TECHNICAL NOTE #:	**TN_VFD_BRK_004**
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CALCULATING DB RESISTORS

In certain applications it is necessary to add dynamic braking (DB) resistors to inverters. Inverters produce approximately 20% braking torque, and by adding the DB resistors it will be possible to get higher braking torque. This technical note will show you how to size your DB resistor and braking Module (SDBU)**.**

Why use a DB resistor and Module?
When a motor is braking or has an overhauling load, the motor will act as a generator and the energy from the motor will flow back to the inverter. When this happens the inverter DC bus will rise to a point that will trip the inverter on "Overvoltage" fault. If the inverter did not have this fault the DC bus voltage could rise to a level that may cause the inverter damage. To prevent the Voltage from rising to the "Overvoltage" trip level a DB resistor and module can be added to help regulate the DC Bus voltage and the excess voltage is dissipated across the DB resistor in the form of heat.

Calculating the DB resistor
The following steps will tell you how to calculate the dB resistor values.

1. Converting horsepower (HP) of the motor to Kilowatts (KW).

   KW = HP x 746

   Ex. KW = 50HP x 746
   KW = 37,300W

2. Calculating the Peak kilowatts and DB resistor resistance. This will require knowing the DC bus turn on level.

   Turn on levels:

   230Vac – 350Vdc
   460Vac – 750Vdc
   575Vac – 925Vdc

   $R = (TL)^2/PKW$

   PKW = KW x BT X .8

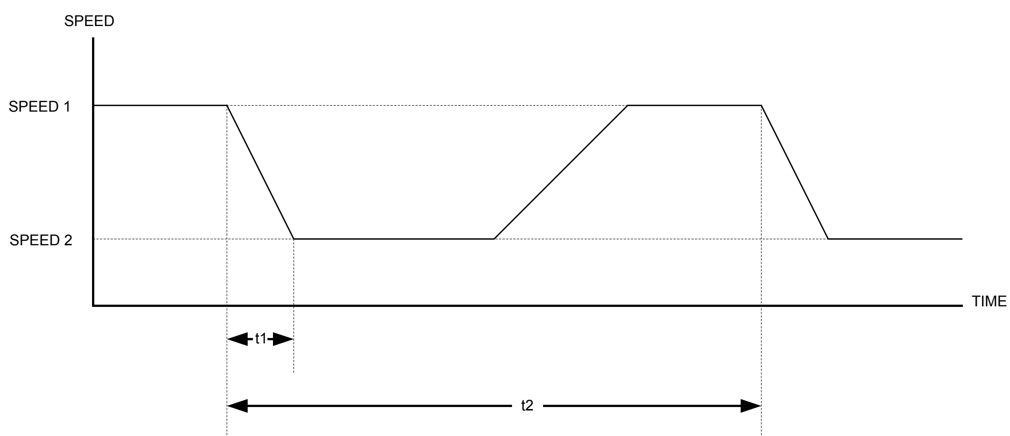
   TL = Turn on level
   R = resistance
   PKW = Peak Kilowatts
   BT = Braking torque (1.5 = 150% braking torque)
   .8 = efficiency

Ex. PKW = 37,300W x 1.5 x .8
PKW = 44,760W
R = $(750)^2$/44,760W
R= 12.6ohms

We will round this off to 13 ohms.

Note:
The resistor value can go up or down by changing the amount of braking torque. You must check to make sure this value does not fall below the minimum resistance value. (See TN: TN_VFD_BRK001) If resistance is below the minimum resistance value, damage will occur to the brake circuit, or the resistance value would have to be doubled or tripled and two or three resistors would have to be used with two or three braking modules.

3. Calculating the Duty Cycle.



Duty cycle (DC) = t1/t2 x 100%

t1 = deceleration time in seconds
t2 = total cycle time in seconds

Ex. Duty cycle = 10s/100s x 100%
Duty cycle = .1s x100%
Duty cycle = 10%

Note:
In the following formulas we will use the value of t1/t2, which in the above example we will use .1 as 10% duty cycle.

4. Calculating the DB resistor wattage.

DB resistor wattage = PKW x $\sqrt{(DC)}$ x .5
DB resistor wattage = 44,760W x $\sqrt{(.1)}$ x .5
DB resistor wattage = 7,077WATTS

So from the above formulas we determined that for a 50HP, 460V drive and motor with a 150% braking torque and 10% duty cycle we will use a 13Ω, 7,077Watt resistor. Now we need to size the braking module, based on using an SDBU.

<u>Sizing the SDBU Braking Module</u>

1. Calculating the peak current. To size the peak current we need to know the peak Kilowatts and DB resistance from the above information.

Peak current = $\sqrt{(PKW/R)}$

From the examples above we use 44,760W and 13 ohms

Peak current = $\sqrt{(44,760/13)}$
Peak current = 58.67A

Note:
The peak current should not exceed the overload rating of the drive.

2. Calculating the Continuous current

Continuous current = Peak current x $\sqrt{(DC)}$
Continuous current = 58.67A x $\sqrt{(.1)}$
Continuous current = 18.55A

Note:
The value of .1 is the used for a 10% duty cycle(.2=20%, .3=30%, etc.).

The continuous current is 18.55A, so we would use an SDBU-30 rated at 30A continuous. If the current value was above 30A then we would use an SDBU-80 rated at 80A continuous.

If the continuous current is above the SDBU current value, then two or three SDBU's would have to be used with two or three braking resistors.

<u>Example of Sizing Multiple Braking Modules and Resistors</u>

250HP motor, 460V, 150% BT, 10% duty

KW = 250 x 746
KW = 186,500W

PKW = 186,500 x 1.5 x .8
PKW = 223,800W

R = 750^2/223,800
R = 2.5Ω

Minimum resistance per TN: TN_VFD_BRK001 is 5 ohms. So we would use qty 2 – 5Ω resistors.

DB Resistor wattage = 223,800W x $\sqrt{(.1)}$ x .5
DB Resistor wattage = 35,386W
Since we are using 2 resistors we can divide the wattage by 2.

35,386/2 = 17,693W each

To determine what size of SDBU we will need, we can calculate the peak and continuous current.

Peak current = $\sqrt{(223{,}800/2.5)}$
Peak current = 299A

Continuous current = 299 x $\sqrt{(.1)}$
Continuous current = 94.5A

For 2 units we divide the continuous current by 2

94.5/2 = 47A
47A>30A and <80A

So in conclusion for the 250HP, 460V motor with 150% braking torque and 10% duty cycle we will need to use qty 2 SDBU-80 modules and 2 - 5Ω, 17,693W resistors connected in parallel. See the SDBU instruction manual for connection of modules and resistors.