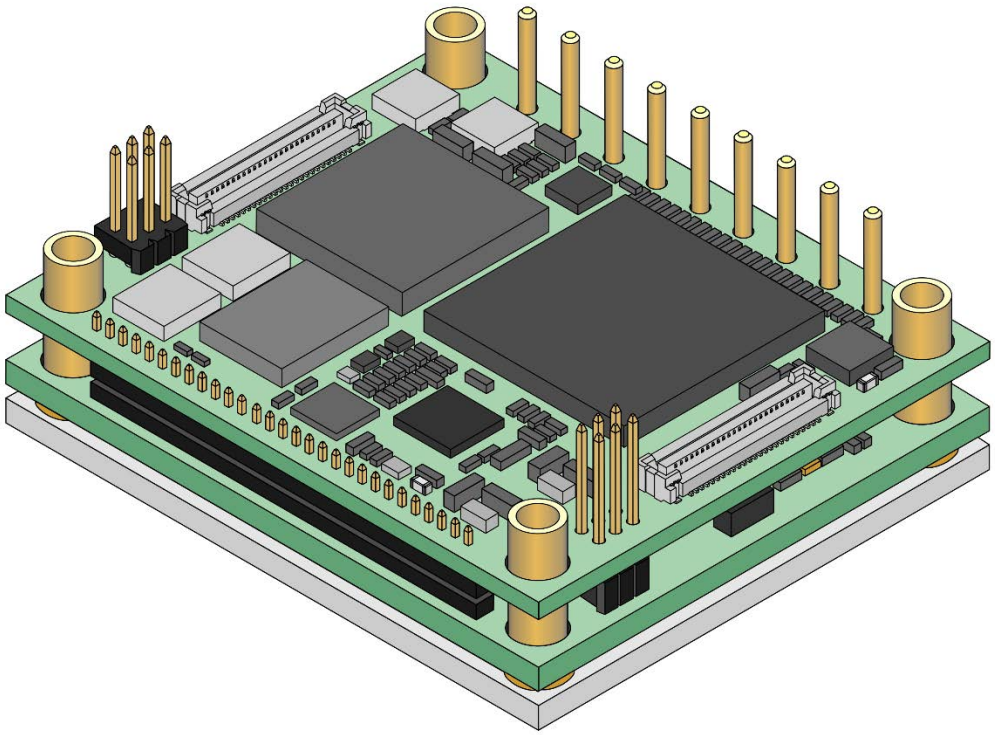
Elmo
Dedicated To Excel

Titanium Castanet
Digital Servo Drive Installation Guide

Safety Capability: S, O



June 2025 (Ver. 2.002)

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.

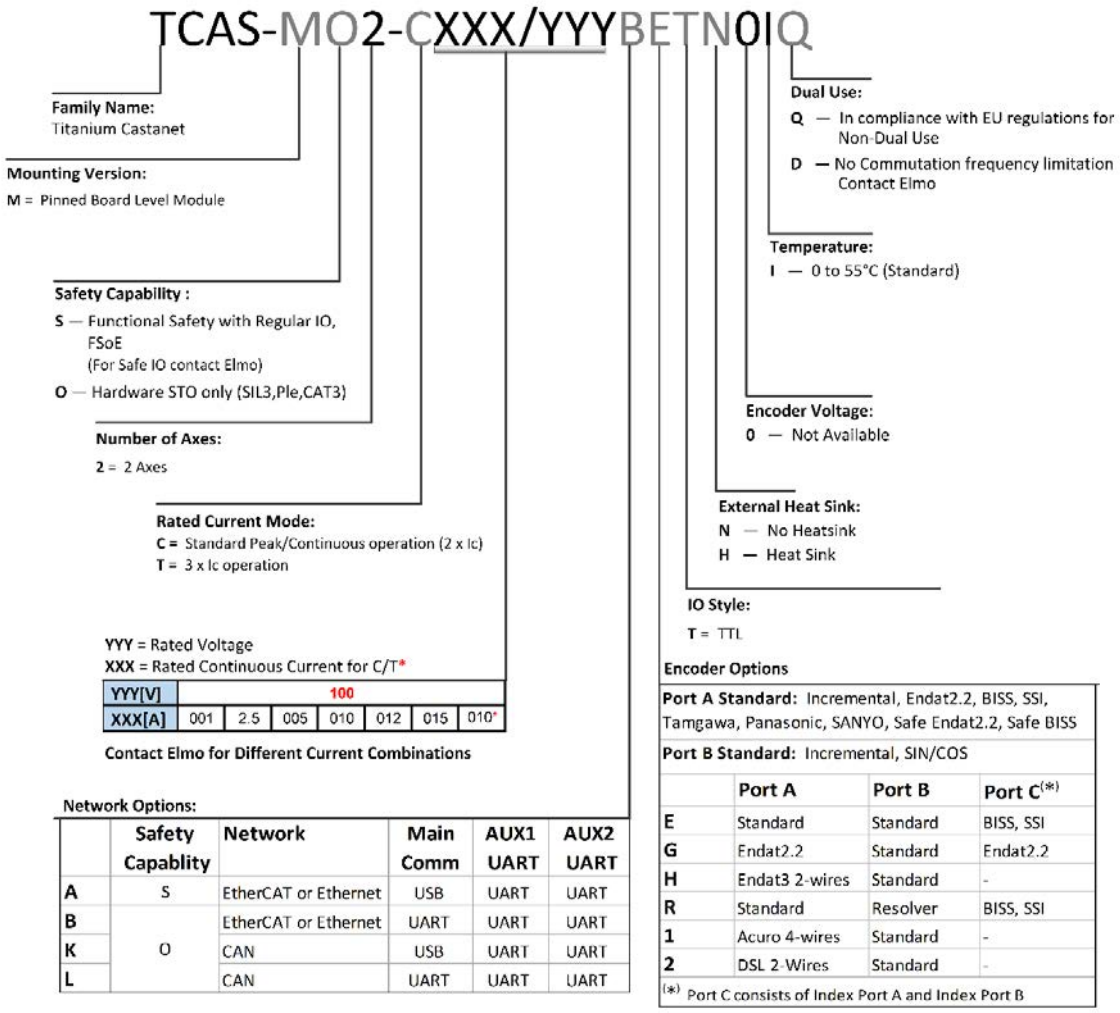
EtherCAT® and Safety over EtherCAT® are registered trademarks and patented technologies, licensed by Beckhoff Automation GmbH, Germany.

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-CASIG (Ver. 2.002)

Catalog Number



Revision History

Version	Date	Details
Ver. 2.000	Feb 2025	New P/N. Updates to the following chapters: 1, 2, 3.1, 3.2, 4, 5.1, 5.2 (removed 60V models), 5.4. (removed 1 axis option, changed analog input, added communications), 5.6 (edited tables, added Dual Use), 6.1, 6.4 (text and drawing edit), 7.1 (text and drawing edit), 7.4, 7.6 (text and drawing edit), 7.7, 7.8, 7.9 (removed 7.9.1 section), 7.10 (table updates), 8.2 (added connection diagrams for networks), 8.4 (added), 8.6 (updated drawing), 8.7 (text and drawing updates), 8.8 Feedbacks: rearranged chapter, many updates to text, tables and drawings for Port A and B, 8.9 Analog Inputs: many text updates, removed single ended, 8.10 STO: updated text and drawing, 8.11 Digital I/O: updated text and drawings, 8.12 Communication: updated text and drawings, added CAN and USB, 10 Dimensions: updated drawing and added drawing for drive w/heatsink.
Ver 2.001	Mar 2025	Minor drawing update and added link in section 8.7.1
Ver 2.002	Jun 2025	Updated P/N Updated chapter 4 (SIL3, Ple, CAT3) Updated pollution degree in 5.5 and drawing update in chapter 8.8.1.3

Chapter 1 This Installation Guide

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

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

The Titanium Drive and Titanium Safety Drive Manuals are currently unavailable.

Chapter 2 Functional Safety

Titanium Castanet **servo drives will support Functional Safety. It is necessary to implement the instructions in the Titanium Safety Drive Manual regarding the Safety blocks; STO, Feedbacks, IOs, and Power Supplies with Functional Safety.**

Important: **The integration board of the T-CAS for Functional Safety must be designed and approved according to the safety standards IEC61800-5-2. Contact Elmo for an Application Note.**

Chapter 3 Safety Information

In order to achieve the optimum, safe operation of the Titanium Castanet, 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 Castanet 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 Castanet 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 Castanet 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 (implanted in the Interface) and EtherCAT (Safety Capability "S") circuits are separated from power circuits by basic 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 2 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 Castanet to an approved isolated power 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 Castanet, 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 Castanet 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 Castanet 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 Castanet is a double axes advanced high power density servo drive, delivering up to **1.6 kW of continuous power** or **4.8 kW of peak power** in a 19.45 cm^3 (1.18 in^3) compact package (40 x 34 x 15.4 mm (1.57" x 1.34" x 0.60")). The Titanium Castanet is designed to have a PCB mounted on top of it. It has four designated spacers for M2 screws to attach it to the heat sink.

This advanced, dual axes, high power density servo drive provides top performance, advanced networking and built-in safety, as well as a fully featured motion controller and local intelligence.

The Titanium Castanet is provided in two Safety Capability configurations:

- **TCAS-MS2-CXXX/YYYzzTz0Iz** - Servo drive with Function Safety ready for Safe IO
  This configuration permits operation of safety functions only via FSOE (Fail Safe Over EtherCAT).
- **TCAS-MO2-CXXX/YYYzzTz0Iz** - Servo drive with STO (SIL3, Ple, CAT3)
  The servo drive configuration supports only STO.

Power to the Titanium Castanet is provided by a DC power source which is isolated from the Mains. The Titanium Castanet operates with dual isolated power supplies from the main, a main DC power source and a control supply.

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 Castanet 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 language. For more information about software tools refer to the Elmo Application Studio (EASIII) User Guide.

Chapter 5 Technical Information

5.1 Physical Specifications

Feature	Data	
Mounting Method	Panel mounting	
Degrees of Protection	IP00	
Part Number	**Weight (g (oz))**	**Dimensions (mm (in))**
TCAS-Mz2-CXXX/YYYzzT**N**0Iz	24.0 g (0.85 oz)	40 x 34 x 15.4 mm (1.57" x 1.34" x 0.60")
TCAS-Mz2-CXXX/YYYzzT**H**0Iz	48.7 g (1.72 oz))	41 x 54 x 19.4 mm (1.6" x 2.13" x 0.76")

Table 1: Physical Specifications

5.2 Technical Data

5.2.1 100V Models

Feature	Units	1/100	2.5/100	5/100	10/100	12/100	15/100
Minimum supply voltage	VDC	10					
Nominal supply voltage	VDC	80					
Maximum supply voltage	VDC	90					
Maximum continuous power output	W	80W per axis. 160W in total	200W per axis. 400W in total	400W per axis. 800W in total	800W per axis. 1600W in total	960W per axis. 1920W in total	1200W per axis. 2400W in total
Efficiency at rated power (at nominal conditions)	%	> 99					
Maximum output voltage		Up to 96% of DC bus voltage					
Ic, Amplitude sinusoidal/DC continuous current	A	1	2.5	5	10	12	15[1]
Sinusoidal continuous RMS current limit (Ic)	A	0.7	1.8	3.5	7.07	8.48	10.6[1]
Peak current limit	A	2 x Ic					

Table 2: 100V Models Technical Data

[1] Max Continuous Current for this model may be limited in peak time duration and the Total Sum of current for both axes. Please contact ELMO for further information.

5.2.2 T Models

Feature	Units	10/100
Minimum supply voltage	VDC	10
Nominal supply voltage	VDC	80
Maximum supply voltage	VDC	90
Maximum continuous power output	W	800W per axis. 1600W in total
Efficiency at rated power (at nominal conditions)	%	> 99
Maximum output voltage		Up to 96% of DC bus voltage
Ic, Amplitude sinusoidal/DC continuous current	A	10
Sinusoidal continuous RMS current limit (Ic)	A	7.07
Peak current limit	A	3 x Ic

Table 3: T Models Technical Data

Note (on current ratings):
The current ratings of the Titanium Castanet 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 input voltage for Safety	**Isolated DC Source: 14V ÷ 60 V**
Control supply input power	≤4 W without external loading ≤8 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 Output Power Supply

The following table describes the power supplies that the Titanium Castanet provides to the integration board

Feature	Purpose	Details
5V supply	Power to Encoder	Maximum 3 Watt
11V supply		
3.3 V	LEDs, Drive status indicator, RS-transmitters and receivers.	Maximum 300mA

Table 7: Output Power Supply

5.4.4 Communication

Communication Type	Network Option in P/N	Electrical Interface
EtherCAT/Ethernet	A, B	100-BaseT
USB	A, K	USB 2.0
CAN	K, L	
Main UART	B, L	3.3V TTL level
2 X Aux UART (AUX1 + AUX2)	A, B, K, L	

Table 8: Communication

5.4.5 Analog Input

Feature	Resolution	No.	Electrical Interface
Analog Inputs	12-bits	4	0 ÷ 3.2V

Table 9: Analog Input

5.4.6 IO Features for Safety Capability: S

Note: Safety Capability S is ready for Safe IO design from the customer.

Feature	Details	No.	Electrical Interface
STO	STO1, STO2	per axis	5V Logic, Opto Isolated
Digital Input	(IN1, IN2, IN3, IN4, IN5, IN6, IN7, IN8)	8	TTL 3.3 V
Digital Output	(OUT1, OUT2, OUT3, OUT4, OUT7, and OUT8)	6	TTL 3.3 V

Table 10: IO Features for Safety Capability S

5.4.7 IO Features for Safety Capability: O

Feature	Details	No.	Electrical Interface
STO	STO1, STO2	per axis	5V Logic, Opto Isolated
Digital Input	(IN1, IN2, IN3, IN4, IN5, IN6)	6	TTL 3.3 V
Digital Output	(OUT1, OUT2, OUT7, and OUT8)	4	TTL 3.3 V

Table 11: IO Features

5.5 Environmental Conditions

You can guarantee the safe operation of the Titanium Castanet by ensuring that it is installed in an appropriate environment.

Warning:
During operation the Titanium Castanet becomes hot to the touch (the heatsink and wires may heat up to 92 °C). Care should be taken when handling it.

Feature	Details
Operating ambient temperature	0 °C to 55 °C (32 °F to 131 °F)
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	TBD

Table 12: Environmental Conditions

5.6 Standards and Certifications

Standards and Certifications are currently unavailable.

The following tables describe the Main Standards of the Titanium Castanet 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 13: 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 14: 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 15: 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 16: Environmental Standards

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

6.1 Unpacking the Drive Components

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

- Titanium Castanet servo drive
- Elmo Application Studio (EASIII) software

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

To unpack the Titanium Castanet:

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 Castanet you have unpacked is the appropriate type for your requirements, locate the part number sticker on the side of the Titanium Castanet. It looks like this:

T-CSTNT-351E

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

TCAS-Mz2-zXXX/YYYzzzz0IQ	Fuse	Circuit Breaker
TBD	TBD	TBD
TBD	TBD	TBD

Table 17: 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 Mounting the Titanium Castanet

6.3.1 Integrating the Titanium Castanet

The Titanium Castanet was designed for mounting on a printed circuit board (PCB) via the four designated spacers in the corners of the PCB. When integrating the Titanium Castanet into a device, be sure to leave about 1 cm (0.4") outward from the heat-sink to enable free air convection around the drive. The Titanium Castanet can be attached to socket connectors mounted on the PCB. If the PCB is enclosed in a metal chassis, we recommend that the Titanium Castanet be screw-mounted to it as well to help with heat dissipation.

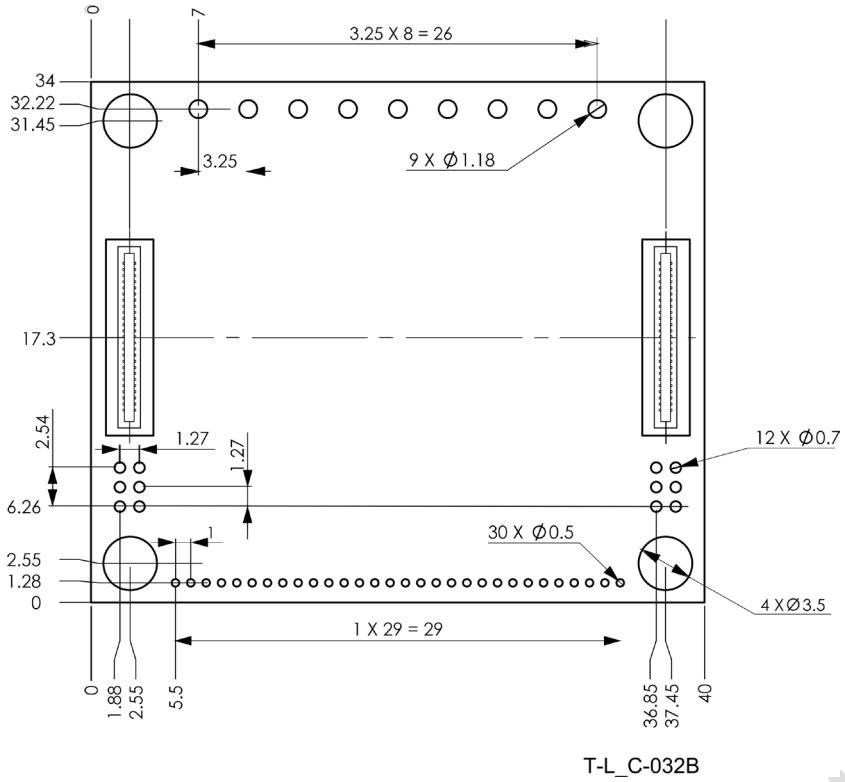


Figure 1: Titanium Castanet Dimensions - All measurements are in mm

6.3.2 Mounting Thermal Pads

To better absorb the heat from the processor, mount a thermal pad on the processor of the Titanium Castanet.

To mount a thermal pad onto the Titanium Castanet:

1. Remove the backing of the thermal pad (Part Number: IMT-30PMAS01) to reveal the glue side.
2. Place the Thermal pad on the processor of the Titanium Castanet.
3. Slightly press the pad down onto the processor, but not completely, to allow for movement.
4. Align the pad. See Figure 2.
5. Gently press the pad down completely.

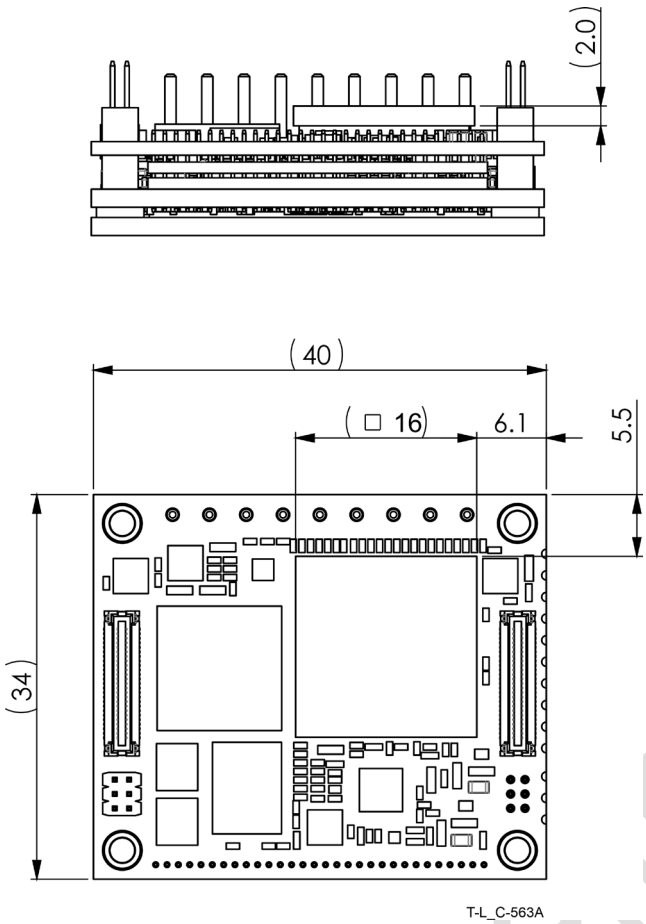


Figure 2: Aligning the thermal pad

Note: The thermal pad should contain at least the following parameters:

- Thermal Conductivity of: 3.15 W/m.K
- Hardness (Shore OO): 5
- Thickness: 2.0mm.

Note: **When designing the interface board, keep the marked area (16x16mm) free of components and with exposed copper for optimal heat dissipation.**

6.4 Mounting Titanium Castanet onto an External Heat Sink

To mount the Titanium Castanet onto an external heat sink:

1. Mount the heat sink under the base of the Titanium Castanet.
2. Place a Thermally conductive phase change material (for example HALA: TPC-W-PC-E) between the lower surface of the servo drive, and the upper surface of the heatsink.
3. Use four M2 head cup Allen screws to secure the heat sink under the servo drive.
4. Tighten the screws to the relevant torque force (recommended 0.1 Nm) applicable to an M2 stainless steel A2 screw.

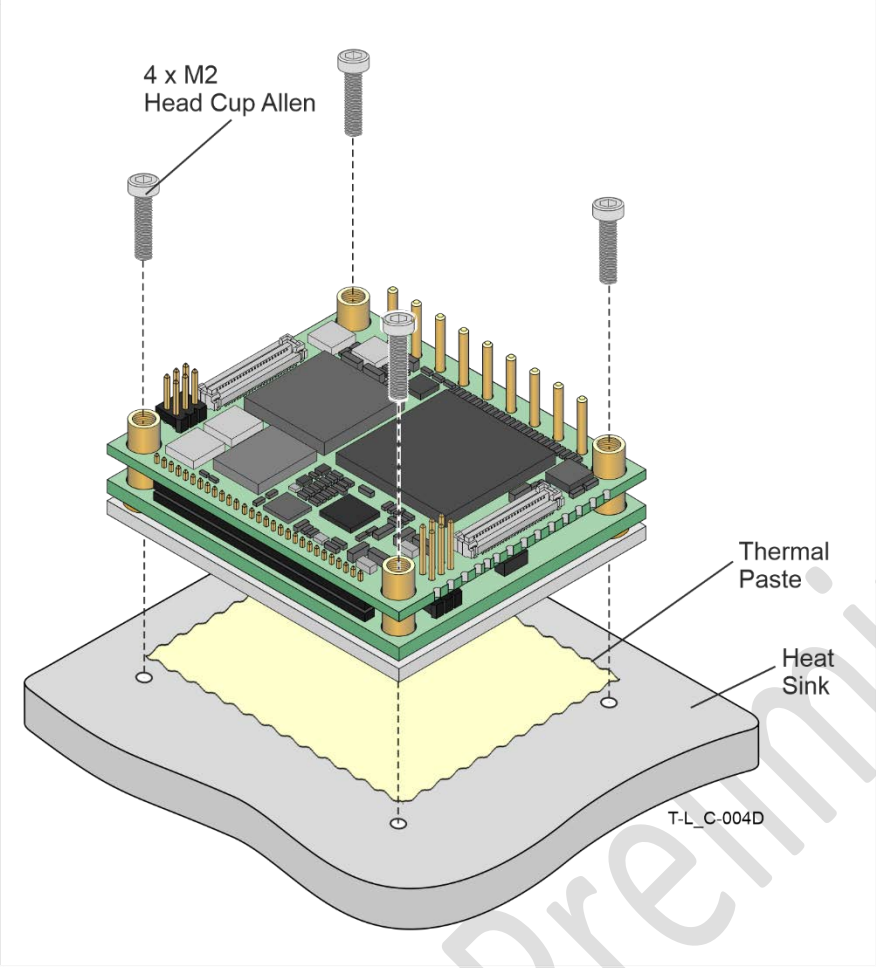


Figure 3: Mounting the Titanium Castanet onto the Heat Sink covered with Thermal Paste

Chapter 7 Connections

7.1 Ports

The Titanium Castanet has the following ports:

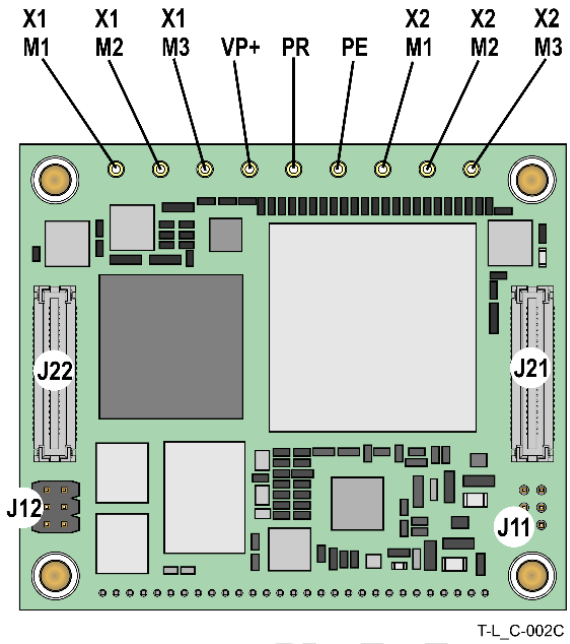
Ports	No. of Pins	Type	Function	Connector and Pin Locations
Power Pins				
X1_M1	1	TH - Pins	Power / Motor	
X1_M2	1			
X1_M3	1			
X2_M1	1			
X2_M2	1			
X2_M3	1			
VP	1		DC+ Power Input	
PR	1		DC- Power Input Return	
PE	1		Protective Earth	
Other Pins and Connectors				
J11	6	TH - Header 2*3, 1.27mm	VL, 5V	
J12	6	Header 2*3, 1.27mm	STO	
J21	50	Molex: 204927-0501 SMT connector board to board	COMM, LEDs, AIN & Resolver	
J22	50		Feedback & I/O	

Table 18: Connections

7.2 Motor Power Pins

The following table describes the motor power pins in the Titanium Castanet.

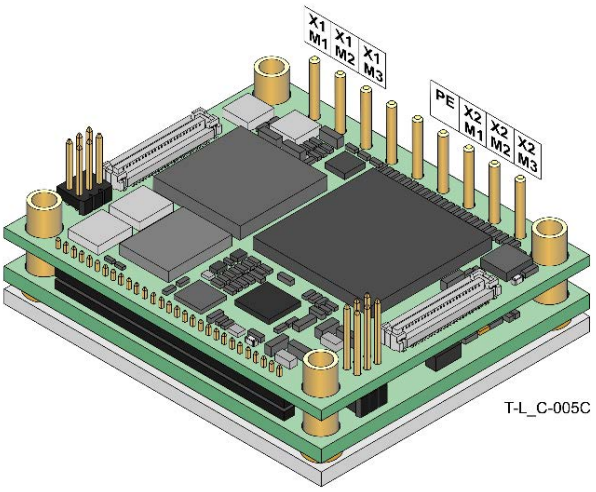
Pins	Type	Function	Pin Positions
X1_M1	Output	Motor Phase	
X1_M2	Output	Motor Phase	
X1_M3	Output	Motor Phase	
PE		Protective Earth	
X2_M1	Output	Motor Phase	
X2_M2	Output	Motor Phase	
X2_M3	Output	Motor Phase	

Table 19: Motor Power pins

7.3 Main Power Pins

The following table describes the main power pins in the Titanium Castanet.

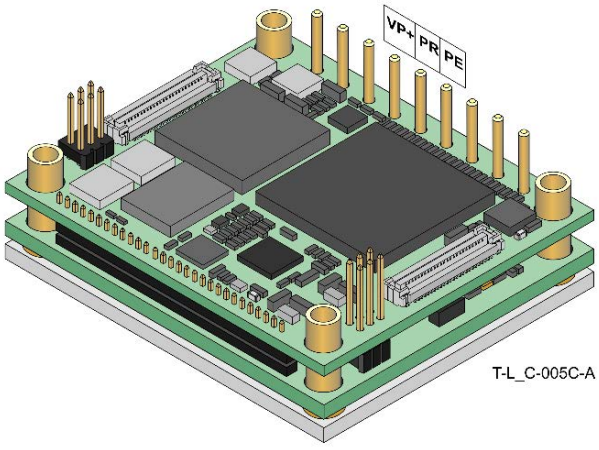
Pin	Type	Function	Pin Positions
VP	Supply, Input	DC+ Power IN	
PR	Supply, Input	DC- Power IN	
PE		Protective Earth	

Table 20: Main Power Pins

7.4 Control Supply Pins (J11)

The following table describes the VL and 5V pins in the Titanium Castanet.

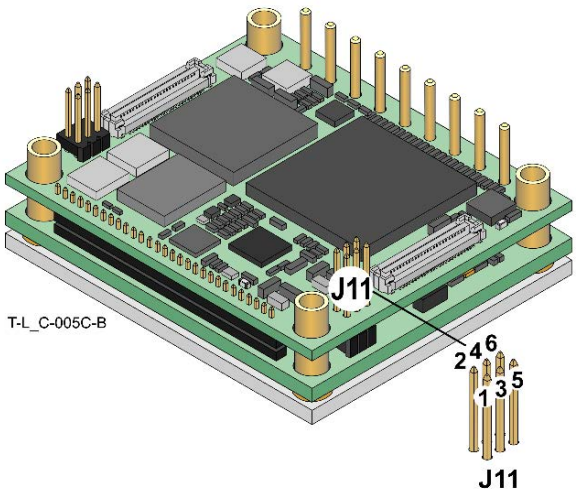
Pin No.	Signal	Function	Pin Positions
1	COMRET	Common Return	
2	+5V	Encoder +5V supply	
3	COMRET	Common Return	
4	+11V	+11V Encoder supply	
5	VL-	Control Supply Return	
6	VL_USER	Control Supply Input	

Table 21: VL and 5V Connector Pinouts - J11

7.5 STO Pins (J12)

The following table describes the STO pins in the Titanium Castanet.

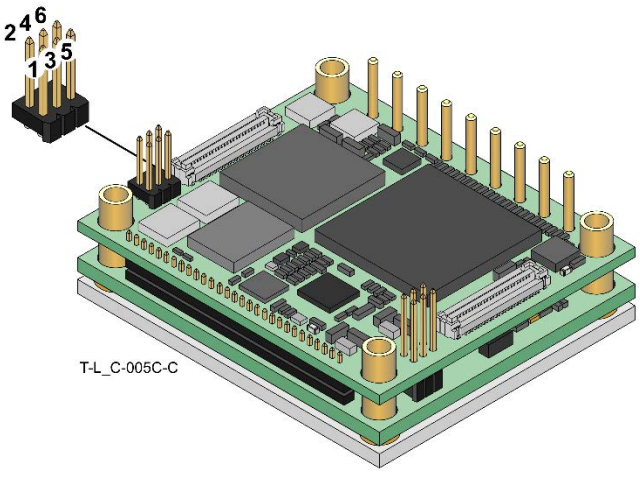
Pin No.	Signal	Function	Pin Positions
1	X2_STO_RET	X2 STO Signal Return	
2	X1_STO_RET	X1 STO Signal Return	
3	X2_STO2	X2 STO2 Input Opto isolated	
4	X1_STO2	X1 STO2 Input Opto isolated	
5	X2_STO1	X2 STO1 Input Opto isolated	
6	X1_STO1	X1 STO1 Input Opto isolated	

Table 22: STO Connector Pinouts - J12

7.6 Mating Connectors – Integrating the Titanium Castanet

Port	No. Pins	Socket	Function
Power Pins			
X1_M1	1	MILL-MAX 3520-0-57-15-18-27-10-0	Power / Motor
X1_M2	1		
X1_M3	1		
X2_M1	1		
X2_M2	1		
X2_M3	1		
VP	1		DC+ Power Input
PR	1		DC- Power Input Return
PE	1		Protective Earth
Other Pins and Connectors			
P11	6	Socket 2*3, 1.27mm SAMTEC - CLP-103-02-F-D	VL, 5V
P12	6		STO
P21	50	SMT connector board to board Molex: 204928-0501	COMM, LEDs, AIN & Resolver
P22	50		Feedback & I/O

Table 23: Mating Connectors

The following drawing describes how to connect the mating connectors and pins to the top board:

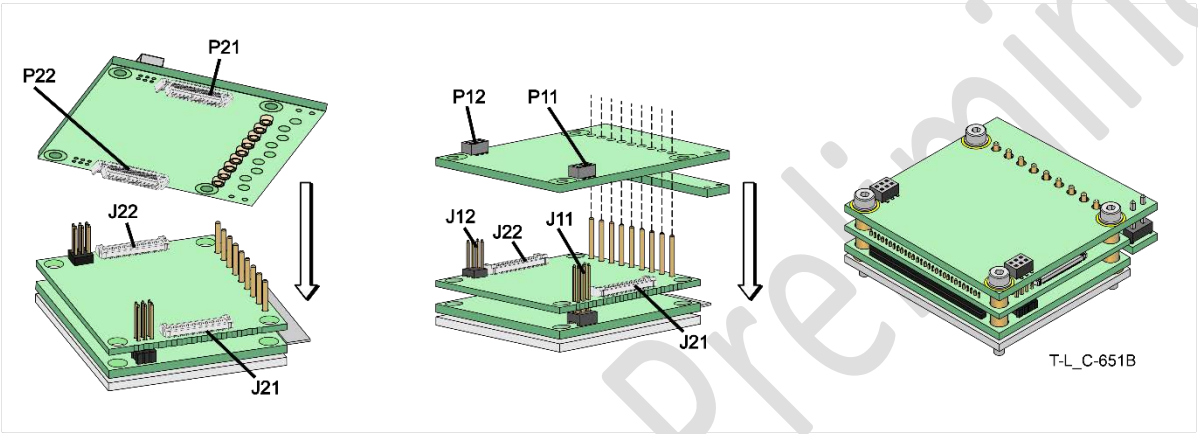


Figure 4: Connecting the Power Pins and Connectors to the top board

Note: Regarding integrating the Titanium Castanet:

- Connectors J21 and J22 require mating.
- For Power and DC pins, J11, J12, VL, 5V & STO connectors: we recommend soldering.

7.7 COMM, LED, Clock, Analog Input, and Resolver Pins (J21)

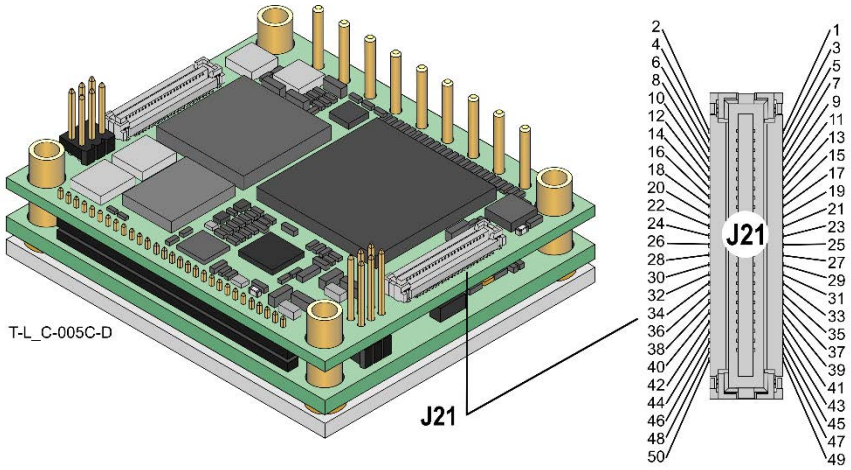


Figure 5: J21 Connector – Pin Positions

The following table describes the EtherCAT/Ethernet communication, LEDs, Clocks, Analog Inputs, Resolver, and Grounding pins in the Titanium Castanet.

Important: Reserved pins must be left open.

Pin No. (J21)	Signal	Function
1	PHY_OUT_TX+	EtherCAT OUT TX+
2	PHY_OUT_RX-	EtherCAT OUT RX-
3	PHY_OUT_TX-	EtherCAT OUT TX-
4	PHY_OUT_RX+	EtherCAT OUT RX+
5	COMRET	Common Return
6	COMRET	Common Return
7	PHY_IN_TX-	EtherCAT IN TX- / Ethernet TX-
8	PHY_IN_RX+	EtherCAT IN RX+ /Ethernet RX+
9	PHY_IN_TX+	EtherCAT IN TX+ / Ethernet TX+
10	PHY_IN_RX-	EtherCAT IN RX- / Ethernet RX-
11	COMRET	Common Return
12	+3.3 V	3.3V Supply Voltage
13	PHY_IN_LINK_ACT	Indicates EtherCAT IN
	CANL	CAN_L BUS (dominant low)

Pin No. (J21)	Signal	Function
14	PHY_OUT_LINK_ACT	Indicates EtherCAT OUT
15	PHY_IN_SPEED	Indicates EtherCAT IN
	CANH	CAN_H BUS (dominant high)
16	PHY_OUT_SPEED	Indicates EtherCAT OUT
17	LED_ECAT_RUN	EtherCAT status LED Run
18	LED1	Drive Status-1 – Red light
19	LED_ECAT_ERR	EtherCAT status LED Error
20	LED2	Drive Status-2 – Green light
21	Reserved	
22	Reserved	
23	Reserved	
24	Reserved	
25	SB_DIN	Serial Bus for Ext. IO (available in the future)
26	SB_CLK	Serial Bus for Ext. IO (available in the future)
27	SB_DOUT	Serial Bus for Ext. IO (available in the future)
28	SB_LOAD	Serial Bus for Ext. IO (available in the future)
29	COMRET	Common Return
30	+3.3 V	3.3V Supply Voltage
31	ANALOG_IN2	Analog input 2
32	ANALOG_IN1	Analog input 1
33	ANALOG_IN4	Analog input 4
34	ANALOG_IN3	Analog input 3
35	MAIN_UART_TX	Main Serial Bus output – interpreter
36	MAIN_UART_RX	Main Serial Bus input – interpreter
37	AUX2_UART_TX	AUX2 Serial Bus output – interpreter
38	AUX2_UART_RX	AUX2 Serial Bus input – interpreter
39	AUX1_UART_TX	AUX1 Serial Bus output
40	AUX1_UART_RX	AUX1 Serial Bus input
41	USB_DP	USB_P
42	USB_DM	USB_N
43	X1_RESOLVER_CLK	Reserved for Resolver
44	X2_RESOLVER_CLK	Reserved for Resolver

Pin No. (J21)	Signal	Function
45	X1_PortB_I_AN	Reserved for Resolver
46	X2_PortB_I_AN	Reserved for Resolver
47	Reserved	
48	Reserved	
49	Reserved	
50	Reserved	

Table 24: COMM, LED, Clock, Analog Input, and Resolver Pins - J21

7.8 Extended IO Pins

For details on Extended Digital IO, refer to a future Titanium Safety Drive Manual. Figure 6 Shows the position Extended Digital IO pins.

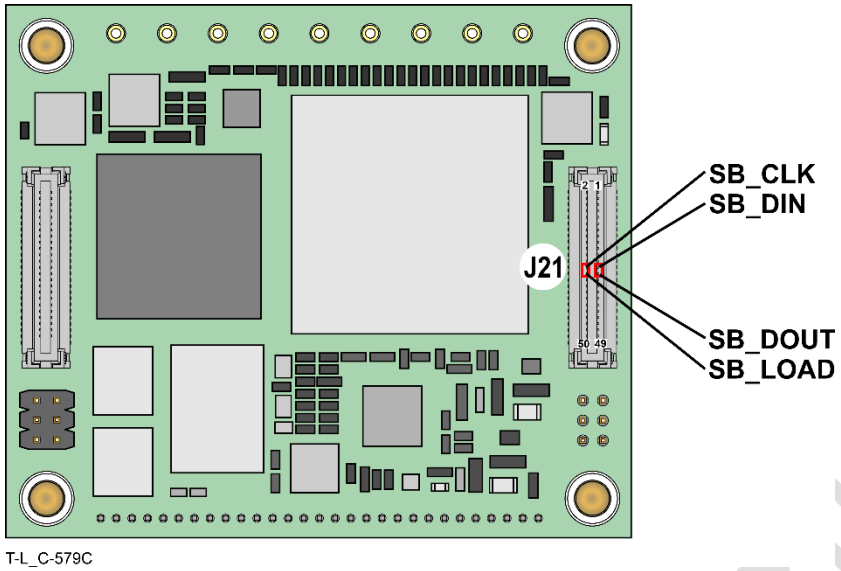


Figure 6: Titanium Castanet Extended IO Pins Positions

Note:
Contact Elmo for additional information.

7.9 Drive Status Indicator

Figure 7 shows the position of the Drive Status Indicator pin which is used for immediate indication of the Initiation and Working states.

For details of the Drive Status Indicator wiring, refer to the Titanium Safety Drive Manual.

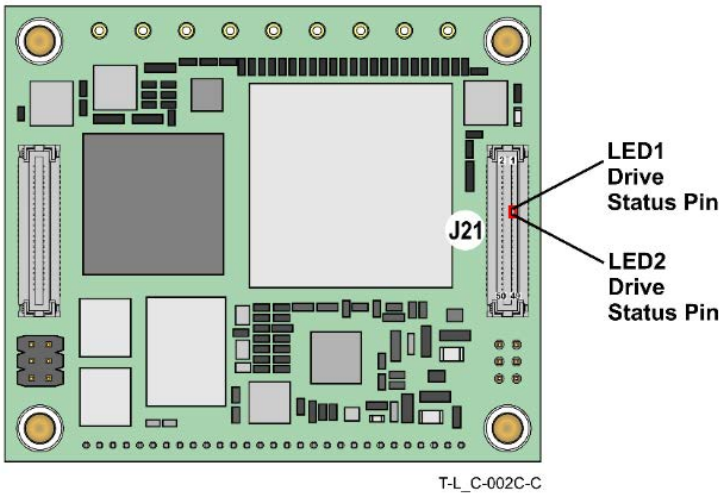


Figure 7: Titanium Castanet Drive Status Indicator pins

The following figure (Figure 8) describes the LED diagram connection:

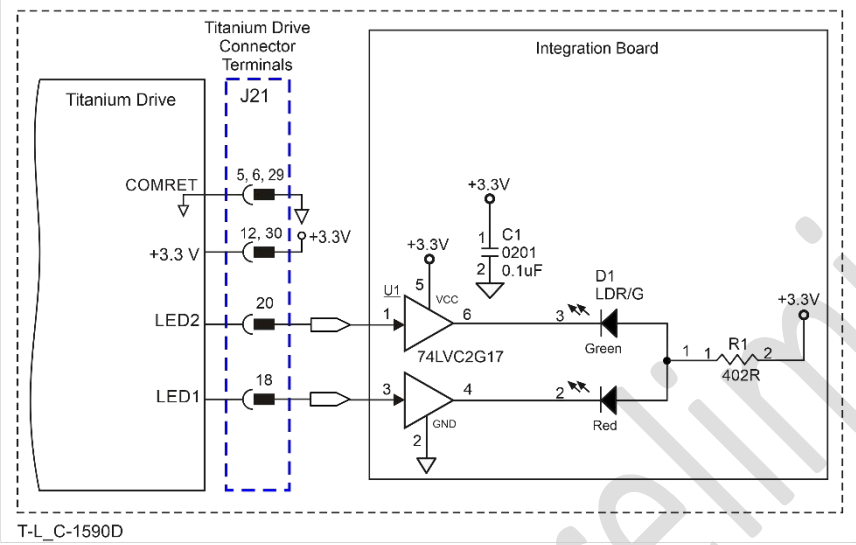


Figure 8: Serial for Drive Status LEDs

7.10 Feedback and I/O Pins (J22)

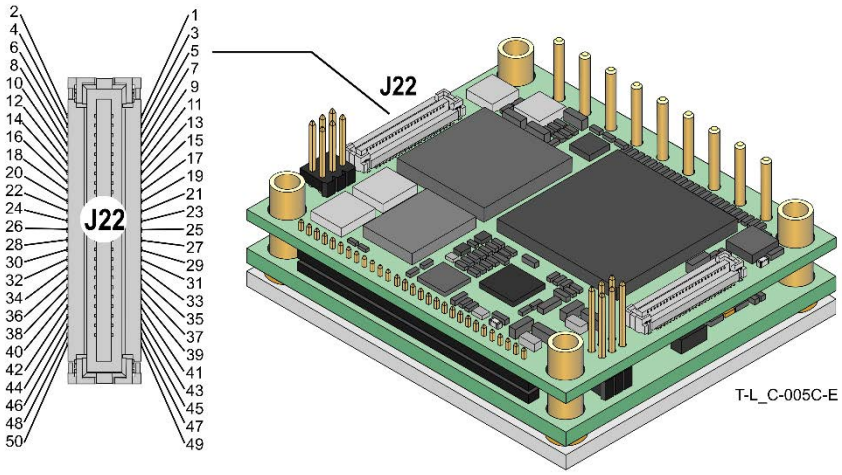


Figure 9: J22 Connector – Pin Positions

The following table describes the Ports X1_A, X1_B, X2_A, and X2_B Feedback and I/O pins in the Titanium Castanet.

Pin# (J22)	Signal	Axis	Function	
			Port A: General or Incremental Encoder	**Main Absolute Encoder**
1	X1_PortA_A+	1	Differential I/O A+	Differential Output CLK+
2	X2_PortA_A+	2	Differential I/O A+	Differential Output CLK+
3	X1_PortA_A-	1	Differential I/O A-	Differential Output CLK-
4	X2_PortA_A-	2	Differential I/O A-	Differential Output CLK-
5	X1_PortA_B+	1	Differential I/O B+	Differential In/Out DATA+
6	X2_PortA_B+	2	Differential I/O B+	Differential In/Out DATA+
7	X1_PortA_B-	1	Differential I/O B-	Differential In/Out DATA-
8	X2_PortA_B-	2	Differential I/O B-	Differential In/Out DATA-
			Port A: General or Incremental Encoder	**Auxiliary Absolute Encoder**
9	X1_PortA_I+	1	Differential I/O Index+	Differential Output CLK+
10	X2_PortA_I+	2	Differential I/O Index+	Differential Output CLK+
11	X1_PortA_I-	1	Differential I/O Index-	Differential Output CLK-
12	X2_PortA_I-	2	Differential I/O Index-	Differential Output CLK-
			General	
13	X1_HA	1	Hall A	
14	X2_HA	2	Hall A	
15	X1_HB	1	Hall B	
16	X2_HB	2	Hall B	
17	X1_HC	1	Hall C	
18	X2_HC	2	Hall C	

Pin# (J22)	Signal	Axis	Function		
19	IO_ERROR		Safety IO Error (Reserved for Safe IO)		
20	IO_VDD_ENABLE_n		Safety VDD Enable (Reserved for Safe IO)		
21	COMRET		Common Return		
22	IO_VDD_EXIST		Safety VDD detection (Reserved for Safe IO)		
23	IN1_PRI		Digital input 1		
24	IN2_SEC		Digital input 2		
25	IN3_PRI		Digital input 3		
26	IN4_SEC		Digital input 4		
27	IN5_PRI		Digital input 5		
28	IN6_SEC		Digital input 6		
29	IN7_PRI		Digital input 7 (Reserved for Safe IO)		
30	IN8_SEC		Digital input 8 (Reserved for Safe IO)		
31	OUT1_SEC		Digital output 1		
32	OUT2_PRI		Digital output 2		
33	OUT3_SEC		Digital output 3		
34	OUT4_PRI		Digital output 4		
35	OUT7_SEC		Digital output 7		
36	OUT8_PRI		Digital output 8		
			Port B: Incremental Encoder		
37	X1_PortB_A+	1	Differential Input A+		
38	X2_PortB_A+	2	Differential Input A+		
39	X1_PortB_A-	1	Differential Input A-		
40	X2_PortB_A-	2	Differential Input A-		
41	X1_PortB_B+	1	Differential Input B+		
42	X2_PortB_B+	2	Differential Input B+		
43	X1_PortB_B-	1	Differential Input B-		
44	X2_PortB_B-	2	Differential Input B-		
			General	**Resolver**	**Auxiliary Absolute Encoder**
45	X1_PortB_I+	1	Differential I/O Index+	Differential Input Excitation signal	Differential I/O Data+
46	X2_PortB_I+	2	Differential I/O Index+	Differential Input Excitation signal	Differential I/O Data+
47	X1_PortB_I-	1	Differential I/O Index-	Differential Input Excitation signal	Differential I/O Data-
48	X2_PortB_I-	2	Differential I/O Index-	Differential Input Excitation signal	Differential I/O Data-
49	COMRET		Common Return		
50	COMRET		Common Return		

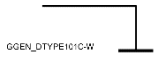
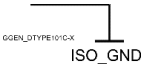
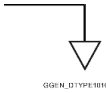
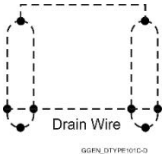
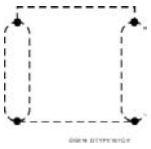
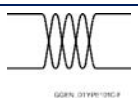
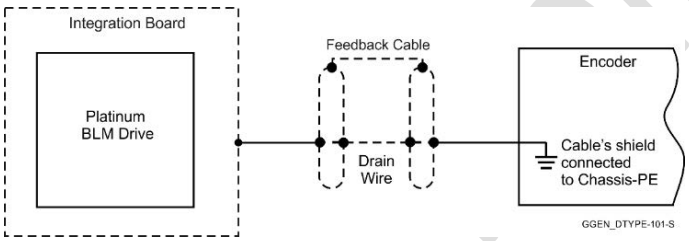
Table 25: Feedback and I/O Connector Pinouts - J22

Chapter 8 Wiring

8.1 Wiring Legend

Once the product is mounted, you are ready to wire the device. Proper wiring, grounding, and shielding are essential for ensuring safe, immune and optimal servo performance of the drive.

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 Castanet Connection Diagram

8.2.1 Connections Diagram for EtherCAT, Safety Capability S, Network A

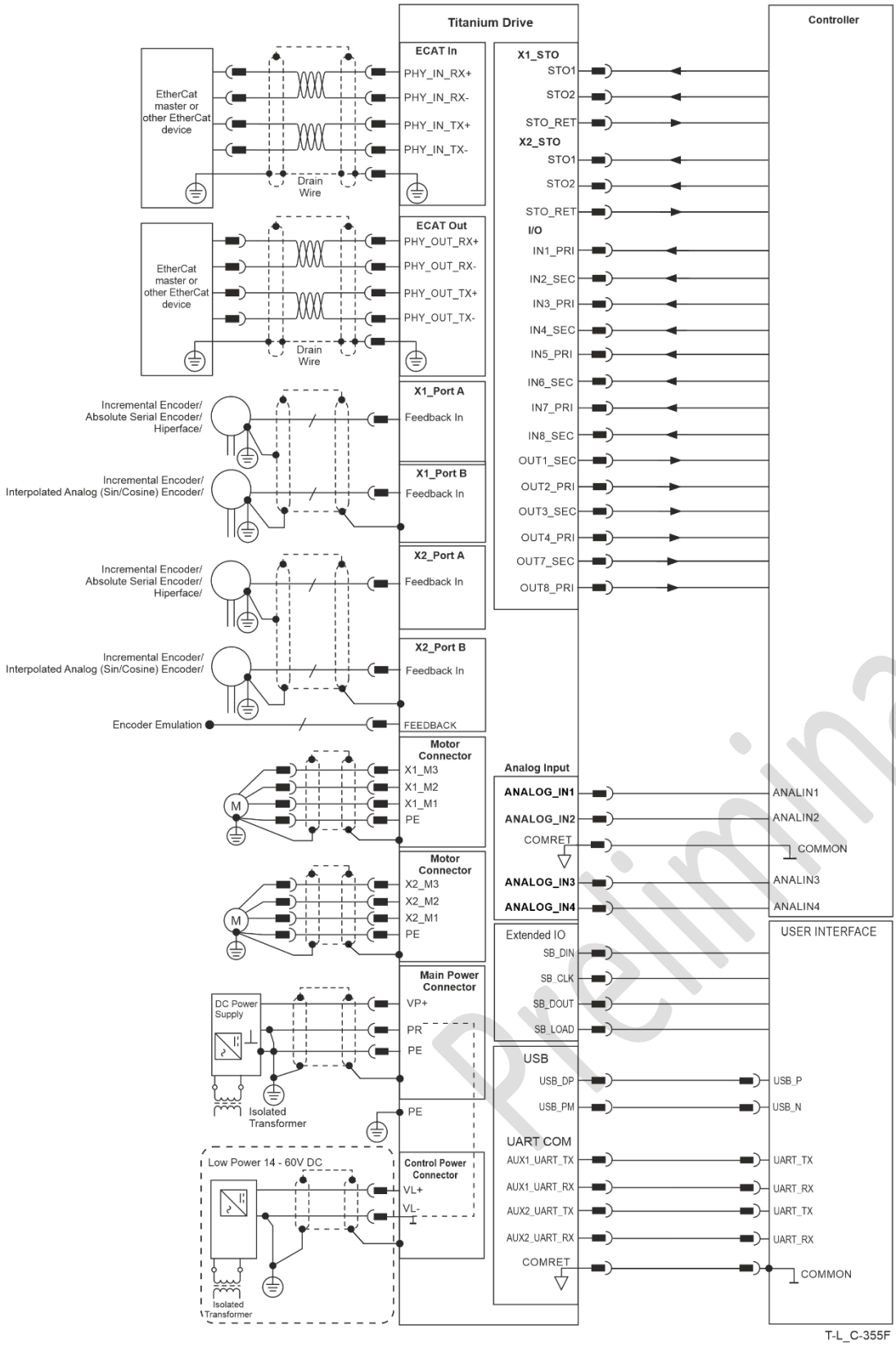


Figure 10: Titanium Castanet Connections Diagram for EtherCAT, Safety Capability S, Network A

8.2.2 Connections Diagram for EtherCAT, Safety Capability O, Network B

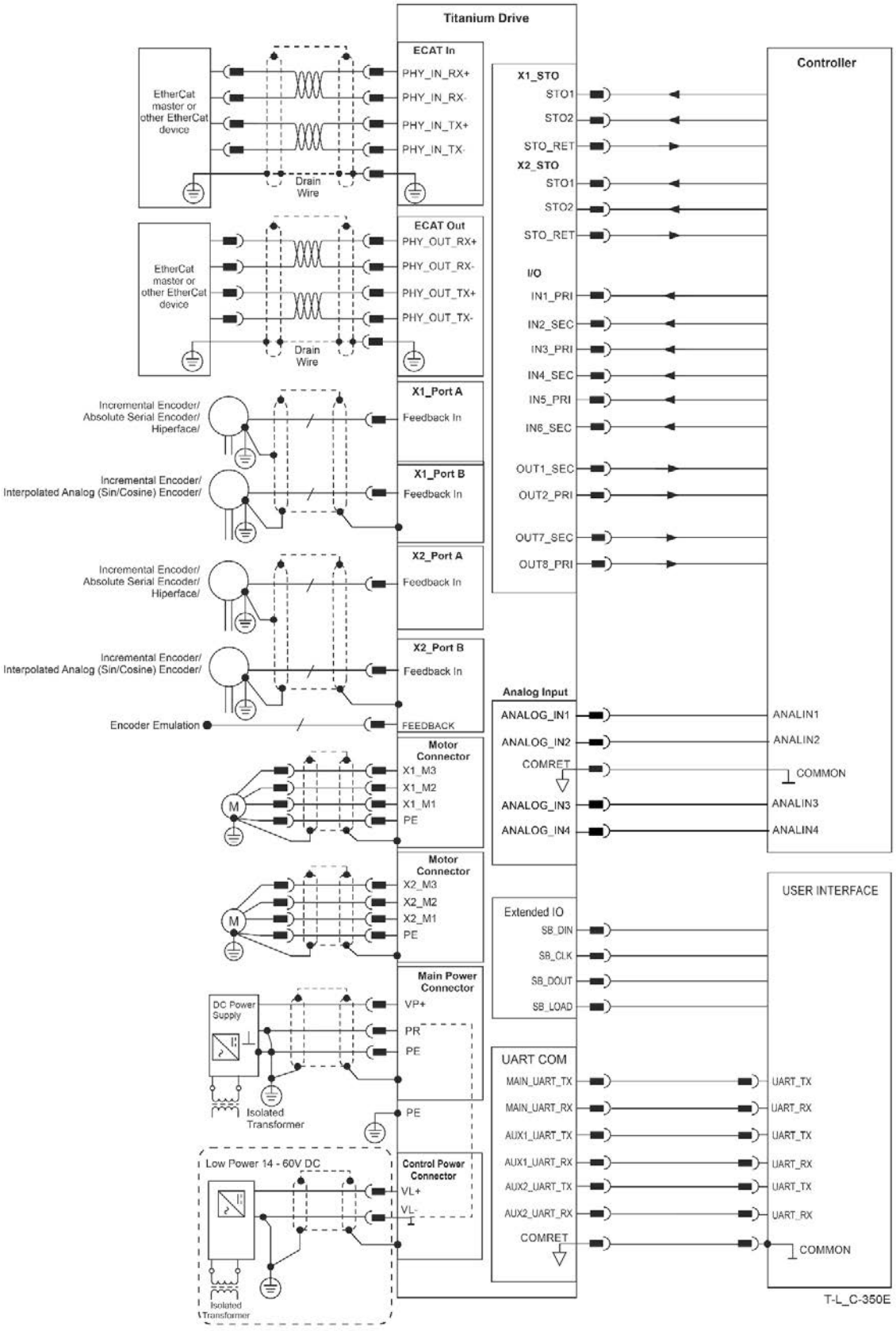


Figure 11: Titanium Castanet Connections Diagram for EtherCAT, Safety Capability O, Network B

8.2.3 Connections Diagram for CAN, Safety Capability O, Network K

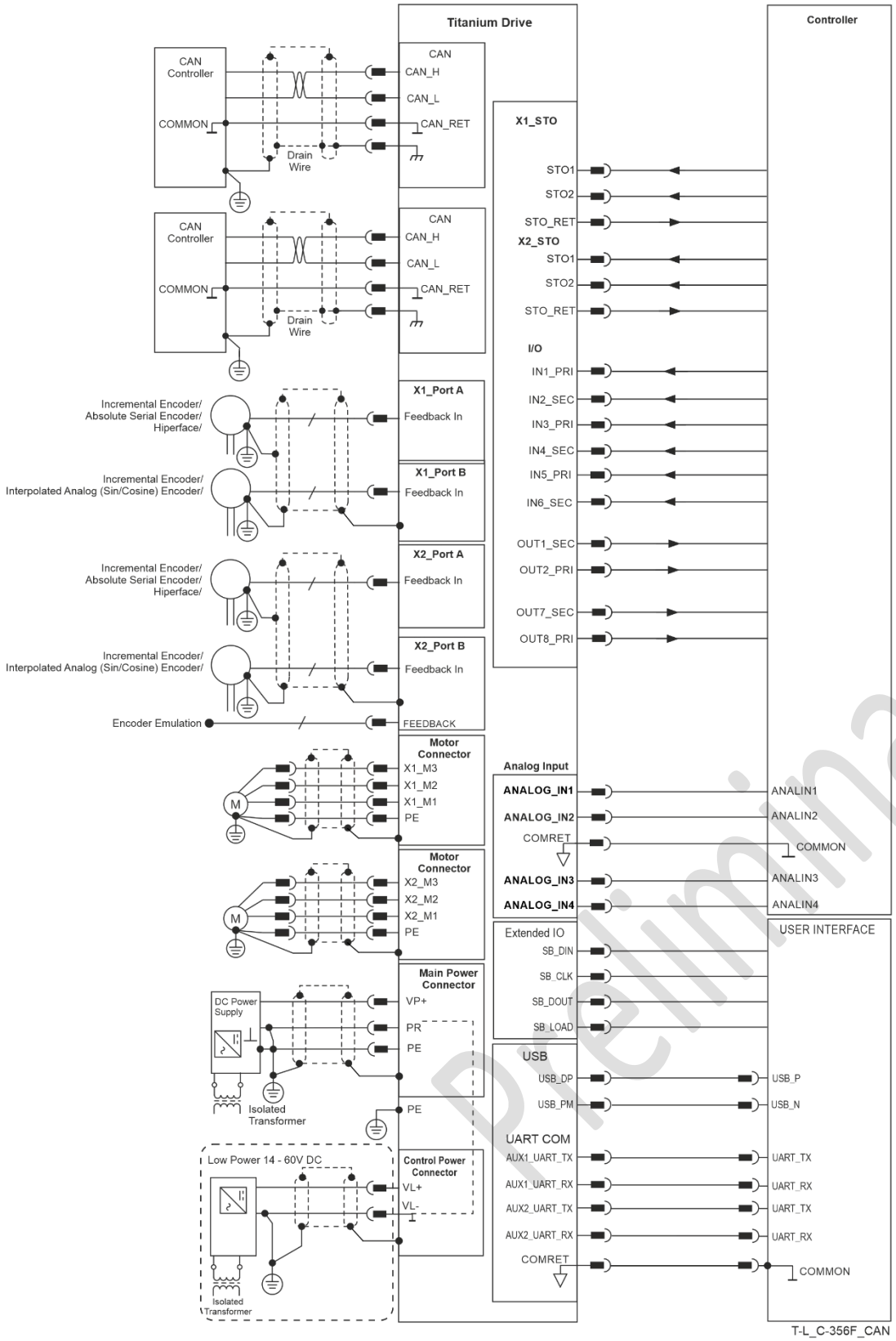


Figure 12: Titanium Castanet Connections Diagram for CAN, Safety Capability O, Network K

8.2.4 Connections Diagram for CAN, Safety Capability O, Network L

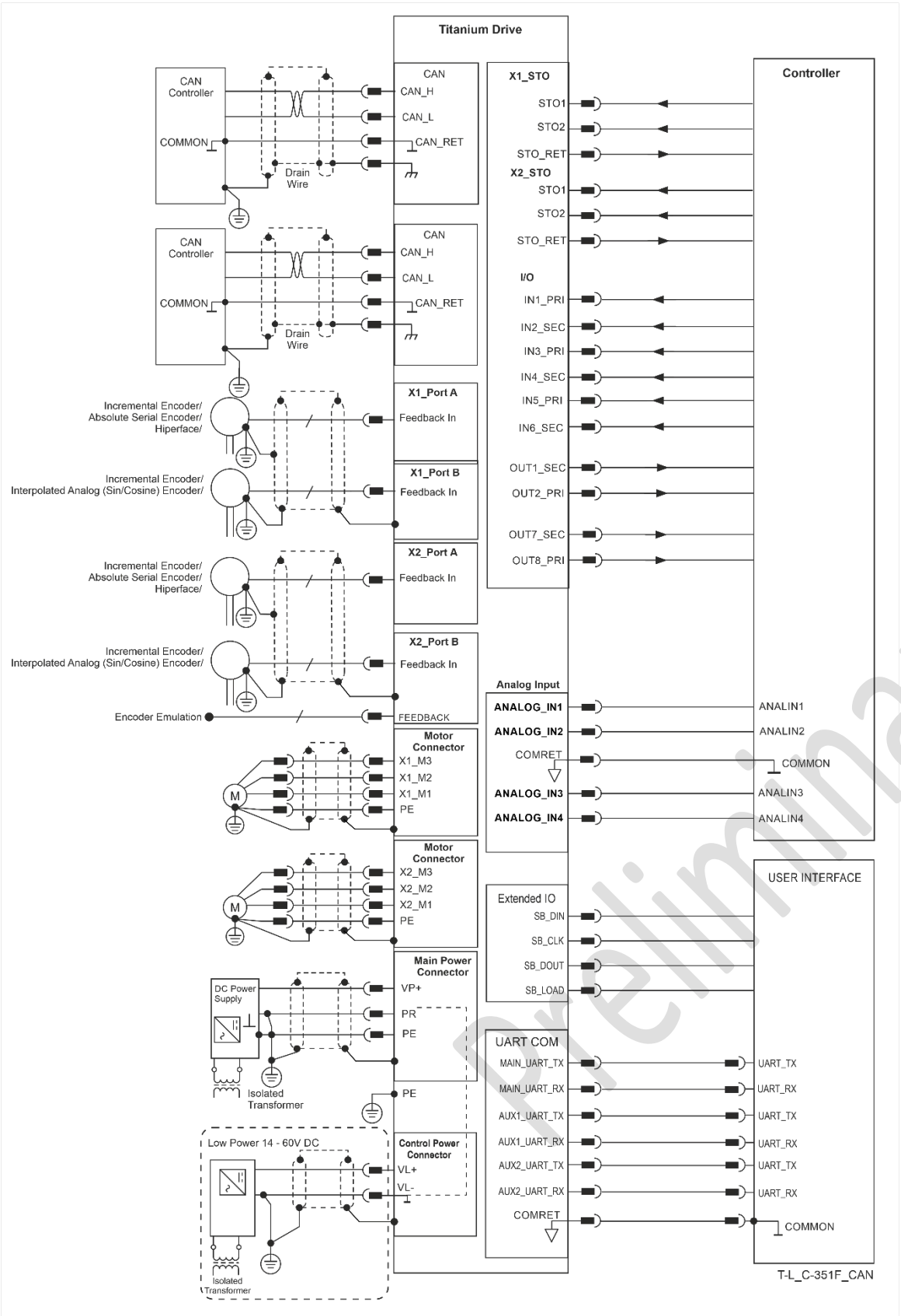


Figure 13: Titanium Castanet Connections Diagram for CAN, Safety Capability O, Network L

8.3 Integrating the Titanium Castanet on a PCB

The Titanium Castanet is designed to be mounted on a PCB by using the 4 spacers and screwing it directly to the PCB. See Chapter 4 Product Description and 6.3 Mounting the Titanium Castanet.

8.3.1 Power Returns (PR)

In the Titanium Castanet, the power stage and control stage are internally connected, and the negative node of the DC power bus is designated as PR.

The maximum realistic Power Return is achieved using a plane, which connects between the Titanium Drive and the power source. The impedance on this plane must be as low as possible to reduce the impedance between the "Grounds". This effectively reduces the levels of common mode differences, interferences, EMI, etc.

8.3.2 COMRET

For details of the COMRET, refer to a future **Titanium Drive Hardware Manual**.

8.3.3 Earth Connection (PE)

The PE (Protective Earth connection) terminal is connected internally in the drive to the Titanium Castanet's chassis (heat-sink + metal cover) which serves as an EMI common plane. Any other assembly metallic parts (such as the chassis) should also be connected to the PE.

Under normal operating conditions, the PE trace carries no current. The only time these traces carry current is under unusual conditions (such as when the device has become a potential shock or fire hazard while conducting external EMI interferences directly to ground). When connected properly the PE trace prevents these hazards from affecting the drive.

8.3.4 Power Return (PR), Common Return (COMRET) and Earth Connections (PE)

Safety regulations (UL61800-5-1, IEC61800-5-1, and UL508C) require that the servo drive, as a "stand alone", must withstand breakdown voltages of 1.7KV for the 100V models, between PE to PR. However, the connections between PE to PR and the COMRET are essential for the safe operation of the servo drive. Therefore, the following topology must be used:

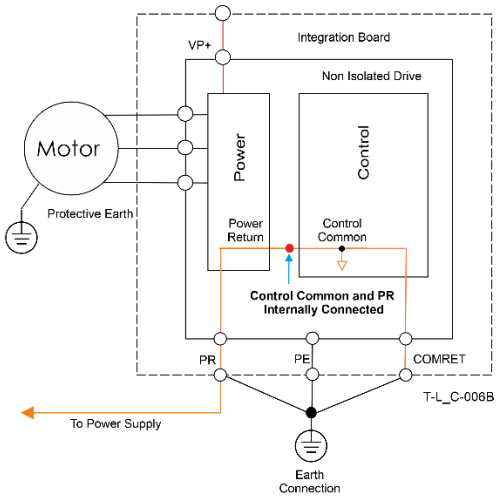


Figure 14: Titanium Castanet Earth Connections

The connections to PE are essential but must be done externally to the integration board.
The COMRET should be connected to the PR in the Integration Board.

8.4 Logic, Control Cabling and Wiring

For functional safety applications, shielded and twisted wires should be used.

8.4.1 Feedback Ports, VL, RS232, RS422, Analog Input, USB

For short distances between the drive and control, 0.5 to 1.0 m wires can be used, and shielding is not required. For longer distances than 1.0 m and/or in a high EMI environment, shielded and twisted wires should be used. Drain wires should be connected to Elmo COMRET.

8.4.2 Digital Inputs/Outputs, STO

Wires can be always used, no need for twisting, no need for shielding.

8.4.3 EtherCAT

Use CAT5e cables.

8.5 Power Conductors PCB layout

The PCB is virtually divided into two zones: Power Zone, and Control & Communication Zone.

- **Power Zone**
  This area is dedicated to Power conductors only: VP+, PR, PE, and motor leads.
- **Control and Communication Zone**
  This area of the PCB is dedicated to Control low level signals.

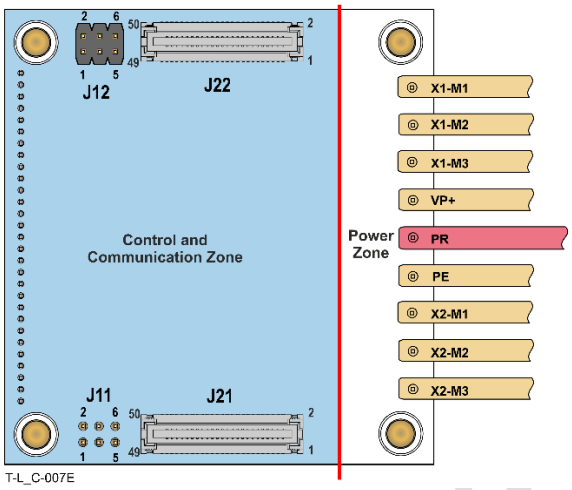


Figure 15: Titanium Castanet Power Conductors PCB layout

For more details, refer to the **Titanium Drive Hardware Manual**.

8.6 Motor Power Per Axis

When connecting several drives to several similar motors, all should be wired in an identical manner. This will enable the same settings to run on all drives.

For Motor connections for each axis, use the following connection diagrams and procedure per axis, depending on the motor type.

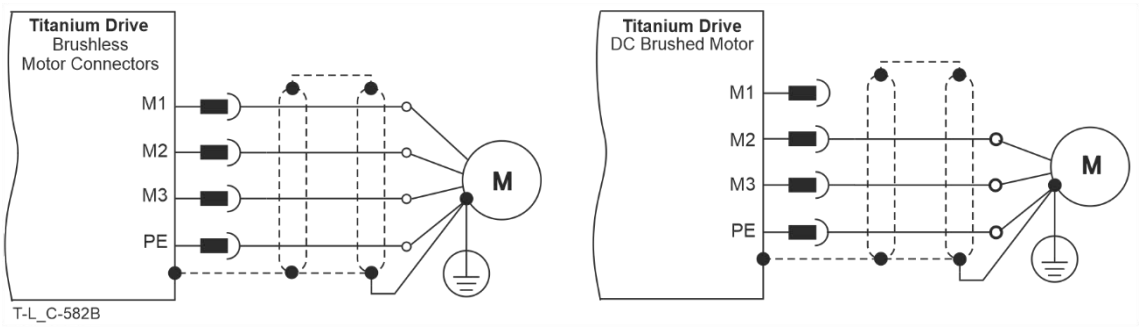


Figure 16: Brushless and Brushed Motor Power Connection Diagrams

To connect the motor:

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 Castanet.
   Make sure not to bundle the wires.

Note:
The PE terminal is combined, hence used by both cables.

3. The phase connection is arbitrary as Elmo Application Studio (EAS III) will establish the proper commutation automatically during setup. When tuning a number of 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.
4. For high EMI environment, it is highly recommended to use a two 4-wire shielded (not twisted) cable for the motor connection (PE terminal is combined). The gauge is determined by the actual RMS current consumption of the motor.
5. Connect the cable shield to the closest ground connection at the motor end.
   For better EMI performance, the shield should be connected to Earth Connection (heat sink mounting holes).

8.7 Main and Control Power

The power rating for the Titanium Castanet is **100V**.

Two DC power sources are required:

- DC power source of
  - 10 to 90V, isolated from the Mains – for the 100V model.
- Control supply 14 to 60 VDC for the logic, isolated from the Mains.

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

To connect the main power:

1. The DC power supply source must be isolated from the Mains.
2. Verify that the rectified VDC is indeed within the range of the drive.
3. Connect the cable shield to the closest earth connection near the power supply.
4. Connect the PE (GND) 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.

8.7.1 Control Supply

The Control Power (VL) for Safety configuration (see 7.4 Control Supply Pins (J11) for details) must be 14V to 60V.

To connect your integration board to the control supply:

1. The source of the control supply must be isolated from the Mains.
2. For safety reasons, connect the return (common) of the control supply source to the closest earth connection near the control supply source.
3. Connect the cable shield to the closest earth connection near the control supply source.
4. Before applying power, verify the polarity of the connection.

8.7.2 Dual Power Supply

Two DC power sources are required for Functional Safety. To implement Functional Safety, refer to the Titanium Safety Drive Manual.

- Main power isolated from the Mains:
  - 10 to 90VDC for 100V models
- Control Power supply: 14V to 60V for the logic, isolated from the Mains.

8.7.2.1 Ordinary Option

The following figure describes the connection of the main power and control power.

Note: It is required to add Input Capacitance of TBD.

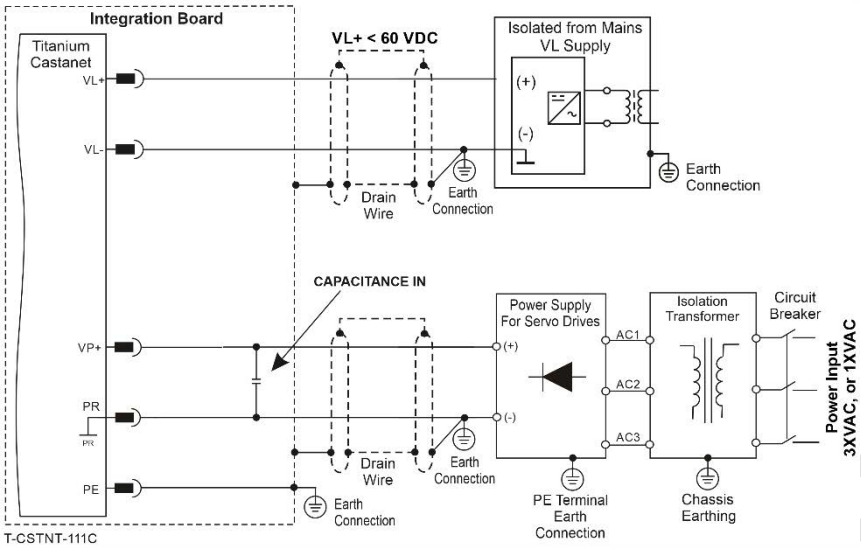


Figure 17: Ordinary Option: Separate VP and VL Power Supplies Connection Diagram

Note:

- Make sure to connect the PR to the closest earth connection near the power supply.
- VL and VP can be connected when VL < 60 is guaranteed, including the consideration of back EMF.

8.7.2.2 SMPS Option

Important: Since VP is not isolated in the current scenario, VP must be limited to 60V to electrocution. To be used in accordance with **UL61800-5-1**.

This option describes a topology with a main power without regeneration, but with limited Braking capabilities dependent on additional capacitance.

The $C_{external}$ can be mounted on the Integration Board if there are no space limitations.

Minimum capacitance of the Power supply: **Cexternal > Drive's Rated Current *20uF**

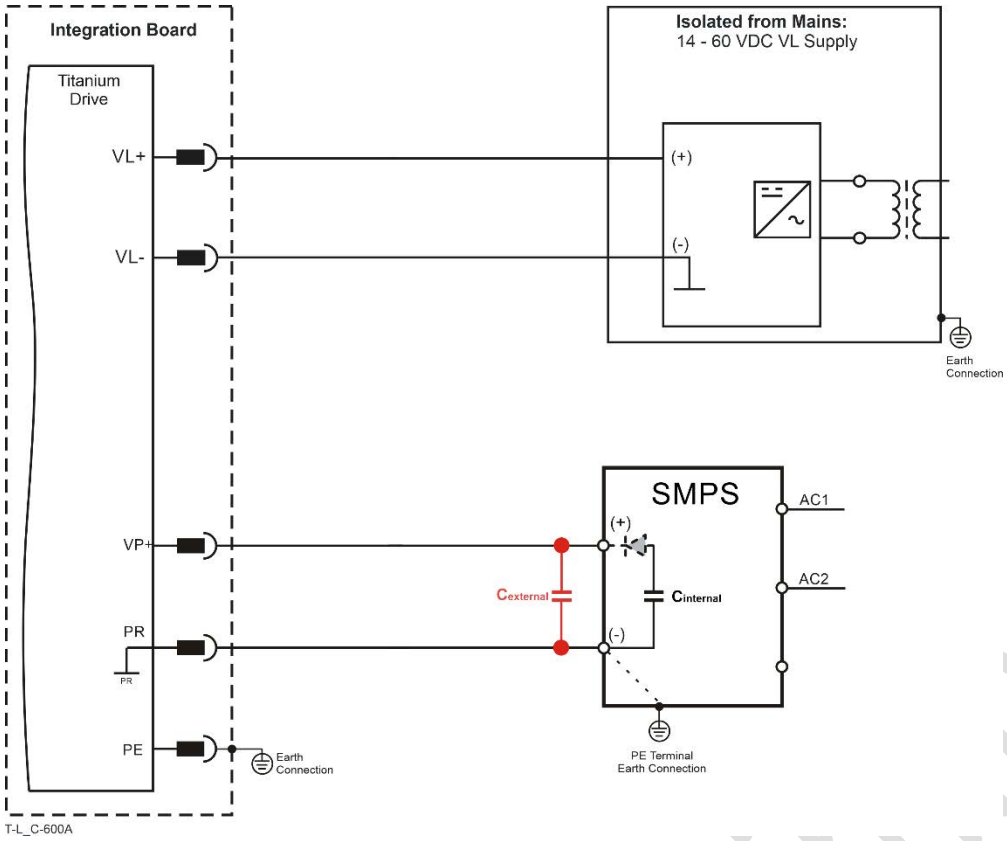


Figure 18: SMPS Option: Separate VP and VL Power Supplies Connection Diagram

Note: The minus (-) is connected to the PE in SMPE.

8.8 Feedback

To implement Functional Safety, refer to the Titanium Safety Drive Manual.

8.8.1 Feedback(s) Port A for Axes 1 & 2

Port A supports the following feedbacks:

- Incremental Encoder – see 8.8.1.3
- Main Absolute Encoder – see 8.8.1.4
- Auxiliary Absolute Encoder – see 8.8.4.
- Hiperface Encoder – see 8.8.3.
- Pulse-width modulation (PWM) signal input
- Pulse & Direction signal inputs
- Emulated Encoder output – see 8.8.5.
- Capture input from Index channel of Port A
- Output Compare selected channel according to the firmware

The signals and functions are described in the following tables:

Port A (J22) Axis 1		Incremental Encoder	Absolute Encoder
Pin #	Signal	Function	Function
1	X1_PortA_A+	Channel A +	Main Absolute encoder clock+
3	X1_PortA_A-	Channel A -	Main Absolute encoder clock-
5	X1_PortA_B+	Channel B+	Main Absolute encoder data+
7	X1_PortA_B-	Channel B -	Main Absolute encoder data-
9	X1_PortA_I+	Channel Index+	Auxiliary Absolute encoder clock+
11	X1_PortA_I-	Channel Index-	Auxiliary Absolute encoder clock-

Table 26: Feedback Port A for Axis 1

Port A (J22) Axis 2		Incremental Encoder	Absolute Encoder
Pin #	Signal	Function	Function
2	X2_PortA_A+	Channel A +	Main Absolute encoder clock+
4	X2_PortA_A-	Channel A -	Main Absolute encoder clock-
6	X2_PortA_B+	Channel B+	Main Absolute encoder data+
8	X2_PortA_B-	Channel B -	Main Absolute encoder data-
10	X2_PortA_I+	Channel Index+	Auxiliary Absolute encoder clock+
12	X2_PortA_I-	Channel Index-	Auxiliary Absolute encoder clock-

Table 27: Feedback Port A for Axis 2

8.8.1.1 Power Signals

Port A (J22) Axis 1 & 2		Incremental Encoder	Absolute Serial Encoder
21, 49, 50	COMRET	Common Return	Common Return

Table 28: Feedback Port A for Axes 1 & 2

8.8.1.2 Control Supply

Pin# (J11)	Signal	Function
1	COMRET	Common Return
2	+5V	+5V Encoder
3	COMRET	Common Return
4	+11V	+11V Encoder

Table 29: Control Supply for Port A (from J11)

Note: The control supply voltage should be chosen based on the encoder used – please refer to the manufacture encoder datasheet for the required supply.

8.8.1.3 Incremental Encoder

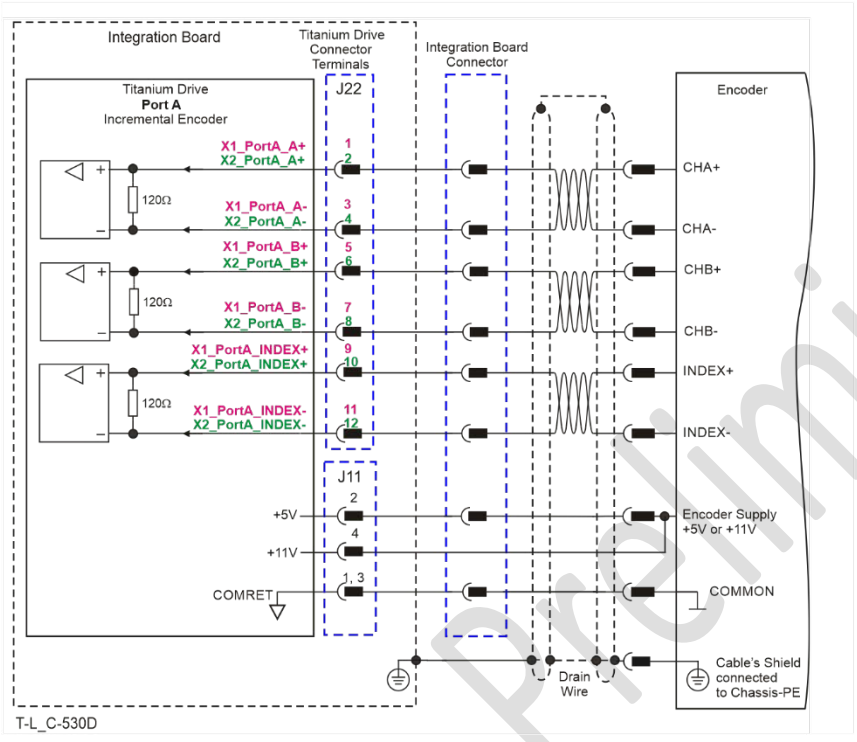


Figure 19: Port A Incremental Encoder Input for Axes 1 & 2 – Recommended Connection Diagram

8.8.1.4 Main Absolute Serial Encoder

The Port A absolute encoder supports the following encoder types:

- 6-wires encoders
- 4-wires encoders
- 2-wires encoders

8.8.1.4.1 6-Wire Encoders

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
- SSI

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

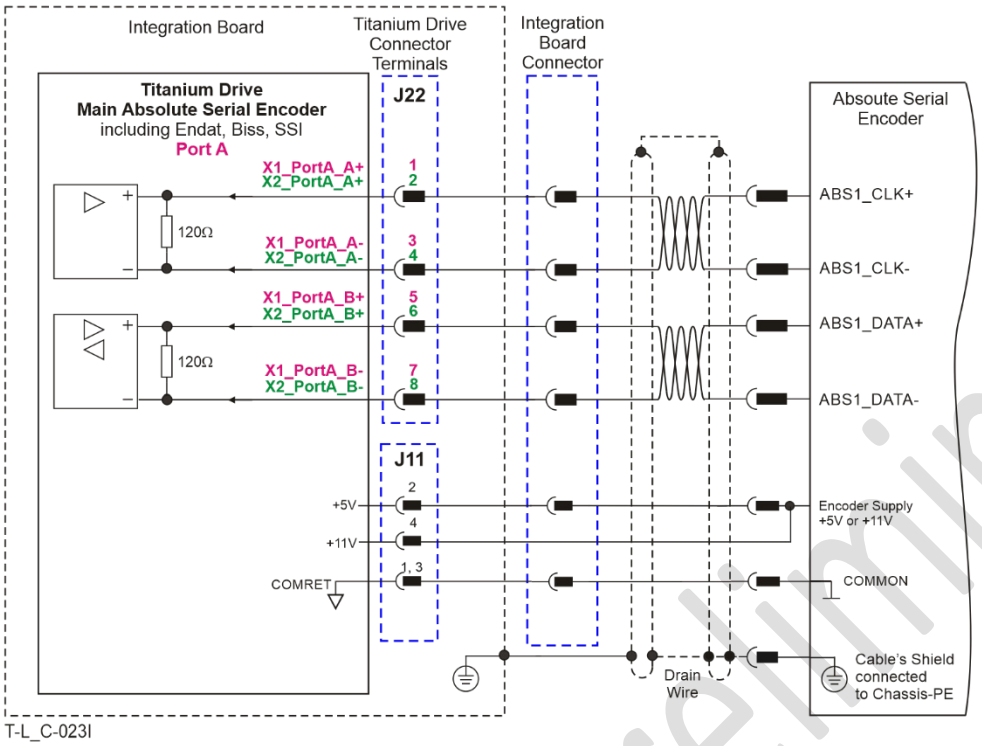


Figure 20: Port A Main Absolute Serial Encoder – Recommended Connection Diagram for Endat, Biss, SSI

8.8.1.4.2 4-Wire Encoders

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

The following Absolute Encoder types are supported:

- Panasonic, Tamagawa
- Sanyo

The following is the connection diagram 4-wire encoder:

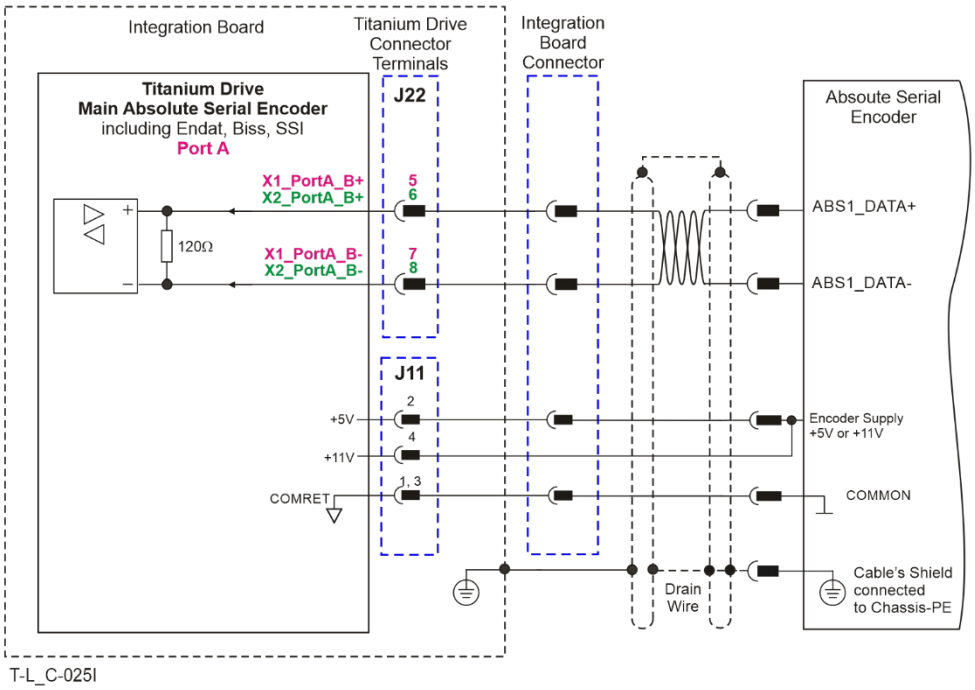


Figure 21: Port A Main Absolute Serial Encoder – Recommended Connection Diagram for Panasonic, Tamagawa, Sanyo

8.8.1.4.3 2-Wire Encoders

The 2-wire encoder includes Differential Absolute Data with power.

The following Absolute Encoder types are supported:

- Endat3
- Hiperface DSL
- Acuro

The connection diagram of the 2-wire encoder is the same as the diagram connection diagram of 4-Wire encoder. Refer to Figure 21.

8.8.2 Feedback(s) 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)
- Hiperface Encoder – see 8.8.3.
- Emulated Encoder output – see 8.8.5.

The signals and functions are described in the following tables:

Port B (J22) Axis 1		Incremental Encoder	ABS Serial Encoder	SIN/COS Encoder	Resolver
Pin #	**Signal**	**Function**	**Function**	**Function**	**Function**
37	X1_PortB_A+	Channel A +		Sine+	Sine+
39	X1_PortB_A-	Channel A -		Sine-	Sine-
41	X1_PortB_B+	Channel B+		Cosine+	Cosine+
43	X1_PortB_B-	Channel B -		Cosine-	Cosine-
45	X1_PortB_I+	Channel Index+	Auxiliary Absolute encoder data+	Index+	RESOLVER_OUT+ Vref complement f=1/TS, 50mA Maximum
47	X1_PortB_I-	Channel Index-	Auxiliary Absolute encoder data-	Index-	RESOLVER_OUT- Vref complement f=1/TS, 50mA Maximum
J21 Connector					
43	X1_RESOLVER_CLK				Reserved for Resolver
45	X1_PortB_I_AN				Reserved for Resolver

Table 30: Feedback Port B for Axis 1

Port B (J22) Axis 2		Incremental Encoder	ABS Serial Encoder	SIN/COS Encoder	Resolver
Pin #	**Signal**	**Function**	**Function**	**Function**	**Function**
38	X2_PortB_A+	Channel A +		Sine+	Sine+
40	X2_PortB_A-	Channel A -		Sine-	Sine-
42	X2_PortB_B+	Channel B+		Cosine+	Cosine+
44	X2_PortB_B-	Channel B -		Cosine-	Cosine-
46	X2_PortB_I+	Channel Index+	Auxiliary Absolute encoder data+	Index+	RESOLVER_OUT+ Vref complement f=1/TS, 50mA Maximum
48	X2_PortB_I-	Channel Index-	Auxiliary Absolute encoder data-	Index-	RESOLVER_OUT- Vref complement f=1/TS, 50mA Maximum
J21 Connector					
44	X2_RESOLVER_CLK				Reserved for Resolver
46	X2_PortB_I_AN				Reserved for Resolver

Table 31: Feedback Port B for Axis 2

8.8.2.1 Power Signals

Port B (J22) Axes 1 & 2		For all encoders
21, 49, 50	COMRET	Common Return

Table 32: Feedback Port B for Axes 1 & 2 – Power Signals

8.8.2.2 Control Supply

Pin# (J11)	Signal	Function
1	COMRET	Common Return
2	+5V	+5V Encoder
3	COMRET	Common Return
4	+11V	+11V Encoder

Table 33: Control Supply for Port B (from J11)

Note: The control supply voltage should be chosen based on the encoder used – please refer to the manufacture encoder datasheet for the required supply.

8.8.2.3 Incremental Encoder

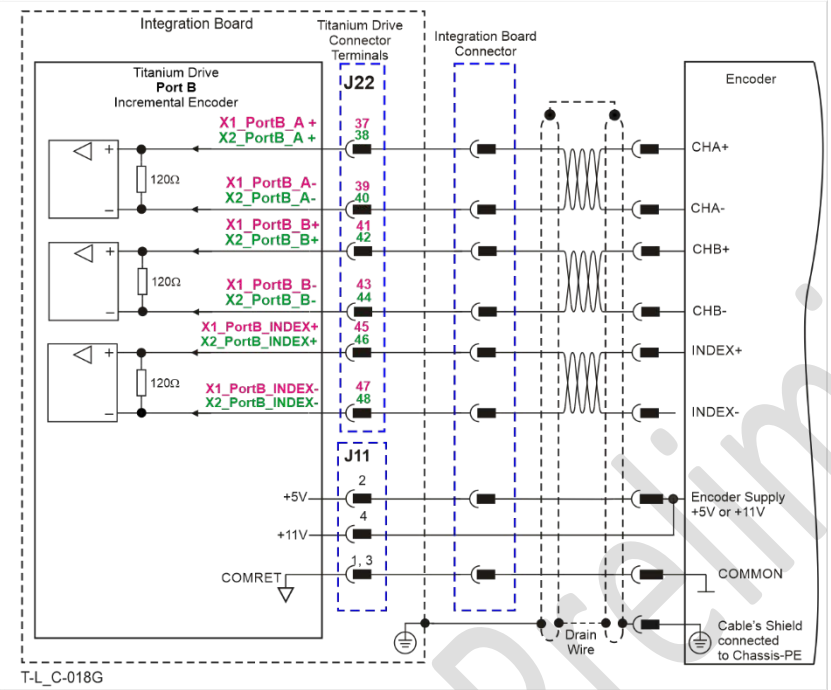


Figure 22: Port B Incremental Encoder Input for Axes 1 & 2 – Recommended Connection Diagram

8.8.2.4 Interpolated Analog (Sine/Cosine) Encoder

The following is the connection diagram of the Port B Interpolated Analog Encoder input for axes 1 and 2:

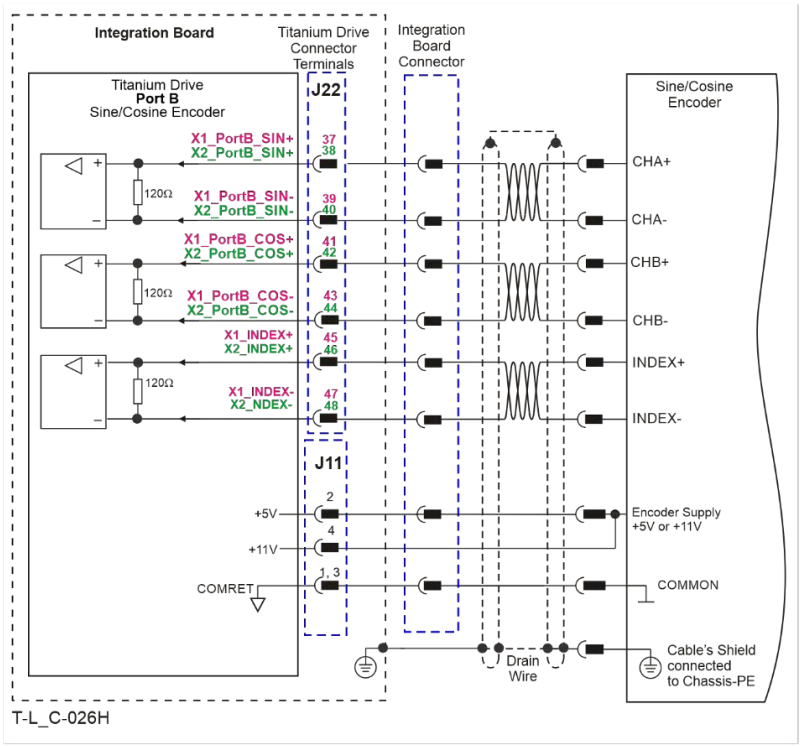


Figure 23: Port B Interpolated Analog Encoder for Axes 1 & 2 Connection Diagram

8.8.2.5 Resolver

The Resolver needs a circuit in the integration board to generate the excitation signal.

The following is the connection diagram of the Port B Resolver input for axes 1 and 2:

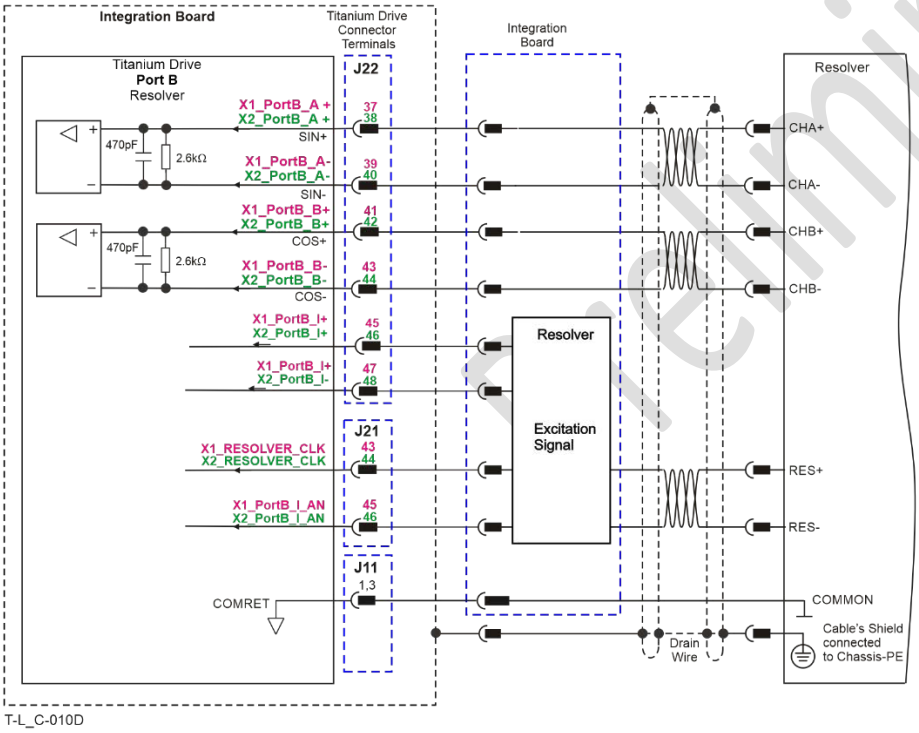


Figure 24: Port B Resolver for Axes 1 & 2 Connection Diagram

8.8.3 Hiperface

The following is the connection diagram of the Hyperface for Port A and Port B, axes 1 and 2:

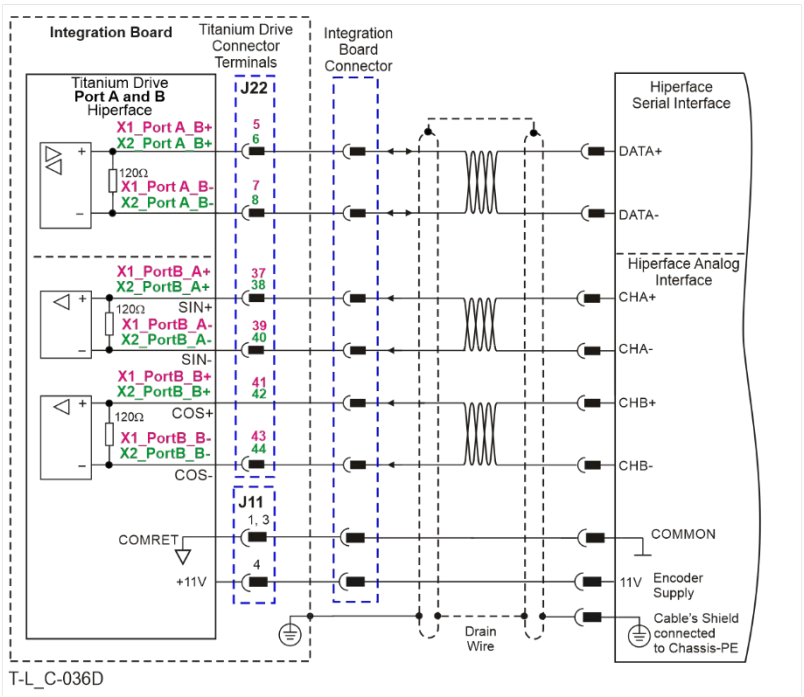


Figure 25: Hiperface Encoder – Recommended Connection Diagram for Sick Hiperface Encoder

8.8.4 Auxiliary Absolute Serial Encoder

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

The Auxiliary Absolute encoder supports the 6-wire encoder types (Diff ABS Clock, Diff ABS Data, Encoder Power, and GND):

- Endat 2.2
- Biss C and Biss B
- SSI

The following is the connection diagram for the Auxiliary Absolute Serial Encoder for axes 1 and 2:

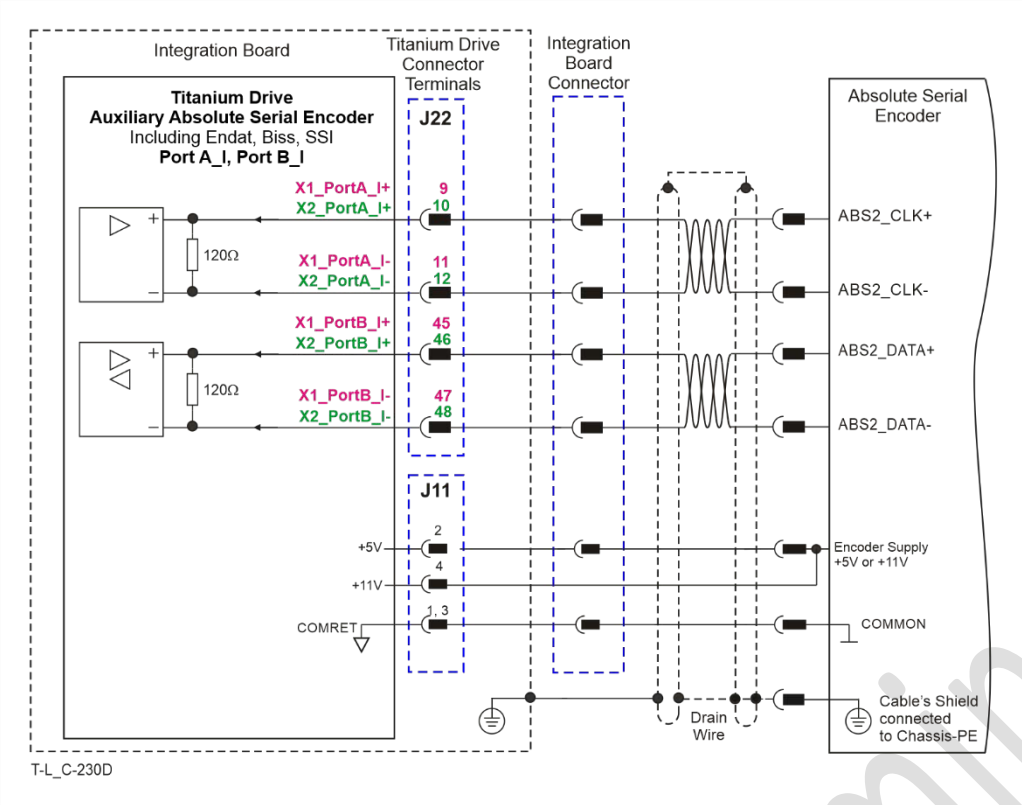


Figure 26: Port A & B Auxiliary Absolute Serial Encoder – Recommended Connection Diagram for Endat, Biss, SSI

8.8.5 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 EASIII application.

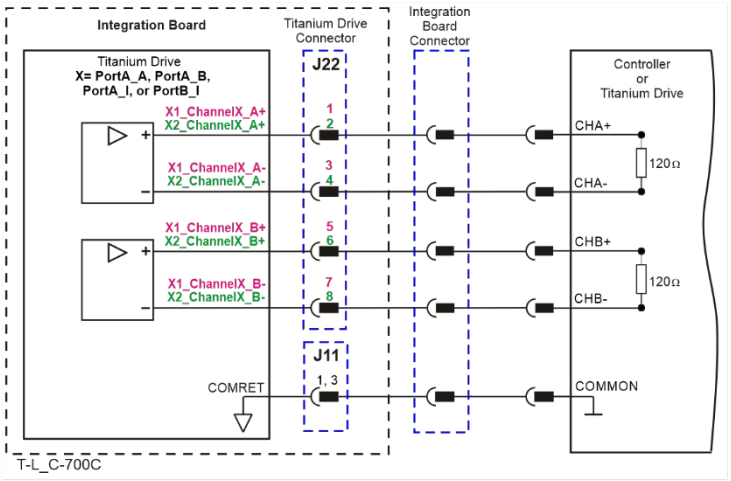


Figure 27: Emulated Encoder Output

8.8.6 Hall Sensors

The Hall Sensor signals and functions are described in the following table:

Hall Sensors (J22)				Hall Encoder
Pin # Axis 1	**Signal for Axis 1**	**Pin# Axis 2**	**Signal for Axis 2**	**Function**
13	X1_HA	14	X2_HA	Hall A
15	X1_HB	16	X2_HB	Hall B
17	X1_HC	18	X2_HC	Hall C

Table 34: Hall Sensors Signals and Functions

The following is the connection diagram of the Hall Sensors:

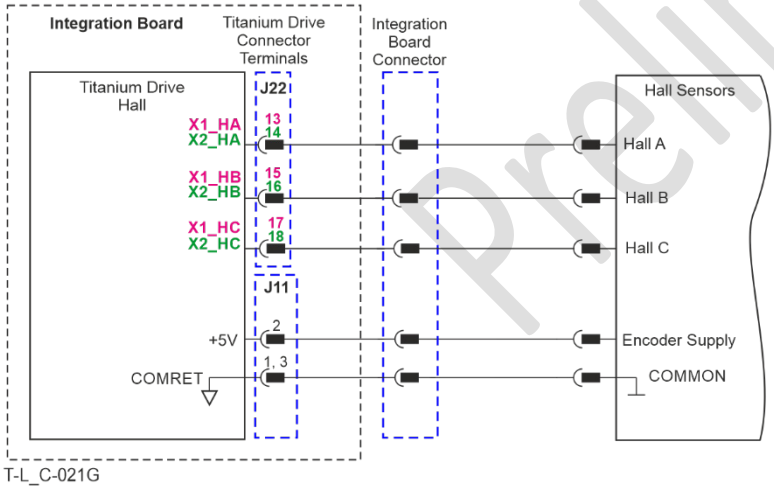


Figure 28: Hall Sensors Connection Diagram

8.9 Analog Inputs

There are four single ended analog inputs for the Titanium Castanet:

Pin# (J21)	Signal	Electriacl Interface
32	ANALOG_IN1	0 ÷ 3.2V with a reference of 1.6 V
31	ANALOG_IN2	
34	ANALOG_IN3	
33	ANALOG_IN4	

Table 35: Analog Input signals

8.9.1 Differential Interface to Analog Inputs in the Integration Board

The following paragraph describes Differential interface to the Analog Input. The following table describes the specification of the Differential Analog Input.

Input Signal	Electrical Interface
Differential Analog Input	±10V

Table 36: Differential Analog Input Specification

The following circuit describes the recommended Differential interface to the Analog Input.

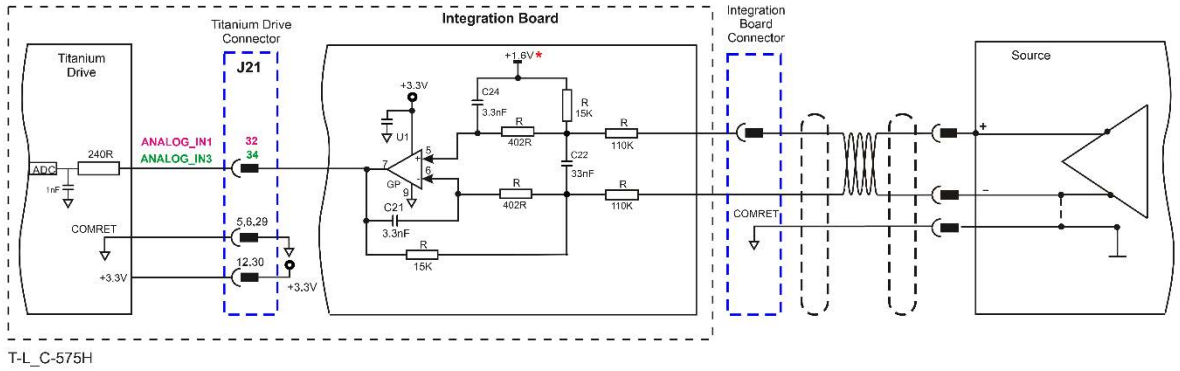


Figure 29: Recommended Differential interface to Analog Input

*The 1.6 V supply needs to be generated in the integration board by a voltage divider, or, for better accuracy, a Voltage Reference component.

Layout Recommendations for Integration board:

The differential lines should be routed together and as close as possible. The **Analog Inputs** signals should be separated. The analog return should be laid at the reference layer of the signals.

8.10 STO (Safe Torque Off)

Important: Refer to the Titanium Safety Drive Manual for STO Implementation.

The following table describes the STO1 and STO2 pins:

Pin No. (J12)	Signal	Axis	Function
1	X2_STO_RET	2	X2 STO Signal Return
2	X1_STO_RET	1	X1 STO Signal Return
3	X2_STO2	2	X2 STO2 Input
4	X1_STO2	1	X1 STO2 Input
5	X2_STO1	2	X2 STO1 Input
6	X1_STO1	1	X1 STO1 Input

Table 37: STO Pins and Signals

The following diagram describes the 5V Logic for the STO input interfaces.

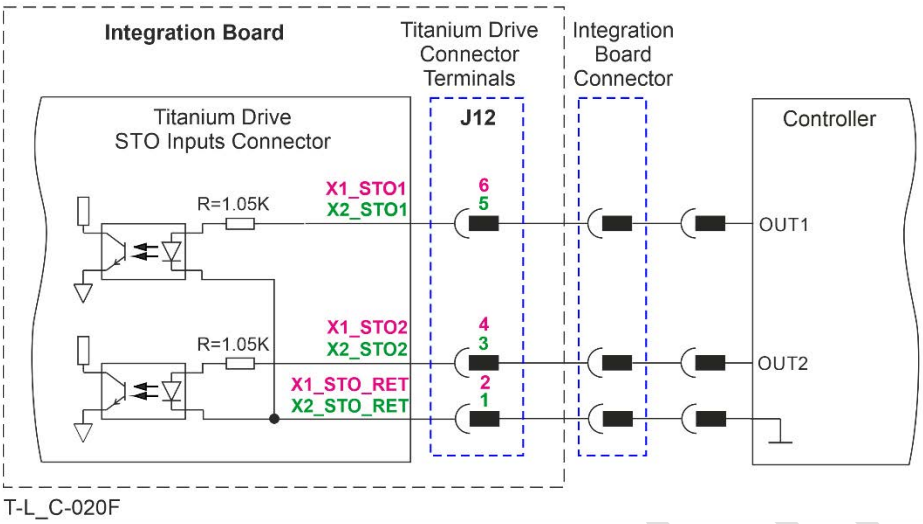


Figure 30: STO Input Connection – 5V Logic

8.11 Digital I/Os

Important: Refer to the Titanium Safety Drive Manual for Digital IO implementation for Functional Safety.

The following table describes the digital inputs and outputs:

Pin# (J22)	Signal	Function
23	IN1_PRI	Digital input 1
24	IN2_SEC	Digital input 2
25	IN3_PRI	Digital input 3
26	IN4_SEC	Digital input 4
27	IN5_PRI	Digital input 5
28	IN6_SEC	Digital input 6
29	IN7_PRI	Digital input 7 (Reserved for Safe IO)
30	IN8_SEC	Digital input 8 (Reserved for Safe IO)
31	OUT1_SEC	Digital output 1
32	OUT2_PRI	Digital output 2
33	OUT3_SEC	Digital output 3
34	OUT4_PRI	Digital output 4
35	OUT7_SEC	Digital output 7
36	OUT8_PRI	Digital output 8

Table 38: Digital I/Os Pins and Signals

8.11.1 Digital Inputs

The following table describes the electrical specification of the inputs IN1 to IN6.

Feature	Details
Input Voltage (VIN)	0 to 3.6V
V_{ih} min	2.4 V
V_{il} max	0.8V
Minimum pulse width	> 250 µsec
Execution time (all inputs): the time from application of voltage on input until execution is complete	0 < T < 250 µsec
High-speed inputs – 1–6 minimum pulse width, in high-speed mode	T = 5 µsec if the input functionality is set to latch/capture (index/strobe). **Notes:** **Home mode is high-speed mode and can be used for fast capture and precise homing.**
Capture with differential input Port A, Port B Index	T > 0.1 µsec if the differential input functionality is set to touch probe/capture (index/strobe).

Table 39: Digital Input Features

The following diagram describes the connection of IN1 to IN6 to Optocoupler in order to isolate the digital inputs.

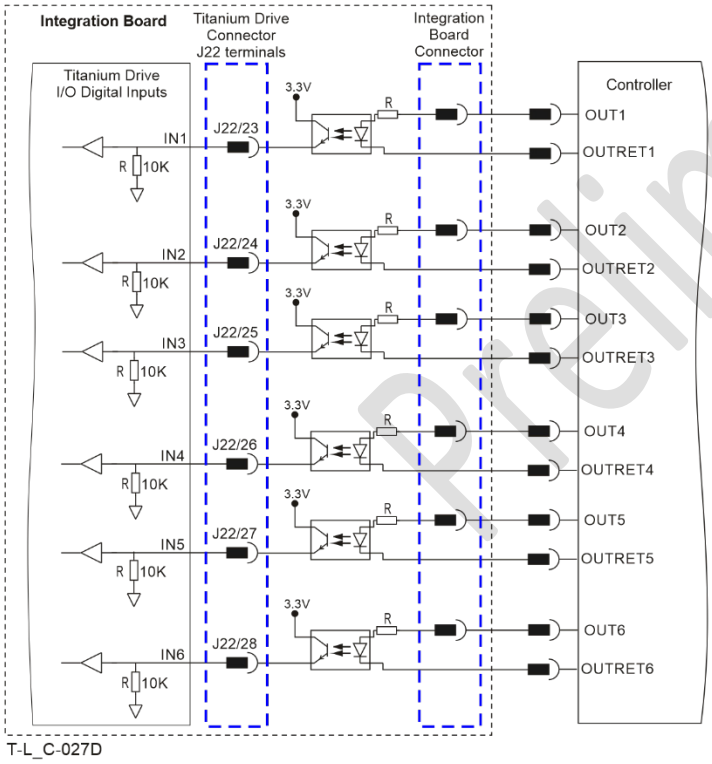


Figure 31: Digital Input TTL Logic Connection Diagram

8.11.2 Digital Outputs

Digital outputs 1 to 6 are 3.3V Logic.

The following table describes the electrical specification of outputs 1 to 6:

Feature	Details
Type of output	TTL 3.3V Logic
Maximum output current I_{out} (max) (V_{out} = Low)	4 mA
V_{OL} Max	0.45V
V_{OH} Min	2.4V
T_{on} (Time from low to high)	< 1 µsec
T_{off} (Time from high to Low)	< 1µsec
Executable time	0< T< 250 µsec

Table 40: Digital Output Features

The following diagram describes the connection of OUT1, OUT2, OUT3, OUT4, OUT7, and OUT8 to Optocoupler in order to isolate the digital outputs.

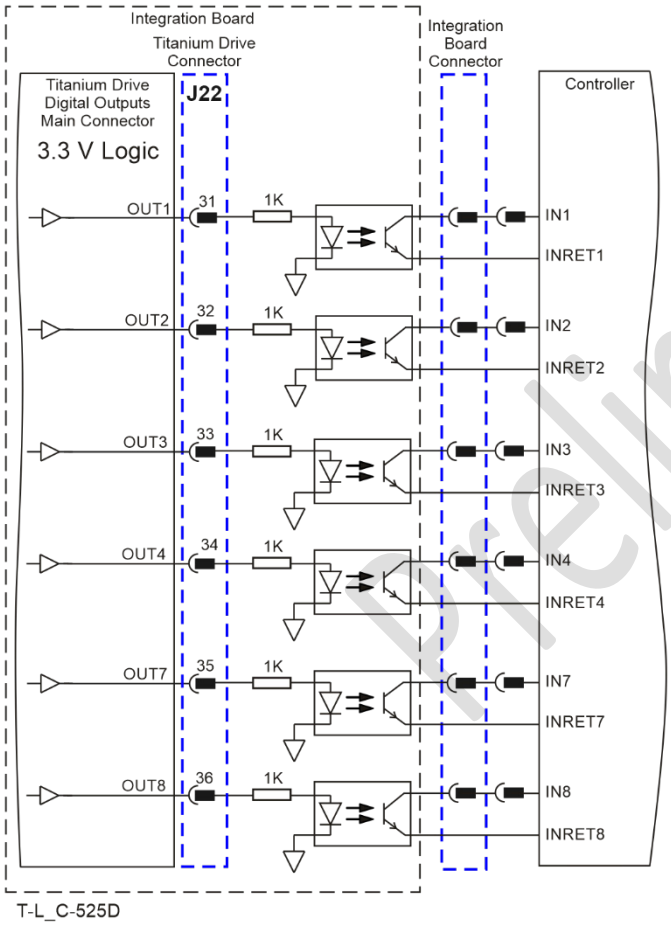


Figure 32: Digital Output TTL Logic Connection Diagram

8.12 Communication

The Titanium Castanet supports the following communication channels:

- EtherCAT/Ethernet or CAN
- USB 2.0
- RS-232 Serial Communication
- RS-422 (Differential RS-232) Serial Communication

8.12.1 EtherCAT/Ethernet

The Titanium Castanet serves as an EtherCAT slave device, therefore it includes EtherCAT-IN and EtherCAT-OUT ports. It also includes LED indicators.

Pin No. (J21)	Signal	Function
1	PHY_OUT_TX+	EtherCAT OUT TX+
2	PHY_OUT_RX-	EtherCAT OUT RX-
3	PHY_OUT_TX-	EtherCAT OUT TX-
4	PHY_OUT_RX+	EtherCAT OUT RX+
7	PHY_IN_TX-	EtherCAT IN TX- / Ethernet TX-
8	PHY_IN_RX+	EtherCAT IN RX+ /Ethernet RX+
9	PHY_IN_TX+	EtherCAT IN TX+ / Ethernet TX+
10	PHY_IN_RX-	EtherCAT IN RX- / Ethernet RX-
13	PHY_IN_LINK_ACT	Indicates EtherCAT IN
14	PHY_OUT_LINK_ACT	Indicates EtherCAT OUT
15	PHY_IN_SPEED	Indicates EtherCAT IN
16	PHY_OUT_SPEED	Indicates EtherCAT OUT
17	LED_ECAT_RUN	EtherCAT status LED Run
19	LED_ECAT_ERR	EtherCAT status LED Error

Table 41: EtherCAT Pins and Signals

The EtherCAT-IN port can be configured to an Ethernet port.

For details of the EtherCAT/Ethernet connections, refer to the Titanium Drive Manual.

8.12.1.1 EtherCAT Status Indicator

The EtherCAT Status Indicator is a green/red dual LED. It combines run indication (when green) and error indication (when red) of the EtherCAT device.

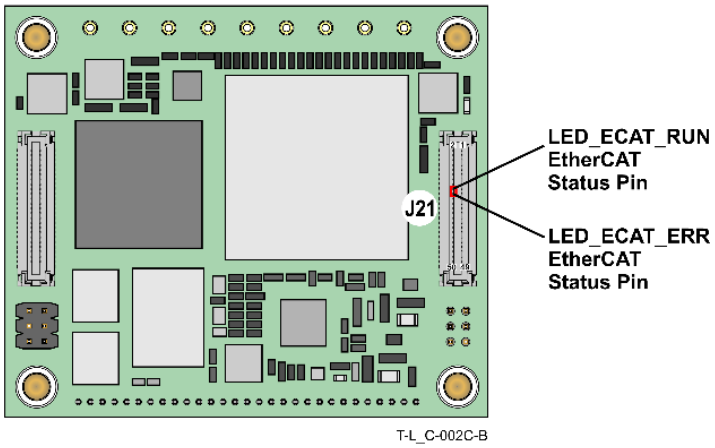


Figure 33: EtherCAT Status Indicators

The following figure describes the diagram connection the LED:

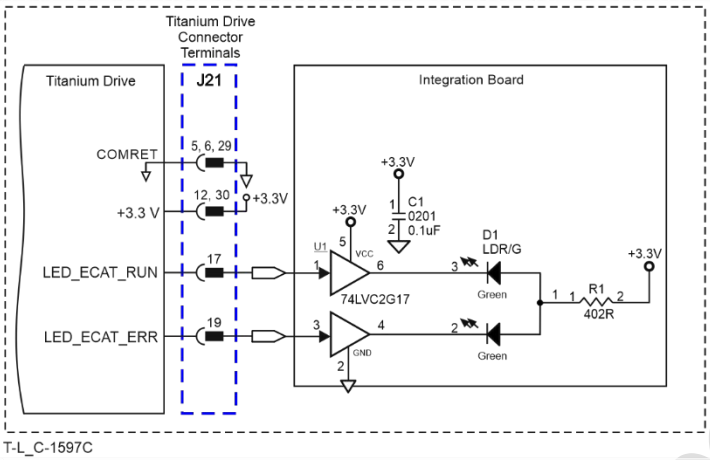


Figure 34: EtherCAT Status LED

8.12.1.2 EtherCAT Link Indicators

The EtherCAT Link Indicators are green LEDs. 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.

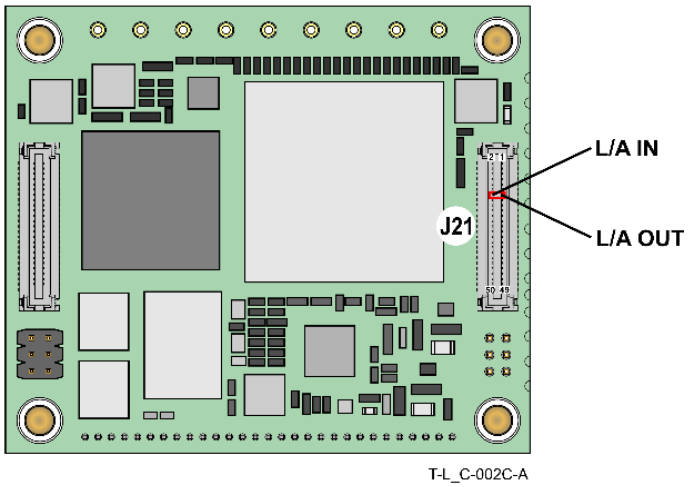


Figure 35: EtherCAT Link Indicators

The following figure describes the connections of the status LED.

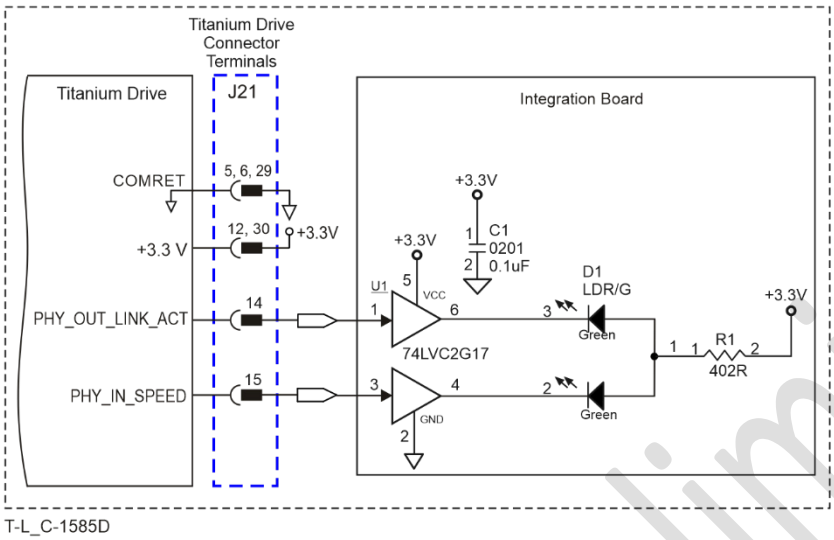


Figure 36: EtherCAT LINK Indicator LEDs

8.12.2 CAN

Figure 37 displays the CAN connectivity.

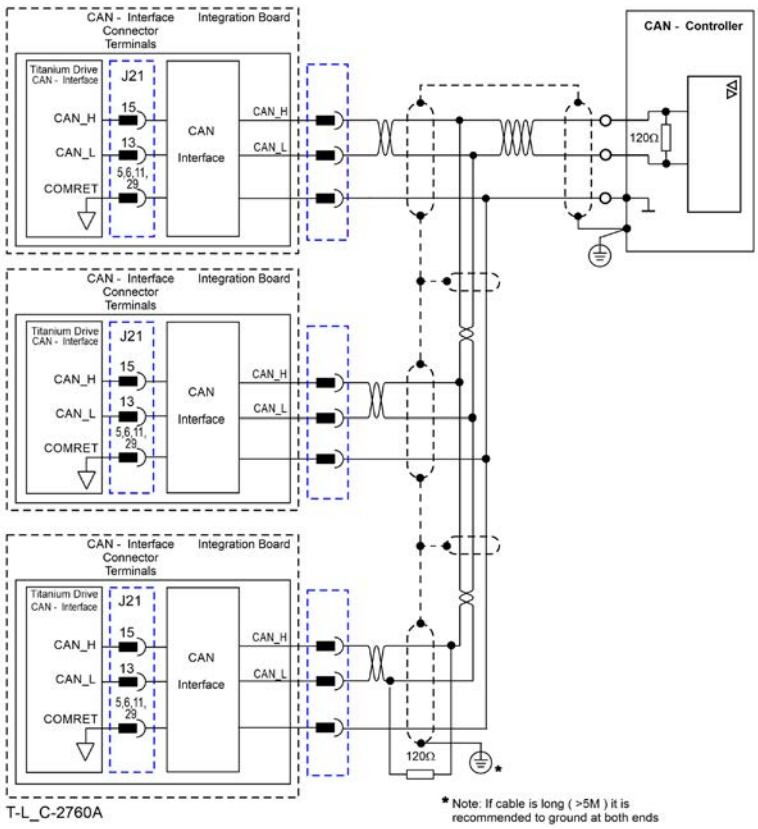


Figure 37: CAN Bus Connection

Important:
A 120 Ω termination resistor should be connected at each end of the network cable.

8.12.3 UART

The Titanium Castanet provides three ports of UART to allow the customer to have diagnostics communication with the drive. The following table describes the pinouts:

Pin No. (J21)	Signal Network B,L	Signal Network A,K	Description	Function
35	MAIN_UART_TX	Not used	Main Receive UART	Interpreter, SIL, general use
36	MAIN_UART_RX	Not used	Main Transmit UART	
37	AUX2_UART_TX	AUX2_UART_TX	AUX2 Transmit UART	Interpreter, SIL, general use
38	AUX2_UART_RX	AUX2_UART_RX	AUX2 Receive UART	
39	AUX1_UART_TX	AUX1_UART_TX	AUX1 Transmit UART	General use
40	AUX1_UART_RX	AUX1_UART_RX	AUX1 Receive UART	

Table 42: UART Pins and Signals

8.12.3.1 Interface to Standard RS-232 to UARTs in the Integration Board

Each UART can have an interface on the integration board of the customer to standard RS-232 or differential RS-232.

Figure 38 describes the connection diagram for Standard RS-232 using the RS232 Transceiver.

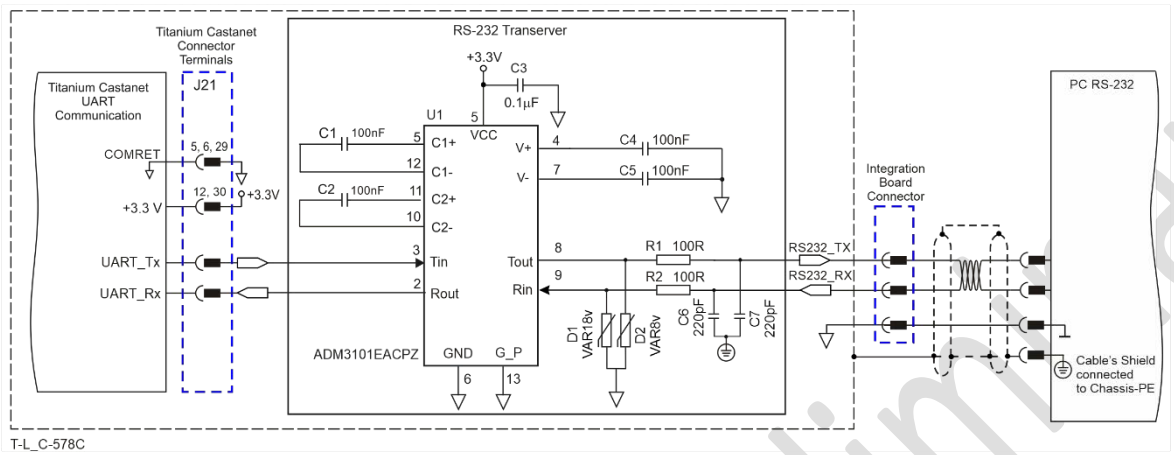


Figure 38: Standard RS-232 connection diagram

8.12.3.2 Interface to Differential RS-232 to UARTs in the Integration Board

Figure 39 describes the Differential RS-232 (RS-422) connection diagram using the RS-422 Transceiver.

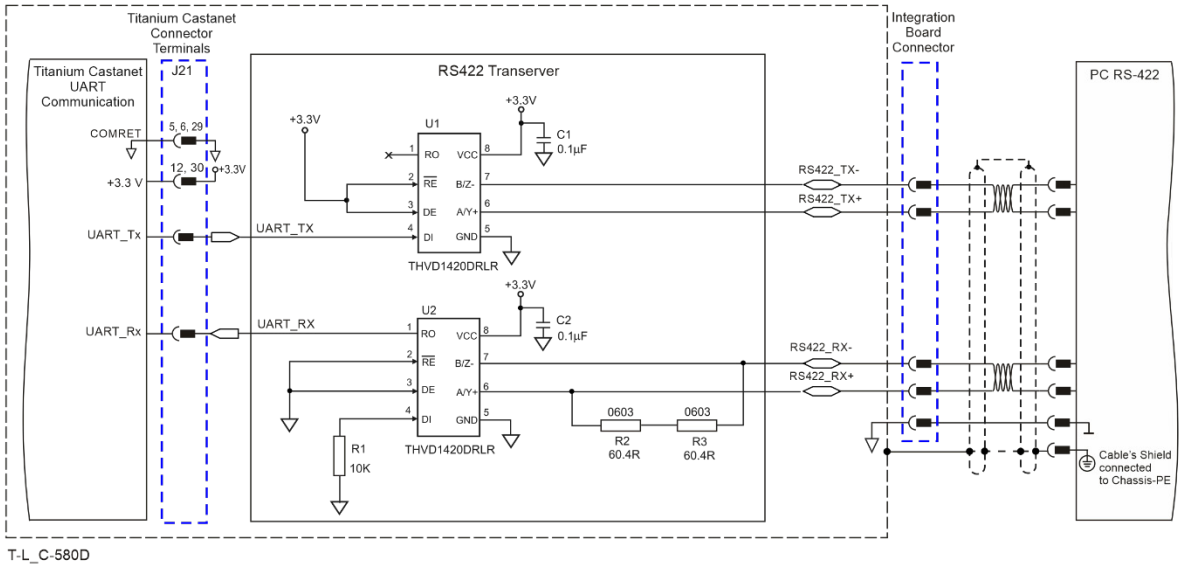


Figure 39: Differential RS-232 connection diagram

8.12.4 USB 2.0

Important:
It should be noted that throughout the USB section the following applies:
For short distances between the drive and control, 0.5 to 1.0 m wires can be used, and shielding is not required. For longer distances than 1.0 m and/or high EMI environment, shielded and twisted wires should be used. Drain wires should be connected to Elmo COMRET.

The following table describes the USB pins:

Pin# (J21)	Signal	Function
29	COMRET	Common return
41	USB_DP	USB_P
42	USB_DM	USB_N

Table 43: USB pins

Figure 40 shows the network connection diagram for the USB.

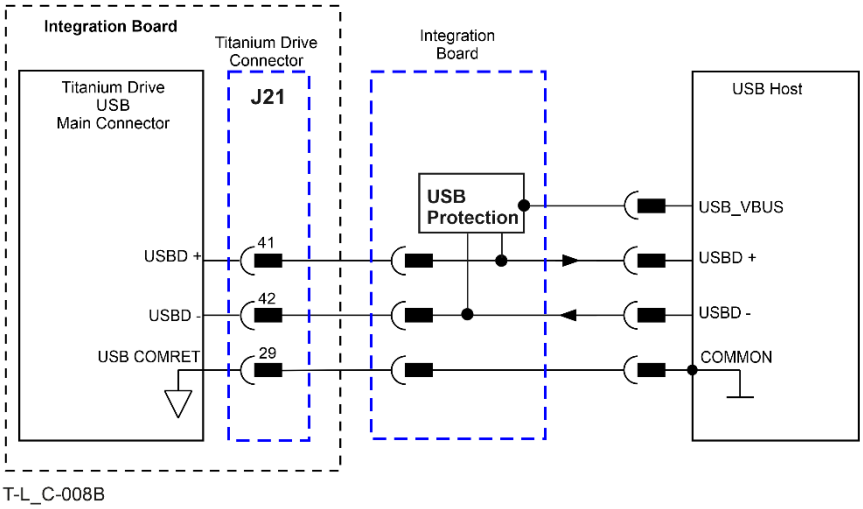


Figure 40: USB Network Diagram

Chapter 9 Powering Up

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

9.1 Initializing the System

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

9.2 Heat Dissipation

TBD

9.2.1 Thermal Data

TBD

9.2.2 Heat Dissipation Data

TBD

9.2.3 How to Use the Charts

TBD

Chapter 10 Dimensions

This chapter provides detailed technical dimensions regarding the Titanium Castanet.

10.1 Titanium Castanet Dimensions without Heatsink

These are the dimensions of the Titanium Castanet without the external heatsink.

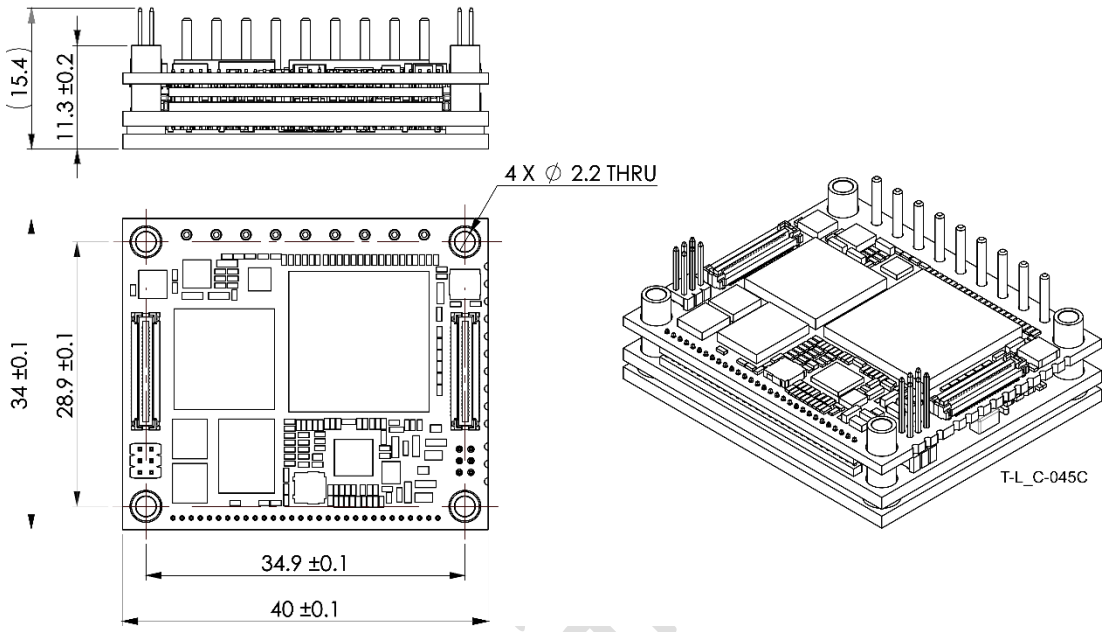


Figure 41: Titanium Castanet Dimensions – without Heatsink

10.2 Titanium Castanet Dimensions with Heatsink

An additional heatsink can be order for products with P/N TCAS-Mz2-CXXX/YYYzzz**H**0Iz. The dimensions increase by a length of 1 mm, a width of 20 mm, and a height of 4 mm.

Note: The heatsink can be purchased separate from the module and the customer needs to attach it according to the instructions in 6.4.

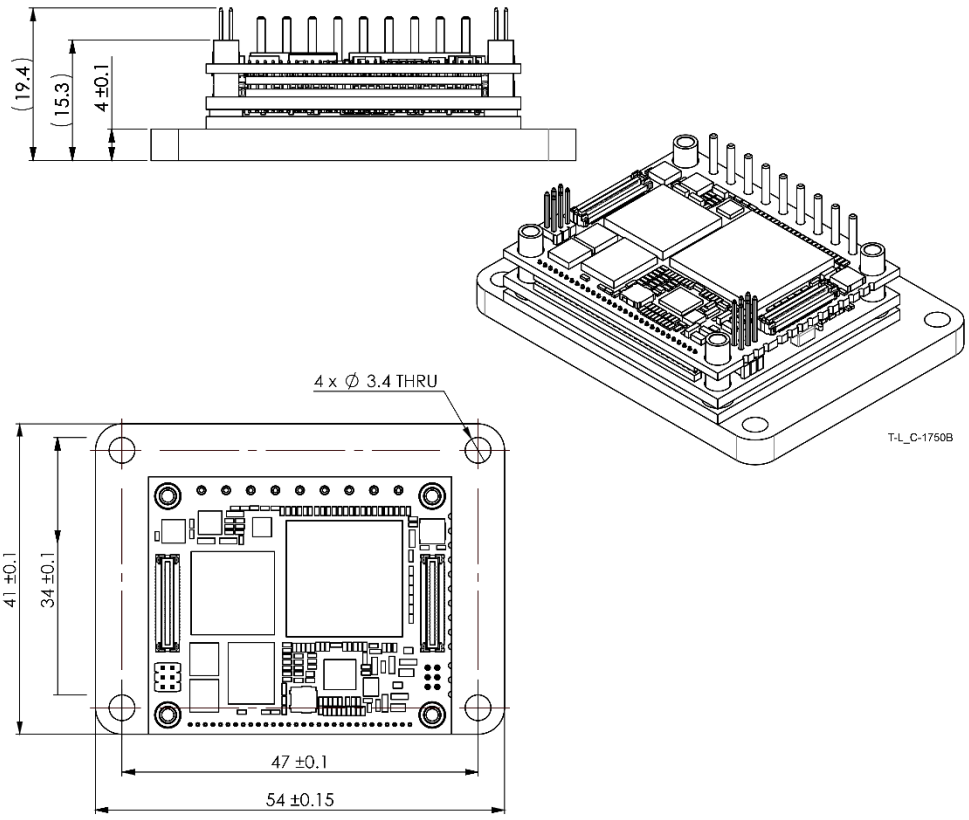


Figure 42: Titanium Castanet Dimensions – with Heatsink

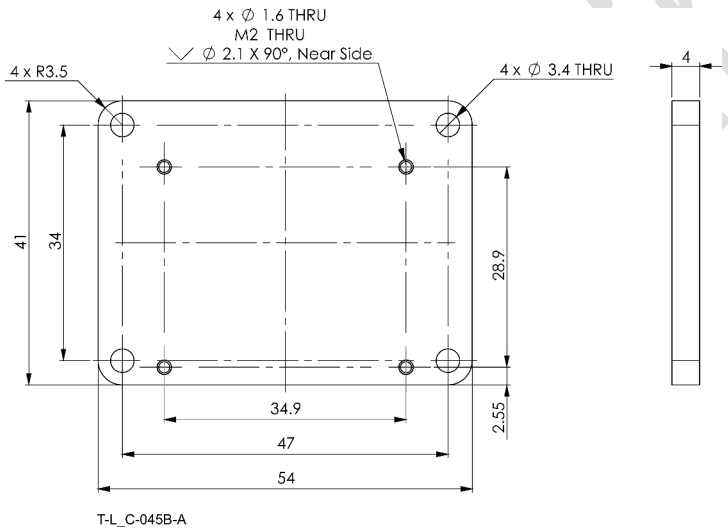
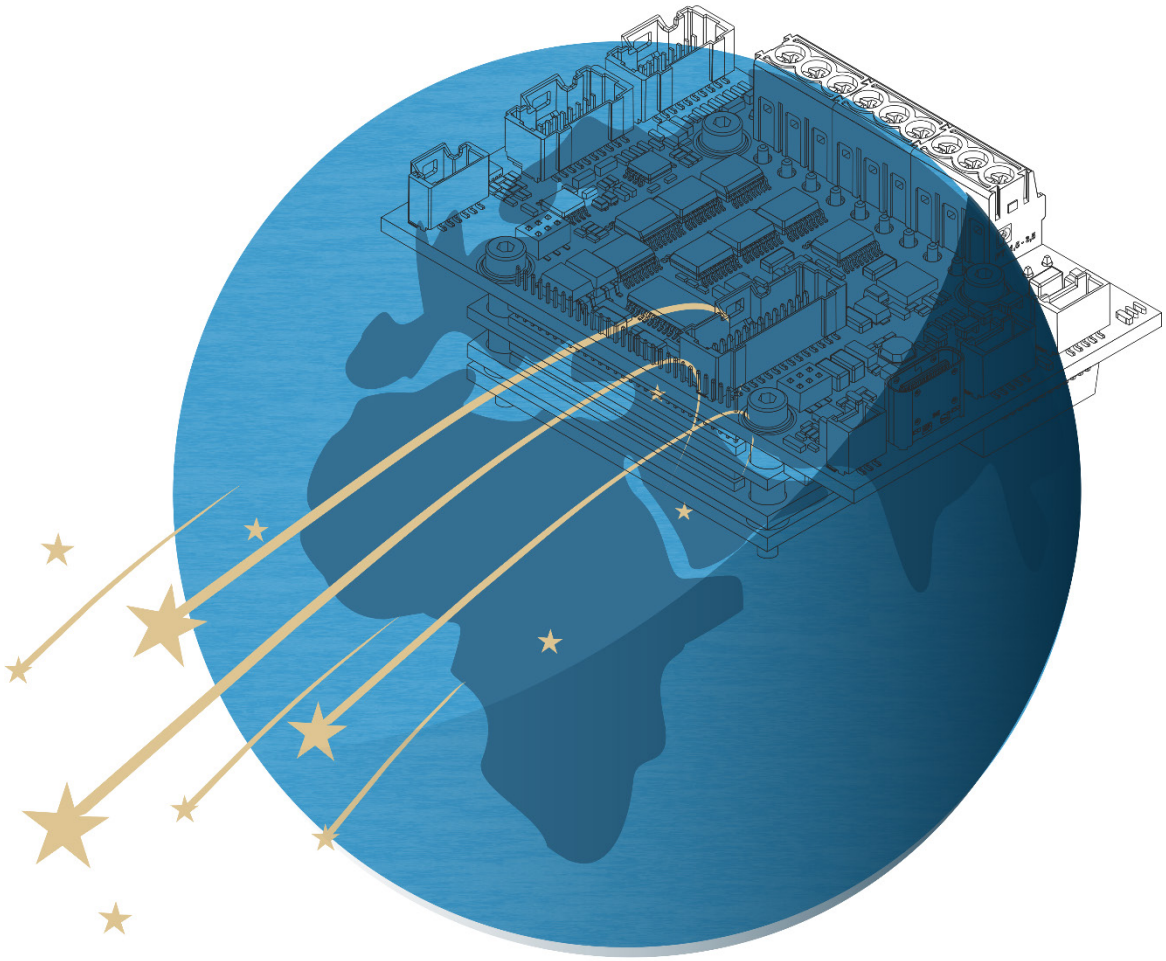


Figure 43: External heat sink for the Titanium Castanet

Elmo

Dedicated To Excel



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