HITACHI
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SJ300-EL Series Inverter for Elevator Applications Instruction Manual Supplement

- Three-phase Input 200V Class
- Three-phase Input 400V Class

NOTE: REFER ALSO TO SJ300 SERIES INSTRUCTION MANUAL NB613X

Manual Number:
HAL6114X
February 2005

After reading this manual,
keep it handy for future reference.

Hitachi America, Ltd.

NOTES:

Table of Contents

NOTES:

1. General Description

1.1 Functionality

Please be sure to take into account all applicable standards and regulations before applying the SJ300EL inverter to an elevator system.

1.2 Instruction manual

This supplementary manual for the SJ300EL Elevator AC Inverter is to be used in conjunction with the SJ300 general purpose inverter manual. Information shown in this manual takes precedence over the manuals of the SJ300 inverter (and the SJ-FB option card manual, if used), where there are differences.

1.3 Functionality

Differences of functions versus the general purpose SJ300 inverter are shown in the following table. The settings can be viewed or modified by the standard digital operator or the optional copy unit (SRW-0EX). Multi-language display however is not supported with the SJ300EL and the SRW-0EX.

1.4 Added and modified functions vs. standard SJ300

#	Function name	Contents	Remark
1	Characteristics of S-curve acceleration & deceleration for elevators	Characteristics of each curve portion and linear portion can be adjusted separately.	
2	Acceleration/ deceleration time setting of multi-stage speed	Acceleration/deceleration time can be set for each multistage speed (0-7) independently.	
3	Gain adjustment (P-gain, I-gain)	P-gain and I-gain can be adjusted for each of up to 8 (eight) preset frequencies.	
4	Torque bias gain adjustment	Torque bias setting input can be given via voltage input or torque bias input.	
5	Battery backup function	Emergency drive (low speed) can be done by an external battery in case of main power failure.	Note1
6	Control mode changeover in case of emergency	Changes the control mode to V/Hz (V/f) or SLV in case vector control cannot function due to an encoder failure.	
7	Brake control function	Brake ON frequency and brake OFF frequency can be set separately. Brake ON and OFF wait time can be set Separately. Additionally, delay time at brake OFF can be set. Delay time can be set at brake OFF.	
8	Encoder Errors	If the signal from the encoder doesn't correspond to the inverter output for any reason, then the inverter displays a trip event.	

Note 1) Please contact Hitachi with the following information if the battery back-up function is needed.

- Specification of the control power supply
- Specification of the battery power supply

1.5 Deleted functions vs. standard SJ300

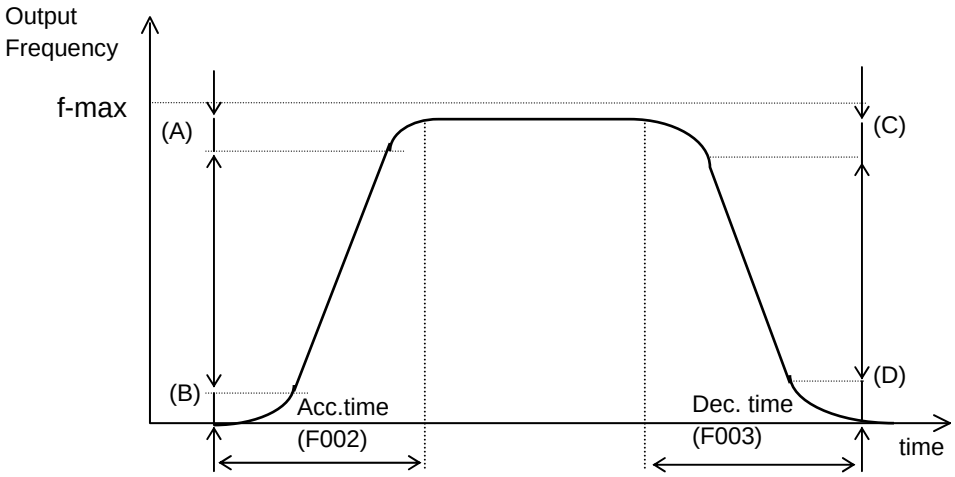
#	Function name	Contents	Remark
1	2nd and 3rd motor functions	A203/A303 Base frequency,2nd and 3rd motor A204/A304 Maximum frequency, 2nd and 3rd motor A220/A320 Multi-speed 0, 2nd and 3rd motor A242/A342 Manual torque boost, 2nd and 3rd motor A243/A343 Manual torque boost point, 2nd and 3rd motor A344 3rd control A292/A392 Acceleration time2, 2nd and 3rd motor A293/A393 Deceleration time2, 2nd and 3rd motor A294 2nd stage adjustable selection(2nd motor) A295 2nd acceleration frequency(2nd motor) A296 2nd deceleration frequency (2nd motor) b212/b312 Electronic thermal level, 2nd and 3rd b213/b313 2nd and 3rd electronic thermal characteristic selection H202 2nd motor constant selection H203 2nd allowable motor selection H204 2nd motor pole selection H205 2nd speed response setting H206/H306 2nd and 3rd stabilized factor H220 2nd motor constant R1 H221 2nd motor constant R2 H222 2nd motor constant L H223 2nd motor constant I0 H224 2nd motor constant J H230 2nd motor constant R1(Autotuning data) H231 2nd motor constant R2(Autotuning data) H232 2nd motor constant L(Autotuning data) H233 2nd motor constant I0(Autotuning data) H234 2nd motor constant J(Autotuning data) H250 2nd PI-control proportion gain setting H251 2nd PI-control integration gain setting H252 2nd P-control proportion gain setting H260 2nd 0Hz-SLV limiter setting Intelligent input terminal: 08(SET), 17(SET3)	
2	Free setting V/f function	b100-b113 Free V/f setting function	
3	Auto-torque boost function	A041/A241 Torque boost selection, 1st and 2nd	
4	Multi-speed 8 - 15	A028-A035 Multi-speed 8 - 15 Intelligent input terminal: 05 (CF4)	

#	Function name	Contents	Remark
5	Jogging operation	A038 Jogging frequency A039 Jogging selection Intelligent input terminal: 06(JG)	
6	energy-saving operation mode	A085 Operation mode selection A086 Energy-saving response-accuracy adjustment	
7	PID function	A071-A076 PID function C044 PID deviation setting level Intelligent input terminal: 23(PID), 24(PIDC) Intelligent output terminal: 04(OD)	
8	Up/Down Function, Up/Down Memory Mode Selection	C101 UP/DWN selection Intelligent input terminal: 27(UP), 28(DWN), 29(UDC)	
9	Country code for initialization	b085 Country code for initialization	
10	Rotational direction restriction	b035 Operation direction restrict	
11	Controlled deceleration and stop at power loss	b050 - b054 Stopping of deceleration at power OFF	
12	Restart mode after RESET	C103 Restart mode after RESET	Only 0Hz start is available for C103
13	User Selectable Functions, Function Code Display Restriction	b037, U001 to U012	

NOTES:

2. Explanation of Functions

2.1 S-curve acceleration and deceleration for elevator (EL S-curve)



Shape of curve portions (A) to (D) above can be adjusted separately, as shown in the following table. Setting value is a % of target frequency.

<Setting items>

Function Code	Function Name	Setting Range	Remarks
A097	Acceleration pattern selection	Select “04”	
A098	Deceleration pattern selection	Select “04”	
P060	Curve ratio 1 during acceleration	0. – 50 (%)	Portion (B)
P061	Curve ratio 2 during acceleration	0. – 50 (%)	Portion (A)
P062	Curve ratio 1 during deceleration	0. – 50 (%)	Portion (C)
P063	Curve ratio 2 during deceleration	0. – 50 (%)	Portion (D)

(Note 1) A linear characteristic will result (A097 = A098=00) if 0% is set for the curve ratio.

(Note 2) A linear characteristic will result if the change of the target speed is less than or equal to 10% of the maximum frequency.

(Note 3) All of the curve constants are ignored if “04” is selected in A097 and A098. Refer to the manual for standard S-curve acceleration & deceleration description.

(Note 4) The S-curve will be recalculated if the target speed is changed while accelerating or decelerating. Therefore do not use analog signals for the target speed.

(Note 5) Curve ratio for acceleration/deceleration must be in the range of 10% up to 50%.

2.2 Multi-speed and acceleration/deceleration time

Different acceleration and deceleration times can be set for each multistage speed. The acceleration time is the one used between the current speed and target speed during acceleration. The deceleration time is the one used between the current speed and creep speed (speed-7), or between the current speed and the target speed during deceleration. Therefore use the deceleration time of A027 for creep speed at stopping. Furthermore, inverter decelerates with the deceleration time that is set on that multistage speed when the RUN command is removed.

Related parameters are shown in following table.

< Additional setting items>

Function Code	Function Name	Setting range
A020	Multi-speed 0	0.00, starting frequency-maximum. frequency(Hz)
F002	Acceleration time for multi-speed 0	0.01-99.99/100.0-999.9/1000.-3600.(s)
F003	Deceleration time for multi-speed 0	0.01-99.99/100.0-999.9/1000.-3600.(s)
A021	Multi-speed 1	0.00, starting frequency-maximum. frequency(Hz)
A221	Acceleration time for multi-speed 1	0.01-99.99/100.0-999.9/1000.-3600.(s)
A321	Deceleration time for multi-speed 1	0.01-99.99/100.0-999.9/1000.-3600.(s)
A022	Multi-speed 2	0.00, starting frequency-maximum. frequency(Hz)
A222	Acceleration time for multi-speed 2	0.01-99.99/100.0-999.9/1000.-3600.(s)
A322	Deceleration time for multi-speed 2	0.01-99.99/100.0-999.9/1000.-3600.(s)
A023	Multi-speed 3	0.00, starting frequency-maximum. frequency(Hz)
A223	Acceleration time for multi-speed 3	0.01-99.99/100.0-999.9/1000.-3600.(s)
A323	Deceleration time for multi-speed 3	0.01-99.99/100.0-999.9/1000.-3600.(s)
A024	Multi-speed 4	0.00, starting frequency-maximum. frequency(Hz)
A224	Acceleration time for multi-speed 4	0.01-99.99/100.0-999.9/1000.-3600.(s)
A324	Deceleration time for multi-speed 4	0.01-99.99/100.0-999.9/1000.-3600.(s)
A025	Multi-speed 5	0.00, starting frequency-maximum. frequency(Hz)
A225	Acceleration time for multi-speed 5	0.01-99.99/100.0-999.9/1000.-3600.(s)
A325	Deceleration time for multi-speed 5	0.01-99.99/100.0-999.9/1000.-3600.(s)
A026	Multi-speed 6	0.00, starting frequency-maximum. frequency(Hz)
A226	Acceleration time for multi-speed 6	0.01-99.99/100.0-999.9/1000.-3600.(s)
A326	Deceleration time for multi-speed 6	0.01-99.99/100.0-999.9/1000.-3600.(s)
A027	Multi-speed7 (creep speed)	0.00, starting frequency-maximum. frequency(Hz)
A227	Acceleration time for multi-speed 7	0.01-99.99/100.0-999.9/1000.-3600.(s)
A327	Deceleration time for multi-speed 7	0.01-99.99/100.0-999.9/1000.-3600.(s)

(example 1)

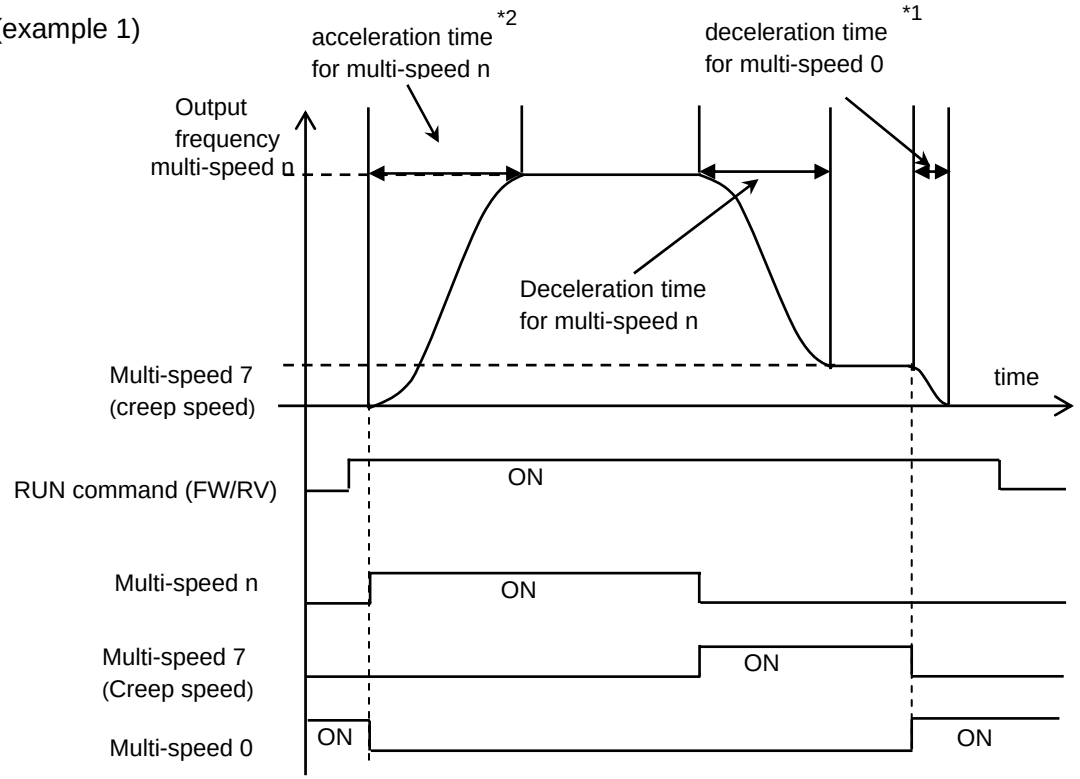


Figure 1 - Timing chart for creep speed

(Note 1) A linear characteristic will result if the change of the target speed is the same or less than 10% of the maximum frequency.

(Note 2) The time setting is the time it takes to accelerate from zero to the maximum frequency and to decelerate from the maximum frequency to zero.

(example 2) Be sure to set A027 for the creep speed at stop. Otherwise the inverter operates like shown in the following figure.

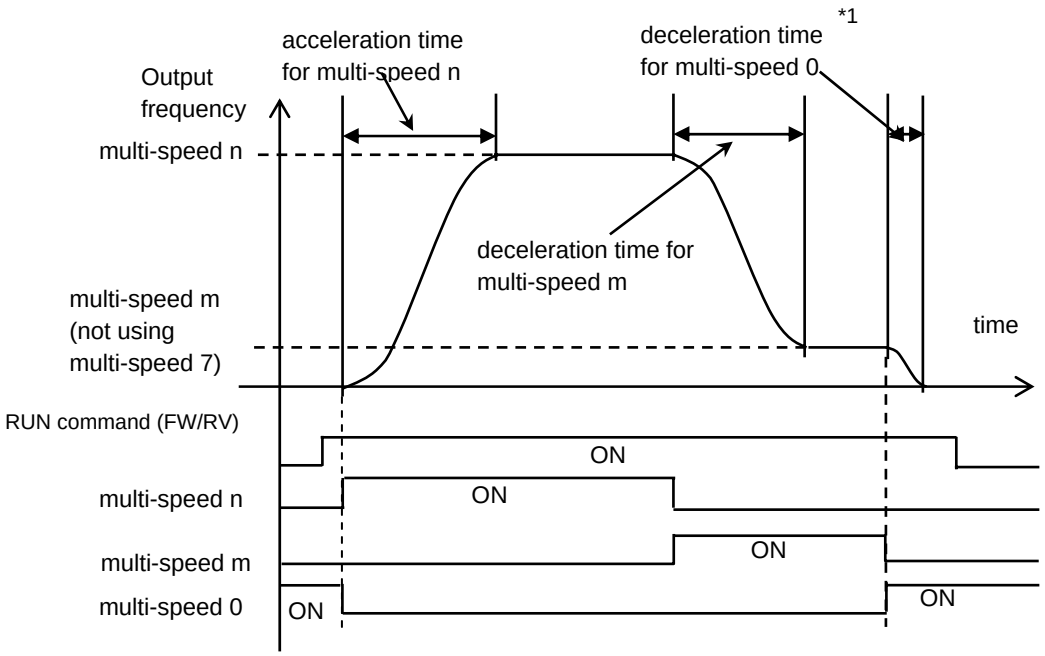


Figure 2 - Timing chart when not using creep speed at stop

2.3 Multi-speed Gain adjustment

Unique ASR (automatic speed regulator) gains (P-gain and I-gain) can be assigned for each output frequency. The gain of 100% is calculated based on a value of motor inertia (J: H024, H034), speed response coefficient (H005) and parameters of H070, H071, and H072, adjustable from 0% up to 100%. Set the frequencies so f1<f2<⋯<fn<⋯<f7<f8. There is no restriction for the setting of the gains.
Set gain of the maximum frequency (G8 in following figure) is maintained when a higher target frequency is set.

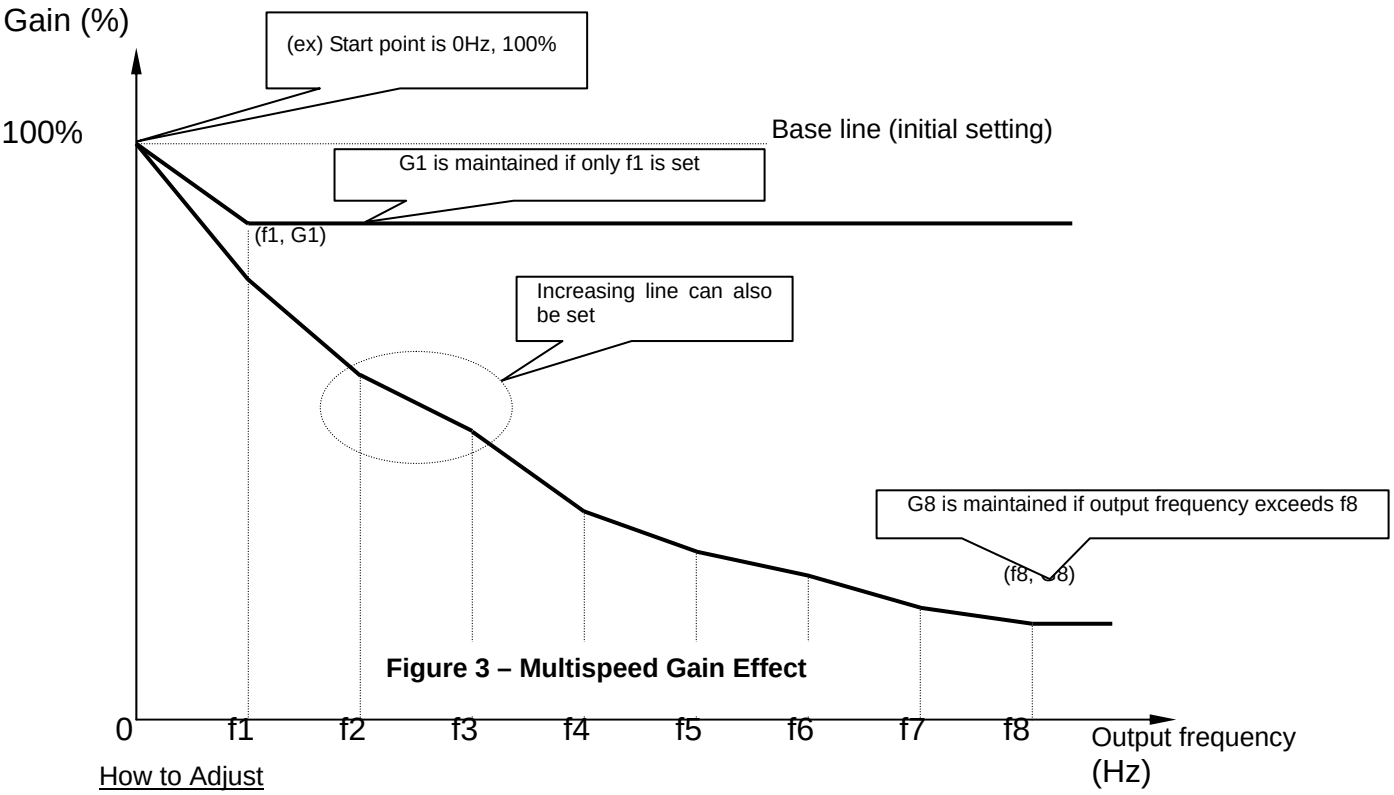


Figure 3 – Multispeed Gain Effect

How to Adjust

(1) The purpose of this function is to get high gain at brake OFF and at stopping, and to have low gain at higher speed. Therefore increase the gain at a speed that is lower than the creep speed as a rough initial target.

(2) When using a geared motor decrease H005, H050, H051, H070, H071, and/or H072. Set H005 of around 1.0-2.0 in the range of lower than the creep speed, as a rough target.

< Additional setting items>

Function Code	Function Name	Setting Range	Remarks
P069	Gain adjustment permission	00 : OFF / 01 : ON	
P070	Frequency 1 for P-gain adjustment	0 ~ max. frequency	
P071	Frequency 2 for P-gain adjustment	0 or P070 ~ max. frequency	
P072	Frequency 3 for P-gain adjustment	0 or P071 ~ max. frequency	
P073	Frequency 4 for P-gain adjustment	0 or P072 ~ max. frequency	
P074	Frequency 5 for P-gain adjustment	0 or P073 ~ max. frequency	
P075	Frequency 6 for P-gain adjustment	0 or P074 ~ max. frequency	
P076	Frequency 7 for P-gain adjustment	0 or P075 ~ max. frequency	
P077	Frequency 8 for P-gain adjustment	0 or P076 ~ max. frequency	
P080	P-gain 1	0 ~ 100%	
P081	P-gain 2	0 ~ 100%	
P082	P-gain 3	0 ~ 100%	
P083	P-gain 4	0 ~ 100%	
P084	P-gain 5	0 ~ 100%	
P085	P-gain 6	0 ~ 100%	
P086	P-gain 7	0 ~ 100%	
P087	P-gain 8	0 ~ 100%	
P090	Frequency 1 for I-gain adjustment	0 ~ max. frequency	
P091	Frequency 2 for I-gain adjustment	0 or P090 ~ max. frequency	
P092	Frequency 3 for I-gain adjustment	0 or P091 ~ max. frequency	
P093	Frequency 4 for I-gain adjustment	0 or P092 ~ max. frequency	
P094	Frequency 5 for I-gain adjustment	0 or P093 ~ max. frequency	
P095	Frequency 6 for I-gain adjustment	0 or P094 ~ max. frequency	
P096	Frequency 7 for I-gain adjustment	0 or P095 ~ max. frequency	
P097	Frequency 8 for I-gain adjustment	0 or P096 ~ max. frequency	
P100	I-gain 1	0 ~ 100%	
P101	I-gain 2	0 ~ 100%	
P102	I-gain 3	0 ~ 100%	
P103	I-gain 4	0 ~ 100%	
P104	I-gain 5	0 ~ 100%	
P105	I-gain 6	0 ~ 100%	
P106	I-gain 7	0 ~ 100%	
P107	I-gain 8	0 ~ 100%	

2.4 Torque bias

The inverter is able to accept an analog voltage signal from a load cell that represents car weight. This signal is used to adjust the instantaneous starting torque to achieve smooth motion regardless of load.

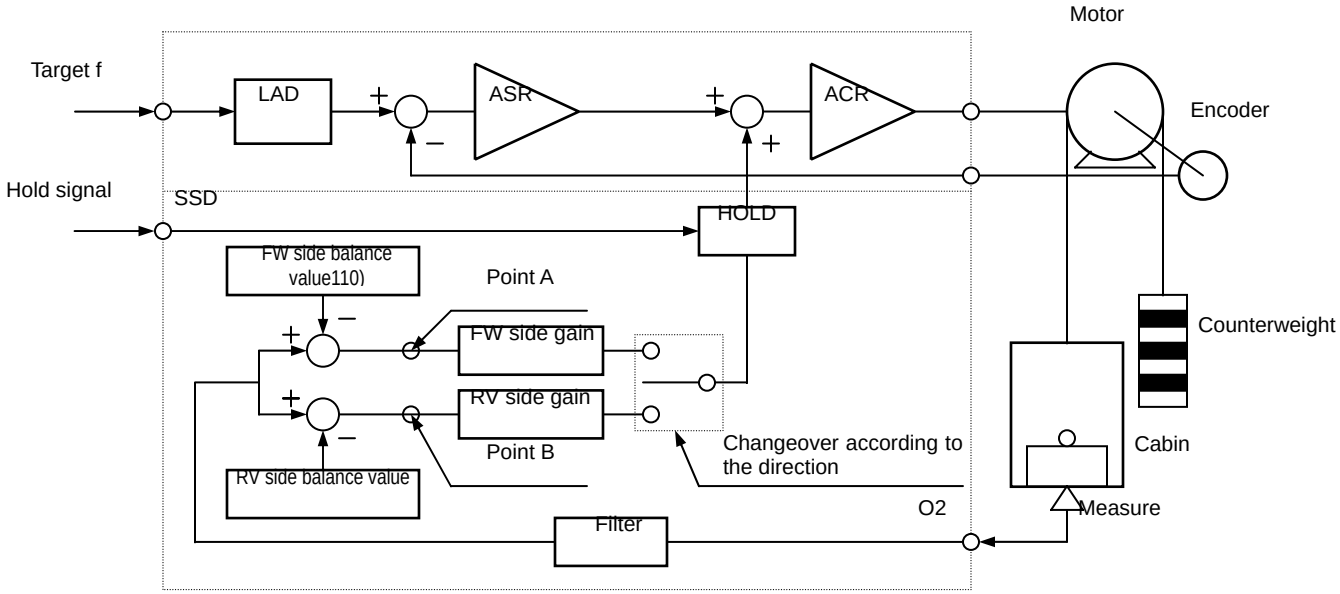


Figure 4 – Torque bias circuit diagram

< Additional setting items>

Function Code	Function Name	Setting Range	Remarks
A071	Selection of Torque Bias Input	-	00: O Input 01: OI Input (Note 2) 02: O2 Input (Note 3)
P110	FW side balance value	0.0 - 10.0 (V)	Total weight output at balanced point (FW direction side)
P111	RV side balance value	0.0 - 10.0 (V)	Total weight output at balanced point (RV direction side)
P112	FW side gain	0.0 - 200.0 (%)	Torque value to be added in case of max. weight (FW direction side)
P113	RV side gain	0.0 - 200.0 (%)	Torque value to be added in case of max. weight (RV direction side)
P114	Time constant of the filter	5 - 500 (ms)	
C001 - C008	Intelligent input terminals 1 - 8	-	50: SSD

Note 1: Do not configure the same analog input for torque bias input (A071), frequency source setting (A001), and torque limit input (B040).

Note 2: When OI input is used for torque bias, the ranges of P110 and P111 are still 0 – 10 V, so it will be necessary to translate the 4 – 20 mA signal value to 0 – 10 V for these parameter settings.

Note 3: When O2 is selected for torque bias, the range is 0 to +10 V. Negative values are ignored.

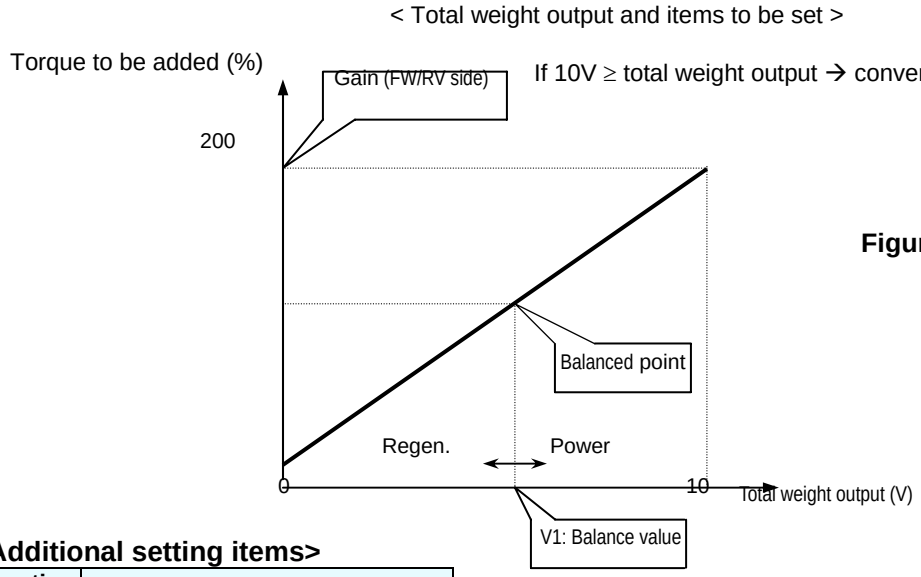


Figure 5 – Balance Point

< Additional setting items>

Function Code	Function Name
d107	Point A (FW deviation) monitor
d108	Point B (RV deviation) monitor

< How to adjust >
Bias weight adjustment and gain adjustment of the analog weight signal are required when using the torque bias function.

① Bias weight adjustment (Balance adjustment)
Put weight in the elevator car to balance it with the counterweight. Then adjust the following parameters to make the deviation values at points A (d107) and B (d108) 0 (zero).

$$\textit{Balance value (P110, P111)} = \left(1 - \frac{V_1 \ [V]}{10 \ [V]}\right) \times 100 \ \ [\%]$$

V1 : Voltage when the car and counterweight are balanced (see Figure 5).

② Gain adjustment

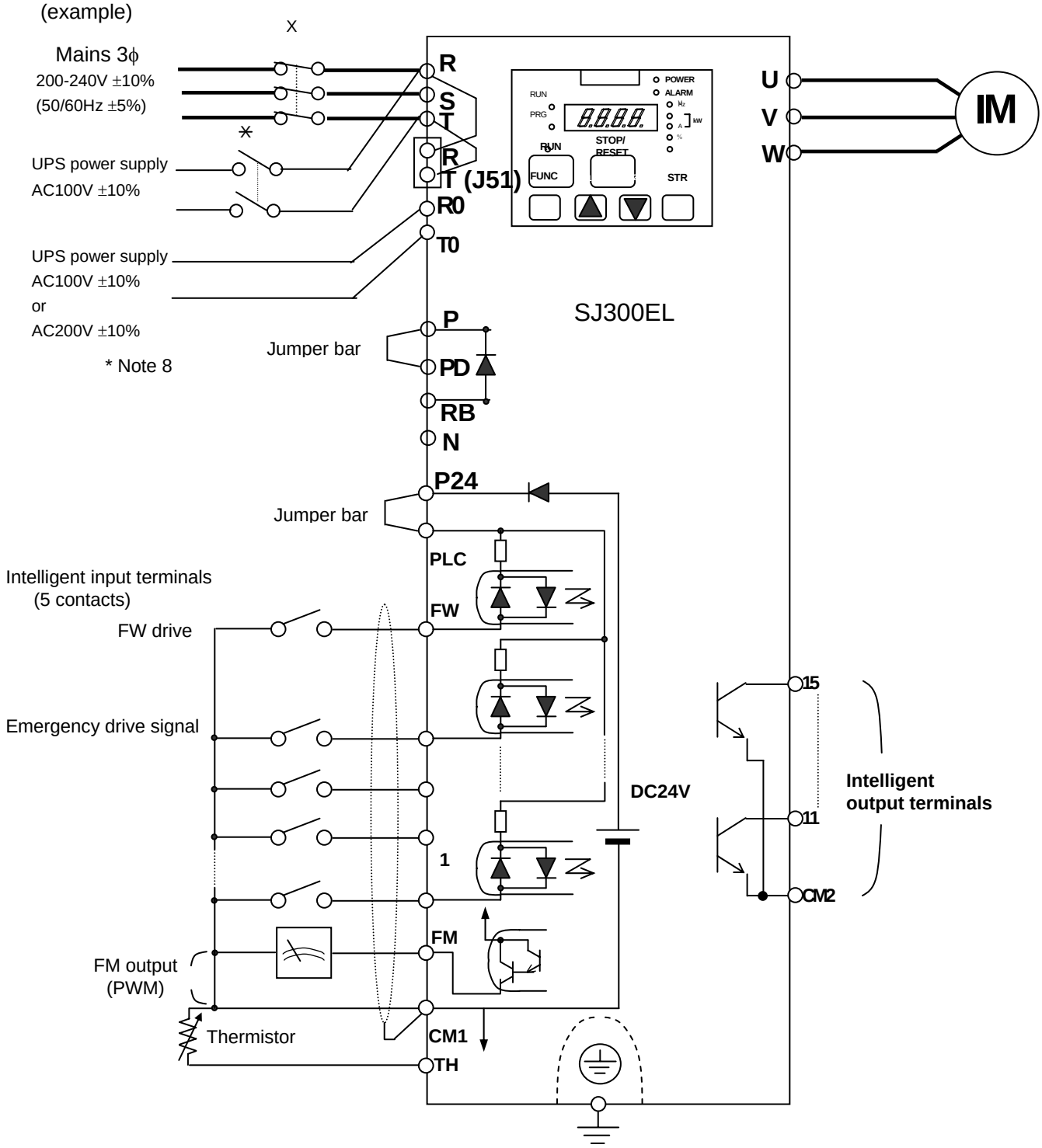
$$\textit{Gain} = \frac{\alpha}{100} \times 1.82 \times \frac{10 \ [V]}{V_2 \ [V] - V_1 \ [V]}$$

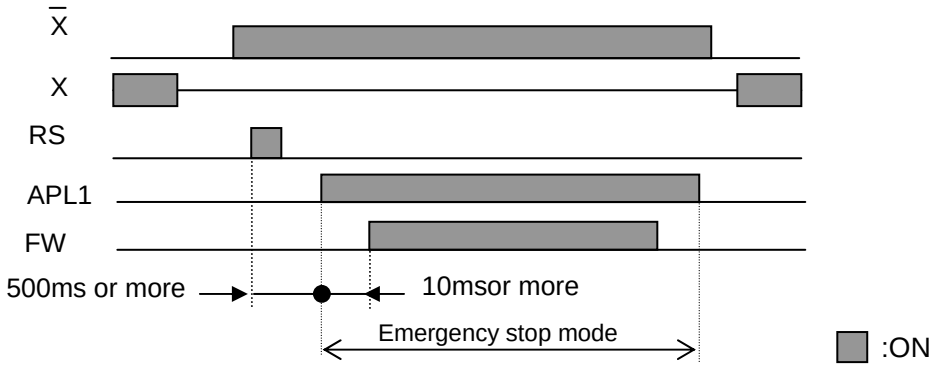
α: Torque bias value (%) at maximum load weight
V1: Voltage when the car and counterweight are balanced
V2: output voltage of the sensor at maximum load weight

2.5 Battery backup function

This custom function allows emergency operation at low speed via an external battery or UPS system in case of main AC power failure. This feature is NOT standard. Please contact Hitachi representatives with

Details of UPS power supply or battery system.
(example)





(Note 1) Do not turn contactor X and $\overline{X}$ ON at the same time. Be sure to allow 10 seconds or more for the changeover period.
(Note 2) Do not turn APL1 ON while the inverter is driven by the mains with contactor X ON.
(Note 3) Changeover to battery backup mode and back is valid only when the inverter is stopped. Do not turn APL1 OFF during the battery backup mode.
(Note 4 Surge current must not exceed 500A in case of connecting the battery at emergency. Select a contactor for $\overline{X}$ which can withstand the surge current.
(Note 5) If there has been a fault when going into the emergency driving mode, clear the error first.
(Note 6) Output frequency of the inverter during emergency driving mode (f_E) must not exceed the following value.

$$f_E \leq f_b \times \frac{V_B}{V_m \times 1.35} \times \frac{2}{3}$$

fb : Rated (base) frequency of the motor
V_B : Voltage of the battery
V_m : Rated voltage of the motor

(Note 7) Under-voltage trip will occur when the UPS voltage comes down to AC100V-15% during emergency driving operation.

< Additional setting items>

Function Code	Function Name	Remarks
C001 - C008	Intelligent input terminals 1~8	51 : APL1

2.6 Control mode changeover in case of emergency

If the elevator cannot operate in vector mode with feedback mode (due to encoder failure, for example), the control mode can be changed to V/f or SLV mode to allow short term emergency operation. Changeover is initiated by an intelligent input configured to the [ECM] function.

NOTE: Do not use this mode as a normal operation mode.

< Additional setting items>

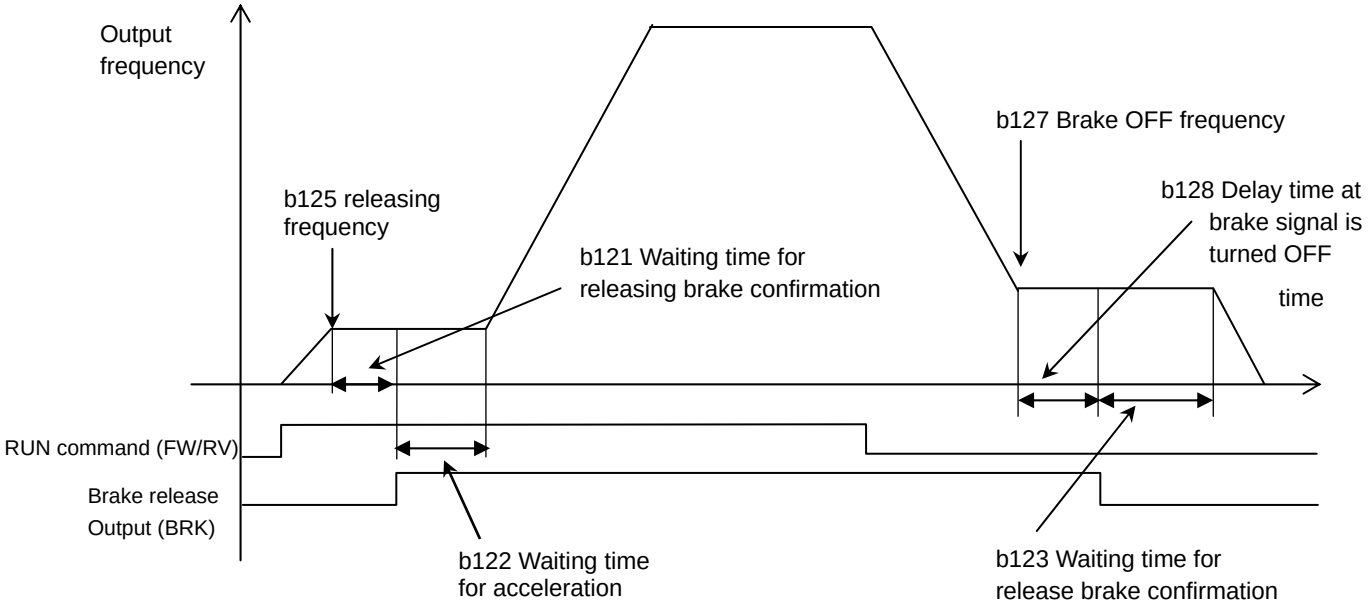
Function Code	Function Name	Setting
A244	Control mode on emergency changeover	00: V/f constant torque 01: V/f variable torque 02: sensorless vector SLV 03: 0 Hz domain SLV
C001 - C008	Intelligent input terminals 1 - 8	Set to 52: ECM

2.7 Braking control function

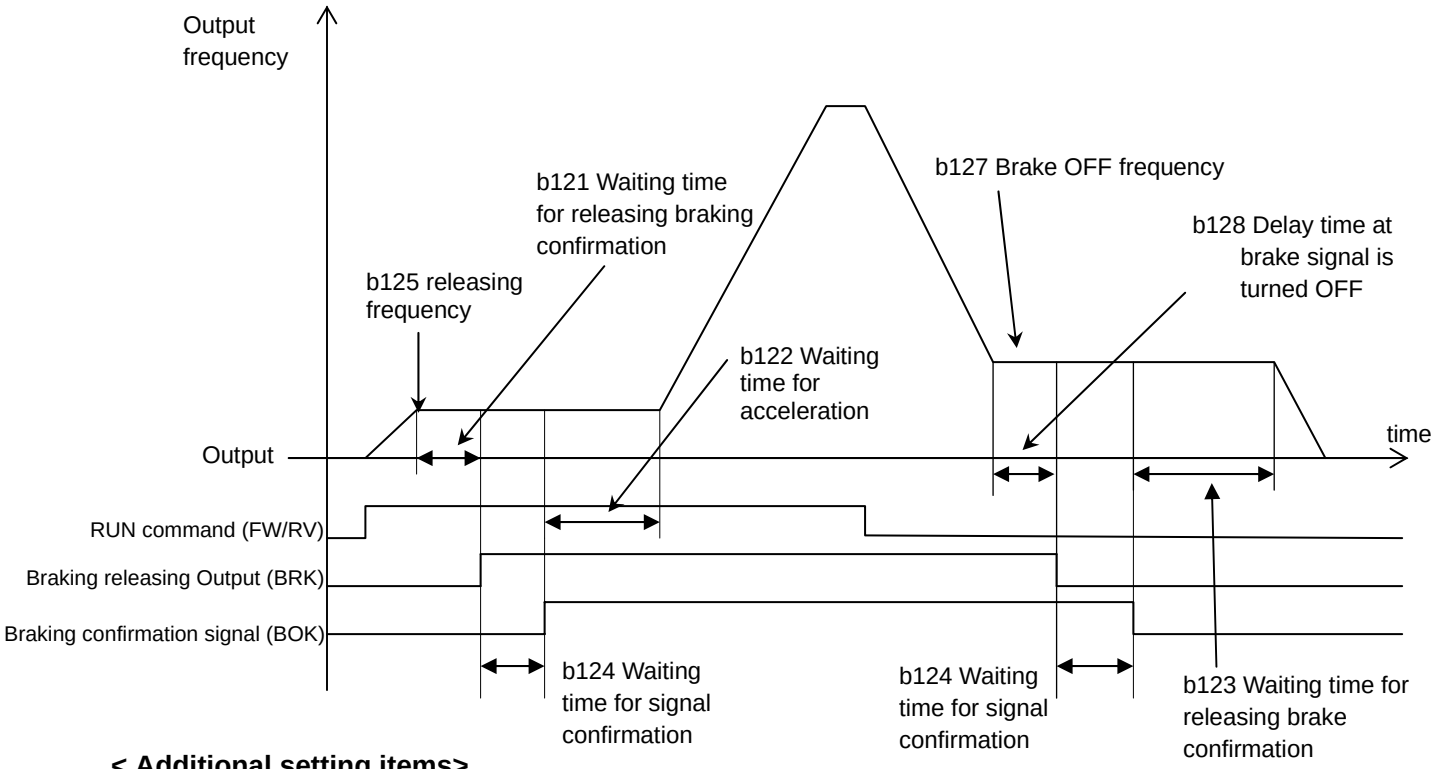
The following functions are added to the brake control function vs. the standard SJ300 series.

1. Brake ON and OFF frequency
   Brake ON frequency and brake OFF frequency can be set separately.
2. Delay time at brake (BRK) OFF
   Delay time can be set at brake OFF.

(example 1) Timing chart below shows result when brake confirmation signal (BOK) is not assigned



(example 2) Time-chart below shows result when brake confirmation signal (BOK) is assigned



< Additional setting items>

Function Code	Function Name	Initial Setting	Remarks
b120	Braking control selection	00	
b121	Waiting time for releasing braking conformation	0.00 s	
b122	Waiting time for acceleration	0.00 s	
b123	Waiting time for stop	0.00 s	
b124	Waiting time for signal conformation	0.00 s	
b125	Releasing frequency	0.00 Hz	Releasing only.
b126	Releasing current	Rated current of inverter	
b127	Brake OFF frequency	0.00 Hz	Additional setting items
b128	Delay time at brake signal is turned OFF	0.50 s	Additional setting items

2.8 Encoder Errors

If the signal from encoder doesn't correspond to the inverter output for any reason, then the inverter displays a trip event.

1. Speed deviation error
   Inverter enters the trip state when a speed deviation is detected due to abnormal signal from encoder or abnormal shaft speed caused by the load. For inverter to record a trip event, the speed difference between reference and actual motor speed must be more than the threshold for 200ms. The threshold for speed deviation (P027) is configurable. An output signal for excess speed deviation (22: [DSE]) can be assigned to an intelligent output terminal for use by an external controller or other device.

   Speed overshoot due to the inertia of the load can also trigger this function.

   This function can be disabled with parameter P051.

   Error display (Speed deviation)
   OPE-S: E63.X or E73.X
   SRW: OP1-3 or OP2-3

2. Motor rotational direction error
   When the encoder is connected with A and B phases reversed and the motor turns in a wrong direction, the inverter records a trip event. In other words, if a forward (reverse) rotation is commanded but the feedback signal from the encoder indicates reverse (forward) rotation for 200ms, then the inverter will trip. The motor rotational direction signal (27: DRN) can be assigned to an intelligent output terminal for use by an external controller or other device.

   Motor rotational direction error can also be triggered by reverse torque bias or the car slipping upward or downward on brake release.

   This function can be disabled by parameter P051.

   Error display (Motor rotational direction)
   OPE-S: E64.X or E74.X
   SRW: OP1-4 or OP2-4

Function Code	Function Name	Setting Range	Remarks
P027	Threshold to detect speed deviation error	0.00-99.99/100.0-120.0(Hz)	
P050	Encoder disorder trip selection (Speed deviation)	–	00: OFF, 01: ON
P051	Encoder disorder trip selection (Motor rotational direction)	–	00: OFF, 01: ON
C021 - C026	Intelligent output terminal 1 - 5	–	22: DSE, 27: DRN

Note: If before the encoder error, another error (e.g. over current) is detected, then the prior error causes the trip event. Therefore the encoder error display may not be shown even if there is an encoder error.

2.9 Frequency Conversion Function

Some users may find it more convenient to monitor and program speed dependent parameters in familiar units of linear speed, such as feet per minute, meters per second, etc. The inverter has the capability of displaying certain key parameters in terms of vertical linear speed units rather than in frequency units (Hz), if so desired. The factory default setting is Hz (frequency).

This function is activated by setting parameter A074 to “01”, and inputting the vertical speed at maximum frequency into parameter A075. This value is often referred to as the “contract speed” of the elevator. The inverter does all the calculations to display the proper units.
Parameters that would be converted include Scaled Output Frequency Monitor (d007), Output Frequency Setting (F001), Multi-speeds 1 – 7 (A020 – A027). Please refer to the parameter tables in Chapter 3 to see a complete listing of parameters that are affected by this function.

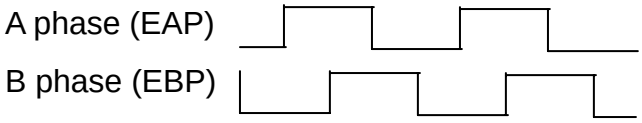
For example, if an elevator system has a contract speed of 250 feet/minute at the motor base frequency of 60 Hz, you would set parameter A075 to “250”, and A075 to “01.” Then all frequency dependent parameters shown in the tables would be in units of feet/minute.

2.10 Encoder Phase Configuration

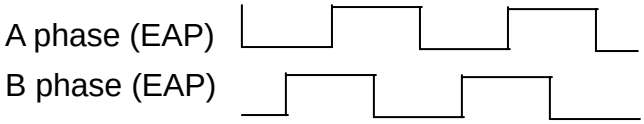
Using this setting, if the encoder is connected with A and B phase reversed, the signal from the encoder can be reversed without actually changing the encoder wiring. This configuration doesn't affect the Z phase.

For proper operation, the inverter expects the encoder signal to be as follows when motor rotates in the forward direction:

P010 = 00: 'A' phase first (Standard encoder, recommended)



P010 = 01: 'B' phase first



Depending on the configuration of the particular encoder installed, the signal phases may be reversed. Instead of rewiring the inverter, simply set parameter P010 as shown below.

Function Code	Function Name	Setting Range	Remarks
P010	Encoder phase configuration	–	00: OFF (A phase first) 01: ON (B Phase first)

2.11 Auto-tuning with Elevator Cable Connected to Motor Shaft

With this function, motor constants can be measured without disconnecting the cable from the motor, and inverter parameters can be auto-tuned. Motor constants R1, R2 and L are automatically measured. During auto-tuning, the inverter outputs DC voltage to excite the motor. This DC excitation does not rotate the motor. Nevertheless, the brake should be always engaged during this process. Then, you will manually adjust parameters of I_0 (no load current) and J (inertia). To obtain correct values for I_0, refer to motor specifications or test report. Otherwise, typical values can be used. You can also measure the appropriate value following the procedure which is described in Chapter 4.

NOTES:

3. Parameter Setting Tables

Function Mode

	Code	Function name	Setting range	Initial data
Base setting	A001	Frequency setting selection	00(VR)/01(terminal)/02(operator)/03(RS485)/04(option1)/05(option2)	02
	A002	Operation setting selection	01(terminal)/02(operator)/03(RS485)/04(option1)/05(option2)	01
	A003	Base frequency	30. - Maximum. frequency(Hz)	60.
	A004	Maximum frequency	30. - 400. (Hz)	60.
Analog input setting	A005	[AT] Selection	00: Select between [O] and [OI] at [AT]/ 01: Select between [O] and [O2] at [AT]	
	A006	[O2] Selection	00: No summing [OI] and [O2]/01: Sum [OI] and [O2], no negative/02: Sum [OI] and [O2] negative allowed	
	*A011	0 start	0.00-99.99/100.0-400.0 (Hz)	0.00
	*A012	0 end	0.00-99.99/100.0-400.0 (Hz)	0.00
	A013	0 start rate	0.-100.0(%)	0.
	A014	0 end rate	0.-100.0(%)	100.
	A015	0 start selection	00 (external starting frequency)/01(0Hz)	01
	A016	O, OI, O2 sampling	1.-30.(times)	8.
Multistage speed setting	A019	Multi-speed selection	00(binary : range is to 16 stage speed with 4 terminals)/ 01(bit : range is to 8 stage speed with 7 terminals)	00
	*A020	Multi-speed 0	0.00, starting frequency-maximum. frequency(Hz)	0.00
	F002	Acceleration time for multi-speed 0 and 7	0.01-99.99/100.0-999.9/1000.-3600.(s)	30.0
	F003	Deceleration time for multi-speed 0 and 7	0.01-99.99/100.0-999.9/1000.-3600.(s)	30.0
	*A021	Multi-speed 1	0.00, starting frequency-maximum. frequency(Hz)	50.00
	A221	Acceleration time for multi-speed 1	0.01-99.99/100.0-999.9/1000.-3600.(s)	5.0
	A321	Deceleration time for multi-speed 1	0.01-99.99/100.0-999.9/1000.-3600.(s)	5.0
	A022	Multi-speed 2	0.00, starting frequency-maximum. frequency(Hz)	40.00
	A222	Acceleration time for multi-speed 2	0.01-99.99/100.0-999.9/1000.-3600.(s)	5.0
	A322	Deceleration time for multi-speed 2	0.01-99.99/100.0-999.9/1000.-3600.(s)	5.0
	*A023	Multi-speed 3	0.00, starting frequency-maximum. frequency(Hz)	20.00
	A223	Acceleration time for multi-speed 3	0.01-99.99/100.0-999.9/1000.-3600.(s)	5.0
	A323	Deceleration time for multi-speed 3	0.01-99.99/100.0-999.9/1000.-3600.(s)	5.0
	*A024	Multi-speed 4	0.00, starting frequency-maximum. frequency(Hz)	10.00
	A224	Acceleration time for multi-speed 4	0.01-99.99/100.0-999.9/1000.-3600.(s)	5.0
	A324	Deceleration time for multi-speed 4	0.01-99.99/100.0-999.9/1000.-3600.(s)	5.0
	*A025	Multi-speed 5	0.00, starting frequency-maximum. frequency(Hz)	10.00
	A225	Acceleration time for multi-speed 5	0.01-99.99/100.0-999.9/1000.-3600.(s)	5.0
	A325	Deceleration time for multi-speed 5	0.01-99.99/100.0-999.9/1000.-3600.(s)	5.0
	*A026	Multi-speed 6	0.00, starting frequency-maximum. frequency(Hz)	10.00
	A226	Acceleration time for multi-speed 6	0.01-99.99/100.0-999.9/1000.-3600.(s)	5.0
	A326	deceleration time for multi-speed 6	0.01-99.99/100.0-999.9/1000.-3600.(s)	5.0
	*A027	Multi-speed7 (creep speed)	0.00, starting frequency-maximum. frequency(Hz)	2.00
	A227	Acceleration time for multi-speed 7	0.01-99.99/100.0-999.9/1000.-3600.(s)	5.0
	A327	deceleration time for multi-speed 7	0.01-99.99/100.0-999.9/1000.-3600.(s)	5.0
V/f characteristic	A042	Manual torque boost	0.0-20.0(%)	1.0
	A043	Manual torque boost point	0.0-50.0(%)	5.0
	A044	1st control	00/(VC)/01(VP1.7power)/02(free V/f setting)/03(SLV)/ 04(0Hz-SLV)/05(V2)	05
	A244	2nd control	00/(VC)/01(VP1.7power)/02(free V/f setting) /03(SLV)/04(0Hz-SLV)	00
	A045	Output voltage gain	20. - 100.	90.
Direct current braking	A051	DC braking selection	00(invalid)/01(valid)	00
	A052	DC braking frequency	0.00-60.00(Hz)	0.50
	A053	DC braking wait time	0.0 - 5.0(s)	0.0
	A054	DC braking power	0. - 100. (%)	0.
	A055	DC braking time	0.0 - 60.0(s)	0.0
	A056	DC braking edge/level selection	00(edge action)/01(level action)	01
	A057	DC braking power (starting time)	0. - 100. (%)	0.
	A058	DC braking time(starting time)	0.00-60.0(s)	0.0
	A059	DC braking carrier frequency	0.5-15(kHz) Derating	5.0
Upper and lower limiter jump frequency	*A061	1st frequency maximum limiter	0.00, 1st frequency lower limiter-maximum frequency(Hz)	0.00
	*A062	1st frequency minimum limiter	0.00, start frequency- 1st frequency maximum limiter (Hz)	0.00
	*A063	Jump frequency1	0.00-99.99/100.0-400.0(Hz)	0.00
	*A064	Jump frequency Width 1	0.00-10.00(Hz)	0.50
	*A065	Jump frequency2	0.00-99.99/100.0-400.0(Hz)	0.00
	*A066	Jump frequency Width 2	0.00-10.00(Hz)	0.50
	*A067	Jump frequency3	0.00-99.99/100.0-400.0(Hz)	0.00
	*A068	Jump frequency Width 3	0.00-10.00(Hz)	0.50
	*A069	Acceleration stop frequency	0.00-99.99/100.0-400.0(Hz)	0.00
	A070	Acceleration stop time	0.00-60.0(s)	0.0
	A071	Selection of Torque Bias Input	00: [O] input/01: [OI] input/02: [O2] input	00
Freq Conv	*A074	Frequency Conversion Enable	00 (OFF) / 01 (ON)	00
	*A075	Linear Speed at Max Freq (A004)	0.1-3000.0	100.0
AVR	A081	AVR selection	00(ON always)/01(OFF always)/02(OFF on decelerating)	00
	A082	Motor voltage selection	200/215/220/230/240, 380/400/415/440/460/480	(200/400)

Function Mode

Code		Function name	Setting range	Initial data	remarks
adjustable function	A092	Acceleration time2	0.01-99.99/100.0-999.9/1000.-3600.(s)	15.00	
	A093	Deceleration time2	0.01-99.99/100.0-999.9/1000.-3600.(s)	15.00	
	A094	2nd stage adjustable selection	00(change with 2CH terminal)/01(change with setting)	00	
	*A095	2nd acceleration frequency	0.00-99.99/100.0-400.0(Hz)	0.00	
	*A096	2nd deceleration frequency	0.00-99.99/100.0-400.0(Hz)	0.00	
	A097	Acceleration pattern selection	00(straight line)/01(S-curve)/02(U-curve)/03(reverse U-curve)/ 04(EL-S curve)	04	
	A098	Deceleration pattern selection	00(straight line)/01(S-curve)/02(U-curve)/03(reverse U-curve)/ 04(EL-S curve)	04	
External frequency adjustment	*A101	OI start frequency	0.00-99.99/100.0-400.0(Hz)	0.00	
	*A102	OI end frequency	0.00-99.99/100.0-400.0(Hz)	0.00	
	A103	OI start current	0.-100. (%)	20.	
	A104	OI end current	0.-100. (%)	100.	
	A105	OI start selection	00(external start frequency)/01(0Hz)	01	
	*A111	O2 start frequency	0.00-99.99/100.0-400.0(Hz)	0.00	
	*A112	O2 end frequency	0.00-99.99/100.0-400.0(Hz)	0.00	
	A113	O2 start voltage	0.-100. (%)	-100%	
	A114	O2 end voltage	0.-100. (%)	100%	
Accel. Decel.	A131	Acceleration curve constant	01(small swelling)-10(large swelling)	01	
	A132	Deceleration curve constant	01(small swelling-10(large swelling)	01	
Instantaneous power failure restart	b001	Retry selection	00(trip)/01(0Hz start)/02(start after equal frequency)/ 03(trip after equaling frequency and deceleration stop)	00	
	b002	Allowable under-voltage power failure time	0.3-1.0(s)	0.3	
	b003	Retry wait time	0.3-100.(s)	1.0	
	b004	Instantaneous power failure/ under-voltage trip during stop	00(invalid/01(valid)/02(invalid during stop and deceleration by stop command)	01	
	b005	Instantaneous power failure/ under-voltage retry time selection	00(16 times)/01(free)	00	
	b006	Open-phase selection	00(invalid)/01(valid)	00	
	*b007	Frequency setting to match	0.00-99.99/100.0-400.0(Hz)	0.00	
Electronic thermal	b012	Electronic thermal level	0.2*constant current-1.20*constant current (A)	Rated Current of inverter	
	b013	1st electronic thermal characteristic selection	00(reduced characteristic)/ 01(constant torque characteristic)/ 02(free setting)	01	
	*b015	Free electronic thermal frequency 1	0.-400.(Hz)	0.	
	b016	Free electronic thermal current 1	0.0-1000.(A)	0.0	
	*b017	Free electronic thermal frequency 2	0.-400.(Hz)	0.	
	b018	Free electronic thermal current 2	0.0-1000. (A)	0.0	
	*b019	Free electronic thermal frequency 3	0.-400.(Hz)	0.	
	b020	Free electronic thermal current 3	0.0-1000.(A)	0.0	
Overload limit	b021	Overload restriction selection	00(invalid)/01(enabled on acceleration / constant speed)/ 02(enabled on constant speed)/03(enabled on acceleration / constant speed (speed increasing at regenerating mode))	01	
	b022	Overload restriction level	0.50* rated current-2.00* rated current(A)	Rated current of Inverter x 1.50	
	b023	Overload restriction limit constant	0.10-30.00(s)	1.00	
	b024	Overload restriction 2 selection	00(invalid)/01(enabled on acceleration / constant speed)/ 02(enabled on constant speed)/03(enabled on acceleration / constant speed (speed increasing at regenerating mode))	01	
	b025	Overload restriction level 2	0.50*rated current-2.00*rated current(A)	Rated current of Inverter x 1.50	
	b026	Overload restriction constant 2	0.10-30.00(s)	1.00	
Lock	b031	Software lock mode selection	00(impossible to change the data except this item when SFT terminal is ON)/01(impossible to change the data except setting frequency item when SFT terminal is ON)/02(impossible to change the data except this item)/ 03(impossible to change the data except setting frequency item)/ 10(possible to change data on operating)	01	

Function mode

	Code	Function name	Setting range	Initial data	remarks
Intelligent input terminal setting	C001	Intelligent input 1 setting	01/(RV:Reverse is valid)/02(CF1:Multi-speed1)/ 03(CF2:Multi-speed2)/ 04(CF3:Multi-speed3)/07(DB:External DC braking)/ 09(2CH:two-stage adjustable speed)/ 11(FRS:Free-run)/ 12(EXT:External trip)/13(USP:Unattended start protection)/ 14(CS:commercial change)/15(SFT:software lock)/ 16(AT:Analog input voltage/current select)/18(RS:Reset inverter)/ 20(STA:3wire run)/ 21(STP:3wire keep)/ 22(F/R:3wire forward/reverse)/ 26(CAS:Control gain switch function)/ 31(OPE:Operating by operator select)/ 32(SF1:Multi-speed bit1)/ 33(SF2:Multi-speed bit2)/ 34(SF3:Multi-speed bit3)/ 35(SF4:Multi-speed bit4)/36(SF5:Multi speed bit5)/ 37(SF6:Multi-speed bit6)/ 38(SF7:Multi-speed bit7)/ 39(OLR:Overload restriction change) / 40(TL:Torque limit select)/ 41(TRQ1:Torque limit switch 1)/42(TRQ2:Torque limit switch 2)/ 43((PPI:P/PI switch)/44(BOK:Braking comformation)/ 45(ORT:Orientation)/ 46(LAC:LAD cancel)/ 47(PCLR:Position error clear)/ 48(STAT: Permission of pulse train)/ 50(SSD:Torque bias hold)/52(ECM:Changeover in case of emergency)/ no (NO: No assign)	18(RS)	
	C002	Intelligent input 2 setting		15(SFT)	
	C003	Intelligent input 3 setting		09(2CH)	
	C004	Intelligent input 4 setting		11(FRS)	
	C005	Intelligent input 5 setting		04(CF3)	
	C006	Intelligent input 6 setting		03(CF2)	
	C007	Intelligent input 7 setting		02(CF1)	
	C008	Intelligent input 8 setting		01(RV)	
Intelligent Input terminal active state setting	C011	Intelligent input 1 a/b (NO/NC) selection	00(NO)/01(NC)	00	
	C012	Intelligent input 2 a/b (NO/NC) selection	00(NO)/01(NC)	00	
	C013	Intelligent input 3 a/b (NO/NC) selection	00(NO)/01(NC)	00	
	C014	Intelligent input 4 a/b (NO/NC) selection	00(NO)/01(NC)	00	
	C015	Intelligent input 5 a/b (NO/NC) selection	00(NO)/01(NC)	00	
	C016	Intelligent input 6 a/b (NO/NC) selection	00(NO)/01(NC)	00	
	C017	Intelligent input 7a/b (NO/NC) selection	00(NO)/01(NC)	00	
	C018	Intelligent input 8 a/b (NO/NC) selection	00(NO)/01(NC)	00	
	C019	Input FW a/b (NO/NC) Selection	00(NO)/01(NC)	00	
Intelligent output terminal setting	C021	Intelligent output 11 setting	00(RUN: running) / 01(FA1:Frequency arrival type1 signal) / 02(FA2:over setting frequency) / 03(OL: Overload advance notice signal)/ 05(AL: Alarm signal)/06(FA3:Only setting frequency) / 07(OTQ: Over-torque signal) / 08(IP: On instantaneous stop) / 09(UV: Under voltage) / 10(TRQ: Torque limit)/ 11(RNT: RUN time over) / 12(ONT:ON time over) / 13(THM: thermal caution) / 19(BRK: Brake release signal) / 20(BER: Brake error signal) / 21(ZS: Zero speed detect signal)/22(DSE: Speed error over signal) / 23(POK: Positioning completion signal)/24(FA4:Over frequency 2 signal)/ 25(FA5: Only setting frequency) / 26(OL2: Overload advance notice signal (2) (Intelligent output terminal 11-13 or 11-14 becomes AC0-AC2 or AC0-AC3 (Can: Alarm code output) forcibly when alarm code output is selected in C062)	01(FA1)	
	C022	Intelligent output 12 setting		00(RUN)	
	C023	Intelligent output 13 setting		03(OL)	
	C024	Intelligent output 14 setting		19(BRK)	
	C025	Intelligent output 15 setting		21(ZS)	
	C026	Alarm relay output		05(AL)	
Analog Outputs	C027	FM selection	00(Output frequency)/01(Output current) /02(Output torque)/ 03(Digital output frequency)/04(Output voltage)/ 05(Input electric power)/06(thermal load rate)/07(LAD frequency)	00	
	C028	AM selection	00(Output frequency)/01(Output current)/02(Output torque)/ 04(Output voltage)/05(Input electric power)/06(thermal load rate)/ 07(LAD frequency)	00	
	C029	AMI selection	00(Output frequency)/01(Output current)/02(Output torque)/ 04(Output voltage)/05(Input electric power)/ 06(Thermal load rate)/07(LAD frequency)	00	
Output terminal state setting Output level setting	C031	Intelligent output 11 a/b	00(NO)/01(NC)	00	
	C032	Intelligent output 12 a/b	00(NO)/01(NC)	00	
	C033	Intelligent output 13 a/b	00(NO)/01(NC)	00	
	C034	Intelligent output 14 a/b	00(NO)/01(NC)	00	
	C035	Intelligent output 15 a/b	00(NO)/01(NC)	00	
	C036	Alarm relay output a/b	00(NO)/01(NC)	01	

Function mode

Code		Function name	Setting range	Initial data	remarks
Output terminal state setting • Output level setting	C040	Overload advance notice signal output mode	00(On accel. And decel, constant speed)/01(Only constant speed)	01	
	C041	Overload advance notice level	0.0-2.0*rated current(A)	Inverter rated current	
	*C042	Frequency arrival setting for acceleration.	0.00-99.99/100.0-400.0(Hz)	0.00	
	*C043	Arrival frequency setting for deceleration.	0.00-99.99/100.0-400.0(Hz)	0.00	
	*C045	Frequency arrival setting for acceleration 2.	0.00-99.99/100.0-400.0(Hz)	0.00	
	*C046	Arrival frequency setting for deceleration 2.	0.00-99.99/100.0-400.0(Hz)	0.00	
	C055	Over torque level setting (Forward-driving)	0.-200.(%)	100.	
	C056	Over torque level setting (Reverse-regenerating)	0.-200.(%)	100.	
	C057	Over torque level setting (Reverse-driving)	0.-200.(%)	100.	
	C058	Over torque level setting (Forward-regenerating)	0.-200.(%)	100.	
	C061	Thermal warning level setting	0.-100.(%)	80.	
	C062	Alarm code selection	00(Invalid)/01(3bit)/02(4bit)	00	
	*C063	Zero speed detection level setting	0.00-99.99/100.(Hz)	0.00	
Communication function adiustment	C070	Data command	02(operator)/03(RS485)/04(option1)/05(option2)	02	
	C071	Communicating transmission speed	02(loop-back test) 03(2400bps)/04(4800bps)/05(9600bps)/06(19200bps)	04	
	C072	Communication code	1. -32.	1.	
	C073	Communication bit	7(7bit)/8(8bit)	7	
	C074	Communication parity	00(no parity name)/01(even parity)/02(odd parity)	00	
	C075	Communication stop bit	1(bit)/2(bit)	1	
	C078	Communication waiting time	0.-1000.(ms)	0.	
Analog meter setting	C081	O adjustment	0.-9999./1000-6553(10000-65530)	Setting on forwarding	
	C082	OI adjustment	0.-9999./1000-6553(10000-65530)	Setting on forwarding	
	C083	O2 adjustment	0.-9999./1000-6553(10000-65530)	Setting on forwarding	
	C085	Thermistor adjustment	0.0 - 1000.	105.0	
	C086	AM offset adjustment	0.0 - 10.0(V)	0.0	
	C087	AMI adjustment	0. - 255.	80	
	C088	AMI offset adjustment	0. - 20.0(mA)	Setting on forwarding	
Miscellaneous	b034	RUN time/Power ON time level	0.-9999./1000-6553(10000-65530)hr	0.	
	b036	Start reduced voltage	00(Start reduced voltage time small)-06(Start reduced voltage time large)	06	
	b037	Display selection	00(all display)/01(each function display)/02(User setting / main setting)	00	
	b040	Torque limit mode selection	00(4 quadrant mode)/01(Terminal operation)/ 02(Analog input)/03(Option1)/04(Option2)	00	
	b041	Torque limit level 1 setting (Forward-driving at 4 quadrant mode)	0.-200.(%)/no(Invalid)	150.	
	b042	Torque limit level 2 setting (Reverse-regenerating at 4 quadrant mode)	0.-200.(%)/no(Invalid)	150.	
	b043	Torque limit level 3 setting (Reverse-driving at 4 quadrant mode)	0.-200.(%)/no(Invalid)	150.	
	b044	Torque limit level 4 setting (Forward-regenerating at 4 quadrant mode)	0.-200.(%)/no(Invalid)	150.	
	b045	Torque LAD-STOP selection	00(Invalid)/01(Valid)	00	
	b046	Reverse run prevention selection	00(Invalid)/01(Valid)	00	
	b080	AM adjustment	0. - 255.	180	
	b081	FM adjustment	0. - 255.	60	
	*b082	Start frequency adjustment	0.10-9.99(Hz)	0.10	
	b083	Carrier frequency setting	0.5-15.0(kHz) Derating enable, <0.5-10kHz>	5.0	
	b084	Initialize mode	00(Trip history clear)/01(Data initialization)/ 02(Trip history clear + data initialization)	00	
	b086	Frequency scalar conversion factor	0.1-99.9	1.0	
	b087	STOP key enable	00(valid)/01(invalid)	00	

Function mode

Code		Function name	Setting range	Initial data	remarks
Miscellaneous	b088	Resume on FRS cancellation mode	00(0Hz start)/01(Start f-equaling)	00	
	b090	BRD usage ratio	0.0-100.0(%)	0.0	
	b091	Stop mode selection	00(deceleration stop)/01(Free-run stop)	00	
	b092	Cooling fan control	00(Always ON)/ 01(ON during run, After power ON, then for 5 minutes on stop is implied.)	01	
	b095	BRD selection	00(invalid)/01(valid<invalid during stop>)/02(valid<valid during stop>)	00	
	b096	BRD ON level	330-380/660-760(V)	360/720	
	b098	Thermistor selection	00(invalid)/01(Positive temperature coefficient enable)/02 (NTC enable)	00	
	b099	Thermistor error level	0. – 9999. (ohm)	3000.	
	b120	Braking control selection	00(Invalid)/01(valid)	01	
	b121	Waiting time for releasing braking conformation	0.00-5.00(s)	0.10	
	b122	Waiting time for acceleration	0.00-5.00(s)	0.40	
	b123	Waiting time for stop	0.00-5.00(s)	0.40	
	b124	Waiting time for signal conformation	0.00-5.00(s)	0.00	
	*b125	Releasing frequency	0.00-99.99/100.0-400.0(Hz)	0.00	
	b126	Releasing current	0.00*rated current-2.00*rated current(A)	0.10* rated current of inverter	
	*b127	Brake OFF frequency	0.00-400.00Hz	0.00	
	b128	Delay time at brake signal is turned OFF	0.00-5.00s	0.50	
	C091	Debug mode selection	00(No display)/01(Display)	00	
	C102	Reset selection	00(Trip cancel during ON)/01(Trip cancel during OFF)/ 02(Valid only during trip<Cancel during ON>)	00	
	C111	Overload advance notice level	0.0-2.0*rated current(A)	Inverter rated current	
	C121	O zero adjustment	0.-9999./1000-6553(10000-65530)	Set on forwarding	
	C122	OI zero adjustment	0.-9999./1000-6553(10000-65530)	Set on forwarding	
	C123	O2 zero adjustment	0.-9999./1000-6553(10000-65530)	Set on forwarding	
Motor Constants	H001	Autotuning selection	00(Invalid)/01(Valid(the motor does not rotate))/ 02(Valid(the motor rotates))	00	
	H002	1st motor constant selection	00(Hitachi general purpose motor data)/01(Autotuning data)/ 02(Autotuning data with online autotuning)	00	
	H003	1st allowable motor selection	0.20-75.0(kW) <0.2-160kW>	Set on forwarding	
	H004	1st motor pole selection	2/4/6/8(pole)	4	
	H005	1st speed response setting	0.001-9.999/10.00-65.53	4.00	
	H006	1st stabilized factor	0. - 255.	100.	
	H020	1st motor constant R1	0.000-9.999/10.00-65.53(ohm)	Set on forwarding	
	H021	1st motor constant R2	0.000-9.999/10.00-65.53(ohm)	Set on forwarding	
	H022	1st motor constant L	0.00-99.99/100.0-655.3(mH)	Set on forwarding	
	H023	1st motor constant I0	0.00-99.99/100.0-655.3(A)	Set on forwarding	
	H024	1st motor constant J	0.001-9.999/10.00-99.99/100.0-9999.(kgm^2)	Set on forwarding	
	H030	1st motor constant R1 (Autotuning data)	0.000-9.999/10.00-65.53(ohm)	Set on forwarding	
	H031	1st motor constant R2 (Autotuning data)	0.000-9.999/10.00-65.53(ohm)	Set on forwarding	
	H032	1st motor constant L (Autotuning data)	0.00-99.99/100.0-655.3(mH)	Set on forwarding	
	H033	1st motor constant I0 (Autotuning data)	0.00-99.99/100.0-655.3(A)	Set on forwarding	
	H034	1st motor constant J	0.001-9.999/10.00-99.99/100.0-9999.(kgm^2)	Set on forwarding	
	H050	1st PI-control proportion gain setting	0.00-99.99/100.0-999.9/1000.(%)	100.0	
	H051	1st PI-control integration gain setting	0.00-99.99/100.0-999.9/1000.(%)	100.0	
	H052	1st P-control proportion gain setting	0.01-10.00	1.00	
	H060	1st 0Hz-SLV limiter setting	0.-100.(%)	100.	
	H070	PI-control proportion gain for switching	0.00-99.99/100.0-999.9/1000.(%)	100.0	
	H071	PI-control integration gain for switching	0.00-99.99/100.0-999.9/1000.(%)	100.0	
	H072	P-control proportion gain for switching	0.00-10.00	1.00	

Function mode

Code		Function name	Setting range	Initial data	remarks
Option	P001	Option1 operation selection on error	00(TRP)/01(RUN)	00	
	P002	Option2 operation selection on error	00(TRP)/01(RUN)	00	
	P010	Feed-back option selection	00(Invalid)/01(Valid)	00	
	P011	Encoder pulse number setting	128.-9999./1000-6500(10000-65000) (pulse)	1024	
	P012	Control mode selection	00(ASR mode)/01(APR mode)	00	
	P013	Pulse train input mode selection	00(Mode 0)/01(Mode 1)/02(Mode 2)/03(Mode 3)	00	
	P014	Orientation stop position setting	0.-4095.	0.	
	*P015	Orientation speed setting	0.00-99.99/100.0-120.0(Hz)	5.00	
	P016	Orientation direction selection	00(Forward)/01(Reverse)	00	
	P017	Orientation completion range setting	0.-9999./1000(10000) (pulse)	5	
	P018	Orientation completion delay time setting	0.00-9.99(s)	0.00	
	P019	Electronic gear position selection	00(Feedback)/01(Reference)	00	
	P020	Electronic gear numerator of ratio setting	0.-9999.	1.	
	P021	Electronic gear denominator of ratio setting	0.-9999.	1.	
	P022	Position control feed-forward gain setting	0.00-99.99/100.0-655.3	0.00	
	P023	Position control loop gain setting	0.00-99.99/100.0	0.50	
	P025	Compensation of secondary resistor selection	00(Invalid)/01(Valid)	00	
	P026	Over-speed detect level setting	0.00-99.99/100.0-150.0(%)	135.0	
	*P027	Speed-error over detect level setting	0.00-99.99/100.0-120.0(Hz)	7.50	
	P031	Digital input option input mode selection (Acc/Dec)	00(operator)/01(option1)/02(option2)	00	
	P032	Stop position setting for orientation input mode selection	00(operator)/01(option1)/02(option2)	00	
	P050	Encoder Fault Trip Selection – Speed Deviation	00(OFF)/01(ON)	00	
	P051	Encoder Fault Trip Selection – Reverse Rotation Direction	00(OFF)/01(ON)	00	
	P060	Curve ratio1 during acceleration	0.-50.(%)	30.	
	P061	Curve ratio2 during acceleration	0.-50.(%)	30.	
	P062	Curve ratio1 during deceleration	0.-50.(%)	30.	
	P063	Curve ratio2 during deceleration	0.-50.(%)	30.	
	P069	Gain adjustment permission	00(off)/01(on)	01	
	*P070	Frequency 1 for P-gain adjustment	0.-max.frequency	0.3	
	*P071	Frequency 2 for P-gain adjustment	0. or P070-max.frequency	0.7	
	*P072	Frequency 3 for P-gain adjustment	0. or P071-max.frequency	1.0	
	*P073	Frequency 4 for P-gain adjustment	0. or P072-max.frequency	2.0	
	*P074	Frequency 5 for P-gain adjustment	0. or P073-max.frequency	50.0	
	*P075	Frequency 6 for P-gain adjustment	0. or P074-max.frequency	50.0	
	*P076	Frequency 7 for P-gain adjustment	0. or P075-max.frequency	50.0	
	*P077	Frequency 8 for P-gain adjustment	0. or P076-max.frequency	50.0	
	P080	P-gain 1	0.-100.(%)	80.	
	P081	P-gain 2	0.-100.(%)	70.	
	P082	P-gain 3	0.-100.(%)	60.	
	P083	P-gain 4	0.-100.(%)	50.	
	P084	P-gain 5	0.-100.(%)	50.	
	P085	P-gain 6	0.-100.(%)	50.	
	P086	P-gain 7	0.-100.(%)	50.	
	P087	P-gain 8	0.-100.(%)	50.	

Option	*P090	Frequency 1 for I-gain adjustment	0.-max.frequency	0.3	
	*P091	Frequency 2 for I-gain adjustment	0. or P090-max.frequency	0.7	
	*P092	Frequency 3 for I-gain adjustment	0. or P091-max.frequency	1.0	
	*P093	Frequency 4 for I-gain adjustment	0. or P092-max.frequency	2.0	
	*P094	Frequency 5 for I-gain adjustment	0. or P093-max.frequency	50.0	
	*P095	Frequency 6 for I-gain adjustment	0. or P094-max.frequency	50.0	
	*P096	Frequency 7 for I-gain adjustment	0. or P095-max.frequency	50.0	
	*P097	Frequency 8 for I-gain adjustment	0. or P096-max.frequency	50.0	
	P100	I-gain 1	0.-100.(%)	80.	
	P101	I-gain 2	0.-100.(%)	70.	
	P102	I-gain 3	0.-100.(%)	60.	
	P103	I-gain 4	0.-100.(%)	50.	
	P104	I-gain 5	0.-100.(%)	50.	
	P105	I-gain 6	0.-100.(%)	50.	
	P106	I-gain 7	0.-100.(%)	50.	
	P107	I-gain 8	0.-100.(%)	50.	
	P110	FW side balance value	0.0-10.0(v)	0.0	
	P111	RV side balance value	0.0-10.0(v)	0.0	
	P112	FW side gain	0.0-200.0(%)	0.0	
	P113	RV side gain	0.0-200.0(%)	0.0	
	P114	Time constant of the filter	5.-500.(ms)	5.	

*X00x Note: Parameters indicated with an asterisk and yellow highlight are affected by setting of the frequency conversion function (parameter A074). See the function description in Chapter 2. In addition to the parameters listed above, the following parameters will also be scaled if this function is enabled:

D007 – Scaled Output Frequency Monitor
F001 – Output Frequency Setting

NOTES:

4. Adjustment

4.1 Frequency Source Setting

Select frequency source for operation. There are two typical command sources for elevator applications:

1. Speed Reference by multi-speed
2. Speed Reference by analog voltage or current input

Consider their features to select the command sources best suited to your application.

1. **Multi-speed**
   The multi-speed feature allows you to preset various speeds (up to eight) by programming the desired speed values to parameters A020 to A027. For example, you could preset high, mid, low, leveling, creep, and maintenance speeds. Then the desired speed can be selected using the intelligent input terminals. The multi-speed selection can be configured as binary or bits via parameter A019. (Refer to SJ300 Instruction Manual)

   In this case, softer acceleration and deceleration can be obtained by setting A097 and A098 parameters to S curve (03) or EL-S curve (04). Frequency source setting (A001) should be set to 02 (operator).

2. **Analog Voltage or Current Input**
   Speed can be controlled by analog voltage [O](0 to 10V) or analog current [OI](4 to 20mA). This method of frequency reference source might be used in order to utilize the acceleration or deceleration curves generated by a specialized elevator controller. Consequently, acceleration and deceleration time should be set close to the filter constant, and below 1/20 to 1/50 of acceleration/deceleration time generated by external the elevator controller.

   The analog input is filtered as the average of 8 values (default setting of parameter A016), with a sample rate of every 2ms. In the case of near minimum acceleration time (0.01s), the inverter response may be slower due to the setting of the analog input filter.

   In this case, acceleration curve (A097 and A098) should be set to linear (00). The frequency source setting (A001) should be set to terminal (01). An intelligent input terminal must be configured for the [AT] function (16), and should be turned on or off (via jumper or programming) to select the [0] or [0I] terminal, as appropriate.

4.2 Setting and Adjustment of Motor Constants

When using vector control, the motor parameters shown below must be entered into the inverter to obtain optimal performance. This is normally done via the auto-tuning procedure described in Appendix A, whereby the key parameters are measured automatically. This procedure must be performed before initial operation of the elevator. For elevator applications the specific auto-tune procedure used depends on whether or not the cable can be disconnected from the motor. Once auto-tuning is completed, certain of the parameters must be manually fine tuned to obtain the smoothest possible ride characteristics. The procedure in Appendix A is the preferred method to use.

Manual Procedure for Setting Motor Constants

If for any reason, auto-tuning cannot be used, then the following manual procedure can be used to achieve suitable performance.

1. Motor Base Frequency (A003) and motor maximum frequency(A004)
   Set the Motor base frequency and maximum frequency setting.

2. Motor AVR Voltage and Output Voltage Gain.
   Set the motor AVR voltage and gain setting to match the motor nameplate data. Some inverter duty motors may have special voltage ratings. Set the parameters as follows:
   Motor AVR votage (A082) x Output voltage gain (A045) = Motor rated voltage

Caution: Setting the incorrect voltage may result in motor overheating.

3. Motor Capacity（H003）
   Select appropriate kilowatt capacity for the connected motor.

4. Motor Poles (H004)
   Select the motor poles. For the default motor setup, items 5 to 9 below are automatically configured depending on the settings of items 3 and 4 above.

5. Motor Constant R1 (H020 or H030)
   Input the primary resistance per phase based on a Y-connection. Motor constants for a delta connection should be converted dividing by $\sqrt{3}$.

6. Motor Constant R2 (H021 or H031)
   Input the secondary resistance per phase based on a Y-connection. Motor constants for a delta connection should be converted dividing by $\sqrt{3}$.

7. Motor constant L (H022 or H032)

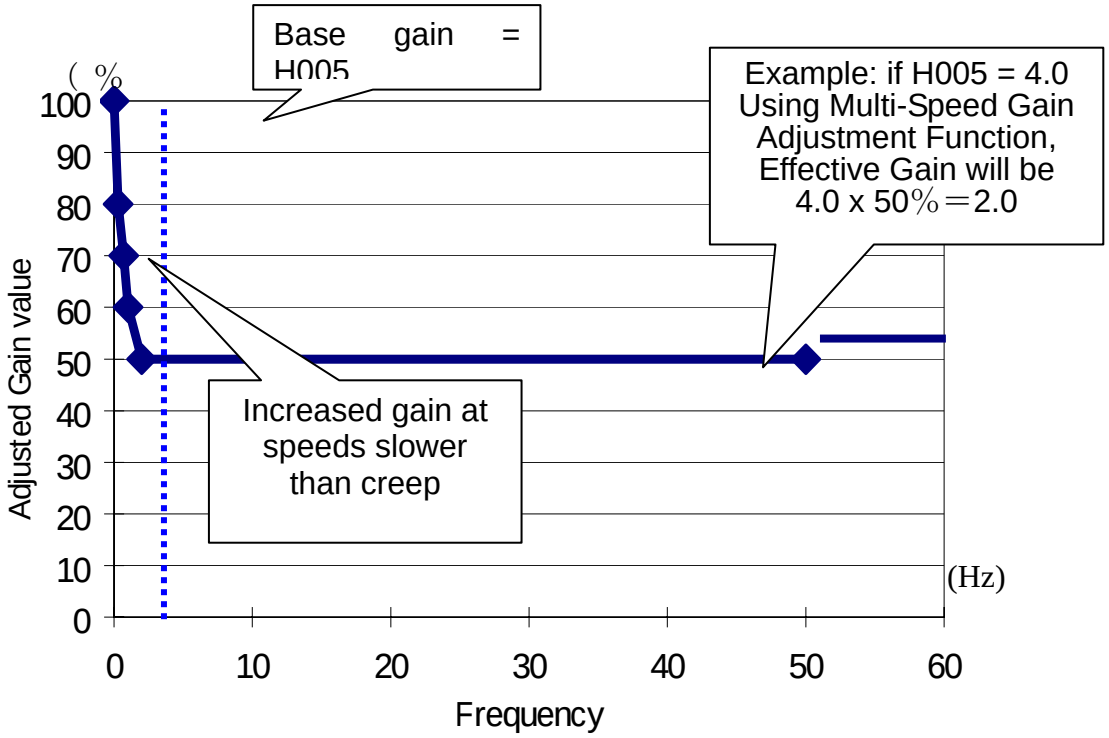
Input the inductance phase based on a Y-connection. Motor constants for a delta connection should be converted being divided by $\sqrt{3}$.

8. Motor no-load (excitation) current I_0 (H023 or H033)
   Input excitation or no-load current. This can be obtained from motor specification sheets provided by the manufacturer. If safe and feasible, it can also be measured using a current clamp by running the motor with no load at base speed.

9. Motor inertia J (H024 or H034)
   In the beginning, input approximately 6 times the inertia value of motor itself. For further adjustment, refer to Section 4.4.

4.3 Adjustment of Speed Response

Optimization of speed response is achieved by adjusting the response to the torque change when the brake is released. For a typical elevator application, the Motor Speed Proportional Gain Constant (H005) setting should be in the range of 2.0 to 10.0. If the elevator is slipping at brake release, increase the value of this parameter. However, settings higher than 2.0 may result in instability such as hunting or vibration of cables or gears. To avert this, utilize the multi-speed gain function described in Chapter 2, Section 2.3. This function allows higher gain at the time of brake release and at stopping, while decreasing the gain at higher speeds. In general, gain should be set higher for frequencies slower than creep. Gain for speeds higher than creep should be set lower, in the range of 1.0 to 2.0. Abrupt changes of gain may cause shock to the system. It is preferable to obtain smoother characteristic utilizing the multispeed gain function.



Note: If you increase the speed response with H005, multi-speed gain adjustment should be utilized to decrease the value to the range 1.0 to 2.0 for higher speeds.

4.4 Adjustment of Inertia

Inertia J (H024 and H034) should be adjusted to avoid overshoots or undershoots as shown in Figure 2.1. These undershoots or overshoots decrease with an increased value of inertia J. Increase the value of inertia J gradually to eliminate overshoot and undershoot. The figures below show the frequency of inverter output obtained from the analog voltage (AM terminal). The output of this frequency monitor signal is identical to actual rotation speed in vector mode with feedback.

Figure 2.1 Characteristic before inertia

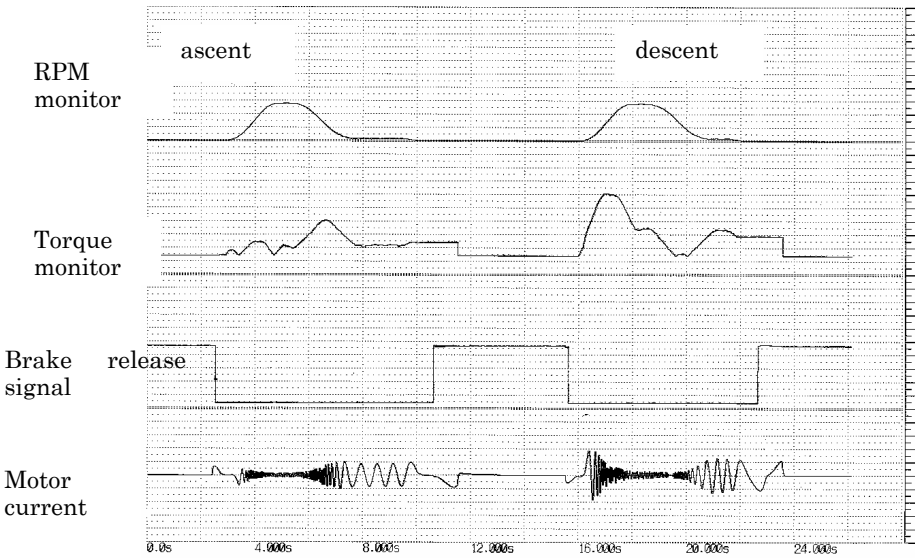


Figure 2.2 Characteristics after inertia adjustment

4.5 Adjustment of Ride Quality, Brake Timing and Acceleration Time

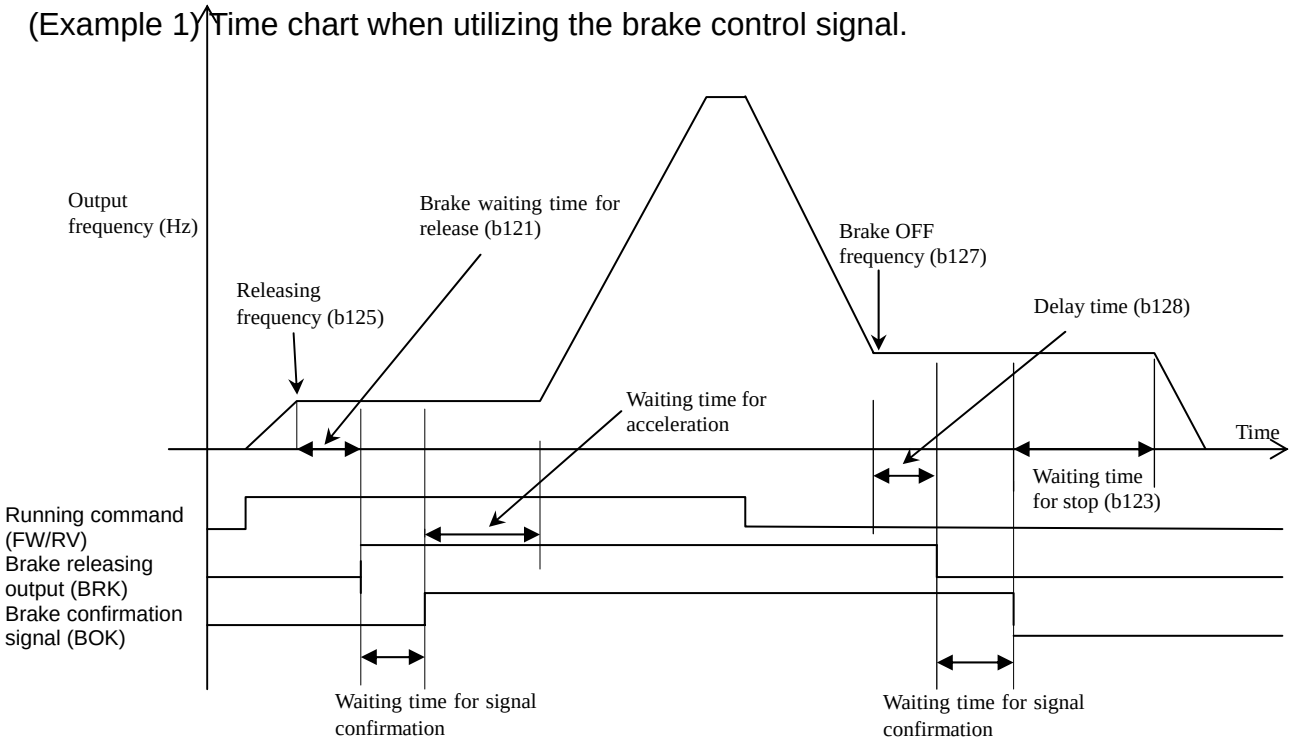
You can check the ride quality by observing the torque monitor signal. A torque curve with a trapezoidal shape is ideal, as shown in Figure 2.2. Then further fine-tuning should be done by actually riding the elevator. Points to be concerned with are:

1. Does shock occur when the brake is released? At that moment, how does motor axis rotate? Check that the timing of a brake is accurate. Does torque respond quickly enough?
2. Is the ride comfortable during at acceleration and deceleration? Tune the rates and amount of deviation for acceleration and deceleration.
3. Does shock occur when the brake closes? At that moment, how does motor axis rotate? Check that the timing of the brake engagement is accurate. Is the deceleration time from creep speed too short?

For using the brake control signal, refer to Chapter 2, Section 2.7.

Relative to brake control, two typical conditions are shown below.

(Example 1) Time chart when utilizing the brake control signal.



- The brake release signal (BRK) becomes active when both the brake release frequency (b125) and the brake release current (b126) conditions are satisfied.
- When above condition is satisfied, it is assumed to take the brake waiting time for release (b121) for inverter and motor to be energized.
- brake wait time for acclerelation (b122) is:

  (a) When not using the brake confirmation signal (BOK), this is the time lag from output of brake release siganal to actual release of the brake.

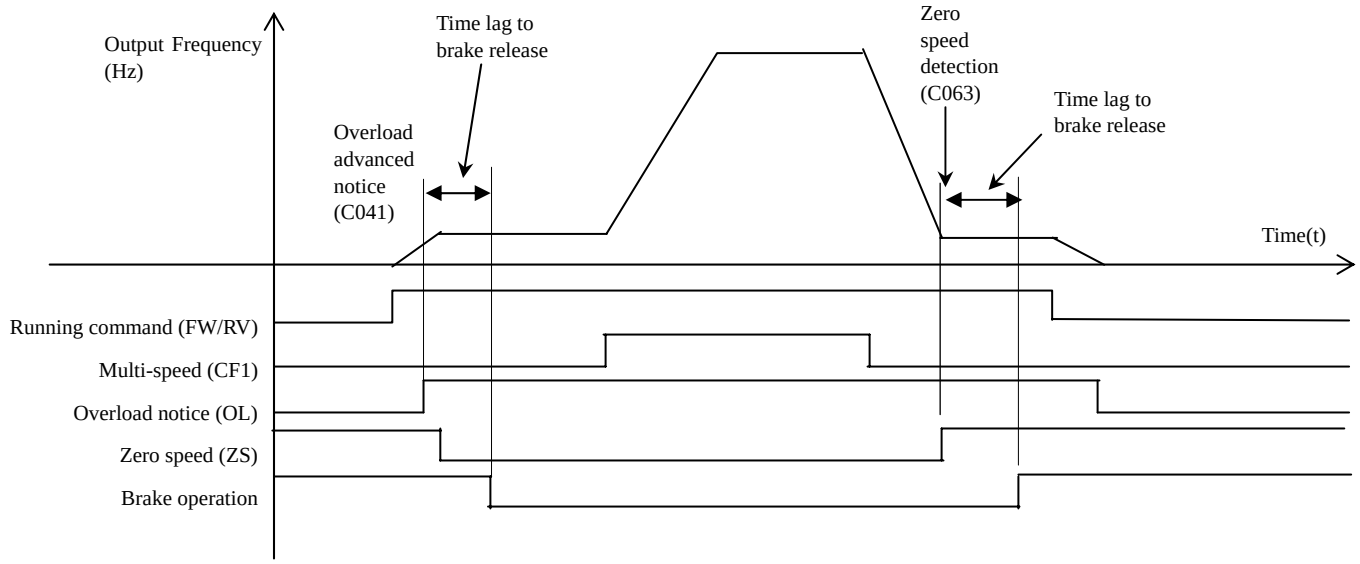
  (b) When using brake confirmation signal (BOK), this is the time lag from receiving BOK until brake has actually released. Therefore, under the case of (a) , it is required that the brake wait time for acclerelation(b122) should be longer than the time in which actually brake has been released. Under the case of (b), since the brake has been already released, brake wait time for

acclerelation(b122) can be 0s.

- The motor must be energized before release of the brake. The sum of brake wait time for release (b121) and brake wait time for acceleration (b122) should be the time for motor to be energized.
- Motor response is stabilized within delay time (b128) after frequency of brake off (b127).
- Brake wait time for stop (b123) provides a time lag for the brake to actually close. This value should be set longer than the actual time it takes for brake to close. Consequently, for the case (b) using brake confirmation signal (BOK), this value can be set to 0s.
- The lower the motor rotational speed is, the less shock occurs when brake is released or closed. In order to make speed as slow as possibe, carefully observe the motor shaft and tune the following parameters: Operation frequency, brake release frequency (b125), brake wait time for release (b121), brake OFF frequency (b127), waiting time for stop (b123) and speed gains.

Brake should be released using the overload advance warning signal [OL], which is detected internally by monitoring motor current. Time lag to brake release is adjusted with external logic. For the brake off signal, either use Zero speed detection or a time lag from the stop command.

Every brake has a time lag to release or close. Therefore this time lag must be taken into account using the parameters of the inverter and external logic. If this can not be accomplished, the best ride quality may not be achieved.



NOTES:

Appendix A – Auto-tuning Procedure

SJ300EL Elevator Inverter Auto-tuning Procedure

It is necessary to perform the SJ300EL motor auto-tuning procedure to ensure optimal performance of the inverter when operating in the sensorless vector (SLV) or vector control with feedback modes. The procedure determines and records the electrical characteristics of the attached motor. The procedure is similar to that of the general purpose SJ300 inverter. We recommend you familiarize yourself with the general procedure in Chapter 4 of the SJ300 manual before proceeding with auto-tuning.

There are two general ways that auto-tuning can be carried out in elevator applications. Whether or not the elevator cables can be removed from the motor pulley will determine which method should be used.

AUTO-TUNING WITH ELEVATOR CABLE DISCONNECTED

If the cable can be disconnected from the motor, the online auto-tuning can be performed in the same manner as the standard SJ300 inverter, allowing the motor shaft to rotate (**H001 = 02**). This is also referred to as DYNAMIC auto-tuning. See page A-3.

AUTO-TUNING WITH ELEVATOR CABLE CONNECTED TO MOTOR SHAFT

If the cable CANNOT be disconnected, perform auto tuning by the following procedure instead. The motor shaft will NOT rotate in this case.

1. Place the necessary weight in the elevator car so the counter weight and car are balanced.

2. Perform STATIC auto tuning according to the normal SJ300 procedure, but with **H001 = 01** (no motor rotation). See page 43.

3. After confirmation of normal termination, set **H002 = 01** to command the inverter to use the auto-tuned motor values.

4. The next steps will fine-tune I_0 (motor no load current) parameter (**H033**) while running the actual system. First, enter an estimated I_0 value for the motor depending on type as :

   4-pole motor – motor nameplate current **x** 0.35
   6-pole motor – motor nameplate current **x** 0.45

5. Operate the car at a low speed (less than 50% of contract speed)

6. Observe the SJ300EL torque monitor by setting keypad display to monitor parameter **D012**. Display is in percent of full load torque. Adjust the counterweight so that the torque monitor reads less than 15% of rated torque.

7. Adjust **H033** (I_0) until the torque monitor reading (parameter **D012**) is less than 5% of rated torque.

8. Make sure it is safe to run the car at contract (maximum design) speed.

9. Run the car at contract speed fully loaded and at minimum load, in both directions. Be sure the torque and current never exceed 150% of the drive full load ratings. Confirm this by monitoring parameters **D002** for current in amperes, and **D012** for torque in percent of full load torque.

10. Check for any unstable or irregular elevator motion. Manually adjust the motor parameters if necessary. See page 47.

Auto-tuning of Motor Constants

The SJ300 inverter features auto-tuning, which detects and records the motor characteristic parameters to use in all vector control modes. Auto-tuning determines the resistance and inductance of motor windings. Therefore, the motor must be connected to the inverter for this procedure. Note that the auto-tuning feature is not associated with PID loop operation, which is common on some control devices. The auto-tuning procedure must be conducted while the inverter is stopped (not in Run mode), so it can use special output pulses to detect motor characteristics. When using the inverter in sensorless vector control, sensorless vector control - 0Hz domain, or vector control with encoder feedback, the motor circuit constants are important. If they are unknown, then you must first conduct the auto-tuning procedure. The inverter will determine the constants and write new values for the related “H” Group settings. The auto-tuning procedure requires that the inverter be configured to operate the 1st motor (do not set the inverter to use 2nd and 3rd motor data during an auto-tuning procedure).

Function Code	Name	Range	Notes
H001	Auto-tuning Enable Setting	00	Disabled
		01	Enabled, **without** motor rotation (STATIC)
		02	Enabled, **with** motor rotation (DYNAMIC)
H002	Motor data selection, 1st motor	00	Inverter uses default TYPICAL motor parameters
		01	Inverter uses Auto-tuning motor parameters
		02	Adaptive tuning parameters
H003	Motor capacity, 1st motor	0.2 – 75, 0.2 – 160	Units: kW
H004	Motor poles setting	2 / 4 / 6 / 8	Units: poles
H030	Auto-tuned motor constant R1	Set automatically	Units: ohms
H031	Auto-tuned motor constant R2	Set automatically	Units: ohms
H032	Auto-tuned motor constant L	Set automatically	Units: mH
H033	Auto-tuned motor constant Io	Set automatically	Units: A
H034	Auto-tuned motor constant J	Set automatically	Units: kgm^2
A003	Base frequency setting	30 to maximum freq.	Units: Hz
A051	DC braking enable	00	Disabled (Disable during auto-tuning)
		01	Enabled
A082	AVR voltage select	200/215/220/230/240	Valid setting choices for 200V class inverters
		380/400/415/440/ 460/480	Valid setting choices for 400V class inverters

WARNING: You may need to disconnect the load from the motor before performing the DYNAMIC autotuning procedure. The inverter runs the motor forward and backward for several seconds without regard to load movement limits.

Preparation for the Auto-tuning Procedure

Be sure to check the following items and verify the related inverter configuration before going further in this procedure.

1. Adjust the motor base frequency (**A003**) and the motor voltage selection (**A082**) to match the specifications of the motor used in the auto-tuning procedure.

2. Verify that the motor is not more than one frame size smaller than the rated size for the inverter. Otherwise, the motor characteristic measurements may be inaccurate.

3. Be sure that no outside force will drive the motor during auto-tuning (balance car and counterweight if cable is attached).

4. If DC braking is enabled (**A051 = 01**), the motor constants will not be accurately set. Therefore, disable DC braking (**A051 = 00**) before starting the auto-tuning procedure.

5. When auto-tuning WITH motor rotation (**DYNAMIC, H002 = 02**), be certain to consider and verify the following points:

    a. The motor will rotate at up to 80% of the base frequency (speed); so make sure that this will not cause any mechanical or safety problems.
    b. Do not attempt to either run or stop the motor during the auto-tuning procedure unless it is an emergency. If this occurs, re-initialize the inverter's parameters to the factory default settings (see "Restoring Factory Default Settings" on page 6–9 of the inverter instruction manual). Then reprogram the parameters unique to your application, and initiate the auto-tuning procedure again.
    c. Release any mechanical brake that would interfere with the motor rotating freely (not necessary if using STATIC auto-tuning).
    d. Disconnect any mechanical load from the motor if performing DYNAMIC auto-tuning. The torque during dynamic auto-tuning may not be enough to move some loads.

6. Note that even when you select **H001 = 01** for no rotation, sometimes slight motor rotation will occur.

7. When using a motor that is one frame size smaller than the inverter rating, enable the overload restriction function. Multiply the nameplate current of the motor by 1.5, and then set the overload restriction level (**B022**) to this value. This parameter is scaled in amperes.

8. **Make sure A001 = 02, A097 = 00, and A098 = 00. Otherwise auto-tuning will fail with a CPU error (E11).**

Performing the Auto-tuning Procedure

After the preparations above are complete, perform the auto-tuning procedure by following the steps:

1. Set **H001 = 01** (auto-tuning ***without*** motor rotation, or STATIC), or **H001 = 02** (auto-tuning ***with*** motor rotation, or DYNAMIC).

2. Turn the RUN command ON. The inverter will then automatically sequence through the following actions:

   a. First AC excitation (motor does not rotate)
   b. Second AC excitation (motor does not rotate)
   c. First DC excitation (motor does not rotate)

Note: For STATIC auto-tuning (H001 = 01), the next two steps ('d' and 'e') are skipped.

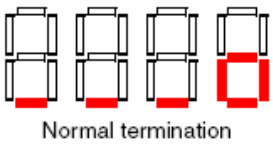
   d. V/F running - this step occurs ONLY if H001 = 02 (motor accelerates up to 80% of base frequency)
   e. SLV running - this step occurs ONLY if H001 = 02 (motor accelerates up to x% of the base frequency), where "x" varies with time T during this step:

   x = 40% when T < 50s

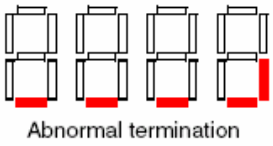
   x = 20% when 50s < T < 100s

   x = 10% when T => 100s

   f. Second DC excitation
   g. Displays the pass/fail result of the auto-tuning as follows:



Normal termination



Abnormal termination

NOTE: During the AC and DC motor excitation steps above, you may notice that the motor makes a slight humming or whistling sound. This sound is normal.

If the auto-tuning procedure is successful, the inverter updates the motor characteristic parameters and indicates *normal termination* of the procedure as shown. Pressing any key on the keypad will clear the result from the display.

Now return to Page 41, Step 3.

Possible Problems You May Encounter

The following problems may be encountered during the autotuning procedure:

- **Trip during auto-tuning –** A trip event will cause the auto-tuning sequence to quit. The display will show the error code for the trip rather than the abnormal termination indication. After eliminating the cause of the trip, then conduct the autotuning procedure again.

- **Power loss or stop during auto-tuning –** If the auto-tuning procedure is interrupted by power loss, the Stop key, or by turning OFF the Run command, the auto-tuning constants may or may not be stored in the inverter. It will be necessary to restore the inverter's factory default settings (see "Restoring Factory Default Settings" on page 6–9 of the SJ300 Inverter Instruction Manual). After reinitializing the inverter, perform the entire auto-tuning procedure again.

- **Control mode setting –** The auto-tuning procedure will have an abnormal termination if the control mode of the inverter is set to any of V/F settings.

Manual Adjustment of Motor Parameters

Should the performance after auto-tuning not be optimal, the various motor parameters may be manually adjusted. The following table shows the symptoms and suggested adjustment for various operating conditions. Observe the system and make the adjustment indicated until acceptable performance is obtained.

Operation Status	Symptom	Adjustment	Parameter
Powered running	When the speed deviation is negative	Slowly increase the motor constant R2 in relation to auto-tuning data, within 1 to 1.2 times preset R2	H031
	When the speed deviation is positive	Slowly decrease the motor constant R2 in relation to auto-tuning data, within 0.8 to 1 times preset R2	H031
Regeneration (status with a decelerating torque)	When low frequency (a few Hz) torque is insufficient	Slowly increase the motor speed constant R1 in relation to auto-tuning data within 1 to 1.2 times R1	H030
		Slowly increase the motor constant I_0 (motor no-load current) in relation to auto-tuning data, within 1 to 1.2 times preset I_0 value	H033
During acceleration	A sudden jerk at start of rotation	Increase motor constant J slowly within 1 to 1.2 times the preset constant	H034
During deceleration	Unstable motor rotation	Decrease the speed response	H05
		Set motor constant J smaller than the preset constant	H034
During torque limiting	Insufficient torque during torque limit at low speed	Set the overload restriction level lower than the torque limit level	B031, B041-B044
At low-frequency operation	Irregular rotation	Set motor constant J larger than the preset constant	H034

NOTES:

Appendix B – Jerk Rate Calculator Program

The SJ300-EL inverter has a variety of parameters that allow for the control of the speed and acceleration contours. However, some elevator system designers may specify a particular **jerk rate** for their system. While jerk rates cannot be programmed directly into the SJ300-EL, by appropriate settings of the available parameters, jerk rate can be controlled fairly accurately. There is a definite mathematical relationship between the various inverter parameters and the jerk rate that is obtained.

In order to eliminate the necessity of doing cumbersome manual calculations, Hitachi has developed an automated Jerk Rate Calculator Program to do these calculations for you. This program is available at the Hitachi America AC Inverter web site by going to: www.hitachi.us/inverters, then navigate to the **Software Downloads** section in the right column. You will find the calculator on that page.

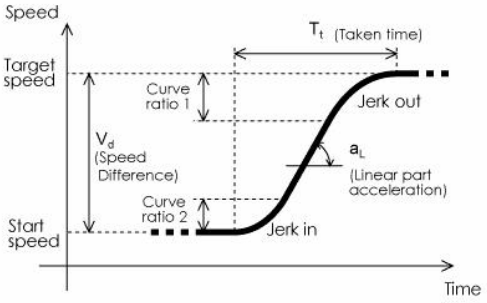
The program will open in a window on your web browser, and will allow you to enter key values, such as maximum frequency, linear speed at maximum frequency, desired jerk rates, maximum desired acceleration, and preset speeds, etc. The program will then calculate the required inverter parameters to achieve the specified performance.

A screen image of the calculator program appears on the next page.

SJ300-EL Parameter Calculating Program for Constant Jerk Rate

Acceleration pattern selection	Elevator S curve	A097:	04
Deceleration pattern selection	Elevator S curve	A098:	04
Max frequency		A004:	
Speed at Max frequency (N/A)		A075:	
Frequency Conversion Function	☐ Enable	A074:	0

Speed unit of Max freqency(A075) *note ◉ m/s (or other L/T) ○ feet/min



	Jerk in [Hz/s²]	Jerk out [Hz/s²]	Max a_L [Hz/s]	Curve ratio 1	Curve ratio 2
During Acc				P060:	P061:
During Dec				P062:	P063:

No.	Multi speed [Hz]	Start spd selection	V_d [Hz]	T_t [s]	a_L [Hz/s]	Multi speed [Hz]	Acc time [s]	Dec time [s]	Remarks
0	0 (stop)	Multi-speed 7 (creep)				A020:	F002:	F003:	
1		Multi-speed 0				A021:	A221:	A321:	
2		Multi-speed 0				A022:	A222:	A322:	
3		Multi-speed 0				A023:	A223:	A323:	
4		Multi-speed 0				A024:	A224:	A324:	
5		Multi-speed 0				A025:	A225:	A325:	
6		Multi-speed 0				A026:	A226:	A326:	
7		Multi speed 1-6	N/A	N/A	N/A	A027:	A227:	A327:	

Index

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