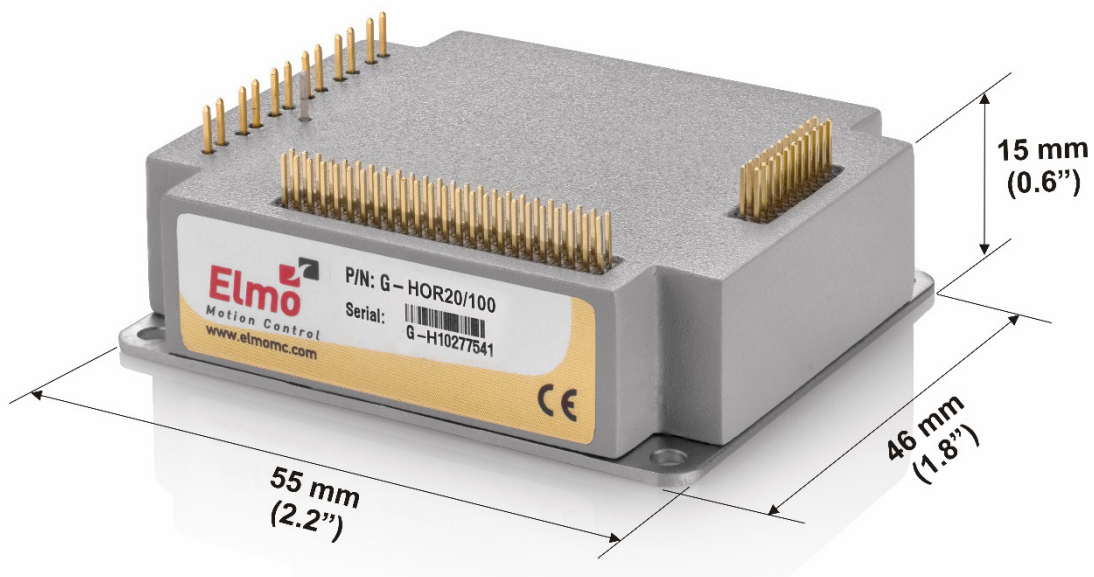


Inspiring Motion

Since 1988

# Gold Hornet Digital Servo Drive Installation Guide EtherCAT and CAN



March 2016 (Ver. 1.105)

[www.elmomc.com](http://www.elmomc.com)

**Elmo**  
Motion Control

# Notice

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

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

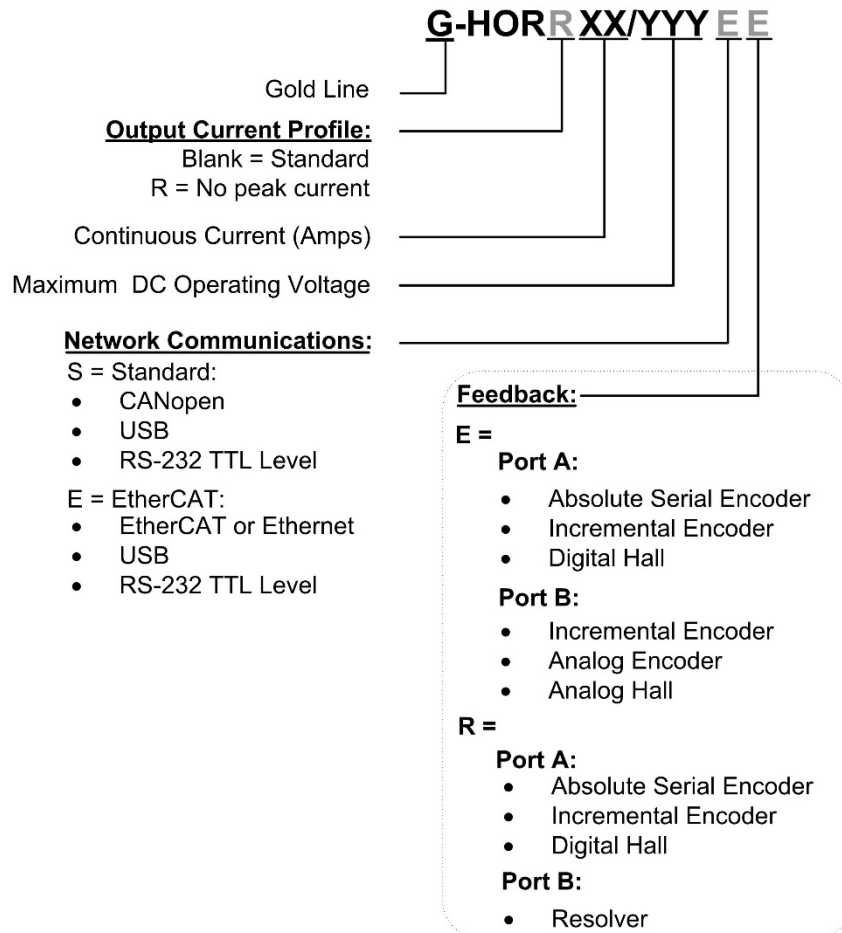
Document no. MAN-G-HOR (Ver. 1.105)

Copyright © 2016

Elmo Motion Control Ltd.

All rights reserved.

## Catalog Number





- Chapter 1: This Installation Guide .....5**
  
- Chapter 2: Safety Information .....5**
  - 2.1. Warnings .....6
  - 2.2. Cautions.....6
  - 2.3. CE Marking Conformance.....6
  - 2.4. Warranty Information .....6
  
- Chapter 3: Product Description.....7**
  
- Chapter 4: Technical Information.....8**
  - 4.1. Physical Specifications.....8
  - 4.2. Technical Data .....8
    - 4.2.1. Control Supply .....9
    - 4.2.2. Product Features .....10
    - 4.2.3. Environmental Conditions .....11
    - 4.2.4. Gold Line Standards.....12
  
- Chapter 5: Installation.....13**
  - 5.1. Unpacking the Drive Components .....13
  
- Chapter 6: Mounting the Gold Hornet.....14**
  
- Chapter 7: Integrating the Gold Hornet on a PCB.....16**
  - 7.1. Power Returns (PR) .....16
  - 7.2. COMRET.....16
  - 7.3. Earth Connection (PE) .....16
  - 7.4. Power Return (PR), Common Return (COMRET) and Earth Connections (PE).....17
  - 7.5. Power Conductors PCB layout.....18
  
- Chapter 8: The Gold Hornet Connection Diagram .....19**
  
- Chapter 9: PCB Connections .....21**
  - 9.1. Wiring legend .....21
  - 9.2. Connector Types.....23
  - 9.3. Drive Status Indicator .....23
  - 9.4. Motor Power Connector Pinouts .....24
  - 9.5. Main Power and Control Connector .....26
    - 9.5.1. Main Power .....26
    - 9.5.2. Control Supply .....27
    - 9.5.3. Power Supply for the Power Rating 200 V .....28
    - 9.5.4. Power Supply for power rating 100 V .....29
      - 9.5.4.1. Single Power Supply .....29
      - 9.5.4.2. Shared Optional Backup Supply .....31

9.6.	Connector J2 - Feedback, Analog Inputs, RS-232, USB, EtherCAT, Ethernet, and CAN32	
9.6.1.	Feedback Port A.....	35
9.6.1.1.	Incremental Encoder .....	35
9.6.1.2.	Hall Sensors .....	36
9.6.1.3.	Absolute Serial Encoder.....	37
9.6.1.4.	Hiperface .....	39
9.6.2.	Feedback Port B.....	40
9.6.2.1.	Incremental Encoder .....	40
9.6.2.2.	Interpolated Analog (Sine/Cosine) Encoder .....	41
9.6.2.3.	Resolver .....	42
9.6.3.	Port C – Emulated Encoder Output .....	43
9.6.4.	Analog Inputs.....	44
9.6.4.1.	Analog Input 1 .....	44
9.6.4.2.	Analog Input 2 .....	45
9.6.5.	RS232 TTL Logic Level .....	46
9.6.6.	USB 2.0 .....	47
9.6.7.	EtherCAT/Ethernet .....	48
9.6.8.	CAN .....	49
9.7.	Connector J1 - Digital I/O, Analog Inputs, LEDs, and STO .....	50
9.7.1.	Digital Inputs.....	52
9.7.1.1.	TTL voltage level .....	52
9.7.2.	Digital Outputs.....	53
9.7.2.1.	Isolated Open Collector and Open Emitter .....	53
9.7.3.	Analog Inputs.....	53
9.7.4.	STO Input Interfaces - TTL Mode.....	54
9.7.5.	EtherCAT Status Indicator .....	54
<b>Chapter 10:</b>	<b>Powering Up .....</b>	<b>55</b>
10.1.	Initializing the System .....	55
<b>Chapter 11:</b>	<b>Heat Dissipation .....</b>	<b>56</b>
11.1.1.	Thermal Data .....	56
11.1.2.	Heat Dissipation Data .....	56
11.1.3.	How to Use the Charts.....	57
<b>Chapter 12:</b>	<b>Dimensions .....</b>	<b>58</b>



## Chapter 1: This Installation Guide

This installation Guide details the technical data, pinouts, and power connectivity of the Gold Hornet. 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 Hornet, 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 Hornet 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 Hornet 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 Hornet 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 Hornet to an approved control supply, connect it through a line that is separated from hazardous live voltages using reinforced or double insulation in accordance with approved safety standards.
- Before switching on the Gold Hornet, 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 Hornet 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 Hornet 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 time of installation, or 12 months from time of shipment, whichever comes first. No other warranties, expressed or implied — and including a warranty of merchantability and fitness for a particular purpose — extend beyond this warranty.



## Chapter 3: Product Description

The Gold Hornet is an advanced high power density servo drive, delivering up to **1.6 kW of continuous power** or **3.2 kW of peak power** in a 38.0 cc (2.32 in<sup>3</sup>) package (55 x 46 x 15 mm or 2.2" x 1.8" x 0.6"). The Gold Hornet is designed to be mounted on a PCB by soldering its pins directly to the PCB.

This advanced, high power density servo drive provides top performance, advanced networking and built-in safety, as well as a fully featured motion controller and local intelligence. Power to the Gold Hornet is provided by a DC power source which is isolated from the Mains. The Gold Hornet can operate with single or dual power supplies. If separation between the main DC power source and a control supply is required, then a control supply (isolated from the Mains) is required.

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

The Gold Hornet 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.

The Gold Hornet is available in a variety of models. There are multiple power rating options, two different communications options, a number of feedback options and different I/O configuration possibilities.



## Chapter 4: Technical Information

### 4.1. Physical Specifications

Feature	Units	All Types
Weight	g (oz)	55 g (1.94 oz)
Dimension	mm (in)	55 x 46 x 15 mm (2.2" x 1.8" x 0.6")
Mounting method		PCB mount

### 4.2. Technical Data

Feature	Units	1/100	2.5/100	5/100	10/100	15/100	20/100
Minimum supply voltage	VDC	12					
Nominal supply voltage	VDC	85					
Maximum supply voltage	VDC	95					
Maximum continuous power output	W	80	200	400	800	1200	1600
Efficiency at rated power (at nominal conditions)	%	> 99					
Maximum output voltage		> 95% of DC bus voltage at f = 22 kHz					
Control power supply	VDC	12 to 95 VDC (up to 6 VA inc. 5 V/2 x 200 mA for encoder)					
Amplitude sinusoidal/DC continuous current	A	1.0	2.5	5	10	15	20
Sinusoidal continuous RMS current limit (I <sub>c</sub> )	A	0.7	1.8	3.5	7	10.6	14.1
Peak current limit	A	2 x I <sub>c</sub>					

Table 1: Technical Data

**Note on current ratings:** The current ratings of the Gold Hornet 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.





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

Feature	Units	3/200	6/200	9/200
Minimum supply voltage	VDC	12		
Nominal supply voltage	VDC	170		
Maximum supply voltage	VDC	195		
Maximum continuous power output	W	480	960	1450
Efficiency at rated power (at nominal conditions)	%	> 99		
Maximum output voltage		> 95% of DC bus voltage at f = 22 kHz		
Control supply	VDC	12 to 95 VDC (up to 6 VA inc. 5 V/1 x 200 mA for encoder)		
Amplitude sinusoidal/DC continuous current	A	3	6	9
Sinusoidal continuous RMS current limit (Ic)	A	2.1	4.2	6.3
Peak current limit	A	2 x Ic		

#### 4.2.1. Control Supply

Feature	Details
Control supply	<i>Isolated DC source only</i>
Control supply input voltage	12 to 95 V
Control supply input power	≤4 VA without external loading ≤6 VA with full external loading



### 4.2.2. Product Features

Main Feature	Details	Presence / No.
STO	TTL	√
Digital Input Option	TTL	6
Digital Output Option	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	√
	CAN	√
	RS-232 TTL level	√



### 4.2.3. Environmental Conditions

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

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

Feature	Operation Conditions	Range
<b>Ambient Temperature Range</b>	Non-operating conditions	-50 °C to +100 °C (-58 °F to 212 °F)
	Operating conditions	-40 °C to +70 °C (-40 °F to 160 °F)
<b>Temperature Shock</b>	Non-operating conditions	-40 °C to +70 °C (-40 °F to 160 °F) within 3 min
<b>Altitude</b>	Non-operating conditions	Unlimited
	Operating conditions	-400 m to 12,000 m (-1312 to 39370 feet)
<b>Maximum Humidity</b>	Non-operating conditions	Up to 95% relative humidity non-condensing at 35 °C (95 °F)
	Operating conditions	Up to 95% relative humidity non-condensing at 25 °C (77 °F), up to 90% relative humidity non-condensing at 42 °C (108 °F)
<b>Vibration</b>	Operating conditions	20 Hz to 2,000 Hz, 14.6 g
<b>Mechanical Shock</b>	Non-operating conditions	±40g; Half sine, 11 msec
	Operating conditions	±20g; Half sine, 11 msec
<b>Atmosphere</b>	Operating area atmosphere	No flammable gases or vapors permitted in area
<b>Protection level</b>		IP00



#### 4.2.4. Gold Line Standards

The following table describes the Main Standards of the Gold Hornet servo drive. For further details refer to Chapter 17 in 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>Approved IEC/EN 61800-5-1</b>	Adjustable speed electrical power drive systems Safety requirements – Electrical, thermal and energy
<b>Recognized UL61800-5-1</b>	Adjustable speed electrical power drive systems Safety requirements – Electrical, thermal and energy
<b>Recognized 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>Recognized CSA C22.2 NO. 14-13</b>	Industrial Control Equipment



## Chapter 5: Installation

The Gold Whistle 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 Hornet, verify that you have all of its components, as follows:

- The Gold Hornet servo drive
- The Elmo Application Studio (EAS) software and software manual

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

#### To unpack the Gold Hornet:

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



GHOR0038A

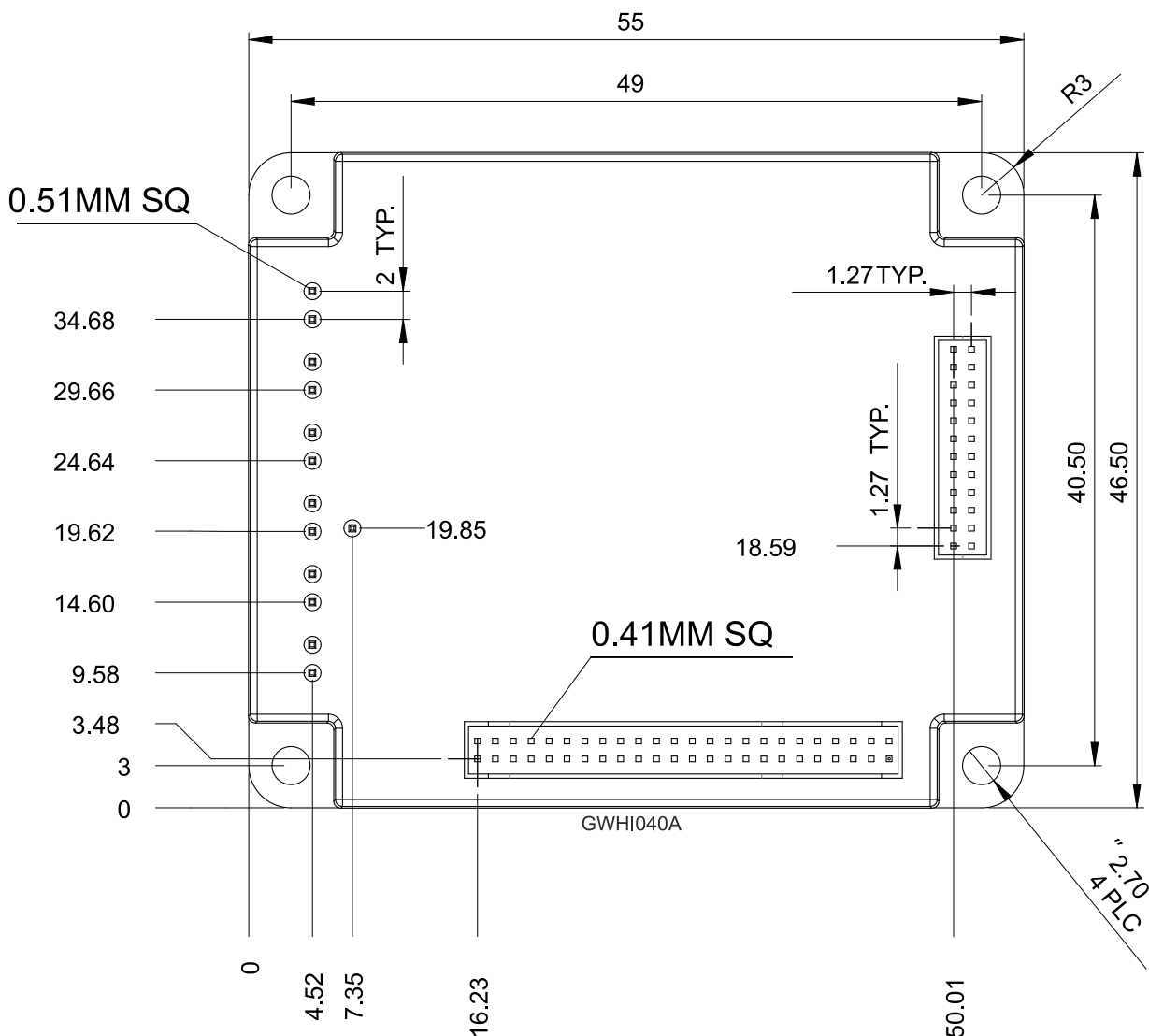
4. Verify that the Gold Hornet type is the one that you ordered, and ensure that the voltage meets your specific requirements.

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 Homet

The Gold Homet was designed for mounting on a printed circuit board (PCB) via 1.27 mm pitch 0.41 mm square pins and 2 mm pitch 0.51 mm square pins. When integrating the Gold Homet 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. We recommend that the Gold Homet be soldered directly to the board. Alternatively, though this is not recommended, the Gold Homet can be attached to socket connectors mounted on the PCB. If the PCB is enclosed in a metal chassis, we recommend that the Gold Homet be screw-mounted to it as well to help with heat dissipation. The Gold Homet has screw-mount holes on each corner of the heat-sink for this purpose – see below.

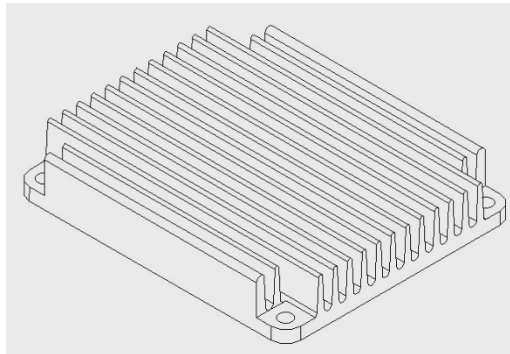


All measurements are in mm

Figure 1: Gold Homet Dimensions



When the Gold Hornet is not connected to a metal chassis, the application's thermal profile may require a solution for heat dissipation due to insufficient air convection. In this case, we recommend that you connect an external heat sink. Elmo has an external heat sink (Catalog number: WHI-HEAT-SINK-2) that can be ordered for this purpose, see Figure 2 below.



**Figure 2: Gold Hornet External Heat Sink**



## **Chapter 7: Integrating the Gold Hornet on a PCB**

The Gold Gold Hornet is designed to be mounted on a PCB by soldering its pins directly to the PCB. Refer to Chapter 5 in the MAN-G-Board Level Modules Hardware Manual and the Gold Line Whistle Design Guide MAN-G-WHIIDG for further information.

### **7.1. Power Returns (PR)**

In the Gold Hornet, the power stage and control stage are internally connected, and the negative node of the DC power bus is designates as PR

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

### **7.2. COMRET**

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

### **7.3. Earth Connection (PE)**

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

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





## 7.4. Power Return (PR), Common Return (COMRET) and Earth Connections (PE)

Safety regulations (UL61800-5-1, IEC61800-5-1, and UL508C) require that the servo drive, as a “stand alone”, must withstand breakdown voltages of 2KV for the 200V models, and 1.7KV for the 100V models, between PE to PR. However, the connections between PE to PR and the COMRET are essential for the safe operation of the servo drive. Therefore the following topology must be used:

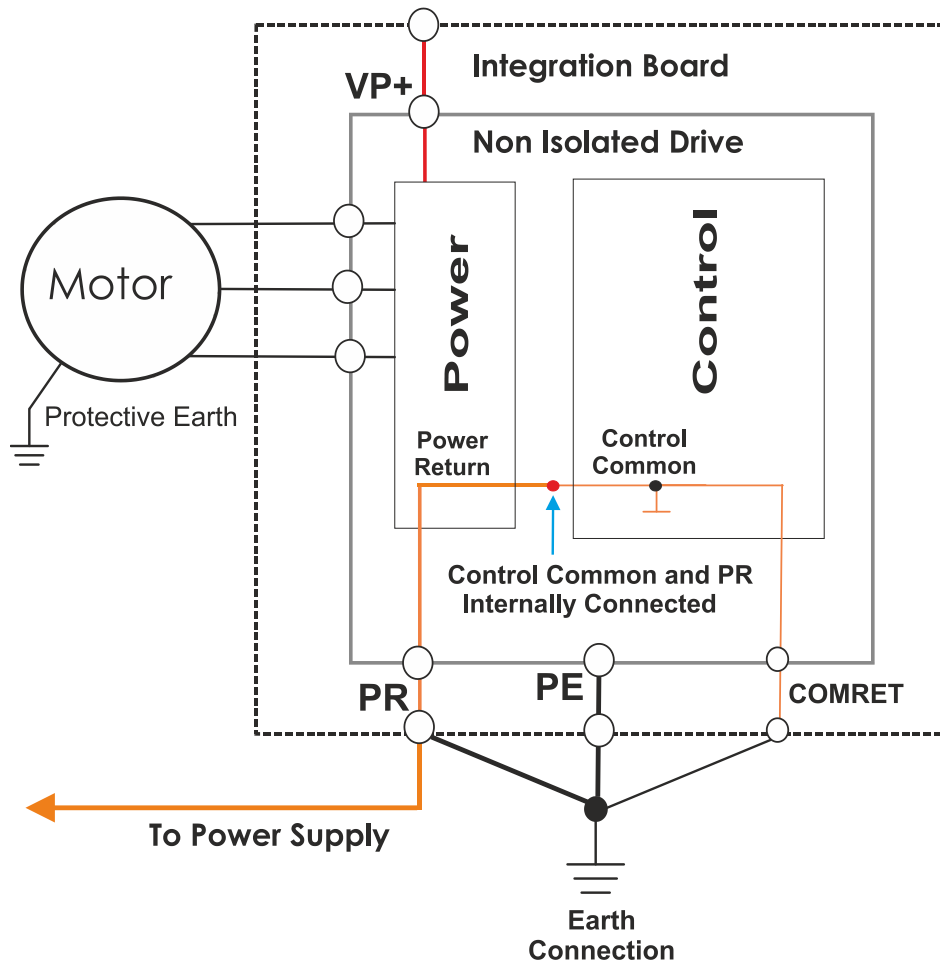


Figure 3: Gold Hornet Earth Connections

The connections to PE are essential, but must be done externally to the integration board.



## 7.5. 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+, PR, PE, VL+, VL-, VN- and motor leads.
- **Control and Communication Zone**  
This area of the PCB is dedicated to Control low level signals

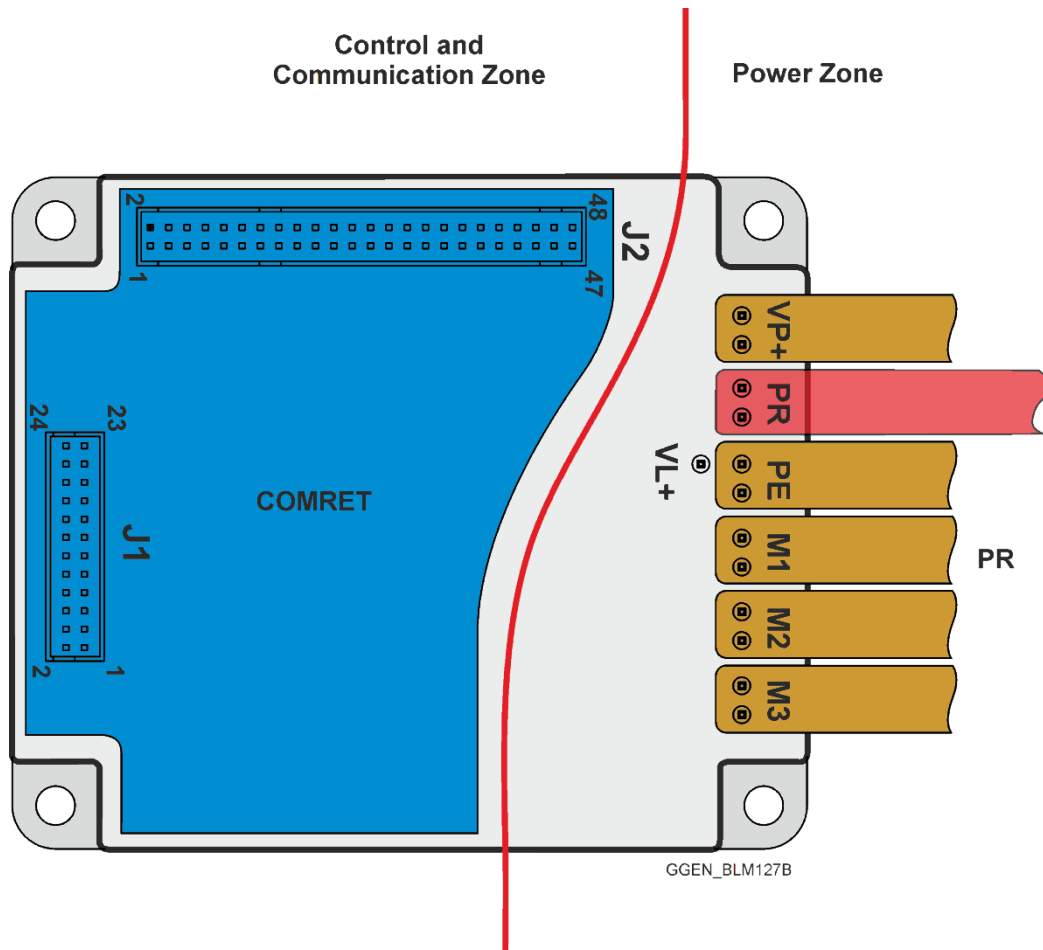
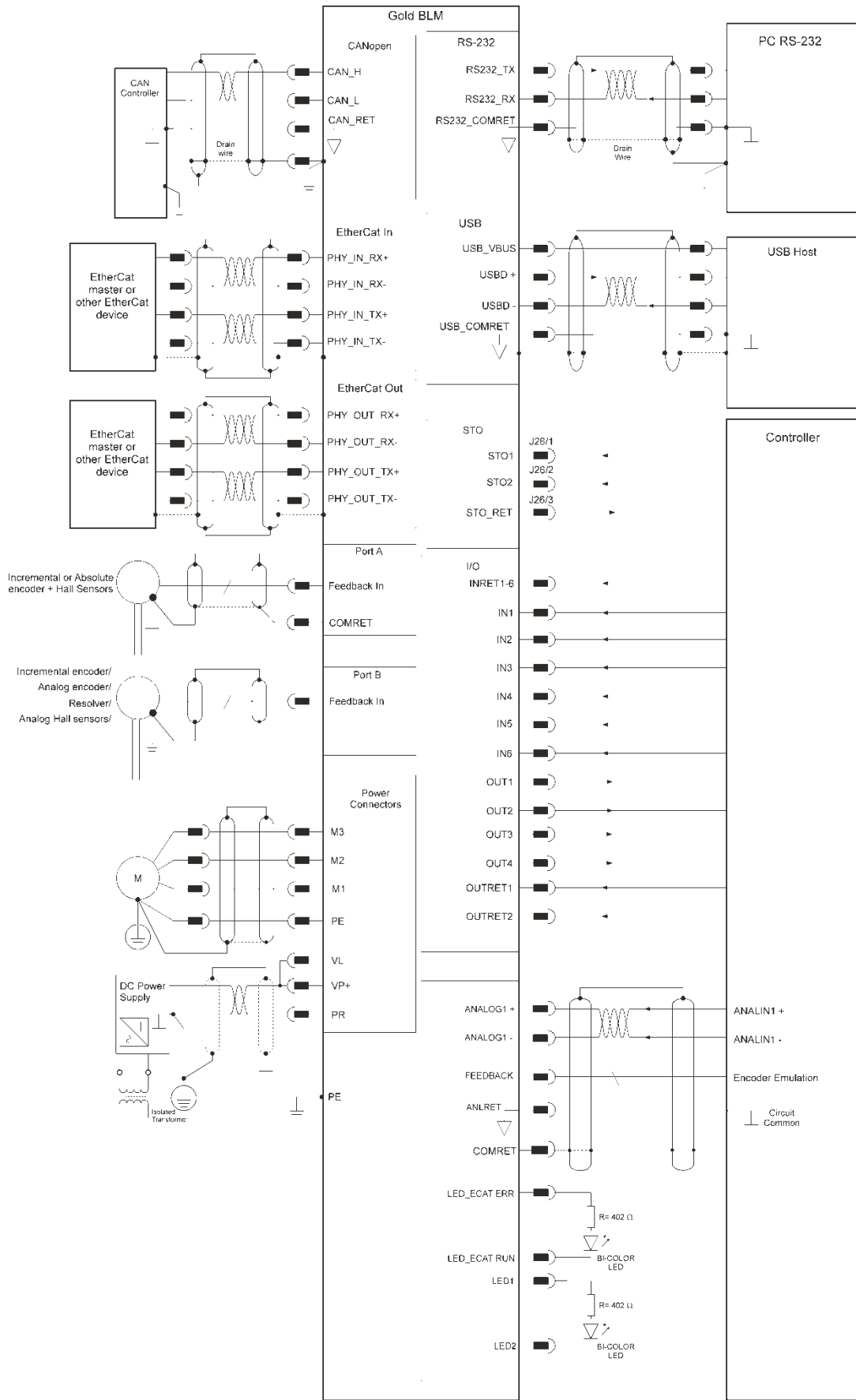


Figure 4: Gold Hornet Power Conductors PCB layout

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



## ***Chapter 8: The Gold Hornet Connection Diagram***



GW1019F




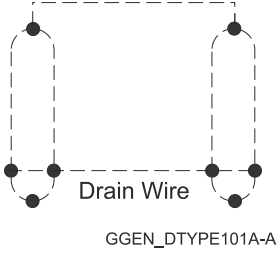
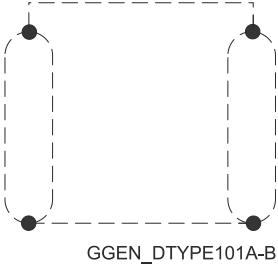
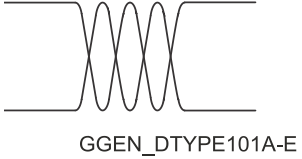
Figure 5: The Gold Hornet Connection Diagram



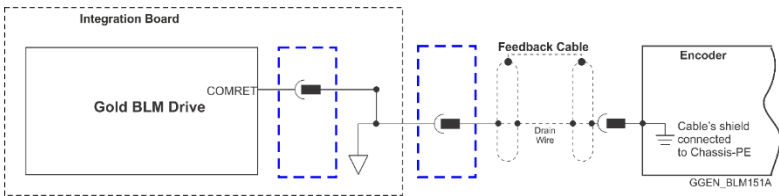
## Chapter 9: PCB Connections

### 9.1. Wiring legend

The following table legend describes the wiring symbols detailed in all installation guides. All the wiring diagrams show wiring for D-TYPE connectors.

Wiring Symbol	Description
	Earth connection (PE)
	Earth Connection
	Common at the Controller
	Shielded cable with drain wire. The drain wire is a non-insulated wire that is in direct contact with the braid (shielding). Shielded cable with drain wire significantly simplifies the wiring and earthing.
	Shielded cable braid only, without drain wire.
	Twisted-pair wires



Wiring Symbol	Description
 <p>The diagram illustrates the wiring for encoder earthing. On the left, an 'Integration Board' contains a 'Gold BLM Drive' with a 'COMRET' terminal. A connection point is shown with a ground symbol. A 'Feedback Cable' is connected to this point. The 'Feedback Cable' is shown with a 'Drain Wire' and is connected to an 'Encoder'. The 'Encoder' has a terminal for 'Cable's shield connected to Chassis-PE'. The part number 'GGEN_BLM151A' is noted below the encoder.</p>	<p><b>Encoder Earthing.</b></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>



## 9.2. Connector Types

The Gold Hornet has nine connectors.

Port	Pins	Type	Function	Connector Location
J2	2x24	1.27 mm pitch 0.41 mm sq	Feedbacks, Digital Halls, Analog Inputs, Communications	
J1	2x12		I/O, LEDs, STO	
M3	1x2	2 mm pitch 0.51 mm sq	Motor power output 3	
M2	1x2		Motor power output 2	
M1	1x2		Motor power output 1	
PE	1x2		Protective earth	
PR	1x2		Power input return	
VP+	1x2		Positive power input	
VL+	1x1	Control power input		

Table 2: 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

For full details see Chapter 8 in the MAN-G-Board Level Modules Hardware Manual.

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

Table 3: Motor Connector

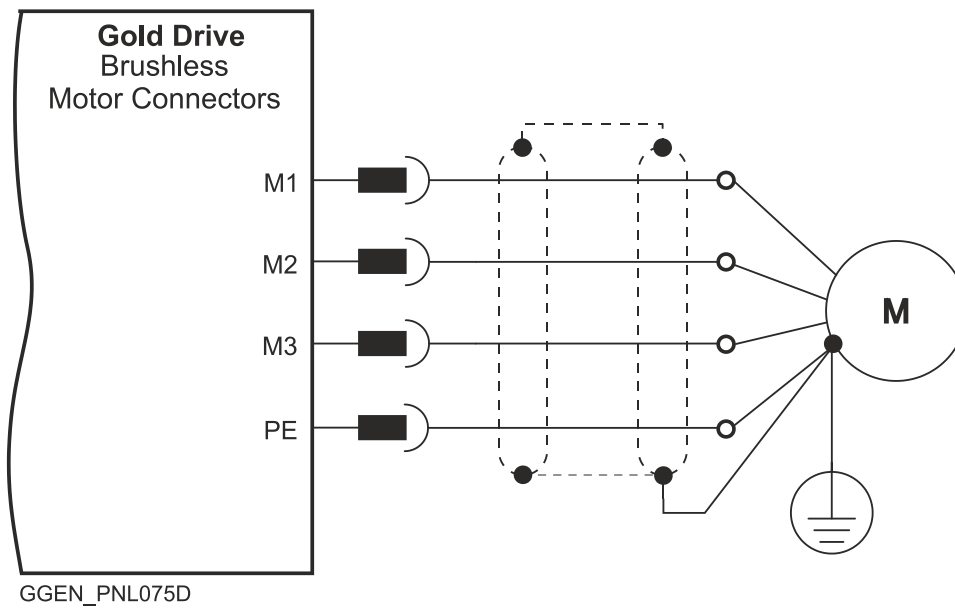


Figure 6: Brushless Motor Power Connection Diagram



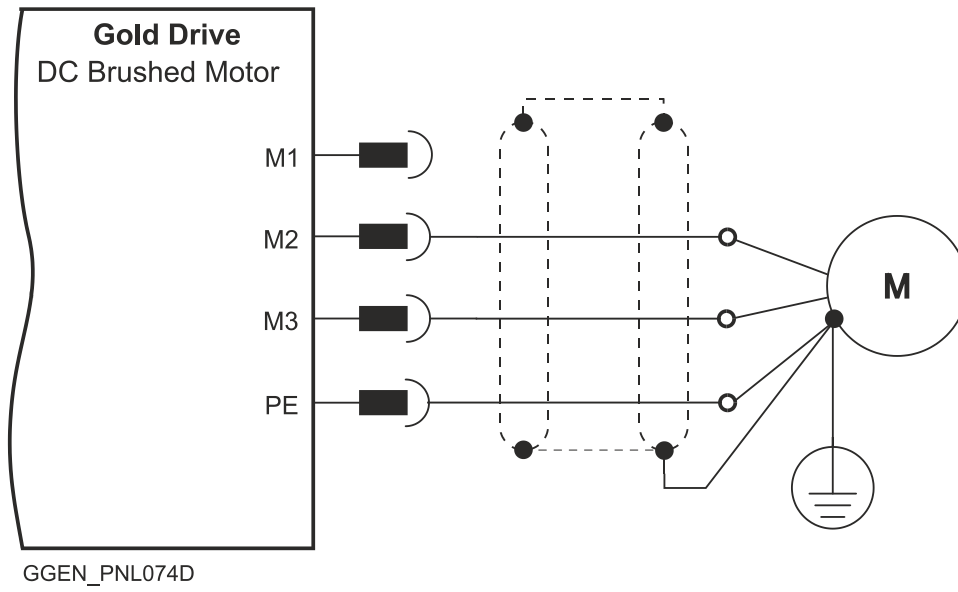


Figure 7: Brushed Motor Power Connection Diagram



## 9.5. Main Power and Control Connector

There are two power ratings for the Gold Hornet:

- 100V for is 12 to 95 VDC
- 200V for the 12 to 195 VDC

### For power rating 200V

Two DC power sources are required, a DC power source of 12 - 195V isolated from the Mains, and a control supply 12-95V (isolated from the Mains) for the logic.

### For power rating of 100V

Only a single DC Power source of 12 to 95 VDC isolated from the Mains, is required for the main power and also for the control power. However, a control power supply can be added for the logic.

### 9.5.1. Main Power

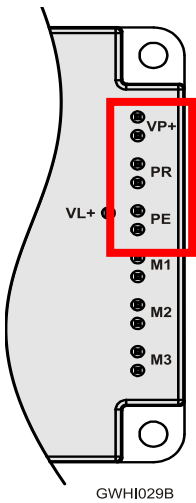
Pin	Function	Cable	Pin Positions
VP+	Pos. Power input	Power	
PR	Power return	Power	
PE	Protective earth	Power	
Connector Type: 2 mm pitch 0.51 mm sq			

Table 4: Connector for Main Power

**Note:** The source of the 12 to 195 VDC power supply must be isolated.

Connect the DC power cable to the VP+ and PR terminals on the Main Power Connector.

#### To connect your integration board to the DC power supply:

1. The source of the VDC power supply must be isolated from the Mains.
2. For best immunity, it is highly recommended to use twisted and shielded cables for the DC power supply. A 3-wire shielded cable should be used. The gauge is determined by the actual current consumption of the motor.
3. Connect the cable shield to the closest earth connection near the power supply.
4. Connect the PE to the closest earth connection near the power supply.
5. Connect the PR to the closest earth connection near the power supply.
6. Before applying power, first verify the polarity of the connection.



### 9.5.2. Control Supply

The Control supply is required for the 200V power rating, and can be added for the 100V power rating.

**Note:** The source of the Control Supply must be from the Mains.

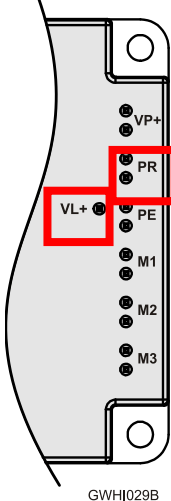
Pin	Function	Pin Positions
VL+	Control Supply Input	
PR	Control Supply Return	
Connector Type: 2 mm pitch 0.51 mm sq		

Table 5: Control Supply Pins

Connect the VL+ and PR terminal to the Control Connector.

**To connect your integration board to the control supply:**

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



### 9.5.3. Power Supply for the Power Rating 200 V

For Power Rating 200 V, two DC power sources are required, a main power 12 to 195V DC power source isolated from the Mains, and a control power supply 12 to 95V (isolated from the Mains) for the logic. The following figure describes the connection of main power and control.

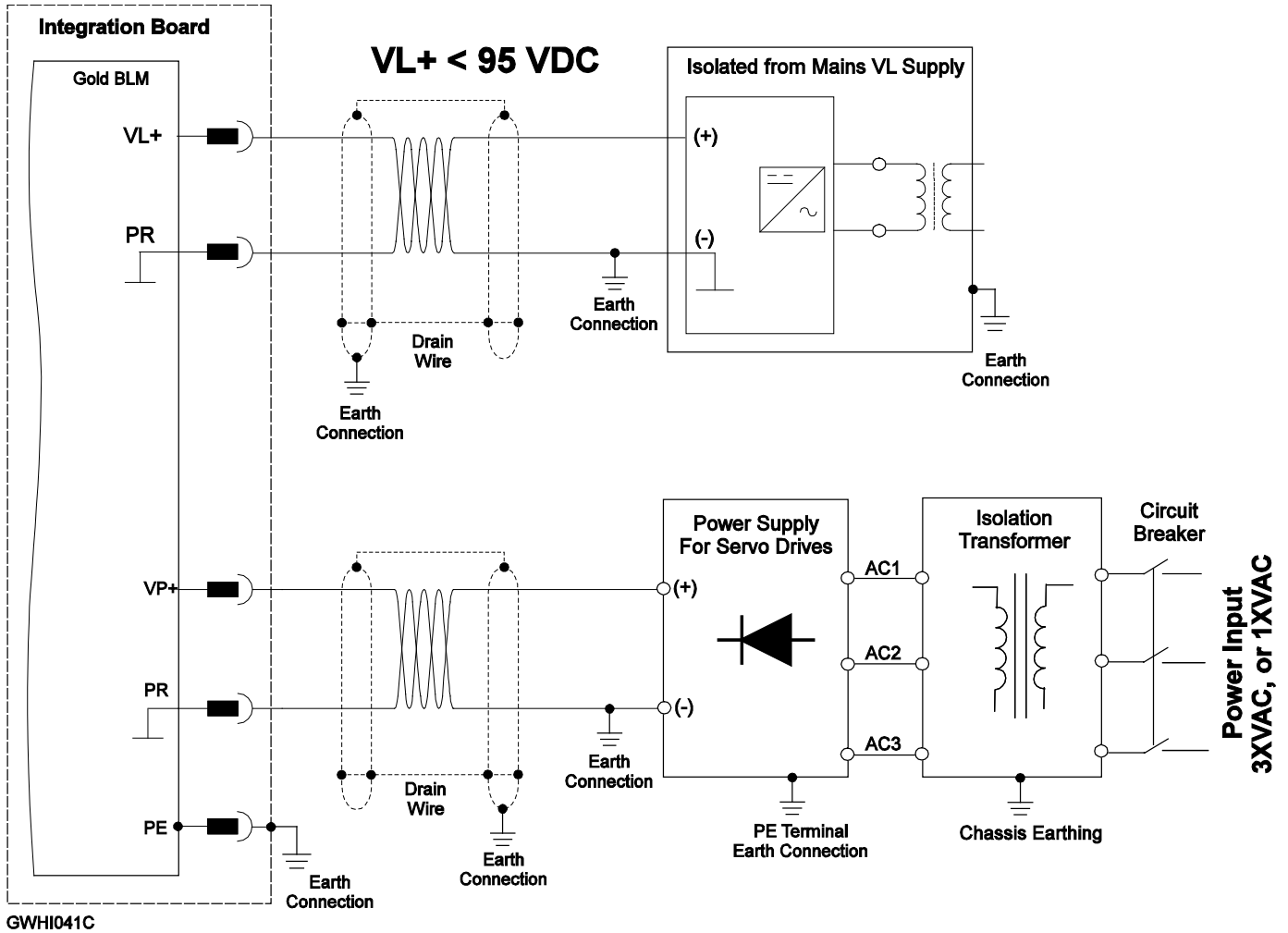


Figure 8: Power Supply Connection Diagram for Power Rating 200V

**Note:** Make sure to connect the PR to the closest earth connection near the power supply.



### 9.5.4. Power Supply for power rating 100 V

#### 9.5.4.1. Single Power Supply

Only one power supply is required for the main and control power.

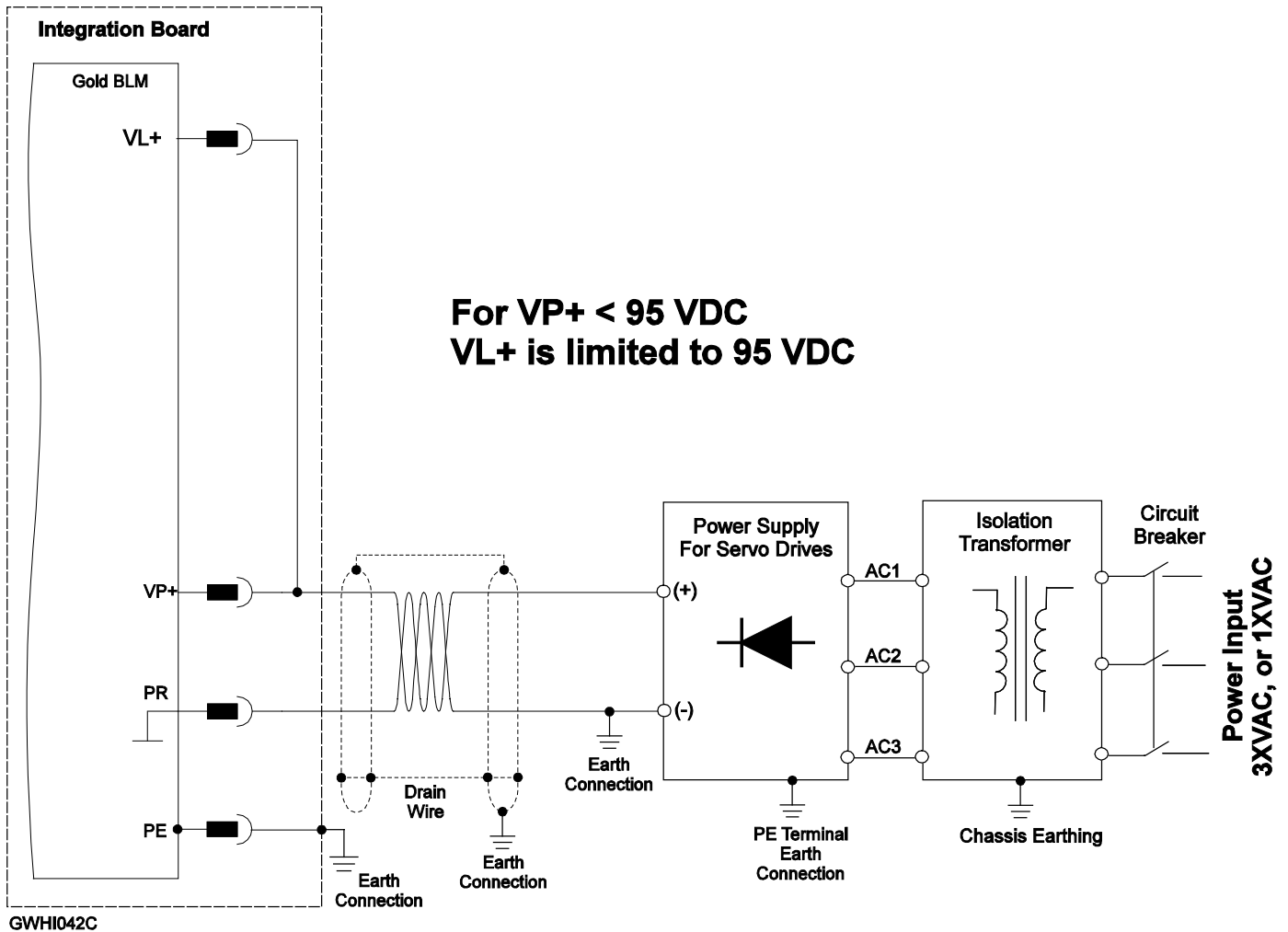


Figure 9: Single Power Supply Connection Diagram with VL+ Connected Internally

**Note:** Make sure to connect the PR to the closest earth connection near the power supply.

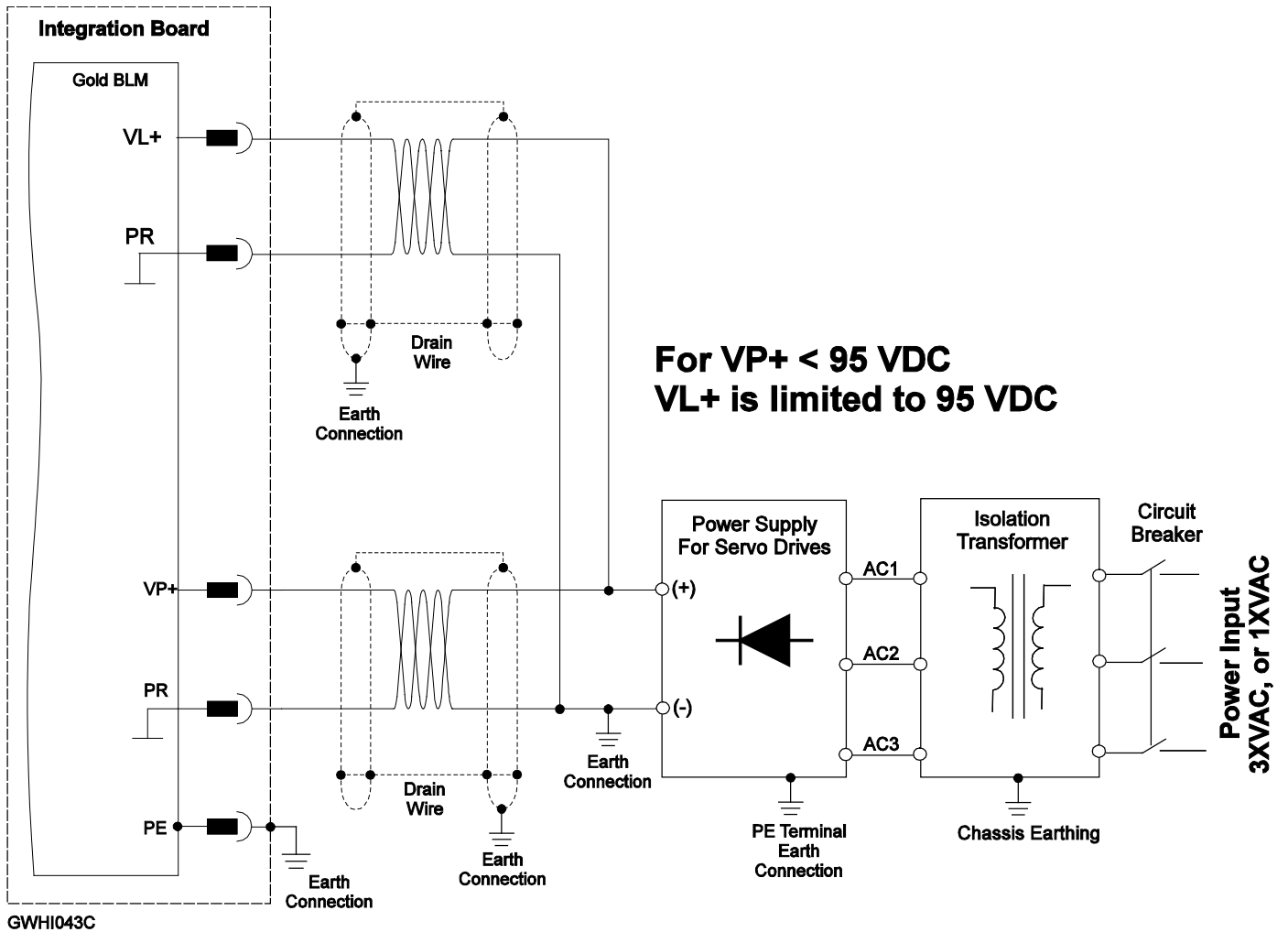


Figure 10: Single Power Supply Connection Diagram with VL+ Connected Externally

**Note:** Make sure to connect the PR to the closest earth connection near the power supply.



### 9.5.4.2. Shared Optional Backup Supply

A single DC Power Supply can supply the power for logic as well as the main power. If separation between the main DC power source and a control supply is required, then a control supply (isolated from the Mains) can be connected by implementing "diode coupling" (Figure 11).

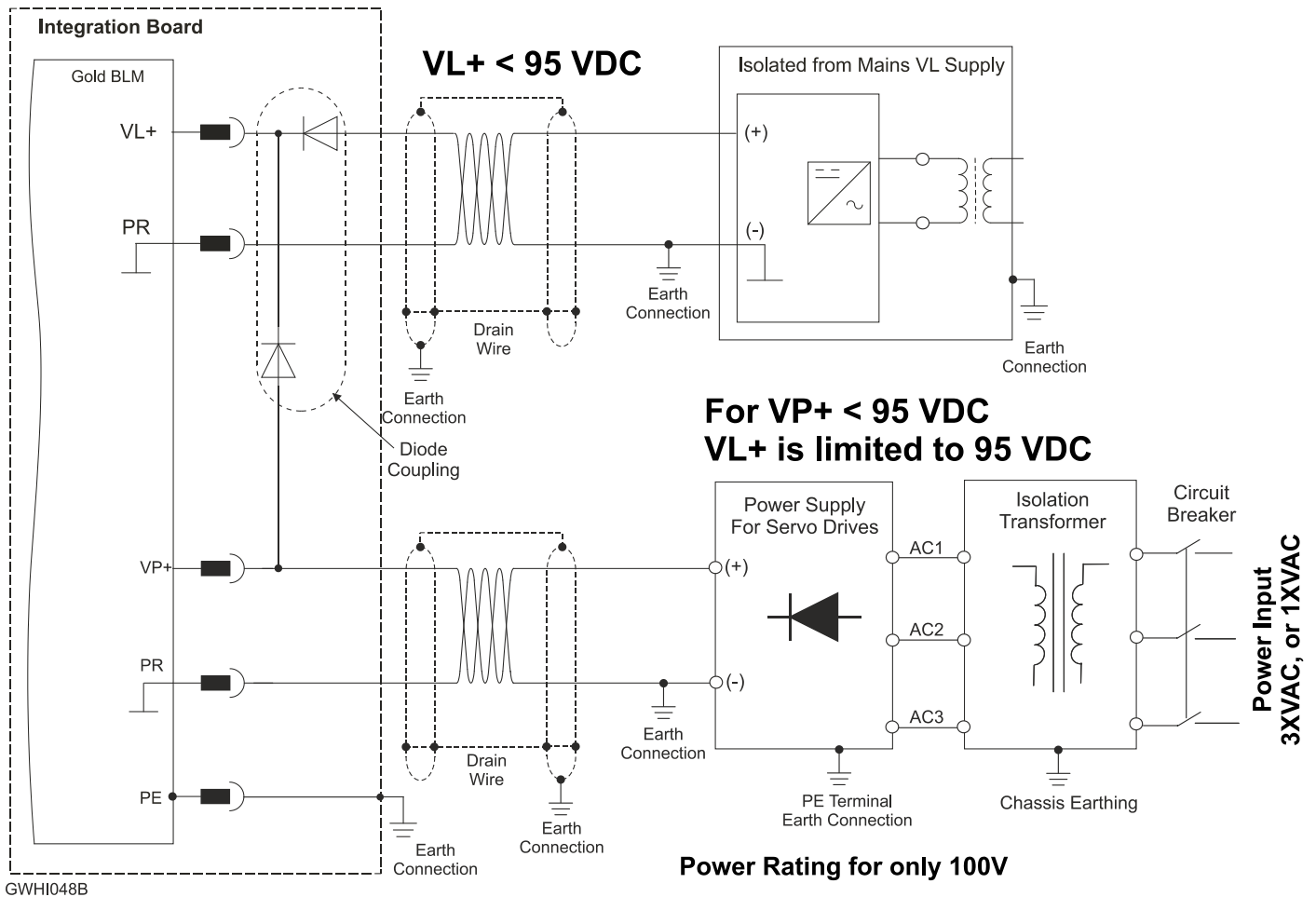
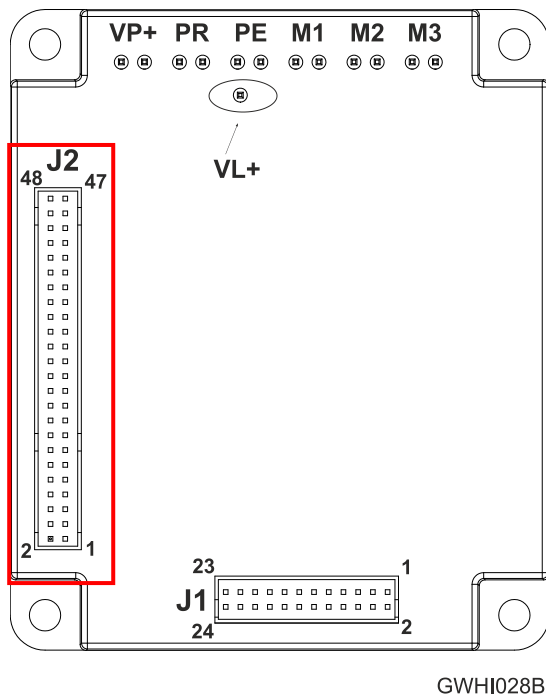


Figure 11: Shared Optional Power Supply Connection Diagram

**Note:** Make sure to connect the PR to the closest earth connection near the power supply.



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



**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 Hornet and are thus not operational simultaneously. See the part number diagram in Section 5.1 above for the different Gold Hornet 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
7	PortA_ENC_B-/ABS_DATA-	Port A - channel B complement / Absolute encoder Data-
8	PortC_ENCO_B+	Port C - channel B output





Pin (J2)	Signal	Function
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
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
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



Pin (J2)	Signal	Function
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	USB D-	USB_N line
42	USB D+	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: <b>Option 1:</b> RS232 receive (default) <b>Option 2:</b> 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: <b>Option 1:</b> RS232 transmit (Default) <b>Option 2:</b> Serial Bus IN for extended I/O (refer to Chapter 13 of the MAN-G-Board Level Modules Hardware Manual)

Table 6: Connector J2 – Feedback and Analog Input



### 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

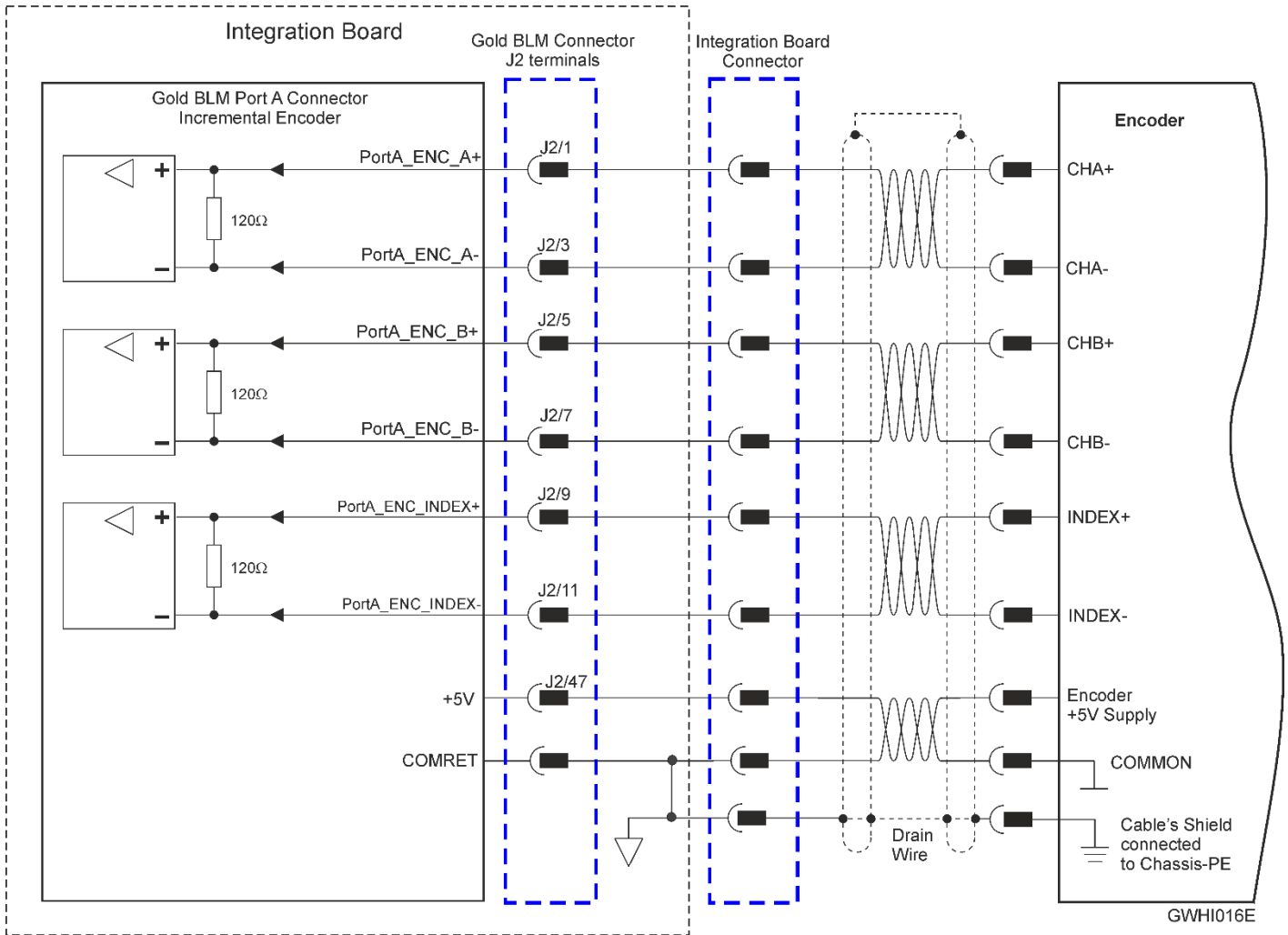


Figure 12: Port A Incremental Encoder Input – Recommended Connection Diagram



### 9.6.1.2. Hall Sensors

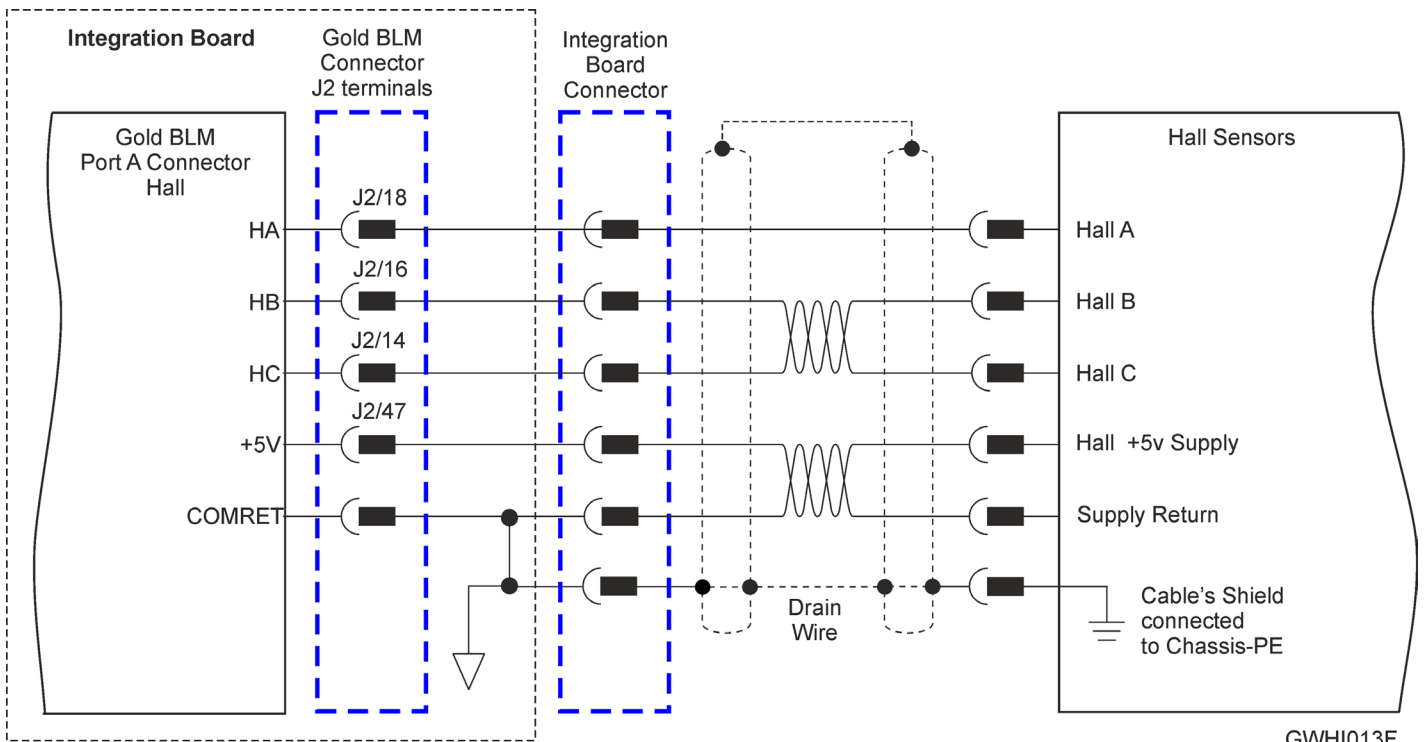


Figure 13: Hall Sensors Connection Diagram



### 9.6.1.3. Absolute Serial Encoder

The following Absolute Encoder are supported:

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

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

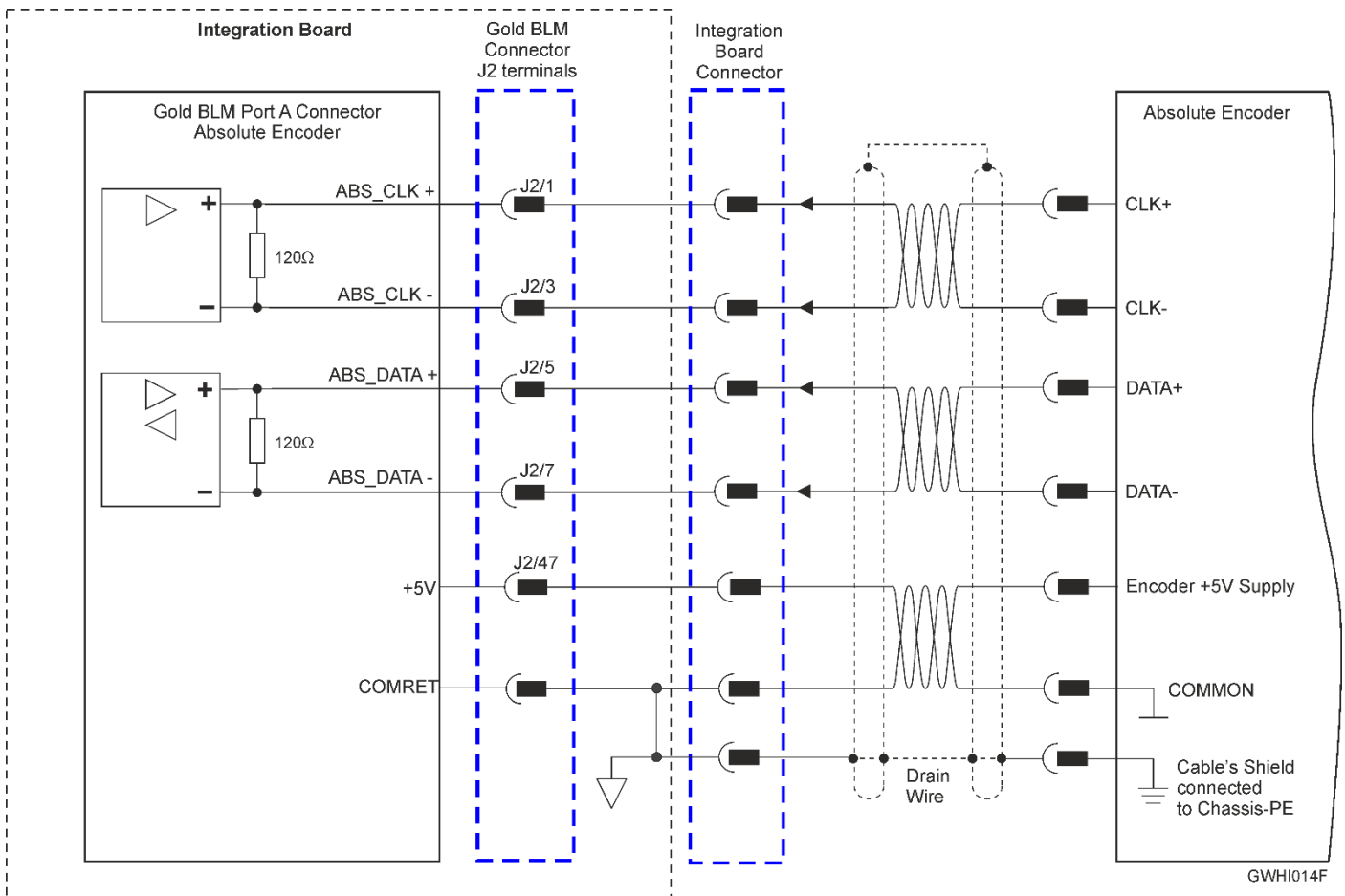
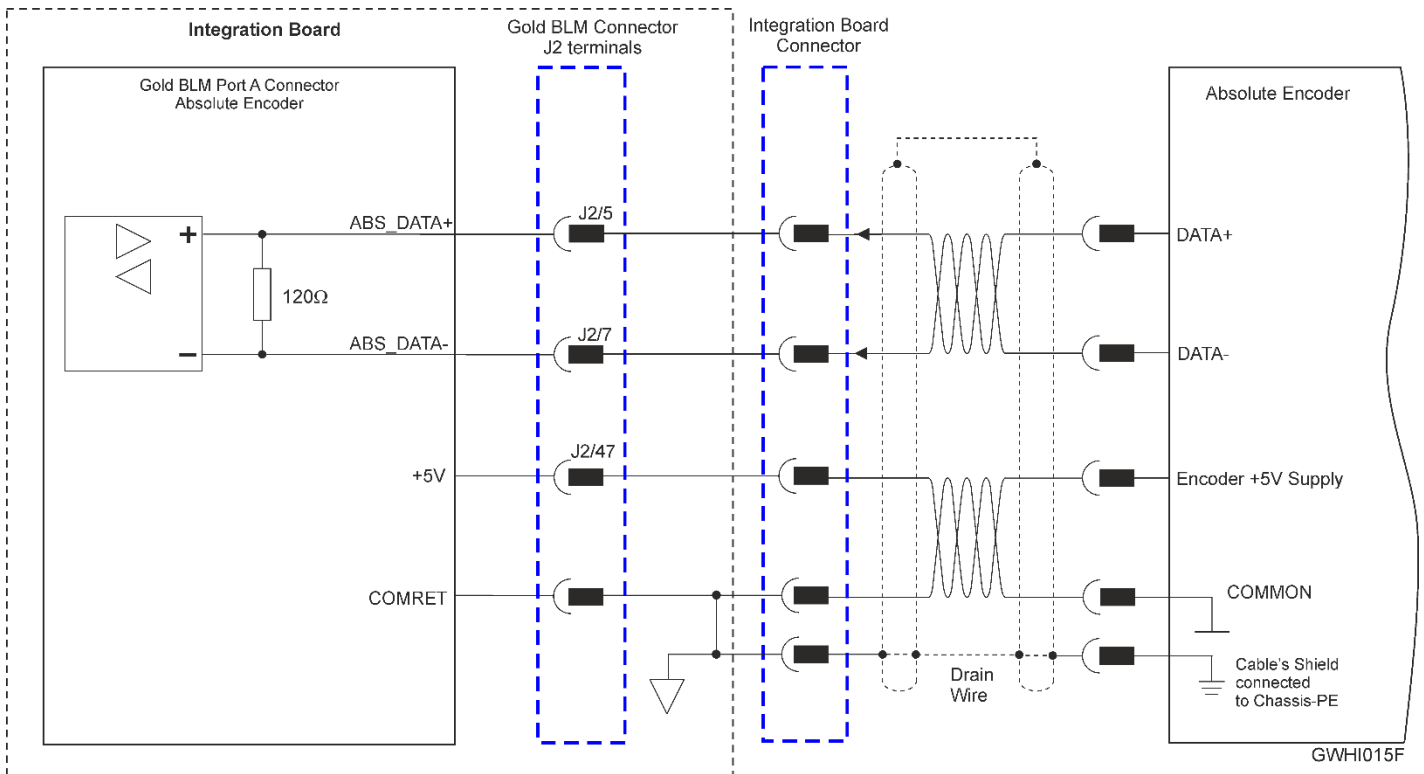


Figure 14: Absolute Serial Encoder – Recommended Connection Diagram for Endat, Biss, SSI



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



**Figure 15: Absolute Serial Encoder – Recommended Connection Diagram for Panasonic, Tamgawai, Sanyo-Danki**



### 9.6.1.4. Hiperface

The following figure describes the connection diagram.

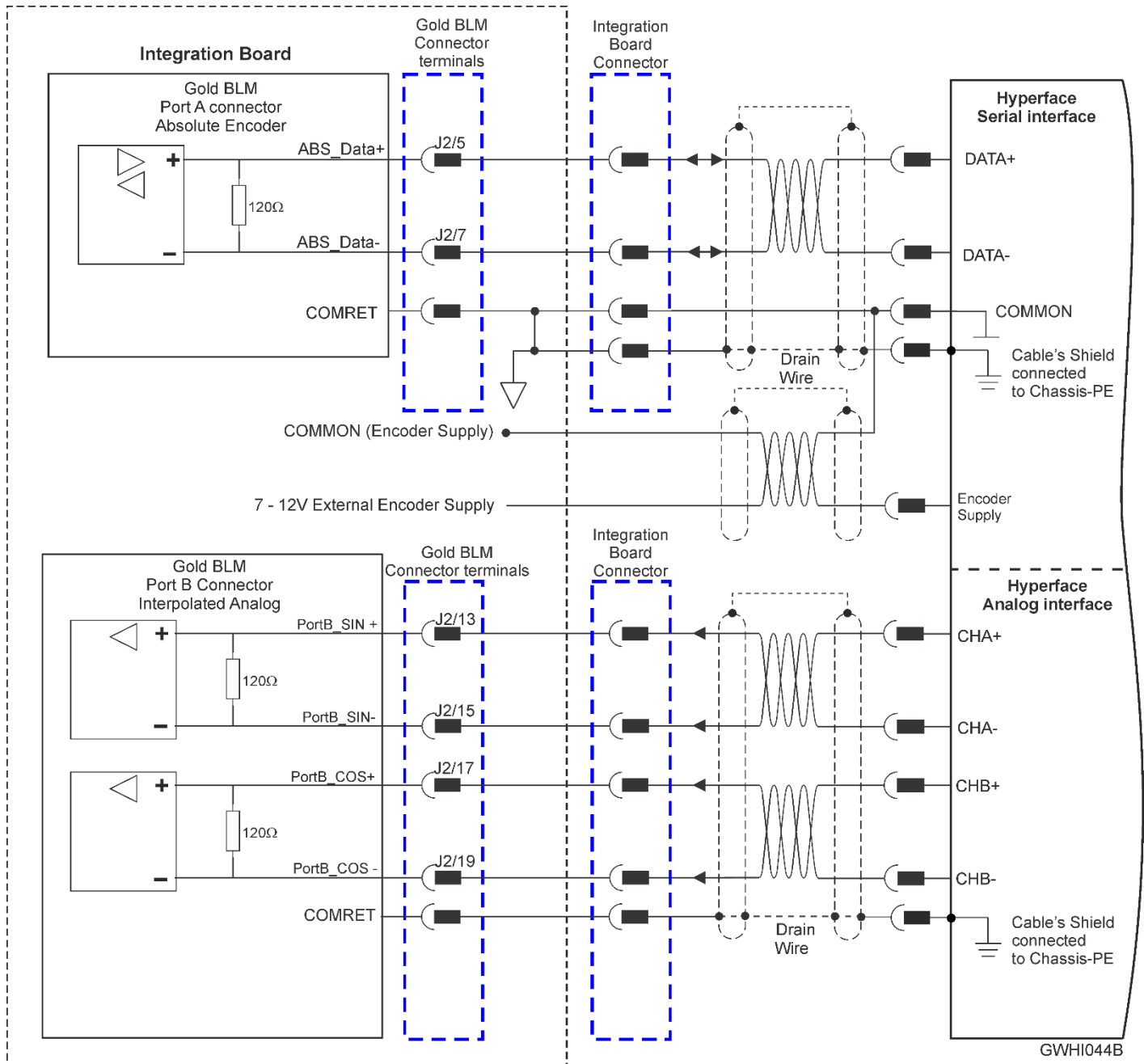


Figure 16: Absolute Serial Encoder – Recommended Connection Diagram for Stegmann Hiperface

**Note:** When the Hiperface protocol is used the RS232 is 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

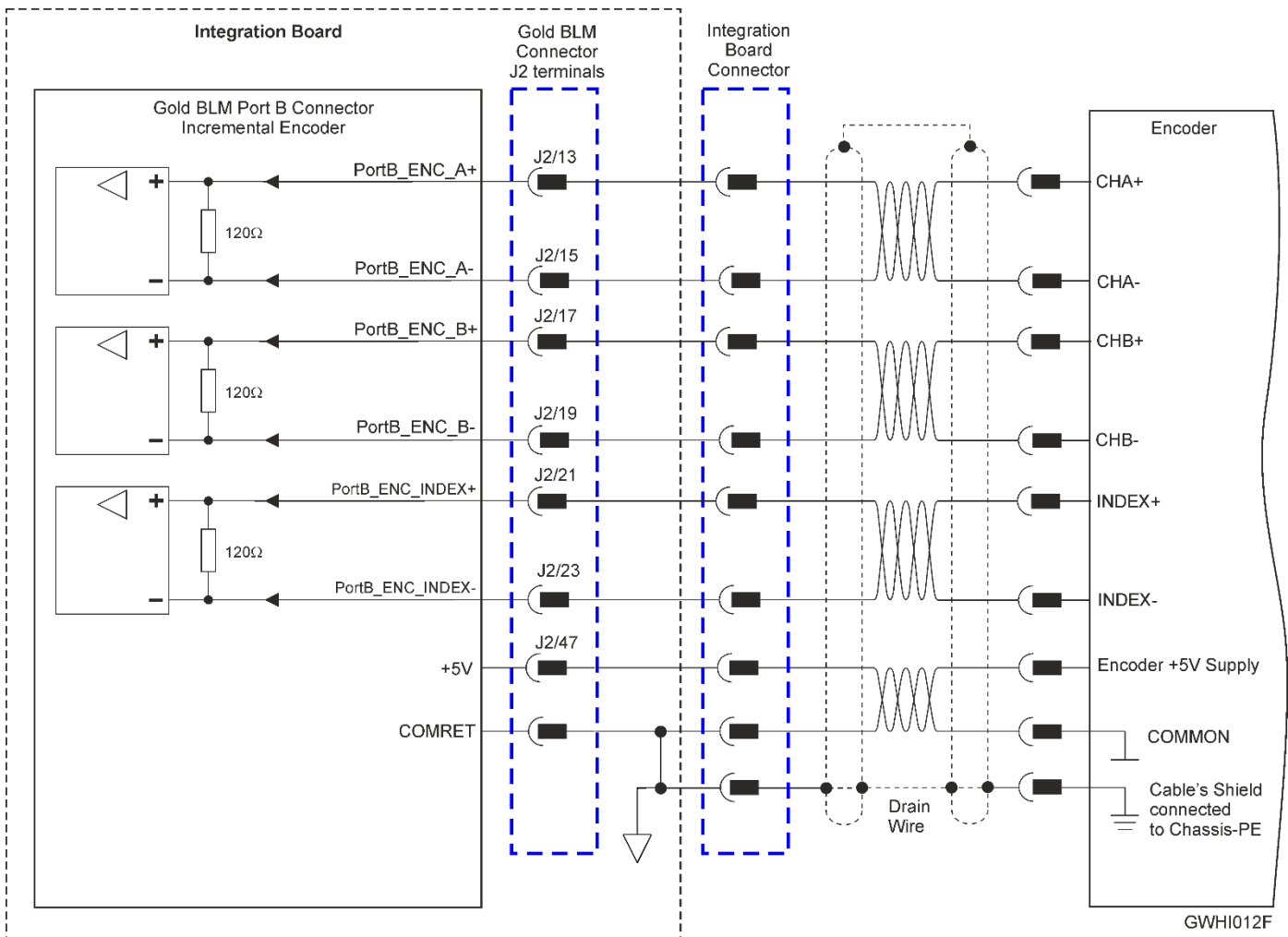


Figure 17: Port B Incremental Encoder Input – Recommended Connection Diagram





### 9.6.2.2. Interpolated Analog (Sine/Cosine) Encoder

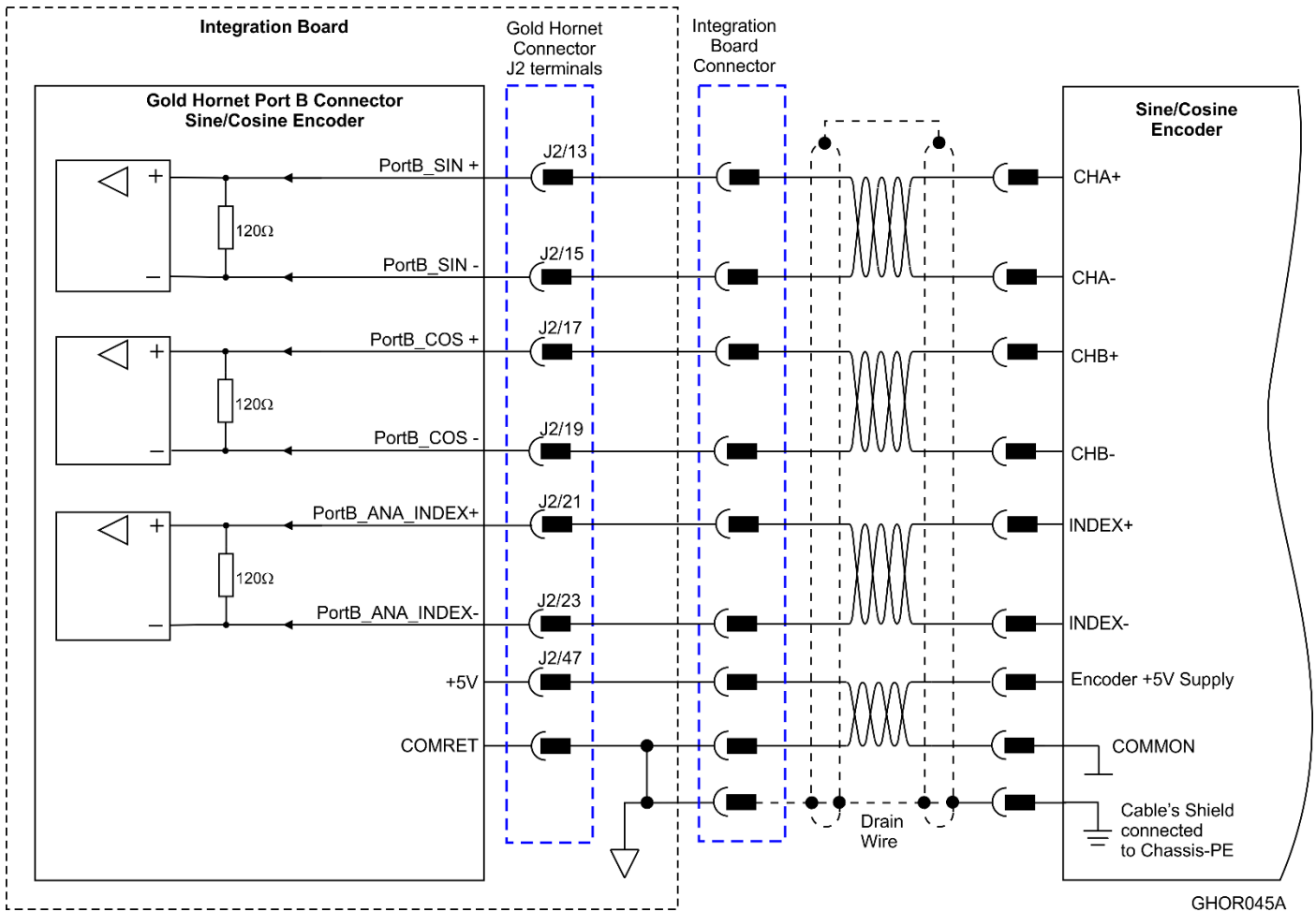


Figure 18: Port B - Interpolated Analog Encoder Connection Diagram



### 9.6.2.3. Resolver

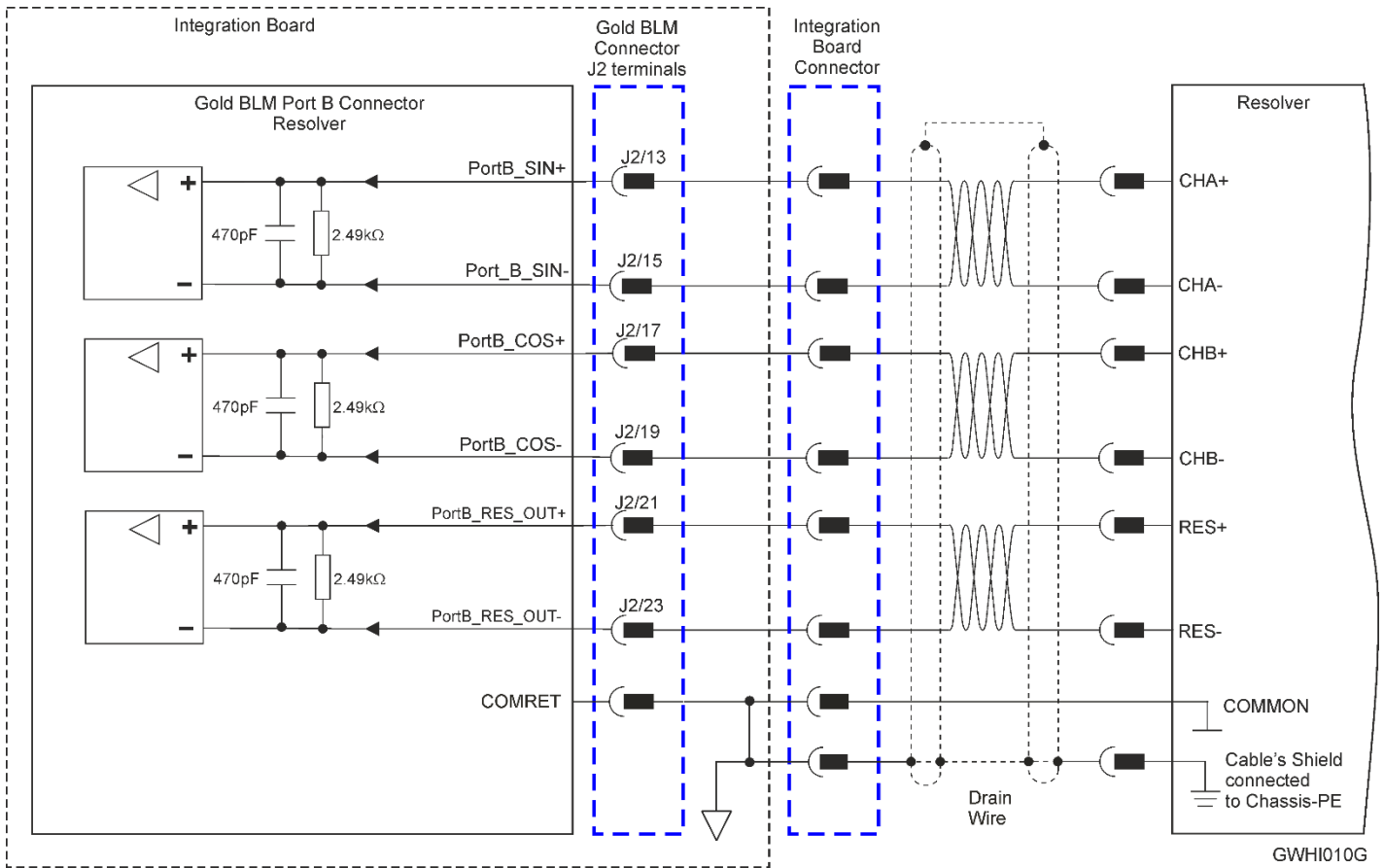


Figure 19: Port B – Resolver Connection Diagram



### 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.

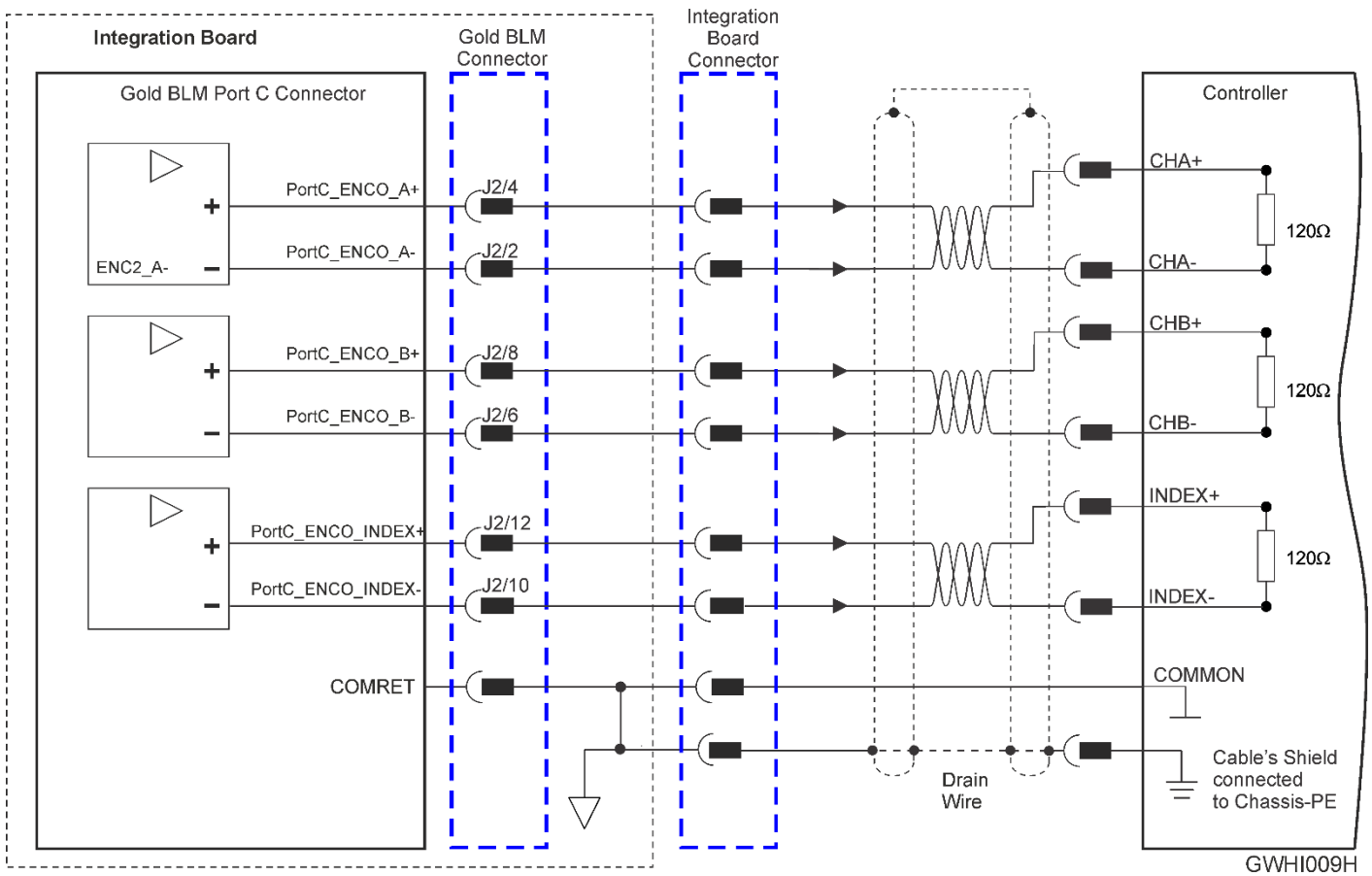


Figure 20: Emulated Encoder Differential Output – Recommended Connection Diagram



### 9.6.4. Analog Inputs

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

- Analog Input 1 – Differential  $\pm 10$  V using Connector J2 in the Gold Hornet
- Analog Input 2 – Single ended using Connector J1 in the Gold Hornet

#### 9.6.4.1. Analog Input 1

The following circuit (Figure 21) describes the internal interface of the Analog input.

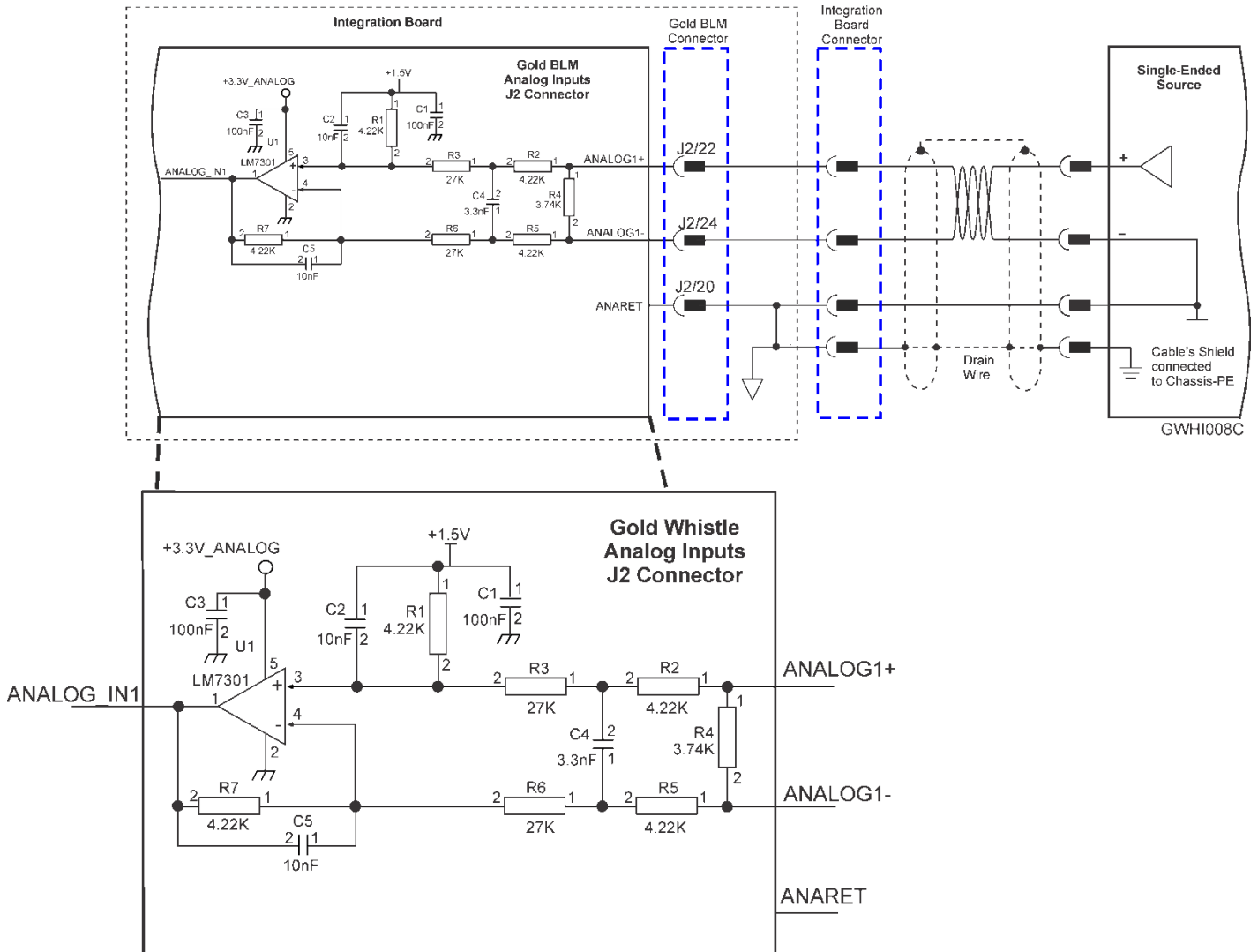


Figure 21: Analog Input with Differential  $\pm 10$  V



### 9.6.4.2. Analog Input 2

The Gold Homet allows an additional single ended Analog input. Figure 22 describes the input interface of the Analog\_input2 in the Gold Homet. It also describes implementation examples for a differential analog input of 10V:

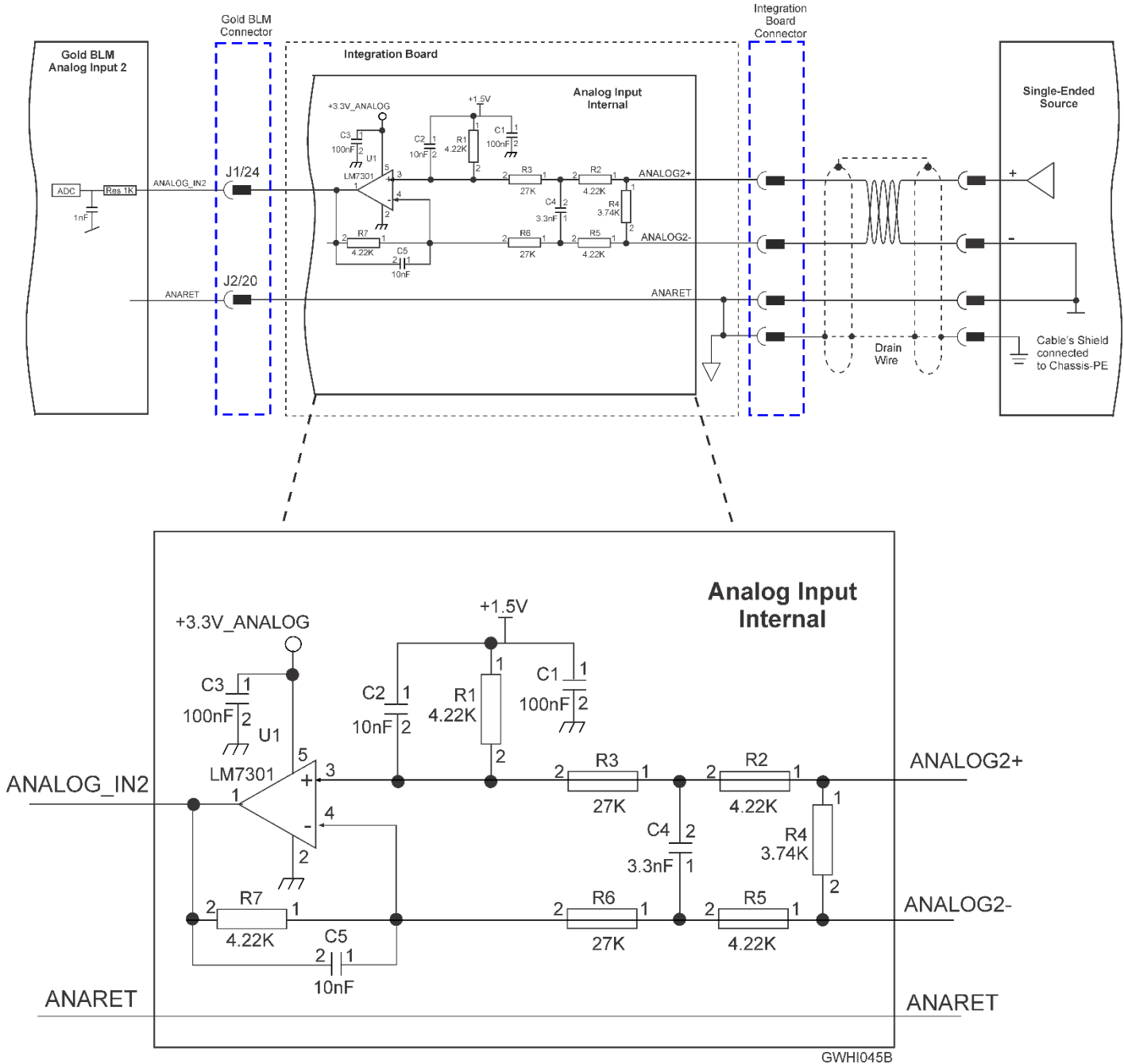


Figure 22: Analog Input 2 Example



### 9.6.5. RS232 TTL Logic Level

Figure 23 describes the standard RS232 connection diagram.

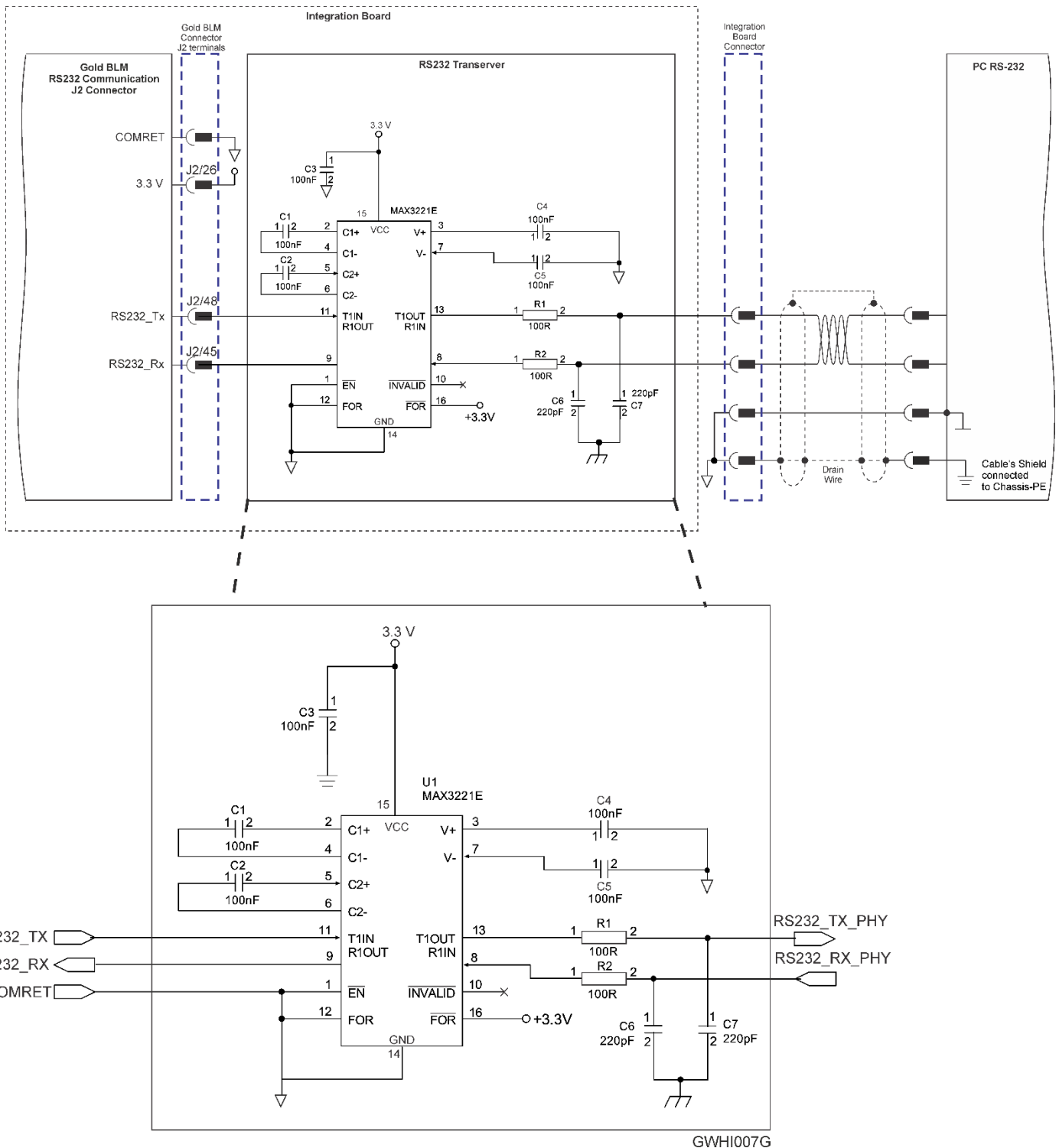


Figure 23: Standard RS232 Voltage Level incorporating RS232 TX/RX Transceiver Connection Diagram



### 9.6.6. USB 2.0

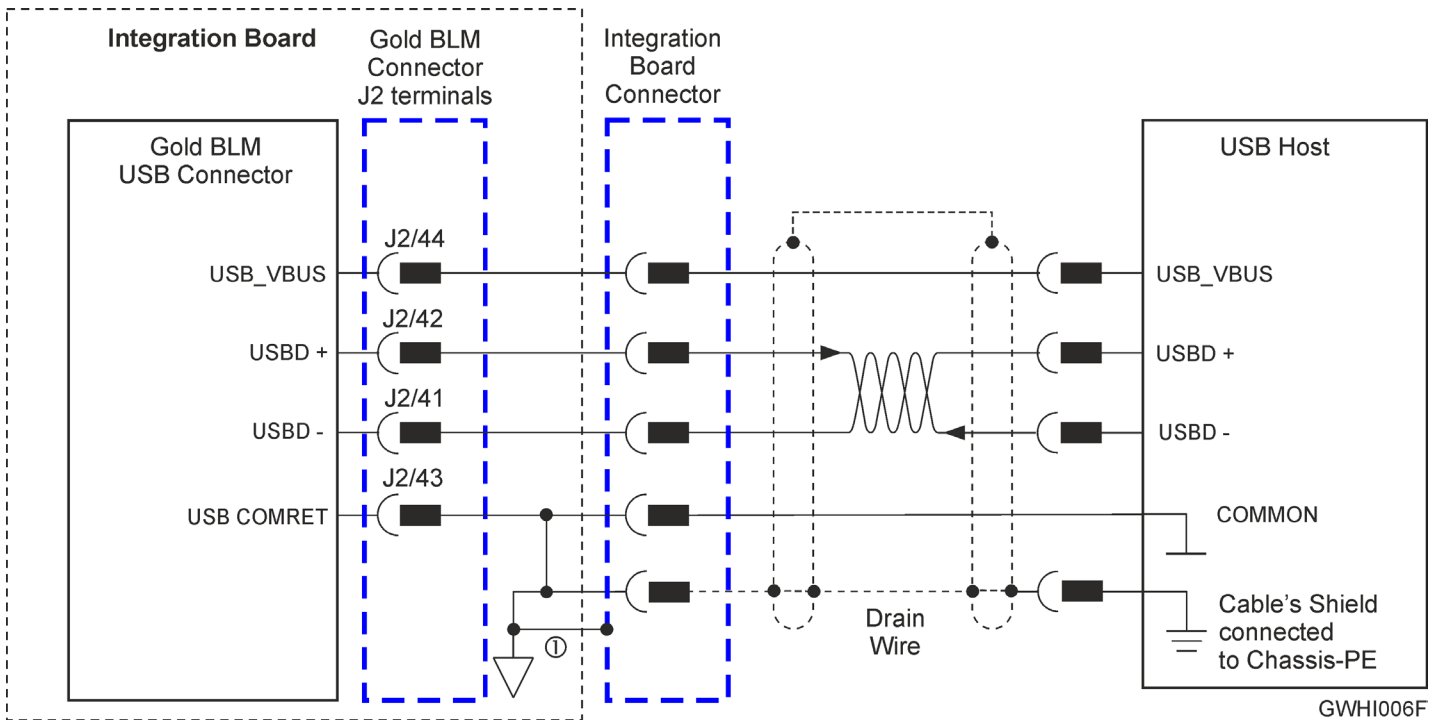


Figure 24: USB Network Diagram

**Note 1:** In the Gold Hornet the shield of the USB connector should be connected to the COMRET and not the PE.



### 9.6.7. EtherCAT/Ethernet

The Gold Hornet serves as an EtherCAT slave device, therefore 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.

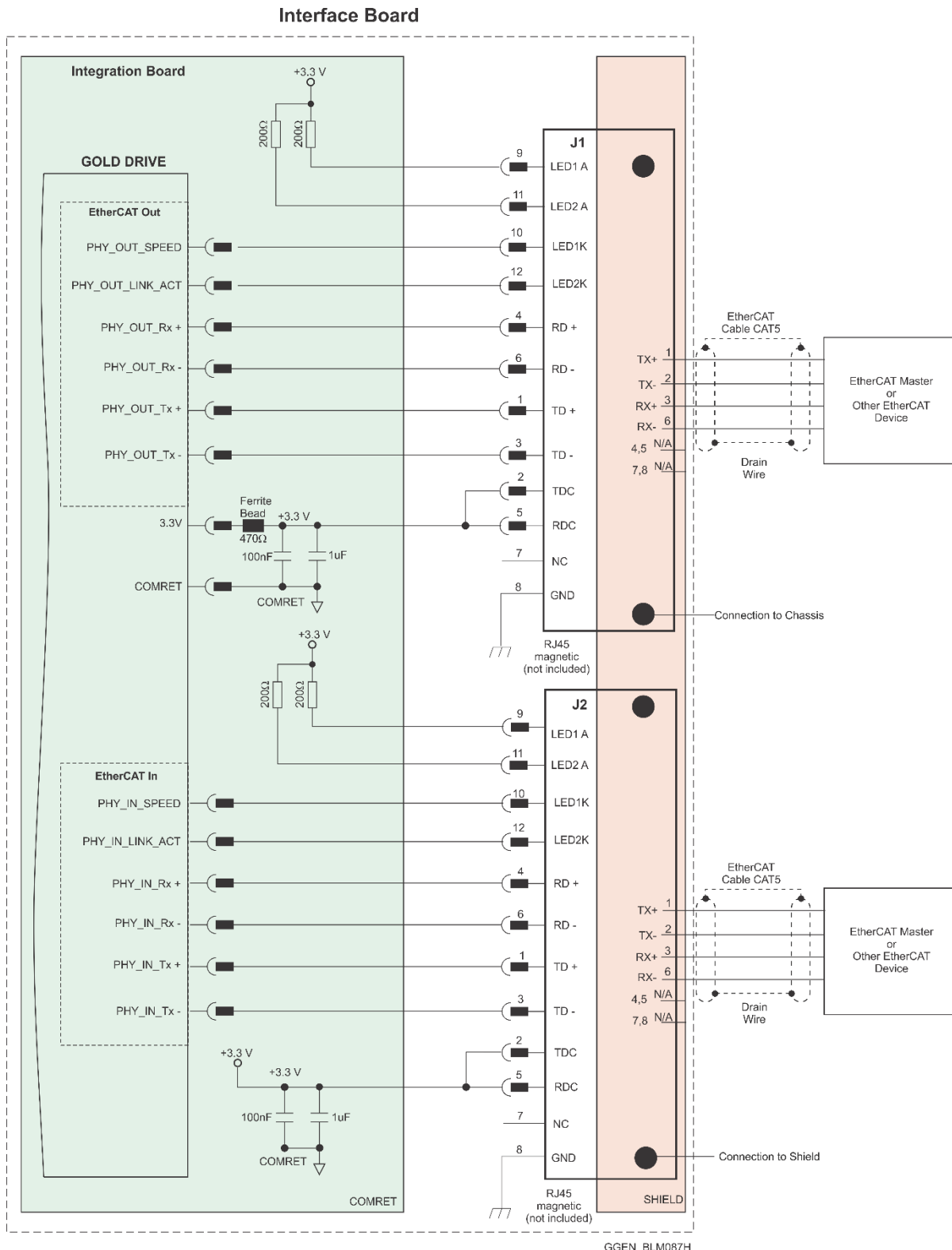


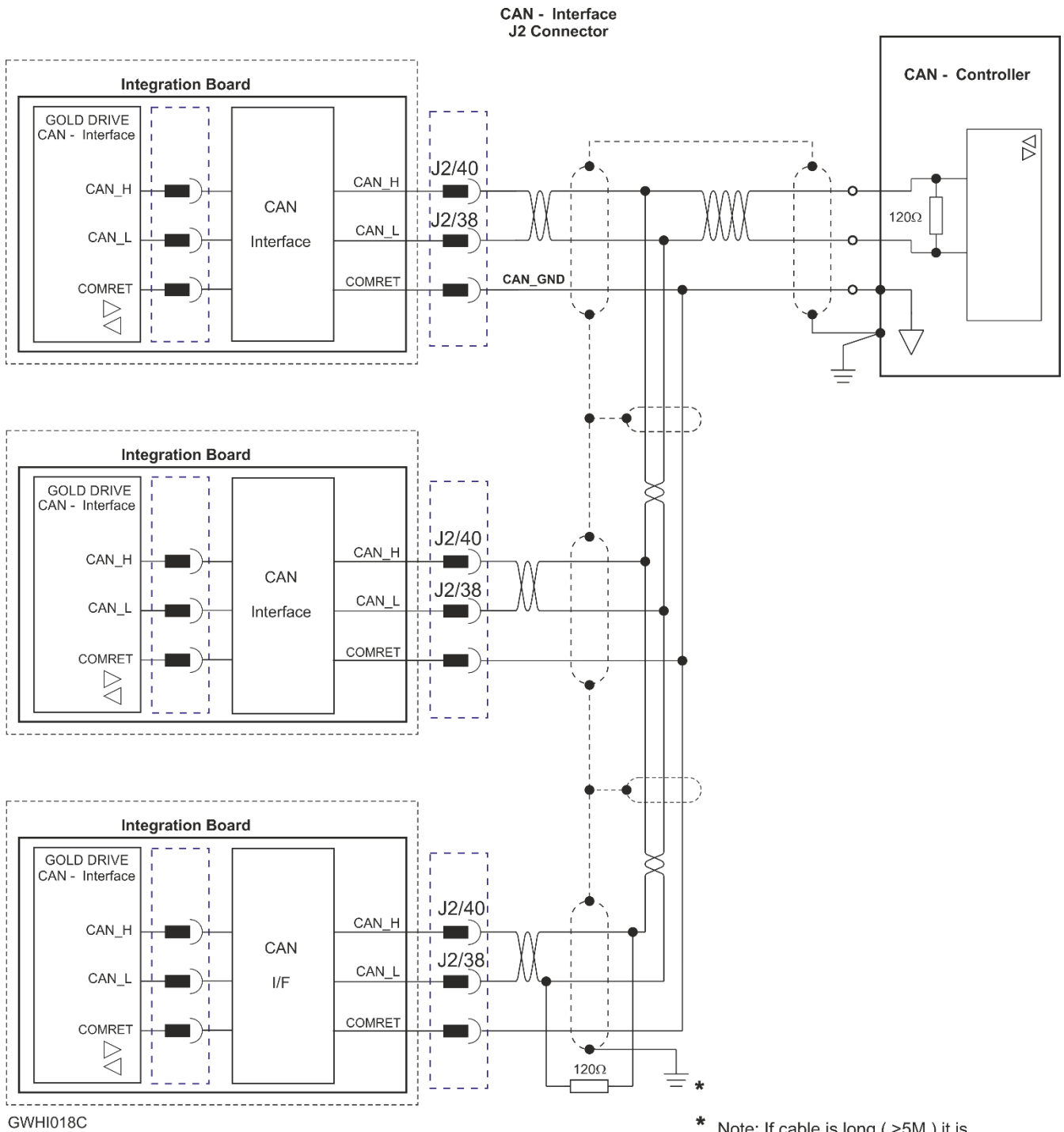
Figure 25: EtherCAT Connection Schematic with Diagram Sign of 3.3V





### 9.6.8. CAN

Figure 26 displays the CAN connectivity.



GWHI018C

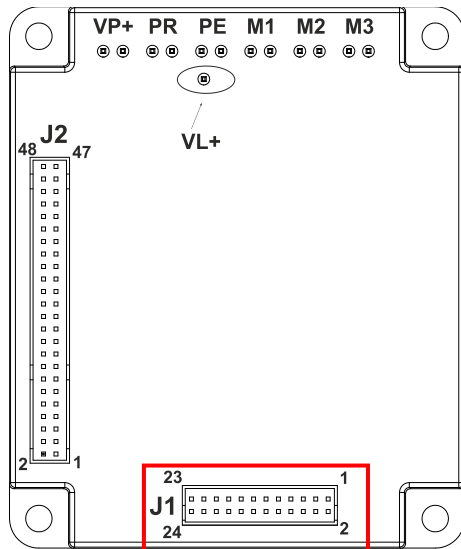
Figure 26: CANbus Connections

**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



GWHI028B

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 Chapter 13 of the MAN-G-Board Level Modules Hardware manual)
2	SB_Clock	Serial Bus_Clock (9.375Mhz) for extended IO (refer to Chapter 13 of the 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
15	OUT2	Programmable output 2
16	OUT1	Programmable output 1
17	OUTRET2	OUT 2 return
18	OUTRET1	OUT 1 return



Pin (J1)	Signal	Function
19	LED2	Bi-color indication output 2 (Cathode)
20	LED1	Bi-color indication output 1 (Cathode)
21	OUT4	Programmable output 4 not isolated ( <b>3.3V TTL level</b> )
22	OUT3	Programmable output 3 not isolated ( <b>3.3V TTL level</b> )
23	COMRET	Common return
24	ANALOG_IN2	Analog input 2

**Table 7: Connector J1 – I/O, LEDs**



## 9.7.1. Digital Inputs

### 9.7.1.1. TTL voltage level

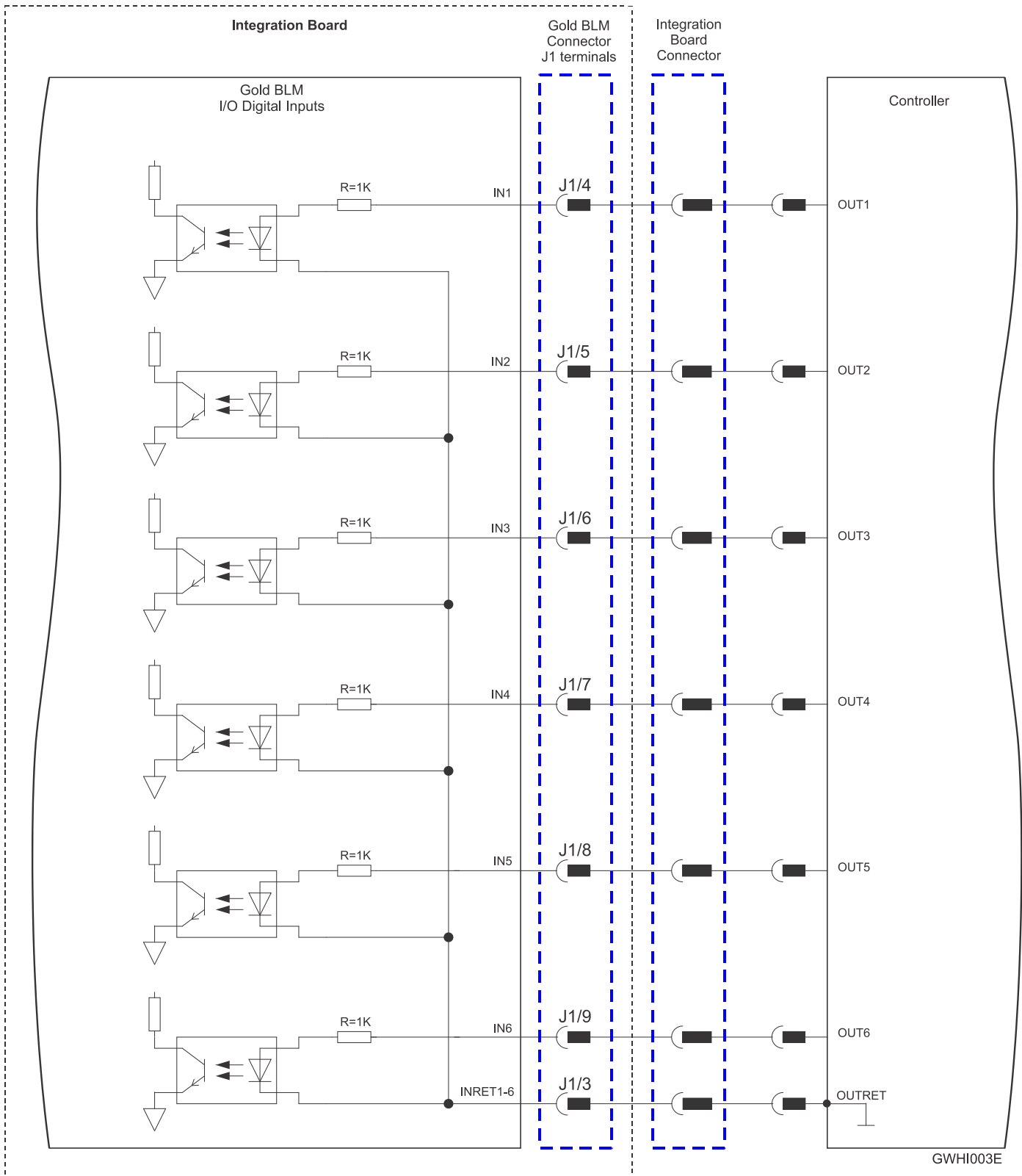


Figure 27: Digital Input TTL Mode Connection Diagram



## 9.7.2. Digital Outputs

### 9.7.2.1. Isolated Open Collector and Open Emitter

The following diagram describes the OUT1 and OUT2 outputs:

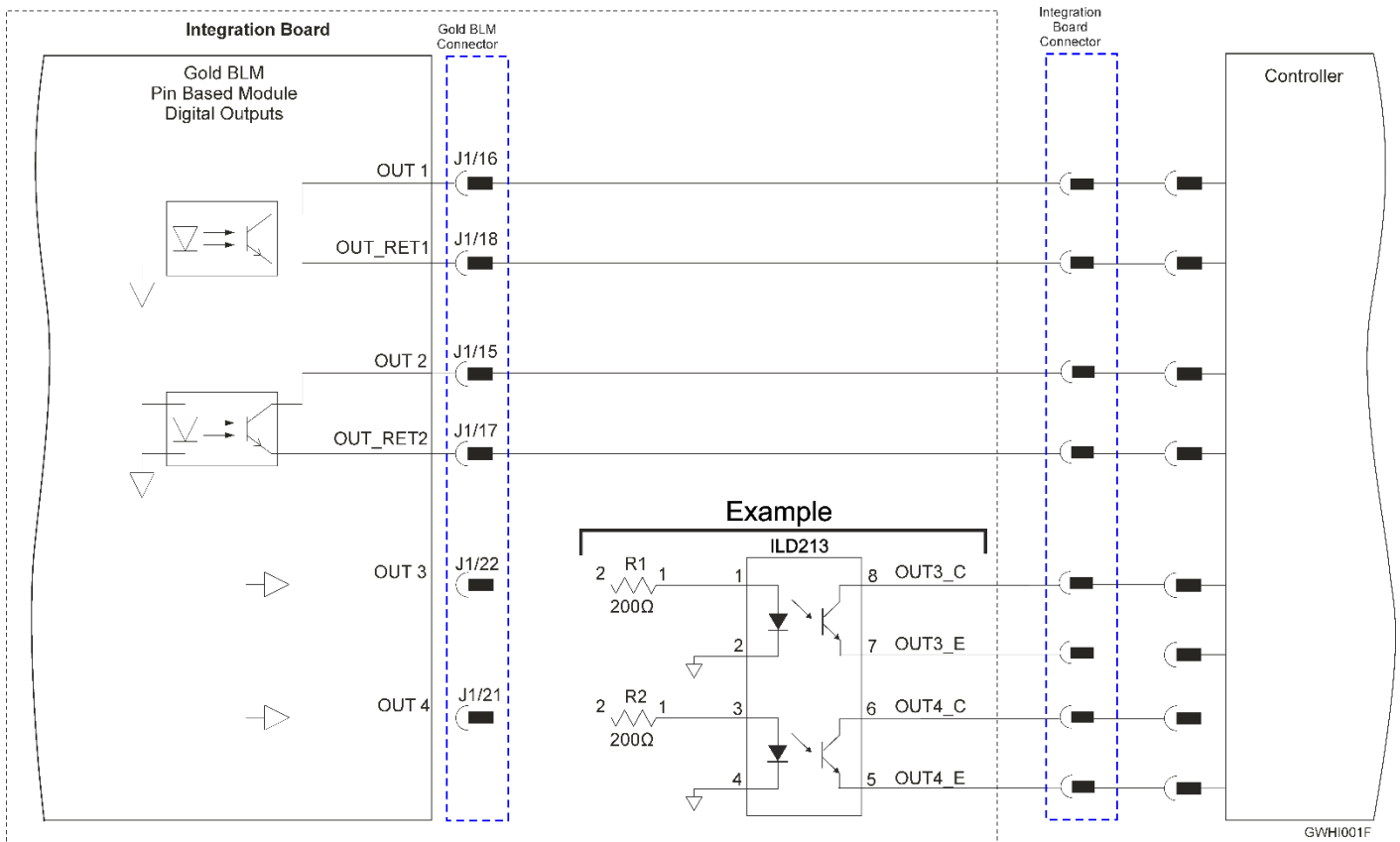


Figure 28: Digital Output Connection Diagram – Isolated Open Collector and Open Emitter Connection

## 9.7.3. Analog Inputs

For details of the Analog Input 2 – Single ended using Connector J1 in the Gold Hornet, 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.

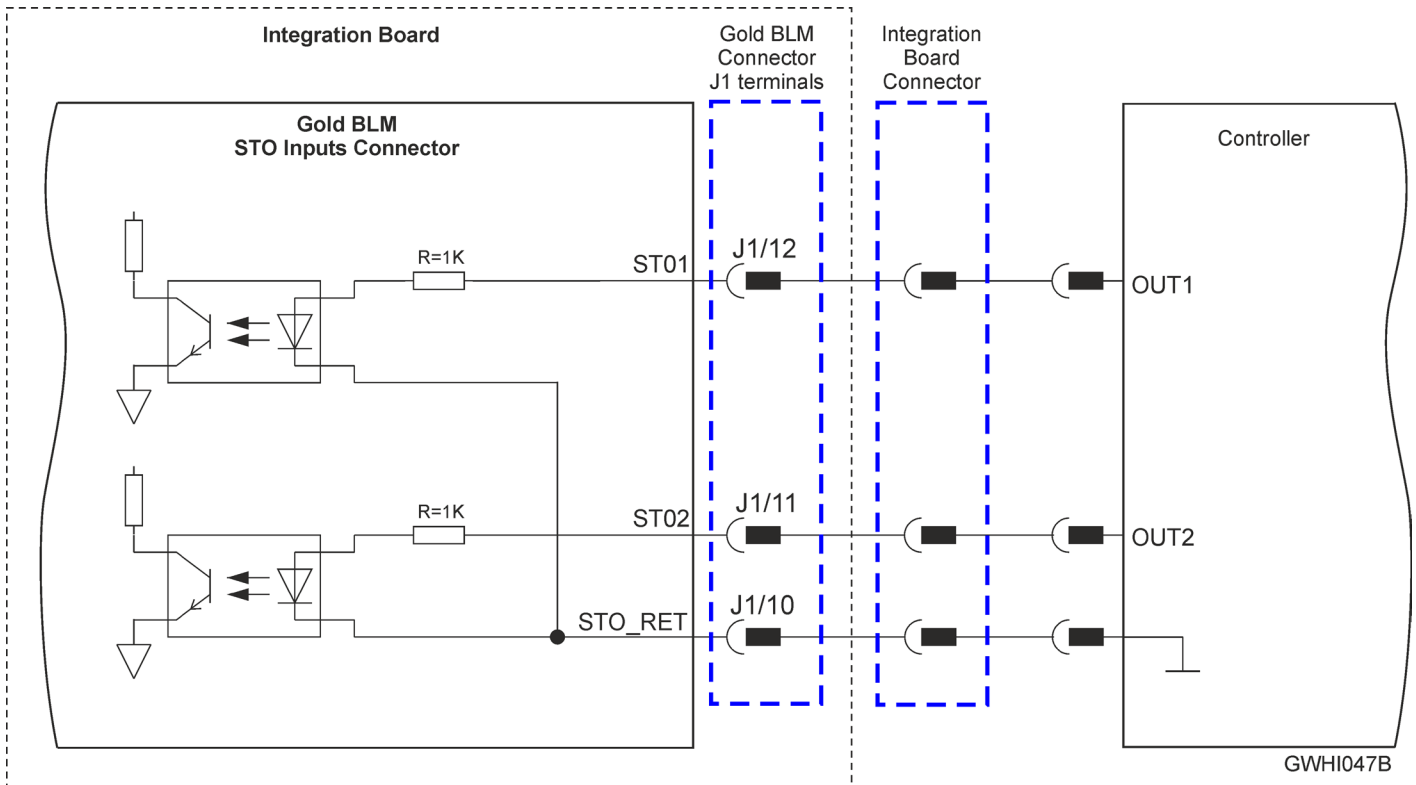


Figure 29: STO Input Connection – TTL Option

### 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 Hornet 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 Hornet 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

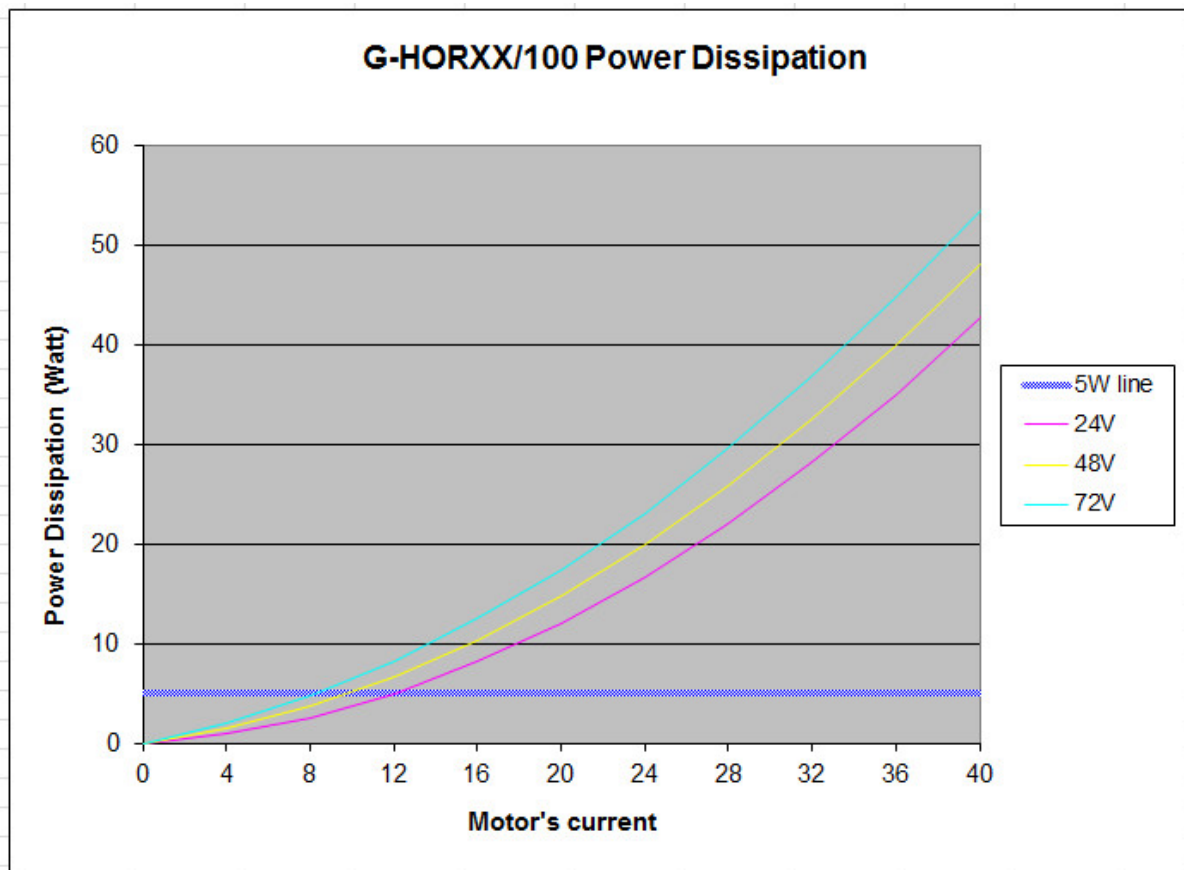
The best way to dissipate heat from the Gold Hornet is to mount it so that its heat-sink faces up. For best results leave approximately 10 mm of space between the Gold Hornet's heat-sink and any other assembly.

### 11.1.1. Thermal Data

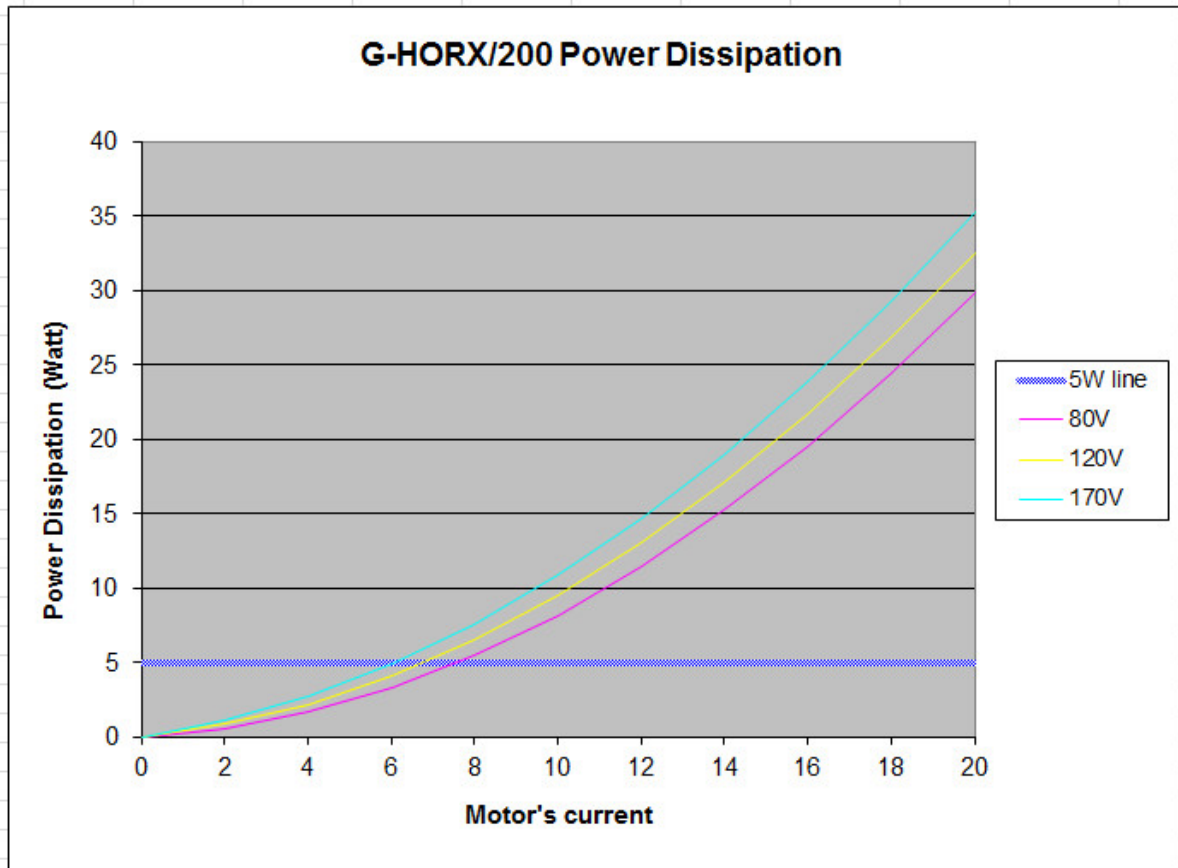
- Heat dissipation capability ( $\theta$ ): Approximately 10 °C/W
- Thermal time constant: Approximately 240 seconds (thermal time constant means that the Gold Hornet will reach 2/3 of its final temperature after 4 minutes)
- Shut-off temperature: 86 °C to 88 °C (measured on the heat sink)

### 11.1.2. Heat Dissipation Data

Heat Dissipation is shown in graphically below:







### 11.1.3. 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.
2. Determine the ambient operating temperature of the Gold Hornet.
3. Calculate the allowable temperature increase as follows:  
for an ambient temperature of 40 °C,  $\Delta T = 80\text{ °C} - 40\text{ °C} = 40\text{ °C}$
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.

If the dissipated power is below 4 W the Gold Hornet will need no additional cooling.

#### Notes:

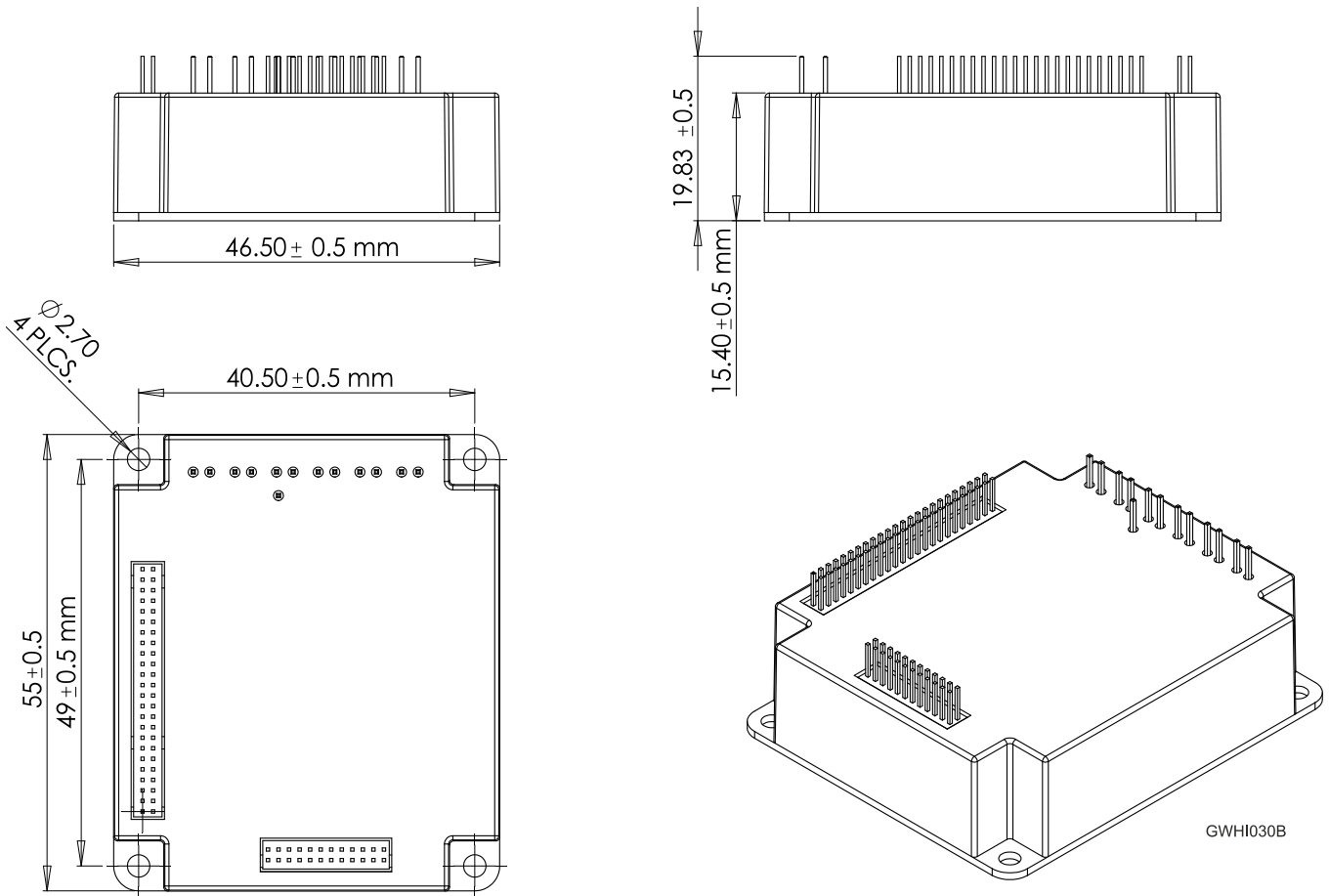
The chart above shows that no heat-sink is required when the heat-sink temperature is 80 °C, ambient temperature is 40 °C and heat dissipated is 4 W.

When an external heat-sink is required, you can use the Elmo external heat-sink (Catalog number: WHI-HEAT-SINK-2).



## Chapter 12: Dimensions

This chapter provides detailed technical dimensions regarding the Gold Hornet.



# Inspiring Motion

*Since 1988*

For a list of Elmo's branches, and your local area office, refer to the Elmo site [www.elmomc.com](http://www.elmomc.com)

