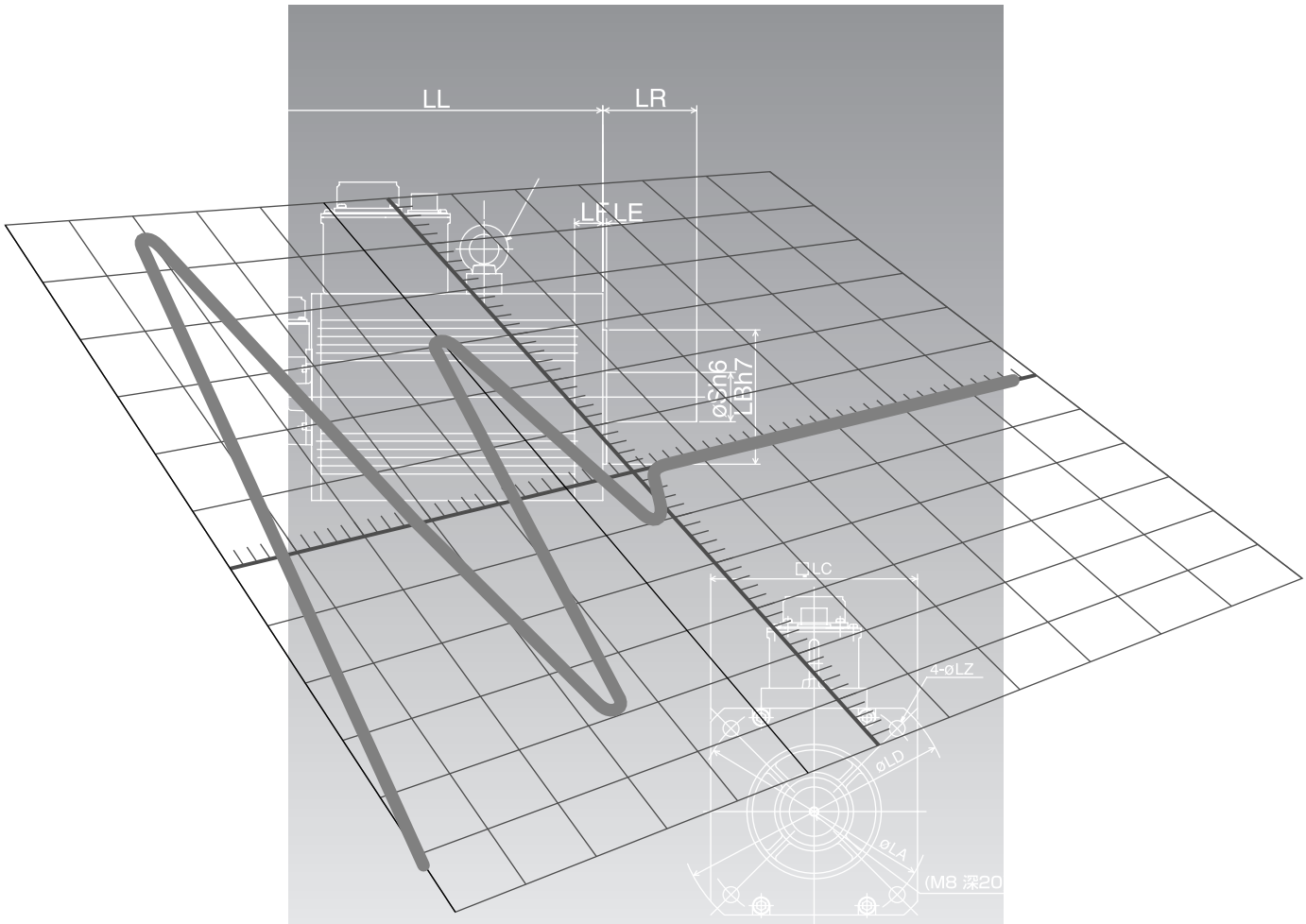
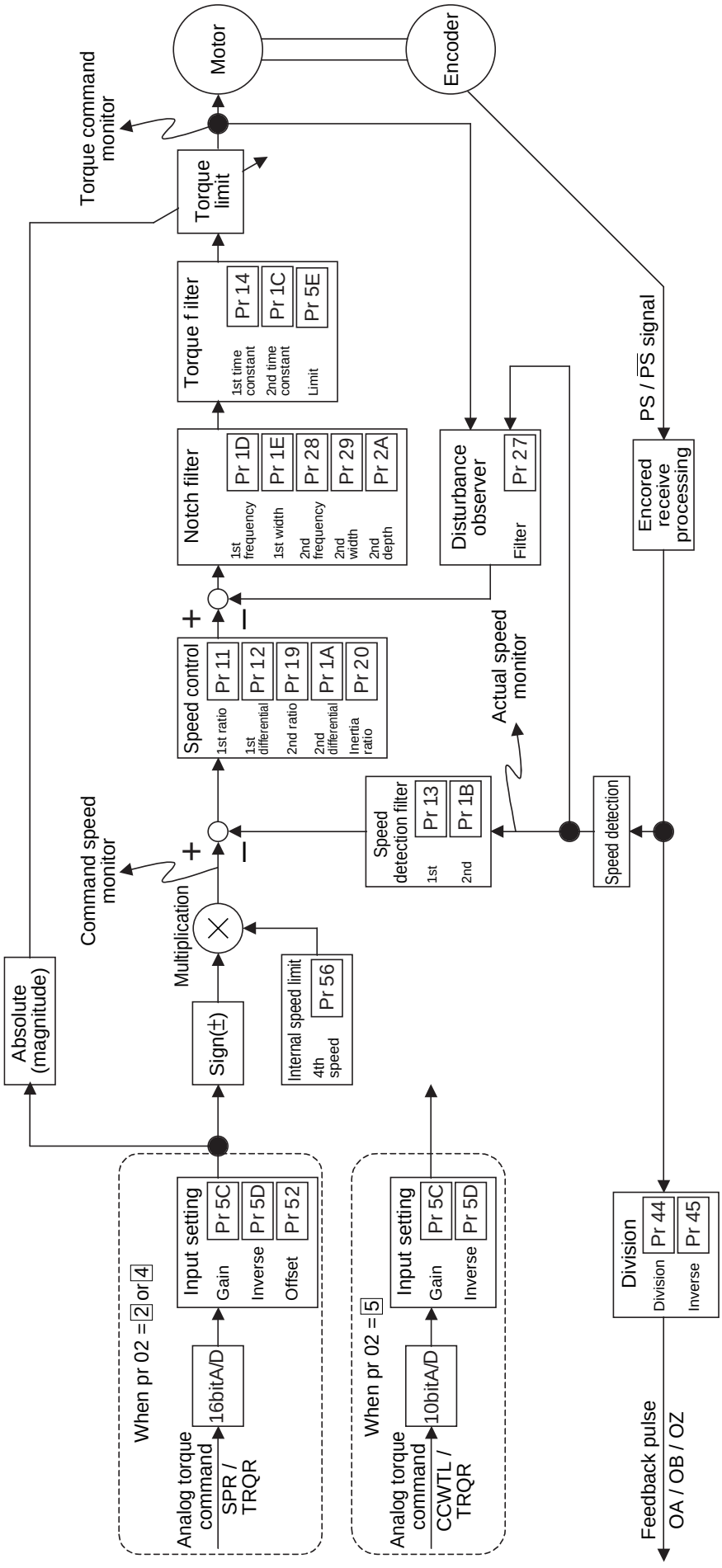


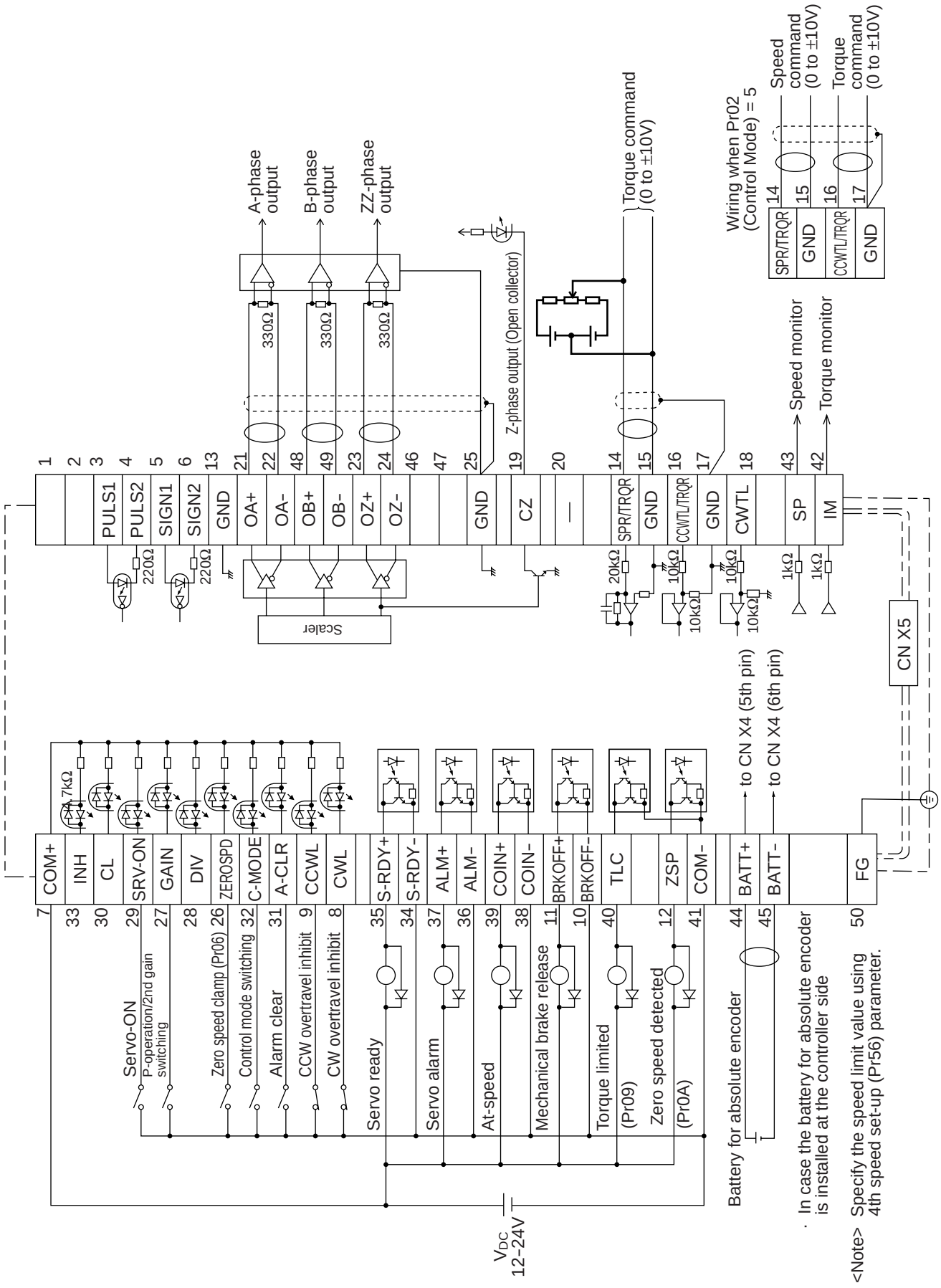
[Connections and Settings in Torque Control Mode]

Torque control block diagram



CN X5 Connector

Circuits Available for Torque control mode



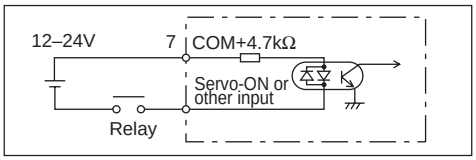
CN X5 Connector

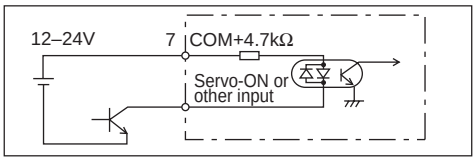
Interface Circuit

Input Circuit

SI SI Connecting to sequence input signals

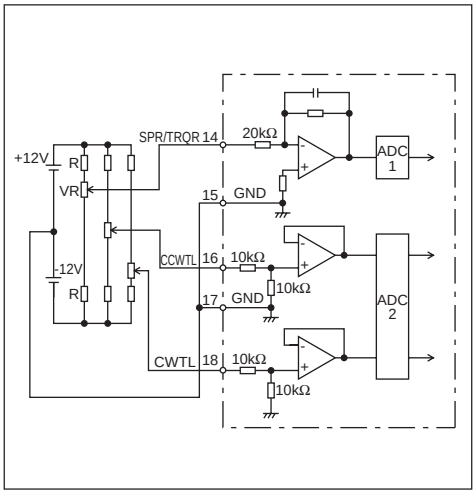
- Connect to a contact of switch and relay, or a transistor of an open collector output.
- Use a switch or relay for micro current so that insufficient contact can be avoided.
- Lower limit of the power supply (12 to 24V) should not be less than 11.4V in order to secure the appropriate level of primary current of the photo coupler.





AI AI Analogue Command Input

- There are three analogue command inputs of SPR/RTQR (14 pins), CCWTL (16 pins) and CWTL (18 pins).
- The maximum permissible input voltage is ±10V. For the input impedance of these inputs, see the right figure.
- If you make a simplified circuit comprising a variable resistor (VR) and resistor (R), refer to the right figure. When the variable range of each input is -10V to +10V, the VR should be a B type resistor of 2kΩ (min.1/2W). The R should be 200Ω (min.1/2W).
- The A/D converters for these inputs should have the following resolution.

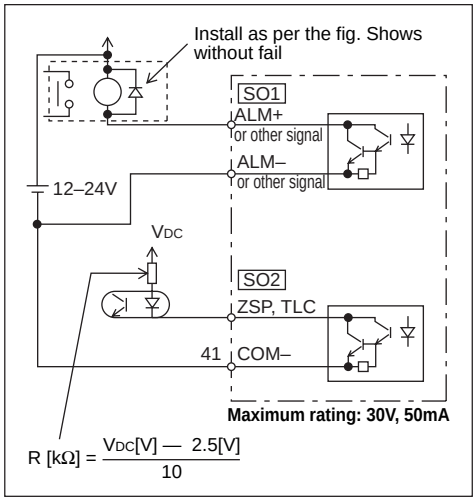


1) ADC1 (SPR and TRQR) : 16 bits (including one bit for sign)
2) ADC2 (CCWTL and CWTL) : 10 bits (including one bit for sign)

Output Circuit

SO1 SO2 Sequence output circuit

- This comprises a Darlington driver with an open collector. This is connected to a relay or photo coupler.
- There exists a collector-to-emitter voltage V_{CE}(SAT) of approx. 1V at transistor ON, because of Darlington connection of the out put transistor. Note that normal TTLIC can't be directly connected since this does not meet VIL requirement.
- This circuit has an independent emitter connection, or an emitter connection that is commonly used as the minus (–) terminal (COM–) of the control power.
- Calculate the value of R using the formula below so as the primary current of the photo coupler become approx. 10mA.

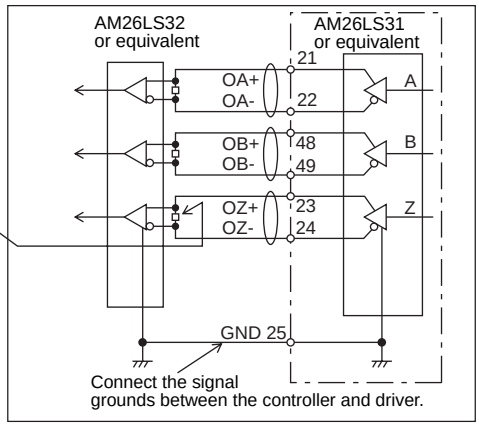


For the recommended primary current value, check the data sheet on the equipment and photo-coupler used.

PO1 Line Driver (Differential Output) Output

- Provides differential outputs of encoder signals (A, B and Z phases) that come from the scalar.
- Receive these signals with a line receivers. In this case, install a resistor of approx. 330Ω between the inputs.
- These outputs are non-insulated signals.

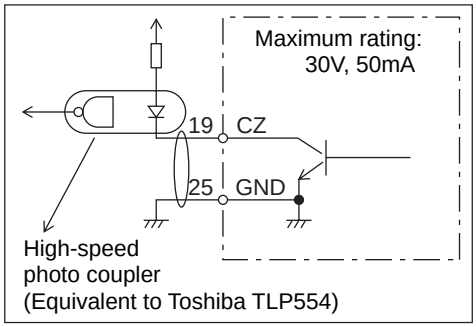
shows a pair of twisted wires.



PO2 Open Collector Output

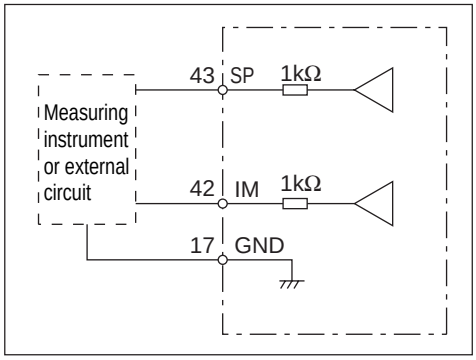
- Outputs Z-phase signals among those from the encoder. The outputs are non-insulated.
- Receive these signal with high-speed photo coupler at controller side, since these Z-phase signal width is normally narrow.

shows a pair of twisted wires.



AO Analogue Monitor Output

- This output is the speed monitor signal (SP) or torque monitor signal (IM).
- The signal range is approx. 0 to ± 9V.
- The output impedance is 1kΩ. Pay attention to the input impedance of your measuring instruments and external circuits connected.



<Resolution>

1) Speed monitor signal (SP): 8r/min./LSB calculated from 6V/3000r/min (Pr07 = 3)
2) Torque monitor signal (IM): 0.4%/LSB calculated from 3V/rated value (100%)

CN X5 Connector

Input signal (common) assignment to CN X5 connector pins

Input Signals (Common) and their Functions

<table>
<tr><th>Signal</th><th>Pin No.</th><th>Symbol</th><th>Function</th><th>I/F circuit</th></tr>
<tr><td>Control signal power (+)</td><td>7</td><td>COM +</td><td>• Connect to (+) of an external power supply (12VDC to 24VDC).
• Use source voltage of 12V±10% – 24V±10%.</td><td>–</td></tr>
<tr><td>Control signal power (–)</td><td>41</td><td>COM –</td><td>• Connect to (–) of an external power supply (12VDC to 24VDC).
• The required capacity depends on the I/O circuit configuration. 0.5A or larger is recommended.</td><td></td></tr>
<tr><td>Servo-ON</td><td>29</td><td>SRV-ON</td><td>• When this signal is connected to COM-, the dynamic brake will be released and the driver is enabled. (Servo-ON).
<Notes>
1. This signal becomes effective about two seconds after power on (see the Timing Chart).
2. Don't use this Servo-ON or Servo-OFF signal to turn on or off the motor. See page 46 "Dynamic Brake" in Preparations.
• Allow at least 50ms delay after the driver is enabled before any command input is entered.
• By opening the connection to COM– , the driver will be disabled(Servo-OFF) and the current flow to the motor will be inhibited.
• Operation of the dynamic brake and clearing action of the position error counter can be selected using Pr69 (Sequence under Servo-OFF).</td><td>SI page 134</td></tr>
<tr><td>Control mode switching</td><td>32</td><td>C-MODE</td><td>• When Pr02 (Control Mode Selection) = 3, 4 or 5, the control mode is selected per the table below.
<table>
<tr><th></th><th colspan="2">Connection with COM–</th></tr>
<tr><th>Pr02 value</th><th>open (1st)</th><th>closed (2nd)</th></tr>
<tr><td>3</td><td>Position control mode</td><td>Speed control mode</td></tr>
<tr><td>4</td><td>Position control mode</td><td>Torque control mode</td></tr>
<tr><td>5</td><td>Speed control mode</td><td>Torque control mode</td></tr>
</table></td><td>SI page 134</td></tr>
<tr><td>CW overtravel inhibit</td><td>8</td><td>CWL</td><td>• If COM– is opened when the movable part of the machine has moved to CW exceeding the limit, the motor does not generate torque.</td><td>SI page 134</td></tr>
<tr><td>CCW overtravel inhibit</td><td>9</td><td>CCWL</td><td>• If COM– is opened when the movable part of the machine has moved CCW exceeding the limit, the motor does not generate torque.
• If you set 1 to Pr04 (Overtravel input inhibited invalid), CWL/CCWL input will be disabled. A factory setting is Disable (1).
• With Pr66 (DB deactivate when driving is inhibited), you can activate dynamic brake when CWL/CCWL input is enabled. According to a factory setting, dynamic brake operates (Pr66 is set to 0).</td><td>SI page 134</td></tr>
<tr><td>Counter clear</td><td>30</td><td>CL</td><td>The function differs depending on the control mode.
<table>
<tr><td>Position control</td><td>• Clears the position error counter.
Connect to COM– to clear the counter.
• Use Pr4D to select the clear mode.
<table>
<tr><th>Pr4D value</th><th>Meaning</th></tr>
<tr><td>0(Factory-setting)</td><td>LEVEL</td></tr>
<tr><td>1</td><td>EDGE</td></tr>
</table></td></tr>
<tr><td>Speed control</td><td>• With speed setting of the 2nd selection input, you can set 4 speeds in combination with INH.
• For details, see Pr05 (Speed Set-Up Switching) description.</td></tr>
<tr><td>Torque control</td><td>• Invalid</td></tr>
</table></td><td>SI page 134</td></tr>
</table>

<table>
<tr><th>Signal</th><th>Pin No.</th><th>Symbol</th><th>Function</th><th>I/F circuit</th></tr>
<tr><td>Command pulse input inhibit</td><td>33</td><td>INH</td><td>The function differs depending on the control mode.
<table>
<tr><td>Position control</td><td>• Enter command pulse input inhibit.
• You can disable this input with Pr43 (disable command pulse input inhibit).
<table>
<tr><th>Pr43 value</th><th>Meaning</th></tr>
<tr><td>1(Factory-setting)</td><td>The INH signal (input) is disabled.</td></tr>
<tr><td>0</td><td>• With COM– closed, the pulse command signal (PULSE SIGN) is enabled.
• With COM– open, the pulse command signal (PULSE SIGN) is inhibited.</td></tr>
</table></td></tr>
<tr><td>Speed control</td><td>• With speed setting of the 1st selection input, you can set 4 speeds in combination with CL input.
• For details, see Pr05 (Speed Set-Up Switching) description.</td></tr>
<tr><td>Torque control</td><td>• Invalid</td></tr>
</table></td><td>SI page 134</td></tr>
<tr><td>Speed zero clamp</td><td>26</td><td>ZEROSPD</td><td>• With COM– open, the speed command is considered zero.
• This input can be made disabled using Pr06.
• With factory setting, disconnecting this pin from COM– sets the speed to zero.
<table>
<tr><th>Pr06 value</th><th>Meaning</th></tr>
<tr><td>0 (Factory-setting)</td><td>ZEROSPD is disabled.</td></tr>
<tr><td>1</td><td>ZEROSPD is enabled.</td></tr>
</table></td><td>SI page 134</td></tr>
<tr><td>Gain switching</td><td>27</td><td>GAIN</td><td>• This is setting of Pr30 (2nd gain setting) and has the following 2 types of functions:
<table>
<tr><th>Pr30 value</th><th>Connection to COM-</th><th>Function</th></tr>
<tr><td rowspan="2">0 (Factory-setting)</td><td>Open</td><td>Speed loop: PI (Proportional / Integral) action</td></tr>
<tr><td>Close</td><td>Speed loop: P (Proportional) action</td></tr>
<tr><td rowspan="3">1</td><td>Open</td><td>• 1st gain selected (Pr10, 11, 12, 13 and 14)</td></tr>
<tr><td>Close</td><td>• 2nd gain selected (Pr18, 19, 1A, 1B, 1C)</td></tr>
<tr><td colspan="2">To use the second gain, set Pr31 to “2”.</td></tr>
</table>
• No.2 Gain change Funcutions, see page 202 "Adjustments ".</td><td>SI page 134</td></tr>
<tr><td>Alarm clear</td><td>31</td><td>A-CLR</td><td>• If the COM- connection is kept closed for more than 120 ms, the alarm status will be cleared.
• For details about not cleared alarm, see page 216 "Protective Functions".</td><td>SI page 134</td></tr>
</table>

CN X5 Connector

Input signal assignment to CN X5 connector pins - designation(logic)

Input Signals (Speed Control) and their Functions

Signal	Pin No.	Symbol	Function	I/F circuit
Speed (torque) command	**14** **(15)**	**SPR/TRQR** **(GND)**	**< At speed control >** • This becomes speed command input (analogue) **0–±10V** • You can set-up the relationship between the command voltage level and the motor speed, with Pr50 (Speed Command Input Gain) . • Use Pr51 to inverse the polarity of the command input. **< At torque control >*** • This becomes torque command input (analogue) **0–±10V** • You can set-up the relationship between the command voltage level and the motor torque, with Pr5C (Torque Command Input Gain) . • Use Pr5D to inverse the polarity of input signals. • Use Pr56 (4th Speed Set-up) to adjust the speed limit in torque control. **< Note >** SPR/TRQR are invalid in position control mode.	AI page 134
CCW torque limit	**16** **(17)**	**CCWTL/ TRQR*** **(GND)**	**< At speed and position control >** • You can limit the motor torque in the CCW direction by entering positive voltage (0 to +10V) to CCWTL. • You can limit the motor torque in the CW direction by entering negative voltage (-10 to 0V) to CWTL. • The torque limit value is proportional to the voltage with a factor of 100%/3V. • CCWTL and CWTL are valid when Pr03 (Torque Limit Input Inhibit) = 0. They are invalid when Pr03 = 1.	AI page 134
CW torque limit	**18** **(17)**	**CWTL** **(GND)**	**< At torque control >*** • Both of CCWTL and CWTL are invalid. • Use the 4th speed set-up(Pr56) to limit the speed.	
Battery +	**44**	**BATT +**	• Connect a backup battery for absolute encoder (pole-sensitive !). • If the battery is connected directly to the driver, it is not necessary to connect a battery to this terminal.	–
Battery -	**45**	**BATT -**		

* When the torque control mode is selected at the speed/torque switching mode (Pr02 = 5), the No.16 pin (CCWTL/TRQR) becomes the torque command input (analogue). You can set-up the relationship between the command voltage level and the motor torque with Pr5C (Torque Command Input Gain).

Output signal assignment to CN X5 connector pins - designation(logic)

Output Signals (Common) and their Functions

Signal	Pin No.	Symbol	Function	I/F circuit
Servo alarm output	**37** **36**	**ALM +** **ALM –**	• This output(transistor) turns OFF, when the driver detects and error(trip).	SO1 page 135
Servo-ready output	**35** **34**	**S-RDY +** **S-RDY -**	• This output(transistor) turns ON, when the main power is on(for both the driver and the motor) and no alarm is active.	SO1 page 135
Mechanical brake release output	**11** **10**	**BRK-OFF +** **BRK-OFF –**	• This is used to release the electromagnetic brake of the motor. • Turn the output transistor ON when releasing brake. • Refer to “Timing Chart” on page 40, on Preparations. • This output(transistor) turns ON , when the brake is released. • See page 40 "Timing Chart".	SO1 page 135

<table>
<tr><th>Signal</th><th>Pin No.</th><th>Symbol</th><th>Function</th><th>I/F circuit</th></tr>
<tr><td>Zero speed detection</td><td>12</td><td>ZSP</td><td>• Signal which is selected at Pr0A (ZSP Output Selection) will be turned on.
<table>
<tr><th>Pr0A value</th><th>Function</th></tr>
<tr><td>0</td><td>Output(transistor) turns ON during the In-toque limiting.</td></tr>
<tr><td>1 (Factory-setting)</td><td>Output(transistor) turns ON when the motor speed becomes lower than that of the preset speed with Pr61(Zero speed).</td></tr>
<tr><td>2*</td><td>Output(transistor) turns ON when either one of over-regeneration, overload or battery warning is activated.</td></tr>
<tr><td>3*</td><td>Output(transistor) turns ON when the over-regeneration (more than 85% of permissible power of the internal regenerative discharge resistor) warning is activated.</td></tr>
<tr><td>4*</td><td>Output(transistor) turns ON when the overload (the effective torque is more than 85% of the overload trip level) warning is activated.</td></tr>
<tr><td>5*</td><td>Output(transistor) turns ON when the battery (the voltage of the backup battery becomes lower than approx. 3.2V at the encoder side) warning is activated.</td></tr>
</table>
* When the setting is a value between 2 and 5, the output transistor will be turned on for at least 1 second upon detecting an alarm condition.</td><td>SO2
page 135</td></tr>
<tr><td>Torque in-limit</td><td>40</td><td>TLC</td><td>• Signal which is selected by Pr09 (TLC Output Selection) will be turned ON. Factory-setting: 0
• See the above ZSP signal for the set-up of Pr09 and functions.</td><td>SO2
page 135</td></tr>
<tr><td>In-position/ At-speed</td><td>39
38</td><td>COIN +
COIN –</td><td>• Function changes at control mode.
<table>
<tr><td>Position</td><td>• In-position output
• Output(transistor) turns ON when the position error is below the preset value by Pr60 (In-Position Range).</td></tr>
<tr><td>Speed and torque</td><td>• At-speed output
• Output(transistor) turns ON when the motor speed reaches the preset value by Pr62 (At-Speed).</td></tr>
</table></td><td>SO1
page 135</td></tr>
<tr><td>A-phase output</td><td>21</td><td>OA +</td><td rowspan="5">• Provides differential outputs of the encoder signals (A, B and Z phases) that come from the driver (equivalent to RS422 signals).
• The logical relation between A and B phases can be selected by Pr45 (Output Pulse Logic Inversion).
• Not insulated</td><td rowspan="5">PO1
page 135</td></tr>
<tr><td></td><td>22</td><td>OA –</td></tr>
<tr><td>B-phase output</td><td>48</td><td>OB +</td></tr>
<tr><td></td><td>49</td><td>OB –</td></tr>
<tr><td>Z-phase output</td><td>23</td><td>OZ +</td></tr>
<tr><td></td><td>24</td><td>OZ –</td><td></td><td></td></tr>
<tr><td>Z-phase output</td><td>19</td><td>CZ</td><td>• Z-phase signal output in an open collector (not insulated)
• Not insulated</td><td>PO2
page 135</td></tr>
<tr><td>Speed monitor output</td><td>43
(17)</td><td>SP
(GND)</td><td>• Outputs the motor speed, or voltage in proportion to the commanded speed with polarity.
+ : CCW rotation
– : CW rotation
• Use Pr07 (Speed Monitor Selection) to switch between actual and commanded speed, and to define the relation between speed and output voltage.</td><td>AO
page 135</td></tr>
<tr><td>Torque monitor output</td><td>42
(17)</td><td>IM
(GND)</td><td>• Outputs the output torque, or voltage in proportion to the position error with polarity.
+ : Fgenerating CCW-torque
– : Fgenerating CW-torque
• Use Pr08 (Torque Monitor Selection) to switch between torque and positional error, and to define the relation between torque/positional error and output voltage.</td><td>AO
page 135</td></tr>
</table>

Output Signals (Others) and their Functions

Signal	Pin No.	Symbol	Function	I/F circuit
Signal ground	**13, 15 17, 25**	**GND**	• Signal ground in the driver • Internally isolated from the control power (COM -).	–
Frame ground	**50**	**FG**	• Internally connected to the earth terminal.	–
(Not in use)	**1, 2, 20 46, 47**	**–**	• No connections should be made.	–

Trial run at Torque Control Mode

Operation with CN X5 Connected

1) Connect CN X5.

2) Connect the control signal (COM+/COM–) to the power supply (12 to 24 VDC) .

3) Turn the main power (driver) ON.

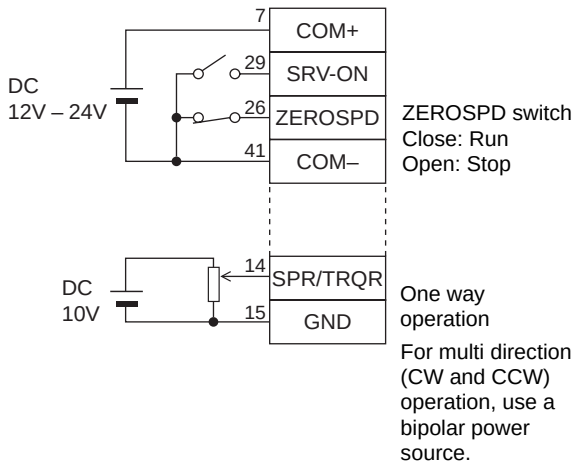
4) Check the defaults of the parameters.

5) Connect between SRV-ON (CN X5 pin 29) and COM- (CN X5 pin 41) to make Servo-On active. The motor will be kept excited.

6) Apply an appropriate DC voltage between Torque command input TRQR (CN X5 pin 14) and GND (CN X5 pin 15) and verify the motor rotating direction (CW/CCW) and then reverse the voltage polarity and then verify reversed motor rotation. Also check the speed set by Pr56.

7) To change torque Pr5C, direction Pr5D and speed limit Pr56 in response to the command voltage, modify the following parameter.
Pr56: 4th speed
Pr5C: torque command input gain
Pr5D: torque command input inversion
See page 144 "Parameter setting" in Torgue control mode.

Wiring Diagram



Parameters

PrNo.	Parameter description	Value
Pr02	Control mode set-up	2
Pr04	Overtravel input inhibit	1
Pr06	ZEROSPD input selection	0
Pr56	4th internal speed	Set as required
Pr5C	Torque command input gain	
Pr5D	Torque command input inversion	

• Use the controller to send command pulses.

Input Signals Status

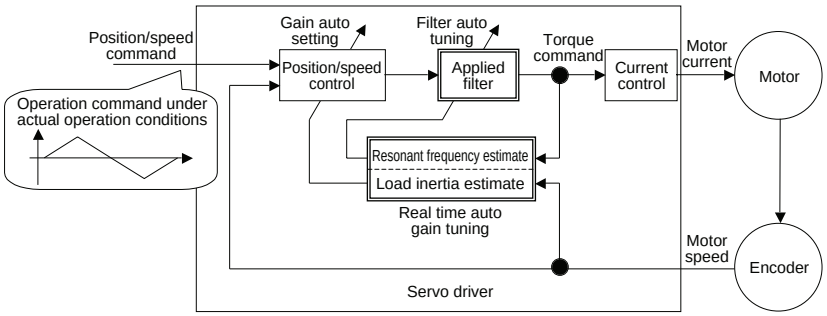
No.	Input signal	Monitor display
0	Servo-ON	+ A
2	CW overtravel inhibit	–
3	CCW overtravel inhibit	–
5	Speed zero clamp	–

MEMO

Real time auto gain tuning

Outline

Load inertia of the machine is estimated at real time, and the optimum gain is set up automatically based on the estimated result. A load, which has a resonance, also can be handled owing to the adaptive filter.



Application range

Under the following conditions, the real time auto gain tuning may not function properly.
In such case, use the normal mode auto gain tuning (see page 193 "Adjustments") or manual gain tuning (see page 197 "Adjustments").

	Conditions under which the real time auto gain tuning is prevented from functioning
Load inertia	• When the load inertia is smaller/larger than the rotor inertia (3 times or less; or 20 times or more) • When the load inertia fluctuates
Load	• When the machine stiffness is extremely low • When any unsecured part resides in such as backlash, etc.
Operation pattern	• In case of a continuous low speed operation under 100 [r/min]. • In case of soft acceleration/deceleration under 2000 [r/min] per 1 [s]. • When acceleration/deceleration torque is smaller than unbalanced load/viscous friction torque.

How to use

[1] Stop the motor (Servo-OFF).

[2] Set up Pr21 (Real-time auto tuning set-up) to 1 – 6.
Set up value before shipment is1.

Setting value	Real-time auto tuning	Changing degree of load inertia during operation	Adaptive filter
0	Not used	–	No
[1]	Used	Little change	Yes
2		Change slowly	
3		Change s haply	
4		Little change	No
5		Change slowly	
6		Change s haply	
7	Not used	–	Yes

When the changing degree of the load inertia is too large, set Pr21 to 3 or 6.
When the influence of resonance is conceivable, select “adaptive filter YES”.

[3] Set 0 – 2 to Pr22 (real-time auto tuning machine stiffness).

[4] Turn the servo ON to operate the machine ordinarily.

[5] To increase the response performance, gradually increase Pr22 (Machine stiffness at real-time auto tuning). When any noise or vibration is found, decrease the Pr22 to a lower value soon.

[6] To store the result, write the data into the EEPROM.

Parameters, which are set up automatically

The following parameters are tuned automatically.

Parameter No.	Name
11	1st speed loop gain
12	1st speed loop integration time constant
13	1st speed detection filter
14	1st torque filter time constant
19	2nd speed loop gain
1A	2nd speed loop integration time constant
1B	2nd speed detection filter
1C	2nd torque filter time constant
20	Inertia ratio

The following parameters are also set up to the following fixed values automatically.

Parameter No.	Name	Set value
27	Disturbance torque observer filter selection	0
30	2nd gain action set-up	1
3A	Torque control switching mode	0

Caution

[1] Immediately after the first servo ON at startup or when Pr22 (machine stiffness at real-time auto tuning) is increased, abnormal noise or oscillation may be generated before load inertia is determined. This is not anomaly if it is stabilized shortly. However when such problems as oscillation or noise that continues for 3 reciprocal operations or longer is encountered frequently, take the following measures:

1) Write the parameter of normal operation into the EEPROM.
2) Decrease the Pr22 (Machine stiffness at real-time auto tuning).
3) Once set up Pr21 (Real-time auto tuning set-up) to 0 to disable the adaptive filter. Then, enable the real time auto tuning again. (resetting of inertia estimate adaptive operation)

[2] After abnormal noise or oscillation, Pr20 (inertial ratio) may be changed to an extreme value. In such a case, also take the above measures.

[3] Among results of real-time auto gain tuning, Pr20 (inertia ratio) is programmed into EEPROM every 30 minutes. When you turn on the power again, auto tuning will be executed using the data as initial value.

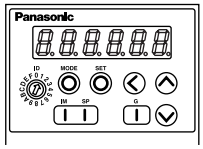
Parameter Setting

Parameters for Function Selection

Default setting is shown by [ ]

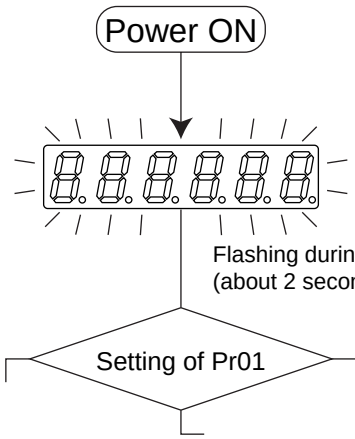
Parameter No.	Parameter Name	Setting range	Function/Description
00	**Axis address**	0 – 15 [1]	In communications with a host device such as a personal computer that uses RS232C/485 with multiple axes, you should identify to which axis the host accesses and use this parameter to confirm axis address in terms of numerals.

- At power on, settings of the rotary switch ID on the front panel (0 – F) will be programmed into parameters of the driver.
- Settings of Pr00 can be changed only by means of the rotary switch ID.



01 LED display at power up — 0 – 15

In the initial condition after turning ON the control power, the following data displayed on the 7-segment LED can be selected.



Setting value	Description
0	Positional deviation
[1]	Motor revolving speed
2	Torque output
3	Control mode
4	I/O signal status
5	Error cause/record
6	Software version
7	Alarm
8	Regenerative load ratio
9	Overload load ratio
10	Inertia ratio
11	Feedback pulse sum
12	Command pulse sum
13	External scale deviation
14	External scale feedback pulse sum
15	Motor auto recognition

See page 56 "Front Panel Key Operations and Display".

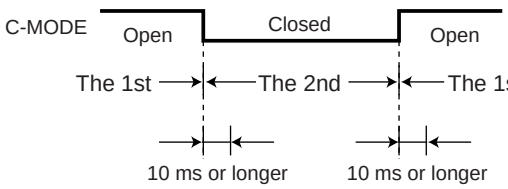
02 Control mode — 0 – 14

Select the control mode of the servo driver.

Setting value	Control mode	
	The 1st Mode	The 2nd Mode*1
0	Position control	–
[1]	Speed control	–
2	Torque control	–
3	Position	Speed control
4	Position	Torque control
5	Speed	Torque control
6	Semi-closed control	–
7	Full-closed control	–
8	Hybrid control	–
9	Speed	External encoder control
10	Speed	Semi-closed control
11	High-stiff equipment position control	–
12	Low-stiff equipment position control	–
13	Low-stiff equipment speed control	–
14	Second full-closed control	–

*1 A special control mode focused on the full-closed specification. For details, refer to “Full-Closed Control” volume on Page 000.

*2 When composite mode (Pr02 = 3,4,5,9,10) is set, you can switch the 1st and 2nd modes with the control mode switch input (C-MODE).

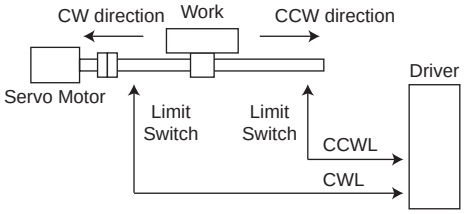


<Caution>

Enter a command after 10ms or longer have passed since C-MODE was entered.

Do not enter any command on position, speed or torque.

Default setting is shown by [ ]

<table>
<tr><th>Parameter No.</th><th>Parameter Name</th><th>Setting range</th><th>Function/Description</th></tr>
<tr><td>04</td><td>Overtravel input inhibit</td><td>0 – 1</td><td>In the case of linear driving, in particular, to prevent mechanical damage due to overtraveling of work, you should provide limit switches on both ends of the axis, as shown below, whereby driving in a direction of switch action is required to be inhibited.


<table>
<tr><th>Setting value</th><th>CCWL/CWL Input</th><th colspan="2">Input</th><th>Connection with COM-</th><th>Action</th></tr>
<tr><td rowspan="4">0</td><td rowspan="4">Enable</td><td rowspan="2">CCWL (CN X5-9 pin)</td><td>Connected</td><td>Normal condition in which the limit switch on CCW side is not operating.</td></tr>
<tr><td>Open</td><td>CCW direction inhibited, CW direction allowed</td></tr>
<tr><td rowspan="2">CWL (CN X5-8 pin)</td><td>Connected</td><td>Normal condition in which the limit switch on CW side is not operating.</td></tr>
<tr><td>Open</td><td>CW direction inhibited, CCW direction allowed</td></tr>
<tr><td>[1]</td><td>Disable</td><td colspan="3">Both CCWL and CWL inputs are ignored and they normally operate as no overtravel inhibit being set.</td></tr>
</table>
<Cautions>
1. When you set 0 to Pr04 and do not connect both CCWL and CWL inputs to COM- (off), abnormal condition in which limits are exceeded in both CCW and CW directions is detected, and the driver will then trip due to “abnormal overtravel input inhibit“.
2. You can set whether or not to activate the dynamic brake when slowdown occurs because CCW or CW overtravel input inhibit has been enabled. For details, refer to descriptions on Pr66 (DB deactivation at overtravel input inhibit).</td></tr>
<tr><td>06</td><td>ZEROSPD input selection</td><td>0 – 1</td><td>This sets switching of enable and disable of speed zero clamp input (ZEROSPD, CNX5 26-pin).
<table>
<tr><th>Setting value</th><th>Function of ZEROSPD Input (26-pin)</th></tr>
<tr><td>[0]</td><td>ZEROSPD input being ignored, it is determined that it is not speed zero clamp state at all times.</td></tr>
<tr><td>1</td><td>ZEROSPD input has been enabled. If connection with COM- is opened, speed command will be regarded as zero.</td></tr>
</table></td></tr>
<tr><td>07</td><td>Speed monitor (SP) selection</td><td>0 – 9</td><td>The parameter selects/sets a relationship between voltage output to the speed monitor signal output (SP: CN X5 43-pin) and the actual motor speed or command speed.
<table>
<tr><th>Setting value</th><th>SP Signals</th><th>Relationship between Output Voltage Level and 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 / 187 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 / 187 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>

Default setting is shown by [ ]

<table>
<tr><th>Parameter No.</th><th>Parameter Name</th><th>Setting range</th><th>Function/Description</th></tr>
<tr><td>08</td><td>Torque monitor (IM) selection</td><td>0 – 12</td><td>The parameter selects/sets a relationship between voltage output to the torque monitor signal output (IM: CN X5 42-pin) and generated torque of the motor or number of deviation pulses.
<table>
<tr><th>Setting value</th><th>IM Signals</th><th>Relationship between output level and torque or number of deviation pulses</th></tr>
<tr><td>[0]</td><td>Torque</td><td>3V / rated (100%) torque</td></tr>
<tr><td>1</td><td rowspan="6">No. of Deviation Pulses</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 – 10</td><td>Enabled under full-closed control (See P156 –.)</td></tr>
<tr><td>11</td><td rowspan="2">Torque</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>TLC output selection</td><td>0 – 5</td><td>The parameter allocates functions of output in torque limits (TLC: CN X5 40-pin).
<table>
<tr><th>Setting value</th><th>Functions</th><th>Remarks</th></tr>
<tr><td>[0]</td><td>Output in torque limit</td><td rowspan="6">For functional details of respective outputs listed left, refer to "Wiring to Connector CN X5" on page 78.</td></tr>
<tr><td>1</td><td>Output of zero-speed detection</td></tr>
<tr><td>2</td><td>Output of an alarm due to either of over-regeneration/overload/absolute battery</td></tr>
<tr><td>3</td><td>Output of over-regeneration alarm</td></tr>
<tr><td>4</td><td>Output of overload alarm</td></tr>
<tr><td>5</td><td>Output of absolute battery alarm</td></tr>
</table></td></tr>
<tr><td>0A</td><td>ZSP output selection</td><td>0 – 5</td><td>The parameter allocates functions of zero speed detection output (ZSP: CN X5 12-pin).
<table>
<tr><th>Setting value</th><th>Functions</th><th>Remarks</th></tr>
<tr><td>0</td><td>Output in torque limit</td><td rowspan="6">For functional details of respective outputs listed left, refer to "Wiring to Connector CN X5" on page 78.</td></tr>
<tr><td>[1]</td><td>Output of zero-speed detection</td></tr>
<tr><td>2</td><td>Output of an alarm due to either of over-regeneration/overload/absolute battery</td></tr>
<tr><td>3</td><td>Output of over-regeneration alarm</td></tr>
<tr><td>4</td><td>Output of overload alarm</td></tr>
<tr><td>5</td><td>Output of absolute battery alarm</td></tr>
</table></td></tr>
<tr><td>0B</td><td>Absolute encoder set up</td><td>0 – 2</td><td>Listed below are settings when you use the absolute encoder:
<table>
<tr><th>Setting value</th><th>Description</th></tr>
<tr><td>0</td><td>To use the absolute encoder as absolute.</td></tr>
<tr><td>[1]</td><td>To use the absolute encoder as incremental.</td></tr>
<tr><td>2</td><td>To use the absolute encode as absolute. In this case, multi-rotation excess counter is ignored.</td></tr>
</table></td></tr>
<tr><td>0C</td><td>Baud rate of RS232C</td><td>0 – 2</td><td>
<table>
<tr><th>Setting 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></td></tr>
<tr><td>0D</td><td>Baud rate of RS485</td><td>0 – 2</td><td>
<table>
<tr><th>Setting 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></td></tr>
</table>

Parameters for Time Constants of Gains and Filters: Related to Real Time Auto Tuning

Default setting is shown by [ ]

Parameter No.	Parameter Name	Setting range	Unit	Function/Description
11	**1st Velocity loop gain**	1 – 3500 [35]*	Hz	• The parameter defines responsiveness of the speed loop. You need to set this speed loop gain high so as to improve responsiveness of the entire servo system by increasing position loop gain.
12	**1st Velocity loop integration time constant**	1 – 1000 [16]*	ms	• This parameter is an integration element of a speed loop and acts to drive quickly the subtle speed deviation into zero. The smaller the setting is, the faster deviation will be zeroed. • Setting of “1000” will remove effects of integration.
13	**1st speed detection filter**	0 – 6 [0]*	–	• The parameter sets in 6 phases (0 to 5) a time constant of the low-pass filter inserted after the block of converting an encoder signal into a speed signal. • Setting this parameter high would increase a time constant, thereby reducing noise of the motor. However, usually use the factory setting (0).
14	**1st torque filter time constant**	0 – 2500 [65]*	0.01ms	• The parameter sets a time constant of the primary delay filter inserted into the torque command unit. • It effects the control of vibration because of the torsion resonance.
19	**2nd Velocity loop gain**	1 – 3500 [35]*	Hz	• A position loop, speed loop, speed detection filter, and torque command filter, respectively, has 2 pairs of gains or time constants (the 1st and 2nd). • Each function/content is similar to the 1st gain/time constraint, described earlier. • For details on switching of the 1st and 2nd gains or time constants, refer to Adjustment volume on page 186. * Pr11 and Pr19 will be set in terms of (Hz) when Pr20 inertia ratio has been set correctly.
1A	**2nd Velocity loop integration time constant**	1 – 1000 [1000]*	ms	
1B	**2nd speed detection filter**	0 – 6 [0]*	–	
1C	**2nd torque filter time constant**	0 – 2500 [65]*	0.01ms	
1D	**1st notch frequency**	100 – 1500 [1500]	Hz	• The parameter sets frequency of the resonance suppression notch filter. • You should set it about 10% lower than the resonance frequency of the mechanical system that has been found by the frequency characteristics analysis facility of the setup assisted software “PANATERMR®”. • Setting this parameter ”1500” would disable the function of notch filter.
1E	**1st notch width selection**	0 – 4 [2]	–	• The parameter sets width of the resonance suppression notch filter in 5 steps. The higher the setting is, the greater the width is. • Normally, use a factory setting.

Note) Standard default setting in [ ] under "Setting range" and marked with * is automatically set during the real time auto gain tuning. To manually change the value, first disable the auto gain tuning feature be seeing page 196 "Disabling of auto tuning function" in Adjustments, and then enter the desired value.

Parameters for real time auto gain tuning

Default setting is shown by [ ]

<table>
<tr><th>Parameter No.</th><th>Parameter Name</th><th>Setting range</th><th>Unit</th><th>Function/Description</th></tr>
<tr><td>20</td><td>Inertia ratio</td><td>0 – 10000
[100]*</td><td>%</td><td>• Defines the ratio of load inertia to the motor's rotor inertia.
Pr20 = (rotor inertia / load inertia) x 100[%]
• When you execute auto gain tuning, load inertia will be estimated and the result will be reflected in this parameter.
Pr11 and Pr19 will be set in terms of (Hz) when inertia ratio has been set correctly. When Pr20 inertia ratio is greater than the actual ratio, setting of the speed loop gain will increase. When Pr20 inertia ratio is smaller than the actual ratio, setting of speed loop gain will decrease.</td></tr>
<tr><td>21</td><td>Real time auto tuning set up</td><td>0 – 7</td><td>–</td><td>• Defines the operation mode of real-time auto tuning. Increasing the set value (3, 6,...) provides higher response to the inertia change during operation. However, operation may become unstable depending on the operation pattern. Normally, set this parameter to "1" or "4".
• If you set this parameter to any value other than 0, Pr27 disturbance observer filter selection will be disabled (0). In addition, if you set the adaptive filter to disabled, Pr2F adaptive filter frequency will be reset to 0.
• When Pr20 is "0", Pr2F (Adaptive notch frequency) is reset to "0".
In the torque control mode, the adaptive notch filter is always invalid.
<table>
<tr><th>Setting value</th><th>Real-time Auto Gain Tuning</th><th>Degree of Changes in Load Inertia</th><th>Adaptive Filter</th></tr>
<tr><td>0</td><td>Not used</td><td>–</td><td>Absent</td></tr>
<tr><td>[1]</td><td rowspan="6">Used</td><td>Hardly changes.</td><td rowspan="3">Present</td></tr>
<tr><td>2</td><td>Changes moderately.</td></tr>
<tr><td>3</td><td>Changes sharply.</td></tr>
<tr><td>4</td><td>Hardly changes.</td><td rowspan="3">Absent</td></tr>
<tr><td>5</td><td>Changes moderately.</td></tr>
<tr><td>6</td><td>Changes sharply.</td></tr>
<tr><td>7</td><td>Not used</td><td>–</td><td>Present</td></tr>
</table>
• Note that any change in this parameter will be enabled when Servo OFF changes to Servo ON.</td></tr>
<tr><td>22</td><td>Machine stiffness at auto tuning</td><td>0 – 15
[4]</td><td>–</td><td>• Defines the machine stiffness during execution of real-time auto tuning.
Low ← Machine stiffness → High
Low ← Servo gain → High
Pr22 | 0 , 1- - - - - - - - - - - - 14, 15
Low ← Responsiveness → High
• If the parameter value is rapidly changed, the gain significantly changes, applying a shock to the machine. Be sure to set a small value first, and increase it gradually, while monitoring the operating condition.</td></tr>
<tr><td>25</td><td>Normal auto tuning motion set up</td><td>0 – 7</td><td>–</td><td>• Defines the operation pattern of the normal mode auto tuning.
<table>
<tr><th>Set value</th><th>Number of revolutions</th><th>Revolving 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>
Example) Setting this parameter to "0" provides two CCW revolutions and two CW revolutions.</td></tr>
</table>

Default setting is shown by [ ]

<table>
<tr><th>Parameter No.</th><th>Parameter Name</th><th>Setting range</th><th>Unit</th><th>Function/Description</th></tr>
<tr><td>27</td><td>Disturbance torque observer filter selection</td><td>0 –255</td><td>–</td><td>• Cut-off frequency of the filter for disturbance torque observer is set.
<table>
<tr><th>Set value</th><th>Cutoff Frequency</th></tr>
<tr><td>[0]*</td><td>Disturbance Observer Disabled</td></tr>
<tr><td>1 – 255</td><td>Enabled, filter cutoff frequency [Hz] = 3.7 x setting</td></tr>
</table>
A larger value provides stronger disturbance suppression; but a larger operation noise is emitted. When using this function, it is necessary to set Pr20 inertia ratio correctly. When Pr.21 real time auto tuning mode setting is altered, Pr27 changes to 0(disabled). Also, while the real time auto tuning is enabled (Pr21 is not 0 or 7), Pr27 is fixed to 0 and the disturbance observer is disabled.</td></tr>
<tr><td>28</td><td>2nd notch frequency</td><td>100 – 1500
[1500]</td><td>Hz</td><td>• Defines the notch frequency of the second resonance suppression notch filter.
• The unit is [Hz]. Match the notch frequency with the machine's resonance frequency.
100 to 1499: Filter enabled 1500: Filter disabled</td></tr>
<tr><td>29</td><td>2nd notch width selection</td><td>0 – 4
[2]</td><td>–</td><td>• Select the notch width of the second resonance suppression notch filter.
• Increasing the set value enlarges the notch width.</td></tr>
<tr><td>2A</td><td>2nd notch depth selection</td><td>0 – 99
[0]</td><td>–</td><td>• Select the notch depth of the second resonance suppression notch filter.
• Increasing the set value reduces the notch depth and the phase delay.</td></tr>
<tr><td>2F</td><td>Adaptive filter frequency</td><td>0 – 64
[0]*</td><td>–</td><td>• Table No. corresponding to the frequency of the applied filter is displayed. (See page 196)
• When the applied filter is enabled (when Pr21 (real time auto tuning mode setting) is 1-3,7), this parameter is set automatically and can not be altered.
0: Filter disabled 1 - 64: Filter enabled
Before using this function, see page 196 “Disabling of auto tuning function” in adjustments.
• When the applied filter is enabled, the parameter is stored in the EEPROM every 30 minutes. And when the applied filter is enabled at turning ON the power next time, the data stored in the EEPROM is used as the initial value to adapt the operation.
• When clearing the parameter to reset the adapted operation due to unsatisfactory operation, once set the applied filter disabled (set Pr21 (real time auto tuning mode setting) to other than 1 - 3, 7), and make it enabled again.
• Refer to “Control of Vibration Damping” of Adjustment volume on page 211.</td></tr>
</table>

Note) Standard default setting in [ ] under "Setting range" and marked with * is automatically set during the real time auto gain tuning. To manually change the value, first disable the auto gain tuning feature be seeing page 196 "Disabling of auto tuning function" in Adjustments, and then enter the desired value.

Parameter Setting

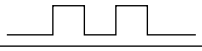
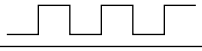
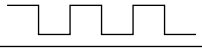
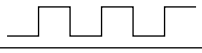
Parameters for Switching to 2nd Gains

Default setting is shown by [ ]

<table>
<tr><th>Parameter No.</th><th>Parameter Name</th><th>Setting range</th><th>Unit</th><th>Function/Description</th></tr>
<tr><td>30</td><td>2nd gain action set up</td><td>0 – 1</td><td>–</td><td>• The parameter selects switching of PI/P operation and the 1st/2nd gain switching.
<table>
<tr><th>Setting value</th><th>Gain Selection/Switching</th></tr>
<tr><td>0</td><td>The 1st Gain (Possible to switch PI/P) *1</td></tr>
<tr><td>[1]*</td><td>Possible to switch the 1st/2nd gain *2</td></tr>
</table>
*1 Switching of 1 PI/P operation is done through gain switching input (GAIN CN X5 27-pin).
<table>
<tr><th>GAIN input</th><th>Operation of speed loop</th></tr>
<tr><td>Open with COM–</td><td>PI operation</td></tr>
<tr><td>Connect to COM–.</td><td>P operation</td></tr>
</table>
*2 For conditions of switching between the 1st and 2nd gains, refer to “Adjustment upon switching gain” of Adjustment volume on page 202.</td></tr>
<tr><td>3A</td><td>Torque control switching mode</td><td>0 – 3</td><td>–</td><td>• The parameter selects conditions for switching between the 1st and 2nd gains in torque control mode.
• This is same as Pr31 except parts related to position and speed control.
<table>
<tr><th>Setting value</th><th>Conditions for Switching Gains</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</td><td>With the gain switching input (GAIN) turned ON, 2nd gain is selected. (Pr30 should be set to 1.)</td></tr>
<tr><td>3 *1</td><td>With much variation of torque command, the 2nd gain is selected.</td></tr>
</table>
*1 For details on levels to be switched, refer to “Adjustment upon switching gain” of Adjustment volume on page 202.</td></tr>
<tr><td>3B</td><td>Torque control switching delay time</td><td>0 – 10000 [0]</td><td>x 166µs</td><td rowspan="3">• This is same as content of:
Pr32: Switching delay time
Pr33: Switching level
Pr34: Hysteresis at switching”
in position control mode.</td></tr>
<tr><td>3C</td><td>Torque control switching level</td><td>0 – 20000 [0]</td><td>–</td></tr>
<tr><td>3D</td><td>Torque control switching hysteresis</td><td>0 – 20000 [0]</td><td>–</td></tr>
</table>

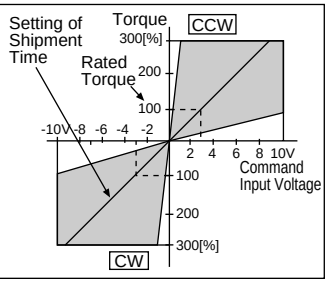
Parameters for Position Control

Default setting is shown by [ ]

<table>
<tr><th>Parameter No.</th><th>Parameter Name</th><th>Setting range</th><th>Function/Description</th></tr>
<tr><td>44</td><td>Output pulses per single turn</td><td>1 – 16384 [2500]</td><td>The parameter sets number of pulses per one revolution of encoder pulse to be output to the host device. The pulse will be set in dividing.
You should directly set in this parameter the number of pulses per revolution needed for your device/system in terms of [Pulse/rev].</td></tr>
<tr><td>45</td><td>Pulse output logic inversion</td><td>0 – 1</td><td>In a relationship of phases of output pulse from the rotary encoder, Phase B pulse is behind pulse A when the motor rotates in CW direction. (Phase B pulse advances ahead of phase A pulse, when the motor rotates in CCW direction.)
Inversion of logic of phase B pulse with this parameter could invert a phase relation of phase B pulse to phase A pulse.
<table>
<tr><th rowspan="2">Setting value</th><th rowspan="2"></th><th>IWhen Motor is Rotating in CCW direction</th><th>IWhen Motor is Rotating in CW direction</th></tr>
<tr><td>A pulse(OA)</td><td>  </td><td>  </td></tr>
<tr><td>[0]</td><td>B pulse(OB) Non-inverting</td><td>  </td><td>  </td></tr>
<tr><td>1</td><td>B pulse(OB) Inverting</td><td>  </td><td>  </td></tr>
</table></td></tr>
</table>

Parameters for Speed Control

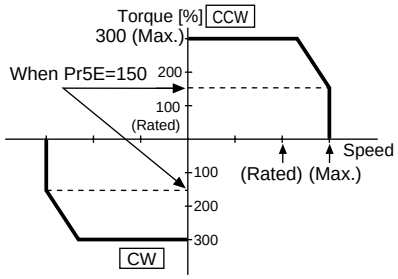
Default setting is shown by [ ]

Parameter No.	Parameter Name	Setting range	Unit	Function/Description
52	**Velocity command offset**	–2047 – 2047 [0]	0.3mV	• This parameter adjusts offset of external analog speed command system including the host device. • Offset volume will be approximately 0.3mV per a set value “1”. • To adjust offset, there are 2 ways of (1) manual adjustment and (2) automatic adjustment. **1) Manual adjustment** • When you make offset adjustment with the driver only: Using this parameter, set a value that prevents the motor from rotating, after you have correctly input 0V in torque command input (SPR/TRQR) (or connected to signal ground). • When the host device establishes a position loop: With servo locked, using this parameter, set a value so that deviation pulse will be zero. **2) Automatic Adjustment** • For details on operating instructions in automatic offset adjustment mode, refer to “Details of Execution Display of Auxiliary Function Mode” of Preparations volume on page 66. • When you execute automatic offset adjustment, result will be reflected in this parameter Pr52.
56	**4th internal speed**	–20000 – 20000 [0]	r/min	The parameter directly sets the 1st to 4th speed of internal command speed of when setting of internal speed has been enabled with the parameter “speed setting internal/external switching” (Pr05), to Pr53 to Pr56, respectively, in the unit of [r/min]. **<Caution>** Polarity of settings shows that of internal command speed. + : CCW direction viewed from the edge of axis for (+) command – : CW direction viewed from the edge of axis for (-) command **Pr56 is a value of speed limits in torque control mode.** **You should set this parameter in a range of rotational speeds of the motor to be used.**
57	**JOG speed set up**	0 – 500 [300]	r/min	The parameter directly sets JOG speed in JOG run in “motor trial run mode” in terms of [r/min]. For details on JOG function, refer to “Trial Run (JOG)” of Preparations volume on page 68.
5C	**Torque command input gain**	10 – 100 [30]	0.1V/ 100%	The parameter sets a relationship between voltage applied to the torque command input (TRQR: CN X5 14-pin) in torque control mode and generated torque of the motor. • Setting is in the unit of [0.1V/100%] and used to set a value of input voltage necessary for calculating rated torque. • At a factory setting of 30, the relationship will be 3V/100%. 
5D	**Torque command input inversion**	0 – 1	–	The parameter inverts polarity of the torque command input signal (TRQR: CN X5 14-pin). In speed/torque switching mode (when Pr02 is 5), torque command input under torque control will be 16-pin of the connector CN X5. [0]: CCW direction viewed from the edge of axis for (+) command 1: CW direction viewed from the edge of axis for (+) command

Parameter Setting

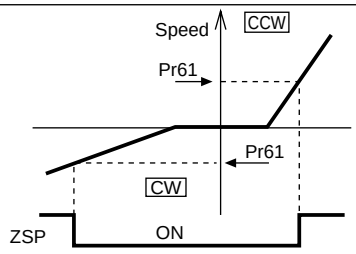
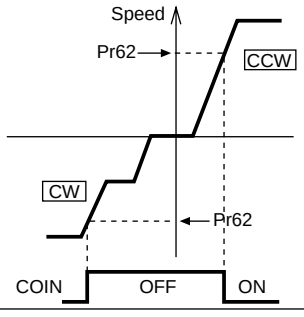
Parameters for Torque Control

Default setting is shown by [ ]

Parameter No.	Parameter Name	Setting range	Unit	Function/Description
5E	**Torque limit**	0 – 500	%	• This function limits maximum torque of the motor through setting of parameters within the driver. • In normal specifications, torque about 3 times higher than the rated is allowed for an instant. This parameter limits the maximum torque, however, if the triple torque may cause a trouble in the strength of motor load (machine). • Setting should be given as a % value to rated torque. • The right figure shows a case in which the maximum torque is limited to 150%. • Pr5E limits maximum torque in both CW and CCW directions simultaneously.  **<Caution>** You cannot set this parameter to a value above a factory setting of the system parameter (i.e., a factory set parameter that cannot be changed through of PANATERM® and panel manipulation) “Maximum Output Torque Setting”. A factory setting may vary depending on a combination of an driver and motor. For further information, refer to “Pr5E Setting of Torque Limit” of Preparations volume on page 55.

Parameters for various sequences

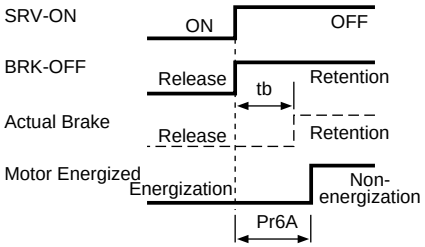
Default setting is shown by [ ]

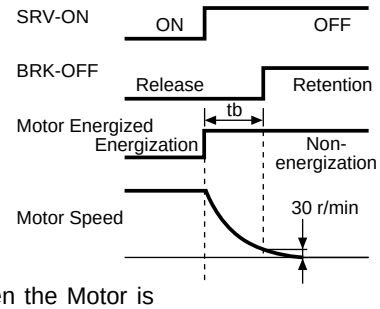
Parameter No.	Parameter Name	Setting range	Unit	Function/Description
61	**Zero speed**	0 – 20000 [50]	r/min	• The parameter directly sets timing to an output zero speed detection output signal (ZSP: CN X5 12-pin) in terms of [r/min]. • A zero speed detection signal (ZSP) is output when motor speed falls below the speed set with this parameter Pr61. • Setting of Pr61 acts on both CW and CCW directions, irrespective of the rotating direction of the motor. 
62	**At-speed**	0 – 20000 [1000]	r/min	• The parameter sets timing to output a at-speed signal (COIN;CN X5 39-pin) in speed control and torque control modes in terms of rotational speed [r/min]. • When the motor speed exceeds setting of this parameter Pr62, at-speed signal (COIN) will be output. • Setting of Pr61 acts on both CW and CCW directions, irrespective of the rotating direction of the motor. 

Default setting is shown by [ ]

<table>
<tr><th>Parameter No.</th><th>Parameter Name</th><th>Setting range</th><th>Unit</th><th>Function/Description</th></tr>
<tr><td>65</td><td>Undervoltage error response at main power-off</td><td>0 – 1</td><td>–</td><td>The parameter sets whether to enable the “protection against main power source under-voltage” function when you shut down the main power of main and control power supplies.
<table>
<tr><th>Setting value</th><th>Main Power Source Under-voltage Protection Action</th></tr>
<tr><td>0</td><td>In this case, if you shut off the main power during Servo ON, it will be SERVO-OFF without a trip. Then, when the main power supply turns ON again, it will be recovered to Servo ON.</td></tr>
<tr><td>[1]</td><td>Shutting off main power during Servo ON will activate abnormal main power supply under-voltage (alarm code No.13) and cause a trip.</td></tr>
</table>
Refer to the timing chart “At Power ON” of Preparations volume on page 40.</td></tr>
<tr><td>66</td><td>Dynamic breke inhibition at overtravel limit</td><td>0 – 1</td><td>–</td><td>The parameter sets driving conditions at decelerated operation after overtravel input inhibit (CCWL: connector CN X5 9-pin or CWL: connector CN X5 8-pin) has been activated and enabled.
<table>
<tr><th>Setting value</th><th>Driving Conditions from Deceleration to Stop</th></tr>
<tr><td>[0]</td><td>The motor decelerates and stops as the dynamic brake (DB) is operated. The motor will be in free condition after it stops.</td></tr>
<tr><td>1</td><td>Free running, the motor decelerates and stops. The motor will be in free condition after it stops.</td></tr>
</table></td></tr>
<tr><td>67</td><td>Error response at main power-off</td><td>0 – 7</td><td>–</td><td>The parameter sets:
(1) Driving conditions during deceleration and after stopping; and
(2) Processing to clear content of the deviation counter
after the main power source is shut off.
<table>
<tr><th rowspan="2">Setting value</th><th colspan="2">Driving Conditions</th><th rowspan="2">Content of Deviation Counter</th></tr>
<tr><th>During Deceleration</th><th>After Stopped</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</td><td>Clear</td></tr>
<tr><td>3</td><td>Free Run</td><td>Free</td><td>Clear</td></tr>
<tr><td>4</td><td>DB</td><td>DB</td><td>Retention</td></tr>
<tr><td>5</td><td>Free Run</td><td>DB</td><td>Retention</td></tr>
<tr><td>6</td><td>DB</td><td>Free</td><td>Retention</td></tr>
<tr><td>7</td><td>Free Run</td><td>Free</td><td>Retention</td></tr>
</table>
DB: Activation of dynamic brake</td></tr>
<tr><td>68</td><td>Error response action</td><td>0 – 3</td><td>–</td><td>The parameter sets driving conditions during deceleration or following stop, after any of protective functions of the driver has been activated and alarm has been generated.
<table>
<tr><th rowspan="2">Setting value</th><th colspan="2">Driving Conditions</th><th rowspan="2">Content of Deviation Counter</th></tr>
<tr><th>During Deceleration</th><th>After Stopped</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</td><td>Clear</td></tr>
<tr><td>3</td><td>Free Run</td><td>Free</td><td>Clear</td></tr>
</table>
(DB: Activation of dynamic brake)
See also “When Abnormality (Alarm) Occurs (Serve ON Command State)” of the timing chart, Preparations volume on page 41.</td></tr>
<tr><td>69</td><td>Sequence at Servo-OFF</td><td>0 – 7
[0]</td><td>–</td><td>• The parameter sets:
1) Driving conditions during deceleration or after stop
2) Processing to clear the deviation counter
following Servo off (SRV-ON signal: CN X5 29-pin turns On ‡ Off).
• A relationship between setting of Pr69 and driving conditions/deviation counter processing conditions is similar to that of Pr67 (Sequence at Main Power Off).
• See also “Serve On/Off Operation When the Motor Stops” of the timing chart of Preparations volume on page 42.</td></tr>
</table>

Default setting is shown by [ ]

<table>
<tr><th>Parameter No.</th><th>Parameter Name</th><th>Setting range</th><th>Unit</th><th>Function/Description</th></tr>
<tr><td>6A</td><td>Mechanical brake delay at motor standstill</td><td>0 – 100
[0]</td><td>2ms</td><td>The parameter sets time till non-energization of motor (servo free) after the brake release signal (BRK-OFF) turns off (brake retained), at Serve Off while the motor stops.
• In order to prevent minor movement/drop of the motor (work) due to operation delay time of the brake (tb):
Setting of Pr6A ≧ tb.
• See “Serve On/Off Operation When the Motor Stops” of the timing chart on page 42.
 

See also “Serve On/Off Operation When the Motor Stops” of the timing chart of Preparations volume on page 43.</td></tr>
<tr><td>6B</td><td>Mechanical brake delay at motor in motion</td><td>0 – 100
[0]</td><td>2ms</td><td>Unlike Pr6A, the parameter sets time till brake release signal (BRK-OFF) turns off (brake retained) after motor non-energization (servo-free), at Servo off while the motor is rotating.
• This should be set to prevent deterioration of the brake due to revolutions of the motor.
• At Servo off while the motor is rotating, time tb in the right figure will be either set time of Pr6B or time till the motor rotational speed falls below approximately 30r/min, whichever is smaller.
• See “Serve On/Off Operation When the Motor is Rotating” of the timing chart of on page 43.
 

See also “Serve On/Off Operation When the Motor Stops” of the timing chart of Preparations volume on page 42.</td></tr>
<tr><td>6C</td><td>External regenerative resister set up</td><td>0 – 3</td><td>–</td><td>This parameter is set depending on whether to use regeneration resistance built in the driver, or to provide a regeneration resistance in the external (connect between RB1 and RB2 of connector CN X 2 in types A to D, and between terminal blocks P and B2 in types E - G).
<table>
<tr><th>Setting value</th><th>Regeneration Resistance to Use</th><th>Protection against Regeneration Resistance Overload</th></tr>
<tr><td>[0]</td><td>Built-in resistance</td><td>According to built-in resistance, (about 1% duty) protection against regeneration resistance overload works.</td></tr>
<tr><td>1</td><td>External resistance</td><td>This is activated with operating limits of the external resistance at 10% duty.</td></tr>
<tr><td>2</td><td>Built-in resistance</td><td>This is activated with operating limits of the external resistance at 100% duty.</td></tr>
<tr><td>3</td><td>External resistance</td><td>Regeneration resistance does not work, and a built-in condenser accommodates all regenerated power.</td></tr>
</table>
<Request>
When you use an external regeneration, you must install external safeguards such as a temperature fuse, etc.
Otherwise, as protection of regeneration resistance would be lost, causing abnormal heat generation and burnout.
<Caution>
Be careful not to touch an external regeneration resistance.
While you are using an external resistance, it may become hot and scald you. For type A, only external regeneration resistance is used.</td></tr>
<tr><td>6D</td><td>Main power-off detection time</td><td>0 – 32767
[35]</td><td>2ms</td><td>The parameter sets time to detect shut-off when shut-off of main power supply continues.</td></tr>
</table>