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TOSVERT VF-AS1

Light-load high-speed operation Instruction Manual

Toshiba Schneider Inverter Corporation

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1. Introduction

Thank you for your purchase of the Toshiba inverter “TOSVERT VF-AS1”.
This instruction manual explains the light-load high-speed operation of VF-AS1.

2. Function

The light-load high-speed operation is used to increase the operating efficiency of the machine by increasing the rotational speed of the motor when it is operated under light load.
This function is useful for constant-torque load applicaions which repeatedly drive light and heavy loads, such as lifts and transfer equipment.
Since VF-AS1 has the learning function for the light-load high-speed operation, it can be easily adjusted by executing the forward run (raising) or reverse run (falling) operation. (F328=3, 4 only)

3. Related parameters

Related parameters for light-load high-speed operation

Title	Communication No.	Function	Adjustment range	Minimum setting unit (Panel/Communication)	Default setting	Write during running	Vector control		PM control	V/f control	Adjustment (Note)
							Speed control	Torque control			
F328	0328	Light-load high-speed operation selection	0:Deselect 1: High-speed operation speed set automatically (Power running at F command :Raising) 2: High-speed operation speed set automatically (Power running at R command : Raising) 3: High-speed operation speed set with F330 (Power running at F command : Raising) 4: High-speed operation speed set with F330 (Power running at R command : Raising)	1/1	0	Disabled	●/●	–	●	●	–
F329	0329	Light-load high-speed learning function	0:No learning 1:Forward run learning 2:Reverse run learning	1/1	0	Disabled	●/●	–	–	–	–
F330	0330	Automatic light-load high-speed operation frequency	30.0 to UL Hz	0.1/0.01	60.0	Disabled	●/●	–	●	●	–
F331	0331	Light-load high-speed operation switching lower limit frequency	30.0 to UL Hz	0.1/0.01	40.0	Enabled	●/●	–	●	●	–
F332	0332	Light-load high-speed operation load waiting time	0.0 to 10.0 sec.	0.1/0.1	0.5	Enabled	●/●	–	●	●	–
F333	0333	Light-load high-speed operation load detection time	0.0 to 10.0 sec.	0.1/0.1	1.0	Enabled	●/●	–	●	●	–
F334	0334	Light-load high-speed operation heavy load detection time	0.0 to 10.0 sec.	0.1/0.1	0.5	Enabled	●/●	–	●	●	–
F335	0335	Switching load torque during power running	-250 to 250%	1/0.01	50	Enabled	●/●	–	●	●	◎
F336	0336	Heavy-load torque during power running	-250 to 250%	1/0.01	100	Enabled	●/●	–	●	●	◎
F337	0337	Heavy-load torque during constant power running	-250 to 250%	1/0.01	50	Enabled	●/●	–	●	●	◎
F338	0338	Switching load torque during regenerative braking	-250 to 250%	1/0.01	50	Enabled	●/●	–	●	●	◎

Sensorless vector/vector with sensor (●:Effective, –:Ineffective)

Note: Parameters F335 to F338 need adjustment according to the load.
Since VF-AS1 has the learning function for the light-load high-speed operation, it can be easily adjusted by executing the forward/reverse run operation (raising/falling for lift application). (F328=1, 2 only)

4. Light-load high-speed operation

4.1 Mode description

The light-load high-speed operation includes the modes below:
Each mode can be set by the light-load high-speed operation selection (F328).

Title/function	Default setting	Action
F328 Light-load high-speed operation selection	0:Deselect	Light-load high-speed operation disabled.
	1:High-speed operation speed set automatically (Power running at F command:Raising)	When inverter judges to be light-load, the high-speed operation frequency is automatically set according to a detected torque.
	2:High-speed operation speed set automatically (Power running at R command: Raising)	
	3:High-speed operation speed set with F330 (Power running at F command: Raising)	When inverter judges to be light-load, the operation is set to the automatic light-load high-speed operation frequency (F330).
	4:High-speed operation speed set with F330 (Power running at R command: Raising)	

Ex.: If automatic setting mode of high-speed operation speed is used,
set F328 to 1 for F (forward command): Raising
set F328 to 2 for R (reverse command): Raising

4.1.1. Automatic setting mode of high-speed operation speed (F328=1, 2)

The diagram on the next page(Fig.1) is the timing chart when the automatic setting mode of high-speed operation speed (F328=1) is applied to lift application.

At the operation frequency above the light-load high-speed operation switching lower limit frequency (F331) (point A in the Fig.1), if a detected torque (*1) after completion of speed reach is below the switching load torque during power running (F335 setting value), the inverter judges to be light-load.
For light-load operation, the frequency decided with the formula is determined as a target frequency (high-speed operation frequency) and the operation is accelerated toward the target frequency. (Point B in the Fig.1 Light-load high-speed operation)

Target frequency = (Value set with F335) × [Base frequency (uL)] / (Detection torque)
when target frequency ≦ UL (≦ FH)

*1: Average torque during light-load high-speed operation load detection time (F333) after light-load high-speed operation load detection waiting time (F332) (5% or more)

Light-load detection is carried out after speed reach when an operation frequency is above the light-load high-speed operation switching lower limit frequency (F331).
When each of conditions below is reached, the light-load high-speed operation is canceled and the operation is returned to the frequency corresponding to a speed command value.

①If a heavy-load torque (F336) is exceeded during acceleration up to the high-speed operation frequency.
②If a heavy-load torque during constant power running (F337) is exceeded after reaching the automatic light-load high-speed operation frequency (F330) and after a lapse of the light-load high-speed operation heavy load detection time (F334).
③If a speed command value less than the light-load high-speed operation switching lower limit frequency (F331) is entered.

Note: The torque monitor at the light-load high-speed switching (detected value) is updated for every operation.
These values can be monitored by setting the standard monitor parameter (F710) and status monitor parameters 1 to 8 (F711 to F718).

Function	Description	Monitor output
Light-load high-speed torque monitor 1 (Detection torque monitor at operation switching)	Average torque during light-load high-speed operation load detection time (F333) after a lapse of light-load high-speed operation load detection waiting time (F332)	Setting No. 64
Light-load high-speed torque monitor 2 (Detection torque monitor at constant speed operation)	Average torque after reaching automatic light-load high-speed operation frequency (F330) and after a lapse of light-load high-speed operation heavy load detection time (F334)	Setting No. 65

《Example of operation》 Light-load high-speed operation selection
(F328=1: High-speed operation speed set automatically): F (Raising)

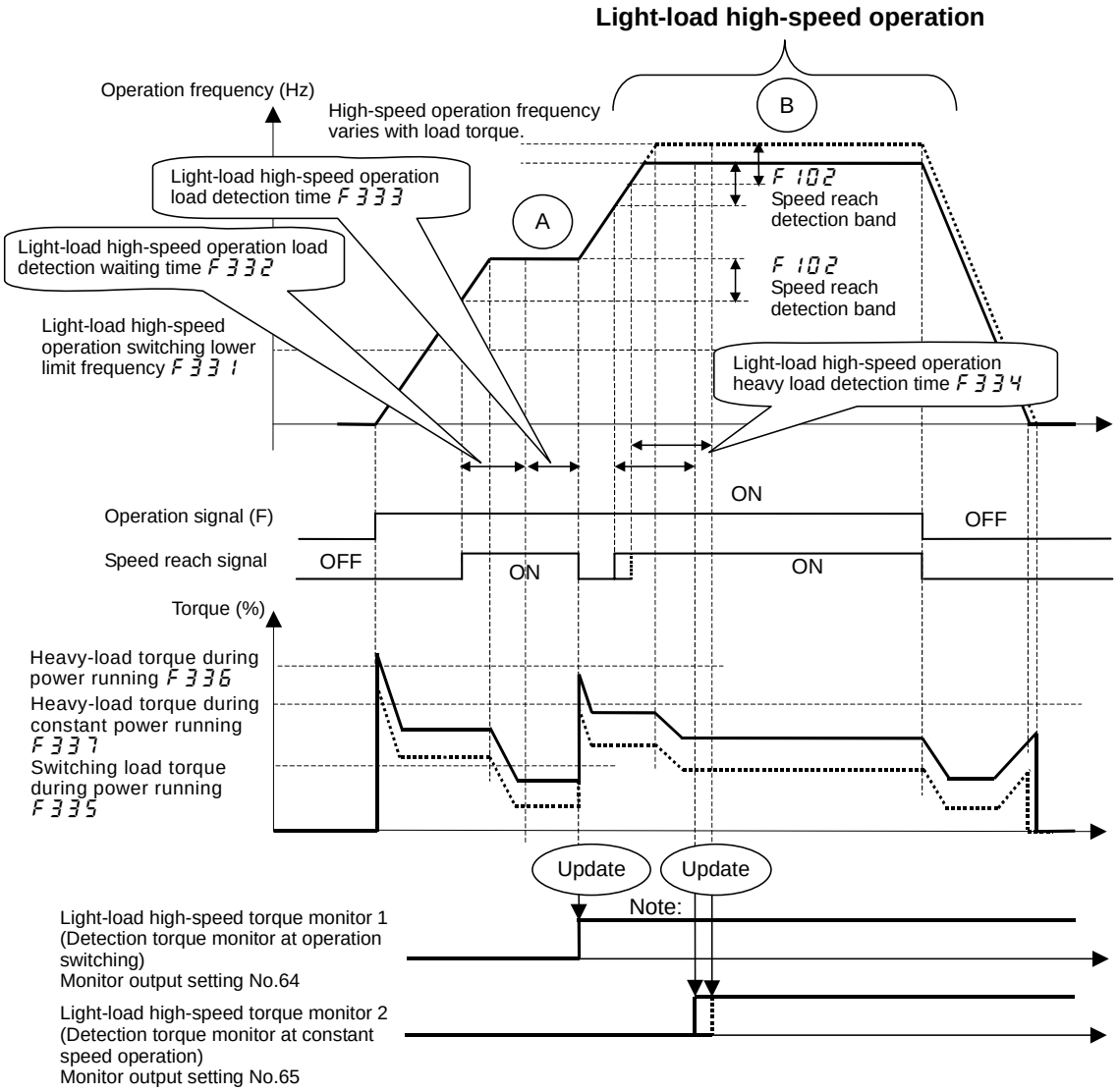

Fig.1

Note: The torque monitor at the light-load high-speed switching (detected value) is updated for every operation.
These values can be monitored by setting the standard monitor parameter (F710) and status monitor parameters 1 to 8 (F711 to F718).

4.1.2. Fixed setting mode of high-speed operation speed (F328=3, 4)

The diagram on the next page(Fig.2) is the timing chart when fixed setting mode of the high-speed operation speed(F328=3) is applied to lift application.

At the operation frequency above the light-load high-speed operation switching lower limit frequency (F331) (point A in the Fig.2), if an average torque during the light-load high-speed operation load detection time (F333) after completion of speed reach and after the light-load high-speed operation load detection waiting time (F332) has elapsed is below the switching load torque during power running (F335), the inverter judges to be light-load detection and is more accelerated up to an automatic light-load high-speed operation frequency (F330). (Point B in the Fig.2 Light-load high-speed operation)

Load torque detection is carried out after speed reach when an operation frequency is above the light-load high-speed operation switching lower limit frequency (F331).
When each of conditions below is reached, the light-load high-speed operation is canceled and the operation is returned to the frequency corresponding to a speed command value.

① If a heavy-load torque (F336) is exceeded during acceleration up to the automatic light-load high-speed operation frequency (F330).
② If a heavy-load torque during constant power running (F337) is exceeded after reaching the automatic light-load high-speed operation frequency (F330) and after a lapse of the light-load high-speed operation heavy load detection time (F334).
③ If a speed command value less than the light-load high-speed operation switching lower limit frequency (F331) is entered.

Note: The torque monitor at the light-load high-speed switching (detected value) is updated for every operation.
These values can be monitored by setting the standard monitor parameter (F710) and status monitor parameters 1 to 8 (F711 to F718).

Function	Description	Monitor output
Light-load high-speed torque monitor 1 (Detection torque monitor at operation switching)	Average torque during light-load high-speed operation load detection time (F333) after a lapse of light-load high-speed operation load detection waiting time (F332)	Setting No. 64
Light-load high-speed torque monitor 2 (Detection torque monitor at constant speed operation)	Average torque after reaching automatic light-load high-speed operation frequency (F330) and after a lapse of light-load high-speed operation heavy load detection time (F334)	Setting No. 65

《Example of operation》Light-load high-speed operation selection (F328=3: High-speed operation set with F330): F (Raising)

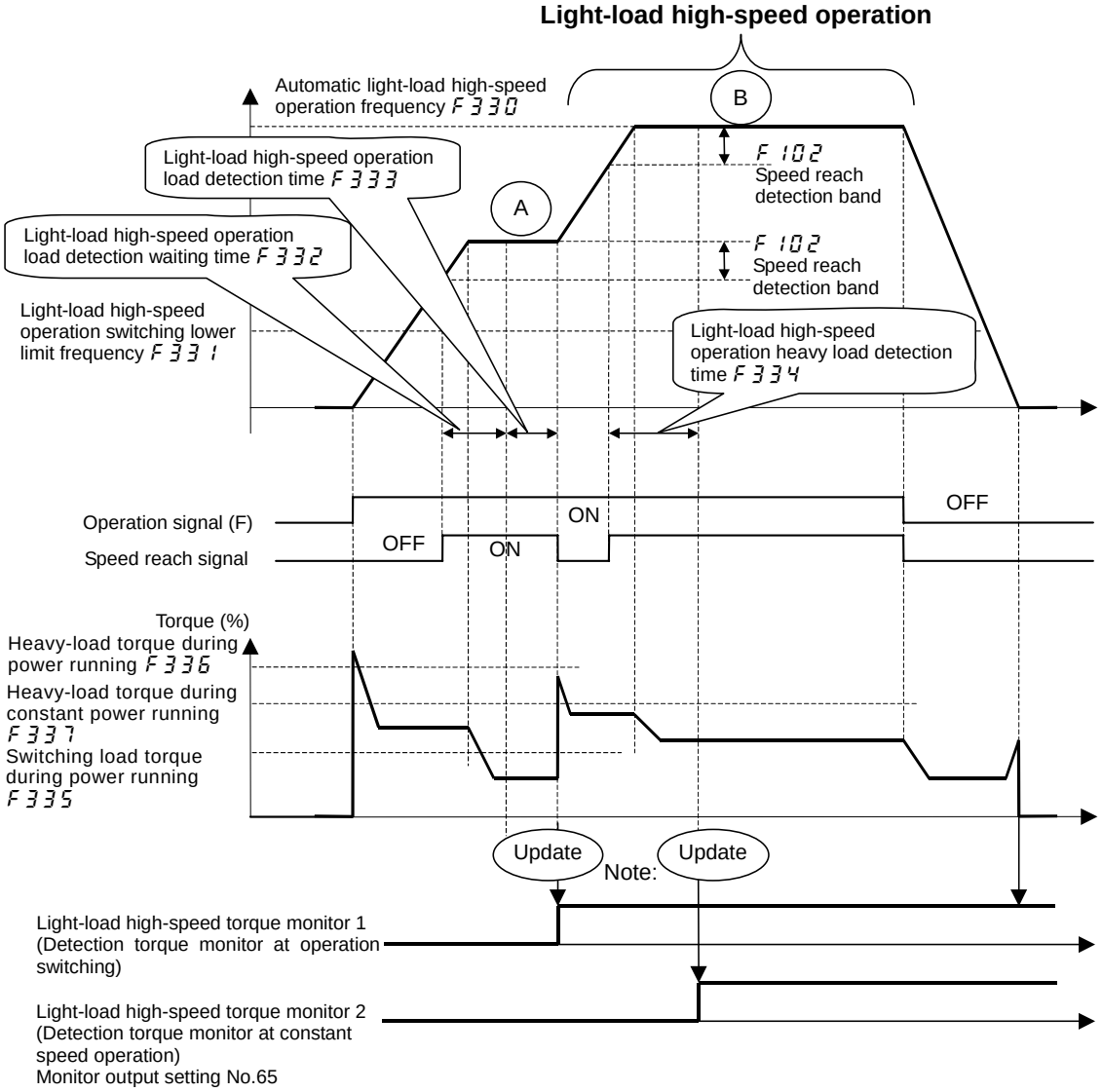

Fig.2

Note: The torque monitor at the light-load high-speed switching (detected value) is updated for every operation.
These values can be monitored by setting the standard monitor parameter (F710) and status monitor parameters 1 to 8 (F711 to F718).

5. How to adjust parameters

If the light-load high-speed operation is used, it is necessary to always set the motor-related parameters (Motor constants) regardless of setting of V/f control mode selection (PL).
Refer to Section 6-22 of VF-AS1 instruction manual (E6581301) to set motor-related parameters.
In addition, for the high-speed operation fixed setting mode (F328=3, 4), the learning action allows the light-load high-speed operation to be adjusted easily.

5.1 Automatic setting mode of high-speed operation speed

《Adjustment method for lift application》

If the light-load high-speed operation is carried out with 60Hz of normal operation, follow the procedure below:

① Set the parameter below at an arbitrary position of the status monitor display selection (F711 to F718).

Light-load high-speed load torque monitor 1 Setting No.64 Ex. of LED display L 20

② Carry out the power running operation while hanging a minimum load for which the light-load high-speed operation is not wanted and check that the operation does not change to the light-load high-speed operation (an operation frequency does not change).
If changing to the light-load high-speed operation, reduce the setting value of the switching load torque during power running (F335).

③ Similarly, carry out the regenerative braking operation while hanging a minimum load for which the light-load high-speed operation is not wanted and check that the operation does not change to the light-load high-speed operation (an operation frequency does not change).
If changing to the light-load high-speed operation, reduce the setting value of the switching load torque during power running (F338).

Standard setting values of the switching load torque during power running (F335) and the switching load torque during regenerative braking (F338) are 105% of torque monitor values checked on the light-load high-speed load torque monitor 1 when power running/regenerative braking operation is carried out with a maximum load for which the light-load high-speed operation can be carried out.

④ When reaching a state where it is possible to switch to the light-load high-speed operation, check that a high-speed operation frequency changes by changing a load.

⑤ Restore the parameter changed in ① to an initial value.

5.2 Fixed setting mode of high-speed operation speed

《Adjustment method using the learning function for lift application》

If the light-load high-speed operation is carried out with 60Hz of normal operation, follow the procedure below:

① Set the automatic light-load high-speed operation frequency (F330). Ex.: F330=90Hz

② Set the light-load high-speed learning function (F329) to 1 (Forward run learning).

③ Carry out the 60Hz-forward power running operation while hanging a maximum load for which the light-load high-speed operation can be carried out and check that the operation changes to the light-load high-speed operation (90Hz operation). (Forward run learning)
During the learning operation, t blinks on the left side of the frequency display LED.

④ Set the light-load high-speed learning function (F329) to 2 (Reverse run learning).

⑤ Similarly, carry out the 60Hz-reverse regenerative braking operation while hanging a maximum load for which the light-load high-speed operation can be carried out and check that the operation changes to the light-load high-speed operation (90Hz operation).

⑥ The parameters below are automatically adjusted by carrying out operations in ③ and ⑤.

Title	Function	Default setting	Values set by learning function
F335	Switching load torque during power running	50	Light-load high-speed load torque monitor 1 during power running +5%
F336	Heavy-load torque during power running	100	Light-load high-speed load torque monitor 2 during power running +5%
F337	Heavy-load torque during constant power running	50	Maximum torque value during acceleration from normal operation speed to high-speed operation (speed reach) during power running +5%
F338	Switching load torque during regenerative braking	50	Light-load high-speed load torque monitor 1 during regenerative braking +5%

⑦ Hang a load for which the light-load high-speed operation is not wanted and check that a normal operation does not change for both of power running/regenerative braking operations.

《Cautions》

- If a result of the learning operation is as follows, the learning operation should be completed when it stops without transition to the high-speed operation.
  Switching load torque during power running (F335) is 70% or more
  Switching load torque during regenerative braking (F338) is 70% or more

- If a detected torque exceeds 150% during acceleration of the high-speed operation, the high-speed operation should be stopped and the learning operation should be completed without reflecting the learning data.

- If a detected torque exceeds 100% during constant speed operation after completion of acceleration of the high-speed operation, the high-speed operation should be stopped and the learning operation should be completed without reflecting the learning data.