

Make Life Easy 

# User Manual

Closed-Loop Stepper System

## **AiC-EC Series**

MMD-AiC-ECU1-V1.1-2107US

Thank you for purchasing Autonics product.  
This manual contains information about the product and its proper use,  
and should be kept in a place where it will be easy to use.

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# Preface

Thank you for purchasing Autonics product.





Please familiarize yourself with the information contained in the **Safety Considerations** sections before using this product.

This manual contains information about the product and its proper use, and should be kept in a place where it will be easy to access.

# User Manual Guide

- Please familiarize yourself with the information in this manual before using the product.
- This manual provides detailed information on the product's features. It does not offer any guarantee concerning matters beyond the scope of this manual.
- This manual may not be edited or reproduced in either part or whole without permission.
- This manual is not provided as part of the product package. Visit our website ([www.autonics.com](http://www.autonics.com)) to download a copy.
- The manual's content may vary depending on changes to the product's software and other unforeseen developments within Autonics, and is subject to change without prior notice. Upgrade notice is provided through out the website.
- We contrived to describe this manual more easily and correctly. However, if there are any corrections or questions, please notify us these on our website.

# User Manual Symbols

Symbol	Descriptions
 <b>Note</b>	Supplementary information for a particular feature.
 <b>Warning</b>	Failure to follow instructions can result in serious injury or death.
 <b>Caution</b>	Failure to follow instructions can lead to a minor injury or product damage.
 <b>Ex.</b>	An example of the concerned feature's use.
01)	Annotation mark.

# Safety Considerations

- Following these safety considerations will ensure the safe and proper use of the product and help prevent accidents, as well as minimizing possible hazards.
- Safety considerations are categorized as Warnings and Cautions, as defined below:

 <b>Warning</b>	Failure to follow these instructions may result in serious injury or death.
--	---

 <b>Caution</b>	Failure to follow these instructions may result in personal injury or product damage.
--	---

## Motor

### Warning

- 01. Fail-safe device must be installed when using the unit with machinery that may cause serious injury or substantial economic loss. (e.g. nuclear power control, medical equipment, ships, vehicles, railways, aircraft, combustion apparatus, safety equipment, crime / disaster prevention devices, etc.)**  
Failure to follow this instruction may result in personal injury, economic loss or fire.
- 02. Do not use the unit in the place where flammable / explosive / corrosive gas, high humidity, direct sunlight, radiant heat, vibration, impact or salinity may be present.**  
Failure to follow this instruction may result in explosion or fire.
- 03. Fix the unit on the metal plate.**  
Failure to follow this instruction may result in personal injury or product and ambient equipment damage.
- 04. Do not connect, repair, or inspect the unit while connected to a power source.**  
Failure to follow this instruction may result in fire.
- 05. Install the unit after considering counter plan against power failure.**  
Failure to follow this instruction may result in personal injury, economic loss or fire.
- 06. Check 'Connections' before wiring.**  
Failure to follow this instruction may result in fire.
- 07. Do not disassemble or modify the unit.**  
Failure to follow this instruction may result in fire or electric shock.
- 08. Install the motor in the housing or ground it.**  
Failure to follow this instruction may result in personal injury, fire or electronic shock.
- 09. Make sure to install covers on motor rotating components.**  
Failure to follow this instruction may result in personal injury
- 10. Do not touch the unit during or after operation for a while.**  
Failure to follow this instruction may result in burn due to high temperature of the surface.
- 11. Upon occurrence of an error, disconnect the power source.**  
Failure to follow this instruction may result in personal injury, fire or electronic shock.

**Caution****01. Use the unit within the rated specifications.**

Failure to follow this instruction may result in fire or product damage.

**02. Use a dry cloth to clean the unit, and do not use water or organic solvent.**

Failure to follow this instruction may result in fire.

**03. The motor may overheat depending on the environment.**

**Install the unit at the well-ventilated environment and forced cooling with a cooling fan.**

Failure to follow this instruction may result in product damage or degradation by heat.

**04. Keep the product away from metal chip, dust, and wire residue which flow into the unit.**

Failure to follow this instruction may result in fire or product damage.

## Driver



### Warning

- 01. Fail-safe device must be installed when using the unit with machinery that may cause serious injury or substantial economic loss. (e.g. nuclear power control, medical equipment, ships, vehicles, railways, aircraft, combustion apparatus, safety equipment, crime / disaster prevention devices, etc.)**

Failure to follow this instruction may result in personal injury, economic loss or fire.

- 02. Do not use the unit in the place where flammable / explosive / corrosive gas, high humidity, direct sunlight, radiant heat, vibration, impact or salinity may be present.**

Failure to follow this instruction may result in explosion or fire.

- 03. Do not connect, repair, or inspect the unit while connected to a power source.**

Failure to follow this instruction may result in fire or electric shock.

- 04. Install the unit after considering counter plan against power failure.**

Failure to follow this instruction may result in personal injury, economic loss or fire.

- 05. Check 'Connections' before wiring.**

Failure to follow this instruction may result in fire.

- 06. Do not disassemble or modify the unit.**

Failure to follow this instruction may result in fire or electric shock.

- 07. Install the driver in the grounded housing or ground it.**

Failure to follow this instruction may result in personal injury, fire or electronic shock.

- 08. Do not touch the unit during or after operation for a while.**

Failure to follow this instruction may result in burn or electric shock due to high temperature of the surface.

- 09. Emergency stop directly when error occurs.**

Failure to follow this instruction may result in personal injury or fire.



**Caution**

- 01. When connecting the power input, use AWG 18 (0.75 mm<sup>2</sup>) cable or over.**
- 02. Brake is non-polar. When connecting the brake, use AWG 24 (0.2 mm<sup>2</sup>) cable or over.**  
Failure to follow this instruction may result in malfunction due to contact failure.
- 03. To use the motor safely, do not apply external force to the motor.**
- 04. It is recommended to use STOPPER for the vertical load.**
- 05. Install over-current prevention device (e.g. the current breaker, etc.) to connect the driver with power.**  
Failure to follow this instruction may result in fire.
- 06. Check the control input signal before supplying power to the driver.**  
Failure to follow this instruction may result in personal injury or product damage by unexpected driver movement.
- 07. Install a safety device to maintain the vertical position after turn off the power of the driver.**  
Failure to follow this instruction may result in personal injury or product damage by releasing holding torque of the motor.
- 08. Use the unit within the rated specifications.**  
Failure to follow this instruction may result in fire or product damage.
- 09. Use a dry cloth to clean the unit, and do not use water or organic solvent.**  
Failure to follow this instruction may result in fire or electric shock.
- 10. The driver may overheat depending on the environment.  
Install the unit at the well-ventilated environment and forced cooling with a cooling fan.**  
Failure to follow this instruction may result in product damage or degradation by heat.
- 11. Keep the product away from metal chip, dust, and wire residue which flow into the unit.**  
Failure to follow this instruction may result in fire or product damage.
- 12. Use the designated motor only.**  
Failure to follow this instruction may result in fire or product damage.

**The above specifications, dimensions, etc. are subject to change and some models may be discontinued without notice.  
Be sure to follow cautions written in the instruction manual, user manual, and technical descriptions (catalog, website).**

# Cautions during Use

## Motor

- Follow instructions in 'Cautions during Use'.  
Otherwise, it may cause unexpected accidents.
- At low temperature, reducing the grease's consistency of ball-bearing and etc. causes the friction torque increment.  
Start the motor gradually since motor's torque is in normal state.
- Encoder shield cable must be connected to F.G. terminal.
- When wiring encoder cable, separate it from high voltage cable, power cable, etc. to prevent surge and inductive noise and keep the cable length as short as possible.  
Failure to follow this instruction may result in raised cable resistance, residual voltage and output waveform noise.
- Maintain and inspect regularly the following lists.
  - Unwinding bolts and connection parts for the unit installation and load connection
  - Abnormal sound from ball-bearing of the unit
  - Damage and stress of lead cable of the unit
  - Connection error with driver
  - Inconsistency between the axis of motor output and the center, concentric (eccentric, declination) of the load, etc.
- This unit may be used in the following environments.
  - Indoors (in the environment condition rated in 'Specifications')
  - Altitude max. 2,000 m
  - Pollution degree 2
  - Installation category II

## Driver

- Follow instructions in 'Cautions during Use'. Otherwise, it may cause unexpected accidents.
- Power supply should be insulated and limited voltage/current or Class 2, SELV power supply device.
- Re-supply power after 1 sec from disconnected power.
- In case of unwanted noise generating from peripherals and power, use ferrite core in the wiring.
- Keep the distance between power cable and signal cable over 10 cm.
- The thickness of cable should be same or thicker than the below specifications when connecting the cable for connector.
  - Power connector (PWR): AWG18
  - Motor + Encoder connector (MOTOR): AWG22, AWG24
  - Brake connector (BRAKE): AWG22
  - I/O connector (SIGNAL I/O): AWG28
- Motor vibration and noise may occur in a specific frequency range.
  - Change the motor installation method or attach the damper.
  - Use the unit out of the corresponding frequency range due to changing motor RUN speed.
- Maintain and inspect regularly the following lists.
  - Unwinding bolts and connection parts for the unit installation and load connection
  - Abnormal sound from ball-bearing of the unit
  - Damage and stress of lead cable of the unit
  - Connection error with motor
  - Inconsistency between the axis of motor output and the center, concentric (eccentric, declination) of the load, etc.
- This product does not contain a protection function for a motor unit.
- This unit may be used in the following environments.
  - Indoors (in the environment condition rated in 'Specifications')
  - Altitude max. 2,000 m
  - Pollution degree 2
  - Installation category II

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# Table of Contents

Preface.....	3
User Manual Guide.....	4
User Manual Symbols.....	5
Safety Considerations.....	6
Cautions during Use .....	10
<b>1 Product Overview .....</b>	<b>18</b>
1.1 Features .....	18
1.2 Components and Configuration Diagram .....	19
1.2.1 Components.....	19
1.2.1.1 Driver.....	19
1.2.1.2 Motor.....	19
1.2.2 Configuration Diagram .....	19
1.3 Ordering Information.....	20
1.3.1 Driver.....	20
1.3.2 Motor.....	21
1.4 Set table.....	22
1.4.1 Standard type.....	22
1.4.2 Built-in brake type.....	22
<b>2 Specifications.....</b>	<b>24</b>
2.1 Driver .....	24
2.1.1 Factory Default.....	25
2.1.2 EtherCAT Communication Interface.....	25
2.2 Motor .....	26
2.2.1 Standard Type.....	26
2.2.2 Common Specifications.....	27
2.2.3 Encoder .....	28
2.2.4 Brake.....	28
<b>3 Dimensions.....</b>	<b>29</b>
3.1 Driver .....	29
3.2 Motor .....	30
3.2.1 Standard Type .....	30
3.2.2 Built-in Brake type.....	32
<b>4 Installation of Motor.....</b>	<b>33</b>
4.1 Cautions during Installation.....	33
4.2 Installation Direction of Motor.....	33
4.3 Panel Cut-out Dimensions.....	34
4.4 Cautions during Connection with Load.....	35
4.5 Installation Conditions.....	36
<b>5 Connection .....</b>	<b>37</b>
5.1 Standard Type.....	37
5.2 Built-in Brake Type .....	38
<b>6 Motor Characteristic.....</b>	<b>39</b>

<b>7</b>	<b>Driver Unit Descriptions .....</b>	<b>41</b>
7.1	Connector Specifications.....	41
7.1.1	Suitable Specifications.....	41
7.1.2	Power Connector (PWR).....	41
7.1.3	Motor + Encoder Connector (MOTOR).....	41
7.1.4	I/O Connector (SIGNAL I/O).....	42
7.1.5	USB Connector (COM).....	42
7.1.6	Brake Connector (BRAKE).....	42
7.1.7	EtherCAT Comm. Connector (ECAT IN / ECAT OUT).....	42
7.2	Switch Specifications.....	43
7.2.1	Communication ID setting rotary switch.....	43
7.3	Driver Status Indicator.....	43
7.4	Sold Separately.....	44
7.4.1	Power Cable (CJ-PW-□).....	44
7.4.2	Motor + Encoder Cable (fixed type: C1D14M(B)-□, flexible type: C1DF14M(B)-□).....	44
7.4.3	I/O Cable (CO20-MP□-R, specifications: AiC-EC TAG).....	44
<b>8</b>	<b>Control I/O.....</b>	<b>45</b>
8.1	Input.....	45
8.1.1	Input Signal.....	45
8.1.1.1	ORG.....	45
8.1.1.2	±Limit.....	45
8.1.1.3	Alarm Reset.....	45
8.1.1.4	Hold Off.....	45
8.1.1.5	Stop.....	46
8.1.1.6	EMG.....	46
8.1.1.7	General Input.....	46
8.1.2	Example of Input Circuit Connection.....	46
8.2	Output.....	47
8.2.1	Output Signal.....	47
8.2.1.1	In-Position.....	47
8.2.1.2	Alarm.....	48
8.2.1.3	General Output.....	48
8.2.2	Example of Output Circuit Connection.....	48
<b>9</b>	<b>Electromagnetic Brake .....</b>	<b>49</b>
9.1	Brake Connection.....	49
9.2	Brake Operation.....	49
<b>10</b>	<b>USB Communication .....</b>	<b>50</b>
10.1	atMotion Connection.....	50
10.2	atMotion Control Method.....	52
10.2.1	Motor Control Method.....	52
10.2.2	Alarm Reset Method.....	52
10.2.3	Servo ON Setting Method.....	52
10.2.4	Parameter Save Method.....	52
10.3	Parameter Setting.....	53
10.3.1	Operation & I/O Active Level Setting.....	53
10.3.2	Home Search Mode.....	54
10.3.3	Parameter.....	54
<b>11</b>	<b>EtherCAT Communication .....</b>	<b>55</b>
11.1	EtherCAT Communication Overview.....	55
11.1.1	EtherCAT Communication Interface.....	55

11.1.2	Operation Indicator.....	56
11.1.3	Communication ID Setting.....	56
11.2	EtherCAT Device Protocol.....	57
11.2.1	CANopen over EtherCAT (CoE).....	57
11.2.2	EtherCAT State Machine (ESM).....	58
11.2.3	SyncManager (SM).....	59
11.2.3.1	Mailbox Mode.....	59
11.2.3.2	Buffered Mode.....	60
11.2.4	Process Data Object (PDO).....	61
11.2.4.1	PDO Mapping.....	62
11.2.4.2	PDO Mapping 1 (CSP).....	62
11.2.4.3	PDO Mapping 2 (PP/PV).....	62
11.2.4.4	PDO Mapping 3 (CSV).....	63
11.2.5	Service Data Object(SDO).....	63
11.3	EtherCAT Communication Sync Mode.....	64
11.4	Drive State Machine (DSM).....	65
11.4.1	Controlword.....	66
11.4.2	Statusword.....	66
<b>12</b>	<b>EtherCAT Operation Mode.....</b>	<b>67</b>
12.1	Profile Position Mode (PP).....	67
12.1.1	Driving Method.....	67
12.1.2	Related Object.....	68
12.1.3	Operation Timing Chart.....	70
12.1.3.1	Update Increment Operation after Stop.....	70
12.1.3.2	Update Absolute Operation during Operation.....	70
12.1.3.3	HALT Operation.....	71
12.1.3.4	Absolute Limit Operation.....	71
12.1.3.5	Quick Stop Operation.....	72
12.2	Profile Velocity Mode (PV).....	73
12.2.1	Driving Method.....	73
12.2.2	Related Object.....	74
12.2.3	Operation Timing Chart.....	76
12.2.3.1	Normal Operation.....	76
12.2.3.2	HALT Operation.....	76
12.2.3.3	Internal Limit Operation.....	77
12.2.3.4	Quick Stop Operation.....	77
12.3	Cyclic Synchronous Position Mode (CSP).....	78
12.3.1	Driving Method.....	78
12.3.2	Related Object.....	79
12.3.3	Operation Timing Chart.....	81
12.3.3.1	Normal Operation.....	81
12.3.3.2	HALT Operation.....	81
12.3.3.3	Following error Operation.....	82
12.3.3.4	Internal Limit Operation.....	82
12.3.3.5	Quick Stop Operation.....	83
12.4	Cyclic Synchronous Position Mode (CSV).....	84
12.4.1	Driving Method.....	84
12.4.2	Related Object.....	85
12.4.3	Operation Timing Chart.....	87
12.4.3.1	Normal Operation.....	87
12.4.3.2	HALT Operation.....	87
12.4.3.3	Internal Limit Operation.....	88
12.4.3.4	Quick Stop Operation.....	88

12.5	Home Mode (HM)	89
12.5.1	Driving Method	89
12.5.2	Homing Operation	89
12.5.2.1	Homing on the negative limit switch and index pulse [1]	89
12.5.2.2	Homing on the positive limit switch and index pulse [2]	89
12.5.2.3	Homing on the switch and index pulse (Positive) [7]	90
12.5.2.4	Homing on home switch and index pulse (Negative) [11]	90
12.5.2.5	Homing without an index pulse (Negative limit switch) [17]	91
12.5.2.6	Homing without an index pulse (Positive limit switch) [18]	91
12.5.2.7	Homing without an index pulse (Positive and Home sensor ON) [24]	92
12.5.2.8	Homing without an index pulse (Negative and Home sensor ON) [28]	93
12.5.2.9	Homing on the index pulse (Negative) [33]	94
12.5.2.10	Homing on the index pulse (Positive) [34]	94
12.5.2.11	Set the Origin with Home offset [35]	94
12.5.2.12	Set the Origin and Reset Current Position [37]	95
12.5.2.13	Torque Homing Search- with Home offset [-3]	95
12.5.2.14	Torque Homing Search+ with Home offset [-4]	95
12.5.3	Related Object	96
12.5.4	Operation Timing Chart	98
12.5.4.1	Normal Operation	98
12.5.4.2	HALT Operation	98
12.5.4.3	Homing start OFF Operation	99
12.5.4.4	Quick Stop Operation	99
<b>13</b>	<b>Function</b>	<b>100</b>
13.1	Touch Probe	100
13.1.1	Operation Timing Chart	102
13.2	Remote I/O	103
13.2.1	Remote Input	103
13.2.2	Remote Output	104
13.3	Digital I/O	105
13.3.1	Digital Input	105
13.3.2	Digital Output	106
13.4	Other Functions	107
13.4.1	Software Limit	107
13.4.2	In-Position	107
13.4.3	Motor Gain	108
13.4.4	Speed Filter	108
13.4.5	Motor Rotation Direction	109
13.4.6	Stop Current	109
13.4.7	Resolution	109
13.4.8	Alarm / Warning	110
13.4.8.1	Alarm Display Function	110
13.4.8.2	Warning Display Function	110
13.4.9	Object Save	111
<b>14</b>	<b>Object Dictionary</b>	<b>112</b>
14.1	Communication Object	112
14.1.1	Device type: [1000h]	112
14.1.2	Error Register: [1001h]	112
14.1.3	Device Name: [1008h]	112
14.1.4	Hardware Version: [1009h]	112
14.1.5	Software Version: [100Ah]	112
14.1.6	Identity: [1018h]	113

14.2	PDO Mapping Object.....	114
14.2.1	Receiving PDO Mapping 1 (CSP RxPDO): [1600h] .....	114
14.2.2	Receiving PDO Mapping 2 (PP/PV RxPDO): [1601h] .....	114
14.2.3	Receiving PDO Mapping 3 (CSV RxPDO): [1602h] .....	115
14.2.4	Transmitting PDO Mapping 1 (CSP TxPDO): [1A00h].....	115
14.2.5	Transmitting PDO Mapping 2 (PP/PV TxPDO): [1A01h].....	116
14.2.6	Transmitting PDO Mapping 3 (CSV TxPDO): [1A02h].....	116
14.2.7	SM2 PDO Assign (RxPDO Assign): [1C12h] .....	117
14.2.8	SM3 PDO Assign (TxPDO Assign): [1C13h] .....	117
14.3	Sync Manager Object.....	118
14.3.1	Sync Manager Type: [1C00h] .....	118
14.3.2	SM Output Parameter: [1C32h] .....	119
14.3.3	SM Input Parameter: [1C33h] .....	120
14.4	Manufacturer Specific Object .....	121
14.4.1	Limit Stop Method: [2001h] .....	121
14.4.2	Homing Torque Ratio: [2002h].....	121
14.4.3	Speed Filter & Control Gain: [2003h] .....	122
14.4.4	Start Speed: [2005h].....	122
14.4.5	Stop Current: [2006h].....	122
14.4.6	Main Voltage: [2008h].....	123
14.4.7	Inverter Voltage: [2009h] .....	123
14.4.8	Input Filter: [200Ah].....	123
14.4.9	Input Level: [200Bh] .....	124
14.4.10	Output Level: [200Ch] .....	125
14.4.11	Input Assigned: [200Dh] .....	125
14.4.12	Output Assigned: [200Eh] .....	126
14.4.13	Remote Input Assigned: [200Fh].....	126
14.4.14	Remote Output Assigned: [2010h] .....	127
14.4.15	Remote Input Status: [2011h].....	128
14.4.16	Remote Output Status: [2012h] .....	128
14.4.17	Remote Input Command: [2013h].....	129
14.4.18	Internal Current: [2014h] .....	129
14.4.19	Reference Resolution: [2015h].....	130
14.4.20	Alarm History: [2016h] .....	130
14.4.21	Inposition Mode: [2017h] .....	131
14.4.22	ID Shift: [2018h].....	131
14.4.23	Driver Temperature: [201Ah].....	131
14.4.24	Data Save: [201Bh] .....	131
14.5	Drive Profile Object.....	132
14.5.1	Error Code: [603Fh] .....	132
14.5.2	Controlword: [6040h] .....	133
14.5.3	Statusword: [6041h] .....	134
14.5.4	Quick Stop Option Code: [605Ah].....	135
14.5.5	Shutdown Option Code: [605Bh].....	135
14.5.6	Disable Operation Option Code: [605Ch].....	135
14.5.7	Halt Option Code: [605Dh].....	135
14.5.8	Fault Reaction Code: [605Eh] .....	135
14.5.9	Modes of Operation: [6060h] .....	136
14.5.10	Modes of Operation Display: [6061h].....	136
14.5.11	Position Demand Value: [6062h] .....	136
14.5.12	Position Actual Value: [6064h].....	136
14.5.13	Following Error Window: [6065h] .....	136



14.5.14	Position Window: [6067h]	136
14.5.15	Velocity Demand Value: [606Bh]	137
14.5.16	Velocity Actual Value: [606Ch]	137
14.5.17	Target Position: [607Ah]	137
14.5.18	Home Offset: [607Ch]	137
14.5.19	Software Limit: [607Dh]	137
14.5.20	Polarity: [607Eh]	137
14.5.21	Max Profile Velocity: [607Fh]	137
14.5.22	Profile Velocity: [6081h]	138
14.5.23	Profile Acceleration: [6083h]	138
14.5.24	Profile Deceleration: [6084h]	138
14.5.25	Quick Stop Deceleration: [6085h]	138
14.5.26	Homing Method: [6098h]	138
14.5.27	Homing Speed: [6099h]	139
14.5.28	Homing Acceleration: [609Ah]	139
14.5.29	Touch Probe Function: [60B8h]	140
14.5.30	Touch Probe Status: [60B9h]	141
14.5.31	Touch Probe1 Up Edge Position: [60BAh]	141
14.5.32	Touch Probe1 Down Edge Position: [60BBh]	141
14.5.33	Touch Probe2 Up Edge Position: [60BCh]	141
14.5.34	Touch Probe2 Down Edge Position: [60BDh]	141
14.5.35	Touch Probe1 Up Edge Counter: [60D5h]	142
14.5.36	Touch Probe1 Down Edge Counter: [60D6h]	142
14.5.37	Touch Probe2 Up Edge Counter: [60D7h]	142
14.5.38	Touch Probe2 Down Edge Counter: [60D8h]	142
14.5.39	Supported Homing Methods: [60E3h]	142
14.5.40	Following Error Actual Value: [60F4h]	143
14.5.41	Digital Input: [60FDh]	143
14.5.42	Digital Output: [60FEh]	144
14.5.43	Target Velocity: [60FFh]	144
14.5.44	Supported Drive Modes: [6502h]	145
<b>15</b>	<b>Troubleshooting</b>	<b>146</b>

# 1 Product Overview

## 1.1 Features

AiC-EC series is Ai-Servo with EtherCAT communication. This product supports stable compatibility with various master / slave with open protocol communication EtherCAT and is advantageous for control simultaneous multi-axis synchronized control through 100 Mbps baud rate.

- Closed-loop system with real-time position control
- High speed & high torque drive without missing steps
- Multi-axis simultaneous control with EtherCAT communication
- Windows-based software (atMotion) for easy parameter setting and monitoring
- 7-segment display for alarm / status reading
- Built-in brake type motors available (AiC-D-B-EC Series)

## 1.2 Components and Configuration Diagram

### 1.2.1 Components

#### 1.2.1.1 Driver

Driver  
 Instruction manual  
 Power connector  
 I/O connector  
 Brake connector (AiC-D-B-EC Series)

#### 1.2.1.2 Motor

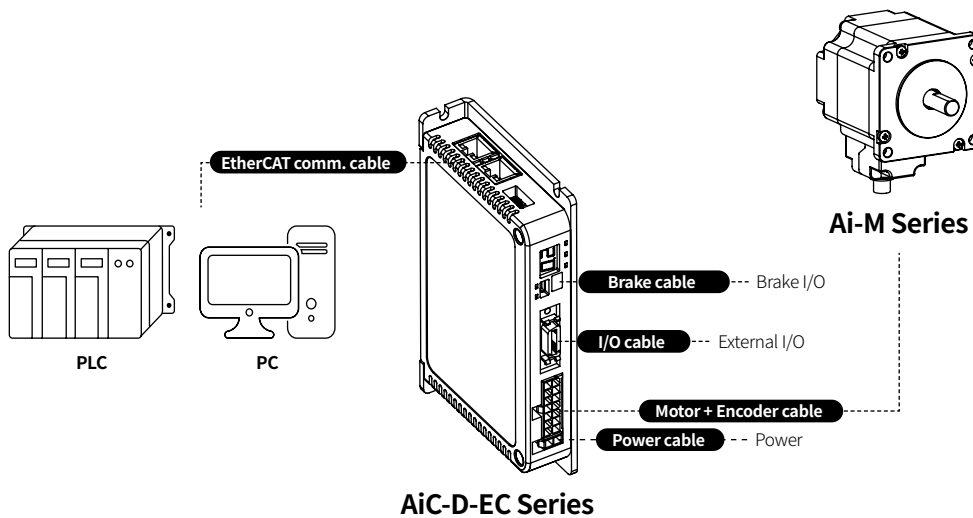
Motor  
 Instruction manual



#### Note

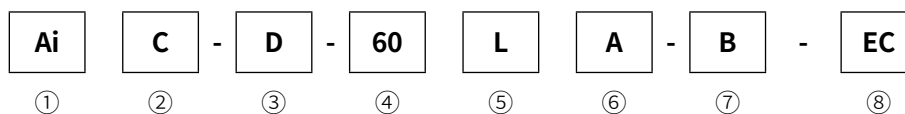
Make sure all of the above components are included with your product package before use. If a component is missing or damaged, please contact Autonics or the product distributor.

### 1.2.2 Configuration Diagram



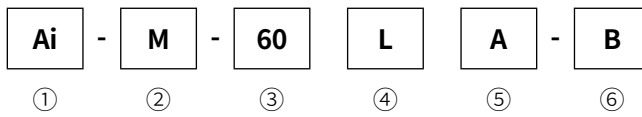
## 1.3 Ordering Information

### 1.3.1 Driver



Item	Descriptions										
① Series	Ai	Artificial intelligent									
② Category	C	Controller									
③ Item	D	Driver									
④ Frame size	20	<input type="checkbox"/> 20 mm									
	28	<input type="checkbox"/> 28 mm									
	35	<input type="checkbox"/> 35 mm									
	42	<input type="checkbox"/> 42 mm									
	56	<input type="checkbox"/> 56 mm									
	60	<input type="checkbox"/> 60 mm									
⑤ Axial length	S	Short size									
	M	Middle size									
	L	Long size									
⑥ Encoder resolution	-	<table style="width: 100%; border-collapse: collapse;"> <tr style="background-color: #f2f2f2;"> <td style="width: 30%;"></td> <td style="text-align: center;"><input type="checkbox"/> <b>20 / 28 / 35 mm</b></td> <td style="text-align: center;"><input type="checkbox"/> <b>42 / 56 / 60 mm</b></td> </tr> <tr> <td style="text-align: center;"><b>A</b></td> <td>4,000 PPR (1,000 PPR × 4)</td> <td>10,000 PPR (2,500 PPR × 4)</td> </tr> <tr> <td style="text-align: center;"><b>B</b></td> <td>16,000 PPR (4,000 PPR × 4)</td> <td style="text-align: center;">-</td> </tr> </table>		<input type="checkbox"/> <b>20 / 28 / 35 mm</b>	<input type="checkbox"/> <b>42 / 56 / 60 mm</b>	<b>A</b>	4,000 PPR (1,000 PPR × 4)	10,000 PPR (2,500 PPR × 4)	<b>B</b>	16,000 PPR (4,000 PPR × 4)	-
			<input type="checkbox"/> <b>20 / 28 / 35 mm</b>	<input type="checkbox"/> <b>42 / 56 / 60 mm</b>							
		<b>A</b>	4,000 PPR (1,000 PPR × 4)	10,000 PPR (2,500 PPR × 4)							
<b>B</b>	16,000 PPR (4,000 PPR × 4)	-									
⑦ Brake	B	Built-in brake type									
⑧ Comm. method	EC	EtherCAT communication									

## 1.3.2 Motor



Item	Description			
① Series	Ai	Artificial intelligent		
② Category	M	Motor		
③ Motor frame size	20	<input type="checkbox"/> 20 mm (20×20 mm)		
	28	<input type="checkbox"/> 28 mm (28×28 mm)		
	35	<input type="checkbox"/> 35 mm (35×35 mm)		
	42	<input type="checkbox"/> 42 mm (42×42 mm)		
	56	<input type="checkbox"/> 56 mm (57.2×57.2 mm)		
	60	<input type="checkbox"/> 60 mm (60×60 mm)		
④ Motor length (standard / built-in brake type)	S	Short size		
		-	<input type="checkbox"/> 42 mm: 67.5 mm / 102.4 mm	
		<input type="checkbox"/> 28 mm: 46 mm	<input type="checkbox"/> 56 mm: 77.2 mm / 112.2 mm	
		<input type="checkbox"/> 35 mm: 41.5 mm	<input type="checkbox"/> 60 mm: 81.8 mm / 116.8 mm	
	M	Middle size		
		<input type="checkbox"/> 20 mm: 41.2 mm	<input type="checkbox"/> 42 mm: 73.5 mm / 108.4 mm	
		<input type="checkbox"/> 28 mm: 59 mm	<input type="checkbox"/> 56 mm: 90.2 mm / 125.2 mm	
		<input type="checkbox"/> 35 mm: 52 mm	<input type="checkbox"/> 60 mm: 102.7 mm / 137.7 mm	
		L	Long size	
			<input type="checkbox"/> 20 mm: 53.1 mm	<input type="checkbox"/> 42 mm: 81.5 mm / 116.4 mm
	<input type="checkbox"/> 28 mm: 65 mm		<input type="checkbox"/> 56 mm: 111.2 mm / 146.2 mm	
	<input type="checkbox"/> 35 mm: 68.5 mm		<input type="checkbox"/> 60 mm: 119.7 mm / 154.7 mm	
⑤ Encoder resolution	-	<input type="checkbox"/> <b>20 / 28 / 35 mm</b>	<input type="checkbox"/> <b>42 / 56 / 60 mm</b>	
		<b>A</b>	4,000 PPR (1,000 PPR × 4)	10,000 PPR (2,500 PPR × 4)
		<b>B</b>	16,000 PPR (4,000 PPR × 4)	-
⑥ Motor type	No mark	Standard type		
	B	Built-in brake type		

## 1.4 Set table

### 1.4.1 Standard type

Motor frame	Set	Driver	Motor
<input type="checkbox"/> 20 mm	AiC-20MA-EC	AiC-D-20MA-EC	Ai-M-20MA
	AiC-20LA-EC	AiC-D-20LA-EC	Ai-M-20LA
<input type="checkbox"/> 28 mm	AiC-28SB-EC	AiC-D-28SB-EC	Ai-M-28SB
	AiC-28MB-EC	AiC-D-28MB-EC	Ai-M-28MB
	AiC-28LB-EC	AiC-D-28LB-EC	Ai-M-28LB
<input type="checkbox"/> 35 mm	AiC-35SB-EC	AiC-D-35SB-EC	Ai-M-35SB
	AiC-35MB-EC	AiC-D-35MB-EC	Ai-M-35MB
	AiC-35LB-EC	AiC-D-35LB-EC	Ai-M-35LB
<input type="checkbox"/> 42 mm	AiC-42SA-EC	AiC-D-42SA-EC	Ai-M-42SA
	AiC-42MA-EC	AiC-D-42MA-EC	Ai-M-42MA
	AiC-42LA-EC	AiC-D-42LA-EC	Ai-M-42LA
<input type="checkbox"/> 56 mm	AiC-56SA-EC	AiC-D-56SA-EC	Ai-M-56SA
	AiC-56MA-EC	AiC-D-56MA-EC	Ai-M-56MA
	AiC-56LA-EC	AiC-D-56LA-EC	Ai-M-56LA
<input type="checkbox"/> 60 mm	AiC-60SA-EC	AiC-D-60SA-EC	Ai-M-60SA
	AiC-60MA-EC	AiC-D-60MA-EC	Ai-M-60MA
	AiC-60LA-EC	AiC-D-60LA-EC	Ai-M-60LA

### 1.4.2 Built-in brake type

Motor frame	Set	Driver	Motor
<input type="checkbox"/> 42 mm	AiC-42SA-B-EC	AiC-D-42SA-B-EC	Ai-M-42SA-B
	AiC-42MA-B-EC	AiC-D-42MA-B-EC	Ai-M-42MA-B
	AiC-42LA-B-EC	AiC-D-42LA-B-EC	Ai-M-42LA-B
<input type="checkbox"/> 56 mm	AiC-56SA-B-EC	AiC-D-56SA-B-EC	Ai-M-56SA-B
	AiC-56MA-B-EC	AiC-D-56MA-B-EC	Ai-M-56MA-B
	AiC-56LA-B-EC	AiC-D-56LA-B-EC	Ai-M-56LA-B
<input type="checkbox"/> 60 mm	AiC-60SA-B-EC	AiC-D-60SA-B-EC	Ai-M-60SA-B
	AiC-60MA-B-EC	AiC-D-60MA-B-EC	Ai-M-60MA-B
	AiC-60LA-B-EC	AiC-D-60LA-B-EC	Ai-M-60LA-B



#### Note

Built-in geared motor and built-in rotary actuator motor are not provided as set. Please purchase the motor and driver separately. Refer to each instruction manual for more details.

- Built-in Geared

Motor frame	Set	Driver	Motor
<input type="checkbox"/> 42 mm	-	AiC-D-42MA-EC	Ai-M-42MA-G5
			Ai-M-42MA-G7.2
			Ai-M-42MA-G10
<input type="checkbox"/> 60 mm	-	AiC-D-60MA-EC	Ai-M-60MA-G5
			Ai-M-60MA-G7.2
			Ai-M-60MA-G10

- Built-in Rotary Actuator

Motor frame	Set	Driver	Motor
<input type="checkbox"/> 60 mm	-	AiC-D-60MA-EC	Ai-M-60MA-R5
			Ai-M-60MA-R7.2
			Ai-M-60MA-R10

## 2 Specifications

### 2.1 Driver

Model	-	<b>AiC-D-28SB-EC</b>	<b>AiC-D-35SB-EC</b>
	<b>AiC-D-20MA-EC</b>	<b>AiC-D-28MB-EC</b>	<b>AiC-D-35MB-EC</b>
	<b>AiC-D-20LA-EC</b>	<b>AiC-D-28LB-EC</b>	<b>AiC-D-35LB-EC</b>
<b>Power supply</b>	24 VDC $\pm$ 10%		
<b>Max. RUN power</b>	$\leq$ 60 W		
<b>Stop power<sup>01)</sup></b>	$\leq$ 10 W		
<b>Max. RUN current<sup>02)</sup></b>	0.6 A / Phase	1.0 A / Phase	1.2 A / Phase
<b>Stop current</b>	20 to 100% of max. RUN current		
<b>Resolution</b>	500, 1000, 1600, 2000, 3600, 4000, 5000, 6400, 7200, 10000 PPR	500, 1000, 1600, 2000, 3600, 5000, 6400, 7200, 10000, 16000 PPR	


Model	<b>AiC-D-42SA-□-EC</b>	<b>AiC-D-56SA-□-EC</b>	<b>AiC-D-60SA-□-EC</b>
	<b>AiC-D-42MA-□-EC</b>	<b>AiC-D-56MA-□-EC</b>	<b>AiC-D-60MA-□-EC</b>
	<b>AiC-D-42LA-□-EC</b>	<b>AiC-D-56LA-□-EC</b>	<b>AiC-D-60LA-□-EC</b>
<b>Power supply</b>	24 VDC $\pm$ 10%		
<b>Max. RUN power</b>	$\leq$ 60 W	$\leq$ 120 W	$\leq$ 240 W
<b>Stop power<sup>01)</sup></b>	$\leq$ 10 W	$\leq$ 12 W	$\leq$ 15 W
<b>Max. RUN current<sup>02)</sup></b>	1.7 A / Phase	3.5 A / Phase	
<b>Stop current</b>	20 to 100% of max. RUN current		
<b>Resolution</b>	500, 1000, 1600, 2000, 3200, 3600, 5000, 6400, 7200, 10000 PPR		

01) Based on ambient temp. 25°C, ambient humi. 55%RH, Stop current 50%

02) When changing the load rapidly, instantaneous peak current may increase. The capacity of power supply should be over 1.5 to 2 times of max. power consumption.

<b>Run method</b>	2-phase bipolar closed-loop control method
<b>Speed filter</b>	Disable, 2, 4, 6, 8, 10, 20, 40, 60, 80, 100, 120, 140, 160, 180, 200 ms
<b>Motor GAIN</b>	0 to 14, Fine Gain
<b>Max. rotation speed</b>	3,000 rpm
<b>In-Position</b>	Fast Response: 0 to 7, Accurate Response: 0 to 7
<b>Operation mode</b>	CSP, CSV, PP, PV, HM
<b>Home search</b>	Homing on the limit switch and index pulse Homing on the home switch and index pulse Homing without an index pulse (limit switch) Homing without an index pulse (Home sensor ON) Homing on the index pulse Set the origin with home offset Set the origin and reset current position Torque homing search with home offset




<b>Input</b>	Exclusive input: 7, General input: 5
<b>Output</b>	Exclusive output: 2, General output: 4
<b>External power supply</b>	VEX (Default: 24 VDC), GEX (GND)
<b>Insulation resistance</b>	$\geq 100 \text{ M}\Omega$ (500 VDC megger)
<b>Dielectric strength</b>	1,000 VAC ~ 60 Hz for 1 minute
<b>Vibration</b>	1.5 mm double amplitude at frequency 10 to 55 Hz (for 1 minute) in each X, Y, Z direction for 2 hours
<b>Shock</b>	300 m/s <sup>2</sup> ( $\approx 30 \text{ G}$ ) in each X, Y, Z direction for 3 times
<b>Ambient temp.</b>	0 to 50°C, storage: -10 to 60°C (no freezing or condensation)
<b>Ambient humi.</b>	35 to 85%RH, storage: 10 to 90%RH (no freezing or condensation)
<b>Protection rating</b>	IP20 (IEC standard)
<b>Approval</b>	CE  RoHS
<b>Unit weight (packaged)</b>	$\approx 350 \text{ g}$ ( $\approx 500 \text{ g}$ )

### 2.1.1 Factory Default

Function	Factory default
Stop current	50% of max. RUN current
Resolution	10,000 PPR
Speed Filter	60 ms
Motor GAIN	0
In-Position	Fast Response 0

### 2.1.2 EtherCAT Communication Interface

<b>Comm. specifications</b>	EtherCAT
<b>Association approval</b> <sup>01)</sup>	
<b>Connection cable</b>	CAT5e class or over (Shield type: SF/FTP, S/FTP, SF/UTP)
<b>Max. comm. distance</b>	Within 100 m distance between nodes
<b>Baud rate</b>	10 / 100 Mbps
<b>Max. ID settings</b> <sup>02)</sup>	99
<b>Topology</b>	Star, Line, Tree

01) EtherCAT® is registered trademark and patented technology, licensed by Beckhoff Automation GmbH, Germany.

02) Max. connectable ID from Master is 1 to 65,535.

## 2.2 Motor

### 2.2.1 Standard Type

Model	Ai-M-20MA	Ai-M-20LA
Max. stop torque	0.018 N m	0.035 N m
Rotor inertia moment	$2 \times 10^{-7} \text{ kg} \cdot \text{m}^2$	
Rated current	0.6 A / Phase	
Basic step angle	1.8° / 0.9° (Full / Half step)	
Resistance	6.6 Ω / Phase ±10%	10.5 Ω / Phase ±10%
Inductance	2.1 mH / Phase ±20%	4.0 mH / Phase ±20%
Unit weight (packaged)	≈ 0.092kg (≈ 0.192kg)	≈ 0.120kg (≈ 0.219kg)

Model	Ai-M-28SB	Ai-M-28MB	Ai-M-28LB
Max. stop torque	0.05 N m	0.14 N m	0.16 N m
Rotor inertia moment	$9 \times 10^{-7} \text{ kg} \cdot \text{m}^2$	$12 \times 10^{-7} \text{ kg} \cdot \text{m}^2$	$18 \times 10^{-7} \text{ kg} \cdot \text{m}^2$
Rated current	1.0 A / Phase		
Basic step angle	1.8° / 0.9° (Full / Half step)		
Resistance	5.78 Ω / Phase ±10%	8.8 Ω / Phase ±10%	10.1 Ω / Phase ±10%
Inductance	3.2 mH / Phase ±20%	6.0 mH / Phase ±20%	6.2 mH / Phase ±20%
Unit weight (packaged)	≈ 0.162 kg (≈ 0.260 kg)	≈ 0.222 kg (≈ 0.318 kg)	≈ 0.248 kg (≈ 0.342 kg)

Model	Ai-M-35SB	Ai-M-35MB	Ai-M-35LB
Max. stop torque	0.07 N m	0.13 N m	0.31 N m
Rotor inertia moment	$8 \times 10^{-7} \text{ kg} \cdot \text{m}^2$	$14 \times 10^{-7} \text{ kg} \cdot \text{m}^2$	$22 \times 10^{-7} \text{ kg} \cdot \text{m}^2$
Rated current	1.2 A / Phase		
Basic step angle	1.8° / 0.9° (Full / Half step)		
Resistance	2.1 Ω / Phase ±10%	3.25 Ω / Phase ±10%	5.0 Ω / Phase ±10%
Inductance	1.25 mH / Phase ±20%	2.85 mH / Phase ±20%	5.6 mH / Phase ±20%
Unit weight (packaged)	≈ 0.180 kg (≈ 0.278 kg)	≈ 0.250 kg (≈ 0.347 kg)	≈ 0.366 kg (≈ 0.456 kg)

Model	Ai-M-42SA-□	Ai-M-42MA-□	Ai-M-42LA-□
Max. stop torque	0.25 N m	0.4 N m	0.48 N m
Rotor inertia moment	$35 \times 10^{-7} \text{ kg} \cdot \text{m}^2$	$54 \times 10^{-7} \text{ kg} \cdot \text{m}^2$	$77 \times 10^{-7} \text{ kg} \cdot \text{m}^2$
Rated current	1.7 A / Phase		
Basic step angle	1.8° / 0.9° (Full / Half step)		
Resistance	1.7 Ω / Phase ±10%	1.85 Ω / Phase ±10%	2.1 Ω / Phase ±10%
Inductance	1.9 mH / Phase ±20%	3.5 mH / Phase ±20%	4.4 mH / Phase ±20%
Unit weight (packaged) <sup>01)</sup>	≈ 0.34 kg (≈ 0.45 kg) ≈ 0.67 kg (≈ 0.77 kg)	≈ 0.41 kg (≈ 0.52 kg) ≈ 0.73 kg (≈ 0.83 kg)	≈ 0.48 kg (≈ 0.59 kg) ≈ 0.80 kg (≈ 0.90 kg)

Model	Ai-M-56SA-□	Ai-M-56MA-□	Ai-M-56LA-□
Max. stop torque	0.6 N m	1.2 N m	2.0 N m
Rotor inertia moment	$140 \times 10^{-7} \text{ kg} \cdot \text{m}^2$	$280 \times 10^{-7} \text{ kg} \cdot \text{m}^2$	$480 \times 10^{-7} \text{ kg} \cdot \text{m}^2$
Rated current	3.5 A / Phase		
Basic step angle	1.8° / 0.9° (Full / Half step)		
Resistance	0.55 Ω / Phase ±10%	0.57 Ω / Phase ±10%	0.93 Ω / Phase ±10%
Inductance	1.05 mH / Phase ±20%	1.8 mH / Phase ±20%	3.7 mH / Phase ±20%
Unit weight (packaged) 01)	≈ 0.62 kg (≈ 0.76 kg) ≈ 1.15 kg (≈ 1.30 kg)	≈ 0.85 kg (≈ 0.99 kg) ≈ 1.38 kg (≈ 1.52 kg)	≈ 1.22 kg (≈ 1.36 kg) ≈ 1.75 kg (≈ 1.90 kg)

Model	Ai-M-60SA-□	Ai-M-60MA-□	Ai-M-60LA-□
Max. stop torque	1.1 N m	2.2 N m	2.9 N m
Rotor inertia moment	$240 \times 10^{-7} \text{ kg} \cdot \text{m}^2$	$490 \times 10^{-7} \text{ kg} \cdot \text{m}^2$	$690 \times 10^{-7} \text{ kg} \cdot \text{m}^2$
Rated current	3.5 A / Phase		
Basic step angle	1.8° / 0.9° (Full / Half step)		
Resistance	1.0 Ω / Phase ±10%	1.23 Ω / Phase ±10%	1.3 Ω / Phase ±10%
Inductance	1.5 mH / Phase ±20%	2.6 mH / Phase ±20%	3.8 mH / Phase ±20%
Unit weight (packaged) 01)	≈ 0.75 kg (≈ 0.89 kg) ≈ 1.36 kg (≈ 1.53 kg)	≈ 1.13 kg (≈ 1.27 kg) ≈ 1.74 kg (≈ 1.90 kg)	≈ 1.44 kg (≈ 1.58 kg) ≈ 2.07 kg (≈ 2.23 kg)

01) Listed in order of  $\begin{matrix} \text{Standard type} \\ \text{Built-in brake type} \end{matrix}$

## 2.2.2 Common Specifications

Motor phase	2-phase	
Run method	Bipolar	
Insulation class	B type (130 °C)	
Insulation resistance	Between Motor coil - Case: $\geq 100 \text{ M}\Omega$ (500 VDC= megger)	
Dielectric strength	Between Motor coil - Case: 500 VAC ~ 50/60 Hz for 1 min	
Vibration	1.5 mm double amplitude at frequency 10 to 55 Hz (for 1 min) in each X, Y, Z direction for 2 hours	
Shock	$\leq 50 \text{ G}$	
Ambient temp.	0 to 50 °C, Storage: -20 to 70 °C (rated at no freezing or condensation)	
Ambient humi.	20 to 85%RH, Storage: 15 to 90%RH (rated at no freezing or condensation)	
Protection rating	IP30 (IEC34-5 Specifications)	
Approval	CE ENEC	
Stop angle error	$\pm 0.09^\circ$ (Full step, No load)	
Shaft vibration	0.03 mm T.I.R.	
Radial Movement <sup>01)</sup>	□ 20 / 28 / 35 mm: $\leq 0.025 \text{ mm T.I.R.}$ (Load: 450 g)	□ 42 / 56 / 60 mm: $\leq 0.025 \text{ mm T.I.R.}$ (Load: 25 N)
Axial Movement <sup>02)</sup>	□ 20 / 28 / 35 mm: $\leq 0.005 \text{ mm T.I.R.}$ (Load: 920 g)	□ 42 / 56 / 60: $\leq 0.01 \text{ mm T.I.R.}$ (Load: 50 N)
Shaft concentricity	0.05 mm T.I.R.	
Shaft perpendicularity	0.075 mm T.I.R.	

01) Amount of radial shaft displacement when applying radial load to the end of the shaft.

02) Amount of axial shaft displacement when applying axial load to the motor shaft.

### 2.2.3 Encoder

Encoder type	Incremental rotary encoder		
Frame size	<input type="checkbox"/> 20 mm	<input type="checkbox"/> 28 mm / <input type="checkbox"/> 35 mm	<input type="checkbox"/> 42 mm / <input type="checkbox"/> 56 mm / <input type="checkbox"/> 60 mm
Power supply	5 VDC $\pm$ 5% (ripple P-P: $\leq$ 5%)		
Current consumption	$\leq$ 50 mA (No load)		
Resolution	4,000 PPR (1,000 PPR $\times$ 4)	16,000 PPR (4,000 PPR $\times$ 4)	10,000 PPR (2,500 PPR $\times$ 4)
Control output	Line driver output		
Output phase	A, $\bar{A}$ , B, $\bar{B}$ , Z, $\bar{Z}$		
Output waveform	Output Duty rate: $\frac{T}{2} \pm \frac{T}{3}$ , A-B phase difference: $\frac{T}{4} \pm \frac{T}{4}$ (T = 1 cycle of A)		Output Duty rate: $\frac{T}{2} \pm \frac{T}{4}$ , A-B phase difference: $\frac{T}{4} \pm \frac{T}{8}$ (T = 1 cycle of A)
Inflow current	$\leq$ 20 mA		
Residual voltage	$\leq$ 0.5 VDC $\pm$		
Outflow current	$\leq$ -20 mA		
Output voltage	$\geq$ 2.5 VDC $\pm$		
Response speed <sup>01)</sup>	$\leq$ 1.5 $\mu$ s	$\leq$ 1 $\mu$ s	$\leq$ 0.5 $\mu$ s
Max. response frequency	200 kHz	1,000 kHz	300 kHz

01) Cable length: 2 m, I sink = 20 mA

### 2.2.4 Brake

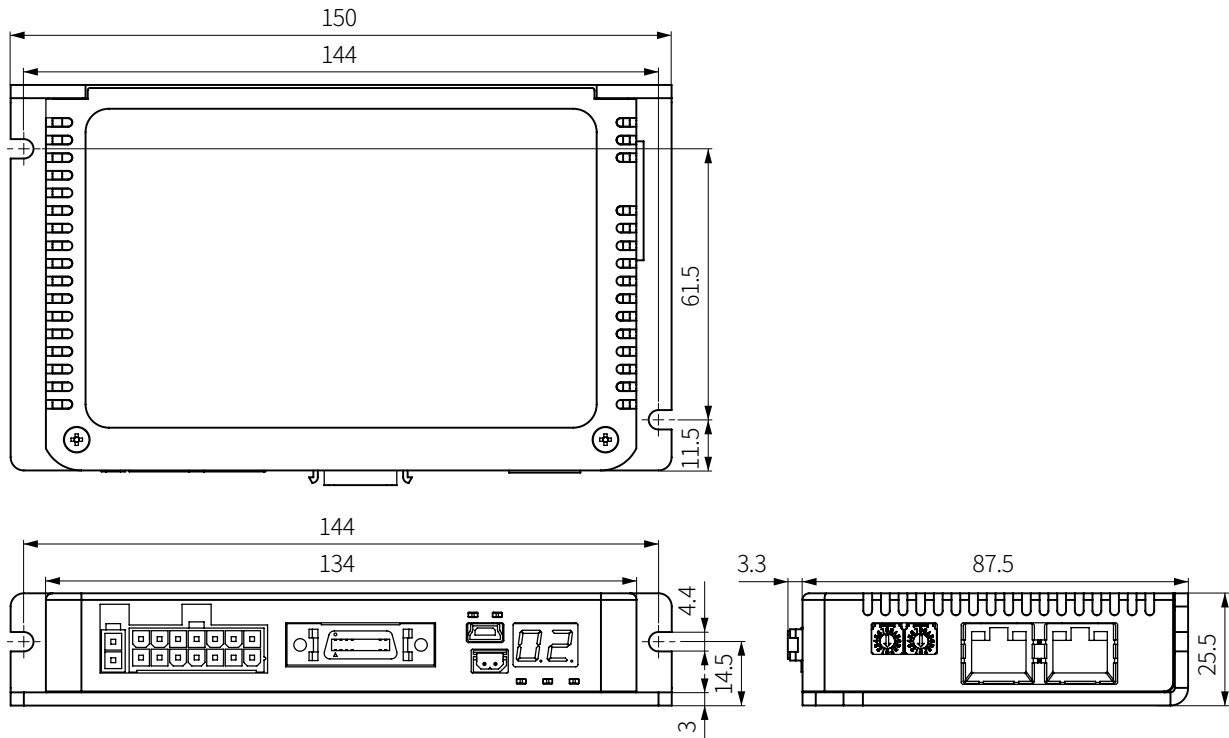
Frame size	<input type="checkbox"/> 42 mm	<input type="checkbox"/> 56 mm	<input type="checkbox"/> 60 mm
Rated excitation voltage <sup>01)</sup>	24 VDC $\pm$ 10%		
Rated excitation current	0.208 A	0.275 A	
Static friction torque	$\geq$ 0.18 N m	$\geq$ 0.8 N m	
Rotation part inertia moment	$6 \times 10^{-7}$ kg $\cdot$ m <sup>2</sup>	$19 \times 10^{-7}$ kg $\cdot$ m <sup>2</sup>	
Insulation class	B type (130 °C)		
B type brake	Brake is released when power ON, brake is locked when power OFF		
Operating time	$\leq$ 25 ms	$\leq$ 30 ms	
Releasing time	$\leq$ 10 ms	$\leq$ 20 ms	

01) In order to reduce the heat generation of the built-in brake, the voltage drops from 24 VDC $\pm$  to 11.5 VDC $\pm$  to control

### 3 Dimensions

#### 3.1 Driver

(unit: mm)

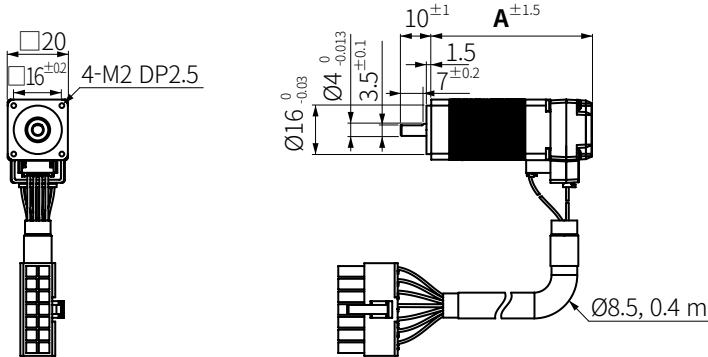
**Note**

Above images may differ from actual units.

### 3.2 Motor

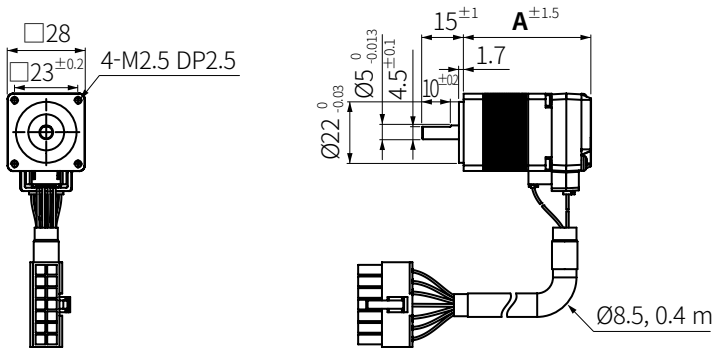
#### 3.2.1 Standard Type

##### (1) Ai-M-20□A



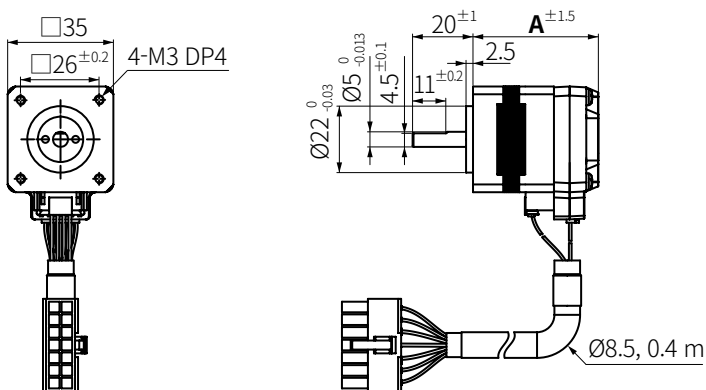
Axial length	S	M	L
A	-	41.2 mm	53.1 mm

##### (2) Ai-M-28□B



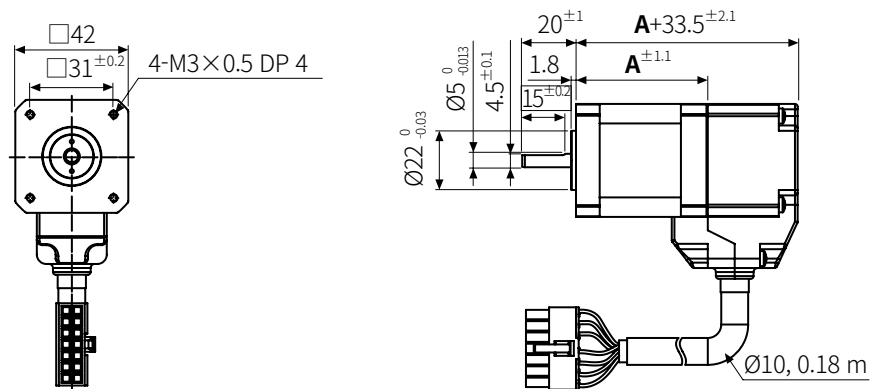
Axial length	S	M	L
A	46 mm	59 mm	65 mm

##### (3) Ai-M-35□B



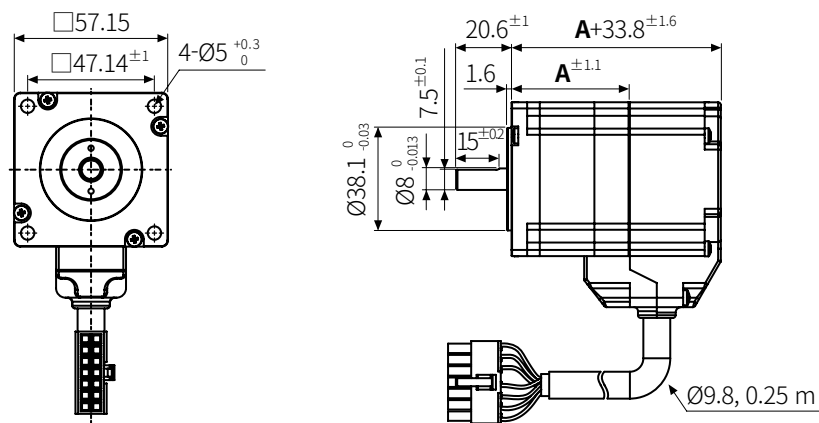
Axial length	S	M	L
A	41.5 mm	52 mm	68.5 mm

## (4) Ai-M-42□A



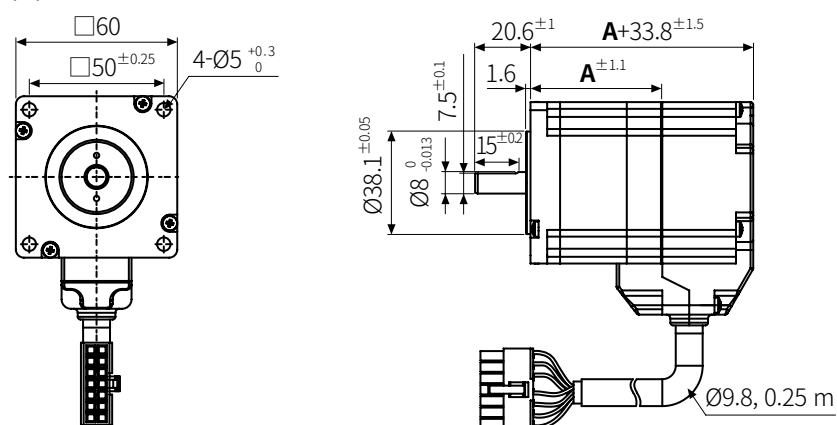
Axial length	S	M	L
A	34 mm	40 mm	48 mm

## (5) Ai-M-56□A



Axial length	S	M	L
A	43.4 mm	56.4 mm	77.4 mm

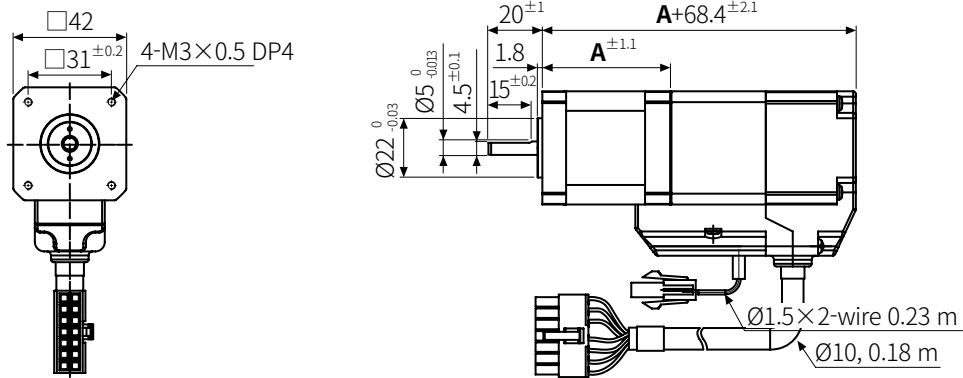
## (6) Ai-M-60□A



Axial length	S	M	L
A	48 mm	68.9 mm	85.9 mm

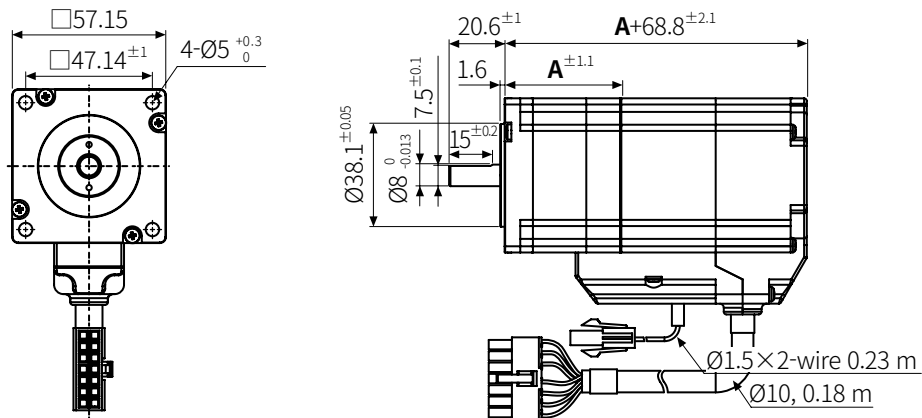
### 3.2.2 Built-in Brake type

#### (1) Ai-M-42□A-B



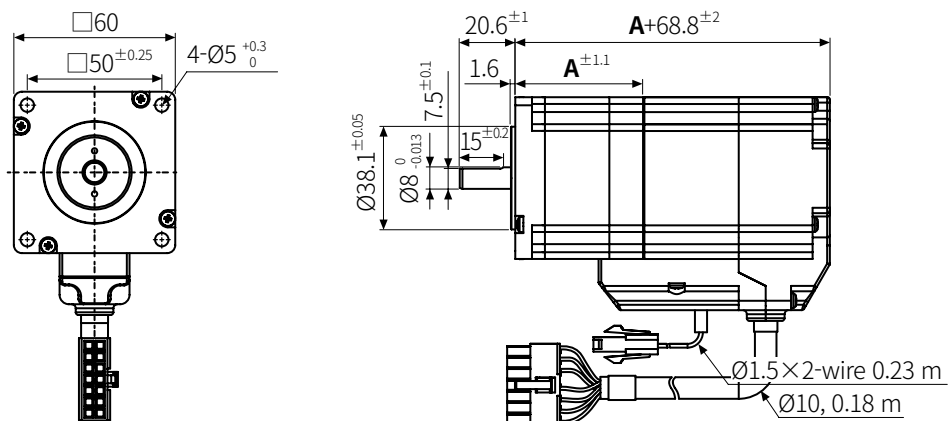
Axial length	S	M	L
A	34 mm	40 mm	48 mm

#### (2) Ai-M-56□A-B



Axial length	S	M	L
A	43.4 mm	56.4 mm	77.4 mm

#### (3) Ai-M-60□A-B



Axial length	S	M	L
A	48 mm	68.9 mm	85.9 mm



## 4 Installation of Motor

### 4.1 Cautions during Installation

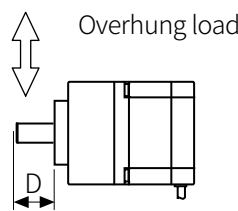
- Follow instructions in ‘Safety Considerations’ and ‘Cautions during Use’. Otherwise, it may cause unexpected accidents.
- Install the motor in a place that meets the certain conditions specified below. It may cause product damage if it is used out of following conditions.
  - Inside of the housing which is installed indoors  
(This unit is designed/manufactured for the purpose of attaching to equipment. Install a ventilation device.)
  - The place without contact with water, oil, or other liquid
  - The place without contact with strong alkali or acidity
  - The place with less electronic noise occurs by welding machine, motor, etc.
  - The place where no radioactive substances and magnetic fields exist. It shall be no vacuum status as well.
- Motor can be installed horizontally and vertically. Refer to allowable load in ‘4.2 Installation Direction of Motor’.
- If a force (30 N) exceeding the specification is applied to the motor cable during installation, it may cause the contact failure and disconnection.  
If the excessive force or frequent cable movement is required, establish safety measures before use.
- In consideration of heat dissipation and vibration prevention, mount the motor as tight as possible against a metal panel with high thermal conductivity such as iron or aluminum.

### 4.2 Installation Direction of Motor

Motor can be installed in any directions-facing up, facing down and side ways. No matter which direction motors to be mounted. Be sure not to apply overhung or thrust load on the shaft.

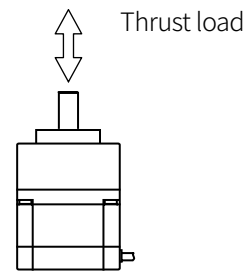
Refer to the table below for allowable shaft overhung load / thrust load.

**Horizontal Installation**



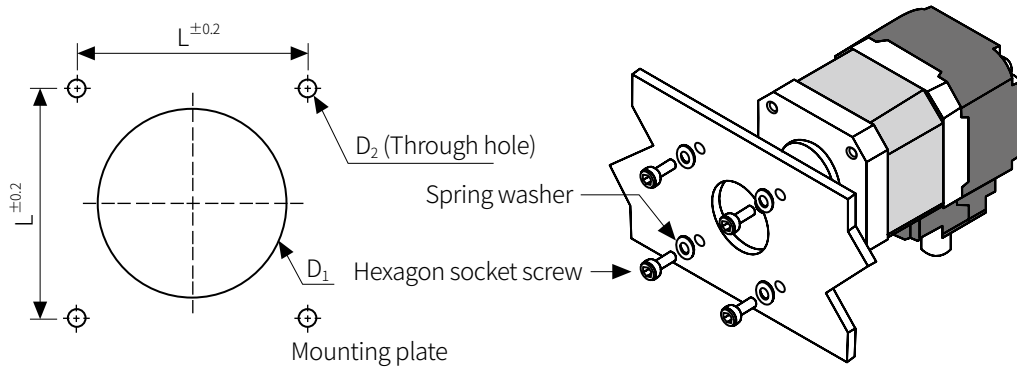
• D: The distance from the shaft in front end (mm)

**Vertical Installation**

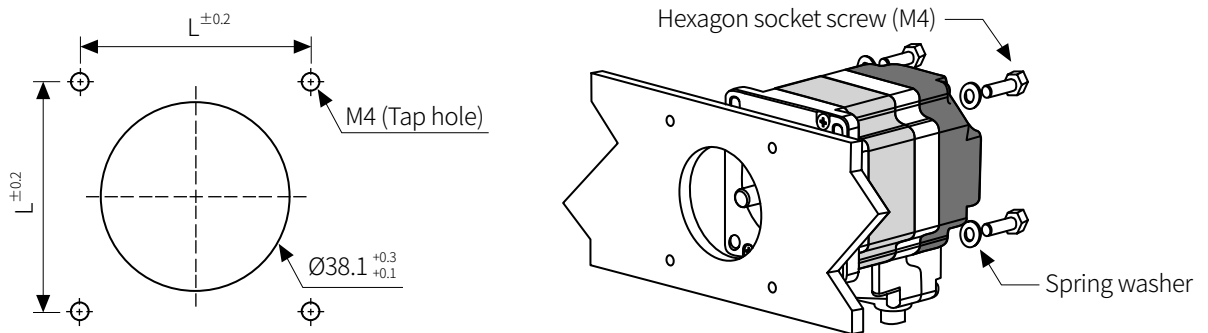
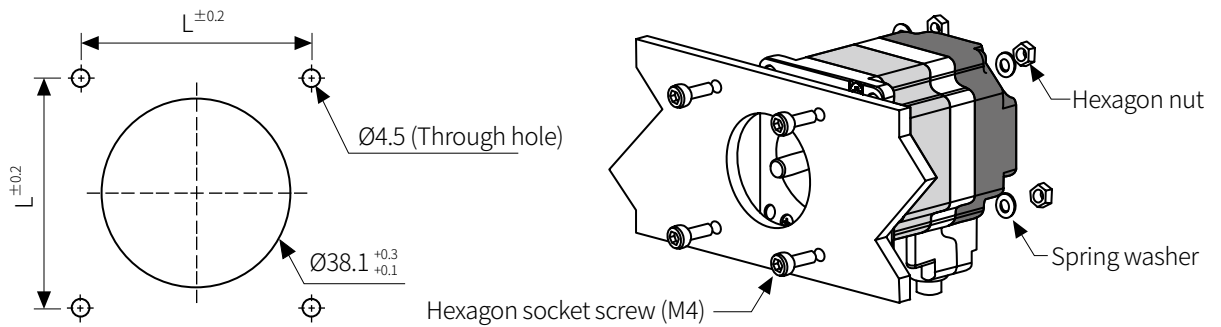


Frame size	Horizontal installation: Overhung allowable load[N]				Vertical installation: Thrust allowable load [N]
	D = 0	D = 5	D = 10	D = 15	
□ 20 mm	12	15	-	-	Under load of motor
□ 28 mm	25	34	52	-	
□ 35 mm	20	25	34	52	
□ 42 mm	20	25	34	52	
□ 56 mm / □ 60 mm	54	67	89	130	

### 4.3 Panel Cut-out Dimensions



Frame size	Mounting plate thickness	Applied bolt	L	D <sub>1</sub>	D <sub>2</sub>
□ 20 mm	≥ 3 mm	M2	16 <sup>±0.2</sup>	Ø16 <sup>+0.21</sup> <sub>0</sub>	4-Ø2.3
□ 28 mm	≥ 4 mm	M2.5	23 <sup>±0.2</sup>	Ø22 <sup>+0.3</sup> <sub>+0.1</sub>	4-Ø2.8
□ 35 mm	≥ 4 mm	M3	26 <sup>±0.2</sup>	Ø22 <sup>+0.3</sup> <sub>+0.1</sub>	4-Ø3.3
□ 42 mm	≥ 4 mm	M3	31 <sup>±0.2</sup>	Ø22 <sup>+0.3</sup> <sub>+0.1</sub>	Ø3.5



Frame size	Mounting plate thickness	Applied bolt	L
□ 56 mm	≥ 5 mm	M4	47.14 <sup>±0.2</sup>
□ 60 mm			50 <sup>±0.2</sup>

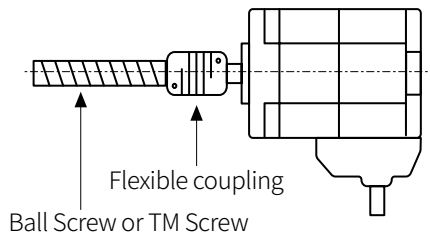
**Note**

With considering heat radiation and vibration isolation, mount the motor as tight as possible against a metal panel having high thermal conductivity such as iron or aluminum.  
 When mounting motors, use hexagon socket screws, spring washers and flat washers.  
 Do not draw the wire with over strength 30N after wiring the encoder.

## 4.4 Cautions during Connection with Load

- Do not disassemble or modify the motor shaft to connect with the load.
- Tighten the screw not to be unscrewed when connecting with load.
- Refer to allowable load in '4.2 Installation Direction of Motor' and take care of potential shock when connecting with load.
- Connect the motor shaft and the load shaft to be parallel.
- If the center with the load is not aligned with the shaft, it may cause unexpected accidents such as severe vibration, shorten life cycle of the shaft bearing and shaft damage.
- When attaching coupling or pulley with motor shaft, be aware of damage on motor shaft and shaft bearing.

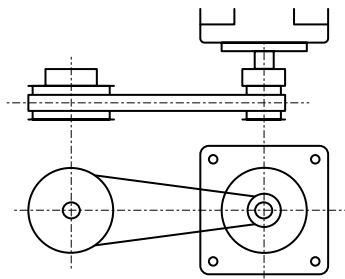
### (1) Direct Load Connection with Coupling



When connecting a load such as Ball screw or Tm screw directly to the shaft of the motor, use flexible coupling as image showing above.

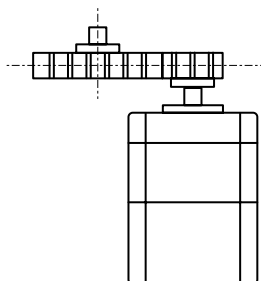
If the center of the load and the shaft is not aligned, it may cause severe vibration, damage on shaft or shortened life cycle of bearings.

### (2) Load Connection with Pulley, Belt, and Wire



The motor shaft and the load shaft should be parallel. Connect the motor shaft and the line which connects the center of two pulleys to a right angle.

### (3) Load Connection with Gear



The motor shaft and the load shaft should be parallel. Connect the motor shaft to the center of gear teeth side to be interlocked.

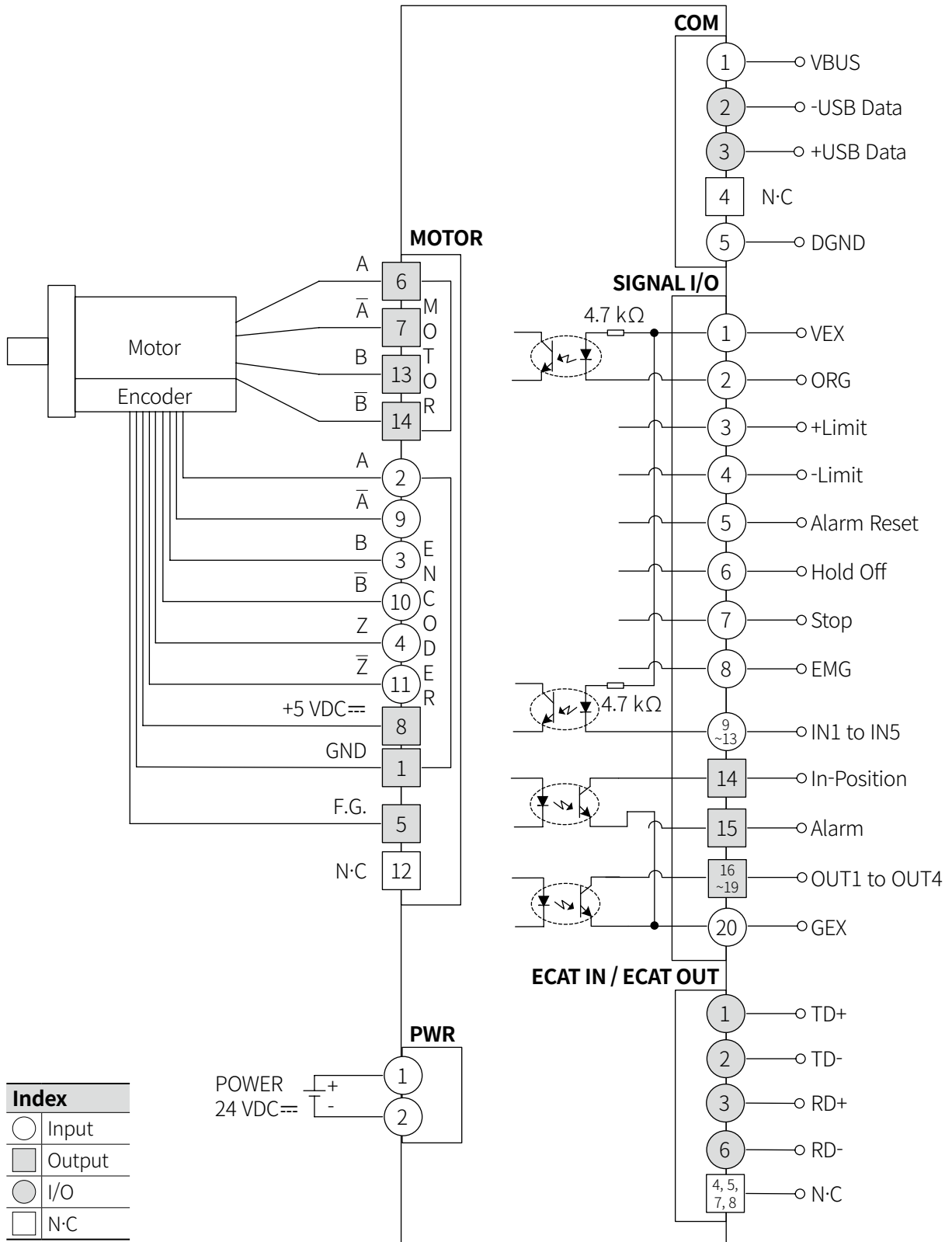
## 4.5 Installation Conditions

Install the motor in a place that meets certain conditions specified below.  
It may cause product damage if instructions are not following.

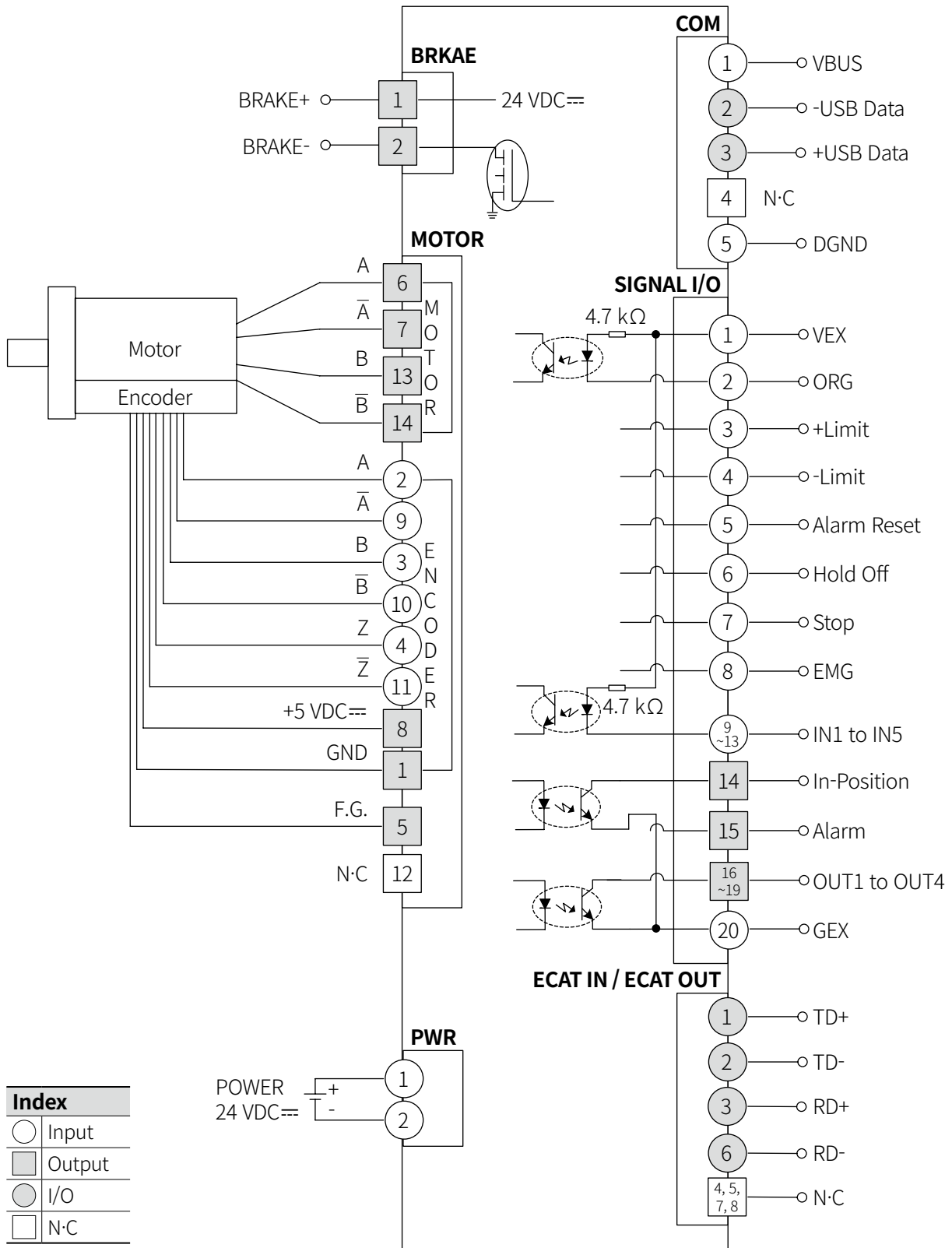
- The inner housing installed indoor (This unit is manufactured and designed for attaching to equipment. Install a ventilation device.)
- Within 0 to 50°C (at non-freezing status) of ambient temperature
- Within 20 to 85%RH (at non-dew status) of ambient humidity
- The place without explosive, flammable and corrosive gas
- The place without direct ray of light
- The place where dust or metal scrap does not enter into the unit
- The place without contact with water, oil, or other liquid
- The place without contact with strong alkali or acid material
- The place where easy heat dissipation could be made
- The place where no continuous vibration or severe shock
- The place with less salt content
- The place with less electronic noise occurs by welding machine, motor, etc.
- The place where radioactive substances and magnetic fields does not exist and is not in the vacuum status

# 5 Connection

## 5.1 Standard Type



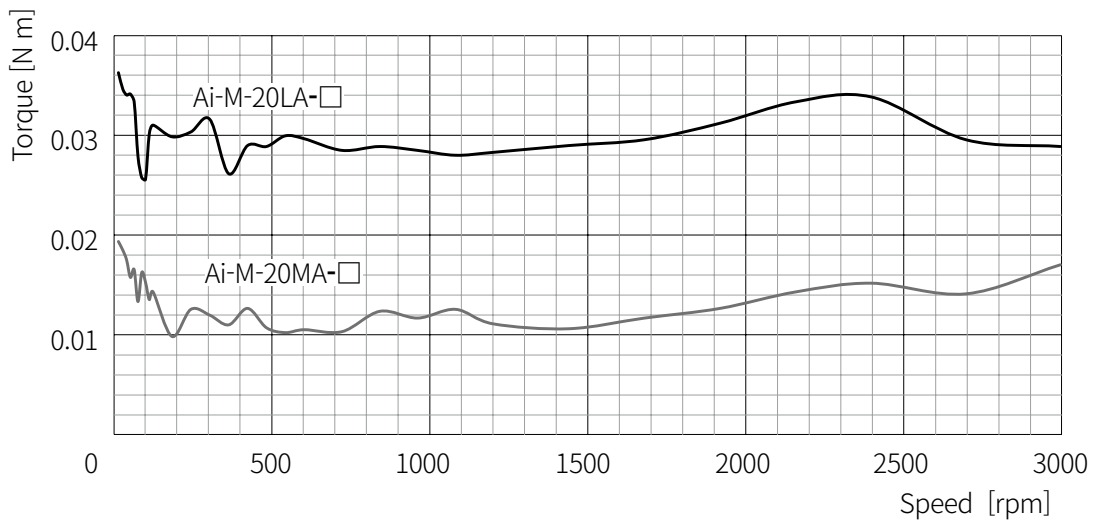
## 5.2 Built-in Brake Type



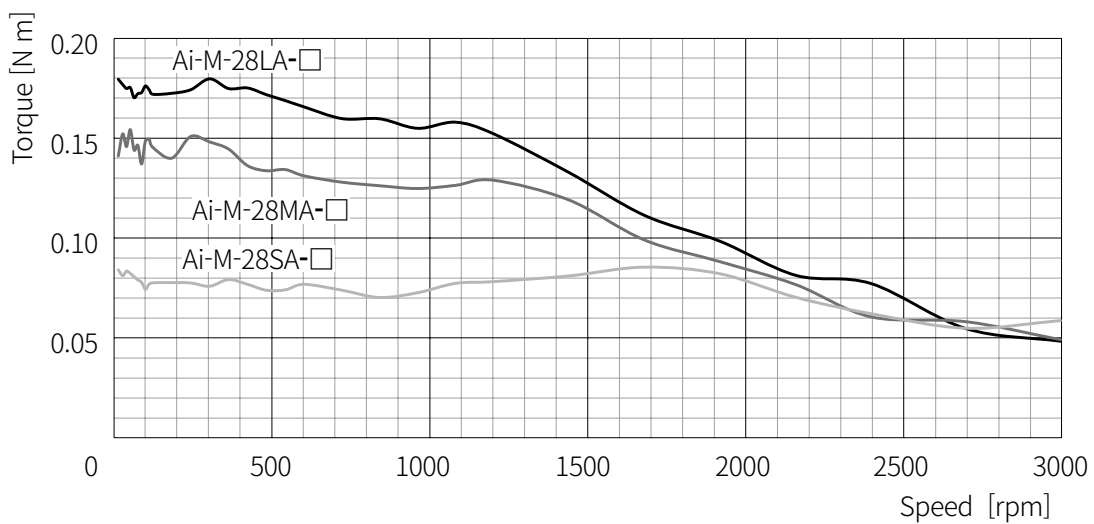
Index	
○	Input
◻	Output
●	I/O
□	N-C

## 6 Motor Characteristic

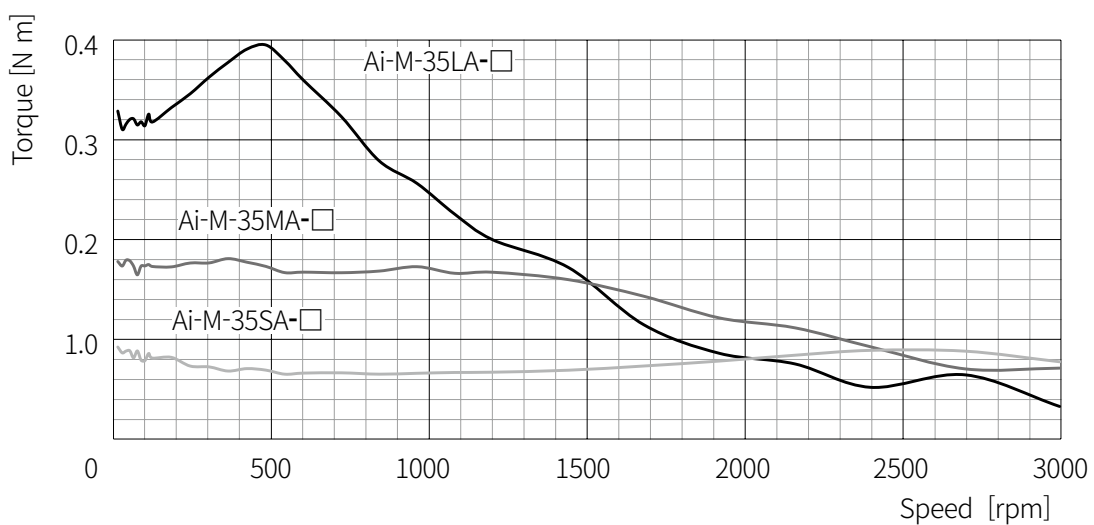
### (1) Ai-M-20 □ A



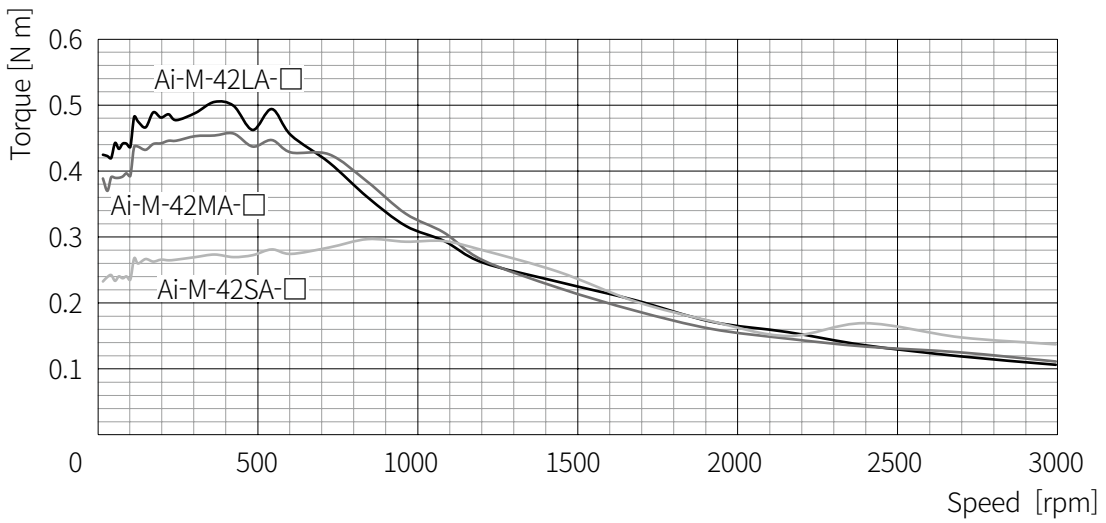
### (2) Ai-M-28 □ B



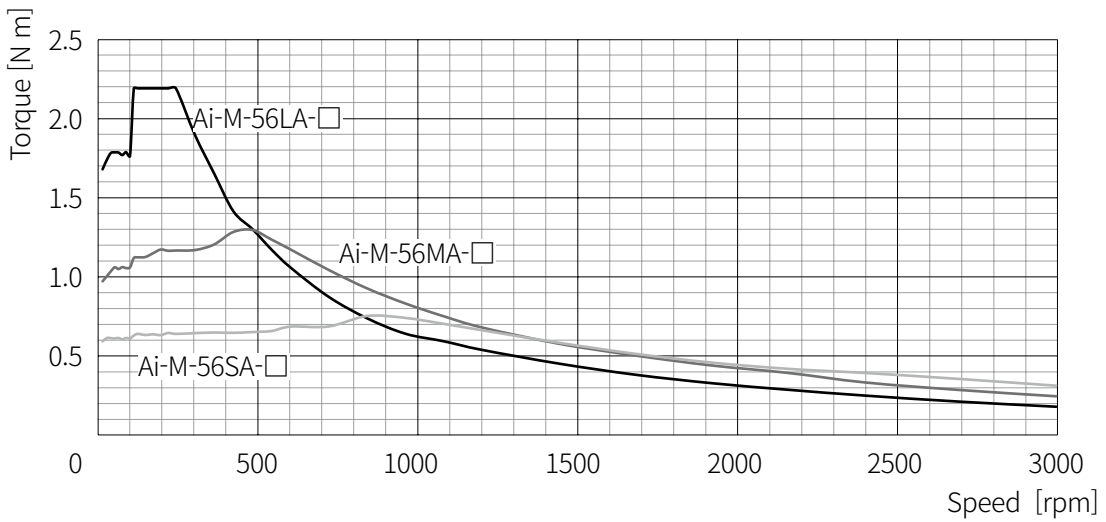
### (3) Ai-M-35 □ B



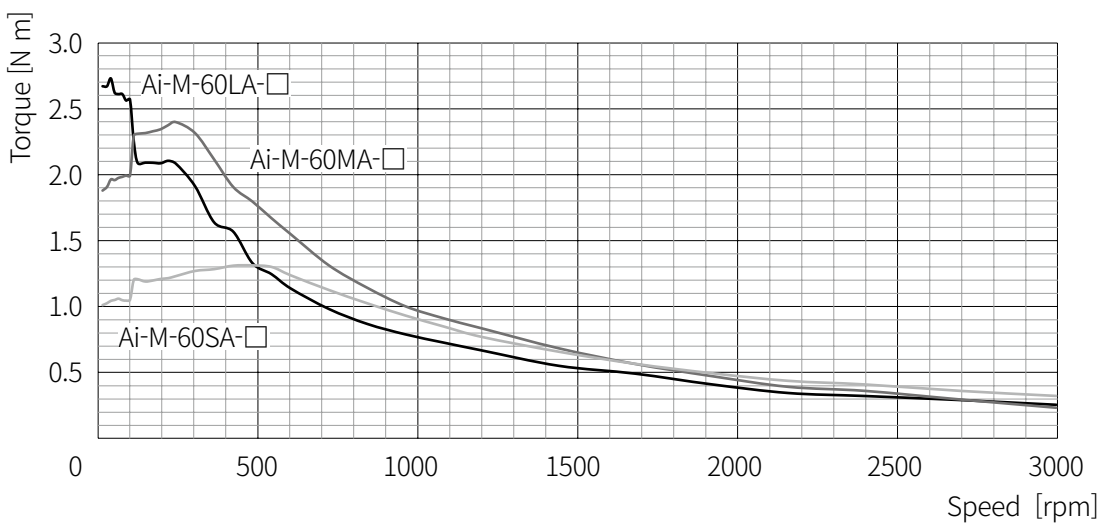
**(4) Ai-M-42□A-□**



**(5) Ai-M-56□A-□**

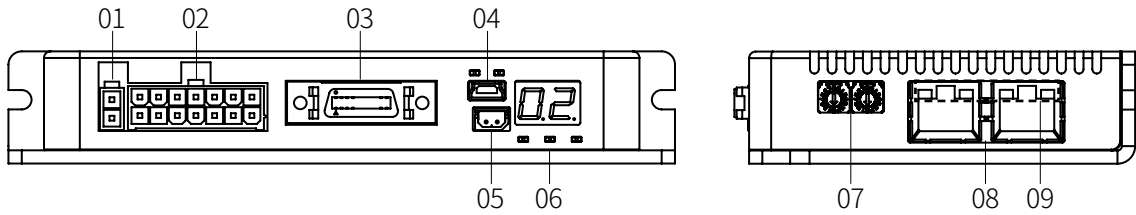


**(6) Ai-M-60□A-□**





# 7 Driver Unit Descriptions



- 01) Power connector
- 02) Motor + Encoder connector
- 03) I/O connector
- 04) USB connector
- 05) Brake connector (AiC-D-B-EC Series)
- 06) Status display part
- 07) Comm. ID setting rotary switch
- 08) EtherCAT comm. connector
- 09) EtherCAT comm. indicator

## 7.1 Connector Specifications

### 7.1.1 Suitable Specifications

The following connectors can be used with equivalent or substitute.

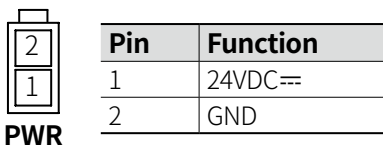
EtherCAT dedicated cable must be used and the performance can not be guaranteed when using other cables.

Type	Connector specifications	Manufacture
Power connector (PWR)	CHD1140-02, connector terminal: CTD1140	HANLIM
Motor + Encoder connector (MOTOR)	5557-14R, connector terminal: <input type="checkbox"/> 20 / 28 / 35 mm: 5556T2 <input type="checkbox"/> 42 / 56 / 60 mm: 5556T	MOLEX
Brake connector (BRAKE)	5264-02, connector terminal: 5263PBT	MOLEX
USB connector (COM)	USB connector	-
I/O connector (SIGNAL I/O)	10120-3000PE, Housing: 10320-52F0-008	3M
EtherCAT comm. connector (ECAT)	RJ45 connector	-

### 7.1.2 Power Connector (PWR)

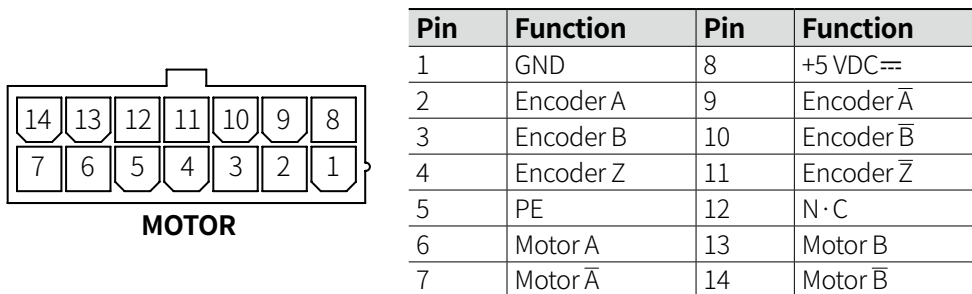
Connects with 24 VDC power. Be sure to the polarity to correct connection.

When polarity direction is reversed, power is not turned on.



### 7.1.3 Motor + Encoder Connector (MOTOR)

Connects the motor and the encoder to the driver.

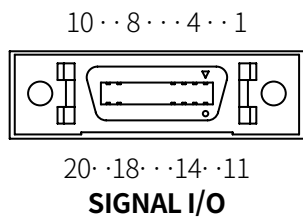


### 7.1.4 I/O Connector (SIGNAL I/O)

Filter: Software input filter is able to set 0 ms, 10 ms or 1.5 ms of 'Input Filter' parameter.

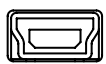
But, "ORG", "±Limit" do not have filters.

When input is ON longer than set time, it recognize as proper signal input.



Pin	Function	I/O	Filter (ms)	Descriptions
1	VEX	-	-	External input power (24 VDC $\equiv$ )
2	ORG	Input	None	Home sensor
3	+Limit	Input	None	+ direction limit sensor
4	-Limit	Input	None	- direction limit sensor
5	Alarm Reset	Input	None /1.5 / 10	Alarm reset
6	Hold Off	Input	None /1.5 / 10	Servo ON/OFF
7	Stop	Input	None /1.5 / 10	Stop
8	EMG	Input	None /1.5 / 10	Emergency stop
9	IN1	Input	None /1.5 / 10	General input 1
10	IN2	Input	None /1.5 / 10	General input 2
11	IN3	Input	None /1.5 / 10	General input 3
12	IN4	Input	None /1.5 / 10	General input 4
13	IN5	Input	None /1.5 / 10	General input 5
14	In-Position	Output	-	In-Position
15	Alarm	Output	-	Alarm
16	OUT1	Output	-	General output 1
17	OUT2	Output	-	General output 2
18	OUT3	Output	-	General output 3
19	OUT4	Output	-	General output 4
20	GEX	-	-	External input ground (0 V)

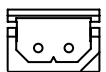
### 7.1.5 USB Connector (COM)



1...5  
COM

Pin	Function	Pin	Function
1	V BUS	4	N·C
2	Data -	5	GND
3	Data +	-	

### 7.1.6 Brake Connector (BRAKE)



2 1  
BRAKE

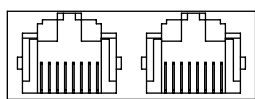
Pin	Function
1	GND
2	24VDC $\equiv$



#### Note

The corresponding connector is only available in built-in brake type.

### 7.1.7 EtherCAT Comm. Connector (ECAT IN / ECAT OUT)

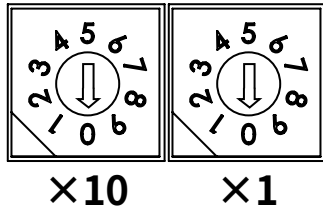


8...1 8...1  
ECAT IN ECAT OUT

Pin	Function	Pin	Function
1	TD+	5	N·C
2	TD-	6	RD-
3	RD+	7	N·C
4	N·C	8	N·C

## 7.2 Switch Specifications

### 7.2.1 Communication ID setting rotary switch



Setting	Comm. ID (×10)	Comm. ID (×1)
0	0×10	0
1	1×10	1
2	2×10	2
3	3×10	3
4	4×10	4
5	5×10	5
6	6×10	6
7	7×10	7
8	8×10	8
9	9×10	9

## 7.3 Driver Status Indicator

Indicator	Color	Descriptions
Alarm / Warning status display part (7-segment)	Red	Displays EtherCAT ID Displays the corresponding number, operation when alarm / warning occurs
Servo ON / OFF indicator (SERVO)	Orange	Turns ON when servo is ON, Turns OFF when servo is OFF
In-Position indicator (INP)	Yellow	Turns ON when motor is placed at command position after positioning input
Power / Alarm indicator (PWR/AL)	Green	Turns ON when the unit operates in normal after power is applied Flashes depending on the warning type
	Red	Flashes depending on the alarm type
EtherCAT comm. status indicator (RUN / ERR)	Green	Turns ON depending on communication normal status (RUN)
	Red	Turns ON depending on communication fail status (ERR)
EtherCAT comm. indicator	Green	Turns ON or flashes depending on connection status

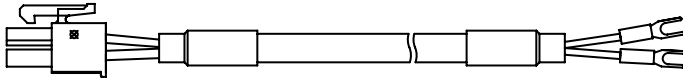


#### Note

For more information of EtherCAT comm. indicator, refer to '11.1.2 Operation Indicator'.

## 7.4 Sold Separately

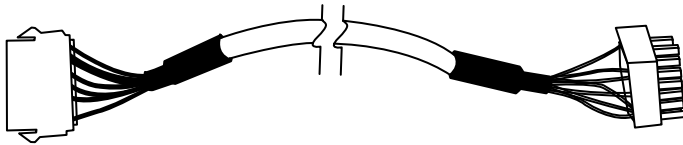
### 7.4.1 Power Cable (CJ-PW-□)



#### Note

Recommended to use ferrite core at both ends of the cable.  
The model name is 010, 020 which indicates the cable length.  
E.g.) CJ-PW-010: 1m power cable

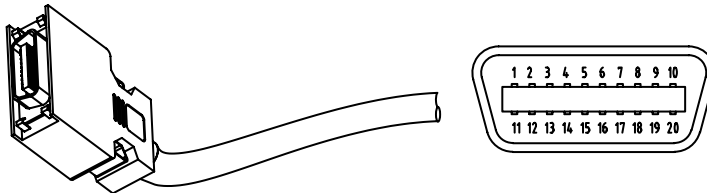
### 7.4.2 Motor + Encoder Cable (fixed type: C1D14M(B)-□, flexible type: C1DF14M(B)-□)



#### Note

Recommended to use ferrite core at both ends of the cable.  
The model name is 1, 2, 3, 5, 7, 10, 15, 20 which indicates the cable length.  
E.g.) C1DF14M-10: 10 m flexible type Motor + Encoder cable  
For built-in brake type, use dedicated cable.  
(fixed type: C1D14MB-□, flexible type: C1DF14MB-□)

### 7.4.3 I/O Cable (CO20-MP□-R, specifications: AiC-EC TAG)



Pin	Function (Name TAG)	Cable color	Dot line color-number	Pin	Function (Name TAG)	Cable color	Dot line color-number
1	VEX	Yellow	Black-1	11	IN3	White	Black-1
2	ORG		Red-1	12	IN4		Red-1
3	+Limit		Black-2	13	IN5		Black-2
4	-Limit		Red-2	14	In-Position		Red-2
5	Alarm Reset		Black-3	15	Alarm		Black-3
6	Hold Off		Red-3	16	OUT1		Red-3
7	Stop		Black-4	17	OUT2		Black-4
8	EMG		Red-4	18	OUT3		Red-4
9	IN1		Black-5	19	OUT4		Black-5
10	IN2		Red-5	20	GEX		Red-5



#### Note

Recommended to use ferrite core at both ends of the cable.  
The model name is 010, 020, 030, 050, 070, 100, 150, 200 which indicates the cable length.  
E.g.) CO20-MP070-R: 7m I/O cable

## 8 Control I/O

Inner signal of all input/output consists of photocoupler.

ON, [H]: photocoupler power ON

OFF, [L]: photocoupler power OFF

### 8.1 Input

#### 8.1.1 Input Signal

Pin	Signal	Descriptions
2	ORG	Home sensor
3	+Limit	+ direction limit sensor
4	-Limit	- direction limit sensor
5	Alarm Reset	Alarm reset
6	Hold Off	Servo ON/OFF
7	Stop	Stop
8	EMG	Emergency stop
9	IN1	General input 1
10	IN2	General input 2
11	IN3	General input 3
12	IN4	General input 4
13	IN5	General input 5

##### 8.1.1.1 ORG

It is used to assign home against object while home search mode.

##### 8.1.1.2 ±Limit

It is used to limit the range of moving range of each axis, and to prevent mechanical collisions. It recognizes as  $\pm$  Hardware Limit input and stops immediately.

##### 8.1.1.3 Alarm Reset

It is used to reset alarm when alarm occurs.

In case of the alarm cause is not removed, the driver does not return to normal state even if Alarm Reset is activated.

When input over designated input filter value, it recognizes and operates properly.

##### 8.1.1.4 Hold Off

It is used to adjust motor shaft position with external force manually.

When Hold Off signal is remained [H] over designated input filter value.

: It recognizes as Servo OFF signal, the motor phase current is blocked and torque is released. Servo ON/OFF indicator, In-Position and its indicator turns OFF.

When Hold Off signal is remained [L] over designated input filter value.

: It recognizes as Servo ON signal, the motor phase current is applied and torque is returned. Servo ON/OFF indicator, In-Position and its indicator turns ON.

Make sure to use this while the motor is stopped. It may cause safety risk while the motor is driving.

**8.1.1.5 Stop**

When input over designated input filter value, it stops according to Quickstop Option Code [605Ah].

**8.1.1.6 EMG**

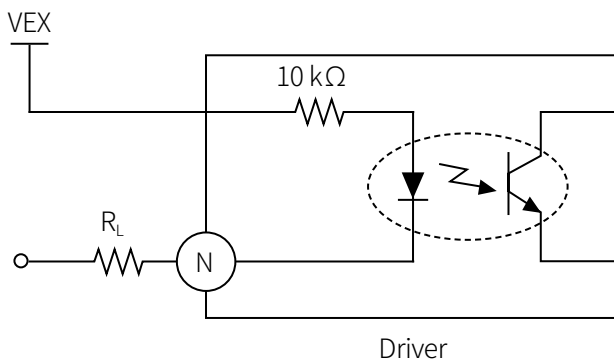
It is used to emergency stop.

When input over designated input filter value, the motor stops immediately and emergency stop alarm occurs.

The motor current is not blocked and the function is not available while the motor stopped.

**8.1.1.7 General Input**

It is used to general use and functions can be assigned to each pin.

**8.1.2 Example of Input Circuit Connection**

N: input pin number

It is recommended to use 24 VDC in VEX and in this case short  $R_L$  to use.

In case of using external power over 24 VDC, select  $R_L$  that  $I_F$  (forward current of primary LED) of photocopler to be around 2.5 mA (max. 10 mA).

$$R_L = \frac{VEX - 1.25 V}{0.0025 A} - 10 \times 10^3 \Omega$$

## 8.2 Output

### 8.2.1 Output Signal

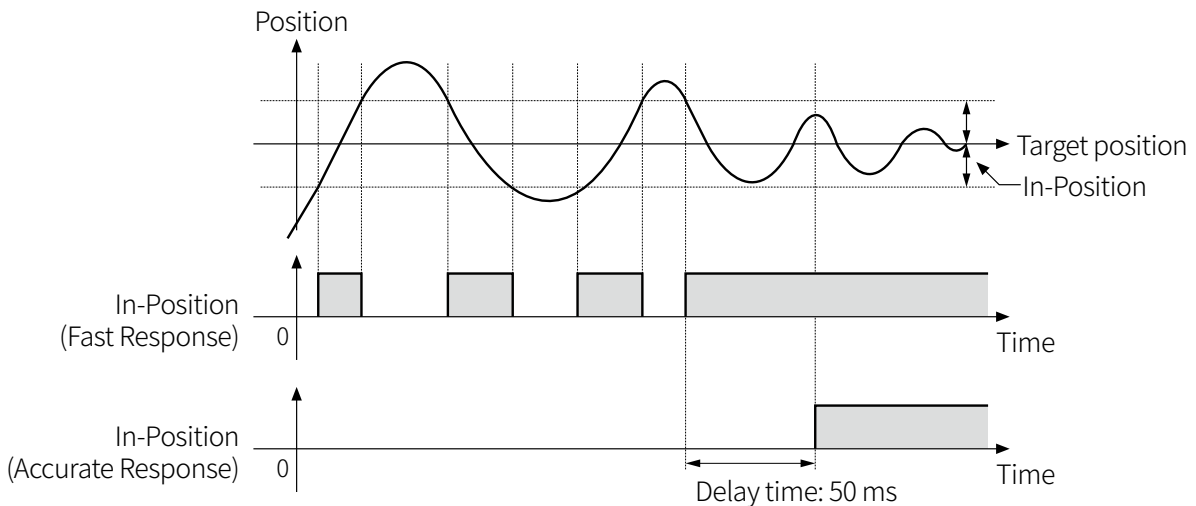
Pin	Signal	Descriptions
14	In-Position	In-Position output
15	Alarm	Alarm output
16	OUT1	General output 1
17	OUT2	General output 2
18	OUT3	General output 3
19	OUT4	General output 4

#### 8.2.1.1 In-Position

It is used to indicate the output condition of the positioning complete signal.

In case of the deviation between motor current position and target position is less than In-Position setting value, In-Position outputs [H] and In-Position indicator turns ON.

In opposite case, In-Position outputs [L] and In-Position turns OFF.



Fast Response		Accurate Response	
Setting	Value	Setting	Value
0 (factory default)	0	0	0
1	±1	1	±1
2	±2	2	±2
3	±3	3	±3
4	±4	4	±4
5	±5	5	±5
6	±6	6	±6
7	±7	7	±7



**Note**

For more accurate control, follow this operation after check In-Position output.

- Fast Response: when the deviation between target position and current position is less than setting value, outputs In-Position immediately.
- Accurate Response: when the deviation between target position and current position is less than setting value and remains over 50 ms, outputs In-Position.

### 8.2.1.2 Alarm

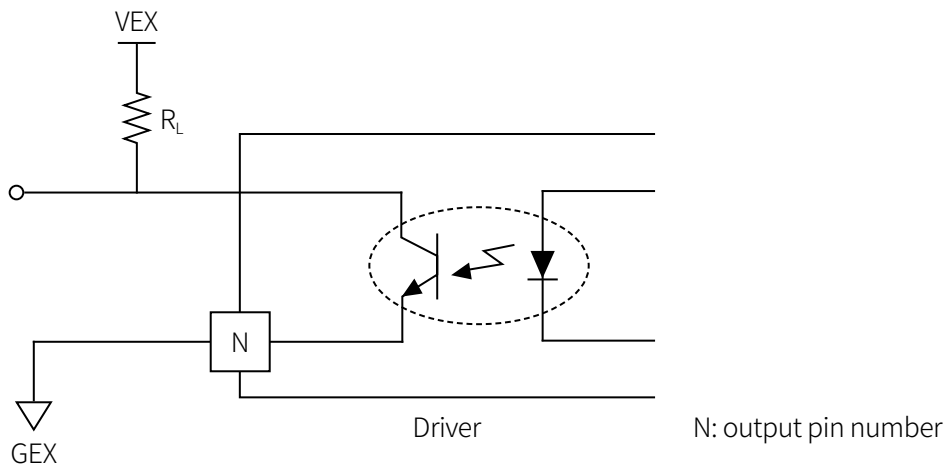
In normal state, output is ON and when alarm occurs, phase current is blocked and output is OFF. Depending on the alarm / warning type, it displays on the alarm / warning display part and the alarm indicator flashes.

The indicator flashes with interval of 400 ms until alarm / warning is cleared.

### 8.2.1.3 General Output

It is used to general use and functions can be assigned to each pin.

## 8.2.2 Example of Output Circuit Connection



External power input over 5-50 VDC is available with open collector method.

Select  $R_L$  that  $I_c$  (collector current of secondary LED) of photo-coupler to be around 10 mA.

$$R_L = \frac{VEX - 0.7V}{0.01A} \Omega$$



## 9 Electromagnetic Brake

Electromagnetic brake is a device that helps maintaining the position of load in the situation of power failure or alarm occur in vertical load.



### Caution

- Electromagnetic brake does not made for maintaining load completely. Do not use as safe brake.
- Do not use electromagnetic brake as brake stop. Brake power will be reduced due to worn out.
- Make sure to use the exclusive power for electromagnetic brake.
- In case of using auxiliary power supply for electromagnetic brake, do not mix the power with the power supply for I/O signals.  
Failure to follow this instruction may result in electromagnetic brake damage or malfunction due to outer disturbance.

### 9.1 Brake Connection

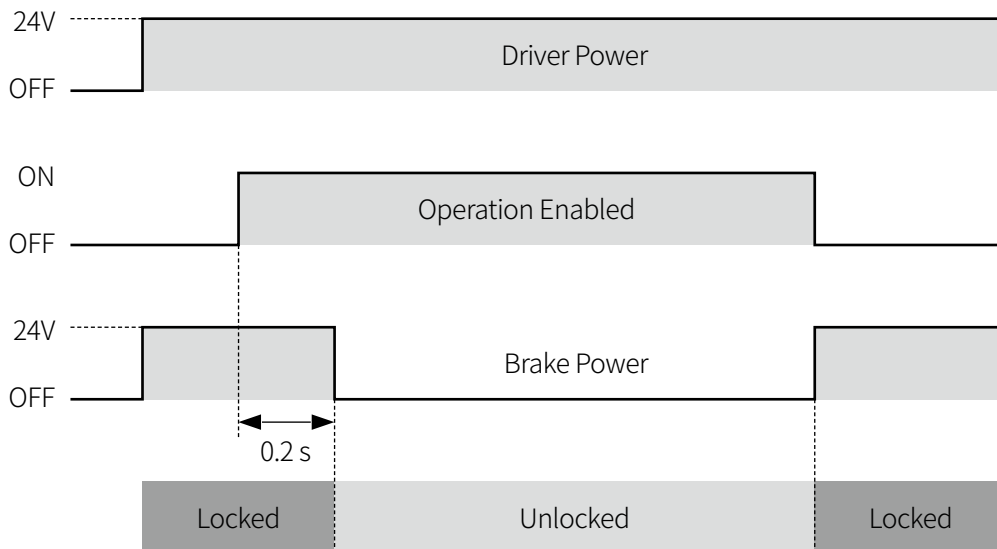
Connect the driver brake connector to motor brake connector.

Brake is non-polar, when connecting the brake, use AWG22 cable or over for connection.

### 9.2 Brake Operation

After connecting the driver with brake, the brake remains locked even though power is applied to the driver.

After connecting communication, when driver status is 'operation enabled', the brake releases by applying rated voltage 24 VDC to the brake, and controls to remain the brake lock released after 0.2 sec.



### Note

Make sure to ventilate or cool the brake so that the temperature remains below 100 °C.

## 10 USB Communication

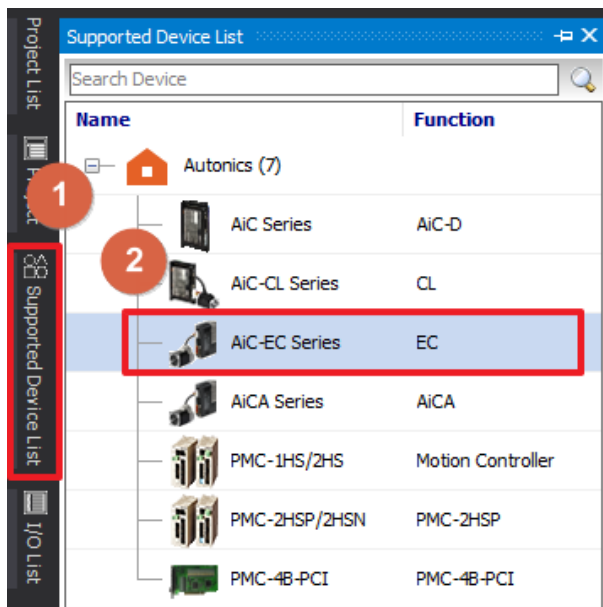
It performs functions such as setting/changing, input/output and status monitoring, parameter storage and trial operation between PC and driver through USB connection.

### Caution

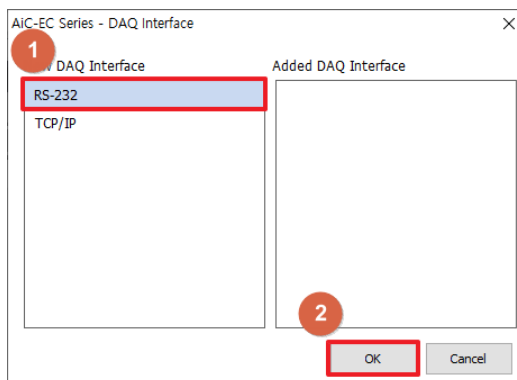
- As a function for trial operation, do not use for other purpose.
- If EtherCAT comm. connector is connected, USB comm. is not available.
- In case of using USB comm. after EtherCAT comm., disconnect EtherCAT comm. connector and re-apply power before use.

### 10.1 atMotion Connection

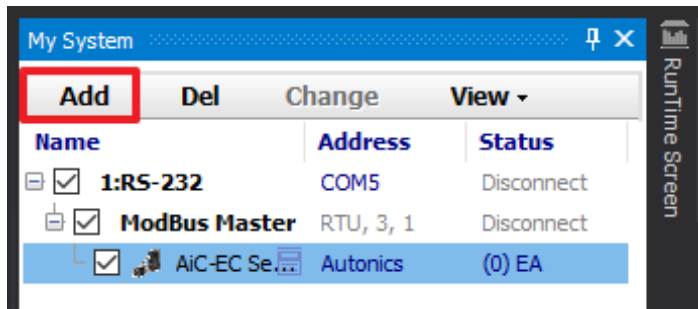
- 01) Visit Autonics website ([www.autonics.com](http://www.autonics.com)) to download newest version of 'atMotion'.
- 02) Run 'atMotion' installed on PC.
- 03) On the left side, select ① 'Supported Device List' - ② 'AiC-EC Series'.



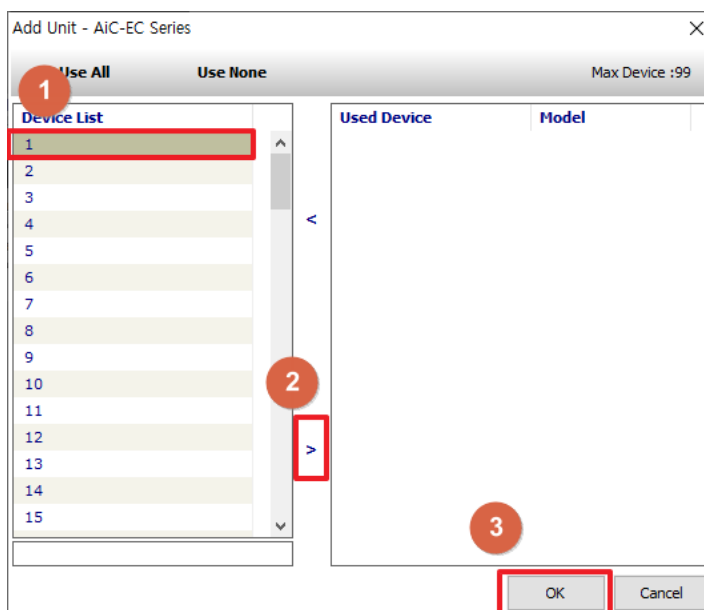
- 04) Set communication method as 'RS-232' at New DAQ interface.



- 05) Click 'Add' button on 'My System' after select the device.



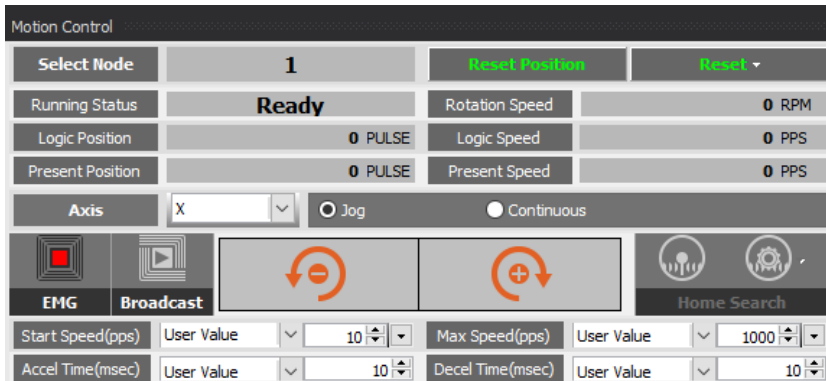
- 06) When 'Add Unit' window shows, double click ① 'Device List' or click ② arrows in the middle to create node number then select ③ 'OK'.



- 07) On the right side, select 'RS-232' and set the baud rate.  
 08) Click 'Connect' on the top of the screen to connect the device.  
 09) To make sure the connection is connected properly, check the device node on the right side of screen.

## 10.2 atMotion Control Method

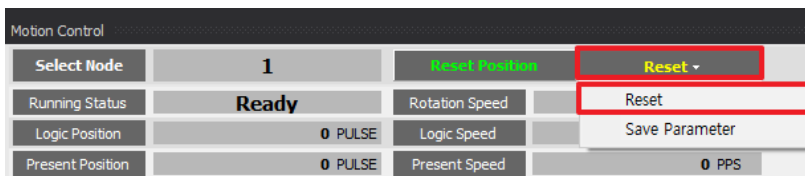
### 10.2.1 Motor Control Method



Set the parameter start speed (pps), max. speed (pps), acceleration time (ms), deceleration time (ms) for trial operation.

Select between Jog and Continuous, operate the driver in CW direction or CCW direction.

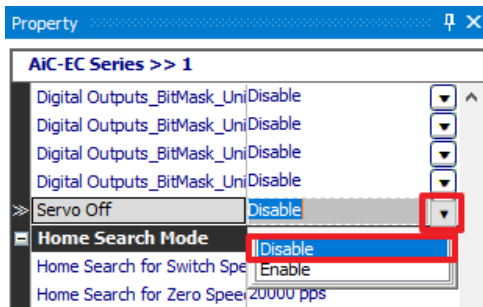
### 10.2.2 Alarm Reset Method



Initialize the alarm by selecting 'Reset' when alarm occurs.

When resetting alarm, set the driver Servo OFF and Servo ON again.

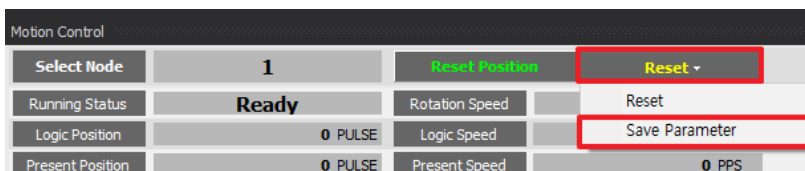
### 10.2.3 Servo ON Setting Method



Disable 'Servo OFF' parameter to Servo ON on property tab.

Conversely, it is able to set Servo OFF by setting as enable.

### 10.2.4 Parameter Save Method



When saving parameters, click 'Save Parameter'.

If the object is saved when the power is applied, save the parameters and re-apply the power.

Save object will be saved in a batch.



**Note**

For more information, refer to 'atMotion user manual'.

## 10.3 Parameter Setting

### 10.3.1 Operation & I/O Active Level Setting

Index	Sub	Parameter	Index	Sub	Parameter
2001h	0h	Limit Stop Mode		1h	Remote Assign Output1
	1h	Input Filter Alarm Reset		2h	Remote Assign Output2
	2h	Input Filter Hold Off		3h	Remote Assign Output3
	3h	Input Filter Stop		4h	Remote Assign Output4
	4h	Input Filter EMG	2010h	5h	Remote Assign Output5
200Ah	5h	Input Filter Universal Input1		6h	Remote Assign Output6
	6h	Input Filter Universal Input2		7h	Remote Assign Output7
	7h	Input Filter Universal Input3		8h	Remote Assign Output8
	8h	Input Filter Universal Input4	2017h	0h	Inposition Mode
	9h	Input Filter Universal Input5	605Ah	0h	Quickstop Option
		ORG	605Bh	0h	Shutdown Option
		+/- Limit	605Ch	0h	Disable Operation Option
		Alarm Reset	605Dh	0h	Halt Option
		Hold Off	605Eh	0h	Fault Reaction Option
		Stop	6060h	0h	Modes of Operation
		EMG	607Eh	0h	Polarity
		IN1			Touch Probe1-Function Act
		IN2			Touch Probe1-Trigger Act
200Bh	0h	IN3			Touch Probe1-Trigger Sel
		IN4			Touch Probe1-Up Edge Act
		IN5	60B8h	0h	Touch Probe1-Down Edge Act
		Inposition			Touch Probe2-Function Act
		Alarm			Touch Probe2-Trigger Act
		Out1			Touch Probe2-Trigger Sel
		Out2			Touch Probe2-Up Edge Act
		Out3			Touch Probe2-Down Edge Act
		Out4			Digital Outputs_Brake
	1h	Assign Input1			Digital Outputs_Universal1
	2h	Assign Input2		1h	Digital Outputs_Universal2
200Dh	3h	Assign Input3			Digital Outputs_Universal3
	4h	Assign Input4			Digital Outputs_Universal4
	5h	Assign Input5	60FEh		Digital Outputs_BitMask_Brake
	1h	Assign Output1			Digital Outputs_BitMask_Universal1
	2h	Assign Output2		2h	Digital Outputs_BitMask_Universal2
200Eh	3h	Assign Output3			Digital Outputs_BitMask_Universal3
	4h	Assign Output4			Digital Outputs_BitMask_Universal4
	1h	Remote Assign Input1			
	2h	Remote Assign Input2			
	3h	Remote Assign Input3			
200Fh	4h	Remote Assign Input4			
	5h	Remote Assign Input5			
	6h	Remote Assign Input6			
	7h	Remote Assign Input7			
	8h	Remote Assign Input8			

### 10.3.2 Home Search Mode

Index	Sub	Parameter
6099h	1h	Home Search for Switch Speed
	2h	Home Search for Zero Speed
609Ah	0h	Homing Acceleration
607Ch	0h	Home Offset
2002h	0h	Home Torque Ratio

### 10.3.3 Parameter

Index	Sub	Parameter
2005h	0h	Start Speed
6081h	0h	Profile Velocity
6083h	0h	Profile Acceleration
6084h	0h	Profile Deceleration
607Fh	0h	Max Profile Velocity
6085h	0h	Quickstop Deceleration
6065h	0h	Following Error Window
6067h	0h	Position Window
607Dh	1h	Software Position Limit-
	2h	Software Position Limit+
2015h	0h	Reference Resolution
2005h	0h	Stop Current
2003h	1h	Set Control Gain
	2h	P GAIN
	3h	I GAIN

# 11 EtherCAT Communication

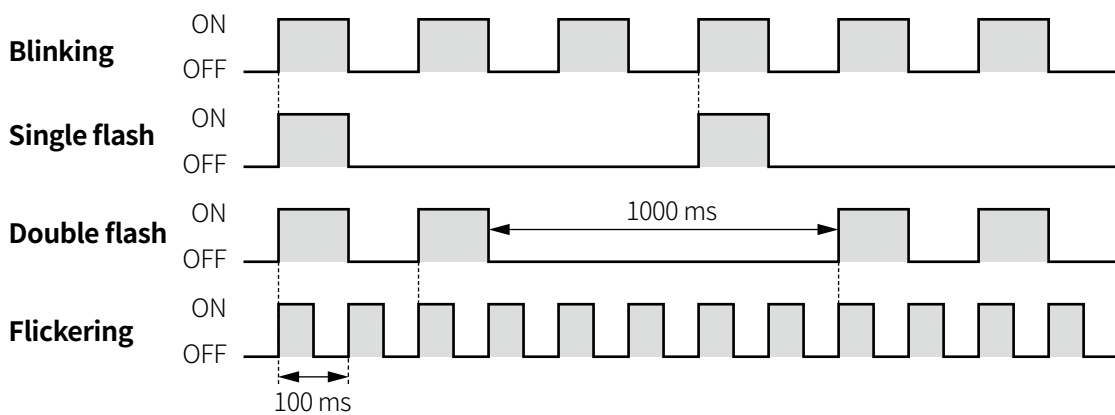
## 11.1 EtherCAT Communication Overview

### 11.1.1 EtherCAT Communication Interface

<b>Communication method</b>	EtherCAT
<b>Physical layer / Protocol</b>	100 BASE-TX / IEEE 802.3
<b>Baudrate</b>	100 Mbps
<b>Comm. period (DC mode)</b>	≥ 250 us
<b>Comm. port / connector</b>	RJ45×2(Shield confrontation) ECAT IN: EtherCAT input ECAT OUT: EtherCAT output
<b>Topology</b>	Daisy Chain (≤ 99 Node)
<b>Process Data</b>	Fixed PDO Mapping
<b>Sync Manager</b>	SM0: Mailbox input SM1: Mailbox output SM2: Process Data input SM3: Process Data output
<b>Mailbox</b>	SDO Mapping
<b>Device profile</b>	IEC 61800-7 CiA402 Drive Profile
<b>Support protocol</b>	CAN application protocol over EtherCAT
<b>DC setting range</b>	250us, 500us, 1ms, 2ms, 4ms, 8ms

### 11.1.2 Operation Indicator

Indicator	Color	Descriptions
EtherCAT comm. status indicator (RUN / ERR)	Green	Turn ON in OP Blinking in pre-op Single flash in safe-op Turn OFF in INIT
	Red	Blinking in case of comm. setting error Single flash in case of comm. data error Double flash in case of disconnected comm.
EtherCAT comm. connection indicator	Green	Turns ON when connected to comm. connector Flickering when comm. operates normally



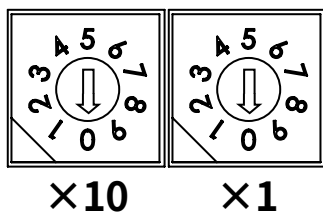
### 11.1.3 Communication ID Setting

EtherCAT supports two communication ID settings. One is automatically assigned by Master, and the other is a method of using the Slave’s rotary switch.

AiC-EC is able to check the ID setting value of the set rotary switch on the alarm / warning status display part, and able to set 10 digit and 1 digit respectively by using two rotary switches.

When the power is applied, the changed ID setting value is applied, and even if the ID setting value changes afterwards, it will not be applied. To change the ID setting value, re-apply the power.

The available range of setting value is 0 to 99.



Setting	Comm. ID (×10)	Comm. ID (×1)
0	0×10	0
1	1×10	1
2	2×10	2
3	3×10	3
4	4×10	4
5	5×10	5
6	6×10	6
7	7×10	7
8	8×10	8
9	9×10	9



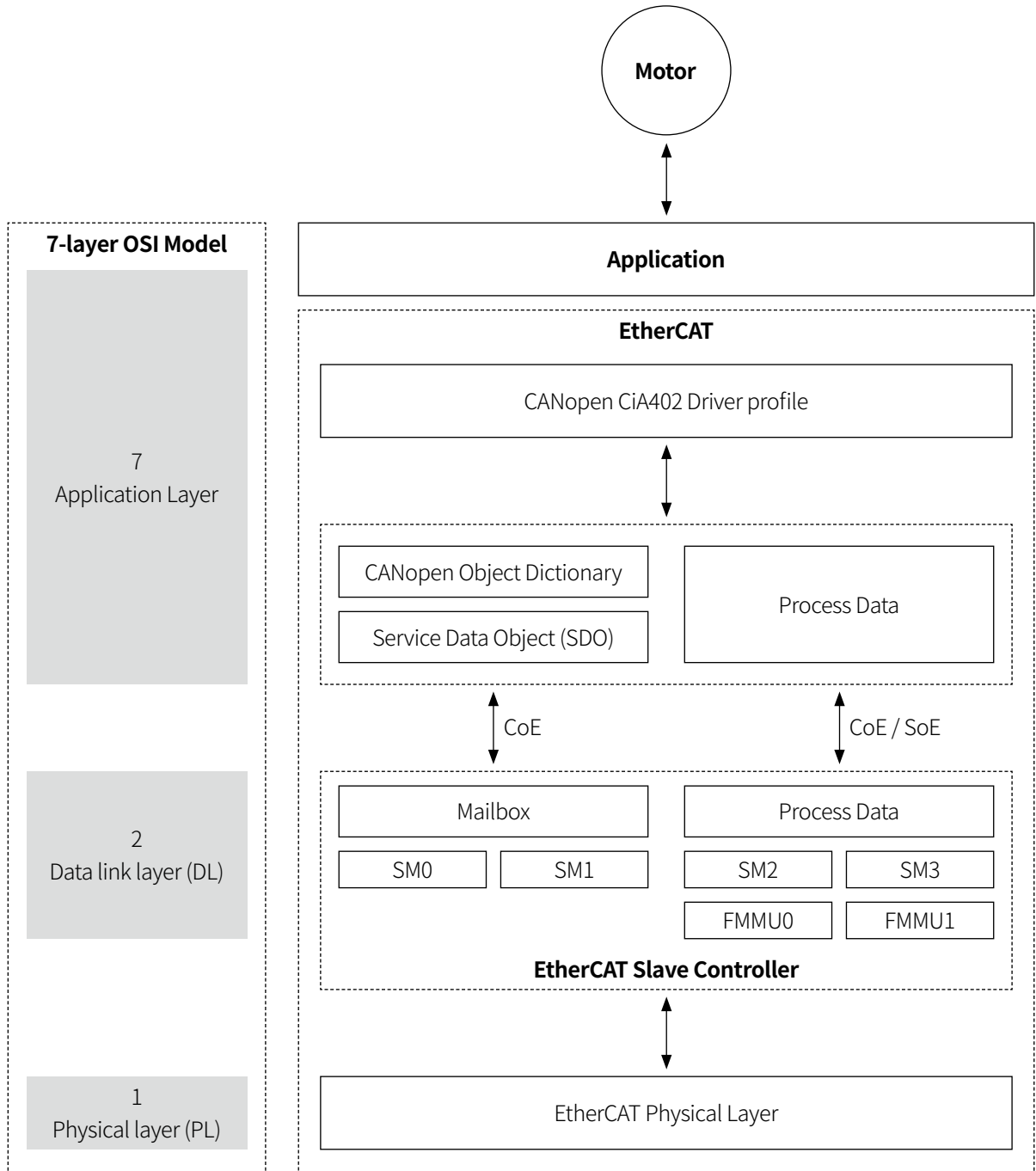
## 11.2 EtherCAT Device Protocol

### 11.2.1 CANopen over EtherCAT (CoE)

AiC-EC is a slave device that supports CANopen application protocol with built-in EtherCAT communication.

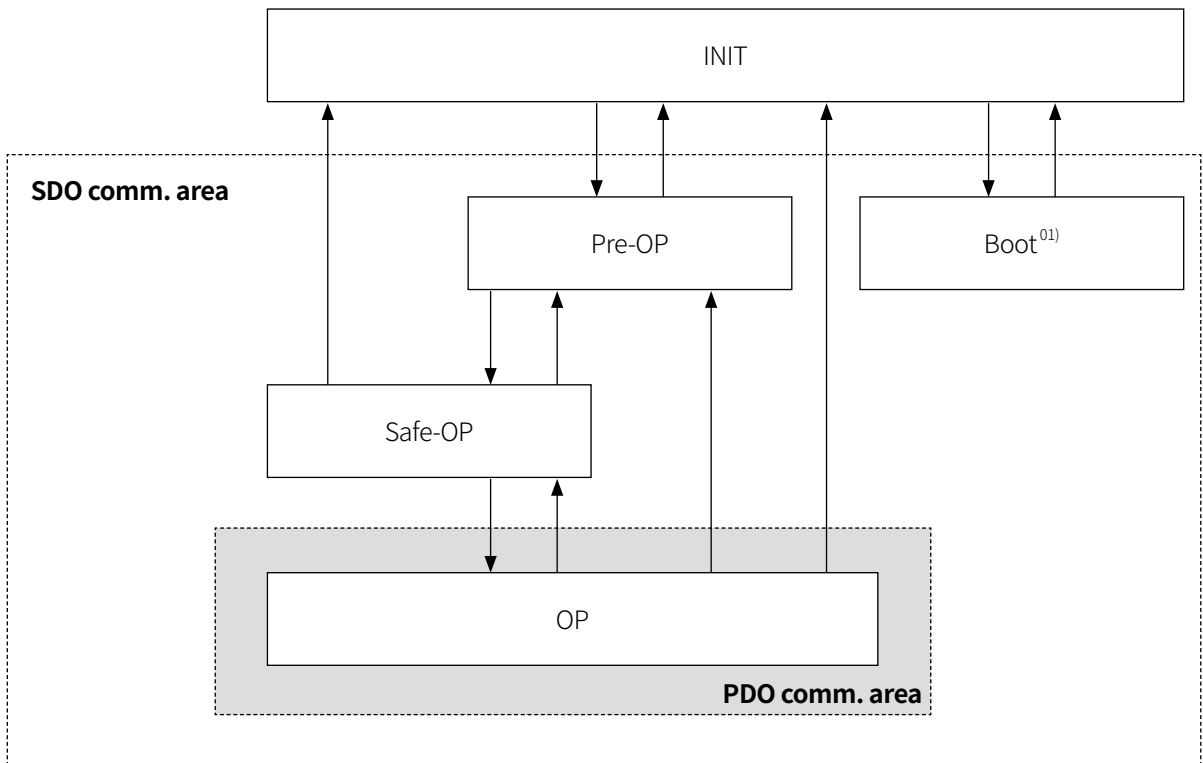
All CoE based data is defined in Object dictionary, and parameters are exchanged and controlled in real time through Mailbox (SDO) and Tx / Rx data (PDO).

The device uses Ethernet based LAN cable (RJ45 connector) physically.



### 11.2.2 EtherCAT State Machine (ESM)

ESM is controlled by Master.



01) AiC-EC does not support Boot mode.

ESM State	Descriptions
Init (INIT)	Initialized state and comm. connection is not available.
Pre-Operational (Pre-OP)	After initializing, this state will turn into this and operate initial network setup. SDO (Mailbox comm.) is only available.
Safe-Operational (Safe-OP)	Through TxPDO, the driver status is able to transferred to Master. SDO (Mailbox comm.) and TxPDO (transmit) are available.
Operational (OP)	Through PDO comm., the command is able to received from Master to driver. SDO (Mailbox comm.), TxPDO (transmit) and RxPDO (receive) are available.
Bootstrap (Boot)	Following state is mainly used for firmware upgrade, and SDO (Mailbox comm.) is only available.

### 11.2.3 SyncManager (SM)

In order to ensure the stability and consistency of data transmission between Master and Slave, the interrupt type channel is provided.

It is composed by Mater and able to configure communication mode and direction. It refers to specific memory buffer to exchange data, and SM accesses these memory buffers to exchange data. SyncManager contains Mailbox mode and Buffered mode.

Channel	Operation mode	Start address	Descriptions
SM0	Receive Mailbox	0x1000	Mailbox dedicated input channel Used for asynchronous data input
SM1	Transmit Mailbox	0x1400	Mailbox dedicated output channel Used for asynchronous data output
SM2	Receive PDO	0x1800	PDO comm. mode dedicated input channel Used for synchronous data input
SM3	Transmit PDO	0x1C00	PDO comm. mode dedicated output channel Used for synchronous data output

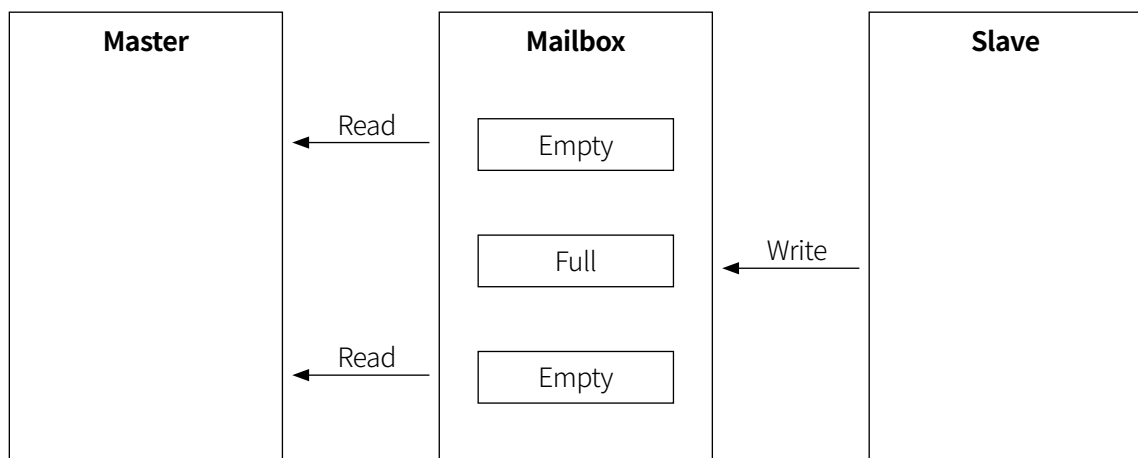
#### 11.2.3.1 Mailbox Mode

Mailbox transceives data only when either connection between Master and Slave is completed.

At first, the data is written to a buffer and saved in a buffer until the receive read the buffer.

There is no data loss due to Handshake mechanism is used.

It is asynchronous and is generally used for SDO communication.



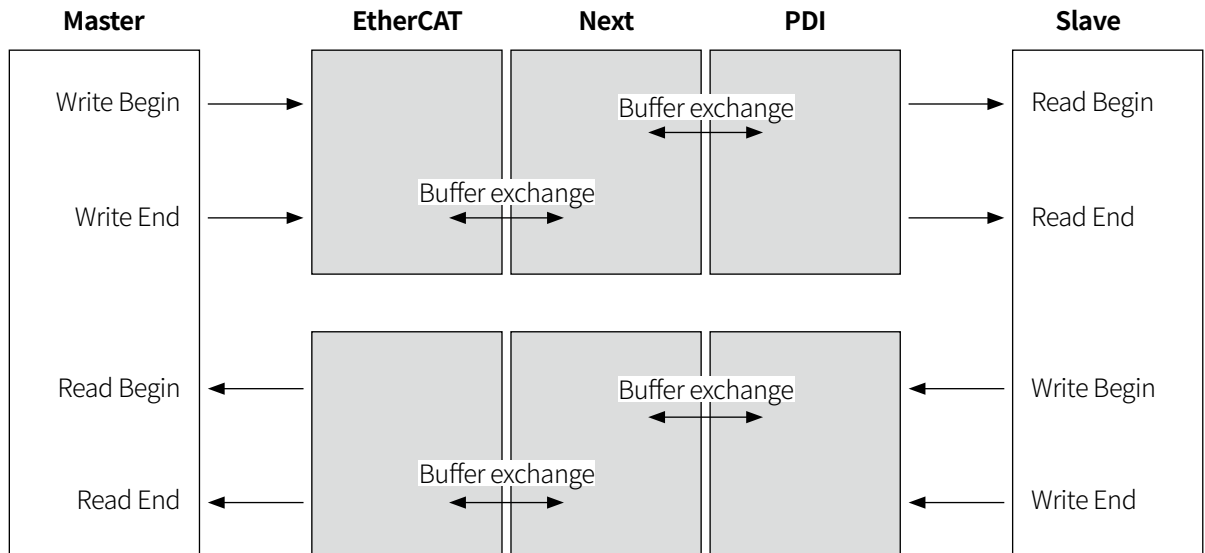
**11.2.3.2 Buffered Mode**

In Buffered mode, both Master and Slave can access the communication buffer at any time.

The data receive side can read the recently written buffer, and the data transmit side can update the buffer value at all time.

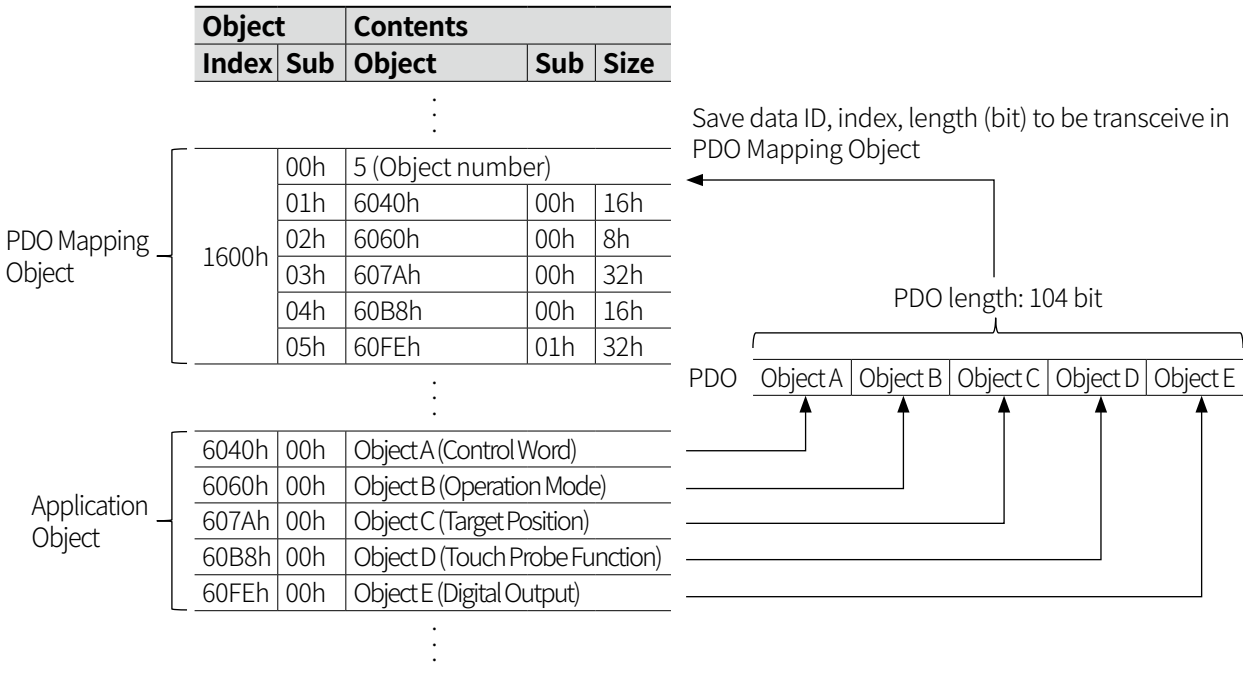
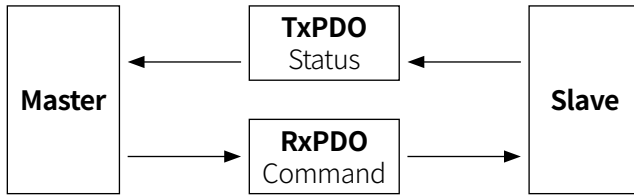
If the writing speed from Master is faster than receiving buffer reading speed, the previous data will be dumped and writing is available immediately.

It is used for PDO communication that operates as a periodic signal.

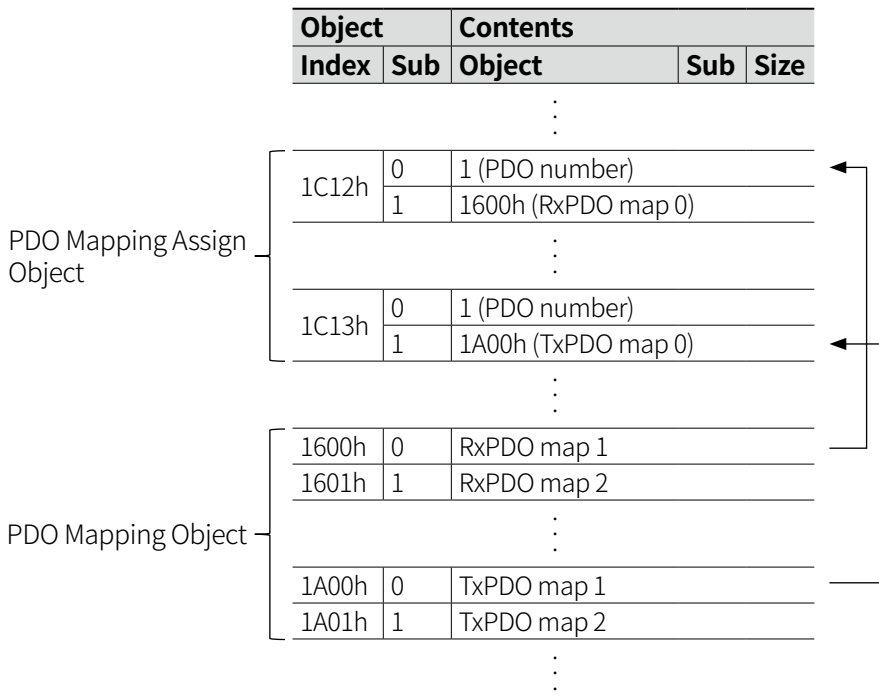


### 11.2.4 Process Data Object (PDO)

PDO assigns Object and is used for real-time data transfer between Master and Slave.  
 PDO consists of RxPDO and TxPDO, and allocates data to be transferred by mapping objects to PDO.



Allocate RxPDO to Assign Object 1C12h and TxPDO to Assign Object 1C13h to transceive mapped PDO.



### 11.2.4.1 PDO Mapping

AiC-EC series uses fixed PDO mapping.

PDO mapping content cannot be changed but can be read or written through SDO.

RxPDO is assigned to 1600h, 1601h, 1602h, and TxPDO is assigned to 1A00h, 1A01h, 1A02h.

RxPDO Mapping Object		TxPDO Mapping Object	
PDO	Index	PDO	Index
RxPDO1	1600h	TxPDO1	1A00h
RxPDO2	1601h	TxPDO2	1A01h
RxPDO3	1602h	TxPDO3	1A02h

### 11.2.4.2 PDO Mapping 1 (CSP)

The following mapping is only used in Cyclic Synchronous Position (CSP) mode.

Latch function is supported.

<b>RxPDO [1600h]</b>	Controlword [6040h] Modes of Operation [6060h] Target Position [607Ah] Touch Probe Function [60B8h] Digital Output [60FEh]
<b>TxPDO [1A00h]</b>	Statusword [6041h] Modes of Operation Display [6061h] Position Actual Value [6064h] Touch Probe1 Up Edge Position [60BAh] Touch Probe1 Down Edge Position [60BBh] Touch Probe2 Up Edge Position [60BCh] Touch Probe2 Down Edge Position [60BDh] Digital Inputs [60FDh]

### 11.2.4.3 PDO Mapping 2 (PP/PV)

The following mapping is only used in Profile Position (PP) and Profile Velocity (PV) mode.

Latch function is not supported.

<b>RxPDO [1601h]</b>	Controlword [6040h] Modes of Operation [6060h] Target Position [607Ah] Profile Velocity [6081h] Digital Output [60FEh]
<b>TxPDO [1A01h]</b>	Statusword [6041h] Modes of Operation Display [6061h] Position Actual Value [6064h] Digital Inputs [60FDh]

#### 11.2.4.4 PDO Mapping 3 (CSV)

The following mapping is only used in Cyclic Synchronous Position (CSV) mode. Latch function is supported.

<b>RxPDO [1602h]</b>	Controlword [6040h] Modes of Operation [6060h] Touch Probe Function [60B8h] Digital Output [60FEh] Target Velocity [60FFh]
<b>TxPDO [1A02h]</b>	Statusword [6041h] Modes of Operation Display [6061h] Velocity Actual Value [6064h] Touch Probe1 Up Edge Position [60BAh] Touch Probe1 Down Edge Position [60BBh] Touch Probe2 Up Edge Position [60BCh] Touch Probe2 Down Edge Position [60BDh] Digital Inputs [60FDh]

#### 11.2.5 Service Data Object(SDO)

All objects defined in Object Dictionary are communicated asynchronously in Mailbox communication. It is used when the user sets a value for a specific object or monitors the status.

### 11.3 EtherCAT Communication Sync Mode

AiC-EC series is able to select total 3 communication sync mode.

- **Free-Run mode**

Slave operates asynchronously by internal timer event independent of synchronization signal.

- **SM Event sync mode**

Whenever RxPDO receive is completed from Master, SM event occurs.

Slave is synchronized on the corresponding signal. Jitter may take several  $\mu\text{s}$  at the point of receive complete.

- **DC Event sync mode**

Master and Slave operate in synchronized. At this point, jitter is available to real-time synchronous communication in several ns.

DC Event sync mode comm. cycle can be set up to 250  $\mu\text{s}$ , 500  $\mu\text{s}$ , 1 ms, 2 ms, 4 ms and 8 ms.

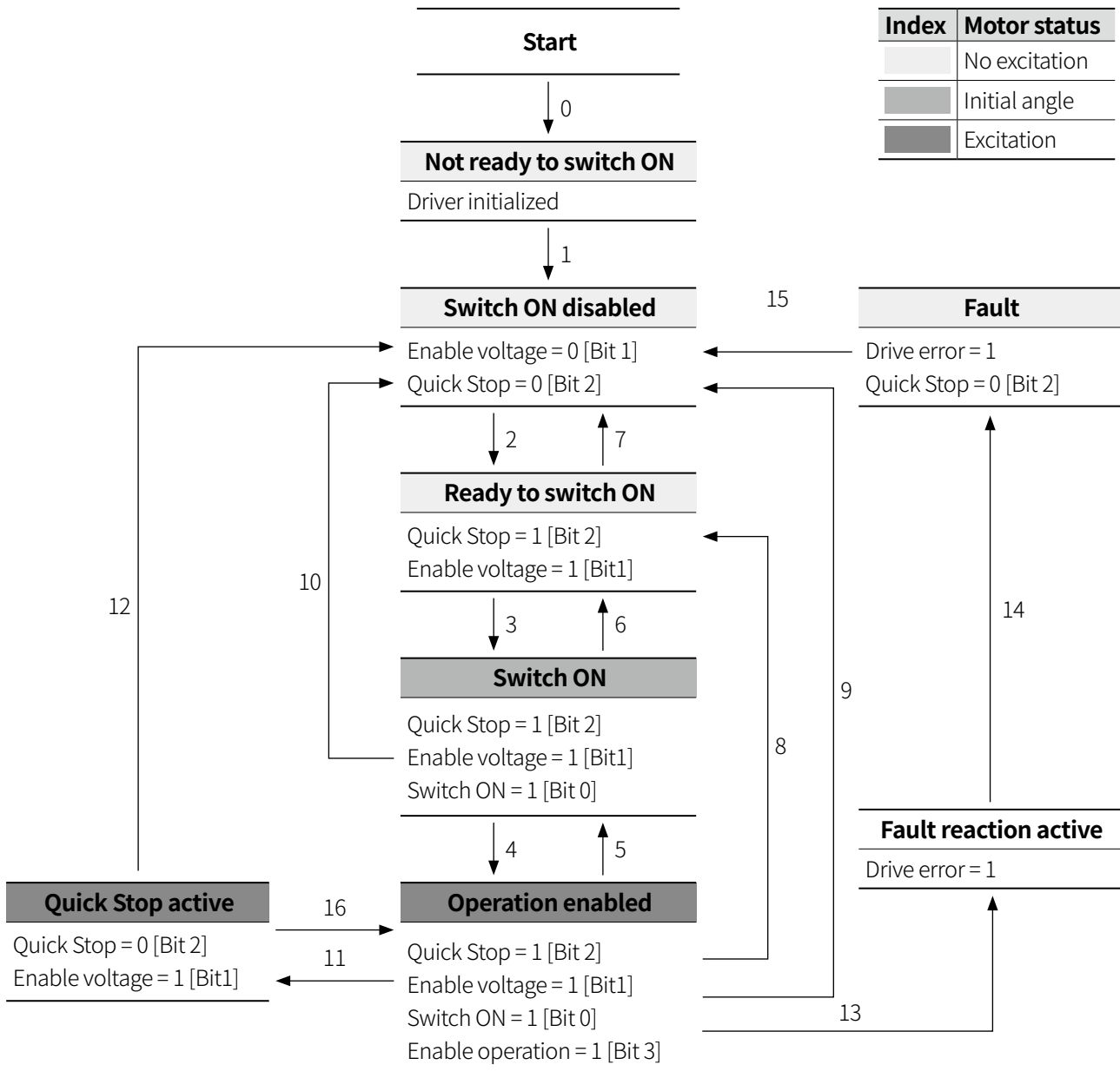


### 11.4 Drive State Machine (DSM)

AiC-EC series supports CiA402 profile and can be moved through Controlword [6040h].

Also, the current status can be checked through Statusword [6041h].

In the following diagram, the square indicates the status, and No. 2 to 10 and 15 indicate the status control command.



No.	Status descriptions
0	Automatically moving on when the power is applied by the power ON command.
1	Automatically moving on when the driver initialization is completed with the driver initialization command.
2	Moving on when Quick Stop and Enable voltage bit are 1 by Shutdown command.
3	Moving on when Switch ON bit is 1 by Switch ON command.
4	Moving on when Enable operation bit is 1 by Enable operation command.
5	Moving on when Enable operation bit is 0 by Disable operation command.
6	Moving on when Switch ON bit is 0 by Shutdown command.
7	Moving on when Quick Stop or Enable voltage bit is 0 by Quick Stop or Disable voltage command.
8	Moving on when Switch ON bit is 0 by Shutdown command.
9	Moving on when Enable voltage bit is 0 by Disable voltage command.
10	Moving on when Quick Stop or Enable voltage bit is 0 by Quick Stop or Disable voltage command.
11	Moving on when Quick Stop bit is 0 by Quick Stop command.
12	Automatically moving on by Quick Stop option code [605Ah].
13	Detecting Fault signal.
14	Automatically moving on after Fault occurs.
15	Moving on when Fault reset bit is 1 by Fault reset command.
16	Moving on when Quick Stop, Switch ON and Enable operation bits are 1 by Enable operation command.

### 11.4.1 Controlword

It controls the status by combining Controlword [6040h] bit at Master.

Command	Controlword [6040h]					Status
	Bit 7	Bit 3	Bit 2	Bit 1	Bit 0	
Shut down	0	×	1	1	0	2, 6, 8
Switch ON	0	0	1	1	1	3
Switched ON disabled	0	1	1	1	1	3 + 4
Disable voltage	0	×	×	0	×	7, 9, 10, 12
Quick Stop	0	×	0	1	×	7, 10, 11
Disable operation	0	0	1	1	1	5
Enable operation	0	1	1	1	1	4, 16
Fault reset	0 → 1	×	×	×	×	15

Automatically switches to Operation enabled (Servo ON) status after Switched ON (Servo Ready) status. When Fault occurs, the status becomes Switched ON disabled, and when Bit 7 is set to 1, the Fault reset will be operated.

After that, depending on Bit 0 to 3 command, the status will be changed.

After Fault reset, it must be restored to 0 before transmitting the next command.

### 11.4.2 Statusword

It displays the Slave status through Statusword [6041h] according to Controlword [6040h] from Master.

Command	Statusword [6041h]						
	Bit 6	Bit 5	Bit 4	Bit 3	Bit 2	Bit 1	Bit 0
Not ready to switch ON	0	0	×	0	0	0	0
Switch ON disabled	1	1	×	0	0	0	0
Ready to switch ON	0	1	×	0	0	0	1
Switched ON	0	1	×	0	0	1	1
Operation enabled	0	1	×	0	1	1	1
Fault reaction active	0	1	×	1	1	1	1
Fault	0	1	×	1	0	0	0

## 12 EtherCAT Operation Mode

AiC-EC series is able to operate the following modes.

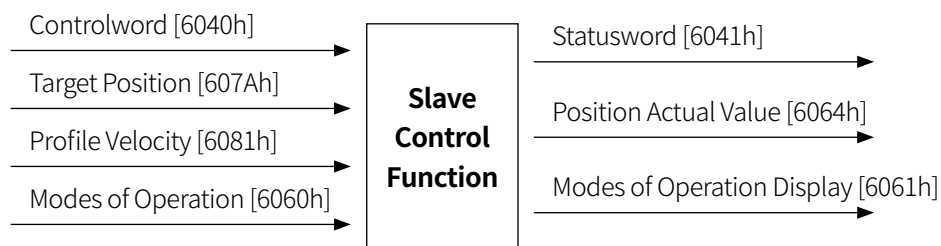
Mode	Descriptions	Modes of Operation
-	Invalid drive function	0 (Factory default)
PP	Operating at designated target position	1
PV	Operating at specified speed	3
CSP	Operating to designated target position according to real-time value	8
CSV	Operating at specified speed according to real-time value	9
HM	Operating home search by specified method	6

### 12.1 Profile Position Mode (PP)

PP mode is a mode in which the driver creates and operates a profile, and sets the target position, speed, acceleration and etc in Master.

#### 12.1.1 Driving Method

- 01) PDO mapping uses [1601h].
- 02) Set the Modes of Operation [6060h] value as 1.
- 03) Set the driver status by Controlword [6040h] Enable Operation (Bit 3) setting.
- 04) Set the objects required for driving. (Refer to the following table for related object.)
- 05) Set the desired position mode through Controlword [6040h] Bit 5 and 6.
- 06) Start operation by assigning Controlword [6040h] New set Position (Bit 4) value from 0 to 1.  
Controlword [6040h] New set Position (Bit4) is only available in rising edge.
- 07) When position move is completed, the motor stops and the driver is in stand by status.



## 12.1.2 Related Object

### (1) PDO related object

Index	Sub	Index & Sub Name	Type	Access	PDO mapping	Value (default)	Save	Reflect timing
6040h	0h	Controlword	U16	RW	RxPDO	0: Switch ON 1: Enable Voltage 2: Quick Stop 3: Enable Operation 4: 0 → 1 - New set Position bit 5: 0 - Operate after stop 1 - New set Position 6: 0 - Absolute 1 - Increment 7: Fault reset 8: Halt 9: Operation mode specific 11 to 15: Manufacturer specific	-	Immed.
6060h	0h	Modes of Operation	INT8	RW	RxPDO	0: Invalid drive function 1: PP (Profile Position Mode) 3: PV (Profile Velocity Mode) 6: HM (Homing Mode) 8: CSP (Cyclic Sync Position) 9: CSV (Cyclic Sync Velocity) 10: CST (Cyclic Sync Torque)	Save	After stop
607Ah	0h	Target Position	INT32	RW	RxPDO	-	-	Immed.
6081h	0h	Profile Velocity	U32	RW	RxPDO	1 to 2,500,000	Save	After stop
60FEh	1h	Output setting	U32	RW	RxPDO	0 to FFFF FFFFh (0)	-	Immed.
6041h	0h	Statusword <sup>01)</sup>	U16	RO	TxPDO	0: Ready to switch ON 1: Switched ON 2: Operation enabled 3: Fault 4: Voltage enabled 5: Quick Stop 6: Switch ON disabled 7: Warning 8: Manufacturer specific 9: Remote 0 - Controlword in progress 1 - Controlword complete 10: Target reached 0: Position not determined 1: Position complete and Halt stop complete 11: Internal limit active 12: 0 - Unreceived 1 - New Position received 13: Reserved 14, 15: Manufacturer specific	-	-
6061h	0h	Modes of Operation Display	INT8	RO	TxPDO	-	-	-
6064h	0h	Position Actual Value	INT32	RO	TxPDO	-	-	-
60FDh	0h	Digital Input	U32	RO	TxPDO	Detail	-	-

01) Statusword [6041h] Remote (Bit 9) returns '0' while PDO or SDO command is in progress, returns '1' after completed.

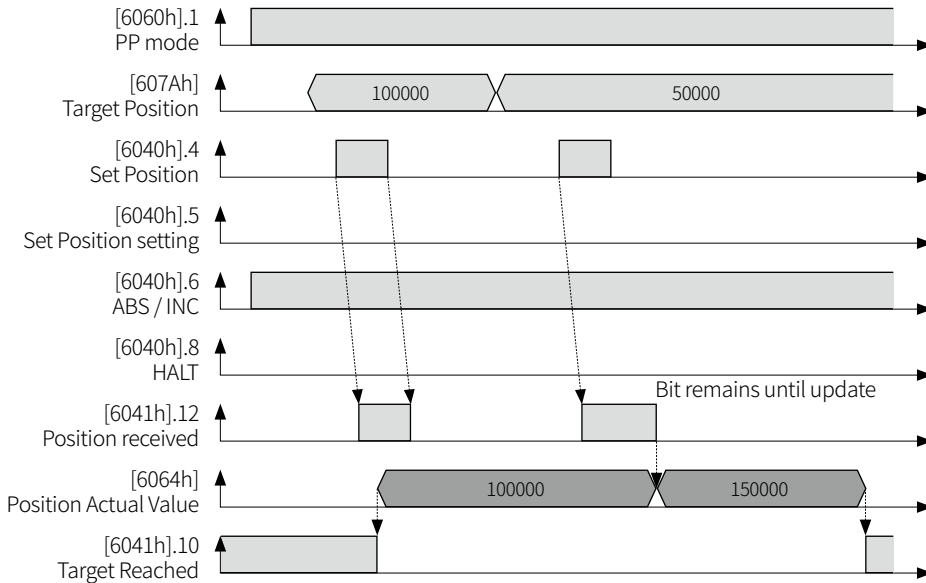
## (2) SDO related object

Index	Sub	Index & Sub Name	Type	Access	Value (default)	Save	Reflect timing
2001h	0h	Limit Stop Method	U16	RW	0 to 1 (0)	Save	After stop
2005h	0h	Start Speed	U16	RW	1 to 50,000 (1)	Save	After stop
605Ah	0h	Quick Stop Option Code	INT16	RW	Quick Stop at [6085h] speed (2)	Save	Immed.
605Dh	0h	Halt Option Code	INT16	RW	Deceleration stop at [6084h] speed - P(1)	Save	Immed.
605Eh	0h	Fault Reaction Option Code	INT16	RW	0: Hold Off	Save	Immed.
607Dh	1h	-Software Limit	INT32	RW	(-2,147,483,648)	Save	Power ON
	2h	+Software Limit	INT32	RW	(2,147,483,647)		
6083h	0h	Profile Acceleration [step/s <sup>2</sup> ]	U32	RW	1 to 1,000,000,000 (500,000)	Save	After stop
6084h	0h	Profile Deceleration [step/s <sup>2</sup> ]	U32	RW	1 to 1,000,000,000 (500,000)	Save	After stop
6085h	0h	Quick Stop Deceleration[step/s <sup>2</sup> ]	U32	RW	500 to 500,000,000 (5,000,000)	Save	After stop
60B8h	0h	Touch Probe Function	U16	RW	0000h to FFFFh	-	Immed.
60FEh	1h	Output setting	U32	RW	0 to FFFF FFFFh (0)	-	Immed.
60FDh	0h	Digital Input	U32	RO	Detail	-	-

### 12.1.3 Operation Timing Chart

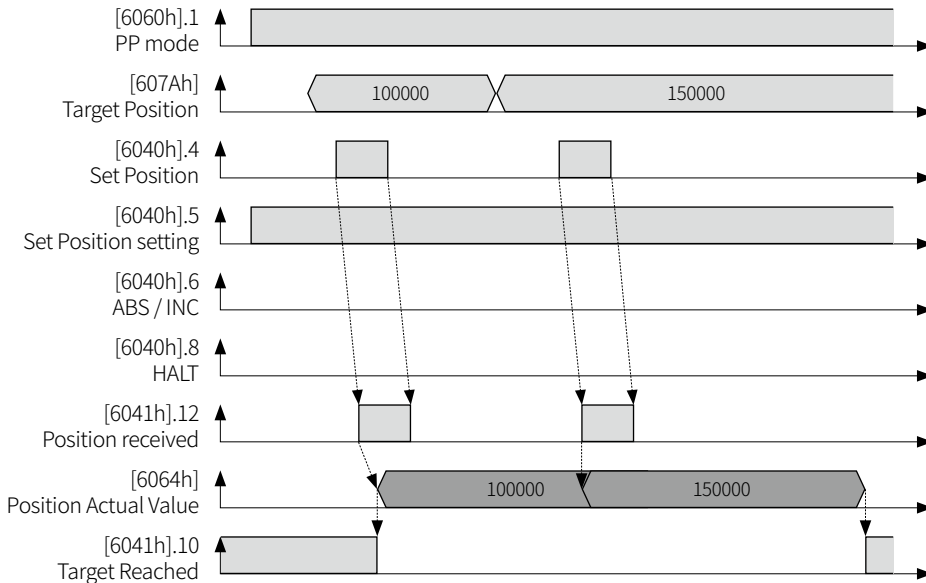
#### 12.1.3.1 Update Increment Operation after Stop

- When the new target position move is instructed, if the previous move is still in progress, the next new position move command is executed after completing the previous position move.
- Statusword [6041h] Set Position received (Bit 12), that is SET when the new target position move is instructed, will be RESET after Controlword [6040h] New set Position (Bit 4) is RESET and completing previous position move.
- Statusword [6041h] Target reached (Bit 10) will be SET after all position move is completed.
- Controlword [6040h] New set Position (Bit 4) is valid only in rising edge.



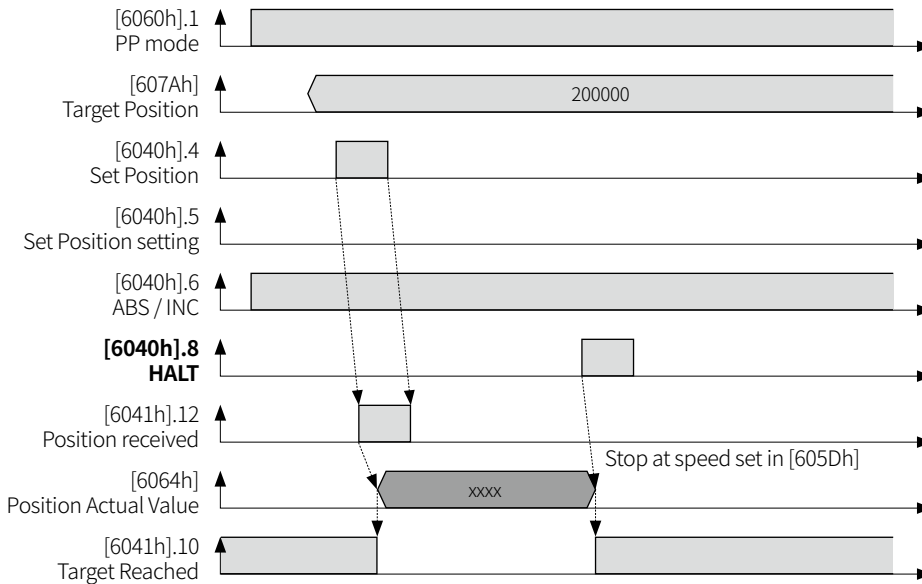
#### 12.1.3.2 Update Absolute Operation during Operation

- Update during operation is available only in Absolute position mode.
- Controlword [6040h] New set Position (Bit 4) is valid only in rising edge.



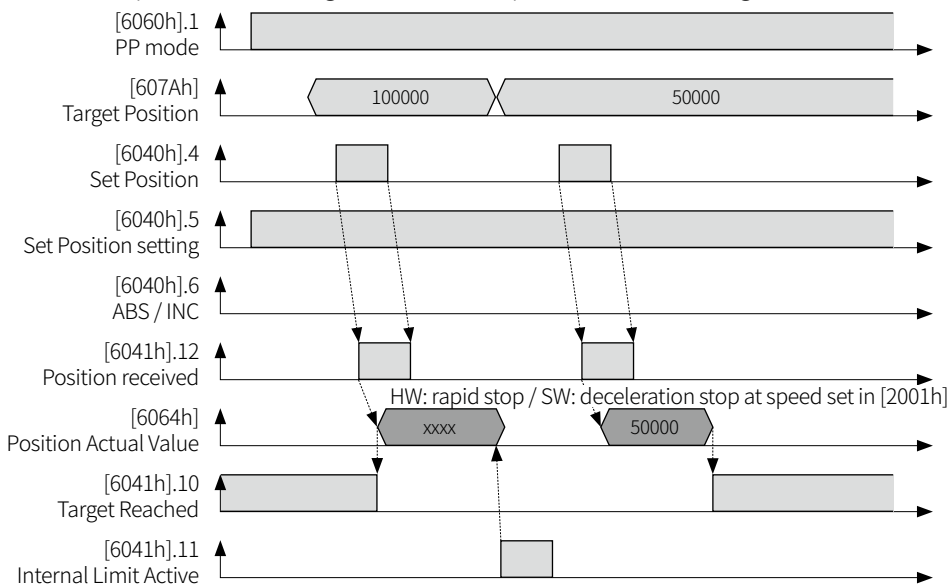
### 12.1.3.3 HALT Operation

- If Controlword [6040h] HALT (Bit 8) is SET while driving, it stops at speed set in Halt Option Code [605Dh].
- Statusword [6041h] Target reached (Bit 10) will be SET after HALT stop.
- Previous position value will be ignored after HALT stop.



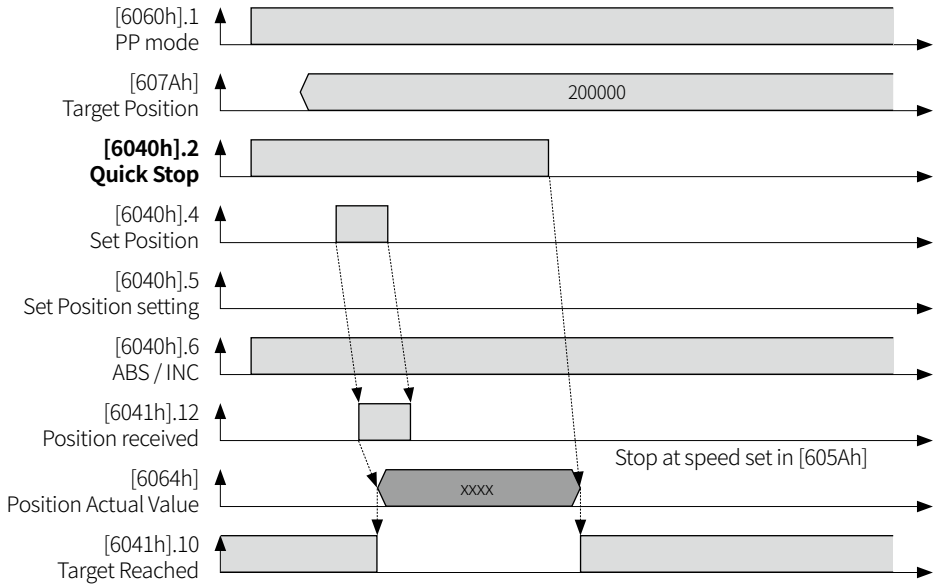
### 12.1.3.4 Absolute Limit Operation

- If Limit Sensor is ON while driving, it stops rapidly.
- When current position Position Actual Value [6064h] is out of the setting range of Software Position Limit [6074Dh], it stops at the speed set in Limit Stop Method [2001h].
- When the target position is not reached due to Limit error, Statusword [6041h] Target Reached (Bit 10) is RESET.
- In case of Hardware Limit or Software Limit error status, Statusword [6041h] Internal Limit Active (Bit 11) will be SET.
- To operate PP mode again after Limit warning error, RESET the Controlword [6040h] Set Position (Bit 4) and Set Position setting (Bit 5) and ABS / INC setting (Bit 6) and SET the Bit corresponding to the desired position mode again to normal operate after releasing alarm.



12.1.3.5 Quick Stop Operation

- If Controlword [6040h] Quick Stop (Bit 2) is RESET while driving, it stops at speed set in Quick Stop Option Code [605Ah].
- Statusword [6041h] Target reached (Bit 10) will be SET after stop completed by Quick Stop.



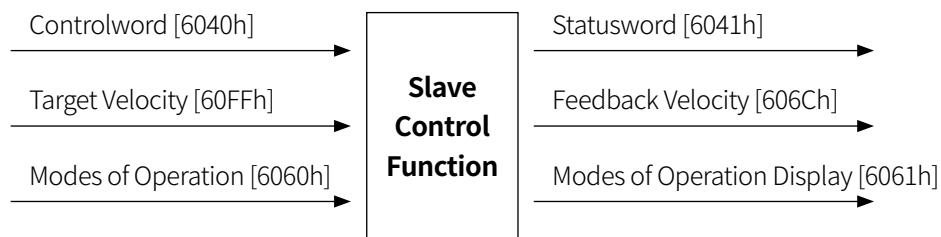


## 12.2 Profile Velocity Mode (PV)

PV mode is a mode in which the driver creates and operates a profile, and sets the speed, acceleration and etc in Master.

### 12.2.1 Driving Method

- 01) PDO mapping uses [1601h].
- 02) Set the Modes of Operation [6060h] value as 3.
- 03) Set the driver status by Controlword [6040h] Enable Operation (Bit 3) setting.
- 04) Set the objects required for driving. (Refer to the following table for related object.)
- 05) Enter command speed in Target Velocity [60FEh].



## 12.2.2 Related Object

### (1) PDO related object

Index	Sub	Index & Sub Name	Type	Access	PDO mapping	Value (default)	Save	Reflect timing
6040h	0h	Controlword	U16	RW	RxPDO	0: Switch ON 1: Enable Voltage 2: Quick Stop 3: Enable Operation 4 to 6: Operation mode specific 7: Fault reset 8: Halt 9: Operation mode specific 11 to 15: Manufacturer specific	-	Immed.
	0h	Modes of Operation	INT8	RW	RxPDO	0: Invalid drive function 1: PP (Profile Position Mode) 3: PV (Profile Velocity Mode) 6: HM (Homing Mode) 8: CSP (Cyclic Sync Position) 9: CSV (Cyclic Sync Velocity) 10: CST (Cyclic Sync Torque)	Save	After stop
60FEh	1h	Output setting	U32	RW	RxPDO	0 to FFFF FFFFh (0)	-	Immed.
60FFh	0h	Target Velocity	INT32	RW	RxPDO	-500,000 to 500,000 (0)	-	Immed.
6041h	0h	Statusword <sup>01)</sup>	U16	RO	TxPDO	0: Ready to switch ON 1: Switched ON 2: Operation enabled 3: Fault 4: Voltage enabled 5: Quick Stop 6: Switch ON disabled 7: Warning 8: Manufacturer specific 9: Remote 0: Controlword in progress 1: Controlword complete 10: Target reached 0: Target speed not reached 1: Target speed reached and Halt stop complete 11: Internal limit active 0: No active 1: Limit active 12: 0 - Not '0' 1 - Command speed is '0' 13: Operation mode specific 14, 15: Manufacturer specific	-	-
6061h	0h	Modes of Operation Display	INT8	RO	TxPDO	-	-	-
606Ch	0h	Velocity Actual Value	INT32	RO	TxPDO	-	-	-
60FDh	0h	Digital Input	U32	RO	TxPDO	Detail	-	-

01) Statusword [6041h] Remote (Bit 9) returns '0' while PDO or SDO command is in progress, returns '1' after completed.

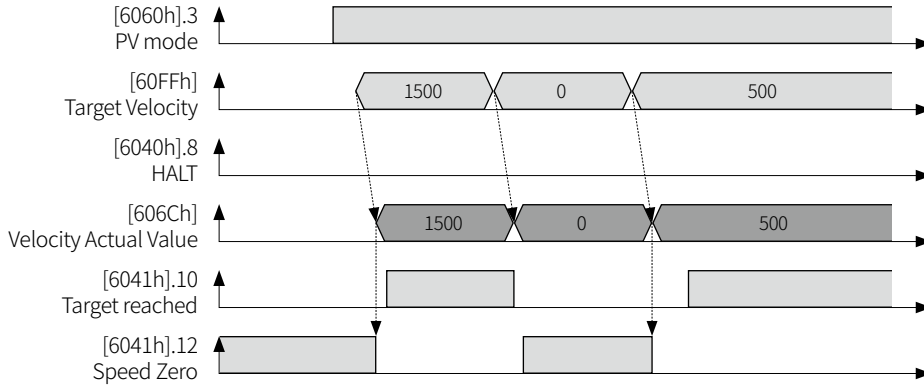
## (2) SDO related object

Index	Sub	Index & Sub Name	Type	Access	Value (default)	Save	Reflect timing
2001h	0h	Limit Stop Method	U16	RW	0~1 (0)	Save	After stop
2005h	0h	Start Speed	U16	RW	1 to 50,000 (1)	Save	After stop
605Ah	0h	Quick Stop Option Code	INT16	RW	Quick Stop at [6085h] speed (2)	Save	Immed.
605Dh	0h	Halt Option Code	INT16	RW	Deceleration stop at [6084h] speed - P(1)	Save	Immed.
605Eh	0h	Fault Reaction Option Code	INT16	RW	0: Hold Off	Save	Immed.
607Dh	1h	-Software Limit	INT32	RW	(-2,147,483,648)	Save	Power ON
	2h	+Software Limit	INT32	RW	(2,147,483,647)		
6083h	0h	Profile Acceleration [step/s <sup>2</sup> ]	U32	RW	1 to 1,000,000,000 (500,000)	Save	After stop
6084h	0h	Profile Deceleration [step/s <sup>2</sup> ]	U32	RW	1 to 1,000,000,000 (500,000)	Save	After stop
6085h	0h	Quick Stop Deceleration[step/s <sup>2</sup> ]	U32	RW	500 to 500,000,000 (5,000,000)	Save	After stop
60B8h	0h	Touch Probe Function	U16	RW	0000h to FFFFh	-	Immed.
60FEh	1h	Output setting	U32	RW	0 to FFFF FFFFh (0)	-	Immed.
60FDh	0h	Digital Input	U32	RO	Detail	-	-

### 12.2.3 Operation Timing Chart

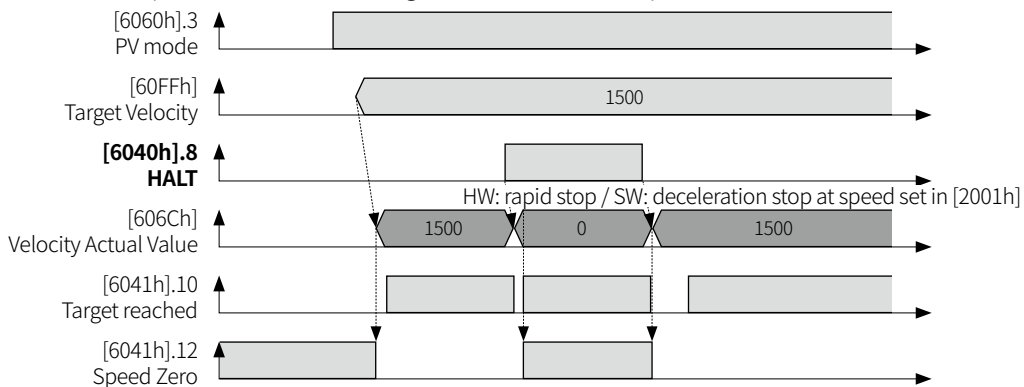
#### 12.2.3.1 Normal Operation

- When the speed reached to Target Velocity [60FFh], Statusword [6041h] Target reached (Bit 10) will be SET.
- When Target Velocity [60FFh] is 0, Statusword [6041h] Target reached (Bit 10) is RESET.
- When Target Velocity [60FFh] is 0, Statusword [6041h] Speed Zero (Bit 12) will be SET.



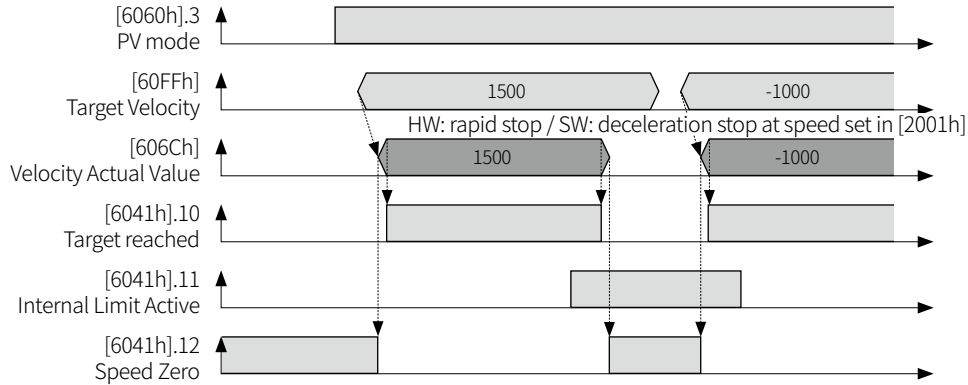
#### 12.2.3.2 HALT Operation

- If Controlword [6040h] HALT (Bit 8) is SET while driving, it stops at speed set in Halt Option Code [605Dh].
- Statusword [6041h] Target reached (Bit 10) will be SET after HALT stop.
- Previous position value will be ignored after HALT stop.



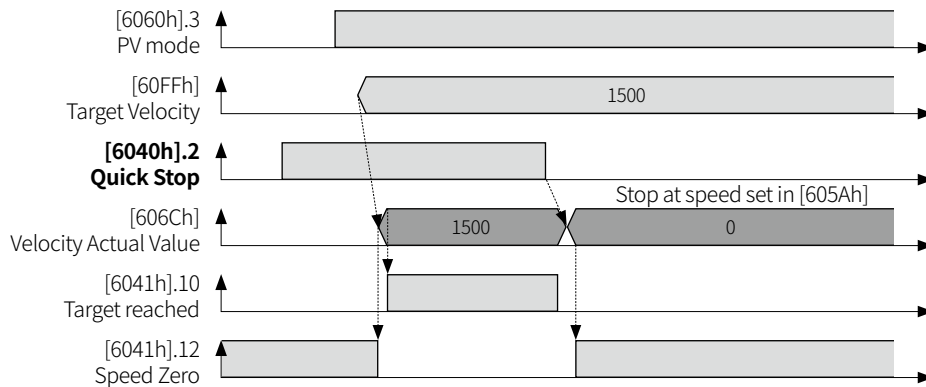
### 12.2.3.3 Internal Limit Operation

- If Limit Sensor is ON while driving, it stops rapidly.
- When current position Position Actual Value [6064h] is out of the setting range of Software Position Limit [6074Dh], it stops at the speed set in Limit Stop Method [2001h].
- In case of Hardware Limit or Software Limit error status, Statusword [6041h] Target Reached (Bit 10) will be RESET, and Statusword [6041h] Internal Limit Active (Bit 11) will be SET.
- Statusword [6041h] Speed Zero (Bit 12) will be SET after stop completed by Limit.



### 12.2.3.4 Quick Stop Operation

- If Controlword [6040h] Quick Stop (Bit 2) is RESET while driving, it stops at speed set in Quick Stop Option Code [605Ah].
- Statusword [6041h] Speed Zero (Bit 12) will be SET after stop completed by Quick Stop.



## 12.3 Cyclic Synchronous Position Mode (CSP)

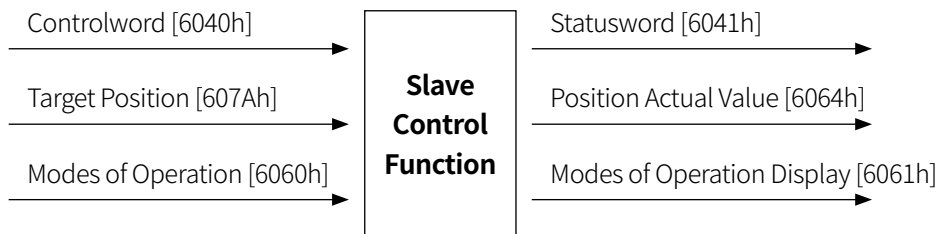
CSP mode is a mode in which the Master creates and operates a profile, and when Target Position [607Ah] is transmitted to the driver by cyclic synchronous communication, the driver executes position control.

CSP mode is recommended only when communication is DC (Distributed Clock) mode.

In case of operating with Free Run mode or SM (Sync Manager) mode, vibration and change in speed may increase.

### 12.3.1 Driving Method

- 01) PDO mapping uses [1600h].
- 02) Set the Modes of Operation [6060h] value as 8.
- 03) Set the objects required for driving. (Refer to the following table for related object.)
- 04) Check if the State Machine status among Statusword [6041h] internal Bit is Operation Enabled.
- 05) Start operation with Target Position [607Ah] value transmitted from Master.



## 12.3.2 Related Object

### (1) PDO related object

Index	Sub	Index & Sub Name	Type	Access	PDO Mapping	Value (default)	Save	Reflect timing
6040h	0h	Controlword	U16	RW	RxPDO	0: Switch ON 1: Enable Voltage 2: Quick Stop 3: Enable Operation 4 to 6: Operation mode specific 7: Fault reset 8: Halt 9, 10: '0' 11 to 15: Manufacturer specific	-	Immed.
6060h	0h	Modes of Operation	INT8	RW	RxPDO	0: Invalid drive function 1: PP (Profile Position Mode) 3: PV (Profile Velocity Mode) 6: HM (Homing Mode) 8: CSP (Cyclic Sync Position) 9: CSV (Cyclic Sync Velocity) 10: CST (Cyclic Sync Torque)	Save	After stop
607Ah	0h	Target Position	INT32	RW	RxPDO	-	-	Immed.
60B8h	0h	Touch Probe Function	U16	RW	RxPDO	0000h to FFFFh	-	Immed.
60FEh	1h	Output setting	U32	RW	RxPDO	0 to FFFF FFFFh (0)	-	Immed.
6041h	0h	Statusword <sup>01)</sup>	U16	RO	TxPDO	0: Ready to switch ON 1: Switched ON 2: Operation enabled 3: Fault 4: Voltage enabled 5: Quick Stop 6: Switch ON disabled 7: Warning 8: Manufacturer specific 9: Remote 0 - Controlword in progress 1 - Controlword complete 10: Reserved 11: Internal limit active 12: 0 - Target position ignored (Invalid target position) 1 - Valid target position 13: 0 - No error 1 - Position difference Error 14, 15: Manufacturer specific	-	-
6061h	0h	Modes of Operation Display	INT8	RO	TxPDO	-	-	-
6064h	0h	Position Actual Value	INT32	RO	TxPDO	-	-	-
60BAh	0h	Touch Probe1 Up Edge Position	INT32	RO	TxPDO	-	-	-
60BBh	0h	Touch Probe1 Down Edge Position	INT32	RO	TxPDO	-	-	-
60BCh	0h	Touch Probe2 Up Edge Position	INT32	RO	TxPDO	-	-	-
60BDh	0h	Touch Probe2 Down Edge Position	INT32	RO	TxPDO	-	-	-
60FDh	0h	Digital Input	U32	RO	TxPDO	Detail	-	-

01) Statusword [6041h] Remote (Bit 9) returns '0' while PDO or SDO command is in progress, returns '1' after completed.

## (2) SDO related object

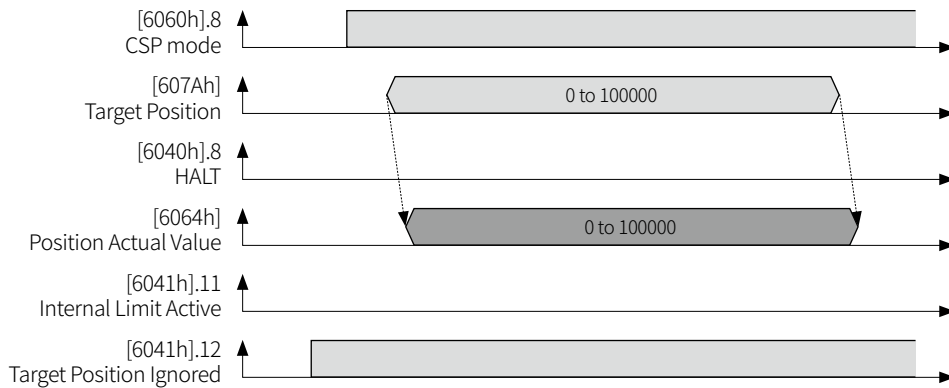
Index	Sub	Index & Sub Name	Type	Access	Value (default)	Save	Reflect timing
2001h	0h	Limit Stop Method	U16	RW	0 to 1 (0)	Save	After stop
605Ah	0h	Quick Stop Option Code	INT16	RW	Quick Stop at [6085h] speed (2)	Save	Immed.
605Dh	0h	Halt Option Code	INT16	RW	Deceleration stop at [6084h] speed - P(1)	Save	Immed.
605Eh	0h	Fault Reaction Option Code	INT16	RW	0: Hold Off	Save	Immed.
6065h	0h	Following Error Window	U32	RW	(50,000)	Save	After stop
607Dh	1h	-Software Limit	INT32	RW	(-2,147,483,648)	Save	Power ON
	2h	+Software Limit	INT32	RW	(2,147,483,647)		
6084h	0h	Profile Deceleration [step/s <sup>2</sup> ]	U32	RW	500 to 500,000,000 (500,000)	Save	After stop
6085h	0h	Quick Stop Deceleration[step/s <sup>2</sup> ]	U32	RW	500 to 500,000,000 (5,000,000)	Save	After stop
60B8h	0h	Touch Probe Function	U16	RW	0000h to FFFFh	-	Immed.
60FEh	1h	Output setting	U32	RW	0 to FFFF FFFFh (0)	-	Immed.
60FDh	0h	Digital Input	U32	RO	Detail	-	-



## 12.3.3 Operation Timing Chart

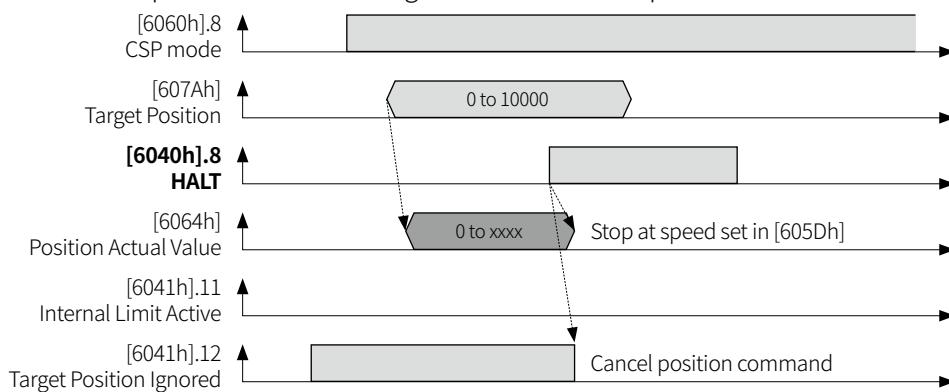
### 12.3.3.1 Normal Operation

- The operation starts with Target Position [607Ah] value transmitted from Master.



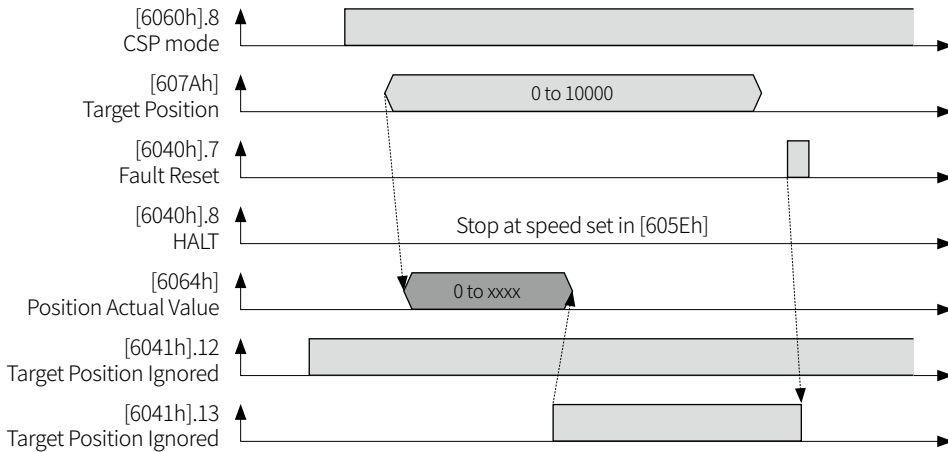
### 12.3.3.2 HALT Operation

- If Controlword [6040h] HALT (Bit 8) is SET while driving, it stops at speed set in Halt Option Code [605Dh]. At this point, if Following error value is reached, error may occur.
- If Controlword [6040h] HALT (Bit 8) is SET, the target position command will be invalid.
- Previous position value will be ignored after HALT stop.



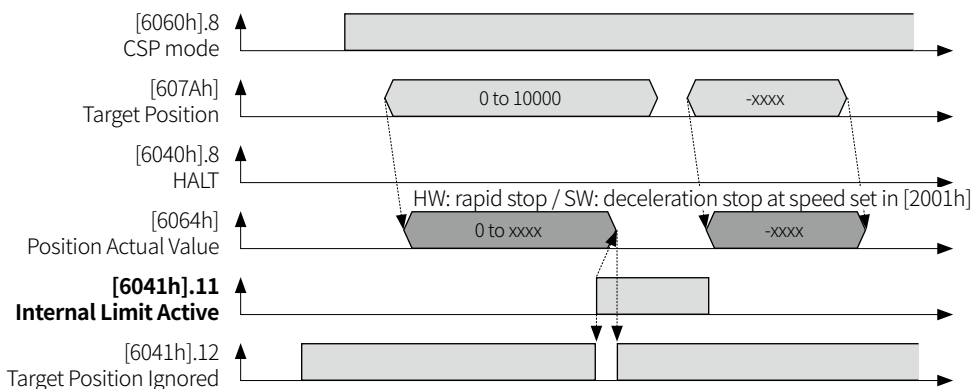
### 12.3.3.3 Following error Operation

- If Following Error [60F4h] value is greater than Following Error Window [6065h] value, the status will be Fault status due to error, Statusword [6041h] Following error (Bit 13) will be SET.
- When Fault Reset by SET the Controlword [6040h] Fault Reset (Bit 7), Following error (Bit 13) will be RESET.



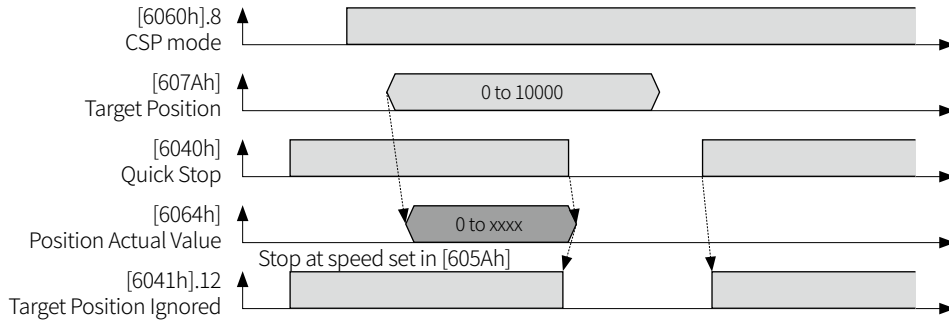
### 12.3.3.4 Internal Limit Operation

- If Limit Sensor is ON while driving, it stops rapidly.
- When current position Position Actual Value [6064h] is out of the setting range of Software Position Limit [6074Dh], it stops at the speed set in Limit Stop Method [2001h].
- When current position Position Actual Value [6064h] is out of the setting range of Software Position Limit [6074Dh], it stops at the speed set in Limit Stop Method [2001h].
- In case of Hardware Limit or Software Limit error status, Statusword [6041h] Internal Limit Active (Bit 11) will be SET.
- In case of Software Limit status, Statusword [6041h] Target Position Ignored (Bit 12) will be RESET and SET.
- If Statusword [6041h] Target Position Ignored (Bit 12) is RESET, the target position command will be invalid.



### 12.3.3.5 Quick Stop Operation

- If Controlword [6040h] Quick Stop (Bit 2) is RESET while driving, it stops at speed set in Quick Stop Option Code [605Ah].
- If Controlword [6040h] Quick Stop (Bit 2) is RESET, the target position command will be invalid.

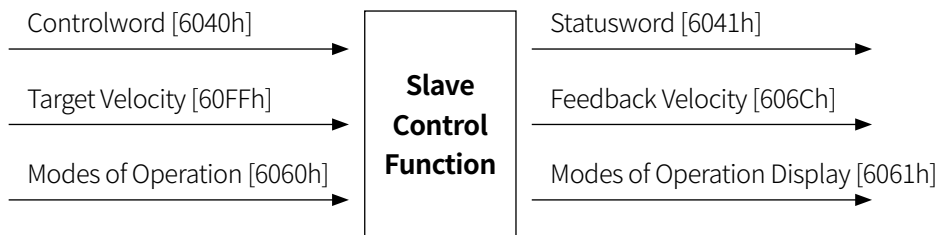


## 12.4 Cyclic Synchronous Position Mode (CSV)

CSV mode is a mode in which the Master creates and operates a profile, and when Target Position [60FFh] is transmitted to the driver by cyclic synchronous communication, the driver executes speed control.

### 12.4.1 Driving Method

- 01) PDO mapping uses [1602h].
- 02) Set the Modes of Operation [6060h] as 9.
- 03) Set the driver status by Controlword [6040h] Enable Operation (Bit 3) setting.
- 04) Set the objects required for driving. (Refer to the following table for related object.)
- 05) Enter command speed in Target Velocity [60FEh].



## 12.4.2 Related Object

### (1) PDO related object

Index	Sub	Index & Sub Name	Type	Access	PDO mapping	Value (default)	Save	Reflect timing
6040h	0h	Controlword	U16	RW	RxPDO	0: Switch ON 1: Enable Voltage 2: Quick Stop 3: Enable Operation 4 to 6: Operation mode specific 7: Fault reset 8: Halt 9, 10: '0' 11 to 15: Manufacturer specific	-	Immed.
6060h	0h	Modes of Operation	INT8	RW	RxPDO	0: Invalid drive function 1: PP (Profile Position Mode) 3: PV (Profile Velocity Mode) 6: HM (Homing Mode) 8: CSP (Cyclic Sync Position) 9: CSV (Cyclic Sync Velocity) 10: CST (Cyclic Sync Torque)	Save	After stop
60B8h	0h	Touch Probe Function	U16	RW	RxPDO	0000h to FFFFh	-	Immed.
60FEh	1h	Digital Output	U32	RW	RxPDO	0 to FFFF FFFFh (0)	-	Immed.
60FFh	0h	Target Velocity	INT32	RW	RxPDO	-500,000 to 500,000 (0)	-	Immed.
6041h	0h	Statusword <sup>01)</sup>	U16	RO	TxPDO	0: Ready to switch ON 1: Switched ON 2: Operation enabled 3: Fault 4: Voltage enabled 5: Quick Stop 6: Switch ON disabled 7: Warning 8: Manufacturer specific 9: Remote 0: Controlword in progress 1: Controlword complete 10: Reserved 11: Internal limit active 12: 0 - Invalid target speed (unable to operate command) 1 - Valid target speed 13: Reserved 14, 15: Manufacturer specific	-	-
6061h	0h	Modes of Operation Display	INT8	RO	TxPDO	-	-	-
606Ch	0h	Velocity Actual Value	INT32	RO	TxPDO	-	-	-
60BAh	0h	Touch Probe1 Up Edge Position	INT32	RO	TxPDO	-	-	-
60BBh	0h	Touch Probe1 Down Edge Position	INT32	RO	TxPDO	-	-	-
60BCh	0h	Touch Probe2 Up Edge Position	INT32	RO	TxPDO	-	-	-
60BDh	0h	Touch Probe2 Down Edge Position	INT32	RO	TxPDO	-	-	-
60FDh	0h	Digital Input	U32	RO	TxPDO	Detail	-	-

01) Statusword [6041h] Remote (Bit 9) returns '0' while PDO or SDO command is in progress, returns '1' after completed.

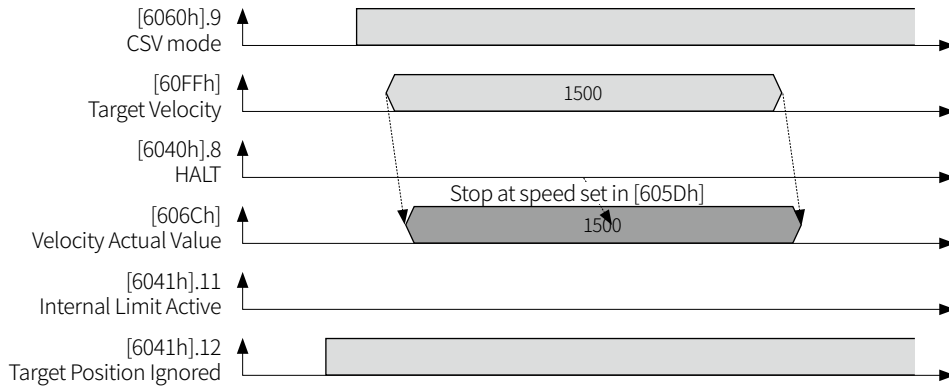
## (2) SDO related object

Index	Sub	Index & Sub Name	Type	Access	Value (default)	Save	Reflect timing
2001h	0h	Limit Stop Method	U16	RW	0 to 1 (0)	Save	After stop
605Ah	0h	Quick Stop Option Code	INT16	RW	Quick Stop at [6085h] speed (2)	Save	Immed.
605Dh	0h	Halt Option Code	INT16	RW	Deceleration stop at [6084h] speed - P(1)	Save	Immed.
605Eh	0h	Fault Reaction Option Code	INT16	RW	0: Hold Off	Save	Immed.
607Dh	1h	-Software Limit	INT32	RW	(-2,147,483,648)	Save	Power ON
	2h	+Software Limit	INT32	RW	(2,147,483,647)		
6084h	0h	Profile Deceleration [step/s <sup>2</sup> ]	U32	RW	1 to 1,000,000,000 (500,000)	Save	After stop
6085h	0h	Quick Stop Deceleration [step/s <sup>2</sup> ]	U32	RW	500 to 500,000,000 (5,000,000)	Save	After stop
60B8h	0h	Touch Probe Function	U16	RW	0000h to FFFFh	-	Immed.
60FEh	1h	Output setting	U32	RW	0 to FFFF FFFFh (0)	-	Immed.
60FDh	0h	Digital Input	U32	RO	Detail	-	-

### 12.4.3 Operation Timing Chart

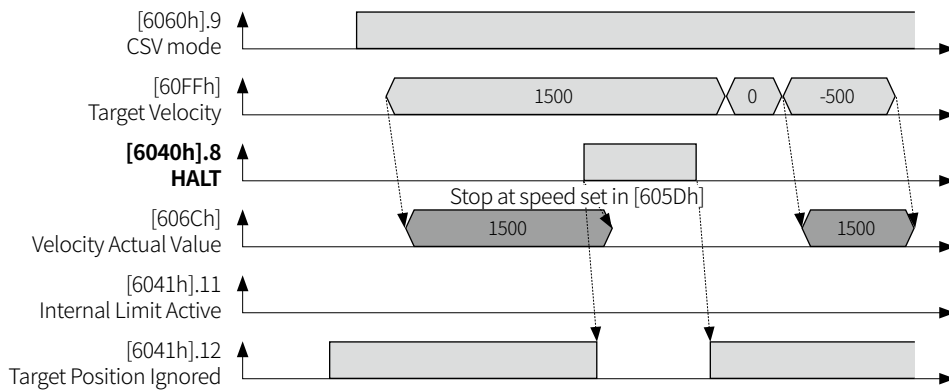
#### 12.4.3.1 Normal Operation

- Master operates with Target Velocity [60FFh] value.



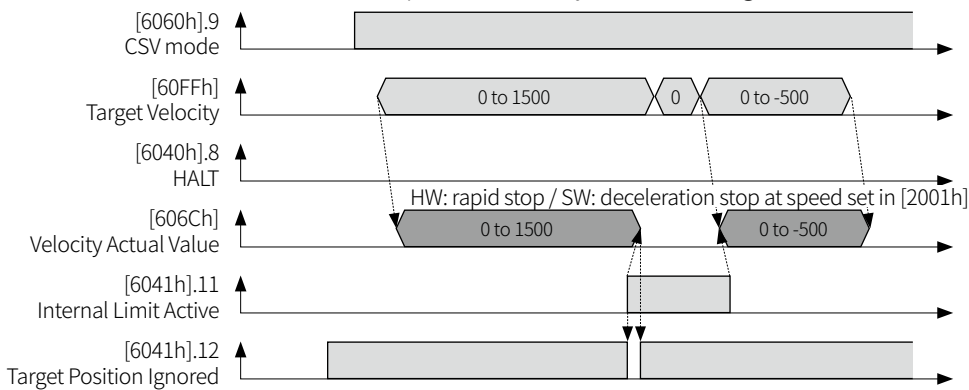
#### 12.4.3.2 HALT Operation

- If Controlword [6040h] HALT (Bit 8) is SET while driving, it stops at speed set in Halt Option Code [605Dh].
- If Controlword [6040h] HALT (Bit 8) is SET, the target position command will be invalid.
- Previous position value will be ignored after HALT stop.



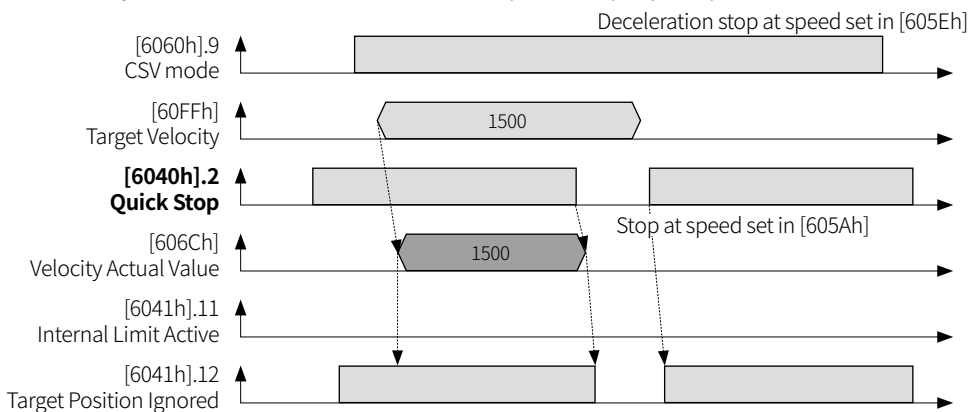
### 12.4.3.3 Internal Limit Operation

- If Limit Sensor is ON while driving, it stops rapidly.
- When current position Position Actual Value [6064h] is out of the setting range of Software Position Limit [6074Dh], it stops at the speed set in Limit Stop Method [2001h].
- In case of Hardware Limit or Software Limit error status, Statusword [6041h] Internal Limit Active (Bit 11) will be SET.
- In case of Software Limit error status, Statusword [6041h] Target Position Ignored (Bit 12) will be RESET and SET.
- If Statusword [6041h] Target Position Ignored (Bit 12) is RESET, the target position command will be invalid.
- To operate CSV mode again after Limit Warning Error, enter speed value 0 to Target Velocity [60FFh] and in reverse direction, it will operate normally after releasing alarm.



### 12.4.3.4 Quick Stop Operation

- If Controlword [6040h] Quick Stop (Bit 2) is RESET while driving, it stops at speed set in Quick Stop Option Code [605Ah].
- After stopping by Quick Stop, Statusword [6041h] Target Position Ignored (Bit 12) will be SET.
- After stopping by Quick Stop, and restart CSV mode, SET the Quick Stop (Bit 2), enter 0 on Target Velocity [60FFh] and desired command speed for proper operation.





## 12.5 Home Mode (HM)

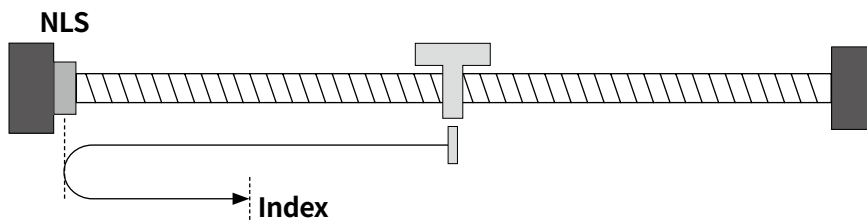
HM mode operates to return to the sensor home.

### 12.5.1 Driving Method

- 01) Set the Modes of Operation [6060h] as 6.
- 02) Set the modes refer to '12.5.2 Homing Operation'.
- 03) Set the driver status by Controlword [6040h] Enable Operation (Bit 3) setting.
- 04) Start Home mode by setting Controlword [6040h] Homing Operation Start (Bit 4) as SET.

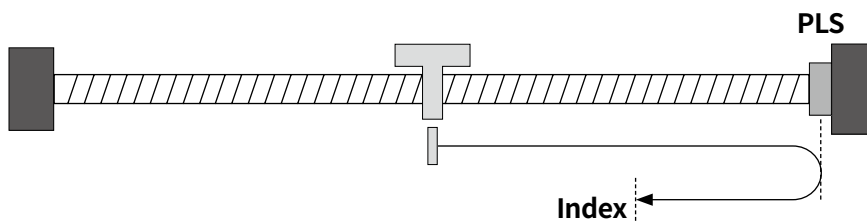
### 12.5.2 Homing Operation

#### 12.5.2.1 Homing on the negative limit switch and index pulse [1]



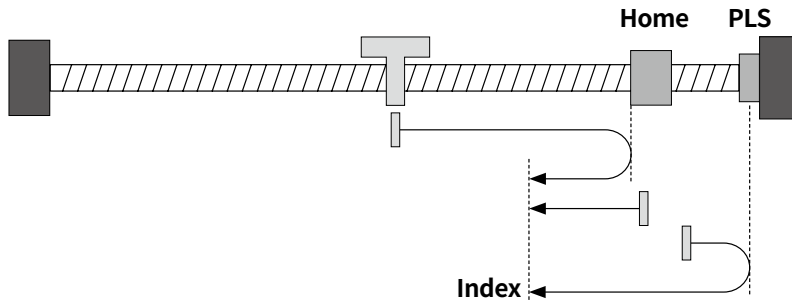
- 01) Move to the negative direction NLS (Negative Limit Sensor) at speed of [Index: 6099h / Sub: 01h].
- 02) When NLS is detected, move to the opposite direction at speed of [Index: 6099h / Sub: 02h]
- 03) When Index Pulse is detected, it stops and set the current position as Home.

#### 12.5.2.2 Homing on the positive limit switch and index pulse [2]



- 01) Move to the positive direction PLS (Positive Limit Sensor) at speed of [Index: 6099h / Sub: 01h].
  - 02) When PLS is detected, move to the opposite direction at speed of [Index: 6099h / Sub: 02h]
  - 03) When Index Pulse is detected, it stops and set the current position as Home.
- Homing alarm occurs when PLS is detected at NLS homing, and when NLS is detected at PLS homing.

### 12.5.2.3 Homing on the switch and index pulse (Positive) [7]



#### A: In case of Home Sensor is located in Positive direction

- 01) Move to the positive direction at speed of [Index: 6099h / Sub: 01h].
- 02) When Home Sensor is detected, move to the opposite direction at speed of [Index: 6099h / Sub: 02h]
- 03) When Index Pulse is detected, it stops and set the current position as Home.

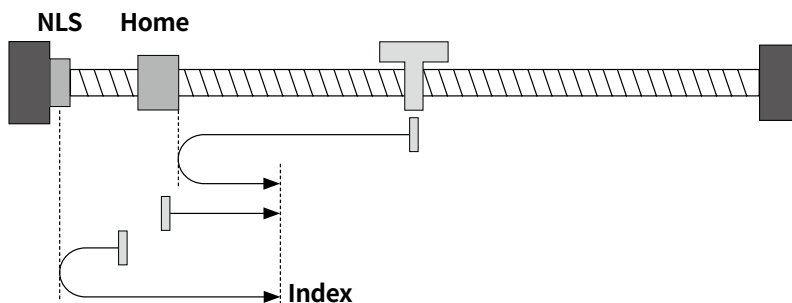
#### B: In case of the current position is in Home Sensor

- 01) Move to the negative direction at speed of [Index: 6099h / Sub: 01h].
- 02) After leaving Home Sensor and when Index Pulse is detected, it stops and set the current position as Home.

#### C: In case of Home Sensor is located in Negative direction

- 01) Move to the positive direction at speed of [Index: 6099h / Sub: 01h].
- 02) When PLS is detected, move to the opposite direction at speed of [Index: 6099h / Sub: 01h]
- 03) When Home Sensor is detected, leave Home Sensor to the same direction at speed of [Index: 6099h / Sub: 02h].
- 04) After leaving Home Sensor and when Index Pulse is detected, it stops and set the current position as Home.

### 12.5.2.4 Homing on home switch and index pulse (Negative) [11]



#### A: In case of Home Sensor is located in Negative direction

- 01) Move to the negative direction at speed of [Index: 6099h / Sub: 01h].
- 02) When Home Sensor is detected, move to the opposite direction at speed of [Index: 6099h / Sub: 02h]
- 03) When Index Pulse is detected, it stops and set the current position as Home.

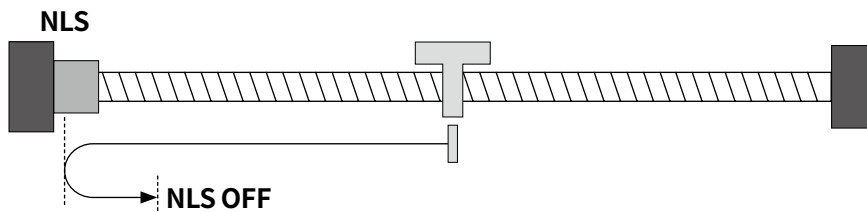
#### B: In case of the current position is in Home Sensor

- 01) Move to the positive direction at speed of [Index: 6099h / Sub: 02h].
- 02) After leaving Home Sensor and when Index Pulse is detected, it stops and set the current position as Home.

#### C: In case of Home Sensor is located in Positive direction

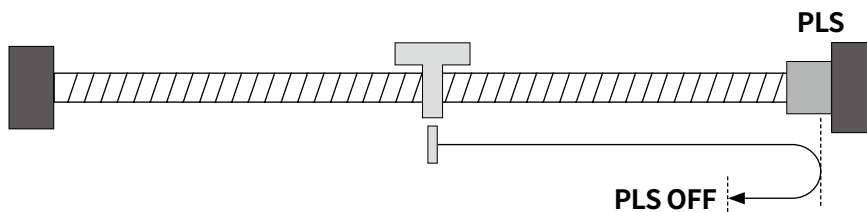
- 01) Move to the negative direction at speed of [Index: 6099h / Sub: 01h].
  - 02) When NLS is detected, move to the opposite direction at speed of [Index: 6099h / Sub: 01h]
  - 03) When Home Sensor is detected, leave Home Sensor to the same direction at speed of [Index: 6099h / Sub: 02h].
  - 04) After leaving Home Sensor and when Index Pulse is detected, it stops and set the current position as Home.
- Homing alarm occurs when PLS is detected at NLS homing, and when NLS is detected at PLS homing.

### 12.5.2.5 Homing without an index pulse (Negative limit switch) [17]



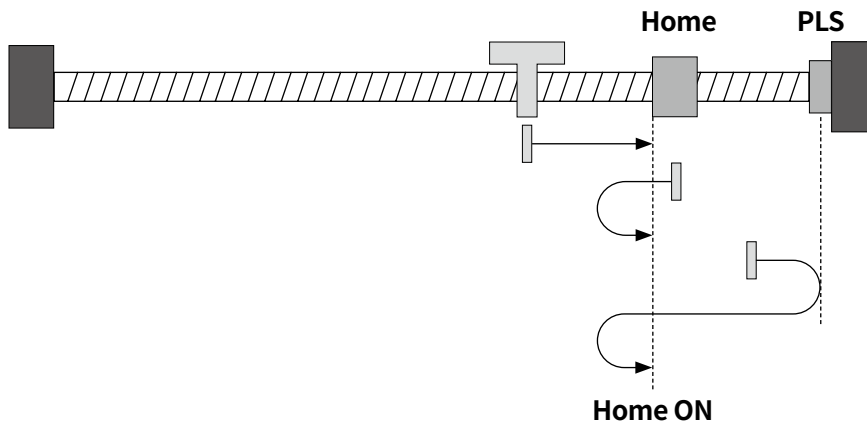
- 01) Move to the negative direction NLS (Negative Limit Sensor) at speed of [Index: 6099h / Sub: 01h].
- 02) When NLS is detected, move to the opposite direction at speed of [Index: 6099h / Sub: 02h]
- 03) When NLS is OFF, it stops and set the current position as Home.

### 12.5.2.6 Homing without an index pulse (Positive limit switch) [18]



- 01) Move to the positive direction PLS (Positive Limit Sensor) at speed of [Index: 6099h / Sub: 01h].
  - 02) When PLS is detected, move to the opposite direction at speed of [Index: 6099h / Sub: 02h]
  - 03) When PLS is OFF, it stops and set the current position as Home.
- Homing alarm occurs when PLS is detected at NLS homing, and when NLS is detected at PLS homing.

### 12.5.2.7 Homing without an index pulse (Positive and Home sensor ON) [24]



#### **A: In case of Home Sensor is located in Positive direction**

- 01) Move to the positive direction at speed of [Index: 6099h / Sub: 01h].
- 02) When Home Sensor is detected, it stops and moves to the opposite direction and stops after leaving Home Sensor.
- 03) Move to Home Sensor direction at speed of [Index: 6099h / Sub: 02h] again. When Home Sensor is detected, set the current position as Home.

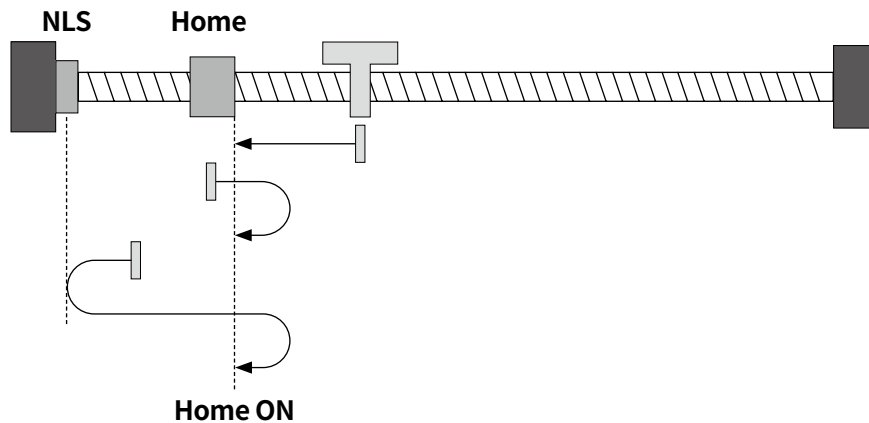
#### **B: In case of the current position is in Home Sensor**

- 01) Move to the negative direction at speed of [Index: 6099h / Sub: 02h].
- 02) After leaving Home Sensor, move to Home Sensor direction at speed of [Index: 6099h / Sub: 02h] again.
- 03) When Home Sensor is detected, it stops and set the current position as Home.

#### **C: In case of Home Sensor is located in Negative direction**

- 01) Move to the positive direction at speed of [Index: 6099h / Sub: 01h].
- 02) When PLS is detected, move to the opposite direction at speed of [Index: 6099h / Sub: 01h]
- 03) When Home Sensor is detected, leave Home Sensor to the same direction.
- 04) After leaving Home Sensor, move to Home Sensor direction at speed of [Index: 6099h / Sub: 02h] again.
- 05) When Home Sensor is detected, it stops and set the current position as Home.

### 12.5.2.8 Homing without an index pulse (Negative and Home sensor ON) [28]



#### A: In case of Home Sensor is located in Negative direction

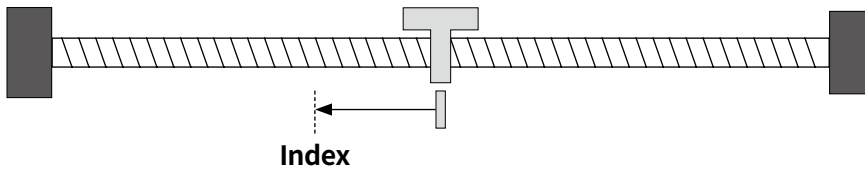
- 01) Move to the negative direction at speed of [Index: 6099h / Sub: 01h].
- 02) When Home Sensor is detected, it stops and moves to the opposite direction and stops after leaving Home Sensor.
- 03) Move to Home Sensor direction at speed of [Index: 6099h / Sub: 02h] again. When Home Sensor is detected, set the current position as Home.

#### B: In case of the current position is in Home Sensor

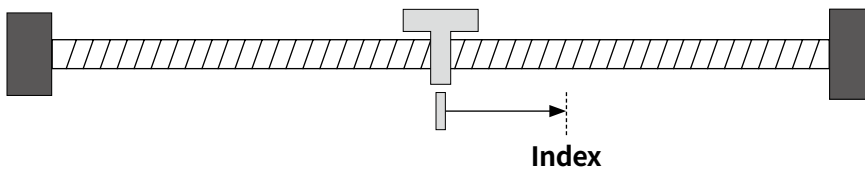
- 01) Move to the positive direction at speed of [Index: 6099h / Sub: 02h].
- 02) After leaving Home Sensor, move to Home Sensor direction at speed of [Index: 6099h / Sub: 02h] again.
- 03) When Home Sensor is detected, it stops and set the current position as Home.

#### C: In case of Home Sensor is located in Positive direction

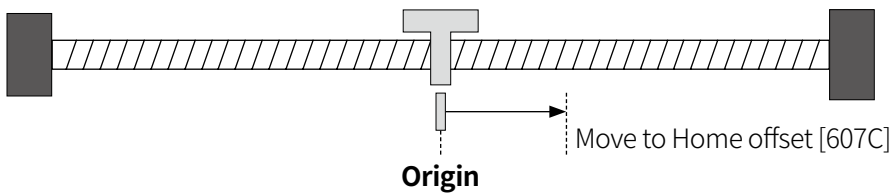
- 01) Move to the negative direction at speed of [Index: 6099h / Sub: 01h].
  - 02) When NLS is detected, move to the opposite direction at speed of [Index: 6099h / Sub: 01h]
  - 03) When Home Sensor is detected, leave Home Sensor to the same direction.
  - 04) After leaving Home Sensor, move to Home Sensor direction at speed of [Index: 6099h / Sub: 02h] again.
  - 05) When Home Sensor is detected, it stops and set the current position as Home.
- Homing alarm occurs when PLS is detected at NLS homing, and when NLS is detected at PLS homing.

**12.5.2.9 Homing on the index pulse (Negative) [33]**

- 01) Move to the negative direction at speed of [Index: 6099h / Sub: 02h] from the current position.
- 02) When Index Pulse is detected, it stops and set the current position as Home.

**12.5.2.10 Homing on the index pulse (Positive) [34]**

- 01) Move to the Positive direction at speed of [Index: 6099h / Sub: 02h] from the current position.
- 02) When Index Pulse is detected, it stops and set the current position as Home.

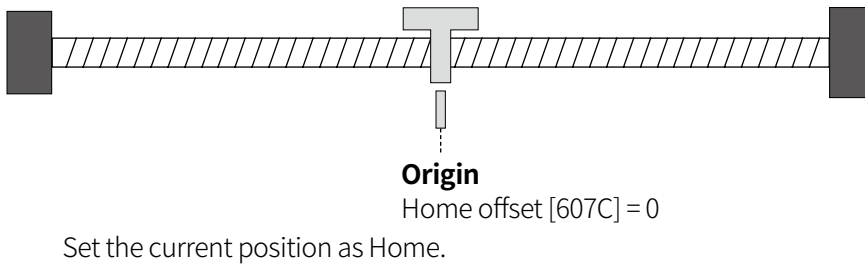
**12.5.2.11 Set the Origin with Home offset [35]****A: In case of Home offset [607C] is '0'**

Set the current position as Home.

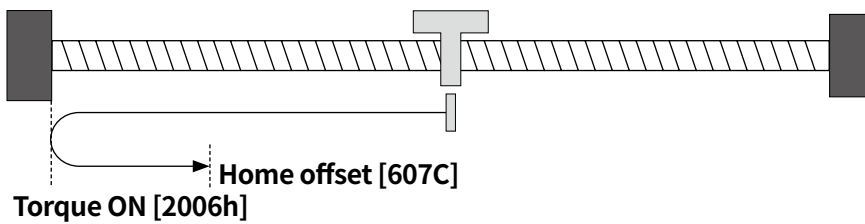
**B: In case of Home offset [607C] is '0'**

- 01) Set the current position as Home.
- 02) Move as much as Offset [607C] at speed of [Index: 6099h / Sub: 02h].

### 12.5.2.12 Set the Origin and Reset Current Position [37]

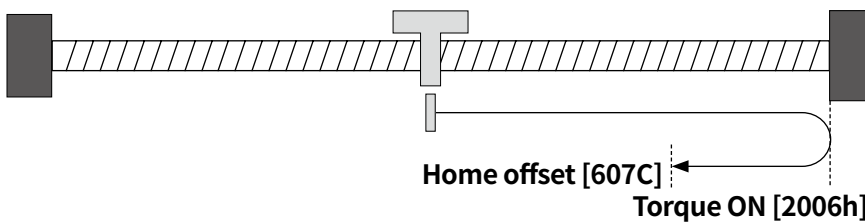


### 12.5.2.13 Torque Homing Search- with Home offset [-3]



- 01) Move to the Negative direction at speed of [Index: 6099h / Sub: 01h] from the current position.
- 02) When the current increases as much as [2002h] setting value due to the damper, move to the positive direction as much as Offset [607C] at speed of [Index: 6099h / Sub: 02h] and stop. Set the current position as Home.

### 12.5.2.14 Torque Homing Search+ with Home offset [-4]



- 01) Move to the Positive direction at speed of [Index: 6099h / Sub: 01h] from the current position.
- 02) When the current increases as much as [2002h] setting value due to the damper, move to the negative direction as much as Offset [607C] at speed of [Index: 6099h / Sub: 02h] and stop. Set the current position as Home.

### 12.5.3 Related Object

#### (1) PDO related object

Index	Sub	Index & Sub Name	Type	Access	PDO mapping	Value (default)	Save	Reflect timing
6040h	0h	Controlword	U16	RW	RxPDO	0: Switch ON 1: Enable Voltage 2: Quick Stop 3: Enable Operation 4: Homing Operation start 5 to 6: Operation mode specific 7: Fault reset 8: Halt 9: Operation mode specific 11 to 15: Manufacturer specific	-	Immed.
6060h	0h	Modes of Operation	INT8	RW	RxPDO	0: Invalid drive function 1: PP(Profile Position Mode) 3: PV(Profile Velocity Mode) 6: HM(Homing Mode) 8: CSP(Cyclic Sync Position) 9: CSV(Cyclic Sync Velocity) 10: CST(Cyclic Sync Torque)	Save	After stop
6041h	0h	Statusword <sup>01)</sup>	U16	RO	TxPDO	0: Ready to switch ON 1: Switched ON 2: Operation enabled 3: Fault 4: Voltage enabled 5: Quick Stop 6: Switch ON disabled 7: Warning 8: Manufacturer specific 9: Remote 0 - Controlword in progress 1 - Controlword complete 10: Target reached 0 - Driving 1 - Homing complete and Halt complete 11: Internal limit active 12: Homing complete 13: Homing error 14, 15: Manufacturer specific	-	-

01) Homing completes when both 10 bit (Target reached) and 12 bit (Homing complete) in [6041h] is '1'.



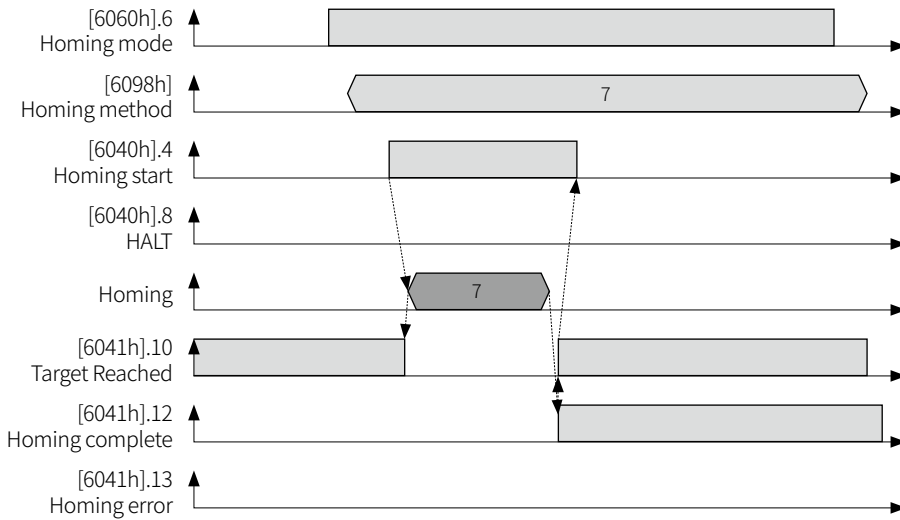
## (2) SDO related object

Index	Sub	Index & Sub Name	Type	Access	Value (default)	Save	Reflect timing
2002h	0h	Homing Torque Ratio	U16	RW	20 to 100 % (20)	Save	After stop
605Ah	0h	Quick Stop Option Code	INT16	RW	Quick Stop at [6085h] speed (2)	Save	Immed.
605Dh	0h	Halt Option Code	INT16	RW	Deceleration stop at [6084h] speed - P(1)	Save	Immed.
607Ch	0h	Home offset	INT32	RW	(100)	Save	Power ON
6084h	0h	Profile Deceleration [step/s <sup>2</sup> ]	U32	RW	500 to 500,000,000 (500,000)	Save	After stop
6085h	0h	Quick Stop Deceleration [step/s <sup>2</sup> ]	U32	RW	500 to 500,000,000 (5,000,000)	Save	After stop
6098h	0h	Homing Method	INT8	RW	-4 to 37	Save	After stop
6099h	1h	Search for Switch	U32	RW	1 to 500,000 (50,000)	Save	After stop
	2h	Search for Zero	U32	RW	1 to 50,000 (20,000)	Save	After stop
609Ah	0h	Homing Acceleration	U32	RW	500 to 500,000,000 (500,000)	Save	After stop
60E3h	1h	Homing Method1	U16	RO	0	-	-
	2h	Homing Method2	U16	RO	1	-	-
	3h	Homing Method3	U16	RO	2	-	-
	4h	Homing Method4	U16	RO	7	-	-
	5h	Homing Method5	U16	RO	11	-	-
	6h	Homing Method6	U16	RO	17	-	-
	7h	Homing Method7	U16	RO	18	-	-
	8h	Homing Method8	U16	RO	24	-	-
	9h	Homing Method9	U16	RO	28	-	-
	10h	Homing Method10	U16	RO	33	-	-
	11h	Homing Method11	U16	RO	34	-	-
	12h	Homing Method12	U16	RO	35	-	-
	13h	Homing Method13	U16	RO	37	-	-
	14h	Homing Method14	U16	RO	-3	-	-
	15h	Homing Method15	U16	RO	-4	-	-

## 12.5.4 Operation Timing Chart

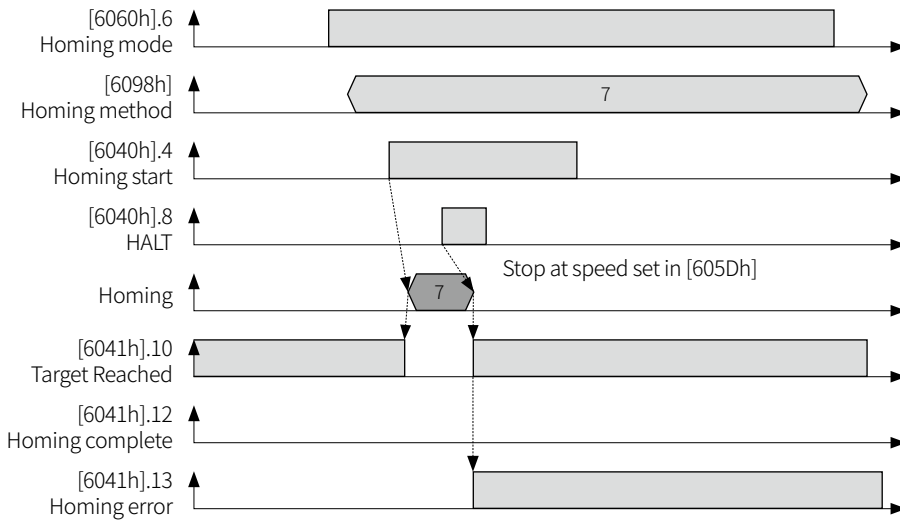
### 12.5.4.1 Normal Operation

- If Controlword [6040h] Homing start (Bit 4) is SET, it operates Home Mode at speed set in Search for Switch [6099h:2h].
- When Home Mode is completed, Statusword [6041h] Homing complete (Bit 12) is SET.



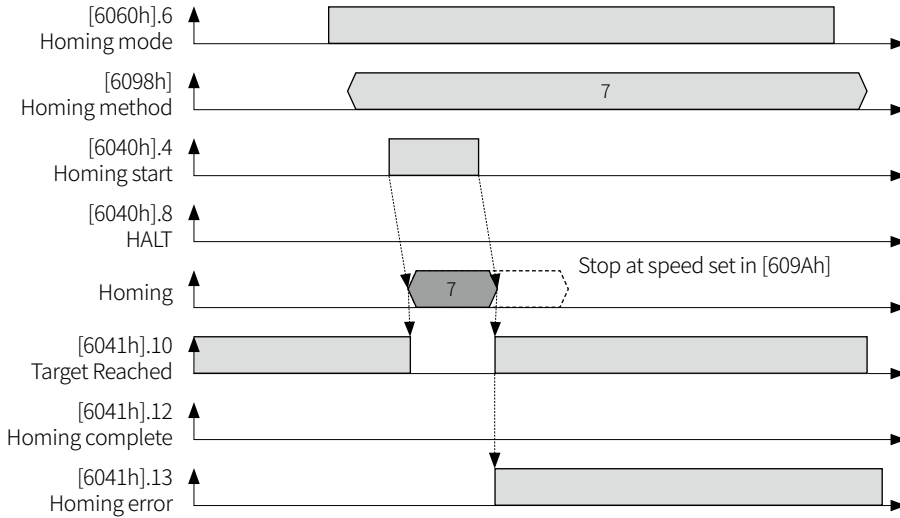
### 12.5.4.2 HALT Operation

- If Controlword [6040h] HALT (Bit 8) is SET while Home Mode driving, Statusword [6041h] Target reached (Bit 10) will be SET and stops at speed set in Halt Option Code [605Dh].
- When Home search error occurs due to HALT signal, Statusword [6041h] Homing error (Bit 13) will be SET.



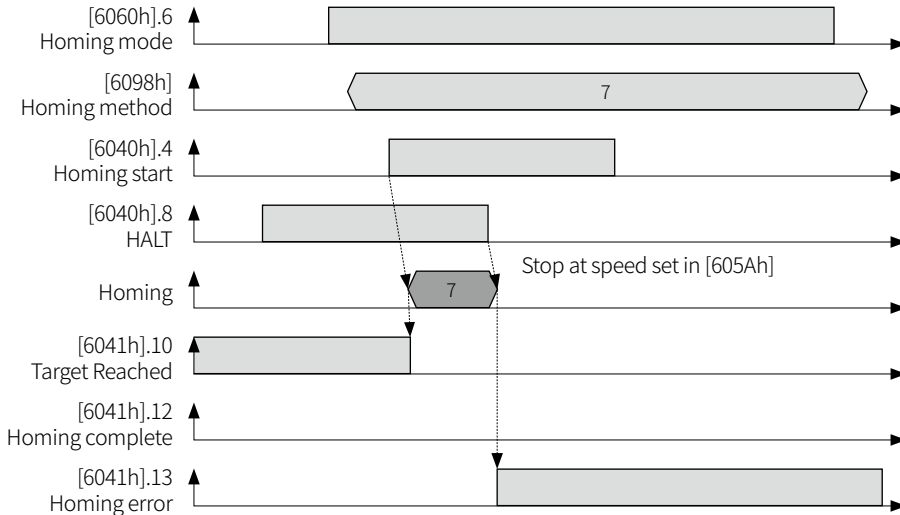
### 12.5.4.3 Homing start OFF Operation

- If Controlword [6040h] Homing start (Bit 4) is RESET while Home Mode driving, it stops at acceleration set in Homing Acceleration [609Ah].
- When Home search error occurs due to Homing start OFF, Statusword [6041h] Homing error (Bit 13) will be SET.



### 12.5.4.4 Quick Stop Operation

- If Controlword [6040h] Quick Stop (Bit 2) is RESET while driving, it stops at speed set in Quick Stop Option Code [605Ah].
- After stopping by Quick Stop, Statusword [6041h] Homing error (Bit 13) will be SET.
- When set Quick Stop Option Code [605Ah] as 5 or 6, it becomes Switch ON disable status after Quick Stop. To operate Homing Mode again, SET the Controlword [6040h] Quick Stop (Bit 2) and RESET and SET the Homing Operation Start (Bit 4) for proper operation.



# 13 Function

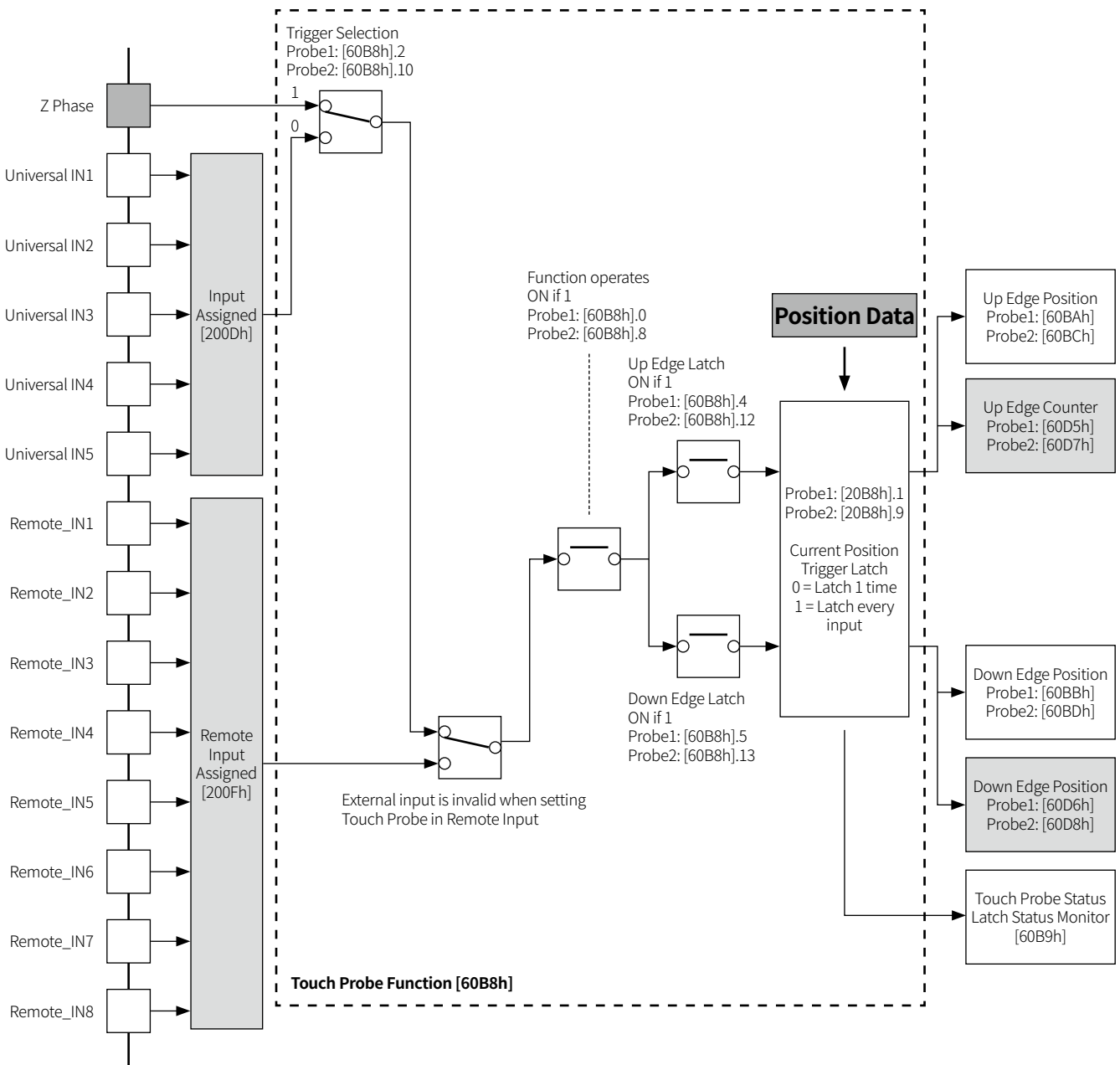
## 13.1 Touch Probe

Touch Probe is a function that records the external general input signal or feedback position when encoder Z-phase operates.

Touch Probe consists of Touch Probe1 and Touch Probe2.

• **Operation setting method**

- 01) Select the latch trigger from the external general input [200Dh], Remote general input [200Fh] or Encoder Z-phase. However, the external general input will be invalid when Remote general input is selected.
- 02) Set whether to operate Touch Probe1 or 2.
- 03) Set whether to operate in Up Edge or Down Edge.



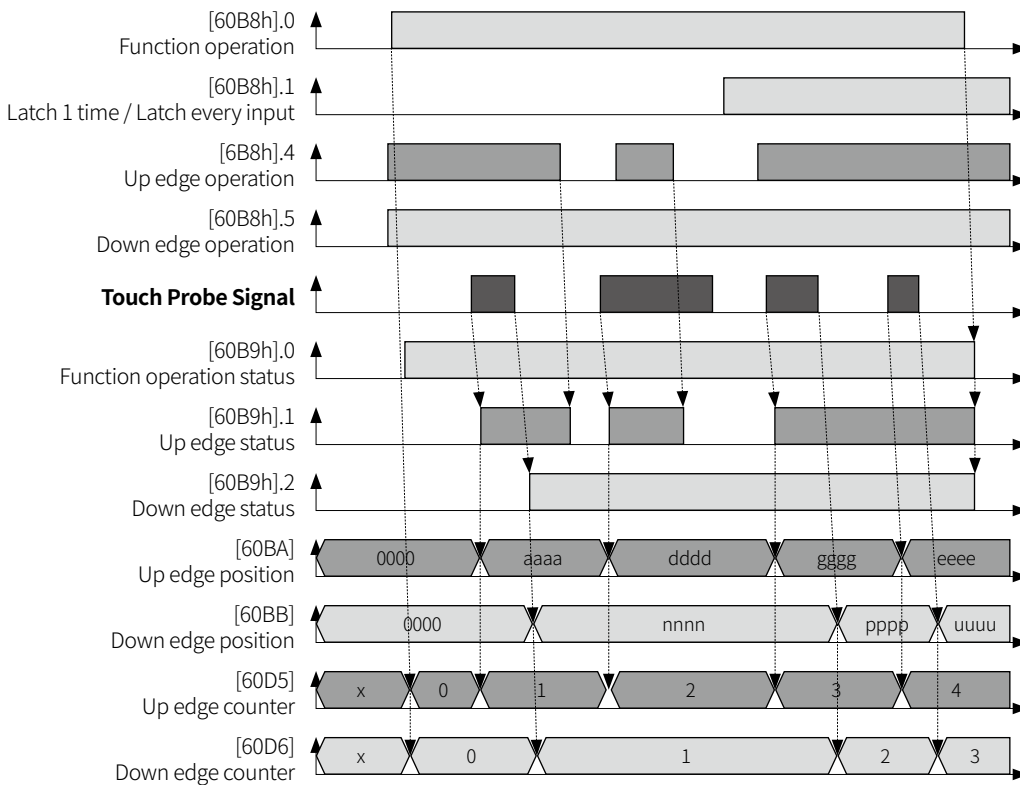
- **Related object**

Index	Name	Type	Access	Value (default)	Save	Reflect timing
200Dh	Input Assigned	U8	RW	0 to 20 (0)	Save	Power ON
200Fh	Remote Input Assigned	U8	RW	0 to 20 (0)	Save	Power ON
60B8h	Touch Probe Function	U16	RW	0000h to FFFFh	-	Immed.
60B9h	Touch Probe Status	U16	RO	Details	-	-
60BAh	Touch Probe1 Up Edge Position	INT32	RO	-	-	-
60BBh	Touch Probe1 Down Edge Position	INT32	RO	-	-	-
60BCh	Touch Probe2 Up Edge Position	INT32	RO	-	-	-
60BDh	Touch Probe2 Down Edge Position	INT32	RO	-	-	-
60D5h	Touch Probe1 Up Edge Counter	U16	RO	-	-	-
60D6h	Touch Probe1 Down Edge Counter	U16	RO	-	-	-
60D7h	Touch Probe2 Up Edge Counter	U16	RO	-	-	-
60D8h	Touch Probe2 Down Edge Counter	U16	RO	-	-	-

- Refer to '14 Object Dictionary' for more detailed information of the corresponding objects.

### 13.1.1 Operation Timing Chart

- Touch Probe Function [60B8h] Bit 0 sets whether to use Touch Probe1 function.
- Touch Probe Status [60B9h] Bit 0 indicates whether to operate Touch Probe1 function.
- In case of setting latch 1 time, the position and counter are updated and countered when the initial trigger is occurred by Touch Probe signal.
- In case of setting latch every input, the position and counter are updated and countered every trigger by Touch Probe signal.
- Touch Probe Status [60B9h] Bit 1 to 2 indicates the input signal detection.
- The detected position value is displayed in Touch Probe1 Up Edge Position [60BAh] and Touch Probe1 Down Edge Position [60BBh].
- The number of times the input signal is detected is displayed in Touch Probe1 Up edge Counter [60D5h] and Touch Probe1 Down edge Counter [60D6h].
- Touch Probe2 function is same as Touch Probe1 function.



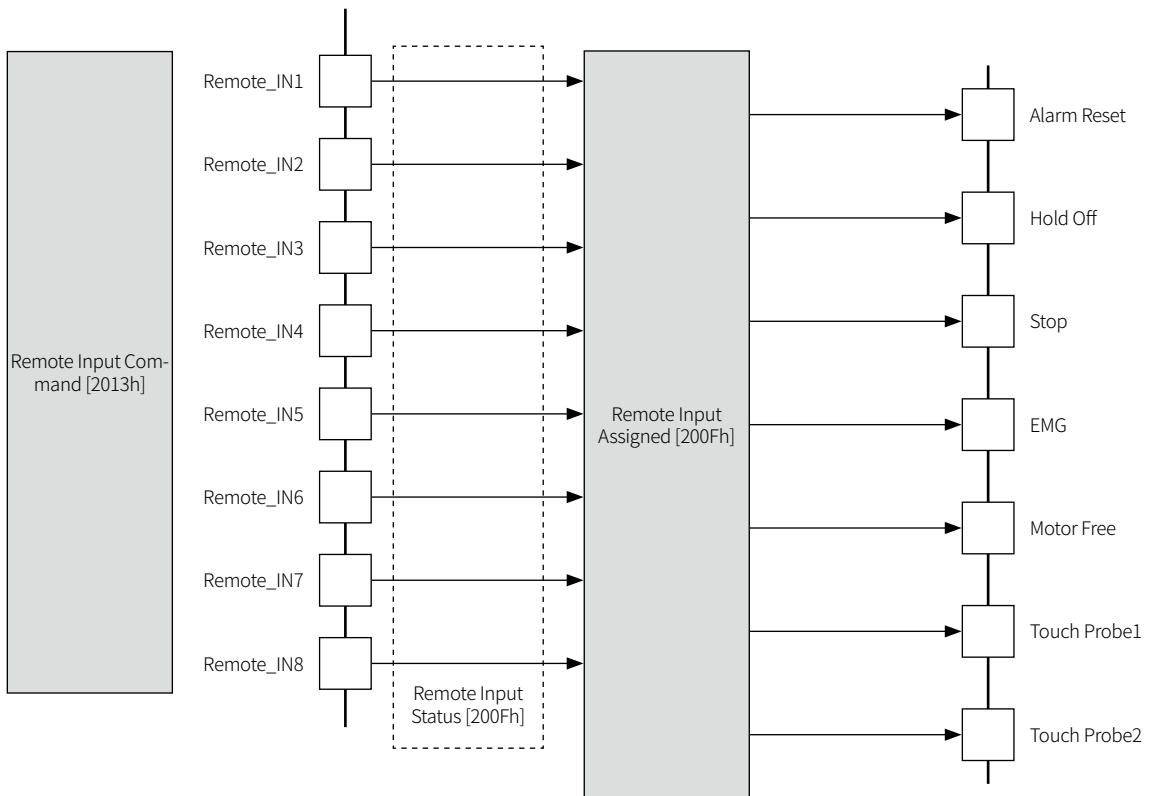
## 13.2 Remote I/O

### 13.2.1 Remote Input

Remote Input is a function that can be used according to Remote Input Command [2013h] setting for functions used in the driver external input.

- **Operation setting method**

- 01) Enter a value to set the function to be used as Remote Input in Remote Input Assigned [200Fh].
- 02) The input signal is ON/OFF by setting the corresponding bit in Remote Input Command [2013h]. However, the external general input will be invalid when Remote general input is used.
- 03) Remote Input Status [2011h] indicates Remote Input status.



- **Related object**

Index	Sub	Name	Type	Access	Value (default)	Save	Reflect timing
200Fh	0h	Number of Entry	U8	RW	8	-	-
	1h	Remote_IN1	U8	RW	0 to 20 (0)	Save	Power ON
	2h	Remote_IN2	U8	RW	0 to 20 (0)	Save	Power ON
	3h	Remote_IN3	U8	RW	0 to 20 (0)	Save	Power ON
	4h	Remote_IN4	U8	RW	0 to 20 (0)	Save	Power ON
	5h	Remote_IN5	U8	RW	0 to 20 (0)	Save	Power ON
	6h	Remote_IN6	U8	RW	0 to 20 (0)	Save	Power ON
	7h	Remote_IN7	U8	RW	0 to 20 (0)	Save	Power ON
8h	Remote_IN8	U8	RW	0 to 20 (0)	Save	Power ON	
2011h	0h	Remote Input Status	U8	RO	Detail	-	-
2013h	0h	Remote Input Command	U8	RW	Detail	-	Immed.

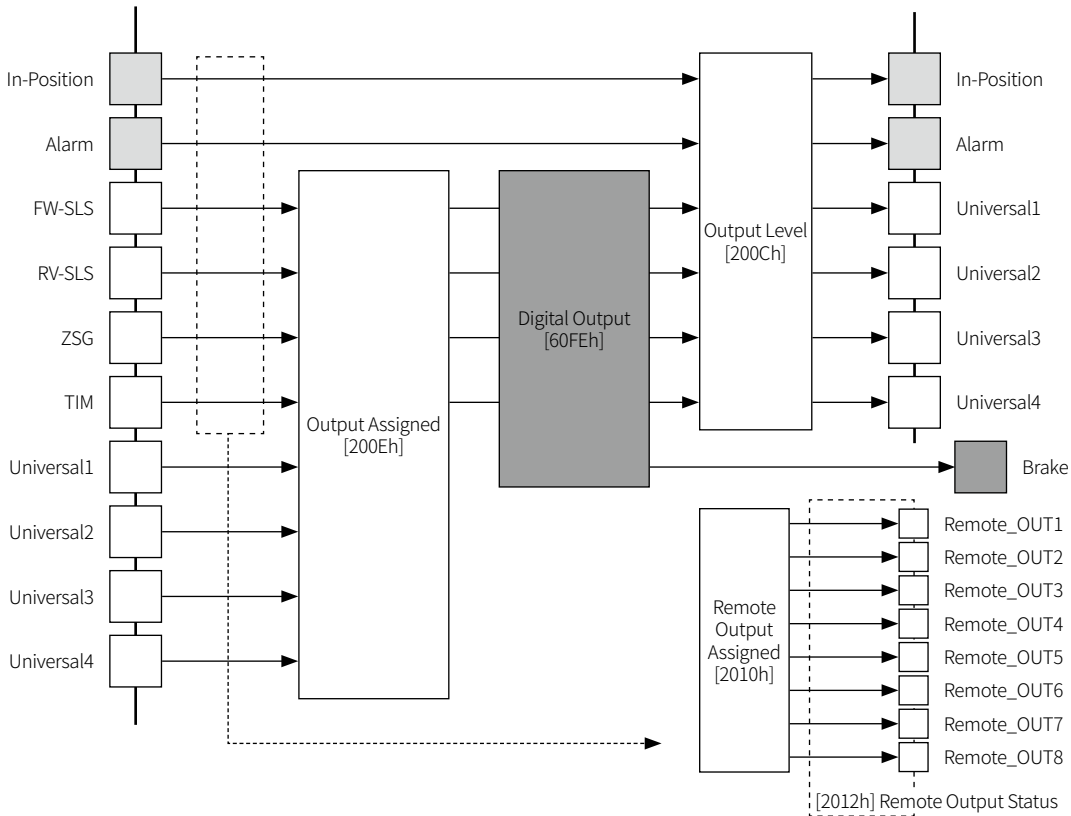
- Refer to '14 Object Dictionary' for more detailed information of the corresponding objects.

### 13.2.2 Remote Output

Remote Output is a function that indicates the function status used in external output in Remote Output Status [2012h] according to Remote Output Assigned [2010h].

• **Operation setting method**

- 01) Enter a value to set the function to be used as Remote Output in Remote Output Assigned [2010h].
- 02) Remote Output Status [2012h] indicates Remote Output status.



• **Related object**

Index	Sub	Name	Type	Access	Value (default)	Save	Reflect timing
	0h	Number of Entry	U8	RW	8	-	-
2010h	1h	Remote_OUT1	U8	RW	0 to 7 (0)	Save	Power ON
	2h	Remote_OUT2	U8	RW	0 to 7 (0)	Save	Power ON
	3h	Remote_OUT3	U8	RW	0 to 7 (0)	Save	Power ON
	4h	Remote_OUT4	U8	RW	0 to 7 (0)	Save	Power ON
	5h	Remote_OUT5	U8	RW	0 to 7 (0)	Save	Power ON
	6h	Remote_OUT6	U8	RW	0 to 7 (0)	Save	Power ON
	7h	Remote_OUT7	U8	RW	0 to 7 (0)	Save	Power ON
	8h	Remote_OUT8	U8	RW	0 to 7 (0)	Save	Power ON
2012h	0h	Remote Output Status	U16	RO	Detail	-	-

- Refer to '14 Object Dictionary' for more detailed information of the corresponding objects.



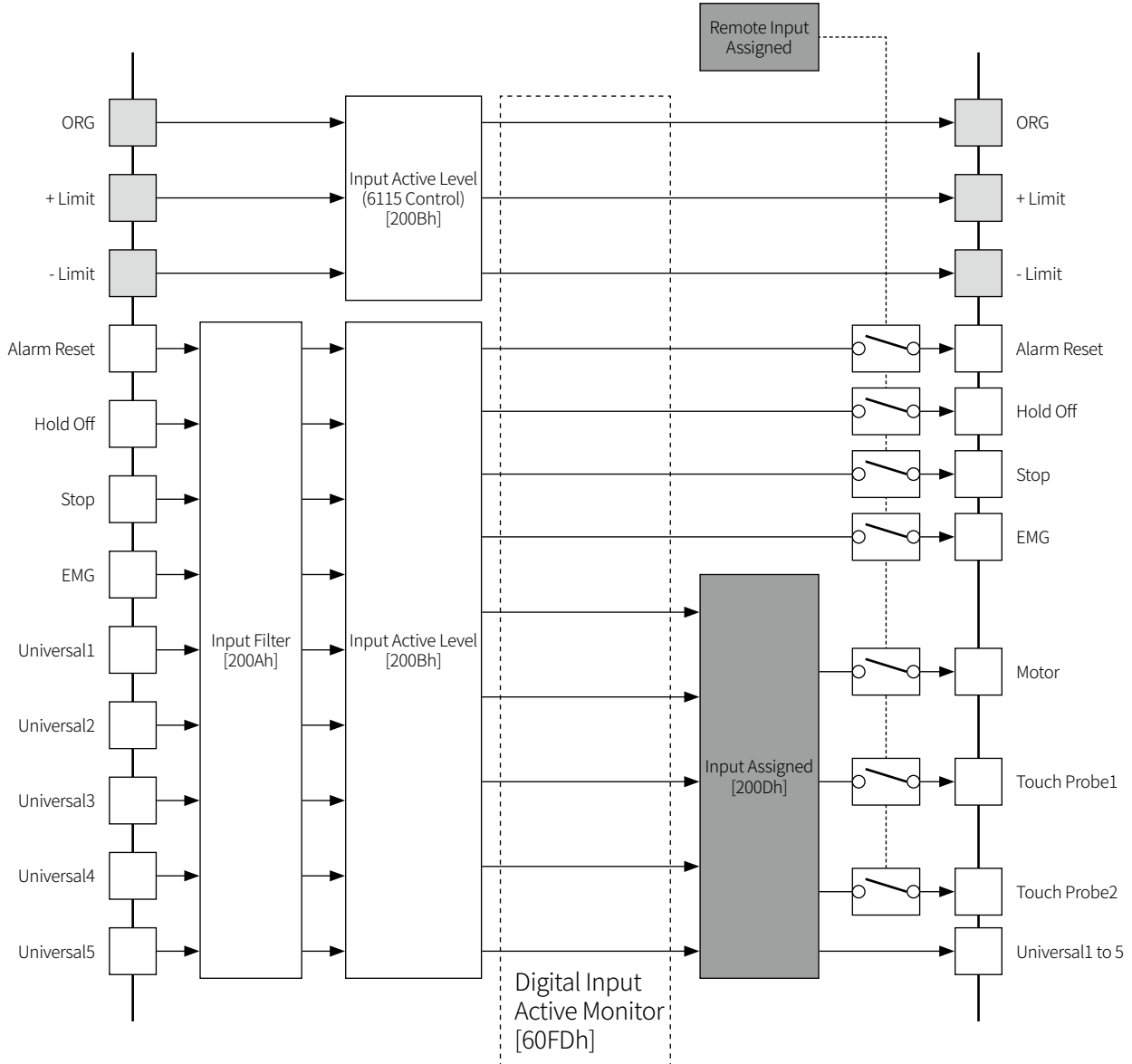
### 13.3 Digital I/O

#### 13.3.1 Digital Input

Digital Input is a function that indicates the driver external input status.

- **Operation setting method**

- 01) When indicating the general input signal existence other than the fixed input, the corresponding input pin is assigned as a general input in Input Assigned [200Dh].
- 02) When the input signal is detected, the corresponding bit will be SET.



- **Related object**

Index	Sub	Name	Type	Access	Value (default)	Save	Reflect timing
200Bh	0h	Input Level	U16	RW	Detail (00h)	Save	Power ON
60FDh	0h	Digital Input	U32	RO	Details	-	-

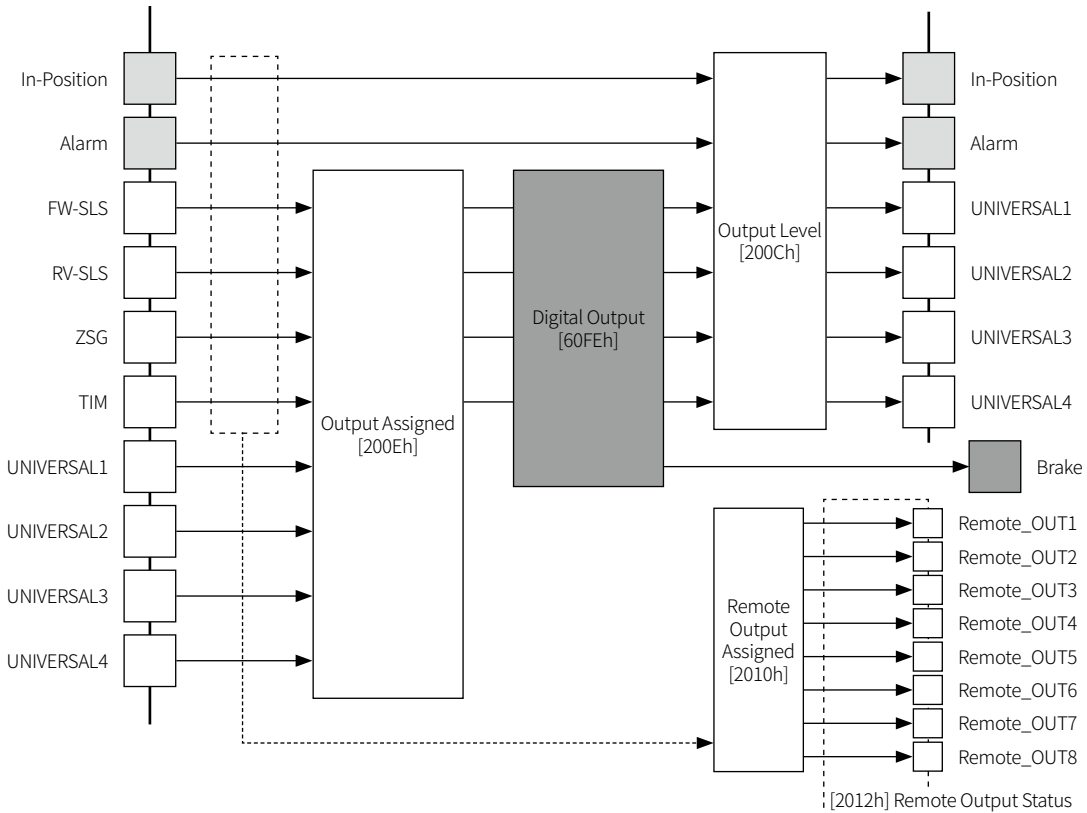
- Refer to '14 Object Dictionary' for more detailed information of the corresponding objects.

### 13.3.2 Digital Output

Digital Output is a function that controls the driver external output.

• **Operation setting method**

- 01) The output pin to be used as a digital output is assigned as a general-purpose output in Output Assigned [200Eh].
- 02) SET Digital Output [60FEh] Bit Mask (2h) bit for brake control and general output validity setting.
- 03) SET Digital Output [60FEh] Output setting (1h) bit to control brake and general output manually.



• **Related Object**

Index	Sub	Name	Type	Access	Value(Default)	Save	Reflect timing
200Eh	0h	Number of Entry	U8	RW	4	-	Power ON
	1h	General output 1	U8	RW	0 to 6 (0)	Save	Power ON
	2h	General output 2	U8	RW	0 to 6 (0)	Save	Power ON
	3h	General output 3	U8	RW	0 to 6 (0)	Save	Power ON
	4h	General output 4	U8	RW	0 to 7 (0)	Save	Power ON
60FEh	0h	Number of Entry	U8	RO	2	-	-
	1h	Output setting	U32	RW	0 to FFFF FFFFh (0)	-	Immed.
	2h	Bit Mask	U32	RW	0 to FFFF FFFFh (0)	-	Immed.

- Refer to '14 Object Dictionary' for more detailed information of the corresponding objects.

## 13.4 Other Functions

### 13.4.1 Software Limit

Drive can be stopped by software limit.

Select the stop condition when detecting software limit range in Limit Stop Method [2001h].

In order to operate software limit, Software Limit [607Dh] value must be set to a value other than 0.

The upper and lower limit can be set separately in Software Limit [607Dh] Sub index (1h, 2h).

- **Related object**

Index	Sub	Name	Type	Access	Value (default)	Save	Reflect timing
2001h	0h	Limit Stop Method	U16	RW	0 to 1 (0) 0: Deceleration stop with [6084h] 1: Quick Stop with [6085h]	Save	After stop
607Dh	1h	-Software Limit	INT32	RW	(-2,147,483,648)	Save	Power ON
	2h	+Software Limit	INT32	RW	(2,147,483,647)	Save	Power ON
6084h	0h	Profile Deceleration	U32	RW	500 to 500,000,000 (500,000)	Save	After stop
6085h	0h	Quick Stop Deceleration	U32	RW	500 to 500,000,000 (5,000,000)	Save	After stop

### 13.4.2 In-Position

In-Position is consisted of Fast Response and Accurate Response.

- Fast Response: When the deviation of the target position and the current position is smaller than the set value, In-Position signal outputs instantly.

- Accurate Response: When the deviation of the target position and the current position is smaller than the set value and maintains over 50 ms, In-Position signal outputs

The mode can be set in Inposition Mode [2017h].

Inposition output range can be set in Position Window [6067h].

For more accurate control, proceed the following operations after checking In-Position output.

Refer to '14.4.21 Inposition Mode: [2017h]' and '14.5.14 Position Window: [6067h]' for more detailed object setting.

- **Related Object**

Index	Sub	Name	Type	Access	Value (default)	Save	Reflect timing
2017h	0h	Inposition Mode	U16	RW	0: Fast Response (0) 1: Accurate Response	Save	After stop
6067h	0h	Position Window	U32	RW	0 to 7 (0)	Save	After stop

### 13.4.3 Motor Gain

It is available to adjust the motor response according to position command by object setting.

According to the load on the motor, it sets the gain and enables the fast position decision and smooth drive.

As much as Gain increased, the transient response improves, error becomes lesser and the motor performance becomes solid.

The Gain setting value is applied when the motor stops.

Gain can be set in Speed Filter & Control Gain [2003h] Sub index (1h).

When setting object as Fine Gain, PI Gain value can be set directly in Speed Filter & Control Gain[2003h] Sub index (2h, 3h).

Gain setting range is 0 to 32. And the object input range is 0 to 32000 with 3 decimal points.

- P Gain: In case of using fraction load, improve the motor response by adjusting Gain

- I Gain: In case of using inertia load, improve the motor response by adjusting Gain

Refer to '14.4.3 Speed Filter & Control Gain: [2003h]' for more detailed object setting.

- **Related object**

Index	Sub	Name	Type	Access	Value (default)	Save	Reflect timing
2003h	1h	Set Control Gain	U16	RW	Speed filter and PI Gain setting (8)	Save	After stop
	2h	P Gain	U16	RW	0 to 32,000	Save	After stop
	3h	I Gain	U16	RW	0 to 32,000	Save	After stop

### 13.4.4 Speed Filter

It is available to adjust the motor response according to command by object setting.

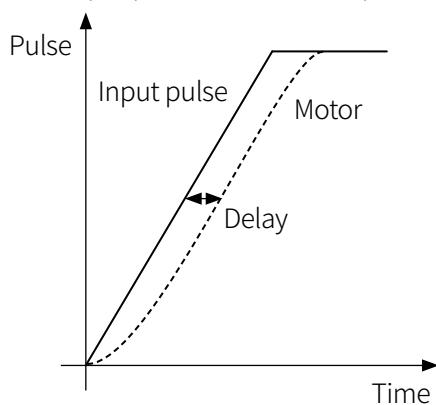
The motor is able to drive smoothly by assigning time delay between command position and motor position with speed filter setting, even though the load is changed or external disturbance.

Refer to '14.4.3 Speed Filter & Control Gain: [2003h]' for more detailed object setting.

- **Related object**

Index	Sub	Name	Type	Access	Value (default)	Save	Reflect timing
2003h	1h	Set Control Gain	U16	RW	Speed filter and PI Gain setting (8)	Save	After stop

<Input pulse and motor response graph>



### 13.4.5 Motor Rotation Direction

The rotation direction can be set by a value set in Polarity [607Eh].

The direction is applied after changing object and re-supplying power.

If Polarity [607Eh] 7 Bit is set to 0, it moves forward and set to 1, it moves backward.

- The rotation direction is based on facing the shaft, and it is clockwise (CW) when rotating to the right.

Refer to '14.5.20 Polarity: [607Eh]' for more detailed object setting.

- **Polarity setting**

	+ RUN	- RUN
<b>Forward</b>	Rotate to CW direction	Rotate to CCW direction
<b>Backward</b>	Rotate to CCW direction	Rotate to CW direction

- **Related object**

Index	Sub	Name	Type	Access	Value (default)	Save	Reflect timing
607Eh	0h	Polarity	U8	RW	0 to 6: Reserved 7: Polarity	Save	After stop

### 13.4.6 Stop Current

Set the stop current that is applied on motor phase for reducing heat and current consumption when motor is stopped.

The initial value is 50 % of max. RUN current, and the value can be changed by object setting.

- **Related object**

Index	Sub	Name	Type	Access	Value (default)	Save	Reflect timing
2006h	0h	Stop Current	U16	RW	20 to 100 % (50)	Save	After stop

### 13.4.7 Resolution

Set the pulse per revolution.

Refer to '14.4.19 Reference Resolution: [2015h]' for more detailed object setting.

- **Related object**

Index	Sub	Name	Type	Access	Value (default)	Save	Reflect timing
2015h	0h	Reference Resolution	U16	RW	500 to 16,000 (10,000)	Save	Power ON

### 13.4.8 Alarm / Warning

The occurred alarms are saved in Alarm History [2016h] Sub index (2h to 11h) from the most recent to 10. If Alarm History [2016h] Sub index (1h) is SET from 0 to 1, the alarm history will be reset. The red LED flashes 0.4 sec interval until the current alarm / warning is solved.

#### 13.4.8.1 Alarm Display Function

It stops motor to protected driver, depending on the error status such as overcurrent or overspeed. Alarm status can be reset by re-applying power after removing alarm caution or assigning 'Alarm Reset' signal.

Display	Alarm type	Descriptions	Torque	Brake
E.5	EtherCAT Comm. error	When comm. disconnected with EtherCAT Master	-	-
E.1	Overcurrent error	When overcurrent flows at motor RUN element	Release	Lock
E.2	Overspeed error	When motor speed is over 3,500 rpm		
E.3	Position tracking error	When the gap between position command value and current position value is over 90°		
E.4	Overload error	When applying load over the rated load for over 1 sec		
E.5	Overheat error	When driver inner temperature is over 80 °C		
E.6	Motor connection error	When motor cable connection error occurs at driver		
E.7	Encoder connection error	When encoder cable connection error occurs at driver		
E.8	Regenerative voltage error	When regenerative voltage is over 78 V		
E.9	Motor misalignment error	When motor is in misalignment		
E.R.	Command speed error	When command speed is over 3,500 rpm		
E.b.	Input voltage error	When input voltage is out of 24 VDC $\pm 10\%$		
E.C.	In-Position error	When position error (over 1) is kept over 3 sec, after motor stopped	Release	Release
E.d.	Memory error	When memory error is detected as power applied		
E.E.	Emergency stop	When emergency stopped with emergency stop command		
E.H.	Home search error	When failed to find home		

#### 13.4.8.2 Warning Display Function

This function notices dangers prior to motor stop with limit signal or overload alarm. When removing warning condition, the driver returns to normal status automatically.

Display	Warning type	Descriptions	Torque	Brake
U.1	+ Software limit	When normal direction (CW) software limit is ON	Remain	Release
U.2	- Software limit	When reverse direction (CCW) software limit is ON		
U.3	+ Hardware limit	When normal direction (CW) hardware limit is ON		
U.4	- Hardware limit	When reverse direction (CCW) hardware limit is ON		
U.5	Overload warning	When maximum load is kept connected over 10 sec (motor or driver can be overheated)		



#### Note

Even though warning occurs, it drives as normal status but it may cause product damage. Other warning may occur while the overload warning occurs.

#### • Related object

Index	Sub	Name	Type	Access	Value (default)	Save	Reflect timing
2016h	1h	Alarm History Clear	U16	RW	Clear: 0 → 1	-	Immed.
	2h to 11h	Alarm History 1 to 10	U16	RO	-	-	-

### 13.4.9 Object Save

Save the object value on EEPROM through Data Save [201Bh].

If 0xF0F0 is entered in Data Save [201Bh] it saves the saved objects in a batch, and if 0xEEEE is entered it initialize the objects.

When the object is saved or initialized, Data Save[201Bh] returns 0x8888 and when the process is incompletd, it returns 0x1111.

- **Related object**

Index	Sub	Name	Type	Access	Value (default)	Save	Reflect timing
201Bh	0h	Data Save	U16	RO	-	-	-

## 14 Object Dictionary

This is the area to save all parameters.

For CiA402 Device profile, the objects and data types are predefined in CANOpen so that the user can configure the objects according to functions. In addition, the manufacturer can directly define and use object and data type.

### 14.1 Communication Object

#### 14.1.1 Device type: [1000h]

Display the device type.

Index	Sub	Type	Access	PDO mapping	Value (default)	Save	Reflect timing
1000h	0h	U32	RO	NO	0004 0192h	-	-

Bit	Name	Content
0 to 15	Device profile	CiA DS402: 0192h
16 to 23	Type	Stepper motor: 04h
24 to 31	Mode bits	Manufacturer specific

#### 14.1.2 Error Register: [1001h]

Display the device error status.

Index	Sub	Type	Access	PDO mapping	Value (default)	Save	Reflect timing
1001h	0h	U8	RO	NO	0 to 7 Bit	-	-

Bit	Content
0	General error
1	Current error
2	Voltage error
3	Temperature error
4	Communication error
5	Profile error
6	Reserved
7	Manufacturer-specific error

#### 14.1.3 Device Name: [1008h]

Display the device name.

Index	Sub	Type	Access	PDO mapping	Value (default)	Save	Reflect timing
1008h	0h	String	RO	NO	AiC-EC Driver	-	-

#### 14.1.4 Hardware Version: [1009h]

Display the hardware version.

Index	Sub	Type	Access	PDO mapping	Value (default)	Save	Reflect timing
1009h	0h	String	RO	NO	Hardware Version	-	-

#### 14.1.5 Software Version: [100Ah]

Display the software version.

Index	Sub	Type	Access	PDO mapping	Value (default)	Save	Reflect timing
100Ah	0h	String	RO	NO	Software Version	-	-



### 14.1.6 Identity: [1018h]

Display the device information.

Index	Sub	Name	Type	Access	PDO mapping	Value (default)	Save	Reflect timing
1018h	0h	Number of Entry	U8	RO	NO	4	-	-
	1h	Vendor ID	U32	RO	NO	759h	-	-
	2h	Product Code	U32	RO	NO	00416943h	-	-
	3h	Revision Number	U32	RO	NO	1h	-	-
	4h	Serial Number	U32	RO	NO	0h	-	-

## 14.2 PDO Mapping Object

### 14.2.1 Receiving PDO Mapping 1 (CSP RxPDO): [1600h]

Index	Sub	Name	Type	Access	PDO mapping	Value (default)	Save	Reflect timing
1600h	0h	Number of Entry	U8	RW	NO	0 to 8 (5)	-	Immed.
	1h	Mapping Object1	U32	RW	NO	(6040 0010h)	-	Immed.
	2h	Mapping Object2	U32	RW	NO	(607A 0020h)	-	Immed.
	3h	Mapping Object3	U32	RW	NO	(60B8 0010h)	-	Immed.
	4h	Mapping Object4	U32	RW	NO	(60FE 0020h)	-	Immed.
	5h	Mapping Object5	U32	RW	NO	(6060 0008h)	-	Immed.
	6h	Mapping Object6	U32	RW	NO	(0000 0000h)	-	Immed.
	7h	Mapping Object7	U32	RW	NO		-	Immed.
	8h	Mapping Object8	U32	RW	NO		-	Immed.

[6040 0010h]: Control Word (16 bit)

[6060 0008h]: Modes of Operation (8 bit)

[607A 0020h]: Target Position (32 bit)

[60B8 0010h]: Touch Probe Function (16 bit)

[60FE 0020h]: Digital Output (32 bit)

### 14.2.2 Receiving PDO Mapping 2 (PP/PV RxPDO): [1601h]

Index	Sub	Name	Type	Access	PDO mapping	Value (default)	Save	Reflect timing
1601h	0h	Number of Entry	U8	RW	NO	0 to 8 (6)	-	Immed.
	1h	Mapping Object1	U32	RW	NO	(6040 0010h)	-	Immed.
	2h	Mapping Object2	U32	RW	NO	(607A 0020h)	-	Immed.
	3h	Mapping Object3	U32	RW	NO	(6081 0020h)	-	Immed.
	4h	Mapping Object4	U32	RW	NO	(60FE 0020h)	-	Immed.
	5h	Mapping Object5	U32	RW	NO	(60FF 0020h)	-	Immed.
	6h	Mapping Object6	U32	RW	NO	(6060 0008h)	-	Immed.
	7h	Mapping Object7	U32	RW	NO	(0000 0000h)	-	Immed.
	8h	Mapping Object8	U32	RW	NO		-	Immed.

[6040 0010h]: Control Word (16 bit)

[6060 0008h]: Modes of Operation (8 bit)

[607A 0020h]: Target Position (32 bit)

[6081 0020h]: Profile Velocity (32 bit)

[60FE 0020h]: Digital Output (32 bit)

[60FF 0020h]: Target Velocity (32 bit)

### 14.2.3 Receiving PDO Mapping 3 (CSV RxPDO): [1602h]

Index	Sub	Name	Type	Access	PDO mapping	Value (default)	Save	Reflect timing
1602h	0h	Number of Entry	U8	RW	NO	0 to 8 (5)	-	Immed.
	1h	Mapping Object1	U32	RW	NO	(6040 0010h)	-	Immed.
	2h	Mapping Object2	U32	RW	NO	(60B8 0010h)	-	Immed.
	3h	Mapping Object3	U32	RW	NO	(60FE 0020h)	-	Immed.
	4h	Mapping Object4	U32	RW	NO	(60FF 0020h)	-	Immed.
	5h	Mapping Object5	U32	RW	NO	(6060 0008h)	-	Immed.
	6h	Mapping Object6	U32	RW	NO	(0000 0000h)	-	Immed.
	7h	Mapping Object7	U32	RW	NO		-	Immed.
	8h	Mapping Object8	U32	RW	NO		-	Immed.

[6040 0010h]: Control Word (16 bit)

[6060 0008h]: Modes of Operation (8 bit)

[60B8 0010h]: Touch Probe Function (16 bit)

[60FE 0020h]: Digital Output (32 bit)

[60FF 0020h]: Target Velocity (32 bit)

### 14.2.4 Transmitting PDO Mapping 1 (CSP TxPDO): [1A00h]

Index	Sub	Name	Type	Access	PDO mapping	Value (default)	Save	Reflect timing
1A00h	0h	Number of Entry	U8	RW	NO	0 to 8 (8)	-	Immed.
	1h	Mapping Object1	U32	RW	NO	(6041 0010h)	-	Immed.
	2h	Mapping Object2	U32	RW	NO	(6064 0020h)	-	Immed.
	3h	Mapping Object3	U32	RW	NO	(60BA 0020h)	-	Immed.
	4h	Mapping Object4	U32	RW	NO	(60BB 0020h)	-	Immed.
	5h	Mapping Object5	U32	RW	NO	(60BC 0020h)	-	Immed.
	6h	Mapping Object6	U32	RW	NO	(60BD 0020h)	-	Immed.
	7h	Mapping Object7	U32	RW	NO	(60FD 0020h)	-	Immed.
	8h	Mapping Object8	U32	RW	NO	(6061 0008h)	-	Immed.

[6041 0010h]: Status Word (16 bit)

[6061 0008h]: Modes of Operation Display (8 bit)

[6064 0020h]: Position Actual Value (32 bit)

[60BA 0020h]: Touch Probe1 Up Edge Position (32 bit)

[60BB 0020h]: Touch Probe1 Down Edge Position (32 bit)

[60BC 0020h]: Touch Probe2 Up Edge Position (32 bit)

[60BD 0020h]: Touch Probe2 Down Edge Position (32 bit)

[60FD 0020h]: Digital Inputs (32 bit)

### 14.2.5 Transmitting PDO Mapping 2 (PP/PV TxPDO): [1A01h]

Index	Sub	Name	Type	Access	PDO mapping	Value (default)	Save	Reflect timing
1A01h	0h	Number of Entry	U8	RW	NO	0 to 8 (5)	-	Immed.
	1h	Mapping Object1	U32	RW	NO	(6041 0010h)	-	Immed.
	2h	Mapping Object2	U32	RW	NO	(6064 0020h)	-	Immed.
	3h	Mapping Object3	U32	RW	NO	(606C 0020h)	-	Immed.
	4h	Mapping Object4	U32	RW	NO	(60FD 0020h)	-	Immed.
	5h	Mapping Object5	U32	RW	NO	(6061 0008h)	-	Immed.
	6h	Mapping Object6	U32	RW	NO	(0000 0000h)	-	Immed.
	7h	Mapping Object7	U32	RW	NO		-	Immed.
	8h	Mapping Object8	U32	RW	NO		-	Immed.

[6041 0010h]: Status Word (16 bit)

[6061 0008h]: Modes of Operation Display (8 bit)

[6064 0020h]: Position Actual Value (32 bit)

[606C 0020h]: Velocity Actual Value (32 bit)

[60FD 0020h]: Digital Inputs (32 bit)

### 14.2.6 Transmitting PDO Mapping 3 (CSV TxPDO): [1A02h]

Index	Sub	Name	Type	Access	PDO mapping	Value (default)	Save	Reflect timing
1A02h	0h	Number of Entry	U8	RW	NO	0 to 8 (8)	-	Immed.
	1h	Mapping Object1	U32	RW	NO	(6041 0010h)	-	Immed.
	2h	Mapping Object2	U32	RW	NO	(6064 0020h)	-	Immed.
	3h	Mapping Object3	U32	RW	NO	(606C 0020h)	-	Immed.
	4h	Mapping Object4	U32	RW	NO	(60BA 0020h)	-	Immed.
	5h	Mapping Object5	U32	RW	NO	(60BB 0020h)	-	Immed.
	6h	Mapping Object6	U32	RW	NO	(60BC 0020h)	-	Immed.
	7h	Mapping Object7	U32	RW	NO	(60BD 0020h)	-	Immed.
	8h	Mapping Object8	U32	RW	NO	(60FD 0020h)	-	Immed.

[6041 0010h]: Status Word (16 bit)

[6061 0008h]: Modes of Operation Display (8 bit)

[606C 0020h]: Velocity Actual Value (32 bit)

[60BA 0020h]: Touch Probe1 Up Edge Position (32 bit)

[60BB 0020h]: Touch Probe1 Down Edge Position (32 bit)

[60BC 0020h]: Touch Probe2 Up Edge Position (32 bit)

[60BD 0020h]: Touch Probe2 Down Edge Position (32 bit)

[60FD 0020h]: Digital Inputs (32 bit)

**14.2.7 SM2 PDO Assign (RxPDO Assign): [1C12h]**

Set the objects corresponding to Sync Manager2 PDO output.  
(Changeable when pre-operational mode)

Index	Sub	Name	Type	Access	PDO mapping	Value (default)	Save	Reflect timing
1C12h	0h	Number of Entry	U8	RW	NO	1	-	Immed.
	1h	PDO1 allocation	U16	RW	NO	(1600h)	-	Immed.

**14.2.8 SM3 PDO Assign (TxPDO Assign): [1C13h]**

Set the objects corresponding to Sync Manager3 PDO input. (Changeable when pre-operational mode)

Index	Sub	Name	Type	Access	PDO mapping	Value (default)	Save	Reflect timing
1C12h	0h	Number of Entry	U8	RW	NO	1	-	Immed.
	1h	PDO1 allocation	U16	RW	NO	(1A00h)	-	Immed.

## 14.3 Sync Manager Object

### 14.3.1 Sync Manager Type: [1C00h]

Set the communication type of Sync Manager.

Index	Sub	Name	Type	Access	PDO mapping	Value (default)	Save	Reflect timing
1C00h	0h	Number of Entry	U8	RO	NO	4	-	-
	1h	SM0 communication type	U8	RO	NO	1: Mailbox Rx (M → S)	-	-
	2h	SM1 communication type	U8	RO	NO	2: Mailbox Tx (S → M)	-	-
	3h	SM2 communication type	U8	RO	NO	3: PDO output (M → S)	-	-
	4h	SM3 communication type	U8	RO	NO	4: PDO input (S → M)	-	-

### 14.3.2 SM Output Parameter: [1C32h]

Set the sync type and display the status of Sync Manager2 (SM2).

Index	Sub	Name	Type	Access	PDO mapping	Value (default)	Save	Reflect timing
1C32h	0h	Number of Entry	U8	RO	NO	32	-	-
	1h	Sync Type	U16	RW	NO	00, 01, 02h (02h)	-	Immed.
	2h	Cycle Time [ns]	U32	RW	NO	-	-	-
	3h	Shift Time [ns]	U32	RO	NO	0	-	-
	4h	Synchronization Types Supported	U16	RO	NO	0007h	-	-
	5h	Minimum Cycle Time [ns]	U32	RO	NO	0000 0000h	-	-
	6h	Calculate and Copy Time [ns]	U32	RO	NO	0000 0000h	-	-
	8h	Get cycle time	U16	RW	NO	0000h	-	Immed.
	9h	Delay Time [ns]	U16	RO	NO	0	-	-
	Ah	Sync0 cycle time	U32	RW	NO	0000 0000h	-	Immed.
	Bh	SM_Event Missed	U16	RO	NO	0000h	-	-
	Ch	Cycle Time Too small	U16	RO	NO	0000h	-	-
	20h	Sync Error	BOOL	RO	NO	0	-	-

Bit	Name	Content
1h	Sync Type	00h: Free Run mode (Async Mode) 01h: SM2 Event Sync Mode 02h: DC Mode (SYNC0 Event Sync)
2h	Cycle Time [ns]	Display Cycle Time of SYNC0 Event.
3h	Shift Time [ns]	Shift Time is not supported. (0)
4h	Synchronization Types Supported	Display supported sync type. Bit 0: Free Run Mode (Async Mode) Bit 1: SM2 Event Sync Mode Bit 2: DC Mode (SYNC0 Event Sync)
5h	Minimum Cycle Time [ns]	Display supported min. Cycle Time.
6h	Calculate and Copy Time [ns]	Display the min. value of internal calculation and copy time required from SM2 Event to SYNC0 Event.
8h	Get cycle time	Set Cycle Time.
9h	Delay Time [ns]	Delay Time is not supported. (0)
Ah	Sync0 cycle time	Set Cycle time of Sync0.
Bh	SM_Event Missed	Display missing SM2 Event.
Ch	Cycle Time Too small	Display the Cycle Time which is too small.
20h	Sync Error	Become 1 when Sync Error occurs.

### 14.3.3 SM Input Parameter: [1C33h]

Set the sync type and display the status of Sync Manager3 (SM3).

Index	Sub	Name	Type	Access	PDO mapping	Value (default)	Save	Reflect timing
1C33h	0h	Number of Entry	U8	RO	NO	32	-	-
	1h	Sync Type	U16	RW	NO	00, 01, 02h (02h)	-	Immed.
	2h	Cycle Time [ns]	U32	RW	NO	-	-	-
	3h	Shift Time [ns]	U32	RO	NO	0	-	-
	4h	Synchronization Types Supported	U16	RO	NO	0007h	-	-
	5h	Minimum Cycle Time [ns]	U32	RO	NO	0003 D090h (250,000 ns)	-	-
	6h	Calculate and Copy Time [ns]	U32	RO	NO	0000 0000h	-	-
	8h	Get cycle time	U16	RW	NO	0000h	-	Immed.
	9h	Delay Time [ns]	U16	RO	NO	0	-	-
	Ah	Sync0 cycle time	U32	RW	NO	0000 0000h	-	Immed.
	Bh	SM_Event Missed	U16	RO	NO	0000h	-	-
	Ch	Cycle Time Too small	U16	RO	NO	0000h	-	-
	20h	Sync Error	BOOL	RO	NO	0	-	-

Bit	Name	Content
1h	Sync Type	00h: Free Run mode (Async Mode) 01h: SM2 Event Sync Mode 02h: DC Mode (SYNC0 Event Sync)
2h	Cycle Time [ns]	Display Cycle Time of SYNC0 Event.
3h	Shift Time [ns]	Shift Time is not supported. (0)
4h	Synchronization Types Supported	Display supported sync type. Bit 0: Free Run Mode (Async Mode) Bit 1: SM2 Event Sync Mode Bit 2: DC Mode (SYNC0 Event Sync)
5h	Minimum Cycle Time [ns]	Display supported min. Cycle Time.
6h	Calculate and Copy Time [ns]	Display the min. value of internal calculation and copy time required from SM2 Event to SYNC0 Event.
8h	Get cycle time	Set Cycle Time.
9h	Delay Time [ns]	Delay Time is not supported. (0)
Ah	Sync0 cycle time	Set Cycle time of Sync0.
Bh	SM_Event Missed	Display missing SM2 Event.
Ch	Cycle Time Too small	Display the Cycle Time which is too small.
20h	Sync Error	Become 1 when Sync Error occurs.



## 14.4 Manufacturer Specific Object

### 14.4.1 Limit Stop Method: [2001h]

Select the stop condition when detecting the software limit range.

Index	Sub	Type	Access	PDO mapping	Value (default)	Save	Reflect timing
2001h	0h	U16	RW	NO	0 to 1 (0) 0: Deceleration stop with [6084h] 1: Quick Stop with [6085h]	Save	After stop

- In case of setting deceleration stop time value [6084h] as long (small value), it may stop out of expected range.
- It stop immediately when detecting hardware limit.  
(It may occur overcurrent fault due to fast stop, if the sensor is detected at high speed.)

### 14.4.2 Homing Torque Ratio: [2002h]

Set the torque when Homing mode -1 to -4 setting.

Index	Sub	Type	Access	PDO mapping	Value (default)	Save	Reflect timing
2002h	0h	U16	RW	NO	20 to 100 % (20)	Save	After stop

- If the set torque value is less than the drive torque, it may be recognized as the damper is touched without actually touching, and the home may be completed. Thus be aware of this condition.

### 14.4.3 Speed Filter & Control Gain: [2003h]

Set the driver's speed filter and Gain value.

Index	Sub	Name	Type	Access	PDO mapping	Value (default)	Save	Reflect timing
2003h	0h	Number of Entry	U8	RO	NO	3	-	After stop
	1h	Set Control Gain	U16	RW	NO	Speed filter and P I Gain setting (8)	Save	After stop
	2h	P Gain	U16	RW	NO	0 to 32,000	Save	After stop
	3h	I Gain	U16	RW	NO	0 to 32,000	Save	After stop

- If 0 to 0x0F value is entered in control gain, it can set as speed filter.  
If 0 to 0xE0 value is entered in control gain, the gain value is set by manufacturer P, I Gain is applied.  
If Fine Gain (0xF0) P, I Gain setting is set, the P, I Gain value set in Sub index 2h, 3h are applied respectively.

#### Control Gain setting

Gain		Speed filter	
Value	Upper value	Value	Lower value
0	0	0	0
1	1	1	1
2	2	2	2
3	3	3	3
4	4	4	4
5	5	5	5
6	6	6	6
7	7	7	7
8	8	8	8
9	9	9	9
10	A	10	A
11	B	11	B
12	C	12	C
13	D	13	D
14	E	14	E
Fine Gain	F	15	F

#### Example of setting)

- Gain: 11 (B) / Speed filter: 8 (8) = 0xB8 (184)
- Gain: 6 (6) / Speed filter: 10 (A) = 0x6A (106)
- Gain: Fine Gain (F) / Speed filter: 14 (E) = 0xFE (254)
- Gain: 5 (5) / Speed filter: 7 (7) = 0x57 (87)
- Gain: 12 (C) / Speed filter: 15 (F) = 0xCF (207)

### 14.4.4 Start Speed: [2005h]

Set the initial speed in PP, PV mode. [Pulse / sec]

Index	Sub	Type	Access	PDO mapping	Value (default)	Save	Reflect timing
2005h	0h	U16	RW	NO	1 to 50,000 (1)	Save	After stop

### 14.4.5 Stop Current: [2006h]

Set the ratio of stop current when motor stops.

Index	Sub	Type	Access	PDO mapping	Value (default)	Save	Reflect timing
2006h	0h	U16	RW	NO	20 to 100 % (50)	Save	After stop

### 14.4.6 Main Voltage: [2008h]

Display the main voltage to 2 decimal digits. [1 / 100 V]

Index	Sub	Type	Access	PDO mapping	Value (default)	Save	Reflect timing
2008h	0h	U16	RO	NO	-	-	-

- E.g.) Main Voltage: 2395 = 23.95 V

### 14.4.7 Inverter Voltage: [2009h]

Display the voltage applied to inverter to 2 decimal digits. [1 / 100 V]

Index	Sub	Type	Access	PDO mapping	Value (default)	Save	Reflect timing
2009h	0h	U16	RO	NO	-	-	-

- E.g.) Inverter Voltage: 5639 = 56.39 V

### 14.4.8 Input Filter: [200Ah]

Set the filter value of the input signal input to the driver.

Index	Sub	Name	Type	Access	PDO mapping	Value (default)	Save	Reflect timing
200Ah	0h	Number of Entry	U8	RO	NO	9	-	-
	1h	Alarm Reset	U8	RW	NO	0 to 2 (0)	Save	After stop
	2h	Hold Off	U8	RW	NO	0 to 2 (0)	Save	After stop
	3h	Stop	U8	RW	NO	0 to 2 (0)	Save	After stop
	4h	EMG	U8	RW	NO	0 to 2 (0)	Save	After stop
	5h	General input 1	U8	RW	NO	0 to 2 (0)	Save	After stop
	6h	General input 2	U8	RW	NO	0 to 2 (0)	Save	After stop
	7h	General input 3	U8	RW	NO	0 to 2 (0)	Save	After stop
	8h	General input 4	U8	RW	NO	0 to 2 (0)	Save	After stop
	9h	General input 5	U8	RW	NO	0 to 2 (0)	Save	After stop

Value	Descriptions
0	No filter
1	1.5 ms
2	10 ms

### 14.4.9 Input Level: [200Bh]

Set the input level value input to the driver.

Index	Sub	Type	Access	PDO mapping	Value (default)	Save	Reflect timing
200Bh	0h	U16	RW	NO	Detail (00h)	Save	Power ON

Bit	Name	Status	Descriptions
0	ORG	1	High active
		0	Low active
2	+/-Limit	1	High active
		0	Low active
3	Alarm Reset	1	High active
		0	Low active
4	Hold Off	1	High active
		0	Low active
5	Stop	1	High active
		0	Low active
6	EMG	1	High active
		0	Low active
7	General input 1	1	High active
		0	Low active
8	General input 2	1	High active
		0	Low active
9	General input 3	1	High active
		0	Low active
10	General input 4	1	High active
		0	Low active
11	General input 5	1	High active
		0	Low active
12 to 15	Reserved		

- + Limit and - Limit input level change together.

#### Example of setting)

Reset, EMG: Low active and etc:

When setting as High active, enter '0xFB7h'  
due to it is '1111 1011 0111'

### 14.4.10 Output Level: [200Ch]

Set the output level value output to the driver.

Index	Sub	Type	Access	PDO mapping	Value (default)	Save	Reflect timing
200Ch	0h	U16	RW	NO	Detail (00h)	Save	Power ON

Bit	Name	Status	Descriptions
0	In-Position	1	High output
		0	Low output
1	Alarm	1	High output
		0	Low output
2	General output 1	1	High output
		0	Low output
3	General output 2	1	High output
		0	Low output
4	General output 3	1	High output
		0	Low output
5	General output 4	1	High output
		0	Low output
6 to 15	Reserved		

#### Example of setting)

Alarm: Low output and etc:

When setting as High active, enter '0xFDh' due to it is '1111 1101'.

### 14.4.11 Input Assigned: [200Dh]

Assign driver input.

Index	Sub	Name	Type	Access	PDO mapping	Value (default)	Save	Reflect timing
200Dh	0h	Number of Entry	U8	RO	NO	5	-	Power ON
	1h	General input 1	U8	RW	NO	0 to 20 (0)	Save	Power ON
	2h	General input 2	U8	RW	NO	0 to 20 (0)	Save	Power ON
	3h	General input 3	U8	RW	NO	0 to 20 (0)	Save	Power ON
	4h	General input 4	U8	RW	NO	0 to 20 (0)	Save	Power ON
	5h	General input 5	U8	RW	NO	0 to 20 (0)	Save	Power ON

Value	Contents	Descriptions
0	Disabled	Disable the input
2	General input	Input general signal
17	Motor free	Cut off the motor's excitation current to make it unexcited status. If Brake is attached, release the brake.
19	Touch Probe1 Source	Used as external latch signal of Touch Probe1.
20	Touch Probe2 Source	Used as external latch signal of Touch Probe2.

- Duplicate input setting is not allowed, and small sub index value is applied first.  
(General input 1: motor free, General input 2: when motor free setting, general input 1 is only applied, 2 is general input)

### 14.4.12 Output Assigned: [200Eh]

Assign driver output.

Index	Sub	Name	Type	Access	PDO mapping	Value (default)	Save	Reflect timing
200Eh	0h	Number of Entry	U8	RW	NO	4	-	Power ON
	1h	General output 1	U8	RW	NO	0 to 6 (0)	Save	Power ON
	2h	General output 2	U8	RW	NO	0 to 6 (0)	Save	Power ON
	3h	General output 3	U8	RW	NO	0 to 6 (0)	Save	Power ON
	4h	General output 4	U8	RW	NO	0 to 7 (0)	Save	Power ON

Value	Contents	Descriptions
0	Disable	Disable the output
1	General output	Output general signal
4	FW-SLS	+ software limit reach output
5	RV-SLS	- software limit reach output
6	ZSG	Output every 1 rotation of the index output motor
7	TIM	Output every 7.2° rotation (Only available in general output 4)

- In case of TIM, ZSG output, it may be difficult to measure accurately if the rotation speed is fast.

### 14.4.13 Remote Input Assigned: [200Fh]

Set the command value to be input from Master.

Index	Sub	Name	Type	Access	PDO mapping	Value (default)	Save	Reflect timing
200Fh	0h	Number of Entry	U8	RW	NO	8	-	Power ON
	1h	Remote IN 1	U8	RW	NO	0 to 20 (0)	Save	Power ON
	2h	Remote IN 2	U8	RW	NO	0 to 20 (0)	Save	Power ON
	3h	Remote IN 3	U8	RW	NO	0 to 20 (0)	Save	Power ON
	4h	Remote IN 4	U8	RW	NO	0 to 20 (0)	Save	Power ON
	5h	Remote IN 5	U8	RW	NO	0 to 20 (0)	Save	Power ON
	6h	Remote IN 6	U8	RW	NO	0 to 20 (0)	Save	Power ON
	7h	Remote IN 7	U8	RW	NO	0 to 20 (0)	Save	Power ON
	8h	Remote IN 8	U8	RW	NO	0 to 20 (0)	Save	Power ON

Value	Contents	Descriptions
0	Disable	Disable the input
5	Alarm Reset (fixed)	Driver reset
6	Hold Off (fixed)	Servo ON/OFF
7	Stop (fixed)	Drive stop (Stop according to [605Ah] Quick Stop Option Code)
8	EMG (fixed)	Drive emergent stop
17	Motor free	Cut off the motor's excitation current to make it unexcited status. If Brake is attached, release the brake.
19	Touch Probe1 Source	Used as external latch signal of Touch Probe1.
20	Touch Probe2 Source	Used as external latch signal of Touch Probe2.

- When signal is ON, input as '1', and input as '0' when OFF.
- When the function used in the driver external input is used in Remote Input setting, the driver input is invalid.

### 14.4.14 Remote Output Assigned: [2010h]

Set the command value to be output to Master.

Index	Sub	Name	Type	Access	PDO mapping	Value (default)	Save	Reflect timing
2010h	0h	Number of Entry	U8	RW	NO	8	-	Power ON
	1h	Remote OUT 1	U8	RW	NO	0 to 7 (0)	Save	Power ON
	2h	Remote OUT 2	U8	RW	NO	0 to 7 (0)	Save	Power ON
	3h	Remote OUT 3	U8	RW	NO	0 to 7 (0)	Save	Power ON
	4h	Remote OUT 4	U8	RW	NO	0 to 7 (0)	Save	Power ON
	5h	Remote OUT 5	U8	RW	NO	0 to 7 (0)	Save	Power ON
	6h	Remote OUT 6	U8	RW	NO	0 to 7 (0)	Save	Power ON
	7h	Remote OUT 7	U8	RW	NO	0 to 7 (0)	Save	Power ON
	8h	Remote OUT 8	U8	RW	NO	0 to 7 (0)	Save	Power ON

Value	Contents	Descriptions
0	Disable	Disable the output
2	In-Position (fixed)	Output when positioning drive is completed.
3	Alarm Out (fixed)	Output when alarm occurs.
4	FW-SLS	+ software limit reach output
5	RV-SLS	- software limit reach output
6	ZSG	Output every 1 rotation of Z phase position
7	TIM	Output every 7.2° rotation <sup>01)</sup>

01) In case of using in remote, it may be difficult to obtain accurate value due to communication cycle.

- When signal is ON, output as '1', and input as '0' when OFF.

### 14.4.15 Remote Input Status: [2011h]

Display the Remote Input status.

Index	Sub	Type	Access	PDO mapping	Value (default)	Save	Reflect timing
2011h	0h	U16	RO	NO	Detail	-	-

Bit	Name	Status	Contents
0	Remote_IN1	0	No input value
		1	Input
1	Remote_IN2	0	No input value
		1	Input
2	Remote_IN3	0	No input value
		1	Input
3	Remote_IN4	0	No input value
		1	Input
4	Remote_IN5	0	No input value
		1	Input
5	Remote_IN6	0	No input value
		1	Input
6	Remote_IN7	0	No input value
		1	Input
7	Remote_IN8	0	No input value
		1	Input

### 14.4.16 Remote Output Status: [2012h]

Display the Remote Output status.

Index	Sub	Type	Access	PDO mapping	Value (default)	Save	Reflect timing
2012h	0h	U16	RO	NO	Detail	-	-

Bit	Name	Status	Contents
0	Remote_OUT1	0	No output value
		1	Output
1	Remote_OUT2	0	No output value
		1	Output
2	Remote_OUT3	0	No output value
		1	Output
3	Remote_OUT4	0	No output value
		1	Output
4	Remote_OUT5	0	No output value
		1	Output
5	Remote_OUT6	0	No output value
		1	Output
6	Remote_OUT7	0	No output value
		1	Output
7	Remote_OUT8	0	No output value
		1	Output



**14.4.17 Remote Input Command: [2013h]**

Command Remote Input from Master to driver.

Index	Sub	Type	Access	PDO mapping	Value (default)	Save	Reflect timing
2013h	0h	U16	RW	NO	Detail	-	Immediately

Bit	Name	Status	Contents
0	Remote_IN1	0	No input value
		1	Input ON
1	Remote_IN2	0	No input value
		1	Input ON
2	Remote_IN3	0	No input value
		1	Input ON
3	Remote_IN4	0	No input value
		1	Input ON
4	Remote_IN5	0	No input value
		1	Input ON
5	Remote_IN6	0	No input value
		1	Input ON
6	Remote_IN7	0	No input value
		1	Input ON
7	Remote_IN8	0	No input value
		1	Input ON

**14.4.18 Internal Current: [2014h]**

Display internal output current in driver. (unit: mA)

Index	Sub	Type	Access	PDO mapping	Value (default)	Save	Reflect timing
2014h	0h	U32	RO	NO	-	-	-

### 14.4.19 Reference Resolution: [2015h]

Set the pulse per revolution.

Index	Sub	Type	Access	PDO mapping	Value (default)	Save	Reflect timing
2015h	0h	U16	RW	NO	500 to 16,000 (10,000)	Save	Power ON

#### Settable resolution value

<input type="checkbox"/> 20 mm	<input type="checkbox"/> 28 / 35 mm	<input type="checkbox"/> 42 / 56 / 60 mm
500	500	500
1,000	1,000	1,000
1,600	1,600	1,600
2,000	2,000	2,000
3,600	3,600	3,200
4,000	5,000	3,600
5,000	6,400	5,000
6,400	7,200	6,400
7,200	10,000	7,200
10,000	16,000	10,000

### 14.4.20 Alarm History: [2016h]

Save in order of 1 to 10 in the alarm history whenever alarm occurs.

Index	Sub	Name	Type	Access	PDO mapping	Value (default)	Save	Reflect timing
2016h	0h	Number of Entry	U8	RW	NO	11	-	-
	1h	Alarm History Clear	U16	RW	NO	Clear: 0 → 1	-	Immed.
	2h	Alarm History 1	U16	RO	NO	-	-	-
	3h	Alarm History 2	U16	RO	NO	-	-	-
	4h	Alarm History 3	U16	RO	NO	-	-	-
	5h	Alarm History 4	U16	RO	NO	-	-	-
	6h	Alarm History 5	U16	RO	NO	-	-	-
	7h	Alarm History 6	U16	RO	NO	-	-	-
	8h	Alarm History 7	U16	RO	NO	-	-	-
	9h	Alarm History 8	U16	RO	NO	-	-	-
	10h	Alarm History 9	U16	RO	NO	-	-	-
11h	Alarm History 10	U16	RO	NO	-	-	-	

- When saved up to Alarm History 10, roll back to Alarm History 1 and save.

#### Alarm History 1 to 10

Error Code	Contents	Error Code	Contents
FF00h	No error	FF08h	Regenerative voltage error
FFC5h	Communication error	FF09h	Motor alignment error
FF01h	Overcurrent error	FF10h	Command speed error
FF02h	Overspeed error	FF11h	Input voltage error
FF03h	Position tracking error	FF12h	In-position error
FF04h	Overload error	FF13h	Memory error
FF05h	Overheat error	FF14h	Emergency stop
FF06h	Motor connection error	FF15h	Home search error
FF07h	Encoder connection error	-	-

**14.4.21 Inposition Mode: [2017h]**

Set the In-Position value.

Index	Sub	Type	Access	PDO mapping	Value (default)	Save	Reflect timing
2017h	0h	U16	RW	NO	(0) 0: Fast Response 1: Accurate Response	Save	After stop

**14.4.22 ID Shift: [2018h]**

Shift the ID value set with the communication ID setting rotary switch by 100 units.

Index	Sub	Type	Access	PDO mapping	Value (default)	Save	Reflect timing
2018h	0h	U16	RW	NO	0 to 644 (0)	Save	Power ON

- E.g.) Set 99 with rotary switch, set ID Shift as 1, ID will be 199. Thus the max. number of selectable ID is 65535.

**Device ID**

ID Shift × 100	Rotary × 10	Rotary × 1	Final ID
0	0 to 9	0 to 9	0 to 99
1	0 to 9	0 to 9	100 to 199
2	0 to 9	0 to 9	200 to 299
3	0 to 9	0 to 9	300 to 399
			⋮
			⋮
			⋮
655	0 to 9	0 to 9	65500 to 65535

**14.4.23 Driver Temperature: [201Ah]**

Display the driver temperature in Celsius degree.

Index	Sub	Type	Access	PDO mapping	Value (default)	Save	Reflect timing
201Ah	0h	U16	RO	NO	-	-	-

**14.4.24 Data Save: [201Bh]**

Save and reset the parameters.

Index	Sub	Type	Access	PDO mapping	Value (default)	Save	Reflect timing
201Bh	0h	U16	RO	NO	-	-	-

Value	Contents
F0F0h (61680)	Save the parameters. (Batch save the save object) Return 8888h when completed. Return 1111h when incompletd.
EEEEh (61166)	Reset the parameters. Return 8888h when completed. Return 1111h when incompletd.

## 14.5 Drive Profile Object

### 14.5.1 Error Code: [603Fh]

Display the error code occurring in the device.

Index	Sub	Type	Access	PDO Mapping	Value (default)	Save	Reflect timing
603Fh	0h	U16	RO	NO	0000h: No error FFC5h: Communication error FF01h: Overcurrent error FF02h: Overspeed error FF03h: Position tracking error FF04h: Overload error FF05h: Overheat error FF06h: Motor connection error FF07h: Encoder connection error FF08h: Regenerative voltage error FF09h: Motor alignment error FF10h: Input command error FF11h: Input voltage error FF12h: In-Position error FF13h: Memory error FF14h: Emergency stop FF15h: Home search error	-	-

- Error Code displays the most recent Error Code.

## 14.5.2 Controlword: [6040h]

Control the device status.

Index	Sub	Type	Access	PDO Mapping	Value (default)	Save	Reflect timing
6040h	0h	U16	RW	RxPDO	0: Switch ON 1: Enable Voltage 2: Quick Stop 3: Enable Operation 4 to 6: Operation mode specific 7: Fault reset 8: Halt 9: Operation mode specific 11 to 15: Manufacturer specific	-	Immediately

Command	Bit 7	Bit 3	Bit 2	Bit 1	Bit 0	Status shift number
Shutdown	-	-	1	1	0	2, 6, 8
Switch ON	-	0	1	1	1	3
Switch ON + Enable operation	-	1	1	1	1	3 + 4
Disable voltage	-	-	-	0	-	7, 9, 10, 12
Quick Stop	-	-	0	1	-	7, 10, 11
Disable operation	-	0	1	1	1	5
Enable operation	-	1	1	1	1	4, 16
Fault reset	0 -> 1	-	-	-	-	15
Not ready to switch ON	Automatically status shifts when power is applied					0
Switch ON disabled	Automatically status shifts when driver is reset					1
Ready to switch ON	Status shifts after stop					2
Fault reaction active + Fault	Alarm occurs					13, 14

- Condition of Ready to switch ON → Switch ON
  - ESM must be Operational.
  - Main power must be applied.
  - Free Run must be OFF.

### 14.5.3 Statusword: [6041h]

Display the device status.

Index	Sub	Type	Access	PDO Mapping	Value (default)	Save	Reflect timing
6041h	0h	U16	RO	TxPDO	0: Ready to switch ON 1: Switched ON 2: Operation enabled 3: Fault 4: Voltage enabled 5: Quick Stop 6: Switch ON disabled 7: Warning 8: Manufacturer specific 9: Remote 10: Target reached 11: Internal limit active 12, 13: Operation mode specific 14, 15: Manufacturer specific	-	-

Bit	Name	Contents
0	Ready to switch ON	Displays Drive State Machine status. For more information, refer to the table below.
1	Switched ON	
2	Operation enabled	
3	Fault	
4	Voltage enabled	
5	Quick Stop	
6	Switch ON disabled	
7	Warning	Becomes 1 when warning occurs.
8	Manufacturer specific	Displays operation mode.
9	Remote	Becomes 1 when driver reset is completed.
10	Target reached	Varies from operation mode.
11	Internal limit active	Displays the function limitation status according to internal limit
12	Operation mode specific	Varies from operation mode.
13		
14	Manufacturer specific	Maker's unique bit.
15		

State	Bit 6	Bit 5	Bit 4	Bit 3	Bit 2	Bit 1	Bit 0
Start	0	0	0	0	0	0	0
Not ready to switch ON	0	0	0	0	0	0	0
Fault	0	1	-	1	0	0	0
Fault reaction active	0	1	-	1	1	1	1
Switch ON disabled	1	1	-	0	0	0	0
Ready to switch ON	0	1	-	0	0	0	1
Switched ON	0	1	-	0	0	1	1
Operation enabled	0	1	-	0	1	1	1
Quick Stop active	0	0	-	0	1	1	1

- Bit 4 becomes 1 when main power is applied.

#### 14.5.4 Quick Stop Option Code: [605Ah]

Set the operation when Quick Stop.

Index	Sub	Type	Access	PDO Mapping	Value (default)	Save	Reflect timing
605Ah	0h	INT16	RW	NO	0: Hold Off (2) - D 1: Deceleration stop at [6084h] speed - D 2: Quick Stop at [6085h] speed - D 5: Deceleration stop at [6084h] speed - S 6: Quick Stop at [6085h] speed - S	Save	Immediately

- D: Switch to Switch ON disabled after stop.
- S: Remain Quick Stop active after stop.

#### 14.5.5 Shutdown Option Code: [605Bh]

Set the operation when Shutdown.

Index	Sub	Type	Access	PDO Mapping	Value (default)	Save	Reflect timing
605Bh	0h	INT16	RW	NO	0: Hold Off (1) 1: Deceleration stop at [6084h] speed - Hold Off	Save	Immediately

#### 14.5.6 Disable Operation Option Code: [605Ch]

Set the Disable Operation. (Operation when switching from Operation enable to Switched ON)

Index	Sub	Type	Access	PDO Mapping	Value (default)	Save	Reflect timing
605Ch	0h	INT16	RW	NO	0: Hold Off (1) 1: Deceleration stop at [6084h] speed - Hold Off	Save	Immediately

#### 14.5.7 Halt Option Code: [605Dh]

Set the Halt Operation.

Index	Sub	Type	Access	PDO Mapping	Value (default)	Save	Reflect timing
605Dh	0h	INT16	RW	NO	0: Hold Off - P (1) 1: Deceleration stop at [6084h] speed - P 2: Quick Stop at [6085h] speed - P	Save	Immediately

- P: Remains Operation Enabled after stop.
- Ignore past position value after stop.

#### 14.5.8 Fault Reaction Code: [605Eh]

Set the operation when Fault.

Index	Sub	Type	Access	PDO Mapping	Value (default)	Save	Reflect timing
605Eh	0h	INT16	RW	NO	0: Hold Off - P (1) 1: Deceleration stop at [6084h] speed - P 2: Quick Stop at [6085h] speed - P	Save	Immediately

- The setting is applied only to fault that does not turn OFF the switch.

**14.5.9 Modes of Operation: [6060h]**

Set the operation mode.

Index	Sub	Type	Access	PDO Mapping	Value (default)	Save	Reflect timing
6060h	0h	INT8	RW	RxPDO	0: Driving function invalid (0) 1: PP (Profile Position Mode) 3: PV (Profile Velocity Mode) 6: HM (Homing Mode) 8: CSP (Cyclic Sync Position) 9: CSV (Cyclic Sync Velocity)	Save	After stop

**14.5.10 Modes of Operation Display: [6061h]**

Display the operation mode.

Index	Sub	Type	Access	PDO Mapping	Value (default)	Save	Reflect timing
6061h	0h	INT8	RO	TxPDO	0 to 9 (0)	-	After stop

**14.5.11 Position Demand Value: [6062h]**

Display the position command value.

Index	Sub	Type	Access	PDO Mapping	Value (default)	Save	Reflect timing
6062h	0h	INT32	RO	TxPDO	-2,147,483,648 to 2,147,483,647 (0)	-	-

**14.5.12 Position Actual Value: [6064h]**

Display the motor current position value.

Index	Sub	Type	Access	PDO Mapping	Value (default)	Save	Reflect timing
6064h	0h	INT32	RO	TxPDO	-2,147,483,648 to 2,147,483,647 (0)	-	-

**14.5.13 Following Error Window: [6065h]**

Set the error range value of position difference error.

Index	Sub	Type	Access	PDO Mapping	Value (default)	Save	Reflect timing
6065h	0h	U32	RW	NO	10,000 to 1,000,000 (50,000)	Save	After stop

- When position difference value is greater than Following Error Window [6065h], position tracking error will occur.
- The setting is valid only in CSP mode.

**14.5.14 Position Window: [6067h]**

Set the In-Position output range. (1 = 1 Pulse, Encoder: 0.036° in case of 10000 pulse)

Index	Sub	Type	Access	PDO Mapping	Value (default)	Save	Reflect timing
6067h	0h	U32	RW	NO	0 to 7(0)	Save	After stop



**14.5.15 Velocity Demand Value: [606Bh]**

Display the command speed in PV mode and CSV mode.

Index	Sub	Type	Access	PDO Mapping	Value (default)	Save	Reflect timing
606Bh	0h	INT32	RO	TxPDO	-	-	-

**14.5.16 Velocity Actual Value: [606Ch]**

Display the motor current speed value.

Index	Sub	Type	Access	PDO Mapping	Value (default)	Save	Reflect timing
606Ch	0h	INT32	RO	TxPDO	-	-	-

**14.5.17 Target Position: [607Ah]**

Set the target position value.

Index	Sub	Type	Access	PDO Mapping	Value (default)	Save	Reflect timing
607Ah	0h	INT32	RW	RxPDO	-2,147,483,648 to 2,147,483,647 (0)	-	-

**14.5.18 Home Offset: [607Ch]**

Set the sensor home position and offset value.

Index	Sub	Type	Access	PDO Mapping	Value (default)	Save	Reflect timing
607Ch	0h	INT32	RW	NO	-2,147,483,648 to 2,147,483,647 (100)	Save	Power ON

**14.5.19 Software Limit: [607Dh]**

Set the software limit.

Index	Sub	Name	Type	Access	PDO Mapping	Value (default)	Save	Reflect timing
607Dh	0h	Number of Entry	U8	RO	NO	2	-	-
	1h	-Software Limit	INT32	RW	NO	(-2,147,483,648)	Save	Power ON
	2h	+Software Limit	INT32	RW	NO	(2,147,483,647)	Save	Power ON

- If the software limit value is set to '0', the software limit function is invalid.

**14.5.20 Polarity: [607Eh]**

Set the motor rotation direction.

Index	Sub	Type	Access	PDO Mapping	Value (default)	Save	Reflect timing
607Eh	0h	U8	RW	RxPDO	0 to 6 bit: Reserved 7 bit: Polarity	Save	Power ON

- If the setting value is set to '0x00', rotates to forward direction, and if the setting value is set to '0x80', rotates to backward direction.

**14.5.21 Max Profile Velocity: [607Fh]**

Set the max. allowed speed in PP mode. [Pulse / sec]

Index	Sub	Type	Access	PDO Mapping	Value (default)	Save	Reflect timing
607Fh	0h	U32	RW	NO	1 to 1,000,000 (800,000)	Save	After stop

- The setting can be applied only in PP mode.

**14.5.22 Profile Velocity: [6081h]**

Set the speed in PP mode. [Pulse / sec]

Index	Sub	Type	Access	PDO Mapping	Value (default)	Save	Reflect timing
6081h	0h	U32	RW	RxPDO	1 to 500,000 (200,000)	Save	After stop

**14.5.23 Profile Acceleration: [6083h]**

Set the acceleration in PP mode and PV mode. [Pulse / sec<sup>2</sup>]

Index	Sub	Type	Access	PDO Mapping	Value (default)	Save	Reflect timing
6083h	0h	U32	RW	RxPDO	500 to 500,000,000 (500,000)	Save	After stop

**14.5.24 Profile Deceleration: [6084h]**

Set the deceleration in PP mode and PV mode. [Pulse / sec<sup>2</sup>]

Index	Sub	Type	Access	PDO Mapping	Value (default)	Save	Reflect timing
6084h	0h	U32	RW	RxPDO	500 to 500,000,000 (500,000)	Save	After stop

- Do not set the [6083h] profile acceleration more than 2 times slower.

**14.5.25 Quick Stop Deceleration: [6085h]**

Set the Quick Stop deceleration. [ Pulse / sec<sup>2</sup>]

Index	Sub	Type	Access	PDO Mapping	Value (default)	Save	Reflect timing
6085h	0h	U32	RW	RxPDO	500 to 500,000,000 (5,000,000)	Save	After stop

**14.5.26 Homing Method: [6098h]**

Set the home search method.

Index	Sub	Type	Access	PDO Mapping	Value (default)	Save	Reflect timing
6098h	0h	INT8	RW	NO	Detail (1)	Save	After stop

Value	Descriptions
0	No homing operation
1	Homing on the negative limit switch and index pulse
2	Homing on the positive limit switch and index pulse
7	Homing on the home switch and index pulse (Positive)
11	Homing on the home switch and index pulse (Negative)
17	Homing without an index pulse (Negative limit switch)
18	Homing without an index pulse (Positive limit switch)
24	Homing without an index pulse (Positive and Home sensor ON)
28	Homing without an index pulse (Negative and Home sensor ON)
33	Homing on the index pulse (Negative)
34	Homing on the index pulse (Positive)
35	Set the Origin with Home offset
37	Set the Origin and Reset Current Position
-3	Torque Homing Search- with Home offset
-4	Torque Homing Search+ with Home offset

### 14.5.27 Homing Speed: [6099h]

Set the speed in home search mode. [Pulse / sec]

Index	Sub	Name	Type	Access	PDO Mapping	Value (default)	Save	Reflect timing
6099h	0h	Number of Entry	U8	RO	NO	2	-	-
	1h	Search for Switch	U32	RW	NO	1 to 500,000 (50,000)	Save	After stop
	2h	Search for Zero	U32	RW	NO	1 to 50,000 (20,000)	Save	After stop

- Search for Switch must be set greater than Search for Zero.

### 14.5.28 Homing Acceleration: [609Ah]

Set the acceleration in home search mode. [Pulse / sec<sup>2</sup>]

Index	Sub	Type	Access	PDO Mapping	Value (default)	Save	Reflect timing
609Ah	0h	U32	RW	NO	500 to 500,000,000 (500,000)	Save	After stop

### 14.5.29 Touch Probe Function: [60B8h]

Set the touch prove operation.

Index	Sub	Type	Access	PDO Mapping	Value (default)	Save	Reflect timing
60B8h	0h	U16	RW	RxPDO	0000h to FFFFh (0000)	-	Immediately

Bit	Touch Probe	Name	Value	Contents
0	Touch Probe1	Function operation	0	Does not operate Touch Probe1 function.
			1	Operates Touch Probe1 function.
1		Trigger operation	0	Latches only once in the first trigger operation.
			1	Latches each time a trigger is input.
2		Trigger selection	0	Sets the external general input [200Dh, 200Fh] as trigger.
			1	Set the Z phase as trigger.
3		Reserved	0	Reserved
			1	
4		Up edge operation	0	Does not operate.
			1	Operates in trigger up edge.
5		Down edge operation	0	Does not operate.
			1	Operates in trigger down edge.
6		Reserved	0	Reserved
			1	
7		Reserved	0	Reserved
			1	
8	Touch Probe2	Function operation	0	Does not operate Touch Probe2 function.
			1	Operates Touch Probe2 function.
9		Trigger operation	0	Latches only once in the first trigger operation.
			1	Latches each time a trigger is input.
10		Trigger selection	0	Sets the external general input [200Dh, 200Fh] as trigger.
			1	Set the Z phase as trigger.
11		Reserved	0	Reserved
			1	
12		Up edge operation	0	Does not operate.
			1	Operates in trigger up edge.
13		Down edge operation	0	Does not operate.
			1	Operates in trigger down edge.
14		Reserved	0	Reserved
			1	
15		Reserved	0	Reserved
			1	

- When using touch probe for external input, be sure to set [200Dh] as touch probe for proper operation.

**14.5.30 Touch Probe Status: [60B9h]**

Display the touch probe status.

Index	Sub	Type	Access	PDO Mapping	Value (default)	Save	Reflect timing
60B9h	0h	U16	RO	TxPDO	Detail	-	-

Bit	Touch Probe	Name	Value	Descriptions
0	Touch Probe1	Function operation status	0	Touch Probe1 function is not operating.
			1	Touch Probe1 function is operating.
1		Up edge latch status	0	Does not latch.
			1	Latches to up edge
2		Down edge latch status	0	Does not latch.
			1	Latches to down edge.
3 to 7		Reserved	0	Reserved
8		Touch Probe2	Function operation status	0
	1			Touch Probe2 function is operating.
9	Up edge latch status		0	Does not latch.
			1	Latches to up edge.
10	Down edge latch status		0	Does not latch.
			1	Latches to down edge.
11 to 15	Reserved		0	Reserved

**14.5.31 Touch Probe1 Up Edge Position: [60BAh]**

Display the position value latched by the up edge of touch probe1.

Index	Sub	Type	Access	PDO Mapping	Value (default)	Save	Reflect timing
60BAh	0h	INT32	RO	TxPDO	-	-	-

**14.5.32 Touch Probe1 Down Edge Position: [60BBh]**

Display the position value latched by the down edge of touch probe1.

Index	Sub	Type	Access	PDO Mapping	Value (default)	Save	Reflect timing
60BBh	0h	INT32	RO	TxPDO	-	-	-

**14.5.33 Touch Probe2 Up Edge Position: [60BCh]**

Display the position value latched by the up edge of touch probe2.

Index	Sub	Type	Access	PDO Mapping	Value (default)	Save	Reflect timing
60BCh	0h	INT32	RO	TxPDO	-	-	-

**14.5.34 Touch Probe2 Down Edge Position: [60BDh]**

Display the position value latched by the down edge of touch probe2.

Index	Sub	Type	Access	PDO Mapping	Value (default)	Save	Reflect timing
60BDh	0h	INT32	RO	TxPDO	-	-	-

**14.5.35 Touch Probe1 Up Edge Counter: [60D5h]**

Display the number of touch probe1 up edge detection.

Index	Sub	Type	Access	PDO Mapping	Value (default)	Save	Reflect timing
60D5h	0h	U16	RO	TxPDO	-	-	-

**14.5.36 Touch Probe1 Down Edge Counter: [60D6h]**

Display the number of touch probe1 down edge detection.

Index	Sub	Type	Access	PDO Mapping	Value (default)	Save	Reflect timing
60D6h	0h	U16	RO	TxPDO	-	-	-

**14.5.37 Touch Probe2 Up Edge Counter: [60D7h]**

Display the number of touch probe2 up edge detection.

Index	Sub	Type	Access	PDO Mapping	Value (default)	Save	Reflect timing
60D7h	0h	U16	RO	TxPDO	-	-	-

**14.5.38 Touch Probe2 Down Edge Counter: [60D8h]**

Display the number of touch probe2 down edge detection.

Index	Sub	Type	Access	PDO Mapping	Value (default)	Save	Reflect timing
60D8h	0h	U16	RO	TxPDO	-	-	-

**14.5.39 Supported Homing Methods: [60E3h]**

Display the supported homing method.

Index	Sub	Name	Type	Access	PDO Mapping	Value (default)	Save	Reflect timing
60E3h	0h	Number of Entry	U8	RO	NO	15	-	-
	1h	Homing Method1	U16	RO	NO	0	-	-
	2h	Homing Method2	U16	RO	NO	1	-	-
	3h	Homing Method3	U16	RO	NO	2	-	-
	4h	Homing Method4	U16	RO	NO	7	-	-
	5h	Homing Method5	U16	RO	NO	11	-	-
	6h	Homing Method6	U16	RO	NO	17	-	-
	7h	Homing Method7	U16	RO	NO	18	-	-
	8h	Homing Method8	U16	RO	NO	24	-	-
	9h	Homing Method9	U16	RO	NO	28	-	-
	10h	Homing Method10	U16	RO	NO	33	-	-
	11h	Homing Method11	U16	RO	NO	34	-	-
	12h	Homing Method12	U16	RO	NO	35	-	-
	13h	Homing Method13	U16	RO	NO	37	-	-
	14h	Homing Method14	U16	RO	NO	-3	-	-
	15h	Homing Method15	U16	RO	NO	-4	-	-

- For more information, refer to '14.5.26 Homing Method: [6098h]'.

#### 14.5.40 Following Error Actual Value: [60F4h]

Display the deviation between command position and detection (feedback) position.

Index	Sub	Type	Access	PDO Mapping	Value (default)	Save	Reflect timing
60F4h	0h	INT32	RO	TxPDO	-	-	-

#### 14.5.41 Digital Input: [60FDh]

Display the digital input status.

Index	Sub	Type	Access	PDO Mapping	Value (default)	Save	Reflect timing
60FDh	0h	U32	RO	TxPDO	Detail	-	-

Bit	Name	Status	Contents
0	ORG	0	No signal
		1	Origin sensor detection
1	+LIMIT	0	No signal
		1	+Limit sensor detection
2	-LIMIT	0	No signal
		1	-Limit sensor detection
3 to 15	Reserved		
16	Alarm Reset	0	No signal
		1	Reset signal detection
17	Hold Off	0	No signal
		1	Servo ON signal detection
18	Stop	0	No signal
		1	STOP signal detection
19	EMG	0	No signal
		1	Emergency signal detection
20 to 23	Reserved		
24	General input 1	0	No signal
		1	General input 1 detection
25	General input 2	0	No signal
		1	General input 2 detection
26	General input 3	0	No signal
		1	General input 3 detection
27	General input 4	0	No signal
		1	General input 4 detection
28	General input 5	0	No signal
		1	General input 5 detection
29 to 31	Reserved		

- The status displays the signal presence regardless of input level setting set in [200Bh].
- General input detection is available only when the corresponding input pin is assigned as general input in Input Assigned [200Dh].

### 14.5.42 Digital Output: [60FEh]

Control the digital output.

Index	Sub	Name	Type	Access	PDO Mapping	Value (default)	Save	Reflect timing
60FEh	0h	Number of Entry	U8	RO	NO	2	-	-
	1h	Output setting	U32	RW	RxPDO	0 to FFFF FFFFh (0)	-	Immed.
	2h	Bit Mask	U32	RW	NO	0 to FFFF FFFFh (0)	-	Immed.

- Output setting (1h) controls the brake and general output manually.
- Bit Mask (2h) sets the brake control and valid/invalid of general output.
- In case of controlling general output, the corresponding output pin must be assigned as general output in Output Assigned [200Eh] to enable control.

Bit	Bit Mask (2h)	Output setting (1h)	Contents
0 to 31	0	Don't care	Output invalid
0	1	0	Brake lock
		1	Brake release
1 to 15		Reserved	
16		0	General output 1 OFF
		1	General output 1 ON
17		0	General output 2 OFF
		1	General output 2 ON
18		0	General output 3 OFF
		1	General output 3 ON
19		0	General output 4 OFF
	1	General output 4 ON	
20 to 31		Reserved	

- General output is output with the output level value set in [200Ch].

### 14.5.43 Target Velocity: [60FFh]

Set the drive speed in CSV mode and PV mode.

Index	Sub	Type	Access	PDO Mapping	Value (default)	Save	Reflect timing
60FFh	0h	INT32	RW	RxPDO	-500,000 to 500,000 (0)	-	Immediately



### 14.5.44 Supported Drive Modes: [6502h]

Display the current supported drive mode.

Index	Sub	Type	Access	PDO Mapping	Value (default)	Save	Reflect timing
6502h	0h	U32	RO	NO	0000 0080h	-	-

Bit	Name	Value
0	PP (Profile Position Mode)	1
1	VL (Velocity Mode)	0
2	PV (Profile Velocity Mode)	1
3	TQ (Profile Torque Mode)	0
4	Reserved	0
5	HM (Homing Mode)	1
6	IP (Interpolated Position Mode)	0
7	CSP (Cyclic Sync Position Mode)	1
8	CSV (Cyclic Sync Velocity Mode)	1
9	CST (Cyclic Sync Torque Mode)	0
10 to 31	Reserved	0

- 1: Supported
- 0: Not supported

## 15 Troubleshooting

Malfunction	Causes	Troubleshooting
When communication is not connected	The communication cable is not connected.	Check communication cable wiring. Check communication cable connected correctly.
	The communication port or period settings are not correct.	Check communication port and period settings are correct.
	XML file does not match.	Check provided XML file is imported properly.
When motor does not excite	Hold Off is not ON.	Check the Hold Off input signal. In case of ON, Servo is OFF and excitation of the motor is released.
	Alarm occurs.	Check the alarm type and remove the cause.
When the motor rotates to the opposite direction of the designated direction	Polarity parameter setting is not correct.	Check the Polarity parameter settings.
When motor drives unstable	Connection between motor and encoder is unstable.	Check the driver and motor are connected correctly.
	Motor Gain value is not correct.	Change the motor Gain parameter as the appropriate value.

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\* Dimensions or specifications on this manual are subject to change and some models may be discontinued without notice.