Power Electronics International, Inc.® 847-428-9494 Fax 847-428-7744 PEinfo.com
561-8 Plate Drive, East Dundee, IL 60118 USA

Represented by: **TCA Industrial Controls**
P.O. Box 10125 • Pleasanton, California 94588-0125
Phone (925) 426-0073 • Fax (925) 426-0094 • tcacontrols.com

TECH-NOTE: Hoist VFD Control -- Choosing the Components

Two Main Categories for Hoists

There are two main categories for hoists. The first category is a hoist with a mechanical load brake or self-locking worm gear. This type of hoist is distinguished by its ability to mechanically prevent the load from causing the system to accelerate without the application of positive motor torque. The other category comprises all hoists that do not fit into the first category. These also include any system with an eddy current brake or with a conical rotor motor. The eddy current system is an electrical braking system and a conical rotor is your holding brake when you are not running.

Which category a hoist fits into is fairly easy to determine. If the hoist does not require the motor torque in the down direction to keep the load from falling, it fits into the Load Brake category. If the system does require motor torque, the motor will regenerates energy back into the system to hold the load and is part of the No Load Brake category. With a drive, this is call dynamic braking and requires resistors to dissipate the regeneration energy.

Hoist Control Requirements

The electrical and mechanical controls need to do the following.

1. Supply enough energy to the hoisting system to lift full load at rated speed.
2. Dissipate or take out of the hoisting system the energy of lowering the load at rated speed.
3. Provide over speed protection.
4. Provide two means of braking for the load.

Items 3 and 4 are the most important requirements. These are the parts of the control system that insure the safe control of the load. These requirements are also called out in CMAA 70 & 74; section 5.14.6 for #3 and sections 4.9.1 & 4.9.2 for #4.

With a Load Brake a standard open loop V/Hz VFD will handle most applications.

With a Load Brake type hoist, the mechanical load brake itself handles items 2, and 3 above along with being the second brake while the motor does the lifting. The VFD then only needs to run the motor and control the electric brake.

Without Load Brake a closed loop VFD (flux vector) with encoder is required.

No Load Brake systems require more from the VFD control system. The drive needs to be able to dump full power into properly sized regeneration resistors. This regenerative braking torque provides the second means of braking and takes the energy out of the system while lowering the load. The over speed protection is then handled with encoder feedback to the VFD. Motor speed & direction information (encoder feedback) is a very important safety component for hoist without mechanical load brakes. It dates back to static step less controls. When VFD's were looked at for hoist control on these hoists, the VFD choice was based on which designs were available with closed loop control. The choice was (and is) a closed loop Flux Vector Drive

Power Electronics International, Inc.® 847-428-9494 Fax 847-428-7744 PEinfo.com
561-8 Plate Drive, East Dundee, IL 60118 USA

Represented by: **TCA Industrial Controls**
P.O. Box 10125 • Pleasanton, California 94588-0125
Phone (925) 426-0073 • Fax (925) 426-0094 • tcacontrols.com

TECH-NOTE: Hoist VFD Control -- No Load Brake Hoist

AC drives for hoist applications are becoming very popular. If there is no mechanical load brake in the hoist, certain power and safety issues must be addressed. Since the motor is used to hold the load, it is very important that the drive has more motor information than just motor amps. Using motor speed & direction feedback along with motor current gives the drive a true indication of what the motor is doing. AC drive type used for this application is a closed loop, flux vector drive.

For No Load brake applications, there are three requirements:

- Flux Vector Drive
- Dynamic Braking
- Encoder Feedback

FLUX VECTOR DRIVE – The most common type of AC drive that can take an encoder feedback is a flux vector drive. Where the true flux vector technology is not required from a safety perspective, it does offer superior performance and allows features like floating the load and 1000:1 speed range. PEI's flux vector drive is the **Multi-Vector**® Series. PEI can provide the drive module or full built up systems are available. See the Multi-Vector® section following this page for more information.

DYNAMIC BRAKING -- Without a mechanical load brake, the motor is used to keep the load from falling. The regenerative energy must be dissipated. This is done with a dynamic braking (DB) system consists of a DB transistor and DB resistor. The DB transistor is built into every PEI drive. A separate DB resistor package must be utilized for No Load Brake Hoist applications. PEI will supply the needed resistor.

ENCODER FEEDBACK – To give the motor speed feedback to the drive requires an optical encoder. It is a simple device that sends pulses back to the drive indicating both speed and direction. The most common encoders are 1024 pulses per revolution, with "quaderature" (A & B channels -- to derive direction), and include "complements" (apposing channels that goes low when its counterpart goes high – for increased noise immunity). The best location to mount the encoder is on the motor shaft. Generally a stub shaft is mounted on the back of the motor shaft to add an encoder. Using the Multi-Vector® drive, it does not have to be mounted on the motor. It can be mounted on any of the rotating device such as the drum or gearbox. Do note you will not get the micro-speed performance and the loss of some special vector features if you do not mount it on the motor. You also have to address backlash issues of the gearing as well. The cable assembly between the encoder and drive should be shielded and one continuous cable with no terminations except at the motor and drive and the shield grounded at the drive end only.

Power Electronics® International, Inc.
847-428-9494 Fax 847-428-7744 PEinfo.com
561-8 Plate Drive, East Dundee, IL 60118 USA

Represented by: **TCA Industrial Controls**
P.O. Box 10125 • Pleasanton, California 94588-0125
Phone (925) 426-0073 • Fax (925) 426-0094 • tcacontrols.com

Multi-Vector®

The NEW STANDARD for AC Hoist speed control -- **IT'S BUILT BETTER!**

Built Rugged:

- Multi-Vector® is specifically designed for hoist control – not a reprogrammed general-purpose vector drive.
- High reliability and designed for high duty cycle use
- Tough – CMAA duties A through F
- **Regeneration transistor circuitry built inside** – no more DB units
- All steel constructed enclosures – no plastic
- High temperature rating – 50°C ambient rated
- **300% overload capacity for 5-minutes**

Built Easier to Use:

- Super quick setup – **no need to decouple the motor from hoist**
- Auto-Tuning is three simple steps
- Easy to use test run mode to read current, torque, encoder, etc. – safely
- No option boards required – designed for 110vac control directly to the drive and the encoder feedback circuitry is built in as standard
- Encoder wiring automatically tested
- 3 separate power supplies built in –
  - 10 vdc (20 mA) typically for analog input – no trim resistor needed for full scale
  - 24 vdc (50 mA) auxiliary power if you find a need for it
  - 12 vdc for encoder – higher voltage to ensure precision encoder performance
- Since the Multi-Vector® is specifically designed for hoisting, most variables are automatically set and through our highly praised Gang-Set™ programming, setup is a snap!
- Wide variety of programmable I/O for special functions
- Familiar adjustments – most of the same parameters as other PE drives

Built to Impress:

- Ultra smooth & stable low speed and load float – No Vibration!
- No roll-back or drift of hoist on starting or stopping
- Quick system check means no more long delays to start run function
- Quick & easy installations – up and running in minutes, not hours or days!
- More features with less programming
- Can handle the big jobs and keep working

Built to be Safer:

- Super quick reliability check prior to every run – checks for phase loss, motor continuity, brake loss, encoder operation, and proper torque
- No operation without proper control signals
- Optically isolated inputs – rugged and reliable
- Numerous digital signal processor checking to help assure safety
- Safety is number one priority in the design – safest system available since the hardware and software are not limited to "general purpose" design.

PE high quality is well known
PE support is easily the best
PE deliveries – best in the industry
PE is made in the USA – we make them!