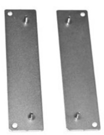
CONDUIT ENTRY KIT

This option is a conduit box allowing three or more conduit entries. It attaches to the bottom of the drive controller. See the documentation supplied with the option for installation instructions. Without removal of the vent cover on the top of the drive controller and with the addition of this kit, the drive controller complies with UL Type 1 standards.

Kit Catalog No.	Drive Controller Catalog No. ATV28H••••••
VW3A28811A	U09M2U, U18M2U
VW3A28812A	U29M2U, U18N4U, U29N4U, U18S6XU, U29S6XU
VW3A28813A	U41N4U, U54N4U, U72N4U, U41M2U, U54M2U, U72M2U, U41S6XU, U72S6XU
VW3A28814A	U90M2U, D12M2U, D12N4U, U90N4U, U90S6XU, D12S6XU
VW3A28815	D16N4U, D23N4U, D16S6XU, D23S6XU

DIN RAIL KIT

The DIN rail kit is for use with drive controllers ATV28HU09M2U and U18M2U. It allows these smaller drive controllers to be DIN rail mounted.



ATV18 REPLACEMENT KIT

This option provides brackets that allow an ATV28 drive controller to be secured to existing panel mounting holes for an ATV18 drive controller.

Kit Catalog No.	Drive Controller Catalog No. ATV28H••••••
VW3A28821A	U09M2U, U18M2U
VW3A28822	U29M2U, U18N4U, U29N4U
VW3A28823	U41N4U, U54N4U, U72N4U, U41M2U, U54M2U, U72M2U
VW3A28824	U90M2U, D12M2U, D12N4U, U90N4U
VW3A28825	D16N4U, D23N4U

DYNAMIC BRAKING RESISTOR KITS FOR 230/460 V CONTROLLERS

The dynamic braking resistor kit allows the ATV28 drive controllers to function in quadrants 2 and 4 of the four quadrant speed/torque curve. In these quadrants of motor operation, the motor is essentially a generator through which energy is transferred from the motor load back to the drive controller. This results in elevated DC bus voltage to the drive controller which may cause it to shut down to protect itself. Dynamic braking resistor kits are commonly used to dissipate the excess energy generated by the motor operating in this mode. The flow of current to the braking resistor is controlled by the dynamic braking transistor. Applications include machines with high inertia, overhauling loads, and machines with fast cycles.

The following table shows the minimum ohmic value of the resistor that can be used with the ATV28 drive controllers. Using lower than recommended values will cause excessive current flow, exceeding the rating of the dynamic braking transistor.

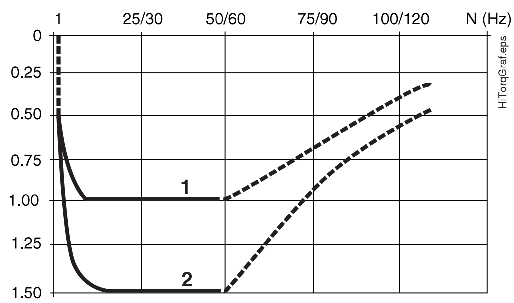
Minimum Dynamic Braking Resistance Values

208/230 V Drive Controller Part No.	PA / PB Minimum Resistance Ω	460 V Drive Controller Part No.	PA / PB Minimum Resistance Ω	575 V Drive Controller Part No.	PA / PB Minimum Resistance Ω
ATV28HU09M2U	65	ATV28HU18N4U	95	ATV28HU18S6XU	100
ATV28HU18M2U	45	ATV28HU29N4U		ATV28HU29S6XU	
ATV28HU29M2U	30	ATV28HU41N4U	70	ATV28HU41S6XU	85
ATV28HU41M2U		ATV28HU54N4U		ATV28HU72S6XU	65
ATV28HU54M2U	25	ATV28HU72N4U		ATV28HU90S6XU	38
ATV28HU72M2U		ATV28HU90N4U	45	ATV28HD12S6XU	
ATV28HU90M2U	10	ATV28HD12N4U		ATV28HD16S6XU	
ATV28HD12M2U		ATV28HD16N4U	25	ATV28HD23S6XU	
		ATV28HD23N4U			

The following charts show the motor braking torque capacity of an ATV28 drive controller with a braking resistor.

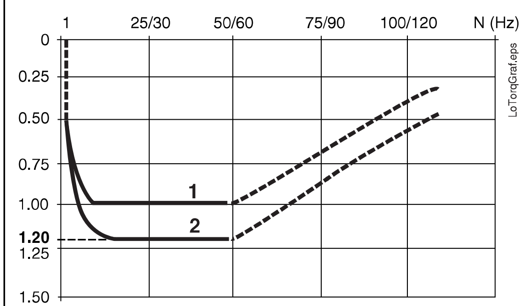
Braking Torque with Resistor

Constant-Torque Applications



1. Continuous braking torque (driving load) load factor = 100%.
2. Maximum transient braking torque (for 60 s).

Variable-Torque Applications



1. Continuous braking torque (driving load) load factor = 100%.
2. Maximum transient braking torque (for 60 s).

Calculating Resistor Size

The standard dynamic braking (DB) resistor assemblies are suitable for a wide variety of drive system stopping 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 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 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} = 1020 V for 575 V drives
  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.

The following example illustrates the process:

Given

The application consists of a 5 hp, 460 Vac, 1740 rpm motor (N_{base} = base speed) with a rotor inertia of 0.28 lb-ft^2. The motor is being controlled by an ATV28HU72N4 operating in the constant torque mode. The motor is driving a machine with an inertia 10 times that of the motor with no interposing gear box. 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/minute.

Mechanical System Parameters:

Rated motor torque: T_n = (HP x 5250)/N_{base} = (5 x 5250)/1740 = 15.1 lb-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 lb-ft)/10 = 1.51 lb-ft

Mechanical system overhauling torque: T_o = 0.00 lb-ft

Mechanical system combined inertia: J_c = 0.28 lb-ft^2 + (10) x 0.28 lb-ft^2 = 3.08 lb-ft^2

Mechanical system inertial torque for a 5 second deceleration rate (as set by controller deceleration ramp):
T_j = Jc x (N_d)/(308 x (t_d)) = 3.08 x 1740/(308 x 5) = 3.48 lb-ft

Required braking torque from motor: $T_b = T_j + T_o - T_r$ = 3.48 + 0.00 – 1.51 = 1.97 lb-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 constant torque applications).

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 (T_b) when decelerating from a given speed
$P_i = T_b$ x N_{base}/(7.04) = (1.97 x 1740)/(7.04) = 487 W

The braking power that must be absorbed for a time (t_d) during stopping or speed changing operation: P_d = 0.5 x P_i = 0.5 x 487 = 243 W for a period of t_d seconds

The average braking power that must be dissipated during a machine cycle:
$P_a = P_d$ x t_d/t_c = 243 x 5/30 = 40.5 W

Capability of VW3A66711 DB resistor assembly for ATV28U72N4 controller:

Peak braking power that can be developed with VW3A66711 DB resistor assembly with controller configured for 460 Vac input line operation: $P_i = (V_{db})^2/R_{db}$ = (850 V)^2/120 Ω = 6020 W

The braking power that can be absorbed for t_d (based on DB resistor hot state current-time characteristic curve shown below):
$P_d = R_{db}$ x ((Multiple of I_r at t_d) x Ir)^2 = 120 Ω x (3.5 x 1.0)^2 = 1470 W

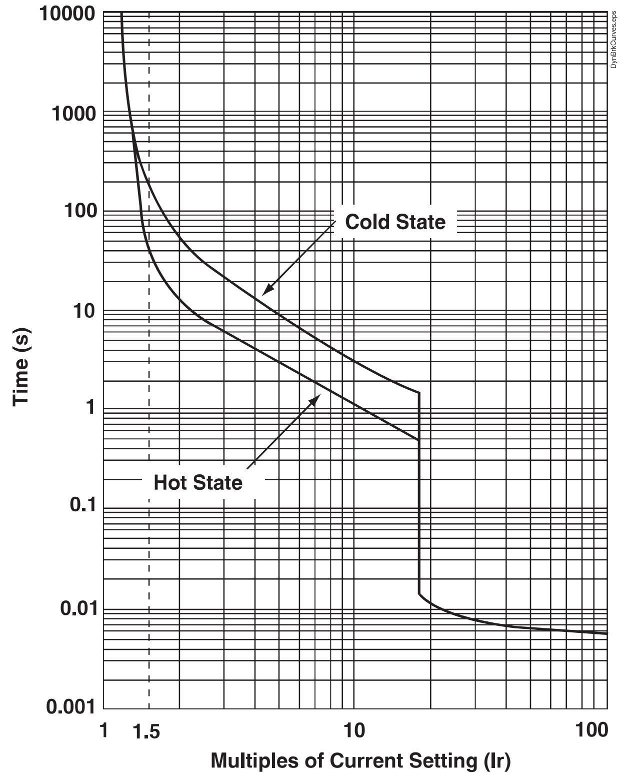
Since R_{db} limits the peak current that can be drawn from the drive controller DC bus, the value of [(Multiple of I_r) x I_r] must be limited to no greater than (√ P_i/R_{db}).

The average braking power that can be dissipated continuously:
$P_a = R_{db}$ x $(I_r)^2$ = 120 Ω x (1)^2 = 120 W

For this example, the VW3A66711 DB resistor assembly will work as intended for the application.

Current/Time Characteristics for DB Resistor Assemblies

The figure below shows the allowable GV2 trip times as a function of current setting multiples with the dynamic braking resistor assembly located in a 40 °C (104 °F) ambient temperature environment. See page 19 for an example of how to calculate resistor size.



The kits in the following table use the thermal protection of a GV2 manual starter and have a Type 1 rating per UL 50. The insulation system is suitable for use in a Pollution Degree 3 environment (refer to NEMA ICS-1 Annex A). The package is UL/CSA marked.

Dynamic Braking Kits Technical Specifications

Dynamic Braking Kit for:	Ohmic Value (Rdb) Ω	Continuous Current Rating of Assembly ♦ (Ir) A	Average Power (W)	Catalog Number
ATV28HU09M2U ATV28HU18N4U–U72N4U	120	1.0	120	VW3A66711
ATV28HU18M2U–U41M2U ATV28HU90N4U–D12N4	56	1.45	118	VW3A66712
ATV28HU54M2U–U72M2U ATV28HD16N4U–D23N4U	28	2.7	204	VW3A66713
ATV28HU90M2U–D12M2U	14	3.8	202	VW3A66714

♦ 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 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.