

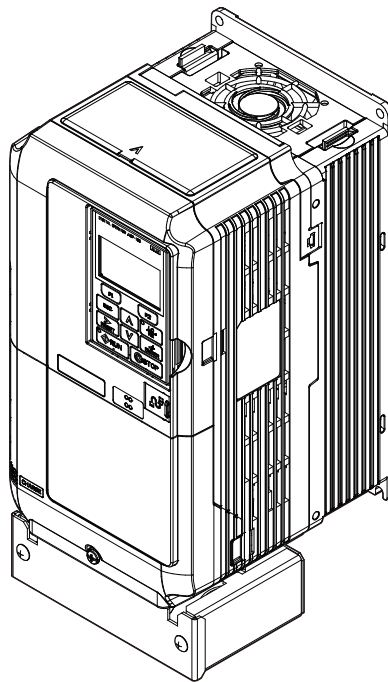
## YASKAWA AC Drive - A1000

# Overvoltage Suppression Custom Software Supplement

Software Number: VSA91013□

Drive Models: 200 V Class, CIMR-AU2A0004□A□ to CIMR-AU2A0415□A□  
400 V Class, CIMR-AU4A0002□A□ to CIMR-AU4A0675□A□  
600 V Class, CIMR-AU5A0003□A□ to CIMR-AU5A0242□A□

To properly use the product, read this manual thoroughly and retain for easy reference, inspection, and maintenance. Ensure the end user receives this manual.





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Refer to the A1000 Technical Manual for content not described in this document.

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# 1 Preface and Safety

Yaskawa manufactures products used as components in a wide variety of industrial systems and equipment. The selection and application of Yaskawa products remain the responsibility of the equipment manufacturer or end user. Yaskawa accepts no responsibility for the way its products are incorporated into the final system design. Under no circumstances should any Yaskawa product be incorporated into any product or design as the exclusive or sole safety control. Without exception, all controls should be designed to detect faults dynamically and fail safely under all circumstances. All systems or equipment designed to incorporate a product manufactured by Yaskawa must be supplied to the end user with appropriate warnings and instructions as to the safe use and operation of that part. Any warnings provided by Yaskawa must be promptly provided to the end user. Yaskawa offers an express warranty only as to the quality of its products in conforming to standards and specifications published in the Yaskawa manual. **NO OTHER WARRANTY, EXPRESS OR IMPLIED, IS OFFERED.** Yaskawa assumes no liability for any personal injury, property damage, losses, or claims arising from misapplication of its products.

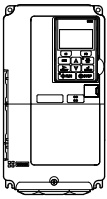
## ◆ Applicable Documentation

The following manuals are available for the A1000 Drive:

### Custom Software Supplement

	<b>Yaskawa AC Drive - Overvoltage Suppression A1000 Custom Software Supplement</b> <b>Manual No: TM.A1000SW.062</b>
Read this manual first. This supplement is an addendum to the A1000 Quick Start Guide and Technical Manual. It lists the effects of this custom software on the parameters in the drive and function descriptions in the manual. To obtain the supplement access this site: U.S: <a href="http://www.yaskawa.com">http://www.yaskawa.com</a>	

### Yaskawa Drive

	<b>Yaskawa AC Drive - A1000 Quick Start Guide</b>	To obtain instruction manuals for Yaskawa products access these sites: U.S.: <a href="http://www.yaskawa.com">http://www.yaskawa.com</a> Other areas: contact a Yaskawa representative. For questions, contact the local Yaskawa sales office or the nearest Yaskawa representative.
	<b>Yaskawa AC Drive - A1000 Technical Manual</b>	

## ◆ Supplemental Safety Information

Read and understand this manual and the A1000 Quick Start Guide before installing, operating, or servicing this option unit. Install the drive according to the A1000 Quick Start Guide and local codes. Observe all cautions and warnings in this document and the standard drive technical manuals.

Refer to the A1000 Quick Start Guide and Technical Manual for safety information and to install and start-up the drive.

This document is a supplement to the standard drive technical manual. It describes the effects on the drive parameters and functions with the software installed.

- Custom software is provided to add functionality to a standard drive to enhance or enable use in a specific application.
- The software is loaded to the flash ROM area of the control board, and replaces the standard drive software.

## ◆ Obtaining Support

When seeking support for a drive with custom software, it is imperative to provide the unique part number shown on the drive nameplate. The software is flashed to the control board memory and the operation of parameters, functions, and monitors are different than the standard drive software, as described herein.

Refer to Yaskawa office locations listed on the back cover of this manual.

## 2 Overvoltage Suppression A1000 Custom Software

### ◆ Overview

The Overvoltage Suppression (OV Suppression) feature minimizes the chance of Overvoltage trips and the need for dynamic braking for eccentric load applications by controlling the amount of regenerative energy during overhauling conditions. This firmware is not available as factory installed on A1000 and therefore offered free of charge for download.

### ◆ Applicable Models

This Overvoltage Suppression software is available for the drive models listed in [Table 1](#).

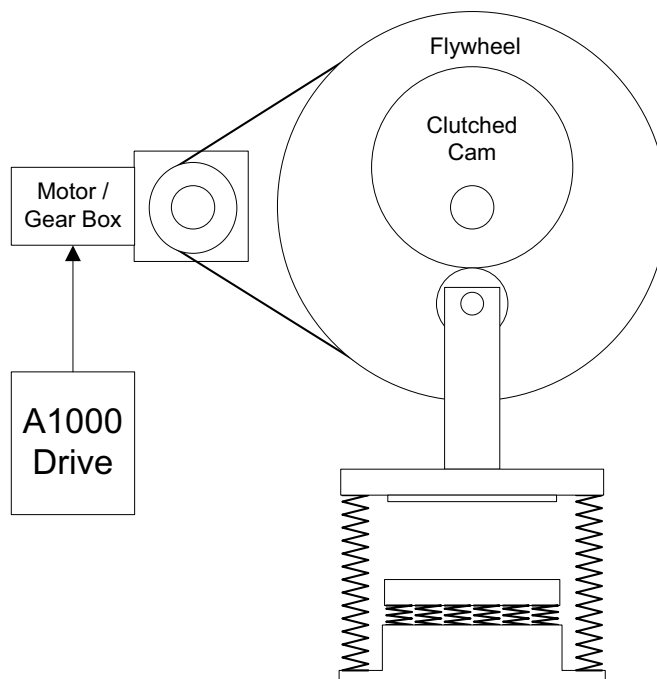
**Table 1 Applicable Models**

Voltage Class	Model	Software Version
200 V	CIMR-AU2A0004 to CIMR-AU2A0415	VSA91013□
400 V	CIMR-AU4A0002 to CIMR-AU4A0675	
600 V	CIMR-AU5A0003 to CIMR-AU5A0242	

### ◆ Basic Concepts and Principles

Overvoltage Suppression software allows the drive to control rotating machinery where part of the machine's cycle creates a cyclic regenerative (over-hauling) load. This custom software is specifically designed for Pump Jack Oil Well and Stamping/Punch Press applications. This software eliminates the need for dynamic braking resistors typically required in cyclic regenerative applications.

This software monitors the torque-producing current ( $I_q$ ) in the motor, and regulates this against an  $I_q$  setpoint using a PI controller. The output frequency is increased to force a higher (positive)  $I_q$  should the torque producing current fall below the setpoint. This will avoid a regenerative condition in the motor. This function is disabled during auto-tuning.



**Figure 1 Stamping Press Application**

### ◆ Changes from Standard Product

- Several parameter defaults are changed.
- The Stationary auto-tuning method (T1-01 = 1) will not set E2-02 (Rated Slip) and E2-03 (No-load Current). Therefore, these parameters must be manually set using the motor's nameplate data.

### ◆ Limitations

- V/f and Open Loop Vector are the only control modes (A1-02 = 0 or 2) that support the OV Suppression function. Closed Loop V/f and Closed Loop Vector are available (A1-02 = 1 or 3) but the OV Suppression function is disabled.
- The "Ramp to Stop" stopping method (b1-03 = 0) is deleted.
- When reverse operation is prohibited (b1-04 = 1) and the motor is moving in the reverse direction, OV Suppression is disabled (This condition can occur due to a bi-directional speed search).
- OV Suppression cannot be used to shorten deceleration time on applications with large loads.
- Torque Ramp during Start is only active in Open Loop Vector control mode (A1-02 = 2).

### ◆ Precautions

**NOTICE:** The OV Suppression function (P1-01 = 1) should not be used in conjunction with standard drive OV Suppression function (L3-11 = 1) as it may cause unstable operation.

**NOTICE:** The motor connected to a drive with this software on it needs to be mechanically capable of operation at the maximum allowed frequency (Parameter E1-04).

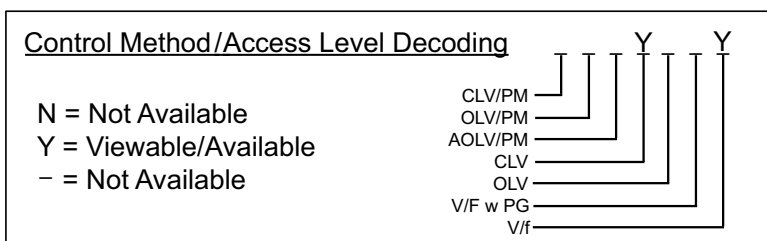
**Note:** The Overvoltage Suppression feature works best in Open Loop Vector (A1-02 = 2), only AFTER a full Rotational auto-tune is performed (T1-01 = 0). If a Rotational auto-tune cannot be performed, a Stationary auto-tune can be performed (T1-01 = 1). You must manually set E2-02 (Rated Slip) and E2-03 (No-load Current) from the motor's nameplate data before running the auto-tune as the Stationary auto-tuning method will not tune these parameters in this software. If performance is not achieved after the Stationary auto-tune, use the V/F control mode (A1-02 = 0) instead.

**Note:** The Overvoltage Suppression function is NOT active when the output frequency is at the maximum output frequency (E1-04). This is because the function needs frequency headroom to work.

### ◆ Related Parameters and Functions

The legend below is used in this section to indicate which parameters are available in which control modes.

The parameter tables in this section are used to set up the drive for operation with the software.



## 2 Overvoltage Suppression A1000 Custom Software

**Table 2 Parameter Default Changes**

No.	MEMOBUS/ Modbus Address	Name Digital Operator Display	Description	Units	Range	Default Value
A1-02	0102h	Control Method Selection <b>Control Method</b>	0: V/F 1: V/F w/PG 2: Open Loop Vector 3: Flux Vector  Note: The OV Suppression function is only available in V/f and Open Loop Vector (A1-02 = 0 or 2).	-	0 to 3	0
b1-03	0182h	Stopping Method Selection <b>Stopping Method</b>	0: Ramp to Stop 1: Coast to Stop 2: DC Injection to Stop 3: Coast to Stop With Timer	-	0 to 3	1
E1-04	0303h	Maximum Output Frequency <b>Max Frequency</b>	Maximum frequency that the drive will output.	0.1 Hz	40.0 to 400.0	90.0 <1> <2>
E3-04	031Ah	Motor 2 Maximum Output Frequency <b>Max Frequency</b>	The maximum frequency that the drive will output to the motor during motor 2 operation.	0.1 Hz	40.0 to 400.0	90.0 <1> <2>

<1> Following 2 or 3-wire initialization (A1-03 = 2220/3330) this parameter will appear in modified constants.

<2> Default setting is determined by the control mode. When using PM motors, the default setting is determined by the motor code set to E5-01.

**Table 3 Overvoltage Suppression and Torque Ramp During Start Parameters**

No.	MEMOBUS/ Modbus Address	Name Digital Operator Display	Description	Range	Default Value	Change During Run	Control Method/ Access Level
P1-01	0600h	Overvoltage Suppression Selection <b>OVS Select</b>	Enables or disables the overvoltage suppression function. 0: Disabled 1: Enabled	0 to 1	0	No	---- Y- Y
P1-02	0601h	OV Suppression PI Setpoint (Iq) <b>OVS Reg Setpoint</b>	This parameter sets the OV Suppression PI setpoint in percent of motor torque-producing current (Iq). Iq is calculated based on FLA & NLA. Note: 100% Iq = 100% motor rated torque.	-100.0 to 100.0 %	8.0	Yes	---- Y- Y
P1-03 <1>	0602h	OVS Regulator Gain <b>OVS Gain</b>	This parameter sets the gain of the OVS PI controller. This determines the responsiveness of the Iq regulator. A larger setting equals more responsiveness.	0.0 to 25.00	2.80	Yes	---- Y- Y
P1-04 <1>	0603h	OVS Regulator Integral Time <b>OVS I Time</b>	This parameter sets the integral time of the OVS PI controller. This determines the responsiveness of the Iq regulator. A smaller setting equals more responsiveness.	0.00 to 160.00	0.10 sec	Yes	---- Y- Y
P1-05	0604h	OV Suppression Positive Integral Limit <b>OV Reg I Limit</b>	This parameter sets the positive limit of the integrator in the OV Suppression PI controller. Note: 100% = Fmax (E1-04).	0.0 to 100.0	100.0 %	No	---- Y- Y
P1-06	0605h	OV Suppression Positive Overall Limit <b>OV Reg Limit</b>	This parameter sets the positive limit of the OV Suppression PI controller (P+I). Note: 100% = Fmax (E1-04). Note: A setting of 0.0% disables the OV Suppression PI controller.	0.0 to 100.0	100.0 %	No	---- Y- Y
P1-07	0606h	OVS Regulator Feedback Filter <b>Feedback Filter</b>	This parameter sets the 1st order filter time of the motor torque-producing current feedback. A larger setting equals a more filtered feedback but less responsiveness.	5 to 10000	30 msec	Yes	---- Y- Y
P1-08	0607h	OVS Regulator Gain Frequency <b>OVS Gain Freq</b> <2>	Gain change endpoint.	0.00 to 400.00 Hz	90.00 Hz	Yes	---- Y- Y
P1-09	0608h	OVS Regulator Gain Multiplier <b>OVS Gain Mult</b> <2>	This parameter sets gain multiplier for the OV regulator gain based on output frequency.	1.000 to 10.000	1.300	Yes	---- Y- Y



## 2 Overvoltage Suppression A1000 Custom Software

No.	MEMOBUS/ Modbus Address	Name Digital Operator Display	Description	Range	Default Value	Change During Run	Control Method/ Access Level
P2-01	060Ah	Belt Break Detection <b>Belt Break Det</b>	This parameter configures the Belt Break Detection function. If the drive's soft starter is at maximum output frequency (E1-04) for more than 30 seconds, a belt break fault (B-BRK) will occur. 0: Disabled 1: Enabled	0 to 1	1	No	---- Y - Y
<b>Function: Torque Ramp During Start</b>							
P3-01	0614h	Torque Limit During Start <b>Start Torque</b>	This parameter determines the forward and reverse motoring torque limits after a run command is received, but before the torque start timer (P3-02) expires. This parameter overwrites L7-01 and L7-02.	0 to 300	200 %	No	---- Y --
P3-02	0615h	Torque Limit During Start Timer <b>Start Torq Time</b>	This parameter sets the time that parameter P3-01 will overwrite L7-01 and L7-02 after a run command is received.	0.0 to 10.0	0.0 sec	No	---- Y --
P3-03	0616h	Torque Limit During Start Ramp Time <b>Torq Lim Ramp Tm</b>	This parameter sets the time required to ramp the torque limit 100%. This determines the rate at which the torque limits will return to the L7-01 and L7-02 values at the end of the starting torque time (P3-02).	0.1 to 10.0	1.0 sec	No	---- Y --

<1> The response of this parameter will be affected by drive size. If a drive is replaced with one of a different size (current rating), this parameter may need adjustment.

<2> Making large changes in these settings while the drive is running can result in large and very rapid changes in the output frequency. Change these parameters in small increments only.

**Table 4 Additional Function Text**

Function No.	Function Name Digital Operator Display
P (Function group)	Overvoltage Suppression <b>OV Suppression</b>
P1	Overvoltage Suppression <b>OV Suppression</b>
P2	Belt Break <b>Belt Break</b>
P3	Torque Limit During Start <b>Torque Dur Start</b>
U7	Overvoltage Suppression <b>OV Suppression</b>

**Table 5 Monitors U1-□□**

Monitor No.	MEMOBUS/ Modbus Address	Monitor Name Digital Operator Display	Description	Analog output scaling	Unit	Control Method/ Access Level
U7-02	0661h	Soft Start Frequency Reference <b>Soft Start Freq</b>	Displays the frequency reference after the soft starter, but before the OV Regulator PI controller output.	100% = Fmax (E1-04)	0.01 Hz	---- Y - Y
U7-03	0662h	Overvoltage Frequency Reference <b>OV Reg Total Ref</b>	Displays the frequency reference after the output of the OV Regulator PI controller.	100% = Fmax (E1-04)	0.01 Hz	---- Y - Y
U7-04	0663h	Overvoltage Suppression Regulator Error Signal <b>OV Reg Error</b>	Displays the error (setpoint - feedback) of the OV Regulator PI controller.	100% = Motor Rated Torque (Iq)	0.1 %	---- Y - Y
U7-05	0664h	Overvoltage Suppression Regulator Output <b>OV Reg Output</b>	Displays the output of the OV Regulator PI controller.	100% = Fmax (E1-04)	0.1 %	---- Y - Y

**Table 6 Multi-Function Input Settings H1-□□**

Setting	Description	Control Method/ Access Level
80	OVS Disable Closed: Disables the OV Suppression function if OV Suppression is enabled (P1-01=1).  Note: If this input is opened while OV Suppression is running, the drive will ramp the OV Suppression regulator setpoint from -100% to P1-02 at a fixed rate of 122% / second to prevent irregularities in motor operation.	---- Y - Y

### ◆ Troubleshooting

Table 7 Fault

Fault Indication LCD <Memobus>	Description	Cause	Countermeasures
Belt Break Detection Fault </> <b>B-BRK</b> Belt Break <3Ch>	The drive's output frequency was at the maximum output frequency (E1-04) for more than 30 seconds. See section 6.3 for details.	The belt has broken or the motor has become uncoupled from the load.	Service or repair belt or coupling.

<1> The JVOP-182 LED operator does not support the letter "k." On this operator, the Belt Break fault will be displayed as "b-br."

Table 8 Alarms

Alarm Indication LCD <Memobus>	Description	Cause	Countermeasures
Stopping Method Selection Error <b>OPE12</b> Stopping Method <0Ch>	This Operator Programming Error occurs when the drive is in V/f or OLV control mode, OV Suppression functionality is enabled, and a stopping method has been selected which is not compatible with OV Suppression.	OV Suppression is enabled (P1-01 = 1), the control mode is V/f (A1-02 = 0) or OLV (A1-02 = 2), and one of the following stopping methods has been selected: -Ramp to Stop, (b1-03 = 0) -Coast to Stop w/ Timer (b1-03 = 3)	1.If OV Suppression functionality is required, select either Coast to Stop (b1-03 = 1) or DC Injection Braking to Stop (b1-03 = 2) stopping method. 2.Switch to an alternate control mode. 3.Disable OV Suppression (P1-01 = 0).

### ◆ Function Descriptions

#### ■ Overvoltage Regulator

The motor torque-producing current is detected and subtracted from the OV Regulator setpoint (P1-01). The result (error) is run through the OV Regulator PI controller. The PI controller will add frequency to the frequency reference in order to maintain a constant Iq setpoint. The PI controller will NOT subtract frequency from the frequency reference. This is done to keep the torque producing current positive (motoring) thus preventing regeneration and subsequent overvoltage faults (OV). This eliminates the need for a dynamic braking resistor package.

#### ■ Optimizing Performance when Using Open Loop Vector Control

In order to obtain optimal performance when using the Open Loop Vector control method (A1-02 = 2), a motor auto-tune should be performed. Ideally, the motor should be uncoupled from the load, and a Rotational auto-tune (T1-01 = 0) should be performed.

If the motor cannot be uncoupled from the load, then a Stationary auto-tune (T1-01 = 1) should be performed. In this software, Motor Rated Slip and Motor No-Load Current are not calculated in the Stationary auto-tuning method. Therefore, these need to be calculated and manually entered prior to running the Stationary auto-tune. After entering the E2-02 and E2-03 values, perform the auto-tune.

##### Motor Rated Slip (E2-02) should be calculated as follows:

Example: 4-pole, 60 Hz motor, Motor Rated Speed = 1730 RPM  
 $E2-02 = (\text{Motor Synchronous Speed} - \text{Motor Rated Speed}) \times \text{Motor Poles}/120$   
 $E2-02 = (1800 \text{ RPM} - 1730 \text{ RPM}) \times 4/120$   
 $E2-02 = 2.33 \text{ Hz}$

##### Motor No-Load Current (E2-03) is calculated as follows:

Motor No-Load Current (E2-03) can sometimes be read directly off of the motor nameplate; it is often listed as NLA (no-load amps). If there is no listing on the nameplate, motor no-load current can be estimated as follows:

Motor full load current (FLA)  $\times$  35%.  
 Example: 4-pole, 60 Hz motor, Motor FLA = 60 Amps.  
 $E2-03 = 60 \text{ Amps} \times 35\%$   
 $E2-03 = 21 \text{ Amps}$

## ■ OV Regulator Gain Increase Function

Parameters P1-08 (OV Regulator Gain Frequency) and P1-09 (OV Regulator Gain Multiplier) automatically increase the overvoltage suppression regulator gain when the drive's output is above the motor base frequency (E1-06). This is sometimes necessary to compensate for the motor's reduced torque characteristics above its base speed (otherwise known as the constant horsepower or field weakening area). Figure 2. below is an example when P1-08 = 90.00 Hz, and P1-09 = 2.000.

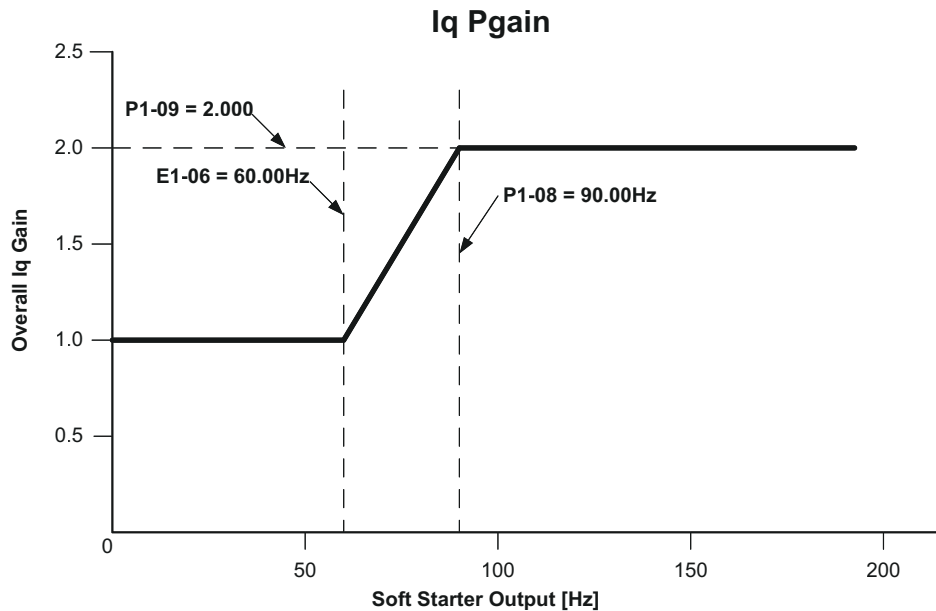


Figure 2 OV Regulator Gain Multiplier Above Motor Base Speed

## ■ Belt Break Detection

If the drive's output frequency is at maximum frequency (with a 1 Hz bandwidth) for more than 30 continuous seconds, the drive will assume that the belt or coupling between the motor and the machinery has become disconnected. The drive will fault on a belt-break fault (B-BRK), energize the fault contacts (MA, MB, and MC), and coast to stop.

### ■ Motor Torque Ramp During Start

#### Overview

This function is intended for machines which require a higher starting torque and control of separate torque limits during motor start.

#### Detailed Description

When a run command is first issued, the drive will internally use parameter P3-01 as both the forward and the reverse motoring torque limit, for the time specified in parameter P3-02. When the P3-02 time expires, the torque limit ramps back to the L7-01 & L7-02 values, at a rate determined by parameter P3-03. The time set into parameter P3-03 represents a torque limit change of 100%. P3-02 can be more than, less than, or the same as L7-01 or L7-02. This function is disabled during auto-tuning.

Example: If P3-01 = 200%, L7-01 = 50%, and P3-03 = 2.0 seconds, the torque limit ramp time would be calculated as follows:

$$\Delta\text{Torque Limit} = \text{P3-01} - \text{L7-01} = 200\% - 50\% = 150\%$$

$$\text{Ramp Time} = \Delta\text{Torque Limit} \times \text{P3-03}/100\% = (150\% \times 2.0)/100\% = 3.0 \text{ seconds}$$

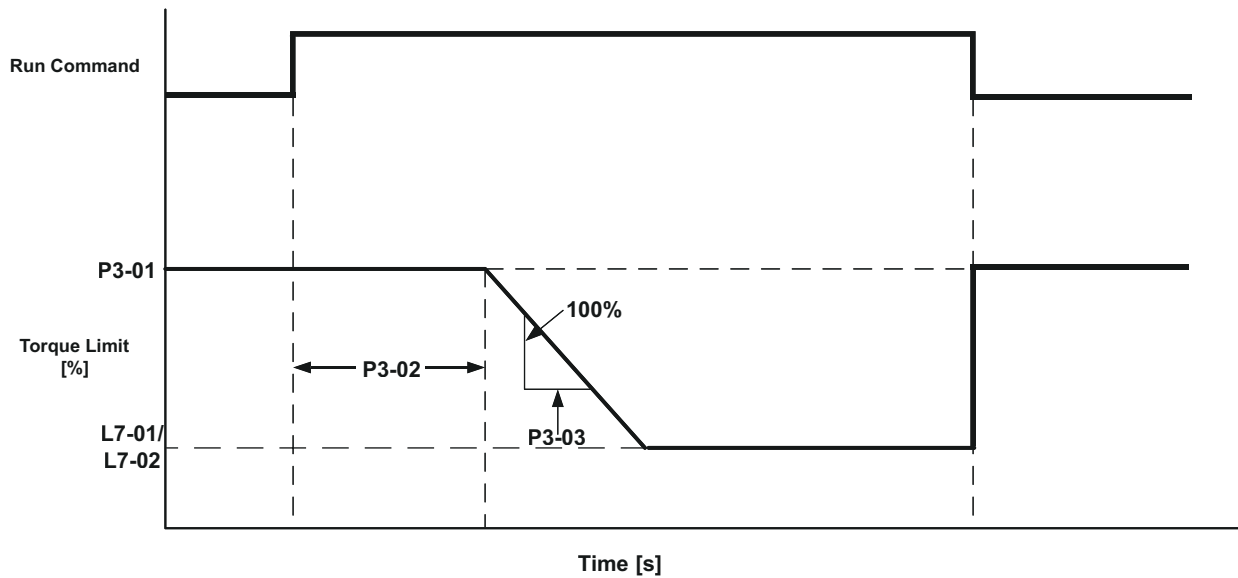


Figure 3 Motoring Torque Limit at Start

#### Limitations

Torque Ramp During Start is only active in the OLV control mode (A1-02 = 2).




### 3 Revision History

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## 3 Revision History

The revision dates and the numbers of the revised manuals appear on the bottom of the back cover.

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# YASKAWA AC Drive - A1000

## Overvoltage Suppression Custom Software Supplement

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