

# **Gold Solo Mandolin Digital Servo Drive Installation Guide EtherCAT and CAN**



**Elmo**  
Motion Control  
www.elmomc.com

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CE

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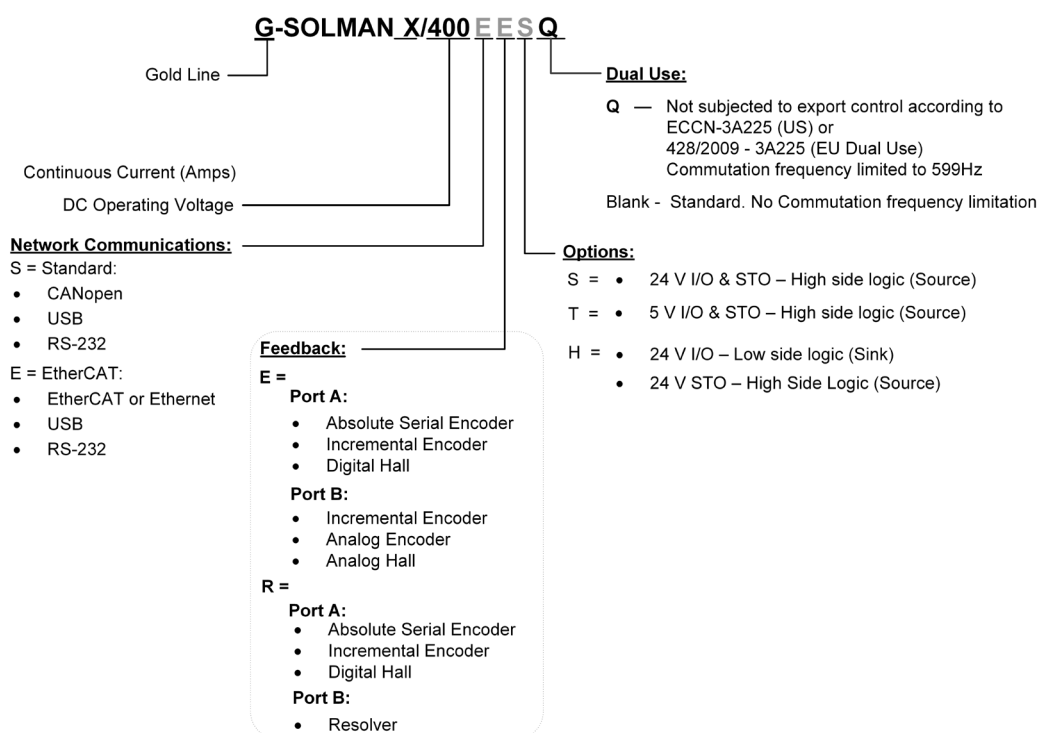
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## Catalog Number



## Cable Kit

- Catalog number: CBL-GSOLWHIKIT01 (can be ordered separately)
- For further details, see the documentation for this cable kit ([MAN-CBLKIT-GSOLMAN.pdf](#)).



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## Chapter 1: This Installation Guide

This installation Guide details the technical data, pinouts, and power connectivity of the Gold Solo Mandolin. For a comprehensive detailed description of the functions, refer to the MAN-G-Panel Mounted Drives Hardware manual, which describes Panel Mounted products.

## Chapter 2: Safety Information

In order to achieve the optimum, safe operation of the Gold Solo Mandolin, 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 Solo Mandolin 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 Solo Mandolin 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. 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 Solo Mandolin 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.



## 2.2. Cautions

- The maximum DC power supply connected to the instrument must comply with the parameters outlined in this guide.
- When connecting the Gold Solo Mandolin to an approved Control backup 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 Solo Mandolin, 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

## 2.3. CE Marking Conformance

The Gold Solo Mandolin 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 Solo Mandolin 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.

## 2.4. Warranty Information

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



## Chapter 3: Product Description

The Gold Solo Mandolin series of digital servo drives are highly resilient and designed to deliver the highest density of power and intelligence. The Gold Solo Mandolin delivers up to **2300 W of continuous power** or **4600 W of peak power** in a compact package.

The digital drives are part of Elmo's advanced Gold Line. They operate from a DC power source in current, velocity, position and advanced position modes, in conjunction with a permanent-magnet synchronous brushless motor, DC brush motor, linear motor or voice coil. They are designed for use with any type of sinusoidal and trapezoidal commutation, with vector control. The Gold Solo Mandolin can operate as a stand-alone device or as part of a multi-axis system in a distributed configuration on a real-time network.

The Gold Solo Mandolin drive 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 information about software tools refer to the Elmo Application Studio (EASII) User Guide.

Power to the Gold Solo Mandolin is provided by a 100 to 400 V Direct to Main DC source. The Gold Solo Mandolin can operate with the main power supply only (VP+ and VN-), with no need for a Control backup supply. If backup functionality is required for storing control parameters in case of power-outs, a control power supply with a range of 18 to 40 V can be connected, providing maximum flexibility and optional backup functionality when needed.

**Note:** The Control backup supply can operate from an isolated voltage source within the range of 18 to 40 VDC.

The Gold Solo Mandolin is a stand-alone version of the Gold Mandolin module (PCB-mounted).

### 3.1.1. Accessories

- Catalog number: CBL-GSOLWHIKIT01 (can be ordered separately)
- For further details, see the documentation for this cable kit ([MAN-CBLKIT-GSOLMAN.pdf](#)).



## Chapter 4: Technical Information

### 4.1. Physical Specifications

Feature	Units	All Types
Weight	g (oz)	235 g (8.29 oz)
EtherCAT Dimensions	mm (in)	70.0 x 70.0 x 55.9 (2.76" x 2.76" x 2.20")
CAN Dimensions	mm (in)	70.0 x 70.0 x 55.2 (2.76" x 2.76" x 2.17")
Mounting method		Panel/Wall Mounted

### 4.2. Technical Data

Feature	Units	5/400	7/400
Minimum supply voltage	VDC	100	
Nominal supply voltage	VDC	325	
Maximum supply voltage	VDC	400	
Maximum continuous power output	W	1600	2300
Efficiency at rated power (at nominal conditions)	%	> 98	
Control backup supply voltage option	VDC	18 to 40 VDC	
Control backup supply	VA	≤5 VA without external loading ≤8 VA with full external loading	
Continuous current limit (Ic) Amplitude sinusoidal/DC trapezoidal commutation	A	5	7
Sinusoidal continuous RMS current limit (Ic)	A	3.55	4.95
Peak current limit	A	2 x Ic	

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



#### 4.2.1. Control Backup Supply

Feature	Details
Control backup supply	<i>Isolated DC source only</i>
Control backup supply input voltage	18 VDC to 40 VDC
Control backup supply input power	≤5 VA without external loading ≤8 VA with full external loading

#### 4.2.2. Product Features

Main Feature	Details	Presence and No.
<b>STO</b>	TTL, or	✓
	PLC Source	✓
<b>Digital Input</b>	TTL, or	6
	PLC Source, or	6
	PLC Sink	6
<b>Digital Output</b>	TTL, or	2
	PLC Source, or	2
	PLC Sink	2
<b>Analog Input</b>	Differential ±10V	1
<b>Feedback</b>	Standard Port A, B, & C	✓
<b>Communication Option</b>	USB	✓
	EtherCAT or	✓
	CAN	✓
	RS-232	✓



### 4.2.3. Environmental Conditions

You can guarantee the safe operation of the Gold Solo Mandolin by ensuring that it is installed in an appropriate environment.

Feature	Details
<b>Operating ambient temperature according to IEC60068-2-2</b>	0 °C to 40 °C (32 °F to 104 °F)
<b>Storage temperature</b>	-20 °C to +85 °C ( -4 °F to +185 °F)
<b>Maximum non-condensing humidity according to IEC60068-2-78</b>	95%
<b>Maximum Operating Altitude</b>	2,000 m (6562 feet) It should be noted that servo drives capable of higher operating altitudes are available on request.
<b>Mechanical Shock according to IEC60068-2-27</b>	15g / 11ms Half Sine
<b>Vibration according to IEC60068-2-6</b>	5 Hz ≤ f ≤ 10 Hz: ±10mm 10 Hz ≤ f ≤ 57 Hz: 4G 57 Hz ≤ f ≤ 500 Hz: 5G





#### 4.2.4. Gold Line Standards and Certifications

The following table describes the Main Standards of the Gold Solo Mandolin servo drive. For further details refer to Chapter 17 of the MAN-G-Board Level Modules Hardware Manual.

Main Standards	Item
The related standards below apply to the performance of the servo drives as stated in the environmental conditions in section 4.2.3 Environmental Conditions above.	
<b>STO IEC 61800-5-2:2007 SIL 3</b>	Adjustable speed electrical power drive systems – Safety requirements – Functional
<b>EN ISO 13849-1:2008 PL e, Cat 3</b>	Safety of machinery — Safety-related parts of control systems.
<b>Imminent Approval UL61800-5-1</b>	Adjustable speed electrical power drive systems Safety requirements – Electrical, thermal and energy
<b>In compliance with UL 508C</b>	Power Conversion Equipment
<b>In compliance with UL 840</b>	Insulation Coordination Including Clearances and Creepage Distances for Electrical Equipment
<b>Conformity with CE 2006/95/EC</b>	Low-voltage directive 2006/95/EC
<b>Imminent Approval CSA C22.2 NO. 274-13</b>	Adjustable speed drive

##### 4.2.4.1. Dual Use

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

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

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



## Chapter 5: Installation

The Gold Solo Mandolin must be installed in a suitable environment and properly connected to its voltage supplies and the motor.

### 5.1. Unpacking the Drive Components

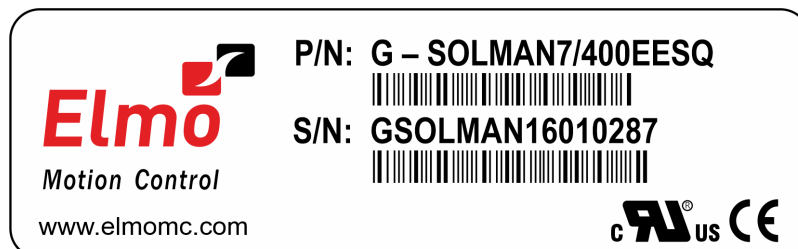
Before you begin working with the Gold Solo Mandolin, verify that you have all of its components, as follows:

- The Gold Solo Mandolin servo drive
- The Elmo Application Studio (EASII) software and user guide

The Gold Solo Mandolin is shipped in a cardboard box with Styrofoam protection.

**To unpack the Gold Solo Mandolin:**

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



4. Verify that the Gold Solo Mandolin type is the one that you ordered, and ensure that the voltage meets your specific requirements.

The part number at the top provides the type designation. Refer to the appropriate part number in the section Catalog Number at the beginning of the installation guide.

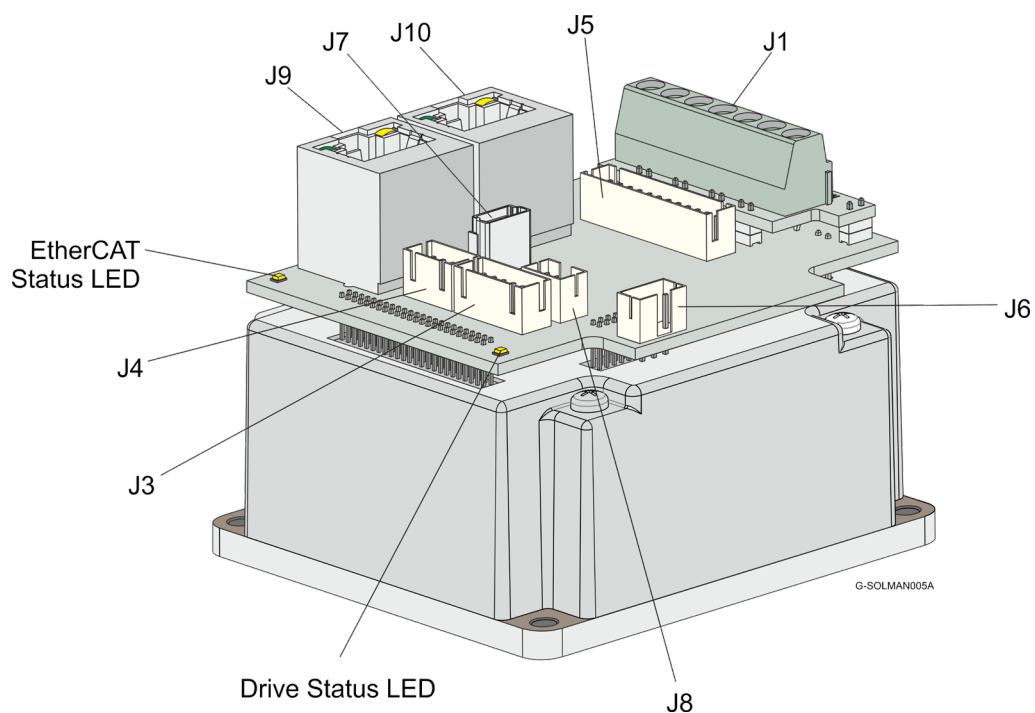


## 5.2. Connector Types

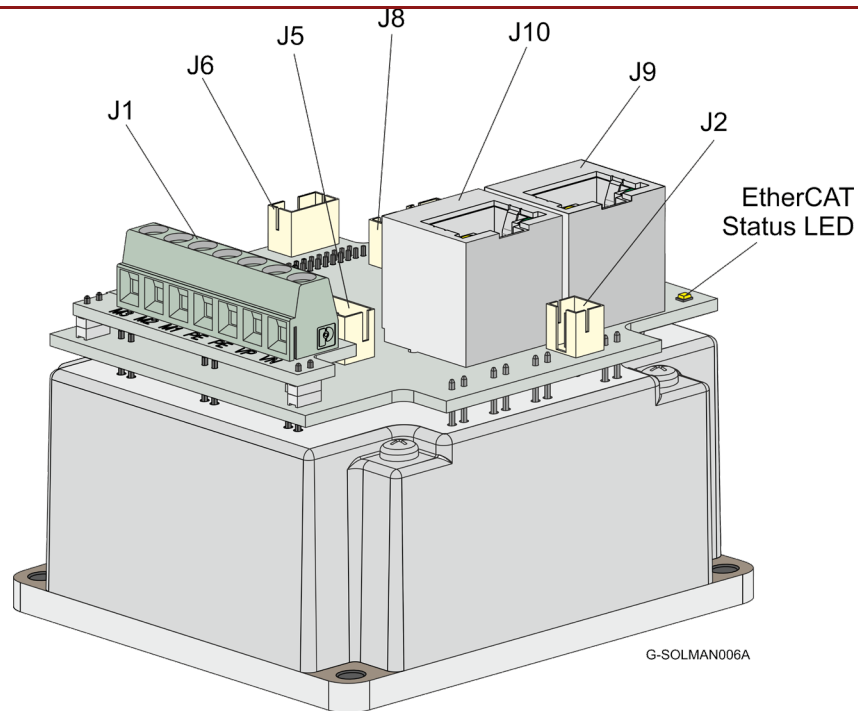
The Gold Solo Mandolin has twelve connectors.

### 5.2.1. Connector Types

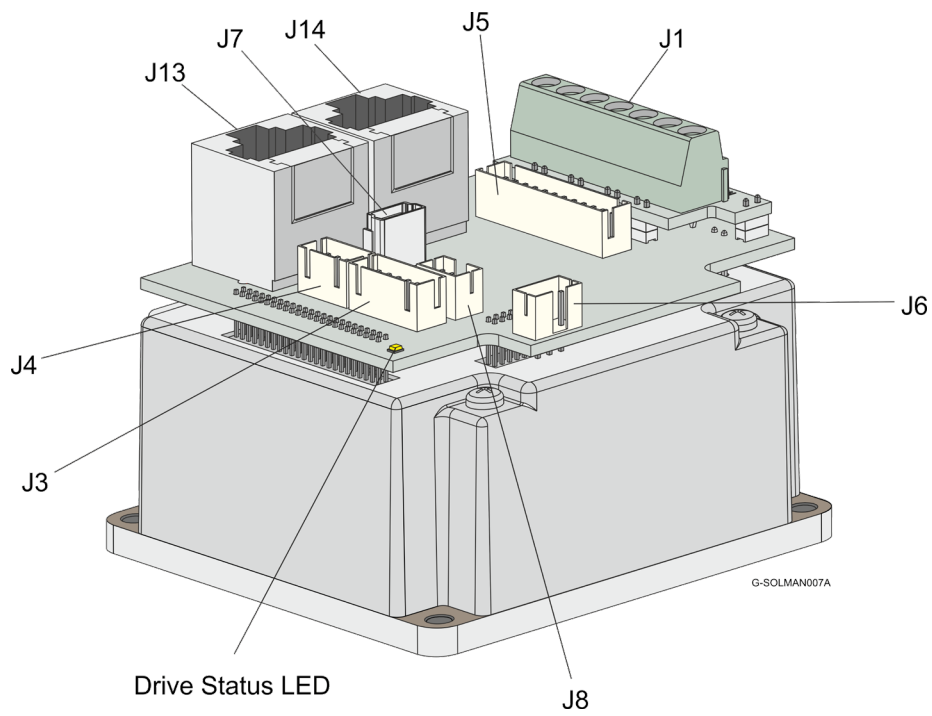
Port	No. Pins	Type	Function
M1, M2, M3, VP+, VN-, PE, PE	7	5.00 mm pitch	Main power and motor's connector
J3	2x6	2.0 mm pitch	Feedback port A
J4	2x4	2.0 mm pitch	Feedback port B
J5	2x12	2.0 mm pitch	I/O and port C
J7	5	USB Device Mini-B	Mini-USB type B
J8	3	2.0 mm pitch	RS-232 communication
J6	3	2.0 mm pitch	STO
J2	2	2.0 mm pitch	Control backup supply
<b>EtherCAT Version</b>			
J9	8	RJ-45	EtherCAT in
J10	8	RJ-45	EtherCAT out
<b>CAN Version</b>			
J13	8	RJ-45	CAN
J14	8	RJ-45	CAN



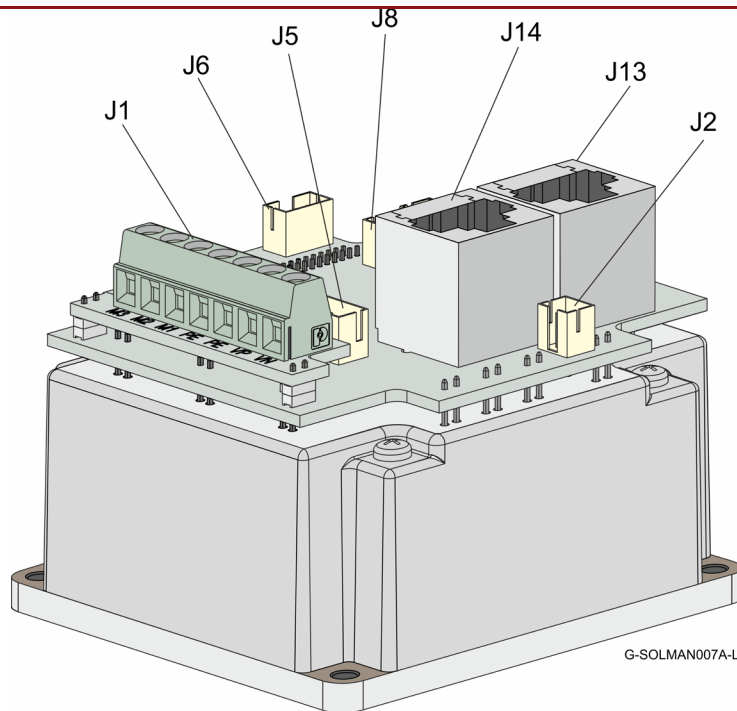
**Figure 1: Connector Locations (Rear view) – EtherCAT**



**Figure 2: Connector Locations(Front view) – EtherCAT**



**Figure 3: Connector Locations(Rear view) – CAN**



**Figure 4: Connector Locations(Front view) – CAN**

**Table 1: Connector Types**

The pinouts in Chapter 6: Wiring describe the function of each pin in the Gold Solo Mandolin connectors that are listed in Table 1.



### 5.3. Mounting the Gold Solo Mandolin

The Gold Solo Mandolin was designed for mounting on a surface. When integrating the Gold Solo Mandolin into a device, be sure to leave about 1 cm (0.4") outward from the heat-sink to enable free air convection around the drive. If the Gold Solo Mandolin is enclosed in a metal chassis, we recommend that the Gold Solo Mandolin be screw-mounted to it to help with heat dissipation. The Gold Solo Mandolin has screw-mount holes on each corner of the heat-sink for this purpose – see below.

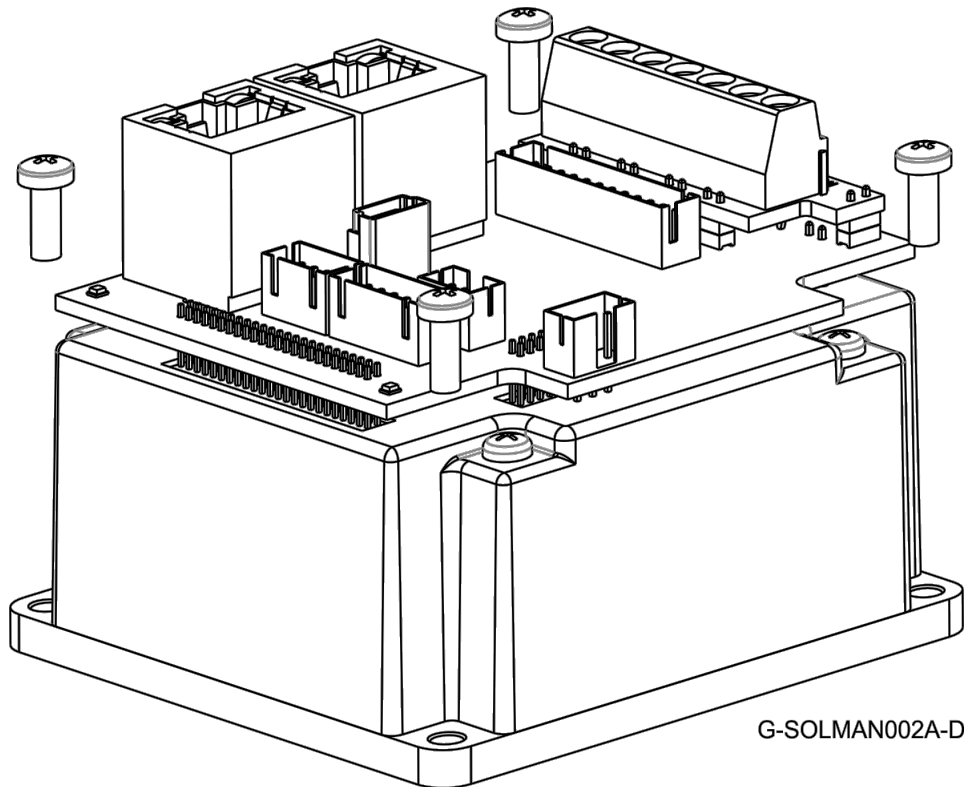
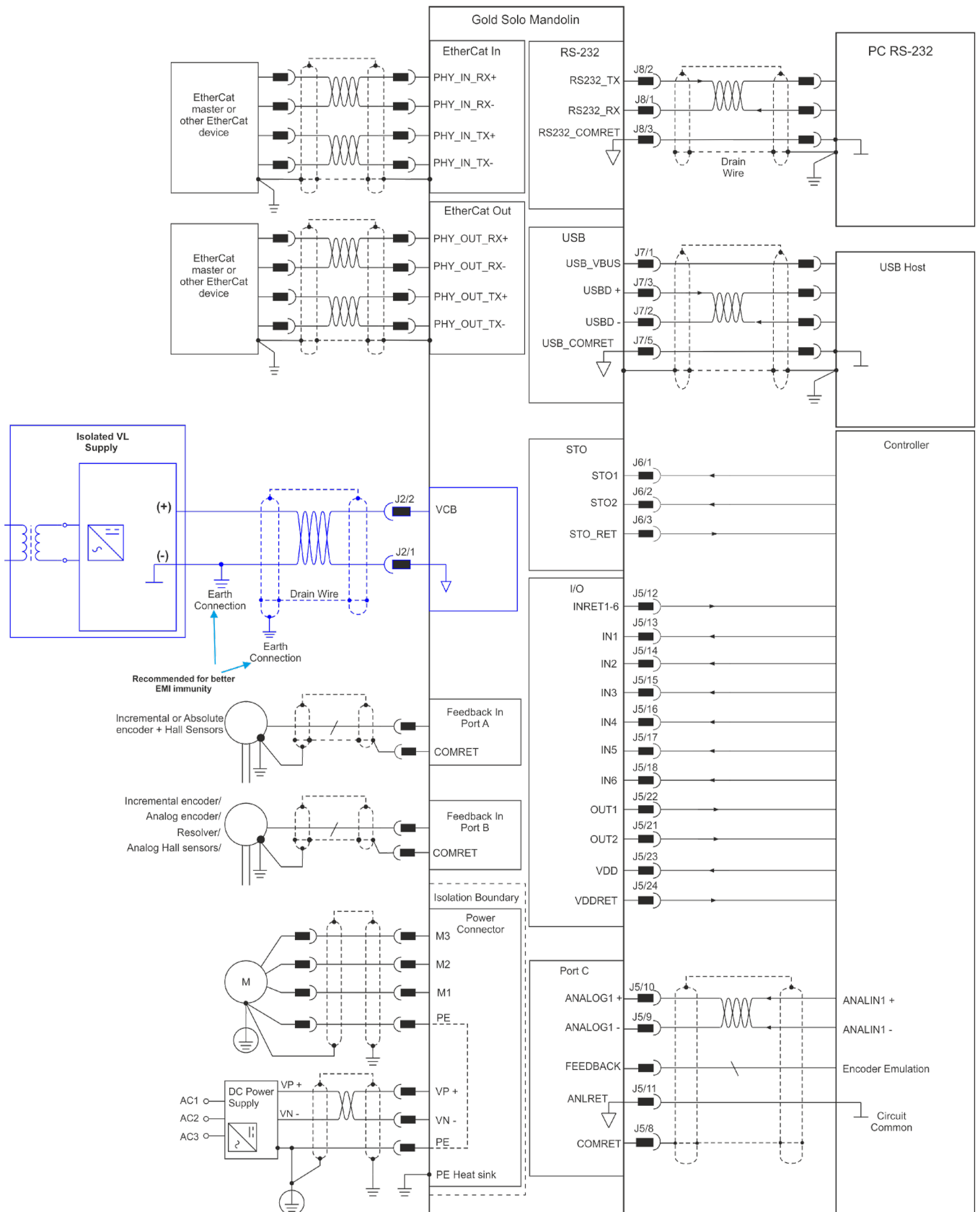


Figure 5: Mounting the Gold Solo Mandolin



## 5.4. The Gold Solo Mandolin Connection Diagrams

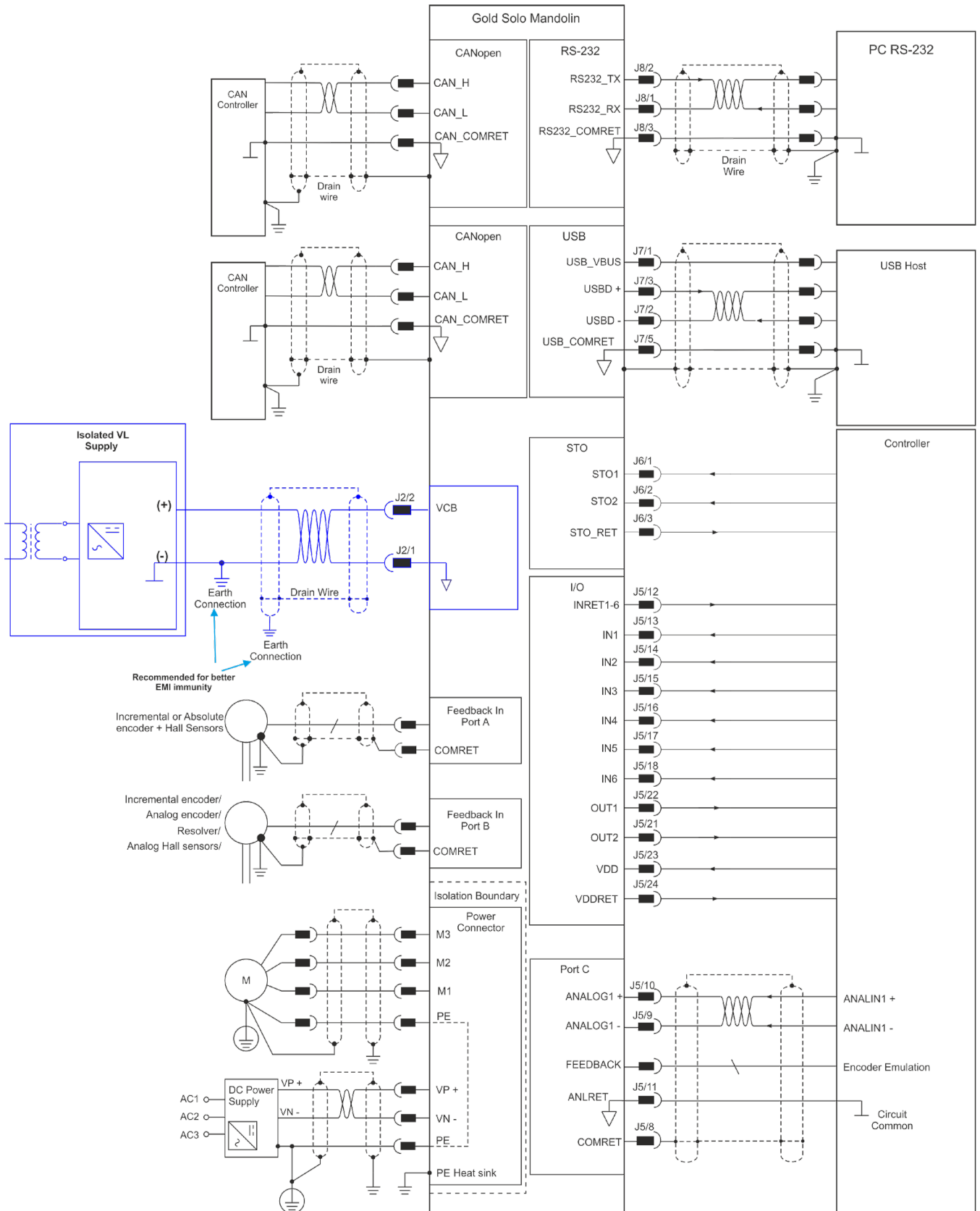
There is a single connection diagram for EtherCAT and one for CAN.



G-SOLMAN033A

Figure 6: Gold Solo Mandolin Connection Diagram for EtherCAT





G-SOLMAN051A

Figure 7: Gold Solo Mandolin Connection Diagram for CAN


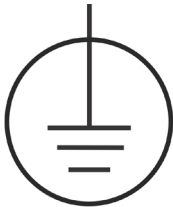
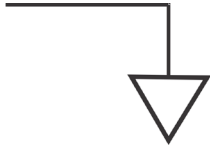
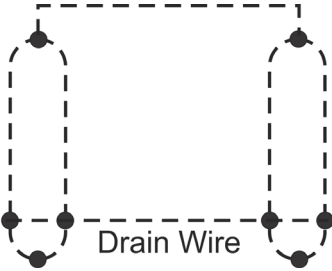
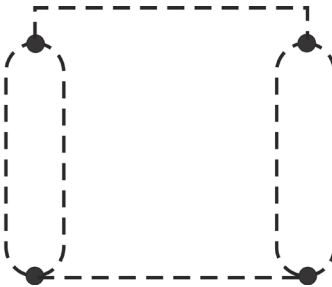
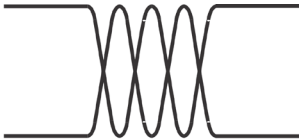


## Chapter 6: Wiring

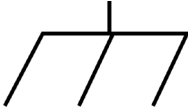
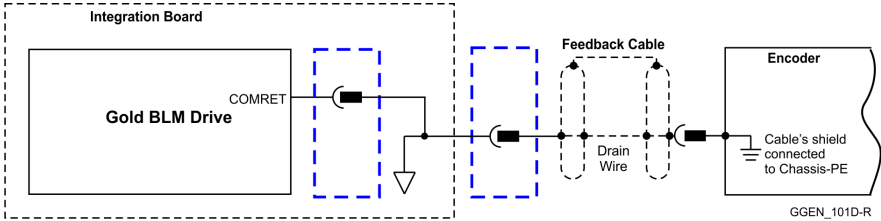
Once the product is mounted, you are ready to wire the device. Proper wiring, grounding and shielding are essential for ensuring safe, immune and optimal servo performance of the drive.

### 6.1. Wiring legend

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

Wiring Symbol	Description
 GGEN_101D-A	Earth connection (PE)
 GGEN_101D-B	Earth Connection
 GGEN_101D-C	Common at the Controller
 GGEN_101D-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_101D-E	Shielded cable braid only, without drain wire.
 GGEN_101D-F	Twisted-pair wires



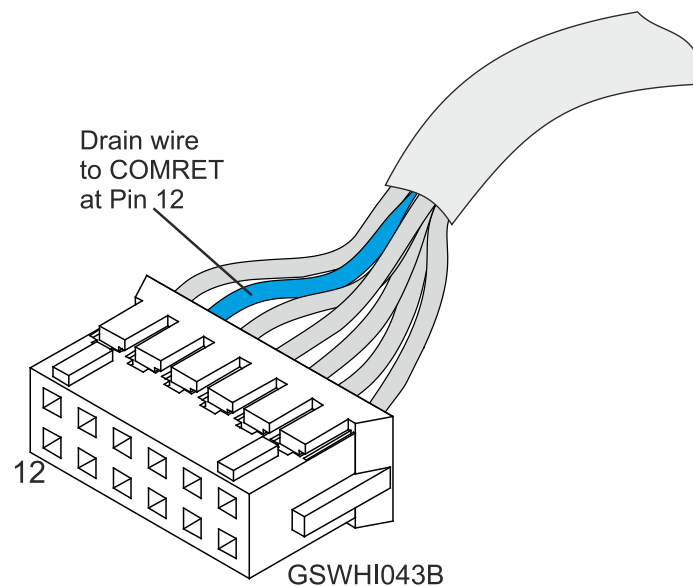
Wiring Symbol	Description
 GGEN_101D-K	Analog Ground
 GGEN_101D-R	<p>Encoder Earthing.</p> <p>The cable's shield is connected to the chassis (PE) in the connector.</p> <p>Earthing the Encoder and connecting the Earth (PE) to the drive COMRET is mandatory to insure reliable operation, high noise immunity and rejection of voltage common mode interferences.</p>



## 6.2. Basic Recommendations

### 6.2.1. General

1. Use shielded cables. For best results, the cable should have an aluminum foil shield covered by copper braid, and should contain a drain wire.  
Use 24, 26 or 28 AWG twisted-pair shielded with drain wire cables.
2. Keep the cable as short as possible.  
Do not mount the power cables of the motor and power bus in the proximity of the control and feedback cables.
3. Ensure that in normal operating conditions, the “earth connection” wires and shield of the control cables *carry no current*. The only time these conductors carry current is under abnormal conditions, when electrical equipment has become a potential shock or fire hazard while conducting external EMI interferences directly to ground, in order to prevent them from affecting the drive. Failing to meet this requirement might result in drive/controller/host failure.
4. After completing the wiring, carefully inspect all wires to ensure tightness, good solder of joints and general safety.



**Figure 8: Feedback and Shrouded Control Cable Assemblies – Example**

5. Where there is only one COMRET pin (Common Return) in the connector, which **MUST** be connected to the DRAIN WIRE and also to COMRET signal of the cable, it is necessary to connect the drain wire and COMRET signal to the same pin.



## 6.2.2. Feedback Cable Port A and Port B Connector

1. On the motor side connections, ground the shield to the motor chassis.
2. At least One COMRET (Common Return) must be connected to the PE.

Implement the following steps to connect the COMRET to the PE:

- a. At the drive, connect the feedback drain wire to one of the COMRET terminals in the Shrouded feedback connector (Figure 9).
- b. At the motor, connect the feedback cable drain wire to the GND motor chassis terminal of the feedback connector (Figure 9).

The drawing displays two earth connections.

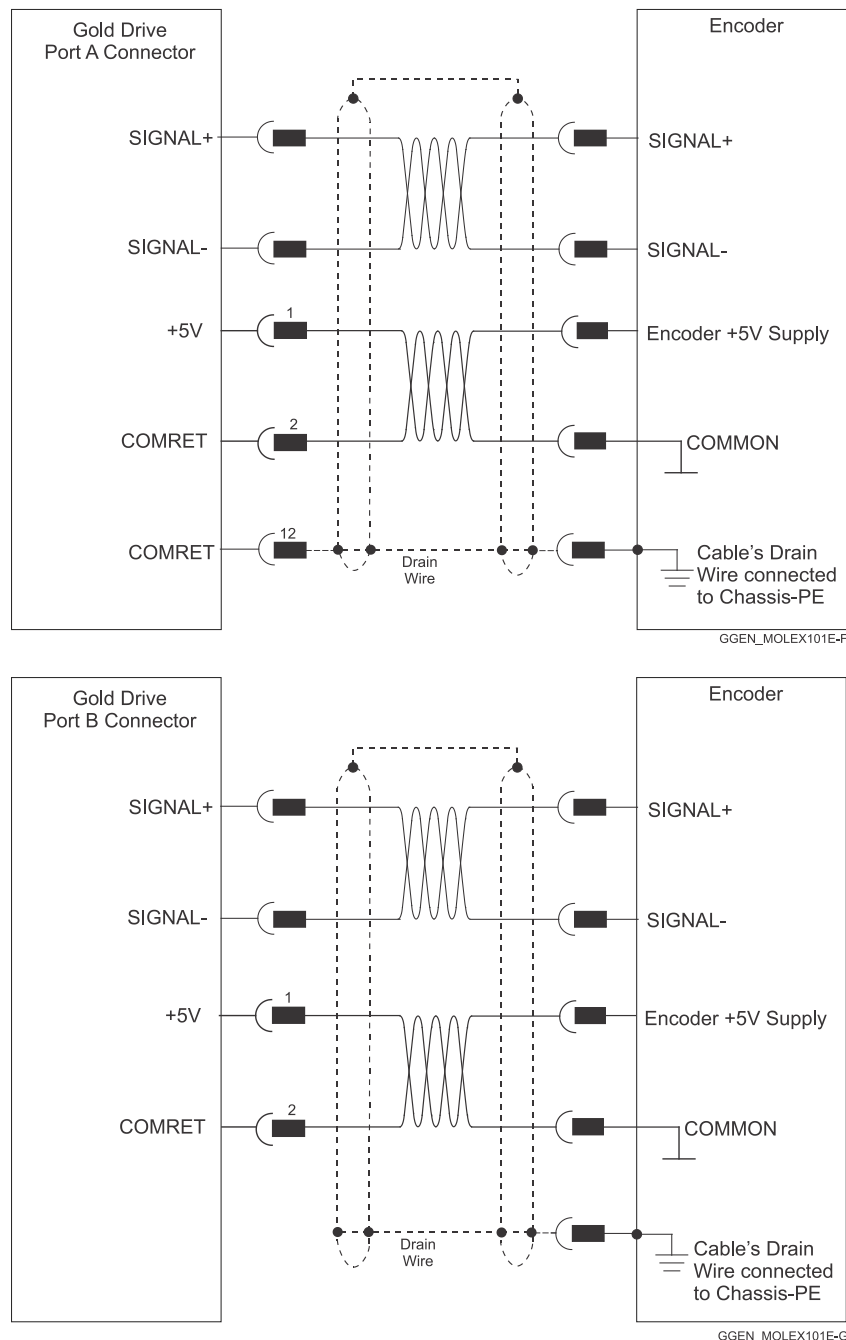


Figure 9: Feedback Port A and B Cable Assemblies



### 6.2.3. Feedback Cable Port C Connector

1. At the controller side connections, follow the controller manufacturer's recommendations concerning the shield.
2. The connection of the Drain wire to the Port C is not mandatory.

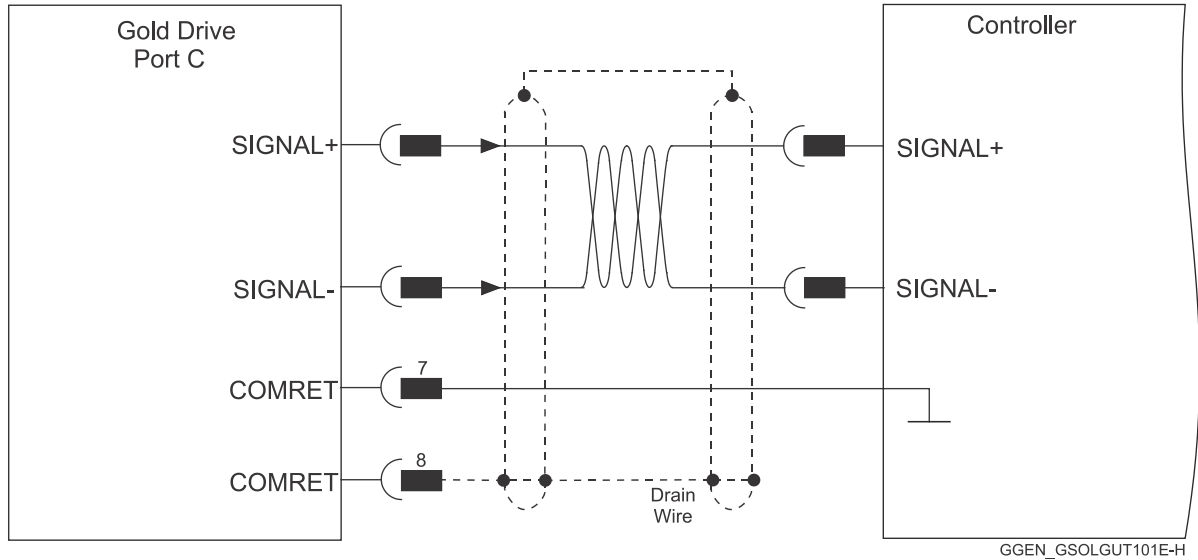


Figure 10: Feedback Port C Cable Assemblies

### 6.2.4. IO Cable Connector

It is recommended to use shielded cable, but is not mandatory.

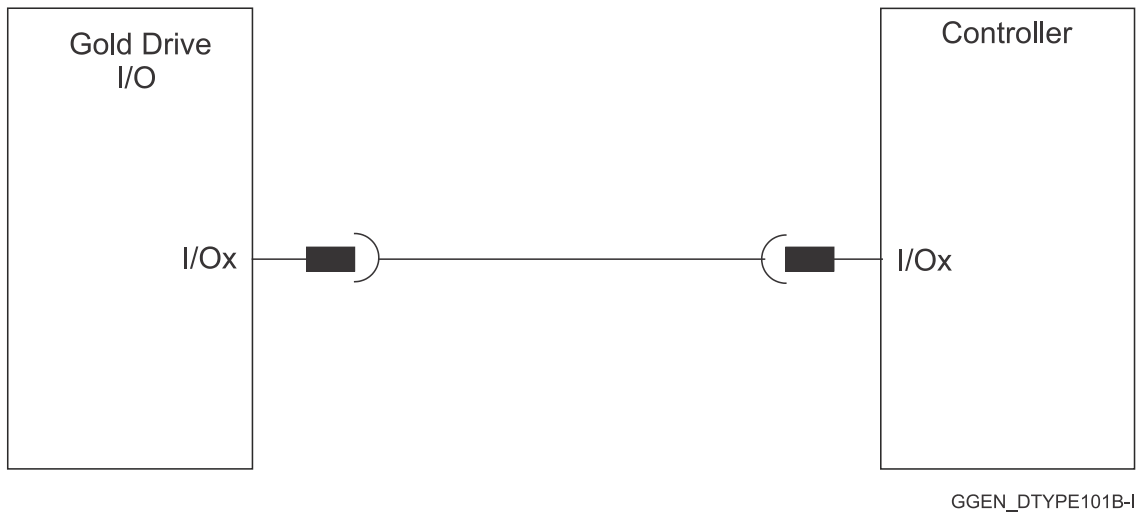


Figure 11: Feedback IO Cable Assemblies



### 6.2.5. STO (Port C) Cable Connector

It is recommended to use shielded cable, but is not mandatory.

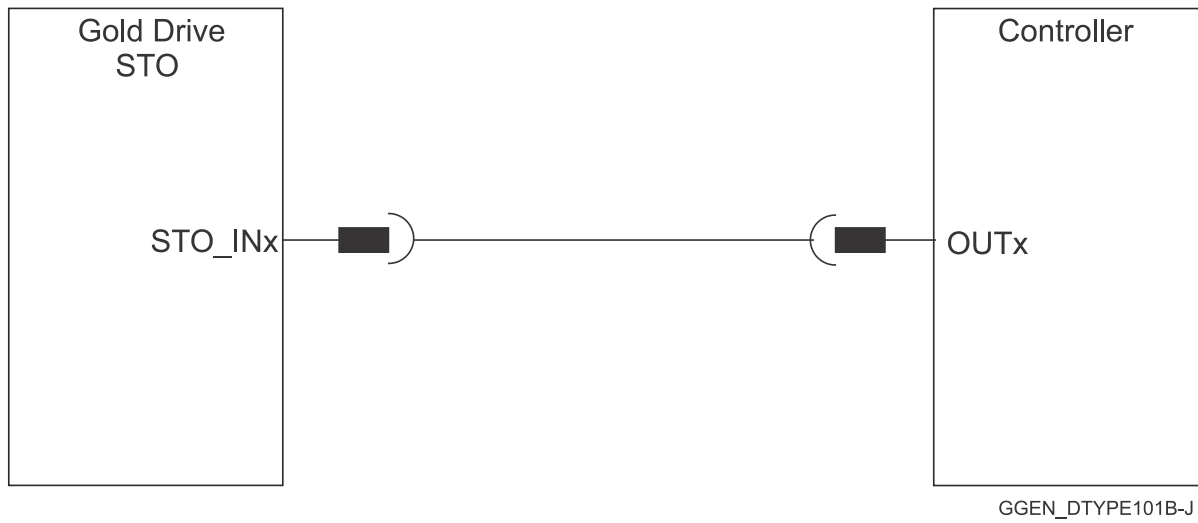


Figure 12: STO Cable Assemblies



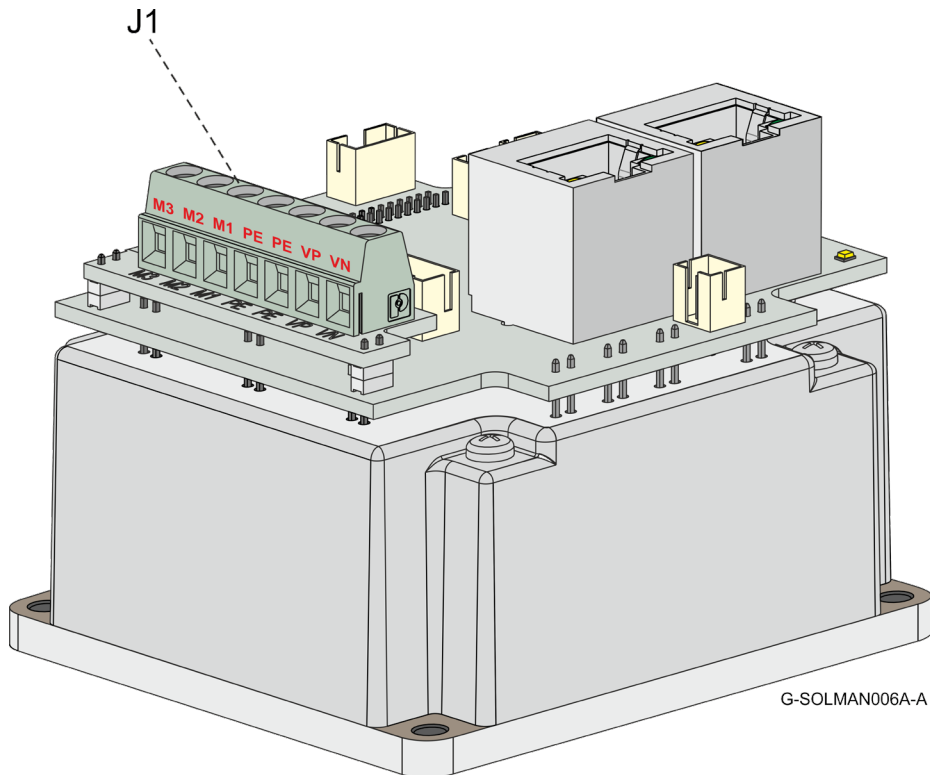


### 6.3. Main Power and Motor Power Connector Pinouts (J1)

See Chapter 8 in the in the MAN-G-Panel Mounted Drives Hardware manual for full details on the Motor Power.

Pin (J1)	Function	Cable	
		Brushless Motor	Brushed DC Motor
M3	Motor phase	Motor	Motor
M2	Motor phase	Motor	Motor
M1	Motor phase	Motor	N/C
PE	Earth Connection	Motor	Motor
PE	Earth Connection	DC Power	
VN-	DC Negative Power input	DC Power	
VP+	DC Positive Power input	DC Power	

### Pin Positions



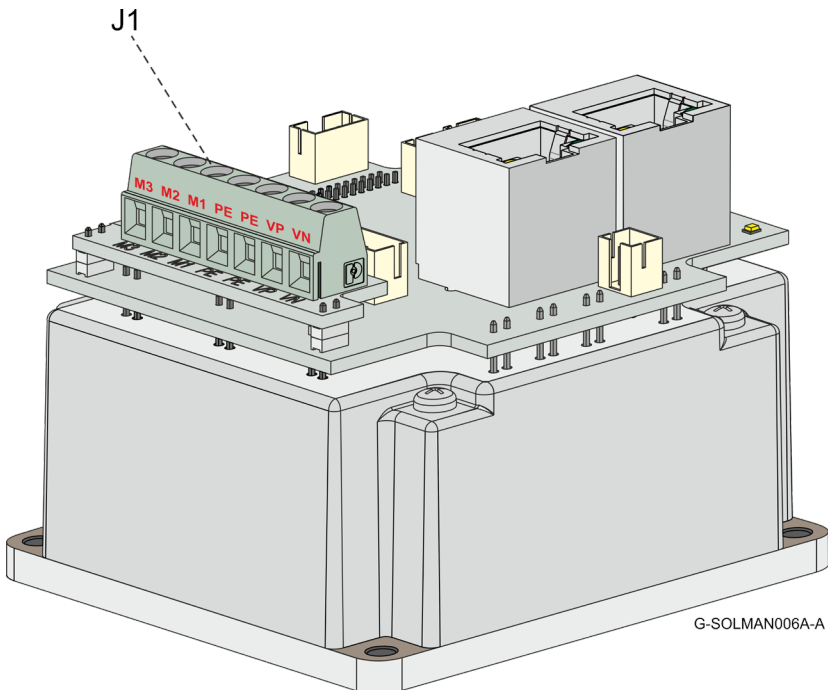
G-SOLMAN006A-A

Connector Type
7-Pin Pluggable 5 mm Phoenix High Current

Table 2: Connectors for Main Power and Motor Power



## 6.4. Motor Power

Pin (J1)	Function	Cable	
		Brushless Motor	Brushed DC Motor
M3	Motor phase	Motor	Motor
M2	Motor phase	Motor	Motor
M1	Motor phase	Motor	N/C
PE	Earth Connection	Motor	Motor
<b>Pin Positions</b>			
			
<b>Connector Type</b>			
7-Pin Pluggable 5 mm Phoenix High Current			

**Table 3: Connector for Motor Power**

To power the drive, connect the M1, M2, M3, and PE pins on the Gold Solo Mandolin. 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.

- 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.
- For better EMI performance, the shield should be connected to Protective Earth (PE terminal). Connect the Braid wire to the PE terminal on the motor connector.
- Ensure that the motor chassis is properly grounded.

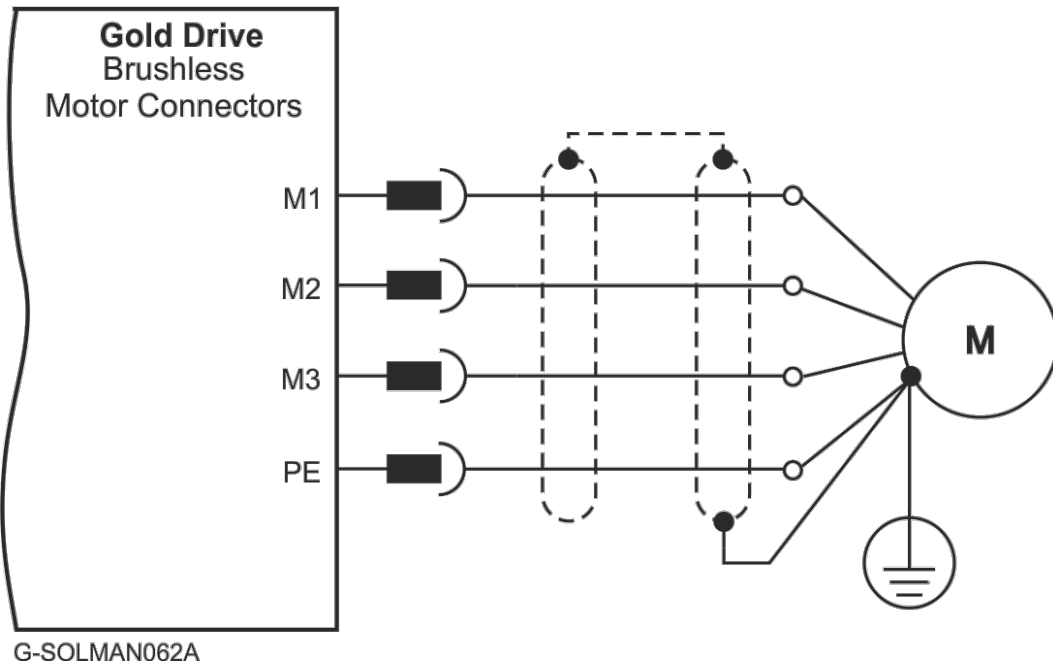


Figure 13: Brushless Motor Power Connection Diagram

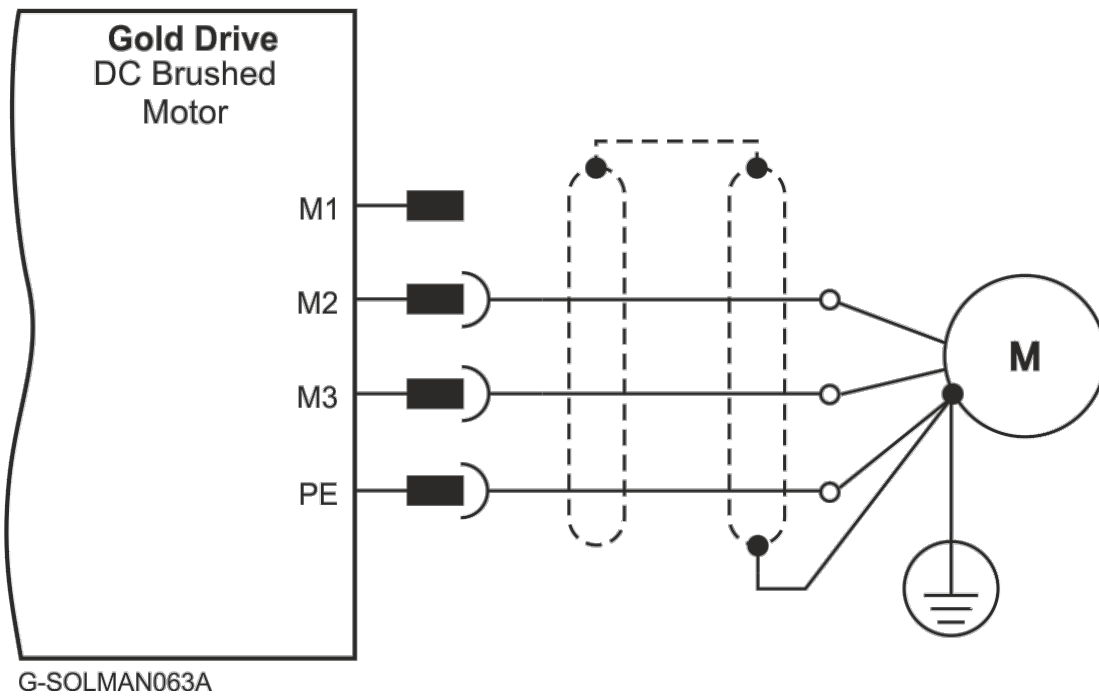


Figure 14: Brushed Motor Power Connection Diagram



## 6.5. Main Power and Control Backup Supply

### 6.5.1. Main Power

Power to the Gold Solo Mandolin (100 V to 400 V) is provided by a direct to mains DC power source (VP+ to VN-).

Pin	Function	Cable
PE	Protective Earth	Power
VN-	DC Negative Power input	Power
VP+	DC Positive Power input	Power

7-Pin Pluggable 5 mm Phoenix High Current

#### Pin Positions

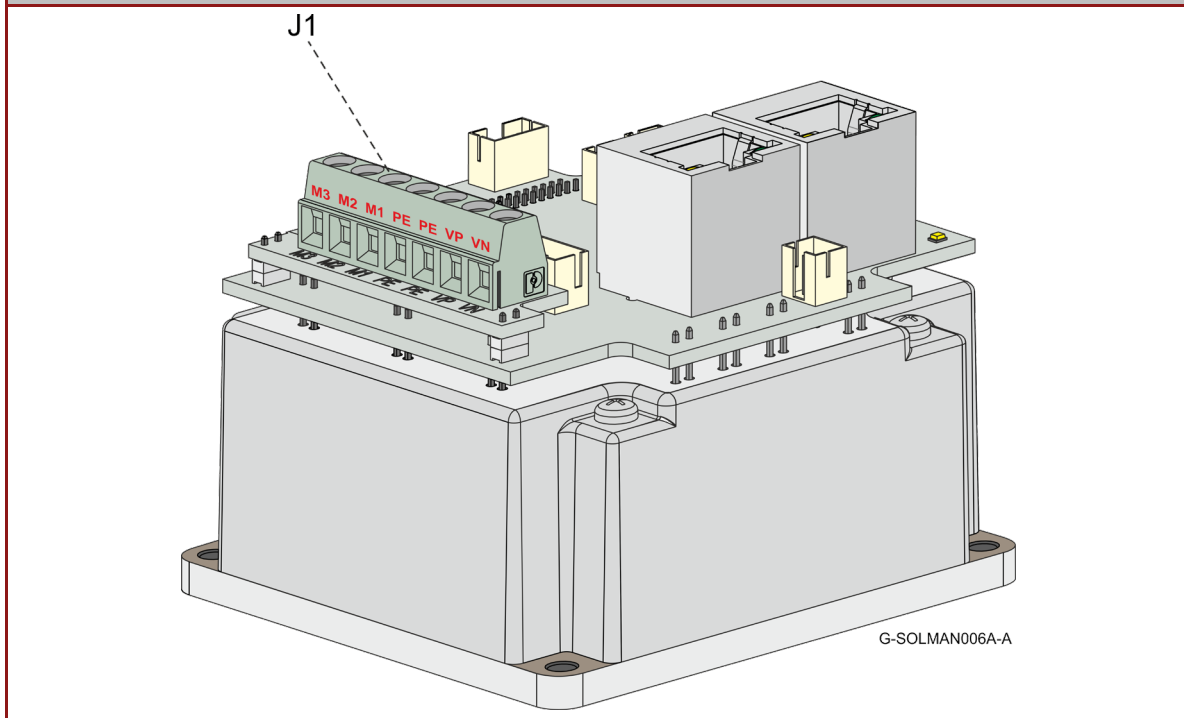


Table 4: Connector for Main Power

The DC power source for the Gold Solo Mandolin is delivered from a separated rectifying unit (supplied by the user). Elmo recommends using the Tambourine rectifier specifically designed for use with Elmo drives which offers a range of versatile options.

The following sections contain topology recommendations for implementing three-phase and single-phase supply chains.

The power stage of the Gold Solo Mandolin is fully isolated from the other sections of the Gold Solo Mandolin, such as the Control backup supply and the heat-sink. **This isolation allows the user to connect the common of the control section to the PE, a connection which significantly contributes to proper functionality, safety and EMI immunity, leading to better performance of the Gold Solo Mandolin.**



In addition, this isolation simplifies the requirements of the DC power supply that is used to power the DC bus of the Gold Solo Mandolin, by allowing it to operate with a non-isolated DC power source (a direct-to-mains connection) which eliminates the need for a bulky and expensive isolation transformer.

However, as well as operating from a non-isolated/direct-to-mains DC power supply, the Gold Solo Mandolin can also operate from an isolated power supply or batteries.

When rectifying an AC voltage source, the AC voltage level must be limited to 270 VAC so as not to exceed the maximum 390 VDC.

**To connect the non-isolated DC power supply:**

1. For best noise immunity, a shielded (not twisted) cable is recommended (not mandatory) for the DC input cable.
2. A 3-wire shielded cable should be used:
  - a. Connect the main input cable to the VP+ and VN- terminals of the main input connector.
  - b. For safety requirements, the green/yellow-wire must be connected to the earth connection (PE terminal). Connect the Earth Connection wire to the PE terminal on the main DC connector.
  - c. For better EMI performance, the shield should be connected to Earth Connection (PE).
3. The gauge of the cable strands is determined by the actual current of the drive.



**Caution For all the following Topologies:**

- Do not connect VN- to PE. **In a direct-to-mains connection the VN- must *not* be connected to the PE**, as this will cause irreparable damage to the system.
- Take care and note that in a direct-to-mains connection the Neutral point is *not* the most negative voltage level. It is the mid-point level of the rectified DC bus.



### 6.5.1.1. Three-Phase Direct-to-Mains Connection Topology

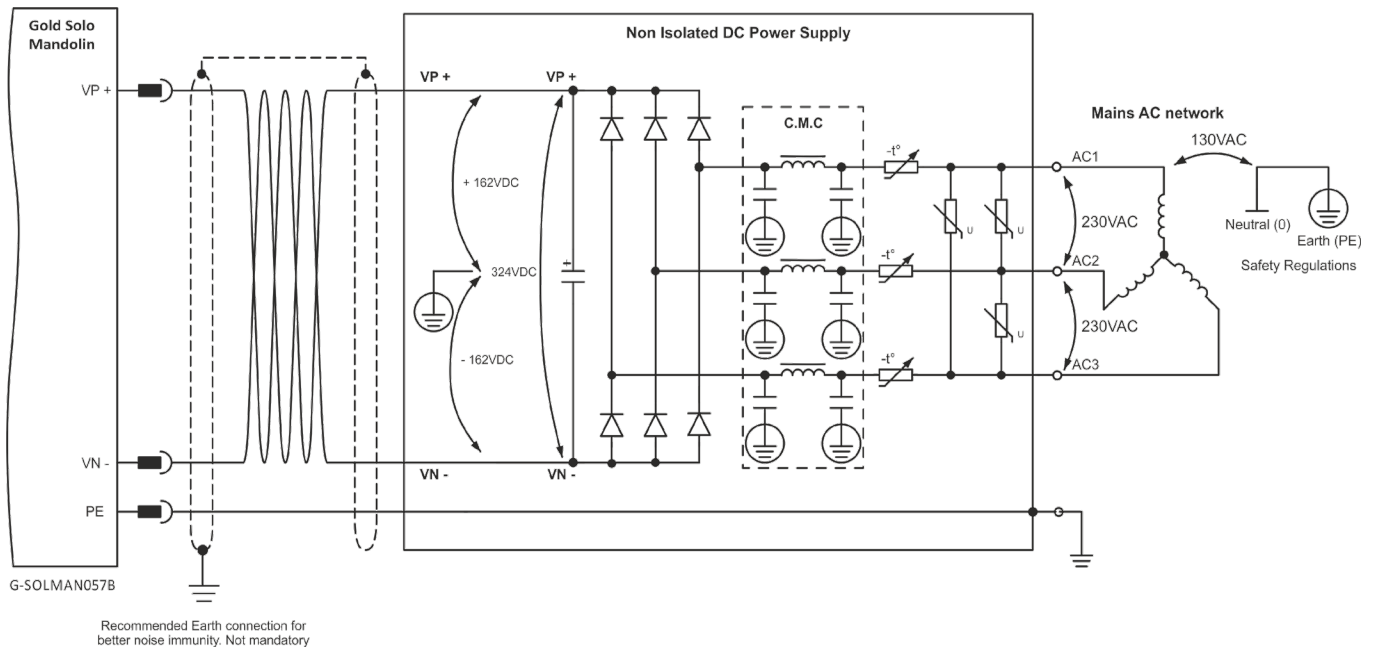


Figure 15: Non-Isolated Three-Phase Connection Topology

### 6.5.1.2. Single-Phase Direct-to-Mains Connection Topology

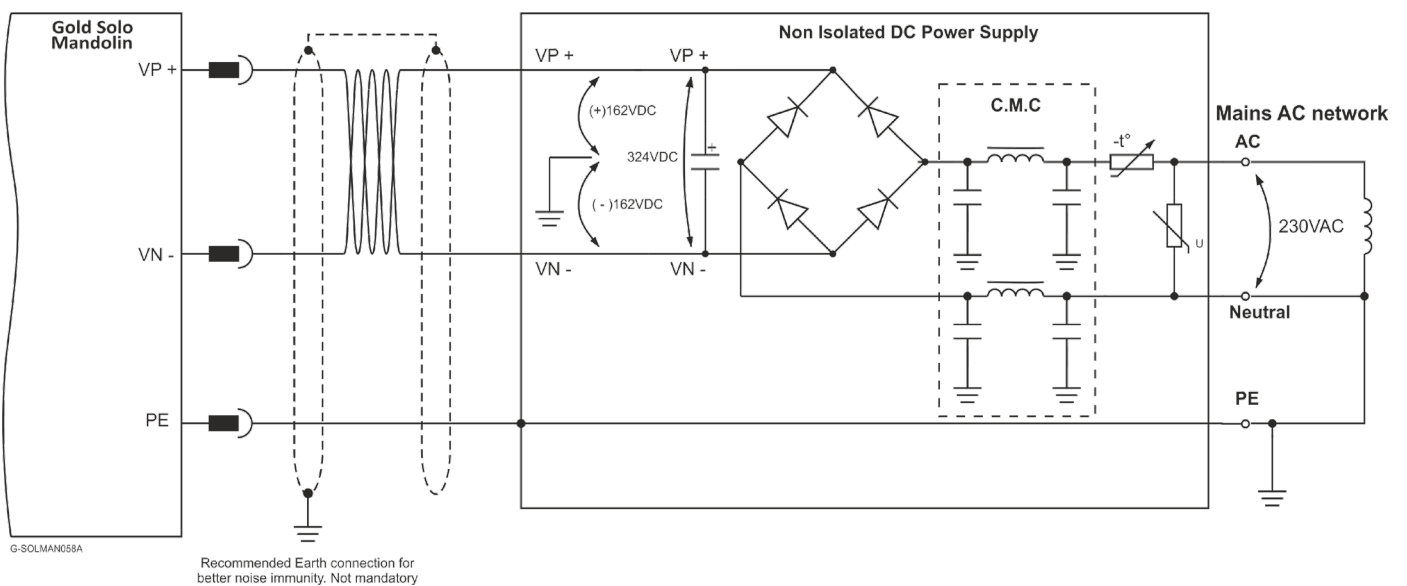


Figure 16: Non-Isolated Single-Phase Connection Topology

The Power Supply is connected directly to the mains AC line.



### 6.5.1.3. Multiple Connections Topology

In a multi-axis application it is likely that a single power supply can feed several drives in parallel. The power supply is connected directly to the mains AC line and it feeds more than one drive.

This topology is efficient and cost saving, by reducing the number of power supplies and the amount of wiring. Most importantly it utilizes an energy sharing environment among all the drives that share the same DC bus network.

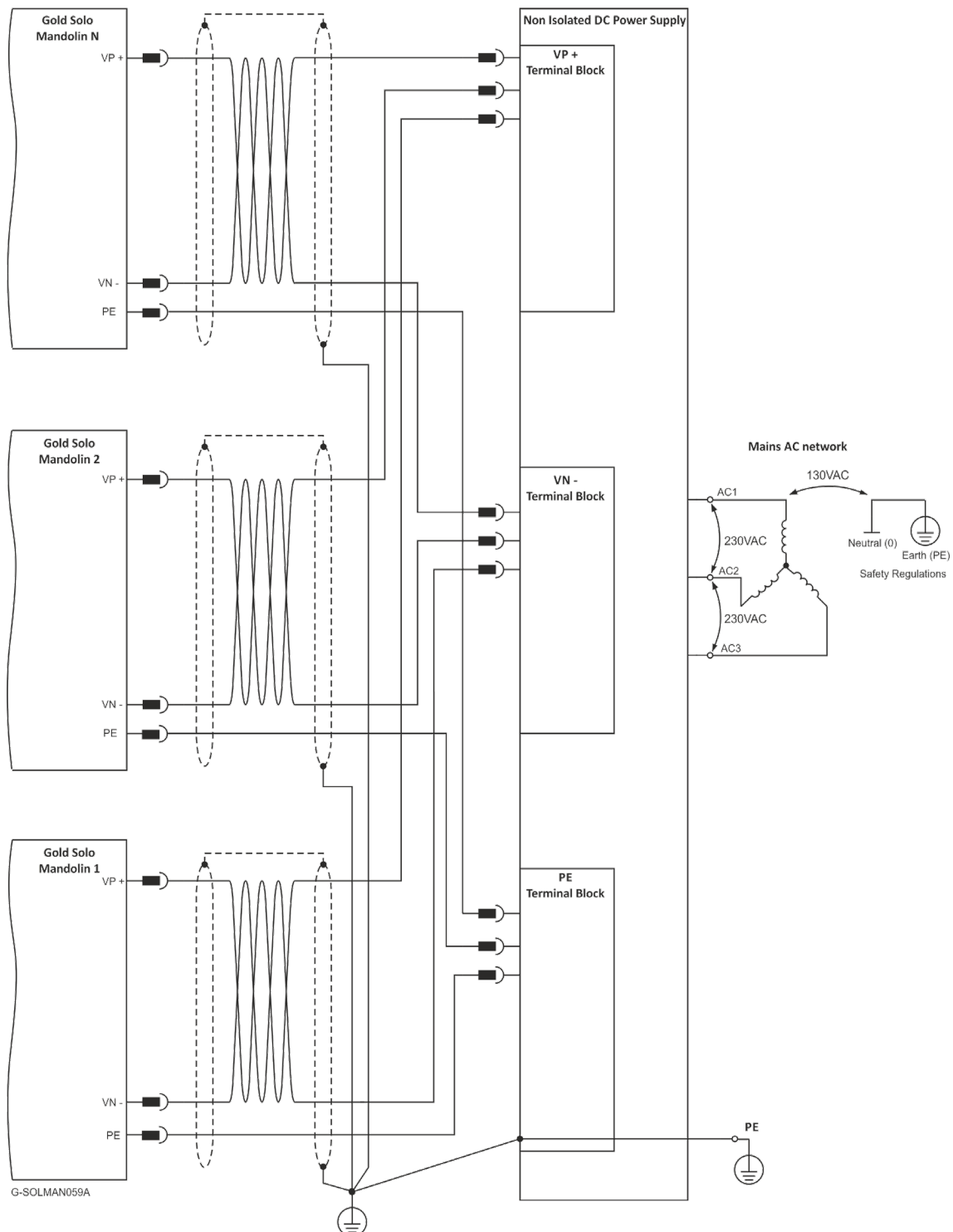


Figure 17: Non-Isolated Three-Phase Multiple Connection Topology





## 6.5.2. Battery Power Supply

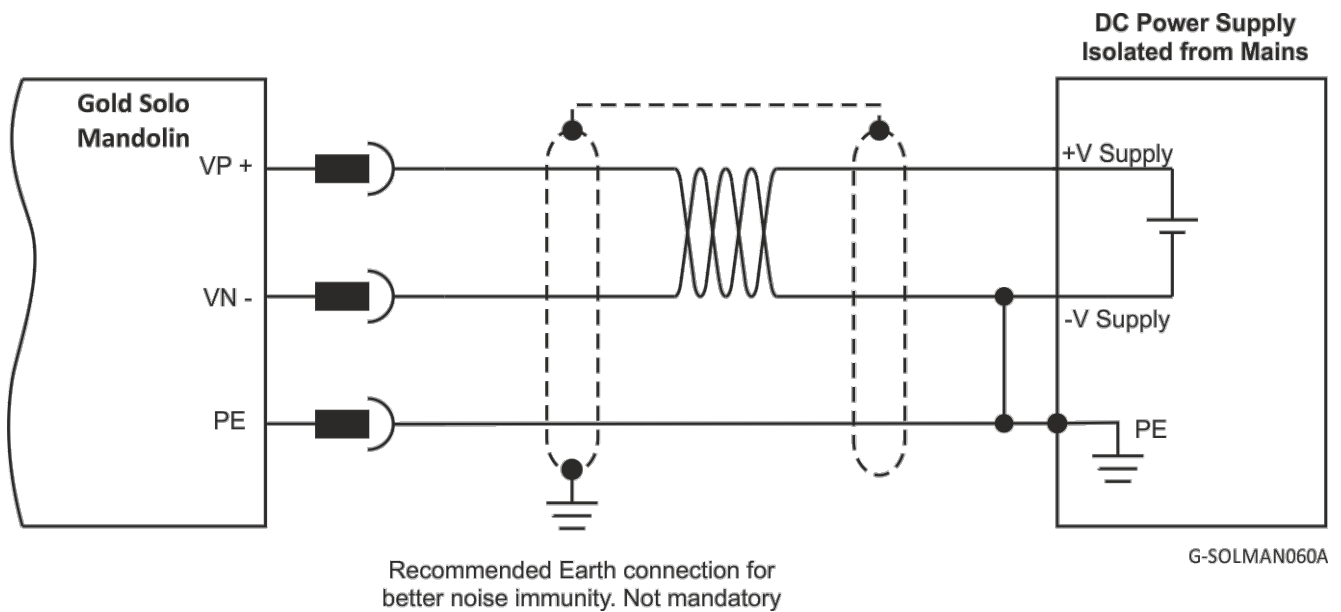


Figure 18: Battery Connection Topology



**Caution:** When using batteries, it is recommended to connect the negative pole to the PE.

When doing so, the charger of the battery **must** be isolated from the mains by an isolation transformer.



### 6.5.3. Control Backup Supply (J2)

Power to the control section derives from a switch-mode power-supply fed internally from the prime source.

Pin (J2)	Function
1	Control backup supply Return
2	Control backup supply Input Positive

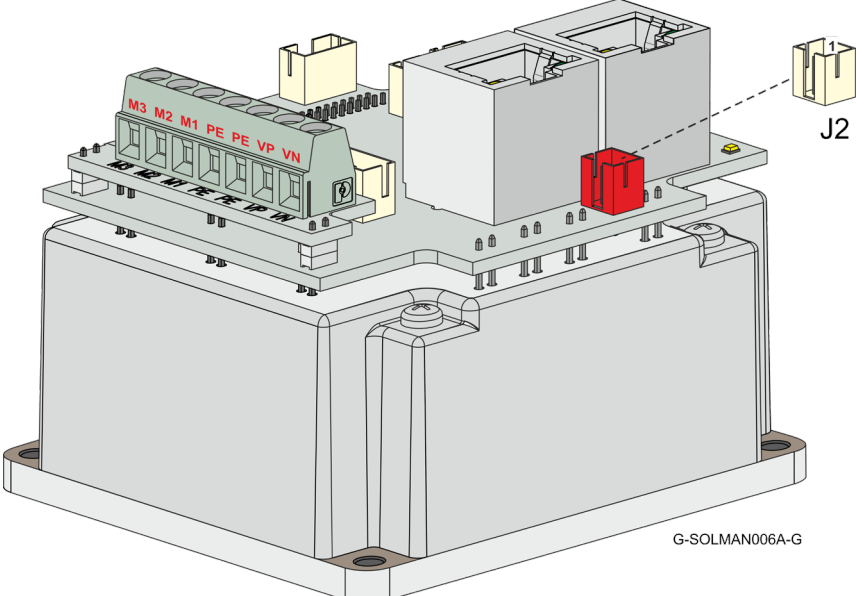
Pin Positions
 <p>G-SOLMAN006A-G</p>

Table 5: 24 VDC Control Backup Supply Pins and Polarity

Only one power supply is required for the main and control power, with no need for a Control backup supply voltage to supply the drive's logic section.

If separation between the main DC power source and a Control backup supply is required, then an external isolated Control backup supply should be connected to VCB terminals in addition to the main power supply. Connect the Control backup supply as described below.

#### To connect your integration board to the Control backup supply:

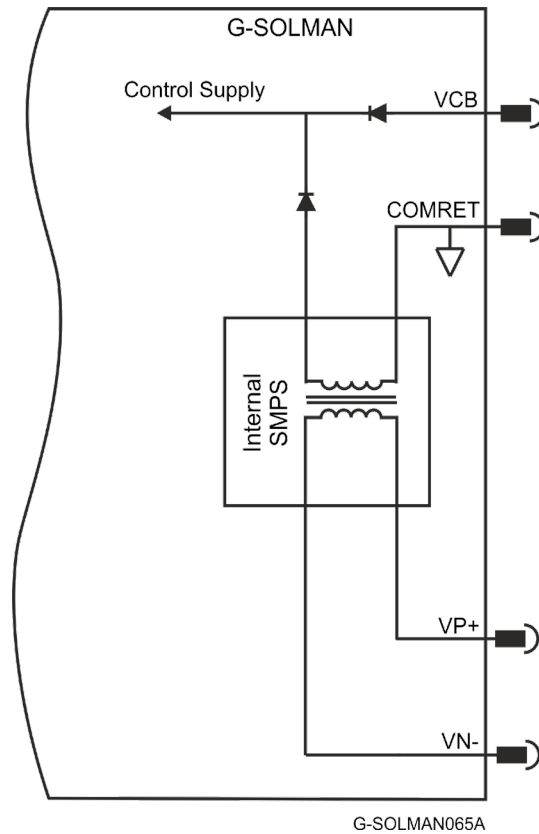
1. Use a 24 AWG twisted pair shielded cable. The shield should have copper braid.
2. The source of the Control backup supply must be isolated with an isolation transformer.
3. For safety and EMI reasons, connect the return of the Control backup supply to the closest ground (PE).
4. Connect the cable shield to the closest ground (PE) near the power source.
5. Before applying power, first verify that the polarity of the connection is correct.

**Note:** The Control backup supply can operate from an isolated voltage source within the range of 18 to 40 VDC.



#### 6.5.4. Main Power and Control Relationship

Power to the Gold Solo Mandolin (100 V to 400 V) is provided by a direct to mains DC power source (VP+ to VN-). However, power to the control section derives from a switch-mode power-supply (Figure 19) fed internally from the prime source.



**Figure 19: Switch-mode Power Supply**

The Gold Solo Mandolin can economically operate from a single direct to Mains power-supply, without the need for an additional Control backup supply (VCB).

However, there may be situations when an additional Control backup supply (VCB) is required, e.g.:

- When a backup functionality is required, for restoring control parameters, while the prime power-supply is turned off.
- By using the STO interface as Enable/Disable interface, the user benefits from the STO circuitry within the drive as start/stop safety function.



#### 6.5.4.1. Single Power Supply Topology

The Gold Solo Mandolin operates from a direct to Mains DC power supply without the necessity for an additional VCB supply for the control section.

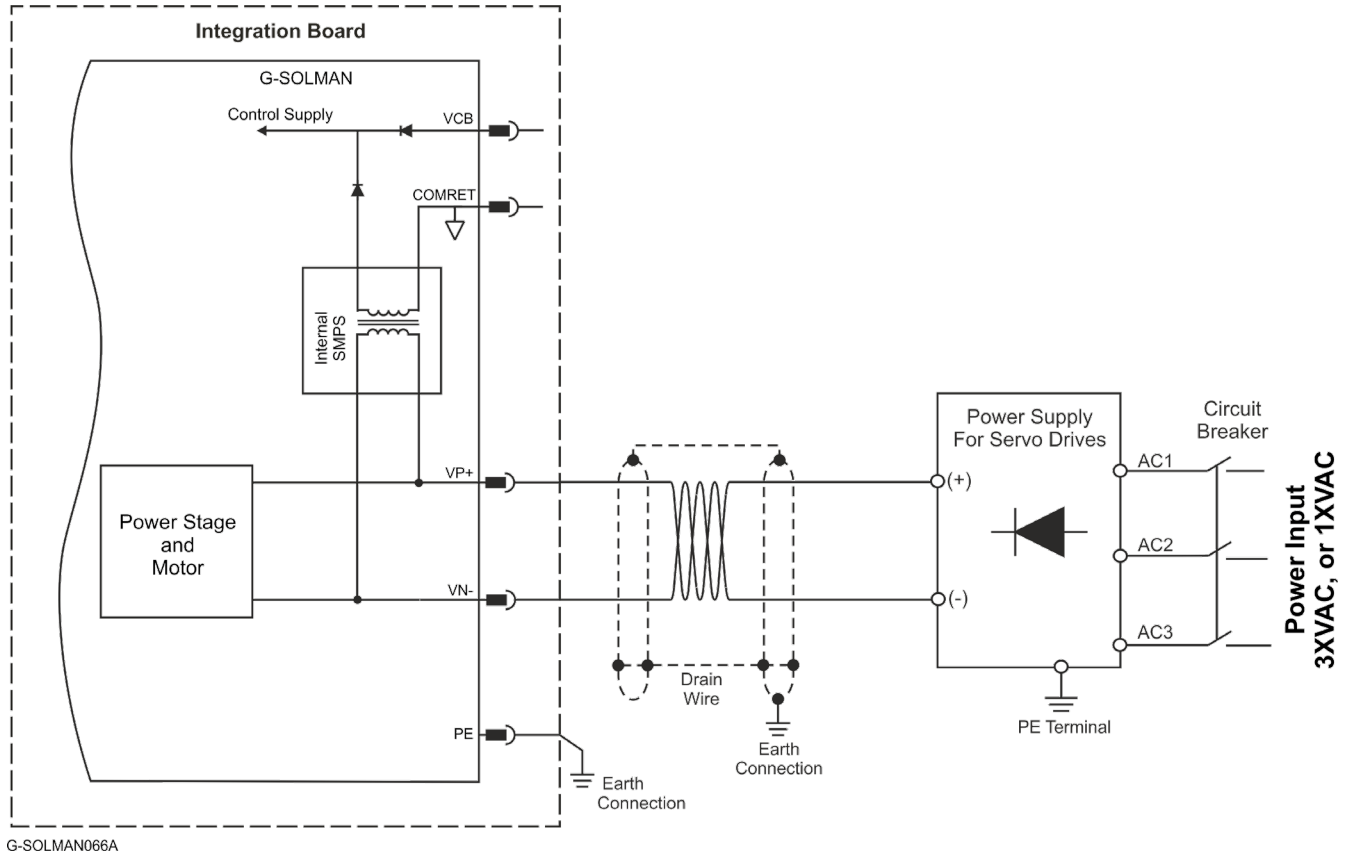


Figure 20: Gold Solo Mandolin Single supply Topology

**Note:**

This topology does not support restoration of the control parameters while the mains DC power supply is turned OFF.



#### 6.5.4.2. Direct to Mains Power Supply and Logic Backup

This topology describes two power sources:

- A prime "direct to the Mains" DC power-supply
- An isolated VCB backup supply

The VCB supply is only required in applications where the control section must stay active, whenever the DC power supply is disconnected.

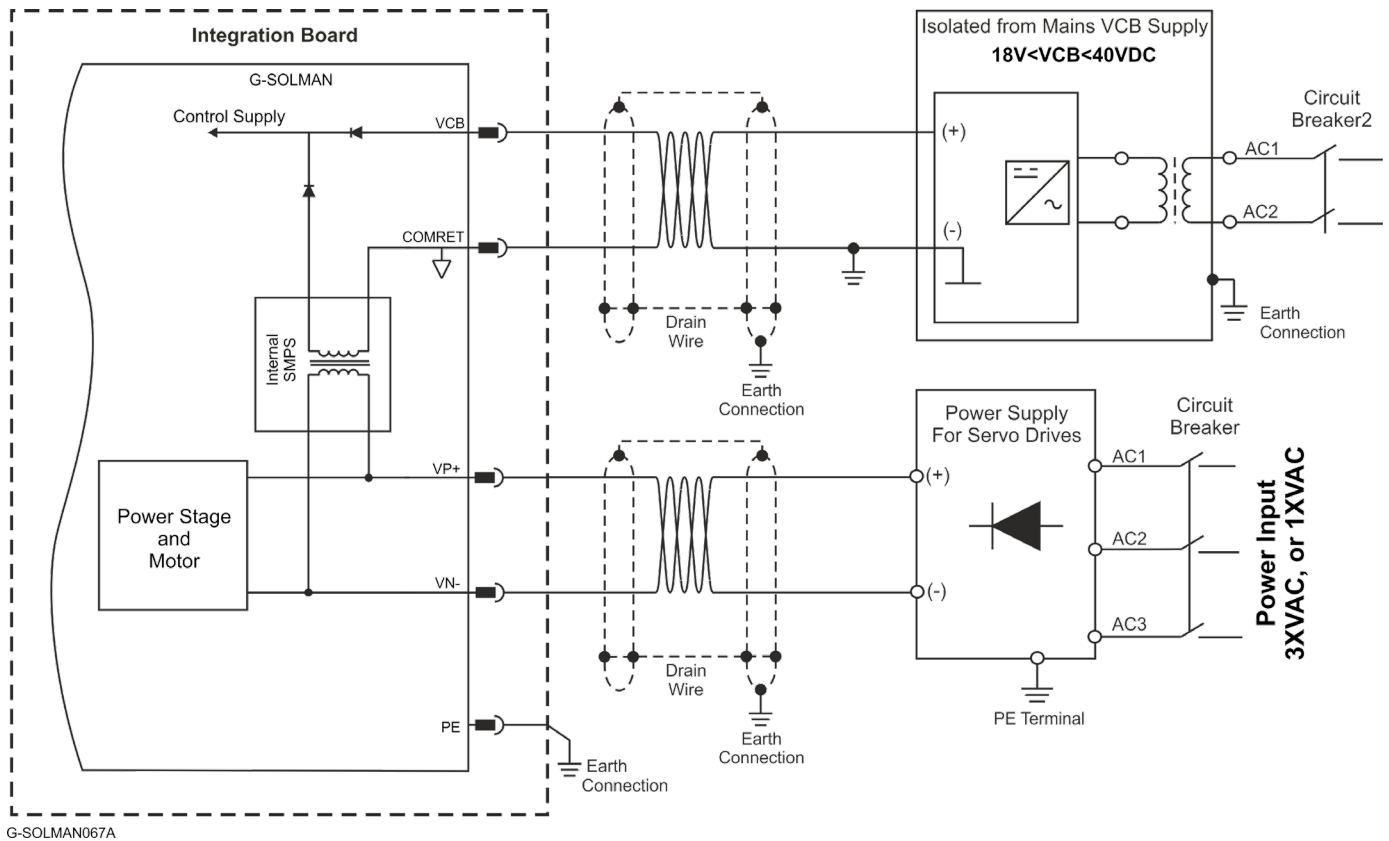


Figure 21: Gold Solo Mandolin VP+ and VCB Topology



### 6.5.4.3. Direct to Mains Power Supply and Low Power 24 VDC Supply (For STO functionality)

This topology describes two power sources:

- A prime "direct to the Mains" DC power-supply
- A low power 24 VDC supply

The Gold Solo Mandolin operates from a direct to Mains DC power supply. In addition, the certified Start-Stop disabling functionality is provided by the STO circuitry, which is activated by the low power 24V supply source.

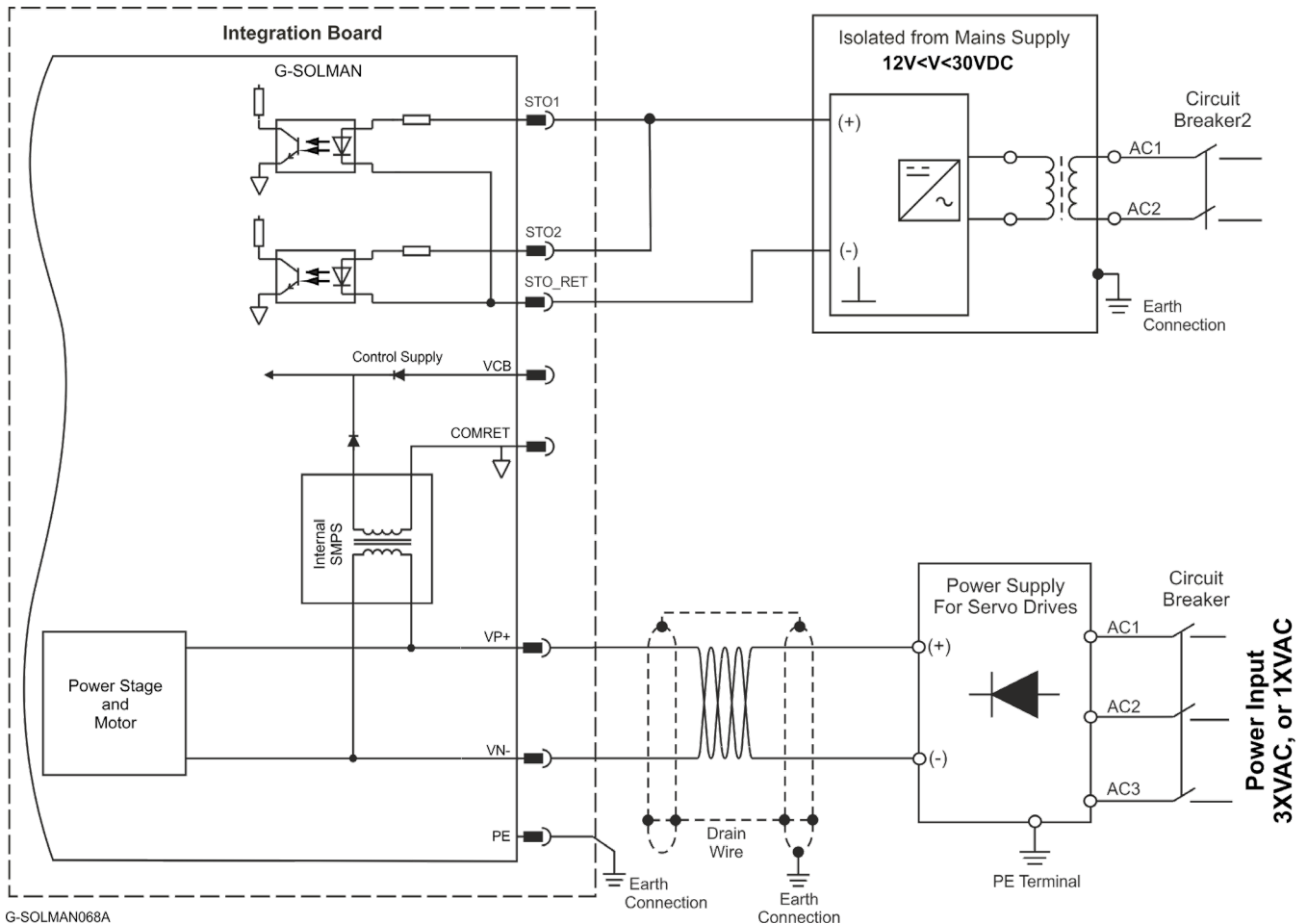
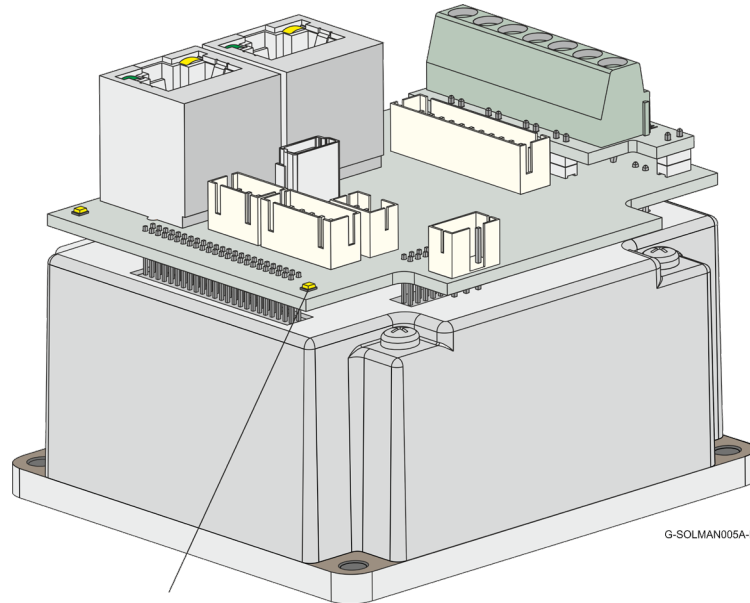


Figure 22: Gold Solo Mandolin "Start-Stop" Functionality via STO



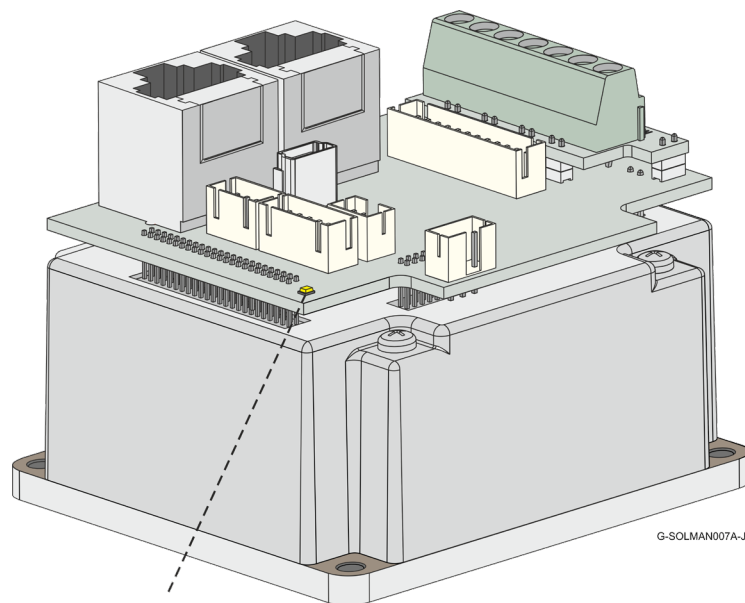
## 6.6. Drive Status Indicator

Figure 23 shows the position of the red/green dual LED, which is used for immediate indication of the Initiation and Working states. For details refer to Chapter 7 Drive Status Indicator, in the MAN-G-Panel Mounted Drives Hardware manual.



Drive Status LED

**Drive Status Indicator - EtherCAT**



Drive Status LED

**Figure 23: Drive Status Indicator - CAN**

The 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).



## 6.7. STO (Safe Torque Off) (J6)

See Chapter 9 in the in the MAN-G-Panel Mounted Drives Hardware manual for full details.

Pin (J6)	Signal	Function
1	STO1	STO 1 input (default 24 V)
2	STO2	STO 2 input (default 24 V)
3	STO_RET	STO signal return

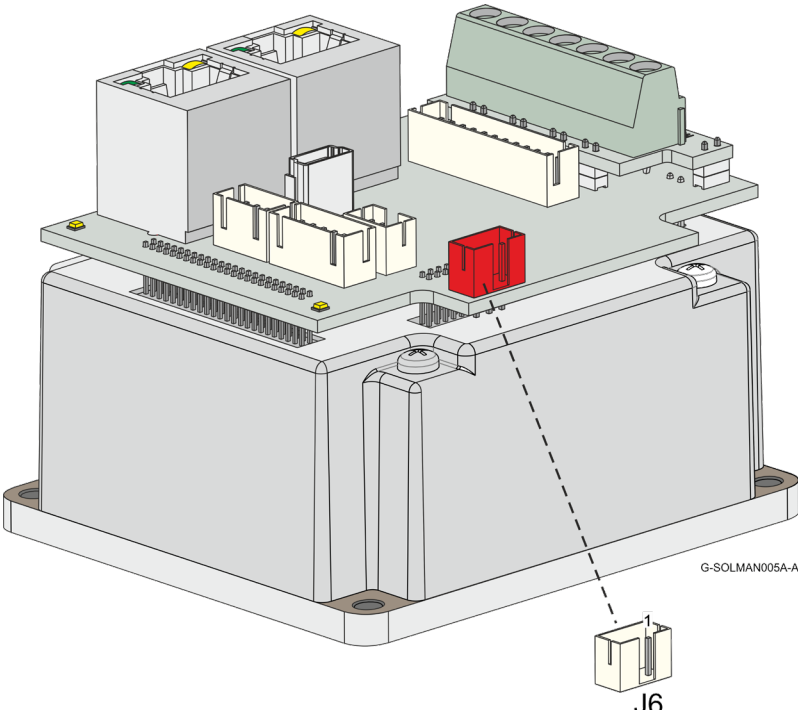
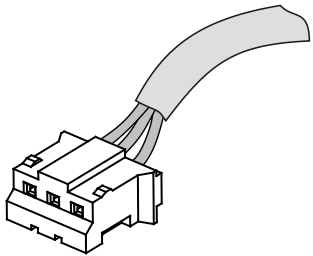
Pin Positions	Cable Connector
 <p>G-SOLMAN005A-A</p> <p>J6</p>	 <p>GSWHI040B</p> <p><b>3-Pin Tyco Plug</b></p> <p>This cable is included in the cable kit described in Section 3.1.1.</p>

Table 6: STO Input Pin Assignments





### 6.7.1. Source Mode – PLC Voltage Level

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

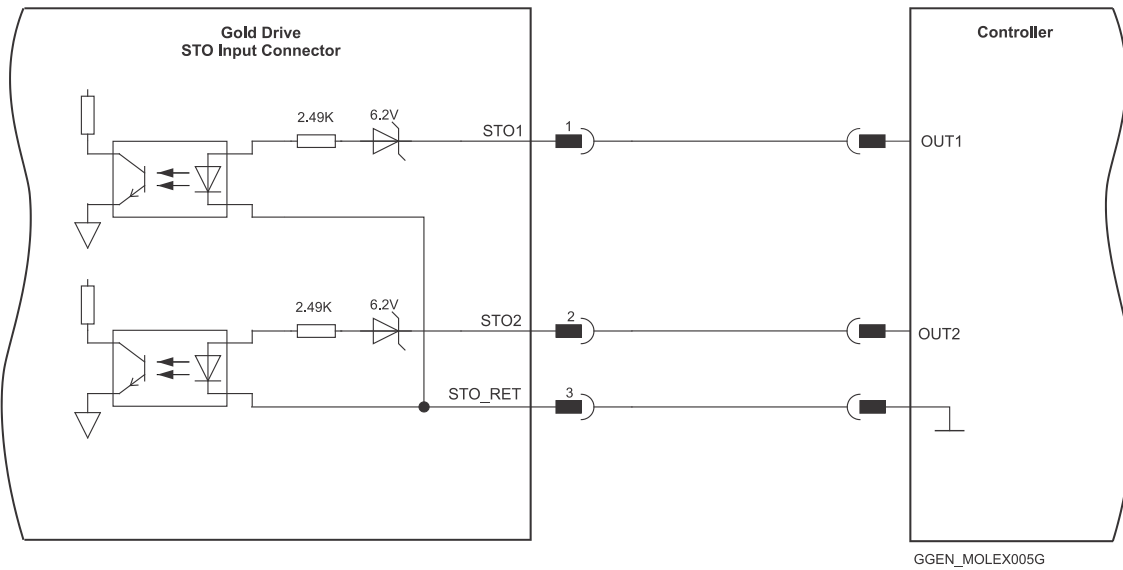


Figure 24: STO Shrouded Type Input Connection – PLC Source Option

### 6.7.2. TTL Mode – TTL Voltage Level

Refer to the diagrams below for TTL option connection.

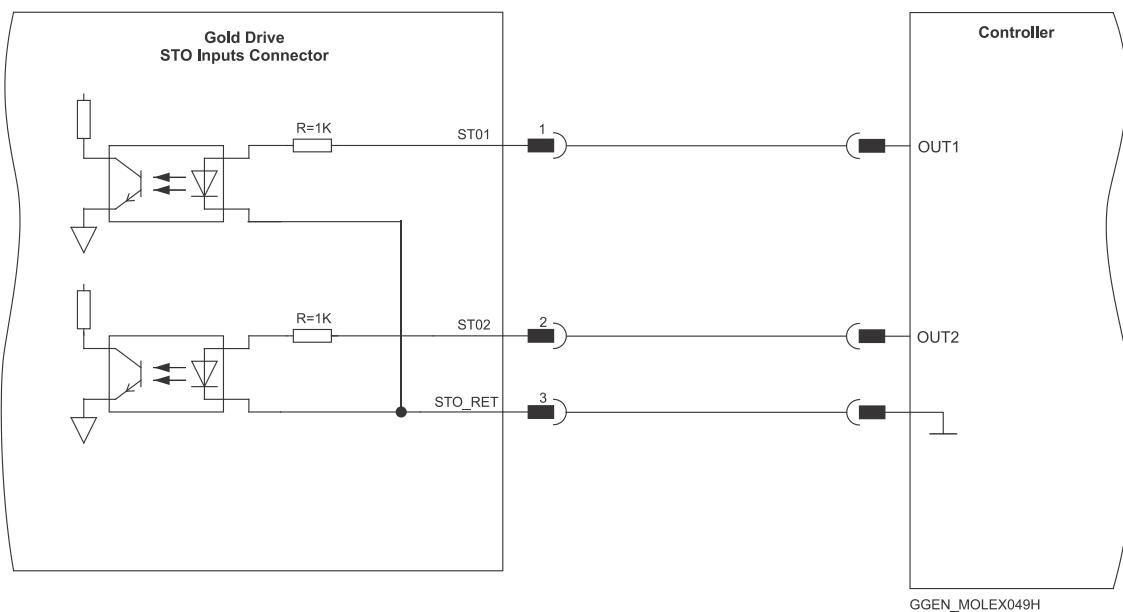


Figure 25: STO Input Connection – TTL Option



## 6.8. Port A Connector (J3)

See Section 10.3 in the in the MAN-G-Panel Mounted Drives Hardware manual for full details.

Incremental Encoder			Absolute Serial Encoder	
Pin (J3)	Signal	Function	Signal	Function
1	+5V	Encoder +5V supply	+5V	Encoder +5V supply
2	COMRET	Common Return	COMRET	Common Return
3	PortA_ENC_A+	Channel A +	ABS_CLK+	Absolute encoder clock+
4	PortA_ENC_A-	Channel A -	ABS_CLK-	Absolute encoder clock-
5	PortA_ENC_B+	Channel B+	ABS_DATA+	Absolute encoder data+
6	PortA_ENC_B-	Channel B -	ABS_DATA-	Absolute encoder data -
7	PortA_ENC_INDEX+	Index+	Reserved	Reserved
8	PortA_ENC_INDEX-	Index -	Reserved	Reserved
9	HA	Hall sensor A	HA	Hall sensor A
10	HB	Hall sensor B	HB	Hall sensor B
11	HC	Hall sensor C	HC	Hall sensor C
12	COMRET	Common Return	COMRET	Common Return

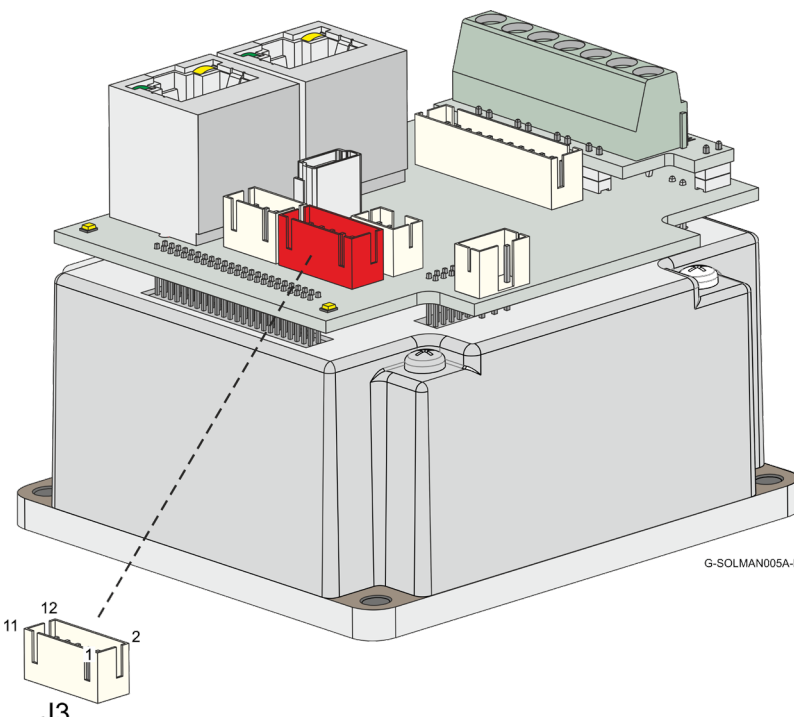
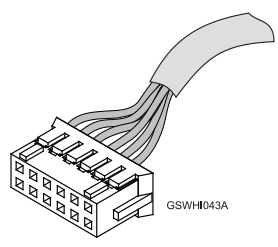
Pin Positions	Cable Connector
 <p>G-SOLMAN005A-B</p>	 <p><b>12-Pin Tyco Plug</b></p> <p>This cable is included in the cable kit described in Section 3.1.1.</p>

Table 7: Port A Pin Assignments



### 6.8.1. Incremental Encoder

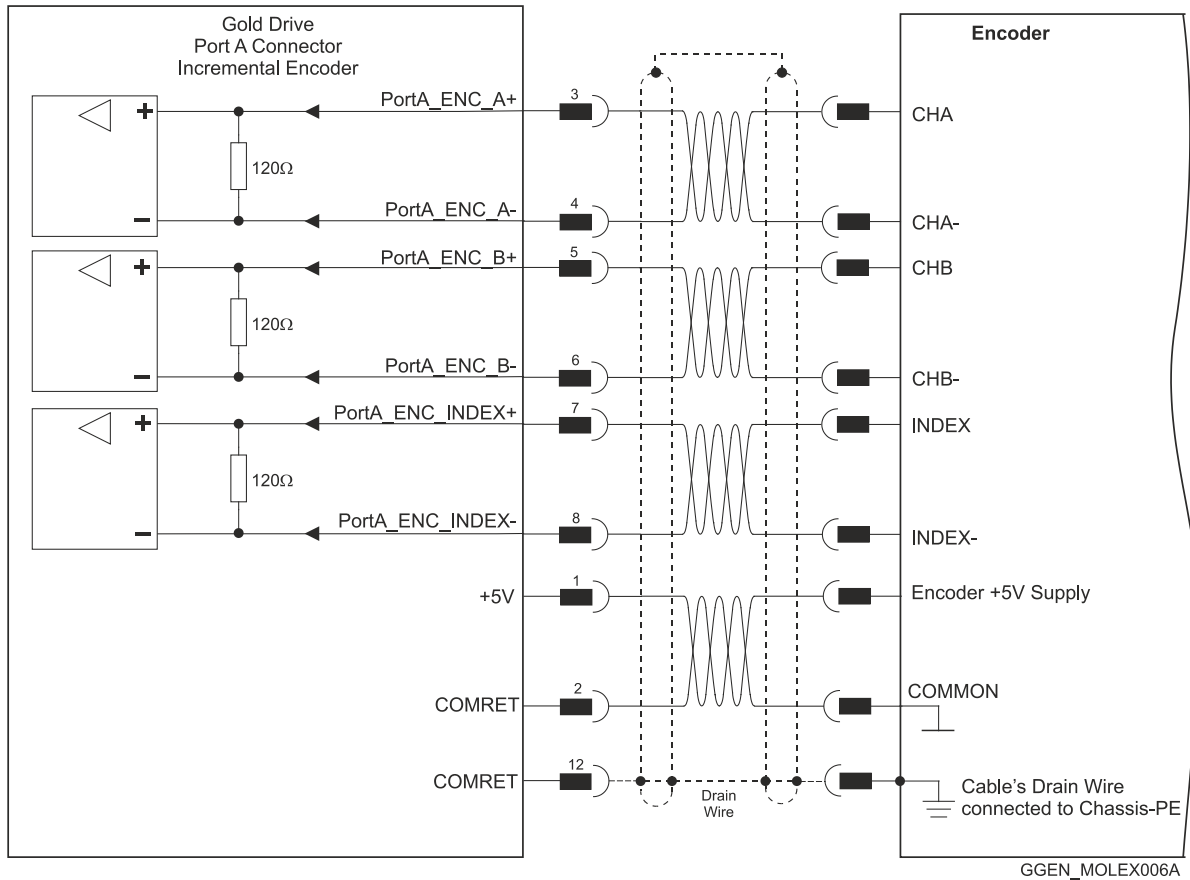


Figure 26: Port A Shrouded Type Incremental Encoder Input – Recommended Connection Diagram

### 6.8.2. Halls Sensor

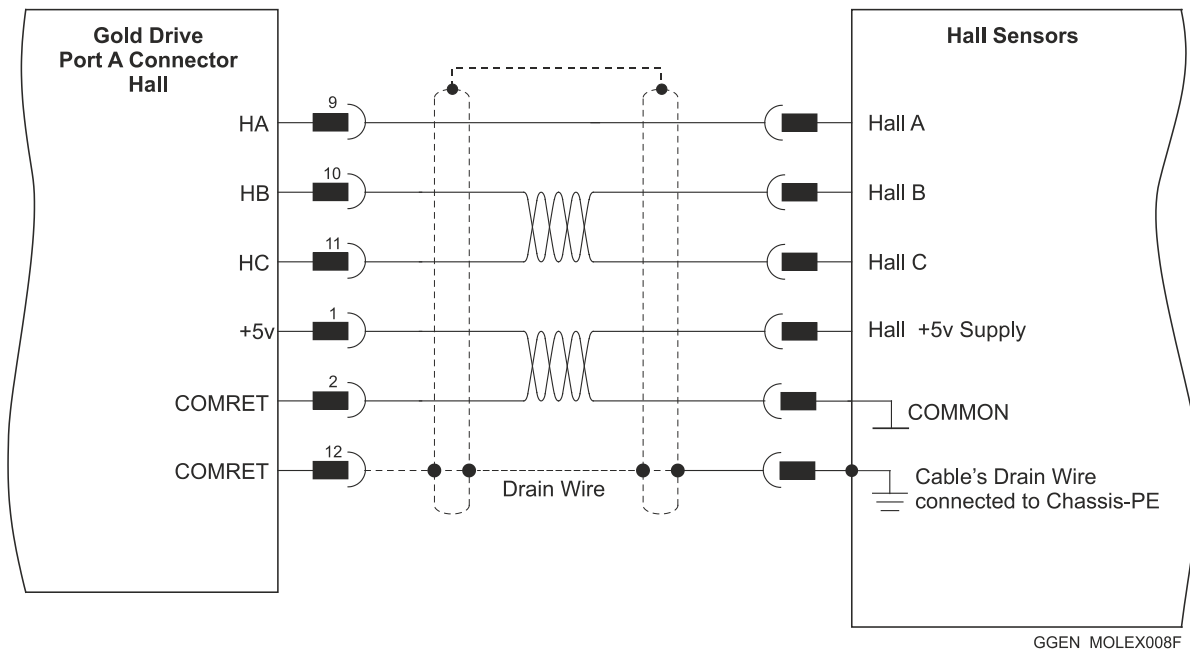


Figure 27: Shrouded Type Hall Sensors Connection Diagram



### 6.8.3. Absolute Serial Encoder

The following figures describe the connections at Port A for the Absolute Serial type encoders.

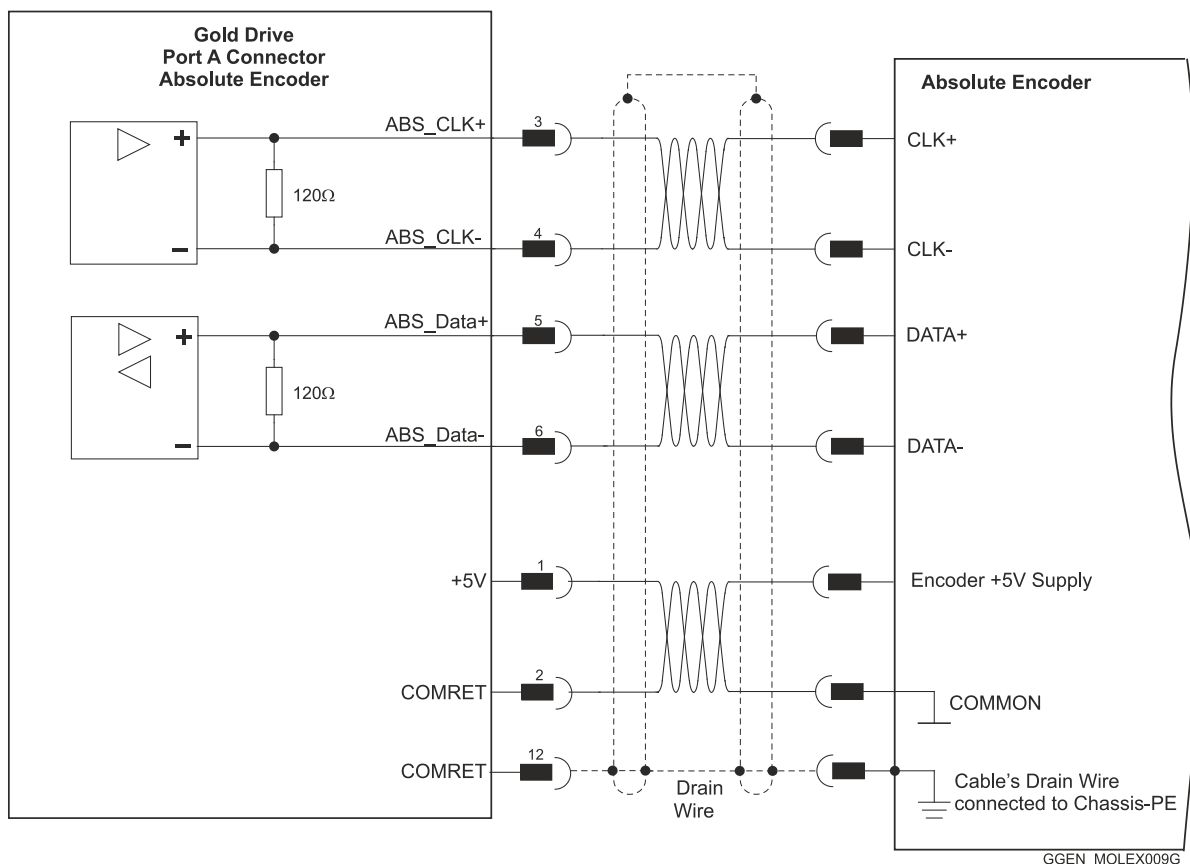


Figure 28: Absolute Serial Encoder – Recommended Connection Diagram for EnDAT, Biss, SSI

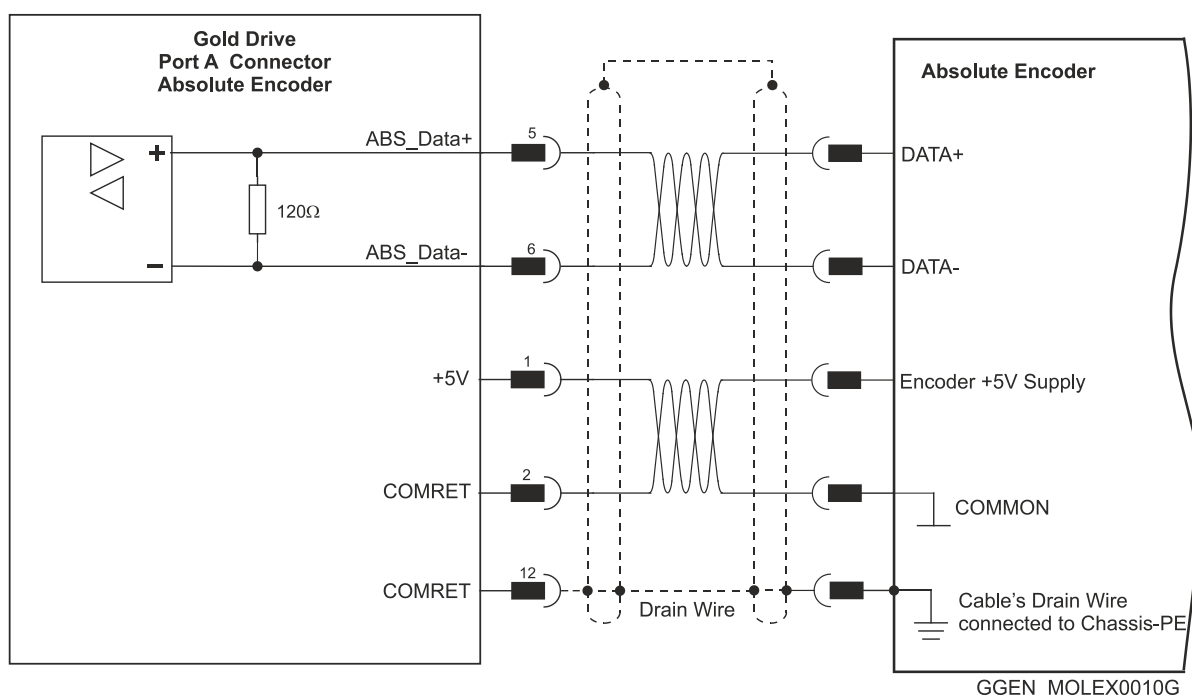


Figure 29: Absolute Serial Encoder – Recommended Connection Diagram for Sensors Supporting Data Line Only (NRZ types, e.g., Panasonic / Mitutoyo / Sanyo Danki / Tamagawa)



### 6.8.3.1. Hiperface

The following figure describes the connection diagram.

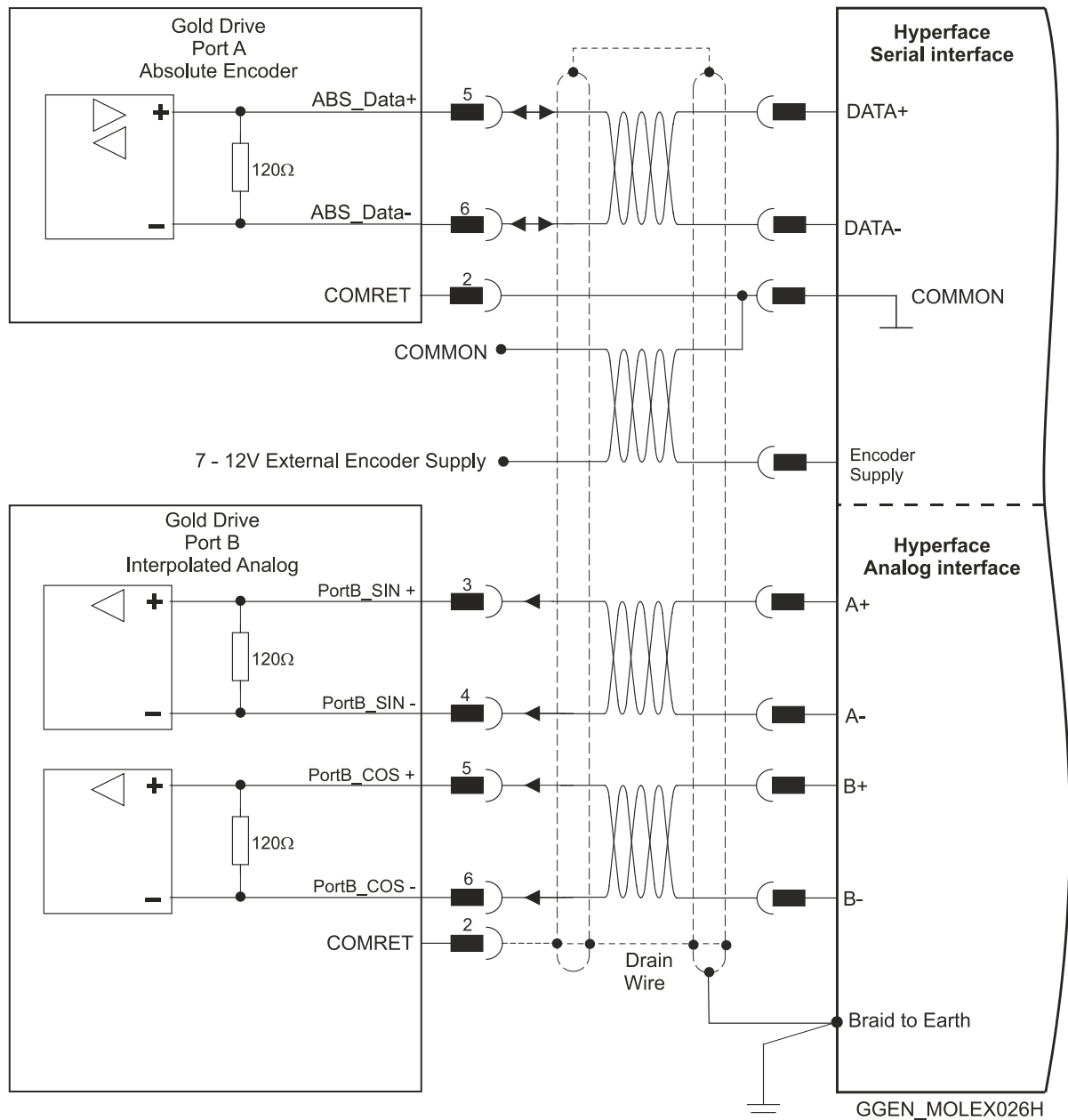


Figure 30: Absolute Serial Encoder – Recommended Shrouded Type Connection Diagram for Stegmann Hiperface

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



## 6.9. Port B Connector (J4)

See Section 10.4 in the in the MAN-G-Panel Mounted Drives Hardware manual for full details.

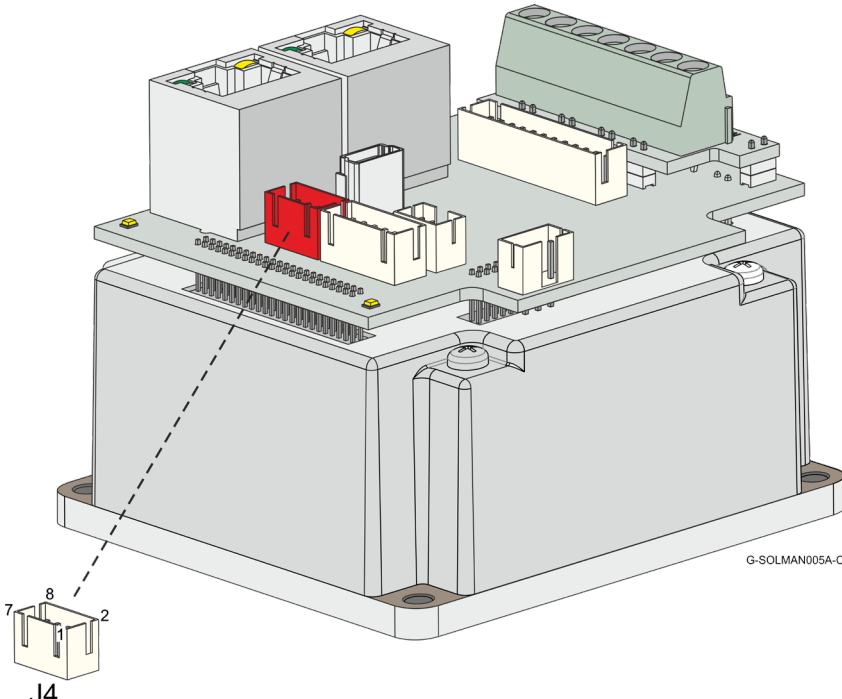
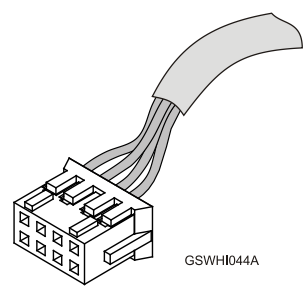
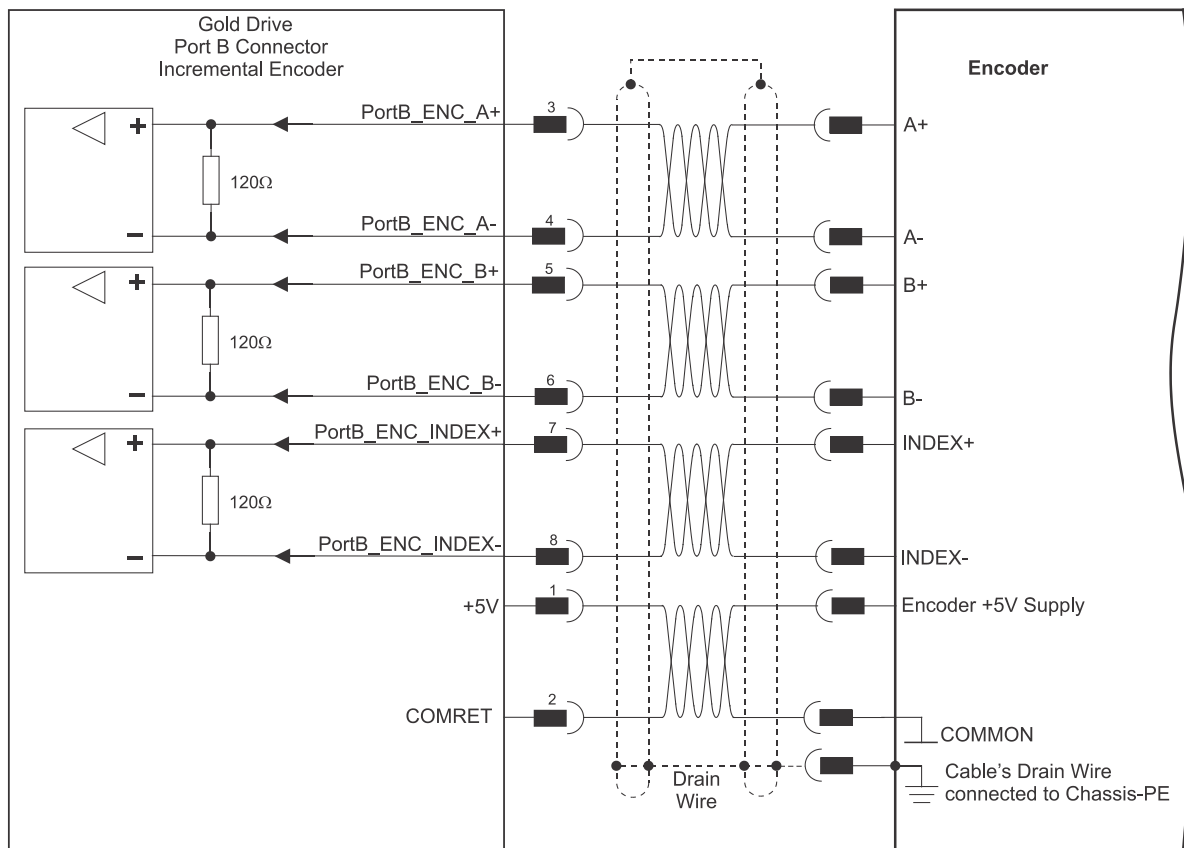
Incremental or Interpolated Analog Encoder			Resolver	
G-SOLMANX/400YEX			G-SOLMANX/400YRX	
Pin (J4)	Signal	Function	Signal	Function
1	+5V	Encoder +5V supply	NC	
2	COMRET	Common Return	COMRET	Common Return
3	PortB_ENC_A+/SIN+	Channel A+/Sine+	SIN+	Sine+
4	PortB_ENC_A-/SIN-	Channel A-/Sine-	SIN-	Sine-
5	PortB_ENC_B+/COS+	Channel B+/Cosine+	COS+	Cosine+
6	PortB_ENC_B-/COS-	Channel B-/Cosine-	COS-	Cosine-
7	PortB_ENC_INDEX+/Analog_Index+	Channel_Index+/Analog_Index+	RESOLVER_OUT+	Vref f=1/TS, 50 mA Max.
8	PortB_ENC_INDEX-/Analog_Index-	Channel_Index- /Analog_Index-	RESOLVER_OUT-	Vref complement f= 1/TS, 50 mA Max.
Pin Positions			Cable Connector	
			 <b>8-Pin Tyco Plug</b> This cable is included in the cable kit described in Section 3.1.1.	

Table 8: Port B Pin Assignments



### 6.9.1. Incremental Encoder

The following figure describes the connections at Port B for the Incremental encoder.



GGEN\_MOLEX027G

**Figure 31: Port B Incremental Encoder Input – Recommended Connection Diagram**



## 6.9.2. Interpolated Analog Encoder

The following figure describes the connections at Port B for the Interpolated Analog encoder.

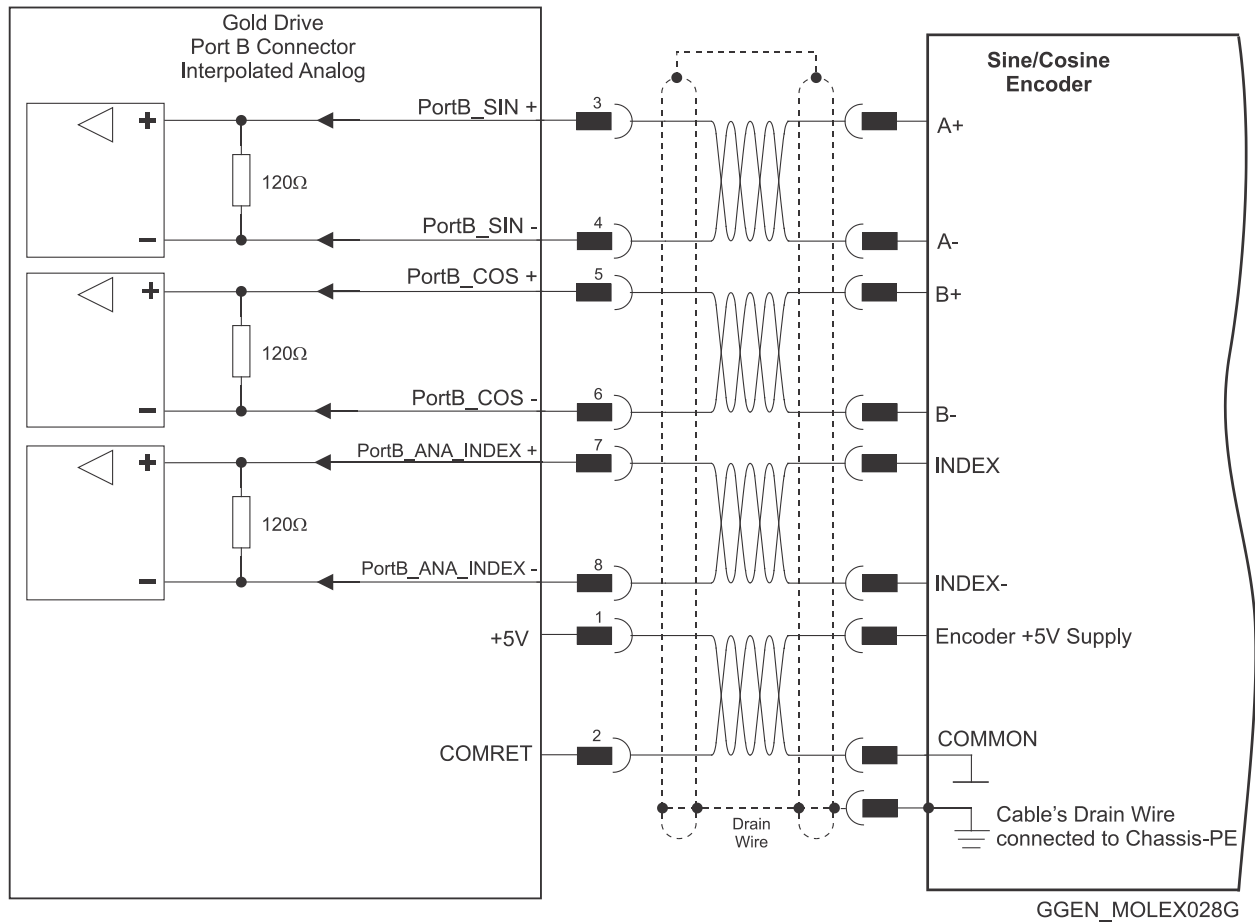


Figure 32: Port B - Interpolated Analog Encoder Shrouded Type Connection Diagram





### 6.9.3. Resolver

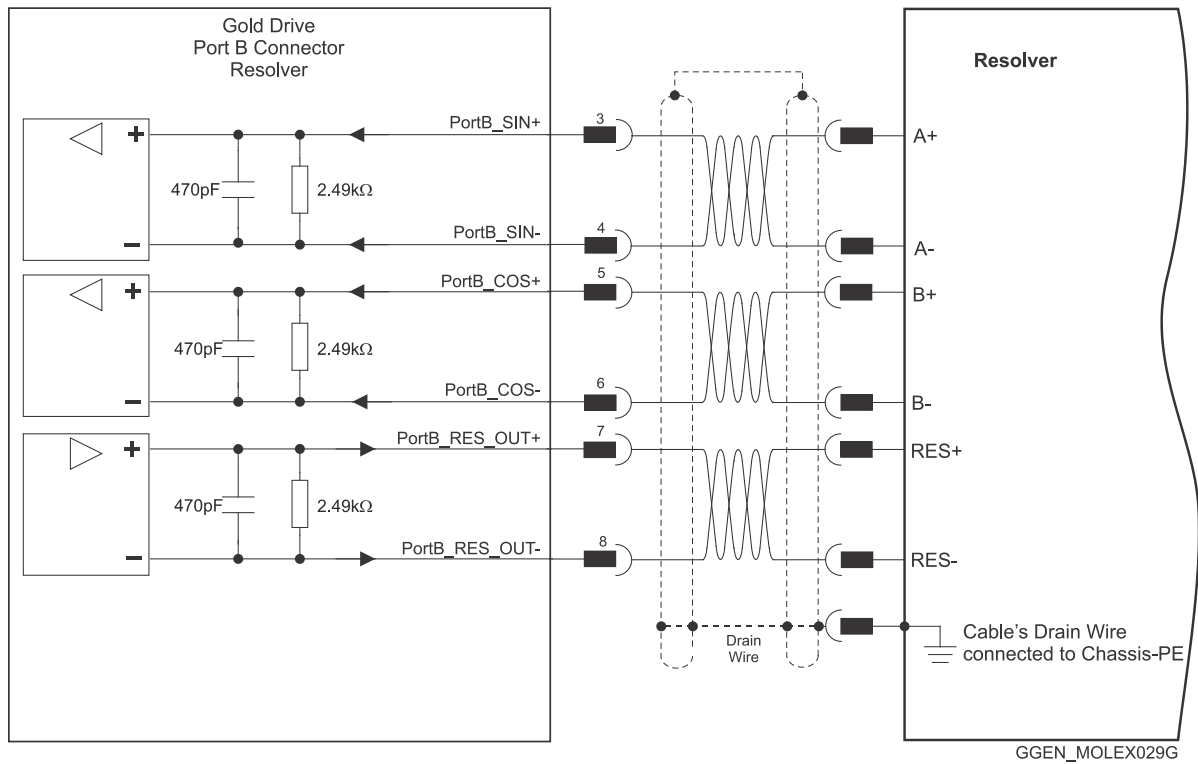


Figure 33: Port B – Resolver Shrouded Type Connection Diagram



## 6.10. Port C, Digital I/Os, and Analog Inputs (J5)

The Port C connector includes the following functions:

- Port C: Refer to Sections 10.5 in the in the MAN-G-Panel Mounted Drives Hardware manual for full details
- I/O: Refer to Chapter 11 in the in the MAN-G-Panel Mounted Drives Hardware manual for full details.
- Analog input: See Section 11.2 in the in the MAN-G-Panel Mounted Drives Hardware manual for full details.

Pin (J5)	Signal	Function
1	PortC_ENCO_A+	Buffered Channel A output
2	PortC_ENCO_A-	Buffered Channel A complement output
3	PortC_ENCO_B+	Buffered Channel B output
4	PortC_ENCO_B-	Buffered Channel B complement output
5	PortC_ENCO_Index+	Buffered INDEX output
6	PortC_ENCO_Index-	Buffered INDEX complement output
7	COMRET	Common return
8	COMRET	Common return
9	ANALOG1-	Analog input complement
10	ANALOG1+	Analog input
11	ANARET	Analog return
12	INRET1_6	Programmable input 1 – 6 return
13	IN1	Programmable input 1 (High speed)
14	IN2	Programmable input 2 (High speed)
15	IN3	Programmable input 3 (High speed)
16	IN4	Programmable input 4 (High speed)
17	IN5	Programmable input 5 (High speed)
18	IN6	Programmable input 6 (High speed)
19	Reserved	Reserved
20	Reserved	Reserved
21	OUT2	Programmable output 2
22	OUT1	Programmable output 1
23	VDD	VDD supply for Output 1-2. Refer to <a href="#">MAN-G-Panel Mounted Drives Hardware Manual</a> for VDD specification
24	VDDRET	VDD supply return for Output 1-2



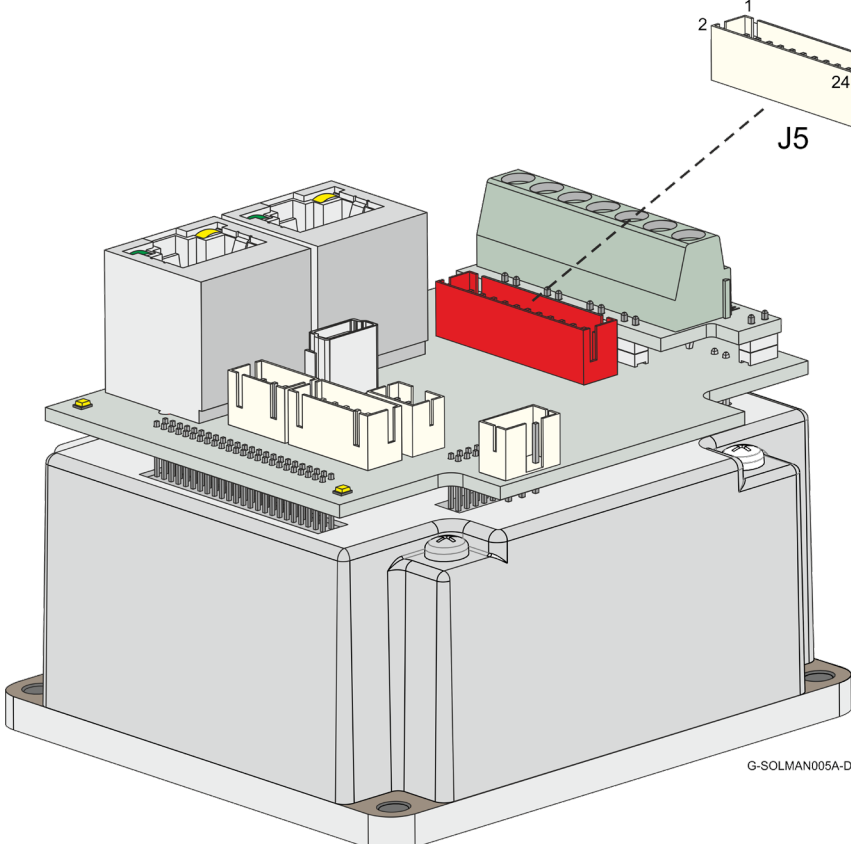
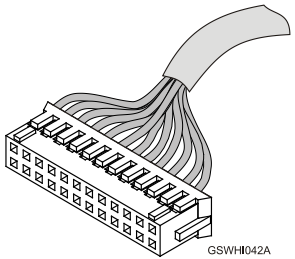
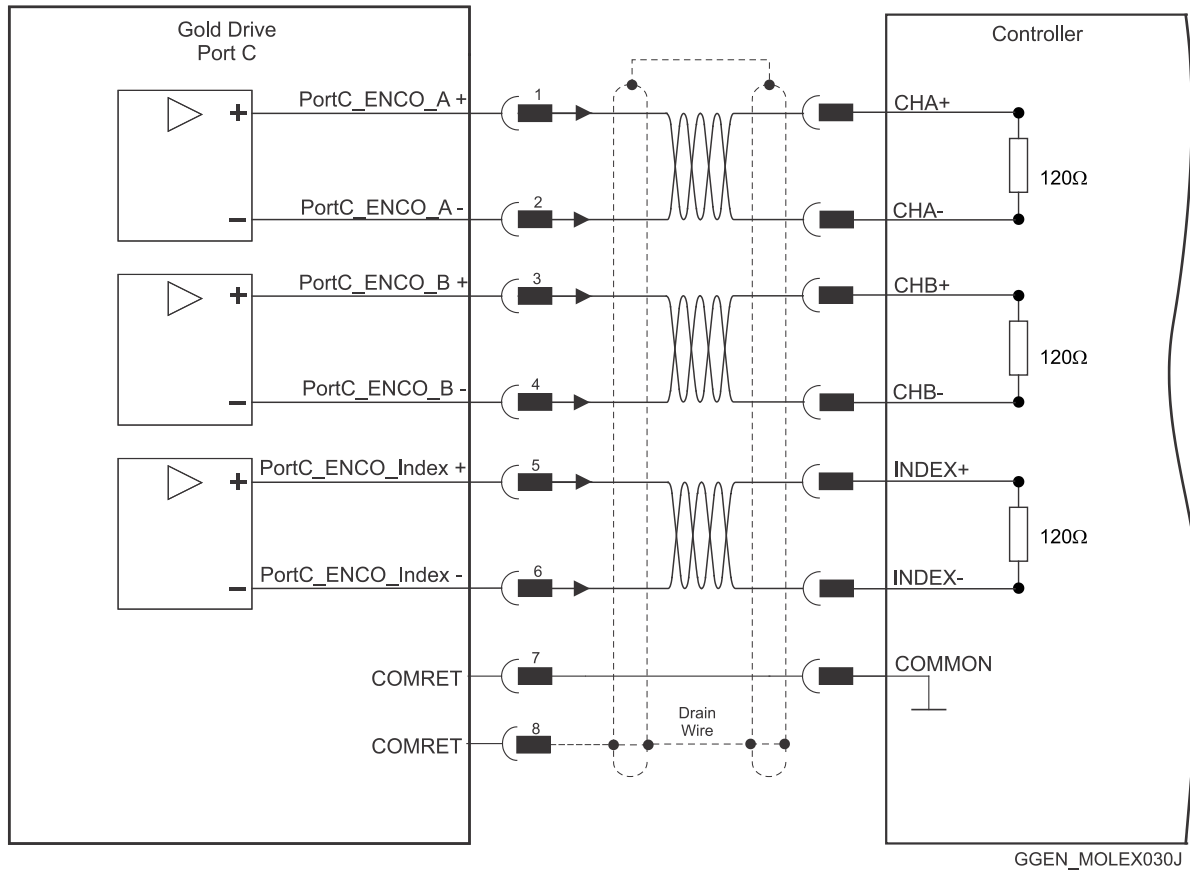
Pin Positions	Cable Connector
	 <p><b>24-Pin Tyco Plug</b></p> <p>This cable is included in the cable kit described in Section 3.1.1.</p>

Table 9: Port C Feedback Out and I/O



### 6.10.1. Port C – Emulated Encoder Output

The following figure describes the connections at Port C for the Emulated Encoder Differential.



**Figure 34: Emulated Encoder Differential Output – Recommended Connection Diagram**

**Note that the user is required to connect a 120  $\Omega$  termination at the end of each differential line.**



## 6.10.2. Analog Input

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

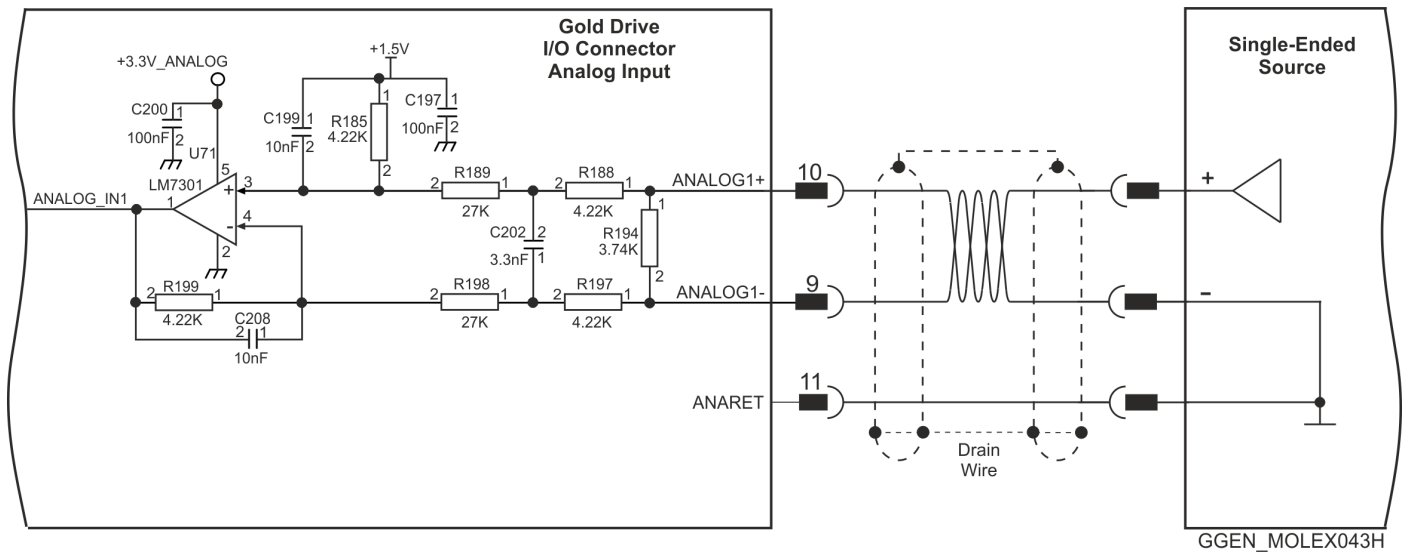


Figure 35: Differential Analog Input



### 6.10.3. Digital Input and Output TTL Mode

The following figure describes the connections at the I/O Port for the Digital Input and Output TTL Mode.

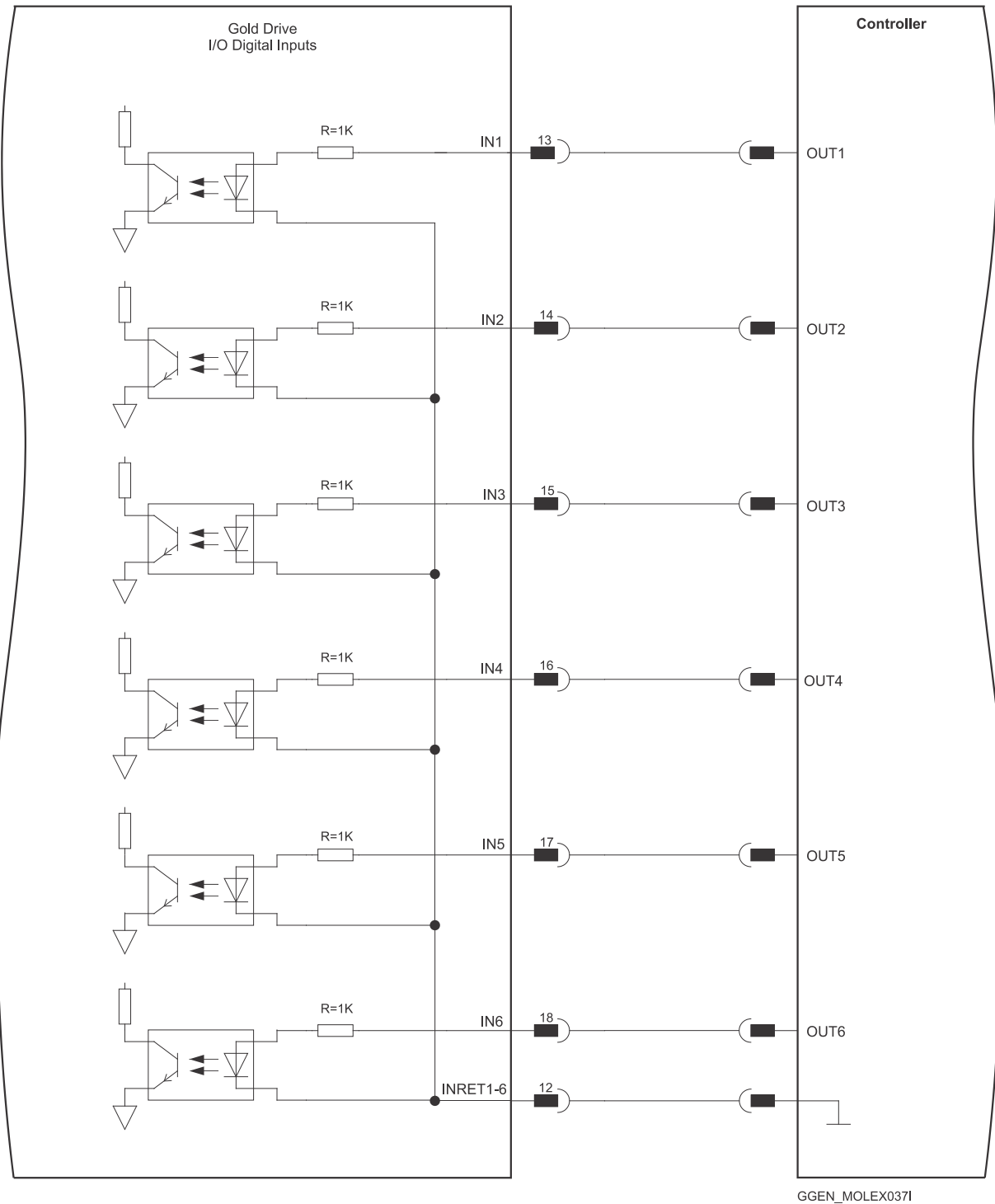


Figure 36: Digital Input TTL Mode Connection Diagram

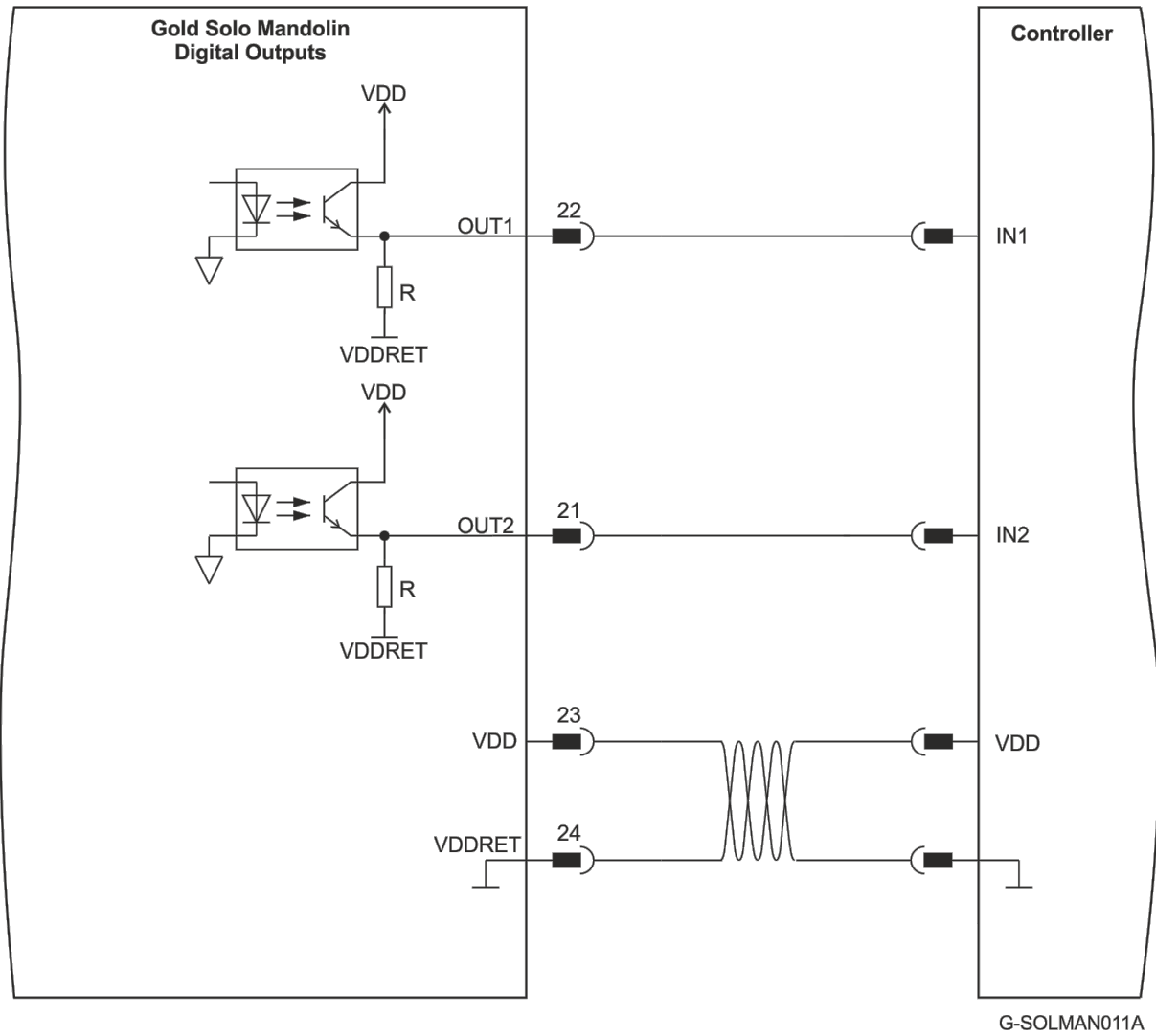


Figure 37: Digital Output Connection Diagram – TTL Option



#### 6.10.4. Digital Input and Output PLC Source Mode

The following figure describes the connections at the I/O Port for the Digital Input and Output PLC Source Mode.

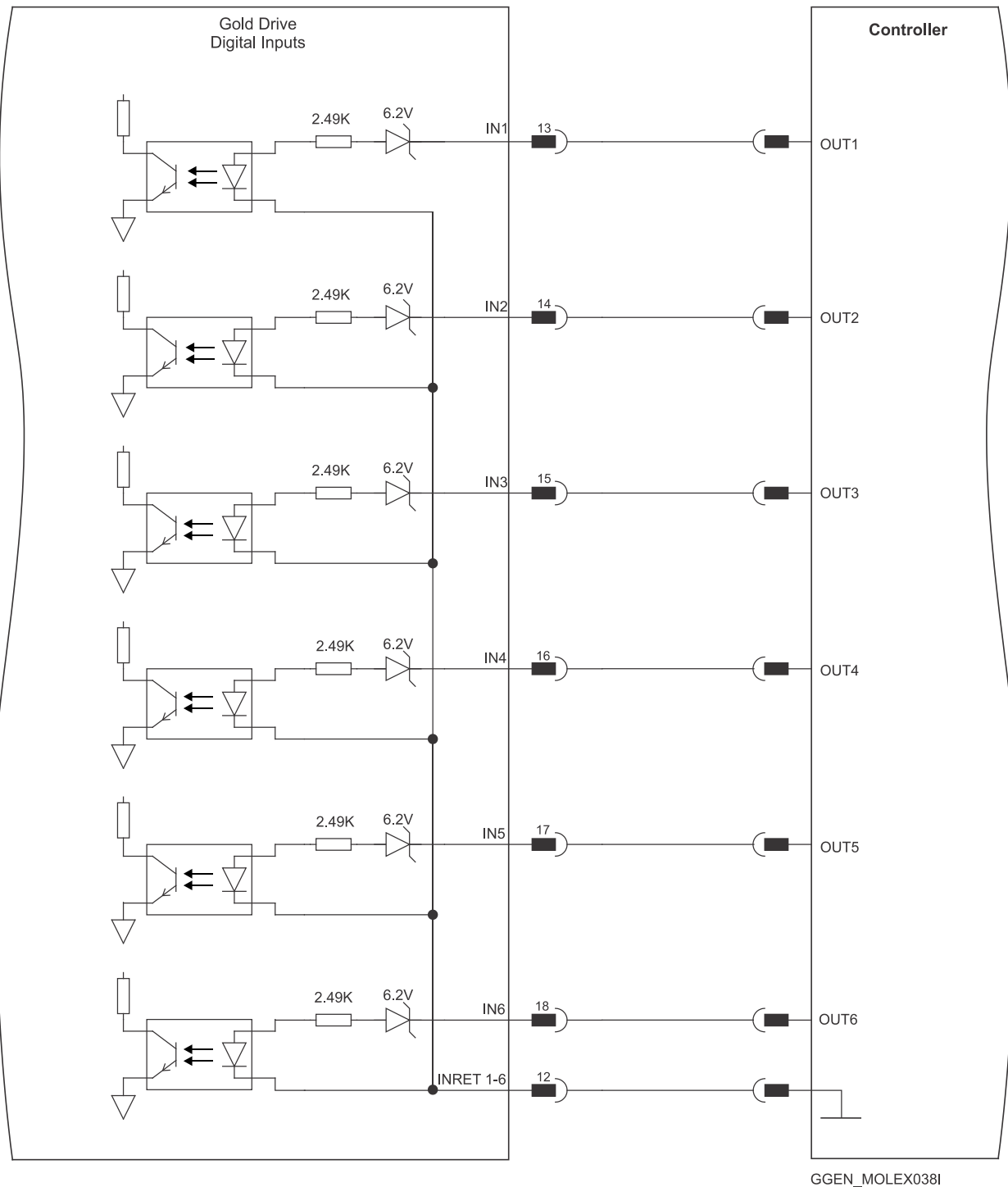


Figure 38: Digital Input Connection Diagram – Source PLC Option



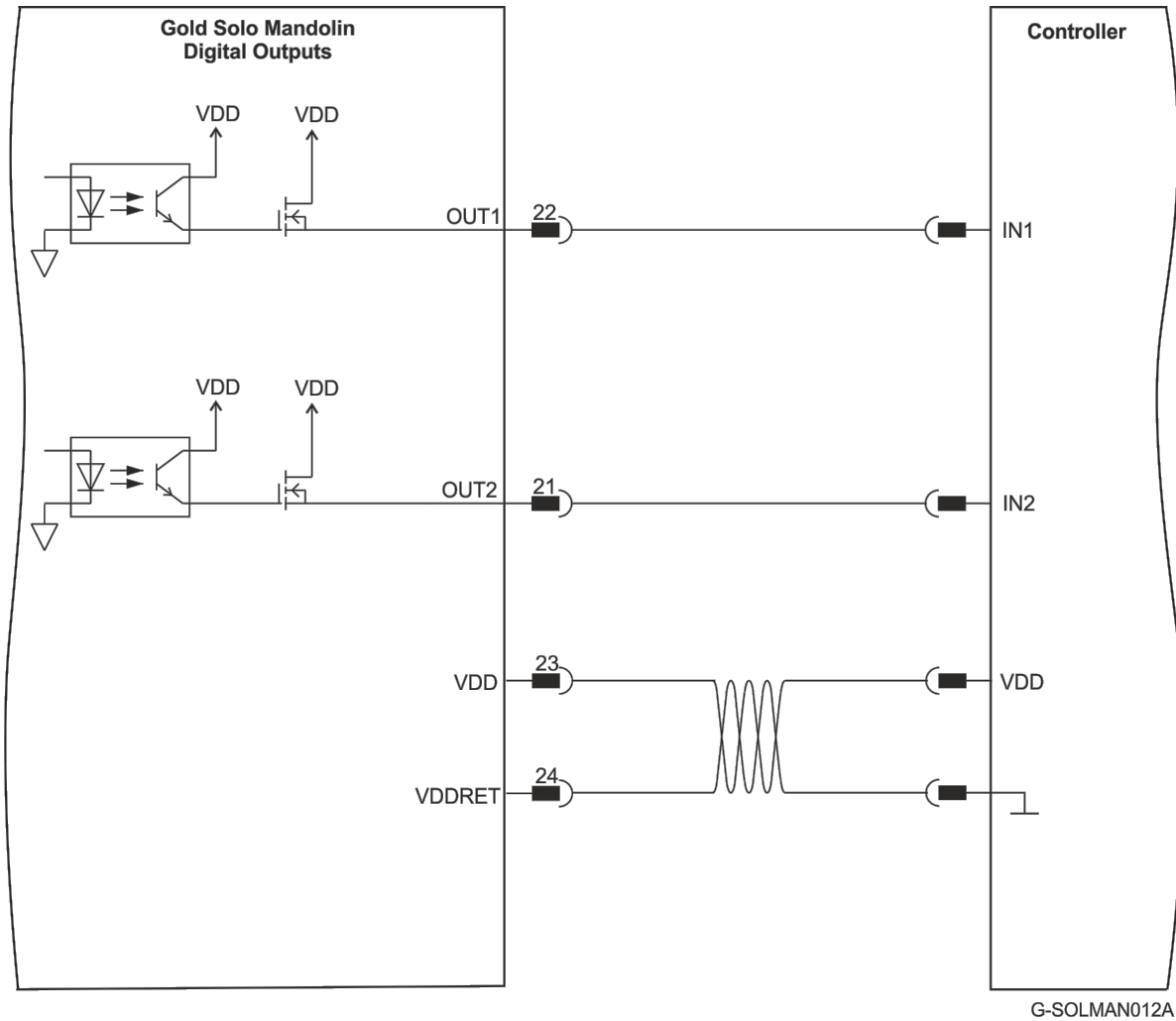


Figure 39: Digital Output Connection Diagram – Source PLC Option



### 6.10.5. Digital Input and Output Sink Mode

The following figure describes the connections at the I/O Port for the Digital Input and Output Sink Mode.

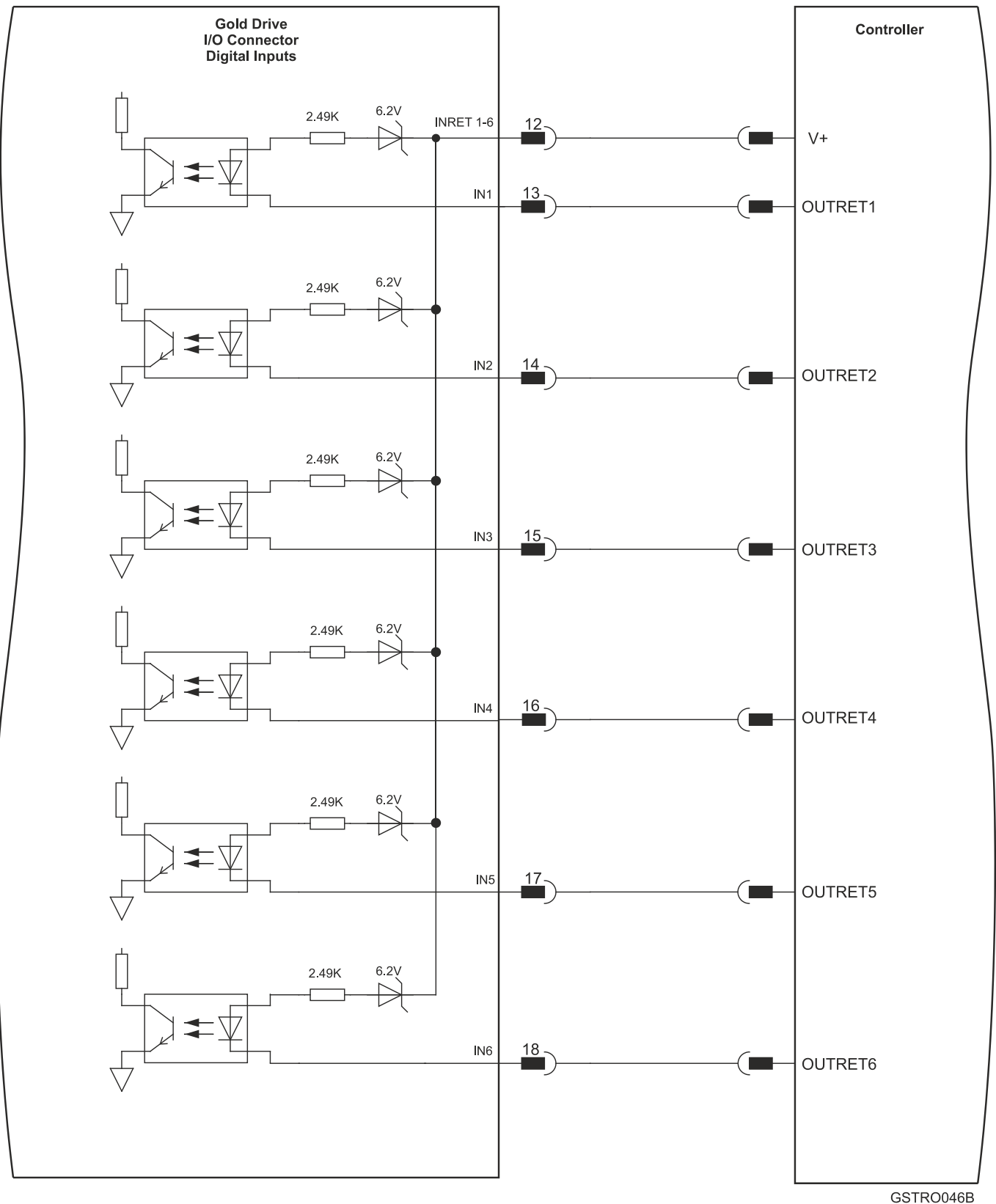


Figure 40: Digital Input Connection Diagram – Sink Mode

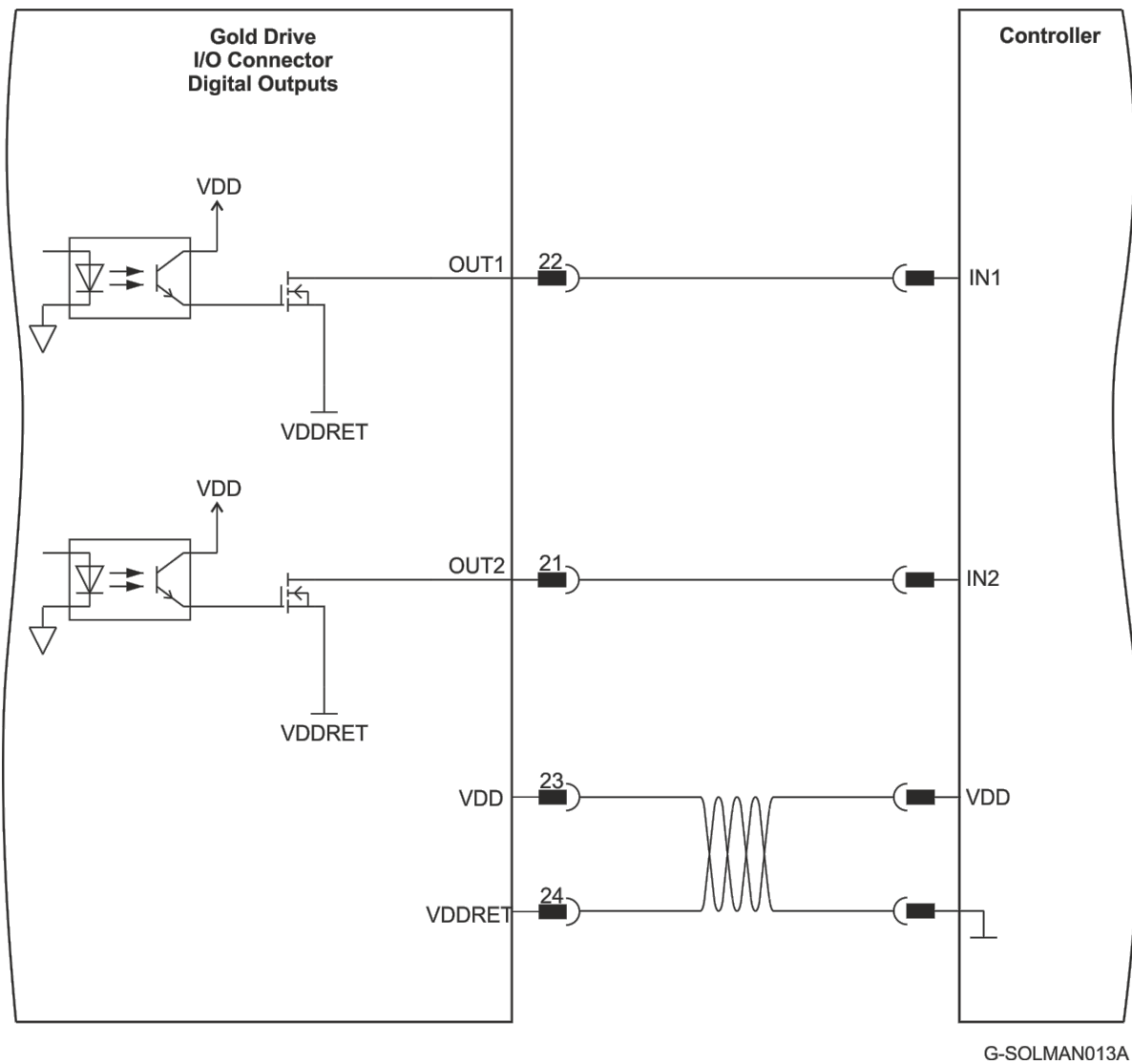


Figure 41: Digital Output Connection Diagram – Sink Mode



## 6.11. USB 2.0 (J7)

See Section 12.1 in the in the MAN-G-Panel Mounted Drives Hardware manual for full details.

Pin (J7)	Signal	Function
1	USB VBUS	USB VBUS 5 V
2	USBD-	USB _N line
3	USBD+	USB _P line
5	USB COMRET	USB communication return

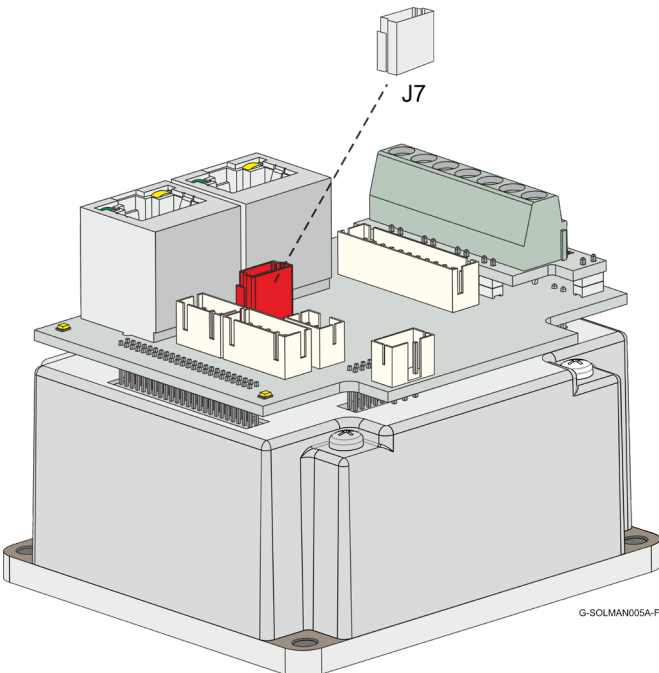
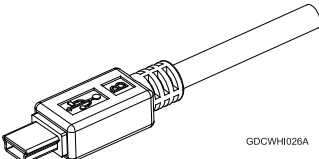
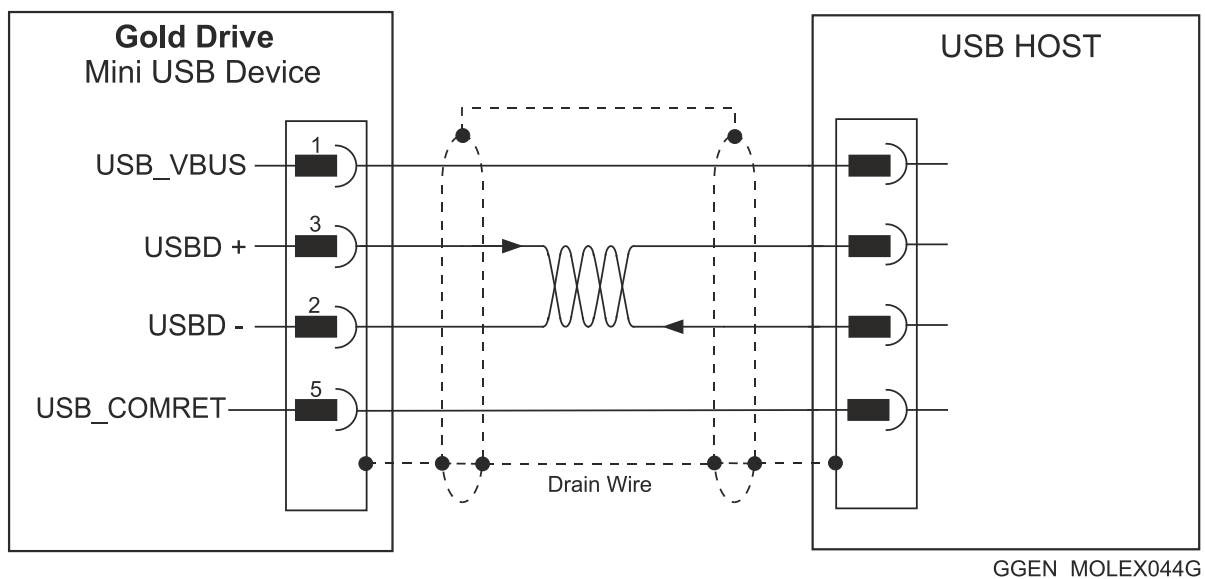
Pin Positions	Cable Connector
	 <b>USB Device Mini-B Plug</b>

Table 9: USB Device Mini-B - Pin Assignments





## 6.12. RS-232 Connector (J8)

See section 12.5 in the in the MAN-G-Panel Mounted Drives Hardware manual for full details.

Pin (J8)	Signal	Function
1	RS232_Rx	RS-232 receive
2	RS232_Tx	RS-232 transmit
3	RS232_COMRET	RS-232 communication return

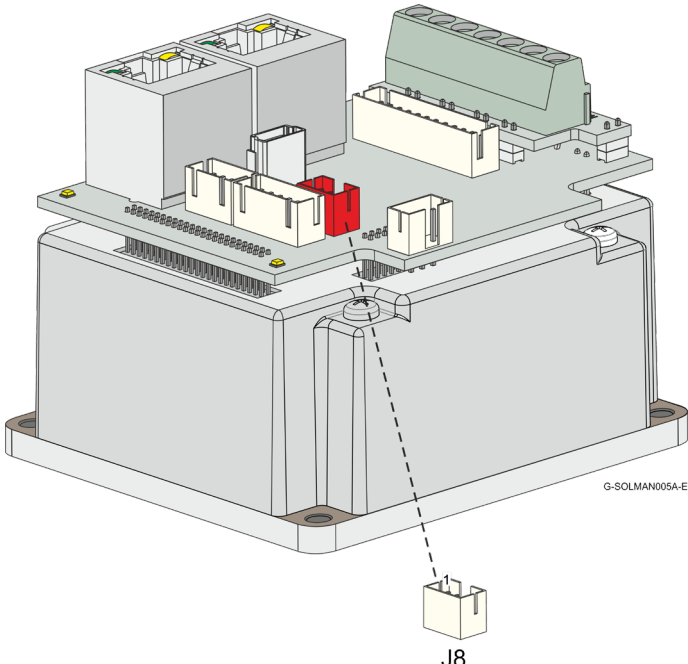
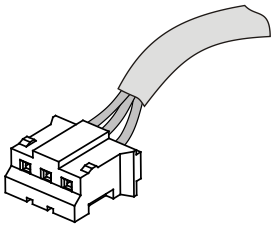
Pin Positions	Cable Connector
 J8	 GSWHI040B <b>3-Pin Tyco Plug</b>

Table 10: RS-232 Pin Assignments

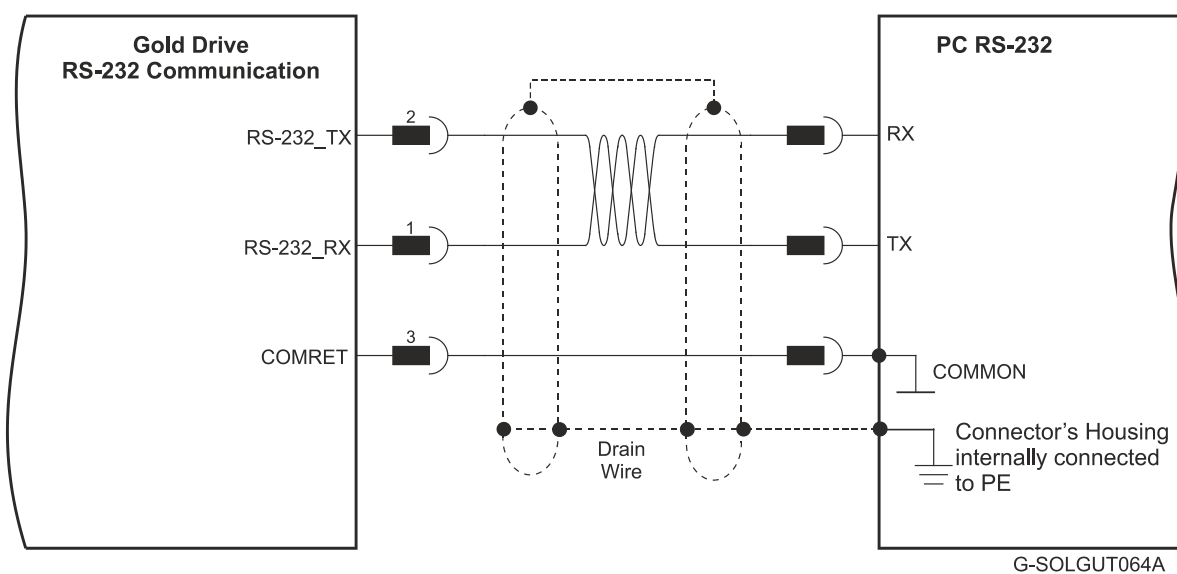


Figure 43: RS-232 Connection Diagram



## 6.13. EtherCAT Communications Version

Fieldbus communications are industrial network protocols for real-time distributed control that allows connection of servo drives. The Gold Solo Mandolin supports the following EtherCAT fieldbus type industrial network protocol:

Fieldbus Type	Product Number
EtherCAT	G-SOLMANX/400EXX

### 6.13.1. EtherCAT IN/Ethernet Connector (J9)

Refer to section 12.2 in the MAN-G-Panel Mounted Drives Hardware manual for more details.

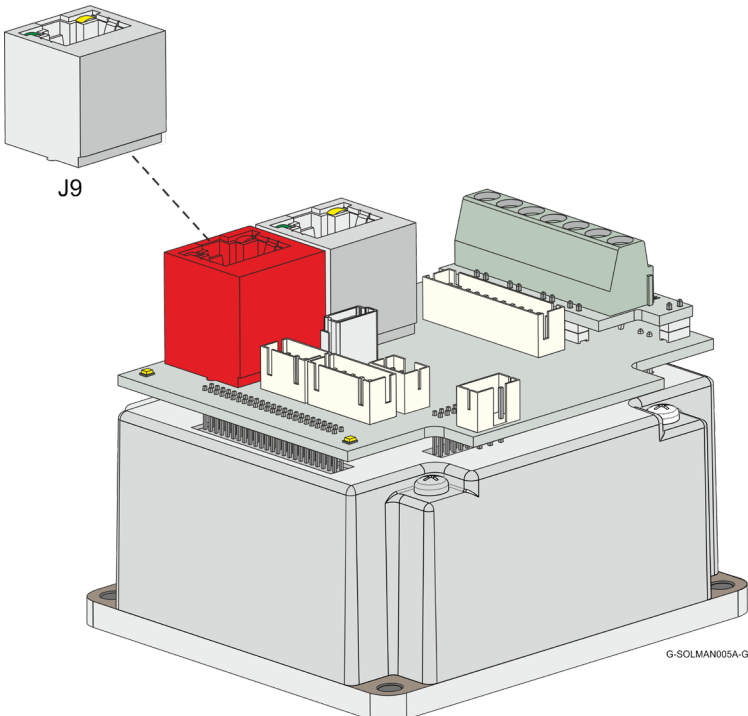
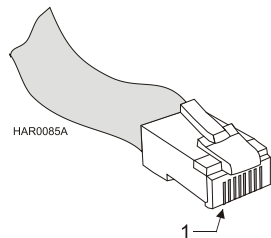
Pin (J9)	Signal	Function
1	EtherCAT_IN_TX+/Ethernet_TX+	EtherCAT in/Ethernet transmit +
2	EtherCAT_IN_TX-/Ethernet_TX-	EtherCAT in/Ethernet transmit -
3	EtherCAT_IN_RX+/Ethernet_RX+	EtherCAT in/Ethernet receive +
4, 5	N/A	
6	EtherCAT_IN_RX-/Ethernet_RX-	EtherCAT in/Ethernet receive -
7, 8	N/A	
Pin Positions		Cable Connector
		 Standard CAT5e Ethernet Cable

Table 11: EtherCAT IN - Pin Assignments



### 6.13.2. EtherCAT OUT Connector (J10)

See Section 12.2 in the MAN-G-Panel Mounted Drives Hardware manual for the electrical diagram.

Pin (J10)	Signal	Function
1	EtherCAT_OUT_TX+	EtherCAT out transmit +
2	EtherCAT_OUT_TX-	EtherCAT out transmit -
3	EtherCAT_OUT_RX+	EtherCAT out receive +
4, 5	N/A	
6	EtherCAT_OUT_RX-	EtherCAT out receive -
7, 8	N/A	

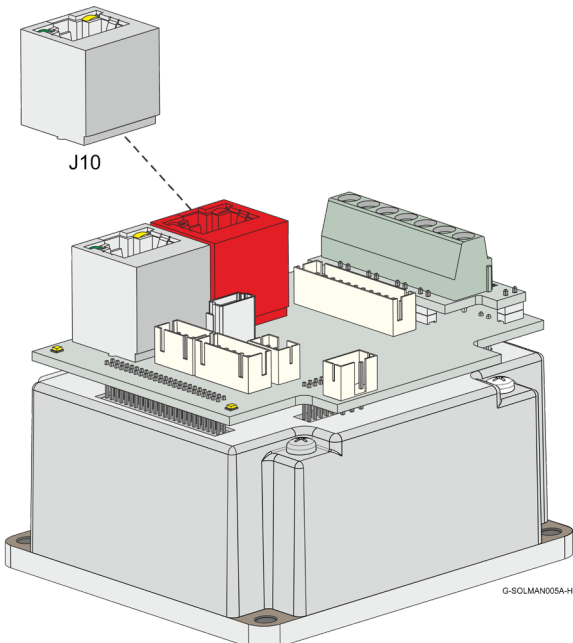
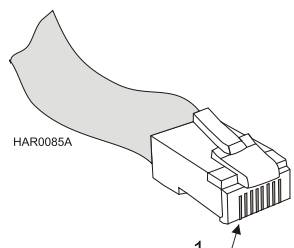
Pin Positions	Cable Connector
	 <b>Standard CAT5e Ethernet Cable</b>

Table 12: EtherCAT OUT - Pin Assignments

### 6.13.3. EtherCAT Wiring

Figure 44 describes the wiring diagram for the EtherCAT connections.

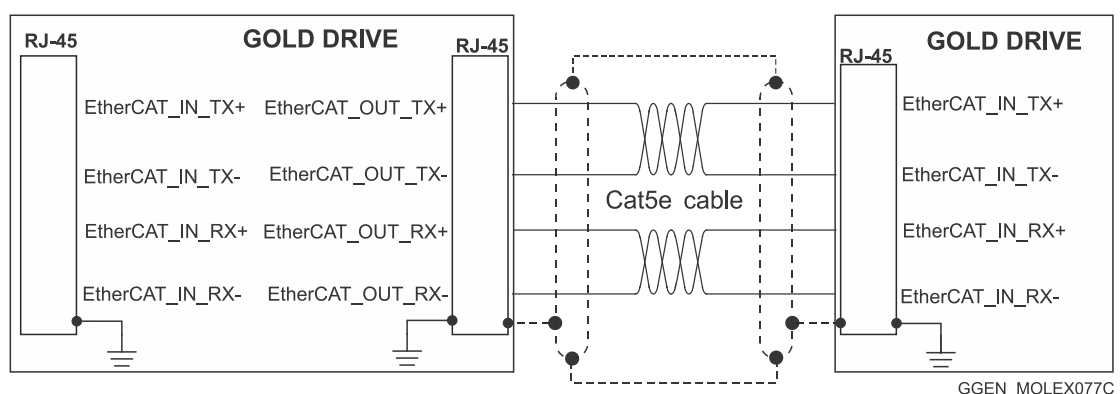
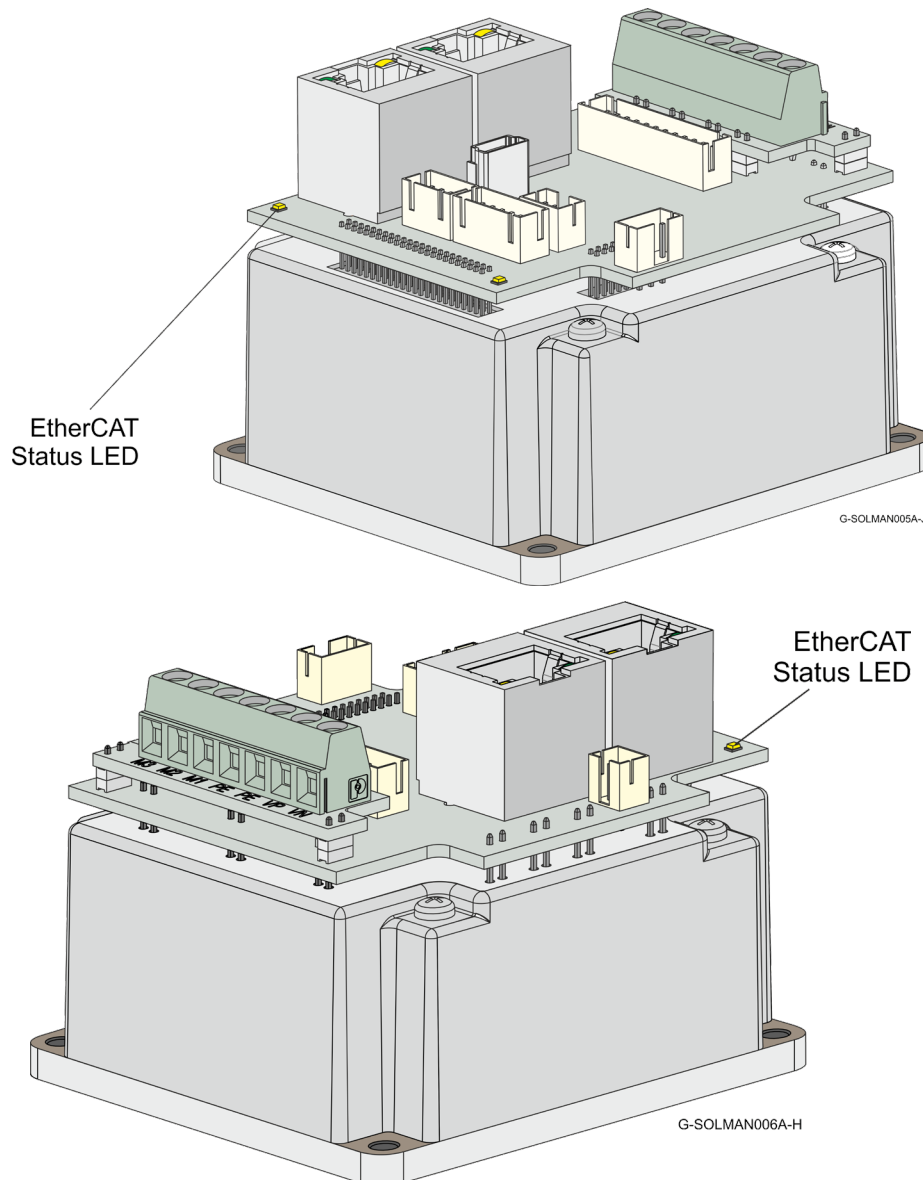


Figure 44: EtherCAT RJ-45 Connections



#### 6.13.4. EtherCAT Status Indicator



**Figure 45: EtherCAT Status LED**

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





## 6.14. CAN Communications Version

Fieldbus communications are industrial network protocols for real-time distributed control that allows connection of servo drives. The Gold Solo Mandolin supports the following CAN fieldbus type industrial network protocol:

Fieldbus Type	Product Number
CAN	G-SOLMANX/400SXX

See Section 12.4 in the MAN-G-Panel Mounted Drives Hardware manual for the electrical diagram.

Pin (J13, J14)	Signal	Function
1	CAN_H	CAN_H bus line (dominant high)
2	CAN_L	CAN_L bus line (dominant low)
3	CAN_RET	CAN Return
4, 5	N/A	—
6	CAN_SHLD	Shield, connected to the RJ plug cover
7	CAN_RET	CAN Return
8	N/A	—

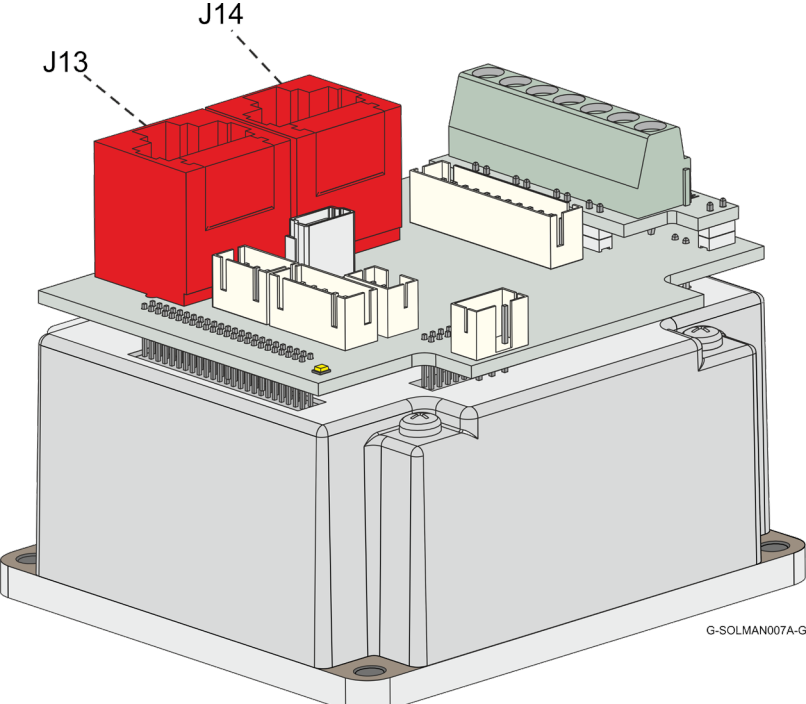
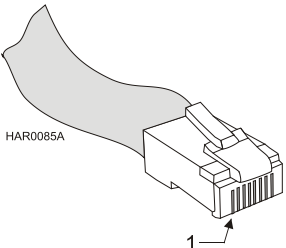
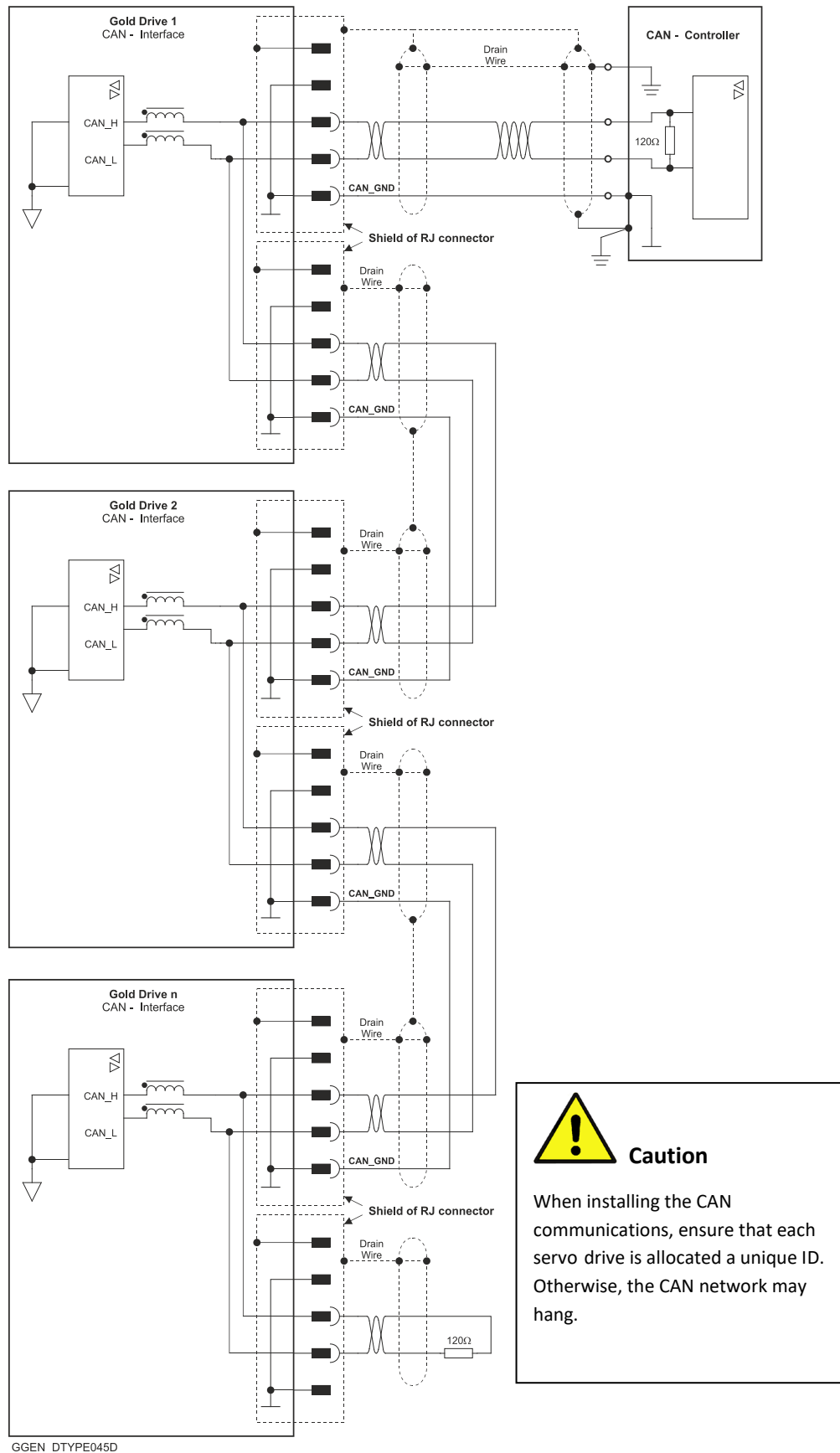
Pin Positions	Cable Connector
	 <b>Standard CAT5e Ethernet Cable</b>

Table 13: CAN Connectors Pin Assignments



## 6.14.1. CAN Wiring





## Chapter 7: Powering Up

After the Gold Solo Mandolin is connected to its device, it is ready to be powered up.



**Caution:**

Before applying power, ensure that the DC supply is within the specified range and that the proper plus-minus connections are in order.

### 7.1. Initializing the System

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



## Chapter 8: Heat Dissipation

The best way to dissipate heat from the Gold Solo Mandolin is to mount it so that its heat-sink faces up. For best results leave approximately 10 mm of space between the Gold Solo Mandolin's heat-sink and any other assembly.

### 8.1. Gold Solo Mandolin Thermal Data

Shut-off temperature: 85 °C to 87 °C (measured on the heat-sink)

### 8.2. Heat Dissipation Data

Heat Dissipation is shown graphically below:

TBD

Figure 47: Dissipation versus Current Graph for 200  $\mu$ S Switching Frequency

TBD

Figure 48: Dissipation versus Current Graph for for 100  $\mu$ S Switching Frequency



TBD

**Figure 49: Dissipation versus Current Graph for for 50  $\mu$ S Switching Frequency**

### 8.3. How to Use the Charts

The charts above are based upon theoretical worst-case conditions. Actual test results show 30% to 50% better power dissipation.

*To determine if your application needs a heat sink:*

1. Allow maximum heat sink temperature to be 80 °C or less (shunt down is 6 °C to 8 °C higher).
2. Determine the ambient operating temperature of the Gold Solo Mandolin as  $\leq 40$  °C.
3. Calculate the allowable temperature increase according to the following example: For an ambient temperature of 40 °C,  $\Delta T = 80$  to  $40^\circ\text{C} = 40^\circ\text{C}$
4. Use the chart to find the actual dissipation power of the drive. Follow the voltage curve to the desired output current and then find the dissipated power.



## Chapter 9: Dimensions

This chapter provides detailed technical information regarding the Gold Solo Mandolin.

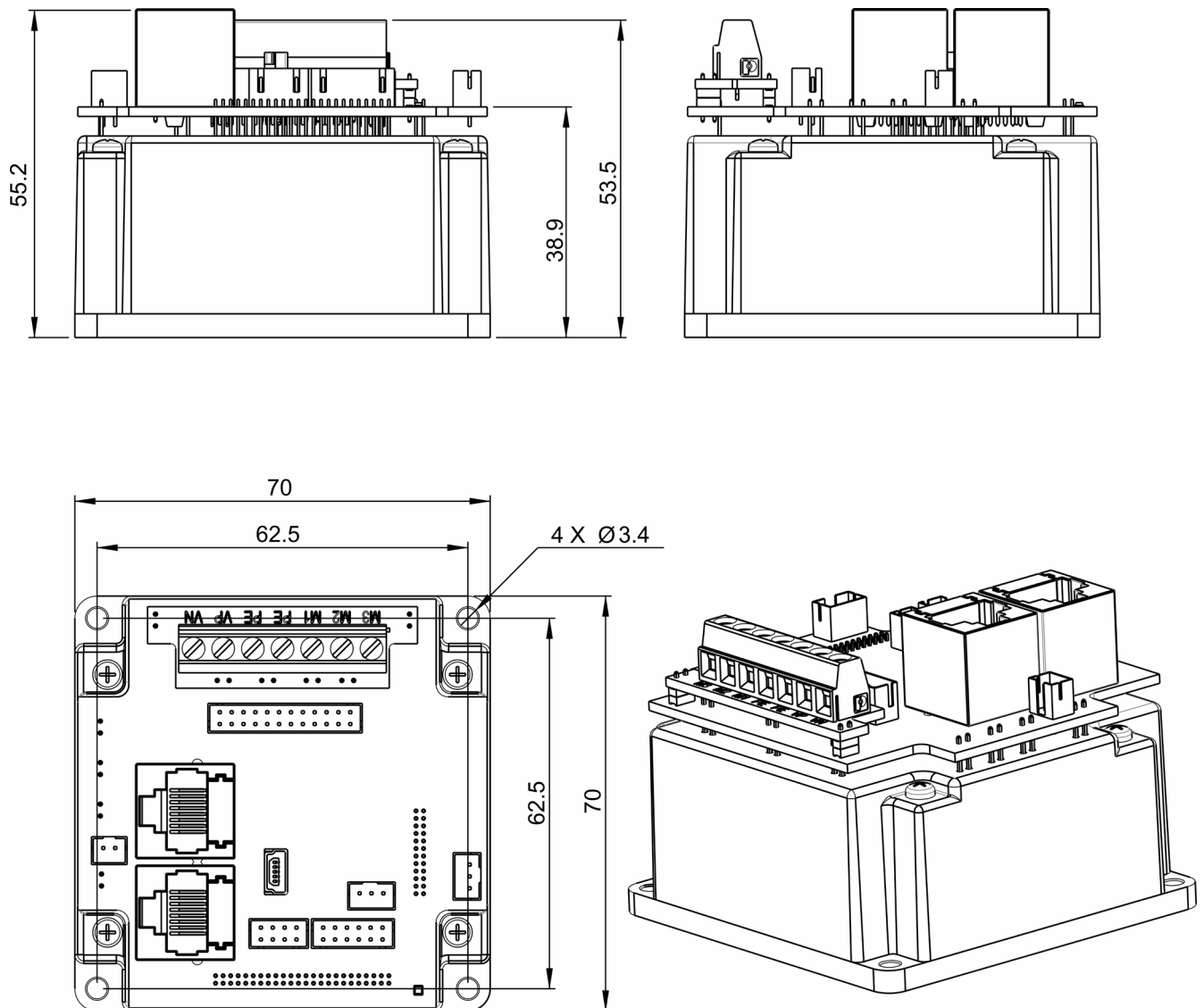
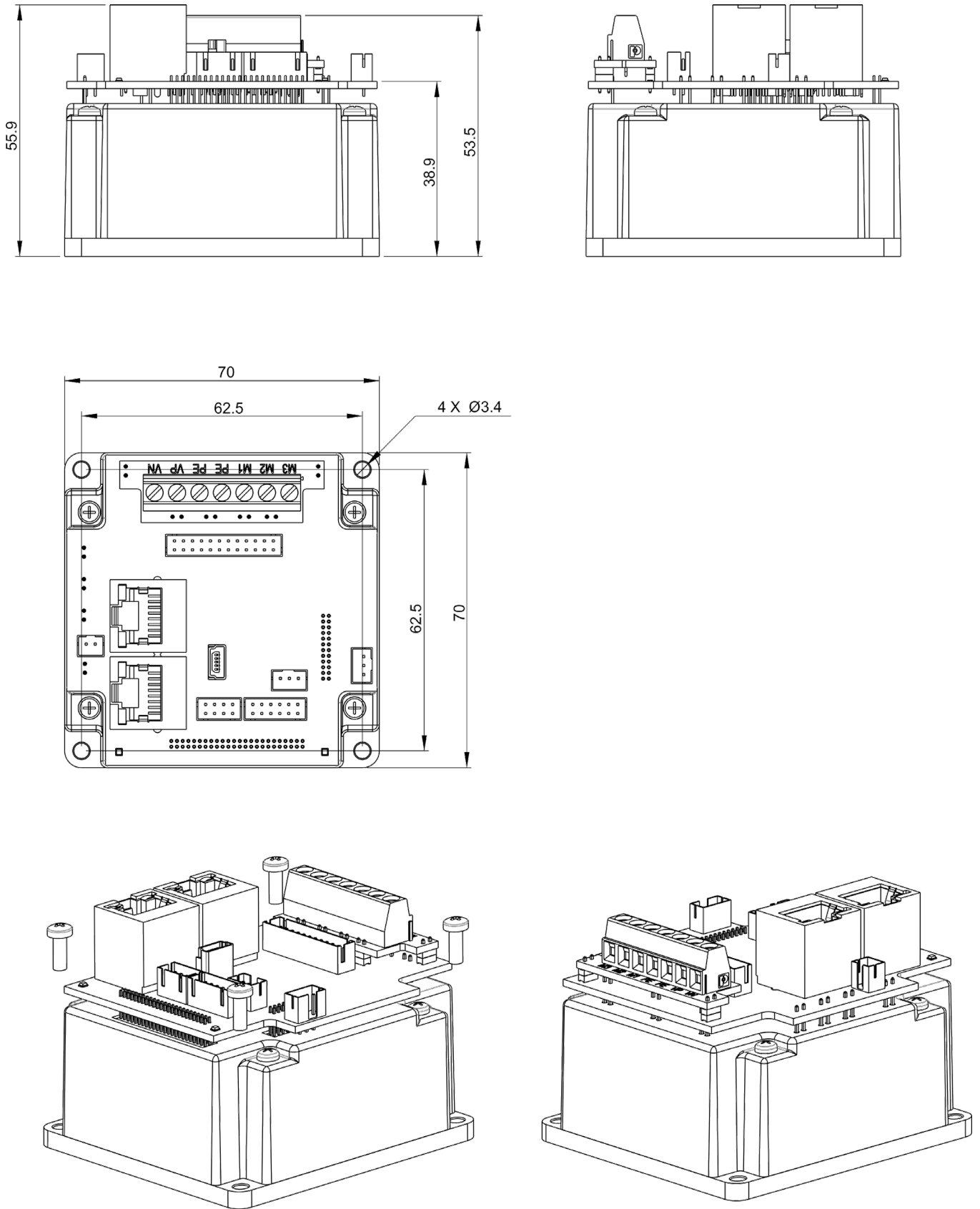


Figure 50: CAN Version Dimensions



G-SOLMAN002A

Figure 51: EtherCAT Version Dimensions



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