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TOSVERT VF-S15

Functions for lift application Instruction Manual

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1. Introduction

TOSVERT VF-S15 has effective functions for lift application.
This instruction manual explains the light-load high-speed operation function and the brake sequence function of VF-S15 for crane and hoists applications.
<Note>
    This instruction manual mentions factory specific coefficient parameters.

2. Functions

VF-S15 has the following functions for lift application.
Use of vector control is based on the execution of brake sequence function or light-load high-speed operation. Therefore, set $Au2$ (Torque boost setting macro function) =2 (Vector control + auto-tuning), or set motor related parameters, $F410 - F417$, and Pt (V/F control mode selection) =3 (Vector control).

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 useful for lifts and material handling applications which repeatedly drive light and heavy loads.
   The learning function of VF-S15 simplifies the adjustment of light-load high-speed operation, just to execute the forward run (rising) or reverse run (falling) operation. ($F328=3$, 4 only)

2) Brake sequence 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 creeping frequency, creeping time and brake release time.

3. Light –load high-speed operation function

3.1 Related parameters

Title	Communication No.	Function	Adjustment range	Minimum setting unit (Panel/ Communication)	Default setting
F327	0327	Offset of light load measurement torque	0-2000 (%)	-	1000
F328	0328	Light-load high-speed operation selection	0:Disabled 1: High-speed operation speed set automatically (Power running at F command: Increase) 2: High-speed operation speed set automatically (Power running at R command: Increase) 3: High-speed operation speed set with F330 (Power running at F command: Increase) 4: High-speed operation speed set with F330 (Power running at R command: Increase)	–	0
F329	0329	Light-load high-speed learning function	0:No learning 1:Forward run learning 2:Reverse run learning	-	0
F330	0330	Automatic light-load high-speed operation frequency	30.0 - UL (Hz)	0.1/0.01	(*1)
F331	0331	Light-load high-speed operation switching lower limit frequency	5.0 - UL (Hz)	0.1/0.01	40.0
F332	0332	Light-load high-speed operation load waiting time	0.0 - 10.0 (s)	0.1/0.1	0.5
F333	0333	Light-load high-speed operation load detection time	0.0 - 10.0 (s)	0.1/0.1	1.0
F334	0334	Light-load high-speed operation heavy load detection time	0.0 - 10.0 (s)	0.1/0.1	0.5
F335	0335	Switching load torque during power running	-250 - 250%	1/0.01	50
F336	0336	Heavy-load torque during power running	-250 - 250%	1/0.01	100
F337	0337	Heavy-load torque during constant power running	-250 - 250%	1/0.01	50
F338	0338	Switching load torque during regenerative braking	-250 - 250%	1/0.01	50
F339	0339	Frequency switching Acceleration/deceleration at light load	0 - UL (Hz)	0.1/0.01	0.0

(*1) Default setting values vary depend on the setup menu setting.

Note 1: Parameters F335 to F338 need adjustment according to the load.
The learning function of VF-S15 simplifies the adjustment of light-load high-speed operation, just to execute the forward run (rising) or reverse run (falling) operation. (F328=3, 4 only)

Note 2: If the judgment whether or not switching to light-load high-speed operation differs from when the motor is cold and when the motor is hot, set the value of F327 larger. Usually, it is set with the default setting value.

Note 3: When operating light-load high-speed operation, use vector control. Set AU2 (Torque boost setting macro function) =2 (Vector control + auto-tuning), or set motor related parameters, F410 – F417, and Pt (V/F control mode selection) =3 (Vector control).

3.2 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: Disabled		Light-load high-speed operation disabled.
	1:High-speed operation speed set automatically (Power running at F command: Increase)		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: Increase)		
	3:High-speed operation speed set with $F330$ (Power running at F command: Increase)		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: Increase)		

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

Note: Light load output and Heavy load output conditions of output terminal functions are different according to $F328$ setting.

1) $F328$ (Light-load high-speed operation selection) =0

Light load output (Function No. 106/107) ON: Less than $F335$ Heavy load output (Function No. 108/109) ON: $F337$ or more

2) $F328$ (Light-load high-speed operation selection) setting is not 0

Light load output (Function No. 106/107) ON: Less than $F335$ or $F338$ Heavy load output (Function No. 108/109) ON: $F335$ or $F338$ or more

3.2.1 Automatic setting mode of high-speed operation speed ($F\ni28=\iota,2$)

The diagram on the next page (Fig.1) is the timing chart when the automatic setting mode of high-speed operation speed ($F\ni28=\iota$) is applied to lift application.

At the operation frequency larger than the light-load high-speed operation switching lower limit frequency ($F\ni\ni\iota$) (point A in the Fig.1), if a detected torque (*1) after reaching the set speed is the switching load torque during power running ($F\ni\ni5$ setting value) or less, the inverter judges that the load is light.
For light-load operation, the frequency decided with the formula below 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 $F\ni\ni5$) × [Base frequency (uL)] / (Detection torque)
        when target frequency $\leqq UL$ ($\leqq FH$)

(*1) Average torque during light-load high-speed operation load detection time ($F\ni\ni\ni$) after light-load high-speed operation load detection waiting time ($F\ni\ni2$) (5% or more)

Light-load detection is carried out after reaching the set speed and when an operation frequency is above the light-load high-speed operation switching lower limit frequency ($F\ni\ni\iota$).
  When reaching the conditions below, the light-load high-speed operation is canceled and the operation is returned to the operation at the frequency of speed command value.

1) The torque is exceeded the heavy-load torque ($F\ni\ni6$) during acceleration up to the high-speed operation frequency.
2) The torque is exceeded the heavy-load torque during constant power running ($F\ni\ni7$) after reaching the automatic light-load high-speed operation frequency ($F\ni\ni0$) and after a lapse of the light-load high-speed operation heavy load detection time ($F\ni\ni4$).
3) The speed command value less than the light-load high-speed operation switching lower limit frequency ($F\ni\ni\iota$) is entered.

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《Example of operation》 Light-load high-speed operation selection
($F 3 2 8 = 1$: High-speed operation speed set automatically): F (Increase)

Light-load

Operation frequency (Hz)

High-speed operation frequency varies with load torque.

B

Light-load high-speed operation load detection time $F 3 3 3$

$F 102$
Speed reach detection band

A

Light-load high-speed operation load waiting time $F 3 3 2$

$F 102$
Speed reach detection band

Light-load high-speed operation switching lower limit frequency $F 3 3 1$

Light-load high-speed operation heavy load detection time $F 3 3 4$

Operation signal (F)   ON   OFF

Speed reach signal   OFF   ON   ON

Torque (%)

Heavy-load torque during power running $F 3 3 6$

Heavy-load torque during constant power running $F 3 3 7$

Switching load torque during power running $F 3 3 5$

Output terminal: Light load output Function No.106   ON   OFF
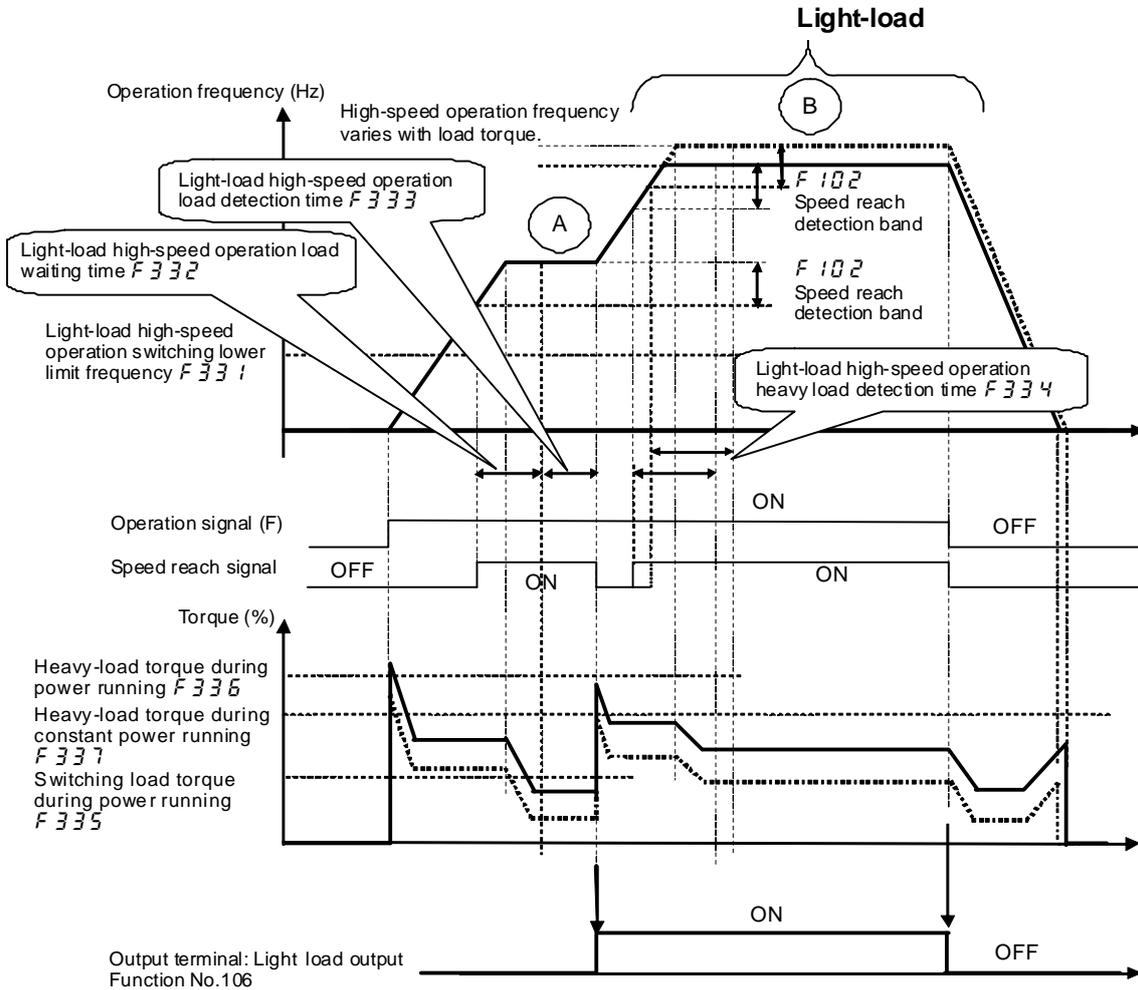
Fig.1

3.2.2 Fixed setting mode of high-speed operation speed (*F 3 2 8 =3, 4*)

The diagram on the next page (Fig.2) is the timing chart when fixed setting mode of the high-speed operation speed (*F 3 2 8 =3*) is applied to lift application.

At the operation frequency larger than the light-load high-speed operation switching lower limit frequency (*F 3 3 1*) (point A in the Fig.2), if an average torque during the light-load high-speed operation load detection time (*F 3 3 3*) after reaching the set speed and after the light-load high-speed operation load detection waiting time (*F 3 3 2*) has elapsed is below the switching load torque during power running (*F 3 3 5*), the inverter judges that light-load is detected and accelerates up to an automatic light-load high-speed operation frequency (*F 3 3 0*). (Point B in the Fig.2 Light-load high-speed operation)

Load torque detection is carried out when an operation frequency is larger than the light-load high-speed operation switching lower limit frequency (*F 3 3 1*) and after reaching the set speed.
When reaching the conditions below, the light-load high-speed operation is canceled and the operation is returned to the operation at the frequency of speed command value.

1) The torque is exceeded the heavy-load torque (*F 3 3 6*) during acceleration up to the automatic light-load high-speed operation frequency (*F 3 3 0*).
2) The torque is exceeded the heavy-load torque during constant power running (*F 3 3 7*) after reaching the automatic light-load high-speed operation frequency (*F 3 3 0*) and after a lapse of the light-load high-speed operation heavy load detection time (*F 3 3 4*).
3) The speed command value less than the light-load high-speed operation switching lower limit frequency (*F 3 3 1*) is entered.

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《Example of operation》 Light-load high-speed operation selection
($F\,328=3$: High-speed operation set with $F\,330$): F (Increase)

Light-load high-speed operation

Automatic light-load high-speed operation frequency $F\,330$

Light-load high-speed operation load detection time $F\,333$

Light-load high-speed operation load waiting time $F\,332$

Light-load high-speed operation switching lower limit frequency $F\,331$

$F\,102$ Speed reach detection band

$F\,102$ Speed reach detection band

Light-load high-speed operation heavy load detection time $F\,334$

Operation signal (F)

Speed reach signal

OFF   ON   ON   OFF

Torque (%)
Heavy-load torque during power running $F\,336$
Heavy-load torque during constant power running $F\,337$
Switching load torque during power running $F\,335$

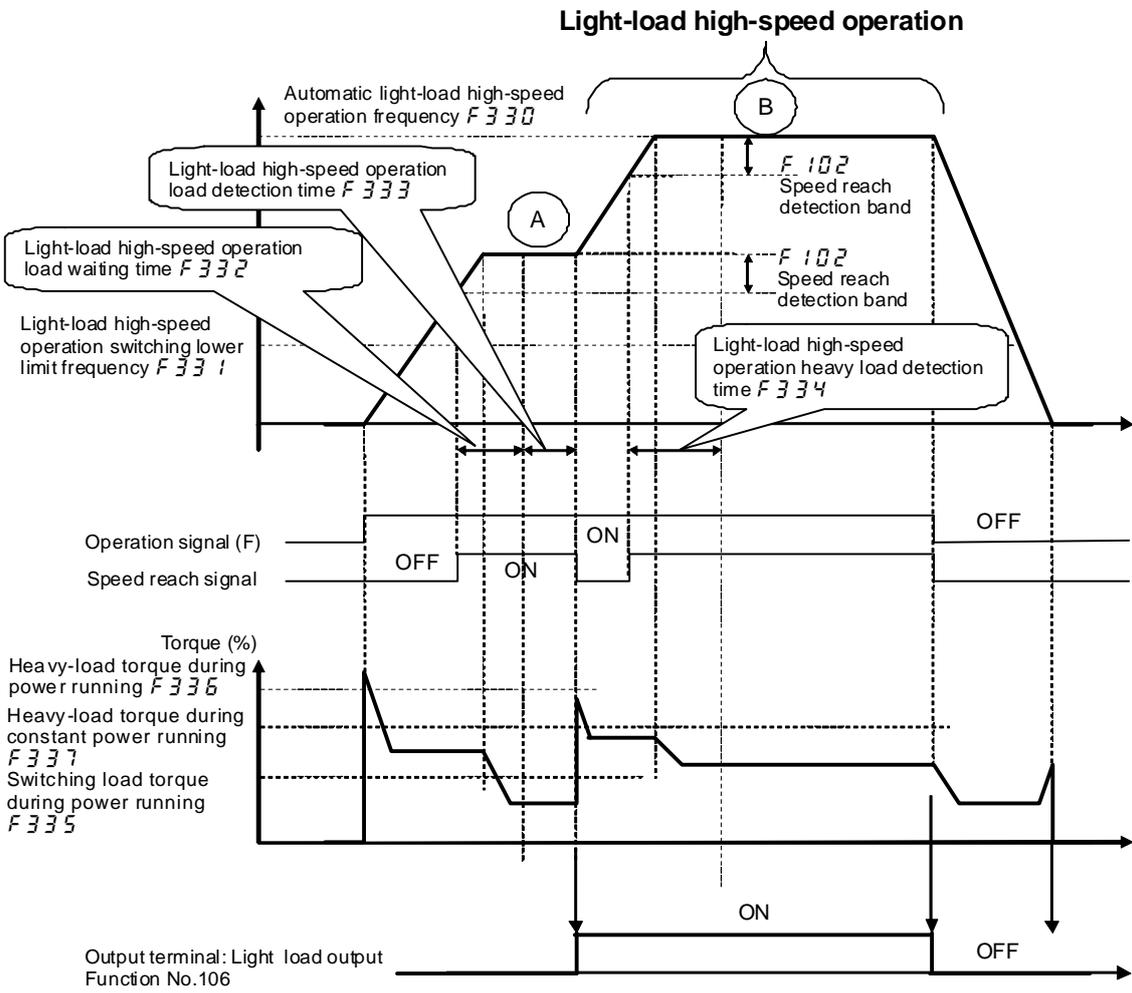Output terminal: Light load output Function No.106

ON   OFF

Fig.2

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3.3 How to adjust parameters

If the light-load high-speed operation is used, be sure to set the motor-related parameters (Motor constants).
Refer to Section 6.25 of VF-S15 instruction manual (E6581611) to set motor-related parameters.
In addition, for the high-speed operation fixed setting mode ($F328=3, 4$), learning function simplifies the adjustment of the light-load high-speed operation.

3.3.1 Automatic setting mode of high-speed operation speed ($F328=1, 2$)

《Adjustment method for lift application》
   If the light-load high-speed operation is carried out with normal operation of 60Hz, follow the procedure below:

1) Set the parameter below at an arbitrary position of the status monitor display selection ($F711$ to $F718$).
   Torque monitor   Set value 7   Ex. of LED display $9\ 20$

2) Set $F335=0$ and $F338=0$ to avoid switching to the light-load high-speed operation.
   $F335$: Switching load torque during power running
   $F338$: Switching load torque during regenerative braking

3) Check the torque monitor value of the following conditions. And set the value of corresponding parameters after each operation is checked.

   (1)Setting of $F335$ (Switching load torque during power running)
     Carry out the power running operation while hanging 100% load at the uL (base frequency).
     Set the maximum torque monitor value after the speed reached uL to $F335$.

   (2)Setting of $F338$ (Switching load torque during regenerative braking)
     Carry out the regenerative braking operation while hanging 100% load at the uL (base frequency).
     Set the maximum torque monitor value after the speed reached uL to $F338$.

   (3)Setting of $F336$ (Heavy-load torque during power running)
     Carry out the power running operation while hanging 100% load at the uL (base frequency).
     Set the torque monitor value during acceleration to $F336$.

   (4)Setting of $F337$ (Heavy-load torque during constant power running)
     Carry out the power running operation while hanging 100% load at the uL (base frequency).
     Set the torque monitor value during constant power running to $F337$.

4) 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 switch to the light-load high-speed operation (operation frequency does not change).
   If switching to the light-load high-speed operation, reduce the setting value of the switching load torque during power running ($F335$).

5) 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 switch to the light-load high-speed operation (operation frequency does not change).
   If switching to the light-load high-speed operation, reduce the setting value of the switching load torque during power running ($F338$).

Change the $F335$ and $F338$ values little by little in order not to switch to the light-load high-speed operation.

6) When reaching a state where the inverter will not switch to the light-load high-speed operation, check that a high-speed operation frequency changes according to the change of load.

7) Restore the parameter changed in 1) to the initial value.
   If checking the torque with the monitor, there is no need to restore the initial value even after the parameters are adjusted.

3.3.2 Fixed setting mode of high-speed operation speed ($F328=3,4$)

《Adjustment method using the learning function for lift application》
If the light-load high-speed operation is carried out with normal operation of 60Hz, 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 <u>the maximum load which allows light-load high-speed operation</u> and check that the operation switches to the light-load high-speed operation (90Hz operation). (Forward run learning)
During the learning operation, tUn 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 <u>the maximum load which allows light-load high-speed operation</u> and check that the operation switches to the light-load high-speed operation (90Hz operation).
During the learning operation, tUn blinks on the left side of the frequency display LED.

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

Title	Function	Default setting
$F335$	Switching load torque during power running	50
$F336$	Heavy-load torque during power running	100
$F337$	Heavy-load torque during constant power running	50
$F338$	Switching load torque during regenerative braking	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 power running or regenerative braking operations.

8) In case of a dynamic lift off at 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 the result of learning operation is as follows, the learning operation is 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 is 150% or more during acceleration of the high-speed operation, the 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 high-speed operation, the high-speed operation stops and the learning operation is completed without reflecting the learning data.

3.3.3 Frequency switching Acceleration/deceleration at light load (*F339*)

During light-load high-speed operation, if operation frequency exceeds frequency switching acceleration/ deceleration at light load (*F339*), switch acceleration/ deceleration time to acceleration/ deceleration time 2 (*F500*, *F501*).

Acceleration/ deceleration time 3 (*F510*, *F511*) has priority over frequency switching Acceleration/ deceleration at light load.

In addition, this function is reset with the following conditions;

- Operation frequency reached the set speed (reached to the set frequency)

- After switching forward/ reverse operation (switching from forward to reverse operation, or conversely)

- After the inverter stopped

4. Brake sequence functions

4.1. Standard connection for lift application

<SINK logic>
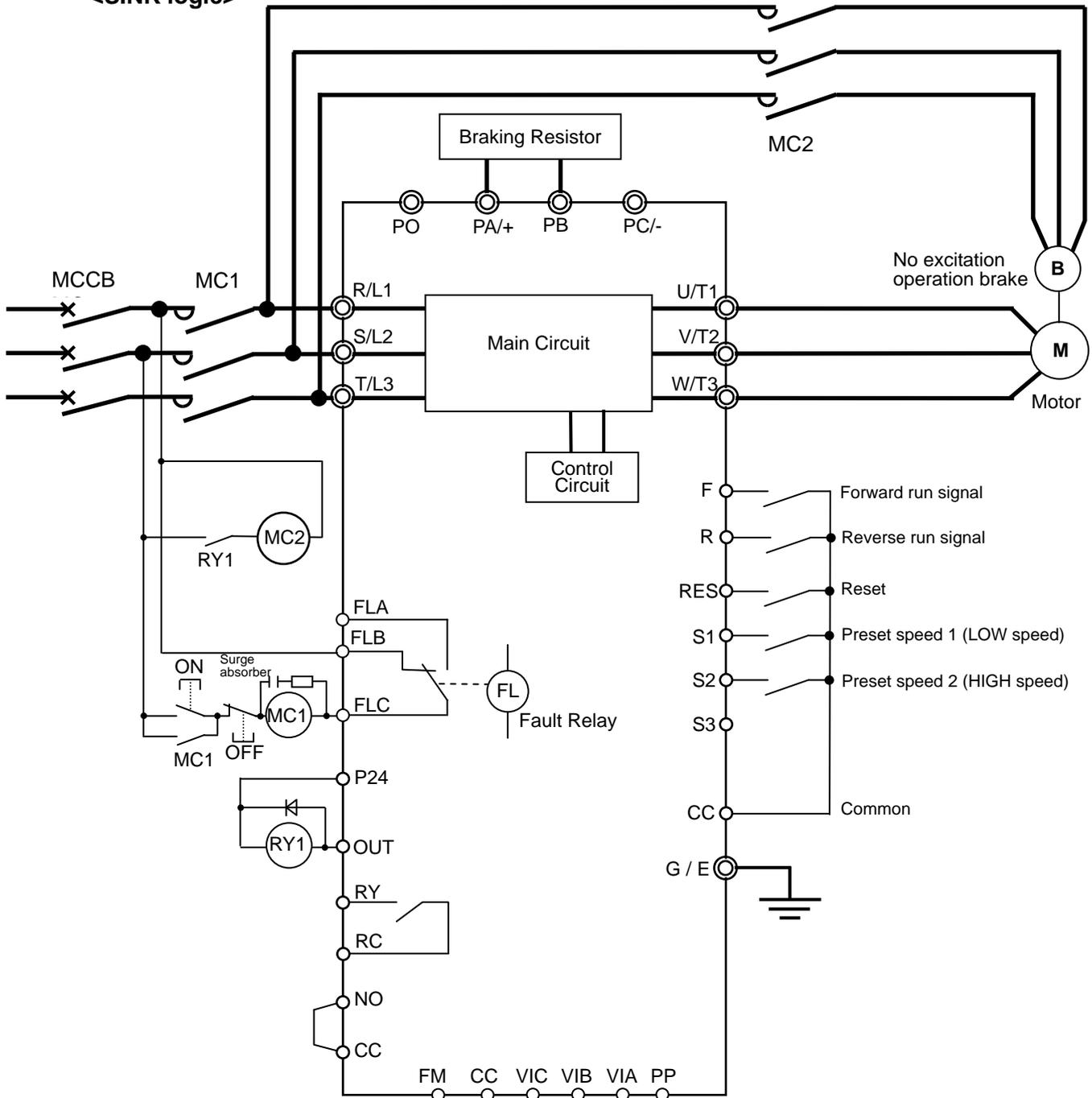
[Operation]   By terminal block
[Speed reference]   Preset speed 1 and 2, Operation panel

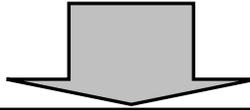# 4.2 Parameter adjustment procedure for brake sequence function

Set $F\,4\,6\,0$ and $F\,4\,6\,2$ following to the table mentioned in 4.3 prior to use brake sequence function,

> Set related parameters such as $C\,\Pi\,0\,d$, $F\,\Pi\,0\,d$.

⬇

> Set vector control parameters (motor constant value) by executing the auto-tuning functions without load.

⬇

> Execute the brake timing learning function without load to roughly adjust the brake ON/OFF timing.
> If brake is not active at switching forward/ reverse operation, adjust speed reference filter coefficient ($F\,4\,6\,2$).

⬇
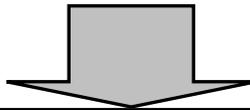
> Operate forward/reverse run with maximum load, and confirm that there is no trouble like 'inverter trip' or 'luggage shifts'.

⬇
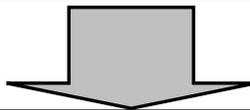
> If 'inverter trip' or 'luggage shifts' occurs, adjust parameters for brake sequence function.

⬇
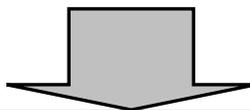
> Completion

4.3 Setting sample of related parameters

Title	Comm. Number	Functions	Setting range	Minimum setting value (Panel/Comm.)	Default value	Setting sample	Notes
CNOd	0003	Command mode selection	0 - 4	-	1	**0**	0:Terminal input enabled
FNOd	0004	Frequency setting mode selection 1	0 - 14	-	0	**3**	3:Setting dial 2
ACC	0009	Acceleration time 1	0.0 - 3600 (s)	0.1/0.1	10.0	**1.0**	
dEC	0010	Deceleration time 1	0.0 - 3600 (s)	0.1/0.1	10.0	**1.0**	
FH	0011	Maximum frequency	30.0 - 500.0(Hz)	0.1/0.01	80.0	**60.0**	
UL	0012	Upper limit frequency	0.5 - *FH* (Hz)	0.1/0.01	(*1)	**60.0**	
LL	0013	Lower limit frequency	0.0 - *UL* (Hz)	0.1/0.01	0.0	**6.0**	
Pt	0015	V/F control mode selection	0 - 8	-	(*1)	**3 (*3)**	3: Vector control
Sr1	0018	Preset speed operation frequency 1	*LL* - *UL*	0.1/0.01	0.0	**10.0**	Operation frequency (Low)
Sr2	0019	Preset speed operation frequency 2	*LL* - *UL*	0.1/0.01	0.0	**60.0**	Operation frequency (High)
F131	0131	Output terminal selection 2A (OUT)	0 - 255	-	6	**68**	68: Brake release signal (*3)
F240	0240	Starting frequency	0.1 - 10.0 (Hz)	0.1/0.01	0.5	**0.5**	
F304	0304	Dynamic braking selection	0 - 4	-	0	**1**	1:Enabled (Resistor overload protection enabled)
F305	0305	Overvoltage limit operation (Deceleration stop mode selection)	0 - 3	-	2	**2 (*4)**	1:Disabled 2:Enabled (quick deceleration)
F308	0308	Dynamic braking resistance	1.0 - 1000 ohm	0.1/0.1	(*2)	**(*5)**	
F309	0309	Dynamic braking resistor capacity	0.01 - 30.00kW	0.01/0.01	(*2)	**(*6)**	
F340	0340	Creeping time 1	0.00 - 10.00 (s)	0.01/0.01	0.00	**0**	Refer to section 4.4.
F341	0341	Braking mode selection	0 - 3	-	0	**1**	
F342	0342	Load portion torque input selection	0 - 4	-	4	**4**	
F343	0343	Hoisting torque bias input (valid only when *F342=4*)	-250 - 250%	1/0.01	100	**100**	
F344	0344	Lowering torque bias multiplier	0 - 100%	1/0.01	100	**60**	
F345	0345	Brake release time	0.00 - 10.00 (s)	0.01/0.01	0.05	**0.05**	
F346	0346	Creeping frequency	*F240* - 20.0Hz	0.1/0.01	3.0	**3.0**	
F347	0347	Creeping time 2	0.00 - 10.00 (s)	0.01/0.01	0.10	**0.10**	
F348	0348	Braking time learning function	0, 1	-	0	**1**	
F400	0400	Auto-tuning	0 - 5	-	0		Refer to of the VFS15 instruction manual (E6581611 : section 6.1.5 or 625)
F401	0401	Slip frequency gain	0 - 250(%)	1/1	70		
F402	0402	Automatic torque boost value	0.1 - 30.0(%)	0.1/0.1	(*2)	**(*3)**	
F405	0405	Motor rated capacity	0.01 - 22.00kW	0.01/0.01	(*2)		
F415	0415	Motor rated current	0.1 - 100.0A	0.1/0.1	(*2)		
F417	0417	Motor rated speed	100 - 64000min^{-1}	1/1	(*1)		
F452	0452	Power running stall continuous trip detection time	0.00 - 10.00 (s)	0.01/0.01	0.00	**0.5(*7)**	
F460	0460	Speed loop gain	0.0: Auto 0.1-25.0	-	0.0	**5.0**	Setting is necessary at the use of brake sequence function.
F462	0462	Speed reference filter coefficient	0-100	-	35	**20 (*8)**	Setting is necessary at the use of brake sequence function.

(*1) Default setting values vary depending on the setup menu setting.

(*2) Default setting values depend on inverter's capacity. Refer to the instruction manual about the default setting values.

(*3) Select the vector control in case of using brake sequence functions (output terminal functions: 68, 69). Set $AU2$ (Torque boost setting macro function) $=2$ (vector control + auto-tuning), or set motor constant parameters ($F401 - F417$) and Pt (V/F control mode selection) $=3$ (vector control)

(*4) $F304$ (Dynamic braking selection) $= 1-4$(Enabled) setting will process automatically as same as $F305$ (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 lift application. If the stall prevention function continues, the inverter judges that the motor has stalled and trips. Set the detection time to about 0.5 seconds.

(*8) If brake is not active when switching forward/ reverse, set the value of Speed reference filter coefficient ($F462$) smaller little by little.

4.4 Brake sequence function

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

■ Starting procedure

At the run command, the motor produce the torque set with $F343$. The brake release request signal is put out through the brake output terminal at the same time the torque is generated. After the brake release time set with $F345$ elapsed, the motor starts to accelerate.

■ Stopping procedure

At the stop command, the operation frequency is decreased to the creep frequency set with parameter $F346$, and delays the braking request for the creep time 1 set with $F340$ to minimize swing of the load. And then, the creep frequency is maintained for the creep time set with $F347$ before the inverter stops.
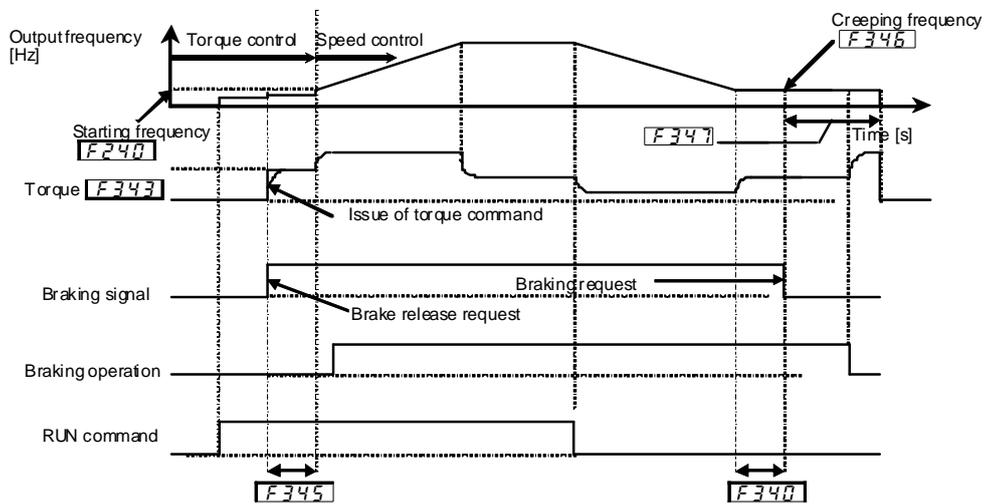
4.4.1 Parameters for brake sequence functions

TITLE	FUNCTIONS	Setting range	Default setting value	**Setting sample**	Notes
F340	Creeping time 1	0.00 - 10.00 (s)	0.00	0	
F341	Braking mode selection	0:Disabled 1:Forward winding up 2:Reverse winding up 3:Horizontal operation	0	1	
F342	Load portion torque input selection	0:Disabled 1:Terminal VIA 2:Terminal VIB 3:Terminal VIC 4:F343	4	4	
F343	Hoisting torque bias input (valid only when F342=4)	-250 - 250(%)	100	100	
F344	Lowering torque bias multiplier	0 - 100(%)	100	60	
F345	Brake release time	0.00 - 10.00 (s)	0.05	0.05	(*1)
F346	Creeping frequency	F240 - 20.0(Hz)	3.0	3.0	(*1)
F347	Creeping time 2	0.00 - 10.00 (s)	0.10	0.10	(*1)
F348	Braking time learning function	0:Disabled 1:Learning (0 after adjustment)	0	1	

F340 : Creeping time 1
Inverter suspends the braking request for the time set with F340 to minimize swing of load.

F341 : Braking mode selection
This parameter is to select operation mode of brake sequence function.
Usually, the forward (Terminal F) operation is winding up.

F342 : Load portion torque input selection
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 = 4, and set the fixed value to F343 (Hoisting torque bias input) .

F343 : Hoisting torque bias input
This parameter is to set hoisting torque bias value and enabled only when F342 = 4.
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 multiplier
The torque bias value at brake release is set by F342 (Load portion torque input selection).
When winding down, the torque bias value is multiplied by this parameter value.
Usually, a necessary torque in winding down is decreased by squaring the mechanical efficiency.
The hoisting torque bias in winding down at 80% machine efficiency is 0.8*0.8=0.64 (about 60%).
Usually, set F344 = 60 to 70.

$\boxed{F\ 3\ 4\ 5}$: Brake release time

The brake release demand signal is output at the same time outputting the set torque after the starting signal is turned on.

After the time set with $F\ 3\ 4\ 5$ (Brake release time), the inverter accelerates.

(*1)This parameter is roughly adjusted by executing $F\ 3\ 4\ 8$ (Braking time learning function)..

$\boxed{F\ 3\ 4\ 6}$: Creeping frequency

At the stop command, braking request is put out after decelerated to $F\ 3\ 4\ 6$ (Creep frequency). A standard setting of the creep frequency is about motor rated slips. For example, in case of 5% slips in 60Hz motor, the creeping frequency is "60Hz*5%=3Hz".

(*1)This parameter is roughly adjusted by executing $F\ 3\ 4\ 8$ (Braking time learning function) .

$\boxed{F\ 3\ 4\ 7}$: Creeping time 2

At the stop command, braking request is put out after decelerated to $F\ 3\ 4\ 6$ (Creep frequency). Then, the creeping frequency is maintained for the time set with $F\ 3\ 4\ 7$ (Creeping time 2).

(*1)This parameter is roughly adjusted by executing $F\ 3\ 4\ 8$ (Braking time learning function)

$\boxed{F\ 3\ 4\ 8}$: Braking time learning function

The brake learning function is executed by forward winding up operation after setting $F\ 3\ 4\ 8$ (Braking time learning function) to 1.

Braking time learning function roughly adjusts the parameters $F\ 3\ 4\ 5$ (Brake release time), $F\ 3\ 4\ 6$ (Creeping frequency), and $F\ 3\ 4\ 7$ (Creeping time 2).

■ Torque bias function ($F\ 3\ 4\ 2$ - $F\ 3\ 4\ 4$)

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.

Reverse run

Forward run

Tension torque bias as additional torque

Additional torque (fixed direction)

<Selection of external signals>

$F\ 3\ 4\ 2$

Voltage signals ─┬─ VIA-CC – 0-10V (0-250%) 1
                 └─ VIB-CC – 0-±10V (-250-250%) 2
Current signals ── VIC-CC – 4(0)-20mA (0-250%) 3

4.4.2 Execution of "Brake time learning"

> The brake function sets automatically the timing (torque establishment when starting) of the preliminary excitation by motor's constant value.
> It is necessary to set related parameters before "brake time learning".

> Before executing "brake time learning", the brake timing may not fit the load torque.
> Execute "brake time learning" at no load or at light load that is 3% of rated load or less.

■ Learning function ($F348$)
This function roughly adjusts the parameters $F345$, $F346$, and $F347$ automatically.
If necessary, fine adjust the parameter setting manually.

■ Learning operation
Set parameter $F348$ to 1 and enter an operation command to start learning.
The frequency and "tUn" are displayed alternately.
Parameter $F343$ (torque) is set, the brake release timing is calculated, and parameter $F345$ (release time) is set based on the calculation result. $F346$ is calculated and set automatically based on the motor constant. At the stop of operation, $F347$ (creep time) is set.

Note 1:　Learning should be performed under light-load conditions.
Note 2:　If a counterweight is provided, a learning error may occur. If so, make an adjustment manually.
Note 3:　Brake learning should be carried out for forward rotation if $F341$ is set to 1 (forward winding), or for reverse rotation if $F341$ is set to 2 (reverse winding).

《Notice for brake sequence function》
Note 4:　For the brake sequence functions, the pre-excitation time is automatically determined by the inverter from motor-related constants.
　　　　When the VFS15S-2022PL-W is used in combination with a Toshiba 4P-2.2kW-60Hz-200V standard motor, the pre-excitation time is approximately 0.1 to 0.2 seconds.
　　　　Depending on the motor, the pre-excitation time may be prolonged.
Note 5:　Select the vector control in case of using brake sequence functions.
　　　　Set $F460$ and $F462$ following to the tables described in 4.3.
　　　　Set $AU2$ (Torque boost setting macro function) $=2$ (vector control + auto-tuning), or set motor constant parameters ($F401$-$F417$) and Pt (V/F control mode selection) $=3$ (vector control).
Note 6:　For checking the inverter operation by brake sequence functions, be sure to connect and run the combined motor.
　　　　As this function calculates the brake timing by detecting output current, calculation error occurs without connecting the motor.

4.4.3 Brake timing with maximum load

Confirm if there is any problem with brake timing with maximum load after completion of adjustment of brake timing at no-load (light load).
Please confirm the following items;

- Whether or not brake is released smoothly without load gap (shifts) at winding up or starting
- With our without load gap (shifts) when the brake operates?
- With or without load gap (shifts) when repeating start (run/stop)?
- With or without unusual noise from the brake at the time of start and stop.
- With or without the inverter trip at the time of start or stop.

If there is no trouble after confirmation, an adjustment of the brake function is completed.

《Useful function for adjustment》

Timing adjustment to release brake at the same time with gaining enough torque and stop after the brake is completely closed are required for lift application.
Therefore, the motor is restrained to some degree at start/stop.
Short restrained time may cause load gap (shifts). But, long restrained time increases motor current, which will cause the inverter trip.

Please use the following parameters for adjustment to confirm a peak output current.
Usually, a peak output current is about 150% of inverter's rated current.

Title	Function	Setting range	Default setting value	Setting sample	Notes
F709	Standard monitor hold function	0:Real time 1:Peak hold 2:Minimum hold	0	1	-
F710	Initial panel display selection	0 - 52	0	1	Output current
F750	EASY key function selection	0:Easy/standard setting mode switching function 1:Shortcut key 2:Local/remote key 3:Monitor peak /minimum hold trigger 4: - 5: -	0	3	-

The status monitor display shows "Peak hold value of output current" by the above parameter settings.
Display changes as the peak value of the output current changes by repeating start/stop.
This value is forcibly reset by pushing the "EASY" key..

4.4.4 Abnormal phenomenon and the measures

Abnormal phenomenon and the measures (adjustment item) according to load and operating condition

Load condition	Operating condition	Abnormal phenomenon	Countermeasure (adjustment item)
No-load	At start	Wind down after winding up a little when the winding down command is issued.	1. Set $F345$ (Brake release time) to short. 2. Lower the value of $F344$ (Lowering torque bias multiplier) by 5%. 3. Lower the value of $F343$ (Hoisting torque bias input) by 5 to 10%.
No-load or load	At start	The load falls slightly (load gap/shift) when winding up.	1. Increase the torque bias value of $F342$ (Load portion torque input selection) and $F343$ (Hoisting torque bias input) by 10 to 20%.
No-load or load	At start or stop	The load falls slightly (load gap/shift) by repeating start/stop (inching) frequently at winding up.	1. Set $F345$ (Brake release time) to short.
No-load or load	At switching forward/ reverse	Brake is not active when switching forward/ reverse.	1. Lower the value of $F462$ (Speed reference filter coefficient) 5 by 5

《**Notice of adjustment**》
When adjusting $F345$ (Brake release time) and $F347$ (Creeping time 2), change the value little by little.
A large value change causes large time lag between when the brake is released and when the enough torque is produced, which may result in fall of the load.