ZED 65

Servo Drive

User Manual

ORIGINAL DOCUMENT
Manual Revision 1.0

Revision History

Manual Rev.	Date	Notes
Rev.1.0	9 May 2025	Preliminary release. Firmware version: 21.10.9.x Motion Suite software version: 1.2.25.x

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CANopen Vendor-ID

Vendor-ID **0x00000513** has been registered to STXI Motion Ltd.

EtherCAT Vendor-ID

Vendor-ID **0x00000D2B** has been registered to STXI Motion Ltd.

Contents

1 Introduction

1.1 Product Description

The ZED is a low voltage servo drive. Its compact size enables near-motor mounting, and installation within the tight space constraints of applications such as electronics assemblies, medical devices, and AGVs/AMRs.

The ZED has digital I/Os, and CANopen, EtherCAT and USB-C communication channels, and support a variety of encoders.

Figure 1-1 ZED servo drive

1.2 Ordering Info

The following table shows the ordering options that comprise the various model numbers of the servo drives in the ZED product line. To enquire about custom options, contact STXI Motion.

Table 1-1. Product Ordering Options

		SD02	-	065		1D		AB		EC	-	000
	ZED SD02 Single-Axis Servo Drive											
	Rating – Cont. Current, Peak Current											
065	45 Arms, 135 Arms peak @ nominal 48 VDC											
	Power											
1D	Bus 24/48 VDC, Logic 24/48 VDC											
	Feedback											
AB	Incremental AqB, index, Halls Absolute single turn 21-bit encoder Absolute multi-turn 24-bit encoder											
	Communication											
CO	CANopen (not available yet)											
EC	EtherCAT											
ES	FSoE (FailSafe over EtherCAT) – Safe Version											
	Options											
000	Standard											

1.3 Product Label

The product label is attached to the side of the ZED servo drive.

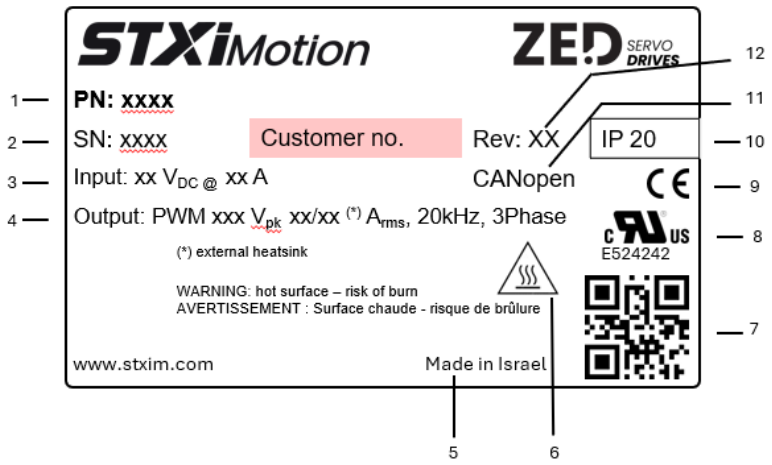


Figure 1-2. Product label on ZED

Item	Description
1	Product number
2	Product serial number
3	Nominal input
4	Nominal output
5	Country of manufacturer
6	Hot surface
7	Identification code
8	UL compliance
9	CE compliance
10	Protection class
11	Fieldbus
12	Hardware revision

1.4 Product Documentation

This documentation describes the ZED servo drive.

It provides the information required for installation and configuration of the ZED.

This documentation is intended for persons who are qualified to assemble, commission, and maintain the equipment described herein.

Before you install the ZED, review the instructions in this manual. Pay particular attention to all safety instructions and warnings. Failure to follow the safety instructions may result in personal injury or equipment damage.

This manual is part of a documentation set, which consists of the following:

- ZED User Manual. Hardware installation, commissioning and tuning.
- TIM-ZED EtherCAT/CANopen User Manual. Implementation of EtherCAT and CANopen protocol in ZED.
- ZED Functional Safety User Manual.

2 Standards Compliance

The ZED has been designed and manufactured according to the standards specified in the following table. Testing and certifications are pending.

Table 2-1. Standards Compliance

Topic	Directive	Standard(s)
Thermal and Electrical Safety	EU Low Voltage Directive 2014/35/EU	EN IEC 61800-5-1
Electromagnetic Compatibility	EMC Directive 2014/30/EU	EN IEC 61800-3 EN IEC 61000-6-7
Functional Safety	Machinery Regulation EU 2023/1203	EN IEC 61508, Parts 1–7 EN IEC 61800-5-2 EN ISO 13849, Parts 1–2
RoHS	RoHS Directive 2011/65/EU	EN IEC 63000
REACH	EC 1907/2006	Not applicable

3 Safety

3.1 Safety Symbols

The following safety symbols are used on the drive and in this manual.

Table 3-1. Safety Symbols

Symbol	Meaning	Description
	Dangerous voltage	Indicates a hazardous situation, which, if not avoided, will result in death or serious injury.
	Caution	Indicates a hazardous situation, which, if not avoided, could result in injury or equipment damage.
	Functional earthing	Identifies a functional earthing (grounding) terminal or conductor, which serves to ensure proper functioning of electronic equipment.
	Caution, hot surface	Indicates the marked item can be hot, and should not be touched without taking care.

3.2 Safety Guidelines

- Before installing or commissioning the ZED, review all relevant product documentation.
- Install and operate the system according to the instructions in this manual.
- 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.
- Failure to follow the safety instructions may result in personal injury or equipment damage.

3.3 Intended Use

The ZED 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 ZED servo drive in the intended application. Based on the results, the appropriate safety measures must be implemented.
- The ZED servo drive must be used in compliance with all applicable safety regulations and directives, and all technical specifications and requirements.
- 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.

3.4 Installation Safety

Incorrect handling of the ZED may cause personal injury and/or damage to equipment.
Perform the installation in strict compliance with product specifications and installation instructions.

Thermal Safety

- During continuous motor operation, the motor body and drive heat up.
- To prevent damage to the product, ensure the temperatures of the ZED components remain at least 5˚C below their threshold (fault) limits:
  - Drive CPU: 115˚C
  - Heat sink: 90˚C
  - Motor: 120˚C
- Motion Suite software reads and reports the temperatures of the drive CPU and the heatsink. It also reports the motor temperature if the motor has a sensor, as defined by the serial parameter **MotorTempSensor**.
- System temperature values can be read from object 2021h (sub-indices 1-6).
- Install the ZED in a manner that allows proper air flow.
- The ZED is rated for use at altitudes up to 2000 meter above sea level.

Electrical Safety

- **ZED power supply**. All connections and terminals with voltages up to 120 VDC in the ZED are equipped with safety extra-low voltage. They are protected against accidental contact in accordance with EN IEC 61800-5-1. For compliance, the ZED power supply must therefore be designed as a SELV/PELV supply (protection class III).

Warning. The use of unsuitable power supply units that are not SELV/PELV can lead to dangerously high voltages in the event of a fault.

- As part of the machine design, the machine builder must generate a hazard analysis for the machine and take appropriate measures to ensure that unforeseen movements cannot cause personal injury and/or damage to equipment.

Functional Safety

The safety functions listed below have been implemented in the ZED.

ZED units can be ordered with STO only, or with a safety motion module (SMM) that provides all the listed safety functions.

For details, refer to the *ZED Functional Safety User Manual*.

Function	Description
STO	Safe torque off
SS1-t	Safe stop 1 time controlled
SS1-r	Safe stop 1 deceleration ramp monitored
SBC	Safe brake control
SOS	Safe operating stop
SLS	Safely-limited speed
SS2-t	Safe stop 2 time controlled
SS2-r	Safe stop 2 deceleration ramp monitored
SSR	Safe speed range
SLA (SAR)	Safely-limited acceleration (safe acceleration range)
SLP	Safely-limited position
SLI	Safely-limited increment
SSM	Safe speed monitor
SDI	Safe direction

4 Handling and Storage

4.1 Transporting

Transport the ZED servo drive in its original packaging materials.

Avoid transporting the ZED in conditions which may cause strong vibrations of the drive, or impact with other objects.

4.2 Packaging

The package contains the ZED servo drive only.

Upon receipt, open the package and remove all packing materials.

Check to ensure there is no visible damage to the ZED servo drive. 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.

Save the original box and packing materials in case you need to pack and return the product to the manufacturer.

5 Specifications

5.1 Electrical

Table 5-1. Electrical Specifications

Feature	Unit	Specification
Input Voltage	VDC	24/48
Min. Voltage	VDC	18
Max. Voltage	VDC	80
Power Rating	W	2000
Rated Current	Arms*	45
Peak Current	Arms*	135

* The specified current applies to nominal voltage.

5.2 Feedback and Control

Table 5-2. Feedback and Control Specifications

Feature	Specification	
Operation Modes	Selectable	Profile position Profile velocity Homing Cyclic synchronous velocity
Display		LEDs
Software Tools	User Interface	Motion Suite, Windows-based
	Functions	Connection settings, Drive info, Power info, I/O configuration, Motion settings and tuning, Fault history/display

5.3 Inputs/Outputs

Table 5-3. Inputs/Outputs Specifications

Feature	Specification
Digital Input	**x 4**
Signal	Configurable opto-isolated, sink/source, Type 1
Functions	Multi-functional. ▪ Home switch ▪ Positive limit switch ▪ Negative limit switch ▪ User (User (user can read the input, no functionality is triggered)
Voltage High Level Input	30 V
Min. High Level Input	11 V
Max. Low Level Input	5 V
Input Resistance	3.6 kΩ
Max. Input Frequency	5 kHz
Propagation Delay Time	200 µs
Insulation voltage	3750 Vrms
Digital Output	**x 2**
Signal	Configurable open collector, opto-isolated sink/source
Functions	Multi-functional. ▪ None ▪ User (user can control the output, no functionality is connected) ▪ Drive is disabled ▪ Drive is enabled
Voltage	30 V
Max. Current	100 mA
Min. Load Resistance	300 Ω
Output Voltage	2 V
Min. Propagation Delay Time	1 ms (may be longer if load current is lower)
Analog Input	**x 1**
Voltage input	0-10V single ended -5 to +5 V differential
Input resistance	7 kΩ
Frequency bandwidth	50 kHz
Deviation	1%-2%
Resolution	12 Bit

5.4 Communication

Table 5-4. Communication Specifications

Feature	Specification
CANopen	CANopen – CiA 301 application layer and CiA 402 device profile for drives and motion control. Baud rate 10 kbps – 1 Mbps CAN ID 1 – 127 (Default 127) Heartbeat producer, SDO, PDO (dynamic mapping)
EtherCAT	CANopen over EtherCAT (CoE) – CiA 301 application layer and CiA 402 device profile for drives and motion control. Communication cycle time: up to 250 µs

5.5 Mechanical

Table 5-5. Dimensions

Feature	Unit	Specification
Dimensions	mm	125 x 85 x 47
Weight	kg	0.47 kg

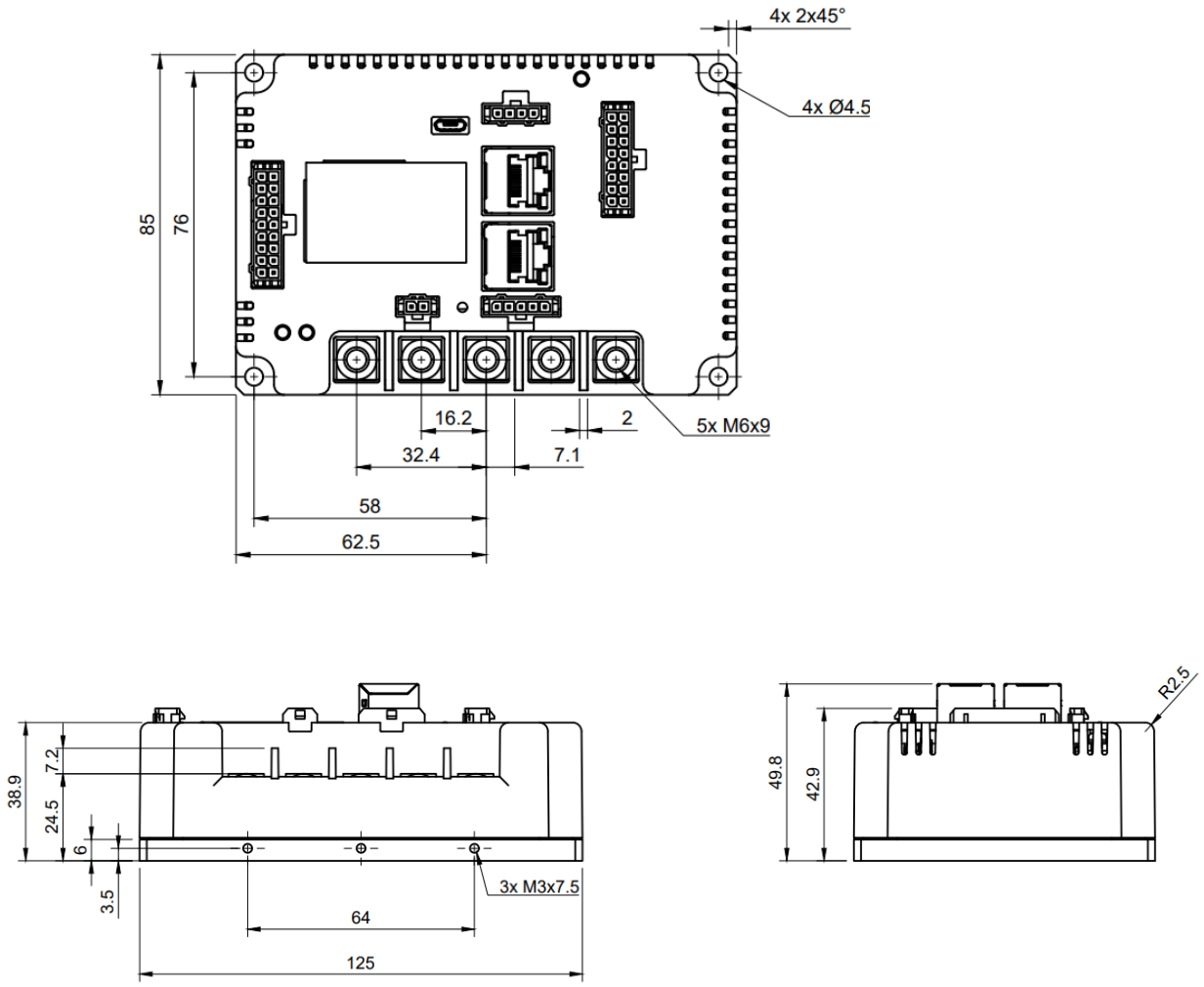


Figure 5-1. Dimensions

5.6 Environmental

The ZED has been designed and manufactured according to the standards specified in the following table. *Testing and certifications are pending*.

Table 5-6. Environmental Specifications

Feature	Specification
Environment	Ambient temperature: Operation: -30 – 45°C Storage: 0 – 70°C
	Humidity: 10 – 90%
	Altitude: <2,000 m (per EN IEC 61800-5-1)
	Vibration: 1g sine vibration from 10 Hz to 150 Hz (per EN IEC 61800-5-1)
	Shock: 5g half-sine for 30 m (per EN IEC 61800-2)
Operating Conditions	Protection class: IP20

6 Installation

6.1 System Design

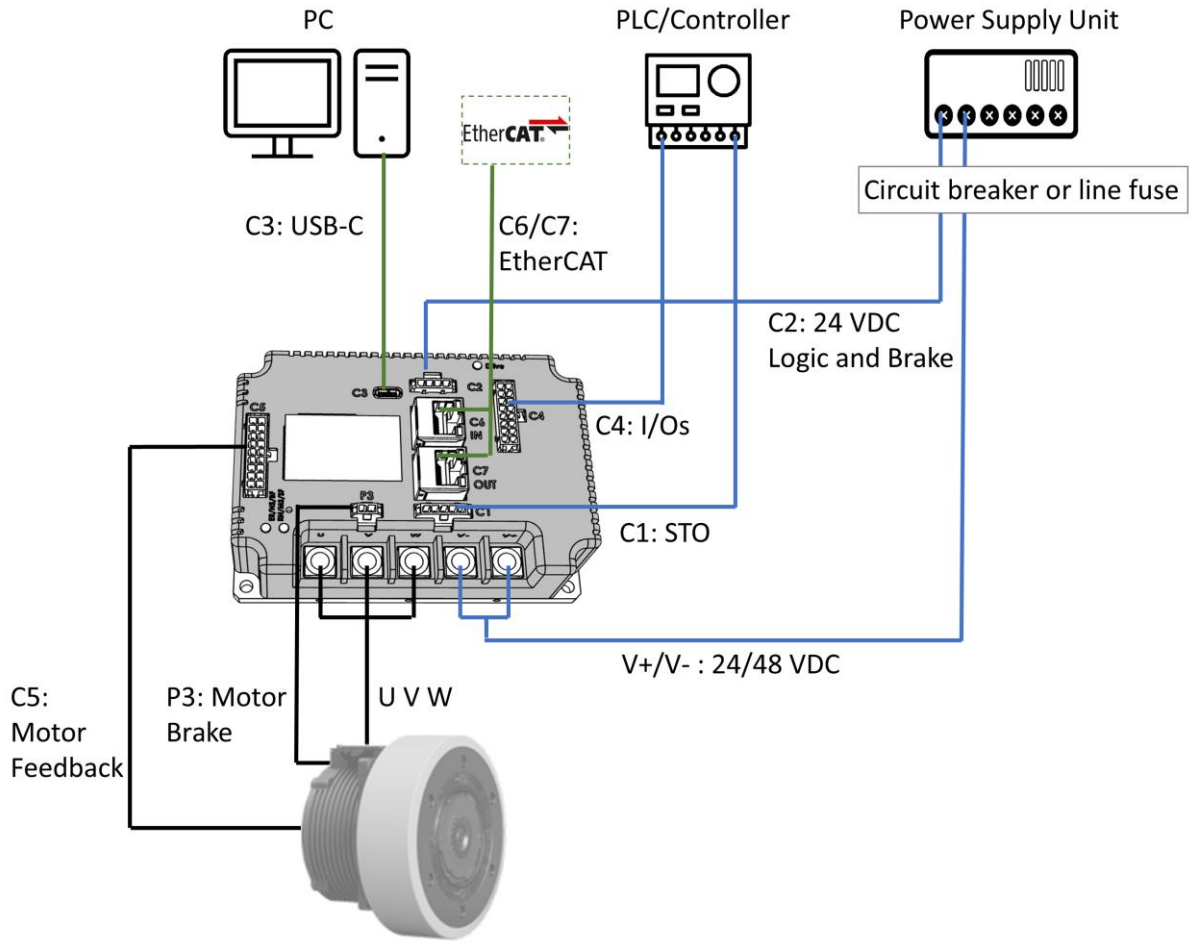


Figure 6-1 ZED system design

6.2 Setup Overview

Perform the following steps to install a ZED system.

1. Mount the ZED.
2. Make all wiring and cable connections, as required by your application:
   - DC bus voltage (V+ , V-)
   - CANopen/EtherCAT (C6, C7
   - Digital inputs, digital outputs (C4)
   - 24VDC supply Brake and Logic (C2)
   - STO (C 1)
   - Motor Power (U, V, W)
   - Motor Brake (P3)

3. Connect the ZED to the PLC and/or the PC (USB-C).
4. Power up the ZED and the PC.
5. Download and install Motion Suite for ZED on the PC, and use it to configure and test the ZED.

6.3 Wiring Guidelines

To ensure optimal performance, wire your system in accordance with the following guidelines:

- To reduce the effects of EMI, the following cables are recommended:
  - Power supply – shielded cables
  - CANopen/EtherCAT communication – twisted pairs and shielded cables
- Twisting must be maintained as close as possible to both ends of the cable.
- Shielding must be maintained at both ends of the cable.
- If connecting the power supply unit (PSU) to more than one ZED, use either a star or a bus connection, as shown in the following figures.

  When using a bus connection, be sure to select an appropriate wire gauge if minimal drive voltage is crucial.

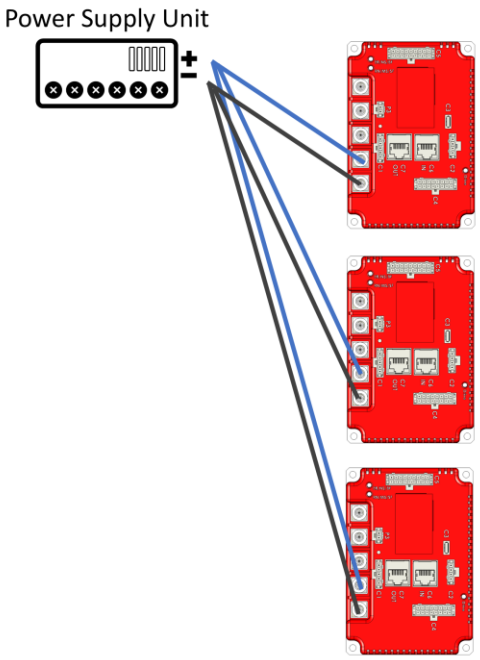


Figure 6-2 Star connection – CANopen ONLY

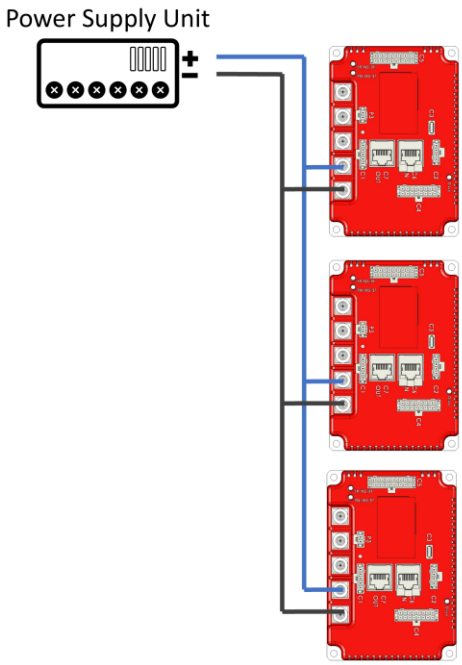


Figure 6-3 Bus connection – CANopen or EtherCAT

Warning: Do not daisy chain input voltage from one ZED to the next.

6.4 Grounding

When connecting the ZED to other control equipment, be sure to follow two basic guidelines for proper functioning of the drive:

- The ZED should be grounded via functional earth ground (FE) of the voltage supply.
- Any motion controller, PLC or PC that is connected to the ZED must be grounded to the same earth ground as the ZED.

For more details, refer to the section *Electrical Safety* in Chapter 3 of this manual.

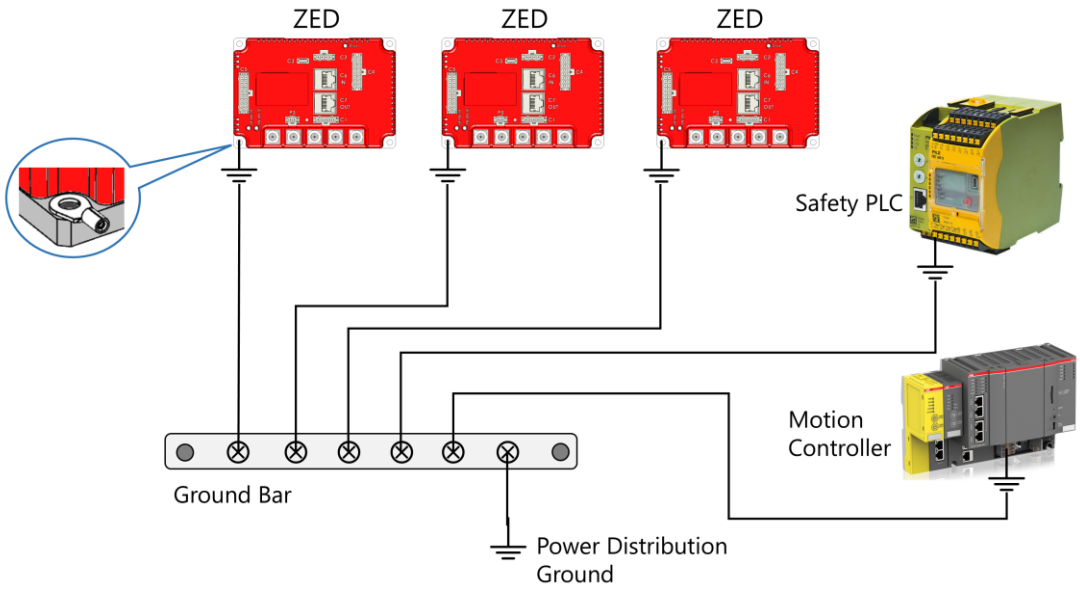


Figure 6-4 Grounding

6.5 Electrical Interfaces

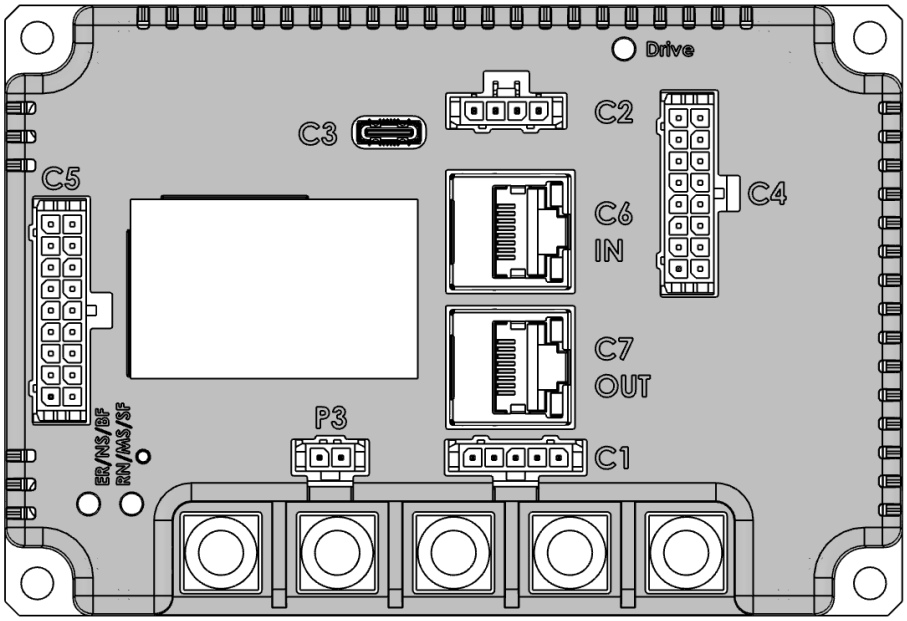


Figure 6-5 ZED interfaces

P1 – Power and Motor

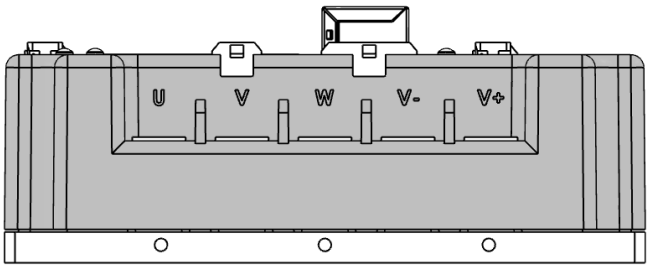


Figure 6-6 Connectors

Table 6-1. P1 Pinout

Pin #	Signal Description	Cable Lug Hole
U	Motor Phase	M6
V	Motor Phase	M6
W	Motor Phase	M6
V -	Power Supply -	M6
V +	Power Supply +	M6

Tightening Torque

Warning. To prevent mechanical damage to the power connectors, do not exceed the maximum tightening torques.

Table 6-2. Tightening Torque Specifications

Thread dimension	Unit	M6
Max. tightening torque	Nm	7.5 ±4%
Breaking torque *	Nm	15

*Determined values (torques). For these mechanical loads, destruction of the threaded shank occurs. The component must never be loaded up to these values.

P3 – Motor Brake

Table 6-3. P3 Connectors

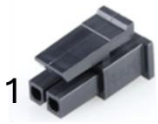
Interface	Item	Manufacturer	Manufacturer PN
	On drive. Micro-Fit 3.0 Vertical Header, 3.00mm Pitch, Single Row, 2 Circuits	Molex	436500215
	Mating connector ▪ Micro-Fit 3.0 Receptacle Housing, Single Row, 2 Circuits ▪ Micro-Fit 3.0 Crimp Terminal, Female	Molex	▪ 436450200 ▪ 430300001

Table 6-4.

Pin #	Signal Description
1	Brake
2	Brake

C1 – STO

Table 6-5. C1 Connectors

Interface	Item	Manufacturer	Manufacturer PN
	On drive. Micro-Fit 3.0 Vertical Header, 3.00mm Pitch, Single Row, 5 Circuits	Molex	436500516
1 	Mating connector, ▪ Micro-Fit 3.0 Receptacle Housing, Single Row, 5 Circuits ▪ Micro-Fit 3.0 Crimp Terminal, Female	Molex	▪ 436450500 ▪ 430300001

Table 6-6. C1 Pinout

Pin #	Signal Description	Signal Description Safe Version
1	STO_1	AN_IN +
2	NC	AN_IN -
3	STO_2	AN_GND
4	NC	OUT_COM
5	STO_GND	OUT_1

C2 – 24 VDC Brake and Aux

Table 6-7. C2 Connectors

Interface	Item	Manufacturer	Manufacturer PN
	On drive. Micro-Fit 3.0 Vertical Header, 3.00mm Pitch, Single Row, 4 Circuits	Molex	436500416
1 	Mating connector Micro-Fit 3.0 Receptacle Housing, Single Row, 4 Circuits Micro-Fit 3.0 Crimp Terminal, Female	Molex	▪ 436450300 ▪ 430300001 -

Table 6-8. C2 Pinout

Pin #	Signal Description
1	24/48 VDC Brake
2	GND_Brake
3	GND_Logic
4	24/48 VDC Logic *

* Must always be connected

C3 – USB C

Figure 6-7 USB interface

The USB interface is intended for use only during commissioning.

Do not use the USB connector as a process interface in an application.

For proper operation, a short USB cable (<3m) and proper installation and grounding of the servo controller are required.

C4 – Digital I/Os

C4 – Digital I/Os

Table 6-9. C4 Connectors

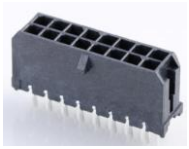
Interface	Item	Manufacturer	Manufacturer PN
	On drive – 16 pin Micro-Fit 3.0 Vertical Header, 3.00mm Pitch, Dual Row, 16 Circuits	Molex	430451613
	Mating connector. ▪ Micro-Fit 3.0 Receptacle Housing, Dual Row, 16 Circuits ▪ Micro-Fit 3.0 Crimp Terminal, Female	Molex	▪ 430251600 ▪ 430300001

Table 6-10. C1 Pinout

Pin #	Signal Description	Signal Description Safe Version
1	OUT_1	IN_4
2	IN_4	IN_2
3	IN_3	
4	IN_2	Safe_IN_6
5	IN_1	Safe_IN_4
6	nc	Safe_IN_2
7	nc	CLK_Test_2
8	ANALG +	Safe_GND
9	OUT_2	IN_3
10	OUT_COM	IN_1
11	nc	IN_COM
12	IN_COM	Safe_IN_5
13	nc	Safe_IN_3
14	nc	Safe_IN_1
15	ANALG -	CLK_Test_1
16	GND	Safe_24VDC

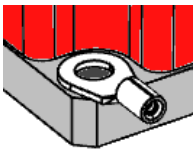
C5 – Feedback

Table 6-11. C5 Connectors

Interface	Item	Manufacturer	Manufacturer PN
	On drive – 18 pin Micro-Fit 3.0 Vertical Header, 3.00mm Pitch, Dual Row, 18 Circuits	Molex	430451812
	Mating connector. ▪ Micro-Fit 3.0 Receptacle Housing, Dual Row, 16 Circuit ▪ Micro-Fit 3.0 Crimp Terminal, Female	Molex	▪ 430251800 ▪ 430300001

Table 6-12. C5 Pinout

Pin #	Signal Description	Signal Description	Signal Description
	Incremental AqB + Halls	**SSI**	**Dual Redundant Motor Feedback (DRM)**
1	A+		ENC1 CLK-
2	B+		ENC1 DATA-
3	Z+		GND
4		SSI_CLK-	ENC2 DATA-
5		SSI_DATA-	ENC2 CLK-
6	HALL-W		
7	HALL-V		GND_Temp
8	GND_Temp	GND_Temp	
9		8V_ENC	
10	A-		ENC1 CLK+
11	B-		ENC1 DATA+
12	Z-		GND
13		SSI_CLK+	ENC2 DATA+
14		SSI_DATA+	ENC2 CLK+
15	GND	GND	
16	HALL-U		
17	Mot_Temp	Mot_Temp	Mot_Temp
18	5V_ENC	5V_ENC	5V_ENC



Make sure that the shield of the feedback cable is connected to a grounding point on the ZED heat sink, using an M4 cable lug.

C6 – Fieldbus IN – EtherCAT

Table 6-13. C5 Connector

Interface	Item	Manufacturer	Manufacturer PN
	On drive – 8 pin RJ45	Amphenol	RJHSE5387

Table 6-14. C6 Pinout

Pin # RJ45 – 8pin	EtherCAT
1	ECAT_OUT_Tx+
3	ECAT_OUT_Rx+
2	ECAT_OUT_Tx-
6	ECAT_OUT_Rx-

C7 – Fieldbus OUT – EtherCAT

Table 6-15. C5 Connector

Interface	Item	Manufacturer	Manufacturer PN
	On drive – 8 pin RJ45	Amphenol	RJHSE5387

Table 6-16. C7 Pinout

Pin # RJ45 – 8pin	EtherCAT
1	ECAT_OUT_Tx+
3	ECAT_OUT_Rx+
2	ECAT_OUT_Tx-
6	ECAT_OUT_Rx-

6.6 Communication Cabling

Note

For commissioning and tuning the ZED, the PC running Motion Suite must be connected to the ZED through a USB-C port with a standard USB cable.

Once the drive is configured, you can then connect it to a PLC or controller over a CANopen/EtherCAT network.

Serial Cabling

A standard USB-C cable as shown below can be used to enable the communication with Motion Suite.

Figure 6-8 USB-C cable

CANopen/EtherCAT Cabling

For fieldbus communication, use a cable with an RJ45 connector to connect to the ZED, to the master controller.

Figure 6-9 CANopen/EtherCAT connector cable (example)

CANopen Chain

If chaining ZED drives in a CANopen network, they can be connector in any order, with cables plugged in to either C6 or C7.

CANopen Termination

In a CANopen network, a 120Ω termination resistor is required on the last node in the chain.

To implement the termination of the CAN bus on the ZED, connect a CANopen line terminator to connector C6/C7 on the last ZED in the chain.

Figure 6-10 CANopen line terminator (example)

EtherCAT Chain

If chaining ZED drives in an EtherCAT network, they must be connected sequentially; that is, master controller to Drive 1 In/C6 > Drive 1 Out/C7to Drive 2/C6 In > Drive 2 Out/C7, and so forth.

6.7 Computer System

The Motion Suite software requires Windows 10, 64-bit or higher.

The PC requires either of the following interfaces for serial communication with the ZED.

- A serial RS232 port
- A USB port with an USB-to-RS232 adaptor with ferrite bead.

To view recorded data, you need Microsoft Office Excel, or a similar spreadsheet software that supports CSV files.

6.8 Fieldbus Devices (CANopen/EtherCAT)

- If using CAN protocol, an EDS (electronic data sheet) file for ZED must be loaded on the PC or PLC controller. Download the file from the STXI Motion website, or contact Technical Support.
- If using EtherCAT protocol, an ESI (EtherCAT slave information)/XML file for ZED must be loaded on the PC or PLC controller. Download the file from the STXI Motion website, or contact Technical Support.

6.9 Motion Suite Software

1. Download the Motion Suite installation file from the STXI Motion website or contact Technical Support.
2. Install the Motion Suite on your PC.
3. When installation is complete, you can start Motion Suite from the Windows Start menu or the shortcut on your desktop.

Figure 6-11 Motion Suite – not connected to ZED

Note Motion Suite functionality is not available unless a ZED drive is connected to and communicating with the PC.

6.10 Power Up and Establish Communication

1. After completing the hardware connections and software installations, turn on power to the ZED.
2. Open Motion Suite software, if not already activated.
3. In the navigation menu, select Communication > **Serial.**
4. Confirm that ZED is the selected drive. If not, change the **Drive** setting to ZED.
5. Select the PC's **COM** port that is connected to the ZED.
6. Click **Connect** to enable communication with the drive.

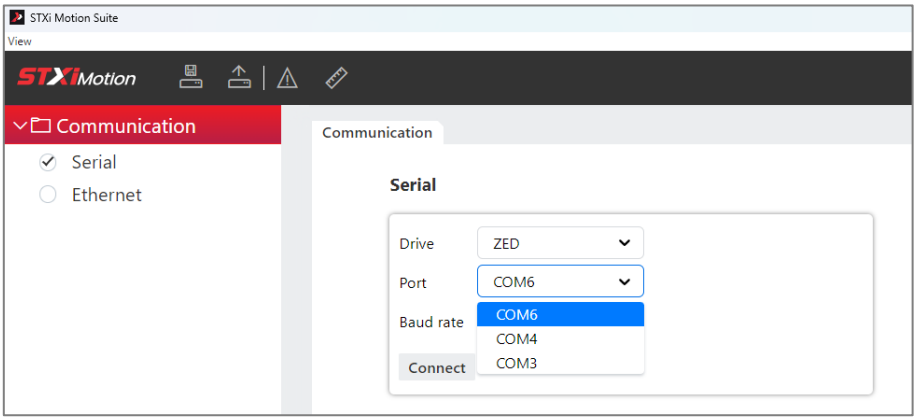


Figure 6-12 Motion Suite – communication settings

Once communication is established, Motion Suite displays **Drive Info** and **Motor Info**.

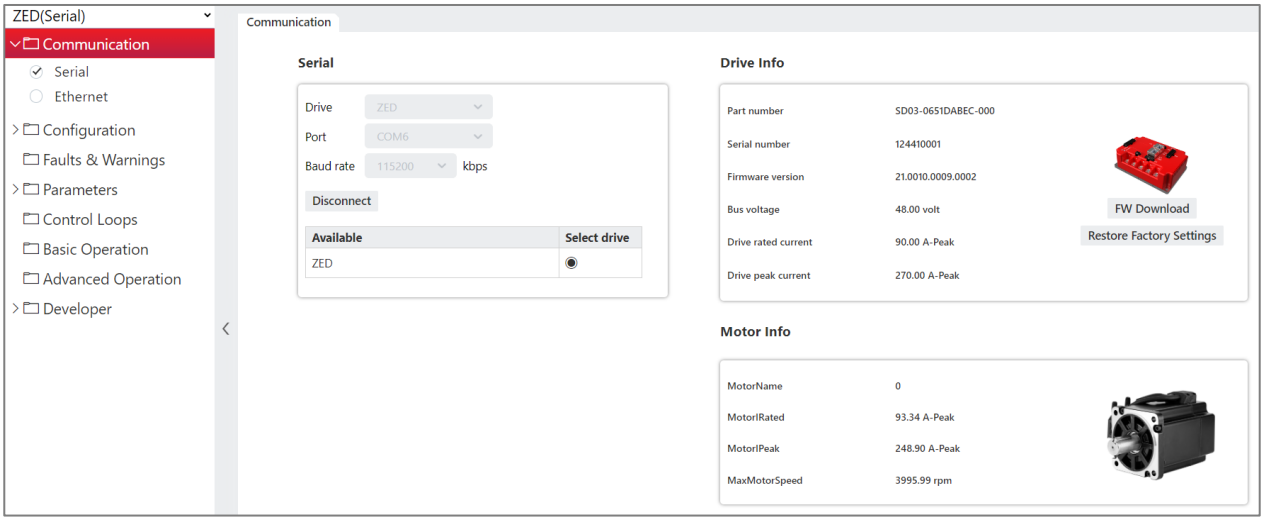


Figure 6-13 Motion Suite – connected to ZED drive

7 Commissioning the ZED Drive

Confirm ZED Info and System Units

1. Note the product information that is displayed in the Communication > **Serial** screen.
2. The **Drive Info** pane displays an image of the ZED drive.

   Refer to the product labels on the ZED to confirm that the displayed data is correct.

Note The **Motor Info** pane reads and displays a preset motor definition from the drive. Once the actual motor is defined, **Motor Info** will display the actual motor connected to the drive.

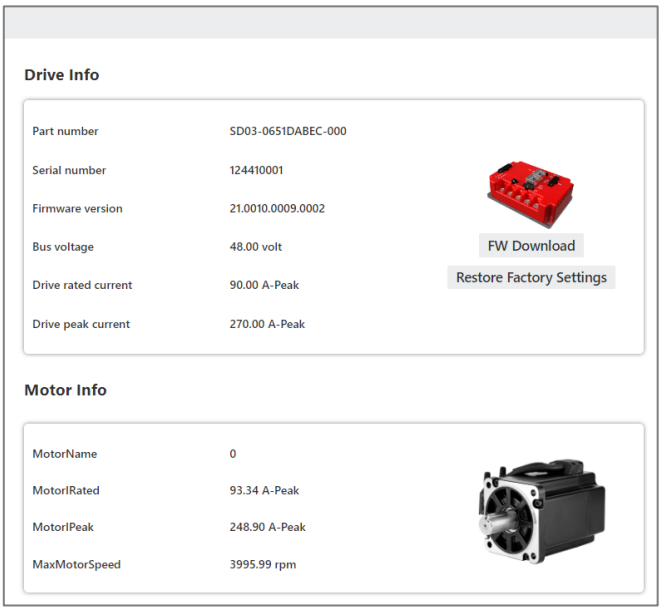


Figure 7-1 Motion Suite – Drive and Motor info

3. In the toolbar, select the Measurement (ruler) button. The **Units** menu opens.

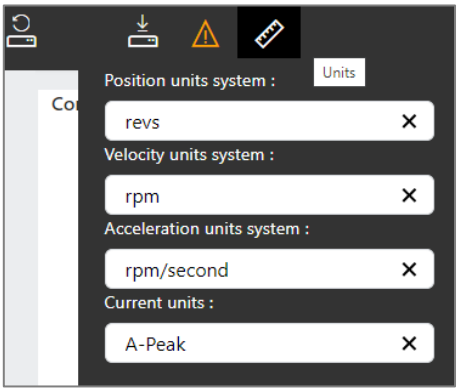


Figure 7-2 Motion Suite – units

4. Confirm that **units** are correctly set for your application. If necessary, you can modify these settings.

Feedback Setup

The feedback device should be defined before the motor setup.

The Configuration > **Feedback** screen allows you to define the motor feedback.

It also allows you to monitor the feedback position.

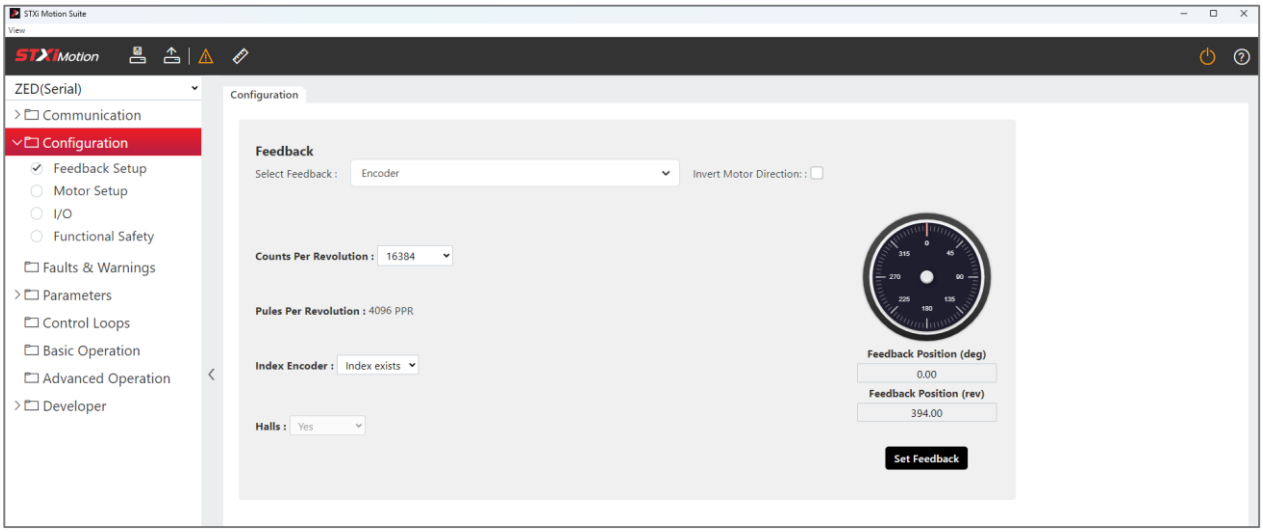


Figure 7-3 Feedback setup

Motor Setup

To perform commissioning, the necessary motor data must first be entered and saved in the drive. Motor definitions can be defined manually, or loaded from a database.

Define Motor Manually

1. From the navigation menu, select **Configuration** > **Motor Setup.**

   The **Motor Setup** screen enables you to define a motor whose parameters are not available in the database.

2. From the **Motor Name** menu, select **Add New Motor**.

3. Refer to the motor's datasheet, and enter appropriate values for the motor parameters.

4. Once defined, these parameters can be saved to the drive, and the motor can be saved to the motor database.

   Select **Save Settings to Database.**

5. At the prompt, enter a name for the motor, and select **Save**.

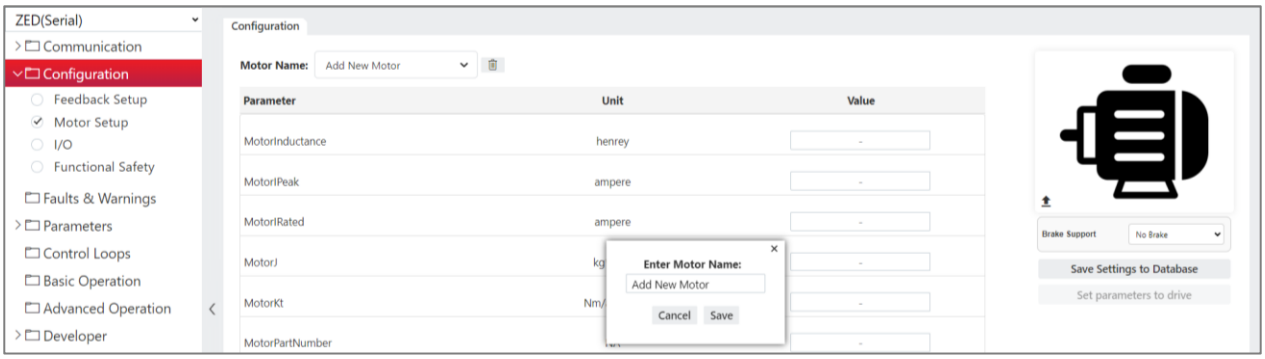


Figure 7-4 Define motor parameters manually - name

6. Select **Set Parameters to Drive**.
7. You are prompted to auto-validate the values.

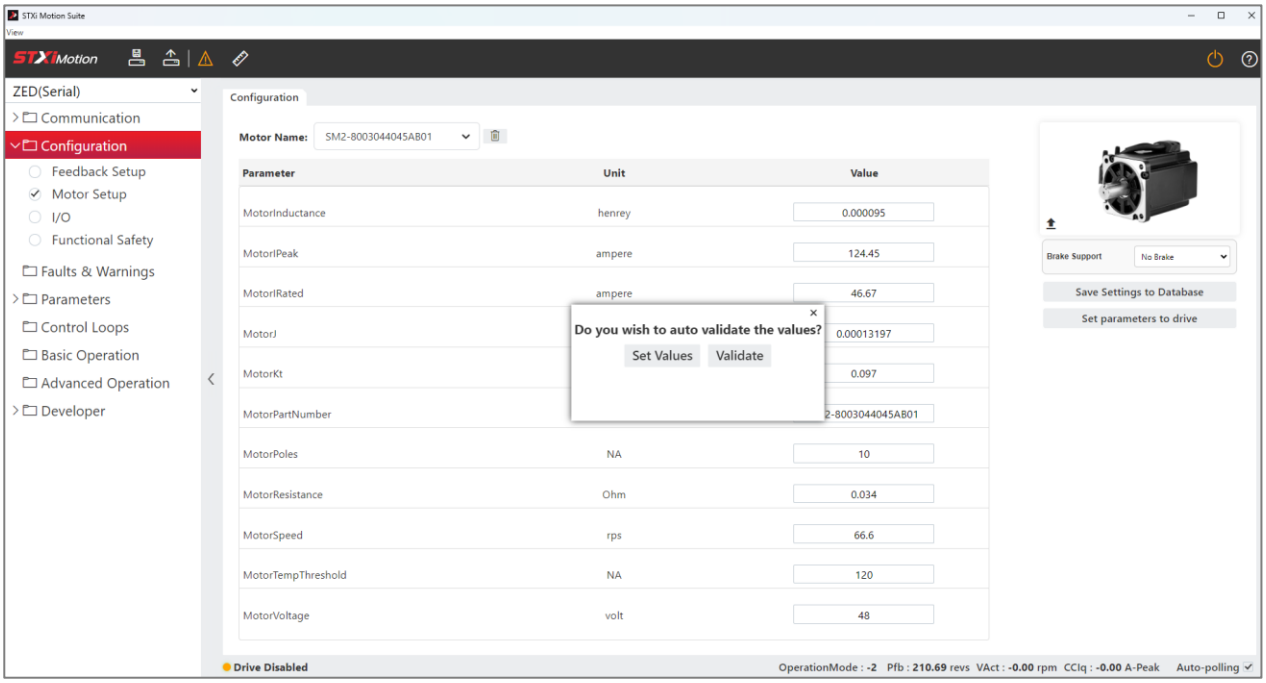


Figure 7-5 Define motor parameters manually - values

8. Select **Set Values**. The motor data is written to the drive.
9. Select **Validate**. The motor will move, and the drive and motor parameters will be calibrated. Note the messages and prompts, and respond accordingly.

Select Motor from Database

The **Motor Setup** screen also enables you to select a motor from the Motion Suite database. You can simply select the motor part number, and Motion Suite prepares the appropriate motor and feedback parameters.

1. From the **Motor Name** menu, select a motor.
2. Select **Set Parameters to Drive**.
3. At the prompt, select **Set Values**. The motor data is written to the drive.
4. Select **Validate**. The motor will move, and the drive and motor parameters will be calibrated. Note the messages and prompts, and respond accordingly.

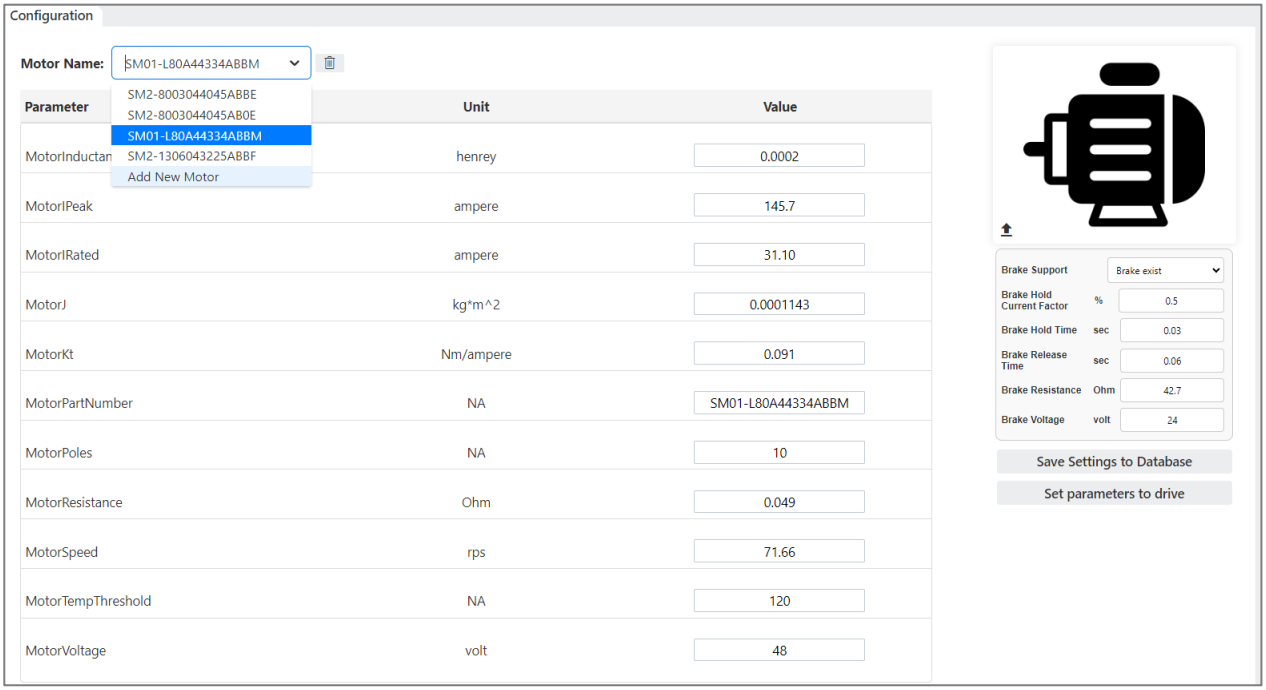


Figure 7-6 Select and load motor parameters from database

Delete Motor from Database

To delete a defined motor, use the Trash icon.

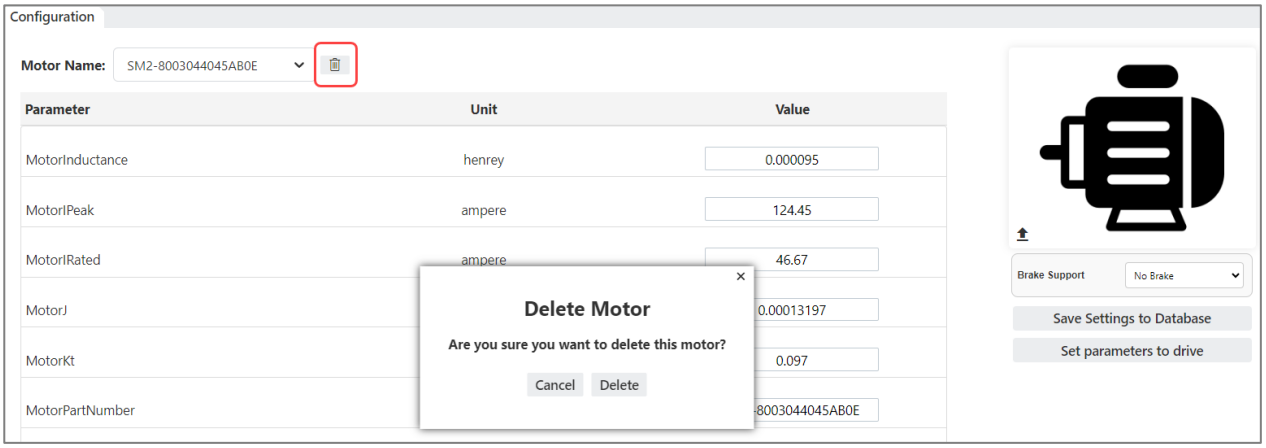


Figure 7-7 Delete motor

Test the Motor Response to a Torque Command

Note Test the motor **without a load** to confirm the motor moves in response to a torque command. After confirming proper motion, you can then add the load and/or install in your application.

To test the motor response, do the following.

1. Open the Basic Operation screen.
2. Select the Torque mode tab.
3. In the Current command field, enter **1** (A-Peak).
4. Press **Run** (or **Update**).

   Check the velocity gauge in the software. You should see a positive value.

   Check the motor. You should see it move in the positive (counter-clockwise) direction. To more easily view the actual motor motion, reduce the A-Peak value.

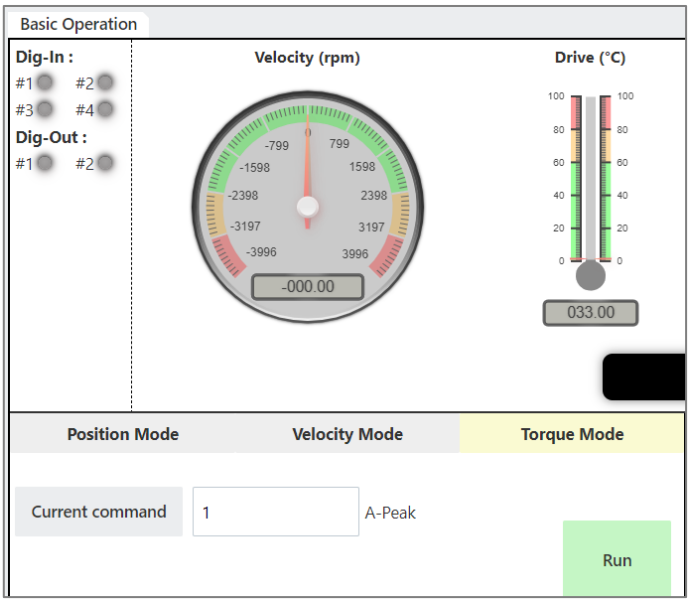


Figure 7-8 Motion Suite – torque positive motion

5. Press **Pause** to stop the motor motion.
6. In the Current command field, enter **-1** (A-Peak).
7. Press **Run** (or **Update**).

   Check the velocity gauge in the software. You should see a negative value.

   Check the motor. You should see it move in the negative (clockwise) direction. To more easily view the actual motor motion, reduce the A-Peak value.

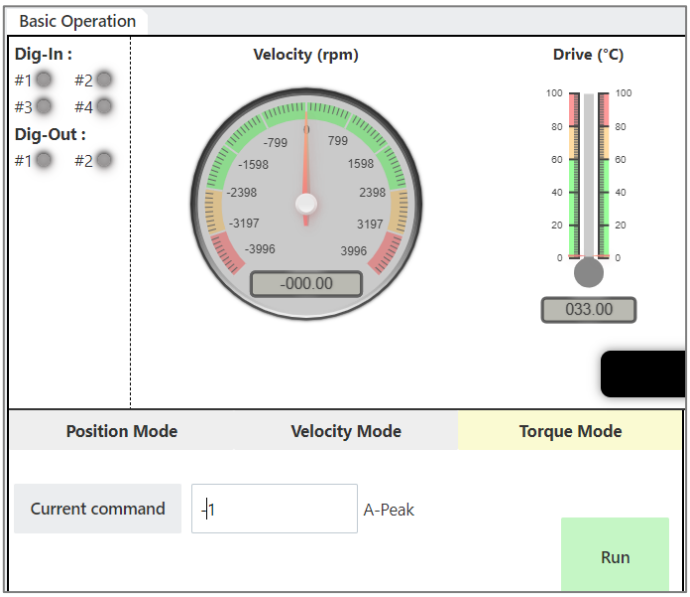


Figure 7-9 Motion Suite – torque negative motion

8. Press **Pause** to stop the motor motion.

If the motor moves as expected, you can now install the ZED in your application system or install the load on the shaft of the motor. Then proceed to tune the drive.

If there is a problem, contact STXI Motion Technical Support.

Turn Off All Velocity Filters

Note There is no need for filters during the drive commissioning procedure.

Note Do not attempt to manipulate filter parameters unless specifically instructed to do so by STXI Motion Technical Support.

1. Open the Control Loops screen.

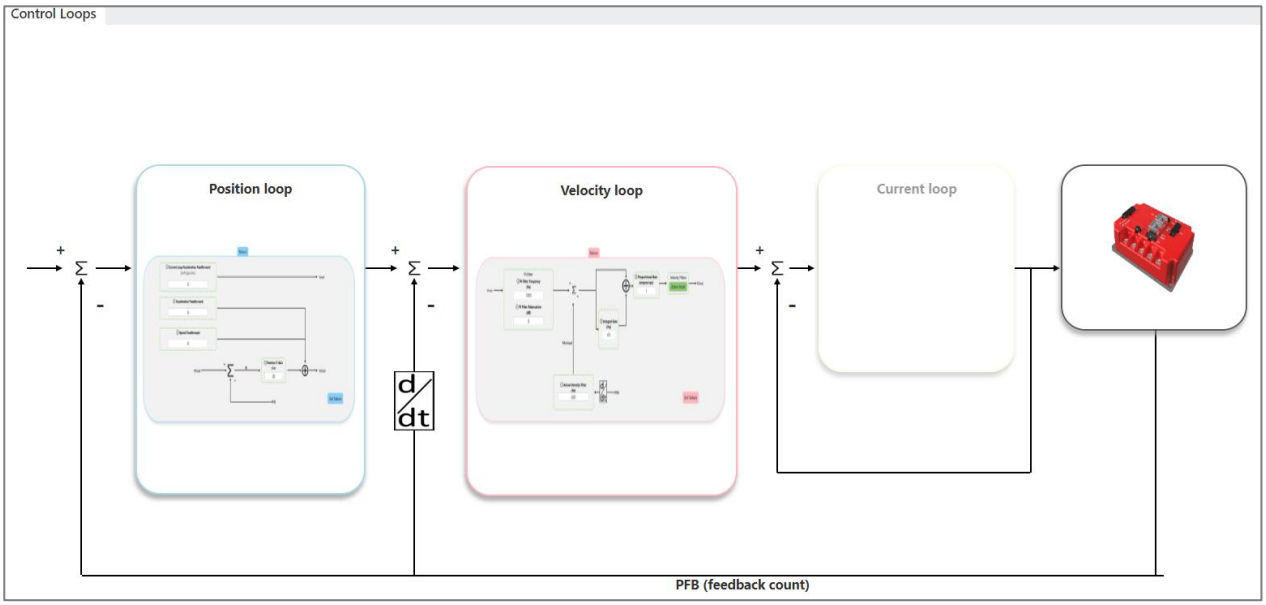


Figure 7-10 Motion Suite – Control Loops screen

2. Click on the Velocity Loop segment to enlarge the schematic dialog box.
3. Clear the option **Hide Filters**.

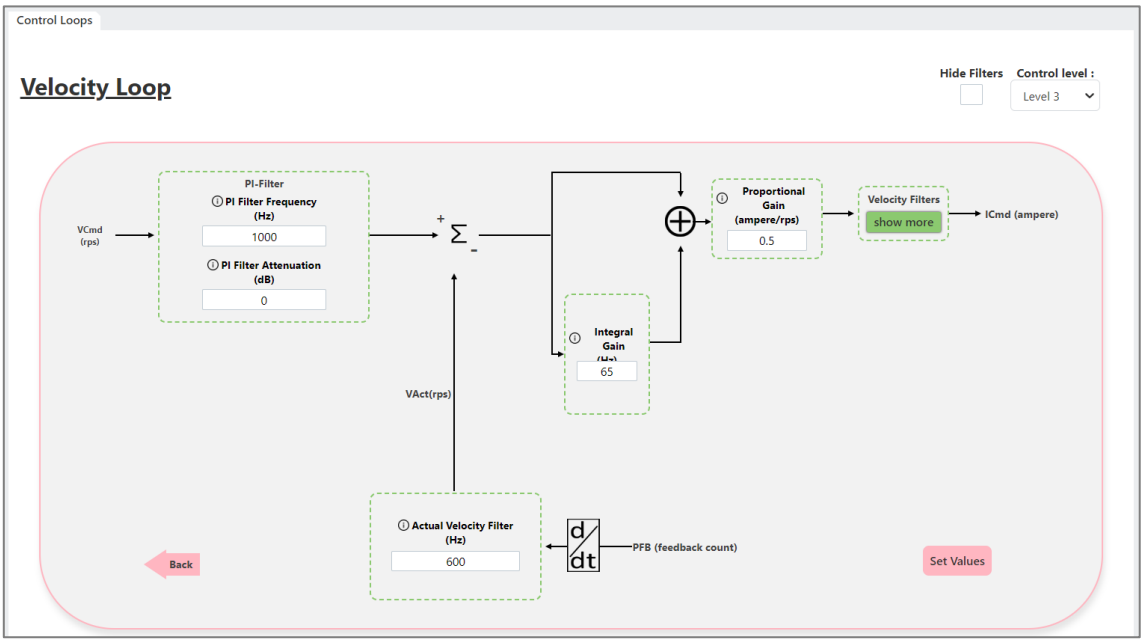


Figure 7-11 Motion Suite – Velocity Loop schematic dialog

4. In the Velocity Filters segment, press **Show More.**
5. In the Velocity Filters dialog box, select **0-None** for both Filter 1 and Filter 2 Type. This turns off all velocity filters.

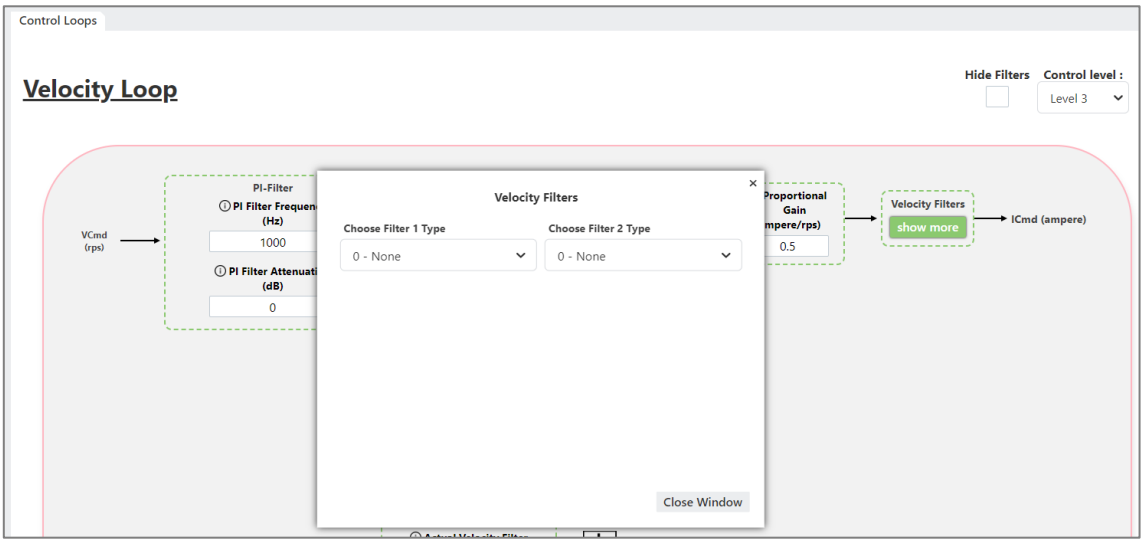


Figure 7-12 Motion Suite – Velocity Filters

Tune the Gains in Velocity Loop

Note

The ZED system has three levels of control, which enable the user to decide whether to use minimal parameter modification, or a more complex control design. Parameter settings from Level 1 can be incorporated into Level 2, which can then be integrated into Level 3 control.

Levels 1 and 2 rely on the ZED Autotuning feature, which is still in development. Therefore, the instructions for tuning the drive use Control Level 3 (L3) parameters.

To set the velocity integral gain (L3ki) and velocity proportional gain (L3kv), do the following.

1. Open the Advanced Operation screen.
2. Select the Velocity Mode tab.
3. Set Acceleration, Deceleration, and Velocity command values appropriate for your application. The values shown in the figure below should be suitable.
4. In the Tuning Parameters pane, set **L3ki** (velocity integral gain) to **0**, and set **L3kv** (velocity proportional gain) to **0.001**. Press **Set parameters**.

Note

Be sure to press **Set parameters** after modifying values in the Tuning Parameters pane. Otherwise, values will not be updated in the drive.

5. In the Recording Setup pane, do the following:
   a. Define a recording time that will be sufficient to capture the entire acceleration phase until the motor reaches a constant velocity. For example, set Gap to **16**, and Points to **2000**. Total time will automatically be set to 2 seconds.
   b. Select the parameters **Vact** and **Vcmd** to be recorded.
   c. Set the Trigger Condition to **Immediate**.

d. Enable the option **Delete Previous Records**.

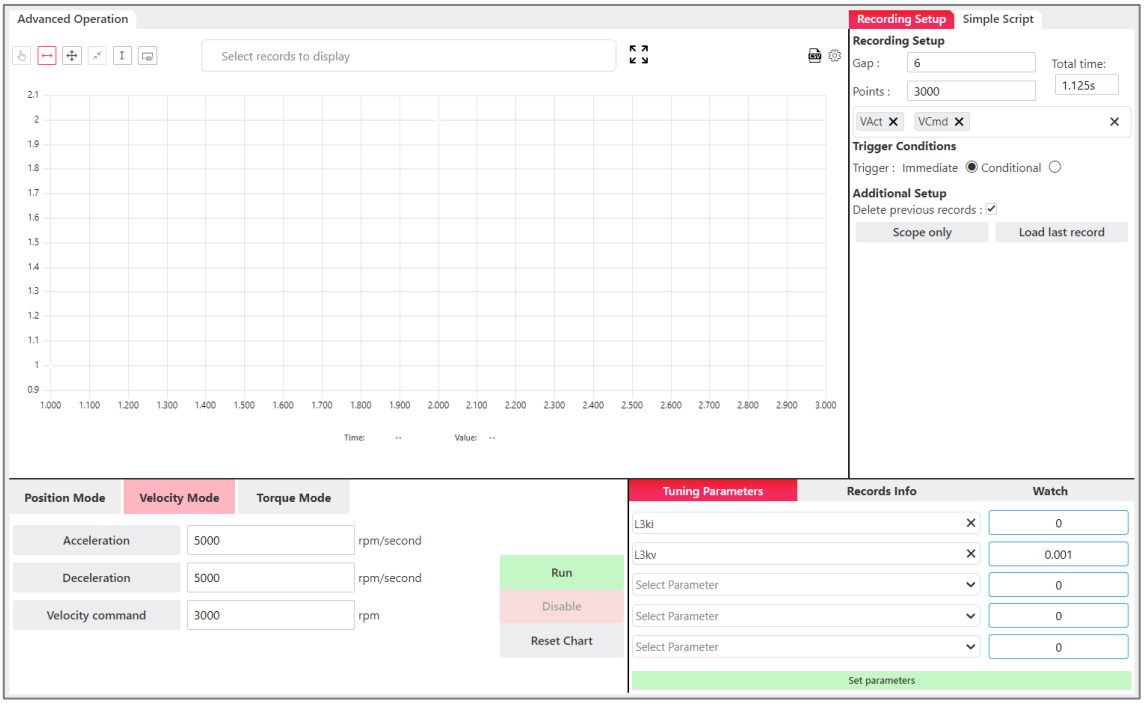


Figure 7-13 Motion Suite – Advanced Operation screen for recording

6. Press **Run**.

Note that the motor should **not** move.

7. Wait for the velocity command to be executed, and for the recording plot to be displayed on the graph.

You should see a half-trapezoid, representing the acceleration and target speed of the velocity command.

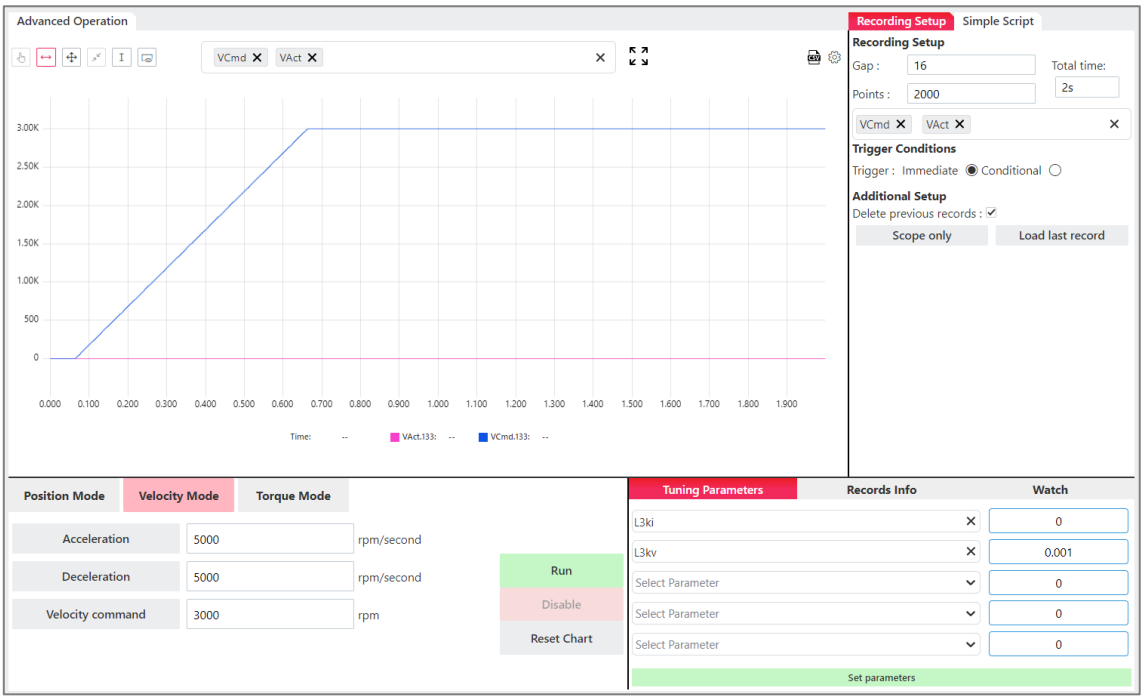


Figure 7-14 Velocity command profile

8. Leave the value of L3ki (velocity integral gain) at **0**, and do the following:

a. Gradually increase the value of L3kv (velocity proportional gain), in increments ranging between 0.5 to 1.0.

b. Press **Set parameters**.

c. Press **Run**.

d. Check the recorded plot.

e. Repeat steps **a to d** until you see that the actual velocity value closely follows the velocity command value.

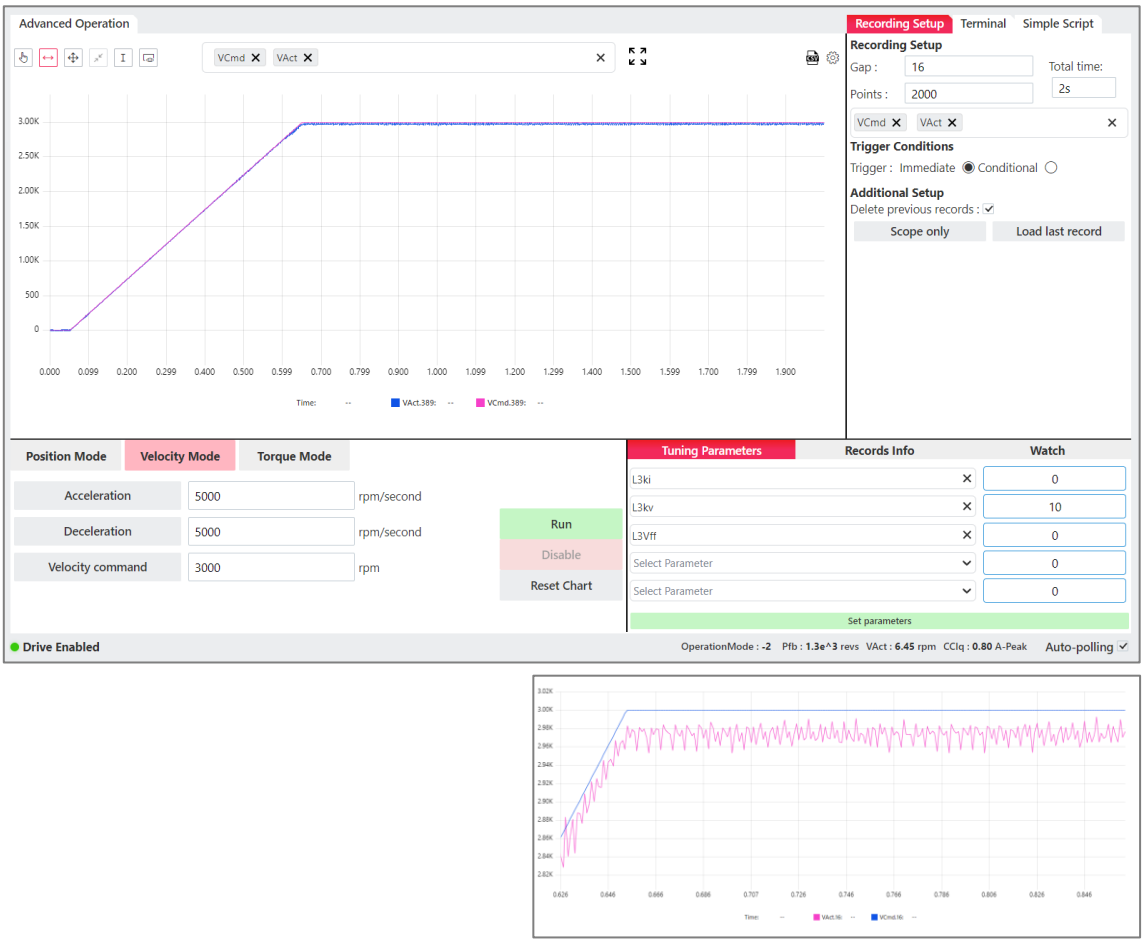


Figure 7-15 Velocity gains – preliminary tuning (inset: before tuning L3ki)

9. With the drive **enabled**, gradually increase the value of L3ki (velocity integral gain), in increments of 10, until you hear the motor making distinct crackling sounds.

   Be sure to press **Set parameters** each time you modify L3ki.

10. Once you reach this noisy motor condition, reduce the value of K3kv by half, and press **Set parameters**.

11. Press **Run**.

    In the recorded plot, you should see that the actual velocity value overlaps the velocity command value.

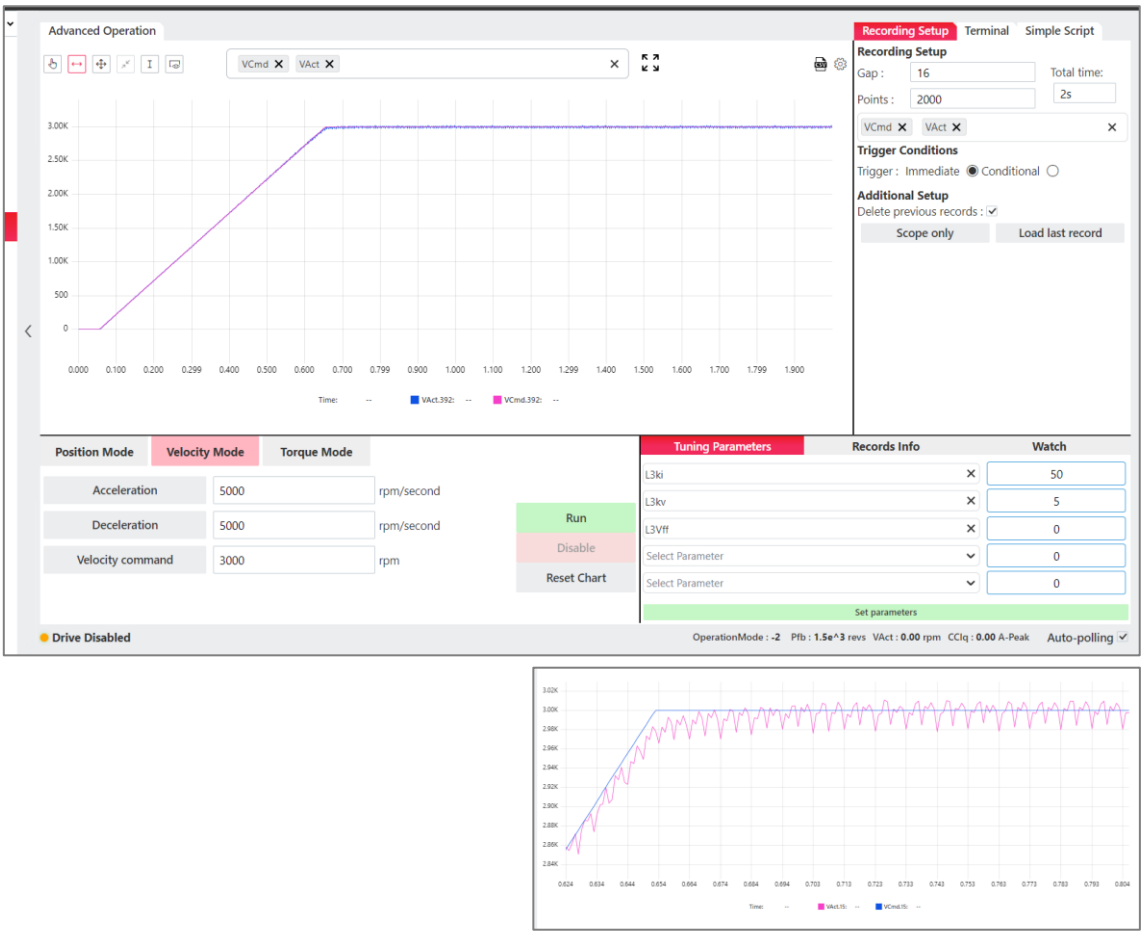


Figure 7-16 Velocity gains optimization (inset: after tuning L3ki)

12. If necessary, continue to adjust the parameters, without causing any distinct motor noise, or with as little noise as possible:

Increase the velocity integral gain (L3ki) in increments ranging between 1 and 2.

Increase the velocity proportional gain (L3kv) in increments ranging between 0.05 and 0.1.

Test the Position Loop

After setting the velocity gains, make sure the position profile is also a trapezoid.

To test the position control loop, execute a position command that is appropriate for your application. The values shown in the figure below should be suitable.

1. In the Advanced Operation screen, select the Position Mode tab.

a. Keep the same Acceleration, Deceleration, and Velocity command values that you used in Velocity Mode.

b. Set the Position command value.

c. Enable the option for **Incremental** position.

2. Press **Run**.

The recorded plot should be a trapezoid that represents the motion profile.

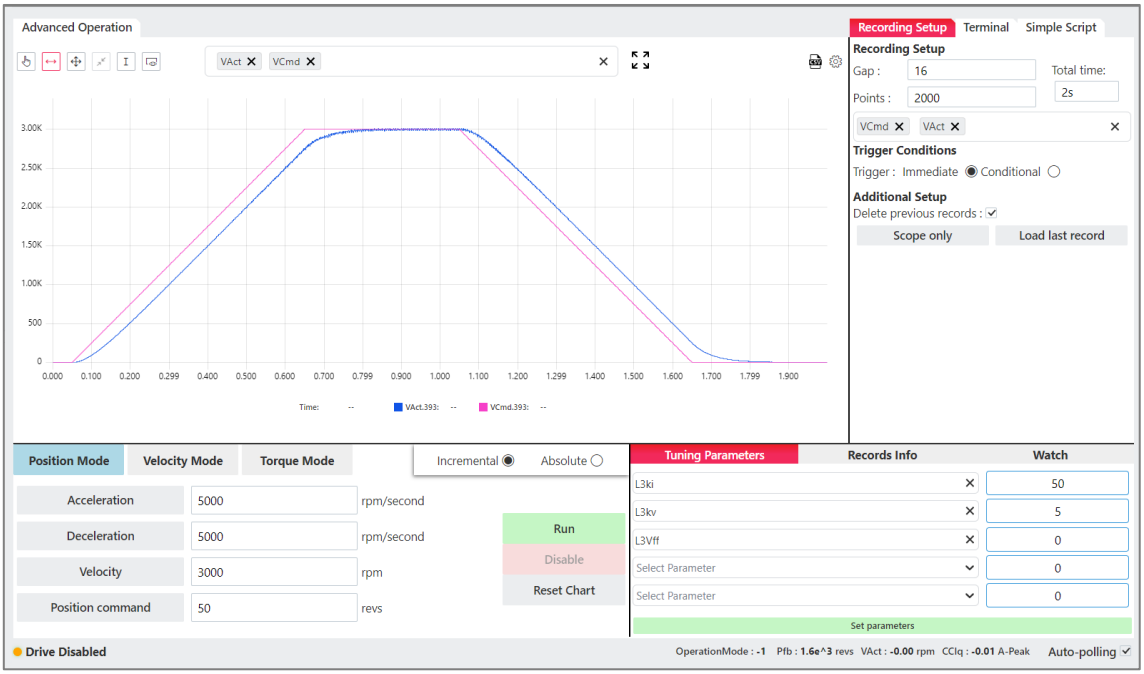


Figure 7-17 Position motion profile

Optimize the Position Error

1. In the Recording Setup pane, delete parameters Vcmd and Vact.

   Select the parameter **Pe** (position error) to be recorded.

2. Press **Run**.

   The recorded plot should be a trapezoid that represents the position error.

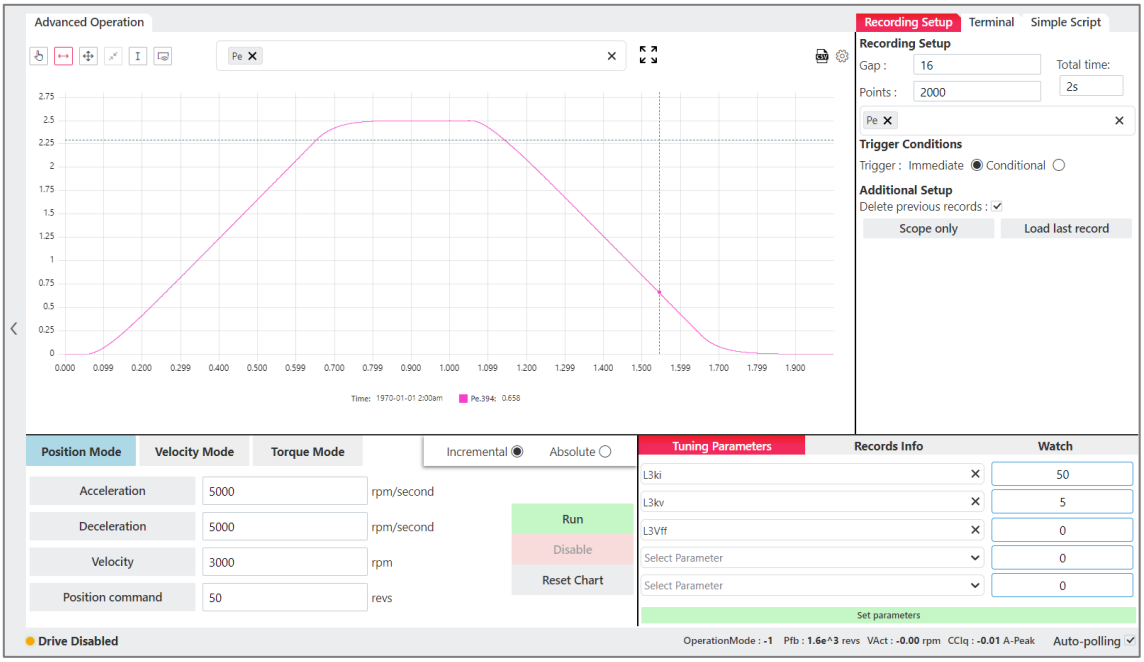


Figure 7-18 Position error profile

3. To reduce the position error and achieve optimal following of the motion profile, add velocity feedforward to the control loop.

   a. In the Tuning Parameters pane, add the parameter **L3Vff** (Velocity Feedforward).

   b. Set the value of L3Vff to **1**, and press **Set parameters**.

   c. Press **Run**.

   The recorded plot of the position error should resemble the one in the following figure.

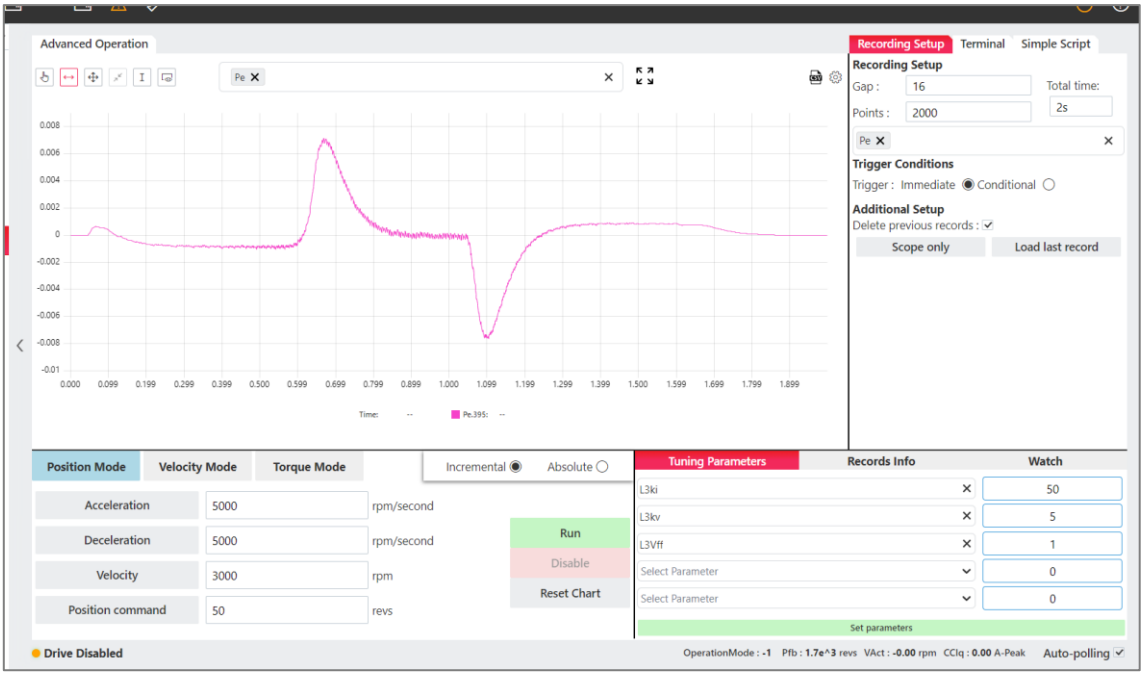


Figure 7-19 Optimization of position error, with velocity feedforward

If the plot displays a velocity ripple, as shown in the following figure, contact STXI Motion Technical Support.

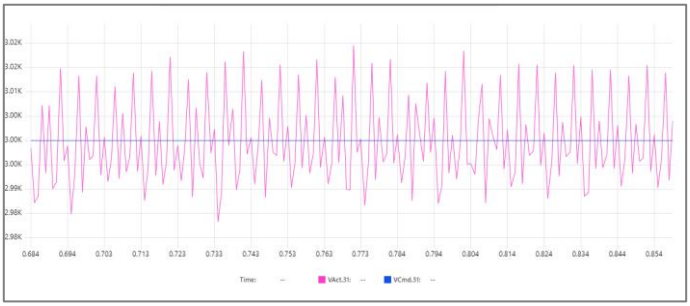


Figure 7-20 Velocity ripple

Save the Control Parameters to the Drive

When you are satisfied with the results of tuning, press the **Save to drive** button in the toolbar.

8 Network Communication

8.1 CANopen Network

CANopen Network Management

CANopen network nodes and states are controlled by network management (NMT) messages. The following diagram shows the network states and transitions.

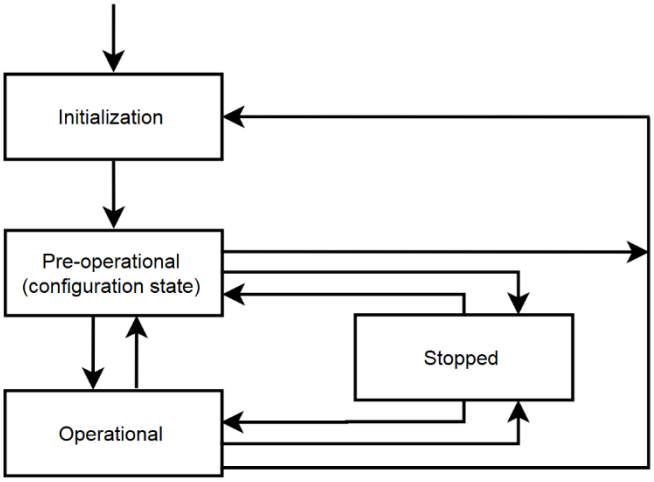


Figure 8-1. CANopen network management (NMT) states

- **Pre-operational state**. This state is used primarily for configuration of the CANopen device; therefore, the exchange of process date via PDOs is not possible in this state, and the device cannot be enabled in this state.
- **Operation state**. In this state the transmission of process data via PDOs is possible. This is the only state in which a device can be enabled.
- **Stopped**. A node cannot transmit or receive any other messages in this state. A device cannot be enabled when in this state.

CANopen Node ID

The default node ID for the ZED is CAN-ID:127.

To modify the node ID, use the serial parameter **CanNodeID**, or CAN object **2100h**.

1. Save the new node ID in the ZED.
2. Cycle power to the drive.
3. The new node ID will be set upon power-up.

CANopen Baud Rate

The default baud rate for the ZED is 1000 kbps.

Possible baud rates in CANopen are: 125, 250, 500, 1000.

To modify the baud rate, use the **serial** parameter **CanBaudRate**.

Note: *A CANopen/EtherCAT object is not yet implemented for Baud Rate.*

1. Save the new baud rate in the ZED.
2. Cycle power to the drive.
3. The new baud rate will be set upon power-up.

8.2 EtherCAT Network

EtherCAT Address

During the start-up phase, the EtherCAT master device sends an auto-addressing telegram to the slave devices – each slave receives an address and auto-increments the address to the next higher number for the following slave. The EtherCAT master then continues to query each EtherCAT slave for details about its properties.

All addressing is performed by the EtherCAT master device according to the EtherCAT standard; there are no address settings for the user to manipulate.

EtherCAT Network Management

EtherCAT network nodes and states are controlled by network management (NMT) messages. The following diagram shows the network states and transitions.

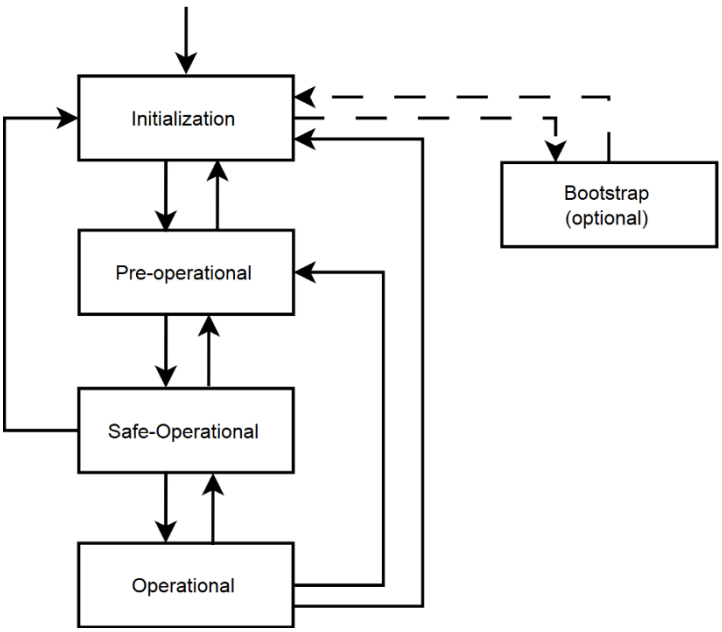


Figure 8-2. EtherCAT network management (NMT) states

- **Init**. No communication on the application layer is available. The master has access only to the DL-information registers.
- **Pre-operational.** Mailbox communication on the application layer available, but no process data communication available.
- **Safe-operational**. Mailbox communication on the application layer, process (input) data communication available. In SafeOp only inputs are evaluated; outputs are kept in 'safe' state.
- **Operational**. Process data inputs and outputs are valid.
- **Bootstrap**. Optional but recommended if firmware updates are required. No process data communication. Communication only via mailbox on Application Layer. Special mailbox configuration is possible, e.g. larger mailbox size. In this state the FoE protocol is usually used for firmware download.

9 Motor Brake Control

9.1 Holding Brake

The brake works according the closed-circuit current principle. To disengage the brake, a brake nominal current must flow through the brake; this is controlled by the drive.

If the power supply is interrupted, as in an emergency stop or a power outage, the brake stops the motor shaft rotation.

When using the holding brake, the ZED requires a separate 24/48 VDC power supply at connector C2, pins 1 and 2 (refer to section *Electrical Interfaces*).

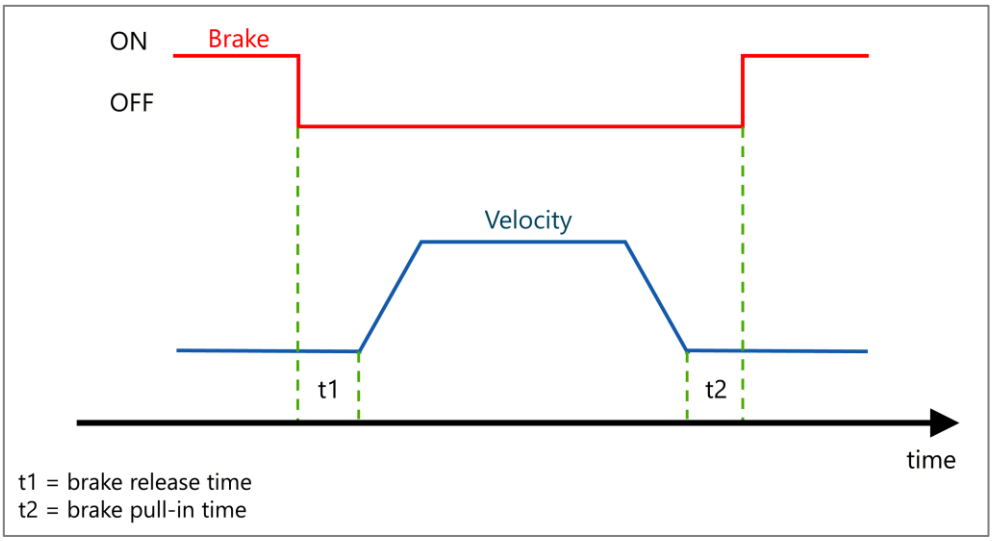


Figure 9-1. Motor brake control

Table 9-1. Motor Brake Specifications

		40 mm Flange	60 mm Flange	80 mm Flange	110 mm Flange	130 mm Flange
Voltage	VDC	24 ±10%	24 ±10%	24 ±10%	24 ±10%	24 ±10%
Power	W	5.3	7.4	13.5	16.8	16.9
Static Torque Min.	Nm	0.32	1.3	4.0	12	15
Resistance (20°C)	Ω	108 ±10%	78 ±10%	42.7 ±10%	34 ±10%	34 ±10%
Release Voltage	V	> 1.5	> 1	> 1.2	> 1.5	> 1.0
Pull-in Voltage	V	≤ 16.8	≤ 16.8	≤ 16.8	≤ 18	≤ 16.8
Release time	ms	≤ 20	30	30	≤ 60	≤ 60
Pull-in time	ms	≤ 35	50	60	≤ 100	≤ 100

Note In vertical axis applications, it is necessary to implement additional safety measures, such as, but not only, mechanical interlocks, redundant brakes.

9.2 PWM Brake Control

PWM brake control refers to the use of pulse width modulation (PWM) to manage motor braking. This method regulates the current flowing through the holding brake by using PWM signals to control the duty cycle of the brake's power supply.

PWM brake control advantages include:

- Can achieve proper and steady brake current in instances of an unstable brake power supply; for example, when connected to the bus voltage of the drive, or when brake voltage is higher than the brake's nominal voltage (according to the brake datasheet).
- After the initial phase of disengaging the brake by applying the brake's nominal current, it can reduce the brake's current while keeping the brake disengaged. This enables reduction of the brake's holding current to 30% of the brake's nominal current. The brake's minimum holding current is 0.3 × brake's nominal current.

Note Reducing the brake's current while disengaged (reducing the brake's holding current) decreases the brake's resistance to external mechanical shocks. If the brake's holding current is set too low, the brake might become engaged during operation. In such instances, the brake's holding current should be increased.

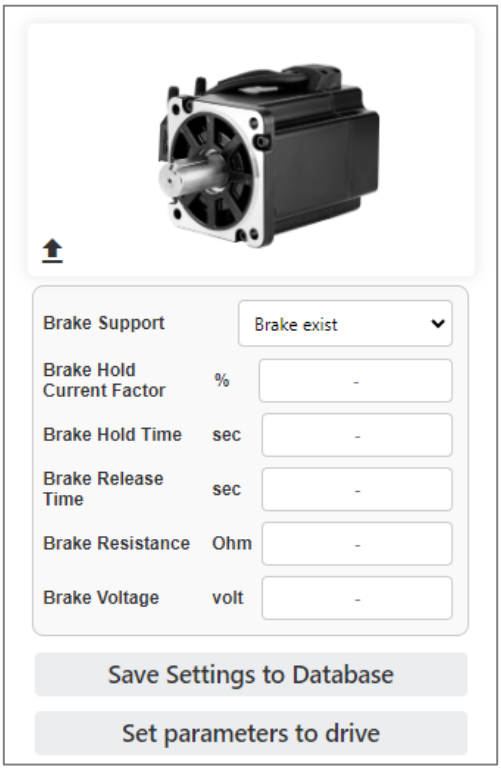


Figure 9-2. Motion Suite brake data input in Motor Setup screen

9.3 Manual Brake Disengagement

There are no specific commands that allow the user to explicitly disengage/engage the brake on the ZED.

During maintenance, however, the user might need to release the brake and move the motor. For such a purpose, use the following procedure:

1. Disable the drive.
2. Use the serial parameter **BrakeSupport**, or the EtherCAT/CANopen object **0x210F**.

   Define the parameter/object value as:

   0: No brake supported.

   The brake is considered disengaged; the motor can be moved.

   1: ZED motor with brake supported.

   The brake is controlled by the drive.
   When the drive is disabled, the brake is engaged; the motor cannot be moved.
   When the drive is enabled, the brake is disengaged; the motor can be moved.

The parameter value can be modified only when the drive is disabled.

The parameter value is stored in the drive's non-volatile (flash) memory.

10 Overload Protection

The overload algorithm protects the ZED drive and motor from overheating due to excessive current by limiting the rms value of the current command so that it does not exceed the rms value of the drive's rated current or the motor's rated current. It is set separately for the drive and for the motor.

OverloadMode (object 0x2022 / subindex 1)

0 = Generates an overload fault when the overload starts limiting the current command

1 = Limits the current command without generating an overload fault

Motor parameters that affect the motor overload algorithm behavior:

MotorIPeak	Object 0x200E, subindex 7. Motor peak current [A]
MotorIRated	Object 0x200E, subindex 6. Motor rated current [A]
OverloadMotorTime	Object 0x2022, subindex 3. Maximum time for the current to be at MotorIPeak [sec]

Drive parameters that affect the drive overload algorithm behavior:

DriveIPeak	Object 0x2020, subindex 2. Drive peak current [A]
DriveIRated	Object 0x2020, subindex 1. Drive rated current [A]
OverloadDriveTime	Object 0x2022, subindex 2. Maximum time for the current to be at DriveIPeak [sec]

When a motor is selected from the Motion Suite database, its current overload parameters are predefined and automatically loaded to the drive. Parameters that affect the overload algorithm of the drive are defined by the manufacturer and should not be changed by the user. However, if you wish to change these parameters for any reason, contact Technical Support.

The overload algorithm generates an overload current limit (DriveOverLoadI, object 0x2022 / subindex 5, and MotorOverLoadI, object 0x2022 / subindex 6).

The initial value of this overload current limit, which is also the maximum value, is greater than the peak current. When the actual current is higher than the rated current, the overload current limit is decreased proportionally to the difference between the actual current and the rated current. When the actual current is lower than the rated current, the overload current limit is increased proportionally to the difference between the rated current and the actual current, up to its maximum value. The overload current limit may limit the current command (Icmd).

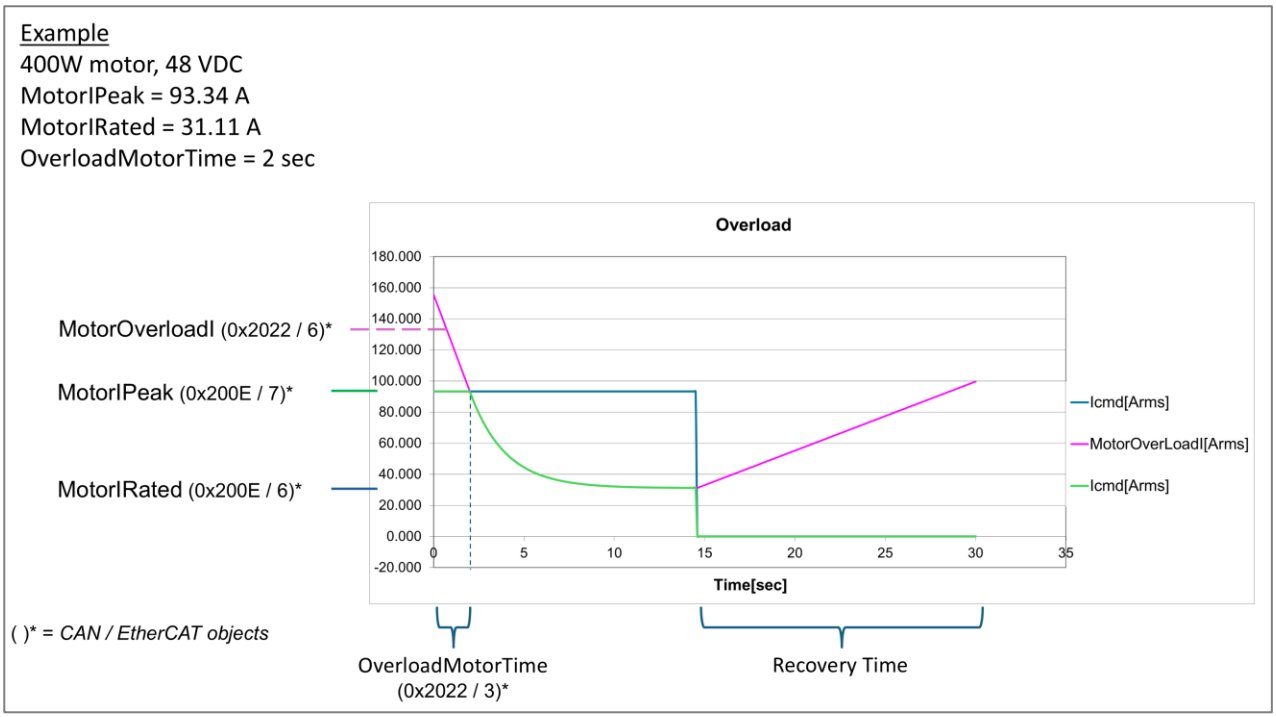


Figure 10-1 Example of ZED overload behavior

11 Digital Inputs and Outputs

11.1 Serial

The digital inputs and outputs can be configured in the Motion Suite software.

In the navigation menu, select Communication > **Configuration** > **IO config**.

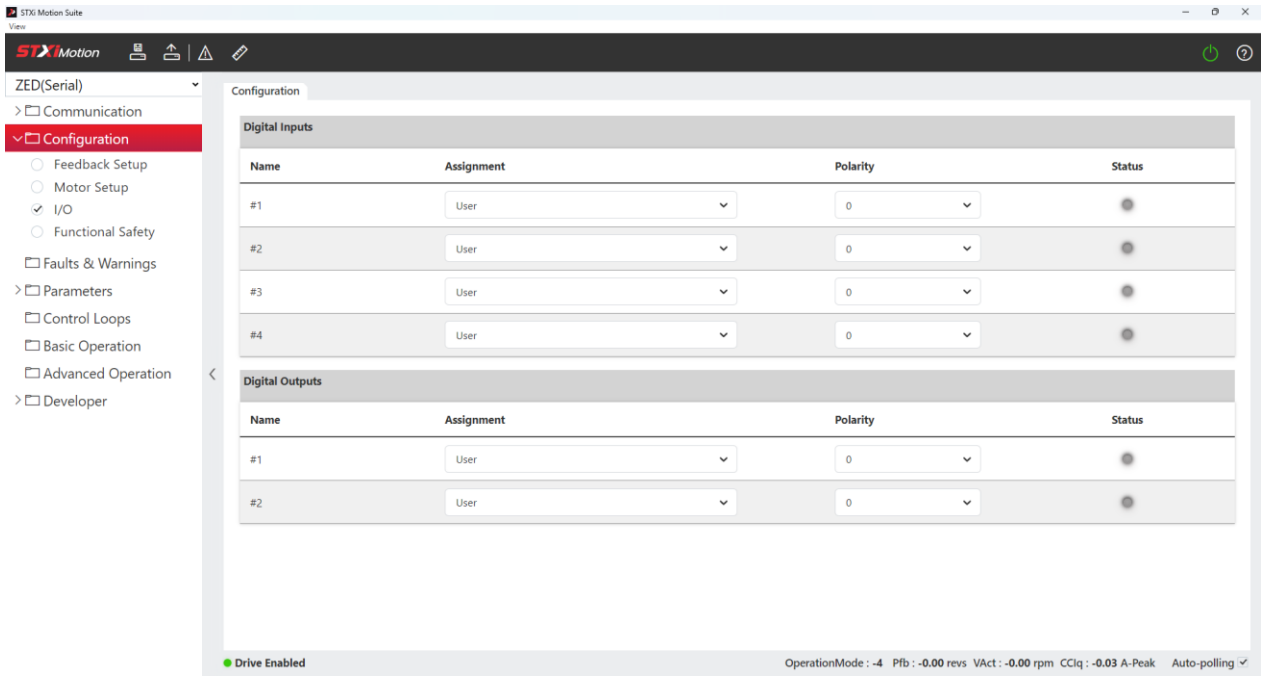


Figure 11-1 Motion Suite – I/O configuration

Digital Inputs

The **Digital Inputs** tab enables you to configure functionality and polarity of the digital inputs, and to monitor the state of the digital inputs.

Element	Description	Serial Parameters
Name	Identifies the specific input.	
Assignment	Defines the functionality of the digital input. 1 = User defined 2 = Position limit 3 = Negative limit 4 = Home switch	DigInput[*1-4*]Assign
Polarity	Defines the polarity of a digital input. 0 = Not inverted 1 = Inverted As a result of inversion, the Status graphic element in the software changes color.	DigInput[*1-4*]Polarity

Connector Pin Number	Indicates the pin number of the input on interface C4.	
Status	A graphic element that toggles between green and gray to reflect the on and off states of the actual input.	DigInput[*1-4*]

Digital Outputs

The **Digital Inputs** pane enables you to configure functionality and polarity of the digital output, and to monitor the state of the digital output.

Element	Description	Serial Parameters
Name	Identifies the specific output.	
Assignment	Defines the functionality of the digital output. 0 = Not used 1 = User defined 2 = Drive disabled 3 = Drive enabled	Out[*1-2*]Assign
Polarity	Defines the polarity of a digital output. 0 = Not inverted 1 = Inverted As a result of inversion, the Status graphic element in the software changes color.	Out[*1-2*]Polarity
Connector Pin Number	Indicates the pin number of the output on interface C4.	
Status	A graphic element that toggles between green and gray to reflect the on and off states of the actual output.	DigOutput[1-2]

11.2 CANopen/EtherCAT

Input and output functionality is implemented in the ZED according to the CAN standard.

- Object 60FDh – Inputs
- Object 60FE – Outputs

Digital Inputs – CANopen

Object 60FDh is organized bit-wise.

Bit	Field	Bit Value	Definition
0	Negative limit switch	0 1	Negative limit switch not reached Negative limit switch reached
1	Positive limit switch	0 1	Negative limit switch not reached Negative limit switch reached
2	Home switch	0 1	Home switch not reached Home limit switch reached
3	Reserved/Interlock	0	Not applicable
4–15	–		Not applicable
16-31	Manufacturer-specific: bit 16 – digital input 1 bit 17 – digital input 2 bit 18 – digital input 3	0 1	Function is not activated Function is activated

Digital Outputs - EtherCAT

Object 60FEh is organized bit-wise.

The object includes sub-indices.

	Field	Bit Value	Definition
Sub-index 01	Set brake	0 1	Switch off / do not set brake Switch on / set brake
Sub-index 01	Reserved	0	Reserved
Sub-index 01	Manufacturer-specific	0 1	Switch off Switch on
Sub-index 02	Each bit	0 1	Disable output Enable outputs

12 Firmware Upgrade

Firmware Upgrade via Motion Suite

Drive firmware is downloaded to drive through a serial (USB-C) connection and the Motion Suite software.

Note Firmware download over CAN or EtherCAT is not yet supported.

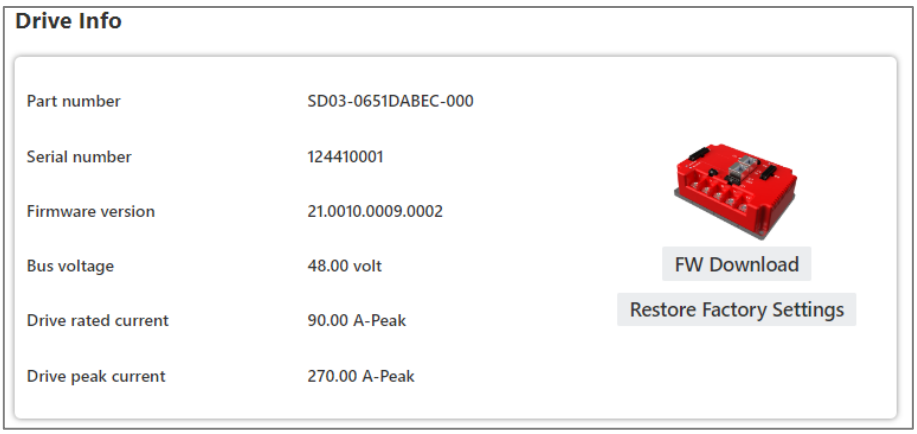


Figure 12-1 Firmware upgrade

Preparation

1. Download the required firmware file from the STXI Motion website, or contact Technical Support. The firmware file has the extension **bHex** or **Hex**.
2. Read the release note or other documentation supplied with the new firmware.
3. Before upgrading the firmware, it is recommended that you backup the drive parameters, since parameter settings may be modified during the upgrade process. After the upgrade is completed, the parameters can be restored.

   To backup parameters from drive:

   a. Open Motion Suite.

   b. In the navigation menu, select **Parameters**.

   c. At the top of the Parameters screen, select **Export Parameters**.

      Export Parameters saves all the parameters in the drive to a CSV file, and automatically downloads the file to the **Download** folder on your PC. You can rename the file and store it in any other location on your PC.

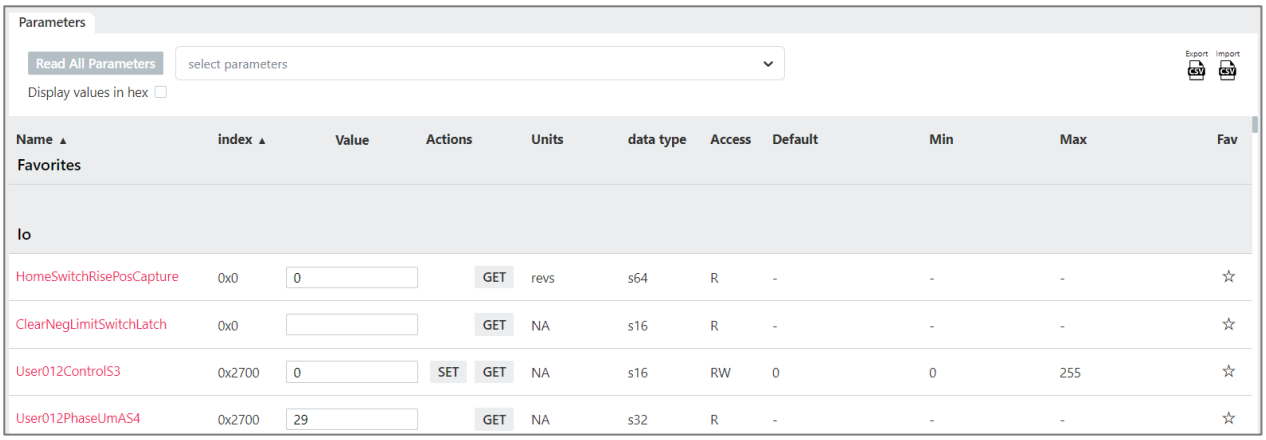


Figure 12-2 Motion Suite – Parameters

Procedure

1. Before downloading firmware to the ZED, make sure the drive is disabled.
2. From the Motion Suite toolbar, select **Download Firmware**. 
3. At the prompt, Select **Load File**.
4. Browse to and select the new firmware file, and click **Open**.
5. Select **Download**.

   Downloading the firmware file to the drive takes 1–2 minutes.

Resuming Operation

1. Confirm that the new firmware has been downloaded to drive. Open the Motion Suite Connections screen, and check the Firmware version displayed in the Product Info pane:

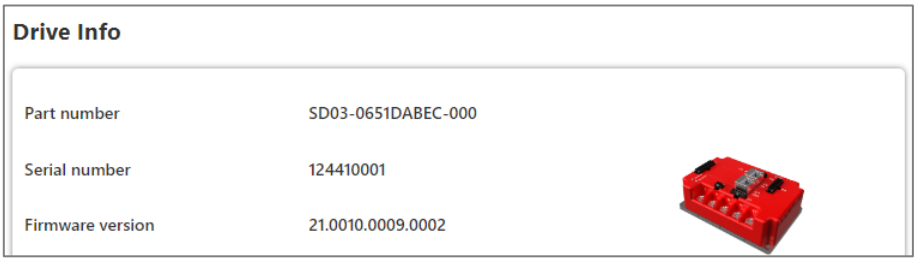


Figure 12-3 Motion Suite – firmware version

2. Restore the saved parameters to the drive.
   a. At the top of the Parameters screen, select **Import Parameters**.
   b. At the prompt, select **Upload file**.
   c. Browse to and select (Open) the CSV file you saved on your PC.
   d. At the prompt, select **Import Parameters**.

3. Check the version release notes.
4. Set any parameters that may have been added in the new version.

Note

If the fault message **Corrupted Parameters** is displayed after the firmware upgrade, press the **Save to drive** button in the toolbar.

13 Troubleshooting

13.1 LEDs

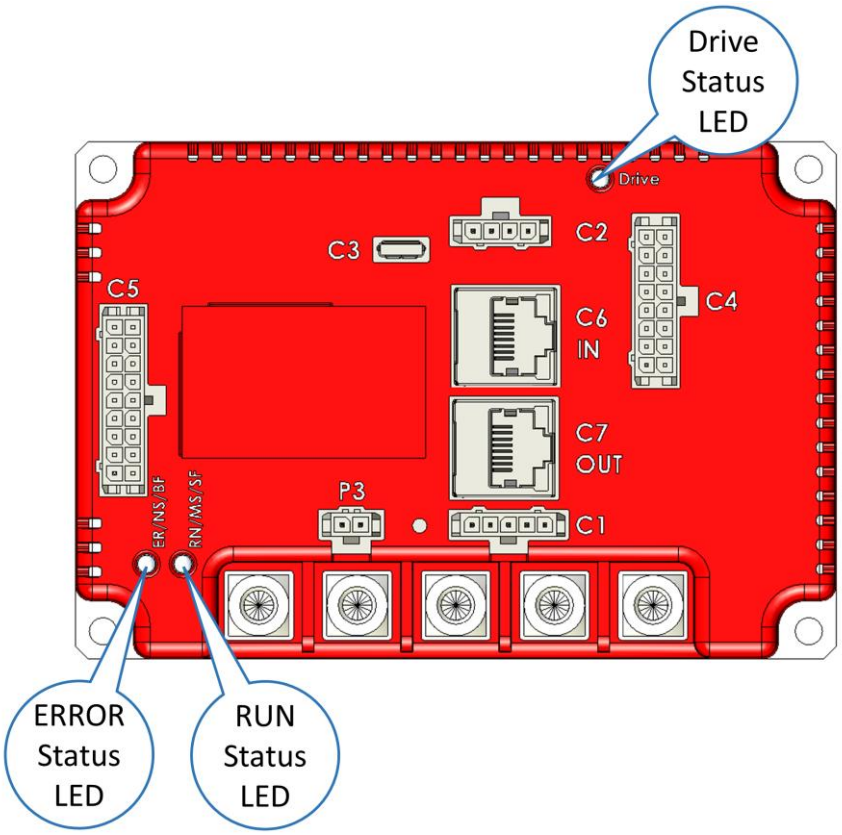


Figure 13-1 LED locations on the ZED

Drive Status LED – CANopen and EtherCAT

One tri-color LED serves as a drive status indicator.

Power Up (boot)

Color	LED state	Description
Green	Blinking	Immediately after power up. Evaluating checksum of the application firmware.
Orange	Blinking	Immediately after power up. Evaluating checksum of a new (recently downloaded) application firmware within a backup sector.
Orange	Blinking (other)	Immediately after power up and before application firmware starts running. Indicates a reprogramming sequence after firmware download.
Orange	Flashing	Application firmware checksum failure. Drive requires repair. (1s on > 1s off > 1s on > 1s off > 1s on > 3s off.)

Operational

Color	LED state	Description
Green	On	The ZED is enabled. No faults.
Green	Flashing	The ZED is disabled. No faults. (1000 ms on, 1000 ms off).
Red	On	A fault has been detected and needs attention. The LED remains lit until the error is resolved.
Red	Flashing	STO disconnected. (1000 ms on, 1000 ms off).
Red	Blinking	STO one channel diagnostic fault. (300 ms on, 300 ms off).
Red/Orange	Blinking	Watchdog. (300 ms red, 300 ms orange)

Run Status LED – CANopen

The **RN/MS/SF** LED is a Run status indicator.

Color	LED State	Slave State	CANopen Description
Green	On	Operational	The device is in Operational state.
Green	Blinking	Pre-operational	The device is in Pre-operational state.
Green	Single flash	Stopped	The device is in Stopped state.

Error Status LED – CANopen

The **ER/NS/BF** LED is an Error status indicator.

Color	LED State	Error Name	CANopen Description
Red	Off	No error	The device is in working condition
Red	On	Bus off	The CAN controller is bus off
Red	Single flash	Warning limit reached	At least one of the error counters of the CAN controller has reached or exceeded the warning level (too many error frames).
Red	Double flash	Error control event	A guard event (NMT-slave or NMT-master) or a heartbeat event (heartbeat consumer) has occurred.

Run Status LED – EtherCAT

The **RN/MS/SF** LED is a Run status indicator.

Color	LED State	Slave State	EtherCAT Definition
Green	On	Operational	The device is in Operational state.
Green	Off	Initialization	The device is in Initialization state.
Green	Blinking	Pre-operational	The device is in Pre-operational state.
Green	Single flash	Safe-operational	The device is in Safe-operational state.

Error Status LED – EtherCAT

The **ER/NS/BF** LED is an Error status indicator.

Color	LED State	Error Name	EtherCAT Definition
Red	Off	No error	EtherCAT communication of the device is in working condition.
Red	On	Application controller failure	A critical communication or application controller error has occurred.
Red	Single flash	Local Error	Slave device application has changed the EtherCAT state autonomously due to local error (Error Indicator bit is set to 1 in AL Status register.) *Unsolicited state change*.
Red	Double flash	Process data watchdog timeout/ EtherCAT watchdog timeout	An application watchdog timeout has occurred.
Red	Blinking	Invalid Configuration	General configuration error
Red	Flickering	Booting error	Booting error was detected. Init state reached, but Error Indicator bit is set to 1 in AL Status register.

Link Activity Status – LEDs C6 and C7 – EtherCAT only

LEDs are embedded in the RJ45 connector.

Color	LED state	Description
Green / Red	Off	No link
	Blinking	Link and activity
	On	Link without activity

13.2 Warnings and Faults

The following tables list the warnings and faults issued through serial communication.

Refer also to object **603Fh** (Error Code) and object **2032h** (Fault word) in the *TIM-ZED EtherCAT/ CANopen User Manual*.

The ZED uses standard CAN error codes whenever possible. If a standard code is not defined, the ZED uses code 0xFF01 for the error.

Warnings

Warnings are not considered faults and do not disable operation. The system automatically clears the warning state when the condition that generated the warning no longer exists.

Fault ID#	Serial String	Fault Word object 2032h Error Mask	Error Code object 603Fh	Description
Sub-index 1				
0	No User Enable	0x0000 0001	0xFF01	Drive is Disabled. Indicates the user enable command (serial command **En** or the relevant bits in fieldbus control word) is missing.
Sub-index 2				
43	Drive Overload Warning	0x0000 0800	0x2351	This warning is issued when the drive's overload current (serial command **DriveOverLoadI**) is slightly above drive's peak current (serial command **DriveIPeak**), and there is no Drive Overload fault
45	Motor Overload Warning	0x0000 2000	0x2351	This warning is issued when the motor's overload current (serial command **MotorOverLoadI**) is slightly above motor's peak current (serial command **MotorIPeak**), and there is not Motor Overload fault.
46	Drive Over Temp Warning	0x0000 4000	0xFF01	This warning is issued when the measured drive temperature (serial command **DriveTemp**) reaches 5°C below the drive temperature threshold (serial command **DriveTempThreshold**); that is, 5°C before the drive temperature fault occurs.
56	Drive Under Voltage Warning	0x0100 0000	0x3120	The warning is issued when the measured bus voltage (serial command **BusVoltageSense**) drops to within 2V of the undervoltage threshold (serial command **UnderVoltageThreshold**); that is 2V before the undervoltage fault occurs.

Fault ID#	Serial String	Fault Word object 2032h Error Mask	Error Code object 603Fh	Description
58	Heatsink Over Temp Warning	0x0400 0000	0x4110	The warning is issued when the measured heatsink temperature (serial command **HeatSinkTemp**) reaches 5°C below the heatsink temperature threshold (serial command **HeatsinkTempThreshold**); that is, 5°C before the heatsink temperature fault occurs.
63	STO Not Active Warning	0x8000 0000	0xFF01	This warning is issued when STO voltage is removed while the drive is enabled.
Sub-index 3				
71	Motor Over Temp Warning	0x0000 0080	0x4110	The warning is issued when the measured motor temperature (serial command **MotorTemp**) reaches 5°C below the motor temperature threshold (serial command **MotorTempThreshold**); that is, 5°C before the motor temperature fault occurs.
86	Pos SW Position Limit Detected	0x0040 0000	0xFF01	Positive software limit switch is active.
87	Neg SW Position Limit Detected	0x0080 0000	0xFF01	Negative software limit switch is active.
88	SW Limits Inhibited: No Homing	0x0100 0000	0xFF01	Software limit switches are enabled only if homing has been performed.
94	Numerical PFB limit warning	0x4000 0000	0xFF01	Position feedback variable (64 bits) is approaching its numerical limit.
Sub-index 4				
100	MTS Overload	0x0000 0010	0xFF01	This warning is issued if the execution time of the main interrupt service routine (ISR) exceeds a threshold. The threshold value may vary in different firmware versions.
102	Safety Module Warning	0x0000 0040	0xFF01	This warning is issued if the safety module (if it exists) reports an internal warning.

Faults

Faults occur when settings or conditions may adversely affect ZED operation or damage the drive.

Faults automatically disable the drive, and the fault status is indicated by LEDs and/or software messages.

The drive fault status is generally latched, and the drive cannot be enabled until the fault status is explicitly cleared. The fault status cannot be cleared until the fault condition no longer exists.

Fault ID#	Serial String	Fault Word object 2032h Error Mask	Error Code object 603Fh	Description	ZED Response
Sub-index 1					
1	Current Offsets Invalid	0x0000 0002	0xFF01	This fault is in effect until the drive completes the offset compensation calculation for the A2D converters, which sample the motor phase U, V and W currents.	Immediate disable
7	Overload Design Failed	0x0000 0080	0xFF01	This fault occurs in two instances: If the drive is enabled and the drive's peak current (serial command **DriveIPeak**) is equal to or below the drive's rated current (serial command **DriveIRated**). This fault occurs if the drive is enabled and the motor's peak current (serial command **MotorIPeak**) is equal to or below the motor's rated current (serial command **MotorIRated**).	Immediate disable
15	Invalid Halls State	0x0000 8000	0x7300	This fault is applicable to motors with an incremental encoder and Hall sensor feedback. This fault occurs when the three Hall switches are all either logically high or logically low, which are invalid Hall states.	Immediate disable
16	Invalid Halls Switch	0x0001 0000	0x7300	This fault is applicable to motors with an incremental encoder and Hall sensor feedback. This fault occurs when an invalid Hall switch is detected.	Immediate disable
22	Manufacturer Info Read Error	0x0040 0000	0xFF01	This fault indicates that reading manufacturer data from non-volatile memory has failed. This fault cannot be cleared by the **Clearfaults** command. Try clearing the fault by power cycling the drive. If the fault persists, contact STXI Motion Technical Support.	Immediate disable

Fault ID#	Serial String	Fault Word object 2032h Error Mask	Error Code object 603Fh	Description	ZED Response
23	Manufacturer Info Write Error	0x0080 0000	0xFF01	This fault indicates that writing manufacturer data to non-volatile memory or erasing manufacturer data from non-volatile memory has failed. This fault cannot be cleared by the **Clearfaults** command. Try clearing the fault by power cycling the drive. If the fault persists, contact STXI Motion Technical Support.	Immediate disable
24	PWM Driver Error	0x0100 0000	0xFF01	This fault occurs in several instances: If the gate driver type could not be read from the manufacturer data in non-volatile memory (serial command **GateDriveType**). If the gate driver type is unknown to the firmware (serial command **GateDriveType**). If configuration of the gate driver (e.g., via SPI interface) has failed. This fault cannot be cleared by the **Clearfaults** command. Try clearing the fault by power cycling the drive. If the fault persists, contact STXI Motion Technical Support.	Immediate disable
25	Fieldbus Sync Loss	0x0200 0000	0xFF01	This fault occurs if the drive loses synchronization with the fieldbus master during enable. Refer to object 210Bh PLL Information Parameters.	Immediate controlled stop
26	Corrupted Parameters File	0x0400 0000	0xFF01	This fault occurs if the loading of parameter data from the flash memory fails due to a missing file, a corrupted file, or unknown/invalid data content. The fault can be cleared by saving the parameter (serial command **SaveParams 1**).	Immediate disable
27	Motor Over Speed	0x0800 0000	0x7310	This fault occurs if the drive is enabled and the actual velocity (serial command **VAct**) briefly exceeds the overspeed threshold (5 consecutive samples). The overspeed threshold is the minimum of the user overspeed setting (serial command **Overspeed**), and 1.2 times the maximum motor speed (serial command **MotorSpeed**).	Immediate disable

Fault ID#	Serial String	Fault Word object 2032h Error Mask	Error Code object 603Fh	Description	ZED Response
28	Drive Over Current	0x1000 0000	0x2220	This fault occurs if the CPU reads a momentary or latched over-current hardware indication on a dedicated CPU input pin. At least 1 second should elapse from the time over-current fault was detected until there is an attempt to clear it. Only 3 over-current fault clears are allowed. The fourth over-current fault cannot be cleared. Try clearing the fault by power cycling the drive.	Immediate disable
29	Drive Over Voltage	0x2000 0000	0x3110	This fault occurs in two instances. If the measured bus voltage (serial command **BusVoltageSense**) exceeds the overvoltage threshold (serial command **OverVoltageThreshold**). **OverVoltageThreshold** is the minimum of: ♦ General ZED maximum voltage rating of the drive (hardware-dependent). ♦ 1.5 times the motor voltage (serial command **MotorVoltage**). ♦ 1.75 times the ZED drive voltage (serial command **Vbus**). By a hardware signal (if that feature is enabled).	Immediate disable
30	Drive Over Temp	0x4000 0000	0x4110	This fault occurs if the measured drive temperature (serial command **DriveTemp**) exceeds the drive temperature threshold (serial command **DriveTempThreshold**).	Immediate controlled stop
31	Motor Over Temp	0x8000 0000	0x4110	This fault occurs if the motor has a temperature sensor, and the measured motor temperature (serial command **MotorTemp**) exceeds the motor temperature threshold (serial command **MotorTempThreshold**).	Immediate controlled stop

Fault ID#	Serial String	Fault Word object 2032h Error Mask	Error Code object 603Fh	Description	ZED Response
Sub-index 2					
32	PE Max Exceeded	0x0000 0001	0x8611	This fault occurs if the drive is enabled and the following error of the position loop (serial command **Pe**) exceeds the user-defined following error threshold (serial command **PeMax**). A **PeMax** value of 0 deactivates this fault. Tuning the control loops will affect generation of this fault.	Immediate controlled stop
33	MT6835 Enc Over Speed Reached	0x0000 0002	0x7300	This fault occurs when, for 3 consecutive cycles of 62.5 µs (3 x 62.5 µs), the MT6835 feedback device reports a **Rotation Overspeed Warning** in it STATUS register. This error is reported by the feedback device itself. The maximum rotation speed of the MT6835 feedback device is 120,000 rpm. This fault cannot be cleared by the **Clearfaults** command. Try clearing the fault by power cycling the drive. If the fault persists, contact STXI Motion Technical Support.	Immediate disable
34	MT6835 Enc Weak Magnetic Field	0x0000 0004	0x7300	This fault occurs when, for 3 consecutive MTS cycles of 62.5 µs (3 x 62.5 µs), the MT6835 feedback device reports a **Weak Magnetic Field Warning** in it STATUS register. This error is reported by the feedback device itself. This fault cannot be cleared by the **Clearfaults** command. Try clearing the fault by power cycling the drive. If the fault persists, contact STXI Motion Technical Support.	Immediate disable
35	MT6835 Enc No Communication	0x0000 0008	0x7300	This fault occurs when, for 3 consecutive MTS cycles of 62.5 µs (3 x 62.5 µs), the CPU reads 0xFFFF,FFFF from the MT6835 feedback device. This is due to a missing connection to the feedback device.	Immediate disable
36	MT6835 Enc CRC Failed	0x0000 0010	0x7300	This fault occurs when, for 3 consecutive MTS cycles of 62.5 µs (3 x 62.5 µs), the CPU detects a CRC error of the data received from the MT6835 feedback device.	Immediate disable

Fault ID#	Serial String	Fault Word object 2032h Error Mask	Error Code object 603Fh	Description	ZED Response
37	EE Emulator Error	0x0000 0020	0xFF01	This fault occurs if a file erasure fails.	Immediate disable
39	Drive Under Voltage	0x0000 0080	0x3120	The fault occurs if the measured bus voltage (serial command **BusVoltageSense**) reaches or drops below the undervoltage threshold (serial command **UnderVoltageThreshold**) for 3 samples.	Immediate controlled stop
42	Drive Overload	0x0000 0400	0x2350	This faults occurs if the command to the current controller (serial command **Icmd**) is saturated by the drive's overload current (serial command **DriveOverLoadI**), and this fault is enabled (serial command **OverloadMode** = 0).	Immediate controlled stop
44	Motor Overload	0x0000 1000	0x2350	This fault occurs if the command to the current controller (serial command **Icmd**) is saturated by the motor's overload current (serial command **MotorOverLoadI**), and this fault is enabled (serial command **OverloadMode** = 0).	Immediate controlled stop
49	Corrupted Faults Log File	0x0002 0000	0xFF01	This fault occurs if the faults log data from the flash memory fails to load (due to, for example, a corrupted file, an excessively large file, a file containing too many faults, or unknown/invalid data content). The fault can be cleared by a successful file erasure (serial command C**learFaultsLog**).	Immediate disable
54	MT6835 Enc Under Voltage	0x0040 0000	0x7300	This fault occurs when, for 3 consecutive MTS cycles of 62.5 µs (3 x 62.5 µs), the MT6835 feedback device reports a **Weak Under Voltage Warning** in its STATUS register. This error is reported by the feedback device itself. This fault cannot be cleared by the **Clearfaults** command. Try clearing the fault by power cycling the drive. If the fault persists, contact STXI Motion Technical Support.	Immediate disable

Fault ID#	Serial String	Fault Word object 2032h Error Mask	Error Code object 603Fh	Description	ZED Response
57	Heatsink Over Temp	0x0100 0000	0x4110	This fault occurs when the measured heatsink temperature (serial command **HeatSinkTemp**) exceeds the heatsink temperature threshold (serial command **HeatsinkTempThreshold**).	Immediate controlled stop
59	Authorization Key Is Missing	0x0200 0000	0xFF01	The error occurs if the product did not receive an authorization key during the production process. Contact STXI Motion Technical Support.	Immediate disable
60	Motor Brake Fault	0x1000 0000	0x7110	This fault occurs in the following instances: Brake overcurrent. The brake current is 1.5 times greater than the brake peak current, where the brake peak current equals brake voltage (serial command **BrakeVoltage**), divided by the brake resistance (serial command **BrakeResistance**), for brake types (serial command **BrakeType**) 1 or 2. The actual brake state (engaged or disengaged) does not match the commanded state, for brake type (serial command **BrakeType**) 1 or 2. Hardware brake fault indication, for brake type (serial command **BrakeType**) 0.	Immediate disable
61	Heatsink Temp Sensor Fault	0x2000 0000	0xFF01	This fault occurs if communication with the heatsink temperature sensor fails. In this case, the displayed heatsink temperature will exceed 1000°C.	Immediate controlled stop
62	STO Not Active Fault	0x4000 0000	0xFF01	This fault occurs if STO voltage is removed while the drive is enabled.	Immediate disable
Sub-index 3					
64	STO Channel 1 Diagnostic Fault	0x0000 0001	0xFF01	This fault occurs if the diagnostics of STO channel 1 detects a failure in this channel; for example, the diagnostic momentarily asserts STO channel 1, but the hardware feedback indicates that STO channel 1 is not asserted. If the diagnostics of both STO channel 1 and STO channel 2 fail, the drive will reset itself. Contact STXI Motion Technical Support.	Immediate controlled stop

Fault ID#	Serial String	Fault Word object 2032h Error Mask	Error Code object 603Fh	Description	ZED Response
65	STO Channel 2 Diagnostic Fault	0x0000 0002	0xFF01	This fault occurs if the diagnostics of STO channel 1 detects a failure in this channel; for example, the diagnostic momentarily asserts STO channel 2, but the hardware feedback indicates that STO channel 2 is not asserted. If the diagnostics of both STO channel 1 and STO channel 2 fail, the drive will reset itself. Contact STXI Motion Technical Support.	Immediate controlled stop
66	BiSS Config Failed	0x0000 0004	0x7300	This fault occurs if initialization of the BiSS encoder fails.	Immediate disable
67	BiSS Communication Fault	0x0000 0008	0x7300	The fault occurs if there are consecutive communication failures (CRC, watchdog, timeout) with the BiSS encoder.	Immediate disable
68	BiSS Feedback Alarm	0x0000 0010	0x7300	This fault occurs if the BiSS encoder sets its alarm bit (encoder temperature sensor) too high.	Immediate disable
69	Biss Feedback Warning Bit is Set	0x0000 0020	0x7300	This fault occurs when the BiSS encoder sets it warning bit. All BiSS encoder warning bits are OR'ed together.	Immediate disable
70	CAN Init Failed	0x0000 0040	0xFF01	This fault occurs if the BiSS encoder set a warning bit in its telegram.	Immediate disable
72	Motor Temp Sensor Fault	0x0000 0100	0xFF01	This fault occurs if initialization of the CAN module fails.	Immediate controlled stop
73	Invalid Drive Peak Current	0x0000 0200	0xFF01	The fault occurs if the drive peak current (serial command **DriveIPeak**) exceeds 1000 A. Contact STXI Motion Technical Support.	Immediate disable
74	Invalid Drive Rated Current	0x0000 0400	0xFF01	The fault occurs if the drive rated current (serial command **DriveIRated**) exceeds 1000 A. Contact STXI Motion Technical Support.	Immediate disable
75	Personality Info Invalid	0x0000 0800	0xFF01	This fault occurs if either the digital board EEPROM or the power board EEPROM was not completely initialized with proper values during production process. Contact STXI Motion Technical Support.	Immediate disable

Fault ID#	Serial String	Fault Word object 2032h Error Mask	Error Code object 603Fh	Description	ZED Response
76	CAN Baud Rate Changed	0x0000 1000	0xFF01	This fault occurs if the CAN baud rate was modified (serial command **CanBaudRate**) after the CAN module was initialized. This fault cannot be cleared. The fault disappears after Save (serial command **SaveParams 1**) and power cycle after the new baud rate is applied.	Immediate disable
77	Unknown Flash Size	0x0000 2000	0xFF01	This fault occurs if the digital board EEPROM does not contain a valid value for the digital board QSPI flash size. The serial command **FlashSize** reads that flash-size value out of the EEPROM and the error is raised in case that the flash size was not yet programmed to the EEPROM (value -1 is returned). Contact STXI Motion Technical Support.	Immediate disable
78	No Remote Enable	0x0000 4000	0xFF01	This fault occurs if the functionality of one of the digital inputs is assigned to mode 5 (serial command **DigInput*n*Assign**), and the input is at low level.	None (special case)
79	Consumer 1 Heartbeat Fault	0x0000 8000	0xFF01	CANopen. This fault occurs if heartbeat 1 is defined and no heartbeat is detected within the designated time (heartbeat period).	Immediate controlled stop
80	Consumer 2 Heartbeat Fault	0x0001 0000	0xFF01	CANopen. This fault occurs if heartbeat 2 is defined and no heartbeat is detected within the designated time (heartbeat period).	Immediate controlled stop
81	Feedback Extrapolations Limit	0x0002 0000	0xFF01	This fault occurs if two or more consecutive feedback interpolations were performed (feedback interpolation is performed when a communication-based feedback device experiences a communication error, such as timing or CRC.	Immediate disable

Fault ID#	Serial String	Fault Word object 2032h Error Mask	Error Code object 603Fh	Description	ZED Response
82	Ethercat PHY Write Fault	0x0004 0000	0xFF01	This fault occurs when a write command to the PHY's register is executed, and the value that is read from the register is not equal to the value that is written. This fault can be cleared.	Immediate disable
83	Fieldbus Connection Loss Fault	0x0008 0000	0x8180	This fault occurs for an EtherCAT drive if the EtherCAT slave stack code reports a Sync Manager Watchdog error in the EtherCAT state machine register AL Status (ESC registers 0x130 and 0x134) and the drive is in the enabled state. This condition may occur, for example, when unplugging the EtherCAT cable.	Immediate controlled stop
84	Encoder Power Failure	0x0010 0000	0x7300	This fault occurs when the encoder power supply fails.	Immediate disable
85	PWM driver power supply failure	0x0020 0000	0x FF01	This fault occures when the PWM driver power supply fails.	Immediate disable
89	Kernel Stack OV	0x0200 0000	0xFF01	Contact STXI Motion Technical Support.	Immediate disable
90	BiSS MT OV Load Failed	0x0400 0000	0x7300	BiSS feedback multiturn overflow feature data could not be loaded.	Immediate disable
91	BiSS MT OV Offline Move Fault	0x0800 0000	0x7300	BiSS feedback multiturn overflow feature has detected a large offline move.	Immediate disable
92	Modulo Configuration Fault	0x1000 0000	0xFF01	Modulo feature configuration error. Modulo high is smaller than modulo low.	Immediate disable
93	Numerical PFB Limit Fault	0x2000 0000	0xFF01	Position feedback variable (64 bits) is near its numerical limit.	Immediate controlled stop
Sub-index 4					
96	Safety Board Does Not Exist	0x0000 0001	0xFF01	This fault occurs when a safety board is not mounted on a drive that supports a safety board.	Immediate disable
97	SSI Encoder No Communication	0x0000 0002	0x7300	This fault occurs if there is no communication to the MA600 encoder over the SSI bus for two or more consecutive trials.	Immediate disable

Fault ID#	Serial String	Fault Word object 2032h Error Mask	Error Code object 603Fh	Description	ZED Response
98	SSI Encoder Parity Error Fault	0x0000 0004	0x7300	This fault occurs if there is a parity error when reading the position information from the MA600 encoder over the SSI bus for two or more consecutive trials.	Immediate disable
99	SSI Encoder Config Failed	0x0000 0008	0x7300	This fault occurs if the internal configuration of the SSI bus to communicate with the MA600 encoder fails.	Immediate disable
100	RTOS OV Event	0x0000 0020	0xFF01	This fault occurs if one or more of the RTOS thread stacks is near to overflow.	Immediate disable
103	Safety Module Fault	0x0000 0080	0xFF01	This fault occurs if the safety module (if it exists) reports an internal fault.	Immediate disable

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