Application Note

# Common Bussing AC Drives

APP-AC-03

## For 650 and 690+ series drives


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## Introduction

On occasion, one or more drives in a system may be absorbing power from the machine and pumping it back into the drive. This condition is called regeneration. This occurs when motors are being “overhauled” (mechanically pulled at a speed faster than their setpoint) or when the drive and motor are “holding back” their speed to provide desired tension, as in the case of unwind stands.

The typical pulse width modulated AC drive is not designed for regenerating power back into the three phase supply lines, so all energy absorbed from the motor goes into the capacitor bank, resulting in increased DC bus voltage inside the drive. When equipped with a standard duty braking module and resistor, the drive is capable of dissipating only short-term energy, typically a few seconds at a time. It is possible to specify a braking module and resistor to dissipate this energy continuously, by taking into consideration the maximum current capacity of the brake switch, the duty cycle and the resulting wattage rating of the resistor. In either case, energy dissipated in a braking resistor is energy wasted.

This regenerative energy can be absorbed by other motoring drives if the drives are connected in a common DC bus configuration. If all the drives on a given line are connected in a common bus configuration, there is no need for other dissipation techniques, (even though some sections may always be in continuous regeneration), since the net power flow into any machine is positive. Braking modules and resistors may be required to dissipate short-term regenerative energy only when the system performs a fast or emergency stop.

If only part of the machine is fitted with AC drives, the situation is slightly more complex. With a good understanding of the application, one can determine the motoring and regenerative requirements for each section driven by the AC drive. Under worst case conditions, if the net flow of power is still into the common-bussed drive sections, there is no need for additional dissipation methods. If it is not, an appropriately sized braking module or even a line regenerative unit should be considered.

## Common Bus Scheme

There are several ways of implementing a common bus scheme. Considerations for precharge on power up, independent drive control, drive faults, load sharing and input circuit protection, must be addressed. The scheme illustrated in Figure 1 is recommended and used by SSD Drives in our factory built systems.

The features of this scheme are:

- A complete drive is used
- No need for separate rectifier, precharge scheme, capacitor bank and inverter modules
- Each drive can be individually removed from the common bus without affecting the system
- Interlocked contactor to put the drive onto the common bus
- High speed fuses to protect the drive capacitors on the common bus

## Guidelines

All drives on a common bus must be powered from the same three-phase AC supply.

### *Ordering the Drive*

The standard drive is used for a common bus scheme. No special options required.

## Line Protection

*(CB in the figure)*
If using a circuit breaker as the mains protection, order one with an auxiliary contact. This circuit breaker needs to be used for interlocking the DC contactor. Refer to the drive instruction manual for sizing and specifying circuit breakers.

## Line fuses

If using fuses as the mains protection, order ones with blown-fuse microswitches. These fuses need to be used for interlocking the DC contactor. Refer to the drive instruction manual for sizing and specifying line fuses.

## Line Reactor

*(LR in the figure)*
A line reactor is required for this common bus scheme. Use a standard line reactor rated at 3% impedance for the HP rating of that section, such as the MTE RL series.

## Drive Healthy Relay

*(DH in the figure)*
The Drive Healthy relay should have a 24VDC coil powered by the drive and is energized when the drive is in a healthy state. See the drive instruction manual for connection information. It is used for interlocking the DC bus contactor, so that in the event of a fault, the drive is removed from the common bus.

## DC Bus Fuses

*(FU in the figure)*
Use 2 semiconductor fuses, rated 700VDC, such as the Bussman FWP series, or Ferraz-Shawmut A70P series. The current rating of these fuses depends upon the expected motoring or regenerative energy for that section. When in doubt, size them for 125% of rated drive current.

## DC Bus Contactor

*(DCC contacts in the figure)*
Use a 2-pole DC contactor rated for 650VDC, such as the ABB EHDB series. The current capacity of this contactor depends upon the expected regenerative energy for that section. When in doubt, size it for 120% of the rated drive current.

## Interlocking the DC Bus Contactor

*(DCC coil in the figure)*
The coil of the DC bus contactor should be energized only if the three-phase AC power is on AND the drive is healthy. This can be done by connecting the circuit breaker auxiliary and drive healthy relay contacts in series with the contactor coil, as shown in Figure 1. When a 'Drive Isolate' or 'Coast Stop' relay is present, its contact may be inserted into the interlock, if desired, to provide an extra permissive.

## Dynamic Braking

*(DBR in the figure)*
If the entire system is on a common bus, the only net regenerative energy produced will be during fast or emergency stopping of the line. It is only at this time that an alternative short-term dissipation method is necessary. Braking modules and resistors should be used strategically under these conditions:

- When in doubt, use braking on all the drives
- When a drive is not the largest in its frame size, the braking module may be capable of more than the power rating of the section. For braking module capability, refer to "Current Rating" in the Dynamic Braking section of the drive instruction manual.

- If there is one drive that is significantly larger than the rest, it is often sufficient to put a braking resistor on that drive alone, taking into consideration that it would be able to absorb and dissipate enough energy to stop the entire system, in the event of a fast stop.

***Caution***

**If every drive does not have a brake, it is important that the large drives have the braking resistors rather than the small ones, so that the braking modules inside the small drives do not have to absorb the total regenerative energy from the common DC bus.**

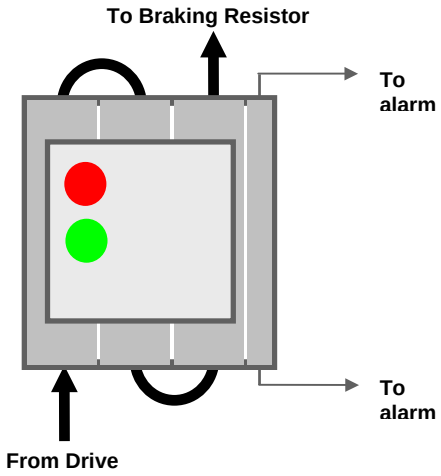
***Caution***

**Do not connect a braking resistor to a drive that is not equipped with a braking module. Serious component damage could occur.**

### *Dynamic Braking Protection*

*(MCP in the figure)*

Ensure that the braking resistor and wire are protected by a motor circuit protector rated at 110% of the continuous current rating of the resistor(s). Use SquareD GV2 series, or equivalent. Route the braking wire through all three poles, as shown in the sketch, to provide DC breaking capability. An auxiliary contact may be used to annunciate an alarm, if a trip should occur.




### *Parameter Change*

Disable Slew Rate Limit in the 690+ when used in a common bus configuration. The parameter may be found under Setup/Motor Control/Slew Rate Limit/Enable. Set it to FALSE.

## Other Dissipation Methods

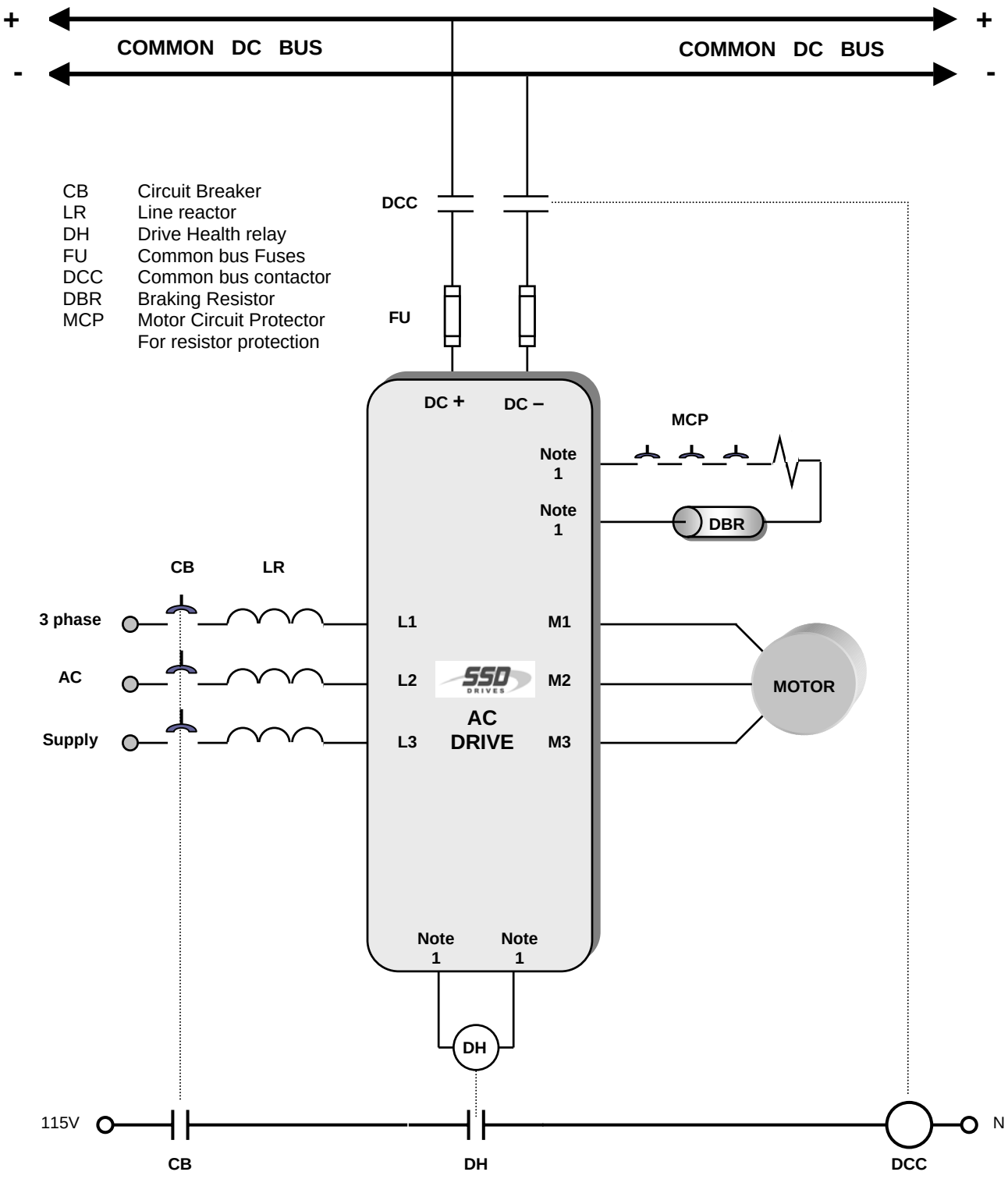
***Large Braking Module***

If specifying braking resistors and modules for individual drives gets very involved, a third party braking module sized for the entire common bus may serve as an alternate solution. This module connects across the DC bus and has a threshold that should be adjusted to 740VDC for a 460V system. When the DC bus voltage exceeds this threshold, the module turns on and dissipates excess energy into a resistor bank. Contact SSD Drives' Product Support Group for details.

***Line Regenerative Unit***

When only a section of the machine has common bussed AC drives, it is possible that the common bus may need to absorb regenerative energy for extended periods. A Line Regenerative Unit may be specified under these circumstances, if the amount of energy to be absorbed exceeds the steady state rating of the braking modules and resistors. This unit connects across the DC bus and the AC supply and conducts when a threshold voltage is exceeded, pumping the excess energy back into the lines. Contact SSD Drives' Product Support Group for details.

**Figure 1**




NOTE 1: Refer to the drive instruction manual for terminal designations for that drive