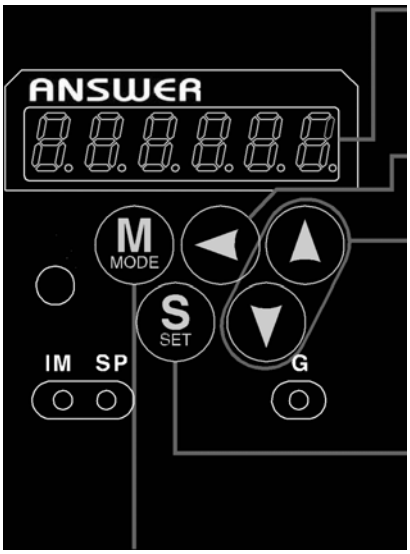
How to Use the Front Panel and Console

Setup with the Front Panel

Composition of Touch Panel and Display



Display LED (6-digit)
All of LED will flash when error occurs,
and switch to error display screen.
All of LED will flash slowly when warning occurs.

Shifting of the digit for data changing to higher digit.
(Valid to the digit whose decimal point flashes.)

Press these to change display and data, select parameters and execute actions.
(Change/Selection/Execution is valid to the digit which decimal point flashes.)
Numerical value increases by pressing , (▲),
decreases by pressing (▼).

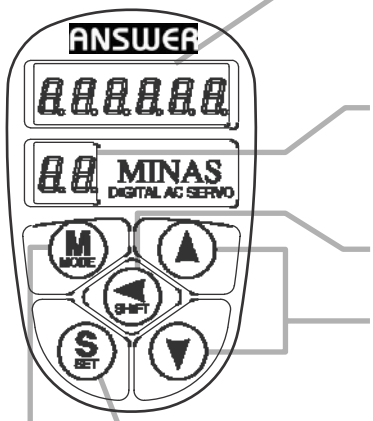
SET Button (valid at any time)
Press this to switch SELECTION and EXECUTTION display.

Mode switching button (valid at SELECTION display)
Press this to switch 5 kinds of mode.

1) Monitor Mode
2) Parameter Set up Mode
3) EEPROM Write Mode
4) Auto-Gain Tuning Mode
5) Auxiliary Function Mode

Setup with the Console

Composition of Touch Panel and Display



Display LED (6-digit)
All of LED will flash when error occurs, and switch to error display screen.

Displays ID No. (address) of selected driver (in 2 digits).
The value set in Pr00(address) is ID No. Parameter No. is displayed (2 digits) at parameter setup mode.

Press this to shift the digit for data change.

Press these to change data or execute selected action of parameter.
Numerical value increases by pressing , (▲),
decreases by pressing (▼).

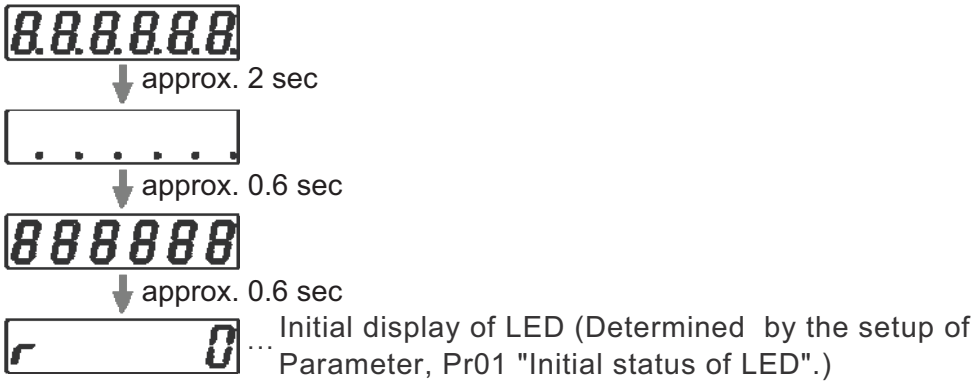
SET Button
Press this to shift each mode which is selected by mode switching button to EXECUTION display.

Mode Switching Button Press this to switch 6 kinds of mode.

1) Monitor mode
2) Parameter setup mode
3) EEPROM write mode
4) Normal auto-gain tuning mode
5) Auxiliary function mode
6) Copy mode

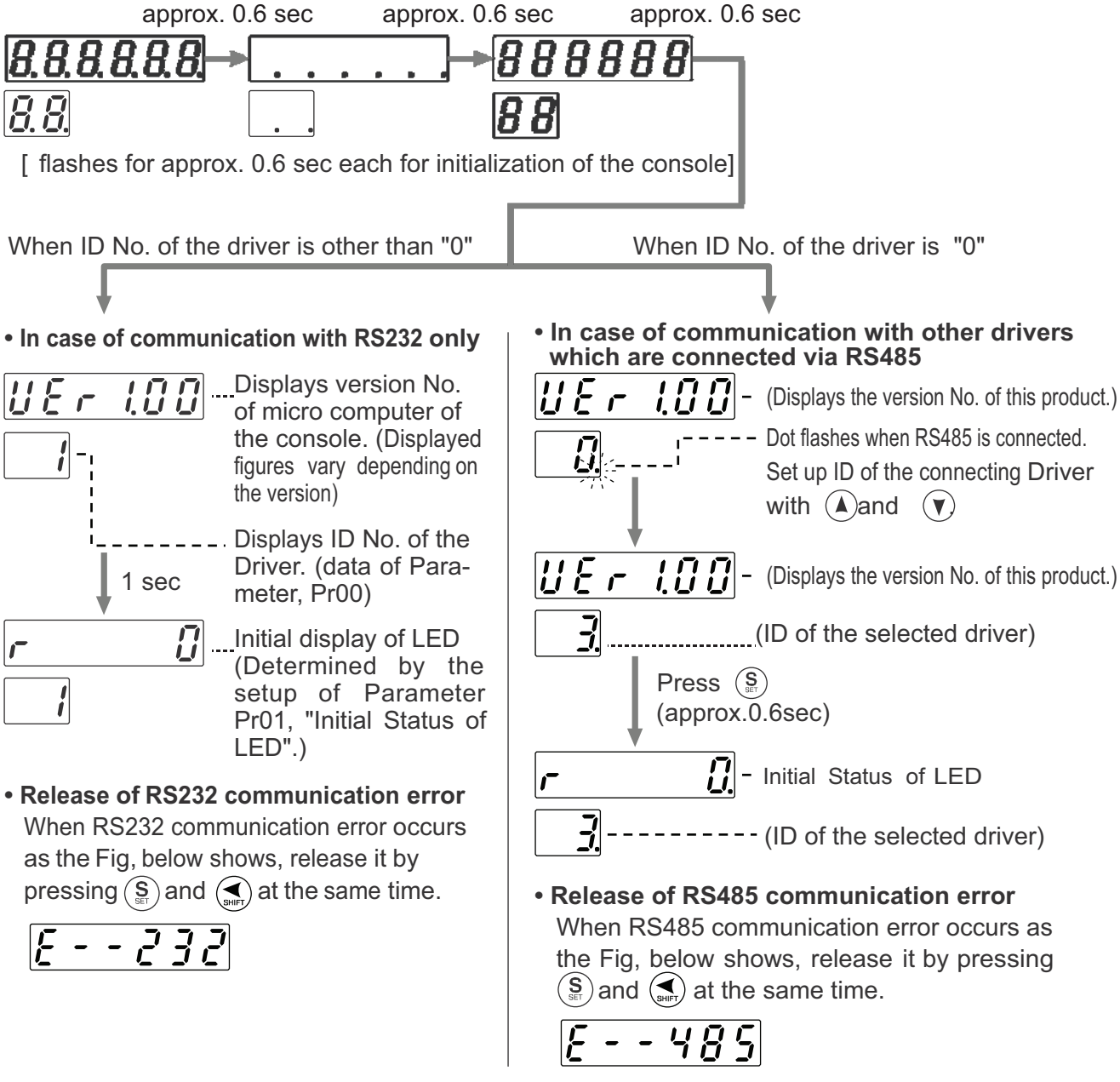
Initial Status of the Front Panel Display (7 Segment LED)

Front panel display shows the following after turning on the power of the driver.



Initial Status of the Console Display (7 Segment LED)

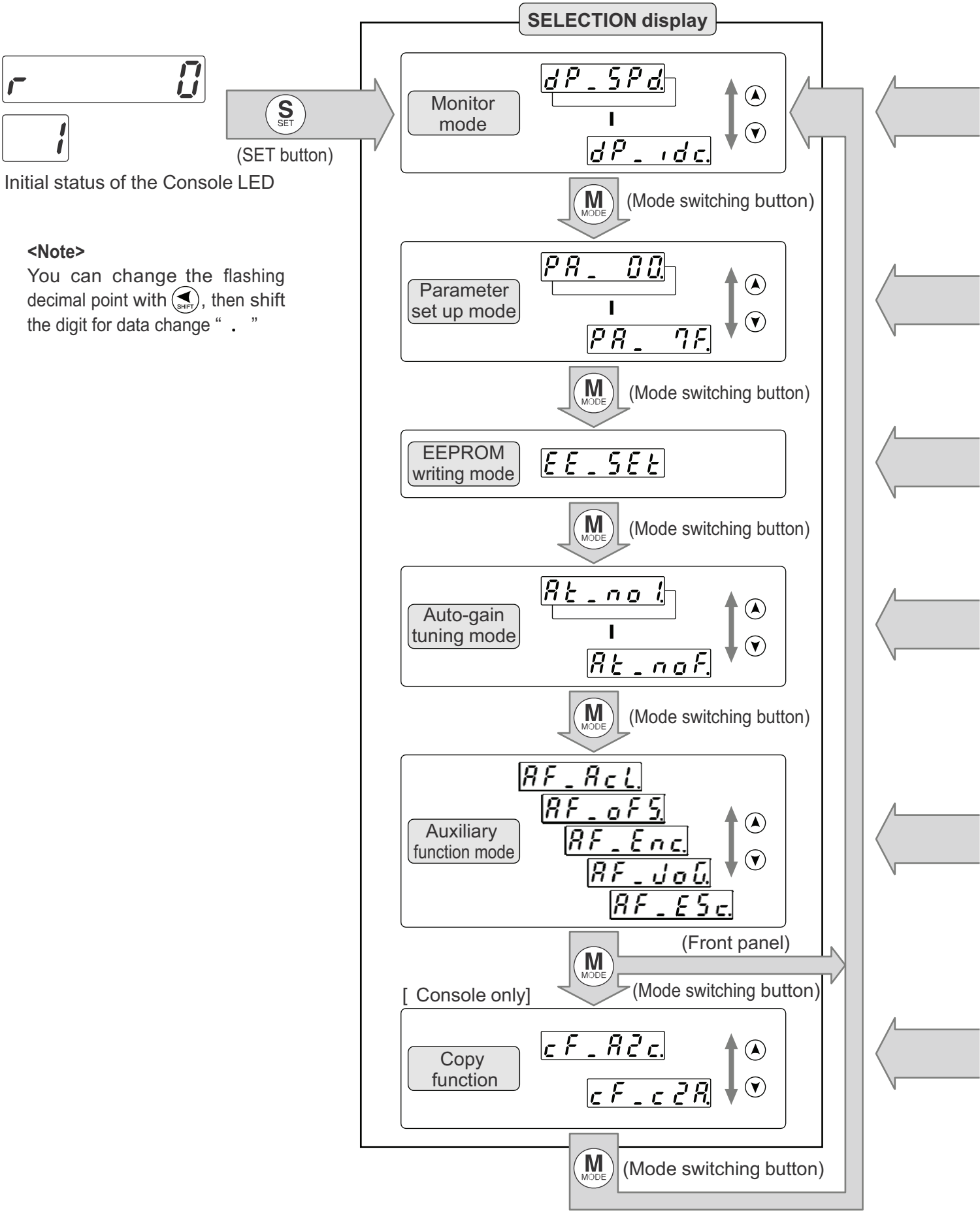
Turn on the power of the driver while inserting the console connector to the driver main body, or inserting the console connector to CN X4 connector.



How to Use the Front Panel and Console

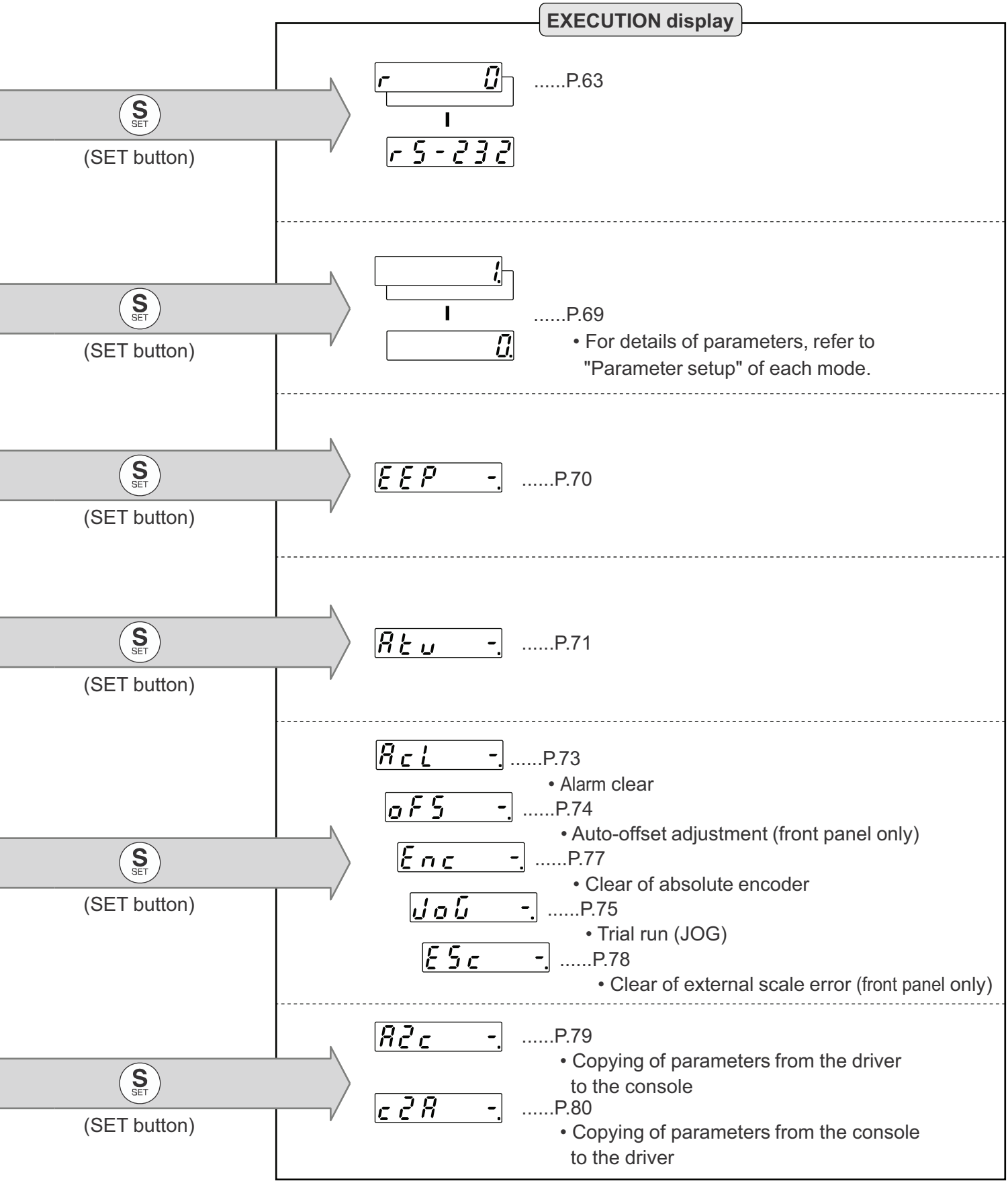
Structure of Each Mode

Use each button on the touch panel to select the structure and switch the mode.



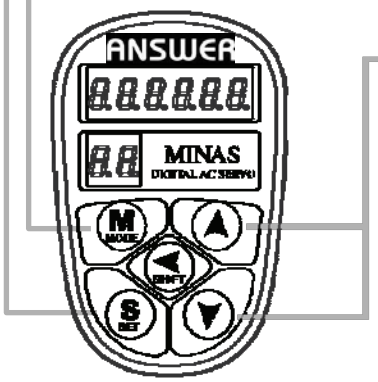
<Note>

You can change the flashing decimal point with (SHIFT), then shift the digit for data change " . "


EXECUTION display
r 0
rS-232
.....P.63
1.
0.
.....P.69
• For details of parameters, refer to "Parameter setup" of each mode.
EEP -.
.....P.70
Atu -.
.....P.71
AcL -.
.....P.73
• Alarm clear
oFS -.
.....P.74
• Auto-offset adjustment (front panel only)
Enc -.
.....P.77
• Clear of absolute encoder
JoG -.
.....P.75
• Trial run (JOG)
ESc -.
.....P.78
• Clear of external scale error (front panel only)
A2c -.
.....P.79
• Copying of parameters from the driver to the console
c2A -.
.....P.80
• Copying of parameters from the console to the driver
S SET
(SET button)
S SET
(SET button)
S SET
(SET button)
S SET
(SET button)
S SET
(SET button)

How to Use the Front Panel and Console

How to Set



1) Insert the console connector to CN X6 of the driver, and turn on the power of the driver.

Parameter setup

2) Press (S SET).

3) Press (M MODE).

4) Select the required parameters with (▲) and (▼).

5) Press (S SET).

6) Change the value with (SHIFT), (▲) and (▼).

7) Press (S SET).

EEPROM writing

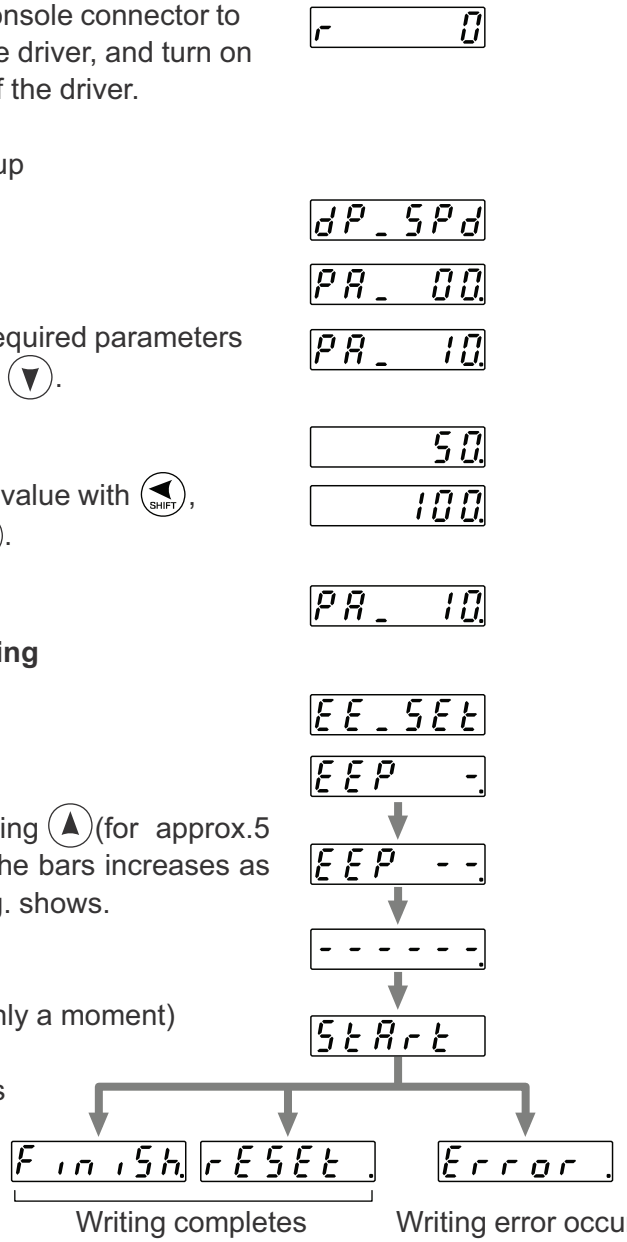
8) Press (M MODE).

9) Press (S SET).

10) Keep pressing (▲) (for approx.5 sec), then the bars increases as the right Fig. shows.

Writing starts.
(displays for only a moment)

Writing finishes



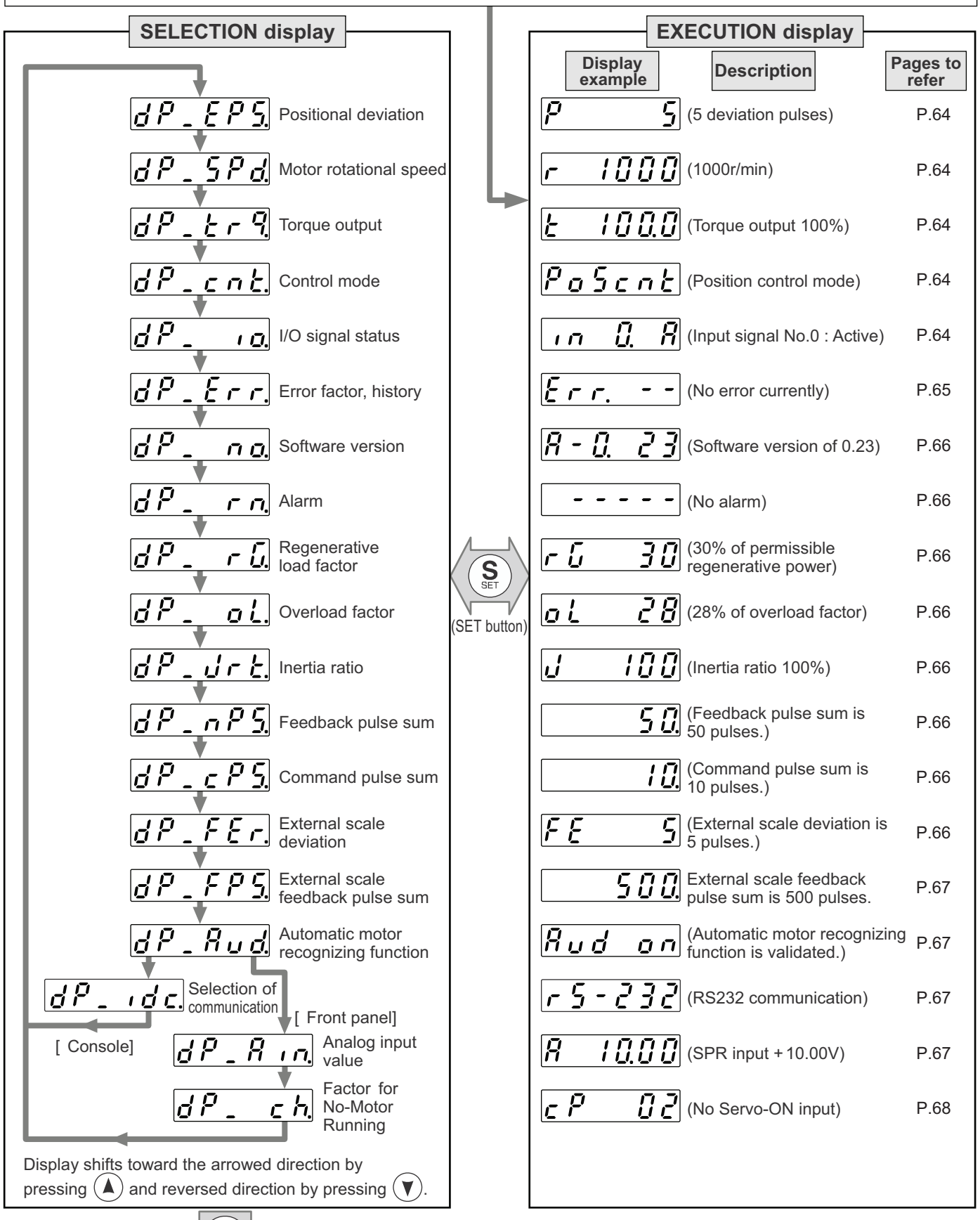
After the writing completes, return to SELECTION display by referring to "Structure of each mode" (P.60 and 61).

<Remarks>

- rESEt. will be displayed when you change the parameter setup which change will be validated only after the reset. Turn off the power of the driver, then reset it.
- When writing error occurs, repeat the writing. If the writing error persists, the console might be a failure.
- Do not shut down the power during EEPROM writing, otherwise wrong data might be written. In such case, set up all parameters again to write them again after full confirmation.
- Do not disconnect the console connector from the driver between StArt and FinISh. If the connector is disconnected, insert the connector and repeat the procedure from the beginning.

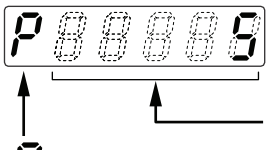
Monitor Mode

When you turn on the Product for the first time, display shows r 0. (at motor stall) To change this display, change the setup of Pr01 (Initial status of LED). (For details, refer to Parameter Setup of each control mode.)



How to Use the Front Panel and Console

Display of Position Deviation, Motor Rotational Speed and Torque Output



P .....Positional deviation (cumulative pulse counts of deviation counter)
- – display : generates rotational torque of CW direction (viewed from shaft end)
  no display : generates rotational torque of CCW direction (viewed from shaft end)

r .....Rotational speed of the motor unit [r/min]
- – display : CW rotation, no display : CCW rotation

t .....Torque command unit [%] (100 for rated torque)
- – display : CW rotation, no display : CCW rotation

<Note>

" + " is not displayed on LED, but only " - " appears.

Display of Control Mode

PoScnt .....Position control mode

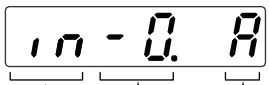
trqcnt .....Torque control mode

SPdcnt .....Velocity control mode

FcLcnt .....Full-closed control mode

Display of I/O Signal Status

Displays the control input and output signal to be connected to CN X5 connector.
Use this function to check if the wiring is correct or not.



A .....Active
(This signal is valid)

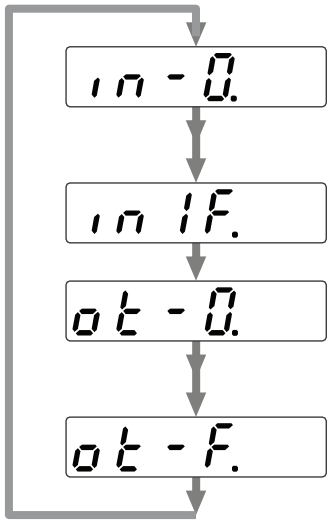
- .....Inactive
(This signal is invalid)

Signal No.
(Hexadecimal number, 0-1F)

in .....Input signal

ot .....Output signal

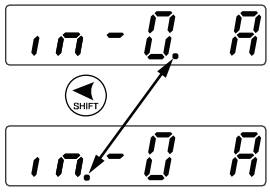
Select the signal No. to be monitored by pressing ▲ ▼.



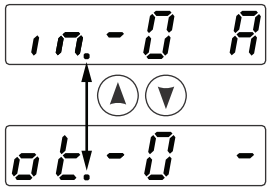
Transition when pressing ▲.

<Note>

- Shift the flashing decimal point with SHIFT.



- The other way to change signal No. at I/O selection mode Signal selection mode.

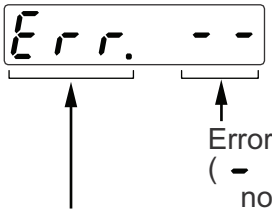


• **Signal No. and its title**

Input signal			
Signal No.	Title	Symbol	Pin No.
0	Servo-ON	SRV-ON	29
1	Alarm clear	A-CLR	31
2	CW over-travel inhibit	CWL	8
3	CCW over-travel inhibit	CCWL	9
4	Control mode switching	C-MODE	32
5	Speed-Zero clamp	ZEROSPD	26
6	Switching of electronic gear	DIV	28
8	Command pulse input inhibition	INH	33
9	Gain switching	GAIN	27
A	Deviation counter clear	CL	30
C	Selection 1 of Internal command speed	INTSPD1	33
D	Selection 2 of Internal command speed	INTSPD2	30
13	Damping control switching input	VS-SEL	26
14	Selection 3 of internal command speed	INTSPD3	28
15	Torque limit switching input	TL-SEL	27

Input signal			
Signal No.	Title	Symbol	Pin No.
0	Servo-Ready	S-RDY	35/34
1	Servo-Alarm	ALM	37/36
2	Positioning complete (In-position)	COIN	39/38
3	Release of external brake	BRK-OFF	11/10
4	Zero-speed detection	ZSP	12
5	Torque in-limit	TLC	40
6	In-speed(Speed coincidence)	V-COIN	12/40
9	At-speed(Speed arrival)	COIN	39/38
A	Full-closed positioning complete	EX-COIN	39/38

Reference of Error Factor and History



• You can refer the last 14 error factors (including present one)
Press ▲ ▼ to select the factor to be referred.

<Note>

• Following errors are not included in the history.
11:Under-voltage protection for control power
13:Under-voltage protection for main power
36:EEPROM parameter error protection
37:EEPROM check code error protection
38:Ocer-travel inhibition input protection
95:Automatic motor recognition error protection

• When one of the errors which are listed in error history occurs, this error and history o shows the same error No.

• When error occurs, the display flashes.

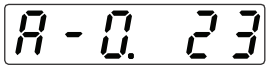
● **Error code No. and its content**

Error code No.	Error content
11	Under-voltage protection for control power
12	Over-voltage protection
13	Under-voltage protection for main power
14	Over-current protection
15	Overheat protection
16	Overload protection
18	Over-regenerative load protection
21	Encoder communication error protection
23	Encoder communication data error protection
24	Excess positional deviation protection
25	Excess hybrid deviation error protection
26	Over-speed protection
27	Command pulse multiplication error protection
28	External scale communication data error protection
29	Deviation counter overflow protection
34	Software limit protection
35	External scale communication data error protection
36	EEPROM parameter error protection
37	EEPROM parameter error protection
38	Run-inhibition input protection

Error code No.	Error content
39	Excess analog input error protection
40	Absolute system-down error protection
41	Absolute counter-over error protection
42	Absolute over-speed error protection
44	Absolute single-turn error protection
45	Absolute multi-turn error protection
47	Absolute status error protection
48	Encoder Z-phase error protection
49	Encoder CS signal error protection
50	External scale status 0 error protection
51	External scale status 1 error protection
52	External scale status 2 error protection
53	External scale status 3 error protection
54	External scale status 4 error protection
55	External scale status 5 error protection
65	Excess CCWTL input protection
66	Excess CWTL input protection
95	Automatic motor recognition error protection
others	Other error

How to Use the Front Panel and Console

Software Version



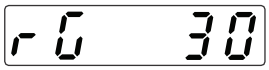
Displays the software version of the driver.

Alarm Display

- .....no alarm A .....Alarm occurrence

- **Over-regeneration alarm** : Turns on when regenerative load reaches more than 85% of alarm trigger level of regenerative load protection. Alarm trigger level is defined as 10% of regenerative resister working ratio, when Pr6C "Selection of external regenerative resister " is 1.
- **Overload alarm** : Turns on when the load reaches 85% or more of alarm trigger level of over-load protection.
- **Battery alarm** : Turns on when battery voltage for absolute encoder falls to alarm level (approx.3.2V) or lower.
- **Cooling fan rotational speed error alarm** : Shows cooling fan rotational speed error.
- **External scale alarm** : Turns on when external scale temperature rises to more than 85˚C or scale rigidity is not enough (adjustment is needed on mounting).

Display of Regenerative Load Factor



Display the ratio (%) against the alarm trigger level of regenerative protection.
This is valid when Pr6C (Selection of external regenerative resistor) is 0 or 1.

Display of Over-load Factor

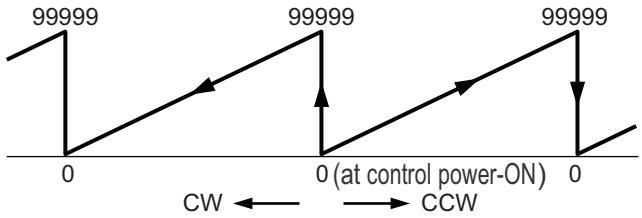
Displays the ratio (%) against the rated load.
Refer to P.258, "Overload Protection Time Characteristics" of When in Trouble.

Display of Inertia Ratio

Displays the inertia ratio (%) .
Value of Pr20 (Inertia ratio) will be displayed as it is.

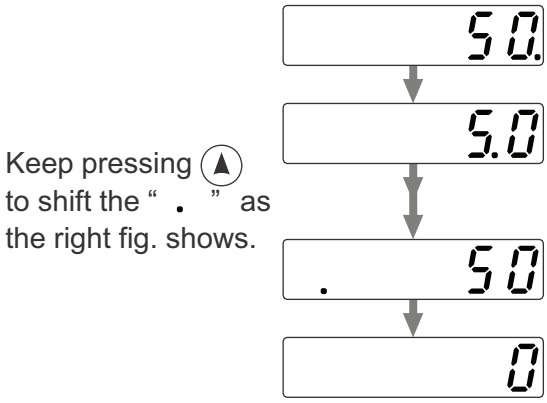
Display of Feedback Pulse Sum, Command Pulse Sum and External Scale Feedback Pulse Sum

Total sum of pulses after control power-ON. Display overflows as the figures show.



By pressing (▲) for approx. 3 sec. or longer on either one of screens of total sum of pulses display, you can clear feedback total sum, command pulse total sum or external scale feedback pulse total sum to " 0 " .

[0-clear EXECUTION display]

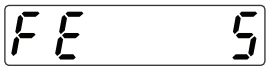


Keep pressing (▲) to shift the " . " as the right fig. shows.

<Cautions>

- You can not clear the each date of [PANATERM®] and console to "0" with this operation.
- Since accumulation process of command pulse cannot be executed when the command pulse input prohibition is validated, during normal auto-gain tuning and while measuring function to frequency characteristics of [PANATERM®] is used, actual pulse input counts may differ from the displayed value of command pulse total sum.

External Scale Deviation



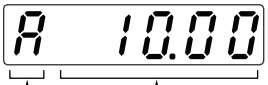
• Polarity (+) : CCW, (-) : CW
Limited by ± 999999.

Note) You can 0-clear the external scale deviation during normal auto-gain tuning and motor trial run.

Automatic Motor Recognizing Function

Automatic recognition is valid.

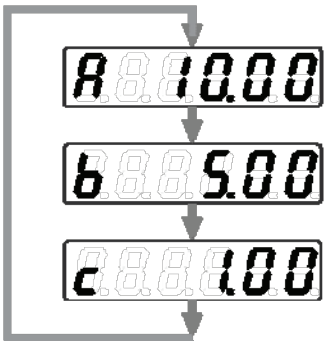
Display of Analog Input Value (Front Panel Only)



Input voltage value [V]

Input signal

•Select the signal No. to be monitored by pressings ▲ ▼.



(SPR analog input value, unit [V]) Displays the value after offset correction.

(CCWTL analog input value, unit [V])

(CWTL analog input value, unit [V])

Note) Voltage exceeding ± 10V can not be displayed correctly.

Switching of the Driver to be Communicated

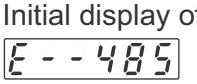
RS232 communication

.....Displays the ID of the connected driver. ID cannot be switched.

RS485 communication

.....Select the ID of the driver to be operated by pressing ▲ ▼.

Initial display of LED of the selected driver will appear by pressing S SET.

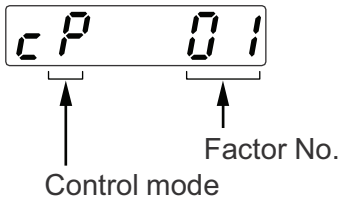


will appear when you select the ID of not-selected driver .

How to Use the Front Panel and Console

Display of the Factor of No-Motor Running

Displays the factor of no-motor running in number.



P .....Position control t .....Torque control

S ..... Velocity control F ..... Full-closed control

• Explanation of factor No.

Factor No.	Factor	Control mode	Content
flashing	Occurrence of error/alarm	all	An error is occurring, and an alarm is triggered.
00	No particular factor	all	No factor is detected for No-motor run. The motor runs in normal case.
01	Main power shutoff	all	The main power of the driver is not turned on.
02	No entry of SRV-ON input	all	The Servo-ON input (SRV-ON) is not connected to COM–.
03	Over-travel inhibition input is valid	all	While Pr04 is 0 (Run-inhibition input is valid), • CCW over-travel inhibition input (CCWL) is open and speed command is CCW direction. • CW over-travel inhibition input (CWL) is open and speed command is CW direction.
04	Torque limit setup is small	all	Either one of the valid torque limit setup value of Pr5E (1st) or Pr5F (2nd) is set to 5% or lower than the rating.
05	Analog torque limit input is valid.	P,S,F	While Pr03 is 0 (analog torque limit input accepted), • CCW analog torque limit input (CCWTL) is negative voltage and speed command is CCW direction. • CW analog torque limit input (CWTL) is positive voltage and speed command is CW direction.
06	INH input is valid.	P,F	Pr43 is 0 (Command pulse inhibition input is valid.), and INH is open.
07	Command pulse input frequency is low.	P,F	The position command per each control cycle is 1 pulse or smaller due to, • No correct entry of command pulse • No correct connection to the input selected with Pr40. • No matching to input status selected with Pr41 pr Pr42.
08	CL input is valid.	P,F	While Pr4E is 0 (Deviation counter clear at level), the deviation counter clear input (CL) is connected to COM–.
09	ZEROSPD input is valid.	S,T	While Pr06 is 1 (Speed zero clamp is valid.), the speed zero clamp input (ZEROSPD) is open.
10	External speed command is small.	S	While the analog speed command is selected, the analog speed command is smaller than 0.06[V] .
11	Internal speed command is 0.	S	While the internal speed command is selected, the internal speed command is set to lower than 30 [r/min]
12	Torque command is small.	T	The analog torque command input (SPR or CCWTL) is smaller than 5 [%] of the rating.
13	Speed limit is small.	T	• While Pr5B is 0 (speed is limited by 4th speed of internal speed), Pr56, (4th speed of speed setup) is set to lower than 30 [r/min] . • While Pr5B is 1 (speed is limited by SPR input), the analog speed limit input (SPR) is smaller than 0.06 [V] .
14	Other factor	all	The motor runs at 20 [r/min] or lower even though the factors from 1 to 13 are cleared, (the command is small, the load is heavy, the motor lock or hitting, driver/motor fault etc.)

<Note>

* Motor might run even though the other number than 0 is displayed.

Parameter Setup Mode

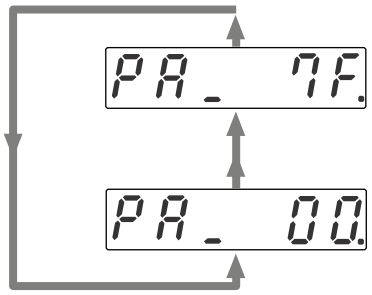
Operation at SELECTION display

Press (M MODE) once after pressing (S SET) from initial status of LED to change the display to Parameter setup mode, 

Parameter No. (Hexadecimal No.)

<Note>
For parameters which place is displayed with " r ", the content changed and written to EEPROM becomes valid after turning off the power once.

Press (▲) or (▼) to select parameter No. to be referred/set.

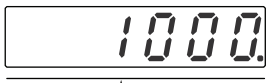


Press (▲) to shift to arrowed direction.

Press (▼) to shift to reversed direction.

Operation at EXECUTION display

Press (S SET) to change to EXECUTION display of



You can change the value which digit has a flashing decimal point.

Parameter value

<Note>
Each parameter has a limit in number of places for upper-shifting.

(1) You can change the decimal point with (◀ SHIFT), then shift the digit for data change.

(2) Press (▲) or (▼) to set up the value of parameter.

Value increases with (▲) decreases with (▼).

After setting up parameters, return to SELECT mode, referring to structure of each mode (P.60 and 61).

<Remarks>
After changing the parameter value and pressing (S SET), the content will be reflected in the control.
Do not extremely change the parameter value which change might affect the motor movement very much (especially velocity loop or position loop gains).

How to Use the Front Panel and Console

EEPROM Writing Mode

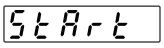
EEPROM Writing

Operation at SELECTION display

Starting from the initial LED status, press (M MODE) two time after pressing (S SET), then brings the display of EEPROM Writing Mode, 

Operation at EXECUTION display

Press (S SET) to make EXECUTION DISPLAY to 

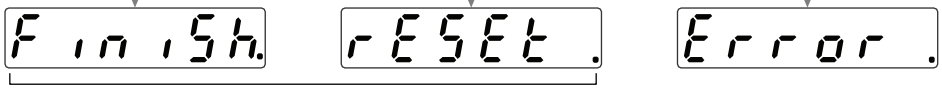
Keep pressing (▲) until the display changes to 

when you execute writing.

" - " increases while keep pressing (▲) (for approx. 5sec) as the right fig. shows.

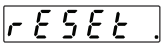
Starts writing.

Finishes writing



Writing completes

Writing error

• When you change the parameters which contents become valid after resetting, 

will be displayed after finishing wiring. Turn off the control power once to reset.

Note 1) When writing error occurs, make writing again. If the writing error repeats many times, this might be a failure.

Note 2) Don't turn off the power during EEPROM writing. Incorrect data might be written. If this happens, set up all of parameters again, and re-write after checking the data.

Auto-Gain Tuning Mode

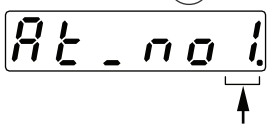
Normal Mode Auto-Gain Tuning Screen

<Remarks>

- For details of normal auto-gain tuning, refer to P.236, "Normal Auto-Gain Tuning" of Adjustment. Pay a special attention to applicable range and cautions.
- The motor will be driven in a preset pattern by the driver in normal auto-gain tuning mode. You can change this pattern with Pr25 (Setup of action at normal auto-gain tuning), however, shift the load to where the operation in this pattern may not cause any trouble, then execute this tuning.
- Depending on the load, oscillation may occur after the tuning. In order to secure the safety, use the protective functions of Pr26 (Setup of software limit), Pr70 (Setup of excess position deviation) or Pr73 (Setup of over-speed level).

Operation at SELECTION display

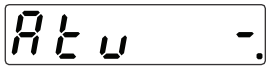
Starting from the initial LED status, press (M MODE) three time after pressing (S SET), then brings the display of normal auto-gain tuning, then press (▲) (▼) to select the machine stiffness No.



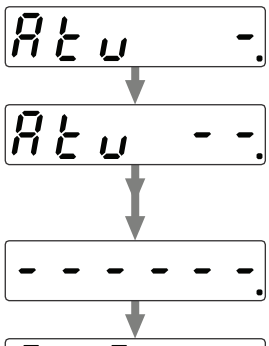
machine stiffness No.
(1 to 9, A (10) to F (15))

<Note>
For machine stiffness No., refer to P.238.

Operation at EXECUTION display

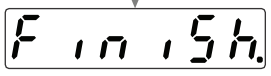
Press (S SET) to make EXECUTION DISPLAY to 

After inhibiting command input, and during Servo-On status,keep pressing (▲) until Console (LED) display changes to StArt .

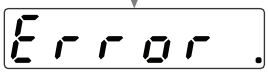


" - " increases by pressing (▲) (approx. 5sec) as the left fig. shows.

Starting of the motor 

Tuning finishes. 

Tuning completes



Tuning error

<Note>
To prevent the loss of gain value due to the power shutdown, write into EEPROM.

After setting up tuning, return to SELECT DISPLAY, referring to structure of each mode (P.60 and 61).

<Remarks>

Don' t disconnect the console from the driver between StArt **and** Finish.
Should the connector is pulled out, insert it again and repeat the procedures from the beginning.

<Note> If the following status occurs during the tuning action, the tuning error occurs.

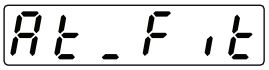
(1) During the tuning action, 1) when an error occurs, 2) when turned to Servo-OFF, 3) even the deviation counter is cleared, 4) when the tuning is actuated close to the limit switch and 5) when the main power is shut off.
(2) When the output torque is saturated because the inertia or load is too large.
(3) When the tuning can not be executed well causing oscillation.

If the tuning error occurs, value of each gain returns to the previous value before the tuning. The driver does not trip except error occurrence. Depending on the load, the driver might oscillate without becoming tuning error. (not showing Error . **)Extra attention should be paid to secure the safety.**

How to Use the Front Panel and Console

Fit-Gain Screen

Operation at SELECTION display



Operation at EXECUTION display

Press (S SET) to call for EXECUTION DISPLAY.

You can change/store the setup of real time auto-gain tuning/adaptive filter or start the fit-gain function by using (▲) (▼) key, after matching the decimal point to (1), (2), (4), (6) by pressing (◄).

(1) Stiffness setup of real time auto-gain tuning / Start of fit-gain

Display	Contents/Expansion function
You can change with (▲)(▼) F Stiffness 15 ⋮ ⋮ 1 Stiffness 1 0 Stiffness 0	with each press of (▲), stiffness changes in numerical/alphabetical order (0 to 9,A(10) to F(15). Fit gain function starts by pressing (▼) at stiffness 0.

(2) Action setup of real time auto-gain tuning/Start of fit-gain

Display	Contents/Expansion function
You can change with (▲)(▼) 7 Valid	No gain switching : Load inertia does not change.
6 Valid	Vertical axis mode : Load inertia changes rapidly.
5 Valid	Vertical axis mode : Load inertia changes slowly.
4 Valid	Vertical axis mode : Load inertia does not change.
3 Valid	Normal mode : Load inertia changes rapidly.
2 Valid	Normal mode : Load inertia changes slowly.
1 Valid	Normal mode : Load inertia does not change.
0 Invalid	Executes automatic gain setup by pressing (▼) for approx.3sec. in this status.

(3) Status of real time auto-gain tuning action (display only)

(blank)	: Invalid
-	: Valid
¯ or _	: Estimating load inertia

(4) Switch of adaptive filter action and copy to 1st notch filter pf adaptive filter setup

Display	Contents/Expansion function
You can change with (▲)(▼) 2 Hold	Save the present adaptive filter setup to Pr1D,Pr1E by pressing (▲) for approx. 3 sec. in this status.
1 Valid	
0 Invalid	Clears 1st notch filter (Pr1D, Pr1E) by pressing (▼) for approx. 3 sec. in this status.

(5) Status of real time auto-gain tuning action (display only)

(blank)	: Invalid
-	: Valid
¯ or _	: Adaptive action working

(6) EEPROM writing

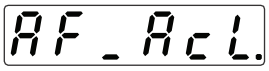
Display	Contents/Expansion function
F	Write the present setup into EEPROM by pressing (▼) approx. 3 sec.

Auxiliary Function Mode

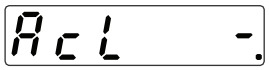
Alarm Clear Screen

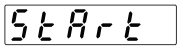
Protective function will be activated and release the motor stall status (error status).

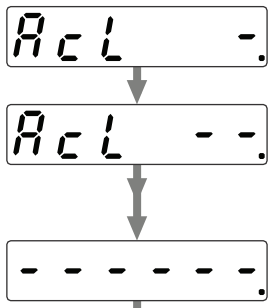
Operation at SELECTION display

Starting from the initial LED status,
Press (M MODE) four time after pressing (S SET),
then press (▲) (▼) to make a display to 

Operation at EXECUTION display

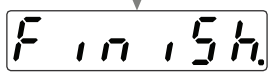
Press (S SET) to call for
EXECUTION display of 

Keep pressing (▲) until the console (LED)
changes to 

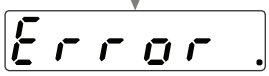


" - " increases by pressing (▲)
(approx. 5sec) as the right fig. shows.

Alarm clear starts. 

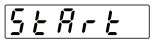
Clearing finishes. 

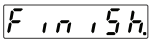
Alarm clear completes



Clear is not finished.
Release the error by resetting the power.

After alarm cleaning, return to SELECTION display, referring to structure of each mode (P.60 and 61).

<Remarks>
Don't disconnect the console from the driver between 

and 

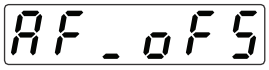
.
Should the connector is pulled out, insert it again and repeat the procedures from the beginning.

How to Use the Front Panel and Console

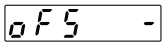
Automatic Offset Adjustment (Front Panel Only)

Automatically adjust the offset value of Pr52 (Velocity command offset) of analog velocity command input (SPR/TRQR).

Operation at SELECTION display



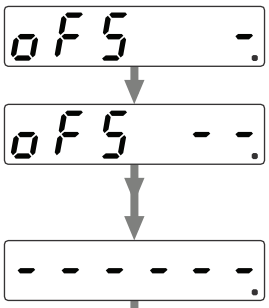
Operation at EXECUTION display

• Press (S SET) to call for EXECUTION display of 

When you execute automatic offset adjustment, make command input to 0V, then keep pressing (▲) until the display changes to

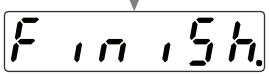
.

" - " increases by pressing (▲) (approx. 5sec) as the right fig. shows.

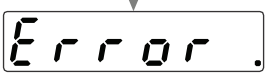


Automatic offset adjustment starts.

Adjustment finishes.



Automatic offset adjustment finishes.



Error occurs.
(Invalid mode is selected, or offset value exceeds the setup range of Pr52.)

<Notes>

This function is invalid at position control mode.

You cannot write the data only by executing automatic offset adjustment.

Execute a writing to EEPROM when you need to reflect the result afterward.

Trial Run (JOG Run)

You can make a trial run (JOG run) without connecting the Connector, CN X5 to the host controller such as PLC.
< Remarks>

- Separate the motor from the load, detach the Connector, CN X5 before the trial run.
- Bring the user parameter setups (especially Pr11-14 and 20) to defaults, to avoid oscillation or other failure.

Inspection Before Trial Run

(1) Inspection on wiring
- Miswiring ?
  (Especially power input and motor output)
- Short or grounded ?
- Loose connection ?

(2) Confirmation of power supply and voltage

(3) Fixing of the servo motor
- Unstable mounting ?

(4) Separation from the mechanical system
(5) Release of the brake
(6) Turn to Servo-OFF after finishing the trial run by pressing S SET .

How to Use the Front Panel and Console

Procedure for Trial Run

When you use the console, insert the console connector to CN X4 of the driver securely and turn on the driver power.

Operation at SELECTION display

Press (M MODE) four time after pressing (S SET), to setup auxiliary function mode, then with (▲) (▼), make a display to AF_JOG.

Operation at EXECUTION display

Press (S SET) to call for EXECUTION DISPLAY of JOG -.

Then keep pressing (▲) until the display of Console (LED) changes to rEAdY.

JOG - increases by pressing (▲) (approx. 5sec) as the left fig. shows.

JOG --

Preparation step 1 for trial run

rEAdY

Error

Not a servo-ready status.
(Shuts off the main when error occurs.)

Then keep pressing (◀ SHIFT) until the display of LED changes to SrV_on.

rEAdY

Keep pressing (◀ SHIFT) (approx. 5 sec) to shift the decimal point toward left as the left fig. shows.

rEAdY.

r.EAdY

Preparation step 2 for trial run

SrV_on

Servo-ON status

Error

Not a Servo-Ready.
Or SRV-ON signal is not entered.

Turns to Servo-OFF by pressing (S SET).

After the Servo-ON of preparation step 2 for trial run,
the motor runs at the preset speed with Pr3D (JPG speed) to CCW direction by pressing (▲) CW by pressing (▼).
The motor stops by pressing (▲) (▼).
After finished trial running, return to SELECTION display, referring to structure of each mode (P.60 and 61).

<Notes>

- Set up torque limit input invalidation (Pr03) to 1, run-inhibit input invalidation (Pr04) to 1 and ZEROSPD input (Pr06) to 0.
- If SRV-ON becomes valid during trial run, the display changes to Error. which is normal run through external command.

<Caution>

If such trouble as disconnection of cable or connector occurs during trial run, the motor makes over-run for maximum 1 sec. Pay an extra attention for securing safety.

Clearing of Absolute Encoder

Only applicable to the system which uses absolute encoder. You can clear the alarm and multi-turn data of the absolute encoder.

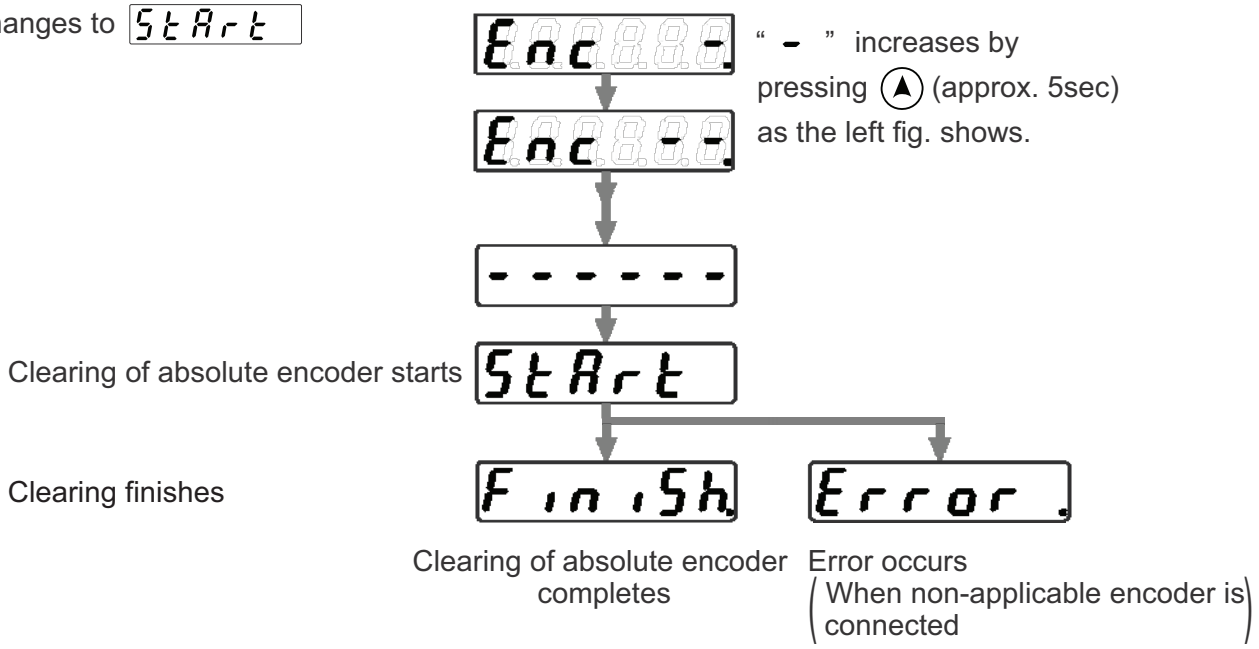
Operation at SELECTION display

Press (M MODE) four time after pressing (S SET), to setup auxiliary function mode, then with (▲) (▼), make a display to AF_Enc

Operation at EXECUTION display

Press (S SET) to call for EXECUTION DISPLAY of Enc -.

Then keep pressing (▲) until the display of Console (LED) changes to StArt



After clearing of absolute encoder finishes, return to SELECTION display, referring to structure of each mode (P.60 and 61).

<Remarks>

Don' t disconnect the console from the driver between StArt **to** FinISh. .

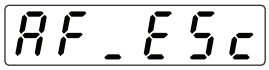
Should the connector is pulled out, insert it again and repeat the procedures from the beginning.

How to Use the Front Panel and Console

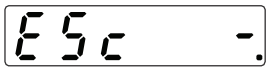
Clearing of External Scale Error (Front panel only)

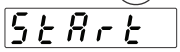
You can clear an error of the external scale.

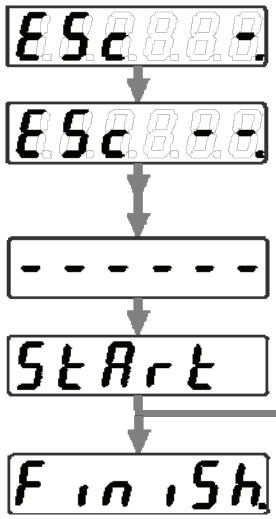
Operation at SELECTION display

Press (M MODE) four time after pressing (S SET), to setup auxiliary function mode, then with (▲)(▼), make a display to 

Operation at EXECUTION display

Press (S SET) to call for EXECUTION DISPLAY of 

Then keep pressing (▲) until the display of Console (LED) changes to 



" - " increases by pressing (▲) (approx. 5sec) as the left fig. shows.

Clearing of absolute encoder starts

Clearing finishes.

Clearing of absolute encoder completes

Error occurs (At other control mode than full-closed control, and when no external scale error has occurred)

After cleaning of External scale Error, return to SELECTION display, referring to the structure of each mode (P.60 and 61).

Copying Function (Console Only)

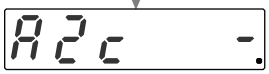
Copying of Parameters from the Driver to the Console

Operation at SELECTION display

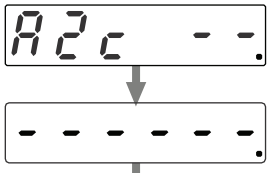
Starting from initial LED status, Press (M MODE) five time after pressing (S SET), then press (▲) (▼), to make a display to

Operation at EXECUTION display

Press (S SET) to call for EXECUTION DISPLAY of

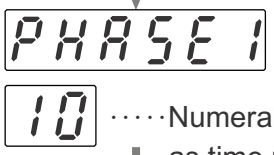


Keep pressing (▲) until the console display (LED) changes to PHASE 1



" - " increases by pressing (▲) (approx. 3sec) as the left fig. shows.

Initialization of EEPROM of the console starts.



·····Numeral decreases as time passes.

Copying of parameters from the driver to the console starts.

Writing of parameters into the console EEPROM starts.

Copying completes normally.

Error display

<Remarks>
If error is displayed, repeat the procedures from the beginning.
Press (S SET) for releasing error.

After copying finishes, return to SELECTION display, referring to structure of each mode (P.60 and 61)

<Remarks>
Don't disconnect the console from the driver between PHASE 1 to PHASE 3
Should the connector is pulled out, insert it again and repeat the procedures from the beginning.
<Note>
If the error display repeats frequently, check the broken cable, disconnection of the connector, misoperation due to noise or failure of console.

How to Use the Front Panel and Console

Copying of Parameters from the Console to the Driver

Operation at SELECTION display

Starting from initial LED status,
Press (M MODE) five time after pressing (S SET), then press
(▲) (▼) to make a display to

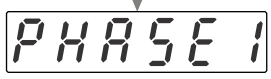
Operation at EXECUTION display

Press (S SET) to call for
EXECUTION DISPLAY of

Keep pressing (▲) until
the console display (LED)
changes to PHASE 1

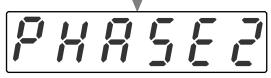
" - " increases by
pressing (▲) (approx. 3sec)
as the left fig. shows.

Reading of EEPROM of the
console starts.

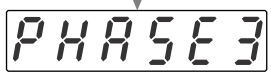


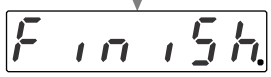
.....Numeral decreases
as time passes.

Copying of parameters from
the console to the driver starts.

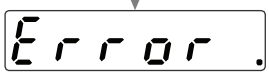


Writing of parameters into
the driver EEPROM starts.





Copying completes normally.



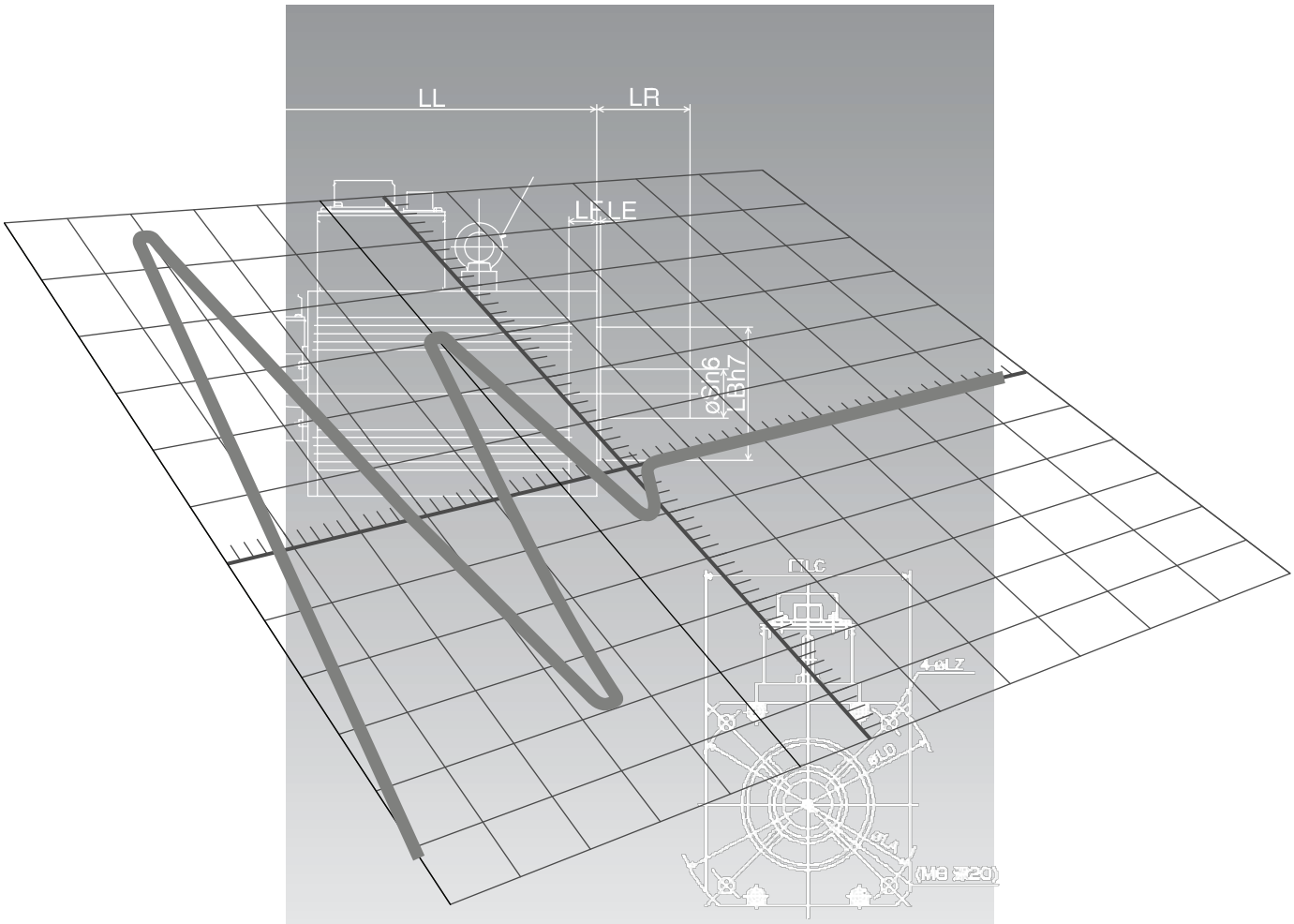
Error display

<Remarks>
If error is displayed, repeat the
procedures from the beginning.
Press (S SET) for releasing error.

After copying finishes, return to SELECTION display, referring to structure of each mode (P.60 and 61).

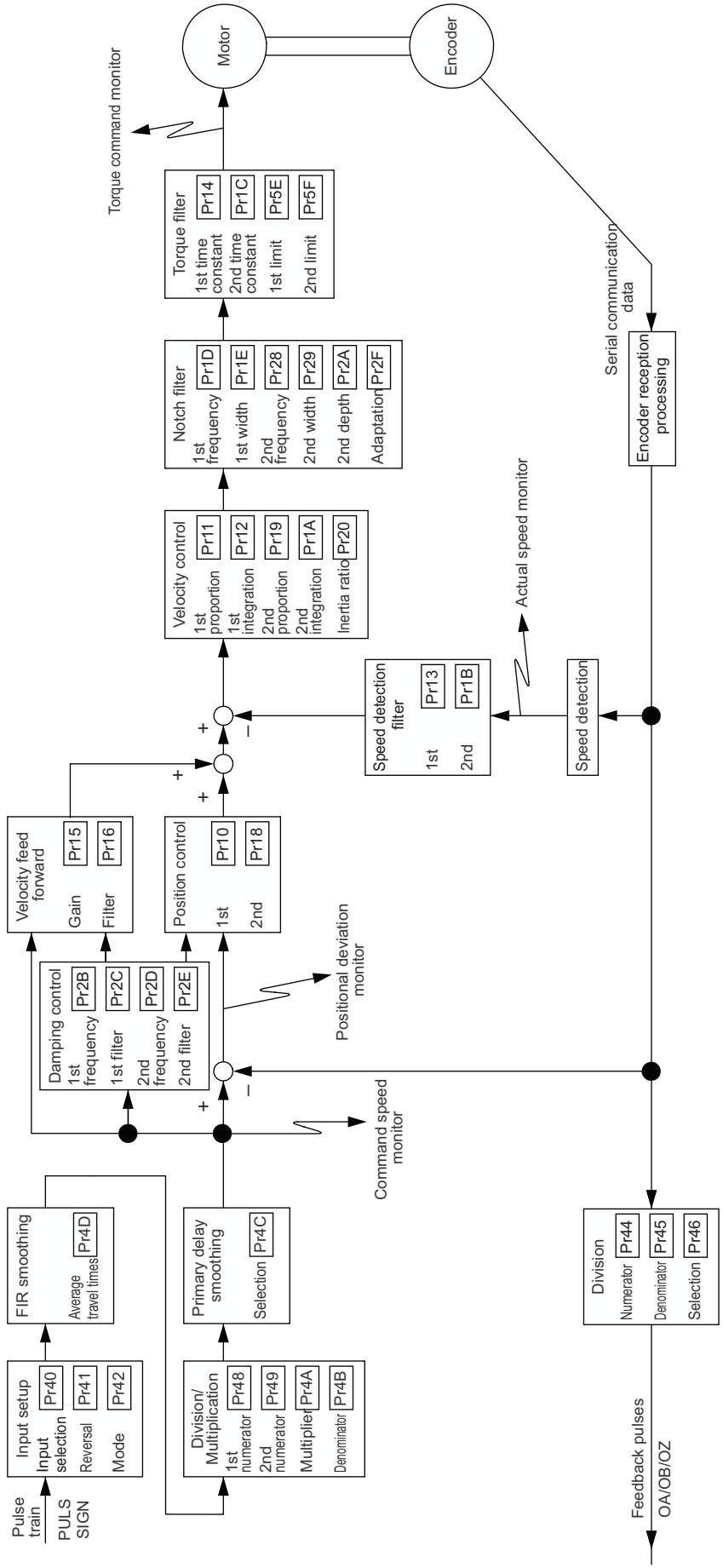
<Remarks>
Don' t disconnect the console from the driver between PHASE 1 **to** PHASE 3
Should the connector is pulled out, insert it again and repeat the procedures from the beginning.

<Note>
If the error display repeats frequently, check the broken cable, disconnection of the connector, misoperation due to noise or failure of console.



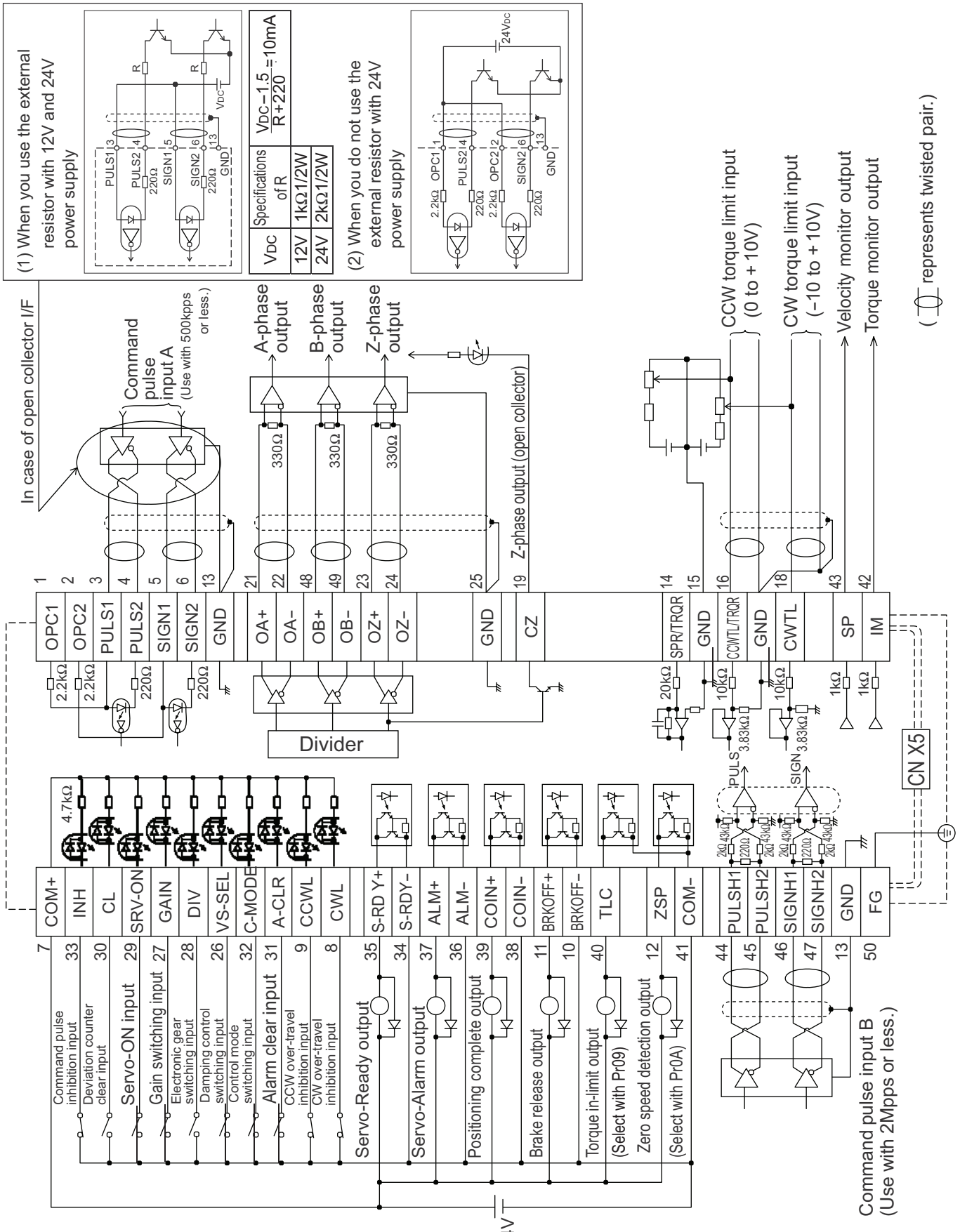
[Connection and Setup of Position Control Mode]

Control Block Diagram of Position Control Mode



Wiring Example to the Connector, CN X5

Wiring Example of Position Control Mode



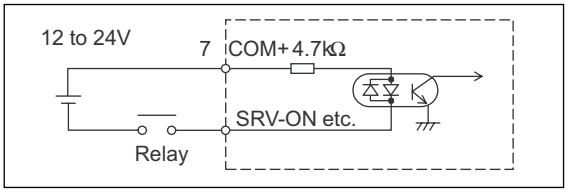
Wiring to the Connector, CN X5

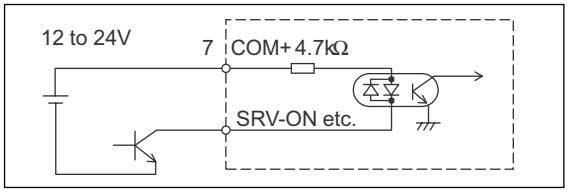
Interface Circuit

Input Circuit

SI Connection to sequence input signals

- Connect to contacts of switches and relays, or open collector output transistors.
- When you use contact inputs, use the switches and relays for micro current to avoid contact failure.
- Make the lower limit voltage of the power supply (12 to 24V) as 11.4V or more in order to secure the primary current for photo-couplers.





PI1 Connection to sequence input signals (Pulse train interface)

(1) Line driver I/F (Input pulse frequency : max. 500kpps)

- This signal transmission method has better noise immunity. We recommend this to secure the signal transmission.

(2)Open collector I/F (Input pulse frequency : max. 200kpps)

- The method which uses an external control signal power supply (V_{DC})
- Current regulating resistor R corresponding to V_{DC} is required in this case.
- Connect the specified resister as below.

V_{DC}	Specifications
12V	1kΩ1/2W
24V	2kΩ1/2W

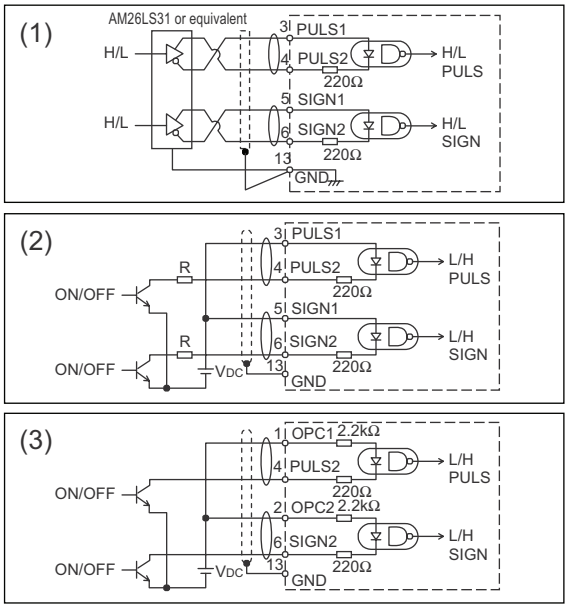
$$\frac{V_{DC}-1.5}{R+220} \fallingdotseq 10mA$$

(3)Open collector I/F (Input pulse frequency : max. 200kpps)

- Connecting diagram when a current regulating resistor is not used with 24V power supply.

represents twisted pair.

Max.input voltage : DC24V,
Rated current : 10mA

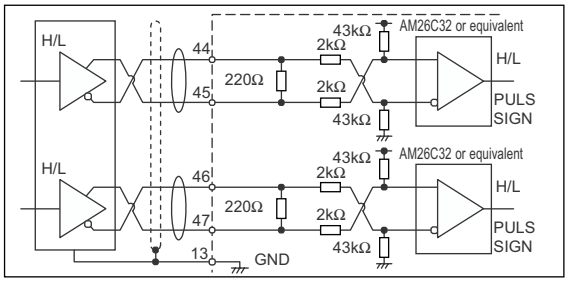


PI2 Connection to sequence input signals (Pulse train interface exclusive to line driver)

Line driver I/F (Input pulse frequency : max. 2Mpps)

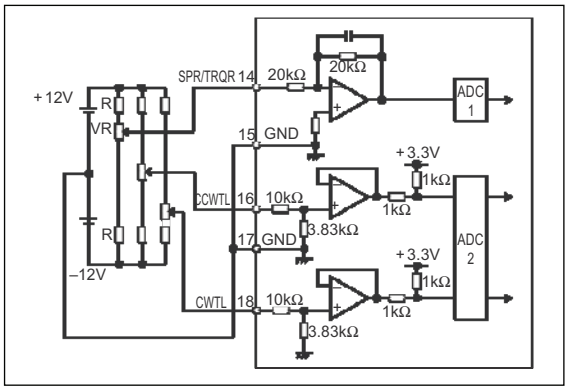
- This signal transmission method has better noise immunity. We recommend this to secure the signal transmission when line driver I/F is used.

represents twisted pair.



AI Analog command input

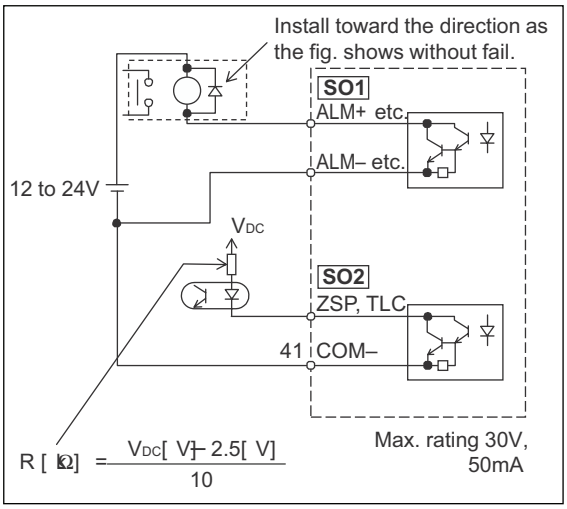
- The analog command input goes through 3 routes, SPR/TRQR(Pin-14), CCWTL (Pin-16) and CWTL (Pin-18).
- Max. permissible input voltage to each input is ±10V. For input impedance of each input, refer to the right Fig.
- When you compose a simple command circuit using variable resistor(VR) and register R, connect as the right Fig. shows. When the variable range of each input is made as –10V to +10V, use VR with 2kΩ, B-characteristics, 1/2W or larger, R with 200Ω, 1/2W or larger.
- A/D converter resolution of each command input is as follows.
  (1)ADC1 : 16 bit (SPR/TRQR), (including 1bit for sign), ±10V
  (2)ADC2 : 10 bit (CCWTL, CWTL), 0 to 3.3V



Output Circuit

SO1 SO2 Sequence output circuit

- The output circuit is composed of open collector transistor outputs in the Darlington connection, and connect to relays or photo-couplers.
- There exists collector to emitter voltage, V_{CE} (SAT) of approx. 1V at transistor-ON, due to the Darlington connection of the output or. Note that normal TTL IC cannot be directly connected since it does not meet VIL.
- There are two types of output, one which emitter side of the output transistor is independent and is connectable individually, and the one which is common to – side of the control power supply (COM–).
- If a recommended primary current value of the photo-coupler is 10mA, decide the resistor value using the formula of the right Fig.

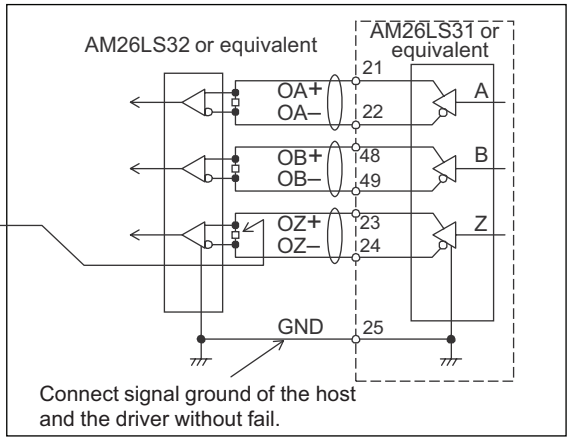


For the recommended primary current value, refer to the data sheet of apparatus or photo-coupler to be used.

PO1 Line driver (Differential output) output

- Feeds out the divided encoder outputs (A, B and Z-phase) in differential through each line driver.
- At the host side, receive these in line receiver. Install a terminal resistor (approx. 330Ω) between line receiver inputs without fail.
- These outputs are not insulated.

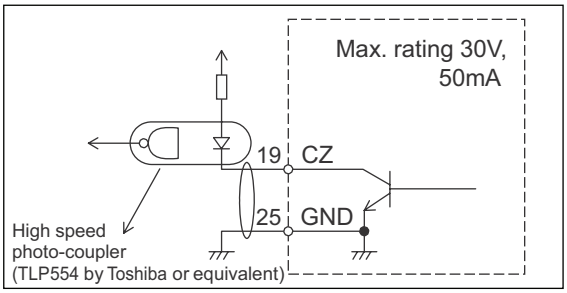
⏚ represents twisted pair.



PO2 Open collector output

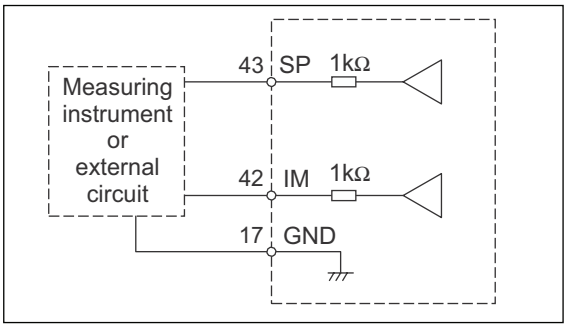
- Feeds out the Z-phase signal among the encoder signals in open collector. This output is not insulated.
- Receive this output with high-speed photo couplers at the host side, since the pulse width of the Z-phase signal is narrow.

⏚ represents twisted pair.



AO Analog monitor output

- There are two outputs, the speed monitor signal output (SP) and the torque monitor signal output (IM)
- Output signal width is ±10V.
- The output impedance is 1kΩ. Pay an attention to the input impedance of the measuring instrument or the external circuit to be connected.



<Resolution>

(1) Speed monitor output (SP)
With a setup of 6V/3000r/min (Pr07= 3), the resolution converted to speed is 8r/min/16mV.

(2) Torque monitor output (IM)
With a relation of 3V/rated torque (100%), the resolution converted to torque is 0.4%/12mV.

Wiring to the Connector, CN X5

Input Signal and Pin No. of the Connector, CN X5

Input Signals (common) and Their Functions

<table>
<tr><th>Title of signal</th><th>Pin No.</th><th>Symbol</th><th>Function</th><th>I/F circuit</th></tr>
<tr><td>Power supply for control signal (+)</td><td>7</td><td>COM+</td><td>• Connect + of the external DC power supply (12 to 24V).
• Use the power supply voltage of 12V ± 5% – 24V ± 5%</td><td>–</td></tr>
<tr><td>Power supply for control signal (–)</td><td>41</td><td>COM–</td><td>• Connect – of the external DC power supply (12 to 24V).
• The power capacity varies depending on a composition of I/O circuit. 0.5A or more is recommended.</td><td>–</td></tr>
<tr><td>CW over-travel inhibit input</td><td>8</td><td>CWL</td><td>• Use this input to inhibit a CW over-travel (CWL).
• Connect this so as to make the connection to COM– open when the moving portion of the machine over-travels the movable range toward CW.
• CWL input will be invalidated when you set up Pr04 (Setup of over-travel inhibit input) to 1.Default is "Invalid (1)".
• You can select the action when the CWL input is validated with the setup of up Pr66 (Sequence at over-travel inhibit). Default is "Emergency stop with dynamic brake".(Pr66= 0)</td><td>SI
P.84</td></tr>
<tr><td>CCW over-travel inhibit input</td><td>9</td><td>CCWL</td><td>• Use this input to inhibit a CCW over-travel (CCWL).
• Connect this so as to make the connection to COM– open when the moving portion of the machine over-travels the movable range toward CCW.
• CWL input will be invalidated when you set up Pr04 (Setup of over-travel inhibit input) to 1.Default is "Invalid (1)".
• You can select the action when the CCWL input is validated with the setup of Pr66 (Sequence at over-travel inhibit). Default is "Emergency stop with dynamic brake".(Pr66= 0)</td><td>SI
P.84</td></tr>
<tr><td>damping control switching input</td><td>26</td><td>VS-SEL</td><td>• Function varies depending on the control mode.
<table>
<tr><td>Velocity/ Torque control</td><td>• Becomes to a speed-zero clamp input (ZEROSPD).
<table>
<tr><th>Pr06</th><th>Connection to COM–</th><th>Content</th></tr>
<tr><td>0</td><td>–</td><td>ZEROSPD input is invalid.</td></tr>
<tr><td rowspan="2">1</td><td>open</td><td>Speed command is 0</td></tr>
<tr><td>close</td><td>Normal action</td></tr>
<tr><td rowspan="2">2</td><td>open</td><td>Speed command is to CCW</td></tr>
<tr><td>close</td><td>Speed command is to CW.</td></tr>
</table>
• In case Pr06 is 2 at torque control, ZERPSPD is invalid.</td></tr>
<tr><td>Position/ Full-closed control</td><td>• Becomes to an input of damping control switching (VS-SEL).
• While Pr24 (Damping filter switching selection) is 1, the 1st damping filter (Pr2B, Pr2C) will be validated when you open this input, and the 2nd damping filter (Pr2D, Pr2E) will be validated when you connect this input to COM–.</td></tr>
</table></td><td>SI
P.84</td></tr>
<tr><td>Gain switching input
or
Torque limit switching input</td><td>27</td><td>GAIN

TL-SEL</td><td>• Function varies depending on the setups of Pr30 (2nd gain setup) and Pr03 (Selection of torque limit).
<table>
<tr><th>Pr03</th><th>Pr30</th><th>Connection to COM–</th><th>Content</th></tr>
<tr><td rowspan="6">0 – 2</td><td rowspan="2">0</td><td>open</td><td>Velocity loop : PI (Proportion/Integration) action</td></tr>
<tr><td>close</td><td>Velocity loop : P (Proportion) action</td></tr>
<tr><td rowspan="4">1</td><td colspan="2">when the setups of Pr31 and Pr36 are 2</td></tr>
<tr><td>open</td><td>1st gain selection (Pr10,11,12,13 and 14)</td></tr>
<tr><td>close</td><td>2nd gain selection (Pr18,19,1A,1B and 1C)</td></tr>
<tr><td colspan="2">when the setups of Pr31 and Pr36 are other than 2</td></tr>
<tr><td>3</td><td>–</td><td colspan="2">invalid</td></tr>
<tr><td>3</td><td>–</td><td colspan="2">• Input of torque limit switching (TL-SEL)
• Pr5E (Setup of 1st torque limit) will be validated when you open this input, and Pr5F (Setup of 2nd torque limit) will be validated when you connect this input to COM–.</td></tr>
</table>
• For details of 2nd gain switching function, refer to P.243 "Gain Switching Function" of Adjustment.</td><td>SI
P.84</td></tr>
</table>

<table>
<tr><th>Title of signal</th><th>Pin No.</th><th>Symbol</th><th>Function</th><th>I/F circuit</th></tr>
<tr><td>Electronic gear (division/ multiplication) switching input</td><td>28</td><td>DIV</td><td>• Function varies depending on the control mode.
<table><tr><td>Position/ Full-closed control</td><td>• You can switch the numerator of electronic gear.
• By connecting to COM–, you can switch the numerator of electronic gear from Pr48 (1st numerator of electronic gear) to Pr49 (2nd numerator of electronic gear)
• For the selection of command division/multiplication, refer to the table of next page, "Numerator selection of command scaling"</td></tr><tr><td>Velocity control</td><td>• Input of internal speed selection 3 (INTSPD3).
• You can make up to 8-speed setups combining INH/ INTSPD1 and CL/INTSPD2 inputs. For details of setup, refer to the table of P.131, "Selection of Internal Speed".</td></tr><tr><td>Torque control</td><td>• This input is invalid.</td></tr></table><Caution>
Do not enter the command pulse 10ms before/after switching.
• Numerator selection of electronic gear<table><tr><th>CN X5 Pin-28 DIV</th><th>Setup of electronic gear</th></tr><tr><td>Open</td><td>$\frac{\text{1st numerator of electronic gear (Pr48)} \times 2^{\text{Multiplier of command scaling (Pr4A)}}}{\text{Denominator of electronic gear (Pr4B)}}$
or
$\frac{\text{Encoder resolution*}}{\text{Command pulse counts per single turn (Pr4B)}}$ * Automatic setup by setting up Pr48 to 0</td></tr><tr><td>Short</td><td>$\frac{\text{2nd numerator of electronic gear (Pr49)} \times 2^{\text{Multiplier of command scaling (Pr4A)}}}{\text{Denominator of electronic gear (Pr4B)}}$
or
$\frac{\text{Encoder resolution*}}{\text{Command pulse counts per single turn (Pr4B)}}$ * Automatic setup by setting up Pr49 to 0</td></tr></table></td><td>SI
P.84</td></tr>
<tr><td>Servo-ON input</td><td>29</td><td>SRV-ON</td><td>• Turns to Servo-ON status by connecting this input to COM–.
• Turns to Servo-OFF status by opening connection to COM–, and current to the motor will be shut off.
• You can select the dynamic brake action and the deviation counter clearing action at Servo-OFF with Pr69 (Sequence at Servo-OFF).
<Caution>
1.Servo-ON input becomes valid approx. 2 sec after power-on.
(see P.42, "Timing Chart" of Preparation.)
2.Never run/stop the motor with Servo-ON/OFF.
3.After shifting to Servo-ON, allow 100ms or longer pause before entering the pulse command.</td><td>SI
P.84</td></tr>
</table>

Wiring to the Connector, CN X5

<table>
<tr><th>Title of signal</th><th>Pin No.</th><th>Symbol</th><th>Function</th><th>I/F circuit</th></tr>
<tr><td>Deviation counter clear input</td><td>30</td><td>CL</td><td>• Function varies depending on the control mode.
<table>
<tr><td>Position/ Full-closed control</td><td>• Input (CL) which clears the positional deviation counter and full-closed deviation counter.
• You can clear the counter of positional deviation and full-closed deviation by connecting this to COM–.
• You can select the clearing mode with Pr4E (Counter clear input mode).
<table>
<tr><th>Pr4E</th><th>Content</th></tr>
<tr><td>0</td><td>Clears the counter of positional deviation and full-closed deviation while CL is connected to COM–.</td></tr>
<tr><td>1
[Default]</td><td>Clears the counter of positional deviation and full-closed deviation only once by connecting CL to COM– from open status.</td></tr>
<tr><td>2</td><td>CL is invalid</td></tr>
</table></td></tr>
<tr><td>Velocity control</td><td>• Input of selection 2 of internal command speed (INTSPD2)
• You can make up to 8-speed setups combining INH/INTSPD1 and CL/INTSPD3 inputs. For details of setup, refer to the table in P.131, "Selection of Internal Speed" of Velocity Control Mode.</td></tr>
<tr><td>Torque control</td><td>• This input is invalid.</td></tr>
</table></td><td>SI
P.84</td></tr>
<tr><td>Alarm clear input</td><td>31</td><td>A-CLR</td><td>• You can release the alarm status by connecting this to COM– for more than 120ms.
• The deviation counter will be cleared at alarm clear.
• There are some alarms which cannot be released with this input.
For details, refer to P.252, "Protective Function " of When in Trouble.</td><td>SI
P.84</td></tr>
<tr><td>Control mode switching input</td><td>32</td><td>C-MODE</td><td>• You can switch the control mode as below by setting up Pr02 (Control mode setup) to 3-5.
<table>
<tr><th>Pr02 setup</th><th>Open (1st)</th><th>Connection to COM– (2nd)</th></tr>
<tr><td>3</td><td>Position control</td><td>Velocity control</td></tr>
<tr><td>4</td><td>Position control</td><td>Torque control</td></tr>
<tr><td>5</td><td>Velocity control</td><td>Torque control</td></tr>
</table>
<Caution>
Depending on how the command is given at each control mode, the action might change rapidly when switching the control mode with C-MODE. Pay an extra attention.</td><td>SI
P.84</td></tr>
<tr><td>Inhibition input of command pulse</td><td>33</td><td>INH</td><td>• Function varies depending on the control mode.
<table>
<tr><td>Position/ Full closed control</td><td>• Inhibition input of command pulse input (INH)
• Ignores the position command pulse by opening the connection to COM–
• You can invalidate this input with Pr43 (Invalidation of command pulse inhibition input)
<table>
<tr><th>Pr43</th><th>Content</th></tr>
<tr><td>0</td><td>INH is valid.</td></tr>
<tr><td>1(Default)</td><td>INH is valid.</td></tr>
</table></td></tr>
<tr><td>Velocity control</td><td>• Selection 1 input of internal command speed (INTSPD1)
•You can make up to 8-speed setups combining INH/INTSPD2 and CL/INTSPD3 inputs. For details of the setup, refer to the table of P.131,
"Selection of Internal Speed" of Velocity Control Mode.</td></tr>
<tr><td>Torque control</td><td>• This input is invalid.</td></tr>
</table></td><td>SI
P.84</td></tr>
</table>

Input Signals (Pulse Train) and Their Functions

You can select appropriate interface out of two kinds, depending on the command pulse specifications.

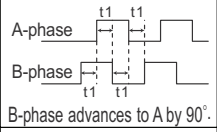
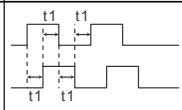
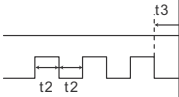
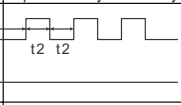
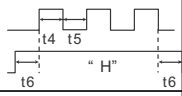
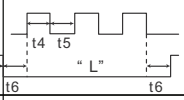
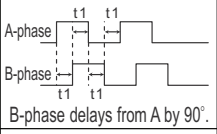
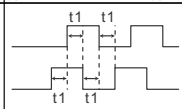
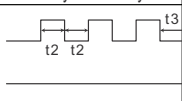
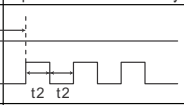
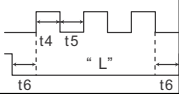
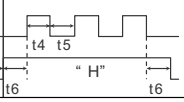
• Pulse train interface exclusive for line driver

Title of signal	Pin No.	Symbol	Function	I/F circuit
Command pulse input 1	44	PULSH1	• Input terminal for position command pulse. You can select by setting up Pr40 (Selection of command pulse input) to 1. • This input becomes invalid at such control mode as velocity control or torque control, where no position command is required. • Permissible max. input frequency is 2Mpps. • You can select up to 6 command pulse input formats with Pr41 (Setup of command pulse rotational direction) and Pr42 (Setup of command pulse input mode). For details, refer to the table below, "Command pulse input format".	PI2 P.84
	45	PULSH2		
Command pulse sign input 1	46	SIGNH1		
	47	SIGNH2		

• Pulse train interface

Title of signal	Pin No.	Symbol	Function	I/F circuit
Command pulse input 2	1	OPC1	• Input terminal for the position command. You can select by setting up Pr40 (Selection of command pulse input) to 0. • This input becomes invalid at such control mode as the velocity control or torque control, where no position command is required. • Permissible max. input frequency is 500kpps at line driver input and 200kpps at open collector input. • You can select up to 6 command pulse input formats with Pr41 (Setup of command pulse rotational direction) and Pr42 (Setup of command pulse input mode). For details, refer to the table below, "Command pulse input format".	PI1 P.84
	3	PULS1		
	4	PULS2		
Command pulse sign input 2	2	OPC2		
	5	SIGN1		
	6	SIGN2		

• Command pulse input format

Pr41 Setup value (Setup of command pulse rotational direction)	Pr42 Setup value (Setup of command pulse input mode)	Command pulse format	Signal title	CCW command	CW command
0	0 or 2	2-phase pulse with 90° difference (A+ B-phase)	PULS SIGN	 B-phase advances to A by 90°.	 B-phase delays from A by 90°.
	1	CW pulse train + CCW pulse train	PULS SIGN		
	3	Pulse train + Sign	PULS SIGN		
1	0 or 2	2-phase pulse with 90° difference (A+ B-phase)	PULS SIGN	 B-phase delays from A by 90°.	 B-phase advances to A by 90°.
	1	CW pulse train + CCW pulse train	PULS SIGN		
	3	Pulse train + Sign	PULS SIGN		

- PULS and SIGN represents the outputs of pulse train in put circuit. Refer to the fig. of P.84, "Input Circuit".
- In case of CW pulse train + CCW pulse train and pulse train + sign, pulse train will be cap tured at the rising edge.
- In case of 2-phase pulse, pulse train will be captured at each edge.

• Permissible max. input frequency of command pulse input signal and min. necessary time width

Input I/F of PULS/SIGN signal		Permissible max. input frequency	Minimum necessary time width					
			t_1	t_2	t_3	t_4	t_5	t_6
Pulse train interface exclusive for line driver		2Mpps	500ns	250ns	250ns	250ns	250ns	250ns
Pulse train interface	Line driver interface	500kpps	2μs	1μs	1μs	1μs	1μs	1μs
	Open collector interface	200kpps	5μs	2.5μs	2.5μs	2.5μs	2.5μs	2.5μs

Set up the rising/falling time of command pulse input signal to 0.1μs or shorter.

Wiring to the Connector, CN X5

Input Signals (Analog Command) and Their Functions

<table>
<tr><th>Title of signal</th><th>Pin No.</th><th>Symbol</th><th>Function</th><th>I/F circuit</th></tr>
<tr>
<td>Speed command input
or
Torque command input</td>
<td>14</td>
<td>SPR

TRQR</td>
<td>• Function varies depending on control mode.
<table>
<tr><th>Pr02</th><th>Control mode</th><th>Function</th></tr>
<tr><td>3</td><td>Position/ Velocity</td><td>• Input of external speed command (SPR) when the velocity control is selected.
• Set up the gain, polarity, offset and filter of the Speed command with;
Pr50 (Speed command input gain)
Pr51 (Speed command input reversal)
Pr52 (Speed command offset)
Pr57 (Speed command filter setup)</td></tr>
<tr><td>4</td><td>Position/ Torque</td><td>• Function varies depending on Pr5B (Selection of torque command)
<table>
<tr><th>Pr5B</th><th>Content</th></tr>
<tr><td>0</td><td>• Torque command (TRQR) will be selected.
• Set up the torque (TRQR) gain, polarity, offset and filter with;
Pr5C (Torque command input gain)
Pr5D (Torque command input reversal)
Pr52 (Speed command offset)
Pr57 (Speed command filter setup)</td></tr>
<tr><td>1</td><td>• Speed limit (SPL) will be selected.
• Set up the speed limit (SPL) gain, offset and filter with;
Pr50 (Speed command input gain)
Pr52 (Speed command offset)
Pr57 (Speed command filter setup)</td></tr>
</table></td></tr>
<tr><td>Others</td><td>Other control mode</td><td>• This input is invalid.</td></tr>
</table>
•The resolution of the A/D converter used in this input is 16 bit (including 1 bit for sign).
± 32767 (LSB) = ± 10[V] , 1[LSB] = 0.3[mV]</td>
<td>AI
P.84</td>
</tr>
</table>

*Function becomes valid when the control mode with underline (▭ / <u>▭</u>)

<Remark>

Do not apply voltage exceeding ±10V to analog command input of SPR/TRQR.

<table>
<tr><th>Title of signal</th><th>Pin No.</th><th>Symbol</th><th>Function</th><th>I/F circuit</th></tr>
<tr><td>CCW-Torque limit input</td><td>16</td><td>CCWTL</td><td>• Function varies depending on Pr02 (Control mode setup).
<table>
<tr><th>Pr02</th><th>Control mode</th><th>Function</th></tr>
<tr><td>2
4</td><td>Torque Control
Position/Torque</td><td>• Function varies depending on Pr5B (Selection of torque command)
<table>
<tr><th>Pr5B</th><th>Content</th></tr>
<tr><td>0</td><td>This input becomes invalid.</td></tr>
<tr><td>1</td><td>• Torque command input (TRQR) will be selected.
• Set up the gain and polarity of the command with;
Pr5C (Torque command input gain)
Pr5D (Torque command input reversal)
• Offset and filter cannot be set up.</td></tr>
</table></td></tr>
<tr><td>5</td><td>Velocity/
Torque</td><td>• Becomes to the torque command input (TRQR).
• Set up the gain and polarity of the command with;
Pr5C (Torque command input gain)
Pr5D (Torque command input reversal)
• Offset and filter cannot be set up.</td></tr>
<tr><td>4
5
Other</td><td><u>Position</u>/Torque
Velocity/Torque
Other
control mode</td><td>• Becomes to the analog torque limit input to CCW (CCWTL).
• Limit the CCW-torque by applying positive voltage (0 to + 10V) (Approx.+ 3V/rated toque)
• Invalidate this input by setting up Pr03 (Torque limit selection) to other than 0.</td></tr>
</table>
• Resolution of A/D converter used in this input is 16 bit (including 1 bit for sign).
± 511 [LSB] ≒ 11.9[V] , 1 [LSB] ≒ 23[mV]</td><td>AI
P.84</td></tr>
<tr><td>CW-Torque limit input</td><td>18</td><td>CWTL</td><td>• Function varies depending on Pr02 (Control mode setup).
<table>
<tr><th>Pr02</th><th>Control mode</th><th>Function</th></tr>
<tr><td>2
4
5</td><td>Torque control
<u>Position</u>/Torque
Velocity/<u>Torque</u></td><td>• This input becomes invalid when the torque control is selected.</td></tr>
<tr><td>4
5
Other</td><td><u>Position</u>/Torque
Velocity/Torque
Other
control mode</td><td>• Becomes to the analog torque limit input to CW (CWTL).
• Limit the CW-torque by applying negative voltage (0 to –10V) (Approx.+ 3V/rated toque).
Invalidate this input by setting up Pr03 (Torque limit selection) to other than 0.</td></tr>
</table>
• Resolution of A/D converter used in this input is 16 bit (including 1 bit for sign).
± 511 [LSB] ≒ 11.9[V] , 1 [LSB] ≒ 23[mV]</td><td>AI
P.84</td></tr>
</table>

*Function becomes valid when the control mode with underline (▭ / <u>▭</u>) is selected while the switching mode is used in the control mode in table.

<Remark>

Do not apply voltage exceeding ±10V to analog command input of CWTL and CCWTL

Wiring to the Connector, CN X5

Output signal and Pin No. of the Connector, CN X5

Output Signals (Common) and Their Functions

Title of signal	Pin No	Symbol	Function	I/F circuit
External brake release signal	**11** **10**	**BRKOFF+** **BRKOFF–**	• Feeds out the timing signal which activates the electromagnetic brake of the motor. • Turns the output transistor ON at the release timing of the electro-magnetic brake. • You can set up the output timing of this signal with Pr6A (Setup of mechanical brake action at stall) and Pr6B (Setup of mechanical brake action at motion). For details, refer to P42, "Timing Chart" of Preparation.)	SO1 P.85
Servo-Ready output	**35** **34**	**S-RDY+** **S-RDY–**	• This signal shows that the driver is ready to be activated. • Output transistor turns ON when both control and main power are ON but not at alarm status.	SO1 P.85
Servo-Alarm output	**37** **36**	**ALM+** **ALM–**	• This signal shows that the driver is in alarm status.. • Output transistor turns ON when the driver is at normal status, and turns OFF at alarm status.	SO1 P.85
Positioning complete (In-position)	**39** **38**	**AT-SPEED+** **AT-SPEED–**	• Function varies depending on the control mode. **Position control**: • Output of positioning complete (COIN) • The output transistor will turn ON when the absolute value of the position deviation pulse becomes smaller than the setup value of Pr60 (Positioning complete range). • You can select the feeding out method with Pr63 (Setup of positioning complete output). **Full-closed control**: • Output of full-closed positioning complete (EX-COIN) • The output transistor will turn ON when the absolute value of full-closed-position deviation pulse becomes smaller than the setup value of Pr60 (Positioning complete range). • You can select the feeding out method with Pr63 (Setup of positioning complete output). **Velocity/ Torque control**: • Output at-speed (speed arrival) (AT-SPEED) • The output transistor will turn ON when the actual motor speed exceeds the setup value of Pr62 (In-speed).	SO1 P.85
Zero-speed detection output signal	**12** **(41)**	**ZSP** **(COM–)**	• Content of the output signal varies depending on Pr0A (Selection of ZSP output). • Default is 1, and feeds out the zero speed detection signal. • For details, see the table below, "Selection of TLC,ZSP output".	SO2 P.85
Torque in-limit signal output	**40** **(41)**	**TLC** **(COM–)**	• Content of the output signal varies depending on Pr09 (Selection of TLC output). • Default is 1, and feeds out the torque in-limit signal. • For details, see the table below, "Selection of TLC,ZSP output".	SO2 P.85

• Selection of TCL and ZSP outputs

Value of Pr09 or Pr0A	X5 TLC : Output of Pin-40	X5 ZSP : Output of Pin-12
0	**• Torque in-limit output (Default of X5 TLC Pr09)** The output transistor turns ON when the torque command is limited by the torque limit during Servo-ON.	
1	**• Zero-speed detection output (Default of X5 ZSP Pr0A)** The output transistor turns ON when the motor speed falls under the preset value with Pr61.	
2	**• Alarm signal output** The output transistor turns ON when either one of the alarms is triggered, over-regeneration alarm, overload alarm, battery alarm, fan-lock alarm or external scale alarm.	
3	**• Over-regeneration alarm** The output transistor turns ON when the regeneration exceeds 85% of the alarm trigger level of the regenerative load protection.	
4	**• Over-load alarm** The output transistor turns ON when the load exceeds 85% of the alarm trigger level of the overload alarm.	
5	**• Battery alarm** The output transistor turns ON when the battery voltage for absolute encoder falls lower than approx. 3.2V.	
6	**• Fan-lock alarm** The output transistor turns ON when the fan stalls for longer than 1s.	
7	**• External scale alarm** The output transistor turns ON when the external scale temperature exceeds 65°, or signal intensity is not enough (adjustment on mounting is required). Valid only at the full-closed control.	
8	**• In-speed (Speed coincidence) output** The output transistor turns ON when the difference between the actual motor speed and the speed command before acceleration/deceleration reaches within the preset range with Pr61. Valid only at the velocity and torque control.	

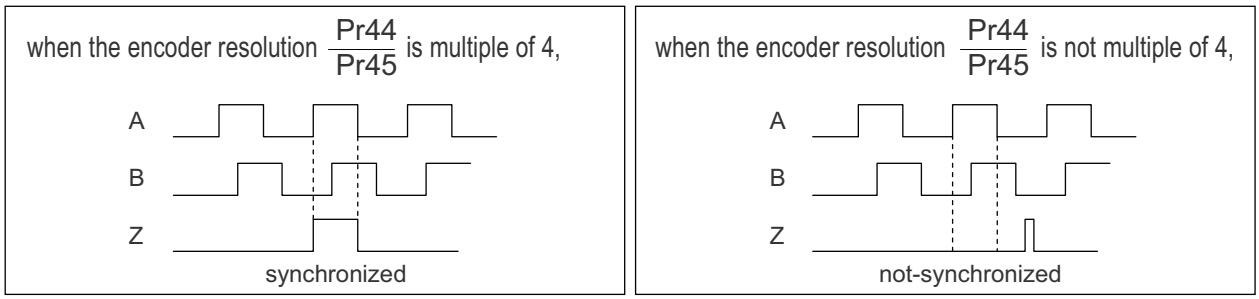
Output Signals (Pulse Train) and Their Functions

Title of signal	Pin No	Symbol	Function	I/F circuit
A-phase output	21	OA +	• Feeds out the divided encoder signal or external scale signal (A, B, Z-phase) in differential. (equivalent to RS422) • You can set up the division ratio with Pr44 (Numerator of pulse output division) and Pr45 (Denominator of pulse output division) • You can select the logic relation between A-phase and B-phase, and the output source with Pr46 (Reversal of pulse output logic). • When the external scale is made as an output source, you can set up the interval of Z-phase pulse output with Pr47 (Setup of external scale Z-phase). • Ground for line driver of output circuit is connected to signal ground (GND) and is not insulated. • Max. output frequency is 4Mpps (after quadrupled)	PO1 P.85
	22	OA –		
B-phase output	48	OB +		
	49	OB –		
Z-phase output	23	OZ +		
	24	OZ –		
Z-phase output	19	CZ	• Open collector output of Z-phase signal • The emitter side of the transistor of the output circuit is connected to the signal ground (GND) and is not insulated.	PO2 P.85

<Note>

• When the output source is the encoder

• If the encoder resolution X $\frac{Pr44}{Pr45}$ is multiple of 4, Z-phase will be fed out synchronizing with A-phase.
In other case, the Z-phase width will be equal to the encoder resolution, and will not synchronize with A-phase because of narrower width than that of A-phase.



• In case of the 5-wire, 2500P/r incremental encoder, the signal sequence might not follow the above fig. until the first Z-phase is fed out. When you use the pulse output as the control signal, rotate the motor one revolution or more to make sure that the Z-phase is fed out at least once before using.

Wiring to the Connector, CN X5

Output Signals (Analog) and Their Functions

<table>
<tr><th>Title of signal</th><th>Pin No</th><th>Symbol</th><th>Function</th><th>I/F circuit</th></tr>
<tr><td>Torque monitor signal output</td><td>42</td><td>IM</td><td>• The content of output signal varies depending on Pr08 (Torque monitor (IM) selection).
• You can set up the scaling with Pr08 value.
<table>
<tr><th>Pr08</th><th>Content of signal</th><th>Function</th></tr>
<tr><td>0,
11,12</td><td>Torque command</td><td>• Feeds out the voltage in proportion to the motor torque command with polarity.
+ : generates CCW torque
– : generates CW torque</td></tr>
<tr><td>1 – 5</td><td>Positional deviation</td><td>• Feeds out the voltage in proportion to the positional deviation pulse counts with polarity.
+ : positional command to CCW of motor position
– : positional command to CW of motor position</td></tr>
<tr><td>6 –10</td><td>Full-closed deviation</td><td>• Feeds out the voltage in proportion to the full-closed deviation pulse counts with polarity.
+ : positional command to CCW of external scale position
– : positional command to CW of external scale position</td></tr>
</table></td><td>AO
P.85</td></tr>
<tr><td>Speed monitor signal output</td><td>43</td><td>SP</td><td>• The content of the output signal varies depending on Pr07 (Speed monitor (IM) selection).
• You can set up the scaling with Pr07 value.
<table>
<tr><th>Pr07</th><th>Control mode</th><th>Function</th></tr>
<tr><td>0 – 4</td><td>Motor speed</td><td>• Feeds out the voltage in proportion to the motor speed with polarity. + : rotates to CCW
– : rotates to CW</td></tr>
<tr><td>5 – 9</td><td>Command speed</td><td>• Feeds out the voltage in proportion to the command speed with polarity.
+ : rotates to CCW
– : rotates to CW</td></tr>
</table></td><td>AO
P.85</td></tr>
</table>

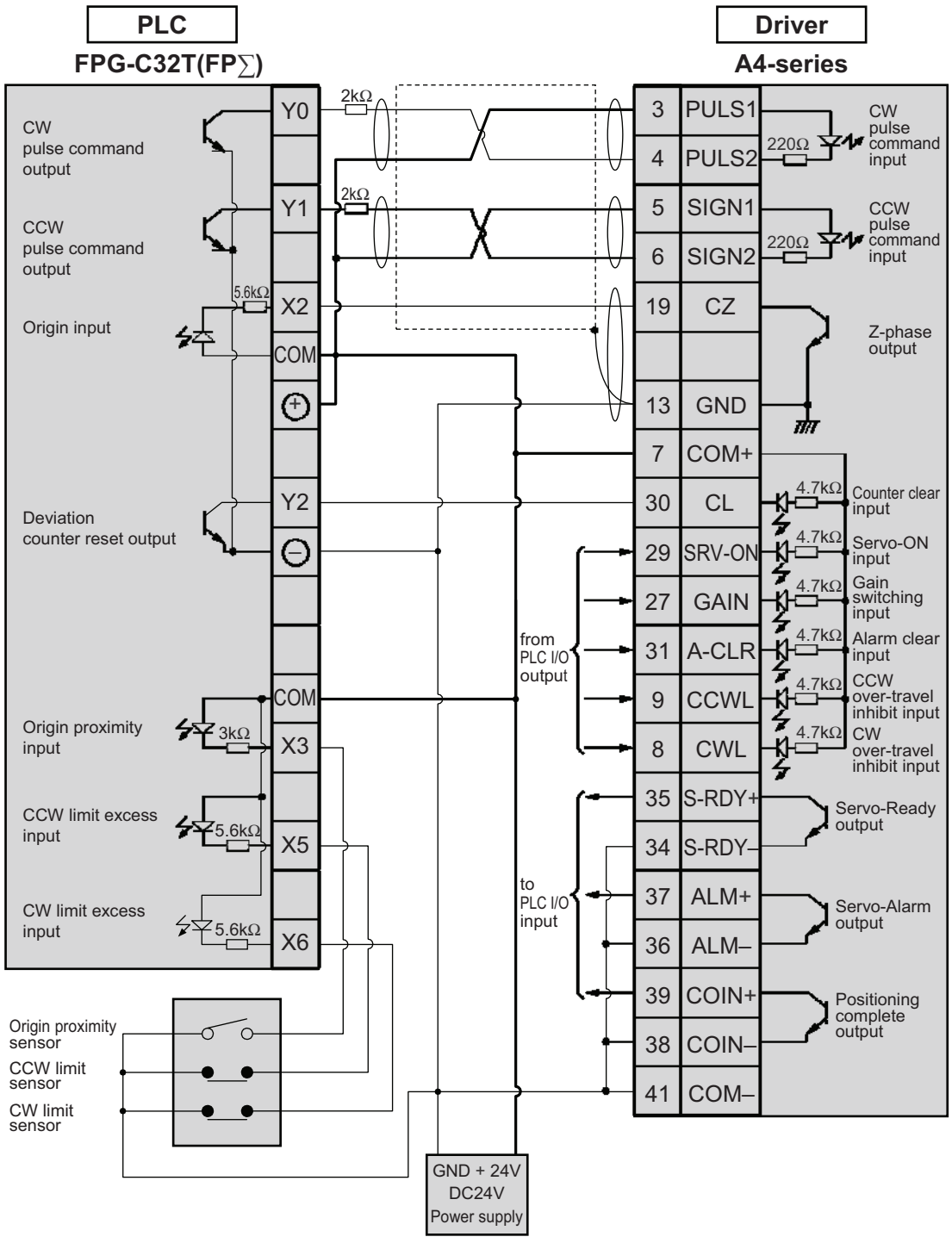
Output Signals (Others) and Their Functions

Title of signal	Pin No	Symbol	Function	I/F circuit
Signal ground	**13,15, 17,25**	**GND**	• Signal ground • This output is insulated from the control signal power (COM–) inside of the driver.	–
Frame ground	**50**	**FG**	• This output is connected to the earth terminal inside of the driver.	–

Wiring to the Connector, CN X5

Connecting Example to Host Controller

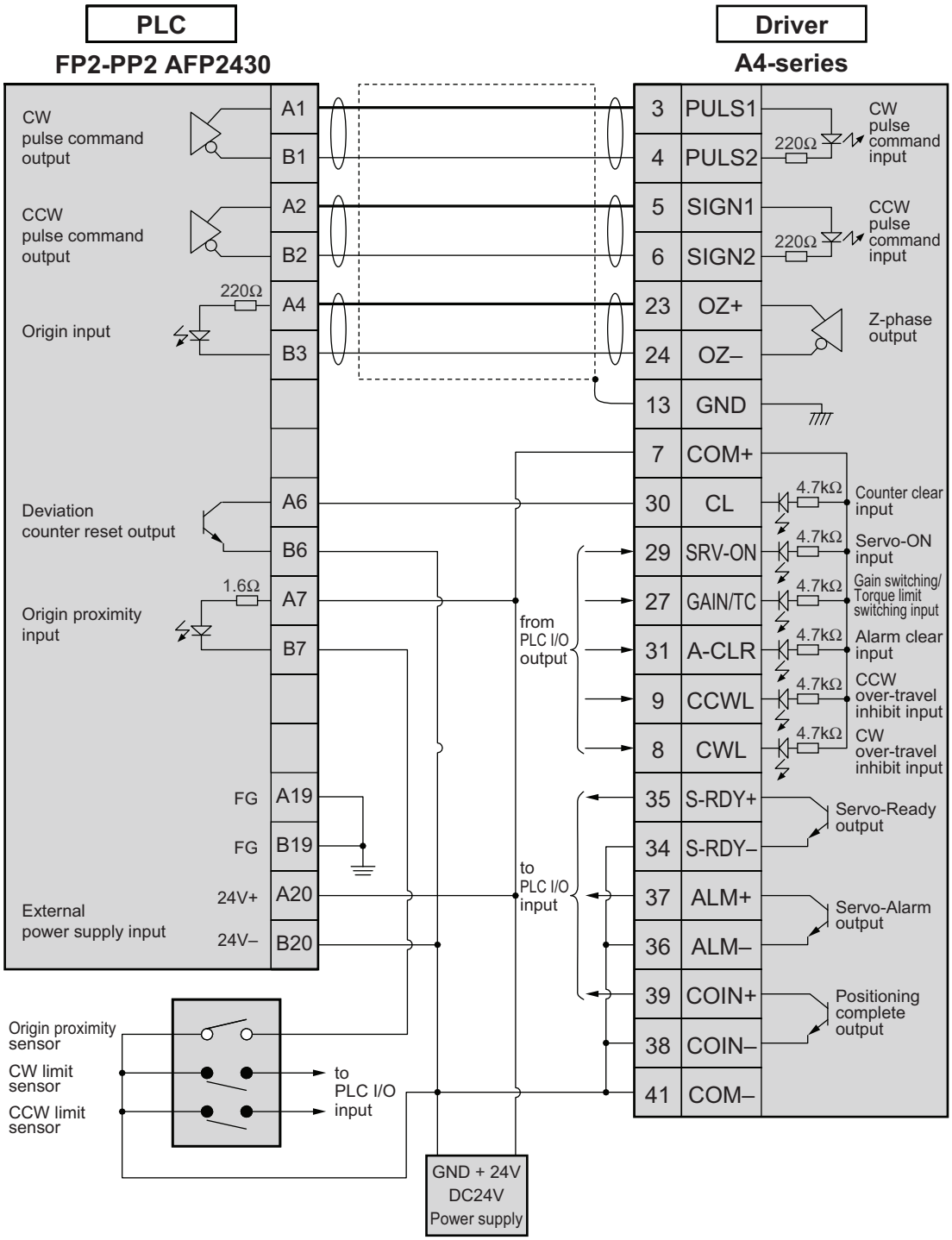
Matsushita Electric Works, FPG-C32T



<Remark>

represents twisted pair wire.

Matsushita Electric Works, FP2-PP2 AFP2430

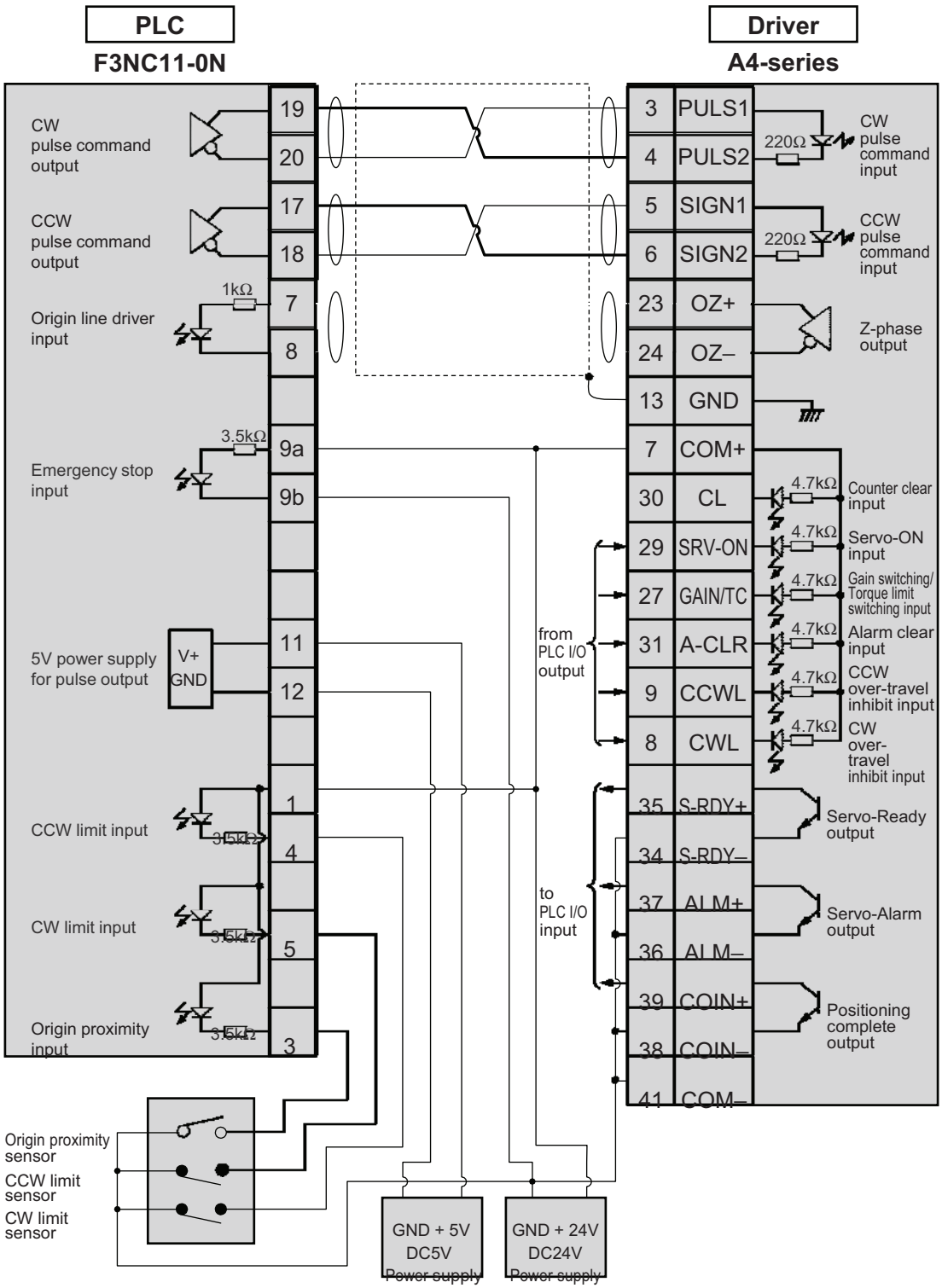


<Remark>

represents twisted pair wire.

Wiring to the Connector, CN X5

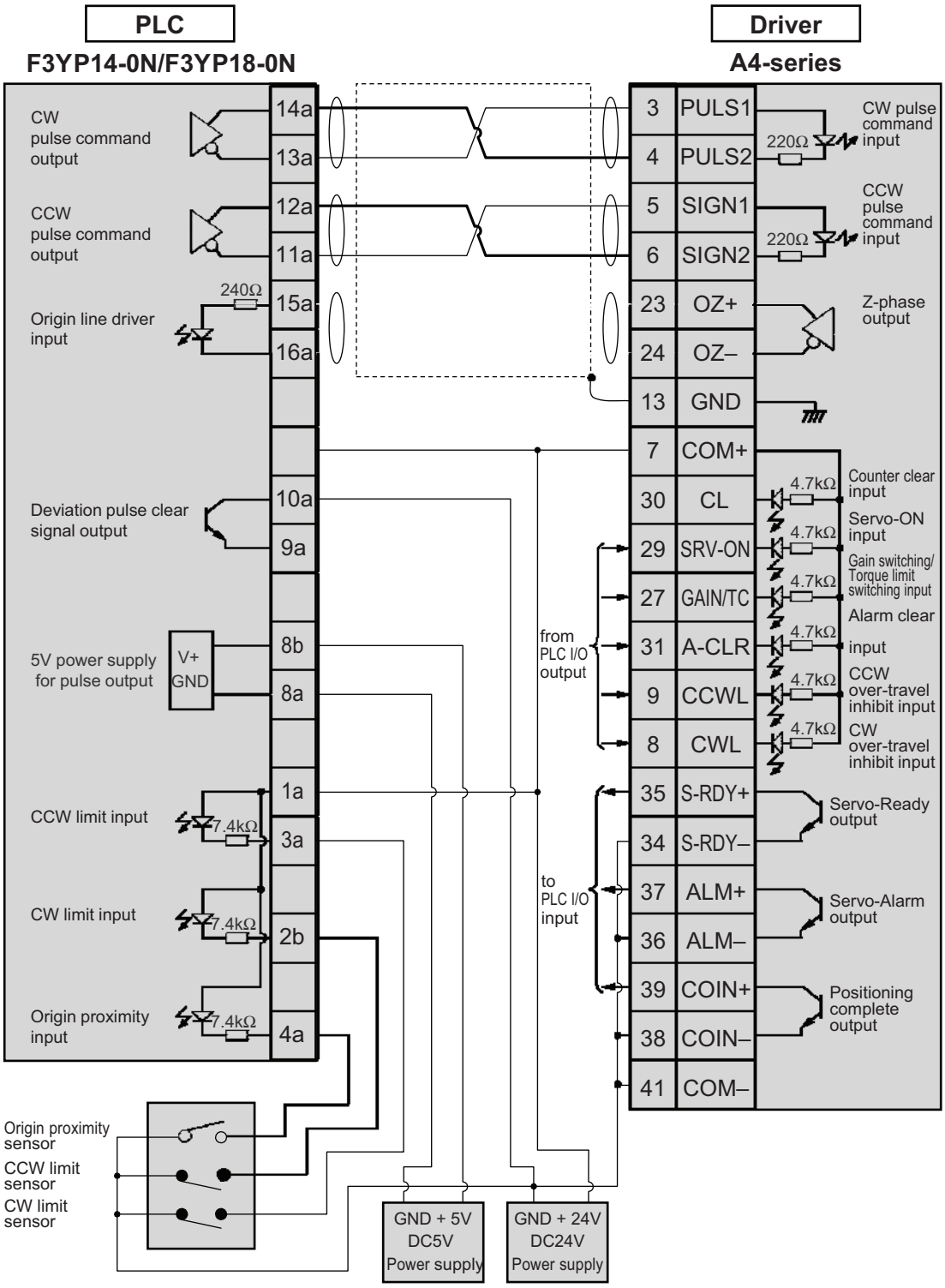
Yokogawa Electric , F3NC11-ON



<Remark>

represents twisted pair wire.

Yokogawa Electric , F3YP14-0N/F3YP18-0N

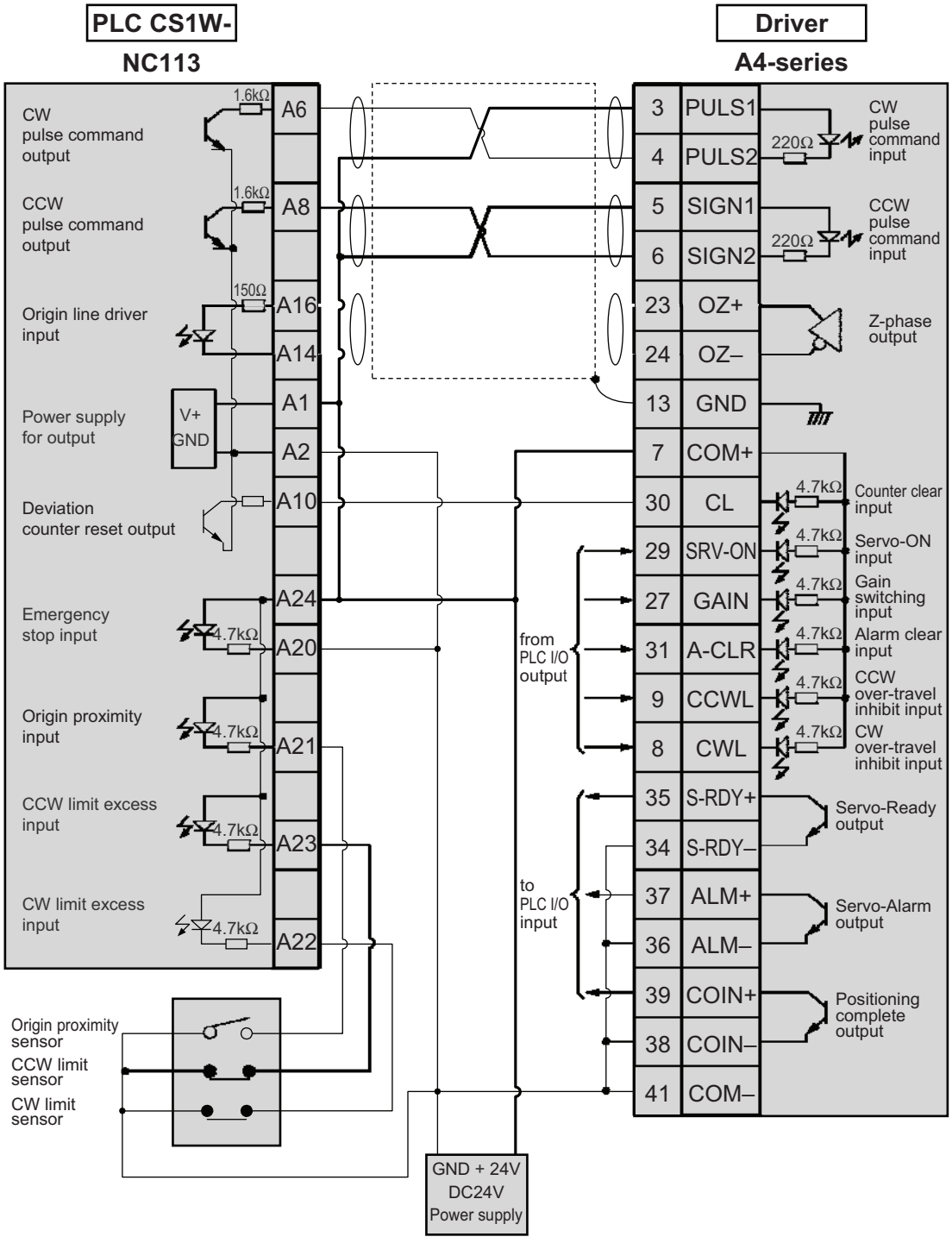


<Remark>

represents twisted pair wire.

Wiring to the Connector, CN X5

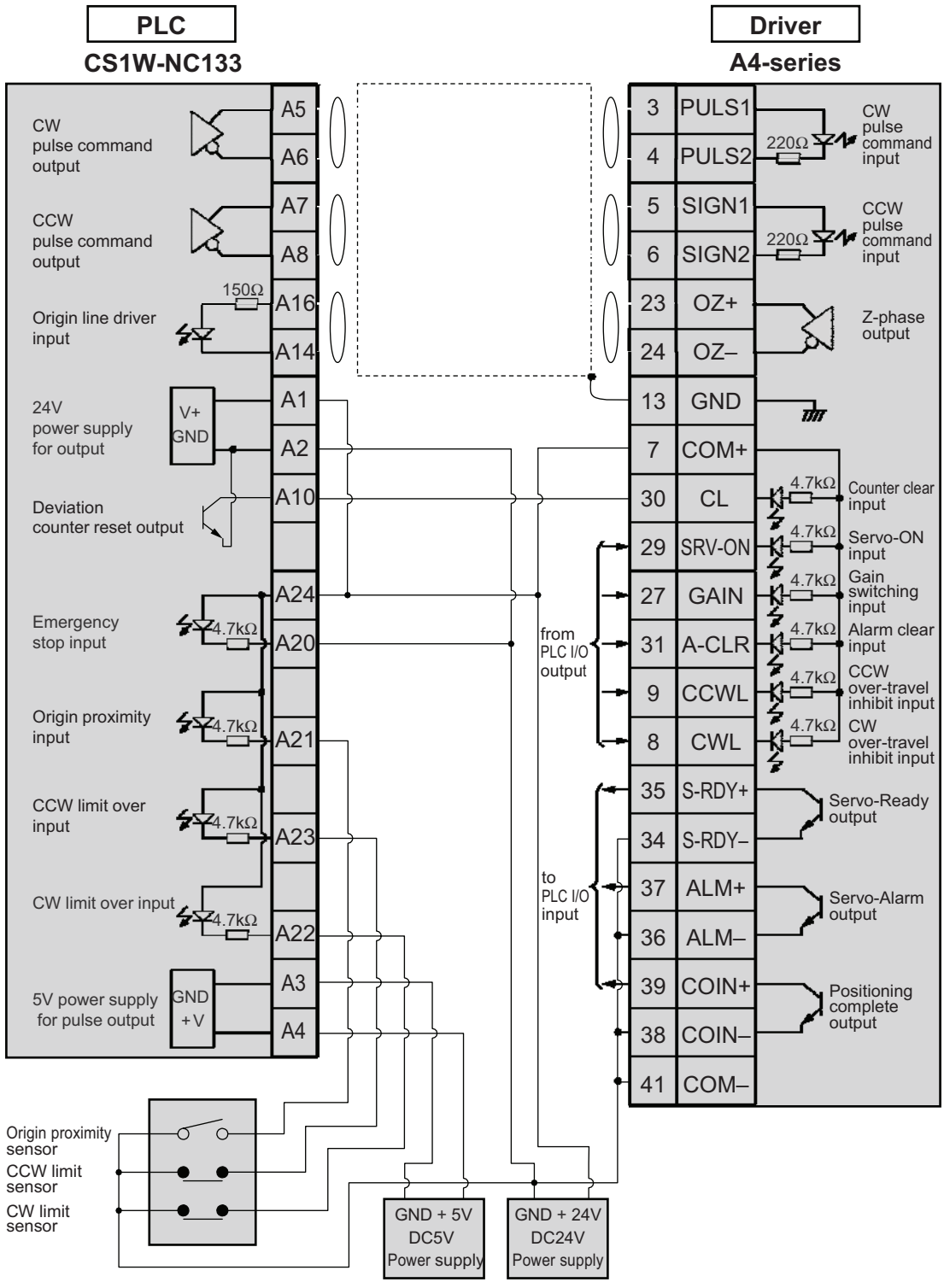
Omron, CS1W-NC113



<Remark>

represents twisted pair wire.

Omron, CS1W-NC133

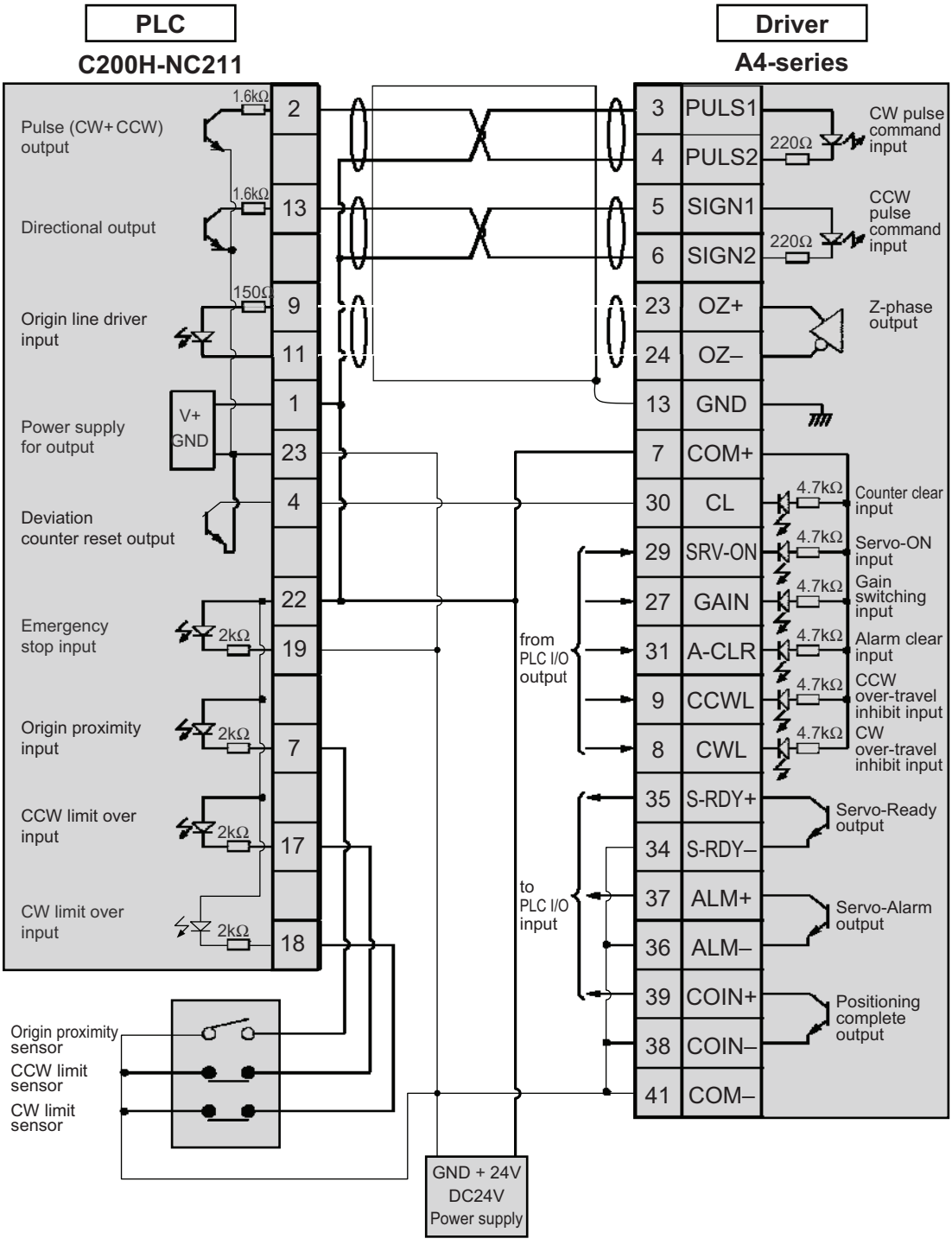


<Remark>

represents twisted pair wire.

Wiring to the Connector, CN X5

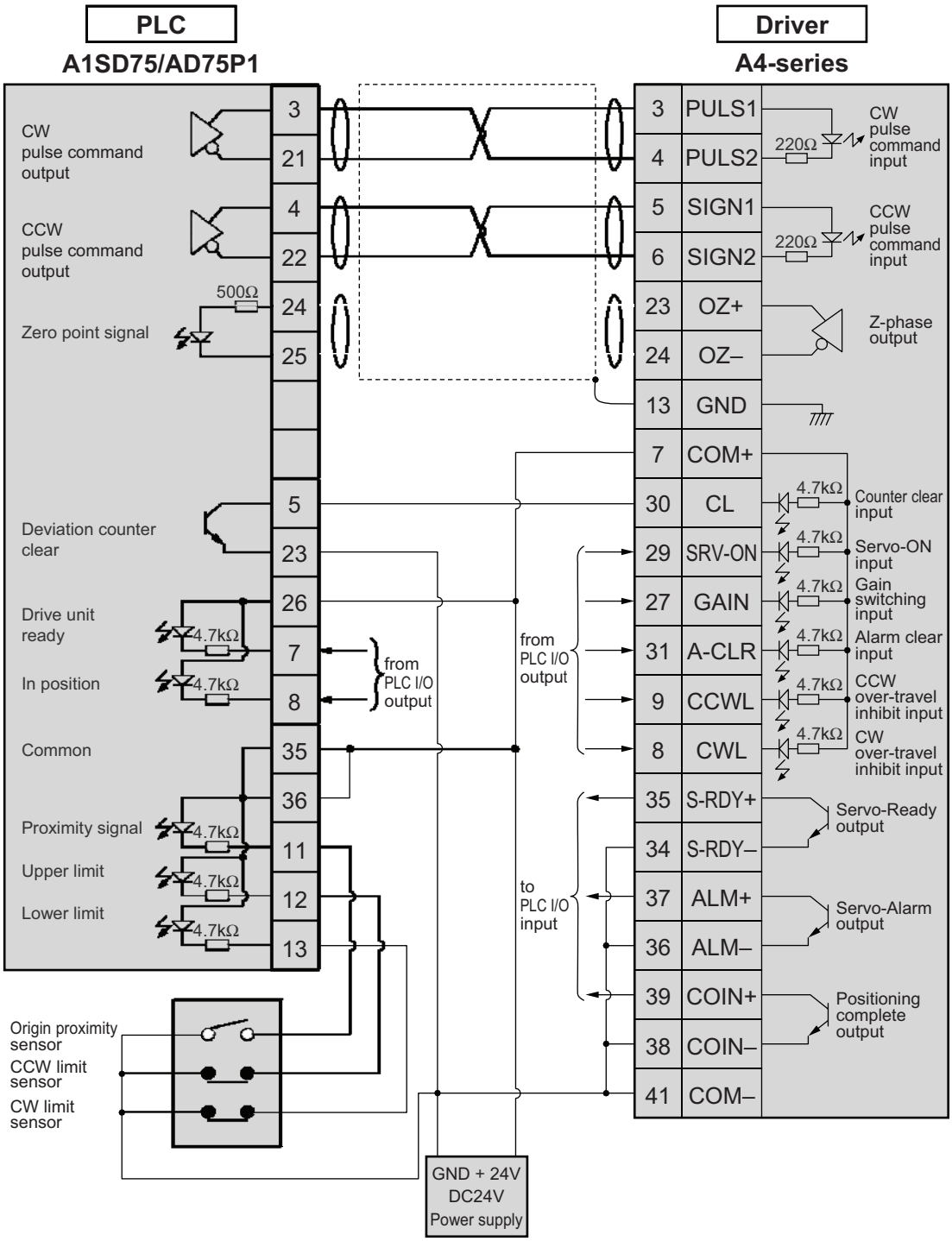
Omron, C200H-NC211



<Remark>

represents twisted pair wire.

Mitsubishi, A1SD75/AD75P1



<Remark>

represents twisted pair wire.

Trial Run (JOG run) at Position Control Mode

Inspection Before Trial Run

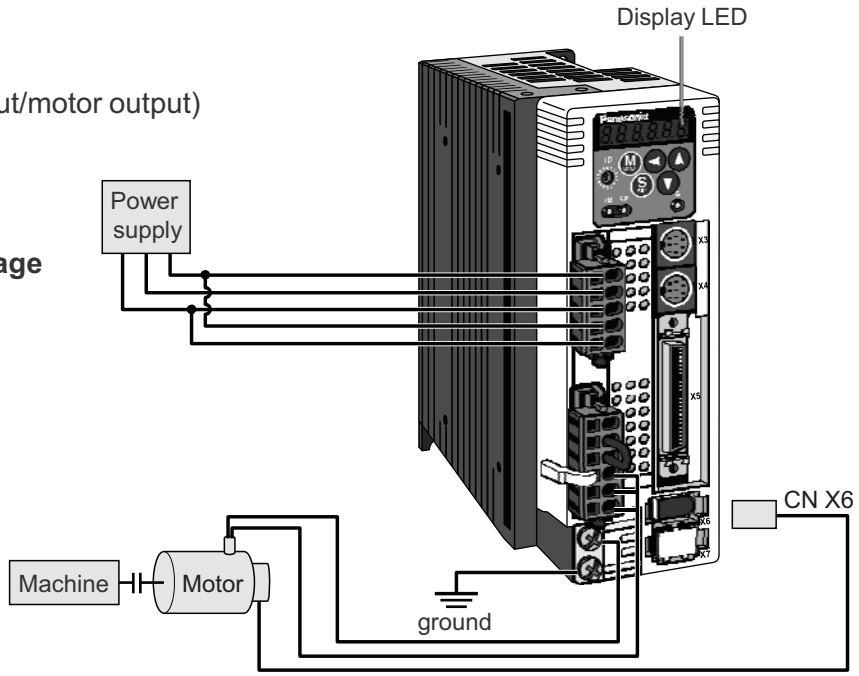
(1) Wiring inspection
- Miswiring
  (Especially power input/motor output)
- Short/Earth
- Loose connection

(2) Check of power/voltage
- Rated voltage

(3) Fixing of the motor
- Unstable fixing

(4) Separation from mechanical system

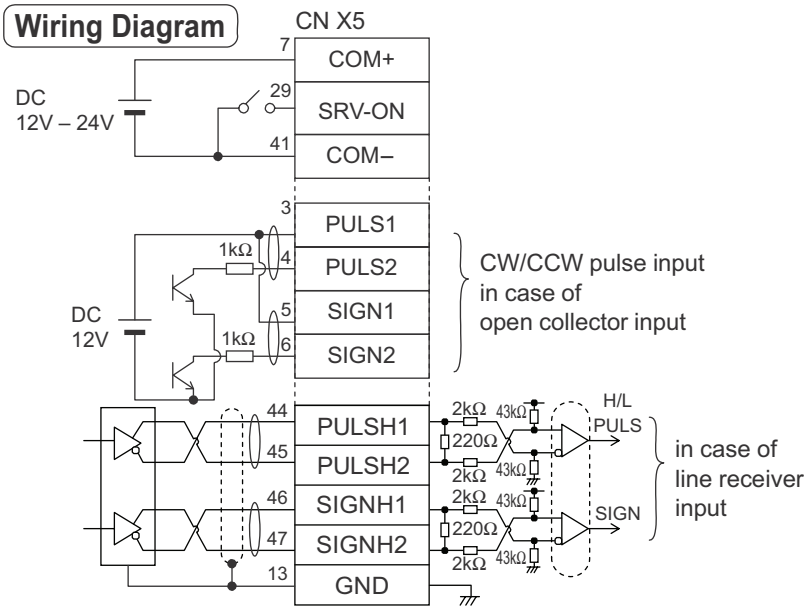
(5) Release of the brake



Trial Run by Connecting the Connector, CN X5

(1) Connect the CN X5.
(2) Enter the power (DC12 to 24V) to control signal (COM+ , COM–)
(3) Enter the power to the driver.
(4) Confirm the default values of parameters.
(5) Match to the output format of the host controller with Pr42 (Command pulse input mode setup).
(6) Write to EEPROM and turn off/on the power (of the driver).
(7) Connect the Servo-ON input (SRV-ON, CN X5, Pin-29) and COM– (CN X5, Pin-41) to bring the driver to Servo-ON status and energize the motor.
(8) Enter low frequency from the host controller to run the motor at low speed.
(9) Check the motor rotational speed at monitor mode whether,
rotational speed is as per the setup or not, and
the motor stops by stopping the command (pulse) or not.
(10) If the motor does not run correctly, refer to P.68, "Display of Factor for No-Motor Running" of Preparation.

Wiring Diagram



Parameter

PrNo.	Title	Setup value
02	Setup of control mode	0
04	Invalidation of over-travel inhibit input	1
40	Selection of command pulse input	0/1
42	Mode setup of command pulse input	1
43	Inhibition setup of command pulse input	1
4E	Counter clear mode	2

• Enter command pulses from the host controller.

Input signal status

No.	Title of signal	Monitor display
0	Servo-ON	+ A

Setup of Motor Rotational Speed and Input Pulse Frequency

Input pulse frequency (pps)	Motor rotational speed (r/min)	$\frac{Pr48 \times 2^{Pr4A}}{Pr4B}$	
		17-bit	2500P/r
2M	3000	$\frac{1 \times 2^{15}}{10000}$	$\frac{2500 \times 2^{0}}{10000}$
500K	3000	$\frac{1 \times 2^{17}}{10000}$	$\frac{10000 \times 2^{0}}{10000}$
250K	3000	$\frac{1 \times 2^{17}}{5000}$	$\frac{10000 \times 2^{0}}{5000}$
100K	3000	$\frac{1 \times 2^{17}}{2000}$	$\frac{10000 \times 2^{0}}{2000}$
500K	1500	$\frac{1 \times 2^{16}}{10000}$	$\frac{50000 \times 2^{0}}{10000}$

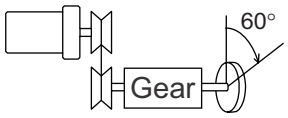
<Note>

Defaults of Pr48 and Pr49 are both 0, and encoder resolution is automatically set up as numerators.Defaults of Pr48 and Pr49 are both 0, and encoder resolution is automatically set up as numerators.

<Remarks>

- Max. input pulse frequency varies depending on input terminals.
- You can set up any values to numerator and denominator, however, setup of an extreme division ratio or multiplication ratio may result in dangerous action. Recommended ratio is 1/50-20.

Relation between the motor rotational speed and input pulse counts



Pulley ratio : $\frac{18}{60}$

Gear ratio : $\frac{12}{73}$

Total reduction ratio : $\frac{18}{365}$

e.g.) When you want to rotate the motor by 60° with the load of total reduction ratio of 18/365.

	Encoder	
	17-bit	2500P/r
$\frac{Pr48 \times 2^{Pr4A}}{Pr4B}$	$\frac{365 \times 2^{10}}{6912}$	$\frac{365 \times 2^{0}}{108}$
Command pulse	To rotate the output shaft by 60°, enter the command of 8192 (2^{13}) pulses from the host controller.	To rotate the output shaft by 60°, enter the command of 10000 pulses from the host controller.
How to determine parameter	$\frac{365}{18} \times \frac{1 \times 2^{17}}{2^{13}} \times \frac{60^\circ}{360^\circ}$ $= \frac{365 \times 2^{17}}{884736}$ Hence the obtained numerator becomes 47841280> 2621440 and denominator exceeds the max value of 10000, you have to reduce to the common denominator to obtain. $\frac{365}{18} \times \frac{1 \times 2^{10}}{2^{6}} \times \frac{60^\circ}{360^\circ}$ $= \frac{365 \times 2^{10}}{6912}$	$\frac{365}{18} \times \frac{10000}{10000} \times \frac{60^\circ}{360^\circ}$ $= \frac{365 \times 2^{0}}{108}$

2^n	Decimal figures
2^0	1
2^1	2
2^2	4
2^3	8
2^4	16
2^5	32
2^6	64
2^7	128
2^8	256
2^9	512
2^{10}	1024
2^{11}	2048
2^{12}	4096
2^{13}	8192
2^{14}	16384
2^{15}	32768
2^{16}	65536
2^{17}	131072

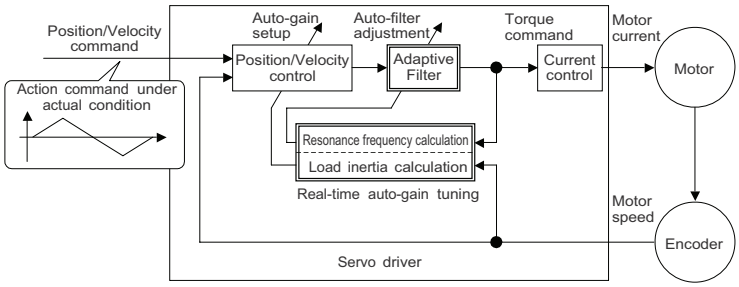
*Refer to P.306 "Division Ratio for Parameters" of Supplement.

Real-Time Auto-Gain Tuning

Outline

The driver estimates the load inertia of the ma-

optimum gain responding to the result. Also the driver automatically suppress the vibration caused by the resonance with an adaptive filter.



Applicable Range

- Real-time auto-gain tuning is applicable to all control modes.

Caution

Real-time auto-gain tuning may not be executed properly under the conditions described in the right table. In these cases, use the normal mode auto-gain tuning (refer to P.236 of Adjustment), or execute a manual gain tuning. (refer to P.240, of Adjustment)

	Conditions which obstruct real-time auto-gain tuning
Load inertia	• Load is too small or large compared to rotor inertia. (less than 3 times or more than 20 times) • Load inertia change too quickly. (10 [s] or less)
Load	• Machine stiffness is extremely low. • Chattering such as backlash exists.
Action pattern	• Motor is running continuously at low speed of 100 [r/min] or lower • Acceleration/deceleration is slow (2000[r/min] per 1[s] or low). • Acceleration/deceleration torque is smaller than unbalanced weighted/viscous friction torque. • When speed condition of 100[r/min] or more and acceleration/deceleration condition of 2000[r/min] per 1[s] are not maintained for 50[ms] .

How to Operate

(1) Bring the motor to stall (Servo-OFF).
(2) Set up Pr21 (Real-time auto-gain tuning mode setup) to 1-7. Default is 1.

Setup value	Real-time auto-gain tuning	Varying degree of load inertia in motion
0	(not in use)	–
<1>	normal mode	no change
2		slow change
3		rapid change
4	vertical axis mode	no change
5		slow change
6		rapid change
7	no-gain switching mode	no change

- When the varying degree of load inertia is large, set up 3 or 6.
- When the motor is used for vertical axis, set up 4-6.
- When vibration occurs during gain switching, set up 7.
- When resonance might give some effect, validate the setup of Pr23 (Setup of adaptive filter mode).

(3) Set up Pr22 (Machine stiffness at real-time auto-gain tuning) to 0 or smaller value.
(4) Turn to Servo-ON to run the machine normally.
(5) Gradually increase Pr22 (Machine stiffness at real-time auto-gain tuning) when you want to obtain better response. Lower the value (0 to 3) when you experience abnormal noise or oscillation.
(6) Write to EEPROM when you want to save the result.

Insert the console connector to CN X6 of the driver, then turn on the driver power. → r 0

Setup of parameter, Pr21

Press (S SET). → dP_SPd
Press (M MODE). → PA_ 00
Match to the parameter No. to be set up with (▲)(▼). (Here match to Pr21.) → PA_ 21
Press (S SET). → 1
Change the setup with (▲)(▼).
Press (S SET). → PA_ 21

Setup of parameter, Pr22

Match to Pr22 with (▲). → PA_ 22
Press (S SET). → 4 (default values)
Numeral increases with (▲), and decreases with (▼).
Press (S SET).

Writing to EEPROM

Press (M MODE). → EE_SEt
Press (S SET). → EEP -
Bars increase as the right fig. shows by keep pressing (▲) (approx. 5sec). → EEP -- → ------
Writing starts (temporary display). → StArt
Finish → FinISh (Writing completes) / rESEt / Error (Writing error occurs)

Return to SELECTION display after writing finishes, referring to "Structure of each mode"(P.60 and 61 of Preparation).

Adaptive Filters

The adaptive filter is validated by setting up Pr23 (Setup of adaptive filter mode) to other than 0.
The adaptive filter automatically estimates a resonance frequency out of vibration component presented in the motor speed in motion, then removes the resonance components from the torque command by setting up the notch filter coefficient automatically, hence reduces the resonance vibration.
The adaptive filter may not operate property under the following conditions. In these cases, use 1st notch filter (Pr1D and 1E) and 2nd notch filter (Pr28-2A) to make measures against resonance according to the manual adjusting procedures.
For details of notch filters, refer to P.246, "Suppression of Machine Resonance" of Adjustment.

	Conditions which obstruct adaptive filter action
Resonance point	• When resonance frequency is lower than 300[Hz] . • While resonance peak is low or control gain is small and when no affect from these condition is given to the motor speed. • When multiple resonance points exist.
Load	• When the motor speed variation with high frequency factor is generated due to non-linear factor such as backlash.
Command pattern	• When acceleration/deceleration is very extreme such as more than 30000 [r/min] per 1 [s] .

<Note>
Even though Pr23 is set up to other than 0, there are other cases when adaptive filter is automatically invalidated. Refer to P.235, "Invalidation of adaptive filter" of Adjustment.

Parameters Which Are Automatically Set Up.

Following parameters are automatically adjusted. Also following parameters are automatically set up.

PrNo.	Title
10	1st gain of position loop
11	1st gain of velocity loop
12	1st time constant of velocity loop integration
13	1st filter of velocity detection
14	1st time constant of torque filter
18	2nd gain of position loop
19	2nd gain of velocity loop
1A	2nd time constant of velocity loop integration
1B	2nd filter of speed detection
1C	2nd time constant of torque filter
20	Inertia ratio
2F	Adaptive filter frequency

PrNo.	Title	Setup value
15	Velocity feed forward	300
16	Time constant of feed forward filter	50
27	Setup of instantaneous speed observer	0
30	2nd gain setup	1
31	1st mode of control switching	10
32	1st delay time of control switching	30
33	1st level of control switching	50
34	1st hysteresis of control switching	33
35	Position gain switching time	20
36	2nd mode of control switching	0

<Notes>
- When the real-time auto-gain tuning is valid, you cannot change parameters which are automatically adjusted.
- Pr31 becomes 10 at position or full closed control and when Pr21 (Setup of Real-Time Auto-Gain Tuning Mode) is 1 to 6, and becomes 0 in other cases.

Cautions

(1) After the start-up, you may experience abnormal noise and oscillation right after the first Servo-ON, or when you increase the setup of Pr22 (Selection of machine stiffness at real-time auto-gain tuning), until load inertia is identified (estimated) or adaptive filter is stabilized, however, these are not failures as long as they disappear immediately. If they persist over 3 reciprocating operations, take the following measures in possible order.
1) Write the parameters which have given the normal operation into EEPROM.
2) Lower the setup of Pr22 (Selection of machine stiffness at real-time auto-gain tuning).
3) Set up both Pr21 (Setup of real-time auto-gain tuning) and Pr23 (Setup of adaptive filter mode) to 0, then set up other value than 0. (Reset of inertia estimation and adaptive action)
4) Invalidate the adaptive filter by setting up Pr23 (Setup of adaptive filter mode setup) to 0, and set up notch filter manually.
(2) When abnormal noise and oscillation occur, Pr20 (Inertia ratio) or Pr2F (Adaptive filter frequency) might have changed to extreme values. Take the same measures as the above in these cases.
(3) Among the results of real-time auto-gain tuning, Pr20 (Inertia ratio) and Pr2F (Adaptive filter frequency) will be written to EEPROM every 30 minutes. When you turn on the power again, auto-gain tuning will be executed using the latest data as initial values.
(4) When you validate the real-time auto-gain tuning, Pr27 (Setup of instantaneous speed observer) will be invalidated automatically.
(5) The adaptive filter is normally invalidated at torque control, however, when you select torque control while you set up Pr02 (Control mode setup) to 4 and 5, the adaptive filter frequency before mode switching will be held.
(6) During the trial run and frequency characteristics measurement of "PANATERM®", the load inertia estimation will be invalidated.

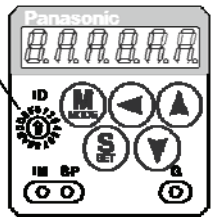
Parameter Setup

Parameters for Functional Selection

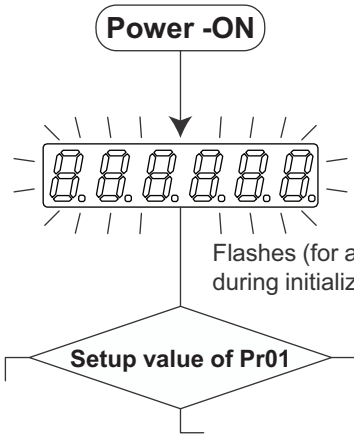
Standard default : < >

PrNo.	Title	Setup range	Function/Content
00 *	Address	0 to 15 <1>	In the communication with the host via RS232/485 for multi-axes application, it is necessary to identify which axis the host is communicating. Use this parameter to confirm the address of the axis in numbers.

- The address is determined by the setup value of rotary switch (0 to F) of the front panel at power-on.
- This value becomes the axis number at serial communication.
- The setup value of this parameter has no effect to the servo action.
- You cannot change the setup of Pr00 with other means than rotary switch.



PrNo.	Title	Setup range	Function/Content
01 *	LED initial status	0 to 17 <1>	You can select the type of data to be displayed on the front panel LED (7 segment) at the initial status after power-on.



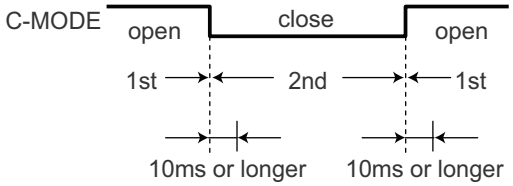
Setup value	Content
0	Positional deviation
<1>	Motor rotational speed
2	Torque output
3	Control mode
4	I/O signal status
5	Error factor/history
6	Software version
7	Alarm
8	Regenerative load factor
9	Over-load factor
10	Inertia ratio
11	Sum of feedback pulses
12	Sum of command pulses
13	External scale deviation
14	Sum of external scale feedback pulses
15	Motor automatic recognizing function
16	Analog input value
17	Factor of "No-Motor Running"

For details of display, refer to P.51 "Setup of Parameter and Mode" of Preparation.

PrNo.	Title	Setup range	Function/Content
02 *	Setup of control mode	0 to 6 <1>	You can set up the control mode to be used.

Setup value	Control mode	
	1st mode	2nd mode
0	Position	–
<1>	Velocity	–
2	Torque	–
3 **1	Position	Velocity
4 **1	Position	Torque
5 **1	Velocity	Torque
6	Full-closed	–

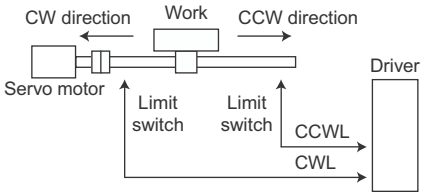
**1) When you set up the combination mode of 3, 4 or 5, you can select either the 1st or the 2nd with control mode switching input (C-MODE).
When C-MODE is open, the 1st mode will be selected.
When C-MODE is shorted, the 2nd mode will be selected.
Don't enter commands 10ms before/after switching.



<Notes>

- For parameters which No. have a suffix of "*", changed contents will be validated when you turn on the control power.

Standard default : < >

<table>
<tr><th>PrNo.</th><th>Title</th><th>Setup range</th><th>Function/Content</th></tr>
<tr><td>03</td><td>Selection of torque limit</td><td>0 to 3
<1></td><td>You can set up the torque limiting method for CCW/CW direction.
<table>
<tr><th>Setup value</th><th>CCW</th><th>CW</th></tr>
<tr><td>0</td><td>X5 CCWTL : Pin-16</td><td>X5 CWTL : Pin-18</td></tr>
<tr><td><1></td><td colspan="2">Pr5E is a limit value for both CCW and CW direction</td></tr>
<tr><td>2</td><td>Set with Pr5E</td><td>Set with Pr5F</td></tr>
<tr><td>3</td><td colspan="2">When GAIN/TL-SEL input is open, set with Pr5E
When GAIN/TL-SEL input is shorted, set with Pr5F</td></tr>
</table>
When the setup value is 0, CCWTL and CWTL will be limited by Pr5E (1st torque limit setup). At the torque control, Pr5E becomes the limiting value for CCW/CW direction regardless of the setup of this parameter.</td></tr>
<tr><td>04
*</td><td>Setup of over-travel inhibit input</td><td>0 to 2
<1></td><td>In linear drive application, you can use this over-travel inhibiting function to inhibit the motor to run to the direction specified by limit switches which are installed at both ends of the axis, so that you can prevent the work load from damaging the machine due to the over-travel. With this input, you can set up the action of over-travel inhibit input.


<table>
<tr><th>Setup value</th><th>CCWL/CWL input</th><th colspan="2">Input</th><th>Action</th></tr>
<tr><td rowspan="4">0</td><td rowspan="4">Valid</td><td rowspan="2">CCWL
(CN X5,Pin-9)</td><td>Close</td><td>Normal status while CCW-side limit switch is not activated.</td></tr>
<tr><td>Open</td><td>Inhibits CCW direction, permits CW direction.</td></tr>
<tr><td rowspan="2">CWL
(CN X5,Pin-9)</td><td>Close</td><td>Normal status while CW-side limit switch is not activated.</td></tr>
<tr><td>Open</td><td>Inhibits CW direction, CCW direction permitted.</td></tr>
<tr><td><1></td><td>Invalid</td><td colspan="3">Both CCWL and CWL inputs will be ignored, and over-travel inhibit function will be invalidated.</td></tr>
<tr><td>2</td><td>Valid</td><td colspan="3">Err38 (Over-travel inhibit input protection) is triggered when either one of the connection of CW or CCW inhibit input to COM– become open.</td></tr>
</table>
<Cautions>
1. When Pr04 is set to 0 and over-travel inhibit input is entered, the motor decelerates and stops according to the preset sequence with Pr66 (Sequence at over-travel inhibition). For details, refer to the explanation of Pr66.
2. When both of CCWL and CWL inputs are opened while Pr04 is set to 0, the driver trips with Err38 (Overtravel inhibit input error) judging that this is an error.
3. When you turn off the limit switch on upper side of the work at vertical axis application, the work may repeat up/down movement because of the loosing of upward torque. In this case, set up Pr66 to 2, or limit with the host controller instead of using this function.</td></tr>
<tr><td>07</td><td>Selection of speed monitor (SP)</td><td>0 to 9
<3></td><td>You can set up the content of analog speed monitor signal output (SP : CN X5, Pin43) and the relation between the output voltage level and the speed.
<table>
<tr><th>Setup value</th><th>Signal of SP</th><th>Relation between the output voltage level and the speed</th></tr>
<tr><td>0</td><td rowspan="5">Motor actual speed</td><td>6V / 47 r/min</td></tr>
<tr><td>1</td><td>6V / 188 r/min</td></tr>
<tr><td>2</td><td>6V / 750 r/min</td></tr>
<tr><td><3></td><td>6V / 3000 r/min</td></tr>
<tr><td>4</td><td>1.5V / 3000 r/min</td></tr>
<tr><td>5</td><td rowspan="5">Command speed</td><td>6V / 47 r/min</td></tr>
<tr><td>6</td><td>6V / 188 r/min</td></tr>
<tr><td>7</td><td>6V / 750 r/min</td></tr>
<tr><td>8</td><td>6V / 3000 r/min</td></tr>
<tr><td>9</td><td>1.5V / 3000 r/min</td></tr>
</table></td></tr>
</table>

Parameter Setup

Standard default : < >

<table>
<tr><th>PrNo.</th><th>Title</th><th>Setup range</th><th>Function/Content</th></tr>
<tr><td>08</td><td>Selection of torque monitor (IM)</td><td>0 to 12
<0></td><td>You can set up the content of the analog torque monitor of the signal output (IM : CN X5, Pin-42), and the relation between the output voltage level and torque or deviation pulse counts.
<table>
<tr><th>Setup value</th><th>Signal of IM</th><th>Relation between the output voltage level and torque or deviation pulse counts</th></tr>
<tr><td><0></td><td>Torque command</td><td>3V/rated (100%) torque</td></tr>
<tr><td>1</td><td rowspan="5">Position deviation</td><td>3V / 31Pulse</td></tr>
<tr><td>2</td><td>3V / 125Pulse</td></tr>
<tr><td>3</td><td>3V / 500Pulse</td></tr>
<tr><td>4</td><td>3V / 2000Pulse</td></tr>
<tr><td>5</td><td>3V / 8000Pulse</td></tr>
<tr><td>6</td><td rowspan="5">Full-closed deviation</td><td>3V / 31Pulse</td></tr>
<tr><td>7</td><td>3V / 125Pulse</td></tr>
<tr><td>8</td><td>3V / 500Pulse</td></tr>
<tr><td>9</td><td>3V / 2000Pulse</td></tr>
<tr><td>10</td><td>3V / 8000Pulse</td></tr>
<tr><td>11</td><td rowspan="2">Torque command</td><td>3V / 200% torque</td></tr>
<tr><td>12</td><td>3V / 400% torque</td></tr>
</table></td></tr>
<tr><td>09</td><td>Selection of TLC output</td><td>0 to 8
<0></td><td>You can assign the function of the torque in-limit output (TLC : CN X5 Pin-40).
<table>
<tr><th>Setup value</th><th>Function</th><th>Note</th></tr>
<tr><td><0></td><td>Torque in-limit output</td><td rowspan="9">For details of function of each output of the left, refer to the table of P.92, "Selection of TCL and ZSP outputs".</td></tr>
<tr><td>1</td><td>Zero speed detection output</td></tr>
<tr><td>2</td><td>Alarm output of either one of Over-regeneration /Over-load/Absolute battery/Fan lock/External scale</td></tr>
<tr><td>3</td><td>Over-regeneration alarm trigger output</td></tr>
<tr><td>4</td><td>Overload alarm output</td></tr>
<tr><td>5</td><td>Absolute battery alarm output</td></tr>
<tr><td>6</td><td>Fan lock alarm output</td></tr>
<tr><td>7</td><td>External scale alarm output</td></tr>
<tr><td>8</td><td>In-speed (Speed coincidence) output</td></tr>
</table></td></tr>
<tr><td>0A</td><td>Selection of ZSP output</td><td>0 to 8
<1></td><td>You can assign the function of the zero speed detection output (ZSP: CN X5 Pin-12).
<table>
<tr><th>Setup value</th><th>Function</th><th>Note</th></tr>
<tr><td>0</td><td>Torque in-limit output</td><td rowspan="9">For details of function of each output of the left, refer to the table of P.92, "Selection of TCL and ZSP outputs".</td></tr>
<tr><td><1></td><td>Zero speed detection output</td></tr>
<tr><td>2</td><td>Alarm output of either one of Over-regeneration /Over-load/Absolute battery/Fan lock/External scale</td></tr>
<tr><td>3</td><td>Over-regeneration alarm trigger output</td></tr>
<tr><td>4</td><td>Overload alarm output</td></tr>
<tr><td>5</td><td>Absolute battery alarm output</td></tr>
<tr><td>6</td><td>Fan lock alarm output</td></tr>
<tr><td>7</td><td>External scale alarm output</td></tr>
<tr><td>8</td><td>In-speed (Speed coincidence) output</td></tr>
</table></td></tr>
<tr><td>0B
*</td><td>Setup of absolute encoder</td><td>0 to 2
<1></td><td>You can set up the using method of 17-bit absolute encoder.
<table>
<tr><th>Setup value</th><th>Content</th></tr>
<tr><td>0</td><td>Use as an absolute encoder.</td></tr>
<tr><td><1></td><td>Use as an incremental encoder.</td></tr>
<tr><td>2</td><td>Use as an absolute encoder, but ignore the multi-turn counter over.</td></tr>
</table>
<Caution>
This parameter will be invalidated when 5-wire, 2500P/r incremental encoder is used.</td></tr>
<tr><td>0C
*</td><td>Baud rate setup of RS232 communication</td><td>0 to 5
<2></td><td>You can set up the communication speed of RS232. • Error of baud rate is ±0.5%.
<table>
<tr><th>Setup value</th><th>Baud rate</th><th>Setup value</th><th>Baud rate</th></tr>
<tr><td>0</td><td>2400bps</td><td>3</td><td>19200bps</td></tr>
<tr><td>1</td><td>4800bps</td><td>4</td><td>38400bps</td></tr>
<tr><td><2></td><td>9600bps</td><td>5</td><td>57600bps</td></tr>
</table></td></tr>
</table>

Standard default : < >

<table>
<tr><th>PrNo.</th><th>Title</th><th>Setup range</th><th>Function/Content</th></tr>
<tr><td>0D
*</td><td>Baud rate setup of RS485 communication</td><td>0 to 5
<2></td><td>You can set up the communication speed of RS485.
• Error of baud rate is ±0.5%.
<table>
<tr><th>Setup value</th><th>Baud rate</th></tr>
<tr><td>0</td><td>2400bps</td></tr>
<tr><td>1</td><td>4800bps</td></tr>
<tr><td><2></td><td>9600bps</td></tr>
</table>
<table>
<tr><th>Setup value</th><th>Baud rate</th></tr>
<tr><td>3</td><td>19200bps</td></tr>
<tr><td>4</td><td>38400bps</td></tr>
<tr><td>5</td><td>57600bps</td></tr>
</table></td></tr>
<tr><td>0E
*</td><td>Setup of front panel lock</td><td>0 to 1
<0></td><td>You can limit the operation of the front panel to the monitor mode only.
You can prevent such a misoperation as unexpected parameter change.
<table>
<tr><th>Setup value</th><th>Content</th></tr>
<tr><td><0></td><td>Valid to all</td></tr>
<tr><td>1</td><td>Monitor mode only</td></tr>
</table>
<Note>
You can still change parameters via communication even though this setup is 1.
To return this parameter to 0, use the console or the "PANATERM®".</td></tr>
</table>

Parameters for Adjustment of Time Constants of Gains and Filters

Standard default : < >

PrNo.	Title	Setup range	Unit	Function/Content
10	1st gain of position loop	0 to 3000 A to C-frame:<63>* D to F-frame:<32>*	1/s	You can determine the response of the positional control system. Higher the gain of position loop you set, faster the positioning time you can obtain. Note that too high setup may cause oscillation.
11	1st gain of velocity loop	1 to 3500 A to C-frame:<35>* D to F-frame:<18>*	Hz	You can determine the response of the velocity loop. In order to increase the response of overall servo system by setting high position loop gain, you need higher setup of this velocity loop gain as well. However, too high setup may cause oscillation. **<Caution>** When the inertia ratio of Pr20 is set correctly, the setup unit of Pr11 becomes (Hz).
12	1st time constant of velocity loop integration	1 to 1000 A to C-frame:<16>* D to F-frame:<31>*	ms	You can set up the integration time constant of velocity loop. Smaller the setup, faster you can dog-in deviation at stall to 0. The integration will be maintained by setting to "999". The integration effect will be lost by setting to "1000".
13	1st filter of speed detection	0 to 5 <0>*	–	You can set up the time constant of the low pass filter (LPF) after the speed detection, in 6 steps. Higher the setup, larger the time constant you can obtain so that you can decrease the motor noise, however, response becomes slow. Use with a default value of 0 in normal operation.
14	1st time constant of torque filter	0 – 2500 A to C-frame:<65>* D to F-frame:<126>*	0.01ms	You can set up the time constant of the 1st delay filter inserted in the torque command portion. You might expect suppression of oscillation caused by distortion resonance.
15	Velocity feed forward	–2000 to 2000 <300>*	0.1%	You can set up the velocity feed forward volume at position control. Higher the setup, smaller positional deviation and better response you can obtain, however this might cause an overshoot.
16	Time constant of feed forward filter	0 to 6400 <50>*	0.01ms	You can set up the time constant of 1st delay filter inserted in velocity feed forward portion. You might expect to improve the overshoot or noise caused by larger setup of above velocity feed forward.

<Notes>

- For parameters which No. have a suffix of "*", changed contents will be validated when you turn on the control power.
- Parameters which default values have a suffix of "*" will be automatically set up during real time auto-gain tuning. When you change manually, invalidate the real-time auto-gain tuning first then set, referring to P.239, "Release of Automatic Gain Adjusting Function" of Adjustment.

Parameter Setup

Standard default : < >

PrNo.	Title	Setup range	Unit	Function/Content
18	2nd gain of position loop	0 to 3000 A to C-frame:<73>* D to F-frame:<38>*	1/s	Position loop, velocity loop, speed detection filter and torque command filter have their 2 pairs of gain or time constant (1st and 2nd). For details of switching the 1st and the 2nd gain or the time constant, refer to P.226, "Adjustment". The function and the content of each parameter is as same as that of the 1st gain and time constant.
19	2nd gain of velocity loop	1 to 3500 A to C-frame:<35>* D to F-frame:<18>*	Hz	
1A	2nd time constant of velocity loop integration	1 to 1000 <1000>*	ms	
1B	2nd filter of velocity detection	0 to 5 <0>*	–	
1C	2nd time constant of torque filter	0 to 2500 A to C-frame:<65>* D to F-frame:<126>*	0.01ms	
1D	1st notch frequency	100 to 1500 <1500>	Hz	You can set up the frequency of the 1st resonance suppressing notch filter. The notch filter function will be invalidated by setting up this parameter to "1500".
1E	1st notch width selection	0 to 4 <2>	–	You can set up the notch filter width of the 1st resonance suppressing filter in 5 steps. Higher the setup, larger the notch width you can obtain. Use with default setup in normal operation.

Parameters for Auto-Gain Tuning

Standard default : < >

PrNo.	Title	Setup range	Unit	Function/Content
20	Inertia ratio	0 to 10000 <250>*	%	You can set up the ratio of the load inertia against the rotor (of the motor) inertia. Pr20= (load inertia/rotor inertia) X 100 [%] When you execute the normal auto-gain tuning, the load inertial will be automatically estimated after the preset action, and this result will be reflected in this parameter. The inertia ratio will be estimated at all time while the real-time auto-gain tuning is valid, and its result will be saved to EEPROM every 30 min. **<Caution>** If the inertia ratio is correctly set, the setup unit of Pr11 and Pr19 becomes (Hz). When the inertia ratio of Pr20 is larger than the actual, the setup unit of the velocity loop gain becomes larger, and when the inertia ratio of Pr20 is smaller than the actual, the setup unit of the velocity loop gain becomes smaller.
21	Setup of real-time auto-gain tuning	0 to 7 <1>	–	You can set up the action mode of the real-time auto-gain tuning. With higher setup such as 3 or 6, the driver respond quickly to the change of the inertia during operation, however it might cause an unstable operation. Use 1 or 4 for normal operation.For the vertical axis application, use with the setup of 4 to 6. When vibration occurs at gain switching, set up this to "7".

Setup value	Real-time auto-gain tuning	Varying degree of load inertia in motion
0	Invalid	–
<1>	Normal mode	Little change
2		Gradual change
3		Rapid change
4	Vertical axis mode	Little change
5		Gradual change
6		Rapid change
7	No gain switching	Little change

Standard default : < >

<table>
<tr><th>PrNo.</th><th>Title</th><th>Setup range</th><th>Unit</th><th>Function/Content</th></tr>
<tr><td>22</td><td>Selection of machine stiffness at real-time auto-gain tuning</td><td>0 to 15
A to C-frame:
<4>
D to F-frame:
<1></td><td>–</td><td>You can set up the machine stiffness in 16 steps while the real-time auto-gain tuning is valid.
low←machine stiffness→high
low← servo gain →high
Pr22 | 0, 1- - - - - - - - - - - - 14, 15
low← response →high
<Caution>
When you change the setup value rapidly, the gain changes rapidly as well, and this may give impact to the machine. Increase the setup gradually watching the movement of the machine.</td></tr>
<tr><td>23</td><td>Setup of adaptive filter mode</td><td>0 to 2
<1></td><td>–</td><td>You can set up the action of the adaptive filter.
0 : Invalid
1 : Valid
2 : Hold (holds the adaptive filter frequency when this setup is changed to 2.)
<Caution>
When you set up the adaptive filter to invalid, the adaptive filter frequency of Pr2F will be reset to 0. The adaptive filter is always invalid at the torque control mode.</td></tr>
<tr><td>24</td><td>Selection of damping filter switching</td><td>0 to 2
<0></td><td>–</td><td>You can select the switching method when you use the damping filter.
0 : No switching (both of 1st and 2nd are valid.)
1 : You can select either 1st or 2nd with damping control switching input (VS-SEL).
when VS-SEL is opened, 1st damping filter selection (Pr2B, 2C)
when VS-SEL is close, 2nd damping filter selection (Pr2D, 2E)
2 : You can switch with the position command direction.
CCW : 1st damping filter selection (Pr2B, 2C).
CW : 2nd damping filter selection (Pr2D, 2E).</td></tr>
<tr><td>25</td><td>Setup of an action at normal mode auto-gain tuning</td><td>0 to 7
<0></td><td>–</td><td>You can set up the action pattern at the normal mode auto-gain tuning.
<table>
<tr><th>Setup value</th><th>Number of revolution</th><th>Rotational direction</th></tr>
<tr><td><0></td><td rowspan="4">2 [revolution]</td><td>CCW→CW</td></tr>
<tr><td>1</td><td>CW→CCW</td></tr>
<tr><td>2</td><td>CCW→CCW</td></tr>
<tr><td>3</td><td>CW→CW</td></tr>
<tr><td>4</td><td rowspan="4">1 [revolution]</td><td>CCW→CW</td></tr>
<tr><td>5</td><td>CW→CCW</td></tr>
<tr><td>6</td><td>CCW→CCW</td></tr>
<tr><td>7</td><td>CW→CW</td></tr>
</table>
e.g.) When the setup is 0, the motor turns 2 revolutions to CCW and 2 revolutions to CW.</td></tr>
<tr><td>26</td><td>Setup of software limit</td><td>0 to 1000
<10></td><td>0.1 revolution</td><td>You can set up the movable range of the motor against the position command input range. When the motor movement exceeds the setup value, software limit protection of Pr34 will be triggered. This parameter is invalid with setup value of 0.</td></tr>
<tr><td>27</td><td>Setup of instantaneous speed observer</td><td>0 to 1
<0>*</td><td>–</td><td>With a high stiffness machine, you can achieve both high response and reduction of vibration at stall, by using this instantaneous speed observer.
<table>
<tr><th>Setup value</th><th>Instantaneous speed observer setup</th></tr>
<tr><td><0>*</td><td>Invalid</td></tr>
<tr><td>1</td><td>Valid</td></tr>
</table>
You need to set up the inertia ratio of Pr20 correctly to use this function.
If you set up Pr21, real-time auto-gain tuning mode setup, to other than 0 (valid), Pr27 becomes 0 (invalid)</td></tr>
</table>

<Notes>

- Parameters which default values have a suffix of "*" will be automatically set up during real time auto-gain tuning. When you change manually, invalidate the real-time auto-gain tuning first then set, referring to P.239, "Release of Automatic Gain Adjusting Function" of Adjustment.

Parameter Setup

Standard default : < >

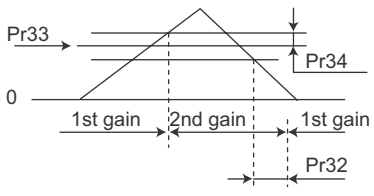
PrNo.	Title	Setup range	Unit	Function/Content
28	2nd notch frequency	100 to 1500 <1500>	Hz	You can set up the 2nd notch width of the resonance suppressing filter in 5 steps. The notch filter function is invalidated by setting up this parameter to "1500".
29	Selection of 2nd notch width	0 to 4 <2>	–	You can set up the notch width of 2nd resonance suppressing filter in 5 steps. Higher the setup, larger the notch width you can obtain. Use with default setup in normal operation.
2A	Selection of 2nd notch depth	0 to 99 <0>	–	You can set up the 2nd notch depth of the resonance suppressing filter. Higher the setup, shallower the notch depth and smaller the phase delay you can obtain.
2B	1st damping frequency	0 to 2000 <0>	0.1Hz	You can set up the 1st damping frequency of the damping control which suppress vibration at the load edge. The driver measures vibration at load edge. Setup unit is 0.1[Hz] . The setup frequency is 10.0 to 200.0[Hz] . Setup of 0 to 99 becomes invalid. Refer to P.250, "Damping control" as well before using this parameter.
2C	Setup of 1st damping filter	–200 to 2000 <0>	0.1Hz	While you set up Pr2B (1st damping frequency), set this up to smaller value when torque saturation occurs, and to larger value when you need faster action.Use with the setup of 0 in normal operation. Refer to P.250, "Damping control" of Adjustment. **<Caution>** Setup is also limited by 10.0[Hz] –Pr2B≦Pr2C≦Pr2B
2D	2nd damping frequency	0 to 2000 <0>	0.1Hz	You can set up the 2nd damping frequency of the damping control which suppress vibration at the load edge. The driver measures vibration at the load edge. Setup unit is 0.1 [Hz] . Setup frequency is 10.0 to 200.0 [Hz] . Setup of 0-99 becomes invalid. Refer to P.250, "Damping control" of Adjustment as well before using this parameter.
2E	Setup of 2nd damping filter	–200 to 2000 <0>	0.1Hz	While you set up Pr2D (2nd damping frequency), set this up to smaller value when torque saturation occurs, and to larger value when you need faster action. Use with the setup of 0 in normal operation. Refer to P.250, "Damping control" of Adjustment. **<Caution>** Setup is also limited by 10.0[Hz] –Pr2D≦Pr2E≦Pr2D
2F	Adaptive filter frequency	0 to 64 <0>	–	Displays the table No. corresponding to the adaptive filter frequency. (Refer to P.234 of Adjustment.) This parameter will be automatically set and cannot be changed while the adaptive filter is valid. (when Pr23 (Setup of adaptive filter mode) is other than 0.) 0 to 4 Filter is invalid. 5 to 48 Filter is valid. 49 to 64 Filter validity changes according to Pr22. This parameter will be saved to EEPROM every 30 minutes while the adaptive filter is valid, and when the adaptive filter is valid at the next power-on, the adaptive action starts taking the saved data in EEPROM as an initial value. **<Caution>** When you need to clear this parameter to reset the adaptive action while the action is not normal, invalidate the adaptive filter (Pr23, "Setup of adaptive filter mode" to 0) once, then validate again. Refer to P.239, "Release of Automatic Gain Adjusting Function" of Adjustment as well.

<Notes>

- For parameters which No. have a suffix of "*", changed contents will be validated when you turn on the control power.
- Parameters which default values have a suffix of "*" will be automatically set up during real time auto-gain tuning. When you change manually, invalidate the real-time auto-gain tuning first then set, referring to P.239, "Release of Automatic Gain Adjusting Function" of Adjustment.

Parameters for Adjustment (2nd Gain Switching Function)

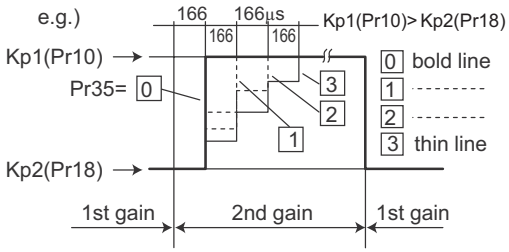
Standard default : < >

<table>
<tr><th>PrNo.</th><th>Title</th><th>Setup range</th><th>Unit</th><th>Function/Content</th></tr>
<tr><td>30</td><td>Setup of 2nd gain</td><td>0 to 1
<1>*</td><td>–</td><td>You can select the PI/P action switching of the velocity control or 1st/2nd gain switching.
<table>
<tr><th>Setup value</th><th>Gain selection/switching</th></tr>
<tr><td>0</td><td>1st gain (PI/P switching enabled) *1</td></tr>
<tr><td><1>*</td><td>1st/2nd gain switching enabled *2</td></tr>
</table>
*1 Switch the PI/P action with the gain switching input (GAIN CN X5, Pin-27). PI is fixed when Pr03 (Torque limit selection) is 3.
<table>
<tr><th>GAIN input</th><th>Action of velocity loop</th></tr>
<tr><td>Open with COM–</td><td>PI action</td></tr>
<tr><td>Connect to COM–</td><td>P action</td></tr>
</table>
*2 For switching condition of the 1st and the 2nd, refer to P.243, "Gain Switching Function" of Adjustment.</td></tr>
<tr><td>31</td><td>1st mode of control switching</td><td>0 to 10
<0>*</td><td>–</td><td>You can select the switching condition of 1st gain and 2nd gain while Pr30 is set to 1.
<table>
<tr><th>Setup value</th><th>Gain switching condition</th></tr>
<tr><td><0>*</td><td>Fixed to the 1st gain.</td></tr>
<tr><td>1</td><td>Fixed to the 2nd gain.</td></tr>
<tr><td>2 *1</td><td>2nd gain selection when the gain switching input is turned on. (Pr30 setup must be 1.)</td></tr>
<tr><td>3 *2</td><td>2nd gain selection when the toque command variation is larger than the setups of Pr33 (1st level of control switching) and Pr34 (1st hysteresis of control switching).</td></tr>
<tr><td>4 *2</td><td>Fixed to the 1st gain.</td></tr>
<tr><td>5 *2</td><td>2nd gain selection when the command speed is larger than the setups of Pr33 (1st level of control switching) and Pr34 (1st hysteresis at control switching).</td></tr>
<tr><td>6 *2</td><td>2nd gain selection when the positional deviation is larger than the setups of Pr33 (1st control switching level) and Pr34 (1st hysteresis of control switching).</td></tr>
<tr><td>7 *2</td><td>2nd gain selection when more than one command pulse exist between 166μs.</td></tr>
<tr><td>8 *2</td><td>2nd gain selection when the positional deviation counter value exceeds the setup of Pr60 (Positioning completer range).</td></tr>
<tr><td>9 *2</td><td>2nd gain selection when the motor actual speed exceeds the setup of Pr33 (1st level of control switching) and Pr34 (1at hysteresis of control switching) .</td></tr>
<tr><td>10 *2</td><td>Switches to the 2nd gain while the position command exists.
Switches to the 1st gain when no-position command status lasts for the setup of Pr32 [x 166μs] and the speed falls slower than the setups of Pr33–34[r/min] .</td></tr>
</table>
*1 Fixed to the 1st gain regardless of GAIN input, when Pr31 is set to 2 and Pr03 (Torque limit selection) is set to 3.
*2 For the switching level and the timing, refer to P.243, "Gain Switching Function" of Adjustment.</td></tr>
<tr><td>32</td><td>1st delay time of control switching</td><td>0 to 10000
<30>*</td><td>x 166μs</td><td>You can set up the delay time when returning from the 2nd to the 1st gain, while Pr31 is set to 3 or 5 to 10.</td></tr>
<tr><td>33</td><td>1st level of control switching</td><td>0 to 20000
<50>*</td><td>–</td><td>You can set up the switching (judging) level of the 1st and the 2nd gains, while Pr31 is set to 3, 5, 6. 9 and 10.
Unit varies depending on the setup of Pr31 (1st mode of control switching)</td></tr>
<tr><td>34</td><td>1st hysteresis of control switching</td><td>0 to 20000
<33>*</td><td>–</td><td>You can set up hysteresis width to be implemented above/below the judging level which is set up with Pr33. Unit varies depending on the setup of Pr31 (1st control switching mode). Definitions of Pr32 (Delay), Pr33 (Level) and Pr34 (Hysteresis) are explained in the fig. below.
 

<Caution>
The setup of Pr33 (Level) and Pr34 (Hysteresis) are valid as absolute values (positive/negative).</td></tr>
</table>

Parameter Setup

Standard default : < >

PrNo.	Title	Setup range	Unit	Function/Content
35	Switching time of position gain	0 – 10000 <20> *	(setup value + 1) x 166μs	You can setup the step-by-step switching time to the position loop gain only at gain switching while the 1st and the 2nd gain switching is valid. **<Caution>** The switching time is only valid when switching from small position gain to large position gain. 
3D	JOG speed setup	0 – 500 <300>	r/min	You can setup the JOG speed. Refer to P.75, "Trial Run"of Preparation.

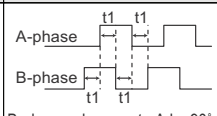
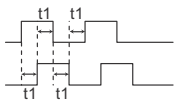
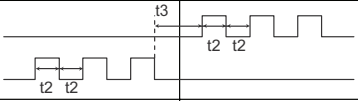
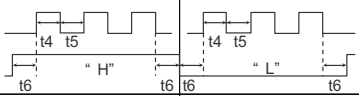
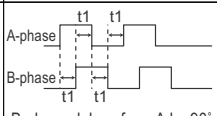
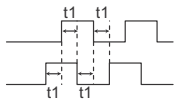
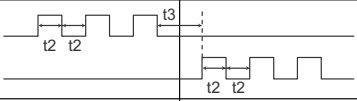
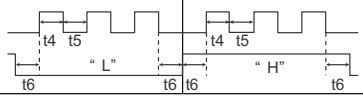
Parameters for Position Control

Standard default : < >

PrNo.	Title	Setup range	Function/Content
40 *	Selection of command pulse input	0 to 1 <0>	You can select either the photo-coupler input or the exclusive input for line driver as the command pulse input.

Setup value	Content
<0>	Photo-coupler input (X5 PULS1:Pin-3, PULS2:Pin-4, SIGN1:Pin-5, SIGN2:Pin-6)
1	Exclusive input for line driver (X5 PULSH1:Pin-44, PULSH2:Pin-45, SIGNH1:Pin-46, SIGNH2:Pin-47)

PrNo.	Title	Setup range	Function/Content
41 *	Command pulse rotational direction setup	0 to 1 <0>	You can set up the rotational direction against the command pulse input, and the command pulse input format.
42 *	Setup of command pulse input mode	0 to 3 <1>	

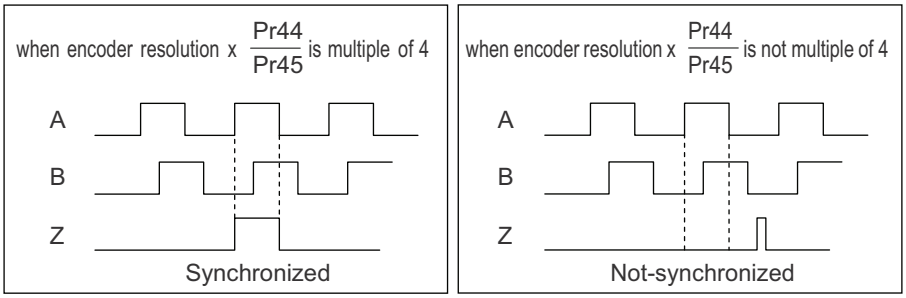
Pr41 setup value (Command pulse rotational direction setup)	Pr42 setup value (Command pulse input mode setup)	Command pulse format	Signal title	CCW command	CW command
<0>	0 or 2	90˚ phase difference 2-phase pulse (A + B-phase)	PULS SIGN		
	<1>	CW pulse train + CCW pulse train	PULS SIGN		
	3	pulse train + Signal	PULS SIGN		
1	0 or 2	90˚ phase difference 2-phase pulse (A + B-phase)	PULS SIGN		
	1	CW pulse train + CCW pulse train	PULS SIGN		
	3	pulse train + Signal	PULS SIGN		

• Permissible max. input frequency, and min. necessary time width of command pulse input signal.

Input I/F of PULS/SIGN signal		Permissible max. input frequency	Min. necessary time width t_1	t_2	t_3	t_4	t_5	t_6
Pulse train interface exclusive to line driver		2Mpps	500ns	250ns	250ns	250ns	250ns	250ns
Pulse train interface	Line driver interface	500kpps	2μs	1μs	1μs	1μs	1μs	1μs
	Open collector interface	200kpps	5μs	2.5μs	2.5μs	2.5μs	2.5μs	2.5μs

Make the rising/falling time of the command pulse input signal to 0.1μs or smaller.

Standard default : < >

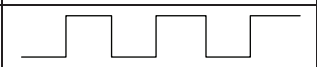
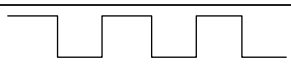
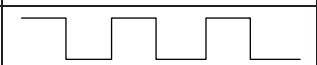
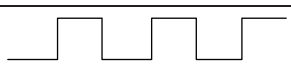
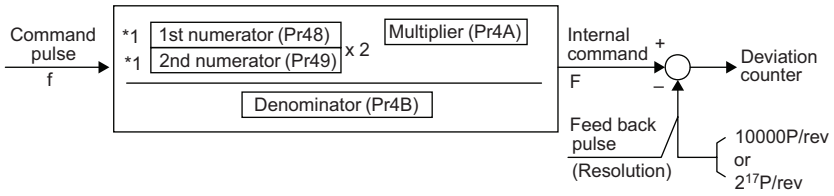
<table>
<tr><th>PrNo.</th><th>Title</th><th>Setup range</th><th>Function/Content</th></tr>
<tr><td>43</td><td>Invalidation of command pulse inhibit input</td><td>0 to 1
<1></td><td>You can select either the validation or the invalidation of the command pulse inhibit input (INH : CN X5 Pin-33).
<table><tr><th>Setup value</th><th>INH input</th></tr><tr><td>0</td><td>Valid</td></tr><tr><td><1></td><td>Invalid</td></tr></table>
Command pulse input will be inhibited by opening the connection of INH input to COM–. When you do not use INH input, set up Pr43 to 1 so that you may not need to connect INH (CN I/F Pin-33) and COM– (Pin-41) outside of the driver.</td></tr>
<tr><td>44
*</td><td>Numerator of pulse output division</td><td>1 to 32767
<2500></td><td rowspan="2">You can set up the pulse counts to be fed out from the pulse output (X5 0A+ : Pin-21, 0A- : Pin-22, 0B+ : Pin-48, 0B- : Pin-49).
• Pr45= <0> (Default)
You can set up the output pulse counts per one motor revolution for each OA and OB with the Pr44 setup. Therefore the pulse output resolution after quadruple can be obtained from the formula below.
The pulse output resolution per one revolution
= Pr44 (Numerator of pulse output division) X4
• Pr45≠0 :
The pulse output resolution per one revolution can be divided by any ration according to the formula below.
Pulse output resolution per one revolution $\frac{\text{Pr44 (Numerator of pulse output division)}}{\text{Pr45 (Denominator of pulse output division)}}$ x Encoder resolution
<Cautions>
• The encoder resolution is 131072 [P/r] for the 17-bit absolute encoder, and 10000 [P/r] for the 5-wire 2500P/r incremental encoder.
• The pulse output resolution per one revolution cannot be greater than the encoder resolution.
(In the above setup, the pulse output resolution equals to the encoder resolution.)
• Z-phase is fed out once per one revolution of the motor.
When the pulse output resolution obtained from the above formula is multiple of 4, Z-phase synchronizes with A-phase. In other case, the Z-phase width equals to output with the encoder resolution, and becomes narrower than A-phase, hence does not synchronize with A-phase.
  </td></tr>
<tr><td>45
*</td><td>Denominator of pulse output division</td><td>0 to 32767
<0></td></tr>
</table>

<Notes>

• For parameters which No. have a suffix of "*", changed contents will be validated when you turn on the control power.

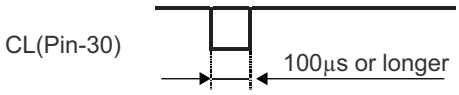
Parameter Setup

Standard default : < >

<table>
<tr><th>PrNo.</th><th>Title</th><th>Setup range</th><th>Function/Content</th></tr>
<tr><td>46
*</td><td>Reversal of pulse output logic</td><td>0 to 3
<0></td><td>You can set up the B-phase logic and the output source of the pulse output (X5 OB+ : Pin-48, OB– : Pin-49). With this parameter, you can reverse the phase relation between the A-phase pulse and the B-phase pulse by reversing the B-phase logic.
<table>
<tr><th>Setup value</th><th>A-phase (OA)</th><th>at motor CCW rotation</th><th>at motor CW rotation</th></tr>
<tr><td><0>, 2</td><td>B-phase(OB) non-reversal</td><td>  </td><td>  </td></tr>
<tr><td>1, 3</td><td>B-phase(OB) reversal</td><td>  </td><td>  </td></tr>
</table>
<table>
<tr><th>Pr46</th><th>B-phase logic</th><th>Output source</th></tr>
<tr><td><0></td><td>Non-reversal</td><td>Encoder position</td></tr>
<tr><td>1</td><td>Reversal</td><td>Encoder position</td></tr>
<tr><td>2 *1</td><td>Non-reversal</td><td>External scale position</td></tr>
<tr><td>3 *1</td><td>Reversal</td><td>External scale position</td></tr>
</table>
*1 The output source of Pr46= 2, 3 is valid only at full-closed control.</td></tr>
<tr><td>48</td><td colspan="3">Electronic gear function-related (Pr48 to 4B)</td></tr>
<tr><td></td><td>1st numerator of electronic gear</td><td>0 to 10000
<0></td><td rowspan="4">Electronic gear (Command pulse division/multiplication) function
• Purpose of this function
(1) You can set up any motor revolution and travel per input command unit.
(2) You can increase the nominal command pulse frequency when you cannot obtain the required speed due to the limit of pulse generator of the host controller.
• Block diagram of electronic gear
 

• "Numerator" selection of electronic gear
*1 : Select the 1st or the 2nd with the command electronic gear input switching (DIV : CN X5, Pin-28)
<table>
<tr><td>DIV input open</td><td>Selection of 1st numerator (Pr48)</td></tr>
<tr><td>DIV input connect to COM–</td><td>Selection of 2nd numerator (Pr49)</td></tr>
</table>
The electronic gear ratio is set with the formula below.
• when the numerator is < 0> (Default) :Numerator (Pr48,49)X2^{Pr4A}) is automatically set equal to encoder resolution, and you can set command pulse per revolution with Pr4B.
$$\text{Electronic gear ratio} = \frac{\text{Encoder resolution}}{\text{Command pulse counts per one revolution (Pr48)}}$$
• when numerator ≠ 0 :
$$\text{Electronic gear ratio} = \frac{\text{Numerator of command electronic gear (Pr48,49)} \times 2^{\text{Multiplier of command div/multiple numerator (Pr4A)}}}{\text{Denominator of command electronic gear (Pr4B)}}$$
<Caution>
In actual calculation of numerator (Pr48, Pr49) X2^{Pr4A}, 4194304 (Pr4D setup value + 1) becomes the max. value.
(to be continued to next page)</td></tr>
<tr><td></td><td>2nd numerator of electronic gear</td><td>0 to 10000
<0></td></tr>
<tr><td>4A</td><td>Multiplier of electronic gear numerator</td><td>0 to 17
<0></td></tr>
<tr><td>4B</td><td>Denominator of electronic gear</td><td>0 to 10000
<10000></td></tr>
</table>

Standard default : < >

<table>
<tr><th>PrNo.</th><th>Title</th><th>Setup range</th><th>Function/Content</th></tr>
<tr><td colspan="4">Electronic gear function-related (Pr48-4B) (continued from the previous page)</td></tr>
<tr><td>48
49
4A
4B</td><td>1st numerator of electronic gear
2nd numerator of electronic gear
Multiplier of electronic gear numerator
Denominator of electronic gear</td><td></td><td><Setup example when numerator≠0>
• When division/multiplication ratio= 1, it is essential to keep the relationship in which the motor turns one revolution with the command input (f) of the encoder resolution.
Therefore, when the encoder resolution is 10000P/r, it is required to enter the input of f= 5000Pulses in case of duplicate, f= 40000Pulse in case of division of 1/4, in order to turn the motor by one revolution.
• Set up Pr48, 4A and 4B so that the internal command (F) after division / multiplication may equal to the encoder resolution (10000 or 2^{17}).
$F = \frac{f \times Pr48 \times 2^{Pr4A}}{Pr4B} = 10000 \text{ or } 2^{17}$
F : Internal command pulse counts per motor one revolution
f : Command pulse counts per one motor revolution.
<table><tr><th>Encoder resolution</th><th>2^{17} (131072)</th><th>10000 (2500P/r x 4)</th></tr><tr><td>Example 1
when making the command input (f) as 5000 per one motor revolution</td><td>$\frac{Pr48\ \boxed{1} \times 2^{\boxed{17}}}{Pr4B\ \ 5000}$ (Pr4A)</td><td>$\frac{Pr48\ \boxed{10000} \times 2^{\boxed{0}}}{Pr4B\ \boxed{5000}}$ (Pr4A)</td></tr><tr><td>Example 2
when making the command input (f) as 40000 per one motor revolution</td><td>$\frac{Pr48\ \boxed{1} \times 2^{\boxed{15}}}{Pr4B\ \ 10000}$ (Pr4A)</td><td>$\frac{Pr48\ \boxed{2500} \times 2^{\boxed{0}}}{Pr4B\ \ 10000}$ (Pr4A)</td></tr></table></td></tr>
<tr><td>4C</td><td>Setup of primary delay smoothing</td><td>0 to 7
<1></td><td>Smoothing filter is the filter for primary delay which is inserted after the electronic gear.
Purpose of smoothing filter
• Reduce the step motion of the motor while the command pulse is rough.
• Actual examples which cause rough command pulse are;
(1) when you set up a high multiplier ratio (10 times or more).
(2) when the command pulse frequency is low.
You can set the time constant of the smoothing filter in 8 steps with Pr4C.
<table><tr><th>Setup value</th><th>Time constant</th></tr><tr><td>0</td><td>No filter function</td></tr><tr><td><1></td><td>Time constant small</td></tr><tr><td>↑</td><td>↓</td></tr><tr><td>7</td><td>Time constant large</td></tr></table></td></tr>
<tr><td>4D
*</td><td>Setup of FIR smoothing</td><td>0 to 31
<0></td><td>You can set up the moving average times of the FIR filter covering the command pulse. (Setup value + 1) become average travel times.</td></tr>
<tr><td>4E</td><td>Counter clear input mode</td><td>0 to 2
<1></td><td>You can set up the clearing conditions of the counter clear input signal which clears the deviation counter.
<table><tr><th>Setup value</th><th>Clearing condition</th></tr><tr><td>0</td><td>Clears the deviation counter at level (shorting for longer than 100μs)*1</td></tr><tr><td><1></td><td>Clears the deviation counter at falling edge (open-shorting for longer than 100μs)*1</td></tr><tr><td>2</td><td>Invalid</td></tr></table>*1 : Min. time width of CL signal
 
</td></tr>
</table>

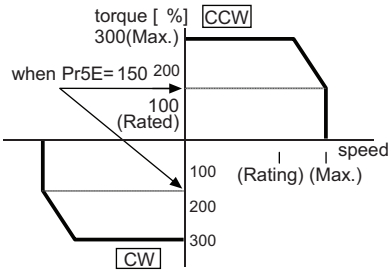
<Notes>

• For parameters which No. have a suffix of "*", changed contents will be validated when you turn on the control power.

Parameter Setup

Parameters for Velocity and Torque Control

Standard default : < >

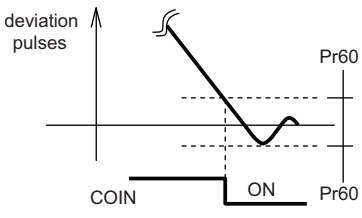
PrNo.	Title	Setup range	Unit	Function/Content
5E	1st torque limit setup	0 to 500 <500> *2	%	You can set up the limit value of the motor output torque (Pr5E : 1st torque, Pr5F : 2nd torque). For the torque limit selection, refer to Pr03 (Torque limit selection).
5F	2nd torque limit setup	0 to 500 <500> *2	%	This torque limit function limits the max. motor torque inside of the driver with parameter setup. In normal operation, this driver permits approx. 3 times larger torque than the rated torque instantaneously. If this 3 times bigger torque causes any trouble to the load (machine) strength, you can use this function to limit the max. torque. • Setup value is to be given in % against the rated torque. • Right fig. shows example of 150% setup with Pr03= 1. • Pr5E limits the max. torque for both CCW and CW directions.  **<Caution>** You cannot set up a larger value to this parameter than the default setup value of "Max. output torque setup" of System parameter (which you cannot change through operation with PANATERM® or panel). Default value varies depending on the combination of the motor and the driver. For details, refer to P.57, "Setup of Torque Limit " of Preparation.

<Note>

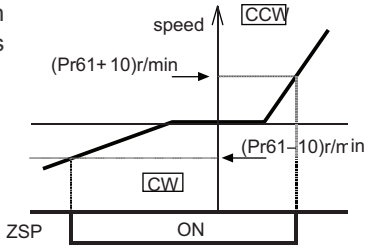
• For parameters which default. has a suffix of "*2", value varies depending on the combination of the driver and the motor.

Parameters for Sequence

Standard default : < >

PrNo.	Title	Setup range	Unit	Function/Content
60	Positioning complete(In-position) range	0 to 32767 <131>	Pulse	You can set up the timing to feed out the positioning complete signal (COIN : CN X5, Pin-39). The positioning complete signal (COIN) will be fed out when the deviation counter pulse counts fall within ± (the setup value), after the command pulse entry is completed. The setup unit should be the encoder pulse counts at the position control and the external scale pulse counts at the full-closed control. • Basic unit of deviation pulse is encoder "resolution", and varies per the encoder as below. (1) 17-bit encoder : 2^{17} = 131072 (2) 2500P/r encoder : 4 X 2500 = 10000 **<Cautions>** 1. If you set up too small value to Pr60, the time until the COIN signal is fed might become longer, or cause chattering at output. 2. The setup of "Positioning complete range" does not give any effect to the final positioning accuracy. 

Standard default : < >

<table>
<tr><th>PrNo.</th><th>Title</th><th>Setup range</th><th>Unit</th><th>Function/Content</th></tr>
<tr><td>61</td><td>Zero-speed</td><td>10 to 20000 <50></td><td>r/min</td><td>You can set up the timing to feed out the zero-speed detection output signal (ZSP : CN X5, Pin-12 or TCL : CN X5, Pin-40) in rotational speed [r/min] .
The zero-speed detection signal (ZSP) will be fed out when the motor speed falls below the setup of this parameter, Pr61.
• The setup of P61 is valid for both CCW and CW direction regardless of the motor rotating direction.
• There is hysteresis of 10 [r/min] .
 
</td></tr>
<tr><td>63</td><td>Setup of positioning complete (In-position) output</td><td>0 to 3 <0></td><td>–</td><td>You can set up the action of the positioning complete signal (COIN : Pin-39 of CN X5) in combination with Pr60 (Positioning complete range).
<table>
<tr><th>Setup value</th><th>Action of positioning complete signal</th></tr>
<tr><td><0></td><td>The signal will turn on when the positional deviation is smaller than Pr60 (Positioning complete range)</td></tr>
<tr><td>1</td><td>The signal will turn on when there is no position command and the positional deviation is smaller than Pr60 (Positioning complete range).</td></tr>
<tr><td>2</td><td>The signal will turn on when there is no position command, the zero-speed detection signal is ON and the positional deviation is smaller than Pr60 (Positioning complete range).</td></tr>
<tr><td>3</td><td>The signal will turn on when there is no position command and the positional deviation is smaller than Pr60 (Positioning complete range). Then holds "ON" status until the next position command is entered.</td></tr>
</table></td></tr>
<tr><td>65</td><td>LV trip selection at main power OFF</td><td>0 to 1 <1></td><td>–</td><td>You can select whether or not to activate Err13 (Main power under-voltage protection) function while the main power shutoff continues for the setup of Pr6D (Main power-OFF detection time).
<table>
<tr><th>Setup value</th><th>Action of main power low voltage protection</th></tr>
<tr><td>0</td><td>When the main power is shut off during Servo-ON, Err13 will not be triggered and the driver turns to Servo-OFF. The driver returns to Servo-ON again after the main power resumption.</td></tr>
<tr><td><1></td><td>When the main power is shut off during Servo-ON, the driver will trip due to Err13 (Main power low voltage protection).</td></tr>
</table>
<Caution>
This parameter is invalid when Pr6D (Detection time of main power OFF)= 1000. Err13 (Main power under-voltage protection) is triggered when setup of P66D is long and P-N voltage of the main converter falls below the specified value before detecting the main power shutoff, regardless of the Pr65 setup. Refer to P.42, "Timing Chart-At Power-ON" of Preparation as well.</td></tr>
<tr><td>66 *</td><td>Sequence at over-travel inhibit</td><td>0 to 2 <0></td><td>–</td><td>You can set up the running condition during deceleration or after stalling, while over-travel inhibit input (CCWL : Connector CN X5, Pin-9 or CWL : Connector CN X5, Pin-8) is valid
<table>
<tr><th>Setup value</th><th>During deceleration</th><th>After stalling</th><th>Deviation counter content</th></tr>
<tr><td><0></td><td>Dynamic brake action</td><td>Torque command= 0 towards inhibited direction</td><td>Hold</td></tr>
<tr><td>1</td><td>Torque command= 0 towards inhibited direction</td><td>Torque command= 0 towards inhibited direction</td><td>Hold</td></tr>
<tr><td>2</td><td>Emergency stop</td><td>Torque command= 0 towards inhibited direction</td><td>Clears before/ after deceleration</td></tr>
</table>
<Caution>
In case of the setup value of 2, torque limit during deceleration will be limited by the setup value of Pr6E (Torque setup at emergency stop).</td></tr>
</table>

<Notes>

• For parameters which No. have a suffix of "*", changed contents will be validated when you turn on the control power.

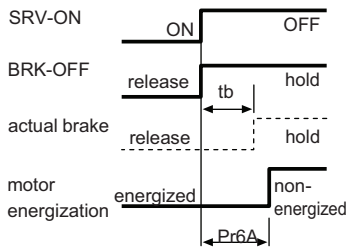
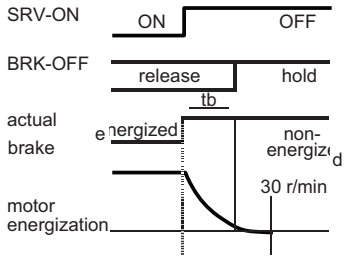
Standard default : < >

<table>
<tr><th>PrNo.</th><th>Title</th><th>Setup range</th><th>Unit</th><th>Function/Content</th></tr>
<tr><td>67</td><td>Sequence at main power OFF</td><td>0 to 9
<0></td><td>–</td><td>When Pr65 (LV trip selection at main power OFF) is 0, you can set up,
1) the action during deceleration and after stalling
2) the clearing of deviation counter content
after the main power is shut off.
<table>
<tr><th rowspan="2">Setup value</th><th colspan="2">Action</th><th rowspan="2">Deviation counter content</th></tr>
<tr><th>During deceleration</th><th>After stalling</th></tr>
<tr><td><0></td><td>DB</td><td>DB</td><td>Clear</td></tr>
<tr><td>1</td><td>Free-run</td><td>DB</td><td>Clear</td></tr>
<tr><td>2</td><td>DB</td><td>Free-run</td><td>Clear</td></tr>
<tr><td>3</td><td>Free-run</td><td>Free-run</td><td>Clear</td></tr>
<tr><td>4</td><td>DB</td><td>DB</td><td>Hold</td></tr>
<tr><td>5</td><td>Free-run</td><td>DB</td><td>Hold</td></tr>
<tr><td>6</td><td>DB</td><td>Free-run</td><td>Hold</td></tr>
<tr><td>7</td><td>Free-run</td><td>Free-run</td><td>Hold</td></tr>
<tr><td>8</td><td>Emergency stop</td><td>DB</td><td>Clear</td></tr>
<tr><td>9</td><td>Emergency stop</td><td>Free-run</td><td>Clear</td></tr>
</table>
(DB: Dynamic Brake action)
<Caution>
In case of the setup value of 8 or 9, torque limit during deceleration will be limited by the setup value of Pr6E (Torque setup at emergency stop).</td></tr>
<tr><td>68</td><td>Sequence at alarm</td><td>0 to 3
<0></td><td>–</td><td>You can set up the action during deceleration or after stalling when some error occurs while either one of the protective functions of the driver is triggered.
<table>
<tr><th rowspan="2">Setup value</th><th colspan="2">Action</th><th rowspan="2">Deviation counter content</th></tr>
<tr><th>During deceleration</th><th>After stalling</th></tr>
<tr><td><0></td><td>DB</td><td>DB</td><td>Hold</td></tr>
<tr><td>1</td><td>Free-run</td><td>DB</td><td>Hold</td></tr>
<tr><td>2</td><td>DB</td><td>Free-run</td><td>Hold</td></tr>
<tr><td>3</td><td>Free-run</td><td>Free-run</td><td>Hold</td></tr>
</table>
(DB: Dynamic Brake action)
<Caution>
The content of the deviation counter will be cleared when clearing the alarm. Refer to P.43, "Timing Chart (When an error (alarm) occurs (at Servo-ON command status)" of Preparation.</td></tr>
<tr><td>69</td><td>Sequence at Servo-Off</td><td>0 to 9
<0></td><td>–</td><td>You can set up,
1) the action during deceleration and after stalling
2) the clear treatment of deviation counter is set up.
The relation between the setup value of Pr69 and the action/deviation counter clearance is same as that of Pr67 (Sequence at Main Power Off)
Refer to P.44, "Timing Chart"-Servo-ON/OFF action while the motor is at stall" of Preparation as well.</td></tr>
</table>

<Notes>

- For parameters which No. have a suffix of "*", changed contents will be validated when you turn on the control power.

Standard default : < >

PrNo.	Title	Setup range	Unit	Function/Content
6A	Setup of mechanical brake action at stalling	0 to 100 <0>	2ms	You can set up the time from when the brake release signal (BRK-OFF : CN X5, Pin-10 and 11) turns off to when the motor is de-energized (Servo-free), when the motor turns to Servo-OFF while the motor is at stall. • Set up to prevent a micro-travel/ drop of the motor (work) due to the action delay time (tb) of the brake • After setting up Pr6a ≧ tb , then compose the sequence so as the brake is actually activated.  Refer to P.44, "Timing Chart"-Servo-ON/OFF Action While the Motor Is at Stall" of Preparation as well.
6B	Setup of mechanical brake action at running	0 to 100 <0>	2ms	You can set up time from when detecting the off of Servo-ON input signal (SRV-ON : CN X5, Pin-29) is to when external brake release signal (BRK-OFF : CN X5, Pin-10 and 11) turns off, while the motor turns to servo off during the motor in motion. • Set up to prevent the brake deterioration due to the motor running. • At Servo-OFF during the motor is running, tb of the right fig. will be a shorter one of either Pr6B setup time, or time lapse till the motor speed falls below 30r/min.  Refer to P.45, "Timing Chart"-Servo-ON/OFF action while the motor is in motion" of Preparation as well.
6C *	Selection of external regenerative resistor	0 to 3 for A, B-frame <3> for C to F-frame <0>	–	With this parameter, you can select either to use the built-in regenerative resistor of the driver, or to separate this built-in regenerative resistor and externally install the regenerative resistor (between RB1 and RB2 of Connector CN X2 in case of A to D-frame, between P and B2 of terminal block in case of E, F-frame).

Setup value	Regenerative resistor to be used	Regenerative processing and regenerative resistor overload
<0> (C, D, E and F-frame)	Built-in resistor	Regenerative processing circuit will be activated and regenerative resistor overload protection will be triggered according to the built-in resistor (approx. 1% duty).
1	External resistor	The driver trips due to regenerative overload protection (Err18), when regenerative processing circuit is activated and its active ratio exceeds 10%,
2	External resistor	Regenerative processing circuit is activated, but no regenerative over-load protection is triggered.
<3> (A, B-frame)	No resistor	Both regenerative processing circuit and regenerative protection are not activated, and built-in capacitor handles all regenerative power.

<Remarks>
Install an external protection such as thermal fuse when you use the external regenerative resistor.
Otherwise, the regenerative resistor might be heated up abnormally and result in burnout, regardless of validation or invalidation of regenerative over-load protection.
<Caution>
When you use the built-in regenerative resistor, never to set up other value than 0. Don't touch the external regenerative resistor.
External regenerative resistor gets very hot, and might cause burning.

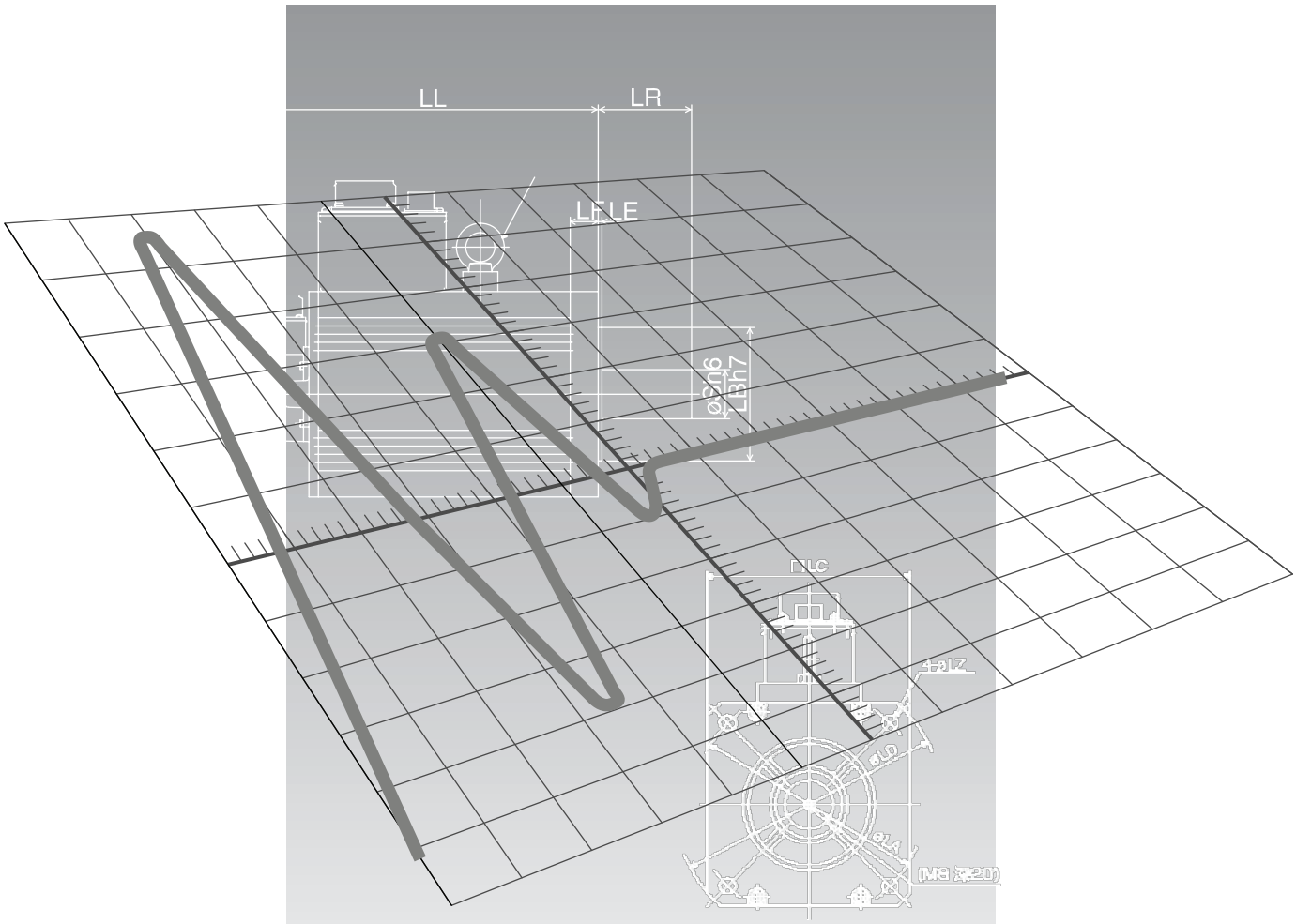
Parameter Setup

Standard default : < >

PrNo.	Title	Setup range	Unit	Function/Content
6D *	Detection time of main power off	35 to 1000 <35>	2ms	You can set up the time to detect the shutoff while the main power is kept shut off continuously. The main power off detection is invalid when you set up this to 1000.
6E	Torque setup at emergency stop	0 to 500 <0>	%	You can set up the torque limit in case of emergency stop as below. • During deceleration of over-travel inhibit with the setup 2 of Pr66 (Sequence at over-travel inhibit input) • During deceleration with the setup of 8 or 9 of Pr67 (Sequence at main power off) • During deceleration with the setup of 8 or 9 of Pr69 (Sequence at Servo-OFF) Normal torque limit is used by setting this to 0.
70	Setup of position deviation excess	0 to 32767 <25000>	256 x resolution	• You can set up the excess range of position deviation. • Set up with the encoder pulse counts at the position control and with the external scale pulse counts at the full-closed control. • Err24 (Error detection of position deviation excess) becomes invalid when you set up this to 0.
72	Setup of over-load level	0 to 500 <0>	%	• You can set up the over-load level. The overload level becomes 115 [%] by setting up this to 0. • Use this with 0 setup in normal operation. Set up other value only when you need to lower the over-load level. • The setup value of this parameter is limited by 115[%] of the motor rating.
73	Setup of over-speed level	0 to 20000 <0>	r/min	• You can set up the over-speed level. The over-speed level becomes 1.2 times of the motor max. speed by setting up this to 0. • Use this with 0 setup in normal operation. Set up other value only when you need to lower the over-speed level. • The setup value of this parameter is limited by 1.2 times of the motor max. speed. **<Caution>** The detection error against the setup value is ±3 [r/min] in case of the 7-wire absolute encoder, and ±36 [r/min] in case of the 5-wire incremental encoder.

<Notes>

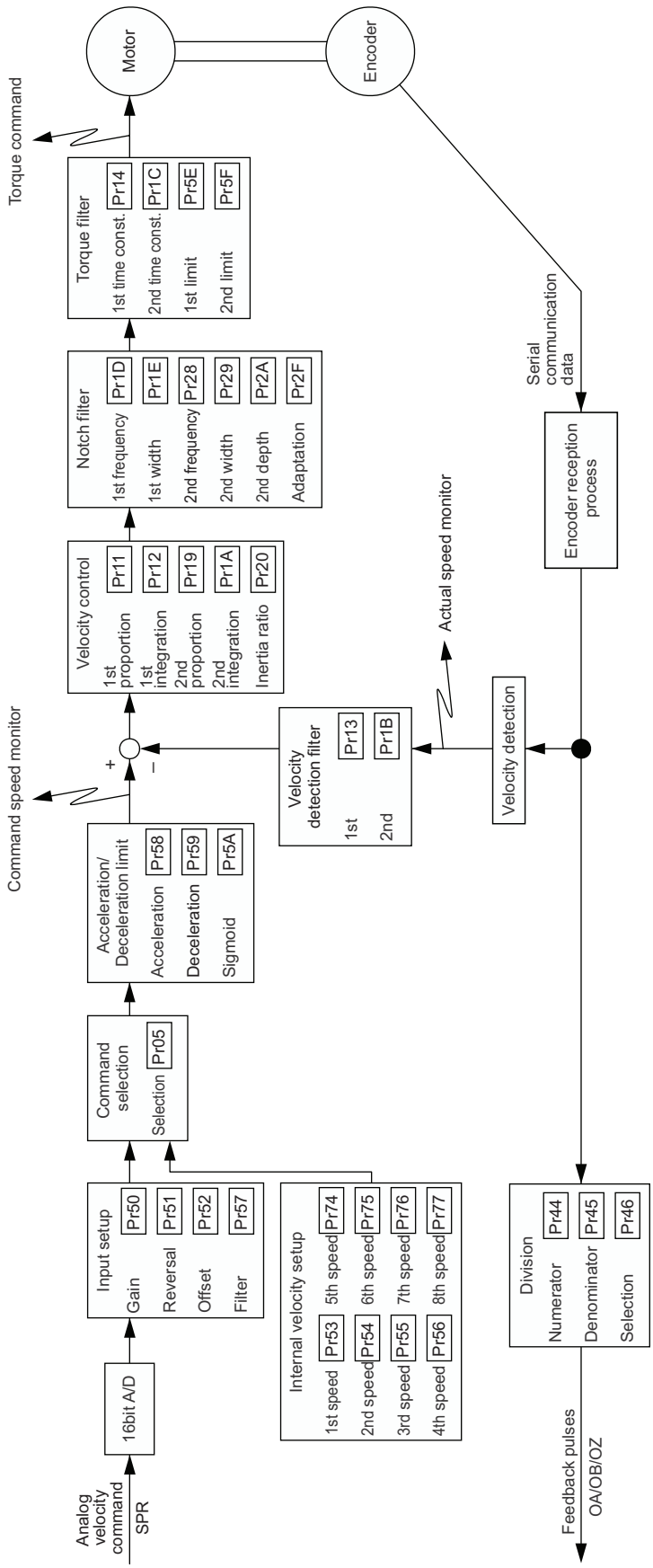
• For parameters which No. have a suffix of "*", changed contents will be validated when you turn on the control power.



[Connection and Setup of Velocity Control Mode]

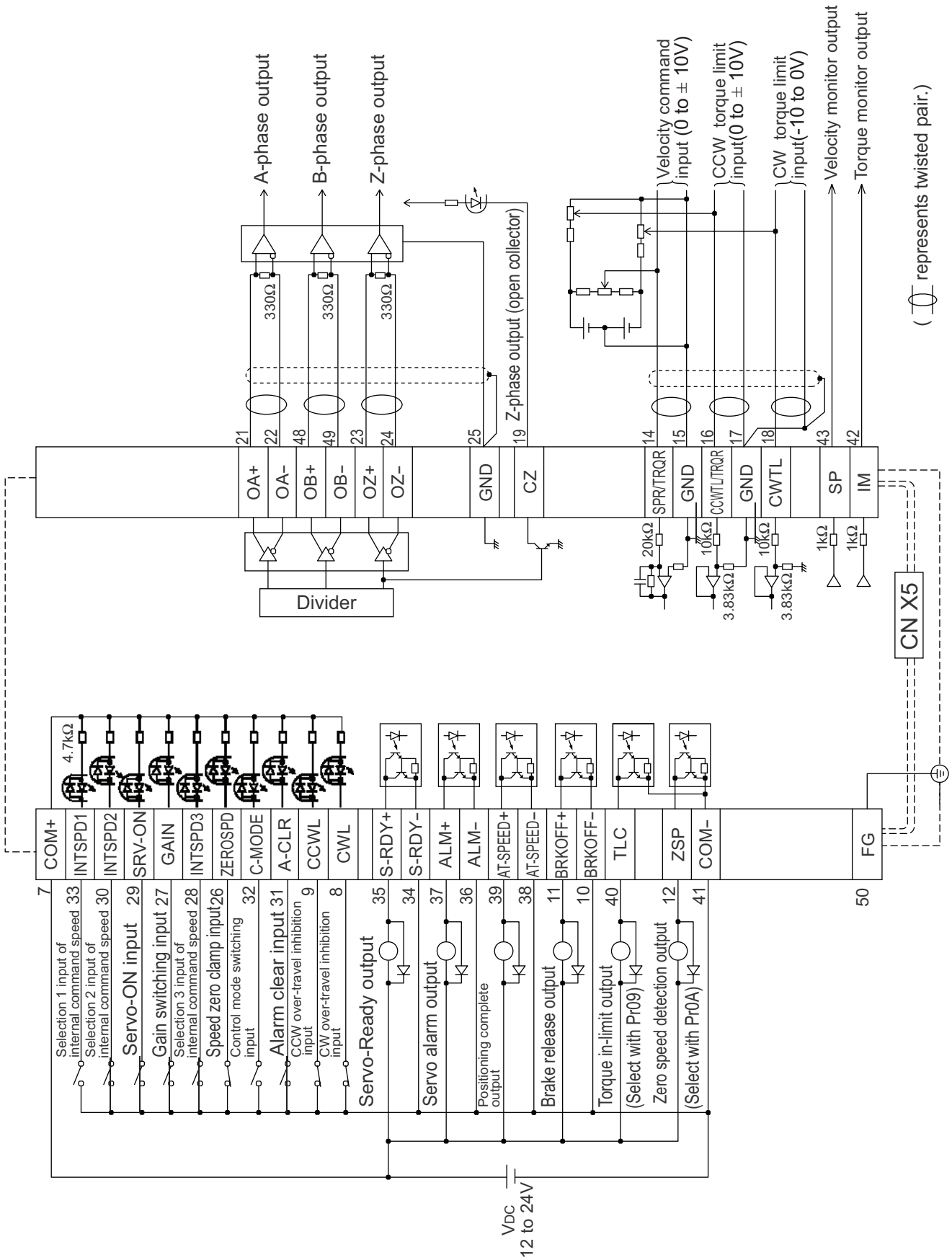
page

Control block diagram of velocity control mode



Wiring Example to the Connector CN X5

Wiring Example of Velocity Control Mode



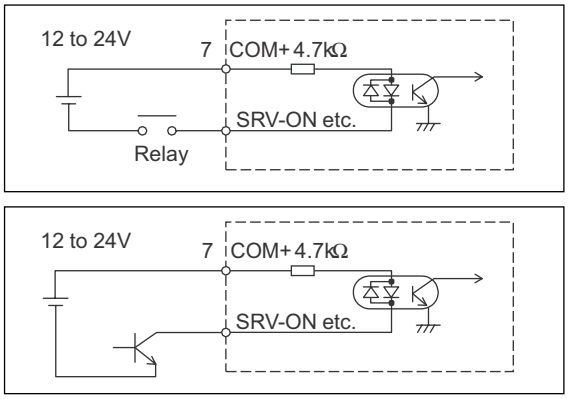
Wiring to the connector, CN X5

Interface Circuit

Input Circuit

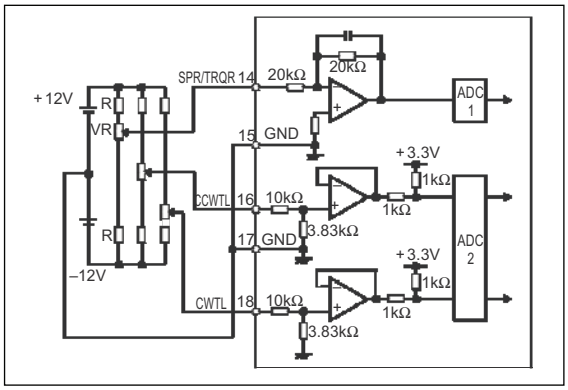
SI Connection to sequence input signals

- Connect to contacts of switches and relays, or open collector output transistors.
- When you use contact inputs, use the switches and relays for micro current to avoid contact failure.
- Make the lower limit voltage of the power supply (12 to 24V) as 11.4V or more in order to secure the primary current for photo-couplers.



AI Analog command input

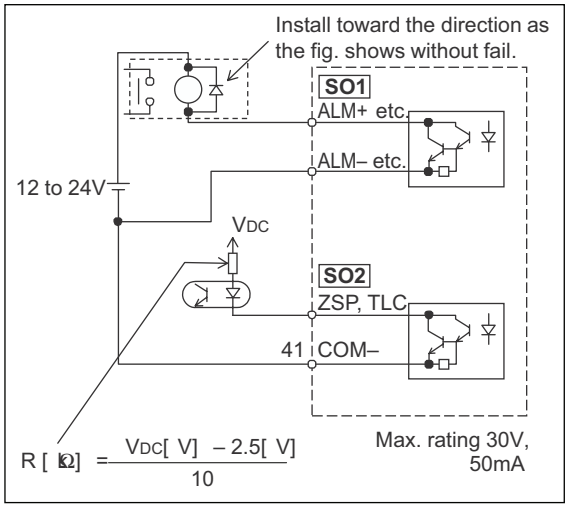
- The analog command input goes through 3 routes, SPR/TRQR(Pin-14), CCWTL (Pin-16) and CWTL (Pin-18).
- Max. permissible input voltage to each input is ±10V. For input impedance of each input, refer to the right Fig.
- When you compose a simple command circuit using variable resistor(VR) and register R, connect as the right Fig. shows. When the variable range of each input is made as –10V to +10V, use VR with 2kΩ, B-characteristics, 1/2W or larger, R with 200Ω, 1/2W or larger.
- A/D converter resolution of each command input is as follows.
  (1)ADC1 : 16 bit (SPR/TRQR), (including 1bit for sign), ±10V
  (2)ADC2 : 10 bit (CCWTL, CWTL), 0 to 3.3V



Output Circuit

SO1 SO2 Sequence output circuit

- The output circuit is composed of open collector transistor outputs in the Darlington connection, and connect to relays or photo-couplers.
- There exists collector to emitter voltage, V_{CE} (SAT) of approx. 1V at transistor-ON, due to the Darlington connection of the output or. Note that normal TTL IC cannot be directly connected since it does not meet VIL.
- There are two types of output, one which emitter side of the output transistor is independent and is connectable individually, and the one which is common to – side of the control power supply (COM–).
- If a recommended primary current value of the photo-coupler is 10mA, decide the resistor value using the formula of the right Fig.

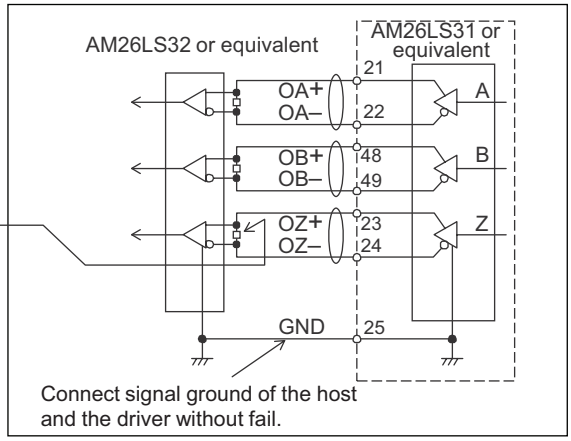


For the recommended primary current value, refer to the data sheet of apparatus or photo-coupler to be used.

PO1 Line driver (Differential output) output

- Feeds out the divided encoder outputs (A, B and Z-phase) in differential through each line driver.
- At the host side, receive these in line receiver. Install a terminal resistor (approx. 330Ω) between line receiver inputs without fail.
- These outputs are not insulated.

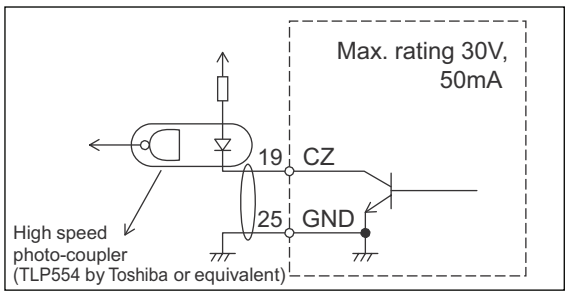
⏚ represents twisted pair.



PO2 Open collector output

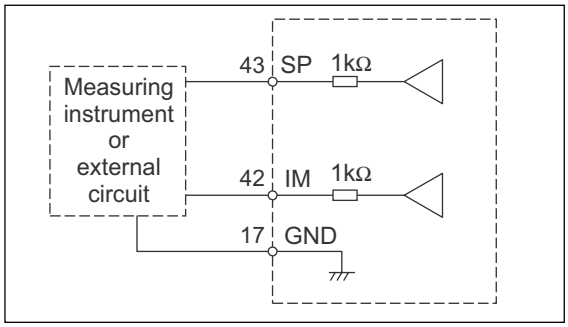
- Feeds out the Z-phase signal among the encoder signals in open collector. This output is not insulated.
- Receive this output with high-speed photo couplers at the host side, since the pulse width of the Z-phase signal is narrow.

⏚ represents twisted pair.



AO Analog monitor output

- There are two outputs, the speed monitor signal output (SP) and the torque monitor signal output (IM)
- Output signal width is ±10V.
- The output impedance is 1kΩ. Pay an attention to the input impedance of the measuring instrument or the external circuit to be connected.



<Resolution>

(1) Speed monitor output (SP)
With a setup of 6V/3000r/min (Pr07= 3), the resolution converted to speed is 8r/min/16mV.

(2) Torque monitor output (IM)
With a relation of 3V/rated torque (100%), the resolution converted to torque is 0.4%/12mV.

Wiring to the connector, CN X5

Input Signal and Pin No. of the Connector, CN X5

Input Signals (common) and Their Functions

<table>
<tr><th>Title of signal</th><th>Pin No.</th><th>Symbol</th><th>Function</th><th>I/F circuit</th></tr>
<tr><td>Power supply for control signal (+)</td><td>7</td><td>COM+</td><td>• Connect + of the external DC power supply (12 to 24V).
• Use the power supply voltage of 12V ± 5% – 24V ± 5%</td><td>–</td></tr>
<tr><td>Power supply for control signal (–)</td><td>41</td><td>COM–</td><td>• Connect – of the external DC power supply (12 to 24V).
• The power capacity varies depending on a composition of I/O circuit. 0.5A or more is recommended.</td><td>–</td></tr>
<tr><td>CW over-travel inhibit input</td><td>8</td><td>CWL</td><td>• Use this input to inhibit a CW over-travel (CWL).
• Connect this so as to make the connection to COM– open when the moving portion of the machine over-travels the movable range toward CW.
• CWL input will be invalidated when you set up Pr04 (Setup of over-travel inhibit input) to 1.Default is "Invalid (1)".
• You can select the action when the CWL input is validated with the setup of up Pr66 (Sequence at over-travel inhibit). Default is "Emergency stop with dynamic brake".(Pr66= 0)</td><td>SI
P.128</td></tr>
<tr><td>CCW over-travel inhibit input</td><td>9</td><td>CCWL</td><td>• Use this input to inhibit a CCW over-travel (CCWL).
• Connect this so as to make the connection to COM- open when the moving portion of the machine over-travels the movable range toward CCW.
• CWL input will be invalidated when you set up Pr04 (Setup of over-travel inhibit input) to 1.Default is "Invalid (1)".
• You can select the action when the CCWL input is validated with the setup of Pr66 (Sequence at over-travel inhibit). Default is "Emergency stop with dynamic brake".(Pr66= 0)</td><td>SI
P.128</td></tr>
<tr><td>Speed zero clamp input</td><td>26</td><td>ZEROSPD</td><td>• Function varies depending on the control mode.
<table>
<tr><td>Velocity/ Torque control</td><td>• Becomes to a speed-zero clamp input (ZEROSPD).
<table>
<tr><th>Pr06</th><th>Connection to COM–</th><th>Content</th></tr>
<tr><td>0</td><td>–</td><td>ZEROSPD input is invalid.</td></tr>
<tr><td rowspan="2">1</td><td>open</td><td>Speed command is 0</td></tr>
<tr><td>close</td><td>Normal action</td></tr>
<tr><td rowspan="2">2</td><td>open</td><td>Speed command is to CCW</td></tr>
<tr><td>close</td><td>Speed command is to CW.</td></tr>
</table>
• In case Pr06 is 2 at torque control, ZERPSPD is invalid.</td></tr>
<tr><td>Position/ Full-closed control</td><td>• Becomes to an input of damping control switching (VS-SEL).
• While Pr24 (Damping filter switching selection) is 1, the 1st damping filter (Pr2B, Pr2C) will be validated when you open this input, and the 2nd damping filter (Pr2D, Pr2E) will be validated when you connect this input to COM–.</td></tr>
</table></td><td>SI
P.128</td></tr>
<tr><td>Gain switching input
or
Torque limit switching input</td><td>27</td><td>GAIN

TL-SEL</td><td>• Function varies depending on the setups of Pr30 (2nd gain setup) and Pr03 (Selection of torque limit).
<table>
<tr><th>Pr03</th><th>Pr30</th><th>Connection to COM–</th><th>Content</th></tr>
<tr><td rowspan="6">0 – 2</td><td rowspan="2">0</td><td>open</td><td>Velocity loop : PI (Proportion/Integration) action</td></tr>
<tr><td>close</td><td>Velocity loop : P (Proportion) action</td></tr>
<tr><td rowspan="4">1</td><td colspan="2">when the setups of Pr31 and Pr36 are 2</td></tr>
<tr><td>open</td><td>1st gain selection (Pr10,11,12,13 and 14)</td></tr>
<tr><td>close</td><td>2nd gain selection (Pr18,19,1A,1B and 1C)</td></tr>
<tr><td colspan="2">when the setups of Pr31 and Pr36 are other than 2</td></tr>
<tr><td colspan="3">invalid</td></tr>
<tr><td>3</td><td>–</td><td colspan="2">• Input of torque limit switching (TL-SEL)
• Pr5E (Setup of 1st torque limit) will be validated when you open this input, and Pr5F (Setup of 2nd torque limit) will be validated when you connect this input to COM–.</td></tr>
</table>
• For details of 2nd gain switching function, refer to P.243 "Gain Switching Function" of Adjustment.</td><td>SI
P.128</td></tr>
</table>

Title of signal	Pin No.	Symbol	Function	I/F circuit
Internal command speed selection 3 input	**28**	**INTSPD3**	• Function varies depending on the control mode. **Position/ Full-closed control**: • You can switch the numerator of electronic gear. • By connecting to COM–, you can switch the numerator of electronic gear from Pr48 (1st numerator of electronic gear) to Pr49 (2nd numerator of electronic gear) • For the selection of command division/multiplication, refer to the table of next page, "Numerator selection of command scaling" **Velocity control**: • Input of internal speed selection 3 (INTSPD3). • You can make up to 8-speed setups combining INH/ INTSPD1 and CL/INTSPD2 inputs. For details of setup, refer to the table of P.131, "Selection of Internal Speed". **Torque control**: • This input is invalid.	SI P.128
Servo-ON input	**29**	**SRV-ON**	• Turns to Servo-ON status by connecting this input to COM–. • Turns to Servo-OFF status by opening connection to COM–, and current to the motor will be shut off. • You can select the dynamic brake action and the deviation counter clearing action at Servo-OFF with Pr69 (Sequence at Servo-OFF). **<Caution>** 1.Servo-ON input becomes valid approx. 2 sec after power-on. (see P.42, "Timing Chart" of Preparation.) 2.Never run/stop the motor with Servo-ON/OFF. 3.After shifting to Servo-ON, allow 100ms or longer pause before entering the pulse command.	SI P.128

• Selection of Internal Speed

Connector Pin No. of X5			Pr05, Internal/external switching of speed setup			
Pin-33 INTSPD1(INH)	Pin-30 INTSPD2(CL)	Pin-28 INTSPD3(DIV)	0	1	2	3
open	open	open	Analog speed command (CN X5, Pin-14)	1st speed of speed setup (Pr53)	1st speed of speed setup (Pr53)	1st speed of speed setup (Pr53)
short	open	open	Analog speed command (CN X5, Pin-14)	2nd speed of speed setup (Pr54)	2nd speed of speed setup (Pr54)	2nd speed of speed setup (Pr54)
open	short	open	Analog speed command (CN X5, Pin-14)	3rd speed of speed setup (Pr55)	3rd speed of speed setup (Pr55)	3rd speed of speed setup (Pr55)
short	short	open	Analog speed command (CN X5, Pin-14)	4th speed of speed setup (Pr56)	Analog speed command (CN X5, Pin-14)	4th speed of speed setup (Pr56)
open	open	short	Analog speed command (CN X5, Pin-14)	1st speed of speed setup (Pr53)	1st speed of speed setup (Pr53)	5th speed of speed setup (Pr74)
short	open	short	Analog speed command (CN X5, Pin-14)	2nd speed of speed setup (Pr54)	2nd speed of speed setup (Pr54)	6th speed of speed setup (P75)
open	short	short	Analog speed command (CN X5, Pin-14)	3rd speed of speed setup (Pr55)	3rd speed of speed setup (Pr55)	7th speed of speed setup (Pr76)
short	short	short	Analog speed command (CN X5, Pin-14)	4th speed of speed setup (Pr56)	Analog speed command (CN X5, Pin-14)	8th speed of speed setup (Pr77)

Wiring to the connector, CN X5

<table>
<tr><th>Title of signal</th><th>Pin No.</th><th>Symbol</th><th>Function</th><th>I/F circuit</th></tr>
<tr><td>Selection 2 input of internal command speed</td><td>30</td><td>INTSPD2</td><td>• Function varies depending on the control mode.
Position/ Full-closed control
• Input (CL) which clears the positional deviation counter and full-closed deviation counter.
• You can clear the counter of positional deviation and full-closed deviation by connecting this to COM–.
• You can select the clearing mode with Pr4E (Counter clear input mode).
<table><tr><th>Pr4E</th><th>Content</th></tr><tr><td>0</td><td>Clears the counter of positional deviation and full-closed deviation while CL is connected to COM–.</td></tr><tr><td>1
[Default]</td><td>Clears the counter of positional deviation and full-closed deviation only once by connecting CL to COM– from open status.</td></tr><tr><td>2</td><td>CL is invalid</td></tr></table>Velocity control
• Input of selection 2 of internal command speed (INTSPD2)
• You can make up to 8-speed setups combining INH/INTSPD1 and CL/INTSPD3 inputs. For details of setup, refer to the table in P.131, "Selection of Internal Speed" of Velocity Control Mode.
Torque control
• This input is invalid.</td><td>SI
P.128</td></tr>
<tr><td>Alarm clear input</td><td>31</td><td>A-CLR</td><td>• You can release the alarm status by connecting this to COM– for more than 120ms.
• The deviation counter will be cleared at alarm clear.
• There are some alarms which cannot be released with this input.
For details, refer to P.252, "Protective Function " of When in Trouble.</td><td>SI
P.128</td></tr>
<tr><td>Control mode switching input</td><td>32</td><td>C-MODE</td><td>• You can switch the control mode as below by setting up Pr02 (Control mode setup) to 3-5.
<table><tr><th>Pr02 setup</th><th>Open (1st)</th><th>Connection to COM– (2nd)</th></tr><tr><td>3</td><td>Position control</td><td>Velocity control</td></tr><tr><td>4</td><td>Position control</td><td>Torque control</td></tr><tr><td>5</td><td>Velocity control</td><td>Torque control</td></tr></table><Caution>
Depending on how the command is given at each control mode, the action might change rapidly when switching the control mode with C-MODE. Pay an extra attention.</td><td>SI
P.128</td></tr>
<tr><td>Selection 1 input of internal command speed</td><td>33</td><td>INTSPD1</td><td>• Function varies depending on the control mode.
Position/ Full closed control
• Inhibition input of command pulse input (INH)
• Ignores the position command pulse by opening the connection to COM–
• You can invalidate this input with Pr43 (Invalidation of command pulse inhibition input)
<table><tr><th>Pr43</th><th>Content</th></tr><tr><td>0</td><td>INH is valid.</td></tr><tr><td>1(Default)</td><td>INH is valid.</td></tr></table>Velocity control
• Selection 1 input of internal command speed (INTSPD1)
•You can make up to 8-speed setups combining INH/INTSPD2 and CL/INTSPD3 inputs. For details of the setup, refer to the table of P.131, "Selection of Internal Speed" of Velocity Control Mode.
Torque control
• This input is invalid.</td><td>SI
P.128</td></tr>
</table>

Input Signals (Analog Command) and Their Functions

<table>
<tr><th>Title of signal</th><th>Pin No.</th><th>Symbol</th><th>Function</th><th>I/F circuit</th></tr>
<tr><td>Speed command input</td><td>14</td><td>SPR</td><td>
• Function varies depending on control mode.
<table>
<tr><th>Pr02</th><th>Control mode</th><th>Function</th></tr>
<tr><td>1
3
5</td><td>Velocity control
Position/ <u>Velocity</u>
<u>Velocity</u>/ Torque</td><td>• Input of external speed command (SPR) when the velocity control is selected.
• Set up the gain, polarity, offset and filter of the Speed command with;
Pr50 (Speed command input gain)
Pr51 (Speed command input reversal)
Pr52 (Speed command offset)
Pr57 (Speed command filter setup)</td></tr>
<tr><td>5</td><td>Velocity/ Torque</td><td>• Function varies depending on Pr5B (Selection of torque command)
<table>
<tr><th>Pr5B</th><th>Content</th></tr>
<tr><td>0</td><td>• This input becomes invalid.</td></tr>
<tr><td>1</td><td>• Speed limit (SPL) will be selected.
• Set up the speed limit (SPL) gain, offset and filter with;
Pr50 (Speed command input gain)
Pr52 (Speed command offset)
Pr57 (Speed command filter setup)</td></tr>
</table></td></tr>
<tr><td>Others</td><td>Other control mode</td><td>• This input is invalid.</td></tr>
</table>
•The resolution of the A/D converter used in this input is 16 bit (including 1 bit for sign).
± 32767 (LSB) = ± 10[V] , 1[LSB] = 0.3[mV]
</td><td>AI
P.128</td></tr>
</table>

*Function becomes valid when the control mode with underline (▭ / <u>▭</u>) is selected while the switching mode is used in the control mode in table.

<Remark>

Do not apply voltage exceeding ±10V to analog command input of SPR

Wiring to the connector, CN X5

<table>
<tr><th>Title of signal</th><th>Pin No.</th><th>Symbol</th><th>Function</th><th>I/F circuit</th></tr>
<tr><td>CCW-Torque limit input</td><td>16</td><td>CCWTL</td><td>• Function varies depending on Pr02 (Control mode setup).
<table>
<tr><th>Pr02</th><th>Control mode</th><th>Function</th></tr>
<tr><td>2
4</td><td>Torque Control
Position/Torque</td><td>• Function varies depending on Pr5B (Selection of torque command)
<table>
<tr><th>Pr5B</th><th>Content</th></tr>
<tr><td>0</td><td>This input becomes invalid.</td></tr>
<tr><td>1</td><td>• Torque command input (TRQR) will be selected.
• Set up the gain and polarity of the command with;
Pr5C (Torque command input gain)
Pr5D (Torque command input reversal)
• Offset and filter cannot be set up.</td></tr>
</table></td></tr>
<tr><td>5</td><td>Velocity/
Torque</td><td>• Becomes to the torque command input (TRQR).
• Set up the gain and polarity of the command with;
Pr5C (Torque command input gain)
Pr5D (Torque command input reversal)
• Offset and filter cannot be set up.</td></tr>
<tr><td>4
5
Other</td><td><u>Position</u>/Torque
Velocity/Torque
Other
control mode</td><td>• Becomes to the analog torque limit input to CCW (CCWTL).
• Limit the CCW-torque by applying positive voltage (0 to +10V) (Approx.+3V/rated toque)
• Invalidate this input by setting up Pr03 (Torque limit selection) to other than 0.</td></tr>
</table>
• Resolution of A/D converter used in this input is 16 bit (including 1 bit for sign).
± 511 [LSB] ≒ 11.9[V] , 1 [LSB] ≒ 23[mV]</td><td>AI
P.128</td></tr>
<tr><td>CW-Torque limit input</td><td>18</td><td>CWTL</td><td>• Function varies depending on Pr02 (Control mode setup).
<table>
<tr><th>Pr02</th><th>Control mode</th><th>Function</th></tr>
<tr><td>2
4
5</td><td>Torque control
Position/<u>Torque</u>
Velocity/<u>Torque</u></td><td>• This input becomes invalid when the torque control is selected.</td></tr>
<tr><td>4
5
Other</td><td><u>Position</u>/Torque
Velocity/Torque
Other
control mode</td><td>• Becomes to the analog torque limit input to CW (CWTL).
• Limit the CW-torque by applying negative voltage (0 to –10V) (Approx.+3V/rated toque).
Invalidate this input by setting up Pr03 (Torque limit selection) to other than 0.</td></tr>
</table>
• Resolution of A/D converter used in this input is 16 bit (including 1 bit for sign).
± 511 [LSB] ≒ 11.9[V] , 1 [LSB] ≒ 23[mV]</td><td>AI
P.128</td></tr>
</table>

*Function becomes valid when the control mode with underline (▭ / <u>▭</u>) is selected while the switching mode is used in the control mode in table.

<Remark>

Do not apply voltage exceeding ±10V to analog command input of CWTL and CCWTL

Output signal and Pin No. of the Connector, CN X5

Output Signals (Common) and Their Functions

Title of signal	Pin No	Symbol	Function	I/F circuit
External brake release signal	**11** **10**	**BRKOFF+** **BRKOFF–**	• Feeds out the timing signal which activates the electromagnetic brake of the motor. • Turns the output transistor ON at the release timing of the electro-magnetic brake. • You can set up the output timing of this signal with Pr6A (Setup of mechanical brake action at stall) and Pr6B (Setup of mechanical brake action at motion). For details, refer to P42, "Timing Chart" of Preparation.)	SO1 P.129
Servo-Ready output	**35** **34**	**S-RDY+** **S-RDY–**	• This signal shows that the driver is ready to be activated. • Output transistor turns ON when both control and main power are ON but not at alarm status.	SO1 P.129
Servo-Alarm output	**37** **36**	**ALM+** **ALM–**	• This signal shows that the driver is in alarm status.. • Output transistor turns ON when the driver is at normal status, and turns OFF at alarm status.	SO1 P.129
Positioning complete (In-position)	**39** **38**	**AT-SPEED+** **AT-SPEED–**	• Function varies depending on the control mode. **Position control**: • Output of positioning complete (COIN) • The output transistor will turn ON when the absolute value of the position deviation pulse becomes smaller than the setup value of Pr60 (Positioning complete range). • You can select the feeding out method with Pr63 (Setup of positioning complete output). **Full-closed control**: • Output of full-closed positioning complete (EX-COIN) • The output transistor will turn ON when the absolute value of full-closed-position deviation pulse becomes smaller than the setup value of Pr60 (Positioning complete range). • You can select the feeding out method with Pr63 (Setup of positioning complete output). **Velocity/ Torque control**: • Output at-speed (speed arrival) (AT-SPEED) • The output transistor will turn ON when the actual motor speed exceeds the setup value of Pr62 (In-speed).	SO1 P.129
Zero-speed detection output signal	**12** **(41)**	**ZSP** **(COM–)**	• Content of the output signal varies depending on Pr0A (Selection of ZSP output). • Default is 1, and feeds out the zero speed detection signal. • For details, see the table below, "Selection of TLC,ZSP output".	SO2 P.129
Torque in-limit signal output	**40** **(41)**	**TLC** **(COM–)**	• Content of the output signal varies depending on Pr09 (Selection of TLC output). • Default is 1, and feeds out the torque in-limit signal. • For details, see the table below, "Selection of TLC,ZSP output".	SO2 P.129

• Selection of TCL and ZSP outputs

Value of Pr09 or Pr0A	X5 TLC : Output of Pin-40	X5 ZSP : Output of Pin-12
0	**• Torque in-limit output (Default of X5 TLC Pr09)** The output transistor turns ON when the torque command is limited by the torque limit during Servo-ON.	
1	**• Zero-speed detection output (Default of X5 ZSP Pr0A)** The output transistor turns ON when the motor speed falls under the preset value with Pr61.	
2	**• Alarm signal output** The output transistor turns ON when either one of the alarms is triggered, over-regeneration alarm, overload alarm, battery alarm, fan-lock alarm or external scale alarm.	
3	**• Over-regeneration alarm** The output transistor turns ON when the regeneration exceeds 85% of the alarm trigger level of the regenerative load protection.	
4	**• Over-load alarm** The output transistor turns ON when the load exceeds 85% of the alarm trigger level of the overload alarm.	
5	**• Battery alarm** The output transistor turns ON when the battery voltage for absolute encoder falls lower than approx. 3.2V.	
6	**• Fan-lock alarm** The output transistor turns ON when the fan stalls for longer than 1s.	
7	**• External scale alarm** The output transistor turns ON when the external scale temperature exceeds 65°, or signal intensity is not enough (adjustment on mounting is required). Valid only at the full-closed control.	
8	**• In-speed (Speed coincidence) output** The output transistor turns ON when the difference between the actual motor speed and the speed command before acceleration/deceleration reaches within the preset range with Pr61. Valid only at the velocity and torque control.	

Wiring to the connector, CN X5

Output Signals (Pulse Train) and Their Functions

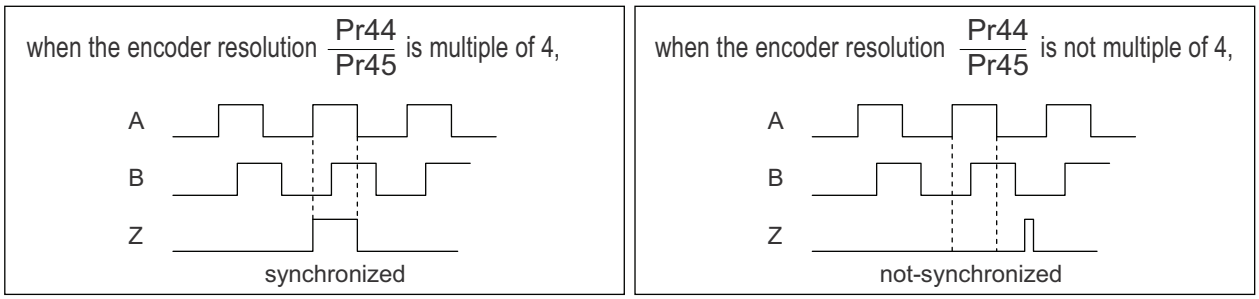
Title of signal	Pin No	Symbol	Function	I/F circuit
A-phase output	21	OA +	• Feeds out the divided encoder signal or external scale signal (A, B, Z-phase) in differential. (equivalent to RS422) • You can set up the division ratio with Pr44 (Numerator of pulse output division) and Pr45 (Denominator of pulse output division) • You can select the logic relation between A-phase and B-phase, and the output source with Pr46 (Reversal of pulse output logic). • When the external scale is made as an output source, you can set up the interval of Z-phase pulse output with Pr47 (Setup of external scale Z-phase). • Ground for line driver of output circuit is connected to signal ground (GND) and is not insulated. • Max. output frequency is 4Mpps (after quadrupled)	PO1 P.129
	22	OA –		
B-phase output	48	OB +		
	49	OB –		
Z-phase output	23	OZ +		
	24	OZ –		
Z-phase output	19	CZ	• Open collector output of Z-phase signal • The emitter side of the transistor of the output circuit is connected to the signal ground (GND) and is not insulated.	PO2 P.129

<Note>

• When the output source is the encoder

• If the encoder resolution X $\frac{Pr44}{Pr45}$ is multiple of 4, Z-phase will be fed out synchronizing with A-phase.

In other case, the Z-phase width will be equal to the encoder resolution, and will not synchronize with A-phase because of narrower width than that of A-phase.



• In case of the 5-wire, 2500P/r incremental encoder, the signal sequence might not follow the above fig. until the first Z-phase is fed out. When you use the pulse output as the control signal, rotate the motor one revolution or more to make sure that the Z-phase is fed out at least once before using.

Output Signals (Analog) and Their Functions

<table>
<tr><th>Title of signal</th><th>Pin No</th><th>Symbol</th><th>Function</th><th>I/F circuit</th></tr>
<tr><td>Torque monitor signal output</td><td>42</td><td>IM</td><td>• The content of output signal varies depending on Pr08 (Torque monitor (IM) selection).
• You can set up the scaling with Pr08 value.
<table>
<tr><th>Pr08</th><th>Content of signal</th><th>Function</th></tr>
<tr><td>0, 11,12</td><td>Torque command</td><td>• Feeds out the voltage in proportion to the motor torque command with polarity.
+ : generates CCW torque
– : generates CW torque</td></tr>
<tr><td>1 – 5</td><td>Positional deviation</td><td>• Feeds out the voltage in proportion to the positional deviation pulse counts with polarity.
+ : positional command to CCW of motor position
– : positional command to CW of motor position</td></tr>
<tr><td>6 –10</td><td>Full-closed deviation</td><td>• Feeds out the voltage in proportion to the full-closed deviation pulse counts with polarity.
+ : positional command to CCW of external scale position
– : positional command to CW of external scale position</td></tr>
</table></td><td>AO
P.129</td></tr>
<tr><td>Speed monitor signal output</td><td>43</td><td>SP</td><td>• The content of the output signal varies depending on Pr07 (Speed monitor (IM) selection).
• You can set up the scaling with Pr07 value.
<table>
<tr><th>Pr07</th><th>Control mode</th><th>Function</th></tr>
<tr><td>0 – 4</td><td>Motor speed</td><td>• Feeds out the voltage in proportion to the motor speed with polarity. + : rotates to CCW
– : rotates to CW</td></tr>
<tr><td>5 – 9</td><td>Command speed</td><td>• Feeds out the voltage in proportion to the command speed with polarity.
+ : rotates to CCW
– : rotates to CW</td></tr>
</table></td><td>AO
P.129</td></tr>
</table>

Output Signals (Others) and Their Functions

Title of signal	Pin No	Symbol	Function	I/F circuit
Signal ground	**13,15, 17,25**	**GND**	• Signal ground • This output is insulated from the control signal power (COM–) inside of the driver.	–
Frame ground	**50**	**FG**	• This output is connected to the earth terminal inside of the driver.	–

Trial Run (JOG run) at Velocity Control Mode

Inspection Before Trial Run

(1) Wiring inspection

- Miswiring
  (Especially power input/motor output)
- Short/Earth
- Loose connection

(2) Check of power/voltage

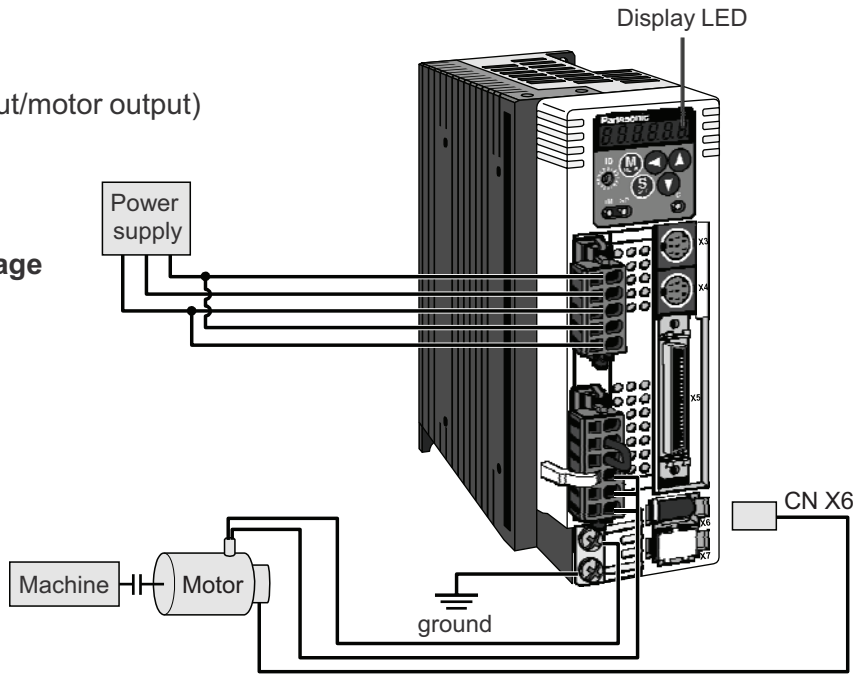
- Rated voltage

(3) Fixing of the motor

- Unstable fixing

(4) Separation from mechanical system

(5) Release of the brake



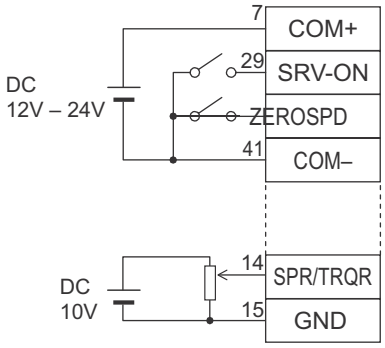
Trial Run by Connecting the Connector, CN X5

1) Connect the CN X5.
2) Enter the power (DC12-24V) to control signal (COM+ , COM–)
3) Enter the power to the driver.
4) Confirm the default values of parameters.
5) Connect the Servo-ON input (SRV-ON, CN X5, Pin-29) and COM– (CN X5, Pin-14) to turn to Servo-ON and energize the motor.
6) Close the speed zero clamp input (ZEROSPD) and apply DC voltage between velocity command input , SPR (CN X5, Pin-14) and GND (CN X5, Pin-15), and gradually increase from 0V to confirm the motor runs.
7) Confirm the motor rotational speed in monitor mode.
   • Whether the rotational speed is per the setup or not.
   • Whether the motor stops with zero command or not.
8) If the motor does rotate at a micro speed with command voltage of 0, correct the command voltage referring to P.74, "Automatic offset adjustment" of Preparation.
9) When you want to change the rotational speed and direction, set up the following parameters again.

Pr50 : Speed command input gain
Pr51 : Speed command input reversal
→ Refer to P.152, "Parameter Setup" (Parameters for Velocity/Torque Control)

10)If the motor does not run correctly, refer to P.68, "Display of Factor for No-Motor Running" of Preparation.

Wiring Diagram



Run with ZEROSPD switch close, and Stop with open

In case of one-directional operation

In case of bi-directional operation (CW/CCW), provide a bipolar power supply, or use with Pr06 = 3.

Parameter

PrNo.	Title	Setup value
02	Setup of control mode	1
04	Invalidation of over-travel inhibit input	1
06	Selection of ZEROSPD input	1
50	Velocity command gain	Set up as required
51	Velocity command reversal	
52	Velocity command offset	
57	Setup of velocity command filter	

Input signal status

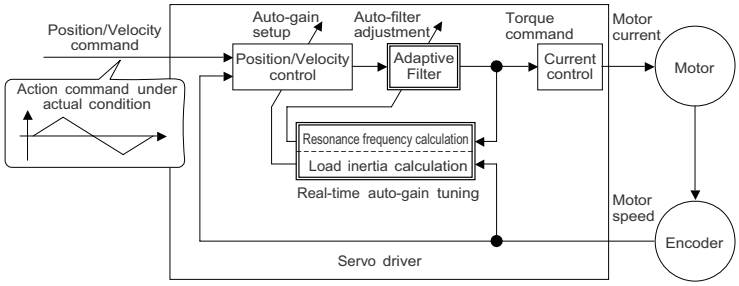
No.	Title of signal	Monitor display
0	Servo-ON	+ A
5	Speed zero clamp	–

Real-Time Auto-Gain Tuning

Outline

The driver estimates the load inertia of the ma-

optimum gain responding to the result. Also the driver automatically suppress the vibration caused by the resonance with an adaptive filter.



Applicable Range

- Real-time auto-gain tuning is applicable to all control modes.

Caution

Real-time auto-gain tuning may not be executed properly under the conditions described in the right table. In these cases, use the normal mode auto-gain tuning (refer to P.236 of Adjustment), or execute a manual gain tuning. (refer to P.240, of Adjustment)

	Conditions which obstruct real-time auto-gain tuning
Load inertia	• Load is too small or large compared to rotor inertia. (less than 3 times or more than 20 times) • Load inertia change too quickly. (10 [s] or less)
Load	• Machine stiffness is extremely low. • Chattering such as backlash exists.
Action pattern	• Motor is running continuously at low speed of 100 [r/min] or lower. • Acceleration/deceleration is slow (2000[r/min] per 1[s] or low). • Acceleration/deceleration torque is smaller than unbalanced weighted/viscous friction torque. • When speed condition of 100[r/min] or more and acceleration/deceleration condition of 2000[r/min] per 1[s] are not maintained for 50[ms] .

How to Operate

(1) Bring the motor to stall (Servo-OFF).
(2) Set up Pr21 (Real-time auto-gain tuning mode setup) to 1-7. Default is 1.

Setup value	Real-time auto-gain tuning	Varying degree of load inertia in motion
0	(not in use)	–
<1>,4,7	normal mode	no change
2,5		slow change
3,6		rapid change

- When the varying degree of load inertia is large, set up 3 or 6.
- When resonance might give some effect, validate the setup of Pr23 (Setup of adaptive filter mode).

(3) Set up Pr22 (Machine stiffness at real-time auto-gain tuning) to 0 or smaller value.
(4) Turn to Servo-ON to run the machine normally.
(5) Gradually increase Pr22 (Machine stiffness at real-time auto-gain tuning) when you want to obtain better response. Lower the value (0 to 3) when you experience abnormal noise or oscillation.
(6) Write to EEPROM when you want to save the result.

Insert the console connector to CN X6 of the driver, then turn on the driver power. → r 0

Setup of parameter, Pr21

Press (S). → dP_SPd
Press (M). → PA_ 00
Match to the parameter No. to be set up with (▲)(▼). (Here match to Pr21.) → PA_ 21
Press (S). → 1
Change the setup with (▲)(▼).
Press (S). → PA_ 21

Setup of parameter, Pr22

Match to Pr22 with (▲). → PA_ 22
Press (S). → 4 (default values)
Numeral increases with (▲), and decreases with (▼).
Press (S).

Writing to EEPROM

Press (M). → EE_SEt
Press (S). → EEP -
Bars increase as the right fig. shows by keep pressing (▲)(approx. 5sec). → EEP -- → ------
Writing starts (temporary display). → StArt
Finish → FinISh (Writing completes) / rESEt / Error (Writing error occurs)

Return to SELECTION display after writing finishes, referring to "Structure of each mode"(P.60 and 61 of Preparation).

Adaptive Filters

The adaptive filter is validated by setting up Pr23 (Setup of adaptive filter mode) to other than 0.
The adaptive filter automatically estimates a resonance frequency out of vibration component presented in the motor speed in motion, then removes the resonance components from the torque command by setting up the notch filter coefficient automatically, hence reduces the resonance vibration.
The adaptive filter may not operate property under the following conditions. In these cases, use 1st notch filter (Pr1D and 1E) and 2nd notch filter (Pr28-2A) to make measures against resonance according to the manual adjusting procedures.
For details of notch filters, refer to P.246, "Suppression of Machine Resonance" of Adjustment.

	Conditions which obstruct adaptive filter action
Resonance point	• When resonance frequency is lower than 300[Hz] . • While resonance peak is low or control gain is small and when no affect from these condition is given to the motor speed. • When multiple resonance points exist.
Load	• When the motor speed variation with high frequency factor is generated due to non-linear factor such as backlash.
Command pattern	• When acceleration/deceleration is very extreme such as more than 30000 [r/min] per 1 [s] .

<Note>
Even though Pr23 is set up to other than 0, there are other cases when adaptive filter is automatically invalidated. Refer to P.235, "Invalidation of adaptive filter" of Adjustment.

Parameters Which Are Automatically Set Up.

Following parameters are automatically adjusted. Also following parameters are automatically set up.

PrNo.	Title
11	1st gain of velocity loop
12	1st time constant of velocity loop integration
13	1st filter of velocity detection
14	1st time constant of torque filter
19	2nd gain of velocity loop
1A	2nd time constant of velocity loop integration
1B	2nd filter of speed detection
1C	2nd time constant of torque filter
20	Inertia ratio
2F	Adaptive filter frequency

PrNo.	Title	Setup value
27	Setup of instantaneous speed observer	0
30	2nd gain setup	1
31	1st mode of control switching	0
32	1st delay time of control switching	30
33	1st level of control switching	50
34	1st hysteresis of control switching	33
36	2nd mode of control switching	0

<Notes>
- When the real-time auto-gain tuning is valid, you cannot change parameters which are automatically adjusted.
- Pr31 becomes 10 at position or full closed control and when Pr21 (Setup of Real-Time Auto-Gain Tuning Mode) is 1 to 6, and becomes 0 in other cases.

Cautions

(1) After the start-up, you may experience abnormal noise and oscillation right after the first Servo-ON, or when you increase the setup of Pr22 (Selection of machine stiffness at real-time auto-gain tuning), until load inertia is identified (estimated) or adaptive filter is stabilized, however, these are not failures as long as they disappear immediately. If they persist over 3 reciprocating operations, take the following measures in possible order.
1) Write the parameters which have given the normal operation into EEPROM.
2) Lower the setup of Pr22 (Selection of machine stiffness at real-time auto-gain tuning).
3) Set up both Pr21 (Setup of real-time auto-gain tuning) and Pr23 (Setup of adaptive filter mode) to 0, then set up other value than 0. (Reset of inertia estimation and adaptive action)
4) Invalidate the adaptive filter by setting up Pr23 (Setup of adaptive filter mode setup) to 0, and set up notch filter manually.
(2) When abnormal noise and oscillation occur, Pr20 (Inertia ratio) or Pr2F (Adaptive filter frequency) might have changed to extreme values. Take the same measures as the above in these cases.
(3) Among the results of real-time auto-gain tuning, Pr20 (Inertia ratio) and Pr2F (Adaptive filter frequency) will be written to EEPROM every 30 minutes. When you turn on the power again, auto-gain tuning will be executed using the latest data as initial values.
(4) When you validate the real-time auto-gain tuning, Pr27 (Setup of instantaneous speed observer) will be invalidated automatically.
(5) The adaptive filter is normally invalidated at torque control, however, when you select torque control while you set up Pr02 (Control mode setup) to 4 and 5, the adaptive filter frequency before mode switching will be held.
(6) During the trial run and frequency characteristics measurement of "PANATERM®", the load inertia estimation will be invalidated.

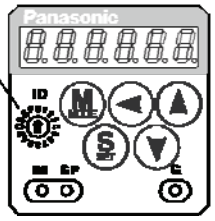
Parameter Setup

Parameters for Functional Selection

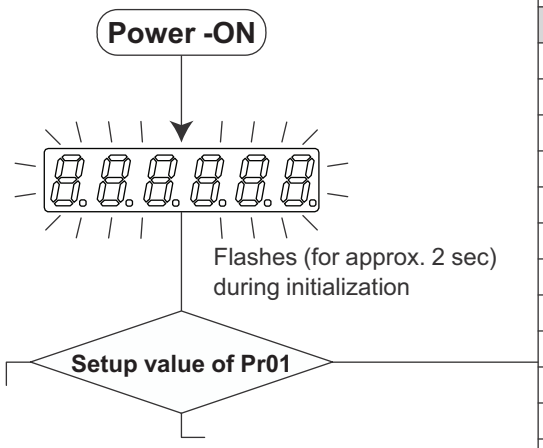
Standard default : < >

PrNo.	Title	Setup range	Function/Content
00 *	Address	0 to 15 <1>	In the communication with the host via RS232/485 for multi-axes application, it is necessary to identify which axis the host is communicating. Use this parameter to confirm the address of the axis in numbers.

- The address is determined by the setup value of rotary switch (0 to F) of the front panel at power-on.
- This value becomes the axis number at serial communication.
- The setup value of this parameter has no effect to the servo action.
- You cannot change the setup of Pr00 with other means than rotary switch.



PrNo.	Title	Setup range	Function/Content
01 *	LED initial status	0 to 17 <1>	You can select the type of data to be displayed on the front panel LED (7 segment) at the initial status after power-on.



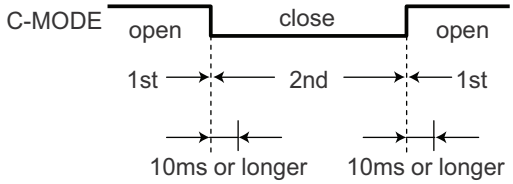
Setup value	Content
0	Positional deviation
<1>	Motor rotational speed
2	Torque output
3	Control mode
4	I/O signal status
5	Error factor/history
6	Software version
7	Alarm
8	Regenerative load factor
9	Over-load factor
10	Inertia ratio
11	Sum of feedback pulses
12	Sum of command pulses
13	External scale deviation
14	Sum of external scale feedback pulses
15	Motor automatic recognizing function
16	Analog input value
17	Factor of "No-Motor Running"

For details of display, refer to P.51 "Setup of Parameter and Mode" of Preparation.

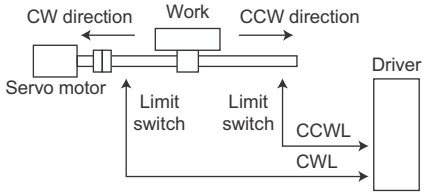
PrNo.	Title	Setup range	Function/Content
02 *	Setup of control mode	0 to 6 <1>	You can set up the control mode to be used.

Setup value	Control mode	
	1st mode	2nd mode
0	Position	–
<1>	Velocity	–
2	Torque	–
3 **1	Position	Velocity
4 **1	Position	Torque
5 **1	Velocity	Torque
6	Full-closed	–

**1) When you set up the combination mode of 3, 4 or 5, you can select either the 1st or the 2nd with control mode switching input (C-MODE).
When C-MODE is open, the 1st mode will be selected.
When C-MODE is shorted, the 2nd mode will be selected.
Don't enter commands 10ms before/after switching.



Standard default : < >

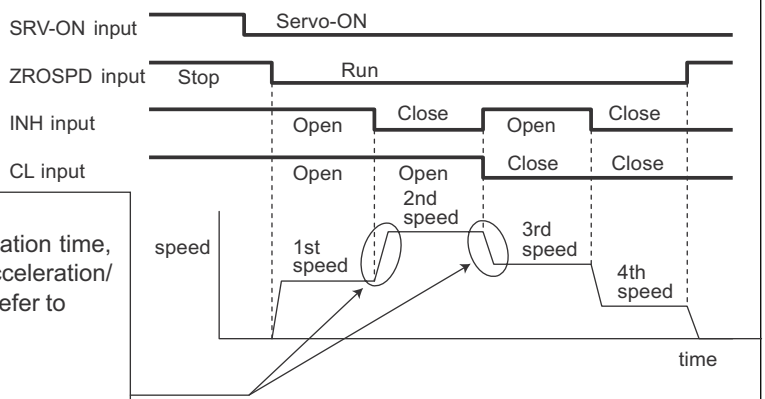
<table>
<tr><th>PrNo.</th><th>Title</th><th>Setup range</th><th>Function/Content</th></tr>
<tr><td>03</td><td>Selection of torque limit</td><td>0 to 3
<1></td><td>You can set up the torque limiting method for CCW/CW direction.
<table>
<tr><th>Setup value</th><th>CCW</th><th>CW</th></tr>
<tr><td>0</td><td>X5 CCWTL : Pin-16</td><td>X5 CWTL : Pin-18</td></tr>
<tr><td><1></td><td colspan="2">Pr5E is a limit value for both CCW and CW direction</td></tr>
<tr><td>2</td><td>Set with Pr5E</td><td>Set with Pr5F</td></tr>
<tr><td>3</td><td colspan="2">When GAIN/TL-SEL input is open, set with Pr5E
When GAIN/TL-SEL input is shorted, set with Pr5F</td></tr>
</table>
When the setup value is 0, CCWTL and CWTL will be limited by Pr5E (1st torque limit setup). At the torque control, Pr5E becomes the limiting value for CCW/CW direction regardless of the setup of this parameter.</td></tr>
<tr><td>04
*</td><td>Setup of over-travel inhibit input</td><td>0 to 2
<1></td><td>In linear drive application, you can use this over-travel inhibiting function to inhibit the motor to run to the direction specified by limit switches which are installed at both ends of the axis, so that you can prevent the work load from damaging the machine due to the over-travel. With this input, you can set up the action of over-travel inhibit input.


<table>
<tr><th>Setup value</th><th>CCWL/CWL input</th><th colspan="2">Input</th><th>Action</th></tr>
<tr><td rowspan="4">0</td><td rowspan="4">Valid</td><td rowspan="2">CCWL
(CN X5,Pin-9)</td><td>Close</td><td>Normal status while CCW-side limit switch is not activated.</td></tr>
<tr><td>Open</td><td>Inhibits CCW direction, permits CW direction.</td></tr>
<tr><td rowspan="2">CWL
(CN X5,Pin-9)</td><td>Close</td><td>Normal status while CW-side limit switch is not activated.</td></tr>
<tr><td>Open</td><td>Inhibits CW direction, CCW direction permitted.</td></tr>
<tr><td><1></td><td>Invalid</td><td colspan="3">Both CCWL and CWL inputs will be ignored, and over-travel inhibit function will be invalidated.</td></tr>
<tr><td>2</td><td>Valid</td><td colspan="3">Err38 (Over-travel inhibit input protection) is triggered when either one of the connection of CW or CCW inhibit input to COM– become open.</td></tr>
</table>
<Cautions>
1. When Pr04 is set to 0 and over-travel inhibit input is entered, the motor decelerates and stops according to the preset sequence with Pr66 (Sequence at over-travel inhibition). For details, refer to the explanation of Pr66.
2. When both of CCWL and CWL inputs are opened while Pr04 is set to 0, the driver trips with Err38 (Overtravel inhibit input error) judging that this is an error.
3. When you turn off the limit switch on upper side of the work at vertical axis application, the work may repeat up/down movement because of the loosing of upward torque. In this case, set up Pr66 to 2, or limit with the host controller instead of using this function.</td></tr>
</table>

<Notes>

• For parameters which No. have a suffix of "*", changed contents will be validated when you turn on the control power.

Standard default : < >

<table>
<tr><th>PrNo.</th><th>Title</th><th>Setup range</th><th>Function/Content</th></tr>
<tr><td>05</td><td>Speed setup, Internal/External switching</td><td>0 to 3
<0></td><td>This driver is equipped with internal speed setup function so that you can control the speed with contact inputs only.
<table>
<tr><th>Setup value</th><th>Speed setup method</th></tr>
<tr><td><0></td><td>External speed command (SPR:CN X5, Pin-14)</td></tr>
<tr><td>1</td><td>Internal speed command 1st to 4th speed (Pr53 to Pr56)</td></tr>
<tr><td>2</td><td>Internal speed command 1st to 3rd speed (Pr53-Pr55), External speed command (SPR)</td></tr>
<tr><td>3</td><td>Internal speed command 1st to 8th speed (Pr53 to Pr56, Pr74 to Pr77)</td></tr>
</table>
• You can select a speed command at velocity control.
• When the setup value is 1 or 2, switch 4 kinds of internal speed command with 2 kinds of contact input.
(1) INH (CN X5, Pin-33) :
Selection 1 input of internal command speed
(2) INH (CN X5, Pin-30) :
Selection 2 input of internal command speed
DIV input is ignored.
• When the setup value is 3, switch 8 kinds of internal speed command with 3 kinds of contact input.
(1) INH (CN X5, Pin-33) :
Selection 1 input of internal command speed
(2) INH (CN X5, Pin-30) :
Selection 2 input of internal command speed
(3) INH (CN X5, Pin-28) :
Selection 3 input of internal command speed
• Selection of internal speed
<table>
<tr><th colspan="3">Connector Pin No. of X5</th><th colspan="4">Pr05, Internal/external switching of speed setup</th></tr>
<tr><th>Pin-33
INTSPD1(INH)</th><th>Pin-30
INTSPD2(CL)</th><th>Pin-28
INTSPD3(DIV)</th><th>0</th><th>1</th><th>2</th><th>3</th></tr>
<tr><td>open</td><td>open</td><td>open</td><td>Analog speed command (CN X5, Pin-14)</td><td>1st speed of speed setup (Pr53)</td><td>1st speed of speed setup (Pr53)</td><td>1st speed of speed setup (Pr53)</td></tr>
<tr><td>short</td><td>open</td><td>open</td><td>Analog speed command (CN X5, Pin-14)</td><td>2nd speed of speed setup (Pr54)</td><td>2nd speed of speed setup (Pr54)</td><td>2nd speed of speed setup (Pr54)</td></tr>
<tr><td>open</td><td>short</td><td>open</td><td>Analog speed command (CN X5, Pin-14)</td><td>3rd speed of speed setup (Pr55)</td><td>3rd speed of speed setup (Pr55)</td><td>3rd speed of speed setup (Pr55)</td></tr>
<tr><td>short</td><td>short</td><td>open</td><td>Analog speed command (CN X5, Pin-14)</td><td>4th speed of speed setup (Pr56)</td><td>Analog speed command (CN X5, Pin-14)</td><td>4th speed of speed setup (Pr56)</td></tr>
<tr><td>open</td><td>open</td><td>short</td><td>Analog speed command (CN X5, Pin-14)</td><td>1st speed of speed setup (Pr53)</td><td>1st speed of speed setup (Pr53)</td><td>5th speed of speed setup (Pr74)</td></tr>
<tr><td>short</td><td>open</td><td>short</td><td>Analog speed command (CN X5, Pin-14)</td><td>2nd speed of speed setup (Pr54)</td><td>2nd speed of speed setup (Pr54)</td><td>6th speed of speed setup (P75)</td></tr>
<tr><td>open</td><td>short</td><td>short</td><td>Analog speed command (CN X5, Pin-14)</td><td>3rd speed of speed setup (Pr55)</td><td>3rd speed of speed setup (Pr55)</td><td>7th speed of speed setup (Pr76)</td></tr>
<tr><td>short</td><td>short</td><td>short</td><td>Analog speed command (CN X5, Pin-14)</td><td>4th speed of speed setup (Pr56)</td><td>Analog speed command (CN X5, Pin-14)</td><td>8th speed of speed setup (Pr77)</td></tr>
</table>
• Example of 4-speed run with internal speed command.
In addition to CL/INH inputs, use the speed zero clamp input (ZEROSPD) and Servo-ON input (SRV-ON) to control the motor stop and start.


<Caution>
You can individually set up acceleration time, deceleration time, and sigmoid acceleration/ deceleration time with parameter. Refer to
Pr58 : Acceleration time setup
Pr59 : Deceleration time setup
Pr5A : Sigmoid acceleration/ deceleration time setup in this Chapter.</td></tr>
<tr><td>06</td><td>Selection of ZEROSPD input</td><td>0 to 2
<0></td><td>You can set up the function of the speed zero clamp input (ZEROSPD : CN X5, Pin-26)
<table>
<tr><th>Setup value</th><th>Function of ZEROSPD (Pin-26)</th></tr>
<tr><td><0></td><td>ZEROSPD input is ignored and the driver judge that it Is not in speed zero clamp status.</td></tr>
<tr><td>1</td><td>ZEROSPD input becomes valid. Speed command is taken as 0 by opening the connection to COM–.</td></tr>
<tr><td>2</td><td>Becomes speed command sign. You can set command direction to CCW by opening the connection to COM–, and CW by closing.</td></tr>
</table></td></tr>
</table>

Standard default : < >

<table>
<tr><th>PrNo.</th><th>Title</th><th>Setup range</th><th>Function/Content</th></tr>
<tr><td>07</td><td>Selection of speed monitor (SP)</td><td>0 to 9
<3></td><td>You can set up the content of analog speed monitor signal output (SP : CN X5, Pin43) and the relation between the output voltage level and the speed.
<table>
<tr><th>Setup value</th><th>Signal of SP</th><th>Relation between the output voltage level and the speed</th></tr>
<tr><td>0</td><td rowspan="5">Motor actual speed</td><td>6V / 47 r/min</td></tr>
<tr><td>1</td><td>6V / 188 r/min</td></tr>
<tr><td>2</td><td>6V / 750 r/min</td></tr>
<tr><td><3></td><td>6V / 3000 r/min</td></tr>
<tr><td>4</td><td>1.5V / 3000 r/min</td></tr>
<tr><td>5</td><td rowspan="5">Command speed</td><td>6V / 47 r/min</td></tr>
<tr><td>6</td><td>6V / 188 r/min</td></tr>
<tr><td>7</td><td>6V / 750 r/min</td></tr>
<tr><td>8</td><td>6V / 3000 r/min</td></tr>
<tr><td>9</td><td>1.5V / 3000 r/min</td></tr>
</table></td></tr>
<tr><td>08</td><td>Selection of torque monitor (IM)</td><td>0 to 12
<0></td><td>You can set up the content of the analog torque monitor of the signal output (IM : CN X5, Pin-42), and the relation between the output voltage level and torque or deviation pulse counts.
<table>
<tr><th>Setup value</th><th>Signal of IM</th><th>Relation between the output voltage level and torque or deviation pulse counts</th></tr>
<tr><td><0></td><td>Torque command</td><td>3V/rated (100%) torque</td></tr>
<tr><td>1</td><td rowspan="5">Position deviation</td><td>3V / 31Pulse</td></tr>
<tr><td>2</td><td>3V / 125Pulse</td></tr>
<tr><td>3</td><td>3V / 500Pulse</td></tr>
<tr><td>4</td><td>3V / 2000Pulse</td></tr>
<tr><td>5</td><td>3V / 8000Pulse</td></tr>
<tr><td>6</td><td rowspan="5">Full-closed deviation</td><td>3V / 31Pulse</td></tr>
<tr><td>7</td><td>3V / 125Pulse</td></tr>
<tr><td>8</td><td>3V / 500Pulse</td></tr>
<tr><td>9</td><td>3V / 2000Pulse</td></tr>
<tr><td>10</td><td>3V / 8000Pulse</td></tr>
<tr><td>11</td><td rowspan="2">Torque command</td><td>3V / 200% torque</td></tr>
<tr><td>12</td><td>3V / 400% torque</td></tr>
</table></td></tr>
<tr><td>09</td><td>Selection of TLC output</td><td>0 to 8
<0></td><td>You can assign the function of the torque in-limit output (TLC : CN X5 Pin-40).
<table>
<tr><th>Setup value</th><th>Function</th><th>Note</th></tr>
<tr><td><0></td><td>Torque in-limit output</td><td rowspan="9">For details of function of each output of the left, refer to the table of P135, "Selection of TCL and ZSP outputs".</td></tr>
<tr><td>1</td><td>Zero speed detection output</td></tr>
<tr><td>2</td><td>Alarm output of either one of Over-regeneration /Over-load/Absolute battery/Fan lock/External scale</td></tr>
<tr><td>3</td><td>Over-regeneration alarm trigger output</td></tr>
<tr><td>4</td><td>Overload alarm output</td></tr>
<tr><td>5</td><td>Absolute battery alarm output</td></tr>
<tr><td>6</td><td>Fan lock alarm output</td></tr>
<tr><td>7</td><td>External scale alarm output</td></tr>
<tr><td>8</td><td>In-speed (Speed coincidence) output</td></tr>
</table></td></tr>
<tr><td>0A</td><td>Selection of ZSP output</td><td>0 to 8
<1></td><td>You can assign the function of the zero speed detection output (ZSP: CN X5 Pin-12).
<table>
<tr><th>Setup value</th><th>Function</th><th>Note</th></tr>
<tr><td>0</td><td>Torque in-limit output</td><td rowspan="9">For details of function of each output of the left, refer to the table of P.135, "Selection of TCL and ZSP outputs".</td></tr>
<tr><td><1></td><td>Zero speed detection output</td></tr>
<tr><td>2</td><td>Alarm output of either one of Over-regeneration /Over-load/Absolute battery/Fan lock/External scale</td></tr>
<tr><td>3</td><td>Over-regeneration alarm trigger output</td></tr>
<tr><td>4</td><td>Overload alarm output</td></tr>
<tr><td>5</td><td>Absolute battery alarm output</td></tr>
<tr><td>6</td><td>Fan lock alarm output</td></tr>
<tr><td>7</td><td>External scale alarm output</td></tr>
<tr><td>8</td><td>In-speed (Speed coincidence) output</td></tr>
</table></td></tr>
</table>

Standard default : < >

<table>
<tr><th>PrNo.</th><th>Title</th><th>Setup range</th><th>Function/Content</th></tr>
<tr><td>0B
*</td><td>Setup of absolute encoder</td><td>0 to 2
<1></td><td>You can set up the using method of 17-bit absolute encoder.
<table>
<tr><th>Setup value</th><th>Content</th></tr>
<tr><td>0</td><td>Use as an absolute encoder.</td></tr>
<tr><td><1></td><td>Use as an incremental encoder.</td></tr>
<tr><td>2</td><td>Use as an absolute encoder, but ignore the multi-turn counter over.</td></tr>
</table>
<Caution>
This parameter will be invalidated when 5-wire, 2500P/r incremental encoder is used.</td></tr>
<tr><td>0C
*</td><td>Baud rate setup of RS232 communication</td><td>0 to 5
<2></td><td>You can set up the communication speed of RS232. • Error of baud rate is ±0.5%.
<table>
<tr><th>Setup value</th><th>Baud rate</th><th>Setup value</th><th>Baud rate</th></tr>
<tr><td>0</td><td>2400bps</td><td>3</td><td>19200bps</td></tr>
<tr><td>1</td><td>4800bps</td><td>4</td><td>38400bps</td></tr>
<tr><td><2></td><td>9600bps</td><td>5</td><td>57600bps</td></tr>
</table></td></tr>
<tr><td>0D
*</td><td>Baud rate setup of RS485 communication</td><td>0 to 5
<2></td><td>You can set up the communication speed of RS485. • Error of baud rate is ±0.5%.
<table>
<tr><th>Setup value</th><th>Baud rate</th><th>Setup value</th><th>Baud rate</th></tr>
<tr><td>0</td><td>2400bps</td><td>3</td><td>19200bps</td></tr>
<tr><td>1</td><td>4800bps</td><td>4</td><td>38400bps</td></tr>
<tr><td><2></td><td>9600bps</td><td>5</td><td>57600bps</td></tr>
</table></td></tr>
<tr><td>0E
*</td><td>Setup of front panel lock</td><td>0 to 1
<0></td><td>You can limit the operation of the front panel to the monitor mode only.
You can prevent such a misoperation as unexpected parameter change.
<table>
<tr><th>Setup value</th><th>Content</th></tr>
<tr><td><0></td><td>Valid to all</td></tr>
<tr><td>1</td><td>Monitor mode only</td></tr>
</table>
<Note>
You can still change parameters via communication even though this setup is 1.
To return this parameter to 0, use the console or the "PANATERM®".</td></tr>
</table>

Parameters for Adjustment of Time Constants of Gains and Filters

Standard default : < >

PrNo.	Title	Setup range	Unit	Function/Content
11	1st gain of velocity loop	1 to 3500 A to C-frame:<35>* D to F-frame:<18>*	Hz	You can determine the response of the velocity loop. In order to increase the response of overall servo system by setting high position loop gain, you need higher setup of this velocity loop gain as well. However, too high setup may cause oscillation. **<Caution>** When the inertia ratio of Pr20 is set correctly, the setup unit of Pr11 becomes (Hz).
12	1st time constant of velocity loop integration	1 to 1000 A to C-frame:<16>* D to F-frame:<31>*	ms	You can set up the integration time constant of velocity loop. Smaller the setup, faster you can dog-in deviation at stall to 0. The integration will be maintained by setting to "999". The integration effect will be lost by setting to "1000".
13	1st filter of speed detection	0 to 5 <0> *	–	You can set up the time constant of the low pass filter (LPF) after the speed detection, in 6 steps. Higher the setup, larger the time constant you can obtain so that you can decrease the motor noise, however, response becomes slow. Use with a default value of 0 in normal operation.
14	1st time constant of torque filter	0 to 2500 A to C-frame:<65>* D to F-frame:<126>*	0.01ms	You can set up the time constant of the 1st delay filter inserted in the torque command portion. You might expect suppression of oscillation caused by distortion resonance.

Standard default : < >

PrNo.	Title	Setup range	Unit	Function/Content
19	2nd gain of velocity loop	1 to 3500 A to C-frame:<35>* D to F-frame:<18>*	Hz	Position loop, velocity loop, speed detection filter and torque command filter have their 2 pairs of gain or time constant (1st and 2nd). For details of switching the 1st and the 2nd gain or the time constant, refer to P.226, "Adjustment". The function and the content of each parameter is as same as that of the 1st gain and time constant.
1A	2nd time constant of velocity loop integration	1 to 1000 <1000>*	ms	
1B	2nd filter of velocity detection	0 to 5 <0>*	–	
1C	2nd time constant of torque filter	0 to 2500 A to C-frame:<65>* D to F-frame:<126>*	0.01ms	
1D	1st notch frequency	100 to 1500 <1500>	Hz	You can set up the frequency of the 1st resonance suppressing notch filter. The notch filter function will be invalidated by setting up this parameter to "1500".
1E	1st notch width selection	0 to 4 <2>	–	You can set up the notch filter width of the 1st resonance suppressing filter in 5 steps. Higher the setup, larger the notch width you can obtain. Use with default setup in normal operation.

Parameters for Auto-Gain Tuning

Standard default : < >

PrNo.	Title	Setup range	Unit	Function/Content
20	Inertia ratio	0 to 10000 <250>*	%	You can set up the ratio of the load inertia against the rotor (of the motor) inertia. Pr20= (load inertia/rotor inertia) X 100 [%] When you execute the normal auto-gain tuning, the load inertial will be automatically estimated after the preset action, and this result will be reflected in this parameter. The inertia ratio will be estimated at all time while the real-time auto-gain tuning is valid, and its result will be saved to EEPROM every 30 min. **<Caution>** If the inertia ratio is correctly set, the setup unit of Pr11 and Pr19 becomes (Hz). When the inertia ratio of Pr20 is larger than the actual, the setup unit of the velocity loop gain becomes larger, and when the inertia ratio of Pr20 is smaller than the actual, the setup unit of the velocity loop gain becomes smaller.
21	Setup of real-time auto-gain tuning	0 to 7 <1>	–	You can set up the action mode of the real-time auto-gain tuning. With higher setup such as 3, the driver respond quickly to the change of the inertia during operation, however it might cause an unstable operation. Use 1for normal operation.

Setup value	Real-time auto-gain tuning	Varying degree of load inertia in motion
0	Invalid	–
<1>, 4, 7	Normal mode	Little change
2, 5		Gradual change
3, 6		Rapid change

<Notes>

- For parameters which No. have a suffix of "*", changed contents will be validated when you turn on the control power.
- Parameters which default values have a suffix of "*" will be automatically set up during real time auto-gain tuning. When you change manually, invalidate the real-time auto-gain tuning first then set, referring to P.239, "Release of Automatic Gain Adjusting Function" of Adjustment.

Parameter Setup

Standard default : < >

<table>
<tr><th>PrNo.</th><th>Title</th><th>Setup range</th><th>Unit</th><th>Function/Content</th></tr>
<tr><td>22</td><td>Selection of machine stiffness at real-time auto-gain tuning</td><td>0 to 15
A to C-frame:
<4>
D to F-frame:
<1></td><td>–</td><td>You can set up the machine stiffness in 16 steps while the real-time auto-gain tuning is valid.
low←machine stiffness→high
low← servo gain →high
Pr22 | 0, 1- - - - - - - - - - - - 14, 15
low← response →high
<Caution>
When you change the setup value rapidly, the gain changes rapidly as well, and this may give impact to the machine. Increase the setup gradually watching the movement of the machine.</td></tr>
<tr><td>23</td><td>Setup of adaptive filter mode</td><td>0 to 2
<1></td><td>–</td><td>You can set up the action of the adaptive filter.
0 : Invalid
1 : Valid
2 : Hold (holds the adaptive filter frequency when this setup is changed to 2.)
<Caution>
When you set up the adaptive filter to invalid, the adaptive filter frequency of Pr2F will be reset to 0. The adaptive filter is always invalid at the torque control mode.</td></tr>
<tr><td>25</td><td>Setup of an action at normal mode auto-gain tuning</td><td>0 to 7
<0></td><td>–</td><td>You can set up the action pattern at the normal mode auto-gain tuning.
<table>
<tr><th>Setup value</th><th>Number of revolution</th><th>Rotational direction</th></tr>
<tr><td><0></td><td rowspan="4">2 [revolution]</td><td>CCW → CW</td></tr>
<tr><td>1</td><td>CW → CCW</td></tr>
<tr><td>2</td><td>CCW → CCW</td></tr>
<tr><td>3</td><td>CW → CW</td></tr>
<tr><td>4</td><td rowspan="4">1 [revolution]</td><td>CCW → CW</td></tr>
<tr><td>5</td><td>CW → CCW</td></tr>
<tr><td>6</td><td>CCW → CCW</td></tr>
<tr><td>7</td><td>CW → CW</td></tr>
</table>
e.g.) When the setup is 0, the motor turns 2 revolutions to CCW and 2 revolutions to CW.</td></tr>
<tr><td rowspan="2">27</td><td>Setup of instantaneous speed observer</td><td>0 to 1
<0>*</td><td>–</td><td>With a high stiffness machine, you can achieve both high response and reduction of vibration at stall, by using this instantaneous speed observer.
<table>
<tr><th>Setup value</th><th>Instantaneous speed observer setup</th></tr>
<tr><td><0>*</td><td>Invalid</td></tr>
<tr><td>1</td><td>Valid</td></tr>
</table></td></tr>
<tr><td colspan="4">You need to set up the inertia ratio of Pr20 correctly to use this function.
If you set up Pr21, real-time auto-gain tuning mode setup, to other than 0 (valid), Pr27 becomes 0 (invalid)</td></tr>
<tr><td>28</td><td>2nd notch frequency</td><td>100 to 1500
<1500></td><td>Hz</td><td>You can set up the 2nd notch width of the resonance suppressing filter in 5 steps. The notch filter function is invalidated by setting up this parameter to "1500".</td></tr>
<tr><td>29</td><td>Selection of 2nd notch width</td><td>0 to 4
<2></td><td>–</td><td>You can set up the notch width of 2nd resonance suppressing filter in 5 steps. Higher the setup, larger the notch width you can obtain.
Use with default setup in normal operation.</td></tr>
<tr><td>2A</td><td>Selection of 2nd notch depth</td><td>0 to 99
<0></td><td>–</td><td>You can set up the 2nd notch depth of the resonance suppressing filter. Higher the setup, shallower the notch depth and smaller the phase delay you can obtain.</td></tr>
</table>

<Notes>

- Parameters which default values have a suffix of "*" will be automatically set up during real time auto-gain tuning. When you change manually, invalidate the real-time auto-gain tuning first then set, referring to P.239, "Release of Automatic Gain Adjusting Function" of Adjustment.

Standard default : < >

PrNo.	Title	Setup range	Unit	Function/Content
2F	Adaptive filter frequency	0 to 64 <0>	–	Displays the table No. corresponding to the adaptive filter frequency. (Refer to P.234 of Adjustment.) This parameter will be automatically set and cannot be changed while the adaptive filter is valid. (when Pr23 (Setup of adaptive filter mode) is other than 0.) 0 to 4 Filter is invalid. 5 to 48 Filter is valid. 49 to 64 Filter validity changes according to Pr22. This parameter will be saved to EEPROM every 30 minutes while the adaptive filter is valid, and when the adaptive filter is valid at the next power-on, the adaptive action starts taking the saved data in EEPROM as an initial value. **<Caution>** When you need to clear this parameter to reset the adaptive action while the action is not normal, invalidate the adaptive filter (Pr23, "Setup of adaptive filter mode" to 0) once, then validate again. Refer to P.239, "Release of Automatic Gain Adjusting Function" of Adjustment as well.

Parameters for Adjustment (2nd Gain Switching Function)

Standard default : < >

PrNo.	Title	Setup range	Unit	Function/Content
30	Setup of 2nd gain	0 to 1 <1>*	–	You can select the PI/P action switching of the velocity control or 1st/2nd gain switching.

Setup value	Gain selection/switching
0	1st gain (PI/P switching enabled) *1
<1>*	1st/2nd gain switching enabled *2

*1 Switch the PI/P action with the gain switching input (GAIN CN X5, Pin-27). PI is fixed when Pr03 (Torque limit selection) is 3.

GAIN input	Action of velocity loop
Open with COM–	PI action
Connect to COM–	P action

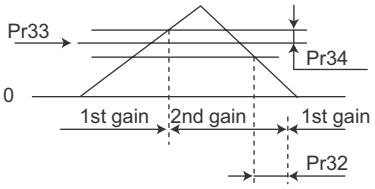
*2 For switching condition of the 1st and the 2nd, refer to P.243, "Gain Switching Function" of Adjustment.

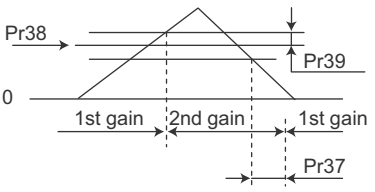
PrNo.	Title	Setup range	Unit	Function/Content
31	1st mode of control switching	0 to 10 <0>*	–	You can select the switching condition of 1st gain and 2nd gain while Pr30 is set to 1.

Setup value		Gain switching condition
<0>*, 6to 10		Fixed to the 1st gain.
1		Fixed to the 2nd gain.
2	*1	2nd gain selection when the gain switching input is turned on. (Pr30 setup must be 1.)
3	*2	2nd gain selection when the toque command variation is larger than the setups of Pr33 (1st level of control switching) and Pr34 (1st hysteresis of control switching).
4	*2	Fixed to the 1st gain.
5	*2	2nd gain selection when the command speed is larger than the setups of Pr33 (1st level of control switching) and Pr34 (1st hysteresis at control switching).

*1 Fixed to the 1st gain regardless of GAIN input, when Pr31 is set to 2 and Pr03 (Torque limit selection) is set to 3.
*2 For the switching level and the timing, refer to P.243, "Gain Switching Function" of Adjustment.

Standard default : < >

<table>
<tr><th>PrNo.</th><th>Title</th><th>Setup range</th><th>Unit</th><th>Function/Content</th></tr>
<tr><td>32</td><td>1st delay time of control switching</td><td>0 to 10000 <30>*</td><td>x 166μs</td><td>You can set up the delay time when returning from the 2nd to the 1st gain, while Pr31 is set to 3 or 5 to 10.</td></tr>
<tr><td>33</td><td>1st level of control switching</td><td>0 to 20000 <50>*</td><td>–</td><td>You can set up the switching (judging) level of the 1st and the 2nd gains, while Pr31 is set to 3, 5, 6. 9 and 10.
Unit varies depending on the setup of Pr31 (1st mode of control switching)</td></tr>
<tr><td>34</td><td>1st hysteresis of control switching</td><td>0 to 20000 <33>*</td><td>–</td><td>You can set up hysteresis width to be implemented above/below the judging level which is set up with Pr33. Unit varies depending on the setup of Pr31 (1st control switching mode). Definitions of Pr32 (Delay), Pr33 (Level) and Pr34 (Hysteresis) are explained in the fig. below.
 

<Caution>
The setup of Pr33 (Level) and Pr34 (Hysteresis) are valid as absolute values (positive/negative).</td></tr>
<tr><td>36</td><td>2nd mode of control switching</td><td>0 to 5 <0>*</td><td>–</td><td>You can select the switching condition of the 1st and 2nd gain while Pr30 is set to 1 and when the 2nd control mode is velocity control.
<table>
<tr><th>Setup value</th><th>Gain switching condition</th></tr>
<tr><td><0>*</td><td>Fixed to the 1st gain</td></tr>
<tr><td>1</td><td>Fixed to the 2nd gain</td></tr>
<tr><td>2 *1</td><td>2nd gain selection when gain switching input is turned on (GAIN : CN X5, Pin-27) (Pr30 setup must be 1.)</td></tr>
<tr><td>3 *2</td><td>2nd gain selection when the torque command variation is larger.</td></tr>
<tr><td>4 *2</td><td>2nd gain selection when the speed command variation (acceleration) is larger.</td></tr>
<tr><td>5 *2</td><td>2nd gain selection when the command speed is larger.</td></tr>
</table>
*1 Fixed to the 1st gain regardless of the GAIN input, when Pr31 is set to 2 and Pr03 (Torque limit selection) is set to 3.
*2 For the switching level and timing, refer to P.244, "Setup of Gain Switching Condition" of Adjustment.</td></tr>
<tr><td>37</td><td>2nd delay time of control switching</td><td>0 to 10000 <0></td><td>x 166μs</td><td>You can set up the delay time when returning from 2nd to 1st gain, while Pr36 is set to 3 to 5.</td></tr>
<tr><td>38</td><td>2nd level of control switching</td><td>0 to 20000 <0></td><td>–</td><td>You can set up the switching (judging) level of the 1st and the 2nd gains, while Pr36 is set to 3 to 5
Unit varies depending on the setup of Pr36 (2nd mode of control switching).</td></tr>
<tr><td>39</td><td>2nd hysteresis of control switching</td><td>0 to 20000 <0></td><td>–</td><td>You can set up the hysteresis width to be implemented above/below the judging level which is set up with Pr38.
Unit varies depending on the setup of Pr36 (2nd mode of control switching).Definition of Pr37 (Delay), Pr38 (Level) and Pr39 (Hysteresis) are explained in the fig. below.
 

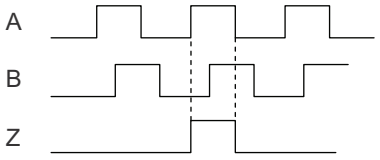
<Caution>
Setup of Pr38 (Level) and Pr39 (Hysteresis) are valid as absolute value (positive/negative).</td></tr>
<tr><td>3D</td><td>JOG speed setup</td><td>0 to 500 <300></td><td>r/min</td><td>You can setup the JOG speed.
Refer to P.75, "Trial Run"of Preparation.</td></tr>
</table>

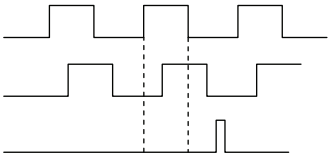
<Notes>

- Parameters which default values have a suffix of "*" will be automatically set up during real time auto-gain tuning. When you change manually, invalidate the real-time auto-gain tuning first then set, referring to P.239, "Release of Automatic Gain Adjusting Function" of Adjustment.

Parameters for Position Control

Standard default : < >

<table>
<tr><th>PrNo.</th><th>Title</th><th>Setup range</th><th>Function/Content</th></tr>
<tr><td>44
*</td><td>Numerator of pulse output division</td><td>1 to 32767
<2500></td><td rowspan="2">You can set up the pulse counts to be fed out from the pulse output (X5 0A+ : Pin-21, 0A- : Pin-22, 0B+ : Pin-48, 0B- : Pin-49).
• Pr45= <0> (Default)
You can set up the output pulse counts per one motor revolution for each OA and OB with the Pr44 setup. Therefore the pulse output resolution after quadruple can be obtained from the formula below.
The pulse output resolution per one revolution
= Pr44 (Numerator of pulse output division) X4
• Pr45≠0 :
The pulse output resolution per one revolution can be divided by any ration according to the formula below.
Pulse output resolution per one revolution $\frac{\text{Pr44 (Numerator of pulse output division)}}{\text{Pr45 (Denominator of pulse output division)}}$ x Encoder resolution
<Cautions>
• The encoder resolution is 131072 [P/r] for the 17-bit absolute encoder, and 10000 [P/r] for the 5-wire 2500P/r incremental encoder.
• The pulse output resolution per one revolution cannot be greater than the encoder resolution.
(In the above setup, the pulse output resolution equals to the encoder resolution.)
• Z-phase is fed out once per one revolution of the motor.
When the pulse output resolution obtained from the above formula is multiple of 4, Z-phase synchronizes with A-phase. In other case, the Z-phase width equals to output with the encoder resolution, and becomes narrower than A-phase, hence does not synchronize with A-phase.
when encoder resolution x $\frac{\text{Pr44}}{\text{Pr45}}$ is multiple of 4
 

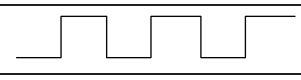
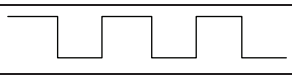
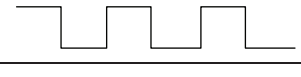
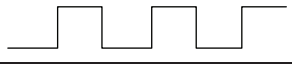
Synchronized
when encoder resolution x $\frac{\text{Pr44}}{\text{Pr45}}$ is not multiple of 4
 

Not-synchronized</td></tr>
<tr><td>45
*</td><td>Denominator of pulse output division</td><td>0 to 32767
<0></td></tr>
</table>

<Notes>

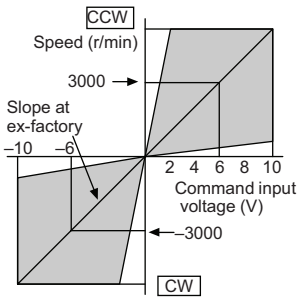
• For parameters which No. have a suffix of "*", changed contents will be validated when you turn on the control power.

Standard default : < >

<table>
<tr><th>PrNo.</th><th>Title</th><th>Setup range</th><th>Function/Content</th></tr>
<tr><td>46
*</td><td>Reversal of pulse output logic</td><td>0 to 3
<0></td><td>You can set up the B-phase logic and the output source of the pulse output (X5 OB+ : Pin-48, OB– : Pin-49). With this parameter, you can reverse the phase relation between the A-phase pulse and the B-phase pulse by reversing the B-phase logic.
<table>
<tr><th>Setup value</th><th>A-phase (OA)</th><th>at motor CCW rotation</th><th>at motor CW rotation</th></tr>
<tr><td><0>, 2</td><td>B-phase(OB) non-reversal</td><td>  </td><td>  </td></tr>
<tr><td>1, 3</td><td>B-phase(OB) reversal</td><td>  </td><td>  </td></tr>
</table>
<table>
<tr><th>Pr46</th><th>B-phase logic</th><th>Output source</th></tr>
<tr><td><0></td><td>Non-reversal</td><td>Encoder position</td></tr>
<tr><td>1</td><td>Reversal</td><td>Encoder position</td></tr>
<tr><td>2 *1</td><td>Non-reversal</td><td>External scale position</td></tr>
<tr><td>3 *1</td><td>Reversal</td><td>External scale position</td></tr>
</table>
*1 The output source of Pr46= 2, 3 is valid only at full-closed control.</td></tr>
</table>

Parameters for Velocity and Torque Control

Standard default : < >

<table>
<tr><th>PrNo.</th><th>Title</th><th>Setup range</th><th>Unit</th><th>Function/Content</th></tr>
<tr><td>50</td><td>Input gain of speed command</td><td>10 to 2000
<500></td><td>(r/min)/V</td><td>You can set up the relation between the voltage applied to the speed command input (SPR : CN X5, Pin-14) and the motor speed.
• You can set up a "slope" of the relation between the command input voltage and the motor speed, with Pr50.
• Default is set to Pr50= 500 [r/min] , hence input of 6V becomes 3000r/min.
<Cautions>
1. Do not apply more than ±10V to the speed command input (SPR).
2. When you compose a position loop outside of the driver while you use the driver in velocity control mode, the setup of Pr50 gives larger variance to the overall servo system.
Pay an extra attention to oscillation caused by larger setup of Pr50.

</td></tr>
</table>

<Notes>

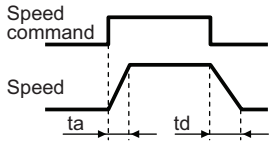
• For parameters which No. have a suffix of "*", changed contents will be validated when you turn on the control power.

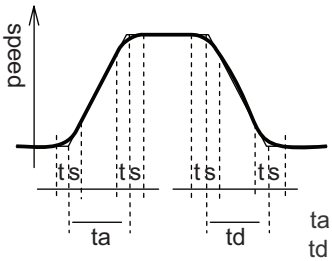
Standard default : < >

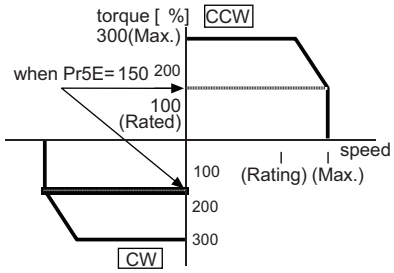
<table>
<tr><th>PrNo.</th><th>Title</th><th>Setup range</th><th>Unit</th><th>Function/Content</th></tr>
<tr><td>51</td><td>Reversal of speed command input</td><td>0 to 1
< 1></td><td>–</td><td>You can reverse the polarity of the speed command input signal (SPR:CN X5, Pin-14). Use this function when you want to change the motor rotational direction without changing the polarity of the command signal from the host.
<table><tr><th>Setup value</th><th>Motor rotating direction</th></tr><tr><td>0</td><td>CCW direction with (+) command (viewed from the motor shaft end</td></tr><tr><td>< 1></td><td>CW direction with (+) command (viewed from the motor shaft end</td></tr></table><Notes>
• Default of this parameter is 1, and the motor turns to CW with (+) signal, this has compatibility to existing MINAS series driver.
• When Pr06 (ZEROSPD) is set to 2, this parameter becomes invalid.
<Caution>
When you compose the servo drive system with this driver set to velocity control mode and external positioning unit, the motor might perform an abnormal action if the polarity of the speed command signal from the unit and the polarity of this parameter setup does not match.</td></tr>
<tr><td>52</td><td>Speed command offset</td><td>–2047 to 2047
< 0></td><td>0.3mV</td><td>• You can make an offset adjustment of analog speed command (SPR : CN X5, Pin-14) with this parameter.
• The offset volume is 0.3mV per setup value of "1".
• There are 2 offset methods, (1) Manual adjustment and (2) Automatic adjustment.
1) Manual adjustment
• When you make an offset adjustment with the driver alone, Enter 0 V exactly to the speed command input (SPR/TRQR), (or connect to the signal ground), then set this parameter up so that the motor may not turn.
• when you compose a position loop with the host,
• Set this parameter up so that the deviation pulse may be reduced to 0 at the Servo-Lock status.
2) Automatic adjustment
• For the details of operation method at automatic offset adjustment mode, refer to P.73, "Auxiliary Function Mode" of Preparation.
• Result after the execution of the automatic offset function will be reflected in this parameter, Pr52.</td></tr>
<tr><td>53</td><td>1st speed of speed setup</td><td rowspan="4">–20000 to 20000
< 0></td><td rowspan="4">r/min</td><td rowspan="8">When the internal speed setup is validated with parameter Pr05, "Switching of internal or external speed setup", you can set up 1st to 4th speed into Pr53 to 56, 5th to 8th speed into Pr74 to 77 in direct unit of [r/min] .
<Caution>
• The polarity of the setup value represents that of the internal command speed.
<table><tr><td>+</td><td>Command to CCW (viewed from the motor shaft end)</td></tr><tr><td>–</td><td>Command to CW (viewed from the motor shaft end)</td></tr></table>• The absolute value of the parameter setup is limited with Pr73 (Setup of over-speed level)</td></tr>
<tr><td>54</td><td>2nd speed of speed setup</td></tr>
<tr><td>55</td><td>3rd speed of speed setup</td></tr>
<tr><td>56</td><td>4th speed of speed setup</td></tr>
<tr><td>74</td><td>5th speed of speed setup</td><td rowspan="4">–20000 to 20000
< 0></td><td rowspan="4">r/min</td></tr>
<tr><td>75</td><td>6th speed of speed setup</td></tr>
<tr><td>76</td><td>7th speed of speed setup</td></tr>
<tr><td>77</td><td>8th speed of speed setup</td></tr>
<tr><td>57</td><td>Setup of speed command filter</td><td>0 to 6400
< 0></td><td>0.01ms</td><td>You can set up the time constant of the primary delay filter to the analog speed command/analog torque command/analog velocity control (SPR : CN X5, Pin-14)</td></tr>
</table>

Parameter Setup

Standard default : < >

<table>
<tr><th>PrNo.</th><th>Title</th><th>Setup range</th><th>Unit</th><th>Function/Content</th></tr>
<tr><td>58</td><td>Acceleration time setup</td><td>0 to 5000
<0></td><td>2ms/
(1000r/min)</td><td rowspan="2">You can make the velocity control while adding acceleration and deceleration command to the speed command inside of the driver. With this function, you can make a soft-start when you enter the step-speed
 

<table>
<tr><td>ta</td><td>Pr58</td><td>x 2ms/(1000r/min)</td></tr>
<tr><td>td</td><td>Pr59</td><td>x 2ms/(1000r/min)</td></tr>
</table>
<Caution>
Do not use these acceleration/deceleration time setup when you use the external position loop. (Set up both Pr58 and Pr59 to 0.)</td></tr>
<tr><td></td><td>setup</td><td><0></td><td>(1000r/min)</td></tr>
<tr><td>5A</td><td>Sigmoid acceleration/ deceleration time setup</td><td>0 to 500
<0></td><td>2ms</td><td>In order to obtain a smooth operation, you can set up the quasi sigmoid acceleration/deceleration in such application as linear acceleration/ deceleration where acceleration variation is large at starting/stopping to cause a strong shock.
 

1. Set up acceleration/deceleration for basic linear portion with Pr58 and Pr59
2.Set up sigmoid time with time width centering the inflection point of linear acceleration/deceleration with Pr5A. (unit : 2ms)
ta : Pr58
td : Pr59
ts : Pr5A
Use with the setup of $\frac{ta}{2} > ts$, ts, and $\frac{td}{2} > ts$</td></tr>
<tr><td>5E</td><td>1st torque limit setup</td><td>0 to 500
<500>
*2</td><td>%</td><td rowspan="2">You can set up the limit value of the motor output torque (Pr5E : 1st torque, Pr5F : 2nd torque). For the torque limit selection, refer to Pr03 (Torque limit selection).
This torque limit function limits the max. motor torque inside of the driver with parameter setup.
In normal operation, this driver permits approx. 3 times larger torque than the rated torque instantaneously. If this 3 times bigger torque causes any trouble to the load (machine) strength, you can use this function to limit the max. torque.
• Setup value is to be given in % against the rated torque.
• Right fig. shows example of 150% setup with Pr03= 1.
• Pr5E limits the max. torque for both CCW and CW directions.
 

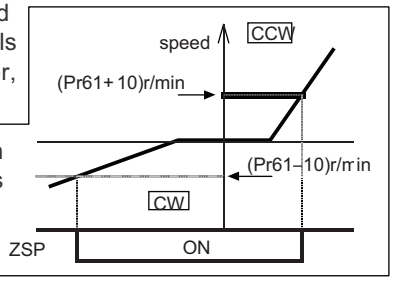
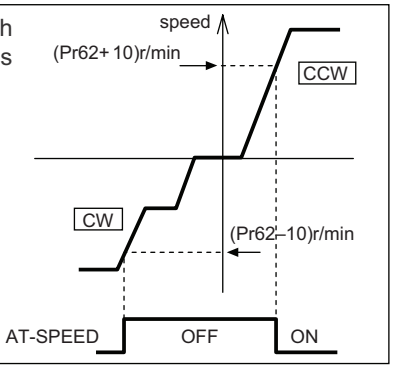
<Caution>
You cannot set up a larger value to this parameter than the default setup value of "Max. output torque setup" of System parameter (which you cannot change through operation with PANATERM® or panel). Default value varies depending on the combination of the motor and the driver. For details, refer to P.57, "Setup of Torque Limit " of Preparation.</td></tr>
<tr><td>5F</td><td>2nd torque limit setup</td><td>0 to 500
<500>
*2</td><td>%</td></tr>
</table>

<Notes>

- For parameters which No. have a suffix of "*", changed contents will be validated when you turn on the control power.
- For parameters which default. has a suffix of "*2", value varies depending on the combination of the driver and the motor.

Parameters for Sequence

Standard default : < >

PrNo.	Title	Setup range	Unit	Function/Content
61	Zero-speed	10 to 20000 <50>	r/min	You can set up the timing to feed out the zero-speed detection output signal (ZSP : CN X5, Pin-12 or TCL : CN X5, Pin-40) in rotational speed [r/min] . The zero-speed detection signal (ZSP) will be fed out when the motor speed falls below the setup of this parameter, Pr61. In-speed (Speed coincidence) signal (V-COIN) will be fed out when the difference between the speed command and the motor speed falls below the setup of this parameter, Pr61. • The setup of P61 is valid for both CCW and CW direction regardless of the motor rotating direction. • There is hysteresis of 10 [r/min] . 
62	At-speed (Speed arrival)	10 to 20000 <50>	r/min	You can set up the timing to feed out the At-speed signal (COIN+ : CN X5, Pin-39, COIN- : CN X5, Pin-38) At-speed (Speed arrival) (COIN) will be fed out when the motor speed exceeds the setup speed of this parameter, Pr62 • The setup of P62 is valid for both CCW and CW direction regardless of the motor rotational direction. • There is hysteresis of 10 [r/min] . 
65	LV trip selection at main power OFF	0 to 1 <1>	–	You can select whether or not to activate Err13 (Main power under-voltage protection) function while the main power shutoff continues for the setup of Pr6D (Main power-OFF detection time). **Setup value** / **Action of main power low voltage protection** 0: When the main power is shut off during Servo-ON, Err13 will not be triggered and the driver turns to Servo-OFF. The driver returns to Servo-ON again after the main power resumption. <1>: When the main power is shut off during Servo-ON, the driver will trip due to Err13 (Main power low voltage protection). **<Caution>** This parameter is invalid when Pr6D (Detection time of main power OFF)= 1000. Err13 (Main power under-voltage protection) is triggered when setup of P66D is long and P-N voltage of the main converter falls below the specified value before detecting the main power shutoff, regardless of the Pr65 setup. Refer to P.42, "Timing Chart-At Power-ON" of Preparation as well.

Parameter Setup

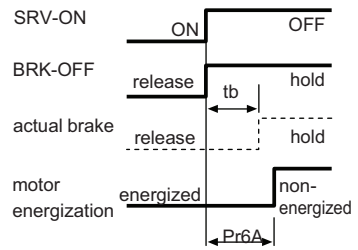
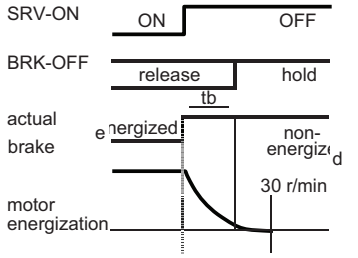
Standard default : < >

<table>
<tr><th>PrNo.</th><th>Title</th><th>Setup range</th><th>Unit</th><th>Function/Content</th></tr>
<tr><td>66
*</td><td>Sequence at over-travel inhibit</td><td>0 to 2
<0></td><td>–</td><td>You can set up the running condition during deceleration or after stalling, while over-travel inhibit input (CCWL : Connector CN X5, Pin-9 or CWL : Connector CN X5, Pin-8) is valid
<table>
<tr><th>Setup value</th><th>During deceleration</th><th>After stalling</th><th>Deviation counter content</th></tr>
<tr><td><0></td><td>Dynamic brake action</td><td>Torque command= 0 towards inhibited direction</td><td>Hold</td></tr>
<tr><td>1</td><td>Torque command= 0 towards inhibited direction</td><td>Torque command= 0 towards inhibited direction</td><td>Hold</td></tr>
<tr><td>2</td><td>Emergency stop</td><td>Torque command= 0 towards inhibited direction</td><td>Clears before/ after deceleration</td></tr>
</table>
<Caution>
In case of the setup value of 2, torque limit during deceleration will be limited by the setup value of Pr6E (Torque setup at emergency stop).</td></tr>
<tr><td>67</td><td>Sequence at main power OFF</td><td>0 to 9
<0></td><td>–</td><td>When Pr65 (LV trip selection at main power OFF) is 0, you can set up,
1) the action during deceleration and after stalling
2) the clearing of deviation counter content
after the main power is shut off.
<table>
<tr><th rowspan="2">Setup value</th><th colspan="2">Action</th><th rowspan="2">Deviation counter content</th></tr>
<tr><th>During deceleration</th><th>After stalling</th></tr>
<tr><td><0></td><td>DB</td><td>DB</td><td>Clear</td></tr>
<tr><td>1</td><td>Free-run</td><td>DB</td><td>Clear</td></tr>
<tr><td>2</td><td>DB</td><td>Free-run</td><td>Clear</td></tr>
<tr><td>3</td><td>Free-run</td><td>Free-run</td><td>Clear</td></tr>
<tr><td>4</td><td>DB</td><td>DB</td><td>Hold</td></tr>
<tr><td>5</td><td>Free-run</td><td>DB</td><td>Hold</td></tr>
<tr><td>6</td><td>DB</td><td>Free-run</td><td>Hold</td></tr>
<tr><td>7</td><td>Free-run</td><td>Free-run</td><td>Hold</td></tr>
<tr><td>8</td><td>Emergency stop</td><td>DB</td><td>Clear</td></tr>
<tr><td>9</td><td>Emergency stop</td><td>Free-run</td><td>Clear</td></tr>
</table>
(DB: Dynamic Brake action)
<Caution>
In case of the setup value of 8 or 9, torque limit during deceleration will be limited by the setup value of Pr6E (Torque setup at emergency stop).</td></tr>
<tr><td>68</td><td>Sequence at alarm</td><td>0 to 3
<0></td><td>–</td><td>You can set up the action during deceleration or after stalling when some error occurs while either one of the protective functions of the driver is triggered.
<table>
<tr><th rowspan="2">Setup value</th><th colspan="2">Action</th><th rowspan="2">Deviation counter content</th></tr>
<tr><th>During deceleration</th><th>After stalling</th></tr>
<tr><td><0></td><td>DB</td><td>DB</td><td>Hold</td></tr>
<tr><td>1</td><td>Free-run</td><td>DB</td><td>Hold</td></tr>
<tr><td>2</td><td>DB</td><td>Free-run</td><td>Hold</td></tr>
<tr><td>3</td><td>Free-run</td><td>Free-run</td><td>Hold</td></tr>
</table>
(DB: Dynamic Brake action)
<Caution>
The content of the deviation counter will be cleared when clearing the alarm. Refer to P.43, "Timing Chart (When an error (alarm) occurs (at Servo-ON command status)" of Preparation.</td></tr>
</table>

<Notes>

- For parameters which No. have a suffix of "*", changed contents will be validated when you turn on the control power.

Standard default : < >

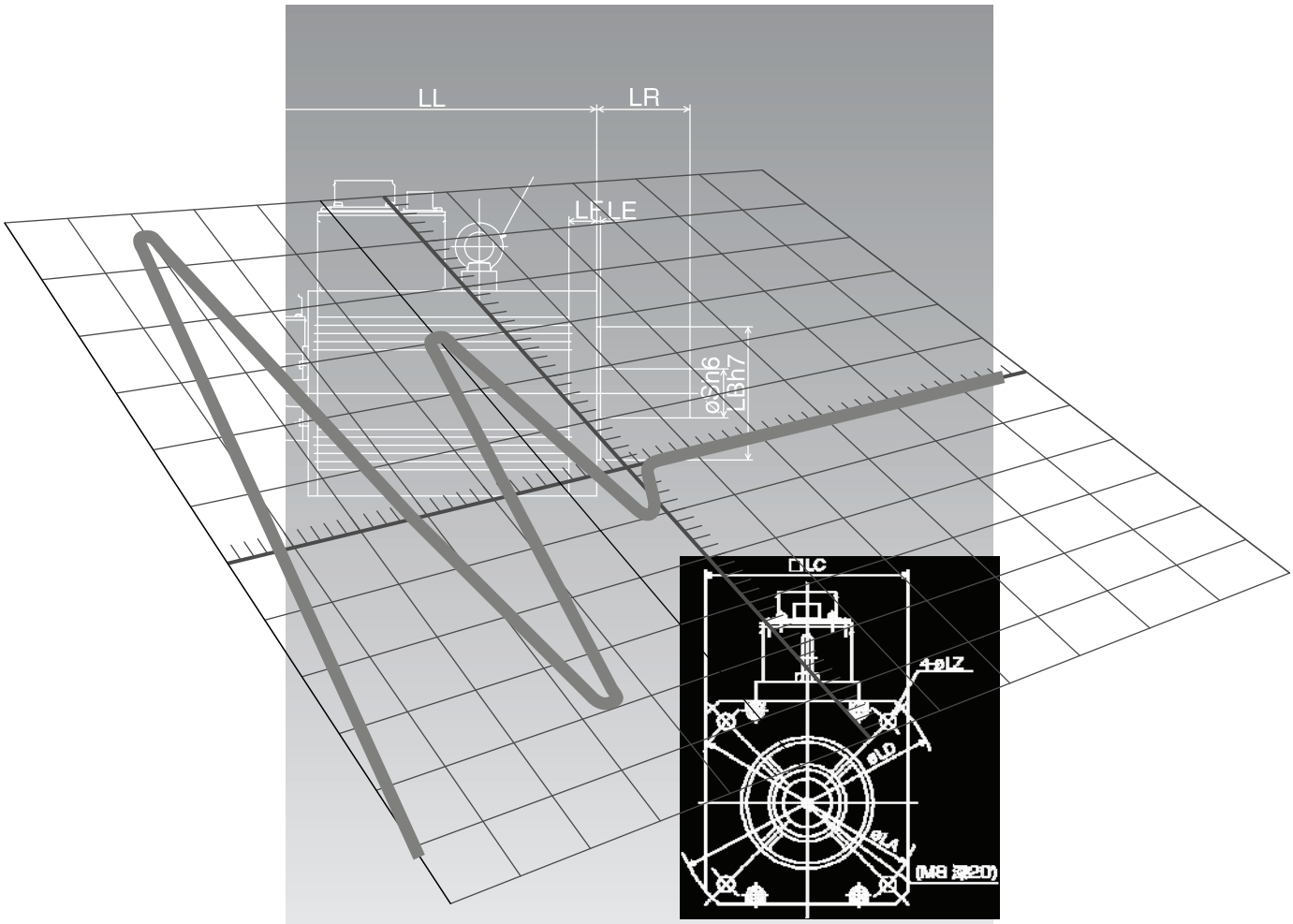
PrNo.	Title	Setup range	Unit	Function/Content
69	Sequence at Servo-Off	0 to 9 <0>	–	You can set up, 1) the action during deceleration and after stalling 2) the clear treatment of deviation counter is set up. The relation between the setup value of Pr69 and the action/deviation counter clearance is same as that of Pr67 (Sequence at Main Power Off) Refer to P.44, "Timing Chart"-Servo-ON/OFF action while the motor is at stall" of Preparation as well.
6A	Setup of mechanical brake action at stalling	0 to 100 <0>	2ms	You can set up the time from when the brake release signal (BRK-OFF : CN X5, Pin-10 and 11) turns off to when the motor is de-energized (Servo-free), when the motor turns to Servo-OFF while the motor is at stall. • Set up to prevent a micro-travel/ drop of the motor (work) due to the action delay time (tb) of the brake • After setting up Pr6a ≧ tb, then compose the sequence so as the brake is actually activated.  Refer to P.44, "Timing Chart"-Servo-ON/OFF Action While the Motor Is at Stall" of Preparation as well.
6B	Setup of mechanical brake action at running	0 to 100 <0>	2ms	You can set up time from when detecting the off of Servo-ON input signal (SRV-ON : CN X5, Pin-29) is to when external brake release signal (BRK-OFF : CN X5, Pin-10 and 11) turns off, while the motor turns to servo off during the motor in motion. • Set up to prevent the brake deterioration due to the motor running. • At Servo-OFF during the motor is running, tb of the right fig. will be a shorter one of either Pr6B setup time, or time lapse till the motor speed falls below 30r/min.  Refer to P.45, "Timing Chart"-Servo-ON/OFF action while the motor is in motion" of Preparation as well.

Standard default : < >

<table>
<tr><th>PrNo.</th><th>Title</th><th>Setup range</th><th>Unit</th><th>Function/Content</th></tr>
<tr><td>6C
*</td><td>Selection of external regenerative resistor</td><td>0 to 3
for
A, B-frame
<3>
for
C to F-frame
<0></td><td>–</td><td>With this parameter, you can select either to use the built-in regenerative resistor of the driver, or to separate this built-in regenerative resistor and externally install the regenerative resistor (between RB1 and RB2 of Connector CN X2 in case of A to D-frame, between P and B2 of terminal block in case of E, F-frame).
<table>
<tr><th>Setup value</th><th>Regenerative resistor to be used</th><th>Regenerative processing and regenerative resistor overload</th></tr>
<tr><td><0>
(C, D, E and F-frame)</td><td>Built-in resistor</td><td>Regenerative processing circuit will be activated and regenerative resistor overload protection will be triggered according to the built-in resistor (approx. 1% duty).</td></tr>
<tr><td>1</td><td>External resistor</td><td>The driver trips due to regenerative overload protection (Err18), when regenerative processing circuit is activated and its active ratio exceeds 10%,</td></tr>
<tr><td>2</td><td>External resistor</td><td>Regenerative processing circuit is activated, but no regenerative over-load protection is triggered.</td></tr>
<tr><td><3>
(A, B-frame)</td><td>No resistor</td><td>Both regenerative processing circuit and regenerative protection are not activated, and built-in capacitor handles all regenerative power.</td></tr>
</table>
<Remarks>
Install an external protection such as thermal fuse when you use the external regenerative resistor.
Otherwise, the regenerative resistor might be heated up abnormally and result in burnout, regardless of validation or invalidation of regenerative over-load protection.
<Caution>
When you use the built-in regenerative resistor, never to set up other value than 0. Don't touch the external regenerative resistor.
External regenerative resistor gets very hot, and might cause burning.</td></tr>
<tr><td>6D
*</td><td>Detection time of main power off</td><td>35 to 1000
<35></td><td>2ms</td><td>You can set up the time to detect the shutoff while the main power is kept shut off continuously.
The main power off detection is invalid when you set up this to 1000.</td></tr>
<tr><td>6E</td><td>Torque setup at emergency stop</td><td>0 to 500
<0></td><td>%</td><td>You can set up the torque limit in case of emergency stop as below.
• During deceleration of over-travel inhibit with the setup 2 of Pr66 (Sequence at over-travel inhibit input)
• During deceleration with the setup of 8 or 9 of Pr67 (Sequence at main power off)
• During deceleration with the setup of 8 or 9 of Pr69 (Sequence at Servo-OFF)
Normal torque limit is used by setting this to 0.</td></tr>
<tr><td>70</td><td>Setup of position deviation excess</td><td>0 to 32767
<25000></td><td>256 x resolution</td><td>• You can set up the excess range of position deviation.
• Set up with the encoder pulse counts at the position control and with the external scale pulse counts at the full-closed control.
• Err24 (Error detection of position deviation excess) becomes invalid when you set up this to 0.</td></tr>
<tr><td>72</td><td>Setup of over-load level</td><td>0 to 500
<0></td><td>%</td><td>• You can set up the over-load level. The overload level becomes 115 [%] by setting up this to 0.
• Use this with 0 setup in normal operation. Set up other value only when you need to lower the over-load level.
• The setup value of this parameter is limited by 115[%] of the motor rating.</td></tr>
<tr><td>73</td><td>Setup of over-speed level</td><td>0 to 20000
<0></td><td>r/min</td><td>• You can set up the over-speed level. The over-speed level becomes 1.2 times of the motor max. speed by setting up this to 0.
• Use this with 0 setup in normal operation. Set up other value only when you need to lower the over-speed level.
• The setup value of this parameter is limited by 1.2 times of the motor max. speed.
<Caution>
The detection error against the setup value is ±3 [r/min] in case of the 7-wire absolute encoder, and ±36 [r/min] in case of the 5-wire incremental encoder.</td></tr>
</table>

<Notes>

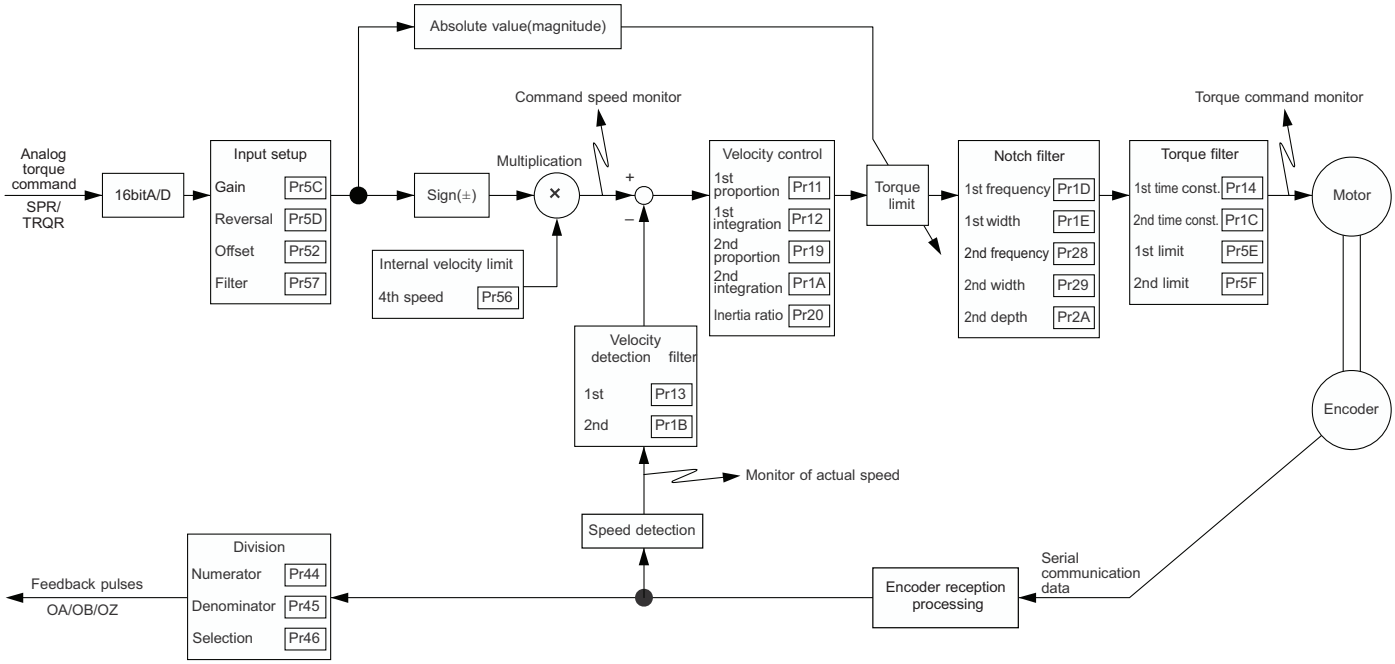
• For parameters which No. have a suffix of "*", changed contents will be validated when you turn on the control power.



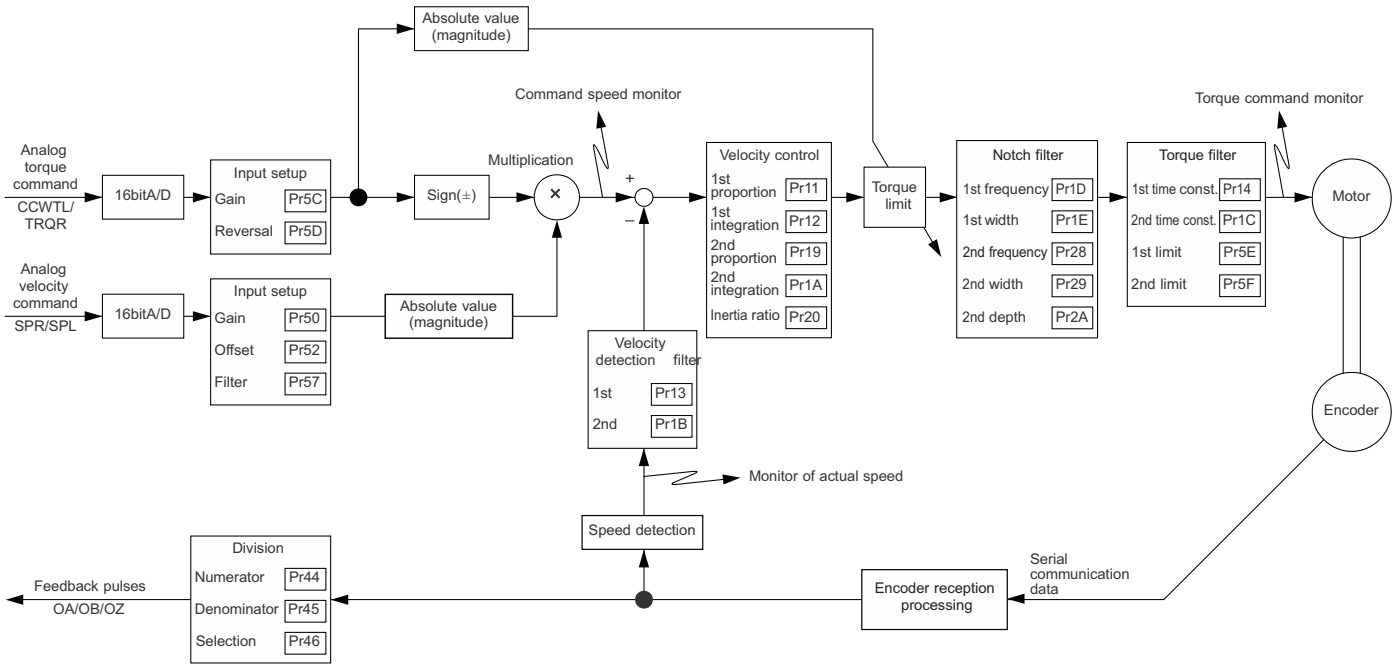
[Connection and Setup of Torque Control Mode]

Control Block Diagram of Torque Control Mode

• when Pr5B (Torque command selection) is 0

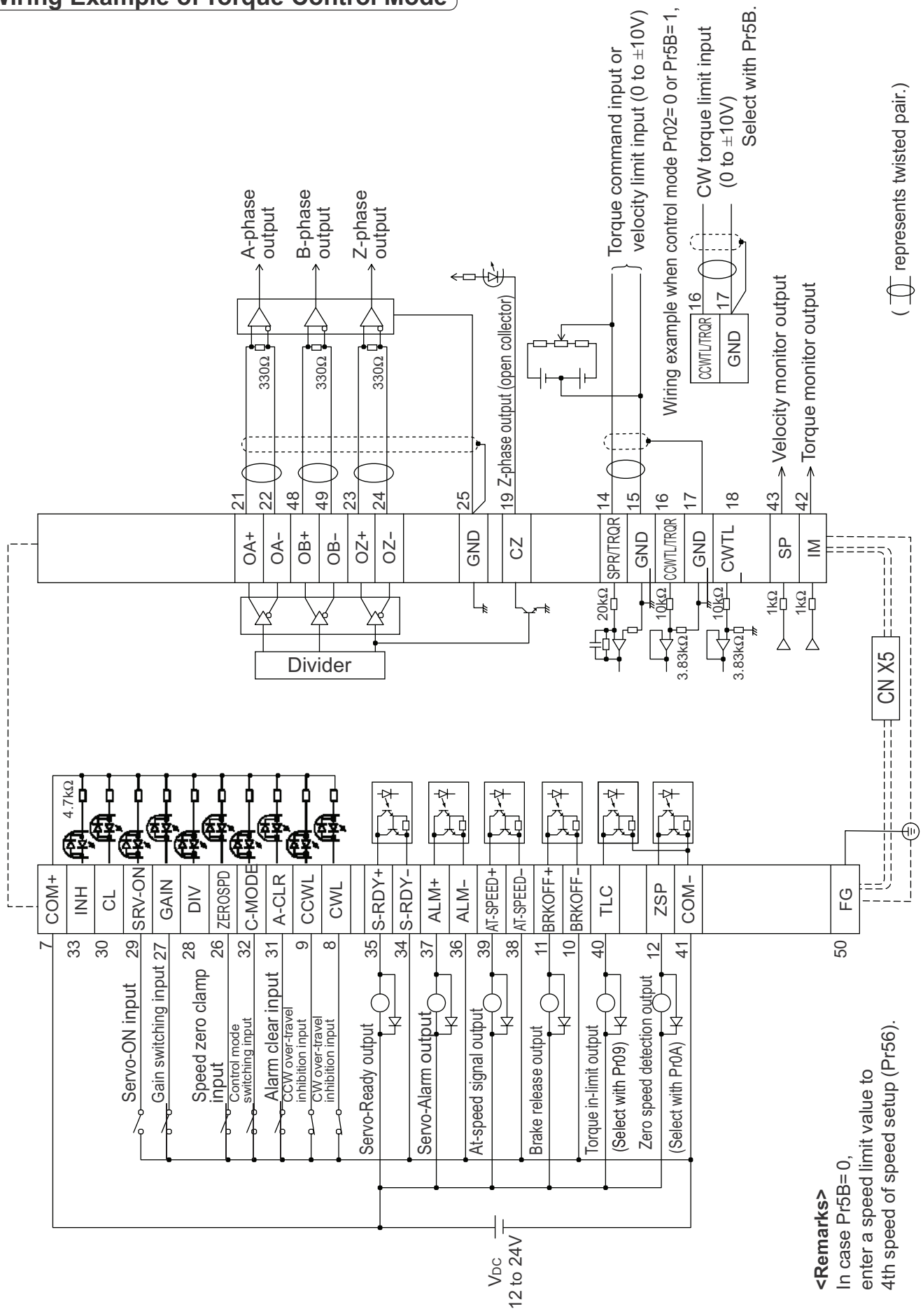


• when Pr5B (Torque command selection) is 1



Wiring Example to the Connector CN X5

Wiring Example of Torque Control Mode



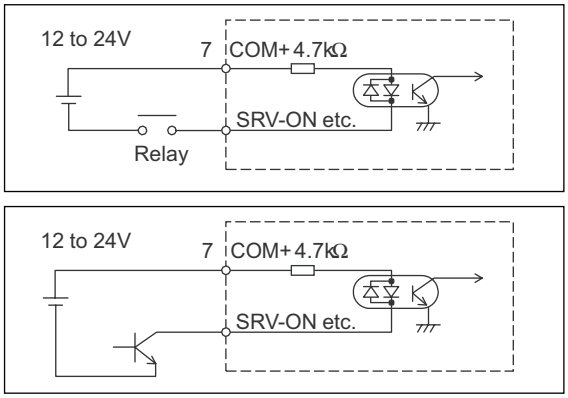
Wiring to the connector, CN X5

Interface Circuit

Input Circuit

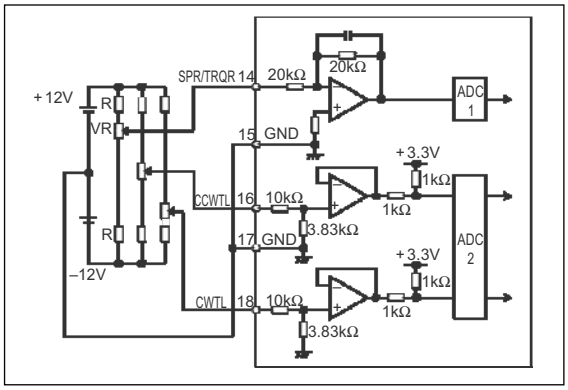
SI Connection to sequence input signals

- Connect to contacts of switches and relays, or open collector output transistors.
- When you use contact inputs, use the switches and relays for micro current to avoid contact failure.
- Make the lower limit voltage of the power supply (12 to 24V) as 11.4V or more in order to secure the primary current for photo-couplers.



AI Analog command input

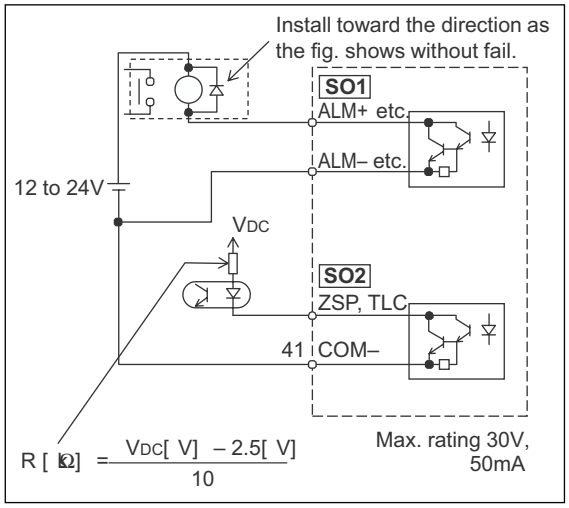
- The analog command input goes through 3 routes, SPR/TRQR(Pin-14), CCWTL (Pin-16) and CWTL (Pin-18).
- Max. permissible input voltage to each input is ±10V. For input impedance of each input, refer to the right Fig.
- When you compose a simple command circuit using variable resistor(VR) and register R, connect as the right Fig. shows. When the variable range of each input is made as –10V to +10V, use VR with 2kΩ, B-characteristics, 1/2W or larger, R with 200Ω, 1/2W or larger.
- A/D converter resolution of each command input is as follows.
  (1)ADC1 : 16 bit (SPR/TRQR), (including 1bit for sign), ±10V
  (2)ADC2 : 10 bit (CCWTL, CWTL), 0 to 3.3V



Output Circuit

SO1 SO2 Sequence output circuit

- The output circuit is composed of open collector transistor outputs in the Darlington connection, and connect to relays or photo-couplers.
- There exists collector to emitter voltage, V_{CE} (SAT) of approx. 1V at transistor-ON, due to the Darlington connection of the output or. Note that normal TTL IC cannot be directly connected since it does not meet VIL.
- There are two types of output, one which emitter side of the output transistor is independent and is connectable individually, and the one which is common to – side of the control power supply (COM–).
- If a recommended primary current value of the photo-coupler is 10mA, decide the resistor value using the formula of the right Fig.

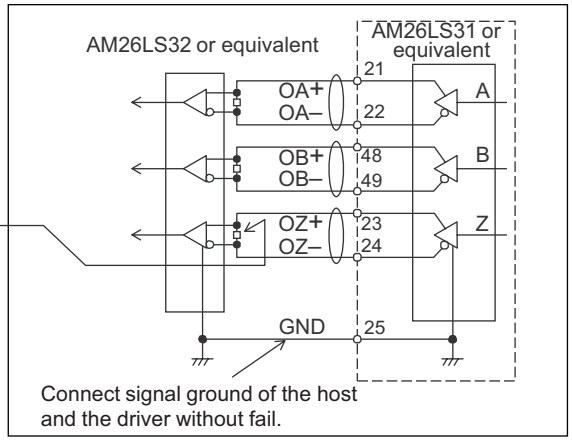


For the recommended primary current value, refer to the data sheet of apparatus or photo-coupler to be used.

PO1 Line driver (Differential output) output

- Feeds out the divided encoder outputs (A, B and Z-phase) in differential through each line driver.
- At the host side, receive these in line receiver. Install a terminal resistor (approx. 330Ω) between line receiver inputs without fail.
- These outputs are not insulated.

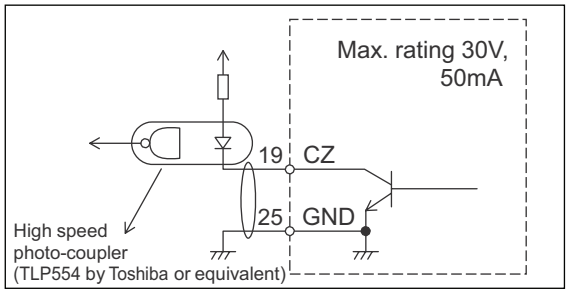
represents twisted pair.



PO2 Open collector output

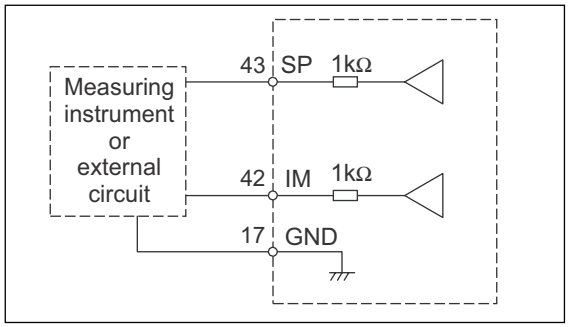
- Feeds out the Z-phase signal among the encoder signals in open collector. This output is not insulated.
- Receive this output with high-speed photo couplers at the host side, since the pulse width of the Z-phase signal is narrow.

represents twisted pair.



AO Analog monitor output

- There are two outputs, the speed monitor signal output (SP) and the torque monitor signal output (IM)
- Output signal width is ±10V.
- The output impedance is 1kΩ. Pay an attention to the input impedance of the measuring instrument or the external circuit to be connected.



<Resolution>

(1) Speed monitor output (SP)
With a setup of 6V/3000r/min (Pr07= 3), the resolution converted to speed is 8r/min/16mV.

(2) Torque monitor output (IM)
With a relation of 3V/rated torque (100%), the resolution converted to torque is 0.4%/12mV.

Wiring to the connector, CN X5

Input Signal and Pin No. of the Connector, CN X5

Input Signals (common) and Their Functions

<table>
<tr><th>Title of signal</th><th>Pin No.</th><th>Symbol</th><th>Function</th><th>I/F circuit</th></tr>
<tr><td>Power supply for control signal (+)</td><td>7</td><td>COM+</td><td>• Connect + of the external DC power supply (12 to 24V).
• Use the power supply voltage of 12V ± 5% – 24V ± 5%</td><td>–</td></tr>
<tr><td>Power supply for control signal (–)</td><td>41</td><td>COM–</td><td>• Connect – of the external DC power supply (12 to 24V).
• The power capacity varies depending on a composition of I/O circuit. 0.5A or more is recommended.</td><td>–</td></tr>
<tr><td>CW over-travel inhibit input</td><td>8</td><td>CWL</td><td>• Use this input to inhibit a CW over-travel (CWL).
• Connect this so as to make the connection to COM– open when the moving portion of the machine over-travels the movable range toward CW.
• CWL input will be invalidated when you set up Pr04 (Setup of over-travel inhibit input) to 1.Default is "Invalid (1)".
• You can select the action when the CWL input is validated with the setup of up Pr66 (Sequence at over-travel inhibit). Default is "Emergency stop with dynamic brake".(Pr66= 0)</td><td>SI
P.162</td></tr>
<tr><td>CCW over-travel inhibit input</td><td>9</td><td>CCWL</td><td>• Use this input to inhibit a CCW over-travel (CCWL).
• Connect this so as to make the connection to COM- open when the moving portion of the machine over-travels the movable range toward CCW.
• CWL input will be invalidated when you set up Pr04 (Setup of over-travel inhibit input) to 1.Default is "Invalid (1)".
• You can select the action when the CCWL input is validated with the setup of Pr66 (Sequence at over-travel inhibit). Default is "Emergency stop with dynamic brake".(Pr66= 0)</td><td>SI
P.162</td></tr>
<tr><td>Speed zero clamp input</td><td>26</td><td>ZEROSPD</td><td>• Function varies depending on the control mode.
<table>
<tr><td>Velocity/ Torque control</td><td>• Becomes to a speed-zero clamp input (ZEROSPD).
<table>
<tr><th>Pr06</th><th>Connection to COM–</th><th>Content</th></tr>
<tr><td>0</td><td>–</td><td>ZEROSPD input is invalid.</td></tr>
<tr><td rowspan="2">1</td><td>open</td><td>Speed command is 0</td></tr>
<tr><td>close</td><td>Normal action</td></tr>
<tr><td rowspan="2">2</td><td>open</td><td>Speed command is to CCW</td></tr>
<tr><td>close</td><td>Speed command is to CW.</td></tr>
</table>
• In case Pr06 is 2 at torque control, ZERPSPD is invalid.</td></tr>
<tr><td>Position/ Full-closed control</td><td>• Becomes to an input of damping control switching (VS-SEL).
• While Pr24 (Damping filter switching selection) is 1, the 1st damping filter (Pr2B, Pr2C) will be validated when you open this input, and the 2nd damping filter (Pr2D, Pr2E) will be validated when you connect this input to COM–.</td></tr>
</table></td><td>SI
P.162</td></tr>
<tr><td>Gain switching input
or
Torque limit switching input</td><td>27</td><td>GAIN

TL-SEL</td><td>• Function varies depending on the setups of Pr30 (2nd gain setup) and Pr03 (Selection of torque limit).
<table>
<tr><th>Pr03</th><th>Pr30</th><th>Connection to COM–</th><th>Content</th></tr>
<tr><td rowspan="6">0 – 2</td><td rowspan="2">0</td><td>open</td><td>Velocity loop : PI (Proportion/Integration) action</td></tr>
<tr><td>close</td><td>Velocity loop : P (Proportion) action</td></tr>
<tr><td rowspan="4">1</td><td colspan="2">when the setups of Pr31 and Pr36 are 2</td></tr>
<tr><td>open</td><td>1st gain selection (Pr10,11,12,13 and 14)</td></tr>
<tr><td>close</td><td>2nd gain selection (Pr18,19,1A,1B and 1C)</td></tr>
<tr><td colspan="2">when the setups of Pr31 and Pr36 are other than 2</td></tr>
<tr><td>3</td><td>–</td><td colspan="2">• Input of torque limit switching (TL-SEL)
• Pr5E (Setup of 1st torque limit) will be validated when you open this input, and Pr5F (Setup of 2nd torque limit) will be validated when you connect this input to COM–.</td></tr>
</table>
• For details of 2nd gain switching function, refer to P.243 "Gain Switching Function" of Adjustment.</td><td>SI
P.162</td></tr>
</table>

<table>
<tr><th>Title of signal</th><th>Pin No.</th><th>Symbol</th><th>Function</th><th>I/F circuit</th></tr>
<tr><td>Servo-ON input</td><td>29</td><td>SRV-ON</td><td>• Turns to Servo-ON status by connecting this input to COM–.
• Turns to Servo-OFF status by opening connection to COM–, and current to the motor will be shut off.
• You can select the dynamic brake action and the deviation counter clearing action at Servo-OFF with Pr69 (Sequence at Servo-OFF).
<Caution>
1.Servo-ON input becomes valid approx. 2 sec after power-on.
(see P.42, "Timing Chart" of Preparation.)
2.Never run/stop the motor with Servo-ON/OFF.
3.After shifting to Servo-ON, allow 100ms or longer pause before entering the pulse command.</td><td>SI
P.162</td></tr>
<tr><td>Alarm clear input</td><td>31</td><td>A-CLR</td><td>• You can release the alarm status by connecting this to COM– for more than 120ms.
• The deviation counter will be cleared at alarm clear.
• There are some alarms which cannot be released with this input.
For details, refer to P.252, "Protective Function " of When in Trouble.</td><td>SI
P.162</td></tr>
<tr><td>Control mode switching input</td><td>32</td><td>C-MODE</td><td>• You can switch the control mode as below by setting up Pr02 (Control mode setup) to 3-5.
<table>
<tr><th>Pr02 setup</th><th>Open (1st)</th><th>Connection to COM– (2nd)</th></tr>
<tr><td>3</td><td>Position control</td><td>Velocity control</td></tr>
<tr><td>4</td><td>Position control</td><td>Torque control</td></tr>
<tr><td>5</td><td>Velocity control</td><td>Torque control</td></tr>
</table>
<Caution>
Depending on how the command is given at each control mode, the action might change rapidly when switching the control mode with C-MODE. Pay an extra attention.</td><td>SI
P.162</td></tr>
</table>

Wiring to the connector, CN X5

Input Signals (Analog Command) and Their Functions

<table>
<tr><th>Title of signal</th><th>Pin No.</th><th>Symbol</th><th>Function</th><th>I/F circuit</th></tr>
<tr><td>Torque command input,
or
Speed limit input</td><td>14</td><td>TRQR

SPL</td><td>• Function varies depending on control mode.
<table>
<tr><th>Pr02</th><th>Control mode</th><th>Function</th></tr>
<tr><td>2
4</td><td>Torque control

Position/ Torque</td><td>• Function varies depending on Pr5B (Selection of torque command)
<table>
<tr><th>Pr5B</th><th>Content</th></tr>
<tr><td>0</td><td>• Torque command (TRQR) will be selected.
• Set up the torque (TRQR) gain, polarity offset and filter with;
Pr5C (Torque command input gain)
Pr5D (Torque command input reversal)
Pr52 (Speed command offset)
Pr57 (Speed command filter setup)</td></tr>
<tr><td>1</td><td>• Speed limit (SPL) will be selected.
• Set up the speed limit (SPL) gain, offset and filter with;
Pr50 (Speed command input gain)
Pr52 (Speed command offset)
Pr57 (Speed command filter setup)</td></tr>
</table></td></tr>
<tr><td>5</td><td>Velocity/ Torque</td><td>• Function varies depending on Pr5B (Selection of torque command)
<table>
<tr><th>Pr5B</th><th>Content</th></tr>
<tr><td>0</td><td>• This input becomes invalid.</td></tr>
<tr><td>1</td><td>• Speed limit (SPL) will be selected.
• Set up the speed limit (SPL) gain, offset and filter with;
Pr50 (Speed command input gain)
Pr52 (Speed command offset)
Pr57 (Speed command filter setup)</td></tr>
</table></td></tr>
<tr><td>Others</td><td>Other control mode</td><td>• This input is invalid.</td></tr>
</table>
•The resolution of the A/D converter used in this input is 16 bit (including 1 bit for sign).
± 32767 (LSB) = ± 10[V] , 1[LSB] = 0.3[mV]</td><td>AI
P.162</td></tr>
</table>

*Function becomes valid when the control mode with underline (▭ / ▭) is selected while the switching mode is used in the control mode in table.

<table>
<tr><th>Title of signal</th><th>Pin No.</th><th>Symbol</th><th>Function</th><th>I/F circuit</th></tr>
<tr><td>Torque command input</td><td>16</td><td>TRQR</td><td>
• Function varies depending on Pr02 (Control mode setup).
<table>
<tr><th>Pr02</th><th>Control mode</th><th>Function</th></tr>
<tr><td>2
4</td><td>Torque Control
Position/Torque</td><td>
• Function varies depending on Pr5B (Selection of torque command)
<table>
<tr><th>Pr5B</th><th>Content</th></tr>
<tr><td>0</td><td>This input becomes invalid.</td></tr>
<tr><td>1</td><td>• Torque command input (TRQR) will be selected.
• Set up the gain and polarity of the command with;
Pr5C (Torque command input gain)
Pr5D (Torque command input reversal)
• Offset and filter cannot be set up.</td></tr>
</table>
</td></tr>
<tr><td>5</td><td>Velocity/
Torque</td><td>• Becomes to the torque command input (TRQR).
• Set up the gain and polarity of the command with;
Pr5C (Torque command input gain)
Pr5D (Torque command input reversal)
• Offset and filter cannot be set up.</td></tr>
<tr><td>4
5
Other</td><td><u>Position</u>/Torque
Velocity/Torque
Other
control mode</td><td>• Becomes to the analog torque limit input to CCW (CCWTL).
• Limit the CCW-torque by applying positive voltage (0 to +10V) (Approx.+3V/rated torque)
• Invalidate this input by setting up Pr03 (Torque limit selection) to other than 0.</td></tr>
</table>
• Resolution of A/D converter used in this input is 16 bit (including 1 bit for sign).
±511 [LSB] ≒ 11.9[V] , 1 [LSB] ≒ 23[mV]
</td><td>AI
P.162</td></tr>
</table>

*Function becomes valid when the control mode with underline (▭ / <u>▭</u>) is selected while the switching mode is used in the control mode in table.

<Remark>

Do not apply more than ±10V to analog command inputs of SPR/TRQR/SPL

Do not apply more than ±10V to analog command input of TRQR.

Wiring to the connector, CN X5

Output signal and Pin No. of the Connector, CN X5

Output Signals (Common) and Their Functions

Title of signal	Pin No	Symbol	Function	I/F circuit
External brake release signal	**11** **10**	**BRKOFF+** **BRKOFF–**	• Feeds out the timing signal which activates the electromagnetic brake of the motor. • Turns the output transistor ON at the release timing of the electro-magnetic brake. • You can set up the output timing of this signal with Pr6A (Setup of mechanical brake action at stall) and Pr6B (Setup of mechanical brake action at motion). For details, refer to P42, "Timing Chart" of Preparation.)	SO1 P.163
Servo-Ready output	**35** **34**	**S-RDY+** **S-RDY–**	• This signal shows that the driver is ready to be activated. • Output transistor turns ON when both control and main power are ON but not at alarm status.	SO1 P.163
Servo-Alarm output	**37** **36**	**ALM+** **ALM–**	• This signal shows that the driver is in alarm status.. • Output transistor turns ON when the driver is at normal status, and turns OFF at alarm status.	SO1 P.163
Speed arrival output	**39** **38**	**AT-SPEED+** **AT-SPEED–**	• Function varies depending on the control mode. **Position control**: • Output of positioning complete (COIN) • The output transistor will turn ON when the absolute value of the position deviation pulse becomes smaller than the setup value of Pr60 (Positioning complete range). • You can select the feeding out method with Pr63 (Setup of positioning complete output). **Full-closed control**: • Output of full-closed positioning complete (EX-COIN) • The output transistor will turn ON when the absolute value of full-closed-position deviation pulse becomes smaller than the setup value of Pr60 (Positioning complete range). • You can select the feeding out method with Pr63 (Setup of positioning complete output). **Velocity/ Torque control**: • Output at-speed (speed arrival) (AT-SPEED) • The output transistor will turn ON when the actual motor speed exceeds the setup value of Pr62 (In-speed).	SO1 P.163
Zero-speed detection output signal	**12** **(41)**	**ZSP** **(COM–)**	• Content of the output signal varies depending on Pr0A (Selection of ZSP output). • Default is 1, and feeds out the zero speed detection signal. • For details, see the table below, "Selection of TLC,ZSP output".	SO2 P.163
Torque in-limit signal output	**40** **(41)**	**TLC** **(COM–)**	• Content of the output signal varies depending on Pr09 (Selection of TLC output). • Default is 1, and feeds out the torque in-limit signal. • For details, see the table below, "Selection of TLC,ZSP output".	SO2 P.163

• Selection of TCL and ZSP outputs

Value of Pr09 or Pr0A	X5 TLC : Output of Pin-40	X5 ZSP : Output of Pin-12
0	**• Torque in-limit output (Default of X5 TLC Pr09)** The output transistor turns ON when the torque command is limited by the torque limit during Servo-ON.	
1	**• Zero-speed detection output (Default of X5 ZSP Pr0A)** The output transistor turns ON when the motor speed falls under the preset value with Pr61.	
2	**• Alarm signal output** The output transistor turns ON when either one of the alarms is triggered, over-regeneration alarm, overload alarm, battery alarm, fan-lock alarm or external scale alarm.	
3	**• Over-regeneration alarm** The output transistor turns ON when the regeneration exceeds 85% of the alarm trigger level of the regenerative load protection.	
4	**• Over-load alarm** The output transistor turns ON when the load exceeds 85% of the alarm trigger level of the overload alarm.	
5	**• Battery alarm** The output transistor turns ON when the battery voltage for absolute encoder falls lower than approx. 3.2V.	
6	**• Fan-lock alarm** The output transistor turns ON when the fan stalls for longer than 1s.	
7	**• External scale alarm** The output transistor turns ON when the external scale temperature exceeds 65°, or signal intensity is not enough (adjustment on mounting is required). Valid only at the full-closed control.	
8	**• In-speed (Speed coincidence) output** The output transistor turns ON when the difference between the actual motor speed and the speed command before acceleration/deceleration reaches within the preset range with Pr61. Valid only at the velocity and torque control.	

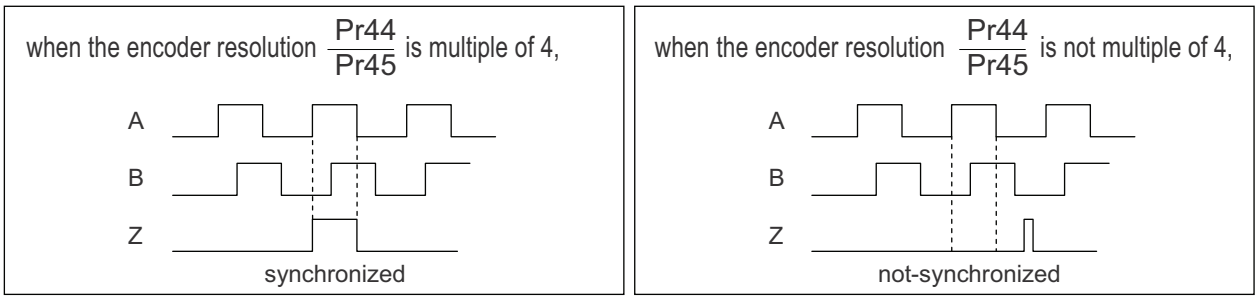
Output Signals (Pulse Train) and Their Functions

Title of signal	Pin No	Symbol	Function	I/F circuit
A-phase output	21	OA +	• Feeds out the divided encoder signal or external scale signal (A, B, Z-phase) in differential. (equivalent to RS422) • You can set up the division ratio with Pr44 (Numerator of pulse output division) and Pr45 (Denominator of pulse output division) • You can select the logic relation between A-phase and B-phase, and the output source with Pr46 (Reversal of pulse output logic). • When the external scale is made as an output source, you can set up the interval of Z-phase pulse output with Pr47 (Setup of external scale Z-phase). • Ground for line driver of output circuit is connected to signal ground (GND) and is not insulated. • Max. output frequency is 4Mpps (after quadrupled)	PO1 P.163
	22	OA –		
B-phase output	48	OB +		
	49	OB –		
Z-phase output	23	OZ +		
	24	OZ –		
Z-phase output	19	CZ	• Open collector output of Z-phase signal • The emitter side of the transistor of the output circuit is connected to the signal ground (GND) and is not insulated.	PO2 P.163

<Note>

• When the output source is the encoder

• If the encoder resolution X $\frac{Pr44}{Pr45}$ is multiple of 4, Z-phase will be fed out synchronizing with A-phase.
In other case, the Z-phase width will be equal to the encoder resolution, and will not synchronize with A-phase because of narrower width than that of A-phase.



• In case of the 5-wire, 2500P/r incremental encoder, the signal sequence might not follow the above fig. until the first Z-phase is fed out. When you use the pulse output as the control signal, rotate the motor one revolution or more to make sure that the Z-phase is fed out at least once before using.

Wiring to the connector, CN X5

Output Signals (Analog) and Their Functions

<table>
<tr><th>Title of signal</th><th>Pin No</th><th>Symbol</th><th>Function</th><th>I/F circuit</th></tr>
<tr><td>Torque monitor signal output</td><td>42</td><td>IM</td><td>• The content of output signal varies depending on Pr08 (Torque monitor (IM) selection).
• You can set up the scaling with Pr08 value.
<table>
<tr><th>Pr08</th><th>Content of signal</th><th>Function</th></tr>
<tr><td>0,
11,12</td><td>Torque command</td><td>• Feeds out the voltage in proportion to the motor torque command with polarity.
+ : generates CCW torque
– : generates CW torque</td></tr>
<tr><td>1 – 5</td><td>Positional deviation</td><td>• Feeds out the voltage in proportion to the positional deviation pulse counts with polarity.
+ : positional command to CCW of motor position
– : positional command to CW of motor position</td></tr>
<tr><td>6 –10</td><td>Full-closed deviation</td><td>• Feeds out the voltage in proportion to the full-closed deviation pulse counts with polarity.
+ : positional command to CCW of external scale position
– : positional command to CW of external scale position</td></tr>
</table></td><td>AO
P.163</td></tr>
<tr><td>Speed monitor signal output</td><td>43</td><td>SP</td><td>• The content of the output signal varies depending on Pr07 (Speed monitor (IM) selection).
• You can set up the scaling with Pr07 value.
<table>
<tr><th>Pr07</th><th>Control mode</th><th>Function</th></tr>
<tr><td>0 – 4</td><td>Motor speed</td><td>• Feeds out the voltage in proportion to the motor speed with polarity. + : rotates to CCW
– : rotates to CW</td></tr>
<tr><td>5 – 9</td><td>Command speed</td><td>• Feeds out the voltage in proportion to the command speed with polarity.
+ : rotates to CCW
– : rotates to CW</td></tr>
</table></td><td>AO
P.163</td></tr>
</table>

Output Signals (Others) and Their Functions

Title of signal	Pin No	Symbol	Function	I/F circuit
Signal ground	**13,15, 17,25**	**GND**	• Signal ground • This output is insulated from the control signal power (COM–) inside of the driver.	–
Frame ground	**50**	**FG**	• This output is connected to the earth terminal inside of the driver.	–

Trial Run (JOG run) at Velocity Control Mode

Inspection Before Trial Run

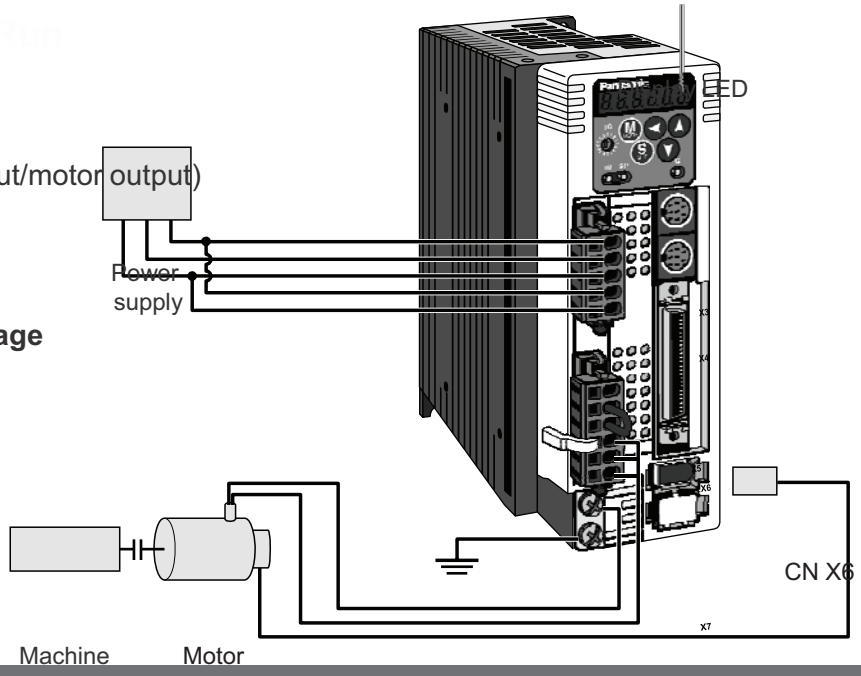
(1) Wiring inspection
- Miswiring
  (Especially power input/motor output)
- Short/Earth
- Loose connection

(2) Check of power/voltage
- Rated voltage

(3) Fixing of the motor
- Unstable fixing

(4) Separation from mechanical system

(5) Release of the brake



Trial Run by Connecting the Connector, CN X5

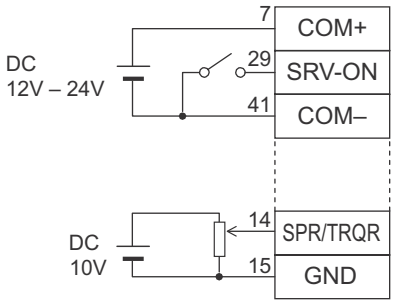
1) Connect the CN X5.
2) Enter the power (DC12-24V) to control signal (COM+ , COM–)
3) Enter the power to the driver.
4) Confirm the default values of parameters.
5) Set a lower value to Pr56 (4th speed of speed setup).
6) Energize the motor by connecting the Servo-ON input (SRV-ON, CN X5, Pin-29) and COM– (Pin-41 of CN X5) to turn to Servo-ON status.
7) Confirm that the motor runs as per the setup of Pr56 by applying DC voltage (positive/negative) between the torque command input (Pin-14 of CN X5) and GND (Pin-41 of CN X5).
8) If you want to change the torque magnitude, direction and velocity limit value against the command voltage, set up the following parameters.

Pr56 : 4th speed of speed setup
Pr5C : Torque command input gain
Pr5D : Torque command input reversal

Refer to P.183, "Parameter Setup-Parameters for Velocity and Torque Control".

9) If the motor does not run correctly, refer to P.68, "Display of factor for No-motor running" of Preparation.

Wiring Diagram



In case of one way running

For bi-directional running (CW/CCW), provide a bipolar power supply.

Parameter

PrNo.	Title	Setup value
02	Setup of control mode	2
04	Invalidation of over-travel inhibit input	1
06	Selection of ZEROSPD	0
56	4th speed of speed setup	lower value
5B	Selection of torque command	0
5C	Torque command input gain	Set up as required
5D	Torque command input reversal	

Input signal status

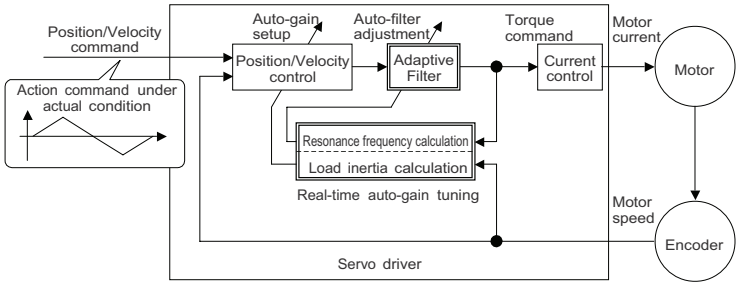
No.	Title of signal	Monitor display
0	Servo-ON	+A
5	Speed zero clamp	–

Real-Time Auto-Gain Tuning

Outline

The driver estimates the load inertia of the ma-

optimum gain responding to the result. Also the driver automatically suppress the vibration caused by the resonance with an adaptive filter.



Applicable Range

- Real-time auto-gain tuning is applicable to all control modes.

Caution

Real-time auto-gain tuning may not be executed properly under the conditions described in the right table. In these cases, use the normal mode auto-gain tuning (refer to P.236 of Adjustment), or execute a manual gain tuning. (refer to P.240, of Adjustment)

	Conditions which obstruct real-time auto-gain tuning
Load inertia	• Load is too small or large compared to rotor inertia. (less than 3 times or more than 20 times) • Load inertia change too quickly. (10 [s] or less)
Load	• Machine stiffness is extremely low. • Chattering such as backlash exists.
Action pattern	• Motor is running continuously at low speed of 100 [r/min] or lower. • Acceleration/deceleration is slow (2000[r/min] per 1[s] or low). • Acceleration/deceleration torque is smaller than unbalanced weighted/viscous friction torque. • When speed condition of 100[r/min] or more and acceleration/deceleration condition of 2000[r/min] per 1[s] are not maintained for 50[ms] .

How to Operate

(1) Bring the motor to stall (Servo-OFF).
(2) Set up Pr21 (Real-time auto-gain tuning mode setup) to 1-7. Default is 1.

Setup value	Real-time auto-gain tuning	Varying degree of load inertia in motion
0	(not in use)	–
<1>,4,	normal mode	no change
2, 5		slow change
3, 6		rapid change

• When the varying degree of load inertia is large, set up 3.

(3) Set up Pr22 (Machine stiffness at real-time auto-gain tuning) to 0 or smaller value.
(4) Turn to Servo-ON to run the machine normally.
(5) Gradually increase Pr22 (Machine stiffness at real-time auto-gain tuning) when you want to obtain better response. Lower the value (0 to 3) when you experience abnormal noise or oscillation.
(6) Write to EEPROM when you want to save the result.

Insert the console connector to CN X6 of the driver, then turn on the driver power. → r 0

Setup of parameter, Pr21

Press (S). → dP_SPd
Press (M). → PA_ 00
Match to the parameter No. to be set up with (▲)(▼). (Here match to Pr21.) → PA_ 21
Press (S). → 1
Change the setup with (▲)(▼).
Press (S). → PA_ 21

Setup of parameter, Pr22

Match to Pr22 with (▲). → PA_ 22
Press (S). → 4 (default values)
Numeral increases with (▲), and decreases with (▼).
Press (S).

Writing to EEPROM

Press (M). → EE_SEt
Press (S). → EEP -
Bars increase as the right fig. shows by keep pressing (▲) (approx. 5sec). → EEP --, ------
Writing starts (temporary display). → StArt

Finish → FinSh (Writing completes) / rESEt / Error (Writing error occurs)

Return to SELECTION display after writing finishes, referring to "Structure of each mode"(P.60 and 61 of Preparation).

Parameters Which Are Automatically Set Up.

Following parameters are automatically adjusted. Also following parameters are automatically set up.

PrNo.	Title
11	1st gain of velocity loop
12	1st time constant of velocity loop integration
13	1st filter of velocity detection
14	1st time constant of torque filter
19	2nd gain of velocity loop
1A	2nd time constant of velocity loop integration
1B	2nd filter of speed detection
1C	2nd time constant of torque filter
20	Inertia ratio

PrNo.	Title	Setup value
30	2nd gain setup	1
31	1st mode of control switching	0
32	1st delay time of control switching	30
33	1st level of control switching	50
34	1st hysteresis of control switching	33
36	2nd mode of control switching	0

<Notes>

- When the real-time auto-gain tuning is valid, you cannot change parameters which are automatically adjusted.
- Pr31 becomes 10 at position or full closed control and when Pr21 (Setup of Real-Time Auto-Gain Tuning Mode) is 1 to 6, and becomes 0 in other cases.

Cautions

(1) After the start-up, you may experience abnormal noise and oscillation right after the first Servo-ON, or when you increase the setup of Pr22 (Selection of machine stiffness at real-time auto-gain tuning), until load inertia is identified (estimated) or adaptive filter is stabilized, however, these are not failures as long as they disappear immediately. If they persist over 3 reciprocating operations, take the following measures in possible order.
   1) Write the parameters which have given the normal operation into EEPROM.
   2) Lower the setup of Pr22 (Selection of machine stiffness at real-time auto-gain tuning).
   3) Set up both Pr21 (Setup of real-time auto-gain tuning) and Pr23 (Setup of adaptive filter mode) to 0, then set up other value than 0. (Reset of inertia estimation and adaptive action)
   4) Invalidate the adaptive filter by setting up Pr23 (Setup of adaptive filter mode setup) to 0, and set up notch filter manually.

(2) When abnormal noise and oscillation occur, Pr20 (Inertia ratio) or Pr2F (Adaptive filter frequency) might have changed to extreme values. Take the same measures as the above in these cases.

(3) Among the results of real-time auto-gain tuning, Pr20 (Inertia ratio) and Pr2F (Adaptive filter frequency) will be written to EEPROM every 30 minutes. When you turn on the power again, auto-gain tuning will be executed using the latest data as initial values.

(4) When you validate the real-time auto-gain tuning, Pr27 (Setup of instantaneous speed observer) will be invalidated automatically.

(5) The adaptive filter is normally invalidated at torque control, however, when you select torque control while you set up Pr02 (Control mode setup) to 4 and 5, the adaptive filter frequency before mode switching will be held.

(6) During the trial run and frequency characteristics measurement of "PANATERM®", the load inertia estimation will be invalidated.

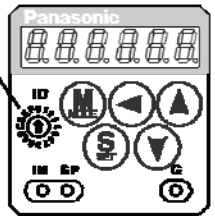
Parameter Setup

Parameters for Functional Selection

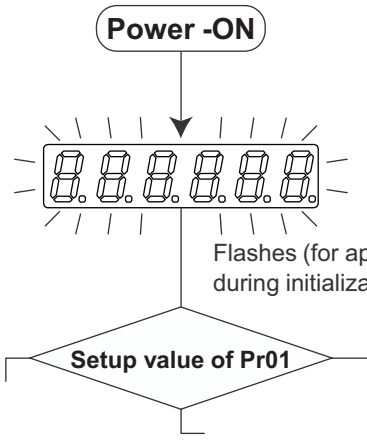
Standard default : < >

PrNo.	Title	Setup range	Function/Content
00 *	Address	0 to 15 <1>	In the communication with the host via RS232/485 for multi-axes application, it is necessary to identify which axis the host is communicating. Use this parameter to confirm the address of the axis in numbers.

- The address is determined by the setup value of rotary switch (0 to F) of the front panel at power-on.
- This value becomes the axis number at serial communication.
- The setup value of this parameter has no effect to the servo action.
- You cannot change the setup of Pr00 with other means than rotary switch.



01 *	LED initial status	0 to 17 <1>	You can select the type of data to be displayed on the front panel LED (7 segment) at the initial status after power-on.



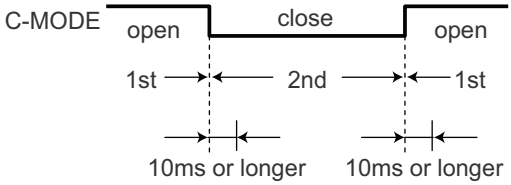
Setup value	Content
0	Positional deviation
<1>	Motor rotational speed
2	Torque output
3	Control mode
4	I/O signal status
5	Error factor/history
6	Software version
7	Alarm
8	Regenerative load factor
9	Over-load factor
10	Inertia ratio
11	Sum of feedback pulses
12	Sum of command pulses
13	External scale deviation
14	Sum of external scale feedback pulses
15	Motor automatic recognizing function
16	Analog input value
17	Factor of "No-Motor Running"

For details of display, refer to P.51 "Setup of Parameter and Mode" of Preparation.

02 *	Setup of control mode	0 to 6 <1>	You can set up the control mode to be used.

Setup value	Control mode	
	1st mode	2nd mode
0	Position	–
<1>	Velocity	–
2	Torque	–
3 **1	Position	Velocity
4 **1	Position	Torque
5 **1	Velocity	Torque
6	Full-closed	–

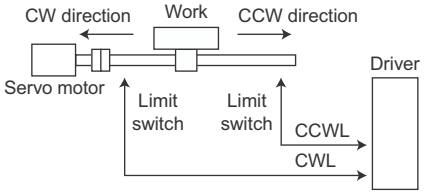
**1) When you set up the combination mode of 3, 4 or 5, you can select either the 1st or the 2nd with control mode switching input (C-MODE).
When C-MODE is open, the 1st mode will be selected.
When C-MODE is shorted, the 2nd mode will be selected.
Don't enter commands 10ms before/after switching.



<Notes>

- For parameters which No. have a suffix of "*", changed contents will be validated when you turn on the control power.

Standard default : < >

<table>
<tr><th>PrNo.</th><th>Title</th><th>Setup range</th><th>Function/Content</th></tr>
<tr><td>04
*</td><td>Setup of over-travel inhibit input</td><td>0 to 2
<1></td><td>In linear drive application, you can use this over-travel inhibiting function to inhibit the motor to run to the direction specified by limit switches which are installed at both ends of the axis, so that you can prevent the work load from damaging the machine due to the over-travel. With this input, you can set up the action of over-travel inhibit input.
 

<table>
<tr><th>Setup value</th><th>CCWL/CWL input</th><th colspan="2">Action</th></tr>
<tr><th></th><th></th><th>Input</th><th>Connection to COM–</th><th></th></tr>
<tr><td rowspan="4">0</td><td rowspan="4">Valid</td><td rowspan="2">CCWL (CN X5,Pin-9)</td><td>Close</td><td>Normal status while CCW-side limit switch is not activated.</td></tr>
<tr><td>Open</td><td>Inhibits CCW direction, permits CW direction.</td></tr>
<tr><td rowspan="2">CWL (CN X5,Pin-9)</td><td>Close</td><td>Normal status while CW-side limit switch is not activated.</td></tr>
<tr><td>Open</td><td>Inhibits CW direction, CCW direction permitted.</td></tr>
<tr><td><1></td><td>Invalid</td><td colspan="3">Both CCWL and CWL inputs will be ignored, and over-travel inhibit function will be invalidated.</td></tr>
<tr><td>2</td><td>Valid</td><td colspan="3">Err38 (Over-travel inhibit input protection) is triggered when either one of the connection of CW or CCW inhibit input to COM– become open.</td></tr>
</table>
<Cautions>
1. When Pr04 is set to 0 and over-travel inhibit input is entered, the motor decelerates and stops according to the preset sequence with Pr66 (Sequence at over-travel inhibition). For details, refer to the explanation of Pr66.
2. When both of CCWL and CWL inputs are opened while Pr04 is set to 0, the driver trips with Err38 (Overtravel inhibit input error) judging that this is an error.
3. When you turn off the limit switch on upper side of the work at vertical axis application, the work may repeat up/down movement because of the loosing of upward torque. In this case, set up Pr66 to 2, or limit with the host controller instead of using this function.</td></tr>
<tr><td>06</td><td>Selection of ZEROSPD input</td><td>0 to 2
<0></td><td>You can set up the function of the speed zero clamp input (ZEROSPD : CN X5, Pin-26)
<table>
<tr><th>Setup value</th><th>Function of ZEROSPD (Pin-26)</th></tr>
<tr><td><0> , 2</td><td>ZEROSPD input is ignored and the driver judge that it Is not in speed zero clamp status.</td></tr>
<tr><td>1</td><td>ZEROSPD input becomes valid. Speed command is taken as 0 by opening the connection to COM–.</td></tr>
</table></td></tr>
<tr><td>07</td><td>Selection of speed monitor (SP)</td><td>0 to 9
<3></td><td>You can set up the content of analog speed monitor signal output (SP : CN X5, Pin43) and the relation between the output voltage level and the speed.
<table>
<tr><th>Setup value</th><th>Signal of SP</th><th>Relation between the output voltage level and the speed</th></tr>
<tr><td>0</td><td rowspan="5">Motor actual speed</td><td>6V / 47 r/min</td></tr>
<tr><td>1</td><td>6V / 188 r/min</td></tr>
<tr><td>2</td><td>6V / 750 r/min</td></tr>
<tr><td><3></td><td>6V / 3000 r/min</td></tr>
<tr><td>4</td><td>1.5V / 3000 r/min</td></tr>
<tr><td>5</td><td rowspan="5">Command speed</td><td>6V / 47 r/min</td></tr>
<tr><td>6</td><td>6V / 188 r/min</td></tr>
<tr><td>7</td><td>6V / 750 r/min</td></tr>
<tr><td>8</td><td>6V / 3000 r/min</td></tr>
<tr><td>9</td><td>1.5V / 3000 r/min</td></tr>
</table></td></tr>
</table>

Parameter Setup

Standard default : < >

<table>
<tr><th>PrNo.</th><th>Title</th><th>Setup range</th><th>Function/Content</th></tr>
<tr><td>08</td><td>Selection of torque monitor (IM)</td><td>0 to 12
<0></td><td>You can set up the content of the analog torque monitor of the signal output (IM : CN X5, Pin-42), and the relation between the output voltage level and torque or deviation pulse counts.
<table>
<tr><th>Setup value</th><th>Signal of IM</th><th>Relation between the output voltage level and torque or deviation pulse counts</th></tr>
<tr><td><0></td><td>Torque command</td><td>3V/rated (100%) torque</td></tr>
<tr><td>1</td><td rowspan="5">Position deviation</td><td>3V / 31Pulse</td></tr>
<tr><td>2</td><td>3V / 125Pulse</td></tr>
<tr><td>3</td><td>3V / 500Pulse</td></tr>
<tr><td>4</td><td>3V / 2000Pulse</td></tr>
<tr><td>5</td><td>3V / 8000Pulse</td></tr>
<tr><td>6</td><td rowspan="5">Full-closed deviation</td><td>3V / 31Pulse</td></tr>
<tr><td>7</td><td>3V / 125Pulse</td></tr>
<tr><td>8</td><td>3V / 500Pulse</td></tr>
<tr><td>9</td><td>3V / 2000Pulse</td></tr>
<tr><td>10</td><td>3V / 8000Pulse</td></tr>
<tr><td>11</td><td rowspan="2">Torque command</td><td>3V / 200% torque</td></tr>
<tr><td>12</td><td>3V / 400% torque</td></tr>
</table></td></tr>
<tr><td>09</td><td>Selection of TLC output</td><td>0 to 8
<0></td><td>You can assign the function of the torque in-limit output (TLC : CN X5 Pin-40).
<table>
<tr><th>Setup value</th><th>Function</th><th>Note</th></tr>
<tr><td><0></td><td>Torque in-limit output</td><td rowspan="9">For details of function of each output of the left, refer to the table of P168, "Selection of TCL and ZSP outputs".</td></tr>
<tr><td>1</td><td>Zero speed detection output</td></tr>
<tr><td>2</td><td>Alarm output of either one of Over-regeneration /Over-load/Absolute battery/Fan lock/External scale</td></tr>
<tr><td>3</td><td>Over-regeneration alarm trigger output</td></tr>
<tr><td>4</td><td>Overload alarm output</td></tr>
<tr><td>5</td><td>Absolute battery alarm output</td></tr>
<tr><td>6</td><td>Fan lock alarm output</td></tr>
<tr><td>7</td><td>External scale alarm output</td></tr>
<tr><td>8</td><td>In-speed (Speed coincidence) output</td></tr>
</table></td></tr>
<tr><td>0A</td><td>Selection of ZSP output</td><td>0 to 8
<1></td><td>You can assign the function of the zero speed detection output (ZSP: CN X5 Pin-12).
<table>
<tr><th>Setup value</th><th>Function</th><th>Note</th></tr>
<tr><td>0</td><td>Torque in-limit output</td><td rowspan="9">For details of function of each output of the left, refer to the table of P.168, "Selection of TCL and ZSP outputs".</td></tr>
<tr><td><1></td><td>Zero speed detection output</td></tr>
<tr><td>2</td><td>Alarm output of either one of Over-regeneration /Over-load/Absolute battery/Fan lock/External scale</td></tr>
<tr><td>3</td><td>Over-regeneration alarm trigger output</td></tr>
<tr><td>4</td><td>Overload alarm output</td></tr>
<tr><td>5</td><td>Absolute battery alarm output</td></tr>
<tr><td>6</td><td>Fan lock alarm output</td></tr>
<tr><td>7</td><td>External scale alarm output</td></tr>
<tr><td>8</td><td>In-speed (Speed coincidence) output</td></tr>
</table></td></tr>
<tr><td>0B
*</td><td>Setup of absolute encoder</td><td>0 to 2
<1></td><td>You can set up the using method of 17-bit absolute encoder.
<table>
<tr><th>Setup value</th><th>Content</th></tr>
<tr><td>0</td><td>Use as an absolute encoder.</td></tr>
<tr><td><1></td><td>Use as an incremental encoder.</td></tr>
<tr><td>2</td><td>Use as an absolute encoder, but ignore the multi-turn counter over.</td></tr>
</table>
<Caution>
This parameter will be invalidated when 5-wire, 2500P/r incremental encoder is used.</td></tr>
<tr><td>0C
*</td><td>Baud rate setup of RS232 communication</td><td>0 to 5
<2></td><td>You can set up the communication speed of RS232.
• Error of baud rate is ±0.5%.
<table>
<tr><th>Setup value</th><th>Baud rate</th></tr>
<tr><td>0</td><td>2400bps</td></tr>
<tr><td>1</td><td>4800bps</td></tr>
<tr><td><2></td><td>9600bps</td></tr>
</table>
<table>
<tr><th>Setup value</th><th>Baud rate</th></tr>
<tr><td>3</td><td>19200bps</td></tr>
<tr><td>4</td><td>38400bps</td></tr>
<tr><td>5</td><td>57600bps</td></tr>
</table></td></tr>
</table>

Standard default : < >

<table>
<tr><th>PrNo.</th><th>Title</th><th>Setup range</th><th>Function/Content</th></tr>
<tr><td>0D
*</td><td>Baud rate setup of RS485 communication</td><td>0 to 5
<2></td><td>You can set up the communication speed of RS485.
• Error of baud rate is ±0.5%.
<table>
<tr><th>Setup value</th><th>Baud rate</th></tr>
<tr><td>0</td><td>2400bps</td></tr>
<tr><td>1</td><td>4800bps</td></tr>
<tr><td><2></td><td>9600bps</td></tr>
</table>
<table>
<tr><th>Setup value</th><th>Baud rate</th></tr>
<tr><td>3</td><td>19200bps</td></tr>
<tr><td>4</td><td>38400bps</td></tr>
<tr><td>5</td><td>57600bps</td></tr>
</table></td></tr>
<tr><td>0E
*</td><td>Setup of front panel lock</td><td>0 to 1
<0></td><td>You can limit the operation of the front panel to the monitor mode only.
You can prevent such a misoperation as unexpected parameter change.
<table>
<tr><th>Setup value</th><th>Content</th></tr>
<tr><td><0></td><td>Valid to all</td></tr>
<tr><td>1</td><td>Monitor mode only</td></tr>
</table>
<Note>
You can still change parameters via communication even though this setup is 1.
To return this parameter to 0, use the console or the "PANATERM®".</td></tr>
</table>

Parameters for Adjustment of Time Constants of Gains and Filters

Standard default : < >

PrNo.	Title	Setup range	Unit	Function/Content
11	1st gain of velocity loop	1 to 3500 A to C-frame:<35>* D to F-frame:<18>*	Hz	You can determine the response of the velocity loop. In order to increase the response of overall servo system by setting high position loop gain, you need higher setup of this velocity loop gain as well. However, too high setup may cause oscillation. **<Caution>** When the inertia ratio of Pr20 is set correctly, the setup unit of Pr11 becomes (Hz).
12	1st time constant of velocity loop integration	1 to 1000 A to C-frame:<16>* D to F-frame:<31>*	ms	You can set up the integration time constant of velocity loop. Smaller the setup, faster you can dog-in deviation at stall to 0. The integration will be maintained by setting to "999". The integration effect will be lost by setting to "1000".
13	1st filter of speed detection	0 to 5 <0> *	–	You can set up the time constant of the low pass filter (LPF) after the speed detection, in 6 steps. Higher the setup, larger the time constant you can obtain so that you can decrease the motor noise, however, response becomes slow. Use with a default value of 0 in normal operation.
14	1st time constant of torque filter	0 to 2500 A to C-frame:<65>* D to F-frame:<126>*	0.01ms	You can set up the time constant of the 1st delay filter inserted in the torque command portion. You might expect suppression of oscillation caused by distortion resonance.
19	2nd gain of velocity loop	1 to 3500 A to C-frame:<35>* D to F-frame:<18>*	Hz	Position loop, velocity loop, speed detection filter and torque command filter have their 2 pairs of gain or time constant (1st and 2nd). For details of switching the 1st and the 2nd gain or the time constant, refer to P.226, "Adjustment". The function and the content of each parameter is as same as that of the 1st gain and time constant.
1A	2nd time constant of velocity loop integration	1 to 1000 <1000> *	ms	
1B	2nd filter of velocity detection	0 to 5 <0> *	–	
1C	2nd time constant of torque filter	0 to 2500 A to C-frame:<65>* D to F-frame:<126>*	0.01ms	
1D	1st notch frequency	100 to 1500 <1500>	Hz	You can set up the frequency of the 1st resonance suppressing notch filter. The notch filter function will be invalidated by setting up this parameter to "1500".

<Notes>

- For parameters which No. have a suffix of "*", changed contents will be validated when you turn on the control power.
- Parameters which default values have a suffix of "*" will be automatically set up during real time auto-gain tuning. When you change manually, invalidate the real-time auto-gain tuning first then set, referring to P.239, "Release of Automatic Gain Adjusting Function" of Adjustment.

Standard default : < >

PrNo.	Title	Setup range	Unit	Function/Content
1E	1st notch width selection	0 to 4 <2>	–	You can set up the notch filter width of the 1st resonance suppressing filter in 5 steps. Higher the setup, larger the notch width you can obtain. Use with default setup in normal operation.

Parameters for Auto-Gain Tuning

Standard default : < >

PrNo.	Title	Setup range	Unit	Function/Content
20	Inertia ratio	0 to 10000 <250> *	%	You can set up the ratio of the load inertia against the rotor (of the motor) inertia. Pr20= (load inertia/rotor inertia) X 100 [%] When you execute the normal auto-gain tuning, the load inertial will be automatically estimated after the preset action, and this result will be reflected in this parameter. The inertia ratio will be estimated at all time while the real-time auto-gain tuning is valid, and its result will be saved to EEPROM every 30 min. **<Caution>** If the inertia ratio is correctly set, the setup unit of Pr11 and Pr19 becomes (Hz). When the inertia ratio of Pr20 is larger than the actual, the setup unit of the velocity loop gain becomes larger, and when the inertia ratio of Pr20 is smaller than the actual, the setup unit of the velocity loop gain becomes smaller.
21	Setup of real-time auto-gain tuning	0 to 7 <1>	–	You can set up the action mode of the real-time auto-gain tuning. With higher setup such as 3, the driver respond quickly to the change of the inertia during operation, however it might cause an unstable operation. Use 1for normal operation.
22	Selection of machine stiffness at real-time auto-gain tuning	0 to 15 A to C-frame: <4> D to F-frame: <1>	–	You can set up the machine stiffness in 16 steps while the real-time auto-gain tuning is valid. low←machine stiffness→high low← servo gain →high Pr22 | 0, 1- - - - - - - - - - - - 14, 15 low← response →high **<Caution>** When you change the setup value rapidly, the gain changes rapidly as well, and this may give impact to the machine. Increase the setup gradually watching the movement of the machine.

Setup value	Real-time auto-gain tuning	Varying degree of load inertia in motion
0	Invalid	–
<1>, 4, 7	Normal mode	Little change
2, 5		Gradual change
3, 6		Rapid change

Standard default : < >

<table>
<tr><th>PrNo.</th><th>Title</th><th>Setup range</th><th>Unit</th><th>Function/Content</th></tr>
<tr><td>25</td><td>Setup of an action at normal mode auto-gain tuning</td><td>0 to 7
<0></td><td>–</td><td>You can set up the action pattern at the normal mode auto-gain tuning.
<table>
<tr><th>Setup value</th><th>Number of revolution</th><th>Rotational direction</th></tr>
<tr><td><0></td><td rowspan="4">2 [revolution]</td><td>CCW → CW</td></tr>
<tr><td>1</td><td>CW → CCW</td></tr>
<tr><td>2</td><td>CCW → CCW</td></tr>
<tr><td>3</td><td>CW → CW</td></tr>
<tr><td>4</td><td rowspan="4">1 [revolution]</td><td>CCW → CW</td></tr>
<tr><td>5</td><td>CW → CCW</td></tr>
<tr><td>6</td><td>CCW → CCW</td></tr>
<tr><td>7</td><td>CW → CW</td></tr>
</table>
e.g.) When the setup is 0, the motor turns 2 revolutions to CCW and 2 revolutions to CW.</td></tr>
<tr><td>28</td><td>2nd notch frequency</td><td>100 to 1500
<1500></td><td>Hz</td><td>You can set up the 2nd notch width of the resonance suppressing filter in 5 steps. The notch filter function is invalidated by setting up this parameter to "1500".</td></tr>
<tr><td>29</td><td>Selection of 2nd notch width</td><td>0 to 4
<2></td><td>–</td><td>You can set up the notch width of 2nd resonance suppressing filter in 5 steps. Higher the setup, larger the notch width you can obtain.
Use with default setup in normal operation.</td></tr>
<tr><td>2A</td><td>Selection of 2nd notch depth</td><td>0 to 99
<0></td><td>–</td><td>You can set up the 2nd notch depth of the resonance suppressing filter. Higher the setup, shallower the notch depth and smaller the phase delay you can obtain.</td></tr>
</table>

Parameters for Adjustment (2nd Gain Switching Function)

Standard default : < >

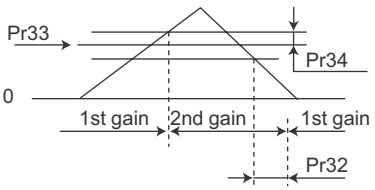
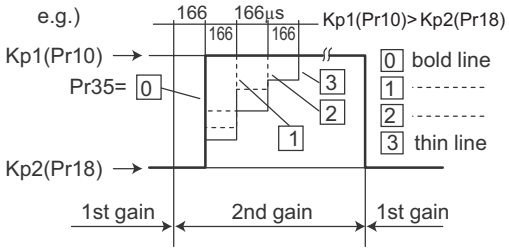
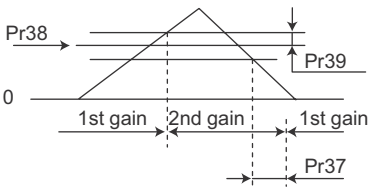
<table>
<tr><th>PrNo.</th><th>Title</th><th>Setup range</th><th>Unit</th><th>Function/Content</th></tr>
<tr><td>30</td><td>Setup of 2nd gain</td><td>0 to 1
<1>*</td><td>–</td><td>You can select the PI/P action switching of the velocity control or 1st/2nd gain switching.
<table>
<tr><th>Setup value</th><th>Gain selection/switching</th></tr>
<tr><td>0</td><td>1st gain (PI/P switching enabled) *1</td></tr>
<tr><td><1>*</td><td>1st/2nd gain switching enabled *2</td></tr>
</table>
*1 Switch the PI/P action with the gain switching input (GAIN CN X5, Pin-27). PI is fixed when Pr03 (Torque limit selection) is 3.
<table>
<tr><th>GAIN input</th><th>Action of velocity loop</th></tr>
<tr><td>Open with COM–</td><td>PI action</td></tr>
<tr><td>Connect to COM–</td><td>P action</td></tr>
</table>
*2 For switching condition of the 1st and the 2nd, refer to P.243, "Gain Switching Function" of Adjustment.</td></tr>
<tr><td>31</td><td>1st mode of control switching</td><td>0 to 10
<0>*</td><td>–</td><td>You can select the switching condition of 1st gain and 2nd gain while Pr30 is set to 1.
<table>
<tr><th>Setup value</th><th>Gain switching condition</th></tr>
<tr><td><0>*, 4to 10</td><td>Fixed to the 1st gain.</td></tr>
<tr><td>1</td><td>Fixed to the 2nd gain.</td></tr>
<tr><td>2 *1</td><td>2nd gain selection when the gain switching input is turned on. (Pr30 setup must be 1.)</td></tr>
<tr><td>3 *2</td><td>2nd gain selection when the toque command variation is larger than the setups of Pr33 (1st level of control switching) and Pr34 (1st hysteresis of control switching).</td></tr>
</table>
*1 Fixed to the 1st gain regardless of GAIN input, when Pr31 is set to 2 and Pr03 (Torque limit selection) is set to 3.
*2 For the switching level and the timing, refer to P.243, "Gain Switching Function" of Adjustment.</td></tr>
</table>

<Notes>

- Parameters which default values have a suffix of "*" will be automatically set up during real time auto-gain tuning. When you change manually, invalidate the real-time auto-gain tuning first then set, referring to P.239, "Release of Automatic Gain Adjusting Function" of Adjustment.

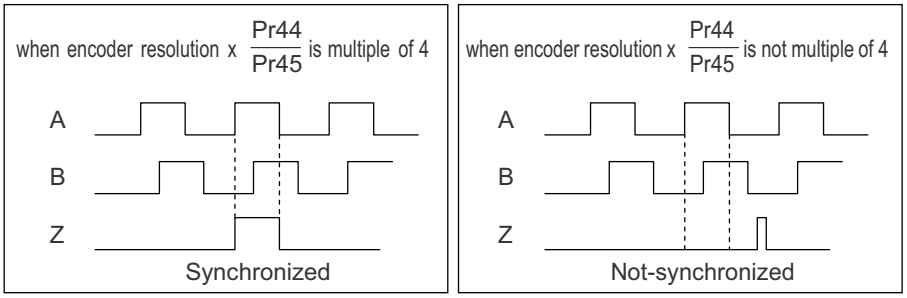
Parameter Setup

Standard default : < >

PrNo.	Title	Setup range	Unit	Function/Content
32	1st delay time of control switching	0 to 10000 <30> *	x 166μs	You can set up the delay time when returning from the 2nd to the 1st gain, while Pr31 is set to 3.
33	1st level of control switching	0 to 20000 <50> *	–	You can set up the switching (judging) level of the 1st and the 2nd gains, while Pr31 is set to 3. Unit varies depending on the setup of Pr31 (1st mode of control switching)
34	1st hysteresis of control switching	0 to 20000 <33> *	–	You can set up hysteresis width to be implemented above/below the judging level which is set up with Pr33. Unit varies depending on the setup of Pr31 (1st control switching mode). Definitions of Pr32 (Delay), Pr33 (Level) and Pr34 (Hysteresis) are explained in the fig. below.  **<Caution>** The setup of Pr33 (Level) and Pr34 (Hysteresis) are valid as absolute values (positive/negative).
35	Switching time of position gain	0 to 10000 <20> *	(setup value + 1) x 166μs	You can setup the step-by-step switching time to the position loop gain only at gain switching while the 1st and the 2nd gain switching is valid.  **<Caution>** The switching time is only valid when switching from small position gain to large position gain.
37	2nd delay time of control switching	0 to 10000 <0>	x 166μs	You can set up the delay time when returning from 2nd to 1st gain, while Pr36 is set to 3 to 5.
38	2nd level of control switching	0 to 20000 <0>	–	You can set up the switching (judging) level of the 1st and the 2nd gains, while Pr36 is set to 3 to 5 Unit varies depending on the setup of Pr36 (2nd mode of control switching).
39	2nd hysteresis of control switching	0 to 20000 <0>	–	You can set up the hysteresis width to be implemented above/below the judging level which is set up with Pr38. Unit varies depending on the setup of Pr36 (2nd mode of control switching).Definition of Pr37 (Delay), Pr38 (Level) and Pr39 (Hysteresis) are explained in the fig. below.  **<Caution>** Setup of Pr38 (Level) and Pr39 (Hysteresis) are valid as absolute value (positive/negative).
3D	JOG speed setup	0 to 500 <300>	r/min	You can setup the JOG speed. Refer to P.75, "Trial Run"of Preparation.

Parameters for Position Control

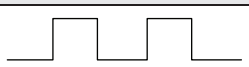
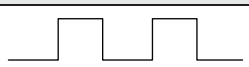
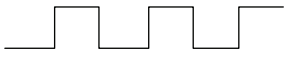
Standard default : < >

<table>
<tr><th>PrNo.</th><th>Title</th><th>Setup range</th><th>Function/Content</th></tr>
<tr><td>44
*</td><td>Numerator of pulse output division</td><td>1 to 32767
<2500></td><td rowspan="2">You can set up the pulse counts to be fed out from the pulse output (X5 0A+ : Pin-21, 0A- : Pin-22, 0B+ : Pin-48, 0B- : Pin-49).
• Pr45= <0> (Default)
You can set up the output pulse counts per one motor revolution for each OA and OB with the Pr44 setup. Therefore the pulse output resolution after quadruple can be obtained from the formula below.
The pulse output resolution per one revolution
= Pr44 (Numerator of pulse output division) X4
• Pr45≠0 :
The pulse output resolution per one revolution can be divided by any ration according to the formula below.
Pulse output resolution per one revolution $\frac{\text{Pr44 (Numerator of pulse output division)}}{\text{Pr45 (Denominator of pulse output division)}}$ x Encoder resolution
<Cautions>
• The encoder resolution is 131072 [P/r] for the 17-bit absolute encoder, and 10000 [P/r] for the 5-wire 2500P/r incremental encoder.
• The pulse output resolution per one revolution cannot be greater than the encoder resolution.
(In the above setup, the pulse output resolution equals to the encoder resolution.)
• Z-phase is fed out once per one revolution of the motor.
When the pulse output resolution obtained from the above formula is multiple of 4, Z-phase synchronizes with A-phase. In other case, the Z-phase width equals to output with the encoder resolution, and becomes narrower than A-phase, hence does not synchronize with A-phase.
 
</td></tr>
<tr><td>45
*</td><td>Denominator of pulse output division</td><td>0 to 32767
<0></td></tr>
</table>

<Notes>

- For parameters which No. have a suffix of "*", changed contents will be validated when you turn on the control power.
- Parameters which default values have a suffix of "*" will be automatically set up during real time auto-gain tuning. When you change manually, invalidate the real-time auto-gain tuning first then set, referring to P.239, "Release of Automatic Gain Adjusting Function" of Adjustment.

Standard default : < >

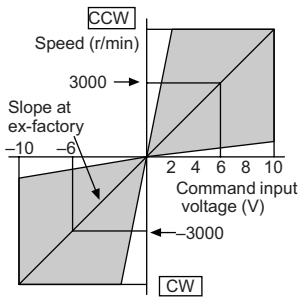
<table>
<tr><th>PrNo.</th><th>Title</th><th>Setup range</th><th>Function/Content</th></tr>
<tr><td>46
*</td><td>Reversal of pulse output logic</td><td>0 to 3
<0></td><td>You can set up the B-phase logic and the output source of the pulse output (X5 OB+ : Pin-48, OB– : Pin-49). With this parameter, you can reverse the phase relation between the A-phase pulse and the B-phase pulse by reversing the B-phase logic.
<table>
<tr><th rowspan="2">Setup value</th><th rowspan="2">A-phase (OA)</th><th>at motor CCW rotation</th><th>at motor CW rotation</th></tr>
<tr><td>  </td><td>  </td></tr>
<tr><td><0>, 2</td><td>B-phase(OB) non-reversal</td><td>  </td><td>  </td></tr>
<tr><td>1, 3</td><td>B-phase(OB) reversal</td><td>  </td><td>  </td></tr>
</table>
<table>
<tr><th>Pr46</th><th>B-phase logic</th><th>Output source</th></tr>
<tr><td><0></td><td>Non-reversal</td><td>Encoder position</td></tr>
<tr><td>1</td><td>Reversal</td><td>Encoder position</td></tr>
<tr><td>2 *1</td><td>Non-reversal</td><td>External scale position</td></tr>
<tr><td>3 *1</td><td>Reversal</td><td>External scale position</td></tr>
</table>
*1 The output source of Pr46= 2, 3 is valid only at full-closed control.</td></tr>
</table>

<Notes>

- For parameters which No. have a suffix of "*", changed contents will be validated when you turn on the control power.

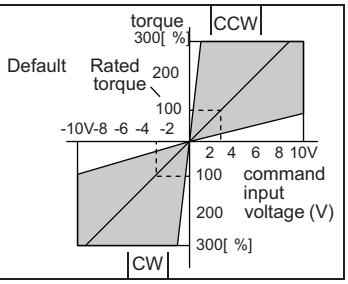
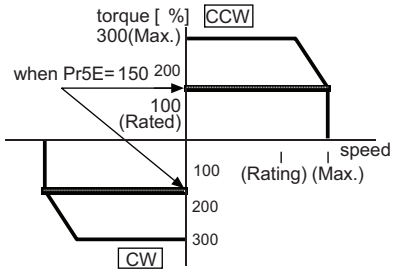
Parameters for Velocity and Torque Control

Standard default : < >

PrNo.	Title	Setup range	Unit	Function/Content
50	Input gain of speed command	10 to 2000 <500>	(r/min)/V	You can set up the relation between the voltage applied to the speed command input (SPR : CN X5, Pin-14) and the motor speed. • You can set up a "slope" of the relation between the command input voltage and the motor speed, with Pr50. • Default is set to Pr50= 500 [r/min] , hence input of 6V becomes 3000r/min. **<Cautions>** 1. Do not apply more than ±10V to the speed command input (SPR). 2. When you compose a position loop outside of the driver while you use the driver in velocity control mode, the setup of Pr50 gives larger variance to the overall servo system. Pay an extra attention to oscillation caused by larger setup of Pr50. 
52	Speed command offset	–2047 to 2047 <0>	0.3mV	• You can make an offset adjustment of analog speed command (SPR : CN X5, Pin-14) with this parameter. • The offset volume is 0.3mV per setup value of "1". • There are 2 offset methods, (1) Manual adjustment and (2) Automatic adjustment. 1) Manual adjustment • When you make an offset adjustment with the driver alone, Enter 0 V exactly to the speed command input (SPR/TRQR), (or connect to the signal ground), then set this parameter up so that the motor may not turn. • when you compose a position loop with the host, • Set this parameter up so that the deviation pulse may be reduced to 0 at the Servo-Lock status. 2) Automatic adjustment • For the details of operation method at automatic offset adjustment mode, refer to P.73, "Auxiliary Function Mode" of Preparation. • Result after the execution of the automatic offset function will be reflected in this parameter, Pr52.
56	4th speed of speed setup	–20000 to 20000 <0>	r/min	You can set up the speed limit value in unit of [r/min] . **<Caution>** The absolute value of the parameter setup is limited by Pr73 (Set up of over-speed level).
57	Setup of speed command filter	0 to 6400 <0>	10μs	You can set up the time constant of the primary delay filter to the analog speed command/analog torque command/analog velocity control (SPR : CN X5, Pin-14)
5B	Selection of torque command	0 to 1 <0>	–	You can select the input of the torque command and the speed limit. **Pr5B** / **Torque command** / **Velocity limit** <0> / SPR/TRQR/SPL / Pr56 1 / CCWTL/TRQR / SPR/TRQR/SPL

Parameter Setup

Standard default : < >

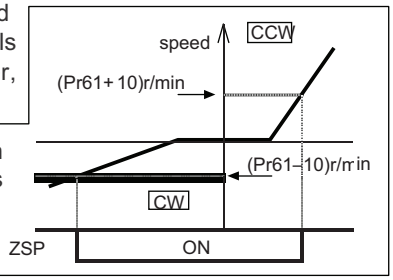
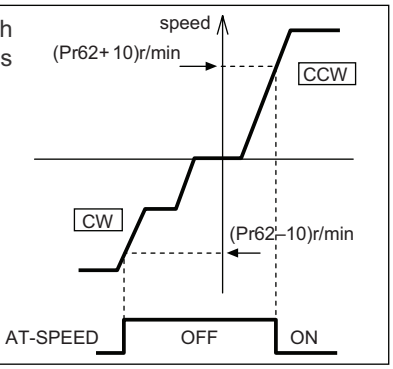
PrNo.	Title	Setup range	Unit	Function/Content
5C	Input gain of torque command	10 to 100 <30>	0.1V/ 100%	You can set the relation between the voltage applied to the torque command input (SPR/TRQR : CN X5, Pin-14 or CCWTL/TRQR : CN X5, Pin-16) and the motor output torque. • Unit of the setup value is [0.1V/100%] and set up input voltage necessary to produce the rated torque. • Default setup of 30 represents 3V/100%. 
5D	Input reversal of torque command	0 to 1 <0>	–	You can reverse the polarity of the torque command input (SPR/TRQR : CN X5, Pin-14 or CCWTL/TRQR : CN X5, Pin-16) **Setup value** / **Direction of motor output torque** <0> : CCW direction (viewed from motor shaft) with (+) command 1 : CW direction (viewed from motor shaft) with (+) command
5E	1st torque limit setup	0 to 500 <500> *2	%	You can limit the max torque for both CCW and CW direction with Pr5E. Pr03 setup and Pr5F are ignored. This torque limit function limits the max. motor torque with the parameter setup. In normal operation, this driver permits approx. 3 times larger torque than the rated torque instantaneously. If this 3 times bigger torque causes any trouble to the load (machine) strength, you can use this function to limit the max. torque. • Setup value is to be given in % against the rated torque. • Right fig. shows example of 150% setup with Pr03= 1. • Pr5E limits the max. torque for both CCW and CW directions.  **<Caution>** You cannot set up a larger value to this parameter than the default setup value of "Max. output torque setup" of System parameter (which you cannot change through operation with PANATERM® or panel). Default value varies depending on the combination of the motor and the driver. For details, refer to P.57, "Setup of Torque Limit " of Preparation.

<Notes>

• For parameters which default. has a suffix of "*2", value varies depending on the combination of the driver and the motor.

Parameters for Sequence

Standard default : < >

<table>
<tr><th>PrNo.</th><th>Title</th><th>Setup range</th><th>Unit</th><th>Function/Content</th></tr>
<tr><td>61</td><td>Zero-speed</td><td>10 to 20000 <50></td><td>r/min</td><td>You can set up the timing to feed out the zero-speed detection output signal (ZSP : CN X5, Pin-12 or TCL : CN X5, Pin-40) in rotational speed [r/min] .
The zero-speed detection signal (ZSP) will be fed out when the motor speed falls below the setup of this parameter, Pr61.
In-speed (Speed coincidence) signal (V-COIN) will be fed out when the difference between the speed command and the motor speed falls below the setup of this parameter, Pr61.
• The setup of P61 is valid for both CCW and CW direction regardless of the motor rotating direction.
• There is hysteresis of 10 [r/min] .
 
</td></tr>
<tr><td>62</td><td>At-speed (Speed arrival)</td><td>10 to 20000 <50></td><td>r/min</td><td>You can set up the timing to feed out the At-speed signal (COIN+ : CN X5, Pin-39, COIN- : CN X5, Pin-38)
At-speed (Speed arrival) (COIN) will be fed out when the motor speed exceeds the setup speed of this parameter, Pr62
• The setup of P62 is valid for both CCW and CW direction regardless of the motor rotational direction.
• There is hysteresis of 10 [r/min] .
 
</td></tr>
<tr><td>65</td><td>LV trip selection at main power OFF</td><td>0 to 1 <1></td><td>–</td><td>You can select whether or not to activate Err13 (Main power under-voltage protection) function while the main power shutoff continues for the setup of Pr6D (Main power-OFF detection time).
<table>
<tr><th>Setup value</th><th>Action of main power low voltage protection</th></tr>
<tr><td>0</td><td>When the main power is shut off during Servo-ON, Err13 will not be triggered and the driver turns to Servo-OFF. The driver returns to Servo-ON again after the main power resumption.</td></tr>
<tr><td><1></td><td>When the main power is shut off during Servo-ON, the driver will trip due to Err13 (Main power low voltage protection).</td></tr>
</table>
<Caution>
This parameter is invalid when Pr6D (Detection time of main power OFF)= 1000. Err13 (Main power under-voltage protection) is triggered when setup of P66D is long and P-N voltage of the main converter falls below the specified value before detecting the main power shutoff, regardless of the Pr65 setup. Refer to P.42, "Timing Chart-At Power-ON" of Preparation as well.</td></tr>
</table>

Parameter Setup

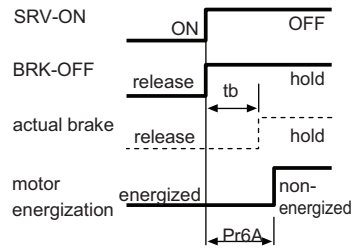
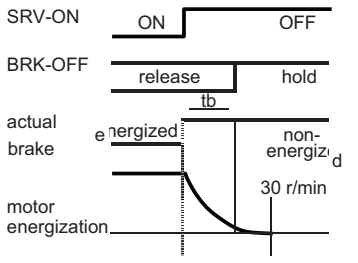
Standard default : < >

<table>
<tr><th>PrNo.</th><th>Title</th><th>Setup range</th><th>Unit</th><th>Function/Content</th></tr>
<tr><td>66
*</td><td>Sequence at over-travel inhibit</td><td>0 to 2
<0></td><td>–</td><td>You can set up the running condition during deceleration or after stalling, while over-travel inhibit input (CCWL : Connector CN X5, Pin-9 or CWL : Connector CN X5, Pin-8) is valid
<table>
<tr><th>Setup value</th><th>During deceleration</th><th>After stalling</th><th>Deviation counter content</th></tr>
<tr><td><0></td><td>Dynamic brake action</td><td>Torque command= 0 towards inhibited direction</td><td>Hold</td></tr>
<tr><td>1</td><td>Torque command= 0 towards inhibited direction</td><td>Torque command= 0 towards inhibited direction</td><td>Hold</td></tr>
<tr><td>2</td><td>Emergency stop</td><td>Torque command= 0 towards inhibited direction</td><td>Clears before/ after deceleration</td></tr>
</table>
<Caution>
In case of the setup value of 2, torque limit during deceleration will be limited by the setup value of Pr6E (Torque setup at emergency stop).</td></tr>
<tr><td>67</td><td>Sequence at main power OFF</td><td>0 to 9
<0></td><td>–</td><td>When Pr65 (LV trip selection at main power OFF) is 0, you can set up,
1) the action during deceleration and after stalling
2) the clearing of deviation counter content
after the main power is shut off.
<table>
<tr><th rowspan="2">Setup value</th><th colspan="2">Action</th><th rowspan="2">Deviation counter content</th></tr>
<tr><th>During deceleration</th><th>After stalling</th></tr>
<tr><td><0></td><td>DB</td><td>DB</td><td>Clear</td></tr>
<tr><td>1</td><td>Free-run</td><td>DB</td><td>Clear</td></tr>
<tr><td>2</td><td>DB</td><td>Free-run</td><td>Clear</td></tr>
<tr><td>3</td><td>Free-run</td><td>Free-run</td><td>Clear</td></tr>
<tr><td>4</td><td>DB</td><td>DB</td><td>Hold</td></tr>
<tr><td>5</td><td>Free-run</td><td>DB</td><td>Hold</td></tr>
<tr><td>6</td><td>DB</td><td>Free-run</td><td>Hold</td></tr>
<tr><td>7</td><td>Free-run</td><td>Free-run</td><td>Hold</td></tr>
<tr><td>8</td><td>Emergency stop</td><td>DB</td><td>Clear</td></tr>
<tr><td>9</td><td>Emergency stop</td><td>Free-run</td><td>Clear</td></tr>
</table>
(DB: Dynamic Brake action)
<Caution>
In case of the setup value of 8 or 9, torque limit during deceleration will be limited by the setup value of Pr6E (Torque setup at emergency stop).</td></tr>
<tr><td>68</td><td>Sequence at alarm</td><td>0 to 3
<0></td><td>–</td><td>You can set up the action during deceleration or after stalling when some error occurs while either one of the protective functions of the driver is triggered.
<table>
<tr><th rowspan="2">Setup value</th><th colspan="2">Action</th><th rowspan="2">Deviation counter content</th></tr>
<tr><th>During deceleration</th><th>After stalling</th></tr>
<tr><td><0></td><td>DB</td><td>DB</td><td>Hold</td></tr>
<tr><td>1</td><td>Free-run</td><td>DB</td><td>Hold</td></tr>
<tr><td>2</td><td>DB</td><td>Free-run</td><td>Hold</td></tr>
<tr><td>3</td><td>Free-run</td><td>Free-run</td><td>Hold</td></tr>
</table>
(DB: Dynamic Brake action)
<Caution>
The content of the deviation counter will be cleared when clearing the alarm. Refer to P.43, "Timing Chart (When an error (alarm) occurs (at Servo-ON command status)" of Preparation.</td></tr>
</table>

<Notes>

- For parameters which No. have a suffix of "*", changed contents will be validated when you turn on the control power.

Standard default : < >

PrNo.	Title	Setup range	Unit	Function/Content
69	Sequence at Servo-Off	0 to 9 <0>	–	You can set up, 1) the action during deceleration and after stalling 2) the clearing of deviation counter content, after turning to Servo-OFF (SRV-ON signal : CN X5, Pin-29 is turned from ON to OFF) The relation between the setup value of Pr69 and the action/deviation counter clearance is same as that of Pr67 (Sequence at Main Power Off) Refer to P.44, "Timing Chart"-Servo-ON/OFF action while the motor is at stall" of Preparation as well.
6A	Setup of mechanical brake action at stalling	0 to 100 <0>	2ms	You can set up the time from when the brake release signal (BRK-OFF : CN X5, Pin-10 and 11) turns off to when the motor is de-energized (Servo-free), when the motor turns to Servo-OFF while the motor is at stall. • Set up to prevent a micro-travel/ drop of the motor (work) due to the action delay time (tb) of the brake • After setting up Pr6a ≧ tb, then compose the sequence so as the brake is actually activated.  Refer to P.44, "Timing Chart"-Servo-ON/OFF Action While the Motor Is at Stall" of Preparation as well.
6B	Setup of mechanical brake action at running	0 to 100 <0>	2ms	You can set up time from when detecting the off of Servo-ON input signal (SRV-ON : CN X5, Pin-29) is to when external brake release signal (BRK-OFF : CN X5, Pin-10 and 11) turns off, while the motor turns to servo off during the motor in motion. • Set up to prevent the brake deterioration due to the motor running. • At Servo-OFF during the motor is running, tb of the right fig. will be a shorter one of either Pr6B setup time, or time lapse till the motor speed falls below 30r/min.  Refer to P.45, "Timing Chart"-Servo-ON/OFF action while the motor is in motion" of Preparation as well.

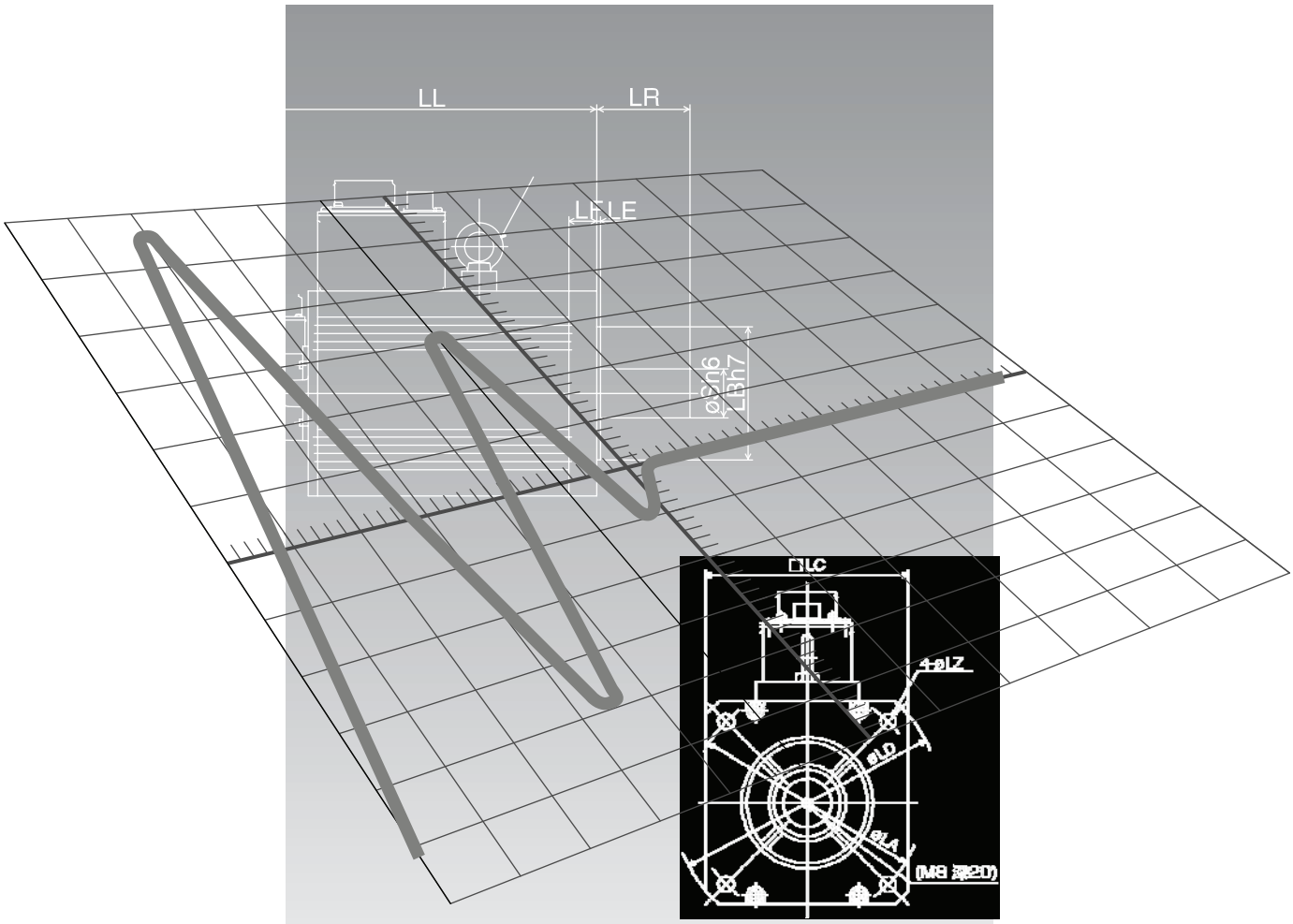
Parameter Setup

Standard default : < >

<table>
<tr><th>PrNo.</th><th>Title</th><th>Setup range</th><th>Unit</th><th>Function/Content</th></tr>
<tr><td>6C
*</td><td>Selection of external regenerative resistor</td><td>0 to 3
for
A, B-frame
<3>
for
C to F-frame
<0></td><td>–</td><td>With this parameter, you can select either to use the built-in regenerative resistor of the driver, or to separate this built-in regenerative resistor and externally install the regenerative resistor (between RB1 and RB2 of Connector CN X2 in case of A to D-frame, between P and B2 of terminal block in case of E, F-frame).
<table>
<tr><th>Setup value</th><th>Regenerative resistor to be used</th><th>Regenerative processing and regenerative resistor overload</th></tr>
<tr><td><0>
(C, D, E and F-frame)</td><td>Built-in resistor</td><td>Regenerative processing circuit will be activated and regenerative resistor overload protection will be triggered according to the built-in resistor (approx. 1% duty).</td></tr>
<tr><td>1</td><td>External resistor</td><td>The driver trips due to regenerative overload protection (Err18), when regenerative processing circuit is activated and its active ratio exceeds 10%,</td></tr>
<tr><td>2</td><td>External resistor</td><td>Regenerative processing circuit is activated, but no regenerative over-load protection is triggered.</td></tr>
<tr><td><3>
(A, B-frame)</td><td>No resistor</td><td>Both regenerative processing circuit and regenerative protection are not activated, and built-in capacitor handles all regenerative power.</td></tr>
</table>
<Remarks>
Install an external protection such as thermal fuse when you use the external regenerative resistor.
Otherwise, the regenerative resistor might be heated up abnormally and result in burnout, regardless of validation or invalidation of regenerative over-load protection.
<Caution>
When you use the built-in regenerative resistor, never to set up other value than 0. Don't touch the external regenerative resistor.
External regenerative resistor gets very hot, and might cause burning.</td></tr>
<tr><td>6D
*</td><td>Detection time of main power off</td><td>35 to 1000
<35></td><td>2ms</td><td>You can set up the time to detect the shutoff while the main power is kept shut off continuously.
The main power off detection is invalid when you set up this to 1000.</td></tr>
<tr><td>6E</td><td>Torque setup at emergency stop</td><td>0 to 500
<0></td><td>%</td><td>You can set up the torque limit in case of emergency stop as below.
• During deceleration of over-travel inhibit with the setup 2 of Pr66 (Sequence at over-travel inhibit input)
• During deceleration with the setup of 8 or 9 of Pr67 (Sequence at main power off)
• During deceleration with the setup of 8 or 9 of Pr69 (Sequence at Servo-OFF)
Normal torque limit is used by setting this to 0.</td></tr>
<tr><td>71</td><td>Setup of analog input excess</td><td>0 to 100
<0></td><td>0.1V</td><td>• You can set up the excess detection judgment level of analog velocity command (SPR : CN X5, Pin-14) with voltage after offset correction.
• Err39 (Analog input excess protective function) becomes invalid when you set up this to 0.</td></tr>
<tr><td>72</td><td>Setup of over-load level</td><td>0 to 500
<0></td><td>%</td><td>• You can set up the over-load level. The overload level becomes 115 [%] by setting up this to 0.
• Use this with 0 setup in normal operation. Set up other value only when you need to lower the over-load level.
• The setup value of this parameter is limited by 115[%] of the motor rating.</td></tr>
<tr><td>73</td><td>Setup of over-speed level</td><td>0 to 20000
<0></td><td>r/min</td><td>• You can set up the over-speed level. The over-speed level becomes 1.2 times of the motor max. speed by setting up this to 0.
• Use this with 0 setup in normal operation. Set up other value only when you need to lower the over-speed level.
• The setup value of this parameter is limited by 1.2 times of the motor max. speed.
<Caution>
The detection error against the setup value is ±3 [r/min] in case of the 7-wire absolute encoder, and ±36 [r/min] in case of the 5-wire incremental encoder.</td></tr>
</table>

<Notes>

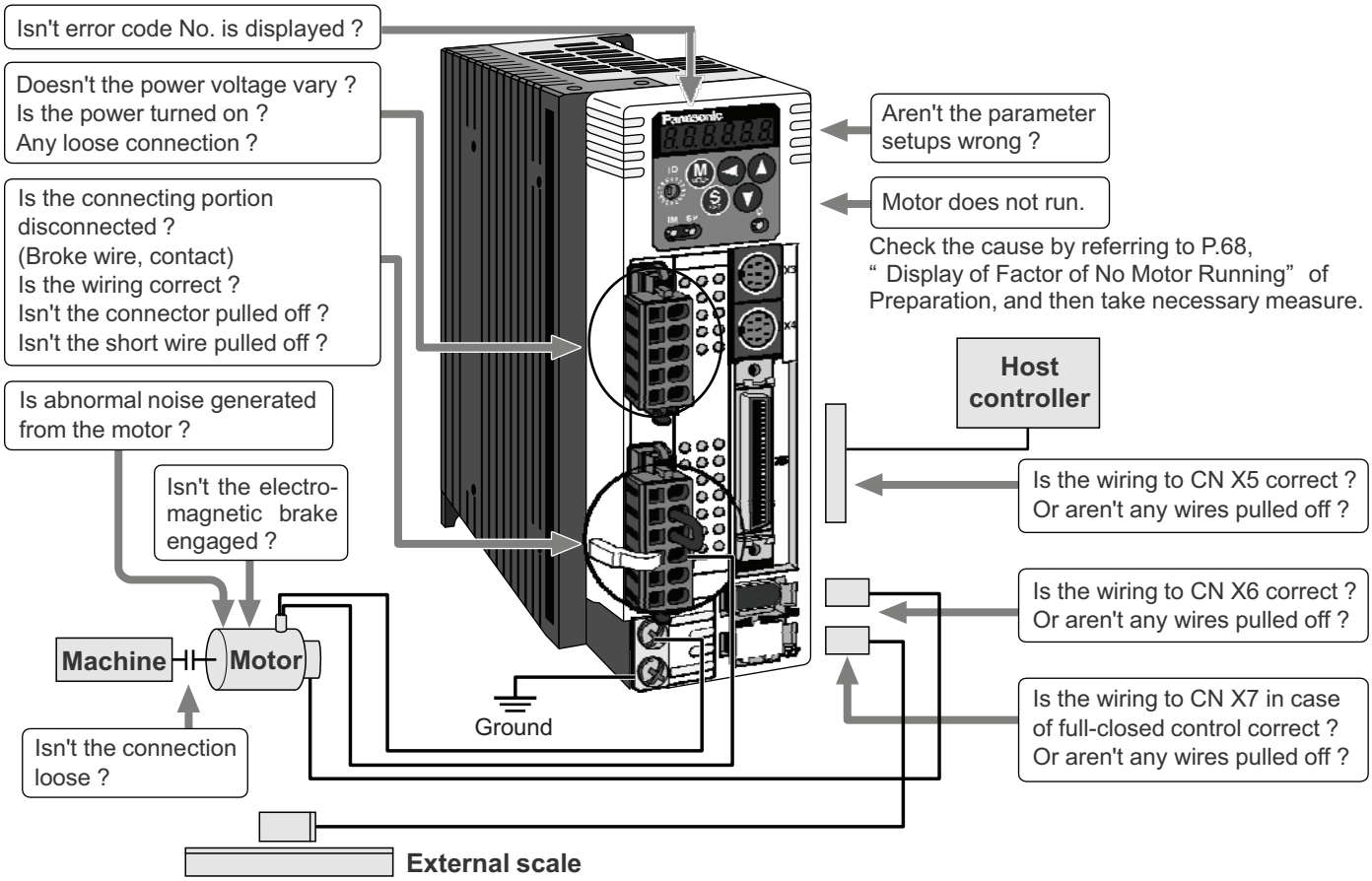
• For parameters which No. have a suffix of "*", changed contents will be validated when you turn on the control power.



[When in Trouble]

When in Trouble

What to Check ?



Protective Function (What is Error Code ?)

- Various protective functions are equipped in the driver. When these are triggered, the motor will stall due to error, according to P.43, "Timing Chart (When error occurs)"of Preparation, and the driver will turn the Servo-Alarm output (ALM) to off (open).

- Error status ands their measures
  - During the error status, the error code No. will be displayed on the front panel LED, and you cannot turn Servo-ON.
  - You can clear the error status by turning on the alarm clear input (A-CLR) for 120ms or longer.
  - When overload protection is triggered, you can clear it by turning on the alarm clear signal (A-CLR) 10 sec or longer after the error occurs. You can clear the time characteristics by turning off the connection between L1C and L2C or r and t of the control power supply of the driver.
  - You can clear the above error by operating the front panel keys. (Refer to P.73, "Alarm Clear Mode" of Preparation.)
  - You can also clear the above error by operating the "PANATERM®".

<Remarks>

- When the protective function with a prefix of "*" in the protective function table is triggered, you cannot clear with alarm clear input (A-CLR). For resumption, shut off the power to remove the cause of the error and re-enter the power.
- Following errors will not be stored in the error history.
  Control power supply under-voltage protection (Error code No. 11)
  Main power supply under-voltage protection (Error code No. 13)
  EEPROM parameter error protection (Error code No. 36)
  EEPROM check code error protection (Error code No. 37)
  Over-travel prohibition input protection (Error code No. 38)
  Motor self-recognition error protection (Error code No. 95)

Protective Function (Detail of Error Code)

Protective function	Error code No.	Causes	Measures
Control power supply under-voltage protection	**11**	Voltage between P and N of the converter portion of the control power supply has fallen below the specified value. 1)Power supply voltage is low. Instantaneous power failure has occurred 2)Lack of power capacity...Power supply voltage has fallen down due to inrush current at the main power-on. 3)Failure of servo driver (failure of the circuit)	Measure the voltage between lines of connector (L1C and L2C) and terminal block (r and t). 1)Increase the power capacity. Change the power supply. 2)Increase the power capacity. 3)Replace the driver with a new one.
Over-voltage protection	**12**	Voltage between P and N of the converter portion of the control power supply has exceeded the specified value 1)Power supply voltage has exceeded the permissible input voltage. Voltage surge due to the phase-advancing capacitor or UPS (Uninterruptible Power Supply) have occurred. 2)Disconnection of the regeneration discharge resistor 3)External regeneration discharge resistor is not appropriate and could not absorb the regeneration energy. 4)Failure of servo driver (failure of the circuit)	Measure the voltage between lines of connector (L1, L2 and L3). 1)Enter correct voltage. Remove a phase-advancing capacitor. 2)Measure the resistance of the external resistor connected between terminal P and B of the driver. Replace the external resistor if the value is ∞. 3)Change to the one with specified resistance and wattage. 4)Replace the driver with a new one.
Main power supply under-voltage protection	**13**	Instantaneous power failure has occurred between L1 and L3 for longer period than the preset time with Pr6D (Main power off detecting time) while Pr65 (LV trip selection at the main power-off) is set to 1. Or the voltage between P and N of the converter portion of the main power supply has fallen below the specified value during Servo-ON. 1)Power supply voltage is low. Instantaneous power failure has occurred 2)Instantaneous power failure has occurred. 3)Lack of power capacity...Power supply voltage has fallen down due to inrush current at the main power-on. 4)Phase lack...3-phase input driver has been operated with single phase input. 5)Failure of servo driver (failure of the circuit)	Measure the voltage between lines of connector (L1, L2 and L3). 1)Increase the power capacity. Change the power supply. Remove the causes of the shutdown of the magnetic contactor or the main power supply, then re-enter the power. 2)Set up the longer time to Pr6D (Main power off detecting time). Set up each phase of the power correctly. 3)Increase the power capacity. For the capacity, refer to P.32, "Driver and List of Applicable Peripheral Equipments" of Preparation. 4)Connect each phase of the power supply (L1, L2 and L3) correctly. For single phase, 100V and 200V driver, use L1 and L3. 5)Replace the driver with a new one.
*** Over-current protection**	**14**	Current through the converter portion has exceeded the specified value. 1)Failure of servo driver (failure of the circuit, IGBT or other components) 2)Short of the motor wire (U, V and W) 3)Earth fault of the motor wire 4)Burnout of the motor 5)Poor contact of the motor wire. 6)Melting of the relays for dynamic brake due to frequent Servo-ON/OFF operation 7)The motor is not applicable to the driver. 8)Timing of pulse input is same as or earlier than Servo-ON. 9)Overheating of the dynamic brake circuit (F-frame only)	1)Turn to Servo-ON, while disconnecting the motor. If error occurs immediately, replace with a new driver. 2)Check that the motor wire (U, V and W) is not shorted, and check the branched out wire out of the connector. Make a correct wiring connection. 3)Measure the insulation resistance between motor wires, U, V and W and earth wire. In case of poor insulation, replace the motor. 4)Check the balance of resister between each motor line, and if unbalance is found, replace the motor. 5)Check the loose connectors. If they are, or pulled out, fix them securely. 6)Replace the driver. Prohibit the run/stop operation with Servo-ON/OFF. 7)Check the name plate and capacity of the motor and driver, and replace with motor applicable to the driver. 8)Enter the pulses 100ms or longer after Servo-ON. 9)Discontinue the run/stop operation with Servo ON-OFF. Allow approx. 3 minutes pause when the dynamic brake is activated during high-speed running.
*** Over-heat protection**	**15**	Temperature of the heat sink or power device has been risen over the specified temperature. 1)Ambient temperature has risen over the specified temperature. 2)Over-load	1)Improve the ambient temperature and cooling condition. 2)Increase the capacity of the driver and motor. Set up longer acceleration/deceleration time. Lower the load.

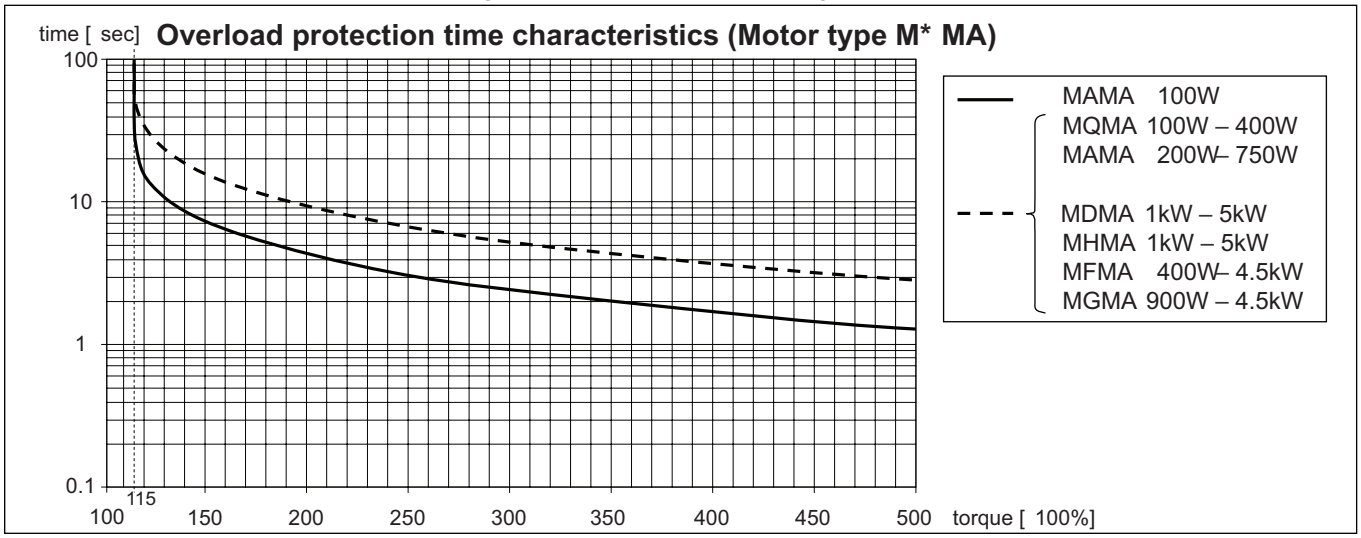
Protective function	Error code No.	Causes	Measures
Over-load protection	**16**	Torque command value has exceeded the over-load level set with Pr72 (Setup of over-load level) and resulted in overload protection according to the time characteristics (described later) 1)Load was heavy and actual torque has exceeded the rated torque and kept running for a long time. 2)Oscillation and hunching action due to poor adjustment. Motor vibration, abnormal noise. Inertia ratio (Pr20) setup error. 3)Miswiring, disconnection of the motor. 4)Machine has collided or the load has gotten heavy. Machine has been distorted. 5)Electromagnetic brake has been kept engaged. 6)While wiring multiple axes, miswiring has occurred by connecting the motor cable to other axis. 7)Pr72 setup has been low.	Check that the torque (current) does not oscillates nor fluctuate up an down very much on the graphic screen of the PANATERM®. Check the over-load alarm display and load factor with the PANATERM®. 1)Increase the capacity of the driver and motor. Set up longer acceleration/deceleration time. Lower the load. 2)Make a re-adjustment. 3)Make a wiring as per the wiring diagram. Replace the cables. Connect the black (W phase), white (V phase) and red (U phase) cables in sequence from the bottom at the CN X2 connector. 4)Remove the cause of distortion. Lower the load. 5)Measure the voltage between brake terminals. Release the brake 6)Make a correct wiring by matching the correct motor and encoder wires. 7)Set up Pr72 to 0. (Set up to max. value of 115% of the driver)
*** Over-regeneration load protection**	**18**	Regenerative energy has exceeded the capacity of regenerative resistor. 1)Due to the regenerative energy during deceleration caused by a large load inertia, converter voltage has risen, and the voltage is risen further due to the lack of capacity of absorbing this energy of the regeneration discharge resistor. 2)Regenerative energy has not been absorbed in the specified time due to a high motor rotational speed. 3)Active limit of the external regenerative resistor has been limited to 10% duty.	Check the load factor of the regenerative resistor on the monitor screen of the PANATERM®. Do not use in the continuous regenerative brake application. 1)Check the running pattern (velocity monitor). Check the load factor of the regenerative resistor and over-regeneration warning display. Increase the capacity of the driver and the motor, and loosen the deceleration time. Use the external regenerative resistor. 2)Check the running pattern (speed monitor). Check the load factor of the regenerative resistor. Increase the capacity of the driver and the motor, and loosen the deceleration time. Lower the motor rotational speed. Use an external regenerative resistor. 3)Set up Pr6C to 2.
		<Remarks> Install an external protection such as thermal fuse without fail when you set up Pr6C to 2. Otherwise, regenerative resistor loses the protection and it may be heated up extremely and may burn out.	
*** Encoder communi-cation error protection**	**21**	Communication between the encoder and the driver has been interrupted in certain times, and disconnection detecting function has been triggered.	• Make a wiring connection of the encoder as per the wiring diagram. Correct the miswiring of the connector pins. Note that the encoder cable to be connected to CN X6. • Secure the power supply for the encoder of DC5V±5% (4.75-5.25V)...pay an attention especially when the encoder cables are long. • Separate the encoder cable and the motor cable if they are bound together. • Connect the shield to FG...Refer to P.38, "Wiring to the Connector, CN X6" of Preparation.
*** Encoder communi-cation data error protection**	**23**	Communication error has occurred in data from the encoder. Mainly data error due to noise. Encoder cables are connected, but communication data has some errors.	
Position deviation excess protection	**24**	Deviation pulses have exceeded the setup of Pr70 (Setup of position deviation excess). 1)The motor movement has not followed the command. 2)Setup value of Pr70 (Setup of position deviation excess) is small.	1)Check that the motor follows to the position command pulses. Check that the output toque has not saturated in torque monitor. Make a gain adjustment. Set up maximum value to Pr5E (Setup of 1st torque limit) and Pr5F (2nd torque limit setup). Make a encoder wiring as per the wiring diagram. Set up the longer acceleration/deceleration time. Lower the load and speed. 2)Set up a larger value to Pr70, or set up 0 (invalid).

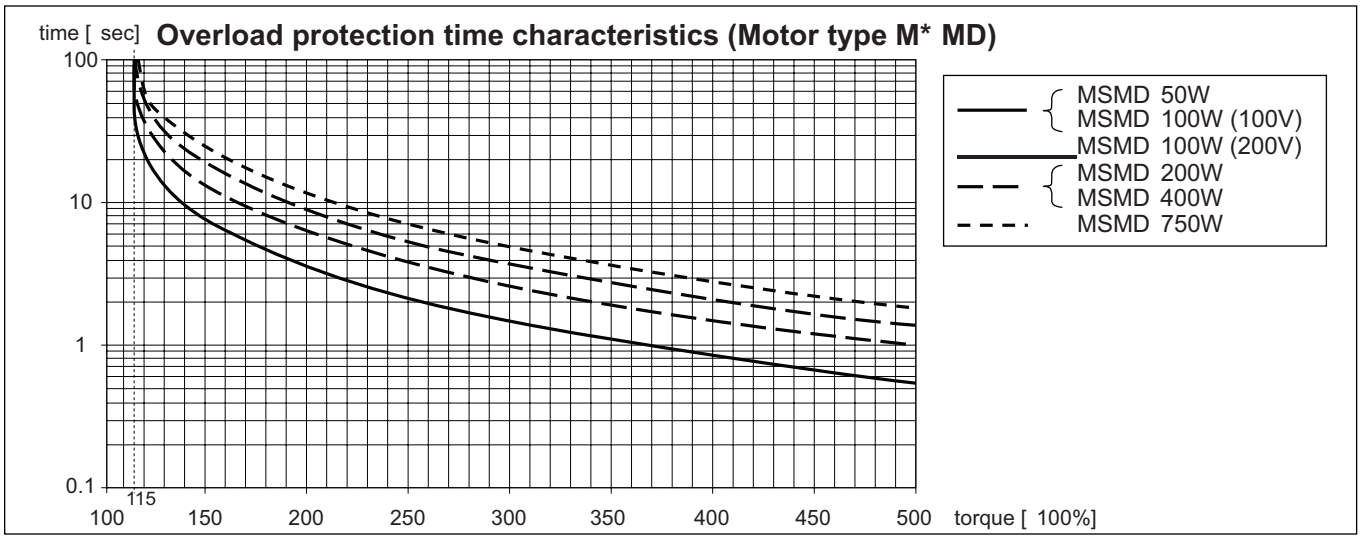
Protective function	Error code No.	Causes	Measures
*** Hybrid deviation excess error protection**	**25**	Position of load by the external scale and position of the motor by the encoder slips larger than the setup pulses with Pr7B (Setup of hybrid deviation excess) at full-closed control.	• Check the connection between the motor and the load. • Check the connection between the external scale and the driver. • Check that the variation of the motor position (encoder feedback value) and the load position (external scale feedback value) is the same sign when you move the load. Check that the numerator and denominator of the external scale division (Pr78, 79 and 7A) and reversal of external scale direction (Pr7C) are correctly set.
Over-speed protection	**26**	The motor rotational speed has exceeded the setup value of Pr73 (Over-speed level setup)	• Do not give an excessive speed command. • Check the command pulse input frequency and division/multiplication ratio. • Make a gain adjustment when an overshoot has occurred due to a poor gain adjustment. • Make a wiring connection of the encoder as per the wiring diagram. • Set up Pr73 to 0 (Set up to motor max. speed x 1.2.)
Electronic gear error protection	**27**	Division and multiplication ratio which are set up with the 1st and the 2nd numerator/denominator of the electronic gear (Pr48 to 4B) are not appropriate.	• Check the setup values of Pr48 to 4B. • Set up the division/multiplication ratio so that the command pulse frequency after division. multiplication may become less than 80Mpps at deviation counter input portion, and 3Mpps at command input portion.
*** External scale communication data error protection**	**28**	Communication error has occurred in data from the encoder. Mainly data error due to noise. Encoder cables are connected, but communication date has some error.	• Secure the power supply for the encoder of DC5±5% (4.75-5.25V)...pay attention especially when the encoder cables are long. • Separate the encoder cable and the motor cable if they are bound together. • Connect the shield to FG...refer to wiring diagram.
Deviation counter overflow protection	**29**	Deviation counter value has exceeded 2^{27} (134217728).	• Check that the motor runs as per the position command pulses. • Check that the output toque has not saturated in torque monitor. • Make a gain adjustment. • Set up maximum value to Pr5E (1st torque limit setup) and Pr5F (2nd torque limit setup). • Make a wiring connection of the encoder as per the wiring diagram.
Software limit protection	**34**	The motor position has exceeded the range set with software limit. 1)Gain has not matched up. 2)Setup value of Pr26 (Software limit setup) is small.	Refer to P.258,"Software Limit Function" before using this. 1)Check the gain (balance of position loop gain and velocity loop gain) and the inertia ratio. 2)Setup a larger value to Pr26.
*** External scale communication error protection**	**35**	Communication between the external scale and the driver has been interrupted in certain times, and disconnection detecting function has been triggered.	• Make a wiring connection of the external scale as per the wiring diagram. • Correct the miswiring of the connector pins.
*** EEPROM parameter error protection**	**36**	Data in parameter storage area has been damaged when reading the data from EEPROM at power-on.	• Set up all parameters again. • If the error persists, replace the driver (it may be a failure.) Return the product to the dealer or manufacturer.
*** EEPROM check code error protection**	**37**	Data for writing confirmation to EEPROM has been damaged when reading the data from EEPROM at power-on.	Replace the driver. (it may be a failure). Return the product to a dealer or manufacturer.
Over-travel inhibit input protection	**38**	Connection of both CW and CCW over-travel inhibit input (CWL, Pin-8/CCW, Pin-9) to COM- have been opened, while Pr04 (Over-travel inhibit input setup) is 0. Or either one of the connection of CW or CCW over-travel inhibit input to COM- has been opened, while Pr04 is set to 2.	• Check that there are not any errors in switches, wires or power supply which are connected to CW/CCW over-travel inhibit input. Check that the rising time of the control power supply (DC12-24V) is not slow.

Protective function	Error code No.	Causes	Measures
Analog input excess protection	**39**	Higher voltage has been applied to the analog command input (SPR : CN X5, Pin-14) than the value that has been set by Pr71 (Analog input excess setup) This protective function is validated when SPR/TRQR/ SPL is valid such cases as, 1)Velocity control when Pr02 (Control mode setup) is set to 1, 3 or 5 and Pr05 (Velocity setup internal/external switching) is set to 0 or 2, and when analog velocity command is selected and speed zero clamp is invalidated. (velocity command is not zero). 2)Torque control when Pr02 (Control mode setup) is set to 2 or 4 and Pr5B (Torque command selection) is set to 0. 3)Torque control when Pr02 (Control mode setup) is set to 2, 4 or 5 and Pr5B (Torque command selection) is set to 1, and speed zero clamp is invalidated (Velocity command is not zero.)	• Set up Pr71 (Setup of analog input excess) correctly. Check the connecting condition of the connector, CN X5. • Set up a larger value to Pr57 (Filter setup of Velocity command). • Set up Pr71 to 0 and invalidate the protective function.
Absolute system down error protection	**40**	Voltage of the built-in capacitor has fallen below the specified value because the power supply or battery for the 17-bit absolute encoder has been down.	After connecting the power supply for the battery, clear the absolute encoder. (Refer to P.271, "Setup (Initialization) of Absolute Encoder" of Supplement.) You cannot clear the alarm unless you clear the absolute encoder.
*** Absolute counter over error protection**	**41**	Multi-turn counter of the 17-bit absolute encoder has exceeded the specified value.	• Set up an appropriate value to Pr0B (Absolute encoder setup) . • Limit the travel from the machine origin within 32767 revolutions.
Absolute over-speed error protection	**42**	The motor speed has exceeded the specified value when only the supply from the battery has been supplied to 17-bit encoder during the power failure.	• Check the supply voltage at the encoder side (5V±5%) • Check the connecting condition of the connector, CN X6. • You cannot clear the alarm unless you clear the absolute encoder.
*** Absolute single turn counter error protection**	**44**	Single turn counter error of 17-bit absolute encoder has been detected. Single turn counter error of 2500[P/r] , 5-wire serial encoder has been detected.	Replace the motor.
*** Absolute multi-turn counter error protection**	**45**	Multi turn counter error of 17-bit absolute encoder has been detected. Multi turn counter error of 2500[P/r] , 5-wire serial encoder has been detected.	Replace the motor.
Absolute status error protection	**47**	17-bit absolute encoder has been running at faster speed than the specified value at power-on.	Arrange so as the motor does not run at power-on.
*** Encoder Z-phase error protection**	**48**	Missing pulse of Z-phase of 2500[P/r] , 5-wire serial encoder has been detected	The encoder might be a failure. Replace the motor.
*** Encoder CS signal error protection**	**49**	CS signal logic error of 2500[P/r] , 5-wire serial encoder has been detected	The encoder might be a failure. Replace the motor.

Protective function	Error code No.	Causes	Measures
*** External scale status 0 error protection**	**50**	Bit 0 of the external scale error code (ALMC) has been turned to 1. Check the specifications of the external scale.	Remove the causes of the error, then clear the external scale error from the front panel. And then, shut off the power to reset.
*** External scale status 1 error protection**	**51**	Bit 1 of the external scale error code (ALMC) has been turned to 1. Check the specifications of the external scale.	
*** External scale status 2 error protection**	**52**	Bit 2 of the external scale error code (ALMC) has been turned to 1. Check the specifications of the external scale.	
*** External scale status 3 error protection**	**53**	Bit 3 of the external scale error code (ALMC) has been turned to 1. Check the specifications of the external scale.	
*** External scale status 4 error protection**	**54**	Bit 4 of the external scale error code (ALMC) has been turned to 1. Check the specifications of the external scale.	
*** External scale status 5 error protection**	**55**	Bit 5 of the external scale error code (ALMC) has been turned to 1. Check the specifications of the external scale.	
CCWTL input excess protection	**65**	Higher voltage than ±10V has been applied to the analog command input (CCWTL : CN X5, Pin-16) This protective function is validated when CCWTL is valid such cases as, 1) Torque control when Pr02 (Control mode setup) is 5, or Pr02 is2 or 4 and when Pr5B (Torque command selection) is 1. 2) Position control, Velocity control and Full-closed control when Pr03 (Torque limit selection) is 0.	• Check the connecting condition of connector, CN X5. • Set the CCWTL voltage within ±10V.
CWTL input excess protection	**66**	Higher voltage than ±10V has been applied to the analog command input (CCWTL : CN X5, Pin-18) This protective function is validated when CCWTL is valid such case as, 1) Position control, Velocity control and Full-closed control when Pr03 (Torque limit selection) is 0.	• Check the connecting condition of connector, CN X5. • Set the CWTL voltage within ±10V.
*** Motor automatic recognition error protection**	**95**	The motor and the driver has not been matched.	Replace the motor which matches to the driver.
*** Other error**	**Other No.**	Control circuit has malfunctioned due to excess noise or other causes. Some error has occurred inside of the driver while triggering self-diagnosis function of the driver.	• Turn off the power once, then re-enter. • If error repeats, this might be a failure. Stop using the products, and replace the motor and the driver. Return the products to the dealer or manufacturer.

• Time characteristics of Err16 (Overload protection)





• Software Limit Function

1) Outline

You can make an alarm stop of the motor with software limit protection (Error code No.34) when the motor travels exceeding the movable range which is set up with Pr26 (Set up of software limit) against the position command input range.

You can prevent the work from colliding to the machine end caused by motor oscillation.

2) Applicable range

This function works under the following conditions.

	Conditions under which the software limit works
Control mode	• Either at position control mode or full-closed control mode Pr02 = 0 : Position control Pr02 = 3 : 1st control mode of Position control/Velocity control Pr02 = 4 : 1st control mode of Position control/torque control Pr02 = 6 : Full-closed control
Others	(1) at Servo-ON (2) when Pr26 (Software limit setup) is other than 0. (3) After the last clearance of the position command input range (0 clearance), the movable range of the motor is within 2147483647 for both CCW and CW direction. Once the motor gets out of the (3) condition, the software limit protection will be invalidated until the later mentioned "5) Condition under which the position command input range is cleared" is satisfied. The position command input range will be 0-cleared when the motor gets out of the conditions of (1) and (2).

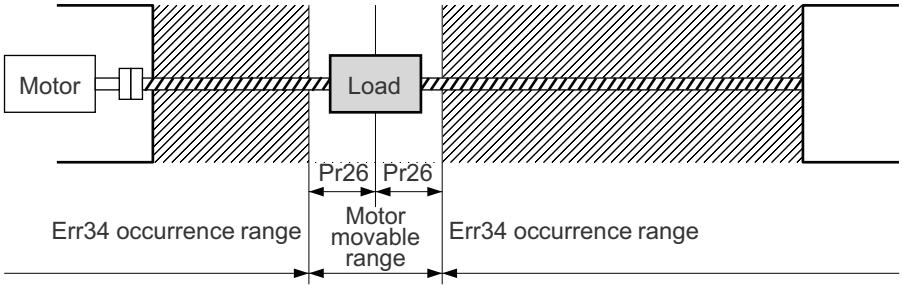
3) Cautions

- This function is not a protection against the abnormal position command.
- When this software limit protection is activated, the motor decelerates and stops according to Pr68 (Sequence at alarm).
  The work (load) may collide to the machine end and be damaged depending on the load during this deceleration, hence set up the range of Pr26 including the deceleration movement.
- This software limit protection will be invalidated during the trial run and frequency characteristics functioning of the PANATERM®.

4) Example of movement

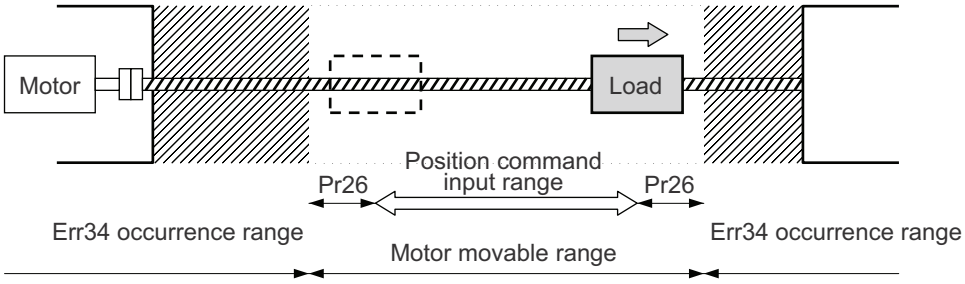
(1) When no position command is entered (Servo-ON status),

The motor movable range will be the travel range which is set at both sides of the motor with Pr26 since no position command is entered. When the load enters to the Err34 occurrence range (oblique line range), software limit protection will be activated.



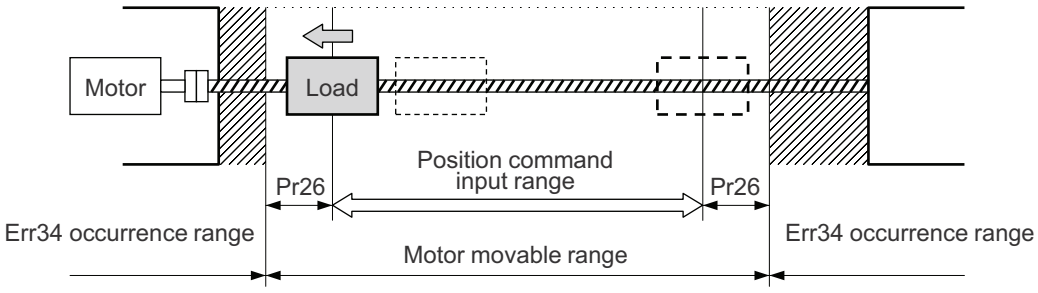
(2) When the load moves to the right (at Servo-ON),

When the position command to the right direction is entered, the motor movable range will be expanded by entered position command, and the movable range will be the position command input range + Pr26 setups in both sides.



(3) When the load moves to the left (at Servo-ON),

When the position command to the left direction, the motor movable range will be expanded further.



5) Condition under which the position command input range is cleared

The position command input range will be 0-cleared under the following conditions.

- when the power is turned on.
- while the position deviation is being cleared (Deviation counter clear is valid, Pr66 (Sequence at over-travel inhibition) is 2 and over-travel inhibition input is valid.)
- At the starting and the finishing of the normal auto-gain tuning.

Motor Does Not Run

When the motor does not run, refer to P.68, "Display of Factor of No-Motor Running" of Preparation as well.

Classification	Causes		Measures
Parameter	Setup of the control mode is not correct	Check that the present control mode is correct with monitor mode of the front panel.	1)Set up Pr02 (Setup of control mode) again. 2)Check that the input to control mode switching (C-MODE) of the CN X5 is correct, when Pr03 is set to 3-5.
	Selection of torque limit is not correct	Check that the external analog input (CWTL/CCWTL) is not used for the torque limit.	1)Set up Pr03 (Selection of torque limit) to 0 and apply -9 [V] to CWTL and +9 [V] to CCWTL when you use the external input. 2)Set up Pr03 (Selection of torque limit) to 1 and set up the max. value to Pr5E (Setup of 1st torque limit) when you use the parameter value.
	Setup of electronic gear is not correct. (Position/Full-closed)	Check that the motor moves by expected revolution against the command pulses.	1)Check the setups of Pr48-4B again. 2)Connect the electronic gear switching input (DIV) of CN X5 to COM–, or invalidate the division/multiplication switching by setting up the same value to Pr48 and Pr49.
Wiring	Servo-ON input of CN X5 (SRV-ON) is open.	Check that the input signal No.0 or No.03 does not show "-", with monitor mode of the front panel.	Check and make a wiring so as to connect the SRV-ON input to COM–.
	CW/CCW over-travel inhibit input of CN X5 (CWTL/CCWTL) is open.	Check that the input signal No.02 or No.03 does not show "A", with monitor mode of the front panel.	1)Check and make a wiring so as to connect both CWL and CCWL inputs to COM–. 2)Set up Pr04 (Setup of over-travel inhibit input) to 1 (invalid) and reset the power.
	Command pulse input setup is incorrect. (Position/Full-closed)	Check that the input pulse counts and variation of command pulse sum does not slips, with monitor mode of the front panel.	1)Check that the command pulses are entered correctly to the direction selected with Pr40 (Selection of command pulse input). 2)Check that the command pulses are entered correctly in the format selected with Pr42 (Setup of command pulse input mode).
	Command pulse input inhibition (INH) of CN X5 is open. (Position/Full-closed)	Check that the input signal No.08 does not show "A", with monitor mode of the front panel.	1)Check and make a wiring so as to connect the INH input to COM-. 2)Set up Pr43 (Invalidation of command pulse inhibition input) to 1 (invalid).
	Counter clear input (CL) of CN X5 is connected to COM–. (Position/Full-closed)	Check that the input signal No.0A does not show "A" , with monitor mode of the front panel.	1)Check and make wiring so as to open the CL input 2)Set up Pr4E (Counter clear input mode) to 2 (invalid).
	Speed command is invalid (Velocity)	Check that the velocity command input method (external analog command/internal velocity command) is correct.	1)Check the setups of Pr50-52 again by setting up Pr05 (Internal or external switching of speed setup) to 0, when you use the external analog command. 2)Set up Pr53-56 and Pr74-77 by setting up Pr05 (Internal or external switching of speed setup) to either one of 1, 2 or 3, when you use the internal speed command.
	Speed zero clamp input (ZEROSPD) of CN X5 is open. (Velocity/Torque)	Check that the input signal No.05 does not show "A" , with monitor mode of the front panel.	1)Check and make wiring so as to connect speed zero clamp input to COM–. 2)Set up Pr06 (Selection of ZEROSPD input) to 0 (invalid).
	Torque command is invalid (Torque)	Check that the torque command input method (SPR/TRQR input, CCWTL/TRQR input) is correct.	1)Check that the input voltage is applied correctly by setting up Pr5B (Selection of torque command) to 0, when you use SPR/TRQR input. 2)Check that the input voltage is applied correctly by setting up Pr5B (Selection of torque command) to 1, when you use the CCWTL/CWTL input.
	Velocity control is invalid (Torque)	Check that the velocity limit input method (internal velocity, SPR/TRQR/SPL input) is correct.	1)Set up the desired value to Pr56 (Speed setup/4th speed) by setting up Pr5B (Selection of torque command) to 0, when you use the internal speed. 2)Check that the input voltage is applied correctly by setting up Pr5B Selection of torque command) to 1, when you use the SPR/TRQR/SPL input.
Installation	Main power is shut off.	Check that the output signal No.0 does not show "-", with monitor mode of the front panel.	Check the wiring/voltage of main power of the driver (L1, L2 and L3).
	The motor shaft drags, the motor does not run.	1)Check that you can turn the motor shaft, after turning off the power and separate it from the machine. 2)Check that you can turn the motor shaft while applying DC24V to the brake in case of the motor with electromagnetic brake.	If you cannot turn the motor shaft, consult with the dealer for repair.

Unstable Rotation (Not Smooth)

Motor Runs Slowly Even with Speed Zero at Velocity Control Mode

Classification	Causes	Measures
Parameter	Setup of the control mode is not correct.	If you set up Pr02 to 1(Velocity control mode) by mistake at position control mode, the motor runs slowly at servo-ON due to speed command offset. Change the setup of Pr02 to 0.
Adjustment	Gain adjustment is not proper.	Increase the setup of Pr11, 1st velocity loop gain. Enter torque filter of Pr14 and increase the setup of Pr11 again.
	Velocity and position command are not stable.	Check the motor movement with check pin of the front panel or the waveform graphic function of the PANATERM®. Review the wiring, connector contact failure and controller.
Wiring	Each input signal of CN X5 is chattering. 1) Servo-ON signal	1)Check the wiring and connection between Pin29 and 41 of the connector, CN X5 using the display function of I/O signal status. Correct the wiring and connection so that the Servo-ON signal can be turned on normally. Review the controller.
	2) CW/CCW torque limit input signal	2)Check the wiring and connection between Pin-18 and 17, 16 and 17 of the connector, CN X5 using tester or oscilloscope. Correct the wiring and connection so that CW/CCW torque limit input can be entered normally.
	3) Deviation counter input signal	3)Check the wiring and connection between Pin-30 and 41, 16 and 17 of the connector, CN X5 using display function of I/O signal status. Correct the wiring and connection so that the deviation counter input can be turned on normally. Review the controller.
	4) Speed zero clamp signal	4)Check the wiring and connection between Pin-26 and 41of the connector, CN X5 using Display function of I/O signal status. Correct the wiring and connection so that the speed zero clamp input can be entered normally. Review the controller.
	5) Command pulse inhibition input	5)Check the wiring and connection between Pin-33 and 41of the connector, CN X5 using display function of I/O signal status. Correct the wiring and connection so that the command pulse inhibition input can be entered normally. Review the controller.
	Noise is on the velocity command.	Use a shield cable for connecting cable to the connector, CN X5. Separate the power line and signal line (30cm or longer) in the separate duct.
	Slip of offset	Check the voltage between Pin-14 and 15 (speed command input) using a tester or an oscilloscope. Adjust the Pr52 value so that the motor stops.

Positioning Accuracy Is Poor

Classification	Causes	Measures
System	Position command is not correct.	Count the feedback pulses with a monitor function of the PANATERM® or feedback pulse monitor mode of the console while repeating the movement of the same distance. If the value does not return to the same value, review the controller. Make a noise measure to command pulse.
	Captures the positioning complete signal at the edge.	Monitor the deviation at positioning complete signal reception with a check pin (IM) or the waveform graphic function of the PANATERM®. Make the controller capture the signal not at the edge but with some time allowance.
	Shape or width of the command pulse is not per the specifications.	If the shape of the command pulse is broken or narrowed, review the pulse generating circuit. Make a noise measure.
	Noise is superposed on deviation counter clear input CL (CN X5, Pin-5).	Make a noise measure to external DC power supply and make no wiring of the unused signal lines.
Adjustment	Position loop gain is small.	Check the position deviation with the monitor function of the PANATERM® or at the monitor mode of the console. Increase the setup of Pr10 within the range where no oscillation occurs.
Parameter	Setup of the positioning complete range is large.	Lower the setup of Pr60 within the range where no chattering of complete signal occurs.
	Command pulse frequency have exceeded 500kpps or 2Mpps.	Lower the command pulse frequency. Change the division/multiplication ratio of 1st and 2nd numerator of command division/multiplication, Pr48 and Pr4B. Use a pulse line interface exclusive to line driver when pulse line interface is used.
	Setup of the division/multiplication is not correct.	Check if the repetition accuracy is same or not. If it does not change, use a larger capacity motor and driver.
	Velocity loop gain is proportion action at motor in stall.	• Set up Pr12 and Pr1A of time constant of velocity loop integration to 999 or smaller. • Review the wiring and connection so that the connection between Pin-27 and 41 of the gain switching input connector, CN X5 becomes off while you set up Pr30 of 2nd gain setup, to 1.
Wiring	Each input signal of CN X5 is chattering. 1) Servo-ON signal	1)Check the wiring and connection between Pin29 and 41 of the connector, CN X5 using the display function of I/O signal status. Correct the wiring and connection so that the servo-On signal can be turned on normally. Review the controller.
	2) Deviation counter clear input signal	2)Check the wiring and connection between Pin-30 and 41, 16 and 17 of the connector, CN X5 using display function of I/O signal status. Correct the wiring and connection so that the deviation counter clear input can be turned on normally. Review the controller.
	3) CW/CCW torque limit input signal	3 Check the wiring and connection between Pin-18 and 17, 16 and 17 of the connector, CN X5 using tester or oscilloscope. Correct the wiring and connection so that CW/CCW torque limit input can be entered normally.
	4) Command pulse inhibition input	4)Check the wiring and connection between Pin-33 and 41of the connector, CN X5 using display function of I/O signal status. Correct the wiring and connection so that the command pulse inhibition input can be entered normally. Review the controller.
Installation	Load inertia is large.	Check the overshoot at stopping with graphic function of the PANATERM®. If no improvement is obtained, increase the driver and motor capacity.

Origin Point Slips

Classification	Causes	Measures
System	Z-phase is not detected.	Check that the Z-phase matches to the center of proximity dog. Execute the homing matching to the controller correctly.
	Homing creep speed is fast	Lower the homing speed at origin proximity. Or widen the origin sensor.
Wiring	Chattering of proximity sensor (proximity dog sensor) output	Check the dog sensor input signal of the controller with oscilloscope. Review the wiring near to proximity dog and make a noise measure or reduce noise.
	Noise is on the encoder line.	Reduce noise (installation of noise filter or ferrite core), shield treatment of I/F cables, use of a twisted pair or separation of power and signal lines.
	No Z-phase signal output	Check the Z-phase signal with oscilloscope. Check that the Pin-13 of the connector, CN X5 is connected to the earth of the controller. Connect the earth of the controller because the open collector interface is not insulated. Replace the motor and driver. Request for repair.
	Miswiring of Z-phase output	Check the wiring to see only one side of the line driver is connected or not. Use a CZ output (open collector if the controller is not differential input.

Abnormal Motor Noise or Vibration

Classification	Causes	Measures
Wiring	Noise is on the speed command.	Measure the speed command inputs of Pin-14 and 15 of the connector, CN X5 with an oscilloscope. Reduce noise (installation of noise filter or ferrite core), shield treatment of I/F cables, use of a twisted pair, separation of power and signal lines.
Adjustment	Gain setup is large.	Lower the gain by setting up lower values to Pr11 and 19, of velocity loop gain and Pr10 and 18 of position loop gain.
Installation	Velocity detection filter is changed.	Enlarge the setup of Pr13 and 1B, velocity detection filter within the range where noise level is acceptable, or return to default value.
	Resonance of the machine and the motor.	Re-adjust Pr14 and 1C (Torque filter). Check if the machine resonance exists or not with frequency characteristics analyzing function of the PANATERM®. Set up the notch frequency to Pr1D or Pr28 if resonance exists.
	Motor bearing	Check the noise and vibration near the bearing of the motor while running the motor with no load. Replace the motor to check. Request for repair.
	Electro-magnetic sound, gear noise, rubbing noise at brake engagement, hub noise or rubbing noise of encoder	Check the noise of the motor while running the motor with no load. Replace the motor to check. Request for repair.

Overshoot/Undershoot

Overheating of the Motor (Motor Burn-Out)

Classification	Causes	Measures
Adjustment	Gain adjustment is not proper.	Check with graphic function of PANATERM® or velocity monitor (SP) or torque monitor (IM). Make a correct gain adjustment. Refer to P.226 of Adjustment.
Installation	Load inertia is large.	Check with graphic function of PANATERM® or velocity monitor (SP) or torque monitor (IM). Make an appropriate adjustment. Increase the motor and driver capacity and lower the inertia ratio. Use a gear reducer.
	Looseness or slip of the machine	Review the mounting to the machine.
	Ambient temperature, environment	Lower the temperature with cooling fan if the ambient temperature exceeds the predications.
	Stall of cooling fan, dirt of fan ventilation duct	Check the cooling fans of the driver and the machine. Replace the driver fan or request for repair.
	Mismatching of the driver and the motor	Check the name plates of the driver and the motor. Select a correct combination of them referring to the instruction manual or catalogue.
	Failure of motor bearing	Check that the motor does not generate rumbling noise while turning it by hand after shutting off the power. Replace the motor and request for repair if the noise is heard.
	Electromagnetic brake is kept engaged (left un-released).	Check the voltage at brake terminals. Apply the power (DC24V) to release the brake.
	Motor failure (oil, water or others)	Avoid the installation place where the motor is subject to high temperature, humidity, oil, dust or iron particles.
	Motor has been turned by external force while dynamic brake has been engaged.	Check the running pattern, working condition and operating status, and inhibit the operation under the condition of the left.

Motor Speed Does Not Reach to the Setup

Motor Revolutions (Travel) Is Too Large or Small

Classification	Causes	Measures
Parameter	Velocity command input gain is not correct.	Check that the setup of Pr50, speed command input gain, is made so as to make the setup of 500 makes 3000 r/min.
Adjustment	Position loop gain is low.	Set up Pr10, position loop gain to approx. 100.
	Division/Multiplication is not proper.	Set up correct values to Pr48, 1st numerator of electronic gear, 4A, numerator multiplier of electronic gear and 4B, denominator of electronic gear. Refer to parameter setup at each mode.

Parameter Returns to Previous Setup

Classification	Causes	Measures
Parameter	No writing to EEPROM has been carried out before turning off the power.	Refer to P.70, "How to Operate-EEPROM Writing" of Preparation.

Display of "Communication port or driver cannot be detected" Appears on the Screen While Using the PANATERM®.

Classification	Causes	Measures
Wiring	Communication cable (for RS232C) is connected to the connector, CN X3.	Connect the communication cable (for RS232C) to connector, CN X4.