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Gold Line Panel Mounted Servo Drive Hardware Manual

December 2015 (Ver. 1.013) www.elmomc.com

Elmo Motion Control

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Chapter 1: Introduction

The Gold Panel Mounted Servo Drive is an advanced high power density servo drive. It provides top servo performance, advanced networking and built-in safety, all in a compact package. The Gold line has a fully featured motion controller and local intelligence.

The GOLD Line includes two main drives families dependent on the environmental operating condition. While the GOLD servo drives are designed to meet ordinary environmental conditions, the GOLD ExtrIQ servo drives are designed to meet Extreme environmental conditions.

The ExtrIQ models are a series of servo drives designed, verified, qualified, manufactured and tested to endure extreme environmental conditions. The ExtrIQ line targets any application that has to withstand any harsh conditions.

The Gold Panel Mounted Servo 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, and is easily set up and tuned using the Elmo Application Studio (EASII) software tools.

As part of the Gold product line, it is fully programmable with the Elmo motion control language. For more about software tools, refer to the Elmo Application Studio Software Manual.

The Gold Panel Mounted Servo Drive is available in a variety of options. There are multiple power rating options, different communications options, a variety of feedback selections and I/O configuration possibilities. The configuration of the drive is determined by the Catalog Number.

This hardware guide describes the hardware features of the Gold Panel Mounted Servo Drive and the steps for its wiring, installation, power-up, and STO, feedback, and IO communication signals. **The wiring diagrams shown are examples, and for specific details of a Gold Panel Mounted Servo Drive, please refer to the specific servo drive hardware manual.** Following these guidelines ensures optimal performance of the drive and the system to which it is connected. While this manual details and describes the generic features of the Elmo servo drives, certain drives have unique features which are fully detailed in their individual manuals.

The Gold Panel Mounted Servo Drives which include the ExtrIQ models share the same signals; but are presented in different types of connectors:

- D-Type
- Shrouded
- Micro Hi-Reliability

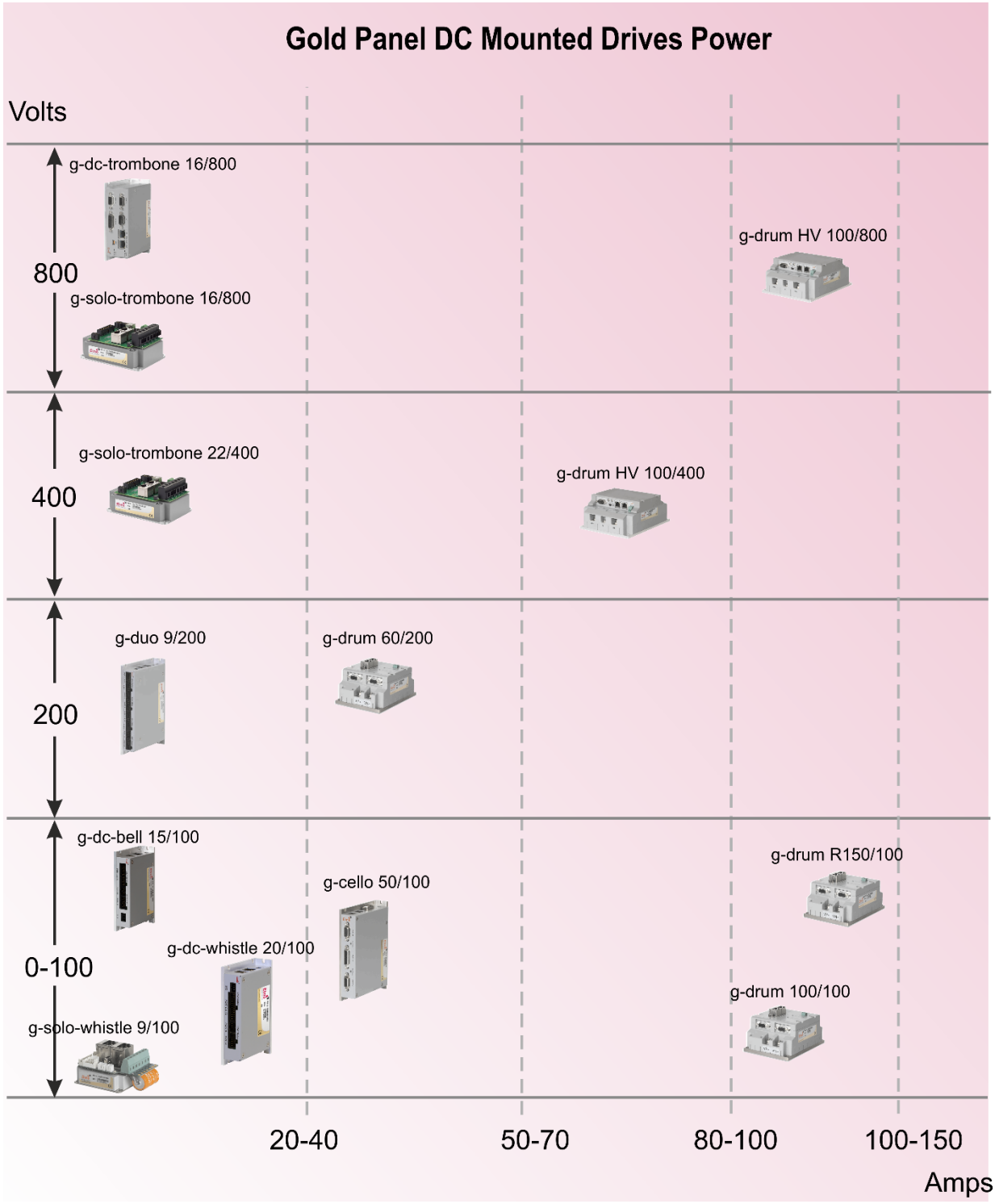
Refer to the specific Gold Panel Mounted Servo Drive Installation Guide for the **main and auxiliary power signal**, pinout, D-Type, and Shrouded connector wiring details.

Other Drive Hardware Manuals Available include the **MAN-G-Board Level Modules Hardware Manual**. This manual describes the Gold series of hardware drives for mounting on a PCB by soldering its pins directly to the PCB.

1.1. Gold Servo Drives Power

1.1.1. DC Products

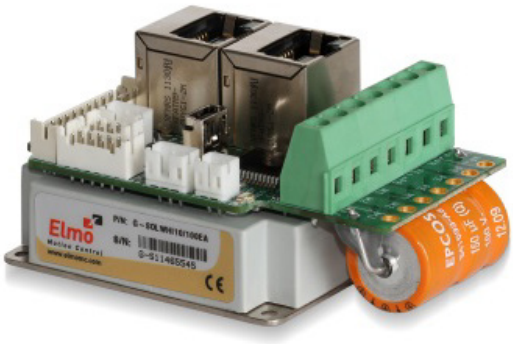
The following describes the range of Gold DC Panel Mounted servo drives which subscribe to the standard Environmental Conditions (refer to section 13.1).



Gold Whistle family				G-DCWHI					
Connector Type				Shrouded connector					
Current/Voltage (Amps/VDC	**1/100**	**2.5/100**	**5/100**	**10/100**	**15/100**	**20/100**	**3/200**	**6/200**	**9/200**
	Continuous Output Current (A) ranges 1 to 20 A. The current is given in amplitude. **Note:** In all drives, the peak current IP=2xIC, except for "R" drives								
Continuous Output Power(W)	**80**	**200**	**400**	**800**	**1200**	**1600**	**480**	**960**	**1450**
	Note: For all non-"R" drives, the power peak is x2.								

STO	TTL *or*	**2**
	PLC Source	**2**
Digital Input Options	TTL, *or*	**6**
	PLC Source, *or*	**6**
	PLC Sink	**6**
Digital Output options	TTL, *or*	**4**
	PLC Source, *or*	**4**
	PLC Sink, or	**4**
Analog Input	Differential ±10V	**1**
Feedback	Standard Port A, B, & C	**√**
Communication Options	USB	**√**
	EtherCAT (option)	**√**
	EtherCAT with Switches (option)	
	CAN (option)	**√**
	EIA RS-232 (Standard)	**-**

<table>
<tr><th colspan="2">Gold Whistle family</th><th colspan="9">G-SOLWHI</th></tr>
<tr><td colspan="2">Connector Type</td><td colspan="9">Shrouded connector</td></tr>
<tr><td rowspan="2">Current/Voltage (Amps/VDC</td><td>1/100</td><td>2.5/100</td><td>5/100</td><td>10/100</td><td>15/100</td><td>20/100</td><td>3/200</td><td>6/200</td><td>9/200</td></tr>
<tr><td colspan="9">Continuous Output Current (A) ranges 1 to 20 A. The current is given in amplitude.
Note: In all drives, the peak current IP=2xIC, except for “R” drives</td></tr>
<tr><td rowspan="2">Continuous Output Power(W)</td><td>80</td><td>200</td><td>400</td><td>800</td><td>1200</td><td>1600</td><td>480</td><td>960</td><td>1450</td></tr>
<tr><td colspan="9">Note: For all non-“R” drives, the power peak is x2.</td></tr>
<tr><td rowspan="2">STO</td><td colspan="5">TTL or</td><td colspan="4">2</td></tr>
<tr><td colspan="5">PLC Source</td><td colspan="4">2</td></tr>
<tr><td rowspan="3">Digital Input Options</td><td colspan="5">TTL, or</td><td colspan="4">6</td></tr>
<tr><td colspan="5">PLC Source, or</td><td colspan="4">6</td></tr>
<tr><td colspan="5">PLC Sink</td><td colspan="4">-</td></tr>
<tr><td rowspan="3">Digital Output options</td><td colspan="5">TTL, or</td><td colspan="4">2</td></tr>
<tr><td colspan="5">PLC Source, or</td><td colspan="4">2</td></tr>
<tr><td colspan="5">PLC Sink, or</td><td colspan="4">-</td></tr>
<tr><td>Analog Input</td><td colspan="5">Differential ±10V</td><td colspan="4">1</td></tr>
<tr><td>Feedback</td><td colspan="5">Standard Port A, B, & C</td><td colspan="4">√</td></tr>
<tr><td rowspan="5">Communication Options</td><td colspan="5">USB</td><td colspan="4">√</td></tr>
<tr><td colspan="5">EtherCAT (option)</td><td colspan="4">√</td></tr>
<tr><td colspan="5">EtherCAT with Switches (option)</td><td colspan="4"></td></tr>
<tr><td colspan="5">CAN (option)</td><td colspan="4">√</td></tr>
<tr><td colspan="5">EIA RS-232 (Standard)</td><td colspan="4">√</td></tr>
</table>



<table>
<tr><th colspan="3">Gold Duo</th><th colspan="6">G-DUO</th></tr>
<tr><td colspan="3">Includes two Gold Whistles</td><td colspan="6"></td></tr>
<tr><td colspan="3">Connector Type</td><td colspan="6">Shrouded connector</td></tr>
<tr><td rowspan="2">Current/Voltage (Amps/VDC</td><td>5/100</td><td>10/100</td><td>15/100</td><td>20/100</td><td>3/200</td><td>6/200</td><td>9/200</td></tr>
<tr><td colspan="7">Continuous Output Current (A) ranges 5 to 20 A. The current is given in amplitude.
Note: In all drives, the peak current IP=2xIC, except for “R” drives</td></tr>
<tr><td rowspan="2">Continuous Output Power(W)</td><td>400</td><td>800</td><td>1200</td><td>1600</td><td>480</td><td>960</td><td>1450</td></tr>
<tr><td colspan="7">Note: For all non-“R” drives, the power peak is x2.</td></tr>
<tr><td rowspan="2">STO</td><td colspan="2">TTL, or</td><td>2</td><td rowspan="10" colspan="4"> 
</td></tr>
<tr><td colspan="2">PLC Source</td><td>2</td></tr>
<tr><td rowspan="3">Digital Input Options</td><td colspan="2">TTL, or</td><td>6</td></tr>
<tr><td colspan="2">PLC Source, or</td><td>6</td></tr>
<tr><td colspan="2">PLC Sink</td><td>-</td></tr>
<tr><td rowspan="3">Digital Output Options</td><td colspan="2">TTL, or</td><td>4</td></tr>
<tr><td colspan="2">PLC Source, or</td><td>4</td></tr>
<tr><td colspan="2">PLC Sink</td><td>-</td></tr>
<tr><td>Analog Input</td><td colspan="2">Differential ±10V</td><td>1</td></tr>
<tr><td>Feedback</td><td colspan="2">Standard Port A, B, & C</td><td>√</td></tr>
<tr><td rowspan="2">Communication Options</td><td colspan="2">USB</td><td>√</td></tr>
<tr><td colspan="2">EtherCAT (option)</td><td>√</td></tr>
</table>

Gold Guitars, Cello			G-SOLGUT				
Connector Type			Shrouded connector				
Current/Voltage (Amps/VDC	**20/100**	**35/100**	**50/100**	**10/200**	**17/200**	**20/200**	
	Continuous Output Current (A) ranges 10 to 50 A. The current is given in amplitude. **Note:** In all drives, the peak current IP=2xIC, except for "R" drives						
Continuous Output Power(W)	**1600**	**2800**	**4000**	**1650**	**2800**	**3300**	
	Note: For all non-"R" drives, the power peak is x2.						
STO	TTL, *or*		**2**				
	PLC Source		**2**				
Digital Input Options	TTL, *or*		**6**				
	PLC Source, *or*		**6**				
	PLC Sink		**6**				
Digital Output Options	TTL, *or*		**4**				
	PLC Source, *or*		**4**				
	PLC Sink		**4**				
Analog Input	Differential ±10V		**1**				
Feedback	Standard Port A, B, & C		**√**				
Communication Options	USB		**√**				
	EtherCAT (option)		**√**				
	EtherCAT with Switches (option)		**√**				
	CAN (option)		**√**				
	EIA RS-232 (Standard)		**√**				

Gold Guitars, Cello			G-CELLO			
Connector Type			D-Type			
Current/Voltage (Amps/VDC	**20/100**	**35/100**	**50/100**	**10/200**	**17/200**	**20/200**
	Continuous Output Current (A) ranges 10 to 50 A. The current is given in amplitude. **Note:** In all drives, the peak current IP=2xIC, except for "R" drives					
Continuous Output Power(W)	**1600**	**2800**	**4000**	**1650**	**2800**	**3300**
	Note: For all non-"R" drives, the power peak is x2.					
STO	TTL, *or*		**2**			
	PLC Source		**2**			
Digital Input Options	TTL, *or*		**6**			
	PLC Source, *or*		**6**			
	PLC Sink		**6**			
Digital Output Options	TTL, *or*		**4**			
	PLC Source, *or*		**4**			
	PLC Sink		**4**			
Analog Input	Differential ±10V		**1**			
Feedback	Standard Port A, B, & C		**√**			
Communication Options	USB		**√**			
	EtherCAT (option)		**√**			
	EtherCAT with Switches (option)		**-**			
	CAN (option)		**√**			
	EIA RS-232 (Standard)		**-**			

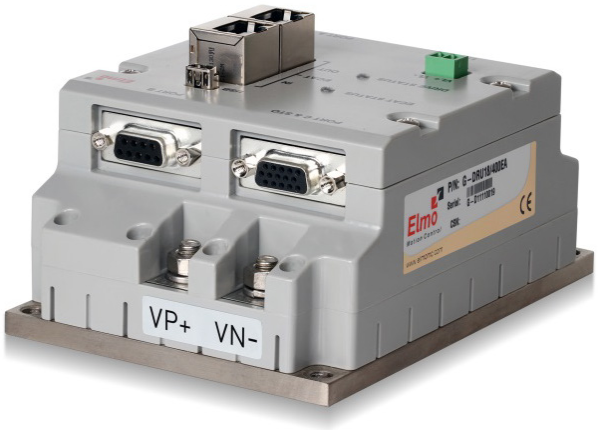
Gold DC Bell									
Connector Type				Shrouded connector					
Current/Voltage (Amps/VDC	**1/100**	**2.5/100**	**5/100**	**10/100**	**15/100**	**3/200**	**6/200**	**9/200**	
	Continuous Output Current (A) ranges 1 to 15 A. The current is given in amplitude. **Note:** In all drives, the peak current IP=2xIC, except for "R" drives								
Continuous Output Power(W)	**80**	**200**	**400**	**800**	**1200**	**480**	**960**	**1450**	
	Note: For all non-"R" drives, the power peak is x2.								
STO	TTL, *or*		**2**						
	PLC Source		**2**						
Digital Input Options	TTL, *or*		**6**						
	PLC Source, *or*		**6**						
	PLC Sink		**6**						
Digital Output Options	TTL, *or*		**4**						
	PLC Source, *or*		**4**						
	PLC Sink		**4**						
Analog Input	Differential ±10V		**1**						
	Single Ended		**-**						
Feedback	Standard Port A, B, & C		**√**						
Communication Options	USB		**√**						
	EtherCAT (option)		**√**						
	EtherCAT with Switches (option)		**-**						
	CAN (option)		**√**						

Gold Trombone family		G-DCTRO								
Connector Type		D-Type								
Current/Voltage (Amps/VDC		**6/400**	**12/400**	**16/400**	**R17/400**	**R22/400**	**8/800**	**12/800**	**R11/800**	**R16/800**
		Continuous Output Current (A) ranges 6 to 22 A. The current is given in amplitude. **Note:** In all drives, the peak current IP=2xIC, except for "R" drives								
Continuous Output Power(W)		**2000**	**4000**	**5000**	**5000**	**5500**	**5000**	**7500**	**7000**	**10,000**
		Continuous Output Power **Note:** For all non-"R" drives, the power peak is x2.								
STO	TTL, *or*	**2**								
	PLC Source	**2**								
Digital Input Options	TTL, *or*	**6**								
	PLC Source, *or*	**6**								
	PLC Sink	**6**								
Digital Output Options	TTL, *or*	**4**								
	PLC Source, *or*	**4**								
	PLC Sink	**4**								
Analog Input	Differential ±10V	**1**								
Feedback	Standard Port A, B, & C	**√**								
Communication Options	USB	**√**								
	EtherCAT (option)	**√**								
	EtherCAT with Switches (option)	**-**								
	CAN (option)	**√**								
	EIA RS-232 (Standard)	**-**								

Gold Trombone family				G-SOLTRO					
Connector Type				Shrouded connector					
Current/Voltage (Amps/VDC	**6/400**	**12/400**	**16/400**	**R17/400**	**R22/400**	**8/800**	**12/800**	**R11/800**	**R16/800**
	Continuous Output Current (A) ranges 6 to 22 A. The current is given in amplitude. **Note:** In all drives, the peak current IP=2xIC, except for "R" drives								
Continuous Output Power(W)	**2000**	**4000**	**5000**	**5000**	**5500**	**5000**	**7500**	**7000**	**10,000**
STO	TTL, *or*			**2**					
	PLC Source			**2**					
Digital Input Options	TTL, *or*			**6**					
	PLC Source, *or*			**6**					
	PLC Sink			**6**					
Digital Output Options	TTL, *or*			**4**					
	PLC Source, *or*			**4**					
	PLC Sink			**4**					
Analog Input	Differential ±10V			**1**					
Feedback	Standard Port A, B, & C			**√**					
Communication Options	USB			**√**					
	EtherCAT (option)			**√**					
	EtherCAT with Switches (option)			**-**					
	CAN (option)			**√**					
	EIA RS-232 (Standard)			**-**					

Gold Drum family		G-DRU (D-Type)
Connector Type		D-Type
Current/Voltage (Amps/VDC		Operating Voltage Range 11 to 390 VDC Continuous Output Current (A) ranges 18 to 100 A. The current is given in amplitude. **Note:** In all drives, the peak current IP=2xIC, except for "R" drives
Continuous Output Power(W)		
STO	TTL, *or*	**2**
	PLC Source	**2**
	STO Output Status (option)	**Replacing OUT4**
Digital Input Options	TTL, *or*	**6**
	PLC Source, *or*	**6**
	PLC Sink	**6**
Digital Output Options	TTL, *or*	**4**
	PLC Source, *or*	**4**
	PLC Sink	**4**
Analog Input	Differential ±10V	**1**
Feedback	Standard Port A, B, & C	**√**
Communication Options	USB	**√**
	EtherCAT (option)	**√**
	EtherCAT with Switches (option)	**-**
	CAN (option)	**√**
	EIA RS-232 (Standard)	**√**
	Differential RS-232	**√**

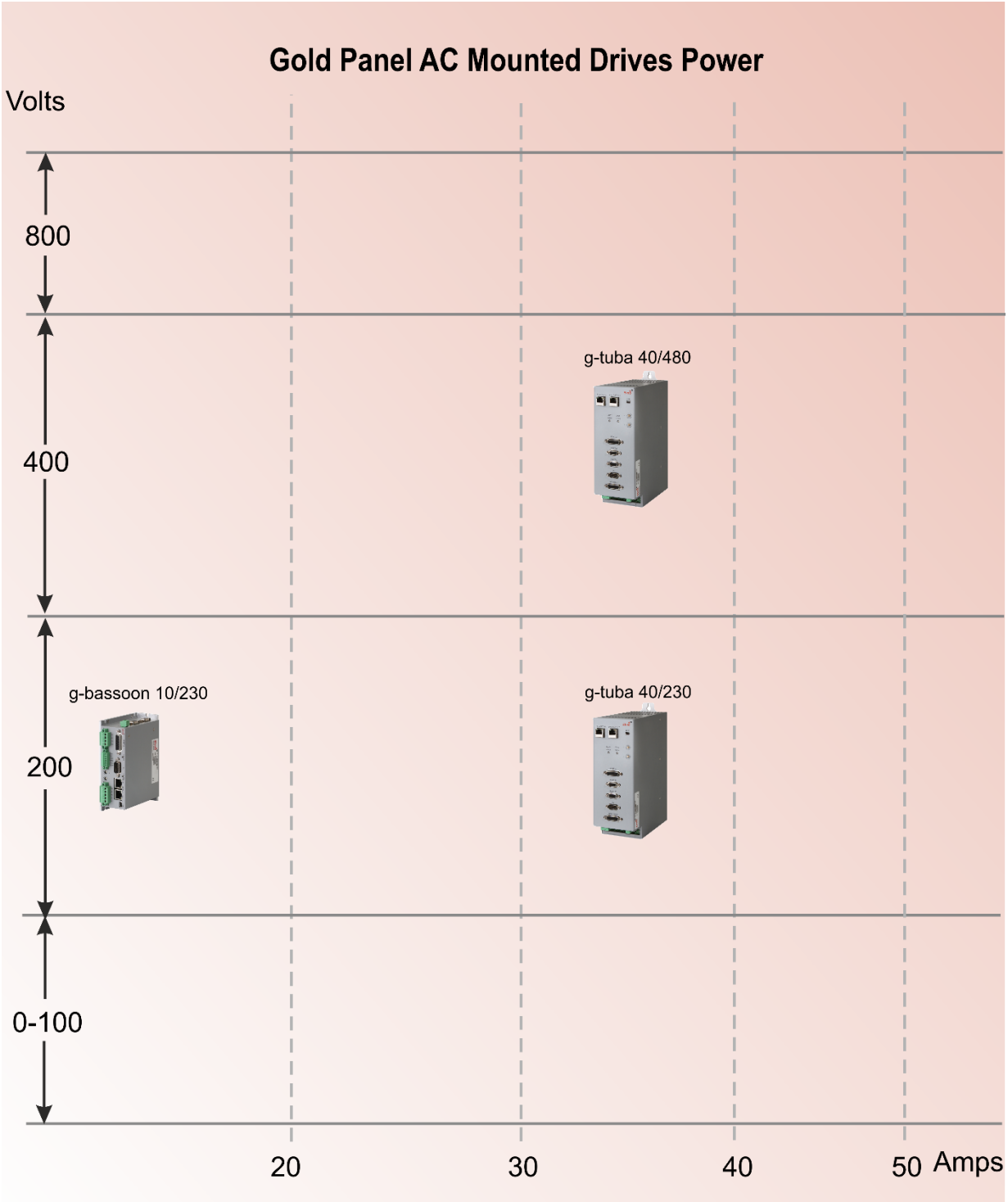
Gold Drum family		G-DRU (RJ-45 Type)	
Connector Type		D-Type+RJ45	
Power	Operating Voltage Range (VDC)	**11 to 390**	
	Continuous Output Current (A) The current is given in amplitude. **Note:** In all drives, the peak current IP=2xIC, except for "R" drives	**18 to 100**	
	Continuous Output Power Range (kW) **Note:** For all non-"R" drives, the power peak is x2.	**2.70 to 9.60**	
STO	TTL, *or*	**2**	
	PLC Source	**2**	
	STO Output Status (option)	**Replacing OUT4, IN6**	
Digital Input Options	TTL, *or*	**6**	
	PLC Source, *or*	**6**	
	PLC Sink	**6**	
Digital Output Options	TTL, *or*	**4**	
	PLC Source, *or*	**4**	
	PLC Sink	**4**	
Analog Input	Differential ±10V	**1**	
Feedback	Standard Port A, B, & C	**√**	
Communication Options	USB	**√**	
	EtherCAT (option)	**√**	
	EtherCAT with Switches (option)	**-**	
	CAN (option)	**√**	
	EIA RS-232 (Standard)	**-**	
	Differential RS-232	**-**	



Gold Drum family		G-DRUHV	
Connector Type		D-Type+RJ45	
Power	Operating Voltage Range (VDC)	**50 to 780**	
	Continuous Output Current (A) The current is given in amplitude. **Note:** In all drives, the peak current IP=2xIC, except for "R" drives	**35 to 100**	
	Continuous Output Power Range (kW) **Note:** For all non-"R" drives, the power peak is x2.	**32.00 to 65.00**	
STO	TTL, *or*	**2**	
	PLC Source	**2**	
	STO Output Status (option)	**Replacing OUT4, IN6**	
Digital Input Options	TTL, *or*	**6**	
	PLC Source, *or*	**6**	
	PLC Sink	**6**	
Digital Output Options	TTL, *or*	**4**	
	PLC Source, *or*	**4**	
	PLC Sink	**4**	
Analog Input	Differential ±10V	**1**	
Feedback	Standard Port A, B, & C	**√**	
Communication Options	USB	**√**	
	EtherCAT (option)	**√**	
	EtherCAT with Switches (option)	**√**	
	CAN (option)	**√**	
	EIA RS-232 (Standard)	**-**	
	Differential RS-232	**-**	

1.1.2. AC Products

The following describes the range of Gold AC Panel Mounted servo drives.

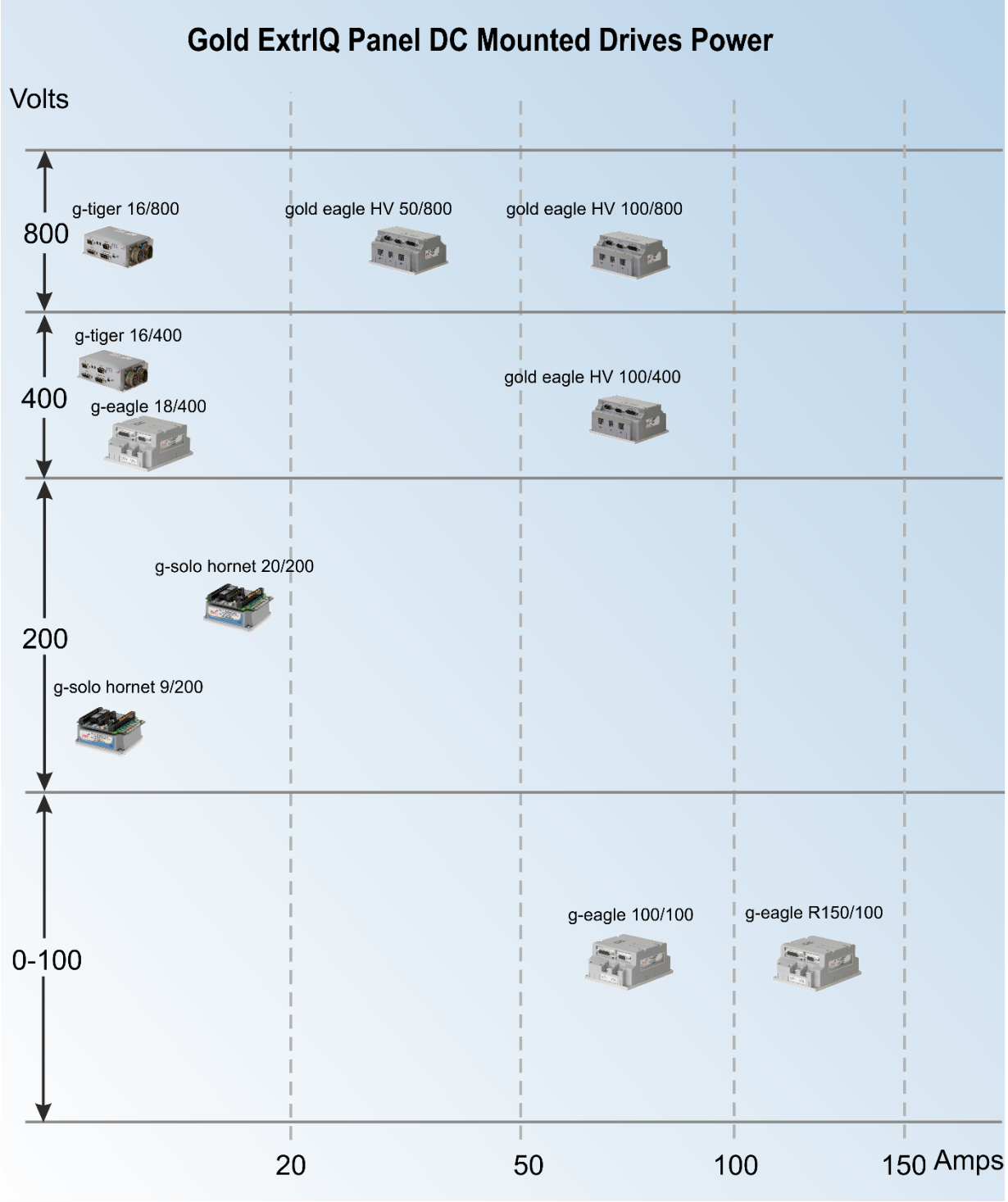


Gold AC Drives		G-TUB	
Connector Type		D-Type+RJ45	
Power	Operating Voltage Range (VAC)	**1 x 60 or 3 x 60 to 3 x 480**	
	Continuous Output Current (A) The current is given in amplitude. **Note:** In all drives, the peak current IP=2xIC, except for "R" drives	**30 to 40**	
	Continuous Output Power Range (kW) **Note:** For all non-"R" drives, the power peak is x2.	**9.50 to 25.00**	
STO	TTL, *or*	**2**	
	PLC Source	**2**	
	STO Output Status (option)	**Replacing OUT4, IN6**	
Digital Input Options	TTL	**6**	
	PLC Source	**6**	
	PLC Sink	**6**	
Digital Output Options	TTL, or	**4**	
	PLC Source, or	**4**	
	PLC Sink	**4**	
Analog Input	Differential ±10V	**1**	
Feedback	Standard Port A, B, & C	**√**	
Communication Options	USB	**√**	
	EtherCAT (option)	**-**	
	EtherCAT with Switches (option)	**√**	
	CAN (option)	**√**	
	EIA RS-232 (Standard)	**-**	
	Differential RS-232	**-**	
Other	Network IO (option)	**√**	
	Network IO (option)	**√**	

Gold AC Drives		G-BAS	
Connector Type		D-Type+RJ45	
Power	Operating Voltage Range (VAC)	**1 x 50 or 3 x 50 to 1 x 270 or 3 x 270**	
	Continuous Output Current (A) The current is given in amplitude. **Note:** In all drives, the peak current IP=2xIC, except for "R" drives	**3 to 10**	
	Continuous Output Power Range (kW) **Note:** For all non-"R" drives, the power peak is x2.	**0.95 to 3.25**	
STO	TTL, *or*	**2**	
	PLC Source	**2**	
	STO Output Status (option)	**Replacing OUT4, IN6**	
Digital Input Options	TTL	**6**	
	PLC Source	**6**	
	PLC Sink	**6**	
Digital Output Options	TTL, or	**4**	
	PLC Source, or	**4**	
	PLC Sink	**4**	
Analog Input	Differential ±10V	**1**	
Feedback	Standard Port A, B, & C	**√**	
Communication Options	USB	**√**	
	EtherCAT (option)	**√**	
	EtherCAT with Switches (option)	**-**	
	CAN (option)	**√**	

1.1.3. ExtrIQ Products

The following describes the range of Gold ExtrIQ Panel Mounted servo drives which subscribe to the Extreme Environmental Conditions (refer to section 13.2).



Hornet family		G-SOLHOR	
Connector Type		Micro Hi-Reliability connector	
Power	Operating Voltage Range (VDC)	**12 to 195**	
	Continuous Output Current (A)	**1 to 20**	
	Continuous Output Power Range (kW)	**0.08 to 1.60**	
STO	Without STO, *or*		
	TTL *or*	**2**	
	PLC source	**2**	
Digital Input Options	TTL *or*	**6**	
	PLC Source	**6**	
Digital Output Options	Optically Isolated Open Collector-emitter	**2**	
Analog Input	Differential ±10V	**1**	
	Single Ended	**-**	
Feedback	Standard Port A, B, & C	**√**	
Communication Options	USB	**√**	
	EtherCAT (option)	**√**	
	EtherCAT with Switches (option)	**-**	
	CAN (option)	**√**	
	EIA RS-232 (Standard)	**√**	
	Differential RS-232	**√**	

Eagle family		G-EAGHV	
Connector Type		D-Type	
Power	Operating Voltage Range (VDC)	**50 to 680**	
	Continuous Output Current (A)	**35 to 100**	
	Continuous Output Power Range (kW)	**16.50 to 65.00**	
STO	TTL, *or*	**2**	
	PLC source	**2**	
	STO Output Status (option)	**Replacing OUT4, IN6**	
Digital Input Options	TTL, *or*	**6**	
	PLC Source, *or*	**6**	
	PLC Sink	**6**	
Digital Output Options	TTL, or	**4**	
	PLC Source, or	**4**	
	PLC Sink, or	**4**	
Analog Input	Differential ±10V	**1**	
Feedback	Standard Port A, B, & C	**√**	
Communication Options	USB	**√**	
	EtherCAT (option)	**√**	
	EtherCAT with Switches (option)	**√**	
	CAN (option)	**√**	
	EIA RS-232 (Standard)	**√**	
	Differential RS-232	**√**	

Eagle family		G-EAG	
Connector Type		D-Type	
Power	Operating Voltage Range (VDC)	**50 to 340**	
	Continuous Output Current (A)	**18 to 150**	
	Continuous Output Power Range (kW)	**3.40 to 12.00**	
STO	TTL, *or*	**2**	
	PLC source	**2**	
	STO Output Status (option)	**Replacing OUT4**	
Digital Input Options	TTL, *or*	**6**	
	PLC Source, *or*	**6**	
	PLC Sink	**6**	
Digital Output Options	TTL, *or*	**4**	
	PLC Source, *or*	**4**	
	PLC Sink	**4**	
Analog Input	Differential ±10V	**1**	
Feedback	Standard Port A, B, & C	**√**	
Communication Options	USB	**√**	
	EtherCAT (option)	**√**	
	EtherCAT with Switches (option)	**√**	
	CAN (option)	**√**	
	EIA RS-232 (Standard)	**√**	
	Differential RS-232	**√**	

Tiger	G-TIG

Connector Type		D-Type
Power	Operating Voltage Range (VDC)	**400 or 800**
	Continuous Output Current (A) The current is given in amplitude. **Note:** In all drives, the peak current IP=2xIC, except for "R" drives	**6 to 22**
	Continuous Output Power Range (kW) **Note:** For all non-"R" drives, the power peak is x2.	**2.0 to 10.0**
STO	TTL, *or*	**√**
	PLC Source, *or*	**√**
	STO Output Status (option)	**Replacing OUT4, IN6**
	PLC Sink (is not fully certified, and not recommended for new designs)	**√**
Digital Input Options	TTL, *or*	**6**
	PLC Source, *or*	**6**
	PLC Sink	**6**
Digital Output Options	TTL, *or*	**4**
	PLC Source, *or*	**4**
	PLC Sink	**4**
Analog Input	Differential ±10V	**1**
Feedback	Standard Port A, B, & C	**√**
Communication Options	USB	**√**
	EtherCAT (option) *or*	**√**
	CAN (option)	**√**
	EtherCAT with Switches (option) *or*	**√**
	RS-232 *or*	**√**
	RS-422	**√**

1.2. Elmo Part Number Description

The Hardware configuration of the Drive is determined by the Elmo part number, consisting of a maximum of eighteen words/digits.

G-[AAANNN]RXXX/YYYEEHZZ

Enclosure Type G- [AAANNN]RXXX/YYYEEHZZ	
AAA	Determines the type of the Package of the product in the family. None = Only one enclosure type in the family (such as DRUM, Cello, etc.) - No letters in P/N SOL = Integration of the Module and Interface board - three letters in the P/N) DC = Encased product - two letters in the P/N
NNN	Family Name (such as DRU, etc.)

Output Current Profile - G- AAANNN**[R]**XXX/YYYEEHZZ	
R	Determines the Current Profile: Blank = Standard current profile R = No peak current profile. The R type drive has no peak current capabilities, but only continuous current capabilities. These are higher than the "traditional" IC (by 1.5) and are only thermally limited.

Continuous Current (Amps) - G- AAANNNR**[XXX]**/YYYEEHZZ
The current may comprise of either one to three digit values. The current is given in amplitude. In all non "R" drives, the peak current is IP = 2xIC.

Maximum Operating Voltage (V) - G- AAANNNRXXX/**[YYY]**EEHZZ
The voltage may comprise of either two or three digit values.

Network Communications – G- AAANNNRXXX/YYY**[E]**EHZZ	
S	Standard, available for all Gold products: • CANopen • USB • RS-232: Relevant for: G-SOLWHI, G-SOLGUT, G-DRU (D-Type), G-SOLHOR, G-EAGHV, G-EAG
E	EtherCAT, available for all Gold products: • EtherCAT or Ethernet. The default configuration of the drive is EtherCAT. However the drive can be configured to the Ethernet mode instead of EtherCAT. • USB • RS-232: Relevant for: G-SOLWHI, G-SOLGUT, G-DRUM (D-Type), G-SOLHOR, G-EAGHV

Network Communications – G- AAANNNRXXX/YYY**[E]**EHZZ	
F	EtherCAT option with ID Rotary switches: This configuration includes Rotary switches for determining the EtherCAT logical Address. • EtherCAT or Ethernet • USB
G	The G option offers EtherCAT without ID switches and Differential RS-232 (RS-422) which is available for specific products i.e. G-SOLWHI, G-SOLGUT, G-DRUM (D-Type), G-SOLHOR, G-EAGHV: • EtherCAT or Ethernet. The default configuration of the drive is EtherCAT. • USB • Differential RS-232 (RS-422)
T	The T option offers CANopen and Differential RS-232 (RS-422) which is available for specific products i.e. G-SOLWHI, G-SOLGUT, G-DRUM (D-Type), G-SOLHOR, G-EAGHV: • CANopen • USB • Differential RS-232 (RS-422)

Feedback - G- AAANNNRXXX/YYYE**[E]**HZZ	
There are two feedback configurations. All Gold drives support in these configurations.	
E	Port A: Absolute Serial Encoder, Incremental Encoder, Digital Hall Port B: Incremental Encoder, Analog Encoder, Analog Hall
R	Port A: Absolute Serial Encoder, Incremental Encoder, Digital Hall Port B: Resolver

I/O and STO Type Table options - G- AAANNNRXXX/YYYEE**[H]**ZZ

For an explanation of the IO refer to Chapter 11: User I/Os.
For an explanation of STO refer to Chapter 9: STO (Safe Torque Off)
Single option from:

	IO	**STO**
T	TTL	TTL
Blank or S	PLC Source	PLC Source
H	PLC SINK	PLC Source (Certified)
AP or A	PLC SINK	PLC SINK (is not fully certified, and not recommended for new designs

Additional options (Available only in specific products) G- AAANNNRXXX/YYYEEH**[ZZ]**	
STO OUT: This is a special output **(open emitter and open collector)** to allow diagnostics of the STO mechanism. This output replaces the regular Digital output (refer to the specific installation guide for details). This option is available in the following products: G-TUB,G-BAS,G-DRU(D-TYPE),G-DRUHV	
O	STO out (This option offers 3 digital outputs instead of 4)
N or Blank	Without STO Out
Network IO: The Network IO allows additional I/Os to the Product (refer to the specific installation guide for the number of additional I/Os) available on G-TUB	
S	Standard
E	Extended I/O
Connector Type (Drum Only): Option applies to G-DRU where communication connections may be using RJ-45 or D-Type.	
Blank	With RJ-45 connectors
D	With D-Type connectors
Heat-Sink (G-DC-Trombone, DRUM) optional type heat-sinks	
Blank	Standard L shape(no fins)
1	L shape fins and fan
2	L shape fins without fan

Chapter 2: Safety Information

In order to achieve the optimum, safe operation of the Gold Panel Mounted Servo Drive, 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 Gold Panel Mounted Servo Drive 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 Gold Panel Mounted Servo Drive 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.

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.

2.1. Safety Referenced in this Document

The following table lists the references to specific sections on Functional Safety and the safety function STO:

Type	Reference
Safety function STO	Chapter 9: STO (Safe Torque Off)
Functional Safety Standards	15.1 Functional Safety

2.2. 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 Gold Panel Mounted Servo Drive from all voltage sources before servicing.
- The high voltage products within the Gold Line range contain grounding conduits for electric current protection. Any disruption to these conduits may cause the instrument to become hot (live) and dangerous.
- After shutting off the power and removing the power source from your equipment, wait at least 1 minute 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.

2.3. Cautions

- The maximum DC power supply connected to the instrument must comply with the parameters outlined in this guide.
- When connecting the Gold Panel Mounted Servo Drive to an approved isolated auxiliary 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 Gold Panel Mounted Servo Drive, 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

2.4. CE Marking Conformance

The Gold Panel Mounted Servo Drive 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 Gold Panel Mounted Servo Drive 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.

2.5. 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 time of installation, or 18 months from time of shipment, whichever comes first. No other warranties, expressed or implied — and including a warranty of merchantability and fitness for a particular purpose — extend beyond this warranty.

Chapter 3: Product Features

3.1. System Architecture

The GOLD line supports a variety of voltage levels. The following figure describes the system architecture of low voltage products (up to 200V, e.g. G-WHI family, G-GUT family).

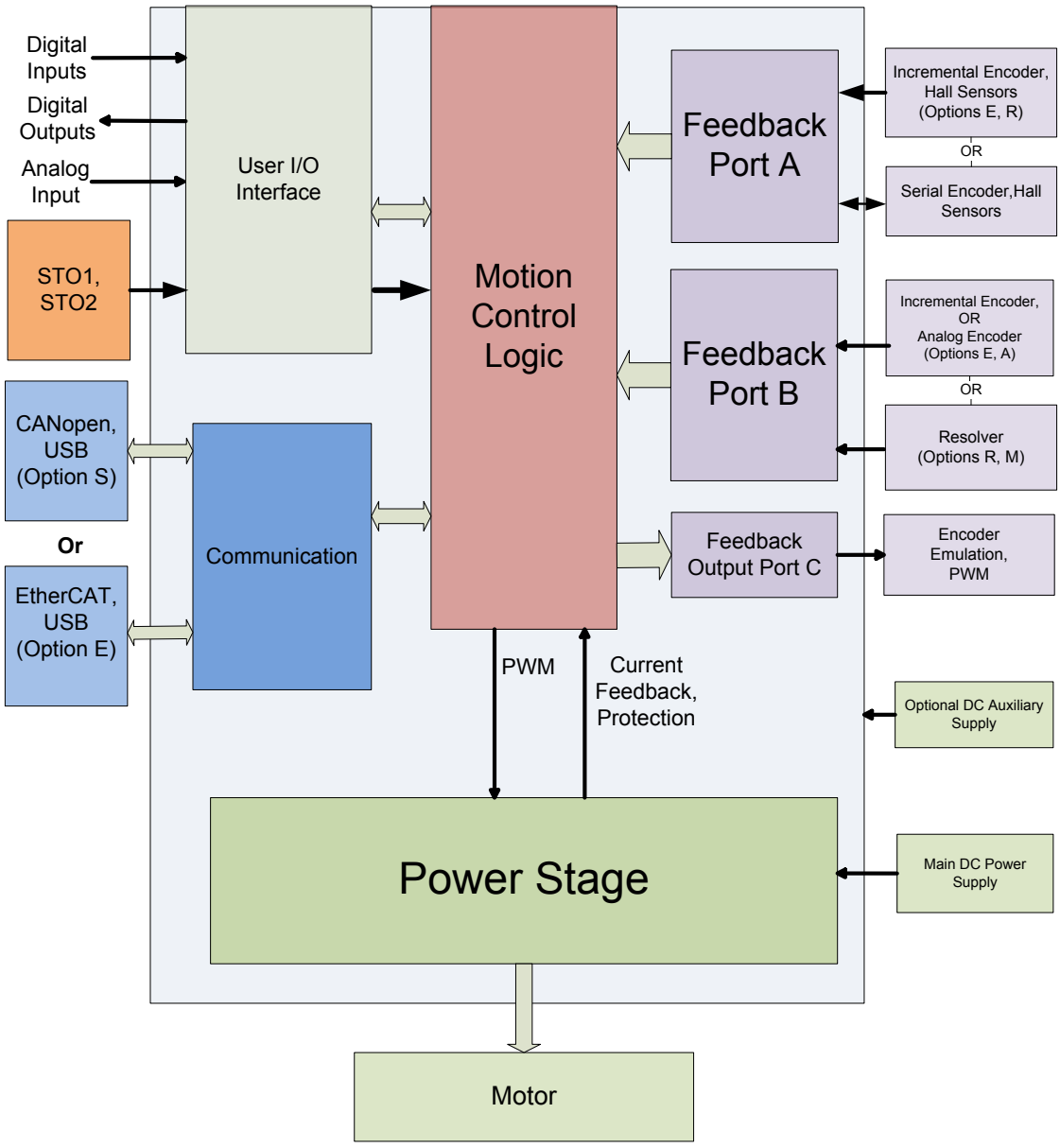


Figure 1: Gold Servo Drive System Block Diagram for Non Isolated products

For high voltage products (e.g. Gold Trombone family, Gold Drum, etc.), the following figure describes the architecture, where the Power stage is fully isolated from the control unit.

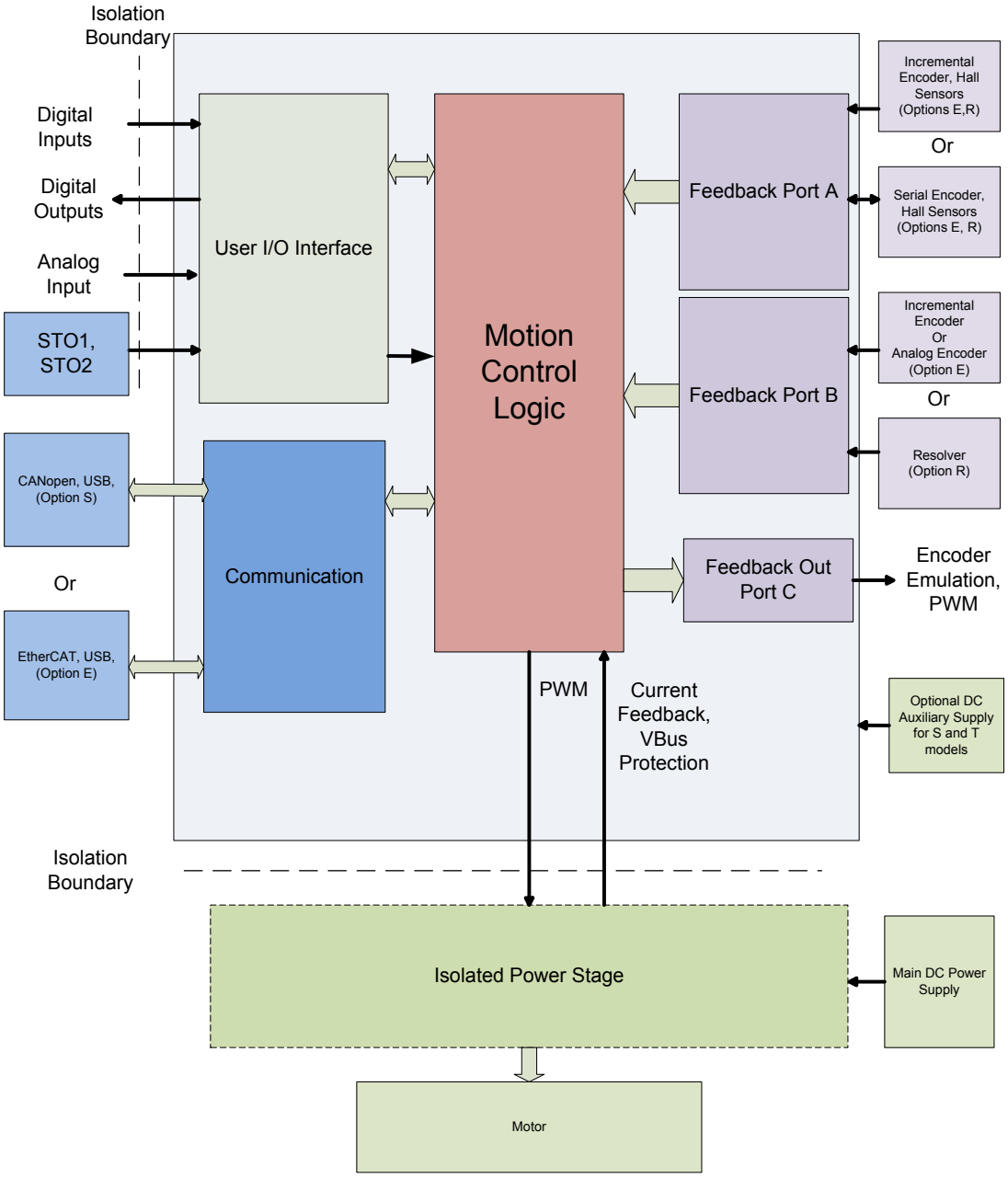


Figure 2: Gold Servo Drive System Block Diagram for Isolated from the mains products

3.2. Servo Control

- Advanced and extremely fast vector control algorithm (current loop bandwidth: 4 kHz)
- Current/Torque sampling rate: up to 25 kHz (40 µs)
- Velocity sampling rate: up to 12.5 kHz (80 µs)
- Position sampling rate: up to 12.5 kHz (80 µs)
- Electrical commutation frequency: up to 4 kHz
- Current closed loop bandwidth exceeds 4 kHz
- Position/Velocity/Acceleration command range – full 32 bit
- Position over velocity, with full dual loop support
- S-curve Profile Smoothing
- Cogging, BEMF and ωxL compensation
- Dual Loop Operation supported by Auto Tuning
- Fast, easy and efficient advanced Auto Tuning
- Motion profiler numeric range:
  - Position up to ±2 x 109 counts
  - Velocity up to 2 x 10^9 counts/sec
  - Acceleration up to 2 x 10^9 counts/sec^2

3.3. Advanced Filters and Gain Scheduling

- "On-the-Fly" gain scheduling of current and velocity
- Velocity and position with "1-2-2" PIP controllers
- Automatic commutation alignment
- Automatic motor phase sequencing
- Current gain scheduling to compensate for the motor's non-linear characteristics
- Advanced filtering: Low pass, Notch, General Biquad
- Current loop gain scheduling to compensate for bus voltage variations
- Velocity gain scheduling for ultimate velocity loop performance
- Gains and filter scheduling vs. position for mechanical coupling optimization, speed and position tracking errors
- High order filters gain scheduling vs. speed and position

3.4. Motion Control

- Motion control programming environment
- Motion modes: PTP, PT, ECAM, Follower, Dual Loop, Current Follower, Fast event capturing inputs

- Full DS-402 motion mode support, in both the CAN and CAN over EtherCAT (CoE) protocols, including Cyclic Position/Velocity modes. Fast (Hardware) event capturing inputs, supporting < 1 µs latch latency
- Fast (hardware) Output Compare, with < 1 µs latency
- Output compare repetition rate:
  - Fixed Gap: Unlimited
  - Table based: 4 kHz
- Motion Commands: Analog current and velocity, pulse-width modulation (PWM) current and velocity, digital (SW) and Pulse and Direction
- Distributed Motion Control
- EASII (Elmo Application Studio) software: an efficient and user friendly auto tuner

3.5. Fully Programmable

- Third generation programming structure
- Event capturing interrupts
- Event triggered programming

3.6. Feedback Ports Options

- There are Port A and Port B feedback input ports that are flexible and configurable. Each port can be programmed to serve as:
  - Commutation feedback and/or
  - Velocity feedback and/or
  - Position feedback
- Port A supports the following sensors, depending on the specific model:
  - Incremental encoder
  - Incremental encoder and digital Hall
  - Absolute serial encoder
  - Absolute serial encoder and digital Hall (for dual loop)
- Port B supports the following sensors, depending on the specific model:
  - Incremental encoder
  - Analog encoder
  - Analog Hall
  - Resolver
- Port C is a flexible and configurable feedback output port. It supports the Encoder emulation outputs of Port A or Port B or internal variables
- Analog input (±10 V ptp) support:
  - Velocity feedback (tachometer)
  - Position feedback (potentiometer)

3.7. Feedback Sensor Specifications

- Incremental Quadrature Encoder (with or without commutation halls) up to 75 Megacounts per second (18 MHz PPS (Pulses Per Second))
- Incremental encoder and digital Halls
- Digital Hall
  - Up to 4 kHz commutation frequency
  - 5 V logic
  - Input voltage up to 15 VDC
- Interpolated Analog (Sine/Cosine) Encoder :
  - Supports 1 V PTP Sine/Cosine
  - Sin-Cos Frequency: up to 500 kHz
  - Internal Interpolation: up to ×8192
  - Automatic Correction of amplitude mismatch, phase mismatch, signal offset
  - Emulated encoder output of the Analog encoder
- Analog Halls (commutation & position)
  - One feedback electrical cycle = one motor's electrical cycle
  - Supports 1 V PTP Sin/Cos
  - Sin/Cos Frequency: up to 500 kHz
  - Internal Interpolation: up to ×8192
  - Automatic correction of amplitude mismatch, phase mismatch, signal offset
- Absolute serial encoders:
  - NRZ (Panasonic, Tamagawa, Mitutoyo, etc.)
  - EnDAT 2.2
  - BiSS
  - SSI
  - Sanyo Denki
  - Stegmann Hiperface
- Resolver
  - 14 bit resolution
  - Up to 512 revolutions per second (RPS)
  - Emulated encoder outputs of the Resolver
- Auxiliary Encoder inputs (ECAM, follower, etc.) single-ended, unbuffered
- The Gold Panel Mounted Servo Drive provides 5 V supply voltage for the encoders, Resolver or Hall supplies

3.8. Communications

The Gold Line offers variety of communication protocols (refer to the communication options of the specific drive):

- EtherCAT networking:
  - EtherCAT Slave
  - CoE (CAN over EtherCAT)
  - EoE (Ethernet over EtherCAT)
  - FoE (File over EtherCAT) for firmware download
  - Supports Distributed Clock
  - EtherCAT cyclic modes supported down to a cycle time of 250 µs
- CAN Network
- Ethernet TCP/IP
  - UDP
  - Telnet
- USB 2.0
- RS-232
- Differential RS-232(RS-422)

3.9. Safe Torque Off (STO)

Two STO (Safe Torque Off) inputs PLC level which can be configured to the TTL level

3.10. Digital Outputs

The Digital Outputs support the following optional functions:

- Fast event capture (for two inputs only)
- Inhibit/Enable motion
- Stop motion under control (hard stop)
- Motion reverse and forward limit switches
- Begin on input
- Abort motion
- Homing
- General purpose

Support up to four digital outputs, which can be configured to the following options:

- Source mode – High Current PLC voltage level, Conforming to IEC 61131-2
- Sink mode – High Current PLC voltage level
- Source mode – TTL voltage level

- Feature for High Current output:
  - Up to 30 VDC

- Opto-isolated (TTL also isolated)
- Up to 250 mA
- Brake output: 500 mA
- Short circuit protection
- Thermal protection.
- Reverse polarity protection

3.11. Differential Outputs

- Three differential outputs:
  - Port C EIA-422 differential output line transmitters
  - Response time < 1 µs
  - Output current: ± 15 mA

3.12. Digital Inputs

- There are six digital inputs, which can be configured to the following options:
  - Source mode – PLC voltage level
  - Sink mode – PLC voltage level
  - Source mode – TTL voltage level
- Optional functions:
  - Fast event capture (for two inputs only)
  - Inhibit/Enable motion
  - Stop motion under control (hard stop)
  - Motion reverse and forward limit switches
  - Begin on input
  - Abort motion
  - Homing
  - General purpose

3.13. Differential Inputs

- Six very fast differential event capture inputs 5 V logic
  - Via Port A or B (three on each port, depending on model)
  - EIA-422 Differential input line receiver
  - Response time < 1 µs

3.14. Analog Input

- One differential **Analog Input** – 12-bit resolution
- Input: ±10 V

3.15. Built-In Protection

- Software error handling
- Abort (hard stops and soft stops)

- Status reporting
- Protection against:
  - Shorts between motor power outputs
  - Shorts between motor power outputs and power input/return
  - Failure of internal power supplies
  - Over-heating
- Continuous temperature measurement. Temperature can be read on the fly; a warning can be initiated x degrees before temperature disable is activated.
  - Over/Under voltage
  - Loss of feedback
  - Following error
  - Current limits

3.16. Status Indication

- Output for a bi-color LED

3.17. Automatic Procedures

- Commutation alignment
- Phase sequencing
- Current loop offset adjustment
- Current loop gain tuning
- Current gain scheduling
- Velocity loop offset adjustment
- Velocity gain tuning
- Velocity gain scheduling
- Position gain tuning

Chapter 4: Installation

The Gold Panel Mounted Servo Drive must be installed in a suitable environment and properly connected to its voltage supplies and the motor.

4.1. How to Use this Guide

In order to install and operate your Elmo Gold servo drive, you will require both this manual and the drive specific installation guide.

1. Use this manual in conjunction with the specific installation guide, which includes mechanical structure of the product, pinouts, power connectivity, and thermal data. After carefully reading the safety instructions in the first chapter, the following chapters provide you with installation instructions as follows:

   - This chapter provides step-by-step instructions for unpacking the Gold Panel Mounted Servo Drive.
   - The various chapters in this manual provide the general wiring background and instructions necessary for all Gold line products.
   - The Specific relevant installation guide provides instructions for mounting, connecting and powering up the Gold Panel Mounted Servo Drive.

2. Perform the STO installation and startup instructions located in Chapter 9:.
3. Perform the instructions in these guides, to successfully mount and install your Gold Panel Mounted Servo Drive. From this stage, you need to consult higher-level Elmo documentation in order to set up and fine-tune the system for optimal operation:

   - The Gold Product Line Software Manual, which describes the comprehensive software used with the Gold Panel Mounted Servo Drive
   - The Gold Product Line Command Reference Manual, which describes, in detail, each software command used to manipulate the Gold Panel Mounted Servo Drive motion controller
   - The Elmo Application Studio Software Manual, which includes explanations of all the software tools that are part of the Elmo Application Studio software environment

4.2. Unpacking the Drive Components

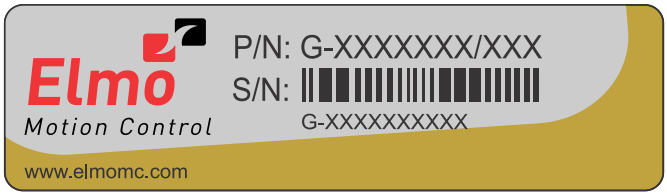
Before you begin working with the Gold Panel Mounted Servo Drive, verify that you have all of its components, as follows:

- The Gold Panel Mounted Servo Drive servo drive
- The Elmo Application Studio software and software manual

The Gold Panel Mounted Servo Drive is shipped in a cardboard box with Styrofoam protection.

To unpack the Gold Panel Mounted Servo Drive:

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 Gold Panel Mounted Servo Drive you have unpacked is the appropriate type for your requirements, locate the part number sticker on the side of the Gold Panel Mounted Servo Drive. It looks like this (example):



GGENERIC001B

4. Verify that the Gold Panel Mounted Servo Drive type is the one that you ordered, and ensure that the voltage meets your specific requirements.
   The part number at the top gives the type designation as described in the specific installation guide.

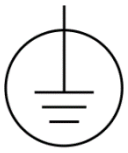
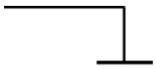
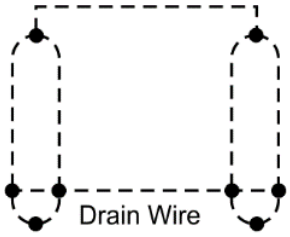
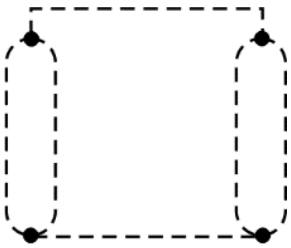
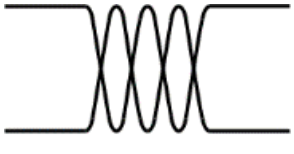
Chapter 5: Wiring

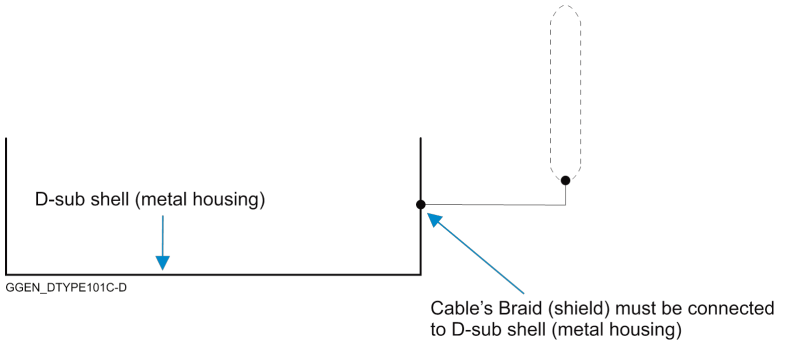
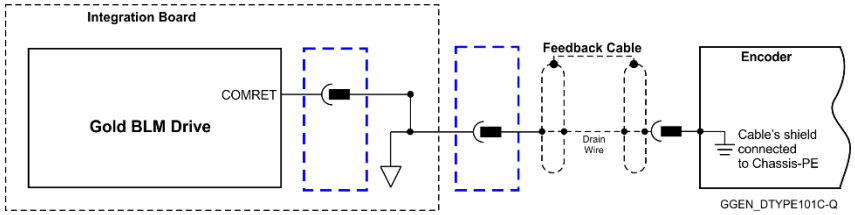
The wiring diagrams shown in this manual are examples and only show the signal name. They do not include pin numbers. For specific details, please refer to the specific servo drive installation guide.

D-Type connector wiring is different to shrouded connector wiring, and this is reflected in the wiring diagrams. For this reason, examples of both D-Type and shrouded connector diagrams are shown.

5.1. Wiring Legend

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

Wiring Symbol	Description
 GGEN_DYPE101C-A	Earth connection (PE)
 GGEN_DYPE101C-B	Earth Connection
 GGEN_DYPE101C-C	Common at the Controller
 GGEN_DTYPE101C-D	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.
 GGEN_DTYPE101C-E	Shielded cable braid only, without drain wire.
 GGEN_DTYPE101C-F	Twisted-pair wires

Wiring Symbol	Description
	In the D-type Connector: The cable`s braid (Shield) must be connected to the D-sub shell (metal housing)
	Encoder Earthing. The cable`s shield is connected to the chassis (PE) in the connector. Earthing the Encoder and connecting the Earth (PE) to the drive COMRET is mandatory to insure reliable operation, high noise immunity and rejection of voltage common mode interferences.

Chapter 6: Common and Returns

In mounted products, the returns are as listed below:

Return Pin	Description
PR	Power Return
COMRET	Common return
PE	The PE (Earth connection) terminal is connected internally in the drive to the Gold Panel Mounted Servo Drive's chassis (heat-sink + metal cover) which serves as an EMI common plane.
ANLRET	Analog input return
STO_RET	The STO inputs are optically isolated from the other parts of the Gold Panel Mounted Servo Drive. STORET is the common of the STO inputs.
INRET	The digital inputs are optically isolated from the other parts of the Gold Panel Mounted Servo Drive. INRET is the common of the Digital inputs.
VDDRET	The digital outputs are optically isolated from the other parts of the Gold Panel Mounted Servo Drive. VDDRET is the common of the Digital output.

Chapter 7: Drive Status Indicator

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

- **Initiation state:** In this state the LED indicates whether the drive is in the boot state (blinking red) or in the operational state (steady red).
- **Working state:** In this state the LED indicates whether the drive is in an amplifier failure state (red) or is ready to enable the motor (green).

Chapter 8: Motor Power

The following table describes the motor power cable connections.

Pin	Function	Cable		
		Brushless Motor	Brushed DC Motor	Stepper Motor Bell Products
PE	Protective Earth connection	Motor	Motor	Motor
M1	Motor phase	Motor	No Connection	Motor
M2	Motor phase	Motor	Motor	Motor
M3	Motor phase	Motor	Motor	Motor
M4	Motor phase	Not used	Not used	Motor

Table 1: Power Motor

The Motor's power cable consists of four wires. Three for the phases and an additional wire to Earth. Safety requires that the Earthing wire will have the same current carrying capability as the other three phases motor's wires. This to be able to short motor's current to the PE in case a failure.

- For best immunity, it is highly recommended to use a 4-wire shielded (not twisted) cable for the motor connection. The gauge is determined by the actual current consumption of the motor.
- Connect the cable shield to the closest ground connection at the motor end.
- Connect the cable shield to the closest PE terminal of the servo drive.
- Ensure that the motor chassis is properly grounded.

The phase connection is arbitrary as Elmo Application Studio (EASII) 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.

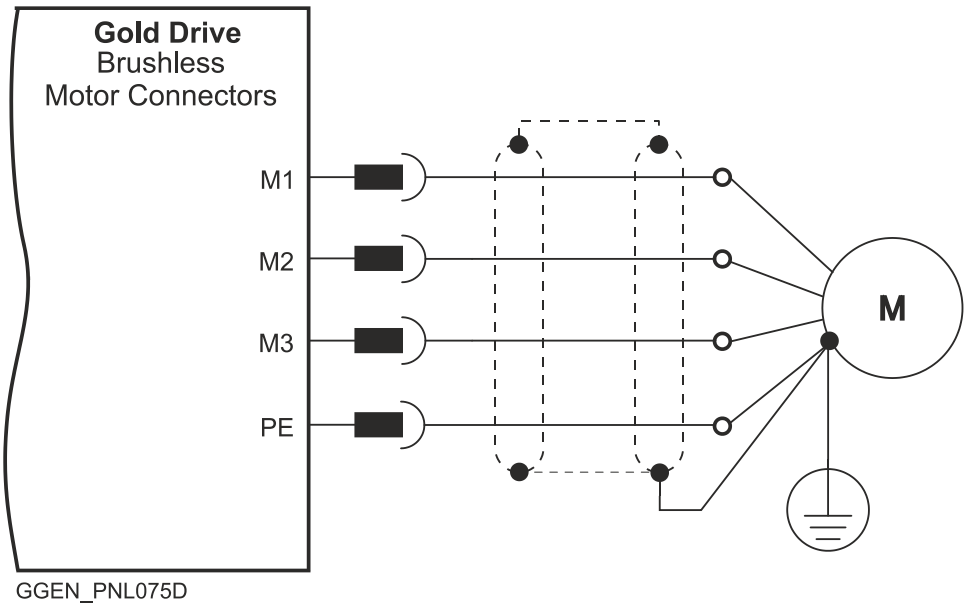


Figure 3: Brushless Motor Power Connection Diagram

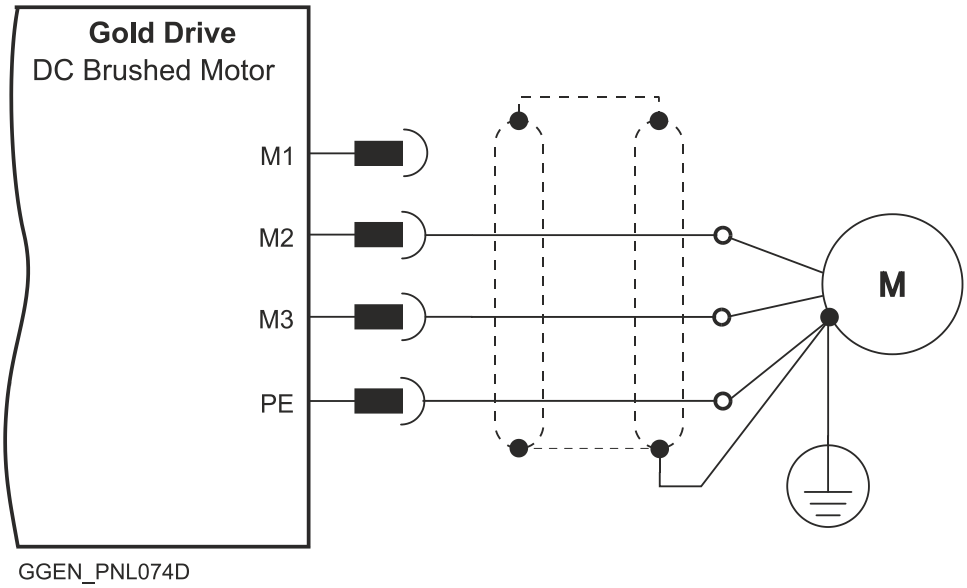


Figure 4: DC Brushed Motor Power Connection Diagram

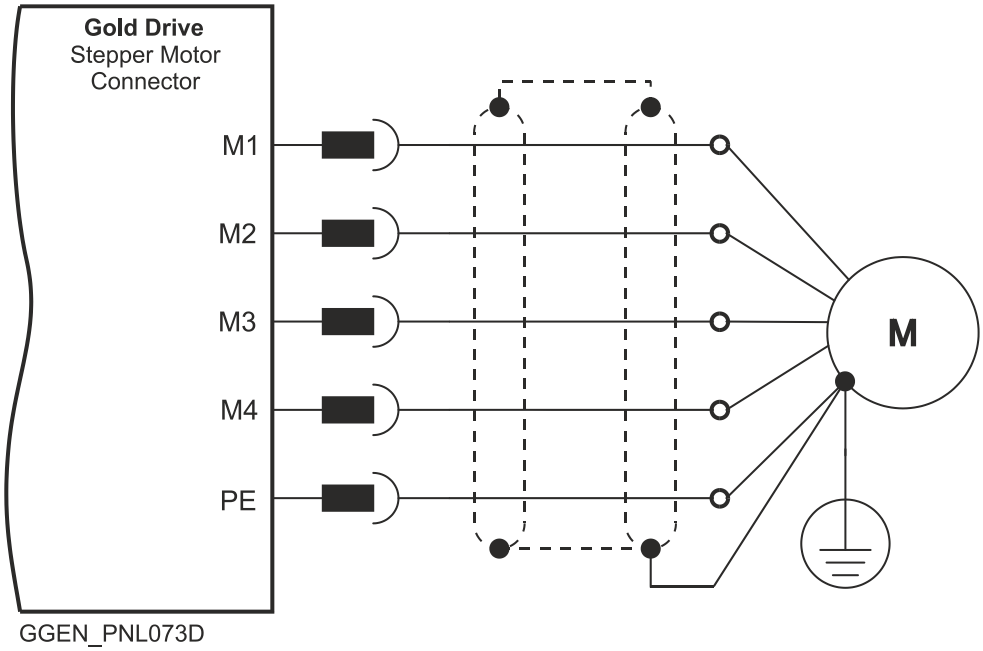


Figure 5: Stepper Motor Power Connection Diagram

Chapter 9: STO (Safe Torque Off)

This chapter describes and specifies the safety requirements in the system level of the Safe Torque Off (STO) for the Gold line. The Gold line drives support Safe Torque Off (STO) according to the following industry safety standards:

Safety Standard	Item
IEC 61800-5-2:2007	Capable up to Safety Integrity Level (SIL)3
EN ISO 13849-1:2008	Capable up to Category 3, Performance Level (PL) e
EN 61508-1:2010	Capable up to Safety Integrity Level (SIL)3
EN 61508-2:2010	Capable up to Safety Integrity Level (SIL)3
EN 61508-3:2010	Capable up to Safety Integrity Level (SIL)3

9.1. STO Signals

Signal	Function
STO1	STO 1 input
STO2	STO 2 input
STO_RET	STO signal return The two digital STO inputs are optically isolated from the other parts of the Gold Panel Mounted Servo Drive, and share one return line.

Table 2: STO Input Pin Assignments

The following signals are drive hardware option. It is not implemented in every product.

Signal	Function
STO_Output_Status_C	Isolated STO Output signal from the Opto-coupler collector
STO_Output_Status_E	Isolated STO Output signal from the Opto-coupler emitter

Table 3: Optional signals for STO Output Status

9.2. STO Functional Description

Activation of the Safe Torque Off (STO) function causes the drive to stop providing power, which controls the motor movement. The STO may be used to prevent unexpected motor rotation while the drive remains connected to a power supply.

The motor can only be electrically activated, when both STO inputs are active, i.e., current flows through the diode of the Optically Isolated STO inputs (see following figure). Whenever one of the inputs is no longer active, power that can generate motion is no longer provided to the motor by the drive. The motor in this case will be "free running" and will come to a rest under its own inertia and frictional forces.

According to Stop Category 0 of IEC 60204-1, the IEC 61800-5-2, and ISO 13849-1 category 3 requirements, it is required that the STO function is governed by two, fully redundant inputs. Thus, the ELMO STO consists of two STO inputs, namely STO1_IN and STO2_IN.

The STO1_IN stops (inhibits) the PWM signals to the High Side Gate Drivers, and the STO2_IN stops (inhibits) the PWM signals to the Low Side Gate Drivers.

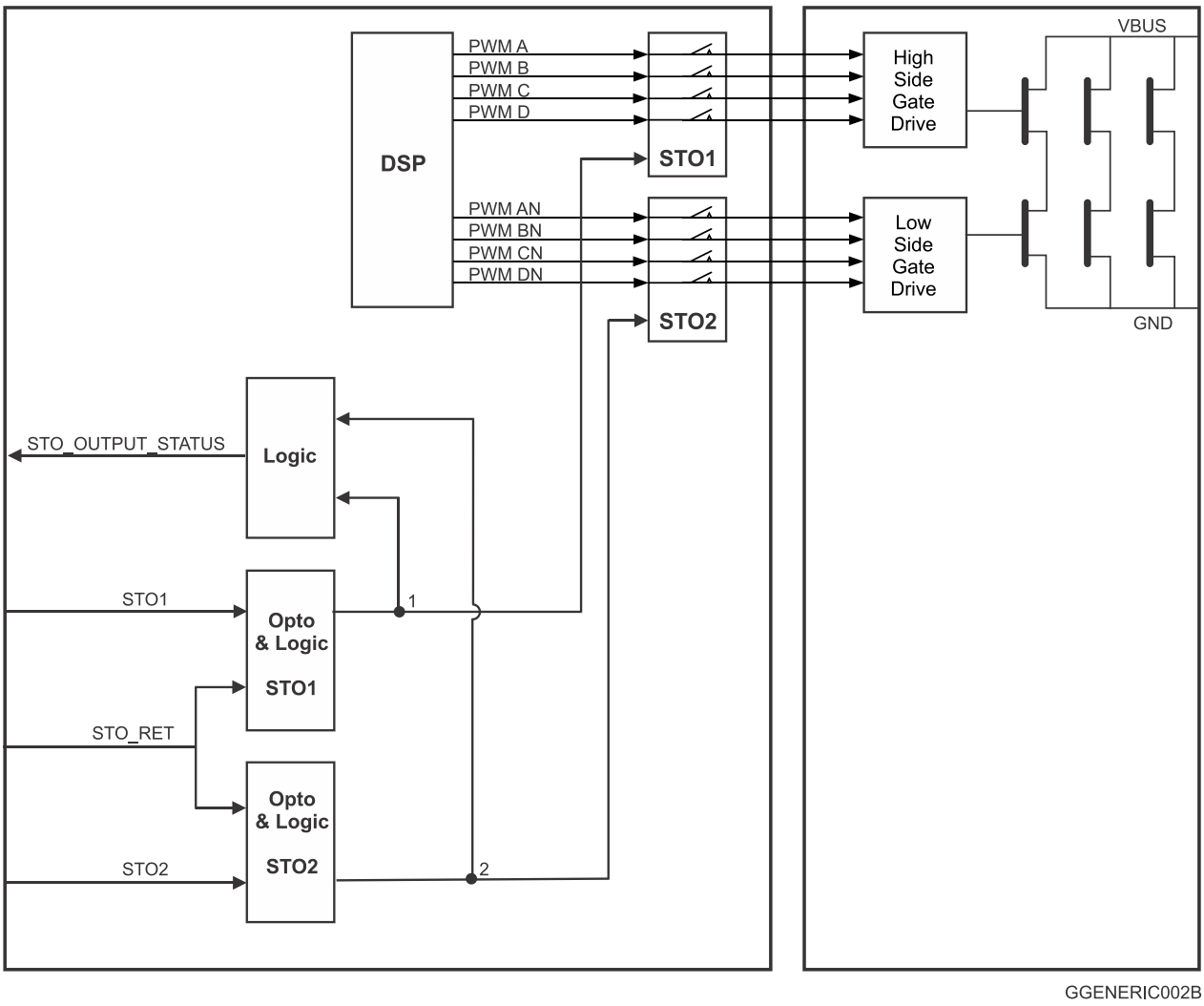


Figure 6: System block Diagram

Note: **PWMD is required for a Stepper Motor in products like the G-Bell.**

Table 4 defines the behavior of the motor as a function of the state of the STO inputs:

STO1_IN	STO2_IN	Motor Function
Non-Active	Non-Active	Disabled
Non-Active	Active	Disabled
Active	Non-Active	Disabled
Active	Active	Can be enabled

Table 4: Behavior of Motor as a Function of State of STO Inputs

In addition to the main inhibitive function of the two STO inputs, their status is also reported back to the DSP for user indication, and for latching the software from enabling the motor automatically when the STO inputs are reactivated (i.e. STO function Not Active). Therefore, once the STO function is **active** (i.e. disabling motor operation), re-initializing the servo loop requires, in addition to the STO function being deactivated (by activating Both STO inputs), the software must also initiate a **motor enable** command.

The STOx_IN signals are isolated using opto-couplers. The output signal of the opto-coupler enters the filter to avert a false command.

9.3. Safety Controller Short Pulses for Diagnostics

The Safety controller can transmit short pulses on the STO_IN for user diagnostics purposes. Elmo does not use these short pulses and they are not required for the Gold Drive diagnostics. These short pulses will not disturb the STO function and motor operation, if the pulse width is less than specified in the STO Timing section (Figure 7).

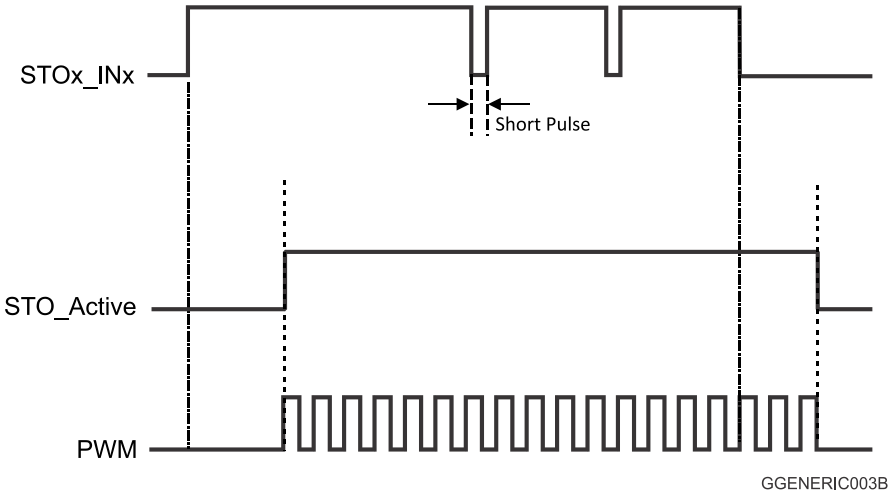


Figure 7: Timing Diagram of short pulses

9.4. STO input Interface

The STO input can be configured in the following options:

- TTL option connection
- PLC Source option connection(default option)
- PLC Sink option connection – **not certified for STO**

9.4.1. Source Mode – PLC Voltage Level

Feature	Details
Type of input	Optically isolated
Input current for all inputs	I_{in} = 2 mA @ Vin = 12 V I_{in} = 9 mA @ Vin = 30V
High-level input voltage	12 V < Vin < 30 V
Low-level input voltage	0 V < Vin < 7 V

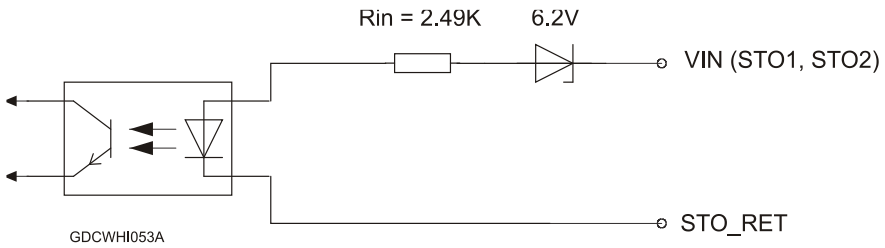


Figure 8: STO PLC Input Schematic

Refer to the diagrams below for the PLC Source option connection.

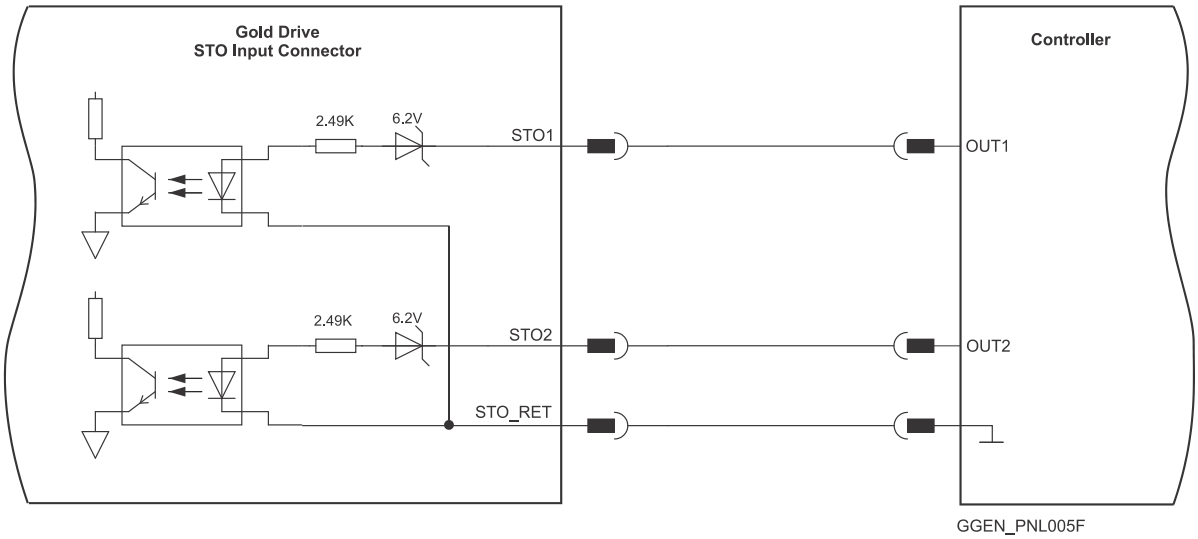


Figure 9: STO Input Connection Example – PLC Source Option

9.4.2. TTL Mode – TTL Voltage Level

Feature	Details
Type of input	Optically isolated
Input current for all inputs	Iin = 1.2 mA @ Vin = 2.4 V Iin = 3.8 mA @ Vin = 5 V Iin = 13.8 mA @ Vin = 15 V
High-level input voltage	2.4 V < Vin < 15 V, 5 V typical
Low-level input voltage	0 V < Vin < 0.8 V

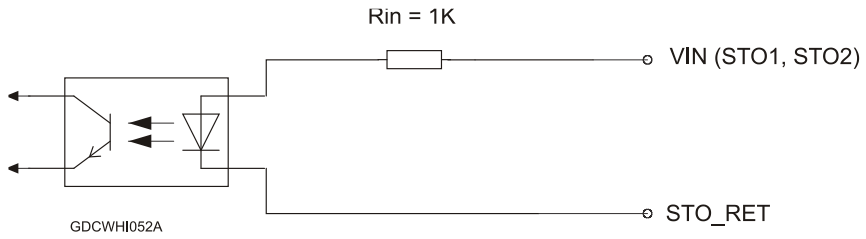


Figure 10: STO TTL Input Schematic

Refer to the diagrams below for TTL option connection.

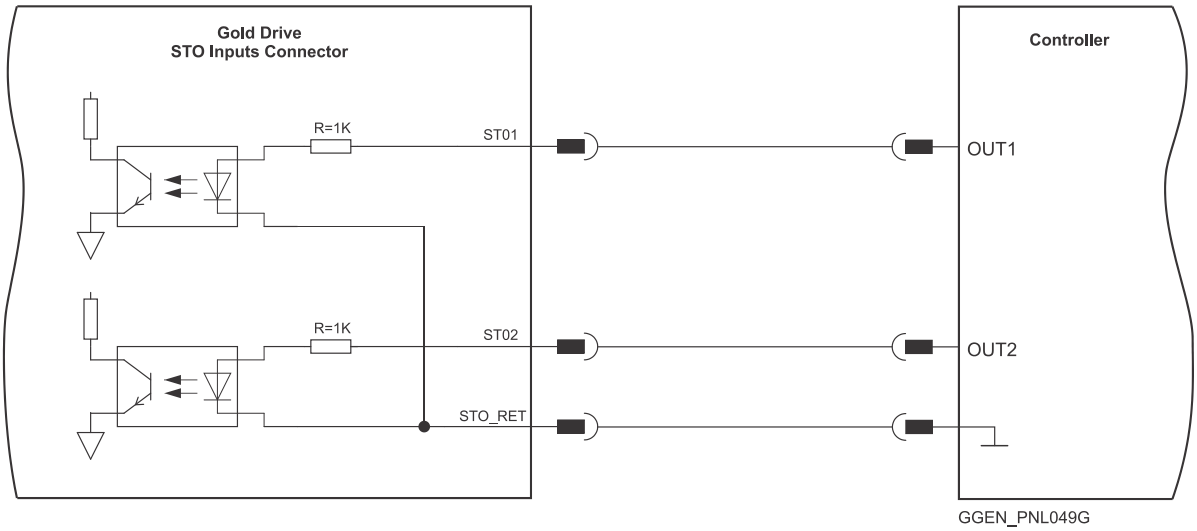


Figure 11: STO Input Connection – TTL Option

9.4.3. STO Connection of Several Drives

The following figure describes how to connect the STO input to several drives.

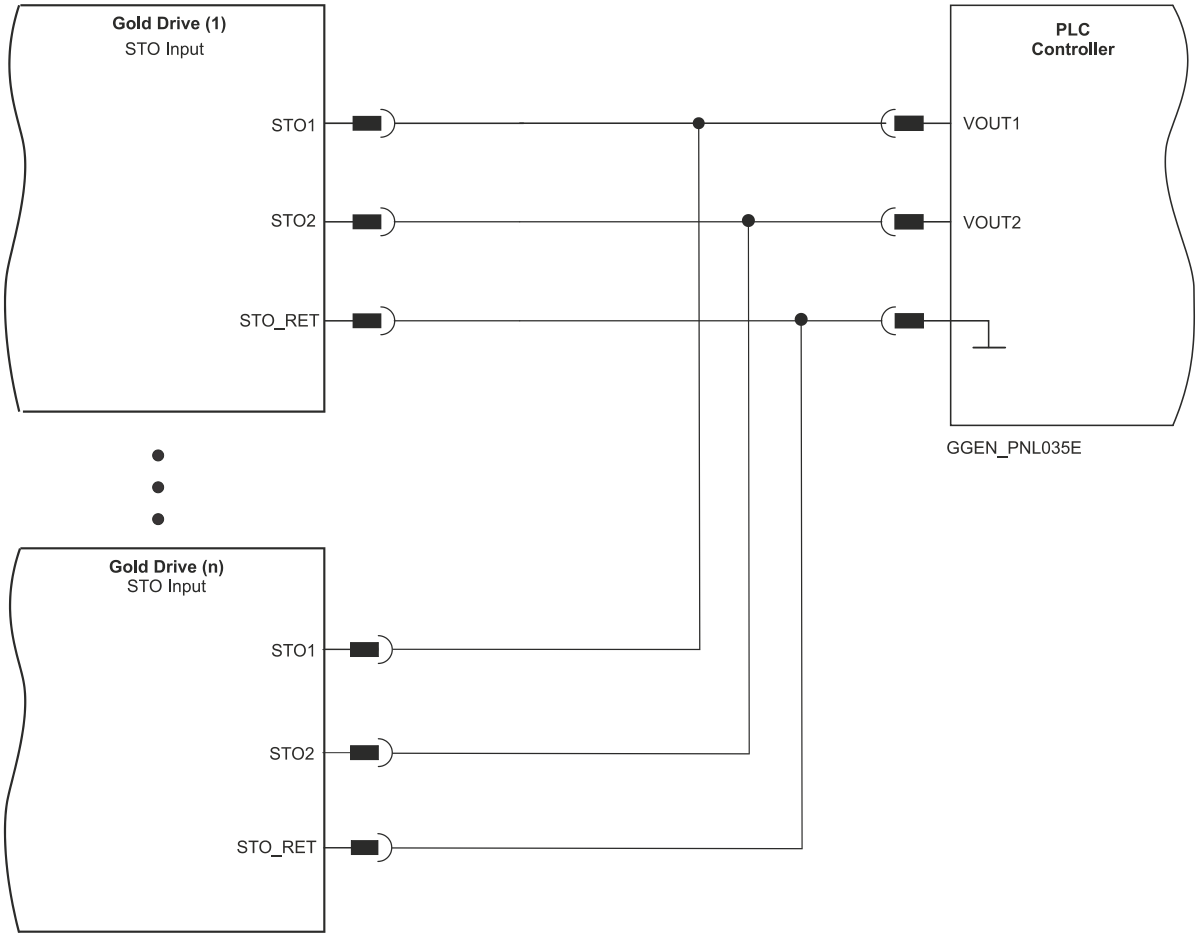


Figure 12: STO Input Status

9.5. STO Output Status (upon customer request)

The STO Output Status can disclose the STO status for user diagnostic propose. Table 5 describes the STO Output logic status:

STO1_IN	STO2_IN	STO_Output Status
0	0	1
0	1	1
1	0	1
1	1	0

Table 5: STO Output Status

Warning: **The STO Output status is not a safety function.**

Figure 13 describes the timing diagram for the STO Output Status.

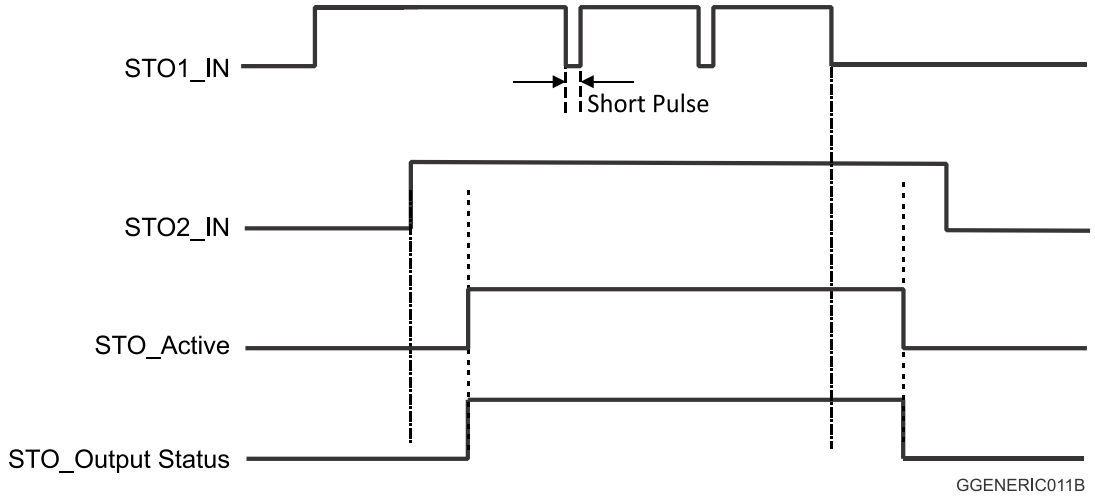


Figure 13: STO Output Status Timing Diagram (Refer to STO Timing)

There Gold drive has two options for STO Output Status:

- **A regular digital output**
  The Gold line servo drives have four digital outputs, one of which can be configured as the STO Output Status. The output can be selected by the command **GO[1 to 4]**.
  The Polarity of STO Output Status is determined by the OL Command.

- **Specific output for STO Output Status**
  In some products (refer to Matrix table) there is an additional option for dedicated STO Output Status pins that allow connection of the STO Output status between several drives. In this case, there are only three digital outputs instead of four. Refer to specific installation guide for information on which Digital Output is the STO output Status.
  The following figure describes the connection:

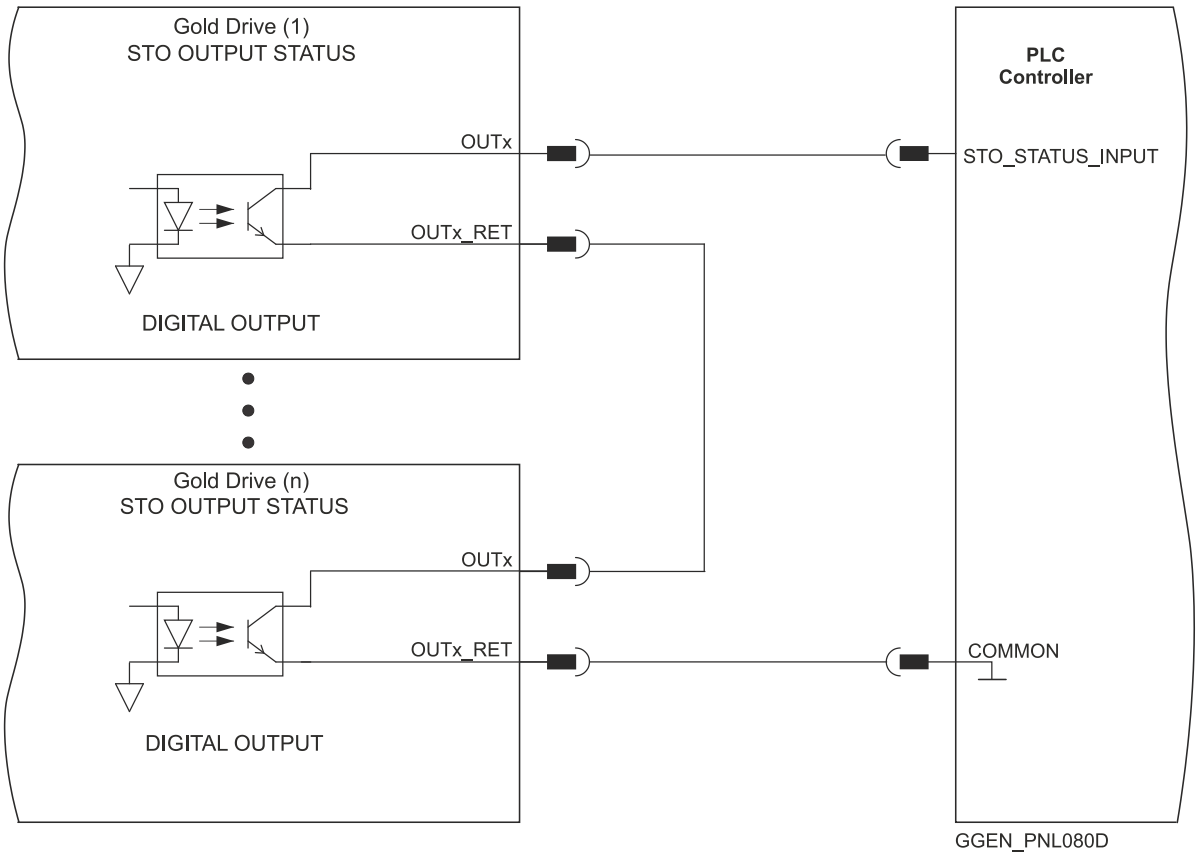


Figure 14: STO Dedicated Output Status

The following table describes the electrical specification of the STO Out Status:

Feature	Details
Type of output	• Optically isolated • Source/Sink
Supply output (VCC)	5 V to 30 V
Max. output current I_{out} (max) (V_{out} = Low)	7 mA
VOL at maximum output voltage (low level)	V_{out} (on) ≤ 0.4 V @ Iout ≤ I_{out} (max)
R_L	The external resistor R_L must be selected to limit the output current to no more than 7 mA. $R_L = \frac{VCC - VOL}{I_{out}(max)}$

9.6. Diagnostics

The STO diagnostic consists of:

- On demand Diagnostic, and
- Periodic diagnosis

9.6.1. On Demand Diagnostics

This diagnostic is run after start-up and also initiated whenever a change in one of the STO inputs (STO1 or STO2) is detected.

9.6.2. Periodical Diagnostics

The STO diagnostic is also run periodically every 240 msec when the STO is active.

The Voltage monitor checks the power supply continuously. If the voltage monitor detects that the voltage of the power supply is more than 4V or less than 2.6V, it will hold the power supply in shut-down and after a while turn it on again.

The following objects and Elmo commands support the STO diagnostic status and error reports:

- STO Status Register – available through the communication channels e.g. CAN, EtherCAT or USB. It is also displayed using the Elmo Application Studio software.
- ELMO Status Register
- Drive Status Indication
- STO output status

9.6.3. STO Status Register

The STO status register includes the state machine data at the time the STO error is detected.

This register is reported via SDO only in the 0x2086 object. In Elmo, it is reported in the **OV[62]** command. The register includes the following formats:

Bits	Description
0-4	For Elmo's internal use only
5-6	0 – STO full diagnostics is in progress. 1 – STO full diagnostics passed, and STO periodic diagnostics is in progress. 2 - Error is detected.
7	Unused
8-12	Error Code range: 0 to 16 For error codes = 2, 3, 6, 8, 9, 12, 13: Please check if the rise time (Time 9 in Figure 17) and the fall time (Time 10 in Figure 17) of the STO_IN signals are accordance with the requirements of section 9.9. This problem can occur if a high capacitance is connected to the STO inputs (e.g. the STO inputs are connected to the main power) causing a violation of the STO

Bits	Description
	timing. Elmo recommend to separate the STO logic power from the system main power. For other error codes = 0, 1, 4, 5, 7, 10, 11, 14, 15, 16: If the error code occurs repeatedly after power up, return the product to the factory.
13-15	Unused
16-20	For Elmo's internal use only
21-31	Unused

Table 6: Object 0x2086 (OV[62]) STO Status Register

9.6.4. ELMO Status Register

The Elmo Status Register, or **SR** command, is a 32bit register which includes the statuses reported from the drive. The Elmo Status Register can be monitored using the DS402 protocol object 0x1002. The Object 0x1002 is mapable. The following are the STO status bits:

Bits	Description
14	STO1_Diag2 current status.
15	STO2_Diag2 current status.
31	STO error. The status can be read in object 0x2086, and further detailed state machine values can be read in **OV[62]** command.

Table 7: Object 0x1002 STO Related bits

Refer to the Gold Command Reference for further details.

9.6.5. Drive Status Indicator

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

- **Initiation state**
  In this state, the LED indicates whether the drive is in the boot state (blinking red) or in the operational state (steady red).
- **Working state**
  In this state, the LED indicates whether the drive is in an amplifier failure state (red) or is ready to enable the motor (green).

If the STO function is active (i.e. disabling motor operation) or if STO diagnostic error is detected, the LED is red. Motor cannot be enabled in this state.

9.6.6. STO Output Status – GO[1 to 4]

The GO command routes the STO status to a specific output. The **GO[x]** index indicates the output number varying between 1 to 16, and the value indicates the output source. The STO output status can be routed to one of the outputs ranging from 1 to 4, by setting the **GO[1 to 4]** value to 7.

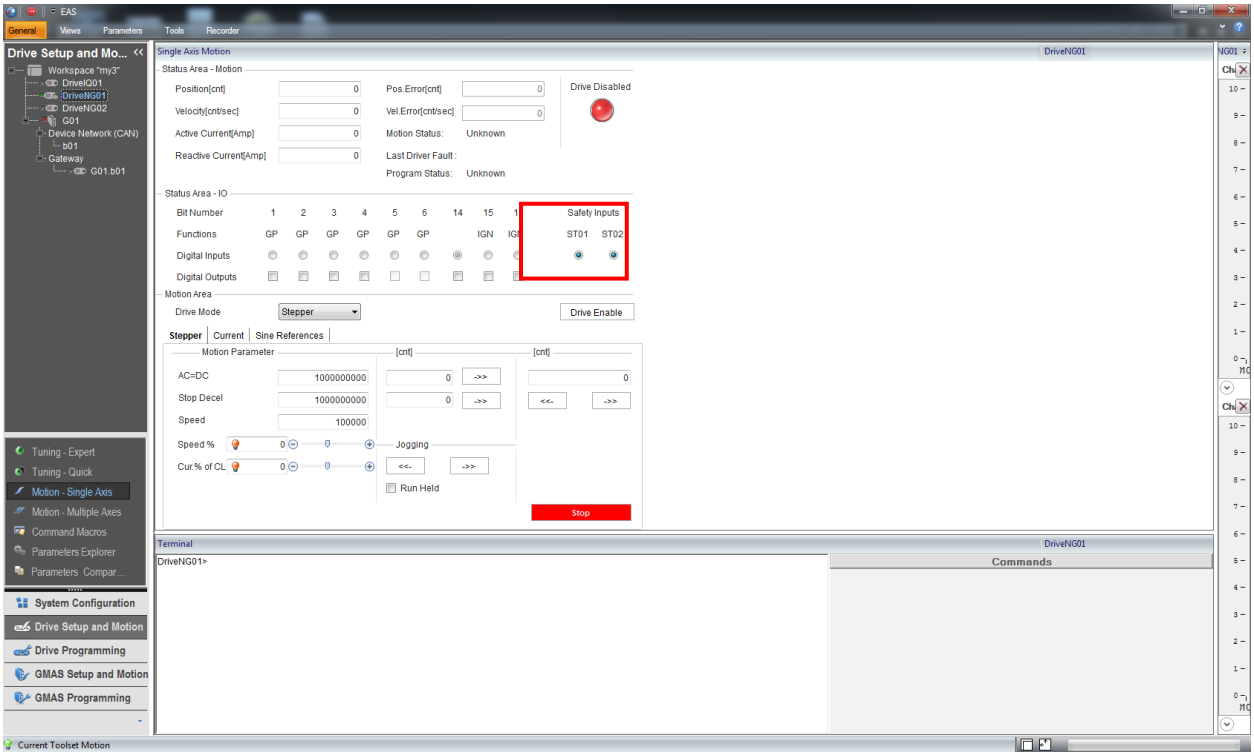
For example by setting **GO[1]**=7, output '1' will behave as "STO output status" signal.

Refer to the Gold Command Reference for further details.

9.7. STO Start-Up

After installing, make sure that the cables are connected correctly and the STO safety mechanism functions as required according to the following procedure:

1. Open the EAS and its System Configuration window.
   Connect the drive via the USB, Ethernet, or other communication channel.
2. Power on the main power supply to the drive(s).
3. Configure the drive(s) in the EAS.
4. Click Drive Setup and Motion and select Motion.
   Locate and view the *Safety Inputs* green LEDs. If necessary, click Refresh to refresh the LED display.



5. Turn OFF /ON the STOx_IN. Check the EAS LED display to see whether the STO status behave according to the following Table 8:

Step #	STO1_IN	STO2_IN	STO Operation
1	Non-Active	Non-Active	Disable
2	Active	Non-Active	Disable
3	Non-Active	Active	Disable
4	Active	Active	Enable

Table 8: State of STO Operation

If an error is detected during the diagnostics, the error led in the EAS screen is lit.

9.8. Maintenance

In order to maintain safety levels, the customer shall run the diagnostic of the STO periodically. To run the STO diagnostics, the STO input lines should be changed from active level (HIGH) to de-active Level (LOW) for more than 10msec.

For SIL 2 the STO diagnostic must be executed periodically within one year.

For SIL 3 the STO diagnostic must be executed periodically every 24 hours

9.9. STO Timing

This section describes the STO timing (Figure 15). When the Software enables the STO function, STO_EN is high.

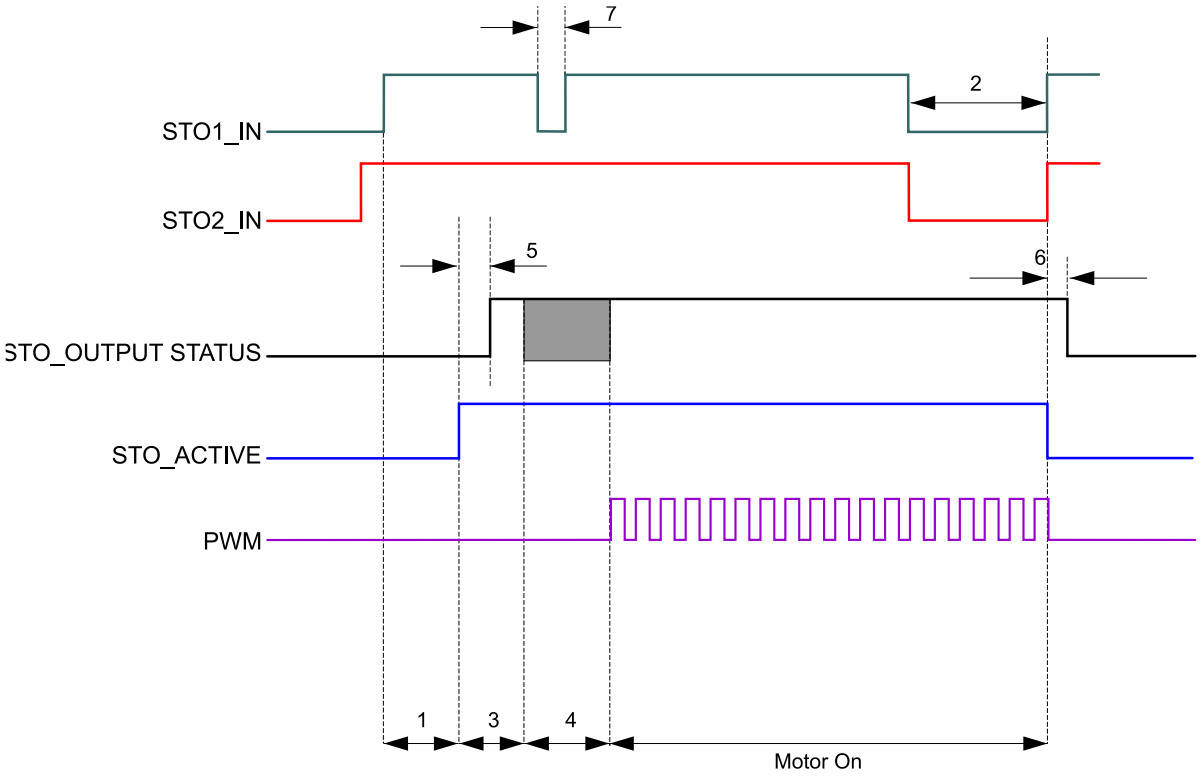


Figure 15: STO Timing Diagram

The following table summarizes the timing parameter of the STO described in Figure 15:

Time	Description	Time
1	The minimum STOx_IN width required for STO activation	5 msec
2	The minimum STOx_IN width that requires for STO deactivation (the Motor is disabled)	9 msec
3	The time from the STO activation until the STO diagnostic can start. The STO signals must be active continuously, for the diagnostic to start.	12 msec
4	Diagnostic time, after which the motor can be enabled **Note: The STO_Output_Status changes during the diagnostic time.**	34 msec
5	The maximum time for STO Output Status on	1 msec

Time	Description	Time
6	The maximum time for STO Output Status off	1 msec
7	The maximum width of the short pulse	1 msec

The Process Safety time described for Time 8 in the table below, is the STO periodic diagnostic which is executed every “Process safety time”. The Diagnostic does not influence the Motor operation.

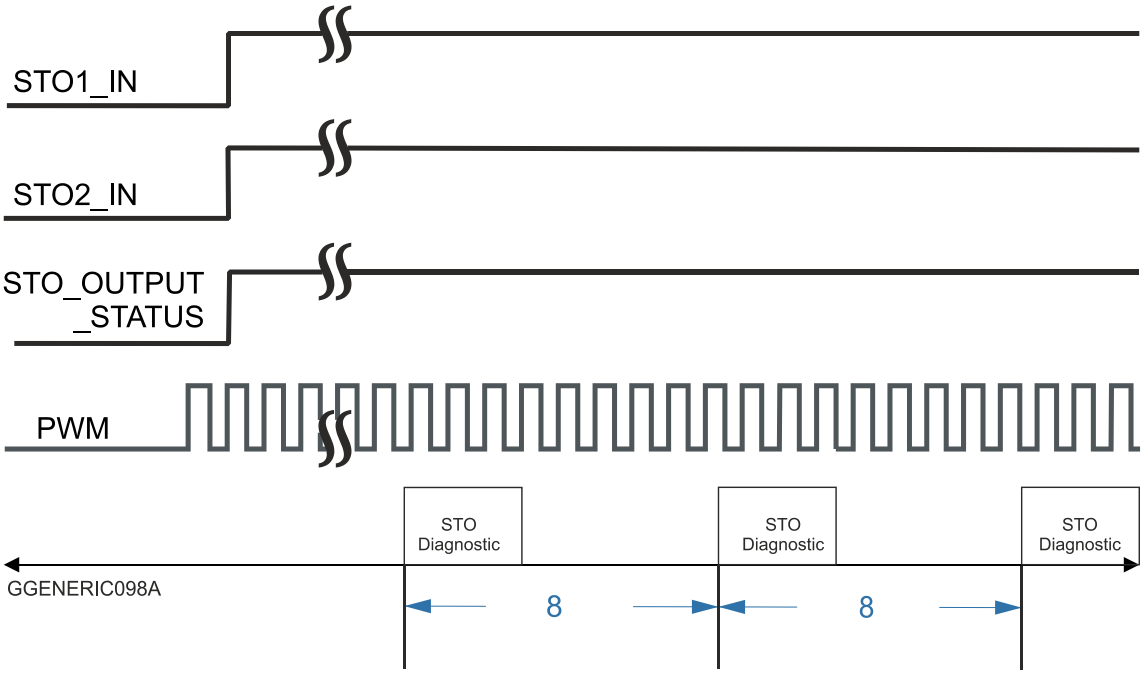


Figure 16: Process Safety Time

Time	Description	Time
8	Process Safety time The STO periodic diagnostic is executed every “Process safety time”. The Diagnostic does not influence the Motor operation	240 msec

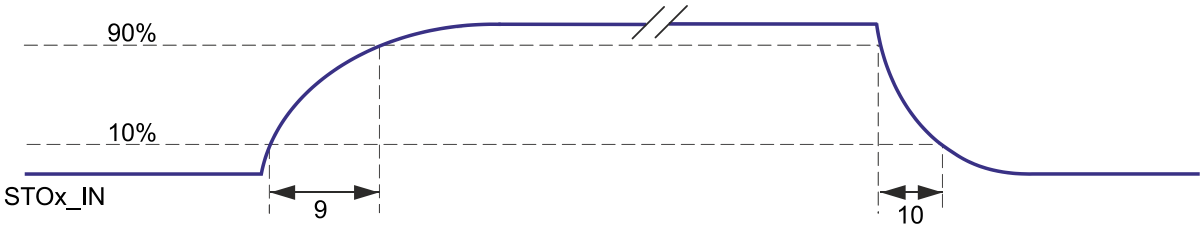


Figure 17: STO Rise and Fall Time

Time	Description	Time
9	Maximum STO rise time	1.5 msec
10	Maximum STO fall time	1.5 msec

Table 9: STO Timing

9.9.1. STO Standards Data

The following table summarizes the STO standards data.

Data	Value
EN ISO 13849-1:2008	
PL	e
Category	3
MTTFd	Higher than 100years
DC	97%
IEC 61508	
SIL	3
PFH	2.71 E-9
SFF	>90% per channel
Lifetime	20 years

Table 8: STO standards data

Note:

In order to maintain the safety level, the customer shall run the diagnostic of the STO periodically. Therefore to run the STO diagnostic the STO input lines should be changed from active level (HIGH) to de-active Level (LOW) for more than 10msec.

For SIL 2 the STO diagnostic must be executed periodically within one year.

For SIL 3 the STO diagnostic must be executed periodically every 24 hours.

Chapter 10: Feedbacks

10.1. Introduction

The Gold Panel Mounted Servo Drive has two configurable motion sensor input ports and one output port: Port A and port B are input ports, port C is the feedback output port. Motion sensors from the controlled motor and from other sources can be connected to any of the available inputs on either port A or B. Software configuration designates each input a role, e.g., the incremental encoder on port B is the controlled motor position feedback, the Hall sensors on port A are commutation feedback, and the incremental encoder on port A is follower input.

The following table describes Gold Servo Drives support of Dual Loop Configurations and Dual Encoders operation.

		Port A				
		Incremental Encoder with Commutation Digital Halls	Incremental Encoder without Commutation Digital Halls	Commutation Digital Halls	Absolute Serial Encoder	Absolute Serial Encoder (Absolute) & Digital Halls
Port B	Incremental Encoder	√	√	√	√	√
	Analog Encoder	√	√	√	√	√
	Analog Halls	√	√	√	√	√
	Resolver	√	√	√	√	√

For more information about sensors and their use refer to the Gold Line Administrative Manual.

10.2. Feedback Supply Voltage

The Gold Panel Mounted Servo Drive has two feedback ports (Main and Auxiliary). The Gold Panel Mounted Servo Drive supplies voltage only to the main feedback device and to the auxiliary feedback device if needed.

Feature	Details
Encoder supply voltage	5 V ±5%
Maximum Encoder supply current	2 x 200 mA Refer to the specific installation guide

10.3. Feedback Port A

Port A supports the following sensor inputs:

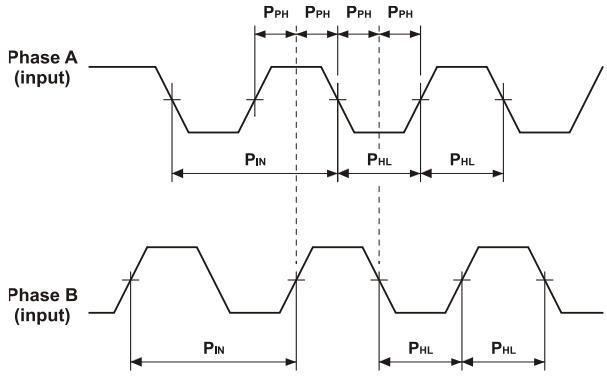
- Digital Hall sensors
- Incremental encoder or absolute serial encoder
- Differential pulse-width modulation (PWM) signal input can be connected to port A. The PWM signal (only pulses) can be connected to one of the pins in port A (A/B or index) depending on other feedbacks.
- Differential Pulse & Direction signal inputs can be connected to port A. The signals can be connected to the applicable pair of matching + and – encoder channels and are configurable by software.

The port A includes the following signals:

Incremental Encoder		Absolute Serial Encoder	
Signal	**Function**	**Signal**	**Function**
+5V	Encoder +5V supply	+5V	Encoder +5V supply
COMRET	Common return	COMRET	Common return
PortA_ENC_A+	Channel A +	ABS_CLK+	Absolute encoder clock+
PortA_ENC_A-	Channel A -	ABS_CLK-	Absolute encoder clock-
PortA_ENC_B+	Channel B+	ABS_DATA+	Absolute encoder data+
PortA_ENC_B-	Channel B -	ABS_DATA-	Absolute encoder data -
PortA_ENC_INDEX+	Index+	Reserved	Reserved
PortA_ENC_INDEX-	Index -	Reserved	Reserved
HA	Hall sensor A	HA	Hall sensor A
HB	Hall sensor B	HB	Hall sensor B
HC	Hall sensor C	HC	Hall sensor C

Table 10: Port A Pin Assignments

10.3.1. Incremental Encoder

Feature	Details
Encoder format	• A, B and Index • Differential • Quadrature
Interface	RS-422
Input resistance	Differential: 120 Ω
Maximum incremental encoder frequency	Maximum absolute: 75 Megacounts per second (18 MHz PPS (Pulses Per Second))
Minimum quadrature input period (PIN)	53 nsec
Minimum quadrature input high/low period (PHL)	26 nsec
Minimum quadrature phase period (PPH)	13 nsec
Maximum encoder input voltage range	Common mode: ±7 V Differential mode: ±7 V
 **Figure 18: Main Feedback - Encoder Phase Diagram**	
Capture with differential input Port A	T > 0.1 µsec if the differential input functionality is set to touch probe/capture (index/strobe).

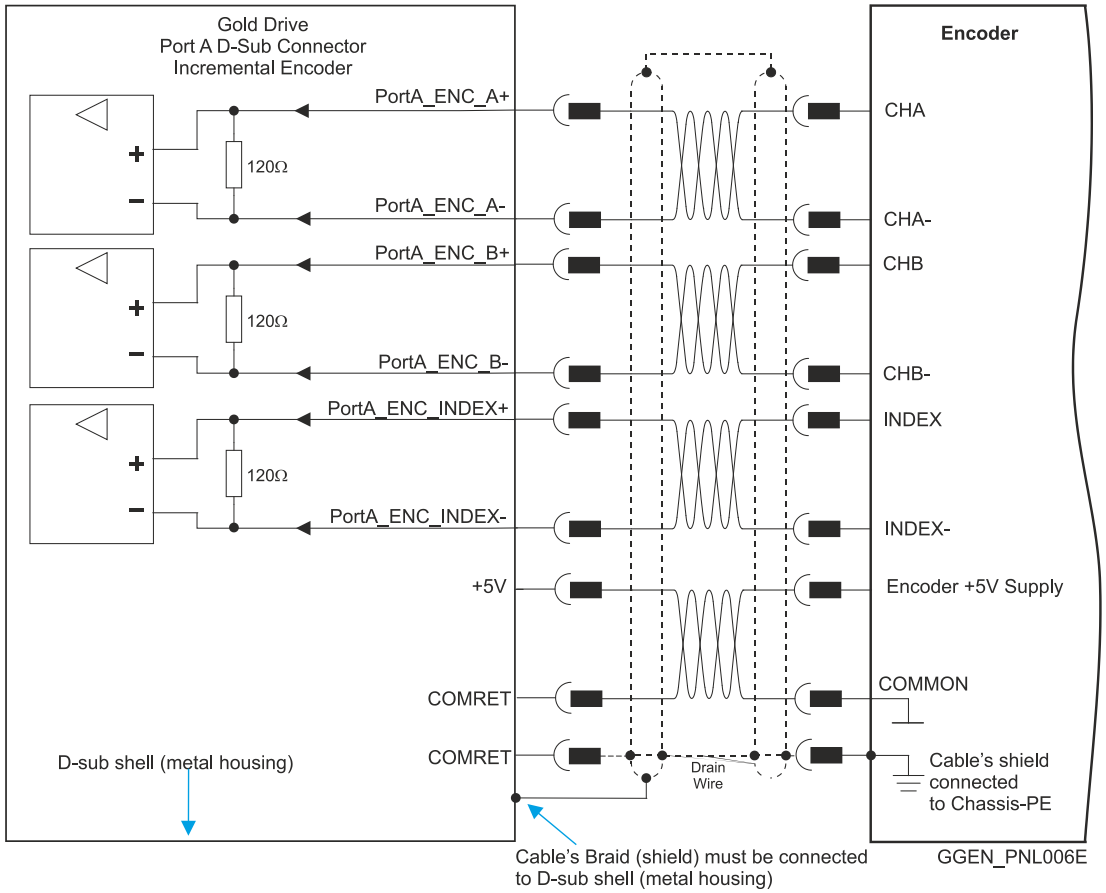


Figure 19: Port A Incremental Encoder Input – D-Type Connection Diagram Example

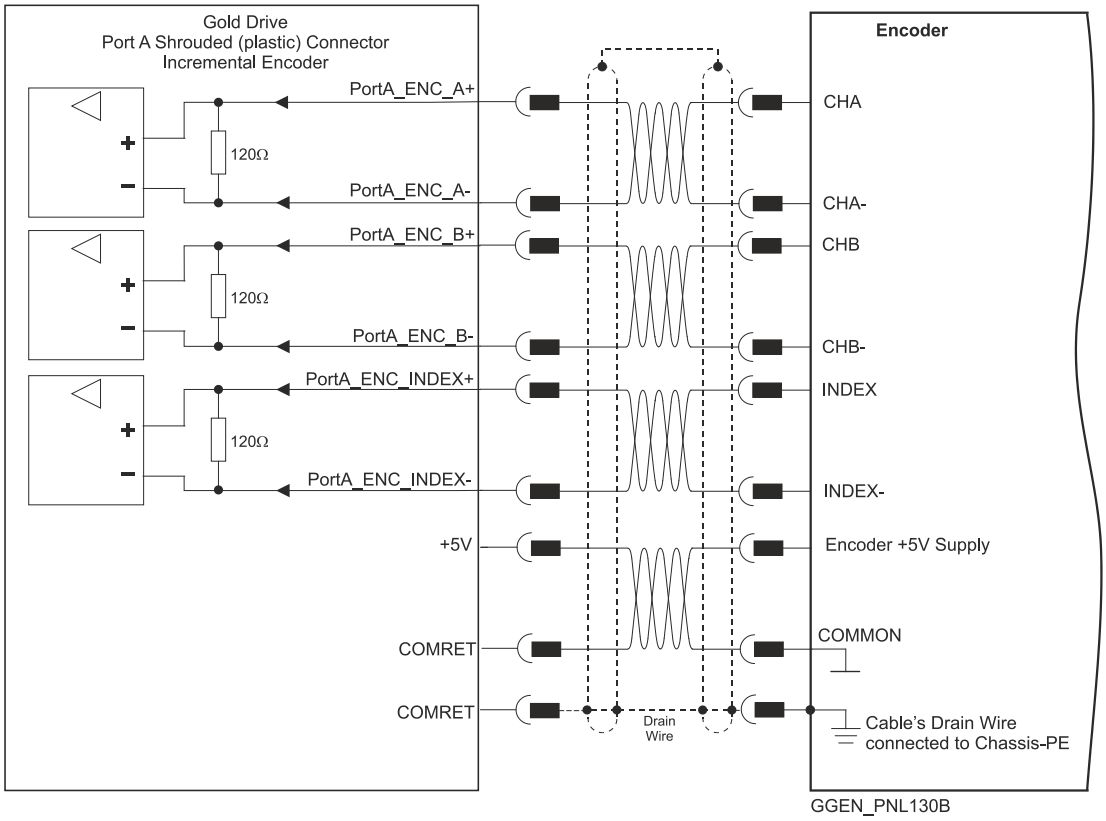


Figure 20: Port A Incremental Encoder Input – Shrouded Type Connection Diagram Example

10.3.2. Hall Sensors

Feature	Details
Halls inputs	• H_A, H_B, H_C. • Single ended inputs • Built in hysteresis of 1 V for noise immunity
Input voltage	Nominal operating range: 0 V < V_{In_Hall} < 5 V Maximum absolute: -1 V < V_{In_Hall} < 15 V High level input voltage: V_{InHigh} > 2.5 V Low level input voltage: V_{InLow} < 1 V
Input current	Sink current (when input pulled to the common): 5 mA
Maximum frequency	f_{MAX} : 3 kHz

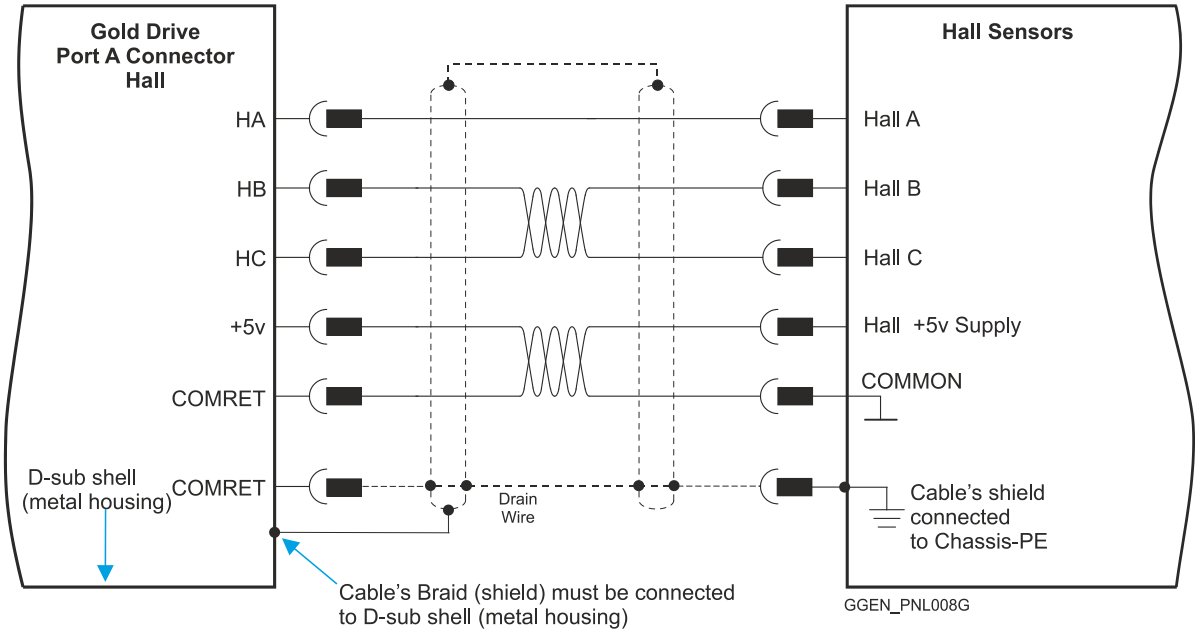


Figure 21: Hall Sensors D-Type Connection Diagram Example

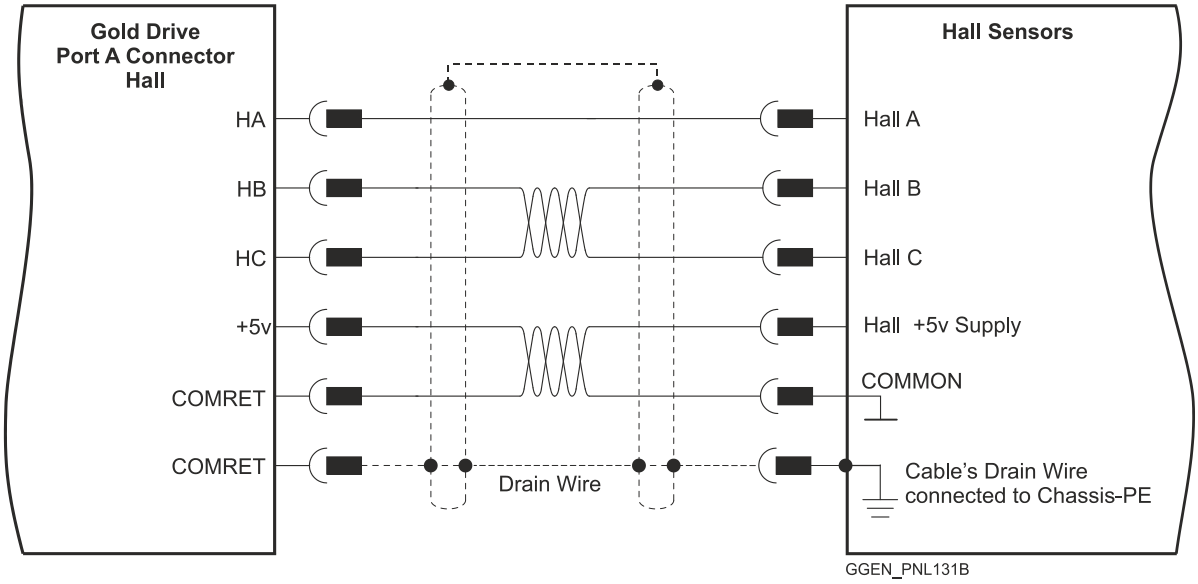


Figure 22: Hall Sensors Shrouded Type Connection Diagram Example

10.3.3. Absolute Serial Encoder

The following Absolute Encoder are supported:

- EnDat 2.2
- Biss C and Biss B
- Pansonic
- Tamagawa
- SSI
- Sanyo
- Nikon
- Hiperface

Gold Drives support various types of True Absolute Serial Interfaces Encoders. The position data is acquired by a communication transmission cycle, generated by the drive at default of 10KHz, and is subsequently used for the servo current, velocity and position loops. Some absolute sensor protocols have up to 96 bits of data (composed of commands / position information / status / errors / CRC codes / etc.), that have to be retrieved on every transmission cycle.

Sensors also require different recovery time, that is the minimal time between each two consecutive transmission cycles, in some cases, can be as high as 40 µsec. As the sample rate of the Gold drives can be as low as 50 µsec, the serial absolute position data should be read at rates of at least 10 kHz (each 2×TS or 100 µsec). For this reason, the Gold drive serial interfaces operate at fast clock rates, of up to 5 MHz. For some slow (low resolutions) SSI interface encoders, Elmo has also implemented serial interfaces at frequency of 625 KHz.

It is important to note that using higher transmission rates (> 2.5 MHz) has no advantage whatsoever, as the data is already read on every velocity loop cycle. Using higher data rates will limit the signal glitch filtering ability, and eventually reduce the transmission immunity to noises.

The communication transmission cycle clock sequence is initiated by the Gold Drive, and is synchronized to the drive servo control loops ISR and PWM pulses within a few nanoseconds. This is important since all absolute sensors also latch (lock) the encoder position value at that point (usually at the falling edge of the first clock of any new transmission cycle). Any jitter at this synchronization would have resulted in significant velocity jitters and would have impaired the drive servo loop performances.

The following are the Absolute Serial Encoder diagram connections for **EnDAT, Biss,** and **SSI**:

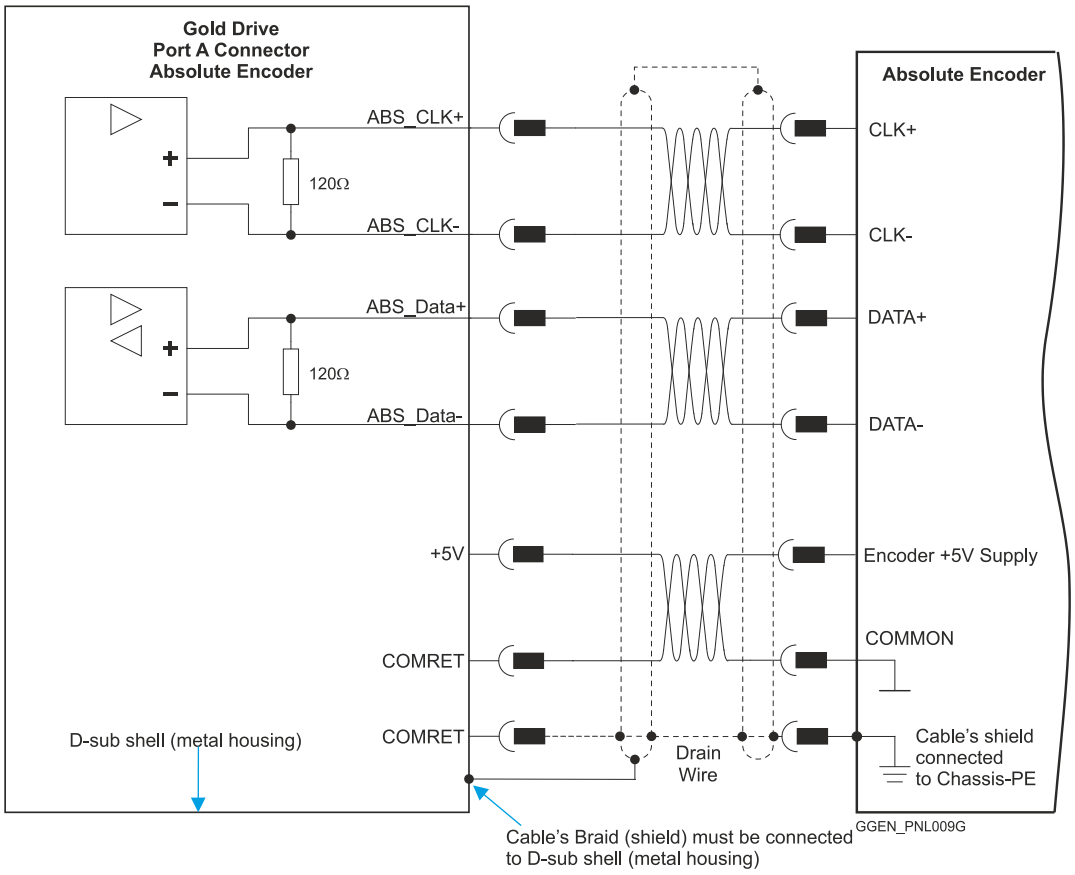


Figure 23: Absolute Serial Encoder – D-Type Connection Diagram Example

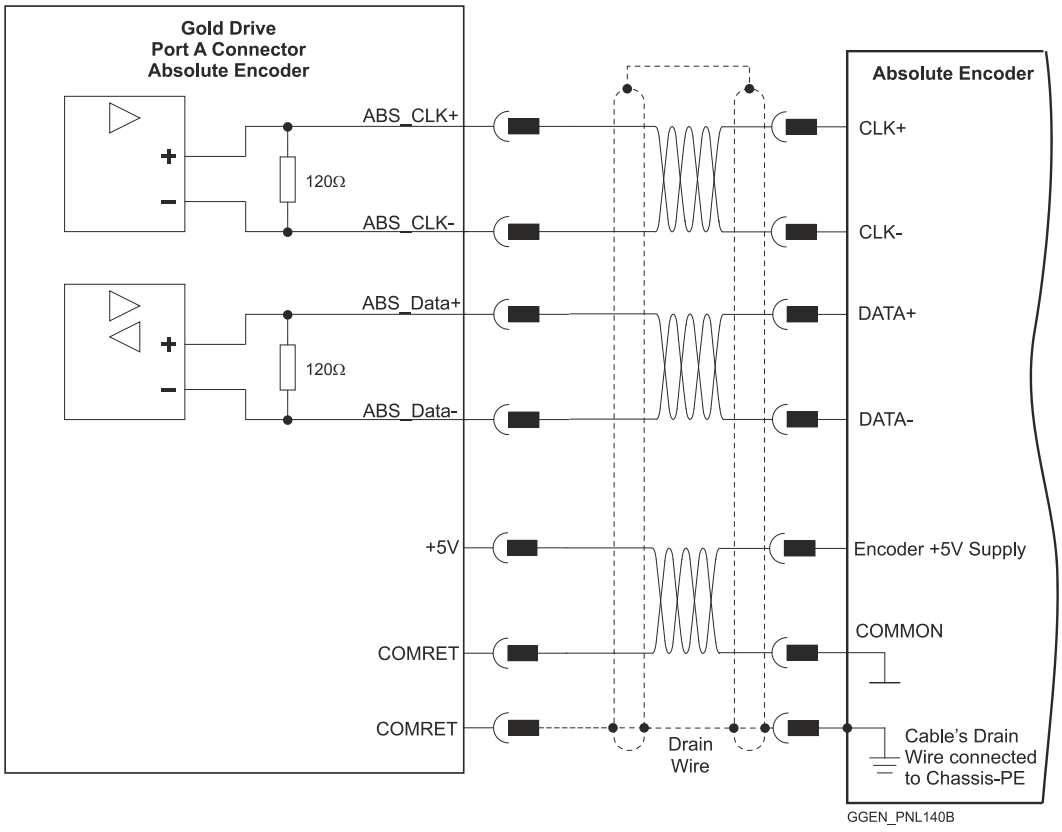


Figure 24: Absolute Serial Encoder – Shrouded Type Connection Diagram Example

The following is the diagram connections of the Panasonic, Tamgawa, Sanyo, Nikon:

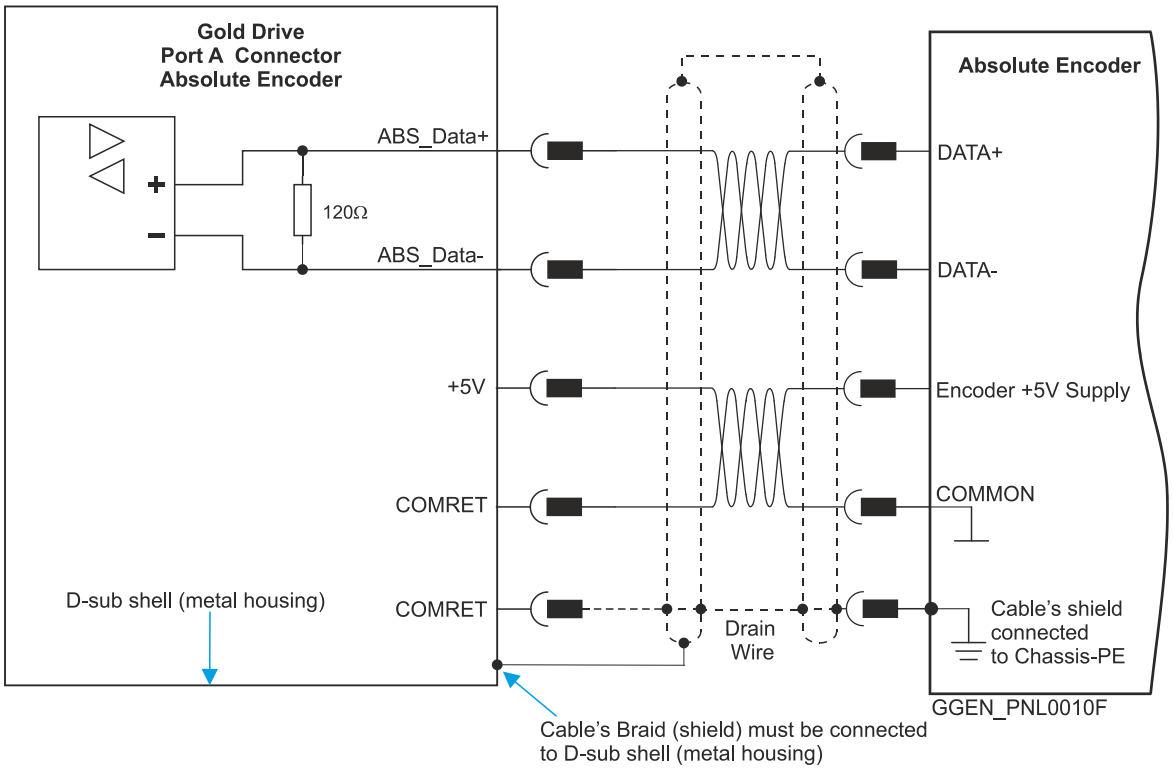


Figure 25: Absolute Serial Encoder – D-Type Connection Diagram Example for Sensors Supporting Data Line Only (NRZ types, e.g., Panasonic / Tamagawa / Sanyo / Nikon)

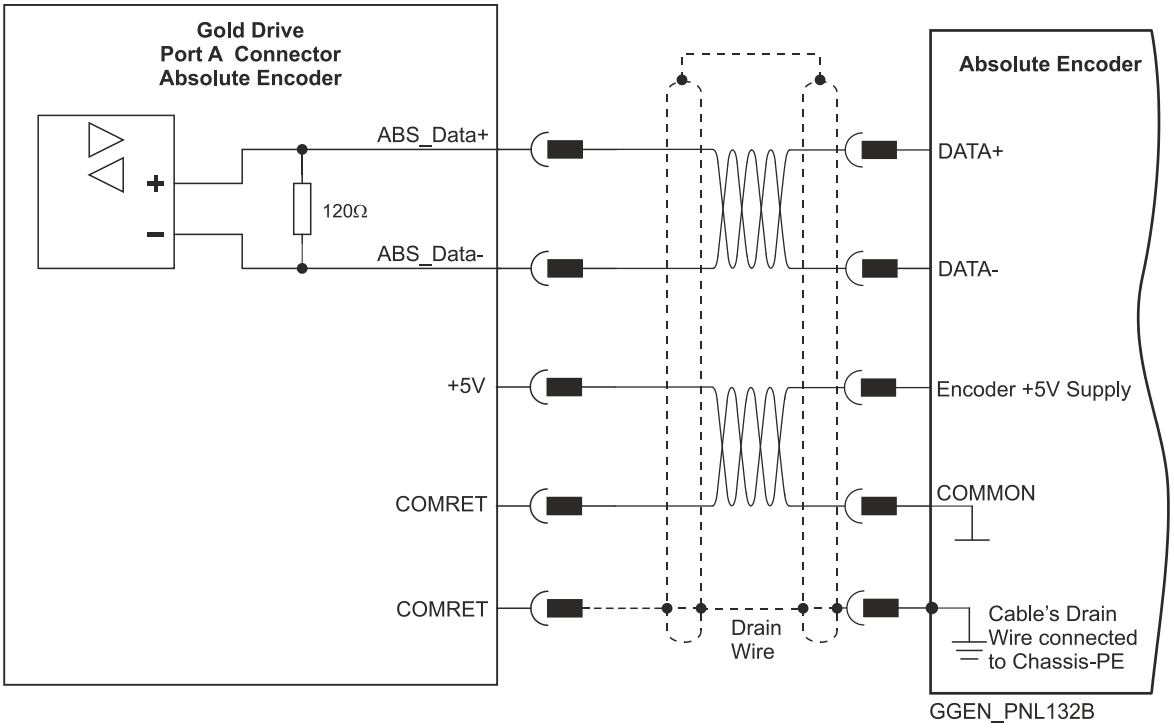


Figure 26: Absolute Serial Encoder – Shrouded Type Connection Diagram Example for Sensors Supporting Data Line Only (NRZ types, e.g., Panasonic / Tamagawa / Sanyo / Nikon)

10.3.3.1. EnDat 2.2

Feature	Details
Interface	• RS-485 • Clock – Differential output line (Clock+, Clock-) • Data – Differential bidirectional line (Data+, Data-,)
Protocol	Serial Protocol
Input Resistance	Differential 120 Ω
Transmission Rate	5 MHz, 2.5 MHz, 1.25Mhz
Cable length	Up to 100 meters cable operation was tested successfully.
Resolution	Elmo supports all known resolutions, both linear (LIC 4000 series) and rotary (ECN series) single and multi-turn devices.
Glitch filter	Advanced (programmable) glitch filtering for better signal noise immunity.
automatic propagation delay compensation	Supported

10.3.3.2. BISS-C and B

- The BiSS Protocol defines both the BiSS B (which supports both register and sensor modes) and BiSS C (supporting the sensor mode only).
- Gold drives support BiSS B (sensor mode only) and BiSS C, in single device (slave) point-to-point configuration.

Feature	Details
Interface	• RS-485 • Clock – Differential output line (clock+, Clock-) • Data – Differential bidirectional line (Data+, Data-,)
Protocol	Serial Protocol
Input Resistance	Differential 120 Ω
Transmission Rate	2.5 MHz, 1.25Mhz
Cable length	Up to 100 meters cable operation was tested successfully.
Glitch filter	Advanced (programmable) glitch filtering for better signal noise immunity.
Automatic propagation delay compensation	Supported

10.3.3.3. Panasonic

Feature	Details
Interface	• RS-485 • Data – Differential bidirectional line (Data+, Data-,)
Protocol	• Half -duplex serial protocol (NRZ)
Input Resistance	Differential 120 Ω
Transmission Rate	Only 2.5 MHz,
Cable length	Up to 100 meters cable operation was tested successfully.
Glitch filter	Advanced (programmable) glitch filtering for better signal noise immunity.
Automatic propagation delay compensation	Supported

10.3.3.4. Tamagawa

Feature	Details
Interface	• RS-485 • Data – Differential bidirectional line (Data+, Data-,)
Protocol	• Half -duplex serial protocol (NRZ)
Input Resistance	Differential 120 Ω
Transmission Rate	Only 2.5 MHz
Cable length	Up to 100 meters cable operation was tested successfully.
Glitch filter	Advanced (programmable) glitch filtering for better signal noise immunity
Automatic propagation delay compensation	Supported

10.3.3.5. Sanyo / Nikon

Feature	Details
Interface	• RS-485 • Data – Differential bidirectional line (Data+, Data-,)
Protocol	• Half -duplex serial protocol (NRZ)
Input Resistance	Differential 120 Ω
Transmission Rate	2.5 MHz or 4 MHz (sensor dependent)
Cable length	Up to 100 meters cable operation was tested successfully.
Glitch filter	advanced (programmable) glitch filtering for better signal noise immunity.
automatic propagation delay compensation	Supported

10.3.3.6. SSI

Feature	Details
Interface	RS-485 Clock – Differential output line (clock+, Clock-) Data – Differential bidirectional line (Data+, Data-,)
Protocol	Serial Protocol. The protocol is left open for vendor specific implementation. It does not define any signal integrity fields, error detection bits, "CRC", or Error Bits, etc.
Input Resistance	Differential 120 Ω
Transmission Rate	2.5 MHz, 1.25Mhz, 625Khz (For some slow (low resolutions) SSI sensors)
Cable length	<20M @ 1.25Mhz <35M @ 625Khz
Glitch filter	Advanced (programmable) glitch filtering for better signal noise immunity.
Automatic propagation delay compensation	Because SSI protocol does not define transmission start and stop bits, automatic propagation delay compensation **cannot** be implemented in SSI

10.3.3.7. Hiperface

Stegmann (now SICK) developed the Hiperface interfaces, based on a mixed serial digital interface and analog (SIN/COS) interfaces. The serial digital interface is a UART communication protocol transferred over an RS-485 physical link, connected to the GOLD Servo Drive Port A ABS_Data+ and ABS_Data-. The Analog (Sin/Cos) interfaces is connected to GOLD Servo Drive Port B SIN+/SIN- and COS+/COS-. The Hiperface requires 7-12 VDC for operation (not provided by the Gold servo drive) provided by the user.

The following figures describe the connection diagram.

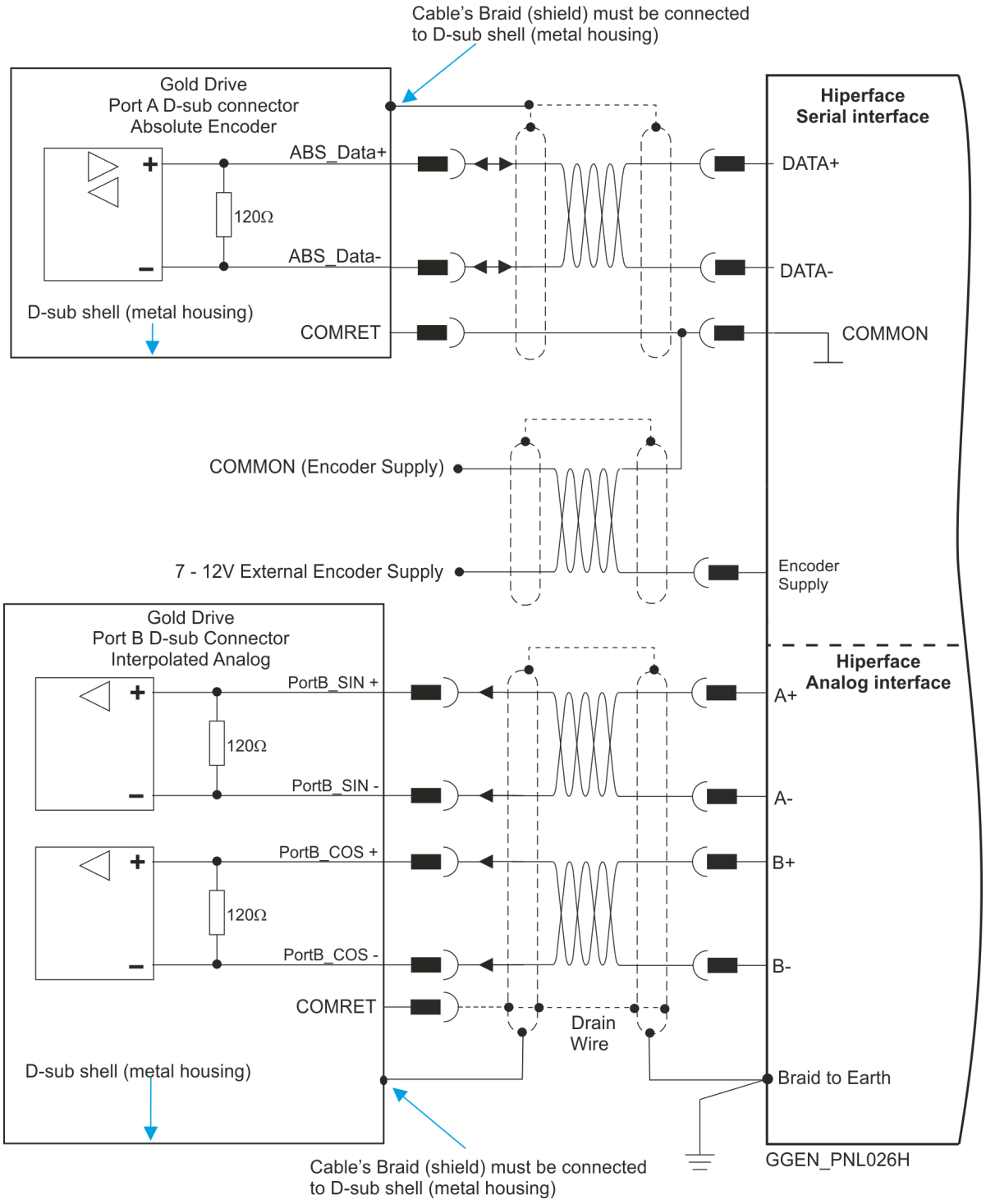


Figure 27: Absolute Serial Encoder – D-Type Connection Diagram Example for Stegmann Hiperface

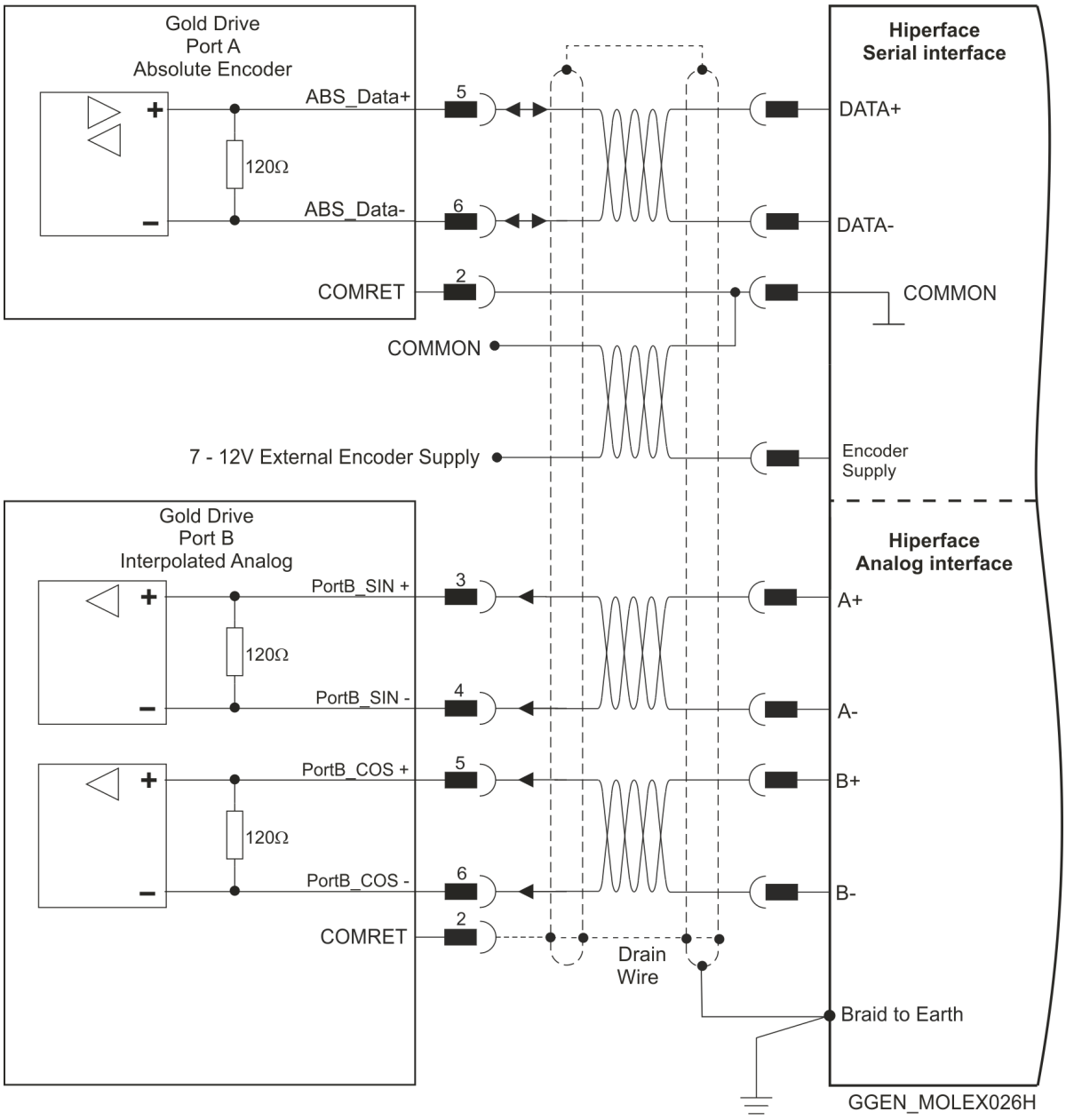


Figure 28: Absolute Serial Encoder – Shrouded Type Connection Diagram Example for Stegmann Hiperface

Note: **When the Hiperface protocol is used, the RS-232 connection is not available**

10.4. Feedback Port B

Port B supports any of the following sensors:

- Incremental encoder, interpolated analog encoder or analog Hall sensors

Or

- Resolver (separate hardware option)

Differential PWM signal input can be connected to port B in the models that support input from an incremental encoder. The PWM signal can be connected to the applicable pair of matching + and – encoder channels and is configurable by software.

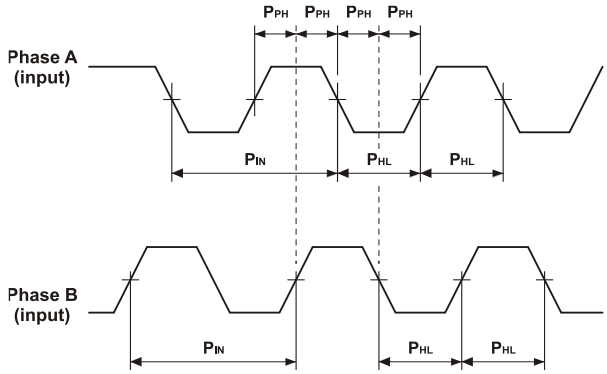
Differential Pulse & Direction signal inputs can be connected to port B in the models that support input from an incremental encoder. The signals can be connected to the applicable pair of matching + and – encoder channels and are configurable by software.

The following table describes the signals of Port B.

Incremental Encoder		Interpolated Analog Encoder		Resolver	
Signal	**Function**	**Signal**	**Function**	**Signal**	**Function**
+5V	Encoder +5V supply	+5V	Encoder +5V supply	NC	
COMRET	Common return	COMRET	Common return	COMRET	Common return
PortB_ENC_A+	Channel A+	PortB_ SIN+	Sine+	PortB_ SIN+	Sine+
PortB_ENC_A-	Channel A -	PortB_ SIN-	Sine-	PortB_ SIN-	Sine-
PortB_ENC_B+	Channel B+	PortB_ COS+	Cosine+	PortB_ COS+	Cosine+
PortB_ENC_B-	Channel B-	PortB_ COS-	Cosine-	PortB_ COS-	Cosine-
PortB_ENC_INDEX+	Channel_Index+	PortB_ANA_Index+	Analog_Index+	PortB_ANA_Index+	RESOLVER_OUT+ Vref f=1/TS, 50 mA Max.
PortB_ENC_INDEX-	Channel_Index-	PortB_ANA_Index-	Analog_Index-	PortB_ANA_Index-	RESOLVER_OUT- Vref complement f= 1/TS, 50 mA Maximum

Table 11: Port B Pin Assignments

10.4.1. Incremental Encoder

Feature	Details
Encoder format	• A, B and Index • Differential • Quadrature
Interface	RS-422
Input resistance	Differential: 120 Ω
Maximum incremental encoder frequency	Maximum absolute: 75 Megacounts per second (18 MHz PPS (Pulses Per Second))
Minimum quadrature input period (PIN)	53 nsec
Minimum quadrature input high/low period (PHL)	26 nsec
Minimum quadrature phase period (PPH)	13 nsec
Maximum encoder input voltage range	Common mode: ±7 V Differential mode: ±7 V
 **Figure 29: Main Feedback - Encoder Phase Diagram**	
Capture with differential input Port B Index	T > 0.1 µsec if the differential input functionality is set to touch probe/capture (index/strobe).

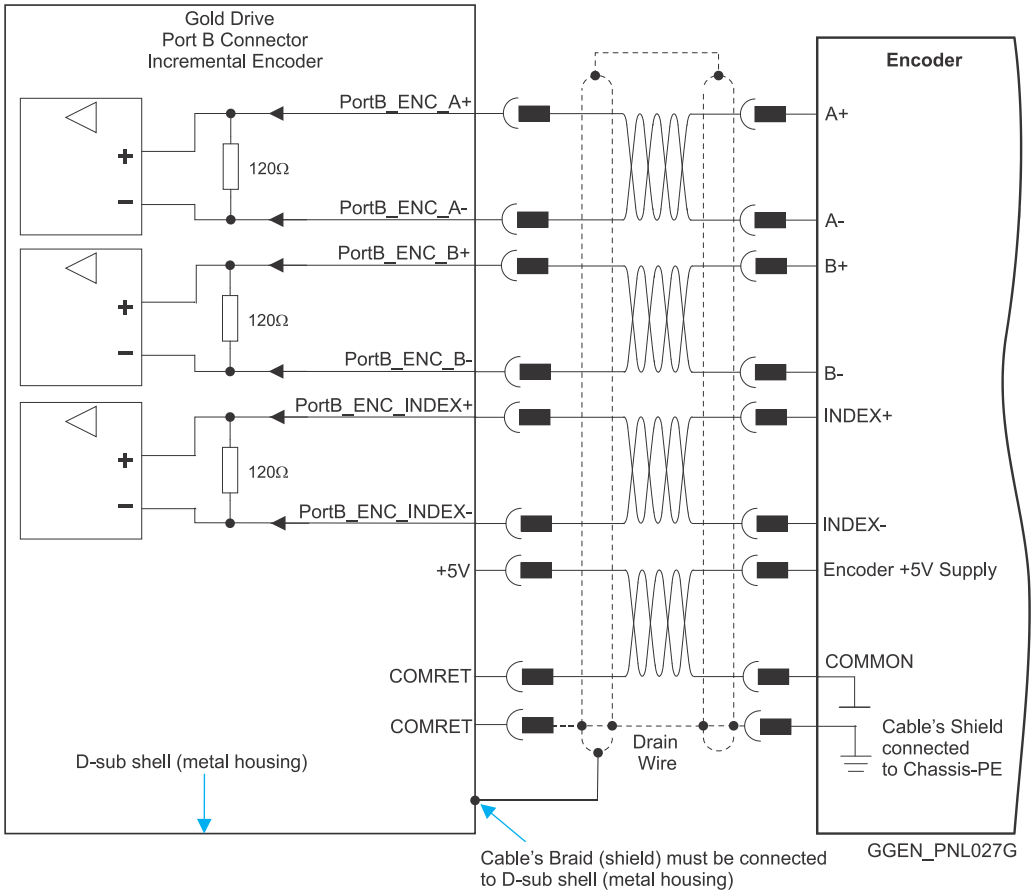


Figure 30: Port B Incremental Encoder Input – D-Type Connection Diagram Example

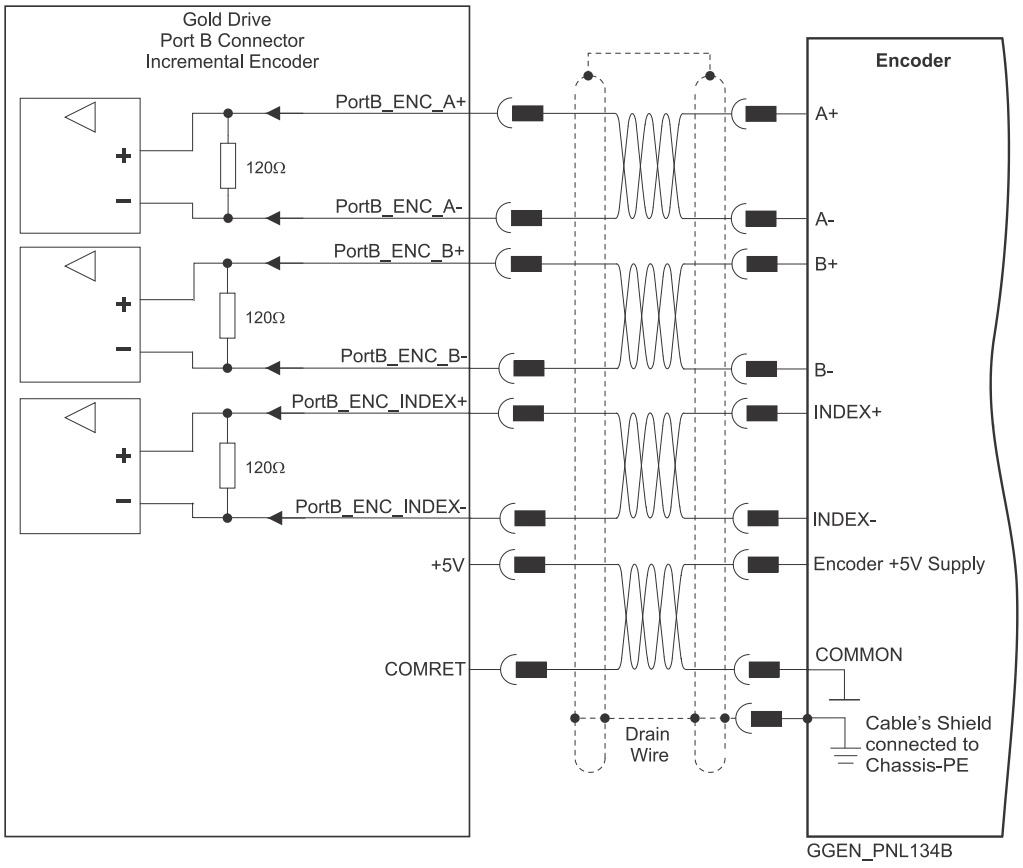


Figure 31: Port B Incremental Encoder Input – Shrouded Type Connection Diagram Example

10.4.2. Interpolated Analog (Sine/Cosine) Encoder

Feature	Details
Analog encoder format	Sine and Cosine signals
Analog input signal level	• Offset voltage: 2.2 V to 2.8 V • Differential, 1 V peak to peak
Input resistance	Differential: 120 Ω
Maximum analog signal frequency	f_{MAX} : 500 kHz
Interpolation multipliers	Programmable: x4 to x16384 (2 to 13 bits)
Maximum "counts" frequency	2 x 10^9 counts/sec
Automatic errors correction	Signal amplitudes mismatch Signal phase shift Signal offsets
Encoder outputs	See Port C Encoder Outputs specifications, Section 10.4.2.

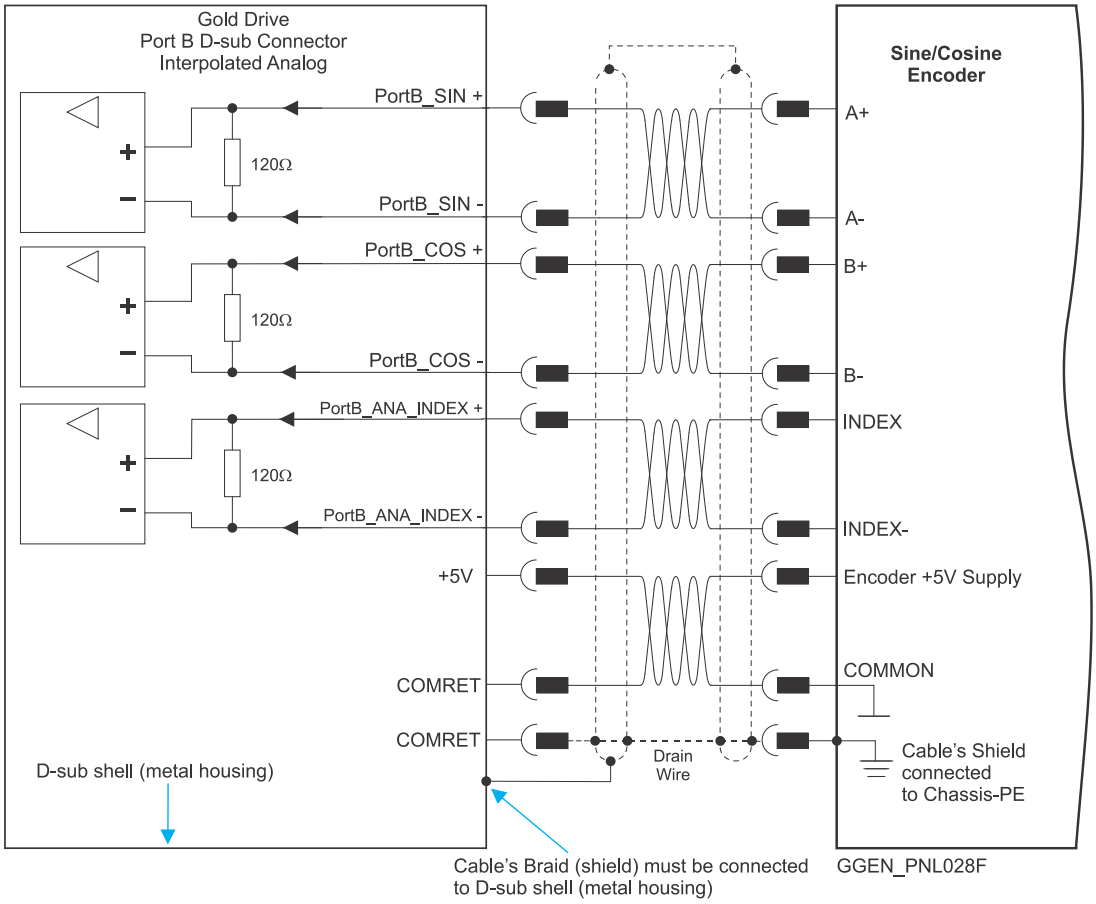


Figure 32: Port B - Interpolated Analog Encoder D-Type Connection Diagram Example

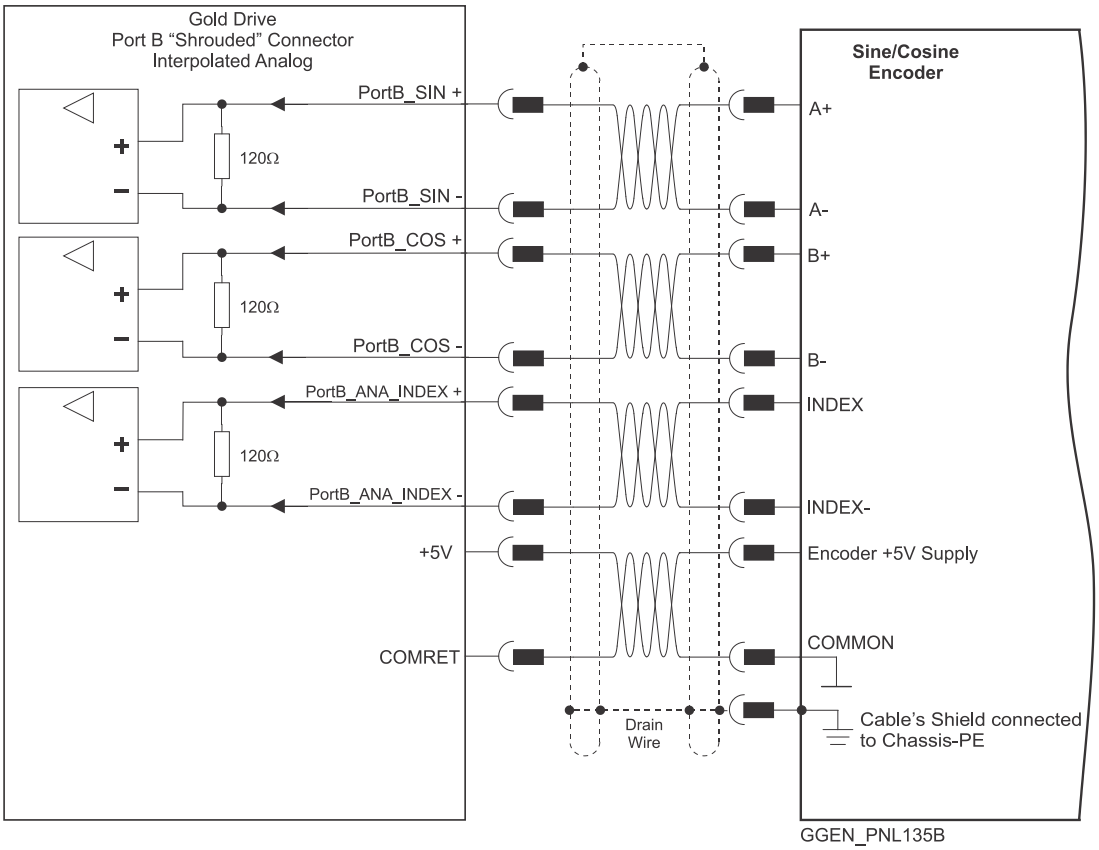


Figure 33: Port B - Interpolated Analog Encoder Shrouded Type Connection Diagram Example

10.4.3. Resolver

Feature	Details
Resolver format	• Sine/Cosine • Differential
Input resistance	Differential 2.49 kΩ
Resolution	Programmable: 2 to 16 bits
Maximum electrical frequency (RPS)	512 revolutions/sec
Resolver transfer ratio	0.5
Reference frequency	Up to 1/Ts (Ts = sample time in seconds)
Reference voltage	Supplied by the Gold Panel Mounted Servo Drive
Reference current	up to ±50 mA RMS
Excitation Voltage	10Vptp, Filtered square wave shape

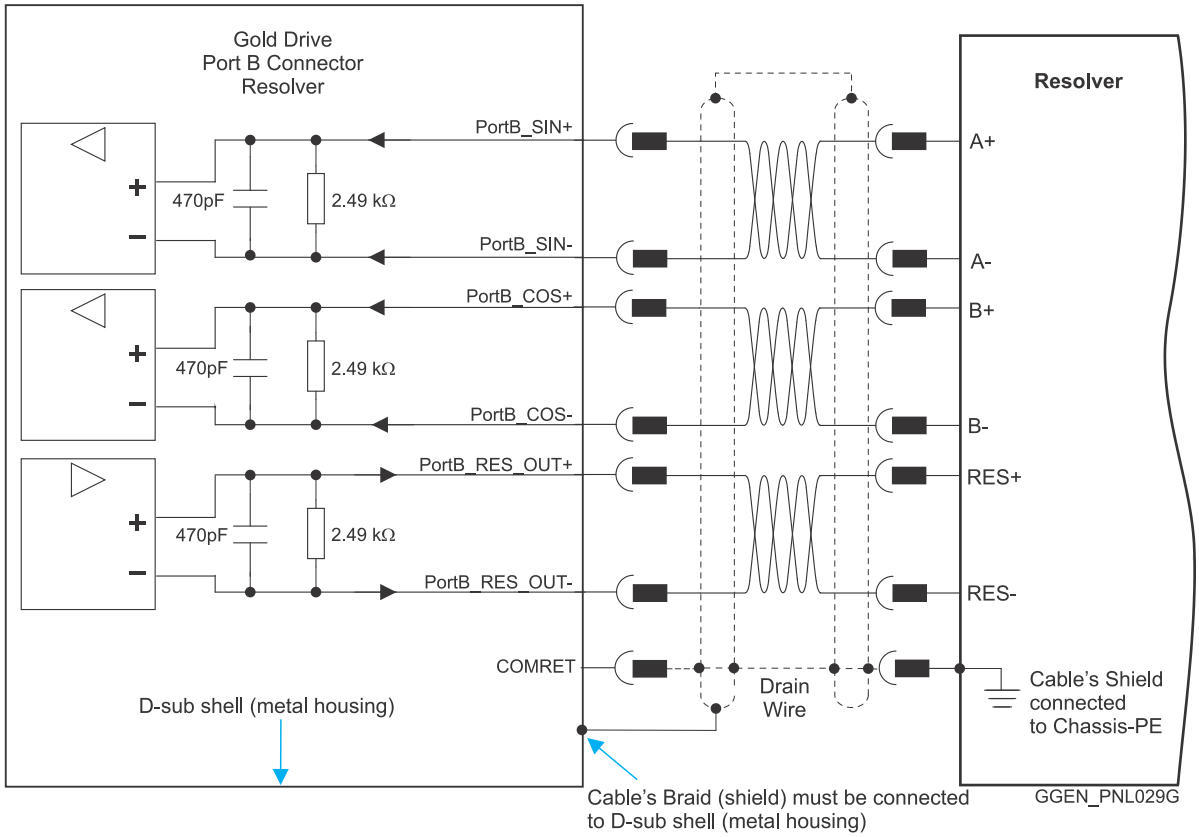


Figure 34: Port B – Resolver D-Type Connection Diagram Example

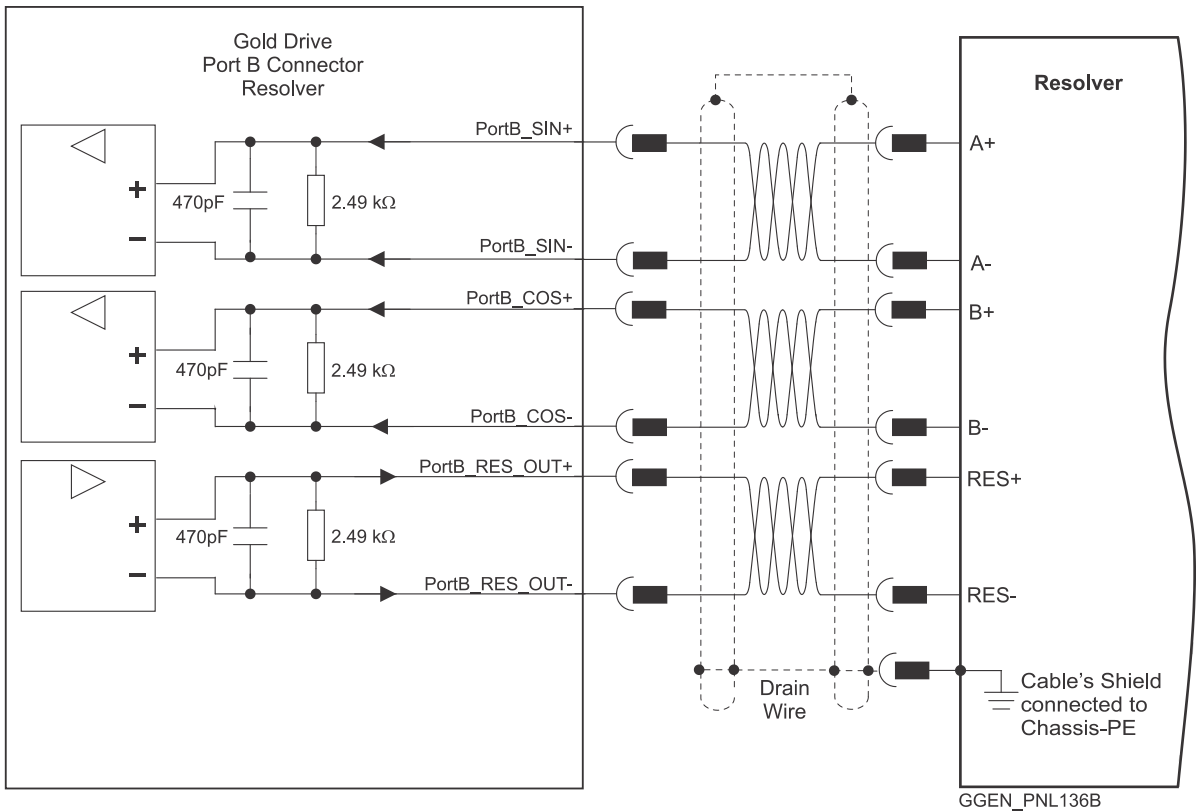


Figure 35: Port B – Resolver Shrouded Type Connection Diagram Example

10.5. Port C –Encoder Output

10.5.1. Introduction

Port C provides encoder output derived from port A or port B feedback inputs, or from internal variables. The output options are:

- Port A/B daisy chain (1:1) for incremental encoder
- Encoder emulation: Emulate any input sensor, digital or analog, or use to emulate an internal variable such as virtual profiler.
- PWM output: Any pair of outputs that is used as an encoder channel (e.g., channel A+ and channel A-) can be configured by software to become PWM output.
- Pulse & Direction output: The output pins that are assigned as channel A and channel B when used as encoder but can be configured by software to become pulse and direction outputs respectively.

This port is used when the Gold Panel Mounted Servo Drive is used:

- A current amplifier to provide position data to the position controller.
- In velocity mode, to provide position data to the position controller.
- As a master in follower or ECAM mode.

10.5.2. Signals

Port C includes the following signals:

Signal	Function
PortC_ENCO_A+	Buffered Channel A output
PortC_ENCO_A-	Buffered Channel A complement output
PortC_ENCO_B+	Buffered Channel B output
PortC_ENCO_B-	Buffered Channel B complement output
PortC_ENCO_Index+	Buffered INDEX output
PortC_ENCO_Index-	Buffered INDEX complement output

Table 12: Port C Feedback Out and I/O

10.5.3. Specification

Feature	Details
Emulated output	A, B, Index Differential
Interface	RS-422
Termination	User is required to connect a 120 Ω termination at the end of each differential line
Output current capability	High level output current: I_{OH} (max) = 30 mA Low level output current: I_{OL} > 30 mA
Available as options	Emulated encoder output of any sensor on Port A or Port B Daisy chain Port A or Port B Emulated encoder output of internal variables Emulated encoder outputs of the tachometer Emulated encoder outputs of the potentiometer
Maximum frequency	f_{MAX}: 8 MHz pulses/output
Edge separation between A & B	Programmable number of clocks to allow adequate noise filtering at remote receiver of emulated encoder signals (default 2 MHz)
Index (marker)	Length of pulse is one quadrature (one quarter of an encoder cycle) and synchronized to A&B

10.5.4. Connections

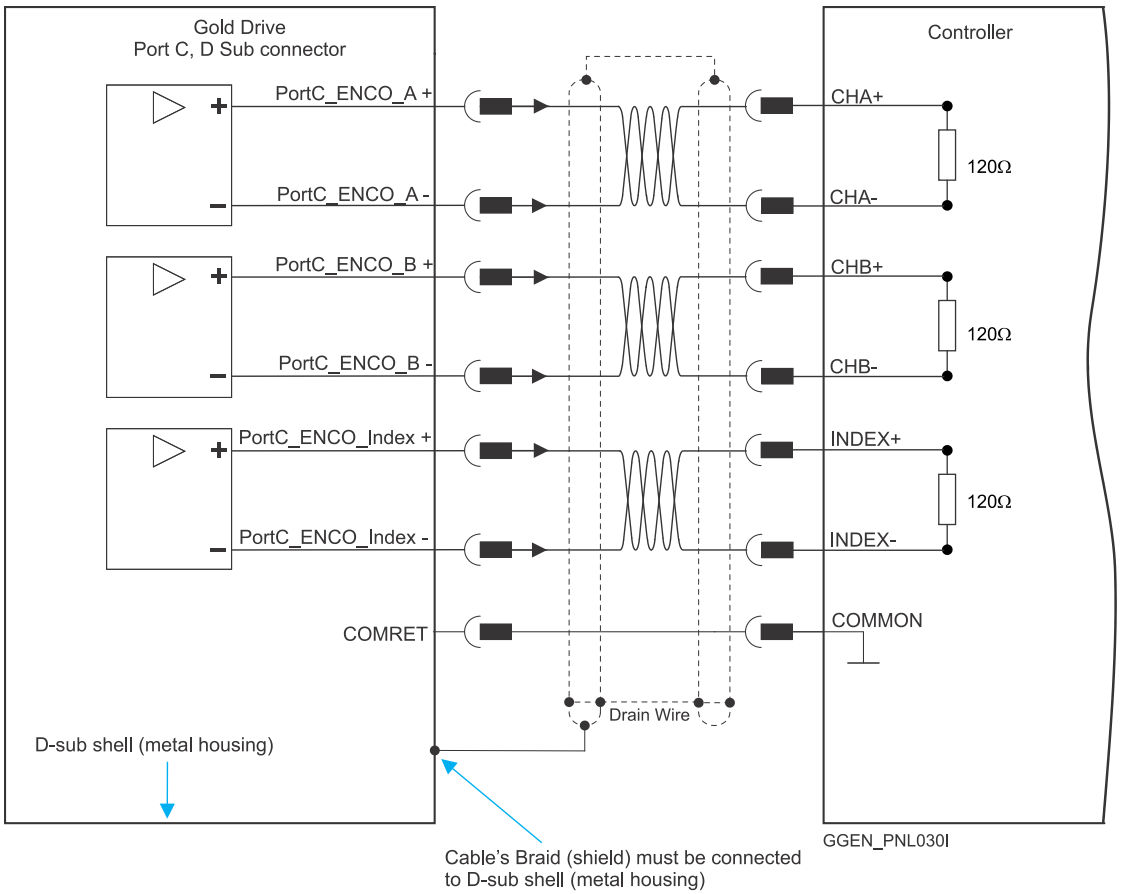


Figure 36: Encoder Differential Output – D-Type Connection Diagram Example

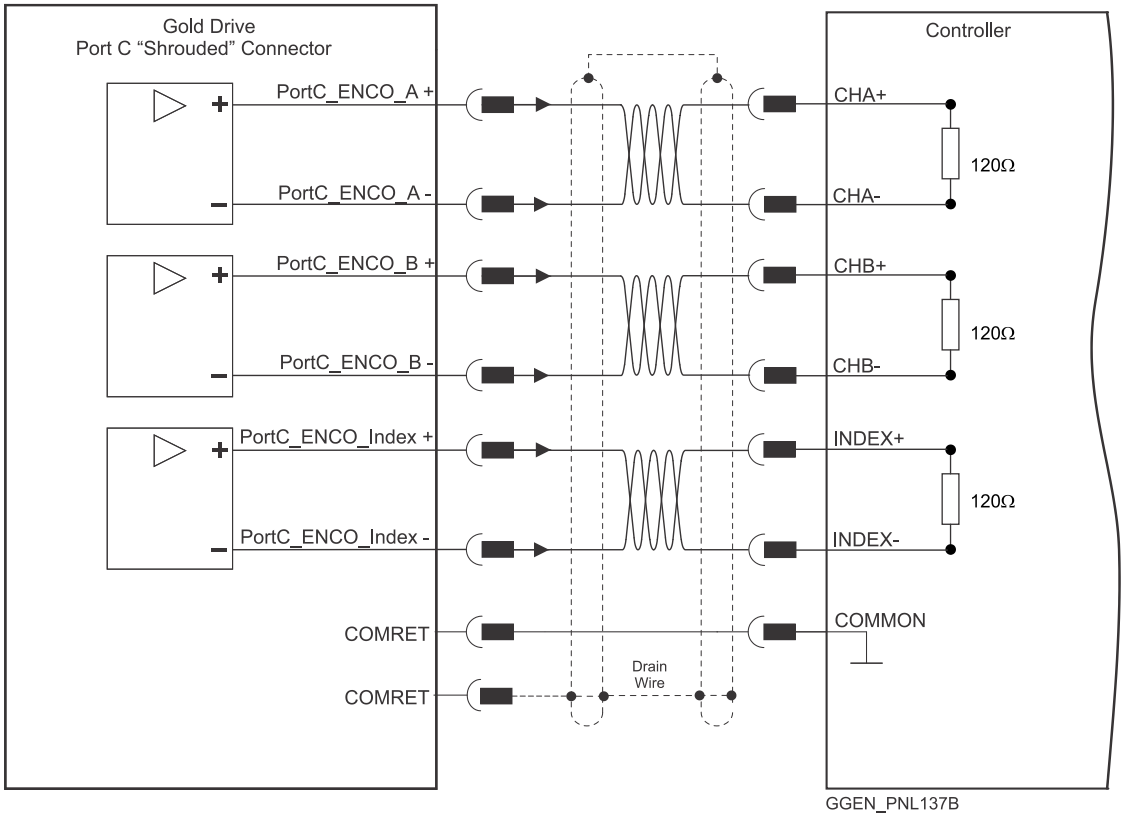


Figure 37: Encoder Differential Output – Shrouded Type Connection Diagram Example

10.6. Gantry

This section describes the hardware connection for the Gantry, and is intended to be part of the installation of the Gantry system. It does not include the software configuration. To configure the Gantry system, refer to the Elmo Application Studio (EAS) User Guide, section Special Tuning Application – Flexible Gantry System.

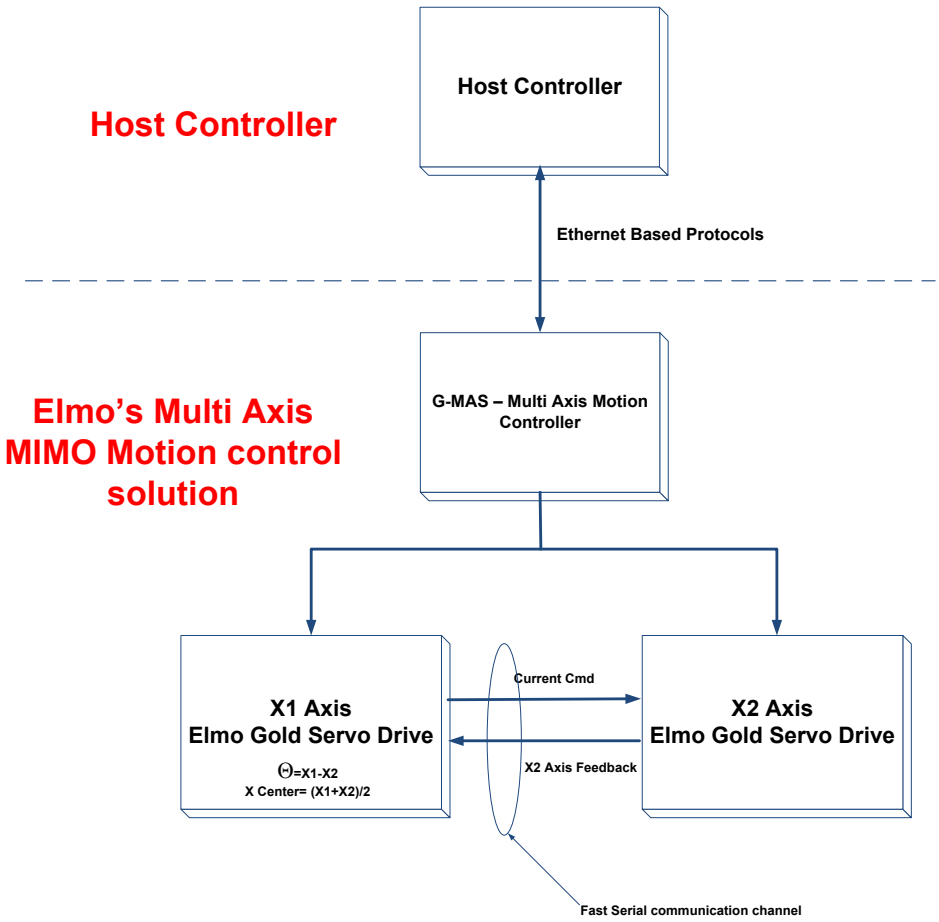


Figure 38: Flexible Gantry system

The flexible Gantry system (Figure 38) demonstrates control of two axes of which the Master performs two separate synchronized control operations; the Master axis locates and resolves the center point of the bridge and resolves the differential position between small anomalous movements of the bridge. To obtain optimum performance, all the PWMs must be synchronized.

There are two options to connect the gantry:

- Connection from Port C to Port A
- Connection from Port C to Port B

10.6.1. Connection from Port C to Port A

Figure 39 and Figure 40 describe the connection between Port C to Port A.

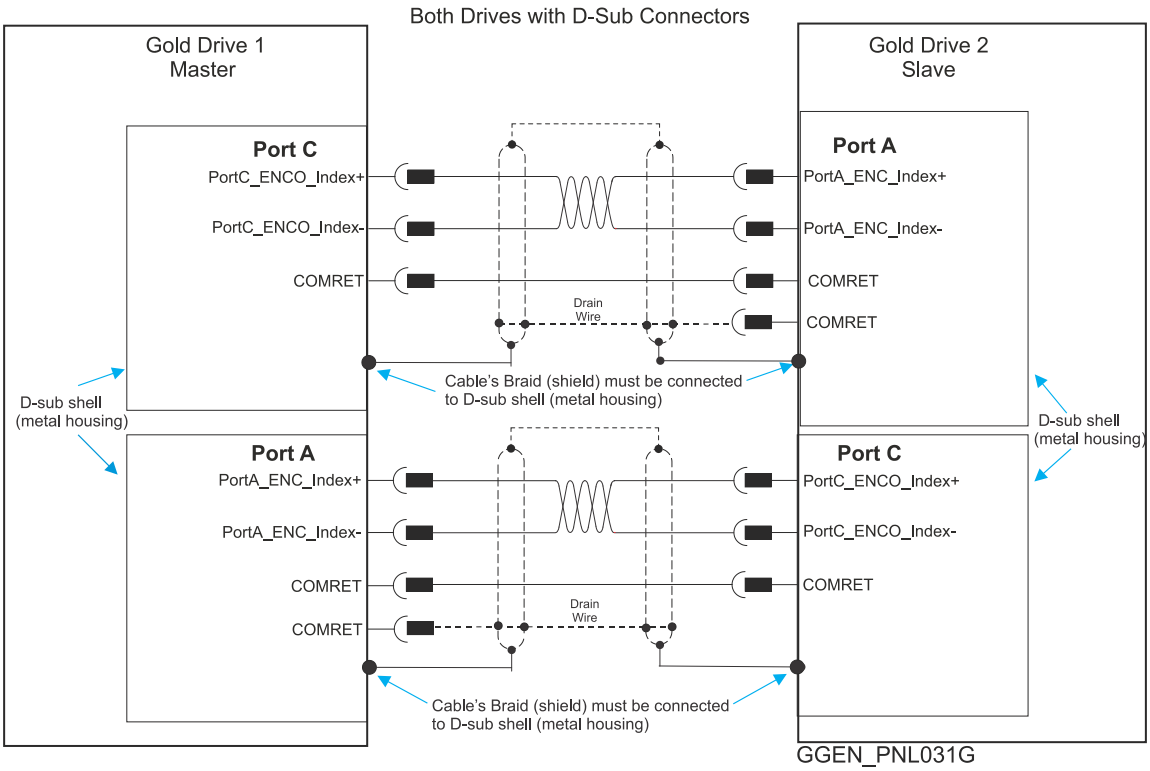


Figure 39: Port C to Port A D-Type Connections Example

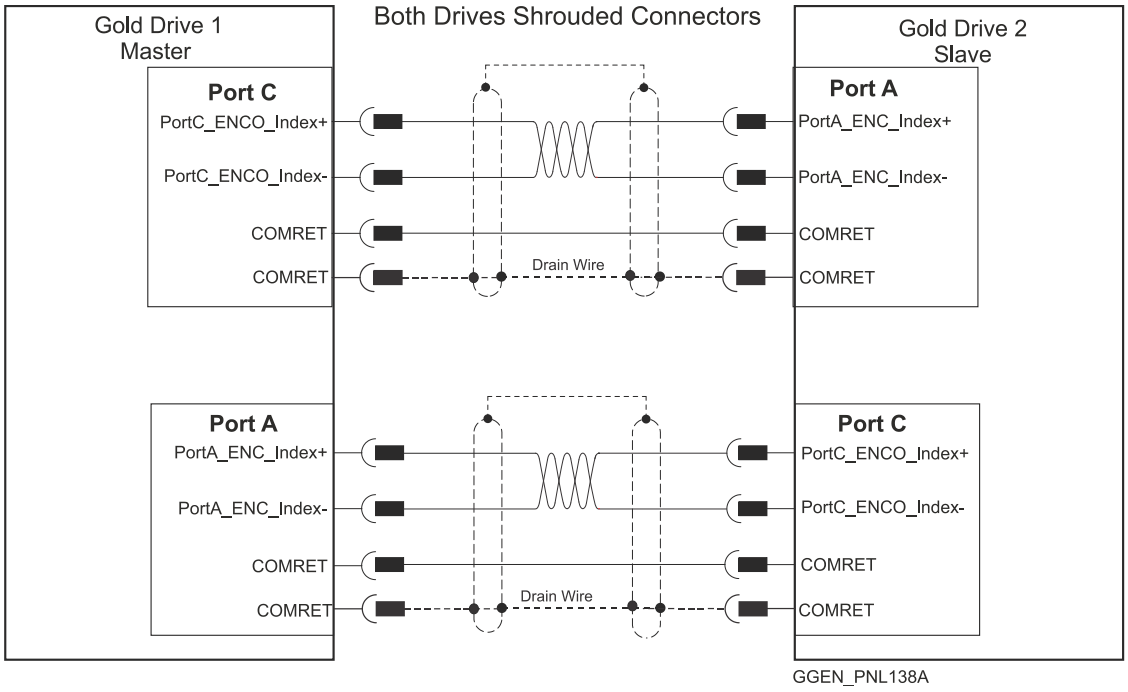


Figure 40: Port C to Port A Shrouded Type Connections Example

10.6.2. Connection from Port C to Port B

Figure 41 and Figure 42 describe the connection between Port C to port B.

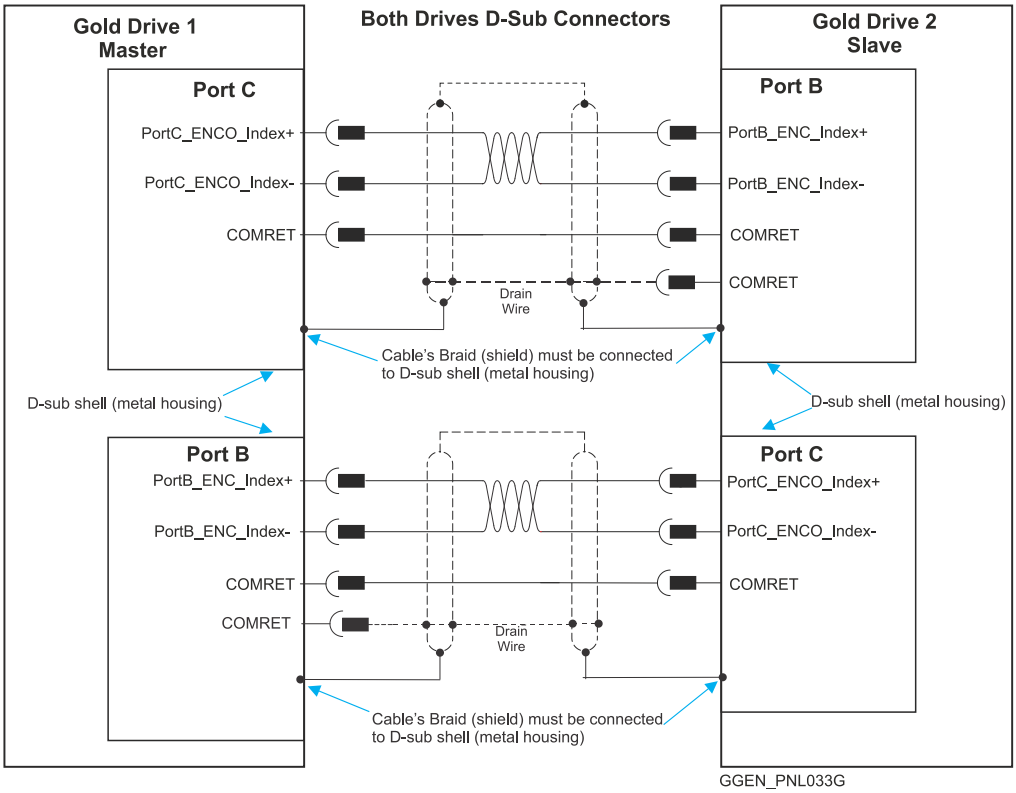


Figure 41: Port C to Port B D-Type Connections

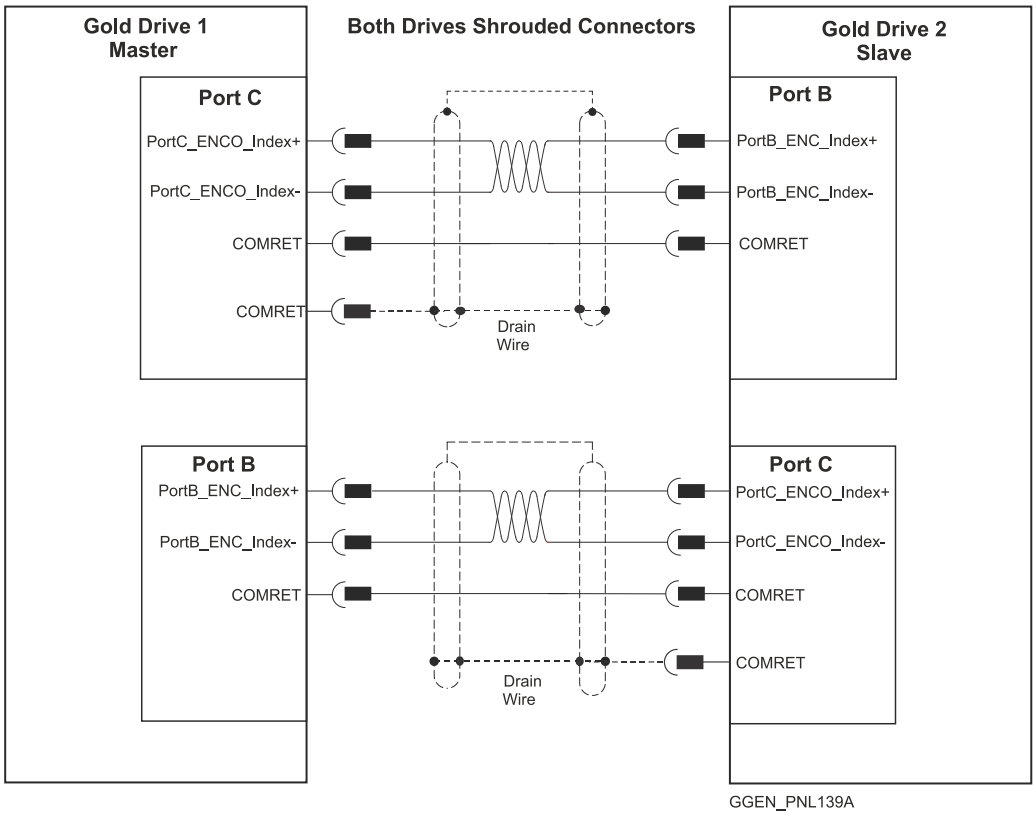


Figure 42: Port C to Port B Shrouded Type Connections

It is however possible to connect the Drive 1 between Port C and Port A, and the Drive 2 between Port C and port B, and similarly vice-versa.

10.6.3. Selecting the Appropriate Cable Configuration

This chapter describes the compromises necessary when deciding which cable configuration to select. The decision will depend on which pin functions are used, and which should be unused. The gantry implementation uses the following pins for communication:

- Index pin of Port C
- Index pin of Port A or index pin of Port B

These pins are used for multiple functions. The two optional gantry cable configurations have pins with the functions described below:

- Connection from Port C to Port A
- Connection from Port C to Port B

10.6.3.1. Connection from Port C to Port A

Index of Port C This pin can be used for the following functions:

- General purpose differential output
- Output Compare
- Communication for gantry

Index of Port A This pin can be used for the following functions:

- Index of incremental Encoder
- Strobe for capturing
- Communication for gantry

When the gantry cable is connected between Port C to Port A, the above pin functions are unused except for the Communication for gantry.

10.6.3.2. Connection from Port C to Port B

Index of Port C This pin can be used for the following functions:

- General purpose differential output
- Output Compare
- Communication for gantry

Index of Port B This pin can be used for the following functions:

- Index of incremental Encoder
- Index of Analog Encoder
- Resolver
- Strobe for capturing
- Communication for gantry

When the gantry cable is connected between Port C to Port B, the above pin functions are unused except for the Communication for gantry.

Chapter 11: User I/Os

This chapter describes the user I/Os which may be Digital, Analog (inputs only), or Network.

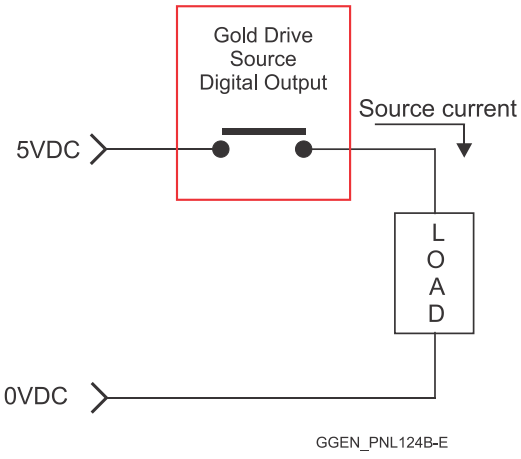
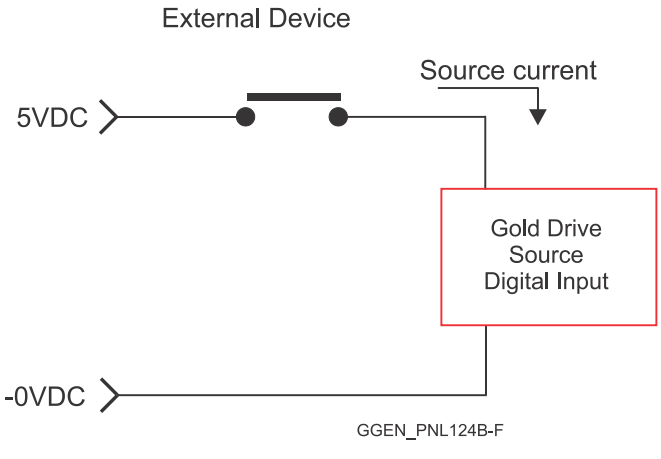
11.1. Digital I/Os

There are six digital inputs and four digital Outputs, which can be configured to the following options:

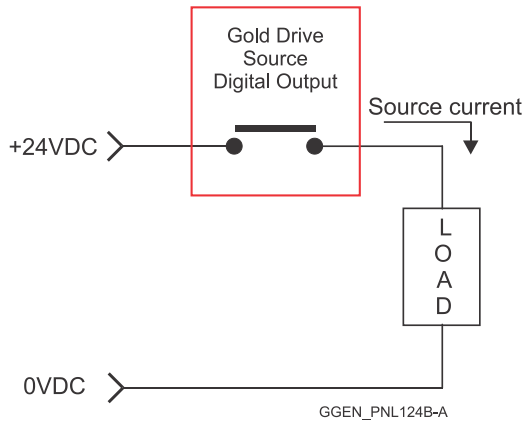
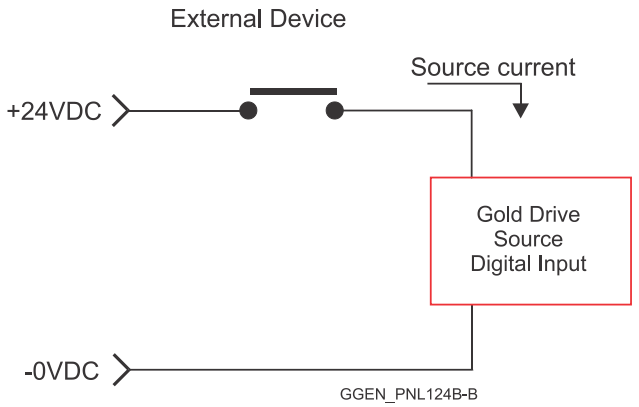
- Source mode – TTL voltage level
- Source mode – PLC voltage level
- Sink mode – PLC voltage level

11.1.1. Introduction

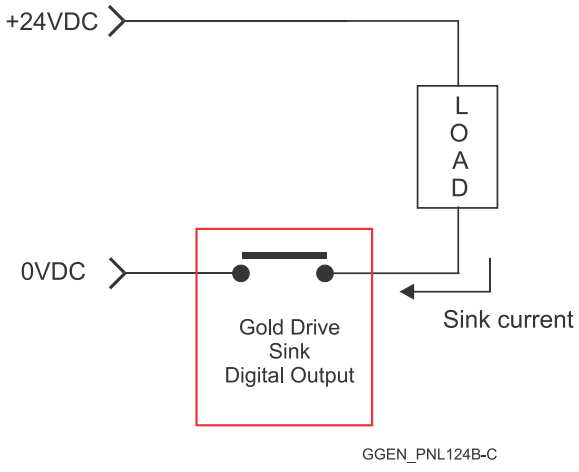
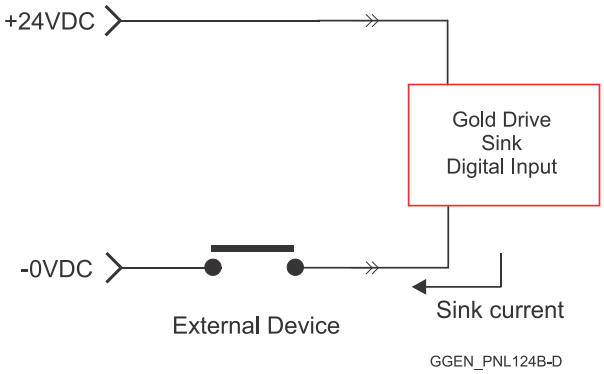
11.1.1.1. Source mode – TTL voltage level

Output	Input
Sourcing Output is an output that "Sources" current through the load. The digital output provides the Power to the load.	**Sourcing Input** is an input that requires an external device to "Source" current to the digital Input. The external device provides a Power to the digital input.
	

11.1.1.2. Source mode – PLC voltage level

Output	Input
Sourcing Output is an output that "Sources" current through the load. The digital output provides the Power to the load.	**Sourcing Input** is an input that requires an external device to "Source" current to the digital Input. The external device provides a Power to the digital input.
	
The Switch can be implemented with a PNP transistor that provide +24VDC.	

11.1.1.3. Sink mode – PLC voltage level

Output	Input
Sinking Output is the output that "Sinks" current through the load. The digital output provides the ground to the load.	**Sinking Input** is an input that require an external device to "Sink" current from the digital Input. The external device provides a ground the digital input.
	

11.1.2. Digital Input and Output Signals

The following are the digital input signals:

Signal	Function
IN1	Programmable digital input 1
IN2	Programmable digital input 2
IN3	Programmable digital input 3
IN4	Programmable digital input 4
IN5	Programmable digital input 5
IN6	Programmable digital input 6
INRET1_6	Programmable input 1 – 6 return The six digital inputs are optically isolated from the other parts of the Gold Panel Mounted Servo Drive

Table 13: Digital Input

The following are the digital output signals:

Signal	Function
OUT1	Programmable output 1
OUT2	Programmable output 2
OUT3	Programmable output 3
OUT4	Programmable output 4
VDD	VDD supply
VDDRET	VDD supply return

Table 14: Digital Output

11.1.2.1. TTL Digital Input

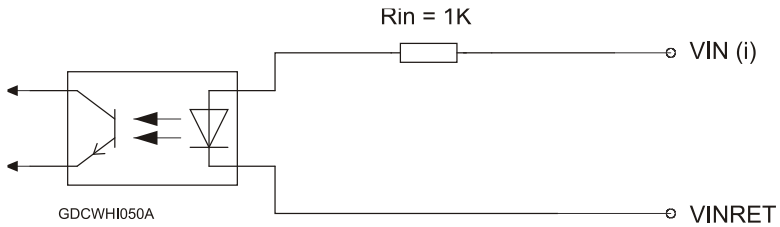
Feature	Details
Type of input	Isolated TTL
Input current	I_{in}= (V_{in}-1.2)/1Kohm I_{in} = 1.2 mA @ V_{in} = 2.4 V I_{in} = 3.8 mA @ V_{in} = 5 V I_{in} = 13.8 mA @ V_{in} = 15 V
High-level input voltage	2.4 V < V_{in} < 15 V, 5 V typical
Low-level input voltage	0 V < V_{in} < 0.8 V
Minimum pulse width	> 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. • Highest speed is achieved when turning on optocouplers.
	
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).

Figure 43: Digital Input TTL Schematic

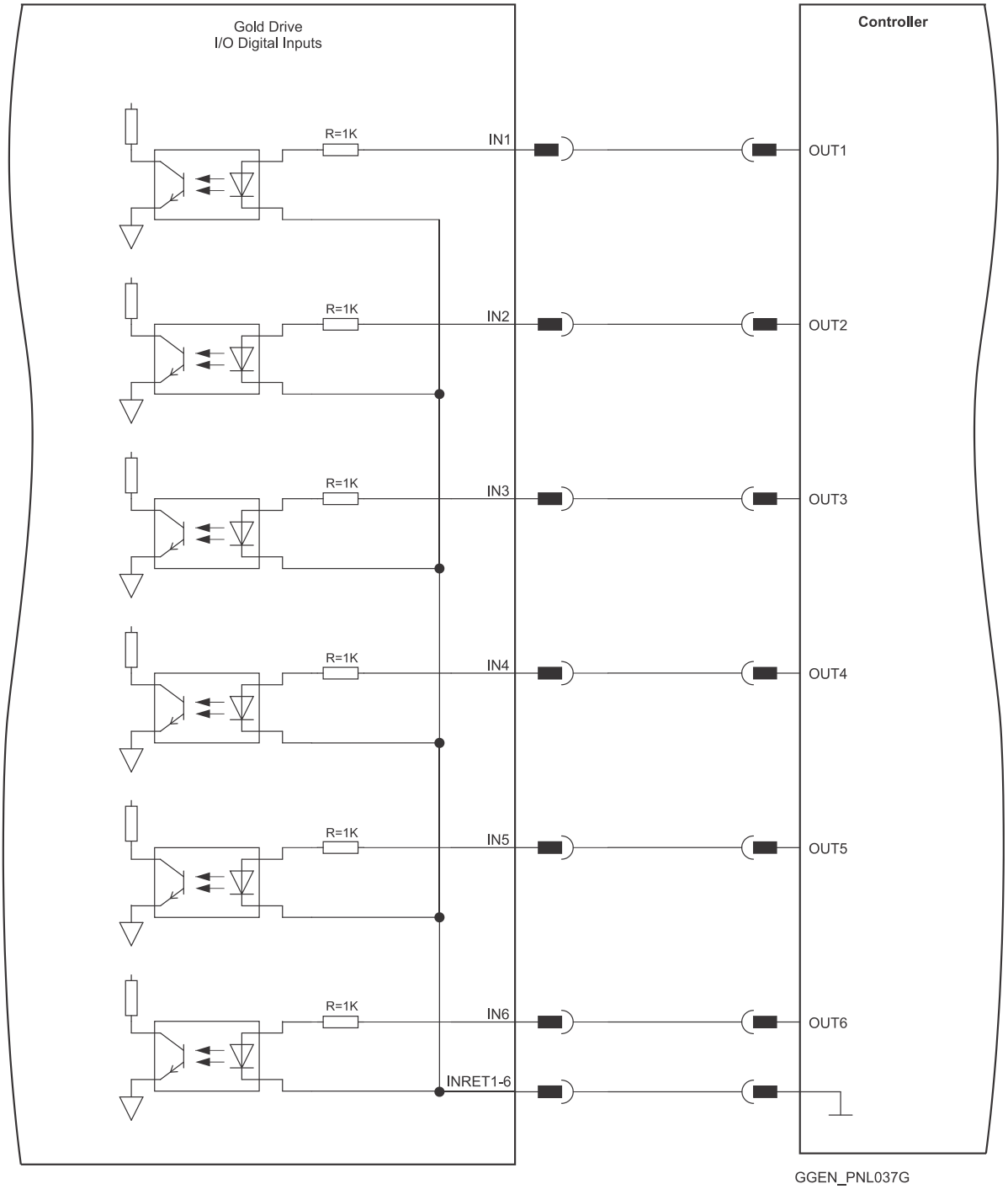


Figure 44: Digital Input TTL Mode Connection Diagram Example

11.1.2.2. TTL Digital Output

Feature	Details
Type of output	Isolated TTL
Supply output (VDD)	5 V to 15 V
Maximum output current I_{out} (max) (V_{out} = Low)	7 mA
VOL at maximum output voltage (low level)	V_{out} (on) ≤ 0.4 V @ I_{out} ≤ 7mA
T_{on} (Time from low to high)	< 2usec
T_{off} (Time from high to Low)	< 20usec
Executable time	0< T< 250 µsec

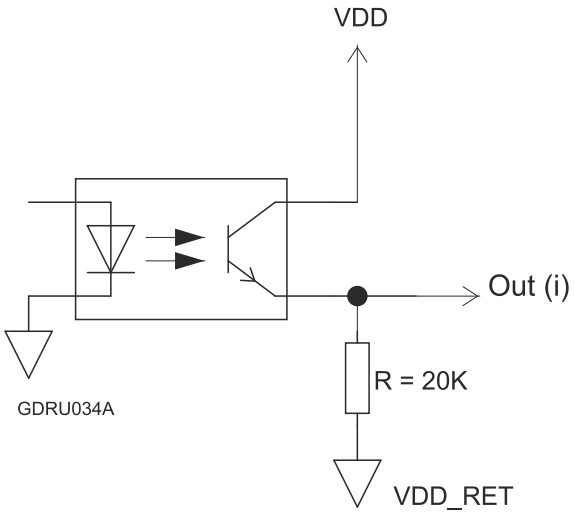


Figure 45: Digital Output TTL Schematic

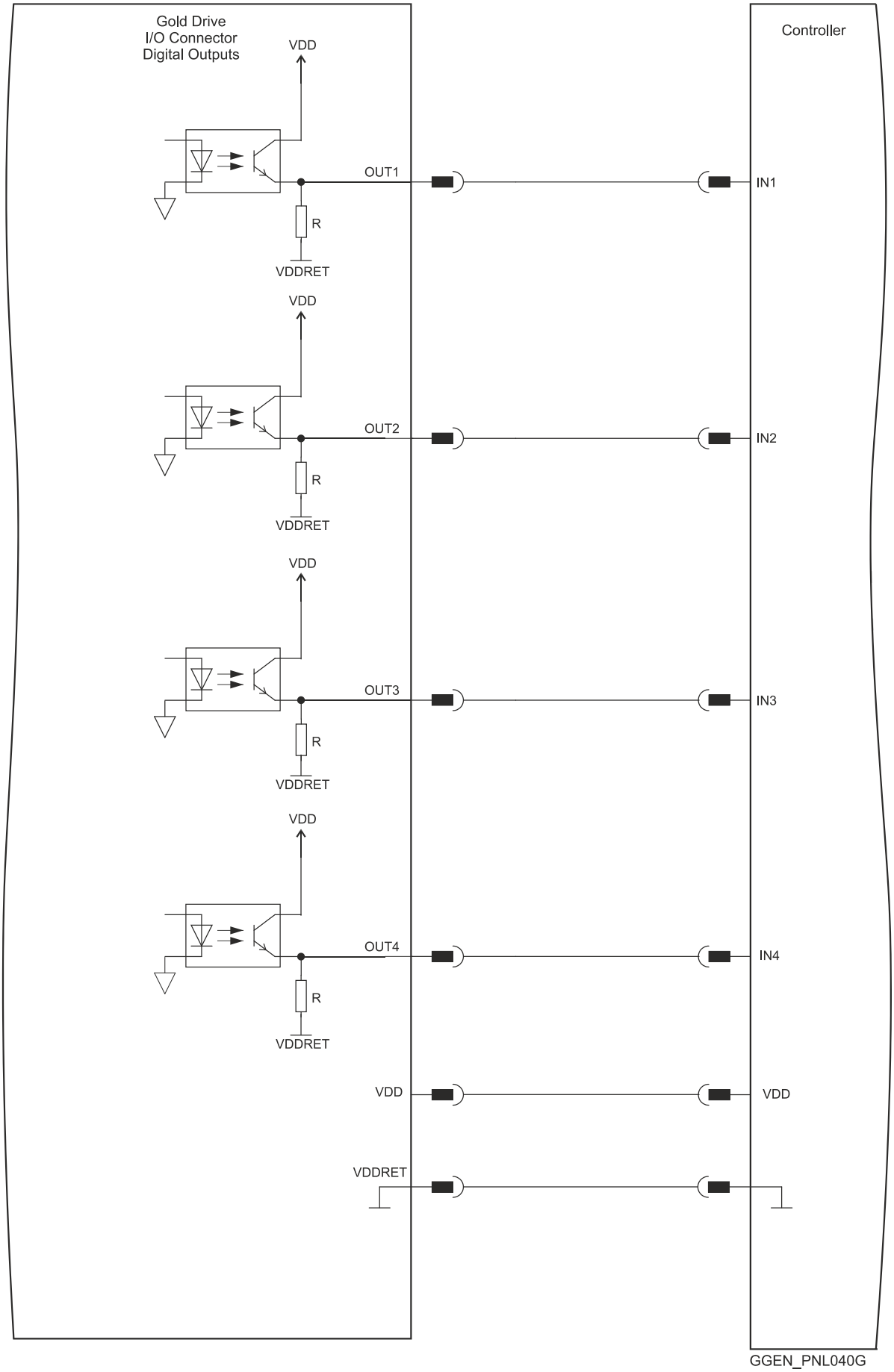


Figure 46: Digital Output Connection Diagram Example – TTL Option

11.1.2.3. Source PLC Voltage Level Digital Input

Feature	Details
Standard	Isolated PLC source Conforming to IEC 61131-2
Input current	I_{in}=(Vin-7.4)/2.5 Kohm I_{in} = 2 mA @ Vin = 12 V I_{in} = 9 mA @ V_{in} = 30 V
High-level input voltage	12 V < Vin < 30 V
Low-level input voltage	0 V < Vin < 7 V
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. • Highest speed is achieved when turning on optocouplers.
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).

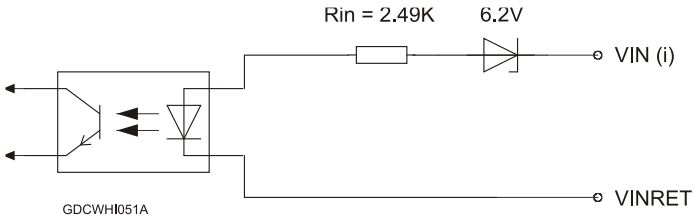


Figure 47: Digital Input Source Schematic

The following are the connection diagram of Digital inputs:

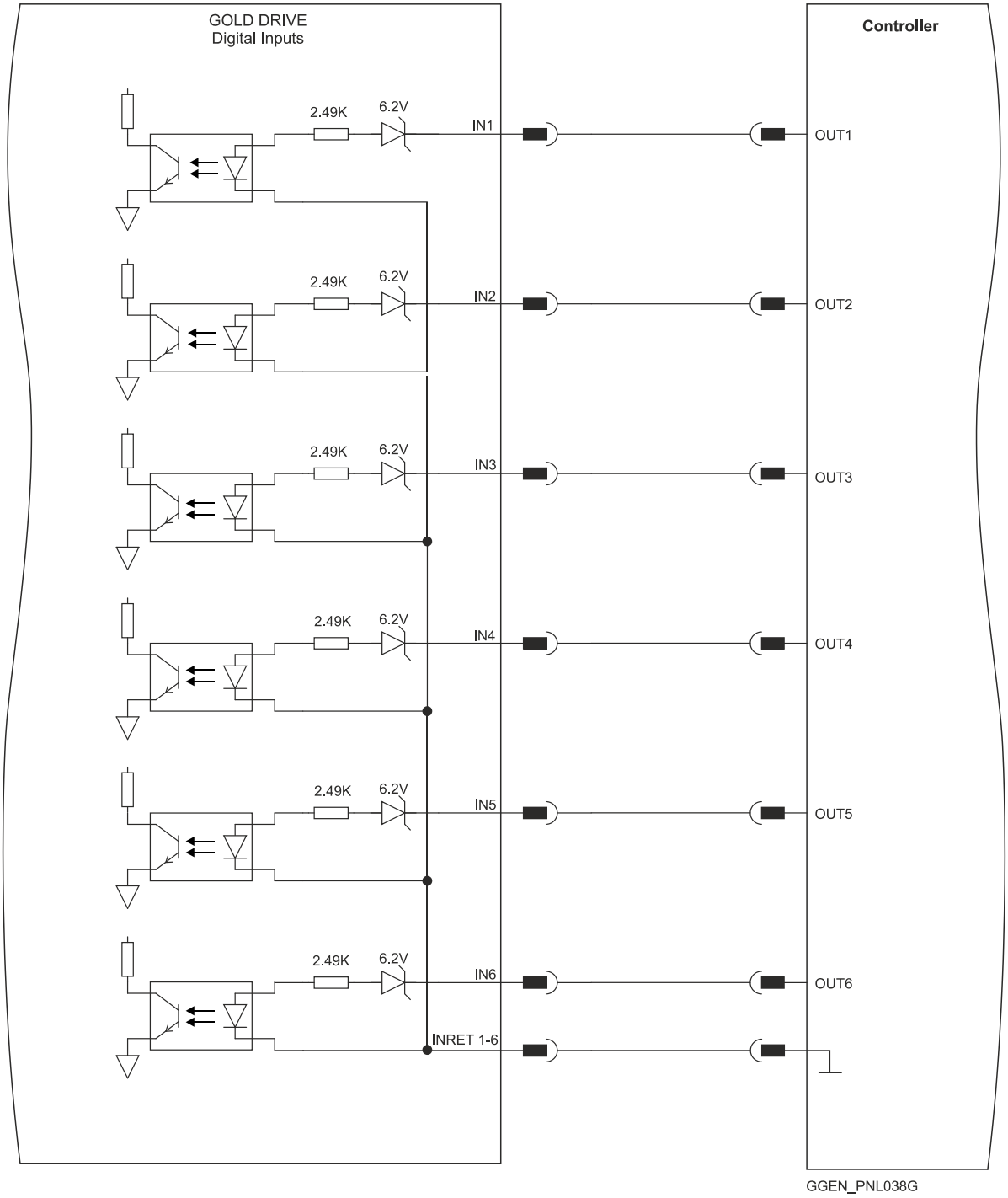


Figure 48: Digital Input Connection Diagram Example – Source PLC Option

11.1.2.4. Source PLC Voltage Level Digital Output

Feature	Details
Type of output	Optically isolated PLC source
Supply output (VDD)	12 V to 30 V
Max. output current I_{out} (max) (V_{out} = High)	I_{out} (max) ≤ 500 mA for Output 1 I_{out} (max) ≤ 250 mA for Outputs 2 up to 4
Total Output Current	Two digital outputs may be connected together in order to achieve higher output current, e.g. for Brakes. The total current of the four digital outputs must not exceed 1250 mA, and the maximum current per output must not exceed 500mA. For example, it is possible to connect OUTS#1+OUT#2 together to pull up to a maximum of 1000 mA, while OUT#3 and OUT#4 can still be used as General Purpose outputs, limited in this case to 125 mA each.
T_{on} (Time from low to high) If V_{dd}= 30V If V_{dd} = 12V	 < 10usec < 85usec
T_{off} (Time from high to Low)	< 85usec
R_L	The external R_L must be selected to limit output current to no more than 500 mA (Output 1) or 250 mA (Outputs 2 to 4). $R_L = \frac{VDD - VOL}{I_{out}(max)}$
Executable time	0 < T < 250 µsec

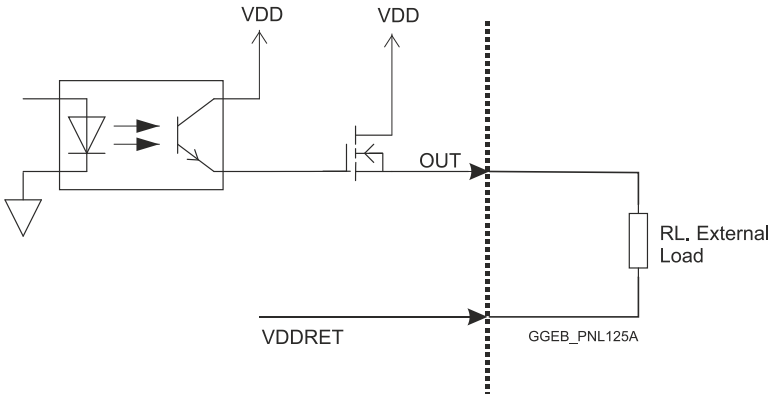


Figure 49: Digital Output Schematic – Source Mode PLC Level

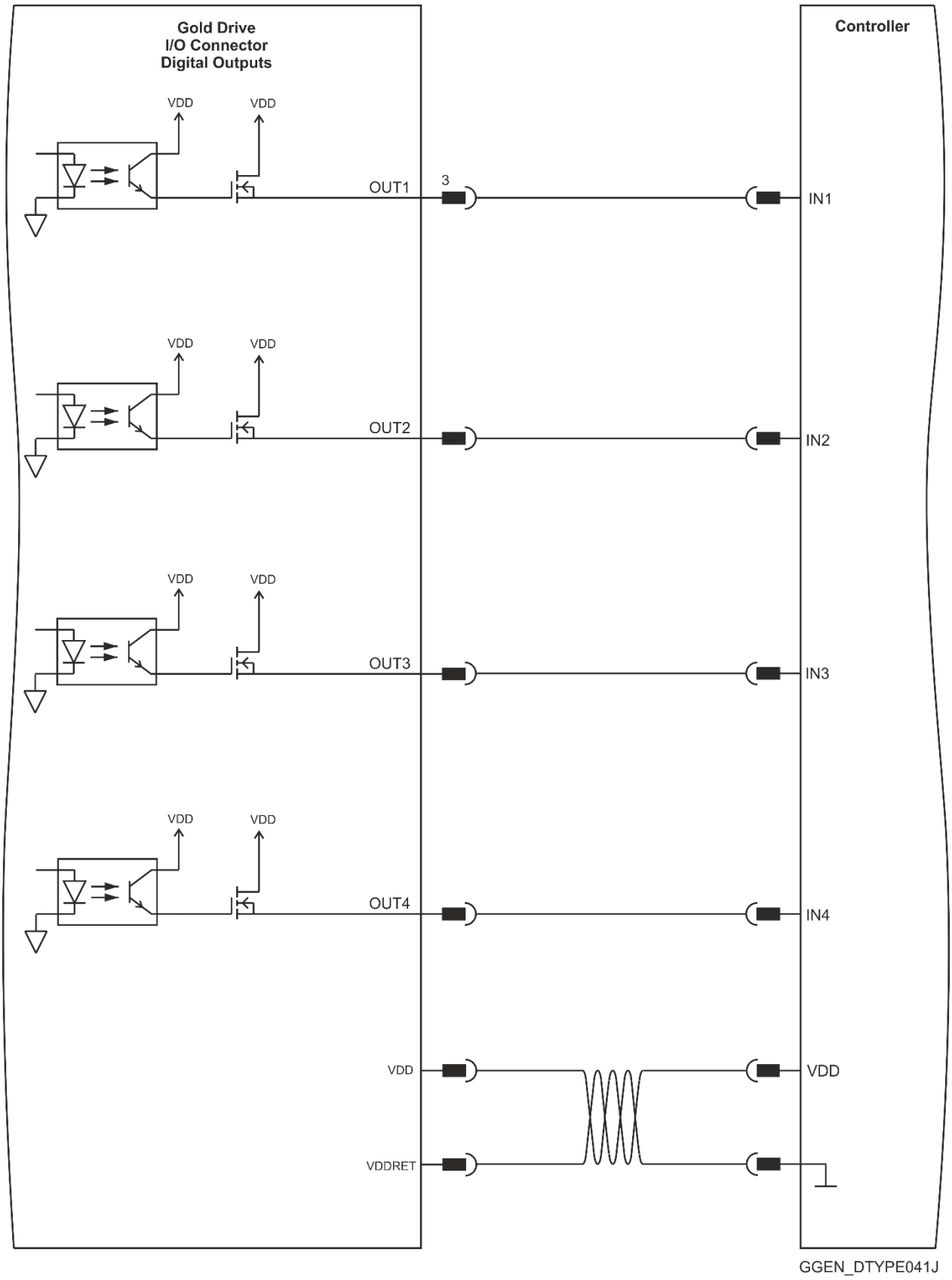


Figure 50: Digital Output Connection Diagram Example – Source PLC Option

11.1.2.5. Sink PLC Voltage Level Digital Input

Feature	Details
Type of input	Isolated PLC Sink
Input current	$I_{in}=(V_{in}-7.4)/2.5Kohm$ I_{in} = 2 mA @ V_{in} = 12 V I_{in} = 9 mA @ V_{in} = 30 V
High-level input voltage	12 V < V_{in} < 30 V
Low-level input voltage	0 V < V_{in} < 7 V
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. • Highest speed is achieved when turning on optocouplers.
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).

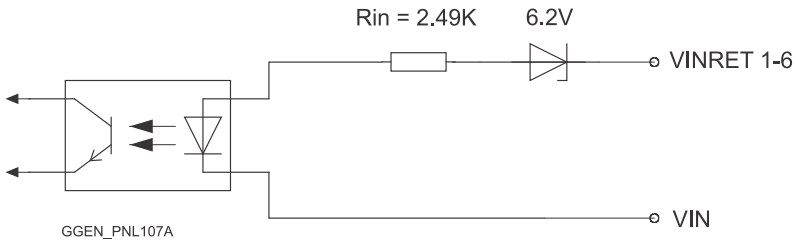


Figure 51: Digital Input Sink Schematic

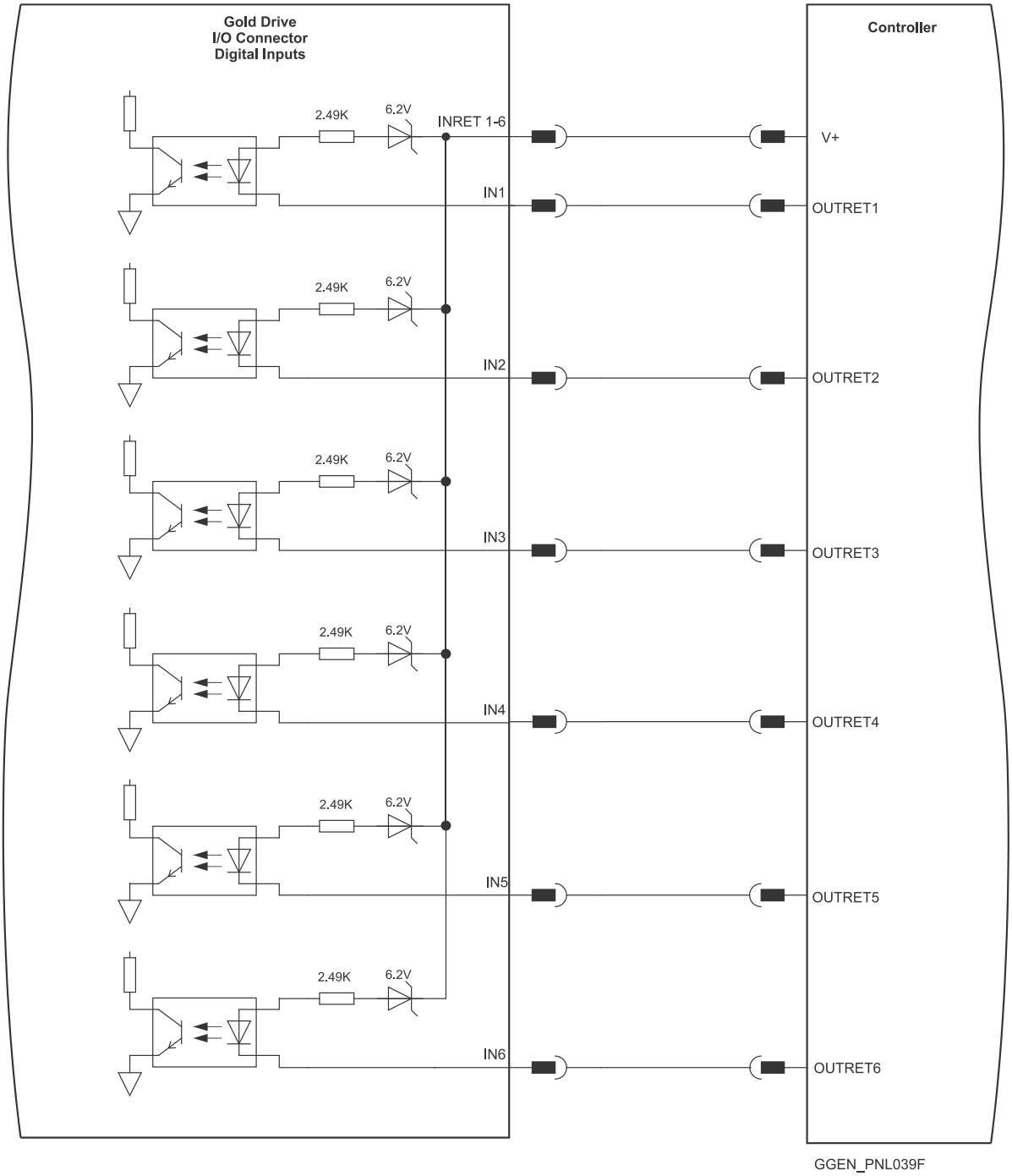


Figure 52: Digital Input Sink Mode Example – PLC voltage level Connection Diagram

11.1.2.6. Sink PLC Voltage Level Digital Output

Feature	Details
Type of output	Isolated PLC Sink
Supply output (VDD)	12 V to 30 V
Max. output current I_{out} (max) (V_{out} = Low)	I_{out} (max) ≤ 300 mA for Output 1 I_{out} (max) ≤ 150 mA for Outputs 2 to 4
Total Output Current	Two digital outputs may be connected together in order to achieve higher output current, e.g. for Brakes. The total current of the four digital outputs must not exceed 750 mA, and the maximum current per output must not exceed 300mA. For example, it is possible to connect OUTS#1+OUT#2 together to pull up to a maximum of 600mA, while OUT#3 and OUT#4 can still be used as General Purpose outputs, limited in this case to 75 mA each.
T_{on} (Time from low to high) If V_{dd}= 30V If V_{dd} = 12V	 < 10usec < 85usec
T_{off} (Time from high to Low)	< 85usec
R_L	The external R_L must be selected to limit output current to no more than 300 mA (Output 1) or 150 mA (Outputs 2 to 4). $R_L = \frac{VDD - VOL}{I_{out}(max)}$
Executable time	0 < T < 250 µsec

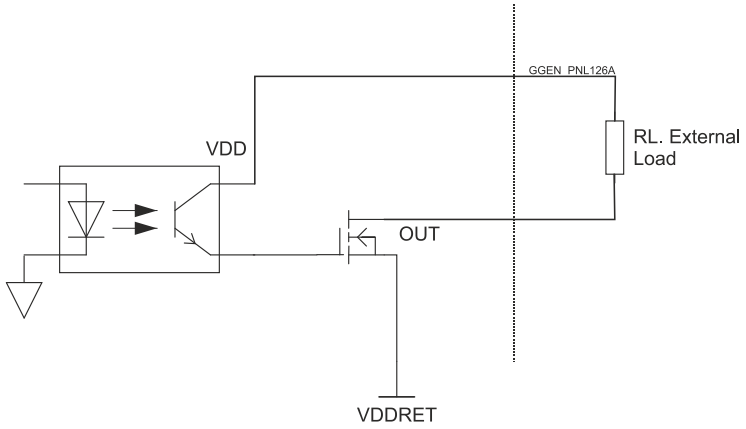


Figure 53: Digital Output Schematic for Sink – PLC level

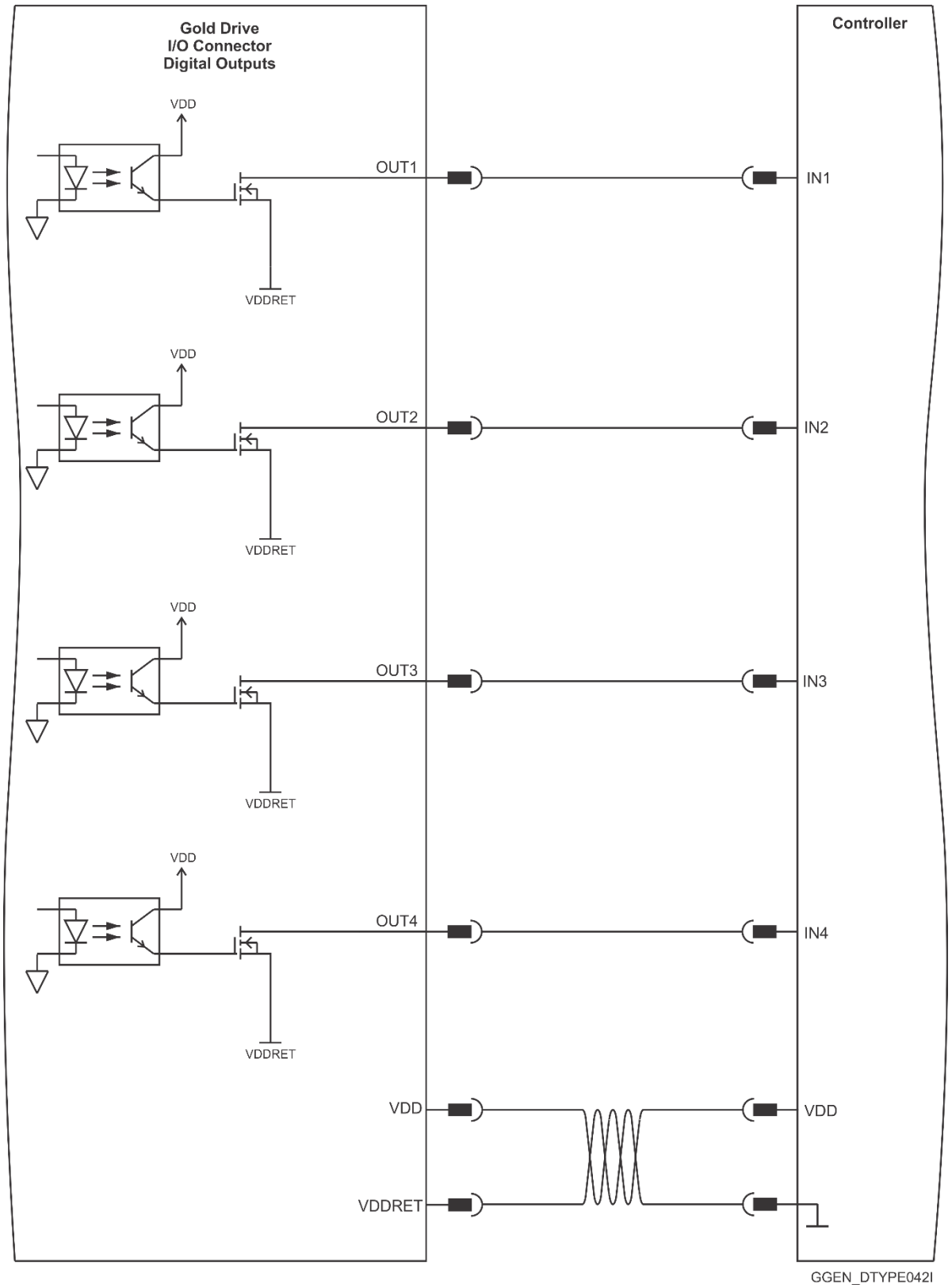


Figure 54: Digital Output Example as Sink Configuration Connection Diagram

11.2. Analog Input

Analog user inputs can be configured by software to be used as either tachometer velocity sensor input or potentiometer position feedback.

The following are the analog input signals:

Signal	Function
ANALOG1+	Analog input 1+
ANALOG1-	Analog input 1-
ANARET	Analog Return

Feature	Details
Maximum operating differential voltage	± 10 V
Maximum absolute differential input voltage	± 16 V
Differential input resistance	3.74 kΩ
Analog input command resolution	12-bit
Sample time	250 µsec

The following circuit describes the internal interface of the Analog input.

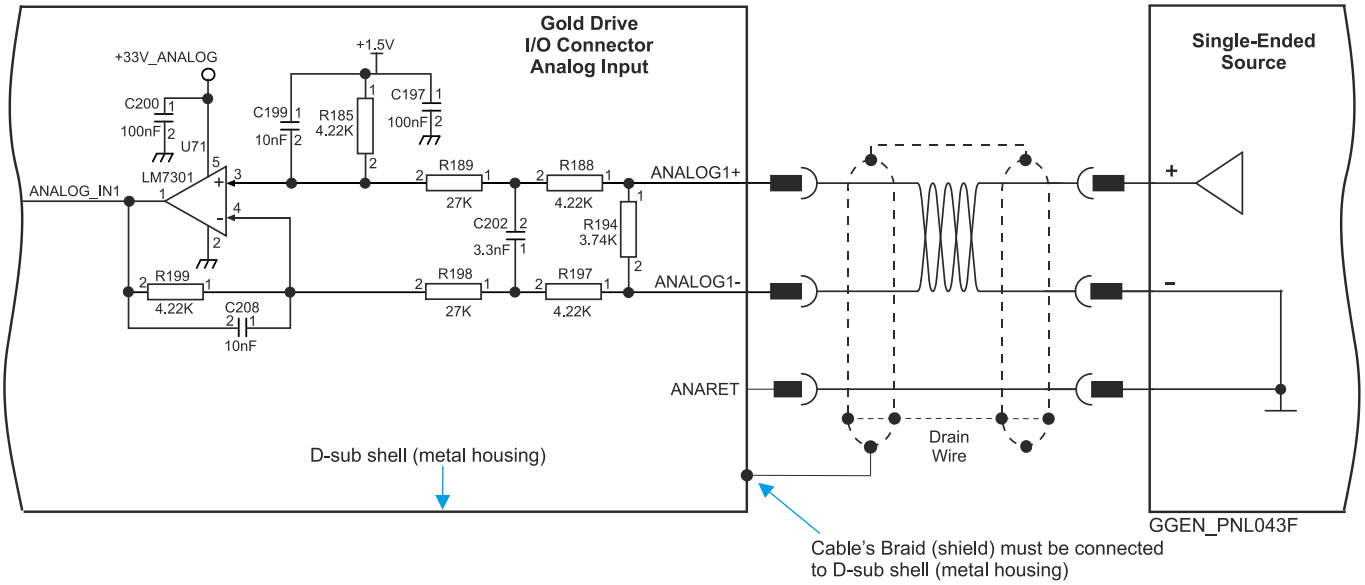


Figure 55: Differential Analog Input for D-Type connector

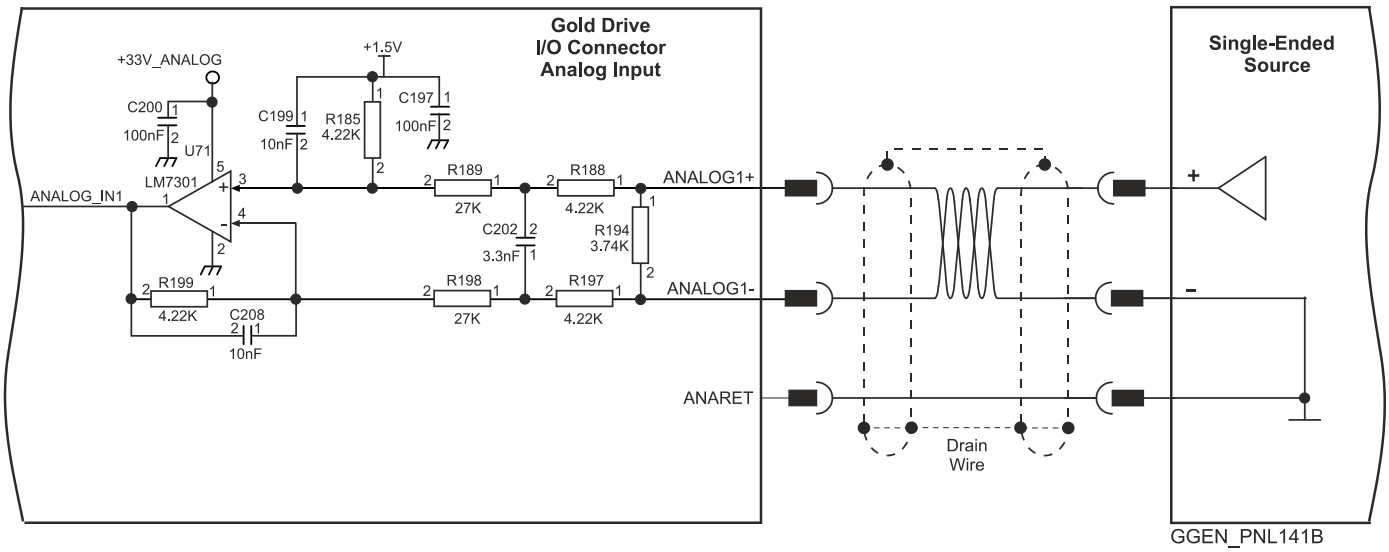


Figure 56: Differential Analog Input for Shrouded Type connector

11.3. Network I/O

Some products, for example in the Gold Tuba, the IO capability is extended. For details, refer to the specific installation guides.

Chapter 12: Communications

The Gold line supports different communication channels:

- EtherCAT
- CAN
- USB
- RS-232
- RS-422 (Differential RS-232)

12.1. USB 2.0

Specification	Details
USB Type	USB 2.0 Device mode
Speed	Up to 12 Mbit/s "Full Speed"
Cable length	maximum 5 m
Cable Type	Standard USB cable • constructed with 4 wires of 20AWG to 28AWG, shield with a foil • D+ and D- comprise a twisted pair in the cable • The shield of the cable is connected to the shield of the connector used for communication
Protocols	For setup and control

Signal	Function
USB VBUS	USB VBUS 5 V
USBD-	USB _N line
USBD+	USB _P line
USB COMRET	Common Return
Drain wire	Shield

Table 15: USB 2.0 - Pin Assignments

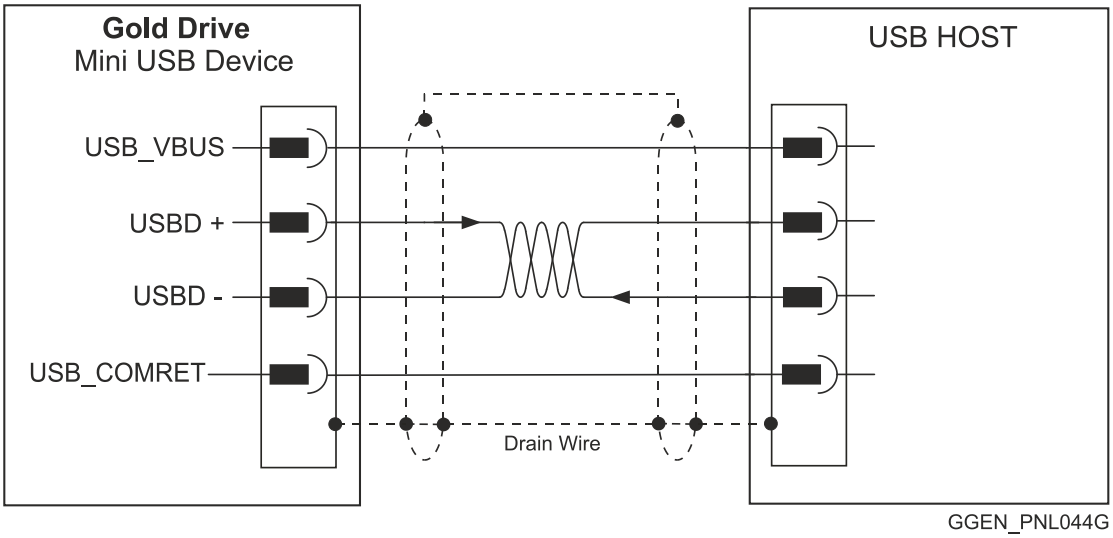


Figure 57: USB Network Diagram Example

12.2. EtherCAT/Ethernet

12.2.1. Introduction

The Gold Panel Mounted Servo Drive serves as an EtherCAT slave device, therefor it includes EtherCAT_IN and EtherCAT_OUT ports. The EtherCAT_IN port can be configured to an Ethernet port using the FW command. Refer to the Gold Command Reference manual.

12.2.2. Specification

Specification	Details
Physical layer	• 100base-T
Speed	• 100 Mbit/sec
Cable Type	CAT5e (Category 5 cable is a high signal integrity cable with four twisted pairs. It is recommended to use with shielded cable).
EtherCAT	
EtherCAT Type	EtherCAT Slave (Includes EtherCAT IN and EtherCAT out ports)
Protocols	CoE, FoE, EoE Distributed clock **Note: During the FoE operation, the USB cable connection must be disconnected.**
Ethernet (EtherCAT IN Port)	
Protocols	UDP

12.2.3. EtherCAT with RJ-45 Connectors

12.2.3.1. Signals

The following table describes the pinouts of EtherCAT.

Signal	Function
EtherCAT_IN_TX+	EtherCAT In transmit+/Ethernet transmit+
EtherCAT_IN_TX-	EtherCAT In transmit-/Ethernet transmit-
EtherCAT_IN_RX+	EtherCAT In receive+/Ethernet receive+
N/A	
EtherCAT_IN_RX-	EtherCAT In receive-/Ethernet receive-
N/A	

Table 16: EtherCAT IN

The following table describes an example of the pinouts of EtherCAT.

Signal	Function
EtherCAT_OUT_TX+	EtherCAT out transmit +
EtherCAT_OUT_TX-	EtherCAT out transmit -
EtherCAT_OUT_RX+	EtherCAT out receive +
N/A	
EtherCAT_OUT_RX-	EtherCAT out receive -
N/A	

Table 17: EtherCAT OUT

In the Ethernet mode only the LEDs of EtherCAT IN will be available.

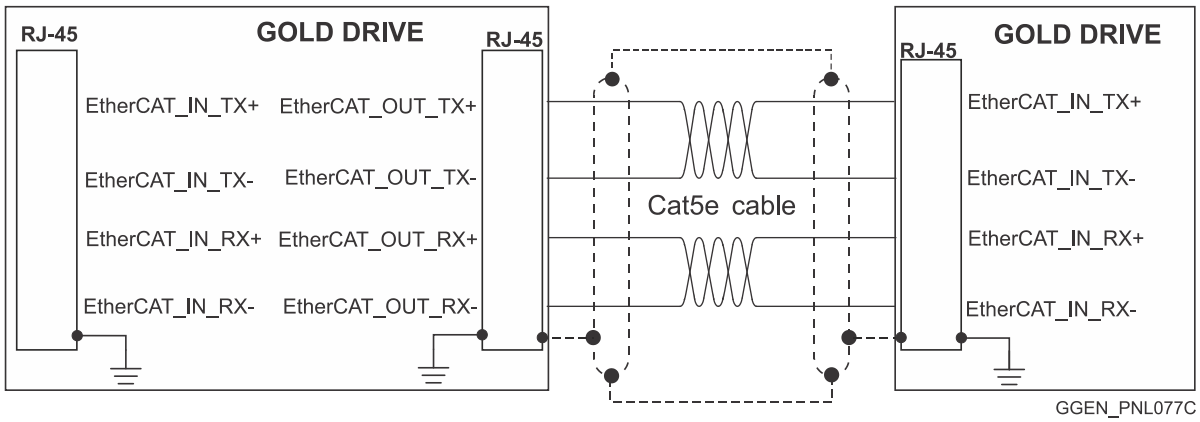


Figure 58: EtherCAT RJ-45 Connections Example

12.2.3.2. EtherCAT Link Indicators

The EtherCAT communication can have two LEDs for EtherCAT in and two LEDs for EtherCAT out. Figure 59 describes the location of the LEDs in the RJ-45 connectors for EtherCAT IN and EtherCAT OUT.

Drives with two RJ-45 connectors, designated as EtherCAT In and EtherCAT Out, have two status LEDs, which are shown in Figure 59.

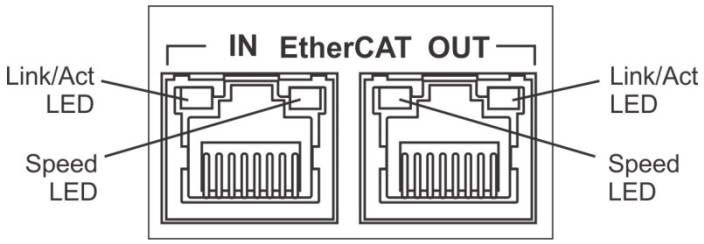


Figure 59: Ethernet Connector LEDs

The green LED is the link/activity indicator Figure 59). It shows the state of the applicable physical link and the activity on that link.

The amber LED is the speed indicator (Figure 59). It shows the speed of the connection on the Ethernet line. The possible states of these LEDs are summarized in Table 18.

If the drive has no RJ-45 connections, then the EtherCAT link indicators (speed LED is not mandatory) are displayed at the front panel. Refer to the drive specific installation guide details.

LED	State	Meaning
Link /Activity	Off	No link is established
	On	A link is established
	Blinking	There is data transmission activity
Speed	On	The connection speed is 100 Mbps The speed of the EtherCAT line must be 100 Mbps. Otherwise, there is no EtherCAT data transmission
	Off	The connection speed is 10 Mbps

Table 18: LED States

It should be noted that in Ethernet mode, only the LEDs of EtherCAT_IN will be available.

12.2.4. EtherCAT with D-TYPE Connectors

In the G-DRUM DTYPE version the EtherCAT Connector is DTYPE. In this case the EtherCAT signals will be same as described in the above paragraph. The pinout will be in accordance with the description in the specific IG.

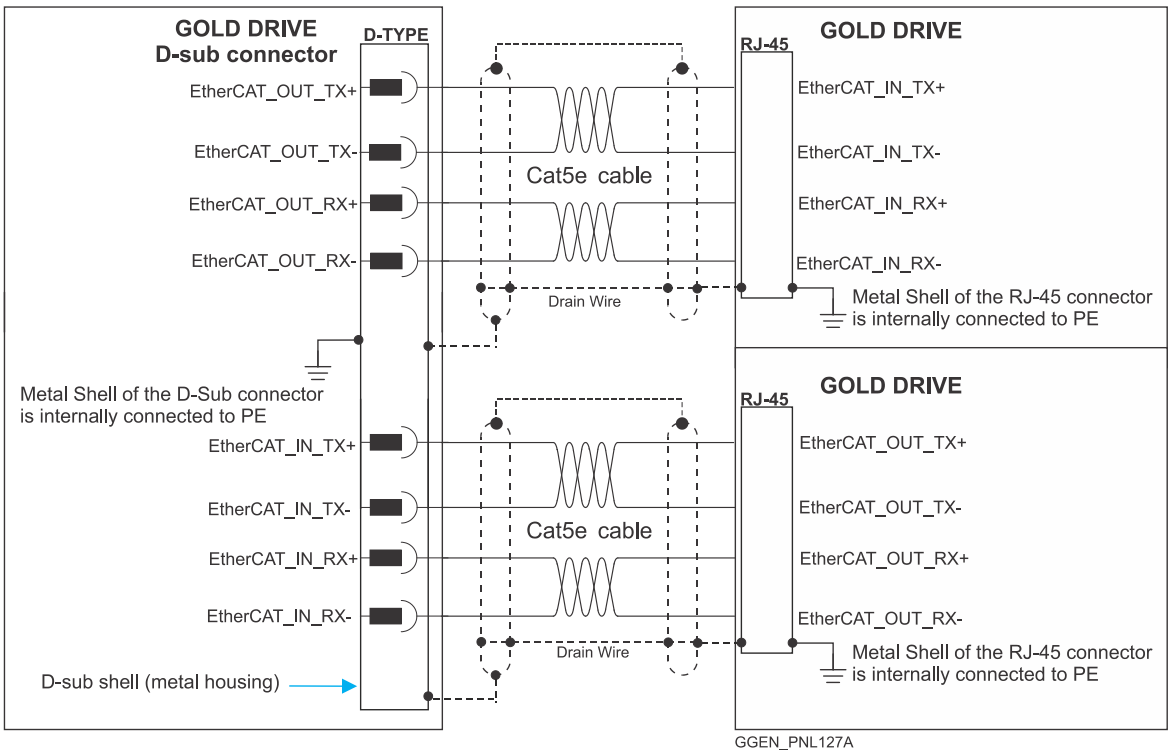


Figure 60: EtherCAT with D-TYPE Connections Example

Also, in the G-DRUM DTYPE version, only Link/Activity LED described in the above paragraph is displayed. The location of the LED is described in the specific Installation Guide.

12.2.5. EtherCAT Status Indicator

The EtherCAT status indicator is a red/green dual LED. It combines run indication (when it is green) and error indication (when it is red) of the EtherCAT device. For further details, see the EtherCAT Application Manual. It should be noted that this LED is not available in the Ethernet mode.

12.2.6. EtherCAT Switches

The EtherCAT address of each axis is specified by two switches. Using a screwdriver, you can set the low and the high bytes of the EtherCAT address.

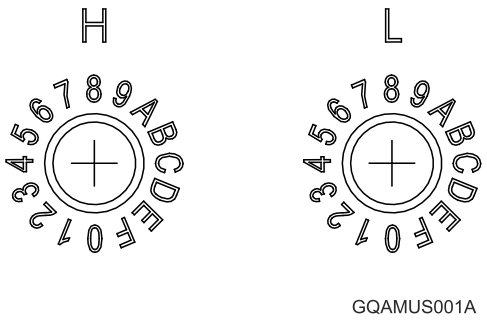


Figure 61: EtherCAT Address Switches

Note: **When the EtherCAT switches are set to 0, it is similar to operating without EtherCAT switches.**

12.2.7. EtherCAT Connectivity

When connecting several EtherCAT devices in a network, the EtherCAT master must always be the first device in the network. The output of each device is connected to the input of the next device. The output of the last device may remain disconnected. If redundancy is required, the output of the last device should be connected to the input of the EtherCAT master.

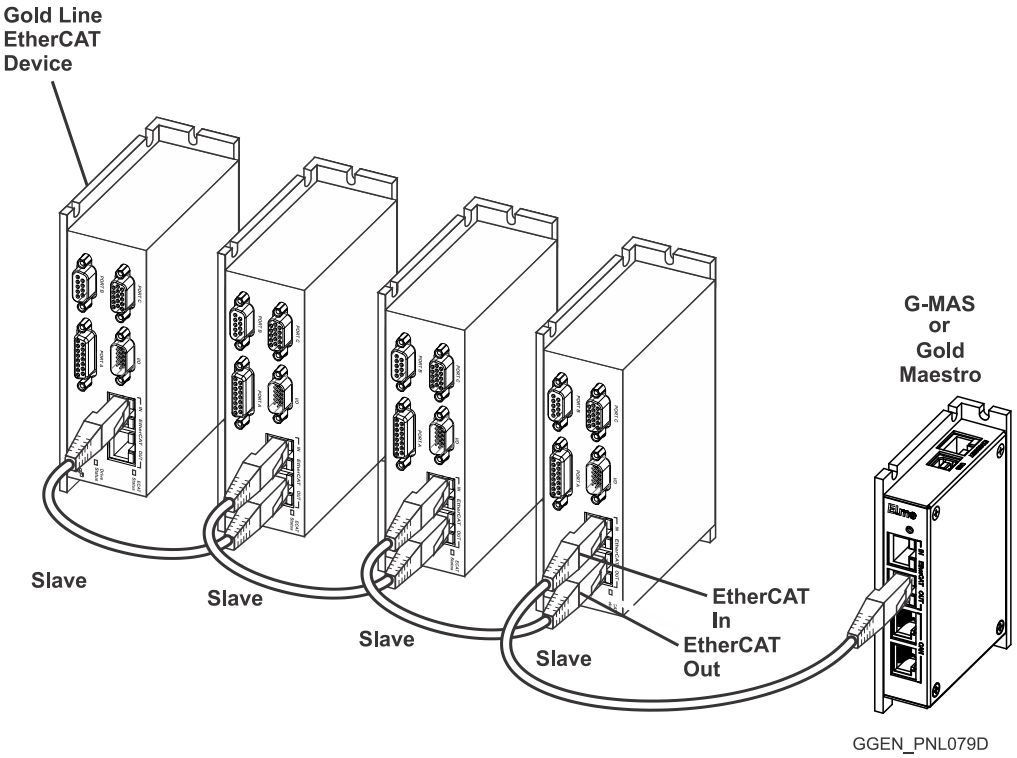


Figure 62: EtherCAT Network with No Redundancy

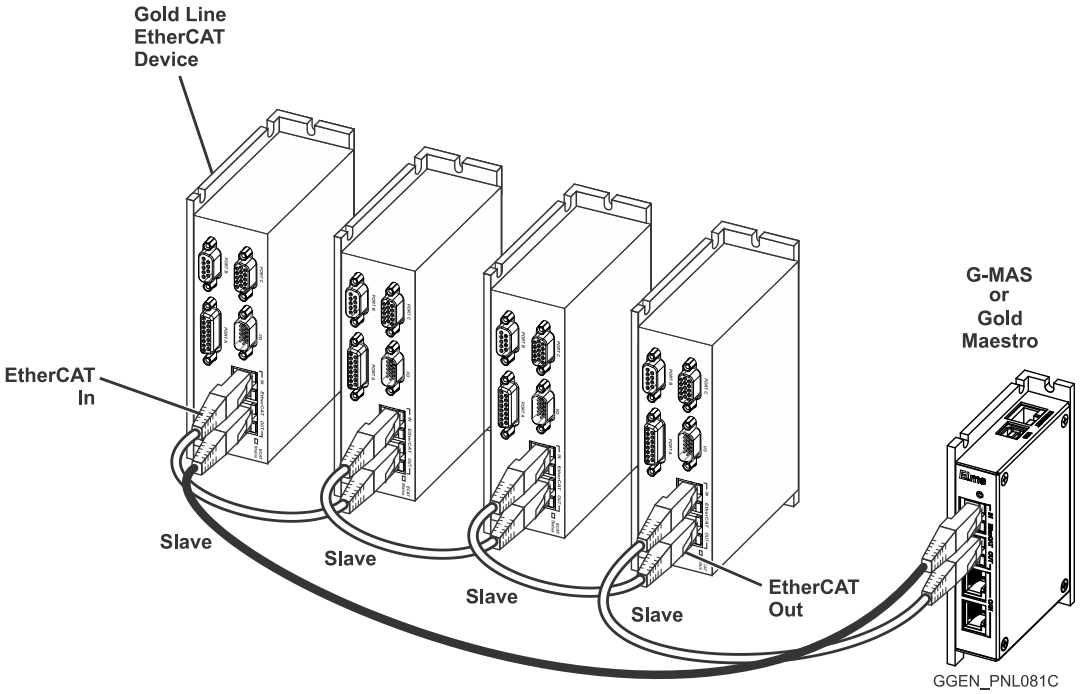


Figure 63: EtherCAT Network with Redundancy

12.3. CAN

Specification	Details
Physical layer	• CAN_H, CAN_L, CAN_RET
Speed	• Maximum Baud Rate of 1 Mbit/sec
Protocols	**Version:** • DS 301 v4.01 **Layer Setting Service and Protocol Support:** • DS 305 **Device Profile** (drive and motion control)**:** • DS 402

The following is recommended for CAN cabling:

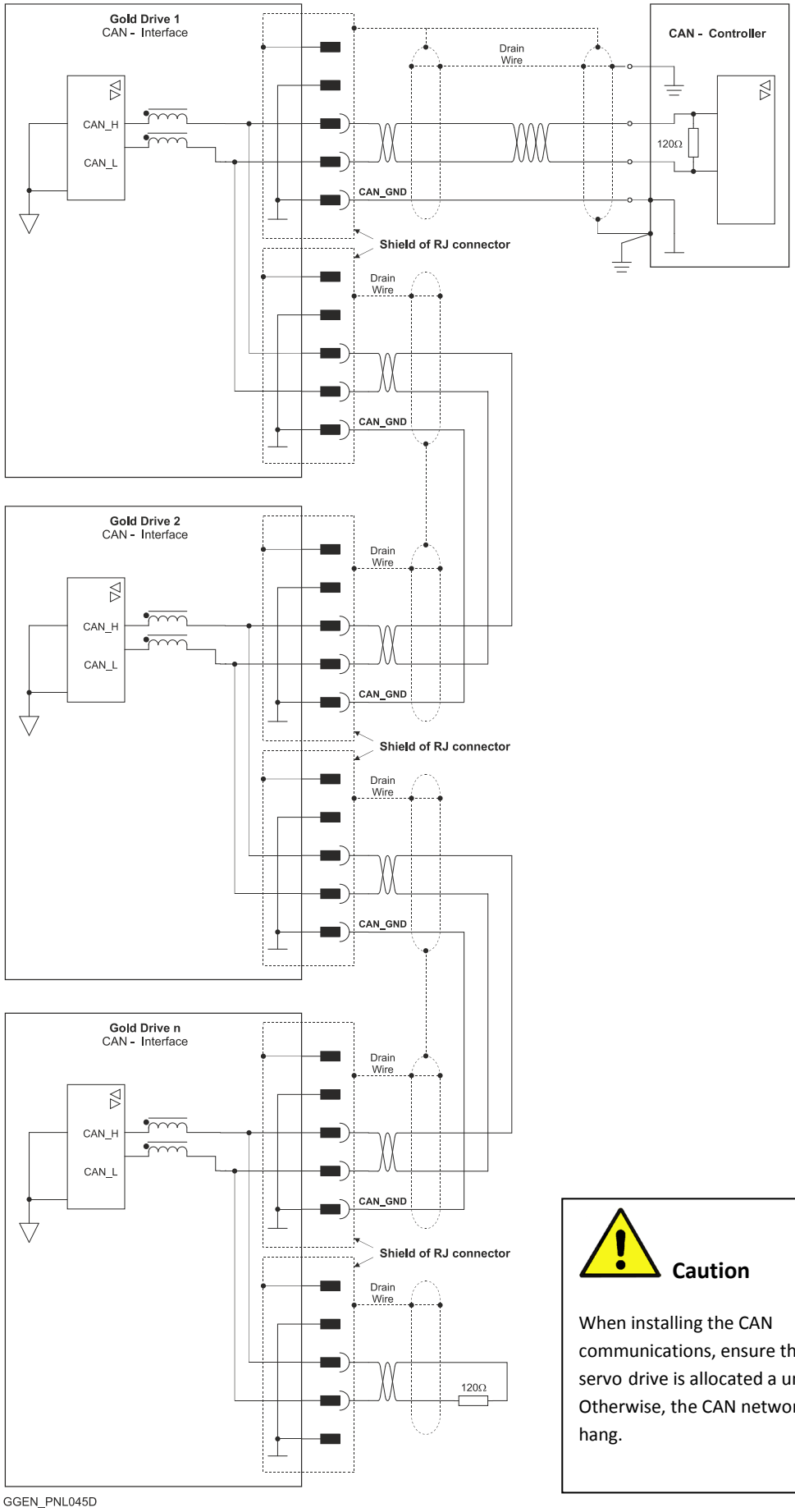
- Use 26 or 28 AWG twisted pair shielded cables. For best results, the shield should have aluminum foil and covered by copper braid with a drain wire
- Connect the shield to the ground of the host (PC). Usually, this connection is soldered internally inside the connector at the PC end. You can use the drain wire to facilitate connection.
- The male RJ plug must have a shield cover.
- Ensure that the shield of the cable is connected to the shield of the RJ plug. The drain wire can be used to facilitate the connection.
- Connect a termination 120-Ohms resistor at each of the two ends of the network cable.

12.3.1. CAN Signals with RJ-45 Connectors

The following table describes an example of the CAN signal pinouts.

Signal	Function
CAN_H	CAN_H bus line (dominant high)
CAN_L	CAN_L bus line (dominant low)
CAN_RET	CAN Return
N/A	—
CAN_SHLD	Shield, connected to the RJ plug cover
CAN_RET	CAN Return
N/A	—

Table 19: CAN Connectors



Caution

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

Figure 64: Gold Panel Mounted Servo Drive Connection Diagram Example – CAN

12.3.2. CAN with D-TYPE Connectors

In the G-DRUM D-TYPE version the CAN Connector is D-TYPE. In this case the signals are the same as described in the above paragraph, with the pinouts as described in the specific installation guide.

12.4. RS-232

RS-232 is supported in the G-SOLWHI, G-SOLGUI and G-DRUM in part numbers with the suffix D.

Specification	Details
Physical layer	Signals: RS232_Rx, RS232_Tx COMRET Full duplex, serial communication
Speed	Baud Rate of 4,800 to 115,200 bit/sec
Protocols	For setup in the Elmo Application Studio (EAS) software and control

The following is the recommended for RS-232 cabling:

1. Connect the shield to the ground of the host (PC). Usually, this connection is soldered internally inside the connector at the PC end. You can use the drain wire to facilitate connection.
2. The RS-232 communication port is **non-isolated**.
3. Ensure that the shield of the cable is connected to the shield of the connector used for RS-232 communications. The drain wire can be used to facilitate the connection.

The following are an example of the RS-232 signals.

Signal	Function
RS-232_RX	RS-232 Receive
RS-232_TX	RS-232 Transmit
COMRET	Common Return

Table 20: RS-232 Pin Assignments

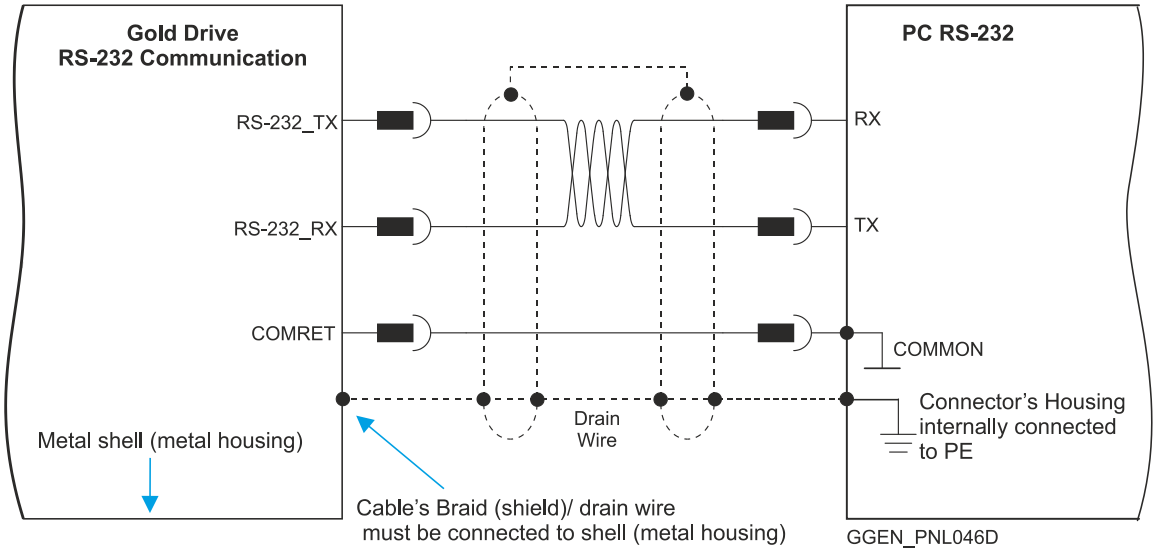


Figure 65: RS-232 D-Type Connection Diagram Example

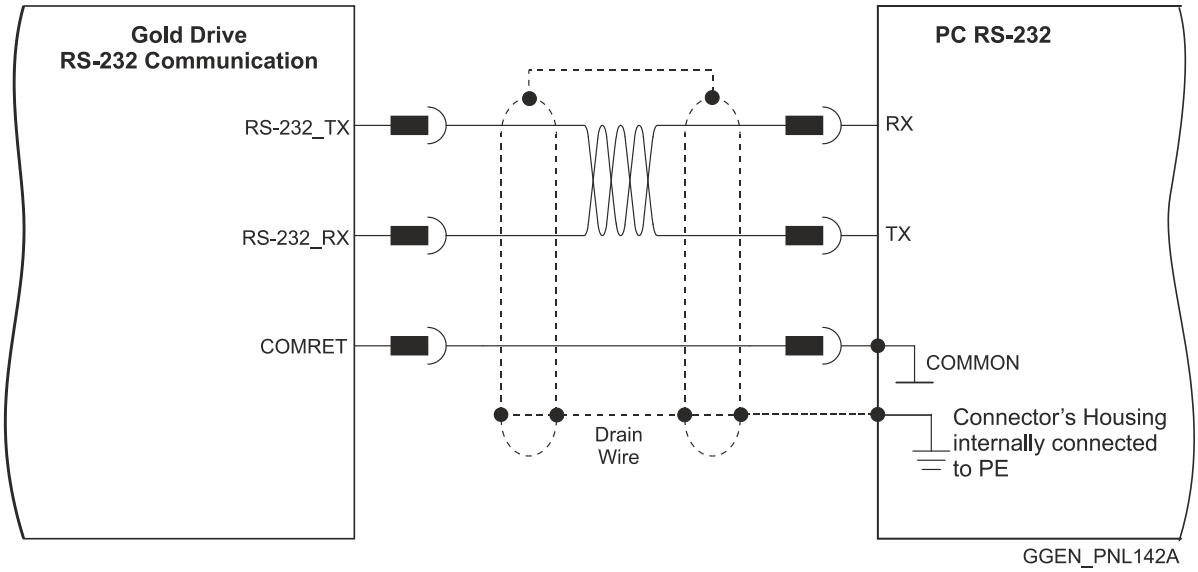


Figure 66: RS-232 RJ-45 Connection Diagram Example

12.5. RS-422 (Differential RS-232)

RS-232 is supported in the Drum, Solo Hornet, Eagle, and Eagle HV, in the part number with the suffix D.

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 4,800 to 115,200 bit/sec
Protocols	For setup and control

The following is recommended when connecting the Differential RS-232 communication cable:

Connect the shield to the ground of the Controller.
Usually, this connection is soldered internally inside the connector at the PC end. You can use the drain wire to facilitate connection.

The following are RS-422 signals :

Signal	Function
RS4-22_TX+	Differential RS-232 Transmit
RS-422_TX-	Differential RS-232 Transmit Complement
RS-422_RX-	Differential RS-232 Receive
RS-422_RX+	Differential RS-232 Receive Complement
COMRET	Common Return

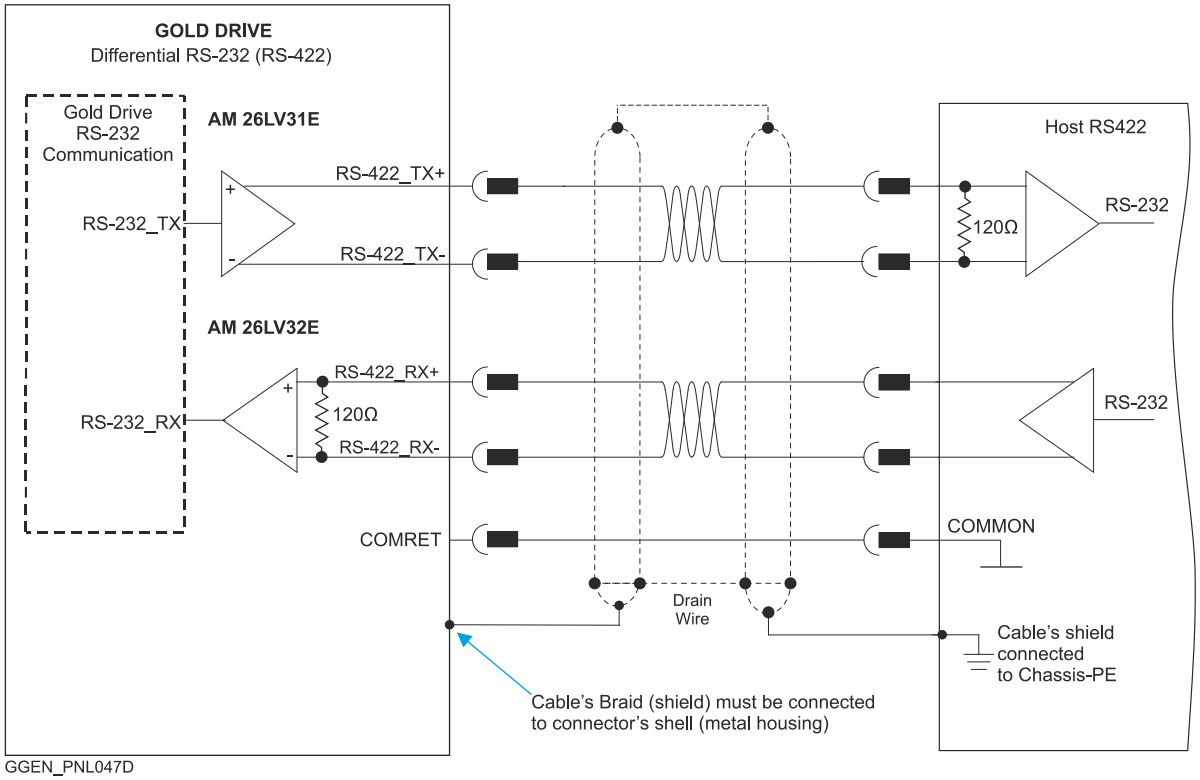


Figure 67: Differential RS-232 D-Type Communication Example

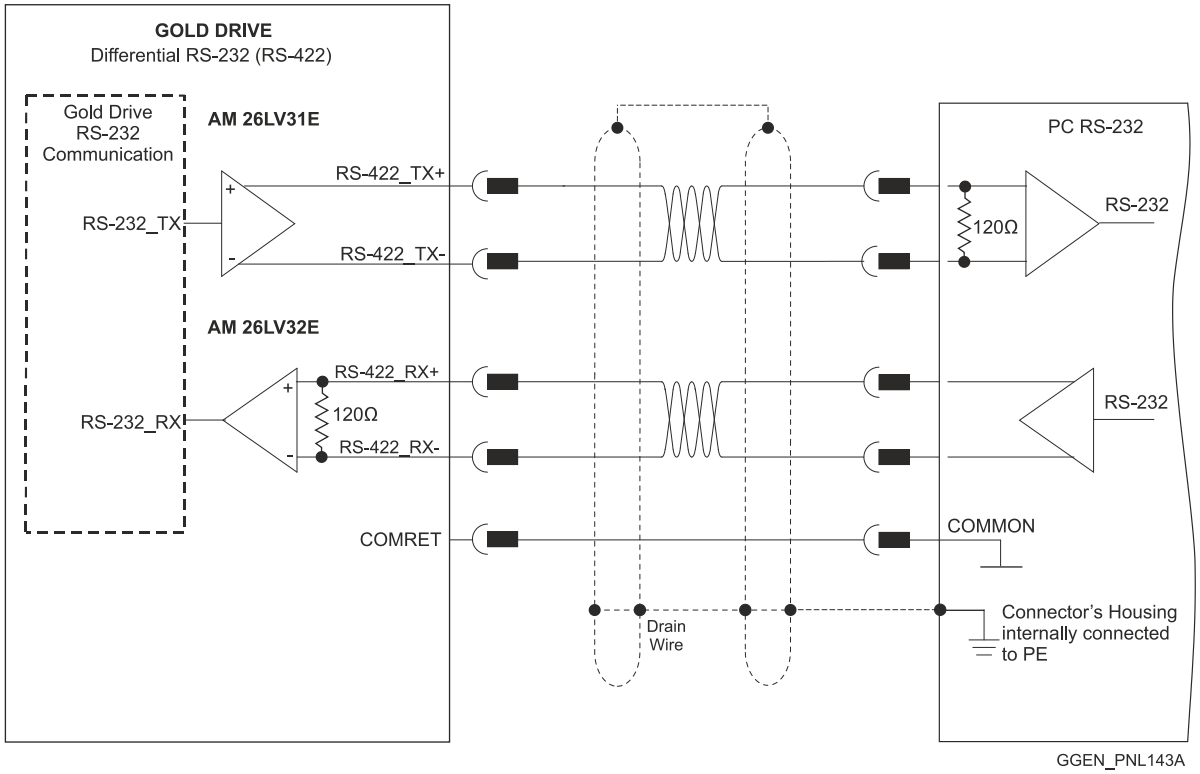


Figure 68: Differential RS-232 RJ-45 Communication Example

Chapter 13: Environmental Conditions

You can guarantee the safe operation of the Gold Panel Mounted Servo Drive by ensuring that it is installed in an appropriate environment.

13.1. Gold Line

Feature	Details
Operating ambient temperature according to IEC60068-2-2	0 °C to 40 °C (32 °F to 104 °F)
Storage temperature	-20 °C to +85 °C (-4 °F to +185 °F)
Maximum non-condensing humidity according to IEC60068-2-78	95%
Maximum Operating Altitude	2,000 m (6562 feet) It should be noted that servo drives capable of higher operating altitudes are available on request.
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

13.2. ExtrIQ Series

The ExtrIQ series of drives support the following extended environmental conditions.

Feature	Operation Conditions	Range
Ambient Temperature Range	Non-operating conditions	-50 °C to +100 °C (-58 °F to 212 °F)
	Operating conditions	-40 °C to +70 °C (-40 °F to 160 °F)
Temperature Shock	Non-operating conditions	-40 °C to +70 °C (-40 °F to 160 °F) within 3 min
Altitude	Non-operating conditions	Unlimited
	Operating conditions	-400 m to 12,000 m (-1312 to 39370 feet)
Maximum Humidity	Non-operating conditions	Up to 95% relative humidity non-condensing at 35 °C (95 °F)
	Operating conditions	Up to 95% relative humidity non-condensing at 25 °C (77 °F), up to 90% relative humidity non-condensing at 42 °C (108 °F)
Vibration	Operating conditions	20 Hz to 2,000 Hz, 14.6 g
Mechanical	Non-operating conditions	±40g; Half sine, 11 msec

Feature	Operation Conditions	Range
Shock	Operating conditions	±20g; Half sine, 11 msec
Atmosphere	Operating area atmosphere	No flammable gases or vapors permitted in area
Protection level		IP32

Chapter 14: Control Specifications

14.1. Current Loop

Feature	Details
Controller type	Vector (for Brushless), digital
Compensation for bus voltage variations	"On-the-fly" automatic gain scheduling
Motor types	• Linear and Rotary motors • AC brushless (sinusoidal) • DC brush • "Voice" coils
Current control	• Fully digital • Sinusoidal with vector control (for Brushless motors) • Programmable PI control filter based on a pair of PI controls of AC current signals and constant power at high speed
Current loop bandwidth	> 4 kHz closed loop
Current sampling time	Programmable 40 to 125 µsec
Current sampling rate	Up to 25 kHz

14.2. Velocity Loop

Feature	Details
Controller type	PI + Four advanced filters + Two advanced gain scheduling filters
Velocity control	• Fully digital • Programmable PI and feed forward control filters • On-the-fly gain scheduling according to either speed or position command or feedback. • Feedback control filters • Automatic, quick, advanced or expert tuning
Velocity and position feedback options	• Incremental Encoder • Digital Halls • Interpolated Analog (sin/cos) Encoder • Resolver Absolute serial encoder **Note:** With all digital feedback options, 1/T with automatic mode switching is activated (gap, frequency and derivative).
Velocity loop bandwidth	< 500 Hz

Feature	Details
Velocity sampling time	50 to 250 µsec; default is 100 µsec
Velocity sampling rate	Up to 20 kHz; default is 10 kHz
Velocity command options	• Internally calculated by jogging • Any supported sensor for tracking • By host communication (Can/EtherCAT) **Note:** All software-calculated profiles support on-the-fly changes.

14.3. Position Loop

Feature	Details
Controller type	PID equivalent (PIP with feed forward)+ two advanced filters + one advanced gain scheduling filter
Position command options	• Software • Pulse and Direction • Any supported sensor for tracking • By host communication (Can/EtherCAT)
Position loop bandwidth	< 200 Hz
Position sampling time	50 to 250 µsec (2x current loop sample time)
Position sampling rate	Up to 20 kHz; default is 10 kHz

Chapter 15: Gold Line Standards

The Gold Panel Mounted Servo Drive servo drive has been developed, produced, tested and documented in accordance with the relevant standards. Elmo Motion Control is not responsible for any deviation from the configuration and installation described in this documentation. Furthermore, Elmo is not responsible for the performance of new measurements or ensuring that regulatory requirements are met.

15.1. Functional Safety

Safe Torque Off (STO) Safety Standard	Item
The related standards below apply to the performance of the servo drives as stated in the environmental conditions Chapter 13: Environmental Conditions.	
IEC 61800-5-2:2007 SIL 3	Adjustable speed electrical power drive systems – Safety requirements – Functional
EN ISO 13849-1:2008 Cat 3, PL e	Safety of machinery — Safety-related parts of control systems.
EN 61508-1:2010 SIL 3	Functional safety of electrical/electronic/ programmable electronic safety-related systems
EN 61508-2:2010 SIL 3	Functional safety of electrical/electronic/ programmable electronic safety-related systems
EN 61508-3:2010 SIL 3	Functional safety of electrical/electronic/ programmable electronic safety-related systems

Safe Torque Off (STO) Safety Standard	Item

ZERTIFIKAT ◆ CERTIFICATE ◆ 認証書 ◆ СЕРТИФИКАТ ◆ CERTIFICADO ◆ CERTIFICAT

Product Service

CERTIFICATE

No. Z10 13 08 84596 001

Holder of Certificate: **Elmo Motion Control Ltd.**
60 Amal St. P.O. Box 3078
49516 Petach-Tikva
ISRAEL

Factory(ies): 84596

Certification Mark:

Product: **Safety Related Programmable Electronic System**

Model(s): **Drive System GOLD LINE**

Parameters:

Safety Function:	STO (EN 61800-5-2) PL e, CAT 3 (EN ISO 13849) SIL 3 (EN 61508)

Further approvals can be found in the report below.

The report below and the user documentation in the currently valid revision are mandatory part of this certificate. The product complies with the following listed safety requirements only if the specifications documented in the currently valid revision of this report are met.

Tested according to:
EN 61508-1:2010 (SIL 3)
EN 61508-2:2010 (SIL 3)
EN 61508-3:2010 (SIL 3)
EN 61800-5-2:2007
EN ISO 13849-1:2008 (Cat 3, PL e)

The product was tested on a voluntary basis and complies with the essential requirements. The certification mark shown above can be affixed on the product. It is not permitted to alter the certification mark in any way. In addition the certification holder must not transfer the certificate to third parties. See also notes overleaf.

Test report no.: EP85169C

Date, 2013-08-12 (Peter Weiss)

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TÜV SÜD Product Service GmbH · Zertifizierstelle · Ridlerstraße 65 · 80339 München · Germany

TÜV®

The following GOLD LINE system components are covered by Certificate no. Z10 13 08 84596 001 and the report to the certificate, report no. EP85169C.

Gold BELL		
Model Name	**Model Part Number**	**Version**
Gold Bell	G-BEL	V03
Gold DC Bell	G-DCBEL	V03
Gold Solo Bell	G-SOLBEL	V03
Gold DRUM		
Model Name	**Model Part Number**	**Version**
Gold Drum	G-DRU	V03
Gold Eagle	G-EAG	V03
Gold GUITAR / Gold CELLO		
Model Name	**Model Part Number**	**Version**
Gold Guitar	G-GUT	V03
Gold Solo Guitar	G-SOLGUT	V03
Gold Cello	G-CEL	V03
Gold Falcon	G-FAL	V03
Gold Hawk	G-HAK	V03
Gold Solo Hawk	G-SOLHAK	V03
Gold WHISTLE		
Model Name	**Model Part Number**	**Version**
Gold Whistle	G-WHI	V03
Gold DC Whistle	G-DCWHI	V03
Gold Solo Whistle	G-SOLWHI	V03
Gold Hornet	G-HOR	V03
Gold Solo Hornet	G-SOLHOR	V03
Gold DC Hornet	G-DCHOR	V03
Gold Duo	G-DUO	V03
Gold Duo AMBA	G-DUO-AMBA	V03
Gold Uno AMBA	G-UNO-AMBA	V03

Gold TROMBONE		
Model Name	**Model Part Number**	**Version**
Gold Trombone	G-TRO	V03
Gold DC Trombone	G-DCTRO	V03
Gold Solo Trombone	G-SOLTRO	V03
Gold Panther	G-PAN	V03
Gold Solo Panther	G-SOLPAN	V03
Gold DC Panther	G-DCPAN	V03
Gold DRUM HV		
Model Name	**Model Part Number**	**Version**
Gold Drum HV	G-DRU	V03
Gold Eagle HV	G-EAG	V03
Gold BASSOON		
Model Name	**Model Part Number**	**Version**
Gold Bassoon	G-BAS	V03
Gold Tuba		
Model Name	**Model Part Number**	**Version**
Gold Tuba	G-TUB	V03

15.2. Safety

Specification	Details
The related standards below apply to the performance of the servo drives as stated in Chapter 13: Environmental Conditions.	
Approved **IEC/EN 61800-5-1**	Adjustable speed electrical power drive systems Safety requirements – Electrical, thermal and energy
Recognized **UL 61800-5-1**	Adjustable speed electrical power drive systems Safety requirements – Electrical, thermal and energy
Conformity with **CE 2006/95/EC**	Low-voltage directive 2006/95/EC
Recognized **CSA C22.2 NO. 14-13** Or Recognized **CSA C22.2 NO. 274-13**	Industrial Control Equipment Adjustable drive speeds

15.3. Environmental

Specification	Details
Approved **IEC60068-2-78**	Environmental testing – Damp heat, steady state
Approved **IEC60068-2-6**	Environmental testing –Vibration (sinusoidal)
Approved **IEC60068-2-2**	Environmental testing – Dry heat
Approved **IEC60068-2-27**	Basic environmental testing procedures - Shock

15.4. EMC

Specification	Details
Approved **IEC/EN 61800-3**	Adjustable speed electrical power drive systems
In compliance with **EN 55011** Class A with **EN 61000-6-2**: Immunity for industrial environment, according to: **IEC 61000-4-2** / criteria B **IEC 61000-4-3** / criteria A **IEC 61000-4-4** / criteria B **IEC 61000-4-5** / criteria B **IEC 61000-4-6** / criteria A **IEC 61000-4-8** / criteria A **IEC 61000-4-11** / criteria B/C	Electromagnetic compatibility (EMC)
Approved **IEC 61326-3-1**	Electrical equipment for measurement, control and laboratory use. Standard required for STO.

15.5. EtherCAT Conformance

EtherCAT Conformance Test – certification

Certificate

EtherCAT Conformance Test

EtherCAT Technology Group

Elmo Motion Control Ltd.

64 Gisin St. Petach Tikva 49103 Israel

EtherCAT Technology Group hereby confirms the above named company that the following family devices are successfully **EtherCAT Conformance Tested**.

Device under Test 1

Product Name:	G-DCWHI
Product Code:	0x30924
Revision Number:	0x103F6

Device under Test 2

Product Name:	G-DCTRO
Product Code:	0x30924
Revision Number:	0x103F6

Device family is listed on one following page.

Assigned Vendor ID:	0x9A
Test Report Number:	0x9A_001
EtherCAT Test Center:	Beckhoff Automation GmbH, Nuremberg, Germany

The following tests were performed:

- EtherCAT Protocol Test (CTT Ver.1.20.52.0)
- Indicator Test
- Labeling Test
- Interoperability Test

Nuremberg, February 27, 2012

Martin Rostan, Executive Director
EtherCAT Technology Group

15.6. Other Compliant Standards

Quality Assurance	
ISO 9001:2008	Quality Management
Design	
• **IPC-D-275** • **IPC-SM-782** • **IPC-CM-770**	Printed wiring for electronic equipment (clearance, creepage, spacing, conductors sizing, etc.)
Reliability	
MIL-HDBK- 217F	Reliability prediction of electronic equipment (rating, de-rating, stress, etc.)
Workmanship	
In compliance with **IPC-A-610**, level 3	Acceptability of electronic assemblies
PCB	
In compliance with **IPC-A-600**, level 3	Acceptability of printed circuit boards
Packing	
In compliance with **EN 100015**	Protection of electrostatic sensitive devices
Environmental	
In compliance with **2002/96/EC**	Waste Electrical and Electronic Equipment regulations (WEEE) **Note:** Out-of-service Elmo drives should be sent to the nearest Elmo sales office.
In compliance with **2002/95/EC** (effective July 2006)	Restrictions on Application of Hazardous Substances in Electric and Electronic Equipment (RoHS)


Inspiring Motion
Since 1988
For a list of Elmo's branches, and your local area office, refer to the Elmo site www.elmomc.com
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