

# *TOSVERT VF-AS3*

PG feedback built-in function manual

**TOSHIBA INDUSTRIAL PRODUCTS AND SYSTEMS CORPORATION**

**Attention**

1. Read this manual carefully before using the inverter. After reading this manual, keep it in a safe place for future maintenance and inspection.
2. The information in this manual is subject to change without prior notice.





## Safety precaution

There is important information on the inverter and in its instruction manual for proper use of the device to prevent injury to users or damage to property. Read the instruction manual attached to the inverter to understand the safety precautions, the symbols and indications completely. Please observe the contents of these manuals at all times.

### ■ Limitation of use

This function is applicable with CPU version 122 or successor and some limitation shown in this manual.

#### WARNING

 Prohibited	<ul style="list-style-type: none"> <li>Do not use PG feedback built-in function with CPU version 120 or predecessor's. This will result in accident.</li> </ul>
 Mandatory	<ul style="list-style-type: none"> <li>Applicable encoder is limited for PG feedback built-in function, use this function with the applicable encoder shown in this manual (refer to section 2.1). Inapplicable encoder use will result in the accident.</li> <li>Use PG feedback built-in function with the pulse frequency up to 30kpps. Use this function with pulse frequency over 30kpps will result in the accident.</li> </ul>

## 1. Overview

This manual describes how to input encoder signals to the terminals [S4] and [S5] to detect motor speed.

This function is applicable under the limitation shown in below.

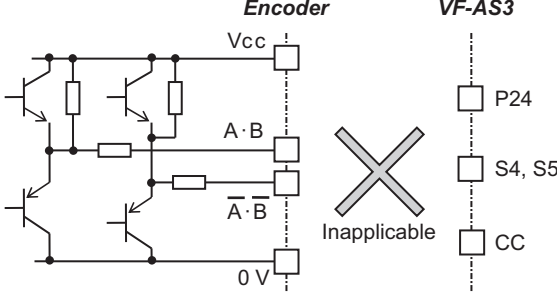
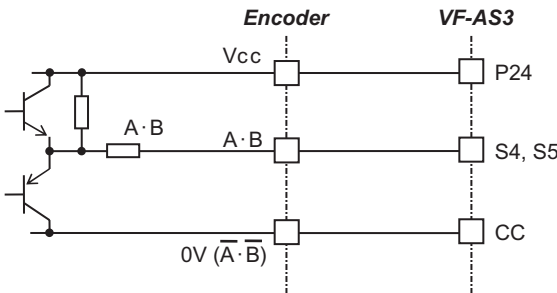
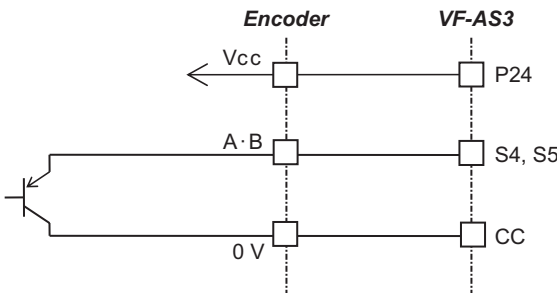
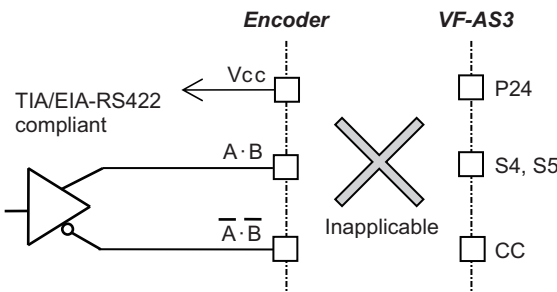
- It is applicable with CPU version 122 or successor.
- Encoder disconnection (wire break) detection is not applicable.
- It is not applicable with Position control function.
- It is not applicable with Servo lock function.
- The maximum pulse frequency is 30kpps.

<Example of the maximum motor speed>

In case of using 1000pulse/round encoder with 4-pole motor, the maximum motor speed for this function is  
 $30000\text{pps} / \{1000\text{ppr} / (4\text{p} / 2)\} = 60\text{Hz}$

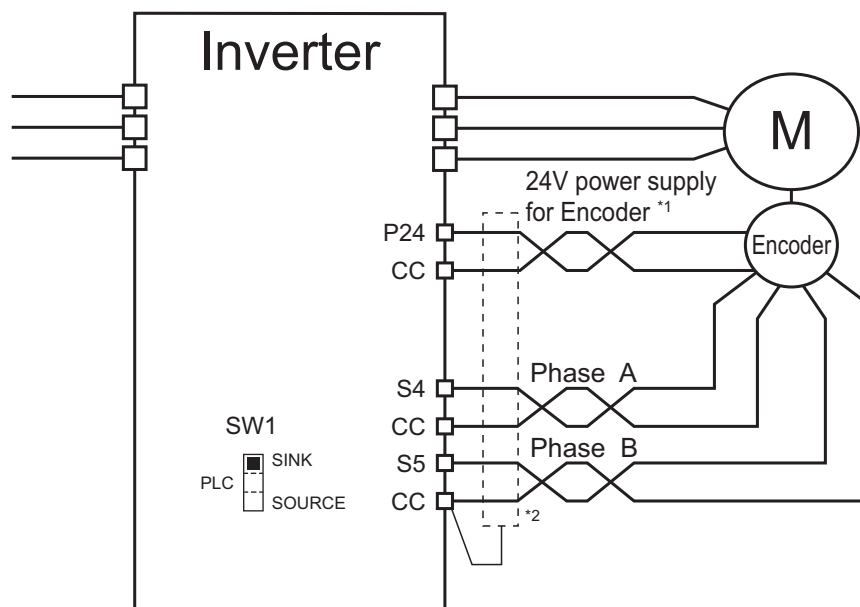
## 2. Installation and wiring

### 2.1 Applicable encoder output type and [S4], [S5] terminal connection

Recommended connection with Encoder		Encoder power supply	Note
Complementary		-	Inapplicable
		24V	<ul style="list-style-type: none"> <li>Input pulse frequency is limited to 30kpps</li> <li>Maximum current of P24 terminal is 200mA</li> <li>Recommended cable length is 100m or less</li> </ul>
Open collector		24V 15V 5V	<ul style="list-style-type: none"> <li>Input pulse frequency is limited to 30kpps</li> <li>Maximum current of P24 terminal is 200mA</li> <li>Prepare the power supply unit separately to use with the encoder supplied by 15V or 5V</li> <li>Set [SW1] to "Sink".</li> <li>Recommended cable length is 10m or less</li> </ul>
Line driver (RS422)		-	Use Digital encoder option VEC008Z. Refer to E6582148 for details.

\* Refer to encoder manual for the schematic.

## 2.2 Connection example



\*1 Power supply for Encoder: 24V is recommended  
When the encoder needs 12V or 5V, connect external power supply.

\*2 Shielded twisted pair cable is recommended.

### 3. Setting of parameters

#### 3.1 Setting terminals [S4] and [S5]

Set <F146> and <F147>.

Title	Parameter name	Adjustment range	Unit	Default setting
F146	Terminal S4 input select	0: Digital input 1: Pulse train input 2: PG input		0
F147	Terminal S5 input select	0: Digital input 1: Pulse train input 2: PG input		0

##### 3.1.1 Using a single-phase encoder

- Using the terminal [S4]: Set <F146> to "2".  
Set <F147> to "0" or "1" according to intended use.
- Using the terminal [S5]: Set <F147> to "2".  
Set <F146> to "0" or "1" according to intended use.

\* When a single-phase encoder is used, only the absolute value of speed can be detected. The rotation direction (forward/reverse) cannot be detected.

##### 3.1.2 Using a two-phase encoder

Set <F146> and <F147> to "2".

- When the pulse phase input to [S4] advances by 90° with respect to the pulse phase input to [S5], it is detected as forward run (speed on the positive side).
- When the pulse phase input to [S4] delays by 90° with respect to the pulse phase input to [S5], it is detected as reverse run (speed on the negative side).

#### 3.2 Setting encoder

##### (1) Set the PG feedback input. Set <F376: PG select> to "0" or "10".

Single-phase feedback input

- With <F376> set to "0", the feedback speed always indicates a positive value (larger than 0).
- With <F376> set to "10", the feedback speed always indicates a negative value (smaller than 0).

Two-phase feedback input

- With <F376> set to "10", the polarity of detection speed is inverted.

##### (2) Set the number of PG output pulses per one rotation of the motor with <F375: PG pulse number>.

Title	Communication No.	Parameter name	Adjustment range	Unit	Minimum setting unit (Panel/Communication)	Default setting
F375	0375	PG pulses number	1 - 9999	pulse		1000

Title	Communication No.	Parameter name	Adjustment range	Unit	Minimum setting unit (Panel/Communication)	Default setting
F376	0376	PG select	0: Terminal S4, S5 can be used as feedback/reference 1: VEC008Z is used as feedback 2: - 3: VEC010Z is used as feedback (V106 or later) 4,5: - 6: VEC008Z is used as reference 7-9: - 10: Terminal S4, S5 can be used as feedback/reference (inversion) 11: VEC008Z is used as feedback (inversion) 12: - 13: VEC010Z is used as feedback (inversion) (V106 or later) 14, 15: - 16: VEC008Z is used as reference (inversion)	-	-	0

\* VEC008Z and VEC010Z are optional, prepare them separately if needed.

### 3.3 Setting V/f pattern

Title	Function Name	Parameter Setting	Setting at Shipment
Pt	V/f Pattern	0: V/f constant 1: Variable torque 2: Automatic torque boost 3: Vector control 1 4: Energy savings 5: Dynamic energy savings (for fan and pump) 6: PM motor control 7: V/f 5-point setting 8: - 9: Vector control 2 (speed / torque) 10: PG feedback control 11: PG feedback vector control (speed / torque) 12: PG feedback PM motor control (V106 or later)	0

When conducting vector control with sensor (speed/torque control), <Pt>= 10,11,12 should be set.

For torque control operation, it is necessary to allocate control switching (torque/position) to one of the terminal function selection <F111> to <F118> (input terminal function selection 1 to 8) (when cmod=0) or to allocate to communication control switching (when cmod=2 to 5), in addition to the above parameters.

For details of adjustment methods by the speed control command and torque control command, refer to the inverter manual.

### 3.4 Setting motor parameters

Title	Function Name	Parameter Setting	Setting at Shipment
F400	Offline auto-tuning	0: - 1: Reset motor parameters (0 after execution) 2: Auto-tuning at run command (0 after execution) 3: Auto-tuning at TB ON 4: Motor parameters auto calculation (0 after execution) 5: 4+2 (0 after execution) 6: Auto-tuning at run command during TB is ON 7: Auto-tuning F402 only at run command during TB is ON	0
F401	Slip frequency gain	0 - 250%	70
F405	Motor rated capacity (motor name plate)	0.10 - 315.0kW	Depends on type form.
F415	Motor rated current (motor name plate)	Depend on capacity	
F417	Motor rated speed (motor name plate)	100 - 64000min <sup>-1</sup>	
F402	Automatic torque boost	0.01 - 30.00%	
F416	Motor no load current	10 - 90%	
F412	Leakage inductance	0.0 - 25.0 %	

The motor parameters requires setting according to the motor used. For details, refer to the inverter manual.

### 3.5 Abnormal speed detection function

#### \* Parameter

Title	Function Name	Adjustment Range	Setting att Shipment
F622	Abnormal speed detection time	0.01 – 100.00sec	0.01
F623	Abnormal speed increase band	0.0: Disabled, 0.01 - 30.00Hz	0.00
F624	Abnormal speed decrease band	0.0: Disabled, 0.01 - 30.00Hz	0.00

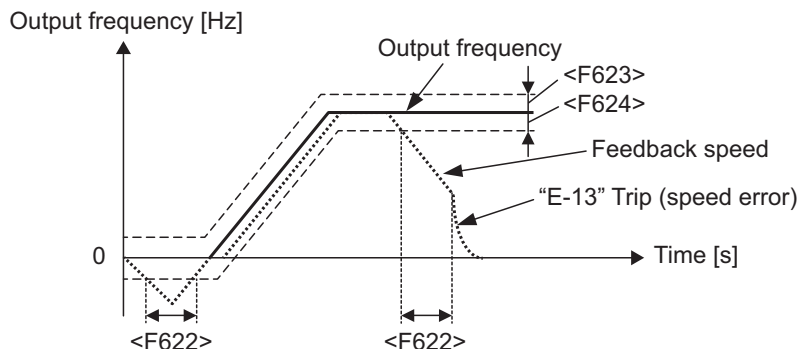
#### \* Functions

If speed feedback (Estimated speed) > (Output frequency + <F623>) or speed feedback (Estimated speed) < (Output frequency - <F624>), and a certain period of time set with <F622: Abnormal speed detection time>, a trip occurs.

You can provide range for a detection level of a trip with a setting of <F623: Abnormal speed increase band> and <F624: Abnormal speed decrease band>.

During torque control, if speed feedback (Estimated speed) > (Speed upper limit + <F623>) or > (Speed lower limit - <F624>) a certain period of time set with <F622: Abnormal speed detection time>, "E-13" trip occurs.





### 3.6 Encoder disconnection (wire break) detection

Encoder disconnection detection is not available for terminal [S4], [S5]. Abnormal speed detection can be substituted (see section 3.5).

In case [S4] signal is disconnected during motor running above threshold speed\*, motor speed detection is still working correctly. However, the speed is decreased to below threshold, motor speed is detected to 0Hz.

\* threshold speed depends on the setting of <F375>, <F417>, and <vL>.

In case [S5] signal is disconnected during motor running, motor speed is detected to 0Hz.

## 4. How to check feedback speed

Encoder connection in A and B phases and rotational direction of motor can be confirmed as follows.

Set the parameters changed back to the original values following confirming the rotational direction.

- (1) Set parameter <Pt (V/F control selected)> = 0 (constant torque characteristics).
- (2) Set parameter <F711 (status monitor 1 display selected)> = 153 (Signed speed feedback (real-time value)).
- (3) Enter an operating command for positive rotation and command frequency of 1-10Hz to the inverter.
- (4) Confirm the motor be turning in the positive direction.
- (5) Display status monitor 1 by using the status monitor indication of inverter.
- (6) Monitor display, when PG input is determined positive turn 3 Hz, "3.0" is displayed. When it is determined negative turn 3.0 Hz, "- 3.0" is displayed. When determined negative rotation, Encoder's A/B phase connections and motor wiring are not correct. They must be corrected. (Refer to section 3.2 for swapping the A-phase and B-phase by parameter setting)

