resistor elements, it is necessary to use high temperature silicon or Teflon wire rated 200ºC. Try to route wiring along the bottom of the enclosure and avoid running the wiring across the top or near the resistor elements. Units are supplied with either #10, 3/8 or 1/2 inch terminal hardware. If you choose to use the factory installed terminal block, then you may connect to it using standard 90ºC rated wire. Be sure to properly ground the resistor enclosure to prevent electrical shock.

A normally closed thermal switch is included with the unit, featuring ¼ inch quick connect terminals.

After installing and wiring to your Powerohm Braking Resistor, return the ventilated cover to its proper position. Securely tighten cover hardware (do not exceed 20 inch-pounds of torque).

MAINTENANCE: Periodically check the unit for loose connections and an accumulation of dust or dirt on the inside and outside of the resistor enclosure. Be sure to allow the unit to cool before servicing (contact may result in burn injury). Remove all power before servicing unit to avoid electrical shock. Allow at least one minute after input power has been removed for the bus voltage to discharge. Electric shock can cause injury or death.

Resistor elements should not glow red under normal operating conditions. If the resistor elements glow red you may need a higher rated braking resistor.

TECHNICAL SUPPORT: If you have any questions about your braking resistor, contact Powerohm for assistance at (800) 838-4694.

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Application / Engineering Notes

1) ND HP = Normal duty HP rating of the drive

2) Torque (% of Motor) = Maximum torque (power) a motor can discharge back through the drive

3) Rated Ohms = the nominal resistance value designed to exceed the minimum resistance rating of the drive. Any listed torque rating less than 100% is due to the limitations of the drive. Applications requiring torque values that exceed the limitations of the drive, may require an external chopper module and a corresponding resistor.

5) Duty cycle %. The duty cycle and braking scheme determine the power rating (watts) and therefore the physical size of the braking resistor. Duty cycle is calculated by dividing the braking stop time by the total cycle time. Maximum cycle time is 2 minutes.

All resistors assemblies come mounted in a screened guarded enclosure and include a prewired terminal block and a normally closed thermal switch.	For outdoor enclosures add 10% to the price and –W to the part number. The standard enclosure finish is mill galvanized, however other finishes are available. Consult factory.

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230V Fuji Standard Enclosed Part Number Index

Powerohm P/N	Ohms	Watts	Encl Qty	Encl P/N	Dimensions	Weight (lbs)	List
PRDB0.75-2	100	100	1	GCE1	12W x 5D x 5H	7	$135.00
PRDB0.75-2C	100	100	1	GCE1	12W x 5D x 5H	7	$135.00
PRDB2.2-2	40	290	1	GCE1	12W x 5D x 5H	7	$137.00
PRDB2.2-2C	40	290	1	GCE1	12W x 5D x 5H	7	$137.00
PRDB3.7-2	33	490	1	GCE2	12W x 7D x 5H	9	$207.00
PRDB3.7-2C	33	490	1	GCE2	12W x 7D x 5H	9	$207.00
PRDB5.5-2	20	730	1	GCE2	12W x 7D x 5H	9	$207.00
PRDB7.5-2	15	990	1	GCE3	12W x 10D x 5H	13	$266.00
PRDB11-2	10	1450	1	GCE4	12W x 13D x 5H	16	$325.00
PRDB15-2	8.6	1980	1	GCE5	12W x 16D x 5H	18	$383.00
PRDB18.5-2	6.8	2440	1	GCE6	19W x 10D x 5H	17	$398.00
PRDB22-2	5.8	2900	1	GCE6	19W x 10D x 5H	19	$484.00
PRDB30-2C	4	3960	1	GCE8	19W x 13D x 5H	27	$593.00
PRDB37-2C	3	4880	1	GCE8	19W x 13D x 5H	28	$633.00
PRDB45-2C	2.5	5940	1	GCE10	19W x 16D x 5H	37	$774.00
PRDB55-2C	2	7260	1	GCE10	19W x 16D x 5H	40	$774.00
PRDB75-2C	1.5	9900	1	GCE15	26.5W x 16D x 5H	55	$1,135.00
PRDB90-2C	1.2	11800	1	GCE15	26.5W x 16D x 5H	59	$1,135.00

460V Fuji Standard Enclosed Part Number Index

Powerohm P/N	Ohms	Watts	Encl Qty	Encl P/N	Dimensions	Weight (lbs)	List
PRDB0.75-4	200	100	1	GCE1	12W x 5D x 5H	7	$135.00
PRDB0.75-4C		100	1	GCE1	12W x 5D x 5H	7	$135.00
PRDB2.2-4	160	290	1	GCE1	12W x 5D x 5H	7	$137.00
PRDB2.2-4C	160	290	1	GCE1	12W x 5D x 5H	7	$137.00
PRDB3.7-4	130	490	1	GCE2	12W x 7D x 5H	9	$207.00
PRDB3.7-4C	130	490	1	GCE2	12W x 7D x 5H	9	$207.00
PRDB5.5-4	80	730	1	GCE2	12W x 7D x 5H	9	$207.00
PRDB7.5-4	60	990	1	GCE3	12W x 10D x 5H	13	$266.00
PRDB11-4	40	1450	1	GCE4	12W x 13D x 5H	16	$325.00
PRDB15-4	34.4	1980	1	GCE5	12W x 16D x 5H	18	$383.00
PRDB18.5-4	27	2250	1	GCE6	19W x 10D x 5H	20	$442.00
PRDB22-4	22	2900	1	GCE8	19W x 13D x 5H	26	$537.00
PRDB30-4C	15	3960	1	GCE8	19W x 13D x 5H	24	$593.00
PRDB37-4C	12	4880	1	GCE8	19W x 13D x 5H	24	$593.00
PRDB45-4C	10	5860	1	GCE9	26.5W x 10D x 5H	26	$599.00
PRDB55-4C	7.5	7260	1	GCE15	26.5W x 16D x 5H	38	$885.00
PRDB75-4C	6.5	9900	1	GCE24	28W x 13D x 10H	55	$1,294.00
PRDB110-4C	4.7	14520	1	GCE24	28W x 13D x 10H	74	$1,419.00
PRDB132-4C	3.9	17420	1	GCE24	28W x 13D x 10H	82	$1,691.00
PRDB160-4C	3.2	21120	1	ED2	30W x 18D x 16H	122	$2,410.00
PRDB200-4C	2.6	29040	1	ED2	30W x 18D x 16H	131	$2,410.00
PRDB220-4C	2.2	29040	1	ED3	30W x 18D x 24H	151	$2,818.00

All standard enclosed resistors assemblies come mounted in a screened guarded enclosure and include a prewired terminal block and a normally closed thermal switch.

For outdoor enclosures add 10% to the price and –W to the part number. The standard enclosure finish is mill galvanized, however other finishes are available. Consult factory.

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TYPE BM BRAKE MODULES

Brake Module P/N	Drive Input Voltage	Minimum Ohms	Continuous Amps	Peak Amps	Dimensions	Weight (lbs)	List Price
BM2-50	200 – 240	1.95	50	200	7” x 11” x 5”	8	$1,280
BM2-115	200 – 240	1.95	115	200	7” x 13” x 5”	10	$1,420
BM240-450	200 – 240	0.65	450	600	7” x 20” x 10”	38	$5,284
BM240-600	200 – 240	0.43	600	900	7” x 20” x 10”	38	$6,894
BM4-50	395 – 480	3.88	50	200	7” x 11” x 5”	8	$1,280
BM4-115	395 – 480	3.88	115	200	7” x 13” x 5”	10	$1,420
BM480-450	395 – 480	1.29	450	600	7” x 20” x 10”	38	$5,654
BM480-600	395 – 480	0.86	600	900	7” x 20” x 10”	38	$7,377
BM6-50	500 – 600	4.85	50	200	7” x 11” x 5”	8	$1,280
BM6-115	500 – 600	4.85	115	200	7” x 13” x 5”	10	$1,420
BM600-450	500 – 600	1.62	450	600	7” x 20” x 10”	38	$5,654
BM600-600	500 – 600	1.08	600	900	7” x 20” x 10”	38	$7,377

VBR LOAD ANALYZER

VBR Part Number			Dimensions	Weight (lbs)	List Price
VBR4-30PF			20” x 20” x 10	50	$4,800
Carrying Case			30” x 28” x 20	40	$1,500
Rental Charge	1 week minimum	Security Deposit $1,750			$900/wk

All resistors assemblies come mounted in a screened guarded enclosure and include a prewired terminal block and a normally closed thermal switch.	For outdoor enclosures add 10% to the price and –W to the part number. The standard enclosure finish is mill galvanized, however other finishes are available. Consult factory.

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