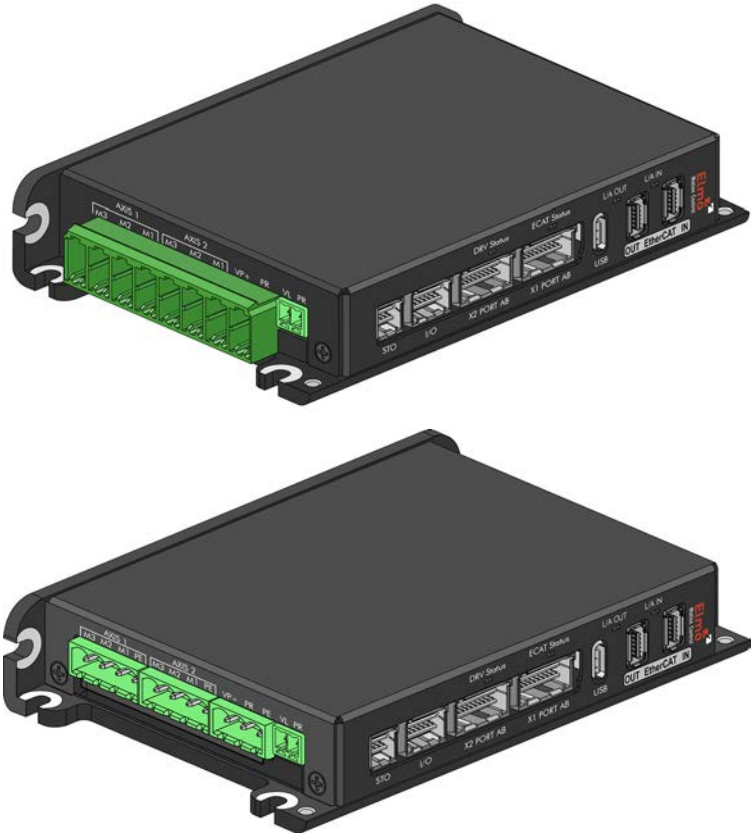
Elmo
Dedicated To Excel

Titanium Harmonica
Digital Servo Drive Installation Guide

Functional Safety

Safety Capabilities: F, S, O

EtherCAT & CAN



June 2025 (Ver. 2.004)

This guide is delivered subject to the following conditions and restrictions:

- This guide contains proprietary information belonging to Elmo Motion Control Ltd. Such information is supplied solely for the purpose of assisting users of Elmo's servo drive(s) in their installation.
- The text and graphics included in this manual are for the purpose of illustration and reference only. The specifications on which they are based are subject to change without notice.
- Elmo Motion Control and the Elmo Motion Control logo are trademarks of Elmo Motion Control Ltd.
- Information in this document is subject to change without notice.

Elmo Motion Control and the Elmo Motion Control logo are registered trademarks of Elmo Motion Control Ltd.

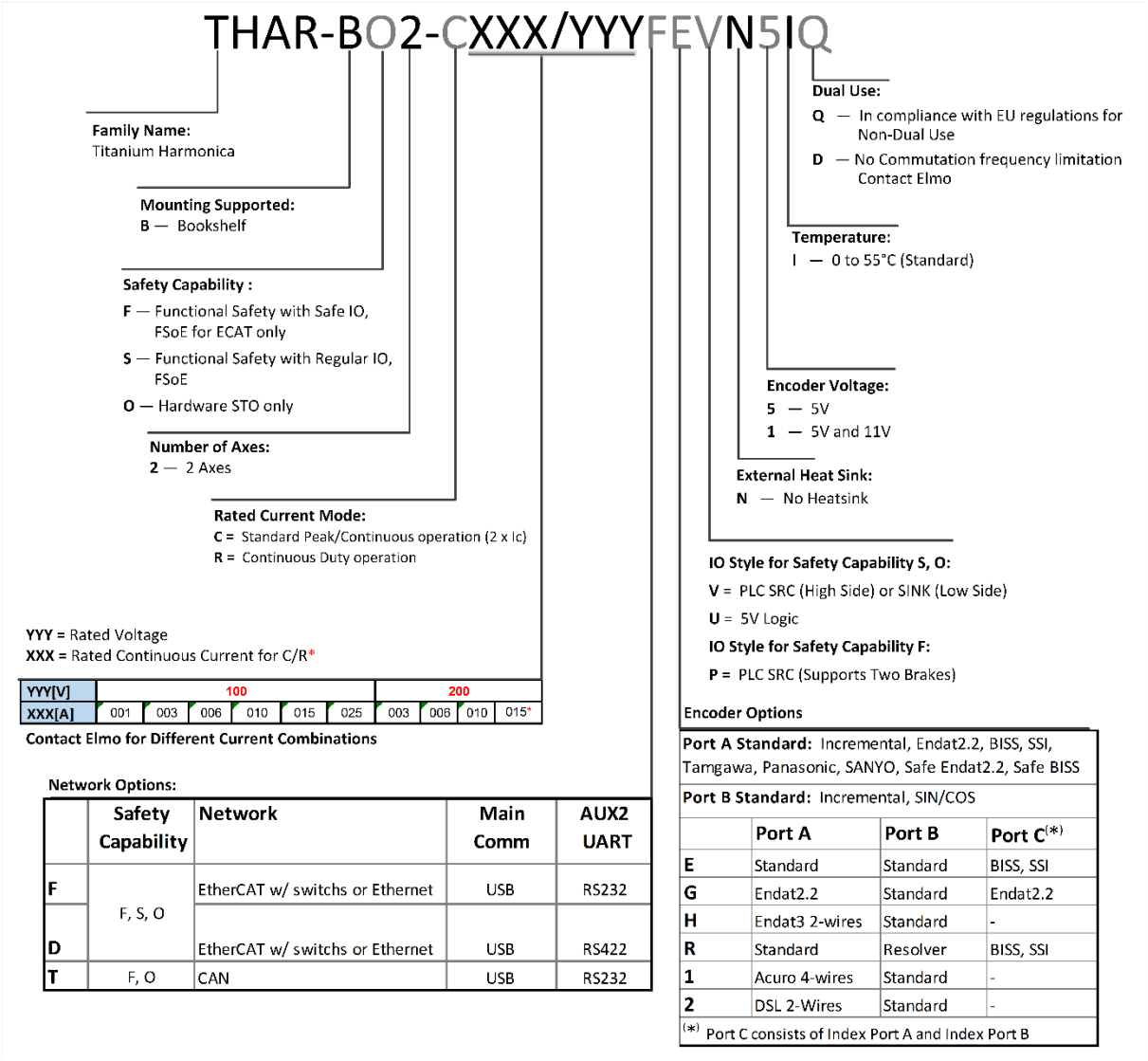
EtherCAT® and Safety over EtherCAT® are registered trademarks and patented technologies, licensed by Beckhoff Automation GmbH, Germany.

EtherCAT® Conformance tested is a registered trademark and patented technology, licensed by Beckhoff Automation GmbH, Germany.

CANopen compliant. CANopen® is a registered trademark and patented technology, licensed by CAN in Automation (CiA) GmbH, Kontumazgarten 3, DE-90429 Nuremberg, Germany.

Document no. MAN-T-HAR-IG (Ver. 2.004)

Catalog Number



Network Options:

	Safety Capability	Network	Main Comm	AUX2 UART
F	F, S, O	EtherCAT w/ switchs or Ethernet	USB	RS232
D		EtherCAT w/ switchs or Ethernet	USB	RS422
T	F, O	CAN	USB	RS232

Encoder Options

Port A Standard: Incremental, Endat2.2, BISS, SSI, Tamgawa, Panasonic, SANYO, Safe Endat2.2, Safe BISS

Port B Standard: Incremental, SIN/COS

	Port A	Port B	Port C(*)
E	Standard	Standard	BISS, SSI
G	Endat2.2	Standard	Endat2.2
H	Endat3 2-wires	Standard	-
R	Standard	Resolver	BISS, SSI
1	Acuro 4-wires	Standard	-
2	DSL 2-Wires	Standard	-

(*) Port C consists of Index Port A and Index Port B

Revision History

Version	Date	Details
Ver. 1.000	Dec 2023	Initial Release
Ver. 1.001	Jan 2024	New P/N, updated 200V models (section 5.2.2), removed R-type models.
Ver. 1.002	Apr 2024	New P/N, removed Dual Use Updated all diagrams due to removal of “Dual” from name. Updated sections 5.4.6 and 5.4.7. Added RS-232, changes to sections 5.4.3, 7.11, 8.2, and 8.11.2. Updates to chapter 8.6 – Feedback
Ver. 1.003	May 2024	Updated Part Number with small change for clarity Updated sections 5.3 Control Supply, 8.2.1 Connection diagram for Safety Capability F,
Ver. 1.004	Jul 2024	Updated sections 5.2.1, 5.2.2 (continuous power). Updated section 8.4 with more info on grounding wires. Updated section 8.5.4 (Capacitance IN note) Updated drawing in section 8.6. Updated drawings throughout the document.
Ver. 1.005	Nov 2024	Updated P/N and manual for CANopen option. Updated tables in sections 5.2.2, 5.4.2, 5.4.3, 5.4.7, 7.1, 7.8, 8.6.1, 8.6.2. Added sections 7.10.3 and 8.11.2 for CANopen Added 4 new connection diagrams in chapter 8.2.2 for CANopen Update to 8.11.3 and 8.11.4 (Networks) and chapter 11 (Cable kit table).
Ver. 2.000	Feb 2025	Updated P/N – added Port C, removed network T Updates to sections 5.2.2, 5.4.3, 7.1, 7.3, 7.7 (subsections, added Port C), 7.10.3, 8.2 all connections diagrams updated, 8.6.3 (Port C) is new, 8.11.3.
Ver. 2.001	May 2025	Updated P/N. Updated section 7.6.1 Encoder Power Supply Pins Added section 8.6.1 Power Signals and Control Supply, then updated all tables in 8.6.2, 8.6.3, 8.6.4, and 8.6.5
Ver. 2.002	May 2025	Updated P/N. Updated diagrams in chapters 8.9.1 and 8.9.3 Some minor updates to drawings throughout the manual.
Ver. 2.003	Jun 2025	Small update to CANopen Safe-IO connections diagrams in chapter 8.2.2.
Ver. 2.004	Jul 2025	Small update to chapters 1, 8.5, 8.6, 8.8. Updated chapter 8.9, Safe Digital I/O, text and all 3 drawings. Added section as introduction to section 8.11 Communication for USB and UART

Chapter 1 This Installation Guide

This installation Guide details the technical data, pinouts, and power connectivity of the Titanium Harmonica.

For a comprehensive specification and detailed description of the functions, refer to the Titanium Drive Manual.

Chapter 2 Functional Safety

The modules of the Titanium Harmonica servo drives support Functional Safety. It is necessary to implement the instructions in the Titanium Safety Drive Manual regarding using STO, Feedbacks, IOs and Power supplies with Functional Safety.

Chapter 3 Safety Information

In order to achieve the optimum, safe operation of the Titanium Harmonica, it is imperative that you implement the safety procedures included in this installation guide. This information is provided to protect you and to keep your work area safe when operating the Titanium Harmonica and accompanying equipment.

Please read this chapter carefully before you begin the installation process.

Before you start, ensure that all system components are connected to earth ground. Electrical safety is provided through a low-resistance earth connection.

Only qualified personnel may install, adjust, maintain and repair the servo drive. A qualified person has the knowledge and authorization to perform tasks such as transporting, assembling, installing, commissioning and operating motors.

The Titanium Harmonica contains electrostatic-sensitive components that can be damaged if handled incorrectly. To prevent any electrostatic damage, avoid contact with highly insulating materials, such as plastic film and synthetic fabrics. Place the product on a conductive surface and ground yourself in order to discharge any possible static electricity build-up.

To avoid any potential hazards that may cause severe personal injury or damage to the product during operation, keep all covers and cabinet doors shut.

The following safety symbols are used in this and all Elmo Motion Control manuals:

	**Warning:** This information is needed to avoid a safety hazard, which might cause bodily injury or death as a result of incorrect operation.
	**Hot Surface Warning:** To alert against surfaces that may reach high temperatures. The heatsink and wires may reach high temperatures.
	**Caution:** This information is necessary to prevent bodily injury, damage to the product or to other equipment.
	**Important:** Identifies information that is critical for successful application and understanding of the product.

The following symbols are used in this document:

	**Note:** Information critical to the understanding and\or operating the feature.
	**Tip:** Information that helps understanding a feature, is good practice or a possible different way of action.

3.1 Warnings

- To avoid electric arcing and hazards to personnel and electrical contacts, never connect/disconnect the servo drive while the power source is on.
- Power cables can carry a high voltage, even when the motor is not in motion. Disconnect the Titanium Harmonica from all voltage sources before servicing.
- The high voltage products within the Titanium Line range contain grounding conduits for electric current protection. Any disruption to these conduits may cause the instrument to become hot (live) and dangerous.
- STO, Safe I/O (Safety Capability "F") and EtherCAT (Safety Capability "F", "S") circuits are separated from power circuits by reinforced insulation and can be supplied by SELV power supply. Other Control and communication level circuits are separated from power circuits by functional insulation. These circuits shall have insulation to their surroundings and other control, or communication circuits based on the Working Voltage and requirements of the end use application.

Capacitance Discharge
After shutting off the power and removing the power source from your equipment, wait at least 10 seconds before touching or disconnecting parts of the equipment that are normally loaded with electrical charges (such as capacitors or contacts). Measuring the electrical contact points with a meter, before touching the equipment, is recommended.

3.2 Cautions

- The maximum DC power supply connected to the instrument must comply with the parameters outlined in this guide.
- When connecting the Titanium Harmonica to an approved control supply, connect it through a line that is separated from hazardous live voltages using reinforced or double insulation in accordance with approved safety standards.
- Before switching on the Titanium Harmonica, verify that all safety precautions have been observed and that the installation procedures in this manual have been followed.
- Make sure that the Safe Torque Off is operational.

3.3 CE Marking Conformance

The Titanium Harmonica is intended for incorporation in a machine or end product. The actual end product must comply with all safety aspects of the relevant requirements of the European Safety of Machinery Directive 2006/42/EC as amended, and with those of the most recent versions of standards EN 60204-1 and EN ISO 12100 at the least, and in accordance with 2006/95/EC.
Concerning electrical equipment designed for use within certain voltage limits, the Titanium Harmonica meets the provisions outlined in 2006/95/EC. The party responsible for ensuring that the equipment meets the limits required by EMC regulations is the manufacturer of the end product.

3.4 Warranty Information

The products covered in this manual are warranted to be free of defects in material and workmanship and conform to the specifications stated either within this document or in the product catalog description. All Elmo drives are warranted for a period of 12 months from the date of shipment. No other warranties expressed or implied — and including a warranty of merchantability and fitness for a particular purpose — extend beyond this warranty.

Chapter 4 Product Description

The Titanium Harmonica is an integrated solution delivering up to **5.6 kW of continuous power** in a compact package (97 x 142 x 26 mm (3.82" x 5.59" x 1.02"). It is designed to simply and efficiently connect Elmo's Titanium Harmonica servo drive directly to the application. The solution consists of the Titanium Harmonica together with a convenient connection interface which either eliminates or reduces development time and resources when designing an application's PCB board.

This advanced, high power density servo drive provides top performance, Functional Safety, advanced networking, as well as a fully featured motion controller and local intelligence.

The Titanium Harmonica is provided in three configurations:

- **Functional Safety with Safe IO (THAR-BF2):** Servo drive with Function Safety and Safe IO – This configuration of Servo drives includes safe Digital IO which support Safe Digital Inputs and Outputs including Brakes. This configuration supports the operation of the safety function either via FSOE (Fail Safe Over EtherCAT), CAN, or via the Safe I/O.
- **Functional Safety with Regular IO (THAR-BS2):** Servo drive with Function Safety excluding Safe IO – This configuration of Servo drives includes regular Digital IO. This configuration permits operation of safety functions only via FSOE.
- **STO Only (THAR-BO2):** Servo drive with STO – The servo drive supports only STO.

The Titanium Harmonica is powered by dual isolated power supplies from the Main.

Main DC power: 10V – 95V for 100V model and 20V – 195V for 200V model

Control power supply: Safety Capability F, S: Max 60V for the logic; Safety Capability O: Max 95V for the logic.

The drive can operate as a stand-alone device or as part of a multi-axis system in a distributed configuration on a real-time network.

The Titanium Harmonica drive is easily set up and tuned, using the Elmo Application Studio (EASIII) software tools. As part of the Titanium product line, it is fully programmable with the Elmo motion control languages. For more information about software tools refer to the Elmo Application Studio (EASIII) User Guide.

4.1 Accessories

The following Titanium Harmonica cable kit may be ordered:

Part Number	Description
CBL-THARKIT01	Kit cable for Safe IO and EtherCAT model
CBL-THARKIT02	Kit cable for REG IO and EtherCAT model
CBL-THARKIT03	Kit cable for Safe IO and CAN model
CBL-THARKIT04	Kit cable for REG IO and CAN model

For further details, see the documentation for Titanium Harmonica cable kit (MAN-THAR-CBLKIT).

Chapter 5 Technical Information

5.1 Physical Specifications

Feature	Data	
Mounting Method	wall-mounting or table-mounting	
Degrees of Protection	IP=00	
Part Number	**Weight (g (oz))**	**Dimensions (mm (in))**
THAR-Bz2-zXXX/YYYzzzNzIz	TBD	97 x 142 x 26 mm (3.82” x 5.59” x 1.02”)

Table 1: Physical Specifications

5.2 Technical Data

There following models are supported:

5.2.1 100V Models

Feature	Units	1/100	3/100	6/100	10/100	15/100	25/100
Minimum supply voltage	VDC	10					
Nominal supply voltage	VDC	85					
Maximum supply voltage	VDC	95					
Maximum continuous power output per axis	W	80	235	470	800	1125	2000
Efficiency at rated power (at nominal conditions)	%	> 99					
Maximum output voltage		Up to 96% of DC bus voltage					
Amplitude sinusoidal/DC continuous current per axis	A	1	3	6	10	15	25
Sinusoidal continuous RMS current limit (Ic) per axis	A	0.7	2.1	4.2	7.1	10	17.7
Peak current limit	A	2 x Ic					

Table 2: 100V Models – Technical Data

5.2.2 200V Models

Elmo now offers a 200 VDC maximum output rating selection of Titanium Harmonica, according to the following technical data:

Feature	Units	3/200	6/200	10/200	R15/200
Minimum supply voltage	VDC	20			
Nominal supply voltage	VDC	170			
Maximum supply voltage	VDC	195			
Maximum continuous power output per axis	W	480	975	1650	2500
Efficiency at rated power (at nominal conditions)	%	> 99			
Maximum output voltage		Up to 96% of DC bus voltage			
Amplitude sinusoidal/DC continuous current per axis	A	3	6	10	15
Sinusoidal continuous RMS current limit (Ic) per axis	A	2.1	4.2	7.1	10.6
Peak current limit	A	2 x Ic			Ic

Table 3: 200V Models – Technical Data

Note (on current ratings):
The current ratings of the Titanium Harmonica are given in units of DC amperes (ratings that are used for trapezoidal commutation or DC motors). The RMS (sinusoidal continuous) value is the DC value divided by 1.41.

5.3 Control Supply

Feature	Details
Control supply for input voltage for Safety	**Isolated DC Source:** 14V to 60V
Control supply input power	≤4.5 W without external loading ≤10 W with full external loading

Table 4: Control Supply

5.4 Product Features

5.4.1 Number of Axes

Feature	Details
Two axes	**X1** and **X2**

Table 5: Number of Axes

5.4.2 Feedback

Feature	Details	Presence and No.
Feedback	Standard Ports A: Incremental Encoder, Absolute Encoders Standard Port B: Incremental Encoder, Sin/COS, option for Resolver. Additional feedbacks: HALL, Auxiliary Absolute Encoder	**2 Axes**

Table 6: Feedback

5.4.3 Encoder Supply per Axis

Feature	Details
5V supply	300 mA per axis (600mA total)
11V supply	180 mA per axis (360mA total)

Table 7: Encoder Supply

5.4.4 Communication

Communication type	Presence and No.		Network Options
USB	√	Main	F, D, T
EtherCAT ***or***	√		F, D
CAN	For Safety Capability F and O		T
RS-422 (Differential RS-232) Serial Communication	√	AUX2	D
RS-232 Serial Communication	√	AUX2	F, T

Table 8: Communication

5.4.5 Analog Input

Feature	Details	Resolution	Presence and No.
Analog Input	Differential ±10V	12-bits	**2**

Table 9: Analog Input

5.4.6 STO

Feature	Details	Presence and No.
2 x STO	5V Logic, Opto Isolated, for IO TYPE = U	√
	PLC source, Opto Isolated, for IO TYPE = V, P	

Table 10: STO

5.4.7 Digital Input

Refer to the Safety Capability in the P/N for the relevant IO capability.

I/O Style	Part Number: I/O Style = P Safe IO	Part Number: I/O Style = U Regular IO – TTL	Part Number: I/O Style = V Regular IO – PLC
Logic/Mode	PLC Source, Isolated	5V Logic	PLC Source *or* PLC Sink isolated
Input	IN1, IN2, IN3, IN4	IN1, IN2, IN3, IN4, IN5, IN6	

Table 11: Digital Inputs

5.4.8 Digital Output

I/O Style	Part Number: I/O Style = P Safe IO	Part Number: I/O Style = U Regular IO – TTL	Part Number: I/O Style = V Regular IO – PLC
I/O Type	Safe IO PLC	Regular IO 5V Logic	Regular IO PLC
Absolute Maximum Voltage	60V	30V	60V
Nominal Recommended VDD	24 ÷ 48V ±10%	4 to 30V	24 ÷ 48V ±10%
OUT1	250mA	15mA	1000mA
OUT2	250mA	15mA	1000mA
OUT3	1000mA	N/A	N/A
OUT4	1000mA	N/A	N/A
OUT7	1000mA	15mA	1000mA
OUT8	1000mA	15mA	1000mA
Total Current[1]	2000mA		2000mA

Table 12: Digital Outputs and Current

[1] **NOTE**: The total output current of the six digital outputs must not exceed the values shown in this table.

5.5 Environmental Conditions

You can guarantee the safe operation of the Titanium Harmonica by ensuring that it is installed in an appropriate environment. The Functional Safety of the servo drive is certified according to the environmental conditions in the following table.

Feature	Details
Operating ambient temperature	0 °C to 55 °C (32 °F to 131 °F)  **Remark:** Functional Safety is applicable to the above operating temperature.
Storage temperature	-40 °C to +85 °C (-40 °F to +185 °F)
Maximum non-condensing humidity according to IEC60068-2-78	95%
Maximum Operating Altitude	2,000 m (6562 feet)
Mechanical Shock according to IEC60068-2-27	15g / 11ms Half Sine
Vibration according to IEC60068-2-6	5 Hz ≤ f ≤ 10 Hz: ±10mm 10 Hz ≤ f ≤ 57 Hz: 4G 57 Hz ≤ f ≤ 500 Hz: 5G
Pollution Degree	Pollution Degree 1

Table 13: Environmental Conditions

5.6 Standards and Certifications

Standards and Certifications are currently unavailable.

The following sections describe the Main Standards of the Titanium Harmonica servo drive.

5.6.1 Functional Safety

Standard	Item
IEC 61800-5-2:2017	Adjustable speed electrical power drive systems – Safety requirements – Functional
EN ISO 13849-1:2015	Safety of machinery — Safety-related parts of control systems.
EN 61508-1:2010	Functional safety of electrical/electronic/ programmable electronic safety-related systems
EN 61508-2:2010	Functional safety of electrical/electronic/ programmable electronic safety-related systems
EN 61508-3:2010	Functional safety of electrical/electronic/ programmable electronic safety-related systems
IEC 61784-3:2016	Functional Safety Filed Bus - FSOE

Table 14: Functional Safety

5.6.2 Electrical Safety

Specification	Details
IEC/EN 61800-5-1:2007	Adjustable speed electrical power drive systems Part 5-1: Safety requirements – Electrical, thermal and energy
UL 61800-5-1	Adjustable speed electrical power drive systems: Safety requirements – Electrical, thermal and energy
CSA C22.2 NO. 274-17	Adjustable speed drives

Table 15: Electrical Safety

5.6.3 Electromagnetic Compatibility

Specification	Details
EN 61800-3:2004/A1:2011	Adjustable speed electrical power drive systems Part 3: EMC requirements and specific test methods
EN 61800-5-2: 2017 Annex E	Adjustable speed electrical power drive systems Part 5-2: Safety requirements – Functional

Table 16: Electromagnetic Compatibility

5.6.4 Environmental

Specification	Details
IEC60068-2-78	Damp heat, steady state
IEC60068-2-6	Vibration (sinusoidal)
IEC60068-2-2	Dry heat
IEC60068-2-27	Shock
IEC60068-2-1	Cold Test

Table 17: Environmental

5.6.5 Dual Use

No export license is required for the Titanium Line products signified with the suffix Q in the Part Number.

The operating frequency of the Titanium Line products is “factory limited” to ≤ 599 Hz and therefore complies with the EU Dual Use Regulation 428/2009, 3A225, and the US Dual Use regulation EAR ECCN# 3A225.

This statement applies to all identical specimens and will become invalid if a change is made in the firmware.

Chapter 6 Installation

The Titanium Harmonica must be installed in a suitable environment and be properly connected to its voltage supplies and the motor.

6.1 Unpacking the Servo Drive Components

Before you begin working with the Titanium Harmonica, verify that you have all of its components, as follows:

- The Titanium Harmonica servo drive
- The Elmo Application Studio (EASIII) software and software manual

The Titanium Harmonica is shipped in a cardboard box with Styrofoam protection.

To unpack the Titanium Harmonica:

1. Carefully remove the servo drive from the box and the Styrofoam.
2. Check the drive to ensure that there is no visible damage to the instrument. If any damage has occurred, report it immediately to the carrier that delivered your drive.
3. To ensure that the Titanium Harmonica you have unpacked is the appropriate type for your requirements, locate the part number sticker on the top of the Titanium Harmonica. It looks like this:

Figure 1: Label with Part Number

4. Verify that the Titanium Harmonica type is the one that you ordered and ensure that the voltage meets your specific requirements.
   The part number at the top provides the type of designation. Refer to the appropriate part number in the Catalog Number section at the beginning of the installation guide.

6.2 Over-Current and Short-Circuit Protection

A serial fuse or circuit breaker should be installed Rated for drive's continuous current rating.

THAR-Bz2-zXXX/YYYzzzNzIz XXX = rated continues current [A]	Fuse	Circuit Breaker
1, 3, 6, 10, 15, 25 / 100V	TBD	Type B
3, 6, 10, R15 / 200V	TBD	Type B
Rated short - circuit breaking capacity 5kA		

Table 18: Continuous Current Rating

PL/CL protection: Peak and Continues Limitation

The peak current of servo drive limit for a given application is programmed to the parameter **PL[1]** amperes.
PL[1]: Value for peak current limit protection.

6.3 Motor Overload Protection

The Titanium Harmonica supports Electronic Motor Overload protection as required by IEC-61800-5-1 with the exception of thermal memory retention and speed sensitivity.

6.4 Mounting the Titanium Harmonica

The Titanium Harmonica can be wall-mounted or table-mounted.

6.4.1 Wall Mounting Titanium Harmonica

The Titanium Harmonica may be mounted via Wall mounting or Table mounting. Always mount the device with the Elmo logo up; in this orientation, the open screw holes will be at the bottom.

To wall-mount the Titanium Harmonica:

- For Rear-side wall-mount: Mount the Titanium Harmonica with two M4 screws. Slide the screw into the securing slot before tightening it with the spanner. See Figure 2.

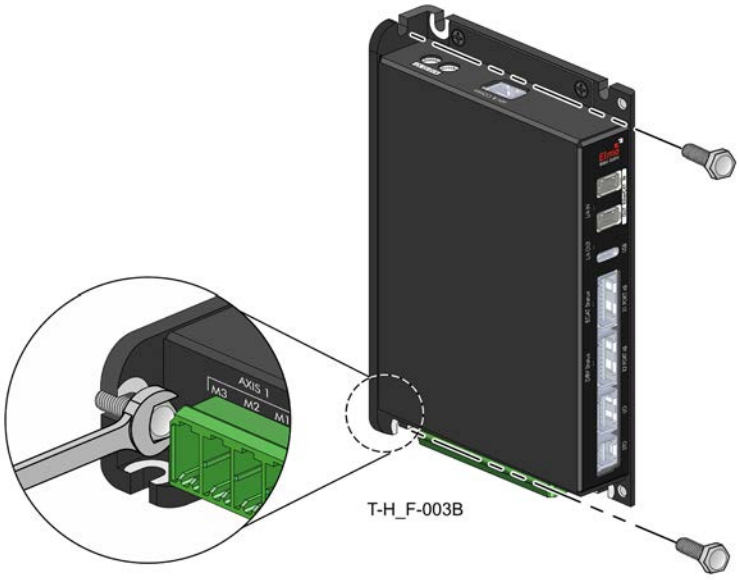


Figure 2: Rear-side wall-mounting Titanium Harmonica

- For Bottom-side wall-mount: Mount the Titanium Harmonica with four M4 screws, see Figure 3.

Figure 3: Bottom-side wall-mounting Titanium Harmonica

6.4.2 Table-Mounting Titanium Harmonica

Guidelines (Dimensional)

The Titanium Harmonica table mounting dimensional guidelines are shown in Figure 64 and Figure 65.

Use the following table to table-mount the Titanium Harmonica:

Dimensions	Table Mounting
Distance between right and left screw holes	136 mm (5.35")
Distance between top and bottom screw holes closest to Titanium Harmonica's **rear** edge and the rear edge	9.5 mm (0.37")
Distance between top and bottom screw holes farthest from Titanium Harmonica's **rear** edge and the rear edge	84.5 mm (3.33")

Table 19: Table Mounting Dimensions

To table-mount the Titanium Harmonica:

- For Table-mount:
  Mount the Titanium Harmonica with four M4 screws, as shown in Figure 4:

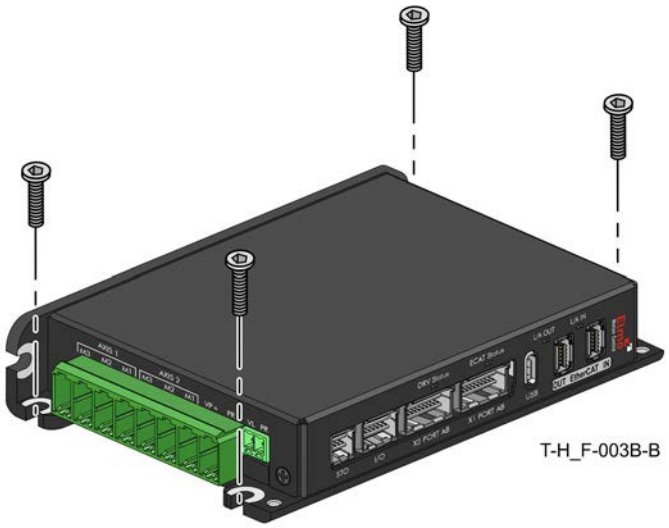


Figure 4: Table Mounting the Titanium Harmonica with four M4 Screws

Chapter 7 Connectors

7.1 Connector Types

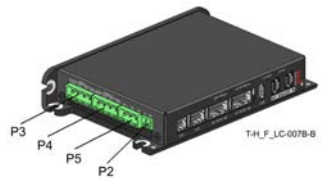
Port	# Pins	On Board Connector Type		Function
Motor and Control: High Current > 10A				
P1: **Axis_1** M1, M2, M3 **Axis_2** M1, M2, M3 VP+, PR	8		WURTH: PWM1P7.62/8SQRVE 8 Pins	Motor phases + power
P2: VL, PR	2		PHOENIX: 1803277, 2 pins	Control Power
Motor and Control: Low Current ≤ 10A				
P3: **Axis_1** PE, M1, M2, M3	4		PHOENIX: 1923775 4 pins HC	Motor phases
P4: **Axis_2** PE, M1, M2, M3	4		PHOENIX: 1923775 4 pins HC	Motor phases
P5: VP+, PR, PE	3		PHOENIX: 1923762 3 pins HC	Power
P2: VL, PR	2		PHOENIX: 1803277, 2 pins	Control Power
Other Connectors				
J1	2x10	Molex: 213228-2030, 20 pin		Feedback Ports A, B
J2	2x10	Molex: 213228-2030, 20 pin		Feedback Ports A, B
J3	2x7	Molex: 213228-1430, 14 pin		I/O
J4	8	Molex: 503148-0890, 213226-0830 (TBD?), 8 pin		STO
J5	12	Molex: 213228-1230, 12 pin		AIN & COMM
X3	24	USB Type C - KYCON: KUSBX-SL-CS1N14B (or similar)		USB
EtherCAT Version				
X1	10	HIROSE: IX61G-A-10P		EtherCAT IN
X2	10	HIROSE: IX61G-A-10P		EtherCAT OUT
CAN Version				
X1	10	HIROSE: IX61G-A-10P		CAN
X2	10	HIROSE: IX61G-A-10P		CAN

Table 20: Connectors

7.2 Connector Locations

The following drawings show the locations of the Titanium Harmonica connectors.

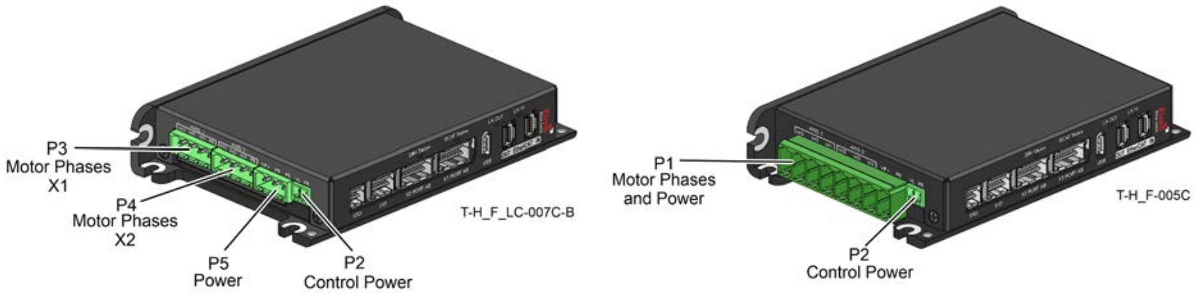


Figure 5: Left Panel Connector Location for Low Current (left) and High Current (right)

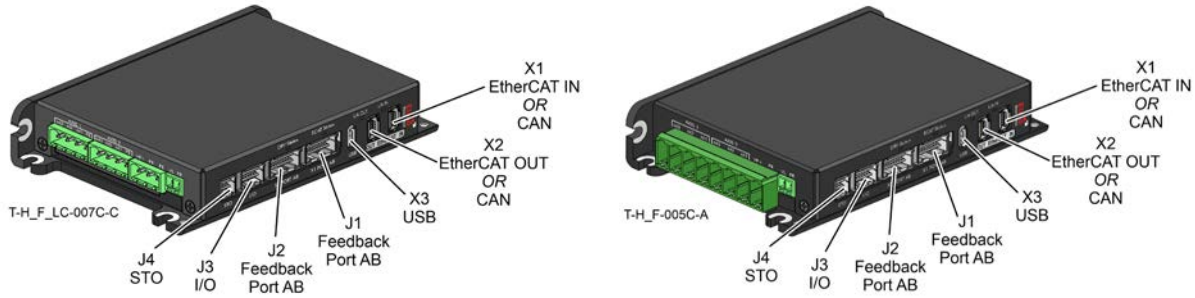


Figure 6: Front Panel Connector Locations for Low Current (left) and High Current (right)

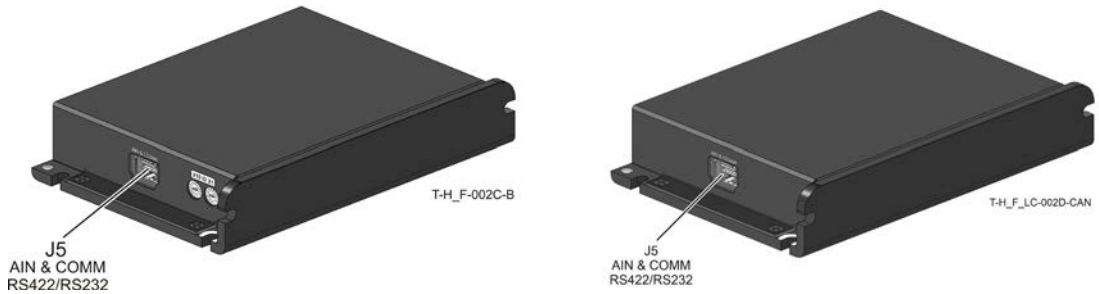


Figure 7: Right Panel Connector Location for EtherCAT (left) and CAN (right)

7.3 Mating Connectors

Connector	Mating Connector Type, Pin Number, and Wire	Mating Connector Elmo P/N	Mating Crimp Terminal	Mating Crimp Terminal Elmo P/N
Low Current ≤ 10A				
P3, **P4** – Phases Low current product	PHOENIX: 1926251, 4 pins HC Conductor cross-section: 24-12AWG	JCW- 109504FC1	N/A	N/A
P5 – VP Power Lowe Current product	PHOENIX: 1926248, 3 pins HC Conductor cross-section: 24-12 AWG	JCW- 109503FC1	N/A	
High Current > 10A				
P1 – VP Power + Phases	WURTH: PWF1P7.62/8VE, 8 Pins Conductor cross-section: 24-8 AWG	JCW- 114108F0W	N/A	N/A
Control Supply				
P2 – VL Power	PHOENIX: 1736638, 2 pins Conductor cross-section: 28-16 AWG	JCW- 108102FC	N/A	N/A
Other Connectors – CLIK Mate				
J1 X1_Port A/B/C	Molex: 503149-2000, 20 pin	JCW- 151520F	502579-1000	JCW- 151500F CT2
J2 X2_Port A/B/C	Molex: 503149-2000, 20 pin	JCW- 151520F		
J3 Port I/O	Molex: 503149-1400, 14 pin	JCW- 151514F0		
J4 STO	Molex: 503149-0800, 8 pin	JCW- 151508F0		
J5 – AIN & COMM	Molex: 503149-1200, 12 pin	JCW- 151512F0		
J6 Spare IO	TBD	TBD		
X1, X2, and X3				
X1 ECAT IN	HIROSE IX30G-A-10S- V (7.0)	JSW- 121410M2	N/A	N/A
X2 ECAT OUT	HIROSE IX30G-A-10S- V (7.0)	JSW- 121410M2	N/A	
X1 CAN	HIROSE IX30G-A-10S- V (7.0)	JSW- 121410M2	N/A	
X2 CAN	HIROSE IX30G-A-10S- V (7.0)	JSW- 121410M2	N/A	
X3 USB Type C	Standard USB Type C cable			

Table 21: Mating Connectors

7.3.1 Mating Connector Locations

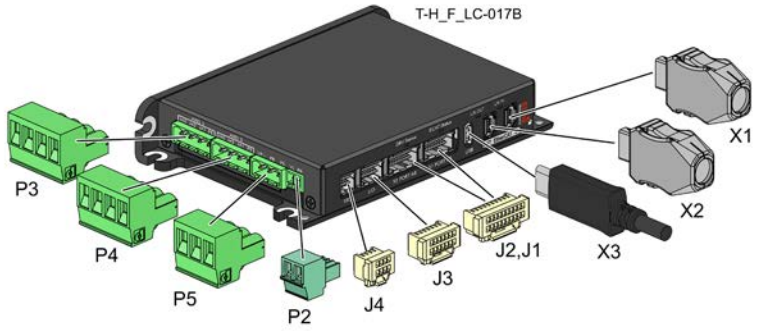


Figure 8: Mating Connectors for Low Current Titanium Harmonica

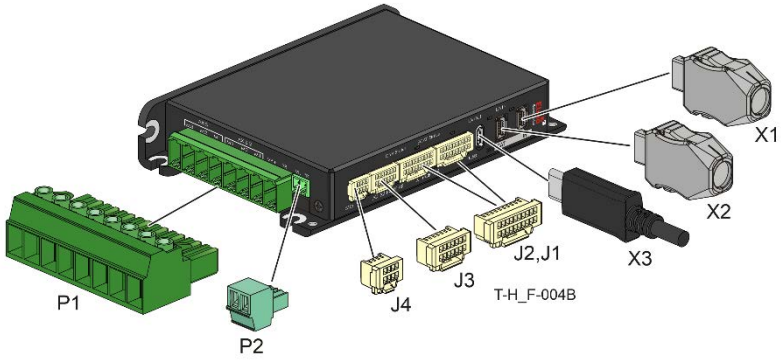


Figure 9: Mating Connectors for High Current Titanium Harmonica

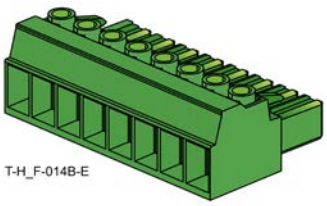
7.4 Motor and Main Power Connector Pinouts

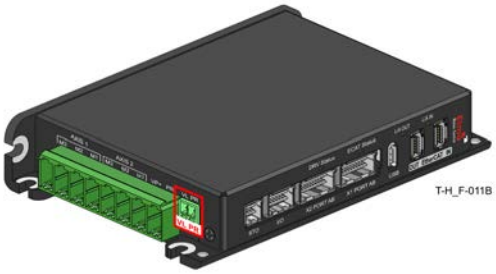
The following sections describe the motor pinouts in the Titanium Harmonica connectors.

For further details, refer to Chapter 10 Input Power Supply in the Platinum Safety Drive Manual.

7.4.1 High Current Option Motor & Power Connectors (P1 & P2)

Connector	Pin #	Signal	Function
P1	1	X1_M3	Axis 1 Motor Phase M3 Output
	2	X1_M2	Axis 1 Motor Phase M2 Output
	3	X1_M1	Axis 1 Motor Phase M1 Output
	4	X2_M3	Axis 2 Motor Phase M3 Output
	5	X2_M2	Axis 2 Motor Phase M2 Output
	6	X2_M1	Axis 2 Motor Phase M1 Output
	7	VP+	DC+ Power Supply Input
	8	PR	DC- Power Supply Input
P2	1	VL+	Logic+ Power Supply Input
	2	PR	Logic- Power Supply Input
Pin Positions			





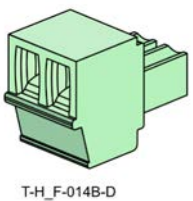


Table 22: High Current Option – Main Power and Motor Connections

7.4.2 Low Current Option
Motor & Main Power Connectors (P2, P3, P4, P5)

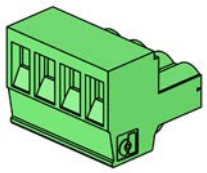
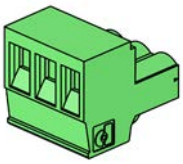
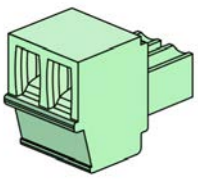
Connector	Pin #	Signal	Function
P3	1	X1_M3	Axis 1 Motor Phase M3 Output
	2	X1_M2	Axis 1 Motor Phase M2 Output
	3	X1_M1	Axis 1 Motor Phase M1 Output
	4	PE	Protective Earth
P4	1	X2_M3	Axis 2 Motor Phase M3 Output
	2	X2_M2	Axis 2 Motor Phase M2 Output
	3	X2_M1	Axis 2 Motor Phase M1 Output
	4	PE	Protective Earth
P5	1	PE	Protective Earth
	2	VP+	DC+ Power Supply Input
	3	PR	DC- Power Supply Input
P2	1	VL+	Logic+ Power Supply Input
	2	PR	Logic- Power Supply Input
Pin Positions			**Connectors**
 			 **4 pins**  **3 pins**
			

Table 23: Low Current Option – Main Power and Motor Connections

7.5 Drive Status Indicator

Figure 10 shows the position of the red/green dual LED, which is used for immediate indication of the Initiation, Working, and Firmware Download states.

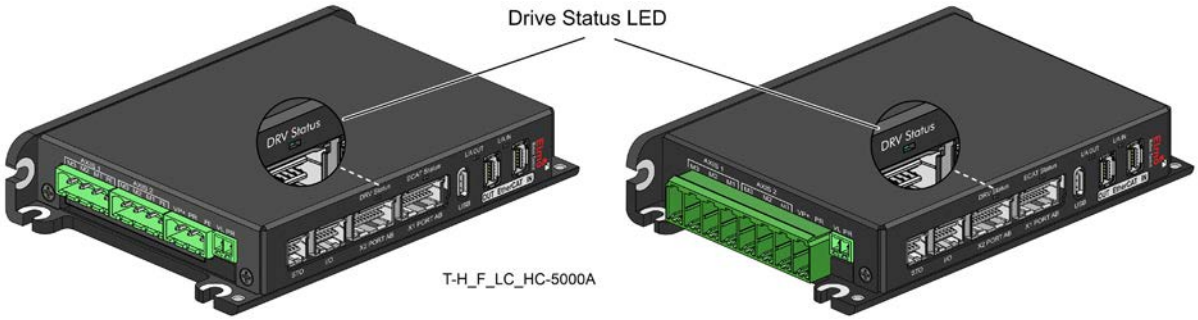


Figure 10: Drive Status Indicator

The red/green dual LED is used for immediate indication of the following states:

STATES	LED \ Time [msec]	Explanation
INITIATION STATE	Blinking: Red 200, Off: 200	If flashing RED ON/OFF, then drive error. Parameter process failed during power up (CD command).
	Blinking: Red 600, Off 200	If slow flashing RED ON/OFF, then drive Safety error. Drive in Safety error (**BZ[2]\BZ[3]**)
WORKING STATE	Steady Green	Power stage ready to enable the motor.
	Steady Red	Drive is in an amplifier failure state Power state error: over\under voltage, over temperature etc.
FIRMWARE DOWNLOAD STATE	Blinking: Red 200, Green 200 Red 600, Green 200	Flashing RED/GREEN during burn Slow flashing RED/GREEN indicates stages of Firmware burn-in or validation. Frequency depends on the stage of burning/validation and the CPLD/FPGA that is been burned.

Table 24:States of the Drive Status Indicator

7.6 Feedback for Ports A & B Connectors (J1, J2)

The following tables describe the Ports A and B connections for Axis 1 and 2 to the 2x10 pin connectors J1 and J2.

Note:
There is also a Port "C" which consists of Index Port A and Index Port B. For details, see 8.6.5.

7.6.1 Encoder Power Supply Pins

Pin#	Signal	PN Option: Encoder Voltage 1	PN Option: Encoder Voltage 5
1	+11V/ +5V Encoder	Encoder +11V supply	Encoder +5V supply
2	+5V Encoder	+5V Encoder	
3	COMRET	Common Return	
4	COMRET	Common Return	
20	COMRET	Common Return	

Table 25: Power Pins for Feedback - Connectors J1 for Axis 1 and J2 for Axis 2

7.6.2 Port A

Port A	Signal		Function	
Pin#	J1 for Axis 1	J2 for Axis 2	Incremental Encoder	Main Absolute Encoder
5	X1_PortA_A+	X2_PortA_A+	Differential I/O A+	A – Differential Output CLK+
7	X1_PortA_A-	X2_PortA_A-	Differential I/O A-	A – Differential Output CLK-
9	X1_PortA_B+	X2_PortA_B+	Differential I/O B+	A – Differential In/Out DATA+
11	X1_PortA_B-	X2_PortA_B-	Differential I/O B-	A – Differential In/Out DATA-
				Auxiliary Absolute Encoder
13	X1_PortA_I+	X2_PortA_I+	Differential I/O Index+	Differential Output CLK+
15	X1_PortA_I-	X2_PortA_I-	Differential I/O Index-	Differential Output CLK-

Table 26: Feedback Port A - Connectors J1 for Axis 1 and J2 for Axis 2

7.6.3 Port B

Port B – Pin # and Signal			Function			
Pin	J1 for Axis 1	J2 for Axis 2	Incremental Encoder	Interpolated Analog Encoder	Auxiliary Absolute Encoder	Resolver
			THAR-Bz2-zXXX/YYYz**E**zNzIz			THAR-Bz2-zXXX/YYYz**R**zNzIz
6	X1_PortB_A+	X2_PortB_A+	Differential Input A+	Sine+		Sine+
8	X1_PortB_A-	X2_PortB_A-	Differential Input A-	Sine-		Sine-
10	X1_PortB_B+	X2_PortB_B+	Differential Input B+	Cosine+		Cosine+
12	X1_PortB_B-	X2_PortB_B-	Differential Input B-	Cosine-		Cosine-
14	X1_PortB_I+	X2_PortB_I+	Differential I/O Index+		Differential I/O Data+	RESOLVER_OUT+
16	X1_PortB_I-	X2_PortB_I-	Differential I/O Index-		Differential I/O Data-	RESOLVER_OUT-

Table 27: Feedback Port B - Connectors J1 for Axis 1 and J2 for Axis 2

7.6.4 Hall Sensors

Pin No.	Signal		Function
	J1 for Axis 1	J2 for Axis 2	
17	X1_HA	X2_HA	Hall A
18	X1_HB	X2_HB	Hall B
19	X1_HC	X2_HC	Hall C

Table 28: Hall Sensors - Connector J1 for Axis 1 and J2 for Axis 2

7.6.5 Pin Positions

This table shows the connector and pinout positions for J1 and J2

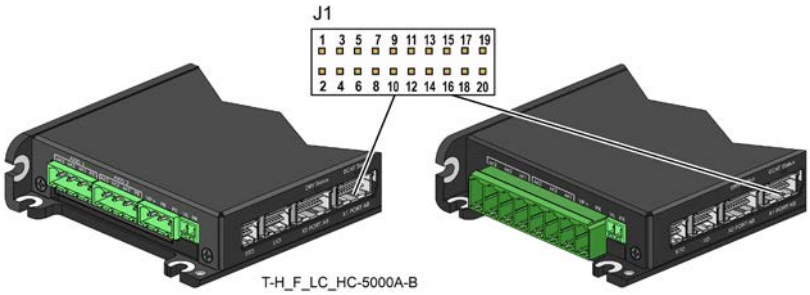
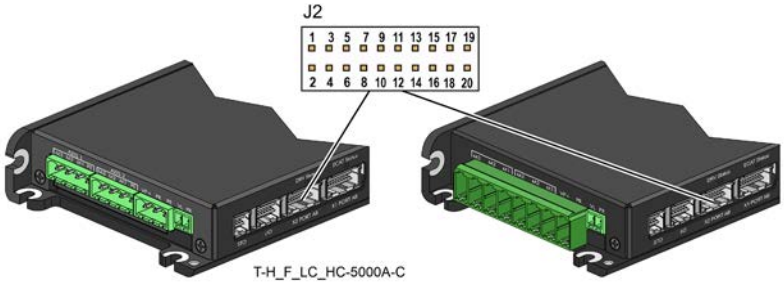
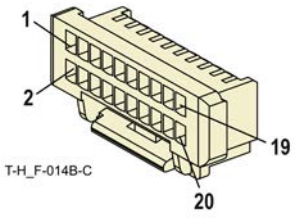
Pin Positions	Mating Connector
 **J1 connector position and pinouts for Low and High Currency**  **J2 connector position and pinouts for Low and High Currency**	 **CON CLIK-MATE HOUSING FE 20 PIN (2 x 10)**

Table 29: Feedback for Port A, B, and C* Connectors (J1 and J2) – Connectors and Pin positions

7.7 Digital IOs, Connector Pinouts (J3)

The following sections describe the I/O connections to the 2x7 pins connector. Refer to Chapters 14 Safe Digital IO and 15 Regular Digital IO in the Platinum Safety Drive Manual for full details.

The Digital I/Os connector includes the following functions:

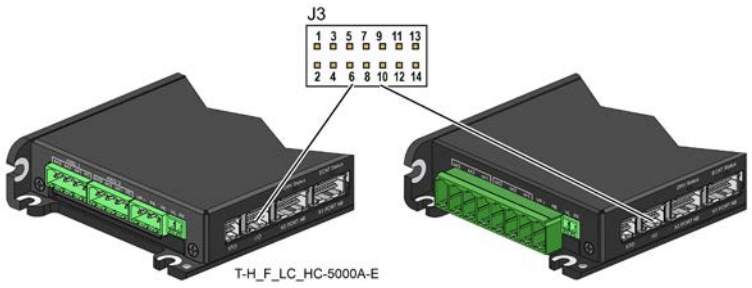
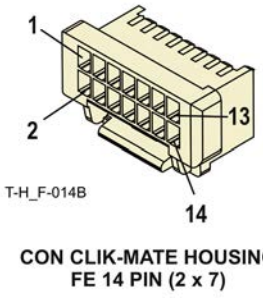
Pin No. J3	Signal	Function		
		Regular IO		Safe IO
		Type U	Type V	Type P
1	VDD_RET	VDD RET		
2	INPUT1	Input 1		
3	VDD	4V to 30V	24 ÷ 48V ±10%	24 ÷ 48V ±10%
4	INPUT2	Input 2		
5	OUTPUT4_SNK (Safe Break-) or INPUT6	Input 6	Input 6	Output 4 Sink
6	INPUT3	Input 3		
7	OUTPUT4_SRC/PLC Select		PLC	Output 4 Source
8	INPUT4	Input 4		
9	OUTPUT7 (Safe Brake +)	Output 7		
10	OUTPUT1	Output 1		
11	OUTPUT8 (Safe Brake -)	Output 8		
12	OUTPUT2	Output 2		
13	Spare/VDD RET (Or INCOM)	VDD RET (Or INCOM)		
14	OUTPUT3 (Safe Brake +) or INPUT5	Input 5	Input 5	Output 3
Pin Positions			**Mating Connector**	
			 CON CLIK-MATE HOUSING FE 14 PIN (2 x 7)	

Table 30: Digital IO Connector pinouts – J3

7.8 STO Connector (J4)

The following table describes the STO connections to the 2x4 pins connector. For further details, refer to Chapter 12 STO in the MAN-P Safety Drive Manual.

Pin No. (J4)	Signal	Function
1	X1_STO1	X1 STO1 input opto isolated
2	X1_STO2	X1 STO2 input opto isolated
3	X1_STO_RET	X1 STO signal return
4	X2_STO1	X2 STO1 input opto isolated
5	X2_STO2	X2 STO2 input opto isolated
6	X2_STO_RET	X2 STO signal return
7	Spare	
8	Spare	

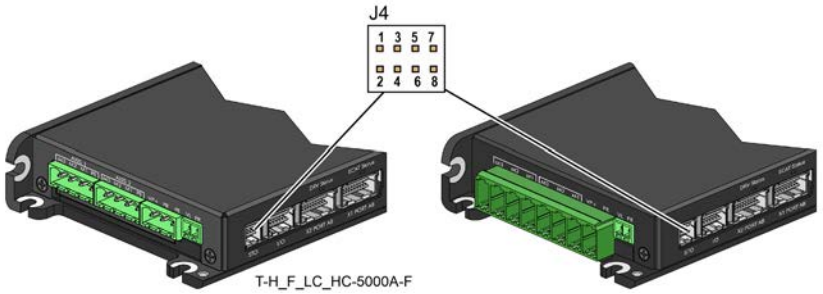
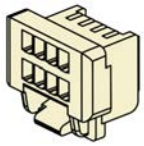
Pin Positions	Mating Connector
	 T-H_F-014B-B CON CLIK-MATE HOUSING FE 8 PIN (2 x 4)

Table 31: STO Connector pinouts - J4

7.9 Analog Inputs & RS-232/RS-422 (Differential RS-232) Serial Communication (J5)

Pin# (J5)	Signal	Function
1	RS422_TX+ / RS232_TX	Isolated AUX2 RS-422 (Differential RS-232) TX+ / RS-232 TX
2	RS422_RX+ / RS232_RX	Isolated AUX2 RS-422 (Differential RS-232) RX+ / RS-232 RX
3	RS422_TX-	Isolated AUX2 RS-422 (Differential RS-232) TX-
4	RS422_RX-	Isolated AUX2 RS-422 (Differential RS-232) RX-
5	RS422_ISO_RET / RS232_ISO_RET	Isolated RS-422 Return / Isolated RS-232 Return
6	Not Connected	
7	X1_Analogi1+	X1 – Analog Input 1+
8	X2_Analogi1+	X2 – Analog Input 1+
9	X1_Analogi1-	X1 – Analog Input 1-
10	X2_Analogi1-	X2 – Analog Input 1-
11	Ground	COMRET
12	Ground	COMRET

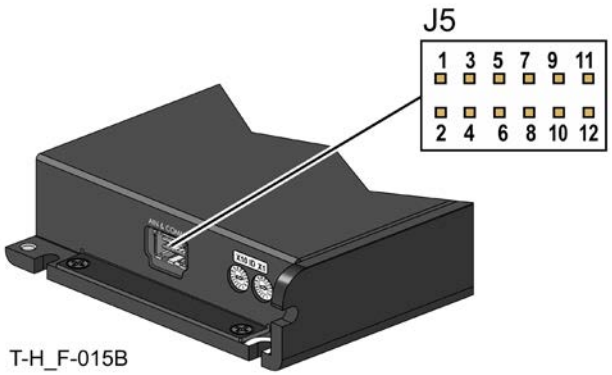
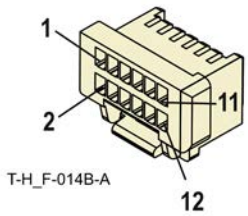
Pin Positions	Connector
	 CON CLIK-MATE HOUSING FE 12 PIN (2 x 6)

Table 32: Analog Inputs & RS-422/RS-232 Communication Pinouts (J5)

7.10 EtherCAT IN/OUT (X1, X2)

The following sections describe the EtherCAT and CANopen connections to the 1x5 pins connectors.

7.10.1 EtherCAT IN Connector (X1)

Pin No.	Signal	Function
1	EtherCAT_IN_TX+	EtherCAT IN Transmit+
2	EtherCAT_IN_TX-	EtherCAT IN Transmit-
3	Not Connected	Not Connected
4	Not Connected	Not Connected
5	Not Connected	Not Connected
6	EtherCAT_IN_RX+	EtherCAT IN Receive+
7	EtherCAT_IN_RX-	EtherCAT IN Receive-
8	Not Connected	Not Connected
9	Not Connected	Not Connected
10	Not Connected	Not Connected

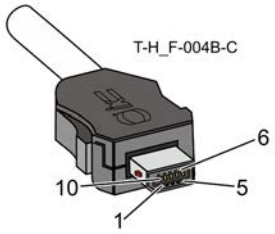
Pin Position	Connector
	

Table 33: EtherCAT IN connector pinouts - X1

7.10.2 EtherCAT OUT (X2)

Pin No.	Signal	Function
	EtherCAT	
1	EtherCAT_OUT_TX+	EtherCAT OUT Transmit+
2	EtherCAT_OUT_TX-	EtherCAT OUT Transmit-
3	Not Connected	Not Connected
4	Not Connected	Not Connected
5	Not Connected	Not Connected
6	EtherCAT_OUT_RX+	EtherCAT OUT Receive+
7	EtherCAT_OUT_RX-	EtherCAT OUT Receive-
8	Not Connected	Not Connected
9	Not Connected	Not Connected
10	Not Connected	Not Connected

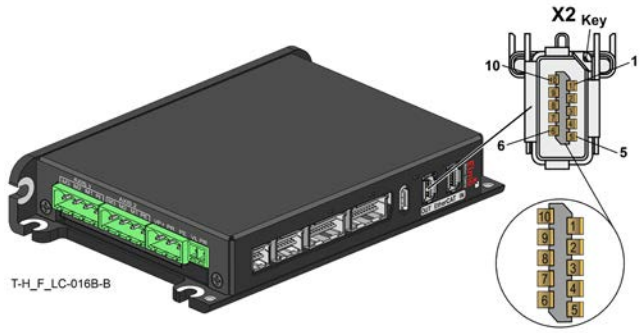
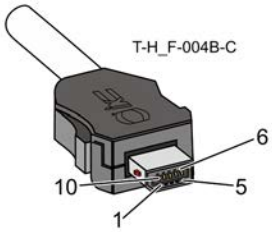
Pin Position	Connector
	

Table 34: EtherCAT OUT connector pinouts - X2

7.10.3 CAN (X1, X2) for Safety Capabilities F and O

Pin No.	Signal	Function
1	Not Connected	Not Connected
2	Not Connected	Not Connected
3	Not Connected	Not Connected
4	CAN_H	Bidirectional, CAN BUS
5	CAN_L	Bidirectional, CAN BUS
6	Not Connected	Not Connected
7	Not Connected	Not Connected
8	Not Connected	Not Connected
9	ISO_RET	Isolation GND for CAN
10	ISO_RET	Isolation GND for CAN

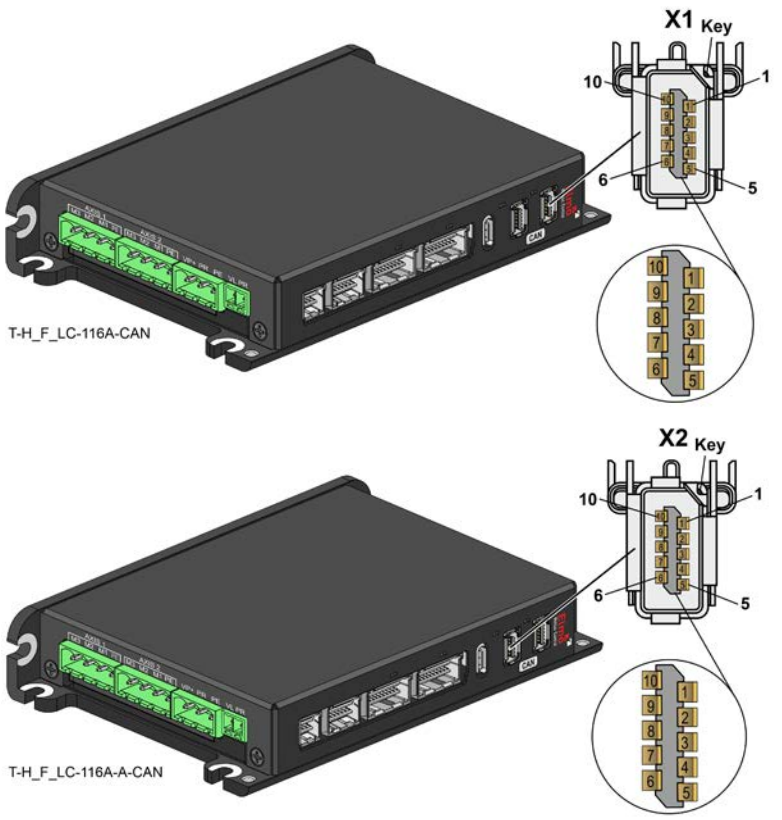
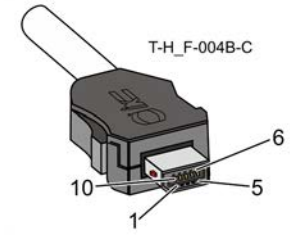
Pin Position	Connector
	

Table 35: CANopen connector pinouts - X1 and X2 for Safety Capability F and O

7.10.4 Connecting EtherCAT/CAN Mating Connectors to X1 and X2

Proper connecting of the mating EtherCAT connectors to the X1 and X2 connectors is shown in Figure 11.

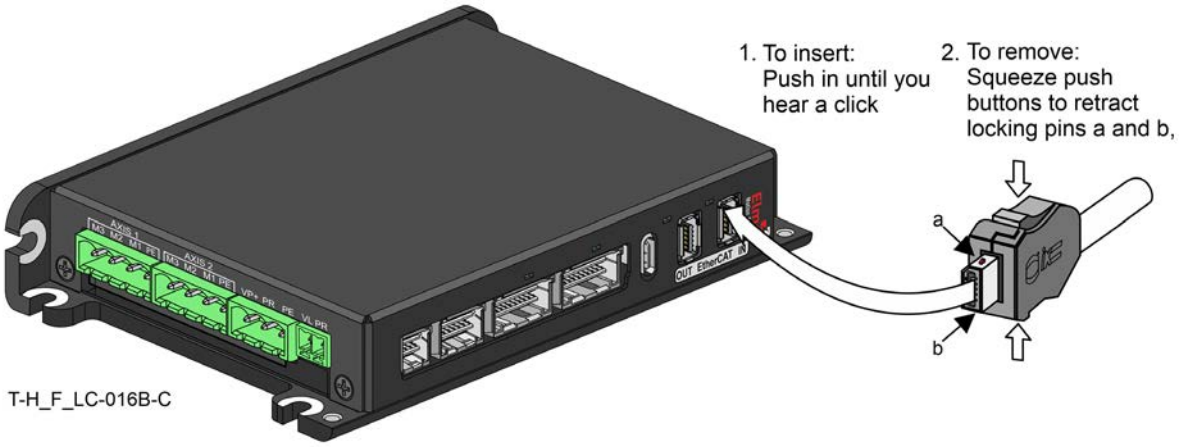


Figure 11: Connecting EtherCAT Mating Connectors to Titanium Harmonica X1 and X2 Connectors

7.11 USB Connector Type C (X3)

Refer to section 17.1 USB in the Platinum Safety Drive Manual for full details.

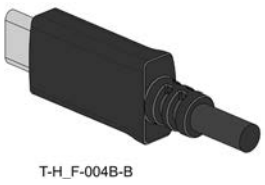
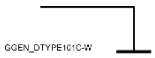
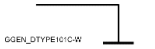
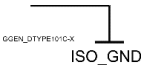
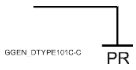
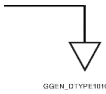
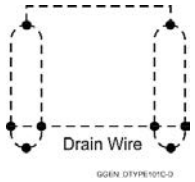
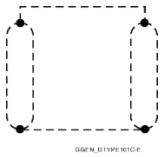
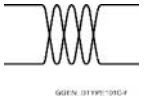
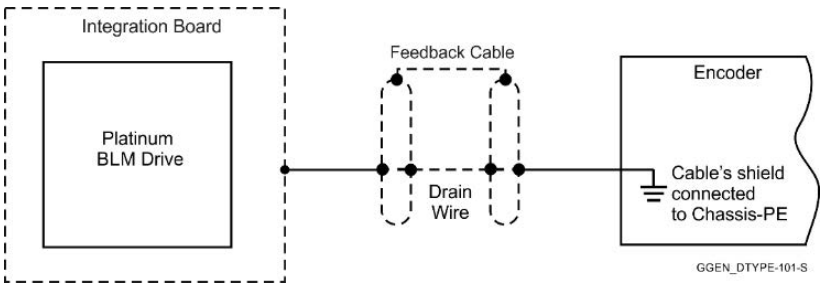
Pin (X3)	Signal	Function
A1	COMRET	Common return
A2	Not Connected	
A3	Not Connected	
A4	USB_VBUS	USB VBUS 5 V
A5	Not Connected	
A6	USBD+	USB _P line
A7	USBD-	USB _N line
A8	Not Connected	
A9	USB_VBUS	USB VBUS 5 V
A10	Not Connected	
A11	Not Connected	
A12	COMRET	Common return
B1	COMRET	Common return
B2	Not Connected	
B3	Not Connected	
B4	USB_VBUS	USB VBUS 5 V
B5	Not Connected	
B6	USBD+	USB _P line
B7	USBD-	USB _N line
B8	Not Connected	
B9	USB_VBUS	USB VBUS 5 V
B10	Not Connected	
B11	Not Connected	
B12	COMRET	Common return
	COMRET	Supply, Connector body
Pin Positions		**Cable Connector**
		

Table 36: USB Device Type C Pin Assignments

Chapter 8 Wiring

8.1 Wiring Legend

The following table legend describes the wiring symbols detailed in all installation guides.

Wiring Symbol	Description
	Earth connection (PE).
	**User Side:** This symbol signifies that any type of grounding may be used on the user side.
	VDD Return.
	Isolated Ground.
	Power Return.
	COMRET Common at the Drive.
	Shielded cable with drain wire. The drain wire is a non-insulated wire that is in direct contact with the braid (shielding). Shielded cable with drain wire significantly simplifies the wiring and earthing.
	Shielded cable braid only, without drain wire.
	Twisted-pair wires.
	Encoder Earthing. The cable`s shield is connected to the chassis (PE) in the connector. The servo drive shield is connected to Earth.

8.2 The Titanium Harmonica Connection Diagrams

8.2.1 Connection Diagrams for EtherCAT Version

8.2.1.1 Connection Diagram for Safety Capability F – High Current

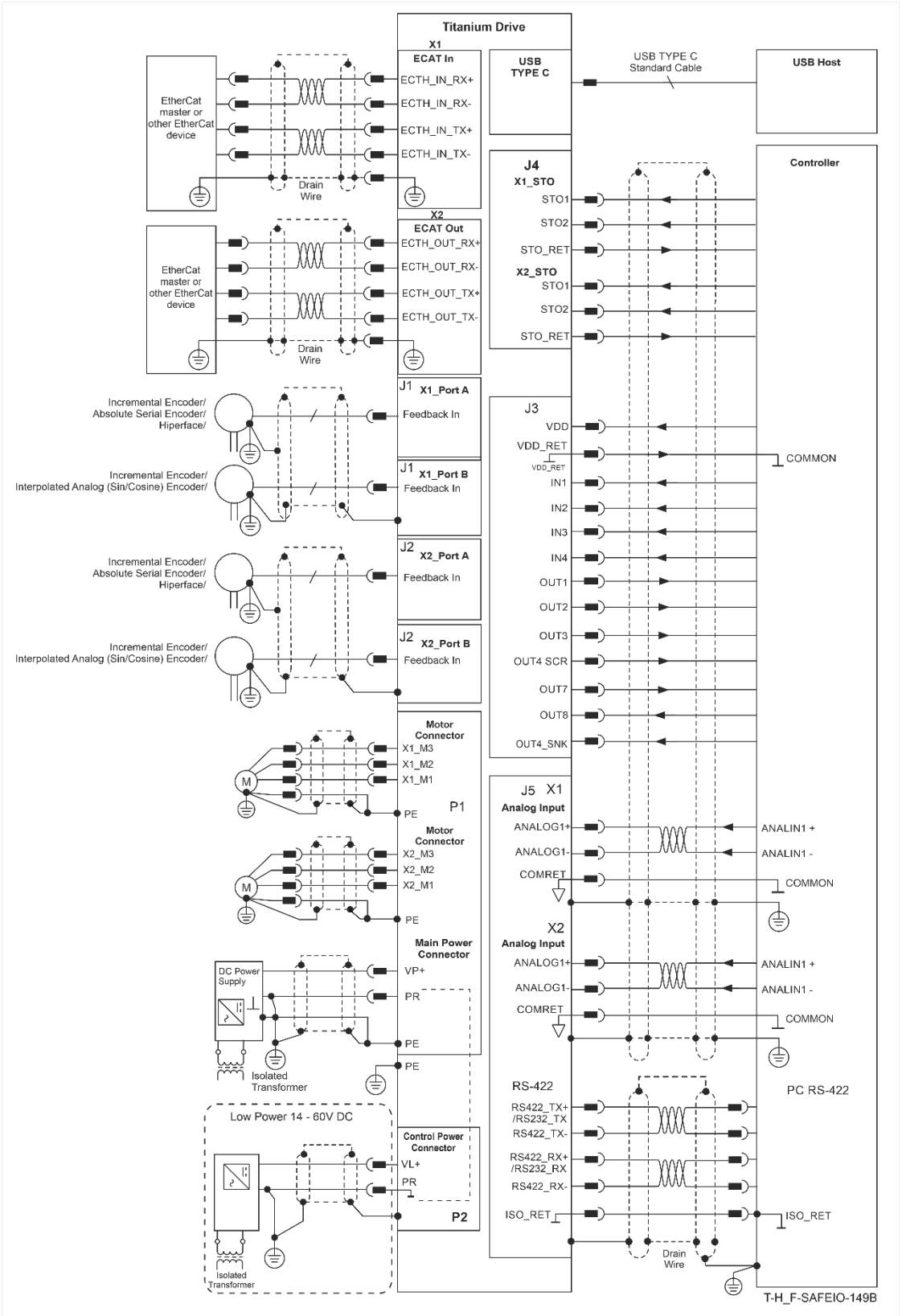


Figure 12: Connection Diagram for Safety Capability F – High Current – EtherCAT version

8.2.1.2 Connection Diagram for Safety Capability F – Low Current

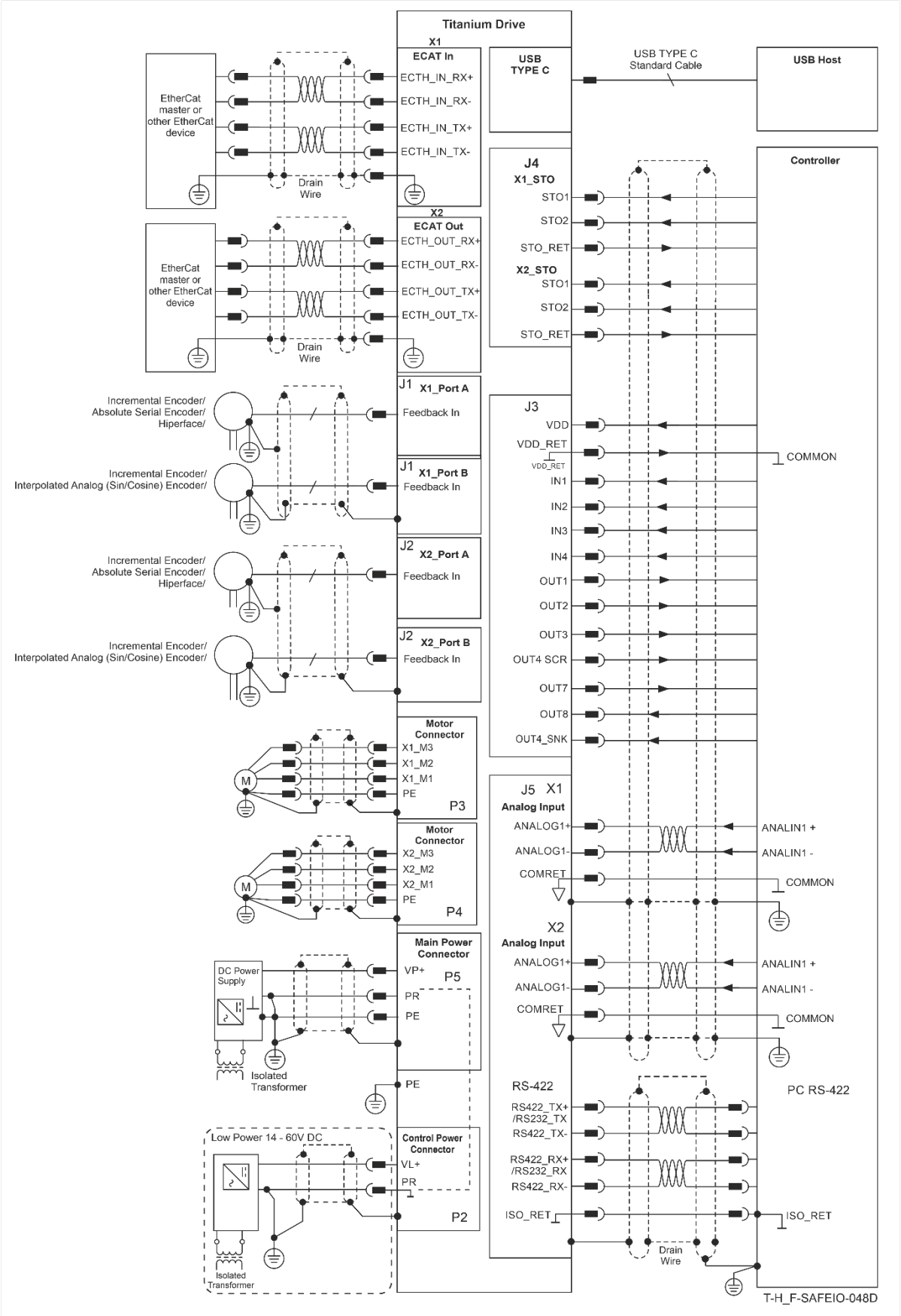


Figure 13: Connection Diagram for Safety Capability F – Low Current – EtherCAT Version

8.2.1.3 Connection Diagram for Safety Capability S, O – High Current

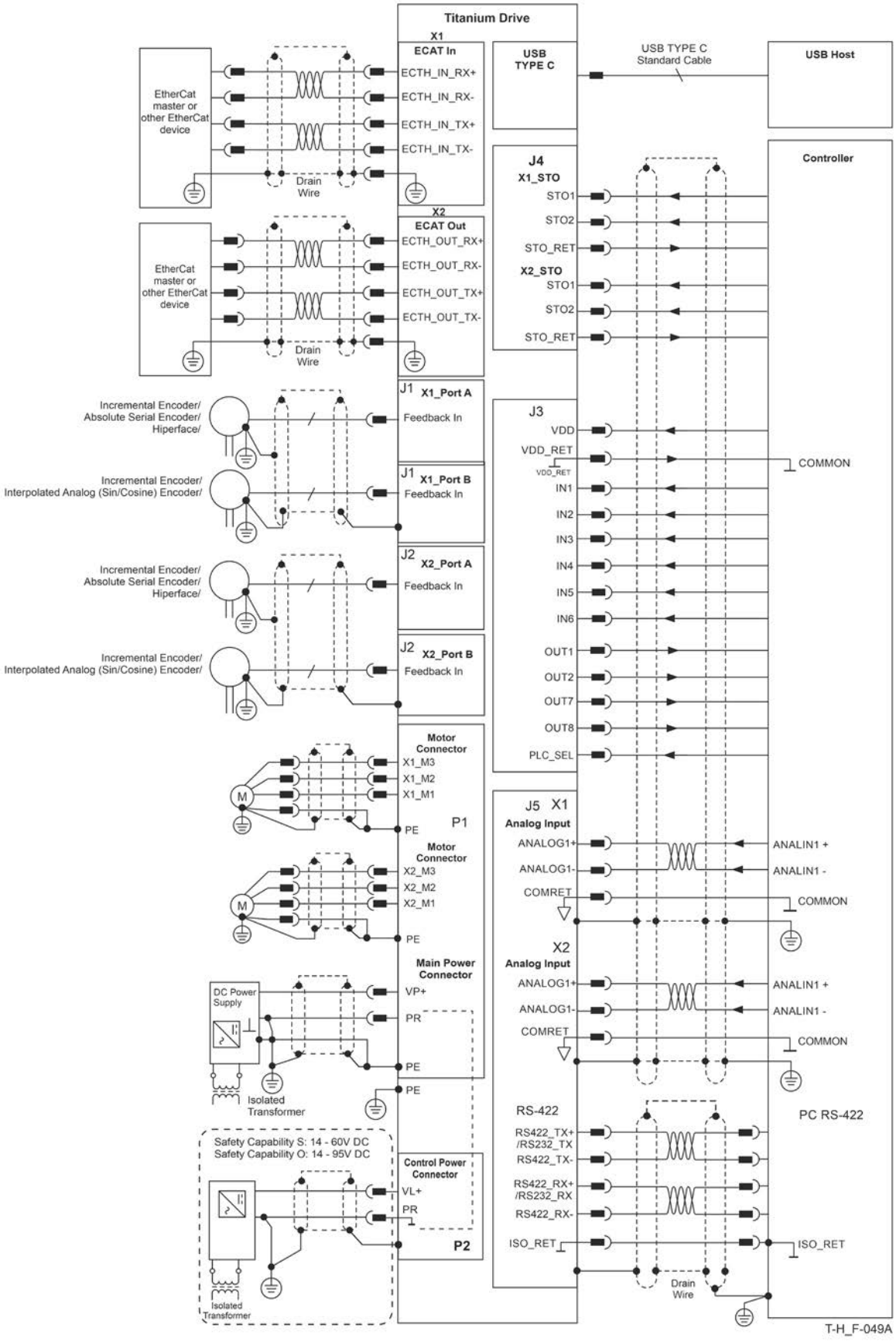


Figure 14: Connection Diagram for Safety Capability S, O – High Current EtherCAT Version

8.2.1.4 Connection Diagram for Safety Capability S, O – Low Current

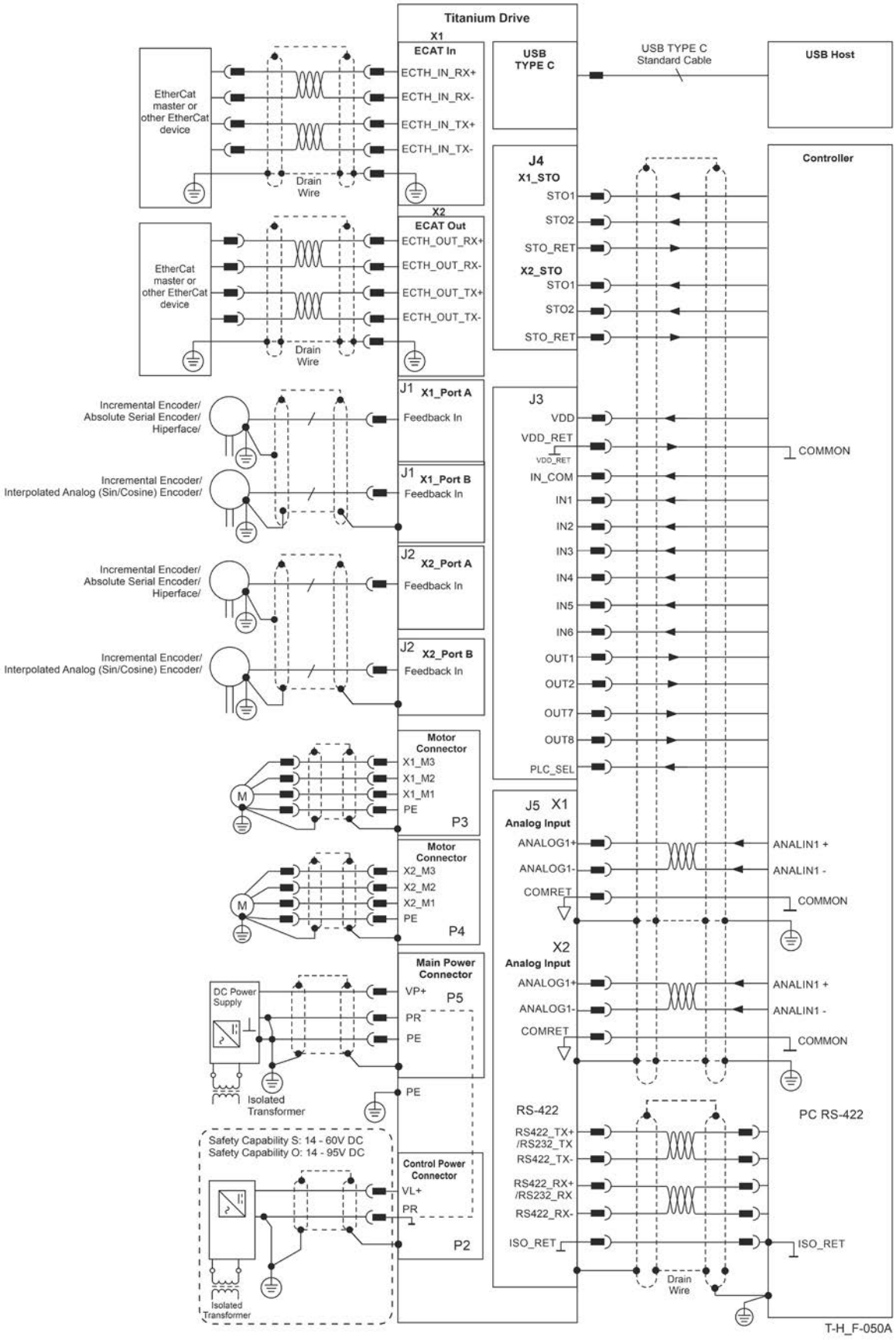


Figure 15: Connection Diagram for Safety Capability S, O – Low Current – EtherCAT Version

8.2.2 Connection Diagrams for CANopen Version

8.2.2.1 Connection Diagram for Safety Capability F – High Current

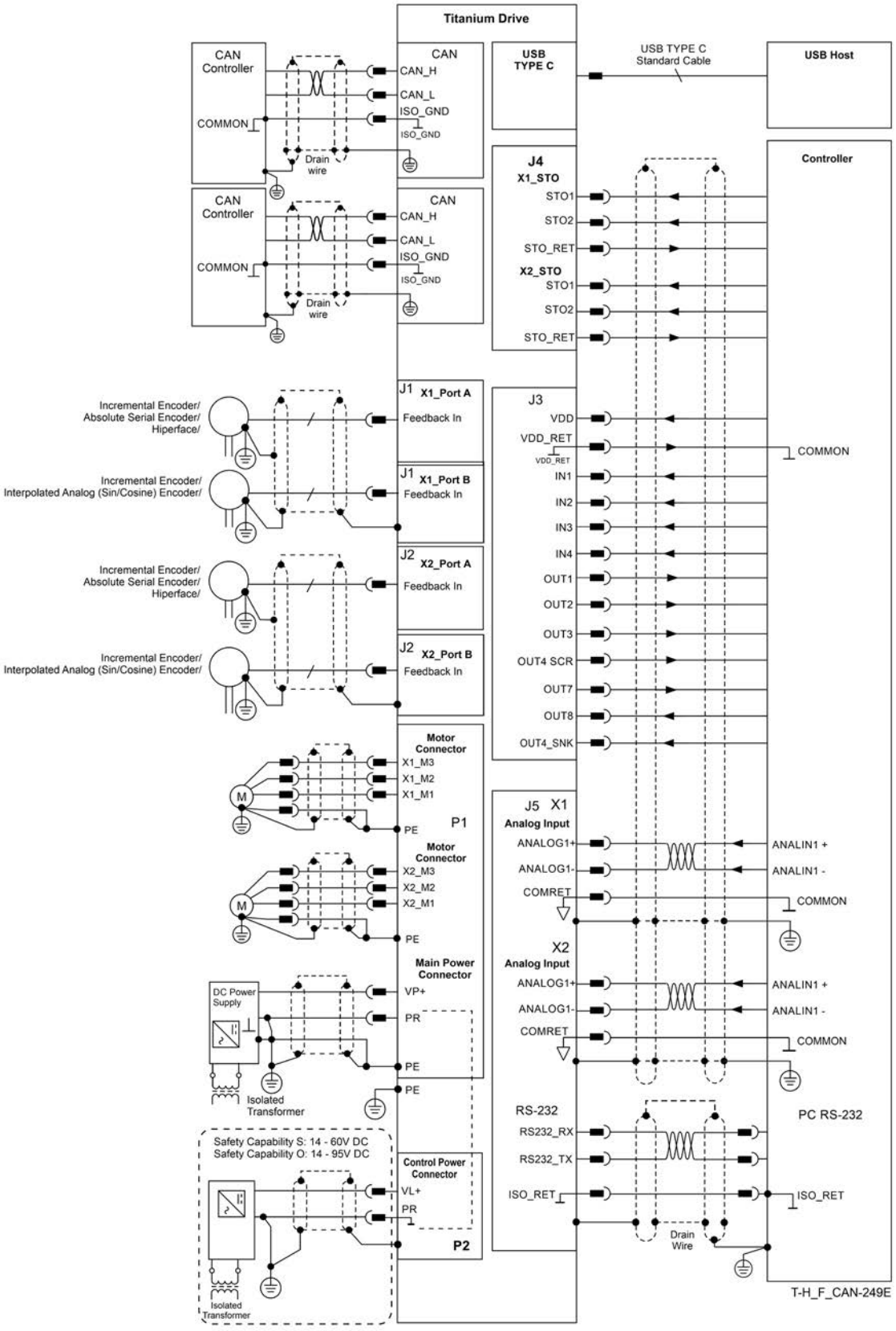


Figure 16: Connection Diagram for Safety Capability F – High Current – CAN Version

8.2.2.2 Connection Diagram for Safety Capability F – Low Current

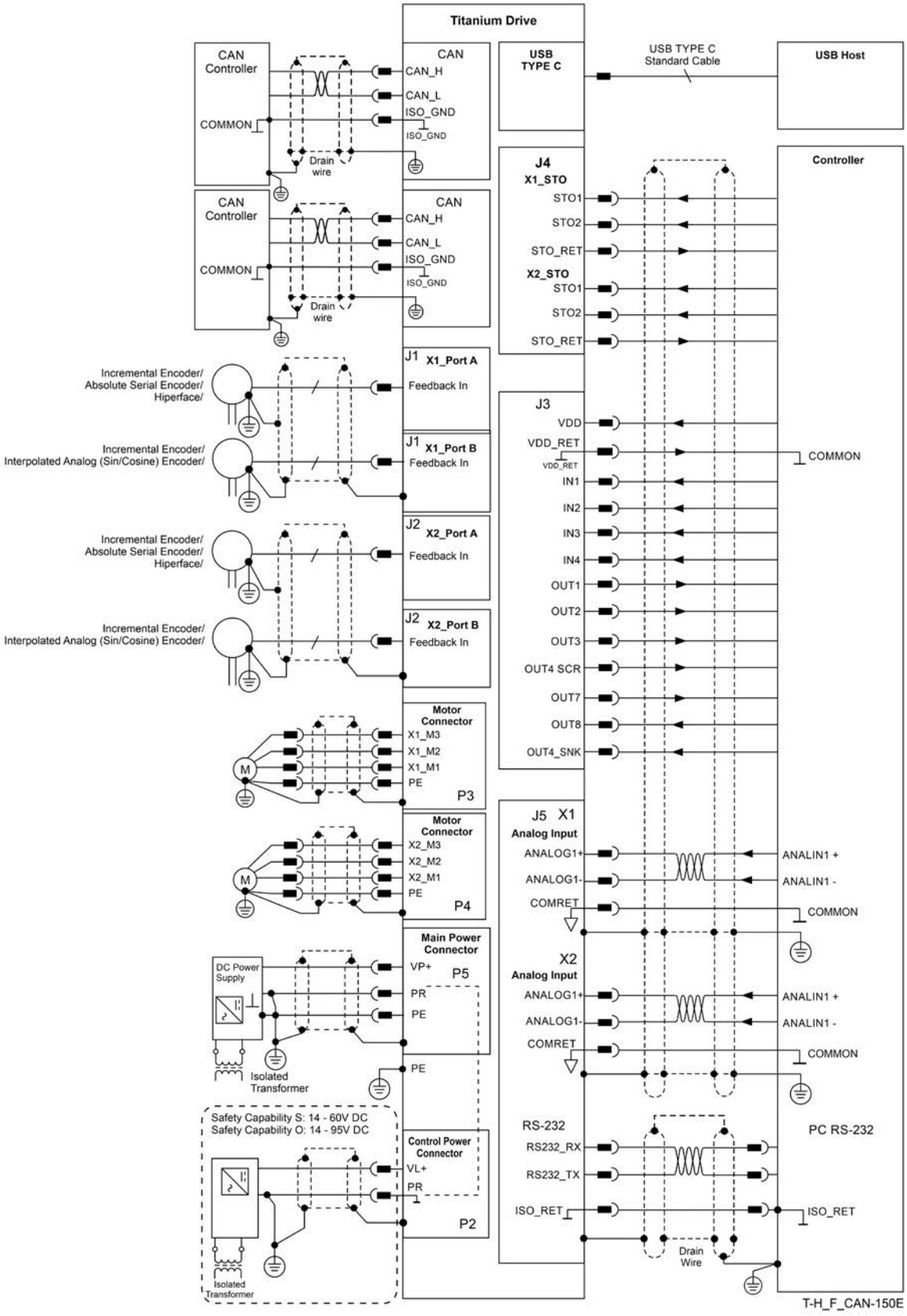


Figure 17: Connection Diagram for Safety Capability F – Low Current – CAN Version

8.2.2.3 Connection Diagram for Safety Capability O – High Current

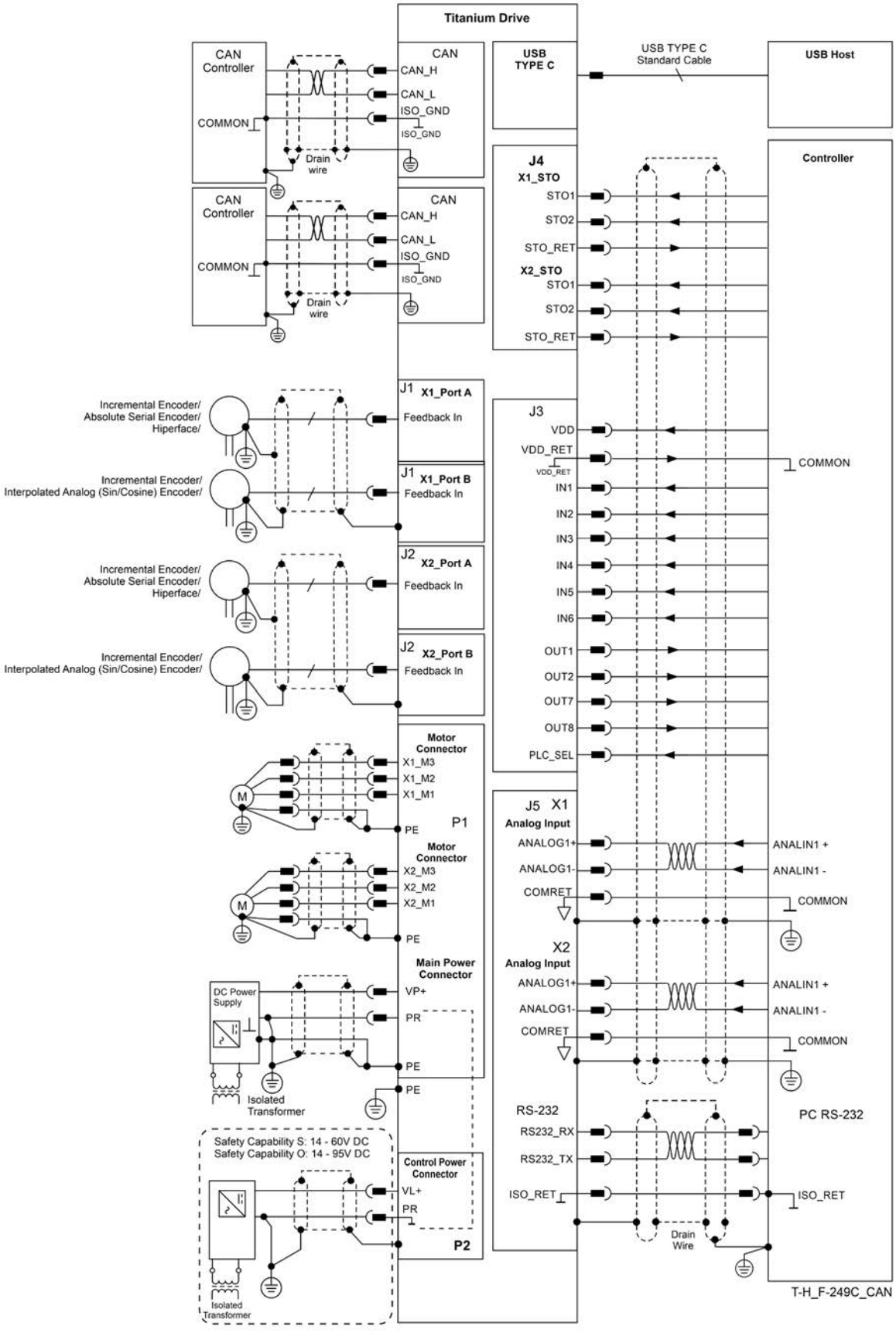


Figure 18: Connection Diagram for Safety Capability O – High Current – CAN Version

8.2.2.4 Connection Diagram for Safety Capability O – Low Current

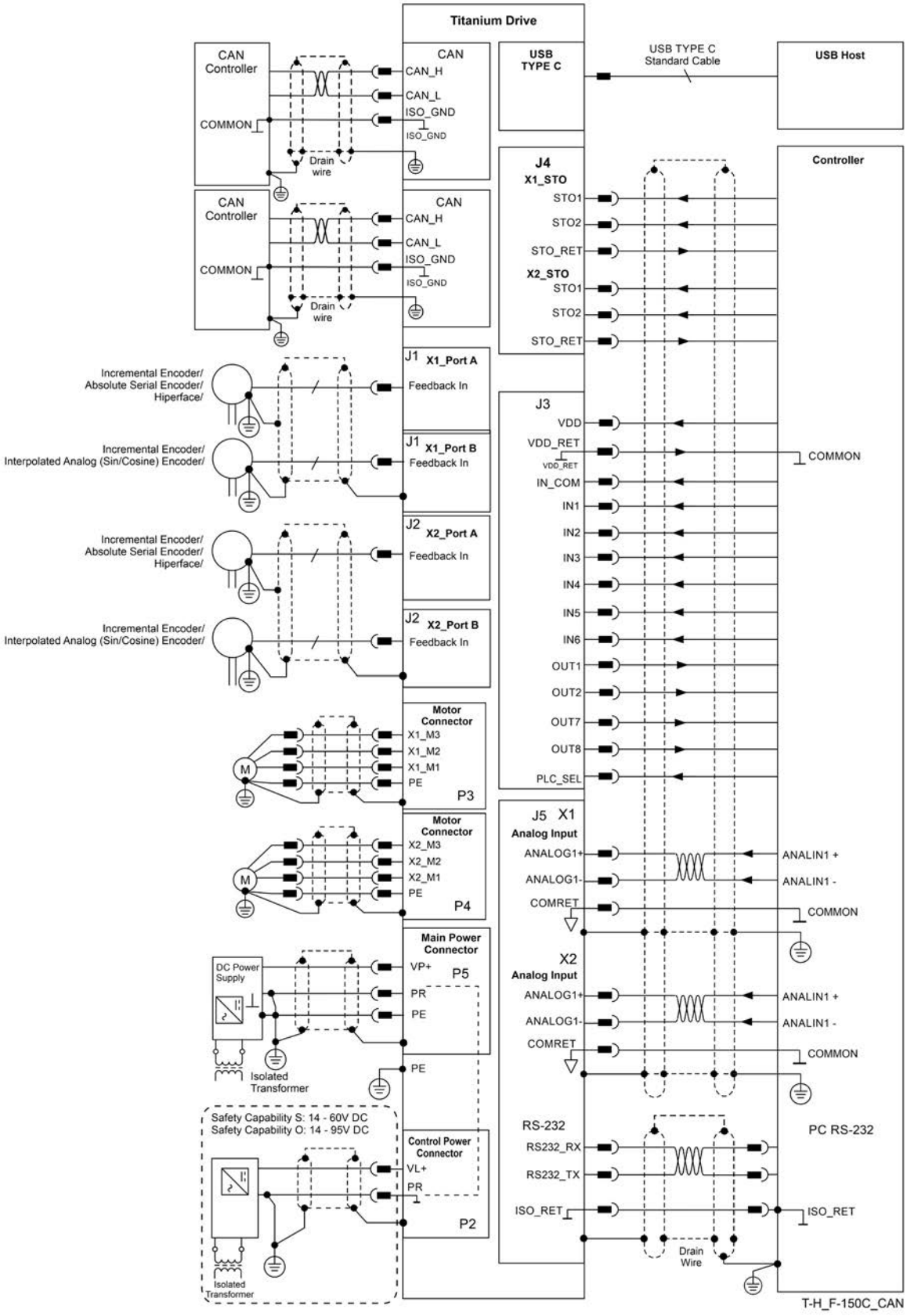


Figure 19: Connection Diagram for Safety Capability S, O – Low Current – CAN Version

8.3 Wiring the Female Connectors

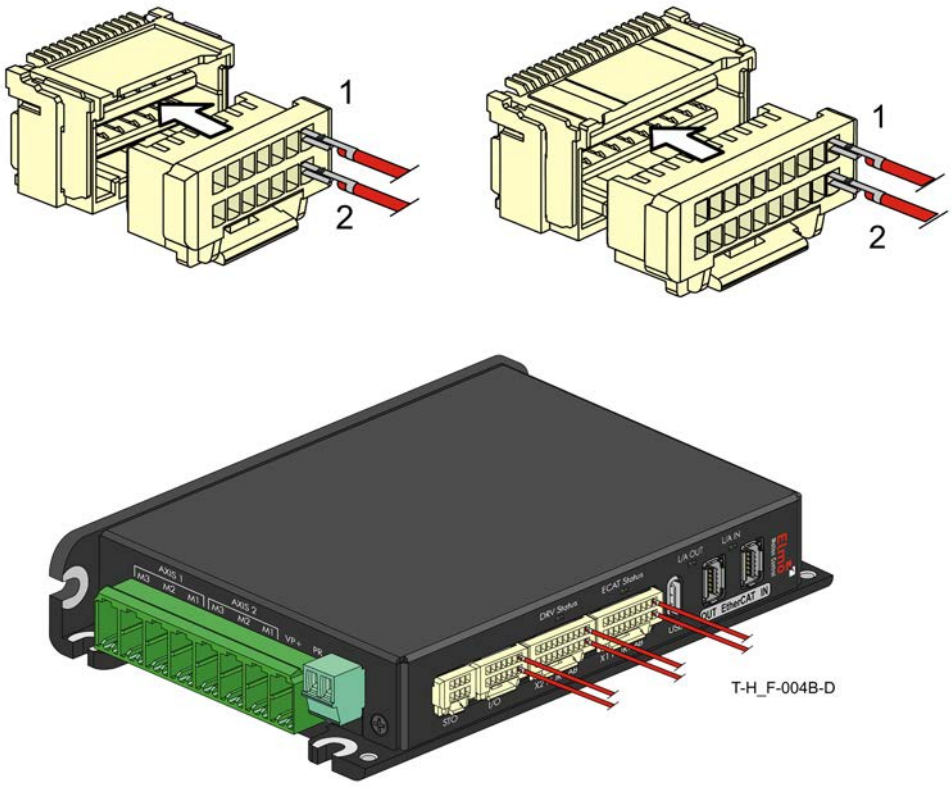


Figure 20: Inserting a wire/pin to the Female Connector

To insert a wire/pin to the female connectors J1, J2, J3, and J4, do the following:

1. Select the relevantly colored wire to insert to a specific rectangular compartment on the female connector.
2. Use the appropriate Molex crimping plier (Molex P/N 63819-1500) to fasten a pin connector to the end of the wire.
3. Place the connector on a flat surface, in the orientation as shown in Figure 20.
   Notice that the rectangular slot has a niche at the bottom of the slot.
4. Insert the wire connector to the slot as shown in Figure 20. Make sure that the connector protrusion is inserted to the bottom of the rectangular slot.
   When inserting the wire connector to a slot in the second row, make sure to rotate the connector in the opposite orientation.
5. Repeat the same procedure for any other wire connections.

8.4 Wiring the Ground Wires

For the Titanium Harmonica Low Current model, only the small grounding holes are needed. For the Titanium Harmonica High Current model, also the larger grounding holes are needed.

8.4.1 Grounding Wires for the High Current Model

For the High Current model, the motor and power cables have an added drain wire which uses the large grounding holes.

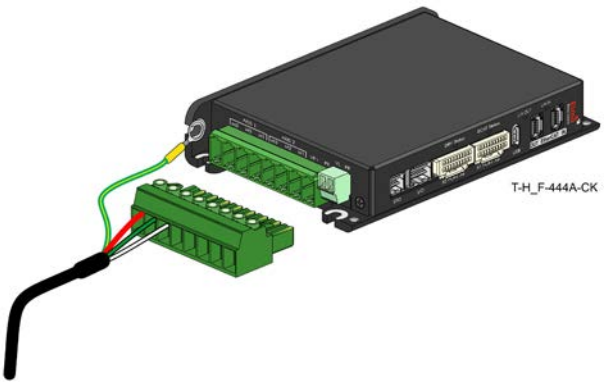


Figure 21: Wiring the ground wires for the motor power for the High Current model

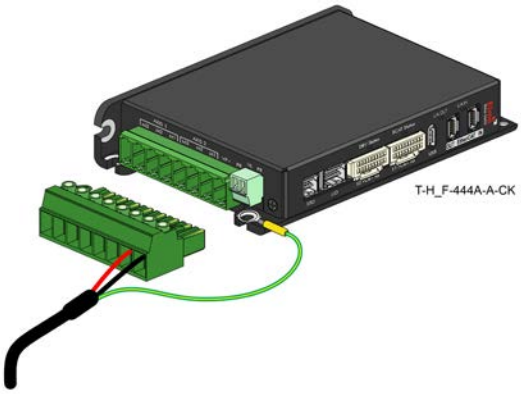
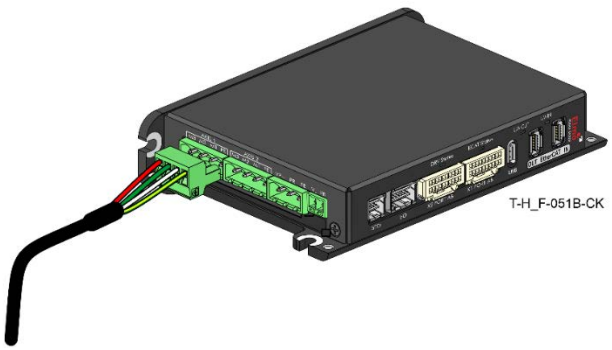


Figure 22: Wiring the ground wires for the DC Power Supply for the High Current model

8.4.2 Grounding Wires for the Low Current Model

For the Low Current model, the motor and power cables contain a grounding wire, so no drain wires are needed.



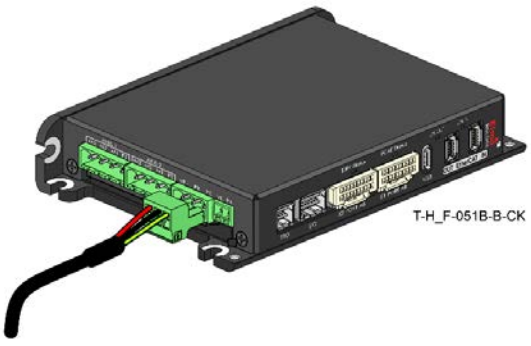


Figure 23: Connecting the Moter cable and the DC Power Supply cable on the Low Current model

8.4.3 Grounding Wires for other Cables

All other cables have drain wires, which use the small grounding holes.

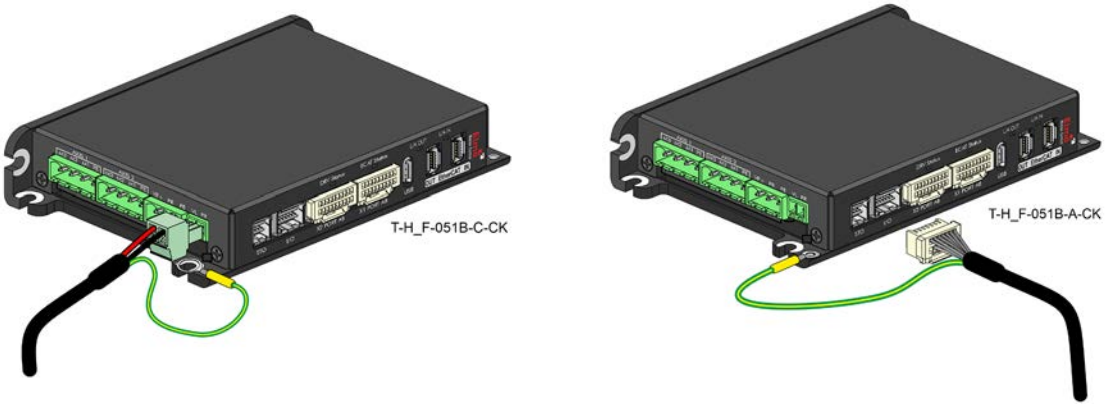


Figure 24: Wiring ground wires for the Low Current model – example

The grounding wires are 10 cm green and yellow wires with yellow terminal rings. Use an M4 screw and a serrated washer to mount the grounding wire. For the High Current model, use one of the three large ground holes for the ground wire.

During the drive installation, to connect the ground wire to ground, do the following:

1. For each connector with an attached grounding wire, select the nearest and most appropriate grounding hole to which to connect the wire.
2. Mount the screw, terminal ring, and washer, to the ground hole as shown below.

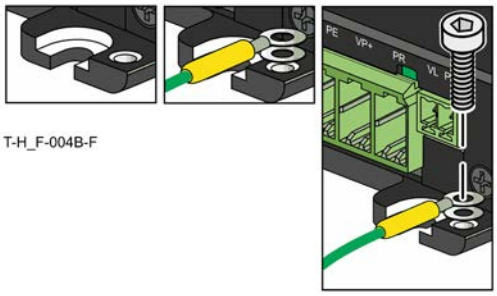


Figure 25: Mounting the terminal ring to the small ground hole

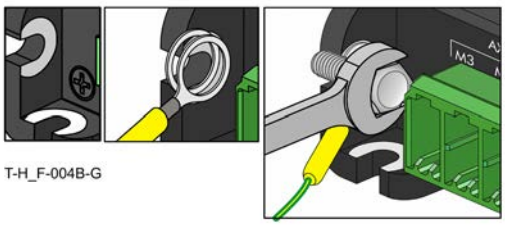


Figure 26: Mounting the terminal ring to a large ground hole

3. Carefully tighten the screw, to secure the terminal ring.

Note:
There may be a need for more ground wires. The grounding holes on the frame of the Titanium Harmonica are dedicated for Elmo's wires, but when more ground wires are necessary, use the remaining grounding holes.

8.5 Main, Control, and Motor Power

Refer to the Power Supplies chapter in the Titanium Safety Drive Manual for details.

8.5.1 Motor Power (P1)

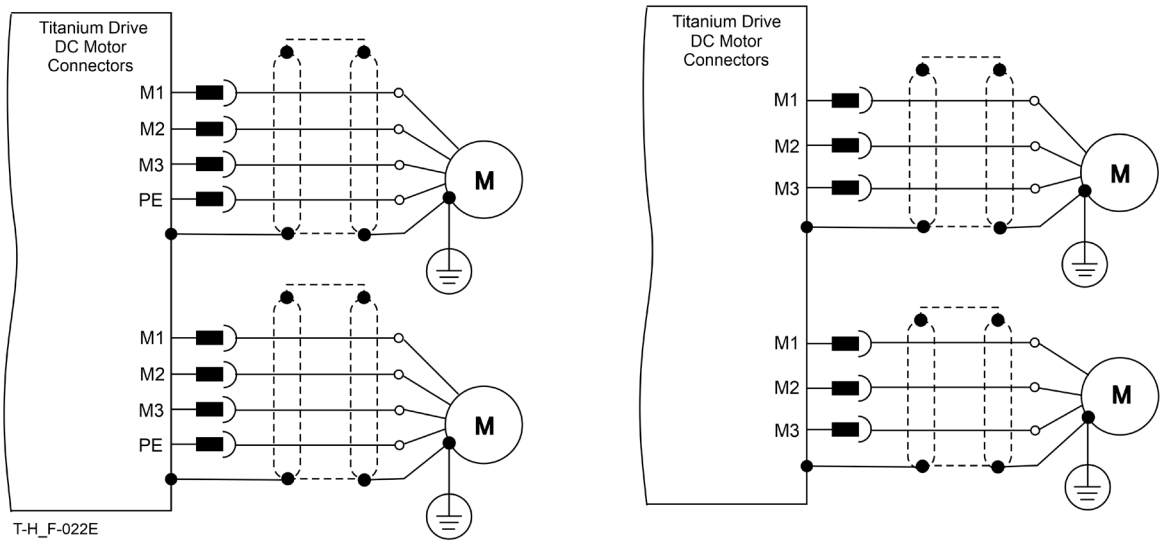


Figure 27: Brushless Motor Power Connection Diagram for Low Current and High Current Models

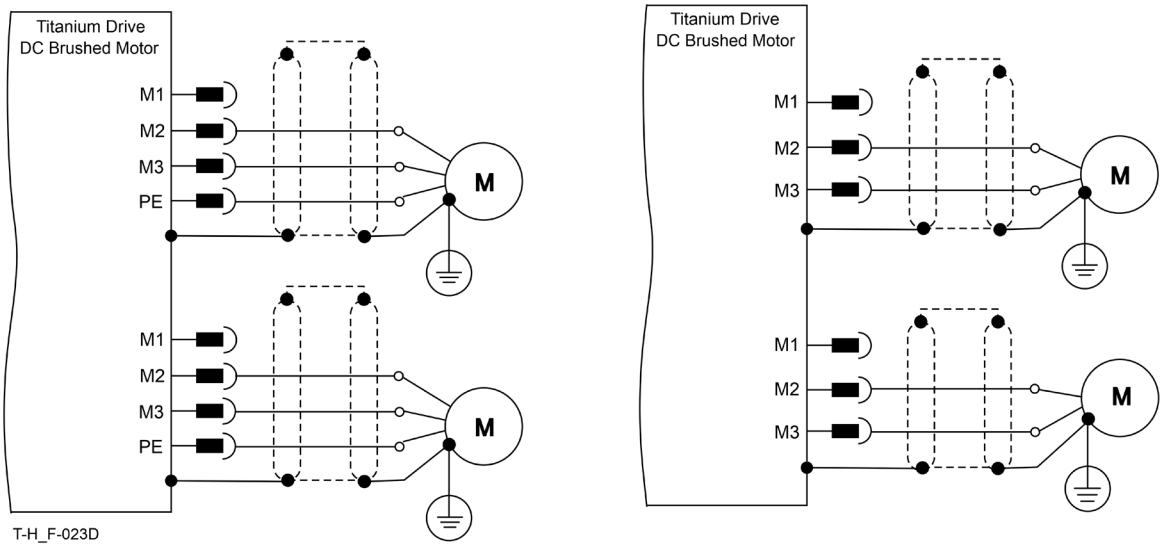


Figure 28: Brushed Motor Power Connection Diagram for Low Current and High Current Models

To connect the motor power:

1. Ensure that the motor chassis is properly earthed.
2. Connect the appropriate wire from the Motor Power cables to the M1, M2, M3, and PE terminals on the Titanium Harmonica.

   The phase connection is arbitrary, as Elmo Application Studio (EAS II) will establish the proper commutation automatically during setup. When tuning several drives, you can copy the setup file to the other drives and thus avoid tuning each drive separately. In this case, the motor-phase order must be the same as on the first drive.

Note:
The Low Current version uses PE terminals for each axis (and has a PE terminal with the DC Power Supply Input), whereas the High Current version does not use PE.

3. For high EMI environment, it is highly recommended to use a 4-wire shielded (not twisted) cable for each axis (the PE terminals is used by the Low Current versions only) in the motor connection. The gauge is determined by the actual RMS current consumption of the motor.
   Connect the cable shield to the closest ground connection at the motor end.
4. For better EMI performance, the shield should be connected to Earth Connection (heat sink mounting holes).
5. To connect two wires to the PE terminal, use a dual wire twin ferrule. Make sure not to bundle the wires. Figure 29 shows the terminals on the Titanium Harmonica.

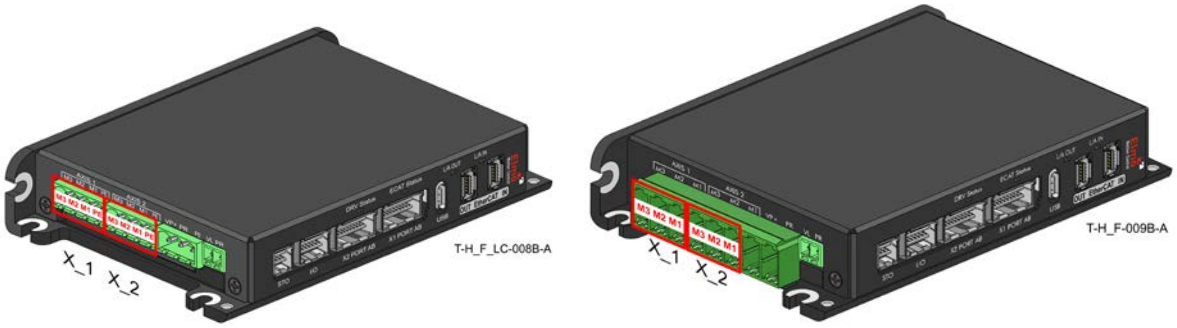


Figure 29: Connecting to the Motor Power

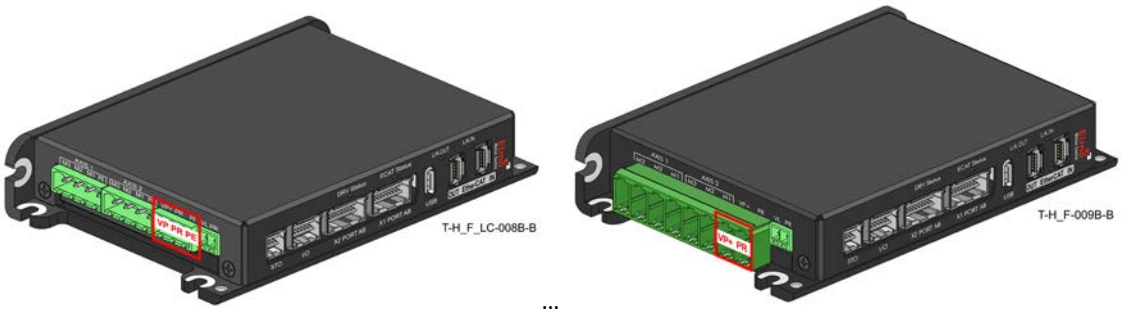
8.5.2 Main Power (P1)

The isolated DC power source is not included with the Titanium Harmonica.

Connect the DC power cable to the VP+ and PR terminals on the main power connector.

To connect the Titanium Harmonica to the DC power source:

1. The source of the VDC power supply must be isolated from the Mains.
2. Verify that the rectified VDC is indeed within the range of the drive.
3. Connect the VP and PR wires to the terminals on the servo-drive, marked in red in Figure 30.
   It is highly recommended to twist the two DC main power cables at intervals of 10 cm.



...

Figure 30: Connecting the Main Power Wires

4. Connect the PE to the closest earth connection near the power supply.
5. Connect the PR to the closest earth connection near the power supply.
6. Before applying power, first verify the polarity of the connection.

8.5.3 Control Supply Connections (P2)

Connect the VL+ and PR terminals to the power supply Control Connector.

To connect the VL+ and PR to the control supply:

1. The source of the control supply must be isolated from the Mains.
2. Connect the return (common) of the control supply source to the closest earth connection near the control supply source.
3. Connect the VL and PR wires to the terminals on the servo-drive as shown in Figure 31 and Figure 32.

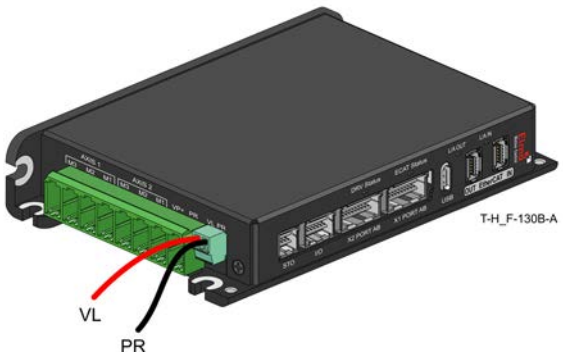


Figure 31: Connecting the Control Supply Wires for High Current Model

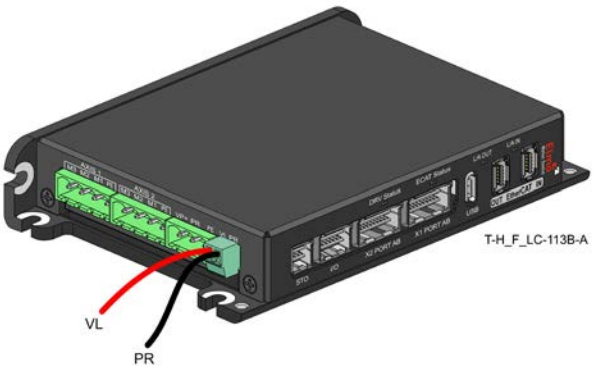


Figure 32: Connecting the Control Supply Wires for Low Current Model

1. Before applying power, first verify the polarity of the connection.

8.5.4 Dual Power Supply

Two DC power sources are required for functional safety:

- Main Power isolated from the Mains:
  - 10 to 95VDC for 100V models.
  - 20 to 195VDC for the 200V models.
- Control Power Supply: for isolated DC Source.
  - For Safety Capability F and S: 14 – 60 V for the logic
  - For Safety Capability O: 14 – 95 V for the logic

Both the Power and Logic supplies are required to be isolated-from-the-mains:

- A battery or main DC power source rectified from the Mains, according to specification.
- A control supply for the logic (VL+, PR)

The following figure describes an ordinary power supply for Servo drives with sufficient internal capacitance and shunt regulator to manage power flow in both directions to-and-from the motor.

Important:

CAPACITANCE IN:

- **For 100V models where the power ≥ 1500W, or**
- **For 200V models where the power ≥ 3500W**

must have a high DC Bus Capacitance connected between the VP+ and the PR as shown in Figure 33**.**

Elmo recommends:

- TAB-100, a DC Bus connection Hub with **2340uF** for 100V models
- TAB-200, a DC Bus connection Hub with **900uF** for 200V models

Please refer to the TABLA Installation Guide.

Note:

The PR, COMRET, and VL- are connected internally in the Titanium Harmonica.

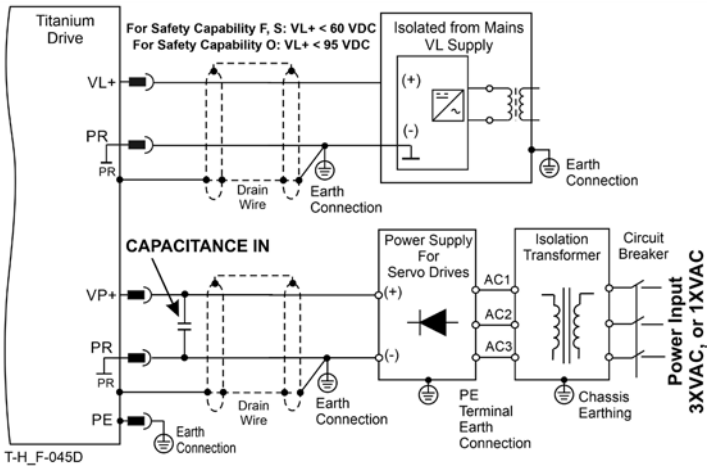


Figure 33: Separate VP and PR Power Supplies Connection Diagram

Note:

- Make sure to connect the PR to the closest earth connection near the power supply.
- For Safety Capability O: VL and VP can be connected when VL < 100 is guaranteed, including the consideration of back EMF.
- For Safety Capability F and S: VL and VP cannot be connected.

8.6 Feedback (J1, J2)

Refer to the Feedback chapter in the Titanium Safety Drive Manual for details.

The Feedback for Axis 1 Port AB sensor pinouts are found in the 2x10 pins connector **J1**.

The Feedback for Axis 2 Port AB sensor pinouts are found in the 2x10 pins connector **J2**.

The following table describes the pin positions for Port AB connections for Axes 1 and 2.

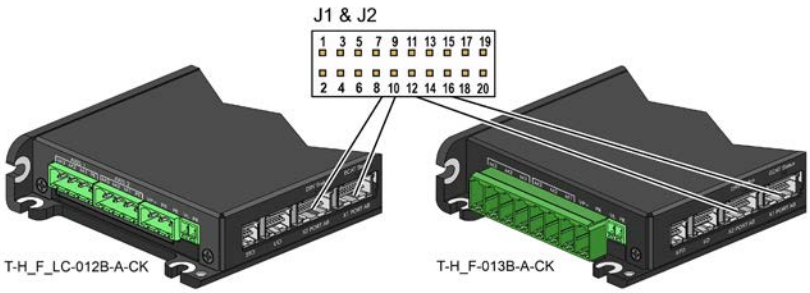
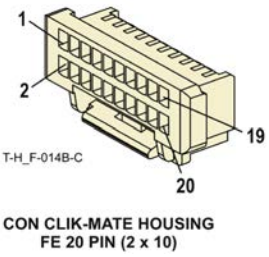
Port A, B Connectors and Pin Positions for Axes 1 and 2	Cable Connector
	

Table 37: Port A, B, Connectors and Pin Positions for Axes 1 & 2

The details of the Feedback for Axes 1 and 2 Port A, B and C*sensor pinouts are described in the following subsections.

8.6.1 Power Signals and Control Supply

Pin#	Signal		Function
Pin#	**J1 for Axis 1**	**J2 for Axis 2**	
1	+11V Encoder/ +5V Encoder	+11V Encoder / +5V Encoder	For PN Option Encoder type 1: +11V supply For PN Option Encoder type 5: +5V supply
2	+5V Encoder	+5V Encoder	Encoder +5V supply
3, 4, 20	COMRET	COMRET	Common Return

Table 38: Feedback for Axes 1 & 2 Port A

8.6.2 Feedback Port A for Axes 1 & 2

Port A supports the following sensor inputs:

- Incremental Encoder or Absolute Serial Encoder, depending on the specific model.
- Differential pulse-width modulation (PWM) signal input can be connected to Port A.
- Differential Pulse & Direction signal inputs can be connected to Port A.
- Emulated Encoder output derived from Port A and Port B Index

The following table describes the Encoder functions for Port A.

Port A – J1 for Axis 1		Incremental Encoder	Absolute Serial Encoder
Pin#	**Signal**	**Function**	**Function**
5	X1_PortA_A+	Channel A+	Main Absolute encoder clock+

Port A – J1 for Axis 1		Incremental Encoder	Absolute Serial Encoder
7	X1_PortA_A-	Channel A -	Main Absolute encoder clock-
9	X1_PortA_B+	Channel B+	Main Absolute encoder data+
11	X1_PortA_B-	Channel B -	Main Absolute encoder data-
13	X1_PortA_I+	Channel Index+	Auxiliary Absolute encoder clock+
15	X1_PortA_I-	Channel Index-	Auxiliary Absolute encoder clock-

Table 39: Feedback for Axis 1 Port A

Port A – J2 for Axis 2		Incremental Encoder	Absolute Serial Encoder
Pin#	**Signal**	**Function**	**Function**
5	X2_PortA_A+	Channel A+	Main Absolute encoder clock+
7	X2_PortA_A-	Channel A -	Main Absolute encoder clock-
9	X2_PortA_B+	Channel B+	Main Absolute encoder data+
11	X2_PortA_B-	Channel B -	Main Absolute encoder data-
13	X2_PortA_I+	Channel Index+	Auxiliary Absolute encoder clock+
15	X2_PortA_I-	Channel Index-	Auxiliary Absolute encoder clock-

Table 40: Feedback for Axis 2 Port A

8.6.2.1 Incremental Encoder

The following figure describes the Incremental Encoder connection diagram.

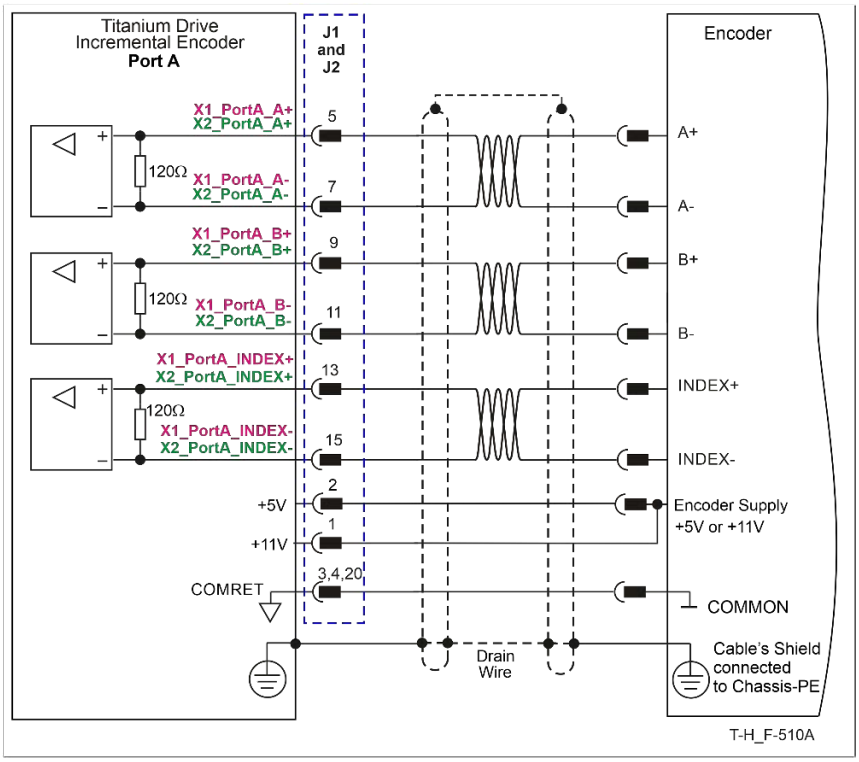


Figure 34: Port A Incremental Encoder Input – Recommended Connection Diagram

8.6.2.2 Main Absolute Serial Encoder

The Port A ABS encoder supports the following encoder types:

- Encoder 6-Wires (for Safety Capabilities F, S, and O)
- Encoder 4-Wires (for Safety Capabilities F, S, and O)
- Encoder 2-Wires (for Safety Capability F)

8.6.2.2.1 Encoder 6-Wires

The 6-wire encoder includes Differential Absolute Clock, Differential Absolute DATA, Encoder Power, and GND.

The following Absolute Encoder types are supported:

- EnDat 2.2
- Biss C and Biss B, Safe BISS
- SSI

The following is the connection diagram for 6-wires encoder for the Main Absolute Serial Encoder:

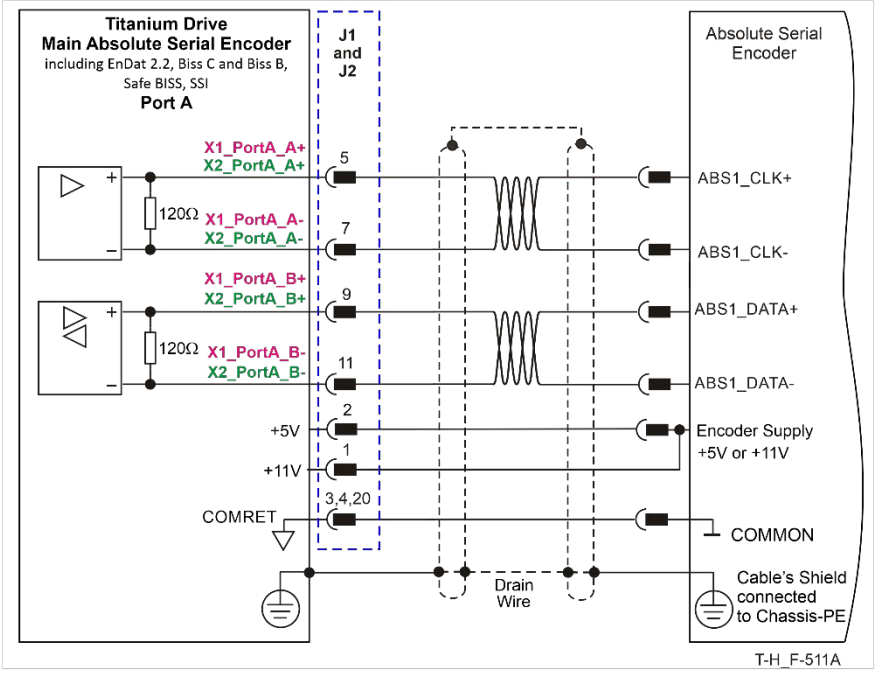


Figure 35: Port A Main Absolute Serial Encoder – Recommended Connection Diagram for EnDat, Biss, SSI

8.6.2.2.2 Encoder Acuro 4-Wires

The 4-wire encoder includes Differential Absolute Data, Encoder Power, and GND.

The following Absolute Encoder types are supported:

- Panasonic (Encoder Option E)
- Tamagawa (Encoder Option E)
- Sanyo-Denki (Encoder Option E)
- Acuro Link (Encoder Option 1)
- SCS (Encoder Option 2)

The following is the feedback connection diagram:

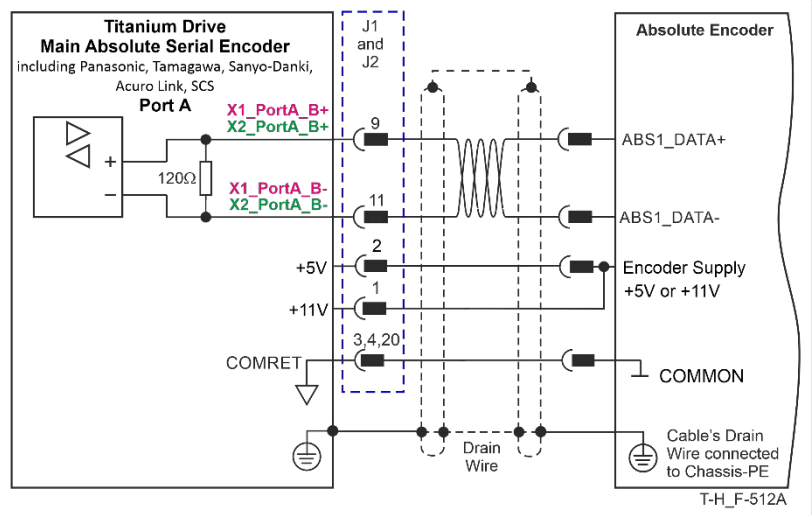


Figure 36: Port A Main Absolute Serial Encoder – 4-Wires Connection Diagram (example)

8.6.2.2.3 Encoder DSL 2-Wires

For Safety Capability F: The 2-wire encoder includes Differential DATA with power.

The following Absolute Encoder types are supported:

- Endat3, Safe Endat3 (Safety Capability F and Encoder Option H)
- SCS Open link (Safety Capability F and Encoder Option 3)
- Hiperface DSL (Safety Capability F and Encoder Option 4)

The following is the feedback connection diagram:

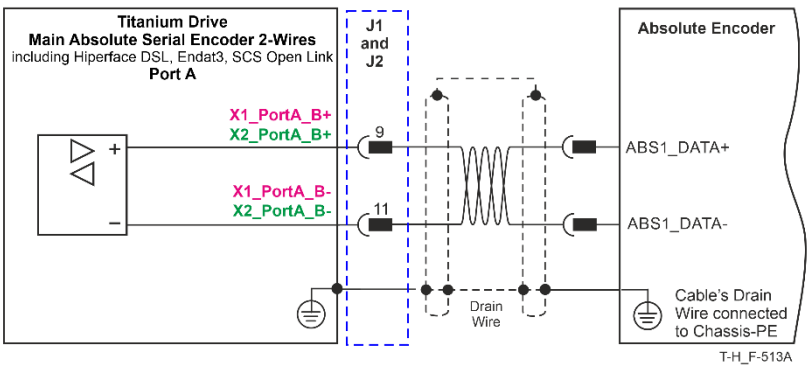


Figure 37: Absolute Serial Encoder - 2 Wires Connection Diagram (example) for Safety Capability F

8.6.3 Feedback Port B for Axes 1 & 2

Port B supports any of the following sensor inputs:

- Incremental Encoder, interpolated analog Encoder **or** Resolver (separate hardware option) for Safety Capability **F**
- Emulated Encoder output derived from Port A and Port B Index

The signals and functions are described in the following table.

Port B J1 for Axis 1		Incremental Encoder	ABS Encoder	SIN/COS Encoder	Resolver
Pin#	Signal	Function	Function	Function	Function
6	X1_PortB_A+	Channel A+		Sine+	Sine+
8	X1_PortB_A-	Channel A -		Sine-	Sine-
10	X1_PortB_B+	Channel B+		Cosine+	Cosine+
12	X1_PortB_B-	Channel B -		Cosine-	Cosine-
14	X1_PortB_I+	Channel Index+	Auxiliary Absolute encoder data+	Index+	RESOLVER_OUT- Vref complement f=1/TS, 50mA Maximum
16	X1_PortB_I-	Channel Index-	Auxiliary Absolute encoder data-	Index-	RESOLVER_OUT+ Vref complement f=1/TS, 50mA Maximum

Table 41: Feedback for Axis 1 Port B

Port B J2 for Axis 2		Incremental Encoder	ABS Encoder	SIN/COS Encoder	Resolver
Pin#	Signal	Function	Function	Function	Function
6	X2_PortB_A+	Channel A+		Sine+	Sine+
8	X2_PortB_A-	Channel A -		Sine-	Sine-
10	X2_PortB_B+	Channel B+		Cosine+	Cosine+
12	X2_PortB_B-	Channel B -		Cosine-	Cosine-
14	X2_PortB_I+	Channel Index+	Auxiliary Absolute encoder data+	Index+	RESOLVER_OUT- Vref complement f=1/TS, 50mA Maximum
16	X2_PortB_I-	Channel Index-	Auxiliary Absolute encoder data-	Index-	RESOLVER_OUT+ Vref complement f=1/TS, 50mA Maximum

Table 42: Feedback for Axis 2 Port B

8.6.3.1 Incremental Encoder

The following figure describes the connection diagram.

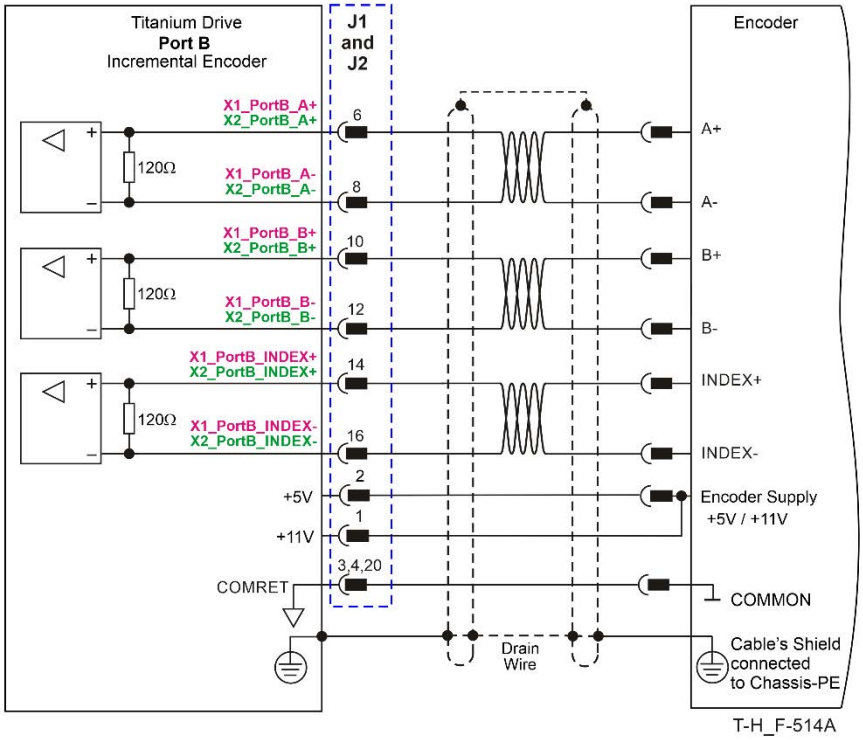


Figure 38: Port B Incremental Encoder Input – Recommended Connection Diagram

8.6.3.2 Interpolated Analog (Sine/Cosine) Encoder

The following figure describes the connection diagram.

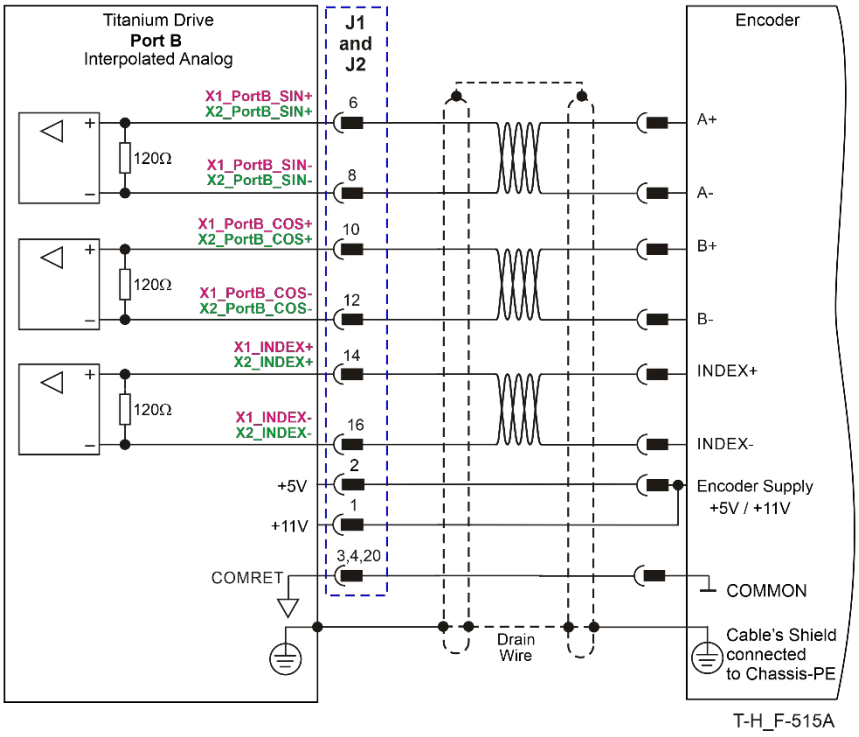


Figure 39: Port B - Interpolated Analog Encoder Connection Diagram

8.6.3.3 Resolver

For Safety Capability F and CAN with Safety Capability O:

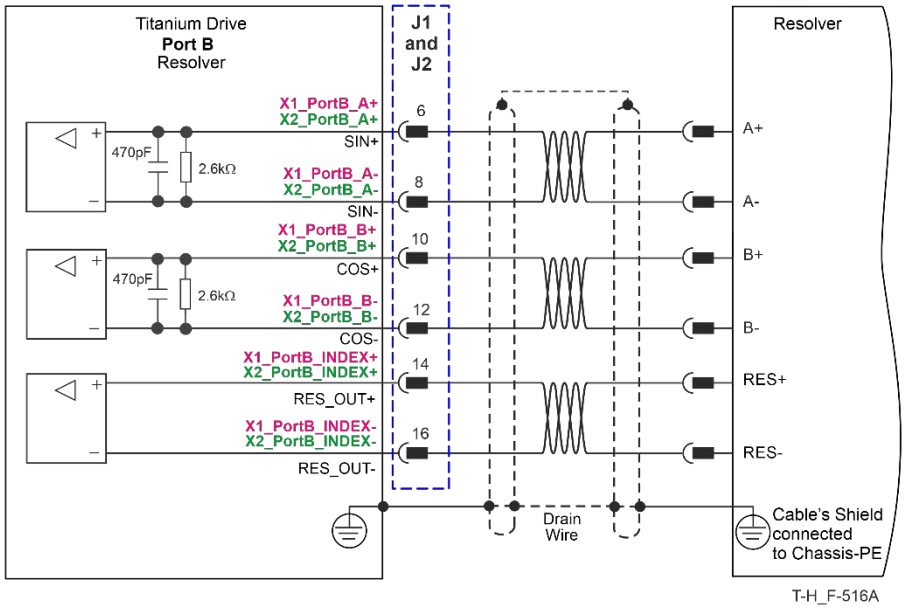


Figure 40: Port B - Resolver Connection Diagram – for Safety Capability F

8.6.4 Hiperface

The following is the connection diagram for Hyperface.

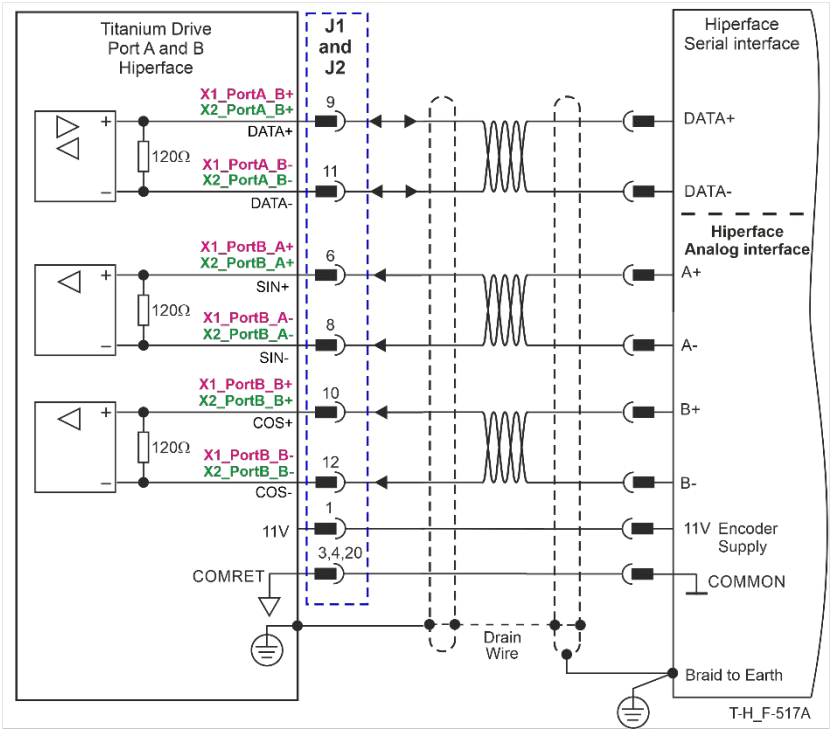


Figure 41: Absolute Serial Encoder – Recommended Connection Diagram for Stegmann Hiperface

8.6.5 Auxiliary Absolute Serial Encoder

The Auxiliary Absolute encoder is derived from the Port A Index channels and the Port B Index channels.

The Auxiliary Absolute encoder supports the 4-wire encoder types:

- EnDat 2.2
- Biss C and Biss B, Safe BISS
- SSI

The Port "C" describes the Auxiliary Absolute Encoder consisting of PortA_I and PortB_I.

Port A, B	J1 for Axis 1	Absolute Serial Encoder
Pin#	**Signal**	**Function**
13	X1_PortA_I+	Auxiliary Absolute encoder clock+
15	X1_PortA_I-	Auxiliary Absolute encoder clock-
14	X1_PortB_I+	Auxiliary Absolute encoder data+
16	X1_PortB_I-	Auxiliary Absolute encoder data -

Table 43: Feedback for Port A and B (Port "C"), Axis 1

Port A, B	J2 for Axis 2	Absolute Serial Encoder
Pin#	**Signal**	**Function**
13	X2_PortA_I+	Auxiliary Absolute encoder clock+
15	X2_PortA_I-	Auxiliary Absolute encoder clock-
14	X2_PortB_I+	Auxiliary Absolute encoder data+
16	X2_PortB_I-	Auxiliary Absolute encoder data -

Table 44: Feedback for Port A and B (Port "C"), Axis 2

The following is the connection diagram for EnDat, Biss, and SSI:

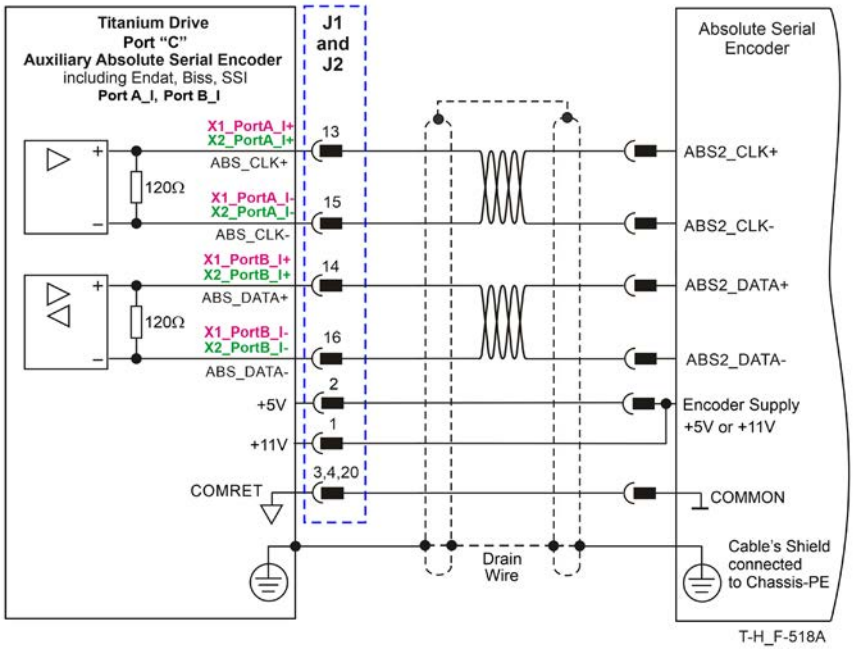


Figure 42: Auxiliary Absolute Serial Encoder for Port "C" – Recommended Connection Diagram for EnDat2.2, BISS, SSI

Note:

Make sure to not exceed the maximum consumption as stated in 5.4.3 Encoder Supply per Axis.

8.6.6 Emulated Encoder Output

The Emulated Encoder output includes two channels, Channel A and Channel B. Each of the following signals may be used for Emulation Output: PortA_A, PortA_B, Port A_I, PortB_I, depending on which pin is available. The pin selection can be set using the EAS application.

In Figure 43, **X** = PortA_A, PortA_B, PortA_I, or PortB_I

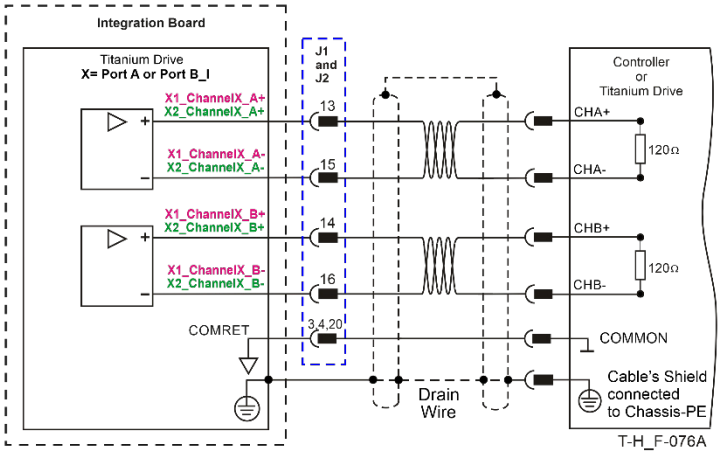


Figure 43: Emulated Encoder Output Options

8.6.7 Hall Sensors

The following table describes the Hall Sensor functions for Axes 1 and 2 Port AB connectors J31 and J32.

Pin No. (J1) for Axis 1		Pin No. (J2) for Axis 2		Function
Pin #	**Signal**	**Pin #**	**Signal**	**Function**
17	X1_HA	17	X2_HA	Hall A
18	X1_HB	18	X2_HB	Hall B
19	X1_HC	19	X2_HC	Hall C
3, 4, 20	COMRET	3, 4, 20	COMRET	Common Return

Table 45: Hall Sensors for Axes 1 & 2

The following figure describes the Hall Sensors Port A and Port B connection diagram for Axes 1 and 2, connectors J1 and J2.

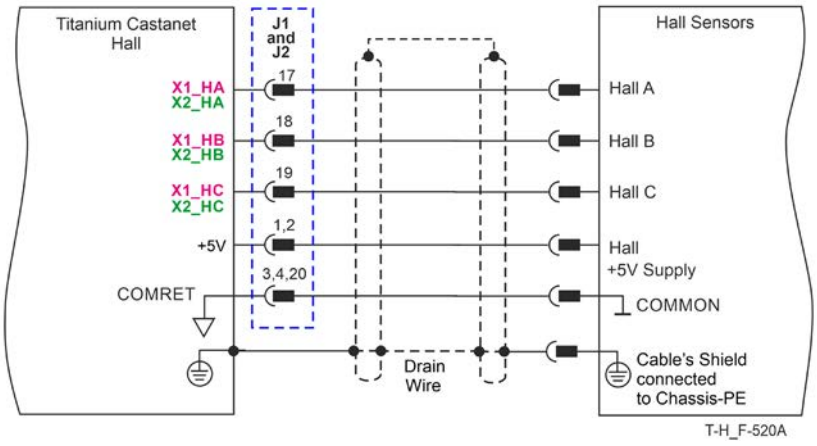


Figure 44: Hall Sensors Connection Diagram - J1 & J2

8.7 Analog Input (J5)

The following table describes the Analog Input pins.

Pin No. J5	Signal	Function
7	X1_ANALOG1+	Analog input 1+ for X1
8	X2_ANALOG1+	Analog input 1+ for X2
9	X1_ANALOG1-	Analog input 1- for X1
10	X2_ANALOG1-	Analog input 1- for X2
11	COMRET	Common Return
12	COMRET	Common Return

Table 46: Analog Input pins

The Analog Inputs are of type Differential ±10 V.

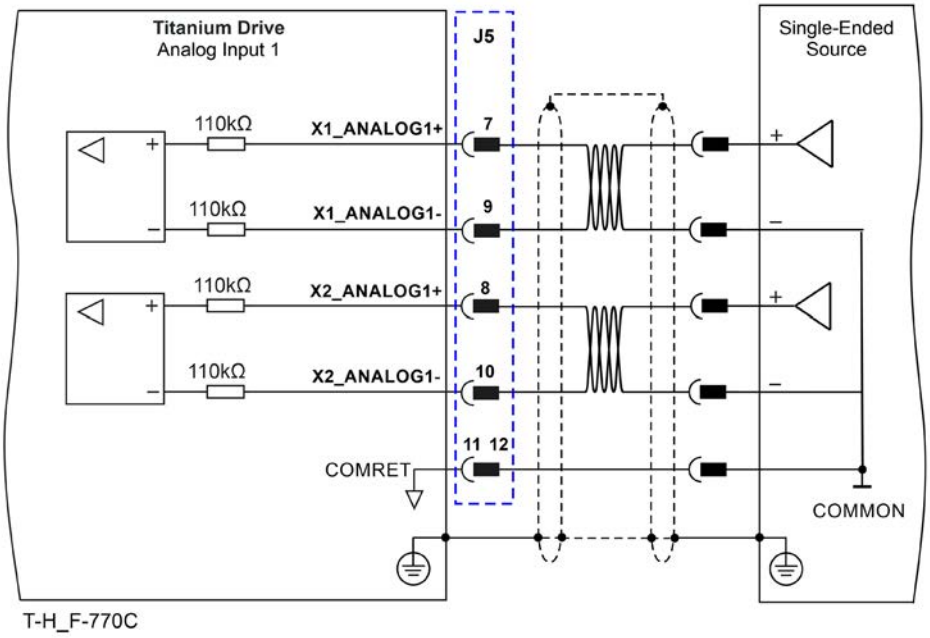


Figure 45: Analog Input

8.8 STO (Safe Torque Off) (J4)

Refer to the STO chapter in the Titanium Safety Drive Manual for details.

The following table describes the STO pins.

Pin No. (J4)	Signal	Function
1	X1_STO1	X1 STO1 input opto isolated
2	X1_STO2	X1 STO2 input opto isolated
3	X1_STO_RET	X1 STO signal return
4	X2_STO1	X2 STO1 input opto isolated
5	X2_STO2	X2 STO2 input opto isolated
6	X2_STO_RET	X2 STO signal return

Table 47: STO pins

8.8.1 PLC Source Mode

The PLC Source option is available for IO-types V and P. Refer to the diagram below for the PLC Source connection:

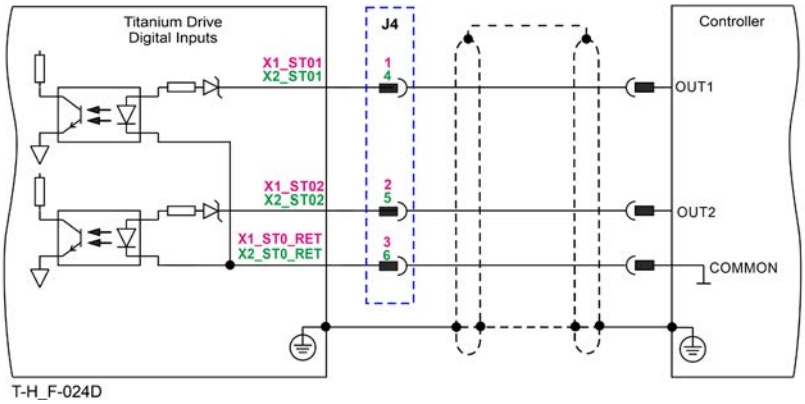


Figure 46: STO Input Connection - PLC Source Mode

8.8.2 5V Logic

The 5V Logic option is available for IO-type U. Refer to the diagram below for the 5V Logic connection:

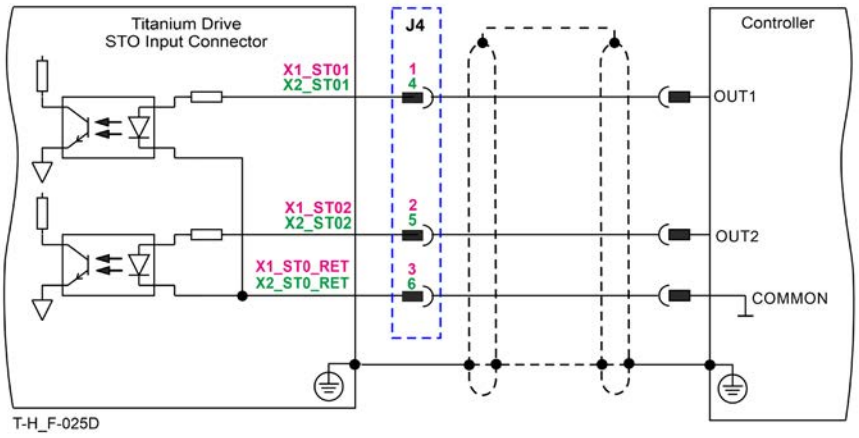


Figure 47: STO Input Connection - 5V Logic

8.9 Safe Digital I/Os (SAFE IO TYPE: P) (J3)

Refer to the Safe Digital IO chapter, in the Titanium Safety Drive Manual for details.

The following table describes the Safe Digital I/O pins:

Pin No. J3	Signal	Function
2	INPUT1	Input 1
4	INPUT2	Input 2
5	OUTPUT4_SNK	Output 4 Sink for Safe Output
6	INPUT3	Input 3
7	OUTPUT4_SRC	Output 4 Source for Regular Output and Test Pulse
8	INPUT4	Input 4
9	OUTPUT7	Output 7
10	OUTPUT1	Output 1
11	OUTPUT8	Output8
12	OUTPUT2	Output 2
14	OUTPUT3	Output 3

Table 48: Safe I/O pins

The following sections show examples of digital inputs and outputs with Test Pulse and OSSD inputs.

8.9.1 Digital Inputs with Test Pulse Connections

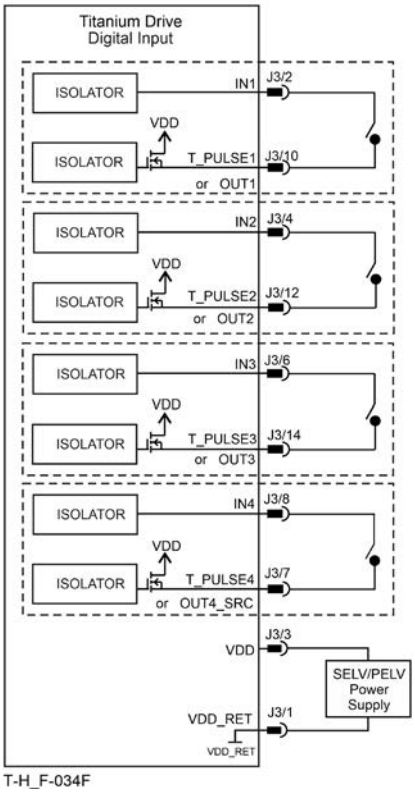


Figure 48: Digital input with Test Pulse

8.9.2 OSSD Inputs Connections

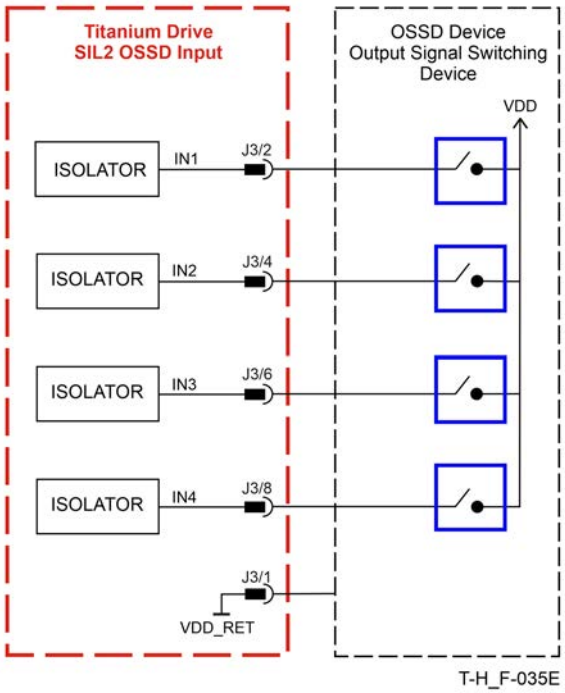


Figure 49: OSSD Input

8.9.3 Digital Outputs

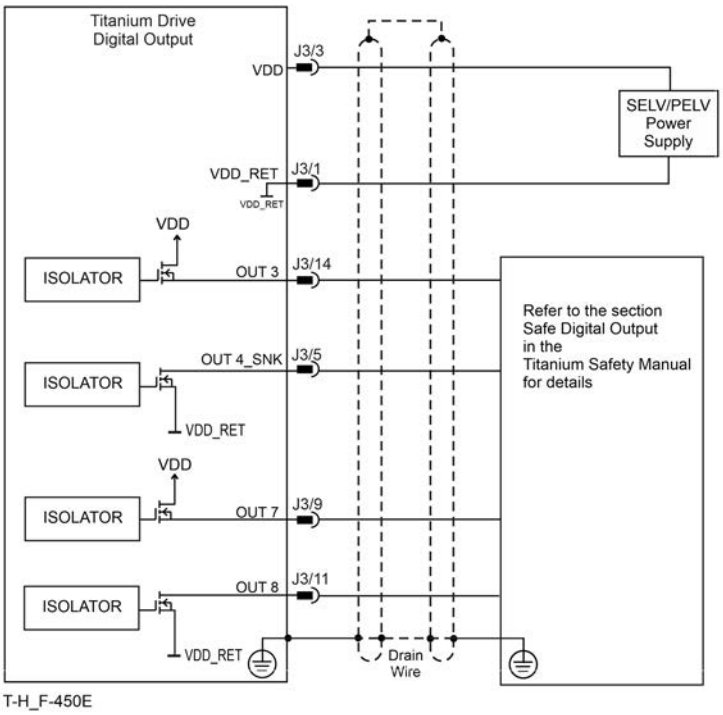


Figure 50: Safe Digital Output – IO TYPE = P

8.10 Regular Digital I/Os (J3)

The following table describes the Regular Digital I/O pins:

Pin No. J3	Signal	Function
2	INPUT1	Input 1
4	INPUT2	Input 2
5	INPUT6	Input 6
6	INPUT3	Input 3
7	PLC	PLC Select
8	INPUT4	Input 4
9	OUTPUT7	Output 7
10	OUTPUT1	Output 1
11	OUTPUT8	Output8
12	OUTPUT2	Output 2
14	INPUT5	Input 5

Table 49: Regular I/O pins

8.10.1 Digital IO 5V Logic Mode (IO TYPE: U)

The following figures describe the connections at the I/O Port for the Digital Input and Output 5V Logic.

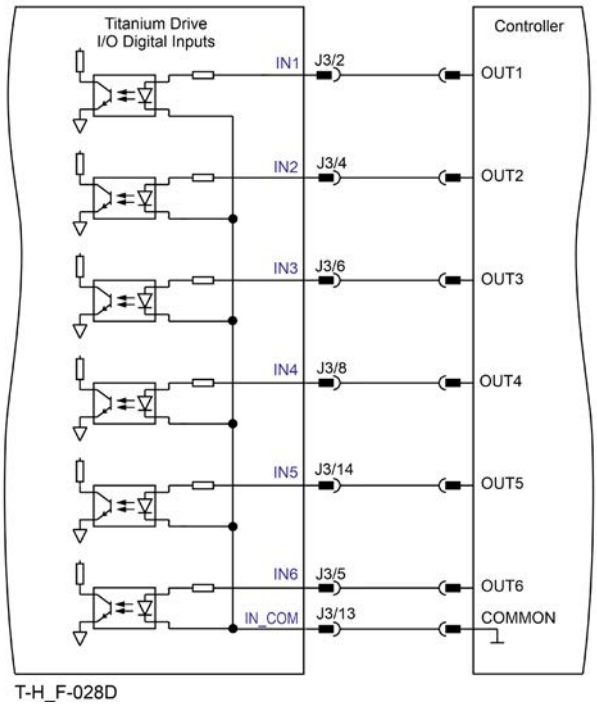


Figure 51: Regular Digital Input 5V Logic Connection Diagram

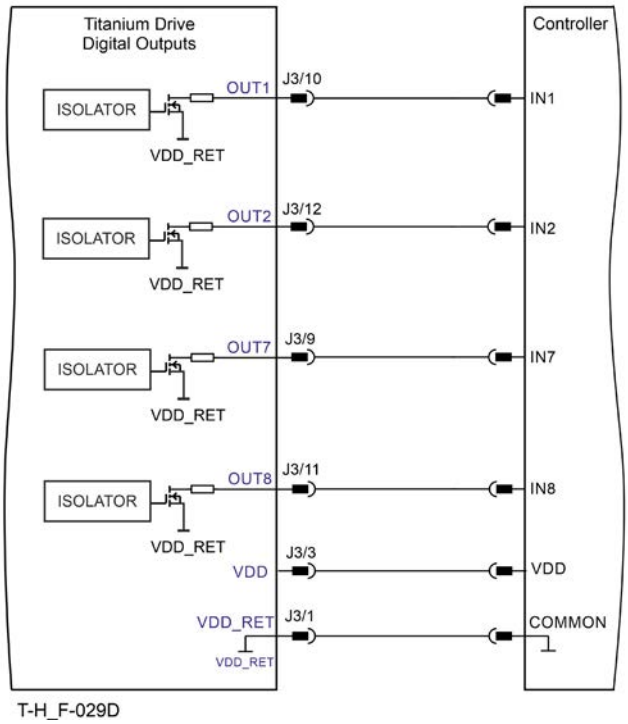


Figure 52: Regular Digital Output Connection Diagram – 5V Logic Option

8.10.2 Digital IO PLC Source and Sink Mode (IO TYPE: V)

8.10.2.1 Digital Input and Output PLC Source Mode

The following figures describe the connections at the I/O Port for the Digital Input and Output PLC Mode.

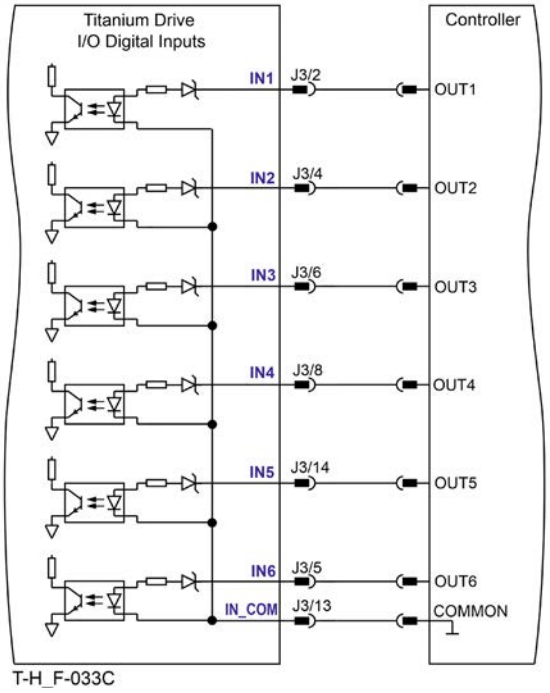


Figure 53: Regular Digital Input Connection Diagram – PLC Source Option

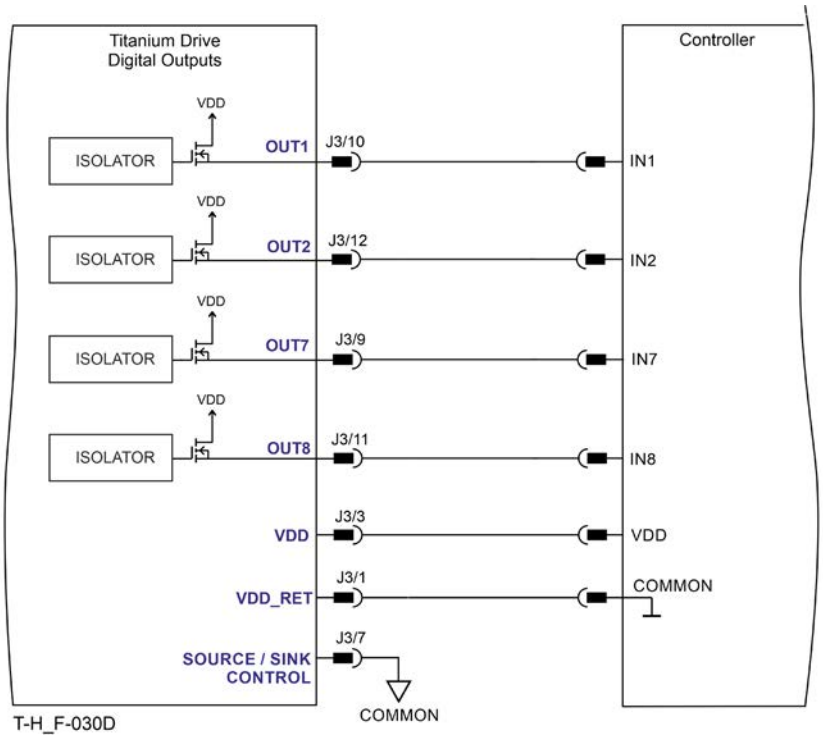


Figure 54: Regular Digital Output Connection Diagram – PLC Source Option

8.10.2.2 Digital Input and Output PLC Sink Mode

The following figures describe the connections at the I/O Port for the Digital Input and Output PLC Sink Mode.

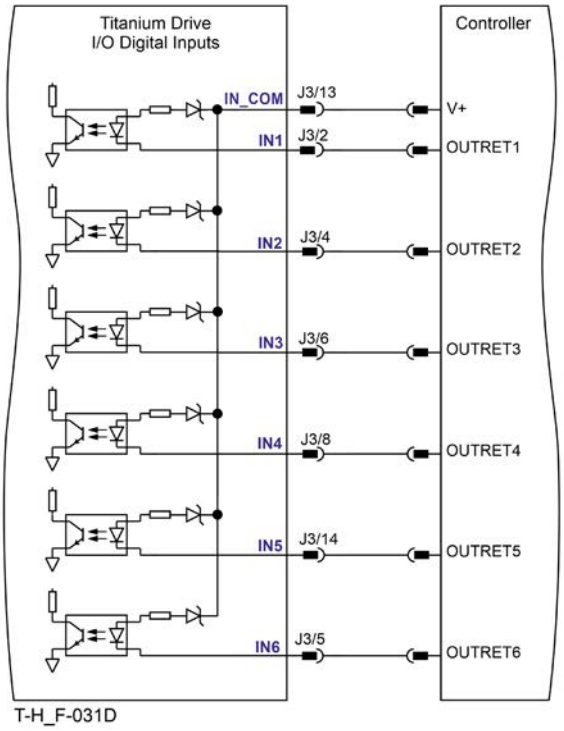


Figure 55: Regular Digital Input Connection Diagram – PLC Sink Option

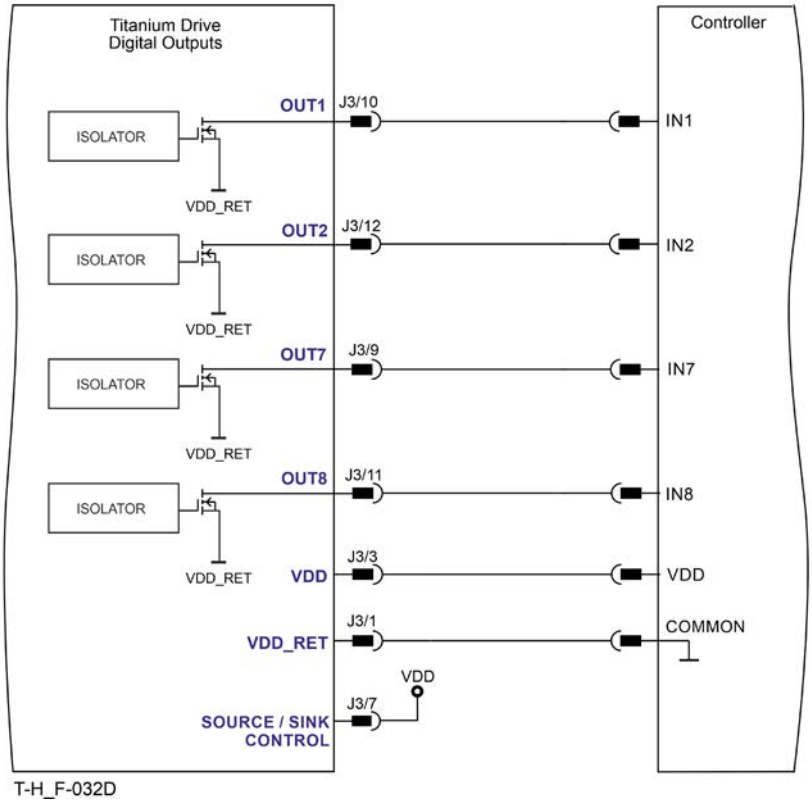


Figure 56: Regular Digital Output Connection Diagram – PLC Sink Option

8.11 Communication (X1, X2, J5)

The Titanium Harmonica supports the following serial communications: ECAT, CAN, USB and UART, described by the usage of the USB and UART in the following table and referenced Network Options of the Part Number below in Figure 57.

USB	Interpreter, SIL, general use
UART AUX2	Interpreter, SIL, general use

	Safety Capability	Network	Main Comm	AUX2 UART
F	F, S, O	EtherCAT w/ switchs or Ethernet	USB	RS232
D		EtherCAT w/ switchs or Ethernet	USB	RS422
T	F, O	CAN	USB	RS232

Figure 57: Network Options for the Titanium Harmonica

8.11.1 EtherCAT (X1, X2)

The following table describes the EtherCAT IN and OUT pins:

EtherCAT Network Options: F, D					
Pin# (X1)	**Signal**	**Function**	**Pin# (X2)**	**Signal**	**Function**
1	EtherCAT_IN_TX+	EtherCAT IN Transmit+	1	EtherCAT_OUT_TX+	EtherCAT OUT Transmit+
2	EtherCAT_IN_TX-	EtherCAT IN Transmit-	2	EtherCAT_OUT_TX-	EtherCAT OUT Transmit-
6	EtherCAT_IN_RX+	EtherCAT IN Receive+	6	EtherCAT_OUT_RX+	EtherCAT OUT Receive+
7	EtherCAT_IN_RX-	EtherCAT IN Receive-	7	EtherCAT_OUT_RX-	EtherCAT OUT Receive-

Table 50: EtherCAT IN and OUT pins

8.11.1.1 EtherCAT Connection

The following drawing describes the EtherCAT communication, and the pinout drawing of the connector.

The Titanium Harmonica can serve as an EtherCAT slave device. For this purpose, it has two Ports X1 and X2, which are designated as EtherCAT IN and EtherCAT OUT.

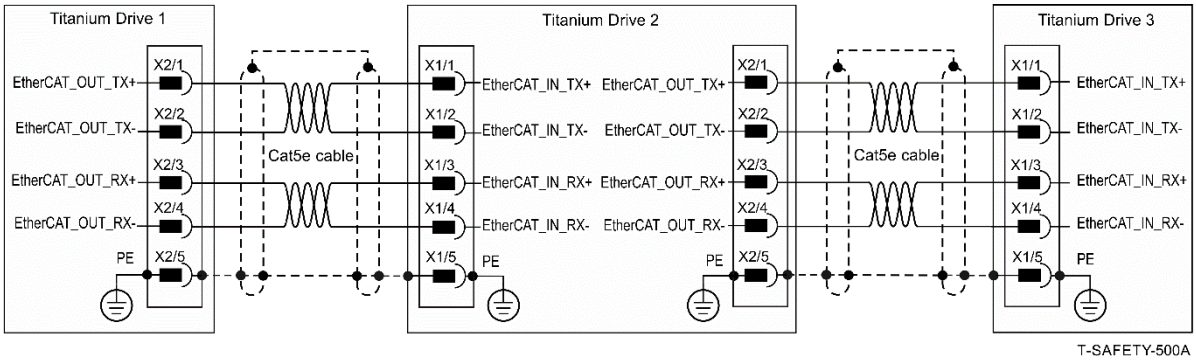


Figure 58: EtherCAT optional Connection Schematic Diagram

Note:
Always use CAT5e cables.

8.11.1.2 EtherCAT Status Indicator

The EtherCAT status indicator is a single red/green dual bi-colored LED that combines the green RUN indicator and the red ERROR indicator of the EtherCAT state machine. For further details, see the EtherCAT Application Manual.

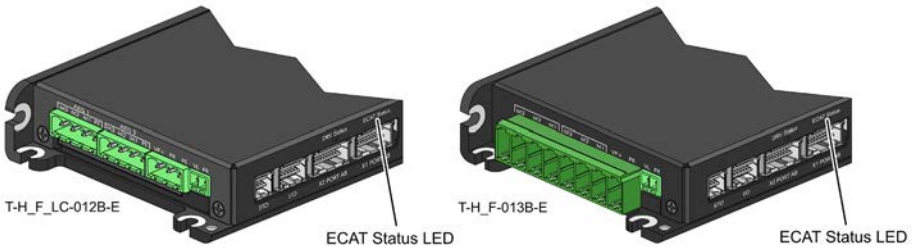


Figure 59: EtherCAT (and Drive) Status Indicators

8.11.1.3 EtherCAT Link Indicators

Each of the EtherCAT Ports has a LED; EtherCAT IN and EtherCAT OUT, which are shown in Figure 59.

Figure 60: Ethernet Link/Activity Connector LEDs

The green LEDs are the link/activity indicators. They show the state of the applicable physical link and the activity on that link; blinking green, both for the Link Act IN, and Link Act OUT.

8.11.1.4 EtherCAT Address Switches

The Titanium Harmonica has two rotary switches that allow the user to define a unique node ID to the slave. EtherCAT address switches set the ECAT address (LOW (x1) is ADD low, HIGH (x10) is ADD high). The two rotary switches offer up to 255 addresses, with the 0-setting referring to No alias address.

Figure 61: EtherCAT Address Switches

Figure 60 displays the switches available in the EtherCAT Version. Refer to section 15.2.5 EtherCAT Switches in the Platinum Safety Drive Manual for full details.

The positions of the switches on the drive are shown in Figure 60. Use a screwdriver to set the low and high bytes values of the drive EtherCAT address. This address is only retrieved after power-up.

8.11.2 CAN (X1, X2)

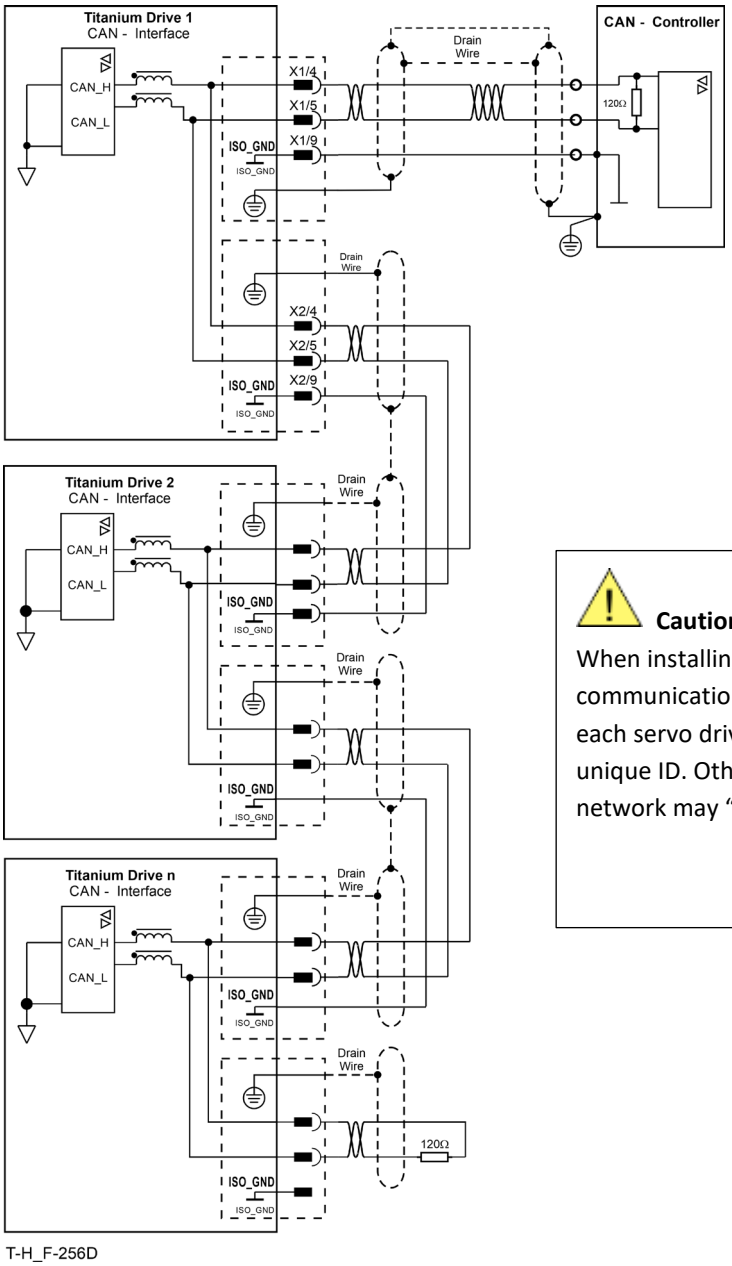
Note: It should be noted that all signals are isolated and the Grounding denoted ISO_GND throughout CAN connections.

The following table describes the CAN pins:

CAN Network Option: T		
Pin No. (X1 and X2)	**Signal**	**Function**
4	CAN_H	Bidirectional, CAN BUS
5	CAN_L	Bidirectional, CAN BUS
9, 10	ISO_RET	Isolation GND for CAN

Table 51: CAN pins

CAN Wiring (for Safety Capability O only):



Caution:
When installing CAN communication, ensure that each servo drive is allocated a unique ID. Otherwise, the CAN network may "hang".

Figure 62: CAN Network Diagram – Drop Off Topology

8.11.3 USB

The Titanium Harmonica supports a USB Type C. The following table describes the USB pins:

USB Network Options: F, D, T		
Pin (X3)	**Signal**	**Function**
A4, A9, B4, B9	USB_VBUS	USB VBUS 5 V
A6, B6	USBD+	USB _P
A7, B7	USBD-	USB _N

Table 52: USB pins

Use a standard USB 2.0 Type C cable and connector to connect the USB. For details, refer to section 7.11.

8.11.4 RS-232 Serial Communication

The Titanium Harmonica uses RS-232 serial communication. The following table describes the RS-232 pins:

RS-232 Network Options: F, T		
Pin No. J5	**Signal**	**Function**
1	RS232_TX	RS-232 Transmit
2	RS232_RX	RS-232 Receive
11, 12	COMRET	Common Return

Table 53: Standard RS-232 pins

The following table describes the RS-232 specification.

Specification	Details
Physical layer	Signals: RS232_Rx, RS232_Tx, COMRET Full duplex, serial communications
Termination	120 Ohm It is required to connect termination of 120 ohm in the end of the TX signals
Speed	Baud Rate of 4800 bit/sec to 3.9M bit/sec
Protocols	See Elmo Application Studio (EASIII) software and control for setup

Table 54: RS-232 Specification

The following figure describes the RS-232 Serial Communication connection diagram:

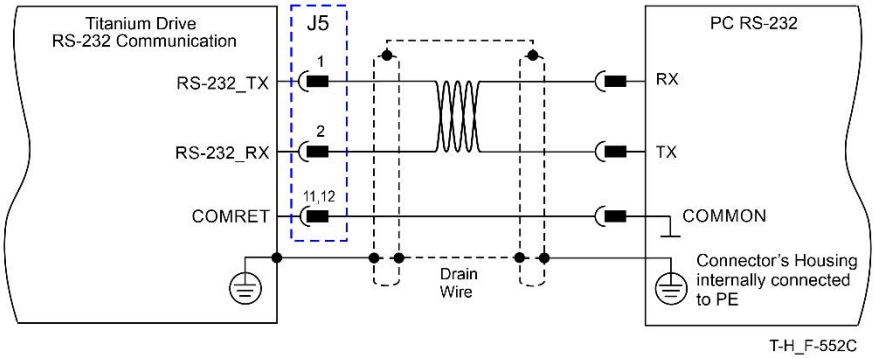


Figure 63: RS-232 Connections Diagram

8.11.5 RS-422 (Differential RS-232) Serial Communication (J5)

The Titanium Harmonica uses RS-422 (Differential RS-232) serial communication.

The following table describes the RS-422 (Differential RS-232) signals and pins:

RS-422 Network Option: D		
Pin# J5	**Signal**	**Function**
1	RS422_TX+	Isolated AUX2 RS-422 TX+ (Differential RS-232 Transmit)
2	RS422_RX+	Isolated AUX2 RS-422 RX+ (Differential RS-232 Receive)
3	RS422_TX-	Isolated AUX2 RS-422 TX- (Differential RS-232 Transmit Complement)
4	RS422_RX-	Isolated AUX2 RS-422 RX- (Differential RS-232 Receive Complement)
11, 12	COMRET	Common Return

Table 55: RS-422 (Differential RS-232) signals and pins

Th following table describes the RS-422 specification.

Specification	Details
Physical layer	Differential RS-232: Full duplex, serial communication
Interface	RS-422
Termination	120 Ohm It is required to connect termination of 120 ohm in the end of the TX signals (refer to the figure below)
Speed	Baud Rate of 0.0048 to 3.60 Mbps
Protocols	For setup and control

Table 56: RS-422 specification

The following figure describes the RS-422 (Differential RS-232) Serial Communication connection diagram.

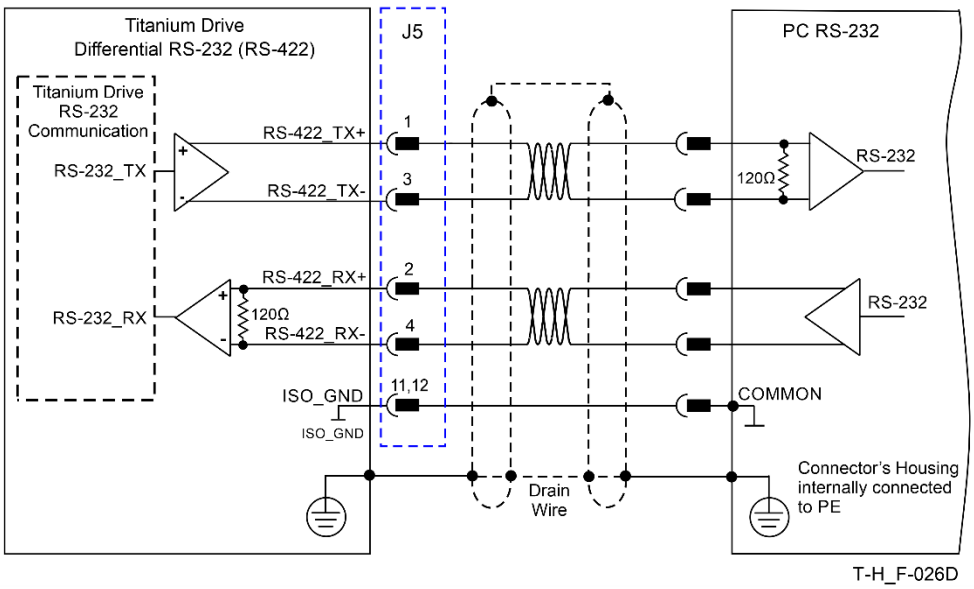


Figure 64: RS-422 (Differential RS-232) Serial Communication Connection Diagram

Chapter 9 Powering Up

After the Titanium Harmonica is connected to its device, it is ready to be powered up.

9.1 Initializing the System

After the Titanium Harmonica has been connected and mounted, the system must be set up and initialized. This is accomplished using the EASIII, Elmo's Windows-based software application. Install the application and then perform setup and initialization according to the directions in the EASIII User Manual.

9.2 Heat Dissipation

TBD

9.2.1 Heat Dissipation Data

TBD

9.2.2 How to Use the Chart

TBD

Chapter 10 Dimensions

This chapter provides detailed technical dimensions regarding the Titanium Harmonica.

10.1 High Current Model

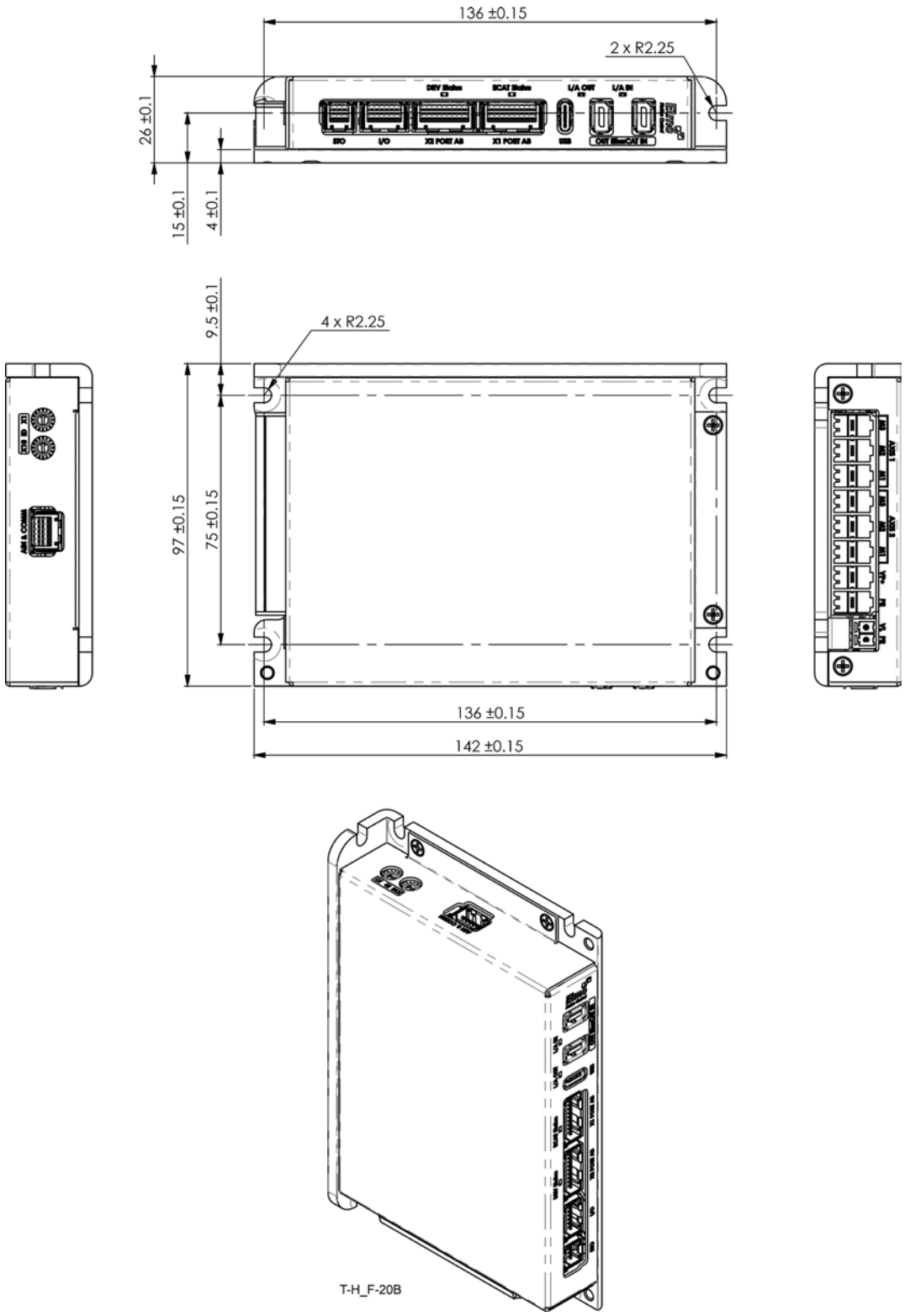
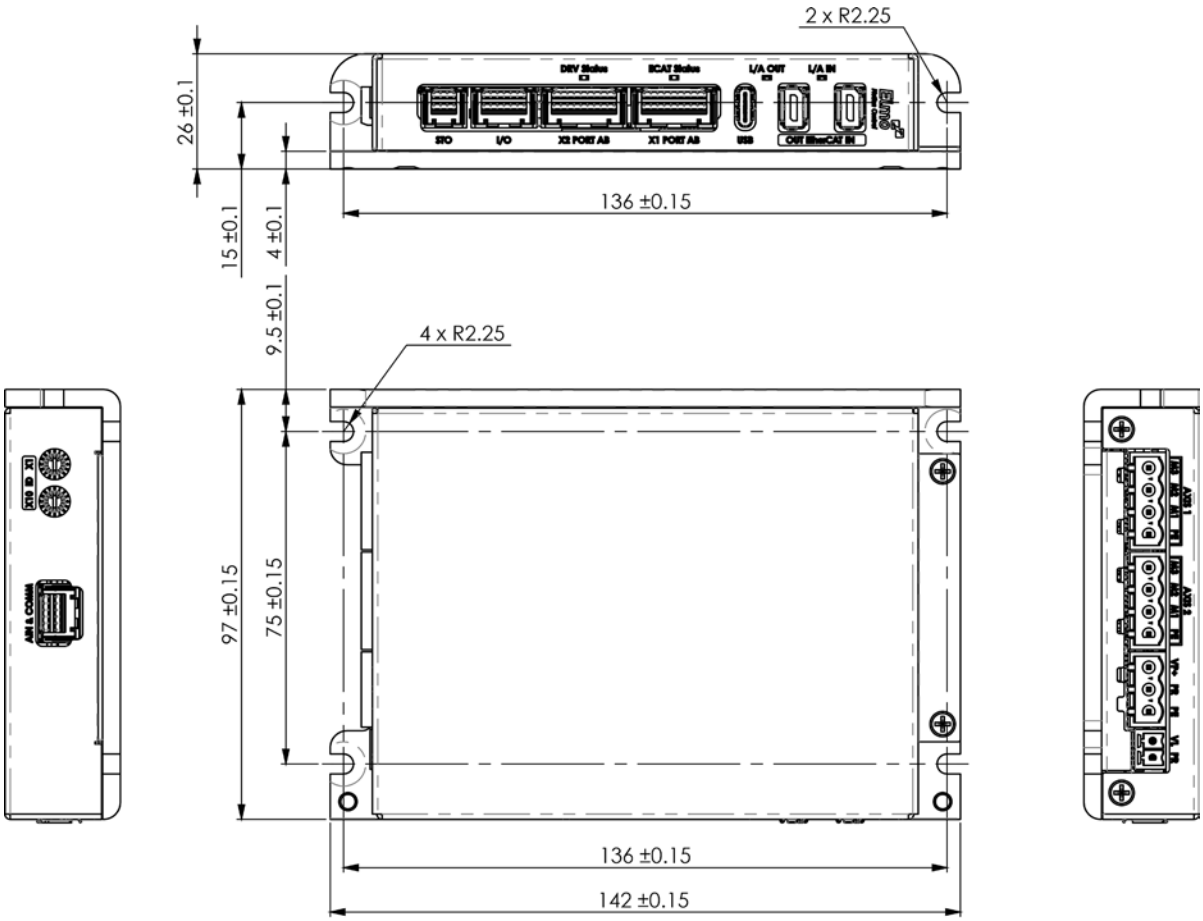


Figure 65: Titanium Harmonica Dimensions – High Current Model

10.2 Low Current Model



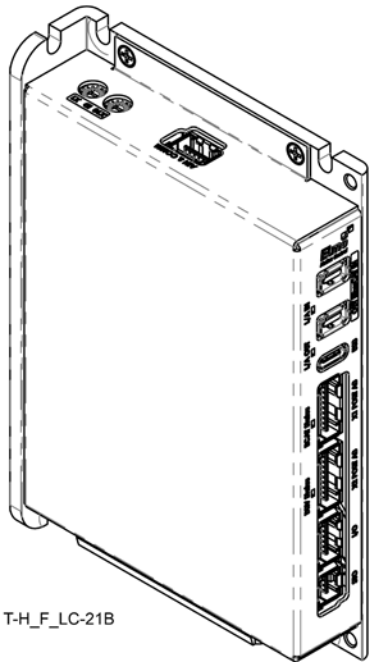


Figure 66: Titanium Harmonica Dimensions – Low Current Model

Chapter 11 Cables and Accessories

The following describes the accessory kits available for the Titanium Harmonica.

Part Number	Description
CBL-THARKIT01	Kit cable for Safe IO and EtherCAT model
CBL-THARKIT02	Kit cable for REG IO and EtherCAT model
CBL-THARKIT03	Kit cable for Safe IO and CAN model
CBL-THARKIT04	Kit cable for REG IO and CAN model

Table 57: Cable Kits

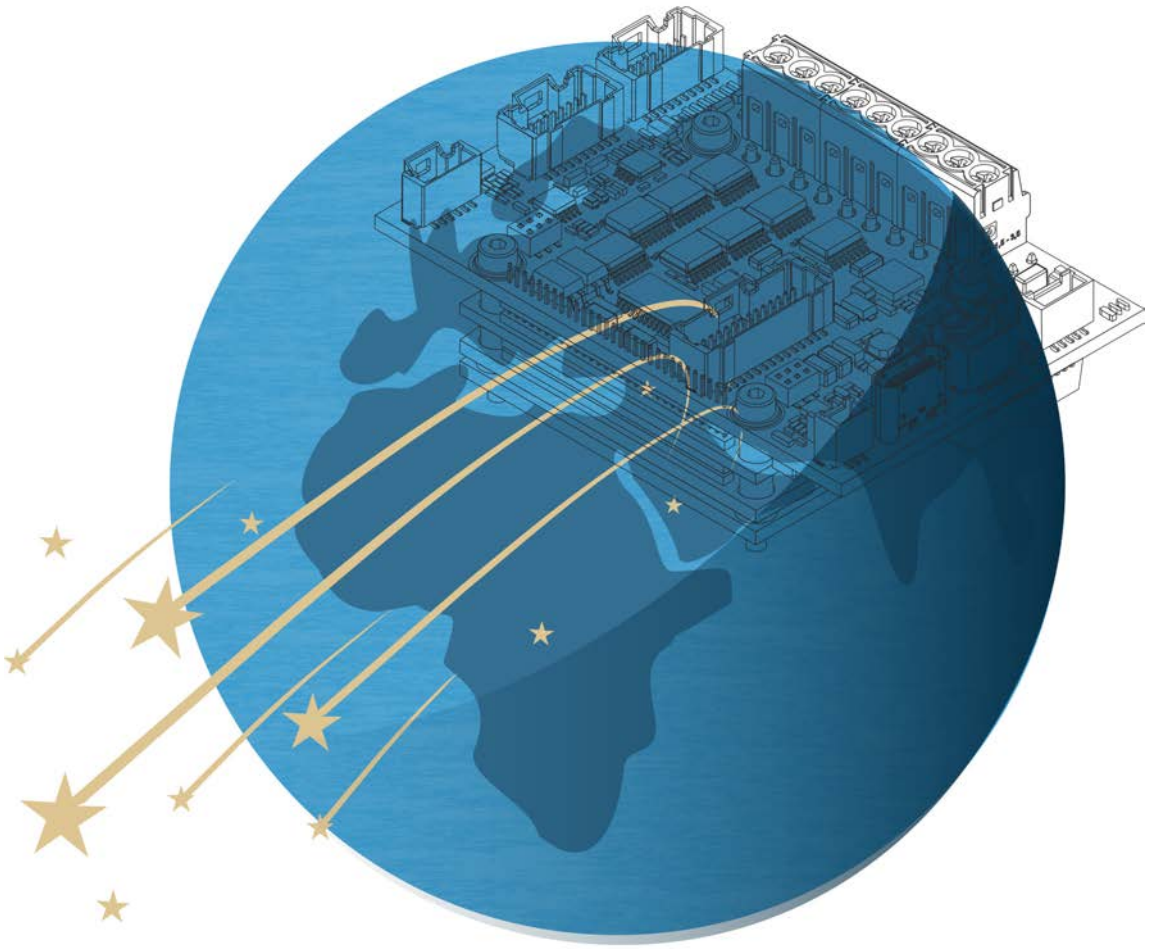
A specific Crimping Tool (available for purchase from Elmo) is required to mount extra connecting pins on the wires. A number of wires are provided in the kit as pre-crimped for convenience:

Tool	Pins
	
Crimping Tool Molex P/N 63819-1500	**Pins for Single Row Connector:** MOLEX P/N 501334-0100
Elmo P/N TOOL-P000040	**Pins for Dual Row Connector:** MOLEX P/N 501193-3000

Table 58: Crimping Tool and Pins

Elmo

Dedicated To Excel



For a list of Elmo's branches and your local area office, refer to the Elmo site www.elmomc.com