Allen-Bradley

1336 IMPACT™ AC Drive

Load Sharing for the 1336 IMPACT AC Drive

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Load Sharing Techniques

Three categories are Droop, Torque Follower, and Speed Trim Follower.

Configurations

Three categories of load sharing techniques will be presented, each having unique characteristics. The subtle differences will be addressed to better identify how to implement each to ensure a successful application. The categories are Droop, Torque Follower, and Speed Trim Follower.

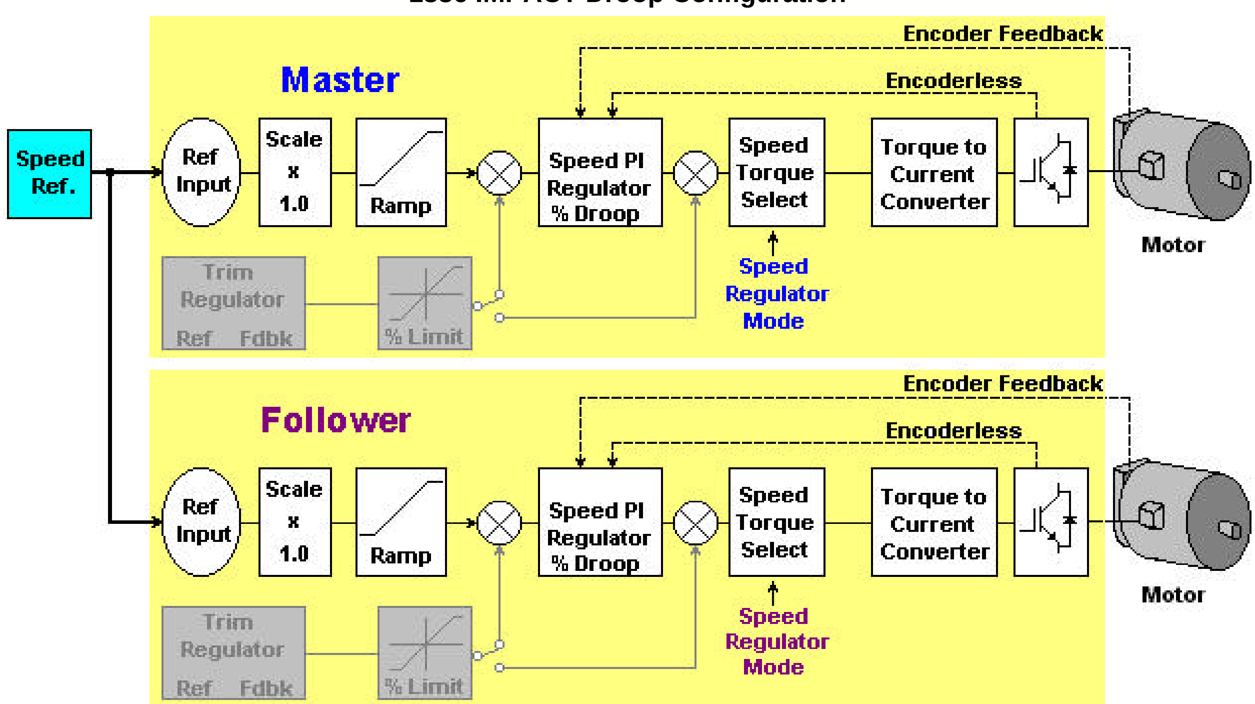
Droop

Drives with the capability of torque regulation, such as the 1336 IMPACT drives, have both a torque regulator and a velocity regulator. The velocity regulator controls motor speed in rpm's not frequency.

Both master and follower drives are operated in droop. This allows all drives to shed load by reducing speed, but helps prevent the system from operating with a rigid speed regulator. If the master drive is not allowed to droop, all follower drives will be "pulled" by the master.

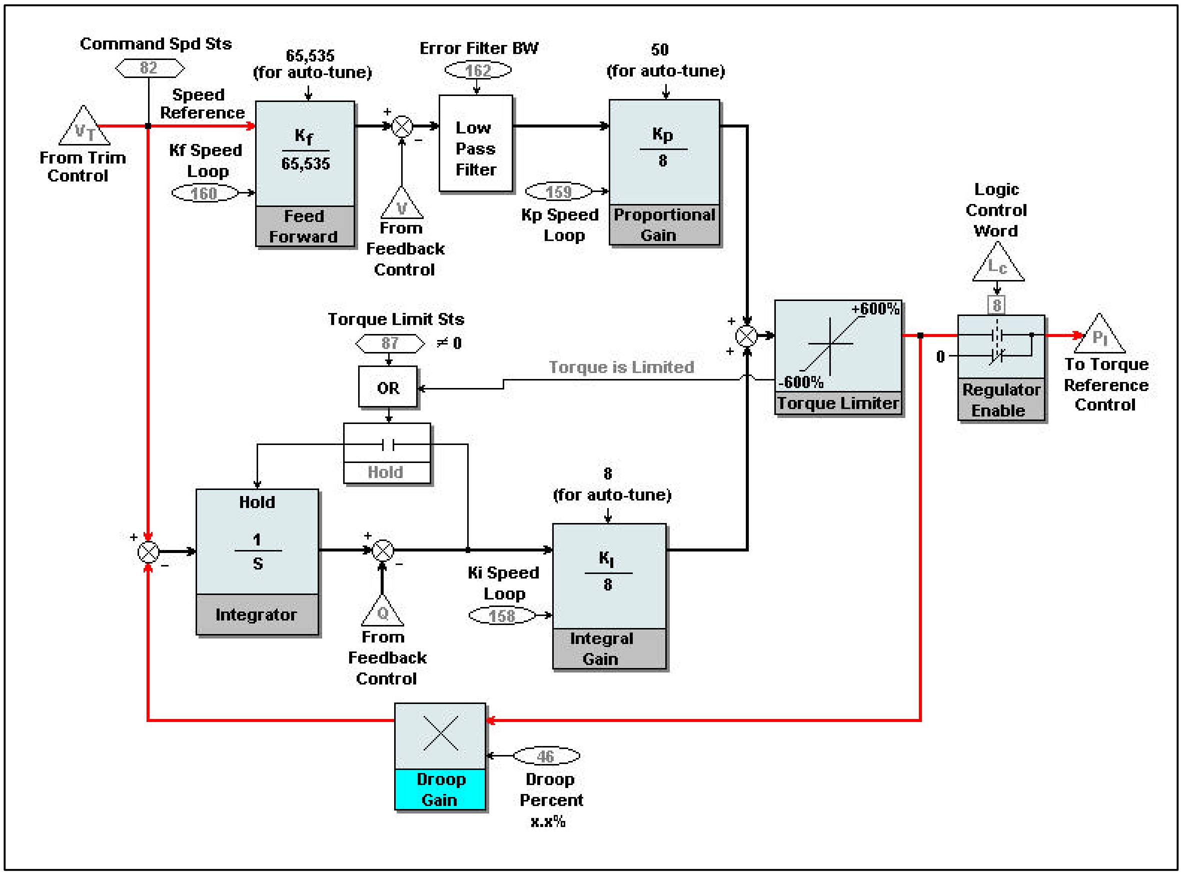
One potential workaround for droop with a master speed regulator is to scale the reference input to the follower drives. The followers need to have a higher reference value since they will be lowering the output during loaded conditions.

1336 IMPACT Droop Configuration



1336 IMPACT Speed PI Regulator

The output of the velocity loop is a torque command used by the torque regulator. The torque regulator then increases or decreases the output torque to reach the desired motor speed.



The output of the torque regulator is feedback to the speed regulator and used by the droop circuitry to subtract a specific rpm from the speed reference at full load. The value programmed into (P46) [Droop Percent] is based on rated motor rpm. For an 1800 rpm motor at full load, a 2% droop value would reduce motor speed by 36 rpm at rated load.

Load Types

Droop should be used when the load coupling is non-rigid. Examples of applications that can benefit from droop are air handling units with a common discharge, or conveyors with small load changes and limited speed range.

Advantages

- *Simple*
- *No extra wiring for interconnection*
- *High performance drive not required*
- *No runaway condition with load loss*

Disadvantages

- *Poor speed regulation*
- *Limited speed range*
- *Sharing of load not precise*
- *Not recommended for more than 2 drives*

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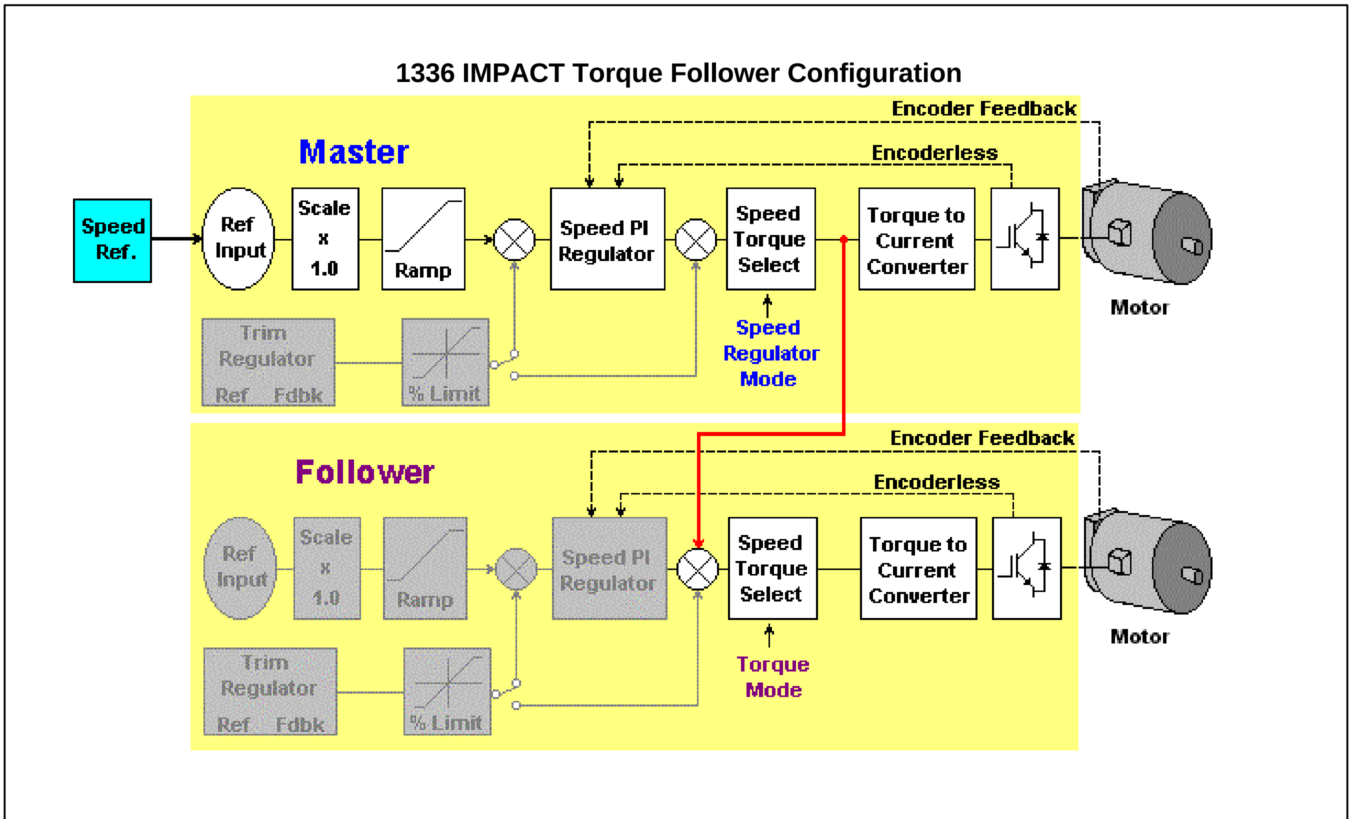
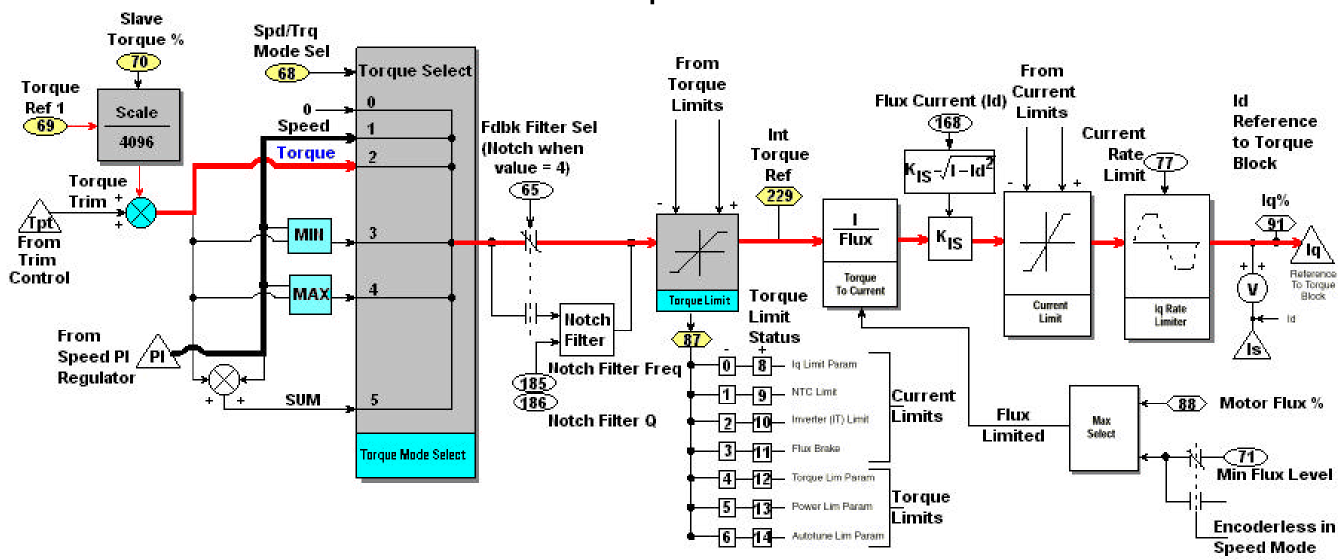
Torque Follower

The master drive is operated in speed regulation. The follower drive(s) are operated in torque regulation mode. Interconnection of the drives is required. The torque reference of the master drive is sent to the follower drives and used as the command.



The internal torque reference (P229) [Int Torque Ref] of the master drive is used as the torque reference for the follower drive(s). This value can be sent to the follower drive(s) via a network connection or by using the analog I/O of the drives.

1336 IMPACT Torque Mode Select Block



The torque mode select block determines the operational mode of the drive. All of the follower drives will operate in torque mode (P68) [Spd/Trq Mode Sel] set to a value of “2”. The internal torque reference of the master drive is used as the input to [Torque Ref 1] (P69) of the follower drives. To scale the torque reference, use (P70) [Slave Torque %].

It may be desirable to operate the follower drives in a torque minimum mode to help prevent motor runaway should the load disappear. Torque minimum allows the drive to operate in torque mode with a speed limit. If the load decreases to a point that the torque reference causes the motor speed to increase rapidly, the drive will automatically switch to speed regulation. The drive will revert to torque regulation when the load increases enough to slow the motor to a value less than the speed regulator reference.

Load Types

Torque follower configurations should be used when the load coupling is rigid. Examples of applications that can benefit from this are conveying lines with a common line shaft, large bull gears with multiple driven motors, or web lines with multi-stage tension regulation.

Advantages

- *Precise load sharing (act as one)*
- *Operation over the entire speed range*
- *Minimum torque mode helps prevent runaway*

Disadvantages

- *Requires torque regulating drive*
- *Interconnection required*
- *Load loss runaway if torque regulator only*

Load Sharing for the 1336 IMPACT AC Drive

Interconnection

Analog I/O may be used for either configuration (single-source or cascade). An example of configuring the links for analog signal control is as follows. (Assumes analog input 1 and output 1.)

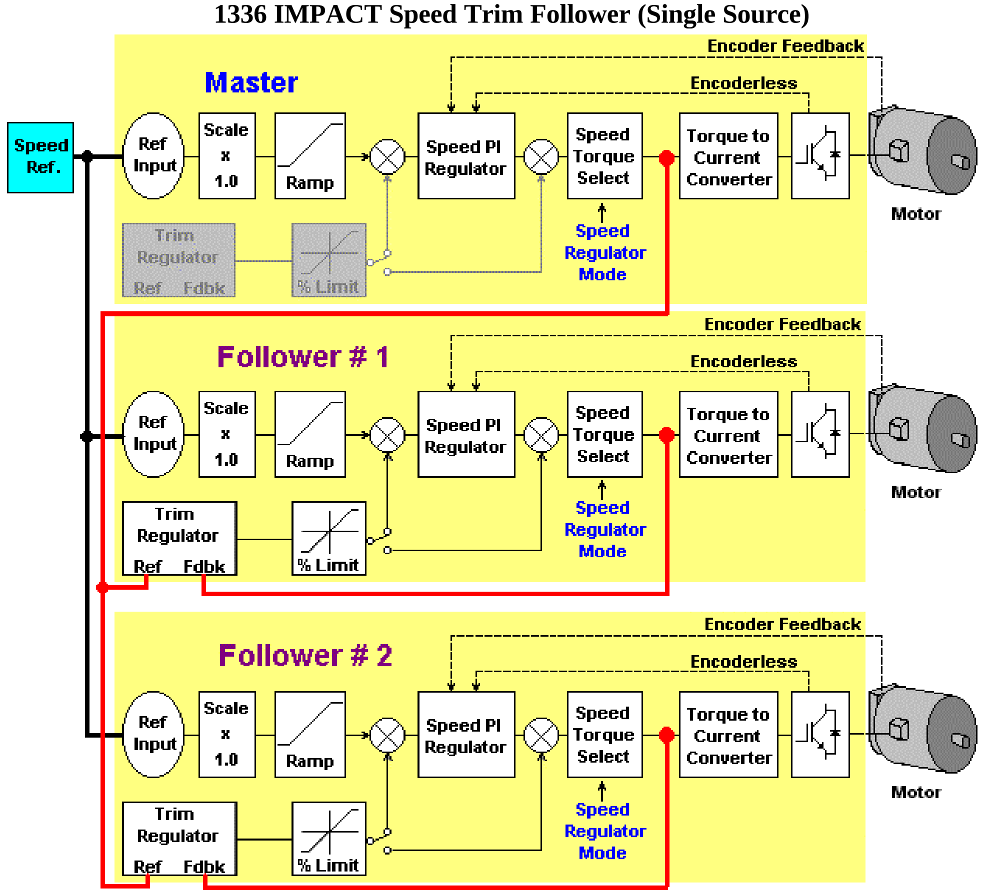
Master Drive	Follower Drive
[Int Torque Ref] → [An Out 1 Value]	[An In 1 Value] → [Torque Ref 1]
<P229> → (P105)	<P96> → (P69)

Speed Trim Follower

The master drive is operated in speed regulation. The follower drive(s) are operated in speed regulation mode with a speed trim. The trim is a function of comparing the torque commands of the master and follower drives.

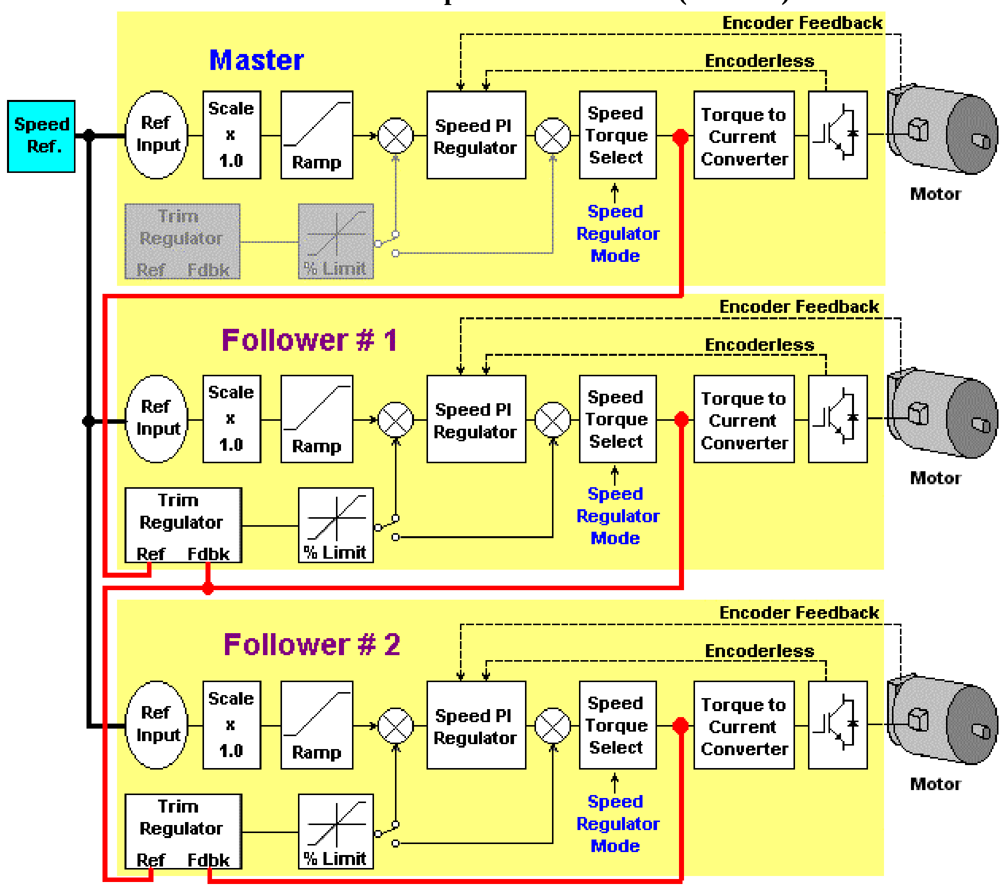
Two types of configurations can be used; one uses a single source (master drive) for a torque reference comparison. The follower drives compare the masters drive torque reference to their own internal value to create the error signal for speed trimming.

1336 IMPACT Speed Trim Follower (Single Source)



The second configuration cascades the torque reference comparison. The first follower compares the master to its internal value. The second follower compares follower 1 and its internal value.

1336 IMPACT Speed Trim Follower (Cascade)

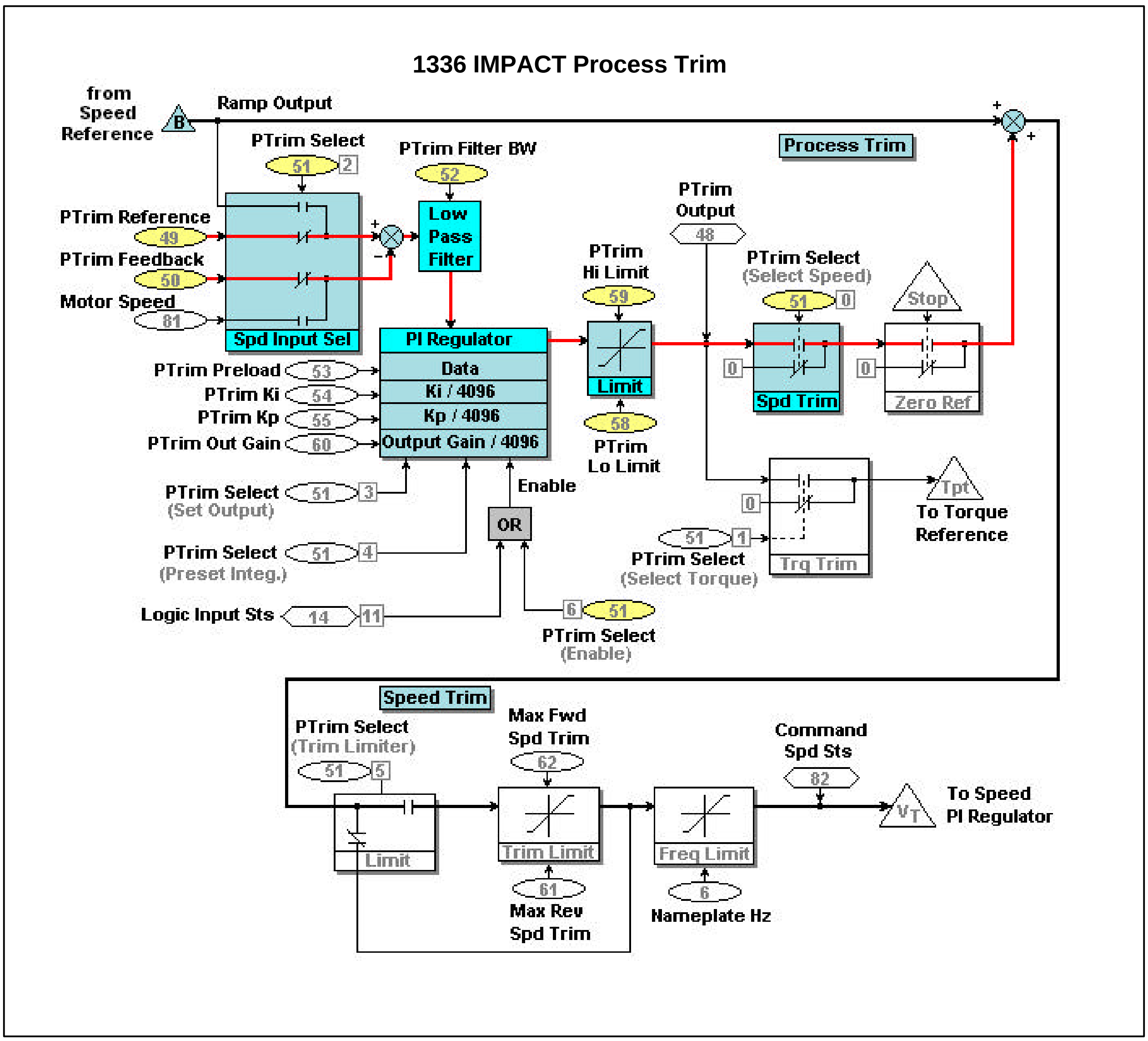


The process trim regulator is used by all follower drives to compare the two torque references. The regulator must be enabled for speed trim. Parameters must be linked to the reference and feedback inputs of the trim regulator. The high and low trim limits must be set to limit how much speed can be trimmed. Filtering may also be required to soften the reaction of the trim regulator.

Interconnection

Analog I/O may be used for either configuration (single source or cascade). An example of configuring the links for analog signal control is as follows. (Assumes analog input 1 and output 1.)

Master Drive	Follower Drive
[Int Torque Ref] → [An Out 1 Value]	[An In 1 Value] → [PTrim Reference]
<P229> → (P105)	<P96> → (P49)



The master drive must send [Iq%] (P91) to the follower. If done with analog I/O, then link P91 to P105 [An Out 1 Value] in the master drive. In the follower drive, link the analog input [An In 1 Value] (P96) to [PTrim Reference] (P49). Then link the torque reference of the follower drive [Iq%] (P91) to (P50) [PTrim Feedback].

Parameter 51 [PTrim Select] configures the regulator. Set bit 0 to select speed trim, and bit 6 to enable the regulator.

Set the limits [PTrim Lo Limit] (P58) and [PTrim Hi Limit] (P59) to small percentage values (-2.5% and +2.5% respectively). This will create a tight band that can be added to or subtracted from the speed reference.

Tuning of the trim regulator is accomplished with [PTrim Filter BW] (P52). The correct setting can be determined by monitoring [PTrim Output] (P48) while adjusting the filter setting. If the filter is not properly tuned, the output signal will rapidly and continuously move between the plus and minus limits causing instability.

Advantages

- *Continuous automatic compensation*
- *Operation over the entire speed range*
- *Trim feature built into drive*
- *Speed regulation*

Disadvantages

- *Requires high performance drive for precision*
- *Requires interconnection wiring*

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