

TOSVERT VF-AS3

Crane Application Function Manual

TOSHIBA INDUSTRIAL PRODUCTS AND SYSTEMS CORPORATION

Note

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.

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1. Introduction

VF-AS3 has functions to be used in crane application.

This instruction manual explains the light-load high-speed operation function and brake function of VF-AS3 for crane and hoists applications.

<Note> This instruction manual mentions manufacturer specific parameters.

2. Functions

VF-AS3 has the following functions for crane application.

1) Light-load high-speed operation function

This function enhances the operating efficiency of the machine by increasing the rotational speed of the motor in case of light-load operation.

This function is applied to crane and material handling applications which repeatedly drive light and heavy loads. The learning function of VF-AS3 simplifies the adjustment of light-load high-speed operation, just to execute the forward run (up) or reverse run (down) operation. (When [F328: Light-load high-speed operation] = "3" or "4")

2) Brake function

To ensure smooth operation, the motor produces enough torque before the brake is released.

The learning function for brake timing simplifies rough adjustment of creep frequency and brake releasing time.

The light-load high-speed operation function and the brake function are effective for vector control.

After setting the parameters for motor, set either of the following.

- Set [AU2: Torque boost setting macro function] = "2: Vector control 1 + Offline auto-tuning".
- Select [Pt: V/f pattern] = "3: Vector control 1", "9: Vector control 2", "10: PG feedback control" or "11: PG feedback vector control" and set [F400: Offline auto-tuning] = "5".

Refer to the instruction manual (E6582062) of the main inverter unit for details of vector control.

3. Light-load high-speed operation function

■ Parameter setting

Title	Parameter name	Adjustment range	Unit	Default setting
F327	Load torque offset at light-load switching	0.00 - 20.00	%	10.00
F328	Light-load high-speed operation	0: Disabled 1: Auto speed (Fwd: up) 2: Auto speed (Rev: up) 3: Speed F330 (Fwd: up) 4: Speed F330 (Rev: up)	-	0
F329	Light-load high-speed learning function	0: - 1: Fwd run only 2: Rev run only	-	0
F330	Light-load high-speed automatic operation frequency	30.0 - UL	Hz	50.0/60.0
F331	Light-load high-speed operation switching lower-limit frequency	5.0 - UL	Hz	40.0
F332	Light-load high-speed operation load detection wait time	0.0 - 10.0	s	0.5
F333	Light-load high-speed operation load detection time	0.0 - 10.0	s	1.0
F334	Light-load high-speed operation heavy load detection time	0.0 - 10.0	s	0.5
F335	Switching load torque during power running	-250 - 250	%	50
F336	Heavy-load torque during power running	-250 - 250	%	100
F337	Heavy-load torque during constant speed power running	-250 - 250	%	50
F338	Switching load torque during regen	-250 - 250	%	50
F339	Acc/Dec switching frequency during light-load	0.0: Disabled 0.1 - UL	Hz	0.0

- The parameters [F335] to [F338] need to be adjusted according to the load.
The learning function of VF-AS3 simplifies the adjustment of light-load high-speed operation, just to execute the forward run (up) or reverse run (down) operation. (When [F328: Light-load high-speed operation] = "3" or "4")
 - If the judgment whether or not to switch to light-load high-speed operation differs when the motor is cold and when the motor is hot, set [F327] to a larger value. Usually, it is set with the default setting value.
 - The light-load high-speed operation function and the brake function are effective for vector control.
After setting the parameters for motor, set either of the following.
 - 1) Set [AU2: Torque boost macro] = "2: Vector control 1 + Offline auto-tuning."
 - 2) Select [Pt: V/f pattern] = "3: Vector control 1", "9: Vector control 2", "10: PG feedback control" or "11: PG feedback vector control" and set [F400: Offline auto-tuning] = "5".
- Refer to the instruction manual (E6582062) of the main inverter unit for details of vector control.

■ Setting of [F328: Light-load high-speed operation]

When the load is judged to be light, select whether the light-load high-speed operation frequency is automatically set according to the detected torque or the fixed [F330: Light-load high-speed automatic operation frequency] value is set.

0: Disabled

Light-load high-speed operation is disabled.

1: Auto speed (Fwd: up)

When the forward command is up. The light-load high-speed operation frequency is automatically set.

2: Auto speed (Rev: up)

When the reverse command is up. The light-load high-speed operation frequency is automatically set.

3: Speed F330 (Fwd: up)

When the forward command is up. [F330] is set to the light-load high-speed operation frequency.

4: Speed F330 (Rev: up)

When the reverse command is up. [F330] is set to the light-load high-speed operation frequency.

1) Automatic setting: When [F328] = "1" or "2"

The operation is performed according to the timing chart on the next page. (When [F328] = "1")

At the operation frequency that is equal to [F331: Light-load high-speed operation switching lower-limit frequency] or more (point A in the figure), if the detected torque after completion of acceleration or deceleration is [F335: Switching load torque during power running] or less, the inverter judges that the load is light. In that case, the operation is accelerated toward the light-load high-speed operation frequency calculated with the following formula. (Point B in the figure: Light-load high-speed operation)

$$\text{Light-load high-speed operation frequency} = [\text{F335}] \times [\text{vL}] / (\text{detected torque})$$

when light-load high-speed operation frequency \leq [UL] (\leq [FH])

[vL: Base frequency]

Detected torque: Average torque during [F333: Light-load high-speed operation load detection time] after [F332: Light-load high-speed operation load detection wait time] (5% or more)

Light-load detection is carried out after completion of acceleration or deceleration and when an operation frequency is [F331] or more. After reaching the conditions below, the light-load high-speed operation is canceled and the operation is returned to the operation with the frequency command value.

- (1) The detected torque exceeds the following judgment value during acceleration up to the light-load high-speed operation frequency.
(Detected torque) + ([F336] - [F335])

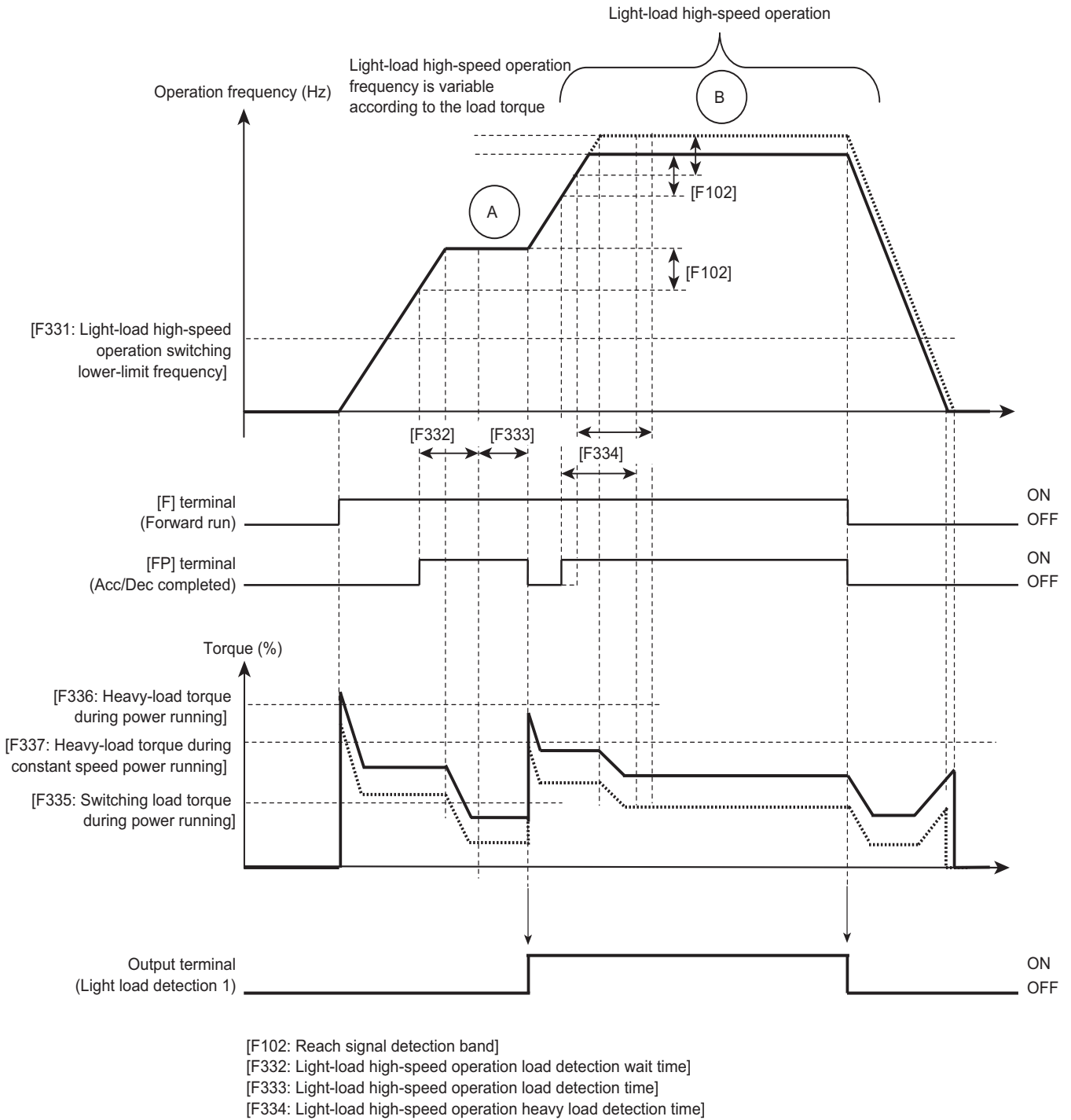
[F336: Heavy-load torque during power running]
[F336] - [F335] is 0% or more

- (2) The detected torque exceeds the following judgment value after reaching the light-load high-speed operation frequency and after a lapse of [F334: Light-load high-speed operation heavy load detection time].
(Detected torque) + ([F337] - [F335])

[F337: Heavy-load torque during constant speed power running]
[F337] - [F335] is 0% or more

- (3) A frequency command value under [F331] is entered.
- (4) "78: Light-load high-speed operation inhibited" signal is ON.

Example of operation: When [F328] = "1"



2) [F330] fixed setting: When [F328] = "3" or "4"

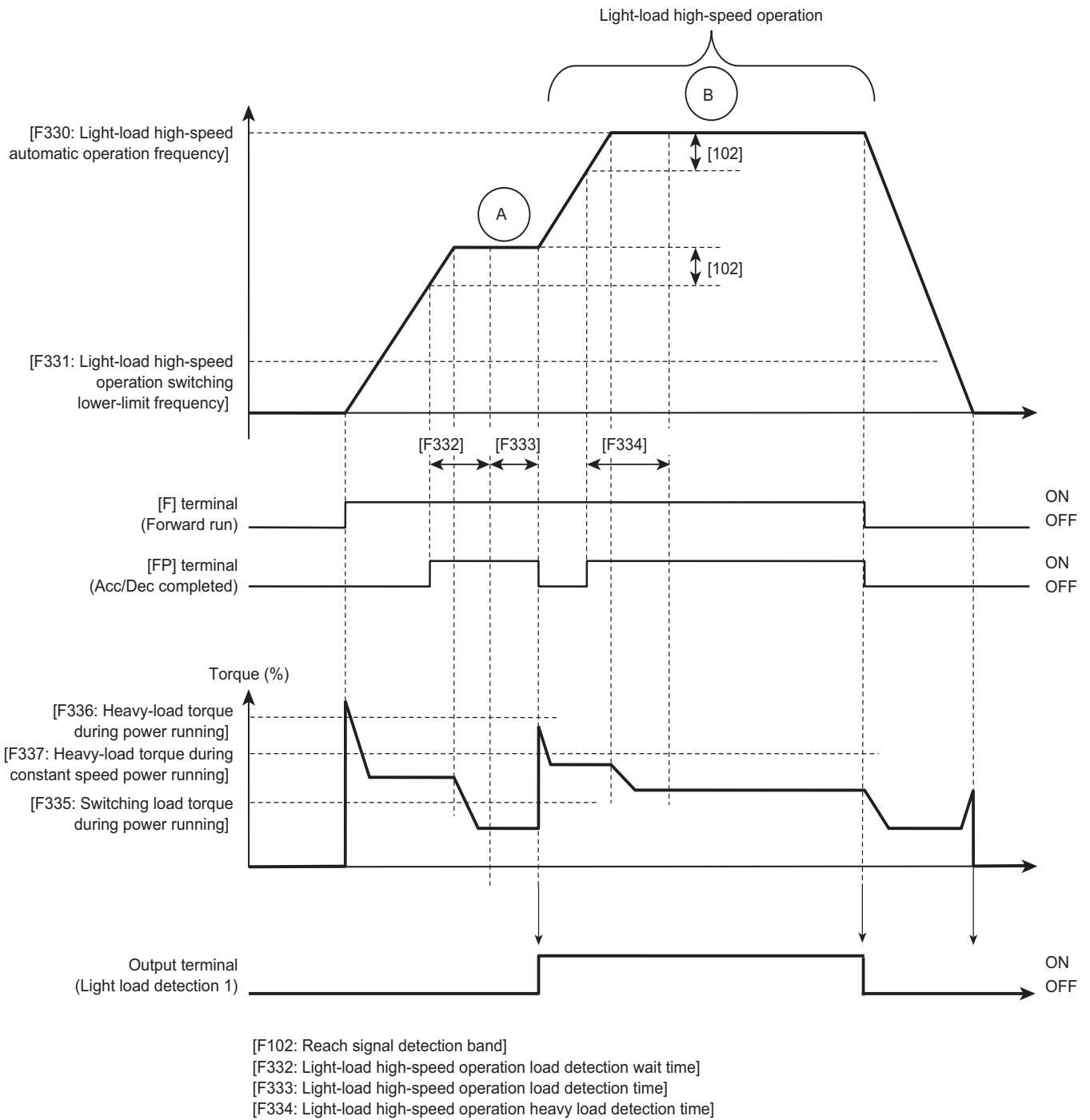
The operation is performed according to the timing chart on the next page. (When [F328] = "3")

At the operation frequency that is equal to [F331: Light-load high-speed operation switching lower-limit frequency] or more (point A in the figure), if the detected torque after completion of acceleration or deceleration is [F335: Switching load torque during power running] or less, the inverter judges that the load is light. In that case, the operation is accelerated toward [F330: Light-load high-speed automatic operation frequency]. (Point B in the figure: Light-load high-speed operation)

Light-load detection is carried out after completion of acceleration or deceleration and when an operation frequency is [F331] or more. After reaching the conditions below, the light-load high-speed operation is canceled and the operation is returned to the operation with the frequency command value.

- (1) The detected torque exceeds [F336: Heavy-load torque during power running] during acceleration up to [f330].
- (2) The detected torque exceeds [F337: Heavy-load torque during constant speed power running] after reaching [F330] and after a lapse of [F334: Light-load high-speed operation heavy load detection time].
- (3) A frequency command value under [F331] is entered.
- (4) "78: Light-load high-speed operation inhibited" signal is ON.

Example of operation: When [F328] = "3"



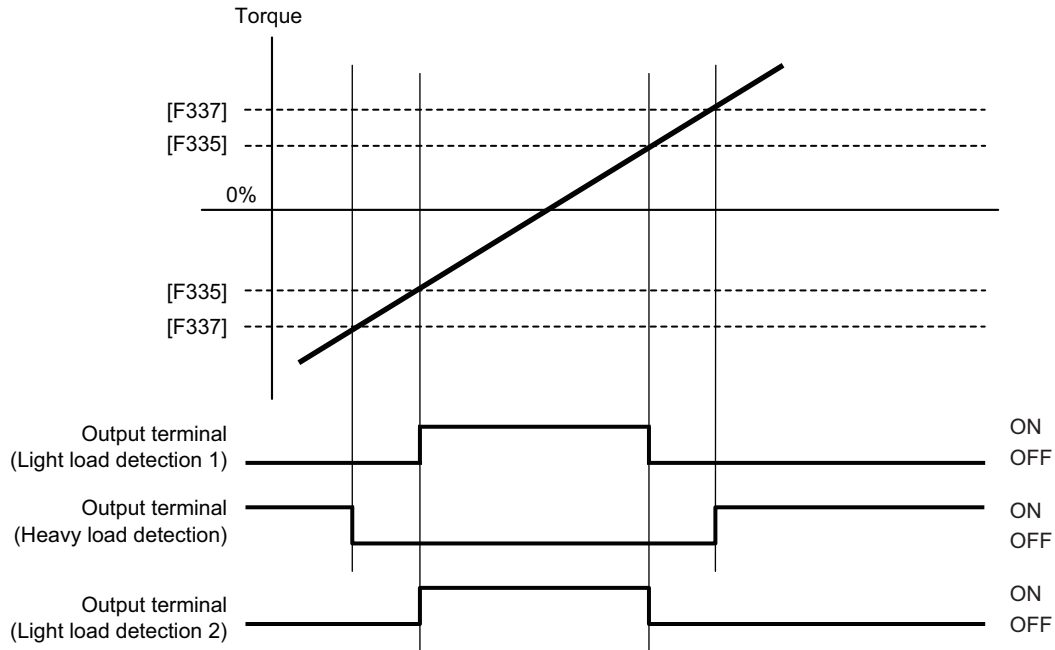
■ **Light-load/heavy-load output signal**

The status of light load/heavy load can be output as a signal from the output terminal.
 The output conditions vary depending on the setting of [F328: Light-load high-speed operation].

1) When [F328] = 0

- "106: Light load detection 1" "164: Light load detection 2" ON: The absolute value of the detected torque is under the absolute value of [F335]
- "108: Heavy load detection" ON: The absolute value of the detected torque is under the absolute value of [F337]

Note) When [F328] = 0, the operations of "106" and "164" are the same.

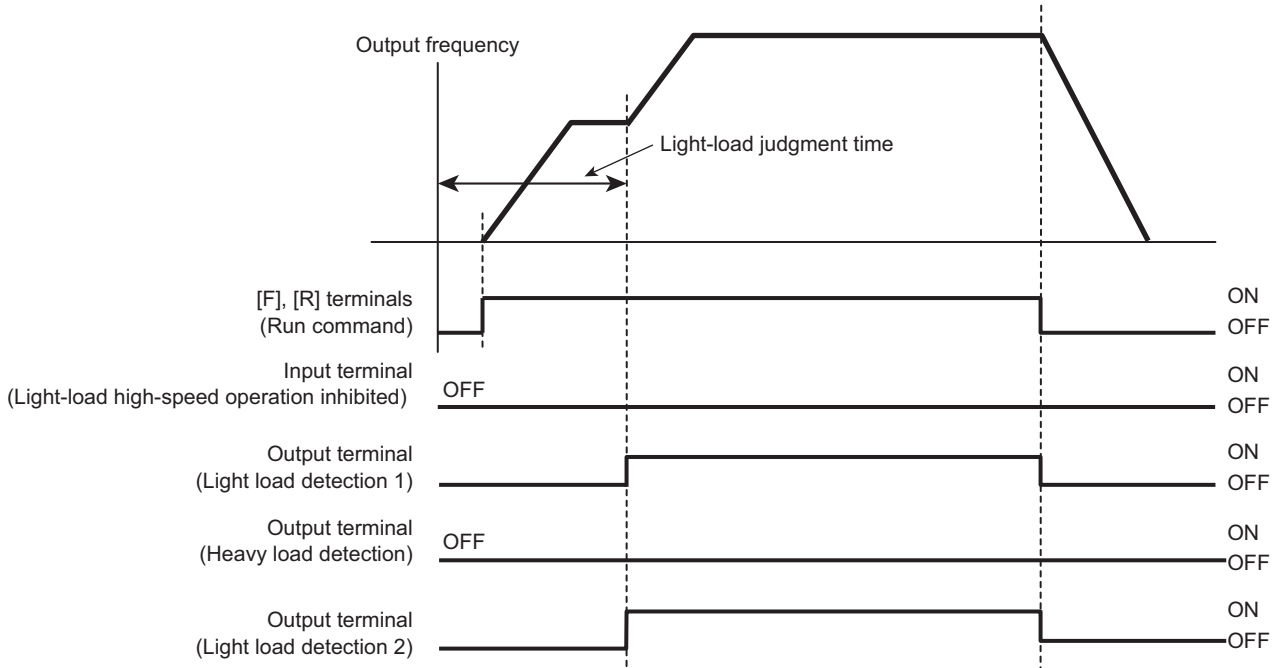


[F335: Switching load torque during power running]
 [F337: Heavy-load torque during constant speed power running]

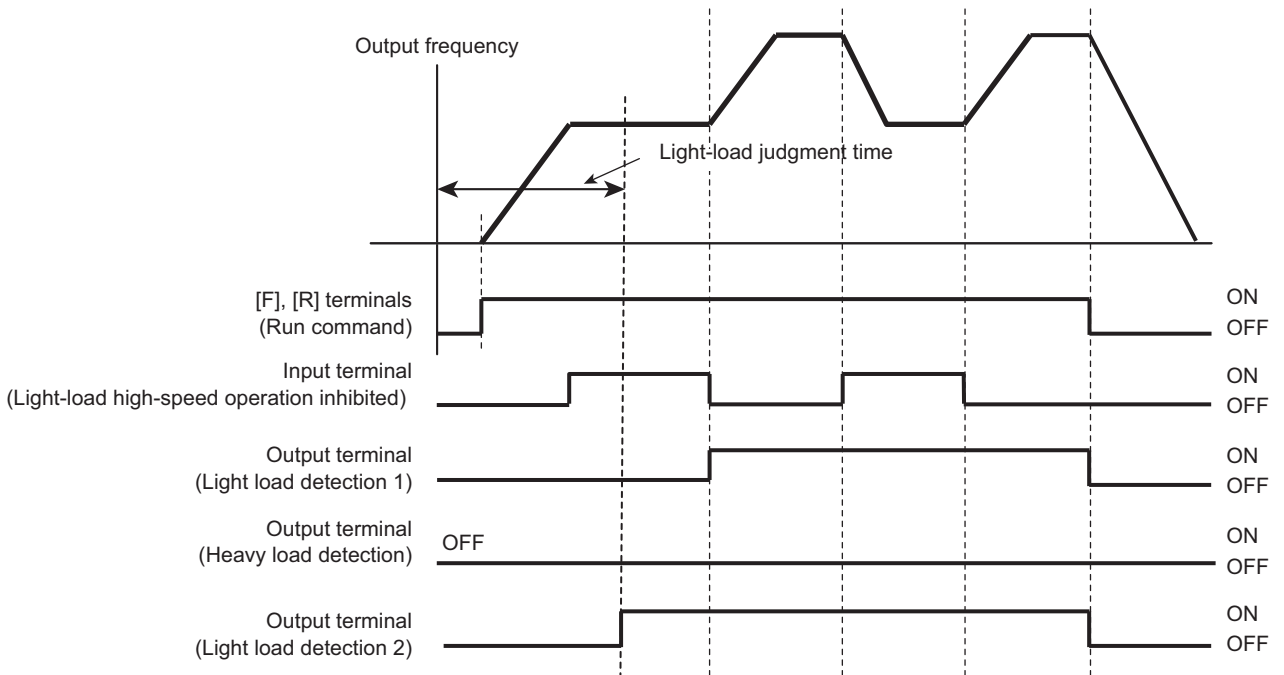
2) When [F328] is not 0

- "106: Light load detection 1" ON: The inverter judges that the operation is light load during light-load judgment time, and heavy-load is not detected during light-load high-speed operation. When "78: Light-load high-speed operation inhibited" is ON before light-load high-speed operation, it is not ON.
- "164: Light load detection 2" ON: The inverter judges that the operation is light load, and heavy-load is not detected during light-load high-speed operation. The signal is not dependent on "78: Light load high-speed operation inhibited."
- "108: Heavy load detection" ON: When heavy-load is detected.

"78: Light-load high-speed operation inhibited" = OFF



"78: Light-load high-speed operation inhibited" = OFF -> ON -> OFF



■ Adjustment method

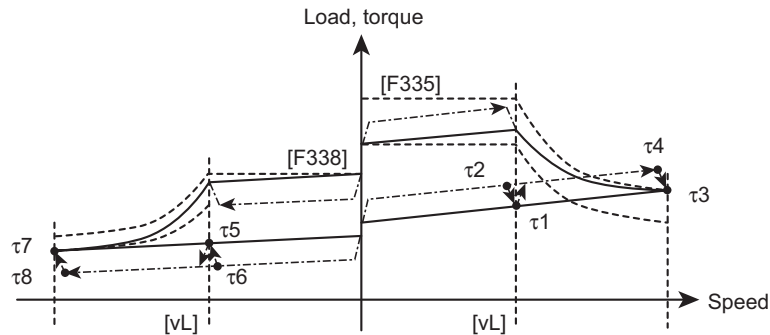
When using the light-load high-speed operation function, be sure to set the parameters for motor. Refer to the instruction manual (E6582062) of the main inverter unit for details of parameters of motor.

With setting of [F328: Light-load high-speed operation] = "3" or "4", the learning functions simplifies adjustment.

1) Automatic setting: When [F328] = "1" or "2"

Adjust in the following procedure. The normal operation is 60Hz.

- (1) Display "Torque" in monitor mode.
Set "8: Torque" in any of [F711] to [F718].
- (2) Set [F328] = 0 to avoid light-load high-speed operation.
- (3) Check the torque monitor values of the following conditions and set them.
For the value, use the maximum load which allows light-load high-speed operation.



Hoisting (Up): Power running operation

- τ1: Steady torque at [vL: Base frequency]
- τ2: Maximum torque during acceleration up to [vL]
- τ3: Steady torque at light-load high-speed operation frequency ([UL: Upper limit frequency])
- τ4: Maximum torque during acceleration up to light-load high-speed operation frequency ([UL])

Lowering (down): Regenerative braking operation

- τ5: Steady torque at [vL: Base frequency]
- τ6: Minimum torque during acceleration up to [vL]
- τ7: Steady torque at light-load high-speed operation frequency ([UL: Upper limit frequency])
- τ8: Minimum torque during acceleration up to light-load high-speed operation frequency ([UL])

τ6 and τ8 are for reference.

Set the values of corresponding parameters after each operation is checked to avoid light-load high-speed operation.

Calculate the parameters with the following formulas and set them.

$$\begin{aligned}
 [F337: \text{Heavy-load torque during constant speed power running}] &= \tau_3 \times [UL]/[vL] \\
 [F335: \text{Switching load torque during power running}] &= [F337] - \text{Max}(\tau_3 - \tau_1, 5\%) \\
 [F336: \text{Heavy-load torque during power running}] &= [F337] + \text{Max}(\tau_4 - \tau_3, 5\%) \\
 [F338: \text{Switching load torque during regen}] &= (\tau_7 + \text{Max}(\tau_5 - \tau_7, 5\%)) \times [UL]/[vL]
 \end{aligned}$$

Setting example:

$$\begin{aligned}
 [UL] &= 120\text{Hz}, [vL] = 60\text{Hz} \\
 \tau_1 &= 30\%, \tau_2 = 40\%, \tau_3 = 40\%, \tau_4 = 50\%, \tau_5 = 15\%, \tau_6 = 5\%, \tau_7 = 10\%, \tau_8 = 0\%
 \end{aligned}$$

$$\begin{aligned}
 [F337] &= 40\% \times 120\text{Hz}/60\text{Hz} = 80\% \\
 [F335] &= 80\% - \text{Max}(40\% - 30\%, 5\%) = 70\% \\
 [F336] &= 80\% + \text{Max}(50\% - 40\%, 5\%) = 90\% \\
 [F338] &= (10\% + \text{Max}(15\% - 10\%, 5\%)) \times 120\text{Hz}/60\text{Hz} = 30\%
 \end{aligned}$$

- Fine-tune [F335] and [F338] values by several percents in order not to switch to the light-load high-speed operation (no operation frequency change). Change [F336] and [F337] values with the above.
- Judgment value of heavy-load during acceleration of the power running = Detected torque value + ([F336] - [F335])
 where
 the torque is detected with an operation frequency equal to [F331: Light-load high-speed operation switching lower-limit frequency] or more
 [F336] - [F335] is 0% or more
- Judgment value of heavy load during constant power running = Detected torque value + ([F337] - [F335])
 where
 the torque is detected with operation frequency equal to [F331] or more
 [F337] - [F335] is 0% or more
- (4) In a state where the inverter will not switch to the light-load high-speed operation, check that the high-speed operation frequency changes according to the change of load.
- (5) Restore the settings of [F711] to [F718] changed in (1) to the initial values.

2) [F330] fixed setting: When [F328] = "3" or "4"

Adjust in the following procedure by using the learning function. The normal operation is 60Hz.

- (1) Set [F330: Light-load high-speed automatic operation frequency]. Example) [F330] = 90Hz
- (2) Set [F329: Light-load high-speed learning function] =2: Fwd run only].
- (3) Carry out the 60Hz-lifting (forward power running) operation while hanging the maximum load which allows light-load high-speed operation and check that the operation switches to the light-load high-speed operation (90Hz operation).
 During the learning operation, "tUn" is displayed.
- (4) Set [F329] = "1: Rev run only"
- (5) Carry out the 60Hz-lifting (reverse regenerative braking) operation while hanging the maximum load which allows light-load high-speed operation and check that the operation switches to the light-load high-speed operation (90Hz operation).
 During the learning operation, "tUn" is displayed.
- (6) The following parameters are automatically set by carrying out operations in (3) and (5).

Title	Parameter name	Default setting
F335	Switching load torque during power running	50
F336	Heavy-load torque during power running	100
F337	Heavy-load torque during constant speed power running	50
F338	Switching load torque during regen	50

- (7) Hang the minimum load which does not allow light-load high-speed operation and check that a normal operation does not switch to either hoisting (power running) or lowering (regenerative braking) operations.
- (8) In case of a dynamic lift off at hoisting (power running) operation, carry out the dynamic lift off after high-speed operation and check that the inverter operates at the normal speed.

Cautions

- If [F335] and [F338] are 70% or more as a result of learning operation, the learning operation is completed when it stops without transition to the high-speed operation.
- If a detected torque is 150% or more during acceleration of the light-load high-speed operation, the light-load high-speed operation stops and the learning operation is completed without reflecting the learning data.
- If a detected torque is 100% or more during constant speed operation after completing the acceleration of the light-load high-speed operation, the light-load high-speed operation stops and the learning operation is completed without reflecting the learning data.
- Do not change the parameters concerning the frequency command value, acceleration time, and direction of rotation, and do not input the "light-load high-speed operation inhibited" signal before the learning operation is completed.

The learning operation may not be completed correctly.

- "tUn2" means that the learning operation cannot be performed correctly, and the possible reasons are as follows.
 - [F331] > [F330]
 - [F328] = "1" or "2"
 - Operation frequency < [F331]
 - Acceleration time > 100s
 - Direction of rotation is opposite to [F329] setting
 - "Light-load high-speed operation inhibited" signal is ONIf learning operation is completed even under the conditions above, "tUn2" is not displayed.
"tUn2" may be displayed because of the torque control at the start of the inverter. It is normal if "tUn2" disappears after output frequency reaches [F331] or more.
- "tUn3" is displayed when the inverter detects heavy load.

- Setting of [F339: Acc/Dec switching frequency during light-load]
During light-load high-speed operation, if operation frequency exceeds [F339], the acceleration/deceleration time is switched to acceleration/deceleration time 2 ([F500], [F501]).
Acceleration/deceleration time 3 ([F510], [F511]) has priority over the above when selected.
This function is reset with the following conditions.
 - Operation frequency reached the set frequency (completion of acceleration/deceleration)
 - After switching forward/reverse operation
 - Stop

4. Brake function

■ Parameter setting

Title	Parameter name	Adjustment range	Unit	Default setting
F325	Brake release wait time	0.00 - 2.50	s	0.00
F326	Brake release undercurrent threshold	0 - 100	%	0
F340	Creep time 1	0.00 - 10.00	s	0.00
F341	Brake function	0: Disabled 1: Fwd hoisting 2: Rev hoisting 3: Horizontal operation	-	0
F342	Load torque input select	0: - 1: Terminal RR 2: Terminal RX 3: Terminal II 4: Terminal AI4 (option) 5 - 11:- 12: F343 13 - 19:- 20: Embedded Ethernet 21: RS485 communication (connector 1) 22: RS485 communication (connector 2) 23: Communication option	-	12
F343	Hoisting torque bias	-250 - 250 (F342=12 only)	%	100
F344	Lowering torque bias rate	0 - 100	%	100
F345	Brake releasing time	0.00 - 10.00	s	0.05
F346	Creep frequency	F240 - 20.0	Hz	3.0
F347	Creep time 2	0.00 - 10.00	s	0.10
F348	Brake learning	0: - 1: Enabled (0 after execution)	-	0
F630	Brake answer wait time	0.0: Disabled 0.1 - 10.0	s	0.0

■ Guideline for the setting

[F325: Brake release wait time]

The brake release command is not output during [F325] setting time when the brake is released.
When you do not want to use this function, set [F325] = "0.00".

[F326: Brake release undercurrent threshold]

The inverter trips as low-current operation fault (UC) if the output current is equal to [F326] or less after a lapse of [F325] setting time when the brake is released.
When you do not want to use this function, set [F326] = "0".

[F340: Creep time 1]

The inverter suspends the braking command for the time set with [F340] to minimize swing of load when the brake is operated.

[F341: Brake function]

This parameter is to select the operation of the brake function.
Usually, the forward operation uses hoisting.

[F342: Load torque input select]

This parameter is to set the brake releasing torque value balanced with the load torque to prevent load gap (shifts) at brake release.
Usually, set [F342] = "12: F343", and set the value to "F343: Hoisting torque bias".

[F343: Hoisting torque bias]

This parameter is enabled when [F342] = "12." It is used to set the hoisting torque bias value.
The 100% value is the motor rated torque determined by [F405: Motor rated capacity] and [F417: Motor rated speed]. Usually, set [F343] = "100." In case of trouble after brake learning, adjust this setting value.

[F344: Lowering torque bias rate]

The torque bias value at brake release is set by [F342]. When lowering, the torque bias value is multiplied by this parameter value.
Usually, a necessary torque in lowering is decreased by squaring the mechanical efficiency. The hoisting torque bias in lowering at 80% machine efficiency is $0.8 \times 0.8 = 0.64$ (about 60%). Usually, set [F344] = "60" to "70."

[F345: Brake releasing time]

With the run command ON, the brake release command is output at the same time as the set torque of [F343] is output.
After the time set with [F345], the inverter accelerates.
This parameter is roughly adjusted by executing [F348: Brake learning].

[F346: Creep frequency]

With the run command OFF, a braking command is output after deceleration to [F346].
Consider the motor rated slips when setting the creep frequency.
For example, in case of 5% slips in 60Hz motor, the creep frequency is $60\text{Hz} \times 5\% = 3\text{Hz}$.
This parameter is roughly adjusted by executing [F348: Brake learning].

[F347: Creep time 2]

With the run command OFF, a braking command is output after deceleration to [F346]. Then, the creep frequency is maintained for the time set with [F347].
This parameter is roughly adjusted by executing [F348: Brake learning].

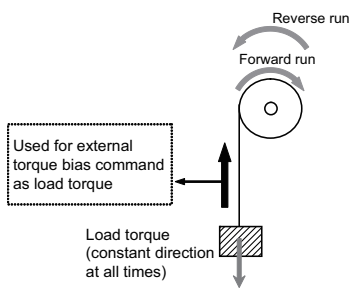
[F348: Brake learning]

The brake learning function is executed by forward winding up operation after setting [F348] = [1: Enabled].
The learning function roughly adjusts the parameters [F345], [F346], and [F347].

[F630: Brake answer wait time]

This parameter can set the waiting time for the brake answer (reply) from the system. Input brake answer to the input terminal with "130: Brake answerback" assigned.
After the operation start, when there is no answer after elapse of the setting time, the inverter trips. The trip display is [E-11].

Memo

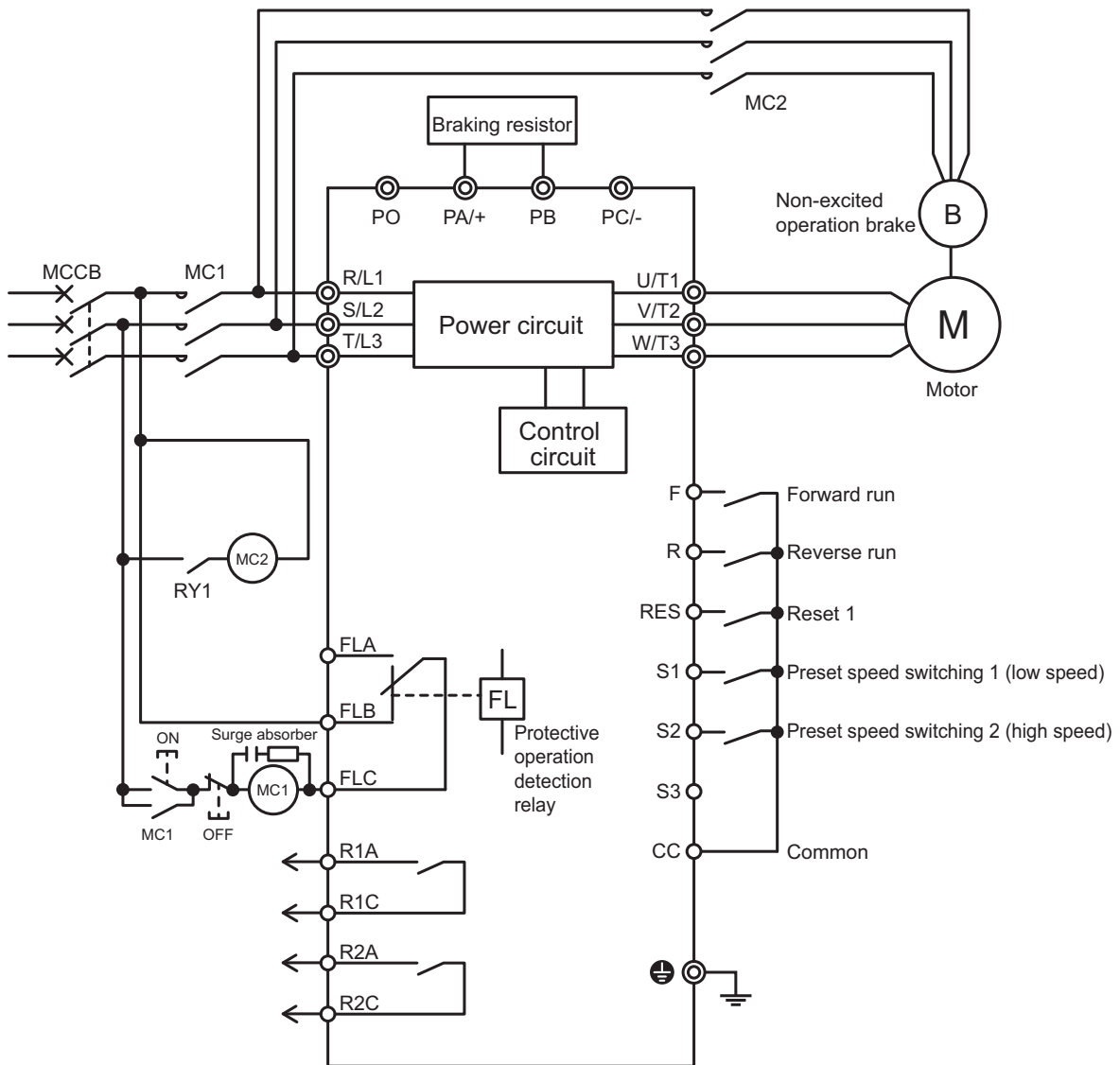


Torque bias ([F342] to [F344])

With this function, the motor produces enough torque balanced with the load portion for the opposite side before the brake is released, which enables smooth start of the load.

■ Example of connection diagram

Sink logic



Run command:

Frequency command:

Terminal

Preset speed 1 and 2, Operation panel

■ Operation of brake function

The brake sequence function is to ensure smooth operation with the motor by producing enough torque before the brake is released.

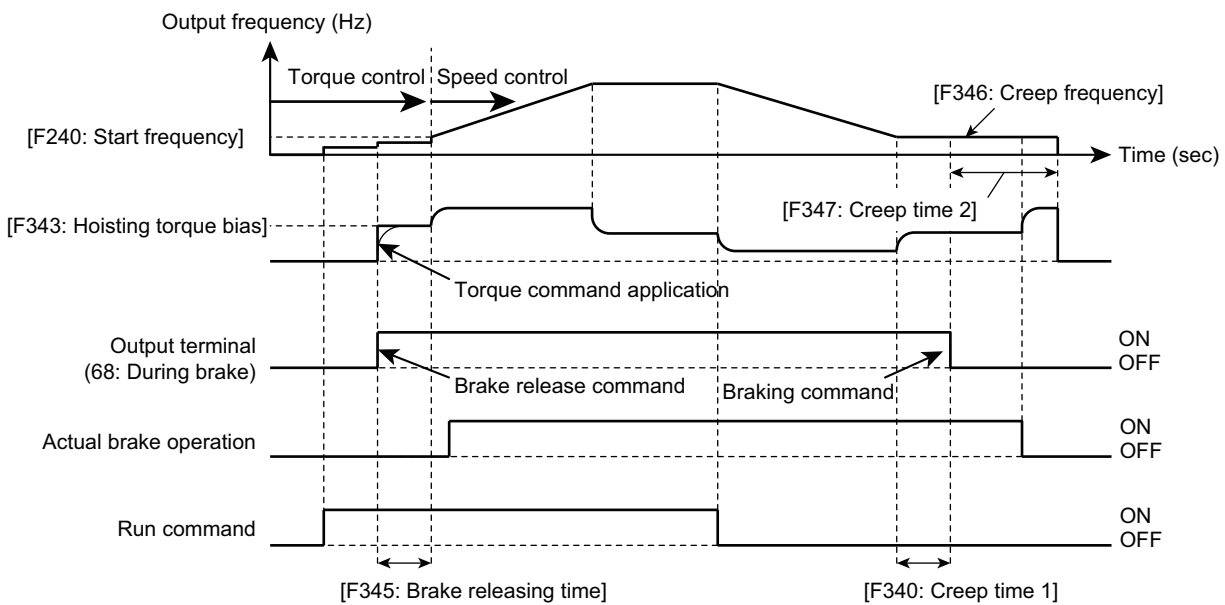
1) Starting procedure

With the run command ON, the brake release command is output at the same time as the set torque of [F343] is output.

After the time set with [F345], the inverter accelerates.

2) Stopping procedure

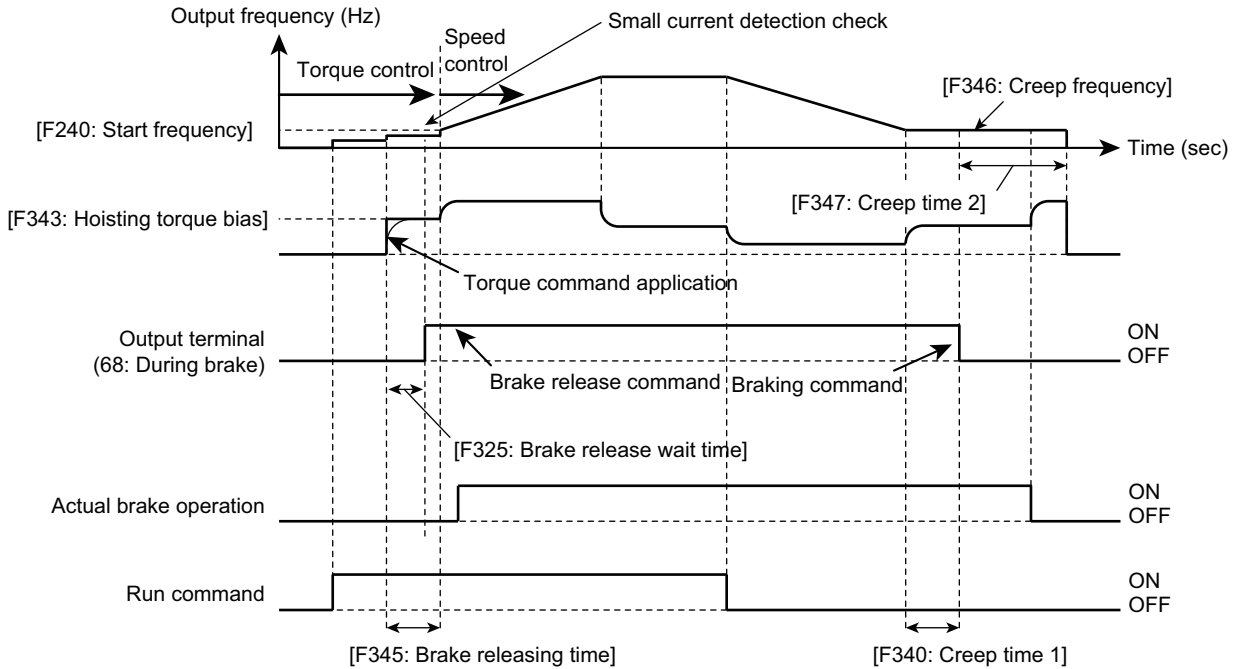
The inverter suspends the braking command for the time set with [F340] to minimize swing of load after deceleration to [F346] with the run command OFF. After the braking command is issued, the creep frequency is maintained for the time set with [F347] before the inverter stops.



3) Undercurrent detection function

The brake release command is not output during [F325] setting time when the brake is released. In addition, the inverter trips as low-current operation fault [UC] if the output current is equal to [F326] or less after a lapse of [F325] setting time when the brake is released. When [F326] = "0", undercurrent detection is not active.

In case of execution of learning function, [F325] time is included in the learning time because the brake release command is not output during [F325] setting time. If [F325] > [F345], the inverter checks the current for the undercurrent detection after a lapse of [F345] setting time.



■ Parameter setting procedure and setting example

Set parameters in the following procedure. The operation procedure of learning is described in "■ Learning operation and execution."

- (1) Set the parameters by referring to the setting example.
For the brake function, set [F460: Speed control response 1]= "5.0" and [F462: Speed reference filter coefficient] = "20."
- (2) Set the parameters for motor and execute the auto-tuning functions without load.
- (3) Execute the learning function without load. The timing of braking/release is roughly adjusted.
If the brake is not active in switching forward/reverse operation, adjust [F462: Speed reference filter coefficient 1].
- (4) Operate lifting (forward)/lowering (reverse) run with maximum load, and confirm that an inverter trip or luggage shift does not occur. If an inverter trip or load shift occurs, adjust parameters for brake function.

Title	Parameter name	Adjustment range	Default setting	Setting example	Remarks
CMOd	Run command select	0 - 5	0	0	0: Terminal
FMOd	Frequency command select 1	0 - 23	1	11	11: Touch wheel 2
ACC	Acceleration time 1	0.0 - 6000 (600.0) (s)	*1	1.0	
dEC	Deceleration time 1		*1	1.0	
FH	Maximum frequency	30.0 - 590.0 (Hz)	*2	60.0	
UL	Upper limit frequency	0.0 - FH (Hz)	*2	60.0	
LL	Lower limit frequency	0.0 - UL(Hz)	0.0	6.0	
Pt	V/f Pattern	0 - 12	0	3 (*3)	3: Vector control 1
Sr1	Preset speed 1	LL-UL	0.0	10.0	Operation frequency (low speed)
Sr2	Preset speed 2	LL-UL	0.0	60.0	Operation frequency (high speed)
F133	Terminal R1 function 1	0 - 255	4	68	68: During brake (*3)
F240	Start frequency	0.0 - 10.0 (Hz)	0.1	0.1	
F304	Dynamic braking, OLr trip	0 - 8	0	1	1: Enabled, OLr trip
F305	Overvoltage limit operation	0 - 3	2	2 (*4)	2: Enabled (quick deceleration)
F308	Braking resistance	0.5 - 1000 (Ω)	*1	*5	
F309	Braking resistor capacity	0.01 - 600.0 (kW)	*1	*6	
F325	Brake release wait time	0.00 - 2.50 (s)	0.00	0.00	

Title	Parameter name	Adjustment range	Default setting	Setting example	Remarks
F326	Brake release undercurrent threshold	0 - 100 (%)	0	0	
F340	Creep time 1	0.00 - 10.00 (s)	0.00	0.00	Refer to "■Learning operation and execution" for the details of setting.
F341	Brake function	0 - 3	0	1	
F342	Load torque input select	0 - 23	12	12	
F343	Hoisting torque bias	-250 - 250 (%)	100	100	
F344	Lowering torque bias rate	0 - 100 (%)	100	60	
F345	Brake releasing time	0.00 - 10.00 (s)	0.05	0.05	
F346	Creep frequency	F240 - 20.0 (Hz)	3.0	3.0	
F347	Creep time 2	0.00 - 10.00 (s)	0.10	0.10	
F348	Brake learning	0 , 1	0	1	
F400	Offline auto-tuning	0 - 7	0	*3	
F401	Slip frequency gain	0 - 250 (%)	70		
F402	Automatic torque boost	0.1 - 30.00 (%)	*1		
F405	Motor rated capacity	0.10 - 315.0 (kW)	*1		
F415	Motor rated current	Depends on the capacity	*1		
F416	Motor no load current	10 - 90 (%)	*1		
F417	Motor rated speed	100 - 64000 (min ⁻¹)	*2		
F452	Stall detection time during power running	0.00 - 10.00 (s)	0.00	0.5 (*7)	
F460	Speed control response 1	0.0 - 25.0	0.0	5.0	Setting is required to use the brake function.
F462	Speed reference filter coefficient 1	0 - 100	35	20 (*8)	

*1: Parameter values vary depending on the capacity. Refer to the instruction manual of the main inverter unit for default setting.

*2: Parameters set with setup menu.

*3: The brake function is enabled in case of vector control.

After setting the parameters for motor, set either of the following.

- Set [AU2: Torque boost setting macro function] = "2: Vector control 1 + Offline auto-tuning."
- Select [Pt: V/f control selection] = "3: Vector control 1", "9: Vector control 2", "10: PG feedback control" or "11: PG feedback vector control" and set [F400: Offline auto-tuning] = "5."

*4: When [F304: Dynamic braking, OLr trip] = "1" to "8" (enabled), the same process is executed automatically as in the case of [F305: Overvoltage limit operation] = "1: Disabled."

*5: The braking resistor with the value smaller than the minimum allowable resistance value cannot be connected.

*6: Set the resistance capacity suitable for specifications of connected braking resistor's capacity.

- *7: This is one of the fall prevention functions of crane application. If stall prevention operation occurs in succession, this function judges that the motor has stalled to trip it.
Set the detection time to about 0.5 seconds.
- *8: If the brake is not active in switching forward/reverse operation, adjust [F462: Speed reference filter coefficient 1] little by little.

■ Learning operation and execution

1) Introduction

- The brake function establishes the torque at the time of starting by using the parameters for motor.
Set the parameters for motor in advance.
- Before executing learning, the brake release/operation timing may not fit the load torque.
Perform learning operation with no load or light load in about 3% or less rating.

2) Rough adjustment in brake timing

In learning operation, rough adjustment of values of [F345: Brake releasing time], [F346: Creep frequency], and [F347: Creep time 2] is executed automatically. Make fine adjustment manually if necessary.

Set [F348: Brake learning] = "1: Enabled."

Learning is executed with the run command ON. During learning, the frequency and [tUn] are displayed alternately.

[F343: Hoisting torque bias] is set, and [F345] is set in timing measurement of brake release. [F346] is set from the parameters for motor with automatic calculation. When the inverter stops, [F347] is set.

When setting [F325], set [F345] to the value of [F345] set in rough adjustment with the value of [F325] added.

Note 1) Learning should be performed under light-load conditions.

Note 2) If a counterweight is provided, a learning error [tUn1] may occur. If so, make an adjustment manually.

Note 3) Learning should be carried out for forward rotation when [F341] = "1: Fwd hoisting", or for reverse rotation when [F341] = "2: Rev hoisting."

Note 4) Be sure to connect and run the combined motor. As this function calculates the brake timing by detecting output current, a calculation error occurs without connecting the motor.

3) Operation check with maximum load

Check if there is any problem with brake timing with maximum load after completion of rough adjustment of brake timing with no load.

Check the following items. If there is no trouble, adjustment of the brake function is completed.

- Is the inverter started smoothly after brake release without load gap (shifts) when winding up is started?
- No load gap (shifts) when the brake operates?
- No load gap (shifts) with repeated start/stop?
- No unusual noise from the brake at the time of start and stop?
- No inverter trip at the time of start or stop?

[Useful function for adjustment with LED extension panel]

Timing adjustment to release brake at the same time with gaining enough torque and stop after the brake is completely closed is required for crane application.

Therefore, the motor is restrained to some degree at start/stop. Short restrained time may cause load gap (shifts), however, long restrained time increases output current, which will cause the inverter trip.

When adjusting from the LED extension panel, the following parameters allows you to confirm the peak output current.

Usually, the peak output current should be about 150% of inverter's rated current.

Title	Parameter name	Adjustment range	Default setting	Setting example	Remarks
F709	Hold function of standard mode	0: Real time 1: Peak hold 2: Minimum hold	0	1	
F710	Standard mode display	0 - 162	0	2	Output current
F750	EASY key function	0: Easy/Setting mode switching 1: Shortcut function 2: Hand/Auto switching 3: Monitor peak and minimum hold trigger	0	3	

The standard mode display shows the peak hold value of output current by the above parameter settings.

The display changes as the peak value of the output current is changed by repeating start/stop.

The peak hold value is forcibly reset by pressing the "EASY" key.

■ Abnormal phenomenon and the measures

Load status	Operation status	Abnormal phenomenon	Countermeasure (adjustment item)
No-load	At startup	Lowering after hoisting a little when the lowering command is issued.	(1) Shorten [F345: Brake releasing time]. (2) Decrease the value of [F344: Lowering torque bias rate] by about 5%. (3) Decrease the value of [F343: Hoisting torque bias] by about 5 to 10%.
No-load/ load	At startup	The load falls slightly (load gap/shift) when hoisting.	(1) Increase the torque bias value of [F342: Load torque input select] and [F343] by about 10 to 20%.
No-load/ load	At startup At stop	The load falls (load gap/shift) when start/ stop (inching) is repeated frequently in hoisting.	(1) Shorten [F345].
No-load/ load	At switching forward/ reverse	The brake is not active when switching forward/ reverse.	(1) Decrease the value of [F462: Speed reference filter coefficient 1] by about 5.

Note 1) When adjusting [F345] and [F347], change the value little by little. A large value of change causes large time lag between brake release and sufficient torque generation, which may result in fall of the load.

