

YASKAWA AC Drive - A1000

Output Voltage PID

Custom Software Supplement

Software Number: VSA91002□

Drive Models: 200 V Class, CIMR-AU2A0004□A□-061 to CIMR-AU2A0415□A□-061
400 V Class, CIMR-AU4A0002□A□-061 to CIMR-AU4A0675□A□-061

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

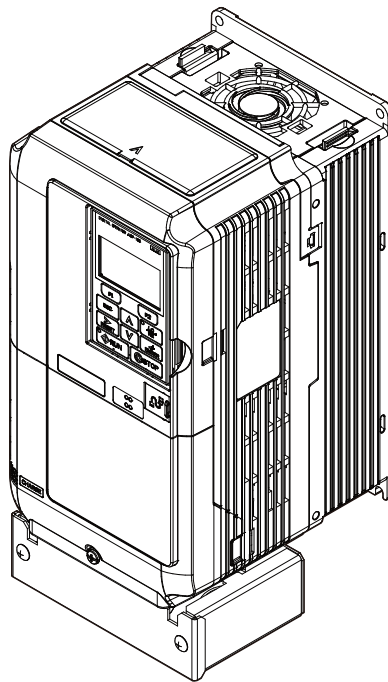




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Refer to the A1000 Technical Manual for content not described in this document.

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1 Preface and Safety

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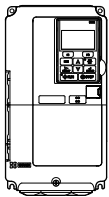
◆ Applicable Documentation

The following manuals are available for the A1000 Drive:

Custom Software Supplement

	Yaskawa AC Drive - Output Voltage PID A1000 Custom Software Supplement Manual No: TM.A1000SW.061
	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: http://www.yaskawa.com

Yaskawa Drive

	Yaskawa AC Drive - A1000 Quick Start Guide	To obtain instruction manuals for Yaskawa products access these sites: U.S.: http://www.yaskawa.com Europe: http://www.yaskawa.eu.com Japan: http://www.e-mechatronics.com Other areas: contact a Yaskawa representative. For questions, contact the local Yaskawa sales office or the nearest Yaskawa representative.
	Yaskawa AC Drive - A1000 Technical Manual	

◆ 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 Output Voltage PID

◆ Overview

This software provides the capability of controlling drive output voltage independent of frequency. The features of this custom software are typically applied as part of a system that conditions line power of varying frequencies and voltages to a specified frequency and voltage to operate connected equipment.

◆ Applicable Models

This Output Voltage PID software is available for the drive models listed in [Table 1](#).

Table 1 Applicable Models

Voltage Class	Model	Software Version
200 V	CIMR-AU2A0004□A□-061 to CIMR-AU2A0415□A□-061	VSA91002□
400 V	CIMR-AU4A0002□A□-061 to CIMR-AU4A0675□A□-061	

◆ Basic Concepts and Principles

An independent PID controller was added, the output of which will trim the output voltage.

Trim range for the PID is +13% to -100%. Additional positive trim (voltage boost) can be added using the Output Current and Iq Current voltage compensation functions.

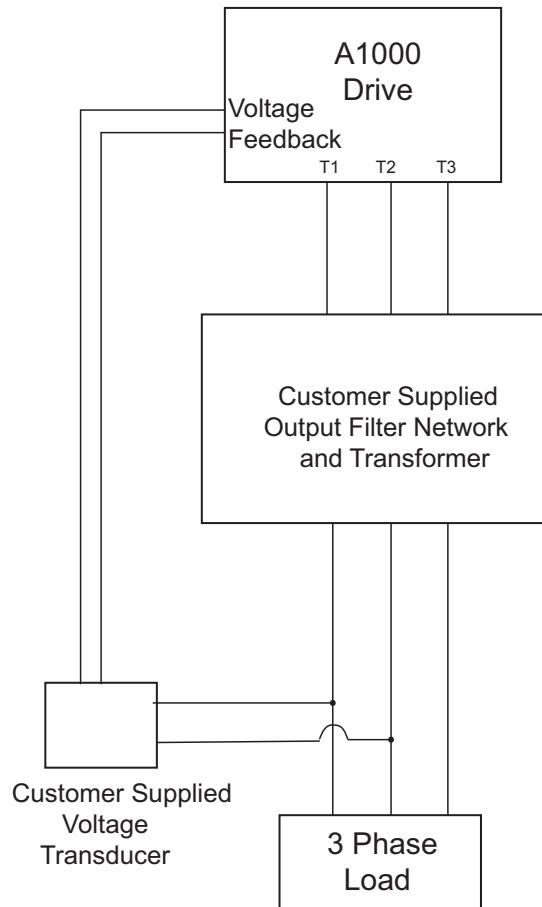


Figure 1 Output Voltage PID Configuration

◆ 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.

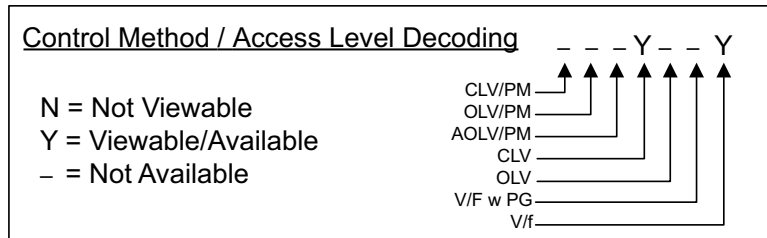


Table 2 Modified Parameters

No.	MEMOBUS/ Modbus Address	Name Digital Operator Display	Description	Range	Default Value	Change During Run	Control Method/ Access Level
A1-02	0102h	Control Method Control Method	Sets the control method. 0: V/Hz 1: V/Hz w/PG 2: Open Loop Vector 3: Flux Vector 4: PM VVC1 5: PM OLV 6: PM CLV	0 to 6	0	No	YYYYYYY
H3-06	0414h	Terminal A3 Function Selection Terminal A3 Sel	Selects the function of the Terminal A3 Multi-Function Analog Input. 0: Freq Ref Bias 1: Freq Ref Gain ... 20: Output V Fdbk 21: V Setpoint	0 to 21	20	No	YYYYYYY
n9-10	05D9h	Automatic Voltage Regulator Time AVR Time	The AVR modifies output voltage based on bus voltage.	0.0 to 100.0	5.0 ms	No	-----Y
n9-14	05DDh	Power Factor Angle Filter 1 Pwr Angle Flt 1	Sets the response of the power factor angle filter.	0 to 1000	10 ms	No	-----Y
n9-15	05DEh	Power Factor Angle Filter 2 Pwr Angle Flt 2	Sets the response of the power factor angle filter.	0 to 1000	10 ms	No	-----Y

Table 3 Additional Parameters

No.	MEMOBUS/ Modbus Address	Name Digital Operator Display	Description	Range	Default Value	Change During Run	Control Method/ Access Level
P1-01	0600h	Output Voltage Setpoint Output V Setpt	Sets the voltage that the output voltage regulator will try and seek if H3-02, H3-06 and H3-10 are not set to "21".	0.0 to 600.0	460.0 Vac	Yes	-----Y
P1-02	0601h	Output Voltage PID Gain Output V Gain	Sets the responsiveness of the output voltage regulator. Higher = more responsive	0.0 to 25.00	1.00	Yes	-----Y
P1-03	0602h	Output Voltage PID Integral Time Output V I Time	Sets the responsiveness of the output voltage regulator. Lower = more responsive	0.00 to 360.00	1.00 sec	Yes	-----Y

2 Output Voltage PID

No.	MEMOBUS/ Modbus Address	Name Digital Operator Display	Description	Range	Default Value	Change During Run	Control Method/ Access Level
P1-04	0603h	Output Voltage PID Integral Limit Output V I Lmt	Limit for the integral function. 100% = E1-05	0.00 to 100.0	100 %	Yes	-----Y
P1-05	0604h	Output Voltage PID Derivative Time Output V Deriv T	Sets the amount of derivative action for the output voltage regulator.	0.00 to 10.00	0.00 sec	Yes	-----Y
P1-06	0605h	Output Voltage PID Limit Output V Limit	Limit for the entire output voltage regulator function (P + I + D). 100% = E1-05	0.0 to 100.0	100 %	Yes	-----Y
P1-07	0606h	Analog Full Scale Voltage Ana Full Scale V	Sets the scaling for the output voltage regulator feedback input (H3-□□ = 20) and the Analog Output Voltage Setpoint (H3-□□ = 21).	0.0 to 1000	600 Vac	No	-----Y
P1-08	0607h	Output Voltage PID Select Output V Select	Selects whether the output voltage control is active or not. 0: Disabled 1: Enabled	0 to 1	1	No	-----Y
P2-01	060Ah	Output Current Voltage Compensation Iac RMS Comp V	Adds output voltage based upon output current.	0 to 200.0	0.0 Vac	Yes	-----Y
P2-02	060Bh	Output Current Voltage Compensation Filter Time Iac RMS FilTime	1st order filter on the RMS output current.	0.01 to 1.00	0.01 sec	Yes	-----Y
P2-03	060Ch	Iq Voltage Compensation Iq Comp V	Adds output voltage based upon Iq (Torque Producing Current).	0.0 to 200.0	0.0 Vac	Yes	-----Y
P2-04	060Dh	Iq Voltage Compensation Filter Time Iq FilTime	1st order filter on the Iq output current.	0.01 to 1.00	0.01 sec	Yes	-----Y

Table 4 Additional Function Text

Function No.	Function Name Digital Operator Display
P	Output Voltage Control Output V Control
P1	Output Voltage PID Output V PID
P2	Voltage Compensation Voltage Comp
U7	Output Voltage Control Output V Control

Table 5 Monitors

Monitor No.	MEMOBUS/ Modbus Address	Monitor Name Digital Operator Display	Description	Analog output scaling	Unit	Control Method/ Access Level
U7-02	0661h	Voltage Feedback Voltage Feedback	Displays the analog feedback sensor voltage, scaled to P1-08.	N/A	0.1 Vac	-----Y

Monitor No.	MEMOBUS/ Modbus Address	Monitor Name Digital Operator Display	Description	Analog output scaling	Unit	Control Method/ Access Level
U7-03	0662h	Voltage Error Voltage Error	Difference between the voltage setpoint (P1-02) and the voltage feedback.	10V:100 Vac	0.1 Vac	-----Y
U7-04	0663h	Output Voltage PID Output Voltage PID Out	Displays the contribution of the output voltage regulator.	10V:100 Vac	0.1 Vac	-----Y
U7-05	0664h	Output Current Voltage Compensation Level Iac Comp Voltage	Displays the contribution of the output current V compensation.	10V:100 Vac	0.1 Vac	-----Y
U7-06	0665h	Iq Voltage Compensation Level Iq Comp Voltage	Displays the contribution of the Iq Voltage compensation.	10V:100 Vac	0.1 Vac	-----Y

Table 6 Multi-Function Input Settings (H1-□□)

Setting	Description
19	PID Disable Closed: Output Voltage PID is disabled.
30	PID Integral Reset Closed: Output Voltage PID Integrator is reset to zero.
31	PID Integral Hold Closed: Output Voltage PID Integrator is held at its present value.

Table 7 Multi-Function Output Settings (H3-□□)

Setting	Description	Analog input scaling	Control Method/ Access Level
20	Output Voltage Feedback Output V Fdbk	Full scale: 10V = P1-07 Value	-----Y
21	Output Voltage Setpoint V Setpoint	Full scale: 10V = P1-07 Value	-----Y

◆ Troubleshooting

Table 8 Fault

Fault Display	Description	Cause	Countermeasures
oPE12 Energy Save ON	The energy savings feature was enabled when the output voltage PID was enabled.	Parameter b8-01 was set to "Enable" when parameter P1-08 is set to "Enable" and control method is V/f.	Set b8-01 = 0 or Set P1-08 = 0

◆ Function Description

■ Output Voltage PID Controller

An independent PID controller was added, the output of which will trim the output voltage.

Positive trim range is +13% of E1-05. Negative trim range is negative 100% max voltage (E1-05). There are also two adjustments available that allow output voltage boost based upon RMS output current and/or Iq current.

The intent is to be able to control the output voltage, AFTER a filter and a transformer, as the output of the drive is NOT used to drive a motor, but instead operate as a UPS power supply operating at a fixed voltage and frequency. There is a customer-supplied sensor that converts the output voltage into a 0 - 10V analog signal, which then acts as a PID feedback.

This software allows the user to toggle between a fixed voltage set point (P1-01) and an analog input (H3-0□=21). Basically, when a multi-function analog input is set to "21", the PID voltage set point becomes that analog input thus ignoring the setting in P1-01. Conversely, P1-01 will be read as the voltage set point if none of the analog inputs are set to "21".

The PID function is enabled by meeting all of the following conditions:

- Output Voltage PID is enabled (P1-08 = 1).
- An analog input is programmed to voltage feedback (H3-0□ = 20).
- Control Mode is V/Hz (A1-02 = 0).
- Drive is running and at a non-zero output frequency.
- Drive is in the "Speed Agree" condition (soft starter output is at the frequency reference).

■ Output Current Voltage Compensation

The Output Current Voltage Compensation function will add to the output voltage depending upon the quantity of drive output current. This feature does not require that the Output Voltage PID be enabled in order to operate. First the drive's internal output current signal is filtered using the P2-02 filter time. Then output voltage is added according to the following formula:

Added Output Voltage = Filtered Output Current/Drive Rated Current x P2-01

The Output Current Voltage Compensation function is enabled by meeting all of the following conditions:

- The Output Current Voltage Compensation parameter is greater than zero (P2-01 > 0)
- Control Mode is V/Hz (A1-02 = 0).
- Drive is running and at a non-zero output frequency

■ Iq Voltage Compensation

The Iq Voltage Compensation function will add to the output voltage depending upon the quantity of drive Secondary (or Iq) current. This feature does not require that the Output Voltage PID be enabled in order to operate. First the drive's internal Iq current signal is filtered using the P2-04 filter time. Then output voltage is added according to the following formula:

Added Output Voltage = Monitor U6-01 x P2-03

Note: The ratio of E2-03/E2-01 will affect the calculation of Monitor U6-01.

The Iq Voltage Compensation function is enabled by meeting all of the following conditions:

- The Iq Voltage Compensation parameter is greater than zero (P2-03 > 0)
- Control Mode is V/Hz (A1-02 = 0).
- Drive is running and at a non-zero output frequency.

Motor 2 Operation

Motor 2 can be selected by programming a multi-function digital input H1-0□ = 16:

- When Motor 2 control method is NOT set to V/f (E3-01 ≠ 0), and the Motor 2 input is closed, the output voltage PID, the output current voltage compensation, and the Iq voltage compensation functions are disabled. Also all of the P1 parameters, P2 parameters, and U7 monitors are not viewable.
- When Motor 2 control method IS set to V/f (E3-01 = 0), and the Motor 2 input is closed, Parameters P1-04 & P1-06 will be scaled to parameter E3-05 (instead of E1-05). All three functions, Output Voltage PID, Output Current Voltage Comp and Iq Voltage Comp, will be operational.

Block Diagram

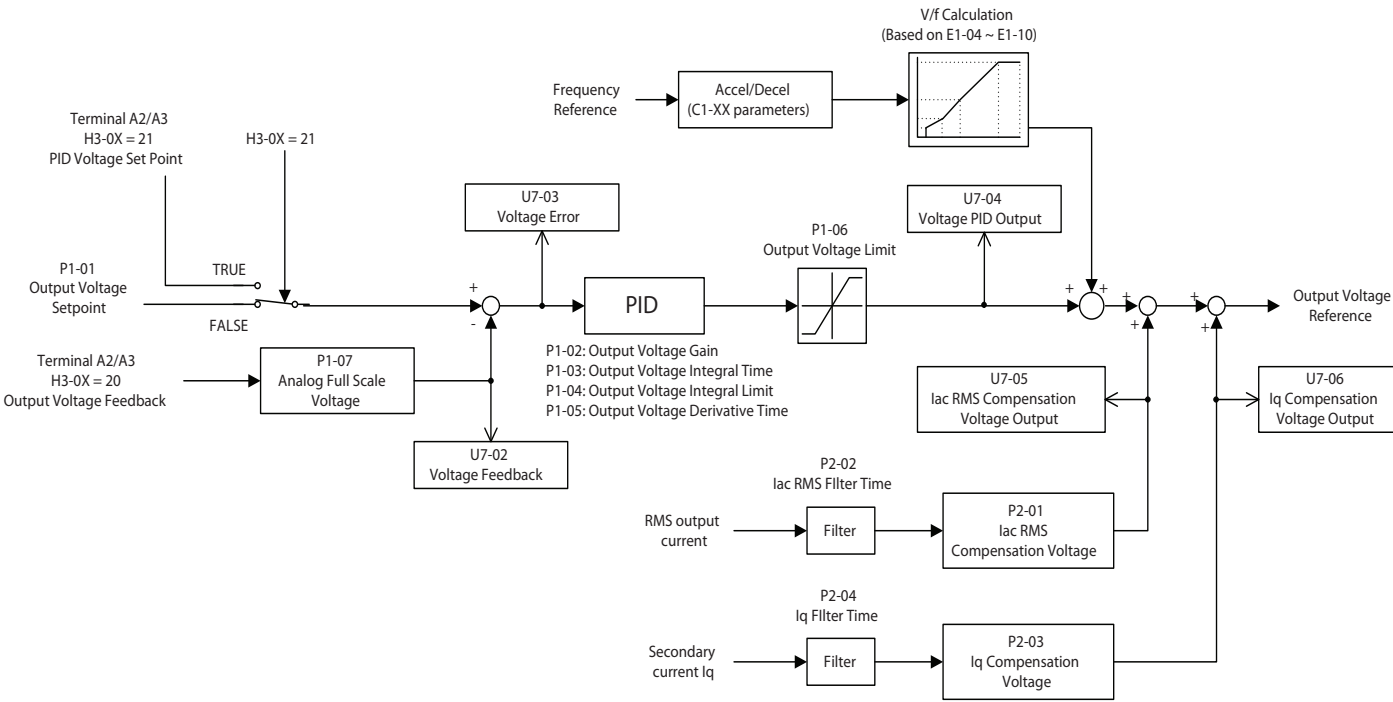



Figure 2 Output Voltage PID Block Diagram

3 Revision History

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

Output Voltage PID

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