

INTRODUCTION

This bulletin contains installation instructions for the dynamic braking resistor kits for ALTIVAR 66 (ATV66), ALTIVAR 58 (ATV58), and ALTIVAR 18 (ATV18) drive controllers:

- For ALTIVAR 66 controllers, see Part 1, page 6.
- For ALTIVAR 58 controllers, see Part 2, page 35.
- For ALTIVAR 18 controllers, see Part 3, page 47.

⚠ WARNING

OVERSPEED HAZARD

- Generation of braking torque throughout the operating speed range of the drive controller requires that dynamic braking be present and operating.
- Dynamic braking resistor must be selected to generate required torque.

NO HOLDING TORQUE

- Dynamic braking does not provide holding torque at zero speed.
- Dynamic braking does not function during loss of power or drive controller fault.
- When required, use separate braking function for holding torque.

LOSS OF BRAKING TORQUE

The dynamic braking resistor contains an internal thermal protection switch to open the circuit if the resistor is overloaded. THIS CAN RESULT IN DRIVE CONTROLLER SHUTDOWN AND LOSS OF BRAKING TORQUE.

- Always verify that the dynamic braking resistor assembly has sufficient capacity for the application.
- Provide alternative braking means in safety-critical applications.

Failure to follow these instructions can result in death, serious injury, or equipment damage.

PART 1: ALTIVAR 66 DYNAMIC BRAKING RESISTOR KIT

Introduction

The dynamic braking resistor kit allows ATV66 drive controllers to function in quadrants 2 and 4 of the speed/torque curve, dissipating the excess braking energy in an external resistor.

Contents of Kit

This kit contains:

- One dynamic braking resistor assembly
- Four liquid-tight nylon sleeves
- One liquid-tight three-hole bushing
- Six danger labels: two French (52012-664-02); two German (52012-664-03); two Spanish (52012-664-04)
- Instruction Bulletin VD0C06N908_ (latest revision)

Technical Specifications

Table 1: Braking Resistor Kit Technical Specifications

For Drives [1]	Ohmic Value Rdb	Continuous Current Rating of Assembly [2] Ir	Catalog Number	Quantity of Kits Used
ATV66U41N4, U54N4, U72N4	120 ¾	1.0 A	VW3A66711	1
ATV66U90N4, D12N4	56 ¾	1.45 A	VW3A66712	1
ATV66D16N4, D23N4	28 ¾	2.7 A	VW3A66713	1
ATV66D33N4, D46N4	14 ¾	3.8 A	VW3A66714	1
ATV66D54N4	10 ¾	10.0 A	VW3A66715	1
ATV66D64N4, D79N4	5 ¾	14.0 A	VW3A66716	1
ATV66C10N4, C13N4, C15N4, C19N4	2.5 ¾	20.0 A	VW3A66717	1
ATV66C23N41	2 ¾ [3]	32.0 A [4]	VW3A66718	2 [5]
ATV66C28N41, C31N41	1.25 ¾ [3]	40.0 A [4]	VW3A66717	2 [5]

[1] For Class 8839 Enclosed ALTIVAR 66 drive controllers, refer to the product nameplate for the part number of the drive controller used.

[2] Current rating of resistor assembly is calculated based on setting of internal overload protective device in assembly, overload setting based on enclosure overtemperature protection, and resistor overload versus time characteristics. Resistors are rated for stopping six times rotor inertia of four-pole motor with drive at current limit. Motor inertias are based on NEMA MG-1 14.45.

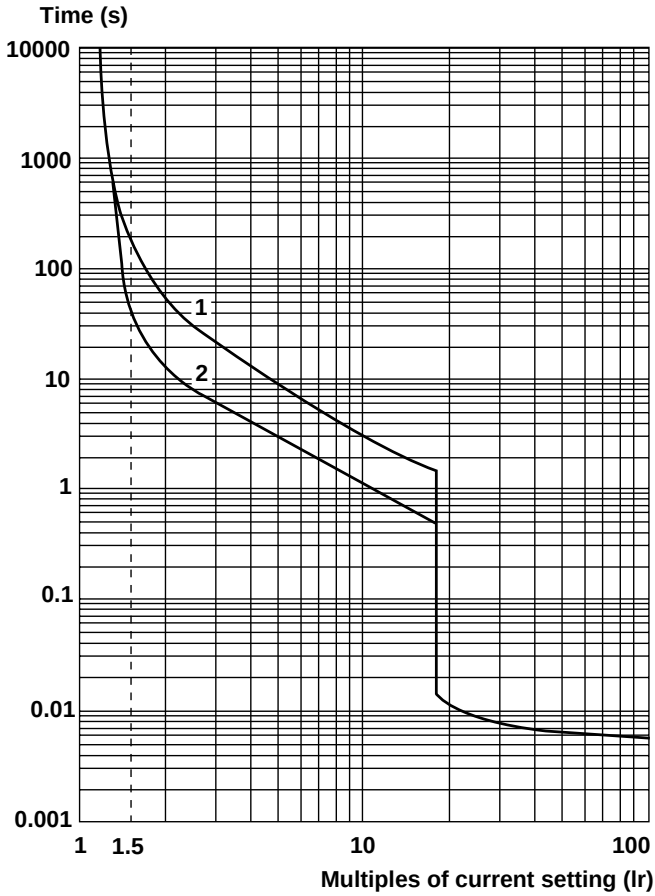
[3] Ohmic value indicated is equivalent resistance of two resistor kits used in parallel. The ohmic value of each resistor kit is twice the value indicated.

[4] The continuous current rating indicated is the equivalent current rating of two resistor kits in parallel. The continuous current rating of each resistor kit is half the value indicated.

[5] Mounting the dynamic braking resistor assemblies on the ATV66C23N41 to C31N41 controllers requires the use of Dynamic Braking Resistor Mounting Plate Kit VY1A66202.

Current-Time Characteristic for DB Resistor Assemblies

Figure 1 shows allowable time according to multiples of current setting with the dynamic braking resistor assembly located in a 40 °C ambient temperature environment. For an example of calculating resistor size, refer to Appendix A.



(1) Cold state
(2) Hot state

Figure 1: Dynamic Braking Curves

Pre-Installation Considerations

The dynamic braking resistor assembly may be wall-mounted or attached to prepared spaces on top of Class 8839 enclosed ALTIVAR 66 drive controllers. The resistor assembly can also be used with certain general purpose enclosures.

The following points should be considered before installation:

- The dynamic braking resistor generates heat during braking. When operating at rated nameplate power in a 40 °C ambient temperature, the resistor enclosure can reach temperatures of 80 °C. The dynamic braking resistor should not be installed below or directly against heat-sensitive materials or equipment. Do not mount against combustible surfaces or on polymeric enclosures. Refer to local and national codes for resistor mounting requirements.
- For proper cooling, always orient the resistor assembly as shown in Figures 13, 14, or 15 on pages 30 - 32. Do not block ventilation openings of the enclosure. Ensure that ventilation and clearance is adequate for the rated power. Calculate the rated power of the assembly from nameplate information using the following formula:

$$\text{Power Rating} = \langle \text{Nameplate Current Rating} \rangle^2 \times \text{Resistance}$$

- If the time-current capability of the resistor is exceeded, protection is provided to prevent resistor damage or excessive enclosure temperatures. A thermal overload switch located inside the dynamic braking resistor assembly will trip and open the resistor circuit to prevent damage. The thermal overload switch may be reset once the overload condition has been corrected. The reset pushbutton of the thermal overload switch is accessed through the small hole in the front of the resistor enclosure (**T**). See Figures 5 and 6 on page 26.
- The mounting surface must be capable of safely supporting the weight of the dynamic braking resistor assembly. Refer to Table 2 for assembly weights.

Table 2: Assembly Weight

Dynamic Braking Assembly Part No.	Weight
VW3A66711 and VW3A66712	11 lbs (5 kg)
VW3A66713 and VW3A66714	16 lbs (7.3 kg)
VW3A66715, 716, 717, 718	58 lbs (26.5 kg)

- The enclosure of the dynamic braking resistor assembly is rated Type 1 per UL 50. The insulation system is intended for use in a Pollution Degree 3 environment (refer to NEMA ICS-1). The installation environment must be compatible with this rating.
- Self-tapping M5 hardware is supplied with the dynamic braking resistor assembly and is intended for reuse during some installation procedures. When threaded into a 0.182 in (4.52 mm) diameter hole, the M5 hardware requires a minimum sheet metal thickness of 0.075 in (1.9 mm) in mild steel for rated thread strength. Do not thread fasteners into dissimilar metals or non-metallic materials. Torque the self-threading M5 fasteners to 32 to 41 lb-in (3.6 to 4.6 N•m).
- When connecting the dynamic braking resistor assembly to the drive controller, use conductors with a cross-sectional size, insulation temperature rating, and insulation voltage rating suitable for the application. For 460 V drive controller applications, follow the recommendations in Table 3 for minimum conductor requirements.

Table 3: PA, PB, GND Minimum Conductor Requirements

Drive Controller Part No.	Individual Conductor Length ð 10 ft (3.0 m)	Individual Conductor Length ð 50 ft (15.2 m)	Individual Conductor Length ð 100 ft (30.4 m)
ATV66U41N4 to U72N4	600 V, #14 AWG, 60/75 °C Copper	—	600 V, #8 AWG, 60/75 °C Copper
ATV66U90N4 to D12N4	600 V, #14 AWG, 60/75 °C Copper	—	600 V, #8 AWG, 60/75 °C Copper
ATV66D16N4 to D23N4	600 V, #10 AWG, 60/75 °C Copper	—	600 V, #8 AWG, 60/75 °C Copper
ATV66D33N4 to D46N4	600 V, #10 AWG, 60/75 °C Copper	—	600 V, #8 AWG, 60/75 °C Copper
ATV66D54N4 to D79N4	600 V, #8 AWG, 60/75 °C Copper	600 V, #4 AWG, 60/75° C Copper	—
ATV66C10N4 to C19N4	600 V, #8 AWG, 60/75 °C Copper	600 V, #4 AWG, 60/75° C Copper	—
ATV66C23N41 to C31N41	600 V, #4 AWG, 60/75 °C Copper [2]	600 V, #4 AWG, 60/75° C Copper [2]	—

[1] In addition to the required continuous current rating, the conductor cross-sectional size has been selected to minimize the possibility of insulation damage should an overcurrent or ground fault occur at the DB resistor assembly. The coordination of the conductors in the table is based upon the maximum input line fuse recommended on the specific drive controller nameplate, the use of feeder ground and line conductors selected per ANSI/NFPA 70 (National Electrical Code), and the optional use of a feeder reactor with saturating characteristics.

[2] Separate PA, PB, and GND conductors must be installed to the drive controller for each dynamic braking resistor unit. Do not series the connections.

- The bushing supplied with the dynamic braking resistor assembly can be used as a feed-through for the three conductors from the dynamic braking resistor assembly while maintaining a Type 12 seal through an enclosure wall. The bushing supplied with kits VW3A66711 to VW3A66714 is compatible with conductors with outside diameters of 0.16 ± 0.01 in (4.0 ± 0.25 mm). The bushing supplied with kits VW3A66715 to VW3A66718 is compatible with conductors with outside diameters of 0.22 ± 0.01 in (5.6 ± 0.25 mm). Both bushings can be used with surface thicknesses to 0.10 in (2.5 mm).
- Refer to ANSI/NFPA 70 (National Electrical Code) for information concerning insulated conductor dimensions. The bushing supplied with kits VW3A66711 to VW3A66714 is primarily intended for use with #10 AWG conductors. The bushing supplied with kits VW3A66715 to VW3A66718 is primarily intended for use with #8 AWG conductors.
- Good wiring practice requires separation of dynamic braking power wiring from all other drive controller wiring. Control and power wiring should cross at right angles only. Use metal conduit for all dynamic braking wiring outside the drive controller enclosure. Do not run control or other power wiring in same conduit with dynamic braking power wiring.

Installation

Before installing the dynamic braking resistor assembly, perform the bus voltage measurement procedure.

Bus Voltage Measurement Procedure

⚠ DANGER

HAZARDOUS VOLTAGE

- Read and understand Bus Voltage Measurement Procedure before installing dynamic braking resistor. Measurement of DC bus capacitor voltage must be performed by qualified personnel.
- DC bus LED is not an accurate indication of absence of DC bus voltage.
- DO NOT short across capacitors or touch unshielded components or terminal strip screw connections with voltage present.
- Many parts in this drive controller, including printed wiring boards, operate at line voltage. DO NOT TOUCH. Use only electrically insulated tools.

Electrical shock will result in death or serious injury.

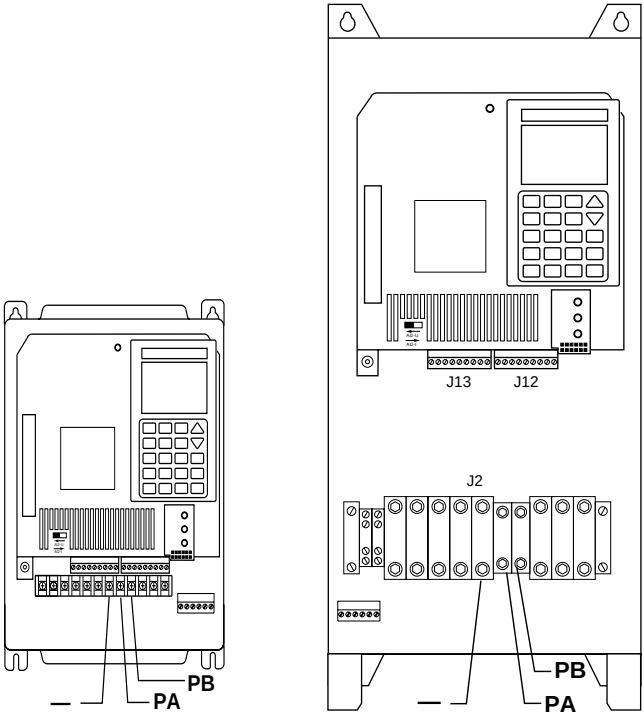
The PA and - terminals are located inside the ALTIVAR 66 drive controller. See Figures 2 - 4 on pages 13 - 15 for terminal locations. To measure bus capacitor voltage:

1. Disconnect and verify that all power is removed from the drive controller. If drive controller is housed in a larger enclosure, disconnect and verify that all power is removed from the enclosure.
2. Wait 1 minute to allow the DC bus to discharge.
3. For Class 8839 enclosed ALTIVAR 66 drive controllers, or for situations where the drive controller is housed in a user-supplied enclosure:
   — Open the outer enclosure door for access to the drive controller.
   — Open the front cover (if present) of the drive controller for access to terminal strip J2 and the PA and - terminals.

   For ALTIVAR 66 drive controllers not housed inside supplementary enclosures, open the front cover of the drive controller for access to terminal strip J2 and the PA and - terminals.
4. Set the volt meter to the 1000 VDC scale. Measure the bus capacitor voltage between the PA and - terminals to verify that the DC voltage

is less than 45 V. **Do not short across capacitor terminals with voltage present!**

5. If the bus capacitors are not fully discharged, contact your local representative — **do not operate the drive controller.**
6. Close all doors to the drive controller and enclosure.



ATV66U41N4 to D12N4

ATV66D16N4 to D79N4

Figure 2: Terminal Strip Locations: ATV66U41N4 to D79N4

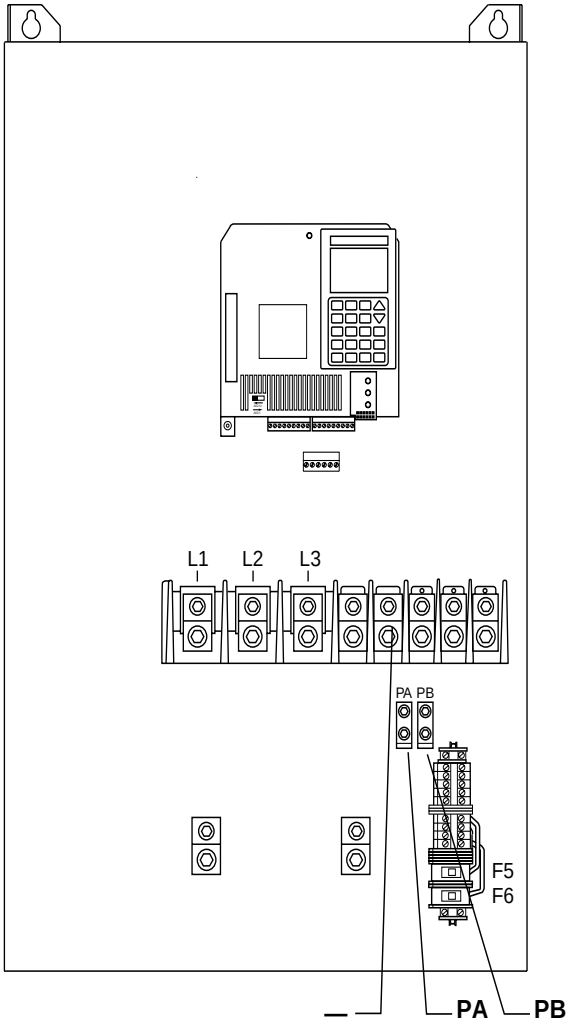


Figure 3: Terminal Strip Locations: ATV66C10N4 to C19N4

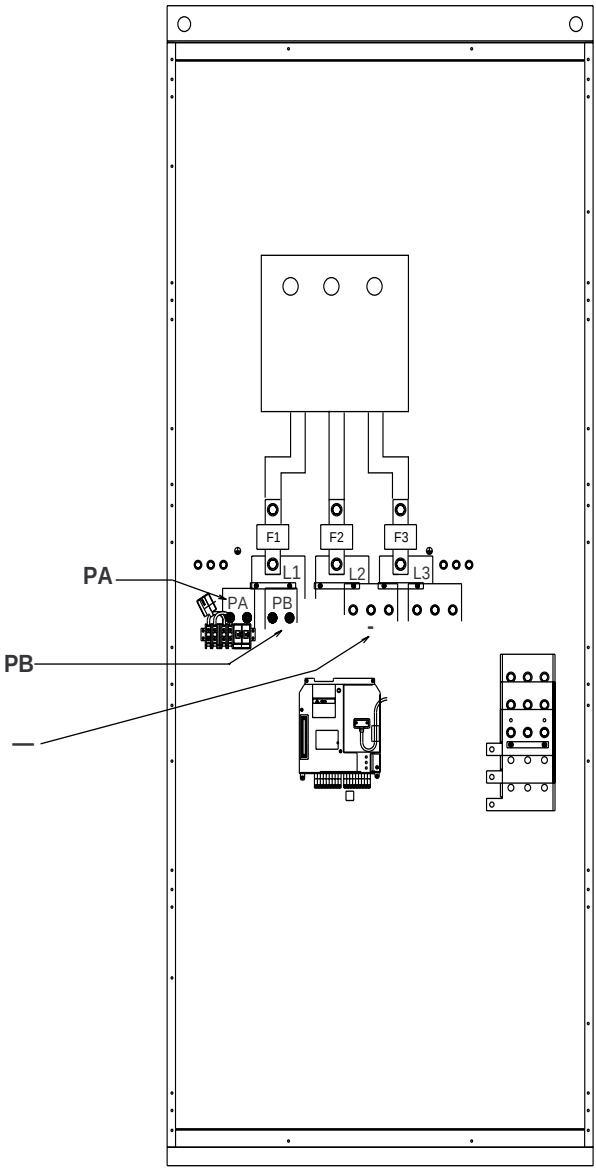


Figure 4: Terminal Strip Locations: ATV66C23N41 to C31N41

Mounting Instructions for Kits VW3A66711, -712, -714

Mounting on Enclosures

1. Remove dynamic braking resistor assembly cover by removing four screws (**A**). See Figure 5 on page 26.
2. Remove bottom pan of dynamic braking resistor assembly by removing four screws (**B**). See Figure 5 on page 26. Keep screws for use in step 4.
3. Refer to hole patterns in Figure 7 on page 27. When drilling or punching holes, avoid dropping metal chips or debris into the enclosure. Clean interior of enclosure thoroughly using a vacuum cleaner equipped with an insulated nozzle. Do not use compressed air to blow debris from the enclosure.

   For Class 8839 Enclosed ALTIVAR 66 Drive Controllers:

   — Locate the center punch marks on top of the enclosure.

   — Drill four 0.182 in (4.52 mm) diameter holes for attachment of the dynamic braking resistor assembly using the M5 self-tapping screws.

   — Punch a 0.80 in (20.32 mm) diameter hole for the feed-through bushing.

   For User-Supplied Enclosures Housing ALTIVAR 66 Drive Controllers:

   NOTE: It is the installer's responsibility to determine the suitability of the enclosure construction for installation of the dynamic braking resistor assembly. Refer to the section "Pre-Installation Considerations" on page 9 for construction requirements.

   — Lay out a hole pattern on the top of the enclosure as illustrated in Figure 7 on page 27.

   — Drill four 0.182 in (4.52 mm) diameter holes (**C**) for attachment of the dynamic braking resistor assembly using the M5 self-tapping screws.

   — Punch a 0.80 in (20.32 mm) diameter hole (**D**) for the feed-through bushing.
4. Position the dynamic braking resistor assembly on top of the enclosure so that the mounting holes align with holes drilled on top of the drive enclosure. Install nylon sleeves (**E**) and secure dynamic braking resistor assembly to top of drive enclosure with the four screws saved from step 2 (**F**). See Figure 9 on page 28.

5. Install the bushing (**G**) into the 0.80 in diameter (20.32 mm) hole in the drive enclosure. See Figure 10 on page 29. When installing the bushing attachment nut (**J**), torque the nut to approximately 24 lb-in (2.8 N•m).
6. Route three conductors (refer to Table 3 on page 10) through the rubber plug (**H**) and bushing so that 6 to 8 in (152.4 to 203.2 mm) of conductor extends into dynamic braking resistor assembly cabinet. If necessary, lubricate conductors using cable soap that will not damage conductor insulation. Once conductors are installed, finger-tighten cap of the feed-through bushing (**I**) so that the three wires are gripped tightly by the bushing. See Figure 10 on page 29.
7. Make connections from terminals PA, PB, and ground on the drive controller (see Figure 2 on page 13) to terminals PA, PB, and ground inside the dynamic braking resistor assembly cabinet (see Figure 11 on page 29).

   NOTE: In ALTIVAR 66 drive controllers, the drive-side ground is made to a lug on the drive controller terminal strip. In Class 8839 enclosed ALTIVAR 66 drive controllers, this connection is made to the ground bar in the enclosure.
8. Verify that the thermal overload switch setting (**K**) matches dynamic braking resistor assembly nameplate current rating, and that thermal overload start switch (**L**) is in On position. See Figure 11 on page 29.
9. Replace dynamic braking resistor cover and secure with four screws (**A**). See Figure 5 on page 26.
10. Attach French, Spanish, or German danger labels (**R**) to dynamic braking resistor assembly enclosure as appropriate. For suggested location of alternate language labels, refer to Figure 5 on page 26 and Figure 11 on page 29.

Wall Mounting Separately from Drive Enclosure

1. Remove dynamic braking resistor assembly cover by removing four screws (**A**). See Figure 5 on page 26.
2. Refer to hole patterns in Figure 13 on page 30 or Figure 14 on page 31. Drill three holes **(M**) in mounting surface.
3. Open conduit entry (**N**) on side of dynamic braking resistor assembly. Conduit entry knockouts are provided for 3/4 in (19.05 mm) and 1/2 in (12.7 mm) pipe.
4. Mount dynamic braking resistor to mounting surface and secure with three user-supplied screws. 1/4 in (6.35 mm) diameter screws are recommended.

5. Make connections (refer to Table 3 on page 10) from terminals PA, PB, and ground on drive controller (see Figure 2 on page 13) to terminals PA, PB, and ground inside dynamic braking resistor assembly cabinet (see Figure 11 on page 29).

   NOTE: In ALTIVAR 66 drive controllers, the drive-side ground is made to a lug on the drive controller terminal strip. In Class 8839 enclosed ALTIVAR 66 drive controllers, this connection is made to the ground bar in the enclosure.
6. Verify that thermal overload switch setting (**K**) matches dynamic braking resistor assembly nameplate current rating, and that thermal overload start switch (**L**) is in On position. See Figure 11 on page 29.
7. Replace dynamic braking resistor cover and secure with four screws (**A**). See Figure 5 on page 26.
8. Attach French, Spanish, or German danger labels (**R**) to dynamic braking resistor assembly enclosure as appropriate. For suggested location of alternate language labels, refer to Figure 5 on page 26 and Figure 11 on page 29.

Mounting Instructions for Kits VW3A66715, -716, -717 (QTY 1)

Mounting on Enclosures

Dynamic braking resistor units VW3A66715, -716, and -717, if ordered as an integral part of a Class 8839 controller, may be supplied unmounted to limit the overall shipping height of the controller. When this is done, the top of the drive controller enclosure is factory prepared to accept the assembly. If the drive controller enclosure has a Type 12 rating, the preparation maintains the integrity of the enclosure construction. When the dynamic braking resistor assembly is installed per this procedure, the Type rating of the enclosure will be maintained. Factory preparation of the top of the enclosure consists of the following:

- All mounting holes are pre-drilled and equipped with M5 self-tapping mounting hardware with nylon sleeves.
- The feed-through bushing has been installed.
- The PA, PB, and GND conductors are installed in the feed-through bushing and connected within the controller. The ends of the conductors exiting the top of the enclosure have been identified with markers and insulated with tape for shipment.

To mount kits VW3A66715, -716, -717 on enclosures:

1. Remove dynamic braking resistor assembly cover by removing six screws (**A**). See Figure 6 on page 26.
2. Remove bottom pan of dynamic braking resistor assembly by removing four screws (**B**). See Figure 6 on page 26. Keep screws for use in step 4.
3. Refer to hole patterns in Figure 8 on page 28. When drilling or punching holes, avoid dropping metal chips or debris into the enclosure. Clean interior of enclosure thoroughly using a vacuum cleaner equipped with an insulated nozzle. Do not use compressed air to blow debris from the enclosure.

   For Class 8839 Enclosed ALTIVAR 66 Drive Enclosures with Unprepared Tops:

   — Locate the center punch marks on top of the enclosure.

   — Drill four 0.182 in (4.52 mm) diameter holes for attachment of the dynamic braking resistor assembly using the M5 self-tapping screws.

   — Punch a 0.80 in (20.32 mm) diameter hole for the feed-through bushing.

   For Class 8839 Enclosed ALTIVAR 66 Drive Controllers with Prepared Tops:

   — Remove the insulating tape from the ends of the PA, PB, and GND conductors.

   — Remove the four M5 screws from the top plate of the enclosure.

   — Attach the dynamic braking resistor assembly on top of the enclosure so that the mounting holes on each side align with the pre-drilled holes. Secure the assembly to the top of the enclosure by re-using the hardware removed in the previous step or use the hardware saved from step 2. See Figure 9 on page 28 (**F**). If the hardware removed in step 2 is used, install the nylon sleeves **(E**) supplied with the kit.

   — Skip to step 7.

For User-Supplied Enclosures Housing ALTIVAR 66 Drive Controllers:

NOTE: It is the installer's responsibility to determine the suitability of the enclosure construction for installation of the dynamic braking resistor assembly. Refer to the section "Pre-Installation Considerations" on page 9 for construction requirements.

— Lay out a hole pattern on top of the enclosure as illustrated in Figure 8 on page 28.

— Drill four 0.182 in (4.52 mm) diameter holes for attachment of the dynamic braking resistor assembly using the M5 self-tapping screws.

— Punch a 0.80 in (20.32 mm) diameter hole for the feed-through bushing.

4. Position dynamic braking resistor assembly on top of the enclosure so that the mounting holes on each side align with holes drilled on top of the drive enclosure. Install nylon sleeves (**E**) and secure dynamic braking resistor assembly to top of drive enclosure with the four screws saved from step 2 (**F**). See Figure 9 on page 28.
5. Install the bushing (**G**) into the 0.80 in diameter (20.32 mm) hole in the drive enclosure. See Figure 10 on page 29. When installing the bushing attachment nut (**J**), torque the nut to approximately 24 lb-in (2.8 N•m).
6. Route three conductors (refer to Table 3 on page 10) through the rubber plug (**H**) and bushing so that 6 to 8 in (152.4 to 203.2 mm) of conductor extends into dynamic braking resistor assembly cabinet. If necessary, lubricate conductors using cable soap that will not damage conductor insulation. Once conductors are installed, finger-tighten cap of the feed-through bushing (**I**) so that the three wires are gripped tightly by the bushing. See Figure 10 on page 29.
7. Make connections from terminals PA, PB, and ground on drive controller (see Figure 2 on page 13 and Figure 3 on page 14) to terminals PA, PB, and ground inside dynamic braking resistor assembly cabinet (see Figure 12 on page 30).

   NOTE: In ALTIVAR 66 drive controllers, the drive-side ground is made to a lug on the drive controller terminal strip. In Class 8839 enclosed ALTIVAR 66 drive controllers, this connection is made to the ground bar in the enclosure.
8. Verify that thermal overload switch setting (**K**) matches dynamic braking resistor assembly nameplate current rating, and that thermal overload start switch (**L**) is in On position. See Figure 12 on page 30.

9. Replace dynamic braking resistor cover and secure with six screws (**A**). See Figure 6 on page 26.
10. Attach French, Spanish, or German danger labels (**R**) to dynamic braking resistor assembly enclosure as appropriate. For suggested location of alternate language labels, refer to Figure 6 on page 26 and Figure 12 on page 30.

Mounting on ALTIVAR 66 Units ATV66C10N4, C13N4, C15N4, C19N4

1. Remove dynamic braking resistor assembly cover by removing six screws (**A**). See Figure 6 on page 26.
2. Open the 1.25 in (30.63 mm) conduit entry (**S**) on drive top cover. See Figure 16 on page 33.

   For ALTIVAR 66 Drives Without a Factory-Provided Top Cover Wire Knockout:

   — With drive door closed and secured by fastening screws, remove the two rear screws (**U**) and six front screws (**T**) from the top of the drive controller (Figure 16 on page 33). Keep screws for later use. Remove the drive top cover.

   — Punch a 0.80 in (20.32 mm) diameter hole in the drive top cover. See Figure 16 on page 33.

   — Replace the drive top cover and secure with only the two back screws (**U**).
3. Remove the six screws (**T**) from the top of the ALTIVAR 66 drive (if not already removed). See Figure 16 on page 33. Keep screws for use in step 5.
4. Install the bushing (**G**) into the 0.80 in (20.32 mm) diameter hole in the bottom pan of the dynamic braking resistor assembly. Assemble the bushing opposite that shown in Figure 10 on page 29. The nut (**J**) should be on the top of the pan. Torque the nut to approximately 24 lb-in (2.8 N•m). Discard the rubber plug (**H**) and cap (**I**).
5. Position dynamic braking resistor assembly on top of the drive so that the mounting holes align with the six holes on the drive top cover. Secure braking resistor assembly with the six screws (**T**) saved from step 3.
6. Route three conductors through the bushing on the dynamic braking resistor assembly mounting pan so that 6 to 8 in (152.4 to 203.2 mm) of conductor extends into dynamic braking resistor assembly cabinet. Make connections to the PA, PB, and ground terminals inside the dynamic braking resistor assembly cabinet. See Figure 12 on page 30.

7. Route the three conductors down the right side of the inside of the drive controller. Connect the PA, PB, and ground conductors from the resistor assemblies to their respective PA, PB, and ground terminals inside the drive controller (see Figure 3 on page 14).
8. Verify that the thermal overload switch setting (**K**) matches dynamic braking resistor assembly nameplate current rating, and that thermal overload start switch (**L**) is in On position. See Figure 12 on page 30.
9. Replace dynamic braking resistor cover and secure with six screws (**A**). See Figure 6 on page 26.
10. Attach French, Spanish, or German danger labels (**R**) to dynamic braking resistor assembly enclosure as appropriate. For suggested location of alternate language labels, refer to Figure 6 on page 26 and Figure 12 on page 30.

Mounting Separately from Controller and/or Controller Enclosure

NOTE: For proper cooling, always orient resistor assembly in an upright position. Do not mount resistor assembly on a wall without a mounting bracket that places the resistor assembly in an upright position.

1. Remove dynamic braking resistor assembly cover by removing six screws (**A**). See Figure 6 on page 26.
2. Refer to hole patterns in Figure 15 on page 32. Drill six holes (**M**) in mounting surface.
3. Open conduit entry (**N**) on side of dynamic braking resistor assembly. Conduit entry knockouts are provided for 1.0 in (24.5 mm) and 1.25 in (30.63 mm) pipe.
4. Mount dynamic braking resistor to mounting surface and secure with six user-supplied screws. 1/4 in (6.35 mm) diameter screws are recommended.
5. Make connections (refer to Table 3 on page 10) from terminals PA, PB, and ground on drive controller (see Figure 2 on page 13 and Figure 3 on page 14) to terminals PA, PB, and ground inside dynamic braking resistor assembly cabinet (see Figure 12 on page 30).
6. Verify that thermal overload switch setting (**K**) matches dynamic braking resistor assembly nameplate current rating, and that thermal overload start switch (**L**) is in On position. See Figure 12 on page 30.
7. Replace dynamic braking resistor cover and secure with six screws (**A**). See Figure 6 on page 26.
8. Attach French, Spanish, or German danger labels (**R**) to dynamic braking resistor assembly enclosure as appropriate. For suggested location of alternate language labels, refer to Figure 6 on page 26 and Figure 12 on page 30.

Mounting Instructions for Kits VW3A66717 (QTY 2) AND -718 (QTY 2)

NOTE: This procedure is for mounting kits VW3A66717 and VW3A66718 when used in parallel with drives ATV66C23N4, C28N4, or C31N4. In some steps, you will refer to figures which show only one resistor assembly. You should perform all steps on both resistor assemblies being installed.

Mounting on ALTIVAR 66 Drive Controller

NOTE: This procedure requires the use of Dynamic Braking Resistor Mounting Plate Kit VY1A66202. The mounting plate is available as a separate kit.

1. Remove dynamic braking resistor assembly covers by removing six screws (**A**) from both resistor assemblies. See Figure 6 on page 26.
2. Remove bottom pans of dynamic braking resistor assemblies by removing four screws (**B**) from both resistor assemblies. See Figure 6 on page 26. Keep screws for use in step 5.
3. Remove the ten screws (**V**) and drive top plate (**X**) from the top of the ALTIVAR 66 drive. See Figure 17 on page 34. Keep screws for use in step 4.
4. Position dynamic braking resistor mounting plate VY1A66202 (**Y**) on top of the drive so that the mounting holes align with the ten holes on the drive top cover. See Figure 17 on page 34. Secure the resistor mounting plate with the ten screws saved from step 3.
5. Position dynamic braking resistor assemblies on top of the mounting plate so that the mounting holes align with the holes on the mounting plate. Make sure the resistor assemblies are oriented as shown in Figure 17 on page 34.
6. Install nylon sleeves (**E**) and secure dynamic braking resistor assemblies to top of drive enclosure with the screws saved from step 2 (**F**). See Figure 9 on page 28.
7. Route three conductors (refer to Table 3 on page 10) from each dynamic braking resistor assembly through the respective bushing in the dynamic braking resistor mounting plate. Make connections to the PA, PB, and ground terminals of the drive controller (see Figure 4 on page 15) and also to the inside of the dynamic braking resistor assembly cabinets (see Figure 12 on page 30).
8. Route the six wires down the left wall of the drive controller. Make connections with the PA, PB, and ground wires from the resistor assemblies to their respective PA, PB, and ground terminals inside the drive controller (see Figure 4 on page 15).

NOTE: In ALTIVAR 66 drive controllers, the drive-side ground is made to a lug on the drive controller. Two PA and PB terminals have been supplied in the drive controller for connection of both resistor assemblies.

9. Verify that thermal overload switch setting (**K**) matches dynamic braking resistor assembly nameplate current ratings, and that thermal overload start switches (**L**) are in On position.
   See Figure 12 on page 30.
10. Replace both dynamic braking resistor covers and secure each with six screws (**A**). See Figure 6 on page 26.
11. Attach French, Spanish, or German danger labels (**R**) to dynamic braking resistor assembly enclosure as appropriate. For suggested location of alternate language labels, refer to Figure 6 on page 26 and Figure 12 on page 30.

Mounting Separately from Drive Controller and/or Enclosure

NOTE: For proper cooling, always orient resistor assemblies in an upright position. Do not mount resistor assemblies on a wall without a mounting bracket that positions the resistor assemblies in an upright position.

1. Remove dynamic braking resistor assembly covers by removing six screws (**A**) from both resistor assemblies. See Figure 6 on page 26.
2. Referring to Figure 15 on page 32, lay out hole patterns for two resistor assemblies. Drill six holes **(M**) for each assembly in mounting surface.
3. Open conduit entries (**N**) on side of dynamic braking resistor assemblies. Conduit entry knockouts are provided for 1.0 in (24.5 mm) and 1.25 in (30.63 mm) pipe.
4. Mount dynamic braking resistor assemblies to mounting surface and secure both with six user-supplied screws each. 1/4 in (6.35 mm) diameter screws are recommended.
5. Route three conductors (refer to Table 3 on page 10) from each dynamic braking resistor assembly to the drive controller. Make connections to the PA, PB, and ground terminals of the drive controller (see Figure 4 on page 15) and also to inside the dynamic braking resistor assembly cabinets (see Figure 12 on page 30).

   NOTE: In ALTIVAR 66 drive controllers, the drive-side ground is made to a lug on the drive controller. Two PA and two PB terminals have been suppled for connection of each of the resistor assemblies.
6. Verify that thermal overload switch setting (**K**) matches dynamic braking resistor assembly nameplate current ratings, and that thermal overload start switches (**L**) are in On position (Figure 12 on page 30).

7. Replace dynamic braking resistor covers and secure each with six screws (**A**). See Figure 6 on page 26.
8. Attach French, Spanish, or German danger labels (**R**) to dynamic braking resistor assembly enclosure as appropriate. For suggested location of alternate language labels, refer to Figure 6 on page 26 and Figure 12 on page 30.

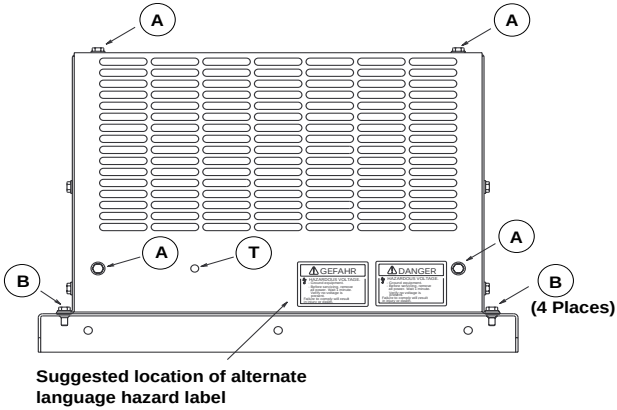


Figure 5: Removing Cover and Bottom Pan: VW3A66711, 712, 713, 714

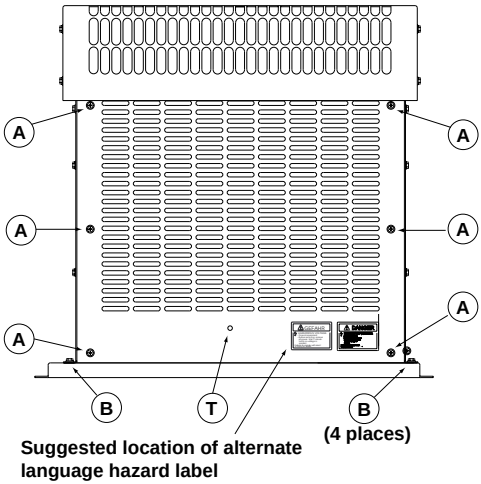


Figure 6: Removing Cover and Bottom Pan: VW3A66715, 716, 717, 718

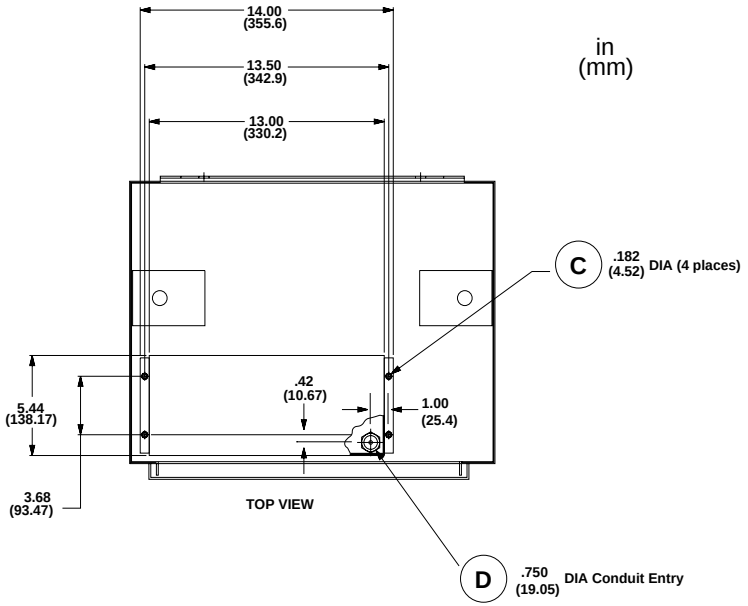


Figure 7: Enclosure Mounting Dimensions: VW3A66711, 712, 713, 714

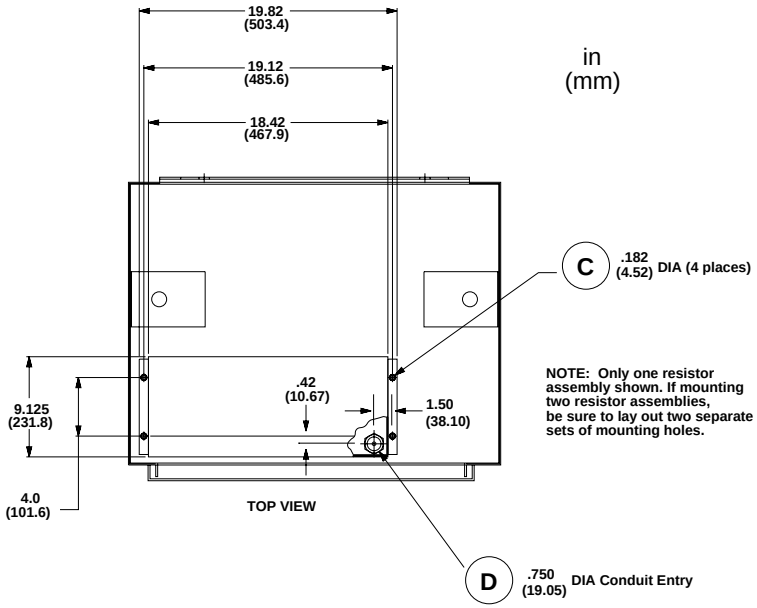


Figure 8: Enclosure Mounting Dimensions: VW3A66715, 716, 717, 718

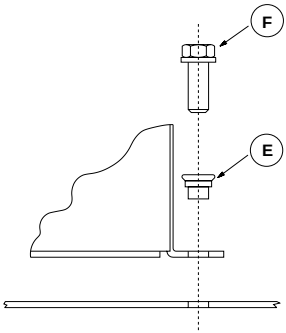


Figure 9: Mounting

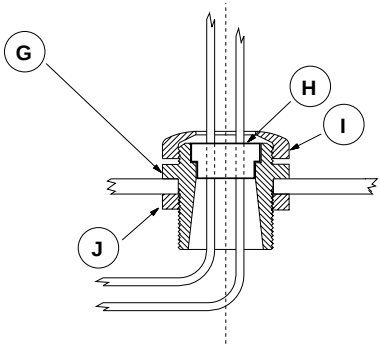


Figure 10: Liquid-Tight Bushing

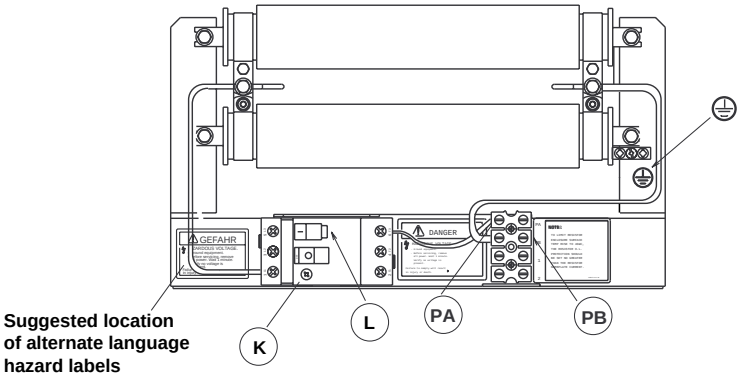


Figure 11: Dynamic Braking Resistor Assembly Terminals: VW3A66711, 712, 713, 714

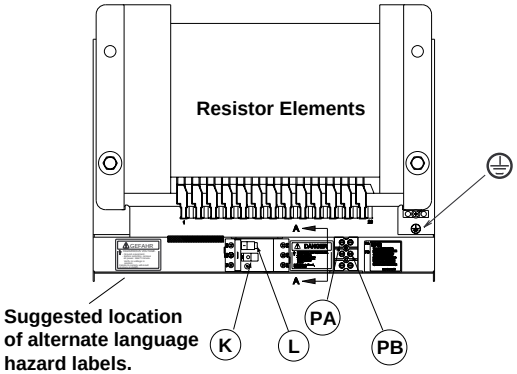


Figure 12: Dynamic Braking Resistor Assembly Terminals: VW3A66715, 716, 717, 718

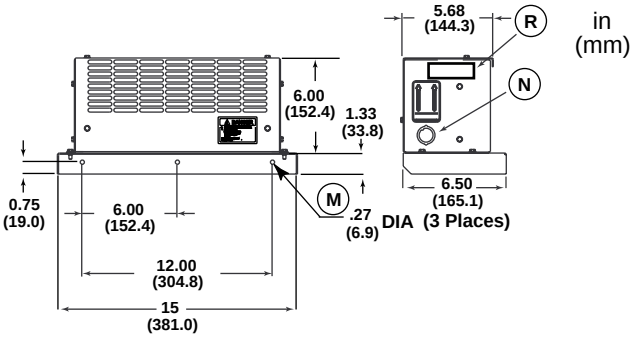


Figure 13: Wall Mounting Dimensions: VW3A66711 and VW3A66712

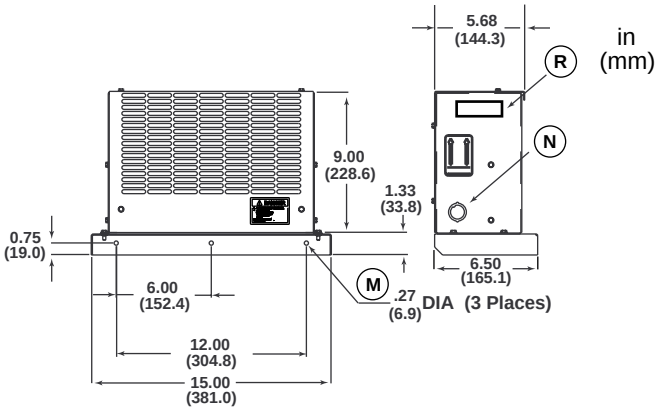


Figure 14: Wall Mounting Dimensions: VW3A66713 and VW3A66714

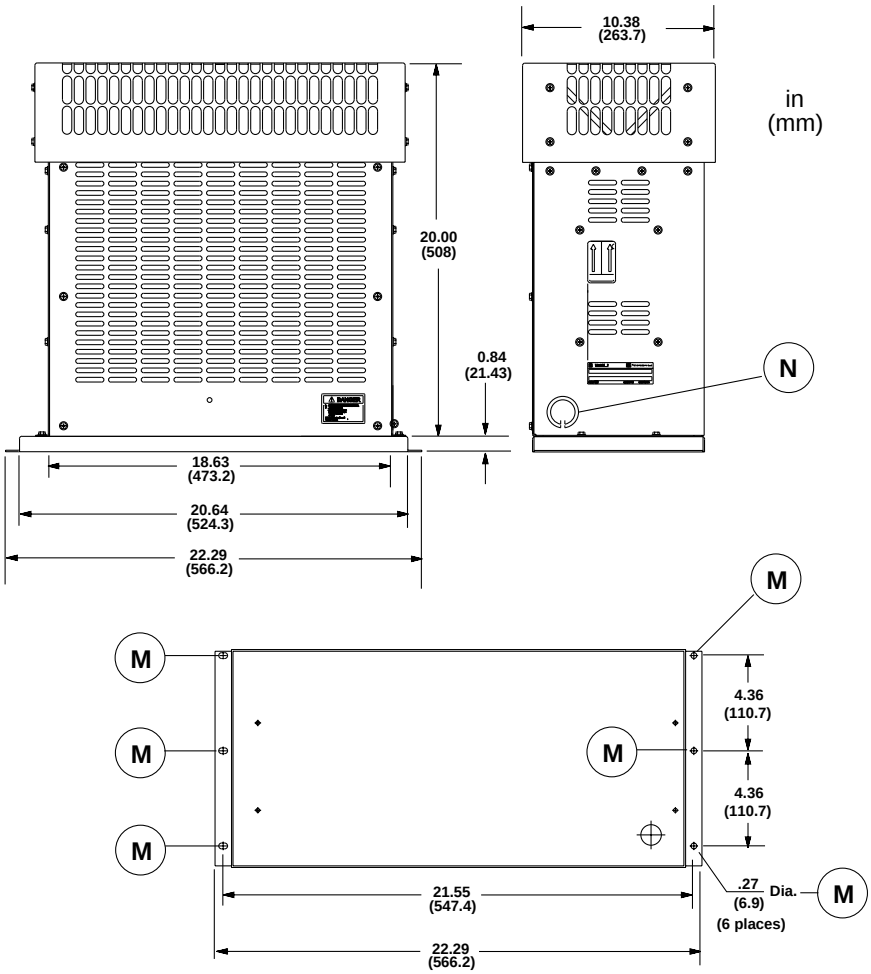


Figure 15: Mounting Dimensions: VW3A66715, 716, 717, 718

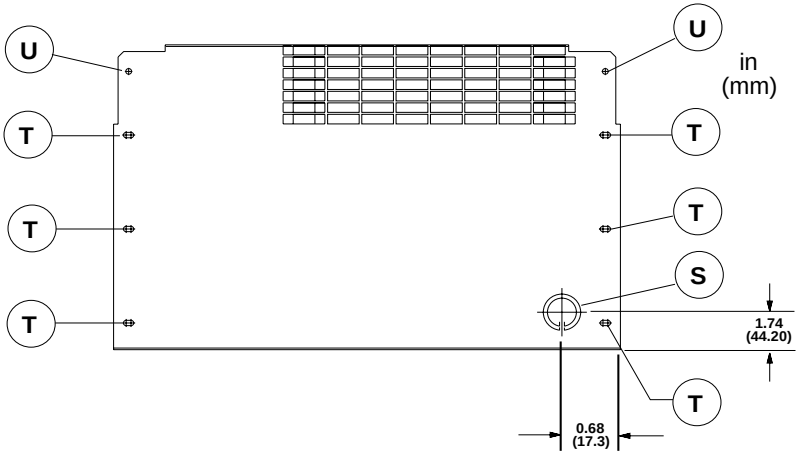


Figure 16: Mounting on ALTIVAR 66 Drive Controller: VW3A66716, 717

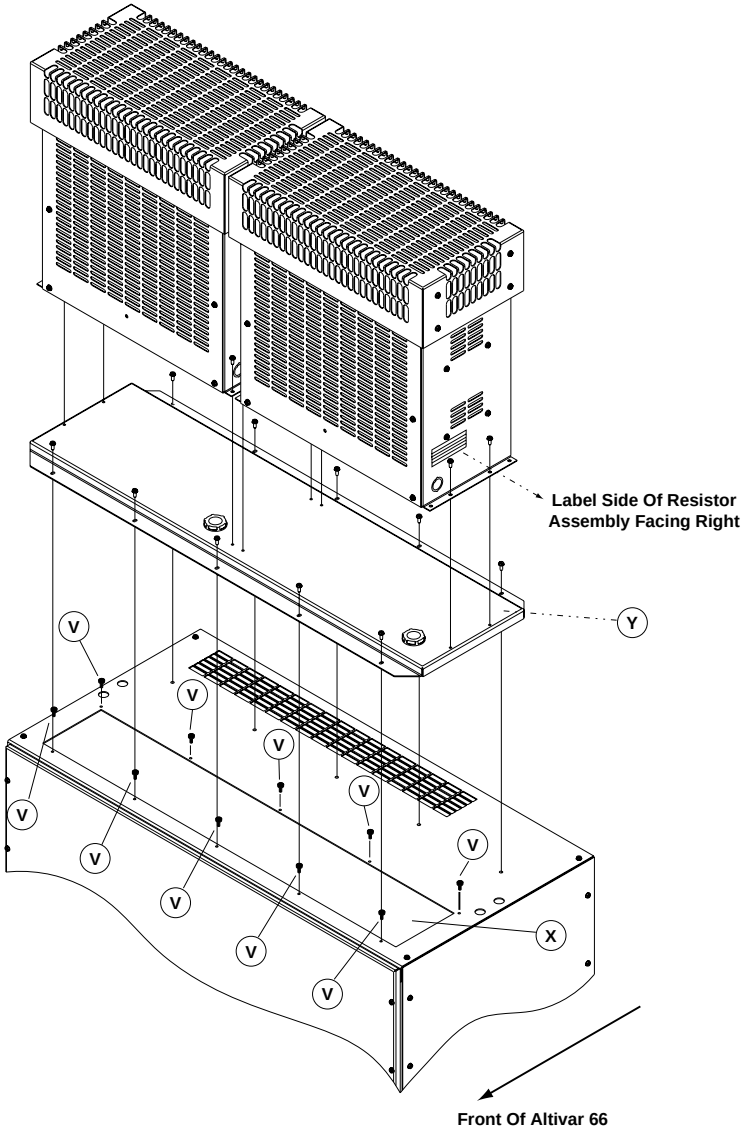


Figure 17: Mounting on ALTIVAR 66 Drive Controller: VW3A66717, 718

PART 2: ALTIVAR 58 DYNAMIC BRAKING RESISTOR KIT

Introduction

The dynamic braking resistor kit allows ALTIVAR 58 drive controllers to function in quadrants 2 and 4 of the speed/torque curve, dissipating the excess braking energy in an external resistor.

Contents of Kit

This kit contains:

- One dynamic braking resistor assembly
- Four liquid-tight nylon sleeves
- One liquid-tight three-hole bushing
- Six danger labels: two French (52012-664-02); two German (52012-664-03); two Spanish (52012-664-04)
- Instruction Bulletin VD0C06N908_ (latest revision)

Technical Specifications

Table 4: Braking Resistor Kit Technical Specifications

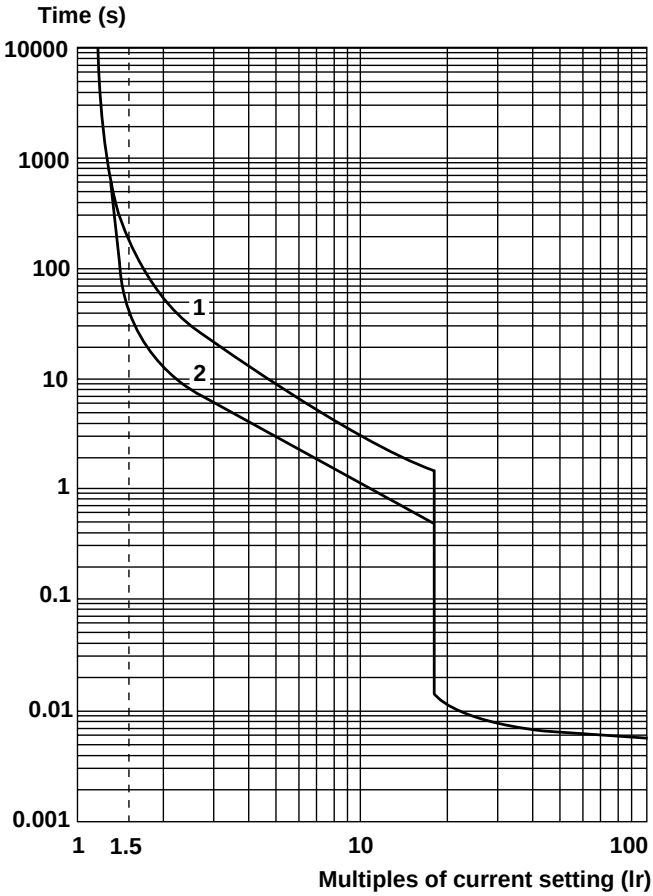
For Drives	Ohmic Value Rdb	Continuous Current Rating of Assembly [1] Ir	Average Power W	Catalog Number
ATV58•U09M2[2], U18M2[2], U18N4, U29N4, U41N4, U54N4, U72N4	120 ¾	1.0 A	120	VW3A66711
ATV58•U29M2, U41M2, U90N4, D12N4	56 ¾	1.45 A	118	VW3A66712
ATV58•U54M2, U72M2, D16N4, D23N4	28 ¾	2.7 A	204	VW3A66713
ATV58•U90M2, D12M2	14 ¾	3.8 A	202	VW3A66714

[1] Current rating of resistor assembly is calculated based on setting of internal overload protective device in assembly, overload setting based on enclosure overtemperature protection, and resistor overload versus time characteristics. Resistors are rated for stopping six times rotor inertia of four-pole motor with drive at current limit. Motor inertias are based on NEMA MG-1 14.45.

[2] Requires external braking module (VW3A58701).

Current-Time Characteristic for DB Resistor Assemblies

Figure 18 shows allowable time according to multiples of current setting with the dynamic braking resistor assembly located in a 40 °C ambient temperature environment. For an example of calculating resistor size, refer to Appendix B.



(1) Cold state
(2) Hot state

Figure 18: Dynamic Braking Curves

Pre-Installation Considerations

The dynamic braking resistor assembly may be wall-mounted. The resistor assembly can also be used with certain general purpose enclosures.

The following points should be considered before installation:

- The dynamic braking resistor generates heat during braking. When operating at rated nameplate power in a 40 °C ambient temperature, the resistor enclosure can reach temperatures of 80 °C. The dynamic braking resistor should not be installed below or directly against heat-sensitive materials or equipment. Do not mount against combustible surfaces or on polymeric enclosures. Refer to local and national codes for resistor mounting requirements.
- For proper cooling, always orient the resistor assembly as shown in Figures 25 and 26 on pages 45 and 46. Do not block ventilation openings of the enclosure. Ensure that ventilation and clearance is adequate for the rated power. Calculate the rated power of the assembly from nameplate information using the following formula:

  $$\text{Power Rating} = (\text{Nameplate Current Rating})^2 \times \text{Resistance}$$

- If the time-current capability of the resistor is exceeded, protection is provided to prevent resistor damage or excessive enclosure temperatures. A thermal overload switch located inside the dynamic braking resistor assembly will trip and open the resistor circuit to prevent damage. The thermal overload switch may be reset once the overload condition has been corrected. The reset pushbutton of the thermal overload switch is accessed through the small hole in the front of the resistor enclosure (**T**). See Figure 20 on page 43.
- The mounting surface must be capable of safely supporting the weight of the dynamic braking resistor assembly. Refer to Table 5 for assembly weights.

Table 5: Assembly Weight

Dynamic Braking Assembly Part No.	Weight
VW3A66711 and VW3A66712	11 lbs (5 kg)
VW3A66713 and VW3A66714	16 lbs (7.3 kg)

- The enclosure of the dynamic braking resistor assembly is rated Type 1 (per UL 50). The insulation system is intended for use in a Pollution Degree 3 environment (refer to NEMA ICS-1). The installation environment must be compatible with this rating.
- Self-tapping M5 hardware is supplied with the dynamic braking resistor assembly and is intended for reuse during some installation procedures. When threaded into a 0.182 in (4.52 mm) diameter hole, the M5 hardware requires a minimum sheet metal thickness of 0.075 in (1.9 mm) in mild steel for rated thread strength. Do not thread fasteners into dissimilar metals or non-metallic materials. The self-threading M5 fasteners should be torqued to 32 to 41 lb-in (3.6 to 4.6 N•m).
- When connecting the dynamic braking resistor assembly to the drive controller, use conductors with a cross-sectional size, insulation temperature rating, and insulation voltage rating suitable for the application. Follow the recommendations in Table 6 for minimum conductor requirements.

Table 6: PA, PB, GND Conductor Requirements

Drive Controller Part No.	**PA, PB, GND Minimum Conductor Requirements** [1]	
	Individual Conductor Length not Exceeding 10 ft (3.0 m)	Individual Conductor Length not Exceeding 100 ft (30.4 m)
ATV58•U09M2 to U18M2	600 V, #14 AWG, 60/75 °C Copper	-
ATV58•U29M2 to U72M2 ATV58•U18N4 to D12N4	600 V, #14 AWG, 60/75 °C Copper	600 V, #8 AWG, 60/75 °C Copper
ATV58•U90M2 to D12M2 ATV58•D16N4 to D23N4	600 V, #10 AWG, 60/75 °C Copper	600 V, #8 AWG, 60/75 °C Copper

[1] In addition to the required continuous current rating, the conductor cross-sectional size has been selected to minimize the possibility of insulation damage should an overcurrent or ground fault occur at the DB resistor assembly. The coordination of the conductors in the table is based upon the maximum input line fuse recommended on the specific drive controller nameplate, the use of feeder ground and line conductors selected per ANSI/NFPA 70 (National Electrical Code), and the optional use of a feeder reactor with saturating characteristics.

- The bushing supplied with the dynamic braking resistor assembly can be used as a feed-through for the three conductors from the dynamic braking resistor assembly while maintaining a Type 12 seal through an enclosure wall. It can be used with surface thicknesses up to 0.10 in (2.5 mm).
- Refer to ANSI/NFPA 70 (National Electrical Code) for information concerning insulated conductor dimensions. The bushing supplied with kits VW3A66711 to VW3A66714 is primarily intended for use with #10 AWG conductors.
- Good wiring practice requires separation of dynamic braking power wiring from all other drive controller wiring. Control and power wiring should cross at right angles only. Use metal conduit for all dynamic braking wiring outside the drive controller enclosure. Do not run control or other power wiring in same conduit with dynamic braking power wiring.

Installation

Bus Voltage Measurement Procedure

⚠ DANGER

HAZARDOUS VOLTAGE

- Read and understand the Bus Voltage Measurement Procedure before performing procedure. Measurement of bus capacitor voltage must be performed by qualified personnel.
- DO NOT short across capacitors or touch unshielded components or terminal strip screw connections with voltage present.
- Many parts in this drive controller, including printed wiring boards, operate at line voltage. DO NOT TOUCH. Use only electrically insulated tools.

Electrical shock will result in death or serious injury

The voltage is measured between the + and - terminals as shown in Table 7. Refer to Figure 19 for terminal location.

Table 7: DC Bus Measurement Terminals

Drive Controller ATV58•	+ Terminal	- Terminal
U09M2 and U18M2	J2-4 (+)	J2-5 (-)
U29M2 to U72M2 and U18N4 to U90N4	J2-5 (PA)	J18-7
U90M2 to D12M2 and D12N4 to D23N4		

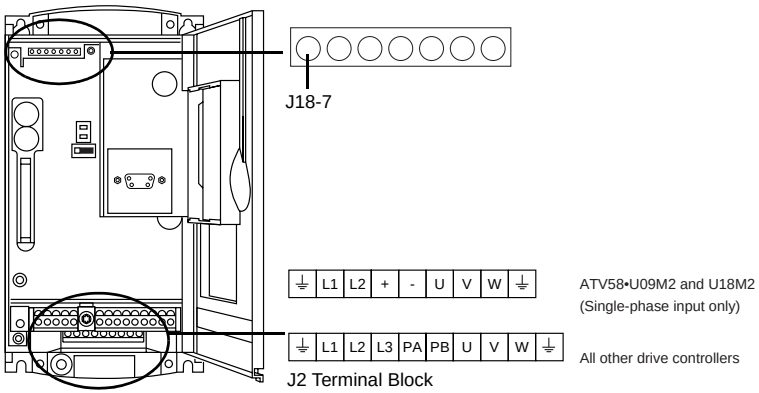


Figure 19: DC Bus Measurement Terminals

To measure the bus capacitor voltage:

1. Disconnect all power from the drive controller.
2. Wait three minutes to allow the DC bus to discharge.
3. Open the cover.
4. Set the voltmeter to the 1000 VDC scale. Measure the voltage between the + terminal and the - terminal to verify that the DC voltage is less than 45 V for each measurement.
5. If the bus capacitors are not fully discharged, contact your local Square D representative – do not operate the drive controller.
6. Replace all covers.

Mounting Instructions for Kits VW3A66711, -712, -713, -714

Mounting on Enclosures

1. Remove dynamic braking resistor assembly cover by removing four screws (**A**). See Figure 20 on page 43.
2. Remove bottom pan of dynamic braking resistor assembly by removing four screws (**B**). See Figure 20 on page 43. Keep screws for use in step 4.
3. Refer to hole patterns in Figure 21 on page 43. When drilling or punching holes, avoid dropping metal chips or debris into the enclosure. Clean interior of enclosure thoroughly using a vacuum cleaner equipped with an insulated nozzle. Do not use compressed air to blow debris from the enclosure.

   For user-supplied enclosures housing ALTIVAR 58 drive controllers:

   NOTE: It is the installer's responsibility to determine the suitability of the enclosure construction for installation of the dynamic braking resistor assembly. Refer to the section "Pre-Installation Considerations" on page 37 for construction requirements.

   — Lay out a hole pattern on the top of the enclosure as illustrated in Figure 21 on page 43.

   — Drill four 0.182 in (4.52 mm) diameter holes (**C**) for attachment of the dynamic braking resistor assembly using the M5 self-tapping screws.

   — Punch a 0.80 in (20.32 mm) diameter hole (**D**) for the feed-through bushing.
4. Position dynamic braking resistor assembly on top of the enclosure so that the mounting holes align with holes drilled on top of the drive enclosure. Install nylon sleeves (**E**) and secure dynamic braking resistor assembly to top of drive enclosure with the four screws saved from step 2 (**F**). See Figure 22 on page 44.
5. Install the bushing (**G**) into the 0.80 in diameter (20.32 mm) hole in the drive enclosure. See Figure 23 on page 44. When installing the bushing attachment nut (**J**), torque the nut to approximately 24 lb-in (2.8 N•m).
6. Route three conductors (refer to Table 6 on page 38) through the rubber plug (**H**) and bushing so that 6 to 8 in (152.4 to 203.2 mm) of conductor extends into dynamic braking resistor assembly cabinet. If necessary, lubricate conductors using cable soap that will not damage conductor insulation. Once conductors are installed, finger-tighten cap of the feed-through bushing (**I**) so that the three wires are gripped tightly by the bushing. See Figure 23 on page 44.

7. Make connections from terminals PA, PB, and ground on drive controller (see Figure 19 on page 40) to terminals PA, PB, and ground inside dynamic braking resistor assembly cabinet (see Figure 24 on page 45).
8. Verify that the thermal overload switch setting (**K**) matches dynamic braking resistor assembly nameplate current rating, and that thermal overload start switch (**L**) is in On position. See Figure 24 on page 45.
9. Replace dynamic braking resistor cover and secure with four screws (**A**). See Figure 20 on page 43.
10. Attach French, Spanish, or German danger labels (**R**) to dynamic braking resistor assembly enclosure as appropriate. For suggested location of alternate language labels, refer to Figure 20 on page 43 and Figure 24 on page 45.

Wall-Mounting Separately from Drive Enclosure

1. Remove dynamic braking resistor assembly cover by removing four screws (**A**). See Figure 20 on page 43.
2. Refer to hole patterns in Figure 25 on page 45 or Figure 26 on page 46. Drill three holes **(M**) in mounting surface.
3. Open conduit entry (**N**) on side of dynamic braking resistor assembly. Conduit entry knockouts are provided for 3/4 in (19.05 mm) and 1/2 in (12.7 mm) pipe.
4. Mount dynamic braking resistor to mounting surface and secure with three user-supplied screws. One-fourth in (6.35 mm) diameter screws are recommended.
5. Make connections from terminals PA, PB, and ground on drive controller (see Figure 19 on page 40) to terminals PA, PB, and ground inside dynamic braking resistor assembly cabinet (see Figure 19 on page 40). Refer to Table 6 on page 38.

   NOTE: In Altivar 58 drive controllers, the drive-side ground may be connected to the power terminal strip.
6. Verify that thermal overload switch setting (**K**) matches dynamic braking resistor assembly nameplate current rating, and that thermal overload start switch (**L**) is in On position. See Figure 24 on page 45.
7. Replace dynamic braking resistor cover and secure with four screws (**A**). See Figure 20 on page 43.
8. Attach French, Spanish, or German danger labels (**R**) to dynamic braking resistor assembly enclosure as appropriate. For suggested location of alternate language labels, refer to Figure 20 on page 43 and Figure 24 on page 45.

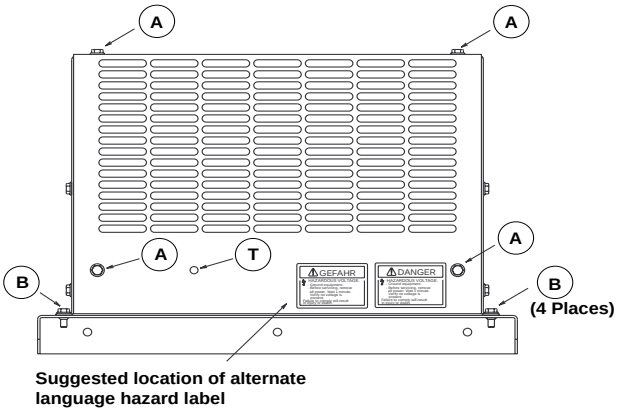


Figure 20: Removing Cover and Bottom Pan: VW3A66711, 712, 713, 714

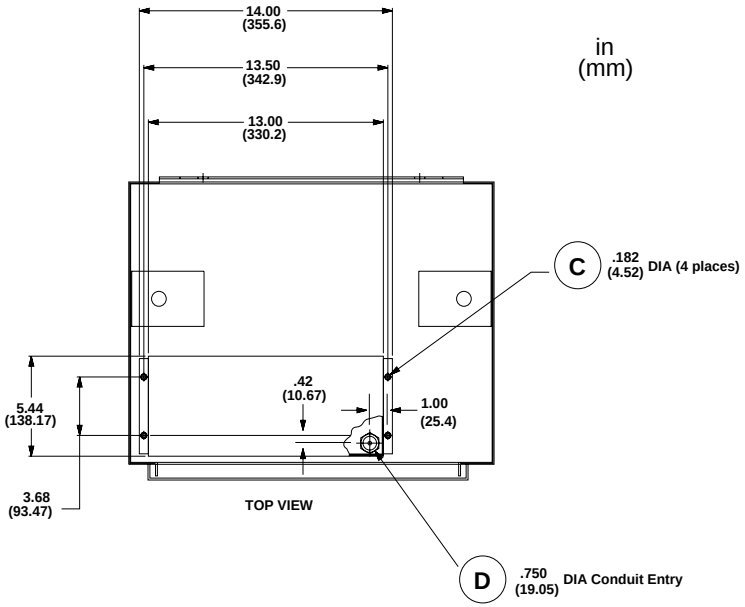


Figure 21: Enclosure Mounting Dimensions: VW3A66711, 712, 713, 714

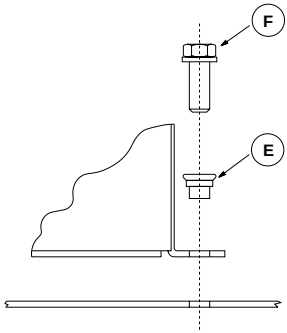


Figure 22: Mounting

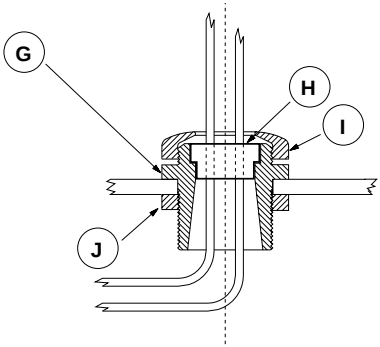


Figure 23: Liquid-Tight Bushing

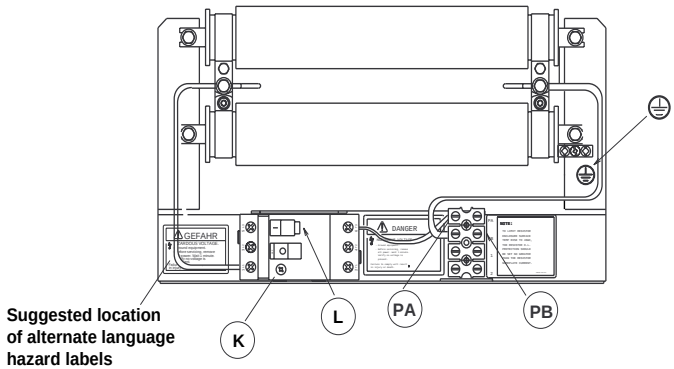


Figure 24: Dynamic Braking Resistor Assembly Terminals: VW3A66711, 712, 713, 714

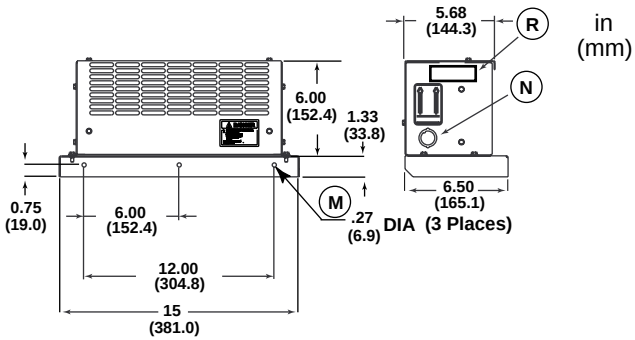


Figure 25: Wall Mounting Dimensions: VW3A66711 and VW3A66712

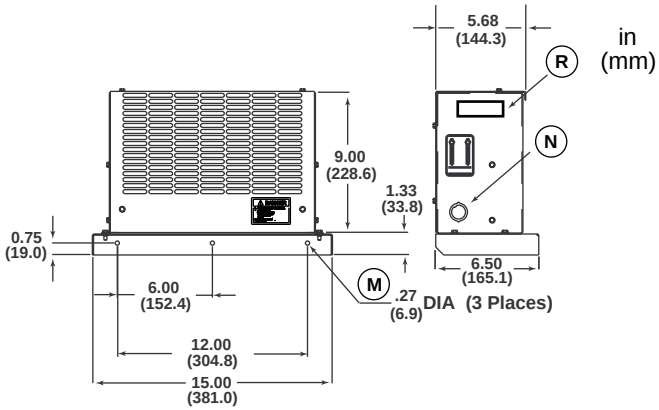


Figure 26: Wall Mounting Dimensions: VW3A66713 and VW3A66714

PART 3: ALTIVAR 18 DYNAMIC BRAKING RESISTOR KIT

Introduction

The dynamic braking resistor kit allows ALTIVAR 18 drive controllers to function in quadrants 2 and 4 of the speed/torque curve, dissipating the excess braking energy in an external resistor.

Contents of Kit

This kit contains:

- One dynamic braking resistor assembly
- Four liquid-tight nylon sleeves
- One liquid-tight three-hole bushing
- Six danger labels: two French (52012-664-02); two German (52012-664-03); two Spanish (52012-664-04)
- Instruction Bulletin VD0C06N908_ (latest revision)

Technical Specifications

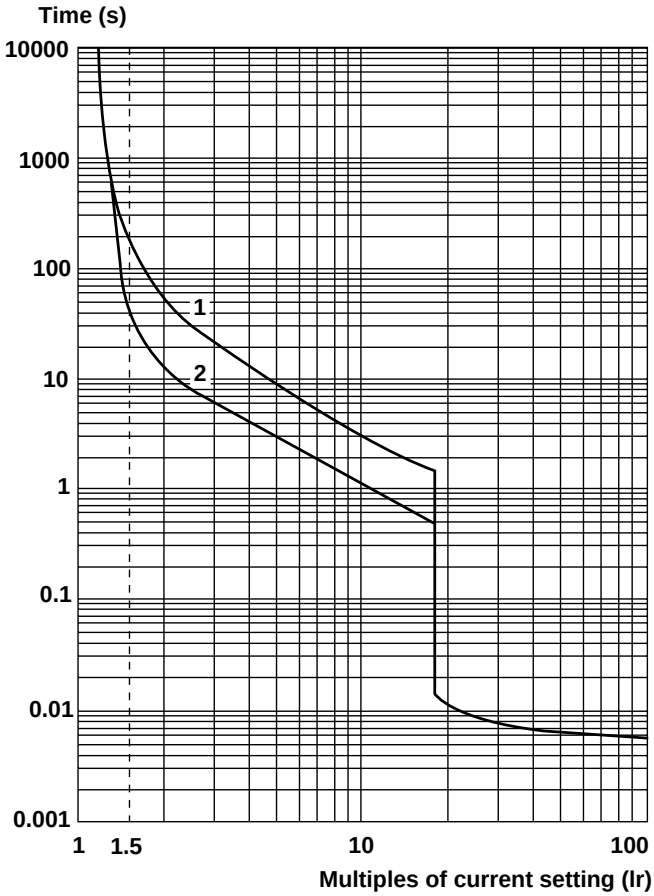
Table 8: Braking Resistor Kit Technical Specifications

For Drives	Ohmic Value Rdb	Continuous Current Rating of Assembly [1] Ir	Average Power W	Catalog Number
ATV18U09M2, U18M2, U18N4, U29N4, U41N4, U54N4	120 ¾	1.0 A	120	VW3A66711
ATV18U29M2, U72N4, U90N4, D12N4	56 ¾	1.45 A	118	VW3A66712
ATV18U41M2, U54M2, U72M2, D16N4, D23N4	28 ¾	2.7 A	204	VW3A66713
ATV18U90M2, D12M2	14 ¾	3.8 A	202	VW3A66714

[1] Current rating of resistor assembly is calculated based on setting of internal overload protective device in assembly, overload setting based on enclosure overtemperature protection, and resistor overload versus time characteristics. Resistors are rated for stopping six times rotor inertia of four-pole motor with drive at current limit. Motor inertias are based on NEMA MG-1 14.45.

Current-Time Characteristic for DB Resistor Assemblies

Figure 27 shows allowable time according to multiples of current setting with the dynamic braking resistor assembly located in a 40 °C ambient temperature environment. For an example of calculating resistor size, refer to Appendix C.



(1) Cold state
(2) Hot state

Figure 27: Dynamic Braking Curves

Pre-Installation Considerations

The dynamic braking resistor assembly may be wall-mounted. The resistor assembly can also be used with certain general purpose enclosures.

The following points should be considered before installation:

- The dynamic braking resistor generates heat during braking. When operating at rated nameplate power in a 40 °C ambient temperature, the resistor enclosure can reach temperatures of 80 °C. The dynamic braking resistor should not be installed below or directly against heat-sensitive materials or equipment. Do not mount against combustible surfaces or on polymeric enclosures. Refer to local and national codes for resistor mounting requirements.
- For proper cooling, always orient the resistor assembly as shown in Figures 35 and 36 on page 59. Do not block ventilation openings of the enclosure. Ensure that ventilation and clearance is adequate for the rated power. Calculate the rated power of the assembly from nameplate information using the following formula:

  $$\text{Power Rating} = (\text{Nameplate Current Rating})^2 \times \text{Resistance}$$

- If the time-current capability of the resistor is exceeded, protection is provided to prevent resistor damage or excessive enclosure temperatures. A thermal overload switch located inside the dynamic braking resistor assembly will trip and open the resistor circuit to prevent damage. The thermal overload switch may be reset once the overload condition has been corrected. The reset pushbutton of the thermal overload switch is accessed through the small hole in the front of the resistor enclosure (**T**). See Figure 30 on page 56.
- The mounting surface must be capable of safely supporting the weight of the dynamic braking resistor assembly. Refer to Table 9 for assembly weights.

Table 9: Assembly Weight

Dynamic Braking Assembly Part No.	Weight
VW3A66711 and VW3A66712	11 lbs (5 kg)
VW3A66713 and VW3A66714	16 lbs (7.3 kg)

- The enclosure of the dynamic braking resistor assembly is rated Type 1 per UL 50. The insulation system is intended for use in a Pollution Degree 3 environment (refer to NEMA ICS-1). The installation environment must be compatible with this rating.
- Self-tapping M5 hardware is supplied with the dynamic braking resistor assembly and is intended for reuse during some installation procedures. When threaded into a 0.182 in (4.52 mm) diameter hole, the M5 hardware requires a minimum sheet metal thickness of 0.075 in (1.9 mm) in mild steel for rated thread strength. Do not thread fasteners into dissimilar metals or non-metallic materials. The self-threading M5 fasteners should be torqued to 32 to 41 lb-in (3.6 to 4.6 N•m).
- When connecting the dynamic braking resistor assembly to the drive controller, use conductors with a cross-sectional size, insulation temperature rating, and insulation voltage rating suitable for the application. Follow the recommendations in Table 10 for minimum conductor requirements.

Table 10: PA, PB, GND Conductor Requirements

Drive Controller Part No.	**PA, PB, GND Minimum Conductor Requirements** [1]	
	Individual Conductor Length not Exceeding 10 ft (3.0 m)	Individual Conductor Length not Exceeding 100 ft (30.4 m)
ATV18U09M2 toU72M2 ATV18U18N4 to U54N4	600 V, #14 AWG, 60/75 °C Copper	-
ATV18U90M2 to D12M2 ATV18U72N4 to D23N4	600 V, #10 AWG, 60/75 °C Copper	-
ATV18U90M2 to D12M2 ATV18U90N4 to D23N4	-	600 V, #8 AWG, 60/75 °C Copper

[1] In addition to the required continuous current rating, the conductor cross-sectional size has been selected to minimize the possibility of insulation damage should an overcurrent or ground fault occur at the DB resistor assembly. The coordination of the conductors in the table is based upon the maximum input line fuse recommended on the specific drive controller nameplate, the use of feeder ground and line conductors selected per ANSI/NFPA 70 (National Electrical Code), and the optional use of a feeder reactor with saturating characteristics.

- The bushing supplied with the dynamic braking resistor assembly can be used as a feed-through for the three conductors from the dynamic braking resistor assembly while maintaining a Type 12 seal through an enclosure wall. It can be used with surface thicknesses up to 0.10 in (2.5 mm).
- Refer to ANSI/NFPA 70 (National Electrical Code) for information concerning insulated conductor dimensions. The bushing supplied with kits VW3A66711 to VW3A66714 is primarily intended for use with #10 AWG conductors.
- Good wiring practice requires separation of dynamic braking power wiring from all other drive controller wiring. Control and power wiring should cross at right angles only. Use metal conduit for all dynamic braking wiring outside the drive controller enclosure. Do not run control or other power wiring in same conduit with dynamic braking power wiring.

Installation

Bus Voltage Measurement Procedure

⚠ DANGER

HAZARDOUS VOLTAGE

- Read and understand the Bus Voltage Measurement Procedure before performing the procedure.
- DO NOT short across capacitors or touch unshielded components or terminal strip screw connections with voltage present.
- Many parts in this drive controller, including printed wiring boards, operate at line voltage. DO NOT TOUCH. Use only electrically insulated tools.

Electrical shock will result in death or serious injury.

Drive Controllers ATV18•••M2 and ATV18U18N4 to D12N4

The voltage is measured between the equipment ground and each terminal on the power terminal strip. The equipment ground is located on the heat sink for drive controllers ATV18U09M2 and U18M2, and on the metal conduit entry plate for the other products. The power terminal strip is located on the power board, as shown in Figure 28 on page 52. A second measurement is made between the PA terminal, located on the power terminal strip and the other terminals on the power terminal strip.

To measure the bus capacitor voltage:

1. Disconnect all power from drive controller.
2. Wait 1 minute to allow the DC bus to discharge.
3. Remove all covers.
4. Set the voltmeter to the 1000 VDC scale. Measure the voltage between the equipment ground terminal and each terminal on the power terminal strip and verify the DC voltage is less than 45 V for each measurement.
5. With the voltmeter at the 1000 VDC scale, measure between the PA terminal and all of the other terminals on the power terminal strip. Verify the DC voltage is less than 45 V for each measurement.
6. If the bus capacitors are not fully discharged, contact your local Square D representative – **do not operate the drive controller**.
7. Replace all covers.

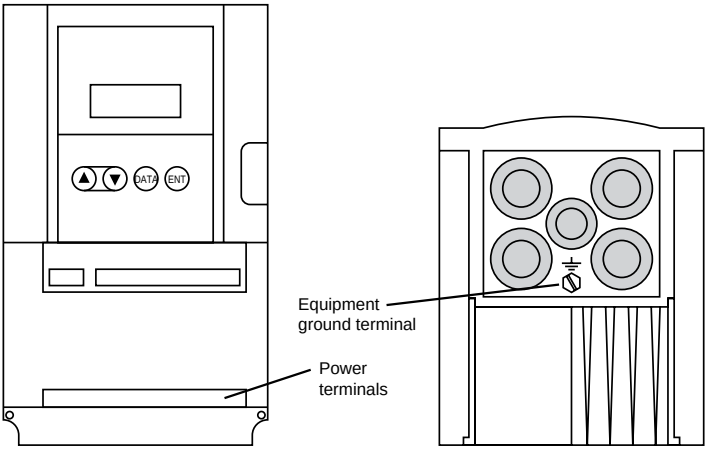


Figure 28: Measuring Bus Capacitor Voltage

Drive Controllers ATV18D16N4 and ATV18D23N4

For these drive controllers, the voltage is measured between the PA and PC terminals located on the power board, as shown in Figure 28.

To measure the bus capacitor voltage:

1. Disconnect all power from drive controller.
2. Wait 1 minute to allow the DC bus to discharge.
3. Remove all covers.
4. Set the voltmeter to the 1000 VDC scale. Measure the bus capacitor voltage between the PA and PC terminals to verify that DC voltage is less than 45 V. **Do not short across capacitor terminals with voltage present!**
5. If the bus capacitors are not fully discharged, contact your local Square D representative – **do not operate the drive controller**.
6. Replace all covers.

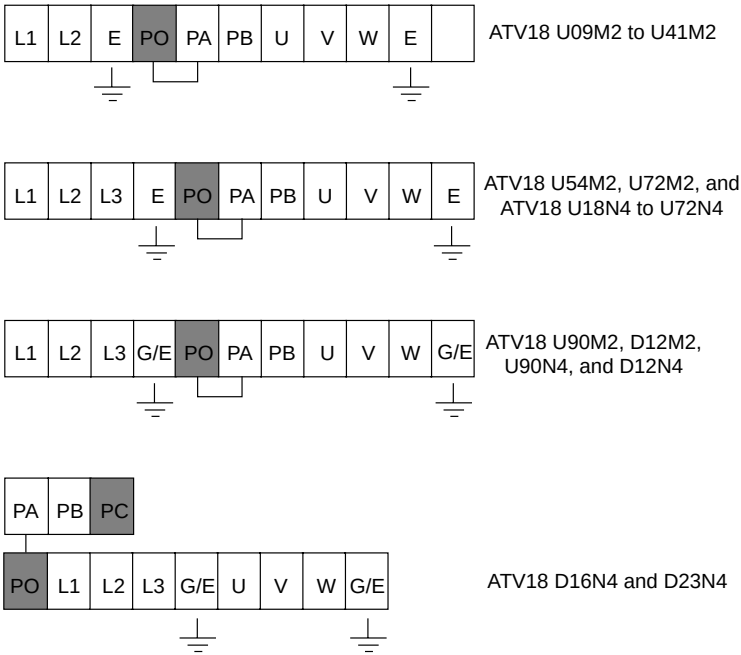


Figure 29: ATV18 Power Terminal Locations

Mounting Kits VW3A66711, -712, -713, -714

Mounting on Enclosures

1. Remove dynamic braking resistor assembly cover by removing four screws (**A**). See Figure 30 on page 56.
2. Remove bottom pan of dynamic braking resistor assembly by removing four screws (**B**). See Figure 30 on page 56. Keep screws for use in step 4.
3. Refer to hole patterns in Figure 31 on page 57. When drilling or punching holes, avoid dropping metal chips or debris into the enclosure. Clean interior of enclosure thoroughly using a vacuum cleaner equipped with an insulated nozzle. Do not use compressed air to blow debris from the enclosure.

   For user-supplied enclosures housing ALTIVAR 18 drive controllers:

   NOTE: It is the installer's responsibility to determine the suitability of the enclosure construction for installation of the dynamic braking resistor assembly. Refer to the section "Pre-Installation Considerations" on page 37 for construction requirements.

   — Lay out a hole pattern on the top of the enclosure as illustrated in Figure 31 on page 57.

   — Drill four 0.182 in (4.52 mm) diameter holes (**C**) for attachment of the dynamic braking resistor assembly using the M5 self-tapping screws.

   — Punch a 0.80 in (20.32 mm) diameter hole (**D**) for the feed-through bushing.
4. Position dynamic braking resistor assembly on top of the enclosure so that the mounting holes align with holes drilled on top of the drive enclosure. Install nylon sleeves (**E**) and secure dynamic braking resistor assembly to top of drive enclosure with the four screws saved from step 2 (**F**). See Figure 32 on page 57.
5. Install the bushing (**G**) into the 0.80 in diameter (20.32 mm) hole in the drive enclosure. See Figure 33 on page 58. When installing the bushing attachment nut (**J**), torque the nut to approximately 24 lb-in (2.8 N•m).
6. Route three conductors (refer to Table 10 on page 50) through the rubber plug (**H**) and bushing so that 6 to 8 in (152.4 to 203.2 mm) of conductor extends into dynamic braking resistor assembly cabinet. If necessary, lubricate conductors using cable soap that will not damage conductor insulation. Once conductors are installed, finger-

tighten cap of the feed-through bushing (**I**) so that the three wires are gripped tightly by the bushing. See Figure 33 on page 58.

7. Make connections from terminals PA, PB, and ground on drive controller (see Figure 29 on page 53) to terminals PA, PB, and ground inside dynamic braking resistor assembly cabinet (see Figure 34 on page 58).
8. Verify that the thermal overload switch setting (**K**) matches dynamic braking resistor assembly nameplate current rating, and that thermal overload start switch (**L**) is in On position. See Figure 34 on page 58.
9. Replace dynamic braking resistor cover and secure with four screws (**A**). See Figure 30 on page 56.
10. Attach French, Spanish, or German danger labels (**R**) to dynamic braking resistor assembly enclosure as appropriate. For suggested location of alternate language labels, refer to Figure 30 on page 56 and Figure 34 on page 58.

Wall-Mounting Separately from Drive Enclosure

1. Remove dynamic braking resistor assembly cover by removing four screws (**A**). See Figure 30 on page 56.
2. Refer to hole patterns in Figure 35 on page 59 or Figure 36 on page 59. Drill three holes **(M**) in mounting surface.
3. Open conduit entry (**N**) on side of dynamic braking resistor assembly. Conduit entry knockouts are provided for 3/4 in (19.05 mm) and 1/2 in (12.7 mm) pipe.
4. Mount dynamic braking resistor to mounting surface and secure with three user-supplied screws. One-fourth in (6.35 mm) diameter screws are recommended.
5. Make connections (refer to Table 10 on page 50) from terminals PA, PB, and ground on drive controller (see Figure 29 on page 53) to terminals PA, PB, and ground inside dynamic braking resistor assembly cabinet (see Figure 34 on page 58).

   NOTE: In Altivar 18 drive controllers, the drive-side ground may be connected to the power terminal strip or to an M5 screw terminal. The screw terminal is located on the heat sink of the ATV18U09M2 and U18M2 and on the metal cable entry plate of all other units.
6. Verify that thermal overload switch setting (**K**) matches dynamic braking resistor assembly nameplate current rating, and that thermal overload start switch (**L**) is in On position. See Figure 34 on page 58.
7. Replace dynamic braking resistor cover and secure with four screws (**A**). See Figure 30 on page 56.

8. Attach French, Spanish, or German danger labels (**R**) to dynamic braking resistor assembly enclosure as appropriate. For suggested location of alternate language labels, refer to Figure 30 on page 56 and Figure 34 on page 58.

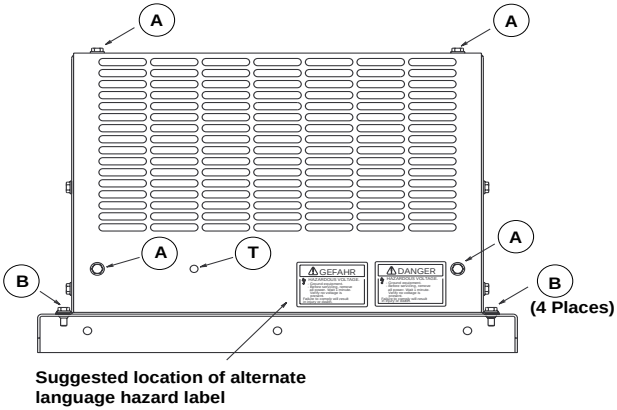


Figure 30: Removing Cover and Bottom Pan: VW3A66711, 712, 713, 714

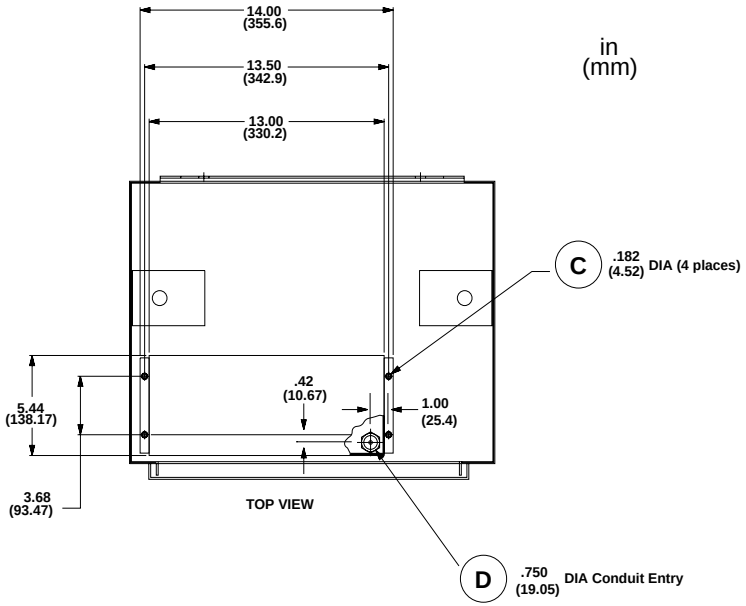


Figure 31: Enclosure Mounting Dimensions: VW3A66711, 712, 713, 714

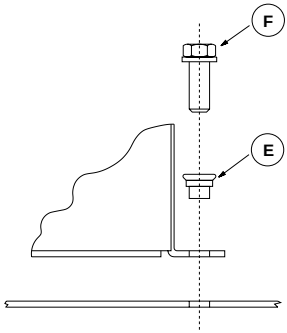


Figure 32: Mounting

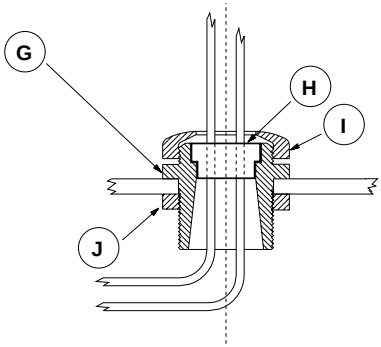


Figure 33: Liquid-Tight Bushing

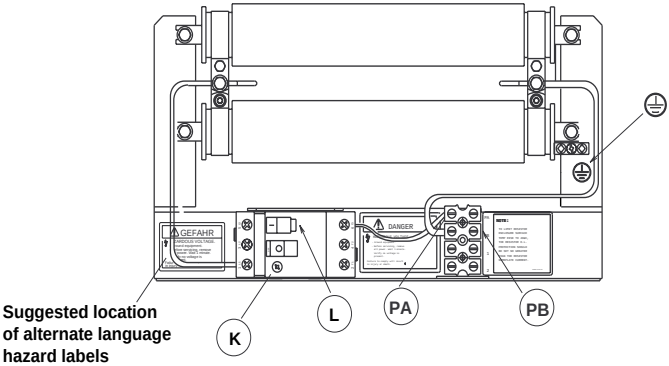


Figure 34: Dynamic Braking Resistor Assembly Terminals: VW3A66711, 712, 713, 714

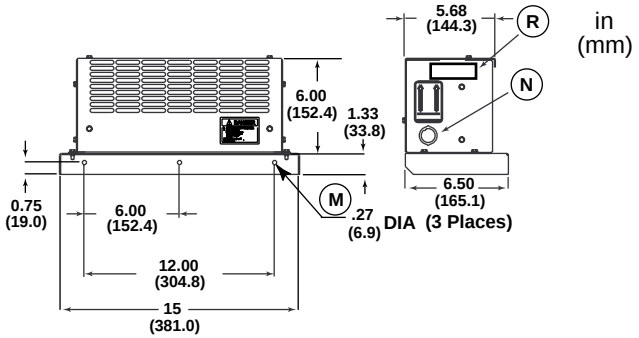


Figure 35: Wall Mounting Dimensions: VW3A66711 and VW3A66712

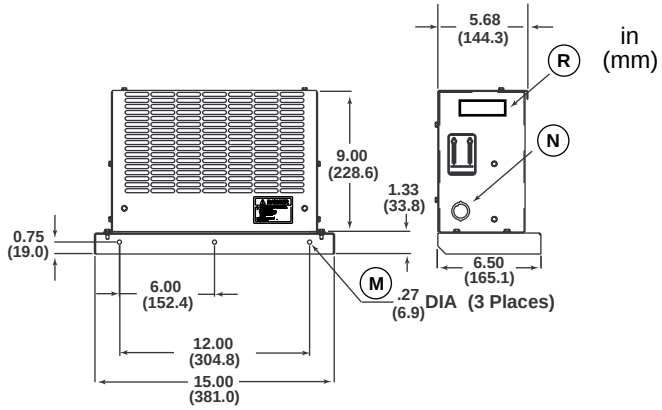


Figure 36: Wall Mounting Dimensions: VW3A66713 and VW3A66714

APPENDIX A: CALCULATING DYNAMIC BRAKING RESISTOR REQUIREMENTS FOR ALTIVAR 66 CONTROLLERS

Introduction

The standard Dynamic Braking (DB) resistor assemblies listed in this manual are suitable for a wide variety of drive system stopping service applications. However, when the driven machinery may present an overhauling load or large inertia to the drive system, the suitability of the DB resistor assembly for the application should be checked.

The suitability of a DB resistor assembly is determined by analyzing the mechanical system of the driven machinery. From the analysis, the following three key parameters are computed:

- The peak braking power required during stopping or speed changes (P_i). The value of P_i determines the maximum allowable ohmic value of the DB resistor.
- The amount of power that must be absorbed (P_s) for a given time (t_d) by the DB resistors during stopping or speed changes of the drive. The value of P_d and T_d determine the required time-current characteristic of the DB resistor.
- The calculation of dynamic braking power requires V_{db}.

  V_{db} = 795 V for 460 V drives
  V_{db} = 397 V for 230 V drives

- The average power that must be dissipated by the DB resistor during an entire cycle of the machine (P_a). The value of P_a determines the required continuous current rating of the DB resistor.

Examples

The following example illustrates the process.

Given:

The application consists of a 5 hp, 1740 rpm motor with a rotor inertia of 0.28 lbf-ft^2. The motor is being controlled by an ATV66U72N4 operating in the constant torque mode. The motor is driving a machine with an inertia 10 times that of the motor with no interposing speed changer. The machine resistive (friction) torque is one-tenth of the rated motor torque at full speed. The requirement is to stop in 5 seconds from rated speed at a rate of 2 cycles per minute.

Mechanical system parameters:

Rated motor torque:

$T_n = (hp \times 5250)/N_{base} = (5 \times 5250)/1740 = 15.1$ lbf-ft

Machine cycle time:

t_c = (60 seconds)/(two operations per minute) = 30 seconds

Machine speed change during deceleration:

$N_d = 1740$ rpm - 0 rpm = 1740 rpm

Machine deceleration time:

$t_d = 5$ seconds

Mechanical system resistive (friction) torque:

$T_r = (15.1 \text{ lbf-ft})/10 = 1.51$ lbf-ft

Mechanical system overhauling torque:

$T_o = 0.00$ lbf-ft

Mechanical system combined inertia:

$J_c = 0.28 \text{ lbf-ft}^2 + (10) \times 0.28 \text{ lbf-ft}^2 = 3.08 \text{ lbf-ft}^2$

Mechanical system inertial torque for a given deceleration rate (as set by controller decel ramp):

$T_j = Jc \times (N_d)/(308 \times (t_d)) = 3.08 \times 1740/(308 \times 5) = 3.48$ lbf-ft

Required braking torque from motor:

$T_b = T_j + To - T_r = 3.48 + 0.00 - 1.51 = 1.97$ lbf-ft

NOTE: The required braking torque must not exceed the motor's ability to produce torque. For inertial loads, including those depicted in the above examples, the required braking torque must not exceed either 1.5 times the motor rated torque for constant torque controllers or 1.1 times the motor rated torque for variable torque controllers.

For machines that can continuously overhaul the motor, the value of overhauling torque (T_o) minus the resistive torque (T_r) must not exceed the motor continuous torque rating at any speed.

DB resistor requirements:

Peak braking power required to develop braking torque (Tb) when decelerating from a given speed (N):

$P_i = T_b \times N/(7.04) = (1.97 \times 1740)/(7.04) = 487$ W

The braking power that must be absorbed for a time (td) during stopping or speed changing operation:

$P_d = 0.5 \times P_i = 0.5 \times 487 = 243$ W for a period of t_d seconds

The average braking power that must be dissipated during a machine cycle:

$P_a = P_d \times t_d/t_c = 243 \times 5/30 = 40.5$ W

Capability of VW3-A66711 DB resistor assembly for ATV66U72N4 controller:

Peak braking power that can be developed with VW3-A66711 DB resistor assembly with controller configured for 460 V input line operation:

$P_i = (V_{db})^2/R_{db} = (795\ V)^2/120W = 5267$ W

The braking power that can be absorbed for t_d (based on DB resistor hot state current-time characteristic curve shown in Figure 1 on page 8):

$P_d = R_{db} \times ((\text{Multiple of } I_r \text{ at } t_d) \times Ir)^2 = 120W \times (3.5 \times 1)^2 = 1470$ W

NOTE: Since R_{db} limits the peak current that can be drawn from the drive controller DC bus, the value of [(Multiple of I_r) x I_r] must be limited to no greater than ($\div p_i/R_{db}$).

The average braking power that can be dissipated continuously:

$P_a = R_{db} \times (I_r)^2 = 120W \times (1)^2 = 120$ W

For the example, the VW3-A66711 DB resistor assembly will work as intended for the application.

APPENDIX B: CALCULATING DYNAMIC BRAKING RESISTOR REQUIREMENTS FOR ALTIVAR 58 CONTROLLERS

Introduction

The standard Dynamic Braking (DB) resistor assemblies listed in this manual are suitable for a wide variety of drive system stopping service applications. However, when the driven machinery may present an overhauling load or large inertia to the drive system, the suitability of the DB resistor assembly for the application should be checked.

The suitability of a DB resistor assembly is determined by analyzing the mechanical system of the driven machinery. From the analysis, the following four key parameters are computed:

- The peak braking power required during stopping or speed changes (P_i). The value of P_i determines the maximum allowable ohmic value of the DB resistor.
- The amount of power that must be absorbed (P_d) for a given time (t_d) by the DB resistors during stopping or speed changes of the drive. The value of P_d and T_d determine the required time-current characteristic of the DB resistor.
- The calculation of dynamic braking power requires V_{db}.
  V_{db} = 850 V for 460 V drives
  V_{db} = 375 V for 230 V drives
- The average power that must be dissipated by the DB resistor during an entire cycle of the machine (P_a). The value of P_a determines the required continuous current rating of the DB resistor.

Examples

The following example illustrates the process.

Given:

The application consists of a 5 hp, 460 V, 1740 rpm motor with a rotor inertia of 0.28 lbf-ft^2. The motor is being controlled by an ATV58U72N4 operating in the constant torque mode. The motor is driving a machine with an inertia 10 times that of the motor with no interposing speed changer. The machine resistive (friction) torque is one-tenth of the rated motor torque at full speed. The requirement is to stop in 5 seconds from rated speed at a rate of 2 cycles per minute.

Mechanical system parameters:

Rated motor torque:

$T_n = (hp \times 5250)/N_{base} = (5 \times 5250)/1740 = 15.1$ lbf-ft

Machine cycle time:

t_c = (60 seconds)/(two operations per minute) = 30 seconds

Machine speed change during deceleration:

$N_d = 1740$ rpm - 0 rpm = 1740 rpm

Machine deceleration time:

$t_d = 5$ seconds

Mechanical system resistive (friction) torque:

$T_r = (15.1$ lbf-ft)/10 = 1.51 lbf-ft

Mechanical system overhauling torque:

$T_o = 0.00$ lbf-ft

Mechanical system combined inertia:

$J_c = 0.28$ lbf-ft^2 + (10) x 0.28 lbf-ft^2 = 3.08 lbf-ft^2

Mechanical system inertial torque for a given deceleration rate (as set by controller decel ramp):

$T_j = Jc \times (N_d)/(308 \times (t_d)) = 3.08 \times 1740/(308 \times 5) = 3.48$ lbf-ft

Required braking torque from motor:

$T_b = T_j + To - T_r = 3.48 + 0.00 - 1.51 = 1.97$ lbf-ft

NOTE: The required braking torque must not exceed the motor's ability to produce torque. For inertial loads, including those depicted in the above examples, the required braking torque must not exceed the torque producing ability of the dynamic braking unit with the recommended braking resistor (approximately 1.5 times the motor rated torque).

For machines that can continuously overhaul the motor, the value of overhauling torque (T_o) minus the resistive torque (T_r) must not exceed the motor continuous torque rating at any speed.

DB resistor requirements:

Peak braking power required to develop braking torque (Tb) when decelerating from a given speed (N):

$P_i = T_b \times N/(7.04) = (1.97 \times 1740)/(7.04) = 487$ W

The braking power that must be absorbed for a time (td) during stopping or speed changing operation:

$P_d = 0.5 \times P_i = 0.5 \times 487 = 243$ W for a period of t_d seconds

The average braking power that must be dissipated during a machine cycle:

$P_a = P_d \times t_d/t_c = 243 \times 5/30 = 40.5$ W

Capability of VW3-A66711 DB resistor assembly for ATV58U72N4 controller:

Peak braking power that can be developed with VW3-A66711 DB resistor assembly with controller configured for 460 V input line operation:

$P_i = (V_{db})^2/R_{db} = (850\ V)^2/120\ \Omega = 6020$ W

The braking power that can be absorbed for t_d (based on DB resistor hot state current-time characteristic curve shown in Figure 18 on page 36):

$P_d = R_{db} \times ((\text{Multiple of } I_r \text{ at } t_d) \times Ir)^2 = 120\Omega \times (3.5 \times 1.0)^2 = 1470$ W

Since R_{db} limits the peak current that can be drawn from the drive controller DC bus, the value of [(Multiple of I_r) x I_r] must be limited to no greater than ($\sqrt{}\ p_i/R_{db}$).

The average braking power that can be dissipated continuously:

$P_a = R_{db} \times (I_r)^2 = 120\Omega \times (1)^2 = 120$ W

For the example, the VW3-A66711 DB resistor assembly will work as intended for the application.

APPENDIX C: CALCULATING DYNAMIC BRAKING RESISTOR REQUIREMENTS FOR ALTIVAR 18 CONTROLLERS

Introduction

The standard Dynamic Braking (DB) resistor assemblies listed in this manual are suitable for a wide variety of drive system stopping service applications. However, when the driven machinery may present an overhauling load or large inertia to the drive system, the suitability of the DB resistor assembly for the application should be checked.

The suitability of a DB resistor assembly is determined by analyzing the mechanical system of the driven machinery. From the analysis, the following four key parameters are computed:

- The peak braking power required during stopping or speed changes (P_i). The value of P_i determines the maximum allowable ohmic value of the DB resistor.
- The amount of power that must be absorbed (P_d) for a given time (t_d) by the DB resistors during stopping or speed changes of the drive. The value of P_d and T_d determine the required time-current characteristic of the DB resistor.
- The calculation of dynamic braking power requires V_{db}.
  V_{db} = 795 V for 460 V drives
  V_{db} = 397 V for 230 V drives
- The average power that must be dissipated by the DB resistor during an entire cycle of the machine (P_a). The value of P_a determines the required continuous current rating of the DB resistor.

Examples

The following example illustrates the process.

Given:

The application consists of a 5 hp, 460 V, 1740 rpm motor with a rotor inertia of 0.28 lbf-ft^2. The motor is being controlled by an ATV18U72N4 operating in the constant torque mode. The motor is driving a machine with an inertia 10 times that of the motor with no interposing speed changer. The machine resistive (friction) torque is one tenth of the rated motor torque at full speed. The requirement is to stop in 5 seconds from rated speed at a rate of 2 cycles per minute.

Mechanical system parameters:

Rated motor torque:

$T_n = (hp \times 5250)/N_{base} = (5 \times 5250)/1740 = 15.1$ lbf-ft

Machine cycle time:

t_c = (60 seconds)/(two operations per minute) = 30 seconds

Machine speed change during deceleration:

$N_d = 1740$ rpm - 0 rpm = 1740 rpm

Machine deceleration time:

$t_d = 5$ seconds

Mechanical system resistive (friction) torque:

$T_r = (15.1$ lbf-ft)/10 = 1.51 lbf-ft

Mechanical system overhauling torque:

$T_o = 0.00$ lbf-ft

Mechanical system combined inertia:

$J_c = 0.28$ lbf-ft^2 + (10) x 0.28 lbf-ft^2 = 3.08 lbf-ft^2

Mechanical system inertial torque for a given deceleration rate (as set by controller decel ramp):

$T_j = Jc \times (N_d)/(308 \times (t_d)) = 3.08 \times 1740/(308 \times 5) = 3.48$ lbf-ft

Required braking torque from motor:

$T_b = T_j + To - T_r = 3.48 + 0.00 - 1.51 = 1.97$ lbf-ft

NOTE: The required braking torque must not exceed the motor's ability to produce torque. For inertial loads, including those depicted in the above examples, the required braking torque must not exceed 1.5 times the motor rated torque for constant torque controllers.

For machines that can continuously overhaul the motor, the value of overhauling torque (T_o) minus the resistive torque (T_r) must not exceed the motor continuous torque rating at any speed.

DB resistor requirements:

Peak braking power required to develop braking torque (Tb) when decelerating from a given speed (N):

$P_i = T_b \times N/(7.04) = (1.97 \times 1740)/(7.04) = 487$ W

The braking power that must be absorbed for a time (td) during stopping or speed changing operation:

$P_d = 0.5 \times P_i = 0.5 \times 487 = 243$ W for a period of t_d seconds

The average braking power that must be dissipated during a machine cycle:

$P_a = P_d \times t_d/t_c = 243 \times 5/30 = 40.5$ W

Capability of VW3-A66712 DB resistor assembly for ATV18U72N4 controller:

Peak braking power that can be developed with VW3-A66712 DB resistor assembly with controller configured for 460 V input line operation:

$P_i = (V_{db})^2/R_{db} = (795\ V)^2/56\Omega = 11{,}286$ W

The braking power that can be absorbed for t_d (based on DB resistor hot state current-time characteristic curve shown in Figure 27 on page 48):

$P_d = R_{db} \times ((\text{Multiple of } I_r \text{ at } t_d) \times Ir)^2 = 56\Omega \times (3.5 \times 1.45)^2 = 1442$ W

Since R_{db} limits the peak current that can be drawn from the drive controller DC bus, the value of [(Multiple of I_r) x I_r] must be limited to no greater than ($\sqrt{\ } p_i/R_{db}$).

The average braking power that can be dissipated continuously:

$P_a = R_{db} \times (I_r)^2 = 56\Omega \times (1.45)^2 = 118$ W

For the example, the VW3-A66712 DB resistor assembly will work as intended for the application.