MITSUBISHI ELECTRIC

INVERTER

A800 Plus

CRANE FUNCTION MANUAL

FR-A820-00046(0.4K) to 04750(90K)-CRN
FR-A840-00023(0.4K) to 06830(280K)-CRN
FR-A842-07700(315K) to 12120(500K)-CRN

Crane Function

The FR-A800-CRN has dedicated functions for crane applications, in addition to the functions of the standard FR-A800 inverter. This Crane Function Manual explains the functions dedicated to the FR-A800-CRN. For the functions not found in this Function Manual, refer to the Instruction Manual of the FR-A800.
In addition to this Crane Function Manual, please read the Instruction Manual of the FR-A800 carefully. Do not use this product until you have a full knowledge of the equipment, safety information and instructions.
Please forward this Function Manual to the end user.

A800-CRN

1 Crane function parameter list

The following parameters are dedicated to the FR-A800-CRN. Set the parameters according to applications.

Pr.	Pr. group	Name	Setting range	Minimum setting increment	Initial value	Refer to page	Customer setting
178 to 189	**T700 to T711**	Input terminal function selection	**54**∗1	1	∗2	**12**	
190 to 196	**M400 to M406**	Output terminal function selection	**221 to 223, 321 to 323**∗1	1	∗2	**11**, **13**	
270	**A200**	Stop-on contact/load torque high-speed frequency control selection	0 to 3, **4, 5,** 11, 13, **15**	1	0	**8**	
1400	**A160**	Low-speed range speed control P gain 1	0 to 1000%, 9999	1%	9999	**3**	
1401	**A161**	Low-speed range speed control P gain 2	0 to 1000%, 9999	1%	9999	**3**	
1402	**A162**	Low-speed range gain corner frequency 1	0 to 60 Hz	0.01 Hz	3 Hz	**3**	
1403	**A163**	Low-speed range gain corner frequency 2	0 to 60 Hz	0.01 Hz	5 Hz	**3**	
1404	**A164**	Shortest-time torque startup selection	0, 1	1	0	**5**	
1405	**A165**	Overload detection time	0 to 10 s	0.1 s	1 s	**11**	
1406	**A166**	Inching prevention time	0 to 5 s	0.01 s	0 s	**6**	
1407	**A167**	Magnetic flux command during pre-excitation	0 to 100%	1%	9999	**7**	
1408	**A168**	Brake opening current for reverse rotation	0 to 400%	0.1%	9999	**14**	
1409	**A169**	Second brake opening current for reverse rotation	0 to 400%	0.1%	9999	**14**	
1410	**A170**	Starting times lower 4 digits	0 to 9999	1	0	**15**	
1411	**A171**	Starting times upper 4 digits	0 to 9999	1	0	**15**	

∗1 For other settings, refer to the Instruction Manual (Detailed) of the FR-A800 inverter.

∗2 For the initial setting of each parameter, refer to the Instruction Manual (Detailed) of the FR-A800 inverter.

2 Low-speed range speed control P gain Sensorless Vector PM

- The P gain for speed control in the low-speed range can be adjusted.
- When an inverter is connected to a lift, the inverter has a load immediately after the lift brake is released. For lift applications, slow response may cause a delay in the brake opening. Adjusting the P gain in the low-speed range improves the response at low speeds, and shortens the time from startup to brake opening. This will contribute to a reduction in tact time.

Pr.	Name	Initial value	Setting range	Description
1400 A160	**Low-speed range speed control P gain 1**	9999	0 to 1000%	Set the proportional gain during speed control in the low-speed range. (Setting this parameter higher improves the trackability for speed command changes. It also reduces the speed fluctuation caused by external disturbance.)
			9999	Low-speed range speed control P gain 1 disabled
1401 A161	**Low-speed range speed control P gain 2**	9999	0 to 1000%	Second function of **Pr.1400** (enabled when RT signal ON)
			9999	Low-speed range speed control P gain 2 disabled
1402 A162	**Low-speed range gain corner frequency 1**	3 Hz	0 to 60 Hz	Set the P gain operation during speed control in the low-speed range
1403 A163	**Low-speed range gain corner frequency 2**	5 Hz	0 to 60 Hz	

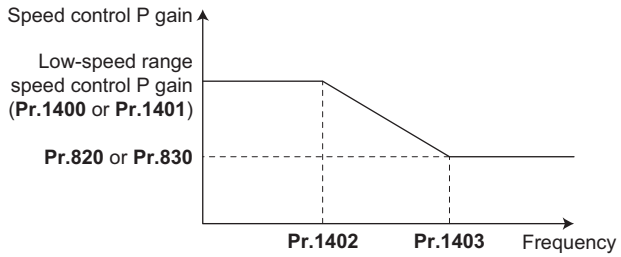
◆Low-speed range speed control P gain operation selection

- Speed control P gain="60% (initial value)" is equivalent to 120 rad/s (speed response of a single motor). (Equivalent to the half the rad/s value during Real sensorless vector control or with the FR-A820-03800(75K) or higher and FR-A840-02160(75K) or higher during vector control.) Setting this parameter higher speeds up the response, but setting this too high causes vibration and acoustic noise.
- Set the P gain value for speed control in the low-speed range in **Pr.1400** and **Pr.1401**.

Pr.1400 setting	Pr.1401 setting	RT signal	
		OFF	ON
0 to 1000	0 to 1000	**Pr.1400 Low-speed range speed control P gain 1** enabled	**Pr.1401 Low-speed range speed control P gain 2** enabled
	9999 (initial value)		**Pr.1400 Low-speed range speed control P gain 1** enabled
9999 (initial value)	0 to 1000	Low-speed range speed control P gain disabled	**Pr.1401 Low-speed range speed control P gain 2** enabled
	9999 (initial value)		Low-speed range speed control P gain disabled

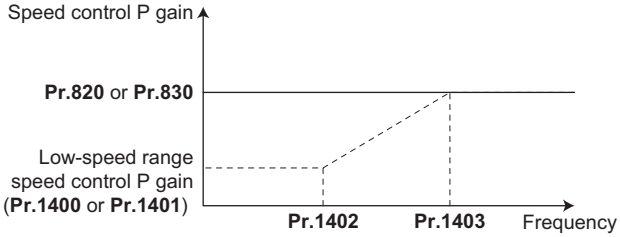
◆Low-speed range speed control P gain operation

- The P gain operation during speed control in the low-speed range is determined by the **Pr.1402** and **Pr.1403** settings.
- When the actual speed reaches or exceeds the speed set in **Pr.1403**, **Pr.820 Speed control P gain 1** (**Pr.830 Speed control P gain 2**) is enabled.
- When the actual speed does not exceed the speed set in **Pr.1402**, the larger value of either **Pr.1400** (**Pr.1401**) setting or **Pr.820** (**Pr.830**) setting is enabled.
- When the actual speed is equal to the speed between the **Pr.1402** and **Pr.1403** settings, the larger value of either the one calculated from **Pr.1400** (**Pr.1401**) setting and **Pr.820** (**Pr.830**) setting, or **Pr.820** (**Pr.830**) setting is enabled, as below.

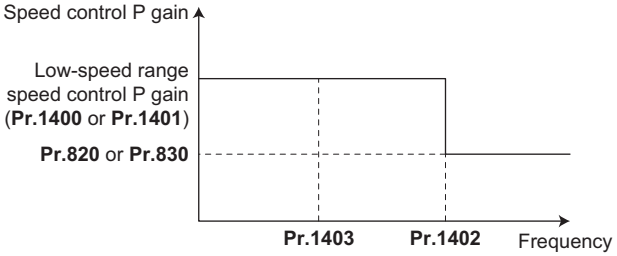


NOTE

- When the **Pr.1400** (**Pr.1401**) setting is smaller than the **Pr.820** (**Pr.830**) setting, the speed control P gain is as below.



- When the value same as **Pr.1403** setting and above is set in **Pr.1402**, the speed control P gain is as below.



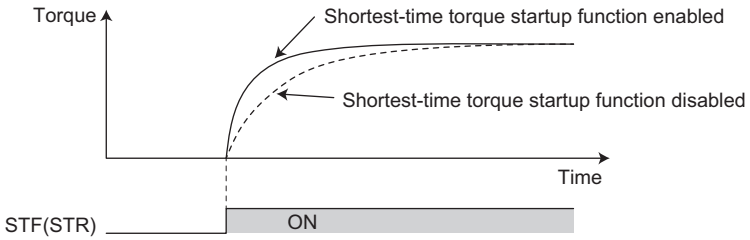
- The low-speed range speed control P gain is valid under Real sensorless vector control, vector control, and PM sensorless vector control (when low-speed range high-torque characteristic is enabled).
- For the details of **Pr.820** (**Pr.830**), refer to the Instruction Manual (Detailed) of the FR-A800 inverter.

3 Shortest-time torque startup Sensorless Vector

- The torque is started up in the shortest time.
- When an inverter is connected to a lift, the load is applied immediately after the lift brake is released. For lift applications, slow torque startup may cause a delay in the brake opening. Using the shortest-time torque startup function shortens the time from startup to brake opening. This will contribute to a reduction in tact time.

Pr.	Name	Initial value	Setting range	Description
1404 **A164**	**Shortest-time torque startup selection**	0	0	Shortest-time torque startup disabled
			1	Shortest-time torque startup enabled

- When **Pr.1404** = "1" and the inverter is not in stop status, the torque is generated by the shortest-time torque startup function.



NOTE

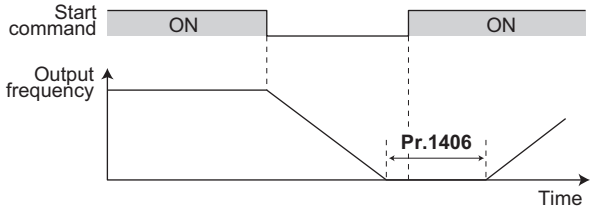
- The shortest-time torque startup function is available under Real sensorless vector control and vector control.

4 Inching time adjustment function

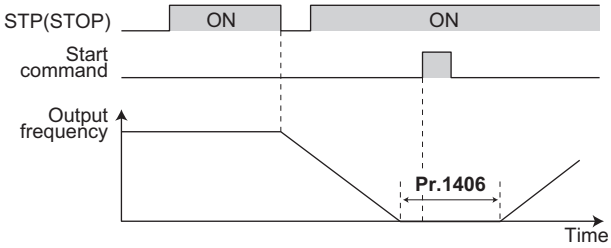
- By setting a waiting time after the inverter is stopped until the inverter is restarted, inching in the setting time can be prevented.
- When the inverter is repeatedly started and stopped for a short time, the overcurrent may occur due to the effect of the motor residual magnetic flux. Adjust the waiting time after the inverter is stopped until the inverter is restarted to suppress current.

Pr.	Name	Initial value	Setting range	Description
1406 A166	**Inching prevention time**	0 s	0 to 5 s	Set the time after the inverter output is stopped until the inverter output can be restarted.

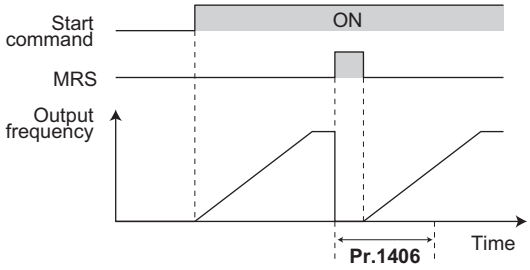
- After the inverter output is stopped by turning OFF the start command, the inverter output cannot be restarted for the time set in **Pr.1406**.



- When the start self-holding function is enabled and the start signal is turned ON within the time set in **Pr.1406**, the ON status is held.



- When the output is shut off by the MRS signal, or when the inverter stops by a "0 Hz" frequency command while the start command is ON, the inverter output restarts even within the time set in **Pr.1406**.



NOTE

- When the output is stopped by simultaneously turning ON both the forward rotation command (STF) and the reverse rotation command (STR), the inverter restarts after the time set in **Pr.1406** has elapsed.
- At the first start after setting **Pr.1406** ≠ "0", the inverter starts running without waiting for the inching prevention time.
- The inching time adjustment function is also enabled during the external JOG operation.
- When the inverter output is shut off during offline auto tuning, the inching time adjustment function is disabled.
- When the pre-excitation/servo ON signal (LX) is turned ON, or during the DC injection brake operation by turning ON the external DC injection brake start signal (X13), the inching time adjustment function is disabled.

⚠ Caution

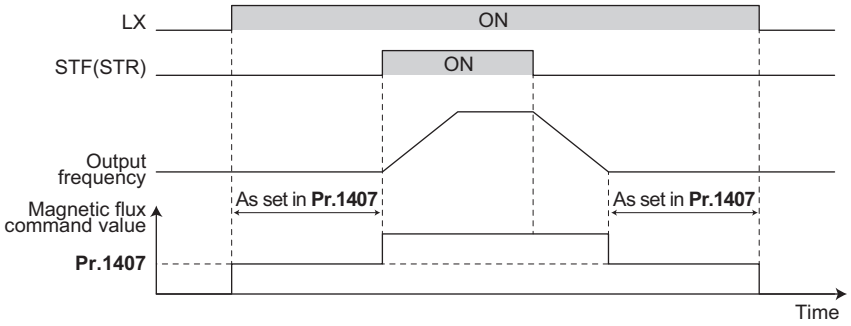
- **When the start command is turned ON during inching time adjustment operation, the motor does not start running immediately. Do not get close to the motor or machine during the time set in Pr.1406 after the start command is ON, regardless of the motor or machine operating status.**

5 Magnetic flux command during pre-excitation Sensorless Vector

- Adjusting the magnetic flux command during pre-excitation reduces the excitation ratio and power consumption during standby.

Pr.	Name	Initial value	Setting range	Description
1407 A167	**Magnetic flux command during pre-excitation**	9999	0 to 100%	Set the magnetic flux command value during pre-excitation.
			9999	Magnetic flux command during pre-excitation disabled

- When the pre-excitation signal (LX) is turned ON while the start command (STF/STR) is OFF, the inverter operates in the magnetic flux command value set in **Pr.1407**.
- When the start command is ON after the LX signal is turned ON, the magnetic flux command value set in **Pr.1407** is invalid, and the inverter operates in normal magnetic flux command value.
- During deceleration after the start command is OFF or during DC injection brake operation, the inverter operates in normal magnetic flux command value.



NOTE

- The magnetic flux command value during pre-excitation is available under Real sensorless vector control and vector control.
- Under Real sensorless vector control, the minimum magnetic flux command value is 25%. (When the magnetic flux command value is set less than 25%, the inverter operates at 25%.)

6 Load torque high-speed frequency control (mode 2)

- Load torque high-speed frequency control is a function that automatically sets the operable frequency according to the load.
- After starting the inverter, the inverter runs at high frequency with a light load, or at low frequency with a heavy load, depending of the value of the current.
  When light loads are moved up or down by a crane, the speed will accelerate automatically, which contributes to reduction in tact time.

Pr.	Name	Initial value		Setting range	Description	
		FM	CA			
4 D301	**Multi-speed setting (high speed)**	60 Hz	50 Hz	0 to 590 Hz	Set the target frequency during forward rotation.	
5 D302	**Multi-speed setting (middle speed)**	30 Hz		0 to 590 Hz	Set the target frequency during reverse rotation.	
270 A200	**Stop-on contact/load torque high-speed frequency control selection**	0		0	Normal operation	
				1	Stop-on-contact control*1	
				2	Load torque high-speed frequency control (mode 1)*1	
				3	Stop-on contact + load torque high- speed frequency control (mode 1)*1	
				4	Load torque high-speed frequency control (mode 2)	
				5	Stop-on contact + load torque high- speed frequency control (mode 2)	
				11	Stop-on-contact control*1	E.OLT invalid under stop-on-contact control
				13	Stop-on contact + load torque high- speed frequency control (mode 1)*1	
				15	Stop-on contact + load torque high- speed frequency control (mode 2)	
271 A201	**High-speed setting maximum current**	50%		0 to 400%	Set the reference torque current value during forward rotation.	
272 A202	**Middle-speed setting minimum current**	100%		0 to 400%	Set the reference torque current value during reverse rotation.	
273 A203	**Current averaging range**	9999		0 to 590 Hz	Set the frequency at which load torque high-speed frequency control (mode 2) is started.	
				9999	Load torque high-speed frequency control (mode 2) starts at 50% of the rated motor frequency.	
274 A204	**Current averaging filter time constant**	16		1 to 4000	Set the time constant of the primary delay filter relative to the output current. (The time constant [ms] is 0.5 × **Pr.274**, and the initial value is 8 ms.) A larger setting results in a stable operation with poorer response.	
286 G400	**Droop gain**	0%		0	Without output frequency compensation	
				0.1 to 1000% *2	Compensate the output frequency to suppress the torque rise after stopping acceleration.	
287 G401	**Droop filter time constant**	0.3 s		0 to 1 s	Set the filter time constant to apply to the current for torque.	
288 G402	**Droop function activation selection**	0		0	Without droop control 2 during acceleration/ deceleration (With 0 limit)	Rated motor frequency is the droop compensation reference.
				1	Countermeasure against winding expansion Constant droop control 2 during operation (With 0 limit)	
				2	Constant droop control 2 during operation (Without 0 limit)	
				10	Without droop control 2 during acceleration/ deceleration (With 0 limit)	Motor speed is the droop compensation reference.
				11	Constant droop control 2 during operation (With 0 limit)	

*1 For the load torque high speed frequency control (mode 1) and the stop-on-contact control, refer to the Instruction Manual (Detailed) of the FR-A800 inverter.

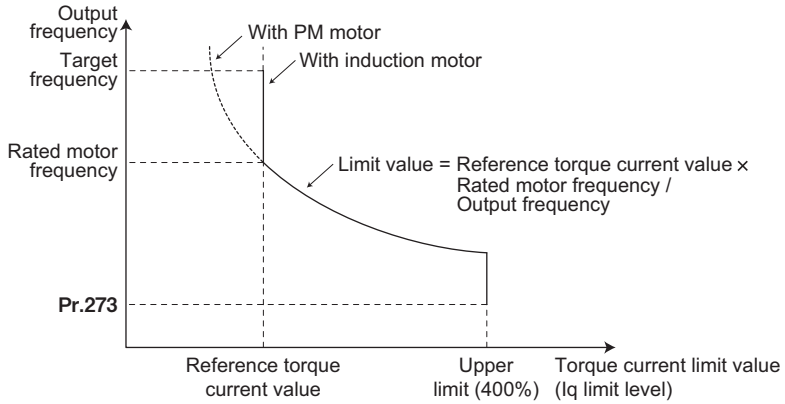
*2 When "load torque high-speed frequency control (mode 2)" is not selected, the droop gain is internally restricted to 100% even if a value exceeding 100% is set.

◆Load torque high speed frequency control (mode 2) setting

- Set "4, 5 or 15" in **Pr.270Stop-on contact/load torque high-speed frequency control selection**.
- When operating with the load torque high speed frequency function selection signal (X19) ON, the load torque high speed frequency control (mode 2) is enabled.

◆Operation of load torque high-speed frequency control (mode 2)

- The maximum frequency (**Pr.4** or **Pr.5**) is used as the target frequency for acceleration.
- When the output current (Iq) reaches or exceeds the torque current limit value (Iq limit level), acceleration is interrupted.
- When the output current (Iq) decreases by the interruption, acceleration starts again.
- By switching between acceleration and stopping, acceleration is controlled so that the torque current matches the torque current limit value.



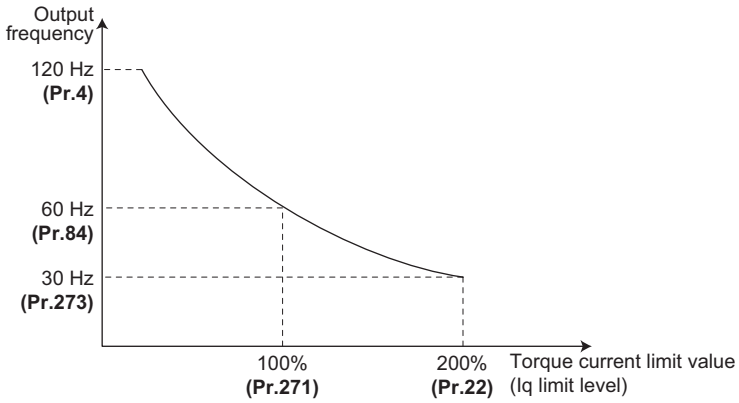
Item		Forward rotation	Reverse rotation
Target frequency		**Pr.4**	**Pr.5**
Reference torque current value		**Pr.271**	**Pr.272**
Rated motor frequency	V/F control	**Pr.3 (Pr.47)**	
	Other than V/F control	**Pr.84 (Pr.457)**	
Torque current maximum limit value		**Pr.22**	

NOTE

- When the output frequency is between 0 and the **Pr.273** setting, load torque high speed frequency control (mode 2) is not activated.
- When the load torque high-speed frequency control (mode 2) is used under V/F control, performing offline auto tuning is recommended in order to increase the accuracy. After setting **Pr.80 Motor capacity** and **Pr.81 Number of motor poles** according to a motor specification (selecting Advanced magnetic flux vector control), perform offline auto tuning by setting **Pr.96 Auto tuning setting/status** = "1 or 101". When the tuning completes, set "9999" in both **Pr.80** and **Pr.81** (select V/F control). For how to perform the offline auto tuning, refer to the Instruction Manual (Detailed) of the FR-A800.
- The automatic restart after instantaneous power failure function, fast-response current limit operation, shortest acceleration/deceleration, and optimum acceleration/deceleration are invalid.
- Under the following operating conditions, the load torque high-speed frequency control (mode 2) is not available:
  PU operation (**Pr.79**), PU + External operation (**Pr.79**), JOG operation, PID control function operation (**Pr.128**), remote setting function operation (**Pr.59**), orientation control function operation, multi-speed setting (RH, RM, and RL signals), torque control, position control.

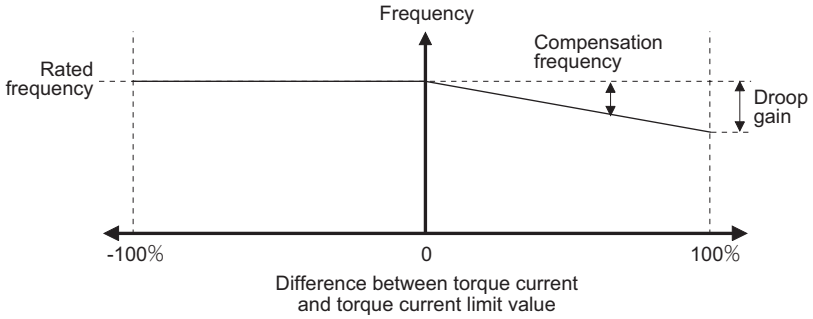
◆Setting example

- When **Pr.4** = "120 Hz", **Pr.22** = "200%", **Pr.84** = "60 Hz", **Pr.271** = "100%", and **Pr.273** = "9999"



◆Countermeasure againts winding expansion (Droop control 2)

- When a wire rope is wound, the motor torque increases along with enlargement in the winding diameter (winding expansion). Set the droop control 2 to compensate the output frequency corresponding to the motor torque increase.
- As a countermeasure against winding expansion, set "1" in **Pr.288 Droop function activation selection**. Set the compensation amount in **Pr.286 Droop gain**.



$$\textbf{Compensation frequency} = \frac{\textbf{Torque current} - \textbf{Torque current limit value}}{\textbf{Rated torque current value}} \times \frac{\textbf{Rated motor frequency} \times \textbf{Droop gain}}{\textbf{100}}$$

NOTE

- Output frequency compensation as a countermeasure against winding expansion is not available under V/F control.
- For the details of the droop control, refer to the Instruction Manual (Detailed) of the FR-A800 inverter.

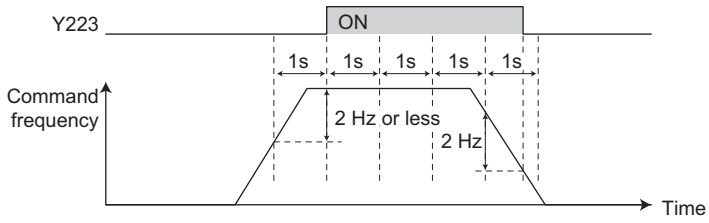
7 Overload detection

- The constant speed signal (Y223) can be output when the range of speed fluctuations is small.
  By the output of the constant speed signal, the load torque without the acceleration/deceleration torque can be confirmed. When this function is used together with the PLC function, the superordinate controller, etc., the control according to the load is enabled.
- The overload can be detected during constant speed operation.
  When too much load is applied (overload) to a crane, the overload detection signal (TU2) output transmits the information to the superordinate controller.

Pr.	Name	Initial value	Setting range	Description
864 **M470**	**Torque detection**	150%	0 to 400%	Set the torque value where the TU2 signal turns ON.
1405 **A165**	**Overload detection time**	1 s	0 to 10 s	Set the time from when the motor torque reaches or exceeds the **Pr.864** setting until the overload detection signal (TU2) is output.

◆Constant speed signal (Y223 signal)

- When the range of the command frequency fluctuations is about 2 Hz/s or less while the inverter is running, the constant speed signal (Y223) is turned ON. When the inverter stops, or when the range of the command frequency fluctuations is more than 2 Hz/s, the constant speed signal (Y223) is turned OFF.
- For the Y223 signal, set "223 (positive logic) or 323 (negative logic)" in one of **Pr.190 to Pr.196 (output terminal function selection)** to assign the function to the output terminal.

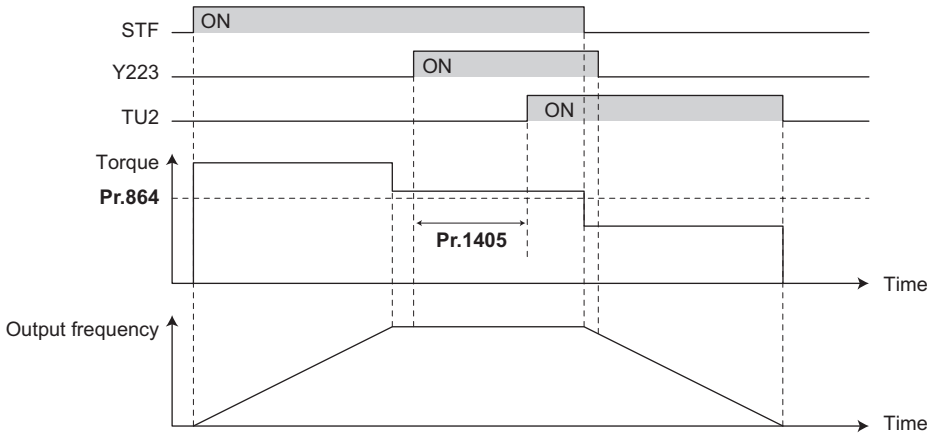


NOTE

- The Y223 signal judges the constant speed status by the range of the command frequency fluctuations. The Y223 signal is not turned ON immediately after the frequency has reached the target frequency.
- Changing the terminal assignment using **Pr.190 to Pr.196 (output terminal function selection)** may affect the other functions. Set parameters after confirming the function of each terminal.

◆Overload detection (Pr.864, Pr.1405, TU2 signal)

- During constant speed operation (the Y223 signal ON), when the motor torque is equal to or higher than the value set in **Pr.864 Torque detection** for a continuous time equal to or longer than the value set in **Pr.1405 Overload detection time**, the overload detection signal (TU2) is turned ON. When the TU2 signal is ON, the TU2 signal stays ON until the inverter output stops.
- For the TU2 signal, set "221 (positive logic) or 321 (negative logic)" in one of **Pr.190 to Pr.196 (output terminal function selection)** to assign the function to the output terminal.



NOTE

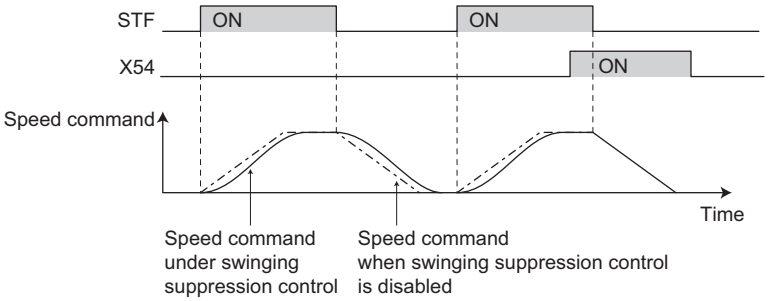
- Under V/F control, the overload is detected by the current to the rated inverter current, instead of the motor torque.
- Changing the terminal assignment using **Pr.190 to Pr.196 (output terminal function selection)** may affect the other functions. Set parameters after confirming the function of each terminal.

8 Swinging suppression control

- When an object is moved by a gantry crane, swinging is suppressed on the crane's traveling axis.
- Swinging suppression control can be disabled by the swinging suppression control disabled signal (X54).

◆Swinging suppression control disabled signal (X54 signal)

- When swinging suppression control is enabled, the travel distance between the positions where the crane starts deceleration and where the crane stops becomes longer. For an emergency stop by a system using a position confirmation sensor, disable swinging suppression control to shorten the stopping distance.
- When swinging suppression control is enabled (**Pr.1073 Swinging suppression control operation selection** = "1") , turning ON the swinging suppression control disabled signal (X54) disables swinging suppression control.
- For the X54 signal, set "54" in any of **Pr.178 to Pr.189 (input terminal function selection)** to assign the function to the input terminal.



NOTE

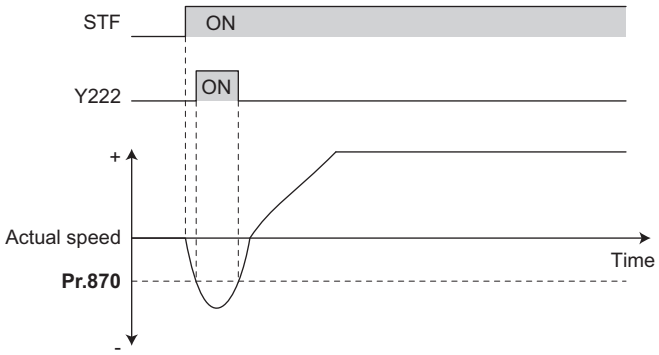
- For the details of swinging suppression control, refer to the Instruction Manual (Detailed) of the FR-A800 inverter.
- Changing the terminal assignment using **Pr.178 to Pr.189 (input terminal function selection)** may affect the other functions. Set parameters after confirming the function of each terminal.

9 Falling detection V/F Magnetic flux Vector

- When the commanded direction differs from the actual motor rotation direction, the falling detection signal (Y222) can be output.
- Slippage during the start of a lift can be checked.

Pr.	Name	Initial value	Setting range	Description
870 M400	**Speed detection hysteresis**	0 Hz	0 to 5 Hz	Set the hysteresis width for the detected frequency.

- When the commanded direction differs from the actual motor rotation direction, and the actual motor speed is higher than the value set in **Pr.870 Speed detection hysteresis**, the falling detection signal (Y222) is turned ON.
- For the Y222 signal, set "222 (positive logic) or 322 (negative logic)" in any of **Pr.190 to Pr.196 (output terminal function selection)** to assign the function to the output terminal.



NOTE

- While the inverter is stopped, or during DC injection brake operation (including zero speed control and servo lock), the Y222 signal is OFF.
- The Y222 signal is available under vector control or encoder feedback control.
- Changing the terminal assignment using **Pr.190 to Pr.196 (output terminal function selection)** may affect the other functions. Set parameters after confirming the function of each terminal.

10 Brake opening current level setting for reverse rotation (Brake sequence function)

- The brake sequence function enables setting of the brake opening level individually for forward rotation and reverse rotation.

Pr.	Name	Initial value	Setting range	Description
1408 A168	**Brake opening current for reverse rotation**	9999	0 to 400%	Set the brake opening current during reverse rotation. Set between 50 and 90% because load slippage is more likely to occur at a start setting is too low.
			9999	During reverse rotation, the **Pr.279** setting is applied.
1409 A169	**Second brake opening current for reverse rotation**	9999	0 to 400%	Set the brake opening current during reverse rotation in the second brake sequence function.
			9999	During reverse rotation, the **Pr.643** setting is applied.

- When the start signal is input to the inverter, the inverter starts running, and when the output frequency reaches the frequency set in **Pr.278 Brake opening frequency** and the output current is equal to or greater than the Brake opening current setting, the brake opening request signal (BOF) is output after the time set in **Pr.280 Brake opening current detection time**.
- The output current level or the motor torque level to output the BOF signal can be set individually for forward rotation and reverse rotation. Set the output current or the motor torque during reverse rotation in **Pr.1408 Brake opening current for reverse rotation**. (When **Pr.1408** = "9999", the Pr.279 setting is applied to the operation even during reverse rotation.)

NOTE

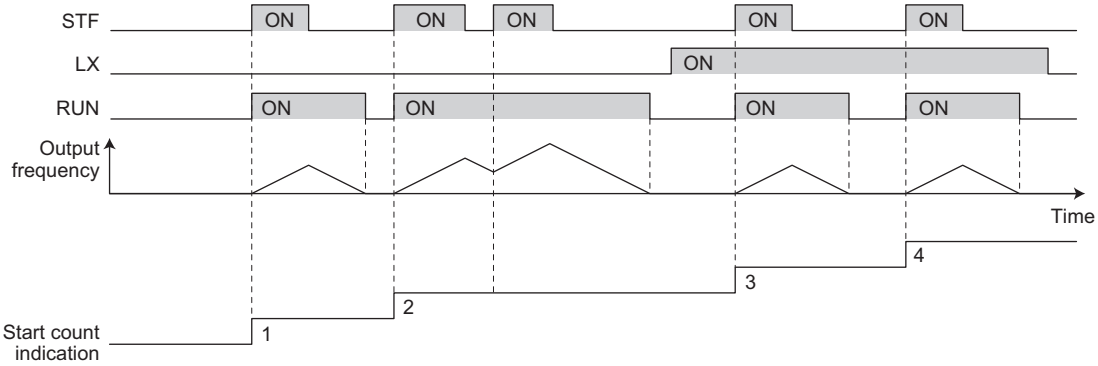
- For the details of the brake sequence function, refer to the Instruction Manual (Detailed) of the FR-A800 inverter.

11 Start count monitor

- The inverter starting times can be counted.
- Confirming the starting times can be used to determinate the timing of the maintenance, using as a reference for system inspection or parts replacement.

Pr.	Name	Initial value	Setting range	Description
1410 A170	**Starting times lower 4 digits**	0	0 to 9999	Displays the lower four digits of the number of the inverter starting times.
1411 A171	**Starting times upper 4 digits**	0	0 to 9999	Displays the upper four digits of the number of the inverter starting times.

- Every start signal input (the RUN signal ON) while the inverter output is stopped is counted as the inverter starting time. (Starting during pre-excitation is also counted.)



- The lower four digits of the number of starting times is displayed in **Pr.1410 Starting times lower 4 digits**, and the upper four digits of the number of starting times is displayed in **Pr.1411 Starting times upper 4 digits**.
- The maximum count is "99999999". When "99999999" is exceeded on the monitor, the monitor value is reset to 0.

Display data		Monitor display
10000	**Pr.1410** (Lower digits monitor)	0
	Pr.1411 (Upper digits monitor)	1
100	**Pr.1410** (Lower digits monitor)	100
	Pr.1411 (Upper digits monitor)	0

NOTE

- Any value can be set in **Pr.1410** or **Pr.1411**. Set "0" to clear the number on the monitor.
- Starting during offline auto tuning is not counted.
- Under position control, the count increases when the LX signal turns ON.
- The counting is enabled even if the RUN signal is not assigned to an output terminal.
- For the RUN signal, refer to the Instruction Manual (Detailed) of the FR-A800 inverter.

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REVISIONS

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