<table>
<tr><th>Constant No.</th><th>Name</th><th>Description</th><th>Remarks</th></tr>
<tr><td>C3-04</td><td>Slip compensation during regeneration</td><td>
<table>
<tr><th>Set Value</th><th>Description</th></tr>
<tr><td>0</td><td>Slip compensation disabled during regeneration</td></tr>
<tr><td>1</td><td>Slip compensation enabled during regeneration</td></tr>
</table>
</td><td></td></tr>
<tr><td>C4-01</td><td>Torque compensation gain</td><td>
Torque compensation is a function to calculate load torque according to output current and to compensate for output voltage required to obtain torque characteristics.

In open loop vector, torque compensation gain does not have to be adjusted.

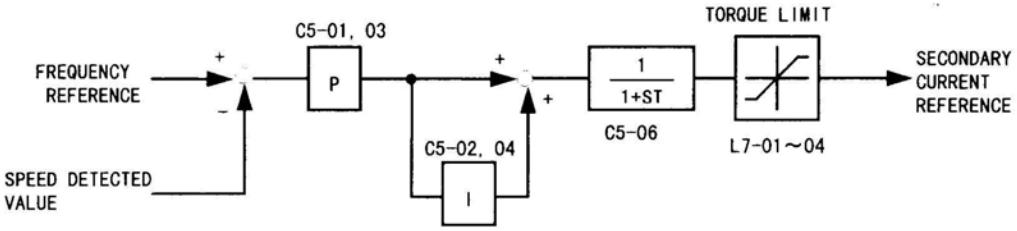
The following outlines the adjusting method in V/f control.
<table>
<tr><th>Run Status</th><th>C4-01 Adjustment *</th></tr>
<tr><td>When sufficient torque is not obtained at low-speed operation</td><td>Increase the set value.</td></tr>
<tr><td>When motor current value is not stable, or motor current value is excessively large at light loads operation</td><td>Decrease the set value.</td></tr>
</table>
* : If torque compensation is increased excessively, the following faults may occur;
・Excessive motor current is applied to cause the inverter to malfunction
・Motor generates excessive heat or vibration.
Therefore, adjust this value little by little, checking the motor current
</td><td></td></tr>
<tr><td>C4-02</td><td>Torque compensation time constant</td><td>
Adjusted when motor output current is not stabilized or speed response is slow.

In open loop vector, torque compensation time constant does not have to be adjusted.
<table>
<tr><th>Run Status</th><th>C4-02 Adjustment *</th></tr>
<tr><td>When motor current value is not stable</td><td>Increase the set value.</td></tr>
<tr><td>When speed responseis slow</td><td>Decrease the set value.</td></tr>
</table>
* : Adjust the value by 10 msec.
</td><td></td></tr>
<tr><td>C5-01</td><td>ASR proportional gain 1</td><td>Sets ASR proportional gain in units of 0.01.</td><td></td></tr>
<tr><td>C5-02</td><td>ASR integral time 1</td><td>Sets ASR integral time 1 in units of msec.</td><td></td></tr>
<tr><td>C5-03</td><td>ASR proportional gain 2</td><td>Sets ASR proportional gain in 2 in units of 0.01.</td><td></td></tr>
<tr><td>C5-04</td><td>ASR integral time 2</td><td>Sets ASR integral time 2 in units of msec.</td><td></td></tr>
<tr><td>C5-05</td><td>ASR limit</td><td>Sets ASR limit of frequency to be compensated for by ASR in units of 1% when V/f control with PG feedback is selected. MAX. output frequency (E1-04) is regarded as 100%.</td><td></td></tr>
<tr><td>C5-06</td><td>ASR primary delay time</td><td>Sets primary delay time constant to control secondary current reference variation in units of 1 msec when flux vector control is selected.</td><td></td></tr>
<tr><td>C5-07</td><td>ASR switching frequency</td><td>Sets frequency to change ASR P-gain and integral time constant in units of 0.1Hz when flux vector control is selected.</td><td></td></tr>
</table>

Constant No.	Description

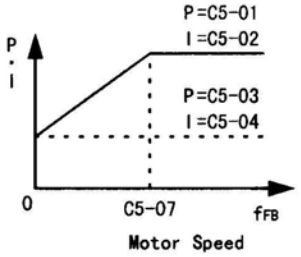
ASR of flux vector

○ The following shows the block diagram.



Note : ASR P-gain in flux vector control is based on the max. frequency.

Proportional gain and integral time are approximated in a straight line by motor speed as shown below.

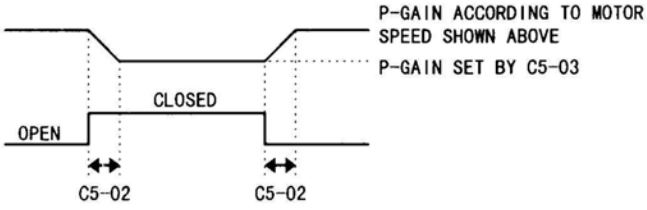


$$f_{FB} = \frac{P \cdot N}{120}$$

P = Number of poles
N = r/min

- When C5-07 0;
  Fixed to P = C5-01, I = C5-02

If 77 is selected to multi-function input terminal, proportional gain can be changed.

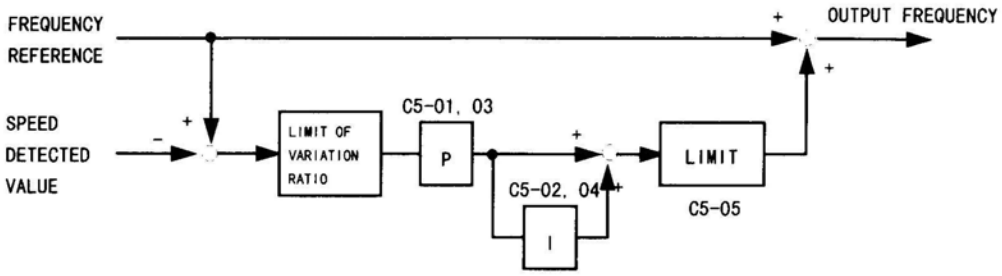


- Changed at time set by C5-02.
- Integral time is not changed.

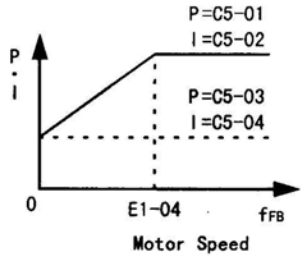
Constant No.	Description

ASR of V/f control with PG

○ The following shows the block diagram.



Proportional gain and integral time are approximated in a straight line by motor speed as shown below.



$$f_{FB}=\frac{P\cdot N}{120}$$

P=Number of motor poles

N=r/min

<table>
<tr><th>Constant No.</th><th>Name</th><th>Description</th><th>Remarks</th></tr>
<tr><td>C6-01

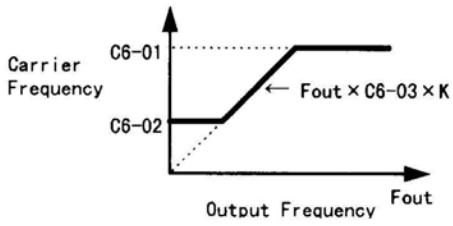
C6-02

C6-03</td><td>Carrier frequency upper limit

Carrier frequency lower limit

Carrier frequency proportional gain</td><td>The following shows the relation between carrier frequency and output frequency according to the set values of C6-01 to 03. Only C6-01 is effective in vector control.

For constant carrier frequency (C6-01 set value); Set C6-03 to 0 and C6-01 and C6-02 to the same value.

Note : Value K varies depending on the upper limit of carrier frequency as described below.

<table><tr><td>C6-01 ≧ 10.0kHz</td><td>K=3</td></tr><tr><td>10.0kHz > C6-01 ≧ 5.0kHz</td><td>K=2</td></tr><tr><td>C6-01 < 5.0kHz</td><td>K=1</td></tr></table>
In the following cases, a setting error (OPE11) occurs :
① C6-03>6 and C6-02>C6-01
② C6-01>5kHz and C6-02 ≦ 5kHz</td><td></td></tr>
<tr><td>C7-01</td><td>Hunting prevention selection</td><td>Current amplitude is varied or the machine vibrates because of frequency of 10 to 30Hz under a light load, which is called hunting. Selects the hunting prevention function in V/f control mode.

<table><tr><th>Set Value</th><th>Description</th></tr><tr><td>0</td><td>Disabled</td></tr><tr><td>1</td><td>Enabled</td></tr></table></td><td></td></tr>
<tr><td>C7-02</td><td>Hunting prevention gain</td><td>Sets hunting prevention in units of 0.1.
The following shows how to adjust hunting prevention gain.

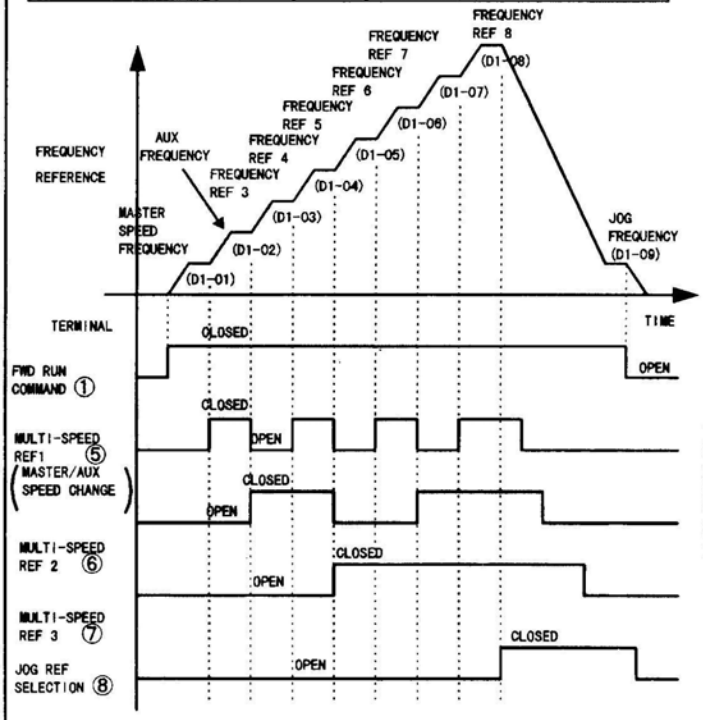
<table><tr><th>Run Status</th><th>C7-02 Adjustment *</th></tr><tr><td>Hunting under light load</td><td>Increase the set value</td></tr><tr><td>Machine vibration or stepout under heavy load</td><td>Decrease the set value.</td></tr></table>
* : Adjust the value by 0.1</td><td></td></tr>
<tr><td>C8-08</td><td>AFR gain</td><td>In open loop vector, adjust the value as shown below when the motor is hunting or in order to increase responsibility.

<table><tr><th>Run Status</th><th>C8-08 Adjustment *</th></tr><tr><td>Torque or speed response is slow</td><td>Increase the set value.</td></tr><tr><td>Hunting</td><td>Decrease the set value.</td></tr></table>
* : Adjust the value by 0.1</td><td></td></tr>
</table>

D FREQUENCY REFERENCE-RELATED CONSTANTS

<table>
<tr><th>Constant No.</th><th>Name</th><th>Description</th><th>Remarks</th></tr>
<tr><td>D1-01
D1-02
D1-03
D1-04
D1-05
D1-06
D1-07
D1-08
D1-09</td><td>Frequency reference 1
Frequency reference 2
Frequency reference 3
Frequency reference 4
Frequency reference 5
Frequency reference 6
Frequency reference 7
Frequency reference 8
Jog frequency reference</td><td>Sets frequency reference.
Setting unit of frequency can be changed according to frequency reference/monitor display unit (01-03)

[Example of multi-step speed operation]
By combining multi-function input multi-step speed references 1 to 3 and jog frequency reference selections, up to 9 steps can be selected.

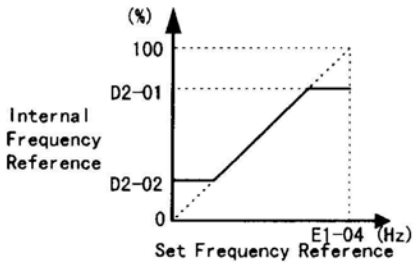
<table>
<tr><th colspan="2">Terminal Constant No.</th><th>Factory Setting</th><th>Set Value</th><th>Name</th></tr>
<tr><td>5</td><td>HI-03</td><td>3</td><td>3</td><td>Multi-step speed reference 1</td></tr>
<tr><td>6</td><td>HI-04</td><td>4</td><td>4</td><td>Multi-step speed reference 2</td></tr>
<tr><td>7</td><td>HI-05</td><td>6</td><td>5</td><td>Multi-step speed reference 3</td></tr>
<tr><td>8</td><td>HI-06</td><td>8</td><td>6</td><td>Jog reference selection</td></tr>
</table>


*1 : Master speed frequency reference becomes constant set value (D1-01) when B1-01 = 0, and analog reference set by control terminal 13 or 14 when B1-01 = 1.

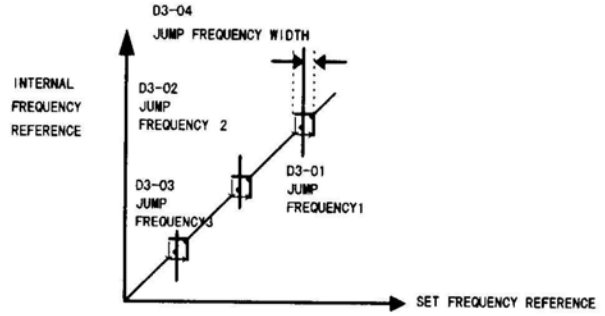
*2 : Auxiliary frequency reference becomes analog frequency reference input from terminal 16 when H3-05 = 00 and the constant set value (D1-02) at any setting other then H3-05 = 00. Set H3-03 to 1F when multi-function analog input (terminal 16) is not used.</td><td></td></tr>
<tr><td>D2-01

D2-02</td><td>Frequency reference upper limit

Frequency reference lower limit</td><td>• Sets the upper/lower limit values of output frequency in the ratio (%) for max. frequency (E1-04).

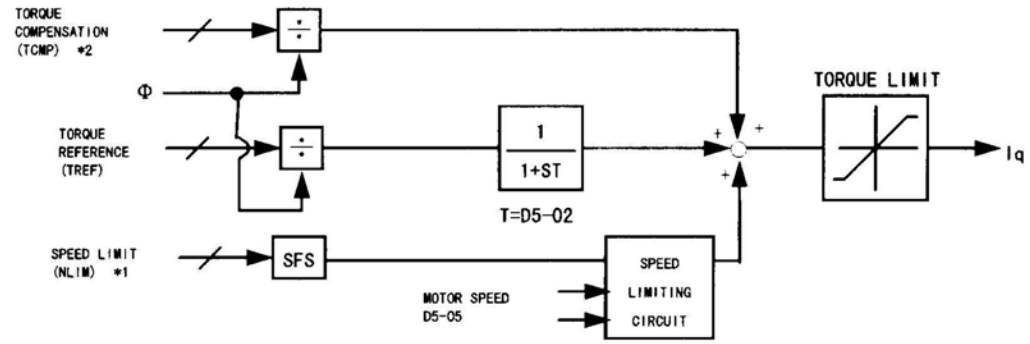
• When frequency reference is zero and a run command is input, the motor accelerates from the min. frequency to the frequency reference lower limit and maintains operation at the frequency reference lower limit.
 
</td><td></td></tr>
</table>

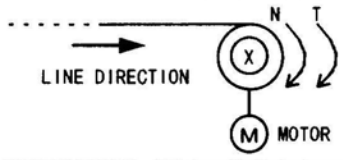
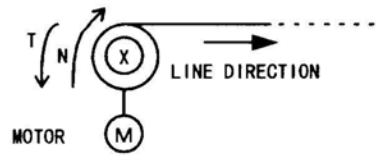
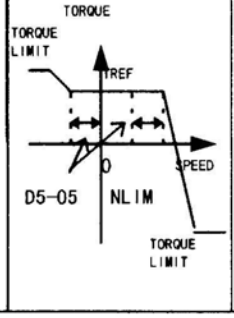
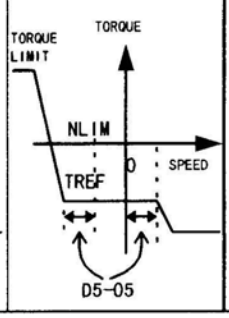
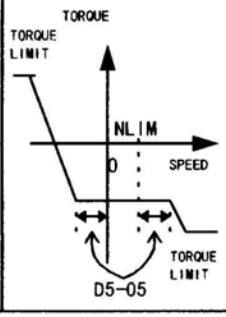
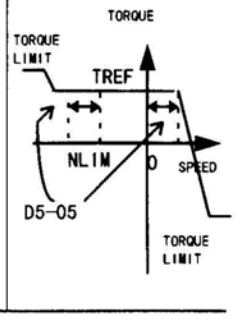
<table>
<tr><th>Constant No.</th><th>Name</th><th>Description</th><th>Remarks</th></tr>
<tr><td>D3-01
D3-02
D3-03
D3-04</td><td>Jump frequency 1
Jump frequency 2
Jump frequency 3
Jump frequency width</td><td>Sets the jump frequency width by combining D3-01 to 04. By setting jump frequency to 0.0Hz, this function is disabled.

D3-01～03－D3-04 ≦Sets the jump frequency width ≦D3-01～03+D3-04
 

Note : Constant speed operation is prohibited in jump frequency. However, output frequency does not jump during accel/decel and smooth accel/decel is available.</td><td>● When some jump frequency width set by D3-01 to 04 are overlapped, be sure to set D3-03≦ D3-02≦D3-01</td></tr>
<tr><td>D4-01</td><td>Reference frequency hold function selection</td><td>Sets whether frequency at HOLD is stored when the power supply is turned OFF or a stop command is input during HOLD by multi-function input terminal UP/DOWN commands or accel/decel stop command.

<table><tr><th>Set Value</th><th>Description</th></tr><tr><td>1</td><td>Does not store frequency during HOLD (but it becomes 0).</td></tr><tr><td>2</td><td>Stores frequency during HOLD and runs at stored frequency at restart of operation.</td></tr></table></td><td></td></tr>
<tr><td>D5-01</td><td>Torque control selection</td><td>Selects speed/torque control
<table><tr><th>Set Value</th><th>Description</th></tr><tr><td>0</td><td>Speed control</td></tr><tr><td>1</td><td>Torque control mode</td></tr></table></td><td>Torque control is enabled only when A1-01 = 3 (flux vector control).</td></tr>
<tr><td>D5-02</td><td>Torque reference delay time</td><td>Sets primary delay time constant for torque reference input in torque control mode in units of 1ms.</td><td></td></tr>
<tr><td>D5-03</td><td>Speed limit selection</td><td>Selects speed limit value in the torque control mode.
<table><tr><th>Set Value</th><th>Description</th></tr><tr><td>1</td><td>Speed limit becomes analog master speed frequency reference set by control terminal 13 or 14, disregarding the setting of frequency reference selection (B1-01).</td></tr><tr><td>2</td><td>Speed limit value becomes the set value of the constant.</td></tr></table></td><td></td></tr>
<tr><td>D5-04</td><td>Speed limit</td><td>Sets speed limit value in the torque control mode in the ratio (%) for the max. frequency when D5-03 = 2.</td><td></td></tr>
<tr><td>D5-05</td><td>Speed limit bias</td><td>Sets bias value for speed limit input in the torque control mode in the ratio (%) for max. frequency.</td><td></td></tr>
<tr><td>D5-06</td><td>Speed/torque control switching timer</td><td>Sets time when speed/torque control select command is input until the control mode is actually changed in the units of 1ms.</td><td>Speed/torque control select is executed by multi-function input function (set value : 71)</td></tr>
</table>

Function	Description
Torque Control Operation	• When A1-01 = 03 (flux control), torque control is enabled. • To select torque control, set torque selection (D5-01) to 1 or close multi-function input terminal speed/torque control selection and set terminal 16 function selection to "torque reference" (H3-05 = 13). 〔Block Diagram〕  *1 : When speed limit selection (D5-03) = 1, master frequency reference input from terminal 13 or 14 becomes the speed limit ; when D5-03 =2, the constant set value (D5-04) becomes the speed limit. *2 : When terminal 14 function selection is set to torque compensation (H3-09 = 14), terminal 14 input value can be used as torque compensated value. 〔Sequence〕 When torque reference> 0 and speed limit> 0 (winder sequence), the following sequence is performed. • When -1× speed limit bias (D5-05) <motor speed < "speed limit +D5-05" torque control is performed with the set torque reference. • When motor speed > "speed limit +D5-05", torque control is performed with the set torque reference. • When motor speed < "-1 × D5-05", the speed limiting circuit outputs plus torque reference to prevent motor speed from increasing to the reverse run side. Therefore, when torque reference > 0 and speed limit > 0, the possible torque control range is; "-1×D5-05" < motor speed "speed limit +D5-05" For the detailed relation of torque reference, speed limit and motor speed, refer to the table shown below.

		Winding		Rewinding	
Configuration					
Rotating Direction		FWD run	REV run	FWD run	REV run
Reference Polarity	Torque Reference (TREF)	+	−	−	+
	Speed Limit (SLIM)	+	−	+	−
Generated Torque					

Function	Description

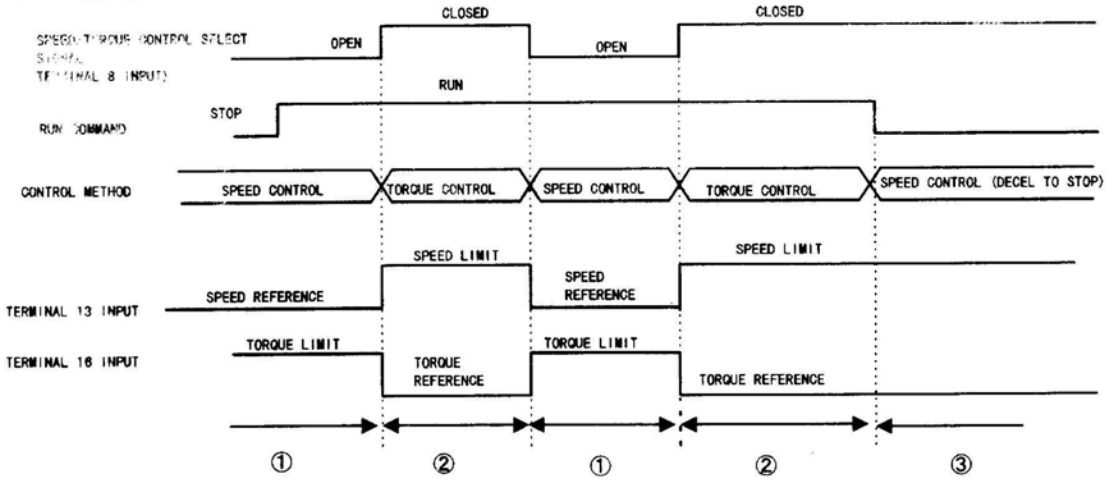
Speed/Torque Control Switching

When A1-03 = 3 (flux control), speed control or torque control can be selected during run by using the multi-function input speed/torque control select command (set value = 71). The following shows an example of selection.

[Constant Setting]

Terminal No.	Constant No.	Factory Setting	Set Value	Description
8	H1-06	8	71	Speed/torque control select
13	B1-01	1	1	Frequency reference selection (terminals 13, 14)
	D5-03	1	1	Speed limit selection (terminals 13, 14)
16	H3-05	1	13	Torque reference/speed limit

[Time Chart]



[Sequence]

① When torque/speed control select command is "OPEN", speed control is performed.

- Speed reference at speed control depends on frequency reference selection (B1-01) setting. To change terminal 13 or 14 master frequency reference to frequency reference, set B1-01 to 1.
- Torque limit at speed control is the smaller absolute value of terminal 16 torque limit or constant set values (L7-01 to 04).
- When a stop command is input during speed control, speed control is maintained and the smaller absolute value of terminal 16 torque limit or constant set values (L7-01 to 04), is used as torque limit. Then the motor decelerates to a stop.

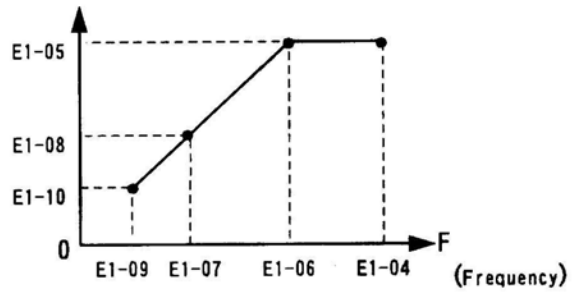
② When torque/speed control select command is "CLOSED", torque control is performed.

- Speed limit under torque control uses terminal 13 or 14 master frequency reference as frequency reference when speed limit selection (D5-03) = 1 and as constant set value (D5-04) when D5-03 = 2, disregarding frequency reference selection (B1-01) setting.
- During torque control, terminal 16 analog input value becomes torque reference.

③ By inputting a stop command during torque control, it is changed to speed control automatically, and the motor decelerates to a stop. Torque limit during deceleration to a stop becomes constant set value (L7-01 to 04).

Note : Actual control mode is changed after the torque /speed control select command is changed and the speed/torque select timer (D5-06) elapses. Terminal 13 speed reference/speed limit and terminal 16 torque limit/torque reference are held in the inverter until the time set to D5-06 elapses.

E MOTOR-RELATED CONSTANTS

<table>
<tr><th>Constant No.</th><th>Name</th><th>Description</th><th>Remarks</th></tr>
<tr><td>E1-01</td><td>Input voltage setting</td><td>Sets inverter input voltage in units of 1V.</td><td></td></tr>
<tr><td>E1-02</td><td>Motor selection</td><td>Motor protective characteristics are changed by this setting.
<table><tr><th>Set Value</th><th>Description</th></tr><tr><td>0</td><td>Standard motor protective characteristics</td></tr><tr><td>1</td><td>Inverter motor protective characteristics</td></tr></table></td><td></td></tr>
<tr><td>E1-03</td><td>V/f pattern selection</td><td>Selects a V/f pattern in the V/f control mode.
<table><tr><th>Set Value</th><th>Description</th></tr><tr><td>0~E</td><td>Preset V/f pattern can be selected.
(For details, refer to Par. 2.7.)</td></tr><tr><td>F</td><td>Custom V/f pattern can be set.</td></tr></table>This setting is fixed to F in the vector control mode.</td><td></td></tr>
<tr><td>E1-04
E1-05
E1-06
E1-07
E1-08
E1-09
E1-10</td><td>Max. output frequency
Max. voltage
Max. voltage frequency
Mid. output frequency
Mid. output frequency voltage
Min. output frequency
Min. output frequency voltage</td><td>When E1-03=1, V/f pattern setting can be adjusted by E1-04 to 10.
 

Set frequency so that E1-09 ≦ E1-07 < E1-06 ≦ E1-04 will be obtained.
Note : If V of the V/f pattern is increased excessively, motor torque can be obtained but the following faults may occur.
• Excessive motor current may cause the inverter malfunction.
• Motor generates heat and vibration.
Therefore, increase the value of V little by little, checking motor current each time.</td><td></td></tr>
</table>

Constant No.	Name	Description	Remarks
E2-01	Motor rated current	Sets motor rated current in units of 0.01A for 7.5kW or less; 0.1A for 11kW or more.	
E2-02	Motor rated slip	Sets motor rated slip in units of 0.01Hz. To convert (r/min) to (Hz), use the following equation ; fs (Rated slip [Hz]) $\text{fs (Rated slip}_{(Hz)}\text{)} = \text{(Rated frequency}_{(Hz)}\text{)} - \frac{\text{(Rated revolutions}_{(r/min)}\text{) (No. of poles)}}{120}$	
E2-03	Motor no-load current	Sets motor no-load current in units of 0.01A for 7.5kW or less: 0.1A for 11kW or more.	
E2-04	Number of motor poles	Sets the number of motor poles.	
E2-05	Motor line-to-line resistance	Sets motor phase-to-phase resistance value in units of 0.01Ω. $\text{Motor line-to-line resistance} = \left(\begin{array}{l}\text{Phase-to-phase}\\ \text{resistance at}\\ \text{insulation}\\ \text{class}\\ \text{temperature}\end{array}\right) \times \frac{273+(25°C+\text{insulation class temperature}) / 2}{273+\text{insulation class temperature}}$	
E2-06	Motor leakage inductance	Sets motor leakage inductance in units of 0.1%.	
E2-07	Motor iron-core saturation coefficient 1	Sets motor iron-core saturation coefficient at 50% of magnetic flux. This constant does not have to be set since it is set automatically by auto-tuning.	
E2-08	Motor iron-core saturation coefficient 2	Sets motor iron-core saturation coefficient at 75% of magnetic flux. This constant does not have to be set since it is set automatically by auto-tuning.	
E2-09	Motor mechanical loss	Sets motor mechanical loss in units of 0.1%. 100% of this value is motor rated output.	