



TOSHIBA

POWER ON
OFF
F1
F2
F3
F4
OK
ESC
STOP

F1 F2 F3 F4

ESC STOP

OK

POWER ON OFF

VF-AS3

VFAS3-2022P

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TOSHIBA (P.O.) KAWASAKI, JAPAN

DANGER

Risk of injury, electric shock or fire.
Read the instruction manual.
Do not open the cover while power is applied or 10 minutes after power has been removed.
Always use proper earth connections.

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Toshiba TOSVERT VF-AS3 Instruction Manual

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PID control Instruction Manual

1. Read this manual carefully before using the inverter. After reading, the user should keep this manual at hand to use it for maintenance and inspection in the future.
2. Please be informed that the contents of this document may be changed without notice.

Note

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TOSVERT™ VF-AS3

PID control Instruction Manual

Toshiba Industrial Products and Systems Corp

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[Page 5: Introduction](#)

Introduction VF-AS3 has four types of PID control function. You can select the type for your application. • Process PID control: For temperature or pressure control of fan and pump, which is performed relatively gently in response to change the speed. •...

[Page 7: Pid Control Selection](#)

PID control selection Select one from the four types of PID control function for your application. 2. 1 Process PID control Process PID control is selected for temperature or pressure control of fan and pump which is performed gently in response to change the speed.

[Page 8](#) E6582112 2) Set the following parameters to suit the motor if necessary. Title Parameter name Maximum frequency Upper limit frequency Lower limit frequency F270 to F275 Jump frequency 1 to 3 F240 Start frequency F241 Run frequency F243 End frequency 3) Set the following parameters to suit the system.

[Page 9: Speed Pid Control](#)

E6582112 b) Adjust the following parameter if necessary. Item Title Parameter name Steady the PID control. (Limit F364 PID1 deviation upper-limit the PID deviation F365 PID1 deviation lower-limit Start the PID control after the F369 PID control start wait time system becomes stable.

[Page 10](#) E6582112 b) It is possible to add or multiply for set value by override function. Item Title Parameter name Addition F660 Override adding input select Multiplication F661 Override multiplying input select 2) Set the following parameters to suit the motor if necessary. Title Parameter name Maximum frequency...

[Page 11: Easy Positioning Pid Control](#)

E6582112 b) Adjust for stability, and quick response. Item Title Parameter name Steady the PID control (Feedback F361 PID1 filter filter) Steady the PID control. (Limit the PID F364 PID1 deviation upper-limit deviation*1) F365 PID1 deviation lower-limit Adjust for quick response F372 PID1 set value increase time F373...

[Page 12](#) E6582112 ■ Parameter setting Refer to chapter 4 and 5 for detail of parameter setting. 1) Set parameters of PG after [Pt]= "10" or "11" setting. Set [240],[F241],[F243] = "0.0(Hz)". Title Parameter name V/f Pattern F375 PG pulses number F376 PG select F377 PG option disconnection detection...

[Page 13](#) E6582112 4) Adjust the PID control gain. Refer to chapter 5 for detail. a) For fundamental adjustment. Item Title Parameter name PID control gain F362 PID1 proportional gain F363 PID1 integral gain F366 PID1 differential gain b) Adjust the following parameter if necessary. Item Title Parameter name...

[Page 14: Dancer Control](#)

E6582112 ■ Trouble shooting If an overvoltage trip occurs during deceleration of the stop position retaining control, make the value of [F362: PID1 proportional gain] smaller. The deceleration time will become longer. Note 1 [dEC: Deceleration time 1] setting is invalid during easy positioning PID control. Output frequency (Hz) Overvoltage trip (during deceleration)

[Page 15](#) E6582112 ■ Diagram Speed reference [FM0d/F207] PID set value PID output PID deviation upper-limit upper-limit Deviation dead band upper-limit Set value [F367] [F364] [F370] [F388] (Dancer position) Jump frequency [F389] control PID set value PID output PID deviation lower-limit lower-limit lower-limit [F368] [F365]...

[Page 16](#) E6582112 Frequency free unit conversion function enables to set the set value and the feedback value easily. Refer to chapter 3 for detail. 2) Set the following parameters to suit the winder system if necessary. Item Title Parameter name Operation by speed Input terminal

function "94/95: Dancer correction OFF"...

[Page 17](#) E6582112 Item Title Parameter name PID control gain F362 PID1 proportional gain F363 PID1 integral gain F366 PID1 differential gain b) Adjust the following parameter if necessary. Item Title Parameter name Steady the PID control. (Limit F364 PID1 deviation upper-limit the PID deviation*1) F365 PID1 deviation lower-limit...

[Page 19: Parameter List Of Pid Control](#)

Parameter list of PID control Title Parameter name Adjustment range Default setting FMod
Frequency command select 1 0: - 1: Terminal RR 2: Terminal RX 3: Terminal II 4: Terminal AI4
(option) 5: Terminal AI5 (option) 6 - 9: - 10: Touch wheel 1 (power off or press OK to save) 11:
Touch wheel 2 (press OK to save)

[Page 20](#) E6582112 Title Parameter name Adjustment range Default setting F218 II point 2
input value 0 - 100 (%) F219 II point 2 frequency 0.0 - 590.0 (Hz) 50.0/ 60.0*1 F240 Start
frequency 0.0 - 10.0 (Hz) F241 Run frequency 0.0 - FH (Hz) F243 End frequency 0.0 - 30.0(Hz)

[Page 21](#) E6582112 Title Parameter name Adjustment range Default setting F372 PID1 set
value increase time 0.1 - 600.0 (s)(Speed PID) 10.0 F373 PID1 set value decrease time 0.1 -
600.0 (s)(Speed PID) 10.0 F374 PID1 set value agreement 0.0 - FH (Hz) detection band F375 PG
pulses number...

[Page 22](#) E6582112 Title Parameter name Adjustment range Default setting F660 Override
adding input select 0: - 1: Terminal RR 2: Terminal RX 3: Terminal II 4: Terminal AI4 (option) 5:
Terminal AI5 (option) 6 - 9: - 10: Touch wheel 1 (power off or press OK to save) 11 - 14: - 15:
Terminal Up/Down frequency...

[Page 23](#) E6582112 FM/AM/pulse output and monitor output function FM/AM/Pulse output
Monitor output Function Communicatio Communicatio Set No. Set No. n No. n No. FD02 FE02
Frequency command value (set value) FD22 FE22 PID feedback value FD48 FE48 PID result
frequency FD58 FE58 PID set value VF-AS3...

[Page 24](#) E6582112 ■ Unit conversion (Free unit conversion) You need to convert the set
value and the feedback value into frequency for the PID control. [F702: Free unit multiplication
factor] and [F703: Target of free unit] enable to set the set value and the feedback value easily.

[Page 25: Setting For Pid Control](#)

Setting for PID control First, set the set value and the feedback value. : 4.1 Then, set other
parameters to suit the motor and the system if necessary. : 4.2, 4.3 Note) Set the set value and
the feedback value by converting each pressure level into frequency. Actual output frequency is
different from setting frequency for PID control.

[Page 26](#) E6582112 Parameter setting Feedback value (Converted frequency) 2 atm [F219]
(60Hz) [F217] (0Hz) 1 atm 20mA 20mA [F216] [F218] 100% It is possible to set or switch the
plus/minus characteristics. • When setting minus characteristic Select minus characteristic by
[F359]. Parameter setting (Converted frequency) [F217]...

[Page 27](#) E6582112 Title Parameter Example of setting F116 Terminal S3 function 54: PID
plus/minus switching (positive logic) F216 II point 1 input value 20 (%) F217 II point 1 frequency
0 (Hz) F218 II point 2 input value 100 (%) F219 II point 2 frequency 60 (Hz) The characteristics is
plus when selecting minus characteristics both [F359] setting and input terminal,...

[Page 28](#) E6582112 Example of Title Parameter name Adjustment range setting F376 PG
select 0: PTI can be used as feedback 1: Digital option is used as feedback 3: resolver option is
used as feedback 6: Digital option is used as reference 10: PTI can be used as feedback
(inversion) 11: Digital option is used as...

[Page 29: Set Value](#)

E6582112 4. 1. 2 Set value Input the target value in relation to the feedback value as set value.
Select the input of set value Title Parameter name Adjustment range (input of set value) F389
PID1 set value select 0: selected by FMod/F207 1: Terminal RR 2: Terminal RX 3: Terminal II...

[Page 30](#) E6582112 Feedback value Feedback value Set value (Converted frequency)

(Converted frequency) 2 atm 60Hz [FPid]= 30Hz (1.5 atm) 1.5 atm 1 atm 20mA 20mA 100%
Example of parameter setting Title Parameter name Example of setting Fpid PID1 set value 30
(Hz) F216 II point 1 input value 20 (%)

[Page 31](#) E6582112 2) Analog input Refer to chapter 6 for detail of analog input characteristic setting. Example of set value setting Input the set value to terminal [RX] by 0 to 10V. Input the feedback signal of 1 to 2 atm into terminal [II] by 4 to 20mA signal. Convert the input level 4-20mA by terminal [III] to 0-60Hz.

[Page 32](#) E6582112 Actual output frequency is, regardless of the converted frequency, the output frequency as a result of PID control. Input the set value to maximum of the feedback value or less. If the process value is 2 atm=10V (60Hz), the deviation becomes zero when the feedback value reaches 2 atm=20mA (60Hz).

[Page 33: Override Function](#)

E6582112 Set value Converted Pressure Feedback value frequency Preset Terminal Terminal (atm) (4 to 20mA) (Hz) speed 1 to 3 [S1] [S2] 1.25 Speed 1 Speed 2 1.75 Speed 3 Example of parameter setting Title Parameter name Example of setting Preset speed 1 15(Hz) Preset speed 2...

[Page 34: Acceleration And Deceleration Time](#)

E6582112 4. 1. 4 Acceleration and deceleration time ■ Process type ■ Dancer control Set the acceleration time [ACC] and deceleration time [dEC] to short for quick response. But excessively small setting causes inverter trip. Refer to 4.3.5 If you can not set acceleration and deceleration time to short. ■...

[Page 35: Set To Suit The System](#)

E6582112 4. 3 Set to suit the system 4. 3. 1 Set if necessary Set the following parameters if necessary. Title Parameter name Description F367 PID1 set value upper- • This is upper limit of set value. • If the set value exceeds the upper limit of feedback value, limit the output frequency is fixed.

[Page 36: Agreement Between Set Value And Feedback Value](#)

E6582112 4. 3. 3 Agreement between set value and feedback value It is possible to output agreement signal between the set value and the feedback value. Signal is output when difference between set by [F389] and the feedback value by [F360] are within \pm [F374]. Title Parameter name Description...

[Page 37: Deviation Limit Of Pid Control](#)

E6582112 4. 3. 5 Deviation limit of PID control When the setting value of [ACC] or [dEC] is made larger to have gradual acceleration/deceleration, the output frequency may be limited by the acceleration/deceleration operation and the frequency may become excessive at a rapid change of PID control output.

[Page 38](#) E6582112 In case of [F392] \neq "0.0Hz" In case of [F392] = "0.0Hz" and [F393] \neq "0.0Hz" Output frequency Output frequency [LL] + [F398] [LL] + [F398] [LL] [LL] Feedback Differential [F392] [F393] [F256] [F256] In case of PID set value > [LL] + [F391] Output frequency Output frequency [F391]...

[Page 39: Output Power Compensation Function](#)

E6582112 4. 3. 7 Output power compensation function ■ Function The output power compensation function can be used with PID control. In case the PID set value is set with analog input etc., the target value may decrease due to aged deterioration of the analog input part etc.

[Page 40: Pid Auto Tuning Function](#)

E6582112 4. 4 PID auto tuning function ■ Function This function is to estimate PID proportional gain and PID integral gain of PID control by auto tuning. You can set the amount of step [A307] and the number of repetitions [A306] to be given to the system during auto tuning.

[Page 41: Pid Control Adjustment](#)

PID control adjustment 5. 1 Summary of adjustment ■ In case with the estimate of PID gain Set

the estimated value of PID gain and check the operation of the system. Adjust the gain if necessary. ■ In case without the estimate of PID gain 1) First, operate the inverter by default setting gain and check the operation of the system.

[Page 42: Proportional \(P\) Gain](#)

E6582112 5. 2. 1 Proportional (P) gain [F362] is the proportional (P) gain of PID1 control. The proportional (P) gain, a factor gained by multiplying the deviation (difference between the set value and the feedback value), is used to perform control so as to make a correction in proportion to the deviation. Although larger gain is effective for quicker response, excessively high gain may cause an unstable operation including vibration.

[Page 43: Applied Adjustment \(Common\)](#)

E6582112 5. 3 Applied adjustment (Common) Make the following adjustments for increasing stability if necessary. 5. 3. 1 PID integral / differential reset You can reset the PID integral value and differential value by input terminal signal. Input terminal function Positive Negative Function...

[Page 44: Set Value Increase Time, Decrease Time](#)

E6582112 5. 4. 2 Set value increase time, decrease time [F372] and [F373] determine the response of feedback value. Set [F372] and [F373] to short for quick response. Increase and decrease rate Increase and decrease rate Input Output Symbol Title Setting value F372 PID1 set value increase time...

[Page 45: Analog Input Characteristics](#)

Analog input characteristics Set the analog input characteristics in case inputting the feedback value and the set value by the analog input terminals. *The following examples are setting from 0 to 60Hz Terminal [RR] Terminal [RR] (0 to 10V input) (0 to 10V input) [F204] (60Hz)

[Page 47: Pid2 Control](#)

PID2 control The PID2 control has two types of PID control blocks internally, and they can be switched by the setting of [A300: PID1,2 switching target]. For example, you can perform the PID control for pressure in the normal situation, and the PID control for temperature under certain conditions.

[Page 48](#) E6582112 2) Set parameters to switch PID1 and PID2 control. Title Parameter name Adjustment range A300 PID1,2 switching target 0: Disabled 1: PID1 feedback 2: PID2 feedback 3: Terminal input 4: Time 5: - 6: - A301 PID1,2 switching level 0 - 200 (%) A302 PID1,2 switching hysteresis...

[Page 49: Parameter List Of Pid2 Control](#)

Parameter list of PID2 control Parameter name of PID2 control is same as PID1 control. However, the choice of [A311], "12" is [A327], and other choices are same as [F389]. Refer to 2.1 to 2.4 and chapter 3 for detail. x: valid -: invalid Parameter Referen...

[Page 51: External Pid Control](#)

External PID control Two types of PID control blocks are provided for controlling the external equipment such as valve and damper. This function can be enabled by setting the parameter or turning on/off the input terminal. The following shows a block diagram of external PID control. Use the parameters of external PID3 control and external PID4 control.

[Page 52](#) E6582112 ■ Parameter setting Parameter setting of external PID3 and PID4 are below. PID3 and PID4 are independent each other. 1) Select the input of set value and feedback value. Item Title Parameter name Set value A341 PID3 set value select A371 PID4 set value select A357...

[Page 53](#) E6582112 3) Adjust the PID control gain. Refer to chapter 5 for detail. a) Fundamental adjustment Item Title Parameter name PID control gain A344 PID3 proportional gain A374 PID4 proportional gain A345 PID3 integral gain A375 PID4 integral gain A348 PID3 differential gain A378 PID4 differential gain...

[Page 54](#) E6582112 ■ Other functions 1) Duty control by digital output This function convert the output of external PID (analog amount: %) to PWM., and output it to the digital output

terminal. It can be used for ON-OFF control. (PID3) When [A340] is one of the value "1", "2", "11", "12", and [A359] is not "0", the result of external PID is converted to PWM pulse whose period is set by [A359 (sec)], and output to the digital output terminal "218/219".

[Page 55](#) E6582112 2) ON-OFF control by digital output terminal This function compare the set value and the feedback value of external PID, and output the result to digital output terminal. It can be used for ON-OFF control. (PID3) When [A340] = "3", compare the set value and the feedback value of external PID, and turn ON / OFF the output terminal "218/219"...

[Page 57: Parameter List Of External Pid Control](#)

Parameter list of external PID control Parameters of external PID3 control Title Parameter name Adjustment range Default setting A340 PID control 3 0: Disabled 1: External Process PID control 2: External Process PID control (link with input terminal) 3: Digital output terminal ON-OFF duty control 4 - 10: - 11: Minus external Process PID control 12: Minus external Process PID control (link...

[Page 58](#) E6582112 Parameters of external PID4 control Title Parameter name Adjustment range Default setting A370 PID control 4 0: Disabled 1: External Process PID control 2: External Process PID control (link with input terminal) 3: Digital output terminal ON-OFF duty control 4 - 10: - 11: Minus external Process PID control 12: Minus external Process PID control (link...

[Page 59](#) E6582112 Parameter of input terminal Title Parameter name Adjustment range Default setting F110 Always active function 1 0 - 153 F127 Always active function 2 0 - 153 F128 Always active function 3 0 - 153 F111 Terminal F function 1 0 - 205 F112 Terminal R function 1...

[Page 60](#) E6582112 Parameter of output terminal Title Parameter name Adjustment range Default setting F130 Terminal FP function 1 0 - 255 F132 Terminal FL function 0 - 255 F133 Terminal R1 function 1 0 - 255 F134 Terminal R2 function 1 0 - 255 F137 Terminal FP function 2...

[Page 61](#) E6582112 Parameter of FM/AM/pulse output and monitor output Title Parameter name Adjustment range Default setting Terminal FM function 0 - 255 F670 Terminal AM function 0 - 255 F672 Terminal MON1 function 0 - 255 F674 Terminal MON2 function 0 - 255 F676 Terminal FP pulse train output function 0 - 149...

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