Velocity Loop Signal Attributes

These are the velocity control signal related attributes associated with a Motion Control Axis.

Velocity Command

Usage	Access	T	Data Type	Default	Min	Max	Semantics of Values
Required - FPV	Get	T	REAL	-	-	-	Velocity Control Units/Second

The Velocity Command attribute is the command velocity output from the Fine Command Generator (if active) into velocity loop when configured for the Velocity Loop control or frequency controller when configured for Frequency Control operation.

Velocity Trim

Usage	Access	T	Data Type	Default	Min	Max	Semantics of Values
Required - FPV	Set/SSV	T	REAL	0	- maxspd	maxspd	Velocity Units

Additional velocity command added to the velocity loop summing junction.

Acceleration Feedforward Command

Usage	Access	T	Data Type	Default	Min	Max	Semantics of Values
Required - PV	Get/GSV	T	REAL	-	-	-	Accel Units

The Acceleration Feedforward Command attribute is a signal that represents a scaled version of the command acceleration profile. This signal is the Acceleration Fine Command signal scaled by Acceleration Feedforward Gain and applied to the output of the velocity loop.

Velocity Reference

Usage	Access	T	Data Type	Default	Min	Max	Semantics of Values
Required - FPV	Get/GSV	T	REAL	-	-	-	Velocity Units

Command velocity reference into velocity loop summing junction, or in the case of Frequency Control, the signal that is scaled to become the Frequency Reference.

Velocity Feedback

Usage	Access	T	Data Type	Default	Min	Max	Semantics of Values
Required - EDI	Get/GSV	T	REAL	-	-	-	Velocity Units

Actual velocity of the axis applied to the velocity summing junction, if applicable, based on Control Mode selection. In most cases the Velocity Feedback signal is derived directly from the feedback device specified by the Feedback Mode selection. If the axis is configured for Feedback Only mode, Velocity Feedback represents the actual velocity of the feedback device. If the axis is configured for Frequency Control, the Velocity Feedback signal is derived from the Velocity Reference signal. If configured for Sensorless Velocity Loop operation, i.e. Feedback Mode set to No Feedback, Velocity Feedback is estimated by the sensorless control algorithm.

Velocity Error

Usage	Access	T	Data Type	Default	Min	Max	Semantics of Values
Required - PV	Get/GSV	T	REAL	-	-	-	Velocity Units

Error between the velocity reference and velocity feedback value that is the output of the velocity loop summing junction.

Velocity Integrator Output

Usage	Access	T	Data Type	Default	Min	Max	Semantics of Values
Required - PV	Get/GSV	T	REAL	-	-	-	Accel Units

Output of velocity integrator representing the contribution of the velocity integrator to Velocity Loop Output.

Velocity Loop Output

Usage	Access	T	Data Type	Default	Min	Max	Semantics of Values
Required - PV	Get/GSV	T	REAL	-	-	-	Accel Units

Output of velocity forward path representing the total control effort of the velocity loop.

Velocity Limit Source

Usage	Access	T	Data Type	Default	Min	Max	Semantics of Values

Attributes
Converter Current Control Configuration Attributes
Converter Current Control Signal Attributes
Converter Current Reference Configuration Attributes
Converter Current Reference Signal Attributes
Converter Output Attributes
Converter Reactive Power Control Attributes
Converter Types
Current Control Signal Attributes
Current Control Configuration Attributes
Cyclic Read and Cyclic Write
DC Bus Condition Attributes
Device Function Codes
Device Commissioning Attributes
Drive General Purpose I/O Attributes
Drive Output Attributes
Drive Parameters
Event Capture Attributes
Exception Factory Limit Info Attributes
Exception User Limit Configuration Attributes
Exception, Fault and Alarm Attributes
Exceptions
Fault and Alarm Behavior
Feedback Interface Types
Feedback Configuration Attributes
Frequency Control Configuration Attributes
Frequency Control Signal Attribute
General Feedback Info Attributes
General Feedback Signal Attributes
General Linear Motor Attributes
General Motor Attributes
General Permanent Magnet Motor Attributes
General Rotary Motor

Optional-PV	Get/GSV	T	DINT	-	-	-	Enumeration: 0 = Not Limited 1 = Positive Limit 2 = Negative Limit 3 = Bus Overvoltage Limit 4 = Max Extended Speed Limit 5 - 127 = (Reserved) 128 – 255 = Vendor Specific

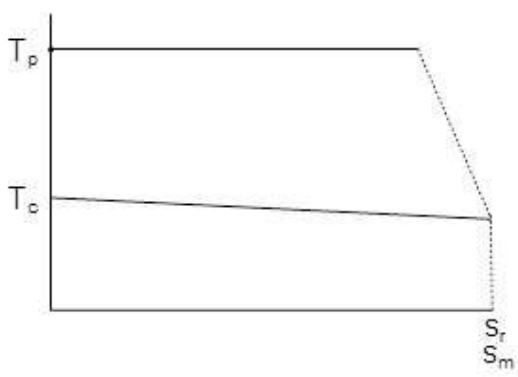
The Velocity Limit Source attribute is an enumerated value that specifies the source of the operative velocity limit.

Velocity Limiter Extensions

Permanent magnet (PM) motor applications sometimes require drives to provide extensions to the velocity limiter function to protect the drive electronics and motor from potentially destructive overspeed conditions when operating at speeds above the motor's rating. The Velocity Limiter serves to protect the drive and motor when applied in these high speed applications.

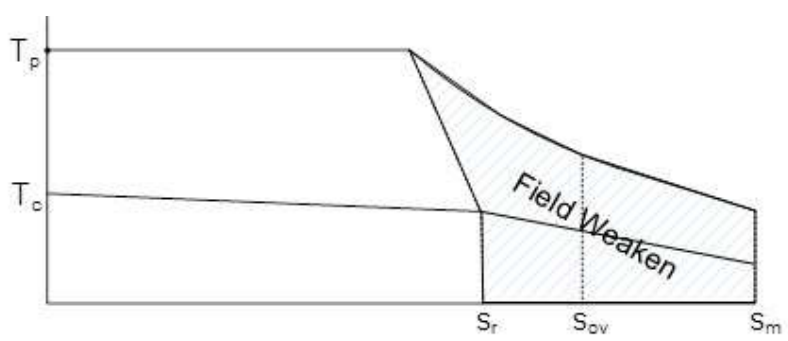
PM Motor Torque-Speed Curve

A generalized Torque-Speed curve for a PM motor is shown in the following graph. The two curves shown define the continuous (T_c) and peak torque (T_p) capabilities of the motor. PM motors typically specify a 'rated speed' (S_r) based on rated voltage and continuous torque and also a 'max speed' (S_m) based on the maximum operating speed. Often the specified rated speed and max speed for the motor are set to the same value.



Field Weakening

PM motors can also be operated using a technique called "field weakening" to extend the top speed capability of the motor. Field weakening uses active current vector control to reduce the effective magnetic field strength from the permanent magnets, enabling higher speeds at the expense of lower torque production. While the use of field weakening to significantly extend motor speed range is more common for Interior PM (IPM) motors, the speed range of Surface-mount PM (SPM) motors can be significantly extended as well. The following graph illustrates the PM Motor Torque-Speed Curve with Field Weakening.



When the drive applies field weakening to a PM motor to reach higher than rated speed, the drive's motor current vector control algorithm effectively decreases the motor Ke. This reduces the resulting Counter EMF (CEMF) voltage to be less than the DC bus voltage. However, if this active current vector control is suddenly removed, the Ke value would revert to the nominal value and the CEMF voltage would increase rapidly. Active control of motor current is lost whenever the power structure is disabled. So the concern is when the power structure is disabled with the motor still spinning. This can be the case when the drive executes a Category 0 Stop due to a control initiated Disable Request, a Major Fault action, or a Safe Torque Off activation.

Three speed values are shown in the preceding figure. As defined in the first figure, the rated speed (S_r) corresponds to operation at rated voltage and continuous torque. This is the maximum continuous torque that can be achieved without field weakening. S_{OV} is the speed at which the CEMF voltage from the nominal Ke would be equivalent to the maximum DC Bus Voltage rating of the drive, or the DC Bus Overvoltage Limit.

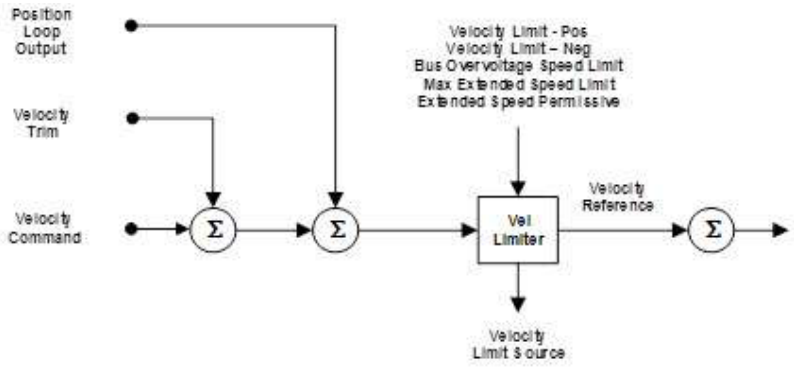
If active motor current control is removed while the motor is operating at speeds above S_{OV}, the CEMF voltage results in a DC Bus overvoltage condition that can damage the drive and, possibly, other drives sharing the same DC Bus.

S_m is the absolute maximum operating speed of the motor based on mechanical constraints. For a rotary motor, S_m would be given by the Rotary Motor Max Speed attribute.

Major damage to devices connected to the DC Bus can occur when the PM motor is allowed to run between S_{OV} and S_m and the drive's power structure is disabled.

Velocity Limiter Behavior Diagram

The following diagram shows the extensions that have been added to the Velocity Limiter to help manage the inherent risks of high speed PM motor operation. In addition to the existing Velocity Limit - Positive/Negative attributes that can be used to limit the Velocity Reference signal, two new limits have been defined based on S_{OV} and S_m defined above. Specifically, the PM Motor Rotary - Bus Overvoltage Speed and PM Motor Linear Bus Overvoltage Speed attributes establish an absolute limit on the Velocity Reference signal that corresponds to S_{OV}. This speed limit can only be exceeded if the PM Motor Extended Speed Permissive attribute is set to True. The PM Motor Rotary Max Extended Speed and PM Motor Linear Max Extended Speed attributes establish an absolute limit on the Velocity Reference signal that corresponds to S_m. The Velocity Limit function limits the Velocity Reference signal to the minimum of these attribute values. The Velocity Limit Source attribute indicates the source of the velocity limit.



Through these extensions to the Velocity Limiter function, a drive that supports field weakening can be configured to safely manage extended speed operation, only allowing operation above S_{OV} by setting the PM Motor Extended Speed Permissive attribute. Systems that can run safely above S_{OV} are generally equipped with a DC Bus Regulator or a Resistive Brake Module.

See also

Position Loop Signal Attributes

Position Loop Configuration Attributes

Velocity Loop Configuration Attributes

General Permanent Magnet Motor Attributes

- Select/Limit Instructions
- Sequential Function Chart (SFC) Instructions
- Statistical Instructions
- Safety Instructions

Studio 5000 Logix Designer Glossary

How are we doing?