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Gold Mandolin
Digital Servo Drive
Installation Guide
EtherCAT and CAN

October 2017 (Ver. 1.002)

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Elmo
Motion Control

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- The text and graphics included in this manual are for the purpose of illustration and reference only. The specifications on which they are based are subject to change without notice.
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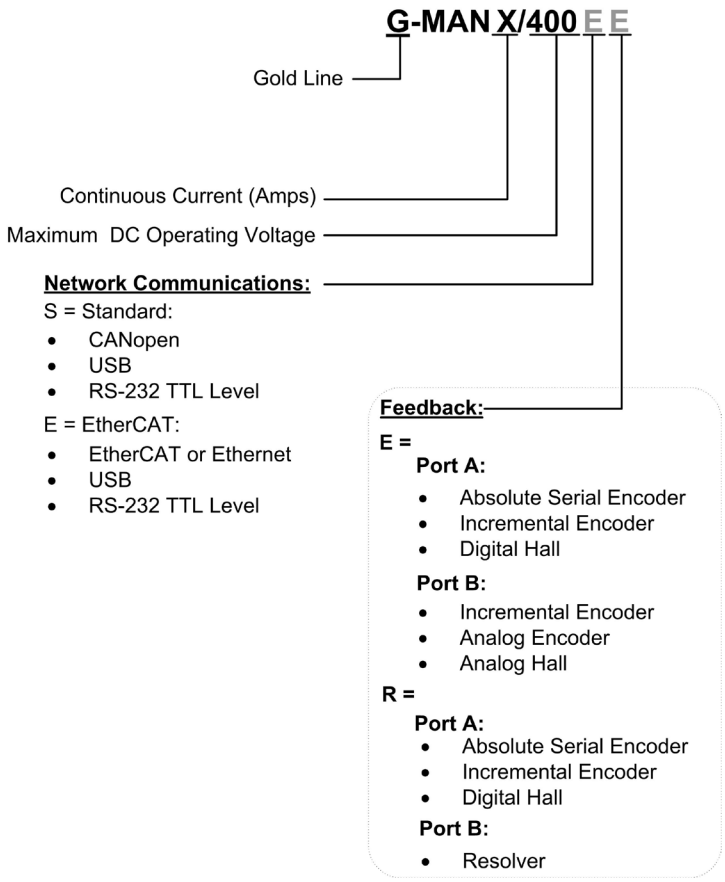
Catalog Number



Chapter 1: This Installation Guide

This installation Guide details the technical data, pinouts, and power connectivity of the Gold Mandolin. For a comprehensive detailed description of the functions and connections of the Board Level Module (BLM) drive, refer to the MAN-G-Board Level Modules Hardware Manual.

Chapter 2: Safety Information

In order to achieve the optimum, safe operation of the Gold 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 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 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 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 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 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 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 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 Mandolin series of digital servo drives are highly resilient and designed to deliver the highest density of power and intelligence. The Gold 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 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 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 Mandolin is provided by a 100 to 400 V Direct to Main DC source. The Gold 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 Mandolin is a PCB-mounted device which enables efficient and cost-effective implementation. However, stand-alone integrated products (the Gold Solo Mandolin) is also available, using pluggable connections.

Chapter 4: Technical Information

4.1. Physical Specifications

Feature	Units	All Types
Weight	g (oz)	200 g (7.05 oz)
Dimension	mm (in)	70.0 x 70.0 x 34.0 (2.76" x 2.76" x 1.34")
Mounting method		PCB 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 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	*Isolated DC source only*
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.
STO	TTL	**√**
Digital Input	TTL	**6**
Digital Output	Open Collector-emitter (isolated)	**2**
	TTL 3.3V(Non Isolation)	**2**
Analog Input	Differential ±10V	**1**
	Single Ended	**1**
Feedback	Standard Port A, B, & C	**√**
Communication Option	USB	**√**
	EtherCAT *or*	**√**
	CAN	**√**
	RS-232 TTL level	**√**

4.2.3. Environmental Conditions

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

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

4.2.4. Gold Line Standards

The following table describes the Main Standards of the Gold 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.	
STO IEC 61800-5-2:2007 SIL 3	Adjustable speed electrical power drive systems – Safety requirements – Functional
EN ISO 13849-1:2008 PL e, Cat 3	Safety of machinery — Safety-related parts of control systems.
Imminent Approval UL61800-5-1	Adjustable speed electrical power drive systems Safety requirements – Electrical, thermal and energy
In compliance with UL 508C	Power Conversion Equipment
In compliance with UL 840	Insulation Coordination Including Clearances and Creepage Distances for Electrical Equipment
Conformity with CE 2006/95/EC	Low-voltage directive 2006/95/EC
Imminent Approval CSA C22.2 NO. 274-13	Adjustable speed drive

Chapter 5: Installation

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

5.1. Unpacking the Drive Components

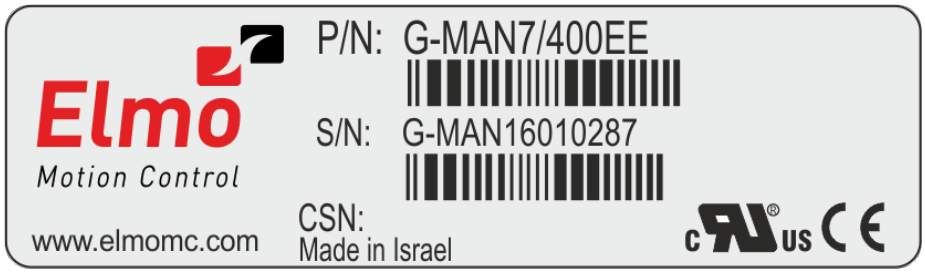
Before you begin working with the Gold Mandolin, verify that you have all of its components, as follows:

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

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

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



G-MAN001A

4. Verify that the Gold 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.

Chapter 6: Mounting the Gold Mandolin

The Gold Mandolin is designed for mounting on a printed circuit board (PCB). It is connected by 1.27 mm pitch 0.40 mm square pins and 2.00 mm pitch 0.51 mm square pins. When integrating the Gold Mandolin into a PCB, be sure to leave about 1 cm (0.4") outward from the heat-sink to enable free convection of the air around the Gold Mandolin. We recommend that the Gold Mandolin be soldered directly to the board. Alternatively, though this is not recommended, the Gold Mandolin can be attached to socket connectors mounted on the PCB. However, if the PCB is enclosed in a metal chassis, we recommend that the Gold Mandolin be screw-mounted to it as well to help with heat dissipation. The Gold Mandolin has screw-mount holes on each corner of the heat-sink for this purpose.

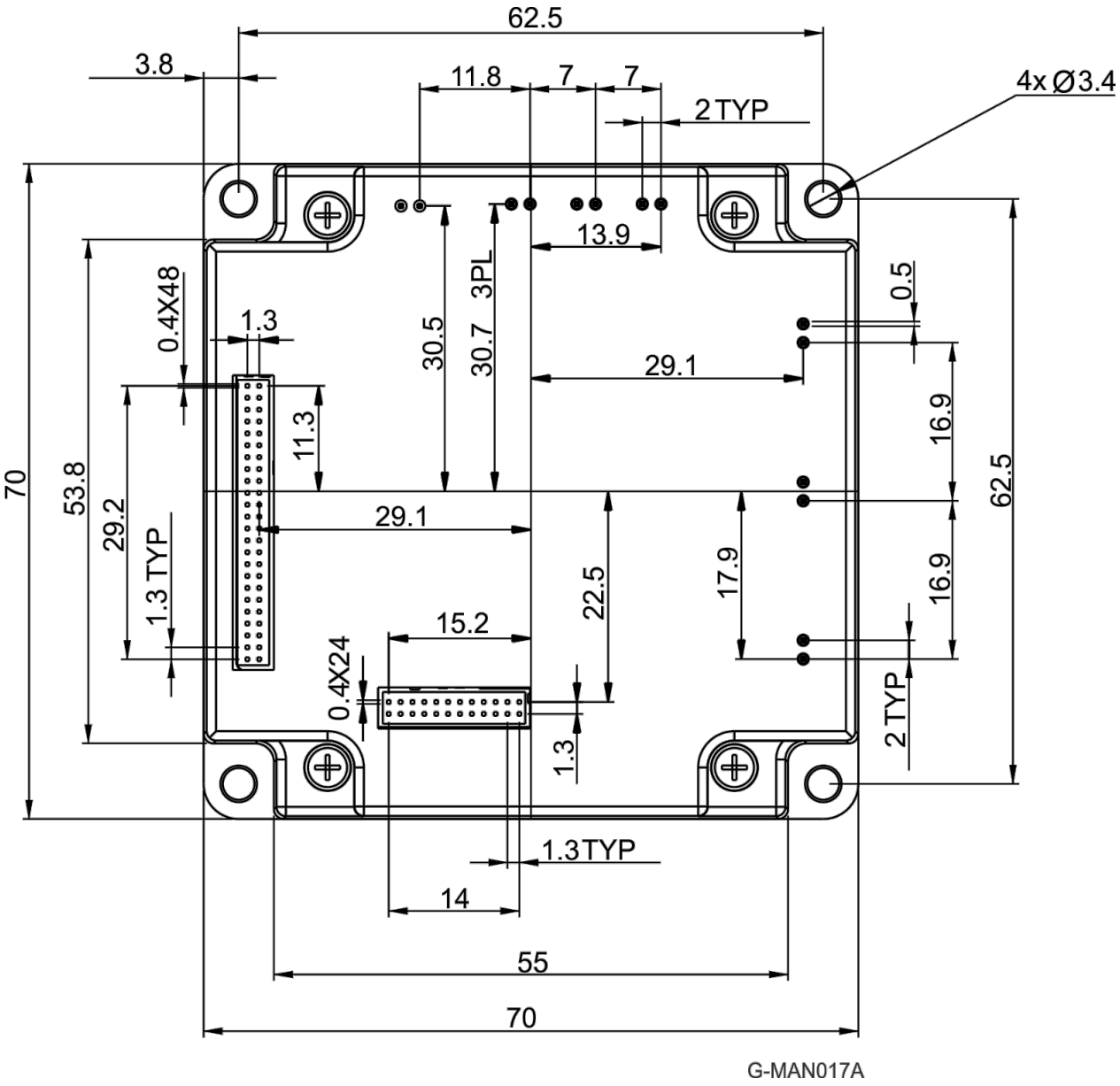


Figure 1: Gold Mandolin Footprint – Top

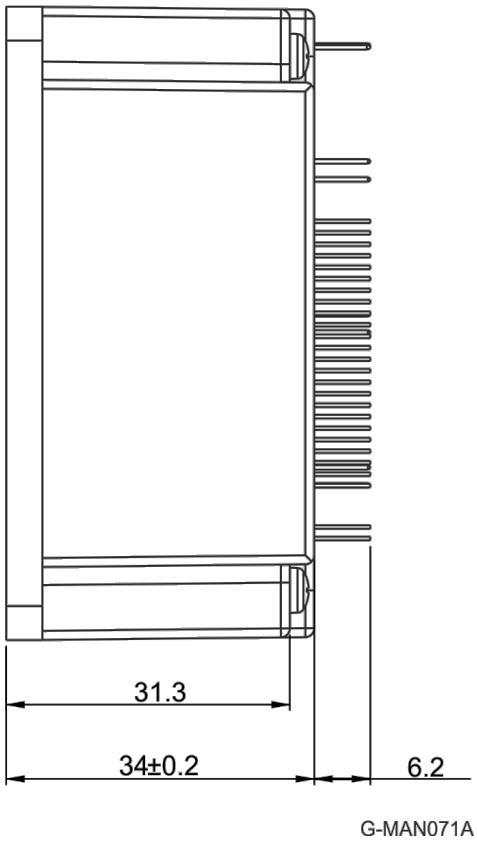


Figure 2: Gold Mandolin Footprint – Side

Chapter 7: Integrating the Gold Mandolin on a PCB

The Gold Mandolin is designed to be mounted on a PCB by soldering its pins directly to the PCB. Refer to Chapter 5 of the MAN-G-Board Level Modules Hardware Manual for further information.

7.1. COMRET

For details of the COMRET, refer to the section 5.4 in the MAN-G-Board Level Modules Hardware Manual.

7.2. Earth Connection (PE)

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

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

7.3. Power Conductors PCB layout

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

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

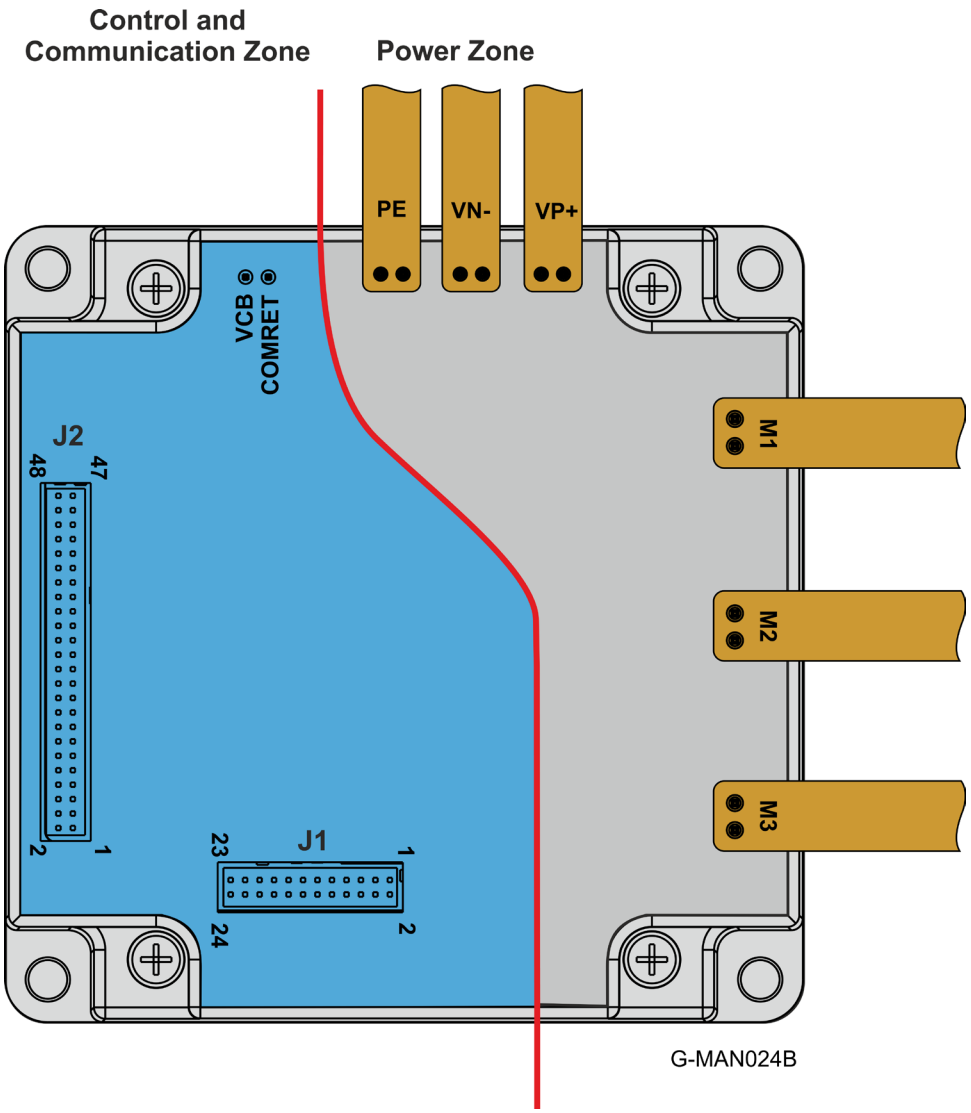


Figure 3: Gold Mandolin Power Conductors PCB layout

For more details, refer to the section 5.4 in the MAN-G-Board Level Modules Hardware Manual.

Chapter 8: The Gold Mandolin Connection Diagrams

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

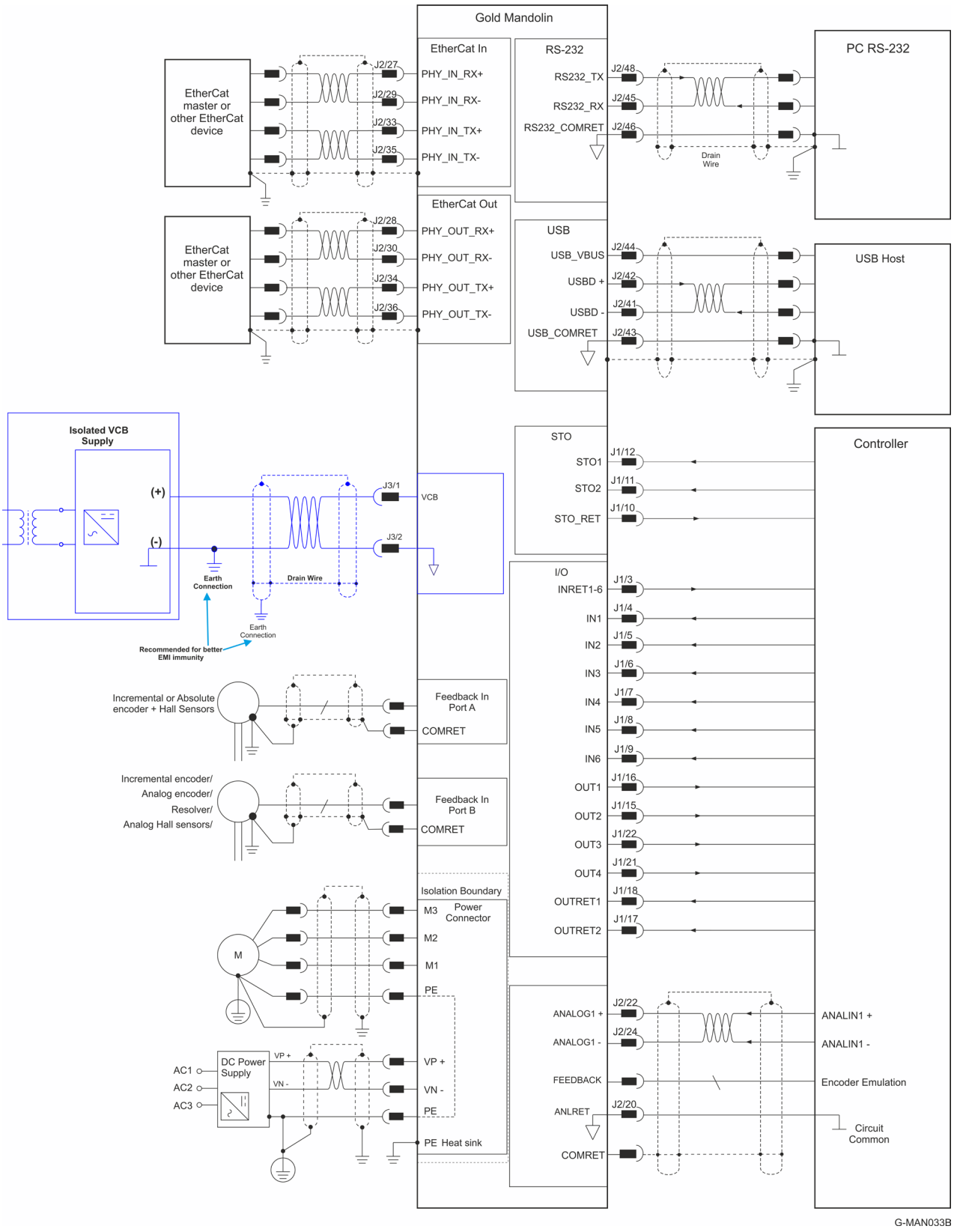


Figure 4: Gold Mandolin Connection Diagram for EtherCAT

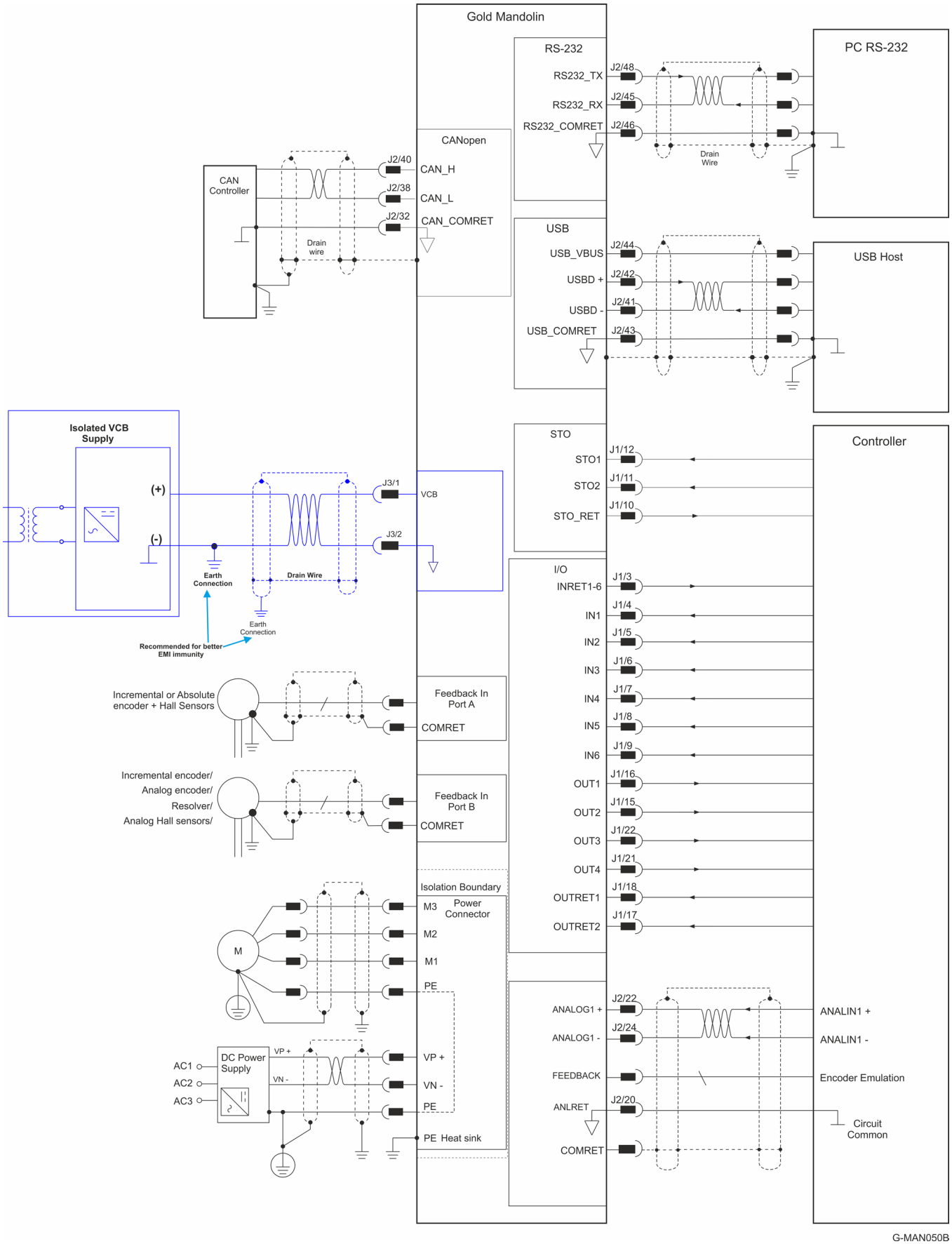
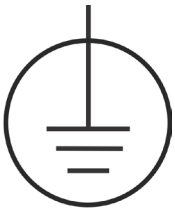
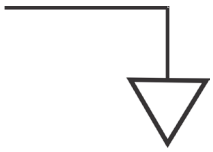
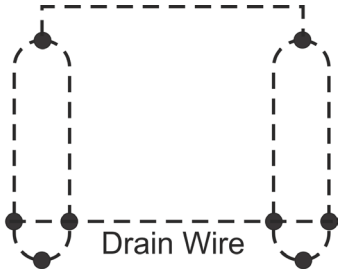
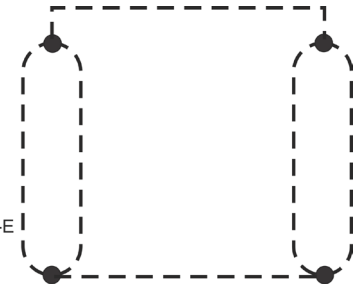
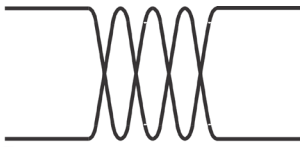
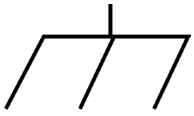


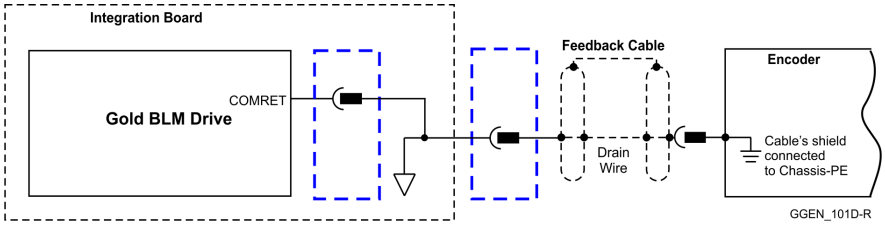
Figure 5: Gold Mandolin Connection Diagram for CAN

Chapter 9: PCB Connections

9.1. 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
 GGEN_101D-K	Analog Ground

Wiring Symbol	Description
	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.

9.2. Connector Types

The Gold Mandolin has 9 connectors.

Port	Pins	Type	Function
J1	2x12	1.27 mm pitch 0.41 mm sq	IO, LEDs, and STO
J2	2x24		Communications and Feedbacks
J3	2	2 mm pitch 0.51 mm sq	Control backup supply
VP+	2		Positive DC power input
VN-	2		Negative DC power input
PE	2		Protective earth
M1	2		Motor power output 1
M2	2		Motor power output 2
M3	2		Motor power output 3
Connector Location			

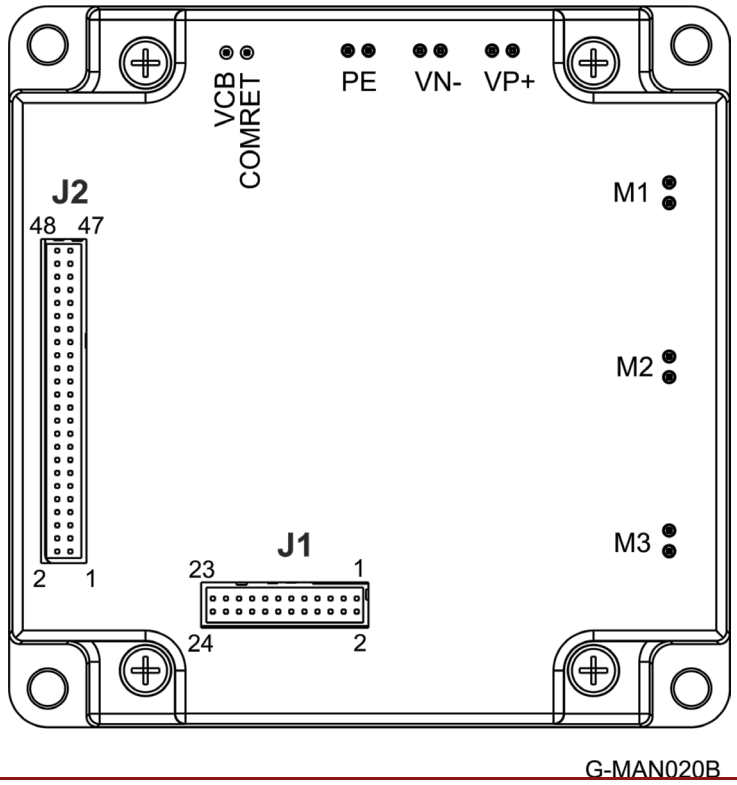


Table 1: Connector Types

9.3. Drive Status Indicator

For details of the Drive Status Indicator wiring, refer to the Chapter 7 in the MAN-G-Board Level Modules Hardware Manual.

9.4. Motor Power Connector Pinouts

Pin	Function	Cable	
		Brushless Motor	**Brushed DC Motor**
M3	Motor phase	Motor	Motor
M2	Motor phase	Motor	Motor
M1	Motor phase	Motor	N/C
PE	Protective Earth	Motor	Motor
Connector Type: 2 mm pitch 0.51 mm sq			
Pin Positions			

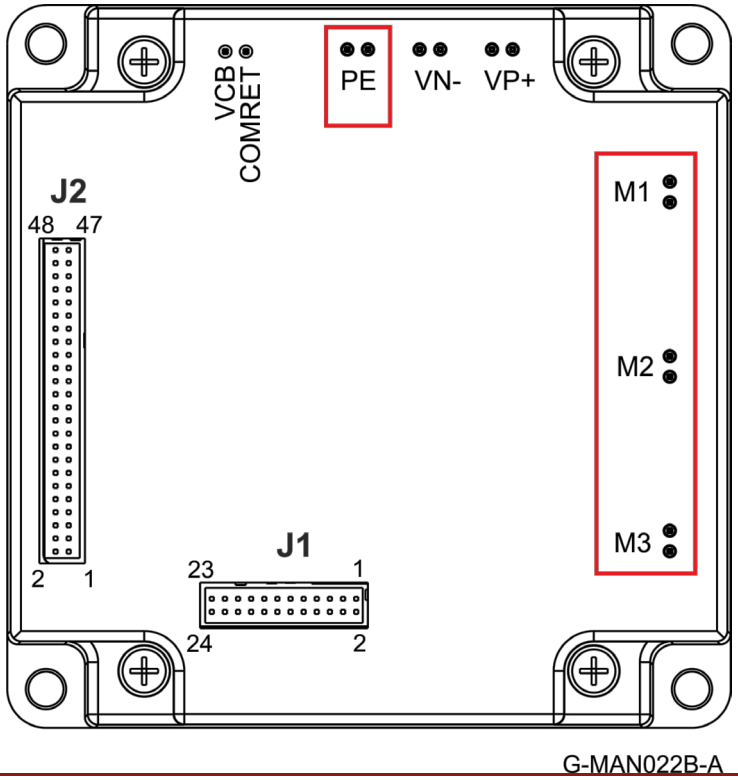


Table 2: Connector for Motor

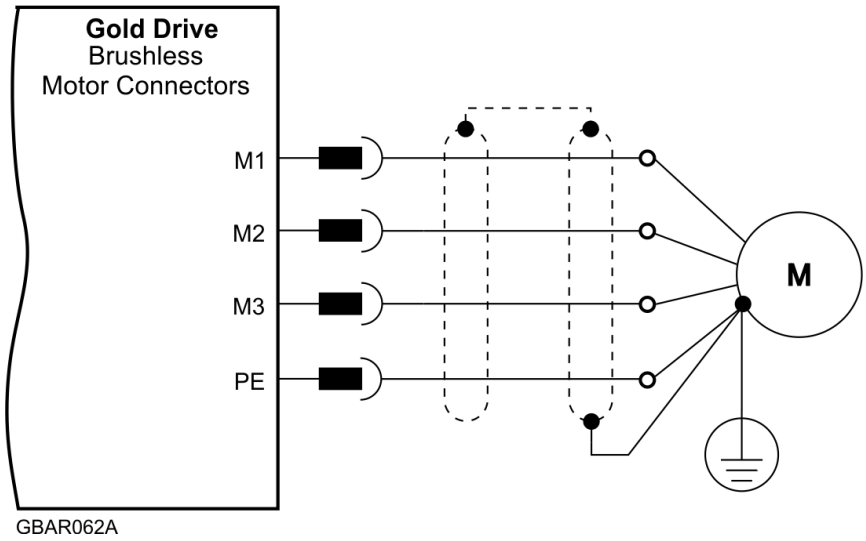


Figure 6: Brushless Motor Power Connection Diagram

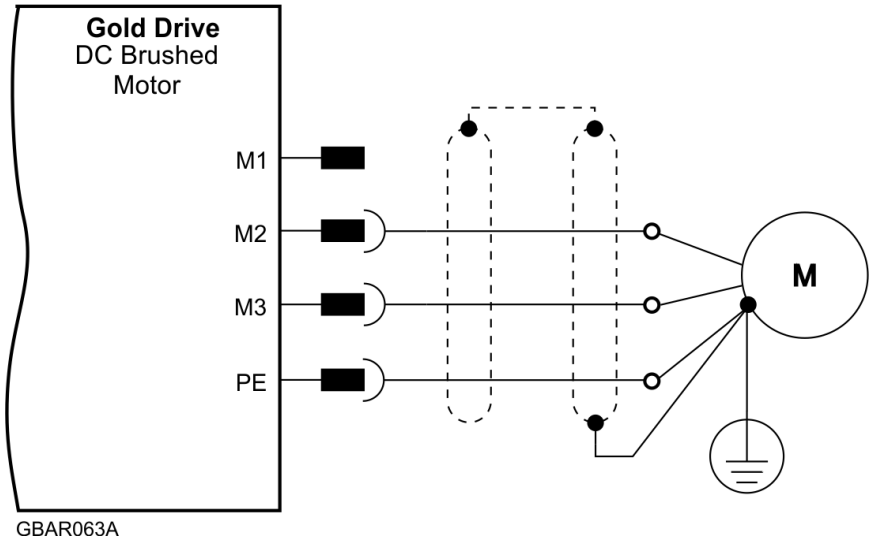


Figure 7: Brushed Motor Power Connection Diagram

9.4.1. Motor Power

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

9.5. Main Power and Control Backup Supply

9.5.1. Main Power

Power to the Gold 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 and Motor
VN-	DC Negative Power input	Power
VP+	DC Positive Power input	Power
Pin Type: 2 mm pitch 0.51 mm sq		
Pin Positions		

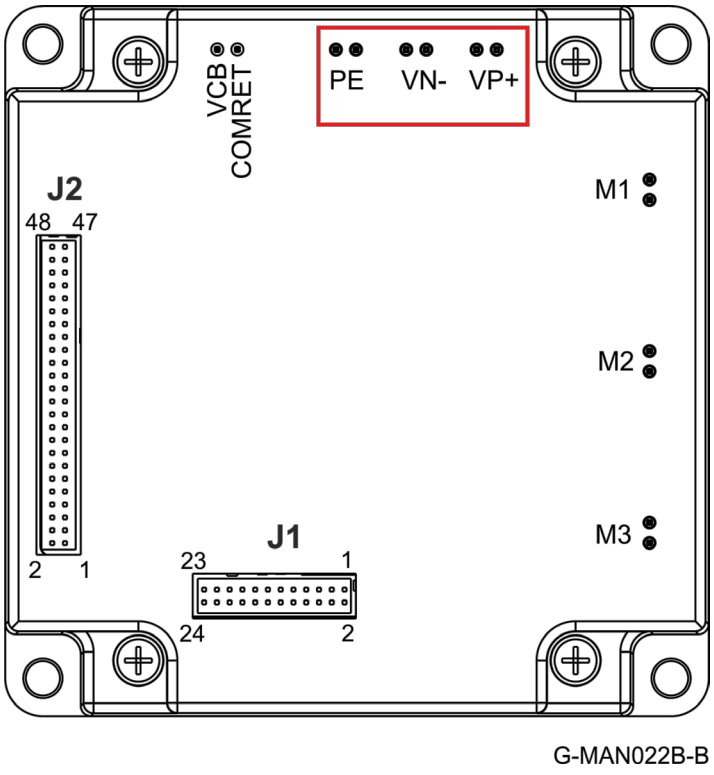


Table 3: Connector for Main Power

The DC power source for the Gold 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 Mandolin is fully isolated from the other sections of the Gold 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 Mandolin.

In addition, this isolation simplifies the requirements of the DC power supply that is used to power the DC bus of the Gold 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 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.

9.5.1.1. Three-Phase Direct-to-Mains Connection Topology

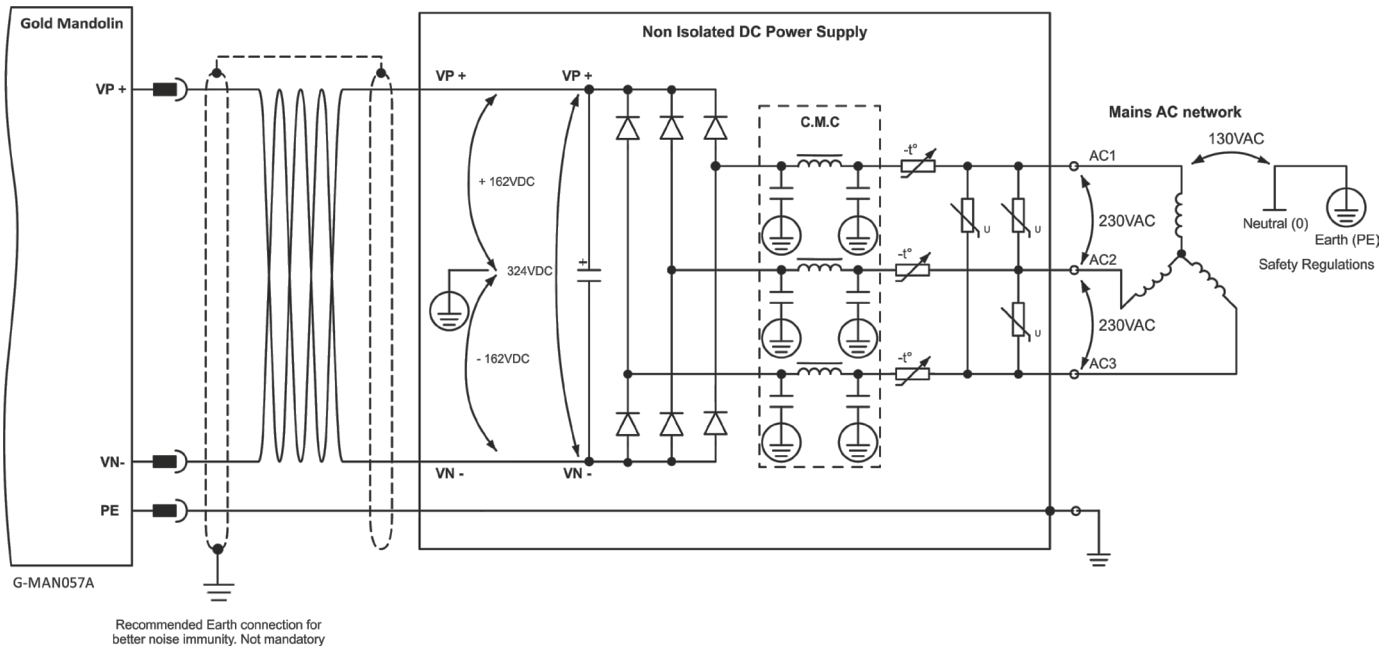


Figure 8: Non-Isolated Three-Phase Connection Topology

9.5.1.2. Single-Phase Direct-to-Mains Connection Topology

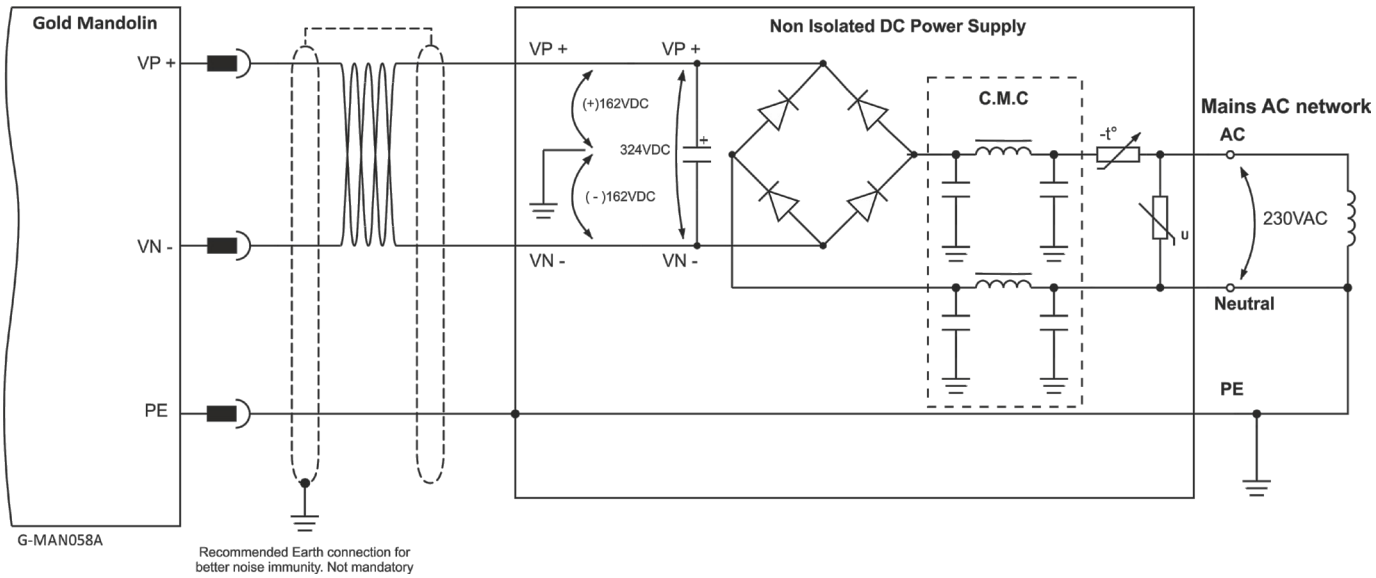


Figure 9: Non-Isolated Single-Phase Connection Topology

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

9.5.1.3. 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.

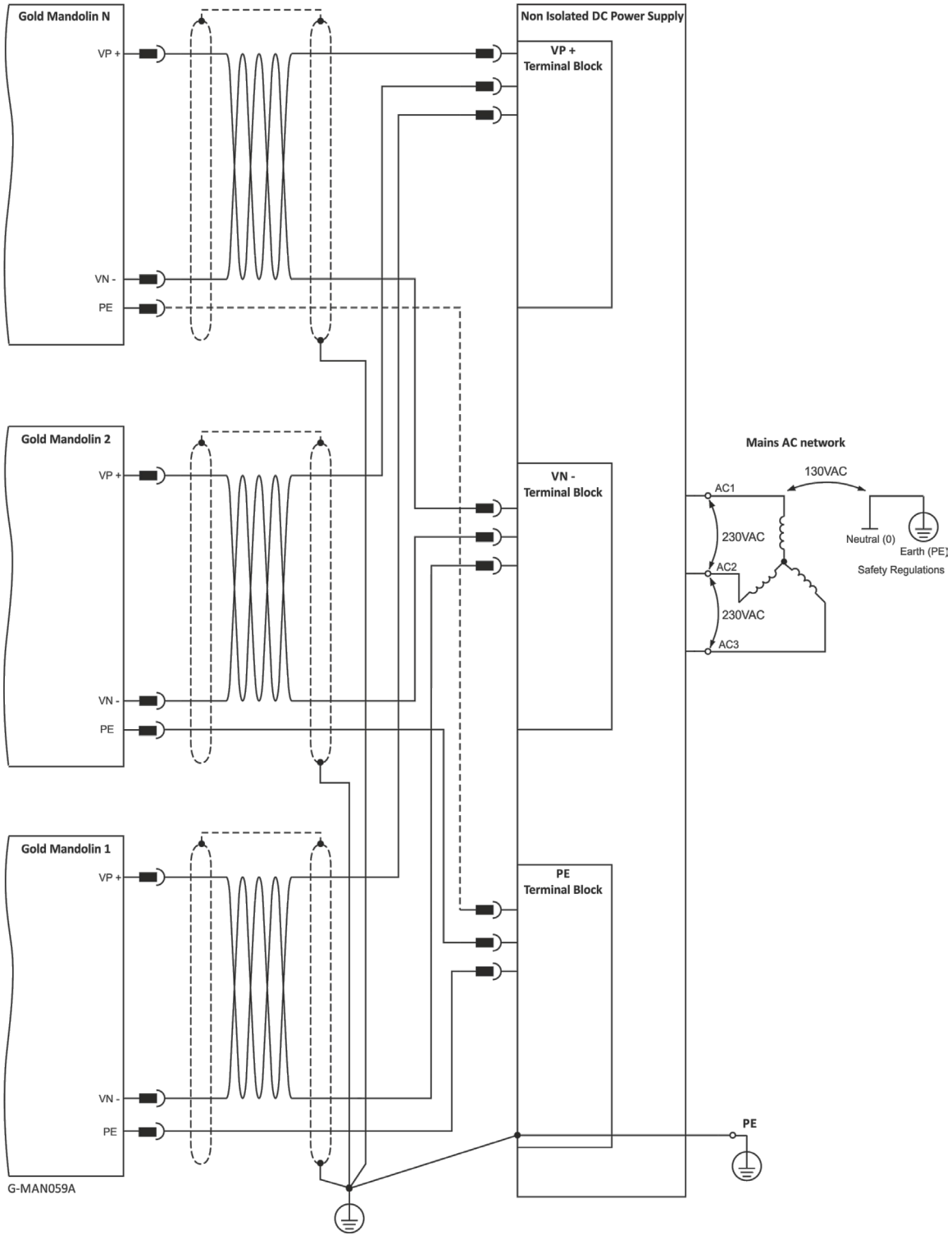


Figure 10: Non-Isolated Three-Phase Multiple Connection Topology

9.5.2. Battery Power Supply

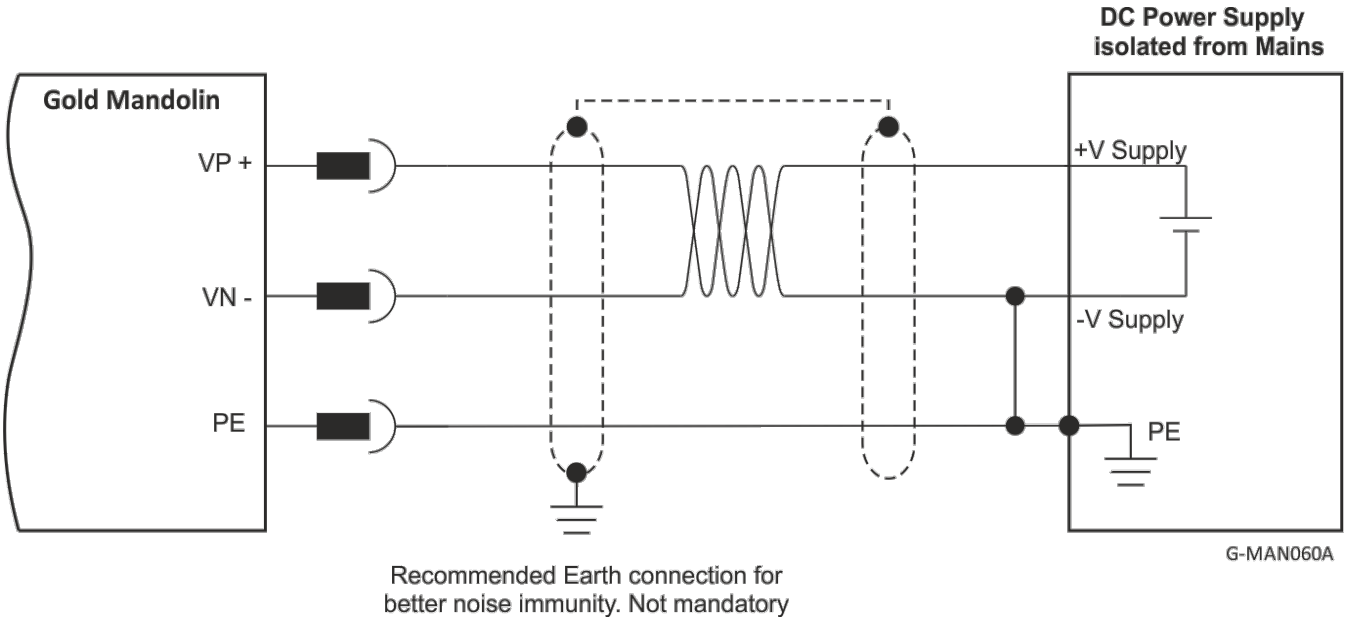


Figure 11: Battery Connection Topology

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.

9.5.3. Control Backup Supply (J3)

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

Pin (J3)	Function
1	Control backup supply Input Positive
2	Common Return
Connector Type: 2 mm pitch 0.51 mm sq	
Pin Positions	

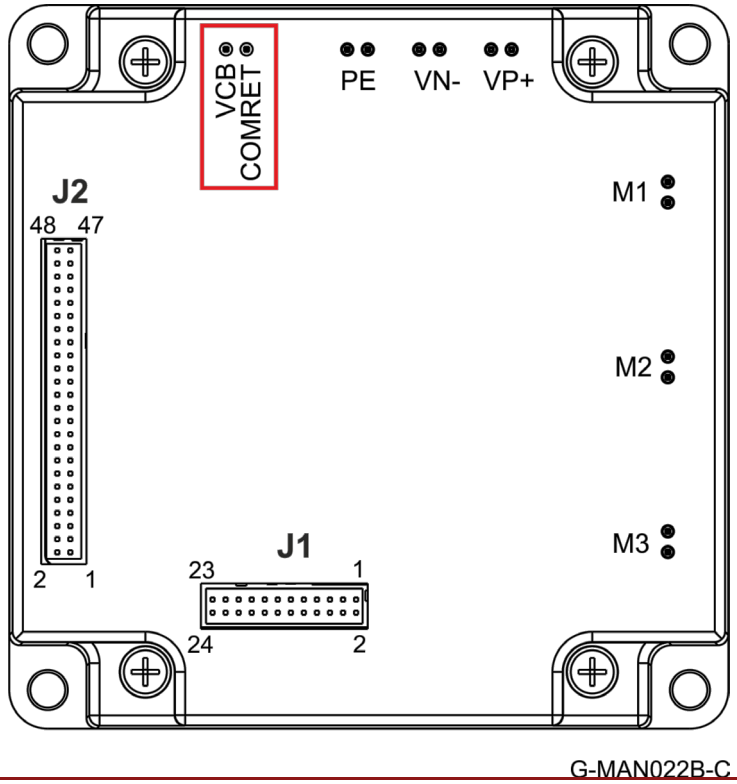


Table 4: 24 VDC Control Supply Pins and Polarity

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.

9.5.4. Main Power and Control Relationship

Power to the Gold 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 12) fed internally from the prime source.

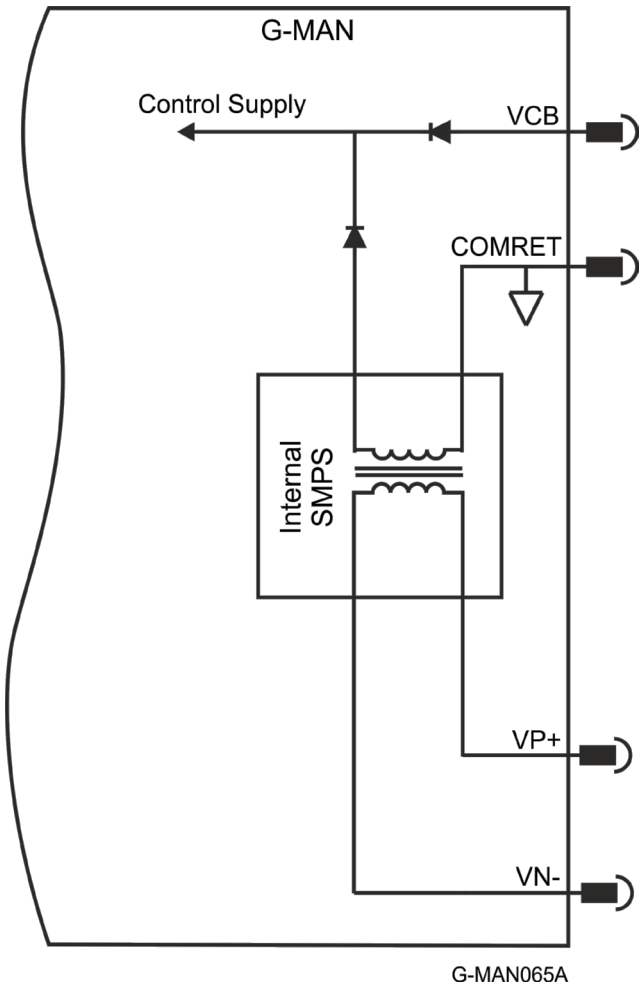


Figure 12: Switch-mode Power Supply

The Gold 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.

9.5.4.1. Single Power Supply Topology

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

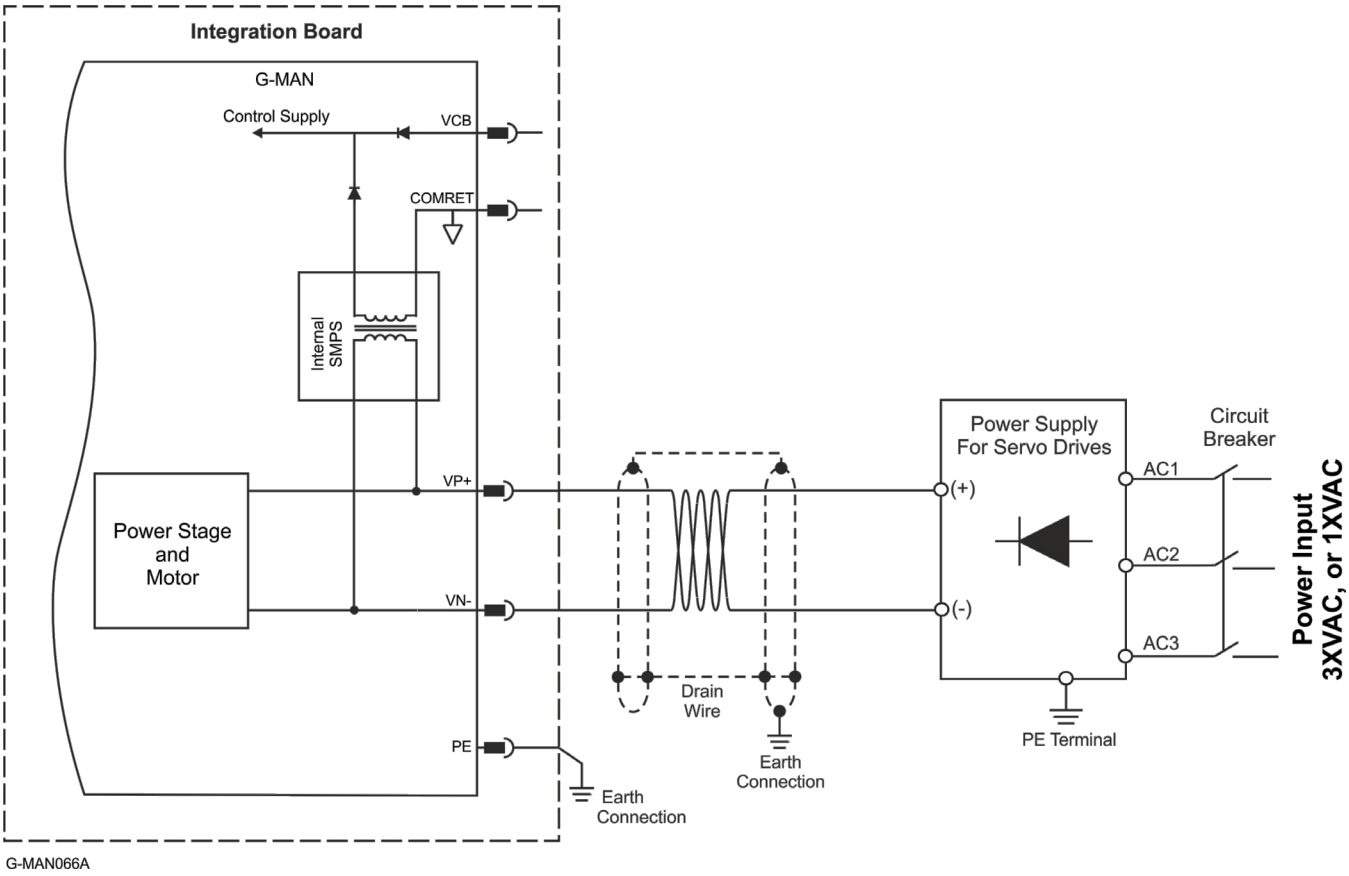


Figure 13: Gold Mandolin Single supply Topology

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

9.5.4.2. 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.

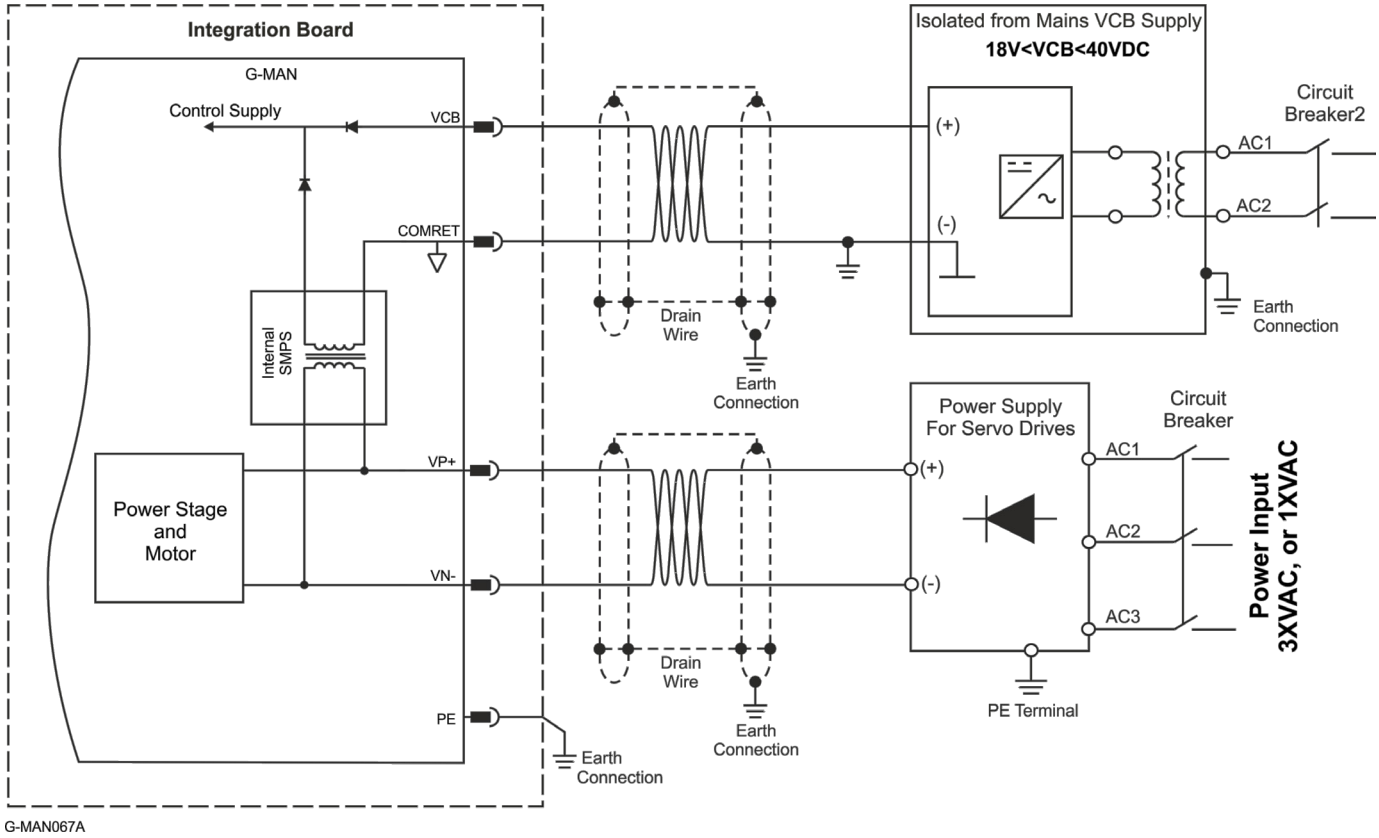
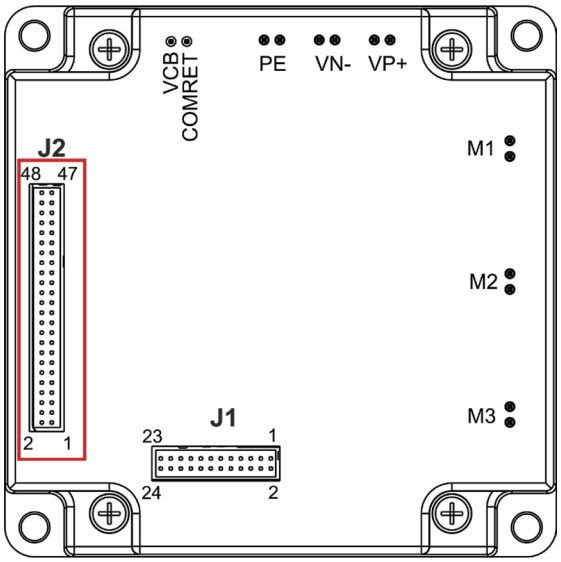


Figure 14: Gold Mandolin VP+ and VCB Topology

9.6. Connector J2 - Feedback, Analog Inputs, RS-232, USB, EtherCAT, Ethernet, and CAN



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Feedback A/B/C, Digital Halls – see Chapter 10: Feedbacks in the MAN-G-Board Level Modules Hardware Manual.

Analog Inputs - For full details on Analog Inputs, see Chapter 12 in the MAN-G-Board Level Modules Hardware Manual.

RS-232 – For full details on RS-232 see section 14.4 in the MAN-G-Board Level Modules Hardware Manual.

USB 2.0 – For full details on USB see section 14.1 in the MAN-G-Board Level Modules Hardware Manual.

EtherCAT/Ethernet – For full details on EtherCAT/Ethernet see section 14.2. in the MAN-G-Board Level Modules Hardware Manual.

CAN – For full details on CAN see section 14.3 in the MAN-G-Board Level Modules Hardware Manual.

Connector Type: 1.27 mm pitch 0.41 mm sq

Note regarding the EtherCAT and CAN communication options:

The J2 Connector exports all supported communication links. However, note that CAN and EtherCAT are not available in the same version of the Gold Mandolin and are thus not operational simultaneously. See the part number diagram in Section Catalog Number above for the different Gold Mandolin configurations.

Pin (J2)	Signal	Function
1	PortA_ENC_A+ /ABS_CLK+	Port A- channel A/ Absolute encoder clock+
2	PortC_ENCO_A-	Port C- channel A complement output
3	PortA_ENC_A-/ABS_CLK-	Port A- channel A complement / Absolute encoder clock-
4	PortC_ENCO_A+	Port C- channel A output
5	PortA_ENC_B+/ABS_DATA+	Port A - channel B/ Absolute encoder Data+
6	PortC_ENCO_B-	Port C - channel B complement output

Pin (J2)	Signal	Function
7	PortA_ENC_B-/ABS_DATA-	Port A - channel B complement / Absolute encoder Data-
8	PortC_ENCO_B+	Port C - channel B output
9	PortA_ENC_INDEX+	Port A – index
10	PortC_ENCO_INDEX-	Port C - index complement output
11	PortA_ENC_INDEX-	Port A - index complement
12	PortC_ENCO_INDEX+	Port C - index output
13	PortB_ENC_A+/SIN+	Port B - channel A/SIN+
14	HC	Hall sensor C input
15	PortB_ENC_A-/SIN-	Port B - channel A complement/SIN-
16	HB	Hall sensor B input
17	PortB_ENC_B+/COS+	Port B - channel B/COS+
18	HA	Hall sensor A input
19	PortB_ENC_B-/COS-	Port B - channel B complement/COS-
20	ANARET	Analog return (Common Return Plane)
21	PortB_ENC_INDEX+/ANALOG_I+ /RESOLVER_OUT+	Port B - Channel_Index+ /Analog_Index+/Resolver_Out+
22	ANALOG1+	Analog input 1
23	PortB_ENC_INDEX-/ANALOG_I- /RESOLVER_OUT-	Port B – Channel_Index /Analog _Index /Resolver_Out Compliments
24	ANALOG1-	Analog input 1 complement
25	COMRET	Common return
26	+3.3V	3.3 V supply voltage for EtherCAT LEDs
27	PHY_IN_RX+	EtherCAT In receive
28	EtherCAT: PHY_OUT_RX+	EtherCAT Out receive
	CAN: Reserved	Reserved
29	PHY_IN_RX-	EtherCAT In receive complement
30	PHY_OUT_RX-	EtherCAT Out receive complement
31	COMRET	Common return
32	COMRET	Common return

Pin (J2)	Signal	Function
33	PHY_IN_TX+	EtherCAT In transmit
34	EtherCAT: PHY_OUT_TX+	EtherCAT Out transmit
	CAN: Reserved	Reserved
35	PHY_IN_TX-	EtherCAT In transmit complement
36	EtherCAT: PHY_OUT_TX-	EtherCAT Out transmit complement
	CAN: Reserved	Reserved
37	PHY_IN_LINK_ACT	EtherCAT In active LED
38	EtherCAT: PHY_OUT_LINK_ACT	EtherCAT Out active LED
	CAN: CAN_L	CAN_L BUS Line(dominant low)
39	PHY_IN_SPEED	EtherCAT In Speed LED
40	EtherCAT: PHY_OUT_SPEED	EtherCAT Out Speed LED
	CAN: CAN_H	CAN_H BUS Line(dominant high)
41	USBD-	USB _N line
42	USBD+	USB _P line
43	COMRET	Common return
44	USB_VBUS	USB VBUS 5V
45	RS232_RX /SB_OUT	There are two options for this pin: **Option 1**: RS232 receive (default) **Option 2**: Serial Bus output for extended I/O (refer to Chapter 13 of the MAN-G-Board Level Modules Hardware Manual.)
46	COMRET	Common return
47	+5VE	Encoder +5 V supply
48	RS232_TX /SB_IN	There are two options for this pin: **Option 1**: RS232 transmit (Default) **Option 2**: Serial Bus IN for extended I/O (refer to Chapter 13 of the MAN-G-Board Level Modules Hardware Manual.)

Table 5: Connector J2 – Feedbacks, Analog Input, and Communication

9.6.1. Feedback Port A

Port A supports the following sensor inputs:

- Digital Hall sensors
- Incremental encoder or absolute serial encoder, depending on the specific model
- Differential pulse-width modulation (PWM) signal input can be connected to port A
- Differential Pulse & Direction signal inputs can be connected to port A

9.6.1.1. Incremental Encoder

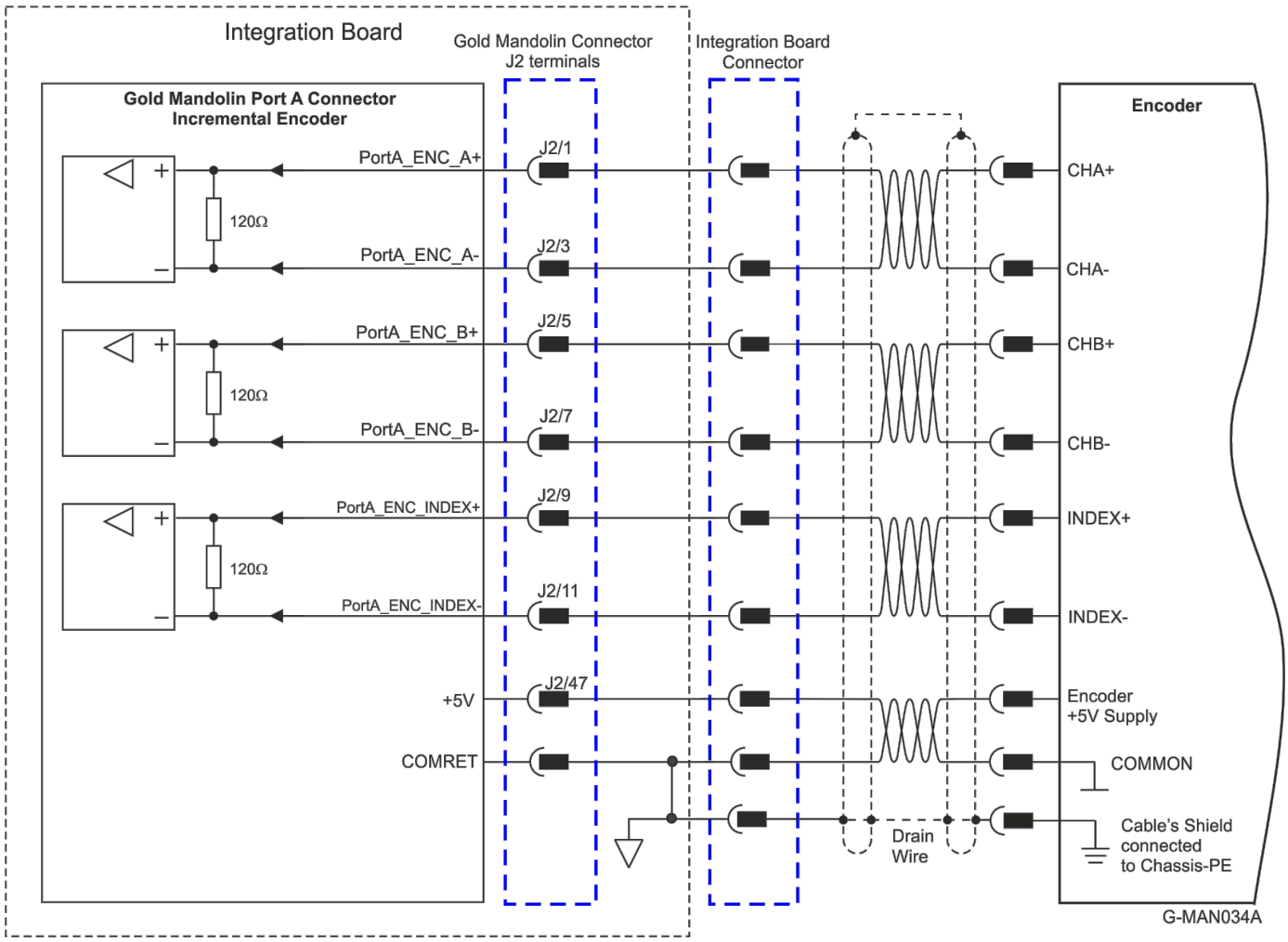


Figure 15: Port A Incremental Encoder Input – Recommended Connection Diagram

9.6.1.2. Hall Sensors

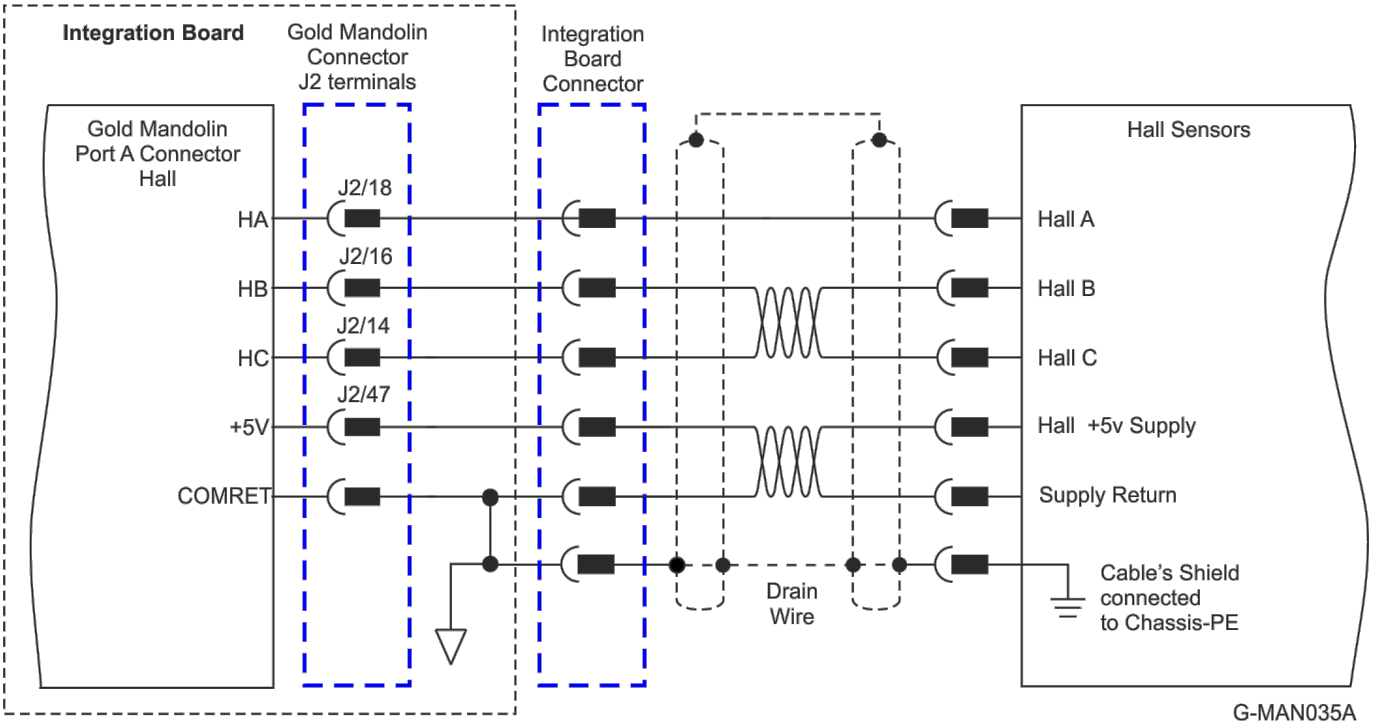


Figure 16: Hall Sensors Connection Diagram

9.6.1.3. Absolute Serial Encoder

The following Absolute Encoder are supported:

- Endat 2.2
- Biss C and Biss B
- Pansonic
- Tamagawa
- SSI
- Sanyo Danki
- Hiperface

The following is the diagram connection of the Endat, Biss, SSI:

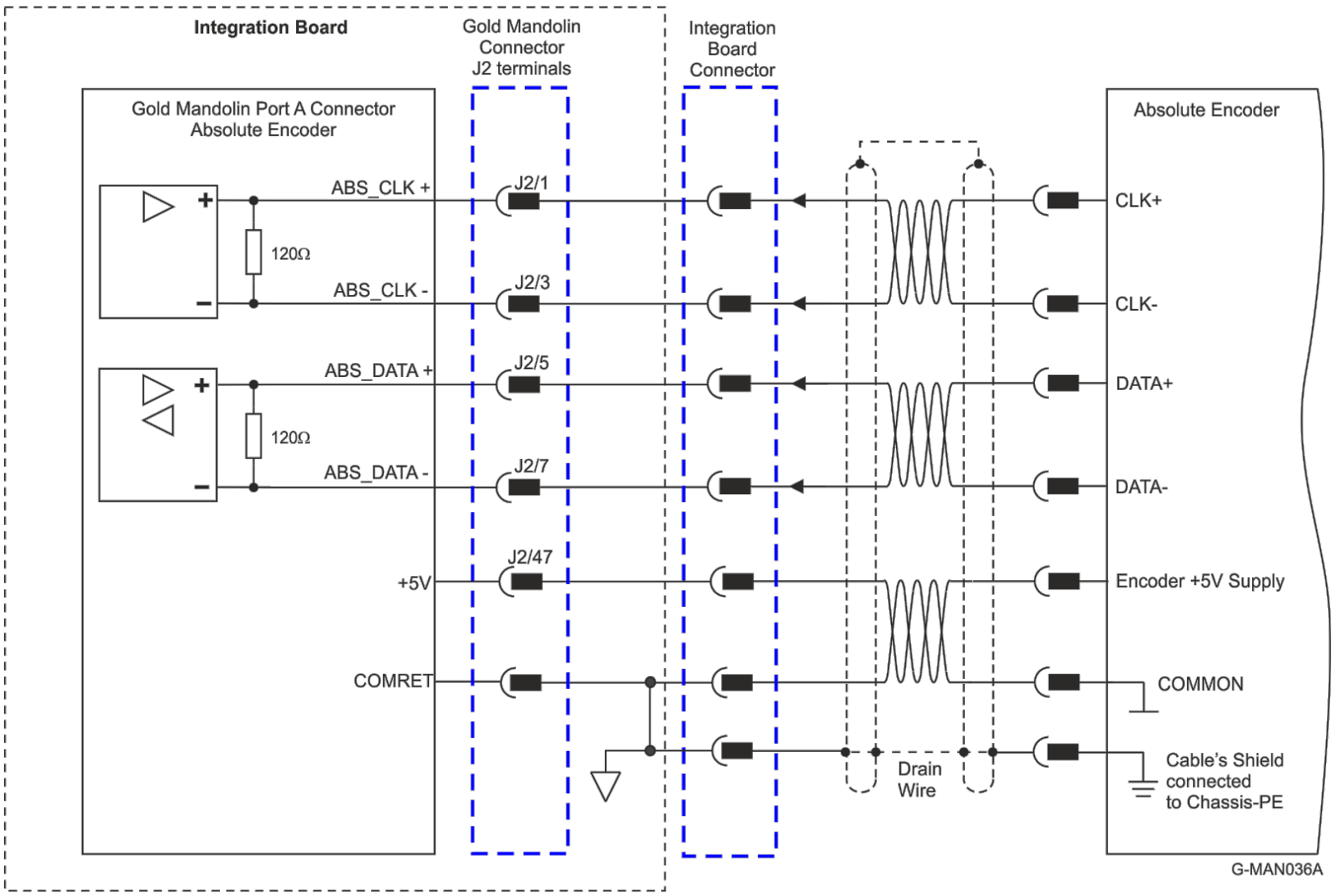


Figure 17: Absolute Serial Encoder – Recommended Connection Diagram for Endat, Biss, SSI

The following is the diagram connection of the Pansonic, Tamgawai, Sanyo-Danki:

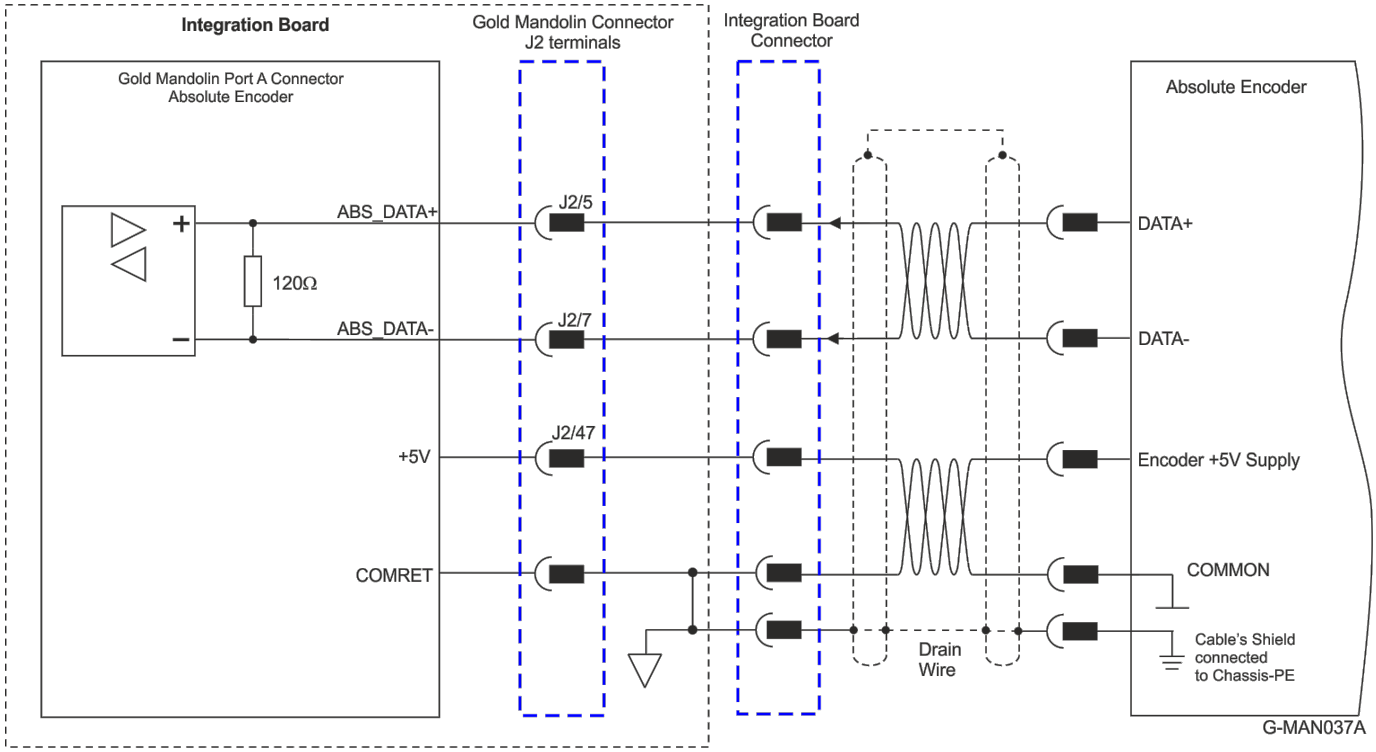


Figure 18: Absolute Serial Encoder – Recommended Connection Diagram for Pansonic, Tamgawai, Sanyo-Danki

9.6.1.4. Hiperface

The following figure describes the connection diagram.

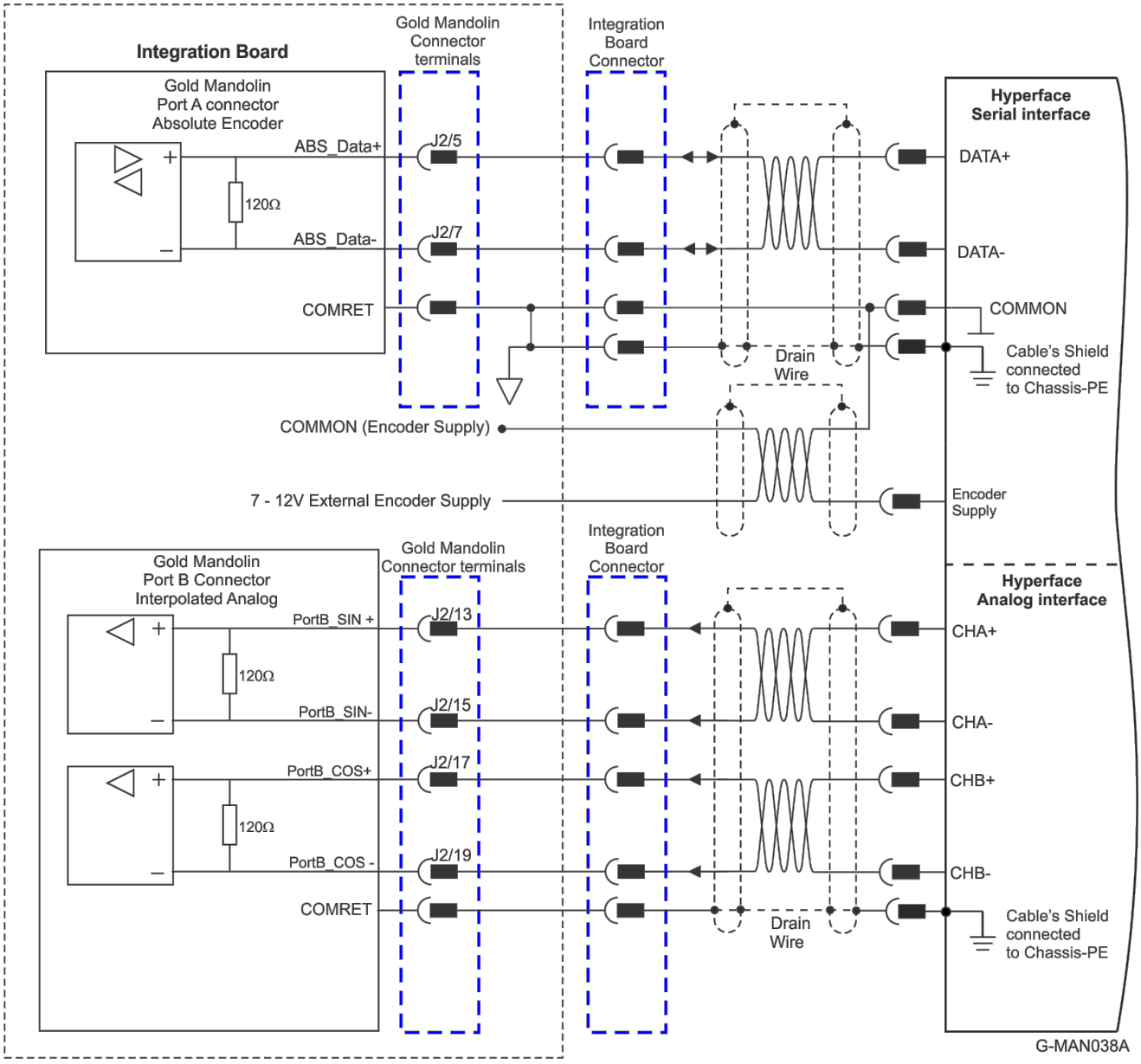


Figure 19: Absolute Serial Encoder – Recommended Connection Diagram for Stegmann Hiperface

Note: When the Hiperface protocol is used the RS232 in not available

9.6.2. 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

Differential Pulse & Direction signal inputs can be connected to port B

9.6.2.1. Incremental Encoder

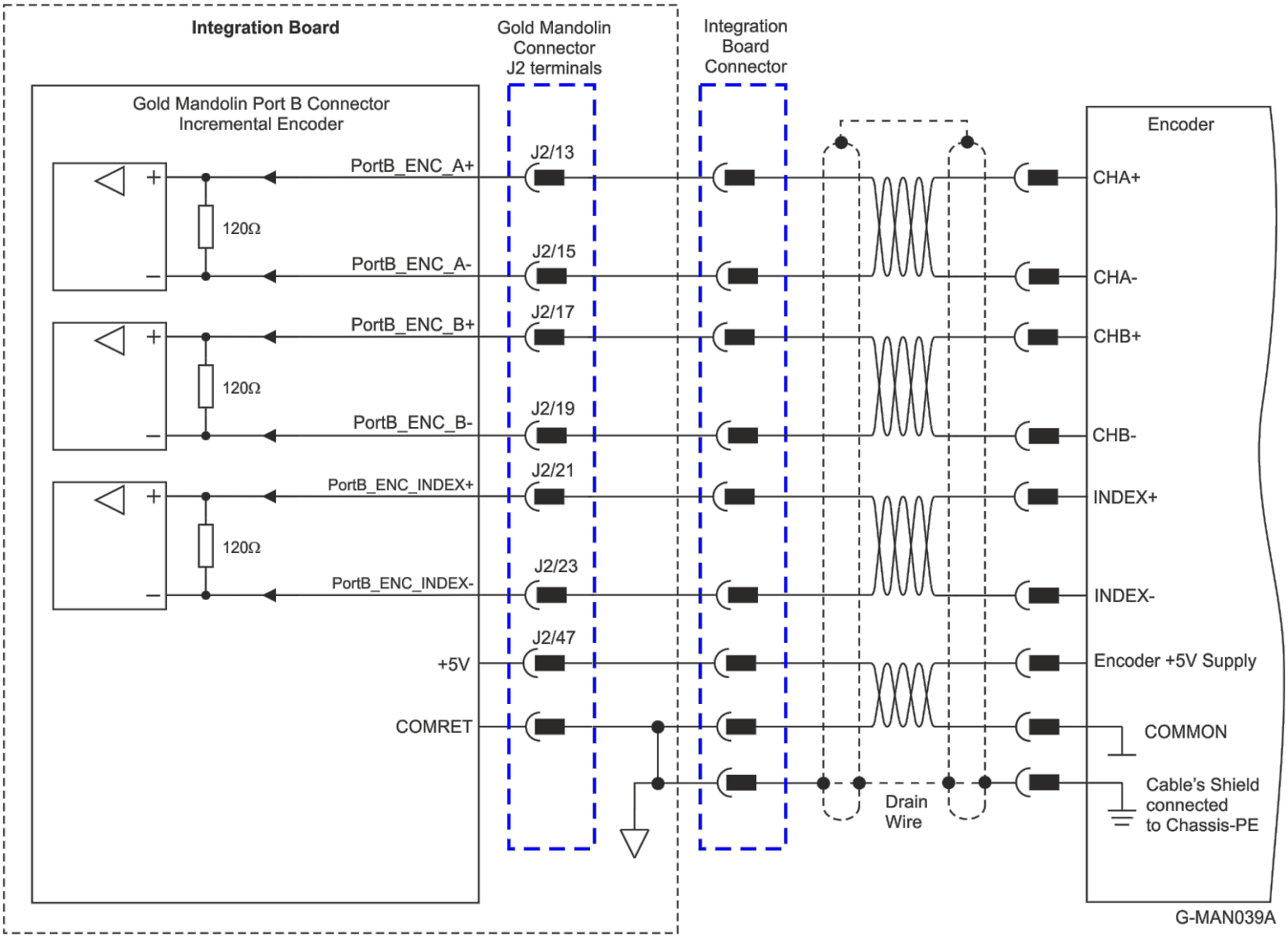


Figure 20: Port B Incremental Encoder Input – Recommended Connection Diagram

9.6.2.2. Interpolated Analog (Sine/Cosine) Encoder

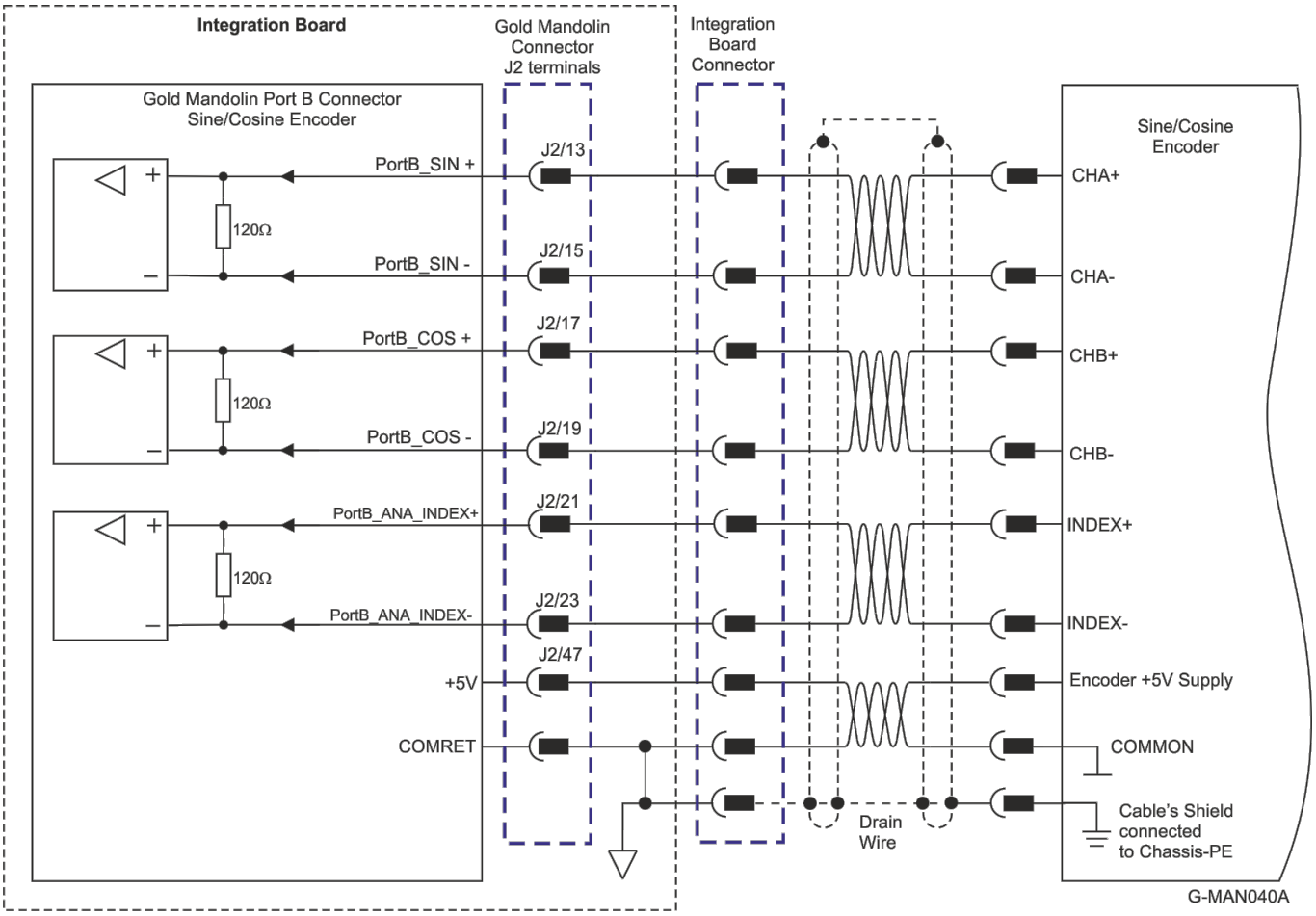


Figure 21: Port B - Interpolated Analog Encoder Connection Diagram

9.6.2.3. Resolver

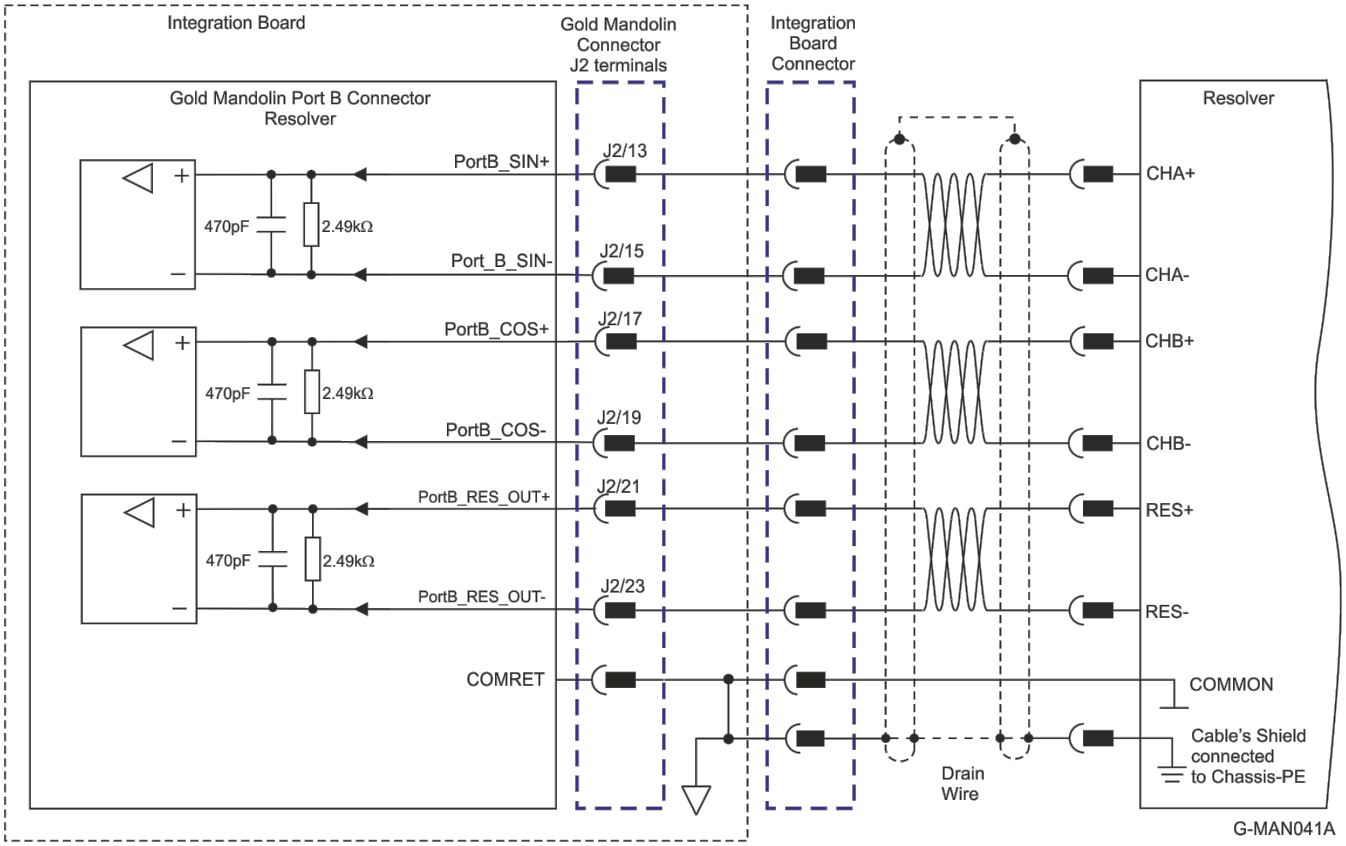


Figure 22: Port B – Resolver Connection Diagram

9.6.3. Port C – Emulated Encoder Output

Port C provides emulated encoder output derived from port A or port B feedback inputs, or from internal variables.

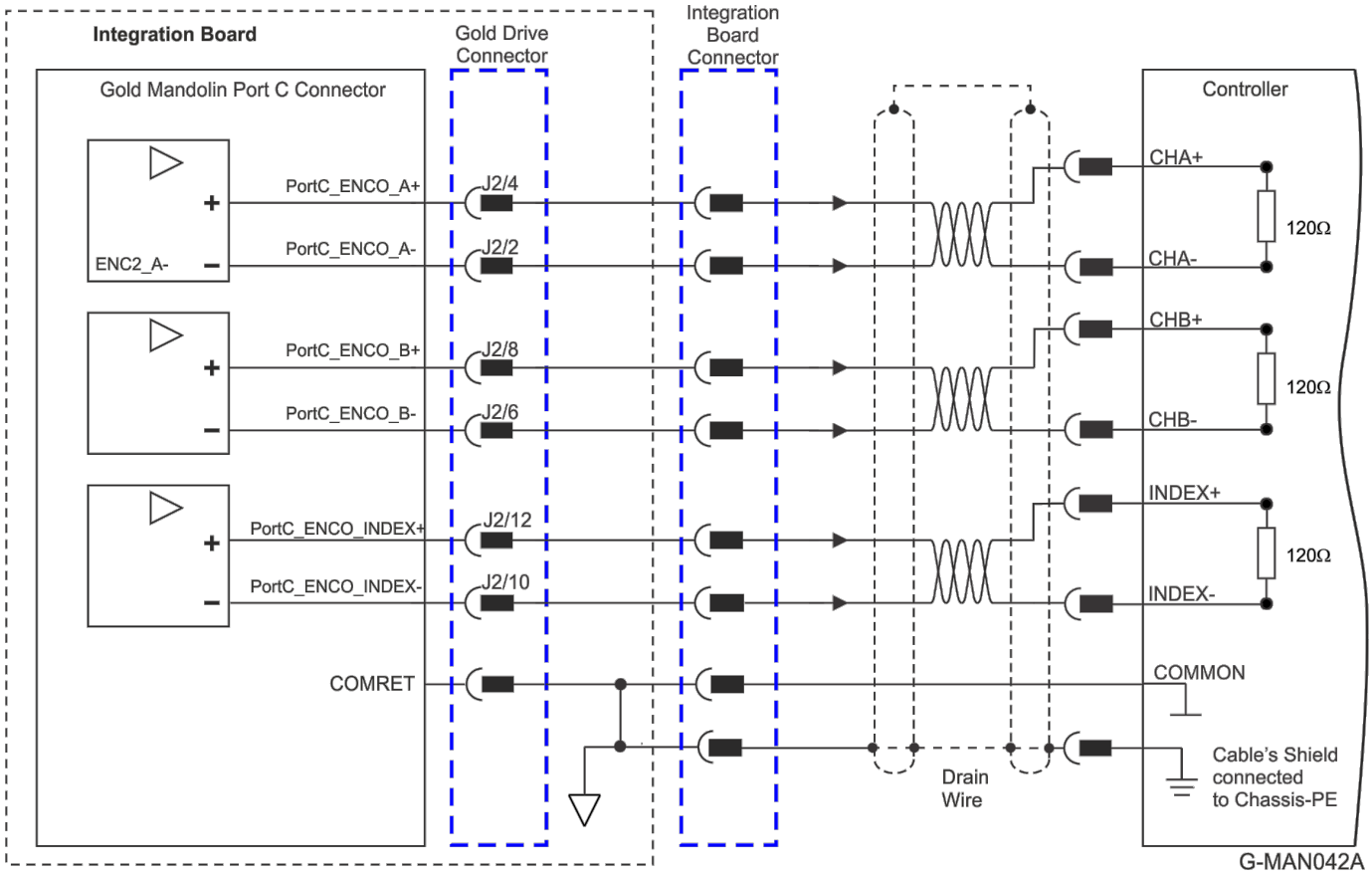


Figure 23: Emulated Encoder Differential Output – Recommended Connection Diagram

9.6.4. Analog Inputs

There are two possible types of Analog Inputs in the Gold Mandolin:

- Analog Input 1 – Differential ±10 V using Connector J2 in the Gold Mandolin
- Analog Input 2 – Single ended using Connector J1 in the Gold Mandolin

9.6.4.1. Analog Input 1

The following circuit (Figure 24) describes the internal interface of the Analog input.

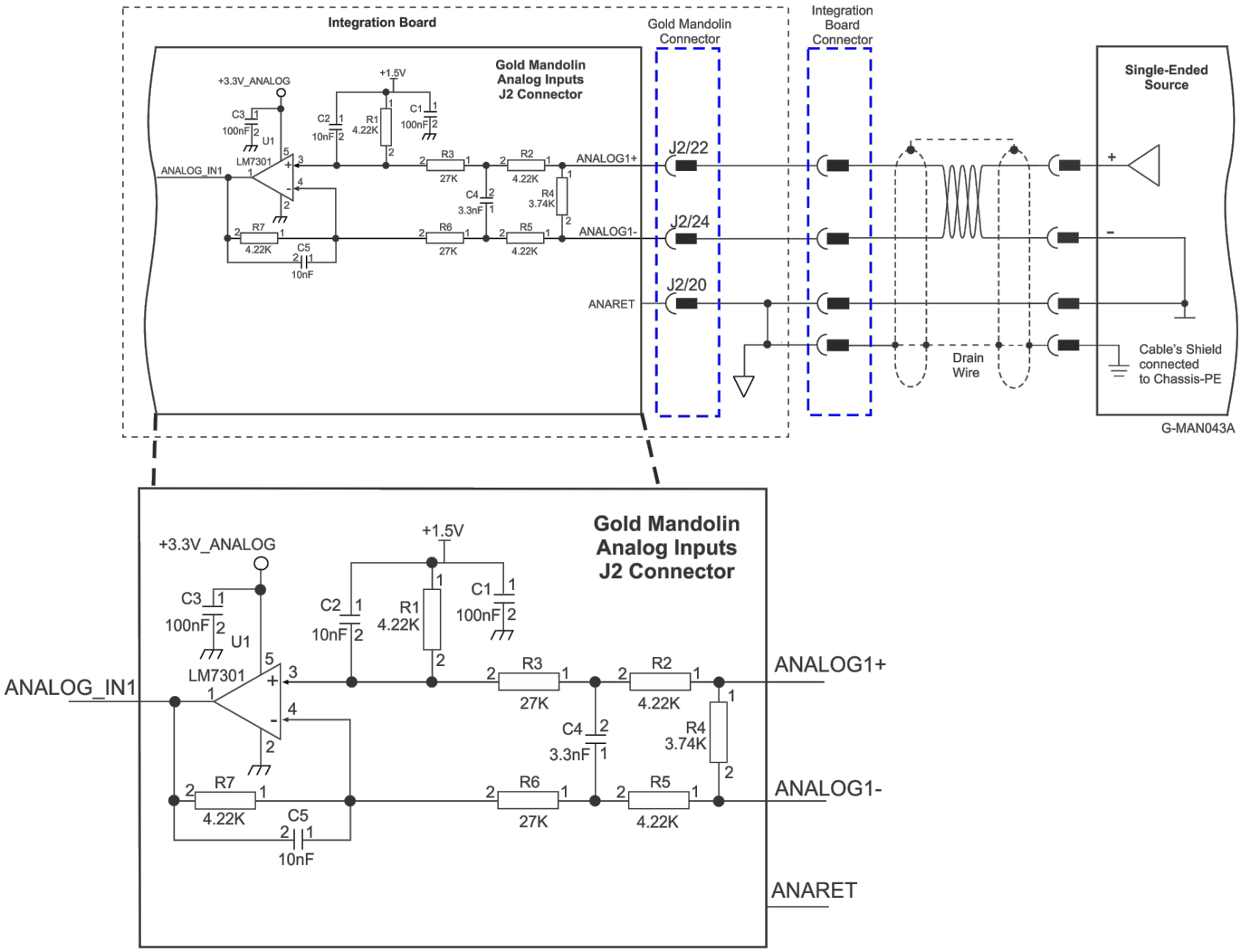


Figure 24: Analog Input with Differential ±10 V

9.6.4.2. Analog Input 2

The Gold Mandolin allows an additional single ended Analog input. Figure 25 describes the input interface of the Analog_input2 in the Gold Mandolin. It also describes implementation examples for a differential analog input of 10V:

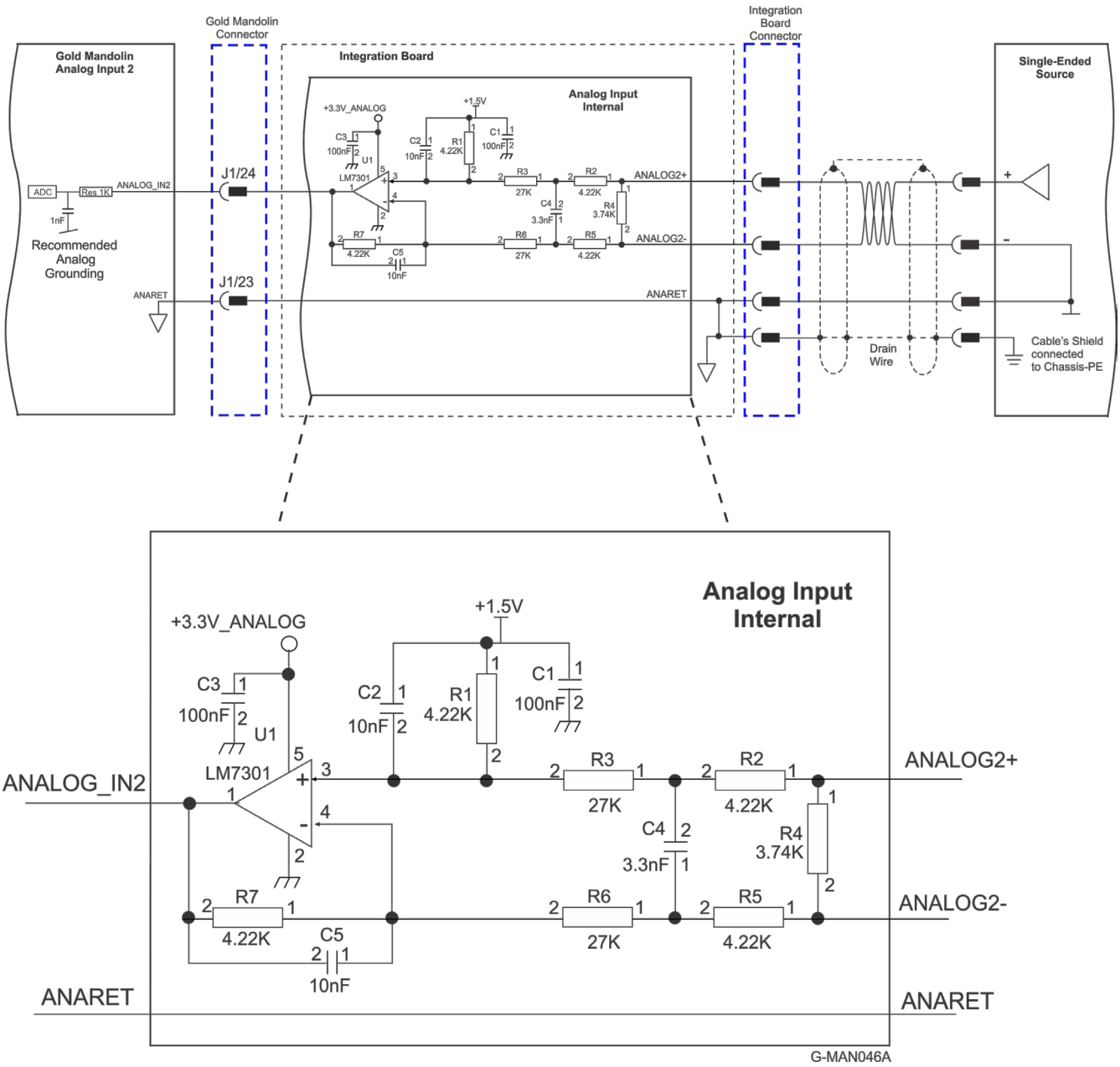


Figure 25: Analog Input 2 Example

9.6.5. RS232 TTL Logic Level

Figure 26 describes the standard RS232 connection diagram.

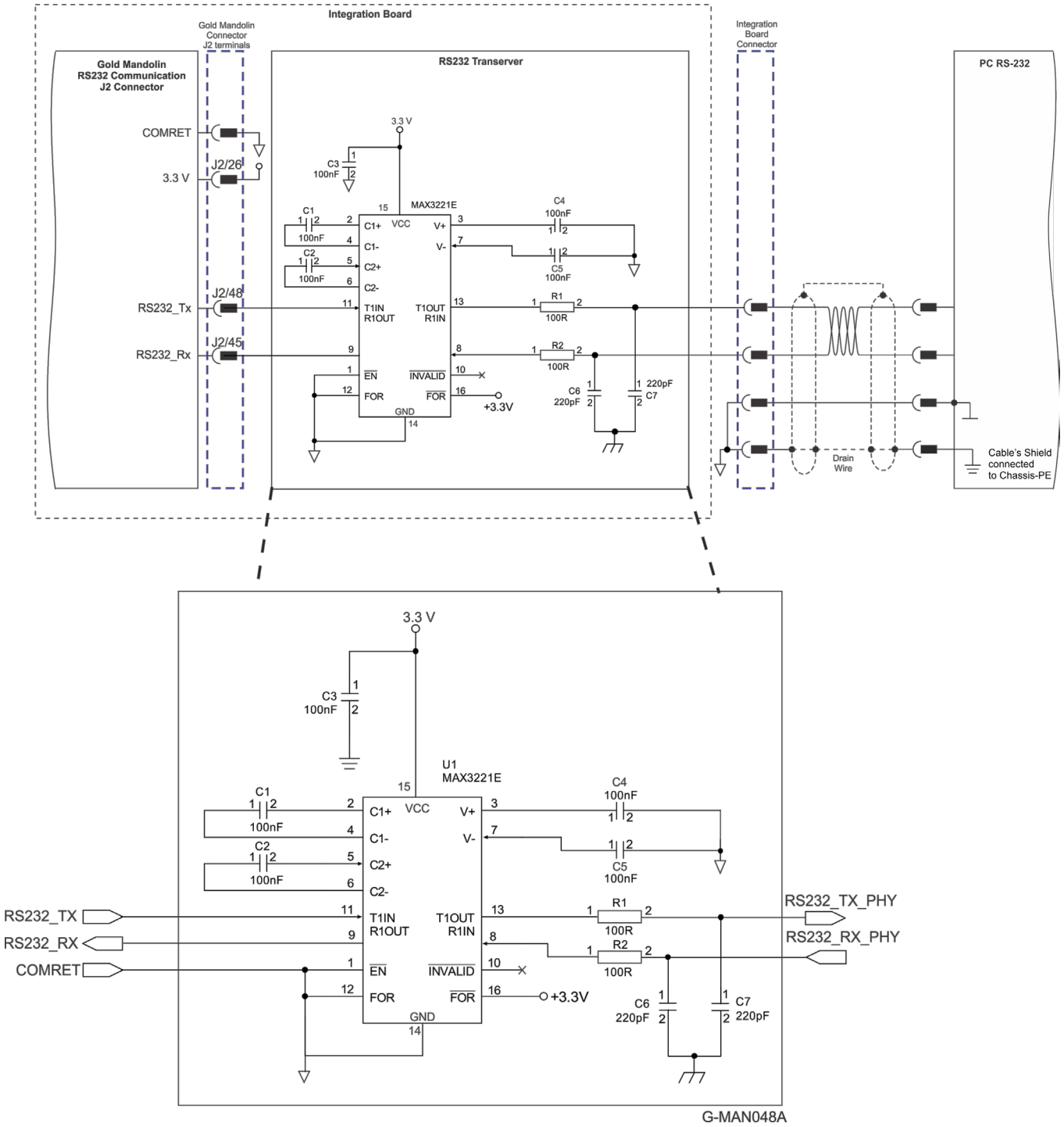


Figure 26: Standard RS232 Voltage Level incorporating RS232 TX/RX Transceiver Connection Diagram

9.6.6. USB 2.0

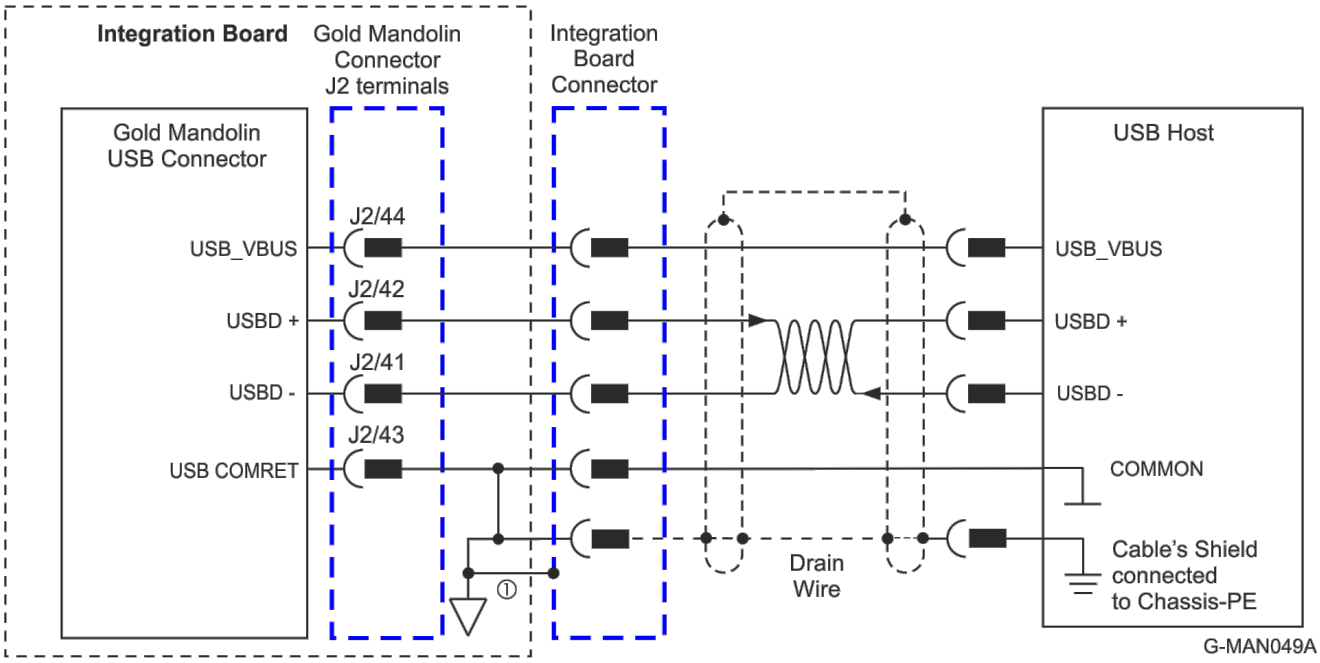


Figure 27: USB Network Diagram

Note ①: In the Gold Mandolin the shield of the USB connector should be connected to the COMRET.

9.6.7. EtherCAT/Ethernet

The Gold Mandolin serves as an EtherCAT slave device, therefor it includes EtherCAT_IN and EtherCAT_OUT ports. It also includes LED indicators. The EtherCAT_IN port can be configured to an Ethernet port.

The following figure describes EtherCAT connection with a standard RJ-45 connector that includes transformer isolation.

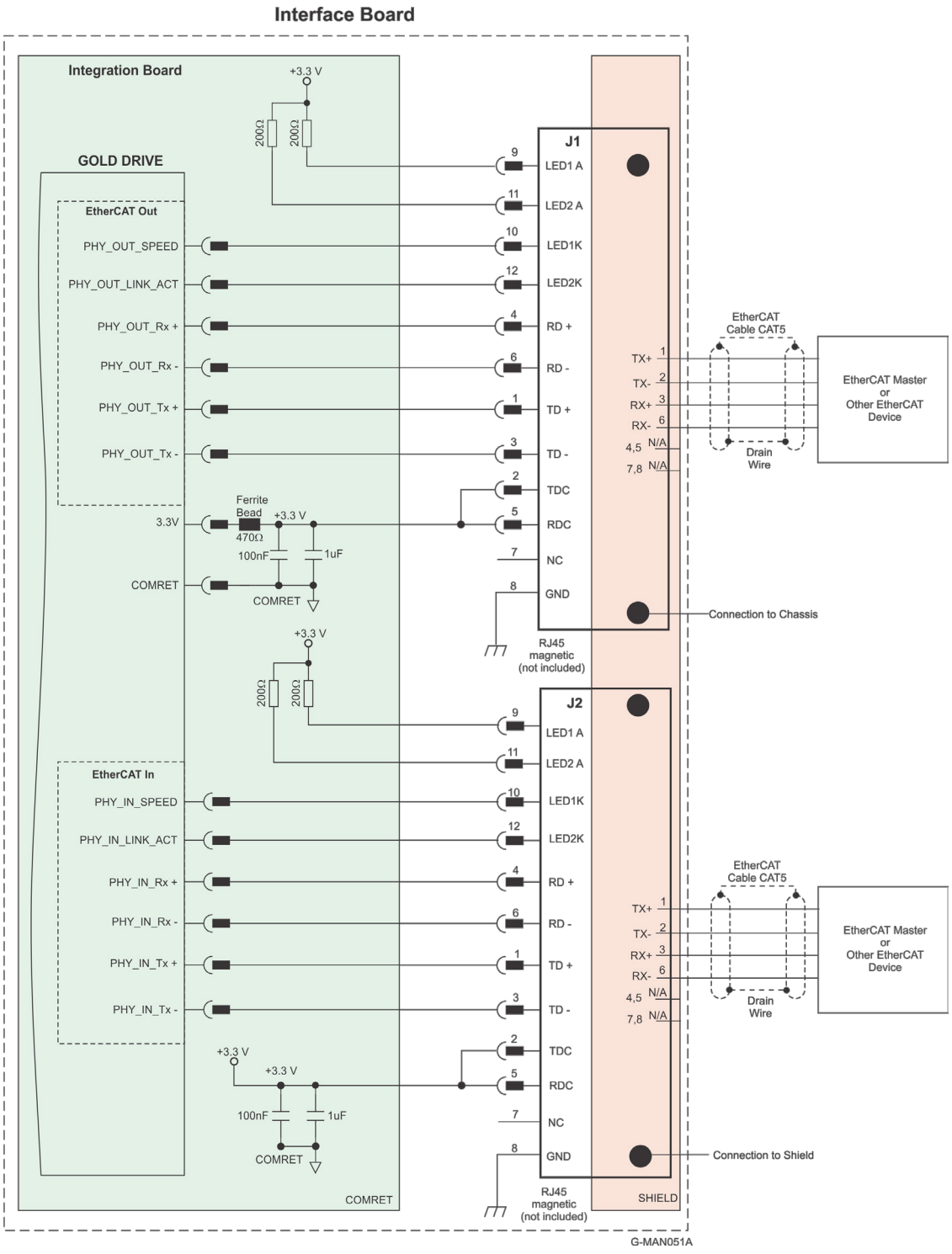


Figure 28: EtherCAT Connection Schematic with Diagram Sign of 3.3V

9.6.8. CAN

Figure 29 displays the CAN connectivity.

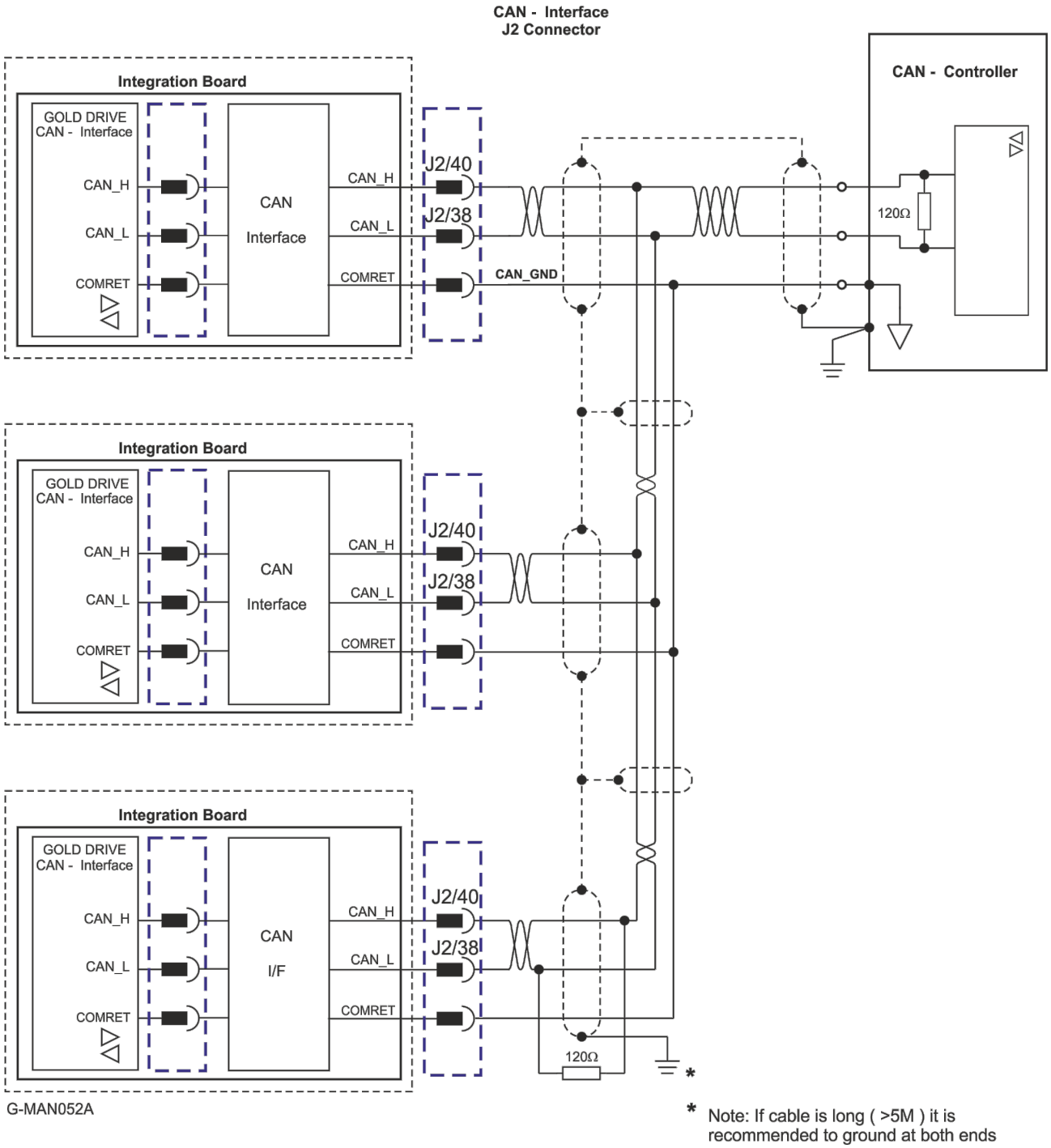
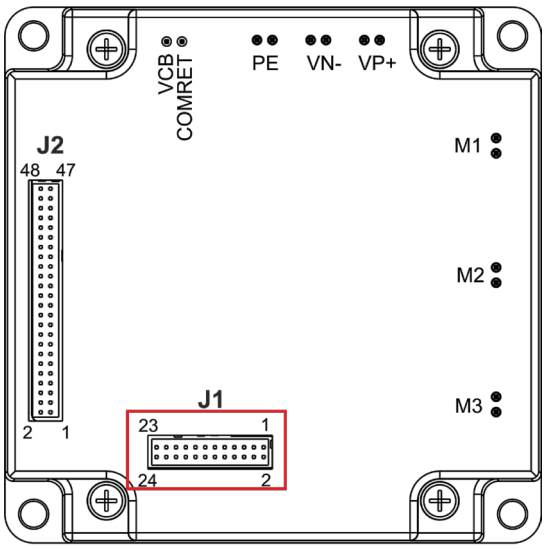


Figure 29: CANbus Connections

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

9.7. Connector J1 - Digital I/O, Analog Inputs, LEDs, and STO



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For full details on Digital and Analog I/Os, see Chapter 11 and 12 in the MAN-G-Board Level Modules Hardware Manual.

For full details on the LEDs, see Chapter 7 Drive Status Indicator, and section 14.2.6 EtherCAT Status Indicator in the in the MAN-G-Board Level Modules Hardware manual for full details.

For full details on STO, see Chapter 9 in the in the MAN-G-Board Level Modules Hardware manual for full details.

Connector Type: 1.27 mm pitch 0.41 mm sq

Pin (J1)	Signal	Function
1	SB_Load	Serial Bus Load for extended IO (refer to MAN-G-Board Level Modules Hardware manual)
2	SB_Clock	Serial Bus_Clock (9.375Mhz) for extended IO (refer to MAN-G-Board Level Modules Hardware manual)
3	INRET1_6	Programmable digital inputs 1–6 return
4	IN1	Programmable digital input 1
5	IN2	Programmable digital input 2
6	IN3	Programmable digital input 3
7	IN4	Programmable digital input 4
8	IN5	Programmable digital input 5
9	IN6	Programmable digital input 6
10	STO_RET	STO signal return
11	STO2	STO 2 input
12	STO1	STO 1 input
13	LED_ETHERCAT ERR	LED Status EtherCAT ERR
14	LED_ETHERCAT RUN	LED Status EtherCAT RUN

Pin (J1)	Signal	Function
15	OUT2	Programmable output 2
16	OUT1	Programmable output 1
17	OUTRET2	OUT 2 return
18	OUTRET1	OUT 1 return
19	LED2	Bi-color indication output 2 (Cathode)
20	LED1	Bi-color indication output 1 (Cathode)
21	OUT4	Programmable output 4 not isolated (**3.3V TTL level**)
22	OUT3	Programmable output 3 not isolated (**3.3V TTL level**)
23	COMRET	Common return
24	ANALOG_IN2	Analog input 2 **Note: For details of the Analog Input 2 refer to section 9.6.4.2 within the details of the J2 connector**.

Table 6: Connector J1 – I/O, LEDs, STO, and Analog Input

9.7.1. Digital Inputs

9.7.1.1. TTL voltage level

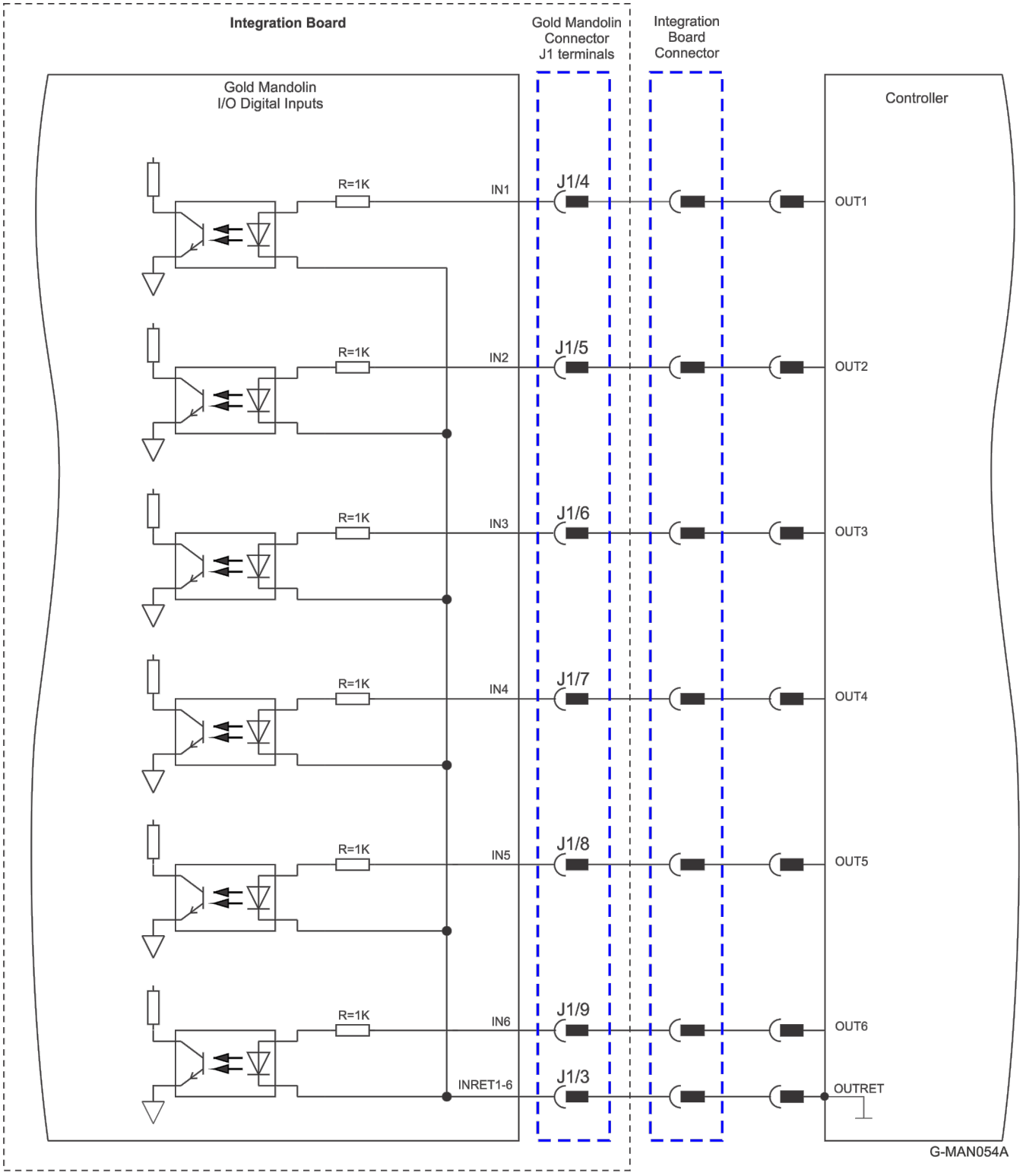


Figure 30: Digital Input TTL Mode Connection Diagram

9.7.2. Digital Outputs

9.7.2.1. Isolated Open Collector and Open Emitter

The following diagram describes theOUT1 and OUT2 outputs:

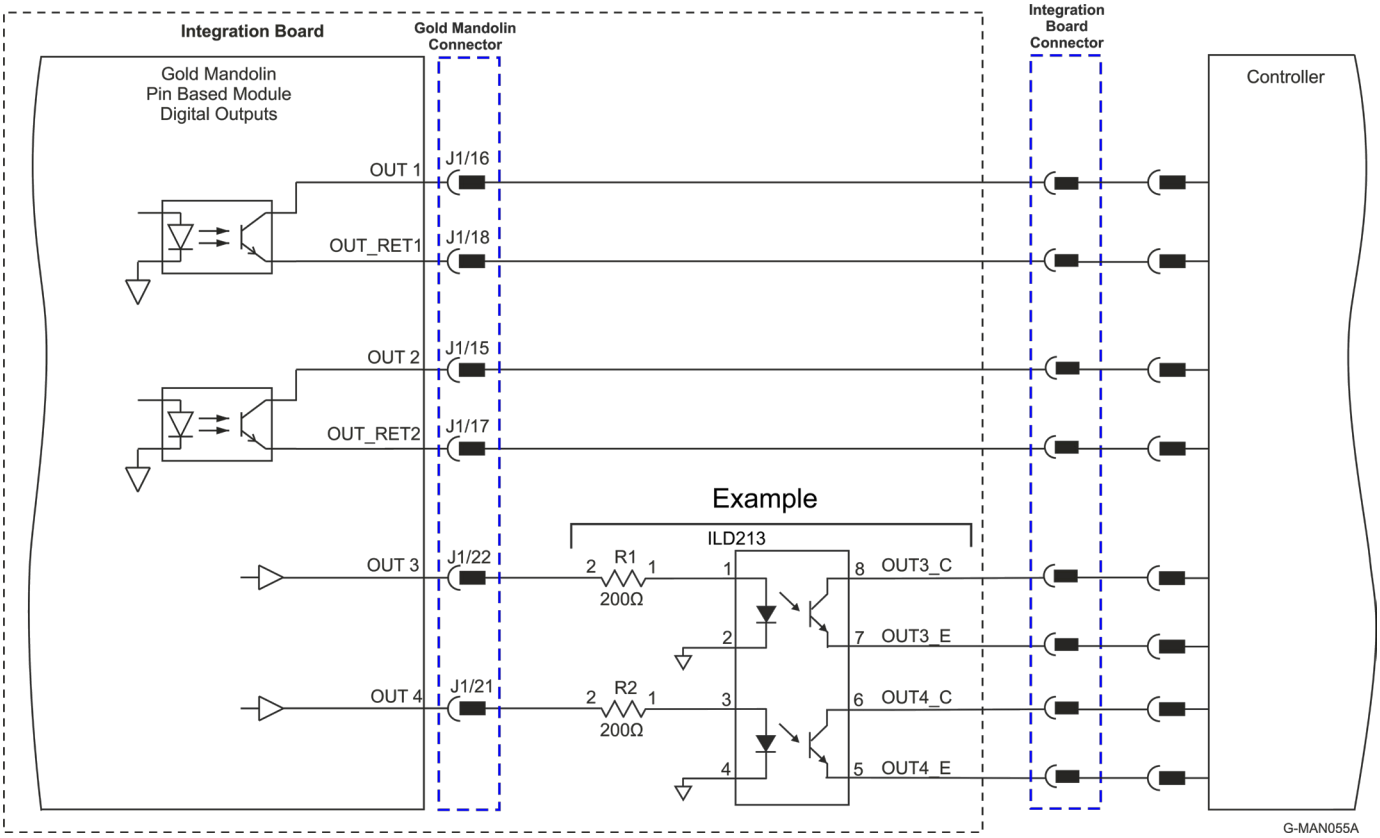


Figure 31: Digital Output Connection Diagram – Isolated Open Collector and Open Emitter Connection

9.7.3. Analog Inputs

For details of the Analog Input 2 – Single ended using Connector J1 in the Gold Mandolin, refer to the section 9.6.4 Analog Inputs for details.

9.7.4. STO Input Interfaces - TTL Mode

The diagram below describes the TTL option connection for the STO input interfaces.

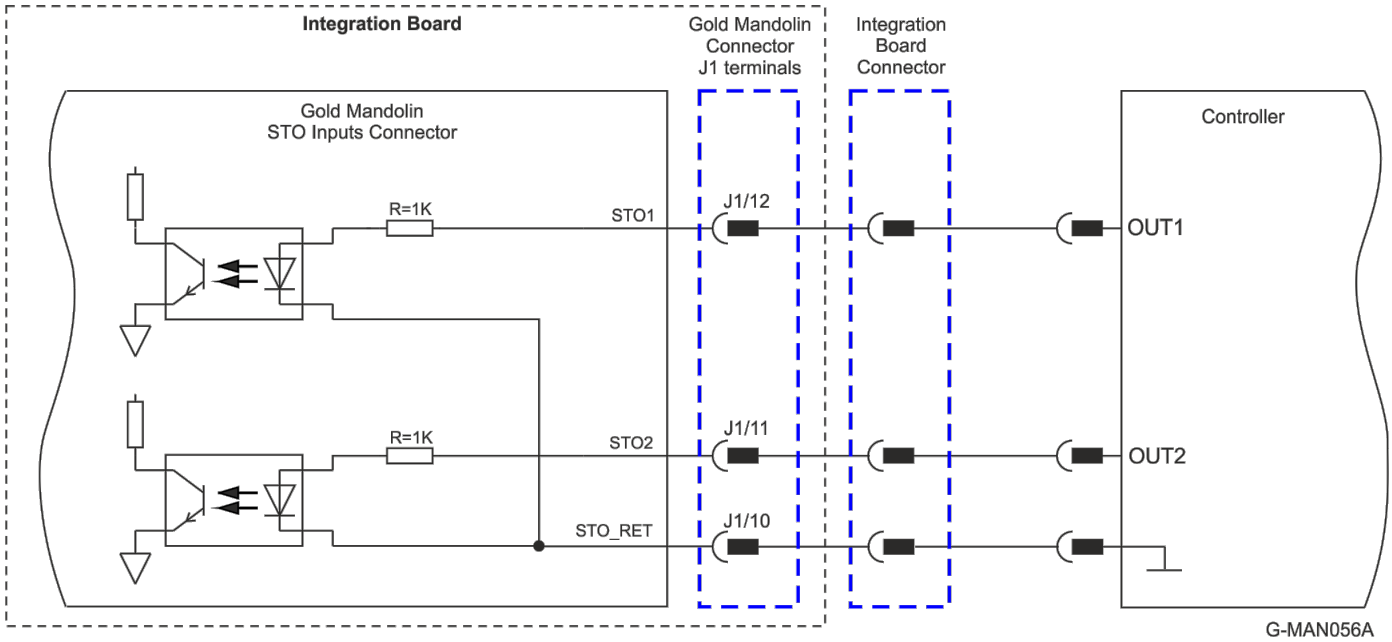


Figure 32: STO Input Connection – TTL Option

9.7.5. EtherCAT Status Indicator

For details of the EtherCAT Status Indicator, refer to the section 14.2.6 EtherCAT Status Indicator in the in the MAN G Board Level Modules Hardware manual for full details.

Chapter 10: Powering Up

After the Gold 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.

10.1. Initializing the System

After the Gold 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 11: Heat Dissipation

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

11.1. Gold Mandolin Thermal Data

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

11.2. Heat Dissipation Data

Heat Dissipation is shown graphically below:

Data to be added soon

11.3. How to Use the Charts

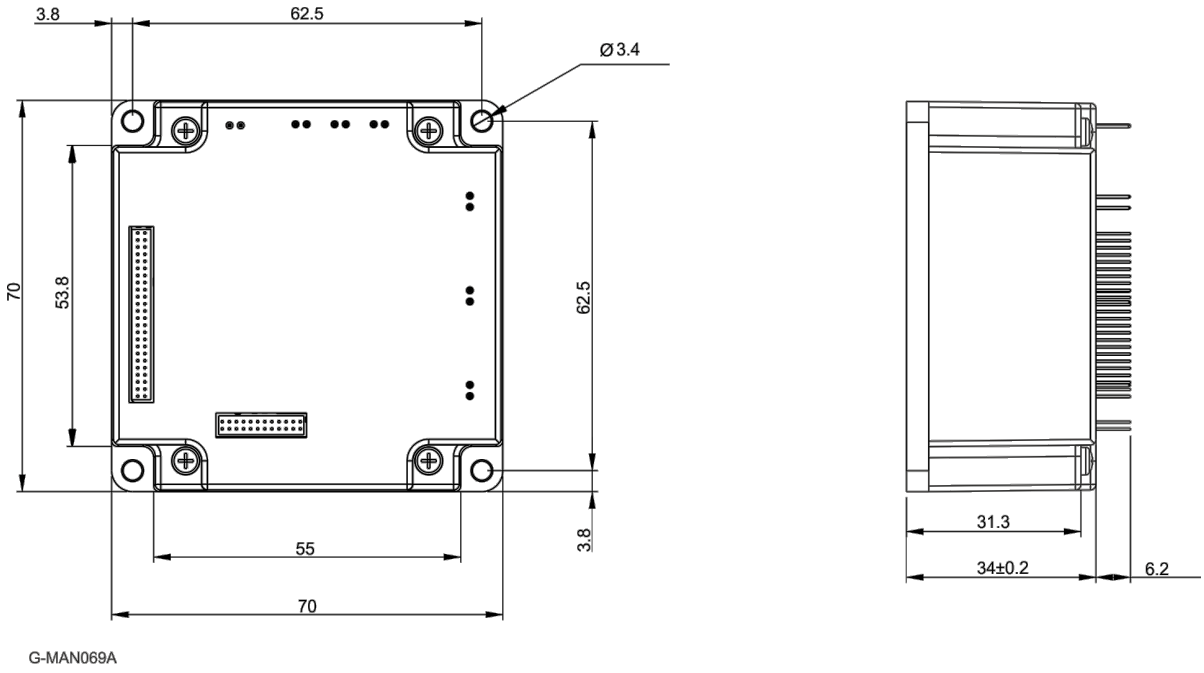
The charts above are based upon theoretical worst-case conditions. Actual test results show 30% to 50% better power dissipation.

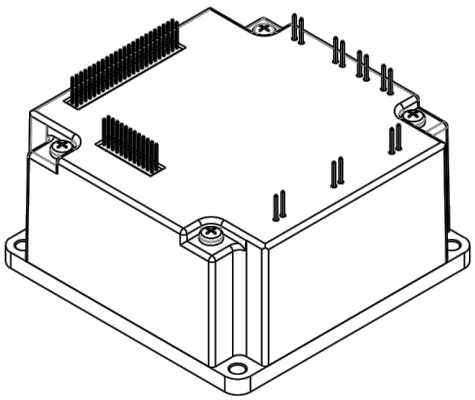
To determine if your application needs a heat sink:

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 Mandolin as ≤ 40 °C.
3. Calculate the allowable temperature increase according to the following example: For an ambient temperature of 40 °C, ΔT = 80 to 40°C = 40°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 12: Dimensions

This chapter provides detailed technical information regarding the Gold Mandolin.



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