



ALLEN-BRADLEY BULLETIN 1336 IMPACT SPEED/TORQUE MODE SELECT

APPLICATION NOTE # 1336E - 1

June 24, 1997

PURPOSE

The purpose of this document is to provide guidelines for wiring and control schemes for the Bulletin 1336 IMPACT AC Drive. This document is to be used as a suggestion only. Users must ensure that installations meet applicable codes and are suitable for the existing conditions.

WHAT THIS NOTE CONTAINS

This note describes the setup and application of the Speed/Torque Mode Select parameter.

INTENDED AUDIENCE

This application note is intended to be used by personnel familiar with the hardware components and programming procedures necessary to operate the Bulletin 1336 IMPACT.


WHERE IT IS USED


The diagrams, parameter settings, and auxiliary hardware used in this application note are designed to address specific issues in many different applications. Some changes by the Users may be necessary to apply the concepts of this document to a specific application.

TERMS AND DEFINITIONS

[] - indicates a parameter name.

Link - A link is a software connection between two parameters that lets one parameter receive information from another.

 - This represents a **source** which is a link parameter that provides the information.

 - This represents a **destination** which is a link parameter receiving the information.

File - A set of categorically similar parameter groups.

Group - A set of parameters that are similar in feature or function.

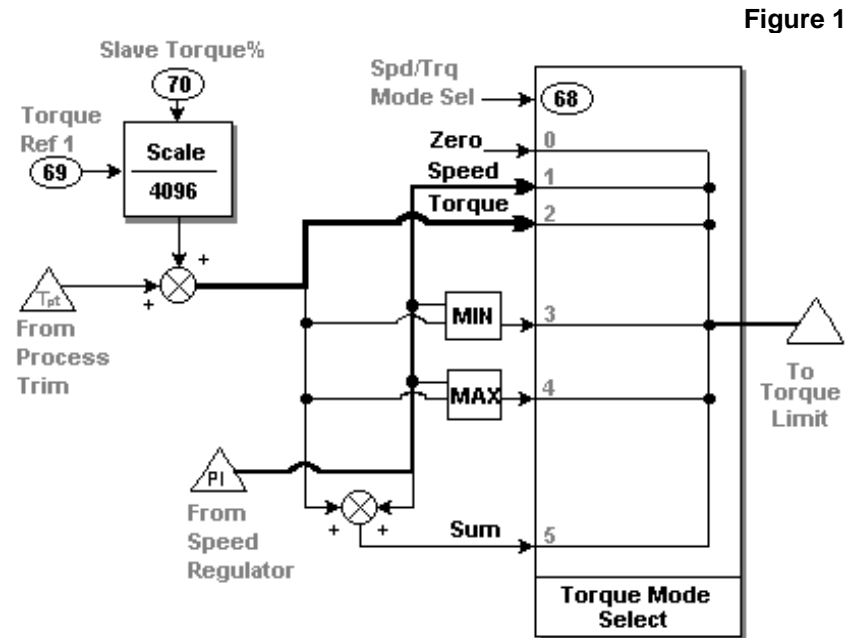
Element - A single parameter within a group.

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HIM - Human Interface Module

DESCRIPTION

The Speed/Torque Mode Select parameter is used to choose the operating mode for the drive. The drive can be programmed to operate as a velocity regulator, a torque regulator, or a combination of the two. Refer to the firmware flowchart shown in figure 1.



As shown in figure 1, parameter 68 [Spd/Trq Mode Sel], is used to select the mode of operation. Zero torque current is allowed when set to (0).

Set to a value of 1, the drive/motor are operated in speed mode. The torque command changes as needed to maintain the desired speed.

Set [Spd/Trq Mode Sel] to a value of 2 for torque mode. In torque regulation mode, the drive controls the desired motor torque. The motor speed will be a result of the torque command and load present at the motor shaft.

Min and Max mode are selected by values 3 and 4 respectively. These two modes offer a combination of speed and torque operation. The drive will automatically switch from speed to torque mode (or from torque to speed) based on the dynamics of the motor/load. The algebraic minimum or maximum of speed/torque will be the operating point for the Min and Max modes.

The Min mode is typically used with positive torque and forward speed operation, the minimum of the two being closest to zero. The Max mode is opposite, typically used with reverse speed and negative torque, the maximum being the least negative (closest to zero).

Sum mode is selected when [Spd/Trq Mode Sel] is set to a value of 5. This mode allows an external torque command to be added to the speed regulators output when desired.

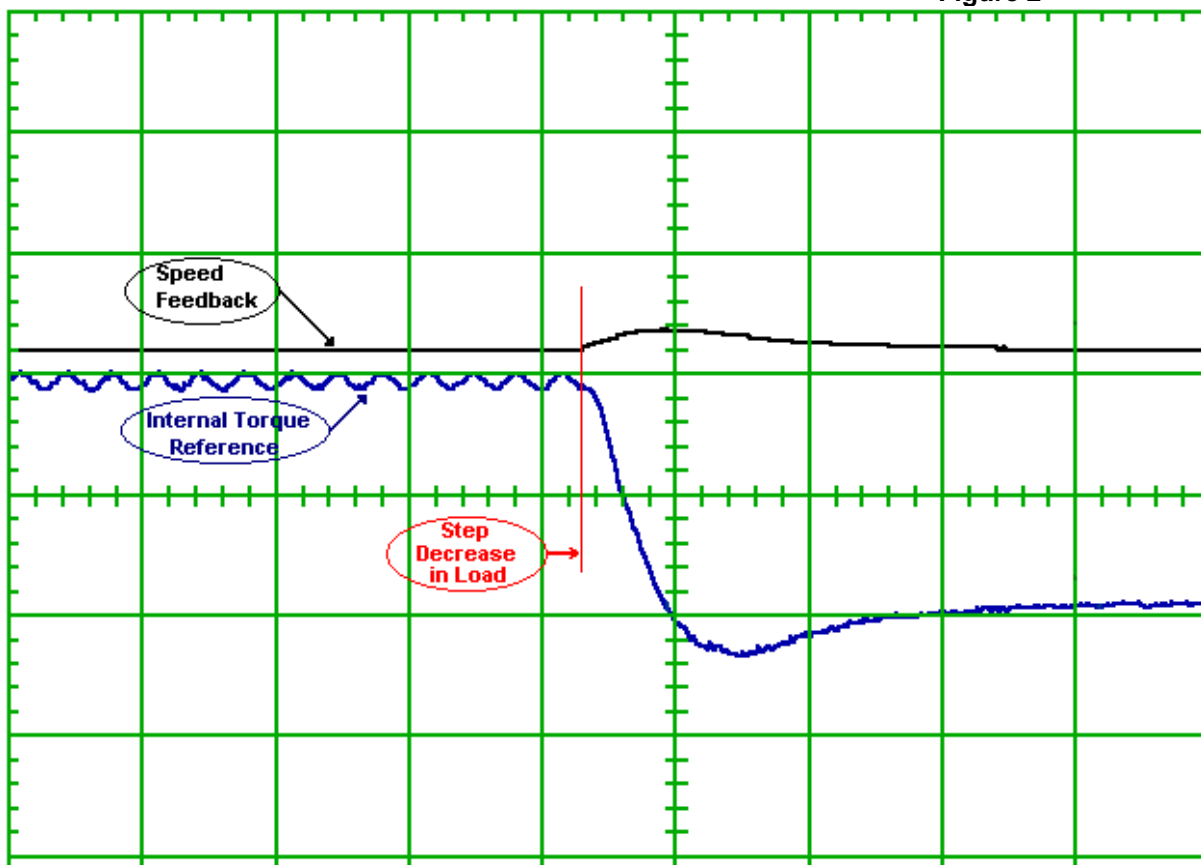
APPLICATION CONSIDERATIONS

SPEED REGULATION MODE

Operating as a speed regulator is the most common and therefore simplest mode to setup. Examples of speed regulated applications are blowers, conveyors, feeders, pumps, saws, and tools.

To configure the drive as a speed regulator, set [Spd/Trq Mode Sel] to 1. Select a speed reference source and program the appropriate link. The factory default link is [SP An In1 Value] \leftarrow 134 \rightarrow 29 [Speed Ref 1]. If left at default, the drive will follow the speed reference of the SCANport 1 input. Typically this reference will be the potentiometer on the drive mounted Human Interface Module. Figure 2 shows the drive operating in speed regulation mode with a step decrease in load. The response of the drive/motor to a change in load is dependent on the tuning of the drive (bandwidth setting), and system inertia.

Figure 2

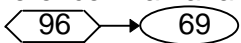


Note that under steady state conditions the speed feedback is steady while the torque reference is a constantly adjusting signal. This is required to maintain the desired speed. At transient state, the torque

reference will change dramatically to compensate for a speed change. A short duration change in speed is the result of increasing or decreasing the load very rapidly.

TORQUE REGULATION MODE

A torque regulated application can be described as any process that requires some tension control. An example of this is a winder or unwinder where material is being “drawn” or pulled with a specific tension required. The process requires another element setting the speed.

Configuring the drive for torque regulation requires [Spd/Trq Mode Sel] to be set to 2. In addition to that, a reference signal must be linked to the Torque Reference. If an analog signal is used for the reference, link [An In1 Value]  [Torque Ref 1].

When operating in a torque mode, the motor current will be adjusted to achieve the desired torque. If the material being wound/unwound breaks, the load will decrease dramatically and the motor can potentially go into a “runaway” condition.

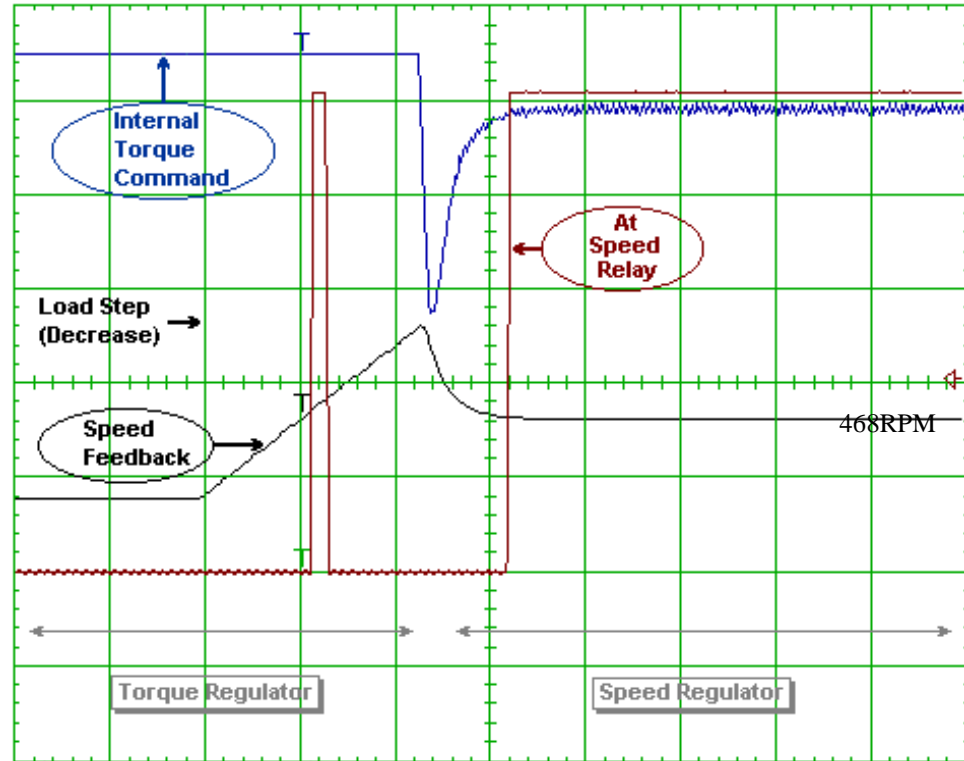
MIN MODE / MAX MODE

This operating mode compares the speed and torque commands, the algebraically minimum value is used. This mode can be thought of as a Speed Limited Adjustable Torque operation. Instead of operating the drive as a pure torque regulator, the “runaway” condition can be avoided by limiting the speed. A winder is a good example for the application of the Min Spd/Trq operating mode. Max mode would be used if both speed and torque are negative.

Figure 3 illustrates how min mode operates. The drive starts out operating as a torque regulator. The torque reference causes the motor to operate at 308rpm. The speed reference is 468rpm, so the minimum is to operate as a torque regulator. While operating in torque regulation, the load decreases and the motor speeds up. Notice the torque command has not changed. When the speed regulator comes out of saturation, it clamps the speed and now the drive operates as a speed regulator. The At Speed Relay then closes.

Figure 3

308RPM



SUM MODE

Configuring the drive in this mode allows an external torque input to be summed with the torque command generated by the speed regulator. The drive requires both a speed reference and a torque reference to be linked.

This mode can be used for applications that have precise speed changes with critical time constraints. If the torque requirement and timing is known for a given speed change, then the external torque input can be used to preload the integrator. The timing of the speed change and the application of an external torque command change must be coordinated for this mode to be useful. The sum mode will then work as a feed forward to the torque regulator.

ZERO TORQUE MODE

Operation in zero torque mode allows the motor to be fully fluxed and ready to rotate when a speed command or torque command is given. For a cyclical application where through put is a high priority this mode can be used. When the [L Option Mode], parameter 116, is set to a value of 19, 20, or 22, logic inputs may be used to switch between operating modes. Refer to the Speed/Torque Select Table.

The logic inputs can select zero torque during the “rest” portion of a machine cycle instead of stopping the drive. When the cycle start occurs, instead of issuing a start to the drive, a speed regulate mode can be selected. The drive will then immediately accelerate the motor without the need for “flux up” time.

Speed/Torque Select Table

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SPD/TRQ 1	SPD/TRQ 2	SPD/TRQ 3	OPERATING MODE
False	False	False	Zero Torque
True	False	False	Speed Regulate
False	True	False	Torque Regulate
True	True	False	Min Speed/Torque
False	False	True	Max Speed/Torque
True	False	True	Sum Speed/Torque
False	True	True	Zero Torque
True	True	True	Zero Torque

Zero Torque may excessively heat the motor if operated in this mode for extended periods of time. No load or flux current is still present when the drive is operating in zero torque mode. A motor with an extended speed range or separate cooling methods (blower) may be required.