Smart Motion Driver

For 5-phase stepper motor

Integrated1/2-axis Motion Controller and Driver

MD5130D/MD5230D

User's Manual

２０１５．　５．１９ Ver1.0
２０１５．　７．　７ Ver2.0

NOVA electronics

■ Revision history

Version	Date	Contents
Ver.1.0	2015. 5.19	
Ver.2.0	2015. 7. 7	･Modified as below. Delete [Note] of Y-axis in 1.1.2. Contents of 4.2.5.9 Controller Reset. [Note] of 5.2.2 Interpolation command LNI. [Note] of 5.2.2 Interpolation command CWI. [Note] of 5.2.2 Interpolation command CCW. Add a table of 6.5.7 Regarding Speed Change during Motor Rotation.

Introduction

Prior to use, read this operation manual carefully to fully understand for correct use and follow all the instructions given in this manual. We shall be exempted from taking responsibility and held harmless for damage or losses incurred by the user if the user fails to observe the instructions. Keep this manual handy for future reference.

■ Checking the contents

When you unpack the package, check for the following accessories. If something is missing or broken, contact the place of purchase.

Product name	Model / Spec	MD5130D	M5230D
Unit	MD5230D／MD5130D	1	1
Power Connector	XW4B-03B1-H1 (Omron) or equivalent	1	1
Motor Connector	XW4B-05B1-H1 (Omron) or equivalent	1	2
Connector for parallel control	20P MIL standard compliant connector	1	1
Connector for axis sensor	16P MIL standard compliant connector	1	2
USB cable	1.5m	1	1
Heat sink(optional)		—	1
*Software CD-ROM	MD51_52 Operation Tool	1	1

*comes with one software CD-ROM at the first purchase.

The descriptions of this manual may change without notice because of the progress of the technologies, etc. Please download the up-date data from our website (http://www.novaelec.co.jp/eng) and/or ask us to supply you directly.
Windows, Windows XP, Windows Vista, Windows 7 and Windows 8.1 are registered trademarks of Microsoft Corporation.

■ CE marking

- This product complies with the following EU Directives.
  EMS: EN61000-6-2 / EMI: EN61000-6-4

[Note]

- The product complies with the EMC Directive; however, the customers' machines and whole apparatus shall be tested for EMC conformity by themselves.

■ RoHS Directive

- This product complies with RoHS Directive 2011/65/EU.

Safety Notice

WARNING

■ General

- This product is not designed or intended to be fail-safe, or for use in any application requiring fail-safe performance, such as in life-support or safety devices or systems that could lead to death, personal injury or severe property or environmental damage (individually and collectively, "critical applications"). Customer must be fully responsible for the use of this product in critical applications.
- Do not use the product in potentially explosive, flammable, corrosive, wet, dusty or direct sunlight environments.
- Person with expertise shall perform installation, connection and inspection.
- Do not install, connect, inspect or move the product during power supply, be sure to turn off the power.
- Stepper motor may step out at stop or during driving depends on conditions of use. In particular, objects being conveyed are subject to fall when step out occurs during up-and-down driving. Ensure that it is thoroughly-tested under load conditions to be used and can be driven securely.
- There is a possibility that the temperature of a connected motor becomes high even within rated current. Adjust the current value or operation interval so as not to exceed the temperature tolerance prescribed by manufacturer.

■ Connection

- Make sure the power input voltage is within the rated range. Otherwise it may cause fire or damage of the product.
- Connect according to the connection diagram correctly and be sure to tighten terminal screws.
- Do not bend, pull or pinch the power supply line or motor lead and signal wires excessively. Otherwise it may cause fire or damage of the product.

■ Disassemble and Repair

- Do not disassemble, repair and modify the product. Otherwise, it may cause fire or injury. Please contact us for inspection and repair.

CAUTION

■ General

- Be very careful if you touch the product during power-on or for some time after power-off, the surface temperature of the product may become high.

■ Placement

- Please set it up to incombustibles such as metal.

■ Operation

- When driving continuously, the surface temperature of the product may become high. Be sure not to exceed the surface temperature of 70°C.
- Provide a means to stop for emergency anytime during operation. Otherwise, breakage or injury may result.
- During operation, do not touch the rotating body or moving body connected to a motor with your hand, body or anything else.
- When you move a rotation axis of a motor by your hand (such as manual positioning), turn off the power, or switch off the excitation and turn off the current to a motor.
- Provide an emergency stop measure or circuit outside the product to securely function in case abnormality of an external power supply, disconnection of a signal line or the driver failure occurs.
- If abnormality occurs, stop the use immediately and turn off the power.

■ Disposal

- When discarding the product, handle it as industrial waste.

1. Outline

MD5130D is 1-axis and MD5230D is 2-axis 5-phase stepper motor unit with bipolar pentagon drive, equipped with high functions. A built-in EEPROM can program driving parameter values and the user program of up to 1000 steps for each axis. The software “MD51_52 Operation Tool” is attached which can edit and register configuration data and a user program.

■ Integrated Motion Controller and Driver

MD5130D and MD5230D are the integrated motion controller with motion control function and microstep driver for 5-phase stepper motor.
The user can easily set configuration and operations using the attached software.

■ Various Operations

Positioning, continuous driving, automatic home search and user program operations can be performed by using the attached software from PC or parallel control signals.

■ User Program Function

The user can register various driving parameters and the user program of up to 1000 steps by 27 kinds of commands for MD5130D and 36 kinds for MD5230D. Thereby the complex operation can easily be performed by registering them in advance.

■ Various Acceleration / Deceleration Drive Mode

There is various acceleration/deceleration driving: constant speed, trapezoidal acceleration/deceleration (symmetry/ non-symmetry) and S-curve acceleration/deceleration driving. In addition, a simple mode is available that does not require a start speed setting.

■ Step Out Detection Function

If the differential between real position and logical position by an encoder signal is more than a specified value, it detects a step out error.

■ Microstep

Microstep resolution is available 16 different resolutions, divided from 1 to 250.

■ Low Vibration Drive

Microstep driver with low vibration function achieves a smooth drive in low-speed driving.
Even when the setting value of Step Resolution is 16 or less (except 5, 10), this can reduce vibration in low-speed driving and enables a smooth drive with less vibration.

■ Interpolation Function

Interpolation driving is operation that 2 axes move, interpolating the position every 1 drive pulse.
MD5230D can execute linear and circular interpolation. Linear interpolation is performed by setting the finish potision to the current coordinates, and then writing the linear interpolation command according to the axis number. Circular interpolation is performed by setting the center coordinates to the current coordinates (start point) and the finish coodinates, and then writing CW or CCW circular interpolation command.

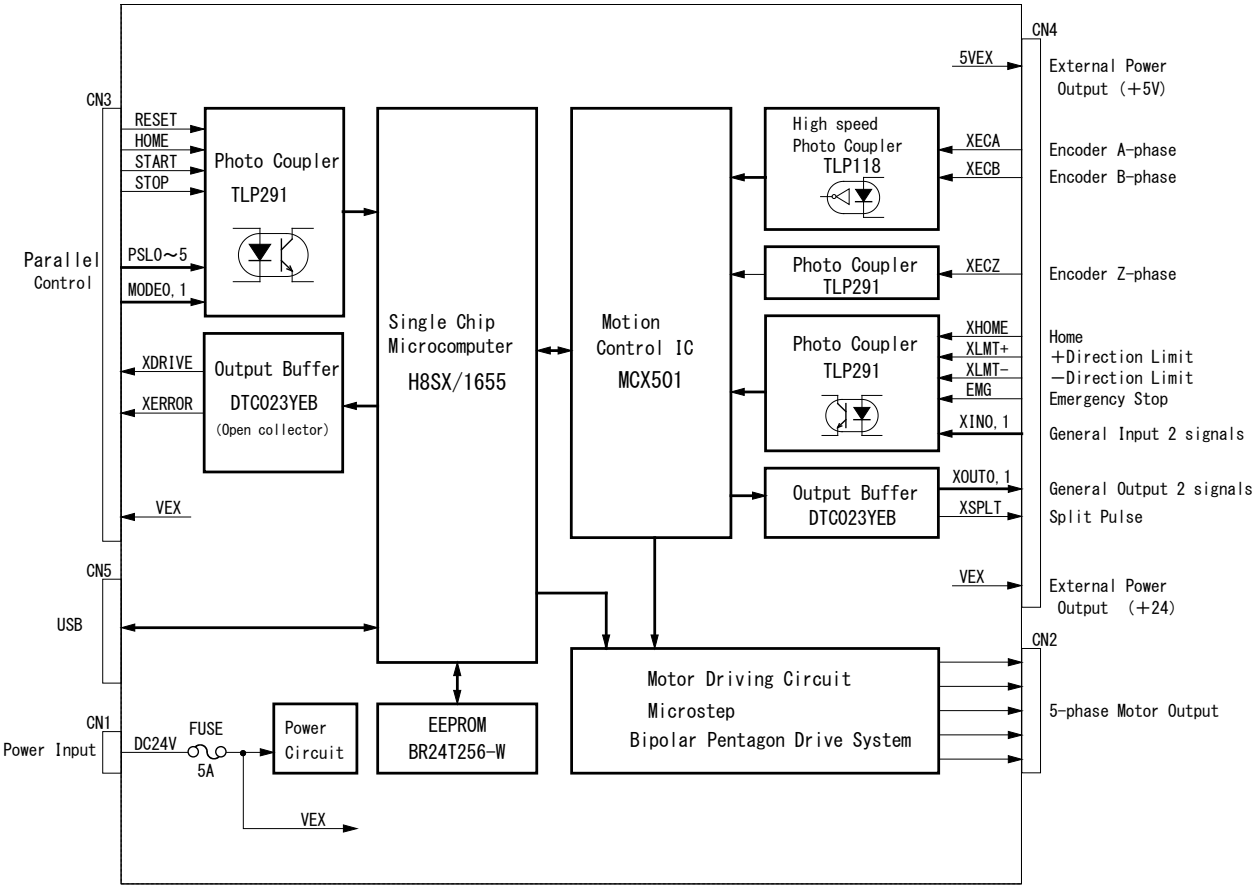
■ Continuous Interpolation

Continuous interpolation can also be executed that performs a series of interpolation processes such as linear interpolation → circular interpolation → linear interpolation → ··· without stopping. It can be performed by continuously writing the interpolation commands in user program.

1.1. Basic Circuit Block Diagram

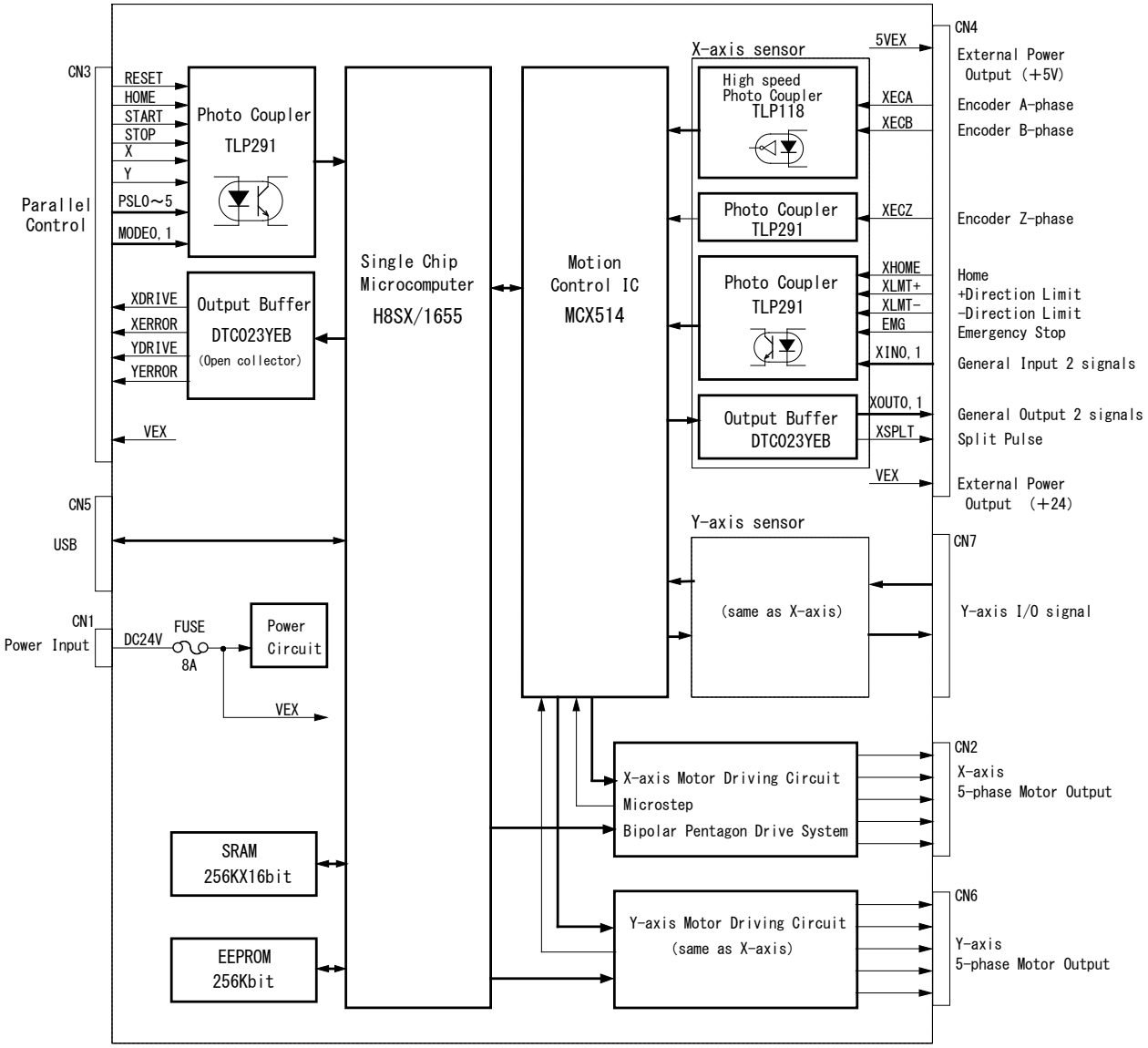
The follows show the MD5130D and MD5230D basic circuit block diagrams.

1.1.1. MD5130D



ＭＤ５１３０Ｄ Circuit Block Diagram

1.1.2. MD5230D

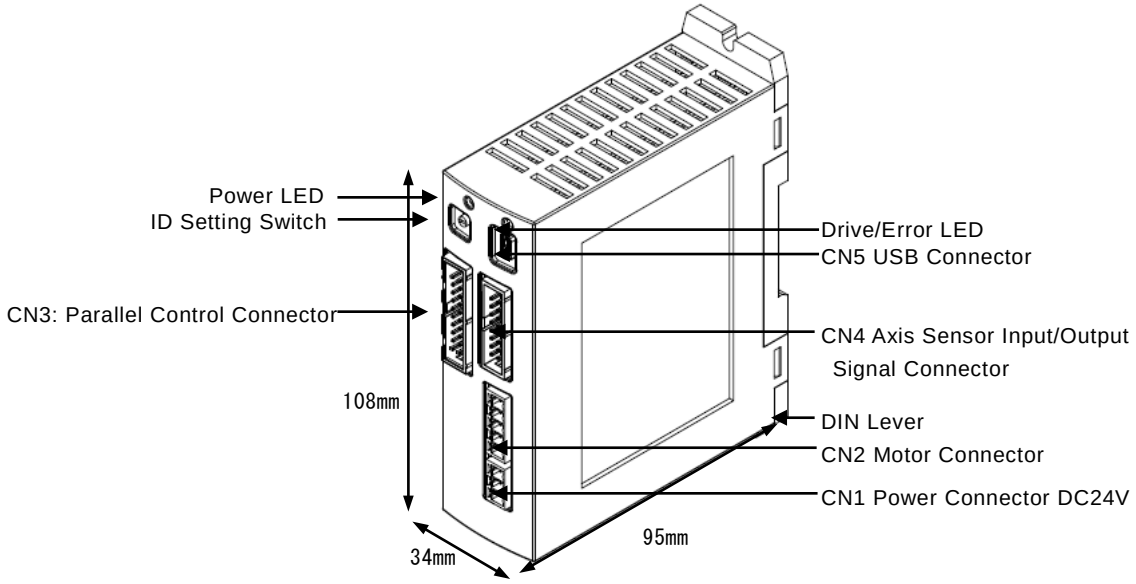


ＭＤ５２３０Ｄ Circuit Block Diagram

1.2. Part Name and Function

1.2.1. MD5130D

The following shows the appearance of the MD5130D, its package dimensions are 108mm (H)×34mm (W)×95.5mm (D). Input/output connectors are placed on the front panel and the rear panel is equipped with DIN rail installing hook.



■ Connector / LED

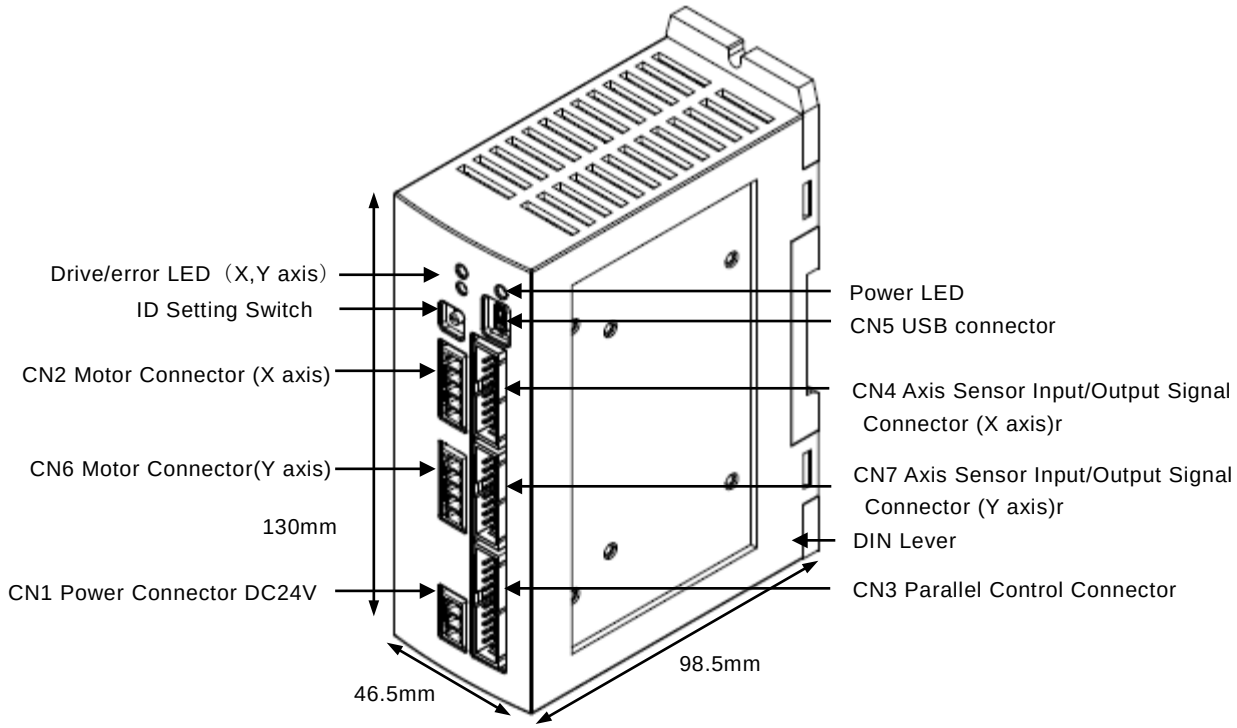
Name	Contents
Power LED (Green)	Lights up during power-on.
Drive/Error LED (Red)	Lights up during motor rotation. When driving end pulse is enabled, it lights up from a start of motor rotation until driving end pulse is OFF. Please refer to Drive/Error LED DIsplay below.
ID Setting Switch	Set the unit ID number 0~F when two or more products are connected to one PC. (Factory default: 0)
CN1 Power Connector	Connected to 24V power source. (Please refer to 7.1)
CN2 5-Phase Stepper Motor Connector	Connect a motor. (Please refer to 7.2)
CN3 Parallel Control Connector	Connect a parallel control signal. (Please refer to 7.3)
CN4 Sensor Connector	Connect a limit sensor signal, an encoder signal. (Please refer to 7.4)
CN5 USB Connector	Connected to PC with USB cable.

■ Drive/Error LED Display

State	LED	Contents
During motor rotation	ON	・Lights up during motor rotation. *When driving end pulse is enabled, it lights up from a start of motor rotation until driving end pulse is OFF.
Error	Blinks at 1-second intervals	・User program error from Host PC occurs. ・Parallel user program error occurs.
	Blinks at 0.2-second intervals	・Hard / Software limit error occurs. ・Error by emergency stop signal (EMG) occurs. ・Step out error occurs. ・Automatic home search error occurs. ・EEPROM access error occurs.

1.2.2. MD5230D

The following shows the appearance of the MD5230D, its package dimensions are 130mm (H)×46.5mm (W)×98.5mm (D). Input/output connectors are placed on the front panel and the rear panel is equipped with DIN rail installing hook.



Heat sink can optionally be mounted.

■ Connector / LED

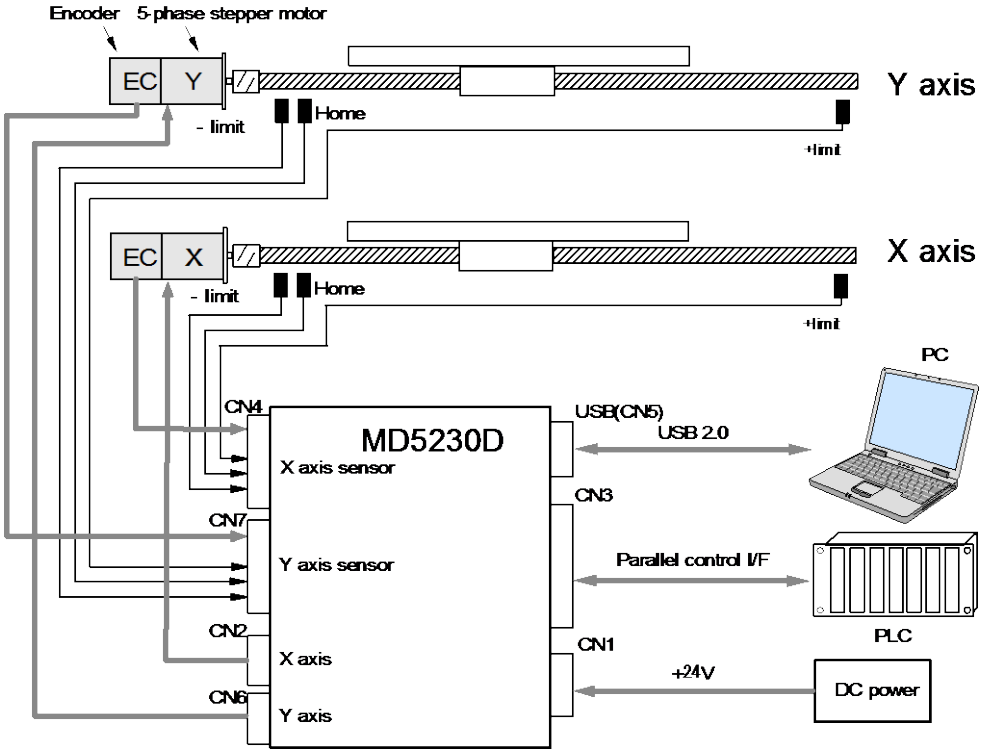
Name	Contents
Power LED (Green)	Lights up during power-on.
Drive/Error LED (Red) (X and Y-axis)	Lights up during motor rotation. When driving end pulse is enabled, it lights up from a start of motor rotation until driving end pulse is OFF. Please refer to Drive/Error LED DIsplay below.
ID Setting Switch	Set the unit ID number 0~F when two or more products are connected to one PC. (Factory default: 0)
CN1 Power Connector	Connected to 24V power source. (Please refer to 7.1)
CN1 Power Connector (X-axis)	Connected to 24V power source. (Please refer to 7.1)
CN3 Parallel Control Connector	Connect a parallel control signal.(Please refer to 7.3)
CN4 Sensor Connector (X-axis)	Connect a limit sensor signal, an encoder signal. (Please refer to 7.4)
CN5 USB Connector	Connected to PC with USB cable.
CN6 5-Phase Stepper Motor Connector (Y-axis)	Connect a motor. (Please refer to 7.2)
CN7 Sensor Connector (Y-axis)	Connect a limit sensor signal, an encoder signal. (Please refer to 7.4)

■ Drive/Error LED Display

State	LED	Contents
During motor rotation	ON	・Lights up during motor rotation. *When driving end pulse is enabled, it lights up from a start of motor rotation until driving end pulse is OFF.
Error	Blinks at 1-second intervals	・User program error from Host PC occurs. ・Parallel user program error occurs.
	Blinks at 0.2-second intervals	・Hard / Software limit error occurs. ・Error by emergency stop signal (EMG) occurs. ・Step out error occurs. ・Automatic home search error occurs. ・EEPROM access error occurs.

1.3. Connection Example

The figure shown below illustrates the basic connection example using MD5230D.



System Configuration Example

CN1: Connect to 24V power source.
CN2: Connect a 5-Phase stepper motor (X-axis).
CN3: Connect a parallel control signal such as a PLC or switches.
CN4: Connect an encoder, a limit sensor or a home signal (X-xis).
CN5: Connect to PC with USB cable and the user can register configuration data and a user program, operate jog feed and perform a user program using the attached software “MD51_52 Operation Tool”.
CN6: Connect a 5-Phase stepper motor (Y-axis).
CN7: Connect an encoder, a limit sensor or a home signal (X-axis).
Encoder:Connect as necessary

MD5130D has no connector for Y-axis(CN6 and 7).

1.4. How to start motor control

To start MD5130D and MD5230D motor control, follow the steps below.

(1) MD51_52 Operation Tool and USB Driver Installation

MD51_52 Operation Tool is the software to register configuration data and a user program to the unit. The user can install it from the attached CD-ROM, or download and install from HP. Please refer to chapter 3 for how to install the software and driver, and chapter 4 for how to operate MD51_52 Operation Tool.

(2) Configuration and User Program Registration

Connect the unit and PC with USB cable and set configuration data by MD Operation Tool and then create a user program. The setting data and created program are written into built-in EEPROM of the unit.

(3) Placement and Wiring

Place the unit and connect wires to proper peripheral equipment. For the placement of this product, please refer to chapter 2, and for the details of each connector and input/output signals, please refer to chapter 7.

(4) Start Motor Control

To start motor control in MD5130D and MD5230D, there are 3 ways as follows.

- Control by using MD51_52Operation Tool
  Connect the unit and PC with USB cable, and the user can perform manual operations such as jog feed, home search and program execution.

- Control by parallel control signals
  Connect a PLC or switches to parallel control connector, and the user can operate it. Please refer to chapter 7 for more details.

- Control by communication command
  MD5130D and MD5230D have communication commands. The user can create your own software with these commands and control a motor.
  For more details, please refer to the attached “MD5130D/MD5230D Communication Command User’s Manual”.

2. Placement

This chapter describes how to place the unit and the location to be placed.

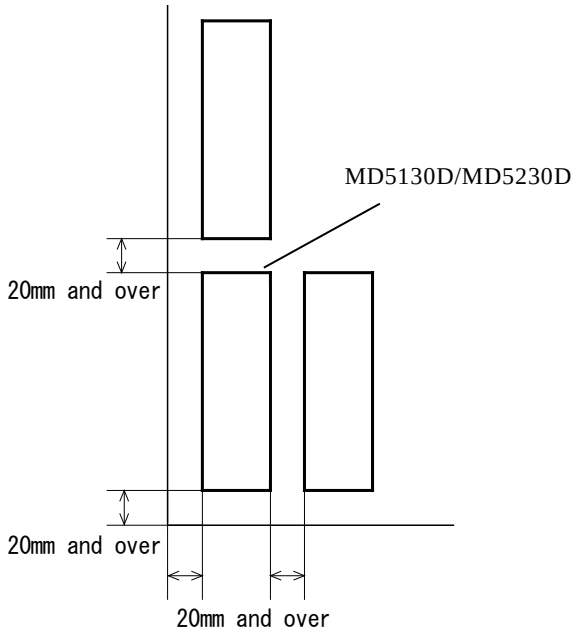
2.1. Installation Place

MD5130D and MD5230D are designed and manufactured for the equipment that is used indoors. Be sure to set up in a proper location as described below.

- Indoor (location out of direct sunlight)
- Location with no explosive, flammable and corrosive fluid or gas.
- Ventilated location where is not filled with heat.
- Location where the temperature is within 0 ~ 40°C (no freezing) and humidity is within 0 ~ 85% (no condensation).
- Location where water (water drop), oil (oil drop) and any other liquid is not splashed.
- Location with less dust, dirt and any other powder.
- Location not exposed to vibration and shock.

2.2. Installation Interval

When you set up this product, keep the product 20mm or more away from other equipment or structures. Make sure to install it vertically (in a vertical position), or heat dissipation effect will be reduced. The product is natural convection cooling, so install it to prevent heat accumulation.



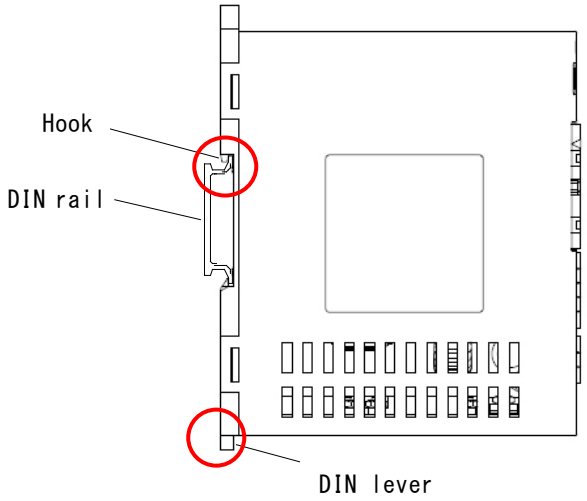
When an optional heat sink is mounted in MD5230D, be sure to space 20mm away from the end of the heat sink.

2.3. Installation

MD5130D and MD5230D can be installed by using DIN rail or screws.

2.3.1. Installation by DIN rail

Mount the hook on the back of the body to DIN rail and pull down the DIN lever of the body by a slotted screwdriver. And then pull up the DIN lever, the body will be locked. To release the body, pull down the DIN lever by a slotted screwdriver, the body will be released and the user can remove the body from DIN rail.

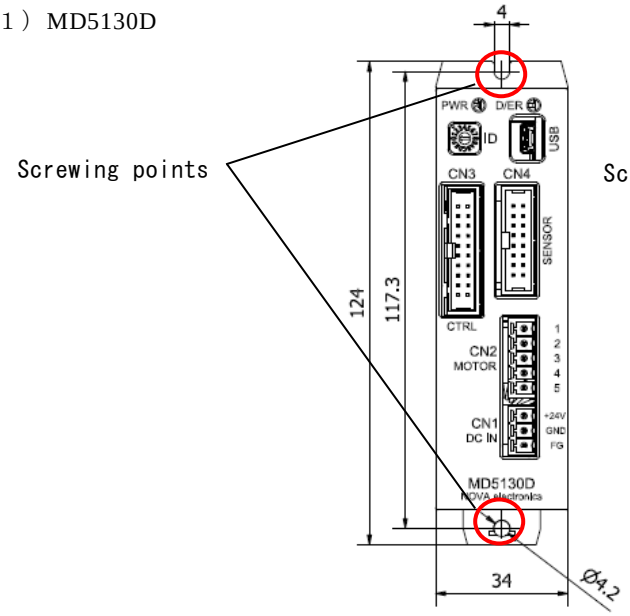


MD5230D installation is the same as MD5130D shown above.

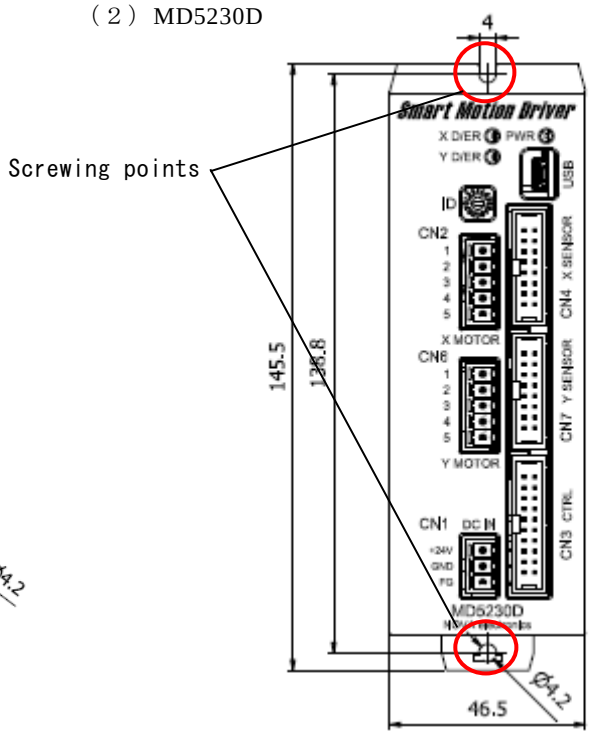
2.3.2. Installation by screws

Fix the two points as shown below using M4 screws, pushing down DIN lever.

（1）MD5130D



（2）MD5230D



3. Setup to PC

This chapter describes how to setup to PC. To operate the unit from PC, install “USB driver” and the attached software “MD51_52 Operation Tool”.

3.1. Operating Systems

MD5130D and MD5230D support the following OS.

- Windows 8.1 (32bit/64bit)
- Windows 7 (32bit/64bit)
- Windows Vista (32bit/64bit)
- Windows XP (32bit/64bit)

[Note]

- To use “MD51_52 Operation Tool”, Microsoft .NET Framework 3.5 or greater needs to be installed.

3.2. Software Configuration

The software is available from the attached CD-ROM or for download

```
[USBDriver folder]          USB driver
    ├[32bit folder]  ----------  32bit OS USB driver
    └[64bit folder]  ----------  64bit OS USB driver

[MDOPTOOL folder]       MD51_52 Operation Tool
    ├[32bit folder]  ----------  32bit OS installer
    └[64bit folder]  ----------  64bit OS installer
```

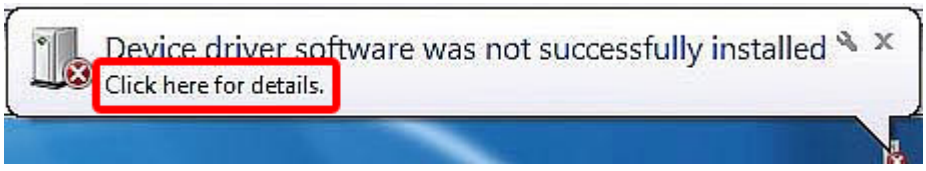
The latest version is available on our web site: http://www.novaelec.co.jp/eng/index.html

3.3. USB Driver Installation

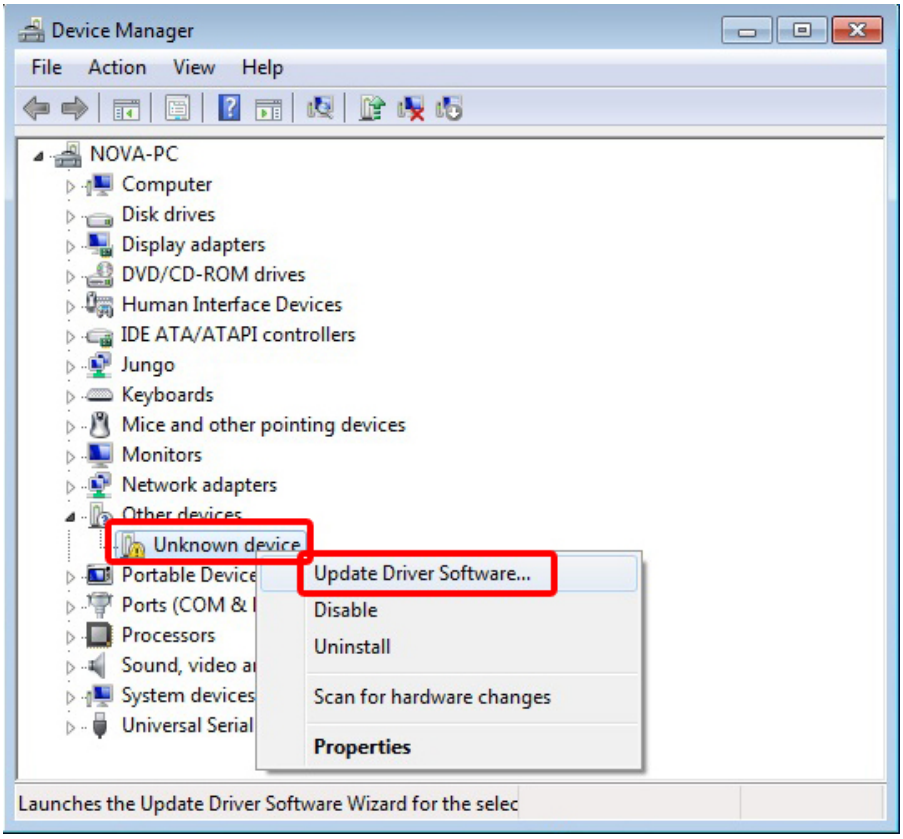
To install USB driver for connecting the unit and PC, follow the steps below. The screenshots are on Windows 7 (32bit).

(1) Turn on PC and the unit. DO NOT CONNECT them at this step.

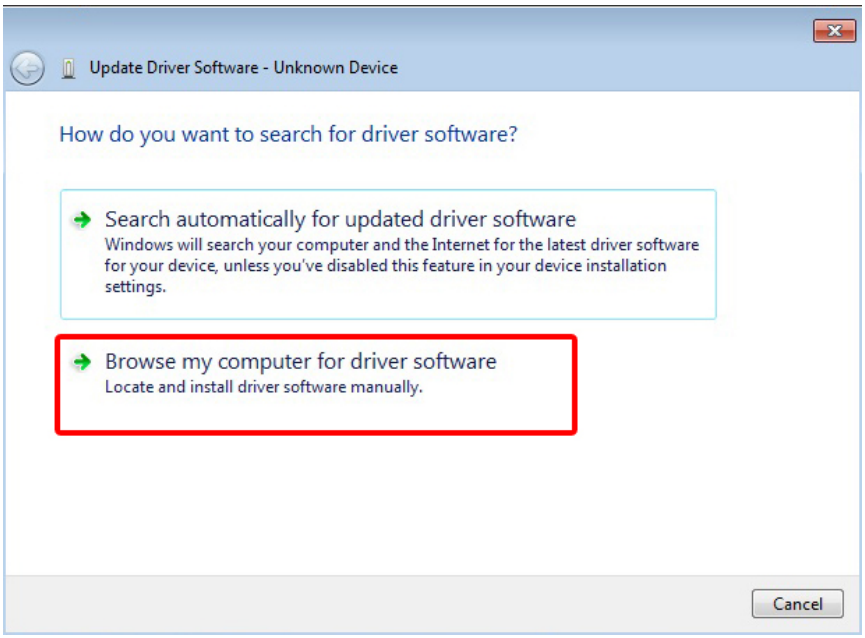
(2) Make sure the PC is started and the unit is powered on. Then connect them with the attached USB cable. The message shown below is displayed, then click “Click here for details.”.



(3) "**Unknown device**" is listed under "**Other devices**" in "**Device Manager**", right-click on"**Unknown device**" and choose "**Update Driver Software…**".



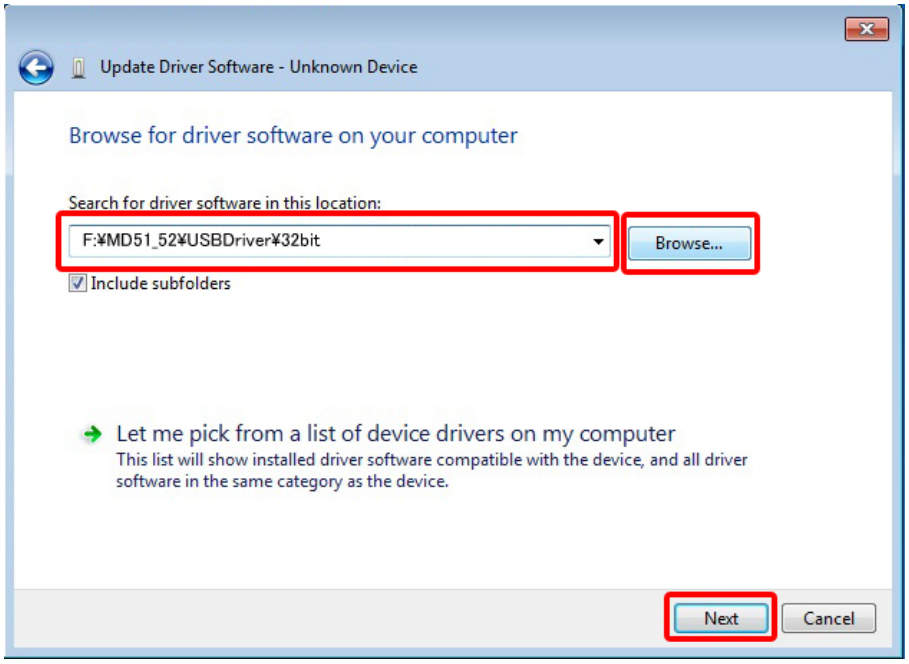
(4) "**Update Driver Software**" window appears, then click "**Browse my computer for driver software**".



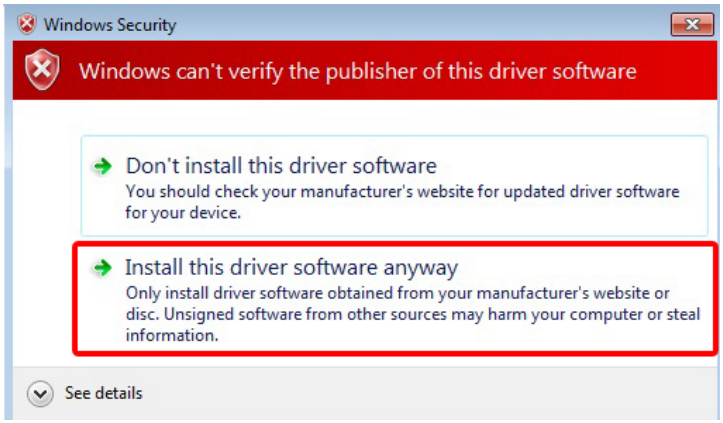
(5) "**Browse for driver software on your computer**" window appears, then click "**Browse…**" button and select one of the following driver folders.

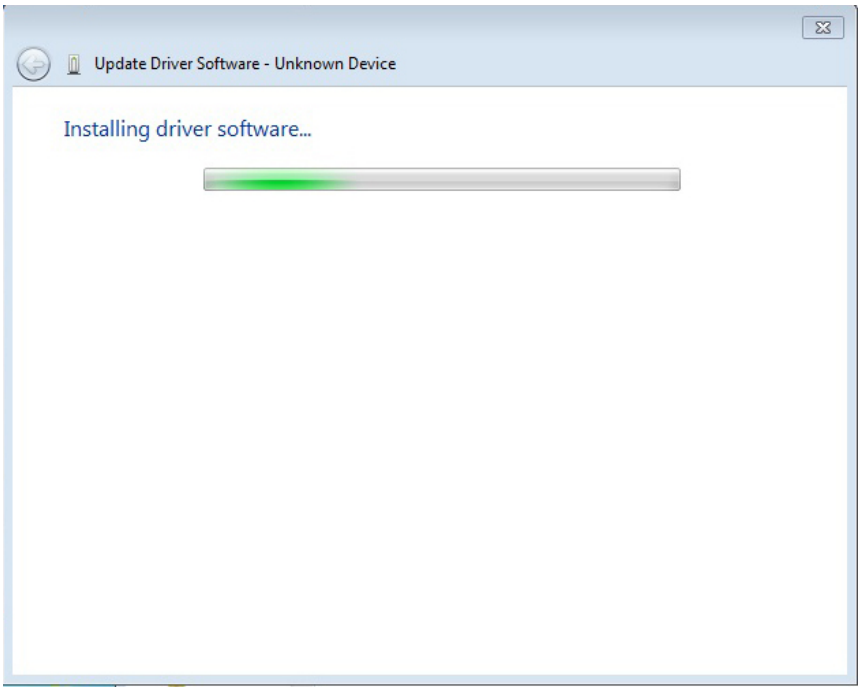
・32bit OS : ¥USBDriver¥32bit
・64bit OS : ¥USBDriver¥64bit

Confirm the path to the folder you chosen, and then click "**Next**".

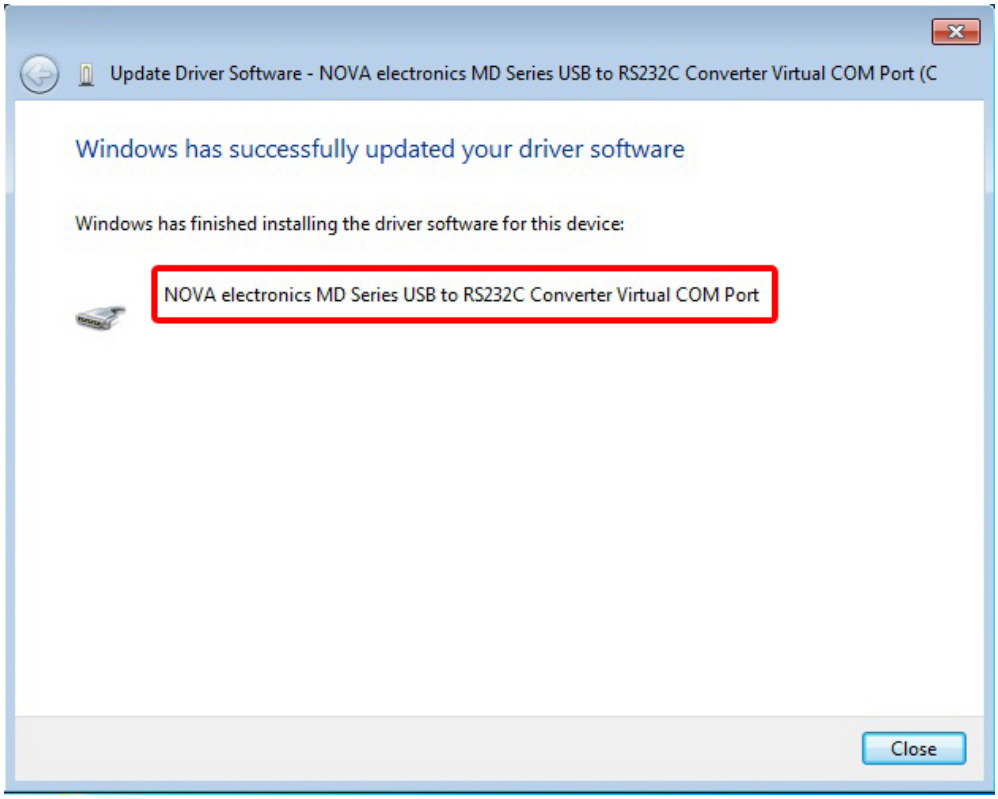


(6) "**Installing driver software…**" window is displayed. If "**Windows Security**" window appears, click "**Install this driver rsoftware anyway**".

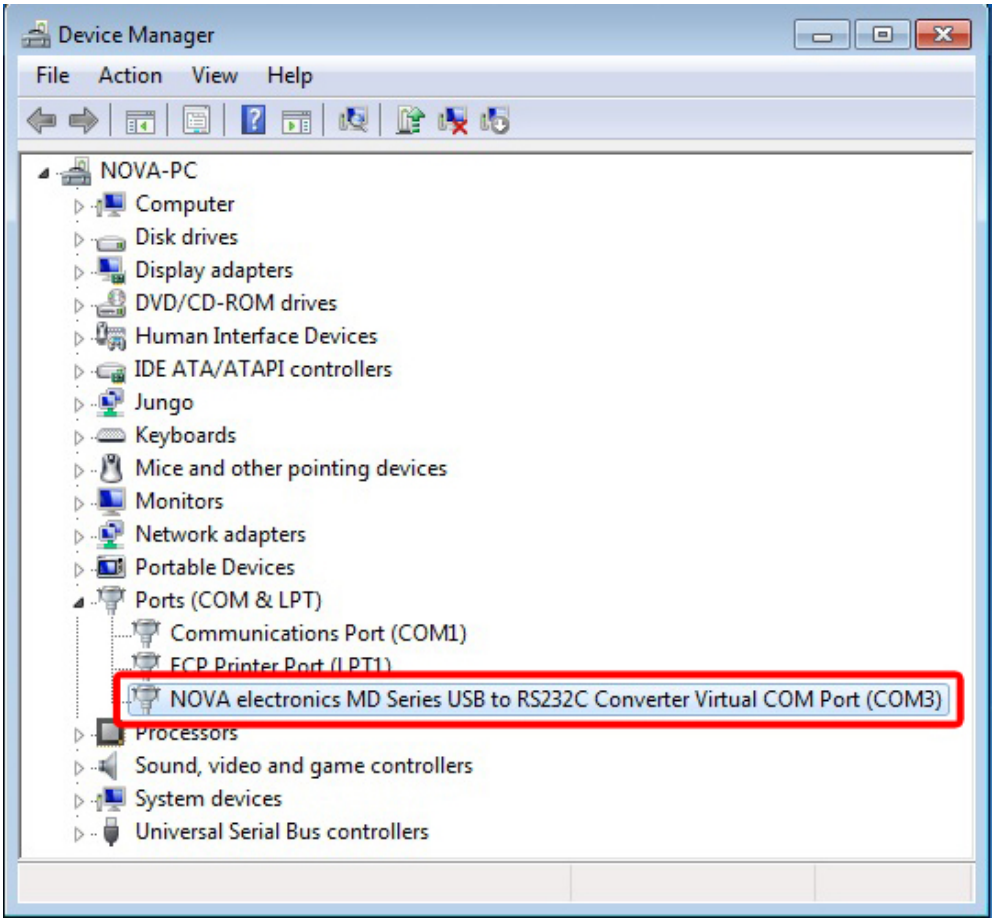




(7) After installation is complete, you will see "**Windows has successfully updated your driver software**" window appears. Then "**Close**" the window.



(8) Check the driver software is successfully installed by the following steps:
Open “Device Manager” and check “**NOVA electronics MD Series USB to RS232C Converter Virtual COM Port (COMx)**” is displayed under Ports (COM and LPT) (COMx denotes COM port number). Right-click on its icon or text and choose “Properties”. If the driver is correctly installed, you can see “**This device is working properly**” in the Device status field in “General” tab of “Properties” window.

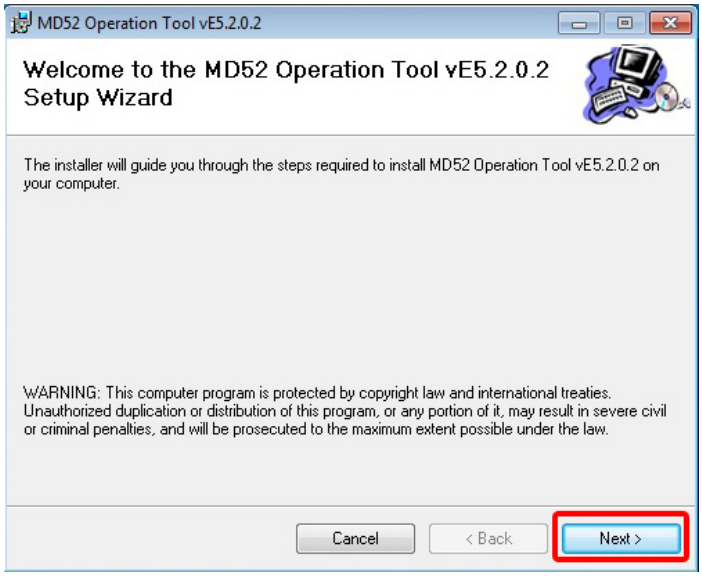


3.4. MD51_52 Operation Tool Installation

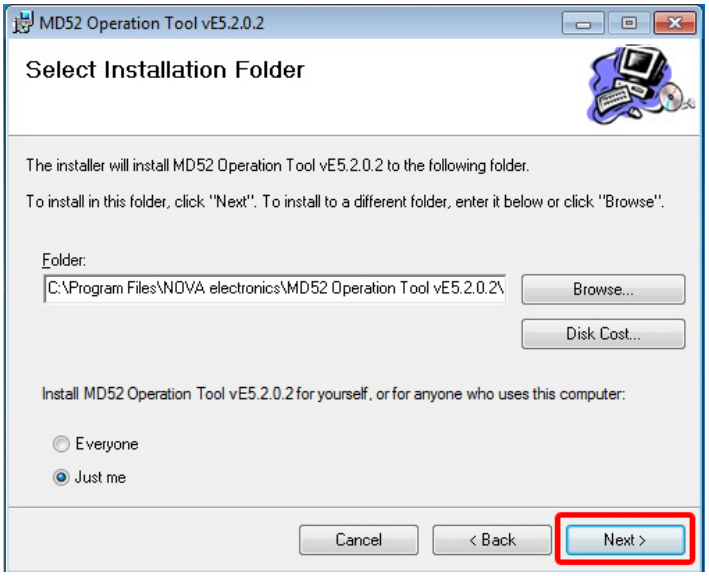
MD Operation51_52 Tool is the software to configure and operate MD5130D and MD5230D from PC. Follow the steps below to install “MD51_52 Operation Tool”. The screenshots are on Windows 7 (32bit).

(1) Execute SetupMD51_52_vJ5_2_x_xx.msi in MDOPTOOL¥32bit folder (for 64bit OS in MDOPTOOL¥64bit folder) (* ”n” and ”m” are the release number.)

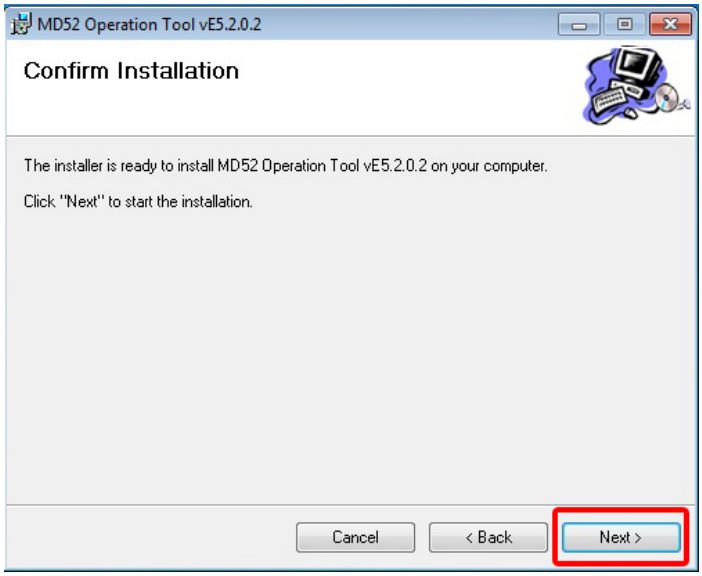
(2) “**MD51_52 Operation Tool Setup Wizard**” appears, click “**Next**”.



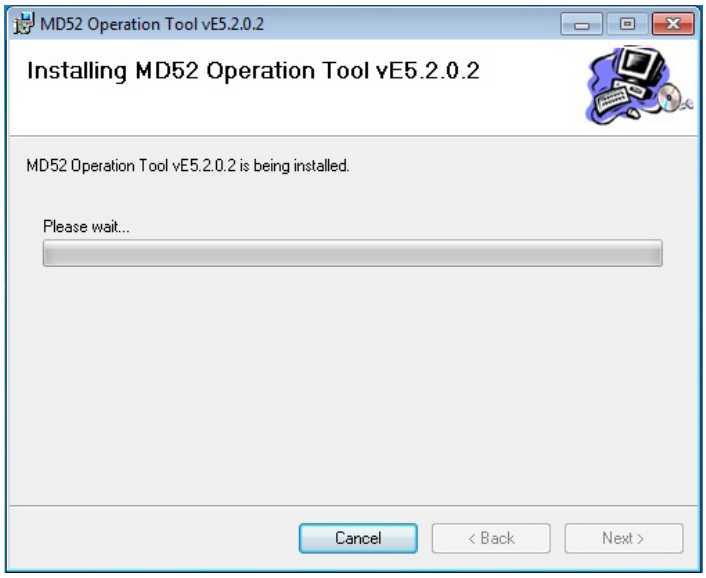
(3) On “**Select Installation Folder**” window, click “**Next**”.



(4) "**Confirm Installation**" window appears. Click "**Next**" and the installation will start.

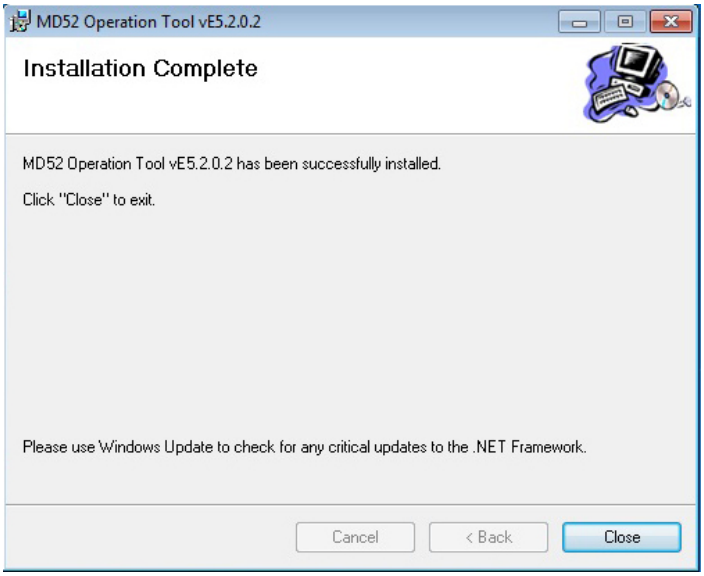


(5) MD51_52 Operation Tool is now installed.



[Note] User account control window appears on Windows7. Please click "Yes".

(5) “**Installation Complete**” window appears. Click “**Close**” to complete the installation.



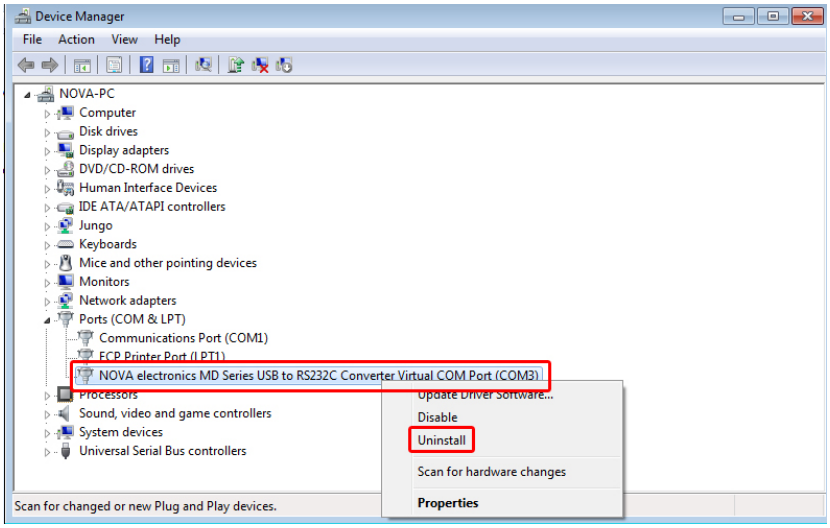
[Note] Please refer to chapter 4.1 and confirm the MD51_52 Operation Tool is working properly when connecting to the unit.

3.5. USB Driver Uninstallation

Uninstall USB driver from PC according to the following steps. The screenshots are on Windows 7 (32bit).
Usually uninstallation is not needed. When updating USB driver to the latest version or removing it from your PC, follow these steps.

(1) Connect MD5130D or MD5230D to be deleted USB driver and PC with USB cable and power on them, then open Device Manager.

(2) Right-click on "**NOVA electronics MD Series USB to RS232C Converter Virtual COM Port(COMx)**" under Ports (COM and LPT) (COMx denotes COM port number) and then click on "**Uninstall**".



(3) "**Confirm Device Uninstall**" window appears, check "**Delete the driver software for this device**" then click "**OK**".

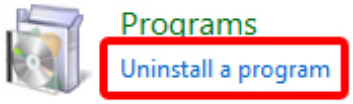
(4) The driver is now uninstalled.
Confirm "**NOVA electronics MD Series USB to RS232C Converter Virtual COM Port(COMx)**" is not listed, and then remove the unit from PC.

3.6. MD Operation Tool Uninstallation

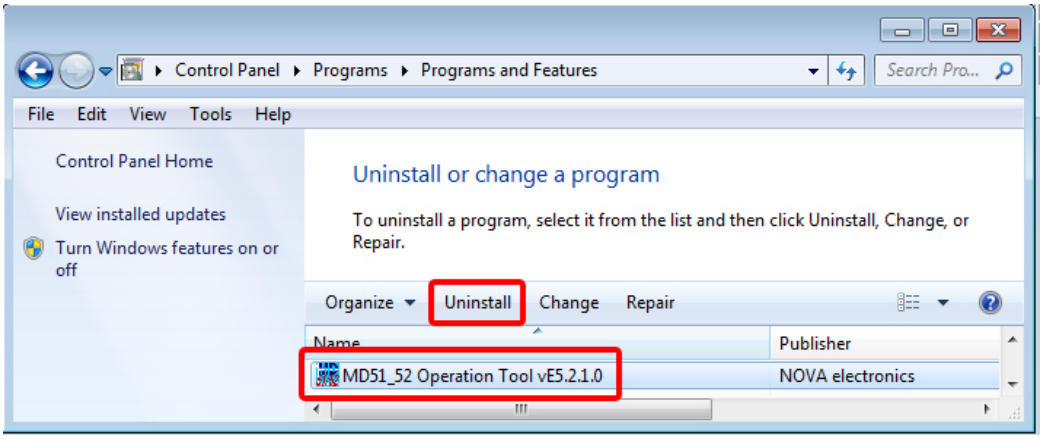
Uninstall MD51_52 Operation Tool from PC according to the following steps. The screenshots are on Windows 7 (32bit). Usually uninstallation is not needed. When updating MD51_52 Operation Tool to the latest version or removing it from your PC, follow these steps.

(1) Click "**Start**" → "**Control Panel**"

(2) Click "**Uninstall a program**" link under the "**Programs**", and "**Uninstall or change a program**" window appears. (Click "**Add or Remove Programs**" if on Windows XP.)



(3) Select MD51_52 Operation Tool and click "**Uninstall**" (Click "**Remove**" if on Windows XP.)



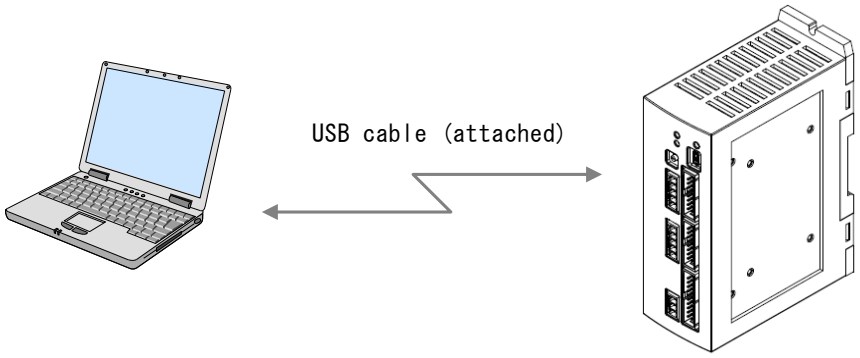
(4) "**Programs and Features**" window appears, then click "**Yes**".

[Note] User account control window appears on Windows7. Please click "Yes".

(5) MD Operation Tool is now uninstalled.
Confirm MD Operation Tool is not listed in "**Uninstall or change a program**", and uninstallation is successfully completed.

4. MD51_52 Operation Tool

MD51_52 Operation Tool is the software to configure and operate MD5130D and MD5230D from PC. After connecting the unit and PC with USB cable and starting MD51_52 Operation Tool, the user can easily perform operations described as below.



Window	Operation
Main	・Jog mode (Scan, Continuous, Preset) ・Automatic home search ・Invoking configuration and user program windows ・Download and upload configuration settings and a user program to a unit. ・Save and Load configuration settings and a user program to PC
Configuration	・Mode ・Speed ・Parameter ・Home search mode ・Split pulse ・Unit name
Program	・User program edit, download and upload to the unit, and execution ・Save and Load a user program in a file to PC
Input / Output	・Status display of input signals, setting of output signals

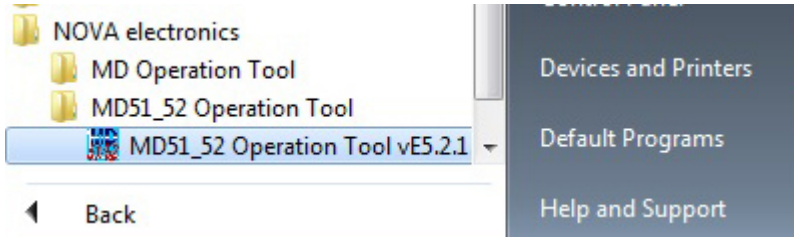
4.1. How to start MD51_52 Operation Tool

Start MD51_52 Operation Tool on your PC according to the following steps.

(1) Connect the unit and PC with USB cable.

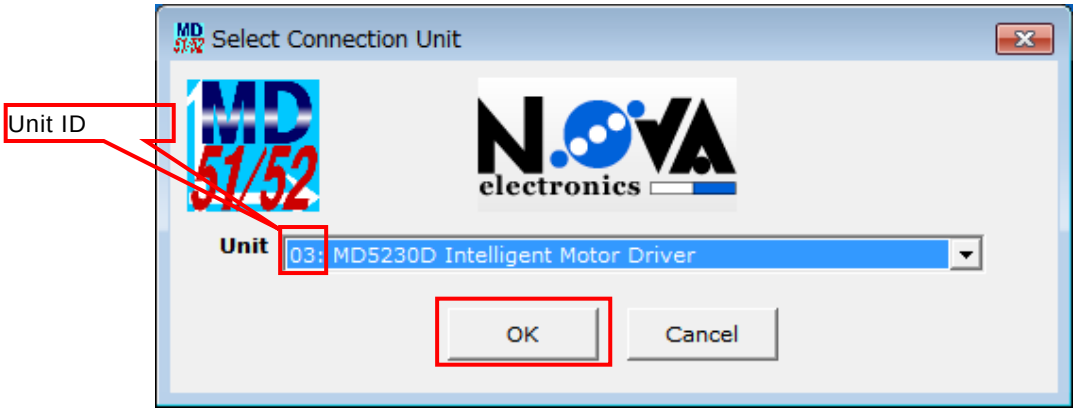
(2) Turn on both power. If this is the first time to use MD5130D or MD5230D, install USB driver and MD51_52 Operation Tool according to the steps in chapter 3.

(3) Start MD51_52 Operation Tool from "**Start**" menu.
On the **Start** menu, point to "**All Programs**", then click "**NOVA electronics**" → "**MD51_52 Operation Tool**" → "**MD51_52 Operation Tool**".



(4) **Select Connection Unit**" window appears.
Select the "**Unit ID**" to connect, and then click "**OK**".

* Unit ID is the identification number of each unit when two or more units are connected to PC. The ID number set by setting switch on the front panel of the unit to being connected to PC is displayed. The default ID is 00.



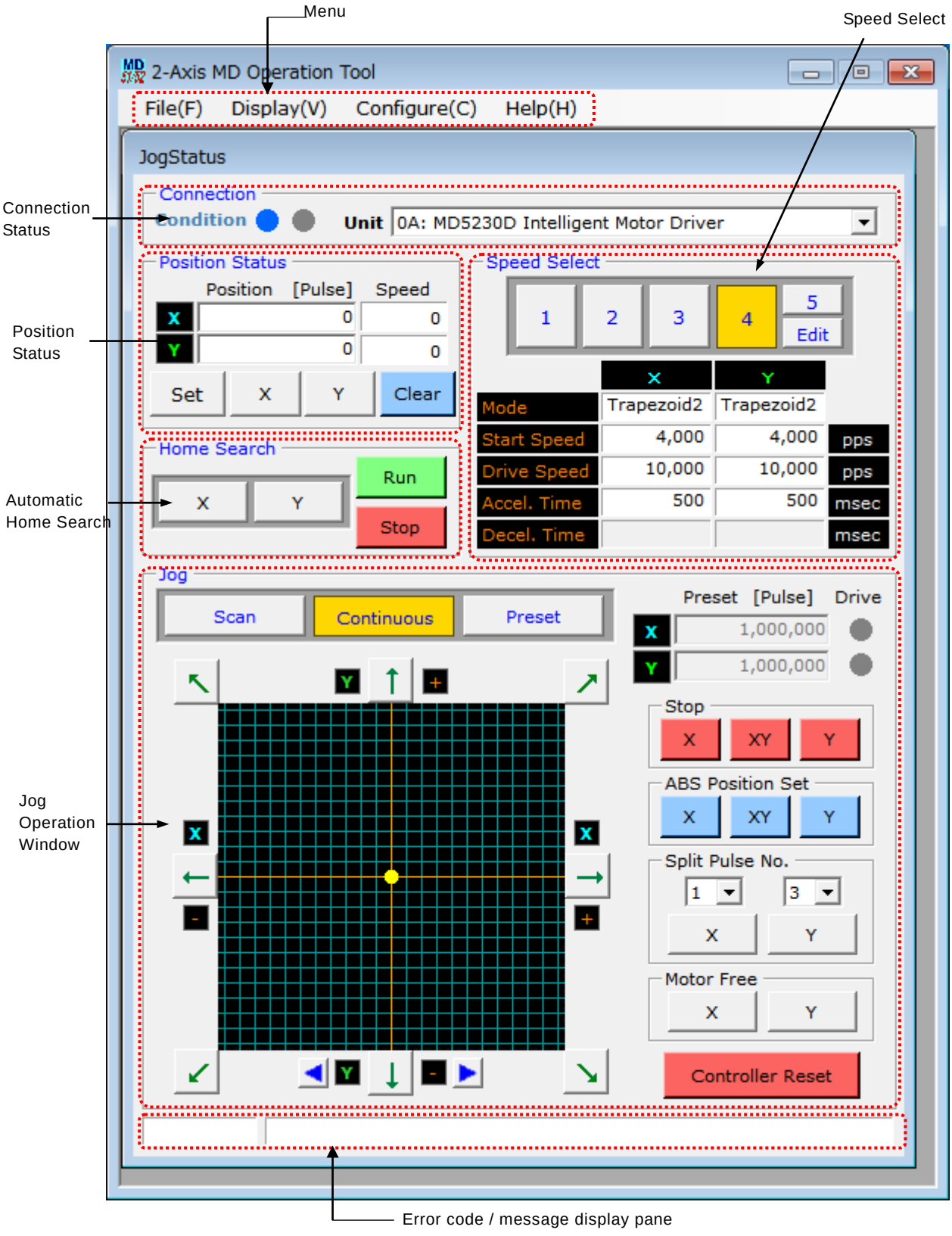
If the connection is correctly established, all the data registered in the unit (configuration settings and a user program) will be uploaded onto your PC and main window appears.
If the connection is not established, blank is displayed in Unit pull-down menu and MD Operation Tool is started in "**Unconnected**" state.

4.2. Main Window

When starting MD51_52 Operation Tool, the following main window appears. In this window, the user can perform operations as below.

- Jog mode (Scan, Continuous, Preset)
- Automatic home search execution
- Writing and reading configuration settings and a user program to/from the unit and save and load them.

In MD5130D, the axis used in MD Operation Tool is X-axis



4.2.1. Connection Status

It displays the connection status with the motion control unit.

Display	Contents
Condition	It displays the connection status with the motion control unit. ・Blue in the left is lighted ● : Unit connected ・Red in the right is lighted ● : Unit unconnected Even though the connection is not established, the user can create user programs and read/save files from a hard disc by using Open/Save in Program window.
Unit	It displays the unit ID and name of the unit to being connected. When two or more units are connected to PC, the user can select from Unit pull-down menu (click on ▼). If the unit is changed, configuration settings and a user program of the unit to being connected will be uploaded to PC. When blank in Unit pull-down menu is selected, communication is disconnected and the status becomes unconnected state. If the status is “unconnected”, try to connect by selecting Unit ID from Unit pull-down menu. After connection is established, configuration settings and a user program will be uploaded from the unit automatically. The Unit ID can be changed by the rotary switch of the unit. The unit can be named by inputting in Unit Name tab in chapter 4.3.6.

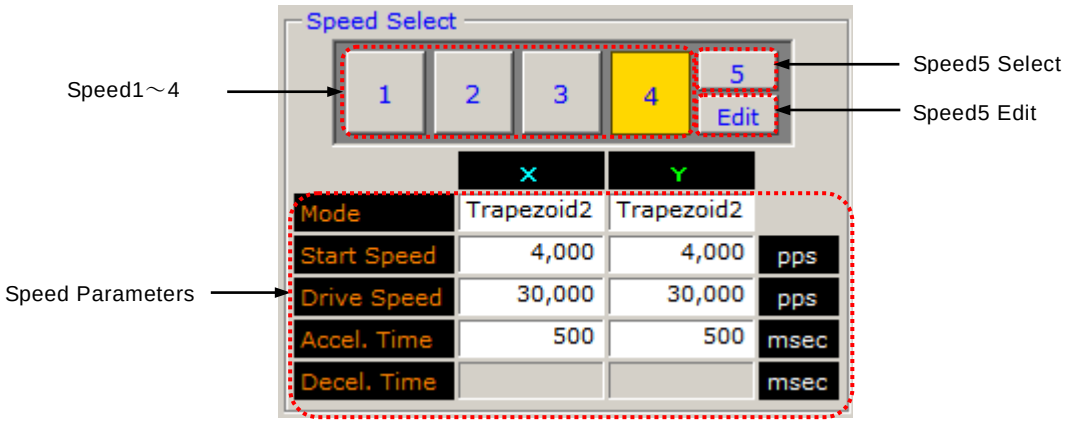
4.2.2. Position Status

It displays the current position (logical position) and speed during motor rotation.

Display	Contents
Position	Displays the current position (logical position). The user can set the logical position to an arbitrary value by directly input, and press Enter in Position field. This value depends on the scaling function. See chapter 4.3.3.4 Pulse Scale Numeration and Denomination.
Speed	Displays the current speed in unit of pps.
Logical position setting button [Set] [X] [Y]	Sets the logical position to an arbitrary value. Click on the axis button, and button will be highlighted in yellow and Position field becomes editable state. Then input the value to set the logical position and click “Set” button, and the logical position will be set and editable state will be cleared.
Clear	Clears Position field to 0. However, it does not clear during motor rotation.

4.2.3. Speed select

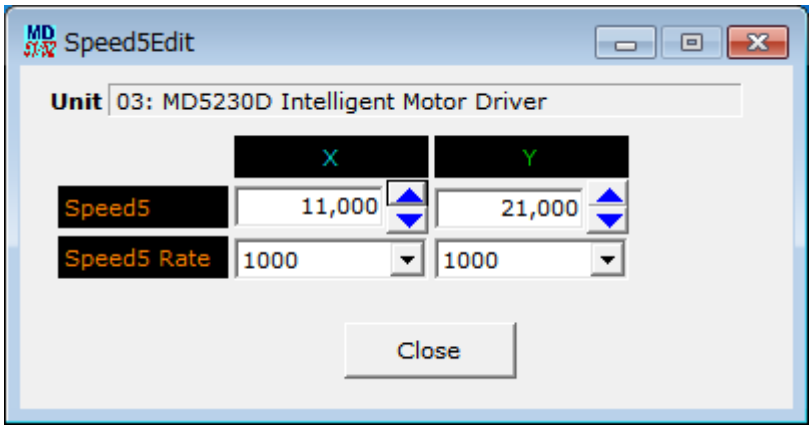
Select the speed to rotate a motor for jog mode. Speed1~4 uses the speed set by Speed Configuration. Speed5 can be freely changed the speed during jog mode and motor rotation.
The button selected from 1 to 5 is highlighted in yellow.



Display	Contents
Speed1～4	Selects the speed to rotate a motor for jog mode. Speed1~4 are the speed1~4 set by Speed settings tab in Configuration window, chapter 4.3.2. In Speed Parameters fields, the setting value of selected speed is displayed.
Speed5	Selects the speed5. Drive speed for speed5 can be set by Speed5 Edit window in chapter 4.3.2.1. Acceleration/deceleration mode and start speed use the setting value that is set in the speed1~4 just before selecting the speed5. The speed button just before selected is highlighted. Speed5 can be changed the speed during driving; however, the speed can not be changed during acceleration/deceleration when acceleration/deceleration mode is S-curve1 and S-curve 2.
Speed5 Edit	Sets the drive speed for speed5. After selecting speed5, clicking “Edit” button opens Speed5 Edit window.
Speed Parameters	Displays each parameter setting for the speed currently selected. When speed5 is selected, the drive speed set in Speed5 Edit window is displayed in “Drive Speed”, and each parameter value just before selecting speed5 is displayed in “Mode”, “Start Speed”, “Accel.Time” and “Decel.Time” fields.

4.2.3.1 Speed5Edit

It sets the drive speed for Speed5. Speed5 can be changed during motor rotation.



Display	Contents
Speed5	Set the drive speed for speed5 within the range of 1～500000(pps). Input the value and press Enter, and the speed will be set. Clicking (▲▼) button increases and decreases the value based on Speed5 Rate.
Speed5 Rate	Select Speed5 Rate from 1, 10, 100, 1000, 10000(pps). When 10 is selected, clicking (▲▼) button increases and decreases the Speed5 value by 10(pps).
Close	Closes Speed5 Edit window.

[Note]

- When Speed5 Edit window is opened, Speed Select can not be changed to Speed1~4 even though a motor stops. To change Speed Select, close Speed5 Edit window.
- As for acceleration time (Accel.Time) and deceleration time (Decel.Time) when selecting Speed5
  The acceleration/deceleration of Speed5 is performed with acceleration/deceleration slope based on the setting value in Speed Select just before selecting Speed5. Please note the acceleration/deceleration time is different from the setting values displayed in Speed Parameters.

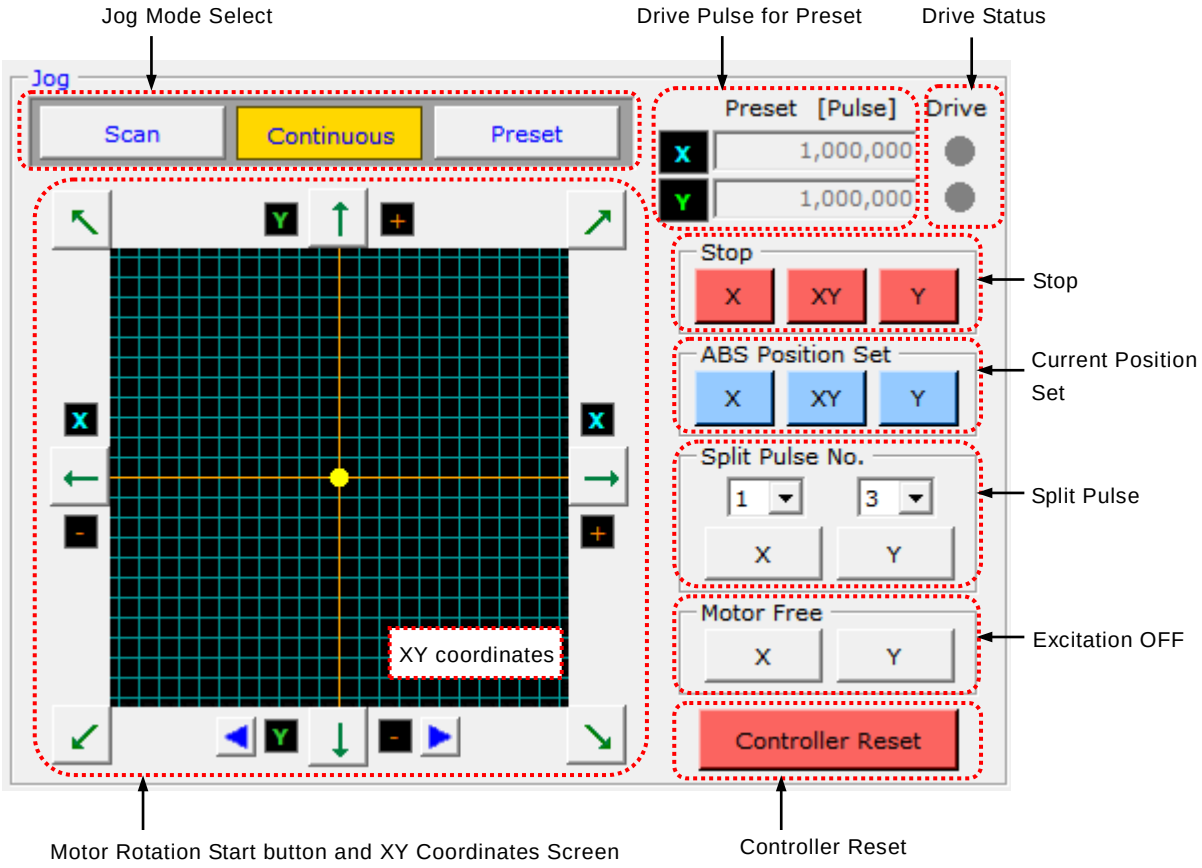
4.2.4. Automatic Home Search

It performs an automatic home search. The mode and speed for an automatic home search must be set in each tab of Configuration window, refer to 4.3 Configuration Settings window : Configuration.

Display	Contents
Axis [X]	Selects the axis to perform an automatic home search, the selected axis button is highlighted in yellow. In MD5130D, select X button.
Run	Clicking the button starts an automatic home search.
Stop	Clicking the button stops an automatic home search.

For more details of Automatic Home Search, see chapter 6.2.

4.2.5. Jog Operation Window : Jog



4.2.5.1 Jog Mode Select : Scan, Continuous, Preset

There are three modes can be set in main window. The selected mode button is highlighted in yellow.

Mode	Contents
Scan	Rotates a motor only while pressing the motor rotation start button, and stops it after releasing the button.
Continuous	Starts a motor rotation when the motor rotation start button is clicked, and keeps it until Stop button is clicked.
Preset	Rotates a motor by Preset value when the motor rotation start button is clicked.

4.2.5.2 Drive Pulse for Preset : Preset

Set the drive pulses for Preset within the range of 1～2147483646 (when in pulse scale numerator / denominator = 1000/1000) This value depends on the scaling function. For more details of the scaling function, See chapter 4.3.3.4 Pulse Scale Numeration and Denomination.

4.2.5.3 Drive Status : Drive

It lights in red during motor rotation.

4.2.5.4 Motor Rotation Start button and XY Coordinates Screen

Display	Contents
Motor Rotation Start button 	Motor rotation start button starts operations in selected jog mode (Scan / Continuous / Preset). Clicking the button starts to rotate a motor in the displayed axis and direction.
Axis and Direction [X] [Y] [＋] [－]	It displays the axis and direction of the motor rotation start button. Clicking XY coordinates screen rotation button changes the axis and direction.
XY Coordinates Screen Rotation button 	It changes the axis and direction of the XY coordinates screen. Clicking  button rotates the coordinate axis 90 degrees to the right. Clicking  button rotates the coordinate axis 90 degrees to the left.
XY coordinates screen	The current position is displayed as a yellow circle on the XY coordinates screen. After starting to rotate a motor, the yellow circle moves. And when Graphics Position Tracing is set (see chapter 4.2.6.2), the locus of a moving point is displayed. The display range of the XY coordinates screen (logical position) depends on the setting value of software limit + and - in “Parameter” in chapter 4.3.3 – “Configuration”. The software limit range equals to the display range of the XY coordinates screen regardless of software limit enable / disable. The display range of the XY coordinates screen is always over ±230.

- Indicate the direction of motor rotation (＋/－) and axis.
  - ＋direction rotation　A motor axis rotates in clockwise direction with respect to the seating plane of a motor.
  - －direction rotation　A motor axis rotates in counterclockwise direction with respect to the seating plane of a motor.

- Jog operations by 10 key
  - 10 key on keyboard can perform jog operations as well, which can perform motor rotation start, stop and speed change.

10 key	Contents
6 key	This key performs the same operation as  button in Jog operation window.
4 key	This key performs the same operation as  button in Jog operation window.
8 key	This key performs the same operation as  button in Jog operation window.
2 key	This key performs the same operation as  button in Jog operation window.
9 key	This key performs the same operation as  button in Jog operation window.
3 key	This key performs the same operation as  button in Jog operation window.
1 key	This key performs the same operation as  button in Jog operation window.
7 key	This key performs the same operation as  button in Jog operation window.
0 key	It stops motor rotation.
Space key	It switches the speed select button. While motor stops, it switches the speed select button 1→2→3→4→5→1→… in order each time space key is pressed.

4.2.5.5 Stop

Clicking the axis button stops motor rotation.
However, while motor rotation is controlled by parallel control signals, the button in Stop pane does not work to stop motor rotation.

4.2.5.6 ABS Position Set

The current position displayed in Position Status is set to the selected row of Program window (4.4.1 User Program Display/Edit area) in the form of ABS command. Click the axis button the user wants to register the current position, and it will be registered. This button will be enabled after Program window is opened. (4.2.6 Display menu).

Speed is set the speed selected in Speed Select (4.2.3) in Main window. Timer is set to 0 and EndP is set to OFF. When the current position is set, the row selected in Program window moves to the next row.

4.2.5.7 Split Pulse

Display	Contents
No.	Select operation of split pulse from Split Pulse 1～4. As for the setting of split pulse, go to “Configure” menu → “Split Pulse”.
Axis button [X/Y]	The button to enable split pulse. When this button is pressed before motor rotation starts, split pulse will output at the start of motor rotation. When this button is pressed during motor rotation, split pulse starts to output from that time. While split pulse is enabled, the axis button is highlighted in yellow. When clicked again in an enabled state, split pulse will be disabled and stop to output split pulses.

For more details of Split Pulse, see chapter 6.3.

4.2.5.8 Excitation OFF：Motor Free

Click the axis button in Motor Free, the excitation of the axis will turn OFF and the button will be highlighted in yellow. When clicked again, it turns back ON. The excitation can not turn ON and OFF during motor rotation. While the excitation turns OFF, the operation of motor rotation can not be performed.

4.2.5.9 Controller Reset

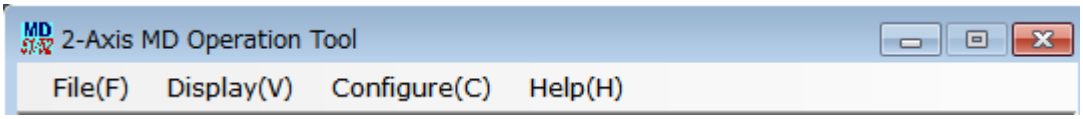
It resets the unit.
If a step out error occurs, release the error by clicking "**Controller Reset**" button.
When the user needs to stop motor rotation urgently, you can stop it by "**Controller Reset**" button.

■ The body is reset as follows.
・X and Y axes motor rotation stops instantly.
・X and Y axes user program operation stops.
・The logical/real position counters of X and Y axes are cleared to 0.
・The Speed Select of X and Y axes is set to 1.
・The Drive error of X and Y axes is cleared.
・The excitation of X and Y axes is turned ON.
・The split pulse of X and Y axes is disabled.

■ MD51_52 Operation Tool is reset as follows.
・When Speed5 Edit window is displayed, it is closed.
・When Run mode is selected in Program window, it is changed to Edit mode.

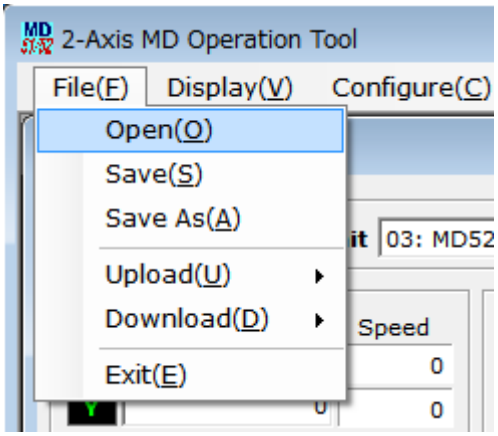
4.2.6. Menu

There are 4 menus, [File(F)], [Display(V)], [Configure(C)] and [Help(H)] on menu bar.



4.2.6.1 File Menu

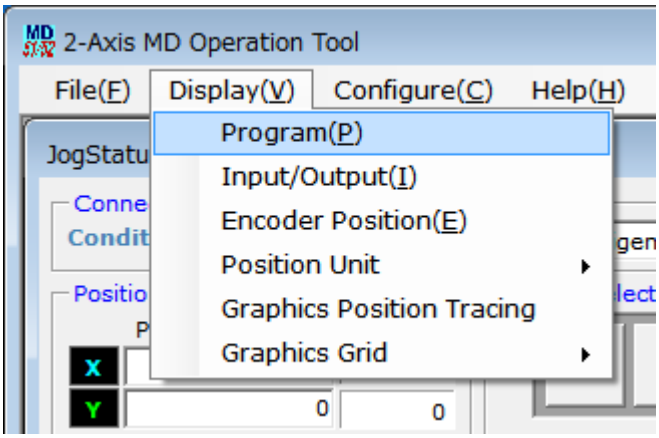
In **File** menu, the user can download and upload configuration settings and a user program to the unit, and save and load them to PC.



File menu	Function	Contents
Open	Read from File	Reads configuration settings and a user program from a saved file. When read out from a file, Program and Configuration windows are automatically opened. (Configuration window is in minimized state.)
Save Save As	Save to File	Saves configuration settings and a user program to a file in CSV format. Save Overwrite and save Save As Rename and save When saved to a file, Program window is automatically opened.
Upload	Read from Unit	Reads data from a unit. Program User program Configuration Configuration settings All All data When MD Operation Tool is opened after connecting to a unit, a user program and configuration settings are automatically uploaded.
Download	Write into Unit	Write data to the EEPROM of a unit. Program User program Configuration Configuration settings All All data When Download is executed, User Program Edit and Configuration windows are automatically opened. (Configuration window is in minimized state.)
Exit	Exit	Exits MD Operation Tool.

4.2.6.2 Display Menu

In **Display** menu, the user can open Program, Input/Output and Encoder Position windows, and change the unit of position.

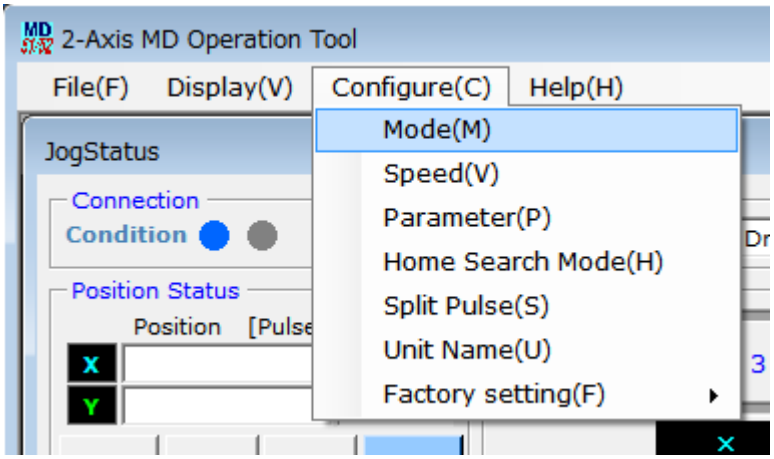


Display menu	Function	Contents
Program	Open Program window	Opens Program window, the user can edit, register and execute a user program in this window. See chapter 4.4 Program.
Input/Output	Open Input/Output window	Opens Input/Output window, the user can display input signal status and operate output signals. See chapter 4.5 Input/Output.
Encoder Position	Open Encoder Position window	Opens Encoder Position window. See chapter 4.6 Encoder Position.
Position Unit	Change Position Unit*1	Changes the unit of position and moving distance from the following 4 options. Pulse, mm, um, inch [Items changed Position Unit] ・Main window：Position ・Main window：Preset ・Parameter window：Software Limit ＋ ・Parameter window：Software Limit － ・Parameter window：Home Search Offset Changing Position Unit does not perform the scaling function but just change the display of unit. The scaling function for parameters can be configured by the setting of pulse scale in Parameter window. For more details of the setting of pulse scale, see chapter 4.3.3.4 Pulse Scale Numeration and Denomination.
Graphics Position Tracing	Display Locus of Moving Point *1	The moving position by motor rotation is displayed with dots in the locus of a moving point. [Note] During high-speed driving, the locus of a moving point becomes coarse.
Graphics Grid	Display Grid Value *1	The value how many squares (grids) to move in the graphics window. The moving amount of grids is determined based on the software limit value in Parameter window.

*1 : A unit needs to be connected..

4.2.6.3 Configure Menu

In **Configure** menu, the user can open each window that can configure settings. And a unit name and reset to factory setting can be performed in this menu.



Configure menu	Function	Contents
Mode	Mode setting	Opens Mode tab in Configuration window. See chapter 4.3.1 Mode Settings tab.
Speed	Speed setting	Opens Speed Settings tab in Configuration window. See chapter 4.3.2 Speed Settings tab.
Parameter	Parameter setting	Opens Parameter Settings tab in Configuration window. See chapter 4.3.3 Parameter Settings tab.
Home Search Mode	Home Search Mode setting	Opens Home Search Mode Settings tab in Configuration window. See chapter 4.3.4 Home Search Mode Settings tab.
Split Pulse	Split Pulse setting	Opens Split Pulse Settings tab in Configuration window. See chapter 4.3.5 Split Pulse Settings tab.
Unit Name	Unit Name setting	Opens Unit Name Settings tab in Configuration window. See chapter 4.3.6 Unit Name Settings tab.
Factory setting	Reset to Factory setting	Resets to factory setting. Program Clear all user programs. Configuration Reset all settings of Configuration to factory setting. All Reset all data to factory setting.

4.2.6.4 Help Menu

In **Help** menu, the user can check the version of a unit firmware and MD51_52 Operation Tool in Version window, the upper part is the version of MD51_52 Operation Tool and lower part is the version of a unit firmware

4.3. Configuration Settings window : Configuration

To operate MD5130D and MD5230D, it is necessary to configure settings based on the user system. Connect the unit and PC with USB cable and start MD51_52 Operation Tool, the user can configure settings in Configuration window. From Configure menu on menu bar of MD51_52 Operation Tool main window, the user can open 5 windows, which are Mode, Speed, Parameter, Home Search Mode and Split Pulse windows. Each window can be switched by the tab in the upper part of Configuration window.

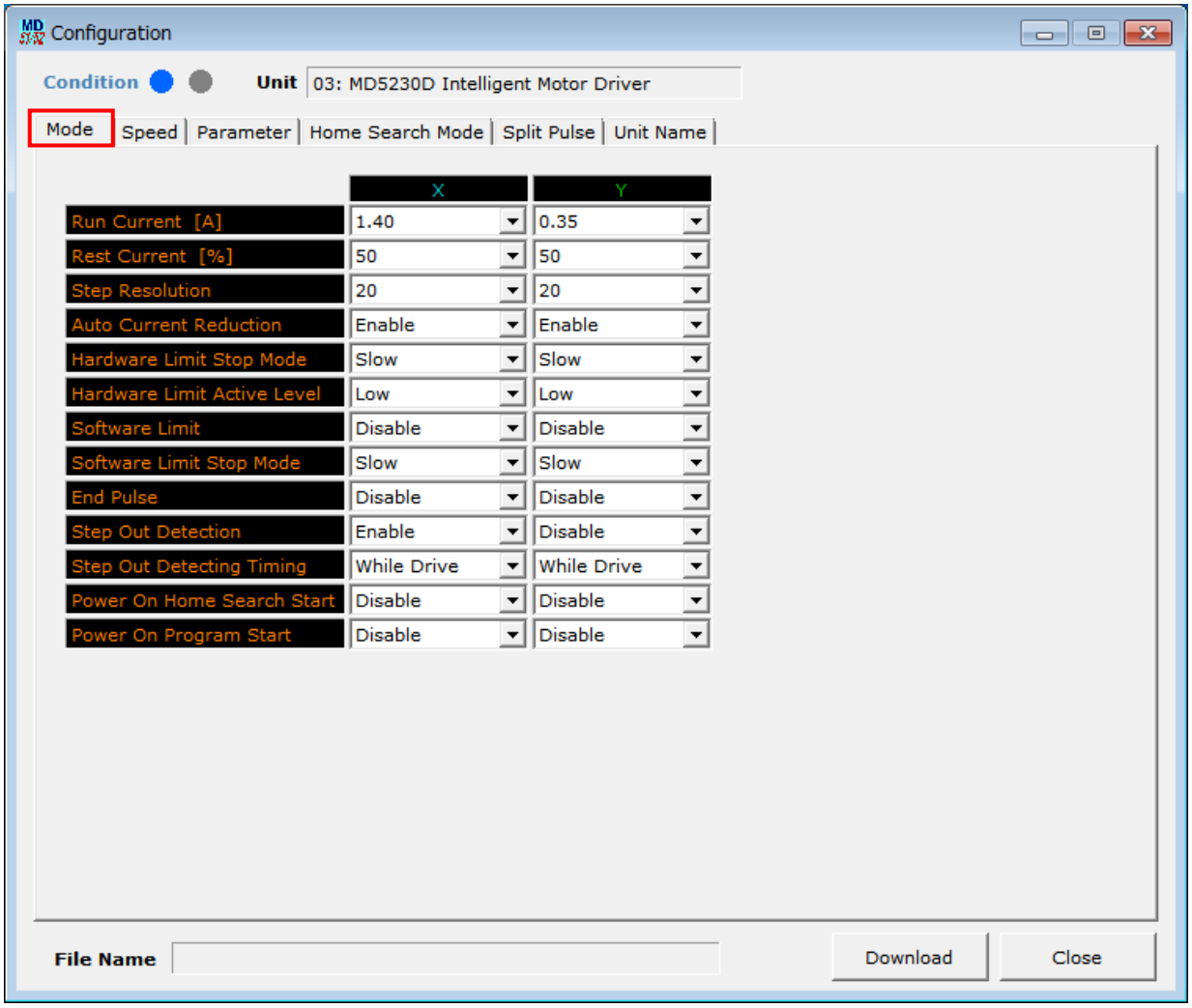
When a unit is not connected, Download button works as Save button. This Save button saves configuration settings and a user program.
For more details, please refert to chapter4.7 for Configuration and Edit / Save User Program When Not in Connection.

[Note]

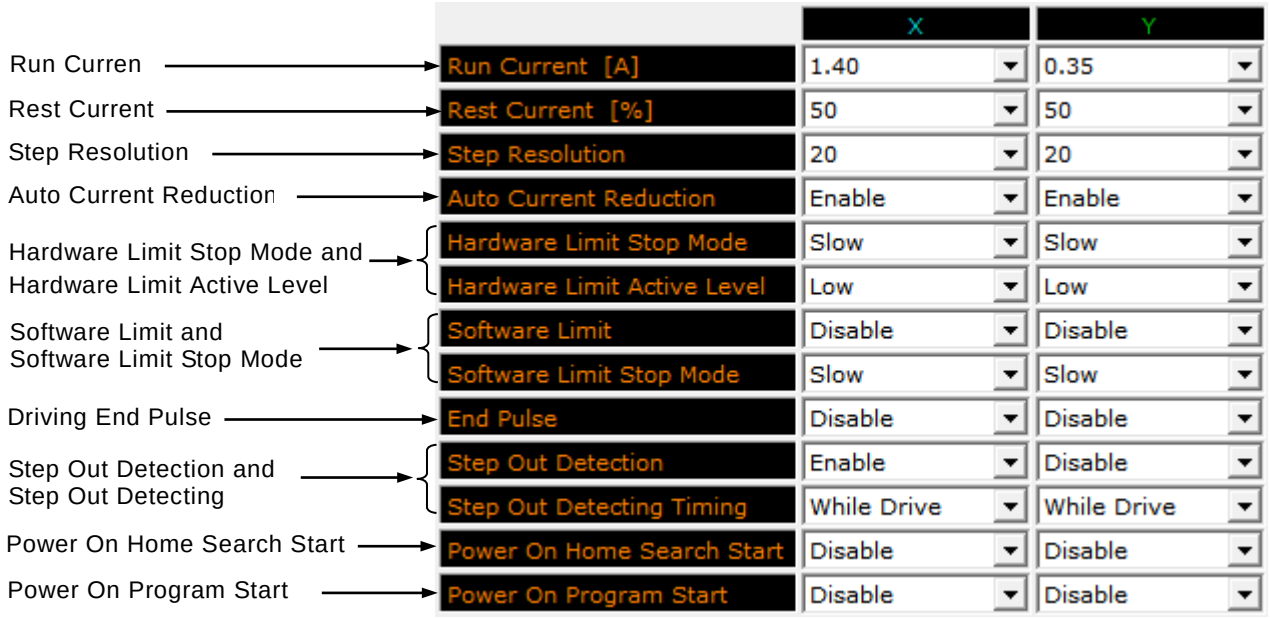
- When configuration settings are changed, writing (download) in the unit is needed. Click Download button in the bottom of Configuration window, and configuration settings in all tabs will be downloaded.

4.3.1. Mode Settings tab : Mode

It configures modes for driving. Each mode can be selected from a list by click ▼.



Setting items in Mode tab are as follows.



Display	Option	Default
Run Current [A]	0.35, 0.42, 0.49, 0.56, 0.63, 0.70, 0.77, 0.84, 0.91, 0.98, 1.05, 1.12, 1.19, 1.26, 1.33, 1.40	0.35[A]
Rest Current [%]	25, 30, 35, 40, 45, 50, 55, 60, 65, 70, 75, 80, 85, 90, 95, 100	50[%]
Step Resolution	1, 2, 4, 5, 8, 10, 16, 20, 25, 40, 50, 80, 100, 125, 200, 250	20
Auto Current Reduction	Disable ／ Enable	Enable
Hardware Limit Stop Mode	Instant ／ Slow	Instant
Hardware Limit Active Level	Low ／ High	Low
Software Limit	Disable ／ Enable	Disable
Software Limit Stop Mode	Slow ／ Instant	Slow
End Pulse	Disable ／ Enable	Disable
Step Out Detection	Disable ／ Enable	Disable
Step Out Detecting Timing	Drive End ／ While Drive	Drive End
Power On Home Search Start	Disable ／ Enable	Disable
Power On Program Start	Disable ／ Enable	Disable

* [ ] indicates a unit.

4.3.1.1 Run Current

It selects a value of driving current per phase during motor rotation.

Tab	Display	Option	Default
Mode	Run Current [A]	0.35, 0.42, 0.49, 0.56, 0.63, 0.70, 0.77, 0.84, 0.91, 0.98, 1.05, 1.12, 1.19, 1.26, 1.33, 1.40	0.35[A]

* [ ] indicates a unit.

The user can select one from 16 kinds from 0.35 to 1.40. The unit of the value is A (ampere).
This sets driving current of a motor during motor rotation. Please be sure to set it within the range of rating of a motor based on the load. The greater a value of current is set, the larger motor torque becomes; however, the heat generation and vibration of the unit and a motor become large. And the smaller a value of current is set, the more motor torque decreases.
The actual value of current fluctuates about ±5% with respect to the setting value.

[Note]

- When the user changes a motor to be connected, set a proper value in MD Operation Tool before connecting a motor.

4.3.1.2 Rest Current

It selects a value of current during motor stop for when Auto Current Reduction is enabled.

Tab	Display	Option	Default
Mode	Rest Current[%]	25, 30, 35, 40, 45, 50, 55, 60, 65, 70, 75, 80, 85, 90, 95, 100	50[%]

Specify a value of current during motor stop by percentage to the setting value of Run Current, there are 16 kinds from 25 to 100, can be selected. The smaller a value of current is set, the more motor torque decreases.

4.3.1.3 Step Resolution

It selects a value of Step Resolution.

Tab	Display	Option	Default
Mode	Step Resolution	1, 2, 4, 5, 8, 10, 16, 20, 25, 40, 50, 80, 100, 125, 200, 250	20

Microstep resolution can be selected from 16 resolution settings from 1 to 250. This is the function to divide the basic step angle of a motor into smaller microsteps. The basic step of 5-phase stepper motor is 500 steps per rotation and the rotation angle is 0.72° per step, so if 20 is set to Step Resolution, steps per rotation is 10000.

[Note]

- Step resolution function is the method of dividing the basic step of motor excitation electrically. It does not assure that the step angel divided by Step resolution is uniform mechanically.

4.3.1.4 Auto Current Reduction

It selects either Enable or Disable for Auto Current Reduction.

Tab	Display	Option	Default
Mode	Auto Current Reduction	Disable/Enable	Enable

Auto Current Reduction function suppresses the heat generation of a motor during motor stop by decreasing driving current automatically while a motor is not rotating. Driving current will be the setting value of Rest Current automatically in 150ms after motor stop.

[Note]

- As the torque decreases during motor stop, be sure not to fall the object to be conveyed especially in up-and-down driving, or it may cause damage to the equipment or injury.

4.3.1.5 Hardware Limit Stop Mode and Active Leve3

It selects a stop mode and logical level for active by a hardware limit signal.

Tab	Display	Option	Default
Mode	Hardware Limit Stop Mode	Instant (Instant stop) / Slow (Deceleration stop)	Instant
	Hardware Limit Active Level	Low (GEX Short-circuited) / High (Open)	Low

Limit input signals (XLMT+/–) for +/– direction are the #9, #10 pins in CN4 connector (see chapter 7.4 CN4 Sensor Connector for Axis).
Hardware Limit Stop Mode selects either instant stop or deceleration stop for when this limit input signal becomes active.
Hardware Limit Active Level specifies the logical level for active. To make active for when an input signal and GEX are short-circuited, set Low to Active level and to make active for when it is open, set High to Active level.

When a hardware limit error occurs, the user can escape from the limit area by rotating a motor in the reverse direction. The

hardware limit signal can also be used as the detection signal of automatic home search. See chapter 6.2 for more details of automatic home search.

4.3.1.6 Software Limit and Stop Mode

It selects either Disable or Enable and a stop mode for Software Limit.

Tab	Display	Option	Default
Mode	Software Limit	Disable / Enable	Disable
	Software Limit Stop Mode	Slow (Deceleration stop) / Instant (Instant stop)	Slow

Software Limit is used to enable or disable the software limit function.
Software Limit Stop Mode selects either deceleration stop or instant stop for when motor rotation stop by the software limit function.
Software Limit is the over run limit function which can internally set as position data, which differs from hardware limit signal input such as an external sensor. If the logical position is over the setting value of software limit + during motor rotation in the + direction, a software limit error occurs and motor rotation stop. Also if over the setting value of software limit– during motor rotation in the – direction, a software limit error occurs and motor rotation stop.
When a software limit error occurs, the user can escape from the limit area by rotating a motor in the reverse direction.
The value of software limit can be set in “Software Limit +” and “Software Limit –” fields in Parameter tab (See chapter 4.3.3.2 Software Limit +/–).

[Note]

- Software limit does not function even if enabled while a home search is running.

4.3.1.7 End Pulse

It selects either Enable or Disable to output driving end pulses at the end of driving.

Tab	Display	Option	Default
Mode	End Pulse	Disable / Enable	Enable

XDRIVE/END output signal for End Pulse is #15 pin in CN3 of the parallel control connector (see chapter 7.3).
For more details of Driving End Pulse, see chapter 7.3.1 Parallel Control Signals, the XDRIVE / ENDP in the table.
The value of end pulse width can be set in “End Pulse Width” field in Parameter tab (see chapter 4.3.3.3).

4.3.1.8 Step Out Detection and Detecting Timing

It selects either Enable or Disable of the step out detection function and the timing to detect step out.

Tab	Display	Option	Default
Mode	Step Out Detection	Disable / Enable	Disable
	Step Out Detecting Timing	Drive End / While Drive	Drive End

Step Out Detection is used to enable or disable the step out detection function.
Step Out Detecting Timing selects the timing to detect step out. When “Drive End” is selected, and if it detects a position deviation that is over the setting value of step out differential during motor stop, it becomes a step out error. When “While Drive” is selected, and if it detects a position deviation that is over the setting value of step out differential during motor rotation, it becomes a step out error and stops motor rotation immediately.
The value of step out differential can be set in “Step Out Differential” field in Parameter tab (see chapter 4.3.3.6). For more details of Step Out Detection Function, see chapter 6.4.

4.3.1.9 Power On Home Search Start

It selects either Enable or Disable for automatic home search at power-on.

Tab	Display	Option	Default
Mode	Power On Home Search Start	Disable / Enable	Disable

Power On Home Search Start is the function to automatically perform a home search when the power is on or the unit is reset by the external RESET signal (see chapter 7.3) of the parallel control connector (CN3). For more details of Automatic Home Search, see chapter 6.2.

Power On Home Search Start cannot be canceled during driving. Make sure to first stop driving by clicking “Controller Reset” button in Main window, and next set to disable in “Power On Home Search Start” field in Mode tab.

[Note]

- “Controller Reset” button in Main window does not start power on home search automatically.
- When using Power On Home Search Start, it recommends to embed home search command into a program rather than to use power on home search start.
- In order to abort the operation by Power On Home Search Start, use “Controller Reset” button in Main window or STOP signal of the parallel control connector (CN3) (See chapter 7.3).

4.3.1.10 Power On Program Start

It selects either Enable or Disable for automatic program start at power-on.

Tab	Display	Option	Default
Mode	Power On Program Start	Disable / Enable	Disable

Power On Program Start is the function to automatically perform program driving when the power is on or the unit is reset by the external RESET signal (see chapter 7.3) of the parallel control connector (CN3).
To perform Power On Program Start, select Enable for power on program start and set MODE1, 0 signals of the parallel control connector (CN3) to program driving mode (See chapter 7.3) and specify the program label number (see chapter 7.3.2.4) of a user program to be executed by PSL0～5 signals (See chapter 7.3).
If Power On Home Search Start is also enabled, the program driving will be performed after completion of home search execution.

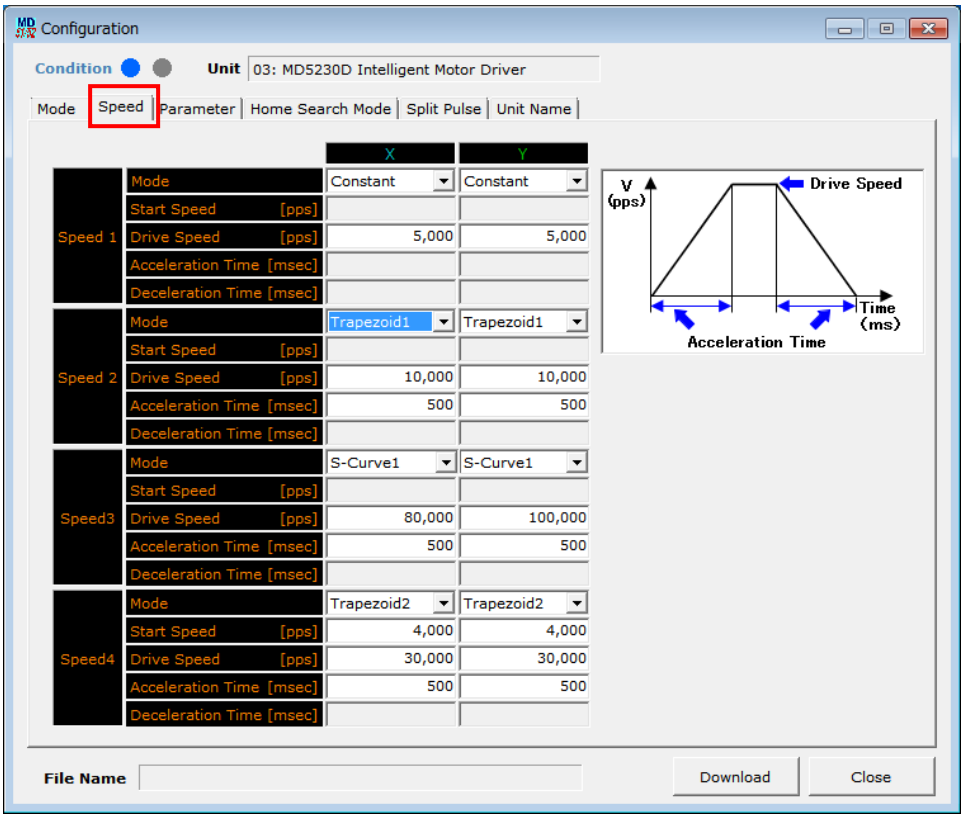
Power On Program Start cannot be canceled during driving. Make sure to first stop the program by clicking “Controller Reset” button in Main window, and next set to disable in “Power On Program Start” field in Mode tab.

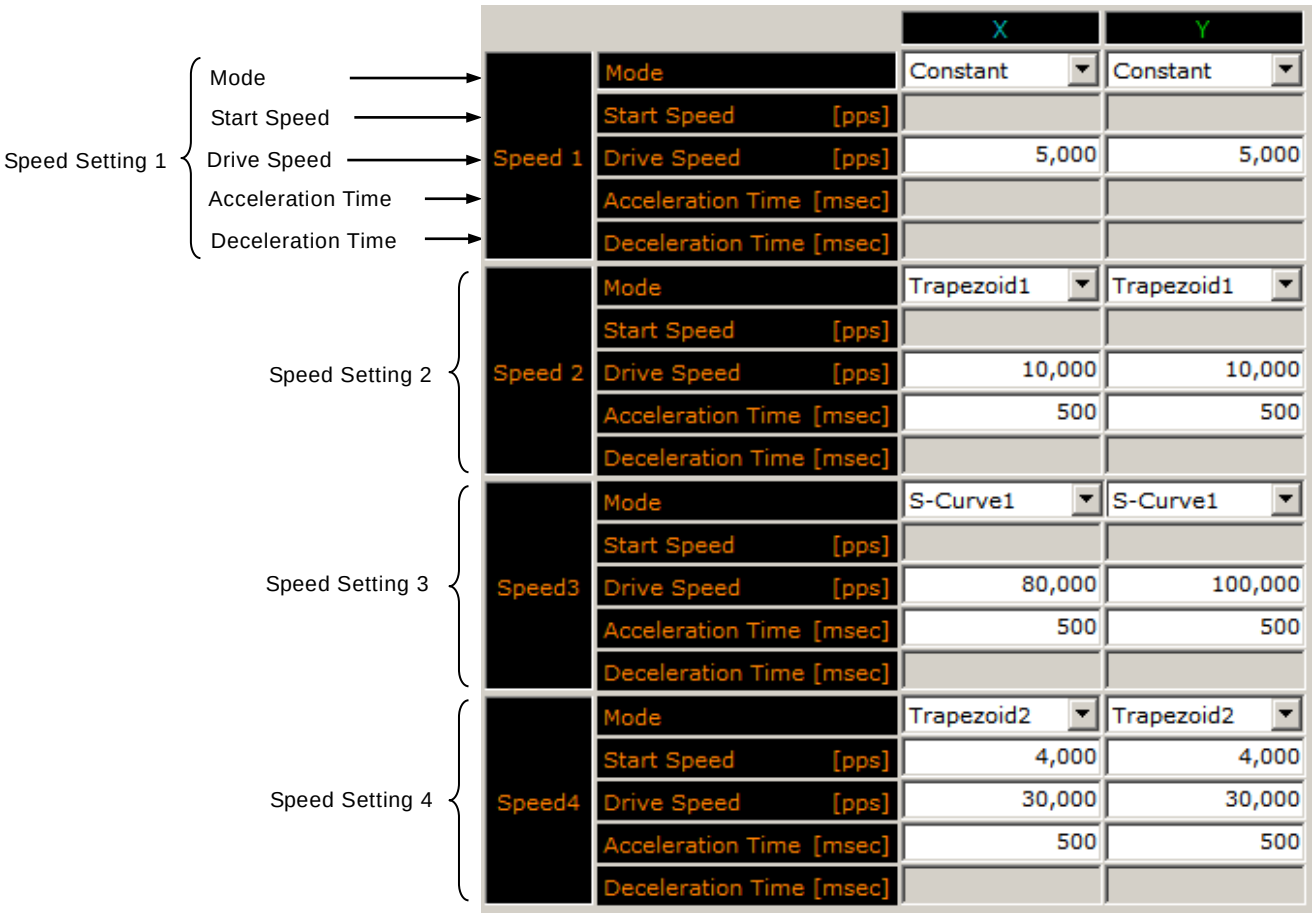
[Note]

- “Controller Reset” button in Main window does not start power on program start automatically.
- When using Power On Program Start, write timer command to the first line of a program to be executed in advance, so as to operate next command after passing the specified period.
- In order to abort program driving by Power On Program Start, use “Controller Reset” button in Main window or STOP signal of the parallel control connector (CN3) (See chapter 7.3).
- In case the label number of a user program that is executed by PSL0～5 signals (see chapter 7.3.2.4) is not specified (all OFF), the program label no.1 (P01) is automatically selected.

4.3.2. Speed Settings tab : Speed

It configures Speed1~4, and the diagram of acceleration/deceleration mode currently selected is shown in the right of the window. The setting range of each item is displayed in “Range of Value”





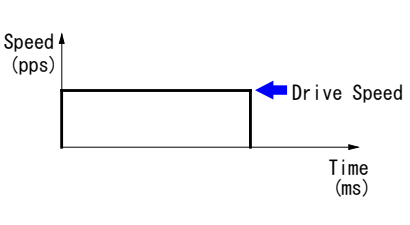
Setting items in Speed tab are as follows in the table.

Display		Option / Range	Default
Speed1	Mode	Constant／Trapezoid1／Trapezoid2／Trapezoid3／S-Curve1／S-Curve2	Constant
	Start Speed [pps]	1 ～ 500000	(Blank)
	Drive Speed [pps]	1 ～ 500000	4000
	Acceleration Time [msec]	1 ～ 10000	(Blank)
	Deceleration Time [msec]	1 ～ 10000	(Blank)
Speed2	Mode	Constant／Trapezoid1／Trapezoid2／Trapezoid3／S-Curve1／S-Curve2	Trapezoid1
	Start Speed [pps]	1 ～ 500000	(Blank)
	Drive Speed [pps]	1 ～ 500000	80000
	Acceleration Time [msec]	1 ～ 10000	500
	Deceleration Time [msec]	1 ～ 10000	(Blank)
Speed3	Mode	Constant／Trapezoid1／Trapezoid2／Trapezoid3／S-Curve1／S-Curve2	S-Curve1
	Start Speed [pps]	1 ～ 500000	(Blank)
	Drive Speed [pps]	1 ～ 500000	80000
	Acceleration Time [msec]	1 ～ 10000	500
	Deceleration Time [msec]	1 ～ 10000	(Blank)
Speed4 *1	Mode	Constant／Trapezoid1／Trapezoid2／Trapezoid3／S-Curve1／S-Curve2	Trapezoid2
	Start Speed [pps]	1 ～ 500000	4000
	Drive Speed [pps]	1 ～ 500000	40000
	Acceleration Time [msec]	1 ～ 10000	500
	Deceleration Time [msec]	1 ～ 10000	(Blank)

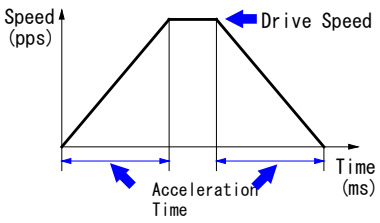
*1 : Speed4 is also used as the speed for high-speed home search and high-speed offset drive of automatic home search operation. For more details of automatic home search, see chapter 6.2.

The user can register 4 patterns of the speed setting, Speed1 ~ 4. And each speed setting has the following items: Mode, Start Speed, Drive Speed, Acceleration /Deceleration Time. Required setting items are different depends on the selecting mode.

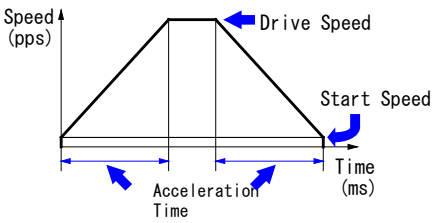
The following figures show the acceleration / deceleration curves that the user can select from mode options, and setting items that are required in each mode. For more details of each setting item, see chapter 6.5.



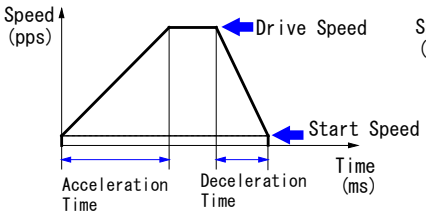
Constant Speed : Constant



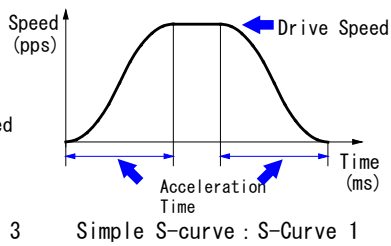
Simple Trapezoid : Trapezoid 1



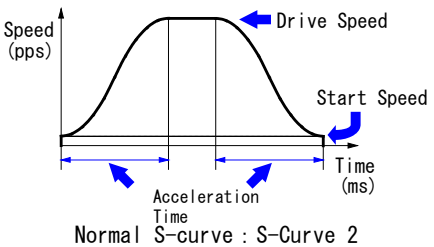
Normal Trapezoid : Trapezoid 2



Non-symmetry Trapezoid : Trapezoid 3



Simple S-curve : S-Curve 1



Normal S-curve : S-Curve 2

4.3.2.1 Mode

It selects acceleration/deceleration mode for speed setting.

Tab	Display	Option	Default
Speed	Mode	Constant (constant speed) Trapezoid1 (simple trapezoid) Trapezoid2 (normal trapezoid) Trapezoid3 (non-symmetry trapezoid) S-Curve1 (simple S-curve) S-Curve2 (normal S-curve)	Speed1 : Constant Speed2 : Trapezoid1 Speed3 : S-Curve1 Speed4 : Trapezoid2

The user can select mode from the following: constant speed driving, simple trapezoidal acceleration/deceleration driving, normal trapezoidal acceleration/deceleration driving, non-symmetry trapezoidal acceleration/deceleration driving, simple S-curve acceleration/deceleration driving and normal S-curve acceleration/deceleration driving. Depend on the selecting mode, required setting items are different described as below.

[NOTE]
In interpolation driving, the mode is limited to Constant.

4.3.2.2 Start Speed

Tab	Display	Range	Default
Speed	Start Speed	1 ～ 500,000 [pps]	Speed1 : — Speed2 : — Speed3 : — Speed4 : 4000

This is the speed at the start of acceleration/deceleration driving and at the end of driving, which is used in normal trapezoidal acceleration/deceleration driving, non-symmetry trapezoidal acceleration/deceleration driving and normal S-curve acceleration/deceleration driving.

4.3.2.3 Drive Speed

It sets a value of drive speed.

Tab	Display	Range	Default
Speed	Drive Speed	1 ～ 500,000 [pps]	Speed1 : 4000 Speed2 : 80000 Speed3 : 80000 Speed4 : 40000

Drive speed is the speed of constant speed period in constant and acceleration/deceleration driving. Set a value larger than start speed; however, set a value smaller than start speed in constant driving. In all acceleration/deceleration modes, drive speed must be set.

4.3.2.4 Acceleration Time

It sets a value of acceleration time for acceleration/deceleration driving.

Tab	Display	Range	Default
Speed	Acceleration Time	1 ～ 10,000 [msec]	Speed1 : — Speed2 : 500 Speed3 : 500 Speed4 : 500

Acceleration time is the time from start speed to drive speed (constant speed driving).
This must be set in all of acceleration/deceleration modes that perform acceleration/deceleration (except constant speed driving). In acceleration/deceleration modes whose acceleration and deceleration time is symmetrical (simple trapezoid, normal trapezoid, simple S-curve and normal S-curve), the value of acceleration time is also used as the value of deceleration time. The unit of the

setting value is milliseconds.

4.3.2.5 Deceleration Time

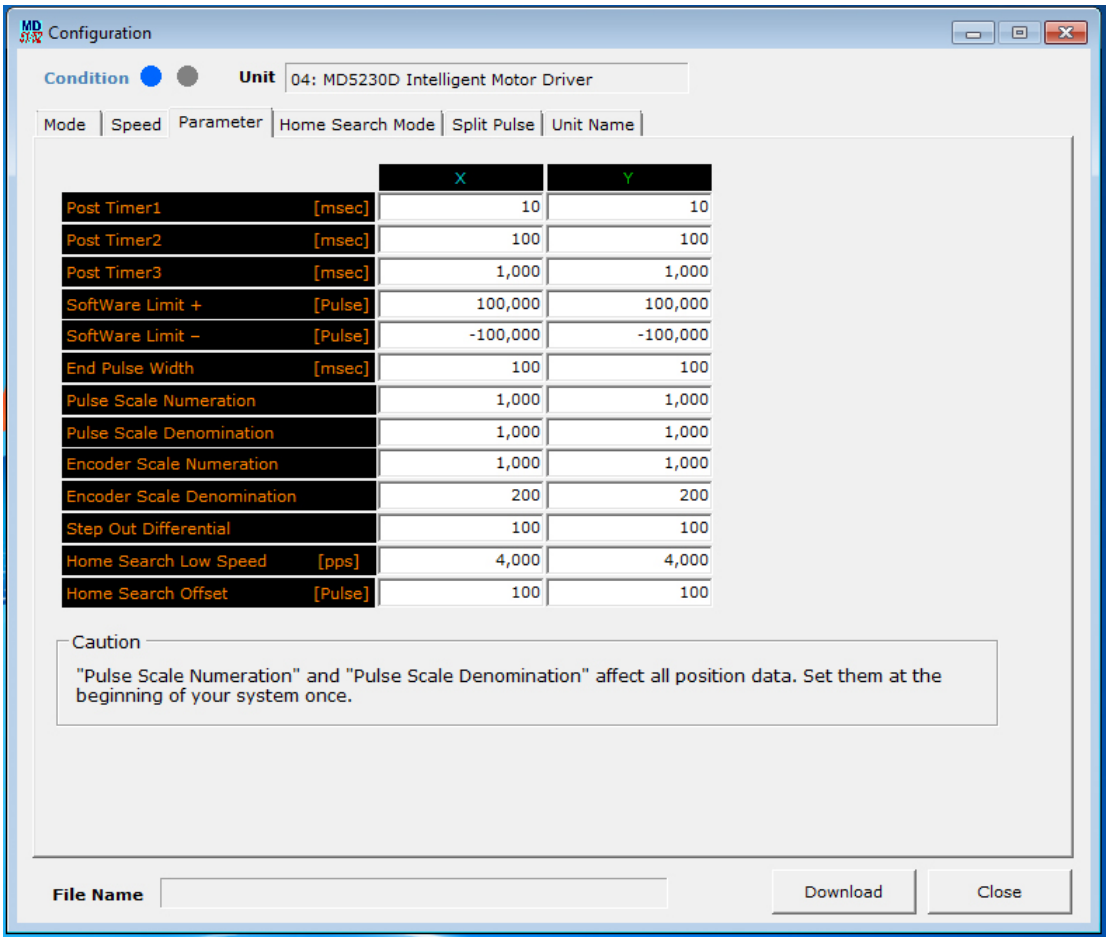
It sets a value of deceleration time for non-symmetry trapezoidal acceleration/deceleration driving.

Tab	Display	Range	Default
Speed	Deceleration Time	1 ～ 10,000 [msec]	Speed1: － Speed2: － Speed3: － Speed4: －

Deceleration time is the time from drive speed (constant speed driving) to start speed.
This must be set in non-symmetry trapezoidal acceleration/deceleration driving. The unit of the setting value is milliseconds.

4.3.3. Parameter Settings tab : Parameter

It configures parameters for driving. The setting range of each item is displayed in “Range of Value”.



Post Timer1~3 →

Software Limit+/- →

End Pulse Width →

Pulse Scale Numeration and Denomination →

Encoder Scale Numeration and Denomination →

Step Out Differential →

HomeSearch Low Speed →

Home Search Offset →

		X	Y
Post Timer1	[msec]	10	10
Post Timer2	[msec]	100	100
Post Timer3	[msec]	1,000	1,000
SoftWare Limit +	[Pulse]	20,000,000	20,000,000
SoftWare Limit –	[Pulse]	-20,000,000	-20,000,000
End Pulse Width	[msec]	100	100
Pulse Scale Numeration		1,000	1,000
Pulse Scale Denomination		1,000	1,000
Encoder Scale Numeration		1,000	1,000
Encoder Scale Denomination		200	200
Step Out Differential		50	50
Home Search Low Speed	[pps]	4,000	3,000
Home Search Offset	[Pulse]	100	100

Setting items in Parameter tab are as follows in the table.

Display	Range	Default
Post Timer 1 [msec]	1 ～ 65535	10
Post Timer 2 [msec]	1 ～ 65535	100
Post Timer 3 [msec]	1 ～ 65535	1000
Software Limit＋	-2147483648 ～ 2147483647 *1	100000
Software Limit－	-2147483648 ～ 2147483647 *1	-100000
End Pulse Width [msec]	1 ～ 65535	100
Pulse Scale Numeration	1 ～ 65535	1000
Pulse Scale Denomination	1 ～ 65535	1000
Encoder Scale Numeration	1 ～ 65535	1000
Encoder Scale Denomination	1 ～ 65535	200
Step Out Differential	1 ～ 65535	100
Home Search Low Speed [pps]	1 ～ 500000	4000
Home Search Offset	-2147483646 ～ 2147483646 *1	100

*1 : When pulse scale denominator = pulse scale numerator. If pulse scale denomination or numeration is changed, the setting range is changed.

4.3.3.1 Post Timer 1~3

It sets post timer.

Tab	Display	Range	Default
Parameter	Post Timer1	1 ～ 65535 [msec]	10
	Post Timer2	1 ～ 65535 [msec]	100
	Post Timer3	1 ～ 65535 [msec]	1000

Post timer is the waiting time until next command starts after execution of user program commands such as ABS (Absolute Position Move), INC (Relative Position Move), SST (Deceleration Stop) and IST (Instant Stop). The unit of the setting value is milliseconds. Three types of post timer can be registered.

[Note]

- The accuracy to the setting value of post timer is approximately ±1msec.

4.3.3.2 Software Limit +/-

It sets the value of Software Limit for + and – directions.

Tab	Display	Range	Default
Parameter	Software Limit +	-2147483648 ~ 2147483647	100000
	Software Limit -	-2147483648 ~ 2147483647	-100000

Software Limit + is used to specify the value of logical position that functions as the software limit in the + direction. When the logical position is over the value of software limit + during motor rotation in the + direction, it stops.
Software Limit – is used to specify the value of logical position that functions as the software limit in the – direction. When the logical position is over the value of software limit – during motor rotation in the – direction, it stops.
To function Software Limit, “Software Limit” must be enabled in mode settings tab and “Software Limit Stop Mode” can be selected from Slow or Instant in mode settings tab. For more details, see chapter 4.3.1.6 Software Limit and Stop Mode.
The setting values of software limit +/– become the maximum display range of XY coordinates screen in jog operation window (see chapter 4.2.5).

[Note]

- The setting of pulse scale is applied to the value of software limit +/–. The above setting range is the range of when pulse scale numerator = pulse scale denominator. For more details of Pulse Scale Numeration and Denomination, see

chapter 4.3.3.4.

4.3.3.3 End Pulse Width

It sets End Pulse Width.

Tab	Display	Range	Default
Parameter	End Pulse Width	1 ~ 65535 [msec]	100

This sets end pulse width for end pulse output from XDRIVE/ENDP signal (see chapter 7.3) of the parallel control connector (CN3) at the stop of motor rotation. The unit of the setting value is milliseconds.
To function End Pulse, “End Pulse” must be enabled in mode settings tab. For more details, see chapter 4.3.1.7 End Pulse.

[Note]

- The accuracy to the setting value of end pulse width is approximately ±1msec.

4.3.3.4 Pulse Scale Numeration and Denomination

It sets the value of Pulse Scale Numeration and Denomination to perform scaling for position data.

Tab	Display	Range	Default
Parameter	Pulse Scale Numeration (numerator)	1~65535	1000
	Pulse Scale Denomination (denominator)	1~65535	1000

Scaling function of pulse scale is the function to convert to the pulse value by multiplying all of the input position data by the specified coefficient. This function allows the user to handle position data in a unit of mm or inch. “Pulse Scale Numeration” field is to set the value of pulse scale numerator and “Pulse Scale Denomination” field is to set the value of pulse scale denominator. MD5130D and MD5230D convert to the pulse value by multiplying the input/display position data by the following coefficient (for more details of Drive Pulse, see chapter 6.1).

$$\text{Drive Pulse Value} = \text{Input Value} \times \frac{\text{Pulse Scale Numerator}}{\text{Pulse Scale Denominator}}$$

$$\text{Displayed Value} = \text{Drive Pulse Value} \times \frac{\text{Pulse Scale Denominator}}{\text{Pulse Scale Numerator}}$$

For example, if 1 pulse of drive pulses is equivalent to 0.01mm of moving distance, to display position data in a unit of mm, set 100/1 to scale numerator/scale denominator. If input value 1(mm) is written, it converts to 100 pulses and 100 pulses are displayed as 1.00. If calculation result is after the decimal point, it is rounded off up to the valid decimal place for 1 pulse and then will be displayed. Position data which scaling is performed is as follows.

Window	Position Data Performed Scaling
Main Window	Position display, Preset moving distance
Encoder Position Window	Encoder E-scale P-scale display
Configuration : Parameter Tab	Software Limit +/-, Home Search Offset
Program Window	ABS, INC, ABA, ICA, PJP, POS, WTP commands’ position data

[Note]

- The values of pulse scale numerator and denominator affect all the position data. Configure them at the beginning of system development based on circumstances such as step resolution or ball screw pitch. Once configure values, do not change them on the way.
- The factory default of pulse scale numerator/denominator is 1000/1000, which indicates input/display equal to drive pulse value.

4.3.3.5 Encoder Scale Numeration and Denomination

It sets the value of Encoder Scale Numeration and Denomination in order to perform scaling to the value counted by an encoder input signal.

Tab	Display	Range	Default
Parameter	Encoder Scale Numeration (numerator)	1～65535	1000
	Encoder Scale Denomination (denominator)	1～65535	200

This settings are in order to match to the logical position (in a unit of pulse), where the count value of an encoder input signal multiplied by the specified coefficient. This obtains the pulse conversion value of real position. For more details of Encoder Input and count method, see chapter 6.1.

$$\text{Converted pulses of real position} = \text{Encoder signal count value} \times \frac{\text{Encoder Scale numerator}}{\text{Encoder Scale denominator}}$$

The relationship between the pulse number of the encoder to be used per rotation and encoder scale numerator /denominator to match the logical position and real position with respect to the setting value of step resolution can be calculated as follows.

$$\frac{\text{Encoder Scale numerator}}{\text{Encoder Scale denominator}} = \frac{500 \times \text{Step Resolution}}{\text{Pulse Number per Rotation} \times 4}$$

When the pulse number per rotation of the encoder is 500 pulses, the setting example of encoder scale numerator and denominator with respect to the setting value of step resolution is as follows.

Step Resolution	Encoder Scale Numerator	Encoder Scale Denominator
1	1000	4000
2	1000	2000
4	1000	1000
5	1000	800
8	1000	500
10	1000	400
16	1000	250
20	1000	200
25	1000	160
40	1000	100
50	1000	80
80	1000	50
100	1000	40
125	1000	32
200	1000	20
250	1000	16

The factory default of encoder scale numerator and denominator is 1000/200, so when the pulse number per rotation of the encoder is 500 pulses, real position counter counts 10000 per rotation.
If step resolution is changed, modify the value of encoder scale setting appropriately.

[Note]

- When using Step Out Detection of chapter 6.4, be sure to match the logical position and real position by using this function in advance.

4.3.3.6 Step Out Differential

It sets the limit value of the difference between the logical position and the pulse conversion value of real position for detecting step out.

Tab	Display	Range	Default
Parameter	Step Out Differential	1～65535	100

When the difference between the logical position and pulse conversion value of real position exceed this value during motor rotation, it occurs a step out error. Step Out Differential must properly be set based on the pulse number per rotation of the encoder to be used or step resolution. If step out differential is too small, it may occur a step out error even though a motor normally rotates. Use the formula below to determine the recommended value.

$$\text{Step Out Differential} \geqq \frac{500 \times \text{Step Resolution}}{\text{Pulse Number per Rotation}} \times 4$$

To function Step Out Detection, set to enable Step Out Detection in mode tab (see chapter 4.3.1.8). If the user needs to perform Step Out Detection during motor rotation, set to"While Drive" in Step Out Detecting Timing in mode tab (see chapter 4.3.1.8). For more details of Step Out Detection Function, see chapter 6.4

[Note]
The setting of pulse scale (see chapter 4.3.3.4 Pulse Scale Numeration and Denomination) is not applied to the setting value of Step Out Differential. The setting value is a unit of drive pulse.

4.3.3.7 Home Search Low Speed

It sets search speed for step 2, step 3 of automatic home search.

Tab	Display	Range	Default
Parameter	Home Search Low Speed	1 ～ 500000 [pps]	4000

To immediately stop search operation, set the lower value for home search low speed than start speed of home search high speed (Speed4).
The action mode of automatic home search can be set in Home Search Mode tab (see chapter 4.3.4). For more details of Automatic Home Search, see chapter 6.2.

4.3.3.8 Home Search Offset

It sets offset drive for step 4 of automatic home search.

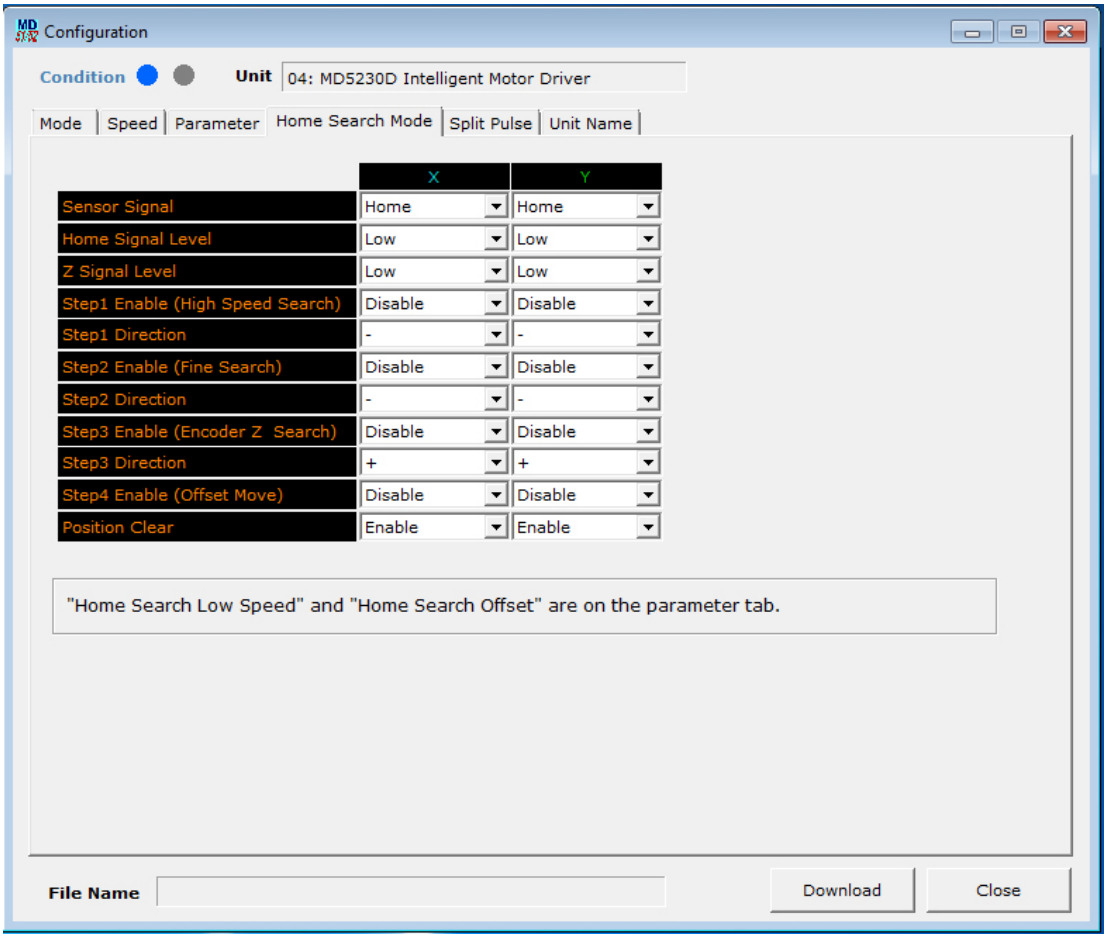
Tab	Display	Range	Default
Parameter	Home Search Offset	-2147483646 ～ 2147483646	100

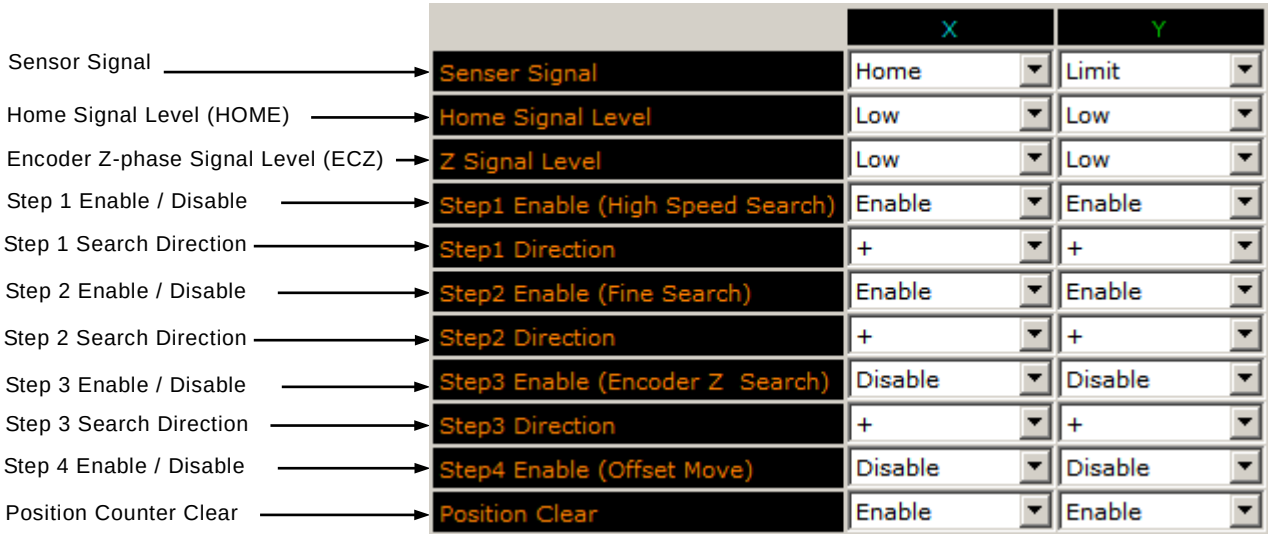
Home Search Offset drives in the + direction when setting a positive value, and drives in the – direction when setting a negative value.
The setting of pulse scale (see chapter 4.3.3.4 Pulse Scale Numeration and Denomination) is applied to the setting value of Home Search Offset. The above setting range is the range of when pulse scale numerator = pulse scale denominator.

The action mode setting of automatic home search can be set in Home Search Mode tab (see chapter 4.3.4). For more details of Automatic Home Search, see chapter 6.2.

4.3.4. Home Search Mode Settings tab : Home Search Mode

It configures modes for automatic home search. Each mode can be selected from a list by click ▼.





Setting items in Home Search Mode tab are as follows.

Display	Option	Default
Sensor Signal	Home / Limit	Home
Home Signal Level	Low / High	Low
Z Signal Level	Low / High	Low
Step1 Enable (High Speed Search)	Disable / Enable	Disable
Step1 Direction	＋ / －	－
Step2 Enable (Fine Search)	Disable / Enable	Disable
Step2 Direction	＋ / －	－
Step3 Enable (Encoder Z Search)	Disable / Enable	Disable
Step3 Direction	＋ / －	＋
Step4 Enable (Offset Move)	Disable / Enable	Disable
Position Clear	Disable / Enable	Enable

In Home Search Mode tab, the user can set the action mode of automatic home search. For more details of Automatic Home Search, see chapter 6.2.

4.3.4.1 Sensor Signal

It selects a sensor signal for searching at step1 and 2.

Tab	Display	Option	Default
Home Search Mode	Sensor Signal	Home / Limit	Home

Sensor Signal can be selected from either Home or Hardware Limit signal (see chapter 7.4).
Home signal is the #8 pin in CN4 connector. Limit signals of the + and – directions are the #9, #10 pins in CN4 connector (see chapter 7.4 CN4 Sensor Connector for Axis). If Limit signal is selected, the limit signal of the search direction at step1 and 2 becomes the sensor signal.

4.3.4.2 Home Signal Level (HOME)

It selects an active logical level for HOME signal.

Tab	Display	Option	Default
Home Search Mode	Home Signal Level	Low (GEX Short-circuited）/ High (Open)	Low

Home signal is the #8 pin in CN4 connector (see chapter 7.4).
When an active logical level is set to Low, detection operation of step 1, 2 starts, and when Home signal becomes short-circuiting with GEX, the operation takes the signal as active and then it stops. When set to High, and when Home signal becomes open, the operation takes it as active and then it stops.

4.3.4.3 Encoder Z-phase Signal Level (ECZ)

It sets an active logical level for encoder Z-phase signal (ECZ) detected in step 3.

Tab	Display	Option	Default
Home Search Mode	Z Signal Level	Low (GEX Short-circuited）/ High (Open)	Low

Encoder Z-phase signal (ECZ) is the #4 pin in CN4 connector (see chapter 7.4).
When an active logical level is set to Low, detection operation of step 3 starts, and when the signal becomes short-circuiting with GEX, the operation takes the signal as active and then it stops. When set to High, and when the signal becomes open, the

operation takes it as active and then it stops.

4.3.4.4 Step 1~4 Enable / Disable

It sets to execute or not to execute each step of home search operation.

Tab	Display	Option	Default
Home Search Mode	Step1 Enable	Disable (non-execution) / Enable (execution)	Disable
	Step2 Enable	Disable (non-execution) / Enable (execution)	Disable
	Step3 Enable	Disable (non-execution) / Enable (execution)	Disable
	Step4 Enable	Disable (non-execution) / Enable (execution)	Disable

When selecting Disable (non-execution), the step is not executed and proceeds with next step. When selecting Enable (execution), search operations for each step are executed in the specified direction. See chapter 6.2.1 for more details on each step.

4.3.4.5 Step 1~3 Search Direction

It selects a search direction for each step of home search operation.

Tab	Display	Option	Default
Home Search Mode	Step1 Direction	+ / −	−
	Step2 Direction	+ / −	−
	Step3 Direction	+ / −	+

When selecting +, search operation is executed in the + direction. And when selecting –, search operation is executed in the – direction. The direction of high-speed offset driving at step 4 can be set in “Home Search Offset” field in Parameter settings tab (see chapter 4.3.3.8).

4.3.4.6 Position Counter Clear

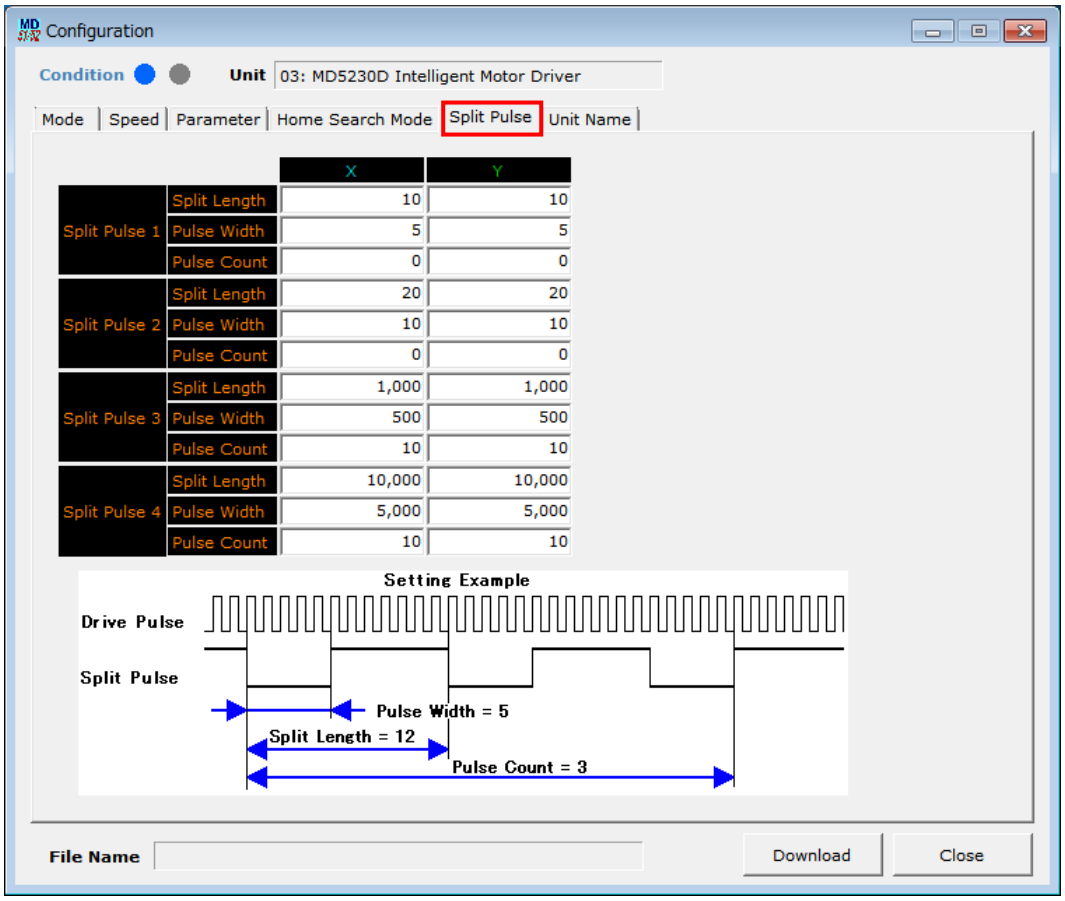
It selects to clear or not to clear the position counter at the end of automatic home search.

Tab	Display	Option	Default
Home Search Mode	Position Clear	Disable (not clear) / Enable (clear)	Enable

When enabled, the logical and real positions are cleared to 0 at the normal end of automatic home search.

4.3.5. Split Pulse Settings tab：Split Pulse

It configures Split Pulse 1~4. The setting range of each item is displayed in “Range of Value”.



		X	Y
Split Pulse 1	Split Length	10	10
	Pulse Width	5	5
	Pulse Count	0	0
Split Pulse 2	Split Length	20	20
	Pulse Width	10	10
	Pulse Count	0	0
Split Pulse 3	Split Length	1,000	1,000
	Pulse Width	500	500
	Pulse Count	10	10
Split Pulse 4	Split Length	10,000	10,000
	Pulse Width	5,000	5,000
	Pulse Count	10	10

Split Pulse Settings 1: Split Length, Pulse Width, Pulse Count

Split Pulse Settings 2

Split Pulse Settings 3

Split Pulse Settings 4

Setting items in Split Pulse tab are as follows in the table.

Display		Range	Default
Split Pulse 1	Split length	2 ~ 65535	Split Pulse 1
	Pulse width	1 ~ 65534	5
	Split pulse number	1~65535 or 0 (infinite)	0
Split Pulse 2	Split length	2 ~ 65535	Split Pulse 2
	Pulse width	1 ~ 65534	10
	Split pulse number	1~65535 or 0 (infinite)	0
Split Pulse 3	Split length	2 ~ 65535	Split Pulse 3
	Pulse width	1 ~ 65534	500
	Split pulse number	1~65535 or 0 (infinite)	10
Split Pulse 4	Split length	2 ~ 65535	Split Pulse 4
	Pulse width	1 ~ 65534	5000
	Split pulse number	1~65535 or 0 (infinite)	10

The user can register 4 split pulse settings 1 ~ 4. Each split pulse setting has items that split length (cycle), pulse width and split pulse number. For more details of Split Pulse function, see chapter 6.3.

4.3.5.1 Split Length

Tab	Display	Range	Default
Split Pulse	Split Length	2~65535	Split Pulse 1 : 10 Split Pulse 2 : 20 Split Pulse 3 : 1000 Split Pulse 4 : 10000

Split Length is the intervals from when split pulse is on to when next split pulse is on, and it can be specified by the drive pulse number. The setting value must be a pulse width < a split length.

4.3.5.2 Pulse Width

It sets the pulse width of a split pulse.

Tab	Display	Range	Default
Split Pulse	Pulse Width	1~65534	Split Pulse 1 : 5 Split Pulse 2 : 10 Split Pulse 3 : 500 Split Pulse 4 : 5000

Pulse Width is the ON width of one pulse of split pulse output signal, and it can be specified by the drive pulse number.
The setting value must be a pulse width < a split length.

4.3.5.3 Pulse Count

It sets the output pulse number of split pulse.

Tab	Display	Range	Default
Split Pulse	Pulse Count	1~65535 or 0 (infinite)	Split Pulse 1 : 0 Split Pulse 2 : 0 Split Pulse 3 : 10 Split Pulse 4 : 10

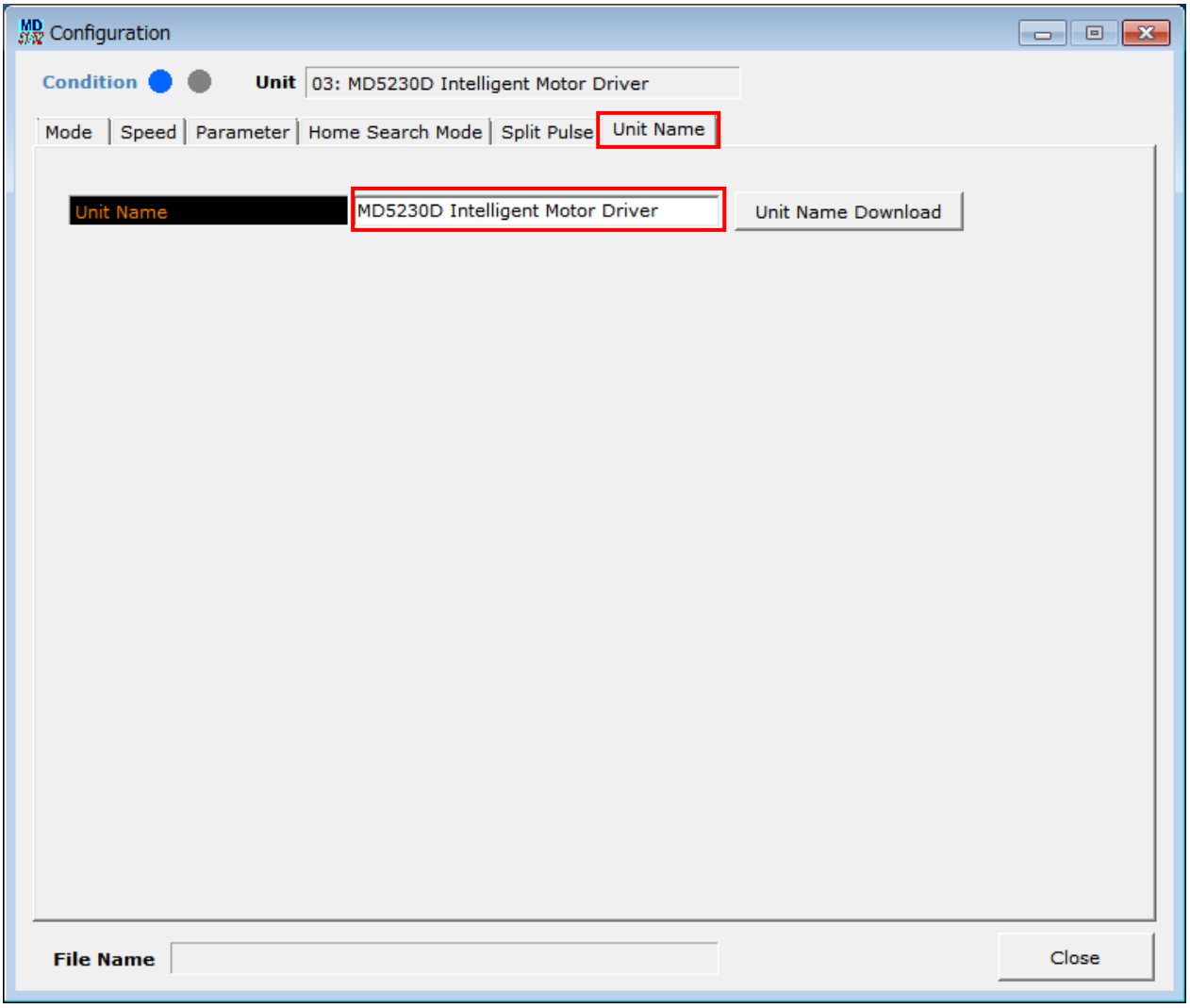
Pulse Count is the number of output split pulse.
When 0 is set, it continues to output split pulses until stopped by jog operation window, split pulse stop command (PST) of a user program, or motor rotation stops.

[Note]The setting of pulse scale (see chapter 4.3.3.4 Pulse Scale Numeration and Denomination) is not applied to each setting value of split pulse. Even when setting Pulse Scale Numeration and Denomination, each setting value of split pulse must be set

in a unit of drive pulse.

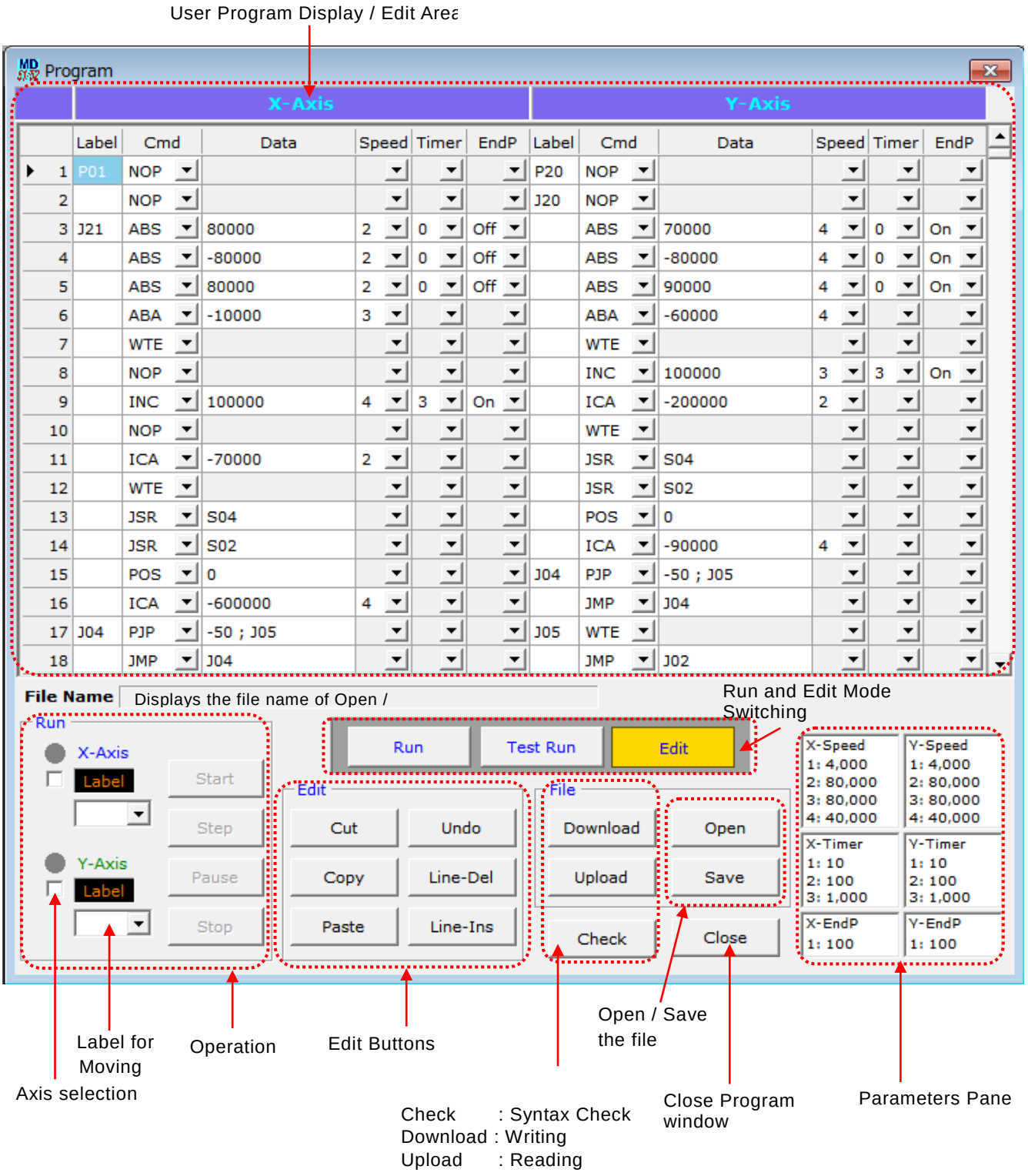
4.3.6. Unit Name Settings tab : Unit Name

It sets the unit name of MD5130D and MD5230D. Please use half-width alphanumeric characters and symbols 32 characters or less.
When the unit is connected, the user can write the unit name into the unit by clicking "**Unit Name Download**" button.
Download button in other tabs does not work to write into the unit.



4.4. User Program Settings window : Program

Program window is used to display, edit, register and execute a user program. There are two modes: Edit mode that edits and registers a user program, and Run mode that executes a user program.



4.4.1. User Program Display / Edit Area

This is used to create and edit a user program. As shown in the table below, the user needs to configure each item. For more details of User Program and Input / Output Ports, see chapter 5.

Item	Command	Contents
Label	Set program label (P01～P63), jump label (J01～J63) or subroutine label (S01～S19)	
Cmd	Select command by click ▼. ABS：Absolute position move　ABA：Absolute position move start　INC：Relative position move ICA：Relative position move start　CNT：Continuous move start　SST：Deceleration stop IST：Instant stop　HOM：Home search　OUT：Output port ON/OFF OTP：Output port ON Pulse　SSP：Split pulse start　PST：Split pulse stop JMP：Unconditional jump　IJP：Input condition jump　PJP：Position condition jump JSR：Subroutine jump　RET：Subroutine return　REP：Repetition start RED：Repetition end　TIM：Timer　WTP：Waiting position passage WTE：Waiting driving end　END：Program end　PAS：Pause for debug SPD：Drive speed　POS：Current position　NOP：No operation 【Commands only for MD5230D】 ABB：2-axis simultaneous absolute position move　ICB：2-axis simultaneous relative position move　. HMB：2-axis simultaneous home search　LNI：2-axis linear interpolation move CEN：Circular interpolation center setting　CWI：CW circular interpolation move CCW：CCW circular interpolation move	
Data	ABS, ABA, ABB	Absolute position move
	INC, ICA, ICB	Relative position move
	CNT	Direction（+/-）
	LNI	X/Y linear interpolation finish position(Relative pulse number)
	CWI, CCW	X/Y circular interpolation finish position(Relative pulse number)
	CEN	X/Y circular center position(Relative pulse number)
	OUT	Output port number ; Output state (ON / OFF)
	OTP	Output port number ; Pulse width (1～65535msec)
	SSP	Split pulse settings number (1～4)
	JMP	Jump destination label
	IJP	Input port number ; Signal level (Hi / Low) ; Jump destination label
	PJP	Absolute position ; Jump destination label
	JSR	Subroutine label
	REP	Repetition number (1～255)
	TIM	Waiting time (1～65535msec)
	WTP, POS	Absolute position
	SPD	Drive speed (1～500000)
	Other Commands	Non-required
Speed	ABS, ABA, INC, ICA, CNTABB, ICB, LNI, CWI, CCW	Select drive speed1~4 (see chapter 4.3.2). When inputting a selected command to the current line, it sets the same value as Speed value that the command is first found in the upper than the current line. If not found, Speed:1 is set.
	Other Commands	Non-required
Timer	ABS, INC, SST, IST ABB, ICB	Select post timer 1~3 (see chapter 4.3.3.1.). If not needed, select 0. When inputting a selected command to the current line, it sets the same value as Timer value that the command is first found in the upper than the current line. If not found, Timer:0 is set.
	Other Commands	Non-required
EndP	ABS, INC, HOM ABB, ICB, HMB	Select On to output end pulse and select Off not to output end pulse after the completion of the command. When inputting a selected command to the current line, it sets the same value as EndP value that the command is first found in the upper than the current line. If not found, EndP:Off is set. Note: When selecting On, End Pulse must be enabled in mode settings tab in Configuration window.
	Other Commands	Non-required

[Note] Handling of blank lines in a program

- The blank line in a program is deleted and shifted up, and written into the unit at download. If the user keeps a blank line, set NOP command to that line.

4.4.2. Edit Buttons

The user can cut, copy and paste by these buttons in user program display / edit area. Also, the same operation can be performed from right-click menu on user program display / edit area. These are available in Edit mode in Program window

Item	Function	Contents
Cut	Cut Selection	Copies the selection to the clipboard and removes the selection from the display area. The selection should be a single cell or row, or continuous blocks of cells or rows.
Copy	Copy Selection	Copies the selection to the clipboard. The selection should be a single cell or row, or continuous blocks of cells or rows.
Paste	Paste	Pastes the contents of the clipboard to the selected cell below in the display area.
Undo	Undo	Undoes the last action.
Line-Del (Delete)	Delete Row	Deletes a selected row, the row of an active cell or continuous blocks of rows.
Line-Ins (Insert)	Insert Row	Inserts blank lines of the number of selected lines before the active row or cell. Multiple lines can be inserted. The lines over 1000 will be deleted.

4.4.3. Syntax Check

It checks syntax error in a user program

Item	Function	Contents
Check	Syntax Check	Performs syntax check in a user program. If syntax error is detected, the error message appears and moves the focus to that line.

4.4.4. Download / Upload / Open / Save

It downloads to the unit / uploads from the unit and opens / saves in a file.

Item	Function	Contents
Download	Write into the unit	A user program in the edit area is written into the unit, which must be written before execution of the program. For MD5130D, blank lines in the program are deleted and shifted up at download. *1
Upload	Read from the unit	A user program is read from the unit.
Open	Open the file	A user program and configuration settings are load from the file. When the file is open, configuration settings window automatically opens. *1
Save	Save in the file	Saves a user program and configuration settings in the file. The file is saved in CSV format. See Appendix for more details. *1

*1 : It cannot operate them during jog operation, motor rotation by parallel control signals (see chapter 7.3.2) and program execution.

4.4.5. Label for Moving

It moves to the specified labeled line in a user program.

Item	Function	Contents
X and Y-axis Label	Move to the label	Moves to a specified labeled line. When clicking on ▼, the list of labels currently used is displayed. For MD5130D, Y-axis side is invalid.

4.4.6. Parameters Pane

It displays the settings of speed, post timer and end pulse width that are currently set.

Item	Contents
Speed	Displays the setting values of drive speed1～4 (see chapter 4.3.2).
Timer	Displays the setting values of post timer 1～3 (see chapter 4.3.3.1.).
EndP	Displays the setting value of end pulse width (see chapter 4.3.3.3).

4.4.7. Run and Edit Mode Switching

It switches Run mode and Edit mode in Program window. Edit mode is used to edit a user program and Run mode is used to execute a user program. The mode currently selected is highlighted in yellow. Factory default is Edit mode.

Item	Function	Contents
Run	Switch to Run	Switches to Run mode that can execute a registered program. To switch to Run mode after a user program is edited or opened, it must be downloaded to the unit.
Edit	Switch to Edit	Switches to Edit mode that can edit or register a program. In this mode, the user can edit a user program, download to the unit and save in the file. However, it cannot switch to Edit mode while executing a program.
Test Run *1	Switch to Test Run	During Excitation OFF (Motor Free), a registered user program shifts to Run mode. In Run mode, the user can check user program operation etc. without motor rotation. ・Disable the Step Out Detection to prevent from functioning. ・A motor does not rotate, but OUT command or other operations are performed.

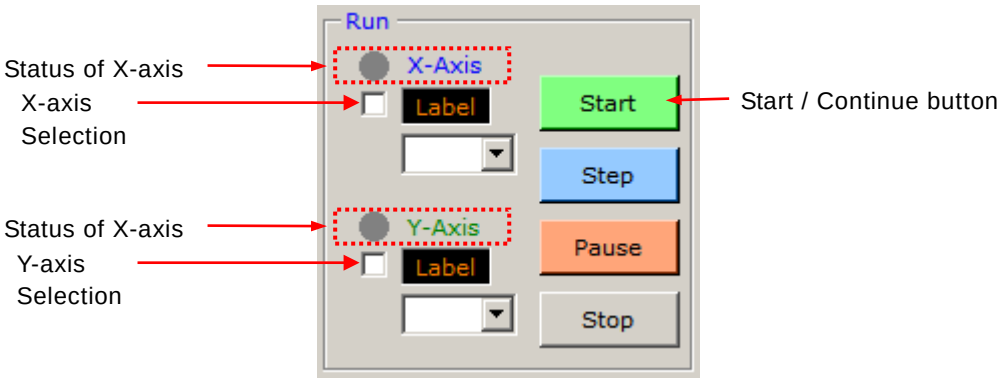
*1 : Test Run mode is the mode only for MD5230D.

[Note] Notes on Run and Edit mode

- In Run mode, a user program cannot be edited and configuration settings cannot be downloaded. And jog operation cannot be performed in Main window. When the user needs to perform jog operation, stop the program and switch to Edit mode and then perform the jog operation.

4.4.8. Operation Pane

The user can start, pause or stop a user program and execute single step. There are available in Run mode.



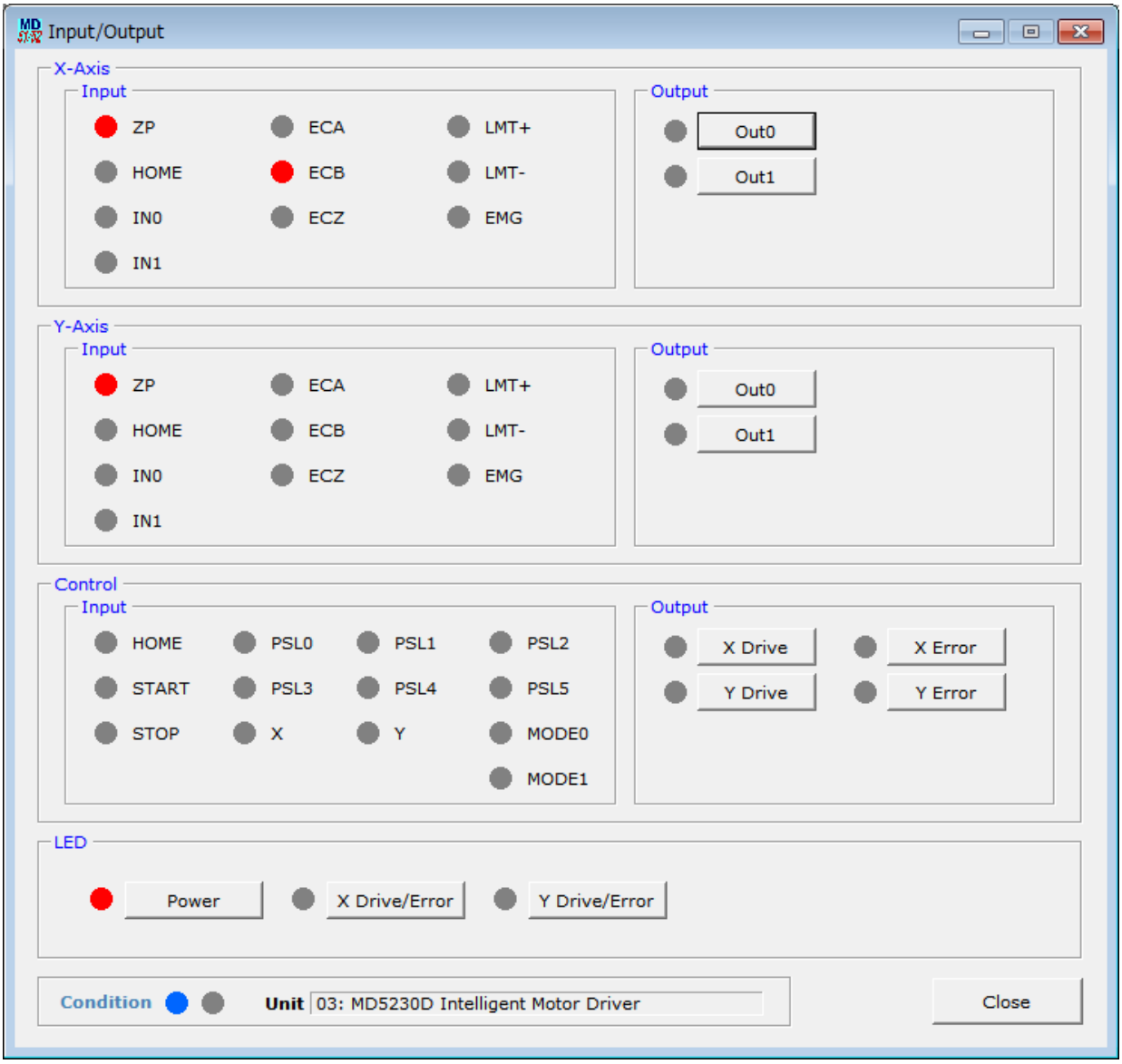
Item	Function	Contents
Status of X and Y-axis		Displays the status of a user program. ・Red ● : During execution or pause ・Gray ● : Not in execution (during stopping) For MD5130D, Y-axis side is invalid.
X and Y-axis Label	Label selection move	Moves to the specified label in a user program. For MD5130D, Y-axis side is invalid.
X and Y-axis Selection	Select execution axis	Selects the execution axis for a user program / priority axis for a trace. Invalid for MD5130D.
Start/Continue	Start / Continue a user program	When Start button is clicked, it starts execution of code from the line selected by the label. When Pause button is clicked during execution, Start button changes to Continue button. When Continue button is clicked, it re-executes the code from the paused line.
Step	Single Step Execution	The user can execute single step at a specific line in a user program. While stopping or pausing a user program, if Step button is clicked, it only executes the selected line and suspends on the next line.
Pause	Pause	Pauses a running program. When Pause button is clicked, after the completion of the code currently executed, it moves to the next line and pauses.
Stop	Stop user program	Ends a user program. And while rotating a motor, it stops motor rotation.

[Note]

- About status display
  If MD Operation Tool is closed during the execution of a user program, the program keeps on executing. To release the program execution, Open MD Operation Tool again and click Contoller Reset button.
- About selection of execution axis
  When the user executes the program including 2-axis simultaneous or interpolation commands, select X-axis only.
- About single step execution
  When the user executes single step at an arbitrary line without pressing Start button, or when the user moves to an arbitrary line by executing single step after pause, re-execution by “Continue” button may not work properly.

4.5. Input / Output window : Input/Output

Input/Output window displays the current state of input/output signals in CN3, 4 connectors. Output signals can be controlled the output state for testing. For more details of CN3, 4 connectors, see chapter 7.3 and 7.4.

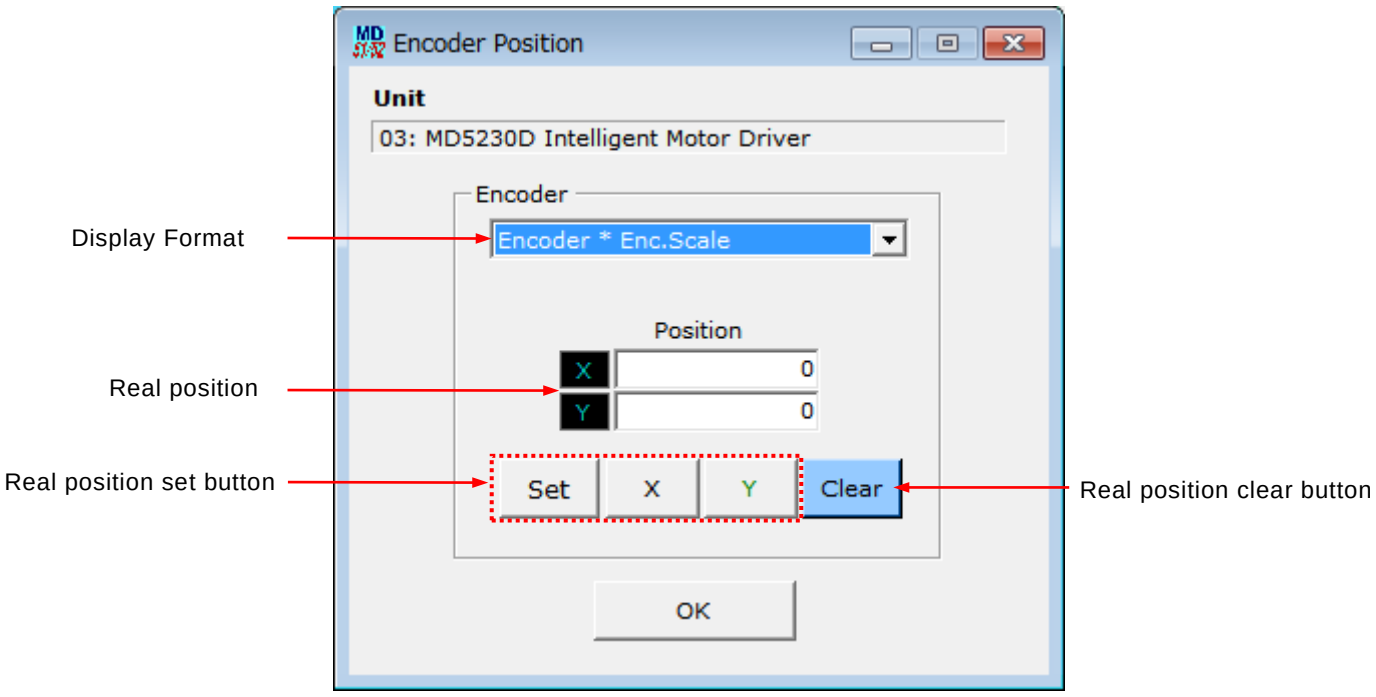


Item	Contents
X-Axis	Displays the state of sensor input / output signals for the axis in CN4. The display of input state differs depending on each input signal. ［Input］: Input Signal ●ZP This is the internal signal indicating the excitation sequence of a motor is the initial state (excitation home). ●HOME, ECZ, LMT+, LMT- It lights when the state of an input signal is active. For example in HOME signal, when Home Signal Level is set to Low, it lights when the input signal is short-circuited with GEX. ●EMG It lights when an input signal is turned ON during motor rotation. ●IN0, IN1, ECA, ECB It lights when the input signal is short-circuited with GEX. ［Output］: Output Signal *1 It lights when the output signal is ON (output transistor is ON). The user can switch the output state ON and OFF by clicking on a signal button.
Y-Axis	Displays the state of sensor input / output signals for the axis in CN7. The display of input state differs depending on each input signal. ［Input］: Input Signal ●ZP This is the internal signal indicating the excitation sequence of a motor is the initial state (excitation home). ●HOME, ECZ, LMT+, LMT- It lights when the state of an input signal is active. For example in HOME signal, when Home Signal Level is set to Low, it lights when the input signal is short-circuited with GEX. ●EMG It lights when an input signal is turned ON during motor rotation. ●IN0, IN1, ECA, ECB It lights when the input signal is short-circuited with GEX. ［Output］: Output Signal *1 It lights when the output signal is ON (output transistor is ON). The user can switch the output state ON and OFF by clicking on a signal button.
Control	Displays the state of the parallel control signals in CN3. ［Input］: Input Signal X and Y-axis signals are invalid for MD5130D. ［Output］: Output Signal It lights when the output signal is ON (output transistor is ON). The user can switch the output state ON and OFF by clicking on a signal button.
LED	Displays the LED lighting state of the unit.. The user can test to turn on / off the LED of POWER, XDRIVE/ERROR on the front panel by clicking the button.

*1 It does not display SPLT output signal in CN4/7.

4.6. Real Position Display window : Encoder Position

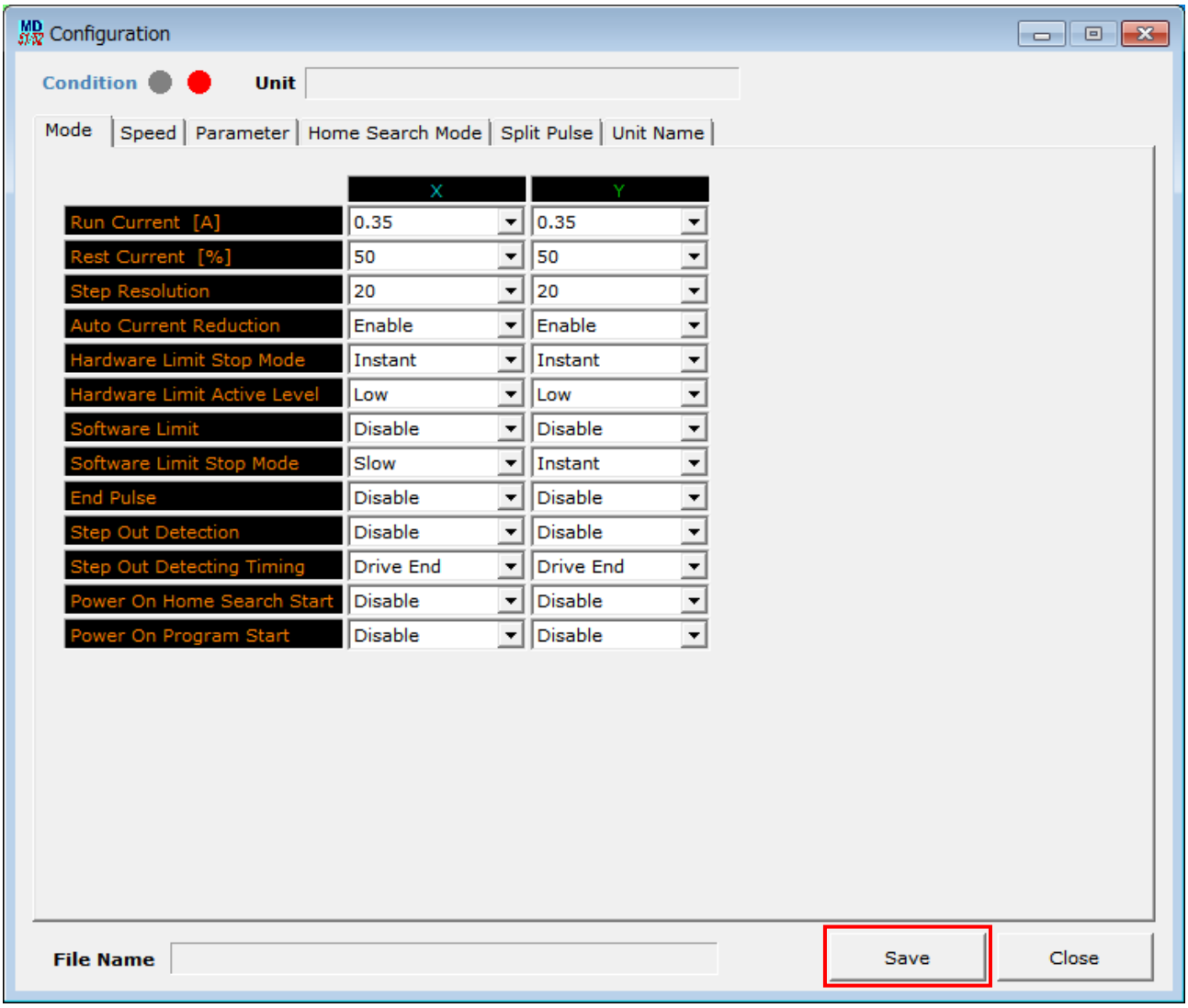
Encoder position window displays the information of real position from the encoder.



Item	Contents
Display Format	Selects display format for encoder count values displayed in real position field “Position” from 3 types. Encoder … (1) Displays the value counted by quad edge evaluation of quadrature pulses of encoder signal ECA, ECB. Encoder * Enc.Scale … (2) Displays the pulse conversion value of real position that the value of (1) multiplied / divided by the encoder scale. Encoder * Enc.Scale * Pul.Scale … (3) Displays the value that the value (2) multiplied / divided by the pulse scale.
Real position	Displays the real position in a format selected in Display Format. For MD5130D, Y-axis side is invalid.
Real position set button [Set] [X]	Sets the real position to an arbitrary value. <How to set> ① Click Axis button. ② Input a value in Position field. ③ Click [Set] button. For MD5130D, Y-axis side is invalid.
Real position clear button	Clears the real position to 0.
OK	Close the Encoder position window.

4.7. Configuration and Edit / Save User Program When Not in Connection

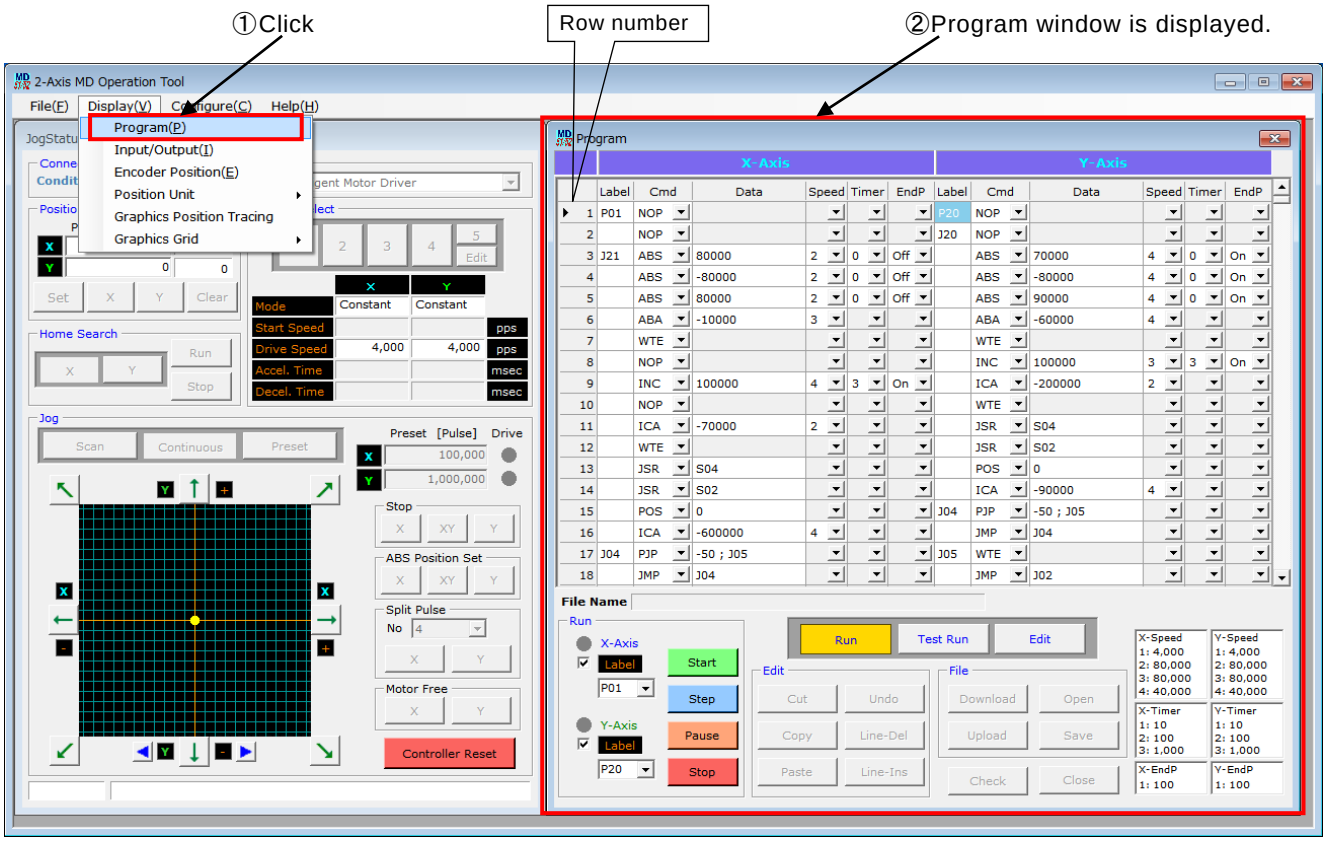
When the unit is not connected to PC, the user can create, edit and save configuration data and a user program from MD51_52 Operation Tool.
In Configuration window, in order to save in a file after editing, click "**Save**" button in the right bottom of Configuration window (When not in connection, "Download" button changes to "**Save**" button). In Program window, in order to save a user program in a file after editing, click "**Save**" button in Program window.
In both windows, configuration data and a user program are saved in a file with CSV format by clicking "**Save**" button at one time.



Configuration Window When Not in Connection

5. User Program

MD5130D and MD5230D can create a user program of up to 1000 steps. By setting the label number, the user can register a maximum of 63 programs in 1000 steps.
To create a user program, connect the unit and PC with USB cable and start “MD51_52 Operation Tool”, and the user can program in Program window which opens by clicking [Display] → [Program] in Main window of MD51_52 Operation Tool. The user can create, edit, register to the unit, save in a file and execute a user program in Program window. For more details of how to use Program window, see chapter 4.4.
This chapter describes the label for a user program and each command.



To execute the created program, there are the following 3 methods. As for each operation method, please refer to each chapter.

- Execution from Program window in MD51_52 Operation Tool (see chapter 4.4 User Program Settings window).
- Execution by parallel control signals (see chapter 7.3.2.4 Program Driving Operation).
- Execution by Power On Program Start (see chapter 4.3.1.10 Power On Program Start).

5.1. Label

MD5130D and MD5230D Program window have 3 types of labels: Program Label, Jump Label and Subroutine Label. Program label is the label that identifies multiple programs, and jump label is the label that indicates the jump destination of a program or in a subroutine, and subroutine label is the label that identifies the subroutine called from a program or subroutine.

Label	Label Number
Program Label	P01～P63
Jump Label	J01～J63
Subroutine Label	S01～S19

5.1.1. Program Label (P Label)

Program label is the label that identifies multiple programs. User program can register multiple programs, which can be each identified by a program label. 63 Program labels are available from P01 to P63. When executing a program from MD51_52 Operation Tool, select a registered label number and click "**Start**" button. Or, specify a program number by parallel control signals, and the user can execute a program. For more details of execution by parallel control signals, see chapter 7.3.2.4 Program Driving Operation.

[Note]

- Program label must be written in the first line ofX-axis..
- One program must have one or more END command in it. For more details of commands, see chapter 5.2 and after, User Program Commands.

5.1.2. Jump Label (J Label)

Jump label is the label that indicates the jump destination of program commands (JMP, IJP, PJP) in a user program. 63 Jump labels are available from J01 to J63. The jump destination specified by a jump label must be within the range of a jump source program or subroutine. For more details of commands, see chapter 5.2 and after, User Program Commands.

5.1.3. Subroutine Label (S Label)

User program can describe subroutines. Multiple subroutines can be registered and identified by a subroutine label. 19 Subroutine labels are available from S01 to S19. The user can call a subroutine from a program or other subroutines by subroutine jump command (JSR). Calling from a subroutine to another subroutine can be performed up to 3 levels deep. When describing a subroutine, S label must be written in the head line of a subroutine. In addition, in order to terminate S label subroutine, be sure to write subroutine return command (RET) that indicates the return from a subroutine.

[Note]

- A subroutine cannot be described in the line number 1.
- Be sure to describe a subroutine outside a P label program.
- In order to jump to the head line of a subroutine, write NOP command in the head line, then write a jump label (J label) in the next line.
- The user cannot execute a program by specifying a subroutine label.
- A subroutine cannot call itself from a subroutine. For example, subroutine jump command (JSR) in S01 label cannot call S01 itself.

Please refer to chapter 5.4 for examples of program description.

5.2. User Program Commands

36 user program commands are prepared as follows:

Command Type	Code	Contents	Available unit
Drive Commands	ABS	Absolute position move	MD51/MD52
	ABB	2-axis simultaneous absolute position move	MD52
	ABA	Absolute position move start	MD51/MD52
	INC	Relative position move	MD51/MD52
	ICB	2-axis simultaneous relative position move	MD52
	ICA	Relative position move start	MD51/MD52
	CNT	Continuous move start	MD51/MD52
	SST	Deceleration stop	MD51/MD52
	IST	Instant stop	MD51/MD52
	HOM	Home search	MD51/MD52
	HMB	2-axis simultaneous home search	MD52
Interpolation Drive commands	LNI	2-axis linear interpolation move	MD52
	CEN	Circular interpolation center setting	MD52
	CWI	CW circular interpolation move	MD52
	CCW	CCW circular interpolation move	MD52
Signal Output Commands	OUT	Output port ON/OFF	MD51/MD52
	OTP	Output port ON Pulse	MD51/MD52
	SSP	Split pulse start	MD51/MD52
	PST	Split pulse stop	MD51/MD52
Program Control Commands	IJP	Input condition jump	MD51/MD52
	PJP	Position condition jump	MD51/MD52
	JMP	Unconditional Jump	MD51/MD52
	JSR	Subroutine jump	MD51/MD52
	RET	Subroutine return	MD51/MD52
	REP	Repetition start	MD51/MD52
	RED	Repetition end	MD51/MD52
	END	Program end	MD51/MD52
	TIM	Timer	MD51/MD52
	WTE	Waiting driving end	MD51/MD52
	WTP	Waiting position passage	MD51/MD52
	PAS	Pause for debug	MD51/MD52
	RNY	Y-axis program start	MD52
	WTY	Waiting Y-axis program end	MD52
Other commands	SPD	Drive speed	MD51/MD52
	POS	Current position	MD51/MD52
	NOP	No operation	MD51/MD52

[Note]
Each command takes execution time about 2～5msec.

5.2.1. Drive Commands

There are two kinds of drive commands: the commands that start or stop a motor and execute an automatic home search.

AB Absolute position move [MD5130D/MD5230D]

Cmd	Data	Speed	Timer	EndP
ABS	Absolute Position（-2147483646 ～ +2147483646）	1～4	0～3	Off/On

The axis moves from the current position to the absolute position specified by Data. After completion of moving by this command, it will shift to next command line execution.

Data： Specifies the destination position by absolute value.
This value can be placed in a unit of mm or inch when the pulse scale numeration/denomination (see chapter 4.3.3.4 Pulse Scale Numeration and Denomination) are set. Factory default is pulse scale numerator=denominator, so it is drive pulse value. The setting range in drive pulse value is -2147483646 ~ +2147483646.

Speed： Selects speed settings (such as acceleration/deceleration mode and drive speed) from Speed1~4.
Speed settings can be set in Speed tab in Configuration window (see chapter 4.3.2).

Timer： Specifies the waiting time of until the next command is executed after completion of moving. When 1~3 is assigned to Timer, the time of post timer 1~3 that is registered in Parameter tab in Configuration window (see chapter 4.3.3.1), is used. When setting without the waiting time, set 0 to Timer.
In the line that End Pulse (EndP) is set to On, it will wait for an amount of specified time after End Pulse is On.

EndP： Selects whether end pulse is output or not after completion of moving.
When On is set in EndP, end pulse is output from the XDRIVE/ENDP output signal (see chapter 7.3) of the parallel control connector (CN3). When Off is set, end pulse is not output.
To output end pulse, End Pulse must be enabled in Mode tab in Configuration window (see chapter 4.3.1.7). The pulse width of end pulse can be set in Parameter tab in Configuration window (see chapter 4.3.3.3).

ABB 2-axis simultaneous absolute position move [MD5230D]

Cmd	Data	Speed	Timer	EndP
ABB	Absolute Position（-2147483646 ～ +2147483646）	1～4	0～3	Off／On

Write this command in the same line of X and Y-axis.
X and Y-axis simultaneously start to move from the current position to the absolute position specified by Data. After completion of moving by this command, it will shift to next command line execution.

Data： Specifies the destination position by absolute value.
This value can be placed in a unit of mm or inch when the pulse scale numeration/denomination (see chapter 4.3.3.4 Pulse Scale Numeration and Denomination) are set. Factory default is pulse scale numerator=denominator, so it is drive pulse value. The setting range in drive pulse value is -2147483646 ~ +2147483646.

Speed： Selects speed settings (such as acceleration/deceleration mode and drive speed) from Speed1~4.
Speed settings can be set in Speed tab in Configuration window (see chapter 4.3.2).

Timer： Specifies the waiting time of until the next command is executed after completion of moving. When 1~3 is assigned to Timer, the time of post timer 1~3 that is registered in Parameter tab in Configuration window (see chapter 4.3.3.1), is used. When setting without the waiting time, set 0 to Timer.
In the line that End Pulse (EndP) is set to On, it will wait for an amount of specified time after End Pulse is On.

EndP： Selects whether end pulse is output or not after completion of moving.
When On is set in EndP, end pulse is output from the XDRIVE/ENDP output signal (see chapter 7.3) of the parallel control connector (CN3). When Off is set, end pulse is not output.
To output end pulse, End Pulse must be enabled in Mode tab in Configuration window (see chapter 4.3.1.7). The pulse width of end pulse can be set in Parameter tab in Configuration window (see chapter 4.3.3.3).

ABA Absolute position move start [MD5130D/MD5230D]

Cmd	Data	Speed	Timer	EndP
ABA	Absolute Position（-2147483646 ～ +2147483646）	1～4	—	—

The axis moves from the current position to the absolute position specified by Data. Immediately after starting to move by this command, it shifts to next command line execution.

Data： Specifies the destination position by absolute value.
This value can be placed in a unit of mm or inch when the pulse scale numeration/denomination (see chapter 4.3.3.4 Pulse Scale Numeration and Denomination) are set. Factory default is pulse scale numerator=denominator, so it is drive pulse value. The setting range in drive pulse value is -2147483646 ~ +2147483646.

Speed： Selects speed settings (such as acceleration/deceleration mode and drive speed) from Speed1~4.
Speed settings can be set in Speed tab in Configuration window (see chapter 4.3.2).

INC Relative position move [MD5130D/MD5230D]

Cmd	Data	Speed	Timer	EndP
INC	Relative Position（-2147483646 ～ +2147483646）	1～4	0～3	Off/On

The axis moves from the current position to the relative position specified by Data. After completion of moving by this command, it will shift to next command line execution.

Data： Specifies the destination position by relative value. When setting positive value, it moves in the + direction (CW rotation) and when setting negative value, it moves in the – direction (CCW rotation).
This value can be placed in a unit of mm or inch when the pulse scale numeration/denomination (see chapter 4.3.3.4 Pulse Scale Numeration and Denomination) are set. Factory default is pulse scale numerator=denominator, so it is drive pulse value. The setting range in drive pulse value is -2147483646 ~ +2147483646.

■ Direction of motor axis rotation
・＋direction rotation： A motor axis rotates in CW rotation (clockwise direction) with respect to the seating plane of a motor.
・－direction rotation： A motor axis rotates in CCW rotation (counterclockwise direction) with respect to the seating plane

Speed： Selects speed settings (such as acceleration/deceleration mode and drive speed) from Speed1~4.
Speed settings can be set in Speed tab in Configuration window (see chapter 4.3.2).

Timer： Specifies the waiting time of until the next command line is executed after completion of moving. When 1~3 is assigned to Timer, the time of post timer 1~3 that is registered in Parameter tab in Configuration window (see chapter 4.3.3.1), is used. When setting without the waiting time, set 0 to Timer.
In the line that End Pulse (EndP) is set to On, it will wait for an amount of specified time after End Pulse is On.

EndP： Selects whether end pulse is output or not after completion of moving.
When On is set in EndP, end pulse is output from the XDRIVE/ENDP output signal (see chapter 7.3) of the parallel control connector (CN3). When Off is set, end pulse is not output.
To output end pulse, End Pulse must be enabled in Mode tab in Configuration window (see chapter 4.3.1.7). The pulse width of end pulse can be set in Parameter tab in Configuration window (see chapter 4.3.3.3).

ICB 2-axis simultaneous relative position move [MD5230D]

Cmd	Data	Speed	Timer	EndP
ICB	Relative Position（-2147483646 ～ +2147483646）	1～4	0～3	Off/On

Write this command in the same line of X and Y-axis.
X and Y-axis simultaneously start to move from the current position to the relative position specified by Data. After completion of moving by this command, it will shift to next command line execution.

Data： Specifies the destination position by relative value. When setting positive value, it moves in the + direction (CW rotation) and when setting negative value, it moves in the – direction (CCW rotation).
This value can be placed in a unit of mm or inch when the pulse scale numeration/denomination (see chapter 4.3.3.4 Pulse Scale Numeration and Denomination) are set. Factory default is pulse scale numerator=denominator, so it is drive pulse value. The setting range in drive pulse value is -2147483646 ~ +2147483646.

■ Direction of motor axis rotation
・＋direction rotation： A motor axis rotates in CW rotation (clockwise direction) with respect to the seating plane of a motor.
・－direction rotation： A motor axis rotates in CCW rotation (counterclockwise direction) with respect to the seating

Speed： Selects speed settings (such as acceleration/deceleration mode and drive speed) from Speed1~4.
Speed settings can be set in Speed tab in Configuration window (see chapter 4.3.2).

Timer： Specifies the waiting time of until the next command line is executed after completion of moving. When 1~3 is assigned to Timer, the time of post timer 1~3 that is registered in Parameter tab in Configuration window (see chapter 4.3.3.1), is used. When setting without the waiting time, set 0 to Timer.
In the line that End Pulse (EndP) is set to On, it will wait for an amount of specified time after End Pulse is On.

EndP： Selects whether end pulse is output or not after completion of moving.
When On is set in EndP, end pulse is output from the XDRIVE/ENDP output signal (see chapter 7.3) of the parallel control connector (CN3). When Off is set, end pulse is not output.
To output end pulse, End Pulse must be enabled in Mode tab in Configuration window (see chapter 4.3.1.7). The pulse width of end pulse can be set in Parameter tab in Configuration window (see chapter 4.3.3.3).

ICA Relative position move start [MD5130D/MD5230D]

Cmd	Data	Speed	Timer	EndP
ICA	Relative Position（-2147483646 ～ +2147483646）	1～4	—	—

The axis moves from the current position to the relative position specified by Data. Immediately after starting to move by this command, it shifts to next command line execution.

Data： Specifies the destination position by relative value. When setting positive value, it moves in the + direction (CW rotation) and when setting negative value, it moves in the – direction (CCW rotation).
This value can be placed in a unit of mm or inch when the pulse scale numeration/denomination (see chapter 4.3.3.4 Pulse Scale Numeration and Denomination) are set. Factory default is pulse scale numerator=denominator, so it is drive pulse value. The setting range in drive pulse value is -2147483646 ~ +2147483646.

Speed： Selects speed settings (such as acceleration/deceleration mode and drive speed) from Speed1~4.
Speed settings can be set in Speed tab in Configuration window (see chapter 4.3.2).

CNT Continuous move start [MD5130D/MD5230D]

Cmd	Data	Speed	Timer	EndP
CNT	+ / -（Moving Direction）	1～4	—	—

The axis moves continuously in the direction specified by Data. Immediately after starting to move by this command, it shifts to next command line execution.

Data： Specifies the direction to move continuously. When setting +, it moves continuously in the + direction (CW rotation) and when setting -, it moves continuously in the – direction (CCW rotation).

Speed： Selects speed settings (such as acceleration/deceleration mode and drive speed) from Speed1~4.
Speed settings can be set in Speed tab in Configuration window (see chapter 4.3.2).

SST Deceleration stop [MD5130D/MD5230D]

Cmd	Data	Speed	Timer	EndP
SST	—	—	0～3	—

The axis driving decelerates and stops according to the acceleration/deceleration mode of axis to perform decelerating stop. However, if acceleration/deceleration mode is constant speed driving, it stops immediately. After stop of axis driving by this command, it will shift to next command line execution.
When this command is executed during stop, it waits the time specified by Timer and then shifts to next command line execution.

Timer： Specifies the waiting time of until the next command line is executed after completion of decelerating stop.
When 1~3 is assigned to Timer, the time of post timer 1~3 that is registered in Parameter tab in Configuration window (see chapter 4.3.3.1), is used. When setting without the waiting time, set 0 to Timer.

IST Instant stop [MD5130D/MD5230D]

Cmd	Data	Speed	Timer	EndP
IST	—	—	0～3	—

The axis driving stops immediately. After stop of axis driving by this command, it will shift to next command line execution. When this command is executed during stop, it waits the time specified by Timer and then shifts to next command line execution.

Timer : Specifies the waiting time of until the next command line is executed after instant stop.
When 1~3 is assigned to Timer, the time of post timer 1~3 that is registered in Parameter tab in Configuration window (see chapter 4.3.3.1), is used. When setting without the waiting time, set 0 to Timer.

HOM Home search [MD5130D/MD5230D]

Cmd	Data	Speed	Timer	EndP
HOM	—	—	—	Off/On

Execute a home search according to the procedures set by home search mode (see chapter 4.3.4). After home search is finished, it will shift to next command line execution. For more details of Automatic Home Search, see chapter 6.2.

EndP : Selects whether end pulse is output or not after home search is finished.
When On is set in EndP, end pulse is output from the XDRIVE/ENDP output signal (see chapter 7.3) of the parallel control connector (CN3). When Off is set, end pulse is not output.
To output end pulse, End Pulse must be enabled in Mode tab in Configuration window (see chapter 4.3.1.7). The pulse width of end pulse can be set in Parameter tab in Configuration window (see chapter 4.3.3.3).

HMB 2-axis simultaneous home search [MD5230D]

Cmd	Data	Speed	Timer	EndP
HMB	—	—	—	Off／On

Write this command in the same line of X and Y-axis.
Execute a home search for the both axes according to the procedures set by home search mode (see chapter 4.3.4). After home search is finished, it will shift to next command line execution. For more details of Automatic Home Search, see chapter 6.2.

EndP : Selects whether end pulse is output or not after home search is finished.
When On is set in EndP, end pulse is output from the XDRIVE/ENDP output signal (see chapter 7.3) of the parallel control connector (CN3). When Off is set, end pulse is not output.
To output end pulse, End Pulse must be enabled in Mode tab in Configuration window (see chapter 4.3.1.7). The pulse width of end pulse can be set in Parameter tab in Configuration window (see chapter 4.3.3.3).

5.2.2. Interpolation commands

Linear interpolation, circular interpolation and circular interpolation center setting commands are available as interpolation commands. The interpolation command must be written in the same line of interpolation axes X and Y.
The user can perform continuous interpolation driving by continuously writng interpolation commands. Be sure to take 3msec or more for driving time of one interpolation. If the command other than interpolation commands is used during continuous interpolation commands, continuity of interpolation is not guaranteed.
See chapter 5.5.6 for the program example using interpolation commands, and Appendix B for the program example of continuous interpolation.

LNI 2-axis linear interpolation move [MD5230D]

Cmd	Data	Speed	Timer	EndP
LNI	Finish position X-axis: -134217728 ～ +134217728 Y-axis: -134217728 ～ +134217728	X-axis:1～4 Y-axis:Not selected.	—	—

Write this command in the same line of X and Y-axis.
It drives X and Y axes by linear interpolation from the current position to the relative position specified by Data. It starts 2-axis linear interpolation driving from the current position to the finish position, and then immediately shifts to next command line execution.
If using this command singly (discontinuous interpolation), acceleration / deceleration driving in Trapezoid mode is available.

Data： Specifies the destination position by relative value. When setting positive value, it moves in the + direction (CW rotation) and when setting negative value, it moves in the – direction (CCW rotation).
This value can be placed in a unit of mm or inch when the pulse scale numeration/denomination (see chapter 4.3.3.4 Pulse Scale Numeration and Denomination) are set. Factory default is pulse scale numerator=denominator, so it is drive pulse value. The setting range in drive pulse value is -134217728 ～ +134217728.

Speed： X-axis:Selects speed settings (such as acceleration/deceleration mode and drive speed) from Speed1~4.
Speed settings can be set in Speed tab in Configuration window (see chapter 4.3.2).
Y-axis：Not selected.

[Note]
・S-curve(S-Curve1/S-Curve2) mode cannot be selected in Speed setting
・In continuous interpolation driving, be sure to set the mode to Constant, other modes except Constant cannot be used.
・Speed of interpolation commands is only valid for X axis, and invalid for Y axis.

CEN Circular interpolation center setting [MD5230D]

Cmd	Data	Speed	Timer	EndP
CEN	Circular center point X-axis: -268435455 ～ +268435455 Y-axis:-268435455 ～ +268435455	—	—	—

Write this command in the same line of X and Y-axis.
Specifies the circular center point by the relative position to the current position, and then immediately shifts to next command line execution.

Data： Specifies the relative position to the current position X and Y-axis. This value can be placed in a unit of mm or inch when the pulse scale numeration/denomination (see chapter 4.3.3.4 Pulse Scale Numeration and Denomination) are set. Factory default is pulse scale numerator=denominator, so it is drive pulse value. The setting range in drive pulse value is -268435455 ～ +268435455.

CWI CW circular interpolation move [MD5230D]

Cmd	Data	Speed	Timer	EndP
CWI	Finish position X-axis: -268435455 ～ +268435455 Y-axis: -268435455 ～ +268435455	X-axis:1～4 Y-axis:Not selected.	—	—

Write this command in the same line of X and Y-axis.
It drives X and Y axes by circular interpolation from the current position to the relative position specified by Data in the clockwise direction (CW), centering the position specified by Circular interpolation center setting. It starts circular interpolation driving from the current position to the finish position in the CW direction, and then immediately shifts to next command line execution.

Data： Specifies the relative position(finish position) to the current position X and Y-axis. When the finish position is set to (0,0), a full circle will come out. This value can be placed in a unit of mm or inch when the pulse scale numeration/denomination (see chapter 4.3.3.4 Pulse Scale Numeration and Denomination) are set. Factory default is pulse scale numerator=denominator, so it is drive pulse value. The setting range in drive pulse value is -268435455 ～ +268435455.

Speed： X-axis:Selects speed settings (such as acceleration/deceleration mode and drive speed) from Speed1~4. Speed settings can be set in Speed tab in Configuration window (see chapter 4.3.2).
Y-axis：Not selected.

[Note]
- Be sure to set the mode to Constant, other modes except Constant cannot be used.
- Speed of interpolation commands is only valid for X-axis, and invalid for Y axis.
- When the start and finish points of a circular arc are not on the X or Y-axis, the finish points of both axes may deviate by ±1 pulse. When both are on the X or Y-axis, this deviation does not occur.

CCW CCW circular interpolation move [MD5230D]

Cmd	Data	Speed	Timer	EndP
CCW	Finish position X-axis: -268435455 ～ +268435455 Y-axis: -268435455 ～ +268435455	X-axis:1～4 Y-axis:Not selected	—	—

Write this command in the same line of X and Y-axis.
It drives X and Y axes by circular interpolation from the current position to the relative position specified by Data in the counter clockwise direction (CCW), centering the position specified by Circular interpolation center setting. It starts circular interpolation driving from the current position to the finish position in the CCW direction, and then immediately shifts to next command line execution.

Data： Specifies the relative position(finish position) to the current position X and Y-axis. When the finish position is set to (0,0), a full circle will come out. This value can be placed in a unit of mm or inch when the pulse scale numeration/denomination (see chapter 4.3.3.4 Pulse Scale Numeration and Denomination) are set. Factory default is pulse scale numerator=denominator, so it is drive pulse value. The setting range in drive pulse value is -268435455 ～ +268435455.

Speed： X-axis:Selects speed settings (such as acceleration/deceleration mode and drive speed) from Speed1~4. Speed settings can be set in Speed tab in Configuration window (see chapter 4.3.2).
Y-axis：Not selected.

[Note]
- Be sure to set the mode to Constant, other modes except Constant cannot be used.

- Speed of interpolation commands is only valid for X-axis, and invalid for Y axis.
- When the start and finish points of a circular arc are not on the X or Y-axis, the finish points of both axes may deviate by ±1 pulse. When both are on the X or Y-axis, this deviation does not occur.

5.2.2.1 Limitation on the coding with interpolation

When the commands in the table below is written in the next line to the interpolation command, the command error will occur.

Command Type	Code	Command Type	Code
Y-axis program start	RNY	Deceleration stop	SST
Waiting Y-axis program end	WTY	Instant stop	IST
Absolute position move	ABS	Home search	HOM
2-axis simultaneous absolute position move	ABB	2-axis simultaneous home search	HMB
Relative position move	INC	Drive speed	SPD
2-axis simultaneous relative position move	ICB	Current position	POS
Absolute position move start	ABA	Split pulse start	SSP
Relative position move start	ICA	Split pulse stop	PST
Continuous move start	CNT		

5.2.3. Signal Output Commands

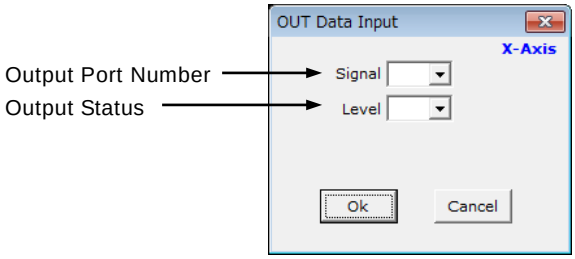
OUT Output port ON/OFF [MD5130D/MD5230D]

Cmd	Data	Speed	Timer	EndP
OUT	Output Port Number ; Output Status（Off / On）	—	—	—

Turn the specified output port ON (turn open collector transistor ON) and OFF (turn open collector transistor OFF). Immediately after starting to execute this command, it shifts to next command line execution.

Data : ● Output Port Number
Specifies the output port number corresponding to the output signal. See chapter 5.3 for output port numbers.
● Output Status
When setting On, open collector transistor turns ON and when setting Off, open collector transistor turns OFF.

<How to input Data>
In Program window, select OUT command in Cmd field or double click on Data field in OUT command line, OUT Data Input window appears and the user can input values, or single click on Data field in OUT command line, and the user can input values directly.



Form of direct input in Data

Cmd	Data
OUT	Output Port Number␣;␣Off/On

※ ␣ : Space

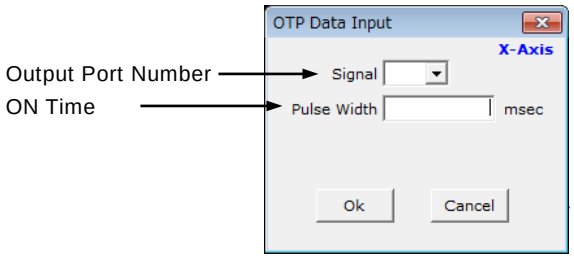
OTP Output port ON Pulse [MD5130D/MD5230D]

Cmd	Data	Speed	Timer	EndP
OTP	Output Port Number ; ON Time（0～65535msec）	—	—	—

Turn the specified output port ON (turn open collector transistor ON) for specified time.
Immediately after starting to execute this command, it shifts to next command line execution without waiting for an amount of specified ON time.

Data : ● Output Port Number
Specifies the output port number corresponding to the output signal. See chapter 5.3 for output port numbers.
● ON Time (msec)
Specifies the time to turn ON in a unit of msec. The range is from 0 to 65535 msec.

<How to input Data>
In Program window, select OTP command in Cmd field or double click on Data field in OTP command line, OTP Data Input window appears and the user can input values, or single click on Data field in OTP command line, and the user can input values directly.



Form of direct input in Data

Cmd	Data
OTP	Output Port Number␣;␣ON Time

※ ␣ : Space

[Note]

- The ON time range of output pulse by OTP command has ±1msec error.

SSP Split pulse start [MD5130D/MD5230D]

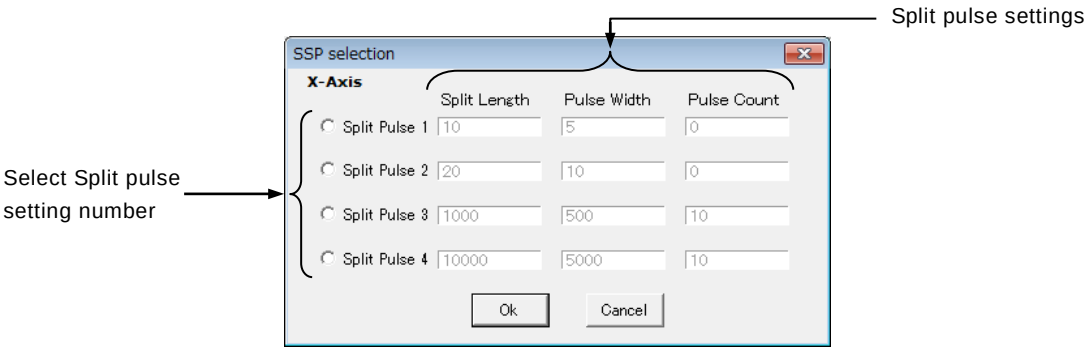
Cmd	Data	Speed	Timer	EndP
SSP	Split pulse setting number (1～4)	–	–	–

This command outputs split pulses. If executed before starting motor rotation, the split pulse is output from the timing of the start of motor rotation. Immediately after starting to execute this command, it shifts to next command line execution.
While the split pulse is in operation, when SSP command is executed that specifies another split pulse setting number differs from the current one, the operation pattern of the split pulse can be changed during operation. For more details of Split Pulse, see chapter 6.3.

Data : Specifies the split pulse setting number for the setting of split pulse output.
Split pulse settings must be set in Split Pulse tab in Configuration window in advance (see chapter 4.3.5).

<How to input Data>

In Program window, select SSP command in Cmd field or double click on Data field in SSP command line, SSP Selection window appears and the user can select, or single click on Data field in SSP command line, and the user can input the split pulse setting number (1~4) directly in Data field.



[Note]

- The actual output of split pulses is delayed about 2~4msec due to the time for command processing.

PST Split pulse stop [MD5130D/MD5230D]

Cmd	Data	Speed	Timer	EndP
PST	–	–	–	–

This command stops to output split pulses. Immediately after starting to execute this command, it shifts to next command line execution. For more details of Split Pulse, see chapter 6.3.

IJP Input condition jump [MD5130D/MD5230D]

Cmd	Data	Speed	Timer	EndP
IJP	Input port number ; Signal level (Low/Hi) ; Jump destination label (J01～J63)	–	–	–

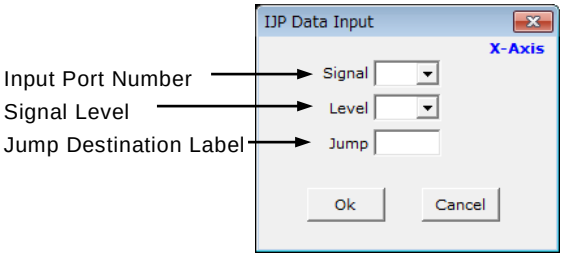
If input port is the specified input state, it jumps to the specified label of a jump destination. If input port is not the specified input state, it shifts to next command line execution.

Data : ● Input Port Number
Specifies the input port number corresponding to the input signal. See chapter 5.3 for input port numbers.

- Signal Level
  When setting Low and if input port is Low level (GEX Short-circuited), it jumps. When setting High and if input port is High level (Open), it jumps.
- Jump Destination Label
  Set the label of a jump destination (J01~J63).
  The jump destination must be in the same program as a jump source or in the same subroutine as a jump source.

<How to input Data>

In Program window, select IJP command in Cmd field or double click on Data field in IJP command line, IJP Data Input window appears and the user can input values, or single click on Data field in IJP command line, and the user can input values directly. When input values directly, J of a jump destination label must be input in uppercase.



Form of direct input in Data

Cmd	Data
IJP	Input Port Number␣;␣Signal Level␣;␣Jump Destination
Label	

※ ␣ : Space

■ Example for waiting for input signal by IJP command (waiting for IN0 signal Low)

Label	Cmd	Data	Speed	Timer	EndP
	:				
J01	IJP	01 ; Low ; J02			
	JMP	J01			
J02	:				
	:				

Process before waiting for input signal

Jump to J02 if X:IN0 signal is Low (ON)
Jump to J01 if X:IN0 signal is not Low (ON)
Repeat until X:IN0 signal becomes Low (ON)

Process after input signal condition is established

[Note]

- The actual operation is delayed about 2~5msec due to the time for command processing.

PJP Position condition jump [MD5130D/MD5230D]

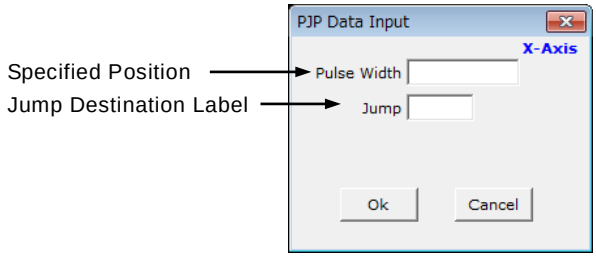
Cmd	Data	Speed	Timer	EndP
PJP	Absolute position (-2147483648 ～ +2147483647) ; Jump destination Label (J01～J63)	—	—	—

If the current position exceeds the specified position (absolute position) with respect to the rotating direction of a motor, it jumps to the specified label of a jump destination. If the current position does not exceed the specified position (absolute position), it shifts to next command line execution. When a motor stops at execution of this command, it shifts to next command line execution.

Data : ● Specified Position (Absolute Position)
Set the specified position by absolute position, which is the condition of position condition jump.
This value can be placed in a unit of mm or inch when the pulse scale numeration/denomination (see chapter 4.3.3.4 Pulse Scale Numeration and Denomination) are set. Factory default is pulse scale numerator=denominator, so it is drive pulse value. The setting range in drive pulse value is -2147483648 ~ +2147483647.

- Jump Destination Label
  Set the label of a jump destination (J01~J63).
  The jump destination must be in the same program as a jump source or in the same subroutine as a jump source.

<How to input Data>
In Program window, select PJP command in Cmd field or double click on Data field in PJP command line, PJP Data Input window appears and the user can input values, or single click on Data field in PJP command line, and the user can input values directly. When input values directly, J of a jump destination label must be input in uppercase.



Form of direct input in Data

Cmd	Data
PJP	Specified Position ␣;␣Jump Destination Label

※ ␣ : Space

[Note]

- The actual operation is delayed about 2~5msec due to the time for command processing.

JMP Unconditional jump [MD5130D/MD5230D]

Cmd	Data	Speed	Timer	EndP
JMP	Jump destination label number（J01～J63）	—	—	—

Jumps to the specified label of a jump destination.

Data : Specifies the label number (J01~J63) to a jump destination. Input J in uppercase.
The jump destination must be in the same program as a jump source or in the same subroutine as a jump source.

JSR Subroutine jump [MD5130D/MD5230D]

Cmd	Data	Speed	Timer	EndP
JSR	Subroutine Label number (S01～S19)	—	—	—

Jumps to the specified subroutine label. Subroutines can be nested up to 3 levels deep.

Data : Specifies the subroutine label number (S01～S19) to a jump destination. Input S in uppercase.

RET Subroutine return [MD5130D/MD5230D]

Cmd	Data	Speed	Timer	EndP
RET	—	—	—	—

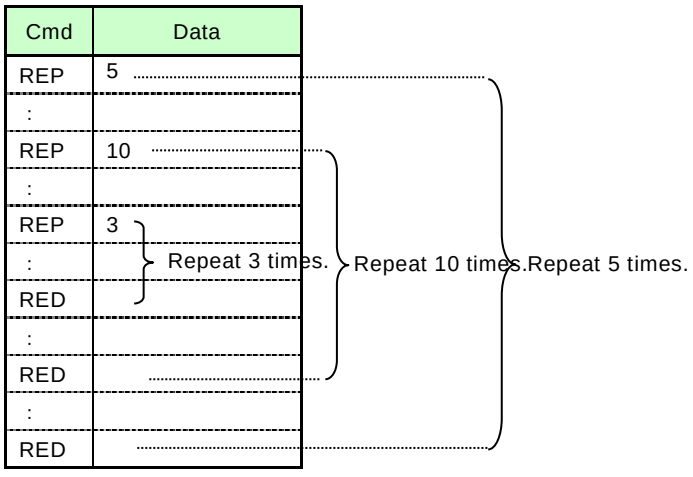
Terminates a subroutine and returns to the subroutine caller, which must be described at the end of a subroutine. After executing this command, it shifts to execute the next command line in subroutine jump command line (JSR) of a jump source.

REP Repetition start [MD5130D/MD5230D]

Cmd	Data	Speed	Timer	EndP
REP	Repetition Number (1～255)	—	—	—

Repeats a specified number of times from next line of this command to Repetition End command (RED).
Repetition End command (RED) must be placed (in the larger line number) under this Repetition Start command (REP). Repetition loop can be nested up to 3 levels deep.

Data : Specifies the repetition number. The range is from 1 to 255.



RED Repetition end [MD5130D/MD5230D]

Cmd	Data	Speed	Timer	EndP
RED	—	—	—	—

Repeats a specified number of times from Repetition Start command (REP) to this command.

END Program end [MD5130D/MD5230D]

Cmd	Data	Speed	Timer	EndP
END	—	—	—	—

Terminates the program. Write at least one END command in one program. Or the user can write two or more END commands in one program.

[Note]
If a motor is rotating, the motor is stopped by decelerating and then the program is terminated. And Speed selection goes back to just before the start of the program.

TIM Timer [MD5130D/MD5230D]

Cmd	Data	Speed	Timer	EndP
TIM	Waiting time (1～65535msec)	—	—	—

Waits for a specific amount of time. After the specific amount of time passes, it shifts to next command line execution.

Data : Specifies the waiting time in a unit of msec. The range is from 1 to 65535 msec.

[Note]
- There is ±1msec error.

WTE Waiting driving end [MD5130D/MD5230D]

Cmd	Data	Speed	Timer	EndP
WTE	—	—	—	—

Waits for the stop of motor rotation. After motor rotation stop, it shifts to next command line execution.
When this command is executed during motor stop, it shifts to next command line execution.

WTP Waiting position passage [MD5130D/MD5230D]

Cmd	Data	Speed	Timer	EndP
WTP	Absolute position（-2147483648 ～ +2147483647）	—	—	—

Waits for passing through the specified position (absolute position) during motor rotation. After passing through the specified position, it shifts to next command line execution.
If this command is executed while motor rotation stop, or if motor rotation stop while waiting for passing through the specified position by this command, or if the specified position is already passed through at execution of this command, an error will

occur and the program will be finished.

Data : Specifies the position to wait for by absolute position.
This value can be placed in a unit of mm or inch when the pulse scale numeration/denomination (see chapter 4.3.3.4 Pulse Scale Numeration and Denomination) are set. Factory default is pulse scale numerator=denominator, so it is drive pulse value. The setting range in drive pulse value is -2147483648 ~ +2147483647.

[Note]

- The actual operation is delayed about 2~5msec due to the time for command processing.

PAS Pause for debug [MD5130D/MD5230D]

Cmd	Data	Speed	Timer	EndP
PAS	–	–	–	–

Pauses a running program. To re-executes it, click "**Continue**" button in Program window in MD Operation Tool. This command is useful for debugging a user program.

[Note]

- Do not execute the program with PAS command by program driving operation using parallel control signals (see chapter 7.3.2.4).

RNY Y-axis program start [MD5230D]

Cmd	Data	Speed	Timer	EndP
RNY	P label(P01～P63)	–	–	–

Write this command in X-axis.
The program starts from the specified program label of Y-axis. Immediately after starting to execute the program of Y-axis, the program execution of X-axis is continued.
This command cannot be used in the program of Y-axis.

WTYWaiting Y-axis program end [MD5230D]

Cmd	Data	Speed	Timer	EndP
WTY	–	–	–	–

Write this command in X-axis.
The program execution of X axis is stopped temporarily until the program of Y axis is finished (END). If the program of Y axis is already finished, the program execution of X axis is continued from next line.
This command cannot be used in the program of Y-axis.

5.2.5. Other Commands

SPD Drive speed [MD5130D/MD5230D]

Cmd	Data	Speed	Timer	EndP
SPD	Drive speed（1～500000 pps）	—	—	—

Changes drive speed if this command is executed during motor rotation. Immediately after starting to execute this command, it shifts to next command line execution without waiting for reaching the specified drive speed.

When drive speed is changed during constant speed driving, it immediately shifts to the drive speed specified by Data.
When drive speed is changed during trapezoidal acceleration / deceleration driving (Trapezoid1, Trapezoid2, Trapezoid3), it accelerates/decelerates up to the drive speed specified by Data. During S-curve acceleration / deceleration driving (S-curve1, S-curve2), drive speed cannot be changed. If SPD command is executed during S-curve acceleration / deceleration driving, an error will occur and the program will be finished.

Data： Specifies drive speed. The range is from 1 to 500000pps.

[Note]
It cannot be used while a motor is rotating by ABA or ICA command.

POS Current position [MD5130D/MD5230D]

Cmd	Data	Speed	Timer	EndP
POS	Absolute position（-2147483648 ～ +2147483647）	—	—	—

Rewrites the current position to an arbitrary value, which is set to the logical and real positions (application value of encoder signal count×encoder scale×pulse scale). Immediately after starting to execute this command, it shifts to next command line execution. If this command is executed during motor rotation, an error will occur and the program will be finished.

Data： Specifies the current position by absolute position.
This value can be placed in a unit of mm or inch when the pulse scale numeration/denomination (see chapter 4.3.3.4 Pulse Scale Numeration and Denomination) are set. Factory default is pulse scale numerator=denominator, so it is drive pulse value. The setting range in drive pulse value is -2147483648 ~ +2147483647.

NOP No operation [MD5130D/MD5230D]

Cmd	Data	Speed	Timer	EndP
NOP	—	—	—	—

No operation is performed.

5.3. Input/Output Ports

■ Input Ports

Input Port Number	Connector	Pin Number	Signal	Signal Description	Signal Category
01	CN4	12	XIN0	General Purpose Input 0	X-axis Signals
02	CN4	13	XIN1	General Purpose Input 1	
03	CN4	2	XECA	Encoder A-phase	
04	CN4	3	XECB	Encoder B-phase	
05	CN4	4	XECZ	Encoder Z-phase	
06	CN4	8	XHOME	Home	
11	CN7	12	YIN0	General Purpose Input 0	Y-axis Signals
12	CN7	13	YIN1	General Purpose Input 1	
13	CN7	2	YECA	Encoder A-phase	
14	CN7	3	YECB	Encoder B-phase	
15	CN7	4	YECZ	Encoder Z-phase	
16	CN7	8	YHOME	Home	
21	CN3	7	PSL0	Program Designation	Parallel Control Signals
22	CN3	8	PSL1		
23	CN3	9	PSL2		
24	CN3	10	PSL3		
25	CN3	11	PSL4		
26	CN3	12	PSL5		

■ Output Ports

Output Port Number	Connector	Pin Number	Signal	Signal Description	Signal Category
01	CN4	14	XOUT0	General Purpose Output 0	X-axis Signals
02	CN4	15	XOUT1	General Purpose Output 1	
11	CN7	14	YOUT0	General Purpose Output 0	
12	CN7	15	YOUT1	General Purpose Output 1	

For more details of the connectors, see chapter 7.3 Parallel Control Connector and 7.4 Sensor Input/Output Signal Connector for Axis.

5.4. User Program Creation and Execution Rules

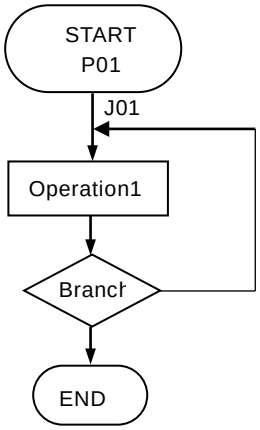
- Program label must be written in the first line of X axis.
- One program must have one or more END command in it.
- In a program using 2 axes simultaneously and interpolation command, X axis must be the main of the program. (If Y axis is the main, it cannot work.)
- In a program using 2 axes simultaneously and interpolation command, a program label (P label) must be registered to only X axis.
- In a program using 2 axes simultaneously and interpolation command, it is not necessary to write END command in Y axis.
- In a program using 2 axes simultaneously and interpolation command, a single command for Y axis is ignored.
- When the user executes a single command for Y axis in a program using 2 axes simultaneously and interpolation command, write a program label to Y axis, and start Y axis by RNY command from X axis. (See Program Example 0.)
- When the user executes a program using 2 axes simultaneously and interpolation command, be sure to execute only X axis.

5.5. Program Example using Label

The program example using labels is shown below. For more details of each user program command, see chapter 5.2 and after

5.5.1. When making a jump to the head of a program

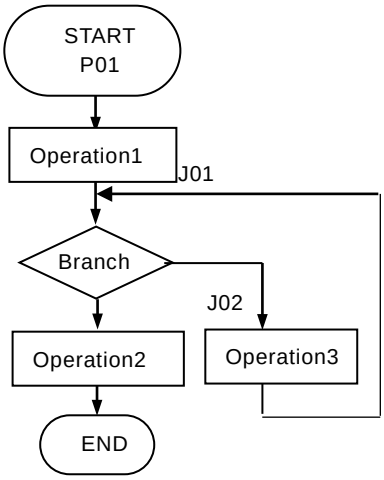
In the first line of a program, a program label number must be written, so a jump label number cannot be written there. In order to jump to the head of a program, write a program label number and NOP command in the first line, and then write actual operation and a jump label number in the second line.
It is the same as above when making a jump to the head of a subroutine in the subroutine.



Label	Cmd	Data	Speed	Timer	EndP	
P01	NOP					Write P label number and NOP command in the first line.
J01	INC	10000	1	0	Off	Operation1: Write J label number. Relative position move to the position +10000, Wait for the timer for 2 seconds.
	TIM	2000				
	IJP	01 ; Low ; J01				Branch: If XIN0 signal is Low (ON), jump to J01.
	END					End the program.

5.5.2. When writing the process of after condition branch to outside of normal operation (after END)

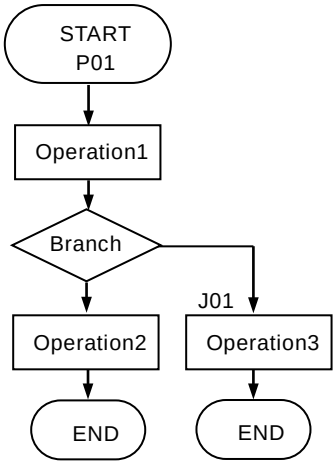
The process after condition branch can be written in the line after END command. The line after the END command line which is written a jump label number belongs in the program label number before END command. And until another program label number or subroutine label number is written, the same program label number is used.
It is the same as above when the user write the process after condition branch to outside of normal operation (after RET) in the subroutine.



Label	Cmd	Data	Speed	Timer	EndP	
P01	INC	1000	1	0	Off	Operation1: Relative position move to the position +1000
J01	IJP	02 ; Low ; J02				Branch:If XIN1 signal is Low (ON), jump to J02 (Operation3) If Hi (Open), to the next line (Operation2)
	INC	20000	2	0	Off	Operation2: Relative position move to the position +20000
	END					Program end command (END)
J02	TIM	200				Operation3: Wait for the timer for 0.2 seconds
	INC	-20000	2	0	Off	Relative position move to the position -20000
	JMP	J01				Unconditional Jump to J01

5.5.3. When finishing the program at the jump destination after condition branch

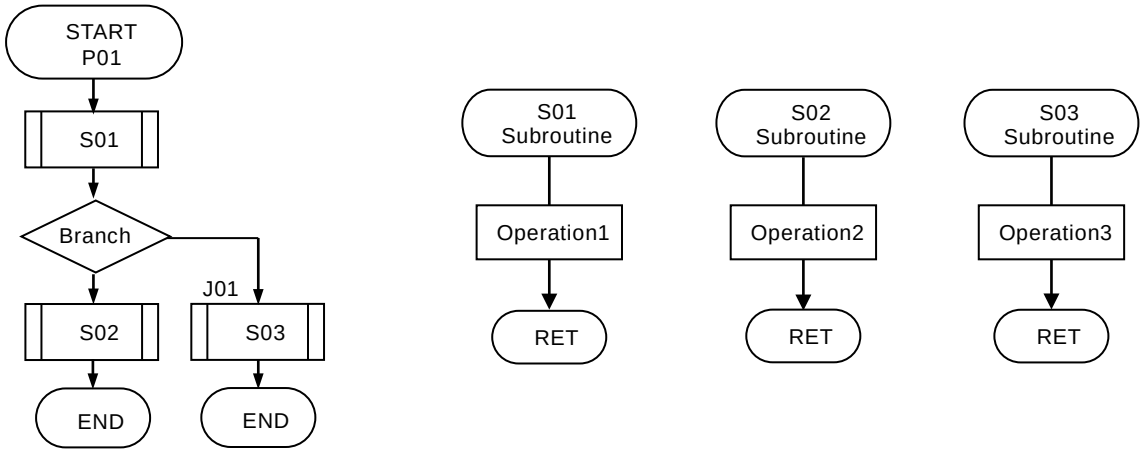
In order to finish the program at the jump destination after condition branch, operation and END command can be written in each jump destination after condition branch, in this case, there are 2 END commands in one program label.
It is the same as above when the user wants the program to return (RET command) from the jump destination after condition branch.



Label	Cmd	Data	Speed	Timer	EndP	
P01	ABS	5000	1	0	Off	Operation1: Absolute position move to the position 5000
	IJP	01 ; Low ; J01				Branch:If XIN0 signal is Low (ON), jump to J01 (Operation3 If Hi (Open), to the next line (Operation2)
	ABS	12500	2	0	Off	Operation2: Absolute position move to the position 12500
	OTP	01 ; 500				Turn XOUT0 ON for 0.5 seconds.
	END					Program end command (END) at the branch to operation2
J01	ABS	50000	2	0	Off	Operation3: Absolute position move to the position 50000
	OTP	02 ; 500				Turn XOUT1 ON for 0.5 seconds
	END					Program end command (END) at the branch to operation3

5.5.4. When calling a subroutine

Write S label in the first line of a subroutine. To terminate a subroutine, write subroutine return command (RET) that indicates the return from a subroutine. Subroutines can be nested up to 3 levels deep.
And when making a jump to the head of a subroutine, write S label number and NOP command in the first line, and then write a jump label number and actual operation in the next line.



Label	Cmd	Data	Speed	Timer	EndP
P01	JSR	S01			
	IJP	01 ; Low ; J01			
	JSR	S02			
	END				
J01	JSR	S03			
	END				
S01	ABS	5000	1	0	Off
	RET				
S02	ABS	12500	2	0	Off
	OTP	01 ; 500			
	RET				
S03	NOP				
J02	IJP	01 ; Low ; J04			
	POS	0			
	ICA	-9000	2		
J03	PJP	-1000 ; J02			
	JMP	J03			
J04	OTP	02 ; 500			
	RET				

Call subroutine S01

Branch:If XIN0 signal is Low (ON), jump to J01
If Hi (Open), to the next line
Call subroutine S02

Program end command (END)

Call subroutine S03

Program end command (END)

S01 subroutine

Operation1: Absolute position move to the position 5000

S02 subroutine

Operation2: Absolute position move to the position 12500
Turn XOUT0 for 0.5 seconds.

S03 subroutine
Operation3:
J02 Branch:If XIN0 signal is Low (ON), jump to J04
If Hi (Open), to the next line
Set the current position to 0.
Relative position move start
J03 When checking the condition of passing position,
Jump to J02
JMP J03
J04 Turn XOUT1 for 0.5 seconds

5.5.5. Program Example by 2-Axis Simultaneous Command

Write a program label to only X axis, and write 2-axis simultaneous command in the same line of X and Y axes. After waiting for the end of both driving, the 2-axis simultaneous command shifts to next command line execution.

X-Axis						Y-Axis					
Label	Cmd	Data	Speed	Timer	EndP	Label	Cmd	Data	Speed	Timer	EndP
P01	NOP										
	ABB	60000	4	0	Off		ABB	60000	2	0	Off
	ABB	0	2	0	Off		ABB	0	4	0	Off
	END										
P02	ICB	10000	1	0	Off		ICB	-20000	2	0	Off
	ICB	10000	2	0	Off		ICB	-20000	1	0	Off
	END										

Write P label to only X-axis

Write in the same line (Each value is set in each axis individually)

5.5.6. Program Example of Linear Interpolation

Write a program label to only X axis, and write linear interpolation command in the same line of X and Y axes.
As linear interpolation command shifts to next command line immediately after the execution, write WTE command in the next line and waits for the end of driving.

X-Axis						Y-Axis					
Label	Cmd	Data	Speed	Timer	EndP	Label	Cmd	Data	Speed	Timer	EndP
P01	NOP										
	LNI	10000	1	0	Off		LNI	5000			
	WTE										
	END										

Write P label to only

Write in the same line

Waiting drive ending.

5.5.7. Program Example of Circular Interpolation

Write a program label to only X axis, and write each circular interpolation command in the same line of X and Y axes.
Write a circular center point by circular interpolation center setting command (CEN), and write interpolation move start command (CWI or CCW) in the next line.
As interpolation move start command shifts to next command line immediately after the execution, write WTE command in the next line and waits for the end of driving.

X-Axis						Y-Axis					
Label	Cmd	Data	Speed	Timer	EndP	Label	Cmd	Data	Speed	Timer	EndP
P01	NOP										
	CEN	0					CEN	-10000			
	CWI	0	1				CWI	0			
	WTE										
	CEN	0					CEN	-10000			
	CCW	0	1				CCW	0			
	WTE										
	END										

Write P label to only X-axis
Write the center point of circle in the same line.
Write the circular interpolation command in the same line.
Waiting drive ending.

5.5.8. Program Example to execute Y axis from the program of X axis

X-Axis						Y-Axis					
Label	Cmd	Data	Speed	Timer	EndP	Label	Cmd	Data	Speed	Timer	EndP
P01	NOP										
	CEN	0					CEN	-10000			
	CWI	0	1				CWI	0			
	WTE										
	RNY	P01									
	WTY										
	END					P01	ABS	5000	3	0	OFF
							ABS	0	3	0	OFF
							END				

Write the program of which main is X-axis.
Activate the program of Y-axis.
Waiting Y-axis program ending.
Write the program of Y-axis.

6. Additional Information on Function

6.1. Drive Pulse and Encoder Input

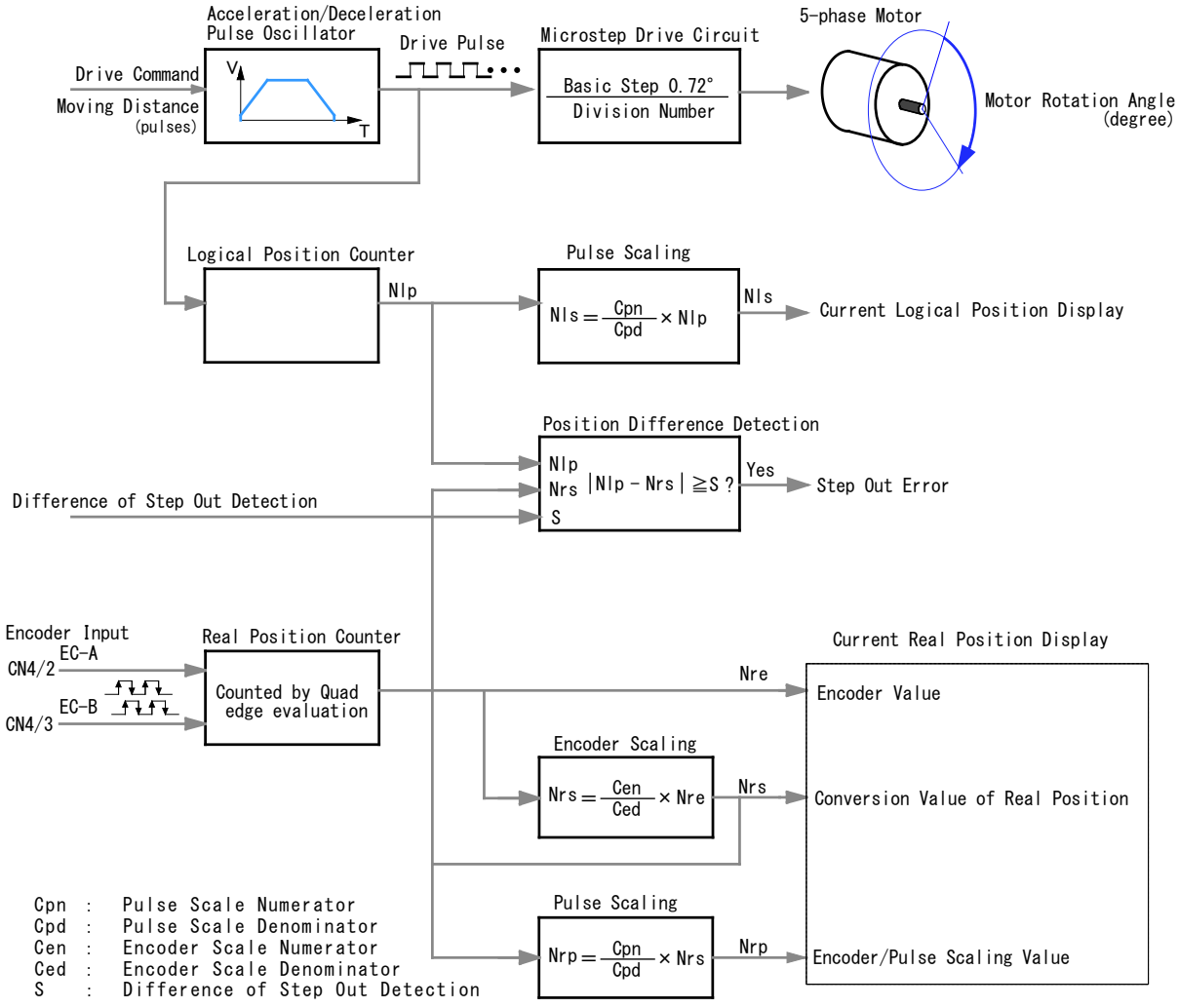
MD5130D and MD5230D treat the moving distance of an object by the unit of drive pulse.When the drive command such as move commands is issued to acceleration/deceleration pulse oscillator in the unit, the pulse oscillator sends the drive pulse to microstep drive circuit. In the microstep drive circuit, a motor is rotated based on the specified step resolution that divides the basic step angle of 5-Phase stepper motor into smaller microsteps.

The connected 5-Phase stepper motor counts one rotation of a motor by 500 drive pulses when the setting value of step resolution is 1. Namely, the step angle of motor rotation is 0.72° per drive pulse. The greater the step resolution, smaller the step angle of motor rotation per drive pulse.
The rotation angle of a motor to the specified moving distance (drive pulse number) can be calculated as follows.

$$\text{Motor Rotation Angle (Degree)} = \frac{0.72}{\text{Step Resolution}} \times \text{Drive Pulse Number}$$

[Note]

- Step resolution function is the method of dividing the basic step of motor excitation electrically. It does not assure that the step angel divided by Step resolution is uniform mechanically.



Drive Pulse and Encoder Input

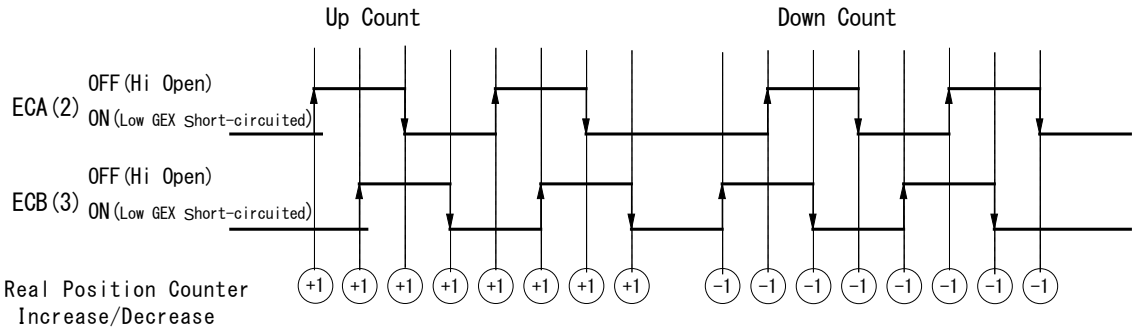
Drive pulses are input to the logical position counter in the unit and the current position of a moving object is always controlled. The current position is multiplied and divided by a specified coefficient using pulse scaling function, and then displayed.

The encoder input signal is taken into the real position counter that is counted by quad edge evaluation (counted at all ↑ ↓ of A/B-phase signals).
The value of the real position counter can be displayed, choosing from the following 3 operation values.

Display Options	Contents
Encoder value	Displays the value of real position counter.
Pulse conversion value of real position	To obtain consistency between the logical position counter and the pulse, it displays the value that the real position count value multiplied and divided by a specified encoder scaling coefficient.
Encoder/ Pulse scaling value	When using the pulse scaling to the logical position, to obtain consistency between the logical position and the moving unit, it displays the value that pulse conversion value of real position multiplied and divided by a specified pulse scaling coefficient.

The step out detection function obtains the difference between the value of logical position counter and pulse conversion value of real position, and if its absolute amount is over a specified value, it will be a step out error.

The relation between encoder input signals ECA , ECB (see chapter 7.4.1) and the real position counter is as follows.



Encoder Input Signal and Real Position Count

As encoder quadrature pulse is counted by quad edge evaluation, when the pulse number is 500 per rotation of an encoder, the real position counter counts 2000 per rotation.

6.2. Automatic Home Search

Automatic home search is the function that automatically returns to a home position.
MD5130D/MD5230D automatic home search performs in order from step1 to step4 shown in the table below once started. For each step, it can be configurable for execution/non-execution, a search direction, input signal for searching and the logical level of signals to be detected (see chapter 4.3.4).
In step1 and 4, search operation is performed using Speed4 set in speed settings tab (see chapter 4.3.2) as the speed of high-speed home search. In step2 and 3, search operation is performed using the speed of low-speed home search set in parameter settings tab (see chapter 4.3.3). The position counter is reset to 0 (can be enabled/disabled) at the end of automatic home search and home search operation is finished.
For more details of detection signals, see chapter 7.4 CN4 Sensor Connector for Axis.

Step Number	Operation	Search Speed	Detection Signal
Step 1	High-speed home search	Home search high speed (Speed4)	Select XHOME or Limit
Step 2	Low-speed home search	Home search low speed	
Step 3	Low-speed encoder Z-phase search	Home search low speed	XECZ
Step 4	High-speed offset drive	Home search high speed (Speed4)	—

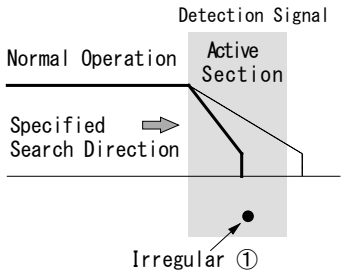
6.2.1. The Description of Automatic Home Search Operation

6.2.1.1 Step 1 High-speed Home Search

In step1, drive pulses are output in a specified direction at the speed set in home search high speed (Speed4 in chapter 4.3.4) until the detection signal (see chapter 4.3.4.1) becomes active, then it will decelerate and stop. To perform acceleration/deceleration driving, set a higher value for the home search high speed (Speed4) than the start speed.

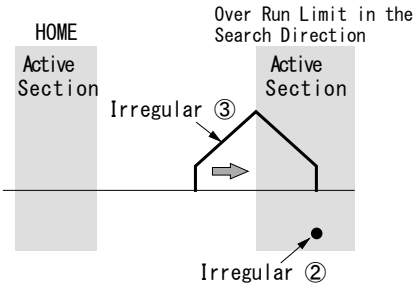
■ Step 1: Irregular operation

① A specified detection signal (HOME/Limit) is already active before Step 1 starts.
→ Proceeds with Step 2.



② When HOME is set as a detection signal and a limit signal in the search direction is already active before Step 1 starts.
→ Proceeds with Step 2.

③ When HOME is set as a detection signal and a limit signal in the search direction becomes activated during execution of step1.
→ Driving decelerates and stops, and proceeds with Step 2.

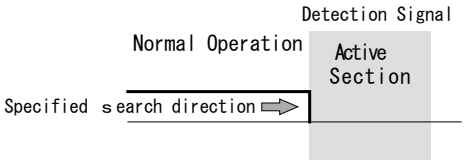


[Note]

- Since Step 1 performs a high-speed search, if the user specifies a limit signal as a detection signal, the limit stop mode must be set to deceleration stop. For more details of the setting of limit stop mode, see chapter 4.3.1.5 Hardware Limit Stop Mode and Active Level.

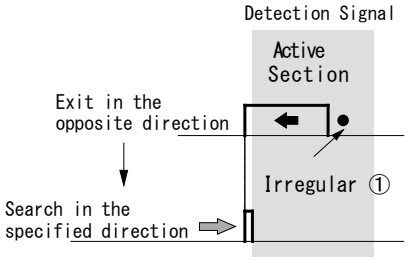
6.2.1.2 Step 2: Low-speed home search

In step2, Drive pulses are output at constant speed in a specified direction using the home search low speed (see chapter 4.3.3) until the detection signal (HOME/Limit) becomes active, then stops immediately. To perform low-speed search operation, set a lower value for the home search low speed than the start speed of Speed4.



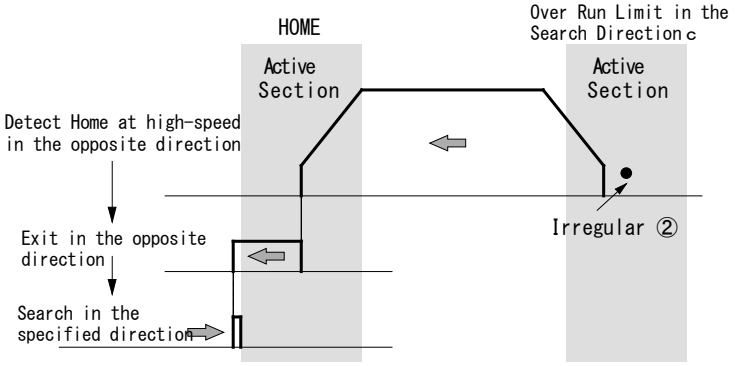
■ Step 2: Irregular operation

① A detection signal (HOME/Limit) is already active before Step 2 starts.
→It drives in the direction opposite to a specified search direction at the home search low speed until the detection signal (HOME/Limit) becomes inactive. When the detection signal becomes inactive, it executes Step 2 from the beginning.



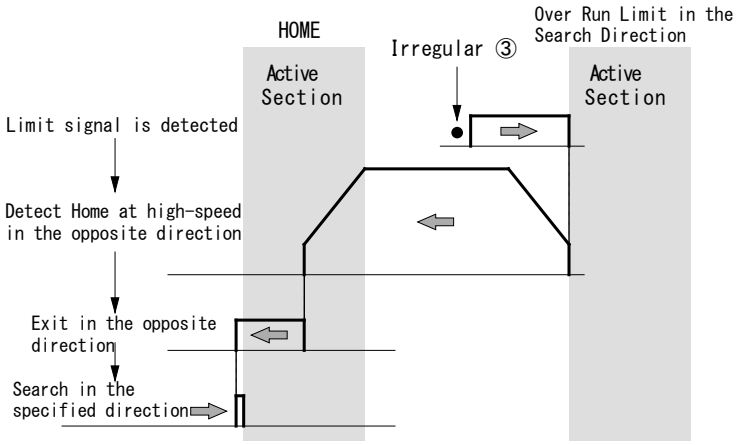
② When HOME is set as a detection signal and a limit signal in the search direction is active before Step 2 starts.

→It drives in the direction opposite to a specified search direction at the home search high speed (Speed4) until the home signal (HOME) becomes active. When HOME signal becomes active, it drives in the direction opposite to a specified search direction at the home search low speed until HOME signal becomes inactive. When HOME signal becomes inactive, it executes Step 2 from the beginning.



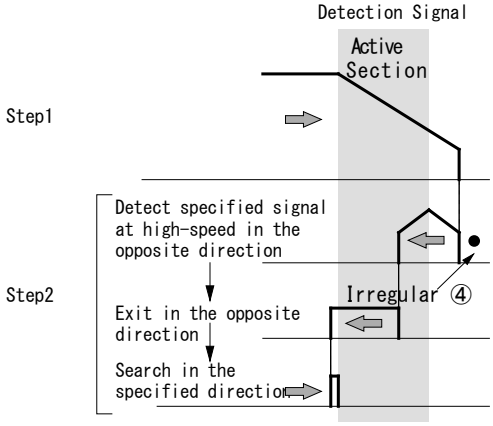
③ When HOME is set as a detection signal and a limit signal in the search direction becomes active during execution of step2.

→Driving stops immediately and the operation described in Irregular operation ② is performed.



④ When a search direction is the same as Step 1 and Step 2, and the detection signal is inactive before Step 2 starts.

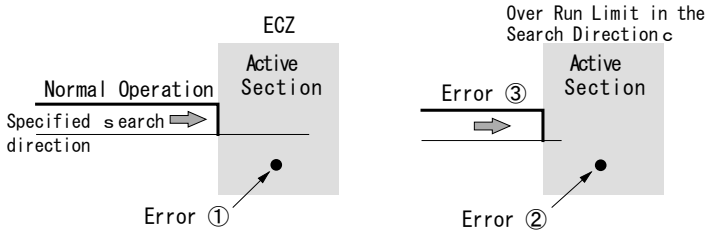
→It drives in the direction opposite to a specified search direction at the home search high speed (Speed4) until the detection signal becomes active. When the detection signal becomes active, it drives in the direction opposite to a specified search direction at the home search low speed until the detection signal becomes inactive. When the detection signal becomes inactive, it executes Step 2 from the beginning.



This operation is appropriate to the home search for a rotating axis.

6.2.1.3 Step 3: Low-speed Encoder Z-phase Search

In step3, Drive pulses are output at constant speed in a specified direction using the home search low speed (see chapter 4.3.3) until the encoder Z-phase signal (ECZ) becomes active, then stops immediately. To perform low-speed search operation, set a lower value for the home search low speed than the start speed of Speed4.



■ Step 3: Irregular operation

① If encoder Z-phase signal (ECZ) is already active at the start of Step 3, an error (Home search error) occurs and home search operation ends. Therefore, adjust the mechanical system for step 3 to always start from inactive state with a stable encoder Z-phase signal (ECZ).

② If the limit signal in the search direction is already active before Step 3 starts, a limit error occurs and home search operation ends.

③ If the limit signal in the search direction is activated during execution of step3, a limit error occurs and home search operation ends.

6.2.1.4 Step 4: High-speed Offset Drive

In step4, at the speed of home search high speed (Speed4 in speed settings tab, see chapter 4.3.2), drive pulses set in home search offset (see chapter 4.3.3.8) are output in the specified direction. This is used when the user wants to move the axis from mechanical home position to operational home position.

[Note]

- While automatic home search is running, software limit is invalid even though set.
- The settings of Speed4 is also applied to the acceleration/deceleration mode, start speed and acceleration/deceleration time of home search high speed.
- As the home search low speed must be lower than the start speed of Speed4, acceleration/deceleration mode of Speed4 is recommended the normal trapezoidal acceleration/deceleration (Trapezoid2) due to settable the start speed.

6.2.2. The Setting Items for Automatic Home Search

The settings for automatic home search can be configured by each settings tab. In Home Search Mode settings tab (see chapter 4.3.4), Sensor Signal, Home Signal Level, ECZ Signal Level, Step1~4 Operation and Position Clear can be set. In Speed Settings tab (see chapter 4.3.2), the speed of home search high speed can be set in Speed4. In Parameter Settings tab (see chapter 4.3.3), the speed of home search low speed and moving distance of home search offset can be set.
And when a limit signal is used as a sensor signal, limit stop mode and active level must be set in Mode Settings tab (see chapter 4.3.1).

Tab	Display	Option / Range	Default
Home Search Mode	Sensor Signal	Home / Limit *1	Home
	Home Signal Level	Low (GEX Short-circuited) / High (Open)	Low
	Z Signal Level	Low (GEX Short-circuited) / High (Open)	Low
	Step1～4 Enable	Disable (non-execution) / Enable (execution)	Disable
	Step1～3 Direction	＋ / －	Step1,2 : - Step 3 : +
	Position Clear	Disable / Enable	Enable
Mode	Hardware Limit Stop Mode	Instant / Slow *2	Instant
	Hardware Limit Active Level	Low (GEX Short-circuited) / High (Open)	Low
Speed [Speed4]	Mode	Constant / Trapezoid1 / Trapezoid2 / Trapezoid3 / S-Curve1 / S-Curve2	Trapezoid2
	Start Speed	1 ～ 500000 [pps]	4000
	Drive Speed	1 ～ 500000 [pps]	40000
	Acceleration Time	1 ～ 10000 [msec]	500
	Deceleration Time	1 ～ 10000 [msec]	(Blank)
Parameter	Home Search Low Speed	1 ～ 500000 [pps]	4000
	Home Search Offset	-2147483646 ～ 2147483646	100

*1 : When Limit signal is selected, the limit signal in the search direction of each step at step1, 2 will be a sensor signal.
*2 : When Limit signal is selected, set to Slow.

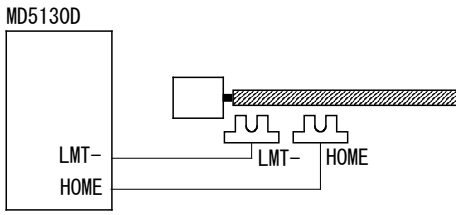
6.2.3. Automatic Home Search Operation and Setting Example

6.2.3.1 Example of Home search using a home signal

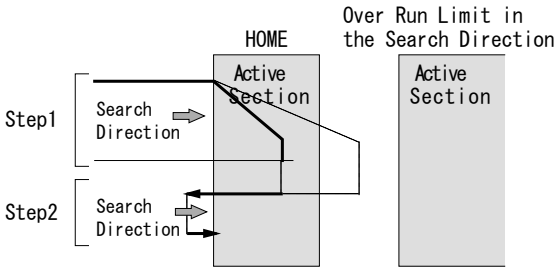
This is the example to perform a home search by setting Home signal to the detection signal for high-speed and low-speed home search.

[Operation Example]

	Input signal and Signal level	Search direction	Search speed
Step1	HOME signal, Low (GEX Short-circuited)	－ direction	40,000pps
Step2	HOME signal, Low (GEX Short-circuited)	－ direction	4,000pps
Step3	Non-execution		
Step4	3500 pulses Offset driving in＋ direction	＋ direction	40,000pps



As shown in the table above, set the same signal level and search direction to step 1 and step 2.
In Step1, it drives up to the home at high-speed (40,000pps) in the – direction. When the home signal becomes active, it performs decelerating stop.
In Step2, if the stop position is within the home signal active section, it escapes from the home signal active section in the opposite direction, and then detects a home signal and stops.
In Step4, it performs offset driving in the + direction and then a home search is finished.



[Note]

- Make sure to set an over run limit ahead of detection direction and connect the signal to the limit input (LMT+/-).
- Set the same search direction to step 1 and step 2 because the same signal is used.

Follow the settings below to perform the operation above.

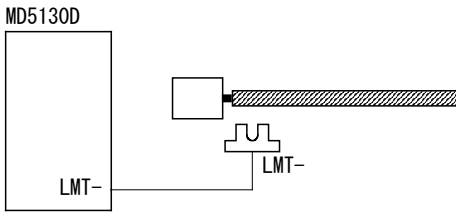
Tab	Item		Setting Value	Remark
Home Search Mode	Sensor Signal	Sensor signal for searching	Home	
	Home Signal Level	Active logical level for HOME	Low	GEX Short-circuited
	Z Signal Level	Active logical level for encoder Z-phase (ECZ)	Low	Not used
	Step1 Enable	Step1 non-execution / execution	Enable	Execution
	Step1 Direction	Step1 search direction	－	－direction
	Step2 Enable	Step2 non-execution / execution	Enable	Execution
	Step2 Direction	Step2 search direction	－	－direction
	Step3 Enable	Step3 non-execution / execution	Disable	Not used
	Step3 Direction	Step3 search direction	－	
	Step4 Enable	Step4 non-execution / execution	Enable	Execution
	Position Clear	Position counter clear	Enable	Position counter clear after finishing home search.
	Mode	Acceleration /deceleration mode	trapezoidal 2	Mode can specify start speed.
	Start Speed	Start speed	4,000	Start speed for trapezoidal driving.
	Drive Speed	Drive speed	40,000	Home search high speed
	Acceleration Time	Acceleration time	500	

Parameter	Home Search Low Speed	Speed at home search low speed	4,000	Set the smaller value than start speed
	Home Search Offset	Moving distance of home search offset	3,500	Positive value drives in + direction and negative value drives in – direction

6.2.3.2 Example of Home search using a limit signal

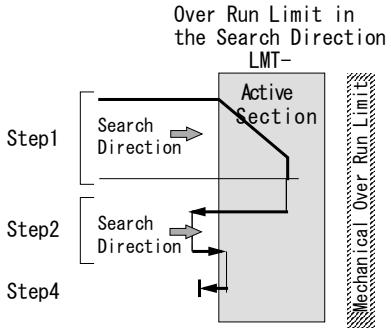
For a simple home search, the limit signal of one side is used as an alternative to a home signal. However, the following two conditions must be applied.

① When high-speed search operation is performed, decelerating stop can sufficiently be performed within the distance from limit signal activation position to mechanical limit position.
② Home search position is not beyond the limit signal active section in the search direction



[Operation Example]

	Input signal and Signal level	Search direction	Search speed
Step1	Limit signal, Low (GEX Short-circuited)	－ direction	10,000pps
Step2	Limit signal, Low (GEX Short-circuited)	－ direction	200pps
Step3	Non-execution		
Step4	500 pulses offset driving in＋direction	＋ direction	10,000pps



As shown in the table above, set the same signal level and search direction to step 1 and step 2.
In Step1, it drives up to the limit at high-speed (10,000pps) in the – direction, and when the -limit signal becomes active, it performs decelerating stop.
In Step2, if the stop position is within the home signal active section, it escapes from the limit active section in the opposite direction, and then detects a limit signal and stops.
In Step4, it performs offset driving in the + direction and then a home search is finished.

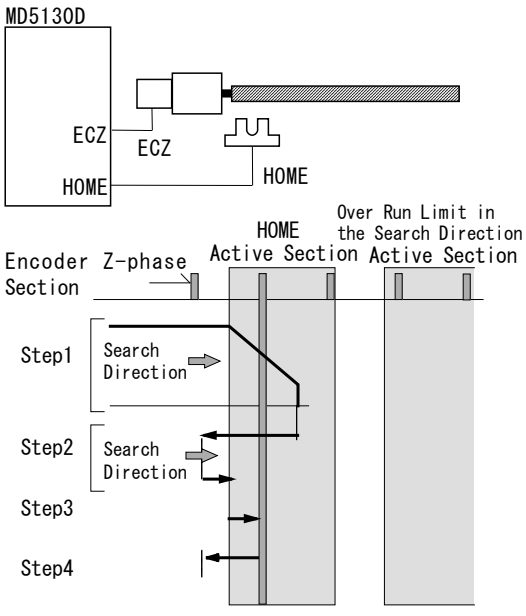
[Note]

- Set the same search direction to step 1 and step 2.
- Step 4 must be enabled. Perform offset driving in the opposite direction of step 1, 2, and escape the limit, and then finish a home search.
- When executing Step 3, set the search direction to the opposite direction of step 1, 2.
- Set the limit stop mode to decelerating stop.

Tab	Item		Setting Value	Remark
Home Search Mode	Sensor Signal	Sensor signal for searching	Limit	
	Home Signal Level	Active logical level for HOME	Low	Not used
	Z Signal Level	Active logical level for encoder Z-phase (ECZ)	Low	Not used
	Step1 Enable	Step1 non-execution / execution	Enable	Execution
	Step1 Direction	Step1 search direction	−	−direction
	Step2 Enable	Step2 non-execution / execution	Enable	Execution
	Step2 Direction	Step2 search direction	−	−direction
	Step3 Enable	Step3 non-execution / execution	Disable	Non-Execution
	Step3 Direction	Step3 search direction	−	
	Step4 Enable	Step4 non-execution / execution	Enable	Execution (Escape from the limit)
	Position Clear	Position counter clear	Enable	Position counter clear after finishing home search.
Mode	Hardware Limit Stop Mode	Stop mode by hardware limit signal.	Slow	Selects a decelerating stop.
	Hardware Limit Active Level	Logical level for active	Low	GEX Short-circuited
Speed [Speed4]	Mode	Acceleration /deceleration mode	trapezoidal 2	Mode can specify start speed.
	Start Speed	Start speed	200	Start speed for trapezoidal driving.
	Drive Speed	Drive speed	10,000	Home search high speed
	Acceleration Time	Acceleration time	500	
Parameter	Home Search Low Speed	Speed at home search low speed	200	Set the smaller value than start speed
	Home Search Offset	Moving distance of home search offset	500	Positive value drives in + direction and negative value drives in – direction

6.2.3.3 Example of Home search using an encoder Z-phase signal

This is the example to perform a home search with high accuracy using an encoder Z-phase signal. Adjust the mechanical system for step 3 to always start from inactive state with a stable encoder Z-phase signal (ECZ).



[Operation Example]

	Input signal and Signal level	Search direction	Search speed
Step1	HOME signal, Low (GEX Short-circuited)	− direction	20,000pps
Step2	HOME signal, Low (GEX Short-circuited)	− direction	500pps
Step3	ECZ signal, Low (GEX Short-circuited)	− direction	500pps
Step4	500 pulses Offset driving in＋direction	＋ direction	20,000pps

As for operations at step 1 and step 2, it is the same as those in chapter 6.2.3.1 Example of Home search using a home signal. In step3, search of an encoder Z-phase signal (ECZ) is performed at home

search low speed in the – direction, and when detected, the operation stops immediately.
In Step4, it performs offset driving in the + direction and then a home search is finished.

[Note]

- When a limit signal is used as a detection signal of step 1 and 2, set the search direction of step 3 (encoder Z-phase search) must be set in the opposite direction of step 1 and 2.

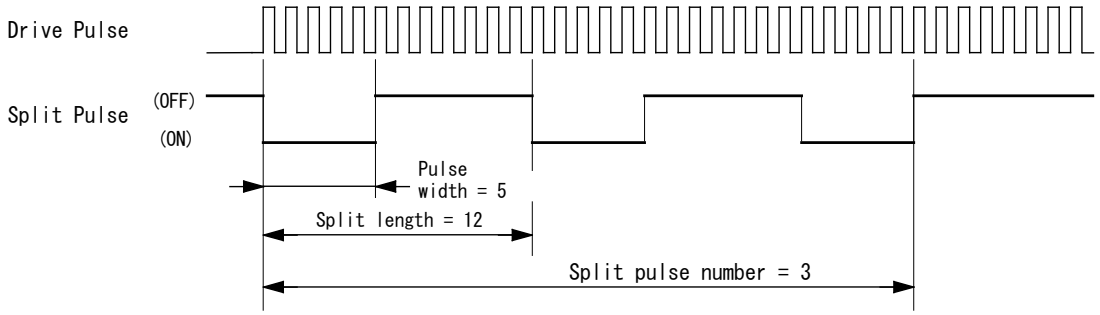
Tab	Item		Setting Value	Remark
Home Search Mode	Sensor Signal	Sensor signal for searching	Home	
	Home Signal Level	Active logical level for HOME	Low	GEX Short-circuited
	Z Signal Level	Active logical level for encoder Z-phase (ECZ)	Low	Not used
	Step1 Enable	Step1 non-execution / execution	Enable	Execution
	Step1 Direction	Step1 search direction	－	－direction
	Step2 Enable	Step2 non-execution / execution	Enable	Execution
	Step2 Direction	Step2 search direction	－	－direction
	Step3 Enable	Step3 non-execution / execution	Enable	Execution
	Step3 Direction	Step3 search direction	－	－direction
	Step4 Enable	Step4 non-execution / execution	Enable	Execution
	Position Clear	Position counter clear	Enable	Position counter clear after finishing home search.
Speed [Speed4]	Mode	Acceleration /deceleration mode	trapezoidal 2	Mode can specify start speed.
	Start Speed	Start speed	500	Start speed for trapezoidal driving.
	Drive Speed	Drive speed	20,000	Home search high speed
	Acceleration Time	Acceleration time	500	
Parameter	Home Search Low Speed	Speed at home search low speed	500	Set the smaller value than start speed
	Home Search Offset	Moving distance of home search offset	3500	Positive value drives in + direction and negative value drives in – direction

6.3. Split Pulse

6.3.1. The Description of Split Pulse

Split pulse is a function that outputs pulses which is synchronized with drive pulses (see chapter 6.1) during operation of a motor. This is useful for when the user wants to perform the other operations at regular pulse intervals, synchronizing with rotation of a motor and axis driving. In MD5130D and MD5230D, the user can register 4 patterns of the split pulse setting, the pulse width of a split pulse, split length (cycle) and split pulse number (see chapter 4.3.5).
Split pulses are output from SPLTP (#16 pin in CN4 connector, see chapter 7.4) of a sensor connector.

As the split pulse is output in synchronization with the drive pulse, the user can output the pulse at regular intervals with respect to the position even during acceleration / deceleration driving.



6.3.1.1 Start of Split Pulse

Split pulse is started by Jog operation window (see chapter 4.2.5) in MD Operation Tool or Split pulse start command (SSP, see chapter 5.2.2).
If the start of split pulse is commanded before starting the drive, it starts to output the split pulse together with the start of driving.

6.3.1.2 Stop of Split Pulse

After the split pulse completes to output the number of pulse count specified by Split pulse settings tab, it is stopped. Also it can be stopped by Jog operation window (see chapter 4.2.5) in MD Operation Tool or Split pulse stop command (PST, see chapter 5.2.2).
As the split pulse is output together with the drive pulse, when driving stops, the split pulse is also stopped. If driving is stopped during execution of a user program, it cannot resume to output from where the split pulse was stopped.

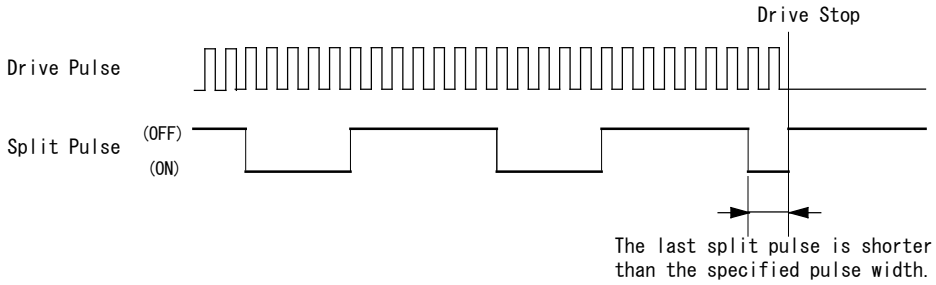
6.3.1.3 Stop Timing of Split Pulse

When Split pulse stop command is issued:

When the split pulse is ON at the issue of stop command, the split pulse is stopped after completing to output the ON width of pulse width specified in Split pulse settings tab.

When driving is stopped:

The split pulse becomes OFF on the way at the timing that driving is stopped.



6.3.2. Split Pulse Setting Items

Split pulse settings can be configured in Split pulse settings tab in Configuration window (see chapter 4.3.5).
In Split pulse settings tab, it can register 4 patterns of the split pulse setting; each can set the pulse width of a split pulse, split length (cycle) and split pulse number.

[Note]

- The setting of pulse scale (see chapter 4.3.3.4) is not applied to each setting value of split pulse.
- Even when setting Pulse Scale Numeration and Denomination, each setting value of split pulse must be set in a unit of drive pulse.
- The actual output of split pulses is delayed about 2~4msec due to the time for command processing during execution of a program.

Tab	Display	Range	Default
Split Pulse	Split Length	2～65535	Split Pulse 1 : 10 Split Pulse 2 : 20 Split Pulse 3 : 1000 Split Pulse 4 : 10000
	Pulse Width	1～65534	Split Pulse 1 : 5 Split Pulse 2 : 10 Split Pulse 3 : 500 Split Pulse 4 : 5000
	Pulse Count	1～65535 or 0 (infinite)	Split Pulse 1 : 0 Split Pulse 2 : 0 Split Pulse 3 : 10 Split Pulse 4 : 10

6.3.3. Setting Example of Split Pulse

The following are the example using the split pulse.

6.3.3.1 Example of output split pulses by predetermined rotation angle

When step resolution is 20, it outputs split pulses of 9 degrees every 45 degrees rotation angle of an axis.
It uses user program function and starts to output the split pulse together with the start of driving, and the split pulse is stopped by the stop of driving.

Split length and pulse width are calculated as follows.
When step resolution is 20, the rotation angle per pulse of drive pulse is 0.72/20=0.036° .

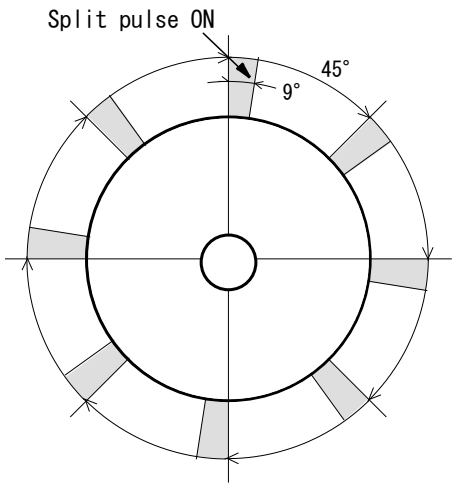
- Split length: When the rotation angle is 45 degrees, the drive pulse number is 45/0.036 = 1250 pulses.
- Pulse width: When the rotation angle is 9 degrees, the drive pulse number is 9/0.036 = 250 pulses.

[Split Pulse Setting]
Set Split Pulse1.

Tab	Setting Item	Value
Split Pulse	Split Length	1250
	Pulse Width	250
	Pulse Count	0 (infinite)

[Speed Setting]
Set Speed1.

Tab	Setting Item	Value
Speed	Mode	Constant
	Drive Speed	2000



Setting Example of Split Pulse

[User Program]

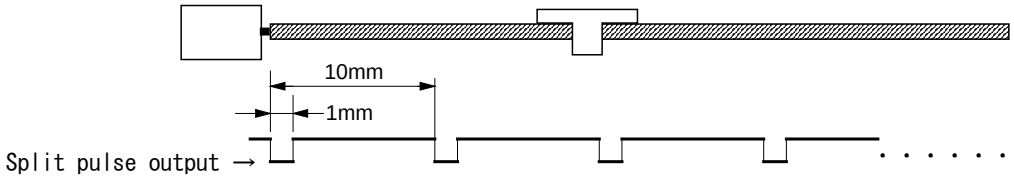
Label	Cmd	Data	Speed	Timer	EndP	Remark
P01	SSP	1				Before starting the drive, split pulse start command is issued.
	INC	10000	1	0	OFF	Driving starts. → Split pulse is started.
	END					

6.3.3.2 Example of output split pulses by predetermined axis driving

When the lead of a ball screw is 2mm, with the setting of step resolution: 20, split pulses are output for the time of 1mm axis driving every 10mm. Using the user program function, it starts to output the split pulse together with the start of driving.
And it stops driving and outputting the split pulse at the 100mm of axis driving.

Split length and pulse width are calculated as follows.
When step resolution is 20 and the lead of a ball screw is 2mm, the moving distance of 1 pulse of drive pulse is 2/500/20=0.0002mm.

- Split length: The drive pulse number of 10mm of axis driving is 10/0.0002 = 50000 pulses.
- Pulse width: The drive pulse number of 1mm of axis driving is 1/0.0002 = 5000 pulses.



[Split Pulse Setting]
Set Split Pulse2.

Tab	Setting Item	Value
Split Pulse	Split Length	50000
	Pulse Width	5000
	Pulse Count	0 (infinite)

[Speed Setting]
Set Speed2.

Tab	Setting Item	Value
Speed	Mode	Constant
	Drive Speed	3000

[User Program]

Label	Cmd	Data	Speed	Timer	EndP	Remark
P01	SSP	2				Before starting the drive, split pulse start command is issued.
	INC	500000	2	0	OFF	Driving starts. → Split pulse is started.
	END					

6.4. Step Out Detection Function

6.4.1 The Description of Step Out Detection Function

Step out detection is the function that monitors the information difference between the real position from an encoder input signal (pulse conversion value of real position) and the logical position from the drive pulse to rotate a motor, and if its difference exceeds a specified value (Step Out Differential), it will be a step out error and stop motor rotation.

To use the step out detection function, the following 4 settings are required.

- Set the encoder scale numerator and denominator (see chapter 4.3.3.5) to match the logical position count value per rotation and the pulse conversion value of real position.
- Set the difference between the logical position count value and the pulse conversion value of real position which detects a step out error as the step out differential (see chapter 4.3.3.6).
- Set the step out detecting timing for a step out error. The user can select either "**Drive End**" that detects it at the end of driving or "**While Drive**" that always detects it every 10ms cycle during motor rotation.
- Enable the step out detection function.

6.4.2 Step Out Detection Function Setting Items

Tab	Display	Option / Range	Default
Parameter	Step Out Differential	1～65535	100
	Encoder Scale Numeration (numerator)	1～65535	1000
	Encoder Scale Denomination (denominator)	1～65535	200
Mode	Step Out Detection	Disable / Enable	Disable
	Step Out Detecting Timing	Drive End / While Drive	Drive End

6.4.3 Setting Example of Step Out Detection Function

The setting example of step out detection function under the conditions below is as follows.

- Pulse number of an encoder per rotation: 500 pulses
- Step resolution : 20
- Step out detecting timing : While Drive

(1) Setting of the encoder scale numerator and denominator

To match the two of count values an encoder and logical position, set the encoder scale numerator and denominator (see chapter 4.3.3.5).

$$\frac{\text{Encoder Scale Numerator}}{\text{Encoder Scale Denominator}} = \frac{500 \times \text{Step Resolution}}{\text{Encoder Pulse Number per Rotation}} \times 4 = \frac{500 \times 20}{500 \times 4} = \frac{10000}{2000}$$

(2) Calculation of step out differential

Use the formula below to determine the recommended value of step out differential (see chapter 4.3.3.6).

$$\text{Step Out Differential} \geqq \frac{500 \times \text{Step Resolution}}{\text{Encoder Pulse Number per Rotation}} \times 4 \geqq \frac{500 \times 20}{500} \times 4 \geqq 80$$

(3) Setting of step out detection function

Based on the above results of the calculation, set each item for the step out detection function as shown below.

Tab	Display	Value
Parameter	Step Out Differential	80
	Encoder Scale Numeration (numerator)	10000
	Encoder Scale Denomination (denominator)	2000
Mode	Step Out Detection	Enable
	Step Out Detecting Timing	While Drive

6.4.1. How to Release Step Out Error

If a step out error occurs, release the MD5130D/5230D error state.
To release the error state, click “Controller Reset” button in the right bottom of Main window in MD51_52 Operation Tool or input Low (GEX Short-circuited) to RESET signal of the #1 pin in CN3 connector.
After the step out error is released and step out factor is cleared, perform the operation to return from abnormal state, such as execution of automatic home search. If the step out error occurs frequently after returning from the error, check the items in the table below.

Item	Contents
Is the encoder scale setting correct?	When the setting value of step resolution differs from the value counted by quad edge evaluation of the pulse number per rotation, set the encoder scale settings correctly, and the position deviation can be properly detected for step out detection. For more details of the encoder scale settings, see chapter 4.3.3.5. If the encoder scale is not correctly set, the step out error will occur.
Is the value of step out differential too small?	When the value of step out differential is too small, the step out error occurs. In case of the encoder of which the pulse number per rotation is 500, it is recommended to set the value 4 times or more than the value of step resolution.
Is the speed setting appropriate?	When the rotating speed is too fast or the speed rapidly changed, the stepper motor causes step out. Confirm the value of drive speed, start speed and acceleration/ deceleration time are appropriate.
Is the motor current appropriate?	When the motor current (Run current) is too small, the torque decreases and it causes step out. The value of Run current (see chapter 4.3.1.1) must be set appropriately within the range of rating of a motor
Is the load to the axis appropriate?	When the load to the motor axis is too large, the stepper motor causes step out. Confirm the load to the motor axis is appropriate.
Are the encoder and motor axis fixed firmly?	If the encoder is not fixed firmly to the motor axis, such the case that the coupling of the rotary encoder to be fixed to the motor axis is loose, the deviation is generated between the information of a specified position and real position from the encoder, and a step out error occurs.

[Note]

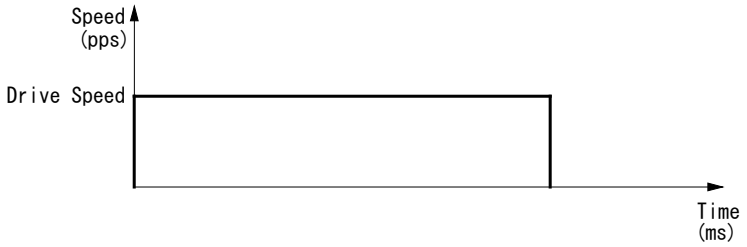
- While automatic home search is executed, step out detection does not function even when enabled.
- When step resolution is changed, be sure to modify the value of the encoder scale setting appropriately.
- When a step out error already occurs, motor rotation (driving) and automatic home search cannot be started and configuration settings cannot be downloaded.
- The setting of pulse scale (see chapter 4.3.3.4) is not applied to the setting value of Step Out Differential.

6.5. Speed Setting

MD5130D and MD5230D can perform constant speed driving, trapezoidal acceleration/deceleration driving, non-symmetry trapezoidal acceleration/deceleration driving and S-curve acceleration/deceleration driving. In addition, for trapezoidal and S-curve acceleration/deceleration driving, a simple mode is available that does not require a start speed setting, where the start speed is automatically calculated.
The user can register 4 patterns of the speed setting.

6.5.1. Constant Speed Driving

Constant speed driving outputs drive pulses at a specified speed from the start to the end of driving without acceleration/deceleration.



Constant Speed Driving

The settings to perform constant speed driving are as follows.

Display	Option / Range	Contents
Mode	Constant	Select [Constant].
Drive Speed	1 ～ 500,000 [pps]	Set drive speed.

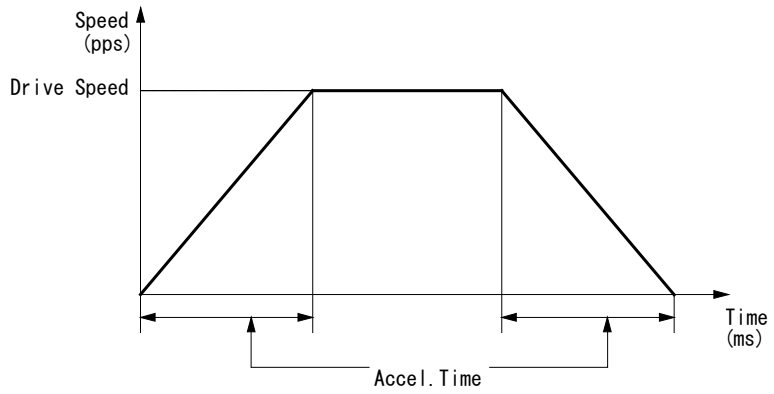
6.5.2. Trapezoidal Acceleration/Deceleration Driving (Trapezoid1, Trapezoid2, Trapezoid3)

3 types of trapezoidal acceleration/deceleration driving are provided: Trapezoid1 is simple trapezoidal acceleration/deceleration driving that does not require a start speed setting, Trapezoid2 is normal trapezoidal acceleration/deceleration driving and Trapezoid3 is non-symmetry trapezoidal acceleration/deceleration driving. Trapezoid1 and Trapezoid2 accelerate up to a specified drive speed at a specified acceleration time and decelerate at the same time. Trapezoid3 can use different time from the acceleration time as the deceleration time at deceleration.

In trapezoidal acceleration/deceleration driving, when the specified moving distance does not reach the drive speed, the triangle form prevention function (see chapter 6.6) works to prevent the speed from rapidly changing from acceleration to deceleration.

6.5.2.1 Simple Trapezoidal Acceleration/Deceleration Driving (Trapezoid1)

Simple trapezoidal acceleration/deceleration driving is trapezoidal acceleration/deceleration driving where the acceleration and deceleration time is equal. The setting of start speed is not required but automatically calculated.
This accelerates from the start of driving to the drive speed at a specified acceleration time and decelerates at the same time, then stops.



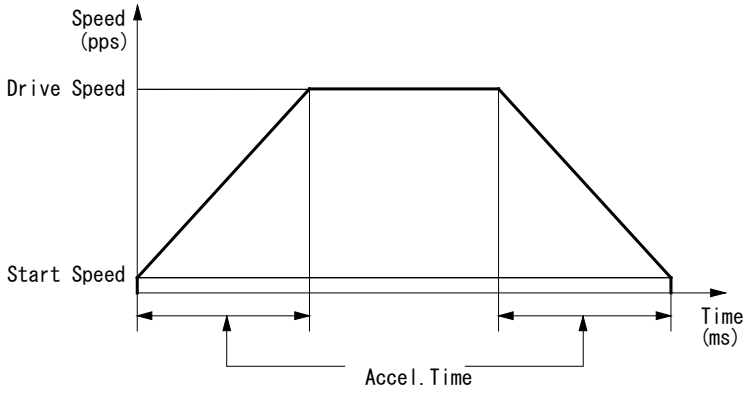
Simple Trapezoidal Acceleration/Deceleration Driving (Trapezoid1)

The settings to perform simple trapezoidal acceleration/deceleration driving are as follows.

Display	Option / Range	Contents
Mode	Trapezoid1	Select [Trapezoid1].
Drive Speed	1 ～ 500,000 [pps]	Set drive speed.
Acceleration Time	1 ～ 10,000 [msec]	Set acceleration time.

6.5.2.2 Normal Trapezoidal Acceleration/Deceleration Driving (Trapezoid2)

Normal trapezoidal acceleration/deceleration driving is trapezoidal acceleration/deceleration driving needs to set a start speed, where the acceleration and deceleration time is equal.



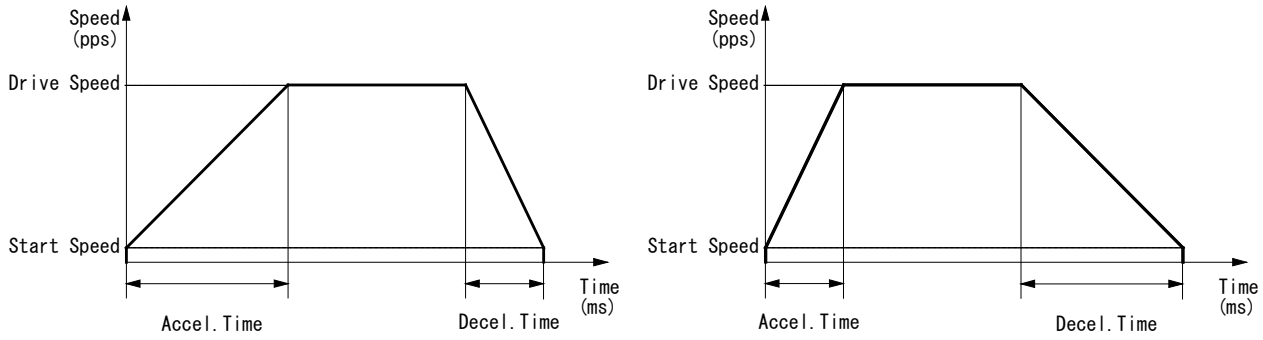
Normal Trapezoidal Acceleration/Deceleration Driving (Trapezoid2)

The settings to perform normal trapezoidal acceleration/deceleration driving are as follows.

Display	Option / Range	Contents
Mode	Trapezoid2	Select [Trapezoid2].
Start Speed	1 ～ 500,000 [pps]	Set start speed.
Drive Speed	1 ～ 500,000 [pps]	Set drive speed.
Acceleration Time	1 ～ 10,000 [msec]	Set acceleration time.

6.5.2.3 Non-symmetry Trapezoidal Acceleration/Deceleration Driving (Trapezoid3)

Non-symmetry trapezoidal acceleration/deceleration driving is trapezoidal acceleration/deceleration driving that the acceleration and deceleration time is different. For example, this mode is useful such as when the user needs to change acceleration and deceleration of up-and down movement because gravity acceleration is applied to the object in the operation of vertical direction.



Non-Symmetry Trapezoidal Acceleration/Deceleration Driving (Trapezoid3)

The settings to perform non-symmetry trapezoidal acceleration/deceleration driving are as follows.

Display	Option / Range	Contents
Mode	Trapezoid3	Select [Trapezoid3].
Start Speed	1 ～ 500,000 [pps]	Set start speed.
Drive Speed	1 ～ 500,000 [pps]	Set drive speed.
Acceleration Time	1 ～ 10,000 [msec]	Set acceleration time.
Deceleration Time	1 ～ 10,000 [msec]	Set deceleration time.

[Note]

- In non-symmetry linear acceleration/deceleration driving, when acceleration time < deceleration time, the following condition is applied to the ratio of acceleration time and deceleration time.

$$td < ta \times \frac{8 \times 10^6}{DV}$$

td : Deceleration time (msec)
ta : Acceleration time (msec)
DV : Drive speed (pps)

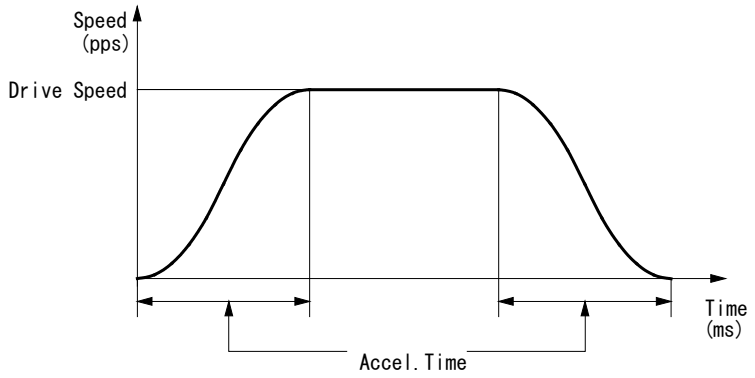
  For example, when the drive speed is 100kpps, deceleration time must be smaller value than 80 times of acceleration time, and cannot be larger than 80 times.
- In non-symmetry linear acceleration/deceleration driving, when acceleration time > deceleration time, the greater the ratio of acceleration time to deceleration time becomes, the greater the creep phenomenon becomes. (the maximum of about 10 pulses when deceleration time / acceleration time = 10 times.) If the creep phenomenon becomes the problem, please handle it by such as increasing the start speed which suppresses the creep.

6.5.3. S-curve Acceleration/Deceleration Driving (S-curve1, S-curve2)

2 types of S-curve acceleration/deceleration driving are provided: S-curve1 is simple S-curve acceleration/deceleration driving that does not require a start speed setting and S-curve2 is normal S-curve acceleration/deceleration driving. S-curve1 and S-curve2 accelerate up to a specified drive speed with a smooth curve that forms a secondary parabolic curve at a specified acceleration time and decelerates with the same curve at the same time, then stops.
In positioning driving of S-curve acceleration/deceleration, when the specified moving distance does not reach the drive speed or when decelerating stop is performed during S-curve acceleration, the triangle form prevention function (see chapter 6.6) works to prevent the speed from rapidly changing from acceleration to deceleration.

6.5.3.1 Simple S-curve Acceleration/Deceleration Driving (S-curve1)

Simple S-curve acceleration/deceleration driving is S-curve acceleration/deceleration driving that does not require a start speed setting, which is automatically calculated.



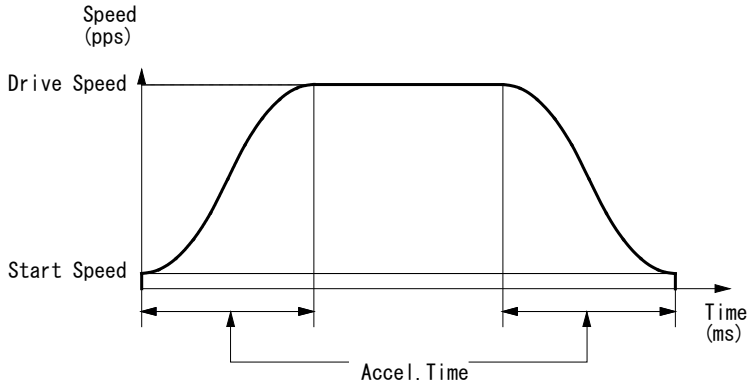
Simple S-Curve Acceleration/Deceleration Driving (S-Curve1)

The settings to perform simple S-curve acceleration/deceleration driving are as follows.

Display	Option / Range	Contents
Mode	S-Curve1	Select [S-curve1].
Drive Speed	1 ～ 500,000 [pps]	Set drive speed.
Acceleration Time	1 ～ 10,000 [msec]	Set acceleration time.

Normal S-curve Acceleration/Deceleration Driving (S-curve2)

Normal S-curve acceleration/deceleration driving is S-curve acceleration/deceleration driving needs to set a start speed.



Normal S-Curve Acceleration/Deceleration Driving (S-Curve2)

The settings to perform normal S-curve acceleration/deceleration driving are as follows.

Display	Option / Range	Contents
Mode	S-Curve2	Select [S-curve2].
Start Speed	1 ～ 500,000 [pps]	Set start speed.
Drive Speed	1 ～ 500,000 [pps]	Set drive speed.
Acceleration Time	1 ～ 10,000 [msec]	Set acceleration time.

6.5.4. Setting Items for Speed Control

The speed setting can be registered up to 4 patterns, which can be set in Speed settings tab (see chapter 4.3.2) in Configuration window. The user selects acceleration/deceleration mode to each Speed1~4, and sets necessary parameters.

Speed Settings	constant speed	simple trapezoid (Trapezoid1)	normal trapezoid (Trapezoid2)	non-symmetry trapezoid (Trapezoid3)	simple S-curve (S-Curve1)	normal S-curve (S-Curve2)
Mode acceleration/deceleration mode	Constant	Trapezoid1	Trapezoid2	Trapezoid3	S-Curve1	S-Curve2
Start Speed	–	–	○	○	–	○
Drive Speed	○	○	○	○	○	○
Acceleration Time	–	○	○	○	○	○
Deceleration Time	–	–	–	○	–	–

* ○: Required, －: Not required

6.5.5. Motor Rotation Speed

The unit of speed is PPS (drive pulse per second) based on drive pulses sent from the MD5130D and MD5230D. To express as motor rotation speed Vr (rpm, rotation number per minute), use the following formula.

$$Vr\,(rpm) = \frac{0.12}{Dms} \times Vd$$

Vd : Drive speed (PPS)
Dms : Step resolution

Step resolution is set to 20 by factory default, so when the drive speed is set to 10kpps, the motor rotates by 60rpm.

6.5.6. Notes on Speed Settings

- When the speed or acceleration of motor rotation is too high with respect to motor performance or load, it may cause step out. So the speed and acceleration time must be set to the appropriate value the system can handle.
- In S-curve acceleration/deceleration driving, when the acceleration time is lower than 43msec and if the drive speed is too high, the acceleration time may be adjusted forcibly.
- In simple trapezoidal acceleration/deceleration driving (Trapezoid1) and simple S-curve acceleration/deceleration driving (S-curve1) that automatically set a start speed, the acceleration time may differ from the setting value of acceleration time. To surely set the acceleration time, use the mode that can set the start speed.

6.5.7. Regarding Speed Change during Motor Rotation

- In Continuous driving, the speed can be changed by selecting Speed1~4, in this case, keep the mode the same as before. If the mode is S-Curve1 or S-Curve2, the speed can be changed at constant speed area only.
- At the constant mode in Preset driving, the speed can be changed by selecting Speed1~4 during motor rotation.
- In Continuous driving and at the constant mode in Preset driving when selecting Speed5, the speed can be changed by changing the value during motor rotation. If the mode is S-Curve1 or S-Curve2, the speed can be changed at constant speed area only.
- The speed change by a user program during motor rotation can be done by SPD command. However, if the mode is S-Curve1 or S-Curve2, it cannot be changed.

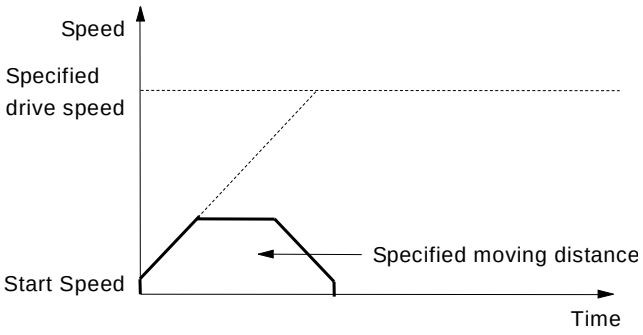
(○ : can change, × : cannot change, △ : cannot change at constant speed area)

Mode	Speed Change during Jog Operation		Speed Change during User Program Operation		
	Continuous	Preset	CNT drive	ABA, ICA commands	Other drive commands
Constant	○	○	○	○	×
Trapezoid1	○	×	○	×	×
Trapezoid2	○	×	○	×	×
Trapezoid3	○	×	○	×	×
S-Curve1	△	×	△	×	×
S-Curve2	△	×	△	×	×

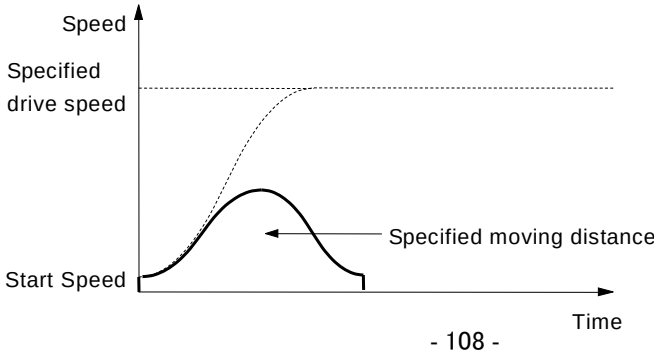
6.6. Triangle Form Prevention Function

When the speed shifts to deceleration during acceleration of motor rotation, vibration and step out likely to occur due to the load on the motor. Triangle form prevention function works to prevent them.

In positioning driving of trapezoidal acceleration/deceleration, when the specified moving distance is too small, the speed does not reach the drive speed, and it makes the constant speed area between acceleration and deceleration in order to prevent the triangle form that caused by starting deceleration instantly in the middle of acceleration.



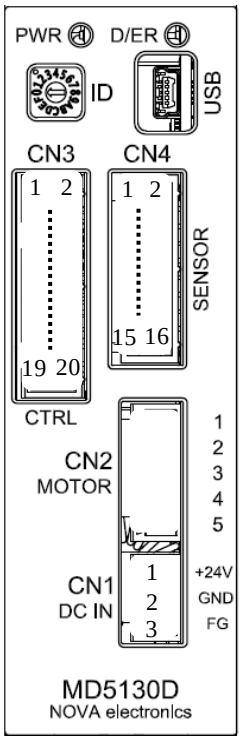
In positioning driving of S-curve acceleration/deceleration, when the specified moving distance is too small, the speed does not reach the drive speed and reduces the maximum speed within the specified moving distance. Thus, it prevents the triangle form and keeps a smooth S-curve from the start to the end of driving.



7. Input/Output Signals

MD5130D and MD5230D each connector position and pin number are shown below. Please be careful not to connect a wrong pin number. Reverse connection of power connector (CN1) or supplying any voltage/current other than specified to each signal may cause the destruction of the internal circuit.

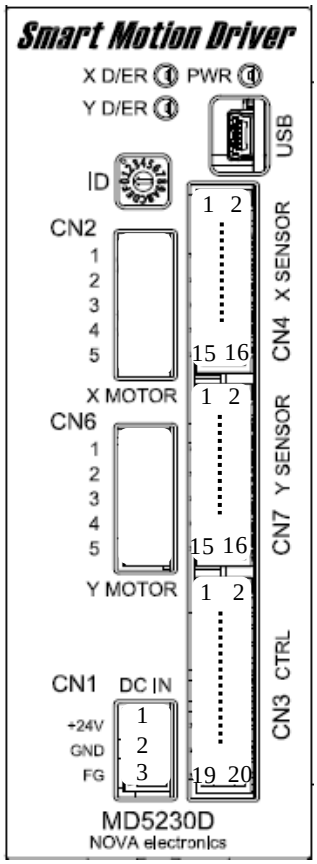
（1）MD5130D



	Connector	Connector Type	Other Side Connector Type
CN1	Power Connector	XW4A-03B1-H1 (OMRON) or equivalent	XW4B-03B1-H1 (OMRON) or equivalent
CN2	Motor Output Connector	XW4A-05B1-H1 (OMRON) or equivalent	XW4B-05B1-H1 (OMRON) or equivalent
CN3	Parallel Control Connector	20P MIL Standard 2.54mm Ribbon Connector	20P MIL Standard 2.54mm Ribbon Connector
CN4	Sensor Input/Output Signal Connector for Axis	16P MIL Standard 2.54mm Ribbon Connector	16P MIL Standard 2.54mm Ribbon Connector
CN5	USB Connector	USB Mini B Connector	Other side of the accessory cable: USB A Connector

[Note]
When you turn the power ON or plug the connector in and out, ensure that the power is OFF and Power indicator goes out.

（2）MD5230D



	Connector	Connector Type	Other Side Connector Type
CN1	Power Connector	XW4A-03B1-H1 (OMRON) or equivalent	XW4B-03B1-H1 (OMRON) or equivalent
CN2	X-axis Motor Output Connector	XW4A-05B1-H1 (OMRON) or equivalent	XW4B-05B1-H1 (OMRON) or equivalent
CN3	Parallel Control Connector	20P MIL Standard 2.54mm Ribbon Connector	20P MIL Standard 2.54mm Ribbon Connector
CN4	X-axis Sensor Input/Output Signal Connector for Axis	16P MIL Standard 2.54mm Ribbon Connector	16P MIL Standard 2.54mm Ribbon Connector
USB (CN5)	USB Connector	USB Mini B Connector	Other side of the accessory cable: USB A Connector
CN6	Y-axis Motor Output Connector	XW4A-05B1-H1 (OMRON) or equivalent	XW4B-05B1-H1 (OMRON) or equivalent
CN7	Y-axis Sensor Input/Output Signal Connector for Axis	16P MIL Standard 2.54mm Ribbon Connector	16P MIL Standard 2.54mm Ribbon Connector

[Note]
When you turn the power ON or plug the connector in and out, ensure that the power is OFF and Power indicator goes out.

7.1. CN1 Power Connector

Connect DC24V power supply.

Pin Number	Signal	Contents
1	+24V	The maximum current consumption of the power depend on the setting of motor driving current. It is about Phase current×2＋0.2 (A).
2	GEX (0V)	
3	FG	Ground it as necessary.

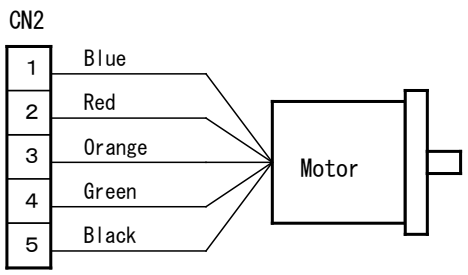
[Note]

- Connect to the terminal in accordance with the polarity.

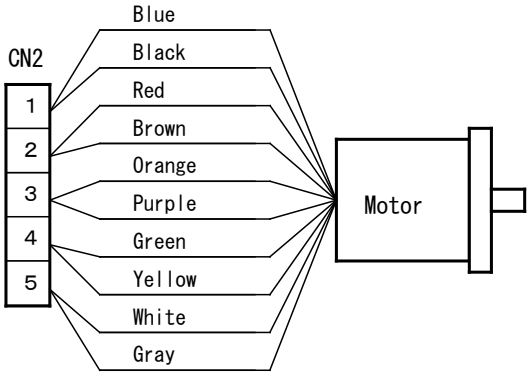
7.2. CN2 Motor Connector

This is the connector to 5-phase stepper motor.
The motor with 5 or 10 leads such as Tamagawa Seiki or Orientalmotor can be applied. Please connect to CN2 connector according to the lead color as shown in the table below.

CN2 Pin Number	Motor lead color with 5 leads	Motor lead color with 10 leads
1	Blue	Blue・Black
2	Red	Red・Brown
3	Orange	Orange・Purple
4	Green	Yellow・Green
5	Black	Gray・White



5 leads Motor Connection Diagram



10 leads Motor Connection Diagram

[Note]

- Ensure that motor leads are correctly connected. Otherwise it may cause damage of the motor and product.
- Wiring from the motor to CN2, twist 5 leads and separate it from other wiring.
- Apparatus or components that easily affected by EMI such as a magnetic sensor must be kept away from motor wiring.
- Shield the motor wiring as necessary.

7.3. CN3 Parallel Control Connector

Connect the parallel control signal to a PLC (Programmable Logic Controller) or mechanical contacts, then the user can control motor rotation by external signals or operate a user program registered in the unit.

7.3.1. Parallel Control Signals

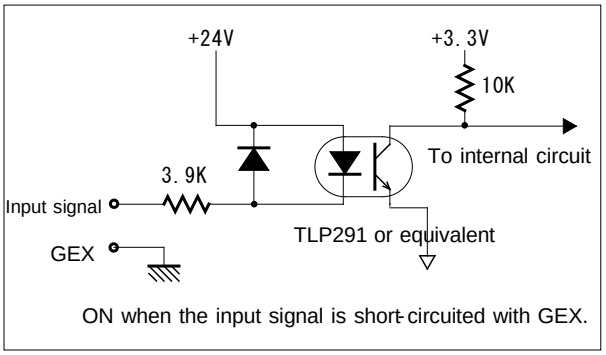
Turning an input signal ON means the signal is short-circuited with GEX by a mechanical contact or open collector output. And turning an output signal ON means the output transistor of an open collector turns ON.

※1 : As MD5130D is only for X axis, it is not necessary axis assignment, and there are not signals for Y axis.

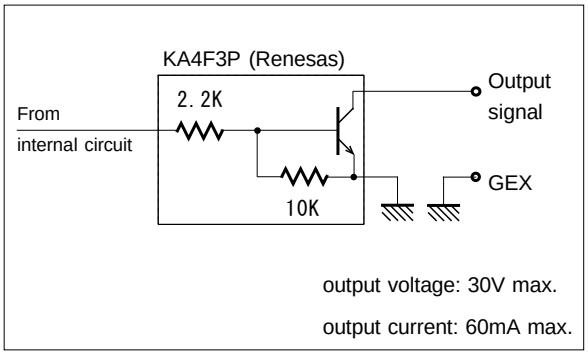
<table>
<tr><th>Pin No.</th><th>Signal</th><th>I/O</th><th colspan="4">Contents</th><th>Circuit</th></tr>
<tr><td>1</td><td>RESET</td><td>Input</td><td colspan="4">Reset :
All the internal operations are reset. It can also be used as an emergency stop signal. Turns ON for 10msec or more.</td><td>A1</td></tr>
<tr><td>2</td><td>HOME</td><td>Input</td><td colspan="4">Automatic home search start strobe :
Turning on starts automatic home search. Turns ON for 10msec or more.</td><td>A1</td></tr>
<tr><td>3</td><td>START</td><td>Input</td><td colspan="4">Program drive start strobe :
In program drive mode, select a program label number and turn this signal ON, and driving starts. Turns ON for 10msec or more.</td><td>A1</td></tr>
<tr><td>4</td><td>STOP (HOFF)</td><td>Input</td><td colspan="4">Motor stop / Program stop (Excitation OFF) :
Turning this signal on during motor rotation or program operation stops a motor and program driving. Turns ON for 10msec or more.
If this signal is turned ON for 3sec or more while stopping a motor and program, motor excitation will be released and keep its state until turned OFF.</td><td>A1</td></tr>
<tr><td>5</td><td>X</td><td rowspan="2">Input</td><td colspan="4" rowspan="2">Axis assignment (※1)
Select the axis when using HOME, START and STOP signals output or specifying a program label number. Turning ON this signal selects the axis.</td><td>—</td></tr>
<tr><td>6</td><td>Y</td><td>—</td></tr>
<tr><td>7</td><td>PSL0 / RUN+ / SCAN+</td><td rowspan="6">Input</td><td>Program 0
/ Run＋ / Scan＋</td><td colspan="3" rowspan="6">・Program driving mode :
Select label number of the program to be executed by PSL0～PSL5 signal.
・Continuous driving mode :
When RUN+ signal is turned ON, a motor rotates in + direction and when RUN- signal is turned ON, it rotates in - direction.
・Scan driving mode :
While SCAN+ signal is turning ON, the motor rotates in + direction and While SCAN- signal is turning ON, it rotates in - direction.
・In Continuous and Scan driving, drive speed can be set by SPD0,1 signals.</td><td rowspan="6">A1</td></tr>
<tr><td>8</td><td>PSL1 / RUN- / SCAN-</td><td>Program 1
/ Run－ / Scan－</td></tr>
<tr><td>9</td><td>PSL2</td><td>Program 2</td></tr>
<tr><td>10</td><td>PSL3</td><td>Program 3</td></tr>
<tr><td>11</td><td>PSL4 / SPD0</td><td>Program 4
/ Drive speed 0</td></tr>
<tr><td>12</td><td>PSL5 / SPD1</td><td>Program 5
/ Drive speed 1</td></tr>
<tr><td rowspan="2">13</td><td rowspan="2">MODE0</td><td rowspan="4">Input</td><td rowspan="2">Driving mode 0</td><td colspan="3">Selects the driving mode.</td><td>A1</td></tr>
<tr><td>MODE1</td><td>MODE0</td><td>Driving mode</td><td rowspan="5"></td></tr>
<tr><td rowspan="2">14</td><td rowspan="2">MODE1</td><td rowspan="3">Driving mode 1</td><td>OFF</td><td>OFF</td><td>—</td></tr>
<tr><td>OFF</td><td>ON</td><td>Scan driving</td></tr>
<tr><td>ON</td><td>OFF</td><td>Continuous driving</td></tr>
<tr><td>15</td><td>XDRIVE / ENDP</td><td>Output</td><td colspan="4">XDRIVE / ENDP : X axis driving / Driving end pulse :
When End pulse is disabled (see chapter 4.3.1.7), it turns ON during motor rotation and turns OFF during motor stop. And turns ON while running automatic home search or a program and turns OFF after the operation is finished.
When End pulse is enabled and after a motor stops, it turns ON for the time specified in end pulse width. Also, after automatic home search is finished, it turns ON for the time specified in end pulse width. While running a user program, it turns ON after the command that enables End pulse is finished.</td><td>B1</td></tr>
</table>

16	–	–	–	–
17	XERROR	Output	X axis Error : Turns ON when the following error occurs. ・User program operation error ・Hard/Software limit error / EMG signal error ・Step out error / automatic home search error This signal can be turned OFF by Reset signal.	B1
18	–	–	–	–
19	GEX		Ground	–
20	VEX		24V Power output (DC24V, under 150mA)	–

Input Signal Circuit A1(CN3 control input signal)



Output Signal Circuit B1(CN3 control output signal)



7.3.2. Operation by Parallel Control Signals

7.3.2.1 Starting Automatic Home Search

In operation by parallel control signals, turning HOME (#2 pin) input signal ON for 10msec or more start automatic home search. Before starting automatic home search, the settings for automatic home search must be configured in MD Operation Tool. For more details of Automatic Home Search, see chapter 6.2.

Setting Item	Input Signal
Driving mode	None (MODE1, 0 regardless of signal designation)
Start signal	HOME (2) = ON : automatic home search start

7.3.2.2 Scan Driving Operation

Scan driving is the function to rotate a motor in the + direction while SCAN+ (#7 pin) input signal is ON and in the – direction while SCAN– (#8 pin) input signal is ON. Drive speed can be selected from Speed1~4 by SPD0, 1 (#11, 12 pins).

Setting Item	Input Signal Setting		
Driving mode	MODE0 (13) = ON MODE1 (14) = OFF		
Speed	Select by SPD0,1 (11,12)		
	SPD1 (12)	SPD0 (11)	Speed
	OFF	OFF	Speed1
	OFF	ON	Speed2
	ON	OFF	Speed3
	ON	ON	Speed4
Motor rotation for +	SCAN+ (7) = ON : Rotation, OFF : Stop		
Motor rotation for -	SCAN- (8) = ON : Rotation, OFF : Stop		

7.3.2.3 Continuous Driving Operation

Continuous driving rotate a motor in the + direction while RUN+ (#7 pin) input signal is ON and in the – direction while RUN– (#8 pin) input signal is ON. It keeps rotating until STOP (#4 pin) input signal turns ON. (When LIMIT input signal in the current direction becomes active, it stops.) Drive speed can be selected from Speed1~4 by SPD0, 1 (#11, 12 pins).

<table>
<tr><th>Setting Item</th><th colspan="3">Input Signal Setting</th></tr>
<tr><td>Driving mode</td><td colspan="3">MODE0 (13) = OFF
MODE1 (14) = ON</td></tr>
<tr><td rowspan="6">Speed</td><td colspan="3">Select by SPD0, 1 (11, 12)</td></tr>
<tr><td>SPD1 (12)</td><td>SPD0 (11)</td><td>Speed</td></tr>
<tr><td>OFF</td><td>OFF</td><td>Speed1</td></tr>
<tr><td>OFF</td><td>ON</td><td>Speed2</td></tr>
<tr><td>ON</td><td>OFF</td><td>Speed3</td></tr>
<tr><td>ON</td><td>ON</td><td>Speed4</td></tr>
<tr><td>Start signal</td><td colspan="3">RUN+ (7) = ON : Start motor rotation in + direction
RUN- (8) = ON : Start motor rotation in - direction</td></tr>
<tr><td>Stop signal</td><td colspan="3">STOP(4) = ON</td></tr>
</table>

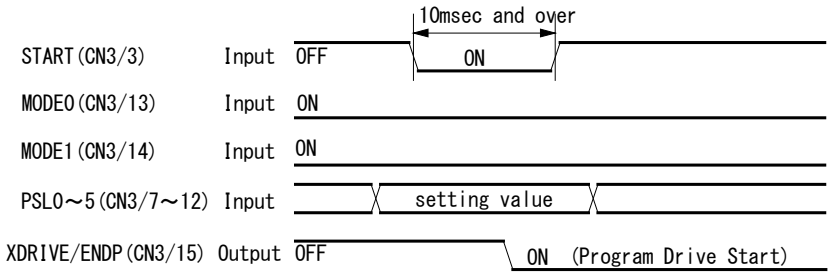
7.3.2.4 Program Driving Operation

Program driving execute a user program registered in the unit. Select the program label number by PSL0~5(#7～12 pins) input signals and then turn START (#3 pin) signal ON, and program driving start. To stop it, turn STOP signal ON. When Stop signal is ON during motor rotation, it stops motor rotation and then stops program driving. For more details of User Program, see chapter 5.

<table>
<tr><th>Setting Item</th><th colspan="7">Input Signal Setting</th></tr>
<tr><td>Driving mode</td><td colspan="7">MODE0 (13) = ON
MODE1 (14) = ON</td></tr>
<tr><td rowspan="20">Label number</td><td colspan="7">Select program number by PSL0～5 (7～12)</td></tr>
<tr><td>Label number</td><td>PSL5
(12)</td><td>PSL4
(11)</td><td>PSL3
(10)</td><td>PSL2
(9)</td><td>PSL1
(8)</td><td>PSL0
(7)</td></tr>
<tr><td>P01</td><td>OFF</td><td>OFF</td><td>OFF</td><td>OFF</td><td>OFF</td><td>OFF</td></tr>
<tr><td>P01</td><td>OFF</td><td>OFF</td><td>OFF</td><td>OFF</td><td>OFF</td><td>ON</td></tr>
<tr><td>P02</td><td>OFF</td><td>OFF</td><td>OFF</td><td>OFF</td><td>ON</td><td>OFF</td></tr>
<tr><td>P03</td><td>OFF</td><td>OFF</td><td>OFF</td><td>OFF</td><td>ON</td><td>ON</td></tr>
<tr><td>:</td><td>:</td><td>:</td><td>:</td><td>:</td><td>:</td><td>:</td></tr>
<tr><td>P14</td><td>OFF</td><td>OFF</td><td>ON</td><td>ON</td><td>ON</td><td>OFF</td></tr>
<tr><td>P15</td><td>OFF</td><td>OFF</td><td>ON</td><td>ON</td><td>ON</td><td>ON</td></tr>
<tr><td>P16</td><td>OFF</td><td>ON</td><td>OFF</td><td>OFF</td><td>OFF</td><td>OFF</td></tr>
<tr><td>P17</td><td>OFF</td><td>ON</td><td>OFF</td><td>OFF</td><td>OFF</td><td>ON</td></tr>
<tr><td>:</td><td>:</td><td>:</td><td>:</td><td>:</td><td>:</td><td>:</td></tr>
<tr><td>P61</td><td>ON</td><td>ON</td><td>ON</td><td>ON</td><td>OFF</td><td>ON</td></tr>
<tr><td>P62</td><td>ON</td><td>ON</td><td>ON</td><td>ON</td><td>ON</td><td>OFF</td></tr>
<tr><td>P63</td><td>ON</td><td>ON</td><td>ON</td><td>ON</td><td>ON</td><td>ON</td></tr>
<tr><td>Start signal</td><td colspan="7">START (3) = ON : Program driving start</td></tr>
<tr><td>Stop signal</td><td colspan="7">STOP (4) = ON : Program driving stop</td></tr>
</table>

The following figure shows the example of input/output signal state in program driving. When End pulse is disabled (see chapter 4.3.1.7) in mode tab, and after program driving start, XDRIVE／ENDP (#15 pin) output signal turns ON. And after the end of program driving, it turns OFF.

【MD5230D】



（There are not X(CN3/5), Y(CN3/6) and YDRIVE/END(CN3/16) signals for MD5130D.）

In mode tab, if End pulse is enabled (see chapter 4.3.1.7), and when the command is finished the line that enables End pulse of the running program, XDRIVE/END output signal outputs ON pulses for the time specified in end pulse width.

[Note]

- START signal must be ON for 10msec or more.
- When program driving is interrupted by STOP signal, it cannot resume from the line where the program was stopped.
- Please avoid starting MD Operation Tool during program driving. First stop the program driving, and then start MD Operation Tool.

7.3.2.5 Excitation OFF Operation

Excitation OFF operation breaks the supply current to a motor, which is useful such as when adjusting the position of a motor axis by manual operation. If STOP signal (#4 pin) is turned ON for 3sec or more while stopping a motor and program, motor excitation will be released and keep its state until STOP signal (#4 pin) is turned OFF. If STOP signal (#4 pin) is turned ON while running a motor or program, it will work to stop a motor or program, and even if STOP signal (#4 pin) is turned ON for 3sec or more, motor excitation will not be released. To release motor excitation, turn STOP signal OFF once.

7.4. CN4, CN7 Sensor Connector for Axis

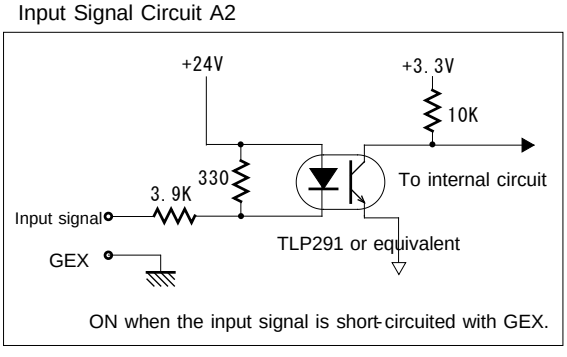
The sensor connector for axis has inputs around the sensor, output of split pulse and general purpose input/output signals. CN4 isInput signal for X-axis CN5 is for Y-axis.

7.4.1. CN4,CN7 Sensor Connector Signals

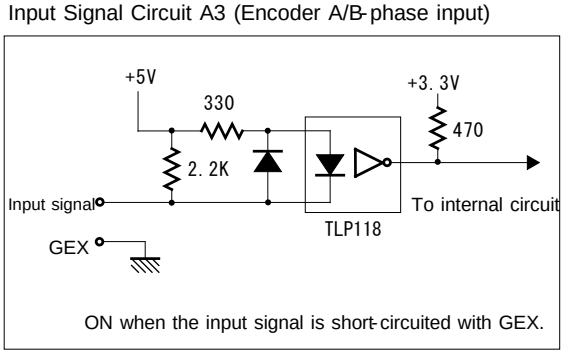
('n' in the table below indicates X or Y-axis.)

Pin No.	Signal	I/O	Contents		Circuit
1	5VEX	—	5V Power output (DC5V, under 200mA) : +5V power output for power sources of encoder, limit sensor, etc.		—
2	nECA	Input	Encoder A-phase	The input signal of encoder quadrature pulses to count the real position. The encoder can be connected to open collector output or line-driver output.	A3
3	nECB		Encoder B-phase		
4	nECZ	Input	Encoder Z-phase : Uses for automatic home search. The encoder can be connected to open collector output or line-driver output.		A4
5	GEX	—	Ground		—
6	GEX				
7	VEX	—	24V Power output (DC24V, under 150mA) : +24V power output for power sources of encoder and limit/home sensor.		
8	nHOME	Input	Home : Home signal for automatic home search.		A2
9	nLMT+	Input	Over limit in the + direction : Over limit signal in the + direction. When this signal is activated during motor rotation in the + direction, driving stops by decelerating or instantly. After stop, even though this signal is active, motor rotation in the opposite direction can be performed.		A2
10	nLMT-		Over limit in the - direction : Over limit in the - direction. When this signal is activated during motor rotation in the - direction, driving stops by decelerating or instantly. After stop, even though this signal is active, motor rotation in the opposite direction can be performed.		
11	EMG	Input	Emergency stop : Turning this signal ON stops motor rotation immediately. This signal cannot select the logical level. If the signal changes from OFF (normal state) to ON (GEX Short-circuited), it performs the emergency stop.		A2
12	nIN0	Input	General input 0	Available general input signals in a user program, which are used by IJP command.	A2
13	nIN1		General input 1		
14	nOUT0	Output	General output 0	Available general output signals that can control ON/OFF in a user program, which are used by OUT and OTP commands.	B1
15	nOUT1		General output 1		
16	nSPLT	Output	Split pulse : Outputs pulses synchronizing with motor rotation.		B1

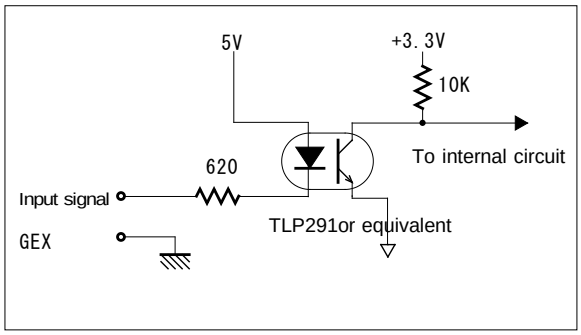
Input Signal Circuit A2



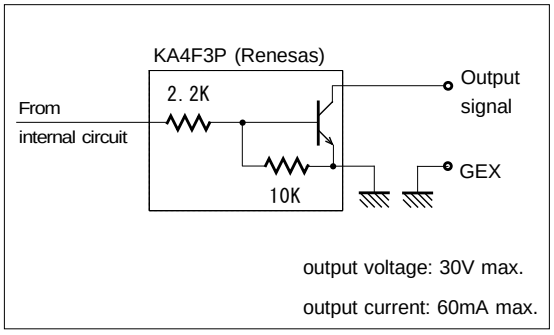
Input Signal Circuit A3 (Encoder A/B-phase input)



Input Signal Circuit A4 (Encoder Z-phase input)



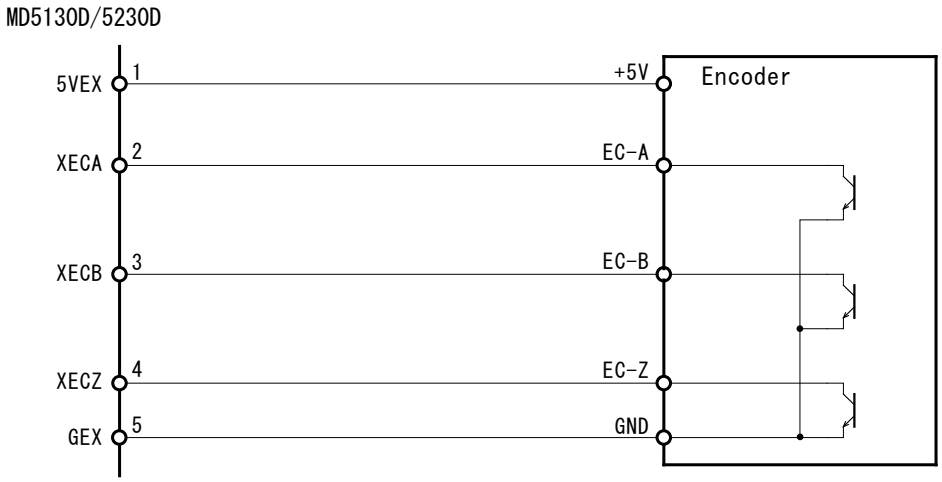
Output Signal Circuit B1



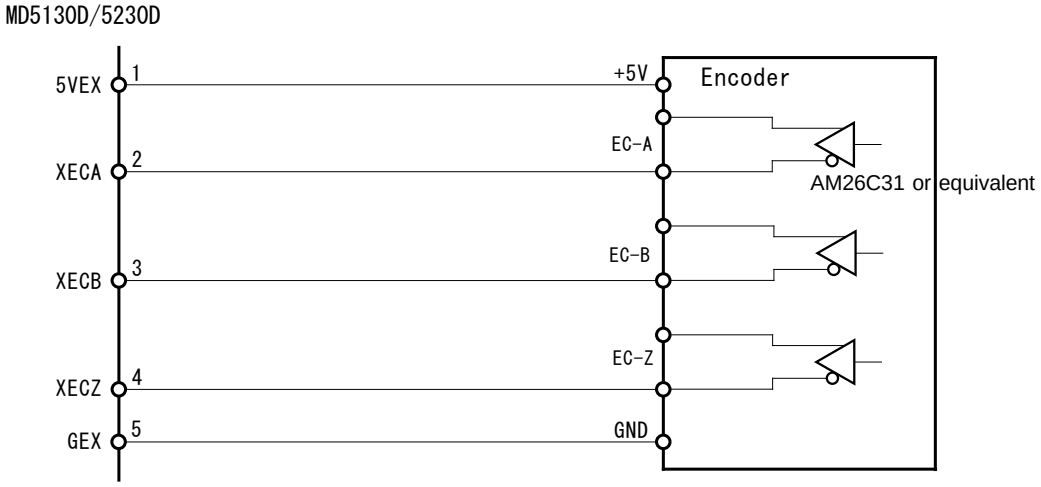
7.4.2. Connection Example

7.4.2.1 Connection Example for Encoder

The connection example for open collector output encoder (5V power source) is shown as follows:

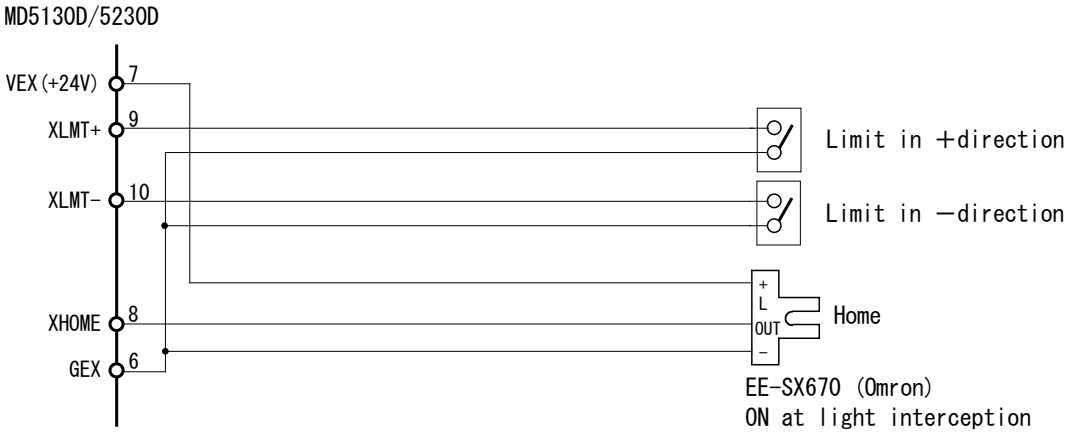


The connection example for line-driver output encoder (5V power source) is shown as follows:



7.4.2.2 Connection Example for Over Limit and Home signal

The connection example for over limit signals and home signal is shown as follows:



[Note]

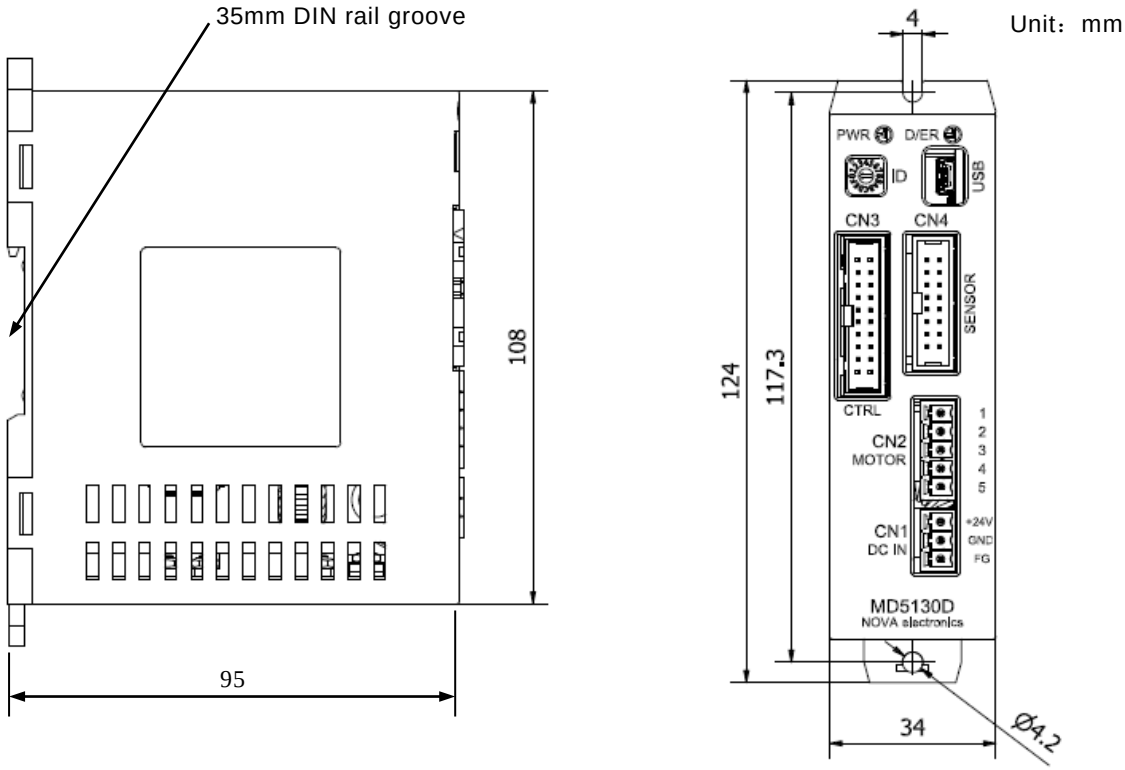
- Use the mechanical contact for small current.
- Two-wire sensor can be connected; however, ensure that the two-wire sensor is for DC24V power supply and leak current 1mA or less.

7.5. CN5 USB Connector

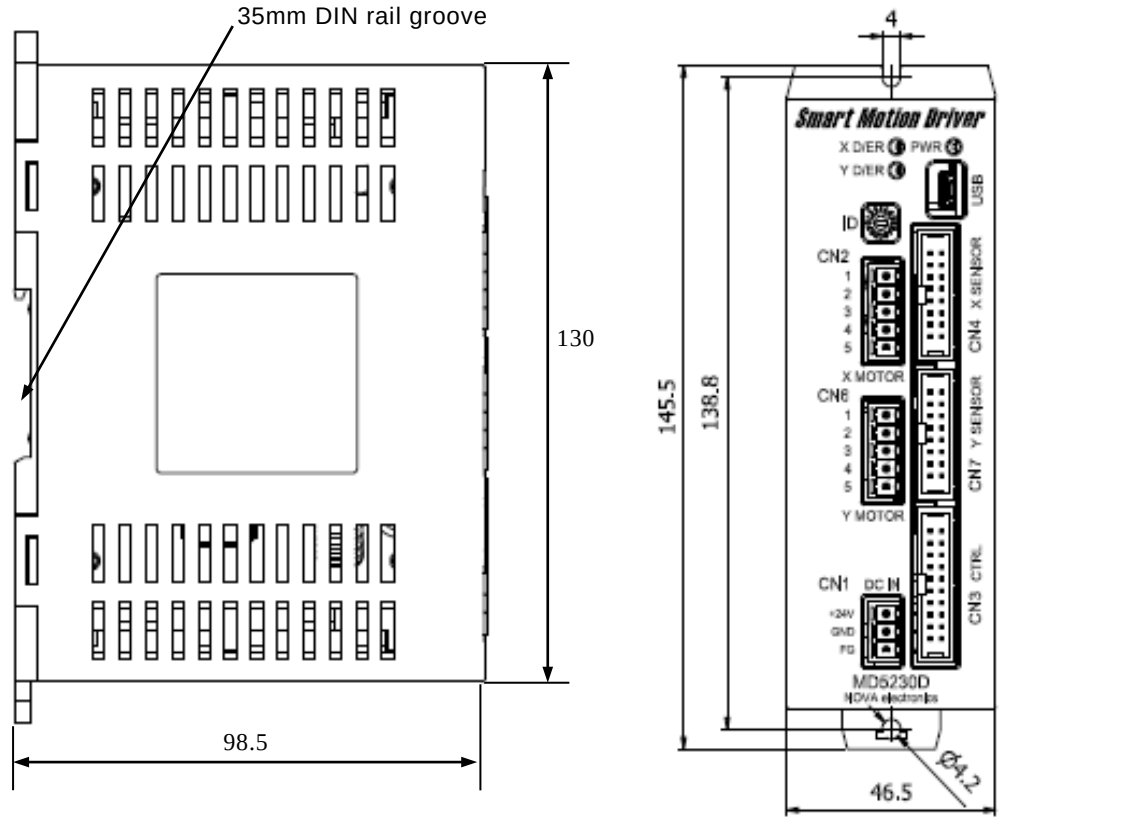
Connect to PC with the attached USB cable.

8. Package Dimensions

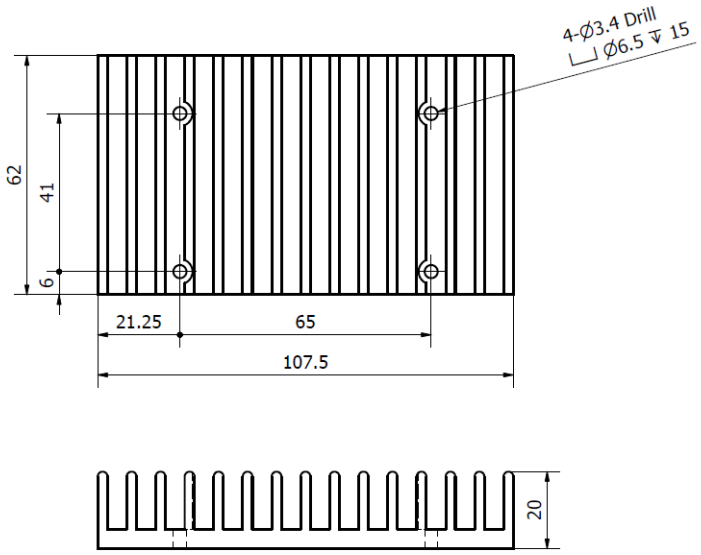
8.1. MD5130D



8.2. MD5230D



8.3. Heat sink (Optional accessory for MD5230D)



9. Message

9.1. Error Message

9.1.1. Error Code List

The following is the list of error code displayed in Error code / message display pane in the bottom of Main window.

Error code	Message	Supplement
2	Operation rejected because of program stop.	
4	Operation rejected because of motor rotation.	
5	Operation rejected because of waiting for motor stop.	
7	Operation rejected because of motor stop.	
8	Operation rejected because of program execution.	
11	EEPROM read error while uploading.	If occurs again after restart, it may be a unit failure. Please contact the maker.
13	Communication time out error while uploading.	Check the USB cable connection.
15	Motor excitation off.	
16	Step out error. Click "Controller Reset". Set proper value.	Cause of step out may be as follows: ・Motor load is too large. ・Motor driving current is insufficient. ・Motor rotation speed (or acceleration) is too high. ・Step Out Differential is too small.
17	Cannot "WTP" because motor stop.	
19	Program stop by STOP signal.	
20	User Program Command rejected for motor rotation.	
23	User Program Command rejected for motor stop.	
27	EEPROM read error while user program running.	If occurs again after restart, it may be a unit failure. Please contact the maker.
28	Over three nested loops of "JSR" or "REP-RED".	
31	Program execution failed.	Check the logic of a user program.
32	Software (+) limit error.	
33	Software (-) limit error.	
34	Hardware (+) limit error.	
35	Hardware (-) limit error.	
37	Emergency error.	
38	Home search error.	See chapter 6.2.1.3 Step 3: Low-speed Encoder Z-phase Search.
39	Motor excitation off.	

Error code	Message	Supplement
41	Continuos interpolation data writing error.	
42	Continuous interpolation error.	
43	Motor excitation off.	
48	Communication time out error while downloading.	
49	Cannot "SPD" while S-curve driving.	
50	Cannot "WTP" because passed through specified position.	
53	Motor stop by STOP signal.	
54	Limit error occurred at the beginning of step 3 stage.	
64	Program label not found.	
67/83	Constant speed is not selected in speed setting	Set to constant speed.
68/84	Drive speed is over in interpolation driving.	Set to 500Kpps or less.
70/85	Cannot use S-curve in interpolation driving.	Set to constant speed.
80	Command rejected while Step out error occurring.	Solve the step out error.
81	Command rejected while STOP signal inputting.	
201	Program get failed.	
202	Program set failed.	
203	Configuration get failed.	
204	Configuration set failed.	

9.1.2. Popup Message List

Message is displayed in a popup window.

Code	Message	Supplement
502/504	Bad input.	Input the appropriate value.
503	Out of range.	
505	Out of range. Maximum:*****	
506	Selection error.	Check the Speed, Timer and EndP parameters in Program window.
507	Input from {0} to {1}.	
508	Select axis.	Select the axis, then operate again.
509	Out of range. Maximum:*****	
511	Speed1 "X"(Y)Acceleration Time changed to **ms	
511	Speed1 "X"(Y)Deceleration Time changed to **ms	
511	Speed2 "X"(Y)Acceleration Time changed to **ms	
511	Speed2 "X"(Y)Deceleration Time changed to **ms	
511	Speed3 "X"(Y)Acceleration Time changed to **ms	
511	Speed3 "X"(Y)Deceleration Time changed to **ms	
511	Speed4 "X"(Y)Acceleration Time changed to **ms	
511	Speed4 "X"(Y)Deceleration Time changed to **ms	
512	Input smaller value into deceleration Time.	
521	Cannot start from subroutine.	
531	Program is editing. Do you save the program?	
550	No command set.	
551	Input from 'P01' to 'P63' for program label.	
552	Input from 'S01' to 'S19' for subroutine label.	
553	Input from 'J01' to 'J63' for jump label.	
554	Top line of the program must have a program label.	Write program label in top line of program.
555	No END command in program.	
557	No assigned jump label.	
558	No assigned subroutine label.	
559	Label is duplicate.	
560	END command exsists in subroutine.	

Code	Message	Supplement
561	Write RET command at end line of subroutine.	
562	Jump label is set out of this program.	
563	Subroutine nested loop is three or less.	Correct the program description.
564	REP command nested loop is three or less.	Correct the program description.
566	Input jump label only.	
567	Input subroutine label only.	
568	Bad composition of "REP-RED".	
572	Program check OK	
591	Timeout error for sending.	Connect USB cable again and restart the unit. If not recovered, please contact the maker.
592	Timeout error for receiving.	Connect USB cable again and restart the unit. If not recovered, please contact the maker.
800	Cannot download while Run mode.	
801	Download configuration data because configuration parameters changed.	
802	Program in unit is unmatched. Main Screen → File(F) → Download(D) → All	
803	Error occurred while downloading.	
804	Unit cannot accept download.	The unit is in operation. Wait for program stop or motor stop by parallel operation. To stop it forcibly, click Reset button.
805	Error occurred while downloading.	
806	Changed configuration data will disappear. Are you sure you want to upload?	
807	Cannot download while motor rotating.	
808	Program empty.	
809	Configuration download completed.	
810	Program download completed.	
811	Factory setting completed.	
812	Program and configuration will become factory setting. Are you sure you want?	
813	Program will be deleted. Are you sure you want?	
814	Program and configuration will become factory setting. Are you sure you want?	
815	Input unit name.	
816	Invalid String Value. Use half-size character only.	
817	Changed program will disappear. Are you sure you want to change Unit?	

Code	Message	Supplement
818	Changed configuration will disappear. Are you sure you want to change Unit?	
819	Changed configuration will be disappear if close. Do you save changed configuration?	
820	Unit name download completed.	
821	Drive speed must be higher than start speed.	
822	Pulse Scale Numerator and Pulse Scale Denominator affect all position data. Do you really want to change those parameters?	
823	Programs were changed. If you download, changed programs would disappear. Do you save programs you changed?	
828	Cannot simultaneously execute X and Y-axis.	
829	Cannot exit MD operation tool while Speed Select 5. Exit MD operation tool while Speed Select 1 ~ 4.	
830	Cannot exit MD operation tool while motor excitation off. Exit MD operation tool while motor excitation on.	

10. Specifications

Specification	MD5130D	MD5230D
Control Axis	1 axis	2 axes (Inedependently programmable for each axis.)
■ Drive function		
Drivable Motor	5-phase stepper motor with 5 leads or 10 leads	
Driving Current	0.35A ～ 1.40A / phase (selectable from 16 kinds)	
Driving System	Bipolar pentagon drive system Microstep drive	
Microstep Divisions	1，2，4，5，8，10，16，20，25，40，50，80，100，125，200，250 (16 kinds)	
Auto Current Reduction	It sets rest current to run current by percentage, selectable from 16 kinds, 25% to 100%.	
■ Control Function		
Speed Setting	・Speed setting number ： 4 (Mode, Start speed, Drive speed, Acceleration Time, Deceleration Time) ・Mode： Constant, linear acceleration/deceleration (Trapezoid) (with / without Start speed), non-symmetry linear acceleration/deceleration, S-curve acceleration/deceleration (with / without Start speed) ・Drive speed, Start speed： Setting range 1pps ～ 500kpps ・Acceleration Time, Deceleration Time： Setting range 1 ～ 65535msec	
Driving Mode	Automatic home search, Scan driving, Continuous driving, Preset driving, Program driving	
Automatic Home Search	・Automatically executes High-speed home search (Step 1) → Low-speed home search (Step 2) → Low-speed encoder Z-phase search (Step 3) → High-speed offset drive (Step 4) ・Each step of search direction and enable/disable can be specified.	
Program Function	・Memory media EEPROM ・Steps 1000 ・Commands 36 commands	

Command Type	Code	Contents	Available unit
Drive Commands	ABS	Absolute position move	MD51/MD52
	ABB	2-axis simultaneous absolute position move	MD52
	ABA	Absolute position move start	MD51/MD52
	INC	Relative position move	MD51/MD52
	ICB	2-axis simultaneous relative position move	MD52
	ICA	Relative position move start	MD51/MD52
	CNT	Continuous move start	MD51/MD52
	SST	Deceleration stop	MD51/MD52
	IST	Instant stop	MD51/MD52
	HOM	Home search	MD51/MD52
	HMB	2-axis simultaneous home search	MD52
Interpolation Drive commands	LNI	2-axis linear interpolation move	MD52
	CEN	Circular interpolation center setting	MD52
	CWI	CW circular interpolation move	MD52
	CCW	CCW circular interpolation move	MD52
Signal Output Commands	OUT	Output port ON/OFF	MD51/MD52
	OTP	Output port ON Pulse	MD51/MD52
	SSP	Split pulse start	MD51/MD52
	PST	Split pulse stop	MD51/MD52
Program Control Commands	IJP	Input condition jump	MD51/MD52
	PJP	Position condition jump	MD51/MD52
	JMP	Unconditional Jump	MD51/MD52
	JSR	Subroutine jump	MD51/MD52
	RET	Subroutine return	MD51/MD52
	REP	Repetition start	MD51/MD52
	RED	Repetition end	MD51/MD52
	END	Program end	MD51/MD52
	TIM	Timer	MD51/MD52

<table>
<tr><td></td><td colspan="2"><table>
<tr><td rowspan="5"></td><td>WTE</td><td>Waiting driving end</td><td>MD51/MD52</td></tr>
<tr><td>WTP</td><td>Waiting position passage</td><td>MD51/MD52</td></tr>
<tr><td>PAS</td><td>Pause for debug</td><td>MD51/MD52</td></tr>
<tr><td>RNY</td><td>Y-axis program start</td><td>MD52</td></tr>
<tr><td>WTY</td><td>Waiting Y-axis program end</td><td>MD52</td></tr>
<tr><td rowspan="3">Other Commands</td><td>SPD</td><td>Drive speed</td><td>MD51/MD52</td></tr>
<tr><td>POS</td><td>Current position</td><td>MD51/MD52</td></tr>
<tr><td>NOP</td><td>No operation</td><td>MD51/MD52</td></tr>
</table>
・Power On Program Start Function</td></tr>
<tr><td>Interpolation Function</td><td>-</td><td>・Linear interpolation
・Circular interpolation
・Continuous interpolation</td></tr>
<tr><td>Step Out Detection Function</td><td colspan="2">・Monitors the position difference between the logical and real positions, and if detects the abnormal difference, motor rotation stops.
・Step Out Differential can be set.</td></tr>
<tr><td>Encoder Scaling Function</td><td colspan="2">・Function to set the scale in order to match the count value of logical and real positions for motor rotation.</td></tr>
<tr><td>Pulse Scaling Function</td><td colspan="2">・Function to set the scale in order to input and display the specified position and logical position according to the actual moving distance (mm).</td></tr>
<tr><td>Hardware Limit</td><td colspan="2">・Number of input signals 2/each axis (each 1 for + and – direction)
・Stop signal active level can be set.
・Stop mode Instant / Slow is selectable.</td></tr>
<tr><td>Software Limit</td><td colspan="2">・Stop mode Instant / Slow is selectable.</td></tr>
<tr><td>Input Signal</td><td colspan="2">・Encoder A / B phase input
High speed photo coupler input (5V) Quadrature pulse input the maximum 400 kHz
・Encoder Z phase input
Photo coupler input (5V) Input width 500usec or more
・Home signal, Limit signals (each 1 for + and – direction), Emergency stop signal, General input : 2 signals
Photo coupler input (24V) Two-wire sensor supported, Turned ON when input signal is short-circuited with GEX.
・External reset signal input, Automatic home search start input, Program driving start input, Program designation 0~5 input, Driving mode designation 0, 1 input
Photo coupler input (24V), Turned ON when input signal is short-circuited with GEX.</td></tr>
<tr><td>Output Signal</td><td colspan="2">・Split pulse output, General output 2 signals, Output during driving / End pulse, Error output
Open collector output, DC30V or less and 60mA or less</td></tr>
<tr><td>Control Interface</td><td colspan="2">・Parallel control I/F
・USB (USB standard V2.0 compliant)
The maximum of 16 units can be connected to one PC with USB cable.</td></tr>
<tr><td colspan="3">■ Others</td></tr>
<tr><td>Input Power Supply</td><td>DC 24V (3A MAX.)</td><td>DC 24V (6A MAX.)</td></tr>
<tr><td>Ambient Temperature</td><td colspan="2">0 ～ 40°</td></tr>
<tr><td>Ambient Humidity</td><td colspan="2">0 ～ 85%RH (No Condensation)</td></tr>
<tr><td>Mass</td><td>245 g</td><td>429 g</td></tr>
<tr><td>Package Dimensions</td><td>108mm (Height) × 34mm (Width) × 95mm (Depth) (except projecting part)</td><td>130mm (Height) × 46.5mm (Width) × 98.5mm (Depth) (except projecting part)</td></tr>
<tr><td>Accessory</td><td>・CN1:XW4B-03B1-H1 (Omron) or equivalent 1
・CN2 ： XW4B-05B1-H1 (Omron) or equivalent 1
・CN3 ： 20P MIL standard 2.54mm connector 1
・CN4 ： 16P MIL standard 2.54mm connector 1
・USB cable (1.5m) 1</td><td>・CN1 ： XW4B-03B1-H1 (Omron) or equivalent 1
・CN2,6 ： XW4B-05B1-H1 (Omron) or equivalent 2
・CN3 ： 20P MIL standard 2.54mm connector 1
・CN4,7 ： 16P MIL standard 2.54mm connector 2
・USB cable (1.5m) 1</td></tr>
<tr><td>Optional Accessory</td><td>-</td><td>Heat sink</td></tr>
<tr><td>System Requirements for the Software</td><td colspan="2">Windows 8.1（32/64bit），Windows 7（32/64bit），Vista（32/64bit），XP（32/64bit）</td></tr>
</table>

Appendix A　CSV File

MD5130D and MD5230D user program file is saved in the format of CSV file. The user can edit a user program file by using spreadsheet software applications in addition to MD Operation Tool. For more details of Save and Open a user program file, refer to Program window (see chapter 4.4.4 Download / Upload / Open / Save).

[Note]

- When the user directly edits a CSV file, do not change the user program file configuration.

1. User Program File Configuration

The program file is composed of Configuration block [Configuration] (data of Mode / Speed / Parameter / Home Search Mode / Split Pulse in Configuration window) and Program block [Program].

1.1 【MD5130D】

[Configuration]	
Mode	
RunCurrentX	0
RestCurrentX	5
StepResolutionX	6
AutoCurrentReductionX	1
HardwareLimitStopModeX	0
HardwareLimitActiveLevelX	0
SoftwareLimitEnableX	1
SoftwareLimitStopModeX	0
EndPulseEanbleX	0
PowerOnHomeSearchStartX	0
PowerOnProgramStartX	0
StepOutDetectionX	0
StepOutDetectingTimingX	1
Parameter	
PostTimer1X	10
PostTimer2X	100
PostTimer3X	1000
HomeSearchOffsetX	10000
HomeSearchLowSpeedX	6000
SoftwareLimitPlusX	8000000
SoftwareLimitMinusX	-8000000
EndPulseWidthX	100
PulseScaleNumerationX	1000
PulseScaleDenominationX	1000
EncoderScaleNumerationX	1000
EncoderScaleDenominationX	200
StepOutDifferentialX	100
Home Seach Mode	
SensorSignalX	0
HomeSignalLevelX	0
ZSignalLevelX	0
Step1EnableX	1
Step1DirectionX	0
Step2EnableX	1
Step2DirectionX	1
Step3EnableX	0
Step3DirectionX	1
Step4EnableX	1
PositionClearX	1
Speed	
Mode1X	1
StartSpeed1X	4000
DriveSpeed1X	4000
AccelerationTime1X	1
DecelerationTime1X	1
AccelerationRate1X	1
DecelerationRate1X	1
AccelerationIncrease1X	1
Mode2X	2
StartSpeed2X	400
DriveSpeed2X	80000
AccelerationTime2X	500

DecelerationTime2X	1
AccelerationRate2X	160000
DecelerationRate2X	1
AccelerationIncrease2X	1
Mode3X	6
StartSpeed3X	8000
DriveSpeed3X	100000
AccelerationTime3X	2000
DecelerationTime3X	1
AccelerationRate3X	536870911
DecelerationRate3X	1
AccelerationIncrease3X	92000
Mode4X	3
StartSpeed4X	1000
DriveSpeed4X	50000
AccelerationTime4X	100
DecelerationTime4X	1
AccelerationRate4X	490000
DecelerationRate4X	1
AccelerationIncrease4X	1
Split Pulse	
SplitLength1X	10
PulseWidth1X	5
PulseCount1X	0
SplitLength2X	20
PulseWidth2X	10
PulseCount2X	0
SplitLength3X	2000
PulseWidth3X	1000
PulseCount3X	0
SplitLength4X	10000
PulseWidth4X	5000
PulseCount4X	10

[Program]	CMD	DATA	SPEED	TIMER	ENDP
P01	NOP				
P01	HOM				0
P01	ABS	1000000	2	0	0
P01	ABA	-1000000	2		
P01	WTE				
P01	INC	1000000	3	0	0
P01	ICA	-2000000	4		
P01	WTP	-10000			
P01	IJP	01␣;␣Hi␣;␣J01			
P01	IST			0	
P01	JMP	J02			
J01	WTE				
P01	JSR	S01			
P01	OTP	01␣;␣1000			
P01	OUT	02␣;␣On			
P01	PJP	100000␣;␣J02			
P01	POS	20000			
P01	SSP	1			
P01	PST				
P01	SPD	30000			
P01	TIM	10000			
J02	NOP				
P01	END				
S01	NOP				
S01	REP	2			
S01	CNT	-	1		
S01	TIM	1000			
S01	SST			0	
S01	CNT	+	1		
S01	TIM	1000			
S01	SST			0	
S01	RED				
S01	RET				

Maximum 1000 lines

␣ : indicates a space.

1.2 【MD5230D】

[ConfigurationY]	
Mode	
RunCurrentY	0
RestCurrentY	5
StepResolutionY	6
AutoCurrentReductionY	1
HardwareLimitStopModeY	0
HardwareLimitActiveLevelY	0
SoftwareLimitEnableY	1
SoftwareLimitStopModeY	0
EndPulseEanbleY	0
PowerOnHomeSearchStartY	0
PowerOnProgramStartY	0
StepOutDetectionY	0
StepOutDetectingTimingY	1
Parameter	
PostTimer1Y	10
PostTimer2Y	100
PostTimer3Y	1000
HomeSearchOffsetY	10000
HomeSearchLowSpeedY	6000
SoftwareLimitPlusY	8000000
SoftwareLimitMinusY	-8000000
EndPulseWidthY	100
PulseScaleNumerationY	1000
PulseScaleDenominationY	1000
EncoderScaleNumerationY	1000
EncoderScaleDenominationY	200
StepOutDifferentialY	100
Home Seach Mode	
SensorSignalY	0
HomeSignalLevelY	0
ZSignalLevelY	0
Step1EnableX	1
Step1DirectionY	0
Step2EnableY	1
Step2DirectionY	1
Step3EnableY	0
Step3DirectionY	1
Step4EnableY	1
PositionClearY	1
Speed	
Mode1Y	1
StartSpeed1Y	4000
DriveSpeed1Y	4000
AccelerationTime1Y	1
DecelerationTime1Y	1
AccelerationRate1Y	1
DecelerationRate1Y	1
AccelerationIncrease1Y	1
Mode2Y	2
StartSpeed2Y	400
DriveSpeed2Y	80000
AccelerationTime2Y	500
DecelerationTime2Y	1
AccelerationRate2Y	160000
DecelerationRate2Y	1
AccelerationIncrease2Y	1
Mode3Y	6
StartSpeed3Y	8000
DriveSpeed3Y	100000
AccelerationTime3Y	2000
DecelerationTime3Y	1
AccelerationRate3Y	536870911
DecelerationRate3Y	1
AccelerationIncrease3Y	92000
Mode4Y	3
StartSpeed4Y	1000

DriveSpeed4Y	50000
AccelerationTime4Y	100
DecelerationTime4Y	1
AccelerationRate4Y	490000
DecelerationRate4Y	1
AccelerationIncrease4Y	1
Split Pulse	
SplitLength1Y	10
PulseWidth1Y	5
PulseCount1Y	0
SplitLength2Y	20
PulseWidth2Y	10
PulseCount2Y	0
SplitLength3Y	2000
PulseWidth3Y	1000
PulseCount3Y	0
SplitLength4Y	10000
PulseWidth4Y	5000
PulseCount4Y	10

[ProgramY]	CMD	DATA	SPEED	TIMER	ENDP
	HMB				
	NOP				
	ABB	156260	1	0	0
	END				
	LNI	37500			
	WTE				
	END				
	NOP				
	CEN	0			
	CCW	0			
	WTE				
	END				
	NOP				
	LNI	-37500			
	WTE				
	END				
	NOP				
	CEN	0			
	CCW	0			
	WTE				
	END				

Maximum
1000 lines

[Configuration]	
Mode	
RunCurrentX	0
RestCurrentX	5
StepResolutionX	6
AutoCurrentReductionX	1
HardwareLimitStopModeX	0
HardwareLimitActiveLevelX	0
SoftwareLimitEnableX	1
SoftwareLimitStopModeX	0
EndPulseEanbleX	0
PowerOnHomeSearchStartX	0
PowerOnProgramStartX	0
StepOutDetectionX	0
StepOutDetectingTimingX	1

Parameter	
PostTimer1X	10
PostTimer2X	100
PostTimer3X	1000
HomeSearchOffsetX	10000
HomeSearchLowSpeedX	6000
SoftwareLimitPlusX	8000000
SoftwareLimitMinusX	-8000000
EndPulseWidthX	100
PulseScaleNumerationX	1000
PulseScaleDenominationX	1000
EncoderScaleNumerationX	1000
EncoderScaleDenominationX	200
StepOutDifferentialX	100
Home Seach Mode	
SensorSignalX	0
HomeSignalLevelX	0
ZSignalLevelX	0
Step1EnableX	1
Step1DirectionX	0
Step2EnableX	1
Step2DirectionX	1
Step3EnableX	0
Step3DirectionX	1
Step4EnableX	1
PositionClearX	1
Speed	
Mode1X	1
StartSpeed1X	4000
DriveSpeed1X	4000
AccelerationTime1X	1
DecelerationTime1X	1
AccelerationRate1X	1
DecelerationRate1X	1
AccelerationIncrease1X	1
Mode2X	2
StartSpeed2X	400
DriveSpeed2X	80000
AccelerationTime2X	500
DecelerationTime2X	1
AccelerationRate2X	160000
DecelerationRate2X	1
AccelerationIncrease2X	1
Mode3X	6
StartSpeed3X	8000
DriveSpeed3X	100000
AccelerationTime3X	2000
DecelerationTime3X	1
AccelerationRate3X	536870911
DecelerationRate3X	1
AccelerationIncrease3X	92000
Mode4X	3
StartSpeed4X	1000
DriveSpeed4X	50000
AccelerationTime4X	100
DecelerationTime4X	1
AccelerationRate4X	490000
DecelerationRate4X	1
AccelerationIncrease4X	1
Split Pulse	
SplitLength1X	10
PulseWidth1X	5
PulseCount1X	0
SplitLength2X	20
PulseWidth2X	10
PulseCount2X	0
SplitLength3X	2000
PulseWidth3X	1000
PulseCount3X	0
SplitLength4X	10000
PulseWidth4X	5000
PulseCount4X	10

[Program]	CMD	DATA	SPEED	TIMER	ENDP
P01	HMB				
P01	OUT	01 ; Off			
P01	ABB	-125000			
P01	END				
P01					
P02	LNI	0			
P02	WTE				
P02	END				
P02					
P03	NOP				
P03	CEN	-125000			
P03	CCW	-250000			
P03	WTE				
P03	END				
P03					
P04	NOP				
P04	LNI	0			
P04	WTE				
P04	END				
P04					
P05	NOP				
P05	CEN	125000			
P05	CCW	250000			
P05	WTE				
P05	END				

␣ : indicates a space.

2. Configuration Block [Configuration]

■ Mode

Mode Item	Default	Details
RunCurrentX(Y)	0	Run current 0: 0.35[A] 1: 0.42[A] 2: 0.49[A] 3: 0.56[A] 4: 0.63[A] 5: 0.70[A] 6: 0.77[A] 7: 0.84[A] 8: 0.91[A] 9: 0.98[A] 10: 1.05[A] 11: 1.12[A] 12: 1.19[A] 13: 1.26[A] 14: 1.33[A] 15: 1.40[A]
RestCurrentX(Y)	5	Rest current 0: 25[%] 1: 30[%] 2: 35[%] 3: 40[%] 4: 45[%] 5: 50[%] 6: 55[%] 7: 60[%] 8: 65[%] 9: 70[%] 10: 75[%] 11: 80[%] 12: 85[%] 13: 90[%] 14: 95[%] 15: 100[%]
StepResolutionX(Y)	6	Step resolution 0: 1 1: 2 2: 4 3: 5 4: 8 5: 10 6: 20 7: 40 8: 80 9: 16 10: 25 11: 50 12: 100 13: 125 14: 200 15: 250
AutoCurrentReductionX(Y)	1	Auto current reduction: 1(Enable)／0(Disable)
HardwareLimitStopModeX(Y)	0	Hardware Limit Stop Mode: 0(Instant)／1(Slow)

HardwareLimitActiveLevelX(Y)	0	Hardware Limit Active Level: 1(High)／0(Low)
SoftwareLimitEnableX(Y)	0	Software Limit: 1(Enable)／0(Disable)
SoftwareLimitStopModeX(Y)	0	Software Limit Stop Mode: 0(Slow)／1(Instant)
EndPulseEanbleX(Y)	0	Driving End Pulse: 1(Enable)／0(Disable)
PowerOnHomeSearchStartX(Y)	0	Power on home search start: 1(Enable)／0(Disable)
PowerOnProgramStartX(Y)	0	Power on program start: 1(Enable)/0(Disable)
StepOutDetectionX(Y)	0	Step out detection: 1(Enable)／0(Disable)
StepOutDetectingTimingX(Y)	0	Step out detecting timing: 1(Drive End)／0(While Drive)

■ Parameter

Parameter Item	Default	Details
PostTimer1X(Y)	10	Post Timer1: 1 ～ 65535 [msec]
PostTimer2X(Y)	100	Post Timer2: 1 ～ 65535 [msec]
PostTimer3X(Y)	1000	Post Timer3: 1 ～ 65535 [msec]
HomeSearchOffsetX(Y)	100	Home Search Offset: -2147483646 ～ 2147483646
HomeSearchLowSpeedX(Y)	4000	Home Search Low Speed: 1 ～ 500000 [pps]
SoftwareLimitPlusX(Y)	2147483647	Software Limit +: -2147483648 ～ 2147483647
SoftwareLimitMinusX(Y)	-2147483648	Software Limit -: -2147483648 ～ 2147483647
EndPulseWidthX(Y)	100	End Pulse Width: 1 ～ 65535 [msec]
PulseScaleNumerationX(Y)	1000	Pulse Scale Numeration(numerator): 1～65535
PulseScaleDenominationX(Y)	1000	Pulse Scale Denomination(denominator): 1～65535
EncoderScaleNumerationX(Y)	1000	Encoder Scale Numeration（numerator）: 1～65535
EncoderScaleDenominationX(Y)	200	Encoder Scale Denomination（denominator）: 1～65535
StepOutDifferentialX(Y)	100	Step Out Differential: 1～65535

■ Home Seach Mode

Home Seach Mode Item	Default	Details
SensorSignalX(Y)	0	Sensor Signal: 0(Home)／1(Limit)
HomeSignalLevelX(Y)	0	Home Signal Level: 1(High)／0(Low)
ZSignalLevelX(Y)	0	Z Phase Signal(ECZ) Level: 1(High)／0(Low)
Step1EnableX(Y)	0	Step1 Enable: 1(execution)／0(non-execution)
Step1DirectionX(Y)	1	Step1 Direction: 1('+')／0('-')
Step2EnableX(Y)	0	Step2 Enable: 1(execution)／0(non-execution)
Step2DirectionX(Y)	1	Step2 Direction: 1('+')／0('-')
Step3EnableX(Y)	0	Step3 Enable: 1(execution)／0(non-execution)
Step3DirectionX(Y)	0	Step3 Direction: 1('+')／0('-')
Step4EnableX(Y)	0	Step4 Enable: 1(execution)／0(non-execution)
PositionClearX(Y)	1	Position Clear: 1(Enable)／0(Disable)

■ Speed

Speed Item	Default	Details	
Mode1X	1	Mode 1: Constant speed (Constant) 2: Simple trapezoid (Trapezoid 1) 3: Normal trapezoid (Trapezoid 2) 4: Non-symmetry trapezoid (Trapezoid 3) 5: Simple S-curve (symmetry) (S-curve 1) 6: Normal S-curve (symmetry) (S-curve 2)	Speed 1
StartSpeed1X	0	Start Speed: 1 ～ 500000[pps]	
DriveSpeed1X	4000	Drive Speed: 1 ～ 500000[pps]	
AccelerationTime1X	0	Acceleration: 1 ～ 10000[msec]	
DecelerationTime1X	0	Deceleration: 1 ～ 10000[msec]	
AccelerationRate1X	1	used in MD Operation Tool. *Note1	
DecelerationRate1X	1	used in MD Operation Tool. *Note1	
AccelerationIncrease1X	1	used in MD Operation Tool. *Note1	
Mode2X	2	Mode 1: Constant speed (Constant) 2: Simple trapezoid (Trapezoid 1) 3: Normal trapezoid (Trapezoid 2) 4: Non-symmetry trapezoid (Trapezoid 3) 5: Simple S-curve (symmetry) (S-curve 1) 6: Normal S-curve (symmetry) (S-curve 2)	Speed 2
StartSpeed2X	0	Start Speed: 1 ～ 500000[pps]	
DriveSpeed2X	80000	Drive Speed: 1 ～ 500000[pps]	
AccelerationTime2X	500	Acceleration: 1 ～ 10000[msec]	
DecelerationTime2X	0	Deceleration: 1 ～ 10000[msec]	
AccelerationRate2X	160000	used in MD Operation Tool. *Note1	
DecelerationRate2X	1	used in MD Operation Tool. *Note1	
AccelerationIncrease2X	1	used in MD Operation Tool. *Note1	
Mode3X	5	Mode 1: Constant speed (Constant) 2: Simple trapezoid (Trapezoid 1) 3: Normal trapezoid (Trapezoid 2) 4: Non-symmetry trapezoid (Trapezoid 3) 5: Simple S-curve (symmetry) (S-curve 1) 6: Normal S-curve (symmetry) (S-curve 2)	Speed 3
StartSpeed3X	0	Start Speed: 1 ～ 500000[pps]	
DriveSpeed3X	80000	Drive Speed: 1 ～ 500000[pps]	
AccelerationTime3X	500	Acceleration: 1 ～ 10000[msec]	
DecelerationTime3X	0	Deceleration: 1 ～ 10000[msec]	
AccelerationRate3X	536870911	used in MD Operation Tool. *Note1	
DecelerationRate3X	1	used in MD Operation Tool. *Note1	
AccelerationIncrease3X	92000	used in MD Operation Tool. *Note1	
Mode4X	3	Mode 1: Constant speed (Constant) 2: Simple trapezoid (Trapezoid 1) 3: Normal trapezoid (Trapezoid 2) 4: Non-symmetry trapezoid (Trapezoid 3) 5: Simple S-curve (symmetry) (S-curve 1) 6: Normal S-curve (symmetry) (S-curve 2)	Speed 4
StartSpeed4X	4000	Start Speed: 1 ～ 500000[pps]	
DriveSpeed4X	40000	Drive Speed: 1 ～ 500000[pps]	
AccelerationTime4X	500	Acceleration: 1 ～ 10000[msec]	
DecelerationTime4X	0	Deceleration: 1 ～ 10000[msec]	
AccelerationRate4X	490000	used in MD Operation Tool. *Note1	
DecelerationRate4X	1	used in MD Operation Tool. *Note1	
AccelerationIncrease4X	1	used in MD Operation Tool. *Note1	

Note1 : Do not change.

■ Split Pulse

Split Pulse Item	Default	Details	
SplitLength1X	10	Split length: 2～65535	Split Pulse 1
PulseWidth1X	5	Pulse width: 1～65534	
PulseCount1X	0	Split pulse number: 1～65535／0(infinite)	
SplitLength2X	20	Split length: 2～65535	Split Pulse 2
PulseWidth2X	10	Pulse width: 1～65534	
PulseCount2X	0	Split pulse number: 1～65535／0(infinite)	
SplitLength3X	1000	Split length: 2～65535	Split Pulse 3
PulseWidth3X	500	Pulse width: 1～65534	
PulseCount3X	10	Split pulse number: 1～65535／0(infinite)	
SplitLength4X	10000	Split length: 2～65535	Split Pulse 4
PulseWidth4X	5000	Pulse width: 1～65534	
PulseCount4X	10	Split pulse number: 1～65535／0(infinite)	

3. Program Block [Program]

[Program]	CMD	DATA	SPEED	TIMER	ENDP
Label Pxx/Sxx/Jxx	Command Code	Data	SPEED options (1～4)	TIMER options (0～3)	END Pulse Output (On／Off)
P01～P63 J01～J63 S01～S19 (See 5.1. Label.)	See 5.2. User Program Commands.	See 4.4.1 User Program Display / Edit Area. See 5.2.1 Drive Commands.	1: Speed1 2: Speed2 3: Speed3 4: Speed4 (See 4.3.2 Speed Settings tab：Speed.)	0: － 1: Post Timer 1 2: Post Timer 2 3: Post Timer 3 (See 4.3.3.1 Post Timer 1~3.)	Outputs driving end pulses at the end of driving 1: On 0: Off

Appendix B　User program

1.　Example of continuous interpolation

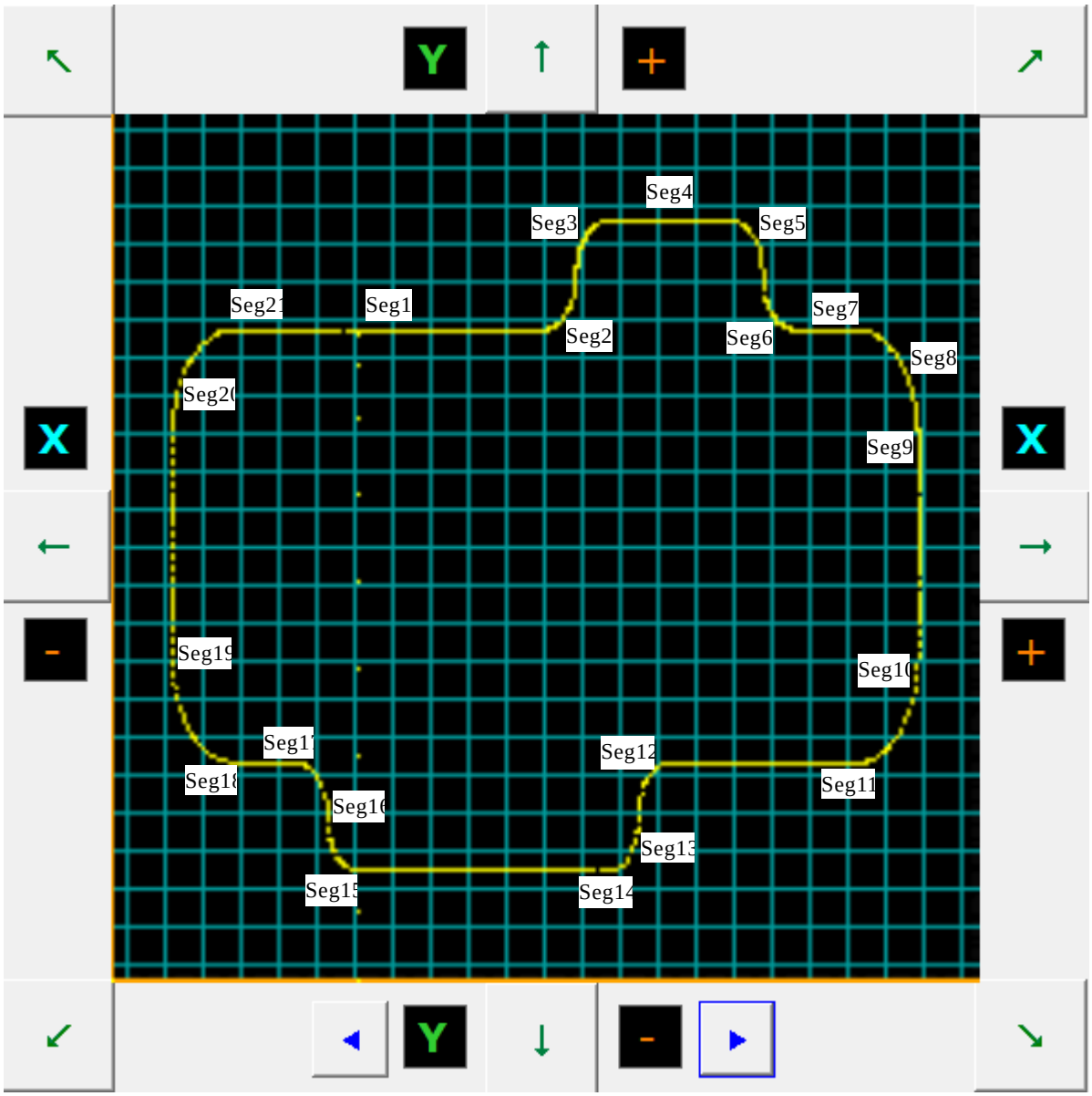
When performing linear or circular continuous interpolation, be sure to set all Speed settings for the interpolation command to be used to Constant mode. Do not select other modes except Constant.

1.1　Continuous interpolation user program combined linear and circular

MD5230D_P25_continuous interpolation user program sample.csv

	X-Axis						Y-Axis					
	Label	Cmd	Data	Speed	Timer	Endp	Label	Cmd	Data	Speed	Timer	Endp
	P25	NOP										
		ABB	0	4	0	On		ABB	6000	4	0	On
Seg1→	J01	LNI	3000	1				LNI	0			
Seg2→		CEN	0					CEN	500			
		CCW	500	1				CCW	500			
Seg3→		CEN	500					CEN	0			
		CWI	500	1				CWI	500			
Seg4→		LNI	2000	1				LNI	0			
Seg5→		CEN	0					CEN	-500			
		CWI	500	1				CWI	-500			
Seg6→		CEN	500					CEN	0			
		CCW	500	1				CCW	-500			
Seg7→		LNI	1000	1				LNI	0			
Seg8→		CEN	0					CEN	-1000			
		CWI	1000	1				CWI	-1000			
Seg9→		LNI	0	1				LNI	-2000			
Seg10→		CEN	-1000					CEN	0			
		CWI	-1000	1				CWI	-1000			
Seg11→		LNI	-3000	1				LNI	0			
Seg12→		CEN	0					CEN	-500			
		CCW	-500	1				CCW	-500			
Seg13→		CEN	-500					CEN	0			
		CWI	-500	1				CWI	-500			
Seg14→		LNI	-4000	1				LNI	0			
Seg15→		CEN	0					CEN	500			
		CWI	-500	1				CWI	500			
Seg16→		CEN	-500					CEN	0			
		CCW	-500	1				CCW	500			
Seg17→		LNI	-1000	1				LNI	0			
Seg18→		CEN	0					CEN	1000			
		CWI	-1000	1				CWI	1000			
Seg19→		LNI	0	1				LNI	2000			
Seg20→		CEN	1000					CEN	0			
		CWI	1000	1				CWI	1000			
Seg21→		LNI	2000	1				LNI	0			
		JMP	J01									
		END										

● User Program Operation Locus of Linear / Ciucular Continuous Interpolation



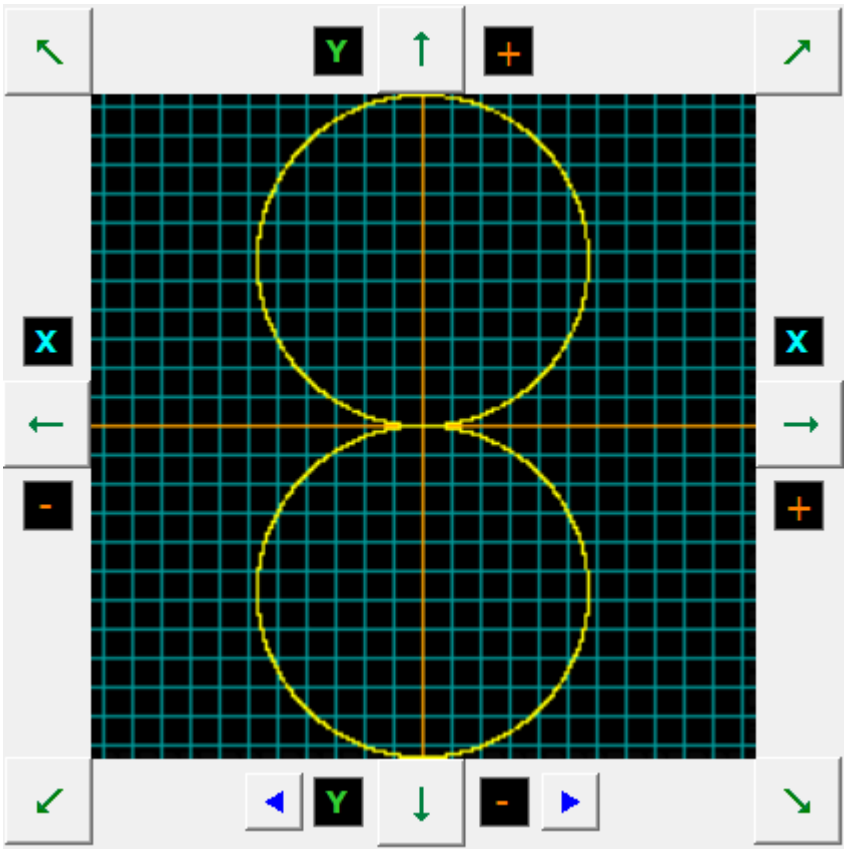
2. Example of circular interpolation

2.1 Circular interpolation user program

MD5230D_P15_circular interpolation user program sample.csv

X-Axis						Y-Axis					
Label	Cmd	Data	Speed	Timer	Endp	Label	Cmd	Data	Speed	Timer	Endp
P15	NOP										
	ABB	0	4	0	Off		ABB	0	4	0	Off
	CEN	0					CEN	1000000			
	CWI	0	2				CWI	0			
	WTE										
	CEN	0					CEN	-1000000			
	CCW	0	4				CCW	0			
	WTE										
	END										

●User Program Operation Locus Ciucular Interpolation



- Speed select Speed2/Speed4