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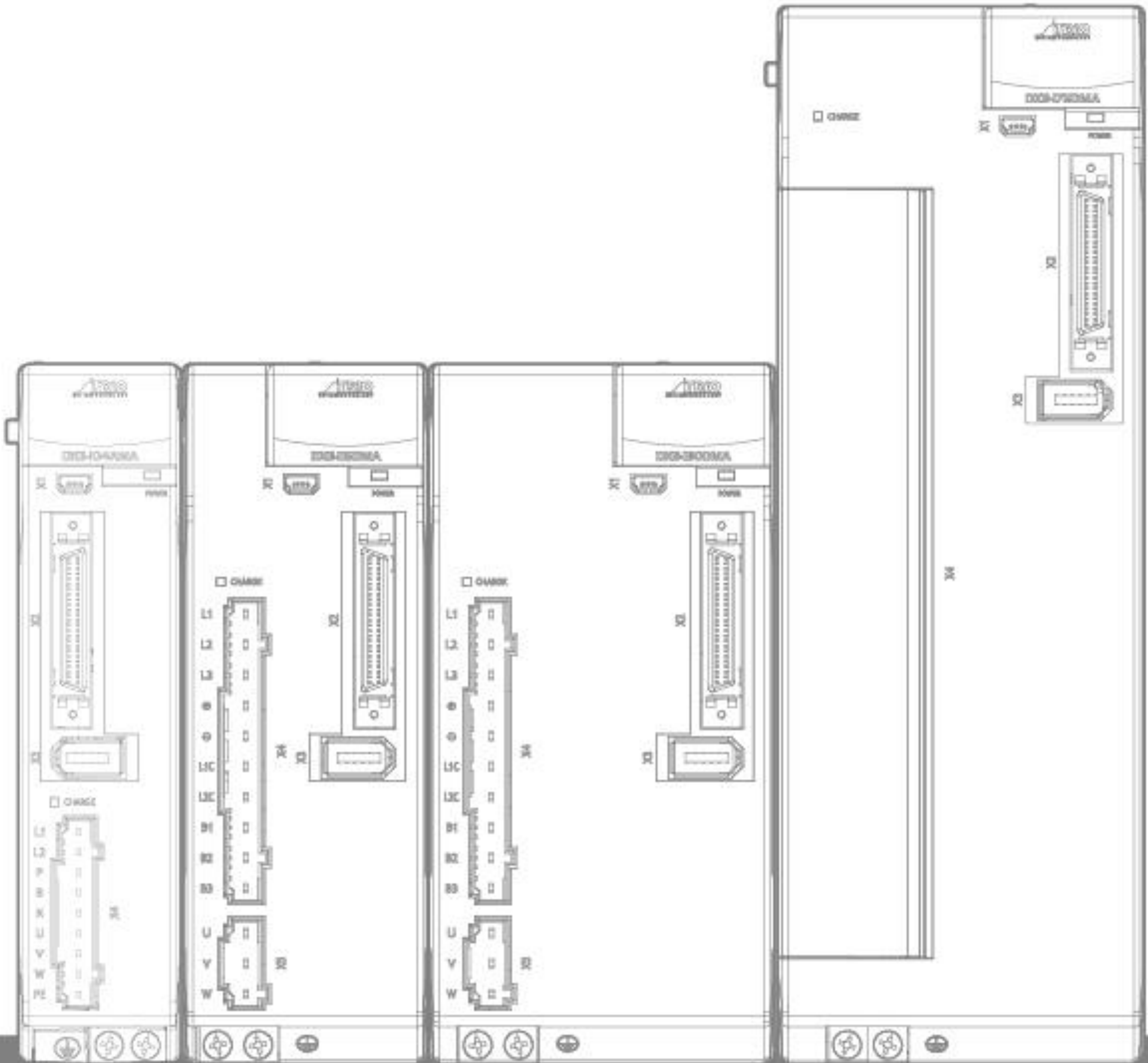


DX3

SINGLE AXIS SERVO DRIVE

Conventional Version

USER MANUAL

About this Manual

Purpose

This manual provides the information required for the Selection, Wiring, Connection, Settings, Trial Operation, Tuning and Functions of the DX3 Series AC Servo Drive with pulse references (referred to as **DX3**).

Read and understand this manual to ensure correct usage of the product.

Terms and Abbreviations

Terms that may be used in this manual are defined as follows.

Term	Meaning
Motor	The Rotary Servo Motor
Drive	A Servo Drive, which is used for controlling the Rotary Servo Motor
Servo System	A Servo Control System consisting of a master controller, drive, motor and peripheral devices
Servo ON	Supplying power to the Motor
Servo OFF	Not supplying power to the Motor
Motion Perfect	The software tool for setting up and adjusting the drive, which is installed in the PC

Abbreviations that may be used in describing EtherCAT or CANopen as well as their meanings are defined as follows.

Abbreviation	Meaning
APRD	Auto-increment Physical Read
APWR	Auto-increment Physical Write
APRW	Auto-increment Physical Read/Write
ARMW	Auto-increment Physical Read/Multiple Write
BRD	Broadcast Read
BRW	Broadcast Read/Write
BWR	Broadcast Write
CiA	CAN in Automation
CoE	CAN application protocol over EtherCAT
DC	Distributed Clocks
EEPROM	Electrically Erasable Programmable Read Only Memory
ESC	EtherCAT Slave Controller
ESI	EtherCAT Slave Information
ESM	EtherCAT State Machine

Abbreviation	Meaning
FMMU	Fieldbus Memory Management Unit
FPRD	Configured Address Physical Read
FPWR	Configured Address Physical Write
FPRW	Configured Address Physical Read/Write
FRMW	Configured Address Physical Read Multiple Write
LRD	Logical memory Read
LWR	Logical memory Write
LRW	Logical memory Read/Write
OD	Object Dictionary
OP	Operational state of EtherCAT state machine
PDO	Process Data Object
PREOP	Pre-Operational state of EtherCAT state machine
RxPDO	Receive PDO, i.e. the process data that the ESC will receive
SAFEOP	Safe-Operational state of EtherCAT state machine
SDO	Service Data Object
SyncManager	Synchronization Manager
TxPDO	Transmit PDO, i.e. the process data to be sent by the ESC

Data types and scopes that may be used in this manual are defined as follows.

Abbreviation	Data type	Scope
INT8	Signed 8 bit	－128～＋127
INT16	Signed 16 bit	－32768～＋32767
INT32	Signed 32 bit	－2147483648～＋2147483627
UINT8	Unsigned 8 bit	0～255
UINT16	Unsigned 16 bit	0～65535
UINT32	Unsigned 32 bit	0～4294967295
STRING	String value	–

Symbols

The symbols that may be found in this document are defined as follows.

Symbol	Description
DANGER	Indicates a hazard with a high level of risk that, if not avoided, will result in death or serious injury.
WARNING	Indicates a hazard with a medium or low level of risk which, if not avoided, could result in minor or moderate injury.
CAUTION	Indicates a potentially hazardous situation that, if not avoided, could cause equipment damage, data loss, and performance degradation, or unexpected results.
IMPORTANT	Indicates precautions or restrictions that must be observed. Also indicates alarm displays and other precautions that will not result in machine damage.
NOTE	Provides additional information to emphasize or supplement important points of the main text.

The names of reverse signals (ones that are taken effect when low) are written with a forward slash (/) before the signal abbreviation. For example:

$\overline{\text{S-ON}}$ = /S-ON $\overline{\text{P-CON}}$ = /P-CON

Parameters are referenced as PnXXX where XXX refers to a unique number. Some parameters have multiple functions encoded within a single parameter. For these parameters, sub-indices are used to reference the multiple functions.

For example:

- Pn112 Speed Feedforward - is a single value without any sub-indices
- Pn000 Basic Function Selection 0 - is made up of 4 sub-indexes describing different functions
  - Pn000.0 Servo ON
  - Pn000.1 Forward Drive Prohibit Input (P-OT)
  - Pn000.2 Reverse Drive Prohibit Input (N-OT)
  - Pn000.3 Reserved parameter (Do not change)

Safety Precautions

General Precautions

DANGER

- Never remove covers, cables, connectors, or optional devices while power is being supplied to the Drive.
- Never connect a three-phase power supply to the terminals U, V, and W of the driver.
- Wait for five minutes after turning the power supply OFF and then make sure that the CHARGE indicator is not lit before starting wiring or inspection work.
  Never touch the power supply terminals after turning OFF the power supply while the CHARGE lamp is lit, because high voltages may still be present in the Drive.

WARNING

- Use a power supply that is appropriate for the product, check number of phases, voltage, frequency, and AC/DC type.
- Connect the ground terminals on the Drive and Motor to ground poles according to local electrical codes.
- Never damage, pull on, apply excessive force to, place heavy objects on, or pinch cables.
- Never attempt to disassemble, repair, or modify the product.
- Make sure that the device in an emergency stop state at any time when the product has been connected to the machine and ready for the operation.
- Never touch inside the Drive.

CAUTION

- The Drive heat sinks, regenerative resistors, Motor, and other components can be very hot while power is ON or soon after the power is turned OFF. Implement safety measures, such as installing covers, so that hands and parts such as cables do not come into contact with hot components.
- For the control power supply, use a power supply device with double insulation or reinforced insulation.
- Never use the product in an environment that is subject to water, corrosive gases, or flammable gases, or near flammable materials.
- Never attempt to use a Drive or Motor that is damaged or that has missing parts.
- Install external emergency stop circuits that shut OFF the power supply and stops operation immediately when an error occurs.
- In locations with poor power supply conditions, install the necessary protective devices (such as AC reactors) to ensure that the input power is supplied within the specified voltage range.
- Always use a Noise Filter to minimize the effects of electromagnetic interference.
- Always use a Motor and Drive in one of the specified combinations.
- Never touch a Drive or Motor with wet hands.

Storage Precautions

CAUTION

- Follow all instructions on the packages, and never place an excessive load on the product during storage.
- Never install or store the product in any of the following locations:
  -- locations that are subject to direct sunlight.
  -- locations that are subject to ambient temperatures exceed product specifications.
  -- locations that are subject to relative humidity exceed product specifications.
  -- locations that are subject to corrosive or flammable gases.
  -- locations that are subject to dust, salts, or iron powder.
  -- locations that are subject to water, oil, or chemicals.
  -- locations that are subject to vibration or shock exceeds product specifications.
  -- locations that are subject to radiation.

Installation Precautions

CAUTION

- Install the Drive in a control cabinet that provides fire and electrical protection.
- Install the Drive and Motor in a way that will support their mass.
- Never install or store the product in any of the following locations:
  -- locations that are subject to direct sunlight.
  -- locations that are subject to ambient temperatures exceed product specifications.
  -- locations that are subject to relative humidity exceed product specifications.
  -- locations that are subject to corrosive or flammable gases.
  -- locations that are subject to dust, salts, or iron powder.
  -- locations that are subject to water, oil, or chemicals.
  -- locations that are subject to vibration or shock exceeds product specifications.
  -- locations that are subject to radiation.
- Never allow any foreign matter to enter a Drive or a Motor with a Cooling Fan.
- Never cover the outlet from cooling fan of Drive or Motor.
- Never step on or place a heavy object on the product.
- Install the Drive in the specified orientation.
- Provide the specified clearances between the Drive and the control cabinet as well as with other devices.

Wiring Precautions

CAUTION

- Never bypass the electromagnetic contactor in the wiring between the Drive and the Motor.
- Firmly connect the power terminal to the Motor terminal.
- Provide an adequate air gap around the Drive installation.
- Use shielded twisted-pair cables or screened unshielded multi-twisted-pair cables for I/O Signal Cables and Encoder Cables.
- The wiring length of the encoder is up to 20 meters.
- Minimize the frequency that the power supply is turned ON and OFF.

Operation Precautions

CAUTION

- In order to prevent accidents, please test the Motor with no load (not connected to the Drive shaft).
- When starting to operate on the supporting machine, set the user parameters that match the machine in advance.
- Note that the signals for the Forward Drive Prohibit (P-OT) and the Reverse Drive Prohibit (N-OT) are disabled during JOG operation.
- When overtravel occurs, the power supply to the Motor is turned OFF and the brake is released. If the Motor is used to drive a vertical load, set the Motor to enter a 'zero-clamped' state after the Motor stops. Also, install safety devices (such as an external brake or counterweight) to prevent the moving parts of the machine from falling.
- If not using auto-tuning, make sure that an appropriate moment of inertia ratio is setup to avoid vibration.
- If an alarm occurs, reset it after troubleshooting the cause and ensuring safety.
- Never use the brake of the Motor for normal braking.

Maintenance Precautions

WARNING

- Wiring and inspections must be performed only by qualified engineers.
- Disconnect all connections to the Drive when testing the insulation resistance of the Drive.
- Never use gasoline, thinner, alcohol, acid or alkaline detergent to avoid discoloration or damage to the casing.
- When replacing the Drive, transfer the user parameters from the replaced Drive to new Drive.
- Never change the wiring while the power is on.
- Never disassemble the Motor without permission.

Disposal Precautions

CAUTION

When disposing of the product, treat it as ordinary industrial waste. However, local ordinances and national laws must be observed. Implement all labelling and warnings as required.

Contents

Chapter 1 DX3 Servo Drive

1.1 Product Features

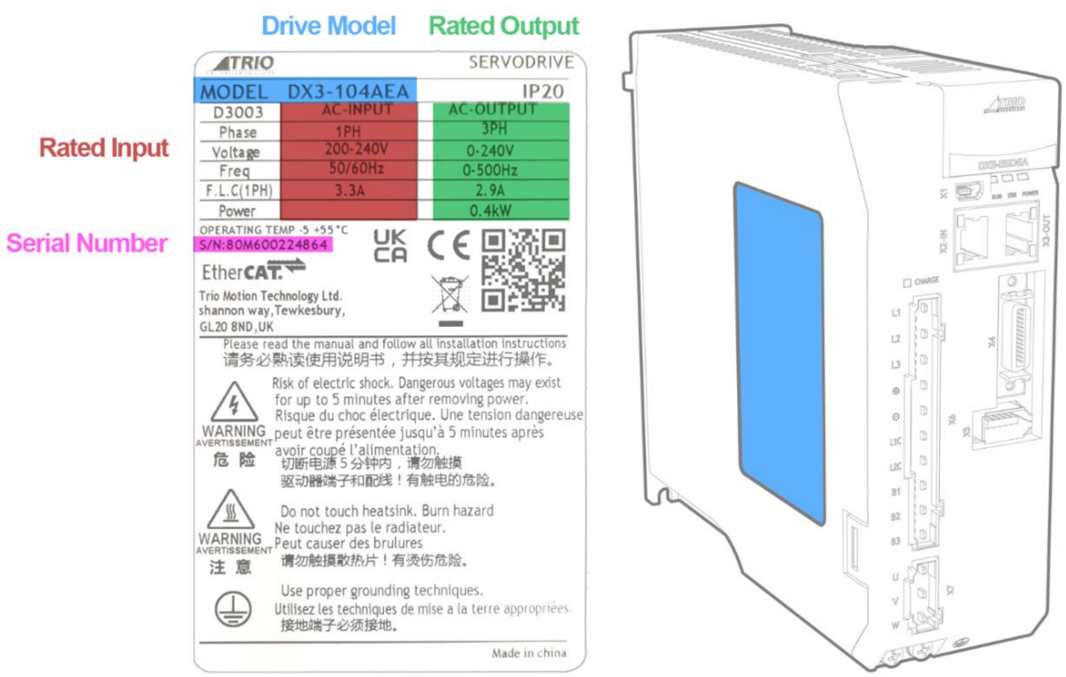
As a new single-axis AC servo product from Trio, DX3 is designed with its excellent performance and practical control functions to create a complete set of solutions with the best cost performance for customers.

Matching with the MX servo motors, compatible with mainstream controllers, it offers high-speed, high-precision, and high-performance machine solutions.

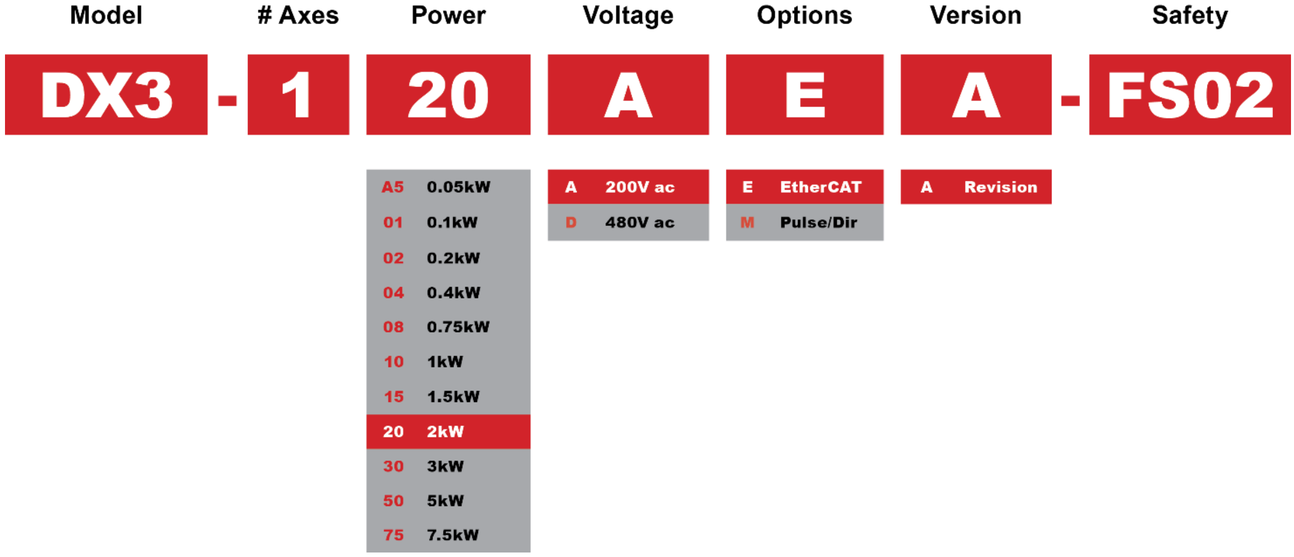
DX3 has the following outstanding features.

- CANopen supported
- Compact size
- Zero stacking gap installation
- 200 V ac from 50 W to 2 kW
- 400 V ac from 1.0KW to 7.5kW
- Compatible with MX servo motors
- 17-bit absolute encoder (magnetic) or 23-bit absolute encoder (photoelectric)
- Comprehensive tuning technology including Auto-tuning function, adaptive vibration suppression, friction compensation

1.2 Interpreting the Nameplate

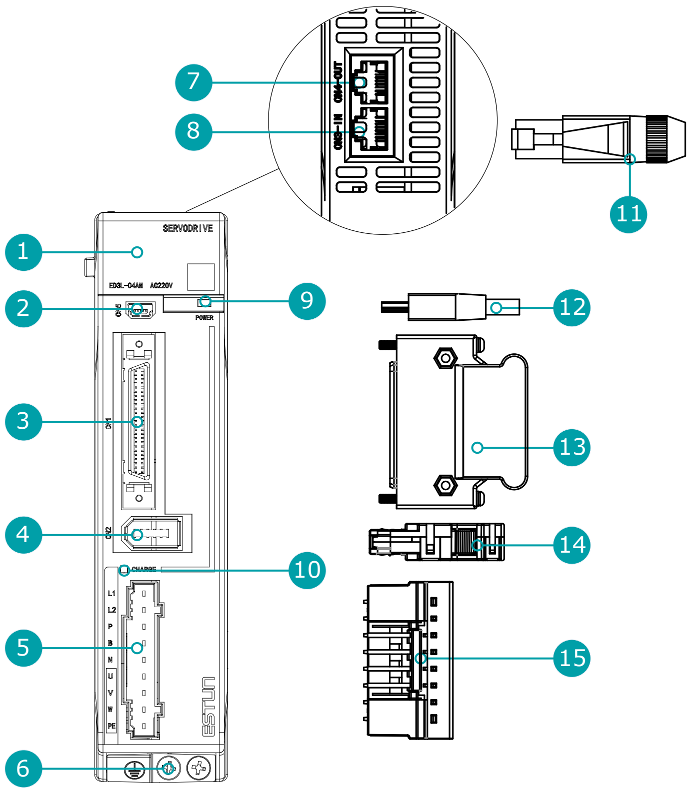


1.3 Model Designations



1.4 Part Names

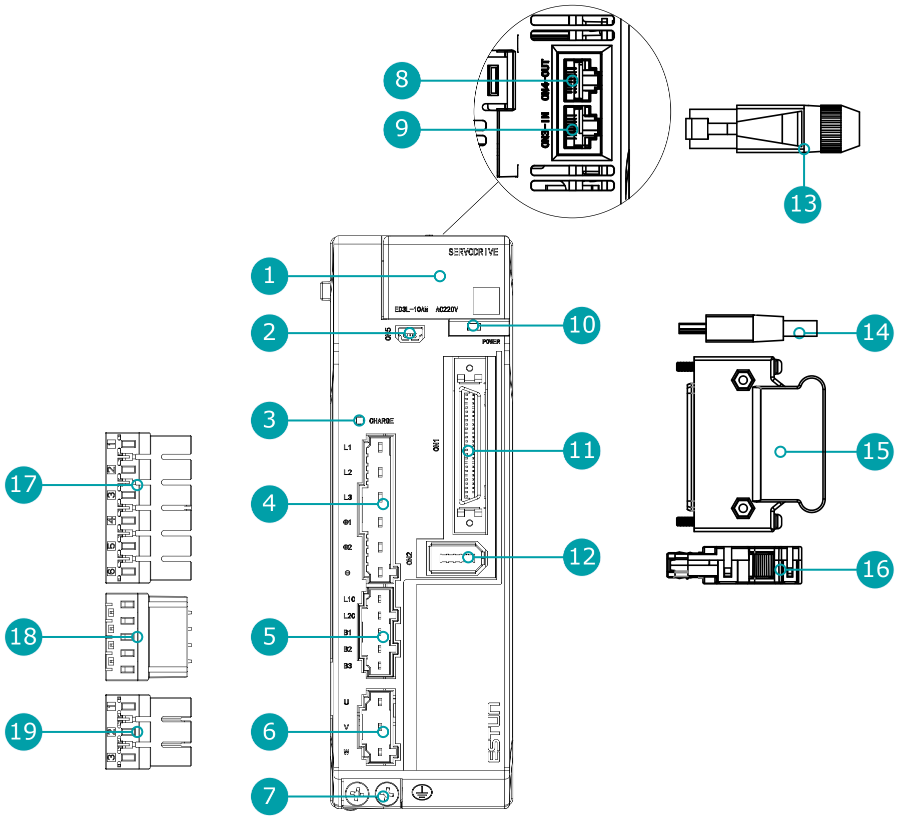
<u>Rated power from 50W to 400W (200VAC)</u>



No.	Name	Description
1	Panel Operator	A module for Servo status displays and parameter settings
2	USB Connector	Connects a computer for Motion Perfect 5.3 or above

No.	Name	Description
3	IO Signal Connector	Connects to sequence I/O signals
4	Encoder Connector	Connects to the encoder in the Motor
5	Main Circuit and Motor Connector	L1, L2: main power input terminals P, N: common DC bus terminals P, B: external regenerative resistor terminals U, V, W: motor power terminals PE: ground terminal
6	Grounding Terminal	Connects to the ground terminal of the Motor main circuit cable
7	External communication output indicators	Output connector of the external communication cable Note: A dust plug has been mounted at the factory.
8	External communication input indicators	Input connector of the external communication cable Note: A dust plug has been mounted at the factory.
9	POWER Indicator Lamp	Lit while the control circuit power is being supplied
10	CHARGE Indicator Lamp	Lit while the main circuit power is being supplied. Note: Even if you turn OFF the main circuit power supply, this indicator will be lit as long as the internal capacitor remains charged. Never touch the main circuit or Motor terminals while this indicator is lit in case the electric shock.
11	External communication Terminals	Standard RJ-45 terminal
12	USB Terminals	Standard Mini USB Type-B
13	IO Signal Terminals	Connection terminals for sequence IO signals
14	Encoder Terminals	Connection terminals for the encoder cable in the Motor
15	Main Circuit and Motor Terminals	Connection terminals for power input and motor power

Rated power from 750W to 2kW (200VAC)



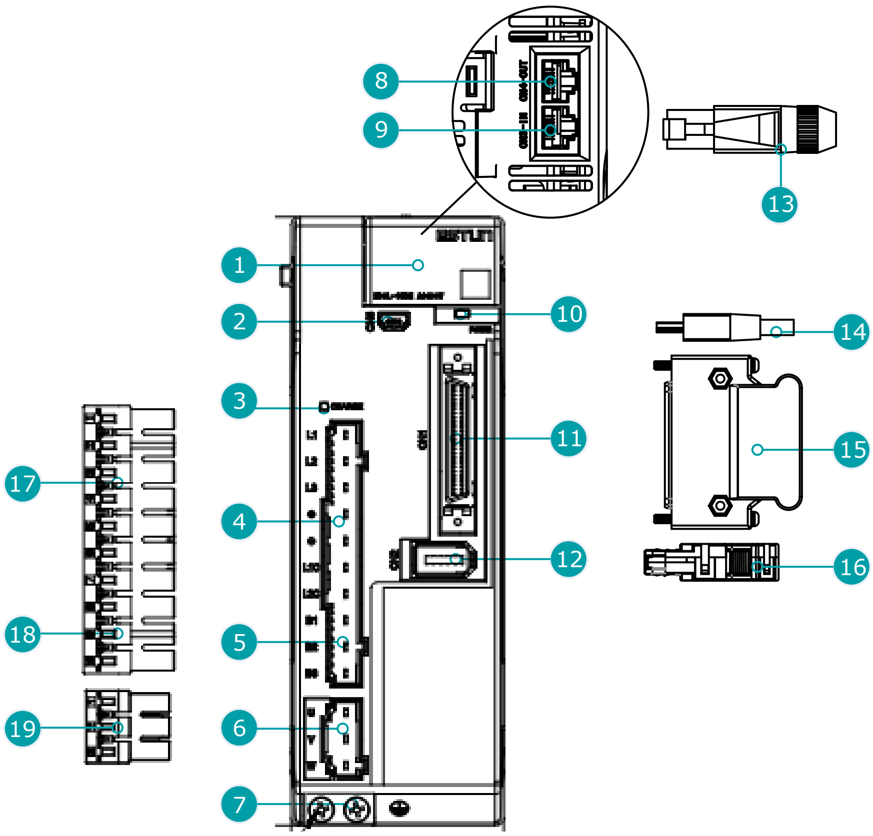
NOTE

The figure above shows an example of a product with a rated power of 750W to 1kW. Products with a rated power of 1.5kW~2kW are similar in appearance and have the same components

No.	Name	Description
1	Panel Operator	A module for Servo status displays and parameter settings
2	USB Connector	Connects a computer for Motion Perfect 5.3 or above
3	CHARGE Indicator Lamp	Lit while the main circuit power is being supplied. Note: Even if you turn OFF the main circuit power supply, this indicator will be lit as long as the internal capacitor remains charged. Never touch the main circuit or Motor terminals while this indicator is lit, in case the electric shock.
4	Main Circuit Connector	• L1, L2, L3: main power input terminals • ⊕1, ⊕2, ⊖: DC terminals
5	Control Circuit Connector	• L1C, L2C: control power input terminals • B1, B2, B3: external regenerative resistor terminals
6	Motor Connector	Connects to a Motor main circuit cable
7	Grounding Terminal	Connects to the ground terminal of the Motor main circuit cable
8	External communication output indicators	Output connector of the external communication cable **Note**: A dust plug has been mounted at the factory.
9	External communication input indicators	Input connector of the external communication cable **Note**: A dust plug has been mounted at the factory.

No.	Name	Description
10	POWER Indicator Lamp	Lit while the control circuit power is being supplied
11	IO Signal Connector	Connects to sequence I/O signals
12	Encoder Connector	Connects to the encoder in the Motor
13	External communication Terminals	Standard RJ-45 terminal
14	USB Terminals	Standard Mini USB Type-B
15	IO Signal Terminals	Connection terminals for sequence IO signals
16	Encoder Terminals	Connection terminals for the encoder cable in the Motor
17	Main Circuit Terminals	The connection terminals for the main circuit power supply
18	Control Circuit Terminals	The connection terminals for the control power supply
19	Motor Terminals	The connection terminals for the Motor main circuit cable

Rated power from 1kW to 3kW (400VAC)



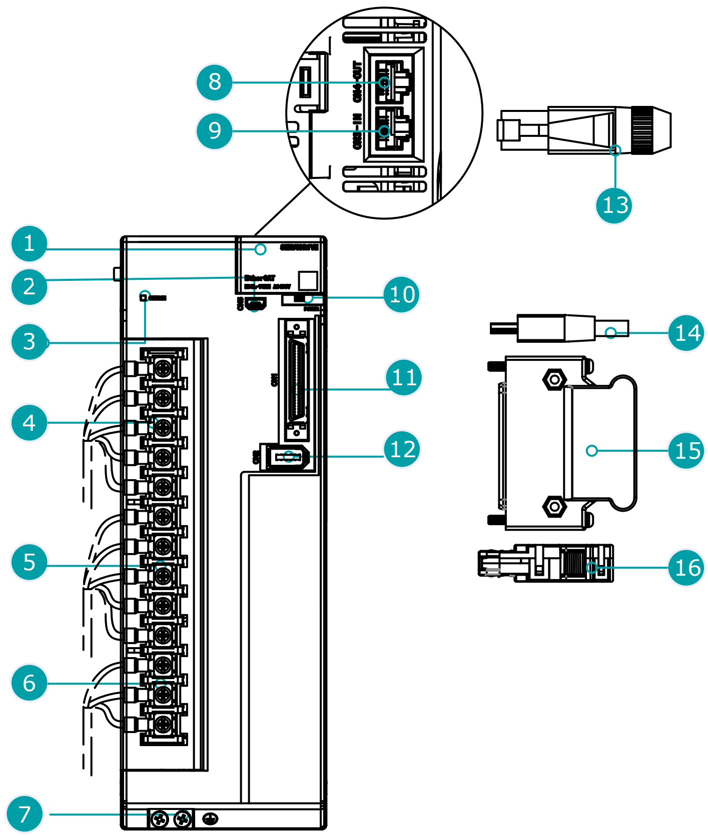
NOTE

The figure above shows an example of a product with a rated power of 1kW to 1.5kW. Products with a rated power of 2kW~3kW are similar in appearance and have the same components

No.	Name	Description
1	Panel Operator	A module for Servo status displays and parameter settings.

No.	Name	Description
2	USB Connector	Socket for USB communication cable when using Motion Perfect 5.3 or above on PC.
3	CHARGE Indicator Lamp	Lights up when the main circuit is powered on. Note: If voltage remains in the capacitors inside the drive after the main circuit has been switched off, and the indicator lamp will be ON, do not touch the main circuit and motor terminals at this time to avoid electric shock.
4	Main Circuit Port	• L1, L2, L3: main power input terminals • ⊕1, ⊕2, ⊖: DC connectors
5	Control Circuit Port	• L1C, L2C: control power input terminals • B1, B2, B3: external regenerative resistor connectors
6	Motor Power Connection Port	Socket for motor power cable.
7	Grounding Terminal	Connected to the earth terminal of the motor power cable.
8	External Communication Output Connection Port	Socket for output signal connection of external communication cable.
9	External Communication Input Connection Port	Socket for input signal connection of external communication cable.
10	POWER Indicator Lamp	Light up when the control circuit is powered on.
11	IO Signal Connection Port	Socket for IO signal connectors.
12	Encoder Connection Port	Socket for the encoder connectors of the motor.
13	External Communication Connector	Standard RJ-45 terminal.
14	USB Connector	Standard Mini USB Type-B.
15	IO Signal Connector	Connector for IO signal cables.
16	Encoder Connector	Connector for motor encoder cables.
17	Main Circuit Connector	Connector for the drive’s main circuit cables.
18	Control Circuit Connector	Connector for the drive control circuit cables.
19	Motor Power Cable Connector	Connector for the motor power cables.

Rated power from：5kW to 7.5kW (400VAC)



No.	Name	Description
1	Panel Operator	A module for Servo status displays and parameter settings.
2	USB Connector	Socket for USB communication cable when using Motion Perfect 5.3 on PC.
3	CHARGE Indicator Lamp	Lights up when the main circuit is powered on. Note: If voltage remains in the capacitors inside the drive after the main circuit has been switched off, and the indicator lamp will be ON, do not touch the main circuit and motor terminals at this time to avoid electric shock.
4	Main Circuit Port	• L1, L2, L3: main power input terminals • ⊕1, ⊕2, ⊖: DC connectors
5	Control Circuit Port	• L1C, L2C: control power input terminals • B1, B2, B3: external regenerative resistor connectors
6	Motor Power Connection Port	Socket for motor power cable.
7	Grounding Terminal	Connected to the earth terminal of the motor power cable.
8	External Communication Output Connection Port	Socket for output signal connection of external communication cable.
9	External Communication Input Connection Port	Socket for input signal connection of external communication cable.
10	POWER Indicator Lamp	Light up when the control circuit is powered on.
11	IO Signal Connection Port	Socket for IO signal connectors.
12	Encoder Connection Port	Socket for the encoder connectors of the motor.

No.	Name	Description
13	External Communication Connector	Standard RJ-45 terminal.
14	USB Connector	Standard Mini USB Type-B.
15	IO Signal Connector	Connector for IO signal cables.
16	Encoder Connector	Connector for motor encoder cables.

1.5 Ratings and Specifications

200VAC									
Drive Model: DX3-		1A5A	101A	102A	104A	108A	110A	115A	120A
Continuous Output Current [Arms]		0.9	1.1	1.5	2.9	5.1	6.9	8.2	11.3
Instantaneous Maximum Output Current [Arms]		3.3	4.0	5.8	11.5	19.5	21.0	24.6	33.9
Power Supply Capacity [kVA]	Single-phase	0.2	0.3	0.6	1.2	1.9	2.6	4.0*	–
	Three-phase	–	–	–	–	1.6	2.0	3.0	3.5

*When operating 1.5kW unit from a single-phase supply, re-rate power to 1.2kW

400VAC							
Drive Model: DX3-		110D	115D	120D	130D	150D	175D
Continuous Output Current [Arms]		3.6	5.0	7.1	12.0	17.0	27.3
Max Output Current [Arms]		10.9	17.7	24.7	37.8	53.0	70.7
Power Supply Capacity [kVA]	Three-phase	1.8	2.8	3.5	5.0	8.2	12.0

General Specification			Description
Input Power	200VAC		• Single-phase AC 200V～240V, -15%～+10%, 50Hz/60Hz • 3-phase AC200V～240V, -15%～+10%, 50Hz/60Hz (rated power ⩾ 0.75kW)
	400VAC		3-phase AC380V～440V, -15%～+10%, 50Hz/60Hz
Control Power	200VAC		Single-phase AC 200V～240V, -15%～+10%, 50Hz/60Hz
	400VAC		Single-phase AC 200V～440V, -15%～+10%, 50Hz/60Hz
Control Method			SVPWM
Feedback			Serial encoder: • 17-bit absolute encoder • 23-bit absolute encoder
Environmental Conditions	Operation	Temperature	• -5℃ to 55℃ (-5℃ to 40℃ for zero stacking gap installation)
		Humidity	5% to 95% (with no condensation)

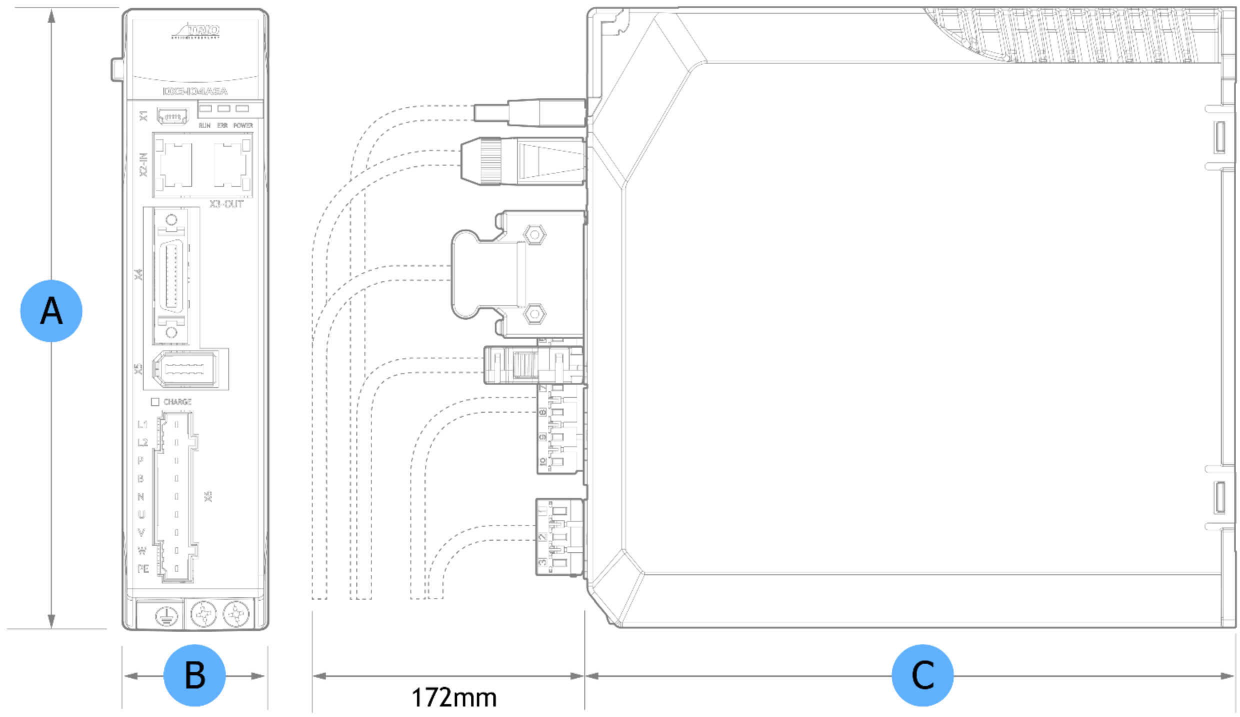
General Specification			Description
	Storage	Temperature	-20℃ to +85℃
		Humidity	5% to 95% (with no condensation)
	Protection Class		All terminals are installed in place to meet IP20
	Altitude		1,000 m or less
	Vibration Resistance		4.9m/s^2
	Shock Resistance		19.6m/s^2
	Power System		TN System
Mounting			Base-mounted
Performance	Speed Control Range		1:5000
	Coefficient of Speed Fluctuation		±0.01% of rated speed max. (For a load fluctuation of 0% to 100%)
			0% of rated speed max. (For a load fluctuation of ±10%)
			±0.1% of rated speed max. (For a temperature fluctuation of 25°C±25°C)
	Soft Start Time Setting		0s to 10s (Can be set separately for acceleration and deceleration.)
Torque Control	Analogue reference	Reference Voltage	±10VDC at rated torque (Variable setting range:±0 to 10VDC) Max. input voltage: ±12V
		Input Impedance	About 10MΩ or above
		Circuit Time Constant	10μs
	Torque selection	Inner setting	4 torque selections
Speed control	Analogue reference	Reference Voltage	±10VDC at rated speed (Variable setting range:±0 to 10VDC) Max. input voltage: ±12V
		Input Impedance	About 10MΩ or above
		Circuit Time Constant	10μs
	Speed selection	Rotation Direction Selection	With /P-CON signal
		Inner setting	7 speed selections
Position Control	Pulse reference	Type	• Sign + pulse train • CCW + CW pulse train • 90°phase difference 2-phase (phase A + phase B)
		Form	Non-insulated linde driver (about + 5V), open collector

General Specification			Description
		Frequency	×1 multiplier: 4Mpps ×2 multiplier: 2Mpps ×4 multiplier: 1Mpps Open collector: 200Kpps Frequency will begin to decline when the duty ratio error occurs..
	PCP	Inner setting	32 position contacts
I/O Signals	Encoder Divided Pulse Output		Phase A, phase B, phase C: Line-driver output. Number of divided output pulses: Any setting is allowed.
	Input Signals		Allowable voltage range: 24 VDC ±20% Number of input points: 10 (2 of them are high-speed optocoupler inputs, fixed as Touch Probe)
			Input Signals are S-ON (Servo ON), P-CON (Proportional Control), ALM-RST (Alarm Reset), CLR (Position Error Clear), P-OT (Forward Drive Prohibit), N-OT (Reverse Drive Prohibit), P-CL (Forward External Torque Limit), N-CL (Reverse External Torque Limit). Except TP1 and TP2, a signal can be allocated and the positive and negative logic can be changed.
	Output Signals		Allowable voltage range: 5 VDC to 30 VDC Number of output points: 4 (1 of them fixed for Servo Alarm)
			Output Signals are TGON (Rotation Detection), ALM (Servo Alarm), SRDY (Servo Ready), COIN (Positioning Completion), PAO (Encoder Divided Pulse, Phase A), PBO (Encoder Divided Pulse, Phase B), PCO (Encoder Divided Pulse, Phase C). Except ALM, a signal can be allocated and the positive and negative logic can be changed.
USB Communications	Interface		Personal computer (with Motion Perfect 5.3 or above)
	Communications Standard		Conforms to USB2.0 standard (12 Mbps)
External communication (RJ45)			Serial communication standard, Modbus protocol
Display			Five 7-segment LEDs
Indicator Lamps			CHARGE, POWER
Panel Operator			4 Buttons
Regenerative Processing			• Rated power from 50W to 400W must connect an external regenerative resistor. • Rated power from 750W to 2kW are built-in.
Protective Functions			Overcurrent, Overvoltage, Undervoltage, Overload, Regeneration Error, Overspeed, etc.
Utility Functions			Alarm history, Jogging, Mechanical analysis, Load inertia identification, Auto-Tuning, etc.

NOTE

When operating from a single-phase power supply for the DX3-115AMA (rated power 1.5 kW), please de-rate to 1.2 kW

1.6 Dimensions



<table>
<tr><th>Product</th><th>Part #</th><th>Output Power</th><th>H (A)</th><th>W (B)</th><th>D ©</th></tr>
<tr><td colspan="6">200V ac</td></tr>
<tr><td>DX3-1A5AMA</td><td>D3020</td><td>50W</td><td rowspan="8">172</td><td rowspan="4">40</td><td rowspan="8">180</td></tr>
<tr><td>DX3-101AMA</td><td>D3021</td><td>100W</td></tr>
<tr><td>DX3-102AMA</td><td>D3022</td><td>200W</td></tr>
<tr><td>DX3-104AMA</td><td>D3023</td><td>400W</td></tr>
<tr><td>DX3-108AMA</td><td>D3024</td><td>750W</td><td rowspan="2">55</td></tr>
<tr><td>DX3-110AMA</td><td>D3025</td><td>1kW</td></tr>
<tr><td>DX3-115AMA</td><td>D3026</td><td>1.5kW</td><td rowspan="2">70</td></tr>
<tr><td>DX3-120AMA</td><td>D3027</td><td>2kW</td></tr>
</table>

<table>
<tr><th>Product</th><th>Part #</th><th>Output Power</th><th>H (A)</th><th>W (B)</th><th>D (C)</th></tr>
<tr><td colspan="6">400V ac</td></tr>
<tr><td>DX3-110DMA</td><td>D3030</td><td>1kW</td><td rowspan="4">172</td><td rowspan="2">60</td><td rowspan="4">180</td></tr>
<tr><td>DX3-115DMA</td><td>D3031</td><td>1.5kW</td></tr>
<tr><td>DX3-120DMA</td><td>D3032</td><td>2kW</td><td rowspan="2">85</td></tr>
<tr><td>DX3-130DMA</td><td>D3033</td><td>3kW</td></tr>
<tr><td>DX3-150DMA</td><td>D3034</td><td>5kW</td><td rowspan="2">260</td><td rowspan="2">90</td><td rowspan="2">230</td></tr>
<tr><td>DX3-175DMA</td><td>D3035</td><td>7.5kW</td></tr>
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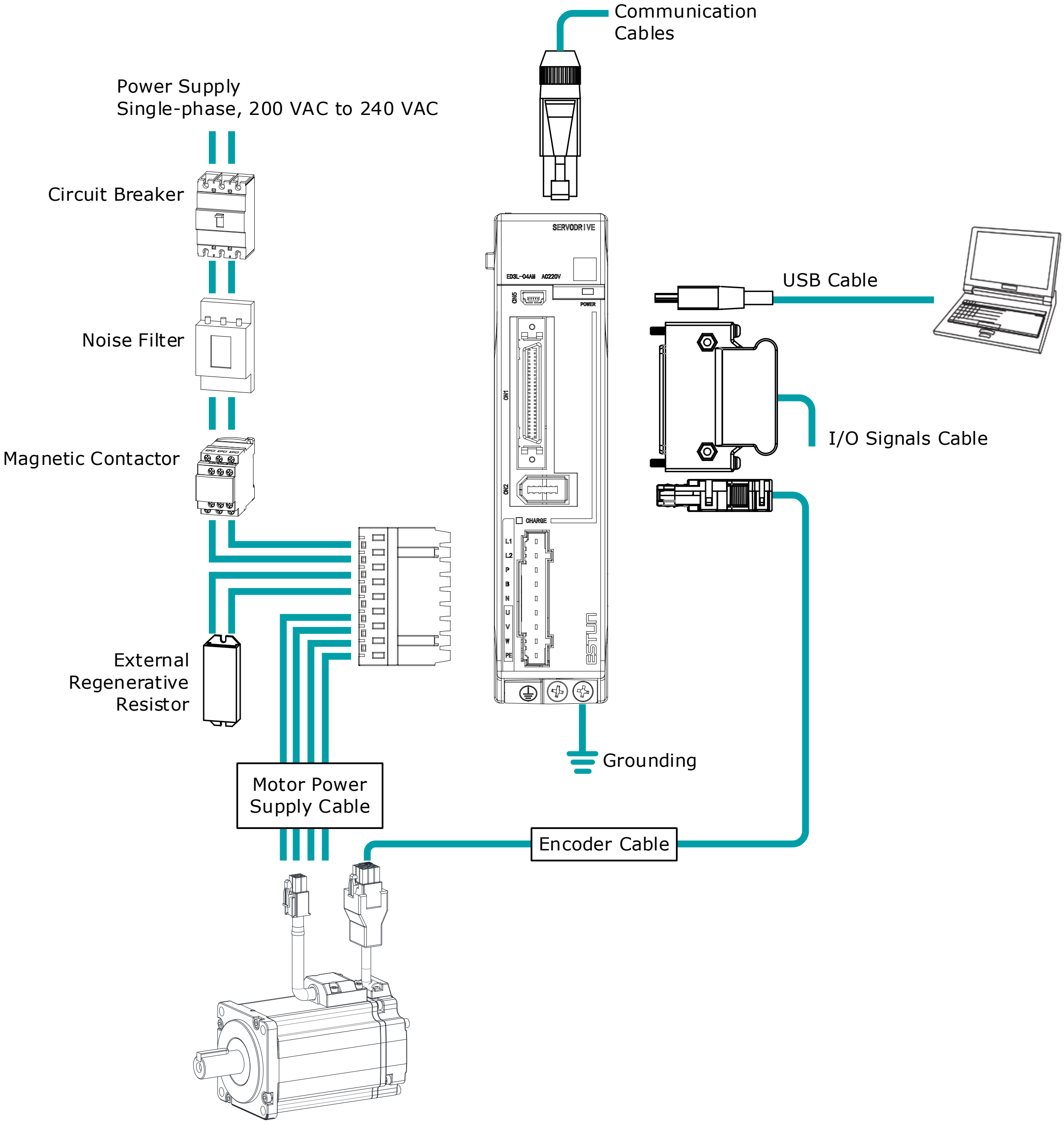
1.7 System Configuration

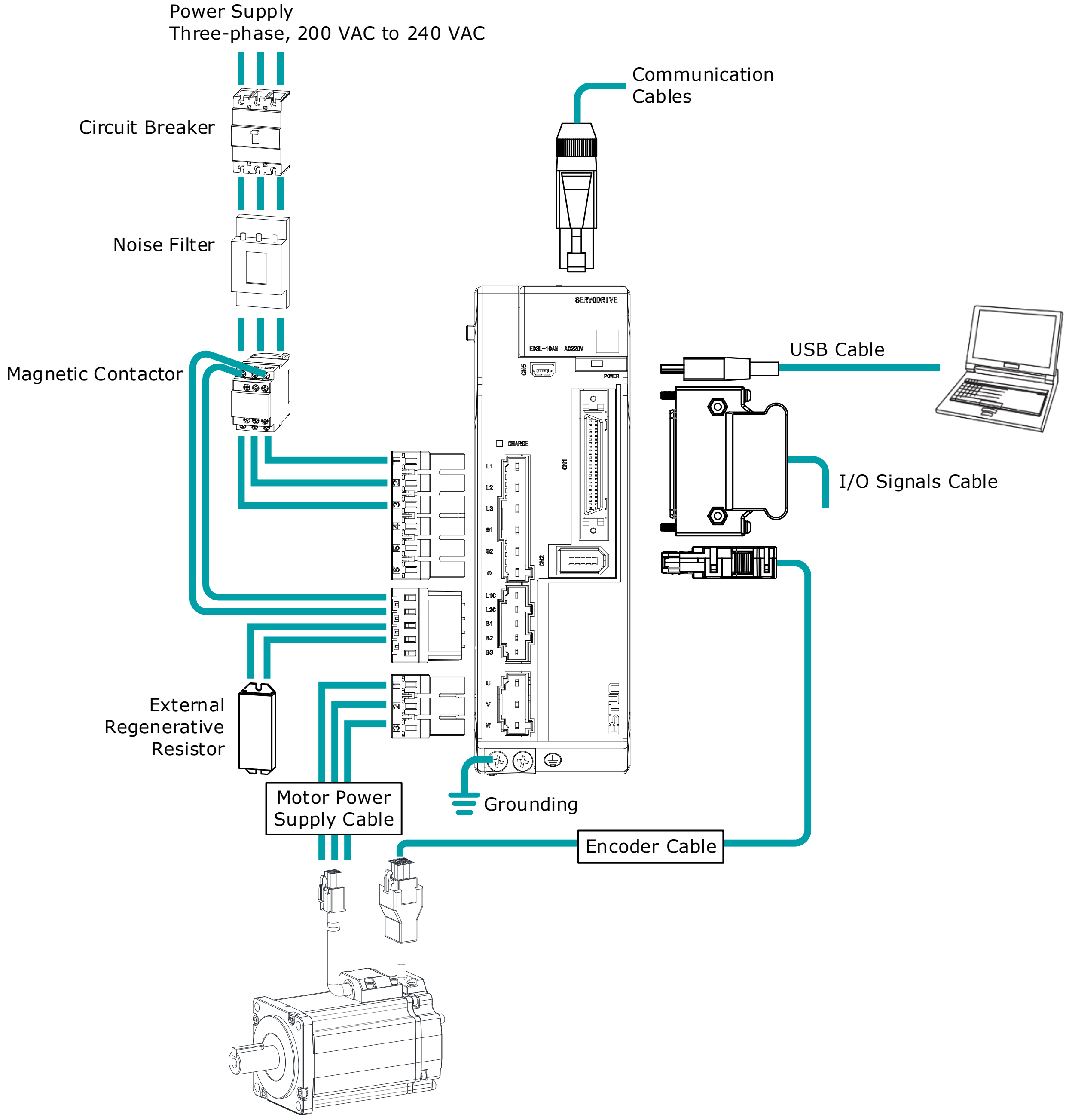
Rated power from 50W to 400W

200VAC, single phase



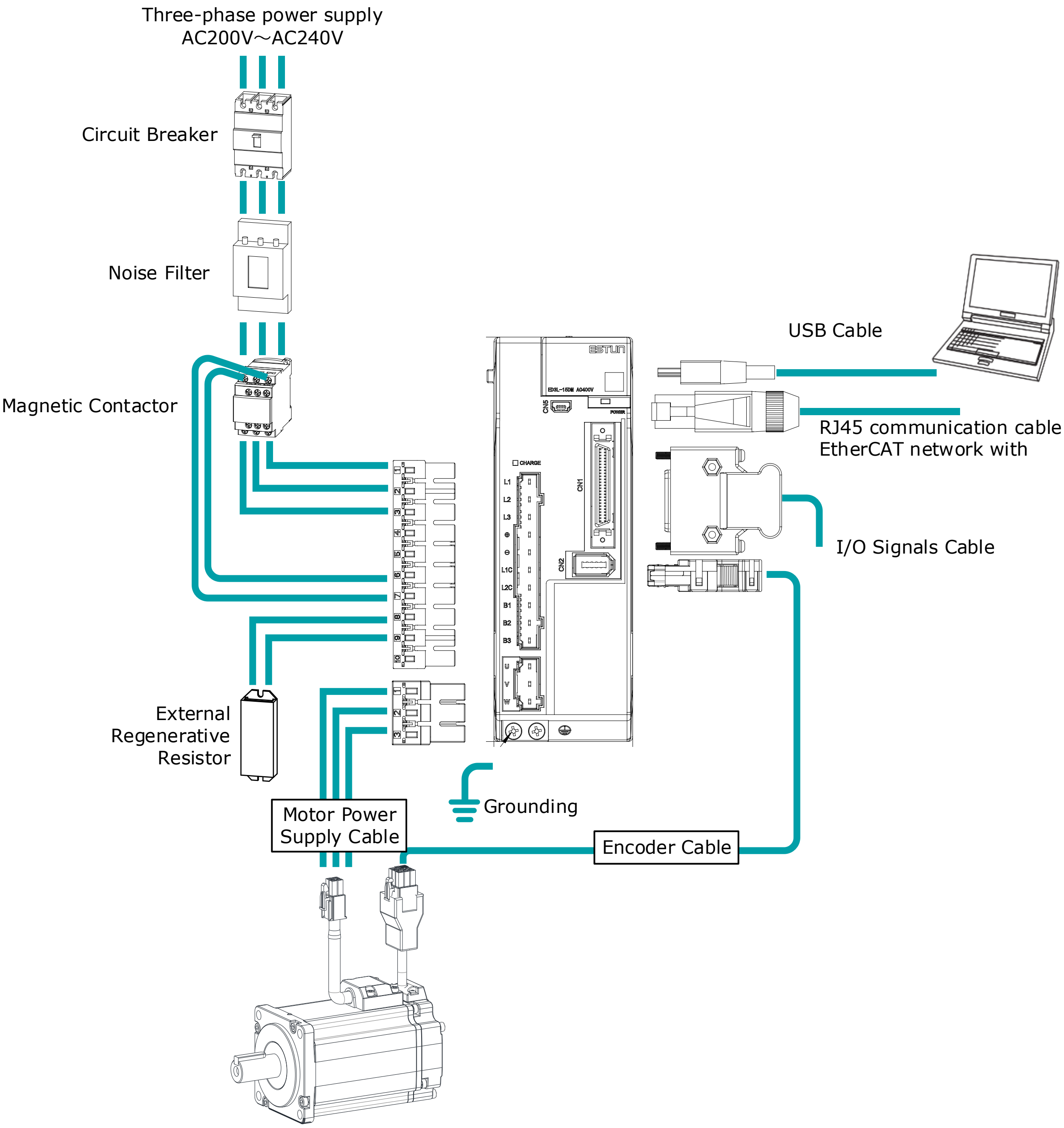
Rated power from 750W to 2kW

200VAC, three phase



Rated power from 1kW to 7.5kW

400VAC, three phase



1.7.2 Minimum System Configuration

The minimum system configuration includes at least the following components.

Component Name	Description
Power Supply	Control power supply (L1C, L2C) See 1.5 Ratings and Specifications for details on power supply
	Mains power supply (L1, L2, L3) See 1.5 Ratings and Specifications for details on power supply

Component Name	Description
Circuit Breaker	Please use a Type C MCB to protect the power cord and to cut the circuit in the event of overcurrent. The minimum current rating of the circuit breaker varies with the drive model.
Noise Filter	Protection against external noise interference from the power cable, with the current rated at 10A or 20A.
Magnetic Contactor	On/off control of the input circuit.
External Regenerative Resistor	The minimum resistance value of the external regenerative resistor varies with the drive model.
Drive	DX3 Series Servo Drives.
Motor	Suitable for use with MXL servo motors or MXM (at rated power ≥ 1kW) servo motors.
Controller	The device provided for servo applications, mechanical motion programming.
PC software	Motion Perfect 5.3 or above software for PC.
Cables	Encoder cables, motor power cables, external communication cables, IO cables, etc.

1.7.3 Peripherals Devices Specification

The table below shows details on regenerative resistor and circuit breaker requirements.

Model	Main circuit voltage	Built-in regenerative resistor	Min. allowable resistor value	Min. rated current of the circuit breaker
DX3-1A5AMA	Single-phase 200 VAC to 240 VAC	–	45Ω	4A(single-phase)
DX3-101AMA	Single-phase 200 VAC to 240 VAC	–	45Ω	4A(single-phase)
DX3-102AMA	Single-phase 200 VAC to 240 VAC	–	45Ω	4A(single-phase)
DX3-104AMA	Single-phase 200 VAC to 240 VAC	–	45Ω	4A(single-phase)
DX3-108AMA	Single-phase or three-phase 200 VAC to 240 VAC	50Ω／60W	25Ω	10A(single-phase)/6A(3-phase)
DX3-110AMA	Single-phase or three-phase 200 VAC to 240 VAC	50Ω／60W	25Ω	10A(single-phase)/6A(3-phase)
DX3-115AMA	Single-phase or three-phase 200 VAC to 240 VAC	40Ω／80W	25Ω	20A(single-phase)/16A(3-phase)
DX3-120AMA	Three-phase 200 VAC to 240 VAC	40Ω／80W	25Ω	16A(3-phase)

Model	Main circuit voltage	Built-in regenerative resistor	Min. allowable resistor value	Min. rated current of the circuit breaker
DX3-110DMA	Three-phase 380 VAC to 440 VAC	100Ω／80W	65Ω	4A(3-phase)
DX3-115DMA	Three-phase 380 VAC to 440 VAC	100Ω／80W	65Ω	6A(3-phase)
DX3-120DMA	Three-phase 380 VAC to 440 VAC	50Ω／80W	40Ω	10A(3-phase)
DX3-130DMA	Three-phase 380 VAC to 440 VAC	50Ω／80W	40Ω	16A(3-phase)
DX3-150DMA	Three-phase 380 VAC to 440 VAC	35Ω／80W	20Ω	20A(3-phase)
DX3-175DMA	Three-phase 380 VAC to 440 VAC	35Ω／80W	20Ω	25A(3-phase)

1.8 Part Numbers

<table>
<tr><th>Drive model</th><th>power</th><th>Motor model</th><th>Encoder cable</th><th>Power cable</th></tr>
<tr><td>DX3-1A5AMA</td><td>50W</td><td>MXL-A5A0430LA</td><td rowspan="7">EC3S-I1724-RX-□□ (no battery)
EC3S-A1724-RX-□□ (with battery)</td><td rowspan="7">EC3P-N8718-RX-□□ (No brakes)
EC3P-B8918-RX-□□ (With brake)</td></tr>
<tr><td>DX3-101AMA</td><td>100W</td><td>MXL-01A0430LA
MXL-01A0430TA</td></tr>
<tr><td>DX3-102AMA</td><td>200W</td><td>MXL-02A0630LA
MXL-02A0430TA</td></tr>
<tr><td>DX3-104AMA</td><td>400W</td><td>MXL-04A0630LA
MXL-04A0630TA</td></tr>
<tr><td>DX3-108AMA</td><td>750W</td><td>MXL-08A0830LA
MXL-08A0830TA</td></tr>
<tr><td rowspan="2">DX3-110AMA</td><td rowspan="2">1kW</td><td>MXL-10A0830LA
MXL-10A0830TA</td></tr>
<tr><td>MXM-09A1315LA
MXM-09A1315TA</td></tr>
<tr><td rowspan="2">DX3-115AMA</td><td rowspan="2">1.5kW</td><td>MXL-15A1030LB
MXL-15A1030TB</td><td rowspan="3">EC3S-I1924-RX-□□ (no battery)
EC3S-A1924-RX-□□ (with battery)</td><td rowspan="3">EC3P-N9314-RX-□□ (No brakes)
EC3P-B9314-RX-□□ (With brake)</td></tr>
<tr><td>MXM-13A1315LA
MXM-13A1315TA</td></tr>
<tr><td>DX3-120AMA</td><td>2kW</td><td>MXL-20A1030LB
MXL-20A1030TB</td></tr>
</table>

Drive model	power	Motor model	Encoder cable	Power cable
		MXM-18A1315LA MXM-18A1315TA		
DX3-110DMA	1kW	MXM-09D1315LA MXM-09D1315TA	EC3S-I1924-RX-□□(no battery) EC3S-A1924-RX-□□(with battery)	EC3P-N9314-RX-□□(No brakes) EC3P-B9314-RX-□□ (With brake)
DX3-115DMA	1.5kW	MXL-15D1030LB MXL-15D1030TB		
		MXM-13D1315LA MXM-13D1315TA		
DX3-120DMA	2kW	MXL-20D1030LB MXL-20D1030TB		
		MXM-18D1315LA MXM-18D1315TA		
DX3-130DMA	3kW	MXL-30D1330LA MXL-30D1330TA		
		MXM-29D1815LA MXM-29D1815TA		EC3P-N8214-RX-□□(No brakes) EC3P-B8214-RX-□□ (With brake)
DX3-150DMA	5kW	MXL-40D1330LA MXL-40D1330TA		EC3P-N9314-RX-□□(No brakes) EC3P-B9314-RX-□□ (With brake)
		MXL-50D1330LA MXL-50D1330TA		
		MXM-44D1815LA MXM-44D1815TA		EC3P-N9219-RX-□□(No brakes) EC3P-B9219-RX-□□ (With brake)
DX3-175DMA	7.5kW	MXM-55D1815LA MXM-55D1815TA		
		MXM-75D1815LA MXM-75D1815TA		EC3P-N9211-RX-□□(No brakes) EC3P-B9211-RX-□□ (With brake)

□□: The last two digits of the cable indicate the length (e.g. 05 for 5m).

Chapter 2 Installation

2.1 Installation Precautions

Installation Near Sources of Heat

- Implement measures to prevent temperature increases caused by external heat sources so that the ambient temperature of the Drive is within the specified limits.

Installation Near Sources of Vibration

- Install a vibration absorber on the installation surface of the Drive so that the Drive will not be subjected to vibration.

Other Precautions

- Never install the Drive in a location subject to high temperatures, high humidity, water drops, cutting oil, excessive dust, excessive dirt, excessive iron powder, corrosive gases, or radioactivity.

2.2 Mounting Types and Orientation

The Drives are based mounted and should be fitted to a non-painted metal surface. Mount the Drive vertically, as is shown in Figure 2-1.

Mount the Drives so that the Display Panel is facing toward the operator. Prepare two or three mounting holes for the Drive and mount it securely in the mounting holes (The number of mounting holes depends on the size of the Drive).

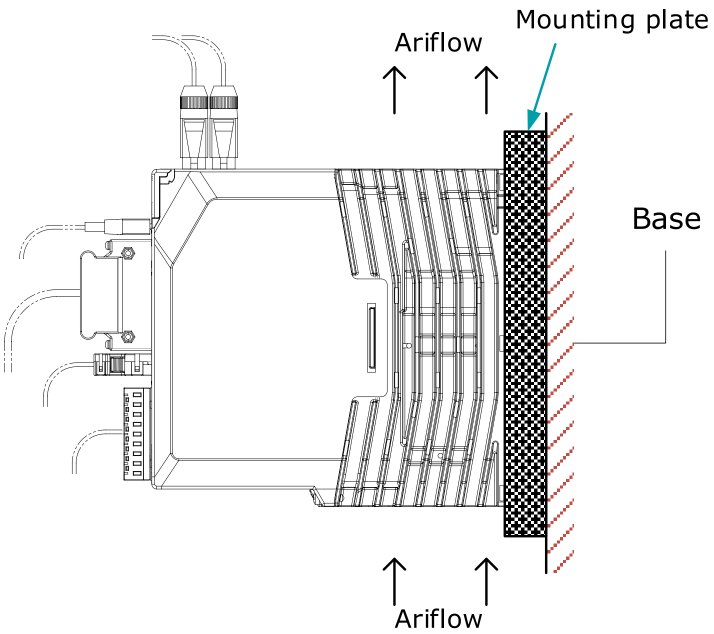


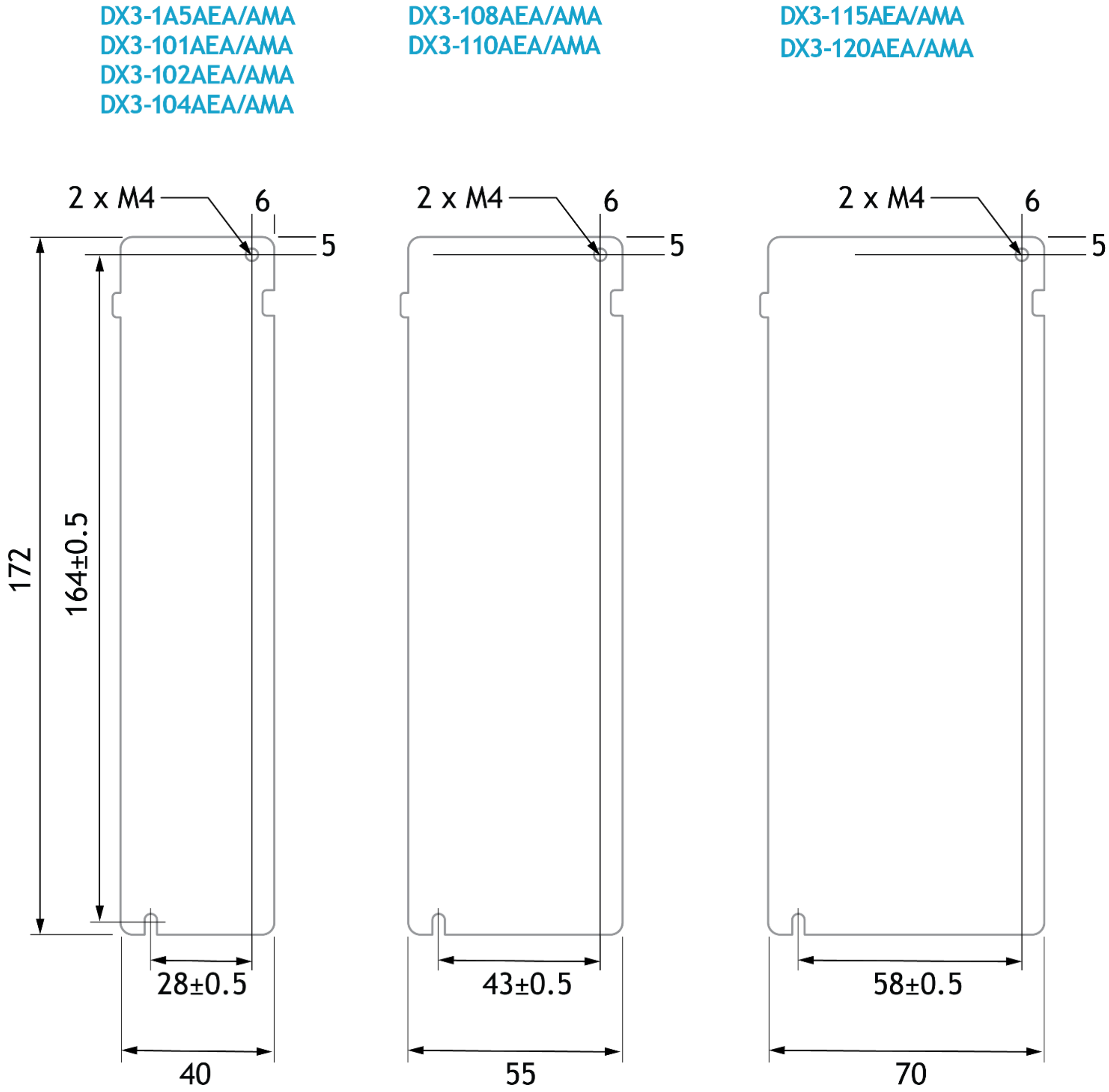
Figure 2-1 Base-mounted diagram

2.3 Mounting Hole Dimensions

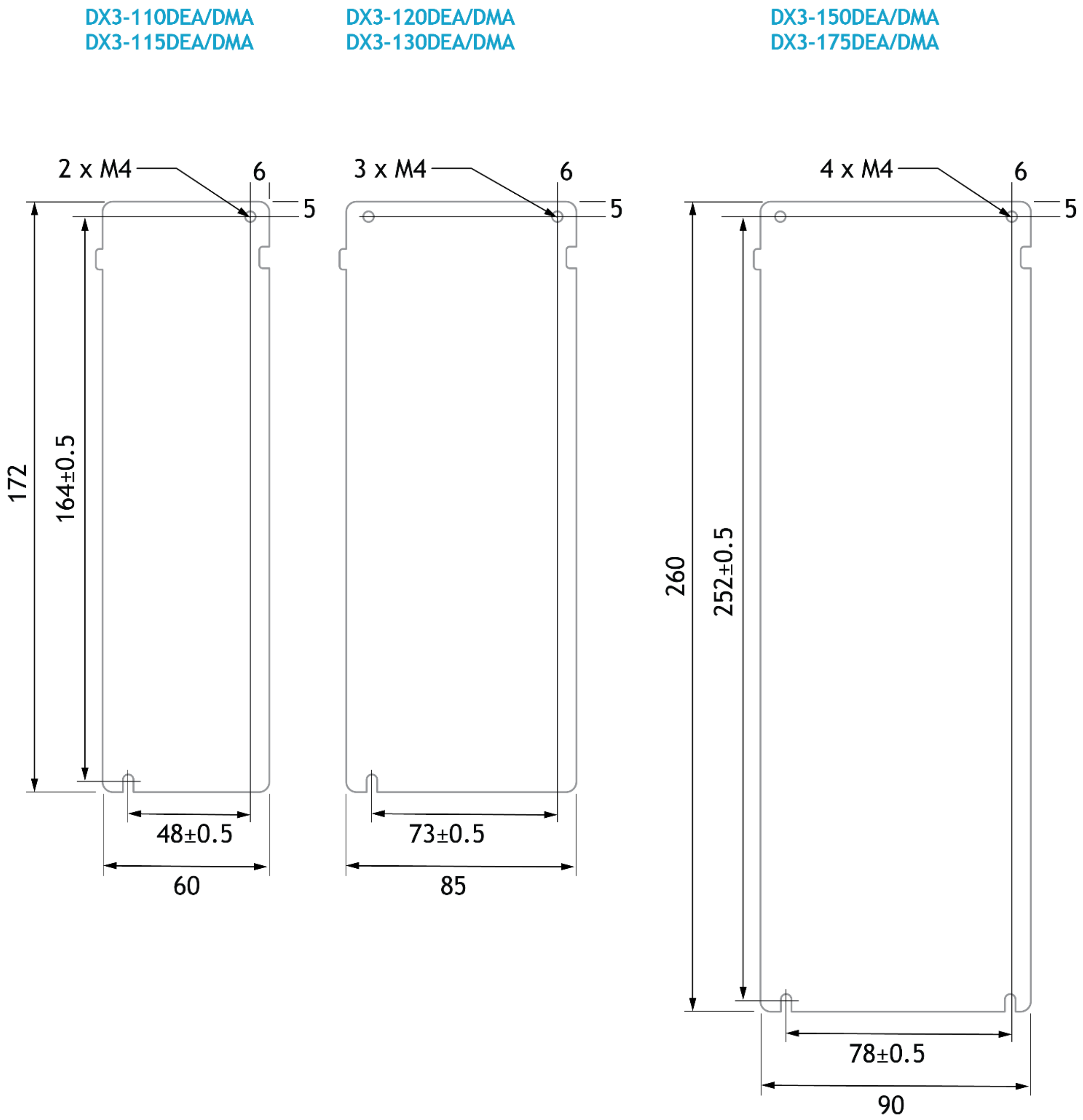
Use all mounting holes to securely mount the Drive to the mounting surface.

To mount the Drive, use a screwdriver that is longer than the depth of the Drive.

Wiring diagram for mounting holes of 200VAC units.



Wiring diagram for mounting holes of 400VAC units



2.4 Mounting Interval

Installing One Drive in a Control Cabinet

When installing a single Drive use Figure 2-2 as a reference for free space around the installation.

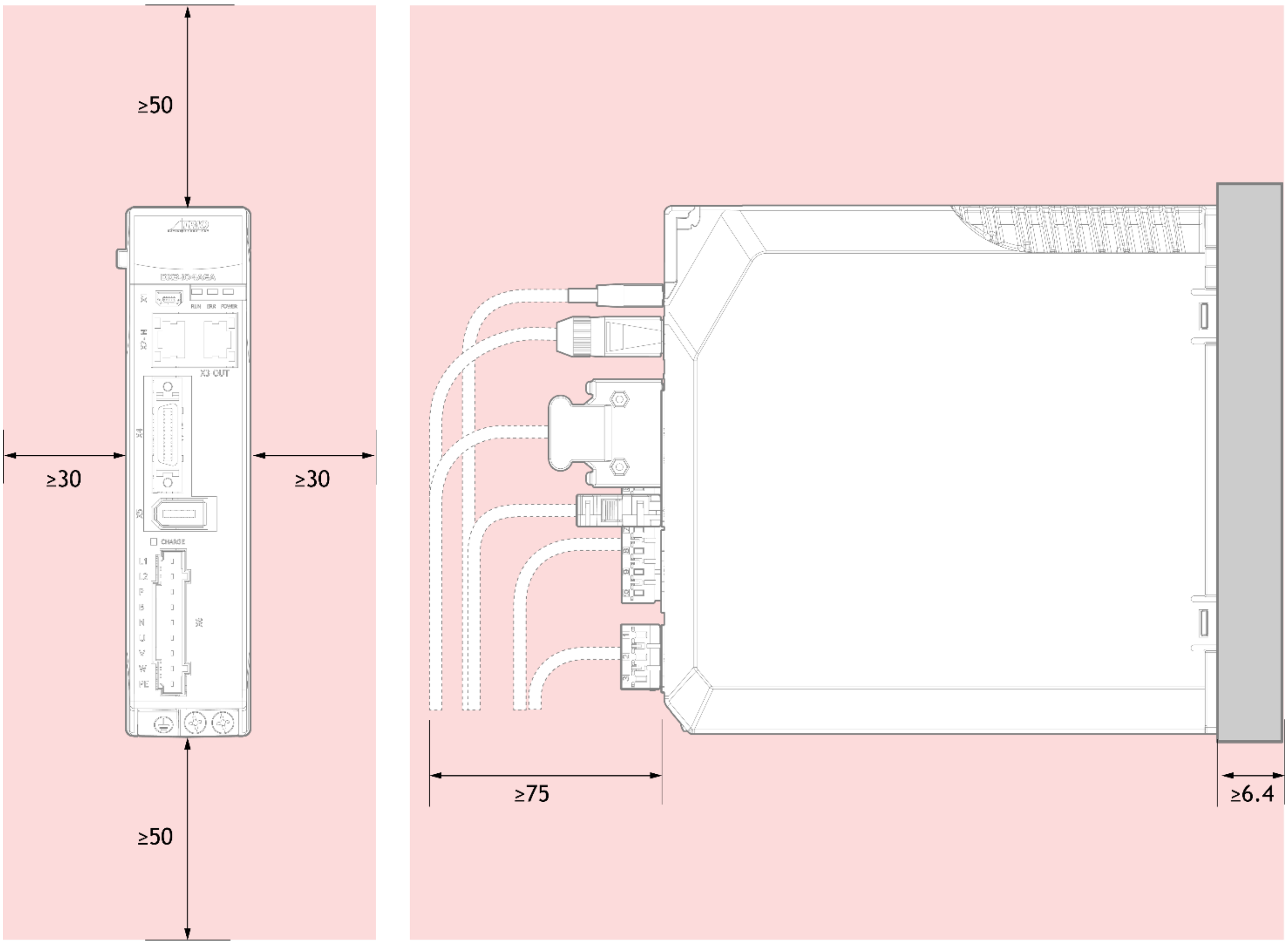


Figure 2-2 Installing a single Drive in a control cabinet

Installing multiple Drives in a Control Cabinet

When installing a multiple Drives use Figure 2-3 as a reference for free space around the installation.

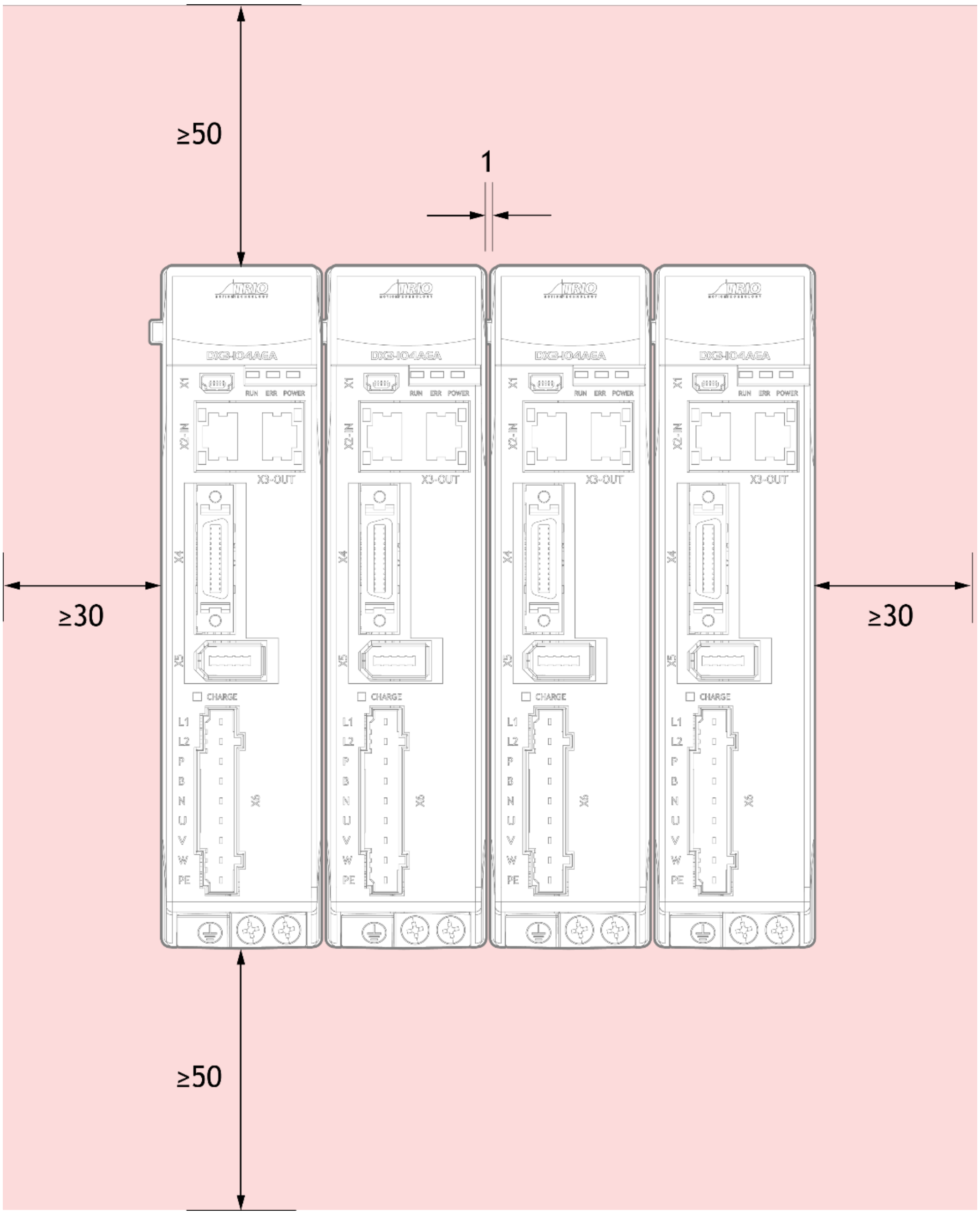


Figure 2-3 Installing multiple Drives in a control cabinet

NOTE

The DX3 can be mounted so that the distance between adjacent Drives is 1mm.

The DX3 50D and 75D drives do not allow close mounting due to wiring, and the distance between drives is to be confirmed upon assembly of the cable, for which 80mm is the recommended.

Chapter 3 Wiring and Connecting

3.1 Precautions for Wiring

3.1.1 General Precautions

DANGER

Never change any wiring while power is being supplied, in case a risk of electric shock or injury.

WARNING

- Wiring and inspections must be performed only by qualified engineers.
- Check all wiring and power supplies carefully.
  Incorrect wiring or incorrect voltage application to the output circuits may cause short-circuit failures. If a short-circuit failure occurs as a result of any of these causes, the holding brake will not work. This could damage the machine or cause an accident that may result in death or injury.
- Connect the AC and DC power supplies to the specified Drive terminals.

CAUTION

- Wait for at least five minutes after turning OFF the power supply and then make sure that the CHARGE indicator is not lit before starting wiring or inspection work. Never touch the power supply terminals while the CHARGE lamp is lit after turning OFF the power supply because high voltage may still remain in the Drive.
- Observe the precautions and instructions for wiring and trial operation precisely as described in this document.
- Check the wiring to be sure it has been performed correctly.
  Connectors and pin layouts are sometimes different for different models. Always confirm the pin layouts in technical documents for your model before operation.
- Use shielded twisted-pair cables or screened unshielded multi-twisted-pair cables for I/O Signal Cables and Encoder Cables.
- The main circuit cable of the Drive must be guaranteed to work normally at 75 °C.
- Observe the following precautions when wiring the Drive's main circuit terminals.
  - Turn ON the power supply to the Drive only after all wiring, including the main circuit terminals, has been completed.
  - If a connector is used for the main circuit terminals, remove the main circuit connector from the Drive before you wire it.
  - Insert only one wire per insertion hole in the main circuit terminals.
  - When you insert a wire, make sure that the conductor wire (e.g. whiskers) does not come into contact with adjacent wires.
- Install molded-case circuit breakers and other safety measures to provide protection against short circuits in external wiring.

IMPORTANT

- Use a molded-case circuit breaker or fuse to protect the main circuit.
  The Drive connects directly to a commercial power supply; it is not isolated through a transformer or other device. Always use a molded-case circuit breaker or fuse to protect the Servo System from accidents involving different power system voltages or other accidents.
- Install an earth leakage breaker.
  The Drive does not have a built-in ground fault protective circuit. To configure a safer system, install a ground fault detector against overloads and short-circuiting, or install a ground fault detector combined with a molded-case circuit breaker.
- Never turn the power supply ON and OFF more than necessary.
  Use the Drive for applications that require the power supply to turn ON and OFF frequently. Such applications will cause elements in the Drive to deteriorate.
- After you have started actual operation, allow at least one hour between turning the power supply ON and OFF (as a guideline).

3.1.2 Countermeasures against Noise

IMPORTANT

The Drive is designed as an industrial device. It therefore provides no measures to prevent radio interference. The Drive uses high-speed switching elements in the main circuit. Therefore, peripheral devices may be affected by switching noise.

If the equipment is to be used near private houses or if radio interference is a problem, take countermeasures against noise.

Since the Drive uses microprocessors, it may be affected by switching noise from peripheral devices.

To prevent the noise from the Drive or the peripheral devices from causing malfunctions of any devices, take the following countermeasures against noise as required.

- Install the input reference device and Noise Filter as close to the Drive as possible.
- Always install a Surge Absorber for relays, solenoids, and Magnetic Contactor coils.
- Never place the following cables in the same duct or bundle them together. Also, separate the cables from each other by at least 30 cm.
- Never share the power supply with an electric welder or electrical discharge machine. If the Drive is placed near a high-frequency generator, install Noise Filters on the input side on the Main Circuit Power Supply Cable and Control Power Supply Cable even if the same power supply is not shared with the high-frequency generator. Refer to the section **Noise Filters** for information on connecting Noise Filters.
- Implement suitable grounding measures. Refer to the section Error! Reference source not found. **REF _Ref34657974 \h * MERGEFORMAT Grounding** for information on grounding measures.

Noise Filters

You must attach Noise Filters in appropriate places to protect the Drive from the adverse effects of noise. Figure 3-1 is an example of wiring for countermeasures against noise.

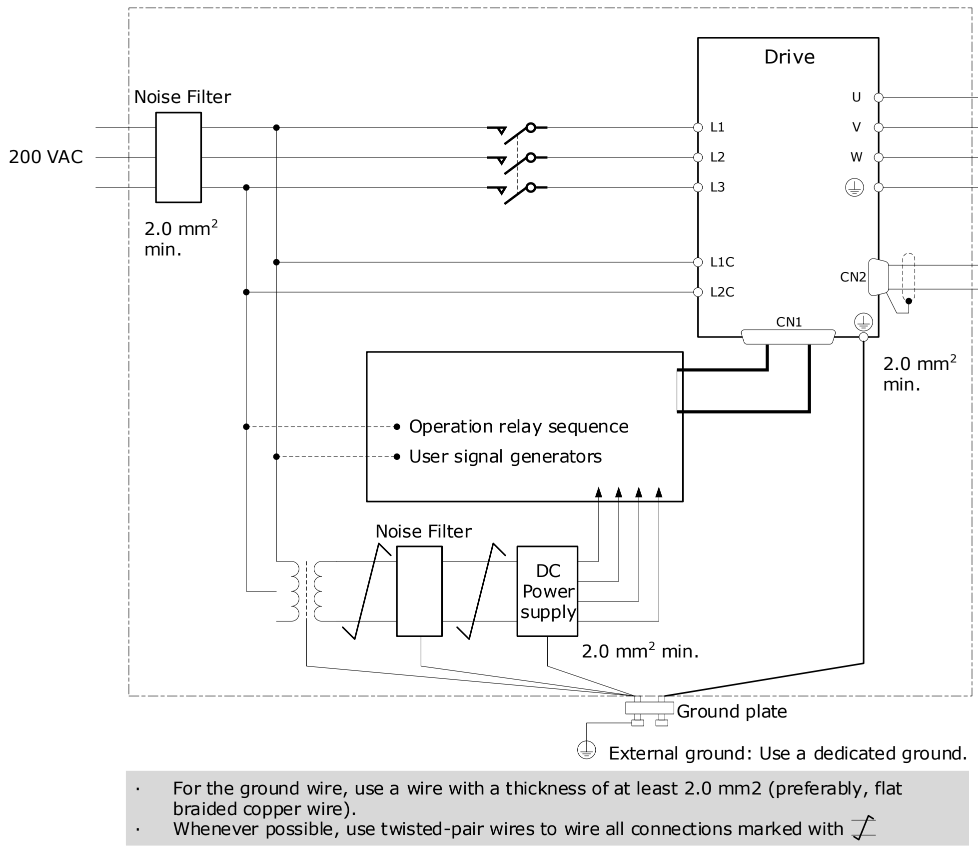
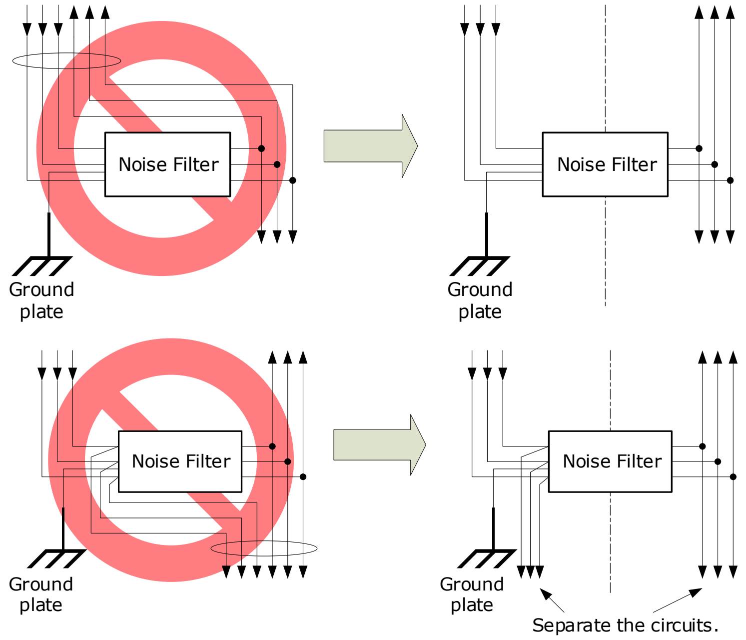


Figure 3-1 Wiring example for countermeasures against noise

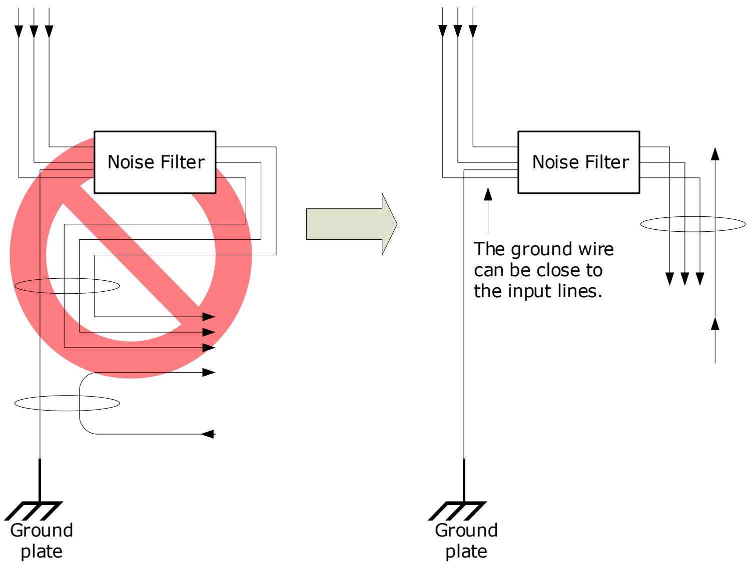
Noise Filter Wiring and Connection Precautions

Always observe the following precautions when wiring or connecting Noise Filters.

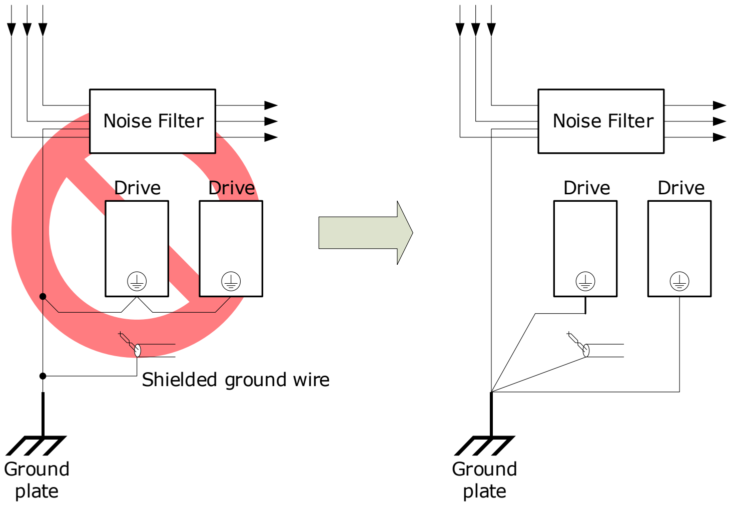
- Separate input lines from output lines. Do not place input lines and output lines in the same duct or bundle them together.



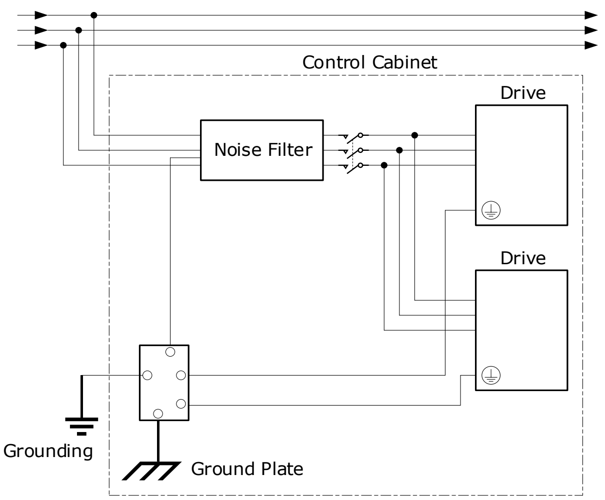
- Separate the Noise Filter ground wire from the output lines. Do not place the Noise Filter ground wire, output lines, and other signal lines in the same duct or bundle them together.



- Connect the Noise Filter ground wire directly to the grounding plate. Do not connect the Noise Filter ground wire to other ground wires.



- If a Noise Filter is located inside a control panel, first connect the Noise Filter ground wire and the ground wires from other devices inside the control panel to the grounding plate for the control panel, then ground the plate.



3.1.3 Recommended EMC Filters

To comply with the limits based on IEC/EN 61800-3 second environment (C2) the Drive and Motor must be installed with an EMC/RFI filter. Recommended filters are:

Drive voltage	DX3 Power Range	EMC C2
200VAC	50W to 1.5kW	Schaffner FN3270H-10-44
	2kW	Schaffner FN3270H-20-44
400VAC	1kW~2 kW	Schaffner FN 3025HP-10-71
	3kW~5 kW	Schaffner FN 3025HP-10-71
	7.5kW	Shanghai Aerodev DNF51-3PH-3×20A

NOTE

These filters have been tested with cable lengths of 3m and 20m

3.1.4 Grounding

Implement grounding measures as described in this section. Implementing suitable grounding measures will also help prevent malfunctions, which can be caused by noise. Always use an unpainted backplane for electrical cabinets.

- Ground the Drive to a resistance of 100 mΩ or less.
- Be sure to ground at one point only.
- Ground the Motor directly if the Motor is insulated from the machine.

Motor Frame Ground or Motor Ground

If the Motor is grounded thought the machine, the switching noise current can flow from the main circuit of the Drive through the stray capacitance of the Motor. To prevent this always connect the Motor frame terminal (FG) or ground terminal (FG) of the Motor to the ground terminal ⏚ on the Drive. Also, be sure to ground the ground terminal ⏚.

Noise on I/O Signal Cables

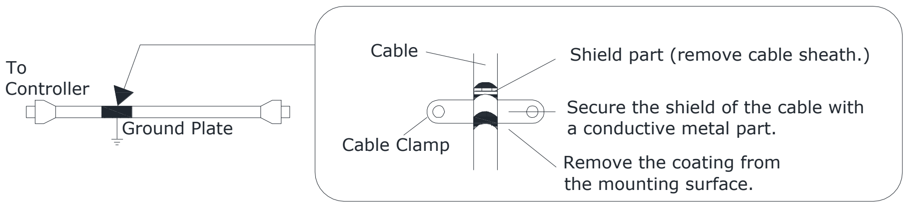
To prevent noise entering the I/O Signal Cable connect the shield of the I/O Signal Cable to the connector shell and ensure the shell is connected to ground.

If placing cables in metal conduits, ensure the conduit is connected to ground.

For all grounding, use a single grounding point.

Cable Fixing

It is recommended that all cable shields are secured with a conductive metal clamp to the ground plate.

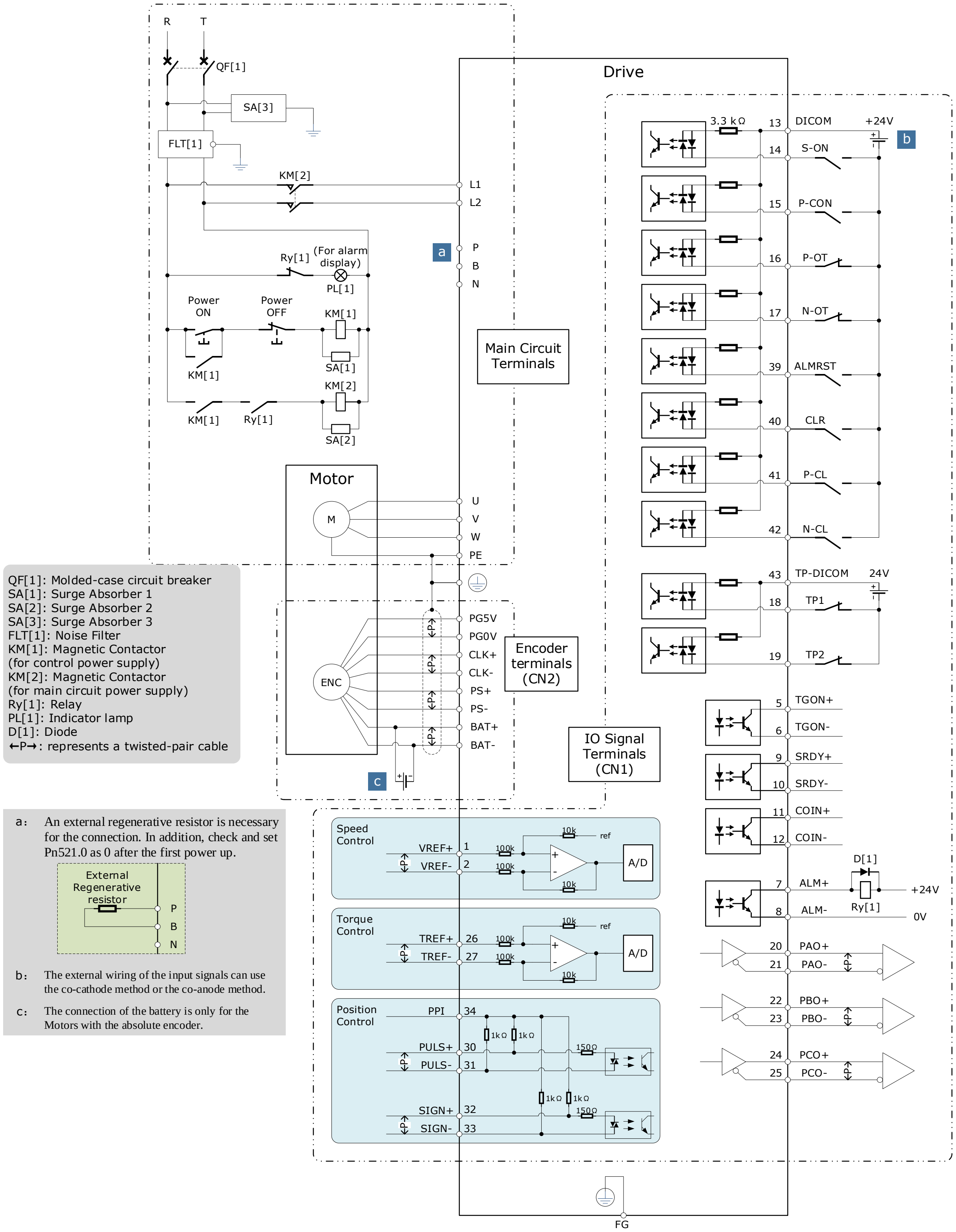


Ferrite Coils

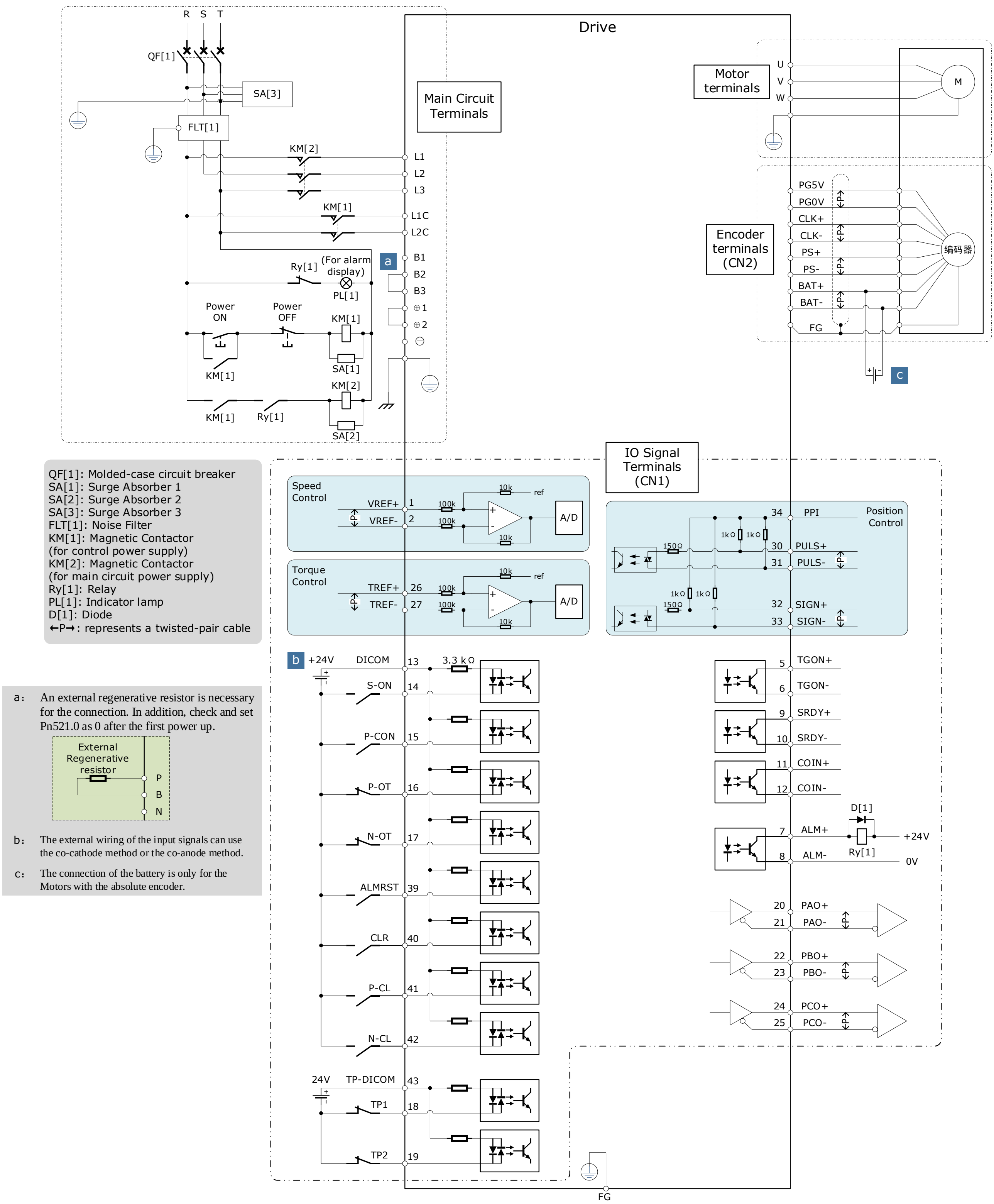
While ferrite coils can be used to solve application specific EMC issues, they should not be necessary for applications.

3.2 Basic Wiring Diagrams

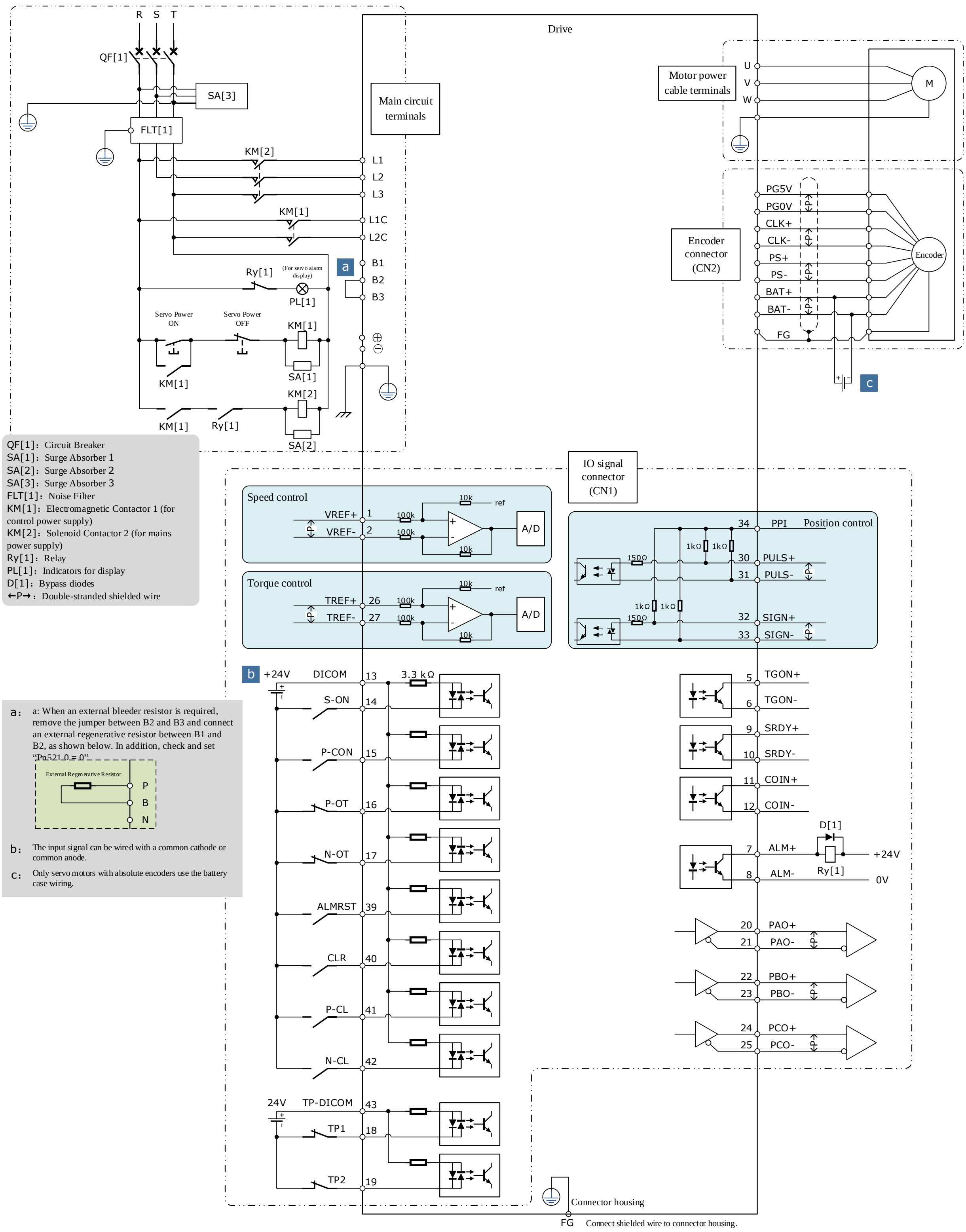
Rated power from 50W to 400W (200VAC)



Rated power from 750W to 2kW (200VAC)

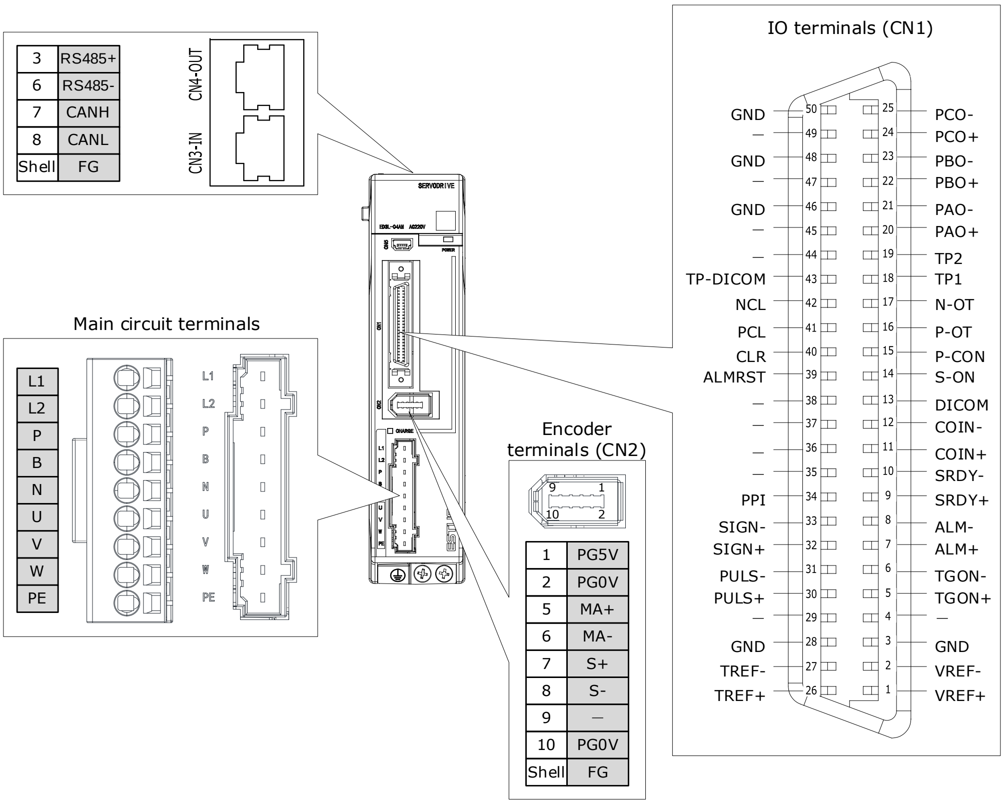


Rated power from 1kW to 7.5kW (400VAC)

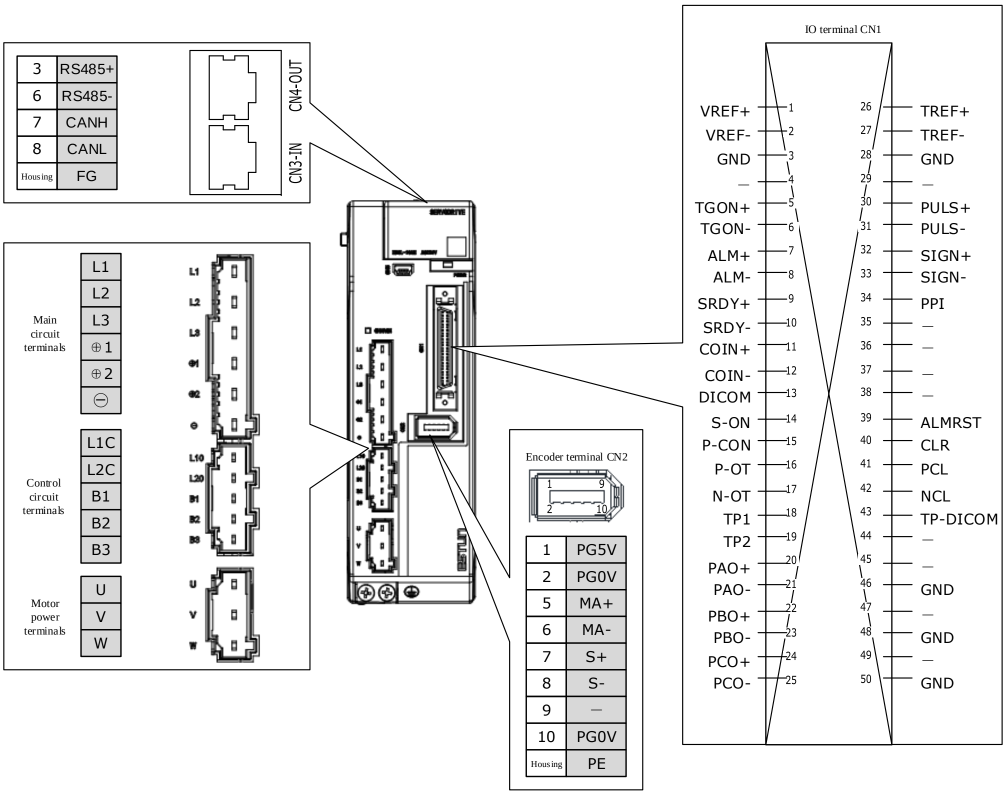


3.3 Terminals Arrangements

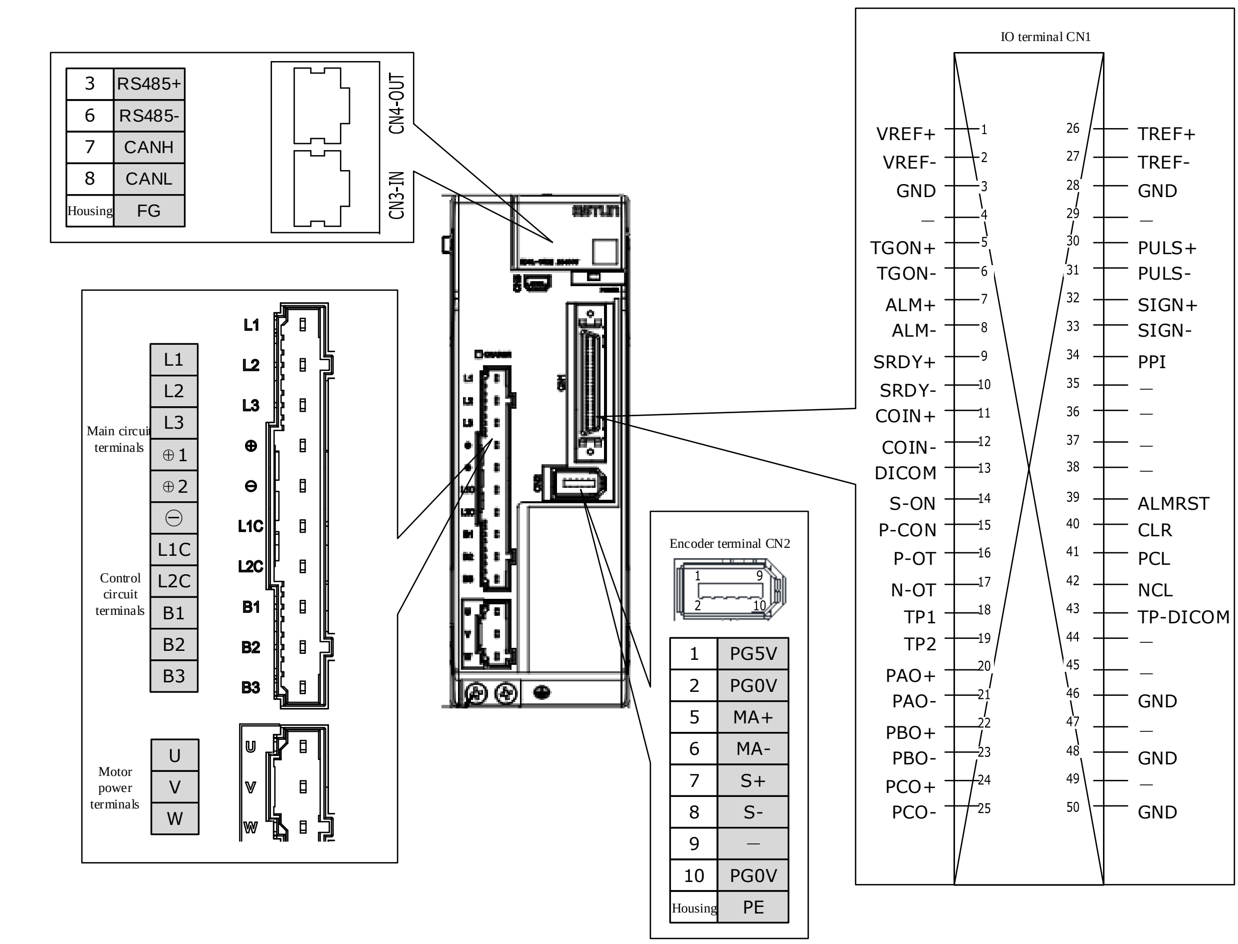
Rated power from 50W to 400W (200VAC_



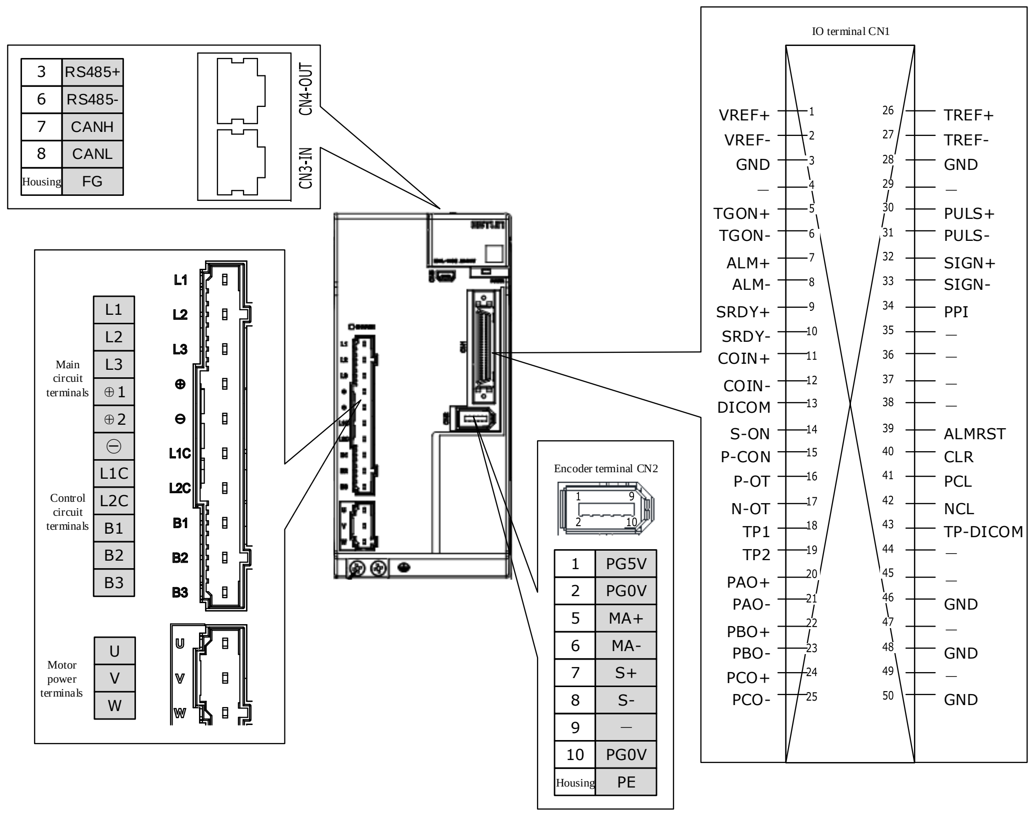
Rated power from 750W to 2kW (200VAC)



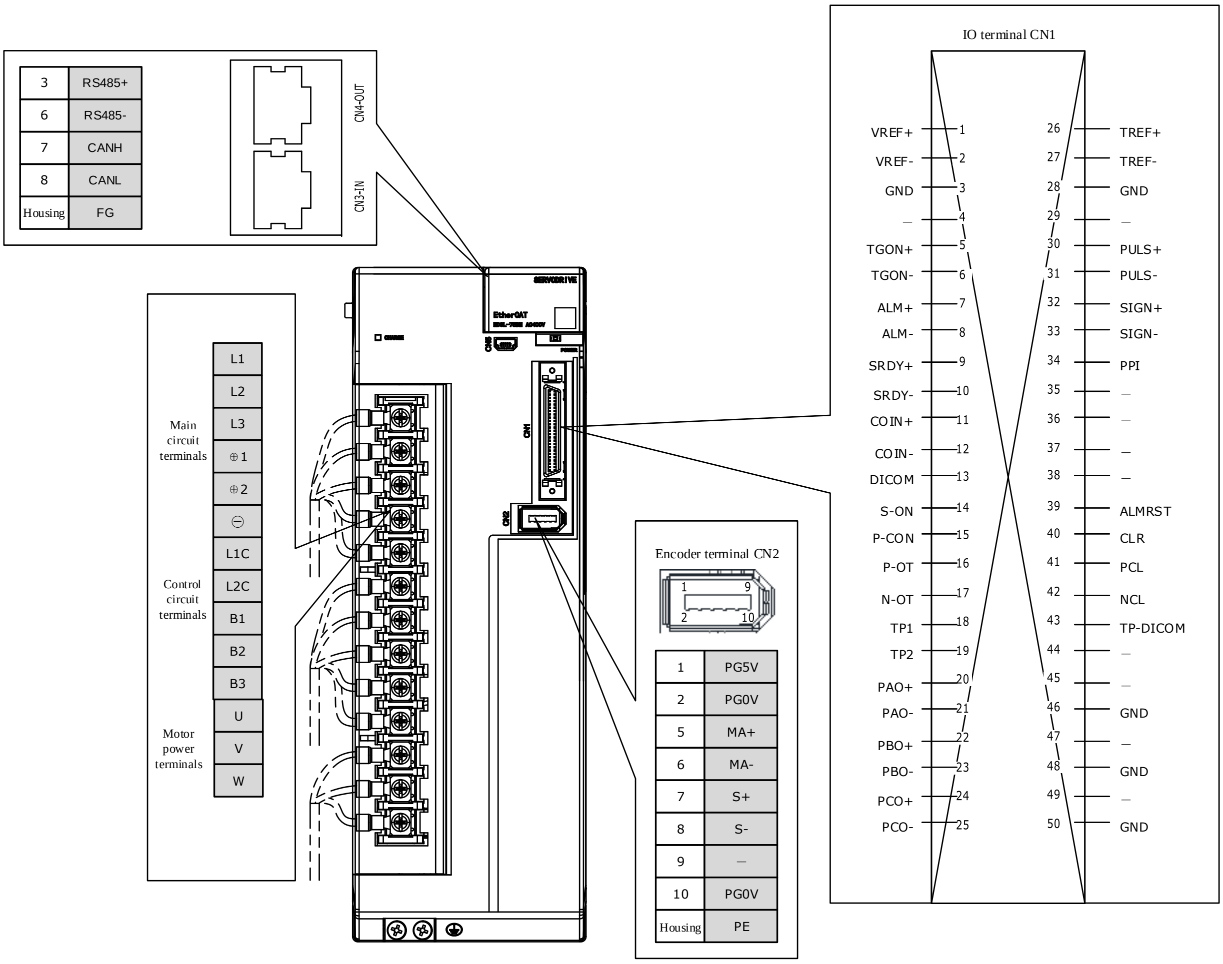
Rated power from 1kW to 1.5kW (400VAC)



Rated power from 2kW to 3kW (400VAC)



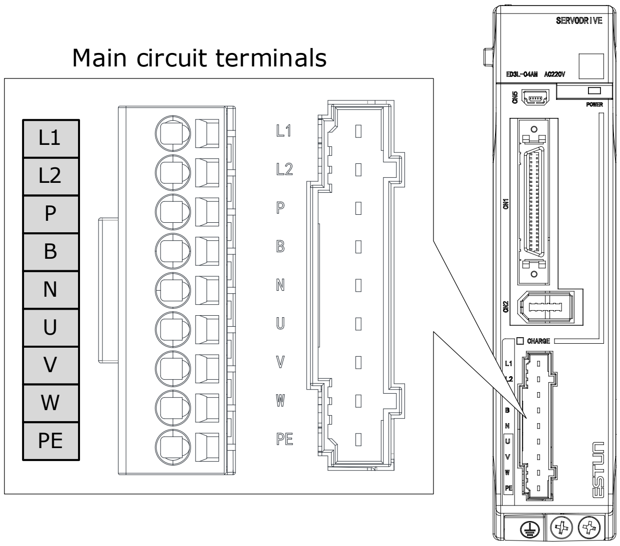
Rated power from 5kW to 7.5kW (400VAC)



3.4 Wiring the Power Supply to Drive

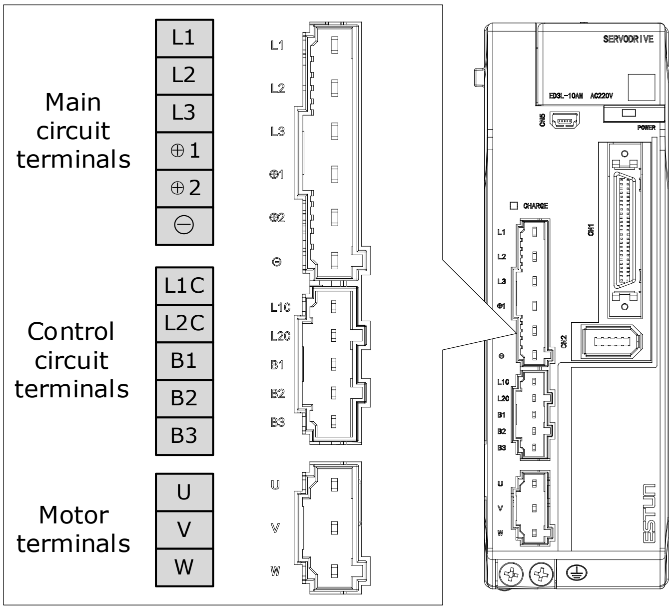
3.4.1 Terminals Arrangement

Rated power from 50W to 400W (200VAC)



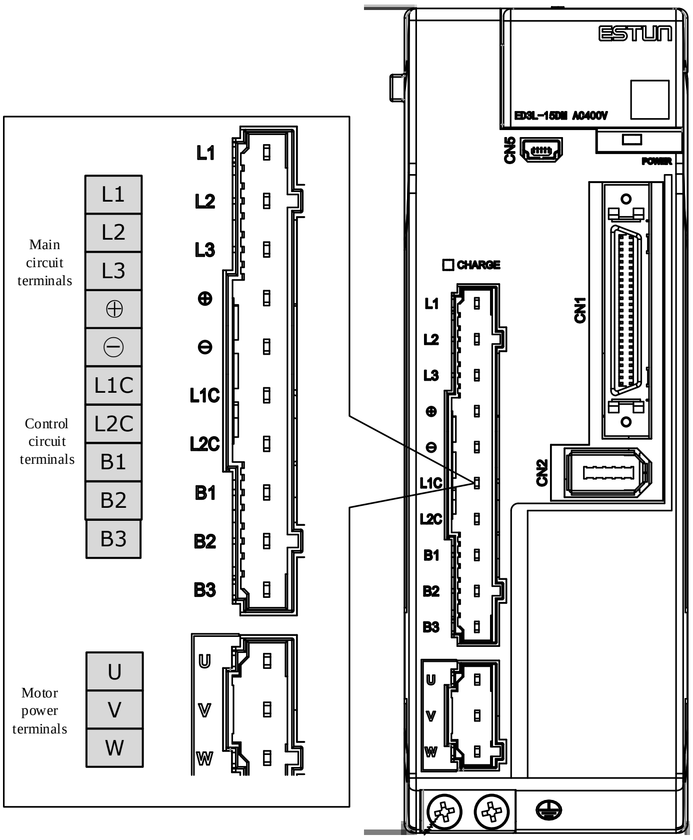
Symbols	Name	Specifications and Reference
L1, L2	Main circuit power supply input terminals	Single-phase, 200 VAC to 240 VAC, -15% to +10%, 50Hz or 60Hz
P, B	Regenerative Resistor terminal	Connects a regenerative resistor with a minimum resistance value of 45 ohm
P, N	DC terminals	For the common DC bus, connect all P of Drive to the positive pole, and N to the negative pole.
U, V, W	Motor terminals	Connects the U-phase, V-phase and W-phase of Motor
PE	Ground terminal	Always connect this terminal to prevent electric shock.

Rated power from 750W to 2kW (200VAC)



Symbols	Name	Specifications and Reference
L1, L2, L3	Main circuit power supply input terminals	Three-phase, 200 VAC to 240 VAC, -15% to +10%, 50Hz or 60Hz
⊕1, ⊕2	DC reactor terminals	For using a DC reactor, remove the short wiring, and connect a DC reactor between ⊕1 and ⊕2.
⊕2, ⊖	DC terminals	For the common DC bus, connect all ⊕2 of Drive to the positive pole, and ⊖ to the negative pole.
L1C, L2C	Control circuit terminals	Single-phase, 200 VAC to 240 VAC, -15% to +10%, 50Hz or 60Hz
B1, B2, B3	Regenerative Resistor terminal	There is a short wiring between B2 and B3 at the factory. • When the busbar capacitance is insufficient, remove the short wiring, and connect an external regenerative resistor between B1 and B2.
U, V, W	Motor terminals	Connects the U-phase, V-phase and W-phase of Motor
⏚	Ground terminal	Always connect this terminal to prevent electric shock.

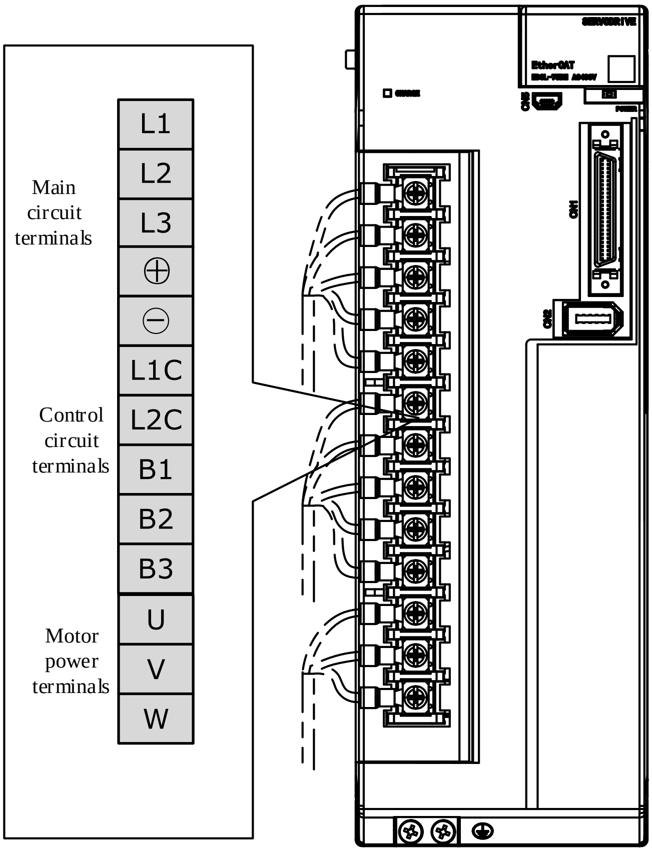
Rated power from 1kW to 3kW (400VAC)



Take for example a product with a power rating of 1kW~1.5kW. Products with power rating from 1.5kW to 3kW are similar in appearance and have the same components

Symbol	Name	Specifications
L1, L2, L3	Power supply input terminals	Three-phase 380 VAC to 440 VAC, -15% to +10%, 50Hz or 60Hz
⊕	DC reactor connectors	Prior to delivery, the connection between ⊕1 and ⊕2 is in a shorted state. When using a DC reactor, a DC reactor is connected between ⊕1 and ⊕2.
⊖	DC busbar connectors	When multiple servo drives are used in a common DC bus configuration, ⊕2 and ⊖ of all drives are connected in series, respectively.
L1C, L2C	Control power terminals	Single phase 200 VAC to 440 VAC, -15% to +10%, 50Hz or 60Hz
B1, B2, B3	Regenerative resistor connectors	• When using the built-in regenerative resistor: Keep the connection between B2 and B3 shorted. • When using an external regenerative resistor: Please remove the jumper between B2 and B3 and connect the external regenerative resistor between B1 and B2.
U, V, W	Motor power connectors	Connect the U, V and W phases of the motor.
⏚	Grounding terminals	Connect the power supply earth terminal for earthing.

Rated power from 5kW to 7.5kW (400VAC)

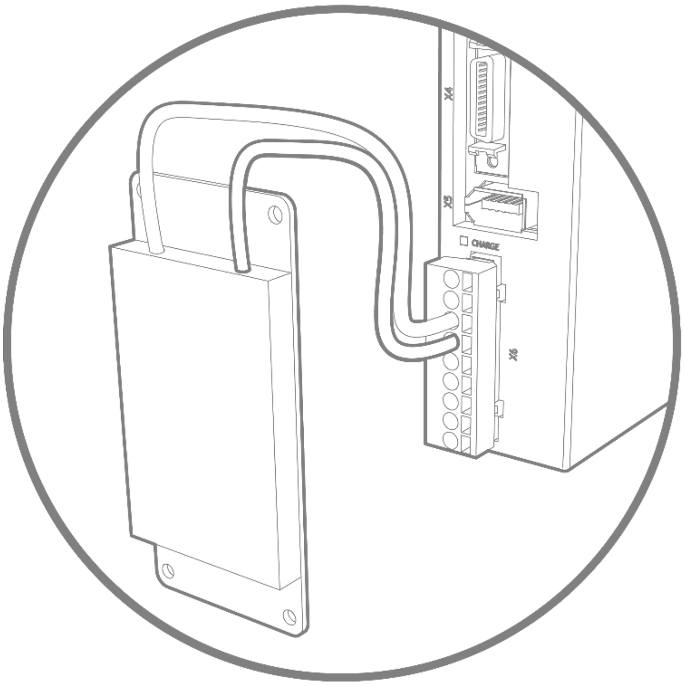


Symbols	Name	Specifications
L1, L2, L3	Power supply input terminals	Three-phase 380 VAC to 440 VAC, -15% to +10%, 50Hz or 60Hz
⊖	DC busbar connectors	When multiple servo drives are used in a common DC bus configuration, ⊕ and ⊖ of all drives are connected in series, respectively.
L1C, L2C	Control power terminals	Single phase 200VAC to 440VAC, -15% to +10%, 50Hz or 60Hz
B1, B2, B3	Regenerative resistor connectors	• When using the built-in regenerative resistor: Keep the connection between B2 and B3 shorted. • When using an external regenerative resistor: Please remove the jumper between B2 and B3 and connect the external regenerative resistor between B1 and B2.
U, V, W	Motor power connectors	Connect the U, V and W phases of the motor.
⏚	Grounding terminals	Connect the power supply earth terminal for earthing.
L1, L2, L3	Power supply input terminals	3-phase 380V～440V, -15%～+10%, 50Hz/60Hz

3.4.2 Wiring a Regenerative Resistor

Drive model	Rated power	Minimum value	Connection terminals
DX3-1A5AMA	50W	45Ω	P, B
DX3-101AMA	100W		
DX3-102AMA	200W		
DX3-104AMA	400W		
DX3-108AMA	750W	25Ω	B1, B2
DX3-110AMA	1kW		
DX3-115AMA	1.5kW	10Ω	B1, B2C
DX3-120AMA	2kW		
DX3-110DMA	1kW	65Ω	B1, B2
DX3-115DMA	1.5kW		
DX3-120DMA	2.0kW	40Ω	B1, B2
DX3-130DMA	3.0kW		
DX3-150DMA	5.0kW	20Ω	B1, B2
DX3-175DMA	7.5kW		

The image below is an example of connecting an external regenerative resistor for the drives rated power from 50W to 400W.



WARNING

Connect the external regenerative resistor as following to avoid damaging the drive or malfunction.

- It is necessary to connect an external regenerative resistor for the drives rated power from 50W to 400W. The minimum resistance value of the external regenerative resistor is 45 ohms.
  Never connect the external regenerative resistor between terminals P and N.
- In the case of the drives rated power from 750W to 1kW, confirms whether the bus capacitance is insufficient. If necessary, connect an external regeneration resistor between terminals B1 and B2. The minimum resistance value of the external regenerative resistor is 25 ohms.
  Never connect the external regenerative resistor between terminals B1 and B3.
- When an external regenerative resistor is connected, check and set Pn521.0 as 0 after the power up.
- Please check and confirm that the external regenerative resistor is mounted on non-combustible materials.

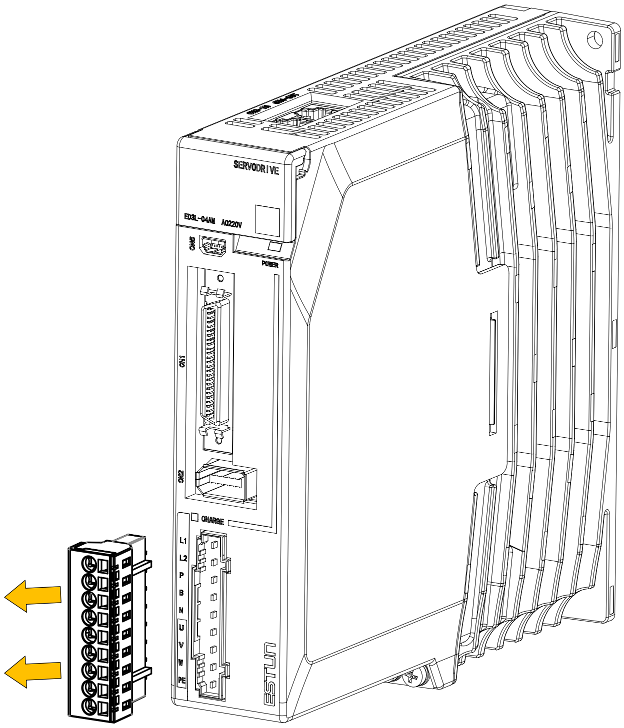
3.4.3 Wiring Procedure

Prepare the following items before preparing the wiring for the Main Circuit Terminals and Control Circuit Terminals.

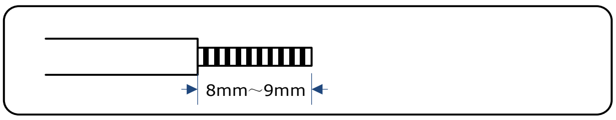
Required Item	Description
Flat-blade screwdriver or Terminal removal tool	• Flat-blade screwdriver: commercially available screwdriver with tip width of 3.0 mm to 3.5 mm • Terminal removal tool: an accessory of the Drive
Cold pressed terminals	Sleeve type ferrule with cross-section from 1.5 mm^2 to 2.5 mm^2
Wiring plier	Commercially available plier with crimping and stripping functions

Follow the procedure below to wire the Main Circuit Terminals and Control Circuit Terminals.

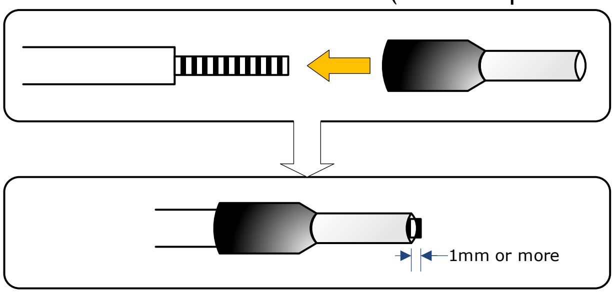
Step 1 Remove the Main Circuit Terminals and Control Circuit Terminals from the Drive.



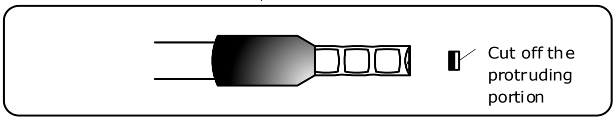
Step 2 Peel off the sheath so that the conductor portion of the cable will protrude from the tip of the ferrule.



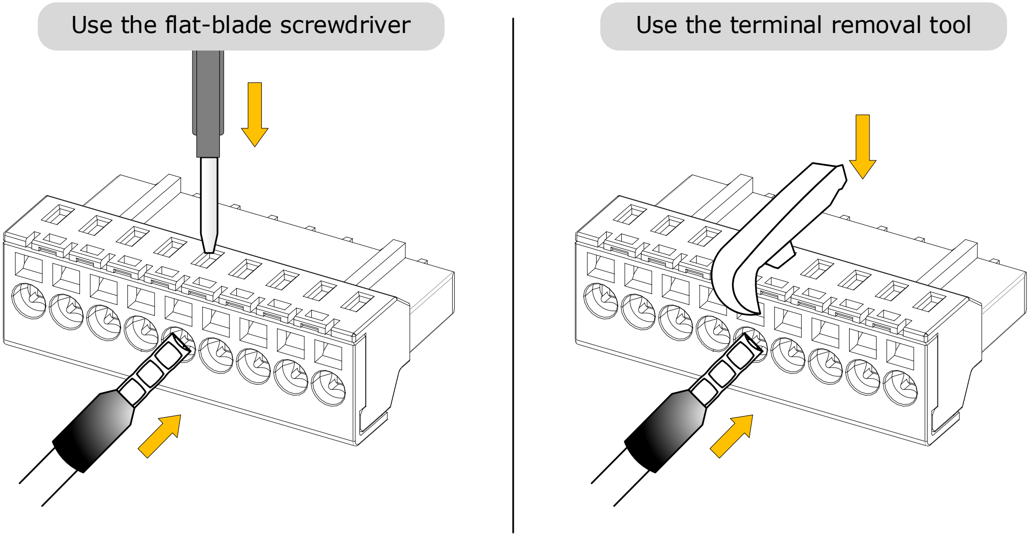
Step 3 Insert the cable into the ferrule (It should protrude 1 mm or more from the ferrule).



Step 4 Crimp the cable that has been inserted into the ferrule, and cut off the cable conductor portion protruding from the ferrule (The allowable protruding length after cutting should not be more than 0.5 mm).



Step 5 Use the flat-blade screwdriver or the terminal removal tool to press down the spring button corresponding to the terminal, and then insert the cable.



Step 6 Insert the crimped cable into the connection terminals, and then pull out the tool.

Step 7 Make all other connections in the same way.

Step 8 To change the wiring, pull the cable out of the connection terminals.
Use the flat-blade screwdriver to press down the spring button corresponding to the terminal, and then gently pull out the cable.

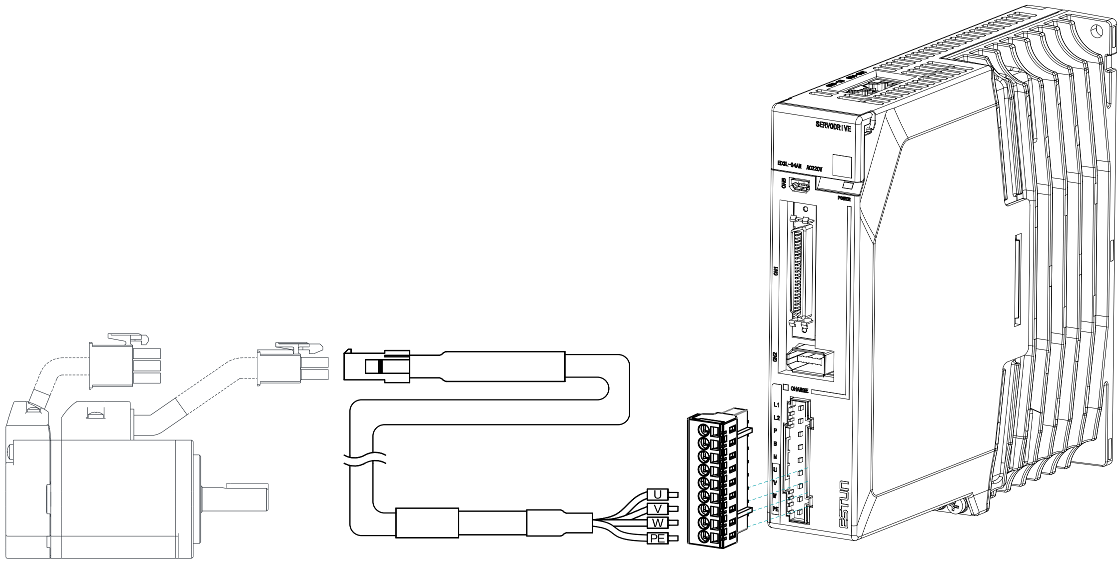
Step 9 When you have completed wiring, attach connection terminals to the Drive.

NOTE

The above wiring procedure is also applicable to the Motor Terminals.

----End

3.4.4 Motor Connection Diagram



3.4.5 Motor Power Cable Description

See table in section 1.8 Part Numbers for details of power cables for specific motor part numbers.

3.4.6 Motor Power Input Wiring Specifications

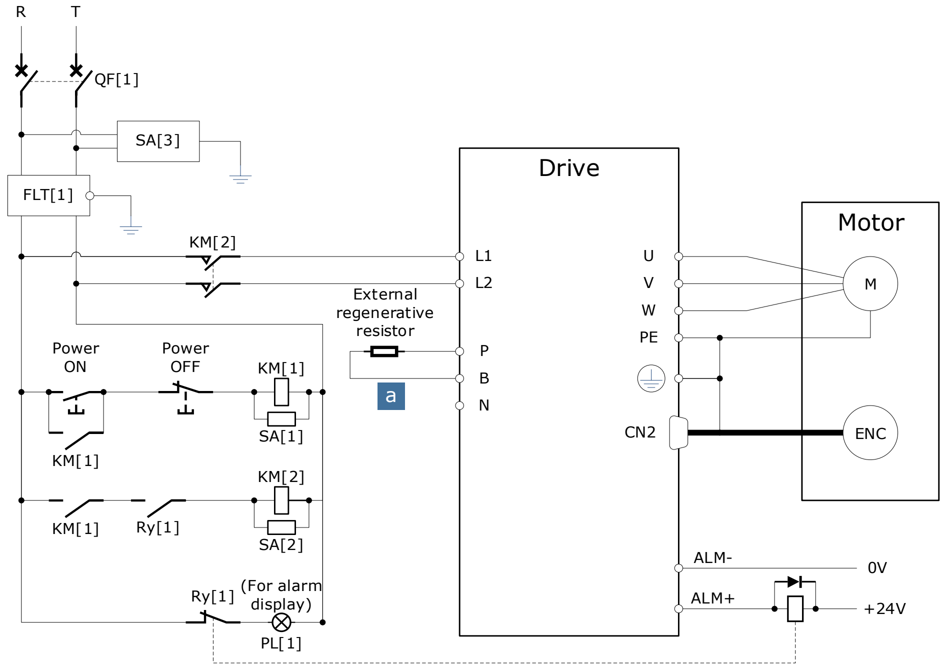
The power input wiring specification depends on the Motor model. The following table shows the recommended wire gauge for each Drive.

Drive model	Recommended wire gauge		
	AWG	Cross-sectional area (mm²)	Rated current (A)
DX3-1A5AMA	14	2.075	8.2
DX3-101AMA	14	2.075	8.2
DX3-102AMA	14	2.075	8.2
DX3-104AMA	14	2.075	8.2
DX3-108AMA	13	2.627	10.4
DX3-110AMA	13	2.627	10.4
DX3-115AMA	12	3.332	13.1
DX3-120AMA	12	3.332	13.1
DX3-110DMA	14	2.075	8.2
DX3-115DMA	14	2.075	8.2
DX3-120DMA	13	2.627	10.4
DX3-130DMA	13	2.627	10.4
DX3-150DMA	10	5.26	20.8
DX3-175DMA	9	6.63	26.2

3.4.7 Power Input Wiring Example

Rated power from 50W to 400W (200VAC)

Single-phase 200 VAC to 240 VAC.

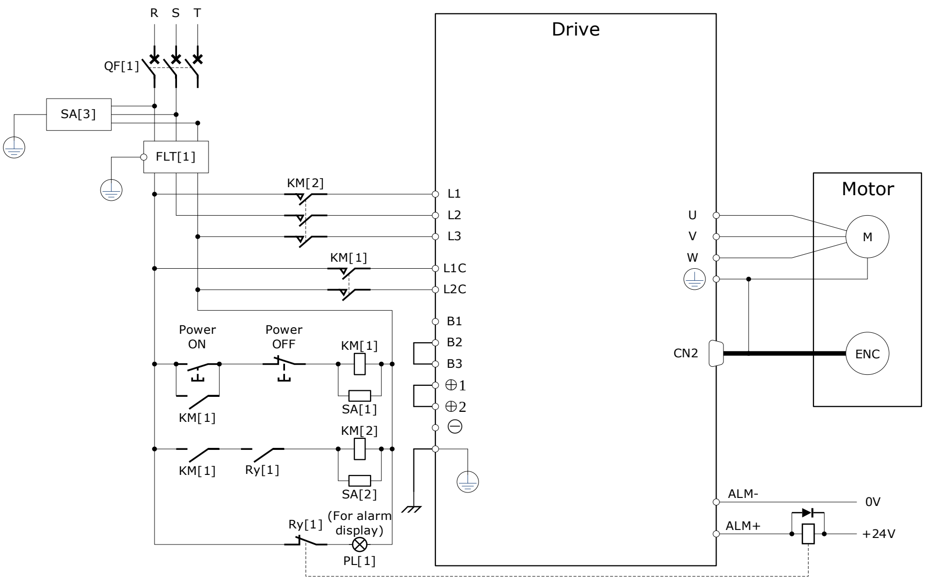


QF[1]: Molded-case circuit breaker
SA[1]: Surge Absorber 1
SA[2]: Surge Absorber 2
SA[3]: Surge Absorber 3
FLT[1]: Noise Filter
Ry[1]: Relay
PL[1]: Indicator lamp
KM[1]: Magnetic Contactor (for control power supply)
KM[2]: Magnetic Contactor (for main circuit power supply)

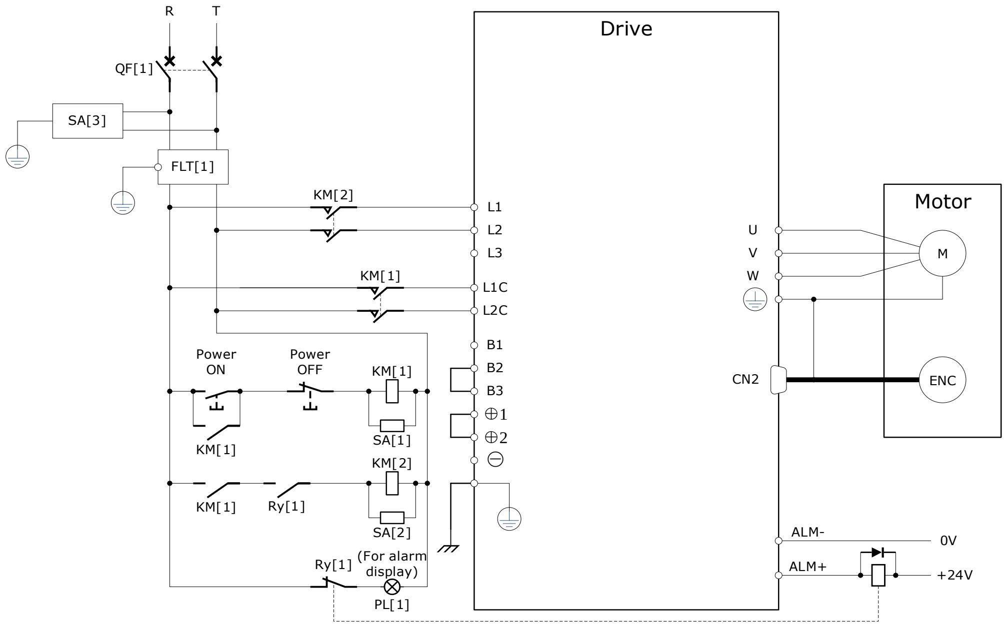
Rated power from 750W to 2kW (200VAC)

Three-phase 200 VAC to 240 VAC (Single-phase can be used up to 1.5kW)

The following figure shows the wiring example for using the three-phase AC input power.



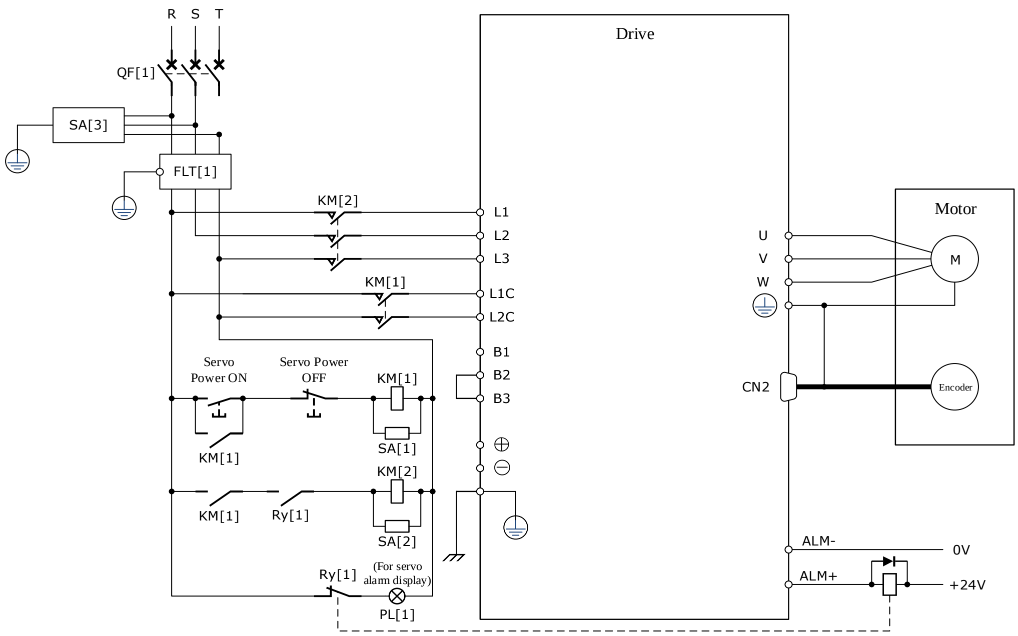
The following figure shows the wiring example for using the single-phase AC input power.



QF[1]: Molded-case circuit breaker
SA[1]: Surge Absorber 1
SA[2]: Surge Absorber 2
SA[3]: Surge Absorber 3
FLT[1]: Noise Filter
Ry[1]: Relay
PL[1]: Indicator lamp
KM[1]: Magnetic Contactor (for control power supply)
KM[2]: Magnetic Contactor (for main circuit power supply)

Rated power from 1kW to 5kW (400VAC

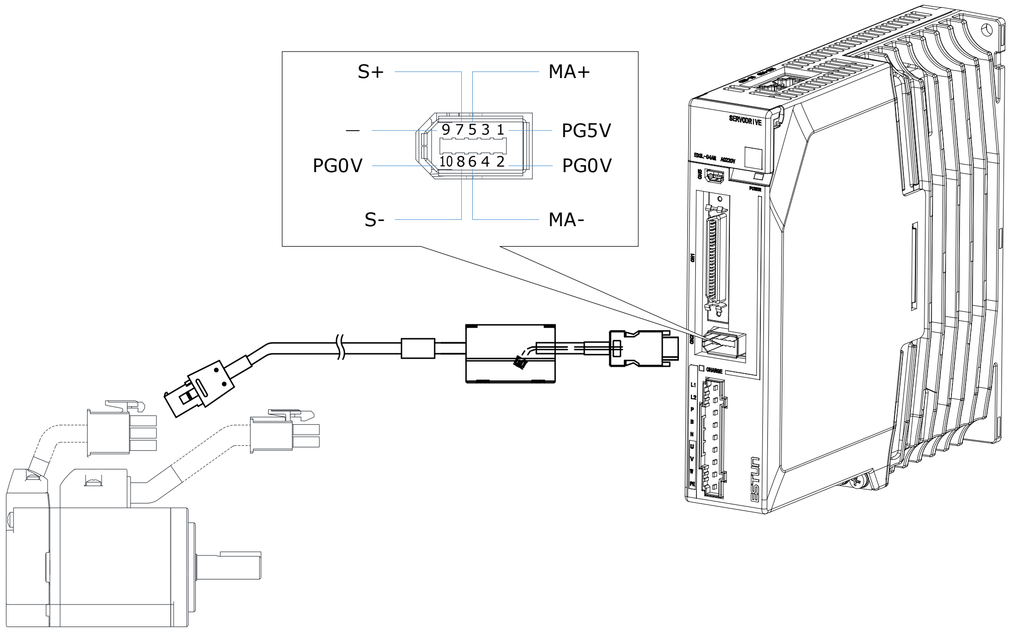
Three-phase 380 VAC to 440 VAC



QF[1]: Circuit breaker
SA[1]: Surge Absorber 1
SA[2]: Surge Absorber 2
SA[3]: Surge Absorber 3
FLT[1]: Noise Filter
KM[1]: Magnetic Contactor (for control power supply)
KM[2]: Magnetic Contactor (for main circuit power supply)
Ry[1]: Relay
PL[1]: Indicator lamp for display

3.5 Wiring the Encoder

3.5.1 Connection Diagram



3.5.2 Encoder Cable Description

The encoder cable depends on the Motor model. See table in section 1.8 Part Numbers for details of encoder cables for specific motor part numbers.

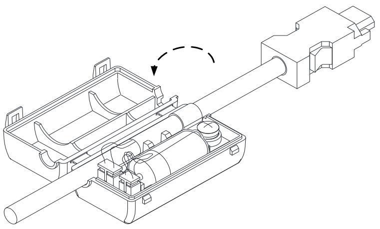
3.5.3 Battery Case Connection

 CAUTION	■ Absolute encoders are fitted on motors with an encoder type of L; e.g. MXL-02A<u>L</u>A211. These encoders require a battery supply to retain the absolute encoder data when the Drive power is removed. ■ Battery model: LS 14500 (3.6V, AA) ■ Replace the battery if the alarm A.47 or A.48 was occurred, and perform the operations <u>Absolute encoder multi-turn reset</u> and <u>Absolute encoder alarm reset</u>.

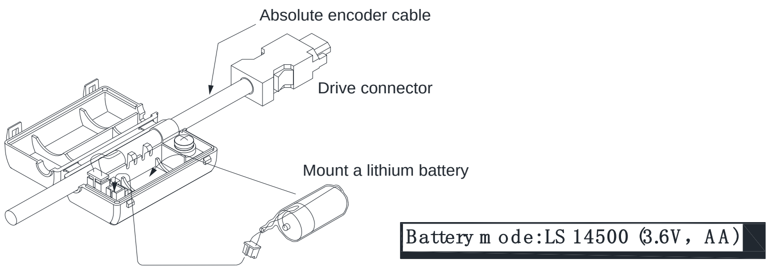
Follow the instructions below to install or replace the battery case.

Step 1 Turn ON only the control power supply to the Drive.

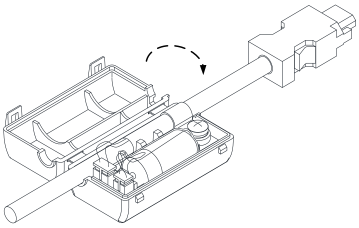
Step 2 Open the cover of the battery case.



Step 3 Remove the old battery and mount a new battery.



Step 4 Close the cover of the battery case.



Step 5 Repower up the Drive.

Step 6 Reset the Alarms.

NOTE

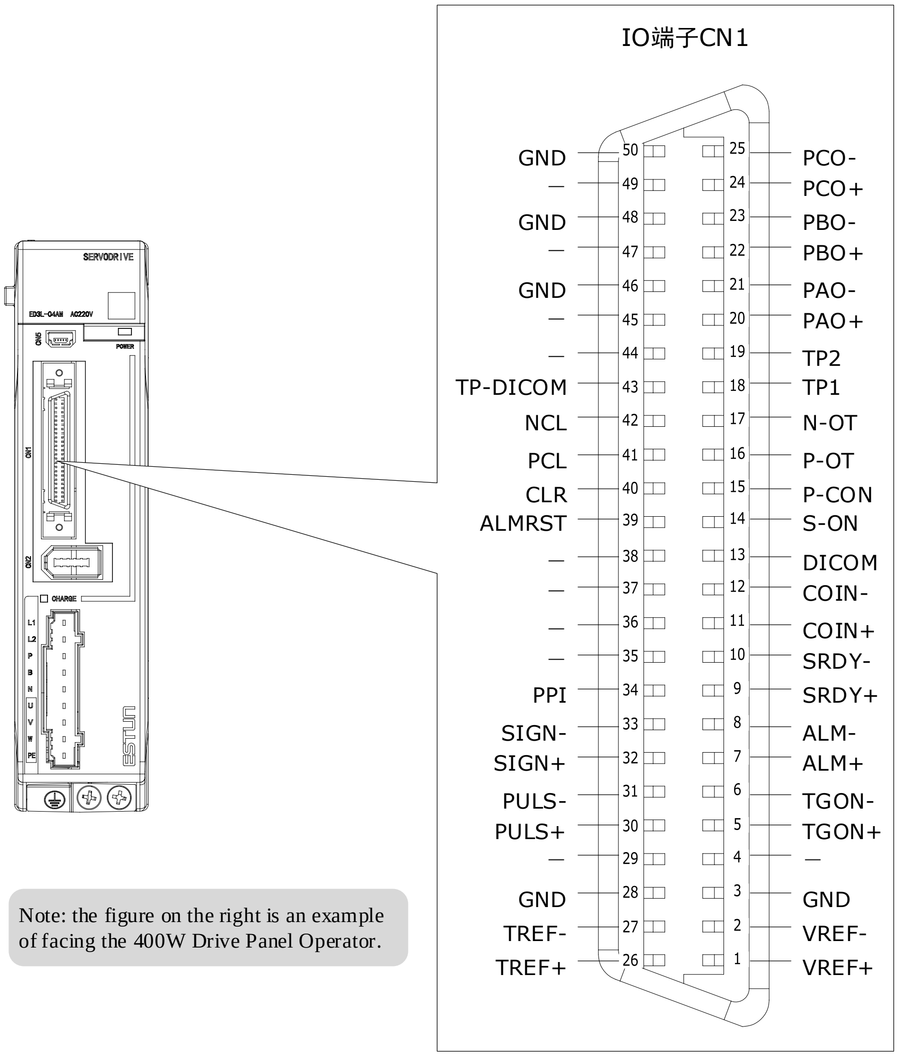
- Perform the Fn011 and Fn010 from the Panel Operator to reset the alarms, for details, see the section **Error! Reference source not found.** and **Error! Reference source no t found.**.
- Also, you can reset the alarms by Motion Perfect V5.3 or above, for details, see Motion Perfect Help Manual

Step 7 Make sure the alarms have been cleared and the Drive operates normally.

----End

3.6 I/O Signal Connections

3.6.1 Signal Diagram



Note: the figure on the right is an example of facing the 400W Drive Panel Operator.

NOTE

- The signal definitions for the IO signals of all drives are the same.
- The factory setting of all I/O signals is for remote operation. Special functionals can be assigned using Pn509, Pn510, and Pn511, see the section 5.7 IO Signal Allocation in detail.

3.6.2 Pin Layout

Pin	Name	Type	Function
1	VREF+	Input	Speed reference differential input: ±10V.
2	VREF-	Input	
5	TGON+	Output	Motor rotation test: ON when the motor speed exceeds the set value.
6	TGON-	Output	
7	ALM+	Output	Servo alarm: OFF when an abnormal condition is detected.

<table>
<tr><th>Pin</th><th>Name</th><th>Type</th><th colspan="2">Function</th></tr>
<tr><td>8</td><td>ALM-</td><td>Output</td><td colspan="2"></td></tr>
<tr><td>9</td><td>SRDY+</td><td>Output</td><td colspan="2" rowspan="2">Servo READY: When the control circuit and the main circuit are turned on, it will be ON if there’s no alarm and no overtravel for servo.</td></tr>
<tr><td>10</td><td>SRDY-</td><td>Output</td></tr>
<tr><td>11</td><td>COIN+</td><td>Output</td><td colspan="2" rowspan="2">Positioning completed: ON after positioning is completed (deviation pulse reaches the set value).</td></tr>
<tr><td>12</td><td>COIN-</td><td>Output</td></tr>
<tr><td>13</td><td>DICOM</td><td>Common</td><td colspan="2">I/O signal power supply, to be supplied by user with a DC 24V power supply.
Range of operating voltage: DC 24V±20%</td></tr>
<tr><td>14</td><td>S-ON</td><td>Input</td><td colspan="2">Servo ON: Motor becomes the turn-on state.</td></tr>
<tr><td rowspan="6">15</td><td rowspan="6">P-CON</td><td rowspan="6">Input</td><td colspan="2">Select the function of this signal by parameter settings.</td></tr>
<tr><td>Proportional Control Switch</td><td>Change the speed ring control mode from PI control to P control when it is ON.</td></tr>
<tr><td>Rotation Direction Switch</td><td>Use this signal to switch the direction of rotation when the function "Set speed selection internally" is used.</td></tr>
<tr><td>Control Mode Switch</td><td>Switch the control method</td></tr>
<tr><td>Zero Clamp</td><td>When [Speed Control] is ON, the command speed is "0".</td></tr>
<tr><td>Command Pulse Prohibited</td><td>When [Position Control] is ON, the command pulse input will be stopped.</td></tr>
<tr><td>16</td><td>P-OT</td><td>Input</td><td>Forward Rotation Prohibited</td><td rowspan="2">Overtravel prohibited: Stop the servo motor when it is OFF.</td></tr>
<tr><td>17</td><td>N-OT</td><td>Input</td><td>Reverse Rotation Prohibited</td></tr>
<tr><td>18</td><td>TP1</td><td>Input</td><td colspan="2" rowspan="2">TouchProbe Input</td></tr>
<tr><td>19</td><td>TP2</td><td>Input</td></tr>
<tr><td>43</td><td>TP-DICOM</td><td>Common</td><td colspan="2">The power supply for the input signal of the TouchProbe is to be supplied by user (DC 24V mains supply). Range of operating voltage: DC 24V±20%</td></tr>
<tr><td>20</td><td>PAO+</td><td>Output</td><td colspan="2" rowspan="2">Encoder pulse dividing pulse output Phase A</td></tr>
<tr><td>21</td><td>PAO-</td><td>Output</td></tr>
<tr><td>22</td><td>PBO+</td><td>Output</td><td colspan="2" rowspan="2">Encoder pulse dividing pulse output Phase B</td></tr>
<tr><td>23</td><td>PBO-</td><td>Output</td></tr>
<tr><td>24</td><td>PCO+</td><td>Output</td><td colspan="2" rowspan="2">Encoder pulse dividing pulse output Phase C</td></tr>
<tr><td>25</td><td>PCO-</td><td>Output</td></tr>
<tr><td>26</td><td>TREF+</td><td>Input</td><td colspan="2" rowspan="2">Torque reference input. Max input voltage: ±12V</td></tr>
<tr><td>27</td><td>TREF-</td><td>Input</td></tr>
<tr><td>30</td><td>PULS+</td><td>Input</td><td colspan="2" rowspan="2">Form of pulse input:
• Symbol + pulse train</td></tr>
<tr><td>31</td><td>PULS-</td><td>Input</td></tr>
</table>

Pin	Name	Type	Function
32	SIGN+	Input	• CCW+CW • Two-phase orthogonal pulse (90º phase difference)
33	SIGN-	Input	
34	PPI	Input	Power supply for open collector command (2KΩ/0.5W resistor is preset inside of the servo drive)
39	ALMRST	Input	Alarm reset: Release the servo alarm state.
40	CLR	Input	Position deviation pulse clear: to clear the position deviation pulse during position control.
41	PCL	Input	Forward Torque Limit
42	NCL	Input	Reverse Torque Limit
3,28,46,48,50	GND	Common	Signal Grounding
Other	–	–	Reserved

3.6.3 Wiring Description

Input Signals Wiring

The input signals of the Drive are divided into two groups, and the details are as follows.

Taking the input signal P-OT as an example, Figure 3-2 shows the connection diagram by using an external 24 VDC power supply, and the wiring of other input signals wiring is the same as it.

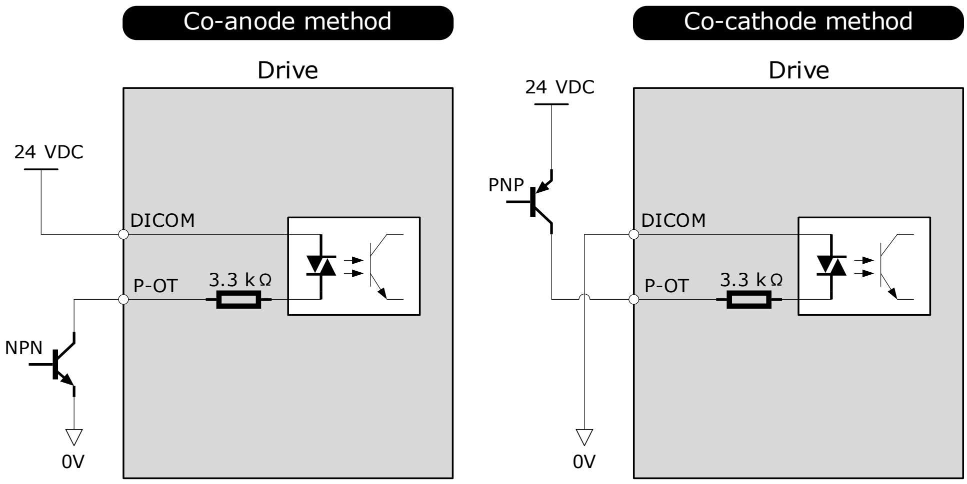


Figure 3-2 P-OT wiring diagram

You can assign the input signals by Pn509 and Pn510. For the input signal allocation, see the section 5.7 IO Signal Allocation.

Output Signals Wiring

Taking the output signal TGON as an example, Figure 3-3 shows the connection diagram for using the optocoupler or relay, and the wiring of other output signals wiring is the same as it.

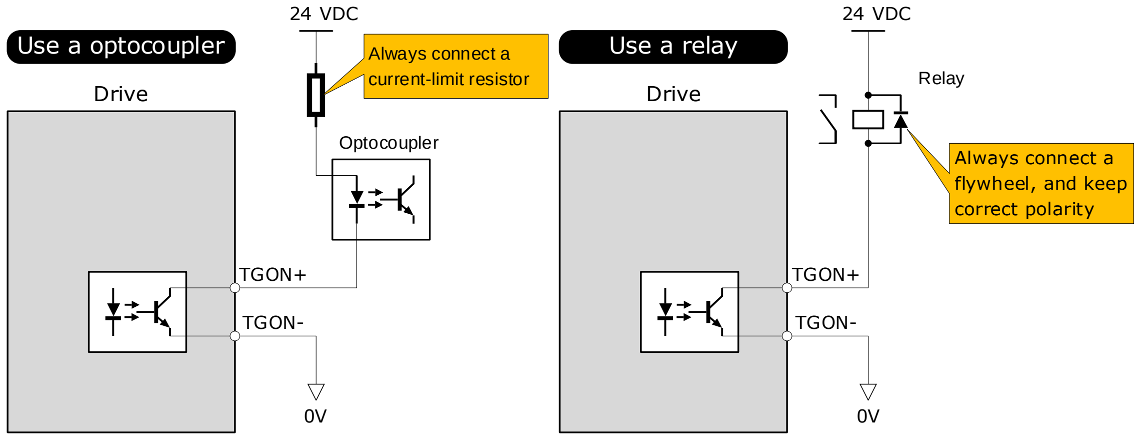


Figure 3-3 TGON wiring diagram

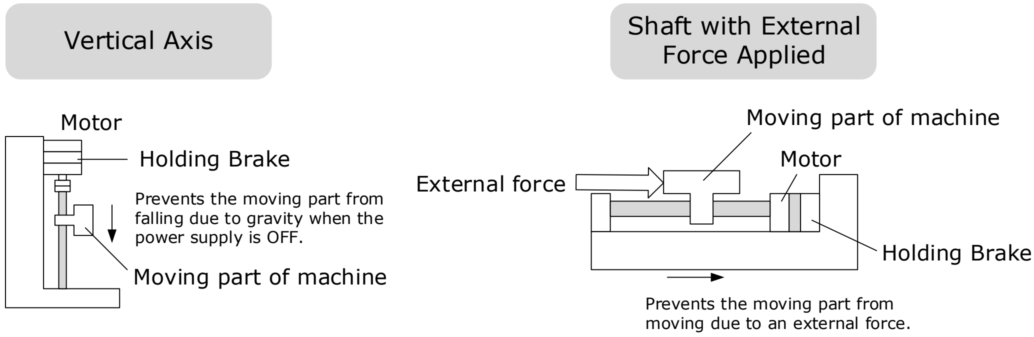
The maximum permissible voltage and current of the optocoupler output circuit inside the servo drive are as follows:
Maximum voltage: 30 VDC
Maximum current: DC 50 mA

You can assign the output signals by Pn511. For the output signal allocation, see the section 5.7 Output Signal Allocations.

3.6.4 Holding Brake Wiring

A holding brake is used to hold the position of the moving part of the machine when the Drive is turned OFF so that the moving part does not move due to gravity or an external force.

You can use the brake that is built into a Motor with a Brake, or you can provide one on the machine. The holding brake is used in the following cases.



IMPORTANT

- The brake built into a Motor with a Brake is a de-energization brake. It is used only to hold the Motor and cannot be used for braking. Use the holding brake only to hold a Motor that is already stopped.
- Keep the input voltage at least 21.6 V to make the brake work.
- The wiring of the brake signal has no polarity, please prepare a 24 VDC external power supply.
- Cable of 0.5mm² or above is recommended.

Taking the drives rated from 50W to 400W as an example, Figure 3-4 shows the connection diagram of the holding brake.

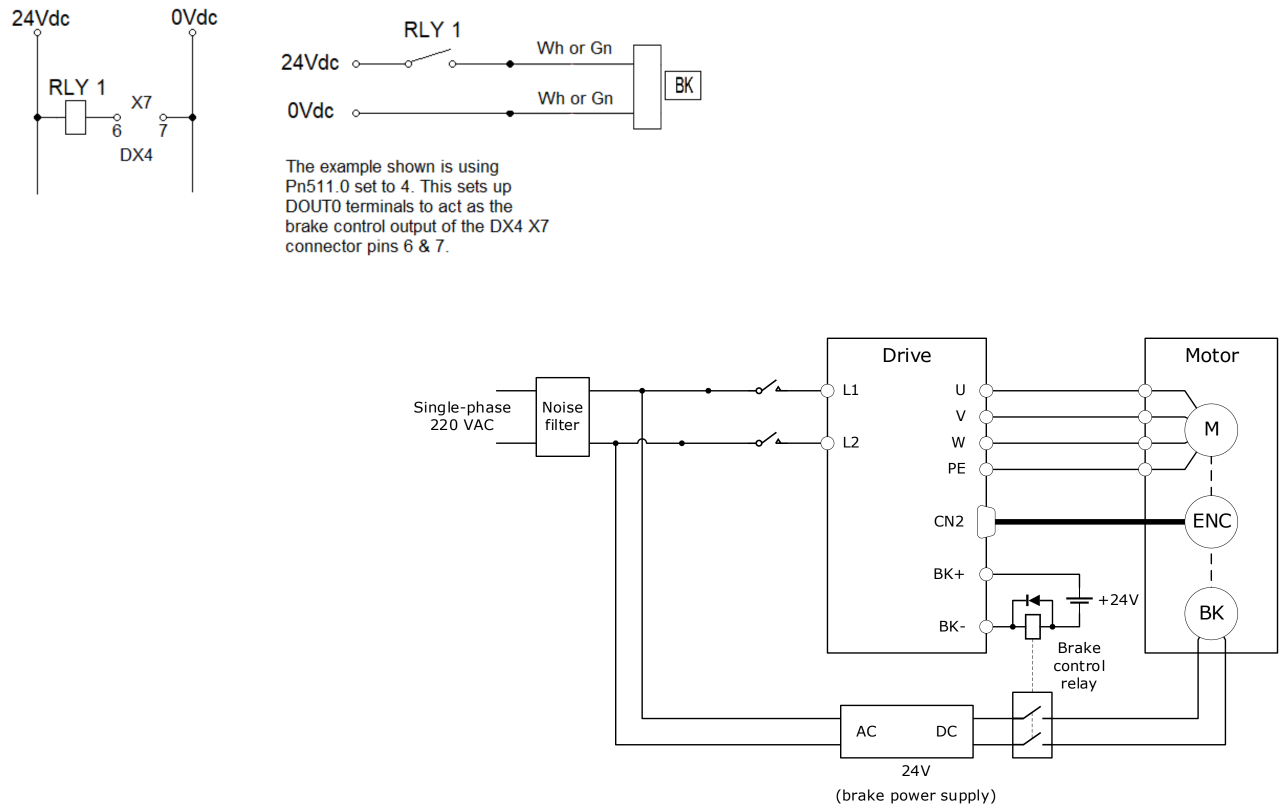


Figure 3-4 Holding brake wiring diagram

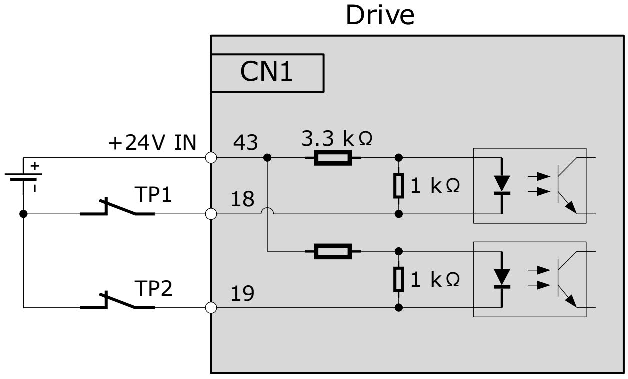
Table 3-1 lists brake specifications for each Motor matched with DX3.

Motor Model	Voltage (V)	Holding torque (Nm)	Brake time (ms)	Release time (ms)	Power (W)
MXL-A5A/01A	24V±10%	≤0.32	20	50	4
MXL-02A/04A	24V±10%	≤1.5	25	50	7.4
MXL-08A/10A	24V±10%	≤3.2	20	70	9.6
MXL-15A/20A MXL-15D/20D	24V±10%	≤8	20	100	17.6±10%
MXL-30A MXL-30D/40D/50D	24V±10%	≤20	40	100	23±10%
MXM-09A/13A/18A MXM-09D/13D/18D	24V±10%	≤20	40	100	23±10%
MXM-29D/44D	24V±10%	≤44	25	150	36±10%
MXM-55D/75D	24V±10%	≤72	25	200	36±10%

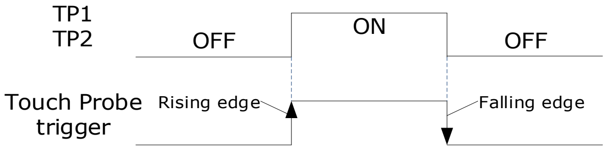
Table 3-1 Brake specifications

3.6.5 Touch Probe Wiring

You shall only use the terminals CN1-18 (TP1) and CN1-19 (TP2) for Touch Probe input signal, which has been allocated at factory. The following figure shows the example diagram for the connection.



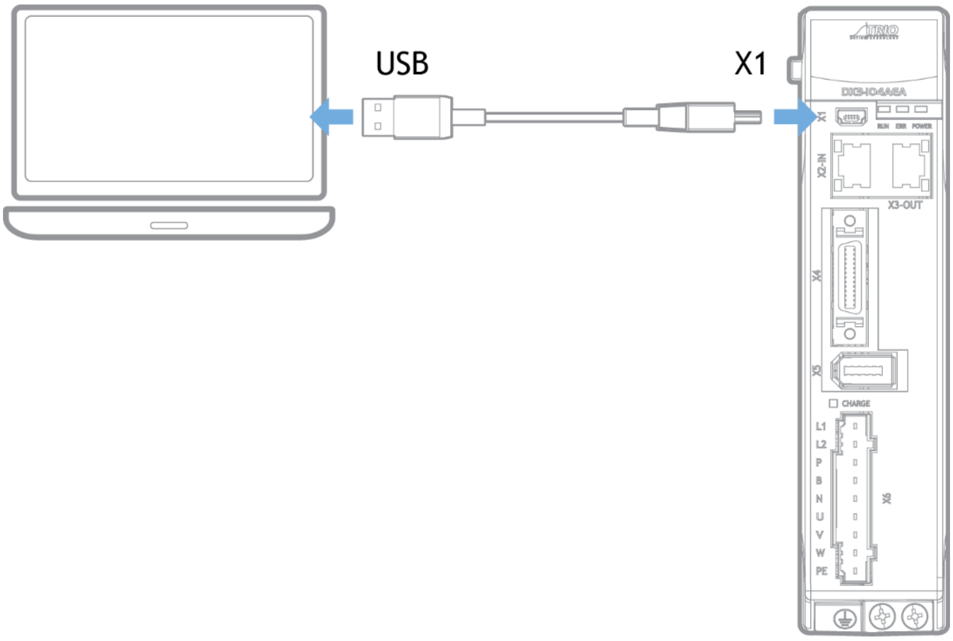
The timing sequence between input signals and trigger is as shown below.



3.7 USB Communication Cable

Connects your PC to a Drive with a USB Communication Cable, to make the online operation of Motion Perfect 5.3 or above.

Connection Diagram



Cable Description

You can purchase the **USB Communication Cable** provided by TRIO, or you can purchase the commercially available products yourself.

The plug connected to your PC is USB Type-A, and the plug connected to the Drive is Mini USB Type-B.

Chapter 4 Basic Settings

You can implement the functions of parameter setting, display, monitoring, alarm, adjustment, etc. of the Drive in the following two ways.

- Use the Panel Operator of the Drive
- Use the Motion Perfect 5.3 or above (Recommended)

4.1 Panel Operator

4.1.1 Key Names and Functions

There is a Panel Operator on the front of the Drive, as is shown in Figure 4-1.

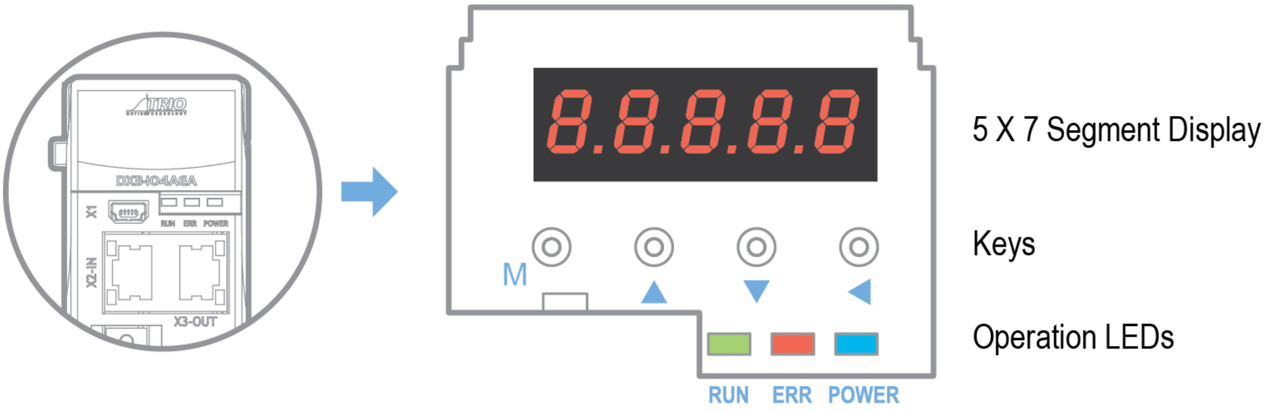


Figure 4-1 Diagram of Panel Operator

The names and functions of the keys on the Panel Operator are as follows.

Key	Functions
M	Press [M] key to select a basic mode, such as the status display mode, utility function mode, parameter setting mode, or monitor mode.
▲	Press [▲] Key to increase the set value.
▼	Press [▼] Key to decrease the set value.
◀	• Data setting key • To display parameter setting and set value. • To shift to the next digit on the left.

4.1.2 Basic Mode Selection

The basic modes include Status Display Mode, Parameter Setting Mode, Utility Function Mode, and Monitor Mode.

Select a basic mode with [M] key to display the operation status, set parameters and operation references, as is shown in Figure 4-2.

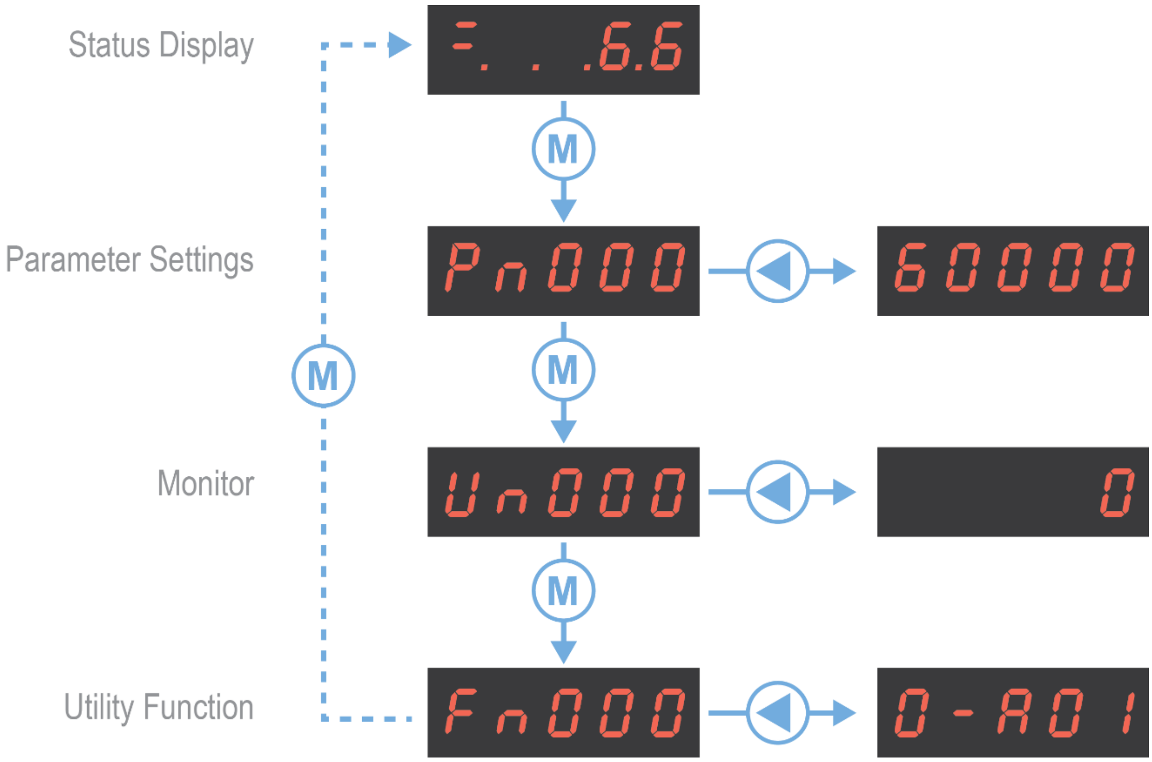


Figure 4-2 Select a basic mode.

4.1.3 Status Display Mode

Power ON the Drive and wait for a while, the Panel Operator will initially display the Servo Status.

The information displayed by the status is divided into two parts as Figure 4-3:

- The first two digits are called **Bit Data**, what indicates the signal states during the operation of Drive.
- The last three digits are called **Code**, what indicates the operation states of Drive.

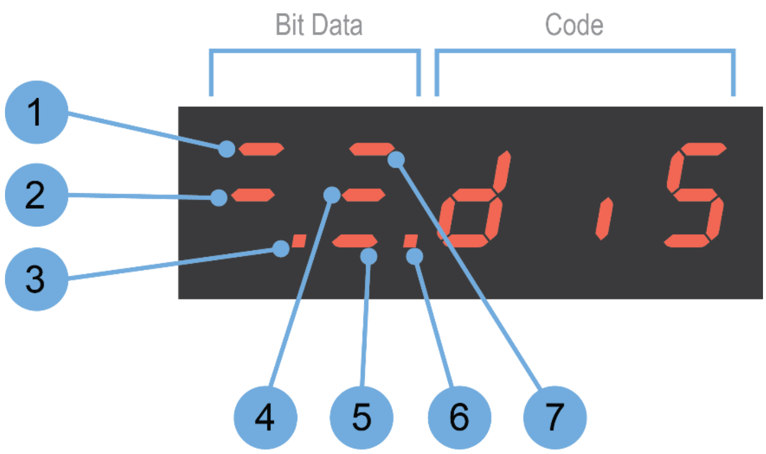


Figure 4-3 Status Display

The display meaning of each segment on Bit Data are shown in Table 4-1 , and they have different meanings under Speed or Torque Control Mode and Position Control Mode

No	Speed Control/Torque Control		Position Control Mode	
	Meaning	Description	Meaning	Description
1	Speed Coincidence (VCMP)	Lit when the difference between the Motor speed and reference speed is the same as or less than the value set in Pn501 (Default setting is 10 rpm). Always lit in Torque Control Mode.	Positioning Completion (COIN)	Lit if error between position reference and actual Motor position is below pre-set value in Pn500 (Default setting is 10 pulses).
2	Servo OFF	Lit when servo is off. Not lit when servo is on.	Servo OFF	Lit when servo is off. Not lit when servo is on.
3	Control Power ON	Lit when Drive control power is ON.	Control Power ON	Lit when Drive control power is ON.
4	Speed Reference Input	Lit if input speed reference exceeds the value pre-set in Pn503 (Default setting is 20 rpm).	Reference Pulse Input	ON when the reference pulse is being input. OFF when no reference pulse is input.
5	Torque Reference Input	Lit if input torque reference exceeds pre-set value (10% rated torque is standard setting).	Deviation Counter Clear Signal Input	Lit when deviation counter clear signal is input.
6	Power Ready	Lit when main power supply circuit is normal.	Power Ready	Lit when main power supply circuit is normal.
7	Rotation Detection (TGON)	Lit if Motor speed exceeds the value pre-set in Pn503 (Default setting is 20 rpm).	Rotation Detection (TGON)	Lit if Motor speed exceeds the value pre-set in Pn503 (Default setting is 20 rpm).

Table 4-1 Display meaning of each segment on Bit Data

The display meanings of Code are shown in Table 4-2.

Code	Meaning
	Servo initialization failed (check the encoder connection)
	Servo OFF (Motor Power OFF)
	Servo Ready
	Run Servo ON (Motor Power ON)

Code	Meaning
	Quick Stop State
	Servo Alarm State
	Safe State
	Forward Drive Prohibited
	Reverse Drive Prohibited
	(Forward and Reverse) Overtravel State
	Alarm Number Display

Table 4-2 Display meanings of Code

NOTE When the Drive is in Servo Alarm State, check and correct the fault according to the Alarm Number Display, and then, you can press [◄] key to try to clear the current alarm.

4.1.4 Parameter Setting Mode

Functions can be selected or adjusted by setting parameters. There are two types of parameters.

- Function Parameters: the functions allocated to each digit of the Panel Operator can be selected.
- Adjustment Parameters: a parameter is set to a value within the specified range of the parameter.

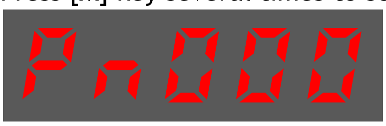
For a description of the parameter settings, please refer to the section Chapter 1

Parameters.

Function Parameters Setting

The example below shows how to change parameter Pn003 (Application Function Selections 3) from **0000** to **1032**.

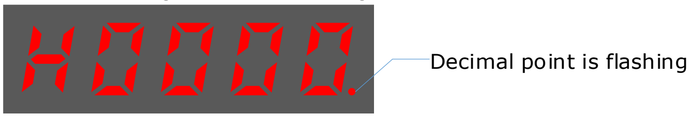
Step 1 Press [M] key several times to select the Parameter Setting Mode.



Step 2 Press [▲] key or [▼] key to select the parameter Pn003.

Step 3 Press [◀] key to display the current value of Pn003.

Step 4 Press and hold [◀] key for 1 second or more, and then a flashing decimal point will appear at the bottom right of the 5th digit.



Step 5 Press [▲] key twice, changing the value of the 5th digit from **0** to **2**.

Step 6 Press [◀] key once, moving the flashing decimal point to the 4th digit.

Step 7 Press [▲] key three times, changing the value of the 4th digit from **0** to **3**.

Step 8 Press [◀] key twice, moving the flashing decimal point to the 2nd digit.

Step 9 Press [▲] key once, changing the value of the 2nd digit from **0** to **1**.

Step 10 Press and hold [◀] key for 1 second or more to return to the display of the Pn003 parameter value or press the [M] key to return to the display of the Pn003.

----End

NOTE

After completing the function parameters setting, restart the Drive to take effect

Adjustment Parameters Setting

The example below shows how to change parameter Pn102 (Speed Loop Gain) from **100** to **85**.

Step 1 Press [M] key several times to select the Parameter Setting Mode.

Step 2 Press [▲] key or [▼] key to select the parameter Pn102.

Step 3 Press [◀] key to display the current value of Pn102.

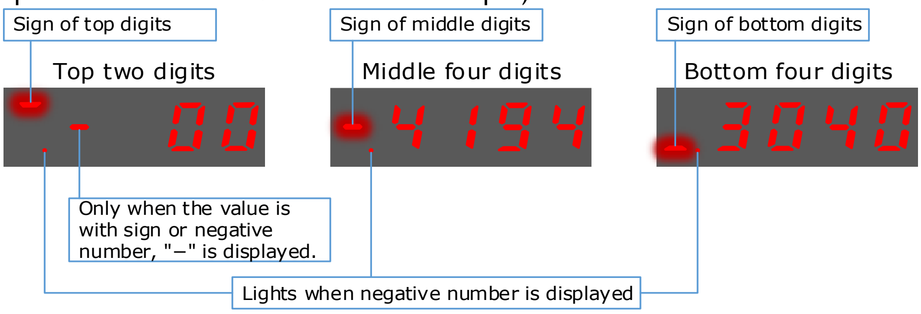
Step 4 Press [▲] key or [▼] key to change the value to 00085.
Press and hold [▲] key or [▼] key to jump the setting value quickly.

Step 5 Press [◀] key or [M] key to return to the display of Pn102.

----End

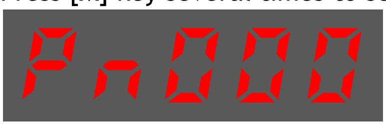
IMPORTANT

Panel Operator can only display 5 digits. The value of some adjustment parameters will be 6 digits or more. The display of the parameter values is as follows (take the display of parameter value -41943040 as an example).

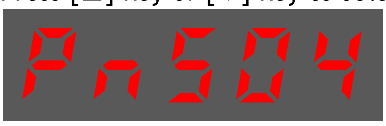


The example below shows how to change parameter Pn504 (Deviation Counter Overflow Alarm) from **41943040** to **42943240**.

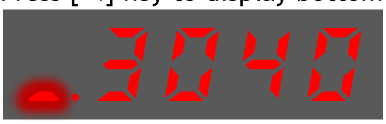
Step 6 Press [M] key several times to select the Parameter Setting Mode.



Step 7 Press [▲] key or [▼] key to select the parameter Pn504.



Step 8 Press [◀] key to display bottom four digits of the current value of Pn504.



Step 9 Press and hold [◀] key for 1 second or more, and then a flashing decimal point will appear at the bottom right of the 5th digit.

Step 10 Press [◀] key twice, moving the flashing decimal point to the 3rd digit.

Step 11 Press [▲] key twice, changing the value of the 3rd digit from **0** to **2**.

Step 12 Press [◀] key four times, moving the flashing decimal point to the 3rd of middle four digits.

Step 13 Press [▲] key once, changing the value of the 3rd digit from **1** to **2**.

Step 14 Press and hold [◀] key for 1 second or more to return to the display of the Pn504 parameter value or 8press the [**M**] key to return to the display of the Pn504.

----End

4.1.5 Monitor Mode

The Monitor Mode can be used for monitoring the reference values, I/O signal status, and Drive internal status.

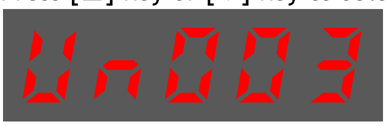
The Monitor Mode can be selected during Motor operation.

Select Monitor Mode

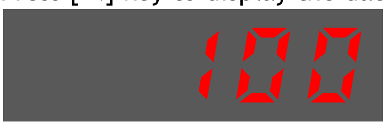
The example below shows how to display, the contents of monitor number Un003 (when the Motor rotates at 100).

Step 1 Press [**M**] key several times to select the Monitor Mode.

Step 2 Press [▲] key or [▼] key to select the monitor number Un003.



Step 3 Press [◀] key to display the data of Un003.



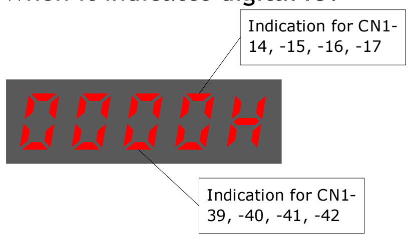
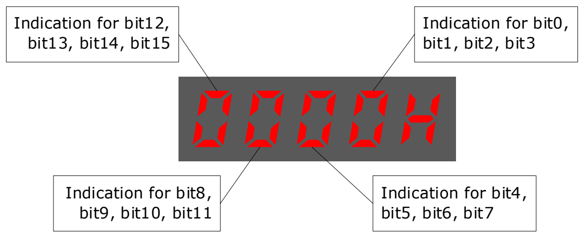
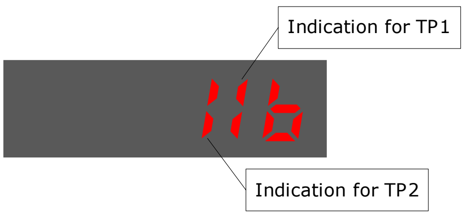
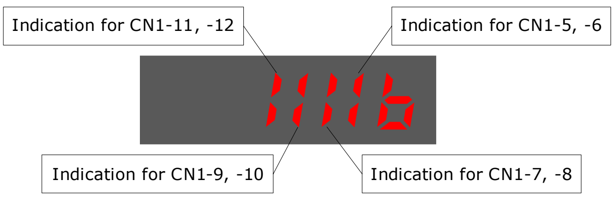
Step 4 Press [◀] key to return to the display of Un003.

---- End

Contents of Monitor Mode Display

Monitor Number	Content of Display	Unit
Un000	Motor speed	rpm
Un001	Input value of speed reference	rpm
Un002	Input percentage of torque reference (relative to rated torque)	%
Un003	Internal torque reference (in percentage to the rated torque)	%
Un004	Encoder Rotation angle pulse number	–
Un005	Input signal monitor	–
Un006	Touch Probe signal monitoring	–
Un007	Output signal monitor	–
Un008	Number of input pulses within 1ms	1 pulse
Un009	Input reference pulse counter	–
Un011	Pulse deviation counter	–
Un013	Reference pulse	1 pulse
Un015	Percentage of load inertia	–
Un016	Motor Overload Ratio	%
Un019	Busbar Voltage	V
Un021	Encoder temperature	℃
Un022	Main board temperature	℃
Un024	PCP target position	–

The status (low level or high level) of input signal allocated to each input terminal is displayed.

Monitor Number	Monitoring data	Description
Un005	• When it indicates digital IO:  • When it indicates virtual IO: 	The value of Hexadecimal, and each bit indicates the signal status of 4 channels. Range: 0000 (0) to1111 (F) 0=Low level; 1=High level The status corresponds to the corresponding pin from right to left.
Un006		The value of Binary, and each column indicates the signal state of 1 channel. 0=Low level; 1=High level
Un007		The value of Binary, and each column indicates the signal state of 1 channel. 0=Low level; 1=High level

NOTE

Un007 represents the state of the output signal. The optocoupler ON and OFF of each output signal depends on whether the output signal is inverted:
If the signal is not inverted, lit for turning the optocoupler ON, and not lit for turning the optocoupler OFF.
If the signal is inverted, lit for turning the optocoupler OFF, and not lit for turning the optocoupler ON.

4.1.6 Utility Function Mode

This section describes how to apply the basic operations using the Panel Operator to run and adjust the Motor.

The following table shows the parameters in the Utility Function Mode.

Function Number	Name
Fn000	Alarm trace data display
Fn001	Initialize parameter settings
Fn002	JOG operation

Function Number	Name
Fn003	Auto adjustment of speed reference offset
Fn004	Manual adjustment of speed reference offset
Fn005	Automatic offset-adjustment of Motor current detection signal
Fn006	Manual offset-adjustment of Motor current detection signal
Fn007	Software version display
Fn009	Load inertia identification
Fn010	Absolute encoder multi-turn reset
Fn011	Absolute encoder alarm reset
Fn017	Auto-tuning tool
Fn018	PJOG operation

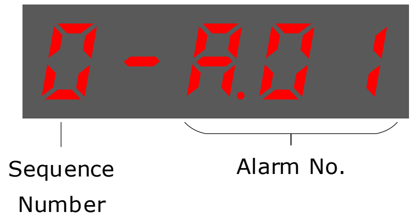
Fn000 (Alarm trace data display)

The alarm trace data display can display up to ten previously occurred alarms. The following are the steps to display the alarm trace data.

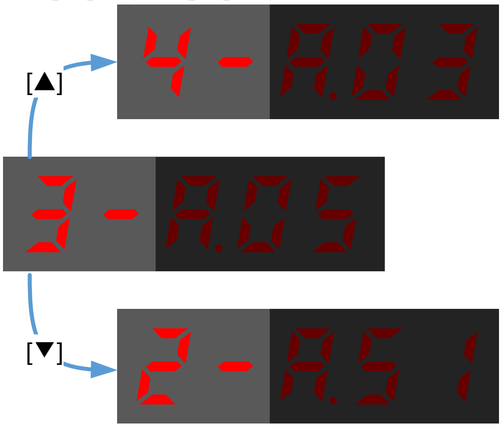
Step 1 Press [M] key several times to select the Utility Function Mode.

Step 2 Press [▲] key or [▼] key to select the function number Fn000.

Step 3 Press [◄] key to display latest alarm number.



Step 4 Press [▲] key or [▼] key to view the other alarm data.



Step 5 Press the [◀] key to return to the display of the Fn000.
Press and hold [◀] key for 1 second or more to clear all the alarm trace data.

----End

Fn001 (Initialize parameter settings)

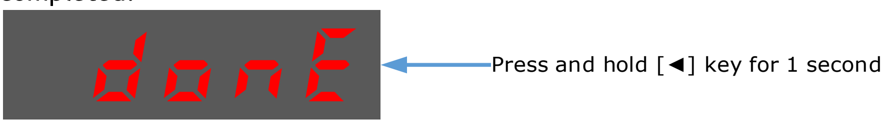
The following are the steps to initialize parameter settings.

Step 1 Press [M] key several times to select the Utility Function Mode.

Step 2 Press [▲] key or [▼] key to select the function number Fn001.

Step 3 Press [◀] key, and Panel Operator displays as below.

Step 4 Press and hold [◀] key for 1 second to initialize the parameter settings, until Panel Operator displays and blinks **done**, which indicates the initialization of parameter setting has been completed.



Step 5 Release [◀] key to return to the display of the Fn001.

----End

Fn002 (JOG operation)

This utility function often used for trial operation, refers to the section 7.3.3 JOG Operation.

Fn005 (Automatic offset-adjustment of Motor current detection signal)

Motor current detection offset adjustment has been performed before shipping. Basically, the user need not perform this adjustment.

IMPORTANT

- Execute the automatic offset adjustment if the torque ripple is too big when compared with that of other Drives.
- Execute the automatic offset adjustment in the servo OFF state.

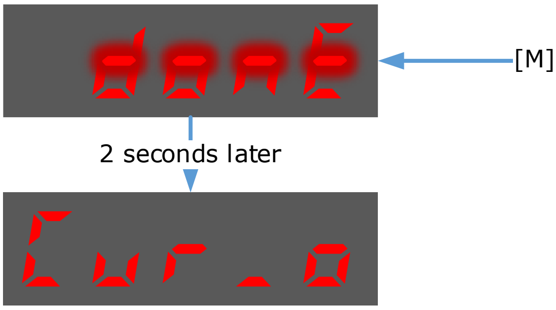
The following are the steps to execute the automatic offset adjustment.

Step 1 Press [M] key several times to select the Utility Function Mode.

Step 2 Press [▲] key or [▼] key to select the function number Fn005.

Step 3 Press [◄] key, and Panel Operator displays as below.

Step 4 Press [M] key to execute the automatic offset adjustment.
Panel Operator displays and blinks **done**, and 2 seconds later, it will return to previous display.



Step 5 Press the [◄] key to return to the display of the Fn005.

----End

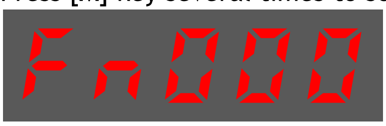
Fn006 (Manual offset-adjustment of Motor current detection signal)

To adjust the offset, perform the automatic adjustment (Fn005) first. And if the torque ripple is still big after the automatic adjustment, perform the manual offset-adjustment as follow.

IMPORTANT

- Please carefully execute the manual offset-adjustment, in case worsen the characteristics of the Motor.
- When executing the manual offset-adjustment, run the Motor at a speed of approximately 100 rpm, and adjust the phase-U and phase-V offsets alternately several times until the torque ripple is minimized.

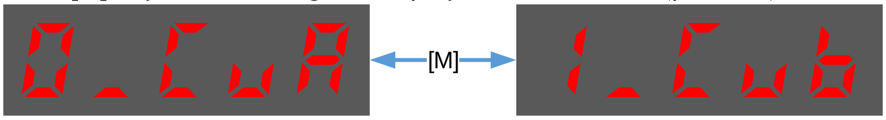
Step 1 Press [M] key several times to select the Utility Function Mode.



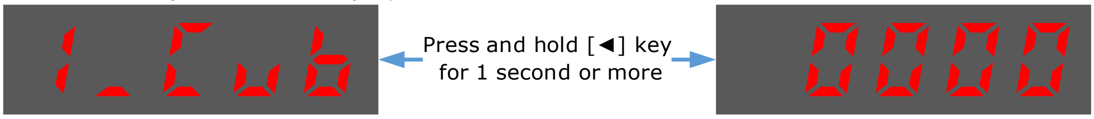
Step 2 Press [▲] key or [▼] key to select the function number Fn006.

Step 3 Press [◀] key, and Panel Operator displays as below.

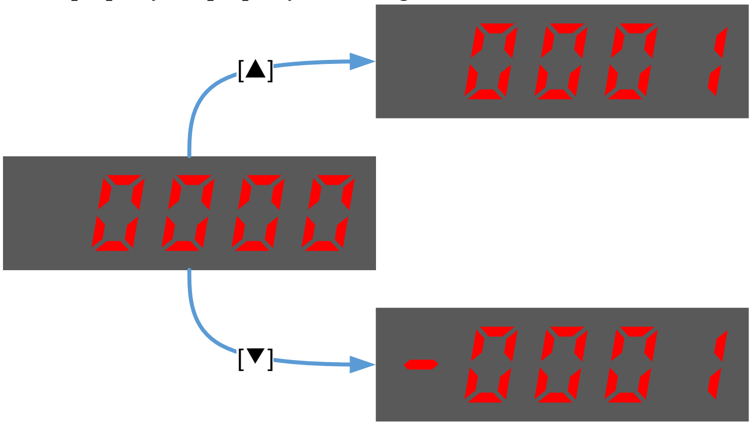
Step 4 Press [M] key for switching the display between 0_CuA (phase-U) and 1_Cub (phase-V).



Step 5 Select one phase display (e.g., 1_Cub, phase-V), and press and hold [◀] key for 1 second or more, Panel Operator will display the current offset value.



Step 6 Press [▲] key or [▼] key to change the offset value.



NOTE: the offset can be adjusted from -1024 to 1024.

Step 7 Press and hold [◀] key for 1 second or more to return to the phase display.

Step 8 Press [◀] key to return to the display of the Fn006.

----End

Fn007 (Software version display)

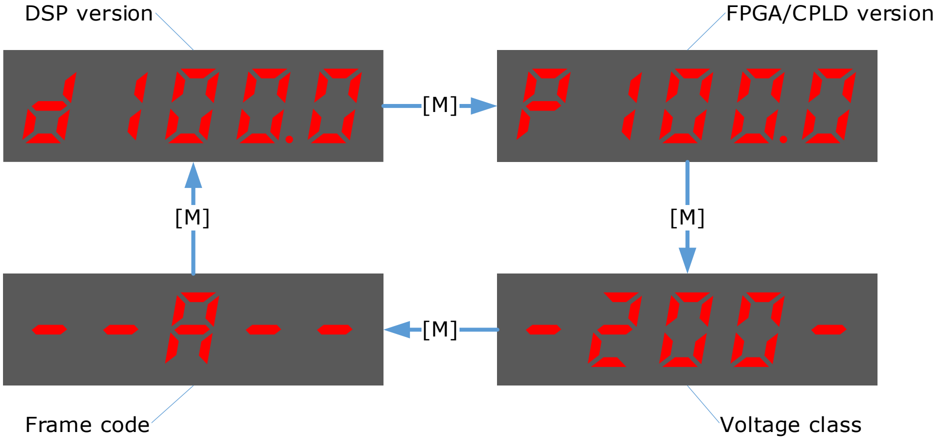
The following are the steps to display the software versions.

Step 1 Press [M] key several times to select the Utility Function Mode.

Step 2 Press [▲] key or [▼] key to select the function number Fn007.

Step 3 Press [◀] key to display the software versions.

Step 4 Press [M] key serval time to display between DSP version, FPGA/CPLD version, Voltage class and Structure code.



Step 5 Press [◀] key to return to the display of the Fn007.

----End

Fn009 (Load inertia identification)

This utility function often used for tuning, refers to the section 1.

Fn010 (Absolute encoder multi-turn reset)

Important

- The clearing of multiturn data from the absolute encoder needs to be performed in the Servo OFF state。
- Before the driver is officially used, please perform a "clear multiturn data of the absolute encoder" operation.

Step 1 Press [M] key several times to select the Utility Function Mode.

Step 2 Press [▲] key or [▼] key to select the function number Fn010.

Step 3 Press [◀] key, and Panel Operator displays as below.

Step 4 Press [M] key to reset the absolute encoder multi-turn data.

Step 5 Press [◀] key to return to the display of the Fn010.

----End

Fn011 (Absolute encoder alarm reset)

Important	▪ The clearing of multiturn data from the absolute encoder needs to be performed in the Servo OFF state。 ▪ After the A.47 and A.48 alarms occur in the drive, the user needs to replace the encoder battery, see "3.5.3 Installing or Replacing the Battery". After the replacement is complete, the alarm can be cleared by Fn011.

Step 1 Press [M] key several times to select the Utility Function Mode.

Step 2 Press [▲] key or [▼] key to select the function number Fn011.

Step 3 Press [◄] key, and Panel Operator displays as below.

Step 4 Press [M] key to reset the absolute encoder multi-turn data.

Step 5 Press [◄] key to return to the display of the Fn011.

----End

Fn017 (Auto-tuning tool)

This utility function often use used for tuning, refers to the section 8.9.2 Auto-Tuning Tool.

Fn018 (PJOG operation)

This utility function often used for trial operation, refers to the section 7.5 Program Jogging.

4.2 Motion Perfect

Motion Perfect is a Microsoft Windows™ based application for the PC, designed to be used in conjunction with Trio Motion Technology's range of multi-tasking motion controllers, servo drives, HMI and IO expansion products.

A PC with the following specifications is required to run Motion Perfect:

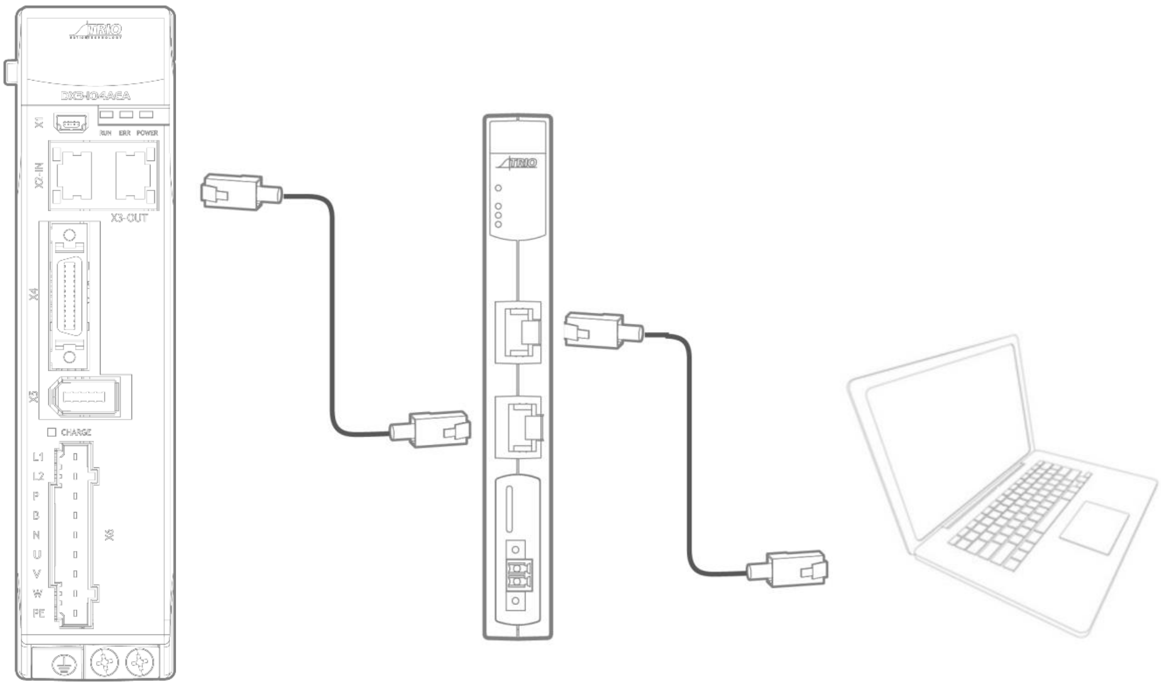
	Minimum	Recommended
Operating System	Windows 10 or Windows 11	
.NET Library	4.8	
Processor	Dual core	2 or more cores
RAM	2GBytes	4GBytes+
Hard Disk Space	1Gb + space for projects	2Gb
3D Graphics	DirectX 9	DirectX 11
Communications	Ethernet	Ethernet

As of 14th January 2020 Microsoft has dropped support for Windows 7. The main consequence of this is that PCs running Windows 7 or older will be more open to malware infection as security related patches will no longer be available. There is no guarantee that all Motion Perfect functionality will work with older operating systems.

Motion Perfect is a free download and is available to from the Trio web site (www.triomotion.com).

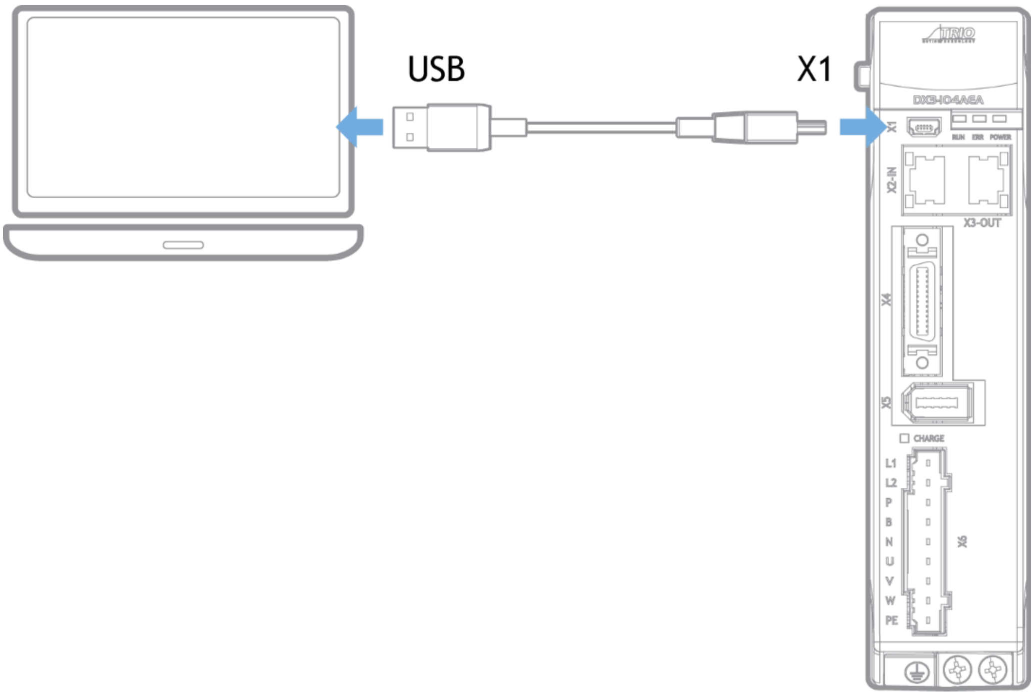
4.3 Connection Setup

To communicate with DX3 the drive must be connected to a Trio controller via EtherCAT or and the Trio controller needs to be connected to a PC via Ethernet and the PC needs to be running Motion Perfect. The DX3 can also be connected directly to the PC via USB in Motion Perfect to access the drive commissioning screens.

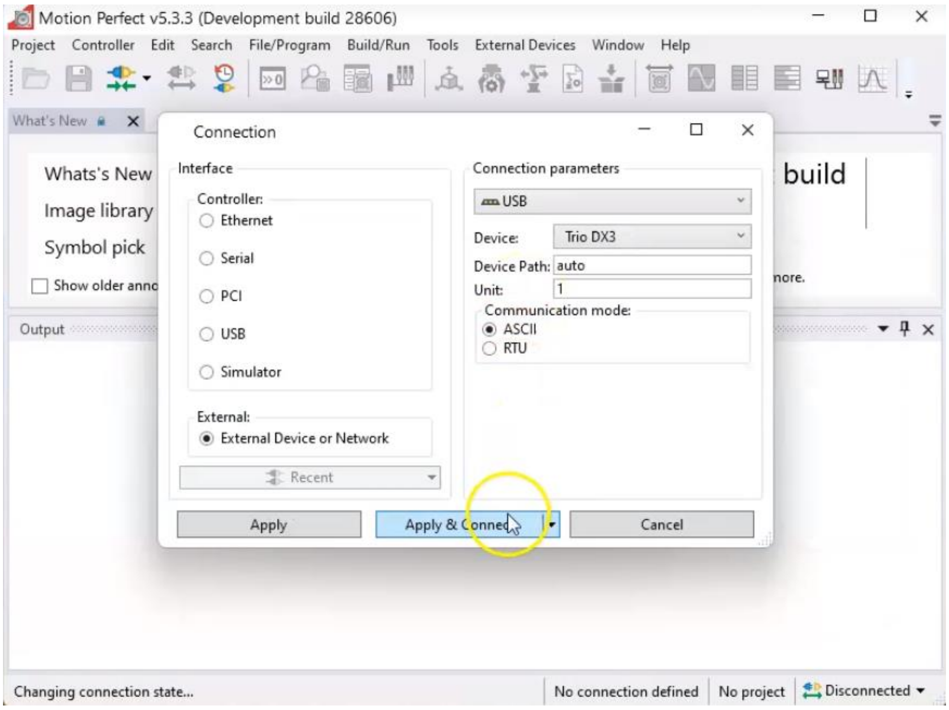


4.3.1 USB Connection

You can connect directly from the DX3 to your PC by using a USB connection cable to access the commissioning screens.

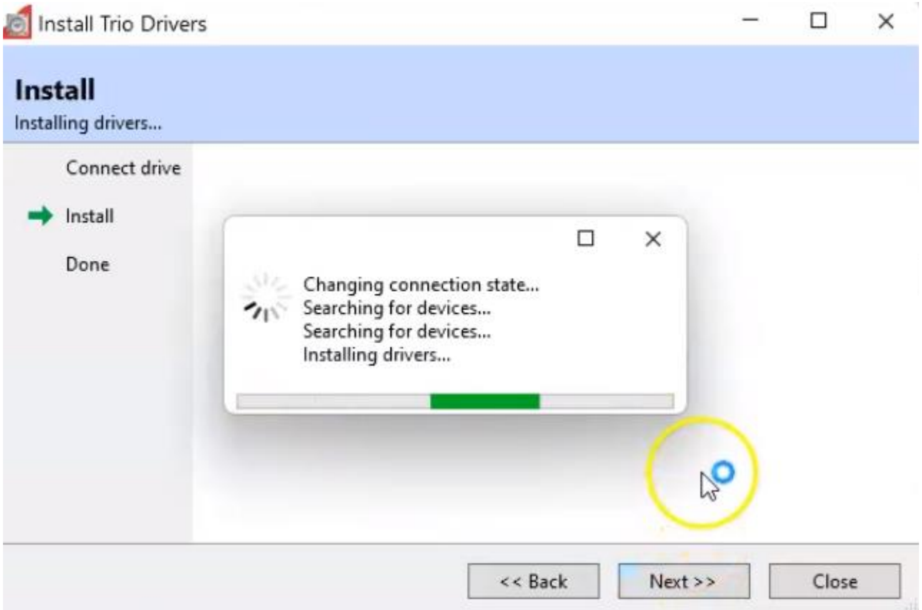


To set up the USB connection, select the external device or network option on the Motion Perfect connection screen. Then select the USB in the connection parameters dropdown menu.

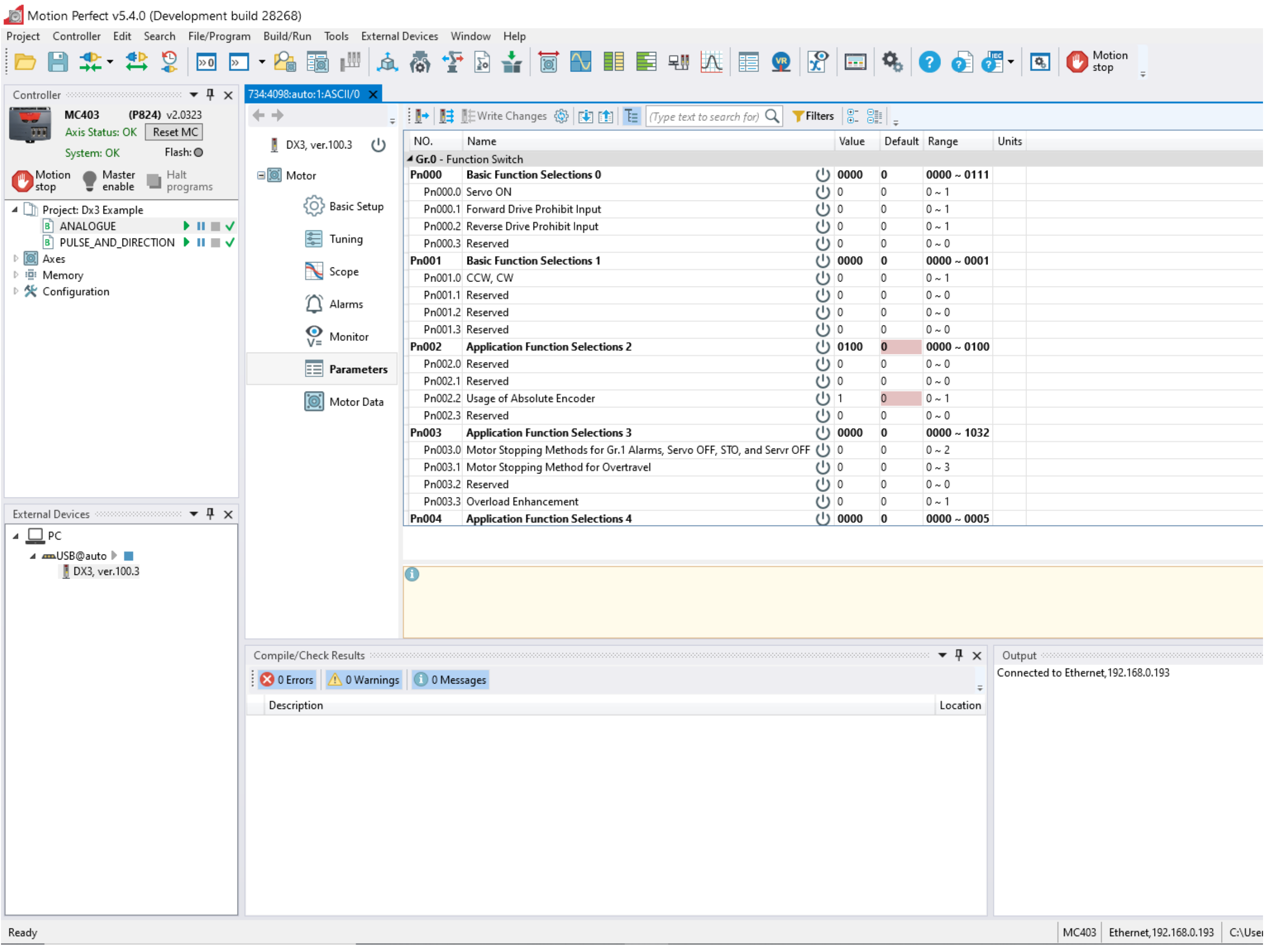


The first time you connect through USB on a computer, Motion Perfect will need to install the necessary drivers through a pop up if it detects they aren’t yet installed.

Answer ‘Yes’ to the USB driver installation, then Motion Perfect will install the USB drivers for the device.

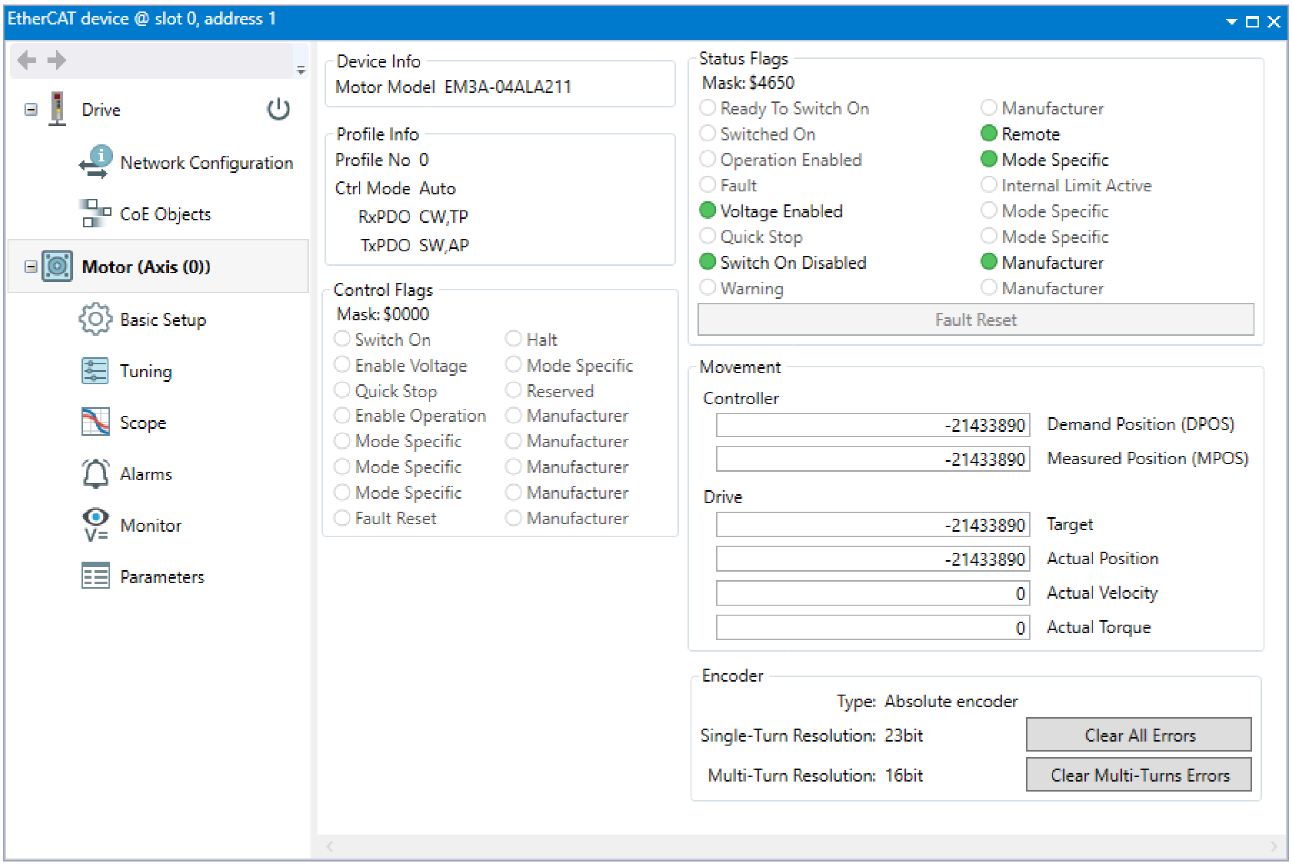


Once the drive is connected the display will appear and the commissioning screen can be used.

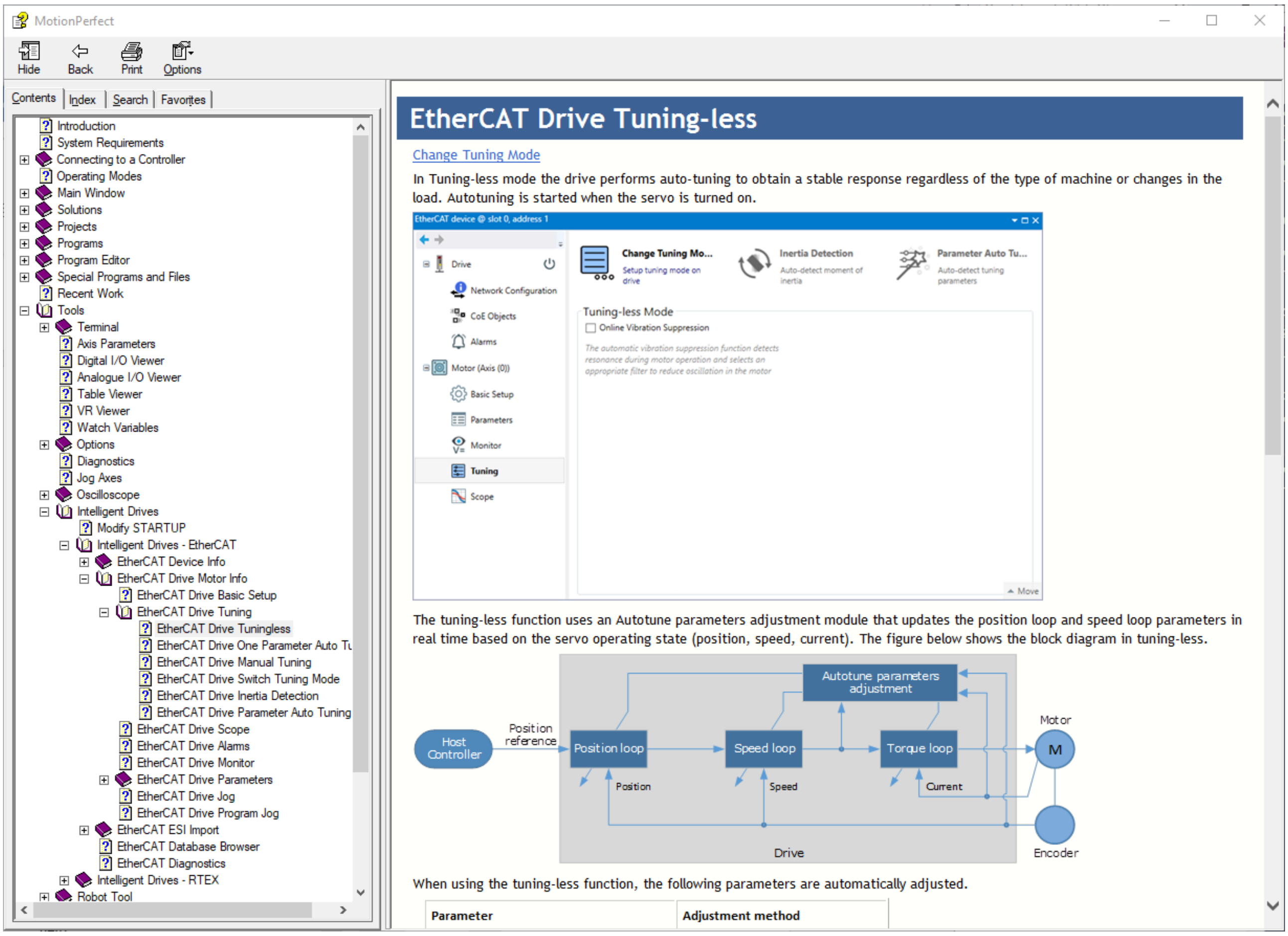

Motion Perfect v5.4.0 (Development build 28268)
Project Controller Edit Search File/Program Build/Run Tools External Devices Window Help
Controller
MC403 (P824) v2.0323
Axis Status: OK Reset MC
System: OK Flash:
Motion stop
Master enable
Halt programs
Project: Dx3 Example
ANALOGUE
PULSE_AND_DIRECTION
Axes
Memory
Configuration
734:4098:auto:1:ASCII/0
DX3, ver.100.3
Motor
Basic Setup
Tuning
Scope
Alarms
Monitor
Parameters
Motor Data
Write Changes
Filters
NO. Name Value Default Range Units
Gr.0 - Function Switch
Pn000 Basic Function Selections 0 0000 0 0000 ~ 0111
Pn000.0 Servo ON 0 0 0 ~ 1
Pn000.1 Forward Drive Prohibit Input 0 0 0 ~ 1
Pn000.2 Reverse Drive Prohibit Input 0 0 0 ~ 1
Pn000.3 Reserved 0 0 0 ~ 0
Pn001 Basic Function Selections 1 0000 0 0000 ~ 0001
Pn001.0 CCW, CW 0 0 0 ~ 1
Pn001.1 Reserved 0 0 0 ~ 0
Pn001.2 Reserved 0 0 0 ~ 0
Pn001.3 Reserved 0 0 0 ~ 0
Pn002 Application Function Selections 2 0100 0 0000 ~ 0100
Pn002.0 Reserved 0 0 0 ~ 0
Pn002.1 Reserved 0 0 0 ~ 0
Pn002.2 Usage of Absolute Encoder 1 0 0 ~ 1
Pn002.3 Reserved 0 0 0 ~ 0
Pn003 Application Function Selections 3 0000 0 0000 ~ 1032
Pn003.0 Motor Stopping Methods for Gr.1 Alarms, Servo OFF, STO, and Servr OFF 0 0 0 ~ 2
Pn003.1 Motor Stopping Method for Overtravel 0 0 0 ~ 3
Pn003.2 Reserved 0 0 0 ~ 0
Pn003.3 Overload Enhancement 0 0 0 ~ 1
Pn004 Application Function Selections 4 0000 0 0000 ~ 0005
External Devices
PC
USB@auto
DX3, ver.100.3
Compile/Check Results
0 Errors 0 Warnings 0 Messages
Description Location
Output
Connected to Ethernet,192.168.0.193
Ready
MC403 Ethernet,192.168.0.193 C:\User

4.4 Drive Commissioning Screens

In either case, double clicking on the drive or motor in either the Controller Tree or the Intelligent Drives tool will open the device configuration screen. This is where all drive configuration and commissioning tools can be found.



From any of the device configuration screens, for help or more information, pressing F1 will launch the Motion Perfect help based on the screen in view.



The commissioning screens for the Drive are listed below. The menu is split into 2 groups, Drive and Motor. The Drive screens are for status and operations that are not necessarily axis specific. The Motor screens show detail that is axis specific.

Drive

- EtherCAT information.
- Device information.
- Update firmware (DSP and FPGA).
- Drive status.

Network Configuration.

- Flexible process data mapping.

CoE Objects

- Read / Write access to all objects.
- Create custom object lists.
- Display values in decimal or hexadecimal.

Motor

- Motor model detected.
- Live monitor of key parameters used by controller.
    - Control word, Status word.
    - DPOS, MPOS.
    - Target.

    - Actual Position, Actual Velocity, Actual Torque.
    - Status of motor feedback device.

Basic Setup

- Allows easy access to basic drive configuration.
- Parameters that define the physical operation of the drive.
    - Power supply type.
    - Motor Direction and Abs. Encoder Usage.
    - Behavior in case of alarm.
    - Internal torque limit.
    - Brake control.

Tuning

- Selection of tuning mode.
- Access to tuning tools.
- Access to control law parameters though graphical interface.
- Generate test move without using the command line.

Scope

- Select up to 8 drive parameters to capture.
- Data capture performed on the drive.
- Zoom / Cursors on graph.
- Save and Load graph data.
- Generate test moves without using the command line.

Alarms

- View active alarm and historical alarm log.
- Trouble shooting tips for all alarm codes.

Monitor

- Read only access to drive status.
- Items in logical groups for viewability.
- Show / Hide option to customize view.
- Import / Export monitor item set.

Parameters

- Read / Write access to all drive parameters.
- Folding tree structure for easy navigation.
- Text search for easy location based on name.
- Filters to identify changes.
- Import and export of full or partial parameter set.
- Create STARTUP program based on full or partial parameter set.

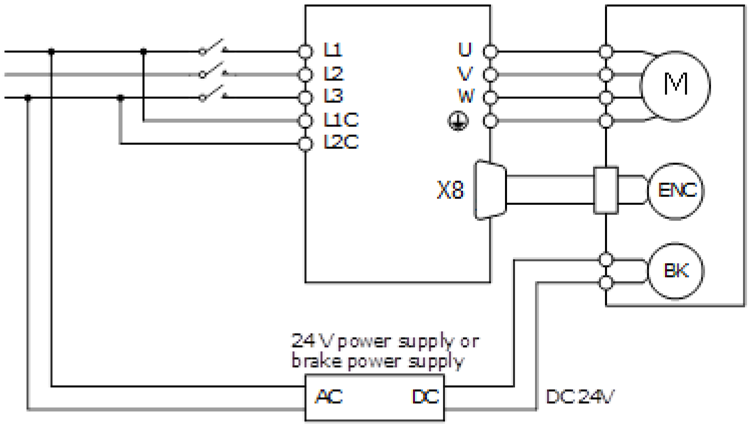
Motor

- View motor details.

4.5 Basic Operation

To ensure safe and correct operation, check the following items before you start.

- Make sure that the Drive and Motor are installed, wired, and connected correctly.
- Make sure that the correct power supply voltage is supplied to the Drive.
- Make sure that there are no loose parts in the Motor mounting.
- If you are using a Motor with an Oil Seal, make sure that the oil seal is not damaged. Also make sure that oil has been applied.
- If you are performing trial operation on a Motor that has been stored for a long period of time, make sure that all Motor inspection and maintenance procedures have been completed.
- If you are using a Motor with a Holding Brake, make sure that the brake is released in advance. To release the brake, you must apply the specified voltage of 24 VDC to the brake.



Once connected to a motor, when the Drive is powered up it will auto detect the motor and perform an auto setup which will allow operation of the motor.

The default power supply selection for the main circuit is Three Phase, 200 VAC, 50Hz. If the supply in use is different to this the drive will generate an alarm. The correct supply type can be selected from the Basic Setup page in the drive commissioning screens or by directly writing to parameter Pn007.1 and Pn007.3

Parameter	Setting	Meaning
Pn007.1	0	Single-phase AC for 1.5kW drive will apply an 80% de-rate for 2.0kW and 3.0kW single-phase is not supported
	1 [Default]	Three-phase AC
	2	DC
Pn007.3	0 [Default]	50 Hz
	1	60 Hz

Once the supply type has been changed the drive will require a re-start for the new selection to apply.

If using an absolute encoder, the drive will generate an alarm if it detects a low battery voltage at the encoder. If a battery is fitted and the voltage is correct, this alarm can be cleared from the Motor page in the drive commissioning screens. If there is no battery fitted, then the usage of the encoder will need to be changed to incremental. Changing the encoder usage from absolute to incremental will not change the encoder resolution but will ignore multi-turn information from the encoder and inhibit the low battery voltage alarm. The correct encoder usage can be selected from the Basic Setup page in the drive commissioning screen or by writing directly to parameter Pn002.2.

Parameter	Setting	Meaning
Pn002.2	0 [Default]	Use the encoder as an absolute encoder (requires encoder battery)

Parameter	Setting	Meaning
	1	Use the encoder as an incremental encoder

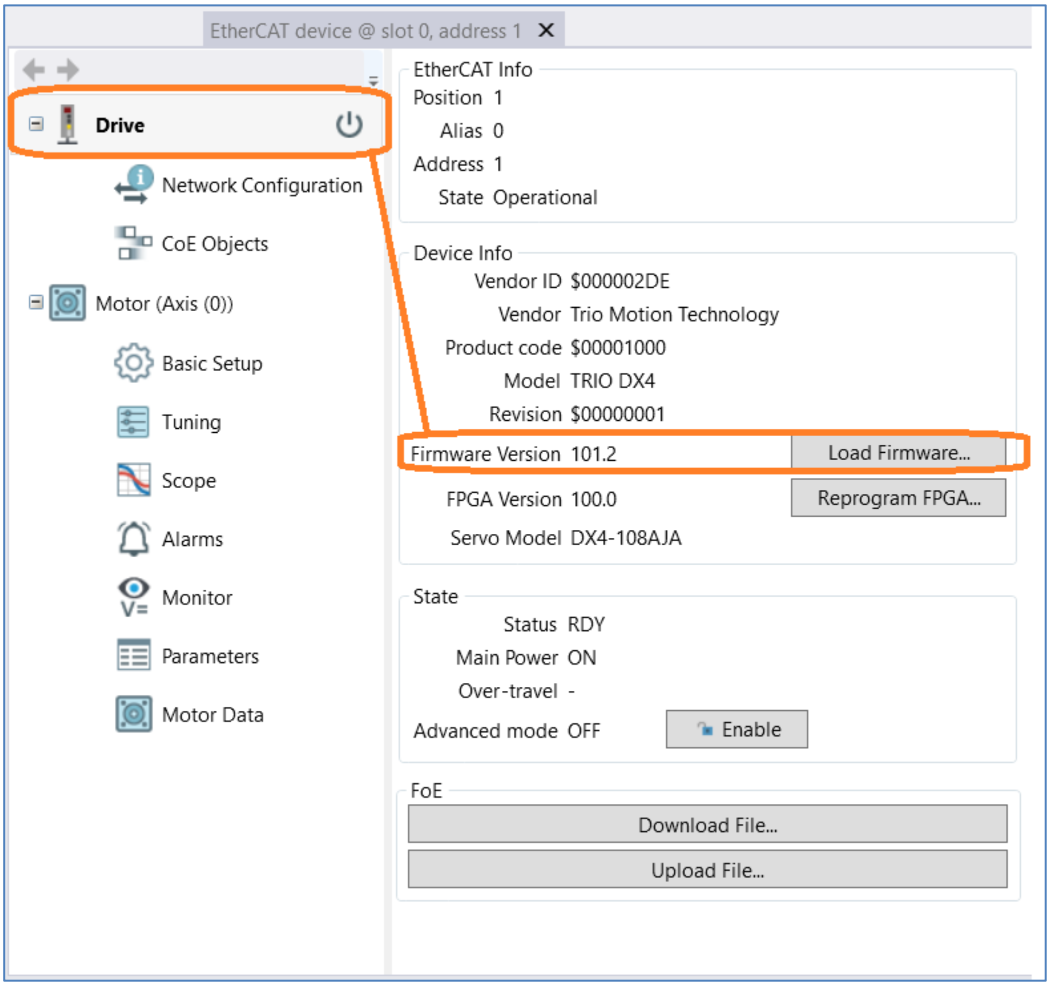
Once the encoder usage has been changed the drive will require a re-start for the new selection to apply.

To perform simple motion the Move panel in the Scope page (or Tuning page) in the drive commissioning screens can be used. This offers either Jog or Program Jog motion.

4.5.1 Drive Firmware

The version of firmware installed on the DX3 drive may not always be the current recommended type.

The current version can be checked by going online to the drive via Motion Perfect and looking at the Drive section of the DX3's properties. An example of this is shown below. To initiate the update of firmware to the drive select the **Load Firmware** button and follow the on-screen instructions when prompted.



Firmware versions are always available for download from the Trio website on the DX3 Product page - Software section.

The correct firmware to download is based on the frame size of the DX3. Using the information below is also an easy-to-use indication on the file name type to use.

Part Number	Frame Size
DX3-1A5A	A
DX3-101A	A
DX3-102A	A
DX3-104A	A
DX3-108A	B
DX3-110A	B
DX3-115A	C
DX3-120A	C
DX3-110D	D
DX3-115D	D
DX3-120D	E
DX3-130D	E
DX3-150D	F
DX3-175D	F

The firmware files have the .bin file extension.

Examples:

DX3_DSP_APP_A_M_A000_V101B4.bin   A frame size firmware version

DX3_DSP_APP_A_M_B000_V101B4.bin   B frame size firmware version

DX3_DSP_APP_A_M_C000_V101B4.bin   C frame size firmware version

4.5.2 Holding Brake

A holding brake is used to hold the position of the moving part of the machine when the drive is turned off, so that the moving part does not move due to gravity or an external force.

Wiring details for the holding brake can be found in 3.6.4 Holding Brake Wiring.

If the motor has a holding brake a digital output on the drive can be assigned for brake control. Any of the digital outputs on the drive can be configured as the brake control output.

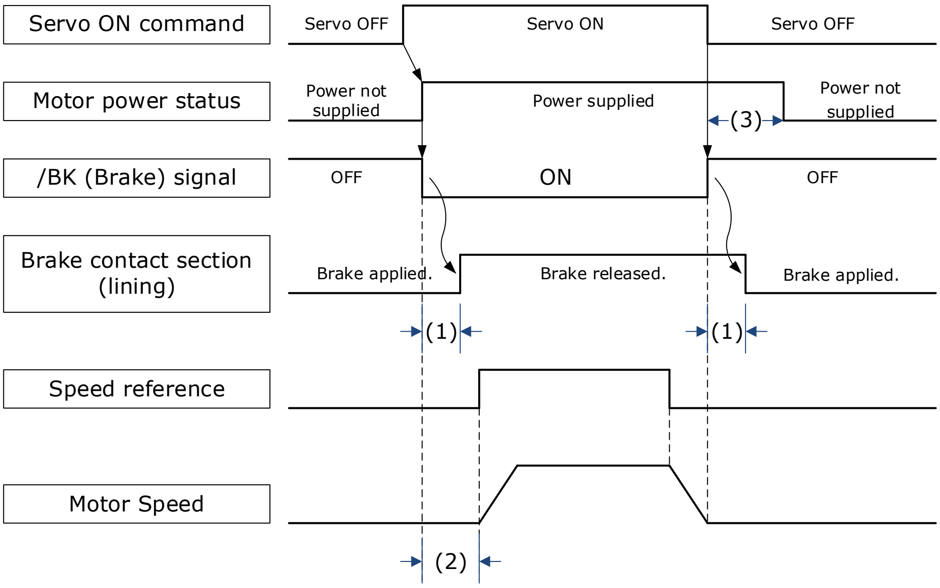
The assignment is made by selecting from the Basic Setup page in the drive commissioning screens or by writing directly to parameter Pn511.

Parameter	Setting	+ Pin	- Pin	Meaning
Pn511.0	4	X7-6	X7-7	The /BK signal is output from X7-6 and X7-7.
Pn511.1	4	X7-8	X7-9	The /BK signal is output from X7-8 and X7-9.
Pn511.2	4	X7-10	X7-11	The /BK signal is output from X7-10 and X7-11.

Selecting a digital output in the Basic Setup screen will enable the brake control timing parameters.

Brake Operating Sequence

The time required to release the brake and the time required to brake should be considered to determine the brake operation timing, as described below.



(1): The brake delay times for motors with Holding Brakes.
(2): Before you output a reference from the host controller to the drive, wait for at least 50 ms plus the time required to release the brake after you send the S-ON command.
(3): Use Pn506 (Brake Engage Delay Time), Pn507 (Brake Engage Speed Threshold), and Pn508 (Brake Engage Timeout) to set the timing of brake operation.

NOTE

Time required to release brake: The time from when the brake signal is turned ON until the brake is actually released.
Time required to brake: The time from when the brake signal is turned OFF until the brake actually operates.

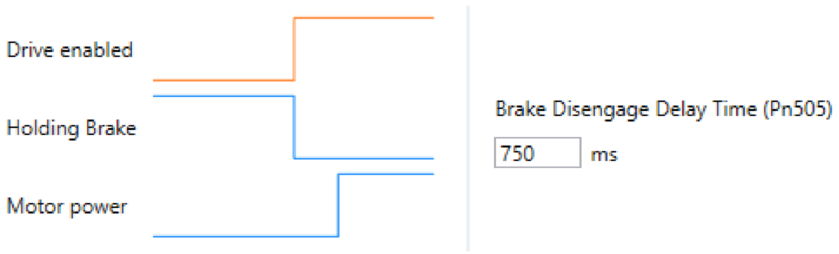
Brake Control when Motor is Stationary

Disabled -> Enabled.

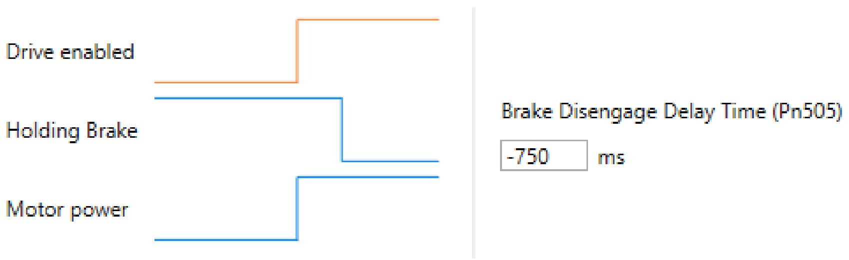
The brake disengage delay time controls the sequence and delay of brake signal when the drive changes from disabled to enabled when the motor is stationary.

Parameter	Name	Range	Unit	Default
Pn505	Brake Disengage Delay Time	-2000 to 2000	ms	0

If Pn505 is a positive value, when the Servo ON command is received, the brake signal will change first, and then power will be supplied to the motor after the delay time.



If Pn505 is a negative value, when the Servo ON command is received, the power will be supplied to the motor immediately, then the brake signal will change after the delay time.



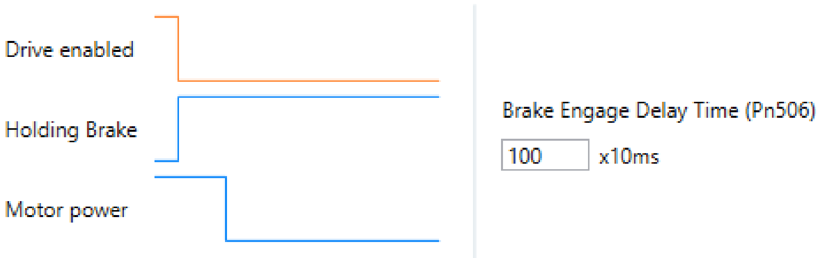
Enabled -> Disabled.

The brake engage delay time controls the delay between the brake signal and motor power when the drive changes from enabled to disabled when the motor is stationary.

Parameter	Name	Range	Unit	Default
Pn506	Brake Engage Delay Time	0 to 500	10ms	0

When the motor is used to control a vertical axis, the machine moving part may move slightly due to gravity or an external force.

This slight motion can be eliminated by setting the Brake Engage Delay Time (Pn506) so that power supply to the motor is stopped after the brake is applied.



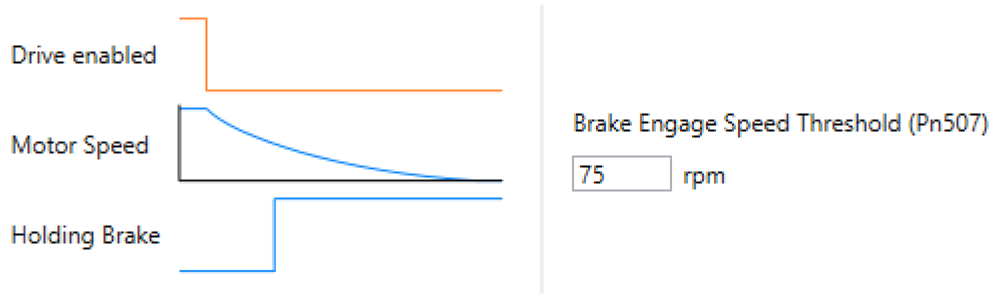
IMPORTANT

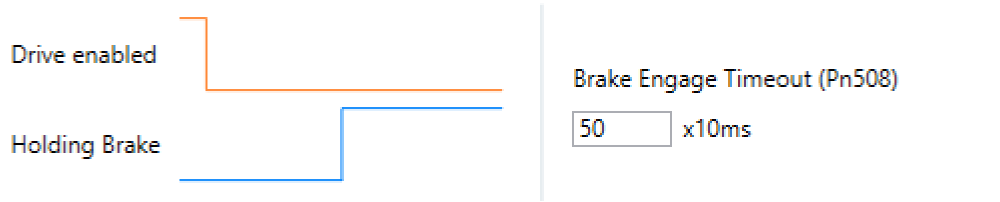
Power supply to the Motor will be stopped immediately when an alarm occurs, regardless of the setting of this parameter. The machine moving part may move due to gravity or an external force before the brake is applied.

Brake Control when Motor is In Motion

If an alarm occurs or the Servo OFF command is received while the motor is operating, the motor will start stopping and the brake signal will be turned OFF. You can adjust the timing of brake signal output by setting the Brake Engage Timeout (Pn508).

Parameter	Name	Range	Unit	Default
Pn507	Brake Enable Speed Threshold	10 to 100	1rpm	100
Pn508	Brake Enable Waiting Time	10 to 100	10ms	50





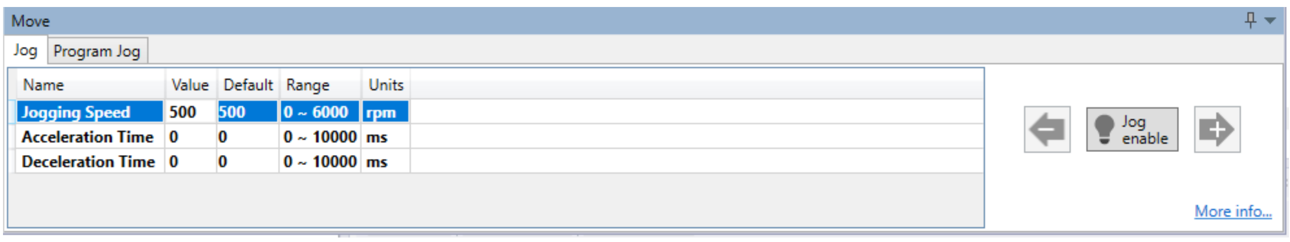
The brake signal changes when either of the following conditions is satisfied:

- When the motor speed falls below the level set in Pn507 after the power to the motor is turned OFF.
- When the time set in Pn508 is exceeded after the power to the motor is turned OFF.

4.5.3 Jog Motion

The 'jog' motion is a velocity profiled move. It has no end point so will generate continuous motion in a specific direction. The velocity profile is defined by acceleration, speed and deceleration value and will generate a trapezoidal velocity profile. Motion is commanded when the mouse button is clicked and halted when the button is released.

The Jog control is shown below:



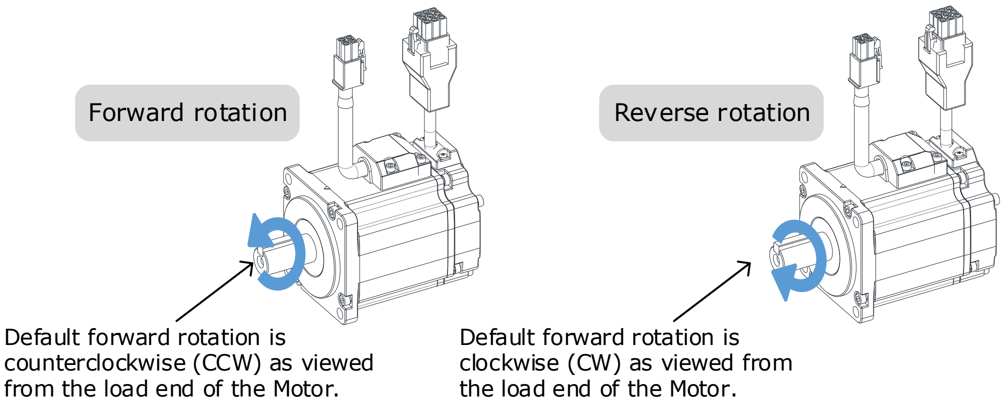
The motion profile is controlled three parameters:

- Jogging Speed: the maximum speed the jog profile will demand in revs per minute (RPM)
- Acceleration Time: the time to accelerate from rest to 1000 RPM in milliseconds (ms)
- Deceleration Time: the time to decelerate from 1000 RPM to rest in milliseconds (ms)

  To initiate motion, first the drive must be enabled by clicking the 'Motor enable' button. This will enable the motion arrows.

  Click and hold the arrow buttons to run the motor. The jog motion is continuous; while the button is pressed the motor will run in the direction of the arrow. The motor will stop when the button is released.

The '+' arrow will cause forward rotation, the '-' arrow will cause reserve rotation.



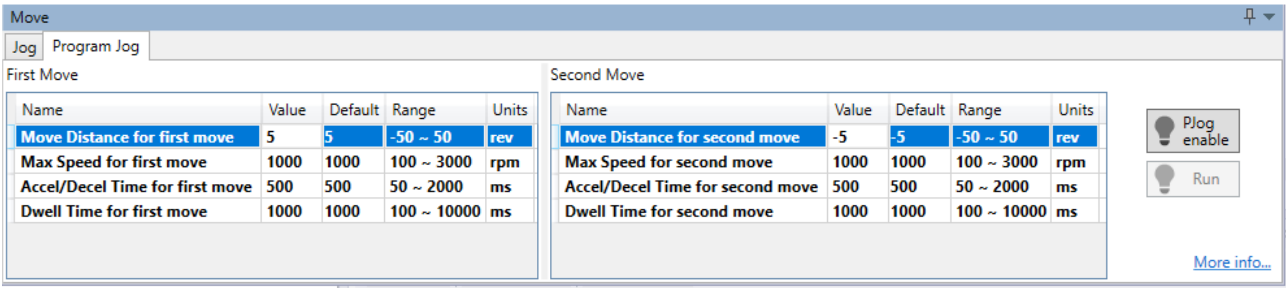
The rotation direction of the Motor can be changed by setting the Motor Direction from the Basic Setup page in the drive commissioning screens. The figure above shows the default setting.

When the drive is enabled via the 'Jog enable' button, the drive switches to a local control mode. While in this mode the position change is not sent to the controller. The controller values of MPOS and DPOS will not change during a jog. When the drive is disabled, the update of MPOS and DPOS on the controller resume.

4.5.4 Program Jog Motion

The 'program jog' motion is a sequence of two profiled moves of a specific distance with a programmable dwell time between moves. Each move has an independent move distance, acceleration, deceleration and speed. Both are profiled using a trapezoidal velocity profile. Once started, the motion will repeat until stopped by the user.

The Program Jog control is shown below:



First Move

Name	Value	Default	Range	Units
Move Distance for first move	5	5	-50 ~ 50	rev
Max Speed for first move	1000	1000	100 ~ 3000	rpm
Accel/Decel Time for first move	500	500	50 ~ 2000	ms
Dwell Time for first move	1000	1000	100 ~ 10000	ms

Second Move

Name	Value	Default	Range	Units
Move Distance for second move	-5	-5	-50 ~ 50	rev
Max Speed for second move	1000	1000	100 ~ 3000	rpm
Accel/Decel Time for second move	500	500	50 ~ 2000	ms
Dwell Time for second move	1000	1000	100 ~ 10000	ms

The parameters controlling the program jog are:

- Move Distance: the distance to move, this is a signed value where a positive value represents forward motion and a negative value represents reverse motion. The distance is specified in revolutions (revs)
- Max Speed: the maximum speed of the profiled velocity in revs per minuite (RPM)
- Accel/Decel Time: the time to accelerate from rest to Max Speed in milliseconds (ms). The deceleration value is the same as acceleration.
- Dwell Time: the delay time before starting the next move in milliseconds (ms)

To initiate motion, first the drive must be enabled by clicking the 'PJog enable' button. This will enable the 'Run' button.

Clicking the 'Run' button will start the motion.

The sequence will run repeatedly until stopped by either clicking the 'Run' button or the 'Jog enable' – during motion clicking either will disable the axis.

When the drive is enabled via the 'PJog enable' button, the drive switches to a local control mode. While in this mode the position change is not sent to the controller. The controller values of MPOS and

DPOS will not change during a jog.   When the drive is disabled, the update of MPOS and DPOS will resume.

Chapter 5 Applications Functions

5.1 Power Supply

The main circuit and control circuit of the Drive can be operated with AC power input. When AC power input is selected, single- phase or three phase power input can be used. You shall to set the parameter Pn007.1 and Pn007.3 (use AC power input) according to the applicable power supply.

Parameter	Setting	Meaning	When Enabled
Pn007.1	0	Use a single-phase AC power supply.	After restart
	1 [Default]	Use a three-phase AC power supply. **NOTE**: This setting is invalid for the Drive power from 50W to 400W.	
Pn007.3	0	AC power supply frequency is 50Hz.	
	1	AC power supply frequency is 60Hz.	

An alarm A.24 (Main Circuit Power Supply Wiring Error) may occur if the setting of Pn007.1 does not match the actual power supply.

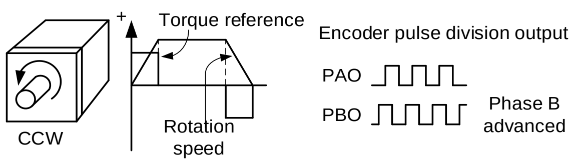
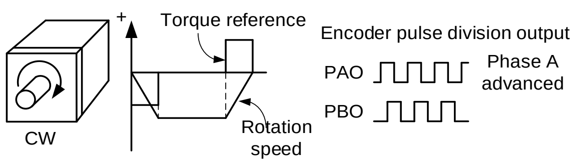
warn

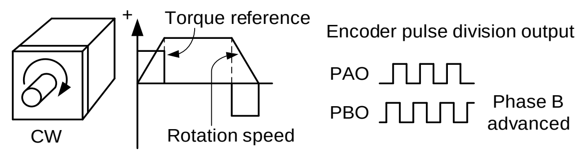
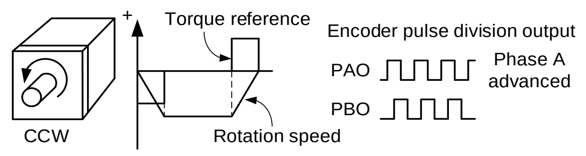
- When using AC power supply and DC power supply to connect to the driver, please make a terminal connection.
  Ac power supply should be connected to the L1/L2/L3 terminals and L1C/L2C terminals of the driver.
- DC power supply should be connected to the B1/decile terminal and one terminal and L1C/L2C terminal of the driver.
- Before using the DC power input, please be sure to set Pn007.1=2 before entering the main loop to avoid burning the internal components of the driver.
- When the DC power supply is input, set the fuse on the power supply wiring.
- No regeneration is performed when using the DC power input, so please perform regenerative energy treatment on the power supply side.

5.2 Motor Rotation Direction

You can reverse the direction of Motor rotation by changing the setting of Pn001.0.

The default setting for Forward Rotation is counter-clockwise (CCW) as viewed from the Drive end.

Parameter	Setting	Reference	Diagram
Pn001.0	0: CCW	Forward Reference	
		Reverse Reference	

Parameter	Setting	Reference	Diagram
	1: CW	Forward Reference	
		Reverse Reference	

5.3 Overtravel Limit

5.3.1 Function Description

Overtravel is a safety function of the Drive that forces the Motor to stop in response to a signal input from a limit switch that is activated when a moving part of the machine exceeds the safe range of movement.

The overtravel signals include the P-OT (Forward Drive Prohibit) and the N-OT (Reverse Drive Prohibit) signals.

You use the P-OT and N-OT signals to stop the machine by installing limit switches at the positions where you want to stop the machine that is operated by the Motor.

An example of wiring for the P-OT signal and the N-OT signal is shown in Figure 5-1.

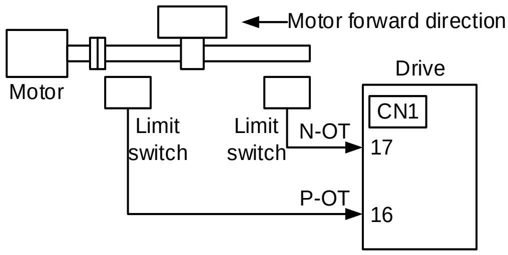


Figure 5-1 Wiring diagram for the overtravel

Using the overtravel function is not necessary for rotating applications such as rotary tables and conveyors. No wiring for overtravel input signals is required.

CAUTION

- To prevent accidents that may result from contact faults or disconnections, use normally closed limit switches.
  Moreover, never change the default settings of the polarity of the overtravel signals (P-OT and N-OT).
- When using the Motor on a vertical axis, the workpiece may fall in the overtravel condition. To prevent this, always set the zero clamp after stopping with Pn003.1=2.

5.3.2 Connecting the Overtravel Signal

To use the overtravel function, connect the following overtravel limit switch input signal terminals.

Type	Name	Pin	Setting	Meaning
Input	P-OT	CN1-16	ON	Forward run allowed. Normal operation status.

Type	Name	Pin	Setting	Meaning
			OFF	Forward run prohibited. Forward overtravel.
	N-OT	CN1-17	ON	Reverse run allowed. Normal operation status.
			OFF	Reverse run prohibited. Reverse overtravel.

5.3.3 Enabling/Disabling the Overtravel Signal

Parameters can be set to disable the overtravel signal. If the parameters are set, there is no need to wire the overtravel input signal.

Parameter	Setting	Meaning	When Enabled
Pn000.1	0 [Default]	Inputs the Forward Drive Prohibited (P-OT) signal from CN1-16. [Default]	After restart
	1	Disables the Forward Drive Prohibited (P-OT) signal. (Always allow forward rotation)	
Pn000.2	0 [Default]	Inputs the Reverse Drive Prohibited (N-OT) signal from CN1-15. [Default]	
	1	Disables the Reverse Drive Prohibited (N-OT) signal. (Always allow reverse rotation)	

In addition, you can disable the overtravel limit function by not setting the values **1** and **2** to parameter Pn509 (not allocate the P-OT signal and N-OT signal).

5.4 Motor Stopping Methods

Following 4 ways are available to stop the drive alarming (Gr.1 or Gr.2), OT state, and servo OFF occurs:

Stop method	Meaning
Stopping by dynamic brake	The electric circuits are internally connected to stop the Motor quickly.
Coasting to a stop	The Motor stops naturally due to friction during operation.
Reverse brake	Emergency stop torque is used to decelerate the Motor to a stop.
Do not stop	Regards Alarms as the Warnings, and the Motor will not be stopped.

Also, you can let the Motor enter the following states after the Motor stops.

State after Stopping	Meaning
Coasting	The Drive does not control the Motor (The machine will move in response to a force from the load).
Dynamic Brake (DB)	The electric circuits are internally connected to hold the Motor.
Zero clamping	A position loop is created, and the Motor remains stopped at a position reference of 0. (The current stop position is held.)
Operation	The state in which the Drive continues to control the Motor.

5.4.1 Motor Stop Methods for Gr.1 Alarms, Safety State and Servo OFF

You can select the Motor stopping methods for Gr.1 Alarms occur, in Safe state or Servo OFF by setting the parameter Pn003.0.

Parameter	Setting	Stop Method	After Stopping	When Enabled
Pn003.0	0[Default]	Stopping by dynamic brake	Coasting	After restart
	1	Stopping by dynamic brake	Dynamic Brake	
	2	Coasting to a stop	Coasting	

5.4.2 Motor Stop Methods for Overtravel

You can select the Motor stopping methods for overtravel occurs by setting the parameter Pn003.1.

Parameter	Setting	Stop Method	After Stopping	When Enabled
Pn003.1	0 [Default]	Stopping by dynamic brake	Coasting	After restart
	1	Inertial running stops	Coasting	
	2	Reverse brake	Zero clamping	
	3	Reverse brake	Coasting	

5.4.3 Motor Stop Methods for Gr.2 Alarms

You can select the Motor stopping methods for Gr.2 Alarms occur by setting the parameter Pn004.0.

Parameter	Setting	Stop Method	After Stopping	When Enabled
Pn004.0	0 [Default]	Stop by dynamic brake	Coasting	After restart
	1	Stop by dynamic brake	Dynamic Brake	
	2	Coast to a stop	Coast	
	3	Reverse brake	Dynamic Brake	
	4	Reverse brake	Coast	
	5	Do not stop, regard as a warning	Operation	

5.4.4 Reverse Brake Torque Limit Setting

If Pn004.0 is set to 3 or 4, the Motor will be decelerated to a stop using the torque set in Pn405 as the maximum torque.

Parameter	Name	Range	Unit	Default	When Enabled
Pn405	Reverse Brake Torque Limit	0 to 350	1%	300	Immediately

NOTE

- This setting is a percentage of the rated torque.
- The default setting is 300%. This setting is large enough to allow you to operate the Motor at the maximum torque. However, the maximum stop torque that you can actually use is the maximum torque of the Motor.

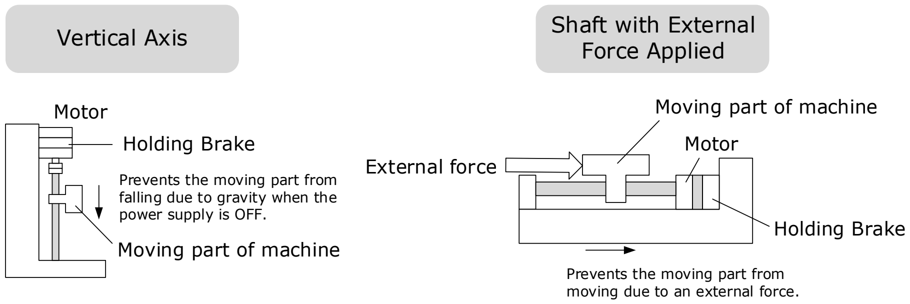
5.5 Holding Brake

5.5.1 Function Description

A holding brake is used to hold the position of the moving part of the machine when the Drive is turned OFF so that the moving part does not move due to gravity or an external force.

You can use the brake that is built into a Motor with a Brake, or you can provide one on the machine.

The holding brake is used in the following cases.

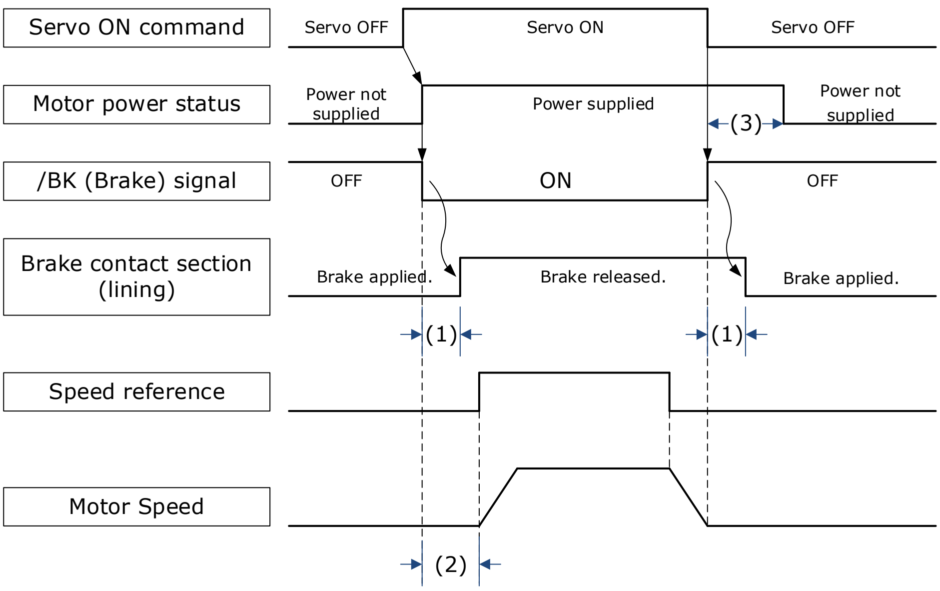


IMPORTANT

The brake built into a Motor with a Brake is a de-energization brake. It is used only to hold the Motor and cannot be used for braking. Use the holding brake only to hold a Motor that is already stopped.

5.5.2 Brake Operating Sequence

You must consider the time required to release the brake and the time required to brake to determine the brake operation timing, as described below.



(1): The brake delay times for Motors with Holding Brakes.
(2): Before you output a reference from the host controller to the Drive, wait for at least 50 ms plus the time required to release the brake after you send the S-ON command.
(3): Use Pn506 (Servo OFF Waiting Time), Pn507 (Brake Enable Speed Threshold), and Pn508 (Brake Enable Waiting Time) to set the timing of when the brake will operate and when the servo will be turned OFF.

NOTE

- Time Required to Release Brake: The time from when the /BK (Brake) signal is turned ON until the brake is actually released.
- Time Required to Brake: The time from when the /BK (Brake) signal is turned OFF until the brake actually operates.

5.5.3 BK (Brake) Signal

The /BK signal is turned OFF (to operate the brake) when the Servo is turned OFF or when an alarm is detected. You can adjust the timing of brake operation (i.e., the timing of turning OFF the /BK signal) with the Servo OFF Waiting time (Pn506).

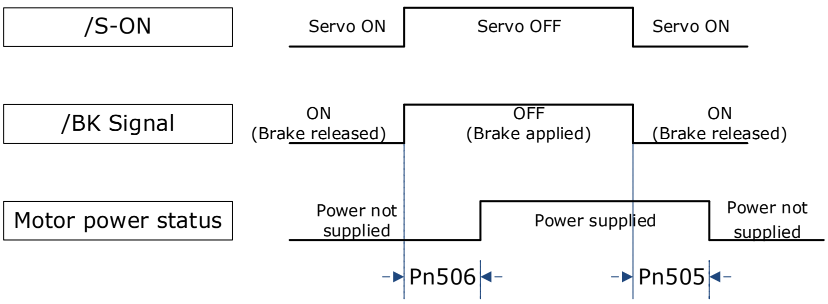
Type	Signal	Pin	Signal Status	Meaning
Output	/BK	Allocated by Pn511	ON	Releases the brake.
			OFF	Activates the brake.

The /BK signal is not allocated in default setting, set its allocation in Pn511.

Parameter	Setting	+ Pin	- Pin	Meaning
Pn511.0	4	CN1-11	CN1-12	The /BK signal is output from output terminal CN1-11 and CN1-12.
Pn511.1	4	CN1-5	CN1-6	The /BK signal is output from output terminal CN1-5 and CN1-6.
Pn511.2	4	CN1-9	CN1-10	The /BK signal is output from output terminal CN1-9 and CN1-10.

5.5.4 Output Timing of /BK Signal when Motor is Stopped

When the Motor is stopped, the /BK signal turns OFF as soon as the S-OFF (Servo OFF) command is received. Use the servo OFF delay time (Pn506) to change the timing to turn OFF power supply to the Motor after the S-OFF command is input.



Parameter	Name	Range	Unit	Default	When Enabled
Pn505	Servo ON Waiting Time	-2000 to 2000	ms	0	Immediately
Pn506	Servo OFF Waiting Time	0 to 500	10ms	0	Immediately

NOTE	• Set Pn505 as a positive value, when S-ON command is received, the /BK signal will be output first, and then power supplied to the Motor after waiting for this setting. • Set Pn505 as a negative value, when S-ON command is received, power supplied to the Motor immediately, and then output the /BK signal after waiting for this setting.

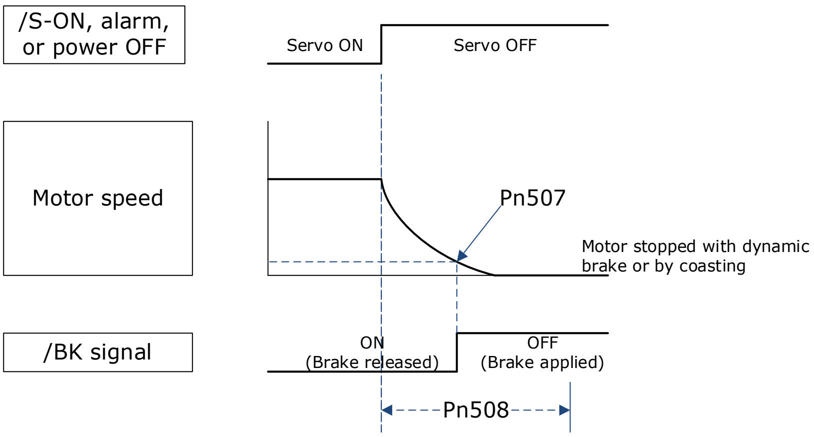
When the Motor is used to control a vertical axis, the machine moving part may move slightly due to gravity or an external force.

You can eliminate this slight motion by setting the servo OFF delay time (Pn506) so that power supply to the Motor is stopped after the brake is applied.

IMPORTANT	Power supply to the Motor will be stopped immediately when an alarm occurs, regardless of the setting of this parameter. The machine moving part may move due to gravity or an external force before the brake is applied.

5.5.5 Output Timing of /BK Signal when Motor is operating

If an alarm occurs or S-OFF command is received while the Motor is operating, the Motor will start stopping and the /BK signal will be turned OFF. You can adjust the timing of /BK signal output by setting the Brake Enable Waiting Time (Pn508).



The /BK signal goes to H level (brake ON) when either of the following conditions is satisfied:

- When the Motor speed falls below the level set in Pn507 after the power to the Motor is turned OFF.
- When the time set in Pn508 is exceeded after the power to the Motor is turned OFF.

Parameter	Name	Range	Unit	Default	When Enabled
Pn507	Brake Enable Speed Threshold	10 to 100	1rpm	100	Immediately
Pn508	Brake Enable Waiting Time	10 to 100	10ms	50	Immediately

5.6 Encoder Settings

5.6.1 Absolute Encoder Selection

Absolute encoders are fitted on motors with an encoder type of L, e.g. MXL-02ALA211. These encoders require a battery supply to retain the absolute encoder data when the Drive power is removed.

With a system that uses an absolute encoder, the host controller can monitor the current position. Therefore, it is not necessary to perform an origin return operation when the power supply to the system is turned ON.

There are two types of encoders for Motors. The usage of the encoder is specified in Pn002.2.

Parameter	Setting	Meaning	When Enabled
Pn002.2	0 [Default]	Use the encoder as an absolute encoder.	After restart
	1	Use the encoder as an incremental encoder.	

IMPORTANT

The default setting of the Drive uses an absolute encoder. If the Motor encoder is an incremental encoder, an A47 alarm or an A48 alarm will occur when the Drive is first powered up.

In this case, set Pn002.2=1 and restart the Drive.

5.6.2 Encoder Alarm Resetting

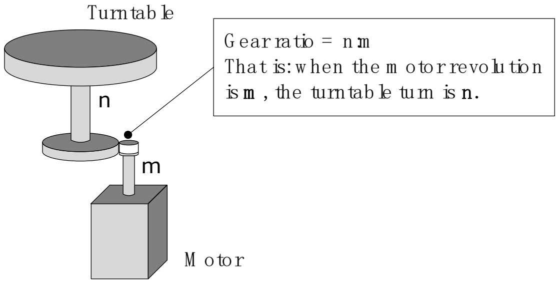
If alarm A.47 or A.48 occurs, replace the battery as soon as possible. After replacing the battery, perform the operation **Absolute encoder alarm reset** and **Fn010 (Absolute encoder multi-turn reset**.

For details about how to replace a battery and how to perform the replacement, see 3.5.4 Installing or Replacing a Battery.

5.6.3 Multiturn Limit Setting

The multiturn limit is used in position control for a turntable or other rotating body.

For example, consider a machine that moves the turntable shown in the following diagram in only one direction.

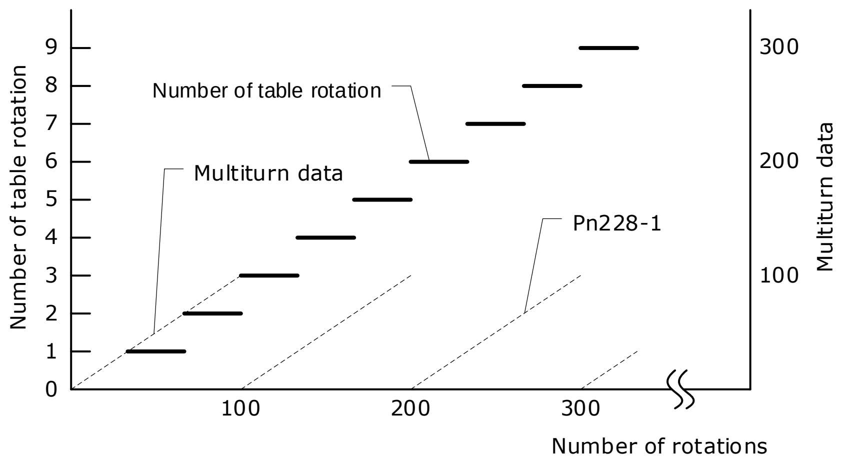


Because the turntable moves in only one direction, the upper limit to the number of revolutions that can be counted by an absolute encoder will eventually be exceeded.

The multiturn limit is used in cases like this to prevent fractions from being produced by the integral ratio of the number motor revolutions and the number of turntable revolutions.

For a machine with a gear ratio of n:m, as shown above, you can set Pn228 (OB 30A9h in EtherCAT) as **m**, and the value of m - 1 will be the setting for the multiturn limit setting.

The relationship between the number of turntable revolutions and the number of motor revolutions is shown in the following figure.



Parameter	Name	Range	Unit	Default	When Enabled
Pn228	Multiturn limit	0 to 65535	1 rev	10	After restart

NOTE
- This parameter is enabled when you use an absolute encoder.

The data will change as shown below when this parameter is set to anything other than the default setting.

- If the motor operates in the reverse direction when the multiturn data is 0, the multiturn data will change to the value set in (Pn228-1).
- If the motor operates in the forward direction when the multiturn data is at the value set in (Pn228-1), the multiturn data will change to 0.

NOTE
- The multiturn data will always be 0 in the following cases. It is not necessary to reset the absolute encoder in these cases.

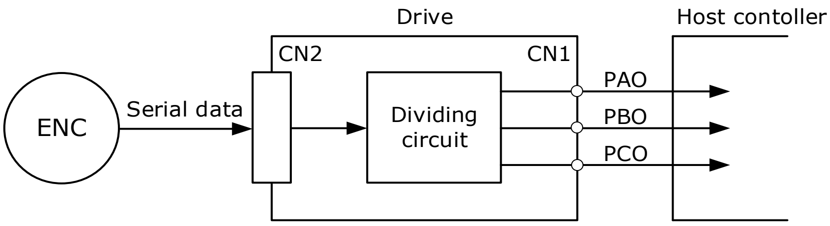
- When you use a single-turn absolute encoder
- When you set Pn002.2 = 1 (Use the encoder as an incremental encoder)

5.6.4 Encoder pulse dividing output

Pulse dividing signals.

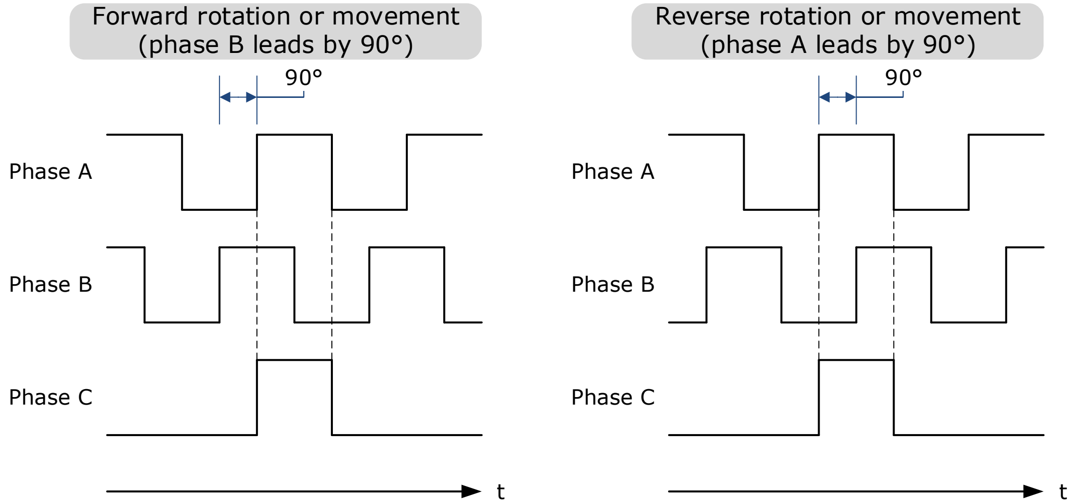
Encoder pulse dividing pulse output processes the signals sent from the encoder inside the driver, and outputs such signals to the outside in the form of two-phase pulses (Phase A, and Phase B) with 90° phase differential. It can be used as position feedback in the host controller.

Signal Name	Connector Pin Number	Name	Description
PAO+	CN1-20	Encoder pulse dividing output Phase A	PG pulse dividing (Pn200): the number of pulses when motor rotates a single revolution. The phase differential between phase A and phase B here is electrical angle of 90°
PAO-	CN1-21		
PBO+	CN1-22	Encoder pulse dividing output Phase B	
PBO-	CN1-23		
PCO+	CN1-24	Encoder pulse dividing output Phase C	The actual phase C output of encoder
PCO-	CN1-25		



Note: Even in the reverse mode (Pn001.0=1), the pulse dividing output phase form is the same as the standard setting (Pn001.0=0).

Output Phase Form



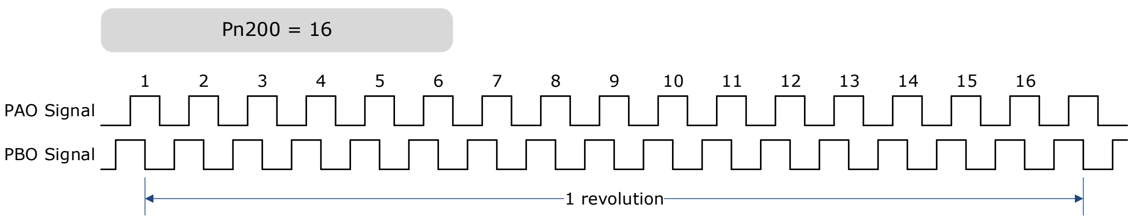
Pulse Dividing Ratio Setting

Encoder pulse dividing means that the divider converts data into the pulse density (Pn200) set by the user parameter based on the pulse data of the motor encoder, and outputs it. The setting unit is the number of pulses/revolutions.

No.	Name	Range	Unit	Default	When Enabled
Pn200	PG dividing ratio	16 to 16384	1 pulse	16384	After restart

- Set the number of pulses for PG output signals (PAO,/PAO,PBO,/PBO) externally from the servo drive through Pn200.
- Feedback pulses from the encoder per revolution are divided inside the servo drive by the number set in Pn200 before being output.
- Set the encoder pulse dividing ratio according to the system specifications of the machine or host controller.
- The setting of the encoder pulse dividing number is restricted by the encoder's resolution.

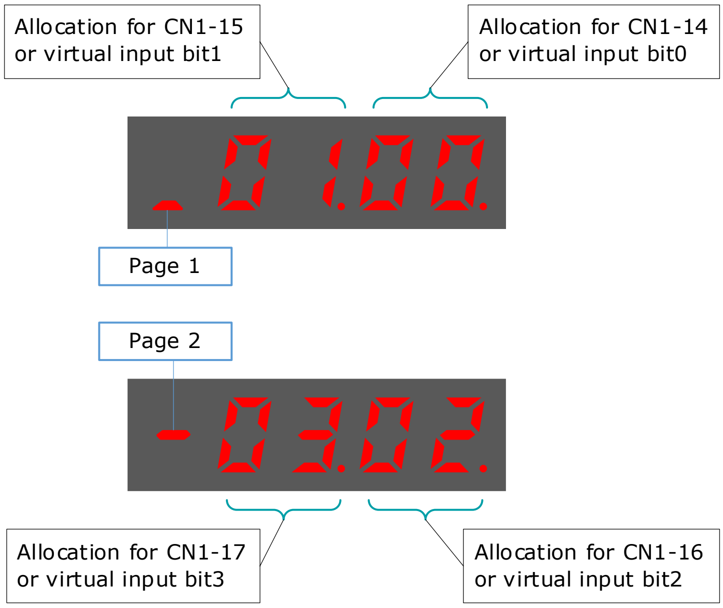
[Output Example] Pn200=16 (when 16 pulses are output per revolution), the output examples of signals of encoder pulse dividing output phase A (PAO) signal and encoder pulse dividing output phase B (PBO) are shown below.



5.7 IO Signal Allocation

Functions are allocated to the pins on the I/O signal connector (CN1) in advance. You can change the allocations and the polarity for some of the connector pins. Function allocations and polarity settings are made with parameters.

Operation panel can only display 5 digits. When distributing IO signals, it is necessary to display or set all the signals by page turning. The display instructions are detailed as follows (take Pn509 as an example).



5.7.1 Input Signal Allocations

<u>Allocation Description</u>

CN1 provides a total of 8 pin numbers available for allocation of input signals, corresponding to the sub-parameters of Pn509 and Pn510. Moreover, there're 8 virtual input bits controlled by Modbus communication, corresponding to the sub-parameters of Pn709 and Pn710.

IMPORTANT

- If you allocate two or more signals to the same input circuit, a logical OR of the inputs will be used and all the allocated signals will operate accordingly. This may result in an unexpected operation.
- Since the pins have priority, only the highest priority pin is in effect if a signal is repeatedly allocated to multiple pins. The priority of the pins is arranged from high to low as follows: CN1-14<CN1-15<CN1-16<CN1-17<CN1-39<CN1-40<CN1-41<CN1-42<bit8<bit9<bit10<bit11<bit12<bit13<bit14<bit15

<u>Default Input Signals</u>

Table 5-1 lists the input signals that can be allocated and their corresponding values. Set the sub-parameters of Pn509, Pn510, Pn709 and Pn710 to use the following values, which means that they are allocated to the corresponding pins.

Signal	Name	Value
S-ON	Servo ON Input Signal	00
P-CON	Proportional Control Reference	01
P-OT	Forward Drive Prohibit Input Signal	02

Signal	Name	Value
N-OT	Reverse Drive Prohibit Input Signal	03
ALMRST	Alarm Clear	04
CLR	Clear Position Deviation Pulse	05
P-CL	Forward External Torque Limit Input Signal	06
N-CL	Reverse External Torque Limit Input Signal	07
G-SEL	Gain Selection Input Signal	08
JDPOS-JOG+	PCP Control, PJOG positive command	09
JDPOS-JOG-	PCP Control, PJOG negative command	0A
JDPOS-HALT	PCP Control, stop command	0B
HmRef	Homing Input Signal	0C
SHOM	Homing Start Signal	0D
ORG	Reference Switch Signal	0E
ZCLAMP	Zero Clamp Signal	0F
TORQ_JD1	Internal torque contact 1	10
TORQ_JD2	Internal torque contact 2	11
TORQ_SPEED_LIMIT1	Internal torque reference limit 1	12
TORQ_SPEED_LIMIT2	Internal torque reference limit 2	13
ANLOD_REV	Analogue input command negation When the control mode is of D-parameter speed, the given speed is reversed	14
POS0	Select PCP connection point as 0	15
POS1	Select PCP connection point as 1	16
POS2	Select PCP connection point as 2	17
POS3	Select PCP connection point as 3	18
POS4	Select PCP connection point as 4	19
ANAG_SEL	Switch the speed command input gain from Pn300 to Pn302 in Analogue speed control mode. Switch the torque command input gain from Pn400 to Pn414 in Analogue torque control mode.	1A
MDP1	Reserved	1A
MD0	Reserved	1B
MD1	Reserved	1C

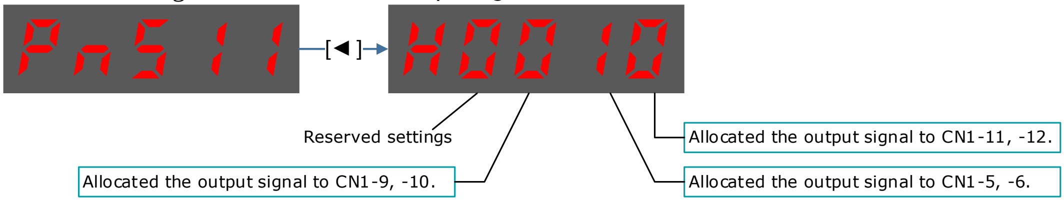
Table 5-1 Default Input signals

5.7.2 Output Signal Allocations

Allocation Description

The I/O signal connector (CN1) on the Drive provides three group of pins (points) for allocating the output signals, corresponding to the parameter Pn511, as is shown in Figure 5-2.

Figure 5-2 Allocation of output signals



IMPORTANT

If you allocate more than one signal to the same output circuit, a logical OR of the signals will be output.

Default Output Signals

Table 5-2 lists the output signals that can be allocated and their corresponding values. Set the parameter Pn511 to use the following values, which means that they are allocated to the corresponding pins.

Signal	Name	Value
COIN/VCMP	Positioning Completion Output Signal or Speed Coincidence Detection Output Signal	0
TGON	Rotation Detection Output Signal	1
S-RDY	Servo Ready Output Signal	2
CLT	Torque Limit Detection Output Signal	3
BK	Brake Output Signal	4
PGC	Motor C-pulse Output Signal	5
OT	Overtravel Output Signal	6
RD	Motor Excitation Output Signal	7
HOME	Homing Completion Output Signal	8
TCR	Torque Detection Output Signal	9
R-OUT1	Remoted IO Output Signal 0	A
R-OUT2	Remoted IO Output Signal 1	B
R-OUT3	Remoted IO Output Signal 2	C

Table 5-2 Default Output signals

5.8 Control Mode Selection

Speed control, position control and torque control are available to servo drive. Set through the control mode selection (Pn005.1).

Parameter	Set Value	Control Mode	Description
Pn005.1	0	Speed Control (Analogue Reference)	Controls servomotor speed using Analogue voltage speed reference.
	1	Position Control (Reference)	Controls the position of the servomotor using pulse train position reference. Controls the position with the number of input pulses and controls the speed with the input pulse frequency. Use when positioning is required.
	2	Torque Control	Controls the servomotor's output torque with Analogue voltage torque reference. Use to output the required amount of torque for operations such as pressing.
	3	Speed Control (contact reference) ↔Speed Control (zero reference)	Use 7 speed parameters (Pn316 to Pn322) and zero reference (halt) pre-set in the servo drive for speed control. When this control mode is selected, no Analogue reference is required.
	4	Speed Control (contact reference) ↔Speed Control (Analogue reference)	These are switching modes for using the above-mentioned control methods described above in combination. Select the control method switching mode that best suits the application.
	5	Speed Control (contact reference) ↔Position Control (pulse train reference)	
	6	Speed Control (contact reference) ↔Torque Control	
	7	Position Control (pulse train reference) ↔ Speed Control (Analogue reference)	
	8	Position Control (pulse train reference) ↔ Torque Control	
	9	Torque Control ↔ Speed Control (Analogue reference)	
	A	Speed Control (Analogue reference) ↔Zero Clamp Control	Use zero clamp function under speed control mode.
	B	Position Control (pulse train reference)↔ Position Control (pulse prohibited)	Use pulse prohibited function under position control mode.
	C	PCP Control	Pre-set the position control and PJOG operation of 32 program contacts in the servo drive. When this control mode is selected, the signal input of an external linear drive is not required.

Parameter	Set Value	Control Mode	Description
	D	Position Control (Parameter reference)	Use the speed control of a speed parameter (Pn304) pre-set in the servo drive. When this control mode is selected, no Analogue reference is required.

5.9 Speed Control

Speed control is selected by Pn005.1:

Parameter	Setting	Meaning	When Enabled
Pn005.1	0	Control mode selection: speed control (Analogue reference)	After restart

5.9.1 Setting speed control

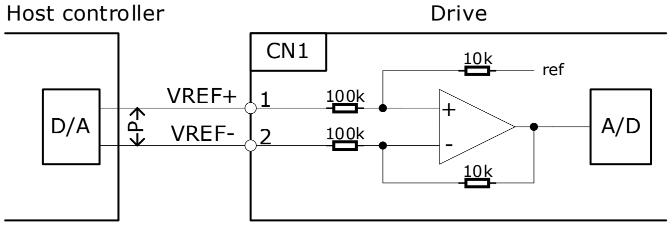
Speed reference input signal

To control the speed of the servo motor at a speed proportional to the input voltage, it is necessary to set the speed reference input signal.

Type	Signal Name	Connector Pin Number	Meaning
Input	VREF+	CN1-1	Speed Reference Input Signal
	VREF-	CN1-2	

NOTE • Maximum input voltage: DC±10V

When performing position control by a host controller such as a programmable controller, connect it to the speed reference output terminal of the host controller.

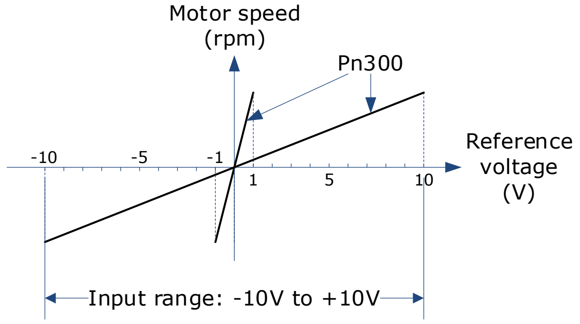


NOTE ←P→ represents a twisted-pair cable.
To suppress noise, be sure to use twisted-pair cables.

Setting speed reference input gain

Sets the Analogue voltage level for the speed reference (V-REF) necessary to operate the servomotor at the rated speed through Pn300.

Number	Name	Range	Unit	Default	When Enabled
Pn300	Analogue Speed Reference Input Gain	0 to 3000	rpm/V	150	Immediately



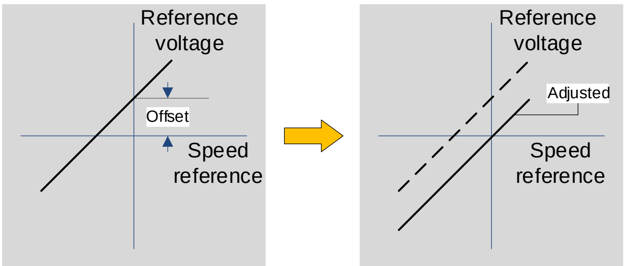
Speed Reference Input Example

Pn300=150 [factory setting]:

Speed Reference Input	Direction	Motor Speed
+1V	Forward	150rpm
+5V	Forward	750rpm
-10V	Reverse	-1500rpm

5.9.2 Adjustment of Speed Reference Offset:

When speed control is used, even if the command is 0V (the command speed is 0 or haled), the servo motor may rotate at a slight speed. This is because there is a slight deviation in the reference inside the servo unit. This slight deviation is called "offset". When the servo motor is moving at a slight speed, it is necessary to use the offset adjustment function to eliminate the offset.



Auto Adjustment of Speed Reference Offset:

The auto adjustment of the Speed Reference Offset is a method for the servo drive to automatically adjust the voltage of the speed command after offset measurement.

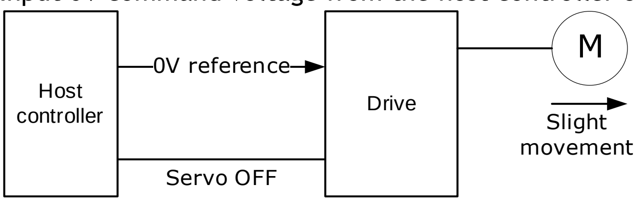
NOTE

- The measured offset will be saved in the servo drive.
- The offset is not a parameter, so the offset will not be reset even if the parameter factory value (Fn001) is restored.

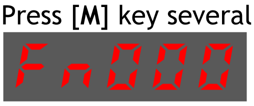
Following provides the steps for auto adjustment of the Speed Reference Offset.

Step 1 Confirm that the servo drive is in the servo OFF state.

Step 2 Input 0V command voltage from the host controller or external circuit.



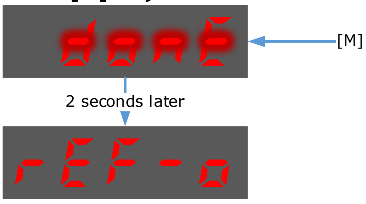
Step 3 Press [M] key several times to select the Utility Function Mode.



Step 4 Press [▲] key or [▼] key to select the function number Fn003.

Step 5 Press [◀] key and the operating panel is displayed as follows.

Step 6 Press [M] key to execute automatic offset adjustment.



Step 7 Press the [◀] key to return to the display of the Fn003.

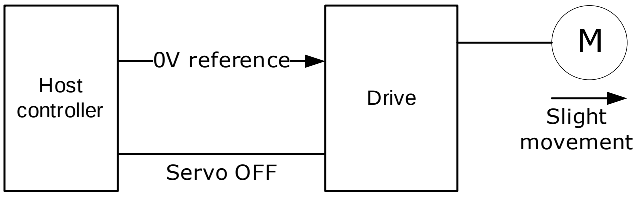
----End

Manual Adjustment of Speed Reference Offset

The manual adjustment of the speed reference offset is a method that inputs the speed command offset directly for adjustment. Use the manual adjustment in the following situations.

- If a loop is formed with the host controller and the position error pulse is set to be zero when servo lock is stopped.
- To deliberately set the offset to some value.
- To check the offset data set in the speed reference offset auto adjustment mode.
- Following provides the steps for manual adjustment of the Speed Reference Offset.

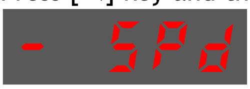
Step 1 Input 0V command voltage from the host controller or external circuit.



Step 2 Press [M] key on operating panel for several times to select the Utility Function Mode.

Step 3 Press [▲] key or [▼] key to select the function number Fn004.

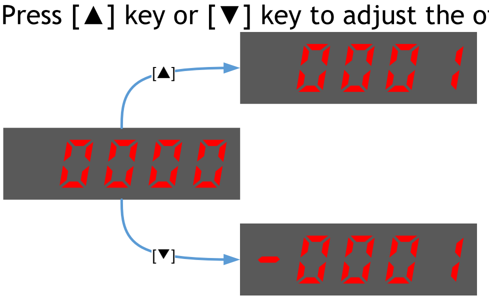
Step 4 Press [◀] key and the operating panel is displayed as follows.



Step 5 Turn ON the servo S-ON signal, so that the servo drive enters the servo ON state.

Step 6 Press the **[M]** key for one second to display the current speed reference offset.

Step 7 Press [▲] key or [▼] key to adjust the offset manually.



[Note] The adjustment range of the offset is -1024 to 1024.

Step 8 Press and hold the [◀] key for 1 second to return to the manual adjustment display.

Step 9 Press the [M] key to return to the display of the Fn004.

----End

5.9.3 Soft Start

The soft start function converts the stepwise speed reference inside the drive to a consistent rate of acceleration and deceleration.

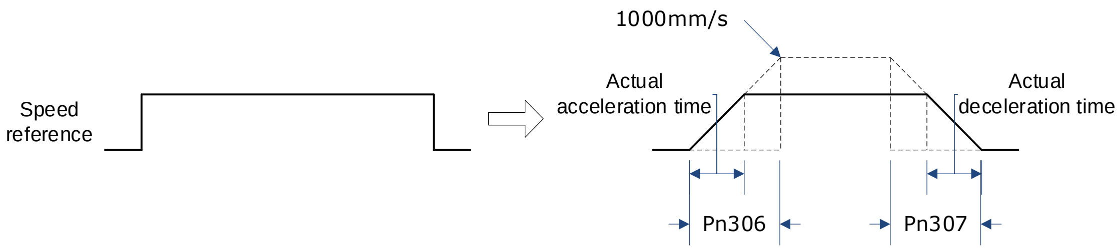
First, the user needs to select the running curve of the speed reference via Pn310 (speed reference curve form).

Parameter	Name	Setting	Description	When Enabled
Pn310	Speed reference curve form	0	Ramp [factory setting]	After restart
		1	S curve	
		2	Primary filtering	
		3	Secondary filtering	

Use this function when you want to achieve smooth speed control (including internally set speed control).

When speed reference uses ramp form (Pn310=0)

The figure below shows the timing diagram of the speed reference in the ramp form (Pn310=0). Among them, Pn306 is the time interval for the motor to accelerate from the stop state to speed of 1000rpm, and Pn307 is the time interval for the motor from 1000rpm to the stop state.



Where:

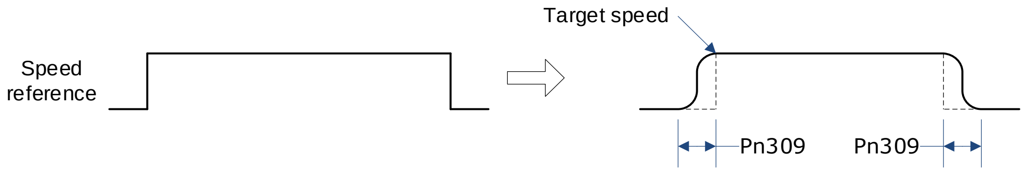
$$\text{Actual acceleration time} = \frac{\text{Target speed}}{1000} \times Pn306$$

$$\text{Actual deceleration time} = \frac{\text{Target speed}}{1000} \times Pn307$$

Parameter	Name	Range	Unit	Default	When Enabled
Pn306	Soft Start Acceleration Time	0 to 10000	ms	0	Immediately
Pn307	Soft Start Deceleration Time	0 to 10000	ms	0	Immediately

When speed reference uses S-curve (Pn310=1)

The figure below shows the timing diagram of the speed reference in the S-curve (Pn310=1). Among them, Pn309 is the time interval for the motor to accelerate from the stop state to the target speed, or the time interval for the motor to decelerate from the target speed to the stop state.



Moreover, transition form of the S-curve via Pn311 can also be selected. User can try and choose the appropriate setting.

Parameter	Name	Range	Unit	Default	When Enabled
Pn309	S-curve rising time	0 to 10000	ms	0	Immediately
Pn311	S shape selection	0 to 3	–	0	After restart

When speed reference uses filtering (Pn310=2 or 3)

Pn308 (speed filter time constant) smooths the speed reference by applying a 1st-order delay filter can be applied to the Analogue speed reference (VREF) input.

This parameter is generally not set. If the set value is too large, the responsiveness may be reduced. It is recommended to set while confirming the responsiveness.

Parameter	Name	Range	Unit	Default	When Enabled
Pn308	Speed Reference Filter Time Constant	0 to 10000	ms	0	Immediately

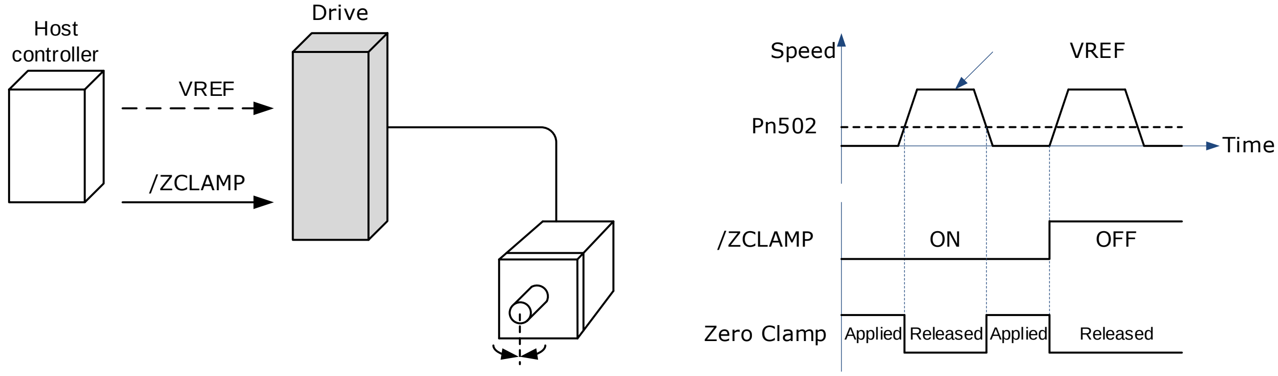
5.9.4 Zero Clamp Function

When the zero clamp function is used for speed control, the upper controller is a system that forms a loop.

The zero clamp function locks the servo when the input voltage of the speed reference (VREF) drops below the set speed in the zero clamp level parameter (Pn502) while the zero clamp signal (/ZCLAMP) is ON (low level). By this moment, a loop is formed inside the servo drive, ignoring the speed reference.

Parameter	Name	Range	Unit	Default	When Enabled
Pn502	Zero Clamp Speed	0 to 3000	rpm	10	Immediately

The servo motor is fixed within ±1 pulse of the zero clamp effective position. Even if it moves due to external force, it returns to the zero-clamp position.



Adjust the position loop gain in Pn104 (position loop gain) if the servomotor oscillates in the zero clamp state. If the gain switching function is used, adjusting Pn109 (2nd position loop gain) is also required.

Zero-Clamp Signal Allocations

The /ZCLAMP signal is not allocated in the factory setting, and the user needs to set it through Pn509 or Pn510.

Type	Signal	Connector Pin Number	Signal State	Meaning
Input	/P-CON	CN1-15	ON (Low level)	Zero clamp function is active
			OFF (High level)	Zero clamp function is inactive
	/ZCLAMP	Allocated via Pn509 or Pn510	ON Low level)	When the input voltage of the speed reference input (VREF) falls below the speed set by Pn502 (zero-clamp speed), the zero clamp function will be validated.
			OFF (High level)	Zero clamp function is inactive

Setting Zero Clamp Function

When the control mode (Pn005.1) is set to A, the zero clamp function is active when the following two conditions are satisfied

- Low level when /P-CON is ON
- The speed reference (VREF) drops below the set value of Pn502

Parameter	Setting	Meaning	When Enabled
Pn005.1	A	Control mode selection: Speed control (Analogue reference) ↔ Zero clamp control	After restart

5.9.5 Speed Coincidence Detection (/VCMP) Signal

The Speed Coincidence Detection (/VCMP) Signal is the signal output when the speed of the servomotor coincides with the reference speed. It is used in occasions such as interlocking with the upper controller. This output signal can only be used during speed control.

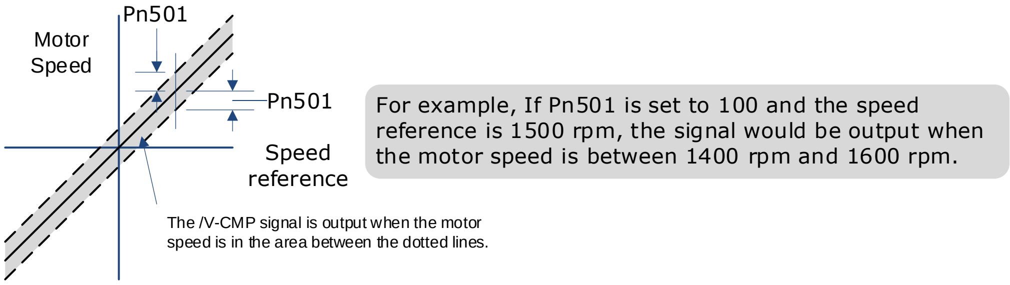
Type	Signal Name	Connector Pin Number	Signal State	Meaning
Output	/VCMP	CN1-11, 12	ON (low level)	Speed coincides.
			OFF (high level)	Speed does not coincide.

NOTE
- In position control, CN1-11, 12 output /COIN (positioning completion) signal.

This output signal can be distributed to other output terminals via Pn511. For details, please refer to "5.7.2 Output Signal Allocation".

No.	Name	Range	Unit	Default	When Enabled
Pn501	Speed Coincidence Error	0 to 100	rpm	10	Immediately

The VCMP signal is output when the difference between the motor speed and the reference speed drops below the set speed of Pn501.

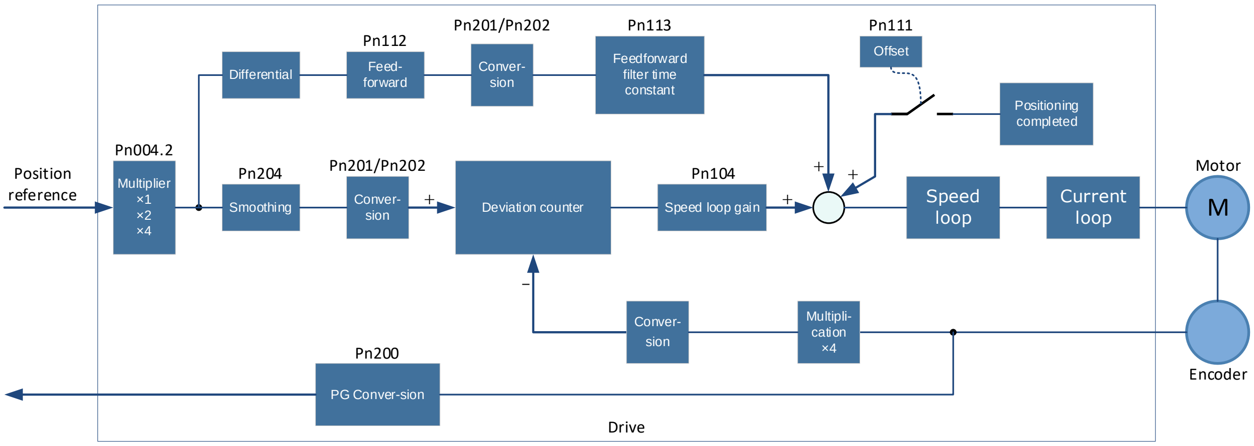


5.10 Position Control

Use Pn005.1 to select Position Control:

Parameter	Setting	Meaning	When Enabled
Pn005.1	1	Control mode selection: position control (pulse train reference)	After restart

The control block diagram for position control is shown in figure below.



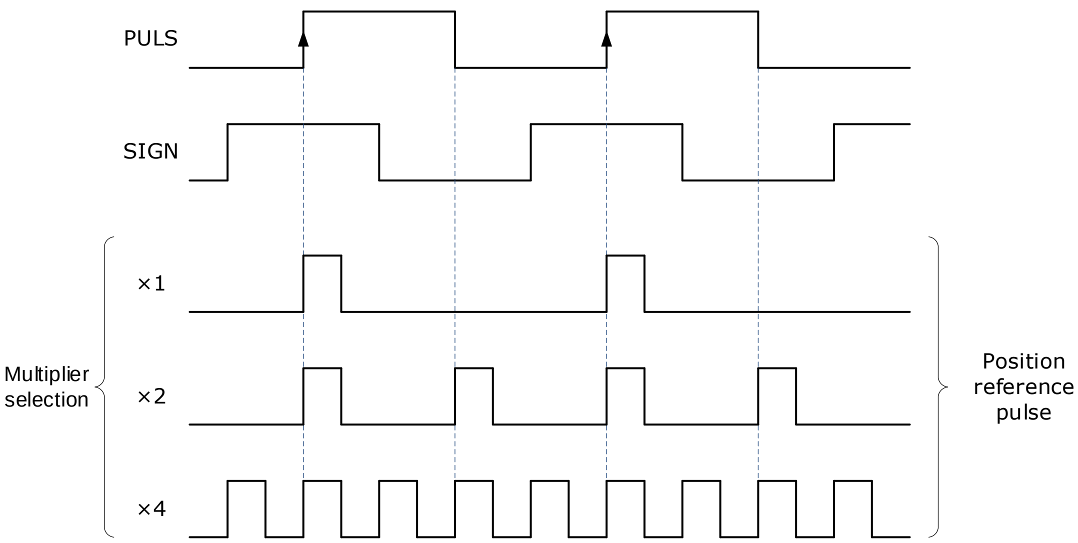
5.10.1 Basic Settings of Position Control

Setting position reference input form

Use Pn004.2 to set the input form of the position reference.

Parameter Setting	Multiplier	Input form	Forward Reference	Reverse Reference
Pn004.2 = 0	–	SIGN + PULS [Positive Logic]	PULS / SIGN H level	PULS / SIGN L level
Pn004.2 = 1	–	CW + CCW [Positive Logic]	CW L level / CCW	CW / CCW L level
Pn004.2 = 2	1	90° phase difference two-phase pulse	90° Phase A / Phase B	90° Phase A / Phase B
Pn004.2 = 3	2			
Pn004.2 = 4	4			

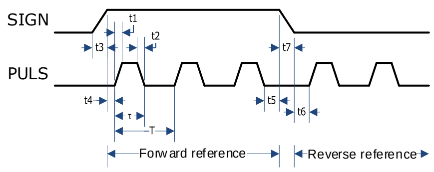
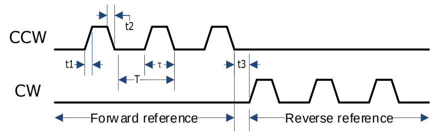
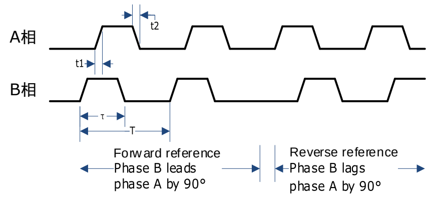
The input multiplier can be set when the 90° phase difference is of two-phase pulse reference form.



Also, the user can choose whether to invert the PULS signal and SIGN signal using Pn004.3.

Parameter	Setting	Meaning	When Enabled
Pn004.3	0	Both PULS reference and SIGN reference are not inverted	After restart
	1	PULS reference is not inverted, but SIGN reference is inverted	
	2	PULS reference is inverted, but SIGN reference is not inverted	
	3	Both PULS reference and SIGN reference are inverted	

Electrical specifications for position reference input

Reference Pulse Signal Form	Electrical Specification		Remark
SIGN + PULS Max reference frequency: 500kpps (For open-collector output: 200kpps)		t1, t2, t3, t7⩽ 0.1μs t4, t5, t6⩾3.0μs τ⩾1.0μs τ÷T⩽0.5	The sign (SIGN) is a forward rotation reference at H level, and a reverse rotation reference at L level.
CW + CCW Max reference frequency: 500kpps (For open-collector output: 200kpps)		t1, t2⩽0.1μs t3⩾3μs τ⩾1.0μs τ÷T⩽0.5	–
90° phase difference two-phase pulse (Phase A + Phase B) Max reference frequency (before frequency multiplier): ×1 input pulse multiplier: 500kpps ×2 input pulse multiplier: 400kpps ×4 input pulse multiplier: 200kpps		t1, t2⩽0.1μs τ⩾1.0μs τ÷T＝0.5	Select the frequency multiplier via Pn004.2.

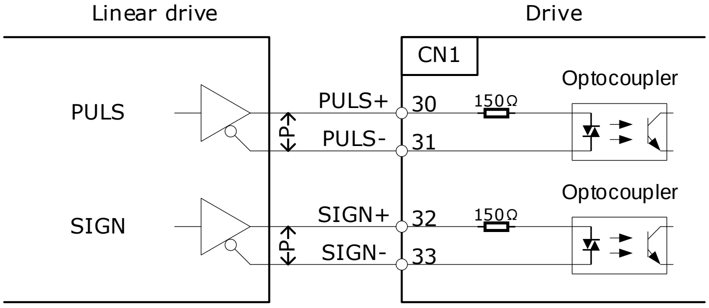
Connection Example

The pulse train output form of the reference controller includes the following.

- Linear drive
- +24V open-collector output
- +12V/+5V open-collector output

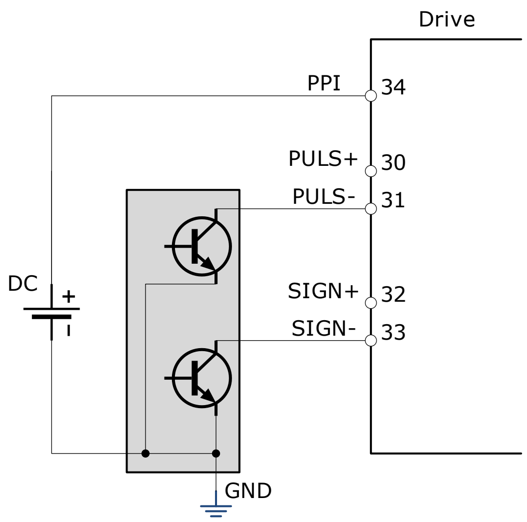
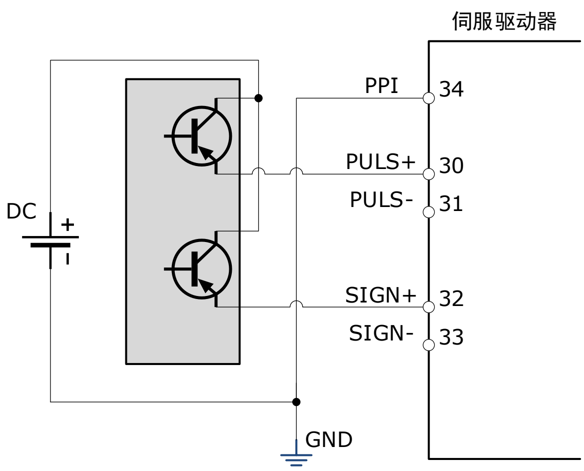
Connection Example for Linear drive Output

Applicable linear driver: SN75174 manufactured by TI or MC3487 or the equivalent.



←P→ represents a twisted-pair cable

Connection Example for Open-Collector Output

NPN Open-Collector Output Connection	PNP Open-Collector Output Connection
	

5.10.2 Function and Setting of Position Error Clear (/CLR) Signal

Allocation of Position Error Clear Signal

Type	Signal Name	Connector Pin Number	Meaning
Input	/CLR	CN1-40	Error counter clear

When the /CLR signal is set to low level, clear error counter:

- The error counter inside the servo drive is set to“0”
- Position loop operation is disabled.

Setting the Clear Signal Mode

In position control mode, pulses will be still presented in the servo drive when servo OFF, thus it should be cleared when servo drive is turned ON (S-ON). Setting Pn004 to choose whether clearing the pulses automatically when servo OFF.

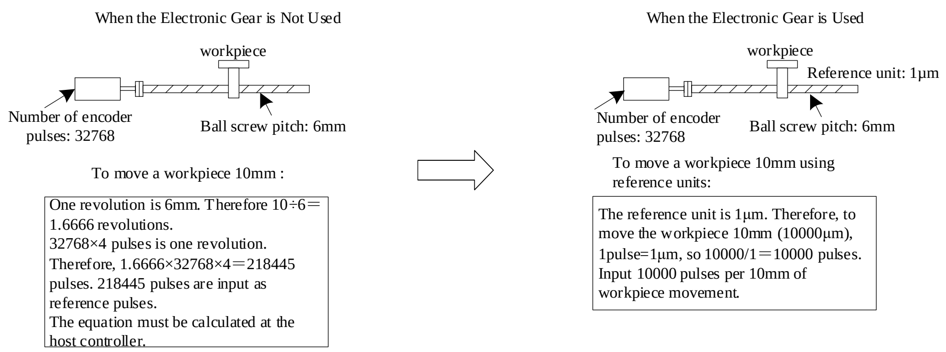
Parameter	Setting	Meaning	When Enabled
Pn004.1	0	Clear the error pulse when S-OFF, and not clear when over-travel.	After restart
	1	Do not clear the error pulse.	
	2	Clear the error pulse when servo is OFF or over-travel (except for zero clamp)	

5.10.3 Electronic Gear

Function Overview

The electronic gear enables the workpiece travel distance per input reference pulse from the reference controller to be set to any value.

One reference pulse from the reference controller, i.e., the minimum position data unit, is called “1 reference unit”.



If the mechanical reduction ratio between the motor shaft and the load side is set to m/n, the setting value of the electronic gear ratio can be calculated according to following formula. (When the servomotor rotates m revolutions, the load shaft rotates n revolutions)

$$\text{Electronic Gear}\frac{B}{A} = \frac{Pn201}{Pn202} = \frac{\text{Encoder pulse number} \times 4}{\text{Travel distance per load shaft revolution}} \times \frac{m}{n}$$

NOTE

- Range of electronic gear ratio: 0.01⩽electronic gear ratio (B/A)⩽100
  If the electronic gear ratio is outside this range, the servo drive will not operate properly. In this case, modify the load configuration or reference unit.
- Divide the numerator and denominator into integers within the setting range when it exceeds the setting range.

2nd Electronic Gear Switching

Switch between electronic gear ratio numerator 1 (Pn201) and electronic gear ratio numerator 2 (Pn203) according to the external/P-CON signal. The switching sequence is determined by the setting of Pn002.0. This function is enabled by user parameter Pn001.3.

Related Parameters

Type	Signal Name	Connector Pin Number	Signal State	Meaning
Input	/P-CON	CN1-15	ON (low level)	Switch to the 2nd electronic gear
			OFF (high level)	Switch to the 1st electronic gear

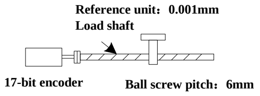
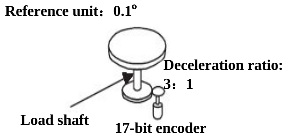
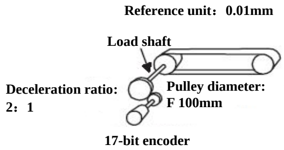
Number	Name	Range	Unit	Default	When Enabled
Pn201	16-bit 1st electronic gear numerator	1 to 100000	–	1	After restart
Pn202	16-bit electronic gear denominator	1 to 100000	–	1	After restart
Pn203	16-bit 2nd electronic gear numerator	1 to 100000	–	1	After restart

Setting Steps

Set the electronic gear ratio as per the steps and instructions described in the table below.

Step	Operation	Description
1	Check machine specifications.	Check the deceleration ratio, ball screw pitch and pulley diameter.
2	Check the number of encoder pulses.	Check the number of encoder pulses for the Servo motor used.
3	Determine the reference unit used.	Determine the reference unit from the host controller, considering the machine specifications and positioning accuracy.
4	Calculate the travel distance per load shaft revolution.	Calculate the number of reference units necessary to turn the load shaft one revolution based on the previously determined reference units.
5	Calculate the electronic gear ratio.	Use the electronic gear ratio equation to calculate the ratio (B/A).
6	Set parameters.	Set parameters using the calculated values.

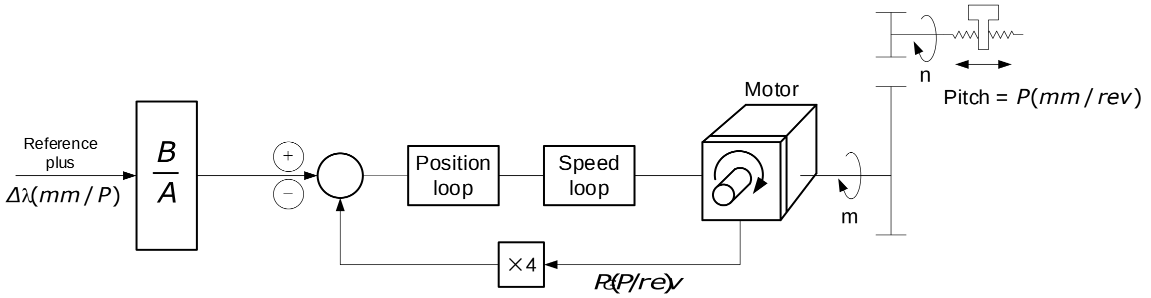
Setting Examples

Step	Operation	Machine Structure		
		Ball Screw 	Disc Table 	Belt and Pulley 
1	Check machine specifications	• Ball screw pitch:6mm • Deceleration ratio: 1/1	• Rotation angle per revolution: 360° • Deceleration ratio: 3/1	• Pulley diameter: 100 mm (pulley circumference: 314mm) • Deceleration ratio: 2/1
2	Encoder	17-bit: 32768P/R	17-bit: 32768P/R	17-bit: 32768P/R
3	Determine the reference unit used	1 reference unit: 0.001mm (1μm)	1 reference unit: 0.1°	1 reference unit: 0.01mm
4	Calculate the travel distance per load shaft revolution	6mm/0.001mm=6000	360° /0.1° =3600	314mm/0.01mm=31400
5	Calculate the electronic gear ratio	$\frac{B}{A}=\frac{32768\times 4}{6000}\times\frac{1}{1}$	$\frac{B}{A}=\frac{32768\times 4}{3600}\times\frac{3}{1}$	$\frac{B}{A}=\frac{32768\times 4}{31400}\times\frac{2}{1}$
6	Set parameters	Pn201 = 131072 Pn202 = 6000	Pn201 = 393216 Pn202 = 3600	Pn201 = 262144 Pn202 = 31400
7	Final result	Pn201 = 32768 Pn202 = 1500	Pn201 = 32768 Pn202 = 300	Pn201 = 32768 Pn202 = 3925

NOTE

- Reduce the fraction (both numerator and denominator) if the calculated result will not be within the setting range.
- For example, reduce the above numerators and denominators by four or other numbers to obtain the final results in step 7 and complete the setting. This parameter is enabled when you use an absolute encoder.

Electronic Gear Ratio Equation



Where: Δl is the reference unit; P_G is the encoder pulse; P is the pitch of the ball screw; m/n is the reduction ratio.

$$\frac{n\times P}{\Delta\ell}\times\frac{B}{A}=4\times P_G\times m \Rightarrow \frac{B}{A}=\frac{4\times P_G\times m\times\Delta\ell}{n\times P}=\frac{4\times P_G}{\frac{P}{\Delta\ell}}\times\frac{m}{n}$$

Set A and B with the following parameters Pn202 and Pn201.

5.10.4 Smoothing

The smoothing filters the reference pulse input to make the travel of the servomotor smoother. This function is more effective in the following cases.

- When the host controller that outputs a reference that cannot perform acceleration/deceleration processing.
- When the reference pulse frequency is too low.
- When the conversion of position reference is large ($\frac{Pn201}{Pn202} \geq 10$)

NOTE • This setting has no effect on the travel distance (reference pulse number).

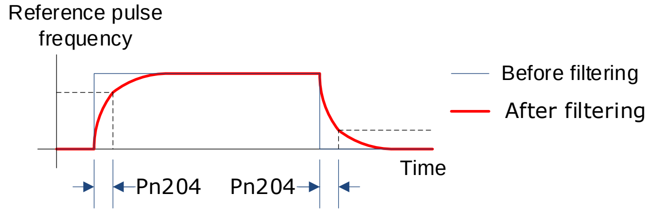
Set the position reference filtering method using Pn205 (position reference filter form selection).

Number	Name	Setting	Meaning	When Enabled
Pn205	Position Reference Filter Form Selection	0 [Factory Setting]	Primary filtering to position reference	After restart
		1	Secondary filtering to position reference	

Then set the filter time of the position reference using Pn204 (position reference filter time constant).

Number	Name	Range	Unit	Default	When Enabled
Pn204	Position Reference Filter Time Constant	0 to 32767	0.1ms	0	Immediately

The figure below shows the 1st order filtering for position reference:



IMPORTANT After changing this parameter, the changed parameter will be effective after user will re-input the position reference next time and input the position error clear (CLR) signal.

5.10.5 Positioning Completion (/COIN) Signal

This signal indicates that servomotor movement has been completed during position control. Use the signal to confirm that positioning has been completed at the host controller.

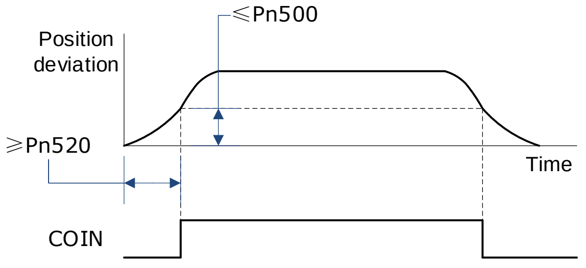
Type	Signal Name	Connector Pin Number	Signal State	Meaning
Output	/COIN	CN1-11, 12	ON (low level)	Positioning has been completed.
			OFF (high level)	Positioning is not completed.

[Note] CN1-11, 12 output the VCMP (speed coincidence) signals during speed control.

This output signal can be allocated to an output terminal with parameter Pn511. Refer to "0 Output Signal Allocation".

The positioning completion (COIN) signal is output when the difference (position error pulse) between the number of reference pulses output by the host controller and the travel distance of the servomotor is less than the value set in tPn500, and the stabilization time is more than the value of Pn520 (position completion time).

Number	Name	Range	Unit	Default	When Enabled
Pn500	Positioning Error	0 to 5000	μm	10	Immediately
Pn520	Position Completion Time	0 to 60000	0.1ms	500	Immediately

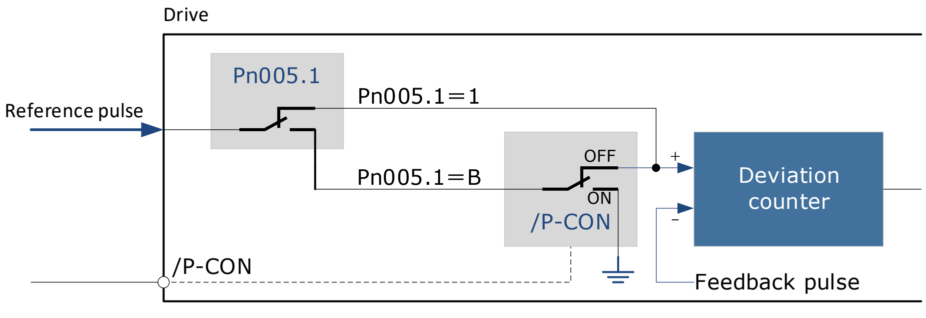


5.10.6 Reference Pulse Inhibit Function (INHIBIT)

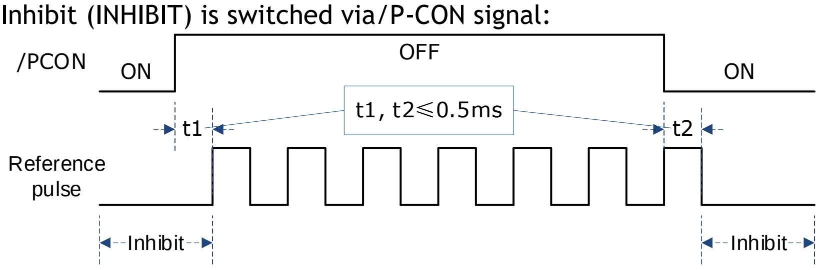
This function stops (inhibits) the Drive from counting input pulses during position control. When this function is active, the Drive enters a state where it cannot receive reference pulse input.

When this function is used, it is necessary to set Pn005.1=B.

Parameter	Setting	Meaning	When Enabled
Pn005.1	B	Control mode selection: position control (pulse train reference) ↔ Position control (pulse inhibit)	After restart



Inhibit (INHIBIT) is switched via/P-CON signal:



Type	Signal Name	Connector Pin Number	Signal State	Meaning
Input	/P-CON	CN1-15	ON (low level)	Stop reference pulses counting
			OFF (high level)	Start reference pulse count

5.11 Torque Control

This mode inputs a torque reference in the form of an Analogue voltage reference to the Drive, and controls the operation of the servomotor using a torque proportional to the input voltage. This control mode needs to be selected via Pn005.1 and Pn409.

Parameter	Setting	Meaning	When Enabled
Pn005.1	2	Control mode selection: torque control	After restart
Pn409	0	Use of external Analogue quantity voltage reference requires the external signal connection	Immediately

5.11.1 Basic Settings of Torque Control

Specification of Torque Reference Signal Input

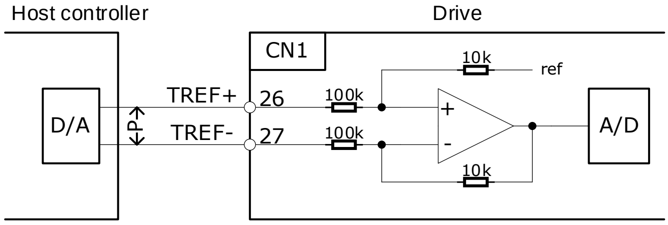
To apply torque control to the servomotor with a torque proportional to the input voltage, it is necessary to set the torque reference input signal.

Type	Signal Name	Connector Pin Number	Meaning
Input	TREF+	CN1-26	Torque Reference Input Signal
	TREF-	CN1-27	

NOTE

- Max input voltage: DC±10V

When performing position control by a host controller such as a programmable controller, connect it to the Analogue reference output terminal of the host controller.

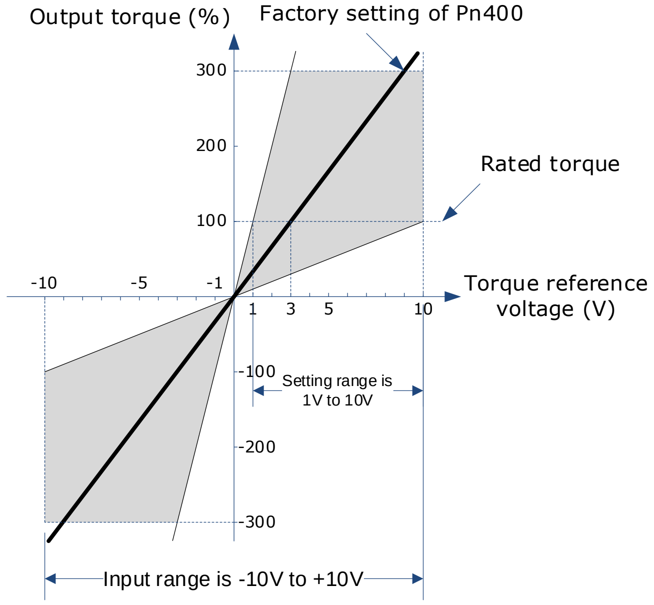


NOTE ←P→ represents a twisted-pair cable.
To suppress noise, be sure to use twisted-pair cables.

Setting Torque Reference Input Gain

Pn400 is used to set the Analogue voltage value of the torque reference (TREF) that operates the servomotor at the rated speed.

Number	Name	Range	Unit	Default	When Enabled
Pn400	Torque Reference Gain	10 to 100	0.1V / 100%	33	Immediately



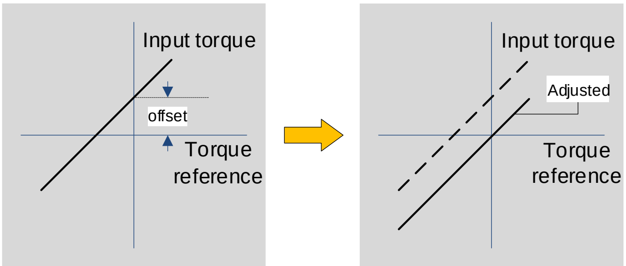
<u>Torque Reference Input Example</u>

When Pn400 = 30:

Torque Reference Input	Travel Direction	Torque
+3V	Forward	Rated torque
+1V	Forward	1/3 rated torque
-1.5V	Reverse	1/2 rated torque

5.11.2 Adjustment of Torque Reference Offset

When using torque control, the servomotor may rotate slowly even when 0V (reference speed is 0 or stop) is specified as the Analogue reference voltage. This occurs when there's slight offset for internal reference of servo drive. Such slight offset is called "Offset". When the servo motor is moving at a low speed, it is necessary to use the offset adjustment function to eliminate the offset.



<u>Auto Adjustment of the Torque Reference Offset</u>

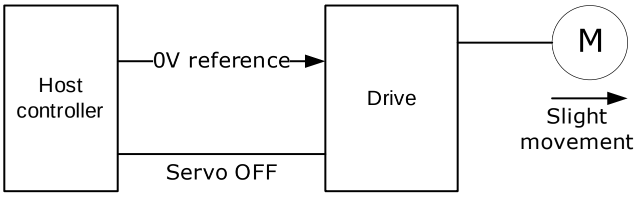
The auto adjustment of torque reference offset automatically measures the offset and adjusts the torque reference voltage automatically.

NOTE	
	• The measured offset will be saved in the servo drive. • The offset is not a parameter, so it will not be reset even if the parameter factory value (Fn001) is restored.

The following provides the operating steps for auto adjustment of the torque reference offset.

Step 1 Make sure that the servo drive is in the servo OFF state.

Step 2 Input the 0V reference voltage from the host controller or external circuit.

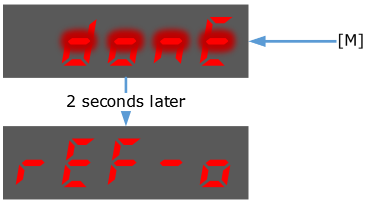


Step 3 Press the **[M]** key to select the utility function mode.

Step 4 Press the [▲] or [▼] key to select the utility function number Fn003.

Step 5 Press [◄] key and the operating panel is displayed as follows.

Step 6 Press the **[M]** key, and the reference offset will be automatically adjusted.



Step 7 Press the [◄] key to return to the utility function mode display Fn003.

----End

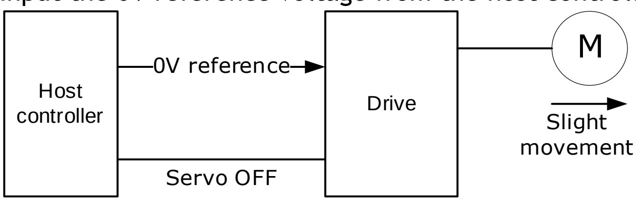
Manual Adjustment of the Torque Reference Offset

The manual adjustment of torque reference offset directly inputs the torque reference offset for adjustment. Manual adjustment is used in the following cases.

- If a position loop is formed with the host controller and the error is zeroed when servo loop is stopped.
- To deliberately set the offset to some value.
- Use this mode to check the offset data that was set in the auto adjustment mode of the torque reference offset.

The following provides the operating steps for manual adjustment of the torque reference offset.

Step 1 Input the 0V reference voltage from the host controller or external circuit.



Step 2 Press the **[M]** key on the operating panel to select the utility function mode.

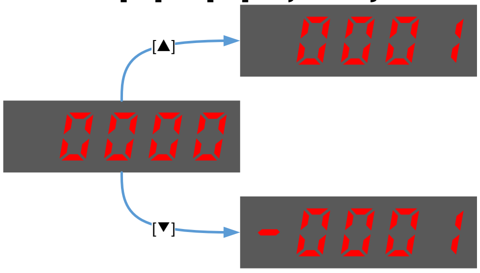
Step 3 Press the [▲] or [▼] key to select the utility function number Fn004.

Step 4 Press [◀] key and the operating panel is displayed as follows.

Step 5 Turn on the S-ON signal to make the servo drive enter the servo ON state.

Step 6 Press and hold the [M] key for 1 sec or longer, the operation panel will display the current torque reference offset.

Step 7 Press the [▲] or [▼] key to adjust the offset manually.



[Note] The adjustment range of the offset is -1024 to 1024.

Step 8 Press and hold the [◀] for 1 sec, and return to the display of manual adjustment.

Step 9 Press the [◀] key to return to the function number display Fn004.

----End

5.11.3 Setting Torque Reference Input Filter

It is possible to apply a 1st-order delay filter to the Analogue torque reference (VREF) input via Pn105 (torque reference filter time constant), to smooth the torque reference.

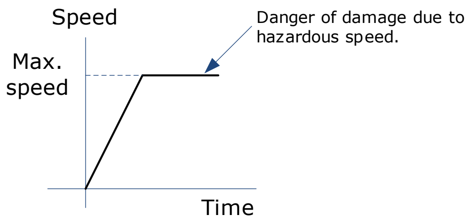
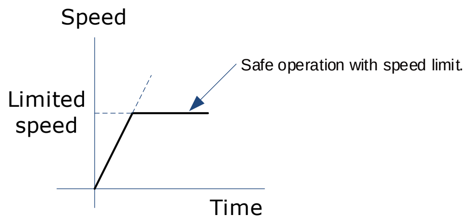
This parameter is generally not set. If the set value is too large, the responsiveness may be reduced. It is recommended to set while confirming the responsiveness.

Number	Name	Range	Unit	Default	When Enabled
Pn105	Torque Reference Filter Time Constant	0 to 2500	0.01ms	50	Immediately

5.11.4 Speed Limit During Torque Control

The speed limit during torque control is a function used to limit the speed of the servomotor in order to protect the machine.

For torque control, the servomotor is controlled to output the specified torque, but the motor speed is not controlled. Therefore, if a reference torque is input that is larger than the machine torque, the speed of the servomotor may increase greatly. If that may occur, use this function to limit the speed.

<table>
<tr><th>With No Speed Limit</th><th>With a Speed Limit</th></tr>
<tr><td>
</td><td>
</td></tr>
</table>

NOTE

- The actual limit of motor speed depends on the load conditions on the motor.

Selection of Speed Limit Detection

Select the speed limit way using Pn001.

<table>
<tr><th>Parameter</th><th>Setting</th><th>Meaning</th><th>When Enabled</th></tr>
<tr><td rowspan="2">Pn001.1</td><td>0</td><td>Use the set value of Pn408 as the speed limit value.</td><td rowspan="2">After restart</td></tr>
<tr><td>1</td><td>The smaller of the speed value corresponding to the Vref input Analogue voltage, and the Pn408 setting value is used as the speed limit value.</td></tr>
</table>

Internal Speed Limit Function

When Pn001.1=0, the internal speed limit function is selected.

In this case, user needs to set Pn408 as the limit value of the maximum motor speed. If the set value of Pn408 exceeds the maximum motor speed, the speed limit value is the maximum speed of the motor.

Number	Name	Range	Unit	Default	When Enabled
Pn408	Speed Limit During Torque Control	0 to 6000	rpm	1500	Immediately

External Speed Limit Function

When Pn001.1=1, the external speed limit function is selected. User can limit the speed via the VREF input signal and the set value of Pn408.

<table>
<tr><th>Type</th><th>Signal Name</th><th>Connector Pin Number</th><th>Meaning</th></tr>
<tr><td rowspan="2">Input</td><td>VREF+</td><td>CN1-1</td><td rowspan="2">Speed reference input signal</td></tr>
<tr><td>VREF-</td><td>CN1-2</td></tr>
</table>

NOTE

- The max. input voltage: DC±10V.

Number	Name	Range	Unit	Default	When Enabled
Pn408	Speed Limit During Torque Control	0 to 6000	rpm	1500	Immediately

In torque control, the motor speed limit value is controlled by Analogue reference:

- When Pn001.1=1, the smaller of the speed limit input from VREF and the set value of Pn408 is valid.
- The voltage value input as the limit value depends on the set value of Pn400, not the polarity.

5.11.5 Internal Torque Contact Control

The internal torque contact control is a method to control the operation of the servo motor by the torque reference generated inside the servo drive. This control mode is selected using Pn005.1 and Pn409.

Parameter	Setting	Meaning	When Enabled
Pn005.1	2	Control mode selection: torque control	After restart
Pn409	1	Use of internal torque contact reference does not require external signal connection	Immediately

Setting Internal Torque Reference

To select a torque contact reference value, user needs to allocate TORQ_JD1 and TORQ_JD2.

Type	Signal Name	Connector Pin Number	Meaning
Input	TORQ_JD1	Allocation via Pn509 or Pn510	Internal torque contact 1
	TORQ_JD2		Internal torque contact 2

The different states of TORQ_JD1 and TORQ_JD2 can be switched to select the corresponding torque contact parameters.

TORQ_JD1	TORQ_JD2	Torque Reference Parameter
0	0	Pn410 (torque contact 1)
1	0	Pn411 (torque contact 2)
0	1	Pn412 (torque contact 3)
1	1	Pn413 (torque contact 4)

Number	Name	Range	Unit	Default	When Enabled
Pn410	Torque Contact 1	-400 to 400	%	0	Immediately
Pn411	Torque Contact 2	-400 to 400	%	0	Immediately
Pn412	Torque Contact 3	-400 to 400	%	0	Immediately
Pn413	Torque Contact 4	-400 to 400	%	0	Immediately

Setting Internal Torque Reference Limit

User needs to allocate TORQ_SPEED_LIMIT1 and TORQ_SPEED_LIMIT2 when using the torque reference limit, so as to select the required speed limit.

Type	Signal Name	Connector Pin Number	Meaning
Input	TORQ_SPEED_LIMIT1	Allocation via Pn509 or Pn510	Internal torque reference limit 1
	TORQ_SPEED_LIMIT2		Internal torque reference limit 2

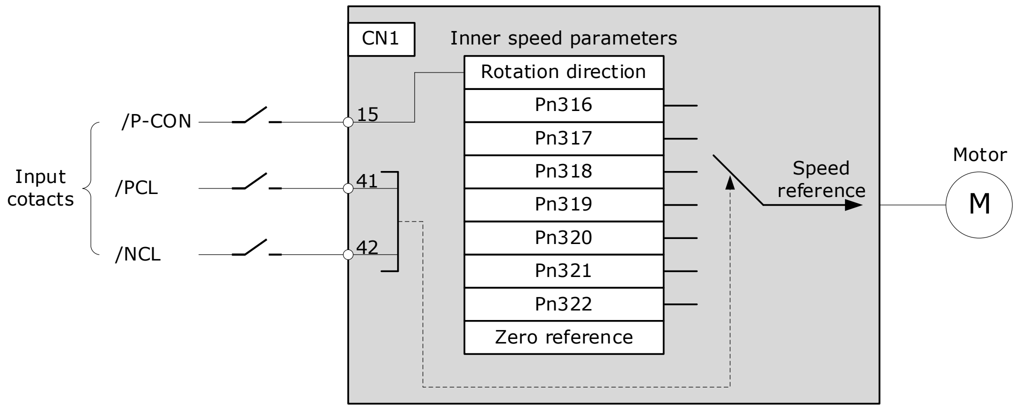
The different states of TORQ_SPEED_LIMIT1 and TORQ_SPEED_LIMIT2 can be switched so as to select the corresponding torque contact parameters.

TORQ_SPEED_LIMIT1	TORQ_SPEED_LIMIT2	Torque Reference Parameter
0	0	Pn316 (speed limit 1)
1	0	Pn317 (speed limit 2)
0	1	Pn318 (speed limit 3)
1	1	Pn319 (speed limit 4)

Number	Name	Range	Unit	Default	When Enabled
Pn316	Speed Limit 1	-6000 to 6000	rpm	100	Immediately
Pn317	Speed Limit 2	-6000 to 6000	rpm	200	Immediately
Pn318	Speed Limit 3	-6000 to 6000	rpm	300	Immediately
Pn319	Speed Limit 4	-6000 to 6000	rpm	-100	Immediately

5.12 Internally Set Speed Control

It is a function that allows to set up to 7 motor speeds in the internal parameters of the servo drive, and selects the speed and moving direction from them through external input signals for speed control and operation. Since it is controlled by the internal parameters of the servo drive, a speed generator and pulse generator are not required to be installed externally.



5.12.1 Basic Settings of Internally Set Speed Control

<u>Setting Input Signal</u>

The input signals for switching the operating speed are listed in table below.

Type	Signal Name	Connector Pin Number	Meaning
Input	P-CON	CN1-15	Switch the moving direction of the servo motor.
	PCL	CN1-41	Select the internally set speed.
	NCL	CN1-42	Select the internally set speed.

Selection of Internally Set Speed Control

Use Pn005.1 to select the torque control:

Parameter	Setting	Meaning	When Enabled
Pn005.1	3	Control mode selection: speed control (contact reference) ↔ speed control (zero reference)	After restart

5.12.2 Speed Setting of Internally Set Speed

Number	Name	Range	Unit	Default	When Enabled
Pn316	Internally Set Speed 1	-6000 to 6000	rpm	100	Immediately
Pn317	Internally Set Speed 2	-6000 to 6000	rpm	200	Immediately
Pn318	Internally Set Speed 3	-6000 to 6000	rpm	300	Immediately
Pn319	Internally Set Speed 4	-6000 to 6000	rpm	-100	Immediately
Pn320	Internally Set Speed 5	-6000 to 6000	rpm	-200	Immediately
Pn321	Internally Set Speed 6	-6000 to 6000	rpm	-300	Immediately
Pn322	Internally Set Speed 7	-6000 to 6000	rpm	500	Immediately

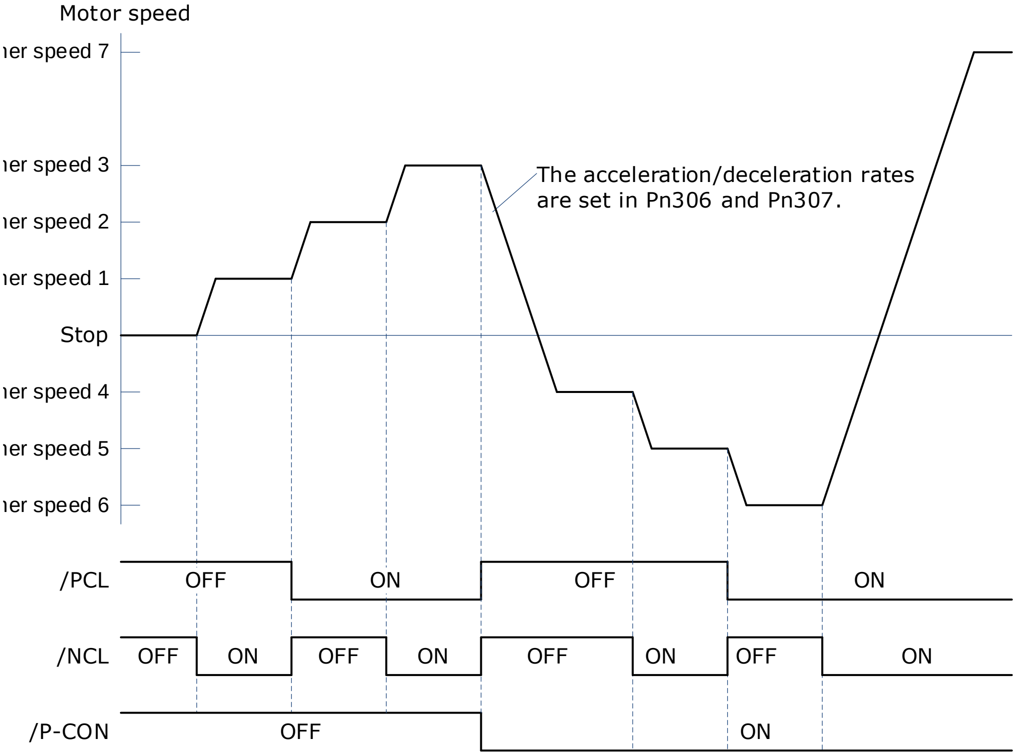
5.12.3 Switching Internally Set Speed by Input Signal

Use ON/OFF combinations of the following input signals to select the internally set speeds.

Signal			Motor Travel Direction	Operating Speed
/P-CON	/PCL	/NCL		
OFF	OFF	OFF	Forward	Switch to speed control (zero reference).
	OFF	ON		Run at internally set speed 1 as set by Pn316.
	ON	OFF		Run at internally set speed 2 as set by Pn317.
	ON	ON		Run at internally set speed 3 as set by Pn318.
ON	OFF	OFF	Reverse	Run at internally set speed 4 as set by Pn319.
	OFF	ON		Run at internally set speed 5 as set by Pn320.
	ON	OFF		Run at internally set speed 6 as set by Pn321.
	ON	ON		Run at internally set speed 7 as set by Pn322.

5.12.4 Running Example of Internally Set Speed Control

Figure below shows an example of operation during internally set speed control. This example is the operation method when internally set speed control and soft start are used in combination. Using the soft start function would reduce the impact of speed switching.



5.13 PCP Control

This function uses the 32 program contacts (PCP[0] to PCP[31]) preset in the drive for purpose of position control and PJOG operation.

When PCP control is selected, the drive will be controlled by the internal pulse generator to generate reference pulses based on the settings of the related parameters. In this case, the signal input from an external linear drive is not required.

5.13.1 PCP Control Selection

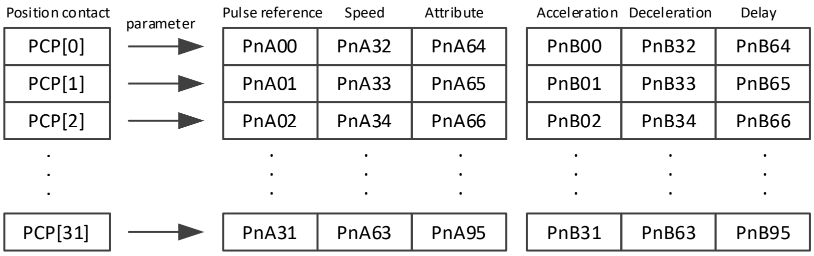
Select PCP control by setting Pn005.1=C.

Parameter	Setting	Meaning	When Enabled
Pn005.1	C	Control mode selection: position control (contact reference)	After restart

5.13.2 Paramter Setting of PCP Control

Parameter Setting of Contact

Servo drive allows to set a total of 32 point references (PCP[0] to PCP[31]). Each contact reference includes pulse reference, speed, attribute, acceleration/deceleration and delay.



The pulse reference defines the number of pulses of the contact, the speed defines the running speed of the contact, the attributes defines the motion attribute of contact, the acceleration and jerk define the acceleration/deceleration of the contact, and the delay defines the delay time after the contact reference is sent.

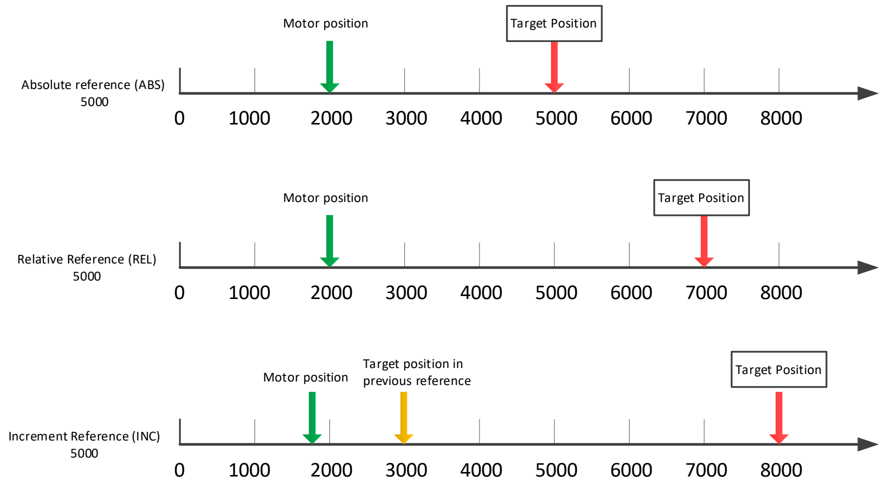
Use Pn014.1to set the IO trigger mode.

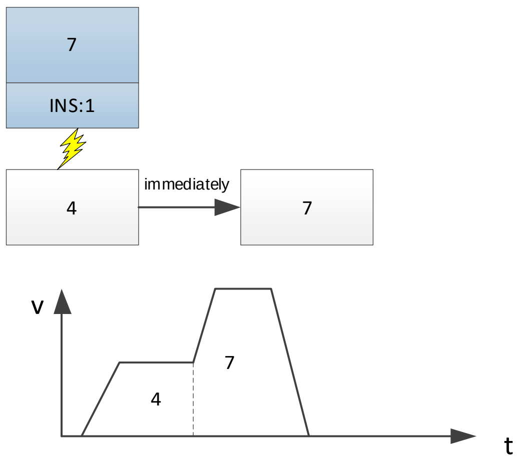
Parameter	Setting	Meaning	When Enabled
Pn014.1	0	Edge trigger mode: Contact is triggered at the falling edge of the /PCON signal, and the servo then reads the contact number	After restart
	1	Level trigger mode: • Control PCP when the /PCON signal is in low level, and the servo reads the contact number. • Operate PJOG when /PCON is in high level.	

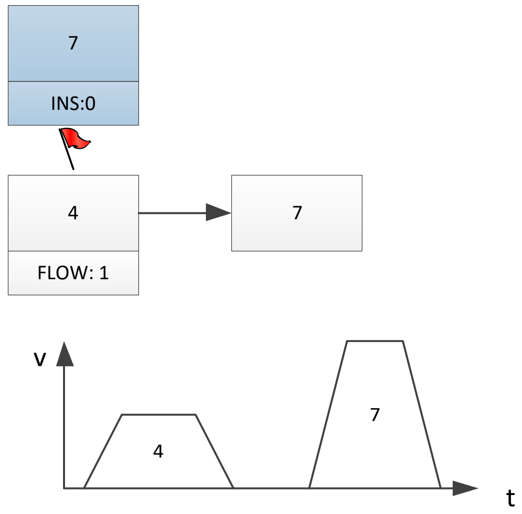
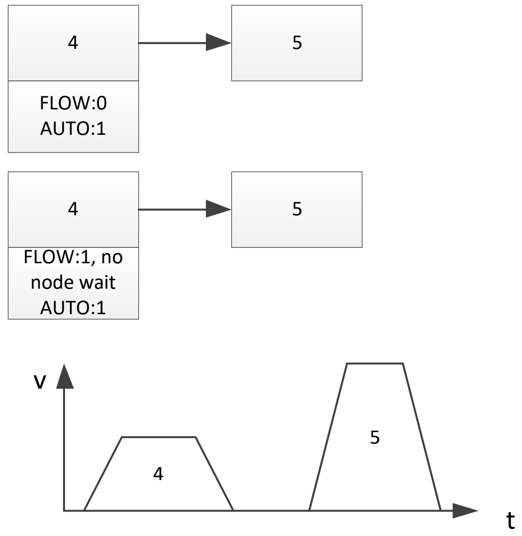
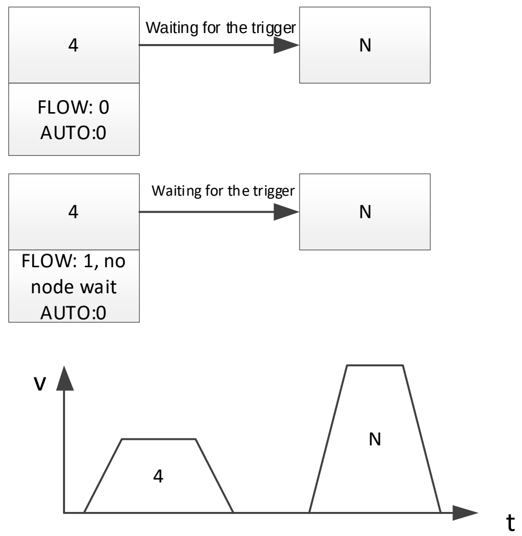
NOTE

- Following shall be noted when setting Pn014.1 = 1.
- Only absolute command (ABS) is supported. When setting the contact as a relative command (REL) or incremental command (INC), the contact will not be executed.
- Automatic loading of the next contact is not supported.
- When /PCON is pulled high during the contact operation, you need to wait for the end of the contact operation before starting PJOG operation.

The attributes in each contact reference are set by the corresponding contact reference with the same meaning. For example, the setting of the attribute parameter PnA64 of PCP[0] is described as follows.

Parameter	Meaning
PnA64.0	CMD: Position Control Reference Mode 0: Absolute Command (ABS): The target position is the value of t position command. 1: Relative Command (REL): The target position is the motor’s current position plus the value of the position command. 2: Incremental Command (INC): The target position is the target position of previous position command plus the value of current position command. 
PnA64.1	INS: The current position contact is interrupted when this contact is triggered.
PnA64.2	FLOW: Allow the next command to be loaded after current node is executed. The next command is the contact triggered when current node is running.
PnA64.3	AUTO: Execution by order. After this contact program is completed, the next contact will be executed in order.

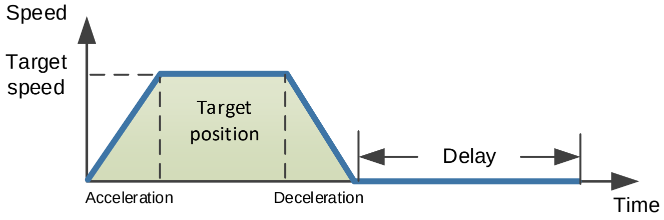
INS	FLOW	AUT	Interpretation	Diagram
✓	○	○	With the highest priority. When the attribute of the currently triggered contact is of interrupt, it updates the target position by interrupting the previous contact directly.	

<table>
<tr><th>INS</th><th>FLOW</th><th>AUT</th><th>Interpretation</th><th>Diagram</th></tr>
<tr><td>×</td><td>✓</td><td>○</td><td>Priority inferior to Interrupt.
When the attribute of the currently triggered contact can be accessed, a new contact is allowed to access upon the execution of this contact and after the delay command is ended.
If there is no new insertion, it is judged whether to load the next automatically.</td><td></td></tr>
<tr><td rowspan="2">×</td><td>×</td><td rowspan="2">✓</td><td rowspan="2">With the lowest priority.
When there’s no contact that needs to be overlapped for current contact, and is not interrupted, the next contact is executed by order.
If a new interruptible contact is triggered when this contact is running, it will be interrupted.
If a new non-interrupted contact is triggered while the contact is running, the new triggered contact is then discarded.</td><td rowspan="2"></td></tr>
<tr><td>✓, overlap is required if no contact</td></tr>
<tr><td rowspan="2">×</td><td>×</td><td rowspan="2">×</td><td rowspan="2">When current contact is running, no new contact other than Interrupt is accepted. It then judges whether the new contact is triggered until the current contact running is ended.</td><td rowspan="2"></td></tr>
<tr><td>✓, overlap is required if no contact</td></tr>
</table>

5.13.3 Contact Command Model

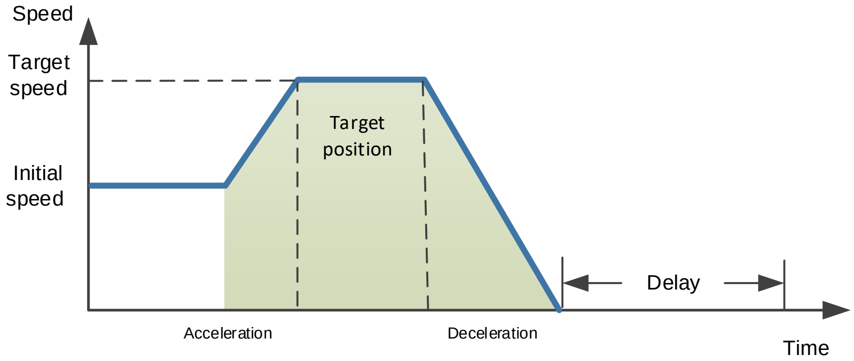
Position Command

The acceleration/deceleration are trapezoidal according to the given position and the acceleration/deceleration planning path, and can be set separately.

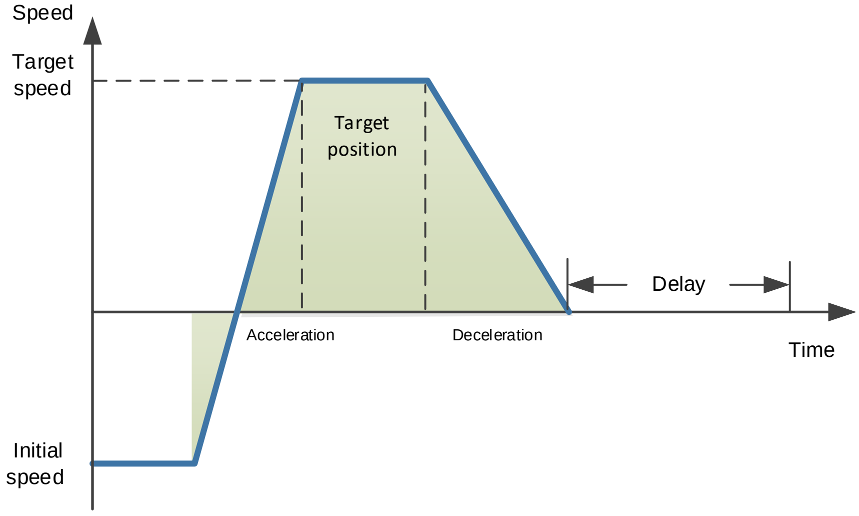


The position planning during Interrupt is to plan the position reference on the basis of the original reference speed.

- The initial speed is in the same direction with the planned position



- The initial speed is the direction opposite to the planned position



PJOG Command

It is valid under PCP contact control. PJOG can only be performed after the contact operation is ended.

At the same time, the contact cannot be triggered during PJOG operation.

PJOG curve is a trapezoidal, Pn305 is for the speed, Pn306 is for the acceleration, and Pn307 is for the deceleration.

Halt Command

This function allows to stop running through the external input signal STOP.

It is valid under PCP contact control. It can stop operation through the IO port during PJOG and PCP contact operation.

Input STOP signal (active at low level) to stop the current motion state, decelerate the speed to zero as per the deceleration set by Pn719. All control states are cleared after stopping, and cannot be restored to the original motion state. They shall be triggered again.

Number	Name	Range	Unit	Default	When Enabled
Pn324	Time required for trapezoidal deceleration at 1000rpm under indexing function	0 to 10000	ms	100	Immediately

5.13.4 Contact Trigger

The contact uses digital IO port trigger mode, by which users can trigger using the commands of POS0, POS1, POS2, POS3, POS4 and PCON.

The relationships are as defined as follows:

IO trigger mode (/PCON active low)	Contact attribute	Trigger signal
Edge	Absolute command (ABS)	/PCON↓
	Relative command (REL)	/PCON↓
	Relative command (REL)	/PCON↓
	PJOG	/PJOG+ or /PJOG- active when no contact is in operation
Level	Absolute command (ABS)	/PCON active
	Relative command (REL)	Not triggered
	Relative command (REL)	Not triggered
	PJOG	/PCON inactive, /PJOG+ or /PJOG- active

The corresponding IO relationships for each contact number are as listed below:

Position Command	POS4	POS3	POS2	POS1	POS0	Triggered Signal
PCP[0]	0	0	0	0	0	/PCON↓
PCP[1]	0	0	0	0	1	/PCON↓
PCP[2]						/PCON↓ or /PCON active
…						
PCP[30]	1	1	1	1	0	/PCON↓ or /PCON active
PCP[31]	1	1	1	1	1	/PCON↓ or /PCON active

* PCP[0] is available by setting parameter Pn014.2=1; Contact 0 is not executed

5.13.5 Software Limits

Compare the current motor running position of the Un009 with the position limit. It stops running if out of limits, and the servo enters the warning state, the servo is still under excitation status, the panel display shows A.XX in flashing status, and the upper computer can read the current warning number (same address as the alarm number) via Modbus. SoftOt output is available if the IO output signal is configured.

In case of a soft limit, there is no need to manually clear the warning but set the reverse motion command to exit the limit state.

Relevant alarm codes:

Alarm code	Name & specification
A.D7	Soft Limit, Forward
A.D8	Soft Limit, Reverse

Parameter	Name & specification	Unit	Setting range	Factory default	Re-power on
Pn015	Soft limit enable	-	0x0000~0x0001	0	Required
Pn325	Soft limit position 1	P	-2,000,000,000~2,000,000,000	2,000,000,000	Not required
Pn326	Soft limit position 2	P	-2,000,000,000~2,000,000,000	-2,000,000,000	Not required

When Pn015.0 = 0, the soft limit function is not enabled

When Pn015.0 = 0, the soft limit function is enabled and warning A.D7 occurs if the current position Un009 is greater than the range of Pn325~Pn326. Warning A.D8 occurs if the current position Un009 is less than the range of Pn325~ Pn326.

When Pn325 < Pn326, the two values are exchanged and the limit range is Pn326~Pn325.

5.13.6 Partial In-place Output

The Contacts 1 to 7 in-place outputs can be individually monitored.

The Pn511 outputs can be configured as follows:

[A]REMOTE0\PCP_COIN0

[B]REMOTE1\PCP_COIN1

[C]REMOTE2\PCP_COIN2

Contact No.	PCP_COIN0	PCP_COIN1	PCP_COIN2	In-place information
xx	0	0	0	Contacts 1 to 7 not in place
PCP[1]	0	0	1	Contact 1 in place
PCP[2]	0	1	0	Contact 2 in place
PCP[3]	0	1	1	Contact 3 in place
PCP[4]	1	0	0	Contact 4 in place
PCP[5]	1	0	1	Contact 5 in place
PCP[6]	1	1	0	Contact 6 in place
PCP[7]	1	1	1	Contact 7 in place

5.13.7 When Overtravel Occurs

During contact operation: When an overtravel occurs, the contact will enter the limit state and exit the contact operation. Un024 is displayed as the current given position.

- If stopping by P-OT, exit the POT by giving a reverse position. The reverse position must be smaller than the current given one.
- If stopping by N-OT, exit NOT by giving a positive position. The positive position must be greater than the current given one.

When PJOG is running:

- PJOG+ can reverse as PJOG- when it stops by encountering P-OT.
- PJOG- can reverse as PJOG- when it stops by encountering N-OT.

5.13.8 Display

Un024 (PCP target position)

- Under non-contact operation state, STOP, PJOG and Servo-off are displayed as the given motor position.
- Under contact operation state, it is displayed as the current target position of PCP.

5.14 Selection of Control Mode Combinations

The servo drive can combine the two control modes and switch between them. The control mode combinations can be selected by setting "4" to "B" in Pn005.1.

Parameter	Setting	Control Mode Combinations	When Enabled
Pn005.1	4	Speed control (contact reference) ↔ speed control (Analogue reference)	After restart
	5	Speed control (contact reference) ↔ position control (pulse train reference)	
	6	Speed control (contact reference) ↔ torque control	
	7	Position control (pulse train reference) ↔ speed control (Analogue reference)	

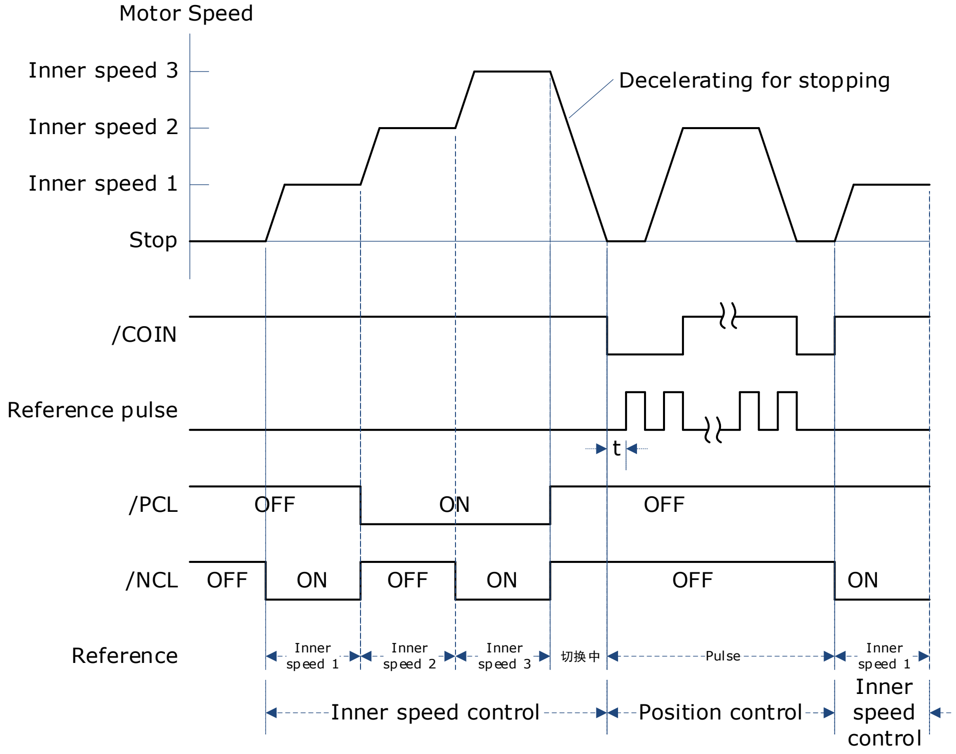
Parameter	Setting	Control Mode Combinations	When Enabled
	8	Position control (pulse train reference) ↔ torque control	
	9	Torque control ↔ Speed control (Analogue reference)	
	A	Speed control (Analogue reference) ↔ zero clamp control	
	B	Position control (pulse train reference) ↔ Position control (pulse prohibited)	

When Pn005.1=4, 5 and 6

Switch the control mode by using /P-CON, /PCL and /NCL signals.

Signal			Running Speed			Motor Traveling Direction
/P-CON	/PCL	/NCL	Pn005.1 = 4	Pn005.1 = 5	Pn005.1 = 6	
OFF	OFF	OFF	Speed Control	Position Control	Torque Control	Forward
	OFF	ON	Run at internally set speed 1 as set by Pn316.			
	ON	OFF	Run at internally set speed 2 as set by Pn317.			
	ON	ON	Run at internally set speed 3 as set by Pn318.			
ON	OFF	OFF	Run at internally set speed 4 as set by Pn319.			Reverse
	OFF	ON	Run at internally set speed 5 as set by Pn320.			
	ON	OFF	Run at internally set speed 6 as set by Pn321.			
	ON	ON	Run at internally set speed 7 as set by Pn322.			

[Example] The running example of Pn005.1 = 5 [Speed control (contact reference) ↔ Position control (pulse train reference)] is detailed as follows.



NOTE

- The value of t is not affected by the use of the soft boot feature. Reads of /PCL and/NCL can result in a maximum delay of 2ms.
- The switch of the speed control (contact command) → position control (pulse column command) switches to position control after the motor deceleration has stopped during the deceleration time set by Pn307.

When Pn005.1=7, 8 and 9

Switch control mode using /P-CON.

Type	Signal Name	Pin Number	Setting	Pn005.1=7	Pn005.1=8	Pn005.1=9
Input	/P-CON	CN1-15	ON	Speed control	Torque control	Speed control
			OFF	Position control	Position control	Torque control

When Pn005.1=A and B

Switch control modes using /P-CON.

Type	Signal Name	Pin Number	Setting	Pn005.1=A	Pn005.1=B
Input	/P-CON	CN1-15	ON	Speed control with zero clamp function	Position control with reference pulse prohibition
			OFF	speed control	Position control

5.15 Torque Limit

The servo drive provides the following three methods for limiting output torque to protect the machine.

Limit Method	Outline
Internal Torque Limits	Torque limiting through the parameters.
External Torque Limits	The torque is limited with an input signal from the host station.
Torque limit of Analogue reference	Torque limiting by Analogue reference

NOTE
- If you set a value that exceeds the maximum torque of the Motor, the torque will be limited to the maximum torque of the Motor.

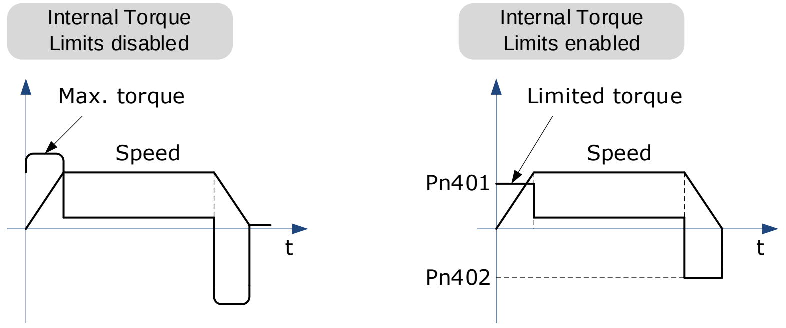
5.15.1 Internal Torque Limits

This function limits the maximum output torque through parameters Pn401 and Pn402.

Parameter	Name	Range	Unit	Default	When Enabled
Pn401	Forward Internal Torque Limit	0 to 350	%	300	Immediately
Pn402	Reverse Internal Torque Limit	0 to 350	%	300	Immediately

NOTE
- The setting unit is the percentage relative to the motor's rated torque.

Figure below shows a comparison of waveform curves with internal torque and without torque limit:



NOTE
- If the setting of Pn401 or Pn402 is too low, the torque may be insufficient for acceleration or deceleration of the Motor.

5.15.2 External Torque Limits

This function limits the torque through the input signal of the upper controller when the torque to be limited at specific times during machine operation. It can be used to push to stop the action or to hold operations for robot workpieces.

<u>Input Signal</u>

The input signals to enable the external torque limits are listed in table below.

Type	Signal Name	Connector Pin Number	Signal State	Meaning
Input	/P-CL	CN1-41	ON	Turn ON the forward external torque limit. [Limit value: Pn403]
			OFF	Turn OFF the forward external torque limit. [Limit value: Pn401]
Input	/NCL	CN1-42	ON	Turn ON the reverse external torque limit. [Limit value: Pn404]
			OFF	Turn OFF the reverse external torque limit. [Limit value: Pn402]

Related Parameters

The related parameters of external torque limit are as follows.

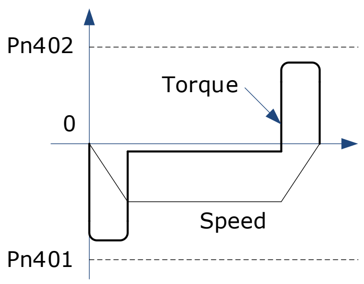
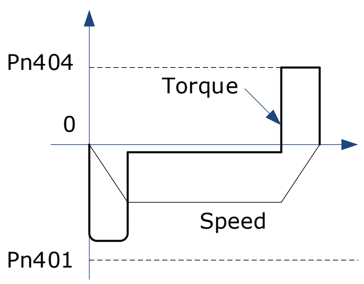
Parameter	Name	Range	Unit	Default	When Enabled
Pn401	Forward Internal Torque Limit	0 to 400	%	350	Immediately
Pn402	Reverse Internal Torque Limit	0 to 400	%	350	Immediately
Pn403	Forward External Torque Limit	0 to 400	%	100	Immediately
Pn404	Reverse External Torque Limit	0 to 400	%	100	Immediately

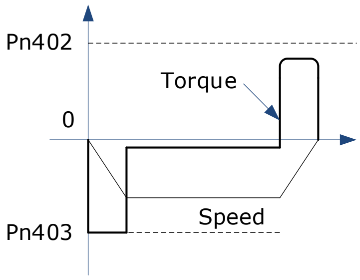
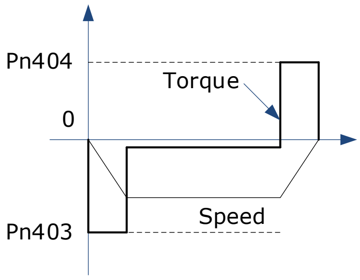
NOTE

- The setting unit is the percentage relative to the motor's rated torque.
- If the setting values of Pn401, Pn402, Pn403 and Pn404 are too low, the torque may be insufficient for motor acceleration/deceleration.

Changes in the Output Torque for External Torque Limits

In the following figure, when setting Pn001.0=0 (under the forward reference, the incremental encoder is used in the positive counting direction), it indicates to set the internal torque limit as 300% of output torque (Pn401 and Pn402 are both 300%).

/PCL	/NCL	Diagram
OFF [H Level]	OFF [H Level]	
OFF [H Level]	ON [L Level]	

/PCL	/NCL	Diagram
ON [L Level]	OFF [H Level]	
ON [L Level]	ON [L Level]	

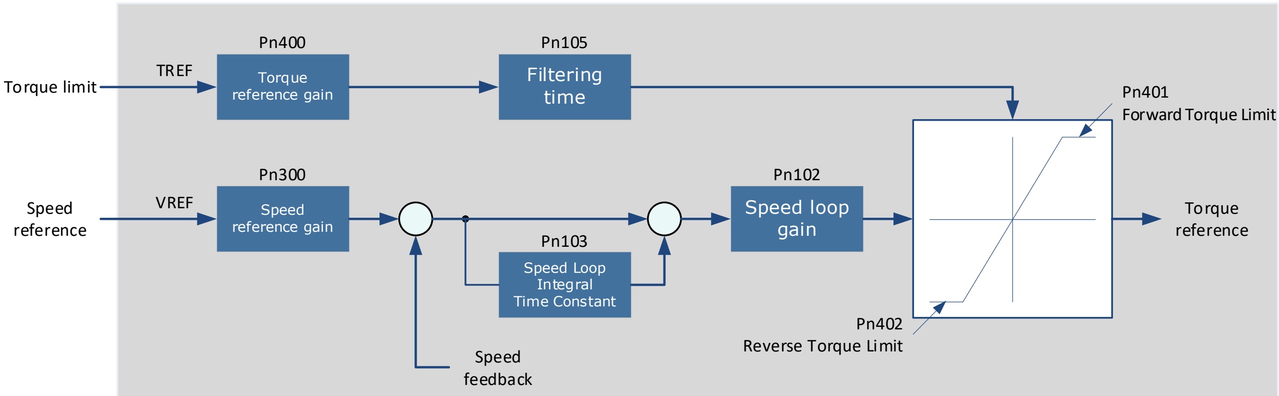
5.15.3 Torque Limiting Using an Analogue Reference

This function uses TREF (CN1-26, -27) as Analogue reference input terminal so as to limit the torque arbitrarily.

This limit method can only be used in speed control or position control, but be invalid in torque control.

Parameter	Setting	Meaning	When Enabled
Pn001.2	1	Use the TREF terminal as the input terminal of external torque limit.	After restart

Figure below is the block diagram under speed control.



[Note] There is no issue with input voltage polarity of the Analogue voltage reference for torque limiting. The absolute values of both + and – voltages are input, and a torque limit value corresponding to that absolute value is applied in the forward or reverse direction.

Input Signal

The input signals when the torque limiting using an Analogue reference is made are as follows.

Type	Signal Name	Connector Pin Number	Meaning
Input	TREF+	CN1-26	Input signal of torque reference
	TREF-	CN1-27	

Related Parameters

The parameters related to the torque limiting using an Analogue reference are as follows.

Number	Name	Range	Unit	Default	When Enabled
Pn401	Forward Internal Torque Limit	0 to 400	%	350	Immediately
Pn402	Reverse Internal Torque Limit	0 to 400	%	300	Immediately
Pn400	Analogue Torque Reference Gain	10 to 100	0.1V/100%	33	Immediately
Pn105	Torque Reference Filter Time Constant	0 to 2500	0.01ms	50	Immediately

5.15.4 Torque Limit Confirmation Signals

Output signal indicating the status of motor output torque limit is shown below.

Type	Signal Name	Connector Pin Number	Output State	Meaning
Input	/CLT	Allocated by Pn511	ON	Motor output torque is being limited.
			OFF	Output torque is not being limited.

For ways to allocate output signals, see "0 Output Signal Allocation".

5.16 Homing

5.16.1 Function Overview

The Storing Origin function is available after homing.

User can choose whether to home directly after power-up.

User may choose whether to continue homing after a limit or to enter a limit state.

Multiple homing modes are supported.

Storing Origin:

Clear origin data when Pn689.2 = 0.

When Pn689.2 = 1, the Storing Origin is performed after homing is completed, which stores the current single-turn position and the multi-turn position information that can be viewed via Un035 and Un036 respectively. (The origin is stored in parameters Pn694 and Pn695, and will not be displayed). When powering up again, there is no need to perform the homing operation again. The current position of the motor (absolute position with respect to the origin position) can be updated by calculating from the current multi-turn position and single-turn position of the motor as well as the stored position information, and homing done signal is then output. The current position can be viewed via Un009.

Warning A.D9 occurs if the Storing Origin function is switched on and succeeded or the origin stored is lost due to no homing operation.

Homing parameters:

User parameters		Meaning
Pn689	b.□□□A	0: Switch off the Homing function 1: Enable the Homing function, which can be triggered by the rising edge of the SHOM signal, or be automatically homed after powering up.
	b.□□B□	0: The first time Servo-on takes effect, no automatic homing is performed and a SHOM signal is required to trigger the homing operation. 1: The first time Servo-on takes effect, the automatic homing is performed without the need for a SHOM signal trigger.
	b.□C□□	0: No origin is stored after homing, and the data originally stored in Pn694 and Pn695 is reset. 1: Origin is stored after homing. When the encoder has a multi-turn position (Pn002.2 = 0), the current position of the motor is automatically updated each time the drive is re-powered and the homing done signal is output. If a multi-turn information error alarm such as encoder A47 occurs, the data stored in Pn694 and Pn695 is cleared and the homing done signal is not output.
	b.D□□□	0: In the process of searching for the trigger point, return to the limit and continue to make homing 1: Homing modes 1~6, search for trigger point and stop when it meets limit, and then enter limit state

NOTE

- Applicable control mode: position control
- Homing operation can only be enabled when /COIN is ON.
- Position control function is invalid during homing process.
- After changing these parameters, turn the power supply ON again to enable the new settings.
- The input connector pin numbers can be assigned to signals SHOM and ORG by means of user parameters.
- After servo is turned ON, it is impossible to start homing under overtravel state (when P-OT/N-OT is enabled).

5.16.2 Related Parameters

Parameter	Description			
Pn685	Speed of finding reference point (hitting the origin signal ORG)			
	Range	Unit	Default	Re-powered or not
	0～3000	rpm	1500	Not required
Pn686	Speed of finding reference point (leaving the origin signal ORG)			
	Range	Unit	Default	Re-powered or not
	0～200	rpm	30	Not required

Parameter	Description			
Pn690	Number of homing offset pulses When homing mode is 7 and 9 (in the case of positive limit deceleration), the positive setting of the offset pulse number is invalid. When homing mode is 8 and 10 (in the case of reverse limit deceleration), the reverse setting of the offset pulse number is invalid.			
	Range	Unit	Default	Re-powered or not
	-9999～9999	10000 Pulse	0	Not required
Pn691	Number of homing offset pulses When homing mode is 7 and 9 (in the case of positive limit deceleration), the positive setting of the offset pulse number is invalid. When homing mode is 8 and 10 (in the case of reverse limit deceleration), the reverse setting of the offset pulse number is invalid.			
	Range	Unit	Default	Re-powered or not
	-9999～9999	1Pulse	0	Not required
Pn692	The homing mode is valid after re-powering on.			
Pn693	Homing acceleration, time taken to accelerate to 1,000rpm, in ms			

NOTE

- When homing mode is 7 and 9 (in the case of positive limit deceleration), the positive setting of the offset pulse number is invalid.
- When homing mode is 8 and 10 (in the case of reverse limit deceleration), the reverse setting of the offset pulse number is invalid.

5.16.3 Selection of Homing Modes

Select homing mode using Pn692. The Homing mode is valid after re-powering on.

Parameter	Setting	Meaning	When Enabled
Pn692	0	Use current position as the origin	After restart
	1	Forward homing, and use deceleration point and origin as the ORG switch	
	2	Reverse homing, and use deceleration point and origin as the ORG switch	
	3	Forward homing, and use the deceleration point as the ORG switch, and the origin as the motor’s Z signal	
	4	Reverse homing, and use the deceleration point as the ORG switch, and the origin ass the motor’s Z signal	
	5	Forward homing, and use the deceleration point and origin as the motor’s Z signal	
	6	Reverse homing, and use deceleration point and origin as the motor’s Z signal	

Parameter	Setting	Meaning	When Enabled
	7	Forward homing, use the deceleration point and origin as the overtravel switches	
	8	Reverse homing, and use deceleration point and origin as the overtravel switches	
	9	Forward homing, and use the deceleration point as an overtravel switch, and the origin as the motor's Z signal	
	10	Reverse homing, and use the deceleration point as an overtravel switch, and the origin as the motor's Z signal	
	11	Power-up and run to home; only applicable when Pn005.1 = 1 and for position control (pulse train command)	

5.16.4 Allocating Homing Signals

SHOM and ORG signals need to be allocated before homing operation, which can be set via Pn509 or Pn510.

Type	Signal Name	Connector Pin Number	Signal State	Meaning
Input	SHOM	Allocated by Pn509 or Pn510	ON= ↑ (rising edge)	Start homing operation.
			OFF= Non-rising edge signal	Homing operation is not executed.
Input	ORG	Allocated by Pn509 or Pn510	ON=High level	Reference position of homing point is valid
			OFF=Low level	Reference position of homing point is invalid

Set the output signal (/HOME) after homing via Pn511.

Setting	Connector Pin Number		Meaning
	＋Terminal	− Terminal	
Pn511.0=8	CN1-11	CN1-12	The signal is output from output terminal CN1-11,12.
Pn511.1=8	CN1-5	CN1-6	The signal is output from output terminal CN1-5,6.
Pn511.2=8	CN1-9	CN1-10	The signal is output from output terminal CN1-9,10.

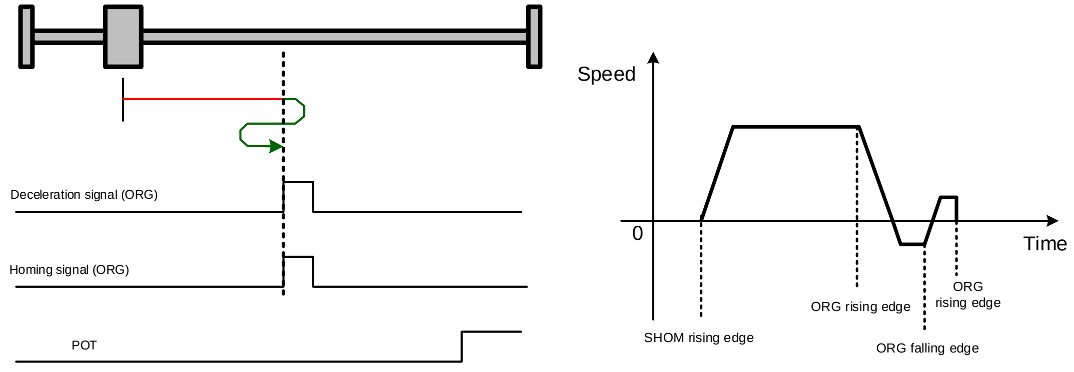
NOTE

- HOME signal is only enabled at low level (ON).

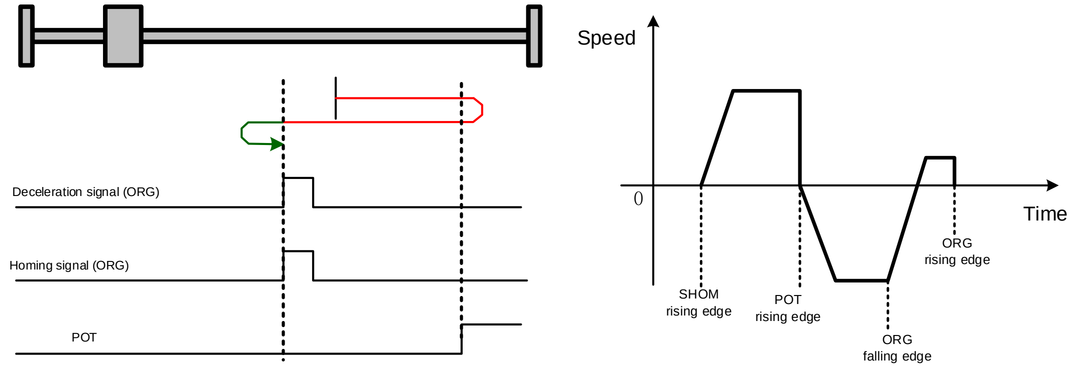
5.16.5 Homing Timing Sequence

<u>Homing modes 1 and 2, using deceleration point and origin as ORG switch</u>

Hit the deceleration signal (ORG rising edge) before encountering the limit signal.

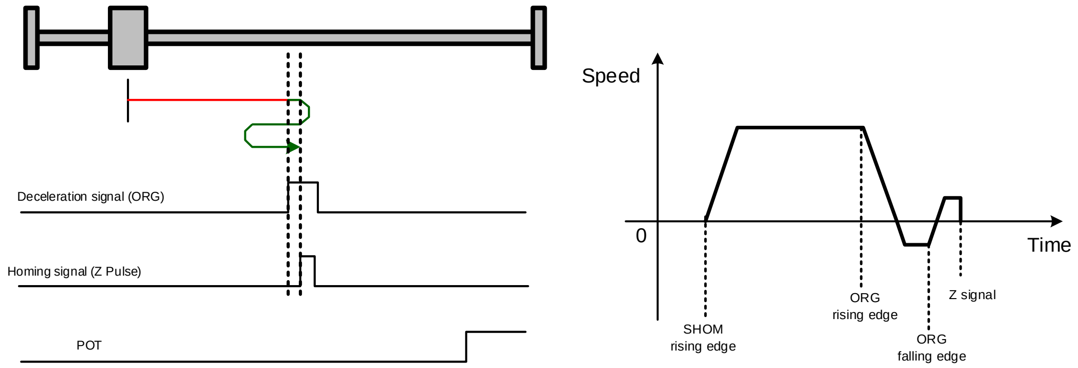


Hit the limit signal before encountering deceleration signal (ORG rising edge).

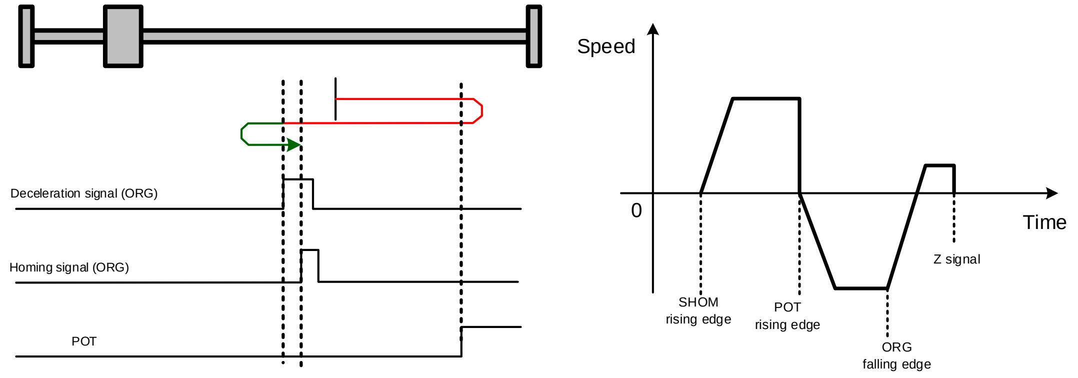


<u>Homing modes 3 and 4, using deceleration point as ORG switch, and origin as Motor's Z signal</u>

Hit the deceleration signal (ORG rising edge) before encountering the limit signal.

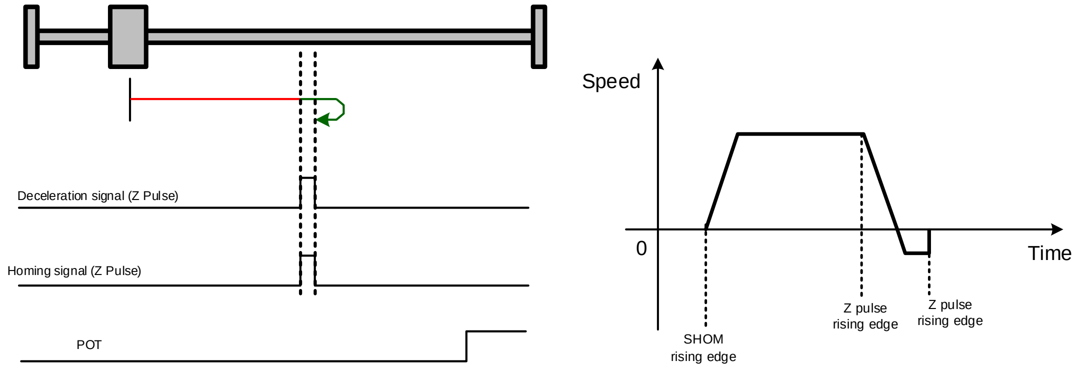


Hit the limit signal before encountering deceleration signal (ORG rising edge).

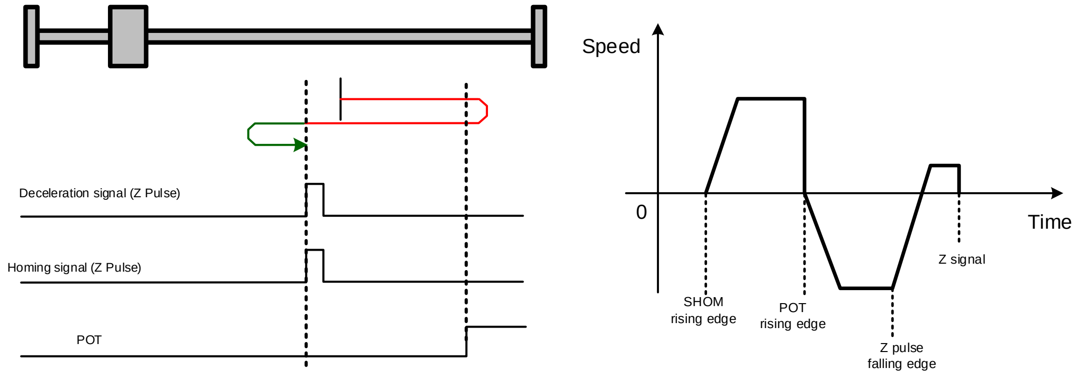


Homing modes 5 and 6, using origin as motor's Z signal

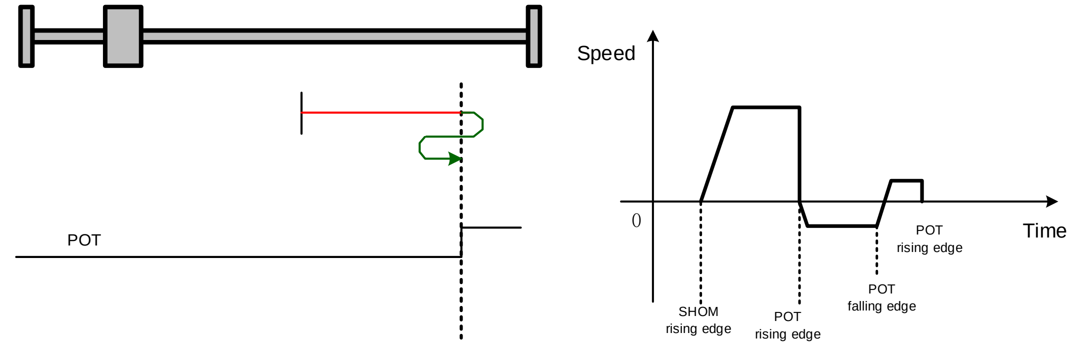
Hit the deceleration signal (Z signal rising edge) before encountering the limit signal.



Hit the limit signal before encountering deceleration signal (Z signal rising edge).

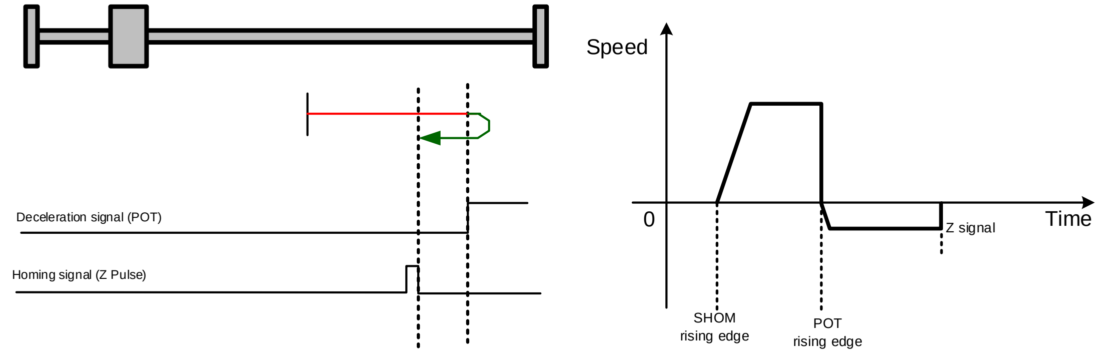


Homing modes 7 and 8, using deceleration point and origin as overtravel switch



Homing modes 9 and 0, using deceleration point as overtravel switch, and origin as motor’s Z signal

Homing finding point does not return when hitting the falling edge of OT.



5.17 Other Output Signals

5.17.1 Alarm Output Signal (/ALM)

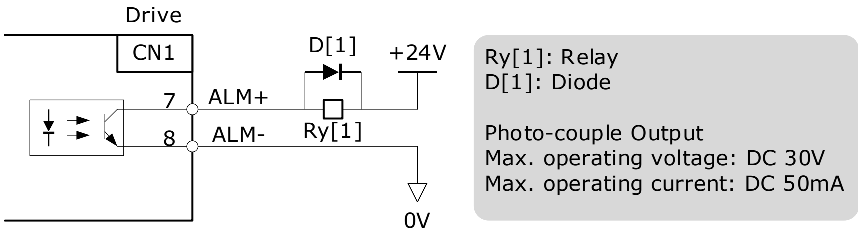
The servo drive outputs an alarm output signal (/ALM) when it detects an alarm.

Connection of Alarm Output Signal

IMPORTANT

The external circuit formed by /ALM must satisfy following conditions: the main circuit power supply of the servo drive is turned OFF through the signal output.

The following diagram shows the right way to connect the Alarm Output Signal:



An external +24V I/O power supply is required.

Type	Signal Name	Connector Pin Number	Signal State	Meaning
Output	/ALM	CN1-7, 8	ON	Servo drive is operating normally.
			OFF	Servo drive is in alarm status

Ways to Reset Alarm

When “servo alarm (ALM)” happens, always remove alarm reasons first, and then turn the input signal "/ALM-RST" to ON position to reset alarm status.

Type	Signal Name	Connector Pin Number	Meaning
Input	ALM-RST	CN1-39	Alarm resets

IMPORTANT

Be sure to check the cause of the alarm before alarm reset.
For the alarm troubleshooting, refer to "10.2 Troubleshooting".

NOTE

- Some alarms may not be reset by the ALM-RST signal. In this case, reset after cutting off the control power.
- User may also try to reset the current alarm by pressing the [◄] key on the operation panel.

5.17.2 Rotation Detection Output Signal (/TGON)

/TGON is output when the motor is currently operating above the setting set in parameter Pn503.

Signal Specification

Type	Signal Name	Connector Pin Number	Signal State	Meaning
Output	/TGON	CN1-5, 6	ON	Motor is running at a speed above the value set in Pn503.
			OFF	Motor is running at a speed lower than the value set in Pn503.

Related Parameters

Number	Name	Range	Unit	Default	When Enabled
Pn503	Detection Speed	0 to 3000	rpm	20	Immediately

5.17.3 Servo Ready (/S-RDY) Output Signal

The servo drive outputs the servo READY signal (/S-RDY) after receiving servo ON (S-ON) signal. The signal is output under the following conditions:

- The main circuit power supply is ON.
- No alarm occurs.

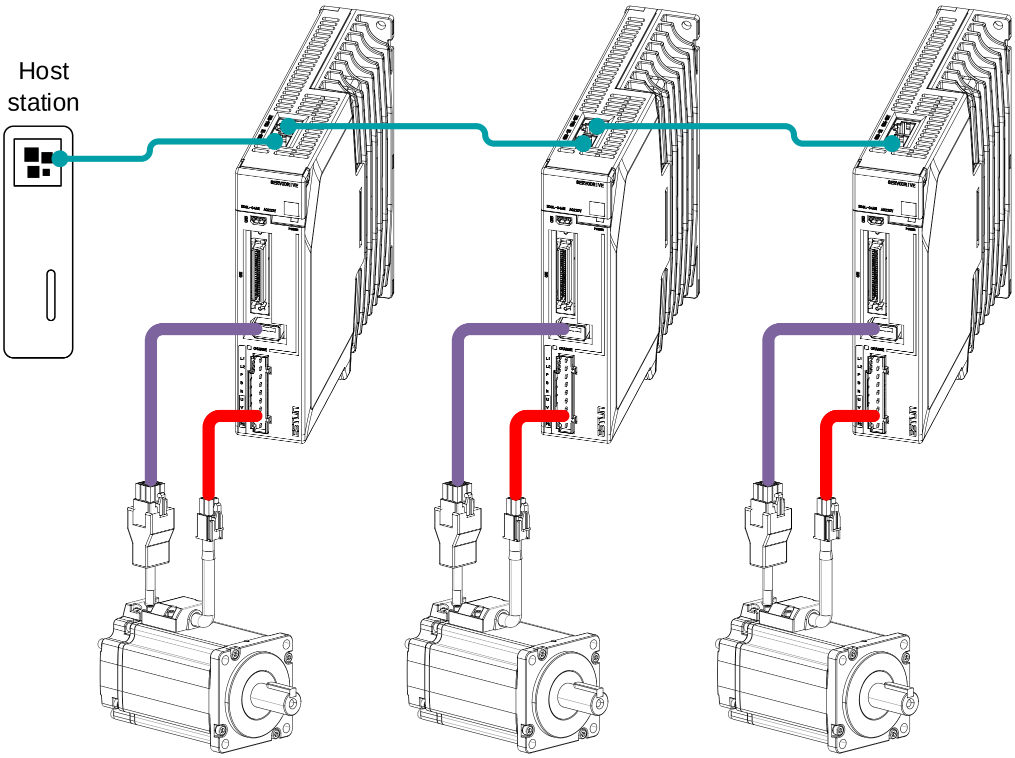
The specification of signal is as follows:

Type	Signal Name	Connector Pin Number	Signal State	Meaning
Output	/S-RDY	CN1-9, 10	ON	Status of the servo ON (S-ON) signal can be received.
			OFF	Status of the servo ON (S-ON) signal cannot be received.

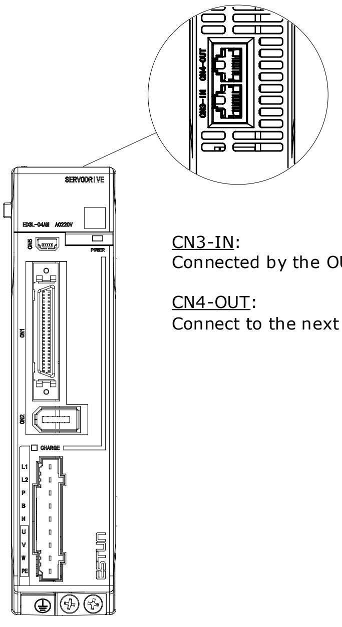
Chapter 6 CANopen Communication

6.1 Wiring and Connection

Connection diagram



Terminal arrangement

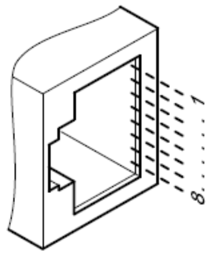


CN3-IN:
Connected by the OUT of the previous drive or controller.

CN4-OUT:
Connect to the next Drive's IN or not connect.

Signal Definition

The external communication connection terminals (CN3-IN and CN4-OUT) are of RJ45 connectors. The interface line as the master or controller is connected from CN3-IN, and CN4-OUT is connected to the CN3-IN terminal of next drive (slave).

Connector	Pin	Definition	Description
	1	–	Reserved
	2	–	
	3	RS485+	RS-485 communication terminal +
	4	GNDW	Signal GND
	5	GNDW	
	6	RS485-	RS-485 communication terminal -
	7	CANH	CAN communication terminal
	8	CANL	
	Housing	FG	Shielded wire is connected to the housing

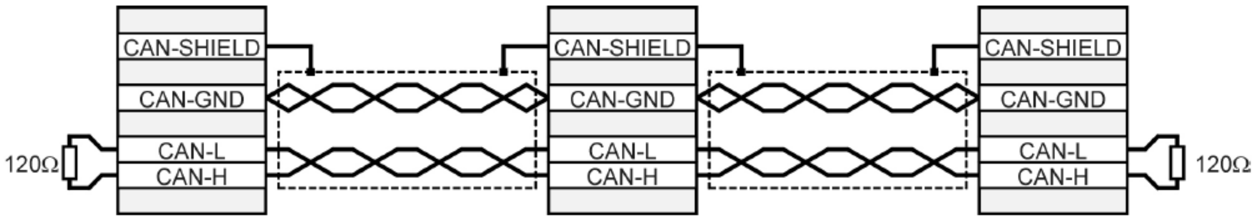
NOTE
- The signal definitions of CN3-IN and CN4-OUT are the same.

Wiring Instructions

When wiring the CANopen communication, following precarious shall be taken.

- Do not short connect pin 1 and pin 2.
- Use UTPs (at least 2 pairs) with shielding layer.
  One pair of UTPs is connected to CANL and CANH; the other is connected to ISO_GND.
- The shielding layer is generally grounded reliably at a single point.
- To prevent signal reflection, it is recommended to connect two 120Ω (1%, 1/4W) terminal matched resistors at both ends of the bus.
- It is recommended that the CAN bus networking node is ≤16.

The wiring diagram is shown below.



6.2 CANopen Overview

6.2.1 CAN Identifier List

Object	COB-ID bit10tobit7	COB-ID (Hexadecimal)	**Index in OD**
NMT	0000	000_h	–
SYNC	0001	080_h	1005_h, 1006_h, 1007_h
TIME STAMP	0010	100_h	1012_h, 1013_h
EMCY	0001	081_h **to** $0FF_h$	1024_h, 1015_h
PDO1 (transmit)	0011	181_h **to** $1FF_h$	1800_h
PDO1 (receive)	0100	201_h **to** $27F_h$	1400_h
PDO2 (transmit)	0101	281_h **to** $2FF_h$	1801_h
PDO2 (receive)	0110	301_h **to** $37F_h$	1401_h
PDO3 (transmit)	0111	381_h **to** $3FF_h$	1802_h
PDO3 (receive)	1000	401_h **to** $47F_h$	1402_h
PDO4 (transmit)	1001	481_h **to** $4FF_h$	1803_h
PDO4 (receive)	1010	501_h **to** $57F_h$	1403_h
SDO (transmit)	1011	581_h **to** $5FF_h$	1200_h
SDO (receive)	1100	601_h **to** $67F_h$	1200_h
Heartbeat	1110	701_h **to** $77F_h$	1016_h, 1017_h

6.2.2 Service Data Objects (SDO)

SDO is used to visit the object dictionary of a device. Visitor is called client. The CANopen device whose object dictionary is visited and required to supply the asked service is called server. CANopen messages from a client and servo all contain 8 bits (not all of them are meaningful). A request from a client must be confirmed by a server.

There are 2 methods of transferring SDO:

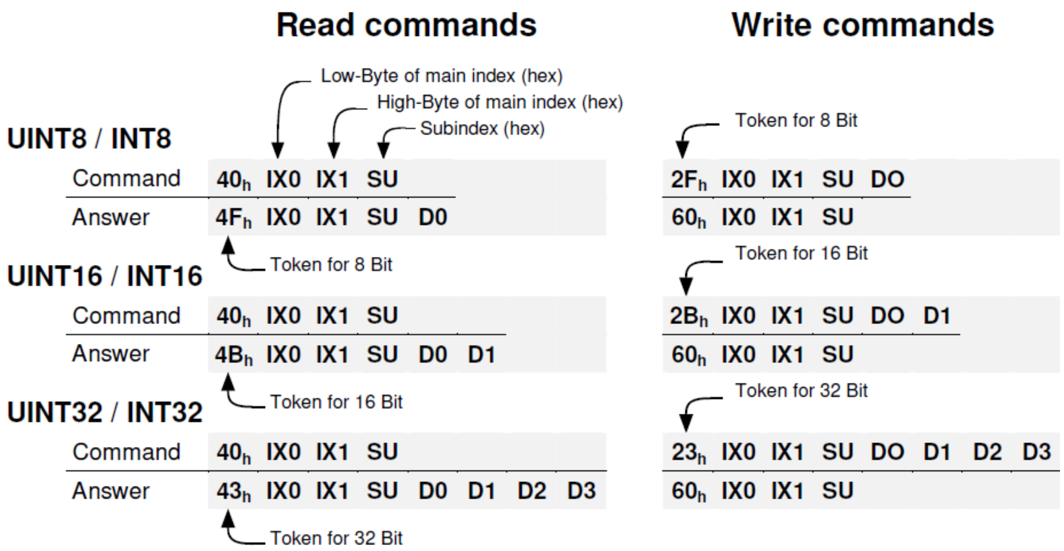
- Expedited transfer: contains 4 bytes at maximum
- Segmented transfer: contains more than 4 bytes

Basic structure of SDO:

Byte0	Byte1 to Byte2	Byte3	Byte4 to Byte7
SDO	Object index	Object sub-index	Data

SDO read/write structure:

SDO message format for parameter read/write operation:



For example:

UINT8 / INT8

	Reading of Obj. 6061_00_h Returning data: 01_h	Writing of Obj. 1401_02_h Data: EF_h
Command:	40_h 61_h 60_h 00_h	$2F_h$ 01_h 14_h 02_h EF_h
Answer:	$4F_h$ 61_h 60_h 00_h 01_h	60_h 01_h 14_h 02_h

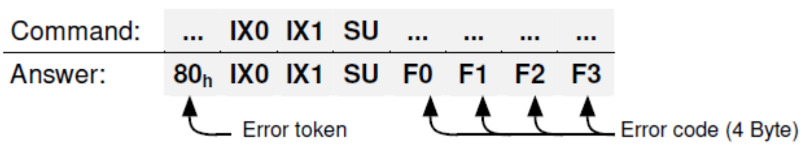
UINT16 / INT16

	Reading of Obj. 6041_00_h Returning data: 1234_h	Writing of Obj. 6040_00_h Data: $03E8_h$
Command:	40_h 41_h 60_h 00_h	$2B_h$ 40_h 60_h 00_h $E8_h$ 03_h
Answer:	$4B_h$ 41_h 60_h 00_h 34_h 12_h	60_h 40_h 60_h 00_h

UINT32 / INT32

	Reading of Obj. 6093_01_h Returning data: 12345678_h	Writing of Obj. 6093_01_h Data: 12345678_h
Command:	40_h 93_h 60_h 01_h	23_h 93_h 60_h 01_h 78_h 56_h 34_h 12_h
Answer:	43_h 93_h 60_h 01_h 78_h 56_h 34_h 12_h	60_h 93_h 60_h 01_h

Format of SDO read/write error message:



Error code is defined as follows:

Error code F3 F2 F1 F0	Description
05 03 00 00_h	Toggle bit not alternated
05 04 00 01_h	Client / server command specifier not valid or unknown
06 01 00 00_h	Unsupported access to an object
06 01 00 01_h	Attempt to read a write only object
06 01 00 02_h	Attempt to write a read only object
06 02 00 00_h	Object does not exist in the object dictionary
06 04 00 41_h	Object cannot be mapped to the PDO
06 04 00 42_h	The number and length of the objects to be mapped would exceed PDO length
06 04 00 47_h	General internal incompatibility in the device
06 07 00 10_h	Data type does not match, length of service parameter does not match
06 07 00 12_h	Data type does not match, length of service parameter too high
06 07 00 13_h	Data type does not match, length of service parameter too low
06 09 00 11_h	Sub-index does not exist
06 04 00 43_h	General parameter incompatibility
06 06 00 00_h	Access failed due to an hardware error *1)
06 09 00 30_h	Value range of parameter exceeded
06 09 00 31_h	Value of parameter written too high
06 09 00 32_h	Value of parameter written too low
06 09 00 36_h	Maximum value is less than minimum value
08 00 00 20_h	Data cannot be transferred or stored to the application *1)
08 00 00 21_h	Data cannot be transferred or stored to the application because of local control
08 00 00 22_h	Data cannot be transferred or stored to the application because of the present device state *3)
08 00 00 23_h	No Object Dictionary is present *2)

6.2.3 Process Data Objects (PDO)

PDO is applied to transferring real time data which will be conveyed from a producer to one or multiple clients. Data transferring will be limited to 1 to 8 bytes. There is no hand-shake restriction in PDO communication, which means data has been redefined, so clients could process the received data for vary short time. PDO content will be only defined by its CAN ID, assuming producers and clients know PDO content from its CAN ID.

2 objects in object dictionary are used for each PDO.

- PDO communication parameter: It contains COB-ID, transferring type, restriction time and cycle of timer used by PDO.
- PDO mapping parameter: It contains a list of objects in the object dictionary. These objects are mapped into PDO, includes their data length in bits. Producers and clients must know this mapping to explain the content of PDO.

The content of PDO's message is predefined or configured when the network initializes. Mapping application object into PDO is described in object dictionary. If a device (producer and client) support dynamic mapping, SDO could be used to configure PDO's mapping parameter. Our servo drive supports dynamic PDO mapping. There are 2 rules for PDO mapping to follow:

- Each PDO could be mapped into 4 objects.
- The length of each PDO will be no more than 64 bits.

<u>PDO mapping process</u>

1. Set the sub-index of PDO coordinated mapping parameter (e.g. 1600_h or $1A00_h$) as o.

2. Revise the sub-index from 1 to 4 of PDO coordinated mapping parameter (e.g. 1600_h or $1A00_h$).
3. Set the sub-index 0 of PDO coordinated mapping parameter (e.g. 1600_h or $1A00_h$) as legal Number (number of PDO's mapping objects)
4. PDO mapping completed.

Ways to transmit PDO

- Synchronous (synchronization by receiving SYNC object)

  Cycle: Transmission triggered after every 1 to 240 SYNC messages.
- Asynchronous

  Transmission triggered by special object event regulated in sub-object protocol.

Definition of transmission type of PDO

Transmission Type	Description	PDO Type
0	Reserved	–
1 to 240	Synchronous: It represents the number of SYNC objects between 2 PDOs.	TPDO/RPDO
240 to 253	Reserved	
254	Asynchronous: If the content of PDO has changed, PDO transmission will be triggered.	TPDO
255	Asynchronous: The content of PDO will be periodically updated and transmitted.	TPDO/RPDO

One PDO could set a frozen time which is the shortest interval time between 2 continuous PDO. It could prevent the bus from being occupied by amount of data with high priority. Frozen time is defined by 16 bit unsigned integer number and its unit is 100us

One PDO could set a timing period. When the regulated time is violated, a PDO transmit could be triggered without a trigger bit. Object timing period is defined as 16 bit unsigned integer and its unit is 1ms.

PDO mapping example

Map the 3 objects to PDO1 (transmit). PDO1 (transmit) is required to be asynchronous periodic type with period time as much as 10ms and frozen time as much as 2ms.

Object	Index — Sub-index	Description
statusword	6041_h - 00_h	Status word
modes_of_operation_display	6061_h - 00_h	Practical operational mode
Position_Actual_Value	6064_h - 00_h	Practical position

Step 1 Clear number_of_mapped_objects

number_of_mapped_objects(1A00 h: 00 h)= 0

Step 2 Set the parameter for mapping objects

Index $=6041_h$ Subin. = 00h Length = 10_h ⇒ 1st_mapped_object($1A00_h$: 01_h)= 60410010_h
Index $=6061_h$ Subin. = 00h Length = 08_h ⇒ 2st_mapped_object($1A00_h$: 02_h)= 60610008_h
Index $=60FD_h$ Subin. = 00h Length = 20_h ⇒ 3st_mapped_object($1A00_h$: 03_h) = $60FD0020_h$

Step 3 Set number_of_mapped_objects

number_of_mapped_objects(1A00 h: 00 h)= 3

Step 4 Set PDO communication parameter

PDO1 (transmit) is asynchronous periodical type ⇒ transmit_type (1800 h: 02 h)= FF h
Frozen time 2ms(20×100us) ⇒ inhibit_time (1800 h: 03 h)= 14 h
Period time 10ms(10×1ms) ⇒ event_time (1800 h: 05 h)= 0A h

Step 5 PDO mapping completed.

PDO Parameters

Drive contains 4 transmit PDOs and 4 receive PDOs. The detailed communication parameter and mapping parameter of the first transmit/receive PDO is as below and those of the rest 3 transmit/receive PDO are the same as the first PDO.

Index	1800 h
Name	transmit_pdo_parameter_tpdo1
Object Code	RECORD
No. of Elements	4

Sub-Index	01 h
Description	cob_id_used_by_pdo_tpdo1
Data Type	UINT32
Access	RW
PDO Mapping	NO
Units	——
Value Range	181 h...1FF h, Bit 31 may be set
Default Value	181 h

Sub-Index	02 h
Description	transmission_type_tpdo1
Data Type	UINT8
Access	RW
PDO Mapping	NO
Units	——
Value Range	1...240,254,255
Default Value	255

Sub-Index	03 h
Description	inhibit_time_tpdo1
Data Type	UINT16
Access	RW
PDO Mapping	NO
Units	100µs
Value Range	——
Default Value	100

Sub-Index	05 $_h$
Description	event_time_tpdo1
Data Type	UINT16
Access	RW
PDO Mapping	NO
Units	1ms
Value Range	——
Default Value	10

Index	1A00 $_h$
Name	transmit_pdo_mapping_tpdo1
Object Code	RECORD
No. of Elements	2

Sub-Index	00 $_h$
Description	number_of_mapped_objects_tpdo1
Data Type	UINT8
Access	RW
PDO Mapping	NO
Units	——
Value Range	0...4
Default Value	2

Sub-Index	01 $_h$
Description	first_mapped_object_tpdo1
Data Type	UINT32
Access	RW
PDO Mapping	NO
Units	——
Value Range	——
Default Value	见表

Sub-Index	02 $_h$
Description	second_mapped_object_tpdo1
Data Type	UINT32
Access	RW
PDO Mapping	NO
Units	——
Value Range	——
Default Value	见表

Sub-Index	03_h
Description	third_mapped_object_tpdo1
Data Type	UINT32
Access	RW
PDO Mapping	NO
Units	——
Value Range	——
Default Value	见表

Sub-Index	04_h
Description	fourth_mapped_object_tpdo1
Data Type	UINT32
Access	RW
PDO Mapping	NO
Units	——
Value Range	——
Default Value	见表

T-PDO1

Index	Comment	Type	Acc.	Default Value
1800_h _00_h	number of entries	UINT8	RO	04_h
1800_h _01_h	COB-ID used by PDO	UINT32	RW	00000181_h
1800_h _02_h	transmission type	UINT8	RW	FF_h
1800_h _03_h	inhibit time (100 μs)	UINT16	RW	64_h
1800_h _05_h	event time (1ms)	UINT16	RW	$0A_h$
$1A00_h$ _00_h	number of mapped objects	UINT8	RW	02_h
$1A00_h$ _01_h	first mapped object	UINT32	RW	60410010_h
$1A00_h$ _02_h	second mapped object	UINT32	RW	60640020_h
$1A00_h$ _03_h	third mapped object	UINT32	RW	00_h
$1A00_h$ _04_h	fourth mapped object	UINT32	RW	00_h

T-PDO2

Index	Comment	Type	Acc.	Default Value
1801_h _00_h	number of entries	UINT8	RO	04_h
1801_h _01_h	COB-ID used by PDO	UINT32	RW	00000281_h
1801_h _02_h	transmission type	UINT8	RW	FF_h
1801_h _03_h	inhibit time (100 μs)	UINT16	RW	64_h

Index	Comment	Type	Acc.	Default Value
1801 h _05 h	event time (1ms)	UINT16	RW	0A h
1A01 h _00 h	number of mapped objects	UINT8	RW	02 h
1A01 h _01 h	first mapped object	UINT32	RW	60640020 h
1A01 h _02 h	second mapped object	UINT32	RW	60610010 h
1A01 h _03 h	third mapped object	UINT32	RW	00 h
1A01 h _04 h	fourth mapped object	UINT32	RW	00 h

T-PDO3

Index	Comment	Type	Acc.	Default Value
1802 h _00 h	number of entries	UINT8	RO	04 h
1802 h _01 h	COB-ID used by PDO	UINT32	RW	00000381 h
1802 h _02 h	transmission type	UINT8	RW	FF h
1802 h _03 h	inhibit time (100 μs)	UINT16	RW	64 h
1802 h _05 h	event time (1ms)	UINT16	RW	0A h
1A02 h _00 h	number of mapped objects	UINT8	RW	00 h
1A02 h _01 h	first mapped object	UINT32	RW	0 h
1A02 h _02 h	second mapped object	UINT32	RW	0 h
1A02 h _03 h	third mapped object	UINT32	RW	00 h
1A02 h _04 h	fourth mapped object	UINT32	RW	00 h

T-PDO4

Index	Comment	Type	Acc.	Default Value
1803 h _00 h	number of entries	UINT8	RO	04 h
1803 h _01 h	COB-ID used by PDO	UINT32	RW	00000481 h
1803 h _02 h	transmission type	UINT8	RW	FF h
1803 h _03 h	inhibit time (100 μs)	UINT16	RW	64 h
1803 h _05 h	event time (1ms)	UINT16	RW	0A h
1A03 h _00 h	number of mapped objects	UINT8	RW	00 h
1A03 h _01 h	first mapped object	UINT32	RW	0 h
1A03 h _02 h	second mapped object	UINT32	RW	0 h
1A03 h _03 h	third mapped object	UINT32	RW	00 h
1A03 h _04 h	fourth mapped object	UINT32	RW	00 h

If **transmit type is 254** (if PDO content has changed, such PDO is triggered to send), use of the following object can shield parts of PDO changers. Only when the un-shield bit has changed, PDO occurs. If wants shielding any bit, the corresponding bit of object write to 0.

tpdo_1_transmit_mask

Index	Comment	Type	Acc.	Default Value
2000 $_h$ _00 $_h$	number of entries	UINT8	RO	02 $_h$
2000 $_h$ _01 $_h$	tpdo_1_transmit_mask_low	UINT32	RW	FFFFFFFF $_h$
2000 $_h$ _02 $_h$	tpdo_1_transmit_mask_high	UINT32	RW	FFFFFFFF $_h$

tpdo_2_transmit_mask

Index	Comment	Type	Acc.	Default Value
2001 $_h$ _00 $_h$	number of entries	UINT8	RO	02 $_h$
2001 $_h$ _01 $_h$	tpdo_2_transmit_mask_low	UINT32	RW	FFFFFFFF $_h$
2001 $_h$ _02 $_h$	tpdo_2_transmit_mask_high	UINT32	RW	FFFFFFFF $_h$

tpdo_3_transmit_mask

Index	Comment	Type	Acc.	Default Value
2002 $_h$ _00 $_h$	number of entries	UINT8	RO	02 $_h$
2002 $_h$ _01 $_h$	tpdo_1_transmit_mask_low	UINT32	RW	FFFFFFFF $_h$
2002 $_h$ _02 $_h$	tpdo_1_transmit_mask_high	UINT32	RW	FFFFFFFF $_h$

tpdo_4_transmit_mask

Index	Comment	Type	Acc.	Default Value
2003 $_h$ _00 $_h$	number of entries	UINT8	RO	02 $_h$
2003 $_h$ _01 $_h$	tpdo_2_transmit_mask_low	UINT32	RW	FFFFFFFF $_h$
2003 $_h$ _02 $_h$	tpdo_2_transmit_mask_high	UINT32	RW	FFFFFFFF $_h$

R-PDO1

Index	Comment	Type	Acc.	Default Value
1400 $_h$ _00 $_h$	number of entries	UINT8	RO	02 $_h$
1400 $_h$ _01 $_h$	COB-ID used by PDO	UINT32	RW	00000201 $_h$
1400 $_h$ _02 $_h$	transmission type	UINT8	RW	FF $_h$
1600 $_h$ _00 $_h$	number of mapped objects	UINT8	RW	02 $_h$
1600 $_h$ _01 $_h$	first mapped object	UINT32	RW	60400010 $_h$
1600 $_h$ _02 $_h$	second mapped object	UINT32	RW	60FF0020 $_h$
1600 $_h$ _03 $_h$	third mapped object	UINT32	RW	00 $_h$
1600 $_h$ _04 $_h$	fourth mapped object	UINT32	RW	00 $_h$

R-PDO2

Index	Comment	Type	Acc.	Default Value
1401 h _00 h	number of entries	UINT8	RO	02 h
1401 h _01 h	COB-ID used by PDO	UINT32	RW	00000301 h
1401 h _02 h	transmission type	UINT8	RW	FF h
1601 h _00 h	number of mapped objects	UINT8	RW	02 h
1601 h _01 h	first mapped object	UINT32	RW	60FF0020 h
1601 h _02 h	second mapped object	UINT32	RW	60600010 h
1601 h _03 h	third mapped object	UINT32	RW	00 h
1601 h _04 h	fourth mapped object	UINT32	RW	00 h

R-PDO3

Index	Comment	Type	Acc.	Default Value
1402 h _00 h	number of entries	UINT8	RO	02 h
1402 h _01 h	COB-ID used by PDO	UINT32	RW	00000401 h
1402 h _02 h	transmission type	UINT8	RW	FF h
1602 h _00 h	number of mapped objects	UINT8	RW	00 h
1602 h _01 h	first mapped object	UINT32	RW	0 h
1602 h _02 h	second mapped object	UINT32	RW	0 h
1602 h _03 h	third mapped object	UINT32	RW	00 h
1602 h _04 h	fourth mapped object	UINT32	RW	00 h

R-PDO4

Index	Comment	Type	Acc.	Default Value
1403 h _00 h	number of entries	UINT8	RO	02 h
1403 h _01 h	COB-ID used by PDO	UINT32	RW	00000501 h
1403 h _02 h	transmission type	UINT8	RW	FF h
1603 h _00 h	number of mapped objects	UINT8	RW	00 h
1603 h _01 h	first mapped object	UINT32	RW	0 h
1603 h _02 h	second mapped object	UINT32	RW	0 h
1603 h _03 h	third mapped object	UINT32	RW	00 h
1603 h _04 h	fourth mapped object	UINT32	RW	00 h

6.2.4 SYNC Message

Synchronization object is used for controlling data synchronize transmit. For example, starting synchronously several axes. The transmission of synchronous message is based on Producer-Customer model. All the nodes of synchronous PDO can receive (at the same time) the message as customer and synchronize other node.

The general mode is that the SYNC master node sends the SYNC object regularly, and the SYNC slave node executes the task synchronously upon receiving it.

CANopen suggests a COB-ID with highest priority to ensure that synchronized signal could be transmitted properly. Without transferring data, SYNC message could be as short as possible.

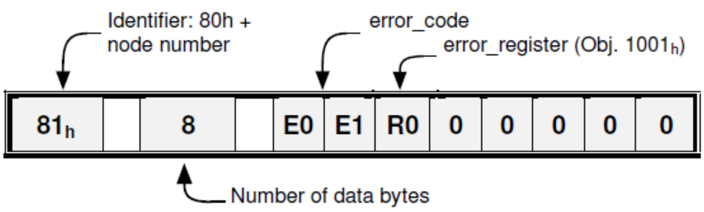
The COB-ID of the SYNC message is fixed at 080_h, and the COB-ID can be read from 1005_h in the object dictionary.

Index	1005_h
Name	cob_id_sync
Object Code	VAR
Data Type	UINT32
Access	RW
PDO Mapping	NO
Units	——
Value Range	80000080_h, 00000080_h
Default Value	00000080_h

6.2.5 Emergency Message

When an alarm occurs to drive, CANopen will initiate an Emergency message to inform the current drive type and error code to clients. Error code displayed on panel can be read on low byte of 603Fh object.

Structure of Emergency Message:



Error Code (Hex)	Description
2310	Over current
3100	Instantaneous power failure
3110	Over voltage
3120	Under voltage
5080	RAM exception
5210	AD sampling error
5420	Regenerative resistor error
5421	Regenerative resistor exception
5581	Parameter checksum exception
5582	Electric gear error
5583	Motor type or drive type error
6100	Illegal error code

Error Code (Hex)	Description
6120	PDO mapping error
6300	CAN communication error(Address or communication baud rate error)
7303	serial encoder error
7305	Incremental encoder error
7380	Resolver error
8100	CAN communication exception
8110	CAN bus overflow
8120	PASSIVE CAN bus turn to PASSIVE
8130	Heartbeat error
8140	CAN BUS OFF
8200	Length of CAN messages error
8210	Length of receiving PDO error
8311	Overload alarm
8480	Over speed alarm

Related Parameters

Index	1003 h
Name	pre_defined_error_field
Object Code	ARRAY
No. of Elements	4
Data Type	UINT32

Sub-Index	01 h
Description	standard_error_field_0
Access	RO
PDO Mapping	NO
Units	——
Value Range	——
Default Value	——

Sub-Index	02 h
Description	standard_error_field_1
Access	RO

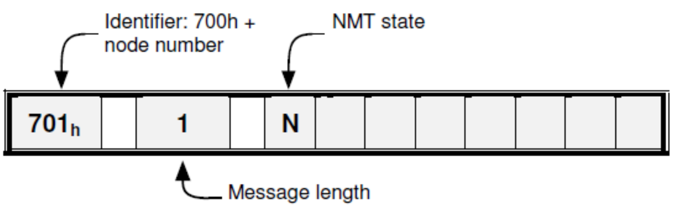
PDO Mapping	NO
Units	——
Value Range	——
Default Value	——

Sub-Index	03_h
Description	standard_error_field_2
Access	RO
PDO Mapping	NO
Units	——
Value Range	——
Default Value	——

Sub-Index	04_h
Description	standard_error_field_3
Access	RO
PDO Mapping	NO
Units	——
Value Range	——
Default Value	——

6.2.6 HEARTBEAT Message

Structure of Heartbeat Message



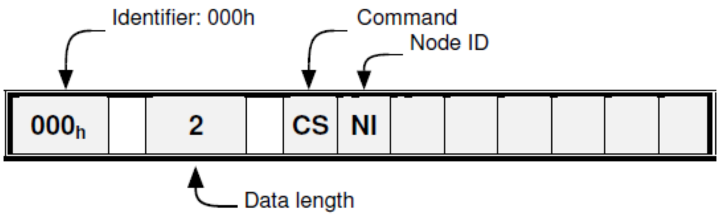
Related Parameters

Index	1017_h
Name	producer_heartbeat_time
Object Code	VAR
Data Type	UINT16

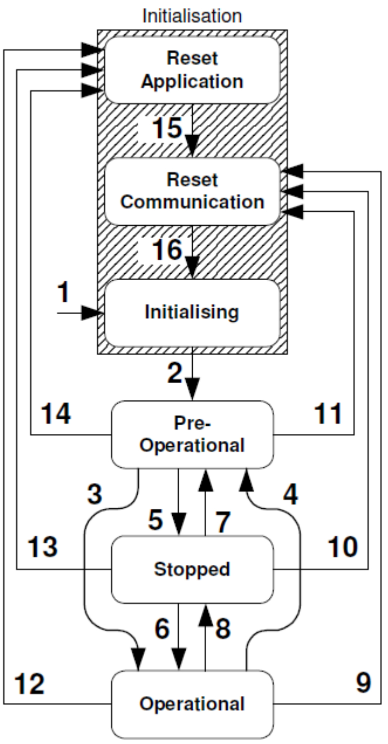
Access	RW
PDO Mapping	NO
Units	ms
Value Range	0 - 65535
Default Value	1000

6.2.7 Network management (NMT service)

Structure of Message



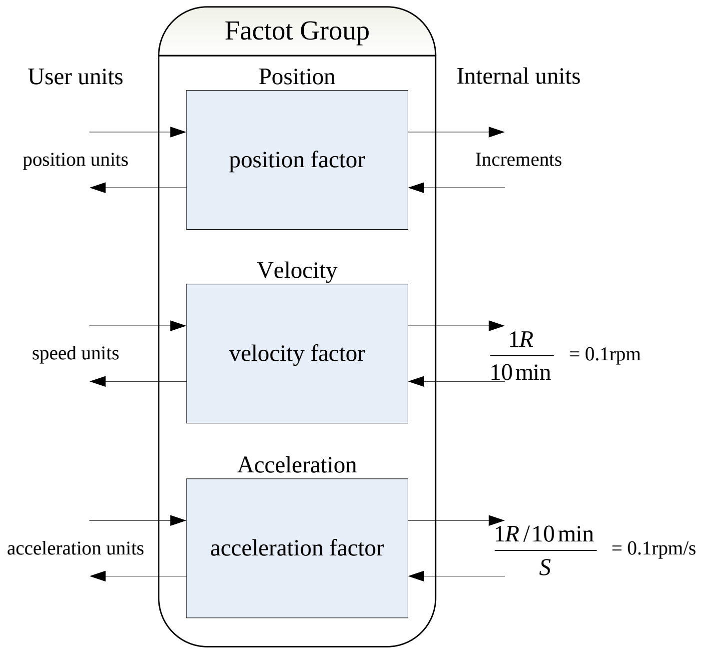
NMT state transition diagram



CS	Meaning	Transition	Target state
01_h	Start Remote Node	3, 6	**Operational**
02_h	Stop Remote Node	5, 8	**Stopped**
80_h	Enter Pre-Operational	4, 7	**Pre-Operational**
81_h	Reset Application	12, 13, 14	**Reset Application**
82_h	Reset Communication	9, 10, 11	**Reset Communication**

Name	Meaning	SDO	PDO	NMT
Reset Application	No communication. All CAN objects are set to their reset values (application parameter set).	-	-	-
Reset Communication	No communication. The CAN controller will be re-initialised.	-	-	-
Initialising	State after Hardware Reset. Reset of the CAN node, sending of the Bootup message	-	-	-
Pre-Operational	Communication via SDOs possible. PDOs inactive (No sending / receiving)	X	-	X
Operational	Communication via SDOs possible. PDOs active (sending / receiving)	X	X	X
Stopped	No communication except heartbeat + NMT	-	-	X

6.3 Unit Conversion



Default user unit of the drive:

Object	Name	Unit	Description
Length	Position Units	Increments	Pulse *
Speed	Speed Units	1R /10min	0.1rpm
Acceleration	Acceleration Units	1R/10min/s	0.1rpm/s
Jerk	Jerk Units	pulse/(s*100μs*100μs)	Value ranged from 1 to 20, the smaller the smoother

* 17-bit encoder outputs 131,072 pulses per revolution
20-bit encoder outputs 8,388,608 pulses per revolution

6.3.1 Parameters for Unit Conversion

Index	Object	Name	Type	Attr.
6093 $_h$	ARRAY	position factor	UINT32	RW
6094 $_h$	ARRAY	velocity factor	UINT32	RW

Index	Object	Name	Type	Attr.
6097 h	ARRAY	acceleration factor	UINT32	RW

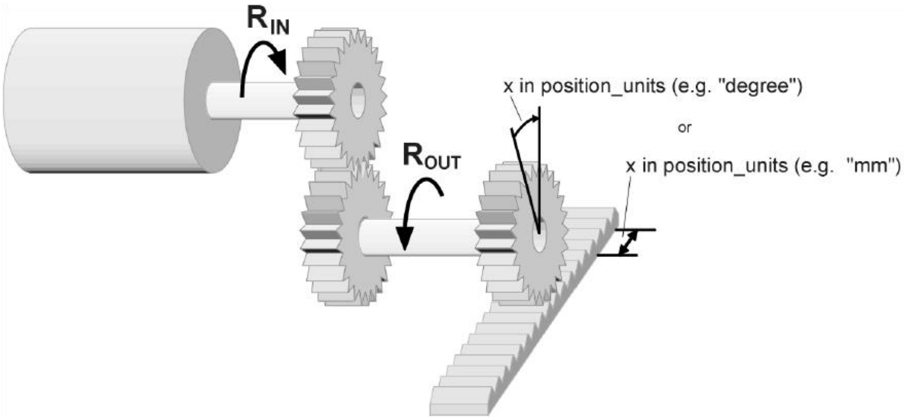
6.3.2 Position factor

Position factor module converts all the measuring units of client into internal unit of servo drive (pulse) and at the same time converts the unit (pulse) of all the output from the drive into the measuring unit of clients (position units). Position factors includes numerator and division.

Index	6093 h
Name	position factor
Object Code	ARRAY
No. of Elements	2
Data Type	UINT32

Sub-Index	01 h
Description	numerator
Access	RW
PDO Mapping	YES
Units	——
Value Range	——
Default Value	Initialized to the value of Pn201 when power on

Sub-Index	02 h
Description	division
Access	RW
PDO Mapping	YES
Units	——
Value Range	——
Default Value	Initialized to the value of Pn202 when power on



For calculating the position factors easily, 2 parameters as below are defined:

- gear_ratio: Reduction ration between the load shaft and the motor shaft. (When motor's revolution is n and load's revolution is m, then gear_ratio = m/n)
- feed_constant: the distance of position units' movement when load shaft rotates for one revolution.

position factor is calculated according to:

$$\textbf{position factor} = \frac{\text{numerator}}{\text{division}} = \frac{\text{gear\_ratio} * \text{encoder\_resolution}}{\text{feed\_constant}}$$

Encoder Type	encoder_resolution (Unit: Inc)
17-bit encoder	131072
20-bit encoder	1048576
23-bit encoder	8388608

6.3.3 Velocity factor

Velocity factor module converts all the speed measuring unit at customer side into drive's internal measuring unit as much as 0.1rpm. And at the same time, it converts the drive's output velocity unit (0.1rpm) into user's velocity units. Velocity factor parameters includes a numerator and a division.

Index	6094 h
Name	velocity factor
Object Code	ARRAY
No. of Elements	2
Data Type	UINT32

Sub-Index	01 h
Description	numerator
Access	RW
PDO Mapping	YES
Units	——
Value Range	——
Default Value	1

Sub-Index	02 h
Description	division
Access	RW
PDO Mapping	YES
Units	——
Value Range	——
Default Value	1

For calculating velocity factor easily, 3 parameters are defined as below:

- time_factor_v: drive's internal time unit and user's time unit. (For example: 1min = 1/10 10min)
- gear_ratio: the reduction ration between the load shaft and the motor shaft. (When motor's revolution is n and load's revolution is m, then gear_ratio = n/m)
- feed_constant: the distance of position units' movement when load shaft rotates for one revolution.

velocity factor is calculated according to:

$$\text{velocity factor} = \frac{\text{numerator}}{\text{division}} = \frac{\text{gear\_ratio} * \text{time\_factor\_v}}{\text{feed\_constant}}$$

6.3.4 Acceleration factor

Acceleration factor module converts all the acceleration units at the perspective of clients into drive's internal unit (0.1rpm) and at the same time converts the output acceleration units (0.1rpm) from the drive into acceleration units at the perspective of clients. Acceleration factor parameters contain numerator and division.

Index	6097 h
Name	acceleration factor
Object Code	ARRAY
No. of Elements	2
Data Type	UINT32

Sub-Index	01 h
Description	numerator
Access	RW
PDO Mapping	YES
Units	——
Value Range	——
Default Value	1

Sub-Index	02 h
Description	division
Access	RW
PDO Mapping	YES
Units	——
Value Range	——
Default Value	1

For calculating velocity factor easily, we could define 3 variables as below:

- time_factor_a: The ratio between drive's internal time square and clients' time square. (For example: 1min2 = 1min*min = 60s*1min =60/10 10min/s)
- gear_ratio: the reduction ration between the load shaft and the motor shaft. (When motor's revolution is n and load' s revolution is m, then gear_ratio = n/m)
- feed_constant: the distance of position units' movement when load shaft rotates for one revolution.

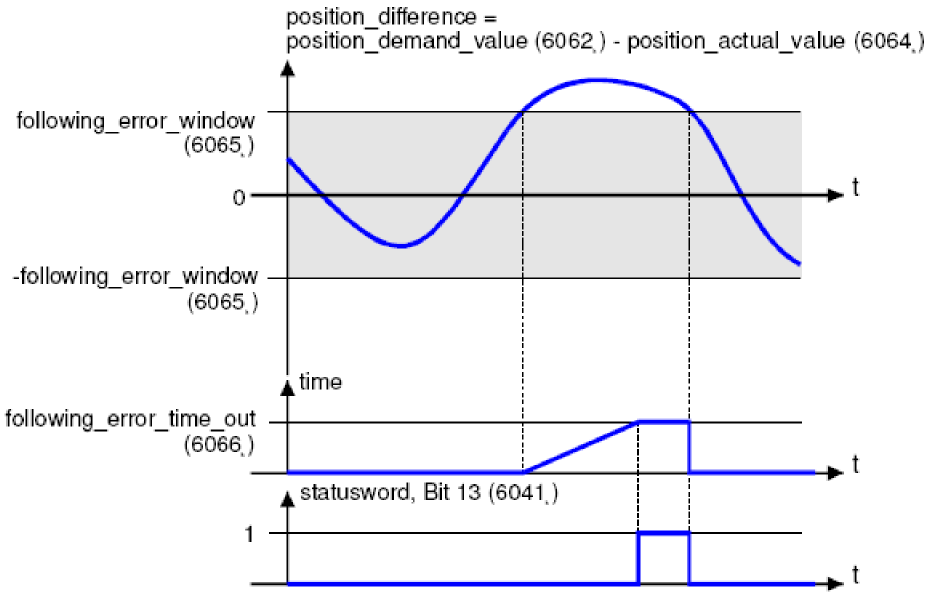
acceleration factor is calculated according to:

$$\text{acceleration factor} = \frac{\text{numerator}}{\text{division}} = \frac{\text{gear\_ratio} * \text{time\_factor\_a}}{\text{feed\_constant}}$$

6.4 Position Control Function

The demanding position (position_demand_value) output from Trajectory unit is the input of drive's position loop. Besides, the actual position(position_actual_value) is measured through the motor's encoder. Position control is influenced by parameter settings. To ensure the stability of the control system, we have to limit the output of postion loop (control_effect). This output becomes the given speed for speed loop. In the Factor group, all the input and output are transformed into the internal measuring unit of the servo drive.

Following Error



The deviation of the actual position value (position_actual_value) from the desired position value (position_demand_value) is named following error. As shown in figure above, if for a certain period of time this following error is bigger than specified in the following error window (following_error_window) bit 13 (following_error) of the object statusword will be set to 1.

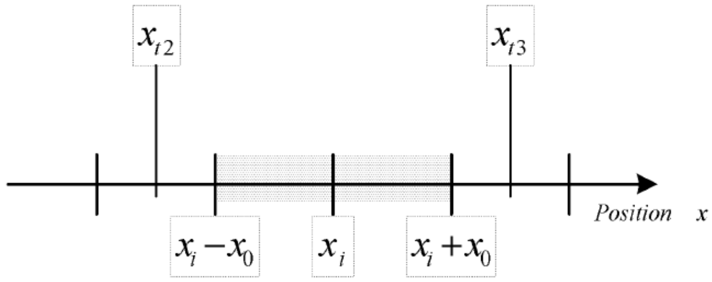
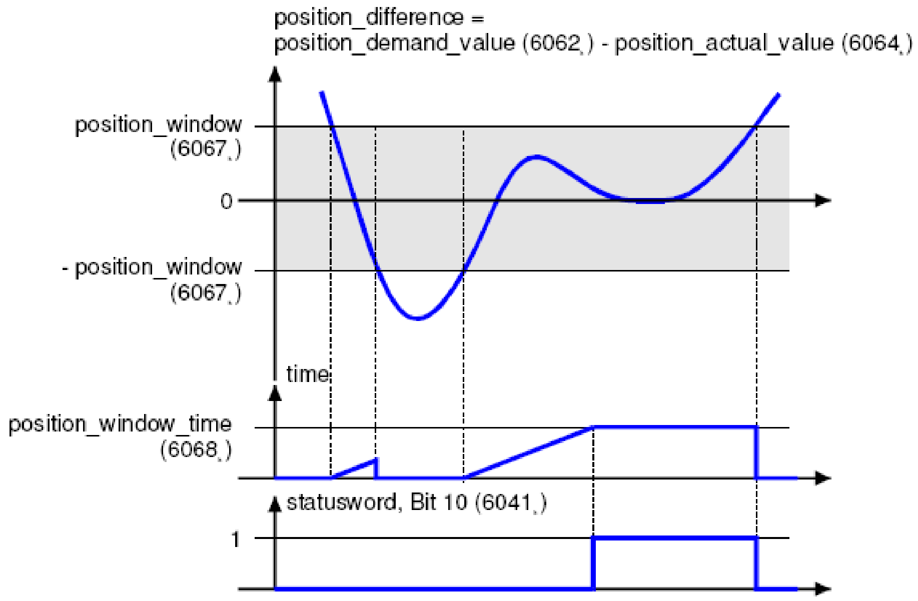


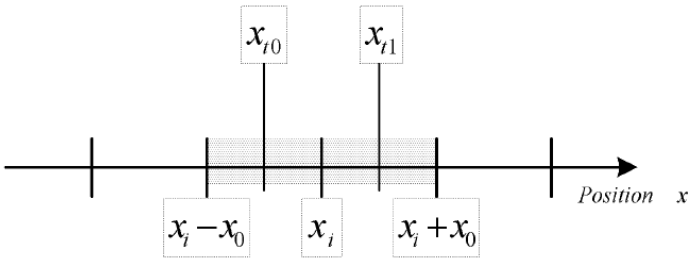
Figure above shows how the window function is defined for the message "following error". The range between xi-x0 and xi+x0 is defined symmetrically around the desired position (position_demand_value) xi. For example the positions x_{t2} and x_{t3} are outside this window (following_error_window). If the drive leaves this window and does not return to the window within the time defined in the object following_error_time_out then bit 13 (following_error) in the statusword will be set to 1.

Position Reached

This function offers the chance to define a position window around the target position (target_position). If the actual position of the drive is within this range for a certain period of time – the position_window_time – bit 10 (target_reached) will be set to 1 in the statusword. As shown in figure below.



The figure below shows the position_windows are symmetrically distributed around the target_position), i.e. the range from xi-x0 to xi + x0. For example, the positionsxt0 and xt1 are in the position windows. If the drive is in the window, a fixed period starts timing. If the fixed period reaches the position_ window_ time and the drive position is always in the window during the time, then bit10 (target_reached) in the statusword_will be set to 1. As soon as the drive position leaves the window, bit10 (target_reached) in the statusword will be cleared to zero immediately.



Related Parameters

Index	Object	Name	Type	Attr.
6062 h	VAR	position_demand_value	INT32	RO
6063 h	VAR	position_actual_value*	INT32	RO
6064 h	VAR	position_actual_value	INT32	RO
6065 h	VAR	following_error_window	UINT32	RW
6066 h	VAR	following_error_time_out	UINT16	RW
6067 h	VAR	position_window	UINT32	RW
6068 h	VAR	position_time	UINT16	RW
60FA h	VAR	control_effort	INT32	RO

Index	6062 $_h$
Name	position_demand_value
Object Code	VAR
Data Type	INT32
Access	RO
PDO Mapping	YES
Units	position units
Value Range	--
Default Value	--

Index	6064 $_h$
Name	position_ actual _value
Object Code	VAR
Data Type	INT32
Access	RO
PDO Mapping	YES
Units	position units
Value Range	--
Default Value	--

Index	6065 $_h$
Name	following_error_window
Object Code	VAR
Data Type	UINT32
Access	RW
PDO Mapping	YES
Units	position units
Value Range	0 - 7FFFFFFF $_h$
Default Value	30000

Index	6066 $_h$
Name	following_error_time_out
Object Code	VAR
Data Type	UINT16
Access	RW

PDO Mapping	YES
Units	ms
Value Range	0 – 65535
Default Value	200

Index	60FA $_h$
Name	control_effort
Object Code	VAR
Data Type	INT32
Access	RO
PDO Mapping	YES
Units	speed units
Value Range	--
Default Value	--

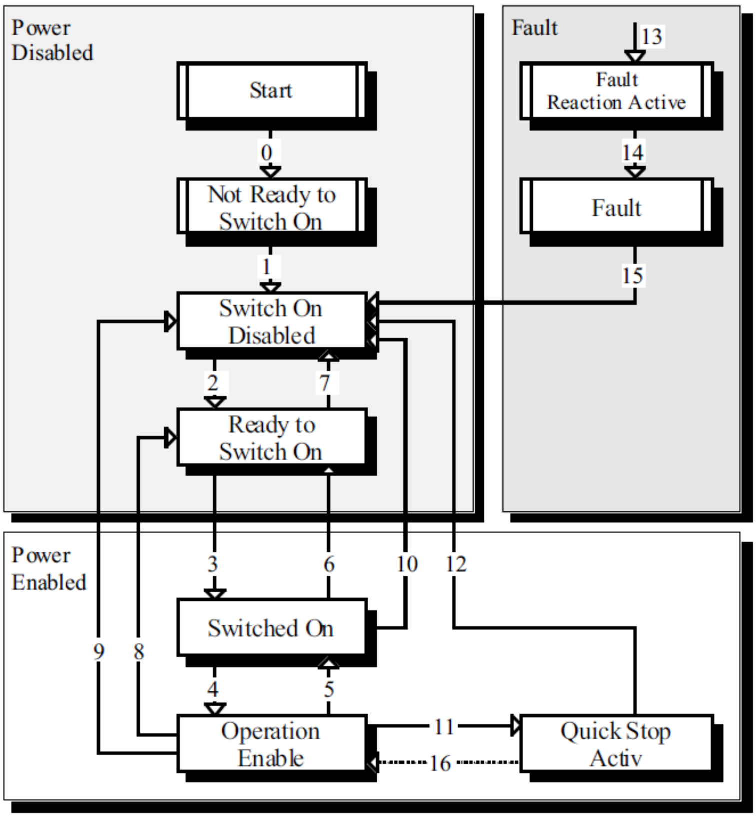
Index	6067 $_h$
Name	position_window
Object Code	VAR
Data Type	UINT32
Access	RW
PDO Mapping	YES
Units	position units
Value Range	--
Default Value	10

Index	6068 $_h$
Name	position_time
Object Code	VAR
Data Type	UINT16
Access	RW
PDO Mapping	YES
Units	ms
Value Range	0 – 65535
Default Value	50

6.5 Device Control

6.5.1 Control State Machine

The master controls the drive through the controlword, and knows the current status of the drive by reading the statusword of the drive.



According to figure above, the state diagram can be divided into three main parts: "Power Disabled" (means the main power supply is switched off), "Power Enabled" (the main power supply is turned on) and “Fault”. All states enter "Fault" after an alarm occurs. After switching on the servo controller initializes itself and enters the state SWITCH_ON_DISABLED. In this state CAN communication is possible and the servo controller can be parameterized (e.g. the working mode of drive can be set to "PP" mode). The main power supply remains switched off and the motor is not excited. Through the state transitions 2, 3 and 4, the state OPERATION_ENABLE will be reached. In this state the main power supply is turned on and the servo controller controls the motor according to the parameterized working mode. Therefore, it must be confirmed that the parameters of the drive have been correctly configured and the corresponding input value is zero before such state. The circuit main power supply will be turned off after state transition 9 is done. Once the driver alarms, the driver enters FAULT.

Status	Description
Not Ready to Switch On	The servo controller executes its self-test. The CAN communication is not working
Switch On Disabled	The self-test has been completed. The CAN communication is activated
Ready to Switch On	Servo driver is waiting for the state of Switch and servo motor is not at main power supply
Switched On	The main power supply is turned on
Operation Enable	The motor is under voltage and is controlled according to working mode
Quick Stop Active	Servo driver will be stopped through its fixed way
Fault Reaction Active	Servo driver tests error and will be stopped through its fixed way, with motor’s main power supply turned on

Status	Description
Fault	An error has occurred. The main power supply has been turned off.

6.5.2 Related Parameters of Device Control

Index	Object	Name	Type	Attr.
6040_h	VAR	controlword	UINT16	RW
6041_h	VAR	statusword	UINT16	RO
$605A_h$	VAR	quick_stop_option_code	INT16	RW
$605B_h$	VAR	shutdown_option_code	INT16	RW
$605C_h$	VAR	disabled_operation_option_code	INT16	RW
$605D_h$	VAR	halt_option_code	INT16	RW
$605E_h$	VAR	fault_reaction_option_code	INT16	RW

6.5.3 Controlword

Index	6040_h
Name	controlword
Object Code	VAR
Data Type	UINT16
Access	RW
PDO Mapping	YES
Units	--
Value Range	--
Default Value	0

15 11	10 9	8	7	6 4	3	2	1	0
manufacturer specific	reserved	halt	Fault reset	Operation mode specific	Enable operation	Quick stop	Enable voltage	Switch on

<u>Bit0to3 and Bit7</u>

The transmission of the state machine is triggered by the control command composed of those 5 bits.

Command	Bit of the *controlword*					Transitions
	Fault reset	Enable operation	Quick stop	Enable voltage	Switch on	
Shutdown	0	X	1	1	0	2,6,8
Switch on	0	0	1	1	1	3*
Switch on	0	1	1	1	1	3**
Disable voltage	0	X	X	0	X	7,9,10,12
Quick stop	0	X	0	1	X	7,10,11
Disable operation	0	0	1	1	1	5
Enable operation	0	1	1	1	1	4,16
Fault reset	↑	X	X	X	X	15

[Note] X means this bit could be ignored.

Bit4, 5, 6 and 8

The definition of this 4 bit is different in different control mode.

Bit	Control mode		
	profile position mode	profile velocity mode	homing mode
4	new_set_point	Reserve	start_homeing_operation
5	change_set_immediately	Reserve	Reserve
6	abs/rel	Reserve	Reserve
8	Halt	Halt	Halt

Other bits

All reserved.

6.5.4 Statusword

Index	6041 h
Name	statusword
Object Code	VAR
Data Type	UINT16
Access	RO
PDO Mapping	YES
Units	--
Value Range	--
Default Value	--

Explanation of statusword bit is as below:

Bit	Description
0	Ready to switch on
1	Switched on

Bit	Description
2	Operation enabled
3	Fault
4	Voltage enabled
5	Quick stop
6	Switch on disabled
7	Warning
8	Reserved
9	Remote
10	Target reached
11	Internal limit active
13 to 12	Operation mode specific
15 to 14	Reserved

Bits 0~3 , Bit 5 and Bit 6

The combination of these bits indicates the status of drives.

Value (binary)	State
xxxx xxxx x0xx 0000	Not ready to switch on
xxxx xxxx x1xx 0000	Switch on disabled
xxxx xxxx x01x 0001	Ready to switch on
xxxx xxxx x01x 0011	Switched on
xxxx xxxx x01x 0111	Operation enabled
xxxx xxxx x00x 0111	Quick stop active
xxxx xxxx x0xx 1111	Fault reaction active
xxxx xxxx x0xx 1000	Fault

Bit 4: Voltage enabled

Main power supply is turned on when this bit is 1.

Bit 5: Quick stop

Driver will halt by following settings (605A h: quick_stop_option_code) when this bit is 0.

Bit 7: Warning

Driver detects alarm when this bit is 1.

Bit 9: Warning

Servo can deal with Controlword when the enabling state of this bit is at 1.

Bit 10: Target reached

In different control modes the meaning of this bit is different.

- In profile position mode, when set position is reached, this bit is set. When Halt is booted, speed is reduced to 0 and this bit will be set. When new position is set, this bit will be cleared.
- In profile Velocity Mode, when the speed reaches the targeted speed, this bit will be set. When Halt is booted and speed is reduced to 0, this bit is set.

Bit 11: Internal limit active

When this bit is 1, it indicates that internal torque has surpassed the set value, or reached the max forward/reverse limit position. It can be confirmed by reading object 60FDh (digital inputs).

Bits 12~13

These 2 bits have different meanings in different control mode.

Bit	Control Mode		
	profile position mode	profile velocity mode	homing mode
12	Set-point acknowledge	Speed	Homing attained
13	Following error	Max slippage error	Homing error

Other bits

All reserved.

6.5.5 Shutdown_option_code

The object shutdown_option_code determines the behavior when the state transition from OPERATION ENABLE to READY TO SWITCH ON is executed.

Index	605B $_h$
Name	shutdown_option_code
Object Code	VAR
Data Type	INT16
Access	RW
PDO Mapping	NO
Units	--
Value Range	0,1
Default Value	0

Value	Description
0	Drive enters OFF state and stops according to Pn003.0 setting
1	After deceleration stops at 6084h, the drive cuts off the power supply to the motor

6.5.6 Disable_operation_option_code

The object disable_operation_option_code determines the behavior if the state transition from OPERATION ENABLE to SWITCHED ON is executed.

Index	605C $_h$
Name	disable_operation_option_code
Object Code	VAR
Data Type	INT16
Access	RW
PDO Mapping	NO
Units	--
Value Range	0,1
Default Value	0

Value	Description
0	Drive enters OFF state and stops according to Pn003.0 setting
1	After decelerates and stops at 6084h, the drive will cut off the power supply to the motor

6.5.7 Quick_stop_option_code

The object quick_stop_option_code determines the behavior if the state transition from Operation Enable to Quick Reaction Active is executed.

Index	605A $_h$
Name	quick_stop_option_code
Object Code	VAR
Data Type	INT16
Access	RW
PDO Mapping	NO
Units	--
Value Range	0,1,2,5,6
Default Value	2

Value	Description
0	Drive enters OFF state and stops according to Pn003.0 setting
1	After decelerates and stops at 6084h, the drive will cut off the power supply to the motor
2	After decelerates and stops at 6085h, the drive will cut off the power supply to the motor
3,4	—
5	After decelerates and stops at 6084h, the drive will stay in QuickStop.
6	After decelerates and stops at 6085h, the drive will stay in QuickStop.

6.5.8 Halt_option_code

halt_option_code determines how to stop when bit.8 (halt) of controlword is set to 1.

Index	605D $_h$
Name	halt_option_code
Object Code	VAR
Data Type	INT16
Access	RW
PDO Mapping	NO
Units	--
Value Range	1,2
Default Value	0

Value	Description
1	Motor decelerates and stops.
2	Motor decelerates and stops urgently.

6.5.9 Fault_reaction_option_code

When an error is occurred, fault_reation_option_code determines how to stop.

Index	605E $_h$
Name	fault_reaction_option_code
Object Code	VAR
Data Type	INT16
Access	RW
PDO Mapping	NO
Units	--
Value Range	0
Default Value	0

Value	Description
0	Shut down the motor excitation signal. Motor is freely rotatable.

6.6 Control Mode

DX3 currently supports 5 control modes in CANopen CiA402:

- Homing Mode
- Profile Position Mode
- Profile Velocity Mode
- Profile Torque Mode
- Interpolated Position Mode

Relevant parameter of control mode

Index	Object	Name	Type	Attr.
6060 h	VAR	modes_of_operation	INT8	RW
6061 h	VAR	modes_of_operation_display	INT8	RO

Modes_of_operation

Drive control mode will be determined by parameters of modes_of_operation.

Index	6060 h
Name	modes_of_operation
Object Code	VAR
Data Type	INT8
Access	RW
PDO Mapping	YES
Units	--
Value Range	1,3,4,6,7
Default Value	1

Value	Description
1	Profile Position Mode
3	Profile Velocity Mode
4	Profile Torque Mode
6	Homing Mode
7	Interpolated Position Mode

Modes_of_operation_display

Drive current control mode could be read from parameters in modes_of_operation_display.

Index	6061 h
Name	modes_of_operation_display

Object Code	VAR
Data Type	INT8
Access	RO
PDO Mapping	YES
Units	--
Value Range	1,3,4,6,7
Default Value	1

[Note] The current control mode could be only known from parameters in modes_of_operation_display.

6.7 Homing Mode

Servo drive currently supports multiple homing mode, and users could choose the suitable homing mode.

The user can determine the way of homing, and its velocity and acceleration. After the servo controller has found its reference, the current position is displayed as the value set by home_offset (607C $_h$).

6.7.1 Control word of homing mode

15 ~ 9	8	7 ~ 5	4	3 ~ 0
*	Halt	*	home_ operation _ start	*

*: Refer to previous chapters

Name	Value	Description
Homing operation start	0	Homing mode inactive
	0 → 1	Start homing mode
	1	Homing mode active
	1 → 0	Interrupt homing mode
Halt	0	Execute the instruction of bit 4
	1	Stop axle with homing acceleration

6.7.2 Status word of homing mode

15 ~ 14	13	12	11	10	9 ~ 0
*	homing_error	homing_attained	*	target_reached	*

*: Refer to previous chapters

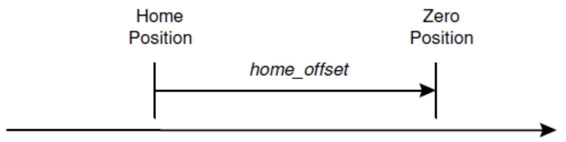
Name	Value	Description
Target reached	0	Halt = 0: Home position not reached Halt = 1: Axle decelerates
	1	Halt = 0: Home position reached Halt = 1: Axle has velocity 0
Homing attained	0	Homing mode not yet completed
	1	Homing mode carried out successfully
Homing error	0	No homing error
	1	Homing error occurred; Homing mode carried out not successfully; The error cause is found by reading the error code

6.7.3 Related Parameters of homing mode

Index	Object	Name	Type	Attr.
607C h	VAR	home_offset	INT32	RW
6098 h	VAR	homing_method	INT8	RW
6099 h	ARRAY	homing_speeds	UINT32	RW
609A h	VAR	homing_acceleration	INT32	RW

home_offset

The parameter home_offset determines the distance between the reference position and the zero position.



Index	607C h
Name	home_offset
Object Code	VAR
Data Type	INT32
Access	RW
PDO Mapping	YES
Units	position units
Value Range	--
Default Value	0

homing_method

4 kinds of signals can be used as the homing signal: positive limit switch, negative limit switch, reference switch and C pulse.

Index	6098 h
Name	homing_method
Object Code	VAR
Data Type	INT8
Access	RW
PDO Mapping	YES
Units	--
Value Range	1-14, 17-22, 23-30, 33-35
Default Value	1

List of Homing Modes

Mode	Direction	Target	Reference Position	CiA402
1	Negative	NOT	C pulse	1
2	Positive	POT	C pulse	2
3	Negative	Reference switch	C pulse	3
4	Positive	Reference switch	C pulse	4
5	Negative	Reference switch	C pulse	5
6	Positive	Reference switch	C pulse	6
7	Positive	Reference switch	C pulse	7
8	Positive	Reference switch	C pulse	8
9	Positive	Reference switch	C pulse	9
10	Positive	Reference switch	C pulse	10
11	Negative	Reference switch	C pulse	11
12	Negative	Reference switch	C pulse	12
13	Negative	Reference switch	C pulse	13
14	Negative	Reference switch	C pulse	14
17	Negative	NOT	NOT	17
18	Positive	POT	POT	18
19	Negative	Reference switch	Reference switch	19
20	Positive	Reference switch	Reference switch	20
21	Negative	Reference switch	Reference switch	21
22	Positive	Reference switch	Reference switch	22
23	Positive	Reference switch	Reference switch	23
24	Positive	Reference switch	Reference switch	24
25	Positive	Reference switch	Reference switch	25
26	Positive	Reference switch	Reference switch	26
27	Negative	Reference switch	Reference switch	27
28	Negative	Reference switch	Reference switch	28
29	Negative	Reference switch	Reference switch	29
30	Negative	Reference switch	Reference switch	30
33	Negative	Current position	C pulse	33
34	Positive	Current position	C pulse	34
35	--	Current position	Current position	35
-4	Positive	Target torque	C pulse	Defined by manufacturer

Mode	Direction	Target	Reference Position	CiA402
-3	Negative	Target torque	C pulse	Defined by manufacturer
-2	Positive	Target torque	Target torque	Defined by manufacturer
-1	Negative	Target torque	Target torque	Defined by manufacturer

homing_speeds

Two kinds of speed are required to find reference point, speed during search for switch and speed during search for zero.

Index	6099 h
Name	homing_speeds
Object Code	ARRAY
No. of Elements	2
Data Type	INT32

Sub-Index	01 h
Name	speed_during_search_for_switch
Object Code	VAR
Data Type	INT32
Access	RW
PDO Mapping	YES
Units	speed units
Value Range	--
Default Value	5000

Sub-Index	02 h
Name	speed_during_search_for_zero
Object Code	VAR
Data Type	INT32
Access	RW
PDO Mapping	YES
Units	speed units
Value Range	--
Default Value	100

Pn207 (stopper torque)

The locked-rotor torque value used by the homing modes -4, -3, -2 and -1. When the machine hits the stop and reaches the torque value set by Pn207 and keeps the filter time set by Pn208, find the C pulse in the reverse direction or make the current position for the origin.

Index	3049_h
Name	Pn207 (stopper torque)
Object Code	VAR
Data Type	UINT16
Access	RW
PDO Mapping	NO
Units	1% rated torque
Value Range	0-200
Default Value	20

Pn208 (blocking time)

The locked-rotor torque value used by the homing modes -4, -3, -2 and -1. When the machine hits the stop and reaches the torque value set by Pn207 and keeps the filter time set by Pn208, find the C pulse in the reverse direction or make the current position for the origin.

Index	$304A_h$
Name	Pn208 (Blocking time)
Object Code	VAR
Data Type	UINT16
Access	RW
PDO Mapping	NO
Units	0.125ms
Value Range	0-10000
Default Value	100

homing_acceleration

The objects homing_acceleration determine the acceleration and deceleration during homing.

Index	$609A_h$
Name	homing_acceleration
Object Code	VAR
Data Type	INT32
Access	RW
PDO Mapping	YES

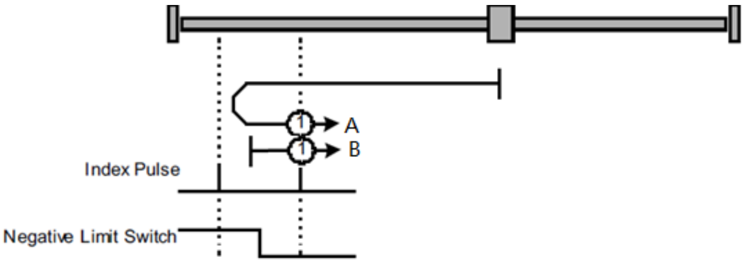
Units	acceleration units
Value Range	--
Default Value	100000

6.7.4 Homing Methods

Method 1: Using C pulse and negative limit switch

A: When homing mode is enabled, if negative limit switch N-OT=0, the drive first moves quickly to the negative direction and stops until it reaches the rising edge of negative limit switch (N-OT). Afterwards the drive slowly returns, and stops until reaches the 1st C pulse of falling edge of negative limit switch (N-OT).

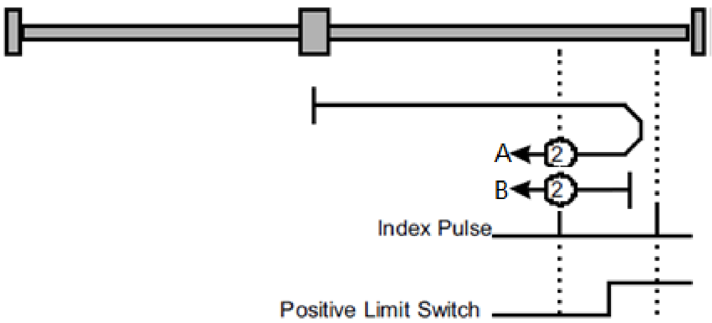
B: When homing mode is enabled, if negative limit switch N-OT=1, the drive first moves slowly to the positive direction, and stops until reaches the 1st C pulse of falling edge of negative limit switch (N-OT).



Method 2: Using C pulse and positive limit switch

A: When homing mode is enabled, if positive limit switch P-OT=0, the drive first moves quickly to the positive direction, and stops until it reaches the rising edge of positive limit switch (P-OT). Afterwards the drive slowly returns, and stops until reaches the 1st C pulse of falling edge of positive limit switch (P-OT).

B: When homing mode is enabled, if positive limit switch P-OT=1, the drive first moves slowly to the negative direction, and stops until reaches the 1st C pulse of falling edge of positive limit switch (P-OT).



Methods 3 and 4: Using C pulse and positive reference switch

- Method 3

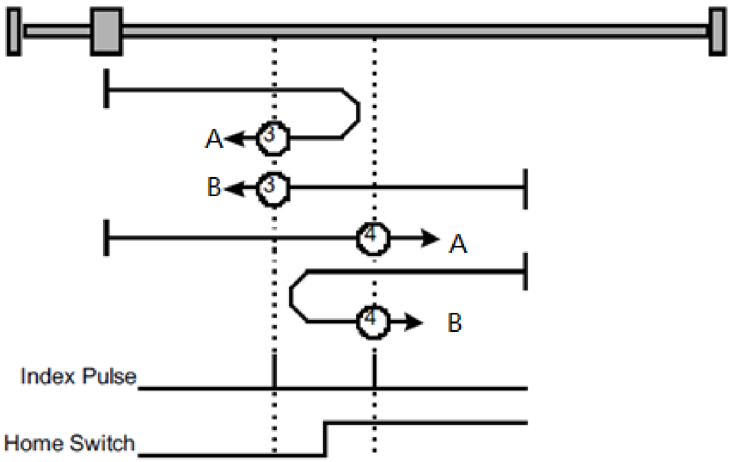
  A: When homing mode is enabled, if positive reference switch H-S=0, the drive first moves quickly to the positive direction, and stops until it reaches the 1st C pulse of rising edge of positive reference switch (H-S). Afterwards the drive slowly returns, and stops until reaches the 1st C pulse of falling edge of positive reference switch (H-S).

B: When homing mode is enabled, if positive reference switch H-S =1, the drive first moves slowly to the negative direction, and stops until reaches the 1st C pulse of falling edge of positive reference switch (H-S).

- Method 4

A: When homing mode is enabled, if positive reference switch H-S =0, the drive first moves slowly to the positive direction, and stops until reaches the 1st C pulse of falling edge of positive reference switch (H-S).

B: When homing mode is enabled, if positive reference switch H-S=1, the drive first moves quickly to the negative direction, and stops until it reaches the 1st C pulse of falling edge of positive reference switch (H-S). Afterwards the drive slowly returns, and stops until reaches the 1st C pulse of rising edge of positive reference switch (H-S).



Methods 5 and 6: Using C pulse and negative reference switch

- Method 5

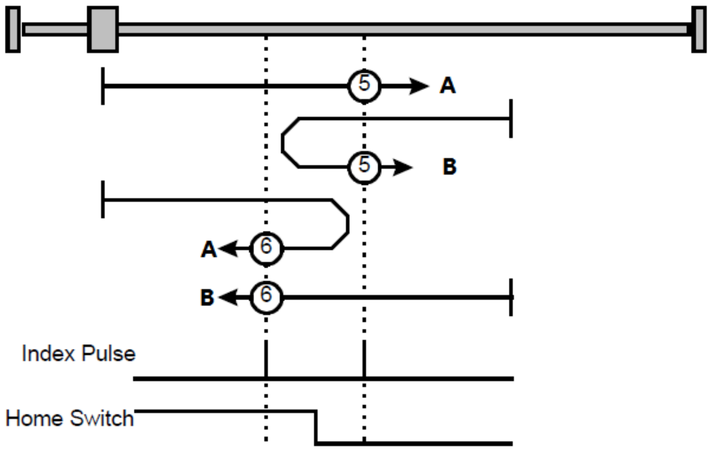
A: When homing mode is enabled, if negative reference switch H-S=1, the drive first moves slowly to the positive direction, and stops until it reaches the 1st C pulse of falling edge of negative reference switch (H-S).

B: When homing mode is enabled, if positive reference switch H-S =0, the drive first moves quickly to the negative direction, and stops until reaches the 1st C pulse of rising edge of negative reference switch (H-S). Afterwards the drive slowly returns, and stops until reaches the 1st C pulse of falling edge of negative reference switch (H-S).

- Method 6

A: When homing mode is enabled, if negative reference switch H-S =1, the drive first moves quickly to the positive direction, and stops until reaches the 1st C pulse of falling edge of negative reference switch (H-S). Afterwards the drive slowly returns, and stops until reaches the 1st C pulse of falling edge of negative reference switch (H-S).

B: When homing mode is enabled, if negative reference switch H-S=0, the drive first moves slowly to the negative direction, and stops until it reaches the 1st C pulse of rising edge of negative reference switch (H-S).



Methods 7~14: Using reference switch , limit switch and C pulse

Methods 7~14 use the reference switch which is only active over parts of the travel.

When the positive limit switch (POT) is used for homing, the initial direction of methods 7~10 is the positive direction

- Method 7

  A: When homing mode is enabled, if reference switch H-S=0, the drive first moves quickly into the positive direction, but not reaches positive limit switch, and stops until it reaches the rising edge of reference switch (H-S). Afterwards the drive slowly returns, and stops until reaches 1st C pulse of the falling edge of reference switch (H-S).

  B: When homing mode is enabled, if reference switch H-S =1, the drive first moves slowly into the negative direction, and stops until reaches 1st C pulse of the falling edge of reference switch (H-S).

  C: When homing mode is enabled, if reference switch H-S=0, the drive first moves quickly into the positive direction, reaches positive limit switch, and moves quickly to the negative direction. When it reaches the rising edge of the reference switch (H-S), it starts to decelerate and continues to run in the negative direction, and stops when it reaches the 1st C pulse after the falling edge of the reference switch (H-S).

- Method 8

  A: When homing mode is enabled, if reference switch H-S=0, the drive first moves quickly into the positive direction, but not reaches positive limit switch, and slows down until it reaches the rising edge of reference switch (H-S). Afterwards it moves to positive direction, and stops until finds the 1st C pulse.

  B: When homing mode is enabled, if reference switch H-S =1, the drive first moves slowly to the negative direction, and turn around until reaches the falling edge of reference switch (H-S). Then moves slowly into the positive direction, and stops when it reaches the 1st C pulse after the rising edge of the reference switch (H-S).

  C: When homing mode is enabled, if reference switch H-S=0, the drive first moves quickly to the positive direction, and reaches positive limit switch; then it moves quickly into the negative direction, and slows down after reaching the rising edge of reference switch (H-S). Afterwards it moves to negative direction, and returns to positive direction slowly. It stops until reaches the 1st C pulse of the rising edge of reference switch (H-S).

- Method 9

  A: When homing mode is enabled, if reference switch H-S=0, the drive first moves in the positive direction quickly, but not reaches the positive limit switch, and it slowly down after reaching the rising edge of the reference switch (HS), and continues to run slowly in the positive direction. Afterwards it slows down and stops after reaching the falling edge of the reference switch (HS). Then the drive returns slowly, and stops when it reaches the 1st C pulse behind the rising edge of the reference switch (HS).

  B: When homing mode is enabled, if reference switch H-S =1, the drive runs slowly in the positive direction directly, reverses after reaching the falling edge of the reference switch (H-S). Afterwards it moves slowly in the negative direction, and stops after it reaches the 1st C pulse of the rising edge of the reference switch (H-S).

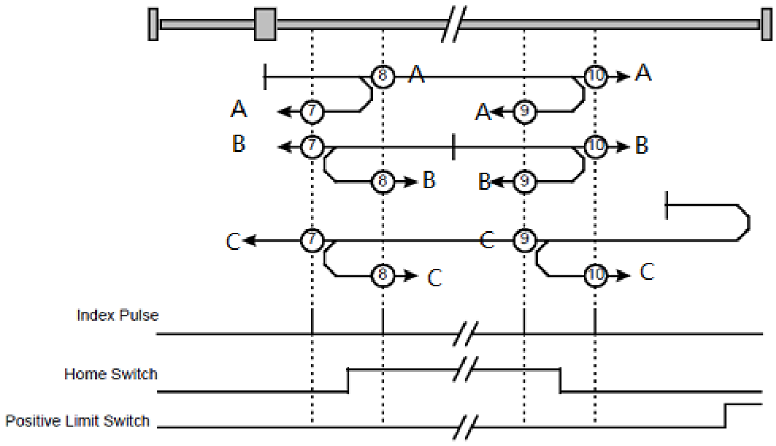
C: When homing mode is enabled, if reference switch H-S=0, the drive moves in the positive direction first, and when it reaches the positive limit switch, the drive automatically runs in the reverse direction at a high speed. After reaching the rising edge of the reference switch (HS), it slows down and continues to move slowly in the negative direction, and stops until the 1st C pulse is found.

- Method 10

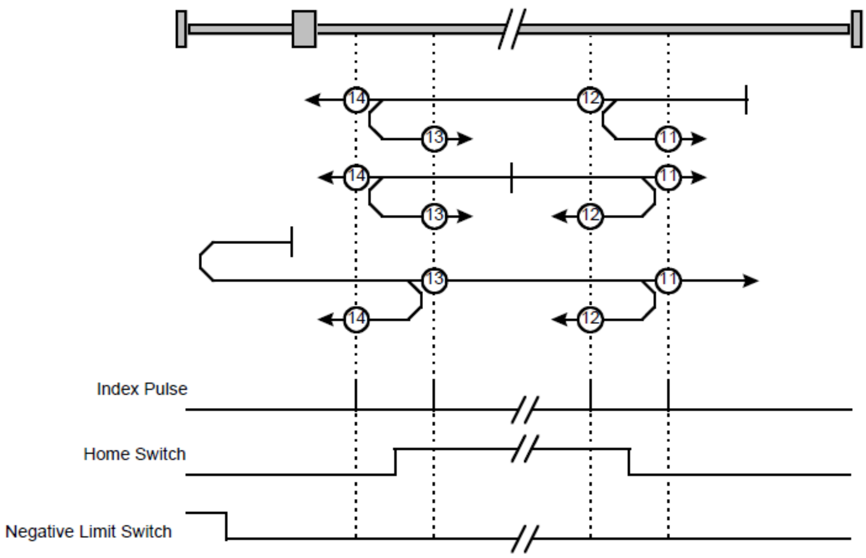
A: When homing mode is enabled, if reference switch H-S=0, the drive first moves in the positive direction quickly, but reaches the positive limit switch, and it slows down when reaching the rising edge of the reference switch (HS), and continues to run slowly in the positive direction. Afterwards it continues to run in the positive direction after reaching the falling edge of the reference switch (HS), and stops until the 1st C pulse is found.

B: When homing mode is enabled, if reference switch H-S =1, the drive runs slowly in the positive direction, and stops at the 1st C pulse behind the falling edge of the reference switch (H-S).

C: When homing mode is enabled, if reference switch H-S=0, the drive moves in the positive direction first, and when it reaches the positive limit switch, the drive automatically runs in the reverse direction at a high speed. After reaching the rising edge of the reference switch (HS), it slows down and stops, and then returns slowly, and continues to move slowly in the positive direction. It stops after reaching the 1st C pulse of the falling edge of the reference switch (H-S.

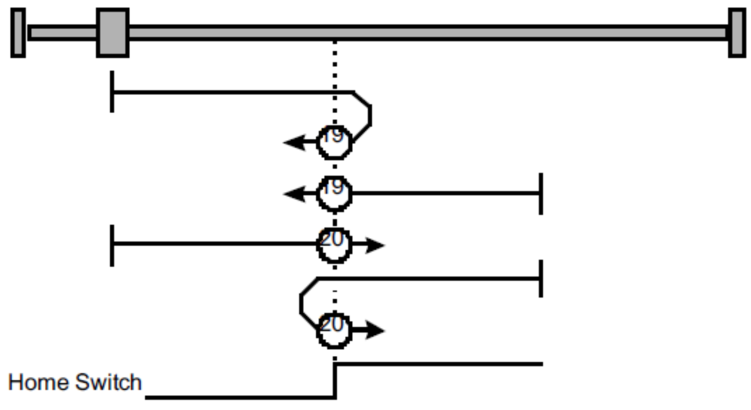


When the negative limit switch (NOT) is used for homing, the method 11~14 is almost same as method 7~10, and the drive first moves to the negative direction.



Methods 17~20, 23~30: Not using C pulse

Homing methods 17~30 are similar to methods 1~4, and 7~14, but the target homing position is not relied on C pulse any more but on the change of limit switch or reference point. For example, as below, method 19 and method 20 are just similar to method 3 and method 4.



Methods 21, 22 Homing by using reference switch

These two homing methods are similar to 5 and 6, except that the C pulse is not used for target zero position, but depends on the change of the reference switch.

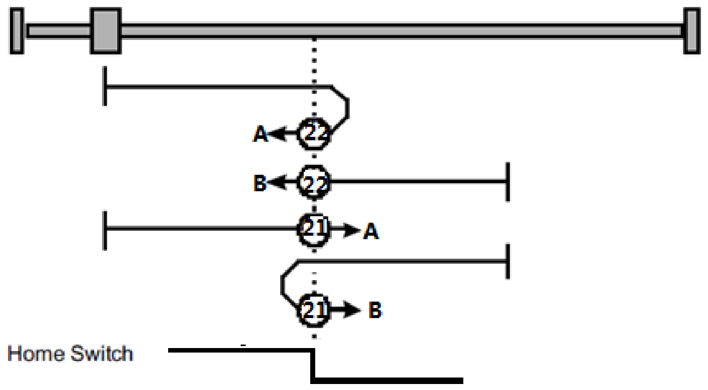
- Method 21

  A: When homing mode is enabled, if reference switch H-S =1, the drive runs slowly in the positive direction, and stops when it reaches the falling edge of the reference switch (H-S).

  B: When homing mode is enabled, if reference switch H-S=0, the drive first moves in the negative direction quickly, slows down and stops when it reaches the rising edge of the reference switch (HS), then the drive returns slowly and runs in the positive direction. It stops when reaching the falling edge of the reference switch (HS).
- Method 22

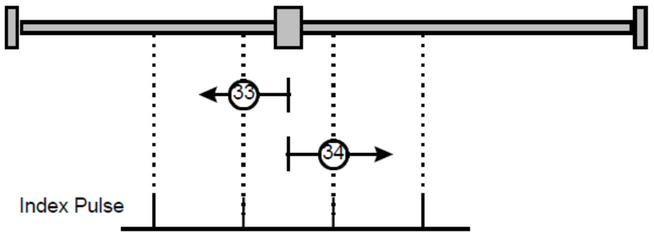
  A: When homing mode is enabled, if reference switch H-S =1, the drive first moves in the positive direction quickly, slows down and stops when it reaches the falling edge of the reference switch (HS). Afterwards it returns slowly, runs in the negative direction, and stops when reaching the rising edge of the reference switch (HS).

  B: When homing mode is enabled, if reference switch H-S=0, the drive runs slowly in the negative direction, and stops when reaching the rising edge of the reference switch (H-S).



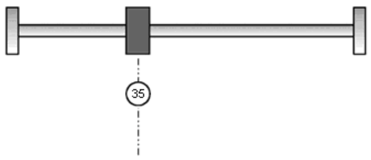
Methods 33 and 34: Homing by using C pulse

- Method 33: The drive moves slowly into the negative direction, and stops when reaching the 1st C pulse.
- Method 34: The drive moves slowly into the positive direction, and stops when reaching the 1st C pulse.



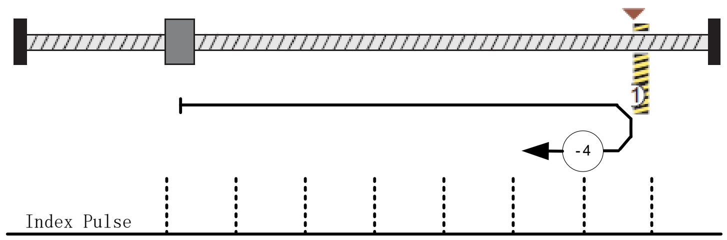
Method 35: Homing on the current position

In this method, the current position shall be taken to be the home position.



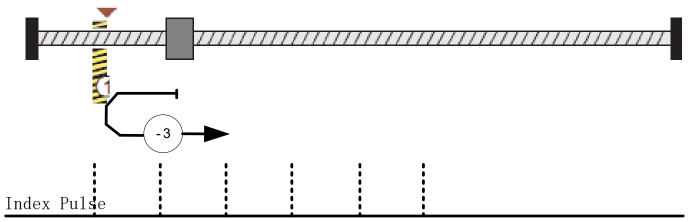
Method-4: Movement in positive direction, hitting an end and reversing to travel, the target homing position is the C pulse

In this method, the motor moves in positive direction. When it hits an end so that the torque set in Pn207 is reached for the blocking time set in Pn208, movement in the opposite direction, and the target homing position is the first C pulse.



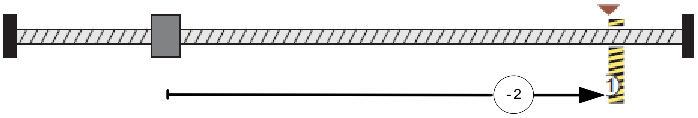
Movement in negative direction, hitting an end and reversing to travel, the target homing position is the C pulse

In this method, the motor moves in negative direction. When it hits an end so that the locked-rotor torque set in Pn207 is reached for the blocking time set in Pn208, movement in the opposite direction, and the target homing position is the first C pulse.



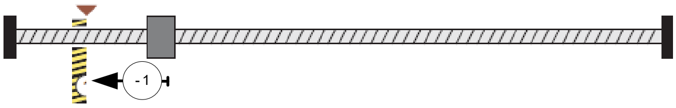
Method -2: Movement in positive direction, hitting an end, makes the current position for the homing point

In this method, the motor moves in positive direction. When the drive hits an end so that the locked-rotor torque set in Pn207 is reached for the blocking time set in Pn208, and makes the current position for the origin.



<u>Method -1: Movement in negative direction, hitting an end, makes the current position for the homing point</u>

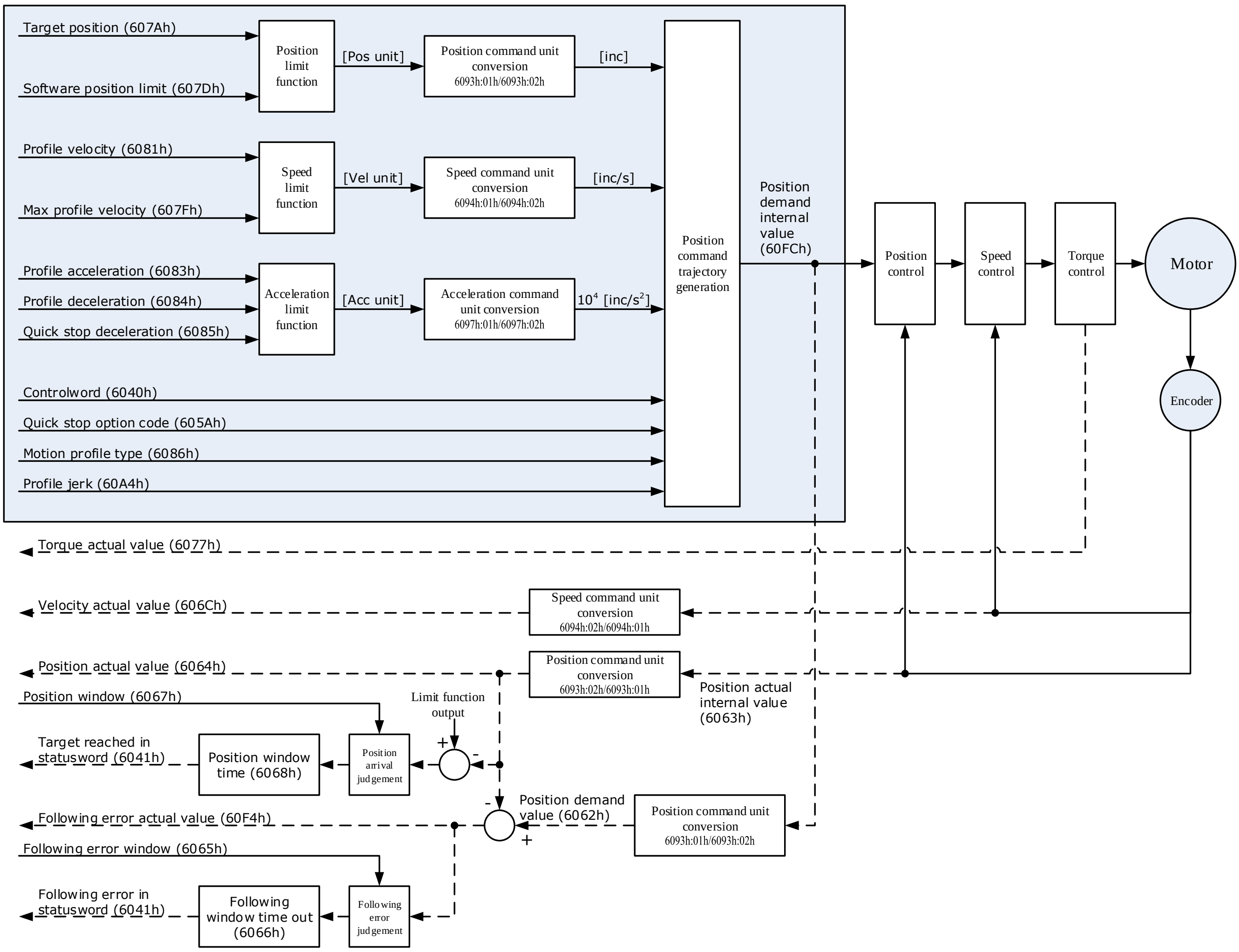
In this method, the motor moves in negative direction. When the drive hits an end so that the locked-rotor torque set in Pn207 is reached for the blocking time set in Pn208, and makes the current position for the origin.



Notes: When starting homing on homing method about input signal, the rotation direction of servo motor is associated with the initial status of the limit switch. Changing the initial status by inverse input, if it is necessary.

6.8 Profile Position Mode

6.8.2 Block Diagram of Profile Position Mode



6.8.3 Control Word

15 ~ 9	8	7	6	5	4	3 ~ 0
*	Halt	*	abs / rel	change set immediately	New set-point	*

*: refer to previous chapters

Name	Value	Description
New set-point	0	Does not assume *target position*
	1	Assume *target position*
Change set immediately	0	Finish the actual positioning and then start the next positioning
	1	Interrupt the actual positioning and start the next positioning
abs / rel	0	*Target position* is an absolute value
	1	*Target position* is a relative value
Halt	0	Execute positioning
	1	Stop axle with *profile deceleration* (if not supported with *profile acceleration*)

6.8.4 Staus Word

15 ~ 14	13	12	11	10	9 ~ 0
*	Following error	Set_point acknowledge	*	Target reached	*

*: refer to previous chapters

Name	Value	Description
Target reached	0	Halt = 0: *Target position* not reached Halt = 1: Axle decelerates
	1	Halt = 0: *Target position* reached Halt = 1: Velocity of axle is 0
Set-point acknowledge	0	Trajectory generator has not assumed the positioning values (yet)
	1	Trajectory generator has assumed the positioning values
Following error	0	No following error
	1	Following error

6.8.5 Related Parameters

Index	Object	Name	Type	Attr.
607A $_h$	VAR	target_position	INT32	RW
6081 $_h$	VAR	profile_velocity	UINT32	RW
6082 $_h$	VAR	end_velocity	UINT32	RW
6083 $_h$	VAR	profile_acceleration	UINT32	RW
6084 $_h$	VAR	profile_deceleration	UINT32	RW
6085 $_h$	VAR	quick_stop_deceleration	UINT32	RW
6086 $_h$	VAR	motion_profile_type	INT16	RW
60A4-01 $_h$	VAR	Profile_jerk1	UINT32	RW

target_position

The object target_position is the given target position, which (target_position) is interpreted either as an absolute or relative position. This depends on bit 6 (relative) of the object control word.

Index	607A h
Name	target_ position
Object Code	VAR
Data Type	INT32
Access	RW
PDO Mapping	YES
Units	position units
Value Range	--
Default Value	0

profile_velocity

The object profile_velocity specifies the speed that usually is reached during a positioning motion at the end of the acceleration ramp.

Index	6081 h
Name	profile_velocity
Object Code	VAR
Data Type	UINT32
Access	RW
PDO Mapping	YES
Units	speed units
Value Range	--
Default Value	0

end_velocity

End_velocity is the speed when servo motor reaches the target_position. Normally we set this value as 0 in order to stop the servo motor when the servo motor reaches the requested position. But in continuous multiple position, this value could be set as a non-zero value.

Index	6082 h
Name	end_velocity
Object Code	VAR
Data Type	UINT32
Access	RW

PDO Mapping	YES
Units	speed units
Value Range	--
Default Value	0

profile_acceleration

Profile_acceleration is the acceleration speed before reaching the target position.

Index	6083 h
Name	profile_acceleration
Object Code	VAR
Data Type	UINT32
Access	RW
PDO Mapping	YES
Units	acceleration units
Value Range	--
Default Value	100000 R/10min/s

profile_deceleration

Profile_deceleration is the deceleration speed before reaching the target position.

Index	6084 h
Name	profile_deceleration
Object Code	VAR
Data Type	UINT32
Access	RW
PDO Mapping	YES
Units	acceleration units
Value Range	--
Default Value	100000 R/10min/s

quick_stop_deceleration

Quick_stop_deceleration is the deceleration speed in Quick Stop.

Index	6085 h
Name	quick_stop_deceleration
Object Code	VAR

Data Type	UINT32
Access	RW
PDO Mapping	YES
Units	acceleration units
Value Range	--
Default Value	200000 R/10min/s

motion_profile_type

Motion_profile_type is used to select the motion curve. Now we only support trapezoid speed curve (set as 0) and S speed curve (set as 2).

Index	6086 $_h$
Name	motion_profile_type
Object Code	VAR
Data Type	INT16
Access	RW
PDO Mapping	YES
Units	--
Value Range	0or2
Default Value	0

profile_jerk1

Profile_jerk1 is used to set the jerk of speed profile. The value is smaller, the speed changing is more smooth.

Index	60A4 -01$_h$
Name	profile_jerk1
Object Code	VAR
Data Type	UINT32
Access	RW
PDO Mapping	YES
Units	jerk units
Value Range	1-20
Default Value	5pulse/(s*100µs*100µs)

6.8.6 Function Description

When the speed profile is trapezia (motion_profile_type=0), two different ways to apply target positions are supported:

Single-step

When the current position is being executed, the controller resends a new position, and at the same time gives a rising edge to bit4 of the controlword, the drive then will re-plan and execute based on the latest position and speed.

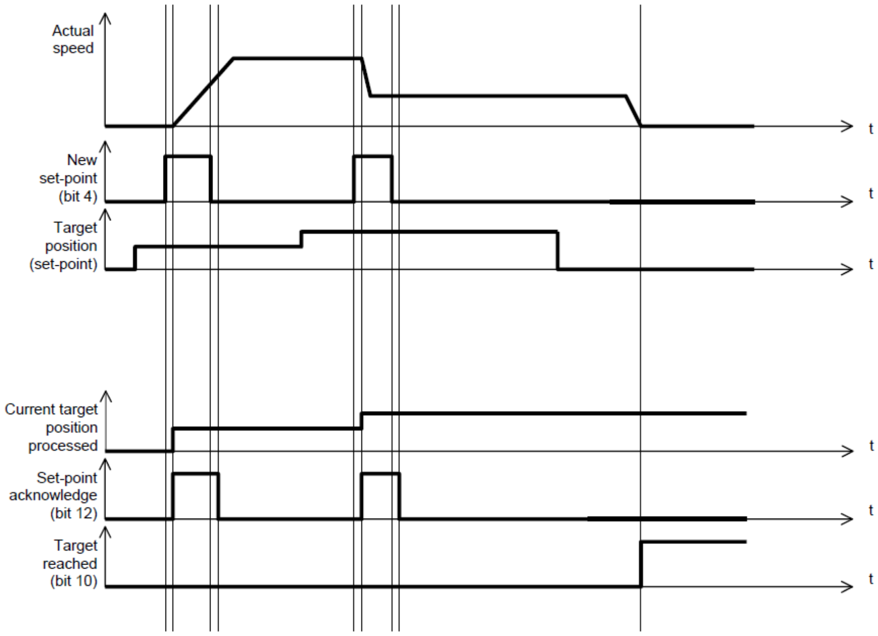
Continuous-step

After the motor reaches the target position, the drive informs the host of "target position reached", and then gets a new target position and starts motion. Before getting a new target position, the motor speed is usually zero.

Both of the above two methods can be changed in real time by bit4 and bit5 of the controlword and bit12 (set_point_acknowledge) of the status word statusword. The position control being executed can be interrupted through the handshake mechanism, and the target position can be reset by using these few words.

Single-step setting procedure

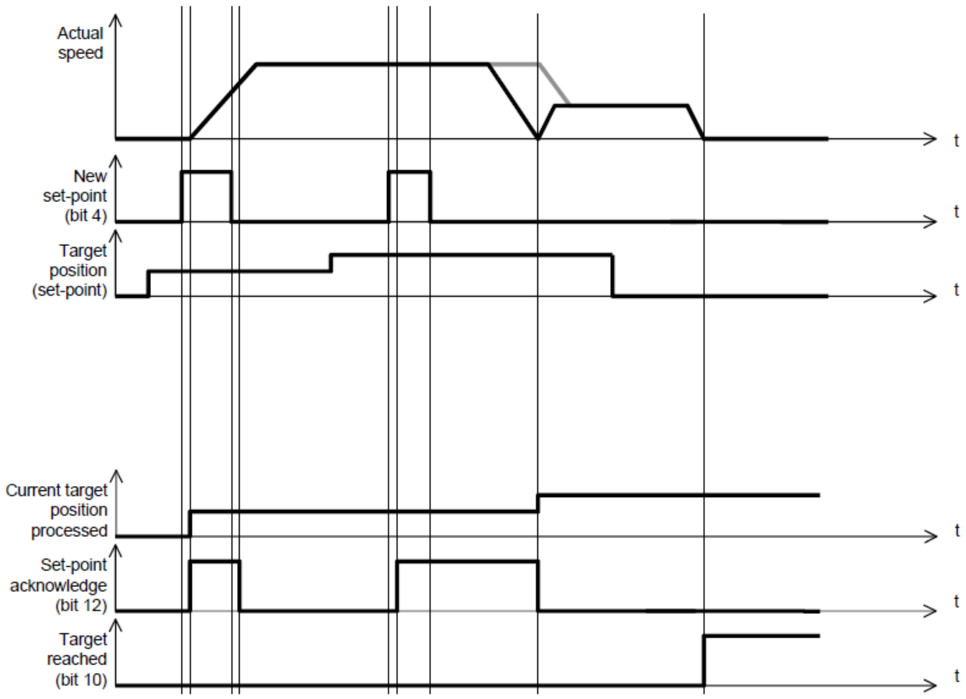
1. Set the NMT status into Operational and set the control mode parameter (6060 $_h$) as 1.
2. According to the actual demand, we could set the target position (target_positon: 607A $_h$) and so on.
3. We need set bit4 (new_set_point) of the control word as 1, bit 5 (change_set_immediately) as 0, bit 6 (absolute/comparative) should be determined by whether the reference target position is an absolute value or a comparative value.
4. We use bit12 (set_point_acknowledge) of the status word to configure the servo drive acknowledge mechanism. And then we start to operate position control.
5. After reaching the target position, servo drive will need to respond through bit 10 (target_reached) of the status word. And then servo drive will follow the program to keep moving or accept new target position.



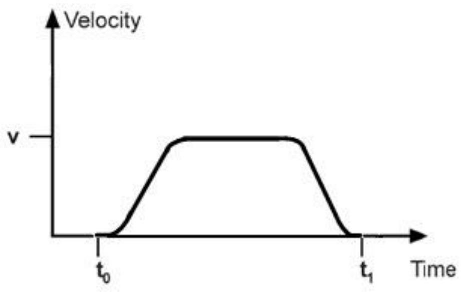
Continuous-step setting procedure

6. At first, set NMT as Operational and control mode parameter (6060 h) as 1.
7. According to actual demand, set the first target position (target_position: 607A h), target speed, acceleration/deceleration and other Related Parameters.

8. Set bit 4 (new_set_point) of control word as 1. Set bit 5 (change_set_immediately) as 0. Set bit6 (absolute/comparative) according to the type of object position.
9. Set bit 12 (set_point_acknowledge) of the status word and then start to operate position control.
10. Set the second target position (target_position: 607A h), target speed, acceleration/deceleration speed.
11. Set bit4 (new_set_point) as 1, bit 5 (change_set_immediately) as 0. Set Bit6 (absolute/comparative) according to the target position type.
12. After reaching the first target position, the servo drive will not stop and keep moving toward the second target position. After reaching the second target position, the servo drive will respond through status word bit 10 (target_reached). Then the servo motor will follow the program to keep moving or accept new target position.

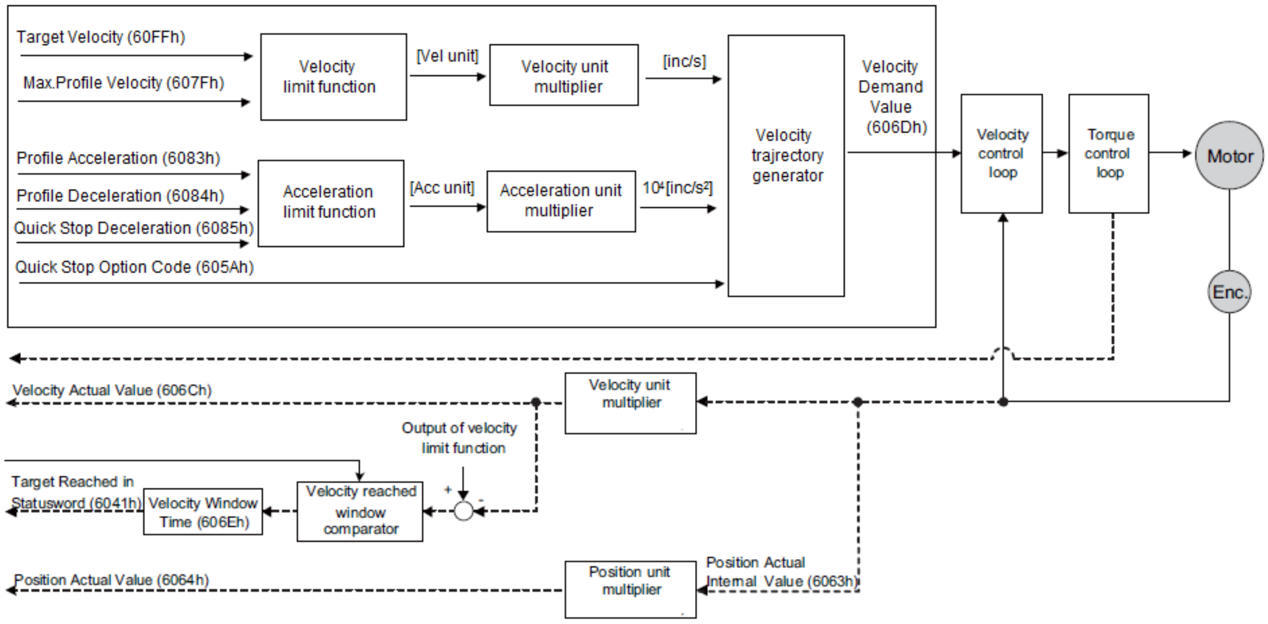


When the speed profile is S (motion_profile_type=2), only **Continuous-step setting** is available. 6083_h (profile_acceleration) limits max acceleration, and 6081h (profile_velocity) limits max speed. 60A4-01 h (VAR Profile_jerk1) limits the jerk. Only symmetrical S linear is available currently.



6.9 Profile Velocity Mode

6.9.1 Block Diagram of Profile Velocity Mode



6.9.2 Control Word

15 ~ 9	8	7 ~ 4	3 ~ 0
*	Halt	*	*

*: Refer to previous chapters

Name	Value	Description
Halt	0	Execute the motion
	1	Stop axle

6.9.3 Status Word

15 ~ 14	13	12	11	10	9 ~ 0
*	MaxSlippageError	Speed	*	Target reached	*

*: Refer to previous chapters

Name	Value	Description
Target reached	0	Halt = 0: *Target velocity* not (yet) reached Halt = 1: Axle decelerates
	1	Halt = 0: *Target velocity* reached Halt = 1: Axle has velocity 0
Speed	0	Speed is not equal 0
	1	Speed is equal 0
Max slippage error	0	Maximum slippage not reached
	1	Maximum slippage reached

6.9.4 Related Parameters

Index	Object	Name	Type	Attr.
6069 h	VAR	velocity_sensor_actual_value	INT32	RO
606B h	VAR	velocity_demand_value	INT32	RO
606C h	VAR	velocity_actual_value	INT32	RO
606D h	VAR	velocity_window	UINT16	RW
606E h	VAR	velocity_window_time	UINT16	RW
606F h	VAR	velocity_threshold	UINT16	RW
6070 h	VAR	velocity_threshold_time	UINT16	RW
607F h	VAR	Max profile velocity	UINT32	RW
60FF h	VAR	target_velocity	INT32	RW

velocity_sensor_actual_value

The master could read velocity_sensor_actual_value to know the current velocity. The parameter's unit is internal speed unit.

Index	6069 h
Name	velocity_sensor_actual_value
Object Code	VAR
Data Type	INT32
Access	RW
PDO Mapping	YES
Units	0.1rmps (1R/10min)
Value Range	--
Default Value	--

velocity_demand_value

The master can read velocity_demand_value to know the current reference speed value of the servo drive. The unit of this parameter is user's velocity unit.

Index	606B h
Name	velocity_demand_value
Object Code	VAR
Data Type	INT32
Access	RO
PDO Mapping	YES
Units	speed units
Value Range	--

Default Value	--

velocity_actual_value

The master can read velocity_ actual _value to know the current velocity of the servo motor. The unit of this parameter is user's velocity unit.

Index	606C $_h$
Name	velocity_actual_value
Object Code	VAR
Data Type	INT32
Access	RO
PDO Mapping	YES
Units	speed units
Value Range	--
Default Value	--

velocity_window

The difference between velocity_actual_value (606C $_h$) and target_velocity (60FF $_h$) is defined as actual velocity error window. If the actual velocity error window is always smaller than velocity_window (606D $_h$) within the time set by velocity_window_time (606E $_h$), then bit 10 of status word (target_reached) will be set to indicate that the set velocity has been reached.

Index	606D $_h$
Name	velocity_window
Object Code	VAR
Data Type	UINT16
Access	RW
PDO Mapping	YES
Units	speed units
Value Range	--
Default Value	20 R/10min

velocity_window_time

Velocity window comparator is composed of velocity_window_time and velocity_window.

Index	606E $_h$
Name	velocity_window_time
Object Code	VAR

Data Type	UINT16
Access	RW
PDO Mapping	YES
Units	ms
Value Range	--
Default Value	0

velocity_threshold

Velocity_threshold indicates a range close to zero speed in order to define if the servo motor has already stopped.

Index	606F h
Name	velocity_threshold
Object Code	VAR
Data Type	UINT16
Access	RW
PDO Mapping	YES
Units	speed units
Value Range	--
Default Value	50

velocity_threshold_time

Velocity_threshold_time is used to set the shortest time when servo motor's speed is under velocity threshold. The unit is: ms. When the time that servo motor's speed is lower than the threshold is more than velocity_threshold_time, status word bit 12 (speed is zero) will be set as 1.

Index	6070 h
Name	velocity_threshold_time
Object Code	VAR
Data Type	UINT16
Access	RW
PDO Mapping	YES
Units	ms
Value Range	--
Default Value	0

Max profile velocity

The object max profile velocity is the speed that the motor cannot exceed. Its unit is the unit of customer's speed.

Index	607F h
Name	Max profile velocity
Object Code	VAR
Data Type	UINT32
Access	RW
PDO Mapping	YES
Units	speed units
Value Range	--
Default Value	0

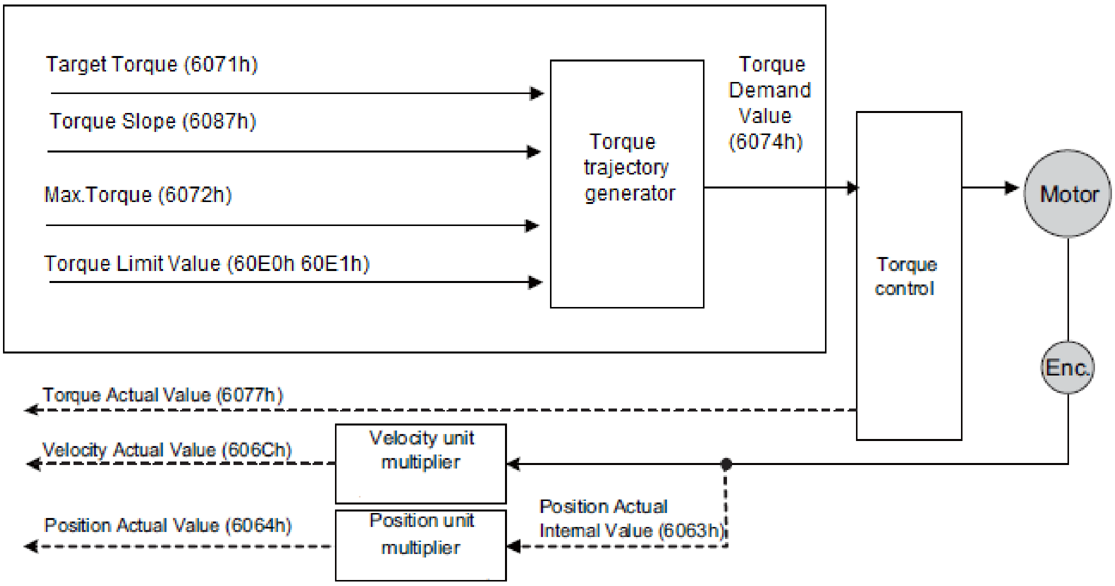
target_velocity

target_velocity is the reference speed.

Index	60FF h
Name	target_velocity
Object Code	VAR
Data Type	INT32
Access	RW
PDO Mapping	YES
Units	speed units
Value Range	--
Default Value	0

6.10 Profile Torque Mode

6.10.1 Block Diagram of Profile Torque Mode



6.10.2 Control Word

15 ~ 9	8	7 ~ 4	3 ~ 0
*	Halt	*	*

*: refer to previous chapters

Bit	Value	Definition
8	0	The motion shall be executed 8 or continued
	1	Axis shall be stopped according to the halt option code (605Dh)

6.10.3 Status Word

15 ~ 14	13	12	11	10	9 ~ 0
*	*	*	*	Target reached	*

*: refer to previous chapters

Bit	Value	Definition
10	0	Target torque not reached
	1	Target torque reached

6.10.4 Related Parameters

Index	Object	Name	Type	Attr.
6071 h	VAR	target_torque	INT16	RW
6072 h	VAR	Max torque	UINT16	RW
6074 h	VAR	torque_demand	INT16	RO
6077 h	VAR	torque_actual_value	INT16	RO
6087 h	VAR	torque_slope	UINT32	RW

target_torque

The master can send a torque reference to the drive through target_torque, the unit is 0.1% of the rated motor torque, which is indicated on the motor nameplate.

Index	6071 h
Name	target_torque
Object Code	VAR
Data Type	INT16
Access	RW
PDO Mapping	YES
Units	0.1% rated torque
Value Range	--
Default Value	--

Max torque

Max torque, the maximum torque allowed by the motor during operation, the unit is 0.1% of the rated torque of the motor.

Index	6072 h
Name	Max torque
Object Code	VAR
Data Type	UINT16
Access	RW
PDO Mapping	YES
Units	0.1% rated torque
Value Range	--
Default Value	0

torque_demand

The output of the torque reference generator. The drive generates the command slope according to the value of target_torque and torque_slope.

Index	6074 h
Name	torque_demand
Object Code	VAR
Data Type	INT16
Access	RO
PDO Mapping	YES
Units	0.1% rated torque
Value Range	--
Default Value	--

torque_actual_value

The master can get the current output torque of the motor by reading torque_actual_value. Its unit is 0.1% of rated torque of the motor.

Index	6077 h
Name	torque_actual_value
Object Code	VAR
Data Type	INT16
Access	RO
PDO Mapping	YES
Units	0.1% rated torque
Value Range	--
Default Value	--

torque_slope

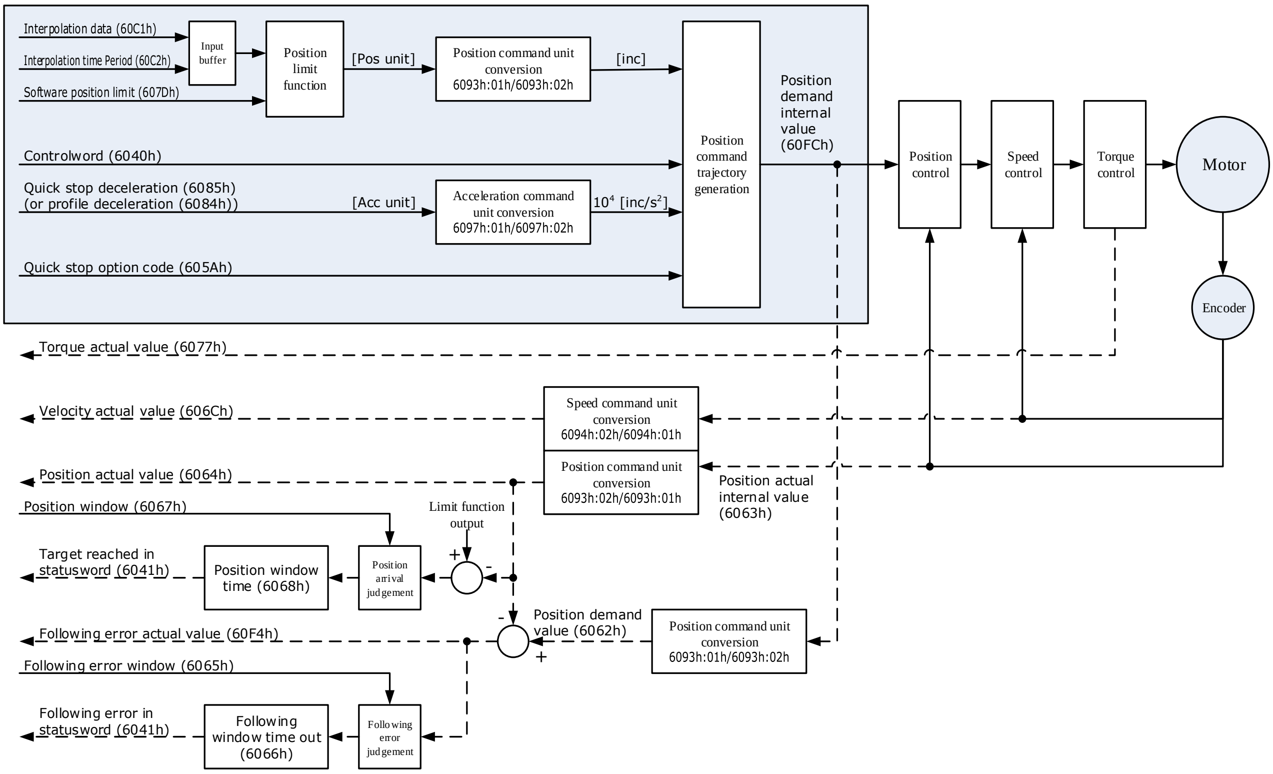
The master can set the change speed of torque reference via torque_slope. Its unit is 0.1% of rated torque per second.

Index	6087 h
Name	torque_slope
Object Code	VAR
Data Type	UINT32
Access	RW
PDO Mapping	YES
Units	0.1% rated torque per second

Value Range	--
Default Value	--

6.11 Interpolated Position Mode

6.11.1 Block Diagram of Interpolated Position Mode



6.11.3 Control Word

15 ~ 9	8	7	6	5	4	3 ~ 0
*	Halt	*	*	*	Enable ip mode	*

*: refer to previous chapters

Name	Value	Description
Enable ip mode	0	Interpolated position mode inactive
	1	Interpolated position mode active
Halt	0	Execute the instruction of bit 4
	1	Stop axle

6.11.4 Status Word

15 ~ 14	13	12	11	10	9 ~ 0
*	*	ip mode active	*	Target reached	*

*: refer to previous chapters

Name	Value	Description
Target reached	0	Halt = 0: Position not (yet) reached Halt = 1: Axle decelerates
	1	Halt = 0: Position reached Halt = 1: Axle has velocity 0
ip mode active	0	Interpolated position mode inactive
	1	Interpolated position mode active

6.11.5 Related Parameters

Index	Object	Name	Type	Attr.
60C0 h	VAR	Interpolation sub mode select	INT16	RW
60C1 h	ARRAY	Interpolation data record	INT32	RW
60C2 h	RECORD	Interpolation time period		RW

Interpolation sub mode select

Interpolation sub mode select is used to select the method of interpolation under IP control. **Only the linear interpolation is available.**

Index	60C0h
Name	Interpolation sub mode select
Object Code	VAR
Data Type	INT16
Access	RW
PDO Mapping	NO
Value Range	0
Default Value	0
Comment	0: Linear interpolation

Interpolation data record

Interpolation data record is used to reserve interpolation potion data. **Our servo drive's interpolation command only uses the first data** whose subindex is 1.

Index	60C1h
Subindex	0
Object Code	ARRAY
Data Type	INT32
Access	RO
PDO Mapping	YES

Value Range	INT8
Default Value	2
Comment	number of entries

Index	60C1h
Subindex	1
Object Code	ARRAY
Data Type	INT32
Access	RW
PDO Mapping	YES
Value Range	INT32
Default Value	0
Comment	the first parameter of ip function

Index	60C1h
Subindex	2
Object Code	ARRAY
Data Type	INT32
Access	RW
PDO Mapping	YES
Value Range	INT32
Default Value	0
Comment	The second parameter of ip function

Interpolation time period

Interpolation time period is used to reserve the time data of interpolation position.

Index	60C2h
Object Code	RECORD
Data Type	Interpolation time period record (0080h)
Category	Conditional: mandatory if ip, csp, csv or cst mode is supported

Index	60C2h
Subindex	0

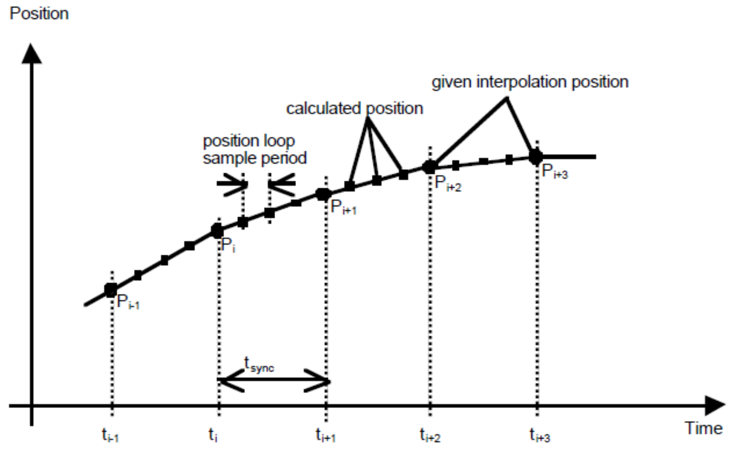
Object Code	RECORD
Data Type	UINT8
Access	C
PDO Mapping	NO
Value Range	02
Default Value	02
Comment	Highest sub-index supported

Index	60C2h
Subindex	01
Object Code	RECORD
Data Type	UINT8
Access	RW
PDO Mapping	YES
Value Range	UINT8
Default Value	01
Comment	Interpolation time period value

Index	60C2h
Subindex	02
Object Code	RECORD
Data Type	INT8
Access	RW
PDO Mapping	YES
Value Range	-128 to +63
Default Value	-3
Comment	Interpolation time index

6.11.6 Functional Description

Interpolation principle of IP mode:



Pi: interpolation position set by the host; tsync: sync period

Explanations

1. In our servo drive, there is no buffer for position data so in IP control, all the position data needs to be updated by the host controller. To achieve synchronization, host controllers need to send the updated position at first and then use SYNC signal to make all the servo drive receive the synchronization information. After receiving the synchronization information, servo drive will synchronize its internal clock. Please notice that the sync period should be not bigger than interpolation cycle period in order to keep the updating of interpolation data.
2. In IP mode, the host controller should at first set the servo's PDO receiving method into sync mode (use SYNC frame to receive and send synchronization information). Since the SYNC is broad casted, each servo drive will only update PDO data after receiving this signal.
3. Before SYNC is sent, host controller should send position data Xi and Controlword to the servo drive.
4. When there is data delay, servo drive will use the last sync date to do interpolation.
5. After one IP period is ended, if there is no further data updating, interpolation cycle overtime alarm (A 69) will happen. Then servo drive will stop.

Recommended RPDO configuration:

- When you use only one RPDO

Control word (index: 6040h, subindex: 0h)	32bit position reference (index:60C1h,subindex:01h)

- When you use two RPDOs

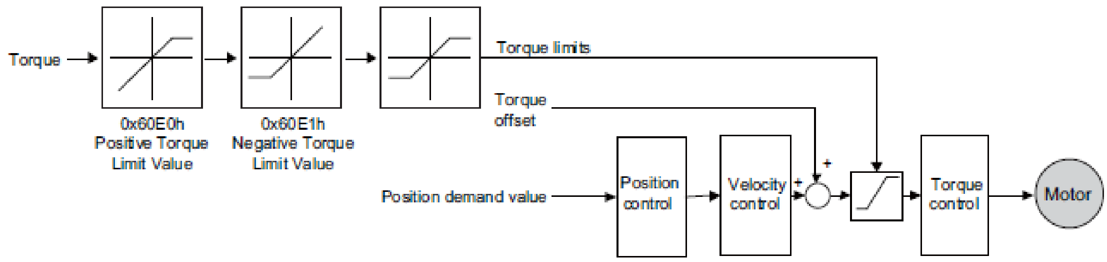
Control word (index:6040h,subindex:0h)	32bit position reference (index:60C1h,subindex:01h)

Configuration process:

1. Configure PDO. (RPDO1 is configured as index: 6040h, subindex: 0h, RPDO2 is configured as index 60c1h, subindex: 1h)
2. Set interpolation cycle (60C2-01h), in micro second (ms).
3. Set PDO as Sync mode (Set the object dictionary (index: 1400h, subindex: 02h) as 1. Set object dictionary (index: 1401h, subindex: 02h) as 1). If sending PDO needs to be in sync mode as well, we need to set object dictionary (index: 1800h, subindex: 02h) as 1 and (index:1801h,subindex:02h) as 1 as well.
4. Set the control mode to PI mode (set the object dictionary (index: 6060h, subindex:0h) to 7);
5. NMT starts node.

6.12 Torque Limit Function

In CANOPEN bus mode, torque limit function is restricted by 0x60E0 and 0x60E1 as below.



PosTorLimit(0x60E0)

PosTorLimit is the positive torque limit, unit: 0.1% rated torque

Index	60E0h
Name	PosTorLimit
Object Code	VAR
Data Type	UINT16
Access	RW
PDO Mapping	YES
Value Range	0-3000
Default Value	3000

NegTorLimit(0x60E1)

NegTorLimit is the negative torque limit, unit: 0.1% rated torque

Index	60E1h
Name	NegTorLimit
Object Code	VAR
Data Type	UINT16
Access	RW
PDO Mapping	YES
Value Range	0-3000
Default Value	3000

6.13 Digital Input /Output

60FE (Physical outputs)

In some cases, some switches (i.e. the origin signal and limit signal) are not sent to the servo drive directly, but sent by the host. You need to use the object 60FE-01h (Physical outputs) to transfer the relevant signals.

Index	60FE h
Name	Digital outputs
Object Code	ARRAY
No. of Elements	2
Data Type	UINT32

Sub-Index	01 h
Name	Physical outputs
Object Code	VAR
Data Type	UINT32
Access	RW
PDO Mapping	YES
Default Value	0

Sub-Index	02 h
Name	Bit mask
Object Code	VAR
Data Type	UINT32
Access	RW
PDO Mapping	YES
Default Value	0

Bit17	Bit28	Bit29	Bit30	Bit31
reserved	Remote0	Remote1	Remote2	reserved

The bit28-bit30 bits of this object correspond only to the input port of CN1 respectively, and then you need to configure the corresponding function of the input port through Pn511 or invert it through 517.

60FD (Physical outputs)

Sometimes, the host controller may read the object 60FDh (Digital Inputs) to monitor the switching on-off inputs of the drive, which are defined as follows:

Index	60FD h

Name	Digital outputs
Object Code	Variable
Data Type	UINT32

Sub-Index	00 h
Name	Physical outputs
Object Code	VAR
Data Type	UINT32
Access	RO
PDO Mapping	YES
Default Value	0

Bit0	Bit1	Bit2	Bit3-15	Bit16	Bit17	Bit18
negative limit switch	positive limit switch	home switch	reserved	CN1_in1	CN1_in2	CN1_in3
Bit19	Bit20	Bit21	Bit22	Bit23	Bit24-31	
CN1_in4	CN1_in5	CN1_in6	CN1_in7	CN1_in8	reserved	

6.14 Functions of TouchProbe

You may use the following trigger events to latch the feedback motor position.

- TouchProbe input 1 (TP1) triggered
- TouchProbe input 2 (TP2) triggered
- Trigger by using C pulse signal

The latch function of two TouchProbes can be used at the same time:

- Latch control object: 60B8h (bit0 to bit7)
- Latch state object: 60B9h (bit0 to bit7)
- The locked position is always stored in the TouchProbe1 position value (60BAh and 60BBh).
- Trigger signal: C pulse signal or EXT1 signal of the encoder

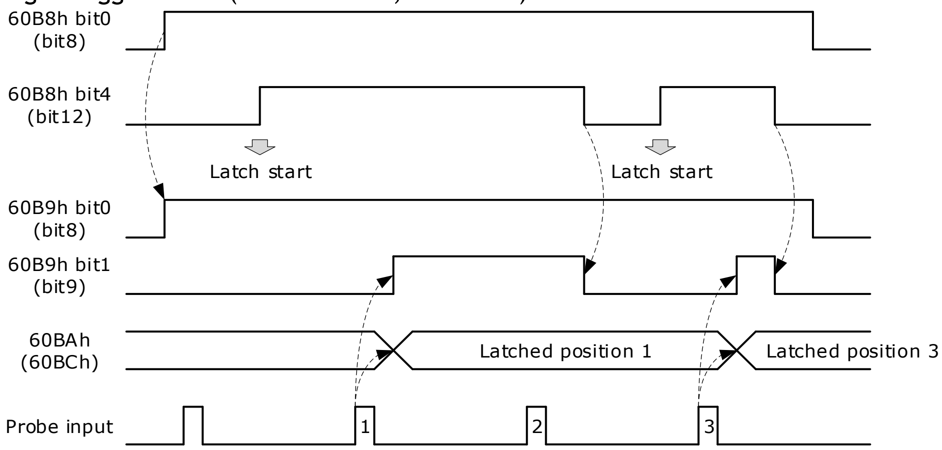
The objects involved in this function are listed in table below:

Index	Sub-index	Name	Visit	Data Type	PDO Mapping	Default
60B8	00	Touch Probe Function	RW	UINT16	Yes	–
60B9	00	Touch Probe Status	RO	UINT16	Yes	–
60BA	00	TouchProbePos1PosValue	RO	INT32	Yes	–
60BB	00	TouchProbeNeg1PosValue	RO	INT32	Yes	–

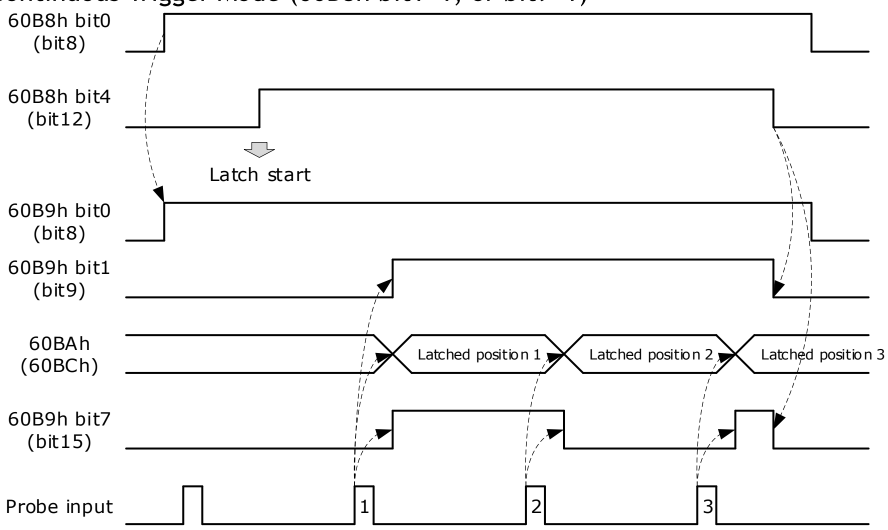
Index	Sub-index	Name	Visit	Data Type	PDO Mapping	Default
60BC	00	TouchProbePos2PosValue	RO	INT32	Yes	–
60BD	00	TouchProbeNeg2PosValue	RO	INT32	Yes	–

Example of the execution process of Touch Probe:

- Single Trigger Mode (60B8h bit1=0, or bit9=0)



- Continuous Trigger Mode (60B8h bit1=1, or bit9=1)



60B8h: Touch Probe Function

The object is configured to the Touch Probe Function.

Index	Sub-index	Name	Access	Data Type	Unit	Range	Default
60B8	00	Touch Probe Function	RW	UINT16	–	0 to 0xFFFF	0

Each bit of Touch Probe Function (60B8h) is described as follows:

Bit	Value	Definition
0	0	Probe 1 not enabled
	1	Probe 1 enabled
1	0	Single trigger, probe 1 is triggered only when the trigger signal is valid for the first time
	1	Continuous trigger, probe 1 is triggered every time the trigger signal is valid
2	0	External IO signal, used as probe 1 trigger signal
	1	C pulse, used as the trigger signal of probe 1
3	0	Reserved
4	0	Not enable the rising edge latch position of probe 1
	1	Enable latch position on rising edge of probe 1
5	0	Not enable the latch position of probe 1 falling edge
	1	Enable the latch position of probe 1 falling edge
6, 7	0	Reserved
8	0	Probe 2 not enabled
	1	Probe 2 enabled
9	0	Single trigger, probe 2 is triggered only when the trigger signal is valid for the first time
	1	Continuous trigger, probe 2 is triggered every time the trigger signal is valid
10	0	External IO signal, used as probe 1 trigger signal
	1	C pulse, used as the trigger signal of probe 1
11	0	Reserved
12	0	Not enable the rising edge latch position of probe 2
	1	Enable latch position on rising edge of probe 2
13	0	Not enable the latch position of probe 2 falling edge
	1	Enable the latch position of probe 2 falling edge
14, 15	0	Reserved

60B9h: Touch Probe Status

Touch Probe Status (60B9h) indicates the touch probe status.

Index	Sub-index	Name	Visit	Data Type	Unit	Range	Default
60B9	00	Touch Probe Status	RO	UINT16	–	–	–

Each bit of Touch Probe Function (60B9h) is described as follows:

Bit	Value	Definition
0	0	Probe 1 not enabled
	1	Probe 1 enabled
1	0	Probe 1 rising edge position latch has not been executed
	1	Probe 1 rising edge position latch has been executed
2	0	Probe 1 falling edge position latch has not been executed
	1	Probe 1 falling edge position latch has been executed
3 to 5	0	Reserved
6,7	0	In continuous mode, bit6 and bit7 record the times that the function of probe 1 has been executed; the value is counted cyclically between 0 and 3.
8	0	Probe 2 not enabled
	1	Probe 2 enabled
9	0	Probe 2 rising edge position latch has not been executed
	1	Probe 2 rising edge position latch has been executed
10	0	Probe 2 falling edge position latch has not been executed
	1	Probe 2 falling edge position latch has been executed
11 to 13	0	Reserved
14, 15	0	In continuous mode, bit14 and bit15 record the times that the function of probe 2 has been executed; the value is counted cyclically between 0 and 3.

60BAh: TouchProbePos1PosValue

TouchProbePos1PosValue (60Bah) indicates the latch location when the Touch Probe1 trigger condition occurs.

Index	Sub-index	Name	Visit	Data Type	Unit	Range	Default
60BA	00	TouchProbePos1PosValue	RO	INT32	–	–	–

60BBh: TouchProbeNeg1PosValue

TouchProbeNeg1PosValue (60BBh) indicates the latch location when the trigger condition for Touch Probe1 falling edge occurs.

Index	Sub-index	Name	Visit	Data Type	Unit	Range	Default
60BB	00	TouchProbeNeg1PosValue	RO	INT32	–	–	–

60BCh: TouchProbePos2PosValue

TouchProbePos2PosValue (60BCh) indicates the latch location when the Touch Probe2 trigger condition occurs.

Index	Sub-index	Name	Visit	Data Type	Unit	Range	Default
60BC	00	TouchProbePos2PosValue	RO	INT32	–	–	–

60BDh: TouchProbeNeg2PosValue

TouchProbeNeg2PosValue (60BDh) indicates the latch location when the trigger condition for Touch Probe2 falling edge occurs.

Index	Sub-index	Name	Visit	Data Type	Unit	Range	Default
60BD	00	TouchProbeNeg2PosValue	RO	INT32	–	–	–

Pn331 and Pn332

You can allocate the TouchProbe functions by Pn331, and set Touch Probe Digital Input Filtering Time by Pn332. The Related Parameters are as following:

Para	Name	Range	Unit	Default	When Enabled
Pn331.0	CN1-18 Signal Allocation	0 to 2	–	0	After restart
Pn331.1	CN1-19 Signal Allocation	0 to 2	–	1	
Pn332	Touch probe Input Signal Filtering Time	0 to 1000	10 ns	0	Immediately

The signal allocation instructions for Touch probe 1 and Touch probe 2 are listed in table below.

Parameter	Setting	Meaning	When Enabled
Pn331.0	0	Allocate Touch probe 1 signal to pin CN1-18	After restart
	1	Allocate Touch probe 2 signal to pin CN1-18	
	2	Not allocated	
Pn331.1	0	Allocate Touch probe 1 signal to pin CN1-19	
	1	Allocate Touch probe 1 signal to pin CN1-19	
	2	Not allocated	

Pn333

You can select whether to invert the Touch Probe 1 and Touch Probe 2 signals through the parameter Pn333. In general, it needs to be set according to the actual input signal level.

Parameter	Setting	Meaning	When Enabled
Pn333.0	0	Do not invert CN-18 signal (take effective when low level)	After restart
	1	Invert CN-18 signal (take effective when high level)	
Pn333.1	0	Do not invert CN-19 signal (take effective when low level)	
	1	Invert CN-19 signal (take effective when high level)	

6.15 Soft Limit Function

Software Position Limit defines the maximum and minimum absolute position commands. Every target position is checked against these limits. The limit positions are specified in user-defined position reference units, the same as for target positions, and are always relative to the machine home position. Before comparing with Target position, you need to use Home Offset to correct the position limit.

- corrected min position limit = min position limit - home offset
- corrected max position limit = max position limit - home offset

The software position limits are enabled at the following conditions:

- When homing is completed
- corrected min position limit < corrected max position limit

When the servo is not homed, if min position limit<max position limit, the servo takes max position limit and min position limit as the position limit; otherwise, the position command is not restricted by the position limit.

Index	Sub-index	Name	Visit	Data Type	Unit	Range	Default
607D	00	Software position	RO	UINT8	–	0 ~ 65535	0
	01	Min position limit	RW	INT32	–	- 2147483648 ~ 2147483647	–
	02	Max position limit	RW	INT32	–	- 2147483648 ~ 2147483647	–

Chapter 7 Trial Operation

7.1 Preparations for Trial Operation

The procedure for trial operation is given below.

Step	Meaning	Reference
1	**Installation** Install the Motor and Drive according to the installation conditions. First, operation is checked with no load. Do not connect the Motor to the machine.	Chapter 2
2	**Wiring and Connections** Wire and connect the Drive. First, Motor operation is checked without a load. Do not connect the X4 connector on the Drive.	0
3	Confirmations before Trial Operation	–
4	Power ON	–
5	**Resetting the Absolute Encoder** If an absolute encoder is used, it is necessary to reset the absolute encoder.	5.6

7.2 Inspections and Confirmations

To ensure safe and correct trial operation, check the following items before you start trial operation.

- Make sure that the Drive and Motor are installed, wired, and connected correctly.
- Make sure that the correct power supply voltage is supplied to the Drive.
- Make sure that there are no loose parts in the Motor mounting.
- If you are using a Motor with an Oil Seal, make sure that the oil seal is not damaged. Also make sure that oil has been applied.
- If you are performing trial operation on a Motor that has been stored for a long period of time, make sure that all Motor inspection and maintenance procedures have been completed.
- If you are using a Motor with a Holding Brake, make sure that the brake is released in advance. To release the brake, you must apply the specified voltage of 24 VDC to the brake, for details see the section 3.6.4 Holding Brake Wiring.

7.3 Motor Operation without a Load

You use jogging for trial operation of the Motor without a load.

Jogging is used to check the operation of the Motor without connecting the Drive to the host controller. The Motor is moved at the preset jogging speed.

WARNING

- During jogging, the overtravel function is disabled.
- Consider the range of motion of your machine when you jog the Motor.

7.3.1 Preparations

Always check the following before you execute jogging.

- The main circuit power supply must be ON.
- There must be no alarms.
- The Servo must not be in Safe State.
- The servo must be OFF.
- The jogging speed must be set considering the operating range of the machine.

7.3.2 Applicable Tools

- Use the Panel Operator of the Drive
- Use the Motion Perfect V5.3 or above (Recommended)

7.3.3 JOG Operation

Use the Panel Operator of the Drive

Before performing the JOG operation by using the Panel Operator, you shall check and set the relevant parameters properly.

For the method of checking and setting parameters by using the Panel Operator, refers to the section 4.1.4 Parameter Setting Mode

Functions can be selected or adjusted by setting parameters. There are two types of parameters.

- Function Parameters: the functions allocated to each digit of the Panel Operator can be selected.
- Adjustment Parameters: a parameter is set to a value within the specified range of the parameter.

For a description of the parameter settings, please refer to the section Chapter 1

Parameters.

Function Parameters Setting

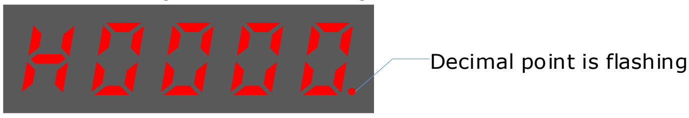
The example below shows how to change parameter Pn003 (Application Function Selections 3) from **0000** to **1032.**

Step 1 Press [M] key several times to select the Parameter Setting Mode.

Step 2 Press [▲] key or [▼] key to select the parameter Pn003.

Step 3 Press [◀] key to display the current value of Pn003.

Step 4 Press and hold [◀] key for 1 second or more, and then a flashing decimal point will appear at the bottom right of the 5th digit.



Step 5 Press [▲] key twice, changing the value of the 5th digit from **0** to **2.**

Step 6 Press [◀] key once, moving the flashing decimal point to the 4th digit.

Step 7 Press [▲] key three times, changing the value of the 4th digit from **0** to **3.**

Step 8 Press [◀] key twice, moving the flashing decimal point to the 2nd digit.

Step 9 Press [▲] key once, changing the value of the 2nd digit from **0** to **1.**

Step 10 Press and hold [◀] key for 1 second or more to return to the display of the Pn003 parameter value or press the [M] key to return to the display of the Pn003.

----End

NOTE

After completing the function parameters setting, restart the Drive to take effect

Adjustment Parameters Setting

The example below shows how to change parameter Pn102 (Speed Loop Gain) from **100** to **85.**

Step 1 Press [M] key several times to select the Parameter Setting Mode.

Step 2 Press [▲] key or [▼] key to select the parameter Pn102.

Step 3 Press [◄] key to display the current value of Pn102.

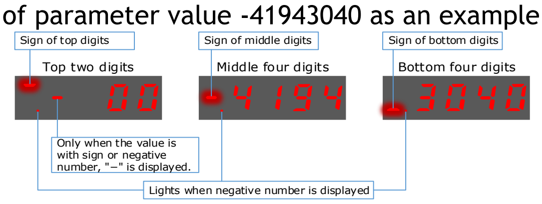
Step 4 Press [▲] key or [▼] key to change the value to 00085.
Press and hold [▲] key or [▼] key to jump the setting value quickly.

Step 5 Press [◄] key or [M] key to return to the display of Pn102.

----End

IMPORTANT

Panel Operator can only display 5 digits. The value of some adjustment parameters will be 6 digits or more. The display of the parameter values is as follows (take the display of parameter value -41943040 as an example).



The example below shows how to change parameter Pn504 (Deviation Counter Overflow Alarm) from **41943040** to **42943240.**

Step 6 Press [M] key several times to select the Parameter Setting Mode.

Step 7 Press [▲] key or [▼] key to select the parameter Pn504.

Step 8 Press [◄] key to display bottom four digits of the current value of Pn504.

Step 9 Press and hold [◄] key for 1 second or more, and then a flashing decimal point will appear at the bottom right of the 5th digit.

Step 10 Press [◄] key twice, moving the flashing decimal point to the 3rd digit.

Step 11 Press [▲] key twice, changing the value of the 3rd digit from **0** to **2.**

Step 12 Press [◄] key four times, moving the flashing decimal point to the 3rd of middle four digits.

Step 13 Press [▲] key once, changing the value of the 3rd digit from **1** to **2.**

Step 14 Press and hold [◄] key for 1 second or more to return to the display of the Pn504 parameter value or 8press the [M] key to return to the display of the Pn504.

----End

7.3.4 Monitor Mode

The Monitor Mode can be used for monitoring the reference values, I/O signal status, and Drive internal status.

The Monitor Mode can be selected during Motor operation.

Select Monitor Mode

The example below shows how to display, the contents of monitor number Un003 (when the Motor rotates at 100).

Step 1 Press [M] key several times to select the Monitor Mode.

Step 2 Press [▲] key or [▼] key to select the monitor number Un003.

Step 3 Press [◄] key to display the data of Un003.

Step 4 Press [◄] key to return to the display of Un003.

.

Following the below steps to jog the Motor.

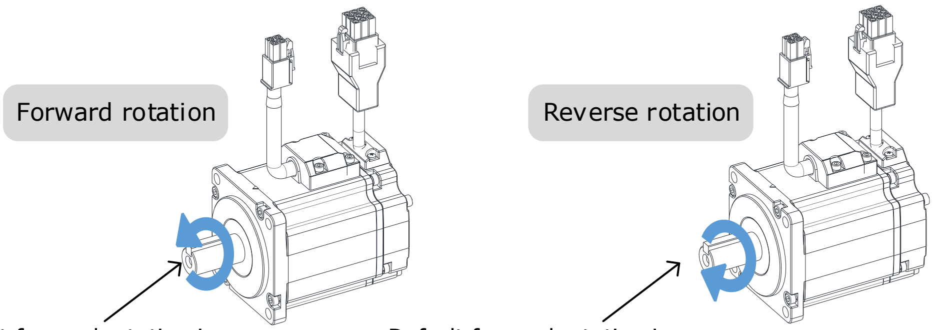
Step 5 Press [M] key several times to select the Utility Function Mode.

Step 6 Press [▲] key or [▼] key to select the function number Fn002.

Step 7 Press [◄] key, and Panel Operator displays as below.

Step 8 Press [M] key to Servo ON (supply power to Motor).
Press [M] key again to Servo OFF (not supply power to Motor).

Step 9 Press [▲] key or [▼] key to run the Motor in forward or reverse direction.
Press and hold [▲] key or [▼] key to run the Motor continuously.



NOTE

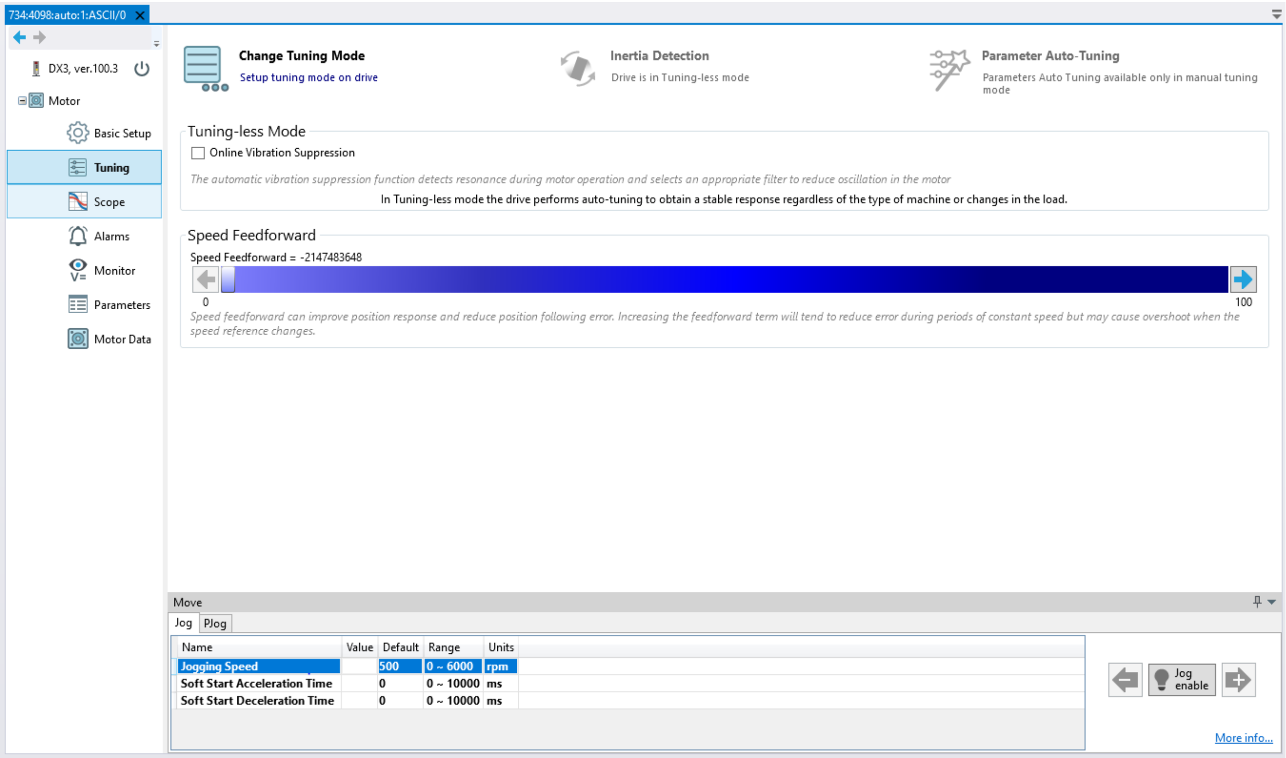
The rotation direction of the Motor depends on the setting of Pn001.0 (CCW, CW). The figure above shows the default setting.

Step 10 Press the [◄] key to return to the display of the Fn002.

----End

Use the Motion Perfect

The Motor will operate only while a button is clicked in the Motion Perfect.



Enter the Tuning page in the drive commissioning section of Motion Perfect, Then select Jog enable to engage the drive and motor. You can then jog the drive by pressing and holding the arrow buttons next to the Jog enable button.

The motor will jog for as long as you hold the arrow buttons. It will more clockwise when using the right button and anticlockwise while using the left.

7.4 Motor Operation with a Load

7.4.1 Precautions

WARNING	Operating mistakes that occur after the Motor is connected to the machine may not only damage the machine, but they may also cause accidents resulting in personal injury.

IMPORTANT	If you disabled the overtravel function for trial operation of the Motor without a load, enable the overtravel function (P-OT and N-OT signal) before you preform trial operation with the Motor connected to the machine in order to provide protection.

If you will use a holding brake, observe the following precautions during trial operation.

- Before you check the operation of the brake, implement measures to prevent vibration from being caused by the machine falling due to gravity or an external force.

- First check the Motor operation and brake operation with the Motor uncoupled from the machine. If no problems are found, connect the Motor to the machine and perform trial operation again.

Control the operation of the brake with the /BK (Brake) signal output from the Drive.

CAUTION	Failures caused by incorrect wiring or incorrect voltage application in the brake circuit may cause the Drive to fail, damage the Drive, damage the equipment, or cause an accident resulting in death or injury. Observe the precautions and instructions for wiring and trial operation precisely as described in this manual.

7.4.2 Preparations

Always confirm the following before you perform the trial operation procedure for both the machine and Motor.

- Make sure that the Drive is connected correctly to both the host controller and the peripheral devices.
- Overtravel wiring
- Brake wiring
- Allocation of the /BK (Brake) signal to a pin on the I/O signal connector (X4)
- Emergency stop circuit wiring
- Host controller wiring

7.4.3 Operation Procedure

Step 1 Enable the overtravel signals.
Refers to the section 5.3 Overtravel Limi.

Step 2 Make the settings for the protective functions, such as the safety function, overtravel, and the brake.

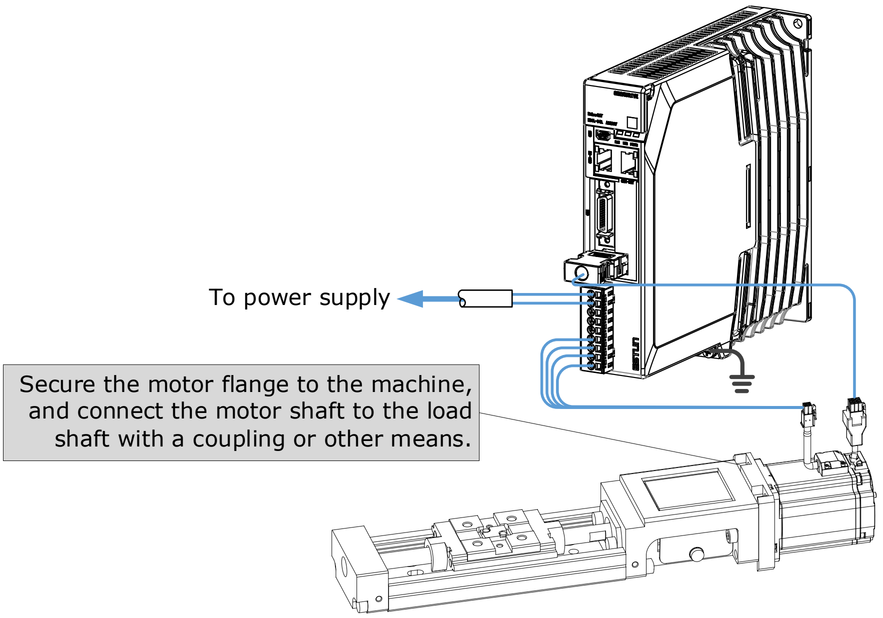
- For details on overtravel settings, refers to the section 5.3 Overtravel Limi.
- For details on holding brake settings, refers to the section 0

NOTE	• This setting is a percentage of the rated torque. • The default setting is 300%. This setting is large enough to allow you to operate the Motor at the maximum torque. However, the maximum stop torque that you can actually use is the maximum torque of the Motor.

- Holding Brake.

Step 3 Turn OFF the power supplies to the Drive.
The control power supply and main circuit power supply will turn OFF.

Step 4 Couple the Motor to the machine.



Step 5 Turn ON the power supplies to the machine and host controller and turn ON the control power supply and main circuit power supply to the Drive.

Step 6 Check the protective functions, such overtravel and the brake, to confirm that they operate correctly.

Step 7 If necessary, adjust the servo gain to improve the Motor response characteristics.
The Motor and machine may not be broken in completely for the trial operation. Therefore, let the system run for a sufficient amount of time to ensure that it is properly broken in.

Step 8 For future maintenance, save the parameter settings with one of the following methods.

- Use Motion Perfect to save the parameters as a file.
- Record the settings manually.

This concludes the procedure for trial operation with both the machine and Motor.

----End

7.5 Program Jogging

You can use program jogging to perform continuous operation with a preset operation pattern, travel distance, movement speed, acceleration/deceleration time, waiting time, and number of movements.

You can use this operation when you set up the system in the same way as for normal jogging to move the Motor without connecting it to the host controller in order to check Motor operation and execute simple positioning operations.

7.5.1 Preparations

Always check the following before you execute program jogging.

- The parameters must not be written prohibited.
- The main circuit power supply must be ON.
- There must be no alarms.
- The Servo must not be in Safe State.
- The servo must be OFF.

- The range of machine motion and the safe movement speed of your machine must be considered when you set the travel distance and movement speed.
- There must be no overtravel.

7.5.2 Operation Description

Program jogging operation consists of two operation patterns (PJOG0 and PJOG1), you can set their relevant parameters respectively. Figure 7-1 shows an example of position-speed timing diagram in PJOG operation.

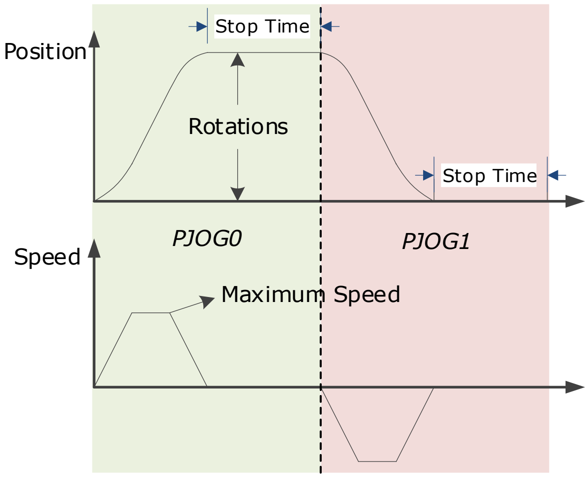


Figure 7-1 Position-speed timing diagram

The Drive will operator the Motor repeatedly according to the parameter settings of the two operation patterns until you stop the program jogging operation manually.

You can set the parameters Pn164 and Pn168 to a negative value for reversing the Motor, so that there are four ways of the operation in the program jogging, as is shown in Figure 7-2.

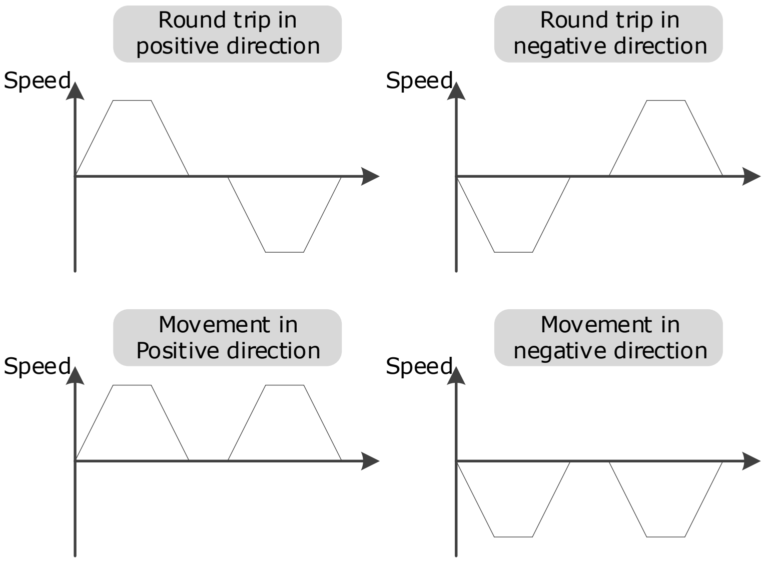


Figure 7-2 Operation in the program jogging

You shall set the Rotations (Pn164 and Pn168) and Max Speed (Pn165 and Pn169) to a proper value. If the Rotations is set too small or the Max Speed is set too large, it is possible that the maximum speed set cannot be reached. In this case, it is necessary to increase the Rotations or decrease the Max Speed.

7.5.3 Relevant Parameters

Parameter	Name	Range	Unit	Default	When Enabled
Pn164	Turns for PJOG0	-50 to 50	rotation	5	Immediately
Pn165	Max Speed for PJOG0	100 to 3000	rpm	1000	Immediately
Pn166	Acc./Dec. Time for PJOG0	50 to 2000	ms	500	Immediately
Pn167	Stop Time for PJOG0	100 to 10000	ms	1000	Immediately
Pn168	Turns for PJOG1	-50 to 50	rotation	5	Immediately
Pn169	Max Speed for PJOG1	100 to 3000	rpm	1000	Immediately
Pn170	Acc./Dec. Time for PJOG1	50 to 2000	ms	500	Immediately
Pn171	Stop Time for PJOG1	100 to 10000	ms	1000	Immediately

7.5.4 Applicable Tools

- Use the Panel Operator of the Drive
- Use the Motion Perfect V5.3 or above (Recommended)

7.5.5 Operation Procedure

Use the Panel Operator of the Drive

Before performing the Program Jogging (PJOG) operation by using the Panel Operator, you shall check and set the following parameters properly.

Check and set the parameters Pn164 to Pn171 as proper values in advance, and ensure the movable parts have sufficient travel in the forward and reverse directions.

For the method of checking and setting parameters by using the Panel Operator, refers to the section 4.1.4 Parameter Setting Mode

Functions can be selected or adjusted by setting parameters. There are two types of parameters.

- Function Parameters: the functions allocated to each digit of the Panel Operator can be selected.
- Adjustment Parameters: a parameter is set to a value within the specified range of the parameter.

For a description of the parameter settings, please refer to the section Chapter 1

Parameters.

Function Parameters Setting

The example below shows how to change parameter Pn003 (Application Function Selections 3) from **0000** to **1032.**

Step 1 Press [M] key several times to select the Parameter Setting Mode.

Step 2 Press [▲] key or [▼] key to select the parameter Pn003.

Step 3 Press [◄] key to display the current value of Pn003.

Step 4 Press and hold [◄] key for 1 second or more, and then a flashing decimal point will appear at the bottom right of the 5th digit.

Decimal point is flashing

Step 5 Press [▲] key twice, changing the value of the 5th digit from **0** to **2.**

Step 6 Press [◄] key once, moving the flashing decimal point to the 4th digit.

Step 7 Press [▲] key three times, changing the value of the 4th digit from **0** to **3.**

Step 8 Press [◄] key twice, moving the flashing decimal point to the 2nd digit.

Step 9 Press [▲] key once, changing the value of the 2nd digit from **0** to **1.**

Step 10 Press and hold [◄] key for 1 second or more to return to the display of the Pn003 parameter value or press the [M] key to return to the display of the Pn003.

----End

NOTE

After completing the function parameters setting, restart the Drive to take effect

Adjustment Parameters Setting

The example below shows how to change parameter Pn102 (Speed Loop Gain) from **100** to **85.**

Step 1 Press [M] key several times to select the Parameter Setting Mode.

Step 2 Press [▲] key or [▼] key to select the parameter Pn102.

Step 3 Press [◄] key to display the current value of Pn102.

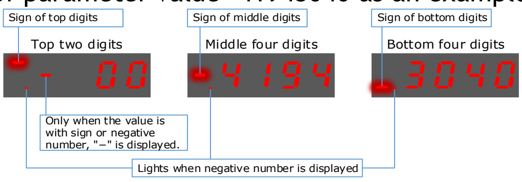
Step 4 Press [▲] key or [▼] key to change the value to 00085.
Press and hold [▲] key or [▼] key to jump the setting value quickly.

Step 5 Press [◄] key or [M] key to return to the display of Pn102.

----End

IMPORTANT

Panel Operator can only display 5 digits. The value of some adjustment parameters will be 6 digits or more. The display of the parameter values is as follows (take the display of parameter value -41943040 as an example).



The example below shows how to change parameter Pn504 (Deviation Counter Overflow Alarm) from **41943040** to **42943240.**

Step 6 Press [M] key several times to select the Parameter Setting Mode.

Step 7 Press [▲] key or [▼] key to select the parameter Pn504.

Step 8 Press [◄] key to display bottom four digits of the current value of Pn504.

Step 9 Press and hold [◄] key for 1 second or more, and then a flashing decimal point will appear at the bottom right of the 5th digit.

Step 10 Press [◄] key twice, moving the flashing decimal point to the 3rd digit.

Step 11 Press [▲] key twice, changing the value of the 3rd digit from **0** to **2.**

Step 12 Press [◄] key four times, moving the flashing decimal point to the 3rd of middle four digits.

Step 13 Press [▲] key once, changing the value of the 3rd digit from **1** to **2.**

Step 14 Press and hold [◄] key for 1 second or more to return to the display of the Pn504 parameter value or 8press the [**M**] key to return to the display of the Pn504.

----End

7.5.6 Monitor Mode

The Monitor Mode can be used for monitoring the reference values, I/O signal status, and Drive internal status.

The Monitor Mode can be selected during Motor operation.

<u>Select Monitor Mode</u>

The example below shows how to display, the contents of monitor number Un003 (when the Motor rotates at 100).

Step 1 Press [**M**] key several times to select the Monitor Mode.

Step 2 Press [▲] key or [▼] key to select the monitor number Un003.

Step 3 Press [◄] key to display the data of Un003.

Step 4 Press [◄] key to return to the display of Un003.

.

The following are the steps to run the Motor between the two programmed operation patterns (PJOG0 and PJOG1).

Step 5 Press [M] key several times to select the Utility Function Mode.

Step 6 Press [▲] key or [▼] key to select the function number Fn018.

Step 7 Press [◄] key, and Panel Operator displays as below.

Step 8 Press [M] key to execute this operation, and Panel Operator displays as below.

Step 9 Press [◄] key to return to the display of the Fn018.

----End

Chapter 8 Tuning

8.1 Overview

8.1.1 Basic Conception

Tuning is the process of satisfying the servo performance by adjusting the parameters involved in the control law.

Tuning Flow

The process of tuning is usually an iterative process, and Figure 8-1 shows the general flow.

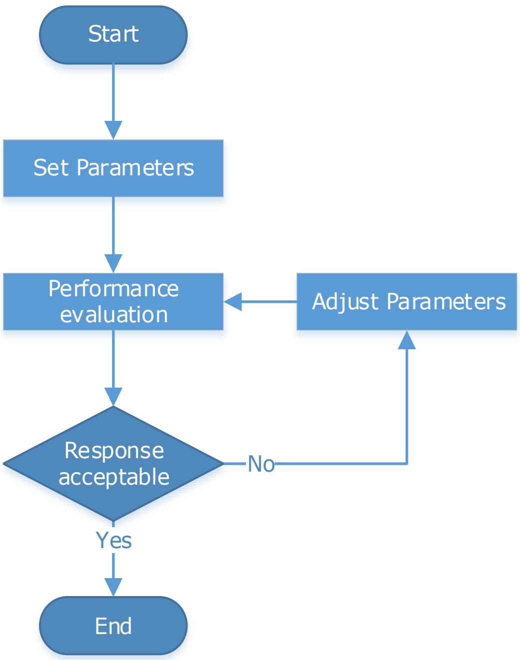


Figure 8-1 General flow

Parameter Classification

There are two types of parameters in the tuning.

- Function Parameters: refers to some application function selections or switches that may improve Servo performance.
- Adjustment Parameters: increasing or decreasing these parameters may improve Servo performance.

Servo Performance

In general, the indicators used to evaluate Servo performance are bandwidth, response time, overshoot, steady state error, anti-load disturbance, speed ripple fluctuation, torque ripple, and so on. **Error! Reference source not found.** shows the comparison of the graphics before and after tuning in the example indicators.

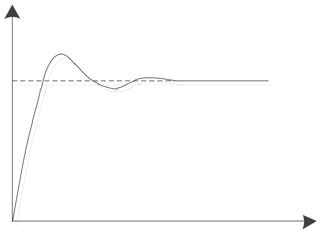
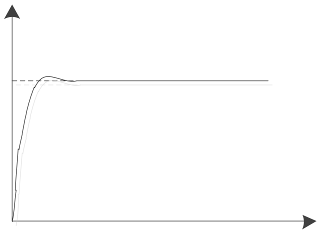
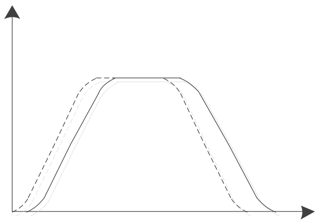
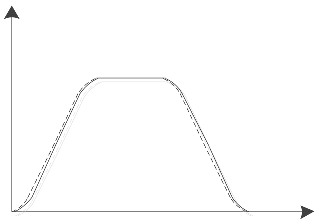
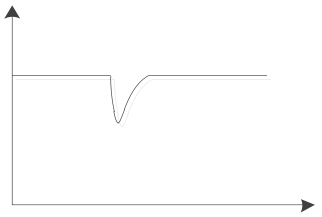
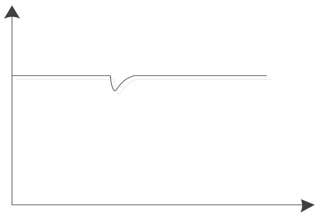
Indicator	Before tuning	After tuning
Speed step response		
Position following		
Anti-load disturbance		

Table 8-1 Comparison of the graphics before and after tuning

8.1.2 Control Block Diagram

It is necessary to learn the Servo control principle and Figure 8-2 shows the Servo control block diagram. The position loop, the speed loop and the torque loop are cascade structures, corresponding to the position control mode, the speed control mode and the torque control mode respectively.

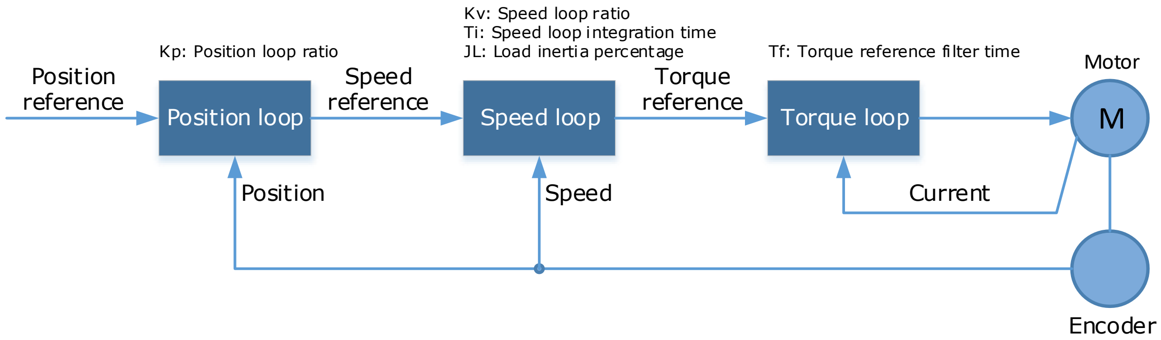


Figure 8-2 Servo control block diagram

NOTE

Only the basic tuning parameters during the tuning are shown in the figure

8.1.3 Tuning Process

The Drive provides a variety of tuning methods, you can adjust the device according to the process shown in **Error! Reference source not found.**, in order to obtain the desired Servo performance.

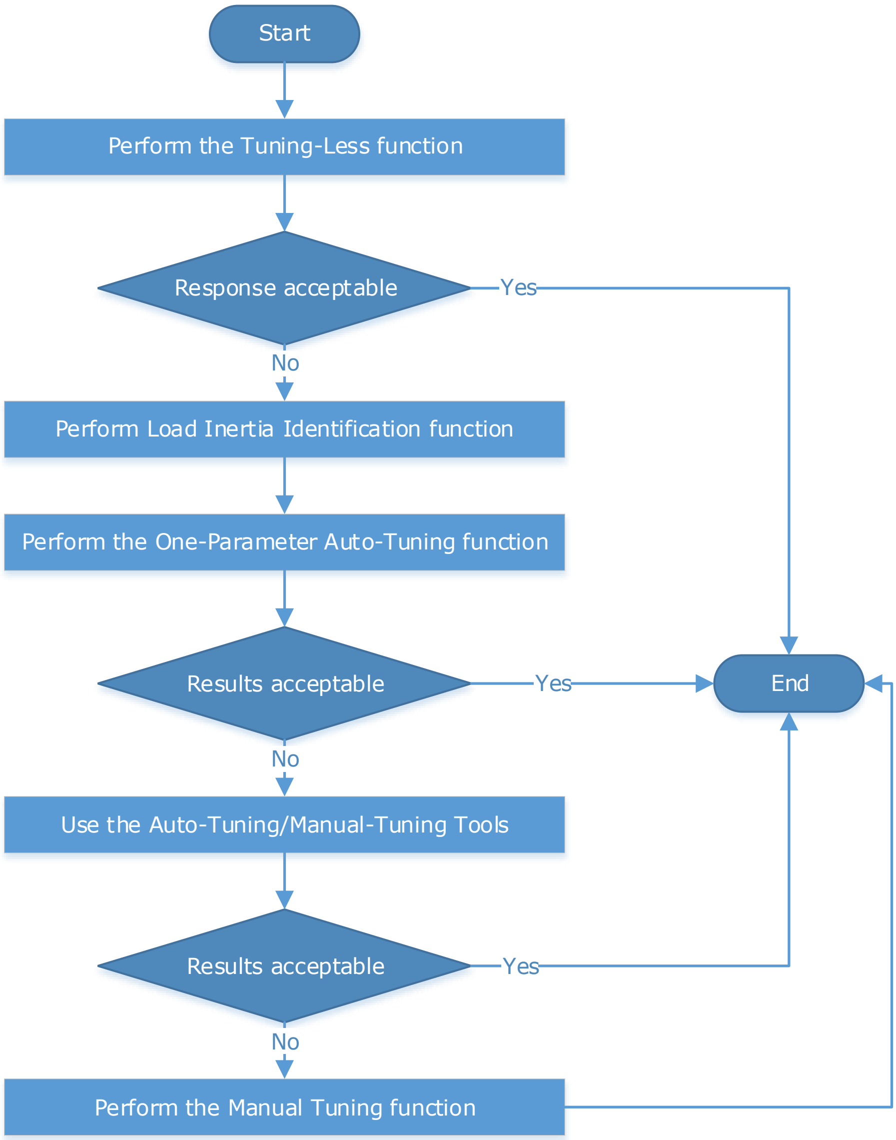


Figure 8-3 Tuning Process

IMPORTANT

It is necessary to perform the tuning operation again if the Motor had been disassembled or the load device had been replaced.

8.1.4 Precautions Before Tuning

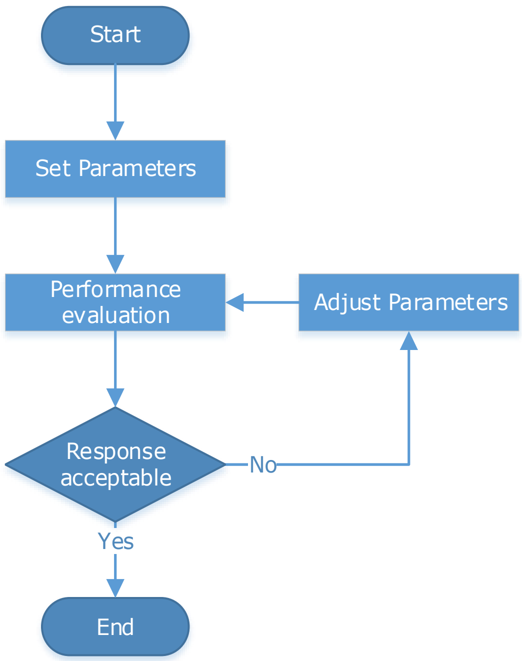
WARNING

- Before performing the tuning operation, make sure the limit function is available.
- Before performing the tuning operation, make sure that an emergency stop can be performed at any time.
- Before performing the tuning operation, you shall set the torque limit according to actual condition.
- Never touch the moving parts during the tuning operation.

8.2 Tuning Modes

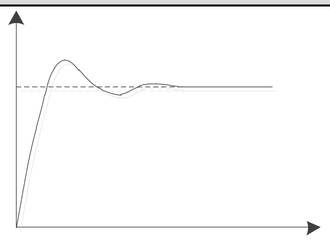
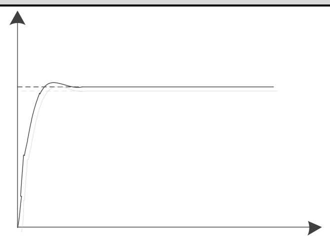
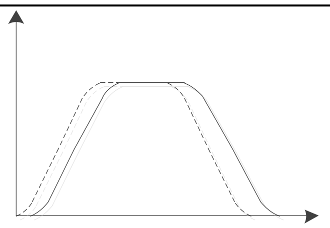
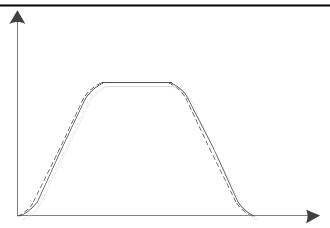
Tuning is the process of satisfying the servo performance by adjusting the parameters involved in the control law.

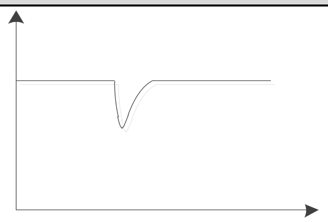
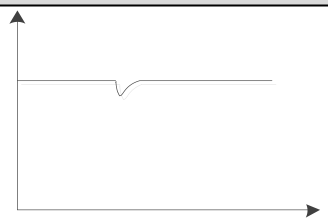
The process of tuning is usually an iterative process; the figure below shows the general flow



There are various indicators used to evaluate servo performance including bandwidth, response time, overshoot, steady state error, anti-load disturbance, speed ripple fluctuation, torque ripple, etc. The importance of these will depending on the application.

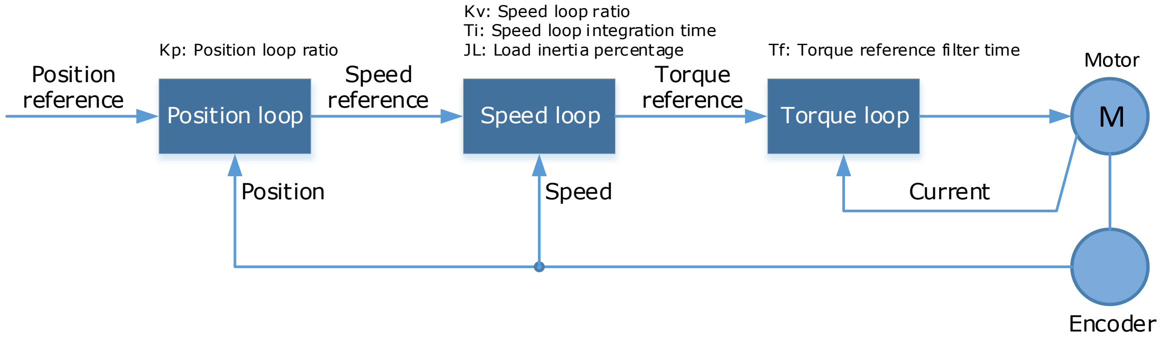
The table below shows examples of speed vs time graphs showing the comparison of before and after tuning.

Indicator	Before tuning	After tuning
Speed step response		
Position following		

Indicator	Before tuning	After tuning
Anti-load disturbance		

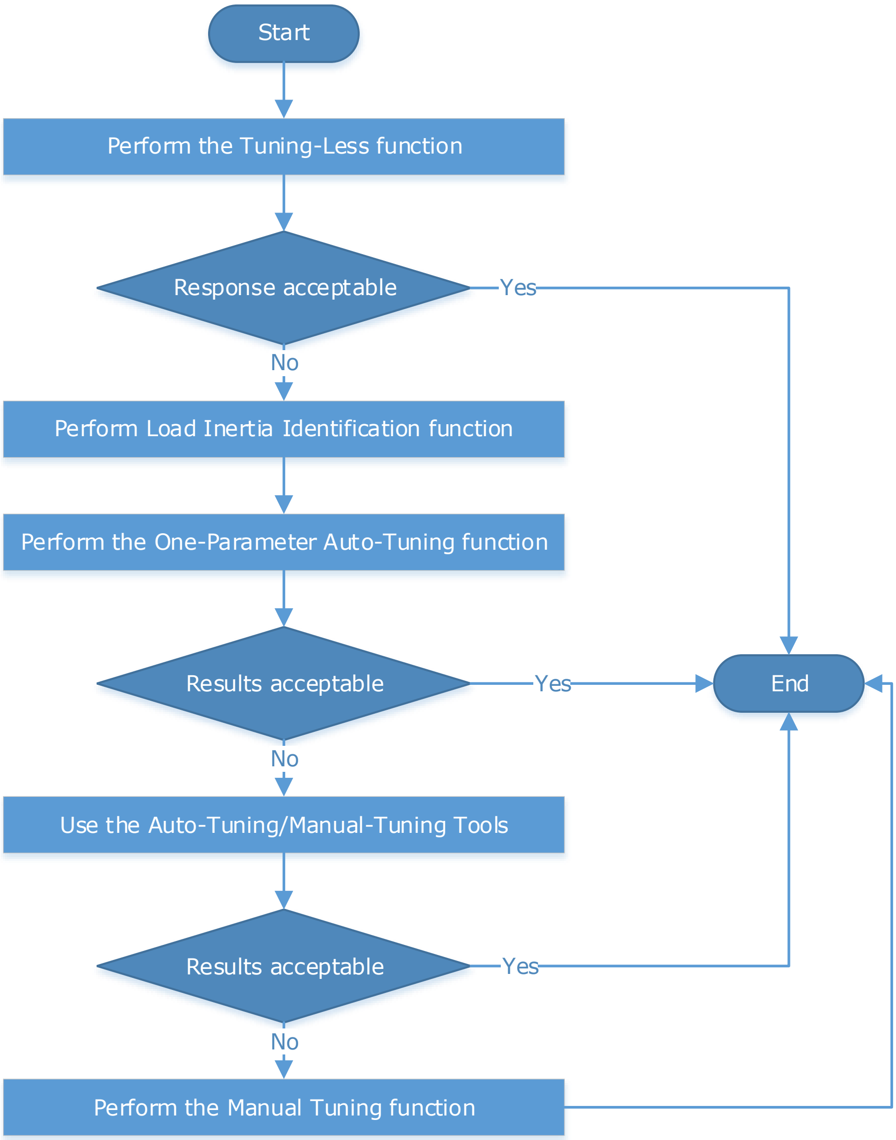
8.3 Tuning Process

When tuning a servo drive is if helpful to understand the servo control principle used. The figure below shows the servo control block diagram. The position loop, the speed loop and the torque loop are cascaded structures, corresponding to the position control mode, the speed control mode and the torque control mode respectively.



NOTE Only the basic tuning parameters during the tuning are shown in the figure

Generally, for tuning the drive follow the process below.



IMPORTANT	It will be necessary to perform the tuning operation again if the motor has been disassembled or the load device had been replaced.

WARNING	Before performing the tuning operation, make sure the limit function is available. Before performing the tuning operation, make sure that an emergency stop can be performed at any time. Before performing the tuning operation, you shall set the torque limit according to actual condition. Never touch the moving parts during the tuning operation.

8.4 Tuning Modes

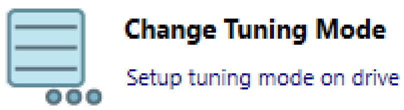
The drive supports 3 different tuning modes and different features are available in each mode.

Tuning-less: the drive performs auto-tuning to obtain a stable response regardless of the type of machine or changes in the load.

One-Parameter Auto-Tuning: similar to the tuning-less function but requires an inertia measurement of the load and uses a rigidity parameter to control the system bandwidth.

Manual Tuning: all gain terms are manually adjusted

The tuning mode can be changed from the Tuning page in the drive commissioning screens. Click on the 'Change Tuning Mode' button.



This will launch a wizard to guide the change of tuning mode.

Alternatively, the tuning mode can be changed by directly writing to parameter Pn100.0.

Parameter	Setting	Meaning
Pn100.0	1 [Default]	Tuning-less
	2	*Reserved*
	3	One-Parameter Auto-Tuning
	4	*Reserved*
	5	Manual tuning

Once the tuning mode has been changed the drive will require a re-start for the new selection to apply.

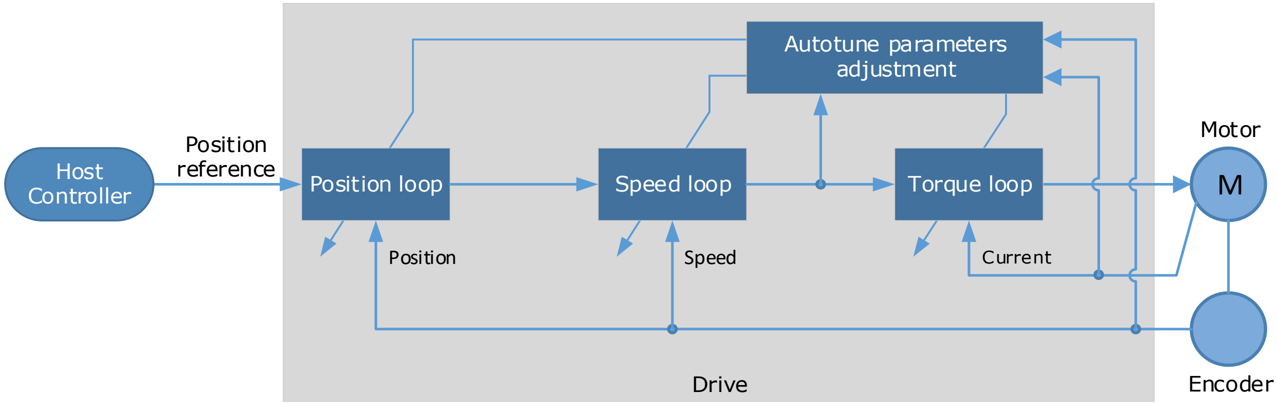
The table below show a summary functions available in each mode:

Function	Tuning-less	One-Parameter	Manual
Feedforward (Velocity and Torque)	Yes	Yes	Yes
Friction Compensation	Yes	Yes	Yes
Feedback Speed Selection	No	Yes	Yes
Load Torque Compensation	No	Yes	Yes
Damping Selection	No	Yes	No
Automatic Vibration Suppression	Yes	Yes	Yes
Intermediate Frequency Vibration Suppression	Yes	Yes	Yes
Notch Filter	Yes	Yes	Yes
Load Oscillation Suppression	No	No	Yes
P / PI Switching	No	Yes	Yes
Gain Switching	No	No	Yes
Model Following Control	No	No	Yes

8.4.1 Tuningless

In Tuning-less mode the drive performs auto-tuning to obtain a stable response regardless of the type of machine or changes in the load. Autotuning is started when the servo is turned on.

The tuning-less function uses an Autotune parameters adjustment module that updates the position loop and speed loop parameters in real time based on the servo operating state (position, speed, current). The figure below shows the block diagram in tuning-less.



When using the tuning-less function, the following parameters are automatically adjusted.

Parameter	Adjustment method
Speed Loop Gain	Auto-tuning
Speed Loop Integral Time	Auto-tuning
Position Loop Gain	Auto-tuning
Torque Command Filter Time	Auto-tuning
Load Inertia Percentage	Auto-tuning

NOTE The gain terms used by the tuning-less model are not shown in the drive parameters

Use Case

Applicable for applications where the motor / load inertia mismatch is no more than 30 times.

Applicable for applications of any motor speed.

Parameters

Parameter	Setting	Description
Pn100.0	1 [Default]	Set the **Tuning Mode** as **Tuning-less**.

Changing the tuning mode will require the drive to be restarted.

Restrictions

The following table shows a summary of functions available in tuning-less mode.

Function	Tuning-less
Feedforward (Velocity and Torque)	Yes
Friction Compensation	Yes
Automatic Vibration Suppression	Yes

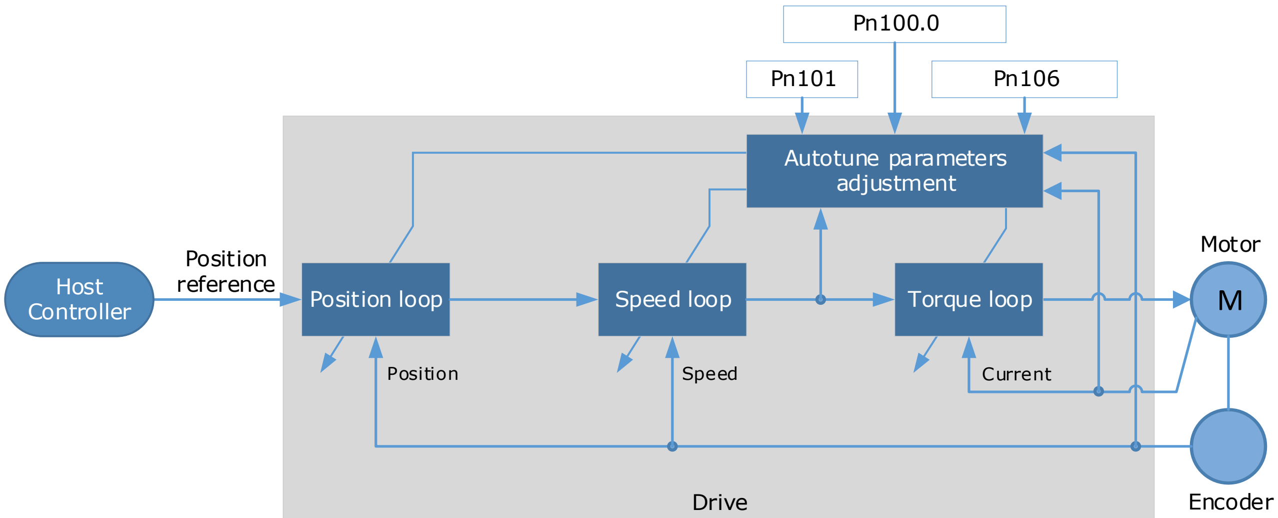
Function	Tuning-less
Intermediate Frequency Vibration Suppression	Yes
Notch Filter	Yes

8.4.2 One-Parameter Auto Tuning

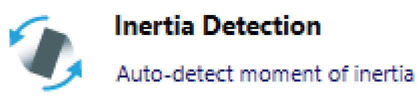
This tuning function is similar to the tuning-less function, using an Autotune parameters adjustment module that updates the position loop and speed loop parameters in real time based on the servo operating state (position, speed, current).

One-Parameter Auto Tuning may offer some advantages over Tuning-less mode due to:

- Tuning is based on a proper load inertia percentage so tends to offer improved performance.
- The user selection of rigidity means that the tuning mode can be applied to more operating conditions.



One-Parameter Auto Tuning requires an inertia measurement of the load. The drive can measure the load inertia using the Inertia Detection tool, which can be launched from the Tuning page in the drive commissioning screens

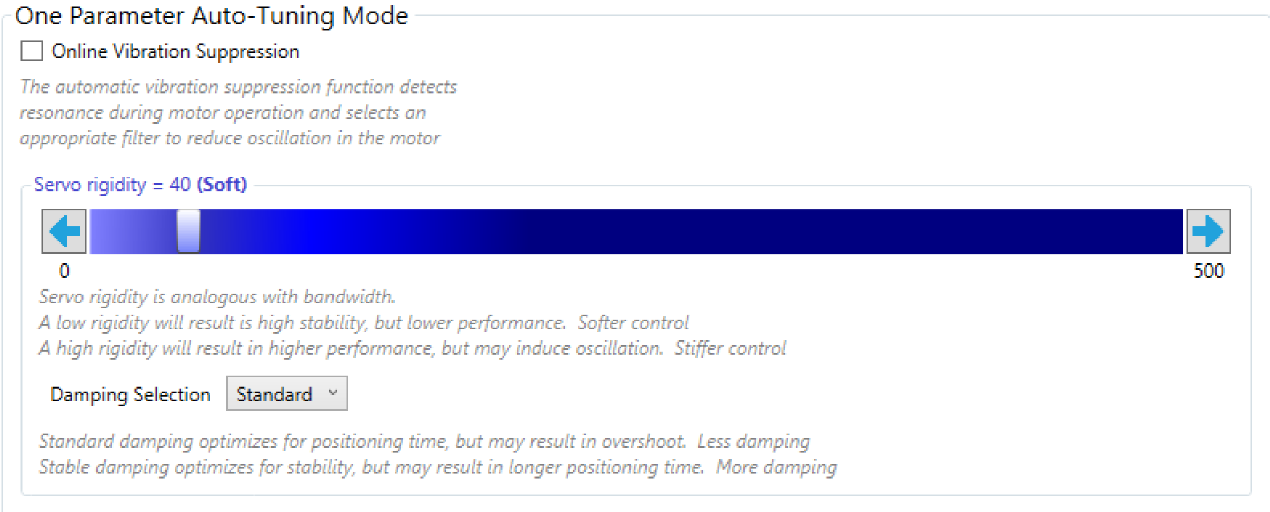


This will launch a wizard to guide the process of inertia detection.

Alternatively, the inertia can be entered by directly writing to parameter Pn106.

Parameter	Name	Description
Pn106	Load Inertia Percentage	Ratio of Motor inertia to load inertia

The stiffness of the control is selected by a rigidity parameter. This can be adjusted by a slider on the Tuning page in the drive commissioning screens.

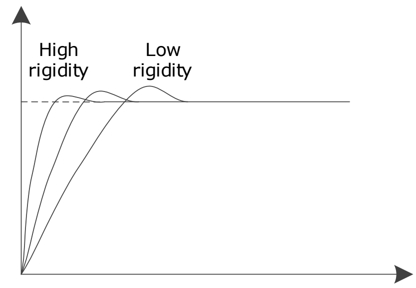


Alternatively, the rigidity can be entered by directly writing to parameter Pn101.

Parameter	Name	Description
Pn101	Servo Rigidity	Determines the response characteristic of the position loop or speed loop.

A lower number corresponds to a lower rigidity, less stiff. This will provide a slower response.

A higher number corresponds to a higher rigidity, more stiff. This will provide a faster response but taken too far may result in oscillation.



When using the One-Parameter Auto-Tuning function, the following parameters are automatically adjusted.

Parameter	Adjustment method
Speed Loop Gain	Auto-tuning
Speed Loop Integral Time	Auto-tuning
Position Loop Gain	Auto-tuning
Torque Command Filter Time	Auto-tuning

NOTE

The gain terms used by the one-parameter model are not shown in the drive parameters

Use Case

Applicable for applications where the motor / load inertia mismatch is no more than 50 times.

Applicable for applications of any motor speed.

Parameters

Parameter	Setting	Meaning
Pn100.0	3	Set the Tuning Mode as One-Parameter Auto-Tuning.
Pn100.3	0 [Default]	Set the damping method in One-Parameter Auto-Tuning as Standard.
	1	Set the damping method in One-Parameter Auto-Tuning as Stable.
Pn101	–	Servo Rigidity (setting depends on application)
Pn106	–	Load Inertia Percentage (setting depends on application)

Changing the tuning mode will require the drive to be restarted.

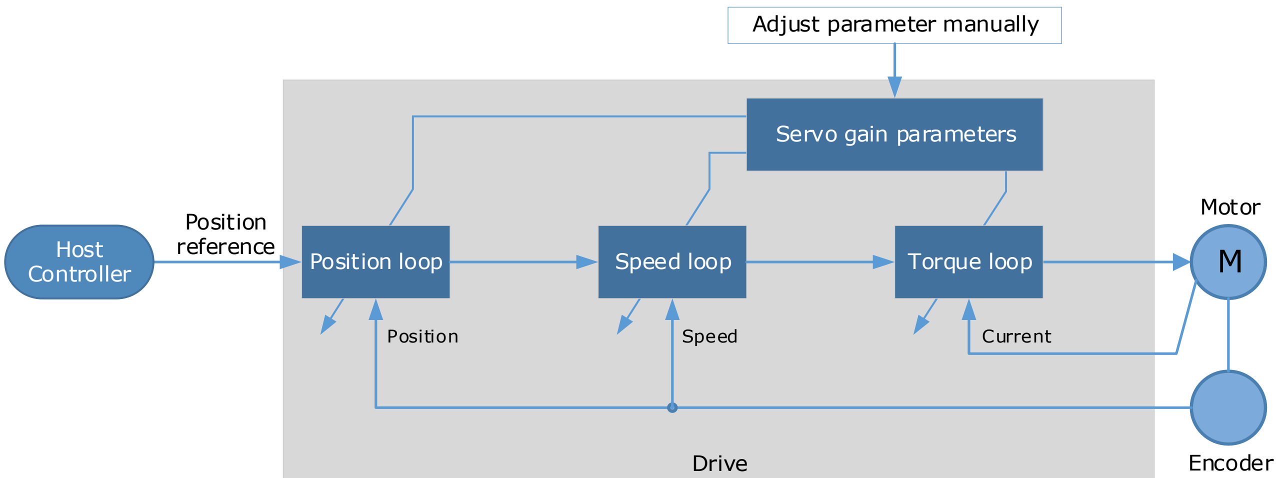
Restrictions

The following table shows a summary of functions available in one-parameter auto-tuning mode.

Function	One-Parameter
Feedforward (Velocity and Torque)	Yes
Friction Compensation	Yes
Feedback Speed Selection	Yes
Load Torque Compensation	Yes
Damping Selection	Yes
Automatic Vibration Suppression	Yes
Intermediate Frequency Vibration Suppression	Yes
Notch Filter	Yes
P / PI Switching	Yes

8.4.3 Manual Tuning

In the Manual Tuning, the gain parameters are manually adjusted without using the autotune parameter adjustment module, until the desired performance is achieved.



It is necessary to adjust the three-loop control parameters of the Servo from the inside out, that is, the adjustment sequence is Torque loop → Speed loop → Position loop. In order to maintain stability, the bandwidth setting should be the largest in the torque loop, then the speed loop, and the position loop should be smallest.

The following parameters need to be adjusted in each loop when performing Manual Tuning.

Torque loop (Torque Control Mode)

- Torque Reference Filter Time (Tf):

The torque reference filter applies to the torque reference to remove the high frequency components, which can effectively reduce the torque ripple of the motor output, eliminate signal noise and reduce the temperature rise of the motor.

The larger the Torque Reference Filter Time, the better the filtering effect on the torque reference. However, the greater the phase lag, and the slower the torque response. Therefore, the smallest acceptable value should be set to obtain a larger torque loop bandwidth in the actual tuning.

Speed loop (Speed Control Mode)

- Relevant parameter in torque loop (Tf)
- Load Inertia Percentage (JL)

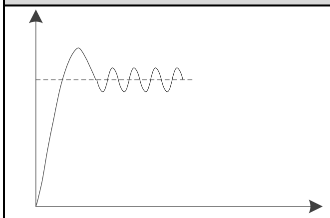
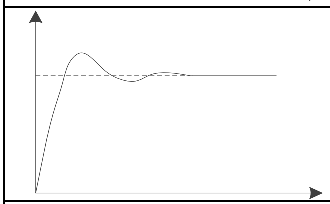
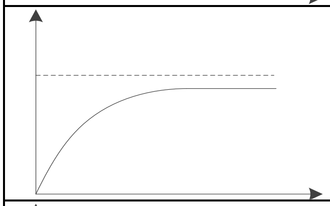
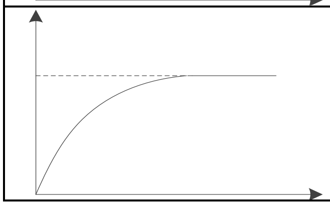
Properly setting the Load Inertia Percentage is a prerequisite for the tuning to obtain the best performance. This can be calculated manually or measured using the Inertia Detection tool which is accessible from the Tuning page in the drive commissioning screens.

- Speed Loop Gain (Kv), Speed Loop Integral Time (Ti)

The speed loop is controlled using a Proportional-Integral Controller that contains Speed Loop Gain and Speed Loop Integral Time. Both determine the speed loop bandwidth and anti-disturbance performance of the Servo.

In general, increasing the setting of the Speed Loop Gain will increase the speed loop bandwidth, and the anti-load disturbance performance will be better. Decreasing the setting of the Speed Loop Integral Time will strengthen the integral action, the speed loop bandwidth will be increased, and the anti-load disturbance performance will be better. In addition, the integral action may reduce the steady-state error to zero.

The table below lists several commonly used adjustment methods based on the characteristics of the speed step response.

Response Curve	Description	Adjustment method
	Speed loop bandwidth is high	Properly decrease the Speed Loop Gain or increase the Speed Loop Integral Time.
	Speed loop damping ratio is low	Properly increase the Speed Loop Integral Time.
	Steady-state error is existed	Properly decrease the Speed Loop Integral Time.
	Speed loop bandwidth is low	Properly increase the Speed Loop Gain or decrease the Speed Loop Integral Time.

It is recommended to increase the Speed Loop Gain and decrease the Speed Loop Integral Time to obtain a larger speed loop bandwidth.

Position loop (Position Control Mode)

- Relevant parameters in speed loop (Kv, Ti, Tf, and JL)
- Position Loop Gain (Kp)

The position loop is controlled using a Proportional Controller that only contains the Position Loop Gain. This parameter determines the position loop bandwidth. Increasing the Position Loop Gain will increase the position loop bandwidth, and the anti-load disturbance performance will be better. If the Position Loop Gain is too high this will cause overshooting and vibration.

It is recommended to set the Position Loop Gain to a quarter of the Speed Loop Gain, and make appropriate adjustments based on this.

Access to all control law parameters is available from the Tuning page or the Parameter page in the drive commissioning screens.

Use Case

Applicable for applications where the motor / load inertia mismatch is no more than 50 times.

Applicable for applications of any motor speed.

Parameters

The parameters for manual tuning are:

Block	Parameter	Name
Position Control	Pn104	Position Loop Gain
Position Control	Pn109	Second Position Loop Gain
Speed Feedforward	Pn112	Speed Feedforward
Speed Feedforward	Pn113	Speed Feedforward Filter Time
Speed Control	Pn102	Speed Loop Gain
Speed Control	Pn107	Second Speed Loop Gain
Speed Control	Pn103	Speed Loop Integral Time
Speed Control	Pn108	Second Speed Loop Integral Time
Speed Control	Pn106	Load Inertia Percentage
Torque Feedforward	Pn114	Torque Feedforward
Torque Feedforward	Pn115	Torque Feedforward Filter Time
Anti-resonance Filter	Pn173	Frequency of Vibration Suppression Filter
Anti-resonance Filter	Pn175	Vibration Suppression
Speed Filter	Pn135	Encoder Speed Filter Time
Notch Filter	Pn181	Frequency of Notch Filter 1
Notch Filter	Pn182	Depth of Notch Filter 1
Notch Filter	Pn183	Width of Notch Filter 1
Notch Filter	Pn184	Frequency of Notch Filter 2
Notch Filter	Pn185	Depth of Notch Filter 2
Notch Filter	Pn186	Width of Notch Filter 2
Notch Filter	Pn187	Frequency of Notch Filter 3

Block	Parameter	Name
Notch Filter	Pn188	Depth of Notch Filter 3
Notch Filter	Pn189	Width of Notch Filter 3
Torque Filter	Pn105	Torque Reference Filter Time
Torque Filter	Pn110	Second Torque Reference Filter Time
Torque Limit	Pn401	Forward Internal Torque Limit
Torque Limit	Pn402	Reverse Internal Torque Limit

Restrictions

The following table shows a summary of functions available in manual tuning mode.

Function	Manual
Feedforward (Velocity and Torque)	Yes
Friction Compensation	Yes
Feedback Speed Selection	Yes
Load Torque Compensation	Yes
Automatic Vibration Suppression	Yes
Intermediate Frequency Vibration Suppression	Yes
Notch Filter	Yes
Load Oscillation Suppression	Yes
P / PI Switching	Yes
Gain Switching	Yes
Model Following Control	Yes

8.5 Compensation

The Drive offers several compensation techniques which can be used in various tuning modes to improve performance.

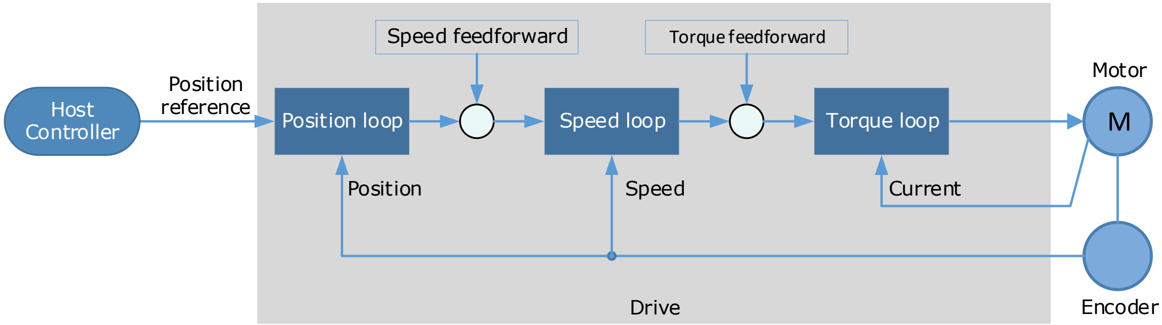
8.5.1 Feedforward

The table below shows the tuning modes where the feed forward function can be used.

Feedforward function	Available
Tuning-less	Yes
One-Parameter Auto Tuning	Yes
Manual Tuning	Yes

Feedforward includes both speed feedforward and torque feedforward.

- Speed feedforward can improve position response and reduce position following error
- Torque feedforward can improve the speed response and reduce the speed following error



In general, the differential of the position reference is used as the feedforward. This is known as an internal feedforward reference and is the default mode of operation. Other options are available for generating the feedforward reference.

- Internal Feedforward (default)
- Model Following Feedforward, available when Model Following Control is selected
- Cubic feedforward

Internal Feedforward

When using internal feedforward the reference is calculated using:

- Internal Speed Feedforward =

  Differential of position reference × Speed Feedforward
- Internal Torque Feedforward =

  Differential of speed reference × Load Inertia Percentage × Torque Feedforward
- Increasing the feedforward term will tend to reduce error during periods where the reference is constant. i.e. during periods of constant speed, the speed feed forward will allow to the control scheme to reduce following error, however the feedforward can introduce overshoot.

In addition, it may be required to filter the noise caused by the differential for the feedforward. Increasing the filter time will reduce the noise but may increase the overshoot.

In the case of high rotation speed, it may be necessary to use the high-speed torque feed forward function, this is selected by setting parameters:

- Pn005.0 to 2 (select high-speed internal torque feedforward)
- Pn005.2 to 0 (use internal torque feedforward)

Model Following Control Feedforward

This is only available when the Model Following Control function has been enabled.

For details on this method, refer to the section 8.8 Model Control Following.

Cubic Interpolation

Uses a cubic algorithm for interpolation of the reference

Parameters

Parameter	Setting	Meaning
Pn005.0	0	Use the general internal torque feedforward.
	2	Use the high-speed internal torque feedforward.
Pn005.2	0	Use the internal torque feedforward.
	1	Use the model following control torque feedforward, which is available when Model Following Control Selection is enabled.
	2	*Reserved*

Parameter	Setting	Meaning
	3	Use the torque feedforward generated by Cubic interpolation algorithm.
Pn005.3	0	Use the internal speed feedforward.
	1	Use the model following control speed feedforward, which is available when Model Following Control Selection is enabled.
	2	*Reserved*
	3	Use the speed feedforward generated by Cubic interpolation algorithm.
Pn112	–	Speed Feedforward
Pn113	–	Speed Feedforward Filter Time
Pn114	–	Torque Feedforward
Pn115	–	Torque Feedforward Filter Time

8.5.2 Friction Compensation

The table below shows the tuning modes where the friction compensation function can be used.

Friction Compensation function	Available
Tuning-less	Yes
One-Parameter Auto Tuning	Yes
Manual Tuning	Yes

Load friction will exist in the transmission system. However, severe load friction may cause low-speed crawling, waveform distortion at speed zero-crossing, positioning lag, etc. This can affect the dynamic and static performance of the system. The friction compensation function allows the drive to compensate for this and may be a requirement in applications with frequent forward and reverse motion, and high speed-stability requirements.

Friction compensation is used to compensate for both viscous friction fluctuations and coulomb friction fluctuations.

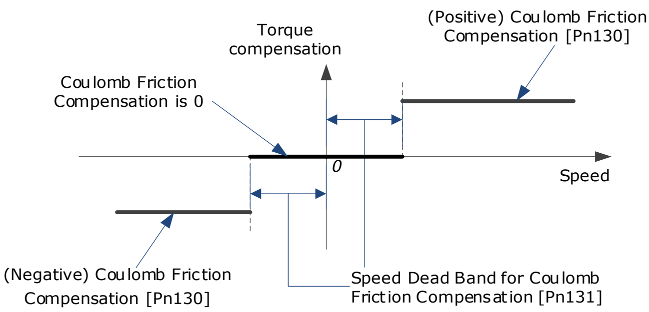
Coulomb Friction Compensation

Coulomb friction compensation is controlled though parameters Pn130 and Pn131.

Parameter	Setting	Meaning
Pn130	–	Coulomb Friction Compensation in 0.1% units of rated torque
Pn131	–	Speed Dead Band for Coulomb Friction Compensation in rpm

The application of coulomb friction compensation is symmetrical around zero speed. It is advisable to set a dead band for the friction compensation to avoid the system changing the compensation direction frequently near zero speed.

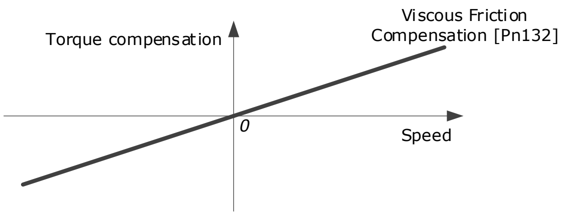
The diagram below shows the application of coulomb friction compensation.



Viscous friction compensation is controlled though parameter Pn132.

Parameter	Setting	Meaning
Pn132	–	Viscous Friction Compensation in 0.1% per 1000rpm

The application of viscous friction compensation is a linear relationship with the actual speed, as is shown below.



As the speed increase, so the viscous friction compensation increases with a rate defined by the Viscous Friction Compensation parameter.

8.5.3 Speed Feedback Selection

The table below shows the tuning modes where the speed feedback function can be used.

Speed Feedback function	Available
Tuning-less	No
One-Parameter Auto Tuning	Yes
Manual Tuning	Yes

By default, the speed feedback is calculated from by differentiating the positional value read from the encoder.

In the case of low speed or low encoder resolution, the method of position differentiation to calculate speed can introduce a large amount of noise in speed feedback which can affect the control performance.

To reduce the noise, a low pass filter can be applied to eliminate the noise and high-frequency components from the speed signal. The speed filter is controller though the Encoder Speed Filter Time parameter.

Parameter	Setting	Meaning
Pn135	–	Encoder Speed Filter Time in 0.01ms

Increase the time constant of the filter will have a stronger effect on the noise resulting in a smoother speed signal. But a strong filter will introduce phase lag, which can reduce the servo performance.

An alternative to using encoder position to calculate speed is to use a speed observer, this can provide a less noisy speed. The observed speed can be tuned to match actual speed using the Load Torque Observer Gain; however, this may introduce overshoot.

Parameter	Setting	Meaning
Pn161	–	Load Torque Observer Gain
Pn162	0 [Default]	Use encoder speed as the feedback speed.
	1	Use observed speed as the feedback speed.

8.5.4 Load Torque Compensation

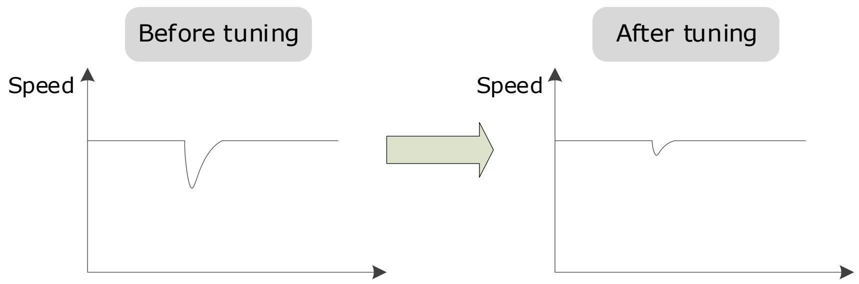
The table below shows the tuning modes where the load torque compensation function can be used.

Load Torque Comp. function	Available
Tuning-less	No
One-Parameter Auto Tuning	Yes
Manual Tuning	Yes

Sudden changes in load torque can significantly affect the speed control during operation. A step change in load torque will generally introduce a decrease in speed which will take some time for the control to rectify.

In applications with continuously changing load torque it is necessary to improve the anti-load disturbance performance of the servo.

The figure below shows the speed drop caused by a sudden load torque. The load torque compensation function can be used to reduce the effect of the load torque change.



Tuning the load torque compensation function can be used to improve the anti-load disturbance performance, considering that the reference response performance and the load disturbance resistance cannot be balanced.

The Load Torque Compensation function adjusts compensation to the torque reference via an observer function. To reduce the overshoot caused by Load Torque Compensation, use the load torque compensation percentage to adjust the compensation value:

Load Torque Compensation = Load Torque Observer × Load Torque Compensation Percentage

Parameter	Setting	Meaning
Pn160	–	Load Torque Compensation Percentage

Increasing this value can improve the load disturbance rejection performance. Too much may cause vibration and overshoot.

In addition, the bandwidth of the load torque observer can be changed via Load Torque Observer Gain. Increasing this will make the observed torque closer to the actual torque but may generate overshoot.

Parameter	Setting	Meaning
Pn161	–	Load Torque Observer Gain

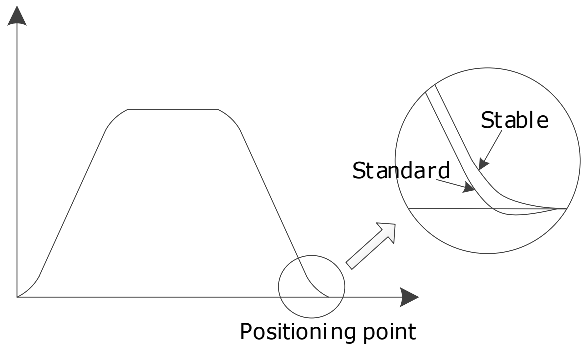
8.5.5 Damping Selection

The table below shows the tuning modes where the damping selection function can be used.

Damping Selection function	Available
Tuning-less	No
One-Parameter Auto Tuning	Yes
Manual Tuning	No

The Damping Selection selects between 2 damping options.

- [0] Standard: Short positioning time, but prone to overshoot.
- [1] Stable: Longer positioning time, but stable.



The damping selection can be made from the Tuning page in the drive commissioning screens.

Alternatively, the damping selection can be changed by directly writing to parameter Pn100.3.

Parameter	Setting	Meaning
Pn100.3	0 [Default]	Shorter positioning time, but prone to overshoot
	1	Longer positioning time, but stable

8.6 Vibration Suppression

The Drive offers several vibration suppression techniques which can be used in various tuning modes to improve performance.

8.6.1 Automatic Vibration Suppression

The table below shows the tuning modes where the automatic vibration suppression function can be used.

Automatic Vibration Suppression	Available
Tuning-less	Yes
One-Parameter Auto Tuning	Yes
Manual Tuning	Yes

The automatic vibration suppression function determines the vibration state of the Motor during operation and identifies the resonant frequency. It then selects either the Notch Filter or the IF Vibration

Parameter	Setting	Meaning
Pn179	–	Amplitude Threshold for Vibration Detection

Suppression according to the characteristics of the vibration. It will set the parameters for IF Vibration Suppression or Notch Filter 2, depending on what is required.

Automatic Vibration Suppression can be enabled from the Tuning screen in the drive parameter pages.

Alternatively, the this can be controlled by directly writing to parameter Pn100.2.

Parameter	Setting	Meaning
Pn100.2	0 [Default]	Automatic Vibration Suppression is disabled.
	1	Automatic Vibration Suppression is enabled.

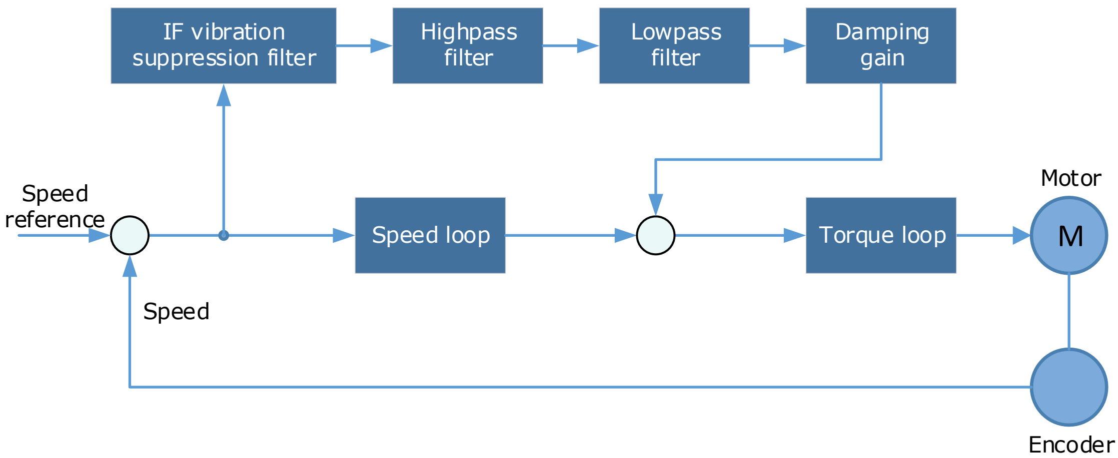
To prevent the automatic vibration suppression acting on incorrect vibrations an amplitude threshold can be applied can. This will prevent the vibration suppression acting on any detected frequency unless it exceeds the threshold.

8.6.2 IF (Intermediate Frequency) Vibration Suppression

The table below shows the tuning modes where the IF vibration suppression function can be used.

IF Vibration Suppression	Available
Tuning-less	Yes
One-Parameter Auto Tuning	Yes
Manual Tuning	Yes

The IF vibration suppression filter is used to process the speed deviation and provide compensation to the torque reference. It is applied for the frequency range 100 Hz to 2000 Hz.



Parameter	Setting	Meaning
Pn173	–	Frequency centre at which vibration suppression is performed
Pn174	–	Bandwidth of the vibration suppression filter. Indicates the range of the adjustment filter around the centre frequency. Increasing this setting can increase the range of vibration suppression, but it will affect the phase of the frequency near the centre
Pn175	–	Vibration Suppression

Parameter	Setting	Meaning
Pn176	–	Low pass Filter Time for Vibration Suppression
Pn177	–	High pass Filter Time for Vibration Suppression
Pn178	–	Level of the final compensated IF vibration suppression

NOTE: Set Pn173 to 2000, indicating the notch filter is unavailable

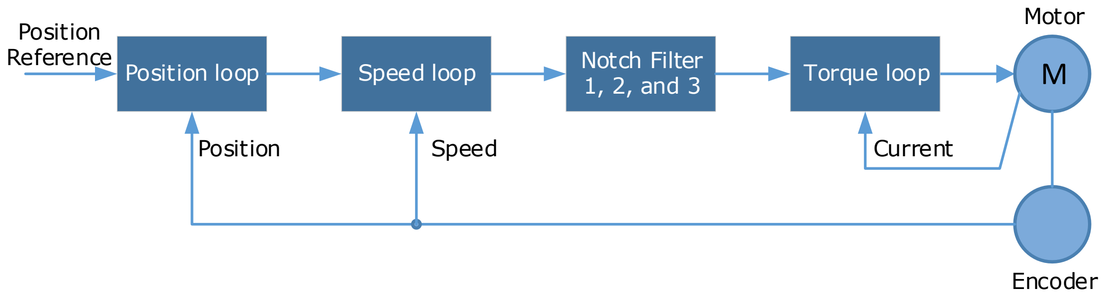
8.6.3 Notch Filter

The table below shows the tuning modes where the notch filter function can be used.

Notch Filter	Available
Tuning-less	Yes
One-Parameter Auto Tuning	Yes
Manual Tuning	Yes

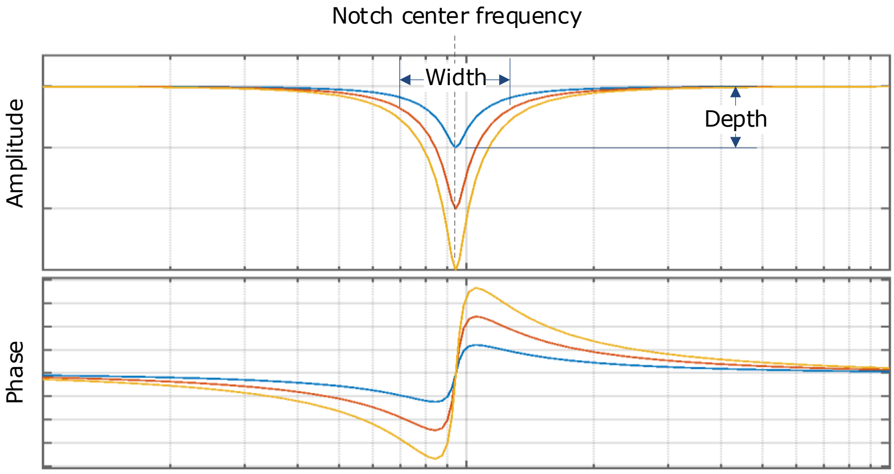
The notch filter is used to eliminate vibration caused by mechanical resonance.

There are three notch filters in the Drive, those who can used independently or in combination.



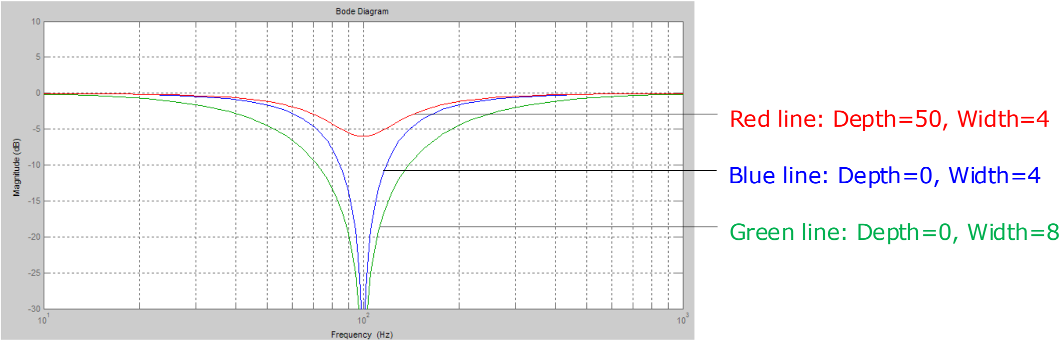
The diagram below shows the relevant parameters for the notch filter.

Notch filter can attenuate the signal at a specific frequency so can be very useful in removing resonance. Setting a correct frequency and width the vibration signal in the torque reference can be filtered out.



Parameters controlling the operation of notch filter are:

- Frequency, setting the frequency of notch filter to 5000 will disable the notch filter.
- Depth, the range of depth is from 0 to 23.
- Width, the range of width is from 0 to 15.



The notch filter parameters can be set from the Tuning page in the drive commissioning screens.

Alternatively, the filters can be configured by directly writing to the parameters.

Parameter	Setting	Meaning
Pn181	–	Frequency of Notch Filter 1
Pn182	–	Depth of Notch Filter 1
Pn183	–	Width of Notch Filter 1
Pn184	–	Frequency of Notch Filter 2
Pn185	–	Depth of Notch Filter 2
Pn186	–	Width of Notch Filter 2
Pn187	–	Frequency of Notch Filter 3
Pn188	–	Depth of Notch Filter 3
Pn189	–	Width of Notch Filter 3

8.6.4 Load Oscillation Suppression

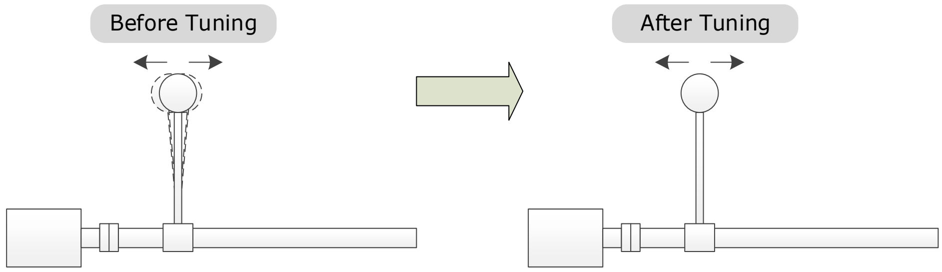
The table below shows the tuning modes where the load oscillation suppression function can be used.

Load Oscillation Suppression	Available
Tuning-less	No
One-Parameter Auto Tuning	No
Manual Tuning	Yes

NOTE

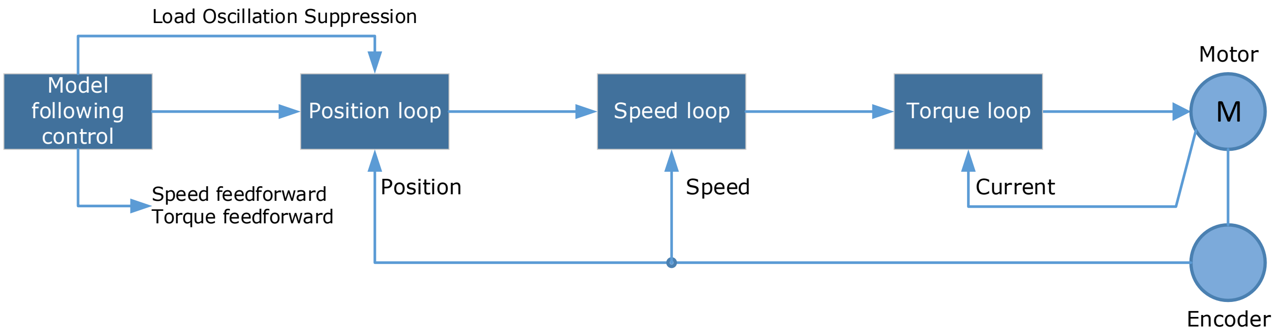
This cannot be used in fully-closed loop control (dual encoder feedback).

The Load Oscillation Suppression function is used for suppressing low frequency jitter at the end of the load during position control.



The aim of the Model Following Control is to maintain the stability of the load position based on a relationship between load position and Motor position. This is done by correcting the position reference and generating new speed and torque feedforward values.

The block diagram below shows Load Oscillation Suppression.



This function is based on the Model Following Control (8.8) and enabled via Pn150.

Parameter	Setting	Meaning
Pn150.0	2	Use the model following control and load oscillation suppression.

NOTE Changing the model following control mode will require the drive to be restarted.

Parameters controlling the operation of load oscillation suppression are:

- Frequency, which specifies the frequency at which Load Oscillation Suppression is to be performed.
- Filter Time, increasing this setting will strengthen the filter. However, it may reduce the suppression effect due to lag.
- Limit, which will clip the output of the Load Oscillation Suppression, helping to reduce overshooting during starting and stopping.

Parameter	Setting	Meaning
Pn155	–	Load Oscillation Frequency in Hz
Pn156	–	Filter Time for Load Oscillation Suppression
Pn157	–	Limit for Load Oscillation Suppression

8.7 Gain Scheduling

The Drive offers several gain scheduling techniques which can be used in various tuning modes to improve performance.

8.7.1 P/PI Switching

The table below shows the tuning modes where the P/PI switching function can be used.

P/PI Switching	Available
Tuning-less	No
One-Parameter Auto Tuning	Yes
Manual Tuning	Yes

By default, the Drive uses a Proportional-Integral (PI) Controller for the speed loop. This can be changed from PI to P control based on some reference condition using parameter Pn116.

Parameter	Setting	Meaning
Pn116	0 [Default]	Use torque reference as the condition (threshold setting: Pn117).
	1	Use position deviation counter as the condition (threshold setting: Pn118).
	2	Use acceleration reference as the condition (threshold setting: Pn119)
	3	Use the speed reference as the condition (threshold setting: Pn120).
	4	Fixed to PI Control.

NOTE Changing the P/PI switching condition will require the drive to be restarted

The relevant threshold parameters are shown in the table below.

Parameter	Setting	Meaning
Pn117	–	Torque Reference threshold
Pn118	–	Deviation Counter threshold
Pn119	–	Acceleration Reference threshold
Pn120	–	Speed Reference threshold

Consider the default settings as an example. The default setting is to use torque reference as the condition, and the default Torque Reference threshold (Pn117) is 200.

- When the torque reference percentage is less than 200, the speed loop adjustment will be PI control
- When the torque reference percentage is greater than 200, the speed loop adjustment will be P control

8.7.2 Gain Switching

The table below shows the tuning modes where the gain switching function can be used.

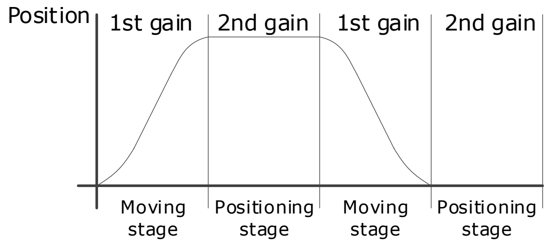
Gain Switching function	Available
Tuning-less	No
One-Parameter Auto Tuning	No
Manual Tuning	Yes

In manual tuning mode a gain switching function can be used which allows the drive to swap between two sets of gain parameters based on operating conditions.

The figure below shows an example:

- The ‘positioning’ gain terms focus on the performance such as position ripples and positional rigidity
- The ‘moving’ gain terms focus on the performance such as following error.

In this case, two switchable groups of gain parameters are required to meet the servo performance.

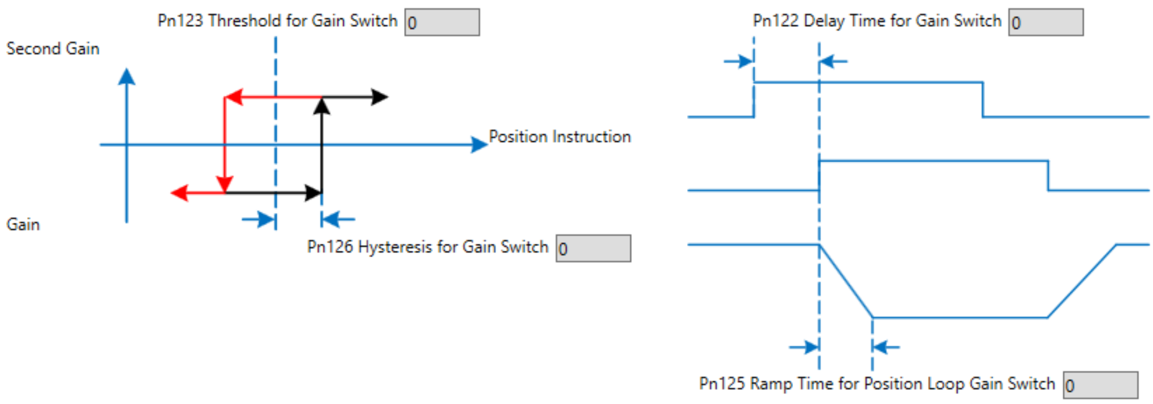


Gain switching can be enabled from the Tuning page in the drive commissioning screens. The conditions for gain switching are selected from a drop down.

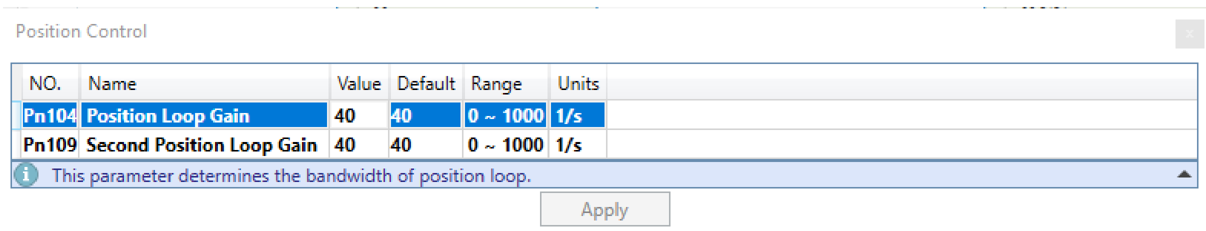
Options are:

- Fixed to first group gains.
- Use digital input (G-SEL) as the condition.
- Use torque reference as the condition.
- Use position deviation counter as the condition.
- Use acceleration as the condition.
- Use speed reference as the condition.
- Use position reference as the condition.
- Use actual speed as the condition.
- Use position reference and actual speed as the condition.
- Fixed to second group gains.
- Use positioning completed flag as the condition.

Once gain switching is selected the switch conditions will be shown.



And any additional gain terms parameters will be available from the control law block diagram


Position Control

NO.	Name	Value	Default	Range	Units
Pn104	Position Loop Gain	40	40	0 ~ 1000	1/s
Pn109	Second Position Loop Gain	40	40	0 ~ 1000	1/s

This parameter determines the bandwidth of position loop.

Apply

Alternatively, gain switching can be enabled by directly to the parameters.

Parameter	Setting	Meaning
Pn121	0 [Default]	Fixed to first group gains.
	1	Use digital input (G-SEL) as the condition.
	2	Use torque reference as the condition (threshold setting: Pn123).
	3	Use position deviation counter as the condition (threshold setting: Pn123).
	4	Use acceleration as the condition (threshold setting: Pn123).
	5	Use speed reference as the condition (threshold setting: Pn123).
	6	Use position reference as the condition (threshold setting: Pn123).
	7	Use actual speed as the condition (threshold setting: Pn123).
	8	Use position reference (Pn123) and actual speed (Pn124) as the condition.
	9	Fixed to second group gains.
	10	Use positioning completed flag as the condition.

NOTE

Changing the gain switching condition will require the drive to be restarted

The parameters for the first gain and the second gain terms are as follows.

Parameter	First Gain	Second Gain
Speed Loop Gain	Pn102	Pn107
Speed Loop Integral Time	Pn103	Pn108
Position Loop Gain	Pn104	Pn109
Torque Command Filter Time	Pn105	Pn110

8.8 Model Control Following

The table below shows the tuning modes where the model control following function can be used.

Model Control Following	Available
Tuning-less	No
One-Parameter Auto Tuning	No
Manual Tuning	Yes

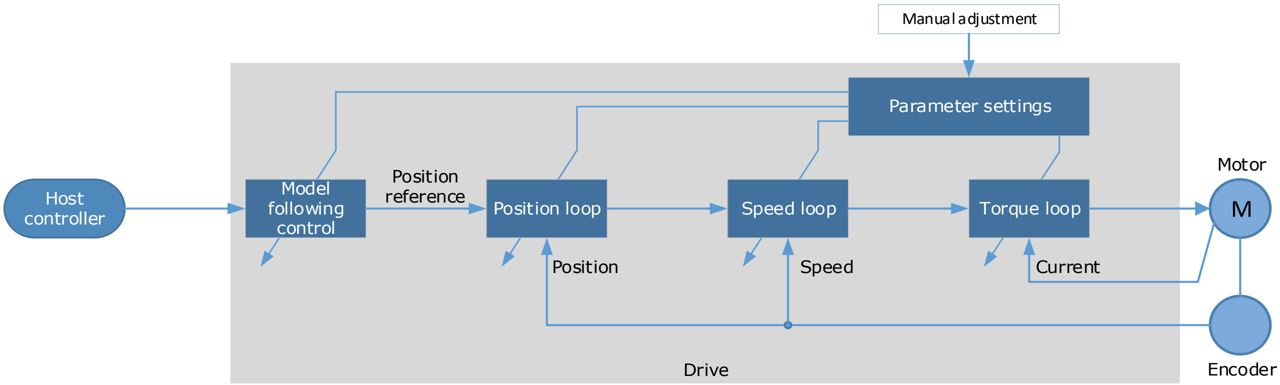
NOTE

This cannot be used in fully-closed loop control (dual encoder feedback).

The Model Following Control is a function which sits before the position loop. In Model Following Control, new position references are generated based on the theoretical Motor control model, and relevant speed feedforward and torque feedforward are generated.

Applying these controls to the actual control loop can significantly improve the response performance and positioning performance of the position control.

The block diagram below shows the implementation of model following control.



The Model Following Control function is enabled via Pn150.

Parameter	Setting	Meaning
Pn150.0	0 [Default]	Do not use Model Following Control.
	1	Use the model following control.
	2	Use the model following control and load oscillation suppression.

NOTE Changing the model following control mode will require the drive to be restarted

To use the Model Following Control properly, the system should be setup in the following order:

Torque Loop → Speed Loop → Position Loop → Model Following Control.

For details on the relevant parameter of Torque Loop, Speed Loop and Position Loop, refers to the section 8.4.3 Manual Tuning.

The relevant parameters for Model Following Control are as follows.

Parameter	Setting	Meaning
Pn151	–	Model Following Control Gain
Pn152	–	Model Following Control Gain Correction
Pn153	–	Model Following Control Speed Feedforward (conditional on Pn005.3=1)
Pn154	–	Model Following Control Torque Feedforward (conditional on Pn005.2=1)

The gain determines the position response performance. Increasing this setting can improve speed of response, but overshooting is likely to occur.

The gain correction determines the damping ratio.

The (speed/torque) feedforward is a percentage factor that is used to adjust the feedforward value.

8.9 Load Identification

There are several tools which can be used help the tuning process.

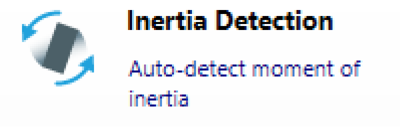
8.9.1 Load Inertia Identification

The table below shows the tuning modes where the load inertia identification function can be used.

Load Inertia Identification	Available
Tuning-less	No
One-Parameter Auto Tuning	Yes
Manual Tuning	Yes

The Load Inertia Identification function is used to calculate the load inertia relative to the Motor rotor inertia (percentage of load inertia).

The Load Inertia Identification function can be started from the Tuning page in the drive commissioning screens. Click on the 'Inertia Detection' button.



This will launch a wizard to guide the inertia detection sequence.

The identification routine will rotate the Motor back and forth either 4 or 8 times, during this movement the inertia is calculated. At the end of the identification routine, the result is displayed with the option to update the inertia value in Pn106.

To perform this function the Drive must be disabled.

WARNING

Ensure the movable parts have sufficient travel in the forward and reverse directions, as the Motor will run for up to 8 rotations during this operation.

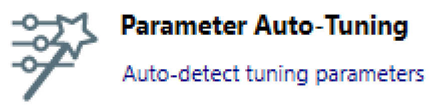
8.9.2 Auto-Tuning Tool

The table below shows the tuning modes where the auto tuning function can be used.

Auto-Tuning function	Available
Tuning-less	No
One-Parameter Auto Tuning	No
Manual Tuning	Yes

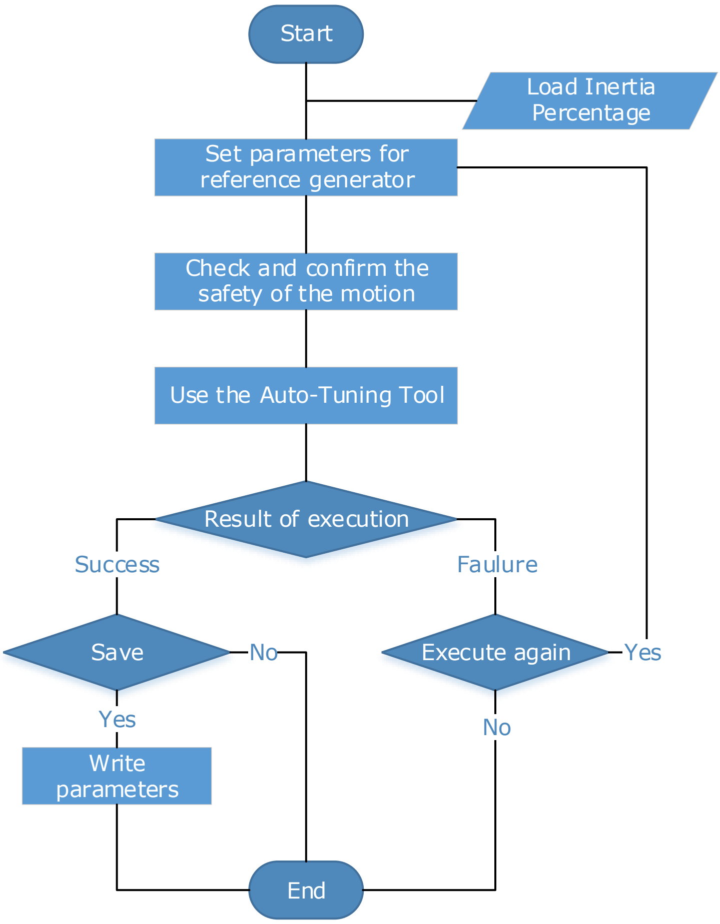
The Auto-Tuning Tool uses the drives internal position reference generator to exercise the Drive while iteratively changing the control parameters to achieve a tuned system.

The Auto-Tuning Tool can be started from the Tuning page in the drive commissioning screens. Click on the 'Parameter Auto Tuning' button.



This will launch a wizard to guide the parameter auto-tuning sequence.

The sequence is described in the flow chart below.



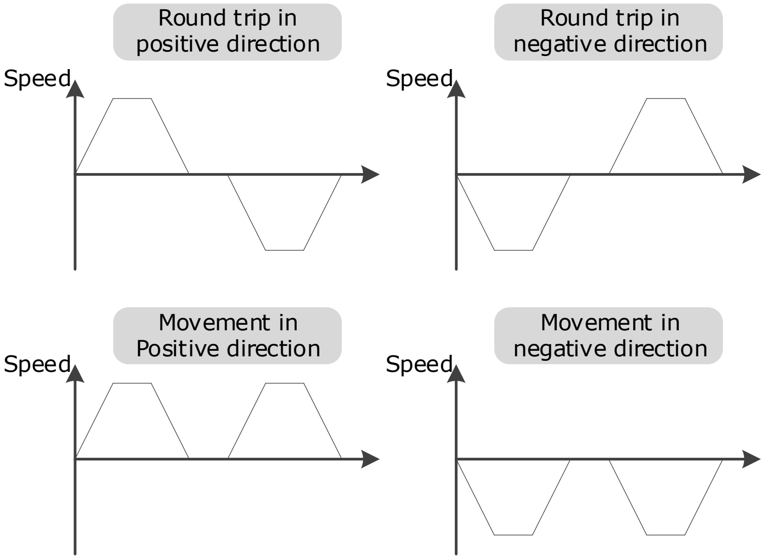
The steps in the wizard are:

- Detect Inertia
- Setup
- Motion Trajectory
- Tuning
- Results

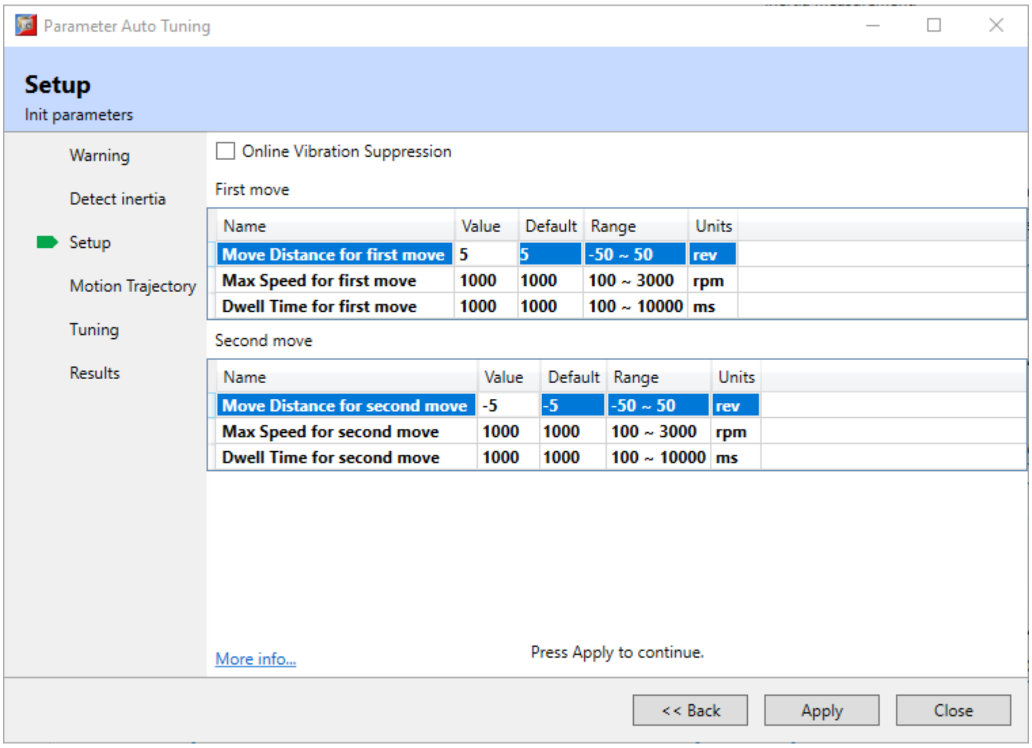
Detect Inertia: A pre-request for the Parameter-Auto Tuning is an accurate measurement of inertia. This can be entered manually or measured using the Inertia Detection tool. For more details on inertia detection see 0There are several tools which can be used help the tuning process.

Load Inertia Identification.

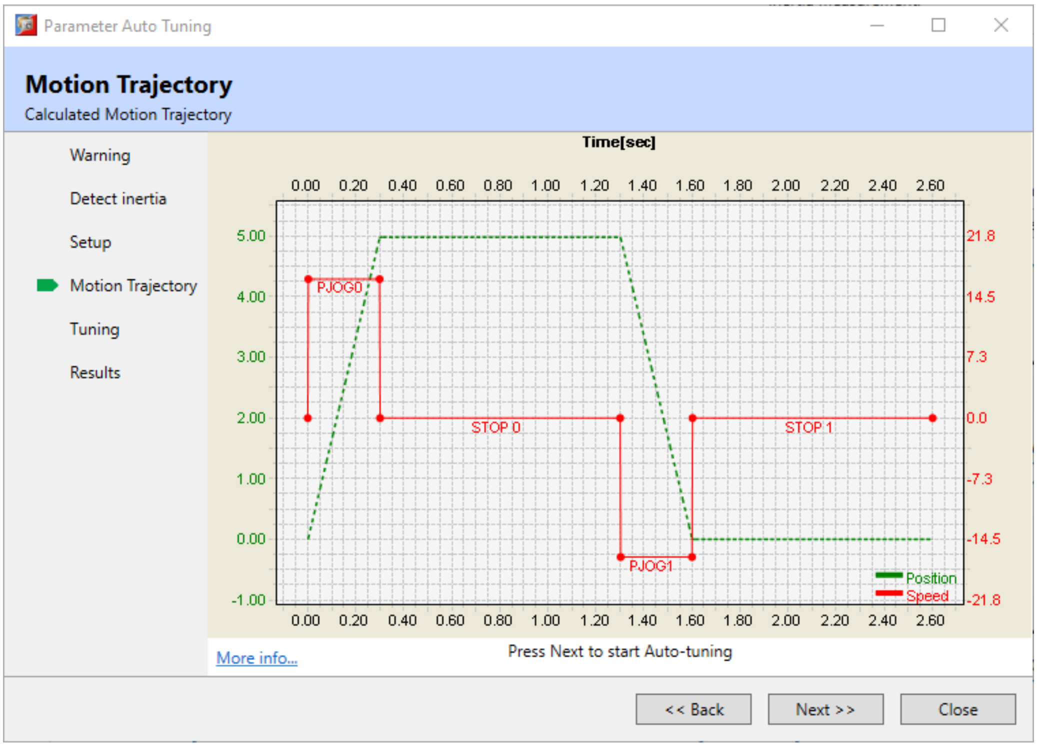
Setup: The drive will repeatedly run two moves during the Parameter Auto-Tuning, these are described by Distance, Speed and Dwell Time. The sequence can be either position/negative or negative/positive.



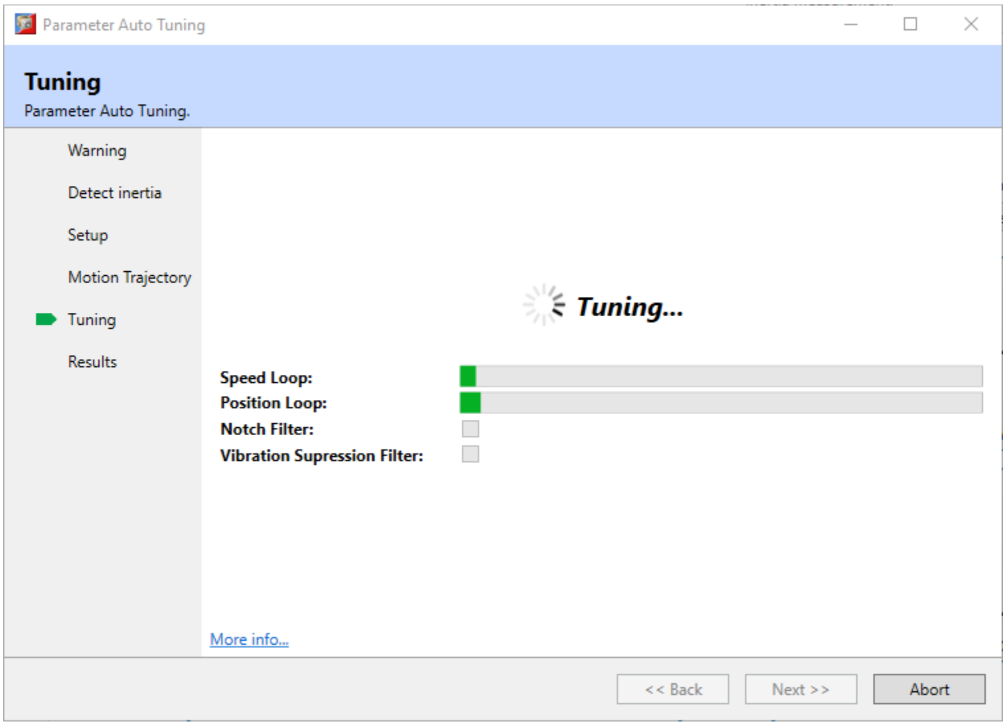
The Setup screen allows entry of the parameters which describe the motion.



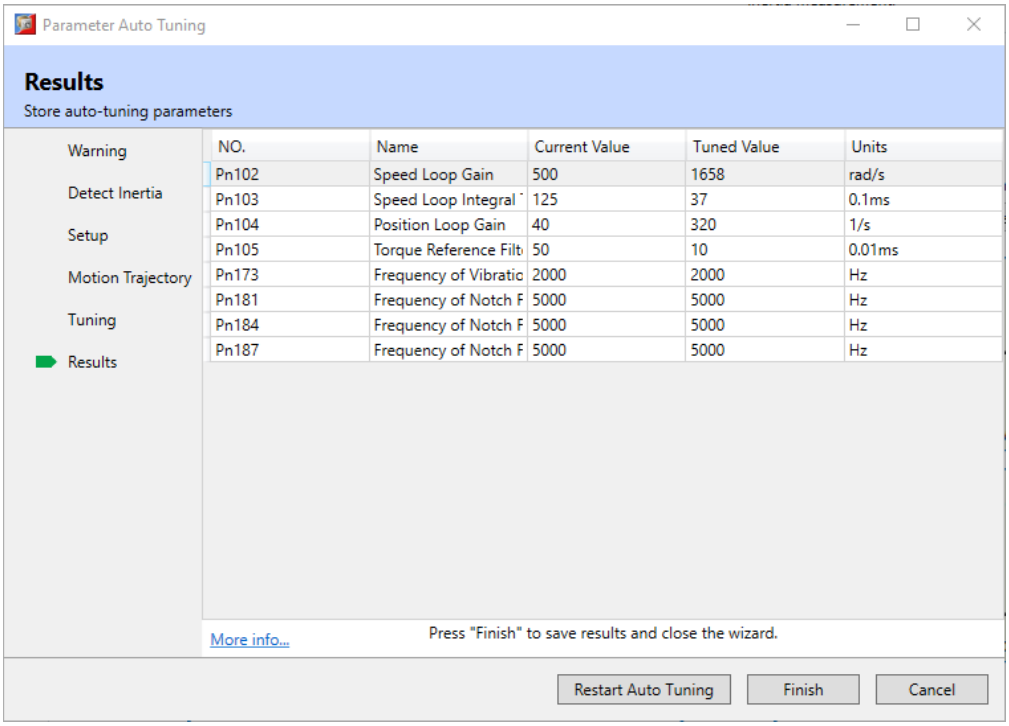
Motion Trajectory: This is an opportunity to review the defined motion sequence before starting the tuning sequence.



Tuning: During the internal tuning process, the progress is displayed on screen.



Results: Once the tuning process has completed, the calculated gain terms will be displayed with an option to save them to the drive.



8.10 Motor Overload Duration & Cycle Times

MXL Motors

Overload %	Overload Time (Secs)				
	50/100W	200W	400W	750W	1KW
150	88.7	184.8	50.4	652.3	115.2
200	12.7	26.4	16.4	93.0	24.0
250	4.3	10.3	8.9	31.8	11.4
300	2.2	6.6	5.7	15.9	7.5
350	1.6	4.6	4.0	11.2	5.3

MXM Motors

Overload %	Overload Time (Secs)			
	1KW	1.5KW	2KW	3KW
150	216.0	120.0	120.0	216.0
200	90.0	50.0	50.0	90.0
250	15.0	12.5	12.5	15.0
300	6.1	5.7	5.7	6.1
350	-	-	-	-

Care must be taken to ensure that the duty cycle is not exceeded when using high percentage overload durations.

For example:
Using a 400W motor at 350% the maximum time at this level must not exceed 4.0 secs.

The motor will now have to wait 45 secs before it is safe to run again at a higher level of percentage overload.

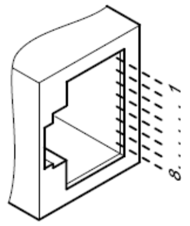
Off Time = (Overload % Factor^2 * Overload Time) - Overload Time

Off Time = $(3.5^2 \times 4.0) - 4.0 = 45.0$s

Chapter 9 MODBUS Communications

9.1 Communication Wiring

The connection terminals CN3-IN and CN4-OUT are used for MODBUS communications.

Connector	Pin	Definition	Description
	3	RS485+	RS-485 communication terminal +
	4	GNDW	Signal GND
	5	GNDW	
	6	RS485-	RS-485 communication termina-
	Housing	FG	Shielded wire is connected to the housing

NOTE The signal definitions of CN3-IN and CN4-OUT are the same.

9.2 Setting Communication Parameters

Number	Name	Setting & Meaning	When Enabled
Pn700.0	MODBUS Communication Baud Rate	[0]: 4800bps [1]: 9600bps [2]: 19200bps	After restart
Pn700.1	Communication Protocol	[0]: 7, N, 2 (Modbus, ASCII) [1]: 7, E, 1 (Modbus, ASCII) [2]: 7, O, 1 (Modbus, ASCII) [3]: 8, N, 2 (Modbus, ASCII) [4]: 8, E, 1 (Modbus, ASCII) [5]: 8, O, 1 (Modbus, ASCII) [6]: 8, N, 2 (Modbus, RTU) [7]: 8, E, 1 (Modbus, RTU) [8]: 8, O, 1 (Modbus, RTU)	
Pn700.2	Communication Protocol Selection	[0] No protocol SCI communication [1] MODBUS SCI communication	
Pn701	Axis Address	Axis address of MODBUS protocol communication	

9.3 MODBUS Communication Protocol

MODBUS communication protocol is only used when Pn700.2 is set to 1. There are two modes for MODBUS communication: ASCII (American Standard Code for information interchange) mode and RTU (Remote Terminal Unit) mode.

9.3.1 Code Meaning

<u>ASCII Mode</u>

Every 8-bit data is consisted by two ASCII characters. For example: One 1-byte data 64_H (Hexadecimal expression) is expressed as ASCII code ‘64’, which contains ‘6’ as ASCII code 36_H and ‘4’as ASCII code 34_H.

ASCII code for number 0 to 9, character A to F are as follows:

Character	‘0’	‘1’	‘2’	‘3’	‘4’	‘5’	‘6’	‘7’
ASCII Code	30_H	31_H	32_H	33_H	34_H	35_H	36_H	37_H
Character	‘8’	‘9’	‘A’	‘B’	‘C’	‘D’	‘E’	‘F’
ASCII Code	38_H	39_H	41_H	42_H	43_H	44_H	45_H	46_H

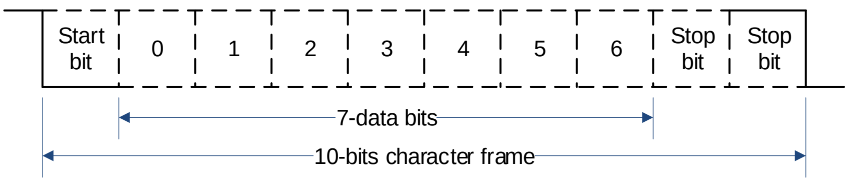
<u>RTU Mode</u>

Every 8-bit data is consisted by two 4-bit hexadecimal data, that is to say, a normal hexadecimal data. For example: decimal data 100 can be expressed as 64_H by 1-byte RTU data.

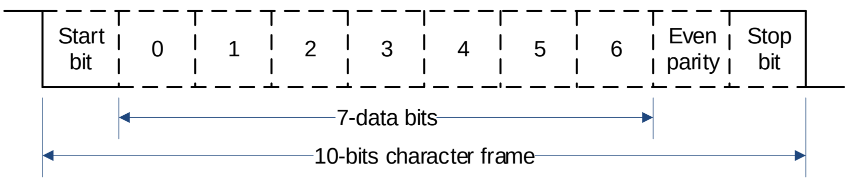
<u>Data Structure</u>

- 10bit character form (7-bit data)

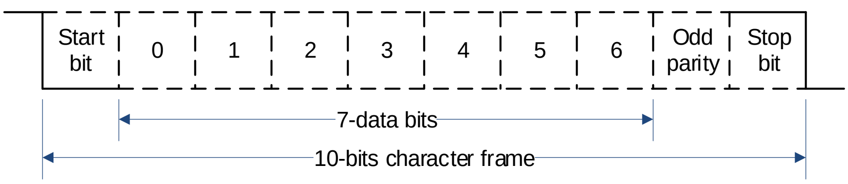
Pn700.1 = 0: 7, N, 2 (Modbus, ASCII)



Pn700.1 = 1: 7, E, 1 (Modbus, ASCII)

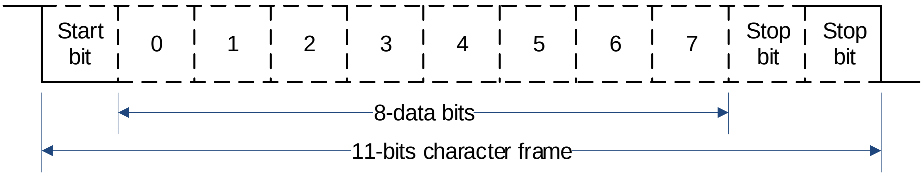


Pn700.1 = 2: 7, O, 1 (Modbus, ASCII)

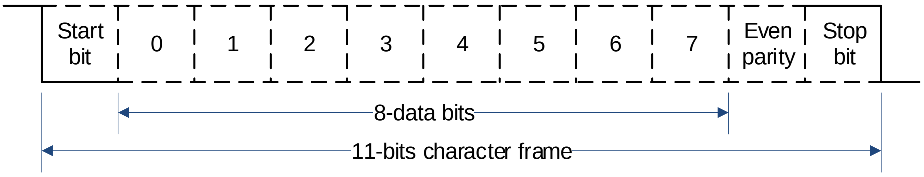


- 11bit character form (8-bit data)

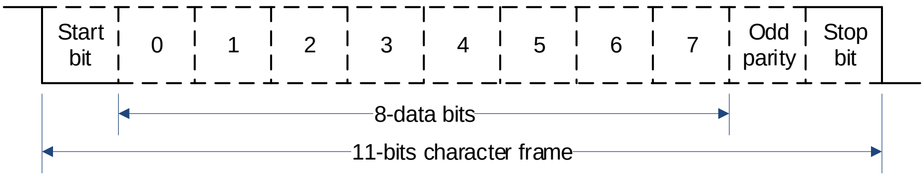
8, N, 2 (Modbus, ASCII / RTU)



8, E, 1 (Modbus, ASCII / RTU)



8, O, 1 (Modbus, ASCII / RTU)



9.3.2 Communication Protocol Structure

ASCII Mode

STX	Start character': ' => (3A H)
ADR	Communication address => 1-byte contains two ASCII codes
CMD	Reference code => 1-byte contains two ASCII codes
DATA(n-1)	
......	Data content => n-word=2n-byte contain 4nASCII codes, n≦12
DATA(0)	
LRC	Checking code=>1-byte contains two ASCII codes
End 1	End code 1=> (0D H) (CR)
End 0	End code 0=> (0A H) (LF)

RTU Mode

STX	Sleep interval of at least 4 bytes transmission time.
ADR	Communication address => 1-byte
CMD	Reference code => 1-byte
DATA(n-1)	
......	Data content => n-word=2n-byte, n≦12
DATA(0)	
CRC	CRC checking code => 1-byte
End 1	Sleep interval of at least 4 bytes transmission time.

Communication protocol data format instructions

- STX (communication start)
  - ASCII mode: ‘: ’ character
  - RTU mode: Sleep interval of at least 4 bytes transmission time (automatically changed according to different communication speed).
- ADR (communication address)

  Valid communication address: 1 to 254

  For example: communicate with the servo drive which address is 32 (20 in hex):
  - ASCII mode: ADR=‘2’, ‘0’=＞‘2’=32_H, ‘0’=30_H
  - RTU mode: ADR=20_H
- CMD (command reference) and DATA (data)

  Data structure is determined by command code. Regular command code is shown as follows: Command code: 03H, read N words(word), N ≦ 20.

For example: read 2 words starting from 0070_H from the servo drive which address is 01_H.

ASCII Mode

Reference Information	
STX	“:”
ADR	‘0’
	‘1’
CMD	‘0’
	‘3’
Data start address	‘0’
	‘0’
	‘7’
	‘0’
Data number (count as word)	‘0’
	‘0’
	‘0’
	‘2’
LRC checking	‘8’
	‘A’
End 1	($0D_H$)(CR)
End 0	($0A_H$)(LF)

Response Information	
STX	“:”
ADR	‘0’
	‘1’
CMD	‘0’
	‘3’
Data number (count as byte)	‘0’
	‘4’
Content of data start address 0200_H	‘0’
	‘0’
	‘0’
	‘0’
Content of second data address 0201_H	‘0’
	‘0’
	‘0’
	‘0’
LRC checking	‘F’
	‘8’
End 1	($0D_H$)(CR)
End 0	($0A_H$)(LF)

RTU Mode

Reference Information	
ADR	01_H
CMD	03_H
Data start address	00_H (high-bit)
	70_H (low-bit)
Data number (count as word)	00_H
	02_H
CRC checking	$C5_H$ (low-bit)
CRC checking	$D0_H$ (high-bit)

Response Information	
ADR	01_H
CMD	03_H
Data number (count as byte)	04_H
Content of data start address 0200_H	00_H (high-bit)
	00_H (low-bit)
Content of second data address 0201_H	00_H (high-bit)
	00_H (low-bit)
CRC checking	FA_H (low-bit)
CRC checking	33_H (high-bit)

For example: write 1(0001_H) into01_H servo address 0070_H. Reference code: 06_H, write in one word

ASCII Mode

Reference Information	
STX	“: ”
ADR	‘0’
	‘1’
CMD	‘0’
	‘6’
Data start address	‘0’
	‘0’
	‘7’
	‘0’
Data content	‘0’
	‘0’
	‘0’
	‘1’
LRC checking	‘8’
	‘8’
End 1	($0D_H$)(CR)
End 0	($0A_H$)(LF)

Response Information	
STX	“: ”
ADR	‘0’
	‘1’
CMD	‘0’
	‘6’
Data number (count as byte)	‘0’
	‘4’
Content of data start address 0200_H	‘0’
	‘0’
	‘7’
	‘0’
Content of second data address 0201_H	‘0’
	‘0’
	‘0’
	‘1’
LRC checking	‘8’
	‘8’
End 1	($0D_H$)(CR)
End 0	($0A_H$)(LF)

RTU Mode				
Reference Information			Response Information	
ADR	01_H		ADR	01_H
CMD	06_H		CMD	06_H
Data start address	00_H (high-bit)		Data start address	00_H (high-bit)
	70_H (low-bit)			70_H (low-bit)
Data content	00_H (high-bit)		Data content	00_H (high-bit)
	01_H (low-bit)			01_H (low-bit)
CRC checking	49_H (low-bit)		CRC checking	49_H (low-bit)
CRC checking	$D1_H$ (high-bit)		CRC checking	$D1_H$ (high-bit)

<u>LRC (ASCII mode) and CRC (RTU mode) Error Detection Value Calculation</u>

- LRC calculation in ASCII mode:

  ASCII mode uses LRC (Longitudinal Redundancy Check) error detection value. The exceeded parts (e.g. the total value is 128_H of hex, then take 28_H only) is taken off by the unit of 256 in the total value from ADR to the last information, then calculate and compensate, the final result is LRC error detection value.

For example: read 1 word from 01_H servo address 0201

STX	': '
ADR	'0'
	'1'
CMD	'0'
	'3'
Data start address	'0'
	'2'
	'0'
	'1'
Data number (count as word)	'0'
	'0'
	'0'
	'1'
LRC checking	'F'
	'8'
End 1	($0D_H$)(CR)
End 0	($0A_H$)(LF)

Add from ADR data to the last data.

$01_H + 03_H + 02_H + 01_H + 00_H + 01_H = 08_H$

The compensate value is $F8_H$ when 2 is used to compensate 08_H, so LRC is “F”,”8”.

- CRC calculation of RTU mode:

  RTU mode uses CRC (Cyclical Redundancy Check) error detection value.

  The process of CRC error detection value calculation is shown as follows:

  Step 1 Load in a 16-bit register of $FFFF_H$, named “CRC” register.

  Step 2 Run XOR calculation between the first bit (bit 0) of instruction information and 16-bit CRC register’s low bit (LSB), and the result is saved to CRC register.

  Step 3 Check the lowest bit (LSB) of CRC register, if it is 0, CRC register moves one bit to right; if it is 1, CRC register moves one bit to right, then run XOR calculation with $A001_H$;

  Step 4 Go to step 5 till the third step has been executed for 8 times, otherwise return to step 3.

  Step 5 Repeat the steps from 2 to 4 for the next bit of instruction information, the comment of CRC register is the CRC error detection value while all the bits have been executed by the same way.

Example

After calculating out the CRC error detection value, the CRC low bit should be filled first in instruction information, and then fill the high bit of CRC. Refer to the following example.

Read 2 words from the 0101 $_H$ address of 01 $_H$ servo. The final CRC register content calculated from ADR to the last bit of data is 94 $_H$, and then the instruction information is shown as follows. Please be sure that 94 $_H$ is transmitted before 37 $_H$.

ADR	01 $_H$
CMD	03 $_H$
Data start address	01$_H$ (high-bit)
	01$_H$ (low-bit)
Data number (count as word)	00 $_H$ (high-bit)
	02$_H$ (low-bit)
CRC checking	94$_H$ (low-bit)
CRC checking	37$_H$ (high-bit)

End1, End0 (Communication is completed.)

- ASCII Mode:
  Communication is ended with (0D $_H$) - [carriage return] and (0A $_H$) - [new line].
- RTU Mode
  When the time exceeds the sleep interval by at least 4 bytes transmission time while in the current communication speed, it means the communication is finished.

9.3.3 Communication Error Disposal

Problems that occur during communication are a result of the following:

- Data address is incorrect while reading/writing parameters.
- The data is not within the parameter setting range while writing.
- Data transmission fault or checking code fault when communication is disturbed.

When the first and second communication faults occur, the servo drive is running normally, and will feed back an error frame.

When the third communication fault occurs, transmission data will be recognized as invalid to give up, and no error frame is returned.

The format of error frame:

Host controller data frame:				
start	Slave station address	Command	Data address, content	Checking
–	–	command	–	–

Servo drive feeds back error frame:				
start	Slave station address	Response code	Error code	Checking
–	–	Command + 80 $_H$	–	–

Error frame responses code=command+80 $_{H;}$

Error code = 00 $_H$: Normal communication

= 01 $_H$: Servo drive cannot identify the required functions

= 02 $_H$: The required data address does not exist in the servo drive

= 03 $_H$: The required data in servo drive is not allowed (beyond the maximum or minimum value of the parameter)

= 04 $_H$: Servo drive starts to perform the requirement, but cannot achieve it.

For example: Servo drive axis number is 03_H, write data 5000 into parameter Pn102 is not allowed, because the range of parameter Pn102 is 1~4000. The servo drive will feedback an error frame, the error code is 03_H (beyond the parameter's maximum value or minimum value). The structure is as follows:

Host controller data frame				
start	Slave station address	Command	Data address, content	Checking
–	03_H	06_H	0066_H 1388_H	–

Servo drive feedback error frame:				
start	Slave station address	Response code	Error code	Checking
–	03_H	86_H	03_H	–

Besides, if the data frame sent from host controller slave station address is 00_H, it determines the data to be broadcast data. The servo drives will not feedback any frames.

9.3.4 Data Communication Address of Servo State

Data Address	Meaning	Description	Operation
01F0 ~ 0B47	Parameter area	Corresponding parameters in parameter list	Read/write
1011 ~ 101A	Alarm information memory area	Ten alarms historical record	Read only
0F00	Virtual DI input		Read/write
0E8C	DI status	Un005	Read only
0E8D	TouchProbe input status	Un006	Read only
0E8E	DO status	Un007	Read only
0E86	Speed feedback	Un000	Read only
0E87	Speed setting	Un001	Read only
0E88	Input torque reference percentage	Un002	Read only
0E89	Internal torque reference percentage	Un003	Read only
0E8A ~ 0E8B	Encoder rotation pulse number	Un004	Read only
0E8F	Pulse setpoint of 1ms	Un008	Read only

Data Address	Meaning	Description	Operation
0E90 ~ 0E93	Current position	Un009	Read only
0E94 ~ 0E97	Deviation pulse counter	Un011	Read only
0E98 ~ 0E9B	Given position	Un013	Read only
0E9C	Percentage of load inertia	Un015	Read only
0E9D	Motor overload ratio	Un016	Read only
0EAD	Servo current alarm number		Read only
0F3A	Encoder multi-turn information		Read only
0F3B ~ 0F3C	Encoder single-turn information		Read only
1021	Clear historical alarms		Write only
1022	Clear current alarms		Write only
1040	Clear encoder alarm		Write only
1041	Clear encoder multi-turn data		Write only

Servo Parameter Area

The Pn parameter of corresponding servo. Pn parameter is 32bit, formed by splicing two consecutive hexadecimal data addresses (low- and high-bit). When reading and writing, operate the low-bit first, then high-bit.

For the start parameter Pn000, the low-bit address is $01F0_H$, and the high-bit address is $01F1_H$.

For other parameters Pn*x*, the low-bit address is $01F0_H$+*x**2, and the high-bit address is $01F1_H$+*x**2.

For example: when writing to Pn000, the data written is 1; write 1 to $01F0_H$ first, and then write 0 to $01F1_H$.

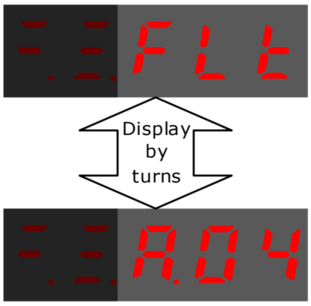
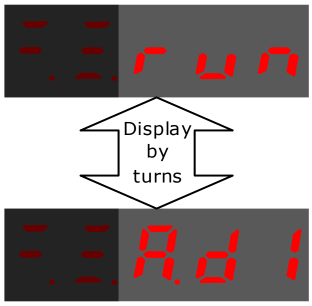
Alarm Information Storage Area

Historical Alarm Number	Description	Communication Address
0	Historical alarm 1 (the latest alarm)	1101_H
1 ~ 8	Historical alarms 2 ~ 9	1102_H ~ 1109_H
9	Historical alarm 10 (the furthest alarm)	$101A_H$

Chapter 10 Alarm Displays

10.1 Alarm Classifications

There are three classifications of alarms for the Drive: Gr.1, Gr.2, and Warning. They will affect the display and operation of the Servo System.

<table>
<tr><th>Classification</th><th>Stopping Method</th><th>Panel Display</th></tr>
<tr><td>Gr.1</td><td>Stops the Motor according to the setting of Pn003.0.
For details, refers to 5.4.1 Motor Stop Methods for Gr.1 Alarms, Safety State and Servo OFF.</td><td rowspan="2">The Panel Operator displays between Alarm No and Servo state FLT by turns.

</td></tr>
<tr><td>Gr.2</td><td>Stops the Motor according to the setting of Pn004.0
For details, refers to 0</td></tr>
<tr><td>Warning</td><td>Do not stop the Motor, and keep the current operation</td><td>The Panel Operator displays between Alarm No and Servo state run by turns.

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

10.2 Alarm Detailed

10.2.1 Gr.1 Warning

A.01： Parameter destruction

Possible causes	Confirm the method	Action
The supply voltage drops instantaneously	Measure the supply voltage.	The supply voltage is set within the specification range and the initialization of the parameter setpoint is performed.
Parameters are written to interrupt power	Confirm the time of the power outage.	Re-write the parameter after restoring the factory value of the parameter (Fn001).
Malfunction due to noise	Confirm the runtime environment.	Take anti-interference countermeasures and then power the drive back in.
Drive failure	Power on the drive. When an alert still occurs, it may be a drive failure.	Replace the drive.

A.03： Motor overspeed

Possible causes	Confirm the method	Action
The U, V, W phase sequence of the motor wiring is incorrect	Confirm the wiring of the motor.	Confirm if there is a problem with the motor wiring.
The instruction input value exceeds the overspeed value	Confirm the input instruction.	Lower the instruction value, or adjust the gain.
The motor speed exceeds the maximum speed	Confirm the waveform of the motor speed.	Reduce the speed command input gain or adjust the setting of the Pn323 (Overspeed Alarm Detection Threshold).
Drive failure	Power on the drive. When an alert still occurs, it may be a drive failure.	It may be a drive failure. Replace the drive.

A.04： Overload

Possible causes	Confirm the method	Action
Motor wiring, encoder wiring, or poor connection	Confirm the wiring。	Check whether there is a problem with the motor wiring and encoder wiring.
The motor runs beyond the overload protection characteristics	Confirm the overload characteristics and operating instructions of the motor。	Revisit load conditions and operating conditions. Or revisit the motor capacity.
Due to mechanical factors, the motor is not driven, resulting in excessive load during operation	Confirm the operating instructions and motor speed.	Improve mechanical factors.

Possible causes	Confirm the method	Action
Drive failure	Power on the drive. When an alert still occurs, it may be a drive failure。	Replace the drive.

A.05：The position deviation counter overflows

Possible causes	Confirm the method	Action
The wiring of the motor U, V, W is incorrect	Confirm the wiring of the motor main circuit cable.	Confirm that the motor cable or encoder cable has problems such as poor contact.
Position commands are too fast	Try lowering the position command speed before running.	Lower the position command speed or command acceleration, or adjust the electronic gear ratio.
The position instruction accelerates too much	Try slowing down the instruction acceleration before running.	With the EtherCAT command, the position command acceleration is reduced.
Deviation counter overflow alarm (Pn504) is low relative to operating conditions	Confirm that the position deviation counter overflow alarm (Pn504) is appropriate.	Correctly set the value of the parameter Pn504.
Drive failure	Power on the drive. When an alert still occurs, it may be a drive failure.	Replace the drive.

A.06：The position deviation pulse overflows

Possible causes	Confirm the method	Action
Servo ON is maintained when the position deviation in servo OFF exceeds the setpoint of (Pn504× electronic gear).	Confirm the amount of positional deviation when servo OFF。	Set the correct deviation counter overflow alarm (Pn504) when servo ON.

A.07：The electronic gear setting or pulse frequency is unreasonable

Possible causes	Confirm the method	Action
The setting of the electronic gear ratio: Pn725/Pn726 (6093-01h/6093-02h) is not within the set range	Confirm that the electronic gear ratio is within a reasonable range	The setting range of the electronic gear ratio depends on the number of encoder bits: Encoder bits≤20, set range: [0.001， 4000] Encoder bits≤21, set range: [0.001， 8000] Encoder bits≤22, set range: [0.001， 16000] Encoder bits≤23, set range: [0.001， 32000] Encoder bits≤24, set range: [0.001， 64000]

A.08：There is a problem with the first channel of current detection

Possible causes	Confirm the method	Action
Drive failure	Power on the drive. When an alert still occurs, it may be a drive failure.	Replace the drive.

A.09：There is a problem with the second channel of current detection

Possible causes	Confirm the method	Action
Drive failure	Power on the drive. When an alert still occurs, it may be a drive failure.	Replace the drive.

A.12：Overcurrent

Possible causes	Confirm the method	Action
The main circuit cable is wired incorrectly, or the contact is poor	Confirm that the wiring is correct.	Modify the wiring.
The main loop cable is shorted internally or a short-to-ground circuit has occurred	Confirm whether a short circuit has occurred between the UVW phases of the cable and between the UVW and the ground.	There is a possibility that the cable will be short-circuited. Replace the cable.
A short circuit or a short circuit to the ground occurs inside the motor	Confirm whether a short circuit has occurred between the UVW phases of the motor terminals and between the UVW and the ground.	It is possible that the motor is faulty. Replace the motor.
A short circuit or short-to-ground circuit occurs inside the drive	Confirm whether a short circuit has occurred between the UVW phases of the motor connection terminals of the drive and between the UVW and the ground.	It may be a drive failure. Replace the drive.
The braking resistor is wired incorrectly or has poor contact	Confirm that the wiring is correct.	Modify the wiring.
Dynamic brakes (emergency stops due to DB or drives) are used frequently, or DB brake circuit damage alarms occur	The DB usage frequency is confirmed by the DB resistor power dissipation. Or use the alarm display to confirm if damage to the DB braking circuit (A.1B) has occurred.	变更驱动器的选型，运行方法和机构，以降低 DB 的使用频率。
Exceeds the braking capacity	Confirm how often the braking resistor is used.	Change the selection, operating method, and mechanism of the drive to reduce the frequency of DB usage.
The braking resistance value of the drive is too small	Confirm how often the braking resistor is used.	Change the braking resistance value to a value above the minimum allowable resistance value of the drive.
High loads are tolerated when the motor is stopped or when running at low speeds	Confirm that the operating conditions are outside the specification range of the servo drive.	Reduce the load on the motor. Or run at a higher operating speed.

Possible causes	Confirm the method	Action
Malfunction due to noise	Improve the noise environment such as wiring and settings to confirm whether there is any effect.	Take anti-interference measures, such as correct wiring of FG. In addition, please use a wire with the same size as the driver main circuit wire for the FG wire size.
Drive failure	Power on the drive. When an alert still occurs, it may be a drive failure.	Replace the drive.

A.13： Overvoltage

Possible causes	Confirm the method	Action
The supply voltage is out of specification	Measure the supply voltage.	Adjust the AC/DC supply voltage to the product specifications.
The power supply is in an unstable state or has been affected by lightning strikes	Measure the supply voltage.	Improve power conditions and power the drive again after setting the surge suppressor. When an alert still occurs, it may be a drive failure. Replace the drive.
Acceleration and deceleration occur when the AC supply voltage exceeds the specification range	Confirm the supply voltage and speed and torque during operation.	Adjust the AC supply voltage to the product specifications.
The external braking resistance value is larger than the operating conditions	Confirm the operating conditions and braking resistance values.	Considering the operating conditions and loads, the braking resistance value is revisited.
Operates above the allowable moment of inertia or mass ratio	Confirm that the moment of inertia or mass ratio is within the allowable range.	Extend the deceleration time or reduce the load.
Drive failure	Power on the drive. When an alert still occurs, it may be a drive failure.	Replace the drive.

A.14： Undervoltage

Possible causes	Confirm the method	Action
The supply voltage is below specification	Measure the supply voltage.	Regulate the supply voltage to the normal range.
The supply voltage drops during operation	Measure the supply voltage.	Increase the power supply capacity.
An instantaneous power outage occurs	Measure the supply voltage.	If the instantaneous stop hold time (Pn538) is changed, it is set to a smaller value.

Possible causes	Confirm the method	Action
The fuse of the drive is blown	–	Replace the drive, connect the reactor to the DC reactor connection terminals (P1, P2), and use the drive.
Drive failure	Power on the drive. When an alert still occurs, it may be a drive failure.	Replace the drive.

A.16: Regeneration abnormalities

Possible causes	Confirm the method	Action
The drive requires an external braking resistor	Confirm the connection of the external regenerative resistor and check the setpoints of Pn535 and Pn536.	After connecting the external braking resistor, set Pn535 and Pn536 to the appropriate values.
When an external braking resistor is not used, the short wiring of B2 and B3 falls off	Confirm the connection of the short wires of B2 and B3.	Properly wire the short wiring.
External regenerative resistors are poorly wired, detached, or disconnected	Confirm the wiring of the external regenerative resistor.	Properly wired external regenerative resistors.
Drive failure	Power on the drive. When an alert still occurs, it may be a drive failure.	Replace the drive.

A.18: The module is overheating

Possible causes	Confirm the method	Action
The ambient temperature is too high	Measure the ambient temperature with a thermometer. Or confirm health through drive provisioning environment monitoring.	Improve drive setup conditions and reduce ambient temperature.
The overload alarm was reset several times by powering it off and then running	Use the alert display to confirm if an overload alert has occurred.	Change the reset method for the alert.
The load is too heavy, or the regeneration capacity is exceeded during operation	The load in operation is confirmed by the cumulative load rate, and the regenerative processing capacity is confirmed by the regenerative load rate.	Revisit load conditions and operating conditions.
The orientation of the drive and the spacing from other drives are unreasonable	Confirm the setup status of the drive.	Install according to the installation standards of the drive.
Drive failure	Power on the drive. When an alert still occurs, it may be a drive failure.	Replace the drive.

A.1D: The temperature sensor is disconnected

Possible causes	Confirm the method	Action
The ambient temperature is too high	Measure the ambient temperature with a thermometer. Or confirm health through drive provisioning environment monitoring.	Improve drive setup conditions and reduce ambient temperature.
The overload alarm was reset several times by powering it off and then running	Use the alert display to confirm if an overload alert has occurred.	Change the reset method for the alert.
The load is too heavy, or the regeneration capacity is exceeded during operation	The load in operation is confirmed by the cumulative load rate, and the regenerative processing capacity is confirmed by the regenerative load rate.	Revisit load conditions and operating conditions.
The orientation of the drive and the spacing from other drives are unreasonable	Confirm the setup status of the drive.	Install according to the installation standards of the drive.
Drive failure	Power on the drive. When an alert still occurs, it may be a drive failure.	Replace the drive.

A.1E: The main charge circuit is faulty

Possible causes	Confirm the method	Action
The drive requires an external braking resistor	Confirm the connection of the external regenerative resistor and check the setpoints of Pn535 and Pn536.	After connecting the external braking resistor, set Pn535 and Pn536 to the appropriate values.
When an external braking resistor is not used, the short wiring of B2 and B3 falls off	Confirm the connection of the short wires of B2 and B3.	Properly wire the short wiring.
External regenerative resistors are poorly wired, detached, or disconnected	Confirm the wiring of the external regenerative resistor.	Properly wired external regenerative resistors.
The external regenerative resistance value or regenerative resistance capacity is insufficient, or it is in a continuous regeneration state	Again, the operating conditions or capacity are confirmed.	Change the regeneration resistance value and regenerative resistance capacity. Adjust the operating conditions again.
Continuously bear negative loads and are in a state of continuous regeneration	Confirm the load applied to the motor in operation.	Revisiting the system, which includes servo, mechanical, and operating conditions.
The capacity set in Pn536 (discharge resistor power) is less than the capacity of the external regenerative resistor	Confirm the connection of the regenerative resistor and the value of Pn536.	Corrects the setpoint of Pn536.
The value set in Pn535 (Discharge Resistor Resistance) is less than the external regenerative resistance value	Confirm the connection of the regenerative resistor and the value of Pn535.	Corrects the setpoint of Pn535.

Possible causes	Confirm the method	Action
The external regeneration resistance value is too large	Confirm that the regeneration resistance value is correct.	Change it to the correct resistance value and capacity.

A.1F： Short-to-ground fault

Possible causes	Confirm the method	Action
The motor cable has a short-circuit to ground	Confirm if a short circuit has occurred between the UVW of the cable and the ground.	There is a possibility that the cable will be short-circuited. Replace the cable.
A short-to-ground circuit has occurred inside the drive	Confirm whether a short circuit has occurred between the UVW and the ground of the motor connection terminal of the drive.	It may be a drive failure. Replace the drive.

A.24： The main loop power supply is wired incorrectly

Possible causes	Confirm the method	Action
A single-phase AC power supply input (Pn007.1 = 0) is not set and a single-phase power supply is entered	Confirm power and parameter settings.	Set the correct power inputs and parameters.

A.37： Control panel communication timed out

Possible causes	Confirm the method	Action
Poor connection between the operator panel and the drive	Confirm the contact of the connector.	Reinsert the connector. Or replace the cable.
Malfunction due to noise	Improve the noise environment such as wiring and settings to confirm whether there is any effect.	Keep the operator panel body or cable away from devices/cables that are generating noise interference.
Operator panel failure	Connect the operator panel again. When an alarm still occurs, it is possible that the operator panel is malfunctioning.	Replace the operator panel.
Drive failure	Power on the drive. When an alert still occurs, it may be a drive failure.	Replace the drive.

A.42： The motor power does not match the drive power

Possible causes	Confirm the method	Action
The drive capacity does not match the capacity of the motor	The drive capacity must be the same as the motor capacity.	Match the capacity of the drive to the motor.

Possible causes	Confirm the method	Action
Encoder failure	After replacing the encoder, confirm that the alarm no longer occurs.	Replace the motor (encoder).
Drive failure	Power on the drive. When an alert still occurs, it may be a drive failure.	Replace the drive.

A.43: The encoder type is incorrect

Possible causes	Confirm the method	Action
Encoder failure	After replacing the encoder, confirm that the alarm no longer occurs.	Replace the motor (encoder).
Drive failure	Power on the drive. When an alert still occurs, it may be a drive failure.	Replace the drive.

A.45: Multi-turn data error

Possible causes	Confirm the method	Action
The battery is poorly connected and not connected	Confirm the connection of the battery.	Properly connect the battery.
The battery voltage is below the specified value	Measure the voltage of the battery.	Replace the battery and clear the alarm. See "3.5.3 Installing or Replacing the Battery".
Drive failure	Power on the drive. When an alert still occurs, it may be a drive failure.	Replace the drive.

A.46: Multi-turn data overflow

Possible causes	Confirm the method	Action
The battery is poorly connected and not connected	Confirm the connection of the battery.	Properly connect the battery.
Multiple laps of data have overflowed	–	Set up one of the following: Use the operator panel to perform Fn010 and Fn011. Using Motion Perfect 5.3 or above, go to the "Functions→ Configuration Wizard→ Encoder Settings", then click "Clear Multiturn Messages" and "Clear Multiturn Alarms".

A.47: The absolute encoder battery voltage is too low

Possible causes	Confirm the method	Action
The battery is poorly connected and not connected	Confirm the connection of the battery.	Properly connect the battery.
The battery voltage is below 2.45V	Measure the voltage of the battery.	Replace the battery and clear the alarm. See "3.5.3 Installing or Replacing the Battery".
Drive failure	Power on the drive. When an alert still occurs, it may be a drive failure.	Replace the drive.

A.48： Absolute encoder battery voltage undervoltage

Possible causes	Confirm the method	Action
The battery is poorly connected and not connected	Confirm the connection of the battery.	Properly connect the battery.
The battery voltage is below 3.0V	Measure the voltage of the battery.	Replace the battery and clear the alarm. See "3.5.3 Installing or Replacing the Battery".
Drive failure	Power on the drive. When an alert still occurs, it may be a drive failure.	Replace the drive.

A.49： Multiple or single turn data anomalies were detected

Possible causes	Confirm the method	Action
The battery is poorly connected and not connected	Confirm the connection of the battery.	Properly connect the battery.
The battery voltage is below 3.0V	Measure the voltage of the battery.	Replace the battery and clear the alarm. See "3.5.3 Installing or Replacing the Battery".
Drive failure	Power on the drive. When an alert still occurs, it may be a drive failure.	Replace the drive.

A.50： The encoder is disconnected

Possible causes	Confirm the method	Action
The encoder cable is wired incorrectly	Confirm the wiring of the motor encoder cable.	Confirm that the motor cable or encoder cable has problems such as poor contact.
Malfunction due to noise	Improve the noise environment such as wiring and settings to confirm whether there is any effect.	Adopt anti-interference countermeasures.
Encoder failure	Power on the drive. When an alarm still occurs, it is possible that the motor is malfunctioning.	Replace the motor.

Possible causes	Confirm the method	Action
Drive failure	Power on the drive. When an alert still occurs, it may be a drive failure.	Replace the drive.

A.51：Absolute encoder overspeed detection

Possible causes	Confirm the method	Action
When the control power is turned on, the motor rotates at a speed of more than 200 rpm	The speed of the motor is confirmed by the speed of the motor when the power is turned on.	Adjust the motor speed to less than 200 rpm and turn on the control power.
Encoder failure	Power on the drive. When an alarm still occurs, it is possible that the motor or absolute encoder is faulty.	Replace the motor or absolute encoder.
Drive failure	Power on the drive. When an alert still occurs, it may be a drive failure.	Replace the drive.

A.52：An error occurred inside the encoder

Possible causes	Confirm the method	Action
Encoder-related alarms have not been reset	Resets the encoder-related alarms	Set up one of the following: Use the operator panel to perform Fn010 and Fn011. Using Motion Perfect 5.3 or above, go to the "Functions→ Configuration Wizard→ Encoder Settings", then click "Clear Multiturn Messages" and "Clear Multiturn Alarms".

A.53：Error encoder lap information

Possible causes	Confirm the method	Action
Encoder-related alarms have not been reset	Resets the encoder-related alarms	Set up one of the following: Use the operator panel to perform Fn010 and Fn011. Using Motion Perfect 5.3 or above, go to the "Functions→ Configuration Wizard→ Encoder Settings", then click "Clear Multiturn Messages" and "Clear Multiturn Alarms".

A.54：Errors occurred at the check digits and cutoff bits in the encoder control domain

Possible causes	Confirm the method	Action
Encoder-related alarms have not been reset	Resets the encoder-related alarms	Set up one of the following: Use the operator panel to perform Fn010 and Fn011. Using Motion Perfect 5.3 or above, go to the "Functions→ Configuration Wizard→ Encoder Settings", then click "Clear Multiturn Messages" and "Clear Multiturn Alarms".

A.58: Information such as encoder zone phase is empty or incorrect

Possible causes	Confirm the method	Action
Encoder failure	Power on the drive. When an alarm still occurs, it is possible that the motor or absolute encoder is faulty.	Replace the motor or absolute encoder.

A.59: Information such as the motor body in the second area of the encoder is empty or wrong

Possible causes	Confirm the method	Action
Encoder failure	Power on the drive. When an alarm still occurs, it is possible that the motor or absolute encoder is faulty.	Replace the motor or absolute encoder.

A.65: Location overflow alarm

Possible causes	Confirm the method	Action
The wiring of the motor U, V, W is incorrect	Confirm the wiring of the motor main circuit cable.	Confirm that the motor cable or encoder cable has problems such as poor contact.
Position commands are too fast	Try lowering the position command speed before running.	Lower the position command speed or command acceleration, or adjust the electronic gear ratio.
The position instruction accelerates too much	Try to reduce the acceleration of the command before running.	With the EtherCAT command, the position command acceleration is reduced.
Deviation counter overflow alarm (Pn504) is low relative to operating conditions	Confirm that the position deviation counter overflow alarm (Pn504) is appropriate.	Correctly set the value of the parameter Pn504.
Drive failure	Power on the drive. When an alert still occurs, it may be a drive failure.	Replace the drive.

A.70: DC synchronization error

Possible causes	Confirm the method	Action
Synchronization timing (Sync0) fluctuations in EtherCAT communication.	–	Reboot the drive to re-establish EtherCAT communication.

A.71: SM Event synchronization event premature

Possible causes	Confirm the method	Action
EtherCAT communication error due to noise.	–	Check the EtherCAT wiring and implement noise countermeasures.
The controller does not update process data during a fixed period of time.	Examine the process data specified by the controller.	Modify the controller's configuration so that it can update process data during a fixed period.
The EtherCAT communication cable or connector wiring is faulty.	Check the EtherCAT communication cables and connector wiring.	Modify the wiring.

A.72: SM Event synchronization event timed out

Possible causes	Confirm the method	Action
EtherCAT communication error due to noise.	–	Check the EtherCAT wiring and implement noise countermeasures.
The controller does not update process data during a fixed period of time.	Examine the process data specified by the controller.	Modify the controller's configuration so that it can update process data during a fixed period.
The EtherCAT communication cable or connector wiring is faulty.	Check the EtherCAT communication cables and connector wiring.	Modify the wiring.

A.73: EtherCAT processor internal error

Possible causes	Confirm the method	Action
Drive failure	Power on the drive. When an alert still occurs, it may be a drive failure.	Replace the drive.

A.74: The position is set in the Cubic interpolation algorithm with a period error

Possible causes	Confirm the method	Action
Synchronization timing (Sync0) fluctuations in EtherCAT communication	–	Reboot the drive to re-establish EtherCAT communication.

A.75: There was an error setting for the synchronization period

Possible causes	Confirm the method	Action
Synchronization timing (Sync0) fluctuations in EtherCAT communication	–	Reboot the drive to re-establish EtherCAT communication.
The setting of object 60C2 is not an integer multiple of 125μs	Check the setpoint of object 60C2	Correctly set object 60C2.

A.76： The acceleration object is set to 0 in PP/PV mode

Possible causes	Confirm the method	Action
The setpoints for objects 6083, 6084, 6085 are incorrect	The setpoints for objects 6083, 6084, 6085 (not 0).	Correctly set objects 6083, 6084, 6085.

A.77： OP mode process data watchdog communication timed out

Possible causes	Confirm the method	Action
Detects whether the master controller sends process data properly	The data transmission interval is detected by the wireshark packet capture software	Reboot the drive to re-establish EtherCAT communication.
Whether the network cable is loose	Check whether the network cable is plugged in tightly	Reseat the network cable

A.81： The motor UVW wiring is wrong

Possible causes	Confirm the method	Action
A short circuit or a short circuit to the ground occurs inside the motor	Confirm whether a short circuit has occurred between the UVW phases of the motor terminals and between the UVW and the ground	It is possible that the motor is faulty. Replace the motor.
The U, V, W phase sequence of the motor wiring is incorrect	Confirm the wiring of the motor.	Confirm if there is a problem with the motor wiring.

A.82： The motor type does not match

Possible causes	Confirm the method	Action
The drive capacity does not match the capacity of the motor	The drive capacity must be the same as the motor capacity。	Match the capacity of the drive to the motor.

A.83： The motor is operating abnormally

Possible causes	Confirm the method	Action
A short circuit or a short circuit to the ground occurs inside the motor	Confirm whether a short circuit has occurred between the UVW phases of the motor terminals and between the UVW and the ground.	It is possible that the motor is faulty. Replace the motor.

Possible causes	Confirm the method	Action
The U, V, W phase sequence of the motor wiring is incorrect	Confirm the wiring of the motor.	Confirm if there is a problem with the motor wiring.

A.F0: Internal logic exceptions

Possible causes	Confirm the method	Action
Drive failure	Power on the drive. When an alert still occurs, it may be a drive failure.	Replace the drive.

Gr.2 Alarm

A.15: The regenerative resistance is damaged

Possible causes	Confirm the method	Action
The drive requires an external braking resistor	Confirm the connection of the external regenerative resistor and check the setpoints of Pn535 and Pn536.	Set the correct values for Pn535 and Pn536.
When an external braking resistor is not used, the short wiring of B2 and B3 falls off	Confirm the connection of the short wires of B2 and B3.	Properly wire the short wiring.
External regenerative resistors are poorly wired, detached, or disconnected	Confirm the wiring of the external regenerative resistor.	Properly wired external regenerative resistors.
Drive failure	Power on the drive. When an alert still occurs, it may be a drive failure.	Replace the drive.

A.1A: The charging resistance is overloaded

Possible causes	Confirm the method	Action
The input power supply is unstable	Measure and confirm the status of the input power supply.	Ensure that the input power supply is stable.
Power is turned on and off too frequently	–	Extend the interval between power on and off or reduce the frequency of power on and off.

A.1B: The DB braking circuit is damaged

Possible causes	Confirm the method	Action
The motor is driven by an external force	Confirm the health status。	Do not drive the motor by external force.

Possible causes	Confirm the method	Action
The rotational or running energy at the time the DB is stopped exceeds the capacity of the DB resistance	The DB usage frequency is confirmed by the DB resistor power dissipation.	Try the following measures. Reduce the command speed of the motor. Adjust the moment of inertia or mass ratio. Reduce the number of DB stops.
Drive failure	Power on the drive. When an alert still occurs, it may be a drive failure.	Replace the drive.

A.20: The main loop power line is out of phase

Possible causes	Confirm the method	Action
Poor wiring of three-phase wires	Confirm the power wiring.	Confirm if there is a problem with the power wiring.
The three-phase power supply is unbalanced	Measure the voltage of each phase of a three-phase power supply.	Corrects the imbalance of the power supply (reversing phase).
A single-phase AC power supply input (Pn007.1 = 0) is not set and a single-phase power supply is entered	Confirm power and parameter settings.	Set the correct power inputs and parameters.
Drive failure	Power on the drive. When an alert still occurs, it may be a drive failure.	Replace the drive.

A.33: USB Power Supply Exceptions

Cause	Way of confirmation	Solution
USB cable is damaged	Confirm USB cable	Replace the USB drive
Drive failure	If the alarm still occurs when the USB cable is replaced, the drive may be faulty	Replace the drive

A.49: Multi-turn or Single-turn Data Exception Detected

Cause	Way of confirmation	Solution
Poor battery connection, or not connected	Confirm battery installation	Install the battery correctly
Battery voltage below 3.0V	Measure the battery voltage	• Replace the battery and clear the alarm. See “3.5.3 Installing or Replacing the Battery”.
Drive failure	Re-apply power to the drive. If the alarm still occurs, the drive may be faulty.	Replace the drive.

A.4A: Excessive Encoder Temperature

Cause	Way of confirmation	Solution
High ambient temperature of the motor	Measure the ambient temperature of the motor.	Adjust the ambient temperature of the motor to below 40°C.
Motor running at a load in excess of the rated value	Confirm load by cumulative load factor.	Adjust the load of the motor before running to a value within the rated value.
Encoder failure	Re-apply power to the drive. If the alarm still occurs, it is possible that the motor or absolute encoder is faulty.	Replace the motor or absolute encoder.
Drive failure	Re-apply power to the drive. If the alarm still occurs, the drive may be faulty.	Replace the drive.

10.2.3 Warnings

A.1C: Fan Disconnection Alarm

Cause	Way of confirmation	Solution
Fan is disconnected	Confirm if the fan is working	Confirm if the internal fan is wired correctly
Fan is damaged	Fan does not work even after correct wiring	Replace the drive

A.33: USB Power Supply Exceptions

Cause	Way of confirmation	Solution
USB cable is damaged	Confirm USB cable	Replace the USB drive
Drive failure	If the alarm still occurs when the USB cable is replaced, the drive may be faulty	Replace the drive

A.49: Multi-turn or Single-turn Data Exception Detected

Cause	Way of confirmation	Solution
Poor battery connection, or not connected	Confirm battery installation	Install the battery correctly
Battery voltage below 3.0V	Measure the battery voltage	• Replace the battery and clear the alarm. See "3.5.3 Installing or Replacing the Battery".
Drive failure	Re-apply power to the drive. If the alarm still occurs, the drive may be faulty.	Replace the drive.

A.4B: Absolute Encoder Battery Undervoltage (Tamagawa)

Cause	Way of confirmation	Solution
Poor battery connection, or not connected	Confirm battery installation	Install the battery correctly
Battery voltage below 3.0V	Measure the battery voltage	Replace the battery and clear the alarm. See “3.5.3 Installing or Replacing the Battery”.
Drive failure	Re-apply power to the drive. If the alarm still occurs, the drive may be faulty.	Replace the drive.

A.D5: Fan Disconnection Warning

Cause	Way of confirmation	Solution
Poor fan wiring	Confirm if the fan is working	Confirm if the internal fan is wired correctly

A.D7: Warning for Reaching Soft Limit Positive Limit

Cause	Way of confirmation	Solution
The current position of the motor is outside the limits in this mode	Compare the current motor position Un009 with the position limits (Pn325,Pn325) to determine if the limits are exceeded	Enabling servo into the limits

A.D8: Warning for Reaching Soft Limit Reverse Limit

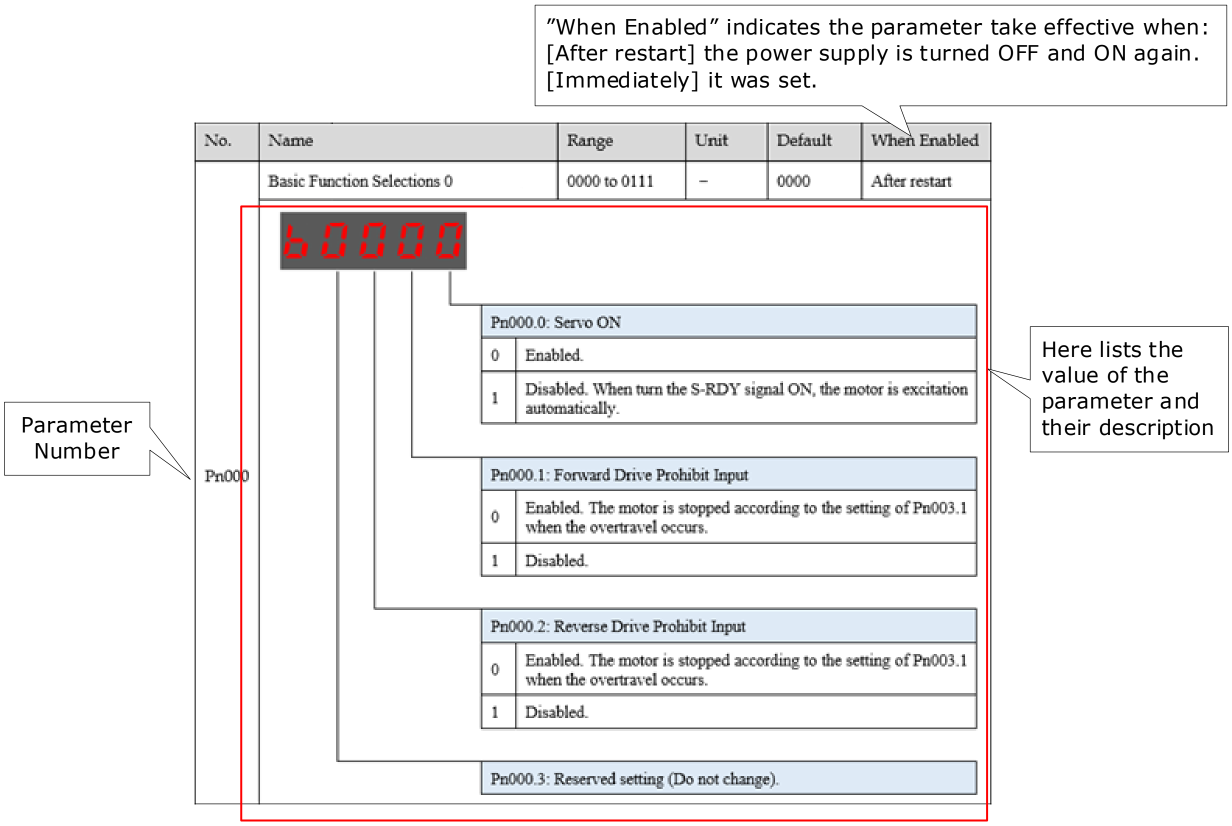
Cause	Way of confirmation	Solution
The current position of the motor is outside the limits in PCP mode	Compare the current motor position Un009 with the position limits (Pn325,Pn325) to determine if the limits are exceeded	Enabling servo into the limits

A.D9: Origin Error Warning

Cause	Way of confirmation	Solution
Loss of stored origin	Confirm if the origin values stored in Un035 and Un036 are correct	1. When Pn689.2 = 1, switch on the Storing Origin function 2. Use multiturn encoder. 3. When Pn002.2=1, use the multiturn encoder as absolute

Chapter 11 Parameters

11.1 Interpreting the Parameter Lists



11.2 Parameters Detailed

No.	Index	Name	Range	Unit	Default
Pn000	Basic Function Selections 0	b0000 to b0111	–	b0000	After restart

Pn000.0: Servo ON	
0	External S-ON Enabled.
1	External S-ON disabled. Servo motor excitation signal is turned ON automatically after S/RDY is output.

Pn000.1: Forward Drive Prohibit Input	
0	External P-OT enabled. Operate in the time sequence setting in Pn004.0 when travel limit occurs.
1	External P-OT Disabled.

Pn000.2: Reverse Drive Prohibit Input	
0	External N-OT enabled. Operate in the time sequence setting in Pn004.0 when travel limit occurs.
1	Disabled.

Pn000.3: Reserved setting (Do not change).

No.	Index	Name	Range	Unit	Default
Pn001	Reserved setting (Do not change).	b0000 to b1111	–	b0000	After restart

Pn001.0: Motor Running Direction Selection	
0	CCW, counter-clockwise rotation in the positive direction
1	CW, clockwise rotation in the positive direction

Pn001.1: Analogue Speed Limit Enabled	
0	Sets the value of Pn406 as the speed limit value during torque control.
1	Use the smaller of the speed value corresponding to the Analogue voltage input by Tref and the set value of Pn406 as the speed limit value during torque control.

Pn001.2: Analogue Torque Limit Enabled	
0	Sets Pn401~Pn404 as torque limit.
1	Sets the value corresponding to Tref input Analogue voltage as torque limit.

Pn001.3: 2nd Electronic Gear Enabled	
0	2nd electronic gear is disabled, PCON signal is used to switch P/PI
1	2nd electronic gear is enabled, PCON signal is only used as 2nd electronic gear.

<table>
<tr><th>No.</th><th>Index</th><th>Name</th><th>Range</th><th>Unit</th><th>Default</th></tr>
<tr><td rowspan="2">Pn002</td><td>Application Function Selections 2</td><td>b0000 to b0100</td><td>–</td><td>b0000</td><td>After restart</td></tr>
<tr><td colspan="5">


Pn002.0: Reserved setting (Do not change).

<table>
<tr><th colspan="2">Pn002.1: Selection of Alarm Mechanism for Tamagawa Protocol Encoders</th></tr>
<tr><td>0</td><td>Alarm A.48 occurs when Tamagawa protocol encoder battery voltage is below 3.0V</td></tr>
<tr><td>1</td><td>Alarm A.48 occurs when Tamagawa protocol encoder battery voltage is below 3.0V, and Alarm A.4b occurs when the battery voltage is below 3V during normal operation</td></tr>
</table>

<table>
<tr><th colspan="2">Pn002.2: Usage of Absolute Encoder</th></tr>
<tr><td>0</td><td>Use the encoder as an absolute encoder.</td></tr>
<tr><td>1</td><td>Use the encoder as an incremental encoder.</td></tr>
</table>

Pn002.3: Reserved setting (Do not change).
</td></tr>
</table>

No.	Index	Name	Range	Unit	Default
Pn003	Application Function Selections 3	h0000 to h1032	–	h0000	After restart

Pn003.0: Motor Stopping Mode In Case of a Gr.1 alarm, STO Active and SOFF	
0	Applying the dynamic brake and then let the Motor coast.
1	DB braking stops and stays DB after stop
2	Stops freely and remains free after stopping

Pn003.1: Motor Stopping Method for Overtravel	
0	DB brake stops, and remains free after stopping
1	Stops freely and remains free after stopping
2	Reverse braking stops, and maintains zero clamp after stop
3	Reverse braking stops, and remains free after stop

Pn003.2: Reserved setting (Do not change).

Pn003.3: Overload Enhancement	
0	Disabled.
1	Enabled. This function can enhance the Motor load for instantaneous more than 2 times rated load, which can be used in the conditions that require frequent start and stop.

No.	Index	Name	Range	Unit	Default
Pn004	Application Function Selections 4	h0000 to h3425	–	h0000	After restart

Pn004.0: Servo OFF and Stop Mode When Overtravel	
0	Motor stopped by dynamic brake. After the motor stopped, the motor will be free;
1	Motor is running freely until it stops.
2	Servo OFF: motor stopped by dynamic brake. When overtravel occurs: Reverse braking stops.
3	Servo OFF: motor is running freely until it stops. When overtravel occurs: Reverse braking stops.
4	Servo OFF: dynamic brake stopped. When overtravel occurs: Reverse braking stops and the motor enters the zero clamp state.
5	Regards it as the Warning, and the Motor will run properly.

Pn004.1: Deviation Counter Clear in Local Control Mode	
0	Reset to zero when Servo is OFF or STO is available.
1	Reserved setting (Do not change).
2	Reset to zero when Servo is OFF, or STO is available, or Overtravel is occurred.

Pn004.2: Reference pulse form	
0	SIGN + PULS
1	CW + CCW
2	A + B (×1)
3	A + B (×2)
4	A + B (×4)

Pn004.3: Inverses pulse	
0	Do not inverse PULS reference and SIGN reference.
1	Do not inverse PULS reference; Inverses SIGN reference.
2	Inverse PULS reference; Do not inverse SIGN reference.
3	Inverse PULS reference and SIGN reference.

No.	Index	Name	Range	Unit	Default
Pn005	Application Function Selections 5	h0000 to h33D3	–	h0010	After restart

Pn005.0: Internal Torque Feedforward Method	
0	Use the general internal torque feedforward.
1	Reserved.
2	Use the high-speed internal torque feedforward.
3	Reserved.

Pn005.1: Local Control Method	
0	Speed control (Analogue reference): use PI control when PCON is OFF, and use P control when PCON is ON.
1	Position control (pulse train reference): use PI control when PCON is OFF, and use P control when PCON is ON.
2	Torque control: PCON is invalid.
3	Speed control (contact reference) ↔ speed control (zero reference): switch to the speed control (zero reference)when PCON, PCL and NCL are OFF
4	Speed control (contact reference) ↔ speed control (Analogue reference): switch to the speed control (Analogue reference) when PCON, PCL and NCL are OFF.
5	Speed control (contact reference) ↔ position control (pulse train reference): switch to the position control (pulse train reference) when the PCON, PCL and NCL signals are OFF.
6	Speed control (contact reference) ↔ Torque control (Analogue reference): switch to the torque control (Analogue reference) when the PCON, PCL and NCL signals are OFF.
7	Position control (pulse train reference) ↔speed control (Analogue reference): when PCON is OFF, position control (pulse train reference) is valid; when PCON is ON, speed control (Analogue reference) is valid.
8	Position control (pulse train reference) ↔Torque control (Analogue reference): When PCON is OFF, position control (pulse train reference) is valid; when PCON is ON, torque control is valid.
9	Torque control (Analogue reference) ↔speed control (Analogue reference): When PCON is OFF, torque control is valid; when PCON is ON, speed control (Analogue reference) is valid.
A	Speed control (Analogue reference) ↔zero clamp control: When PCON is OFF, speed control (Analogue reference) is valid; when PCON is ON, zero clamp control is used.
B	Position control (pulse train reference) ↔Position control (pulse prohibited): When PCON is OFF, position control (pulse train reference) is valid; when PCON is ON, position control (pulse prohibited) is valid.
C	Position control (PCP control)
D	Speed control (parameter reference): PCON is invalid.

Pn005.2: Torque Feedforward Method	
0	Use the internal torque feedforward.
1	Use the model following control torque feedforward, which is available when Model Following Control Selection (Pn150.0) is enabled.
2	Controller setting speed feed-forward: valid in bus control mode, and set by object 0x60B1.
3	Speed feed-forward generated by the Cubic interpolation algorithm: valid after the Cubic interpolation algorithm is selected through the object 0x60C0 in bus control mode.

Pn005.3: Speed Feedforward Method

<table>
<tr><th>No.</th><th>Index</th><th>Name</th><th>Range</th><th>Unit</th><th>Default</th></tr>
<tr><td></td><td colspan="5">
<table>
<tr><td>0</td><td>Use the internal speed feedforward.</td></tr>
<tr><td>1</td><td>Use the model following control speed feedforward, which is available when Model Following Control Selection (Pn150.0) is enabled.</td></tr>
<tr><td>2</td><td>Controller setting speed feed-forward: valid in bus control mode, and set by object 0x60B1.</td></tr>
<tr><td>3</td><td>Speed feed-forward generated by the Cubic interpolation algorithm: valid after the Cubic interpolation algorithm is selected through the object 0x60C0 in bus control mode.</td></tr>
</table>
</td></tr>
<tr><td rowspan="2">Pn006</td><td>Application Function Selections 6</td><td>h0000 to h0001</td><td>–</td><td>h0000</td><td>After restart</td></tr>
<tr><td colspan="5">

<table>
<tr><th colspan="2">Pn006.0: Bus Selection</th></tr>
<tr><td>0</td><td>Non-bus, set the control mode via Pn005.1</td></tr>
<tr><td>1</td><td>CANOpen</td></tr>
</table>

Pn006.1: Reserved setting (Do not change).

Pn006.2: Reserved setting (Do not change).

Pn006.3: Reserved setting (Do not change).
</td></tr>
</table>

No.	Index	Name	Range	Unit	Default
Pn007	Application Function Selections 7	h0000 to h1120	–	h0000	After restart

Pn007.0: Reserved setting (Do not change).	

Pn007.1: Power Supply Selection	
0	Single-phase AC
1	Three-phase AC
2	DC

Pn007.2: Torque Limit Action When Undervoltage Occurs	
0	Disabled.
1	Enabled.

Pn007.3: AC Supply Frequency	
0	50Hz
1	60Hz

No.	Index	Name	Range	Unit	Default
Pn008	Initial Display Selection When Power On	0 to 9999	–	9999	After restart

Set the displayed Un Number when power on the device.
For example, set this parameter to 0, the display is Un000 after powering on the device.

No.	Index	Name	Range	Unit	Default
Pn009	Application Function Selections 9	h0000 to h0001	–	h0000	After restart
	 Pn009.0: Shared DC Bus Function 0 — Disabled. 1 — Enabled. Pn009.1: Reserved setting (Do not change). Pn009.2: Reserved setting (Do not change). Pn009.3: Reserved setting (Do not change).				
Pn010	Application Function Setting 10	h0000 ~ h0001	0000	—	After restart
	 Pn010.0: Gantry Synchro Function 0 — Disabled Gantry Synchro function 1 — Enabled Gantry Synchro function Pn010.1: Reserved Pn010.2: Reserved Pn010.3: Reserved				

No.	Index	Name	Range	Unit	Default
Pn011	Application Function Setting 11	0000 ~ 0001	0000	—	After restart
	 Pn011.0: Gantry Synchro Homing Done Sign 0 — Homing not done 1 — Homing done Pn010.1: Reserved Pn011.2: Reserved Pn011.3: Reserved				
Pn012	Open Threshold of Synchronous Adjustment	0 ~ 10000	pulse	0	After restart
	–				
Pn013	Alarm Threshold for Excessive Position Error	0 ~ 65535	pulse	10000	After restart
	–				

No.	Index	Name	Range	Unit	Default
Pn014	Application Function Setting 14	h0000 ~ h0010	–	h0000	After restart
	 Pn014.0: Reserved Pn014.1: PCP Control IO Trigger Mode 0 Edge 1 Level Pn014.2: PCP Control Contact 0 Trigger Invalid 0 Contact 0 can be triggered 1 Contact 0 cannot be triggered Pn014.3: Reserved				
Pn015	Application Function Setting 15	h0000 ~ h0001	0000	—	After restart
	 Pn015.0: Soft Limit Enable Position Valid under the PCP function 1 Non-enabling the soft-limit function 2 Enabling the soft limit function Pn015.1: Reserved Pn015.2: Auto Vibration Suppression Selection Pn015.3: Auto-tuning Type Selection (valid when Pn100.0 = 3)				
Pn100	Application Function Setting 100	h0001 ~ h1105	–	h0001	After restart

No.	Index	Name	Range	Unit	Default
	 **Pn100.0: Parametric Tuning Mode Selection** 1 – Turning not required 2 – Reserved 3 – Single parameter auto-tuning (requires setting the correct percentage of load inertia Pn106) 4 – Reserved 5 – Manual tuning (requires setting the correct percentage of load inertia Pn106) **Pn100.1: Reserved** **Pn100.2: Auto Vibration Suppression Selection** 0 – Not used 1 – used **Pn100.3: Auto-tuning Type Selection (valid when Pn100.0 = 3)** 0 – Standard: short positioning time, but prone to overshoot 1 – Stable: smooth positioning, but long positioning times				
Pn101	Servo Rigidity Setting	0 ~ 500	Hz	40	Immediately
	This parameter determines the response characteristic of the servo system. The performance can be improved by increasing this value, and decrease if vibration occurs.				
Pn102	Speed Loop Gain	1 to 10000	rad/s	500	Immediately
	This parameter determines the bandwidth of the speed loop.				
Pn103	Speed Loop Integral Time	1 to 5000	0.1ms	125	Immediately
	Reduce this value can shorten positioning time and speed response time.				
Pn104	Position Loop Gain	0 to 1000	1/s	40	Immediately
	This parameter determines the bandwidth of position loop. Increase this value can improve the stiffness of positioning, decrease if the system vibrates.				

No.	Index	Name	Range	Unit	Default
Pn105	Torque Reference Filter Time	0 to 2500	50	0.01ms	Immediately
	This parameter determines the bandwidth of torque reference filter, the filter is used to filter out the noise in torque reference.				
Pn106	Load Inertia Percentage	0 to 9999	%	0	Immediately
	This value should be set to the percentage of load inertia and Motor inertia.				
Pn107	Second Speed Loop Gain	1 to 10000	rad/s	250	Immediately
	–				
Pn108	Second Speed Loop Integral Time	1 to 5000	rad/s	200	Immediately
	–				
Pn109	Second Position Loop Gain	0 to 1000	1/s	40	Immediately
	–				
Pn110	Second Torque Reference Filter Time	0 to 2500	0.01ms	100	Immediately
	–				
Pn112	Speed Feedforward	0 to 100	%	0	Immediately
	This value is a percentage of the internal speed feedforward. This value is available when the internal speed feedforward is selected (Pn005.3=0).				
Pn113	Speed Feedforward Filter Time	0 to 640	0.1ms	0	Immediately
	This parameter determines the bandwidth of internal speed feedforward filter. The filter is used to filter out the noise in internal speed feedforward.				
Pn114	Torque Feedforward	0 to 100	%	0	Immediately
	This value is a percentage of the internal torque feedforward. This value is available when the internal torque feedforward is selected (Pn005.2=0).				
Pn115	Torque Feedforward Filter Time	0 to 640	0.1ms	0	Immediately
	This parameter determines the bandwidth of internal torque feedforward filter. The filter is used to filter out the noise in internal torque feedforward.				

No.	Index	Name	Range	Unit	Default
Pn116	P/PI Switch Mode	0 to 4	–	0	After restart
	[0] Use torque reference as the condition (threshold setting: Pn117). [1] Use position deviation counter as the condition (threshold setting: Pn118). [2] Use acceleration reference as the condition (threshold setting: Pn119). [3] Use the speed reference as the condition (threshold setting: Pn120). [4] Fixed to PI Control.				
Pn117	Torque Reference Threshold for P/PI Switch	0 to 300	%	200	Immediately
	The threshold is used to switch speed controller from PI to P. This value is a percentage of torque reference.				
Pn118	Deviation Counter Threshold for P/PI Switch	0 to 10000	pulse	0	Immediately
	The threshold is used to switch speed controller from PI to P. This value is a pulse number.				
Pn119	Acceleration Reference Threshold for P/PI Switch	0 to 3000	10rpm/s	0	Immediately
	The threshold is used to switch speed controller from PI to P. This value is an acceleration reference.				
Pn120	Speed Reference Threshold for P/PI Switch	0 to 10000	rpm	0	Immediately
	The threshold is used to switch speed controller from PI to P. This value is a speed reference.				
Pn121	Gain Switch Mode	0 to 10	–	0	After restart
	[0] Fixed to first group gains. [1] Use external signal (G-SEL) as the condition. [2] Use torque reference as the condition (threshold setting: Pn117). [3] Use position deviation counter as the condition (threshold setting: Pn118). [4] Use acceleration as the condition (threshold setting: Pn119). [5] Use speed reference as the condition (threshold setting: Pn120). [6] Use position reference as the condition (threshold setting: Pn123). [7] Use actual speed as the condition (threshold setting: Pn124). [8] Use position reference (Pn123) and actual speed (Pn124) as the condition. [9] Fixed to second group gains. [10] Use positioning completed flag as the condition.				
Pn122	Delay Time for Gain Switch	0 to 20000	0.1 ms	0	Immediately
	The delay time for gain switching after the condition has satisfied.				

No.	Index	Name	Range	Unit	Default
Pn123	Threshold for Gain Switch	0 to 20000	–	0	Immediately
	The threshold of speed reference for gain switching.				
Pn124	Speed Threshold for Gain Switch	0 to 2000	rpm	0	Immediately
	This parameter is available only when using position reference and actual speed as the condition (Pn121=8).				
Pn125	Ramp Time for Position Loop Gain Switch	0 to 20000	0.1 ms	0	Immediately
	Ramp time for gain switching, it is only available to position loop gain.				
Pn126	Hysteresis for Gain Switch	0 to 20000	–	0	Immediately
	Hysteresis of gain switching conditions. It is used to prevent gain switching frequently.				
Pn127	Low Speed Filter	0 to 100	1 cycle	0	Immediately
	This parameter determines the performance of the filter for low speed measurement. The filter will filter out the noise in low speed, but the measured speed has significant delay if this value is large.				
Pn130	Coulomb Friction Compensation	0 to 3000	0.1%Tn	0	Immediately
	This parameter is used to compensate coulomb friction. The value is the permillage of coulomb friction and Motor rated torque.				
Pn131	Speed Dead Band for Coulomb Friction Compensation	0 to 100	rpm	0	Immediately
	To set a dead band to disable coulomb friction compensation. It is used to prevent vibration at zero speed.				
Pn132	Viscous Friction Compensation	0 to 1000	0.1%Tn / 1000rpm	0	Immediately
	Sticking damp which is in direct proportion to speed.				
Pn135	Encoder Speed Filter Time	0 to 30000	0.01 ms	4	Immediately
	To set a proper time for smoothing the changes in the feedback speed to reduce vibration. This parameter is available when the instantaneous speed is not used as the speed feedback (Pn162=0).				

No.	Index	Name	Range	Unit	Default
Pn136	Tuning-free Rigidity	0~500	50	Hz	Immediately
	To set the servo rigidity in tuning-free mode				
Pn137	Tuning-free Disturbance Observer bandwidth	0~1000	90	Hz	Immediately
	To set the scale factor of the disturbance observer in tuning-free mode				
Pn138	Percentage of Tuning-free Disturbance Compensation	0~100	100	%	Immediately
	To set the scale factor of the disturbance observer in tuning-free mode				
Pn139	Tuning-free Load Inertia %	0~9999	250	%	Immediately
	To set the percentage of load inertia in the no-tuning mode				
Pn140	Tuning-free Torque Filtering Time Constants	0~2500	100	0.01ms	Immediately
	To set the torque filter time constant in tuning-free mode				
Pn150	Application Function Setting 150	h0000 ~ h0002	–	h0000	After restart
	 **Pn150.0: Model Following Control Selection** 0: Do not use. 1: Use the model following control. 2: Use the model following control and load oscillation suppression. **Pn150.1: Reserved setting (Do not change).** **Pn150.2: Reserved setting (Do not change).** **Pn150.3: Reserved setting (Do not change).**				
Pn151	Model Following Control Gain	10 to 1000	1/s	50	Immediately
	This parameter determines the response characteristic of the servo system. If you increase the setting of the model following control gain, the response characteristic will improve and the positioning time will be shortened.				

No.	Index	Name	Range	Unit	Default
Pn152	Model Following Control Gain Correction	20 to 500	%	100	Immediately
	This parameter is used for correcting the setting of the model following control gain.				
Pn153	Model Following Control Speed Feedforward	0 to 200	%	100	Immediately
	This parameter is used for fine tuning the speed feedforward value output by the model following control gain. If you increase this setting, the bias can be reduced but overshooting will be likely to occur.				
Pn154	Model Following Control Torque Feedforward	0 to 200	%	100	Immediately
	This parameter is used for fine-tuning the torque feedforward value output by the model following control gain. If you increase this setting, the response characteristic can be improved but overshooting will be likely to occur.				
Pn155	Load Oscillation Frequency	50 to 500	0.1Hz	100	Immediately
	In general, this setting is the anti-resonance frequency of the two-mass servo system.				
Pn156	Filter Time for Load Oscillation Suppression	2 to 500	0.1ms	10	Immediately
	If you increase this setting, the response characteristic can be softer but the effect of vibration suppression will be worse.				
Pn157	Limit for Load Oscillation Suppression	0 to 1000	rpm	100	Immediately
	To set a compensation limiting for the jitter suppression at speed feedforward. If you decrease this setting, the response characteristic can be softer but the effect of vibration suppression will be worse.				
Pn160	Load Torque Compensation	0 to 100	%	0	Immediately
	This parameter is a coefficient (percentage) to compensate load torque. Increase this value can improve load disturbance rejection performance but may cause vibration.				
Pn161	Load Torque Observer Gain	0 to 1000	Hz	200	Immediately
	This parameter is used to adjust the response characteristic of the load observer.				
Pn162	Feedback Speed Selection	0 to 1	–	0	After restart
	[0] Use encoder speed as the feedback speed. [1] Use observed speed as the feedback speed.				

No.	Index	Name	Range	Unit	Default
Pn164	Turns for PJOG0	-50 to 50	rotation	5	Immediately
	–				
Pn165	Max Speed for PJOG0	100 to 3000	rpm	1000	Immediately
	–				
Pn166	Acc./Dec. Time for PJOG0	50 to 2000	ms	500	Immediately
	–				
Pn167	Stop Time for PJOG0	100 to 10000	ms	1000	Immediately
	–				
Pn168	Turns for PJOG1	-50 to 50	rotation	-5	Immediately
	–				
Pn169	Max Speed for PJOG1	100 to 3000	rpm	1000	Immediately
	–				
Pn170	Acc./Dec. Time for PJOG1	50 to 2000	ms	500	Immediately
	–				
Pn171	Stop Time for PJOG1	100 to 10000	ms	1000	Immediately
	–				
Pn172	Turns for Inertia Identification	0 to 1	–	0	Immediately
	The number of turns the motor runs in the positive direction when offline inertia is identified [0] 8 rotations. [1] 4 rotations.				
Pn173	Frequency of Vibration Suppression Filter	100 to 2000	Hz	2000	Immediately
	–				
Pn174	Adjust Bandwidth of Vibration Suppression Filter	1 to 100	–	30	Immediately
	–				
Pn175	Vibration Suppression	0 to 500	–	100	Immediately
	–				

No.	Index	Name	Range	Unit	Default
Pn176	Lowpass Filter Time for Vibration Suppression	0 to 50	0.1ms	0	Immediately
	–				
Pn177	Highpass Filter Time for Vibration Suppression	0 to 1000	0.1ms	1000	Immediately
	–				
Pn178	Damping of Vibration Suppression Filter	0 to 500	–	100	Immediately
	–				
Pn179	Amplitude Threshold for Vibration Detection	5 to 500	–	100	Immediately
	This parameter is used for automatic vibration suppression.				
Pn180	Frequency Threshold for Vibration Detection	0 to 100	Hz	100	Immediately
	This parameter is used for automatic vibration suppression.				
Pn181	Frequency of Notch Filter 1	50 to 5000	Hz	5000	Immediately
	–				
Pn182	Depth of Notch Filter 1	0 to 23	–	0	Immediately
	–				
Pn183	Width of Notch Filter 1	0 to 15	–	2	Immediately
	–				
Pn184	Frequency of Notch Filter 2	50 to 5000	Hz	5000	Immediately
	–				
Pn185	Depth of Notch Filter 2	0 to 23	–	0	Immediately
	–				
Pn186	Width of Notch Filter 2	0 to 15	–	2	Immediately
	–				

No.	Index	Name	Range	Unit	Default
Pn187	Frequency of Notch Filter 3	50 to 5000	Hz	5000	Immediately
	–				
Pn188	Depth of Notch Filter 3	0 to 23	–	0	Immediately
	–				
Pn189	Width of Notch Filter 3	0 to 15	–	2	Immediately
	–				
Pn190	Auto Vibration Suppression Status	0 ~ F	–	0	Immediately
	—				
Pn191	Auto Vibration Suppression Amplitude	0 ~ 1000	–	0	Immediately
	—				
Pn200	PG Divided Ratio	16 to 16384	pulse	16384	After restart
	Analogue encoder output orthogonal difference pulses. The meaning of this value is the number of Analogue encoder output orthogonal difference pulses per one motor rotation.				
Pn201	16-bit 1st Electronic Gear Numerator	1 to 100000	–	1	After restart
	The 16-bit electronic gear parameters are valid when Pn009.2=0. The electronic gear enables the reference pulse to relate with the Servo motor travel distance, so the host controller doesn't change the mechanical deceleration ratio and encoder pulses. In fact, it is the setting of frequency doubling or frequency division to the reference pulses.				
Pn202	16-bit 1st Electronic Gear Denominator	1 to 100000	–	1	After restart
	When setting Pn009.2 to 0, it is valid when the 16-bit electronic gear parameter is selected. The use of the electronic gear allows the command pulses to correspond to the amount of motor movement so that the upper unit does not have to pay attention to the mechanical reduction ratio and the number of encoder pulses, which is essentially a setting for multiplying or dividing the command pulses.				
Pn203	16-bit 2nd Electronic Gear Numerator	1 to 100000	–	1	After restart
	When setting Pn009.2 to 0, it is valid when the 16-bit electronic gear parameter is selected. The use of the electronic gear allows the command pulses to correspond to the amount of motor movement so that the upper unit does not have to pay attention to the mechanical reduction ratio and the number of encoder pulses, which is essentially a setting for multiplying or dividing the command pulses.				

No.	Index	Name	Range	Unit	Default
Pn204	Position Reference Filter Time Constant	0 to 32767	0.1 ms	0	Immediately
	This value is used to smooth the input pulses. The effect of smoothness is better when the value is higher, but lag will occur if the value is too large.				
Pn205	Position Reference Filter Form Constant	0 to 1	–	0	After restart
	• 0: 1st order filter • 1: 2nd order filter				
Pn207	Locked-rotor Torque during Homing	10 to 300	%	100	Immediately
	The value limits the torque during homing mode; Unit: % rated torque.				
Pn208	Locked-rotor Torque Time during Homing	4 to 30000	0.1 ms	4	Immediately
	The allowed time for the stalled during homing mode. Unit : 0.1ms				

<table>
<tr><th>No.</th><th>Index</th><th>Name</th><th>Range</th><th>Unit</th><th>Default</th></tr>
<tr><td>Pn210</td><td colspan="5">

<table>
<tr><th colspan="2">Pn210.0: 2nd Encoder Enabling Bit</th></tr>
<tr><td>0</td><td>Not use the 2nd encoder</td></tr>
<tr><td>1</td><td>Use the 2nd encoder</td></tr>
</table>
<table>
<tr><th colspan="2">Pn210.1: Use the 2nd Encoder for Frequency Dividing Output or Not</th></tr>
<tr><td>0</td><td>Use the first encoder frequency dividing output</td></tr>
<tr><td>1</td><td>Use the second encoder frequency dividing output</td></tr>
</table>
<table>
<tr><th colspan="2">Pn210.2: PG Frequency Dividing Pulse Phase Selection</th></tr>
<tr><td>0</td><td>Maintain existing state</td></tr>
<tr><td>1</td><td>Invert the phase of the frequency-dividing pulse</td></tr>
</table>
<table>
<tr><th colspan="2">Pn210.3: 2nd Encoder Pulse Counting Direction</th></tr>
<tr><td>0</td><td>[0] Unchanged</td></tr>
<tr><td>1</td><td>Invert</td></tr>
</table>
</td></tr>
<tr><td rowspan="2">Pn211</td><td>Application Function Setting 211</td><td>b0000 ~ b0001</td><td>0001</td><td>—</td><td>After restart</td></tr>
<tr><td colspan="5"></td></tr>
<tr><td rowspan="2">Pn300</td><td>Analogue Speed Reference Input Gain</td><td>0 to 3000</td><td>150</td><td>rpm/v</td><td>Immediately</td></tr>
<tr><td colspan="5">The corresponding speed to 1V Analogue input.</td></tr>
<tr><td rowspan="2">Pn301</td><td>Analogue Speed Given Zero Bias</td><td>-1000 to 1000</td><td>10 mV</td><td>0</td><td>Immediately</td></tr>
<tr><td colspan="5">This parameter is used to set zero bias of Analogue speed given, and it is related with the Analogue speed reference input gain (Pn300). The Analogue speed reference after setting is calculated as follows:
Analogue speed reference=(Speed reference input Analogue voltage —Analogue speed reference zero bias)×Analogue speed reference input gain</td></tr>
<tr><td rowspan="2">Pn302</td><td>Analogue Speed Command Gain 2</td><td>0 ~ 3000</td><td>150</td><td>rpm/v</td><td>Immediately</td></tr>
<tr><td colspan="5">The speed value corresponding to Analogue input per volt.</td></tr>
</table>

No.	Index	Name	Range	Unit	Default
Pn304	Inner Speed Reference	-6000 to 6000	rpm	500	Immediately
	To set the inner Motor speed reference. This setting is available when servo is in inner speed control mode (Pn006.0 = 0 and Pn005.1 = 1).				
Pn305	Jogging Speed	0 to 6000	rpm	500	Immediately
	To set a speed for the Motor in JOG operation, and the rotation direction is determined by the reference.				
Pn306	Soft Start Acceleration Time	0 to 10000	ms	0	Immediately
	The time to accelerate the motor to 1000rpm on slope speed reference.				
Pn307	Soft Start Deceleration Time	0 to 10000	ms	0	Immediately
	The time to decelerate to 1000rpm on slope speed reference.				
Pn308	Speed Reference Filter Time	0 to 10000	ms	0	Immediately
	To set speed reference filter time.				
Pn309	S-Curve Rise Time	0 to 10000	ms	0	Immediately
	To set a rise time for transiting from one speed point to another speed point in the S-curve.				
Pn310	Speed Reference Smooth Mode Selection	0 to 3	–	0	After restart
	[0] Ramp [1] S-Curve [2] Primary filtering [3] Secondary filtering				
Pn311	S-Curve Selection	0 to 3	–	0	After restart
	To set the transition form of the S-curve.				

<table>
<tr><th>No.</th><th>Index</th><th>Name</th><th>Range</th><th>Unit</th><th>Default</th></tr>
<tr><td rowspan="2">Pn316</td><td>Internal Speed 1</td><td>-6000 to 6000</td><td>rpm</td><td>100</td><td>Immediately</td></tr>
<tr><td colspan="5">The settings of Pn316 to Pn322 are valid when Pn005.1=3, 4, 5 or 6. The table below lists the conditions for each internal speed switching.
<table>
<tr><th colspan="3">Input Signal</th><th rowspan="2">Speed Selection</th></tr>
<tr><th>/P-CON</th><th>/PCL</th><th>/NCL</th></tr>
<tr><td rowspan="4">OFF(H)</td><td>OFF(H)</td><td>OFF(H)</td><td>Zero speed or switch to other control methods</td></tr>
<tr><td>OFF(H)</td><td>ON(L)</td><td>Internal Speed 1</td></tr>
<tr><td>ON(L)</td><td>OFF(H)</td><td>Internal Speed 2</td></tr>
<tr><td>ON(L)</td><td>ON(L)</td><td>Internal Speed 3</td></tr>
<tr><td rowspan="4">ON(L)</td><td>OFF(H)</td><td>OFF(H)</td><td>Internal Speed 4</td></tr>
<tr><td>OFF(H)</td><td>ON(L)</td><td>Internal Speed 5</td></tr>
<tr><td>ON(L)</td><td>OFF(H)</td><td>Internal Speed 6</td></tr>
<tr><td>ON(L)</td><td>ON(L)</td><td>Internal Speed 7</td></tr>
</table></td></tr>
<tr><td rowspan="2">Pn317</td><td>Internal Speed 2</td><td>-6000 to 6000</td><td>rpm</td><td>200</td><td>Immediately</td></tr>
<tr><td colspan="5">Refer to the descriptions in Pn316.</td></tr>
<tr><td rowspan="2">Pn318</td><td>Internal Speed 3</td><td>-6000 to 6000</td><td>rpm</td><td>300</td><td>Immediately</td></tr>
<tr><td colspan="5">Refer to the descriptions in Pn316.</td></tr>
<tr><td rowspan="2">Pn319</td><td>Internal Speed 4</td><td>-6000 to 6000</td><td>rpm</td><td>-100</td><td>Immediately</td></tr>
<tr><td colspan="5">Refer to the descriptions in Pn316.</td></tr>
<tr><td rowspan="2">Pn320</td><td>Internal Speed 5</td><td>-6000 to 6000</td><td>rpm</td><td>-200</td><td>Immediately</td></tr>
<tr><td colspan="5">Refer to the descriptions in Pn316.</td></tr>
<tr><td rowspan="2">Pn321</td><td>Internal Speed 6</td><td>-6000 to 6000</td><td>rpm</td><td>-300</td><td>Immediately</td></tr>
<tr><td colspan="5">Refer to the descriptions in Pn316.</td></tr>
<tr><td rowspan="2">Pn322</td><td>Internal Speed 7</td><td>-6000 to 6000</td><td>rpm</td><td>500</td><td>Immediately</td></tr>
<tr><td colspan="5">Refer to the descriptions in Pn316.</td></tr>
<tr><td rowspan="2">Pn323</td><td>Overspeed Detection Threshold</td><td>1 to 8000</td><td>rpm</td><td>8000</td><td>Immediately</td></tr>
<tr><td colspan="5">A.03 alarm occurs if the Motor velocity exceeds this threshold.</td></tr>
</table>

No.	Index	Name	Range	Unit	Default
Pn324	PCP Controls Time of Stopping Acceleration	0 to 10000	ms	100	Immediately
	The time required for trapezoidal deceleration of 1000 rpm under the indexing function.				
Pn325	Max. Limit Value of Soft Limit	-	2000000000	P	Immediately
	The maximum limit value of soft limit in absolute position				
Pn326	Min. Limit Value of Soft Limit	-	-2000000000	P	Immediately
	The minimum limit value in absolute position				
Pn331	TouchProbe Input Port Allocation	0000 to 0022	–	0010	After restart

Pn331.0: CN1-18 Allocation Signal	
0	Allocate TP1 signal to CN1-18
1	Allocate TP2 signal to CN1-18
2	Do not allocate Touch Probe signal

Pn331.1: CN1-19 Allocation Signal	
0	Allocate TP1 signal to CN1-19
1	Allocate TP2 signal to CN1-19
2	Do not allocate Touch Probe signal

Pn331.2: Reserved

Pn331.3: Reserved

No.	Index	Name	Range	Unit	Default
Pn332	Touch Probe Digital Input Filtering Time	0 to 200	10ns	100	After restart
	–				
Pn333	TouchProbe Input Port Signal Inverts	0000 to 0011	–	0000	After restart
	 **Pn333.0: selection of CN1-18 Signal inverts** 0 – Not inverted (valid during low level) 1 – Inverted (valid during high level) **Pn333.1: Signal inverts selection of CN1-19** 0 – Not inverted (valid during low level) 1 – Inverted (valid during high level) **Pn333.2: Reserved** **Pn333.3: Reserved**				
Pn400	Analogue Torque Reference Gain	10 to 100	0.1V/100%	33	Immediately
	This parameter sets the voltage value of the Analogue input required to reach the rated torque.				
Pn401	Forward Torque Internal Limit	0 to 350	%	350	Immediately
	The value of motor output torque limit, and the parameter setting range is based on the actual overload capacity.				
Pn402	Reverse Torque Internal Limit	0 to 350	%	300	Immediately
	The value of motor output torque limit, and the parameter setting range is based on the actual overload capacity.				
Pn403	Forward Torque External Limit	0 to 350	%	100	Immediately
	The value of motor output torque limit, and the parameter setting range is based on the actual overload capacity.				

No.	Index	Name	Range	Unit	Default
Pn404	Reverse Torque External Limit	0 to 350	%	100	Immediately
	The value of motor output torque limit, and the parameter setting range is based on the actual overload capacity.				
Pn405	Reverse Brake Torque Limit	0 to 350	%	300	Immediately
	The value of motor output torque limit, and the parameter setting range is based on the actual overload capacity.				
Pn406	Torque Limit at Main Circuit Voltage Drop	0 to 100	%	50	Immediately
	–				
Pn407	Release Time for Torque Limit at Main Circuit Voltage Drop	0 to 1000	ms	100	Immediately
	–				
Pn408	Speed Limit during Torque Control	0 to 6000	rpm	1500	Immediately
	–				
Pn409	Torque Mode	0 to 1	–	0	Immediately
	0: Analogue torque mode 1: Torque contact mode				
Pn410	Torque Contact 1	-400 to 400	1/100%	0	Immediately
	–				
Pn411	Torque Contact 2	-400 to 400	1/100%	0	Immediately
	–				
Pn412	Torque Contact 3	-400 to 400	1/100%	0	Immediately
	—				
Pn413	Torque Contact 4	-400 to 400	1/100%	0	Immediately
	–				
Pn414	Analogue Torque Command Gain 2	10 ~ 100	0.1V/100%	Pn414	Immediately
	The parameter means the voltage value of the Analogue input required to achieve the rated torque.				

<table>
<tr><th>No.</th><th>Index</th><th>Name</th><th>Range</th><th>Unit</th><th>Default</th></tr>
<tr><td rowspan="2">Pn415</td><td>Analogue Torque Given Zero Bias</td><td>-1000 to 1000</td><td>10 mv</td><td>0</td><td>Immediately</td></tr>
<tr><td colspan="5">–</td></tr>
<tr><td rowspan="2">Pn500</td><td>Position Arrival Tolerance</td><td>0 to 50000</td><td>pulse</td><td>10</td><td>Immediately</td></tr>
<tr><td colspan="5">The /COIN (Positioning Completion) output signal will turn ON when the deviation counter is less than this setting.</td></tr>
<tr><td rowspan="2">Pn501</td><td>Speed Arrival Tolerance</td><td>0 to 100</td><td>rpm</td><td>10</td><td>Immediately</td></tr>
<tr><td colspan="5">The /VCMP (Speed Coincidence Detection) output signal will turn ON when the deviation between the speed reference and speed feedback is less than this setting.</td></tr>
<tr><td rowspan="2">Pn502</td><td>Zero Clamp Speed</td><td>0 to 3000</td><td>rpm</td><td>10</td><td>Immediately</td></tr>
<tr><td colspan="5">Locks motor at the current position when the input Analogue speed drops below this value.</td></tr>
<tr><td rowspan="2">Pn503</td><td>Rotation Status Detection Threshold</td><td>0 to 3000</td><td>rpm</td><td>20</td><td>Immediately</td></tr>
<tr><td colspan="5">It is considered the Motor has been rotated stably and the /TGON (Rotation Detection) output signal turns ON when the Motor speed exceeds this setting.</td></tr>
<tr><td rowspan="2">Pn504</td><td>Position Deviation Counter Overflow Threshold</td><td>1 to 83886080</td><td>pulse</td><td>1</td><td>Immediately</td></tr>
<tr><td colspan="5">It is considered the deviation counter has been overflowed and an alarm signal outputs when the deviation counter exceeds this setting.
NOTE: the default setting depends on the encoder resolution.</td></tr>
<tr><td rowspan="2">Pn505</td><td>Servo ON Waiting Time</td><td>-2000 to 2000</td><td>ms</td><td>0</td><td>Immediately</td></tr>
<tr><td colspan="5">Parameters from Pn505 to Pn508 are available only when the /BK (Brake Output) signal turns ON.
They are used for controlling the holding brake, so that the moving part of the machine cannot move due to gravity or an external force.
• If this setting is a positive number, when the servo is ON, the /BK signal will turn ON firstly, and wait for this setting time, then excite the Motor.
• If the setting is a negative number, when the servo is ON, the Motor can be excited immediately, and wait for this setting time, then the /BK signal will turn ON.</td></tr>
<tr><td rowspan="2">Pn506</td><td>Servo OFF Waiting Time</td><td>0 to 500</td><td>10 ms</td><td>0</td><td>Immediately</td></tr>
<tr><td colspan="5">The Servo is OFF when setting it as the /BK output (braking acts.) In this case, the machine may sometimes move slightly under the influence of gravity., depending on its components as well as the characteristics of the brake.</td></tr>
<tr><td rowspan="2">Pn507</td><td>Brake Enable Speed Threshold</td><td>10 to 100</td><td>rpm</td><td>100</td><td>Immediately</td></tr>
<tr><td colspan="5">The /BK signal will turn ON when the Motor speed is lower than this setting after the Servo is OFF.</td></tr>
</table>

No.	Index	Name	Range	Unit	Default
Pn508	Brake Enable Waiting Time	10 to 100	10 ms	50	Immediately
	The /BK signal will turn ON when the delay exceeds this setting after the Servo is OFF. The /BK signal tunes ON as long as one of the conditions, Brake Reference Waiting Speed and Brake Reference Waiting Time, is satisfied.				
Pn509	Digital Input Signal Allocations 1	h00000000 to h1C1C1C1C	–	03020100	After restart

_0 100

-0302

Pn509.0: 为 CN1-14 分配信号	
00	S-ON
01	P-CON
02	P-OT
03	N-OT
04	ALMRST
05	CLR
06	P-CL
07	N-CL
08	G-SEL
09	JDPOS-JOG+
0A	JDPOS-JOG-
0B	JDPOS-HALT
0C	HmRef
0D	SHOM
0E	ORG
0F	ZCLAMP
10	TORQ_JD1
11	TORQ_JD2
12	TORQ_SPEED_LIMIT1
13	TORQ_SPEED_LIMIT2
14	ANLOD_REV
15	POS0
16	POS1
17	POS2
18	POS3
19	POS4
1A	ANAG_SEL

Pn509.1: Corresponds to port CN1_15 or virtual input bit1
00~1A: Same allocation as CN1-14.

Pn509.2: Corresponds to port CN1_16 or virtual input bit2
00~1A: Same allocation as CN1-14.

Pn509.3: Corresponds to port CN1 17 or virtual input bit3
00~1A: Same allocation as CN1-14.

No.	Index	Name	Range	Unit	Default
Pn510	Digital Input Signal Allocations 2	h00000000 to h1C1C1C1C	–	07060504	After restart

Pn510.0: 为 CN1-39 分配信号	
00	S-ON
01	P-CON
02	P-OT
03	N-OT
04	ALMRST
05	CLR
06	P-CL
07	N-CL
08	G-SEL
09	JDPOS-JOG+
0A	JDPOS-JOG-
0B	JDPOS-HALT
0C	HmRef
0D	SHOM
0E	ORG
0F	ZCLAMP
10	TORQ_JD1
11	TORQ_JD2
12	TORQ_SPEED_LIMIT1
13	TORQ_SPEED_LIMIT2
14	ANLOD_REV
15	POS0
16	POS1
17	POS2
18	POS3
19	POS4
1A	MDP1

Pn510.1: Corresponds to port CN1_40 or virtual input bit5
00 ~ 1A: Same allocation as CN1-39.

Pn510.2: Corresponds to port CN1_41 or virtual input bit6
00~1A: Same allocation as CN1-39.

Pn510.3: Corresponds to port CN1_42 or virtual input bit7
00~1A: Same allocation as CN1-39.

No.	Index	Name	Range	Unit	Default
Pn511	Digital Output Signal Allocations	h0000 to h0ccc	–	0210	After restart

Pn511.0: Allocate signal to CN1-11, 12	
0	COIN/VCMP
1	TGON
2	S-RDY
3	CLT
4	BK
5	PGC
6	OT
7	RD
8	HOME
9	TCR
A	R-OUT1
B	R-OUT2
C	R-OUT3

Pn511.1: Allocate signal to CN1-05, 06
0 to B: same as the allocation of CN1-11, 12

Pn511.2: Allocate signal to CN1-09, 10
0 to B: same as the allocation of CN1-11, 12

Pn511.3: Reserved setting (Do not change).

No.	Index	Name	Range	Unit	Default
Pn512	Digital Input Signals (Low Bits) from Bus Master	b0000 to b1111	–	0000	After restart

Pn512.0: Select and allocate CN-14 through the bus master	
0	Not enabled.
1	Enabled.

Pn512.1: Select and allocate CN-15 through the bus master	
0	Not enabled.
1	Enabled.

Pn512.2: Select and allocate CN-16 through the bus master	
0	Not enabled.
1	Enabled.

Pn512.3: Select and allocate CN-17 through the bus master	
0	Not enabled.
1	Enabled.

No.	Index	Name	Range	Unit	Default
Pn513	Digital Input Signals (High Bits) from Bus Master	b0000 to b1111	–	0000	After restart
	 **Pn513.0: Select and allocate CN-39 through the bus master** 0 – Not enabled. 1 – Enabled. **Pn513.1: Select and allocate CN-40 through the bus master** 0 – Not enabled. 1 – Enabled. **Pn513.2: Select and allocate CN-41 through the bus master** 0 – Not enabled. 1 – Enabled. **Pn513.3: Select and allocate CN-42 through the bus master** 0 – Not enabled. 1 – Enabled.				
Pn514	Input Port Filtering	0 to 1000	1 cycle	1	Immediately
	To set a filtering time for the input signals. If you increase this setting, the signal changes on the input port will be delayed.				
Pn515	Alarm Output Signal Filter Time	0 to 3	2 cycles	1	Immediately
	To set a filtering time for the alarm signals. If you increase this setting, the alarm will be delayed.				

No.	Index	Name	Range	Unit	Default
Pn516	Digital Input Signal Inverts 1	b0000 to b1111	–	0000	After restart

Pn516.0: CN1-14 inverse selection	
0	The signal is not inverted.
1	The signal is inverted.

Pn516.1: CN1-15 inverse selection	
0	The signal is not inverted.
1	The signal is inverted.

Pn516.2: CN1-16 inverse selection	
0	The signal is not inverted.
1	The signal is inverted.

Pn516.3: CN1-17 inverse selection	
0	The signal is not inverted.
1	The signal is inverted.

No.	Index	Name	Range	Unit	Default
Pn517	Digital Input Signal Inverts 2	0000 to 1111	–	0000	After restart

Pn517.0: CN1-39 inverse selection	
0	The signal is not inverted.
1	The signal is inverted.

Pn517.1: CN1-40 inverse selection	
0	The signal is not inverted.
1	The signal is inverted.

Pn517.2: CN1-41 inverse selection	
0	The signal is not inverted.
1	The signal is inverted.

Pn517.3: CN1-42 inverse selection	
0	The signal is not inverted.
1	The signal is inverted.

Pn518	Dynamic Braking Time	50 ~ 20000	20000	0.5ms	Immediately
	The time required for dynamic braking of the motor.				
Pn519	Serial Encoder Communication Error Tolerance	0 to 10000	1 cycle	3	Immediately
	The warning of serial encoder related alarms can be ignored if the alarms occurred within this setting.				
Pn520	Position Arrival Status Detection Time Threshold	0 to 60000	0.1 ms	500	Immediately
	To set a required time for completing the positioning.				

No.	Index	Name	Range	Unit	Default
Pn521	Application Function Setting 521	b0000 to b0011	–	0010	After restart

Pn521.0: A15 alarm mask bit (for drives of 400W and below, A.15 and A.16 use the same alarm mask bit Pn521.0; for drives of 800W and above, A.15 uses Pn521.0, and A.16 cannot be masked)	
0	Do not mask.
1	Mask (when A15 is masked, the bleeder resistor will not work even if a bleeder battery is connected)

Pn521.1: A06 Mask	
0	Do not mask.
1	Ignore the alarm.

Pn521.2: Reserved setting (Do not change).

Pn521.3: Reserved setting (Do not change).

No.	Index	Name	Range	Unit	Default
Pn525	Motor Overload Detection Start Threshold	100 to 150	%	100	Immediately

A04 alarms occurs if the load percentage exceeds this setting more than a certain time.
The recommended setting is 120 or less, otherwise the Drive or the Motor may be damaged.
This setting is always 115 for the MXL Motors.

<table>
<tr><th>No.</th><th>Index</th><th>Name</th><th>Range</th><th>Unit</th><th>Default</th></tr>
<tr><td rowspan="2">Pn528</td><td>Digital Output Signal Inverts</td><td>b0000 to b1111</td><td>–</td><td>0000</td><td>After restart</td></tr>
<tr><td colspan="5">
<table>
<tr><th colspan="2">Pn528.0: CN1-05, -06 inverse selection</th></tr>
<tr><td>0</td><td>The signal is not inverted.</td></tr>
<tr><td>1</td><td>The signal is inverted.</td></tr>
</table>
<table>
<tr><th colspan="2">Pn528.1: CN1-07, 08 inverse selection</th></tr>
<tr><td>0</td><td>The signal is not inverted.</td></tr>
<tr><td>1</td><td>The signal is inverted.</td></tr>
</table>
<table>
<tr><th colspan="2">Pn528.2: CN1-09, 10 inverse selection</th></tr>
<tr><td>0</td><td>The signal is not inverted.</td></tr>
<tr><td>1</td><td>The signal is inverted.</td></tr>
</table>
<table>
<tr><th colspan="2">Pn528.3: CN1-11, 12 inverse selection</th></tr>
<tr><td>0</td><td>The signal is not inverted.</td></tr>
<tr><td>1</td><td>The signal is inverted.</td></tr>
</table>
</td></tr>
<tr><td rowspan="2">Pn529</td><td>Torque Reaches Status Detection Torque Threshold</td><td>3 to 300</td><td>%</td><td>100</td><td>Immediately</td></tr>
<tr><td colspan="5">The /TCR signal will be output when the torque output exceeds the setting in Pn529 and the time is longer than that set in Pn530.</td></tr>
<tr><td rowspan="2">Pn530</td><td>Torque Detection Output Signal Time</td><td>1 to 1000</td><td>ms</td><td>10</td><td>Immediately</td></tr>
<tr><td colspan="5">The /TCR signal will be output when the torque output exceeds the setting in Pn529 and the time is longer than that set in Pn530.</td></tr>
<tr><td rowspan="2">Pn531</td><td>Pulse Input Filter Time</td><td>10 to 100</td><td>10 ns</td><td>20</td><td>Immediately</td></tr>
<tr><td colspan="5">–</td></tr>
<tr><td rowspan="2">Pn533</td><td>Current Threshold when DB Brake Circuit is Damaged</td><td>1 ~ 9999</td><td>300</td><td>mA</td><td>Immediately</td></tr>
<tr><td colspan="5">–</td></tr>
</table>

No.	Index	Name	Range	Unit	Default
Pn534	Alarm Threshold in case of Excessive IPM Junction Temperature	1 ~ 200	135	℃	Immediately
	–				
Pn535	Discharging Resistor Resistance	25 to 300	Ω	50	After restart
	To set the resistance value for the braking.				
Pn536	Discharging Resistor Power	10 to 2000	W	60	After restart
	To set the resistance value for the braking.				
Pn538	Momentary Power Interruption Hold Time	0 to 50	period	1	Immediately
	Even if the main power supply to the Drive is interrupted momentarily, power supply to the Motor (servo ON status) will be maintained for the time set by this parameter. The setting is a number of periods, and the time of one period depends on the setting of Pn007.3: • Pn007.3=0, the time of one period is 1/50s. Pn007.3=1, the time of one period is 1/60s.				
Pn539	Pump-up Opening Delay Time	0 ~ 100	0	ms	Immediately
	–				
Pn540	Pump-up Closing Delay Time	0 ~ 100	0	ms	Immediately
	–				
Pn541	Current Threshold for Detecting Abnormal Operation	0 to 400	% In	200	Immediately
	Set a percentage threshold for the current to detect that the Motor has been operating abnormally.				
Pn542	Acceleration Threshold for Detecting Abnormal Operation	0 to 1000	krpm/s	50	Immediately
	Set a threshold for the acceleration to detect that the Motor has been operating abnormally.				
Pn685	Speed of Finding Reference Point	0 to 3000	rpm	1500	Immediately
	–				
Pn686	Speed of Homing	0 to 200	rpm	30	Immediately
	Sets the speed of the motor after reaching the limit switch.				

<table>
<tr><th>No.</th><th>Index</th><th>Name</th><th>Range</th><th>Unit</th><th>Default</th></tr>
<tr><td rowspan="2">Pn689</td><td>Homing Mode Setting</td><td>b0000 to b1111</td><td>–</td><td>0000</td><td>After restart</td></tr>
<tr><td colspan="5">


<table>
<tr><th colspan="2">Pn689.0: Homing Enabled</th></tr>
<tr><td>0</td><td>Turn OFF the origin return function</td></tr>
<tr><td>1</td><td>Turn ON the origin return function</td></tr>
</table>
<table>
<tr><th colspan="2">Pn689.1: Direct Homing After Power-on</th></tr>
<tr><td>0</td><td>Homing triggered by SHOM signal</td></tr>
<tr><td>1</td><td>Direct homing after power-on</td></tr>
</table>
<table>
<tr><th colspan="2">Pn689.2: ORG Storage</th></tr>
<tr><td>0</td><td>Do not store the origin</td></tr>
<tr><td>1</td><td>Store the origin</td></tr>
</table>
<table>
<tr><th colspan="2">Pn689.3: Actions when Encountering OT during Homing</th></tr>
<tr><td>0</td><td>Return to find homing position after encountering OT</td></tr>
<tr><td>1</td><td>Enter limit status after encountering OT</td></tr>
</table>
</td></tr>
<tr><td rowspan="2">Pn690</td><td>Offset Pulse Number During Homing (High-Bit)</td><td>-9999 to 9999</td><td>10000 pulse</td><td>0</td><td>Immediately</td></tr>
<tr><td colspan="5">The parameters Pn690 and Pn691 are used in combination, and their algebraic sum is the pulse number of the encoder offset required in the ZRN.</td></tr>
<tr><td rowspan="2">Pn691</td><td>Offset Pulse Number During Homing (Low-Bit)</td><td>-9999 to 9999</td><td>1 pulse</td><td>0</td><td>Immediately</td></tr>
<tr><td colspan="5">Please refer to the instructions in Pn691.</td></tr>
<tr><td rowspan="2">Pn692</td><td>Selection of Homing Mode</td><td>0 to 10</td><td>–</td><td>0</td><td>Immediately</td></tr>
<tr><td colspan="5">–</td></tr>
<tr><td rowspan="2">Pn693</td><td>Homing Acceleration</td><td>0 to 5000</td><td>–</td><td>100</td><td>Immediately</td></tr>
<tr><td colspan="5"></td></tr>
</table>

No.	Index	Name	Range	Unit	Default
Pn694	Origin Storage, Single-turn Position	-2147483648 to 2147483647	–	0	Immediately
Pn695	Origin Storage, Multi-turn Position	-2147483648 to 2147483647	–	0	Immediately
Pn700	Modbus Communication Setting	h0000 to h1182	–	0151	After restart

Pn700.0: MODBUS Communication Baud Rate	
0	4800 bps
1	9600 bps
2	19200 bps

Pn700.1: Selection of MODBUS Protocol	
0	7, N, 2 (Modbus, ASCII)
1	7, E, 1 (Modbus, ASCII)
2	7, O, 1 (Modbus, ASCII)
3	8, N, 2 (Modbus, ASCII)
4	8, E, 1 (Modbus, ASCII)
5	8, O, 1 (Modbus, ASCII)
6	8, N, 2 (Modbus, RTU)
7	8, E, 1 (Modbus, RTU)
8	8, O, 1 (Modbus, RTU)

Pn700.2: SCI Communication Selection	
0	No protocol for SCI communication.
1	Use MODBUS in SCI communication.

Pn700.3 Reserved

No.	Index	Name	Range	Unit	Default
Pn701	MODBUS Axis Address	1 to 247	–	1	After restart
	The axis address during MODBUS protocol communication.				
Pn703	CAN Communication Settings	0 to 5	–	1	After restart
	[0] 50Kbps [1] 100Kbps [2] 125Kbps [3] 250Kbps [4] 500Kbps [5] 1Mbps				
Pn704	CAN Communication Node	1 to 127	–	1	After restart
	The axis address during CANopen communication.				
Pn705	DC Min. Cycle Threshold	1~9999999	11999	10ns	After restart
	To set the DC jitter threshold in the FPGA				
Pn706	Jitter of DC Max. Cycle Threshold	1~99999	499	10ns	Immediately
	To set the DC jitter threshold in the FPGA				

No.	Index	Name	Range	Unit	Default
Pn709	Allocate virtual input signal to port 1	h00000000 to h1C1C1C1C	–	0B0A0908	Immediately

Pn709.0: Allocate signal to Bit8	
00	S-ON
01	P-CON
02	P-OT
03	N-OT
04	ALMRST
05	CLR
06	P-CL
07	N-CL
08	G-SEL
09	JDPOS-JOG+
0A	JDPOS-JOG-
0B	JDPOS-HALT
0C	HmRef
0D	SHOM
0E	ORG
0F	ZCLAMP
10	TORQ_JD1
11	TORQ_JD2
12	TORQ_SPEED_LIMIT1
13	TORQ_SPEED_LIMIT2
14	ANLOD_REV
15	POS0
16	POS1
17	POS2
18	POS3
19	POS4
1A	MDP1
1B	MD0
1C	MD1

Pn709.1: Allocate signal to Bit9
00 to 1C: same as the allocation of Bit8

Pn709.2: Allocate signal to Bit10
00to1C: same as the allocation of Bit8

Pn709.3: Allocate signal to Bit11
00to1C: same as the allocation of Bit8

No.	Index	Name	Range	Unit	Default
Pn710	Allocate virtual input signal to port 2	h00000000 to h1C1C1C1C	–	0F0E0D0C	Immediately

Pn710.0: Allocate signal to Bit12	
00	S-ON
01	P-CON
02	P-OT
03	N-OT
04	ALMRST
05	CLR
06	P-CL
07	N-CL
08	G-SEL
09	JDPOS-JOG+
0A	JDPOS-JOG-
0B	JDPOS-HALT
0C	HmRef
0D	SHOM
0E	ORG
0F	ZCLAMP
10	TORQ_JD1
11	TORQ_JD2
12	TORQ_SPEED_LIMIT1
13	TORQ_SPEED_LIMIT2
14	ANLOD_REV
15	POS0
16	POS1
17	POS2
18	POS3
19	POS4
1A	MDP1
1B	MD0
1C	MD1

Pn710.1: Allocate signal to Bit1
00 to 1C: same as the allocation of Bit12

Pn710.2: Allocate signal to Bit14
00to1C: same as the allocation of Bit12

Pn710.3: Allocate signal to Bit15
00to1C: same as the allocation of Bit12

No.	Index	Name	Range	Unit	Default
Pn716	Virtual Input Port Signal Inverts1	b0000 to b1111	–	0000	Immediately

Pn716.0: bit8 inverse selection	
0	The signal is not inverted.
1	The signal is inverted.

Pn716.1: bit9 inverse selection	
0	The signal is not inverted.
1	The signal is inverted.

Pn716.2: bit10 inverse selection	
0	The signal is not inverted.
1	The signal is inverted.

Pn716.3: bit11 inverse selection	
0	The signal is not inverted.
1	The signal is inverted.

<table>
<tr><th>No.</th><th>Index</th><th>Name</th><th>Range</th><th>Unit</th><th>Default</th></tr>
<tr><td rowspan="2">Pn717</td><td>Virtual Input Port Signal Inverts 2</td><td>b0000 to b1111</td><td>–</td><td>0000</td><td>Immediately</td></tr>
<tr><td colspan="5">


<table>
<tr><th colspan="2">Pn717.0: bit12 inverse selection</th></tr>
<tr><td>0</td><td>The signal is not inverted.</td></tr>
<tr><td>1</td><td>The signal is inverted.</td></tr>
</table>
<table>
<tr><th colspan="2">Pn717.1: bit13 inverse selection</th></tr>
<tr><td>0</td><td>The signal is not inverted.</td></tr>
<tr><td>1</td><td>The signal is inverted.</td></tr>
</table>
<table>
<tr><th colspan="2">Pn717.2: bit14 inverse selection</th></tr>
<tr><td>0</td><td>The signal is not inverted.</td></tr>
<tr><td>1</td><td>The signal is inverted.</td></tr>
</table>
<table>
<tr><th colspan="2">Pn717.3: bit15 inverse selection</th></tr>
<tr><td>0</td><td>The signal is not inverted.</td></tr>
<tr><td>1</td><td>The signal is inverted.</td></tr>
</table>
</td></tr>
<tr><td rowspan="2">Pn720</td><td>Homing Method</td><td>1 to 35</td><td>–</td><td>1</td><td>Immediately</td></tr>
<tr><td colspan="5">Mapping to the object 6098h in CiA402.</td></tr>
<tr><td rowspan="2">Pn721</td><td>Speed during Search for Switch</td><td>1to0x7FFFFFFF</td><td>0.1 rpm</td><td>5000</td><td>Immediately</td></tr>
<tr><td colspan="5">Mapping to the object 6099:01 in CiA402.</td></tr>
<tr><td rowspan="2">Pn722</td><td>Speed during Search for Zero</td><td>1to0x7FFFFFFF</td><td>0.1 rpm</td><td>100</td><td>Immediately</td></tr>
<tr><td colspan="5">Mapping to the object 6099:02 in CiA402.</td></tr>
<tr><td rowspan="2">Pn723</td><td>Homing Acceleration</td><td>1to0x7FFFFFFF</td><td>0.1 rpm/s</td><td>1000000</td><td>Immediately</td></tr>
<tr><td colspan="5">Mapping to the object 609Ah in CiA402.</td></tr>
<tr><td rowspan="2">Pn724</td><td>Home Offset</td><td>-2147483648 to 2147483647</td><td>pulse</td><td>0</td><td>Immediately</td></tr>
<tr><td colspan="5">Mapping to the object 6093-01h in CiA402.</td></tr>
</table>

No.	Index	Name	Range	Unit	Default
Pn725	Bus Electronic Gear Ratio (Numerator)	1 ~1073741824	pulse	1	Immediately
	Mapping to the object 6093:01 in CiA402.				
Pn726	Bus Electronic Gear Ratio (Denominator)	1 ~1073741824	pulse	1	After restart
	Mapping to the object 6093:02 in CiA402.				
Pn728	Tool Magazine Single-turn Storage	-2147483648to 2147483647	pulse	0	Immediately
	Tool magazine origin storage, single-turn position				
Pn729	Auto Signal-step Running Tool Change	0 to 1	–	0	Immediately
	The enabled position for automatic single-step running tool change				
Pn730	Return to Nearest Tool Location Upon Power-on	0 to 1	–	0	After restart
	The enabled position for returning to the nearest position after power it on				
Pn731	Position Offset Threshold for Return to Nearest Tool Location Upon Power-on	0 to 10000	0.0001 round	1000	Immediately
	Range of tool number error is Pn737toPn731, and the disk moves to centre position of the nearest tool location				
Pn732	Returning Speed to Nearest Tool Location Upon Power-on	0 to 500	rpm	100	Immediately
	The speed to return to the nearest tool location (1 arrival distance) after power on				
Pn733	Returning Acceleration to Nearest Tool Location Upon Power-on	0 to 10000	ms	200	Immediately
	The acceleration to return to the nearest tool location after power on (the time required for accelerating from 0 to 1000 revolutions)				
Pn734	Returning Deceleration to Nearest Tool Location Upon Power-on	0 to 10000	ms	200	Immediately
	The deceleration to return to the nearest tool location after power on (the time required for decelerating from 1000 revolutions to 0)				
Pn735	Number of Tool Location	1 to 30	–	20	Immediately
	–				

No.	Index	Name	Range	Unit	Default
Pn736	Tool Change Running Speed	0 to 6000	rpm	3000	Immediately
	–				
Pn737	Tool Number Error Range	0 to 10000	0.0001 round	250	Immediately
	The tool number error range, in which tool location stops and outputs tool number				
Pn738	Near Tool Running Acceleration	0 to 10000	ms	200	Immediately
	The nearest tool running acceleration (the time required for accelerating from 0 to 1000 revolutions)				
Pn739	Near Tool Running Deceleration	0 to 10000	ms	200	Immediately
	The nearest tool running deceleration (the time required for decelerating from 1000 revolutions to 0)				
Pn740	Remote Tool Running Acceleration	0 to 10000	ms	200	Immediately
	The remote tool running acceleration (the time required for accelerating from 0 to 1000 revolutions)				
Pn741	Remote Tool Running Deceleration	0 to 10000	ms	200	Immediately
	The remote tool running acceleration (the time required for decelerating from 1000 revolutions to 0)				
Pn742	Tool Change Delay	0 to 10000	ms	500	Immediately
	The time delayed in tool change				

No.	Index	Name	Range	Unit	Default
Pn800	Motor Power No.	h0000 ~ h050F	0	—	After restart
	 Pn800.0: Motor Power No. Pn800.1: Motor Power No. Pn800.2: Motor Power No. Pn800.3: Motor Power No.				
Pn801	Motor Design Sequence	h0000 ~ h0003	0	—	After restart
	 Pn801.0: Motor Sequence 0 First generation motors 1 Second generation motors 2 Third-party motors 3 MXL motors Pn801.1: Reserved Pn801.2: Reserved Pn801.3: Reserved				
Pn802	Initial Encoder Phase	0 ~ 2147483647	0	—	After restart
	—				
Pn803	Reserved	0 ~ 0	0	—	After restart
	Reserved				
Pn804	Motor Series	0 ~ 5	0	—	After restart

No.	Index	Name	Range	Unit	Default
	[0] EMJ [1] EMG [2] EML [3] EMB [4] *reserved* [5] MXL				

No.	Index	Name	Range	Unit	Default
Pn805	Motor Type	0 ~ 1	0	—	After restart
	[0] SPM [1] IPM				
Pn806	Voltage Class	0 ~ 1	0	—	After restart
	[0] 200V [1] 380V				
Pn807	Motor Power	1 ~ 50000	1	W	After restart
	—				
Pn808	Motor Temperature Sensor Type	0 ~ 3	0	—	After restart
	[0] N/A [1] KTY84 [2] PT1000 [3] PT100				
Pn809	Motor Derating Factor	1 ~ 100	1	0.01Tn	After restart
	—				
Pn810	Rated Torque	1 ~ 10000	1	0.01Nm	After restart
	—				
Pn811	Max. Torque	1 ~ 10000	1	0.01Nm	After restart
	—				
Pn812	Rated current	1 ~ 2000	1	0.1A	After restart
	—				
Pn813	Max. current	1 ~ 2000	1	0.1A	After restart
	—				
Pn814	Rated Speed	1 ~ 10000	1	rpm	After restart
	—				
Pn815	Max. Speed	1 ~ 10000	1	rpm	After restart
	—				
Pn816	Limit Speed	1 ~ 10000	1	rpm	After restart
	—				

No.	Index	Name	Range	Unit	Default
Pn817	a0*10000	-10000 ~ 10000	0	—	After restart
	To convert torque into the corresponding current				
Pn818	a1*10000	-2000 ~ 2000	0	—	After restart
	To convert torque into the corresponding current				
Pn819	a2*10000	-2000 ~ 2000	0	—	After restart
	To convert torque into the corresponding current				
Pn820	a3*10000	0 ~ 0	0	—	After restart
	To convert torque into the corresponding current				
Pn821	a4*10000	0 ~ 0	0	—	After restart
	To convert torque into the corresponding current				
Pn822	b0*10000	-10000 ~ 10000	0	—	After restart
	To convert current into the corresponding torque				
Pn823	b1*10000	-2000 ~ 2000	0	—	After restart
	To convert current into the corresponding torque				
Pn824	b2*10000	-2000 ~ 2000	0	—	After restart
	To convert current into the corresponding torque				
Pn825	b3*10000	0 ~ 0	0	—	After restart
	To convert current into the corresponding torque				
Pn826	b4*10000	0 ~ 0	0	—	After restart
	To convert current into the corresponding torque				
Pn827	Back Electromotive Force Coefficient Ke	1000 ~ 5000	1000	0.01V/Krpm	After restart
	—				
Pn828	Phase Resistance Rs	0 ~ 900000	0	0.001Ω	After restart
	—				
Pn829	Ld	0 ~ 5000	0	0.1mH	After restart
	—				

No.	Index	Name	Range	Unit	Default
Pn830	Lq	0 ~ 5000	0	0.1mH	After restart
	—				
Pn831	Motor Inertia	0 ~ 100000	0	1e-8Kgm^2	After restart
	—				
Pn832	Pair of Poles	0 ~ 20	0	—	After restart
	—				
Pn833	Electrical Time Constant te	0 ~ 10000	0	0.01ms	After restart
	—				
Pn834	Mechanical Time Constant tm	0 ~ 10000	0	0.01ms	After restart
	—				
Pn835	Thermal Time Constant th	0 ~ 10000	0	0.01ms	After restart
	—				
Pn836	Thermal Model Parameter Tp[0]*10000	0 ~ 0	0	—	After restart
	For motor overheating protection and alarm judgement.				
Pn837	Thermal Model Parameter Tp[1]*10000	0 ~ 0	0	—	After restart
	For motor overheating protection and alarm judgement.				
Pn838	Thermal Model Parameter Tp[2]*10000	0 ~ 0	0	—	After restart
	For motor overheating protection and alarm judgement.				
Pn839	Thermal Model Parameter Tp[3]*10000	0 ~ 0	0	—	After restart
	For motor overheating protection and alarm judgement.				
Pn840	Thermal Model Parameter Tp[4]*10000	0 ~ 0	0	—	After restart
	For motor overheating protection and alarm judgement.				
Pn841	Motor Overload Curve Factor k[0]*10000	0 ~ 100000	0	—	After restart
	For motor overload protection and alarm judgement.				
Pn842	Motor Overload Curve Factor k[1]*10000	0 ~ 100000	0	—	After restart
	For motor overload protection and alarm judgement.				

No.	Index	Name	Range	Unit	Default
Pn843	Motor Overload Curve Factor k[2]*10000	0 ~ 100000	0	—	After restart
	For motor overload protection and alarm judgement.				
Pn844	Motor Overload Curve Factor k[3]*10000	0 ~ 0	0	—	After restart
	For motor overload protection and alarm judgement.				
Pn845	Motor Overload Curve Factor k[4]*10000	0 ~ 0	0	—	After restart
	For motor overload protection and alarm judgement.				
Pn846	Motor Oil Seal Property	0 ~ 1	0	—	After restart
	[0] Without oil seal [1] With oil seal				
Pn875	Encoder Type	h0000 ~ h000E	0	—	After restart

No.	Index	Name	Range	Unit	Default

Pn875.0: Encoder Type	
0	–
1	–
2	–
3	17-bit multi-turn, Tamagawa
4	17-bit single-turn, Tamagawa
5	Reserved (resolver)
6	Reserved
7	20-bit multi-turn, Nikon
8	20-bit single-turn, Nikon
9	20-bit multi-turn, Tamagawa
A	19-bit multi-turn, Endat
B	20-bit single-turn, Biss
C	23-bit multi-turn, Tamagawa
D	20-bit single-turn, Tamagawa
E	23-bit multi-turn, Nikon

Pn875.1: Encoder Type, as above

Pn875.2: Reserved

Pn875.3: Reserved

No.	Index	Name	Range	Unit	Default
Pn876	Reserved	0	0	—	After restart
	—				
Pn877	Encoder Type	0 ~ 4	0	—	After restart
	[0] Reserved [1] Tamagawa [2] Nikon [3] Endat [4] Biss-C				
Pn878	Encoder Function Type	0 ~ 1	0		
	[0] Incremental [1] Absolute				
Pn880	Number of Bits of Encoder Resolution Used in the Program	0 ~ 24	0	—	After restart
Pn881	Encoder Multi-turn Information Resolution	0 ~ 20	0	—	After restart
Pn885	Drive Power Level	h0000 ~ h020F	0	—	After restart
	 Pn885.0: Drive Power Level 0 200W 1 400W Pn885.1: Drive Power Level 0 200W 1 400W Pn885.2: Drive Type 0 F version 1 Pn885.3: Reserved				
Pn895	Selection of Motor Phases and Parameter Zones	b0000 ~b1111	0	—	After restart

No.	Index	Name	Range	Unit	Default

Pn895.0: A58 Alarm Mask Bit	
0	Enable the A58 alarm and use the phase information in the EEROM 1 zone
1	Mask the A58 alarm and use the special information set in the Pn parameter as the encoder phase information

Pn895.1: Select A59 Alarm Mask Bit for Phase Information	
0	Enable the A59 alarm and use the phase information in the EEROM 1 zone
1	Mask the A59 alarm and use the special information set in the Pn parameter as the encoder phase information

Pn895.2: Select A42 Alarm Mask Bit for Motor Parameter Information	
0	The A42 alarm is not masked, and drive-motor power mismatch operation is not supported.
1	The A42 alarm is masked, and drive-motor power mismatch operation is supported.

Pn895.3: Type of Motor Manufacturer	
0	ESTUN Motors
1	Third-party Motors

No.	Index	Name	Range	Unit	Default
Pn914	Asynchronous Drag Uq Amplitude	0 ~ 1000	100	‰	After restart
	The Voltage scale in thousands (‰)				
Pn915	Asynchronous Drag Frequency	1 ~ 100	30	—	After restart
	—				
Pn916	Current Loop Bandwidth Setpoint	800 ~ 1200	850	Hz	After restart
	—				
Pn917	Percentage of Deadband Compensation	0 ~ 100	0	%	After restart
	—				
Pn920	Binary Bit Parameter	b0000 ~ b0011	0000	—	After restart
	 **Pn920.0: Test Mode Enable Switch** 0: Ordinary mode 1: Test mode **Pn920.1: Analogue Power-Up Function Enable** 0: Mask the Analogue power-up function 1: Analogue power-up function enabled **Pn920.2: Reserved** **Pn920.3: Reserved**				
Pn921	Hexadecimal Bit Parameter	h0000 ~ h0005	0000	—	After restart

No.	Index	Name	Range	Unit	Default

Pn921.0: Test Mode Selection	
0	Position loop frequency domain
1	Velocity loop frequency domain
2	Current loop frequency domain
3	Current-loop step
4	Velocity loop sweep
5	Current loop sweep

Pn921.1: Reserved

Pn921.2: Reserved

Pn921.3: Reserved

No.	Index	Name	Range	Unit	Default
Pn922	Current Loop Step Test Id % Given	0 ~ 300	0	%	—
	Rated Percentage (%)				
Pn923	Current Loop Step Test Iq % Given	0 ~ 300	0	%	After restart
	Rated Percentage (%)				
Pn924	Current Given Time	0 ~ 30000	1000	62.5us	After restart
	Reserved				
Pn925	Iq % of Given Offset of Current Loop Frequency Response Test	0 ~ 500	45	%	After restart
Pn926	Iq % of Given Amplitude of Current Loop Frequency Response Test	1 ~ 500	30	%	After restart
	—				
Pn927	Reserved	0~0	0	—	After restart
	Reserved				
Pn928	Given Offset for Velocity Loop Frequency Response Test Speed	0 ~ 1000	500	rpm	After restart
	—				
Pn929	Given Amplitude for Velocity Loop Frequency Response Test	1 ~ 1000	30	rpm	After restart
	—				
Pn930	Reserved	0~0	0	—	After restart
	Reserved				
Pn931	DA Output Voltage Amplitude in Frequency Response Test Mode	1 ~ 50	5	0.1V	After restart
	—				
Pn932	Sweep Frequency	1 ~ 3000	50	Hz	After restart
	—				
Pn933	Reserved	0~0	0	—	After restart
	Reserved				
Pn934	Reserved	0~0	0	—	After restart
	Reserved				
Pn935	Speed Ratio per Volt in Position Loop Frequency Domain Test	1 ~ 90000	10	—	After restart

No.	Index	Name	Range	Unit	Default
	The higher the value, the higher the speed during the position loop test.				

No.	Index	Name	Range	Unit	Default
Pn938	Reserved	0~0	0	—	—
	Reserved				
Pn939	STO Function Masking	0 ~ 1	0	—	After restart
	[0] Not mask STO [1] Mask STO				
Pn940	Interrupt Cycle Time Setting	0 ~ 1	1	—	After restart
	[0] 100us interrupt cycle [1] 125us interrupt cycle				
Pn941	MXL Motor Field Weakening Enable Switch	0 ~ 1	1	—	After restart
	[0] Shield the Field Weakening function [1] Enable the Field Weakening function				
Pn942	Field Weakening PI regulator, kp	0 ~ 9000	20	0.01	After restart
	—				
Pn943	Field Weakening PI regulator, ki	0 ~ 9000	4000	0.1	After restart
	—				
Pn944	Field Weakening Idr Max Limit %	0 ~ 100	60	%	After restart
	Max. Limit Value of Field Weakening Idr %				
Pn945	Current Loop Control Mode	0 ~ 1	0	—	After restart
	[0] Voltage feed-forward decoupling control [1] Complex vector control				
Pn946	Magnetically Programmed Motor Sets Communication Frequency Enable ON Switch	0~ 1	1	—	After restart
	Magnetically programmed motor sets the communication frequency to enable the on switch				
Pn949	Motor Torque Limit Bias	-50 ~ 100	20	%	After restart
	Percentage of motor torque limiting bias				
Pn951	Enable Tz	0 ~ 1	1	—	After restart
	[0] Shield Tz [1] Enable Tz				
Pn952	Amplification of Motor Tmax and Pn401/402	100 ~ 200	100	0.01	After restart

No.	Index	Name	Range	Unit	Default
	The amplification of the motor Tmax and of Pn401/402 is used to increase the motor output torque when the Kt calibration is inaccurate.				

No.	Index	Name	Range	Unit	Default
Pn953	Amplify Motor Imax	100 ~ 150	105	0.01	
	Amplify the motor Imax				
Pn954	Alarm Self-test	0 ~ 6	0	—	After restart
	To debug variables. Used to simulate alarms and warnings during alarm self-test. [0] No alarm; [x] Trigger A.Fx				
Pn955	Busbar Voltage Correction	-30 ~ 30	0	V	After restart
	The bus voltage value calculated from the sampling plus this value is the final voltage value used.				
Pn957	ePWM Forced Sync Enabling Bit in EC Mode	0~1	1	—	After restart
	Forced synchronization enable bit of ePWM timer and EC distribution clock [0] No synchronization [1] Forced synchronization (default)				
Pn960	Alarm Mask Register	b0000 ~ b1111	b0000	—	After restart
Pn960	Alarm Mask Register	b0000 ~ b1111	b0000	—	After restart

Pn960.0: A37	
0	Not masked
1	Masked

Pn960.1: A14	
0	Not masked
1	Masked

Pn960.2: A13	
0	Not masked
1	Masked

Pn960.3:A20	
0	Not masked
1	Masked

<table>
<tr><th>No.</th><th>Index</th><th>Name</th><th>Range</th><th>Unit</th><th>Default</th></tr>
<tr><td rowspan="2">Pn961</td><td>Alarm Mask Register</td><td>b0000 ~ b1111</td><td>b0000</td><td>—</td><td>After restart</td></tr>
<tr><td colspan="5">

<table>
<tr><th colspan="2">Pn961.0: A81</th></tr>
<tr><td>0</td><td>Not masked</td></tr>
<tr><td>1</td><td>Masked</td></tr>
<tr><th colspan="2">Pn961.1: A04</th></tr>
<tr><td>0</td><td>Not masked</td></tr>
<tr><td>1</td><td>Masked</td></tr>
<tr><th colspan="2">Pn961.2: A1C</th></tr>
<tr><td>0</td><td>Not masked</td></tr>
<tr><td>1</td><td>Masked</td></tr>
<tr><th colspan="2">Pn961.3:A11</th></tr>
<tr><td>0</td><td>Not masked</td></tr>
<tr><td>1</td><td>Masked</td></tr>
</table></td></tr>
<tr><td>Pn962</td><td>Alarm Mask Register</td><td>b0000 ~ b1111</td><td>0000</td><td>—</td><td>After restart</td></tr>
</table>

No.	Index	Name	Range	Unit	Default

Pn962.0: A18	
0	Not masked
1	Masked

Pn962.1: A19	
0	Not masked
1	Masked

Pn962.2: A23	
0	Not masked
1	Masked

Pn962.3:A16	
0	Not masked
1	Masked

No.	Index	Name	Range	Unit	Default
Pn963	Alarm Mask Register	b0000 ~ b1111	0000	—	After restart

Pn963.0: A24	
0	Not masked
1	Masked

Pn963.1: A1A	
0	Not masked
1	Masked

Pn963.2: A1B	
0	Not masked
1	Masked

Pn963.3:A1F	
0	Not masked
1	Masked

No.	Index	Name	Range	Unit	Default
Pn964	Alarm Mask Register	b0000 ~ b1111	0000	—	After restart

No.	Index	Name	Range	Unit	Default

Pn964.0: A36 Mask Bit (NEXT52 Power Failure)	
0	Not masked
1	Masked

Pn964.1: A.35 Mask Bit (Control Panel Temperature Sensor Disconnected)	
0	Not masked
1	Masked

Pn964.2: A.1d Mask Bit (NTC Disconnected)	
0	Not masked
1	Masked

Pn964.3: A.34 Mask Bit (Control Panel Temperature Sensor Disconnected)	
0	Not masked
1	Masked

No.	Index	Name	Range	Unit	Default
Pn965	Alarm Mask Register	b0000 ~ b001	0000	—	After restart
	 Pn965.0: Mask Bit (Encoder Position Jump Alarm) 0 Not masked 1 Masked Pn965.1: Reserved Pn965.2: Reserved Pn965.3: Reserved				
PnA00	PCP Control Position Pulse 0	-2000000000 to 2000000000	1P	0	Immediately
	The position pulse reference corresponding to PCP control contact 0				
PnA01	PCP Control Position Pulse 1	-2000000000 to 2000000000	1P	0	Immediately
	The position pulse reference corresponding to PCP control contact 1				
PnA02	PCP Control Position Pulse 2	-2000000000 to 2000000000	1P	0	Immediately
	The position pulse reference corresponding to PCP control contact 2				
PnA03	PCP Control Position Pulse 3	-2000000000 to 2000000000	1P	0	Immediately
	The position pulse reference corresponding to PCP control contact 3				
PnA04	PCP Control Position Pulse 4	-2000000000 to 2000000000	1P	0	Immediately
	The position pulse reference corresponding to PCP control contact 4				
PnA05	PCP Control Position Pulse 5	-2000000000 to 2000000000	1P	0	Immediately
	The position pulse reference corresponding to PCP control contact 5				

No.	Index	Name	Range	Unit	Default
PnA06	PCP Control Position Pulse 6	-2000000000 to 2000000000	1P	0	Immediately
	The position pulse reference corresponding to PCP control contact 6				
PnA07	PCP Control Position Pulse 7	-2000000000 to 2000000000	1P	0	Immediately
	The position pulse reference corresponding to PCP control contact 7				
PnA08	PCP Control Position Pulse 8	-2000000000 to 2000000000	1P	0	Immediately
	The position pulse reference corresponding to PCP control contact 8				
PnA09	PCP Control Position Pulse 9	-2000000000 to 2000000000	1P	0	Immediately
	The position pulse reference corresponding to PCP control contact 9				
PnA10	PCP Control Position Pulse 10	-2000000000 to 2000000000	1P	0	Immediately
	The position pulse reference corresponding to PCP control contact 10				
PnA11	PCP Control Position Pulse 11	-2000000000 to 2000000000	1P	0	Immediately
	The position pulse reference corresponding to PCP control contact 11				
PnA12	PCP Control Position Pulse 12	-2000000000 to 2000000000	1P	0	Immediately
	The position pulse reference corresponding to PCP control contact 12				
PnA13	PCP Control Position Pulse 13	-2000000000 to 2000000000	1P	0	Immediately
	The position pulse reference corresponding to PCP control contact 13				
PnA14	PCP Control Position Pulse 14	-2000000000 to 2000000000	1P	0	Immediately
	The position pulse reference corresponding to PCP control contact 14				
PnA15	PCP Control Position Pulse 15	-2000000000 to 2000000000	1P	0	Immediately
	The position pulse reference corresponding to PCP control contact 15				
PnA16	PCP Control Position Pulse 16	-2000000000 to 2000000000	1P	0	Immediately
	The position pulse reference corresponding to PCP control contact 16				

No.	Index	Name	Range	Unit	Default
PnA17	PCP Control Position Pulse 17	-2000000000 to 2000000000	1P	0	Immediately
	The position pulse reference corresponding to PCP control contact 17				
PnA18	PCP Control Position Pulse 18	-2000000000 to 2000000000	1P	0	Immediately
	The position pulse reference corresponding to PCP control contact 18				
PnA19	PCP Control Position Pulse 19	-2000000000 to 2000000000	1P	0	Immediately
	The position pulse reference corresponding to PCP control contact 19				
PnA20	PCP Control Position Pulse 20	-2000000000 to 2000000000	1P	0	Immediately
	The position pulse reference corresponding to PCP control contact 20				
PnA21	PCP Control Position Pulse 21	-2000000000 to 2000000000	1P	0	Immediately
	The position pulse reference corresponding to PCP control contact 21				
PnA22	PCP Control Position Pulse 22	-2000000000 to 2000000000	1P	0	Immediately
	The position pulse reference corresponding to PCP control contact 22				
PnA23	PCP Control Position Pulse 23	-2000000000 to 2000000000	1P	0	Immediately
	The position pulse reference corresponding to PCP control contact 23				
PnA24	PCP Control Position Pulse 24	-2000000000 to 2000000000	1P	0	Immediately
	The position pulse reference corresponding to PCP control contact 24				
PnA25	PCP Control Position Pulse 25	-2000000000 to 2000000000	1P	0	Immediately
	The position pulse reference corresponding to PCP control contact 25				
PnA26	PCP Control Position Pulse 26	-2000000000 to 2000000000	1P	0	Immediately
	The position pulse reference corresponding to PCP control contact 26				
PnA27	PCP Control Position Pulse 27	-2000000000 to 2000000000	1P	0	Immediately
	The position pulse reference corresponding to PCP control contact 27				

No.	Index	Name	Range	Unit	Default
PnA28	PCP Control Position Pulse 28	-2000000000 to 2000000000	1P	0	Immediately
	The position pulse reference corresponding to PCP control contact 28				
PnA29	PCP Control Position Pulse 29	-2000000000 to 2000000000	1P	0	Immediately
	The position pulse reference corresponding to PCP control contact 29				
PnA30	PCP Control Position Pulse 30	-2000000000 to 2000000000	1P	0	Immediately
	The position pulse reference corresponding to PCP control contact 30				
PnA31	PCP Control Position Pulse 31	-2000000000 to 2000000000	1P	0	Immediately
	The position pulse reference corresponding to PCP control contact 31				
PnA32	PCP Control Position Speed 0	0 to 6000	rpm	500	Immediately
	The speed reference corresponding to PCP control contact 0				
PnA33	PCP Control Position Speed 1	0 to 6000	rpm	500	Immediately
	The speed reference corresponding to PCP control contact 1				
PnA34	PCP Control Position Speed 2	0 to 6000	rpm	500	Immediately
	The speed reference corresponding to PCP control contact 2				
PnA35	PCP Control Position Speed 3	0 to 6000	rpm	500	Immediately
	The speed reference corresponding to PCP control contact 3				
PnA36	PCP Control Position Speed 4	0 to 6000	rpm	500	Immediately
	The speed reference corresponding to PCP control contact 4				
PnA37	PCP Control Position Speed 5	0 to 6000	rpm	500	Immediately
	The speed reference corresponding to PCP control contact 5				
PnA38	PCP Control Position Speed 6	0 to 6000	rpm	500	Immediately
	The speed reference corresponding to PCP control contact 6				
PnA39	PCP Control Position Speed 7	0 to 6000	rpm	500	Immediately
	The speed reference corresponding to PCP control contact 7				

No.	Index	Name	Range	Unit	Default
PnA40	PCP Control Position Speed 8	0 to 6000	rpm	500	Immediately
	The speed reference corresponding to PCP control contact 8				
PnA41	PCP Control Position Speed 9	0 to 6000	rpm	500	Immediately
	The speed reference corresponding to PCP control contact 9				
PnA42	PCP Control Position Speed 10	0 to 6000	rpm	500	Immediately
	The speed reference corresponding to PCP control contact 10				
PnA43	PCP Control Position Speed 11	0 to 6000	rpm	500	Immediately
	The speed reference corresponding to PCP control contact 11				
PnA44	PCP Control Position Speed 12	0 to 6000	rpm	500	Immediately
	The speed reference corresponding to PCP control contact 12				
PnA45	PCP Control Position Speed 13	0 to 6000	rpm	500	Immediately
	The speed reference corresponding to PCP control contact 13				
PnA46	PCP Control Position Speed 14	0 to 6000	rpm	500	Immediately
	The speed reference corresponding to PCP control contact 14				
PnA47	PCP Control Position Speed 15	0 to 6000	rpm	500	Immediately
	The speed reference corresponding to PCP control contact 15				
PnA48	PCP Control Position Speed 16	0 to 6000	rpm	500	Immediately
	The speed reference corresponding to PCP control contact 16				
PnA49	PCP Control Position Speed 17	0 to 6000	rpm	500	Immediately
	The speed reference corresponding to PCP control contact 17				
PnA50	PCP Control Position Speed 18	0 to 6000	rpm	500	Immediately
	The speed reference corresponding to PCP control contact 18				
PnA51	PCP Control Position Speed 19	0 to 6000	rpm	500	Immediately
	The speed reference corresponding to PCP control contact 19				
PnA52	PCP Control Position Speed 20	0 to 6000	rpm	500	Immediately
	The speed reference corresponding to PCP control contact 20				

No.	Index	Name	Range	Unit	Default
PnA53	PCP Control Position Speed 21	0 to 6000	rpm	500	Immediately
	The speed reference corresponding to PCP control contact 21				
PnA54	PCP Control Position Speed 22	0 to 6000	rpm	500	Immediately
	The speed reference corresponding to PCP control contact 22				
PnA55	PCP Control Position Speed 23	0 to 6000	rpm	500	Immediately
	The speed reference corresponding to PCP control contact 23				
PnA56	PCP Control Position Speed 24	0 to 6000	rpm	500	Immediately
	The speed reference corresponding to PCP control contact 24				
PnA57	PCP Control Position Speed 25	0 to 6000	rpm	500	Immediately
	The speed reference corresponding to PCP control contact 25				
PnA58	PCP Control Position Speed 26	0 to 6000	rpm	500	Immediately
	The speed reference corresponding to PCP control contact 26				
PnA59	PCP Control Position Speed 27	0 to 6000	rpm	500	Immediately
	The speed reference corresponding to PCP control contact 27				
PnA60	PCP Control Position Speed 28	0 to 6000	rpm	500	Immediately
	The speed reference corresponding to PCP control contact 28				
PnA61	PCP Control Position Speed 29	0 to 6000	rpm	500	Immediately
	The speed reference corresponding to PCP control contact 29				
PnA62	PCP Control Position Speed 30	0 to 6000	rpm	500	Immediately
	The speed reference corresponding to PCP control contact 30				
PnA63	PCP Control Position Speed 31	0 to 6000	rpm	500	Immediately
	The speed reference corresponding to PCP control contact 31				
PnA64	PCP Control Contact Attribute 0	h0000 to h1112	–	0	Immediately
	The attribute corresponding to PCP control contact 0				
PnA65	PCP Control Contact Attribute 1	h0000 to h1112	–	0	Immediately
	The attribute corresponding to PCP control contact 1				

No.	Index	Name	Range	Unit	Default
PnA66	PCP Control Contact Attribute 2	h0000 to h1112	–	0	Immediately
	The attribute corresponding to PCP control contact 2				
PnA67	PCP Control Contact Attribute 3	h0000 to h1112	–	0	Immediately
	The attribute corresponding to PCP control contact 3				
PnA68	PCP Control Contact Attribute 4	h0000 to h1112	–	0	Immediately
	The attribute corresponding to PCP control contact 4				
PnA69	PCP Control Contact Attribute 5	h0000 to h1112	–	0	Immediately
	The attribute corresponding to PCP control contact 5				
PnA70	PCP Control Contact Attribute 6	h0000 to h1112	–	0	Immediately
	The attribute corresponding to PCP control contact 6				
PnA71	PCP Control Contact Attribute 7	h0000 to h1112	–	0	Immediately
	The attribute corresponding to PCP control contact 7				
PnA72	PCP Control Contact Attribute 8	h0000 to h1112	–	0	Immediately
	The attribute corresponding to PCP control contact 8				
PnA73	PCP Control Contact Attribute 9	h0000 to h1112	–	0	Immediately
	The attribute corresponding to PCP control contact 9				
PnA74	PCP Control Contact Attribute 10	h0000 to h1112	–	0	Immediately
	The attribute corresponding to PCP control contact 10				
PnA75	PCP Control Contact Attribute 11	h0000 to h1112	–	0	Immediately
	The attribute corresponding to PCP control contact 11				
PnA76	PCP Control Contact Attribute 12	h0000 to h1112	–	0	Immediately
	The attribute corresponding to PCP control contact 12				

No.	Index	Name	Range	Unit	Default
PnA77	PCP Control Contact Attribute 13	h0000 to h1112	–	0	Immediately
	The attribute corresponding to PCP control contact 13				
PnA78	PCP Control Contact Attribute 14	h0000 to h1112	–	0	Immediately
	The attribute corresponding to PCP control contact 14				
PnA79	PCP Control Contact Attribute 15	h0000 to h1112	–	0	Immediately
	The attribute corresponding to PCP control contact 15				
PnA80	PCP Control Contact Attribute 16	h0000 to h1112	–	0	Immediately
	The attribute corresponding to PCP control contact 16				
PnA81	PCP Control Contact Attribute 17	h0000 to h1112	–	0	Immediately
	The attribute corresponding to PCP control contact 17				
PnA82	PCP Control Contact Attribute 18	h0000 to h1112	–	0	Immediately
	The attribute corresponding to PCP control contact 18				
PnA83	PCP Control Contact Attribute 19	h0000 to h1112	–	0	Immediately
	The attribute corresponding to PCP control contact 19				
PnA84	PCP Control Contact Attribute 20	h0000 to h1112	–	0	Immediately
	The attribute corresponding to PCP control contact 20				
PnA85	PCP Control Contact Attribute 21	h0000 to h1112	–	0	Immediately
	The attribute corresponding to PCP control contact 21				
PnA86	PCP Control Contact Attribute 22	h0000 to h1112	–	0	Immediately
	The attribute corresponding to PCP control contact 22				
PnA87	PCP Control Contact Attribute 23	h0000 to h1112	–	0	Immediately
	The attribute corresponding to PCP control contact 23				

No.	Index	Name	Range	Unit	Default
PnA88	PCP Control Contact Attribute 24	h0000 to h1112	–	0	Immediately
	The attribute corresponding to PCP control contact 24				
PnA89	PCP Control Contact Attribute 25	h0000 to h1112	–	0	Immediately
	The attribute corresponding to PCP control contact 25				
PnA90	PCP Control Contact Attribute 26	h0000 to h1112	–	0	Immediately
	The attribute corresponding to PCP control contact 26				
PnA91	PCP Control Contact Attribute 27	h0000 to h1112	–	0	Immediately
	The attribute corresponding to PCP control contact 27				
PnA92	PCP Control Contact Attribute 28	h0000 to h1112	–	0	Immediately
	The attribute corresponding to PCP control contact 28				
PnA93	PCP Control Contact Attribute 29	h0000 to h1112	–	0	Immediately
	The attribute corresponding to PCP control contact 29				
PnA94	PCP Control Contact Attribute 30	h0000 to h1112	–	0	Immediately
	The attribute corresponding to PCP control contact 30				
PnA95	PCP Control Contact Attribute 31	h0000 to h1112	–	0	Immediately
	The attribute corresponding to PCP control contact 31				
PnB00	PCP Control Contact Acceleration Time 0	0 to 10000	ms	50	Immediately
	The acceleration time corresponding to PCP control contact 0				
PnB01	PCP Control Contact Acceleration Time 1	0 to 10000	ms	50	Immediately
	The acceleration time corresponding to PCP control contact 1				
PnB02	PCP Control Contact Acceleration Time 2	0 to 10000	ms	50	Immediately
	The acceleration time corresponding to PCP control contact 2				

No.	Index	Name	Range	Unit	Default
PnB03	PCP Control Contact Acceleration Time 3	0 to 10000	ms	50	Immediately
	The acceleration time corresponding to PCP control contact 3				
PnB04	PCP Control Contact Acceleration Time 4	0 to 10000	ms	50	Immediately
	The acceleration time corresponding to PCP control contact 4				
PnB05	PCP Control Contact Acceleration Time 5	0 to 10000	ms	50	Immediately
	The acceleration time corresponding to PCP control contact 5				
PnB06	PCP Control Contact Acceleration Time 6	0 to 10000	ms	50	Immediately
	The acceleration time corresponding to PCP control contact 6				
PnB07	PCP Control Contact Acceleration Time 7	0 to 10000	ms	50	Immediately
	The acceleration time corresponding to PCP control contact 7				
PnB08	PCP Control Contact Acceleration Time 8	0 to 10000	ms	50	Immediately
	The acceleration time corresponding to PCP control contact 8				
PnB09	PCP Control Contact Acceleration Time 9	0 to 10000	ms	50	Immediately
	The acceleration time corresponding to PCP control contact 9				
PnB10	PCP Control Contact Acceleration Time 10	0 to 10000	ms	50	Immediately
	The acceleration time corresponding to PCP control contact 10				
PnB11	PCP Control Contact Acceleration Time 11	0 to 10000	ms	50	Immediately
	The acceleration time corresponding to PCP control contact 11				
PnB12	PCP Control Contact Acceleration Time 12	0 to 10000	ms	50	Immediately
	The acceleration time corresponding to PCP control contact 12				
PnB13	PCP Control Contact Acceleration Time 13	0 to 10000	ms	50	Immediately
	The acceleration time corresponding to PCP control contact 13				

No.	Index	Name	Range	Unit	Default
PnB14	PCP Control Contact Acceleration Time 14	0 to 10000	ms	50	Immediately
	The acceleration time corresponding to PCP control contact 14				
PnB15	PCP Control Contact Acceleration Time 15	0 to 10000	ms	50	Immediately
	The acceleration time corresponding to PCP control contact 15				
PnB16	PCP Control Contact Acceleration Time 16	0 to 10000	ms	50	Immediately
	The acceleration time corresponding to PCP control contact 16				
PnB17	PCP Control Contact Acceleration Time 17	0 to 10000	ms	50	Immediately
	The acceleration time corresponding to PCP control contact 17				
PnB18	PCP Control Contact Acceleration Time 18	0 to 10000	ms	50	Immediately
	The acceleration time corresponding to PCP control contact 18				
PnB19	PCP Control Contact Acceleration Time 19	0 to 10000	ms	50	Immediately
	The acceleration time corresponding to PCP control contact 19				
PnB20	PCP Control Contact Acceleration Time 20	0 to 10000	ms	50	Immediately
	The acceleration time corresponding to PCP control contact 20				
PnB21	PCP Control Contact Acceleration Time 21	0 to 10000	ms	50	Immediately
	The acceleration time corresponding to PCP control contact 21				
PnB22	PCP Control Contact Acceleration Time 22	0 to 10000	ms	50	Immediately
	The acceleration time corresponding to PCP control contact 22				
PnB23	PCP Control Contact Acceleration Time 23	0 to 10000	ms	50	Immediately
	The acceleration time corresponding to PCP control contact 23				
PnB24	PCP Control Contact Acceleration Time 24	0 to 10000	ms	50	Immediately
	The acceleration time corresponding to PCP control contact 24				

No.	Index	Name	Range	Unit	Default
PnB25	PCP Control Contact Acceleration Time 25	0 to 10000	ms	50	Immediately
	The acceleration time corresponding to PCP control contact 25				
PnB26	PCP Control Contact Acceleration Time 26	0 to 10000	ms	50	Immediately
	The acceleration time corresponding to PCP control contact 26				
PnB27	PCP Control Contact Acceleration Time 27	0 to 10000	ms	50	Immediately
	The acceleration time corresponding to PCP control contact 27				
PnB28	PCP Control Contact Acceleration Time 28	0 to 10000	ms	50	Immediately
	The acceleration time corresponding to PCP control contact 28				
PnB29	PCP Control Contact Acceleration Time 29	0 to 10000	ms	50	Immediately
	The acceleration time corresponding to PCP control contact 29				
PnB30	PCP Control Contact Acceleration Time 30	0 to 10000	ms	50	Immediately
	The acceleration time corresponding to PCP control contact 30				
PnB31	PCP Control Contact Acceleration Time 31	0 to 10000	ms	50	Immediately
	The acceleration time corresponding to PCP control contact 31				
PnB32	PCP Control Contact Deceleration Time 0	0 to 10000	ms	50	Immediately
	The deceleration time corresponding to PCP control contact 0				
PnB33	PCP Control Contact Deceleration Time 1	0 to 10000	ms	50	Immediately
	The deceleration time corresponding to PCP control contact 1				
PnB34	PCP Control Contact Deceleration Time 2	0 to 10000	ms	50	Immediately
	The deceleration time corresponding to PCP control contact 2				
PnB35	PCP Control Contact Deceleration Time 3	0 to 10000	ms	50	Immediately
	The deceleration time corresponding to PCP control contact 3				

No.	Index	Name	Range	Unit	Default
PnB36	PCP Control Contact Deceleration Time 4	0 to 10000	ms	50	Immediately
	The deceleration time corresponding to PCP control contact 4				
PnB37	PCP Control Contact Deceleration Time 5	0 to 10000	ms	50	Immediately
	The deceleration time corresponding to PCP control contact 5				
PnB38	PCP Control Contact Deceleration Time 6	0 to 10000	ms	50	Immediately
	The deceleration time corresponding to PCP control contact 6				
PnB39	PCP Control Contact Deceleration Time 7	0 to 10000	ms	50	Immediately
	The deceleration time corresponding to PCP control contact 7				
PnB40	PCP Control Contact Deceleration Time 8	0 to 10000	ms	50	Immediately
	The deceleration time corresponding to PCP control contact 8				
PnB41	PCP Control Contact Deceleration Time 9	0 to 10000	ms	50	Immediately
	The deceleration time corresponding to PCP control contact 9				
PnB42	PCP Control Contact Deceleration Time 10	0 to 10000	ms	50	Immediately
	The deceleration time corresponding to PCP control contact 10				
PnB43	PCP Control Contact Deceleration Time 11	0 to 10000	ms	50	Immediately
	The deceleration time corresponding to PCP control contact 11				
PnB44	PCP Control Contact Deceleration Time 12	0 to 10000	ms	50	Immediately
	The deceleration time corresponding to PCP control contact 12				
PnB45	PCP Control Contact Deceleration Time 13	0 to 10000	ms	50	Immediately
	The deceleration time corresponding to PCP control contact 13				
PnB46	PCP Control Contact Deceleration Time 14	0 to 10000	ms	50	Immediately
	The deceleration time corresponding to PCP control contact 14				

No.	Index	Name	Range	Unit	Default
PnB47	PCP Control Contact Deceleration Time 15	0 to 10000	ms	50	Immediately
	The deceleration time corresponding to PCP control contact 15				
PnB48	PCP Control Contact Deceleration Time 16	0 to 10000	ms	50	Immediately
	The deceleration time corresponding to PCP control contact 16				
PnB49	PCP Control Contact Deceleration Time 17	0 to 10000	ms	50	Immediately
	The deceleration time corresponding to PCP control contact 17				
PnB50	PCP Control Contact Deceleration Time 18	0 to 10000	ms	50	Immediately
	The deceleration time corresponding to PCP control contact 18				
PnB51	PCP Control Contact Deceleration Time 19	0 to 10000	ms	50	Immediately
	The deceleration time corresponding to PCP control contact 19				
PnB52	PCP Control Contact Deceleration Time 20	0 to 10000	ms	50	Immediately
	The deceleration time corresponding to PCP control contact 20				
PnB53	PCP Control Contact Deceleration Time 21	0 to 10000	ms	50	Immediately
	The deceleration time corresponding to PCP control contact 21				
PnB54	PCP Control Contact Deceleration Time 22	0 to 10000	ms	50	Immediately
	The deceleration time corresponding to PCP control contact 22				
PnB55	PCP Control Contact Deceleration Time 23	0 to 10000	ms	50	Immediately
	The deceleration time corresponding to PCP control contact 23				
PnB56	PCP Control Contact Deceleration Time 24	0 to 10000	ms	50	Immediately
	The deceleration time corresponding to PCP control contact 24				
PnB57	PCP Control Contact Deceleration Time 25	0 to 10000	ms	50	Immediately
	The deceleration time corresponding to PCP control contact 25				

No.	Index	Name	Range	Unit	Default
PnB58	PCP Control Contact Deceleration Time 26	0 to 10000	ms	50	Immediately
	The deceleration time corresponding to PCP control contact 26				
PnB59	PCP Control Contact Deceleration Time 27	0 to 10000	ms	50	Immediately
	The deceleration time corresponding to PCP control contact 27				
PnB60	PCP Control Contact Deceleration Time 28	0 to 10000	ms	50	Immediately
	The deceleration time corresponding to PCP control contact 28				
PnB61	PCP Control Contact Deceleration Time 29	0 to 10000	ms	50	Immediately
	The deceleration time corresponding to PCP control contact 29				
PnB62	PCP Control Contact Deceleration Time 30	0 to 10000	ms	50	Immediately
	The deceleration time corresponding to PCP control contact 30				
PnB63	PCP Control Contact Deceleration Time 31	0 to 10000	ms	50	Immediately
	The deceleration time corresponding to PCP control contact 31				
PnB64	PCP Control Contact Delay 0	0 to 10000	ms	100	Immediately
	The delay time corresponding to PCP control contact 0				
PnB65	PCP Control Contact Delay 1	0 to 10000	ms	100	Immediately
	The delay time corresponding to PCP control contact 1				
PnB66	PCP Control Contact Delay 2	0 to 10000	ms	100	Immediately
	The delay time corresponding to PCP control contact 2				
PnB67	PCP Control Contact Delay 3	0 to 10000	ms	100	Immediately
	The delay time corresponding to PCP control contact 3				
PnB68	PCP Control Contact Delay 4	0 to 10000	ms	100	Immediately
	The delay time corresponding to PCP control contact 4				
PnB69	PCP Control Contact Delay 5	0 to 10000	ms	100	Immediately
	The delay time corresponding to PCP control contact 5				

No.	Index	Name	Range	Unit	Default
PnB70	PCP Control Contact Delay 6	0 to 10000	ms	100	Immediately
	The delay time corresponding to PCP control contact 6				
PnB71	PCP Control Contact Delay 7	0 to 10000	ms	100	Immediately
	The delay time corresponding to PCP control contact 7				
PnB72	PCP Control Contact Delay 8	0 to 10000	ms	100	Immediately
	The delay time corresponding to PCP control contact 8				
PnB73	PCP Control Contact Delay 9	0 to 10000	ms	100	Immediately
	The delay time corresponding to PCP control contact 9				
PnB74	PCP Control Contact Delay 10	0 to 10000	ms	100	Immediately
	The delay time corresponding to PCP control contact 10				
PnB75	PCP Control Contact Delay 11	0 to 10000	ms	100	Immediately
	The delay time corresponding to PCP control contact 11				
PnB76	PCP Control Contact Delay 12	0 to 10000	ms	100	Immediately
	The delay time corresponding to PCP control contact 12				
PnB77	PCP Control Contact Delay 13	0 to 10000	ms	100	Immediately
	The delay time corresponding to PCP control contact 13				
PnB78	PCP Control Contact Delay 14	0 to 10000	ms	100	Immediately
	The delay time corresponding to PCP control contact 14				
PnB79	PCP Control Contact Delay 15	0 to 10000	ms	100	Immediately
	The delay time corresponding to PCP control contact 15				
PnB80	PCP Control Contact Delay 16	0 to 10000	ms	100	Immediately
	The delay time corresponding to PCP control contact 16				
PnB81	PCP Control Contact Delay 17	0 to 10000	ms	100	Immediately
	The delay time corresponding to PCP control contact 17				
PnB82	PCP Control Contact Delay 18	0 to 10000	ms	100	Immediately
	The delay time corresponding to PCP control contact 18				

No.	Index	Name	Range	Unit	Default
PnB83	PCP Control Contact Delay 19	0 to 10000	ms	100	Immediately
	The delay time corresponding to PCP control contact 19				
PnB84	PCP Control Contact Delay 20	0 to 10000	ms	100	Immediately
	The delay time corresponding to PCP control contact 20				
PnB85	PCP Control Contact Delay 21	0 to 10000	ms	100	Immediately
	The delay time corresponding to PCP control contact 21				
PnB86	PCP Control Contact Delay 22	0 to 10000	ms	100	Immediately
	The delay time corresponding to PCP control contact 22				
PnB87	PCP Control Contact Delay 23	0 to 10000	ms	100	Immediately
	The delay time corresponding to PCP control contact 23				
PnB88	PCP Control Contact Delay 24	0 to 10000	ms	100	Immediately
	The delay time corresponding to PCP control contact 24				
PnB89	PCP Control Contact Delay 25	0 to 10000	ms	100	Immediately
	The delay time corresponding to PCP control contact 25				
PnB90	PCP Control Contact Delay 26	0 to 10000	ms	100	Immediately
	The delay time corresponding to PCP control contact 26				
PnB91	PCP Control Contact Delay 27	0 to 10000	ms	100	Immediately
	The delay time corresponding to PCP control contact 27				
PnB92	PCP Control Contact Delay 28	0 to 10000	ms	100	Immediately
	The delay time corresponding to PCP control contact 28				
PnB93	PCP Control Contact Delay 29	0 to 10000	ms	100	Immediately
	The delay time corresponding to PCP control contact 29				
PnB94	PCP Control Contact Delay 30	0 to 10000	ms	100	Immediately
	The delay time corresponding to PCP control contact 30				
PnB95	PCP Control Contact Delay 31	0 to 10000	ms	100	Immediately
	The delay time corresponding to PCP control contact 31				

Chapter 12 Object Dictionary

Index	Subindex	Object	Name	Type	Attr.	PDO	Support						Unit
							All	IP	PP	PV	PT	HM	
1000	--	VAR	device_type	UINT32	RO	NO	●						
1001	--	VAR	error_register	UINT8	RO	NO	●						
1003	--	VAR	pre_defined_error_field	UINT8	RW	NO	●						
1005	--	VAR	cob_id_sync	UINT32	RW	NO	●						
1006	--	VAR	communication_cycle_period	UINT32	RW	NO	●						
1007	--	VAR	synchronous_window_length	UINT32	RW	NO	●						
1014	--	VAR	cob_id_emergency_message	UINT32	RW	NO	●						
1016	--	ARRAY	consumer_heartbeat_time	--	--	--	●						
1016	0	ARRAY	number_of_entries	UINT8	RO	NO	●						
1016	1	ARRAY	consumer_heartbeat_time1	UINT32	RW	NO	●						
1017		VAR	producer_heartbeat_time	UINT16	RW	NO	●						
1018	--	RECORD	identity_object	--	--	--	●						
1018	0	RECORD	number_of_entries	UINT8	RO	NO	●						
1018	1	RECORD	vendor_id	UINT32	RO	NO	●						
1018	2	RECORD	product_code	UINT32	RO	NO	●						
1018	3	RECORD	revision_number	UINT32	RO	NO	●						
1018	4	RECORD	serial_number	UINT32	RO	NO	●						
1029	--	ARRAY	error_behaviour	--	--	--	●						

Index	Subindex	Object	Name	Type	Attr.	PDO	Support						Unit
							All	IP	PP	PV	PT	HM	
	0		number_of_entries	UINT8	RO	NO	●						
	1		communication_error	UINT8	RW	NO	●						
1200	--	RECORD	server_sdo_parameter	--	--	--	●						
	0		number_of_entries	UINT8	RO	NO	●						
	1		cob_id_client_server	UINT32	RO	NO	●						
	2		cob_id_server_client	UINT32	RO	NO	●						
1400	--	RECORD	receive_pdo_parameter_rpdo1	--	--	--	●						
	0		number_of_entries_rpdo1	UINT8	RO	NO	●						
	1		cob_id_used_by_pdo_rpdo1	UINT32	RO	NO	●						
	2		transmission_type_rpdo1	UINT8	RW	NO	●						
1401	--	RECORD	receive_pdo_parameter_rpdo2	--	--	--	●						
	0		number_of_entries_rpdo2	UINT8	RO	NO	●						
	1		cob_id_used_by_pdo_rpdo2	UINT32	RO	NO	●						
	2		transmission_type_rpdo2	UINT8	RW	NO	●						
1402	--	RECORD	receive_pdo_parameter_rpdo3	--	--	--	●						
	0		number_of_entries_rpdo3	UINT8	RO	NO	●						
	1		cob_id_used_by_pdo_rpdo3	UINT32	RO	NO	●						
	2		transmission_type_rpdo3	UINT8	RW	NO	●						
1403	--	RECORD	receive_pdo_parameter_rpdo4	--	--	--	●						

Index	Subindex	Object	Name	Type	Attr.	PDO	Support						Unit
							All	IP	PP	PV	PT	HM	
	0		number_of_entries_rpdo4	UINT8	RO	NO	●						
	1		cob_id_used_by_pdo_rpdo4	UINT32	RO	NO	●						
	2		transmission_type_rpdo4	UINT8	RW	NO	●						
1600	--	RECORD	receive_pdo_mapping_rpdo1	--	--	--	●						
	0		number_of_entries	UINT8	RO	NO	●						
	1		first_mapped_object_rpdo1	UINT32	RW	NO	●						
	2		second_mapped_object_rpdo1	UINT32	RW	NO	●						
	3		third_mapped_object_rpdo1	UINT32	RW	NO	●						
	4		fourth_mapped_object_rpdo1	UINT32	RW	NO	●						
1601	--	RECORD	receive_pdo_mapping_rpdo2	--	--	--	●						
	0		number_of_entries	UINT8	RO	NO	●						
	1		first_mapped_object_rpdo2	UINT32	RW	NO	●						
	2		second_mapped_object_rpdo2	UINT32	RW	NO	●						
	3		third_mapped_object_rpdo2	UINT32	RW	NO	●						
	4		fourth_mapped_object_rpdo2	UINT32	RW	NO	●						
1602	--	RECORD	receive_pdo_mapping_rpdo3	--	--	--	●						
	0		number_of_entries	UINT8	RO	NO	●						
	1		first_mapped_object_rpdo3	UINT32	RW	NO	●						
	2		second_mapped_object_rpdo3	UINT32	RW	NO	●						
	3		third_mapped_object_rpdo3	UINT32	RW	NO	●						
	4		fourth_mapped_object_rpdo3	UINT32	RW	NO	●						

Index	Subindex	Object	Name	Type	Attr.	PDO	Support						Unit
							All	IP	PP	PV	PT	HM	
1603	--	RECORD	receive_pdo_mapping_rpdo4	--	--	--	●						
	0		number_of_entries	UINT8	RO	NO	●						
	1		first_mapped_object_rpdo4	UINT32	RW	NO	●						
	2		second_mapped_object_rpdo4	UINT32	RW	NO	●						
	3		third_mapped_object_rpdo4	UINT32	RW	NO	●						
	4		fourth_mapped_object_rpdo4	UINT32	RW	NO	●						
1800	--	RECORD	transmit_pdo_parameter_tpdo1	--	--	--	●						
	0		number_of_entries_tpdo1	UINT32	RO	NO	●						
	1		cob_id_used_by_pdo_tpdo1	UINT32	RO	NO	●						
	2		transmission_type_tpdo1	UINT8	RW	NO	●						
	3		inhibit_time_tpdo1	UINT16	RW	NO	●						
	5		event_timer_tpdo1	UINT16	RW	NO	●						
1801	--	RECORD	transmit_pdo_parameter_tpdo2	--	--	--	●						
	0		number_of_entries_tpdo2	UINT32	RO	NO	●						
	1		cob_id_used_by_pdo_tpdo2	UINT32	RO	NO	●						
	2		transmission_type_tpdo2	UINT8	RW	NO	●						
	3		inhibit_time_tpdo2	UINT16	RW	NO	●						
	5		event_timer_tpdo2	UINT16	RW	NO	●						
1802	--	RECORD	transmit_pdo_parameter_tpdo3	--	--	--	●						
	0		number_of_entries_tpdo3	UINT32	RO	NO	●						
	1		cob_id_used_by_pdo_tpdo3	UINT32	RO	NO	●						

Index	Subindex	Object	Name	Type	Attr.	PDO	Support						Unit
							All	IP	PP	PV	PT	HM	
	2		transmission_type_tpdo3	UINT8	RW	NO	●						
	3		inhibit_time_tpdo3	UINT16	RW	NO	●						
	5		event_timer_tpdo3	UINT16	RW	NO	●						
1803	--	RECORD	transmit_pdo_parameter_tpdo4	--	--	--	●						
	0		number_of_entries_tpdo4	UINT32	RO	NO	●						
	1		cob_id_used_by_pdo_tpdo4	UINT32	RO	NO	●						
	2		transmission_type_tpdo4	UINT8	RW	NO	●						
	3		inhibit_time_tpdo4	UINT16	RW	NO	●						
	5		event_timer_tpdo4	UINT16	RW	NO	●						
1A00	--	RECORD	transmit_pdo_mapping_tpdo1	--	--	--	●						
	0		number_of_entries	UINT8	RO	NO	●						
	1		first_mapped_object_tpdo1	UINT32	RW	NO	●						
	2		second_mapped_object_tpdo1	UINT32	RW	NO	●						
	3		third_mapped_object_tpdo1	UINT32	RW	NO	●						
	4		fourth_mapped_object_tpdo1	UINT32	RW	NO	●						
1A01	--	RECORD	transmit_pdo_mapping_tpdo2	--	--	--	●						
	0		number_of_entries	UINT8	RO	NO	●						
	1		first_mapped_object_tpdo2	UINT32	RW	NO	●						
	2		second_mapped_object_tpdo2	UINT32	RW	NO	●						
	3		third_mapped_object_tpdo2	UINT32	RW	NO	●						
	4		fourth_mapped_object_tpdo2	UINT32	RW	NO	●						

Index	Subindex	Object	Name	Type	Attr.	PDO	Support						Unit
							All	IP	PP	PV	PT	HM	
1A02	--	RECORD	transmit_pdo_mapping_tpdo3	--	--	--	•						
	0		number_of_entries	UINT8	RO	NO	•						
	1		first_mapped_object_tpdo3	UINT32	RW	NO	•						
	2		second_mapped_object_tpdo3	UINT32	RW	NO	•						
	3		third_mapped_object_tpdo3	UINT32	RW	NO	•						
	4		fourth_mapped_object_tpdo3	UINT32	RW	NO	•						
1A03	--	RECORD	transmit_pdo_mapping_tpdo4	--	--	--	•						
	0		number_of_entries	UINT8	RO	NO	•						
	1		first_mapped_object_tpdo4	UINT32	RW	NO	•						
	2		second_mapped_object_tpdo4	UINT32	RW	NO	•						
	3		third_mapped_object_tpdo4	UINT32	RW	NO	•						
	4		fourth_mapped_object_tpdo4	UINT32	RW	NO	•						
2000	--	RECORD	mask_tpdo1	--	--	--	•						
	0		number_of_entries	UINT8	RO	NO	•						
	1		mask1_tpdo1	UINT32	RW	NO	•						
	2		mask2_tpdo1	UINT32	RW	NO	•						
2001	--	RECORD	mask_tpdo2	--	--	--	•						
	0		number_of_entries	UINT8	RO	NO	•						
	1		mask1_tpdo2	UINT32	RW	NO	•						
	2		mask2_tpdo2	UINT32	RW	NO	•						
2002	--	RECORD	mask_tpdo3	--	--	--	•						

Index	Subindex	Object	Name	Type	Attr.	PDO	Support						Unit
							All	IP	PP	PV	PT	HM	
	0		number_of_entries	UINT8	RO	NO	●						
	1		mask1_tpdo3	UINT32	RW	NO	●						
	2		mask2_tpdo3	UINT32	RW	NO	●						
2003	--	RECORD	mask_tpdo4	--	--	--	●						
	0		number_of_entries	UINT8	RO	NO	●						
	1		mask1_tpdo4	UINT32	RW	NO	●						
	2		mask2_tpdo4	UINT32	RW	NO	●						
2105	0	VAR	sync_time_period	UINT32	RW	NO	●						
30A5	--	VAR	SinglePos	UINT32	RO	YES	●						pulse
30A6	--	VAR	MultiPos	UINT32	RO	YES	●						--
30A7	--	VAR	HomingStatus	UINT16	RW	NO	●						--
30A8	--	VAR	ExtEncPosition	INT32	RO	YES	●						pulse
30A9	--	VAR	MultiPosAfterProc	UINT32	RO	YES	●						--
30AA	--	VAR	ActualPosAfterProc	UINT32	RO	YES	●						pulse
3164	--	VAR	Pn000 Basic Function Selections 0	INT32	RW	NO	●						--
3165	--	VAR	Pn001 Basic Function Selections 1	INT32	RW	NO	●						--
3166	--	VAR	Pn002 Application Function Selections 2	INT32	RW	NO	●						--
3167	--	VAR	Pn003 Application Function Selections 3	INT32	RW	NO	●						--

Index	Subindex	Object	Name	Type	Attr.	PDO	Support						Unit
							All	IP	PP	PV	PT	HM	
3168	--	VAR	Pn004 Application Function Selections 4	INT32	RW	NO	●						--
3169	--	VAR	Pn005 Application Function Selections 5	INT32	RW	NO	●						--
316A	--	VAR	Pn006 Application Function Selections 6	INT32	RW	NO	●						--
316B	--	VAR	Pn007 Application Function Selections 7	INT32	RW	NO	●						--
316C	--	VAR	Pn008 Power On Options	INT32	RW	NO	●						--
316D	--	VAR	Pn009 Application Function Selections 9	INT32	RW	NO	●						--
31C8	--	VAR	Pn100 Tuning Function Selection	INT32	RW	NO	●						--
31C9	--	VAR	Pn101 Response Frequency Level	INT32	RW	NO	●						Hz
31CA	--	VAR	Pn102 Speed Loop Gain	INT32	RW	NO	●						rad/s
31CB	--	VAR	Pn103 Speed Loop Integral Time	INT32	RW	NO	●						0.1ms
31CC	--	VAR	Pn104 Position Loop Gain	INT32	RW	NO	●						1/s
31CD	--	VAR	Pn105 Torque Reference Filter Time Constant	INT32	RW	NO	●						0.01ms
31CE	--	VAR	Pn106 Load Inertia Percentage	INT32	RW	NO	●						%
31CF	--	VAR	Pn107 Second Speed Loop Gain	INT32	RW	NO	●						rad/s
31D0	--	VAR	Pn108 Second Speed Loop Integral Time	INT32	RW	NO	●						0.1ms

Index	Subindex	Object	Name	Type	Attr.	PDO	Support						Unit
							All	IP	PP	PV	PT	HM	
31D1	--	VAR	Pn109 Second Position Loop Gain	INT32	RW	NO	●						1/s
31D2	--	VAR	Pn110 Second Torque Reference Filter Time Constant	INT32	RW	NO	●						0.01ms
31D4	--	VAR	Pn112 Speed Feedforward	INT32	RW	NO	●						%
31D5	--	VAR	Pn113 Speed Feedforward Filter Time Constant	INT32	RW	NO	●						0.1ms
31D6	--	VAR	Pn114 Torque Feedforward	INT32	RW	NO	●						%
31D7	--	VAR	Pn115 Torque Feedforward Filter Time Constant	INT32	RW	NO	●						0.1ms
31D8	--	VAR	Pn116 P/PI Switching Conditions	INT32	RW	NO	●						--
31D9	--	VAR	Pn117 P/PI Switching Level for Torque Reference	INT32	RW	NO	●						%
31DA	--	VAR	Pn118 P/PI Switching Level for Position Deviation	INT32	RW	NO	●						pulse
31DB	--	VAR	Pn119 P/PI Switching Level for Acceleration	INT32	RW	NO	●						10rmp/s
31DC	--	VAR	Pn120 P/PI Switching Level for Speed Reference	INT32	RW	NO	●						rpm
31DD	--	VAR	Pn121 Gain Switching Conditions	INT32	RW	NO	●						--
31DE	--	VAR	Pn122 Gain Switching Waiting Time	INT32	RW	NO	●						0.1ms
31DF	--	VAR	Pn123 Gain Switching Level	INT32	RW	NO	●						--
31E0	--	VAR	Pn124 Speed Level	INT32	RW	NO	●						rpm

Index	Subindex	Object	Name	Type	Attr.	PDO	Support						Unit
							All	IP	PP	PV	PT	HM	
31E1	--	VAR	Pn125 Position Gain Switching Time	INT32	RW	NO	●						0.1ms
31E2	--	VAR	Pn126 Gain Switching Hysteresis	INT32	RW	NO	●						--
31E3	--	VAR	Pn127 Speed Measurement Filter at Low Speed	INT32	RW	NO	●						1 cycle
31E6	--	VAR	Pn130 Friction Compensation Gain	INT32	RW	NO	●						0.1%Tn
31E7	--	VAR	Pn131 Friction Compensation Speed Hysteresis	INT32	RW	NO	●						rpm
31E8	--	VAR	Pn132 Friction Damping Proportion	INT32	RW	NO	●						0.1%Tn/1000rpm
31EB	--	VAR	Pn135 Speed Feedback Filter Time	INT32	RW	NO	●						0.01ms
31FA	--	VAR	Pn150 Control-Related Selections	INT32	RW	NO	●						--
31FB	--	VAR	Pn151 Model Following Control Gain	INT32	RW	NO	●						1/s
31FC	--	VAR	Pn152 Model Following Control Gain Correction	INT32	RW	NO	●						%
31FD	--	VAR	Pn153 Model Following Control Speed Feedforward Coefficient	INT32	RW	NO	●						%
31FE	--	VAR	Pn154 Model Following Control Torque Feedforward Coefficient	INT32	RW	NO	●						%
31FF	--	VAR	Pn155 Anti-Resonance Frequency for Jitter Suppression	INT32	RW	NO	●						0.1Hz
3200	--	VAR	Pn156 Filter Time Constant for Jitter Suppression	INT32	RW	NO	●						0.1ms

Index	Subindex	Object	Name	Type	Attr.	PDO	Support						Unit
							All	IP	PP	PV	PT	HM	
3201	--	VAR	Pn157 Low frequency jitter suppression speed feedforward compensation amount limiting	INT32	RW	NO	●						rpm
3204	--	VAR	Pn160 Load Disturbance Compensation	INT32	RW	NO	●						%
3205	--	VAR	Pn161 Load Disturbance Detection Gain	INT32	RW	NO	●						Hz
3206	--	VAR	Pn162 Use Estimated Speed	INT32	RW	NO	●						--
3208	--	VAR	Pn164 PJOG0 Rotation Number	INT32	RW	NO	●						rev
3209	--	VAR	Pn165 PJOG0 Rotation Speed	INT32	RW	NO	●						rpm
320A	--	VAR	Pn166 PJOG0 Acceleration/Deceleration Time	INT32	RW	NO	●						ms
320B	--	VAR	Pn167 PJOG0 Stop Time	INT32	RW	NO							ms
320C	--	VAR	Pn168 PJOG1 Rotation Number	INT32	RW	NO	●						rev
320D	--	VAR	Pn169 PJOG1 Rotation Speed	INT32	RW	NO	●						rpm
320E	--	VAR	Pn170 PJOG1 Acceleration/Deceleration Time	INT32	RW	NO	●						ms
320F	--	VAR	Pn171 PJOG1 Stop Time	INT32	RW	NO	●						ms
3210	--	VAR	Pn172 Moment of Inertia Calculation Amount	INT32	RW	NO	●						--
3211	--	VAR	Pn173 Vibration Suppression Frequency at Intermediate-Frequency	INT32	RW	NO	●						Hz
3212	--	VAR	Pn174 Vibration Suppression Bandwidth Adjustment at Intermediate-Frequency	INT32	RW	NO	●						--

Index	Subindex	Object	Name	Type	Attr.	PDO	Support						Unit
							All	IP	PP	PV	PT	HM	
3213	--	VAR	Pn175 Vibration Suppression Damping Gain at Intermediate-Frequency	INT32	RW	NO	●						--
3214	--	VAR	Pn176 Vibration Suppression Lowpass Filter Time at Intermediate-Frequency	INT32	RW	NO	●						0.1ms
3215	--	VAR	Pn177 Vibration Suppression Highpass Filter Time at Intermediate-Frequency	INT32	RW	NO	●						0.1ms
3216	--	VAR	Pn178 Vibration Suppression Proportional Attenuation Gain at Intermediate-Frequency	INT32	RW	NO	●						--
3217	--	VAR	Pn179 Vibration Amplitude Detection Level	INT32	RW	NO	●						--
3218	--	VAR	Pn180 Vibration Frequency Detection Level	INT32	RW	NO	●						Hz
3219	--	VAR	Pn181 Notch Filter Frequency 1	INT32	RW	NO	●						Hz
321A	--	VAR	Pn182 Notch Filter Depth 1	INT32	RW	NO	●						--
321B	--	VAR	Pn183 Notch Filter Width 1	INT32	RW	NO	●						--
321C	--	VAR	Pn184 Notch Filter Frequency 2	INT32	RW	NO	●						Hz
321D	--	VAR	Pn185 Notch Filter Depth 2	INT32	RW	NO	●						--
321E	--	VAR	Pn186 Notch Filter Width 2	INT32	RW	NO	●						--
321F	--	VAR	Pn187 Notch Filter Frequency 3	INT32	RW	NO	●						Hz
3220	--	VAR	Pn188 Notch Filter Depth 3	INT32	RW	NO	●						--
3221	--	VAR	Pn189 Notch Filter Width 3	INT32	RW	NO	●						--

Index	Subindex	Object	Name	Type	Attr.	PDO	Support						Unit
							All	IP	PP	PV	PT	HM	
3222	--	VAR	Pn190 Automatic Vibration Suppression State	INT32	RW	NO	●						--
3223	--	VAR	Pn191 Vibration Frequency Detection Level	INT32	RW	NO	●						--
322C	--	VAR	Pn200 Pulse Numbers for PG Frequency Division	INT32	RW	NO	●						pulse
3233	--	VAR	Pn207 Homing locked-rotor torque	INT32	RW	NO	●						%Tn
3234	--	VAR	Pn208 Homing locked-rotor time	INT32	RW	NO	●						1 cycle
3236	--	VAR	Pn210 2nd Encoder Functions 1	INT32	RW	NO	●						--
3237	--	VAR	Pn211 2nd Encoder Functions 2	INT32	RW	NO	●						--
3238	--	VAR	Pn212 2nd Encoder Resolution	INT32	RW	NO	●						pulse
3239	--	VAR	Pn213 Position Deviation Overflow Warning Level at Fully Closed-loop Control	INT32	RW	NO	●						pulse
323A	--	VAR	Pn214 Position Deviation Reset Level at Fully Closed-loop Control	INT32	RW	NO	●						%
3245	--	VAR	Pn225 Encoder delay compensation mode	INT32	RW	NO	●						--
3246	--	VAR	Pn226 Encoder delay manual compensation value	INT32	RW	NO	●						10ns
3248	--	VAR	Pn228 User Defined Multi-Resolution	INT32	RW	NO	●						--
3294	--	VAR	Pn304 Parameter Reference Speed	INT32	RW	NO	●						rpm

Index	Subindex	Object	Name	Type	Attr.	PDO	Support						Unit
							All	IP	PP	PV	PT	HM	
3295	--	VAR	Pn305 JOG Speed	INT32	RW	NO	●						rpm
3296	--	VAR	Pn306 Soft Start Acceleration Time	INT32	RW	NO	●						ms
3297	--	VAR	Pn307 Soft Start Deceleration Time	INT32	RW	NO	●						ms
3298	--	VAR	Pn308 Speed Feedback Filter Time Constant	INT32	RW	NO	●						ms
3299	--	VAR	Pn309 S-Curve Rise Time	INT32	RW	NO	●						ms
329A	--	VAR	Pn310 Speed Reference Curve Form	INT32	RW	NO	●						--
329B	--	VAR	Pn311 S-Curve Selection	INT32	RW	NO	●						--
32A7	--	VAR	Pn323 Overspeed Detection Level	INT32	RW	NO	●						rpm
32AF	--	VAR	Pn331 Touch Probe Signal Allocation	INT32	RW	NO	●						--
32B0	--	VAR	Pn332 Touch Probe Filtering Time	INT32	RW	NO	●						10ns
32B1	--	VAR	Pn333 Touch Probe Singal Inverts	INT32	RW	NO	●						--
32F5	--	VAR	Pn401 Forward Internal Torque Limit	INT32	RW	NO	●						%
32F6	--	VAR	Pn402 Reverse Internal Torque Limit	INT32	RW	NO	●						%
32F7	--	VAR	Pn403 Forward External Torque Limit	INT32	RW	NO	●						%

Index	Subindex	Object	Name	Type	Attr.	PDO	Support						Unit
							All	IP	PP	PV	PT	HM	
32F8	--	VAR	Pn404 Reverse External Torque Limit	INT32	RW	NO	●						%
32F9	--	VAR	Pn405 Reverse Brake Torque Limit	INT32	RW	NO	●						%
32FA	--	VAR	Pn406 Torque Limit at Undervoltage	INT32	RW	NO	●						%
32FB	--	VAR	Pn407 Release Time for Torque Limit at Undervoltage	INT32	RW	NO	●						ms
32FC	--	VAR	Pn408 Speed Limit during Torque Control	INT32	RW	NO	●						rpm
3358	--	VAR	Pn500 Positioning Completed Width	INT32	RW	NO	●						pulse
3359	--	VAR	Pn501 Speed Coincidence Signal Detection Width	INT32	RW	NO	●						rpm
335B	--	VAR	Pn503 Rotation Detection Speed	INT32	RW	NO	●						rpm
335C	--	VAR	Pn504 Deviation Counter Overflow Alarm	INT32	RW	NO	●						1 pulse
335D	--	VAR	Pn505 Servo ON Waiting Time	INT32	RW	NO	●						ms
335E	--	VAR	Pn506 Brake Reference-Servo OFF Delay Time	INT32	RW	NO	●						10ms
335F	--	VAR	Pn507 Brake Reference Waiting Speed	INT32	RW	NO	●						rpm
3360	--	VAR	Pn508 Brake Reference Waiting Time	INT32	RW	NO	●						10ms
3361	--	VAR	Pn509 Input Signal Allocations 1	INT32	RW	NO	●						--
3362	--	VAR	Pn510 Input Signal Allocations 2	INT32	RW	NO	●						--

Index	Subindex	Object	Name	Type	Attr.	PDO	Support						Unit
							All	IP	PP	PV	PT	HM	
3363	--	VAR	Pn511 Output Signal Allocations	INT32	RW	NO	●						--
3364	--	VAR	Pn512 Input Contact Data (Low Bits) at Bus Control	INT32	RW	NO	●						--
3365	--	VAR	Pn513 Input Contact Data (High Bit) at Bus Control	INT32	RW	NO	●						--
3366	--	VAR	Pn514 Input Signals Filter Time	INT32	RW	NO	●						1 cycle
3367	--	VAR	Pn515 Alarm Signals Filter Time	INT32	RW	NO	●						2 cycle
3368	--	VAR	Pn516 Input Singal Inverts 1	INT32	RW	NO	●						--
3369	--	VAR	Pn517 Input Singal Inverts 2	INT32	RW	NO	●						--
336A	--	VAR	Pn518 Dynamic Brake Time	INT32	RW	NO	●						0.5ms
336B	--	VAR	Pn519 Serial Encoder Error Allowed Time	INT32	RW	NO	●						1 cycle
336C	--	VAR	Pn520 Positioning Completion Time	INT32	RW	NO	●						0.1ms
336D	--	VAR	Pn521 Alarm Masks 1	INT32	RW	NO	●						--
3371	--	VAR	Pn525 Overload Alarm Level	INT32	RW	NO	●						%
3374	--	VAR	Pn528 Output Signal Inverts	INT32	RW	NO	●						--
3375	--	VAR	Pn529 Torque Detection Signal Output Level	INT32	RW	NO	●						%
3376	--	VAR	Pn530 Torque Detection Signal Output Time	INT32	RW	NO	●						ms
3379	--	VAR	Pn533 Dynamic Brake Current Detection Level	INT32	RW	NO	●						mA

Index	Subindex	Object	Name	Type	Attr.	PDO	Support						Unit
							All	IP	PP	PV	PT	HM	
337A	--	VAR	Pn534 IPM Junction Temperature Detection Level	INT32	RW	NO	●						℃
337B	--	VAR	Pn535 Discharging Resistor Resistance	INT32	RW	NO	●						Ω
337C	--	VAR	Pn536 Discharging Resistor Power	INT32	RW	NO	●						W
337E	--	VAR	Pn538 Momentary Power Interruption Hold Time	INT32	RW	NO	●						1 cycle
337F	--	VAR	Pn539 Pumping Turn ON Delay Time	INT32	RW	NO	●						ms
3380	--	VAR	Pn540 Pumping Turn OFF Delay Time	INT32	RW	NO	●						ms
3381	--	VAR	Pn541 Motion Err Iqr Threshold	INT32	RW	NO	●						% In
3382	--	VAR	Pn542 Motion Err Acc Threshold	INT32	RW	NO	●						krpm/s
3423	--	VAR	Pn703 CAN baud	INT32	RW	NO	●						--
3424	--	VAR	Pn704 Device Node Number	INT32	RW	NO	●						--
3434	--	VAR	Pn720 Homing Mode	INT32	RW	NO	●						--
3435	--	VAR	Pn721 Research Reference Point Speed	INT32	RW	NO	●						0.1rpm
3436	--	VAR	Pn722 Origin Research Speed	INT32	RW	NO	●						0.1rpm
3437	--	VAR	Pn723 Origin Research Acceleration	INT32	RW	NO	●						0.1r/m/s
3438	--	VAR	Pn724 Origin Return Offset Pulse	INT32	RW	NO	●						pulse

Index	Subindex	Object	Name	Type	Attr.	PDO	Support						Unit
							All	IP	PP	PV	PT	HM	
3439	--	VAR	Pn725 Electronic Gear Ratio (Numerator)	INT32	RW	NO	●						--
343A	--	VAR	Pn726 Electronic Gear Ratio (Denominator)	INT32	RW	NO	●						--
3484	--	VAR	Pn800 Motor Applied Settings 1	INT32	RW	NO	●						--
3485	--	VAR	Pn801 Motor Applied Settings 2	INT32	RW	NO	●						--
3486	--	VAR	Pn802 Encoder Initial Value	INT32	RW	NO	●						--
3488	--	VAR	Pn804 Motor Serials Selection	INT32	RW	NO	●						--
3489	--	VAR	Pn805 Motor Module Selection	INT32	RW	NO	●						--
348A	--	VAR	Pn806 Motor Voltage Class	INT32	RW	NO	●						--
348B	--	VAR	Pn807 Motor Power	INT32	RW	NO	●						W
348C	--	VAR	Pn808 Motor Temperature Sensor Model	INT32	RW	NO	●						--
348D	--	VAR	Pn809 Motor Derating Factor	INT32	RW	NO	●						0.01Tn
348E	--	VAR	Pn810 Motor Rated Torque	INT32	RW	NO	●						0.01Nm
348F	--	VAR	Pn811 Motor Maximum Torque	INT32	RW	NO	●						0.01Nm
3490	--	VAR	Pn812 Motor Rated Current	INT32	RW	NO	●						0.1A
3491	--	VAR	Pn813 Motor Maximum Curren	INT32	RW	NO	●						0.1A
3492	--	VAR	Pn814 Motor Rated Speed	INT32	RW	NO	●						rpm
3493	--	VAR	Pn815 Motor Maximum Speed	INT32	RW	NO	●						rpm
3494	--	VAR	Pn816 Motor Ultimate Speed	INT32	RW	NO	●						rpm
3495	--	VAR	Pn817 a0*10000	INT32	RW	NO	●						--

Index	Subindex	Object	Name	Type	Attr.	PDO	Support						Unit
							All	IP	PP	PV	PT	HM	
3496	--	VAR	Pn818 a1*10000	INT32	RW	NO	●						--
3497	--	VAR	Pn819 a2*10000	INT32	RW	NO	●						--
3498	--	VAR	Pn820 a3*10000	INT32	RW	NO	●						--
3499	--	VAR	Pn821 a4*10000	INT32	RW	NO	●						--
349A	--	VAR	Pn822 b0*10000	INT32	RW	NO	●						--
349B	--	VAR	Pn823 b1*10000	INT32	RW	NO	●						--
349C	--	VAR	Pn824 b2*10000	INT32	RW	NO	●						--
349D	--	VAR	Pn825 b3*10000	INT32	RW	NO	●						--
349E	--	VAR	Pn826 b4*10000	INT32	RW	NO	●						--
349F	--	VAR	Pn827 Opposing EMF Factor (Ke)	INT32	RW	NO	●						0.01V/Krpm
34A0	--	VAR	Pn828 Phase Resistance (Rs)	INT32	RW	NO	●						0.001Ω
34A1	--	VAR	Pn829 Ld	INT32	RW	NO	●						0.1mH
34A2	--	VAR	Pn830 Lq	INT32	RW	NO	●						0.1mH
34A3	--	VAR	Pn831 Moment of Inertia for Motor	INT32	RW	NO	●						1e-8Kgm^2
34A4	--	VAR	Pn832 Pole Number	INT32	RW	NO	●						--
34A5	--	VAR	Pn833 Electrical Time Constant (te)	INT32	RW	NO	●						0.01ms
34A6	--	VAR	Pn834 Mechanical Time Constant (tm)	INT32	RW	NO	●						0.01ms
34A7	--	VAR	Pn835 Thermal Time Constant (th)	INT32	RW	NO	●						0.01ms

Index	Subindex	Object	Name	Type	Attr.	PDO	Support						Unit
							All	IP	PP	PV	PT	HM	
34A8	--	VAR	Pn836 Thermal Model Parameters Tp[0]*10000	INT32	RW	NO	•						--
34A9	--	VAR	Pn837 Thermal Model Parameters Tp[1]*10000	INT32	RW	NO	•						--
34AA	--	VAR	Pn838 Thermal Model Parameters Tp[2]*10000	INT32	RW	NO	•						--
34AB	--	VAR	Pn839 Thermal Model Parameters Tp[3]*10000	INT32	RW	NO	•						--
34AC	--	VAR	Pn840 Thermal Model Parameters Tp[4]*10000	INT32	RW	NO	•						--
34AD	--	VAR	Pn841 Motor Overload Curve Coefficient k[0]*10000	INT32	RW	NO	•						--
34AE	--	VAR	Pn842 Motor Overload Curve Coefficient k[1]*10000	INT32	RW	NO	•						--
34AF	--	VAR	Pn843 Motor Overload Curve Coefficient k[2]*10000	INT32	RW	NO	•						--
34B0	--	VAR	Pn844 Motor Overload Curve Coefficient k[3]*10000	INT32	RW	NO	•						--
34B1	--	VAR	Pn845 Motor Overload Curve Coefficient k[4]*10000	INT32	RW	NO	•						--
34CF	--	VAR	Pn875 Application Function Select	INT32	RW	NO	•						--
34D1	--	VAR	Pn877 Encoder Protocol Selection	INT32	RW	NO	•						--
34D2	--	VAR	Pn878 Encoder Type Selection	INT32	RW	NO	•						--
34D3	--	VAR	Pn879 Encoder Actual Resolution	INT32	RW	NO	•						--

Index	Subindex	Object	Name	Type	Attr.	PDO	Support						Unit
							All	IP	PP	PV	PT	HM	
34D4	--	VAR	Pn880 Encoder Resolution for Program Using	INT32	RW	NO	●						--
34D5	--	VAR	Pn881 Encoder Resolution for Multi-turn Data	INT32	RW	NO	●						--
34D9	--	VAR	Pn885 Servodrive Applied Setting	INT32	RW	NO	●						--
34E3	--	VAR	Pn895 Alarm Masks 7	INT32	RW	NO	●						--
34F6	--	VAR	Pn914 Asynchronous Drive Amplitude (Uq)	INT32	RW	NO	●						‰
34F7	--	VAR	Pn915 Asynchronous Drive Frequency	INT32	RW	NO	●						--
34F8	--	VAR	Pn916 Current Loop Bandwidth	INT32	RW	NO	●						Hz
34F9	--	VAR	Pn917 Dead Zone Compensation Percentage	INT32	RW	NO	●						%
34FC	--	VAR	Pn920 Function Selection for Test	INT32	RW	NO	●						--
34FD	--	VAR	Pn921 Test Mode Settings	INT32	RW	NO	●						--
34FE	--	VAR	Pn922 Current loop step test Id given percentage	INT32	RW	NO	●						%
34FF	--	VAR	Pn923 Iq Given Percentage for Current Loop Step Test	INT32	RW	NO	●						%
3501	--	VAR	Pn925 Current loop frequency response test Iq given offset percentage	INT32	RW	NO	●						%
3502	--	VAR	Pn926 Current loop frequency response test Iq given amplitude percentage	INT32	RW	NO	●						%

Index	Subindex	Object	Name	Type	Attr.	PDO	Support						Unit
							All	IP	PP	PV	PT	HM	
3504	--	VAR	Pn928 Speed loop frequency response test speed given offset	INT32	RW	NO	●						rpm
3505	--	VAR	Pn929 Speed loop frequency response test speed given amplitude	INT32	RW	NO	●						rpm
3507	--	VAR	Pn931 DA output voltage amplitude in frequency response test mode	INT32	RW	NO	●						0.1V
3508	--	VAR	Pn932 Sweep frequency	INT32	RW	NO	●						Hz
350B	--	VAR	Pn935 One Volt Corresponding Pulse Number	INT32	RW	NO	●						--
350C	--	VAR	Pn936 Output Voltage Scale Factor in Position Loop Frequency Response Test	INT32	RW	NO	●						--
350D	--	VAR	Pn937 Output Voltage Offset in Position Loop Frequency Response Test	INT32	RW	NO	●						--
350F	--	VAR	Pn939 STO Function Selection	INT32	RW	NO	●						--
3510	--	VAR	Pn940 Interrupt Cycle Time	INT32	RW	NO	●						--
3511	--	VAR	Pn941 MXL Motor Flux-weakening Selection	INT32	RW	NO	●						--
3512	--	VAR	Pn942 Flux-weakening PI Regulator (kp)	INT32	RW	NO	●						0.01
3513	--	VAR	Pn943 Flux-weakening PI Regulator (ki)	INT32	RW	NO	●						0.1
3514	--	VAR	Pn944 Mechanical Analyzer Order	INT32	RW	NO	●						--

Index	Subindex	Object	Name	Type	Attr.	PDO	Support						Unit
							All	IP	PP	PV	PT	HM	
351A	--	VAR	Pn950 Overmodulation Selection	INT32	RW	NO	●						--
351B	--	VAR	Pn951 Tz Selection	INT32	RW	NO	●						--
351C	--	VAR	Pn952 Amplifying Tmax, Pn401/Pn402	INT32	RW	NO	●						0.01
351D	--	VAR	Pn953 Motor Amplified (Imax)	INT32	RW	NO	●						0.01
351E	--	VAR	Pn954 Alarm Self-test Selection	INT32	RW	NO	●						--
351F	--	VAR	Pn955 Bus Voltage Correction	INT32	RW	NO	●						V
3521	--	VAR	Pn957 ePWM forced synchronization enable bit in EC mode Validate After Restart	INT32	RW	NO	●						--
3524	--	VAR	Pn960 Alarm Masks 1	INT32	RW	NO	●						--
3525	--	VAR	Pn961 Alarm Masks 2	INT32	RW	NO	●						--
3526	--	VAR	Pn962 Alarm Masks 3	INT32	RW	NO	●						--
3527	--	VAR	Pn963 Alarm Masks 4	INT32	RW	NO	●						--
3528	--	VAR	Pn964 Alarm Masks 5	INT32	RW	NO	●						--
3529	--	VAR	Pn965 Alarm Masks 6	INT32	RW	NO	●						--
3685	--	ARRAY	EncAlmClrVar	--	--	--	●						--
	0		number_of_entries	UINT8	RO	NO	●						--
	1		ClrAllEncAlm	UINT16	RW	NO	●						--
	2		ClrMultiEncAlm	UINT16	RW	NO	●						--
603F	--	VAR	Error_code	UINT16	RO	YES	●						--
6040	--	VAR	controlword	UINT16	RW	YES	●						--

Index	Subindex	Object	Name	Type	Attr.	PDO	Support						Unit
							All	IP	PP	PV	PT	HM	
6041	--	VAR	statusword	UINT16	RO	YES	●						--
605A	--	VAR	quick_stop_option_code	INT16	RW	NO	●						--
605B	--	VAR	shutdown_option_code	INT16	RW	NO	●						--
605C	--	VAR	disable_operation_option_code	INT16	RW	NO	●						--
605D	--	VAR	stop_option_code	INT16	RW	NO	●						--
605E	--	VAR	fault_reaction_option_code	INT16	RW	NO	●						--
6060	--	VAR	modes_of_operation	UINT8	RW	YES	●						--
6061	--	VAR	modes_of_operation_display	UINT8	RO	YES	●						--
6062	--	VAR	position_demand_value	INT32	RO	YES			●				position units
6063	--	VAR	position_actual_value*	INT32	RO	YES			●				inc
6064	--	VAR	position_actual_value	INT32	RO	YES		●	●		●	●	position units
6065	--	VAR	following_error_window	UINT32	RW	YES			●				position units
6066	--	VAR	following_error_time_out	UINT16	RW	YES			●				ms
6067	--	VAR	position_window	UINT32	RW	YES			●				position units
6068	--	VAR	position_window_time	UINT16	RW	YES			●				ms
6069	--	VAR	velocity_sensor_actual_value	INT32	RO	YES				●			speed units
606B	--	VAR	velocity_demand_value	INT32	RO	YES				●			speed units
606C	--	VAR	velocity_actual_value	INT32	RO	YES	●						speed units
606D	--	VAR	velocity_window	UINT16	RW	YES				●			speed units
606E	--	VAR	velocity_window_time	UINT16	RW	YES				●			ms
606F	--	VAR	velocity_threshold	UINT16	RW	YES				●			speed units

Index	Subindex	Object	Name	Type	Attr.	PDO	Support						Unit
							All	IP	PP	PV	PT	HM	
6070	--	VAR	velocity_threshold_time	UINT16	RW	YES				●			ms
6071	--	VAR	target_torque	INT16	RW	YES					●		0.1% Tn
6072	--	VAR	Max_torque	UINT16	RW	YES					●		0.1% Tn
6074	--	VAR	torque_demand_value	INT16	RO	YES					●		0.1% Tn
6077	--	VAR	torque_actual_value	INT32	RO	YES		●	●		●		0.1% Tn
6078	--	VAR	Current actual value	INT16	RO	YES		●	●		●		0.1%In
607A	--	VAR	target_position	INT32	RW	YES			●				position units
607C	--	VAR	home_offset	INT32	RW	YES	●						position units
607D	--	ARRAY	Software_position_limit	--	--	--			●				--
	0		number_of_entries	UINT8	RW	NO			●				--
	1		min_soft_position_limit	INT32	RW	NO			●				position units
	2		max_soft_position_limit	INT32	RW	NO			●				position units
607E	--	VAR	polarity	UINT8	RW	YES	●						position units
607F	--	VAR	Max_profile_velocity	UINT32	RW	YES			●	●			speed units
6080	--	VAR	Max motor speed	UINT32	RW	YES			●				rpm
6081	--	VAR	profile_velocity	UINT32	RW	YES			●				speed units
6082	--	VAR	end_velocity	UINT32	RW	YES			●				speed units
6083	--	VAR	profile_acceleration	UINT32	RW	YES			●	●			acceleration units
6084	--	VAR	profile_deceleration	UINT32	RW	YES			●	●			acceleration units

Index	Subindex	Object	Name	Type	Attr.	PDO	Support						Unit
							All	IP	PP	PV	PT	HM	
6085	--	VAR	quick_stop_deceleration	UINT32	RW	YES			●	●			acceleration units
6086	--	VAR	motion_profile_type	INT16	RW	YES			●				--
6087	--	VAR	torque_slope	UINT32	RW	YES					●		0.1%Tn/S
6093	--	ARRAY	position_factor	--	--	--	●		●		●	●	--
	0		number_of_entries	UINT32	RW	NO	●		●		●	●	--
	1		numerator	UINT32	RW	NO	●		●		●	●	--
	2		divisor	UINT32	RW	NO	●		●		●	●	--
6094	--	ARRAY	velocity_encoder_factor	--	--	--	●						--
	0		number_of_entries	UINT32	RW	NO	●						--
	1		numerator	UINT32	RW	NO	●						--
	2		divisor	UINT32	RW	NO	●						--
6097	--	ARRAY	acceleration_factor	--	--	--	●						--
	0		number_of_entries	UINT8	RW	NO	●						--
	1		numerator	UINT32	RW	NO	●						--
	2		divisor	UINT32	RW	NO	●						--
6098	--	VAR	homing_method	INT8	RW	YES						●	--
6099	--	ARRAY	homing_speeds	--	--	--						●	--
	0		number_of_entries	UINT8	RO	NO						●	--
	1		speed_during_search_for_switch	UINT32	RW	YES						●	speed units
	2		speed_during_search_for_zero	UINT32	RW	YES						●	speed units

Index	Subindex	Object	Name	Type	Attr.	PDO	Support						Unit
							All	IP	PP	PV	PT	HM	
609A	--	VAR	homing_acceleration	UINT32	RW	YES						●	0.1rpm/s
60A4	--	ARRAY	profile_jerk					●	●				--
	0		number_of_entries	UINT8	RO	NO		●	●				--
	1		profile_jerk1	UINT32	RW	YES		●	●				pulse/s/s/125us
60B1	--	VAR	VelocityOffset	INT32	RW	YES	●						speed units
60B2	--	VAR	TorqueOffset	INT16	RW	YES	●						0.1%Tn
60B8	--	VAR	Touch Probe Function	UINT16	RW	YES	●						--
60B9	--	VAR	Touch Probe Status	UINT16	RO	YES	●						--
60BA	--	VAR	Touch Probe Pos1 Pos Value	INT32	RO	YES	●						pulse
60BB	--	VAR	Touch Probe Pos1 Neg Value	INT32	RO	YES	●						pulse
60BC	--	VAR	Touch Probe Pos2 Pos Value	INT32	RO	YES	●						pulse
60BD	--	VAR	Touch Probe Pos2 Neg Value	INT32	RO	YES	●						pulse
60C0	--	VAR	Interpolation sub mode select	INT16	RW	NO	●						--
60C1	--	ARRAY	Interpolation data record										--
	0		number_of_entries	UINT8	RO	NO		●					--
	1		Interpolation data record1	INT32	RW	YES		●					pulse
	2		Interpolation data record2	INT32	RW	NO		●					pulse
60C2	--	ARRAY	Interpolation_Time										--
	0		number_of_entries	UINT8	RO	NO		●					--
	1		Interpolation_Time_Unit	UINT8	RW	NO		●					--
	2		Interpolation_Time_Index	INT8	RW	NO		●					--

Index	Subindex	Object	Name	Type	Attr.	PDO	Support						Unit
							All	IP	PP	PV	PT	HM	
60C5	--	VAR	Max_acceleration	UINT32	RW	YES	●						0.1rpm/s
60C6	--	VAR	Max_deceleration	UINT32	RW	YES	●						0.1rpm/s
60E0	--	VAR	PosTorLimit	UINT16	RW	YES	●						%0.1Tn
60E1	--	VAR	NegTorLimit	UINT16	RW	YES	●						%0.1Tn
60F4	--	VAR	Following_error_actual_value	INT32	RO	YES		●					pulse
60FA	--	VAR	control_effort	INT32	RO	YES		●				●	--
60FC	--	VAR	position_demand_value*	INT32	RO	YES		●				●	pulse
60FD	--	VAR	digital_inputs	UINT32	RO	YES	●						--
60FE	--	ARRAY	digital_outputs										--
	0		number_of_entries	UINT8	RO	NO	●						--
	1		physical_outputs	UINT32	RW	YES	●						--
	2		bit_mask	UINT32	RW	NO	●						--
60FF	--	VAR	target_velocity	INT32	RW	YES				●			speed units
6502	--	VAR	Supported drive modes	UINT32	RO	NO	●						--

Revision History

Date	Version	Revised Contents
September 2022	V0.01	Initial release (DRAFT)
October 2023	V1.00	Updated with formatting changes

Trio Motion Technology Limited

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