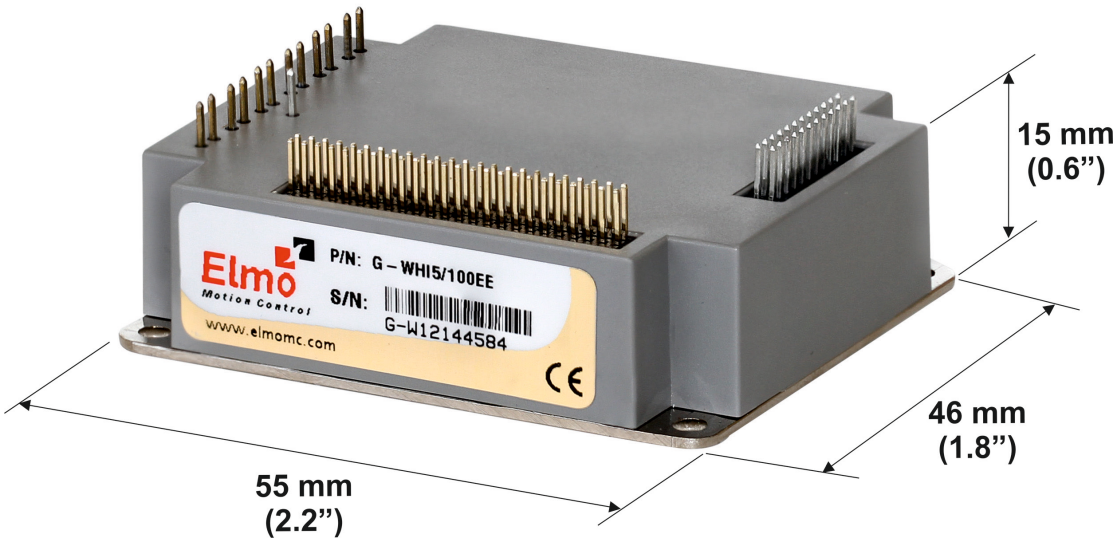
Gold Line

Gold Whistle
Digital Servo Drive
Installation Guide



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Elmo
Motion Control

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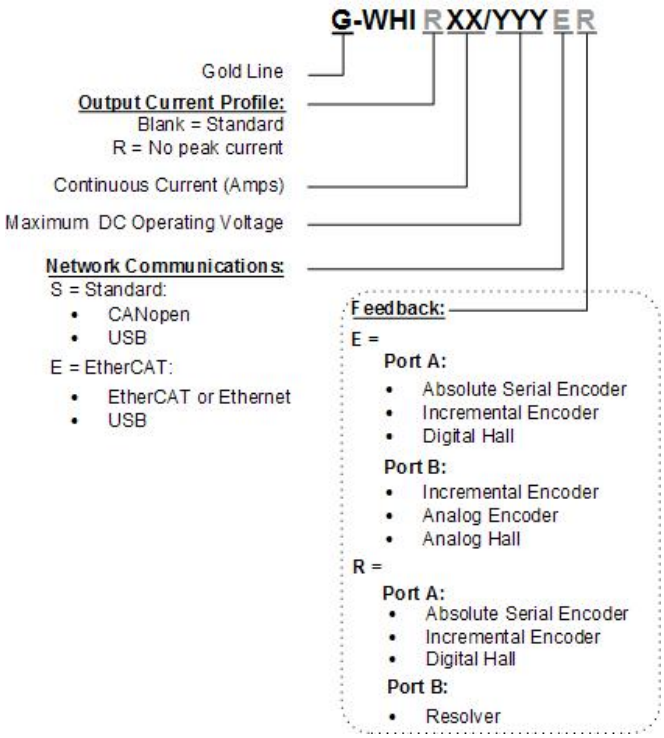
Catalog Number



Revision History

Version	Date	Details
Ver. 1.0	September 2010	Initial release
Ver. 1.1	January 2010	Several updates throughout the manual
Ver. 1.2	September 2012	Several corrections and updates to manual
Ver. 1.201		Several corrections and updates to manual
Ver. 1.202		Several corrections and updates to manual
Ver. 1.203	July 2012	Several corrections and updates to manual
Ver. 1.204	January 2013	Several corrections and updates to manual
Ver. 1.205	January 2013	Added a caution and recommendation on the type of cleaning solution to use for the Elmo unit. Updated the supply output (VDD) voltage range value of the Digital Output Interface for the TTL mode. Updated Section 4.3.2.5: Connector J1 - table. Added Section 3.1: Physical Specifications.
Ver. 1.206	March 2013	Section 3.2: Technical Data- updated the Power Ratings table for the 200 VDC option.

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Table of Contents

Chapter 1: Safety Information

In order to achieve the optimum, safe operation of the Gold Whistle servo drive, it is imperative that you implement the safety procedures included in this installation guide. This information is provided to protect you and to keep your work area safe when operating the Gold Whistle 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 Whistle servo drive contains electrostatic-sensitive components that can be damaged if handled incorrectly. To prevent any electrostatic damage, avoid contact with highly insulating materials, such as plastic film and synthetic fabrics. Place the product on a conductive surface and ground yourself in order to discharge any possible static electricity build-up.

To avoid any potential hazards that may cause severe personal injury or damage to the product during operation, keep all covers and cabinet doors shut.

The following safety symbols are used in this manual:

Warning:
This information is needed to avoid a safety hazard, which might cause bodily injury.

Caution:
This information is necessary for preventing damage to the product or to other equipment.

1.1. 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 Whistle from all voltage sources before it is opened for servicing.
- The Gold Whistle servo drive contains 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.

1.2. Cautions

- The Gold Whistle servo drive contains hot surfaces and electrically-charged components during operation.
- The maximum DC power supply connected to the instrument must comply with the parameters outlined in this guide.
- When connecting the Gold Whistle to an approved isolated 12–95 VDC auxiliary power supply, connect it through a line that is separated from hazardous live voltages using reinforced or double insulation in accordance with approved safety standards.
- Before switching on the Gold Whistle, verify that all safety precautions have been observed and that the installation procedures in this manual have been followed.
- Do not clean any of the Gold Whistle drive's soldering with solvent cleaning fluids of pH greater than 7 (8 to 14). The solvent corrodes the plastic cover causing cracks and eventual damage to the drive's PCBs.

  Elmo recommends using the cleaning fluid Vigon-EFM which is pH Neutral (7).

  For further technical information on this recommended cleaning fluid, select the link:

  http://www.zestron.com/fileadmin/zestron.com-usa/daten/electronics/Product_TI1s/TI1-VIGON_EFM-US.pdf

1.3. Directives and Standards

The Gold Whistle conforms to the following industry safety standards:

Safety Standard	Item
Approved **IEC/EN 61800-5-1, Safety**	Adjustable speed electrical power drive systems
Recognized **UL 508C**	Power Conversion Equipment
In compliance with **UL 840**	Insulation Coordination Including Clearances and Creepage Distances for Electrical Equipment
In compliance with **UL 60950-1** (formerly **UL 1950**)	Safety of Information Technology Equipment Including Electrical Business Equipment
In compliance with **EN 60204-1**	Low Voltage Directive 73/23/EEC

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

1.4. CE Marking Conformance

The Gold Whistle servo drive is intended for incorporation in a machine or end product. The actual end product must comply with all safety aspects of the relevant requirements of the European Safety of Machinery Directive 98/37/EC as amended, and with those of the most recent versions of standards **EN 60204-1** and **EN 292-2** at the least.

According to Annex III of Article 13 of Council Directive 93/68/EEC, amending Council Directive 73/23/EEC concerning electrical equipment designed for use within certain voltage limits, the Gold Whistle meets the provisions outlined in Council Directive 73/23/EEC. The party responsible for ensuring that the equipment meets the limits required by EMC regulations is the manufacturer of the end product.

1.5. Warranty Information

The products covered in this manual are warranted to be free of defects in material and workmanship and conform to the specifications stated either within this document or in the product catalog description. All Elmo drives are warranted for a period of 12 months from the time of installation, or 18 months from time of shipment, whichever comes first. No other warranties, expressed or implied — and including a warranty of merchantability and fitness for a particular purpose — extend beyond this warranty.

Chapter 2: Product Description

2.1. Functional Description

The Gold Whistle is an advanced high power density servo drive. It provides top servo performance, advanced networking and built in safety, all in a small PCB mountable package. The Gold Whistle has a fully featured motion controller and local intelligence.

The Gold Whistle operates from a DC power source. 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 Whistle drive is easily set up and tuned using the Elmo Application Studio (EAS) 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 Software Manual.

The Gold Whistle 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.

2.2. Product Features

Note: The features described in this chapter relate to the range of Gold Whistle models. Depending on the model you have purchased, not all features are available.

To see the features for your model, look at the product label on the Gold Whistle and use the product catalog number schematic that appears at the beginning of this manual and on page 23 to determine which specific features are available to you.

2.2.1. High Power Density

The Gold Whistle delivers up to **1.6 kW of continuous power** or **3.2 kW of peak power** in a 38.0 cc (2.32 in^3) package (55 x 46 x 15 mm or 2.2" x 1.8" x 0.6").

2.2.2. Supply Input

- **Gold Whistle Power rating is 12 to 195 VDC**
- **Two power ratings for Gold Whistle; 100V and 200V:**
  - **For power rating 200V**
    Two power isolated DC power sources are required, main power 12 - 195V and Auxiliary Power 12-95V for the logic.
  - **For power rating of 100V**
    Single DC Power Supply - Power to the Gold Whistle is provided by a 12–95 VDC single isolated DC power source (not included with the Gold Whistle). A “smart” control-

supply algorithm enables the Gold Whistle to operate with only one power supply with no need for an auxiliary power supply for the logic.

Optional Backup (Auxiliary) Supply

If backup functionality is required in case of power loss, e.g., to keep the original position, a 12–95 VDC external isolated supply should be connected (via the Gold Whistle's VL+ terminal). This is more flexible than the requirement for 24 VDC supply. If backup is not needed, a single power supply is used for both the power and logic circuits.

There are two voltage ratings of the Gold Whistle, therefore the correct power supply must be used, according to the maximum operating voltage of the Gold Whistle. Refer to Chapter 3: Technical Information.

2.2.3. Servo Control

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

2.2.4. Advanced Filters and Gain Scheduling

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

2.2.5. Motion Control

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

2.2.6. Fully Programmable

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

2.2.7. Feedback Ports Options

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

2.2.8. Feedback Sensor Specifications

- Incremental Quadrature Encoder (with or without commutation halls) up to 75 Megacounts per second (18 MHz PPS (Pulses Per Second))
- Incremental encoder and digital Halls
- Digital Hall
  - Up to 4 kHz commutation frequency
  - 5 V logic
  - Input voltage up to 15 VDC
- Interpolated Analog (Sine/Cosine) Encoder:
  - Supports 1 V PTP Sine/Cosine
  - Sin-Cos Frequency: up to 500 kHz
  - Internal Interpolation: up to ×8192
  - Automatic Correction of amplitude mismatch, phase mismatch, signal offset
  - Emulated encoder output of the Analog encoder
- Analog Halls (commutation & position)
  - One feedback electrical cycle = one motor's electrical cycle

  - Supports 1 V PTP Sin/Cos
  - Sin/Cos Frequency: up to 500 kHz
  - Internal Interpolation: up to ×8192
  - Automatic correction of amplitude mismatch, phase mismatch, signal offset
- Absolute serial encoders:
  - NRZ (Panasonic, Tamagawa, Mitutoyo, etc.)
  - EnDAT 2.2
  - BiSS/SSI
  - Stegmann Hiperface
- Resolver
  - 14 bit resolution
  - Up to 512 revolutions per second (RPS)
  - Emulated encoder outputs of the Resolver
- Auxiliary Encoder inputs (ECAM, follower, etc.) single-ended, unbuffered
- Tachometer (available on request)
- Potentiometer (available on request)
- The Gold Whistle provides 5 V supply voltage (5 V, 2 x 200 mA max) for the encoders, Resolver or Hall supplies

2.2.9. Communications

- Fast and efficient EtherCAT and CAN networking
- EtherCAT Slave:
  - CoE (CANopen over EtherCAT)
  - EoE (Ethernet over EtherCAT)
  - FoE (File over EtherCAT) for firmware download
  - Supports Distributed Clock
  - EtherCAT cyclic modes supported down to a cycle time of 250 µs
- CANopen (DS-301, DS-305, DS-402)
- Ethernet TCP/IP
  - UDP
  - Telnet
- USB 2.0
- RS-232 (TTL logic level)

2.2.10. Safety

- IEC 61800-5-2, Safe Torque Off (STO)
  - Two STO (Safe Torque Off) inputs
  - Optically isolated
  - TTL Level (5 V logic)
  - Open collector and open emitter
- UL 508C recognition
- UL 60950 compliance
- CE EMC compliance

2.2.11. Outputs

- Two Digital Outputs
  - Optically isolated
  - Output level: up to 30 V
  - Open collector and open emitter
- Three differential outputs:
  - Port C EIA-422 differential output line transmitters
  - Response time < 1 µs
  - Output current: ± 15 mA.

2.2.12. Inputs

- Six digital inputs
  - TTL Level (5 V logic)
  - Optically isolated
  - Fast digital capture data <5 µs
- One Analog input: ± 10 V
- Six very fast differential event capture inputs 5 V logic
  - Via Port A or B (three on each port, depending on model)
  - EIA-422 Differential input line receiver
  - Response time < 1 µs

2.2.13. Built-In Protection

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

2.2.14. Status Indication

- Output for a bi-color LED

2.2.15. Automatic Procedures

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

2.3. System Architecture

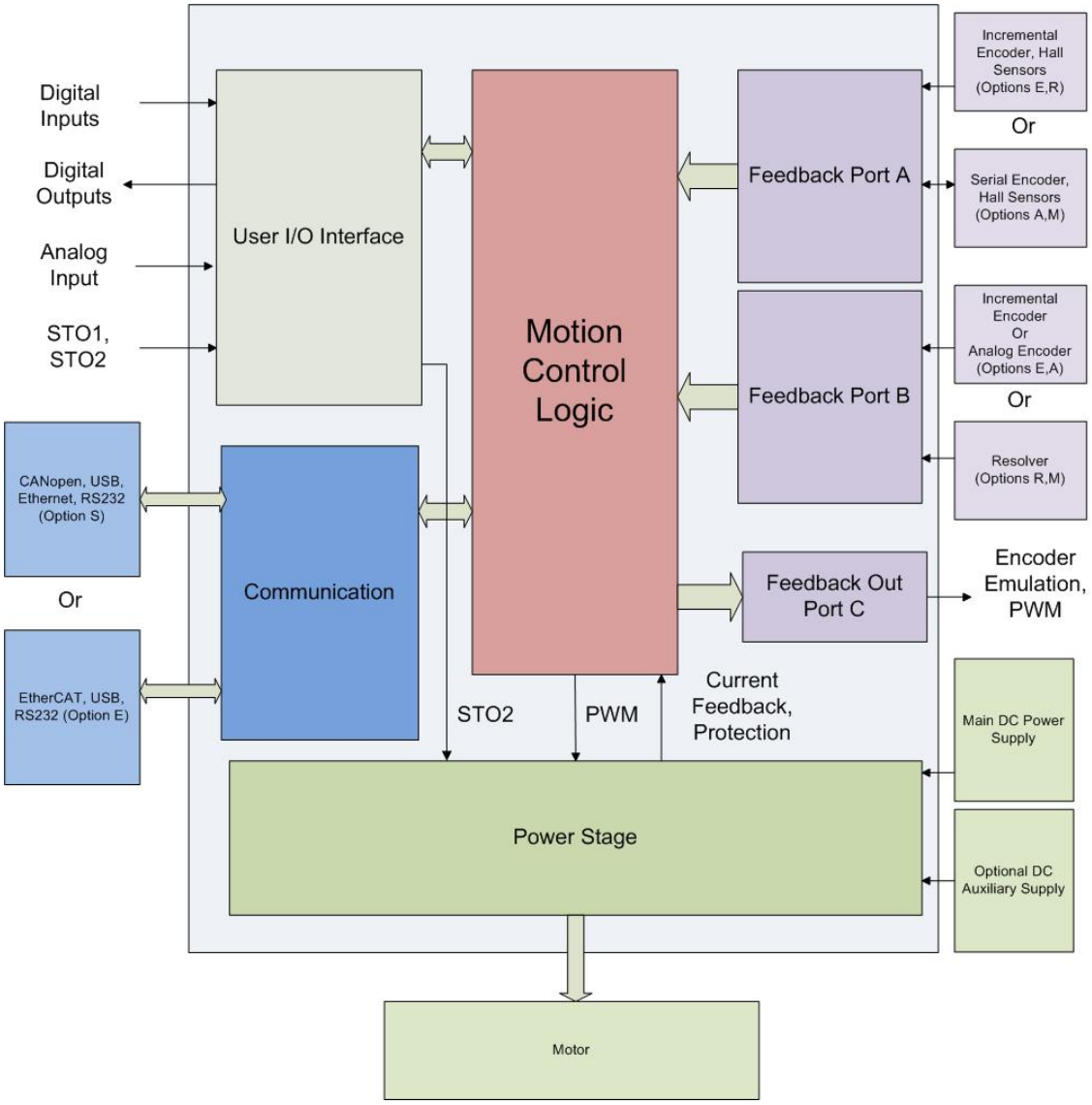


Figure 1: Gold Whistle System Block Diagram

2.4. How to Use this Guide

In order to install and operate your Elmo Gold Whistle servo drive, you will use this manual in conjunction with a set of Elmo documentation. Installation is your first step; after carefully reading the safety instructions in the first chapter, the following chapters provide you with installation instructions as follows:

- Chapter 3 - *Installation*, provides step-by-step instructions for unpacking, mounting, connecting and powering up the Gold Whistle.
- Chapter 4 - *Technical Specifications,* lists all the drive ratings and specifications.

Upon completing the instructions in this guide, your Gold Whistle servo drive should be successfully mounted and installed. From this stage, you need to consult higher-level Elmo documentation in order to set up and fine-tune the system for optimal operation.

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

Chapter 3: Technical Information

3.1. 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

3.2. 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					
Auxiliary 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 (Ic)	A	0.7	1.8	3.5	7	10.6	14.1
Peak current limit	A	2 x Ic					
Digital in/Digital out/Analog in		6/2/1					

Table 1: Technical Data

Note on current ratings: The current ratings of the Gold Whistle 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 Whistle, 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		
Auxiliary 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	3	6	9
Sinusoidal continuous RMS current limit (Ic)	A	2.1	4.2	6.3
Peak current limit	A	2 x Ic		
Digital in/Digital out/Analog in		6/2/1		

3.2.1. Auxiliary Supply

Feature	Details
Auxiliary power supply	*Isolated DC source only*
Auxiliary supply input voltage	12 to 95 V
Auxiliary supply input power	≤4 VA without external loading ≤6 VA with full external loading

Chapter 4: Installation

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

4.1. Site Requirements

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

Feature	Value
Ambient operating temperature	0 °C to 40 °C (32 °F to 104 °F)
Maximum non-condensing humidity	90%
Operating area atmosphere	No flammable gases or vapors permitted in area
Models for extended environmental conditions are available.	

Caution:
The Gold Whistle dissipates its heat by convection. The maximum ambient operating temperature of 40 °C (104 °F) must not be exceeded.

4.2. Unpacking the Drive Components

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

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

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

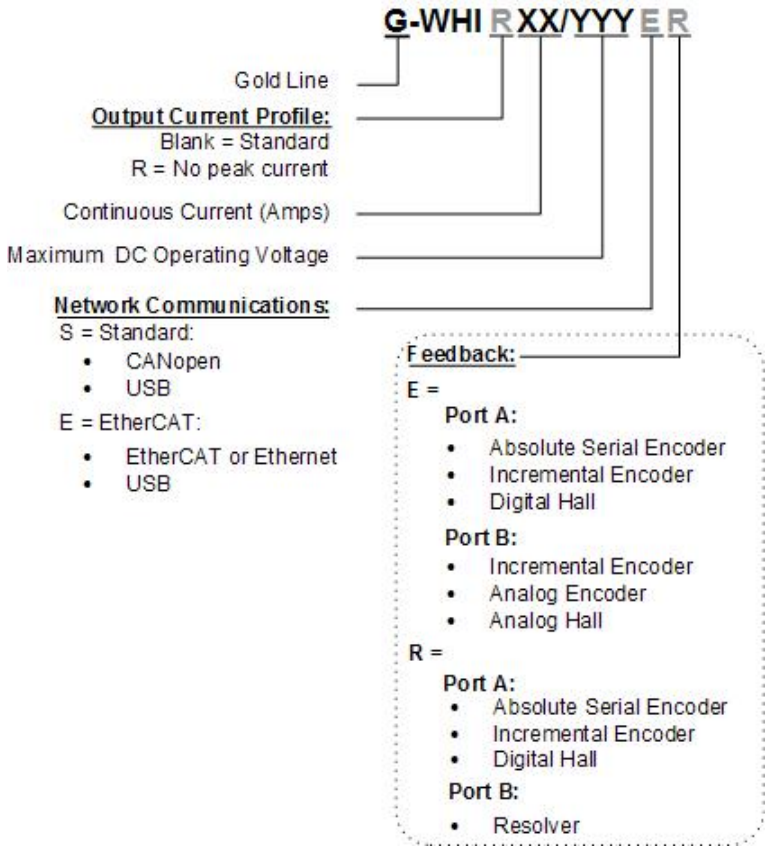
To unpack the Gold Whistle:

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

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

   The part number at the top gives the type designation as follows:



4.3. Connectors

The Gold Whistle has nine connectors.

4.3.1. Connector Types

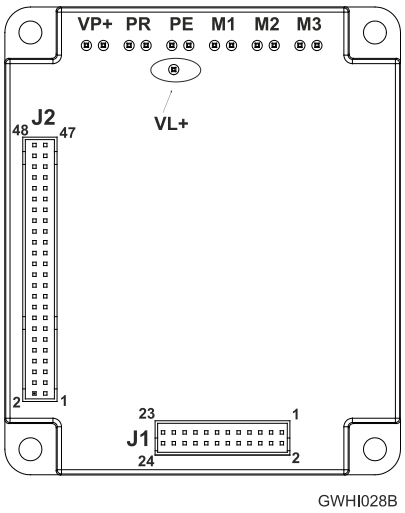
Port	Pins	Type	Function	Connector Location
J2	2x24	1.27 mm pitch 0.41 mm sq	Feedbacks, Digital Halls, Analog Inputs, Communications	
J1	2x12		I/O, LEDs, STO	
M3	1x2	2 mm pitch 0.51 mm sq	Motor power output 3	
M2	1x2		Motor power output 2	
M1	1x2		Motor power output 1	
PE	1x2		Protective earth	
PR	1x2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

Table 2: Connector Types

4.3.2. Pinouts

The pinouts in this section describe the function of each pin in the Gold Whistle connectors that are listed in Table 2.

4.3.2.1. Motor Power

For full details see Section 4.7.1.

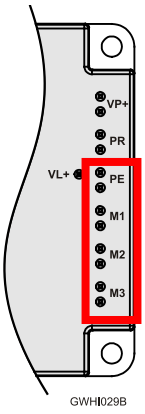
Pin	Function	Cable		Pin Positions
		Brushless Motor	Brushed DC Motor	
PE	Protective earth	Motor	Motor	
M1	Motor phase	Motor	N/C	
M2	Motor phase	Motor	Motor	
M3	Motor phase	Motor	Motor	
Connector Type: 2 mm pitch 0.51 mm sq				

Table 3: Motor Connector

4.3.2.2. Main Power

For full details see Section 4.7.2.

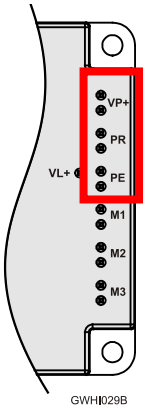
Pin	Function	Cable	Pin Positions
VP+	Pos. Power input	Power	
PR	Power return	Power	
PE	Protective earth	Power	
Connector Type: 2 mm pitch 0.51 mm sq			

Table 4: Connector for Main Power

4.3.2.3. Auxiliary Power Connector

For full details see Section 4.7.2.2.

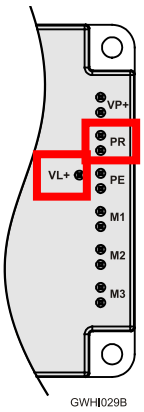
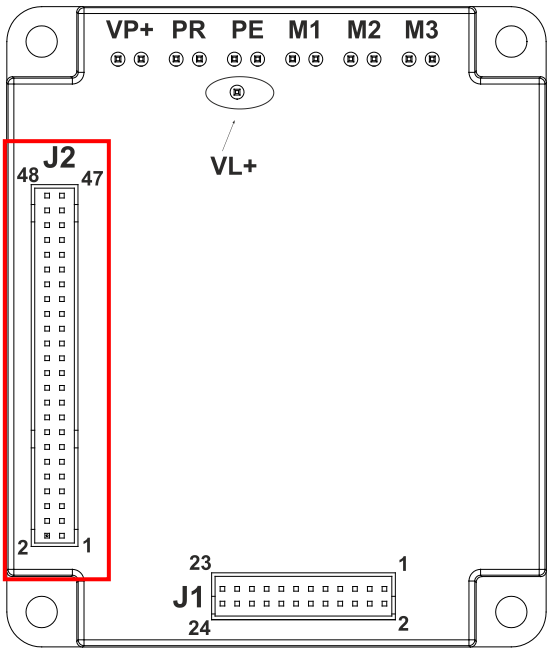
Pin	Function	Pin Positions
VL+	Auxiliary Supply Input	
PR	Auxiliary Supply Return	
Connector Type: 2 mm pitch 0.51 mm sq		

Table 5: Auxiliary Supply Pins

4.3.2.4. Connector J2



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Feedback A/B/C, Digital Halls – see Section 4.9.

Analog Inputs – see Section 4.9.4.

RS-232, EtherCAT, USB – see Section 4.11.

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 Whistle and are thus not operational simultaneously. See the part number diagram in Section 4.2 above for the different Gold Whistle configurations.

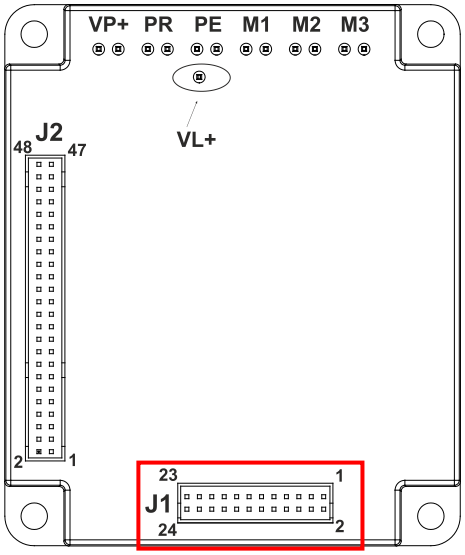
Pin (J2)	Signal	Function
1	PortA_ENC_A+ /ABS_CLK+	Port A- channel A/ Absolute encoder clock+
2	PortC_ENCO_A-	Port C- channel A complement output
3	PortA_ENC_A-/ABS_CLK-	Port A- channel A complement / Absolute encoder clock-
4	PortC_ENCO_A+	Port C- channel A output
5	PortA_ENC_B+/ABS_DATA+	Port A - channel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

Pin (J2)	Signal	Function
8	PortCENCO_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
14	HC	Hall sensor C input
15	PortB_ENC_A-/SIN-	Port B - channel A complement
16	HB	Hall sensor B input
17	PortB_ENC_B+/COS+	Port B - channel B
18	HA	Hall sensor A input
19	PortB_ENC_B-/COS-	Port B - channel B complement
20	ANARET	Analog return
21	PortB_ENC_INDEX+/ANALOG_I+	Port B – index
	RESOLVER_OUT+	Vref
22	ANALOG1+	Analog input 1
23	PortB_ENC_INDEX-/ANALOG_I-	Port B – index complement
	RESOLVER_OUT-	Vref complement
24	ANALOG1-	Analog input 1 complement
25	COMRET	Common return
26	+3.3V	3.3 V supply voltage for EtherCAT LEDs **Note: The pin connector should only be used for the 3.3V EtherCAT LED and EtherCAT RJ-45.**
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

Pin (J2)	Signal	Function
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
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 data complement
42	USBD+	USB data
43	COMRET	Common return
44	USB_VBUS	USB VBUS 5V
45	RS232_RX	RS232 receive
46	COMRET	Common return
47	+5VE	Encoder +5 V supply
48	RS232_TX	RS232 transmit

Table 6: Connector J2 – Feedback and Analog Input

4.3.2.5. Connector J1



GWHI028B

I/O, LEDs, STO (safety)

For full details on user I/Os, see Section 4.10.

For full details on STO, see Section 4.8.

Connector Type: 1.27 mm pitch 0.41 mm sq

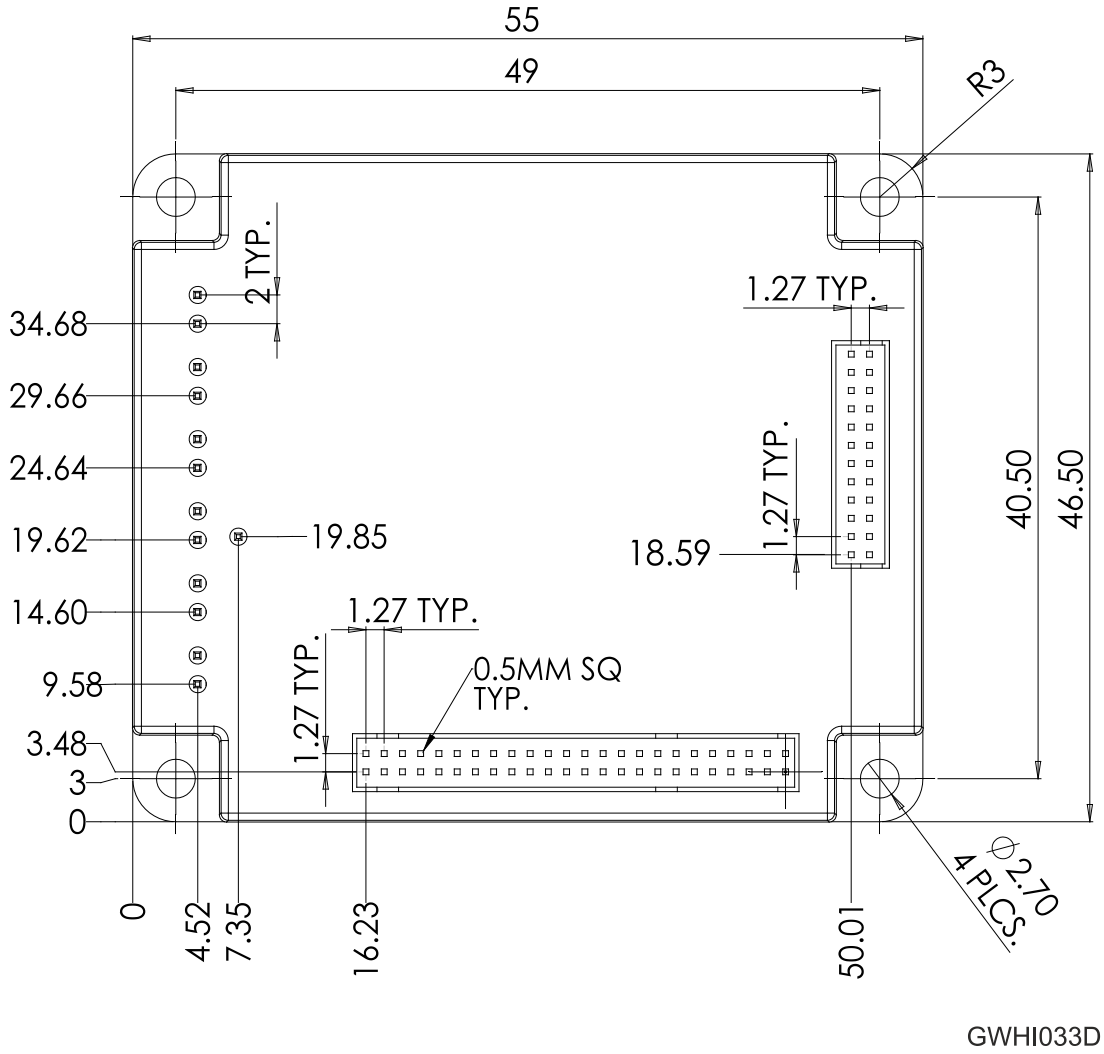
Pin (J1)	Signal	Function
1	Reserved	Reserved
2	Reserved	Reserved
3	INRET1_6	Programmable digital inputs 1–6 return
4	IN1	Programmable digital input 1 (high speed)
5	IN2	Programmable digital input 2 (high speed)
6	IN3	Programmable digital input 3 (high speed)
7	IN4	Programmable digital input 4 (high speed)
8	IN5	Programmable digital input 5 (high speed)
9	IN6	Programmable digital input 6 (high speed)
10	STO_RET	Safety signal return
11	STO2	Safety 2 input
12	STO1	Safety 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 (Anode)
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	Reserved	Reserved

Table 7: Connector J1 – I/O, LEDs

4.4. Mounting the Gold Whistle

The Gold Whistle 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 Whistle into a device, be sure to leave about 1 cm (0.4") outward from the heatsink to enable free air convection around the drive. We recommend that the Gold Whistle be soldered directly to the board. Alternatively, though this is not recommended, the Gold Whistle can be attached to socket connectors mounted on the PCB. If the PCB is enclosed in a metal chassis, we recommend that the Gold Whistle be screw-mounted to it as well to help with heat dissipation. The Gold Whistle has screw-mount holes on each corner of the heatsink for this purpose – see below.



All measurements are in mm

Figure 2: Gold Whistle Dimensions

When the Gold Whistle 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 heatsink. Elmo has an external heatsink (Catalog number: WHI-HEATSINK-2) that can be ordered for this purpose, see Figure 3 below.

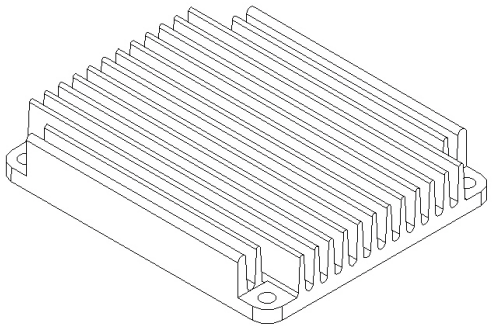


Figure 3: Gold Whistle External Heat Sink

4.5. Integrating the Gold Whistle on a PCB

The Gold Whistle is designed to be mounted on a PCB, either by soldering its pins directly to the PCB or by using suitable socket connectors. Refer to the Gold Line Whistle Design Guide MAN-G-WHIIDG for further information.

4.5.1. Grounds and Returns

The returns in each functional block are listed below:

Functional Block	Return Pin
Power	PR (Power Return)
Internal Switch Mode P.S.	PR (Power Return)
Analog input return	ANLRET (J2/20)
Common return	COMRET (J2/25,31,32,43,46; J1/23)
STO safety signal return	STO_RET (J1/10)
Input Return	IN_RET (J1/3)

Table 8: Grounds and Returns

The returns above are all shorted within the Gold Whistle in a topology that results in optimum performance.

Caution:
Follow these instructions to ensure safe and proper implementation. Failure to meet any of the below-mentioned requirements can result in drive, controller or host failure.

1. When wiring the traces of the above functions, on the Integration Board, the **Returns** of each function must be **wired separately** to its designated terminal on the Gold Whistle. **DO NOT USE A COMMON GROUND PLANE**. Shorting the commons on the Integration Board may cause performance degradation (ground loops, etc).

2. **Digital Inputs**: The six digital inputs are optically isolated from the other parts of the Gold Whistle. All six inputs share one return line, INRET. To retain isolation, the Input Return pin and all other conductors on the input circuit must be laid out separately.

3. **STO**: The two digital STO inputs are optically isolated from the other parts of the Gold Whistle, and share one return line, STO_RET. To retain isolation, the Input Return pin and all other conductors on the input circuit must be laid out separately

4. **Digital Outputs**: The two digital outputs are optically isolated from the other parts of the Gold Whistle. To retain isolation, all the output circuit conductors must be laid out separately.

5. **Return Traces:** The return traces should be as large as possible, but without shorting each other, and with minimal cross-overs.

6. **Main Power Suppl**y and Motor Traces: The power traces must be kept as far away as possible from the feedback, control and communication traces.

7. **PE Terminal:** The PE (Protective Earth) terminal is connected directly to the Gold Whistle's heat-sink which serves as an EMI common plane. The PE terminal should be connected to the system's Protective Earth. Any other metallic parts (such as the chassis) of the assembly should be connected to the Protective Earth as well.

8. Under normal operating conditions, the PE trace carries no current. The only time these traces carry current is under abnormal 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.

4.6. The Gold Whistle Connection Diagram

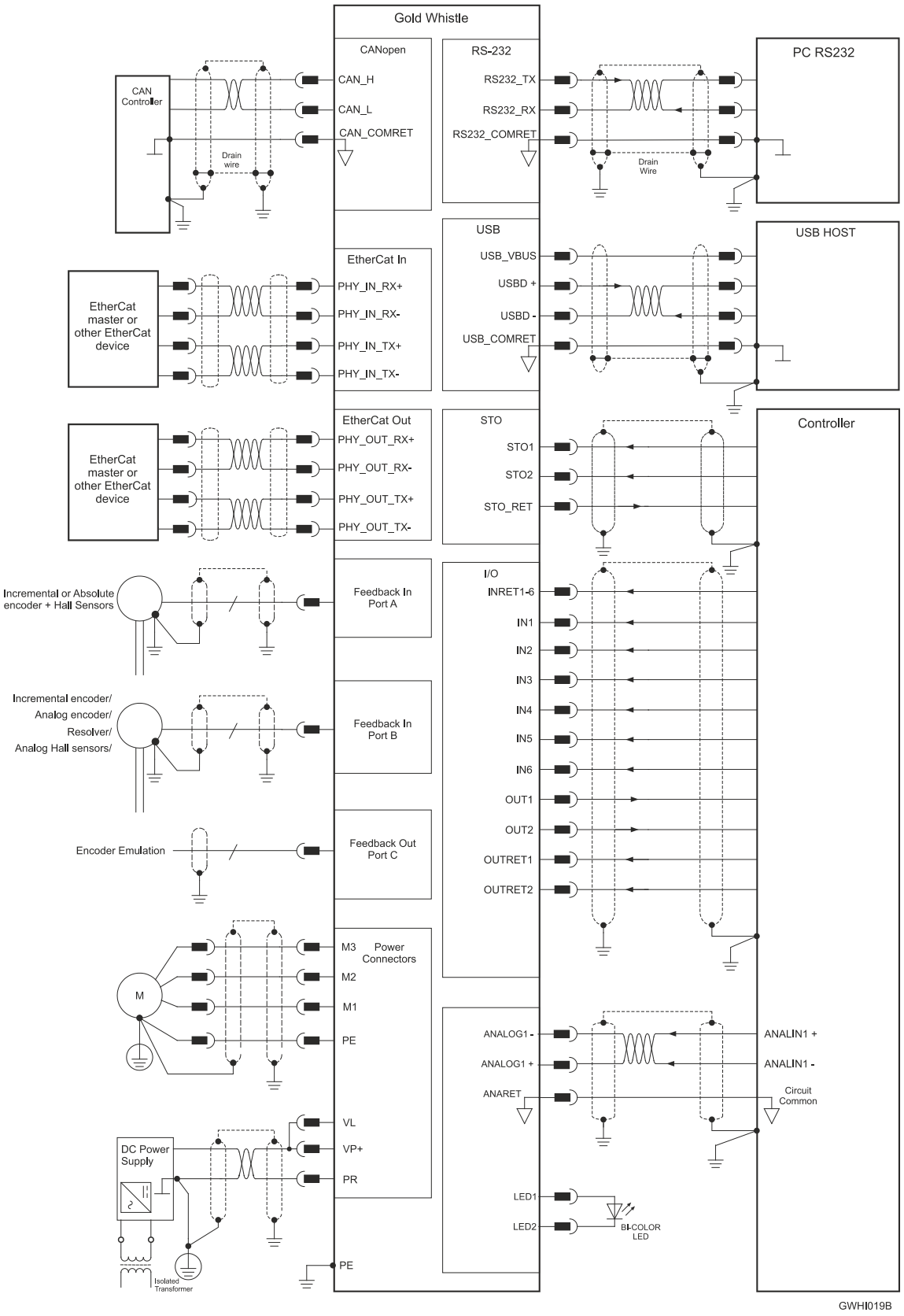


Figure 4: The Gold Whistle Connection Diagram

4.7. Main Power, Auxiliary Power and Motor Power

The Gold Whistle receives power from main and auxiliary supplies and delivers power to the motor.

4.7.1. Motor Power

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

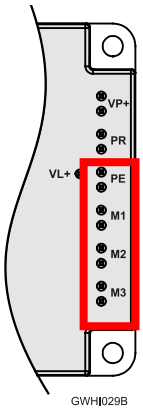
Pin	Function	Cable		Pin Positions
		Brushless Motor	Brushed DC Motor	
PE	Protective earth	Motor	Motor	
M1	Motor phase	Motor	N/C	
M2	Motor phase	Motor	Motor	
M3	Motor phase	Motor	Motor	

Table 9: Motor Connector

Connect the M1, M2, M3 and PE pins on the Gold Whistle in the manner described in Section 4.3.2.1. The phase connection is arbitrary as the Elmo Application Software (EAS) will automatically establish the proper commutation during setup. However, if you plan to copy the setup to other drives, then the phase order on all the drives must be the same.

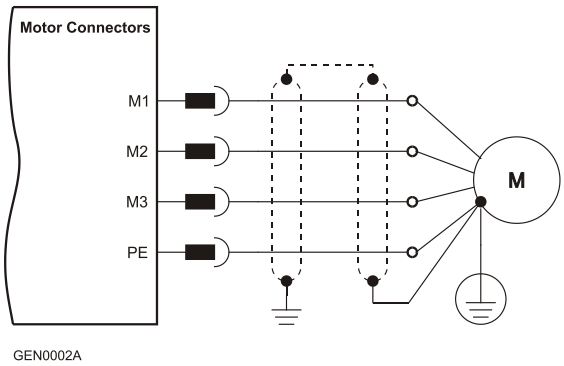


Figure 5: Brushless Motor Power Connection Diagram

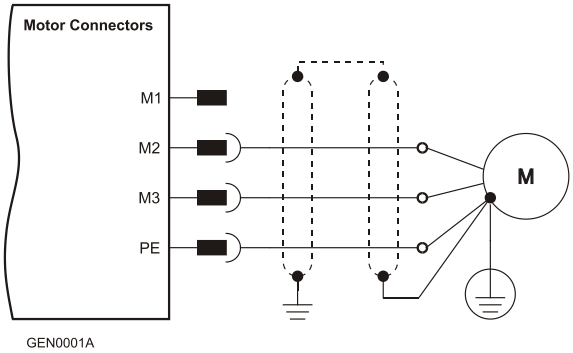


Figure 6: DC Brushed Motor Power Connection Diagram

4.7.2. Main and Auxiliary Power

This section describes the Main and Auxiliary Power for power ratings 200V and 100V, and provides details for the optional Backup (Auxiliary) Supply.

4.7.2.1. Main Power

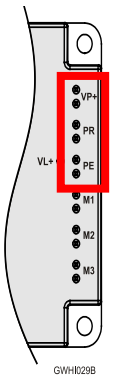
Pin	Function	Cable	Pin Positions
VP+	Pos. Power input	Power	
PR	Power return	Power	
PE	Protective earth	Power	

Table 10: Connector for Main Power

Power to the Gold Whistle is provided by a 12 to 195 VDC source.

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

Notes for connecting the DC power supply

- The source of the 12 to 195 VDC power supply must be isolated.
- 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.
- Connect the cable shield to the closest ground connection near the power supply.
- Connect the PE to the closest ground connection near the power supply.
- Connect the PR to the closest ground connection near the power supply.
- Before applying power, first verify the polarity of the connection.

4.7.2.2. Auxiliary Power Supply (Optional)

Note: The source of the Auxiliary Supply must be isolated.

Connect the VL+ and PR pins on the Gold Whistle in the manner described in Section 4.3.2.1.

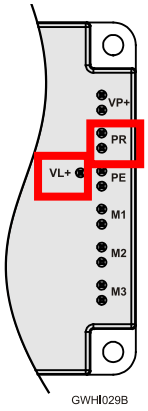
Pin	Function	Pin Positions
VL+	Auxiliary Supply Input	
PR	Auxiliary Supply Return	

Table 11: Auxiliary Supply Pins

Caution:
Power from the Gold Whistle to the motor must come from the Main Supply and **not** from the Auxiliary Supply.

The backup functionality can be used for storing control parameters in case of power-outs, providing maximum flexibility and backup capability when needed.

*Connect the VL+ and PR terminal to the **Auxiliary** Connector.*

Notes for auxiliary supply connections:

- The source of the Auxiliary Supply must be isolated.
- For safety reasons, connect the return (common) of the auxiliary supply source to the closest ground near the auxiliary supply source
- Connect the cable shield to the closest ground near the auxiliary supply source
- Before applying power, first verify the polarity of the connection.

4.7.2.3. Power Rating 200 V

For Power Rating 200 V, two power isolated DC power sources are required, main power 12 - 195V and auxiliary Power 12-95V for the logic.

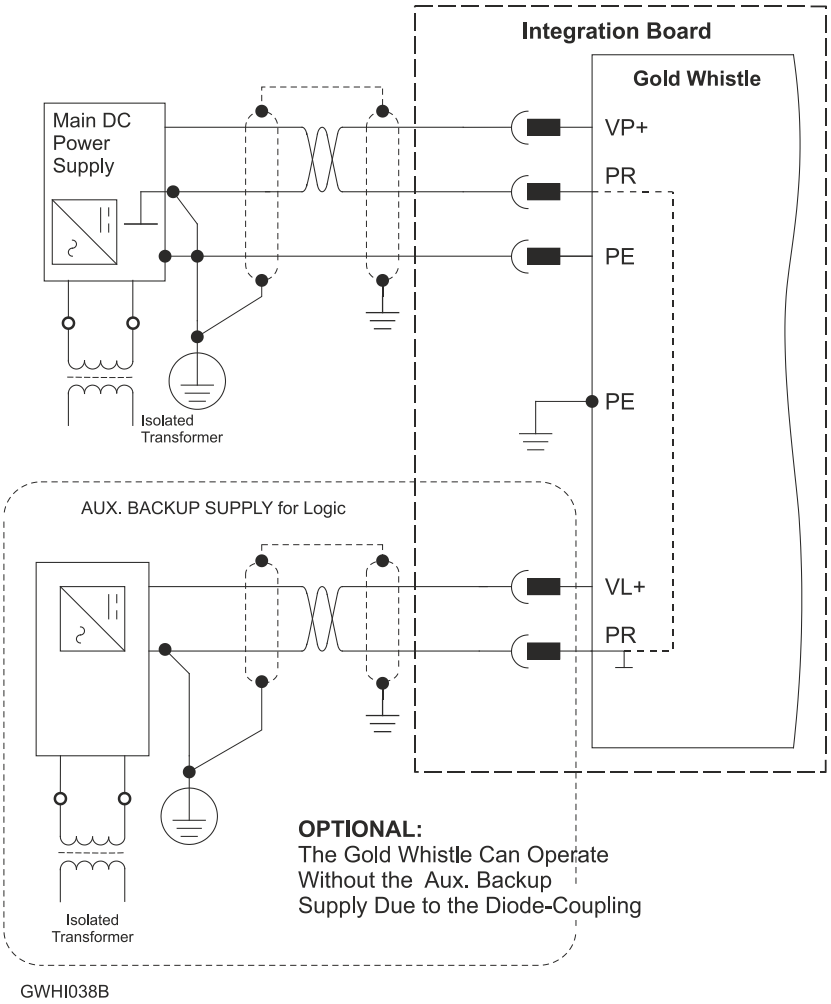


Figure 7: 200 VDC Power Source Connection Diagram

4.7.2.4. Power Rating 100 V

4.7.2.4.a Single Power Supply

For power rating 100 V , a single Power Supply is required which contains a “smart” control-supply algorithm, enabling the Gold Whistle to operate with only one power supply with no need for an auxiliary power supply for the logic.

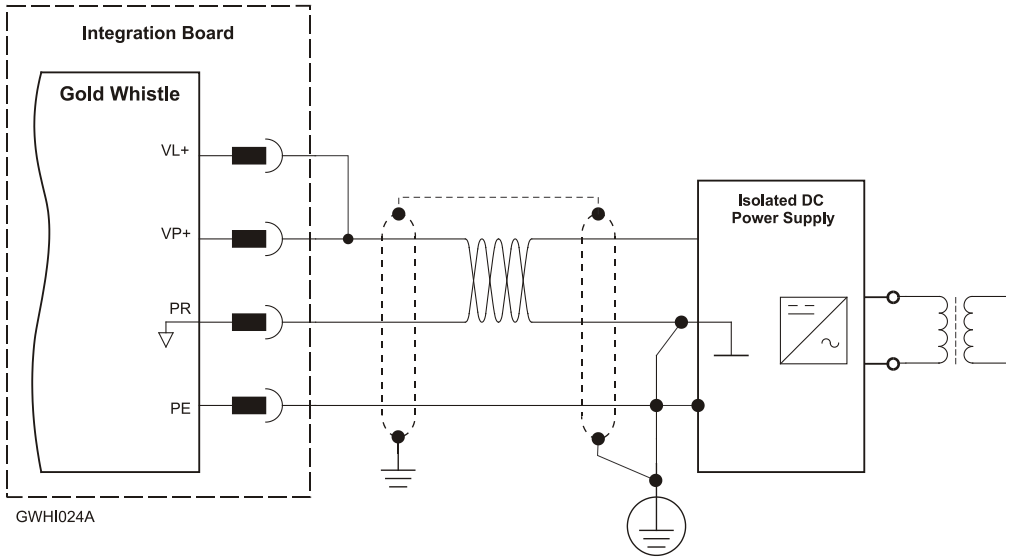


Figure 8: Main Power Supply Connection Diagram (no Auxiliary Supply)

4.7.2.4.b Separate Auxiliary (Backup) Supply

Power to the Auxiliary Supply can be provided by a separate Auxiliary Supply.

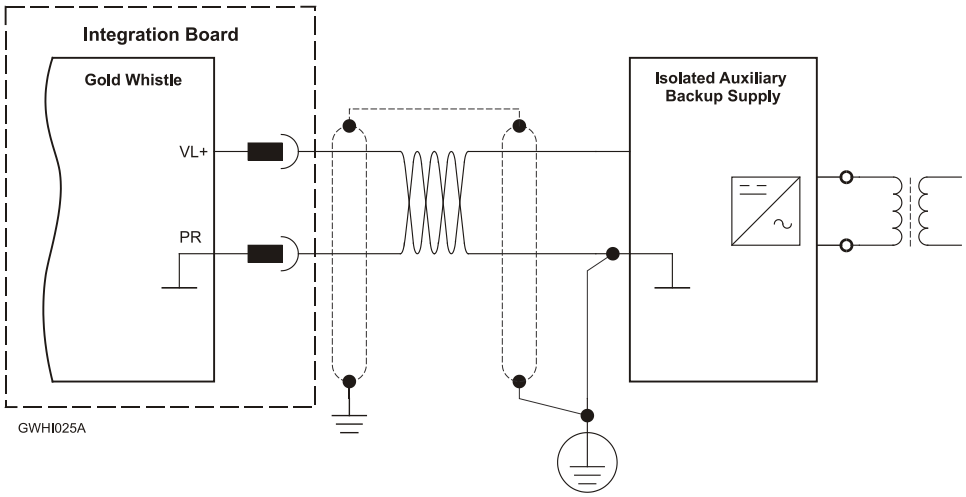


Figure 9: Separate Auxiliary Supply Diagram (Backup)

4.7.2.4.c Shared Optional Backup Supply

A Main DC Power Supply can be designed to supply power to the drive's logic as well as to the Main Power (see Figure 8 and the upper portion of Figure 10). If backup functionality is required for continuous operation of the drive's logic in the event of a main power-out, a backup supply can be connected by implementing "diode coupling", see the Aux. Backup Supply in Figure 10.

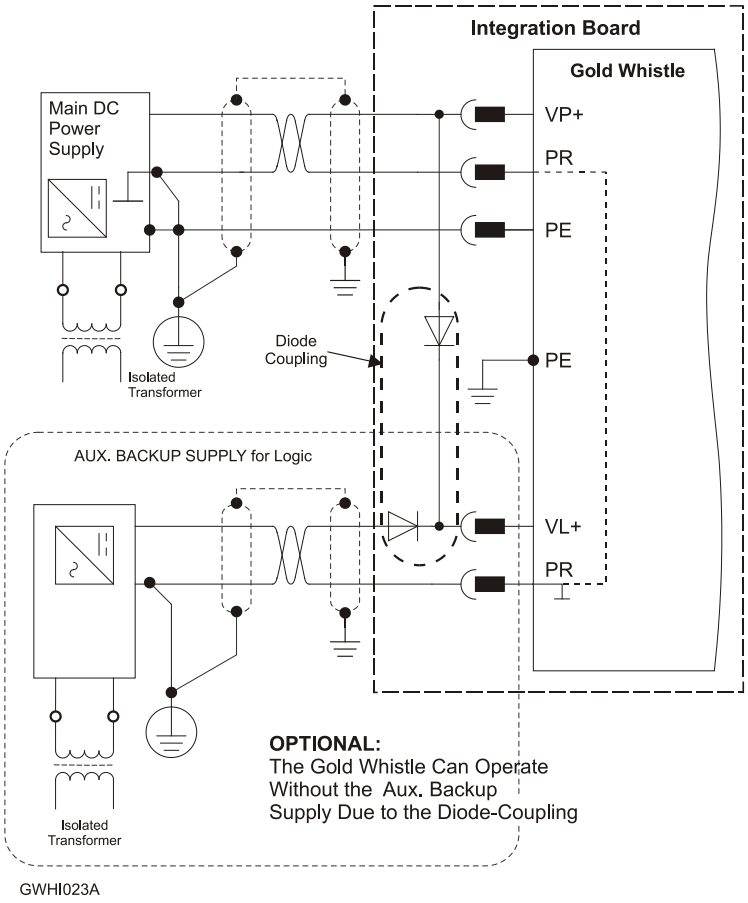


Figure 10: Separate Auxiliary Supply Connection Diagram

4.8. STO (Safe Torque Off) Inputs

Activation of Safe Torque Off causes the drive to stop providing power that can cause rotation (or motion in the case of a linear motor) to the motor.

This function may be used to prevent unexpected motor rotation (of brushless DC motors) without disconnecting the drive from the power supply.

The motor is active only as long as 5 V is provided to both STO1 and STO2. Whenever any input voltage is no longer present, power is not provided to the motor and the motor shaft continues to rotate to an uncontrolled stop.

The STO inputs are latched which means that the motor can be re-enabled by a software command only.

In circumstances where external influences (for example, falling of suspended loads) are present, additional measures such as mechanical brakes are necessary to prevent any hazard.

This function corresponds to an uncontrolled stop in accordance with Stop Category 0 of IEC 60204-1.

Note: This function does not protect against electrical shock, and additional measures to turn the power off are necessary.

The following table defines the behavior of the motor as a function of the state of the STO inputs:

Signal – STO1	Signal – STO2	Function
Not Active	Not Active	Motor is disabled
Not Active	Active	Motor is disabled
Active	Not Active	Motor is disabled
Active	Active	Motor can be enabled

Table 12: Motor Behavior According to Safety Inputs

Note: In the Gold Whistle, STO1 also latches a software disable condition.

Pin (J1)	Signal	Function
12	STO1	Safety 1 input
11	STO2	Safety 2 input
10	STO_RET	STO return

Table 13: STO Inputs Pin Assignments

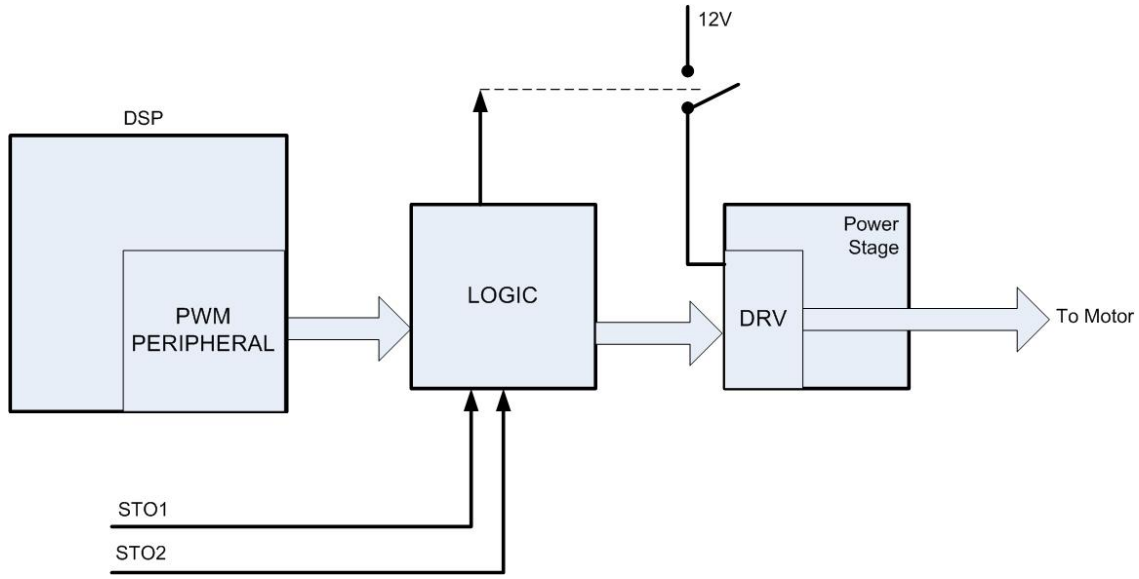


Figure 11: STO Input Functionality – Schematic Drawing

The figure below is for the TTL level.

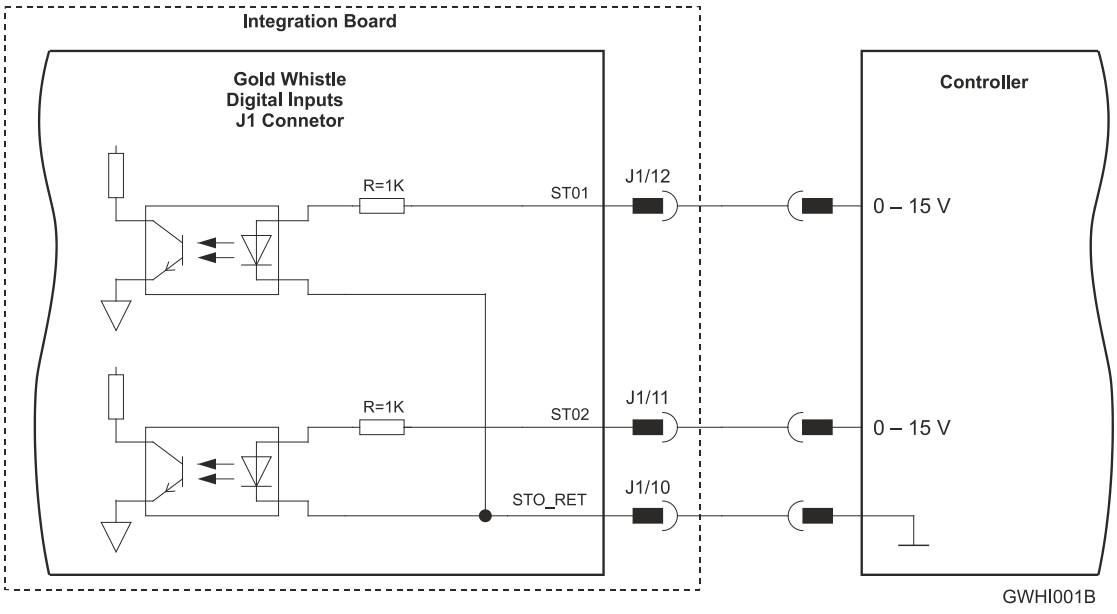


Figure 12: STO Input Connection – TTL Level

The figure below is for PLC.

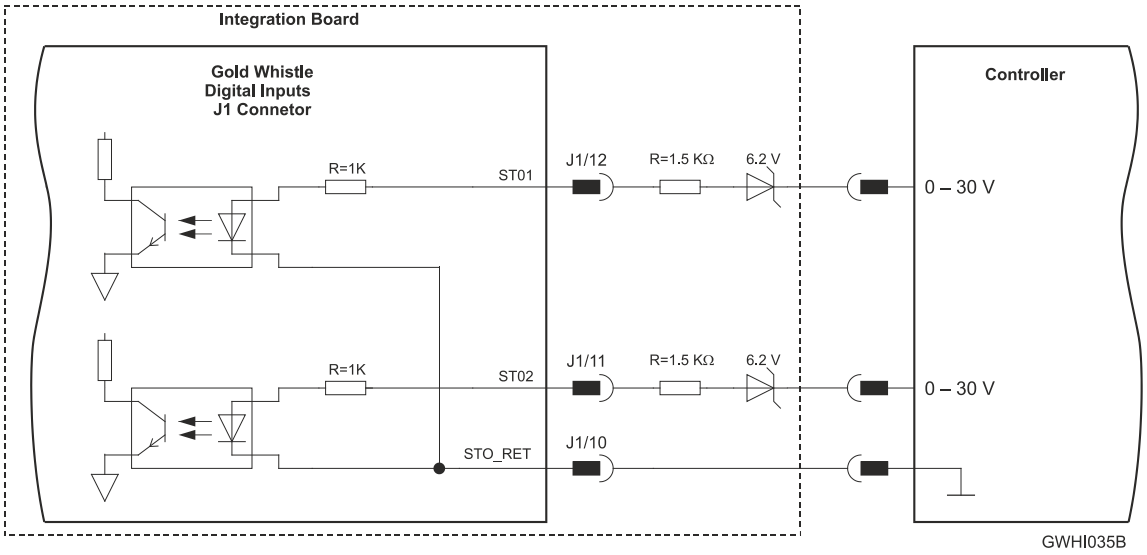


Figure 13: STO Input Connection – PLC

4.9. Feedback

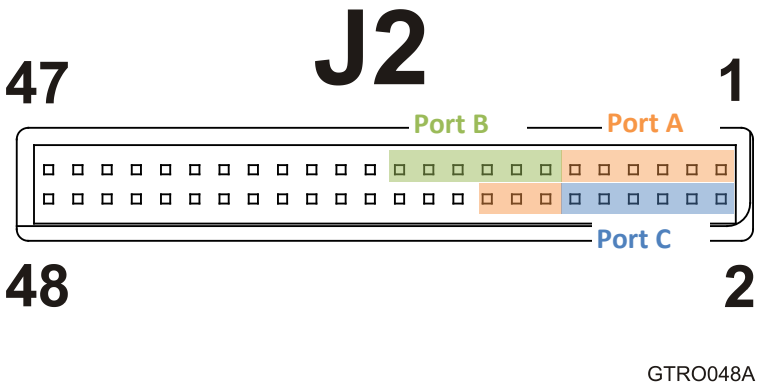


Figure 14: Feedback Ports on J2

The Gold Whistle has two configurable motion sensor input ports, namely, Port A and Port B, together with the emulated buffered output Port C. Motion sensors from the motor are controlled from other sources and can be connected to any of the available inputs on Port A or Port B.

The software configuration designates a role to each input, e.g., the incremental encoder on port B is the controlled motor position feedback, the Hall sensors on port A are commutation feedback, and the incremental encoder on port A is follower input.

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

4.9.1. Port A (J2)

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

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

	Port A - Incremental Encoder		Port A - Absolute Serial Encoder	
	G-WHIXXX/YYYYE/R		G-WHIXXX/YYYYE/R	
Pin (J2)	Signal	Function	Signal	Function
47	+5V	Encoder +5V supply	+5V	Encoder +5V supply
25	SUPRET	Supply return	SUPRET	Supply return
1	PortA_ENC_A+	Channel A+	ABS_CLK+	Abs encoder clock +
3	PortA_ENC_A-	Channel A-	ABS_CLK-	Abs encoder clock -
5	PortA_ENC_B+	Channel B+	ABS_DATA+	Abs encoder data +
7	PortA_ENC_B-	Channel B-	ABS_DATA-	Abs encoder data -
9	PortA_ENC_Index+	Index+	Reserved	Reserved
11	PortA_ENC_Index-	Index-	Reserved	Reserved
14	HC	Hall sensor C	HC	Hall sensor C
16	HB	Hall sensor B	HB	Hall sensor B
18	HA	Hall sensor A	HA	Hall sensor A

Table 14: Port A Pin Assignments

4.9.1.1. Incremental Encoder

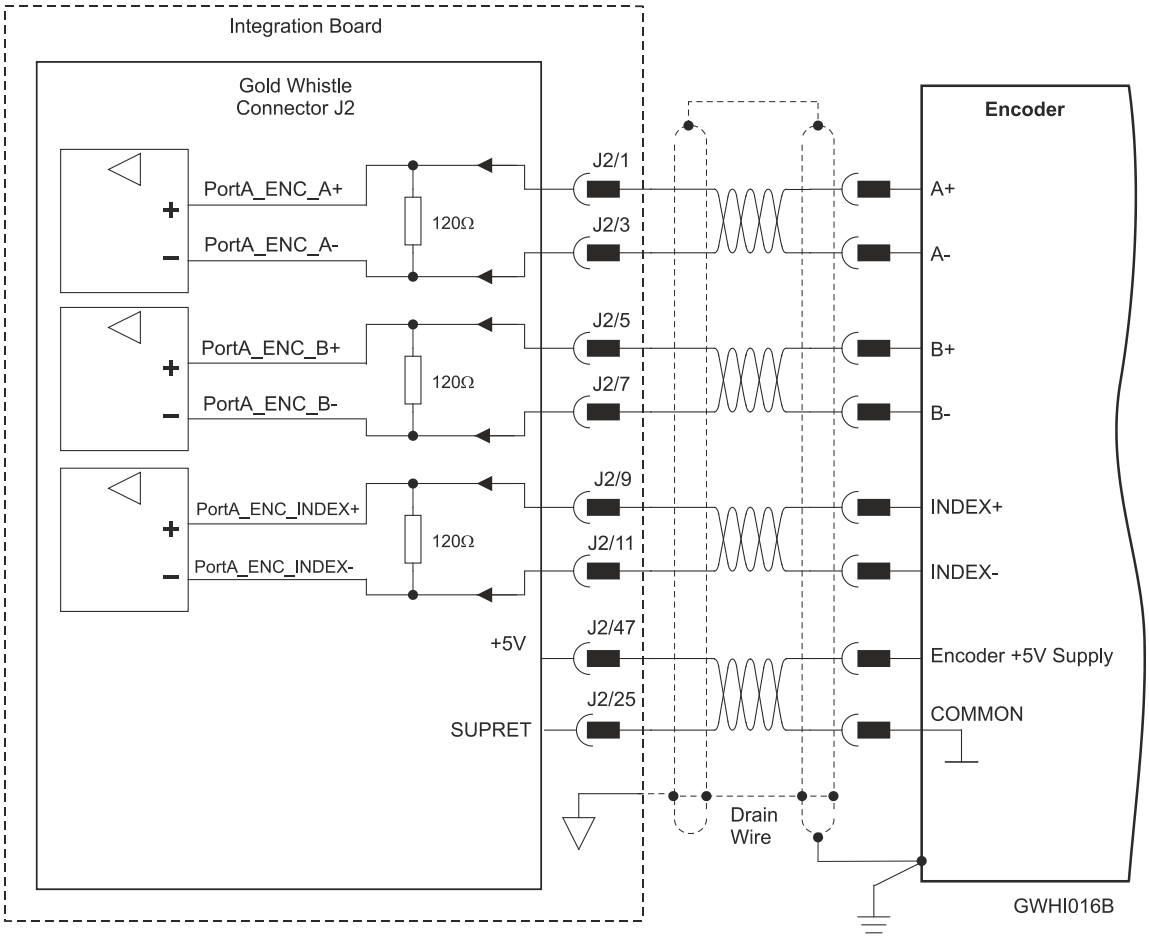


Figure 15: Port A Incremental Encoder Input – Recommended Connection Diagram

4.9.1.2. Absolute Serial Encoder

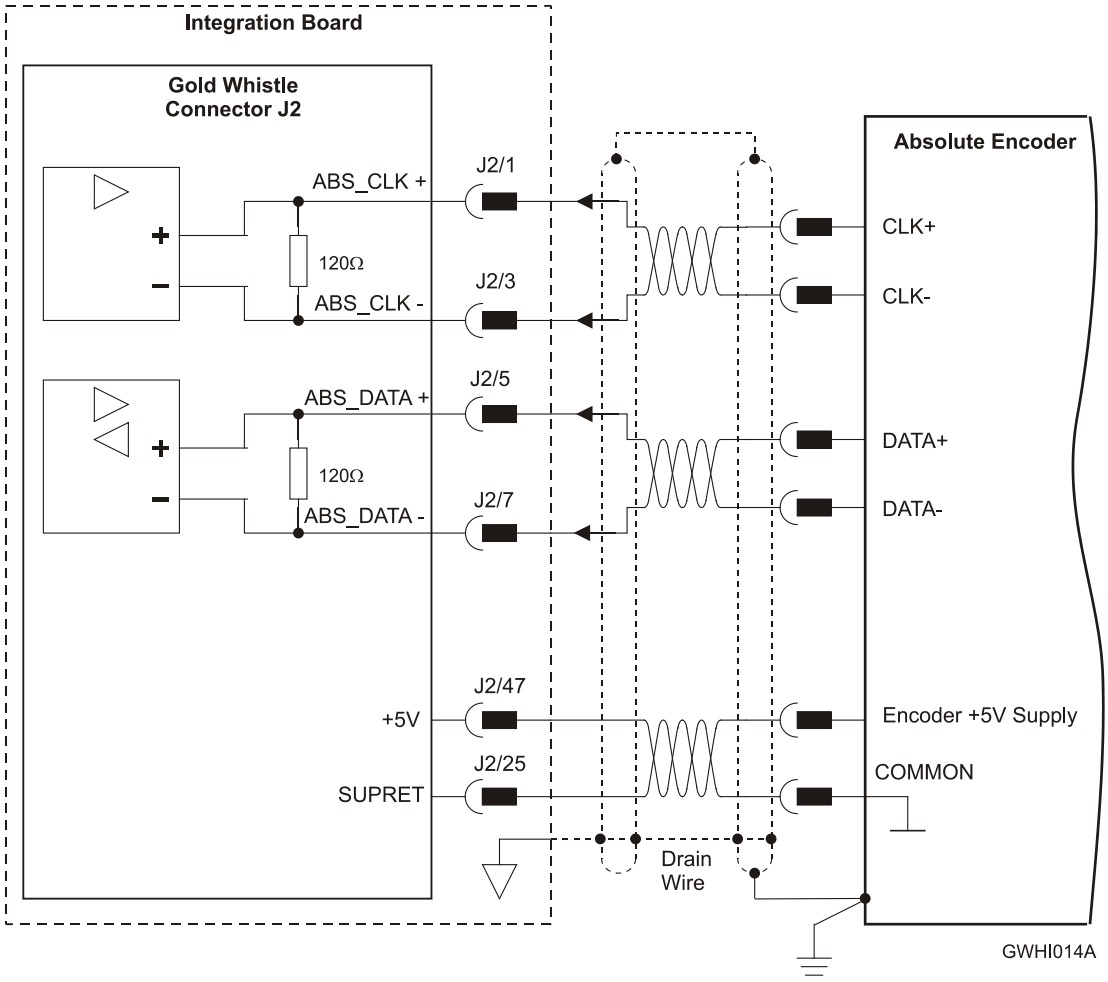


Figure 16: Absolute Serial Encoder – Recommended Connection Diagram for Sensors Supporting Data/Clock (e.g., Biss / SSI / EnDAT, etc.)

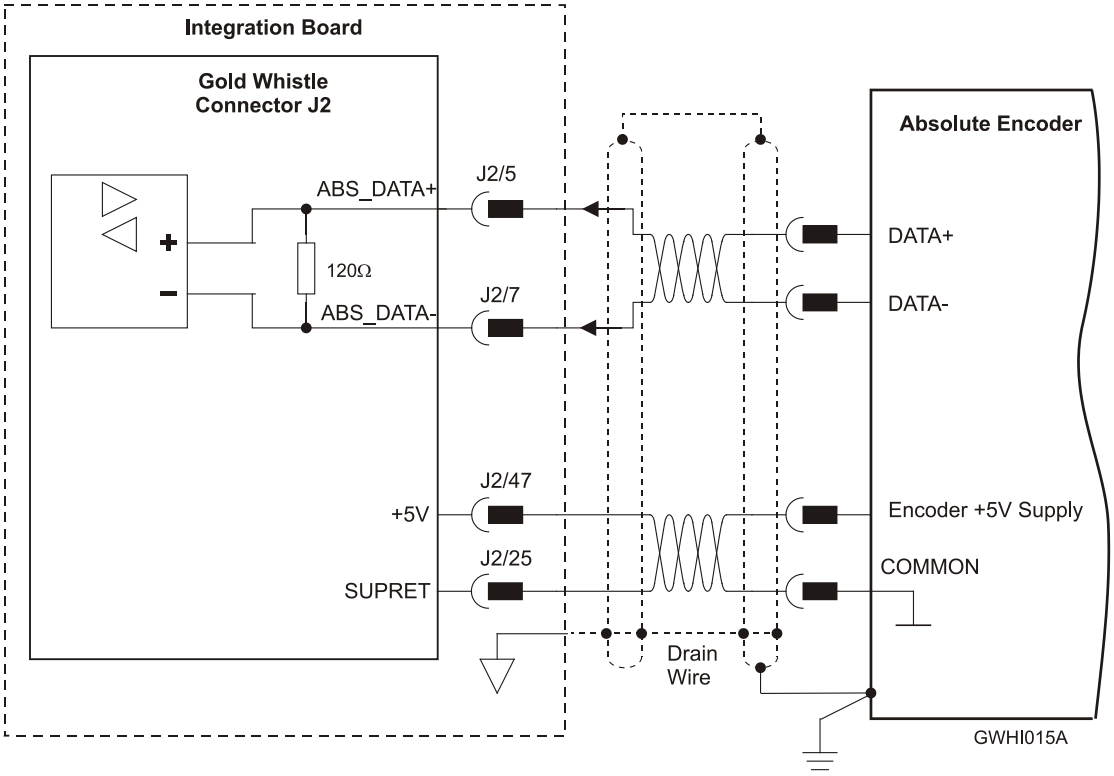


Figure 17: Absolute Serial Encoder – Recommended Connection Diagram for Sensors Supporting Data Line Only (NRZ types, e.g., Panasonic / Mitutoyo / etc.)

4.9.1.3. Hall Sensors

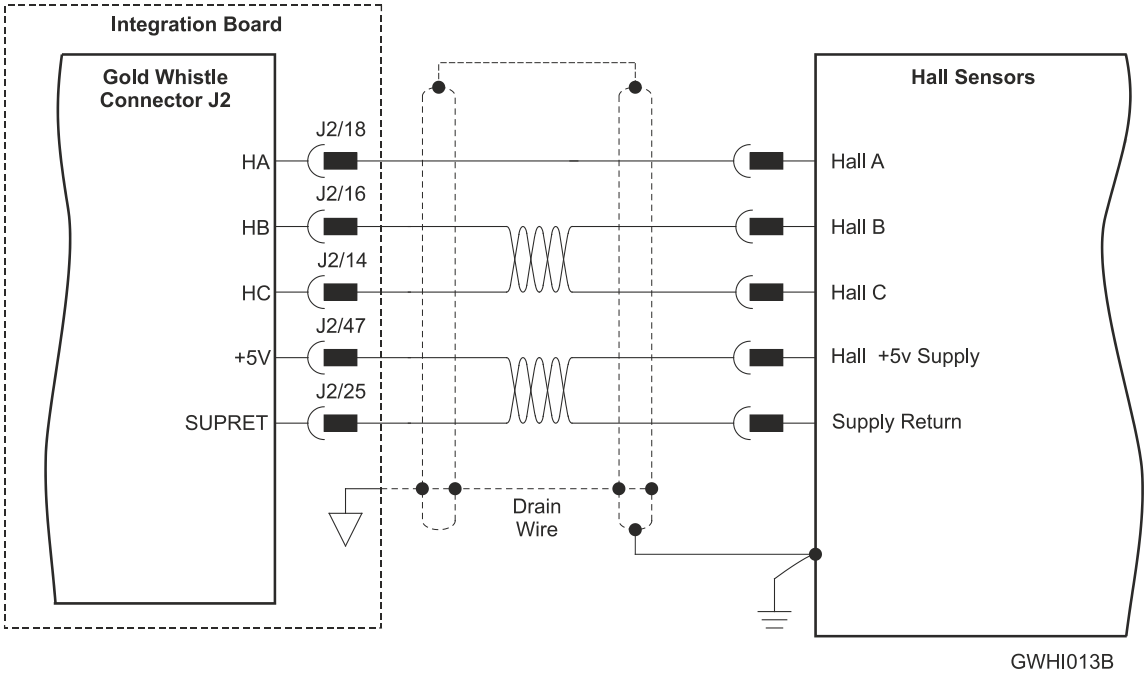


Figure 18: Hall Sensors Connection Diagram

4.9.2. Port B (J2)

Port B supports any of the following sensors:

- Incremental encoder, interpolated analog encoder or analog Hall sensors

Or:

- Resolver (separate hardware option)

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

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

	Port B - Incremental or Interpolated Analog Encoder		Port B - Resolver	
	G-WHI XXX/YYYYE		G-WHI XXX/YYYYR	
Pin (J2)	Signal	Function	Signal	Function
47	+5V	Encoder +5V supply	NC	
25	SUPRET	Supply return	SUPRET	Supply return
13	PortB_ENC_A+/ SIN+	Channel A+ / Sine+	SIN+	Sine+
15	PortB_ENC_A-/ SIN-	Channel A- / Sine-	SIN-	Sine-
17	PortB_ENC_B+/ COS+	Channel B+ / Cosine+	COS+	Cosine+
19	PortB_ENC_B-/ COS-	Channel B - / Cosine -	COS-	Cosine-
21	PortB_ENC_INDEX+/ Analog_Index+	Index +/ Analog_Index+	RESOLVER_OUT+	Vref f=1/TS, 50 mA Max.
23	PortB_ENC_INDEX-/ Analog_Index-	Index -/ Analog_Index-	RESOLVER_OUT-	Vref complement f= 1/TS, 50 mA Maximum

Table 15: Port B Pin Assignments

4.9.2.1. Incremental Encoder

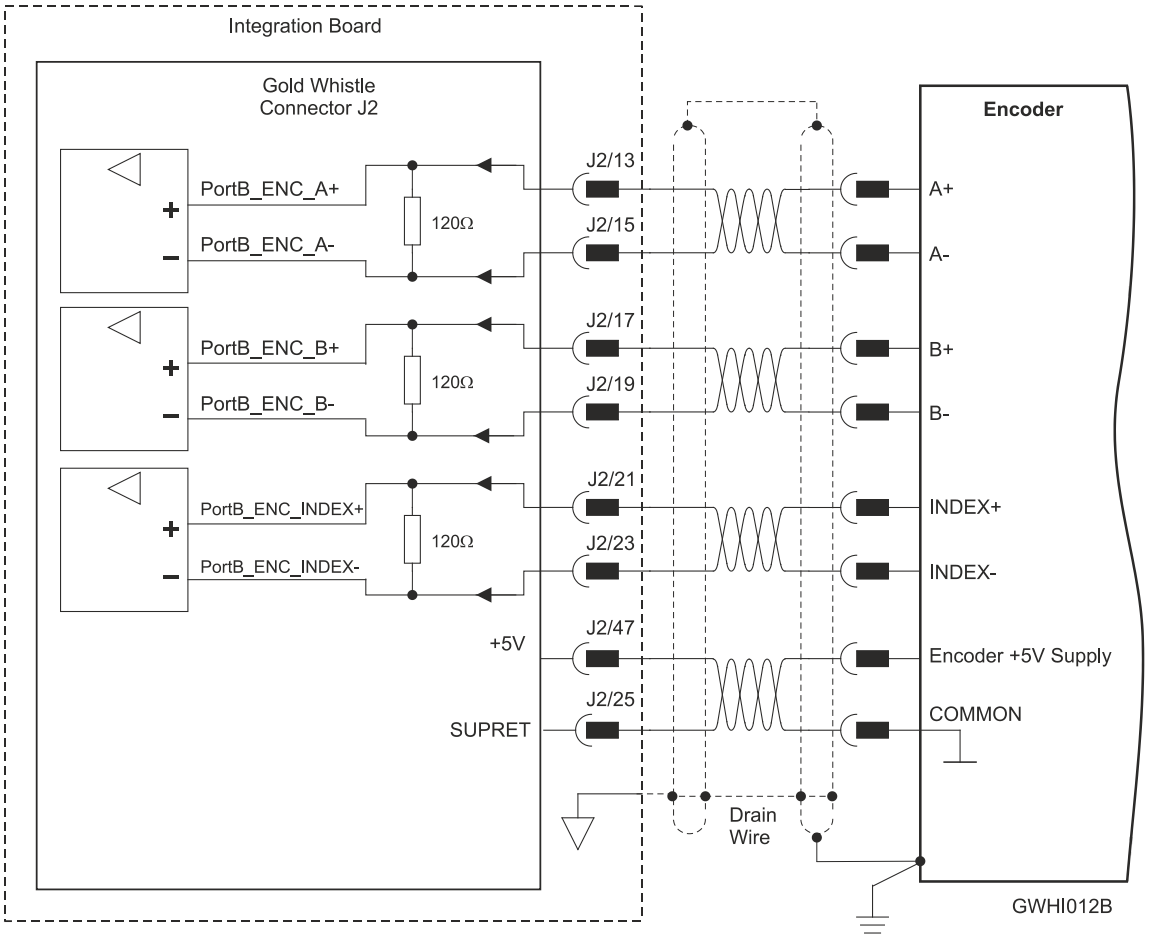


Figure 19: Port B Incremental Encoder Input – Recommended Connection Diagram

4.9.2.2. Interpolated Analog Encoder

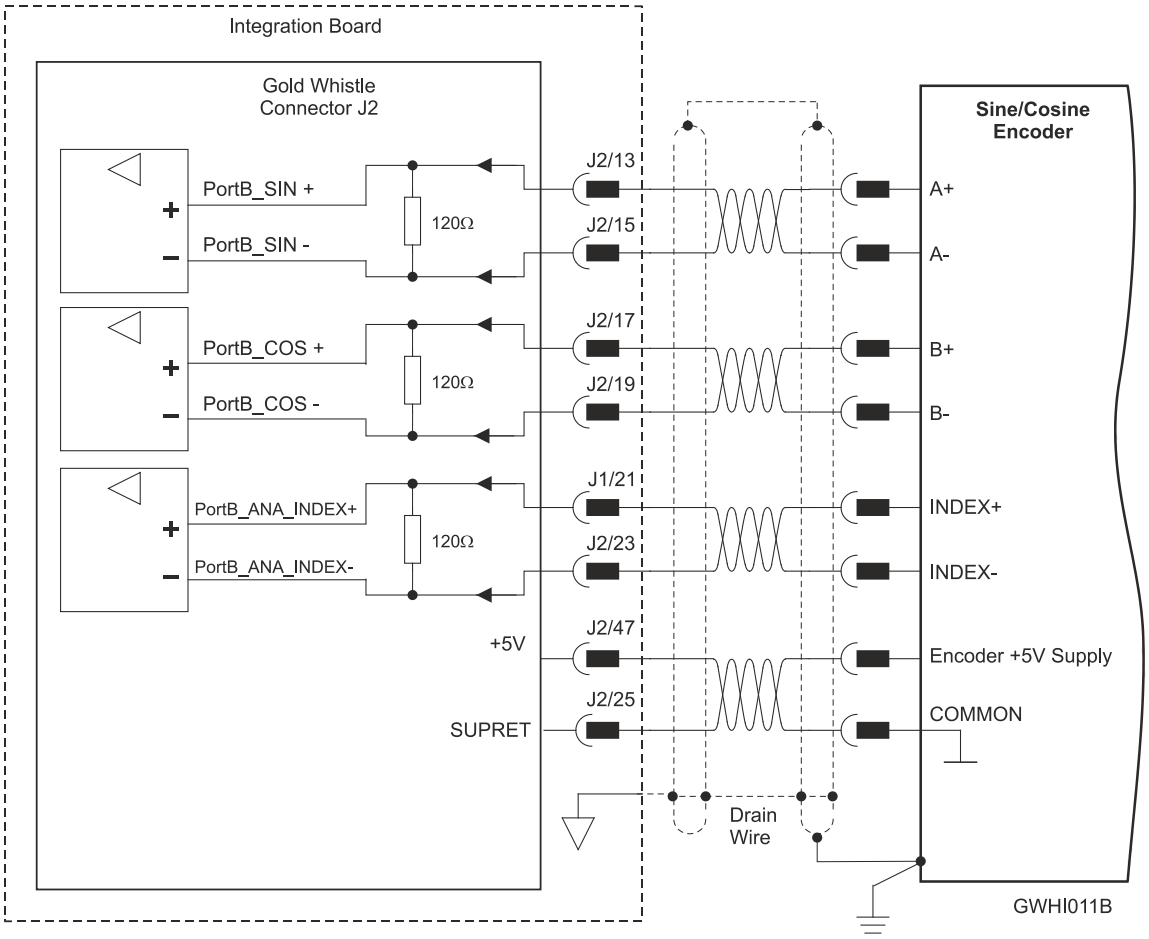


Figure 20: Port B - Interpolated Analog Encoder Connection Diagram

4.9.2.3. Resolver

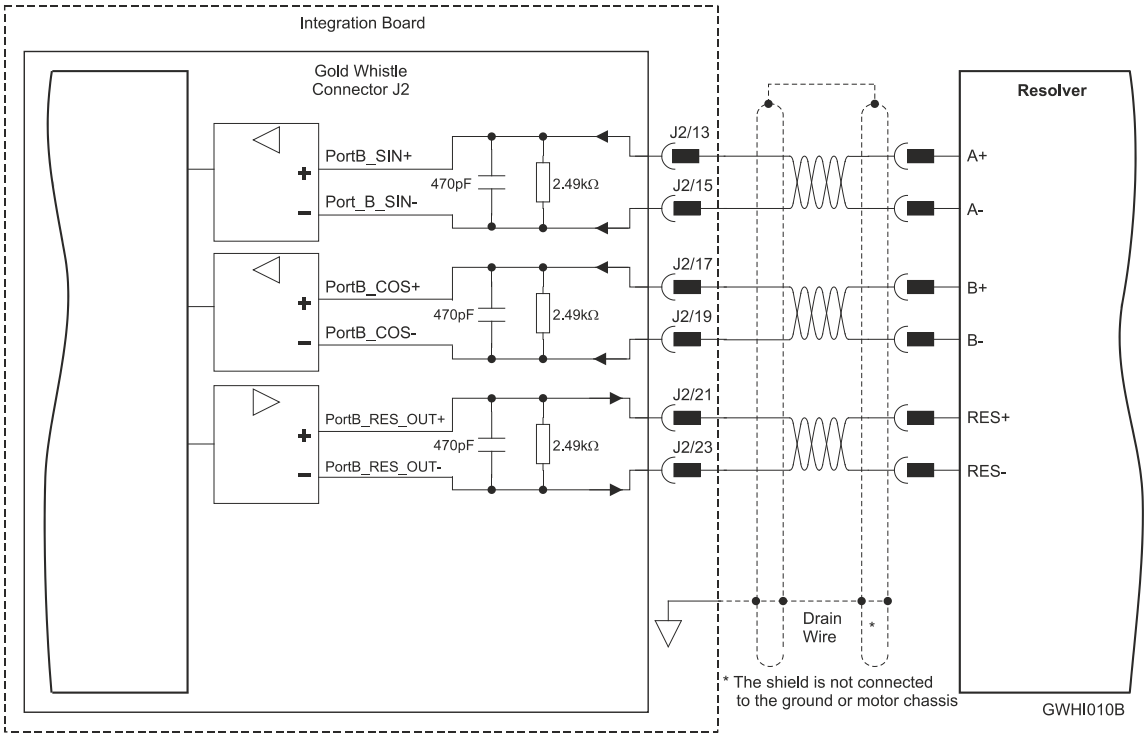


Figure 21: Port B – Resolver Connection Diagram

4.9.3. Port C – Emulated Encoder Output (J2)

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

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

This port is used when:

- The Gold Whistle is used as a current amplifier to provide position data to the position controller.
- The Gold Whistle is used in velocity mode to provide position data to the position controller.
- The Gold Whistle is used as a master in follower or ECAM mode.

Pin (J2)	Signal	Function
2	PortC_ENCO_A-	Buffered Channel A- output/Pulse-/PWM-
4	PortC_ENCO_A+	Buffered Channel A+ output / Pulse+/PWM+
6	PortC_ENCO_B-	Buffered Channel B- output / Dir-
8	PortC_ENCO_B+	Buffered Channel B+ output / Dir+
10	PortC_ENCO_INDEX-	Buffered Channel INDEX- output
12	PortC_ENCO_INDEX+	Buffered Channel INDEX+ output

Table 16: Port C Pin Assignment

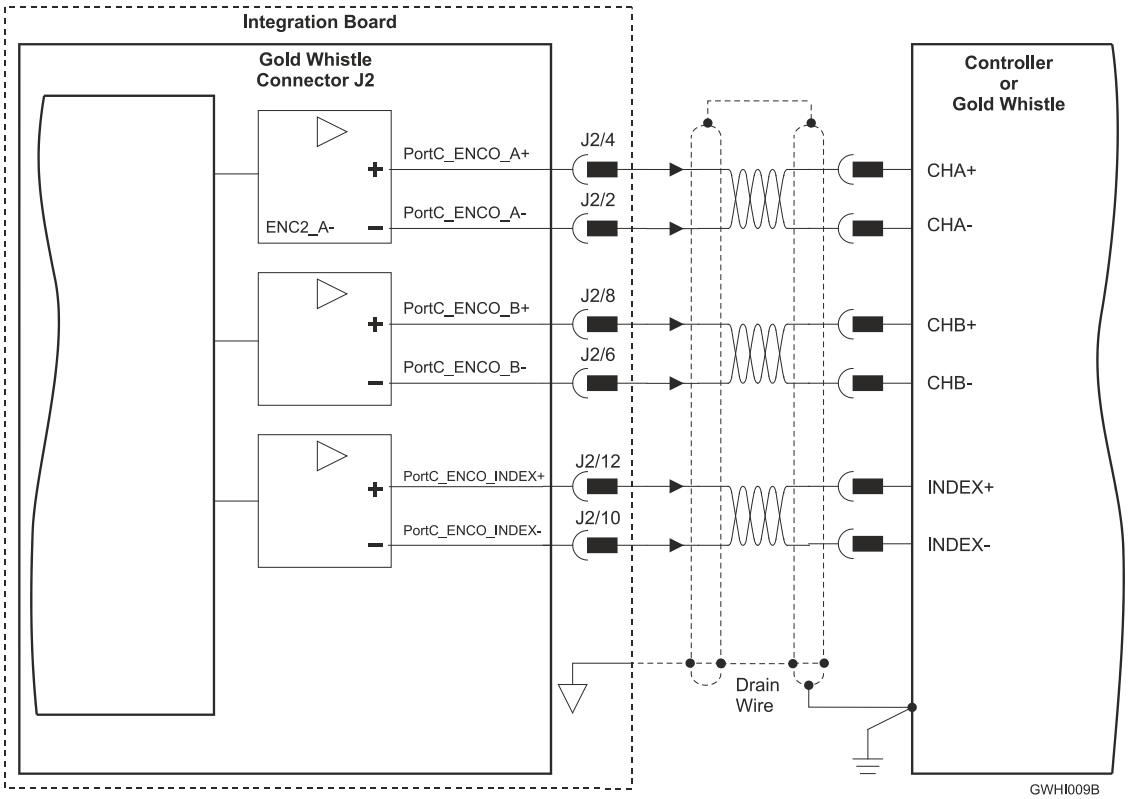


Figure 22: Emulated Encoder Differential Output – Recommended Connection Diagram

4.9.4. Analog Input

An analog user input can be configured by software to be used as either tachometer velocity sensor input or potentiometer position feedback. For connection diagrams refer to Section 4.10.3.

4.10. User I/Os

The Gold Whistle has six programmable digital inputs (J1), four digital outputs (J1) and one analog input (J2).

4.10.1. Digital Inputs (J1)

Each of the pins below can function as an independent input. The inputs conform to the TTL level.

Pin (J1)	Signal	Function
3	INRET1-6	Programmable inputs 1 - 6 return
4	IN1	High speed programmable input 1 (event capture, home, general purpose, RLS, FLS, INH)
5	IN2	High speed programmable input 2 (event capture, home, general purpose, RLS, FLS, INH)
6	IN3	High speed programmable input 3 (event capture, home, general purpose, RLS, FLS, INH)
7	IN4	High speed programmable input 4 (event capture, home, general purpose, RLS, FLS, INH)
8	IN5	High speed programmable input 5 (event capture, home, general purpose, RLS, FLS, INH)
9	IN6	High speed programmable input 6 (event capture, home, general purpose, RLS, FLS, INH)

Table 17: Digital Input Pin Assignments

See Figure 23 for the TTL connection.

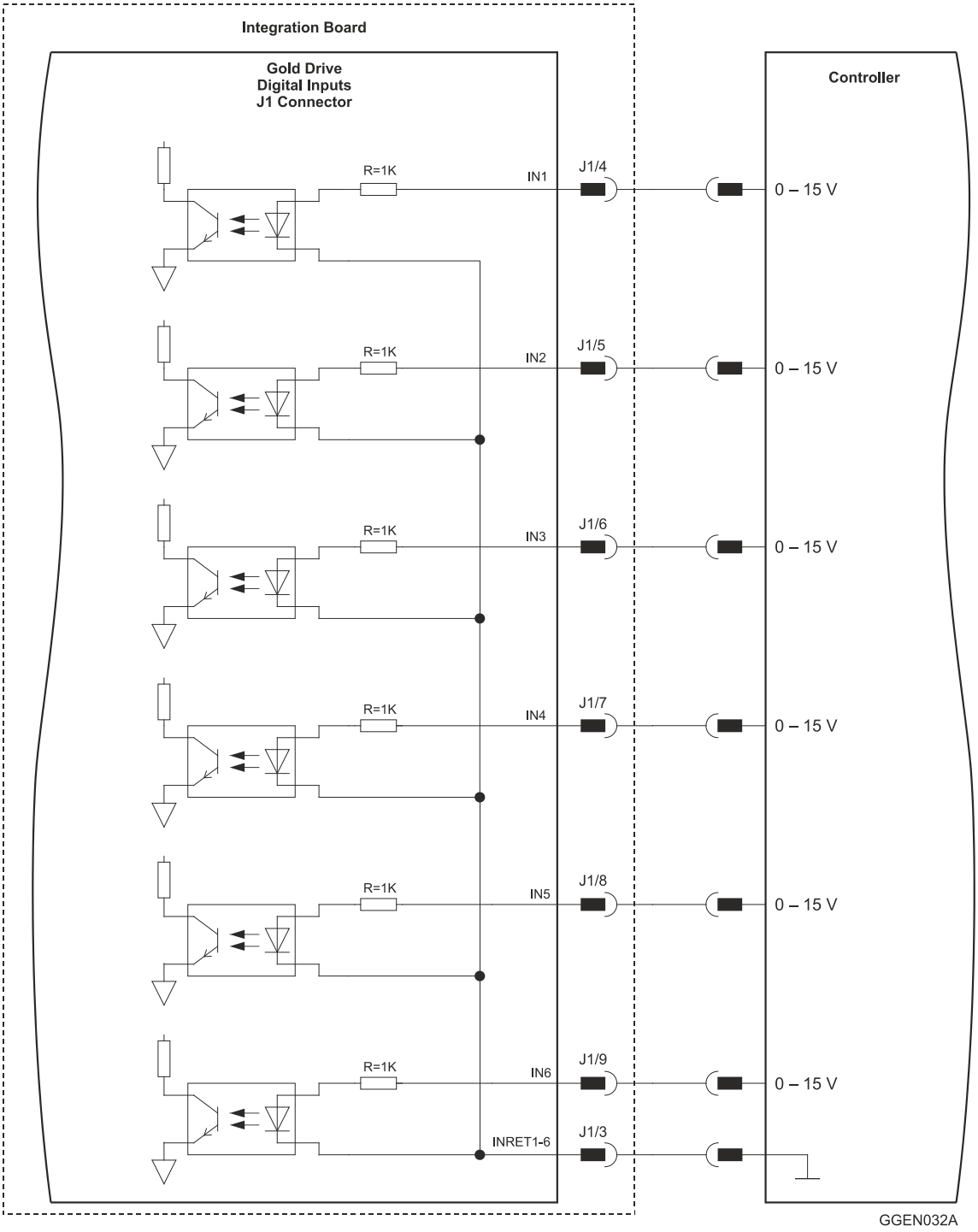


Figure 23: Digital Input Connection Diagram – TTL Level

See the figure below for the PLC connection.

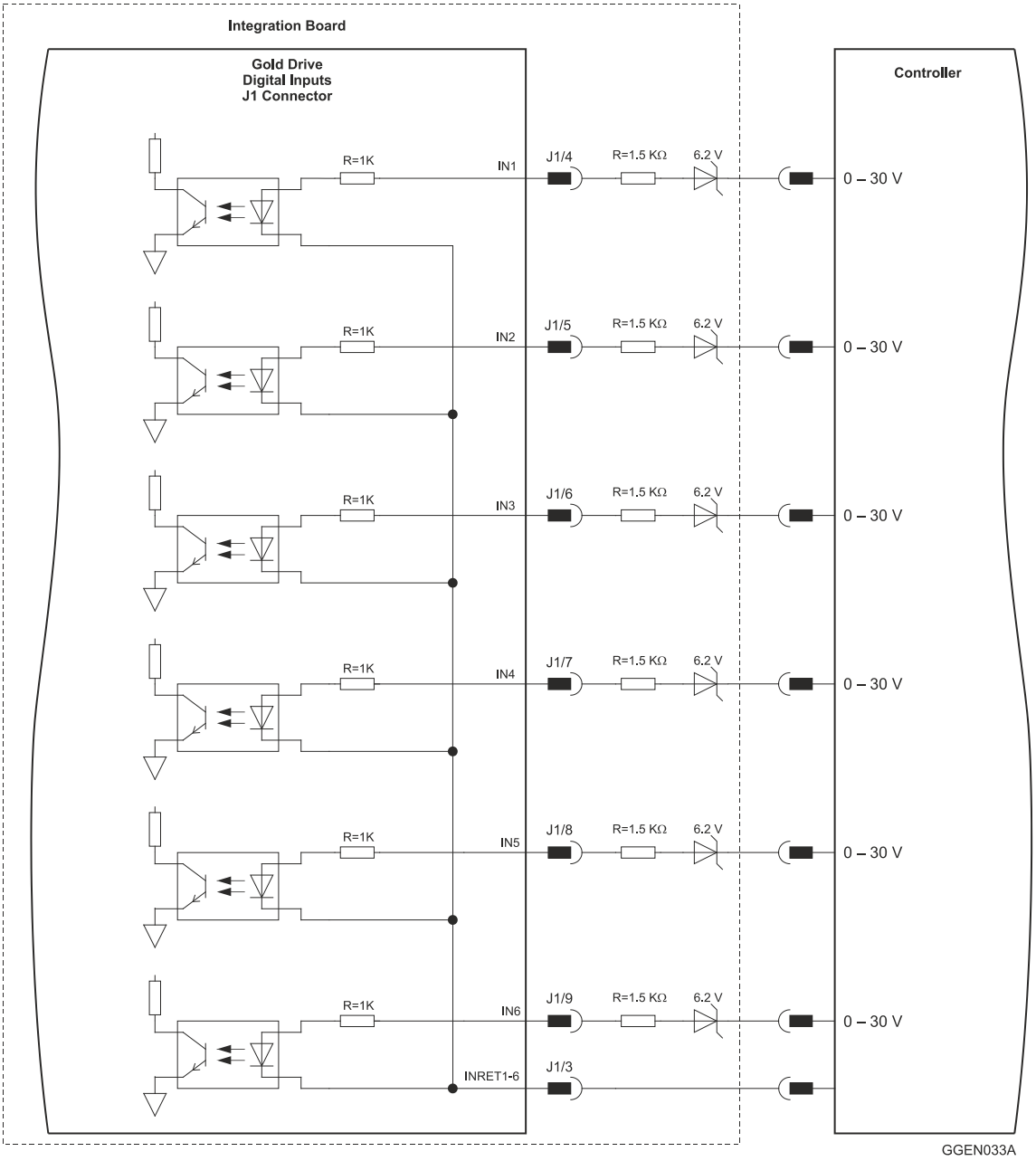


Figure 24: Digital Input Connection Diagram – PLC

4.10.2. Digital Outputs (J1)

The outputs conform to the TTL level.

Pin (J1)	Signal	Function
16	OUT1	High speed programmable digital output 1, output compare
15	OUT2	High speed programmable digital output 2, output compare
18	OUTRET1	OUT 1 Return
17	OUTRET2	OUT 2 Return

Table 18: Digital Output Pin Assignment

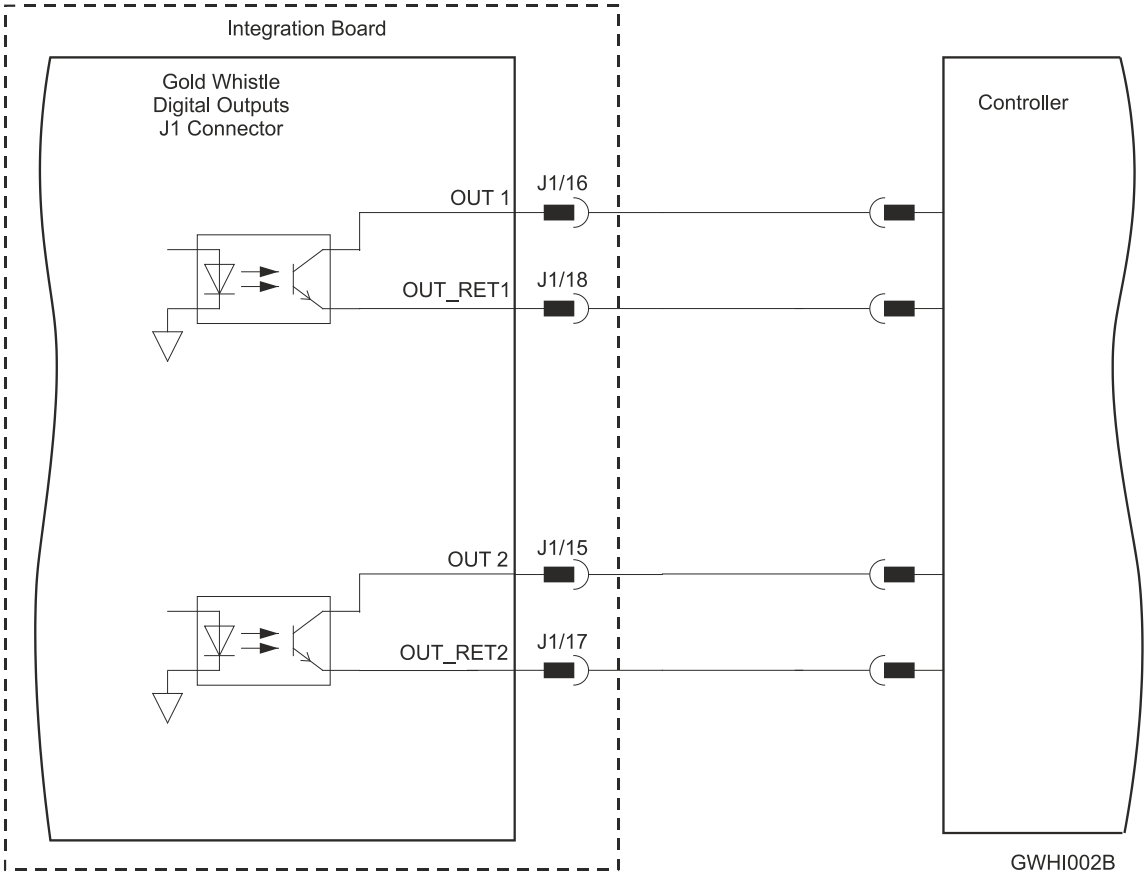


Figure 25: Digital Output Connection Diagram – TTL Connection

4.10.3. Analog Input

Pin (J2)	Signal	Function
22	ANALOG1+	Analog input 1+
24	ANALOG1-	Analog input 1-
20	ANARET	Analog return

Table 19: Analog Input Pin Assignment

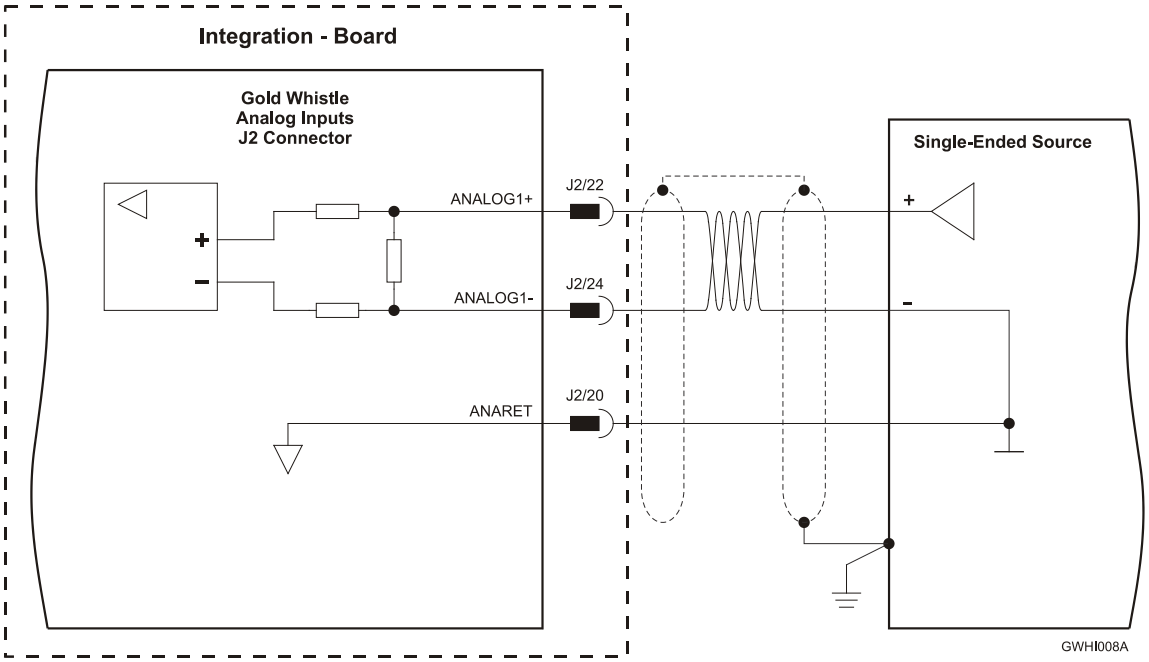


Figure 26: Analog Input with Single-Ended Source

4.11. Communications

The communication interface may differ according to the user's hardware. The Gold Whistle can communicate using the following options:

Standard	EtherCAT
G-WHIXXX/YYYSX	**G-WHIXXX/YYYEX**
CAN	EtherCAT
USB 2.0	USB 2.0
Ethernet	RS-232 (TTL Logic Level)
RS-232 (TTL Logic Level)	

Table 20: Gold Whistle Communication Options

For ease of setup and diagnostics of CAN communication, RS-232 and CAN can be used simultaneously.

When the EtherCAT is connected, and FoE in operation, the USB cable connection must be disconnected.

4.11.1. RS-232 Communication (J2)

The Gold Whistle provides RS-232 with TTL voltage level (Refer to the voltage level in the technical specification in Section 5.7: Communications). Therefore, to implement standard RS-232, you must add a RS-232 Line Driver/Receiver on the integration board in order to translate the TTL logic level to the standard RS-232 voltage level.

The following table describes the Gold Whistle RS-232 pinout:

Pin (J2)	Signal	Function
45	RS232_Rx	RS-232 receive (TTL logic level)
48	RS232_Tx	RS-232 transmit (TTL logic level)
46	RS232_COMRET	Communication return

Table 21: RS-232 Pin Assignments

Figure 27 describes the RS-232 connection diagram:

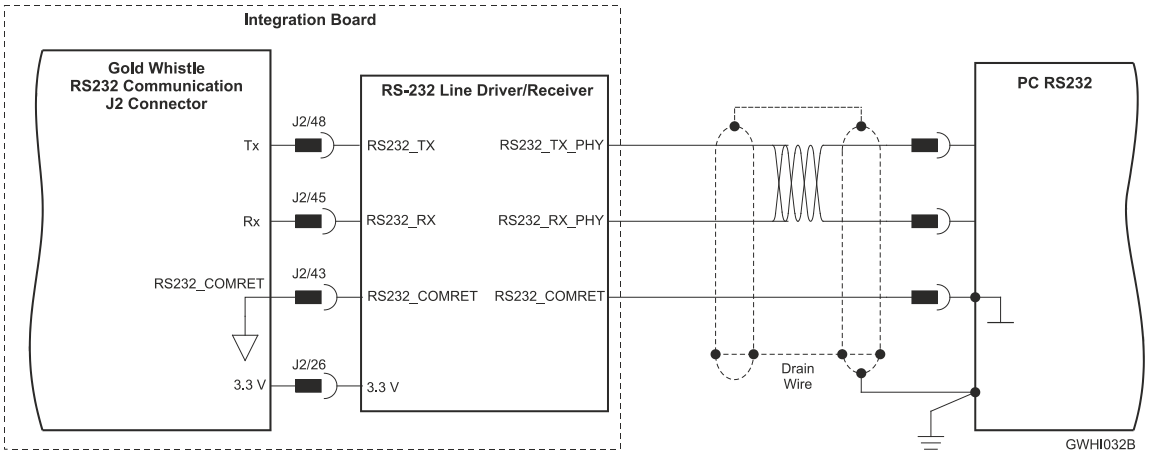


Figure 27: RS-232 Connection Diagram

Note that Elmo does not recommend a specific manufacturer. The following is an example of an RS-232 Line Driver/Receiver. The RS-232 Line Driver/Receiver operates with 3.3 V to 5 V VCC Supply.

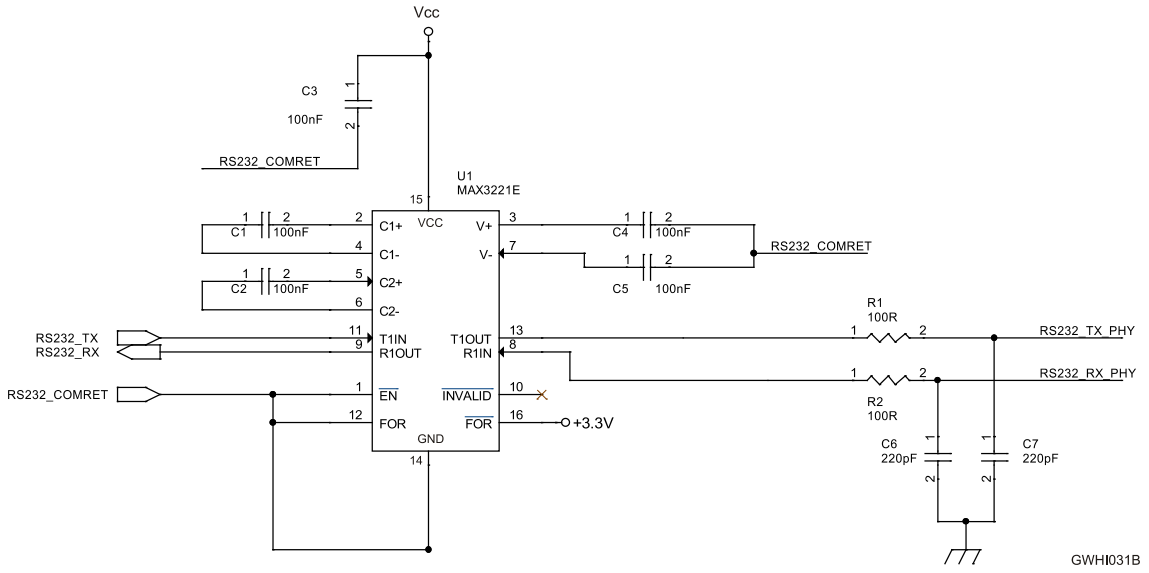


Figure 28: RS-232 – Translator Block Diagram

Notes for connecting the RS-232 communication cable:

- Connect the shield to the ground of the host (PC). Usually, this connection is soldered internally inside the connector at the PC end. You can use the drain wire to facilitate connection.
- The RS-232 communication port is **non-isolated**.

Ensure that the shield of the cable is connected to the shield of the connector used for RS-232 communications. The drain wire can be used to facilitate the connection.

4.11.2. CAN Communication (J2)

Note that CAN functionality is not available if you have the EtherCAT version.

In order to benefit from CAN communication, the user must have an understanding of the basic programming and timing issues of a CAN network.

Notes for connecting the CAN communication cable:

- Connect the shield to the ground of the host (PC). Usually, this connection is soldered internally inside the connector at the PC end. You can use the drain wire to facilitate connection.
- Ensure that the shield of the cable is connected to the shield of the connector used for communications. The drain wire can be used to facilitate the connection.
- Make sure to have a 120 Ohms resistor termination at each of the two ends of the network cable.
- The Gold Whistle's CAN port is non-isolated.

Pin (J2)	Signal	Function
32	CAN_COMRET	CAN Communication Return
38	CAN_L	CAN_L bus line (dominant low)
40	CAN_H	CAN_H bus line (dominant high)

Table 22: CAN Pin Assignments

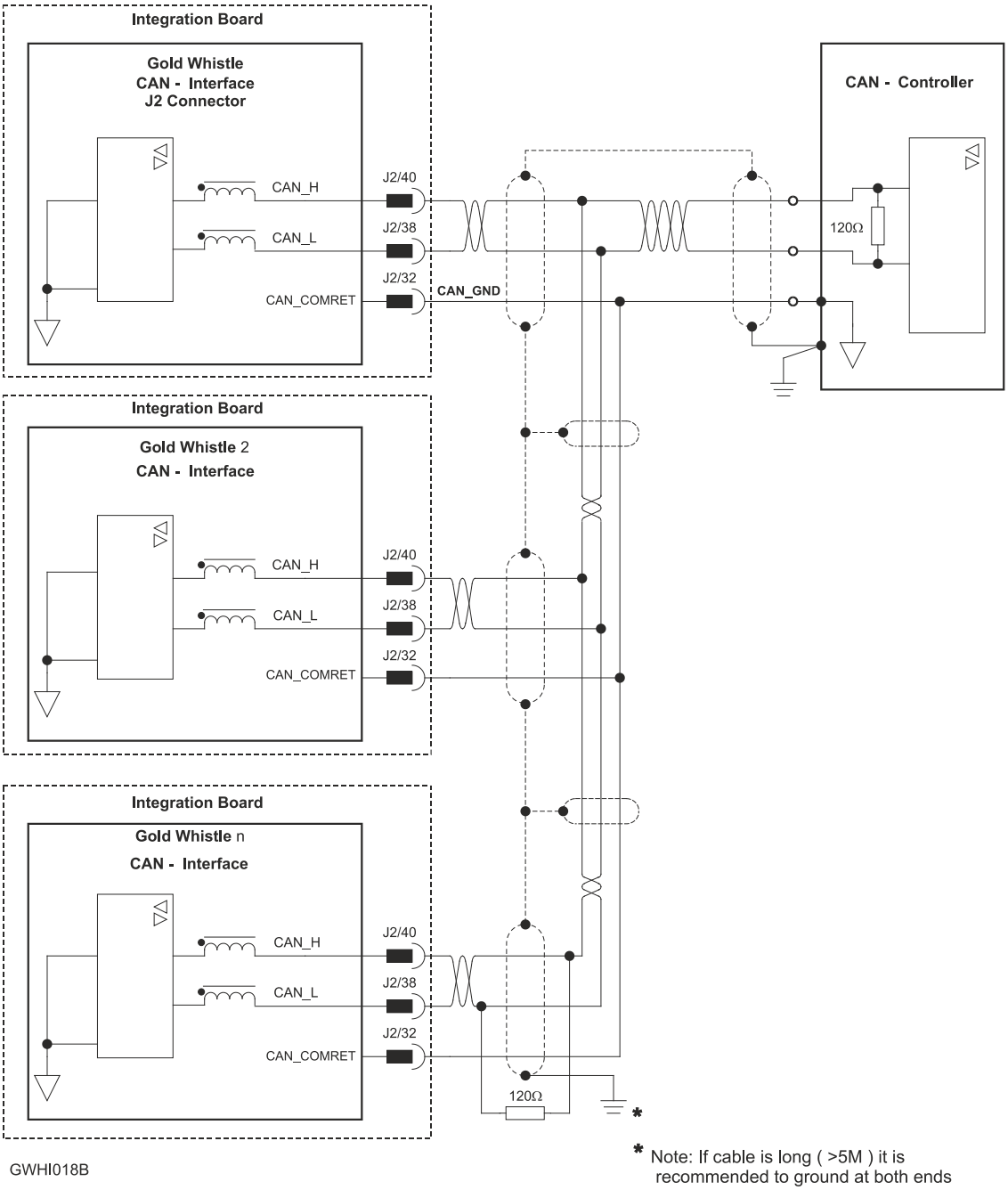


Figure 29: CAN Network Diagram

Caution: When installing CAN communication, ensure that each servo drive is allocated a unique ID. Otherwise, the CAN network may “hang”.

4.11.3. USB 2.0 Communication (J2)

The USB network consists of a Host controller and multiple devices. The Gold Whistle is a USB device.

Notes for connecting the USB communication cable:

- Connect the shield to the ground of the host (PC). Usually, this connection is soldered internally inside the connector at the PC end. You can use the drain wire to facilitate connection.
- Ensure that the shield of the cable is connected to the shield of the connector used for communications. The drain wire can be used to facilitate the connection.

Pin (J2)	Signal	Function
41	USBD-	USB _N line
42	USBD+	USB _P line
43	USB COMRET	USB Communication return
44	USB VBUS	USB VBUS 5 V

Table 23: USB 2.0 Pin Assignments

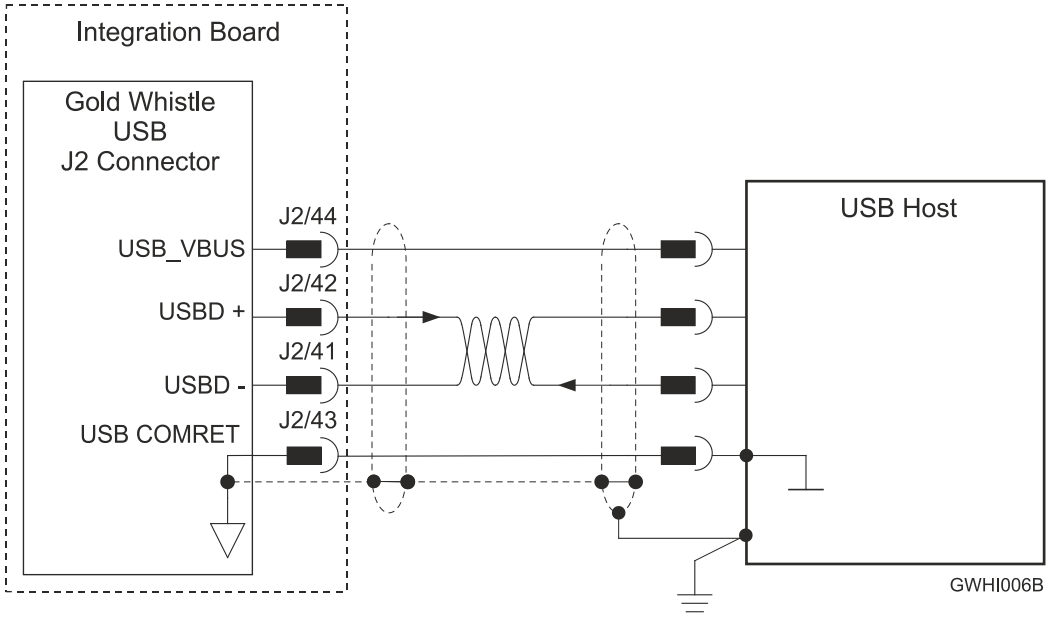


Figure 30: USB Network Diagram

4.11.4. EtherCAT Communication (J2)

To use EtherCAT and Ethernet communication with the Gold Whistle, it is required to use an isolation transformer. The most common solution is to use RJ-45 connectors that include transformer isolation.

This section describes how to connect the Gold Whistle's EtherCAT interface using the above mentioned connectors.

For other available options, please see Section 4.11.6.

Notes for EtherCAT Communication:

- The EtherCAT IN port can be configured as an Ethernet port for TCP/IP – see the EtherCAT Manual.
- It is recommended to use CAT5e (or higher) cable. Category 5e cable is a high signal integrity cable with four twisted pairs.

Pin (J/2)	Signal	Function
26	+3.3V	3.3 V for EtherCAT LEDs
27	PHY_IN_RX+	EtherCAT IN RX+ Line
29	PHY_IN_RX-	EtherCAT IN RX- Line
31	PHY_IN_COMRET	EtherCAT IN Communication Return
33	PHY_IN_TX+	EtherCAT IN TX+ Line
35	PHY_IN_TX-	EtherCAT IN TX- Line
37	PHY_IN_LINK_ACT	Indicates EtherCAT LINK
39	PHY_IN_SPEED	Indicates EtherCAT Speed
28	PHY_OUT_RX+	EtherCAT OUT RX+ Line
30	PHY_OUT_RX-	EtherCAT OUT RX- Line
32	PHY_OUT_ COMRET	EtherCAT OUT Communication return
34	PHY_OUT_TX+	EtherCAT OUT TX+ Line
36	PHY_OUT_TX-	EtherCAT OUT TX- Line
38	PHY_OUT_LINK_ACT	Indicates EtherCAT LINK
40	PHY_OUT_SPEED	Indicates EtherCAT Speed

Table 24: EtherCAT - Pin Assignments

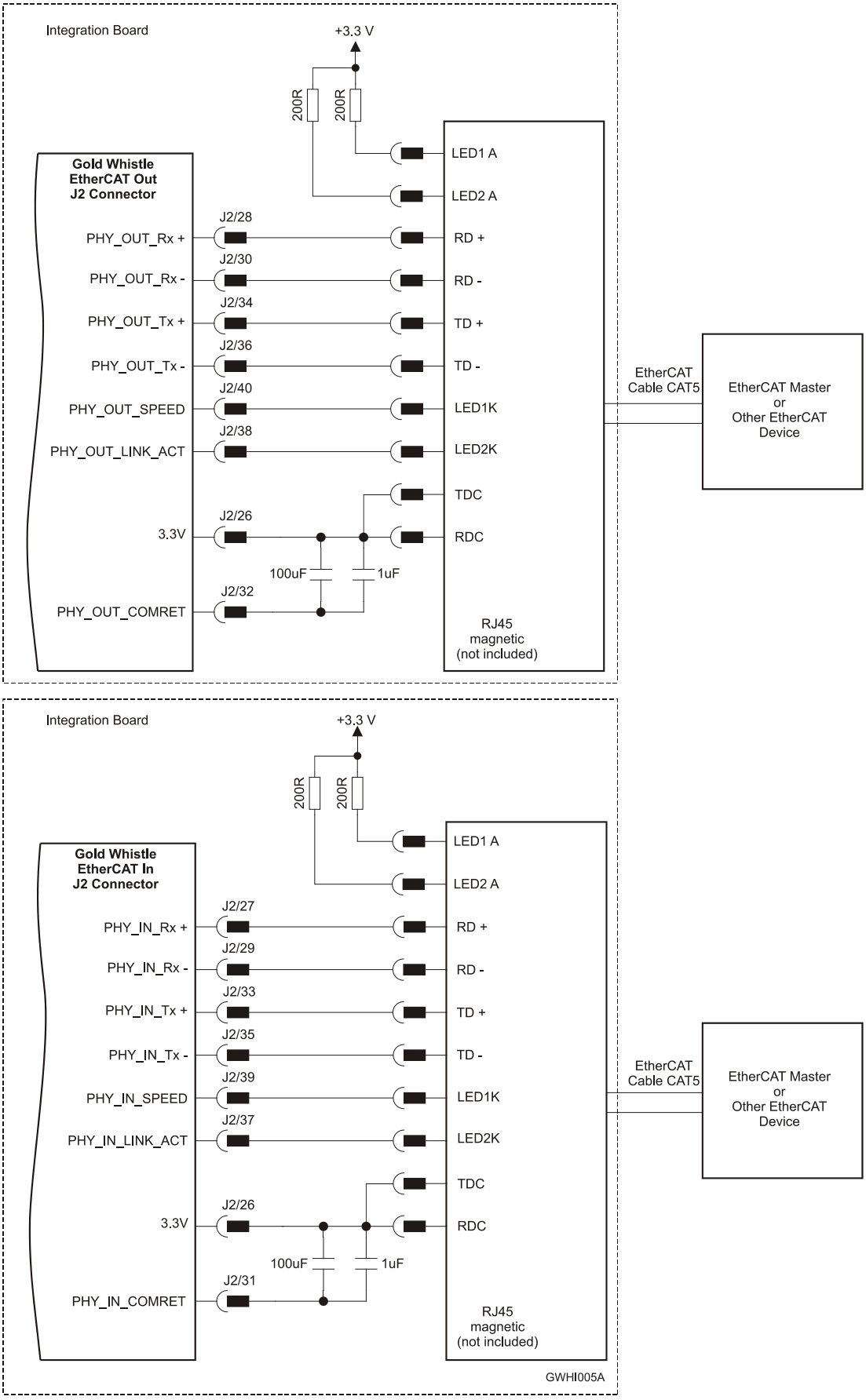


Figure 31: EtherCAT Connection Schematic Diagram

The diagram above ignores line interface for simplicity.

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

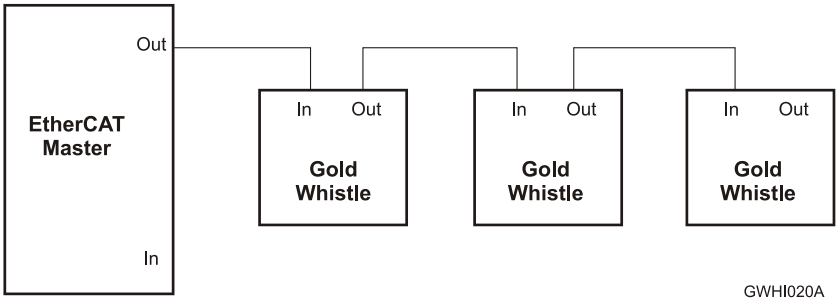


Figure 32: EtherCAT Network with no Redundancy

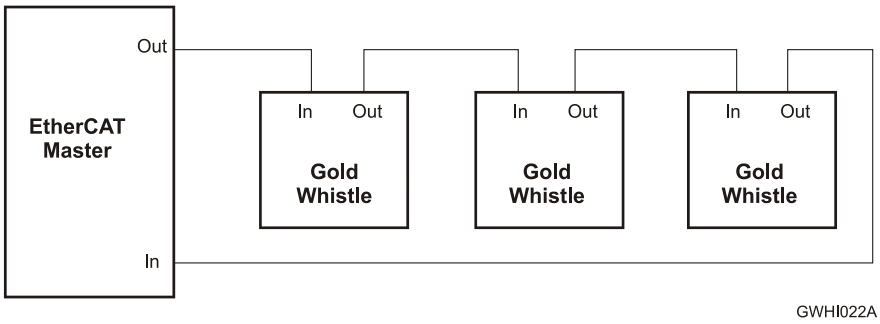


Figure 33: EtherCAT Network with Redundancy

4.11.5. Ethernet Communication (J2)

To use EtherCAT and Ethernet communication with the Gold Whistle, it is required to use an isolation transformer. The most common solution is to use RJ-45 connectors that include transformer isolation.

This section describes how to connect the Gold Whistle Ethernet interface using the above mentioned connectors.

For other available options, please see Section 4.11.6.

Notes for Ethernet Communication:

- The EtherCAT IN port can be configured as an Ethernet port for TCP/IP – see the EtherCAT Manual.
- It is recommended to use CAT5e (or higher) cable. Category 5e cable is a high signal integrity cable with four twisted pairs.

Pin (J2)	Signal	Function
26	+3.3V	3.3 V supply voltage for LEDs
27	PHY_IN_RX+	Ethernet In receive
29	PHY_IN_RX-	Ethernet In receive complement
31	PHY_IN_COMRET	Ethernet In Communication return
33	PHY_IN_TX+	Ethernet In transmit
35	PHY_IN_TX-	Ethernet In transmit complement
37	PHY_IN_LINK_ACT	Ethernet In Link/Active LED
39	PHY_IN_SPEED	Ethernet In Speed LED

Table 25: Ethernet - Pin Assignments

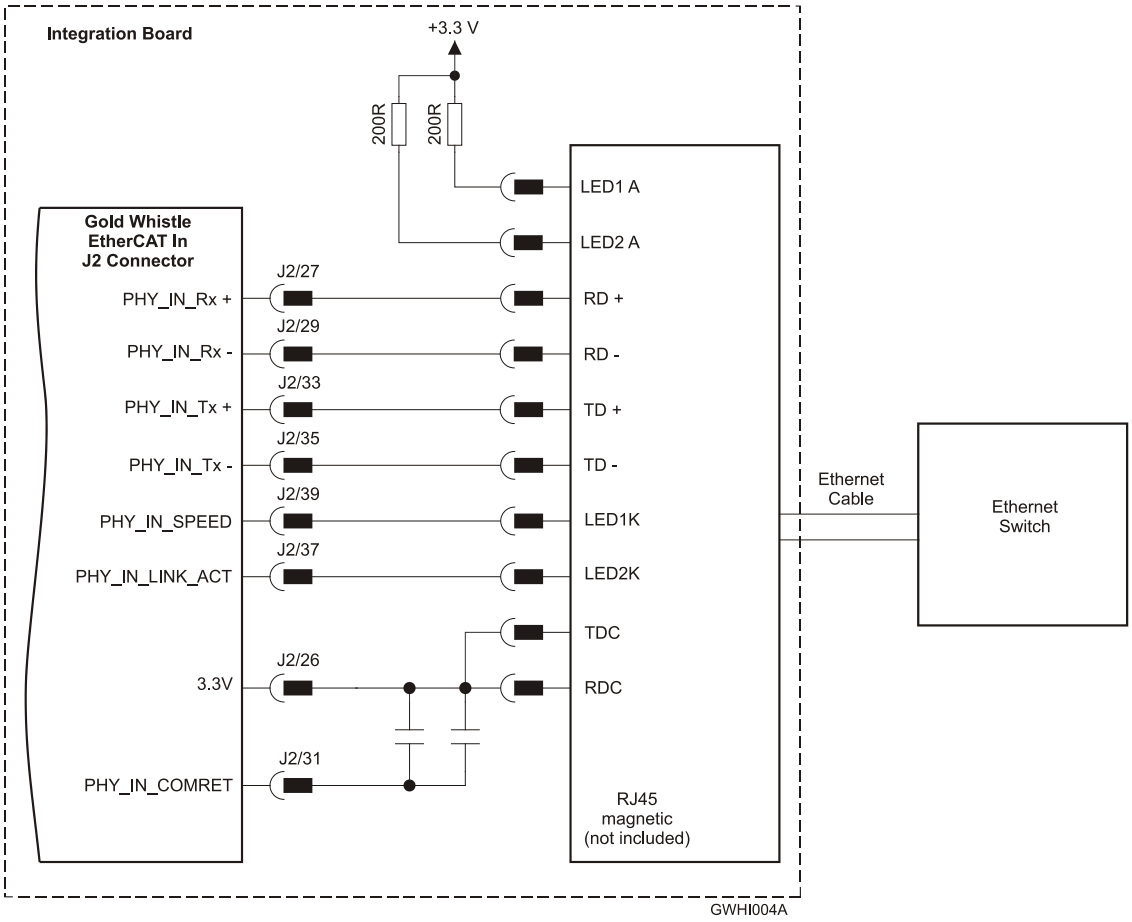


Figure 34: Ethernet Network Schematic Diagram

The diagram above ignores line interface for simplicity.

4.11.6. EtherCAT/Ethernet Line Interface

Ethernet transceivers require either isolation transformers or capacitor coupling for proper functioning. The Gold Whistle unit does not include such isolation, therefore you must take this into consideration when designing the integration board.

In Sections 4.11.4 and 4.11.5, a schematic connection with a standard RJ-45 connector that includes transformer isolation is described.

Other recommended connection options are:

- Gold Whistle to an RJ-45 connector without an integrated magnetic isolation (e.g. M12 connectors). An isolation transformer is required.
- Connecting two EtherCAT ports on the same board can be done using capacitive coupling or transformer coupling.

For more detailed explanations, including layout recommendations and component selection guidelines contact Elmo's technical support.

4.12. Powering Up

After the Gold Whistle 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.

4.13. Initializing the System

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

4.14. Heat Dissipation

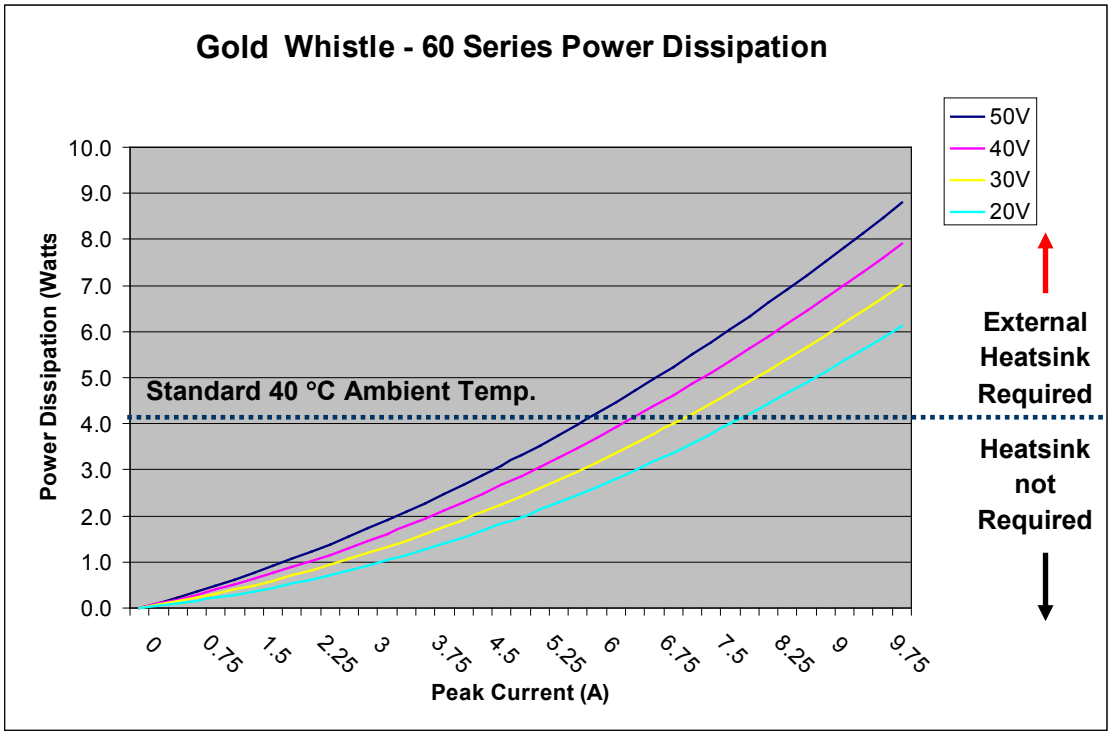
The best way to dissipate heat from the Gold Whistle is to mount it so that its heatsink faces up. For best results leave approximately 10 mm of space between the Gold Whistle's heatsink and any other assembly.

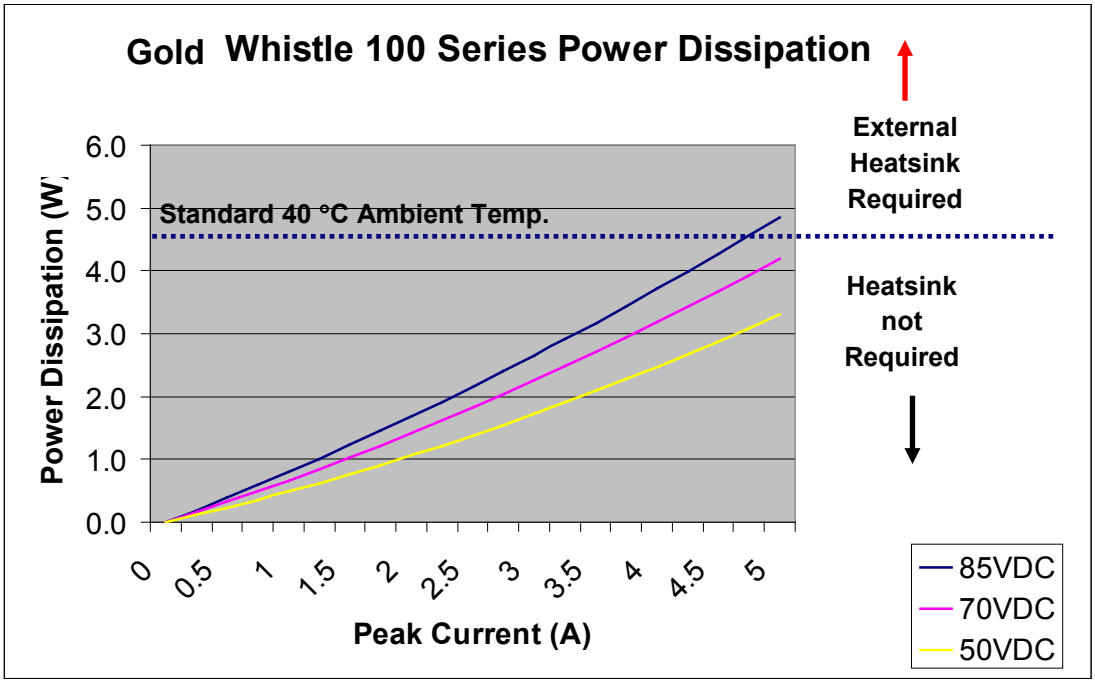
4.14.1. Thermal Data

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

4.14.2. Heat Dissipation Data

Heat Dissipation is shown in graphically below:





4.14.3. 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 heatsink:

1. Allow maximum heatsink temperature to be 80 °C or less.
2. Determine the ambient operating temperature of the Gold Whistle.
3. Calculate the allowable temperature increase as follows:
   - for an ambient temperature of 40 °C , ΔT= 80 °C – 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.
5. If the dissipated power is below 4 W the Gold Whistle will need no additional cooling.

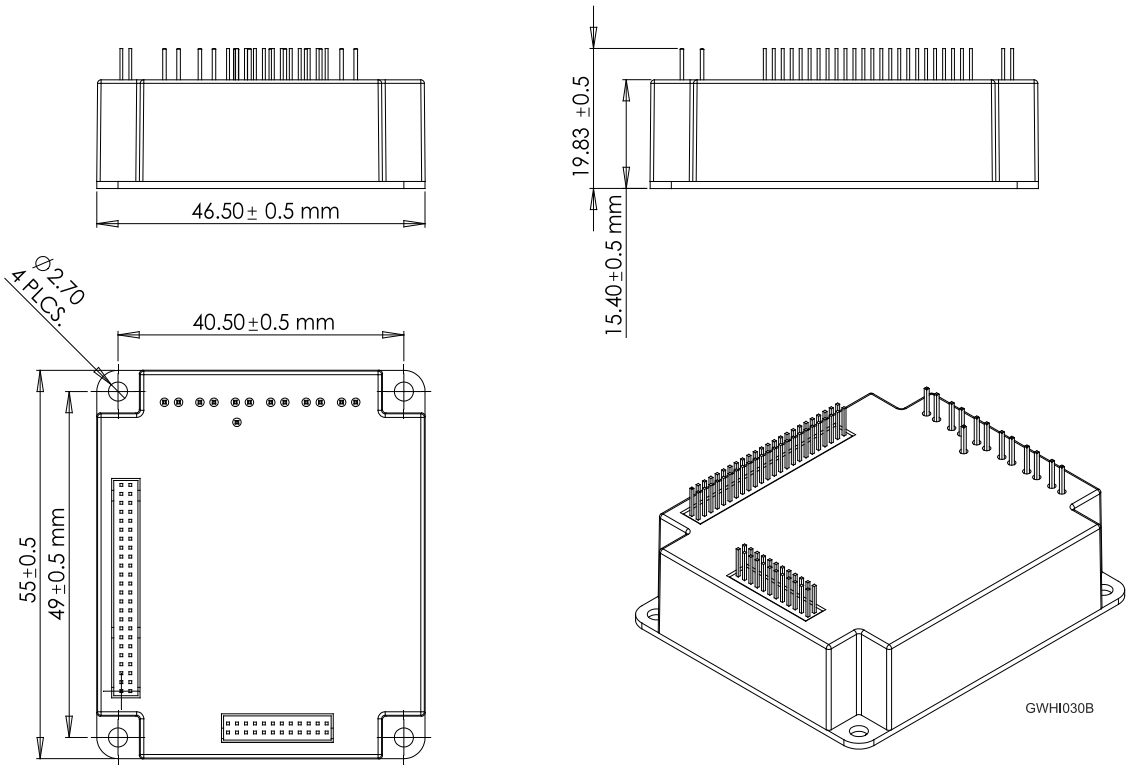
Notes:

- The chart above shows that no heatsink is needed when the heatsink temperature is 80 °C, ambient temperature is 40 °C and heat dissipated is 4 W.
- When an external heatsink is required, you can use the Elmo external heatsink (Catalog number: WHI-HEATSINK-2).

Chapter 5: Technical Specifications

This chapter provides detailed technical information regarding the Gold Whistle. This includes its dimensions, power ratings, the environmental conditions under which it can be used, the standards to which it complies and other specifications.

5.1. Dimensions



5.2. Environmental Conditions

Feature	Details
Ambient operating temperature	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	90%
Maximum Operating Altitude	“Unlimited” (above 10,000 m to 30,000 feet)
Protection level	IP64

5.3. Control Specifications

5.3.1. Current Loop

Feature	Details
Controller type	Vector, digital
Compensation for bus voltage variations	“On-the-fly” automatic gain scheduling
Motor types	• AC brushless (sinusoidal) • DC brushless (trapezoidal) • DC brush • Linear motors • “Voice” coils
Current control	• Fully digital • Sinusoidal with vector control • Programmable PI control filter based on a pair of PI controls of AC current signals and constant power at high speed
Current loop bandwidth	> 4 kHz closed loop
Current sampling time	Programmable 40 to 120 µsec
Current sampling rate	Up to 25 kHz; default 20 kHz

5.3.2. Velocity Loop

Feature	Details
Controller type	PI + Four advanced filters + Two advanced gain scheduling filters
Velocity control	• Fully digital • Programmable PI and feed forward control filters • On-the-fly gain scheduling according to either speed or position command or feedback • Automatic, quick, advanced or expert tuning
Velocity and position feedback options	• Incremental Encoder • Digital Halls • Interpolated Analog (sin/cos) Encoder (optional) • Resolver (optional) • Absolute serial encoder **Note:** With all feedback options, 1/T with automatic mode switching is activated (gap, frequency and derivative).
Velocity loop bandwidth	< 500 Hz
Velocity sampling time	80 to 240 µsec (2x current loop sample time)
Velocity sampling rate	Up to 12.5 kHz; default 10 kHz
Velocity command options	Internally calculated by either jogging or step **Note:** All software-calculated profiles support on-the-fly changes.

5.3.3. Position Loop

Feature	Details
Controller type	"1-2-2" PIP + three advanced filters + one advanced gain scheduling filter
Position command options	• Software • Pulse and Direction
Position loop bandwidth	< 200 Hz
Position sampling time	80 to 240 µsec (2x current loop sample time)
Position sampling rate	Up to 12.5 kHz; default 10 kHz

5.4. Feedbacks

5.4.1. Feedback Supply Voltage

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

Feature	Details
Encoder supply voltage	5 V ± 5% @ 2 x 200 mA (maximum)

5.4.2. Feedback Options

The Gold Whistle can receive and process feedback input from diverse types of devices.

5.4.2.1. Incremental Encoder Input

Feature	Details
Encoder format	• A, B and Index • Differential • Quadrature
Interface	RS-422
Input resistance	Differential: 120 Ω
Maximum incremental encoder frequency	Maximum absolute: 75 Megacounts per second (18 MHz PPS (Pulses Per Second))
Minimum quadrature input period (PIN)	53 nsec
Minimum quadrature input high/low period (PHL)	26 nsec
Minimum quadrature phase period (PPH)	13 nsec
Maximum encoder input voltage range	Common mode: ± 7 V Differential mode: ± 7 V

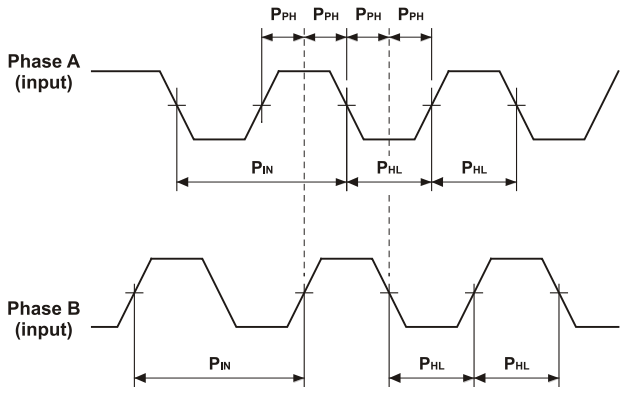


Figure 35: Main Feedback - Encoder Phase Diagram

5.4.2.2. Digital Halls

Feature	Details
Hall inputs	• H_A, H_B, H_C • Single ended inputs • Built in hysteresis of 1 V for noise immunity
Input voltage	Nominal operating range: 0 V < V_{In_Hall} < 5 V Maximum absolute: -1 V < V_{In_Hall} < 15 V High level input voltage: V_{InHigh} > 2.5 V Low level input voltage: V_{InLow} < 1 V
Input current	Sink current (when input pulled to the common): 5 mA
Maximum frequency	f_{MAX} : 4 kHz

5.4.2.3. Interpolated Analog (Sine/Cosine) Encoder

Feature	Details
Analog encoder format	Sine and Cosine signals
Analog input signal level	• Offset voltage: 2.2 V to 2.8 V • Differential, 1 V peak to peak
Input resistance	Differential: 120 Ω
Maximum analog signal frequency	f_{MAX} : 500 kHz
Interpolation multipliers	Programmable: x4 to x8192
Maximum “counts” frequency	2 x 10^9 counts/sec
Automatic error correction	• Signal amplitudes mismatch • Signal phase shift • Signal offsets
Encoder outputs	See Port C Encoder Outputs Specifications, Section 5.4.3.

5.4.2.4. Resolver

Feature	Details
Resolver format	• Sine/Cosine • Differential
Input resistance	Differential 2.49 kΩ
Resolution	Programmable: 10 to 15 bits
Maximum electrical frequency (RPS)	512 revolutions/sec
Resolver transfer ratio	0.5
Reference frequency	1/Ts (Ts = sample time in seconds)
Reference voltage	Supplied by the Gold Whistle
Reference current	up to ±50 mA
Encoder outputs	See Port C Encoder Output Specifications, Section 5.4.3.

5.4.2.5. Absolute Serial Encoder

Feature	Details
Encoder format	• NRZ (Panasonic, Tamagawa, Mitutoyo, etc.) • EnDAT 2.2 • BiSS/SSI • Stegmann Hiperface
Interface	• RS-485 • Clock – Differential output line • Data – Differential bidirectional line
Input Resistance	Differential 120 Ω
Transmission Rate	Up to 2.5 MHz

5.4.3. Port C Feedback Output

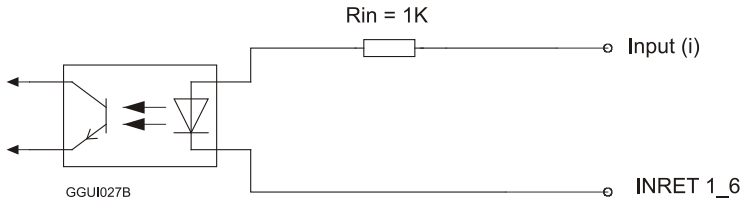
Feature	Details
Emulated output	• A, B, Index • Differential
Interface	• RS-422
Output current capability	Maximum output current: I_{OH} (max) = 2 mA High level output voltage: V_{OH} > 3.0 V Minimum output current: I_{OL} = 2 mA Low level output voltage: V_{OL} < 0.4 V
Available as options	• Emulated encoder output of any sensor on Port A or Port B • Daisy chain Port A or Port B • Emulated encoder output of internal variables • Emulated encoder outputs of the tachometer • Emulated encoder outputs of the potentiometer
Maximum frequency	f_{MAX}: 8 MHz pulses/output
Edge separation between A & B	Programmable number of clocks to allow adequate noise filtering at remote receiver of emulated encoder signals (default 2 MHz)
Index (marker)	Length of pulse is one quadrature (one quarter of an encoder cycle) and synchronized to A&B

5.5. I/Os

The Gold Whistle has:

- 6 Digital Inputs
- 2 Digital Outputs
- 1 Analog Input

5.5.1. Digital Input Interfaces – TTL Mode

Feature	Details
Type of input	Optically isolated
Input current for all inputs	Iin = 3.8 mA @ Vin = 5 V
High-level input voltage	2.4 V < Vin < 15 V, 5 V typical
Low-level input voltage	0 V < Vin < 0.8 V
Minimum pulse width	> 250 µsec
Execution time (all inputs): the time from application of voltage on input until execution is complete	0 < T < 250 µsec
High-speed inputs – 1–6 minimum pulse width, in high-speed mode	T > 5 µsec if the input functionality is set to latch/capture (index/strobe). **Notes:** • Home mode is high-speed mode and can be used for fast capture and precise homing. • Highest speed is achieved when turning on optocouplers.
 **Figure 36: Digital Input Schematic**	
Capture with differential input Port A, Port B Index	T > 0.1 µsec if the differential input functionality is set to touch probe/capture (index/strobe).

5.5.2. Digital Output Interface – TTL Mode

There are 2 types of outputs:

- OUT1 and OUT2 are optically isolated outputs
- OUT3 and OUT4 are TTL 3.3V non isolated outputs

5.5.2.1. OUT1 and OUT2

The following table describes the electrical specification of theOUT1 and OUT2 outputs:

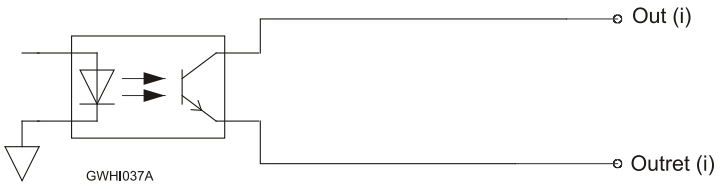
Feature	Details
Type of output	• Optically isolated • Source/Sink
Supply output (VCC)	5 V to 30 V
Max. output current I_{out} (max) (V_{out} = Low)	7 mA
VOL at maximum output voltage (low level)	V_{out} (on) ≤ 0.4 V
R_L	The external resistor R_L must be selected to limit the output current to no more than 7 mA. $R_L = \frac{VCC - VOL}{I_{out}(max)}$
Executable time	0 < T < 250 µsec
	

Figure 37: Digital Output Schematic

5.5.2.2. OUT3 and OUT4

These outputs are 3.3V TTL outputs. The following table describes the electrical specification of the outputs:

Feature	Details
Type of output	3.3V TTL
VOL max (low level)	V_{out} (on) ≤ 0.4 V
VOH min (High level)	2.5V
Max. output current I_{outH} (max)	8 mA

5.5.3. Analog Input

Feature	Details
Maximum operating differential voltage	± 10 V
Maximum absolute differential input voltage	± 16 V
Differential input resistance	3.74 kΩ
Analog input command resolution	14-bit

5.6. Safe Torque Off (STO)

The Gold Whistle has two STO (Safe Torque Off) inputs.

5.6.1. STO Input Interfaces – TTL Mode

Feature	Details
Type of input	Optically isolated
Input current for all inputs	Iin = 3.8 mA @ Vin = 5 V
High-level input voltage	2.4 V < Vin < 15 V, 5 V typical
Low-level input voltage	0 V < Vin < 0.8 V
Minimum pulse width	>3 ms

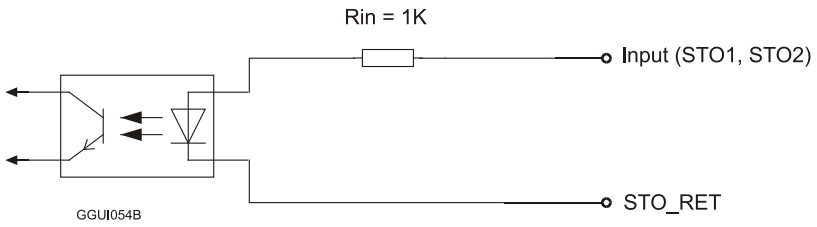


Figure 38: STO Input Schematic

5.7. Communications

<table>
<tr><th>Specification</th><th>Details</th></tr>
<tr><td>RS-232</td><td>Signals:
RS232_Rx, RS232_Tx COMRET
Full duplex, serial communication for setup and control
Baud Rate of 9,600 to 57,600 bit/sec
Electrical Characteristic<table>
<tr><th></th><th></th><th>Min</th><th>Type</th><th>Max</th><th>Unit</th></tr>
<tr><td>V_{IH}</td><td>High-level input voltage</td><td>2</td><td></td><td>3.3</td><td>V</td></tr>
<tr><td>V_{IL}</td><td>Low-level input voltage</td><td></td><td></td><td>0.8</td><td>V</td></tr>
<tr><td>V_{OH}</td><td>High-level output voltage</td><td>2.4</td><td></td><td></td><td>V</td></tr>
<tr><td>V_{OL}</td><td>Low-level output voltage</td><td></td><td></td><td>0.4</td><td>V</td></tr>
</table></td></tr>
<tr><td>CAN</td><td>CAN bus Signals:
CAN_H, CAN_L, CAN_RET
Maximum Baud Rate of 1 Mbit/sec.
Version:
DS 301 v4.01
Layer Setting Service and Protocol Support:
DS 305
Device Profile (drive and motion control):
DS 402</td></tr>
<tr><td>EtherCAT</td><td>100base-T
Baud Rate: 100 Mbit/sec
CAT5 Cable
CoE, FoE, EoE</td></tr>
<tr><td>Ethernet</td><td>100base-T
Baud Rate: 100 Mbit/sec
CAT5 Cable
UDP, Telnet</td></tr>
<tr><td>USB</td><td>USB 2.0 Device mode</td></tr>
</table>

5.8. Pulse-Width Modulation (PWM)

Feature	Details
PWM resolution	Minimum 10-bit Default 12-bit Maximum 14-bit
PWM switching frequency on the load	2/Ts (factory default 40 kHz on the motor)

5.9. Compliance with Standards

Specification	Details
Quality Assurance	
ISO 9001:2008	Quality Management
Design	
Approved **IEC/EN 61800-5-1, Safety**	Printed wiring for electronic equipment (clearance, creepage, spacing, conductors sizing, etc.)
MIL-HDBK- 217F	Reliability prediction of electronic equipment (rating, de-rating, stress, etc.)
• **IPC-D-275** • **IPC-SM-782** • **IPC-CM-770** • **UL 508C** • **UL 840** • **UL 60950**	Printed wiring for electronic equipment (clearance, creepage, spacing, conductors sizing, etc.)
In compliance with **VDE0160-7 (IEC 68)**	Type testing
Safety	
Recognized **UL 508C**	Power Conversion Equipment
In compliance with **UL 840**	Insulation Coordination Including Clearances and Creepage Distances for Electrical Equipment
In compliance with **UL 60950**	Safety of Information Technology Equipment Including Electrical Business Equipment
Approved **IEC/EN 61800-5-1, Safety**	Adjustable speed electrical power drive systems
In compliance with **EN 60204-1**	Low Voltage Directive 73/23/EEC

Specification	Details
EMC	
Approved **IEC/EN 61800-3, EMC**	Adjustable speed electrical power drive systems
In compliance with **EN 55011** Class A with **EN 61000-6-2**: Immunity for industrial environment, according to: **IEC 61000-4-2** / criteria B **IEC 61000-4-3** / criteria A **IEC 61000-4-4** / criteria B **IEC 61000-4-5** / criteria B **IEC 61000-4-6** / criteria A **IEC 61000-4-8** / criteria A **IEC 61000-4-11** / criteria B/C	Electromagnetic compatibility (EMC)
Workmanship	
In compliance with **IPC-A-610**, level 3	Acceptability of electronic assemblies
PCB	
In compliance with **IPC-A-600**, level 2	Acceptability of printed circuit boards
Packing	
In compliance with **EN 100015**	Protection of electrostatic sensitive devices
Environmental	
In compliance with **2002/96/EC**	Waste Electrical and Electronic Equipment regulations (WEEE) **Note:** Out-of-service Elmo drives should be sent to the nearest Elmo sales office.
In compliance with **2002/95/EC** (effective July 2006)	Restrictions on Application of Hazardous Substances in Electric and Electronic Equipment (RoHS)