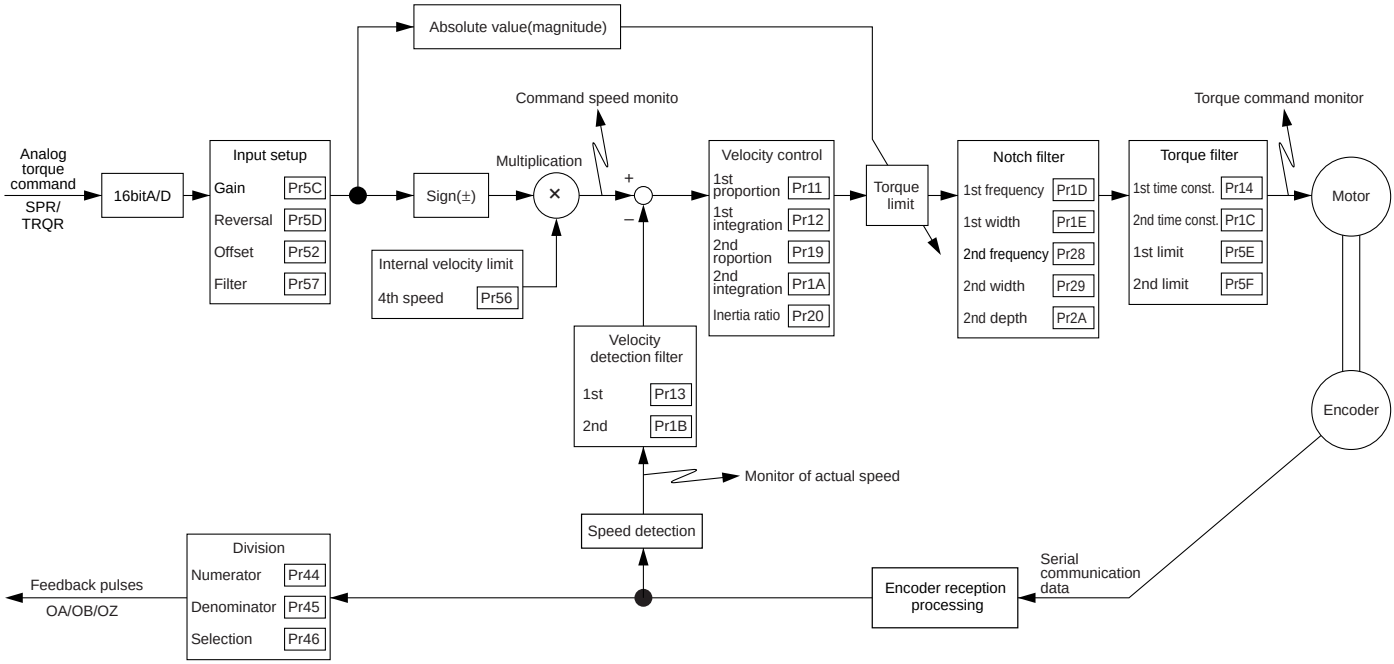
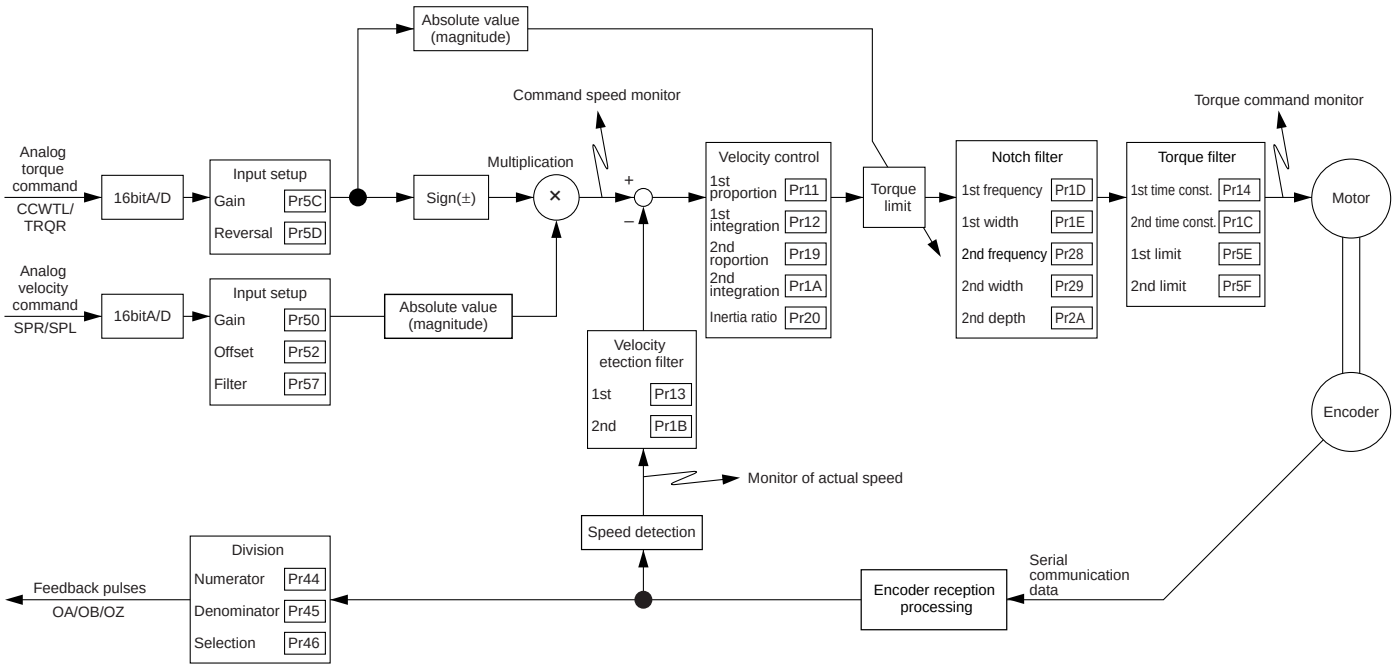
Control Block Diagram of Torque Control Mode

• when Pr5B (Torque command selection) is 0

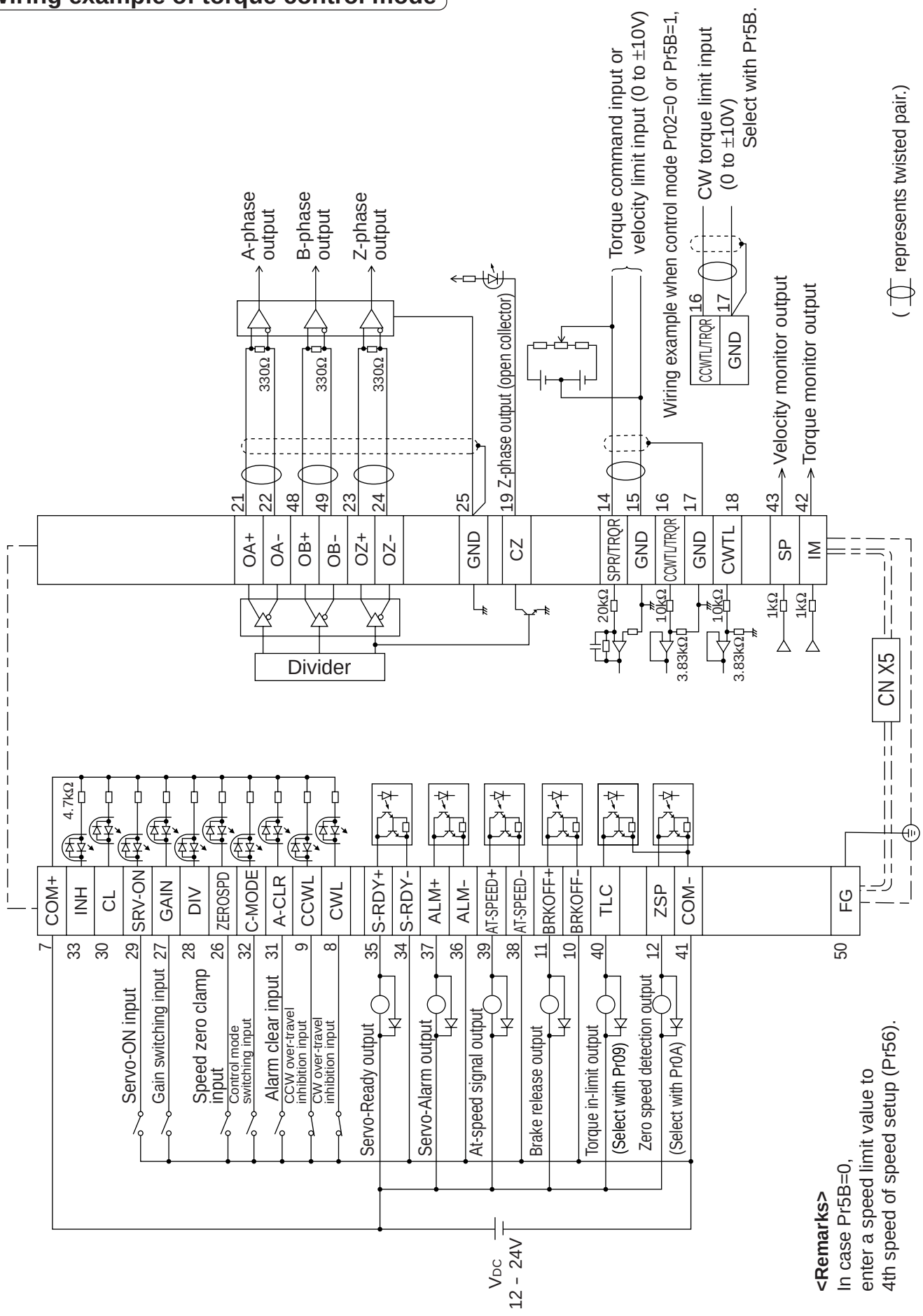


• when Pr5B (Torque command selection) is 1



Wiring Example to the Connector CN X5

Wiring example of torque control mode



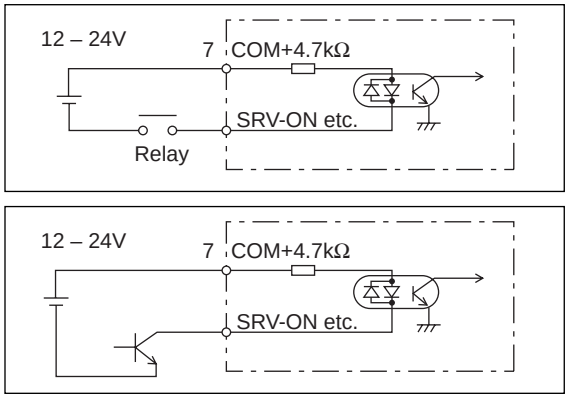
Wiring to the connector, CN X5

Interface Circuit

Input Circuit

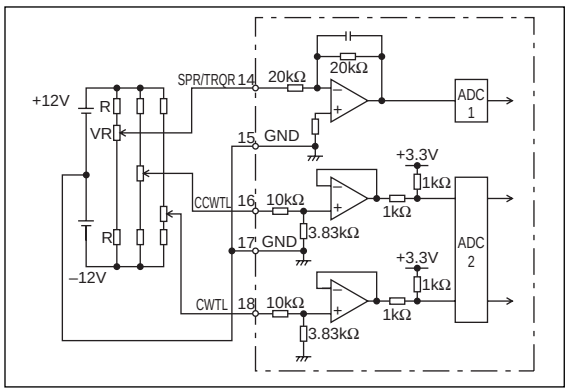
SI Connection to sequence input signals

- 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 – 24V) as 11.4V or more in order to secure the primary current for photo-couplers.



AI Analog command input

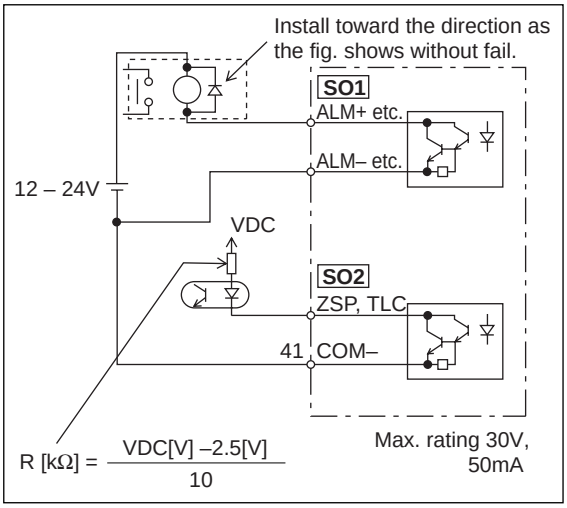
- The analog command input goes through 3 routes, SPR/TRQR(Pin-14), CCWTL (Pin-16) and CWTL (Pin-18).
- Max. permissible input voltage to each input is ±10V. For input impedance of each input, refer to the right Fig.
- When you compose a simple command circuit using variable resistor(VR) and register R, connect as the right Fig. shows. When the variable range of each input is made as –10V – +10V, use VR with 2kΩ, B-char acteristics, 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), ±10
  (2)ADC2 : 10 bit (CCWTL, CWTL), 0 – 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, VCE(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.

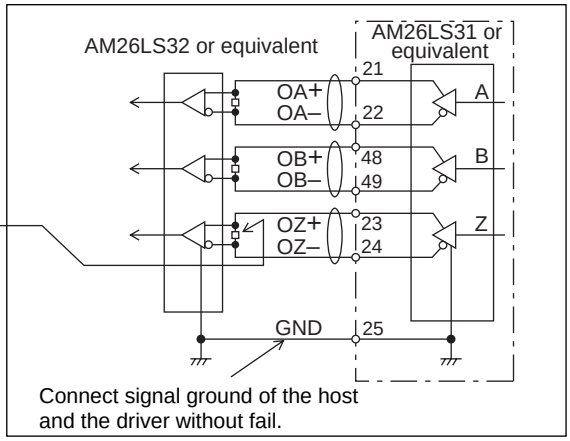


For the recommended primary current value, refer to the data sheet of apparatus or photo-coupler to be used.

SO1 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.

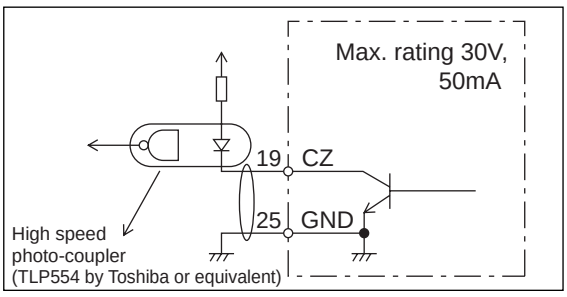
represents twisted pair.



SO2 Open collector output

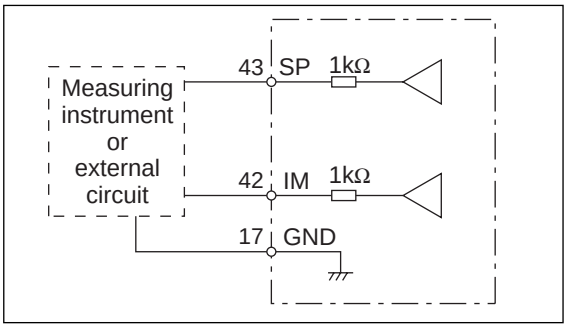
- Feeds out the Z-phase signal among the encoder signals in open collector. This output is not insulated.
- Receive this output with high-speed photo couplers at the host side, since the pulse width of the Z-phase signal is narrow.

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 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.162</td></tr>
</table>

<table>
<tr><th>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>Servo-ON 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 velocity 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 (▭ / ▭)

<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>Position/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.162</td></tr>
</table>

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

<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
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.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

	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.	

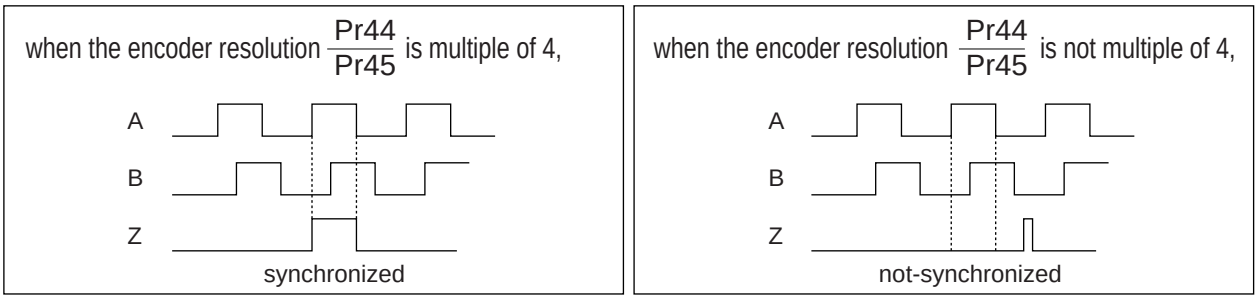
Output Signals (Pulse Train) and Their Functions

itle 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 drivder.	–
Frame ground	**50**	**FG**	• This output is connected to the earth terminal inside of the drivder.	–

Inspection Before Trial Run

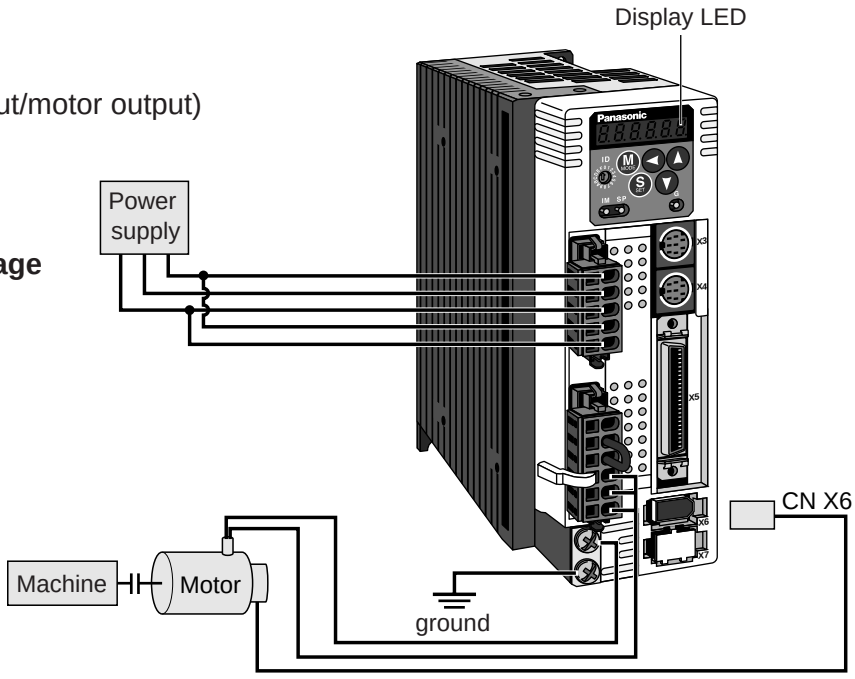
(1) Wiring inspection
- Miswiring
  (Especially power input/motor output)
- Short/Earth
- Loose connection

(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

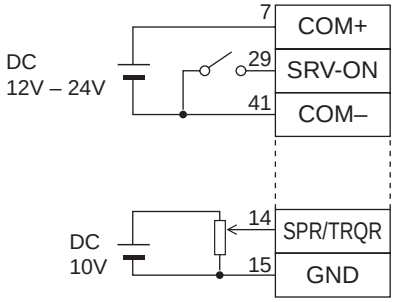
1) Connect the CN X5.
2) Enter the power (DC12-24V) to control signal (COM+, COM–)
3) Enter the power to the driver.
4) Confirm the default values of parameters.
5) Set a lower value to Pr56 (4th speed of speed setup).
6) Enrgize the motor by connecting the Servo-ON input (SRV-ON, CN X5, Pin-29) and 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 parametes.

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

Refer to P.183, "Parameter Setup-Paramteres 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	

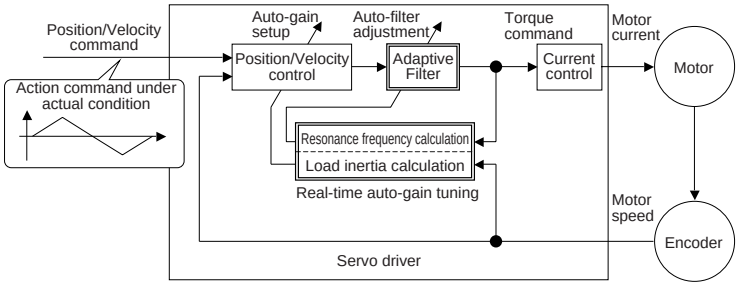
Input signal status

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 machine in real time, and automatically sets up the 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.

(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 X5 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).

Parameters Which Are Automatically Set Up.

Following parameters are automatically adjusted.

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

Also following parameters are automatically set up.

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 1-6, and becomes o 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 (Seleon 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 wtitten to EEPROM every 30 minutes. When you turn on the power again, auto-gain tuning will be exrcuted 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.

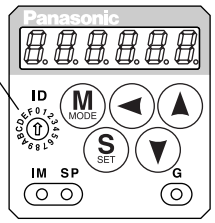
Parameter Setup

Parameters for Functional Selection

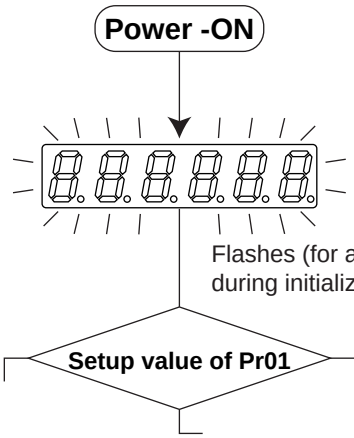
Standard default : < >

PrNo.	Title	Setup range	Function/Content
00 *	Address	0 – 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-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 – 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.



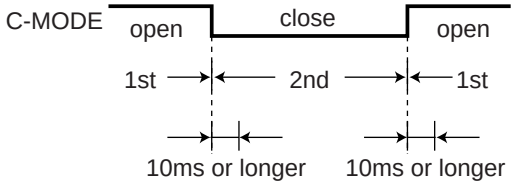
Setup value	Content
0	Positional deviation
<1>	Motor rotational speed
2	Torque output
3	Control mode
4	I/O signal status
5	Error factor/history
6	Software version
7	Alarm
8	Regenerative load factor
9	Over-load factor
10	Inertia ratio
11	Sum of feedback pulses
12	Sum of command pulses
13	External scale 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 – 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	–

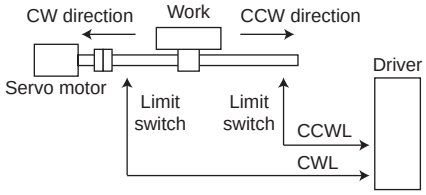
**1) When you set up the combination mode of 3, 4 or 5, you can select either the 1st or the 2nd with control mode switching input (C-MODE).
When C-MODE is open, the 1st mode will be selected.
When C-MODE is shorted, the 2nd mode will be selected.
Don't enter commands 10ms before/after switching.



<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 – 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>Connection to COM–</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 colspan="2">Invalid</td><td colspan="2">Both CCWL and CWL inputs will be ignored, and over-travel inhibit function will be invalidated.</td></tr>
<tr><td>2</td><td colspan="2">Valid</td><td colspan="2">Err38 (Over-travel inhibit input protection) is triggered when either one of the connection of CW or CCW inhibi</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 – 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>
<tr><td>07</td><td>Selection of speed monitor (SP)</td><td>0 – 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 – 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 – 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 – 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 – 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 – 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 – 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 – 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 – 3500 A–C-frame:<35>* D–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 – 1000 A–C-frame:<16>* D–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 – 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–C-frame:<65>* D–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 – 3500 A–C-frame:<35>* D–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 – 1000 <1000>*	ms	
1B	1st filter of speed detection	0 – 5 <0>*	–	
1C	2nd filter of velocity detection	0 – 2500 A–C-frame:<65>* D–F-frame:<126>*	0.01ms	
1D	2nd time constant of torque filter	100 – 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 frequency	0 – 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 – 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-tiem 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 Pr is smaller than the actual, the setup unit of the velocity loop gain becomes smaller.
21	Setup of real-time auto-gain tuning	0 – 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>	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

PrNo.	Title	Setup range	Unit	Function/Content
22	Selection of machine stiffness at real-time auto-gain tuning	0 – 15 A–C-frame: <4> D–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.

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 – 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 – 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 – 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 – 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 : < >

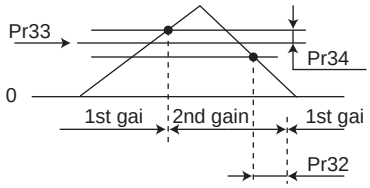
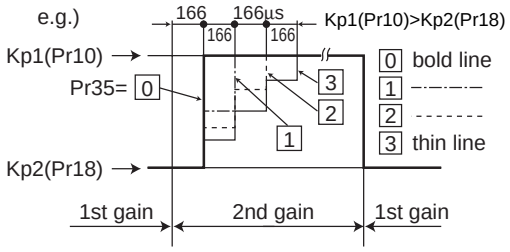
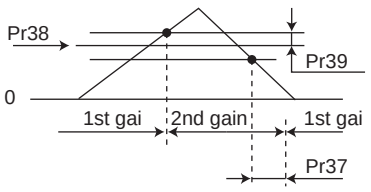
<table>
<tr><th>PrNo.</th><th>Title</th><th>Setup range</th><th>Unit</th><th>Function/Content</th></tr>
<tr><td>30</td><td>Setup of 2nd gain</td><td>0 – 1
<1>*</td><td>–</td><td>You can select the PI/P action switching of the velocity control or 1st/2nd gain switching.
<table>
<tr><th>Setup value</th><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 – 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>*, 4 – 10</td><td>Fixed to the 1st gain.</td></tr>
<tr><td>1</td><td>Fixed to 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.

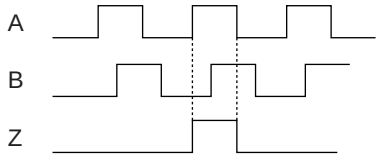
Parameter Setup

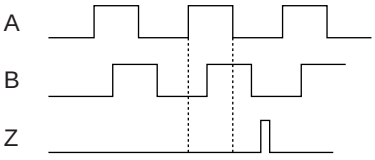
Standard default : < >

PrNo.	Title	Setup range	Unit	Function/Content
32	1st delay time of control switching	0 – 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 or 5-10.
33	1st level of control switching	0 – 20000 <50>*	–	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)
34	1st hysteresis of control switching	0 – 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 – 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 – 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 – 20000 <0>	–	You can set up the switching (judging) level of the 1st and the 2nd gains, while Pr36 is set to 3-5 Unit varies depending on the setup of Pr36 (2nd mode of control switching).
39	2nd hysteresis of control switching	0 – 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 – 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 – 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
 

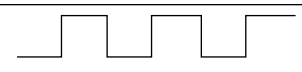
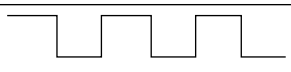
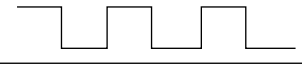
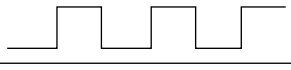
Synchronized
when encoder resolution x $\frac{\text{Pr44}}{\text{Pr45}}$ is not multiple of 4
 

Not-synchronized</td></tr>
<tr><td>45
*</td><td>Deniminator of pulse output division</td><td>0 – 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 : < >

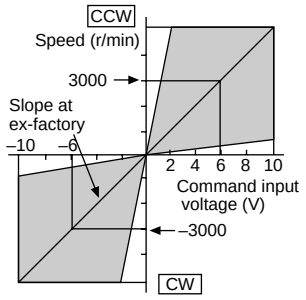
<table>
<tr><th>PrNo.</th><th>Title</th><th>Setup range</th><th>Function/Content</th></tr>
<tr><td>46
*</td><td>Reversal of pulse output logic</td><td>0 – 3
<0></td><td>You can set up the B-phase logic and the output source of the pulse output (X5 OB+ : Pin-48, OB– : Pin-49). With this parameter, you 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 onlt at full-closed control.</td></tr>
</table>

<Notes>

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

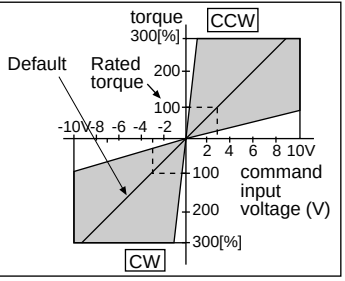
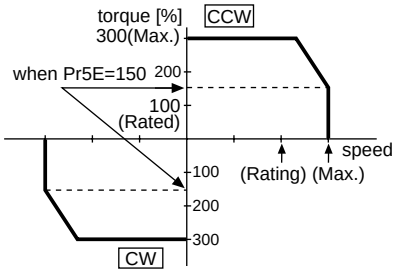
Parameters for Velocity and Torque Control

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 – 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>
<tr><td>52</td><td>Speed command offset</td><td>–2047 – 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>56</td><td>4th speed of speed setup</td><td>–20000 – 20000
<0></td><td>r/min</td><td>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).</td></tr>
<tr><td>57</td><td>Setup of speed command filter</td><td>0 – 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>
<tr><td>5B</td><td>Selection of torque command</td><td>0 – 1
<0></td><td>–</td><td>You can select the input of the torque command and the speed limit.
<table>
<tr><th>Pr5B</th><th>Torque command</th><th>Velocity limit</th></tr>
<tr><td><0></td><td>SPR/TRQR/SPL</td><td>Pr56</td></tr>
<tr><td>1</td><td>CCWTL/TRQR</td><td>SPR/TRQR/SPL</td></tr>
</table></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>5C</td><td>Input gain of torque command</td><td>10 – 100
<30></td><td>0.1V/ 100%</td><td>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%.
 
</td></tr>
<tr><td>5D</td><td>Input reversal of torque command</td><td>0 – 1
<0></td><td>0 – 1</td><td>You can reverse the polarity of the torque command input (SPR/TRQR : CN X5, Pin-14 or CCWTL/TRQR : CN X5, Pin-16)
<table><tr><th>Setup value</th><th>Direction of motor output torque</th></tr><tr><td><0></td><td>CCW direction (viewed from motor shaft) with (+) command</td></tr><tr><td>1</td><td>CW direction (viewed from motor shaft) with (+) command</td></tr></table></td></tr>
<tr><td>5E</td><td>1st torque limit setup</td><td>0 – 500
<500>
*2</td><td>%</td><td>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.
 

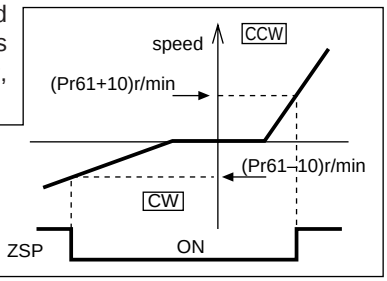
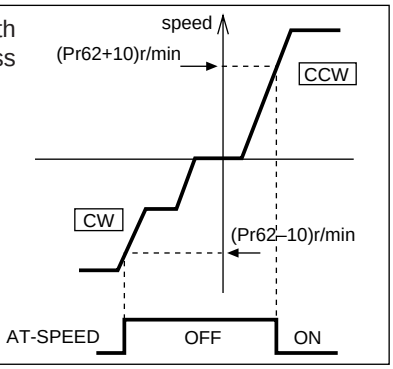
<Caution>
You cannot set up a larger value to this parameter than the default setup value of "Max. output torque setup" of System parameter (which you cannot change through operation with PANATERM® or panel). Default value varies depending on the combination of the motor and the driver. For details,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

<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 : < >

PrNo.	Title	Setup range	Unit	Function/Content
61	Zero-speed	10 – 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 – 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 – 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.

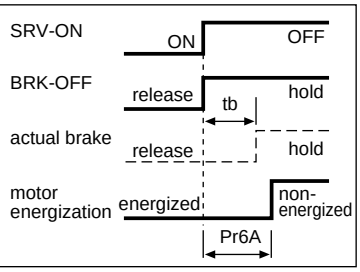
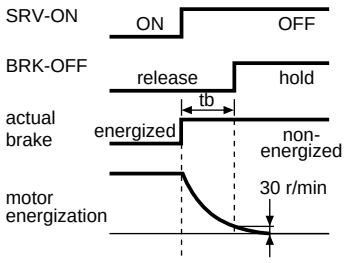
Standard default : < >

<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 – 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 – 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>D</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 – 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 – 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 stall	0 – 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 driver turns to Servo-OFF after 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 – 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.

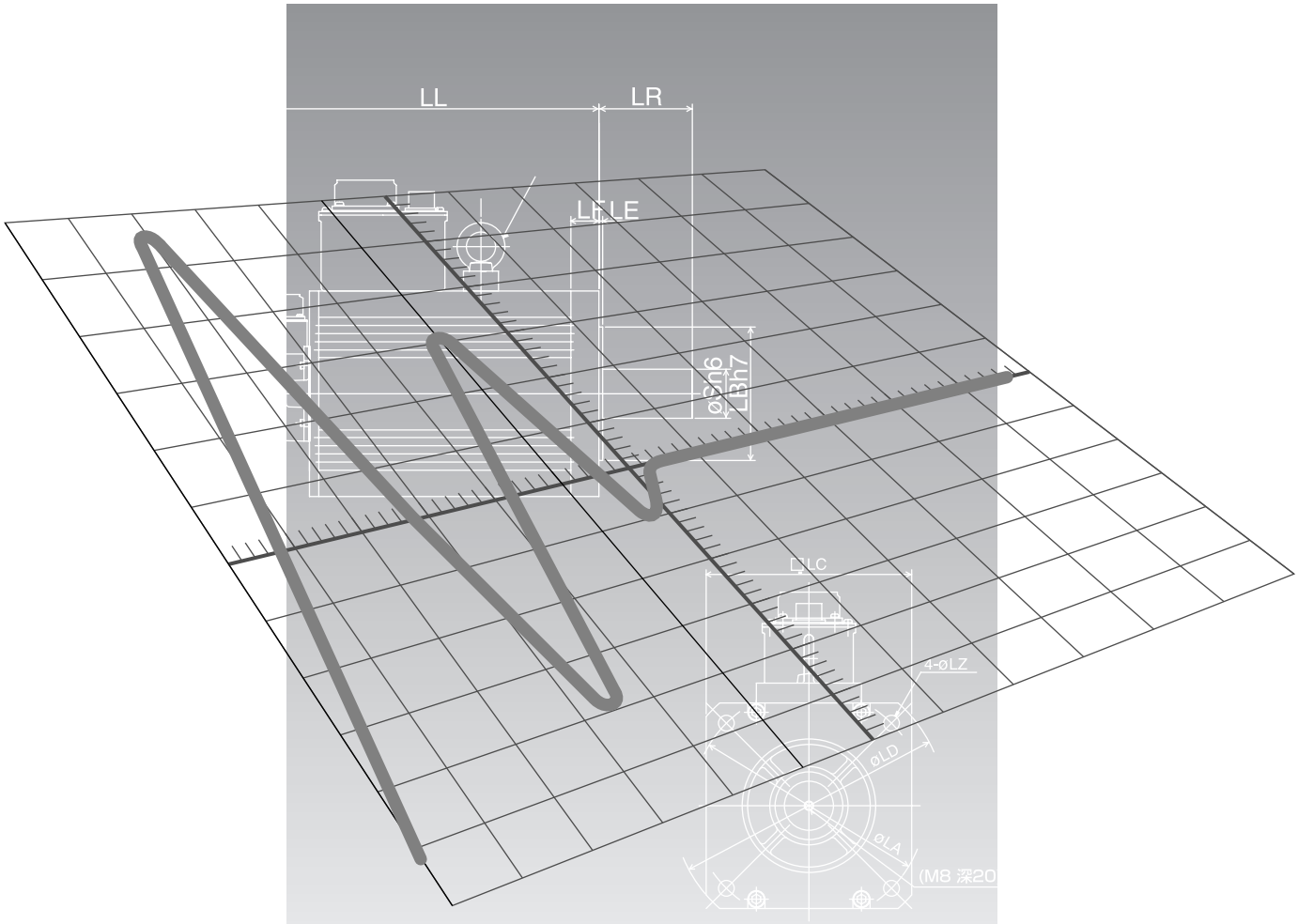
Parameter Setup

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 – 3
for
A, B-frame
<3>
for
B–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-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 ove-rload 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 – 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 – 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 – 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 – 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 – 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.



[Full-Closed Control Mode]