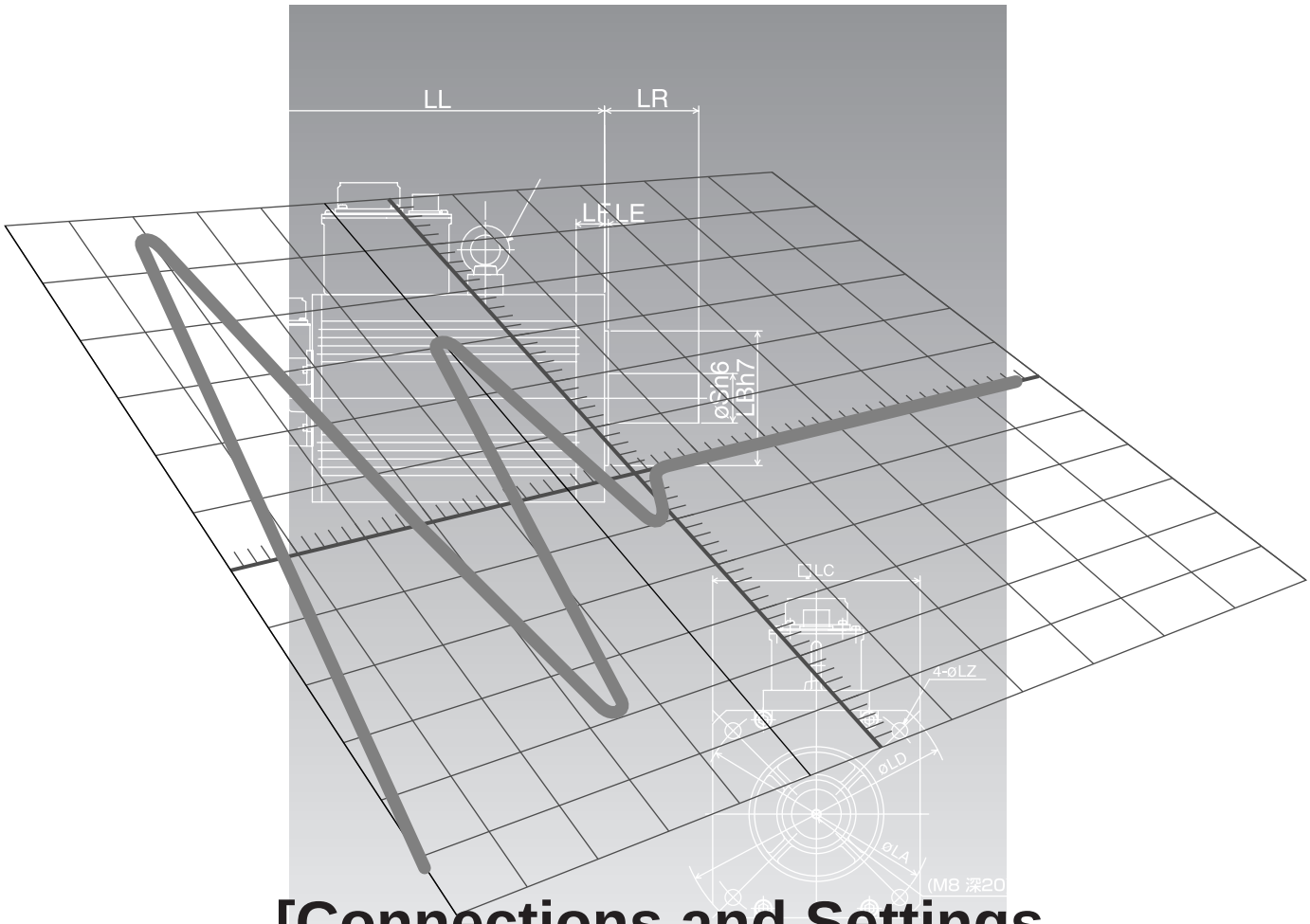
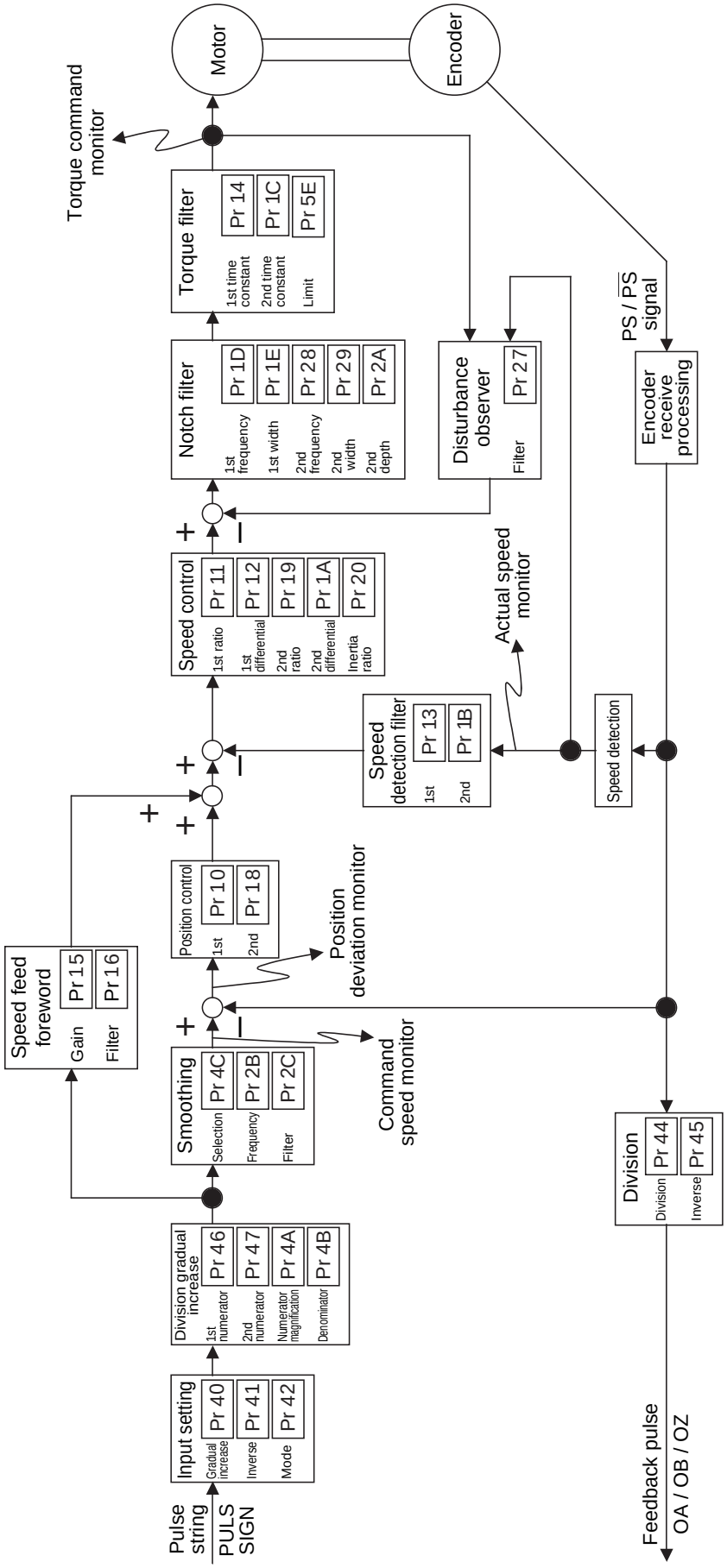


[Connections and Settings in Position Control Mode]

Position control block diagram

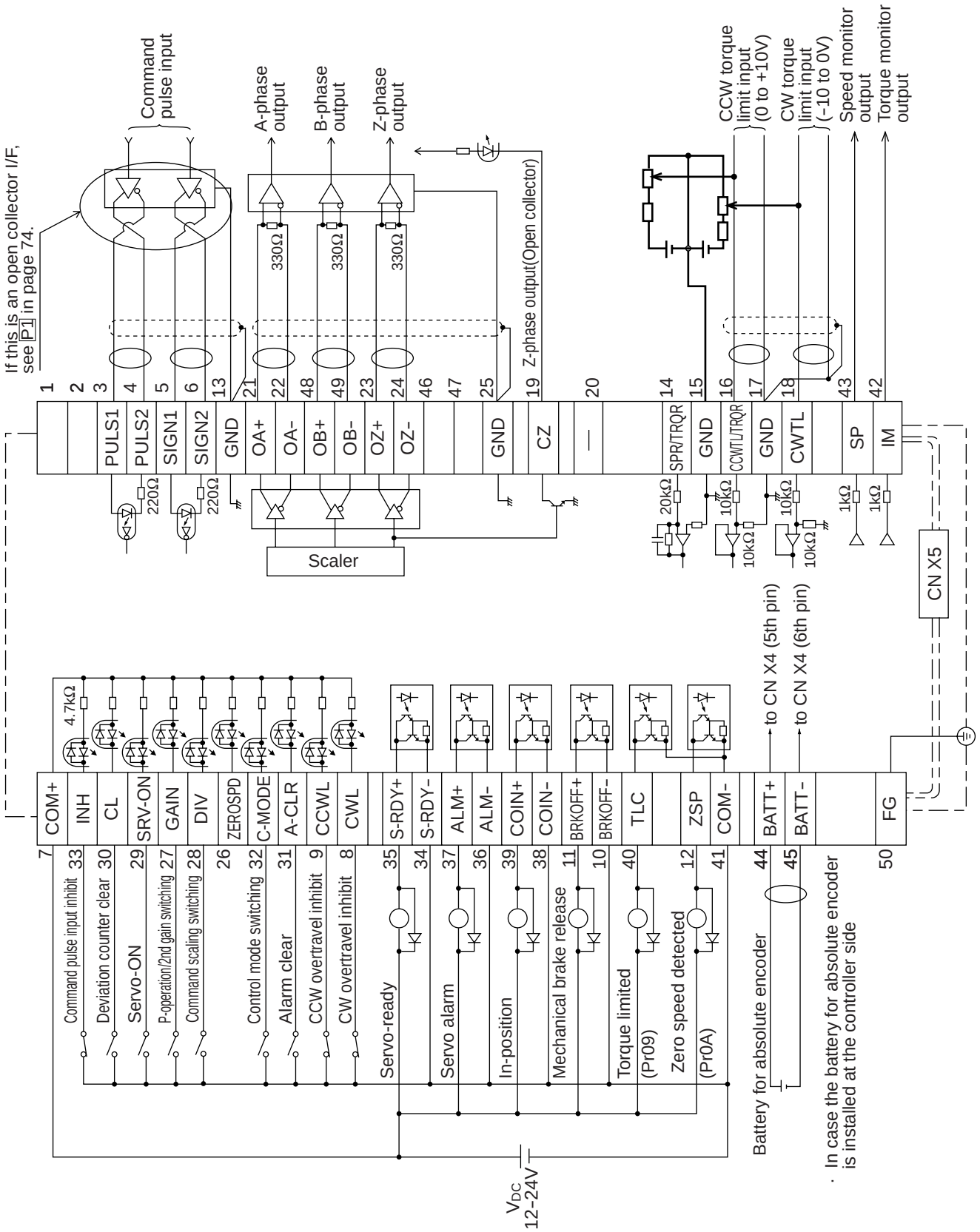
- **Control mode set-up: when Pr02 is [0]***



* For the block diagram showing "Control mode set-up parameter Pr02=[11] (position control for high-stiffness equipment) and Pr02 [12] (position control for low-stiffness equipment), see page 301 "Appendix".

CN X5 Connector

Circuits Available for Position control mode



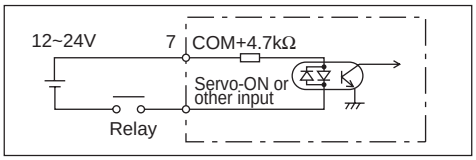
CN X5 Connector

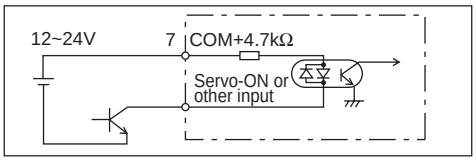
Interface Circuit

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.





PI PI Command pulse input circuit

1) Line Driver I/F
- This is a good signal transmission method that is less sensitive to noises. We recommend you to use this to maintain the reliability of signals.

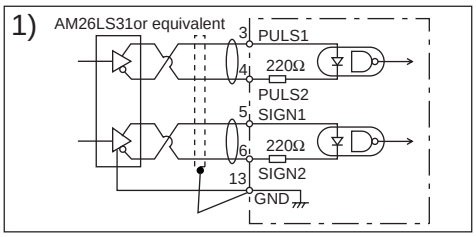
2) Open Collector I/F
- This uses an external control power supply(V_{DC}).
- This requires a current-limiting resistor (R) corresponding to the capacity of the V_{DC} value.
- Be sure to connect specified resistance (R).

V_{DC}	R value
12V	1kΩ 1/2W
24V	2kΩ 1/2W

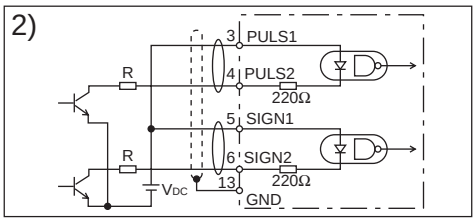
$$\frac{V_{DC} - 1.5}{R + 220} \fallingdotseq 10mA$$

shows a pair of twisted wires.

1)



2)

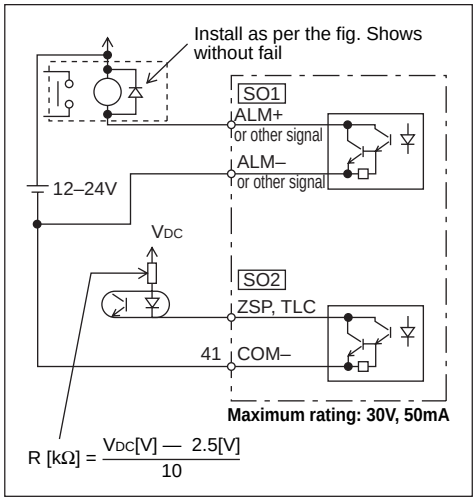


Max. input voltage DC24V
Rated current 10mA

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.

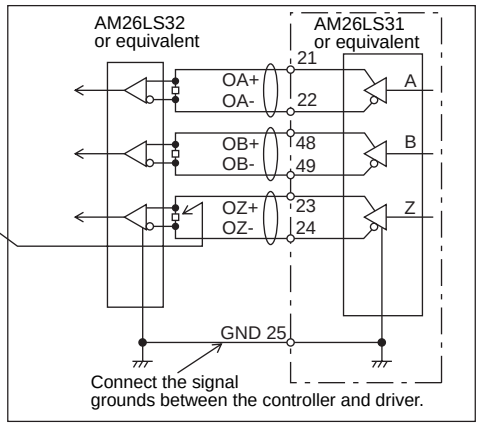


For the recommended primary current value, check the data sheet on the equipment and photo-coupler used.

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.

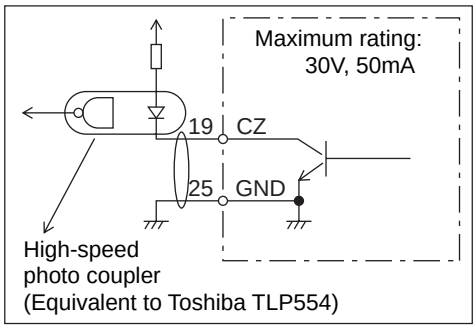
shows a pair of twisted wires.



PO2 Open Collector Output

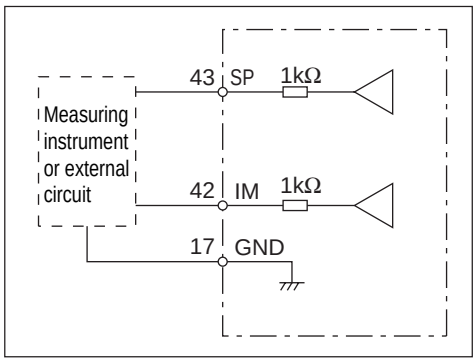
- Outputs Z-phase signals among those from the encoder. The outputs are non-insulated.
- Receive these signal with high-speed photo coupler at controller side, since these Z-phase signal width is normally narrow.

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 74</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 74</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 74</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 74</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 74</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 74</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 74</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="2">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="3">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 74</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 74</td></tr>
</table>

CN X5 Connector

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

Input Signals (Position Control) and their Functions

Signal	Pin No.	Symbol	Function	I/F circuit
Command pulse	**3**	**PULS1**	• This is the input terminal for command pulses. The driver receives this signal by a high-speed photo coupler. **• Max input voltage 24VDC/Rated current 10mA.** • The input impedance of PULSE and SIGN signals is 220Ω. • Command pulses can be input in three different ways. Use Pr42 to select one of the following. 1) Quadrature (A and B) input 2) CW (PULSE)/CCW (SIGN) pulse input 3) Command pulse (PULS)/Sign (SIGN) input	PI page 74
	4	**PULS2**		
Command sign	**5**	**SIGN1**		
	6	**SIGN2**		
Command pulse scalar switch	**28**	**DIV**	• With COM– closed, the numerator of the command scalar is changed from the value stored in Pr46 (Numerator of 1st Command Scalar) to the value stored in Pr47 (Numerator of 2nd Command Scalar). **< Note >** Don't enter command pulses 10 ms after or before switching.	SI page 74
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 –**		

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 75
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 75
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.	SO1 page 75
Zero speed detection	**12**	**ZSP**	• Signal which is selected at Pr0A (ZSP Output Selection) will be turned on.	SO2 page 75

Pr0A value	Function
0	Output(transistor) turns ON during the In-toque limiting.
1 (Factory-setting)	Output(transistor) turns ON when the motor speed becomes lower than that of the preset speed with Pr61(Zero speed).
2*	Output(transistor) turns ON when either one of over-regeneration, overload or battery warning is activated.
3*	Output(transistor) turns ON when the over-regeneration (more than 85% of permissible power of the internal regenerative discharge resistor) warning is activated.
4*	Output(transistor) turns ON when the overload (the effective torque is more than 85% of the overload trip level) warning is activated.
5*	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.

* 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.

<table>
<tr><th>Signal</th><th>Pin No.</th><th>Symbol</th><th>Function</th><th>I/F circuit</th></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 75</td></tr>
<tr><td>In-position/
At-speed</td><td>39
38</td><td>COIN +
COIN –</td><td>• Function changes at control mode.
<Caution>
As positional deviation is always around 0 even during operation in control following commands, COIN (positioning complete signal) may remain ON.
<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 75</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 75</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 75</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 75</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 75</td></tr>
</table>

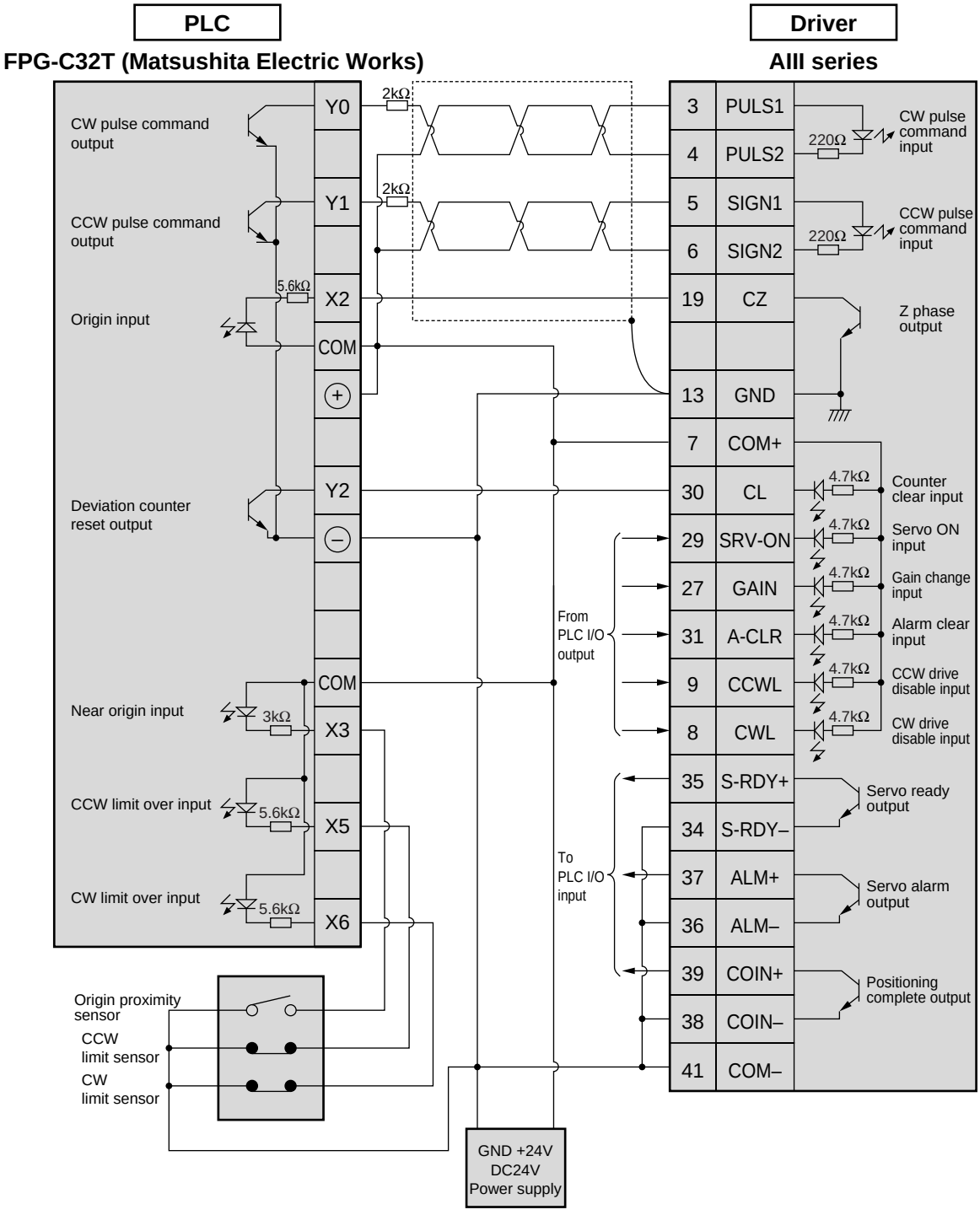
Output Signals (Others) and their Functions

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.	–

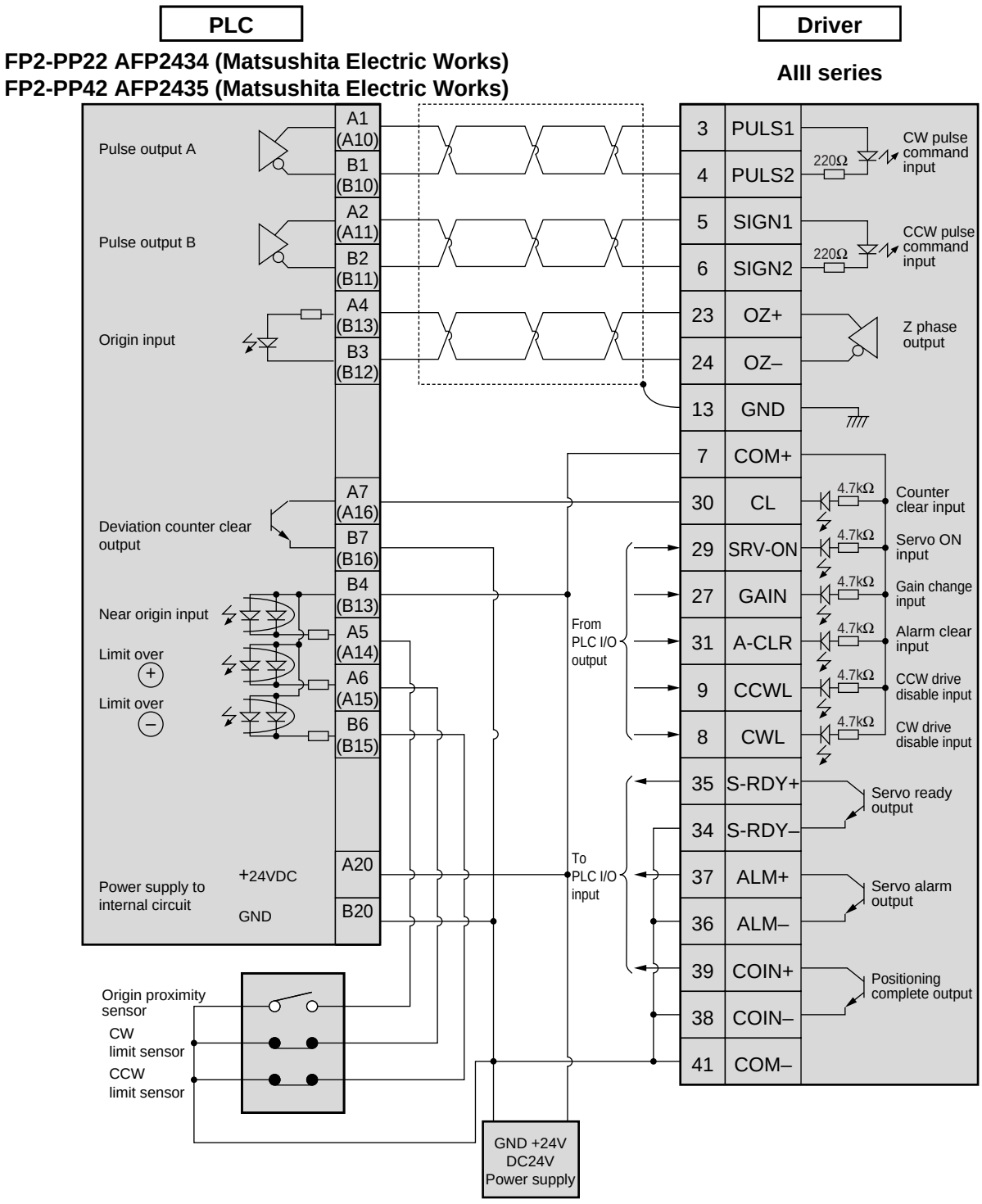
CN X5 Connector

Examples of connection to high order control equipment

Example 1 - PLC: FPG-C32T (Matsushita Electric Works)

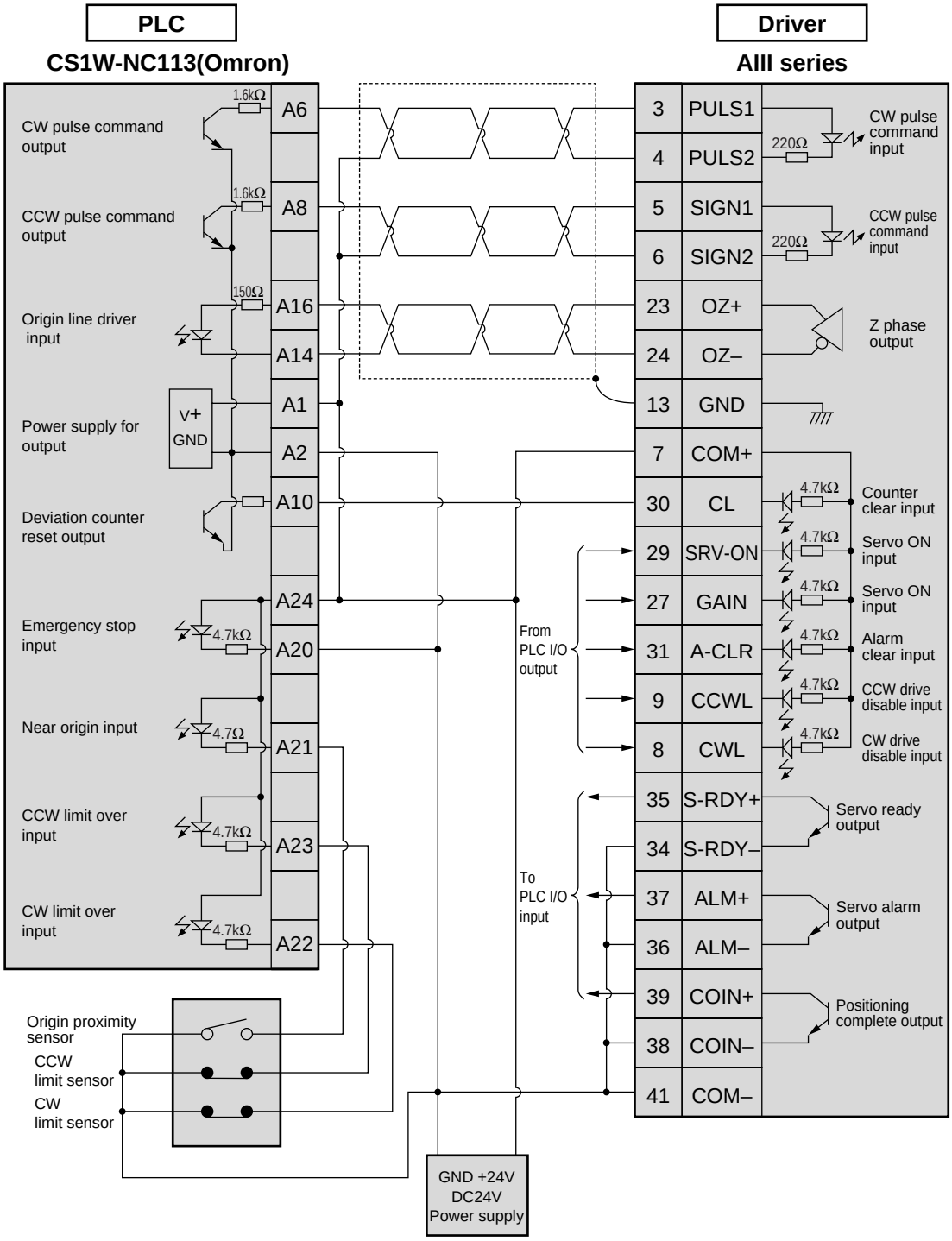


Example 2 - PLC: FP2-PP22 AFP2434/FP2-PP42 AFP2435 (Matsushita Electric Works)

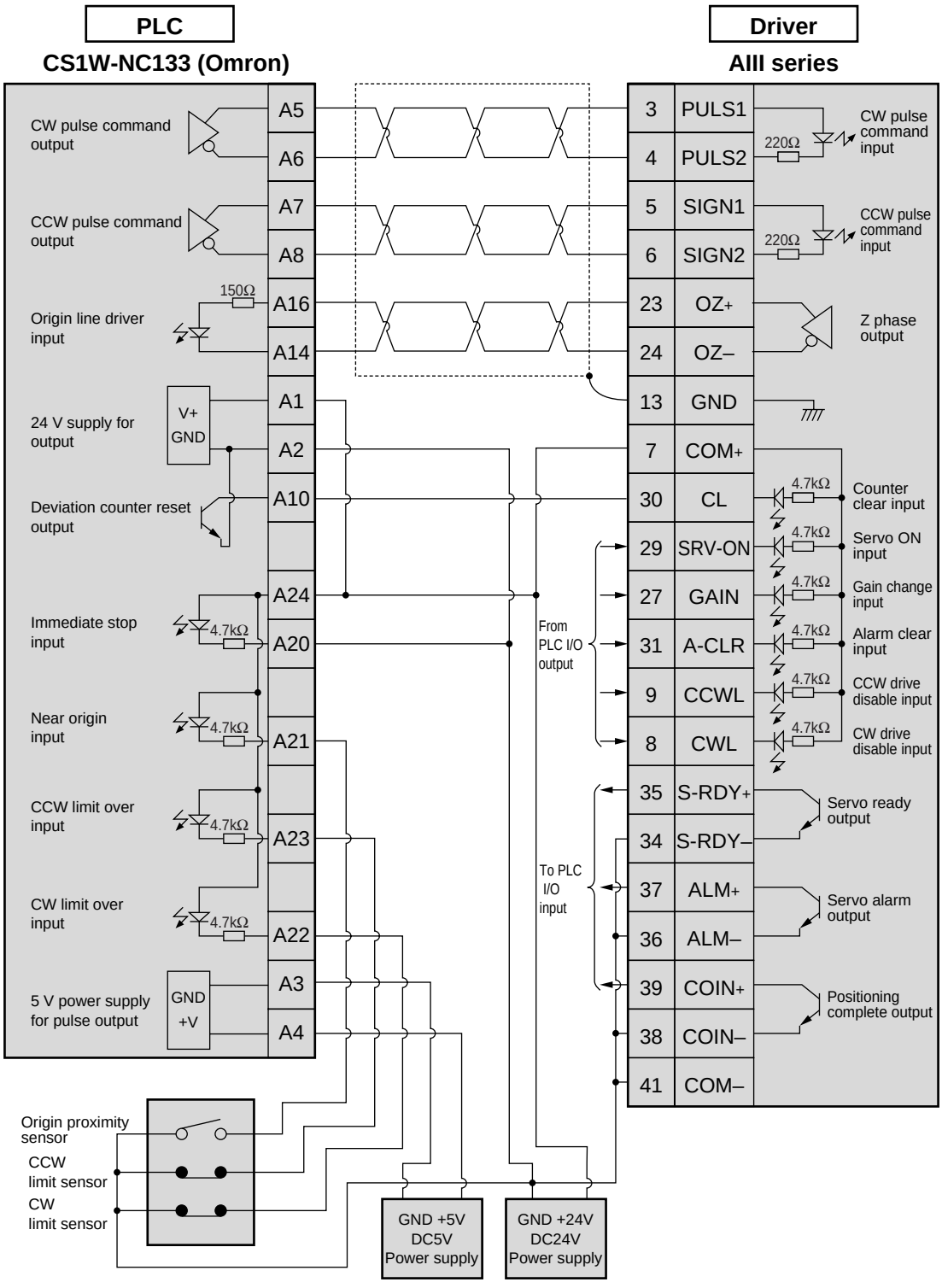


CN X5 Connector

Example 3 - PLC: CS1W-NC113 (Omron)

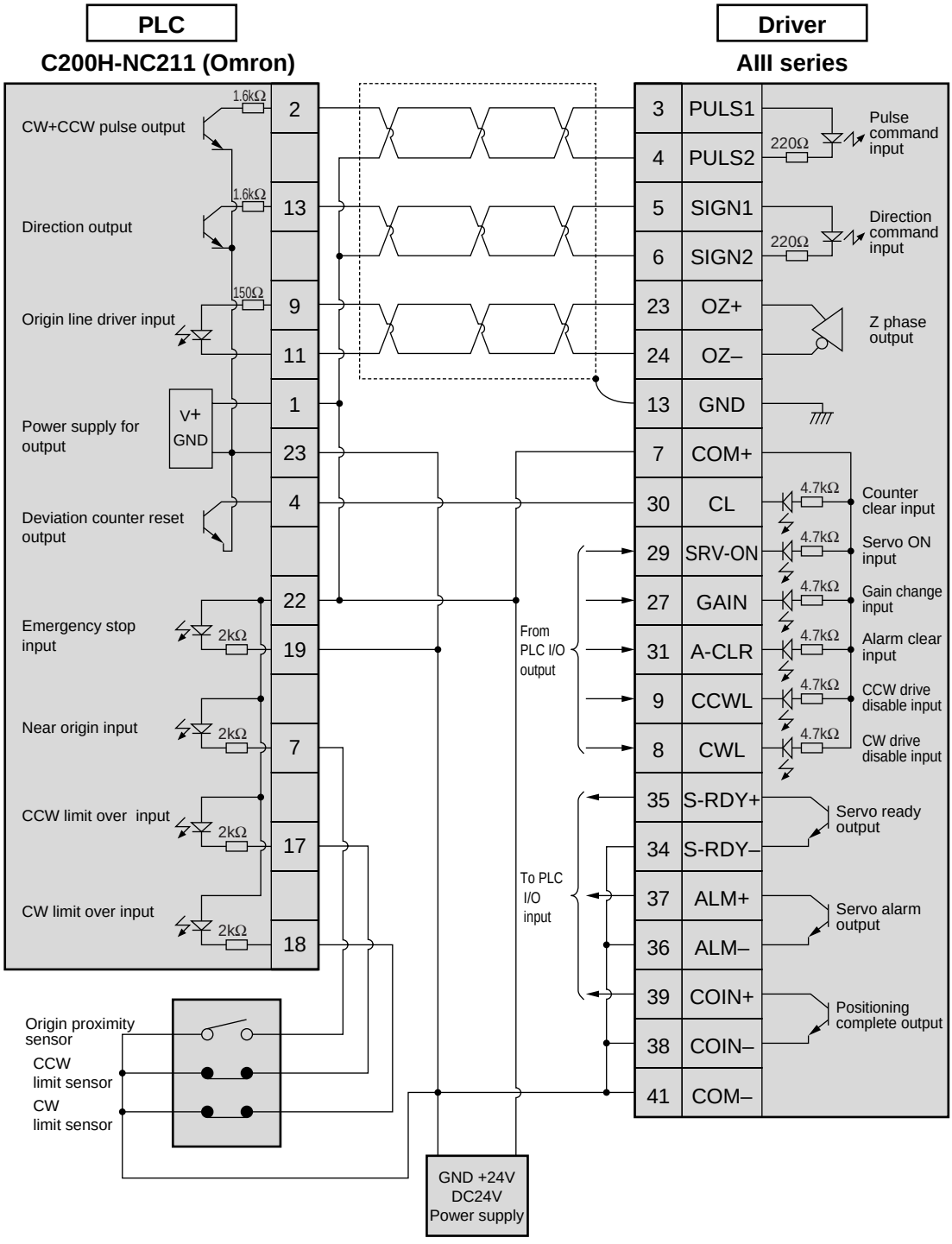


Example 4 - PLC: CS1W-NC133 (Omron)

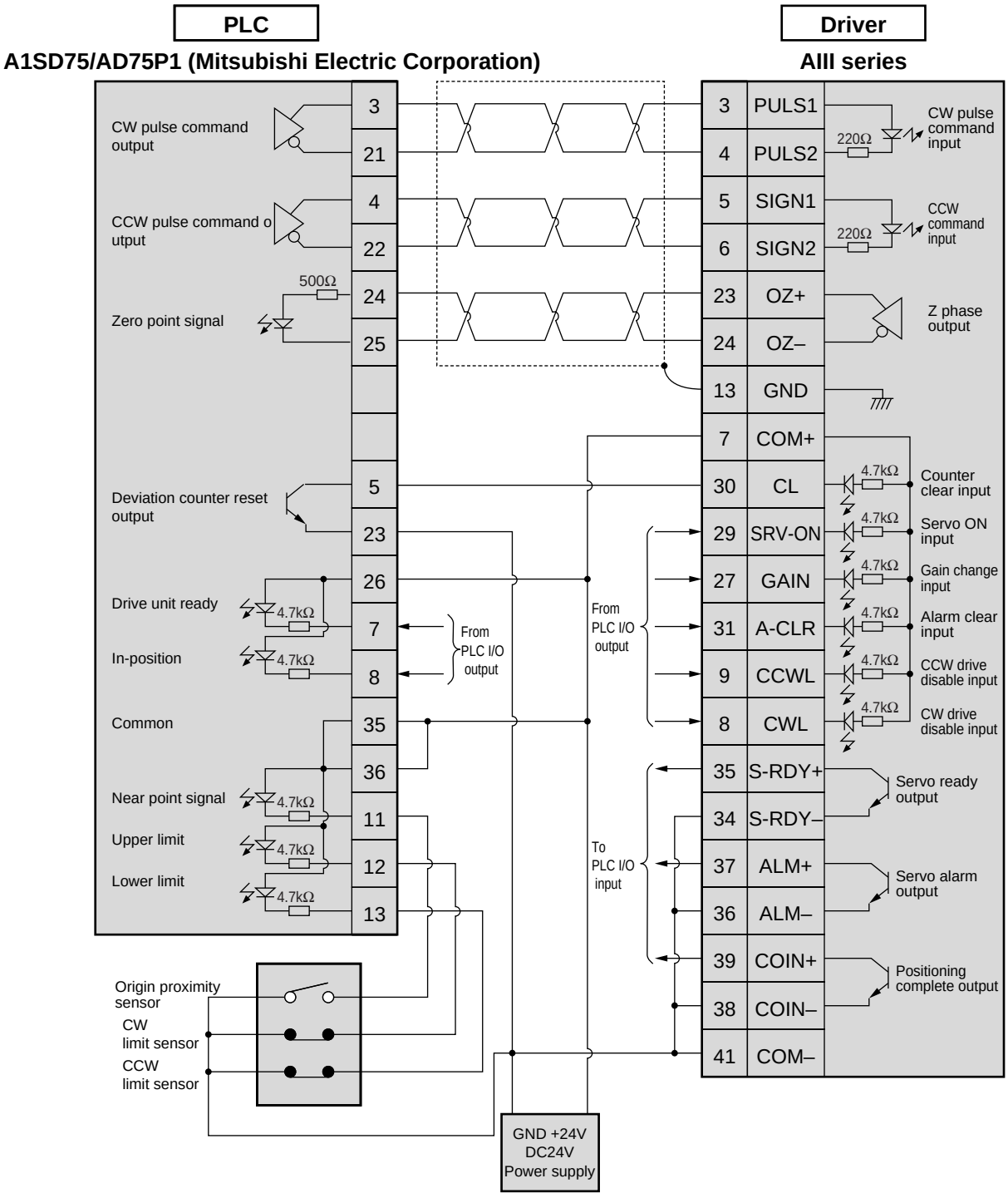


CN X5 Connector

Example 5 - PLC: C200H-NC211 (Omron)



Example 6 - PLC: A1SD75/AD75P1 (Mitsubishi Electric Corporation)



Trial run at Position 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.

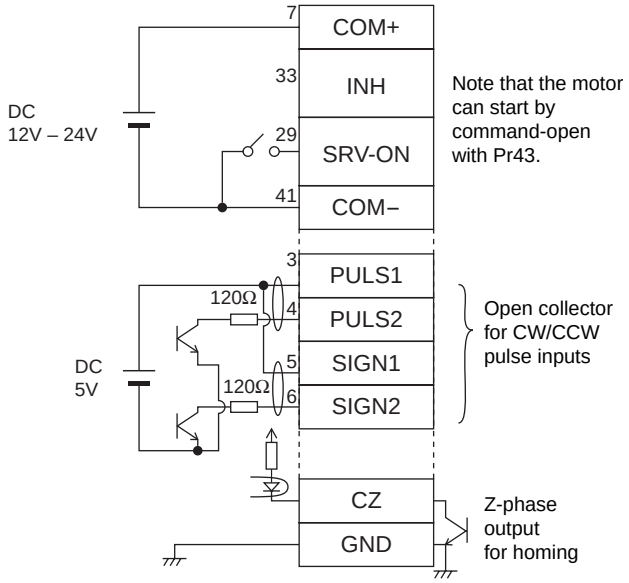
5) Connect between SRV-ON (CN X5 pin 29) and COM– (CN X5 pin 41) to make Servo-On active. The motor will be kept excited.

6) Set Pr42 (Command Pulse Input Mode Set-Up) according to the output form of the controller. Then write it down to EEPROM, followed by turning the power OFF and then ON again.

7) Send a low-frequency pulse signal from the controller to the to run the motor at low speed.

8) Check the motor speed at monitor mode.
   • Make sure that the speed is per the set-up.
   • Check if the motor stops when the command (pulse) is stopped.

Wiring Diagram



Parameters

PrNo.	Parameter description	Value
Pr02	Control mode set-up	0
Pr04	Overtravel input inhibit	1
Pr42	Command pulse input mode set-up	1
Pr43	Command pulse input inhibit	1

• 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	–	
8	Command pulse input inhibit	–	Related to Pr43
A	Counter clear	–	

Set-up of motor speed and input pulse frequency

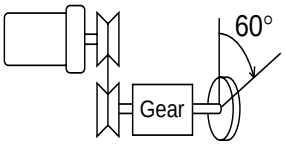
Input pulse frequency (pps)	Motor speed (r/min)	$\frac{\boxed{Pr46} \times 2^{\boxed{Pr4A}}}{\boxed{Pr4B}}$	
		17 bits	2500P/r
500k	3000	$\frac{\boxed{1} \times 2^{\boxed{17}}}{\boxed{10000}}$	$\frac{\boxed{10000} \times 2^{\boxed{0}}}{\boxed{10000}}$
250k	3000	$\frac{\boxed{1} \times 2^{\boxed{17}}}{\boxed{5000}}$	$\frac{\boxed{10000} \times 2^{\boxed{0}}}{\boxed{5000}}$
100k	3000	$\frac{\boxed{1} \times 2^{\boxed{17}}}{\boxed{2000}}$	$\frac{\boxed{10000} \times 2^{\boxed{0}}}{\boxed{2000}}$
500k	1500	$\frac{\boxed{1} \times 2^{\boxed{16}}}{\boxed{10000}}$	$\frac{\boxed{5000} \times 2^{\boxed{0}}}{\boxed{10000}}$

← **Preset value**

* Our preset value causes the motor shaft to rotate by one with 10,000 pulses input. Note that the maximum input pulse frequency is 500 kpps with line driver and 200 kpps with open collector.

* You can set any value by setting any value for the numerator and denominator. However, the motor action will not follow any extreme setting of the ratio. It is recommended to set within a range from 1/50 to 20 times.

Relationship between motor speed and input pulse frequency



Pulley ratio: 18/60
Gear ratio: 12/73
Overall reduction: 18/365

(Example) Rotate the motor by 60 degrees with an overall reduction ratio of 18/365

	Encoder pulse	
	17 bits	2500P/r
$\frac{\boxed{Pr46} \times 2^{\boxed{Pr4A}}}{\boxed{Pr4B}}$	$\frac{\boxed{365} \times 2^{\boxed{10}}}{\boxed{6912}}$	$\frac{\boxed{365} \times 2^{\boxed{0}}}{\boxed{108}}$
Theory	From the controller to the , enter a command with which the motor turns one revolution with 8192 (2^{13}) pulses.	From the controller to the , enter a command with which the motor turns one revolution with 10000 pulses.
Determining the parameter	$\frac{365}{18} \times \frac{1 \times 2^{17}}{2^{13}} \times \frac{60^\circ}{360^\circ}$ $= \frac{\boxed{365} \times 2^{\boxed{17}}}{\boxed{884736}}$ The numerator 47841280 is greater than 2621440, and the denominator is greater than 10,000. Thus, $\frac{365}{18} \times \frac{1 \times 2^{10}}{2^{6}} \times \frac{60^\circ}{360^\circ}$ $= \frac{\boxed{365} \times 2^{\boxed{10}}}{\boxed{6912}}$	$\frac{365}{18} \times \frac{10000}{10000} \times \frac{60^\circ}{360^\circ}$ $= \frac{\boxed{365} \times 2^{\boxed{0}}}{\boxed{108}}$

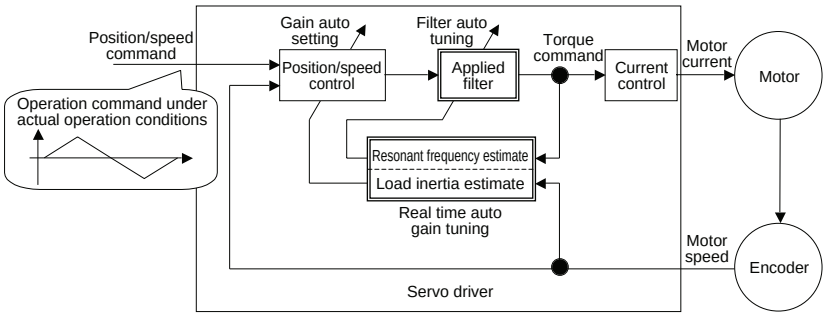
2^n	10 Decimal
2^0	1
2^1	2
2^2	4
2^3	8
2^4	16
2^5	32
2^6	64
2^7	128
2^8	256
2^9	512
2^{10}	1024
2^{11}	2048
2^{12}	4096
2^{13}	8192
2^{14}	16384
2^{15}	32768
2^{16}	65536
2^{17}	131072

* See also “Description on Command Pulse Ratio for Parameter Setup” on page 264.

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.

Description of the adaptive filter

By setting Pr21 (Real-time auto tuning set-up) to 1 – 3 or 7, the adaptive filter is enabled.
In an actual operation state, resonance frequency is estimated based on the vibration component, which appears in motor speed, and resonance point vibration is reduced by removing resonance component from the torque command by the adaptive filter.
The adaptive filter may not function normally under the following conditions. In such a case, take anti-resonance measures using the 1 st . notch frequency (Pr1D and 1E) or second notch filter (Pr28 – 2A) in accordance with the manual tuning procedure.
For details on the notch filter, refer to “To Reduce the Mechanical Resonance” on page 204.

	Conditions under which the adaptive filter is prevented from functioning
Resonance point	• When the resonance frequency is 300 [Hz] or less • When resonance peak is low, or control gain is low; and its influence does not appear on the motor speed • When plural resonance points reside in
Load	• When a motor speed fluctuation having a high frequency component is caused due to a non-linear element such as backlash etc
Command pattern	• When acceleration/deceleration is too sharp like 30000 [r/min] or more per 1 [s]

Parameters, which are set up automatically

The following parameters are tuned automatically.

Parameter No.	Name
10	1st position loop gain
11	1st speed loop gain
12	1st speed loop integration time constant
13	1st speed detection filter
14	1st torque filter time constant
18	2nd position loop gain
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
2F	Adaptive filter frequency

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

Parameter No.	Name	Set value
15	Speed feed forward	300
16	Feed forward filter time constant	50
17	1st position integration gain	0
1F	2nd position integration gain	0
27	Disturbance torque observer filter selection	0
30	2nd gain action set-up	1
31	Position control switching mode	10
32	Position control switching delay time	30
33	Position control switching level	50
34	Position control switching hysteresis	33
35	Position loop gain switching time	20

Caution

[1] Immediately after the first turning the servo ON at start up, or when Pr22 (Machine stiffness at real-time auto tuning) is stated up, sometimes a noise or vibration may be generated until the load inertia is determined or the adaptive filter is stabilized. But, when the machine gets stabilized soon, there is no problem. But, when such problem as vibration or noise continues during a period of 3 reciprocal operations, etc occurs 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)
  *4) Set up the notch filter manually.
    * When disabling he real time auto tuning, see page 196 "Disabling of auto tuning function" in Adjustments.

[2] After a noise or vibration has occurred, Pr20 (Inertia ratio) and/or Pr2F (Adaptive filter frequency) may have been changed into an extreme value. In such a case also, take the above measures.

[3] In the results of the real time auto gain tuning, Pr20 (Inertia ratio) and Pr2F (Adaptive filter frequency) are written into the EEPROM every 30 minutes. And auto tuning is carried out using the data as the initial value.

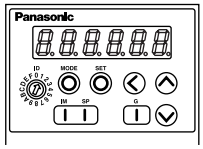
Parameter Setting

Parameters for Function Selection

Default setting is shown by [ ]

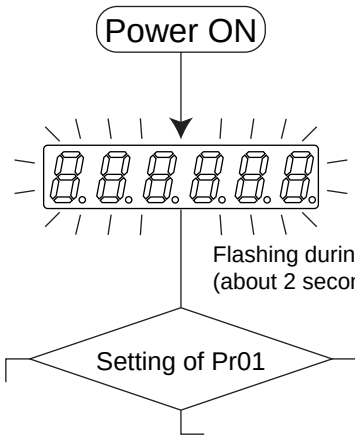
Parameter No.	Parameter Name	Setting range	Function/Description
00	**Axis address**	0 – 15 [1]	In communications with a host device such as a personal computer that uses RS232C/485 with multiple axes, you should identify to which axis the host accesses and use this parameter to confirm axis address in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

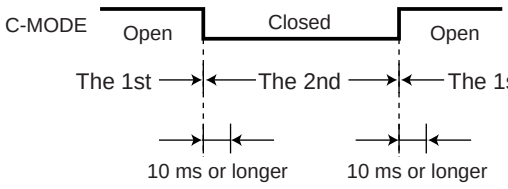
02 Control mode — 0 – 14

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).

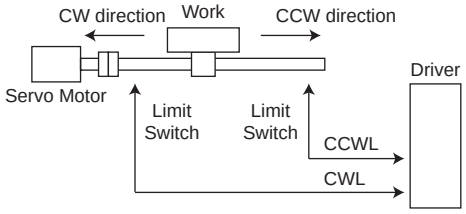


<Caution>

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>03</td><td>Torque limit selection</td><td>0 – 1
[1]</td><td>The parameter is used to disable analog torque limit input (CCWTL, CWTL) signals.
0: Enabled
1: Disabled
If you do not use torque limit functions, set “1” to Pr03.
With Pr03 set to “0” and torque limit input (CCWTL, CWTL) open, no torque will be generated, and thus the motor does not rotate.</td></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 rowspan="2">Setting value</th><th rowspan="2">CCWL/CWL Input</th><th colspan="2">Input</th><th rowspan="2">Action</th></tr>
<tr><th>Input</th><th>Connection with COM-</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).
3. Work may repeat vertical motion as a result of absence of upward torque after you turned off the limit switch on the upper side of work on the vertical axis. In such a case, you should not use this function, and instead execute limit processing on the host controller side.</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
10	**1st position loop gain**	0 – 32767 [63]*	1/s	• The parameter defines responsiveness of the position control system. Higher position gain would shorten time of positioning.
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.
15	**Velocity feed forward**	–2000 – 2000 [300]*	0.1%	• The parameter defines volume of speed feed forward under position control. Setting it to 100% would make positional deviation in operation at a constant rate almost 0. When you set it higher, positional deviation will decrease and responsiveness will be improved. Be careful, however, as overshooting is apt to occur.
16	**Feed forward filter time constant**	0 – 6400 [50]*	0.01ms	• The parameter sets a time constant of the primary delay filter inserted into the speed feed forward unit. • Inclusion of the feed forward function would cause speed overshooting/undershooting. Thus, this filter may make improvement when a positioning completion signal is chattering.
17	**1st position integration gain**	0 – 10000 [0]*	x 10/s^2	• The parameter sets integration gain of a position loop. • This is enabled only in control mode HP. **Note)** In order to prevent excessive oscillation, you may set the parameter only in the range that satisfies the following expression for Pr10. $(Pr10)^2 \geqq 20 \times Pr17$
18	**2nd position loop gain**	0 – 32767 [73]*	1/s	• 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.
19	**2nd velocity loop gain**	1 – 3500 [35]*	Hz	
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.
1F	**2nd position integration gain**	0 – 10000 [0]*	x 10/s^2	• This parameter should be set only when you use the gain switching function to execute optimal tuning. • The parameter sets integration gain. • It is enabled only under control mode HP. Refer to "Adjustment upon switching gain" of Adjustment volume on page 202.

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 GainTuning</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>23</td><td>Fit gain function set up</td><td>0 – 2
[2]</td><td>–</td><td>Operation mode of the fit gain function is set. It can be used in position control mode /semi-closed control mode only.
The larger value provides the finer optimum gain.
0: Disabled
(at the same time, Pr24: result of fit gain function tuning is cleared.)
1: Level 1 enabled (optimum rigidity is searched)
2: Level 2 enabled (optimum gain is searched)
See page 190 "Fit Gain Function" in Adjustments.</td></tr>
<tr><td>24</td><td>Result of fit gain function</td><td>–32768 – 32767
[0]</td><td>–</td><td>• The parameter displays the result of tuning of the fit gain function.
• This value is set automatically by the fit gain function; it can not be altered.</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 [ ]

Parameter No.	Parameter Name	Setting range	Unit	Function/Description
26	**Disturbance torque compensation gain**	0 – 200 [0]	%	• When the control mode is HP, LP, LS or UPF, a gain, in which the torque command is multiplied by a disturbance torque estimate value, is set. • By setting 100 [%], a torque compensation that clears the disturbance torque is applied. • When Pr21 real time auto tuning mode setting is altered, Pr26 changes to 0 (disabled).
27	**Disturbance torque observer filter selection**	0 –255	–	• Cut-off frequency of the filter for disturbance torque observer is set. **Set value** / **Cutoff Frequency** [0]* / Disturbance Observer Disabled 1 – 255 / Enabled, filter cutoff frequency [Hz] = 3.7 x setting 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.
28	**2nd notch frequency**	100 – 1500 [1500]	Hz	• 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
29	**2nd notch width selection**	0 – 4 [2]	–	• Select the notch width of the second resonance suppression notch filter. • Increasing the set value enlarges the notch width.
2A	**2nd notch depth selection**	0 – 99 [0]	–	• Select the notch depth of the second resonance suppression notch filter. • Increasing the set value reduces the notch depth and the phase delay.
2B	**Vibration suppression frequency**	0 – 500 [0]	Hz	• Vibration suppression frequency of the vibration suppression for suppressing vibration at the front end of a load is set. Frequency of vibration at the front end of the load is measured and set. Unit: [Hz] • Minimum setting frequency is 10 [Hz]. When it is set to 0 - 9, it is disabled. • Before using this function, see page 211 "Vibration suppression control" in Adjustments.
2C	**Vibration suppression filter**	–20 – 250 [0]	Hz	• When setting Pr2B (vibration reducing frequency), if torque saturation occurs, set a larger value; if a faster operation is required, set a smaller value. • Before using this function, see page 211 "Vibration suppression control" in Adjustments.
2F	**Adaptive filter frequency**	0 – 64 [0]*	–	• 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.

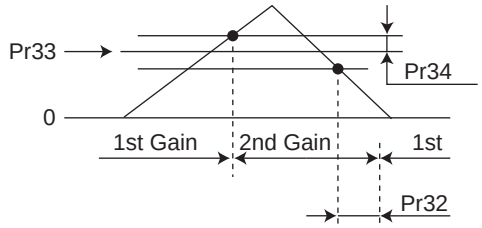
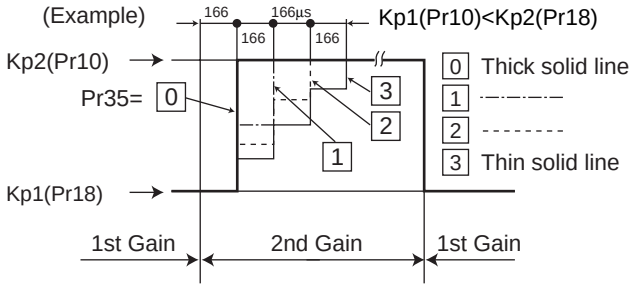
Note) Standard default setting in [ ] under "Setting range" and marked with * is automatically set during the real time auto gain tuning. To manually change the value, first disable the auto gain tuning feature be seeing page 196 "Disabling of auto tuning function" in Adjustments, and then enter the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

Parameters for 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>31</td><td>Position control switching mode</td><td>0 –10</td><td>–</td><td>• The parameter selects conditions of switching the 1st and 2nd gains in position control mode.
<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>The 2nd gain is selected with gain switching input (GAIN) turned ON (Pr30 needs setting of 1).</td></tr>
<tr><td>3 *3</td><td>Torque command variation is greater than setting of Pr33 (position control switching level) and Pr14, and the 2nd gain is selected.</td></tr>
<tr><td>4 *3</td><td>Fixed to the 1st gain.</td></tr>
<tr><td>5 *3</td><td>Command speed is greater than setting of Pr33 (position control switching level) and Pr14, and the 2nd gain is selected.</td></tr>
<tr><td>6 *3</td><td>Positional deviation is greater than setting of Pr33 (position control switching level) and Pr14, and the 2nd gain is selected.</td></tr>
<tr><td>7 *3</td><td>Position command is present and the 2nd gain is selected.
The 2nd gain is selected when the command pulse is 1 or higher in 166ms.</td></tr>
<tr><td>8 *3</td><td>The 2nd gain is selected with positioning not complete.
The 2nd gain is selected when a value of the positional deviation counter is greater than Pr60 (positioning completion range).</td></tr>
<tr><td>9 *3</td><td>Motor actual speed is greater than setting of Pr33 (position control switching level) and Pr34, and the 2nd gain is selected.</td></tr>
<tr><td>[10]* *3</td><td>Switching to the 2nd gain with position command present.
Switching to the 1st gain when absence of position command continues for Pr32 (x 166ms) and speed falls below Pr33 - Pr34 [r/min].</td></tr>
</table>
*3 For levels to be switching and timing, refer to "Adjustment upon switching gain" of Adjustment volume on page 202.</td></tr>
<tr><td>32</td><td>Position control switching delay time</td><td>0 – 10000
[30]*</td><td>x 166µs</td><td>• The parameter sets delay time of diversion from switching conditions set with Pr31 to actual return to the 1st gain, when Pr31 is enabled at settings of 3, 5, 6, 7, 9, and 10.</td></tr>
<tr><td>33</td><td>Position control switching level</td><td>0 – 20000
[50]*</td><td>–</td><td>• The parameter sets judgment level upon switching between the 1st and the 2nd gains, when Pr31 is enabled at settings of 3, 5, 6, 9, and 10.</td></tr>
</table>

Default setting is shown by [ ]

Parameter No.	Parameter Name	Setting range	Unit	Function/Description
34	**Position control switching hysteresis**	0 – 20000 [33]*	–	• The parameter sets width of hysteresis to be provided above and under the judgment level set with Pr33 mentioned above. • The following figure shows definitions of the above-mentioned Pr32 (delay), Pr33 (level) and Pr34 (hysteresis).  **<Caution>** Settings of Pr33 (level) and Pr34 (hysteresis) are enabled as an absolute value (positive/negative).
35	**Position gain switching time**	0 – 10000 [20]*	(Setting +1) x 166µs	• The parameter sets stepped switching time only for position loop gain upon switching gains when the 2nd gain switching function has been enabled.  • Switching time should be provided only when a small position loop gain is switched to a large position loop gain (Kp1 –> Kp2). (This is to alleviate impact on the machine due to rapid change of gain.) • You should set a value smaller than a difference of Kp2 and Kp1.

Parameters for Position Control

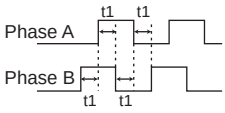
Default setting is shown by [ ]

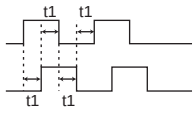
Parameter No.	Parameter Name	Setting range	Function/Description
40	**Command pulse multiplier set up**	1 – 4	• The parameter sets a multiply when “2-phase pulse input” has been selected as a command pulse form with Pr42 (command pulse input mode setting). Setting value / Multiply when 2-phase pulse is input: 1 – x 1 2 – x 2 3 or [4] – x 4
41	**Command pulse logic inversion**	0 – 3	• Each of logics of 2 pulse command input (PULS, SIGN) systems can be individually set inside the driver. Setting value / “PULS” Signal Logic / “SIGN” Signal Logic: [0] – Non-inverting – Non-inverting 1 – Inverting – Non-inverting 2 – Non-inverting – Inverting 3 – Inverting – Inverting

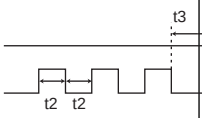
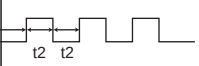
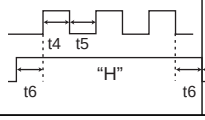
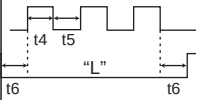
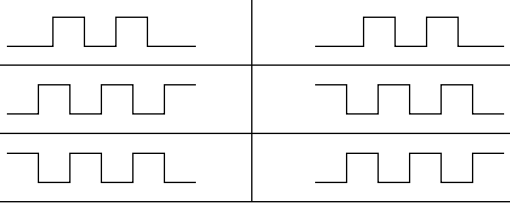
Note) Standard default setting in [ ] under "Setting range" and marked with * is automatically set during the real time auto gain tuning. To manually change the value, first disable the auto gain tuning feature be seeing page 196 "Disabling of auto tuning function" in Adjustments, and then enter the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

Parameter Setting

Default setting is shown by [ ]

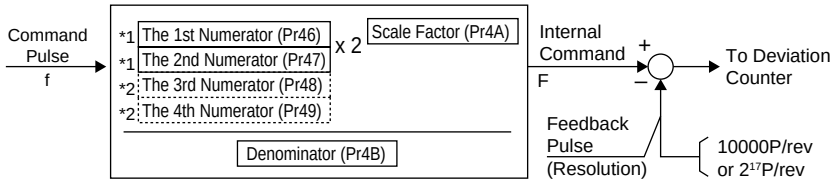
<table>
<tr><th>Parameter No.</th><th>Parameter Name</th><th>Setting range</th><th>Function/Description</th></tr>
<tr><td>42</td><td>Command pulse input mode</td><td>0 – 3</td><td>• The parameter sets an input form of a command pulse to be given from the host device to the driver. Three types of forms listed in the following table can be set. Make selection in accordance with specifications of the host device.
<table>
<tr><th>Setting value</th><th>Command pulse form</th><th>Signal Name</th><th>CCW Command</th><th>CW Command</th></tr>
<tr><td>0 or 2</td><td>90˚ phase difference Two-phase pulse (Phase A + Phase B)</td><td>PULS SIGN</td><td> 

Phase B advances 90˚ ahead of phase A.</td><td> 

Phase B delays 90˚ from phase A</td></tr>
<tr><td>[1]</td><td>CW pulse train + CCW pulse train</td><td>PULS SIGN</td><td> 
</td><td> 
</td></tr>
<tr><td>3</td><td>Pulse train + symbols</td><td>PULS SIGN</td><td> 
</td><td> 
</td></tr>
</table>
Allowed maximum input frequency and required minimum time width of command pulse input signal
<table>
<tr><th rowspan="2">Input I/F of PULS/SIGN signals</th><th rowspan="2">Allowed maximum input frequency</th><th colspan="6">Required minimum time width [μs]</th></tr>
<tr><th>t1</th><th>t2</th><th>t3</th><th>t4</th><th>t5</th><th>t6</th></tr>
<tr><td>Line driver interface</td><td>500kpps</td><td>2</td><td>1</td><td>1</td><td>1</td><td>1</td><td>1</td></tr>
<tr><td>Open collector interface</td><td>200kpps</td><td>5</td><td>2.5</td><td>2.5</td><td>2.5</td><td>2.5</td><td>2.5</td></tr>
</table>
Pulse rise/fall time of command pulse input signal should be set to no more than 0.1μs.</td></tr>
<tr><td>43</td><td>Command pulse inhibit input invalidation</td><td>0 – 1</td><td>• The parameter selects enable/disable of command pulse inhibit input INH: CN X5 33-pin).
<table>
<tr><th>Setting value</th><th>INH Input</th></tr>
<tr><td>0</td><td>Enable</td></tr>
<tr><td>[1]</td><td>Disable</td></tr>
</table>
With INH input, connection with COM- will be open, and command pulse input will be inhibited. If you do not use INH input, set 1 to Pr43. You no longer need to connect INH (CN 1/F 33-pin) and COM- (41-pin) external to the driver.</td></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></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 rowspan="3">  </td><td rowspan="3"></td></tr>
<tr><td>[0]</td><td>B pulse(OB) Non-inverting</td></tr>
<tr><td>1</td><td>B pulse(OB) Inverting</td></tr>
</table></td></tr>
</table>

Default setting is shown by [ ]

Parameter No.	Parameter Name	Setting range	Function/Description
46	Related to command pulse multiply division function (Pr46 to 4B)		
	1st numerator of command pulse ratio	1 – 10000 [10000]	Command pulse multiply division (electronic gear) function Purpose of Use 1) To arbitrarily set rotation/movement of the motor per unit input command pulse. 2) In the case predetermined motor speed cannot be achieved because of limited pulse oscillation capacity (highest possible output frequency) of the host device, multiply function should be used to increase seeming command pulse frequency. • Block Diagram of Multiply Division Unit:
47	**2nd numerator of command pulse ratio**	1 – 10000 [10000]	
48	**3rd numerator of command pulse ratio**	1 – 10000 [10000]	
49	**4th numerator of command pulse ratio**	1 – 10000 [10000]	
4A	**Multiplier of numerator of command pulse ratio**	0 – 17 [0]	• An upper limit of computed value of a numerator will be 2621440. Note that even when you set a value higher than this, it will become invalid and 2621440 will be a numerator. *1: Select the 1st or 2nd numerator by means of command multiply division switching (DIV:CN X5 28-pin).
4B	**Denominator of command pulse ratio**	1 – 10000 [10000]	*2: 3rd and 4th numerators are used for special specifications such as full-closed specification. For further information, refer to “Full-Closed Control” volume on page 156. **<Examples of Setting>** • It is basic to have a relation “a motor rotates once with command input (f) for resolution of an encoder” when the multiply division ratio is 1. Therefore, to rotate the motor once as an example of the case in which the encoder has resolution of 10000P/r, f=5000Pulse at multiply of 2 and f=40000Pulse at 1/4 division should be input. • Pr46, Pr4A and Pr4B should be set so that internal command after multiply division will be equal to resolution of the encoder (i.e., 10000 or 2^{17}).



DIV Off	Select the first numerator (Pr46).
DIV ON	Select the second numerator (Pr47).

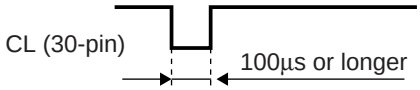
$$F = f \times \frac{Pr46 \times 2^{Pr4A}}{Pr4B} = 10000 \text{ or } 2^{17}$$

F: Number of internal command pulses for one revolution of the motor
f: Number of command pulses for one revolution of the motor

Resolution of Encoder	2^{17} (131072)	10000 (2500P/r x 4)
Example 1: When command input (f) is set to 5000 per revolution of the motor]	$\frac{Pr46\ [1] \times 2^{Pr4A\ [17]}}{Pr4B\ [5000]}$	$\frac{Pr46\ [10000] \times 2^{Pr4A\ [0]}}{Pr4B\ [5000]}$
Example 2: When command input (f) is set to 40000 per revolution of the motor]	$\frac{Pr46\ [1] \times 2^{Pr4A\ [15]}}{Pr4B\ [10000]}$	$\frac{Pr46\ [2500] \times 2^{Pr4A\ [0]}}{Pr4B\ [10000]}$

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.

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>4C</td><td>Smoothing filter</td><td>0 – 7</td><td>A smoothing filter is a primary delay filter inserted after command multiply division unit of command pulse input unit.
Purpose of Smoothing Filter:
• Basically, it is to alleviate stepped movement of the motor when a command pulse is rough.
• Following are the specific examples in which a command pulse becomes rough:
1) When a multiply ratio is set for command multiply division (10 times or higher)
2) When command pulse frequency is low in some cases
• A time constant of the smoothing filter should be set in 8 steps with Pr4C.
<table><tr><th>Setting value</th><th>Time constant</th></tr><tr><td>0</td><td>No filter function</td></tr><tr><td>[1]</td><td>Small time constant</td></tr><tr><td>⟆</td><td>↓</td></tr><tr><td>7</td><td>Great time constant</td></tr></table></td></tr>
<tr><td>4D</td><td>Counter clear input</td><td>0 – 1</td><td>The parameter sets clear conditions of counter clear input signal for clearing the deviation counter (CL: CNX5 30-pin).
<table><tr><th>Setting value</th><th>Clear Conditions</th></tr><tr><td>[0]</td><td>Clear at level (*1).</td></tr><tr><td>1</td><td>Clear at edge (falling edge).</td></tr></table>*1: Minimum time width of CL signal
  </td></tr>
<tr><td>4E</td><td>FIR filter 1 set up</td><td>0 – 31
[0]</td><td>• The parameter selects a FIR filter to be applied to a command pulse.
• This is enabled only when command mode is HP and LP.
• It will be a moving average filter for (setting +1) times.
• Note that any change to this parameter will become valid only after you reset the power source.</td></tr>
<tr><td>4F</td><td>FIR filter 2 set up</td><td>0 – 31
[0]</td><td>• Select the FIR filter for speed feedforward.
• The parameter selects a FIR filter to be applied to the speed feed forward filter.
• This is enabled only when Control mode is HP.
• The filter is a moving average filter (the number of averaging: Set value + 1).
• Note that a change of this parameter becomes valid after the power supply is reset.</td></tr>
</table>

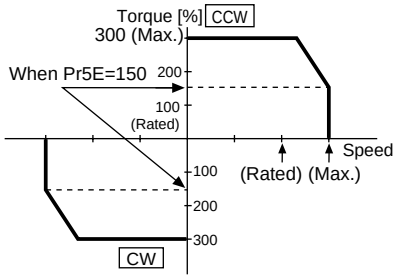
Parameters for Speed Control

Default setting is shown by [ ]

Parameter No.	Parameter Name	Setting range	Unit	Function/Description
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.

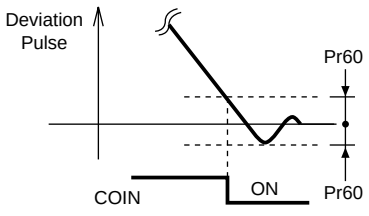
Parameters for Torque Control

Default setting is shown by [ ]

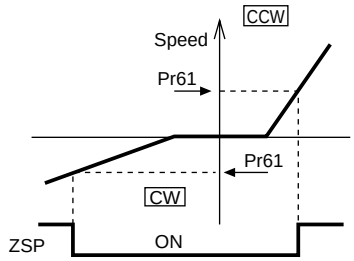
Parameter No.	Parameter Name	Setting range	Unit	Function/Description
5E	**Torque limit**	0 – 500	%	• This function limits maximum torque of the motor through setting of parameters within the driver. • In normal specifications, torque about 3 times higher than the rated is allowed for an instant. This 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

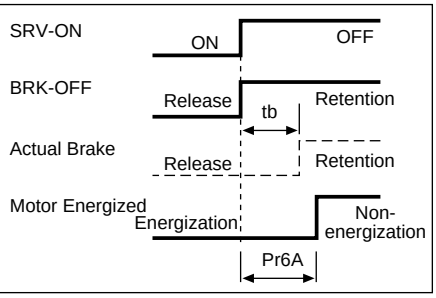
Default setting is shown by [ ]

Parameter No.	Parameter Name	Setting range	Unit	Function/Description
60	**In-position range**	0 – 32767 [131]	Pluse	• The parameter sets timing to output a positioning completion signal (COIN: CN X5 39-pin) when movement of the motor (work) is complete after input of a command pulse ends. • A positioning completion signal (COIN) is output when the number of pulses of the deviation counter is within ± (setting). • A basic unit of deviation pulse is “resolution” of an encoder you will use. Thus, be careful because it varies depending on an encoder, as shown below: 1) 17-bit encoder: 2^{17} = 131072 2) Encoder of 2500 P/rev: 4 x 2500 = 10000 **<Cautions>** 1.Setting Pr60 too small might extend time till COIN signal is output or cause chattering upon output. 2.Setting of “Positioning Completion Range” will have no effect on final positioning precision. 

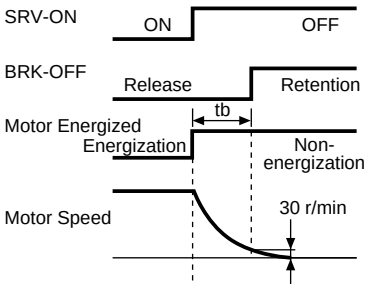
Default setting is shown by [ ]

<table>
<tr><th>Parameter No.</th><th>Parameter Name</th><th>Setting range</th><th>Unit</th><th>Function/Description</th></tr>
<tr><td>61</td><td>Zero speed</td><td>0 – 20000
[50]</td><td>r/min</td><td>• 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 rotating direction of the motor.
• There is hysteresis of 10rpm. The parameter should be set to 10 or greater.
 
</td></tr>
<tr><td>63</td><td>Position error set up</td><td>1 – 32767
[25000]</td><td>–</td><td>The parameter sets a detection level of “protection against excessive positional deviation” function when it is determined that positional deviation is excessive, by using the number of residual pulses.
• Calculate a setting value following the expression shown below:
Setting value = $\frac{\text{Positional deviation excess determination level [PULSE]}}{256}$
<Note>
Note that setting this Pr63 too small, in particular, when positional gain is set low might activate protection against excessive positional deviation even though there was no abnormality.</td></tr>
<tr><td>64</td><td>Position error invalidation</td><td>0 – 1</td><td>–</td><td>This parameter disables “protection against excessive positional deviation”.
<table>
<tr><th>Setting value</th><th>Protection against excessive positional deviation</th></tr>
<tr><td>[0]</td><td>Enabled</td></tr>
<tr><td>1</td><td>Disabled. Operation will continue without determining abnormality, even though positional deviation pulses exceed the judgment level set with Pr63.
If you make a mistake in phase sequence or wiring of the encoder, runaway may occur. You should install a safeguard against runaway in the device.</td></tr>
</table></td></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>
</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>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>
<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.
<table>
<tr><td>• 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.</td><td> 
</td></tr>
</table>
See also “Serve On/Off Operation When the Motor Stops” of the timing chart of Preparations volume on page 43.</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>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>