CD3E Servo Drive

Quick Start Guide

ORIGINAL DOCUMENT
Revision: 1.0
Firmware Version 1.0.0.1

SERVOTRONIX
always in motion™

Revision History

Doc. Rev.	Date	Remarks
1.0	31 July 2024	Initial release

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Technical Support

If you need assistance with the installation and configuration of the CD3E drive, contact Servotronix technical support: tech.support@servotronix.com

Contents

1 Introduction

1.1 CD3E Product Description

CD3E is a high-performance, cost-optimized drive that is intended especially for linear motors. It is designed to work with 50W to 750W motors. Higher power motors will be supported in future versions.

The drive has a broad range of features, as well as a new and advanced commissioning tool – ServoStudio+ software.

1.2 Product Models – Ordering Information

The following diagram shows the ordering options that comprise the various model numbers of the drives in the CD3E product line.

		CD3E – 003 2A EB – 0 0
	CD3E Servo Drive	
	Rating	
	200–240 VAC	
	Cont. [A rms] **Cont. [A rms]**	
003	3 9	
5D5	5.5 17	
	AC and Controller Input Power Supply	
2A	Medium voltage input power supply 1-phase 200 VAC ±10%, 50/60 Hz	
	Communication Interfaces	
EB	EtherCAT, Ethernet	
EG	EtherCAT, Ethernet, Gantry	
AP	Pulse train reference	
	Analog Input	
[***blank***]	Default	
1	One analog input, 16-bit	
	Customized	
[***blank***]	Default	

1.3 Product Package

Upon delivery, open the package and remove all packaging materials.

Check to ensure there is no visible damage to the products. If damage is detected, notify the carrier immediately.

After unpacking, check the part number label on the product. Make sure it matches the product your ordered, and that the voltage meets your specific requirements.

The CD3E package includes the following items:

- CD3E servo drive
- Power mating connector
- STO bypass plug

1.4 Product Label

Table 1-1. CD3E Product Label Codes

Item	Description
Model	Catalog number (ordering information)
S/N	Product serial number. Digits 1–14 = Material code Digits 15–20 = Production year, month and day Digit 21 = Production workshop Digit 22 = Production type Digits 23-27 – Production serial number
HW	Hardware version

Figure 1-1. CD3E Product Label – Example

2 Safety

2.1 Safety Symbols

Safety symbols indicate a potential for personal injury or equipment damage if the prescribed precautions and safe operating practices are not followed.

The following safety-alert symbols are used on the drive and in the documentation.

Symbol	Meaning	Description	ISO 7000/ IEC 60417
	Caution	Indicates caution is necessary when operating the device. Also indicates the current situation needs operator awareness or operator action to avoid undesirable consequences.	0434
	Dangerous voltage	Indicates hazards arising from dangerous voltages.	5036
	Protective earth; protective ground	Identifies any terminal which is intended for connection to an external conductor for protection against electric shock in case of a fault, or the terminal of a protective earth (ground) electrode.	5019
	Caution, hot surface	Indicates the marked item can be hot and should not be touched without taking care.	5041

2.2 Safety Guidelines

Only qualified personnel may perform installation, operation, service and maintenance procedures. These persons must have sufficient technical training and knowledge to foresee and recognize potential hazards that may occur when using the product, modifying settings, and operating the mechanical, electrical and electronic components of the entire machine system.

- All persons working on and with the product must be fully familiar with all applicable standards, directives, and accident prevention regulations when performing such work.
- The CD3E servo drive is intended for use as a component within a machine system.
- The machine builder and integrator must ensure the protection of both personnel and the complete machine system.
- The machine builder and/or integrator must perform a risk assessment in view of using the CD3E drive in the intended application. Based on the results, the appropriate safety measures must be implemented.
- The CD3E drive must be used in compliance with all applicable safety regulations and directives, and all technical specifications and requirements.
- Before installing the CD3E, be sure to review the safety instructions in the product documentation. Failure to follow the safety instructions may result in personal injury or equipment damage.

The CD3E drive utilizes hazardous voltages. It must be properly grounded.

When connecting the CD3E to other control equipment, be sure to follow two basic guidelines to prevent damage to the drive:

- The CD3E must be grounded via the earth ground of the main AC voltage supply.
- Any motion controller, PLC or PC that is connected to the CD3E must be grounded to the same earth ground as the CD3E.

The machine builder and the machine owner are responsible for the safety of the machine operators.

The machine owner and the machine operator are responsible for ensuring personnel cannot enter the hazard zone while the machine is energized unless adequate functional safety mechanisms are in place.

3 Specifications

3.1 Standards Compliance

The product has been developed and produced in accordance with the following standards.

Certification is pending.

Certification	Directive	Standard(s)
Electrical, thermal and energy safety	EU Low Voltage Directive 2014/35/EU	IEC 61800-5-1
Electromagnetic compatibility for power drive systems	EMC Directive 2014/30/EU	IEC 61800-3
RoHS Assessment of electrical and electronic products with respect to the restriction of hazardous substances		EN 50581

3.2 Mechanical Specifications

Table 3-1. Mechanical Specifications

Feature	Specification	CD3E-003-2A	CD3E-5D5-2A
Dimensions	L (mm) W (mm) H (mm)	173 45 160	173 50 160
Weight	kg	1.105	1.232
Connection Hardware	PE ground screw Size/Torque	M4/1.35 Nm	M4/1.35 Nm
Mounting	Vertical, horizontal		
Clearance Distance	Side-to-Side (mm)	20	20
	Top/Bottom (mm)	50	50

The external dimensions of the CD3E drive are shown in the following figures.

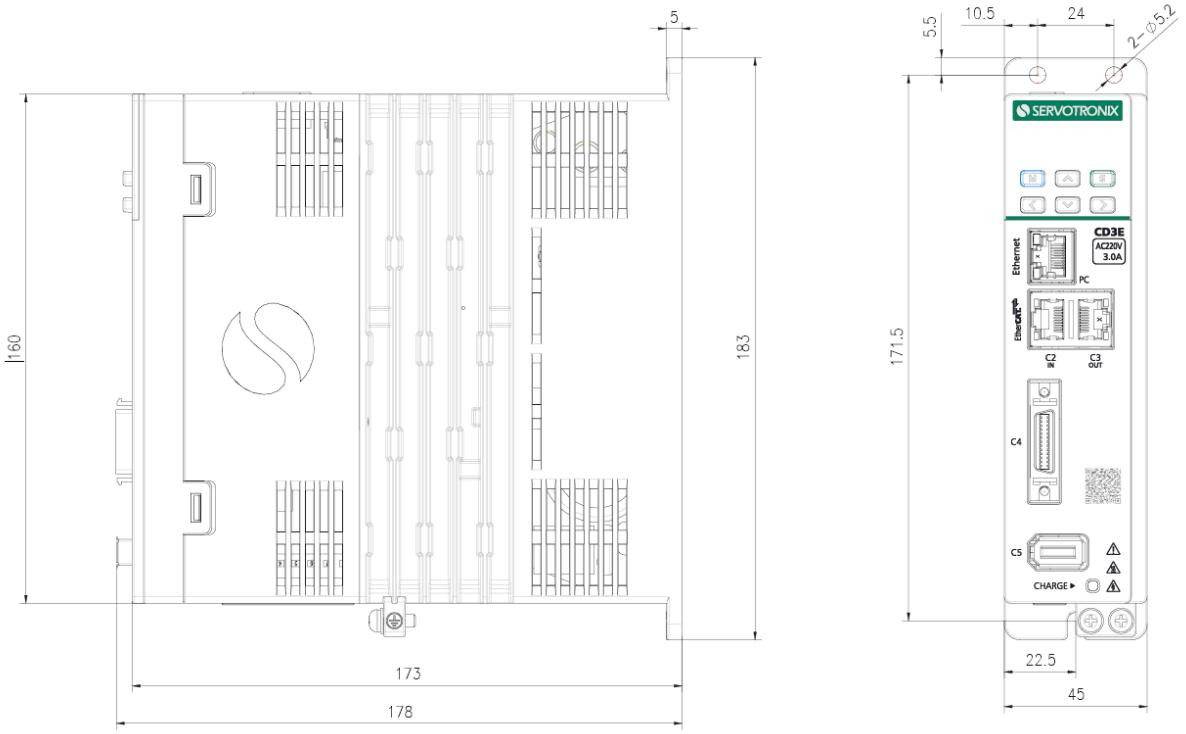


Figure 3-1. CD3E-003 Dimensions (mm)

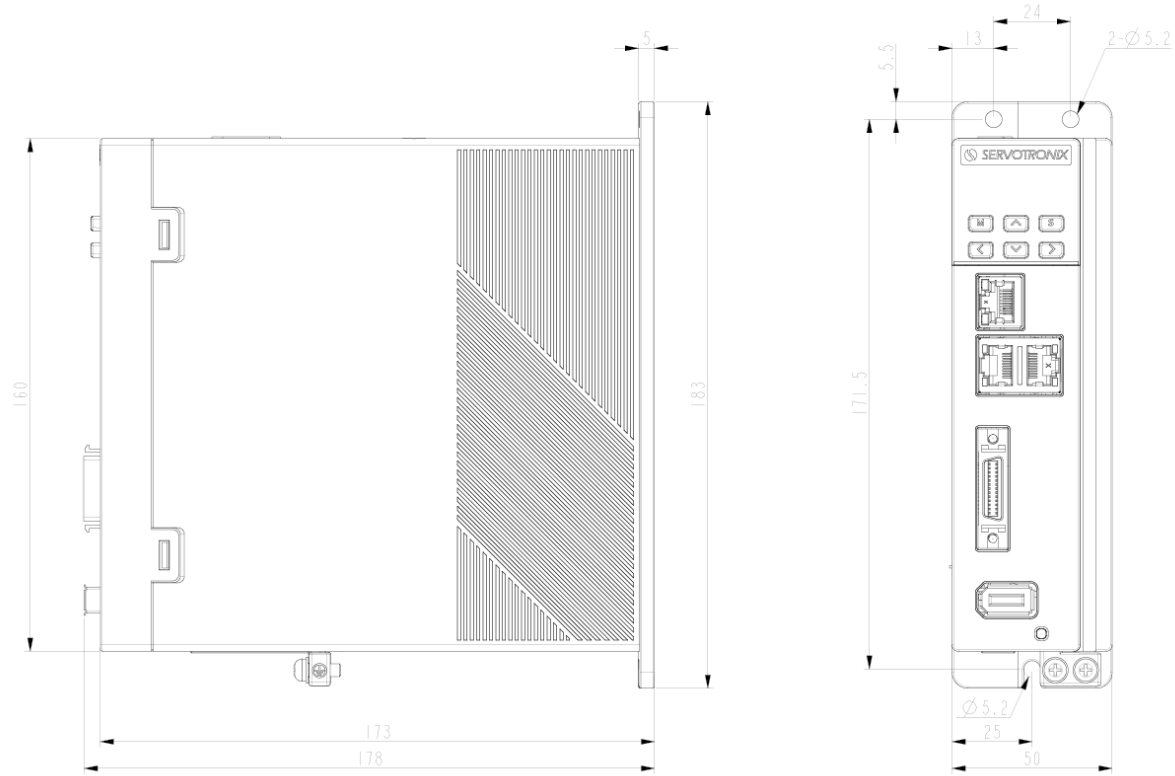


Figure 3-2. CD3E-5D5 Dimensions (mm)

3.3 Electrical Specifications

Table 3-2. Electrical Specifications

Feature	Specification	CD3E-003-2A	CD3E-5D5-2A
Max motor power		400 W	750 W
Input power	Input voltage	1-phase 220 VAC ±10%	1-phase 220 VAC ±10%
	Line frequency	50/60 Hz	50/60 Hz
	Continuous current	4.2 Ams	7.9 Arms
	Line fuses (FRN-R, LPN, or equivalent)	6 A	16 A
Drive output	Continuous output current	3 Arms	5.5 Arms
	Peak output current @2 sec	9 A	17 A
	PWM frequency	8 kHz	8 kHz
External regenerative resistor requirements	Peak current	–	5.5 A
	Minimum resistance	–	40 Ω
	Power rating	–	50 W
Application Information	Internal bus capacitance	660 μF	940 μF

3.4 Control Specifications

Table 3-3. Control Specifications

Feature	Specification	
Motor	Types	Linear motor Rotary motor
	Motor phasing	Automatic configuration of motor phasing and encoder direction
	Motor direction	Clockwise/counter-clockwise, encoder direction
Operation Modes	Control modes	• Current (torque) control • Speed control • Position control
Current (Torque) Control	Update rate	8 kHz
	Control loop	DQ, PI, Feedforward
	Reference command	Ethernet/EtherCAT
	Autotuning	Automatic setting of current control loop parameters
	Parameter tuning method	Automatically sets the parameters of the current control loop

Feature	Specification	
Speed Control	Update rate	4 kHz
	Control loop	PDFF
	Reference command	Ethernet/EtherCAT
	Filter	First-order low-pass filters, notch filters, load disturbance observers, velocity observers
	Parameter tuning method	Rigidity table, automatic parameter setting (load inertia ratio identification), manual parameter setting, load adjustment-free function.
Position Control	Update rate	4 kHz
	Control loop	PID feedforward
	Reference command	Ethernet/EtherCAT
	Parameter tuning method	Rigid table, manual parameter setting, load adjustment-free function
Brake	Method	Dynamic braking, electric motor regenerative braking
Advanced Control Functions		Velocity observer, Friction compensation, Harmonic compensation, Collision detection, Input shaping, Gain scheduling
Tuning	Methods	Autotuning, Frequency analyzer, Inertia and friction estimation
User Interface	GUI	ServoStudio+, web-based, can run on PC and other platforms
	Operator panel	6 keys, 5-digit LED display
	Functions	Set up connections, drive information, power information, motor, feedback, input/output selection/configuration, action setting/tuning, fault history/display, setup wizard, expert view.
Movement units	Position	count (user unit), mm, μm, pitch
	Velocity	mm/s
	Acc/Dec	mm/s^2

3.5 Environmental and Protection Specifications

Table 3-4. Environmental Specifications

Feature	Specification
Protection class	Degree of protection: IP20 Pollution level: IEC 60664-1 class 2 Do not use in environments where exposed to: corrosive or flammable gases, water, oil or chemicals, dust (including iron powder), and salt
Operating temperature	0° to 45°C without derating 45° to 55°C with derating
Storage temperature	-20° to 70°C
Humidity	10 to 90% (no condensation)
Altitude	<1000 m, according to IEC 61800-5-1
Vibration	5.88 m/s^2, 10–60Hz
Protection features	Includes but is not limited: dynamic braking (hardware) low/overvoltage, overcurrent, drive and motor overheating, motor overload protection, driver overload protection, feedback loss, non-configuration, circuit failure.

3.6 STO Specifications

Functional safety has been verified by the manufacturer.

Table 3-5. STO/Functional Safety Specifications

Feature	Specification	
Nominal voltage	24 VDC	
Voltage levels	15–30 VDC 0–5 VDC 5–15 VDC	STO function not active (motion allowed) STO function active (motion not allowed) STO function not defined and not guaranteed
Power supply – external	SELV/PELV required	
Power supply – internal	STO jumper required	
Maximum reaction time	30 ms	

3.7 Communication Specifications

Table 3-6. Communication Specifications

Feature	Specification
Type	EtherCAT over Ethernet (CoE), 100 Mbit
Communication cycle time (minimum)	1 ms
Device configuration file	IEC61800-7 Profile type1 (CiA402) CoE (CANopen over EtherCAT)
Communication object	PDO (Process Data Object) SDO (Service Data Object)
Synchronization type	SYNC0 Event Synchronization

3.8 I/O Specifications

Table 3-7. Digital Inputs/Outputs Specifications

Feature	Specification	
Digital inputs	Quantity	5
	Signal format	Opto-isolated. Configurable as either PNP (sourcing) or NPN (sinking).
	Voltage level	24V
	Maximum input current	6 mA
	Transmission delay time	1 ms
	Maximum frequency	1 kHz
Fast digital inputs	Quantity	2, for touch probe.
	Signal format	Opto-isolated. Configurable as either PNP (sourcing) or NPN (sinking).
	Voltage level	24V
	Maximum input current	12.5 mA
	Transmission delay time	1 μs
	Maximum frequency	500 kHz
Digital outputs	Quantity	3
	Signal format	Opto-isolated. NPN (sinking)
	Voltage level	24V
	Maximum output current	50 mA per output (total 100 mA)
	Short-circuit protection	
	Transmission delay time	1 ms
Fast digital outputs	Quantity	1, in EG models only. For PCOM function, gantry application

Feature	Specification	
	Signal format	Opto-isolated. NPN (sinking)
	Voltage level	5 to 24 V
	Maximum output current	50 mA
	Short-circuit protection	Yes
	Transmission delay time	1 μs

3.9 Motor Feedback Specifications

Table 3-8. Motor Feedback Specification

Feature	Specification
Supply voltage from drive	5.2 VDC
Max. supply current from drive	
Recommended cable type	Shielded twisted-pair copper wire
Encoder type	BiSS-C, AB incremental

4 Installation

4.1 Installation Overview

Perform the following steps to install and setup a CD3E system.

1. Mount the CD3E.
2. Make all wiring and cable connections, as required by your application.
3. After completing all hardware connections, you can power on the drive and PC.
4. Install ServoStudio+ software on the PC.
5. Activate ServoStudio+ and connect to the drive.

4.2 Mounting

4.2.1 Mounting the CD3E

Using the bracket on the back of the CD3E, mount the CD3E on a grounded conductive metal panel. The panel must be sufficiently rigid.

For mounting dimensions, refer to section *Mechanical Specifications*.

4.2.2 Mounting Multiple Units

When multiple CD3E units are mounted side-by-side within a cabinet or enclosure, the recommended minimum spacing between units is 20 mm. The recommended minimum top and bottom clearance is 50 mm for all CD3E models.

It is important to maintain an ambient temperature within the enclosure that does not exceed 45°C. If CD3E units are mounted on a backplane, also make sure the backplane temperature does not exceed 45°C. It is recommended that a cooling fan be installed at the bottom of the cabinet for best circulation.

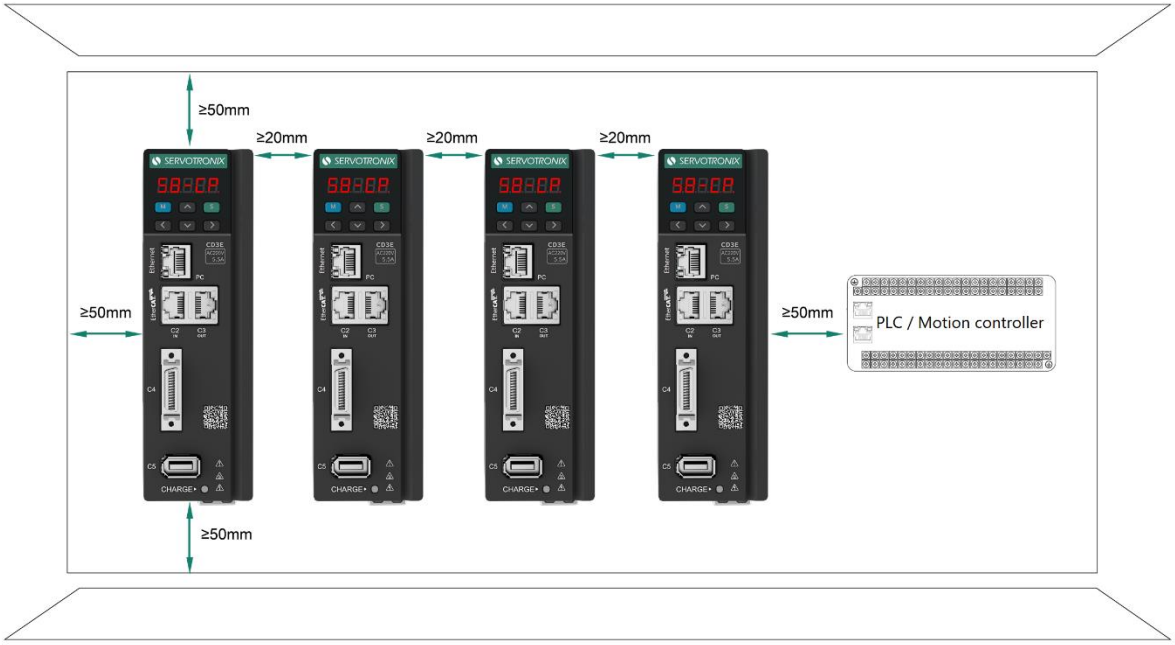


Figure 4-1. Mounting Multiple CD3E Units within Cabinet

4.3 System Wiring Guidelines

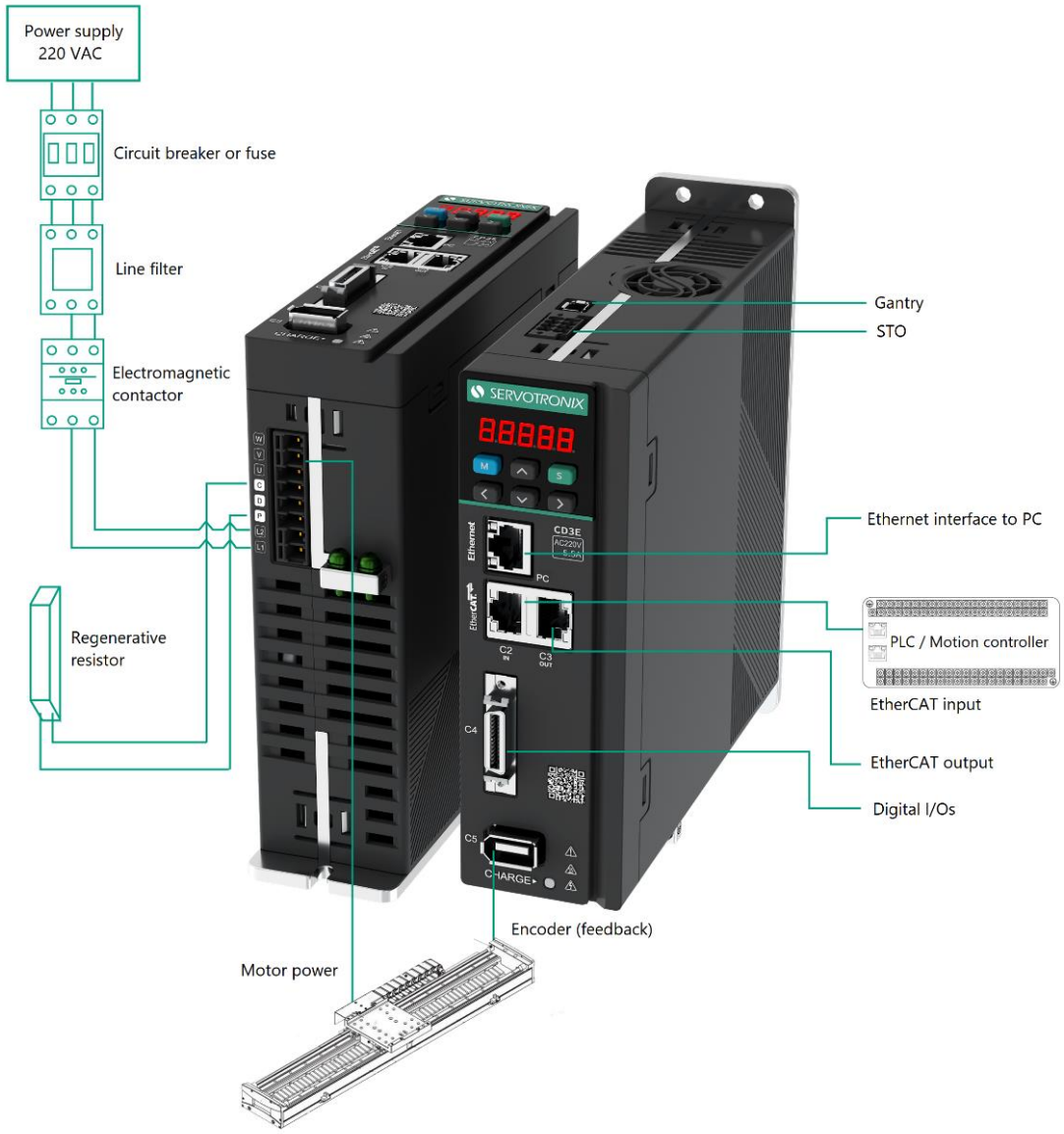


Figure 4-2. System Wiring

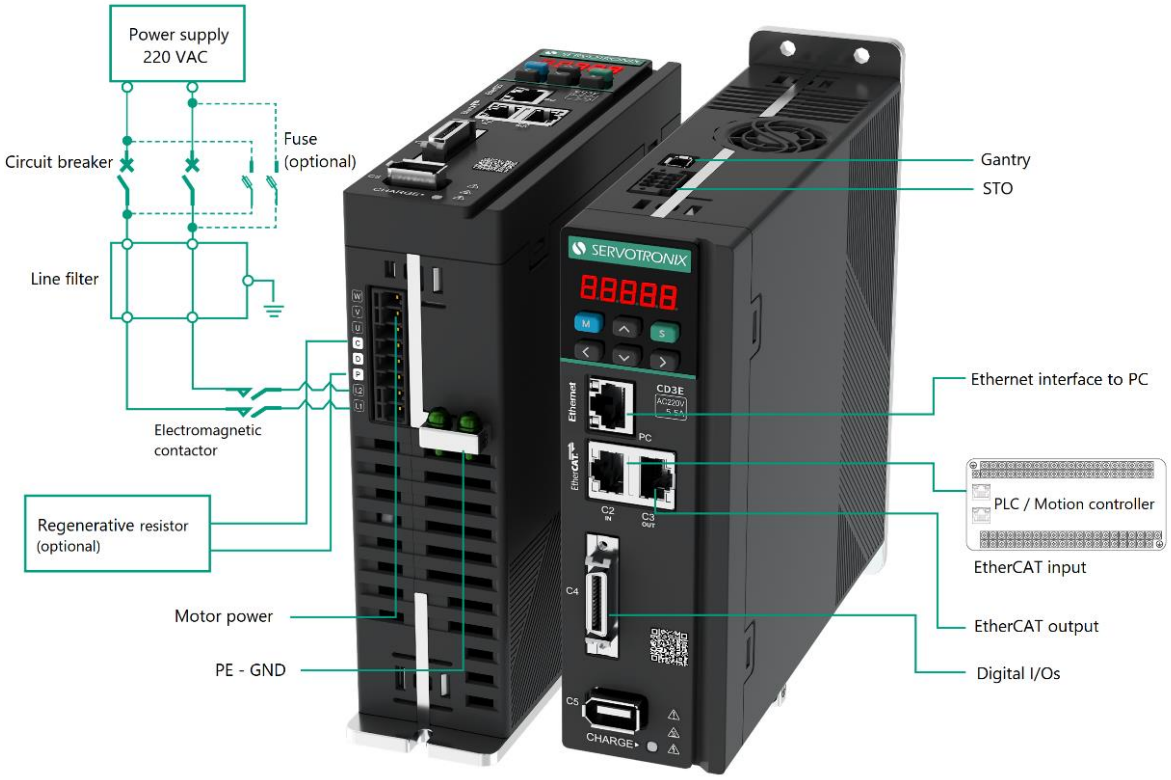


Figure 4-3. System Circuitry

4.3.1 Grounding

When connecting the CD3E to other control equipment, be sure to follow two basic guidelines to prevent damage to the drive:

- The CD3E must be grounded via the earth ground of the main AC voltage supply.
- Any motion controller, PLC or PC that is connected to the CD3E must be grounded to the same earth ground as the CD3E.

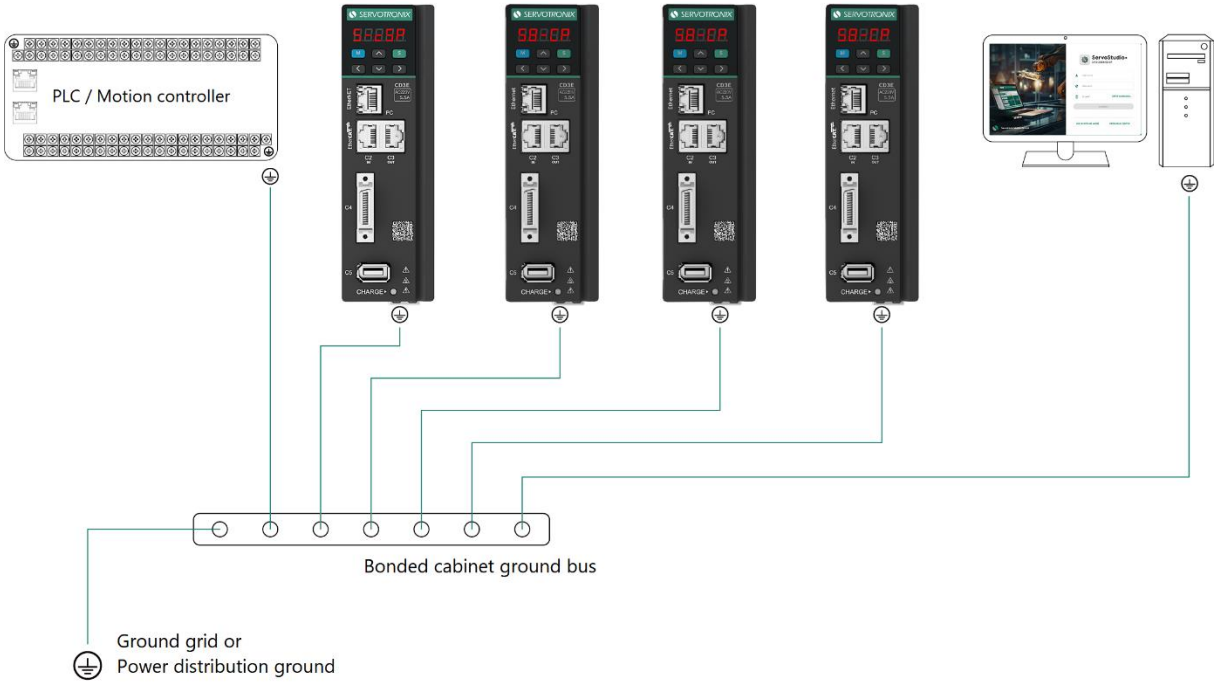


Figure 4-4. System Grounding

System grounding is essential for proper performance of the drive system.

The AC input voltage ground wire must be connected to a PE terminal on the drive. This is necessary for both safety and EMI reduction.

Use a single point ground for the system (star wiring) to avoid ground loops.

It is strongly recommended that the CD3E be mounted to a metallic back panel, and that a high frequency ground be provided to connect the back panel to earth ground. Provide an electrical connection across the entire back surface of the drive panel. Electrically-conductive panels such as aluminum or galvanized steel are recommended. For painted and other coated metal panels, remove all coating behind the drive. The objective is to provide an extremely low impedance path between the filters, drives, power supplies, and earth ground for high-frequency signals that might cause EMI. Use a flat braid or copper busbar to achieve high-frequency grounding. Use the shortest braid possible when connecting high frequency grounds.

Ensure good connections between the cabinet components. Connect the back panel and cabinet door to the cabinet body using several conductive braids. Never rely on hinges or mounting bolts for ground connections. Ensure good ground connection from cabinet to proper earth ground. Ground leads should be the same gauge as the leads to main power or one gauge smaller.

The PC must also be properly grounded.

4.3.2 Shielding and Bonding

To minimize noise emissions and maximize the immunity levels of the drive system, motor and feedback cables must be shielded and properly bonded to a grounded surface.

The shield must be connected to ground at both ends of the cable. Its effect is to reduce the impedance between the cable shield and the back panel.

It is recommended that all shielded cables be bonded to the back panel.

The motor and feedback shielded cables should be exposed as close as possible to the drive. This exposed cable shield is bonded to the back panel using either non-insulated metallic cable clamps or cable bonding clamps.

It is recommended to use a star point shield connection with a shielding busbar.

4.3.3 Input Power Filtering

To meet the CE requirements for industrial environments, the electronic system components in the CD3E require EMI AC line filtering in the input power leads.

Care must be taken to adequately size the system. The type of filter is determined according to the voltage and current rating of the system and whether the incoming line is single phase or three phase.

Implementation of the input power filter must adhere to the following guidelines:

- Maintain separation of leads entering and exiting the mains filter.
- Filter must be mounted on the same panel as the drive.
- Filter must be mounted as close as possible to the drive, to prevent noise from being capacitively coupled into other signal leads and cables.
- When mounting the filter to the panel, remove any paint or material covering. Use an unpainted metallic back panel, if possible.
- Filters are provided with a ground terminal, which must be connected to ground.
- Filters can produce high leakage currents. Filters must be grounded before connecting the supply.
- Filters should not be touched for 10 seconds after removing the supply.

4.3.4 Regeneration

When a motor and load decelerate rapidly, kinetic energy of the load drives the motor shaft energy back to the drive. This regeneration energy must be dissipated or absorbed.

Regenerative energy that is not dissipated is added to the electrical energy already stored in the capacitors of bus module. If the capacitors can absorb the energy, the system does not require a regeneration resistor. However, if excessive energy is added, the voltage on the capacitors will exceed the over-voltage threshold, which then disables the drive.

To prevent over-voltage, and potential damage to the system, excessive regenerative energy must be dissipated by a regeneration resistor.

If your application requires a regenerative resistor for braking a high inertia load during emergency stops, connect an external regenerative resistor to terminals C and P on the Power interface.

5 Interfaces – Pinouts and Wiring

5.1 Power Interface

The power interface serves to connect the AC power supply to the CD3E.

The interface is also used to supply power to the motor phases.

In addition, it provides the connection to an external regenerative power resistor to dissipate energy generated by the motor, typically during deceleration.

Make sure the main voltage rating matches the drive specification. Applying incorrect voltage may cause drive failure.

Do not apply power until all hardware connections are complete.

Prevent inrush surge: Bus power (L1-L2): After switching off bus power, wait 1 minute before switching on again.

Power Pinout

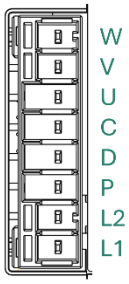


Figure 4-1. Power Interface

Table 5-1. Power Interface

Pin	Name	Description
1	WOUT	Motor phase W
2	VOUT	Motor phase V
3	UOUT	Motor phase U
4	C	Regenerative resister C
5	D	Regenerative resister D
6	P	Regenerative resister P
7	L2	AC power supply – line L2
8	L1	AC power supply – line L1

Mating connector	Sunchu: SC-T3005008SB0XT-45
Wiring	14–12 AWG
Strip length	7 mm

Procedure:Connecting Power

The CD3E has 2 ground PE terminals, located on bottom panel next to the Power interface.

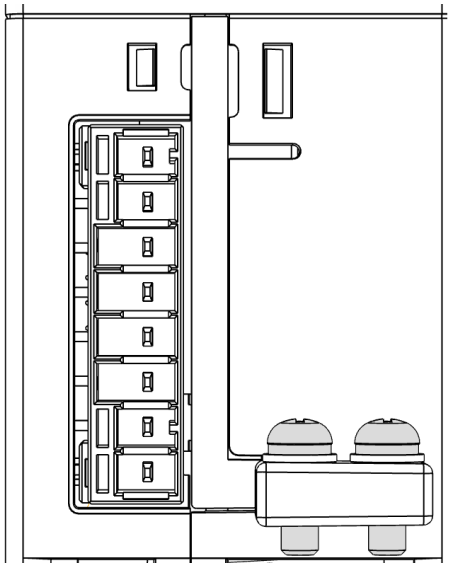


Figure 4-2. PE terminal screws

1. Connect the AC input voltage ground wire to one of the PE terminals. Use an M4 ring or a spade terminal.
2. Connect L1 and L2.
   - If the main voltage is from a single-phase source, connect line and neutral to L1 and L2.
   - If the main voltage is from a 3-phase source, connect any two phases to L1 and L2.

5.2 C1 Interface – STO

Safe torque off (STO) is a safety function that prevents the drive from delivering power to the motor, which can generate torque.

Pins 1 and 2 (24V and 24V_COM) must be connected to enable drive operation.
The STO-enabled signal voltage must be 24 VDC.

Note If the application does not require STO control, use the STO bypass plug supplied with the drive.

C1 Pinout

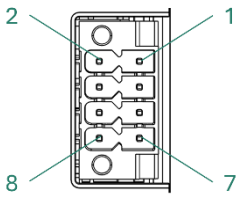


Figure 4-3. Interface C1

Table 5-2. Interface C1

Pin #	Name	Description
1	24V+	24V power supply positive
2	24V_COM	24V power supply ground
3	EXT_STO_1	STO1 switch input
4	EXT_STO_COM	STO switch circuit ground
5	EXT_STO_2	STO2 switch input
6	EXT_STO_COM	STO switch circuit ground
7	NC	*not connected*
8	NC	*not connected*

Description	Bypass plug
Mating connector	Weiling: Part number 12115000001401

C1 Wiring – External Power Supply – STO

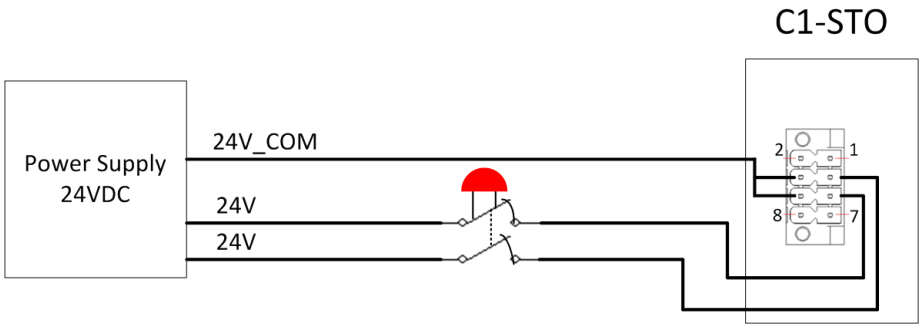


Figure 4-4.

C1 Wiring – Internal Power Supply – STO

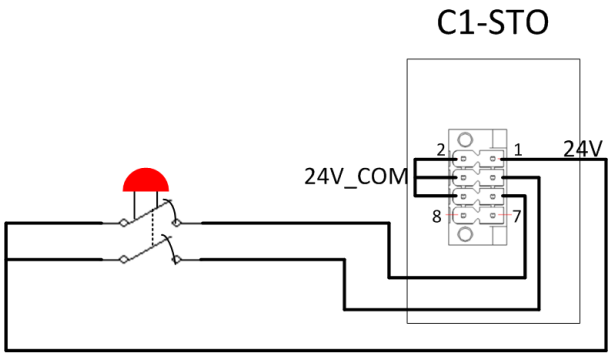


Figure 4-5.

5.3 PC–Ethernet Interface

For commissioning, the drive is connected to the PC through the Ethernet port.

PC–Ethernet Pinout

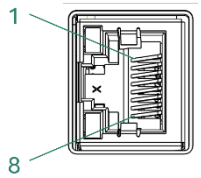


Figure 4-6. Interface PC-Ethernet

Table 5-3. Interface PC-Ethernet

Pin	Name	Description
1	RXP	Ethernet receive – differential positive
2	RXN	Ethernet receive – differential negative
3	TXP	Ethernet drive transmit – differential positive
4	NC	*not connected*
5	NC	*not connected*
6	TXN	Ethernet drive transmit – differential negative
7	NC	*not connected*
8	NC	*not connected*

Mating connector	Any CAT5e compatible shielded connector
Cable	CAT5e or higher, standard Ethernet straight cable

5.4 C2 / C3 Interfaces – EtherCAT

Interfaces C2 and C3 are RJ45 ports that serve as transmitter and receiver for drives operating on an EtherCAT network.

C2/C3 Pinout

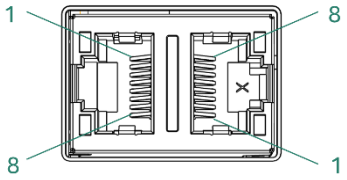


Figure 4-7. Interfaces C2 / C3

Table 5-4. Interfaces C2 / C3

Pin	Name	Description
1	RXP	EtherCAT receive – differential positive
2	RXN	EtherCAT receive – differential negative
3	TXP	EtherCAT drive transmit – differential positive
4	NC	*not connected*
5	NC	*not connected*
6	TXN	EtherCAT drive transmit – differential negative
7	NC	*not connected*
8	NC	*not connected*

Mating connector	Any CAT5e compatible shielded connector
Cable	CAT5e or higher, standard Ethernet straight cable

5.5 C4 Interface – I/Os

Interface C4 enables the connection of external I/O devices to the CD3E.

C4 Pinout

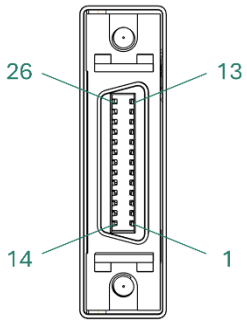


Figure 4-8. Interfaces C4

Table 5-5. Interface C4

Pin	Name	Description
1	OZ-	Encoder emulation output Z-channel – differential negative
2	OZ+	Encoder emulation output Z-channel – differential positive
3	OA+	Encoder emulation output A-channel – differential positive
4	OA-	Encoder emulation output A-channel – differential negative
5	OB+	Encoder emulation output B-channel – differential positive
6	OB-	Encoder emulation output B-channel – differential negative
7	P_COM_GND	PCOM signal GND
8	EXT_DI_2	External digital input 2
9	EXT_DI_3	External digital input 3
10	COM_DO	Common digital output
11	EXT_DI_1	External digital input 1
12	EXT_DO_2+	External digital output 2
13	EXT_DO_3+	External digital output 3
14	OZ_OC	Incremental encoder Z-channel single-ended output
15	GND	Signal GND
16	P_COM_PWR	PCOM signal power supply
17	GND	Signal GND
18	GND	Signal GND
19	Fast_P	PCOM signal output
20	EXT_DO_1+	External digital output 1
21	COM_PD	Fast digital input common
22	COM_INPUT	Common digital input

Pin	Name	Description
23	PULSE_SI	Fast digital input pulse signal
24	DIR_SI	Fast digital input direction signal
25	EXT_DI_5	External digital input 5
26	EXT_DI_4	External digital input 4

Description	SCSI-26 pin
Mating connector	Goldconn Precision Electronics: KSCS026MACAAAXX1

C4 Wiring – Digital Inputs – Source (PNP)

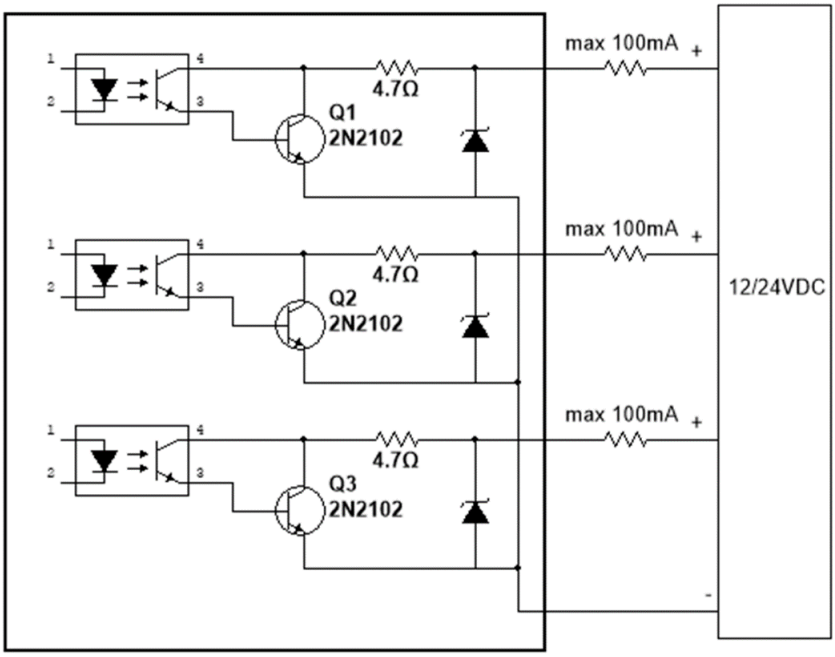


Figure 4-9.

C4 Wiring — Fast Digital Output PCOM

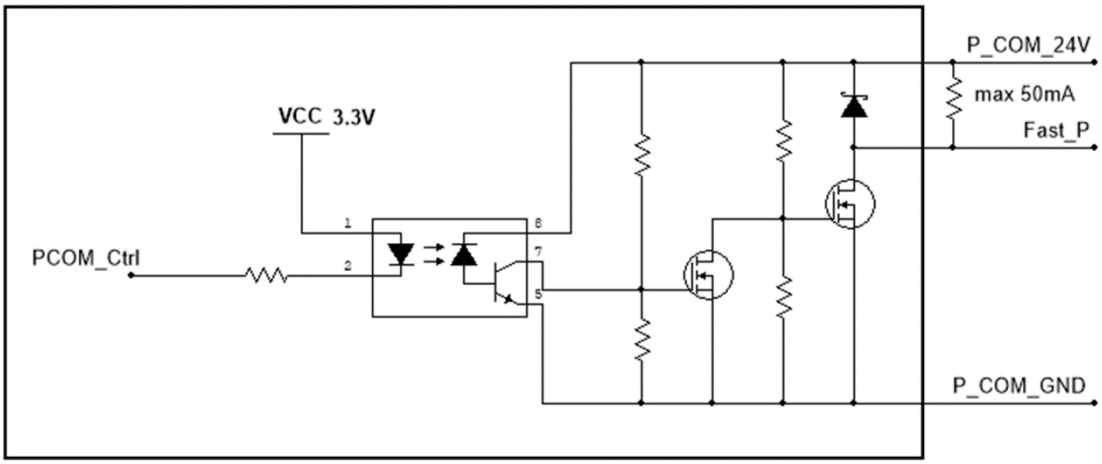


Figure 4-10.

5.6 C5 Interface – Encoder / Motor Feedback

The interface supplies power to the motor encoder.

The connection supports AB incremental encoders and absolute BiSS-C encoders.

C5 Pinout

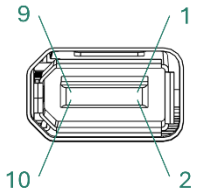


Figure 4-11. Interface C5

Table 5-6. Interface C5

Pin	Name	Description
1	Encoder_5V	Encoder power supply 5V
2	GND	Encoder power supply GND
3	A+/CLK+	ABZ encoder A channel – differential positive or ABS encoder Clock – differential positive
4	A-/CLK-	ABZ encoder A channel – differential negative or ABS encoder Clock – differential negative
5	B+/DATA+	ABZ encoder B channel – differential positive or ABS encoder Data – differential positive
6	B-/DATA-	ABZ encoder B channel – differential negative or ABS encoder Data – differential negative
7	Z+	ABZ encoder Z channel – differential positive
8	Z-	ABZ encoder Z channel – differential negative
9	NC	*not connected*
10	NC	*not connected*

Description	10 pin 1394 connector
Mating connector	WCON-Dongguan: 6131-10FS0BAGA1

C5 Wiring – Motor Feedback

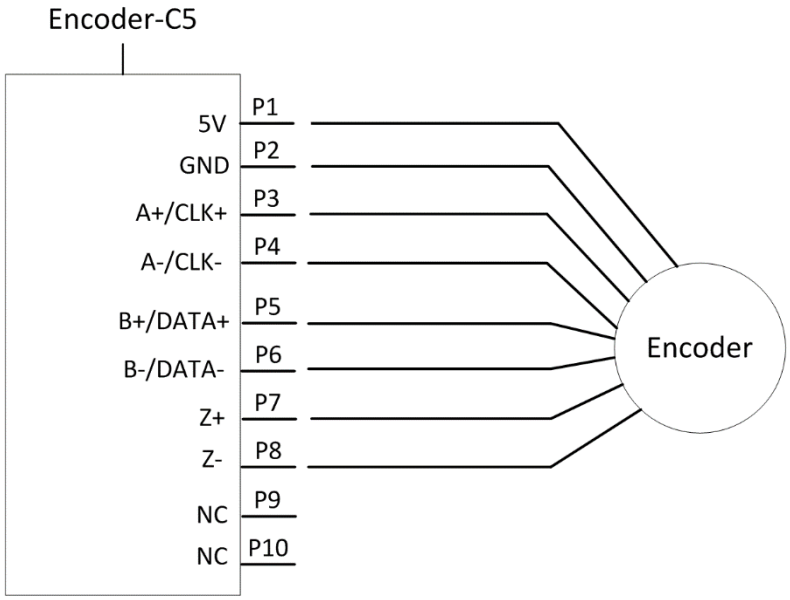


Figure 4-12.

5.7 C6 Interface – Gantry

C6 Pinout

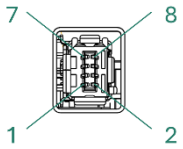


Figure 4-13. Interface C6

Table 5-7. Interface C6

Pin	Name	Description
1	FSI_TX0_CLK_P	Gantry drive transmit – Clock differential – Positive
2	FSI_TX0_CLK_N	Gantry drive transmit – Clock differential – Negative
3	FSI_TX0_D0_P	Gantry drive transmit – Data differential – Positive
4	FSI_TX0_D0_N	Gantry drive transmit – Data differential – Negative
5	FSI_RX1_CLK_P	Gantry receive – Clock differential – Positive
6	FSI_RX1_CLK_N	Gantry receive – Clock differential – Negative
7	FSI_RX1_D0_P	Gantry receive – Data differential – Positive
8	FSI_RX1_D0_N	Gantry receive – Data differential – Negative

Description	8-pin Micro connector
Mating connector	WCON-Dongguan: 6362-08MDHSXMCBA1

C6 Wiring

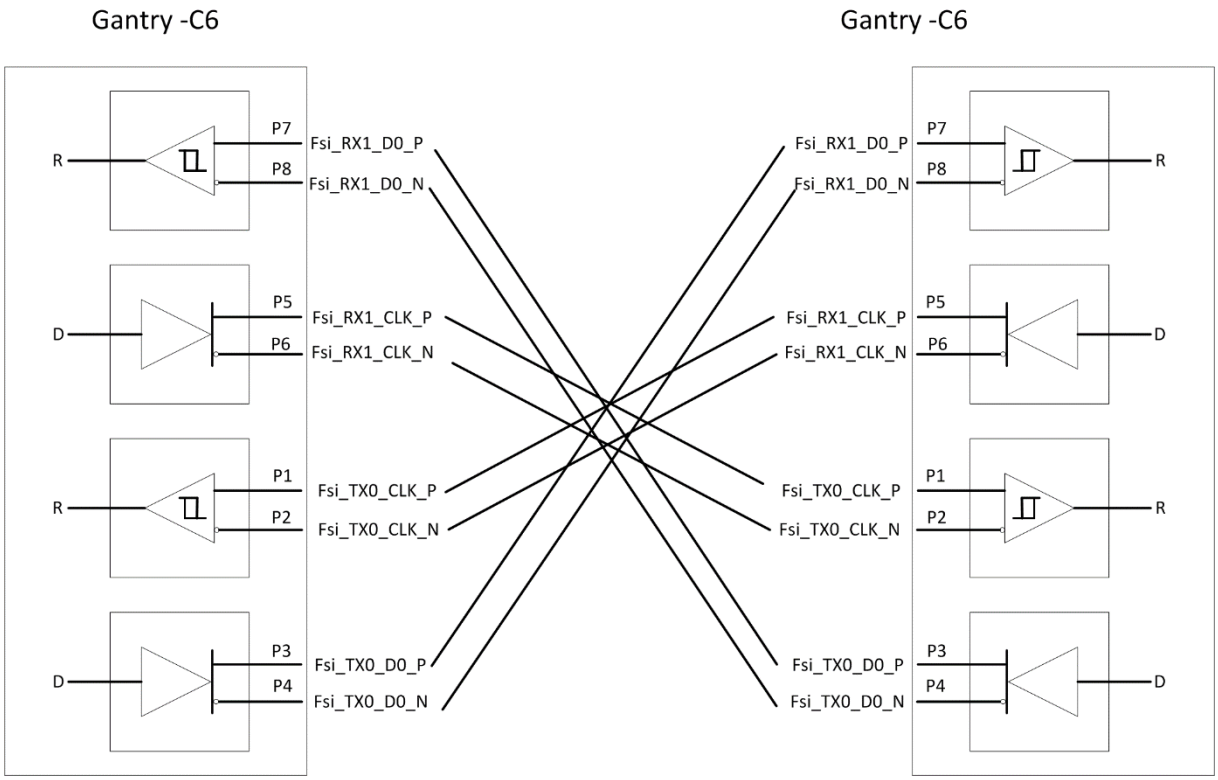


Figure 4-14. Interface C6

6 ServoStudio+ Software

6.1 Software Installation

ServoStudio+ is compatible with Windows 10 and later operating systems. If you require assistance with an older version of Windows, contact Servotronix Technical Support.

Download the ServoStudio+ software installation file from the Servotronix website, or contact Technical Support.

Run the file.

6.2 Activation

1. Activate ServoStudio+ from the desktop icon or the Start menu.
2. ServoStudio+ opens to the home screen.

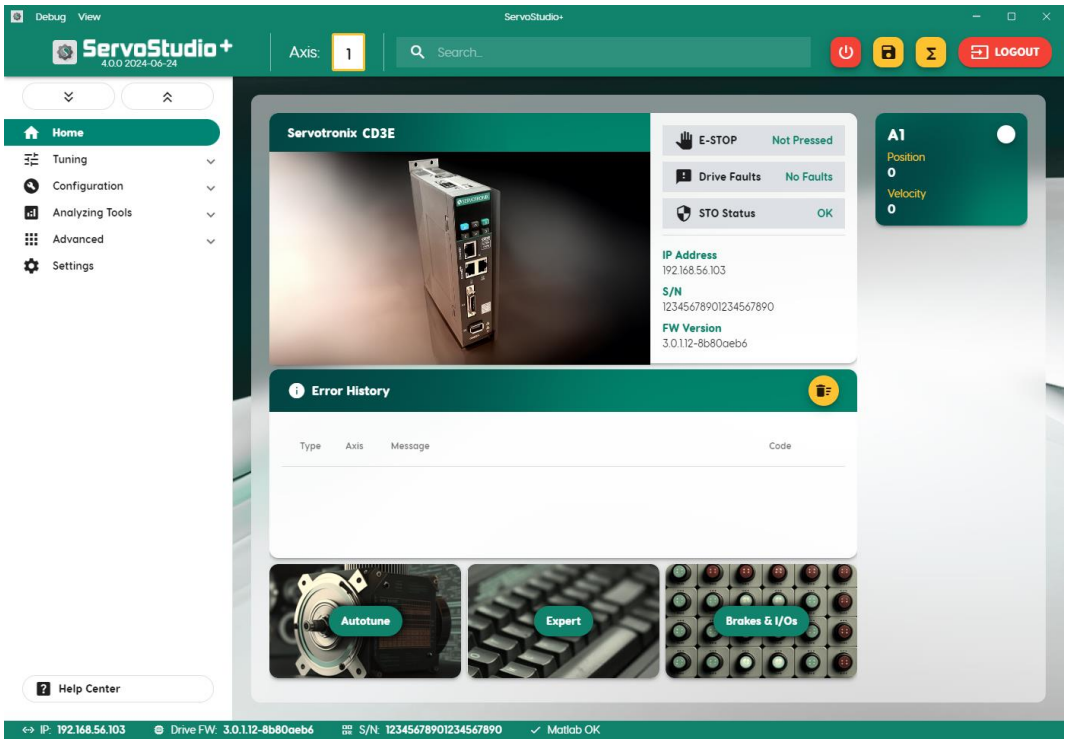


Figure 7-1. Home screen

The axis should be disabled during the basic configuration. If the axis icon is lit (green), it indicates the axis is enabled.

To disable the axis, do either of the following:

- Click the enable/disable button (the POWER icon) in the toolbar at the top of the ServoStudio+ window.
- Click the axis number in the toolbar. Then use the axis toggle button in the axes pane.

Axis color	Meaning
White	Axis disabled
Green	Axis enabled
Yellow	Axis disabled with a warning
Red	Axis disabled with a fault
Green/Yellow split	Axis enabled, with a warning

3. Open the ServoStudio+ navigation menu.

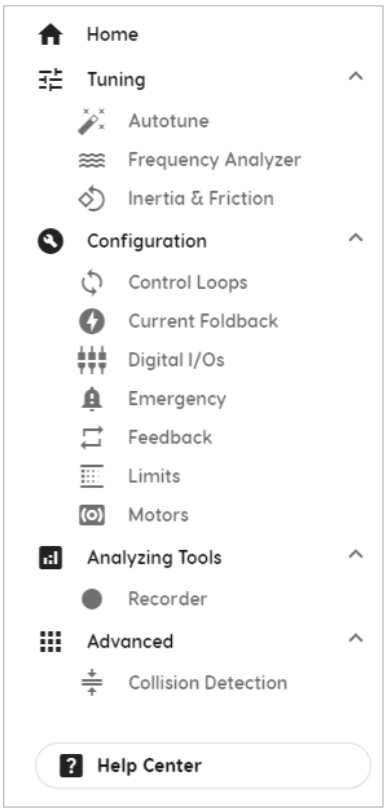


Figure 7-2. Navigation menu

6.3 Parameter Values

The first time a new drive is connected to ServoStudio+, the software displays the drive's factory-defined (default) parameter values.

ServoStudio+ reads and displays values from the drive RAM.

- After you edit a parameter value, press **Enter**, or press **Tab** to move the next field. The new value is sent to the drive RAM, and an update message is displayed.
- To save parameter values to the drive's non-volatile memory at any time, press the **Save** button on the ServoStudio+ toolbar. If not saved, modified parameter values are lost upon power cycle.

7 Basic Drive Configuration

This chapter describes the main steps for configuring the drive system using the ServoStudio+ interface. Depending on your specific drive model and configuration requirements, you might need to configure additional parameters or use other features in ServoStudio+.

7.1 Motors

Use the Motors screen to select a motor from ServoStudio+ databases. When you select the motor family and model, ServoStudio+ sets the appropriate motor and feedback parameters.

ServoStudio+ contains two databases of motor settings.

- The ServoStudio+ library contains a database of motors already defined and supported by Servotronix. These motor settings cannot be modified by users.
- The User library contains all other motors defined by users.

7.1.1 Load Motor Parameters

To load a set of motor parameters:

1. In ServoStudio+, select Configuration > **Motors**.

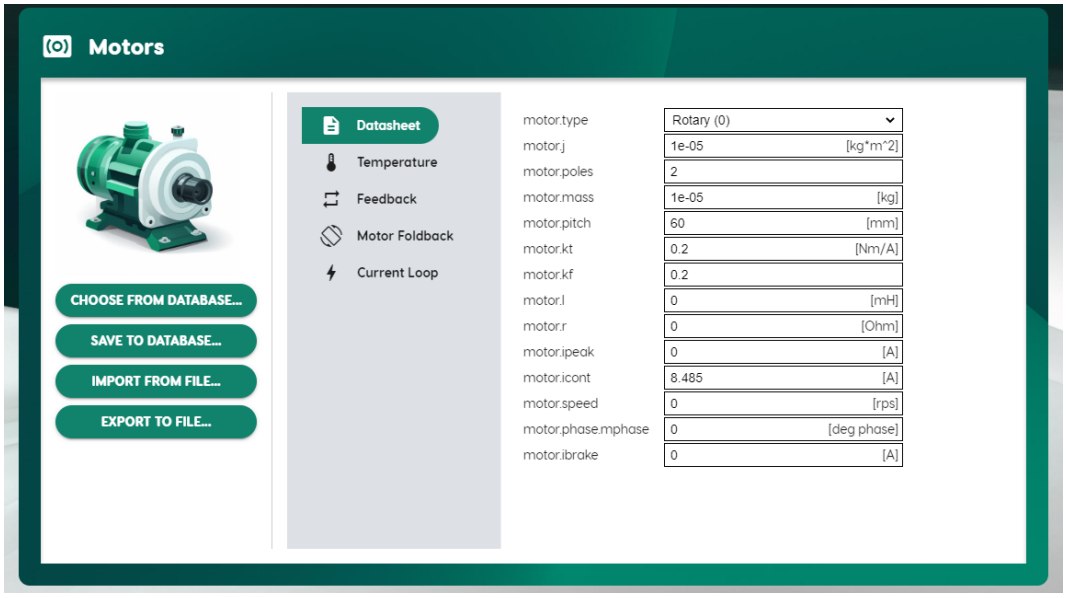
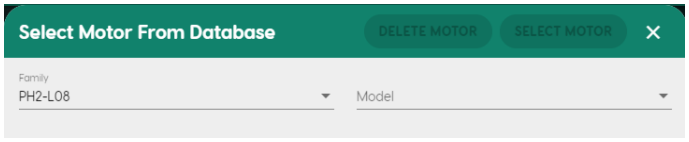


Figure 7-1. Motors

Choose from Database	Opens a menu that lets you select a motor from either the ServoStudio+ database or the User library.  **Family.** Predefined. ServoStudio+ has a number of databases containing predefined sets of parameters for motors. User Motors contains a list of motors whose parameter sets have been created by the user, either by modifying a predefined set, or by defining an entirely new set of parameters for a motor. **Model.** A list of all models in the selected Motor Family that have a predefined set of parameters in ServoStudio+. After choosing the motor, press Select Motor to write this motor's parameter set to the drive.
Import from File	Prompts you to load motor parameters to ServoStudio+ from a JSON file.

2. Select an axis from the menu bar at the top of the ServoStudio+ screen.
3. Select a motor from one of the ServoStudio+ motor libraries.
   a. Select Choose from Database.
   b. Select a motor from the Family and Model lists.

   Alternately, select a motor parameter file.
   a. Select Import from File.
   b. Select the JSON file containing the required motor parameters.

   ServoStudio+ loads and displays the appropriate motor and feedback parameters.
4. Repeat for each axis.

7.1.2 Modify Motor Parameters

To modify parameter values:

1. Click in a parameter field, and enter a new value.

   The modified field is highlighted, and you are prompted to save or discard the changes.

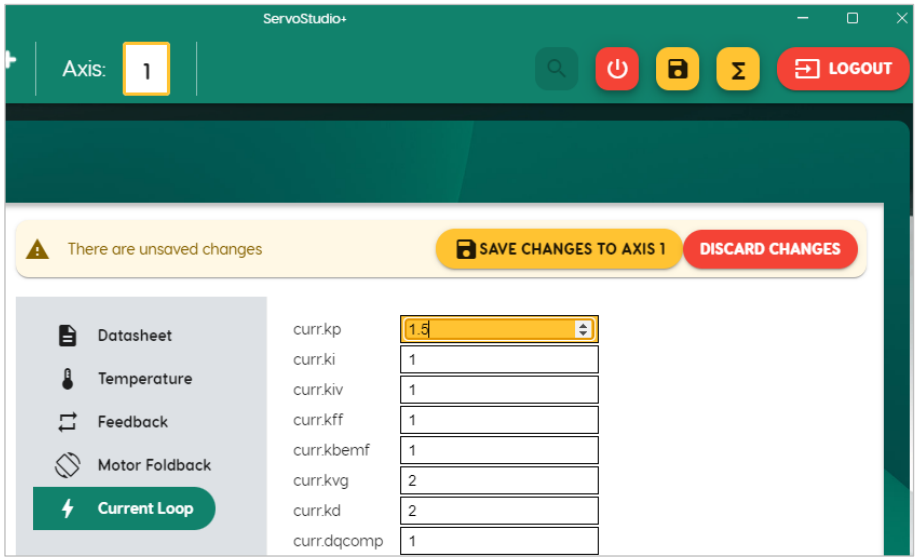


Figure 7-2. Save changes to axis (saves parameter in drive)

2. Select Save Changes to Axis n.

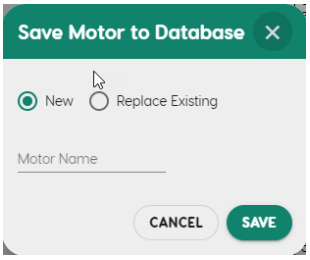
   Save Changes writes the new parameter values to the drive, but does not save the parameter values to the database or a file.

7.1.3 Copy Parameter Values to Another Motor

To copy parameter values from one motor to another:

1. With modified parameter fields highlighted, select the number of the axis you want to copy to.
2. Select Save Changes to Axis.

7.1.4 Save Motor Parameters

Save to Database	Saves motor parameter settings to the database. Does not write to the drive. • **New**. When modifying parameter values of a motor in the ServoStudio+ motor library, you can save the changes only by defining a new motor in the User library. • **Replace Existing**. You can overwrite a file in the User library. 
Export to File	Prompts you to save motor parameters from ServoStudio+ to a JSON file.

7.2 Motor Brakes

Use the Brakes pane in the Digital I/Os screen to activate brake functionality and to monitor the state of all brakes.

ServoStudio+ displays the actual number of brakes connected to the drive, as configured in the drive firmware.

Motor brakes are controlled by dedicated outputs, as configured in the drive firmware.

1. In ServoStudio+, select Configuration > **Digital I/Os**.

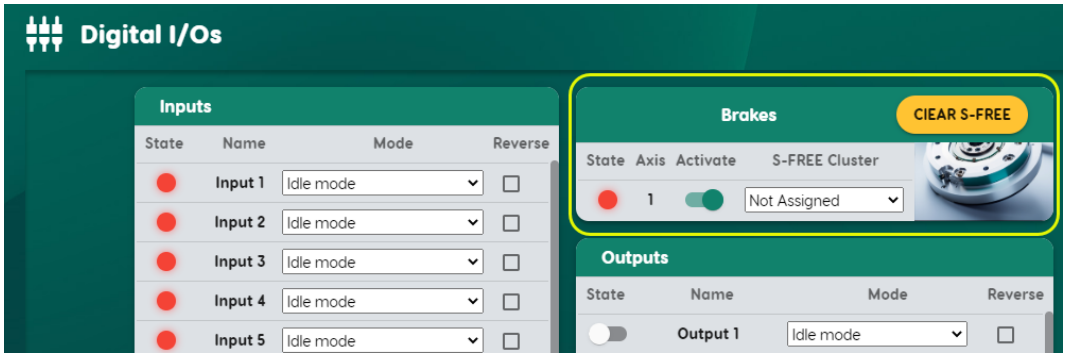


Figure 7-3. Brakes

2. In the Brakes pane, use the toggle button to activate the brake functionality for the axis.

7.3 Limits

Use the Limits screen to view and set parameters for position limits, velocity limits and your application's current limit.

1. In ServoStudio+, select Configuration > **Limits**.

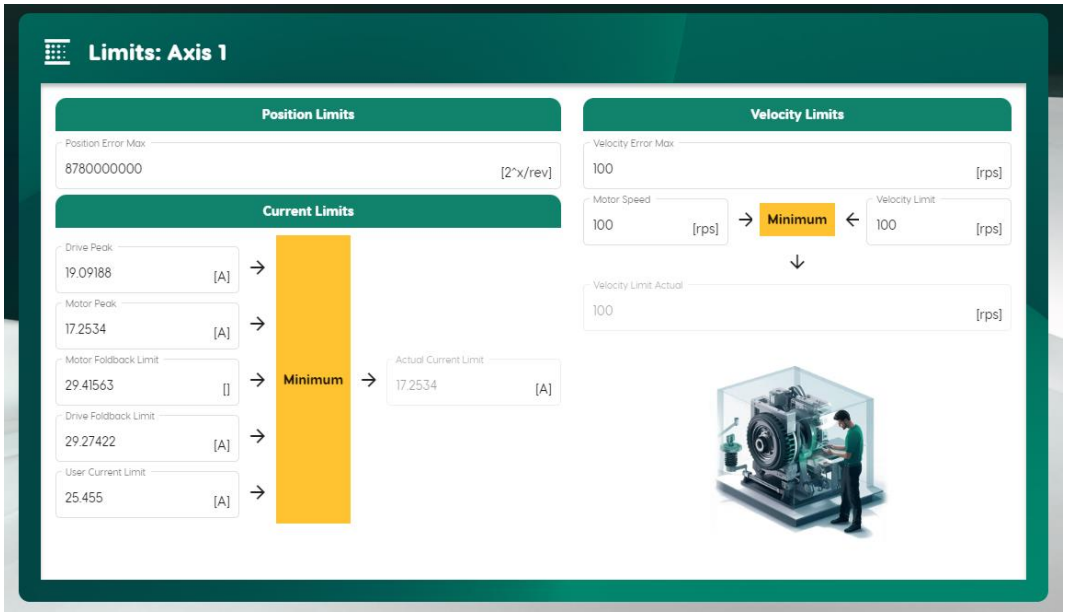


Figure 7-4. Limits

In the Limits screen, confirm and/or configure the position, velocity and current limits as required by your application.

Position Limits	
Position Error Max	The maximum position error value that does not produce a fault for the axis.
Velocity Limits	
Velocity Error Max	The maximum velocity error value that does not produce a fault.
Motor Speed	The maximum motor speed, according to the motor datasheet.
Velocity Limit	The maximum (user-defined) velocity limit for the application.
Actual Velocity Limit	Read only. The actual velocity limit for the application, which is the lowest (minimum) value of all velocity limit inputs, such as motor speed and velocity limit (user limit).
Current	
Drive Peak (Max)	The peak (maximum) current of the axis.
Motor Peak (Max)	The peak (maximum) current of the motor, according to the motor datasheet.
Motor Foldback Limit	Motor foldback current limit
Drive Foldback Limit	Drive foldback current limit.
User Current Limit	The maximum (user-defined) current limit for the application.
Actual Current Limit	Read only. The actual current limit for the application. This value is the lowest (minimum) value of all current limit inputs, such as drive peak, motor peak, and current limit (user limit). The default Current Limit Actual is determined by the parameters in the motor library.

7.4 Save Configuration

After completing your configuration, click the Save button on the ServoStudio+ toolbar to save all parameter values to the drive’s non-volatile memory.

If not saved, modified parameter values are lost during a power cycle (reboot) of the drive. Saved parameters are restored when drive is powered on.

Refer to section *Parameter Values*.

7.5 Autotune the Drive

Caution! Tuning is potentially dangerous. Before starting any tuning routines, make sure there are no persons or obstructions within the motion envelope. Also make sure the emergency stop button is within your reach.

Autotuning serves to tune the drive's velocity and position controllers, such that good performance and quiet operation is achieved with minimal user input.

The autotuning process performs repeated back-and-forth trapezoidal motion profiles while monitoring performance metrics such as current command noise level and position error settling time, and adjusting drive control parameters incrementally between each motion.

The autotuning process has three main stages:

1. The first stage is setting an appropriate trapezoidal motion profile. The profile requires an acceleration/deceleration value that generates an actual peak current that is adequate for operation; that is, higher than the motor continuous (rated) current, and lower than the motor peak current.
2. The second stage is estimating values of unknown mechanical parameters: LMJR, static friction, dynamic friction, and (optionally) resonance frequency. These values are used for tuning the control parameters according to a motor-load model.
3. The third stage is tuning the control gains and filters in order to reach an optimal compromise between tracking performance and robust and quiet operation. This is achieved through trial and error; that is, performing a motion, observing the results, and incrementally adjusting parameters while keeping track of the values that produce the best results.

During autotuning, the drive moves the motor back and forth repeatedly using the trapezoidal profile.

1. In ServoStudio+, select Tuning > Autotune.

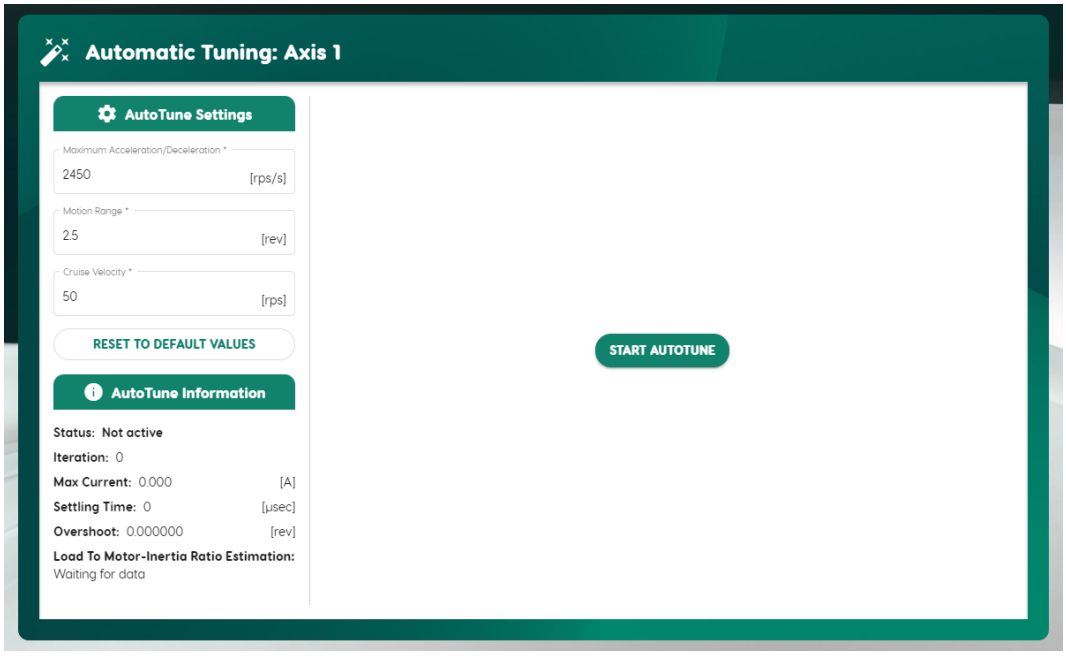


Figure 7-5. Autotuning

2. Make sure the displayed values in Autotune Settings are suitable for your application.

Maximum Acceleration/ Deceleration	Maximum acceleration/deceleration value during autotuning.
Motion Range	Number of motor revolutions during autotuning.
Cruise Velocity	Speed during autotuning.

3. Select **Start Autotune**. Confirm the prompts.

7.6 Test and Evalute

1. When autotuning is complete, view the results on the graph.

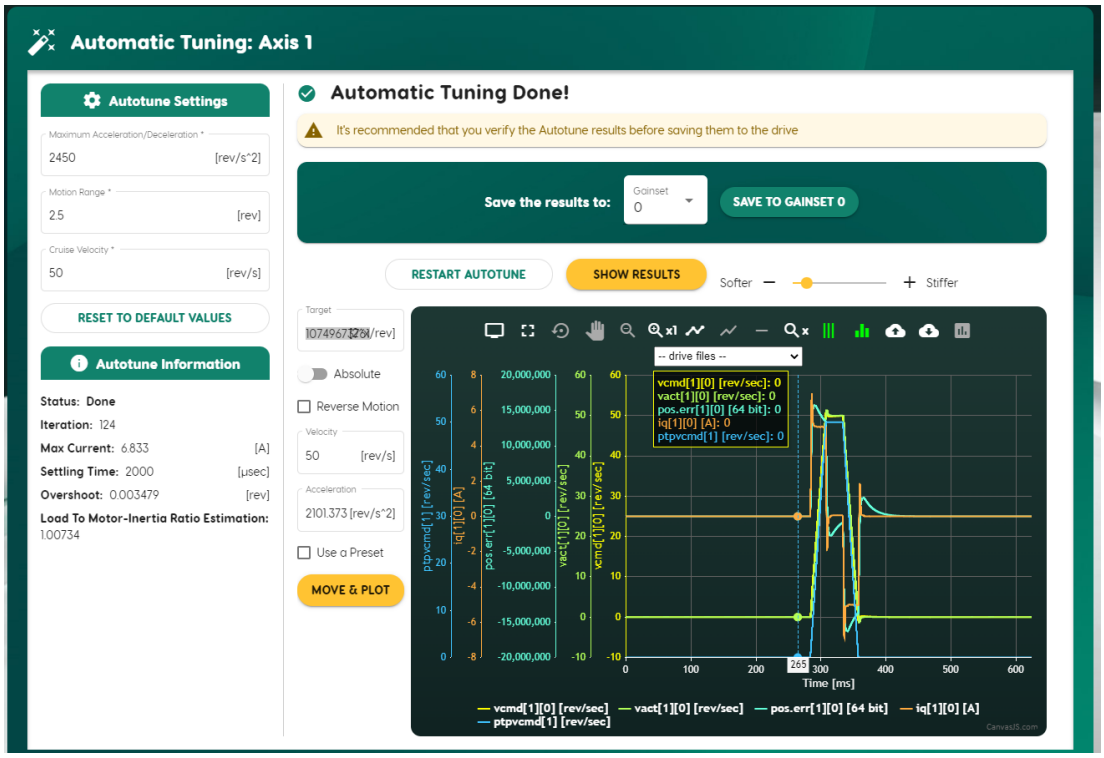


Figure 7-6. Autotuning test results

2. If the results are not satisfactory, modify the settings and/or use the **Softer/Stiffer** slider to adjust the controller performance.
3. If necessary, restart the autotuning process.
4. When you are satisfied with the Autotuning test results, save the parameters to the drive.
5. You can then proceed to optimize drive parameters for your particular application.
   - Use the Analyzing Tools and the Recorder feature to test and validate your drive configuration under real operating conditions.
   - Adjust any parameters as necessary based on your observations.

8 Drive Status

8.1 Operator Panel and LED Display

The CD3E 5-digit display provides indications of drive status, such as operation modes, drive enable status, warnings, and fault conditions.

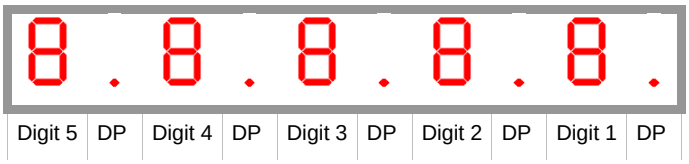


Figure 8-1. 5-digit LED display panel

Figure 8-2. Operator panel control keys

Key	Name	Function
M (mode)	Short press	Switches to next panel display mode (Status > Parameter > Command > Monitor > Fault > Status). While editing, cancels the edited value and returns to mode menu.
S (set)	Short press	Sets the entered value or parameter number.
Up arrow	Short press	Selects and increases the value of digit (value or parameter number).
Up arrow	Long press	Increases the value rapidly.
Down arrow	Short press	Selects and decreases the value of digit (value or parameter number).
Down arrow	Long press	Decreases the value rapidly.
Left arrow	Short press	Moves the cursor one digit to the left.
Right arrow	Short press	Moves the cursor one digit to the right.

8.2 Operator Panel Modes

Use the **M** button to scroll through the display modes.

The operator panel has several modes:

Status (S)	**S**	Indicates the drive's operating mode.
	H H	Homing mode
	C P	Cyclic Synchronous Position mode
	C T	Cyclic Synchronous Torque mode
	0 0	Velocity control mode, using serial commands
	0 2	Torque control mode, using serial commands
	0 8	Position control mode, using serial commands
Warnings	**A**	Indicates a warning. Displays the 4 digits of a CANopen error code, as defined in CiA402*.
Faults	**E**	Indicates a fault. Displays the 4 digits of a CANopen error code, as defined in CiA402*.

** CiA 402-2, Version 5.0.0, February 6, 2024 (Table 25)*