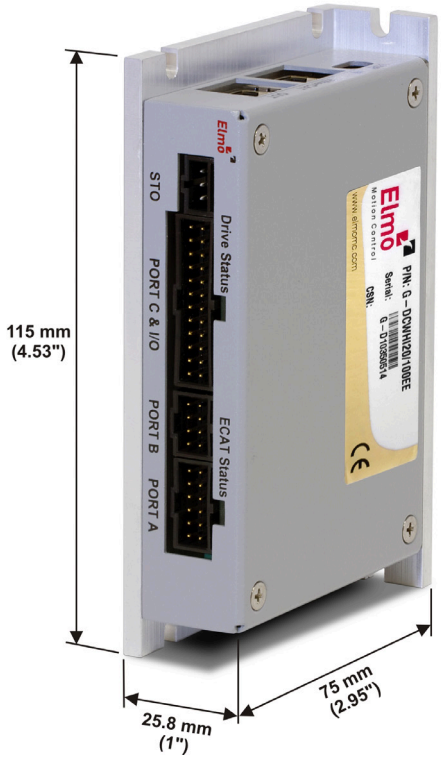
Gold Line

Gold DC Whistle Digital Servo Drive Installation Guide

EtherCAT and CAN



March 2013 (Ver. 1.505)

Elmo Motion Control

www.elmomc.com

Notice

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- 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 DC Whistle servo drive in its installation.
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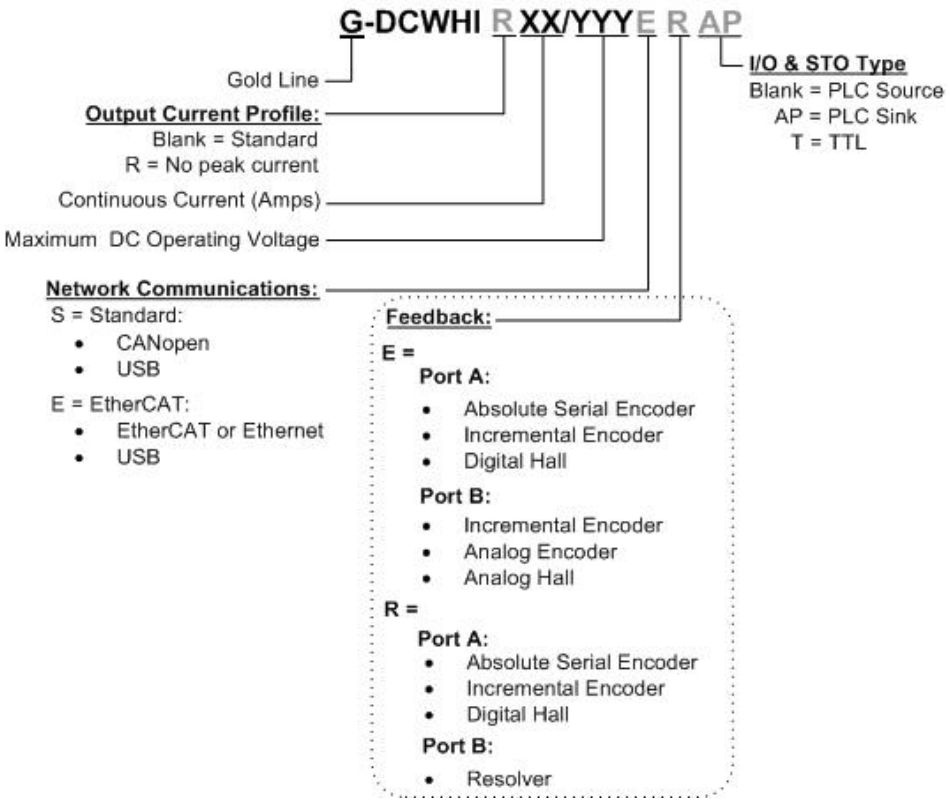
Catalog Number



Note: The part number of the Gold DC Whistle (EtherCAT version) has an E, for example, G-DCWHI20/100**E**, whereas the CAN version has an S, for example, G-DCWHI20/100**S**.

Cable Kit

Catalog number: CBL-GDCWHIKIT02 (can be ordered separately).

For further details, see the documentation for this cable kit (MAN-G-DCWHI-CBLKIT.pdf).

Revision History

Version	Date	Details
Ver. 1.0	October 2010	Initial release
Ver. 1.1	January 2011	Several updates throughout the manual
Ver. 1.2	July 2011	Added references to the applicable cable kit
Ver. 1.3	November 2011	Added information about LED indicators in Sec. 4.3
Ver. 1.4	September 2012	Added version with two LEDs and updated P/N details on Feedbacks Absolute - included as standard. Additionally added I/O Sink option.
Ver. 1.500	October 2012	Two power ratings for Gold DC Whistle; 100 V and 200 V
Ver. 1.501	October 2012	EtherCAT and CAN merged into one document Organized how the Gold DC Whistle features are presented in the document.
Ver. 1.502	November 2012	Section 4.10.3 – Digital Output (Port C & I/O Connector) – deleted voltage value for Pin #23 Section 4.10.4 – Digital Outputs in Sink Configuration - deleted current values
Ver. 1.503	December 2012	General update (links)
Ver. 1.504	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 PLC and TTL modes. Updated Figure 27, Figure 28 and Figure 29. Updated Pin #s 13, 14, 15, 16, 17, and 18 on Section 4.3.2.7: Port C & I/O Connector and on Section 4.10.1: Digital Inputs (Port C & I/O Connector). Added Section 3.1: Physical Specifications.
Ver. 1.505	March 2013	Section 3.2: Technical Data - updated the Power Ratings table for the 200 VDC option.

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Chapter 1: Safety Information

In order to achieve the optimum, safe operation of the Gold DC 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 DC 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 DC 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 DC Whistle from all voltage sources before it is opened for servicing.
- The Gold DC 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 DC 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 DC 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 DC 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 DC 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 DC 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 DC 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 DC 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 DC 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

This installation guide describes the Gold DC Whistle servo drive and the steps for its wiring, installation and power-up. Following these guidelines ensures optimal performance of the drive and the system to which it is connected.

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

The Gold DC 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 DC Whistle drive is easily set up and tuned using 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 about software tools, refer to the Elmo Application Studio Software Manual.

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

2.2. Product Features

Note: The features described in this chapter relate to the range of Gold DC 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 DC Whistle and use the product catalog number schematic that appears at the beginning of this manual and on page 25 to determine which specific features are available to you.

2.2.1. High Power Density

- The Gold DC Whistle delivers up to **1.6 kW of continuous power** or **3.2 kW of peak power** in a 222.5 cc (13.58 in^3) package (115 x 75 x 25.8 mm or 4.5" x 3.0" x 1").

2.2.2. Supply Input

- **Gold DC Whistle Power rating is 12 to 195 VDC**
- **Two power ratings for Gold DC 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 DC Whistle is provided by a 12–95 VDC single isolated DC power source (not included with the Gold DC Whistle). A "smart" control-supply algorithm enables the Gold DC 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 DC 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 DC Whistle, therefore the correct power supply must be used, according to the maximum operating voltage of the Gold DC 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 $\pm 2 \times 10^9$ counts
  - Velocity up to 2×10^9 counts/sec
  - Acceleration up to 2×10^9 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, Dual Loop, Current Follower, Fast event capturing inputs
- Full DS-402 motion mode support, in both the CAN and CAN over EtherCAT (CoE) protocols, including Cyclic Position/Velocity modes. Fast (Hardware) event capturing inputs, supporting < 1 µs latch latency
- Fast (hardware) Output Compare, with < 1 µs latency
- Output compare repetition rate:
  - Fixed Gap: Unlimited
  - Table based: 4 kHz
- Motion Commands: Analog current and velocity, pulse-width modulation (PWM) current and velocity, digital (SW) and Pulse and Direction
- Distributed Motion Control
- 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 DC 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 (CAN over EtherCAT)
  - EoE (Ethernet over EtherCAT)
  - FoE (File over EtherCAT) for firmware download
  - Supports Distributed Clock
  - EtherCAT cyclic modes supported down to a cycle time of 250 µs
- Ethernet TCP/IP
  - UDP
  - Telnet
- USB 2.0

2.2.10. Safety

- IEC 61800-5-2, Safe Torque Off (STO)
- Two STO (Safe Torque Off) inputs PLC level which can be configured to the TTL level (available on request)
- UL 508C recognition
- UL 60950 compliance
- CE EMC compliance

2.2.11. Digital Outputs

- There are four digital outputs, which can be configured to the following options:
  - Source mode – High Current PLC voltage level, Conforming to IEC 61131-2
  - Sink mode – High Current PLC voltage level
  - Source mode – TTL voltage level
- Feature for High Current output:
  - Up to 30 VDC
  - Opto-isolated (TTL also isolated)
  - Up to 250 mA
  - Brake output: 500 mA
  - Short circuit protection
  - Thermal protection.
  - Reverse polarity protection
- Optional functions:
  - Fast event capture (for two inputs only)
  - Inhibit/Enable motion
  - Stop motion under control (hard stop)
  - Motion reverse and forward limit switches
  - Begin on input
  - Abort motion
  - Homing
  - General purpose

2.2.12. Differential Outputs

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

2.2.13. Digital Inputs

- There are six digital inputs, which can be configured to the following options:
  - Source mode – PLC voltage level
  - Sink mode – PLC voltage level
  - Source mode – TTL voltage level
- All the digital inputs are fast digital capture data (<5 µs)
- Optional functions:
  - Fast event capture (for two inputs only)
  - Inhibit/Enable motion
  - Stop motion under control (hard stop)

- Motion reverse and forward limit switches
- Begin on input
- Abort motion
- Homing
- General purpose

2.2.14. Differential Inputs

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

2.2.15. Analog Input

- One **Analog Input** – up to 14-bit resolution
- Input: ±10 V

2.2.16. 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

2.2.17. Status Indication

- Output for a bi-color LED

2.2.18. 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

2.2.19. Accessories

Cable Kit, catalog number: CBL-GDCWHIKIT02 (can be ordered separately)

For further details, see the documentation for this cable kit (MAN-G-DCWHI-CBLKIT.pdf).

2.3. System Architecture

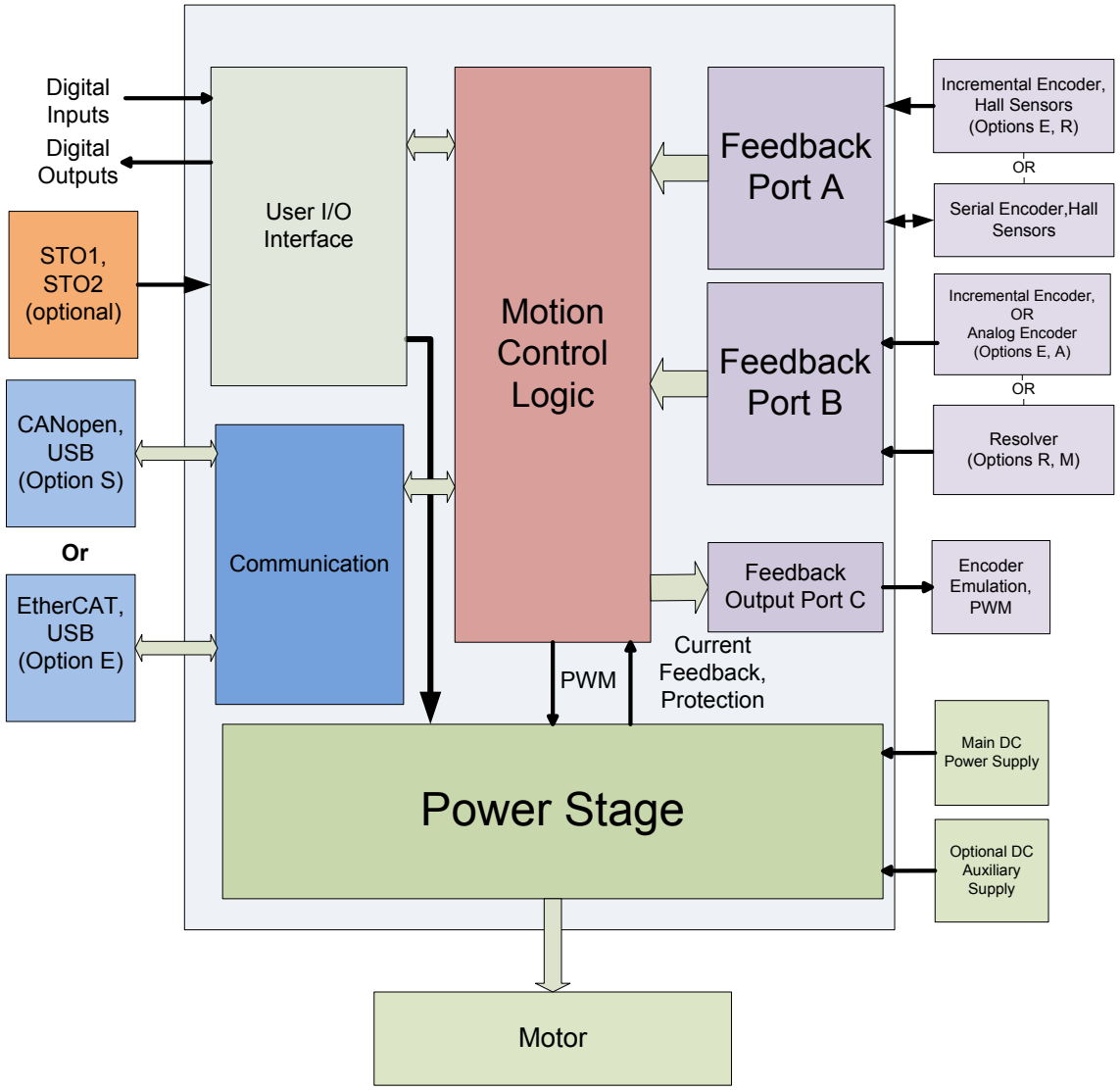


Figure 1: Gold DC Whistle System Block Diagram

2.4. How to Use this Guide

In order to install and operate your Elmo Gold DC 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 DC Whistle.
- Chapter 4 - *Technical Specifications*, lists all the drive ratings and specifications.

Upon completing the instructions in this guide, your Gold DC 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 DC Whistle
- The Gold Product Line Command Reference Manual, which describes, in detail, each software command used to manipulate the Gold DC 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)	267 (9.42 oz)
Dimensions	mm (in)	115 x 75 x 25.8 mm (4.5" x 3.0" x 1")
Mounting method		Wall Mount / Book Shelf

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 – 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		6/4/1					

Table 1: Power Ratings

Note on current ratings: The current ratings of the Gold DC 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 DC 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		6/4/1		

3.2.1. Auxiliary Supply

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

Chapter 4: Installation

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

- The Gold DC Whistle servo drive
- The Elmo Application Studio software and software manual

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

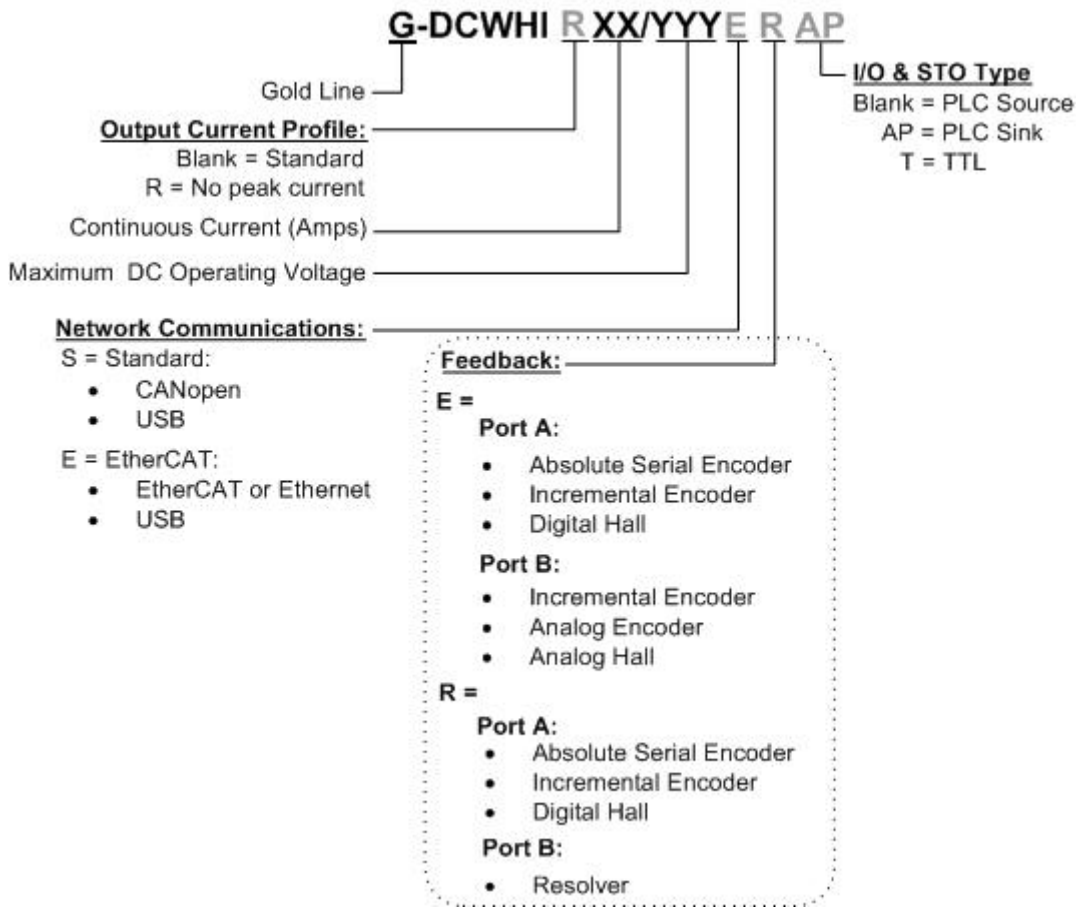
To unpack the Gold DC Whistle:

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

GDCWHI018A

4. Verify that the Gold DC 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:



Note:

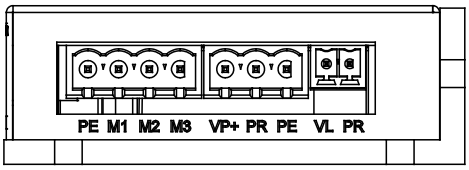
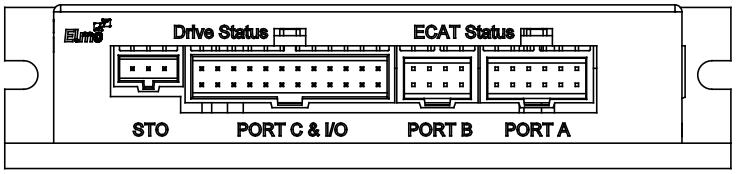
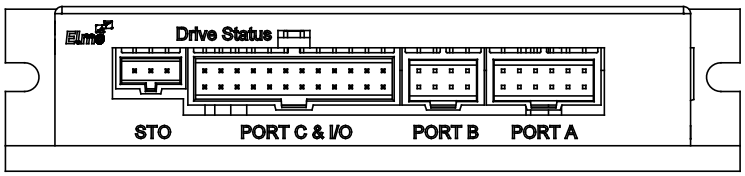
The part number of the Gold DC Whistle (EtherCAT version) has an E, for example, G-DCWHI20/100**E** whereas the CAN version has an S, for example G- DCWHI20/100**S**.

4.3. Connectors and Indicators

The Gold DC Whistle has 10 connectors.

4.3.1. Connector Types

The Gold DC Whistle has the following connectors:

No. Pins	Type	Function
Bottom Connectors		
 GDCWHI022B		
4	Phoenix 5 mm Pitch 'HC'	Motor phases
3	Phoenix 5 mm Pitch 'HC'	Main Power
2	Phoenix 3.81 mm Pitch 'HC'	Auxiliary supply input
Front Connectors		
 GDCWHI023B **Front Connectors - EtherCAT**  GDCWHI058A **Front Connectors - CAN**		
3	2.54 mm Pitch Molex	STO
24	2.54 mm Pitch Molex	Feedback port C and I/O
8	2.54 mm Pitch Molex	Feedback port B
12	2.54 mm Pitch Molex	Feedback port A

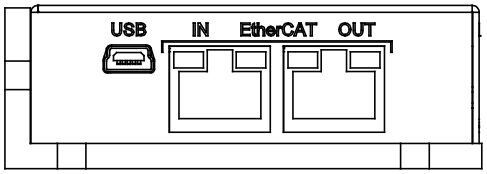
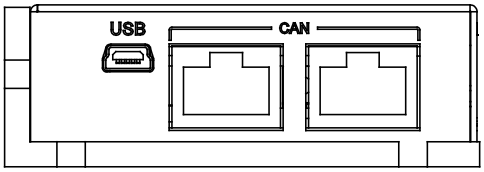
No. Pins	Type	Function
Top Connectors		
 GDCWHI024A **Top Connectors - EtherCAT**  GDCWHI059A **Top Connectors - CAN**		
4	USB Device Mini-B	USB
EtherCAT Version		
8	RJ-45	EtherCAT in
8	RJ-45	EtherCAT out
CAN Version		
8	RJ-45	CAN In
8	RJ-45	CAN Out

Table 2: Connector Types

4.3.2. Pinouts

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

4.3.2.1. Motor Power Connector

See Section 4.7.1 for full details.

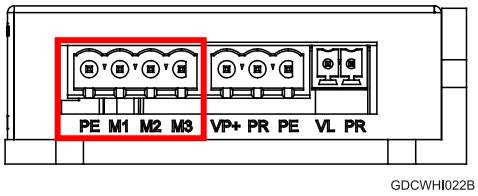
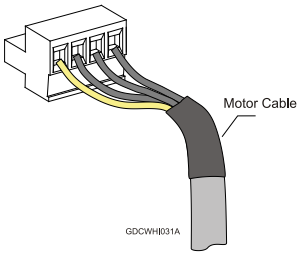
Pin	Function	Cable	
		Brushless Motor	**Brushed DC Motor**
PE	Protective Earth	Motor	Motor
M1	Motor phase	Motor	N/C
M2	Motor phase	Motor	Motor
M3	Motor phase	Motor	Motor
 **4-Pin Phoenix 5 mm Pitch 'HC'**		 **4-Pin Phoenix Plug-in Connector**	

Table 3: Connectors for Motor

4.3.2.2. Main Power Connector

See Section 4.7.2 for full details.

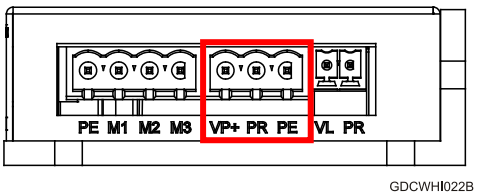
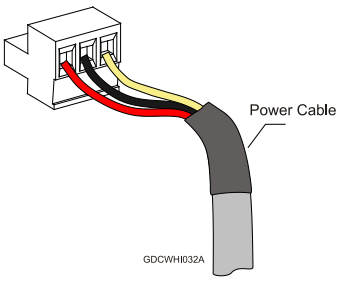
Pin	Function	Cable
VP+	Positive Power input	DC Power
PR	Power return	DC Power
PE	Protective earth	DC Power
 **3-Pin Phoenix 5 mm Pitch 'HC'**		 **3-Pin Phoenix Plug-in Connector**

Table 4: Connectors for Main Power

4.3.2.3. Auxiliary Power Connector

See Section 4.7.2.2 for full details.

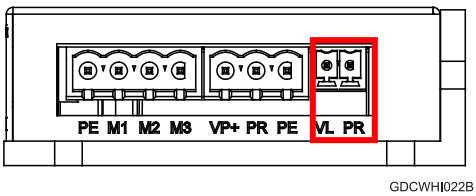
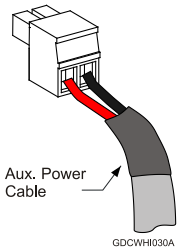
Pin	Function	Cable
VL+	Auxiliary Supply Input	DC Power
PR	Auxiliary Supply Return	DC Power
 **2-Pin Phoenix 3.81 mm Pitch**		 **2-Pin Phoenix Plug-in Connector**

Table 5: Aux. Power Connector – Pin Assignments

4.3.2.4. STO Connector

See Section 4.7.2.4.b for full details.

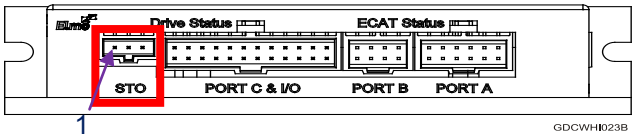
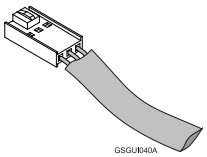
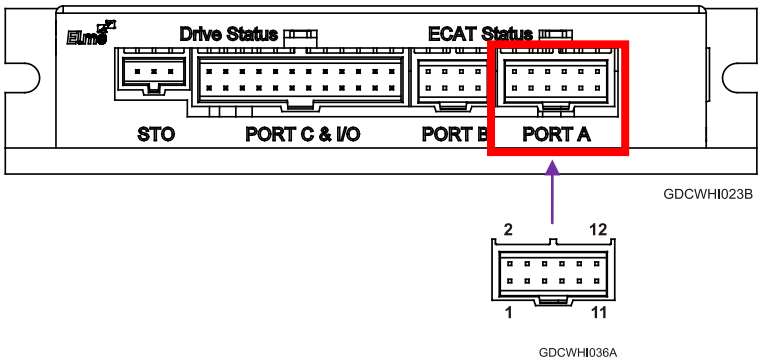
Pin	Signal	Function
1	STO1	STO1 input (default 24 V)
2	STO2	STO2 input (default 24 V)
3	STO_RET	STO signal return
 **3-Pin 2.54 mm Pitch Molex**		 **3-Pin Molex Plug** This cable is included in the cable kit described in Section 2.2.19.

Table 6: STO Input – Pin Assignments

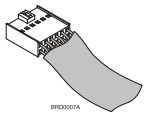
4.3.2.5. Port A Connector

See Section 4.9.1 for full details.

	Incremental Encoder		Absolute Serial Encoder	
Pin	**Signal**	**Function**	**Signal**	**Function**
1	+5V	Encoder +5V supply	+5V	Encoder +5V supply
2	SUPRET	Supply return	SUPRET	Supply return
3	PortA_ENC_A+	Channel A +	ABS_CLK+	Absolute encoder clock+
4	PortA_ENC_A-	Channel A -	ABS_CLK-	Absolute encoder clock-
5	PortA_ENC_B+	Channel B+	ABS_DATA+	Absolute encoder data+
6	PortA_ENC_B-	Channel B -	ABS_DATA-	Absolute encoder data -
7	PortA_ENC_INDEX+	Index+	Reserved	Reserved
8	PortA_ENC_INDEX-	Index -	Reserved	Reserved
9	HA	Hall sensor A	HA	Hall sensor A
10	HB	Hall sensor B	HB	Hall sensor B
11	HC	Hall sensor C	HC	Hall sensor C
12	PE	Protective Earth	PE	Protective Earth



12-Pin 2.54 mm Pitch Molex



12-Pin Molex Plug

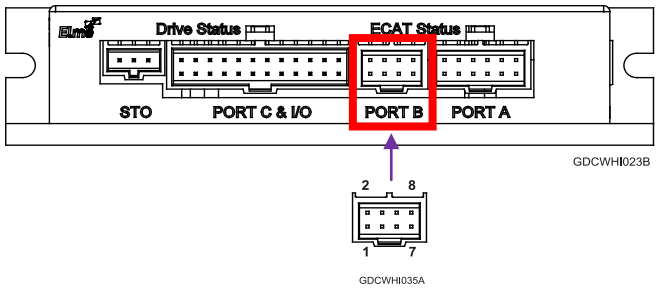
This cable is included in the cable kit described in Section 2.2.19.

Table 7: Port A Pin Assignments

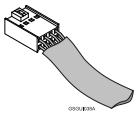
4.3.2.6. Port B Connector

See Section 4.9.2 for full details.

	Incremental or Interpolated Analog Encoder		Resolver	
	G-DCWHIXXX/YYYYEXX		G-DCWHIXXX/YYYYRXX	
Pin	**Signal**	**Function**	**Signal**	**Function**
1	+5V	Encoder +5V supply	NC	
2	SUPRET	Supply return	SUPRET	Supply return
3	PortB_ENC_A+/SIN+	Channel A+/Sine+	SIN+	Sine+
4	PortB_ENC_A-/SIN-	Channel A -/Sine-	SIN-	Sine-
5	PortB_ENC_B+/COS+	Channel B+/ Cosine+	COS+	Cosine+
6	PortB_ENC_B-/COS-	Channel B-/Cosine-	COS-	Cosine-
7	PortB_ENC_INDEX+/ Analog_Index+	Channel_Index+/ Analog_Index+	RESOLVER_OUT+	Vref f=1/TS, 50 mA Max.
8	PortB_ENC_INDEX-/ Analog_Index-	Channel_Index- / Analog_Index-	RESOLVER_OUT-	Vref complement f= 1/TS, 50 mA Maximum



8-Pin 2.54 mm Pitch Molex



8-Pin Molex Plug

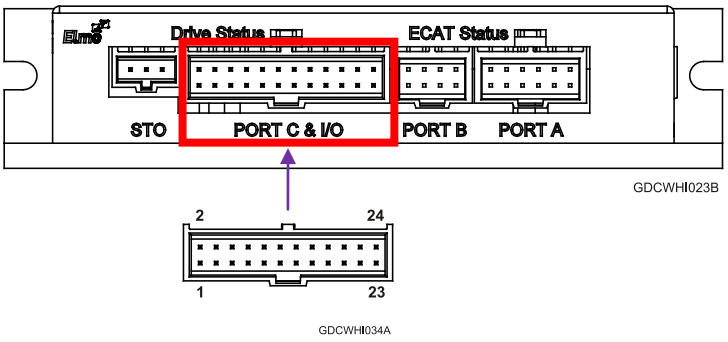
This cable is included in the cable kit described in Section 2.2.19.

Table 8: Port B Pin Assignments

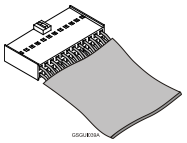
4.3.2.7. Port C & I/O Connector

See Section 4.9.3 for full details on Port C and Section 4.10 for full details on I/O.

Pin	Signal	Function
1	PortC_ENCO_A+	Buffered Channel A output
2	PortC_ENCO_A-	Buffered Channel A complement output
3	PortC_ENCO_B+	Buffered Channel B output
4	PortC_ENCO_B-	Buffered Channel B complement output
5	PortC_ENCO_Index+	Buffered INDEX output
6	PortC_ENCO_Index-	Buffered INDEX complement output
7	COMRET	Common return
8	PE	Protective Earth
9	ANALOG1-	Analog input complement
10	ANALOG1+	Analog input
11	ANARET	Analog return
12	INRET1_6	Programmable input 1 – 6 return
13	IN1	Programmable digital input 1
14	IN2	Programmable digital input 2
15	IN3	Programmable digital input 3
16	IN4	Programmable digital input 4
17	IN5	Programmable digital input 5
18	IN6	Programmable digital input 6
19	OUT4	Programmable output 4
20	OUT3	Programmable output 3
21	OUT2	Programmable output 2
22	OUT1	Programmable output 1
23	VDD	VDD supply (5 V up to 30 V)
24	VDDRET	VDD supply return



24-Pin 2.54 mm Pitch Molex



24-Pin Molex Plug

This cable is included in the cable kit described in Section 2.2.19.

Table 9: Connector J6 – Port C Feedback Out and I/O

4.3.2.8. USB

See Section 4.11.1 for the electrical diagram.

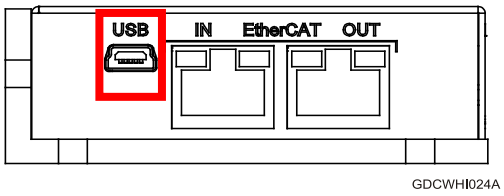
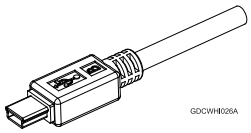
Pin	Signal	Function
1	USB VBUS	USB VBUS 5 V
2	USBD-	USB _N line
3	USBD+	USB _P line
5	USB COMRET	USB communication return
 **USB Device Mini-B**		 **USB Device Mini-B Plug**

Table 10: USB 2.0 Pin Assignments

4.3.3. EtherCAT Communication Version

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

Fieldbus Type	Product Number
EtherCAT	G-DCWHI XX/YYY**E**XX

4.3.3.1. EtherCAT IN/Ethernet

See Section 4.11.2 for the electrical diagram.

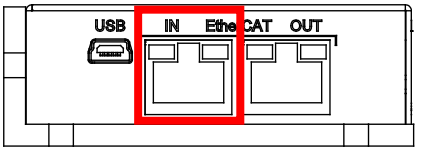
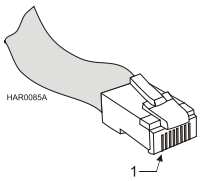
Pin	Signal	Function
1	EtherCAT_IN/Ethernet_TX+	EtherCAT in/Ethernet transmit +
2	EtherCAT_IN/Ethernet_TX-	EtherCAT in/Ethernet transmit -
3	EtherCAT_IN/Ethernet_RX+	EtherCAT in/Ethernet receive +
4, 5	N/A	
6	EtherCAT_IN/Ethernet_RX-	EtherCAT in/Ethernet receive -
7, 8	N/A	
 **8-Pin RJ-45**		 **Standard Ethernet CAT5 Cable**

Table 11: EtherCAT In Pin Assignments

4.3.3.2. EtherCAT OUT

See Section 4.11.2 for the electrical diagram.

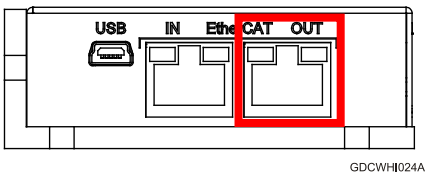
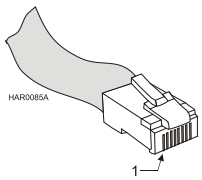
Pin	Signal	Function
1	EtherCAT_OUT_TX+	EtherCAT in transmit +
2	EtherCAT_OUT_TX-	EtherCAT in transmit -
3	EtherCAT_OUT_RX+	EtherCAT in receive +
4, 5	N/A	
6	EtherCAT_OUT_RX-	EtherCAT in receive -
7, 8	N/A	
 **8-Pin RJ-45**		 **Standard Ethernet CAT5 Cable**

Table 12: EtherCAT Out Pin Assignments

4.3.3.3. EtherCAT Link Indicators

The Gold DC Whistle can serve as an EtherCAT slave device. For this purpose it has two RJ-45 connectors, which are designated as EtherCAT In and EtherCAT Out. Each of these RJ-45 connectors has two status LEDs, which are shown in Figure 2.

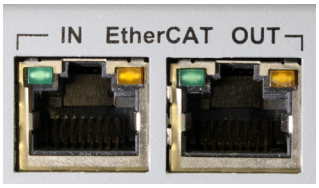


Figure 2: Ethernet Connector LEDs

The green LED is the link/activity indicator (Figure 3). It shows the state of the applicable physical link and the activity on that link.

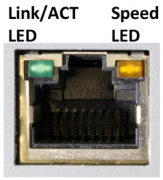


Figure 3: Status LEDs

The amber LED is the speed indicator (Figure 3). It shows the speed of the connection on the Ethernet line. The possible states of these LEDs are summarized in Table 13.

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

Table 13: LED States

4.3.3.4. EtherCAT Status Indicator

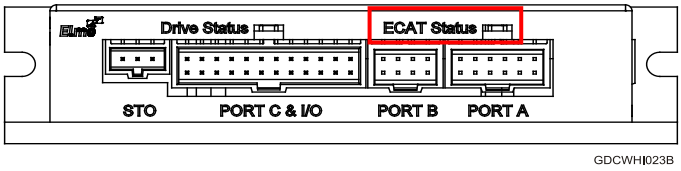


Figure 4: EtherCAT Status LED

The EtherCAT status indicator is a red/green dual LED. It combines run indication (when it is green) and error indication (when it is red) of the EtherCAT device. For further details, see the EtherCAT Manual.

Note: There is no Gold DC Whistle ECAT Status indicator equivalent in the CAN version, refer to the figure below.

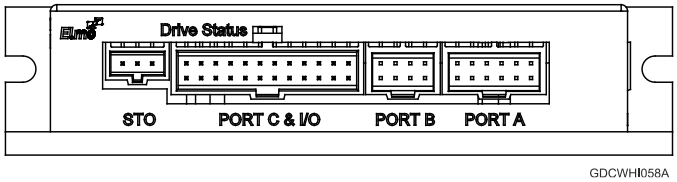


Figure 5: Gold DC Whistle Status Indicator - CAN

4.3.4. CAN Communication Version

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

Fieldbus Type	Product Number
CAN	G-DCWHI XX/YYY**S**XX

See Section 4.11.4 for the electrical diagram.

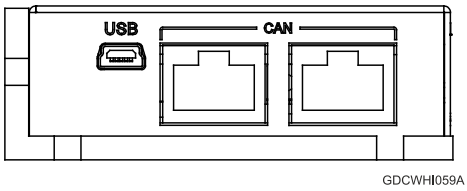
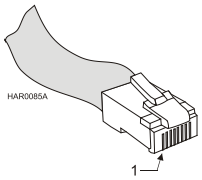
Pin	Signal	Function
1	CAN_H	CAN_H bus line (dominant high)
2	CAN_L	CAN_L bus line (dominant low)
3	CAN_RET	CAN Return
4, 5	N/A	—
6	CAN_SHLD	Shield, connected to the RJ plug cover
7	CAN_RET	CAN Return
8	N/A	—
Pin Position		
		 **Standard CAT5e Ethernet Cable**

Table 14: CAN In/Out Connectors Pin Assignments

4.3.5. Drive Status Indicator

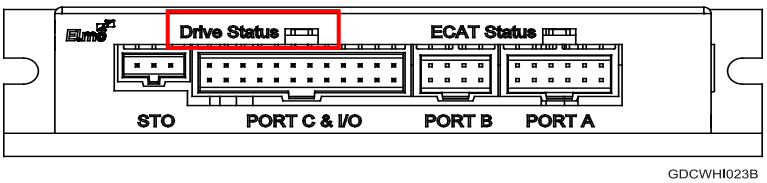


Figure 6: Gold DC Whistle Drive Status LED - EtherCAT

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

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

4.4. Mounting the Gold DC Whistle

The Gold DC Whistle has been designed for two standard mounting options:

- Wall Mount along the back (can also be mounted horizontally on a metal surface)
- Book Shelf along the side

M4 round head screws, one through each opening in the heat sink, are used to mount the Gold DC Whistle (see the diagram below).

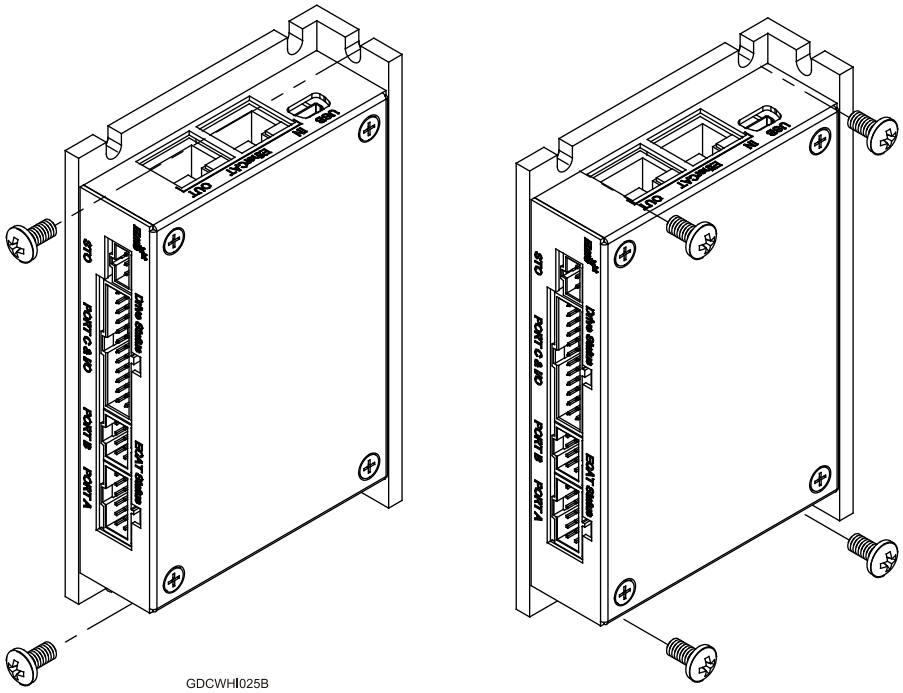


Figure 7: Mounting the Gold DC Whistle

4.5. Wiring the Gold DC Whistle

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

Caution:
Follow these instructions to ensure safe and proper wiring:

- Use twisted pair shielded cables for control, feedback and communication connections. For best results, the cable should have an aluminum foil shield covered by copper braid, and should contain a drain wire.
- The drain wire is a non-insulated wire that is in contact with parts of the cable, usually the shield. It is used to terminate the shield and as a grounding connection.

- The impedance of the wire must be as low as possible. The size of the wire must be thicker than actually required by the carrying current. A 24, 26 or 28 AWG wire for control and feedback cables is satisfactory although 24 AWG is recommended.
- Use shielded wires for motor connections as well. If the wires are long, ensure that the capacitance between the wires is not too high: C < 30 nF is satisfactory for most applications.
- Keep all wires and cables as short as possible.
- Keep the motor wires as far away as possible from the feedback, control and communication cables.
- Ensure that in normal operating conditions, the shielded wires and drain *carry no current.* The only time these conductors carry current is under abnormal conditions, when electrical equipment has become a potential shock or fire hazard while conducting external EMI interferences directly to ground, in order to prevent them from affecting the drive. Failing to meet this requirement can result in drive/controller/host failure.
- After completing the wiring, carefully inspect all wires to ensure tightness, good solder joints and general safety.

4.6. The Gold DC Whistle Connection Diagram

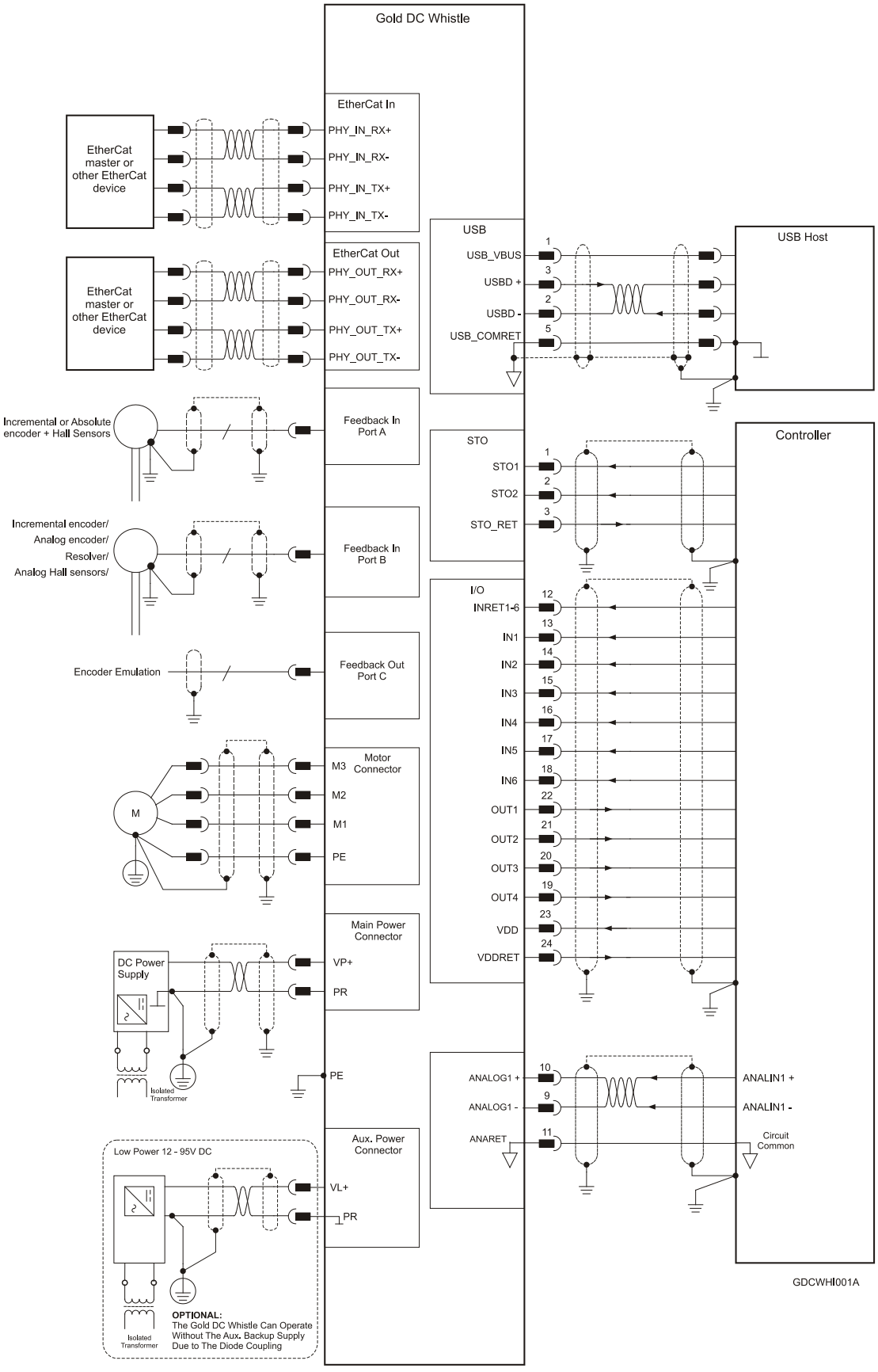


Figure 8: The Gold DC Whistle Connection Diagram – EtherCAT

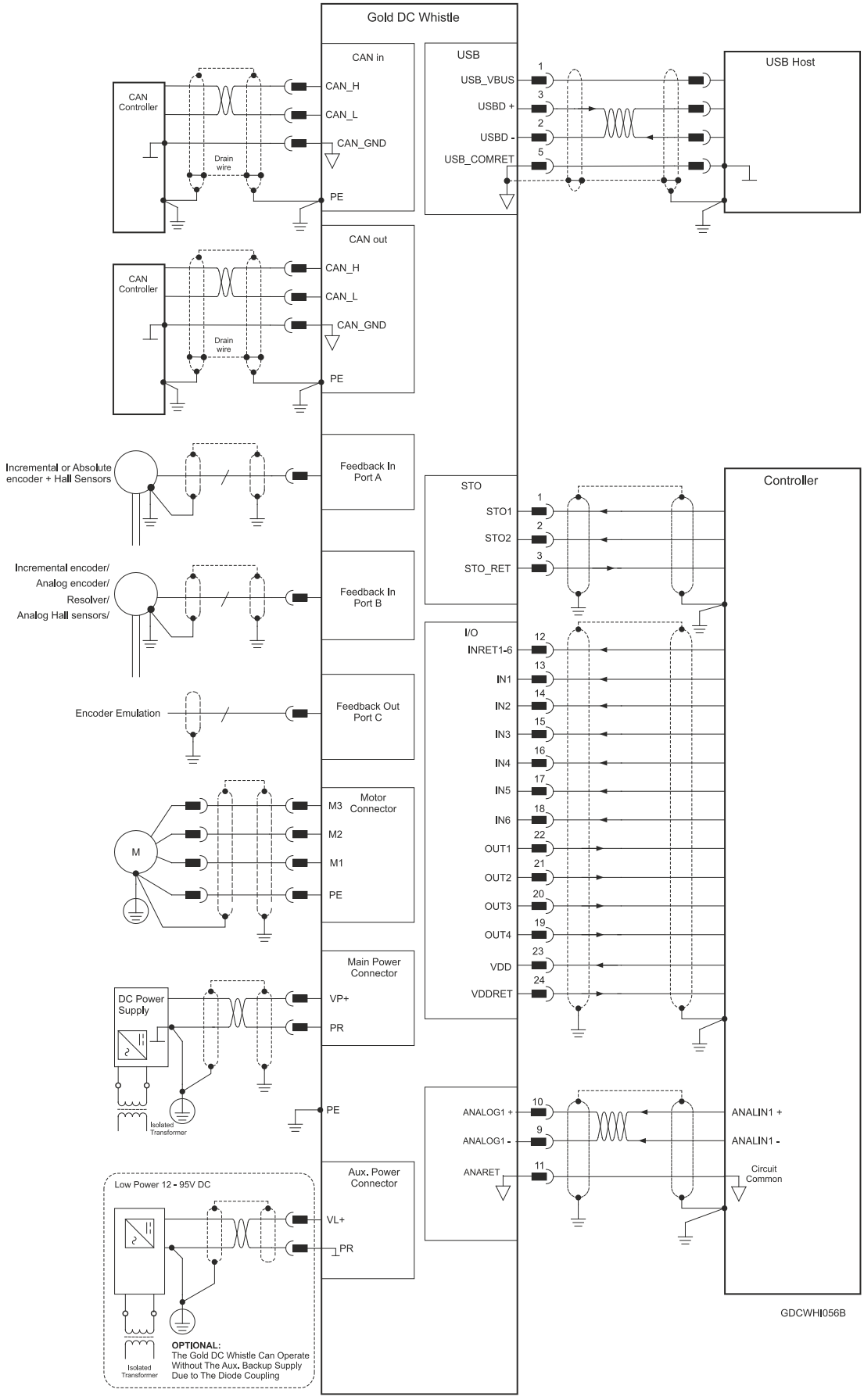


Figure 9: The Gold DC Whistle Connection Diagram - CAN

4.7. Main Power, Auxiliary Power and Motor Power

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

4.7.1. Motor Power

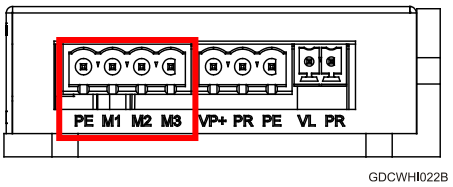
Pin	Function	Cable		Connector Location
		Brushless Motor	Brushed DC Motor	
PE	Protective Earth	Motor	Motor	
M1	Motor phase	Motor	N/C	
M2	Motor phase	Motor	Motor	
M3	Motor phase	Motor	Motor	

Table 15: Motor Connectors

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.

Connect the M1, M2, M3 and PE pins on the Gold DC Whistle. 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.

Notes:

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

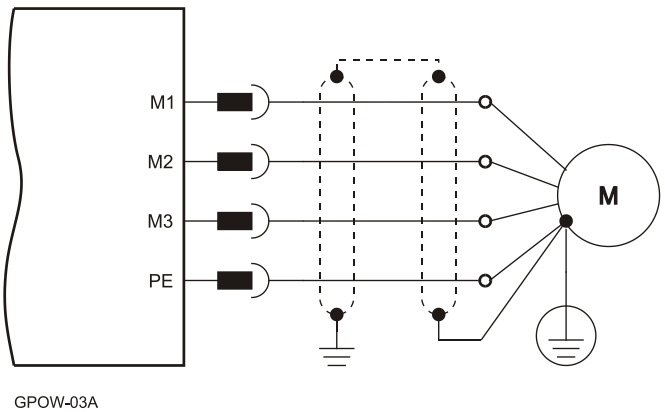


Figure 10: Brushless Motor Power Connection Diagram

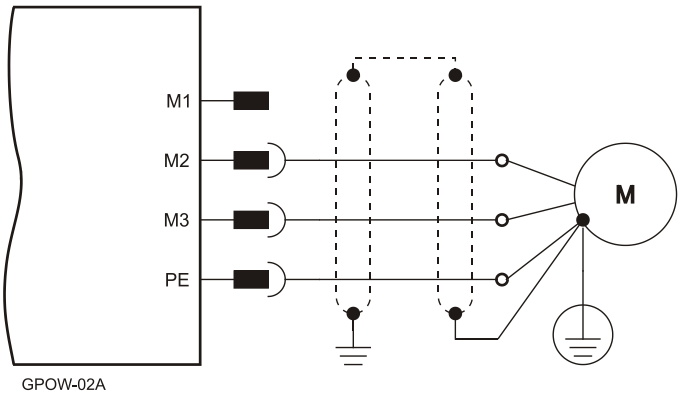


Figure 11: DC Brushed Motor Power Connection Diagram

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

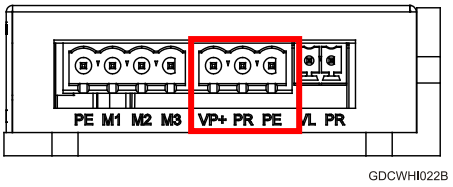
Pin	Function	Cable	Connector Location
VP+	Positive Power input	DC Power	
PR	Power return	DC Power	
PE	Protective earth	DC Power	
PE	Protective Earth	Motor	

Table 16: Connectors for Main Power

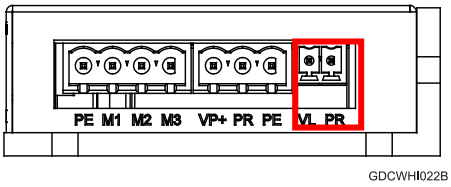
Power to the Gold DC Whistle is provided by a 12 to1 95 VDC source.

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 95 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)

Pin	Function	Cable	Connector Location
VL+	Auxiliary Supply Input	DC Power	 GDCWHI022B
PR	Auxiliary Supply Return	DC Power	

Caution:
Power from the Gold DC 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.

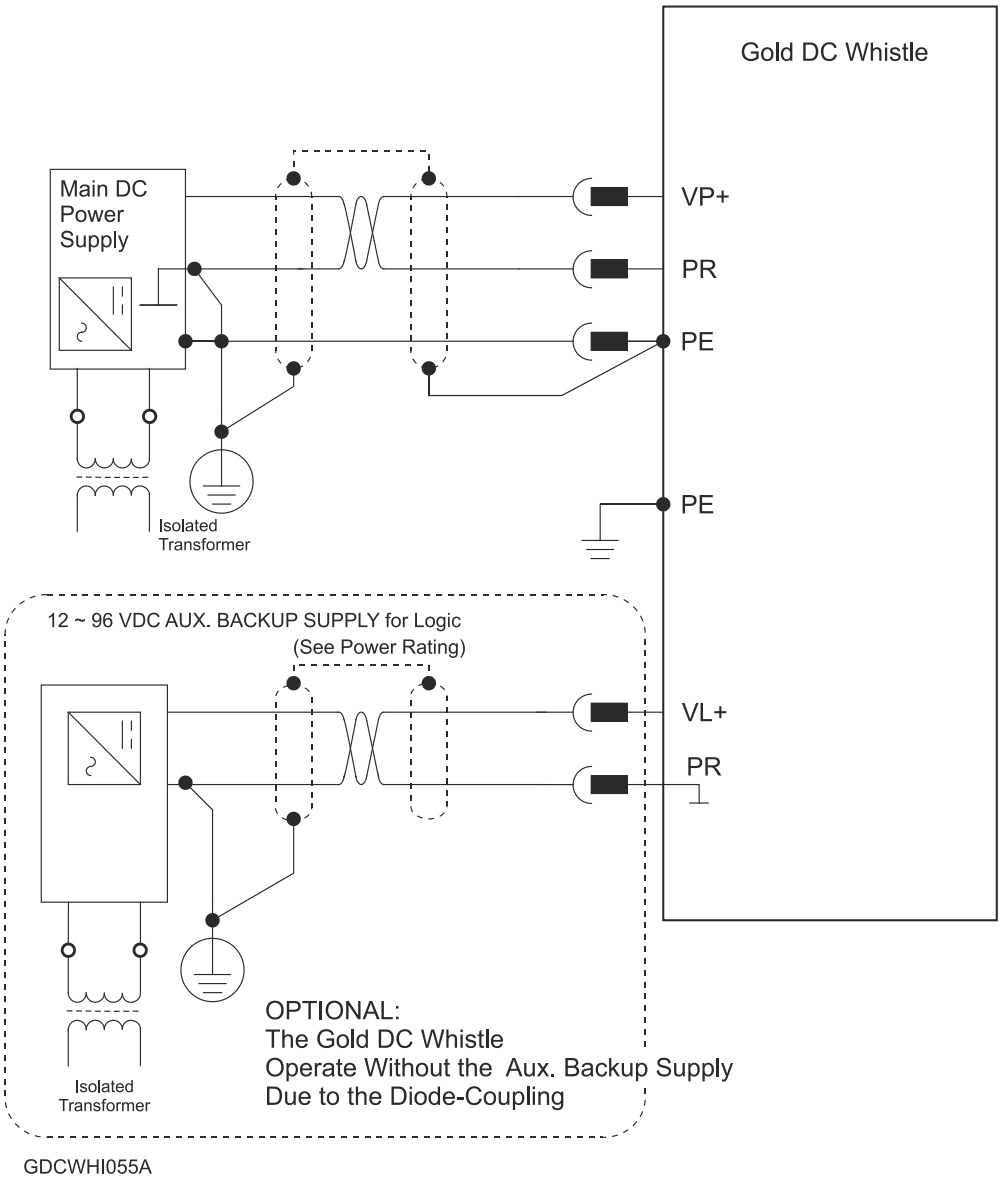


Figure 12: 200 VDC Power Source Connection Diagram

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

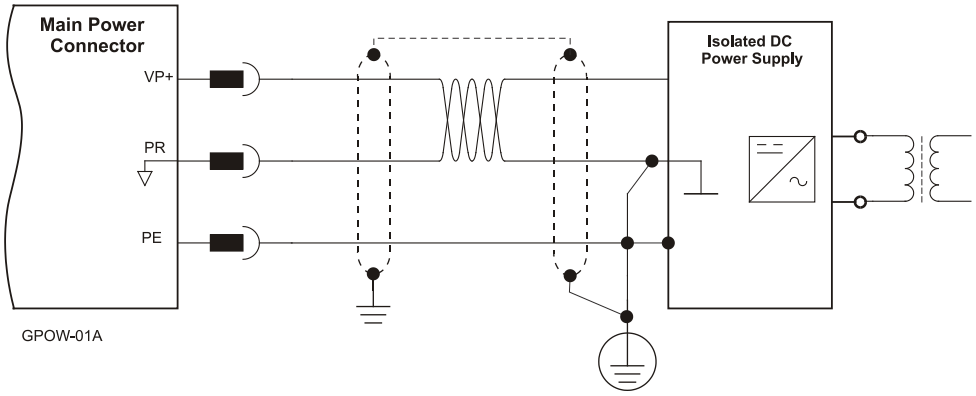


Figure 13: Main Power Supply Connection Diagram (no Auxiliary Supply)

4.7.2.4.b Optional Backup Supply

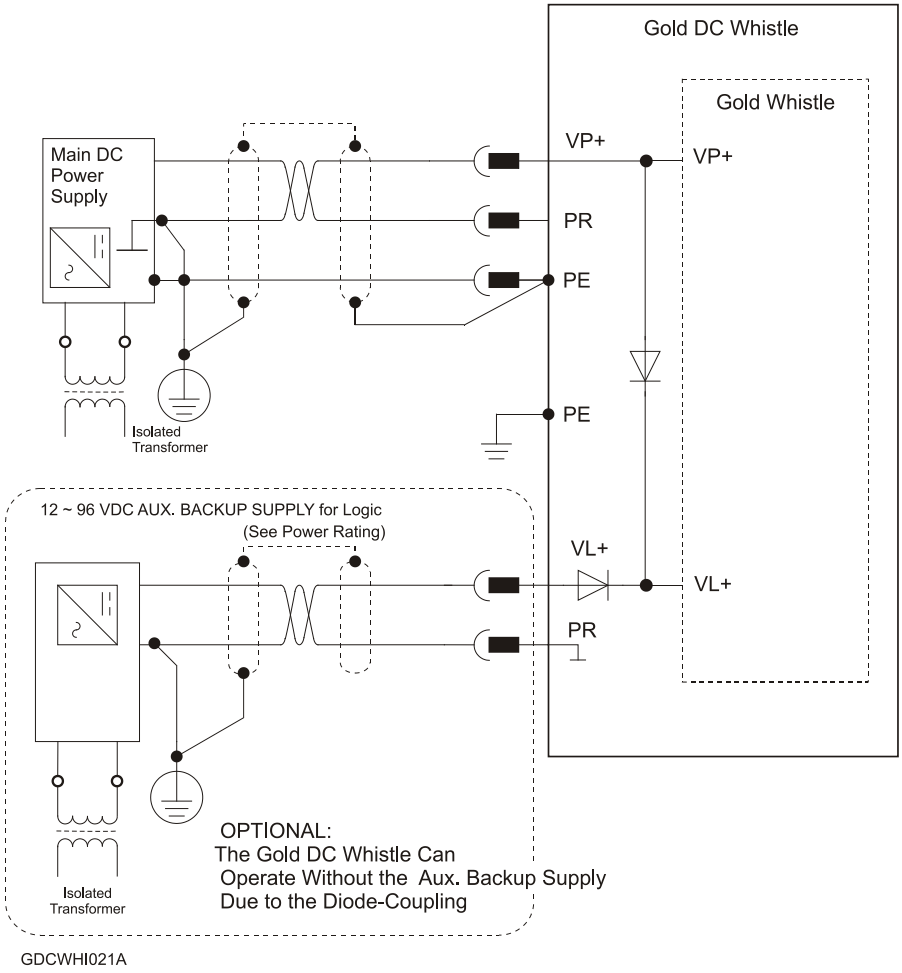


Figure 14: Auxiliary Power Supply Connections Diagram

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 24 VDC (or 5 V for the TTL option) 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 17: Motor Behavior According to STO Inputs

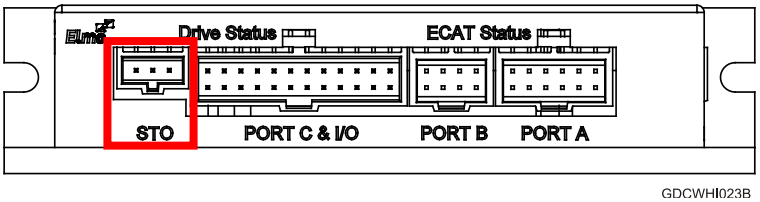
Pin	Signal	Function
1	STO1	STO1 input (default 24 V)
2	STO2	STO2 input (default 24 V)
3	STO_RET	STO signal return
Connector Location		
		

Table 18: STO Inputs Pin Assignments

A cable kit containing a cable that connects to the STO connector is available, see Section 2.2.19 for more details.

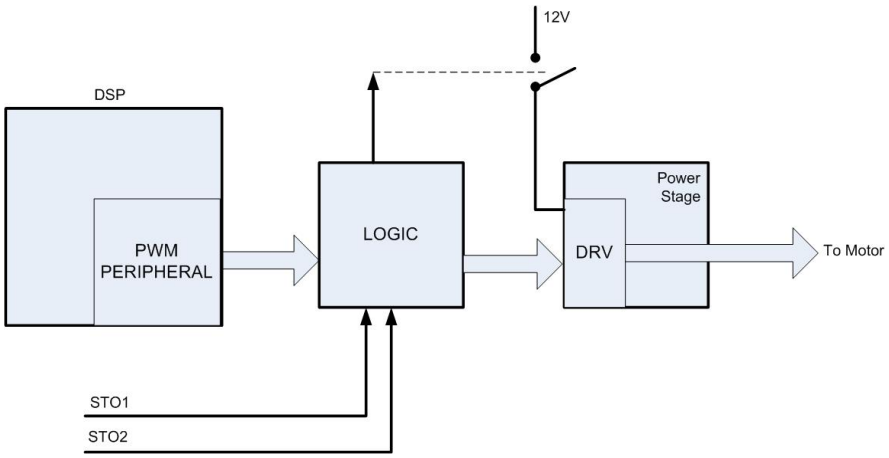


Figure 15: STO Input Functionality – Schematic Drawing

See Figure 16 for the PLC option connection and Figure 17 for the TTL option connection and Figure 18 for the Sink option connection.

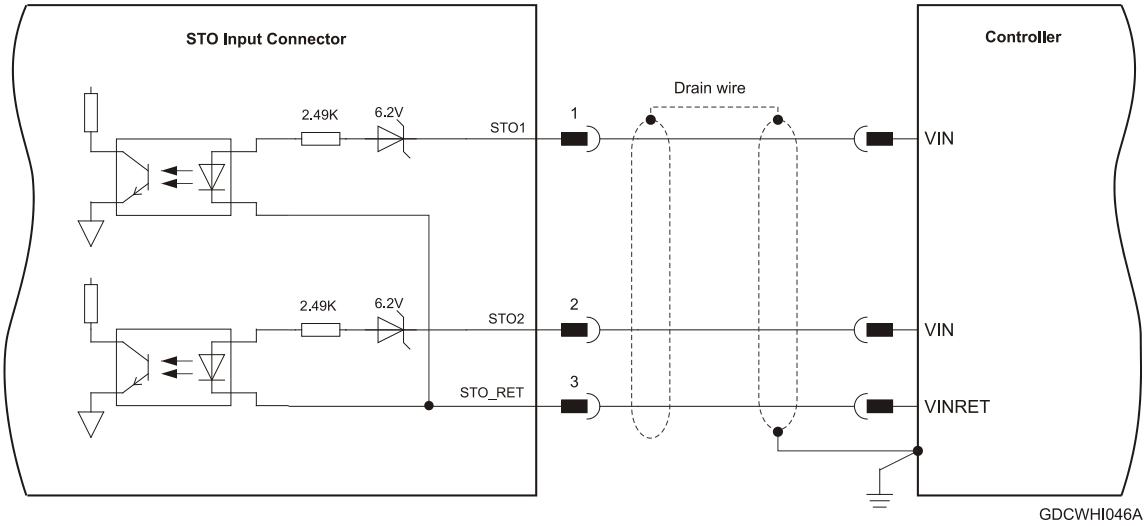


Figure 16: STO Input Connection – PLC Option

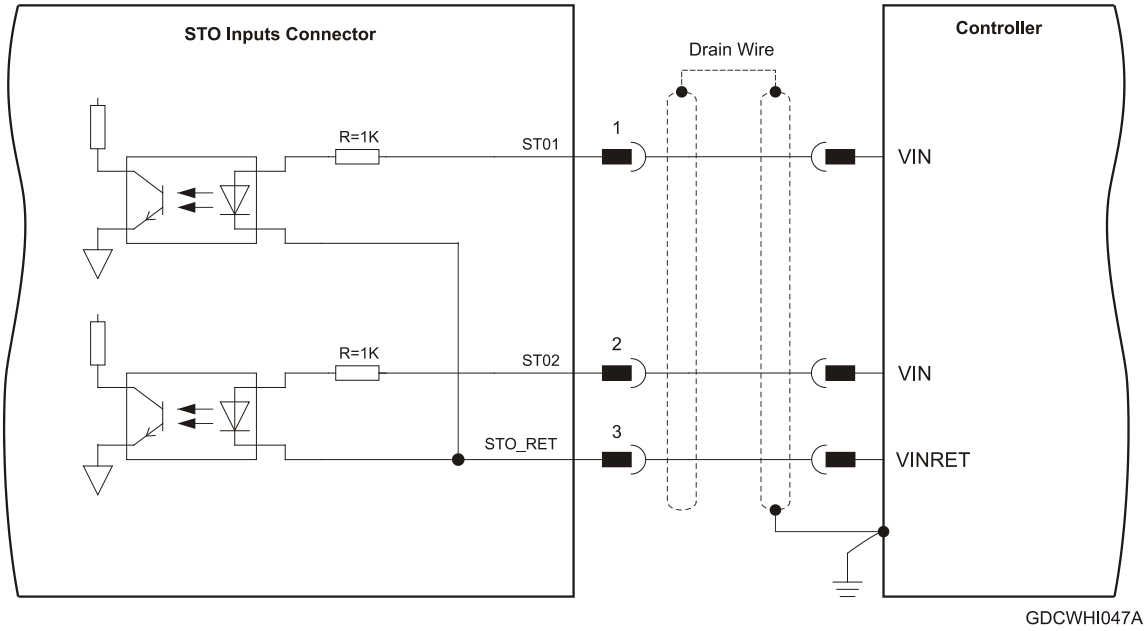


Figure 17: STO Input Connection – TTL Option

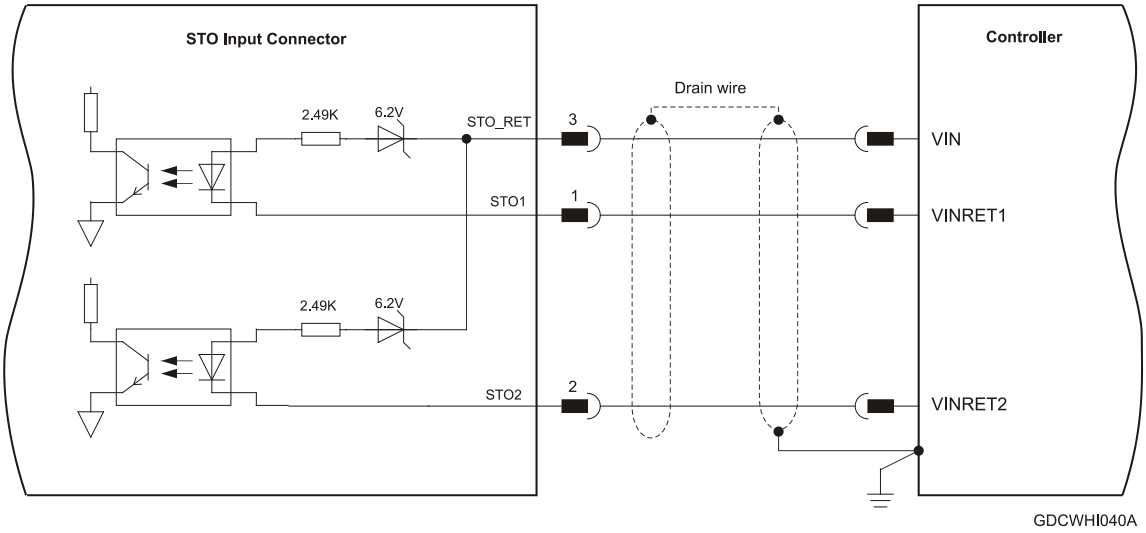


Figure 18: STO Input Sink Connection Option

4.9. Feedback and Analog Input

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

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

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

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

A cable kit containing a cable that connects to port A is available, see Section 2.2.19 for more details.

	Incremental Encoder		Absolute Serial Encoder	
Pin	**Signal**	**Function**	**Signal**	**Function**
1	+5V	Encoder +5V supply	+5V	Encoder +5V supply
2	SUPRET	Supply return	SUPRET	Supply return
3	PortA_ENC_A+	Channel A +	ABS_CLK+	Absolute encoder clock+
4	PortA_ENC_A-	Channel A -	ABS_CLK-	Absolute encoder clock-
5	PortA_ENC_B+	Channel B+	ABS_DATA+	Absolute encoder data+
6	PortA_ENC_B-	Channel B -	ABS_DATA-	Absolute encoder data -
7	PortA_ENC_INDEX+	Index+	Reserved	Reserved
8	PortA_ENC_INDEX-	Index -	Reserved	Reserved
9	HA	Hall sensor A	HA	Hall sensor A
10	HB	Hall sensor B	HB	Hall sensor B
11	HC	Hall sensor C	HC	Hall sensor C
12	PE	Protective Earth	PE	Protective Earth

Connector Location

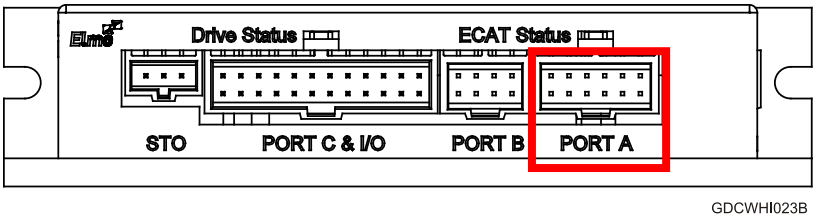


Table 19: Port A Pin Assignments

4.9.1.1. Incremental Encoder

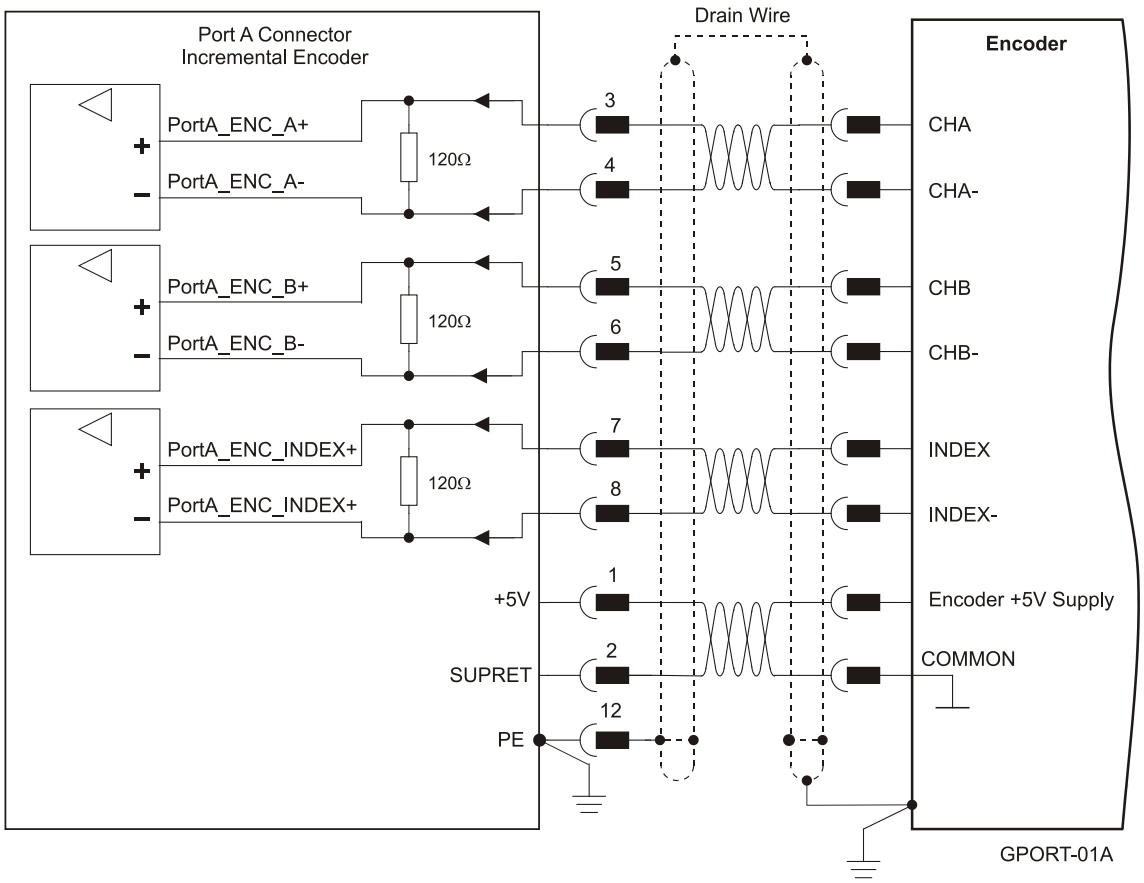


Figure 19: Port A Incremental Encoder Input – Recommended Connection Diagram

4.9.1.2. Absolute Serial Encoder

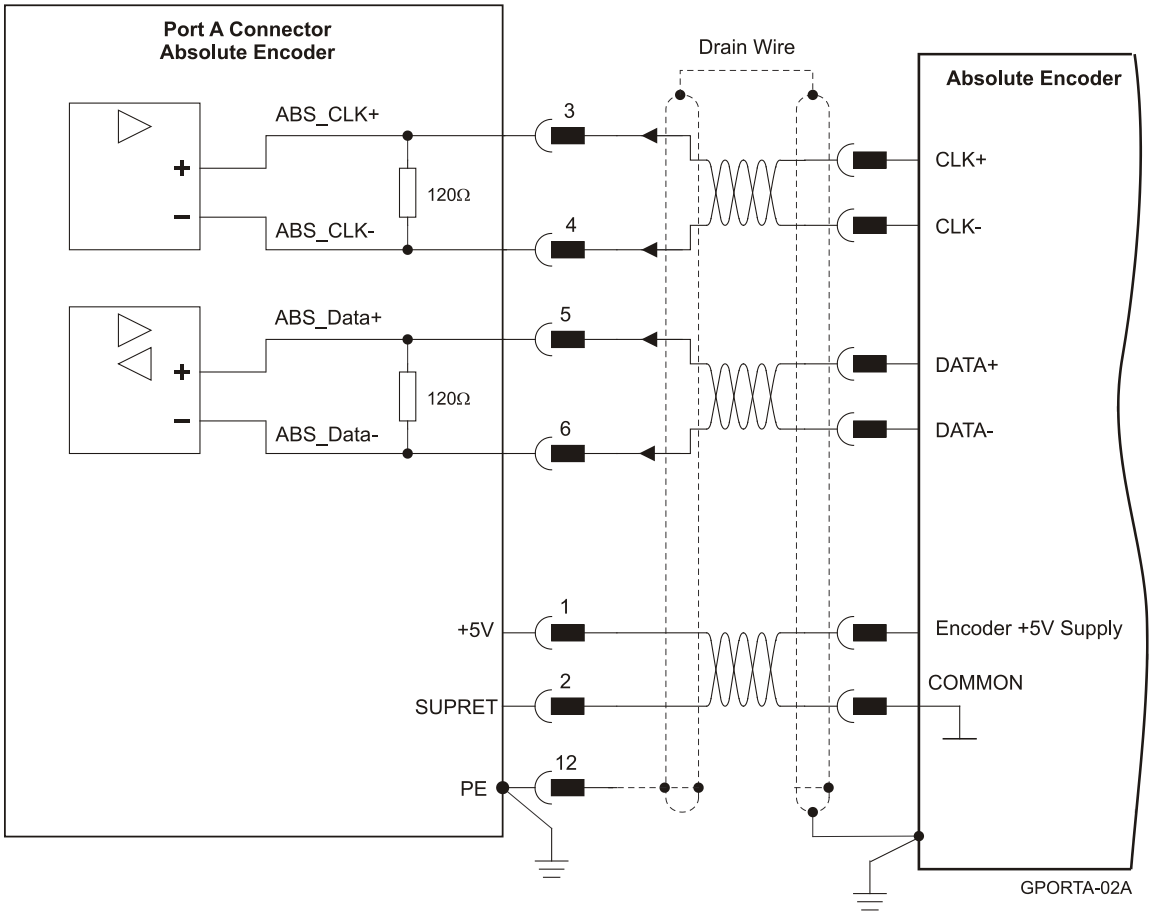


Figure 20: Absolute Serial Encoder – Recommended Connection Diagram for Sensors Supporting Data/Clock (e.g., Biss / SSI / EnDAT, etc.)

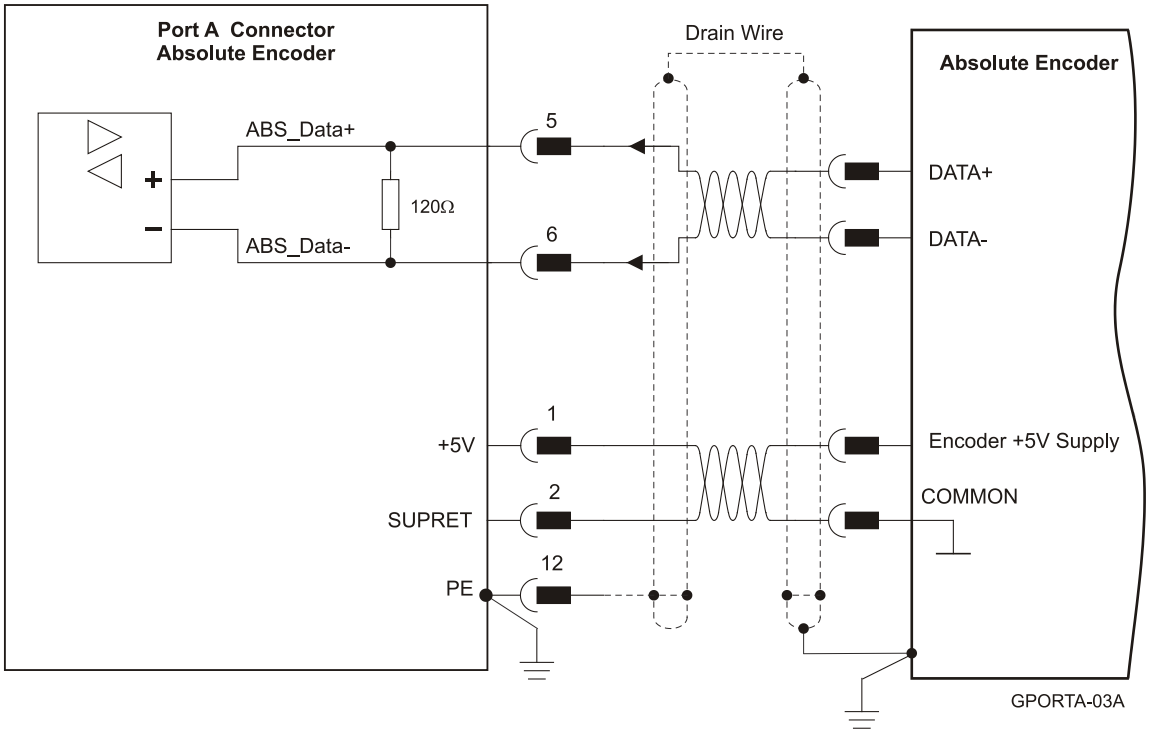


Figure 21: Absolute Serial Encoder – Recommended Connection Diagram for Sensors Supporting Data Line Only (NRZ types, e.g., Panasonic / Mitutoyo / etc.)

4.9.1.3. Hall Sensors

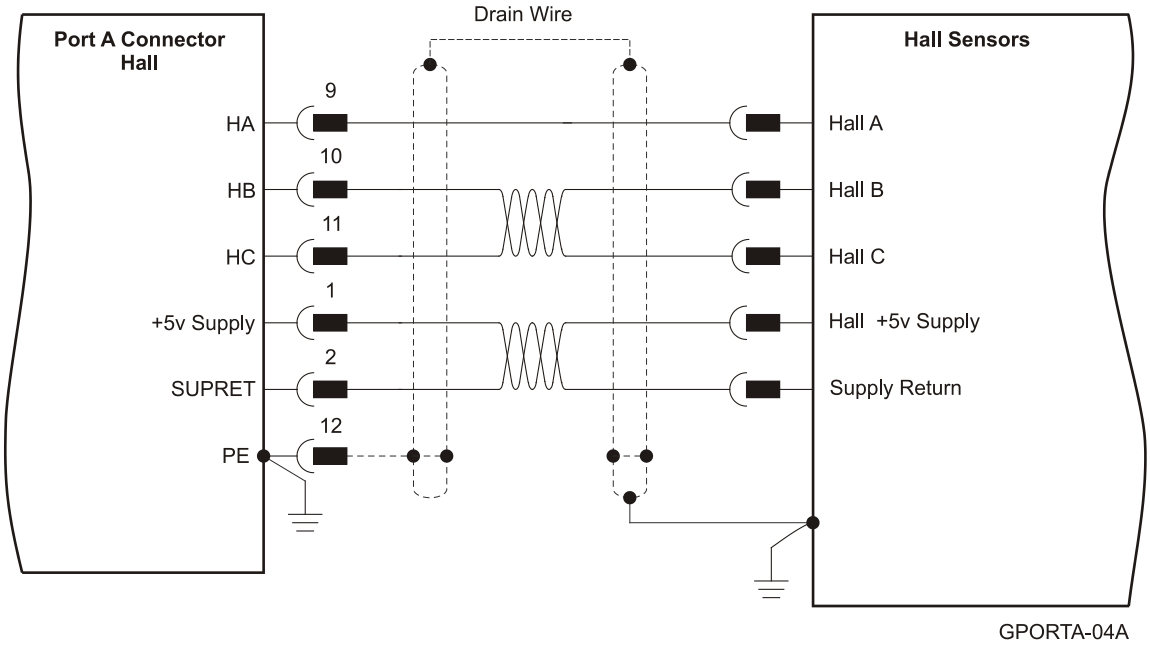


Figure 22: Hall Sensors Connection Diagram

4.9.2. 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 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 & Dir 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.

A cable kit containing a cable that connects to port B is available, see Section 2.2.19 for more details.

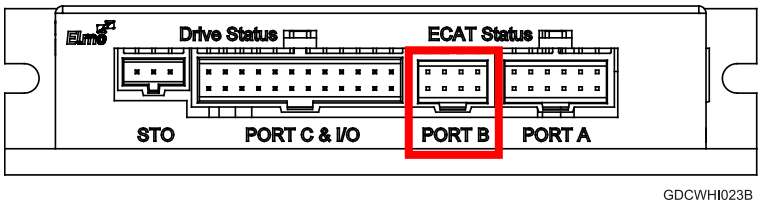
	Incremental or Interpolated Analog Encoder		Resolver	
	Signal	**Pin**	**Signal**	**Function**
1	+5V	Encoder +5V supply	NC	
2	SUPRET	Supply return	SUPRET	Supply return
3	PortB_ENC_A+/SIN+	Channel A+/Sine+	SIN+	Sine+
4	PortB_ENC_A-/SIN-	Channel A -/Sine-	SIN-	Sine-
5	PortB_ENC_B+/COS+	Channel B+/Cosine+	COS+	Cosine+
6	PortB_ENC_B-/COS-	Channel B-/Cosine-	COS-	Cosine-
7	PortB_ENC_INDEX+/ Analog_Index+	Channel_Index+/ Analog_Index+	RESOLVER_OUT+	Vref f=1/TS, 50 mA Max.
8	PortB_ENC_INDEX-/ Analog_Index-	Channel_Index- / Analog_Index-	RESOLVER_OUT-	Vref complement f= 1/TS, 50 mA Maximum
Connector Location				
				

Table 20: Port B Pin Assignments

4.9.2.1. Incremental Encoder

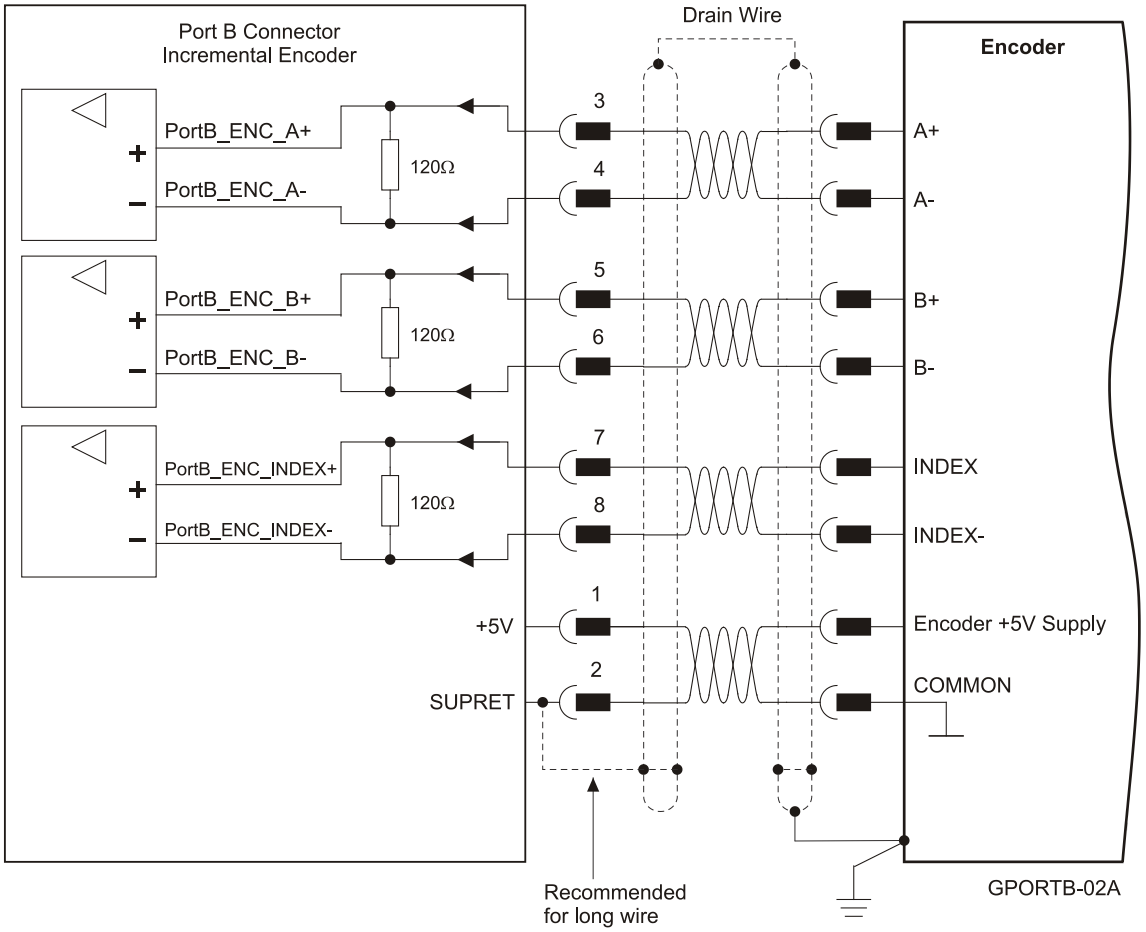


Figure 23: Port B Incremental Encoder Input – Recommended Connection Diagram

4.9.2.2. Interpolated Analog Encoder

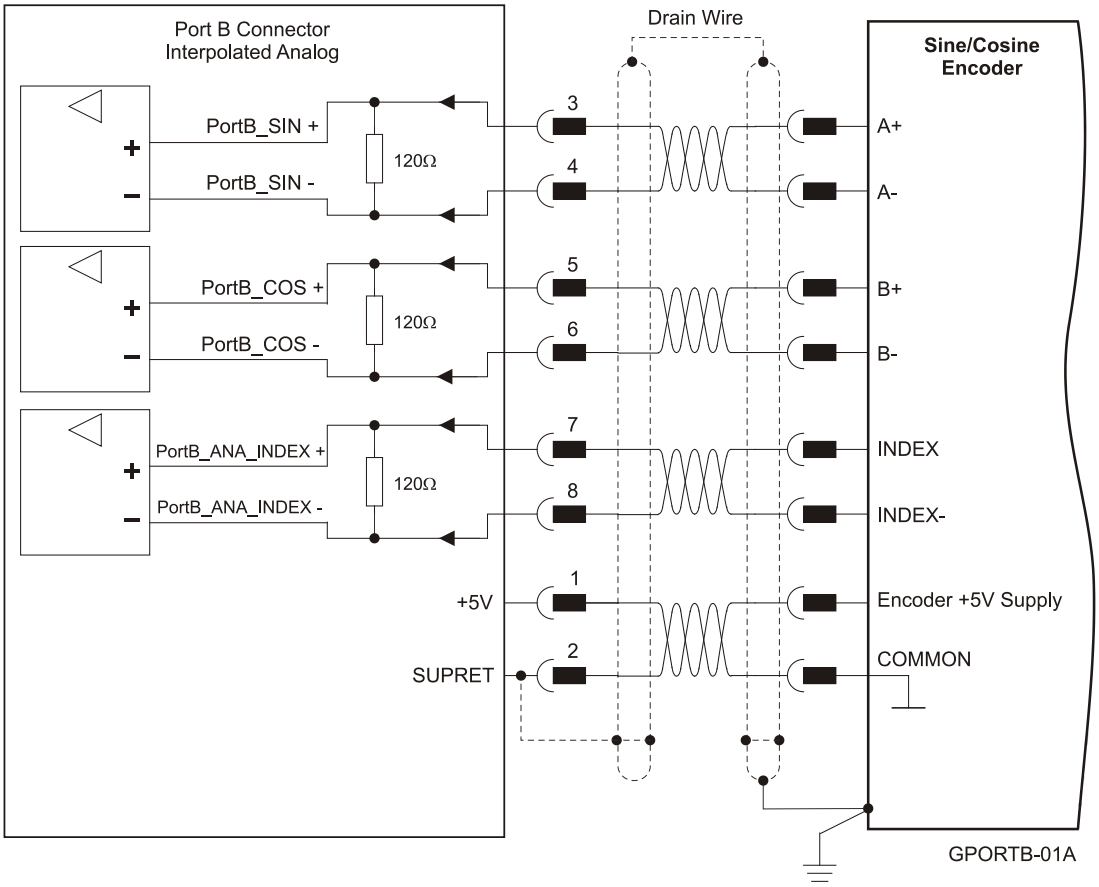


Figure 24: Port B - Interpolated Analog Encoder Connection Diagram

4.9.2.3. Resolver

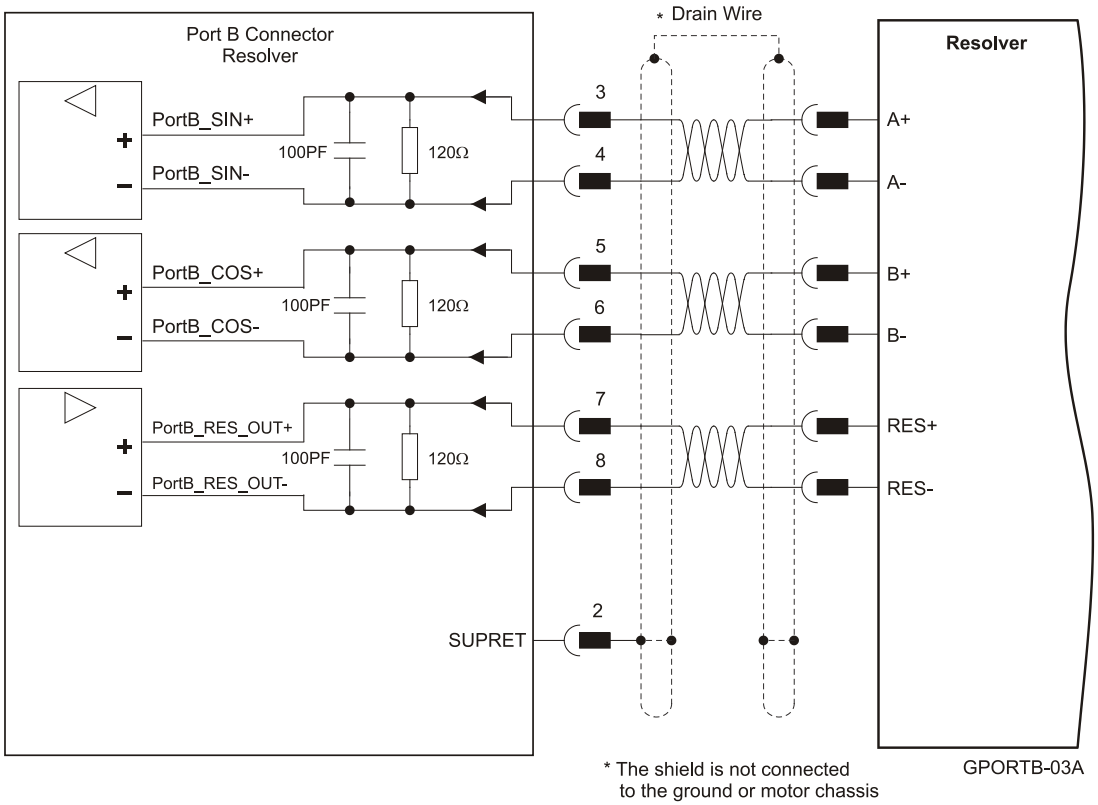


Figure 25: Port B – Resolver Connection Diagram

4.9.3. Port C – Emulated Encoder Output

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

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

This port is used when:

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

A cable kit containing a cable that connects to port C is available, see Section 2.2.19 for details.

Pin	Signal	Function
1	PortC_ENCO_A+	Buffered Channel A output
2	PortC_ENCO_A-	Buffered Channel A complement output
3	PortC_ENCO_B+	Buffered Channel B output
4	PortC_ENCO_B-	Buffered Channel B complement output
5	PortC_ENCO_Index+	Buffered INDEX output
6	PortC_ENCO_Index-	Buffered INDEX complement output
7	COMRET	Common return
8	PE	Protective Earth
Connector Location		

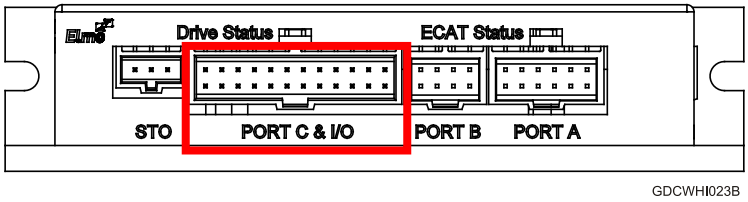


Table 21: Connector J6 – Port C Feedback Out and I/O

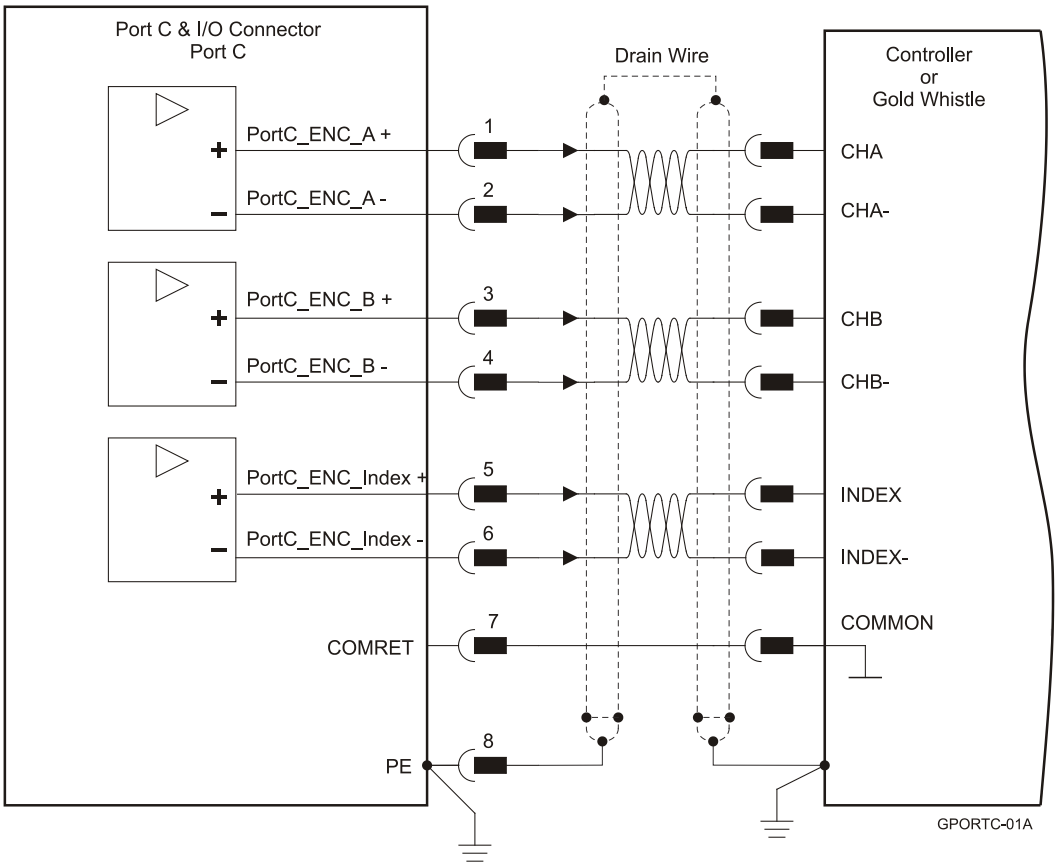


Figure 26: Emulated Encoder Differential Output – Recommended Connection Diagram

4.10. User I/Os

The Gold DC Whistle has six programmable digital inputs, four digital outputs and one analog input.

4.10.1. Digital Inputs (Port C & I/O Connector)

Each of the pins below can function as an independent input. The inputs conform to the PLC standard. TTL configuration is available upon request.

For the full pin table refer to Section 4.3.2.7.

A cable kit containing a cable that connects to the Port C & I/O connector is available, see Section 2.2.19 for details.

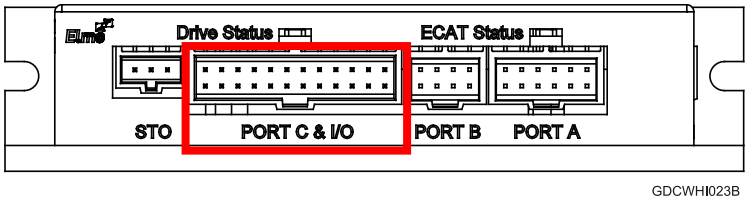
Pin	Signal	Function
12	INRET1_6	Programmable input 1 – 6 return
13	IN1	Programmable digital input 1
14	IN2	Programmable digital input 2
15	IN3	Programmable digital input 3
16	IN4	Programmable digital input 4
17	IN5	Programmable digital input 5
18	IN6	Programmable digital input 6
Connector Location		
		

Table 22: Connector J6 – Digital Input

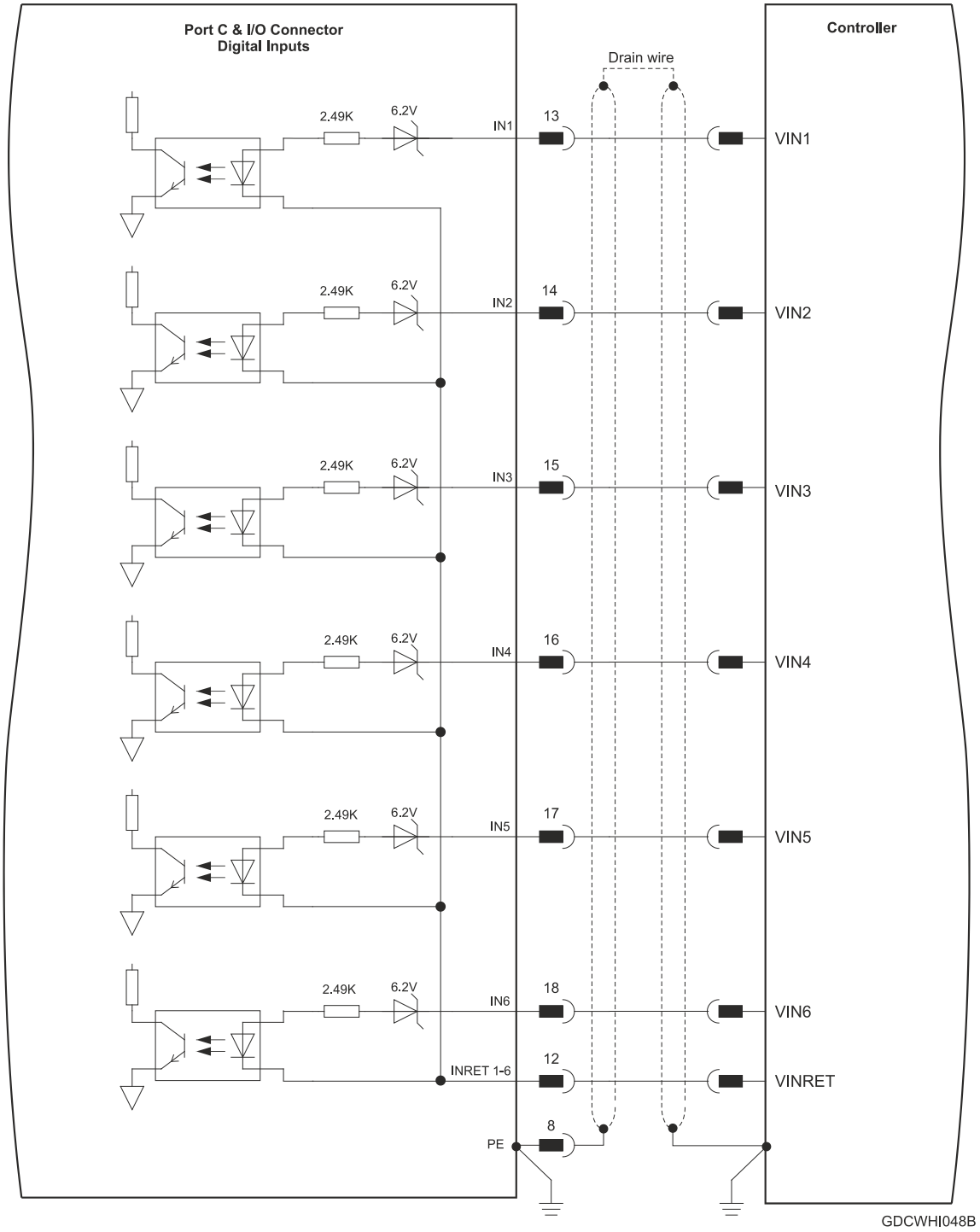


Figure 27: Digital Input PLC Mode Connection Diagram

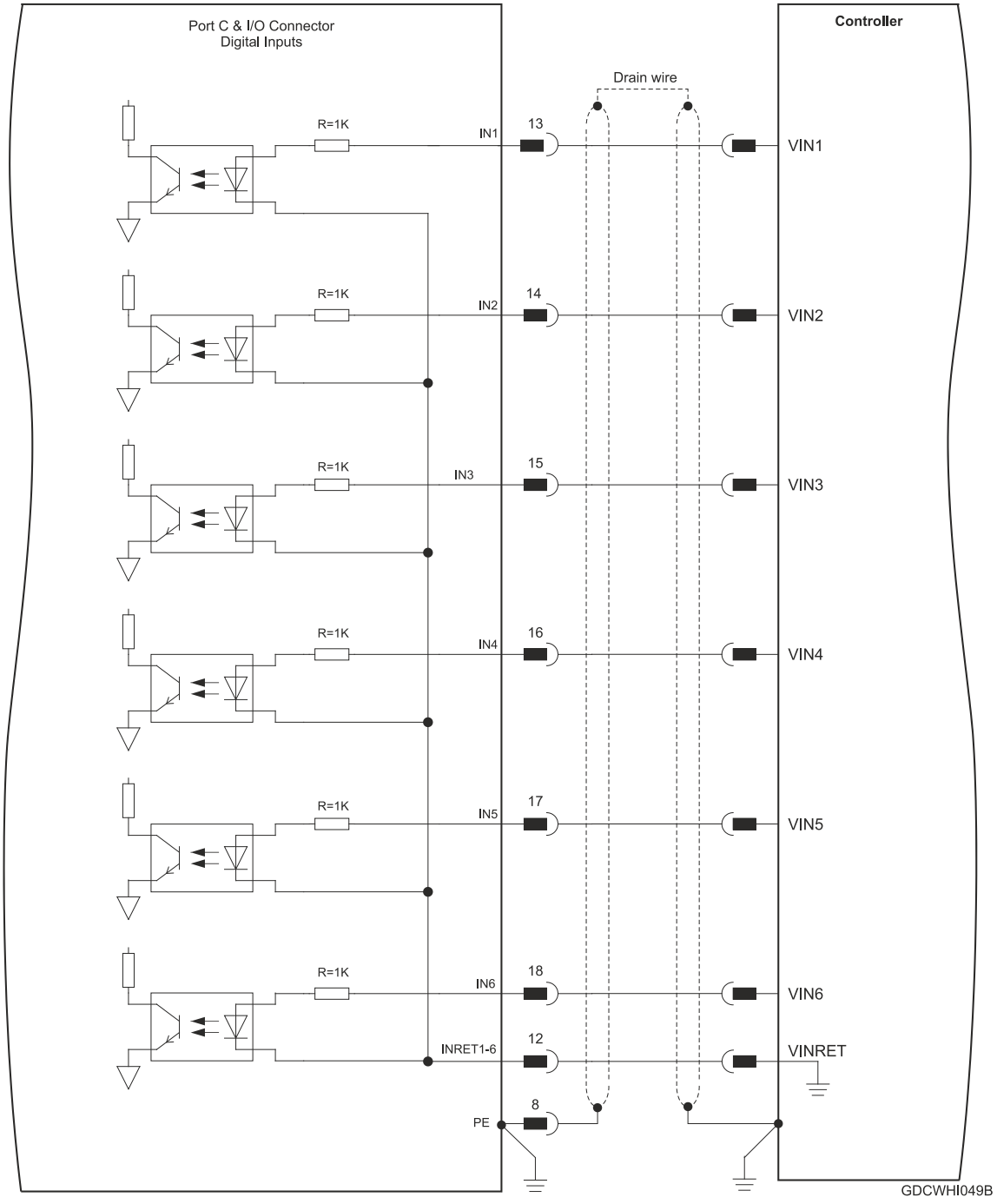


Figure 28: Digital Input TTL Mode Connection Diagram

4.10.2. Digital Inputs in Sink Configuration (Port C & I/O Connector)

Port C has a 24-pin header. The I/Os for Port C detailed below; Digital Input as Source Configuration is the default, with the option of Digital Input as Sink Configuration upon request, according to the Part Number AP.

Note: The digital input conforms to **PLC standard**. The input interface can be customized for **TTL**, upon request.

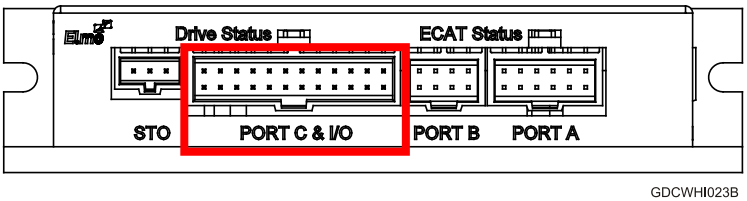
Signal	Function
INRET	General input return 1 to 6/"Common Cathode"
Connector Location	
	

Table 23: Connector J6 – Digital Input

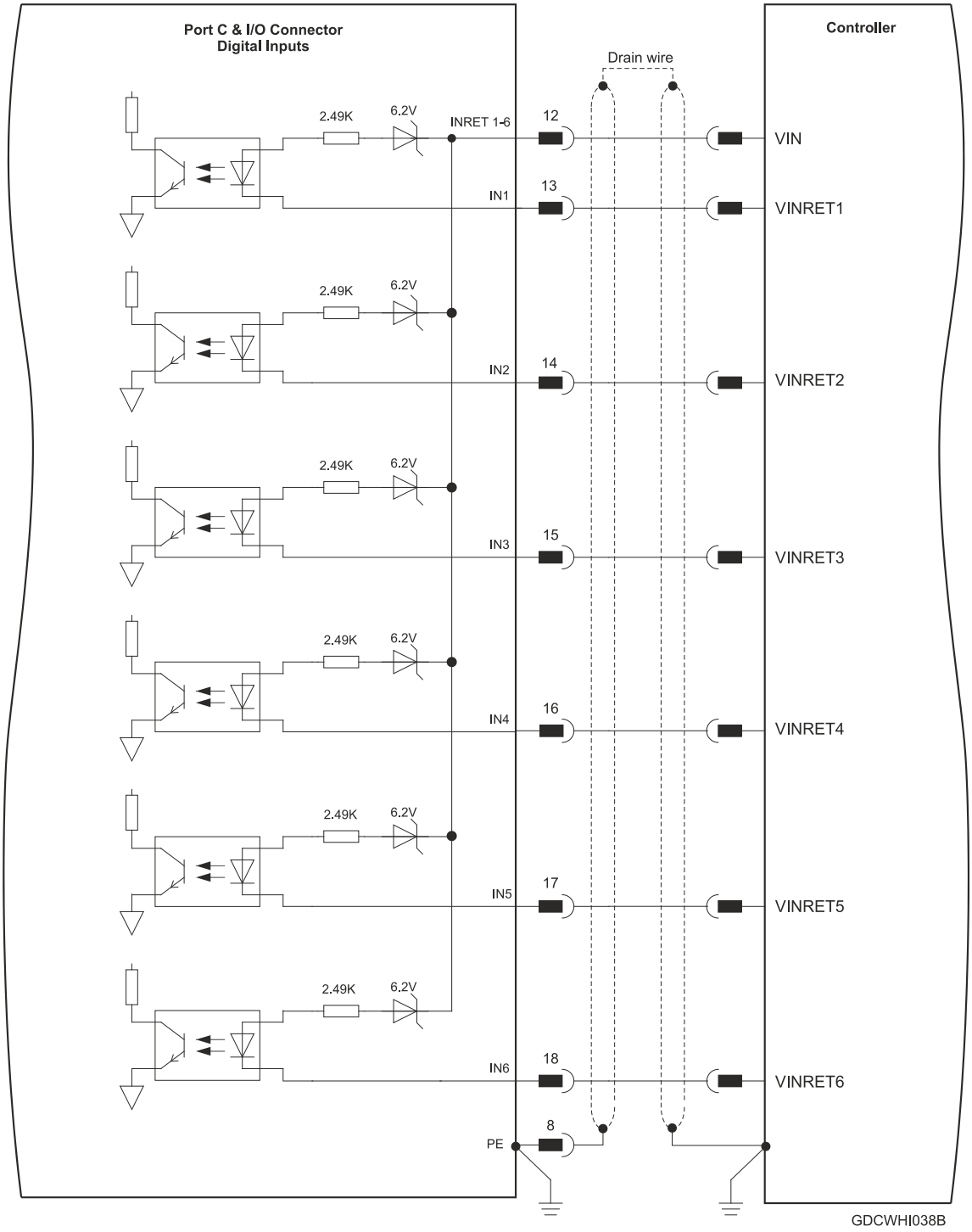


Figure 29: Digital Input as Sink Configuration Connection Diagram

4.10.3. Digital Output (Port C & I/O Connector)

The outputs conform to PLC standard. TTL configuration is available upon request.

For the full pin table refer to Section 4.3.2.7.

Pin	Signal	Function
19	OUT4	Programmable output 4
20	OUT3	Programmable output 3
21	OUT2	Programmable output 2
22	OUT1	Programmable output 1
23	VDD	VDD supply
24	VDDRET	VDD supply return
Connector Location		

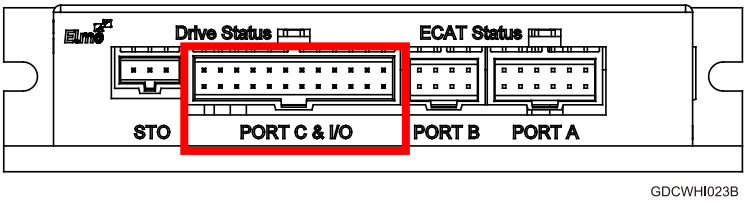


Table 24: Connector J6 – Digital Output

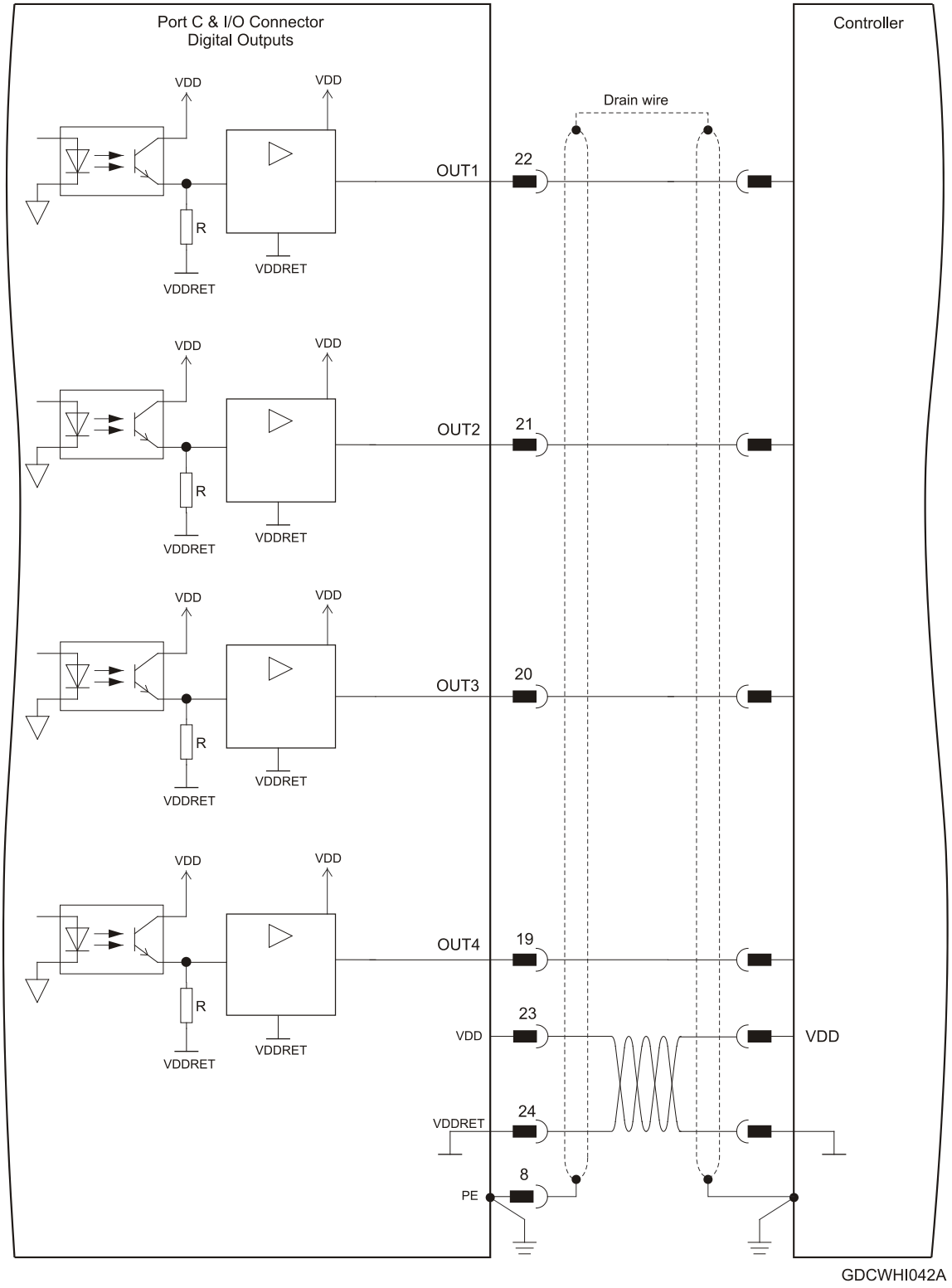


Figure 30: Digital Output Connection Diagram – PLC Option

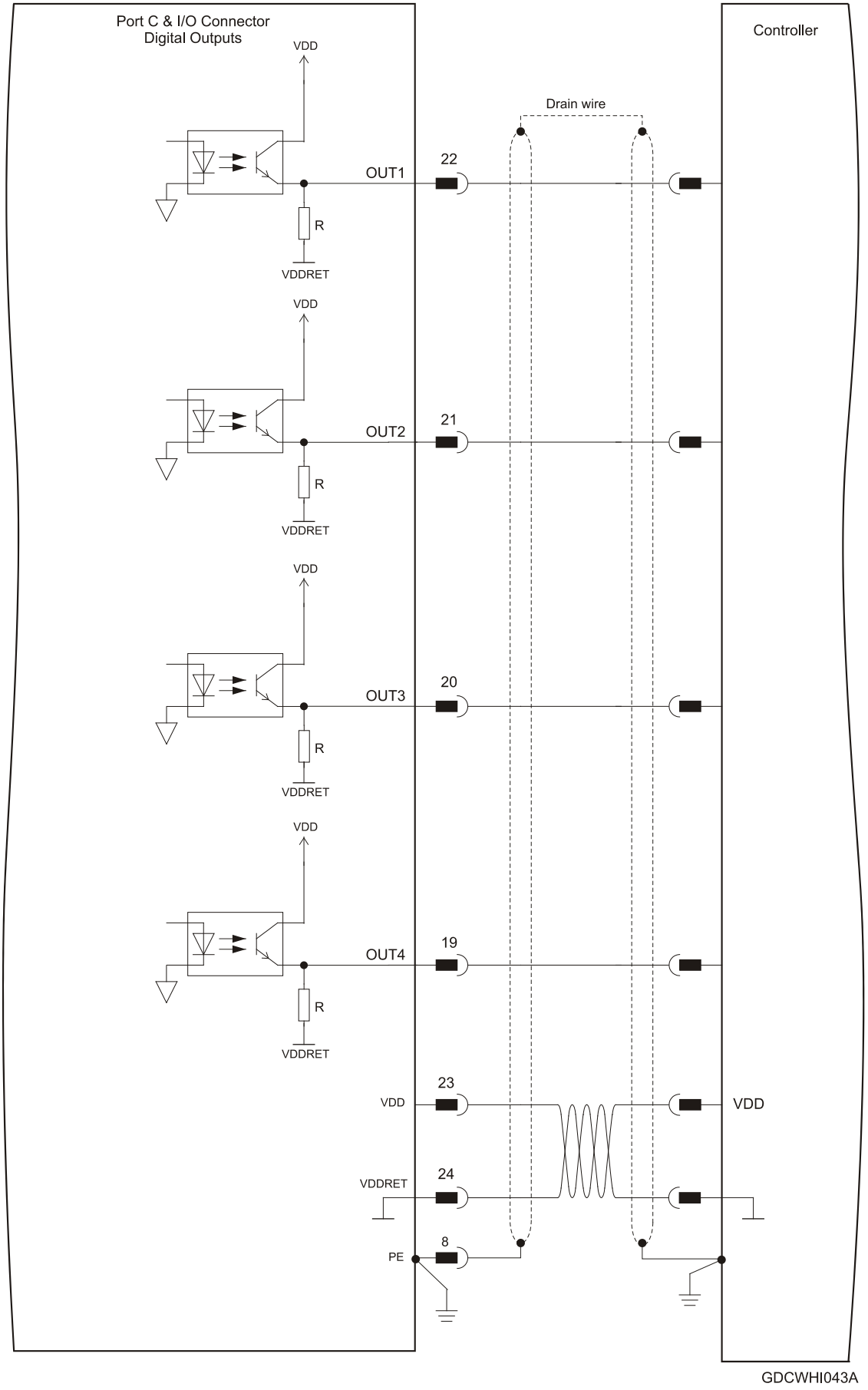


Figure 31: Digital Output Connection Diagram – TTL Option

4.10.4. Digital Outputs in Sink Configuration (Port C & I/O Connector)

The I/Os for Port C detailed below; Digital Output as Source Configuration is the default, with the option for Digital Output as Sink Configuration, upon request, according to the Part Number AP.

Note: The outputs conform to PLC standard. The outputs can be customized to conform to TTL configuration, upon request.

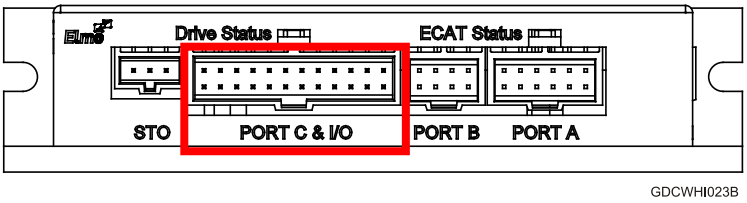
Signal	Function
OUT1	Programmable output
OUT2	Programmable output
OUT3	Programmable output
OUT4	Programmable output
Connector Location	
	

Table 25: Connector J6 – Digital Output

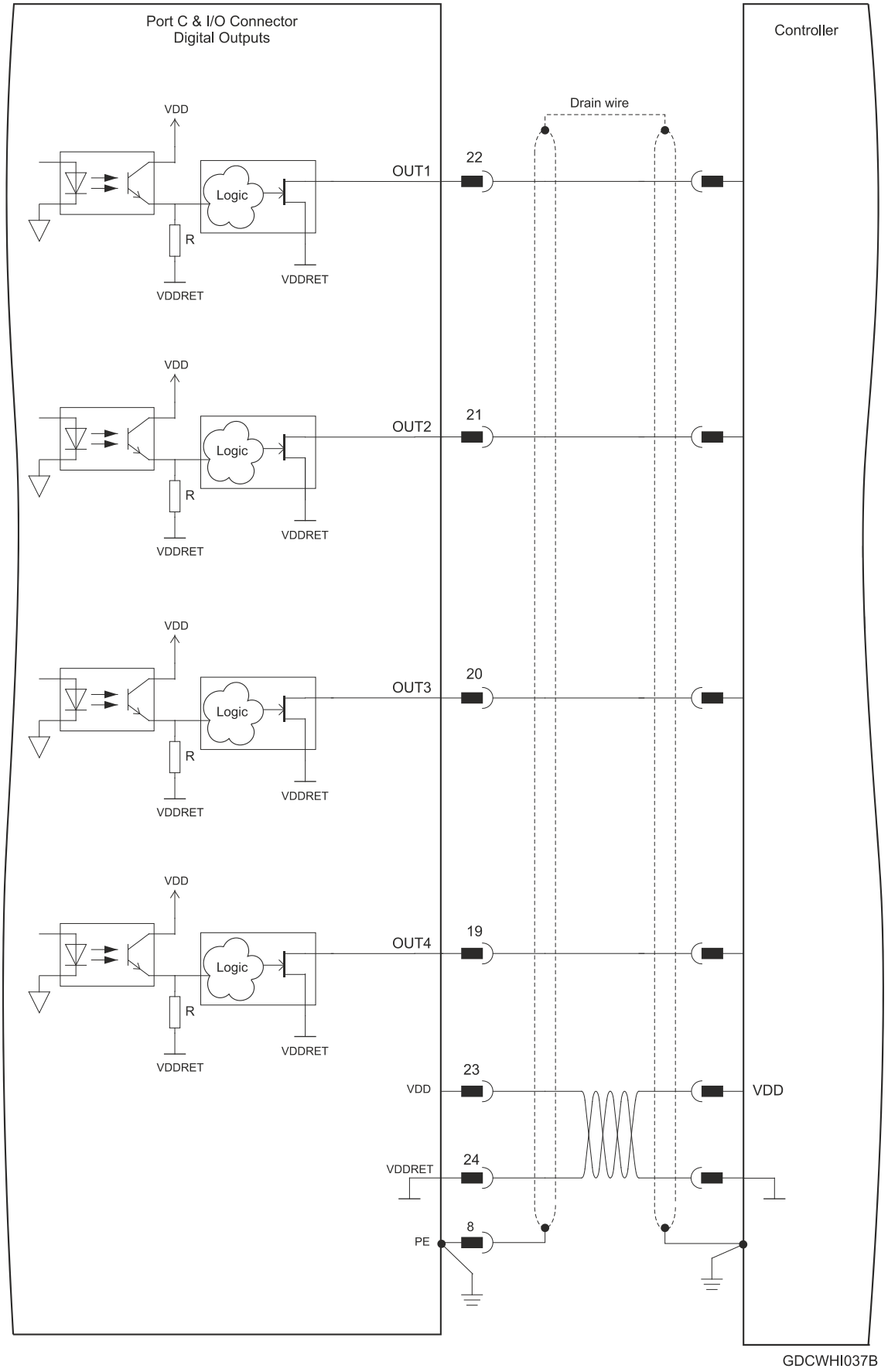


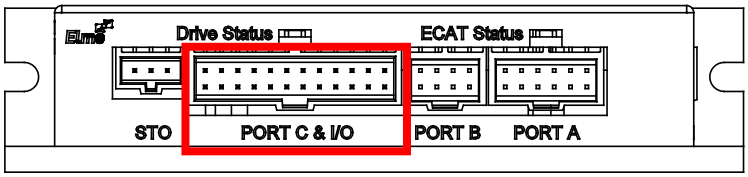
Figure 32: Digital Output as Sink Configuration Connection Diagram

4.10.5. Analog Input (Port C & I/O Connector)

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

For the full pin table refer to Section 4.3.2.7.

Pin	Signal	Function
9	ANALOG1-	Analog input 1-
10	ANALOG1+	Analog input 1+
11	ANARET	Analog ground
Connector Location		



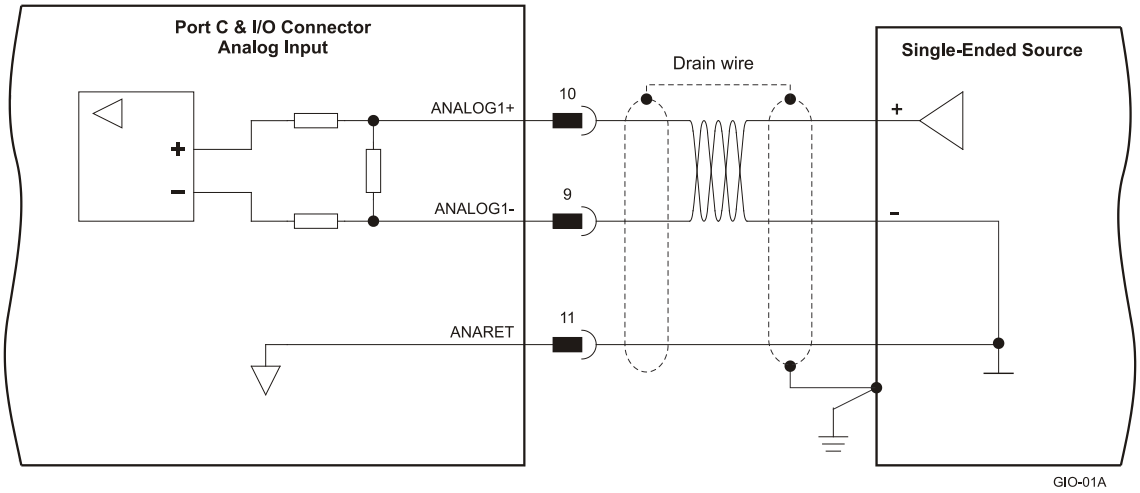


Figure 33: Analog Input with Single-Ended Source

4.11. Communications

The EtherCAT version of the Gold DC Whistle supports EtherCAT and USB 2.0 communications.

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

4.11.1. USB 2.0 Communication

The USB Network consists of Host controller and multiple devices. The Gold DC Whistle is a USB Device.

Notes for connecting the USB communication cable:

- Connect a standard USB cable.
- D+ and D- comprise a twisted pair in the cable.
- The maximum cable length is 5 m.
- The cable shield should only be connected to ground at the host.
- The shield of the cable is connected to the shield of the connector used for communication.

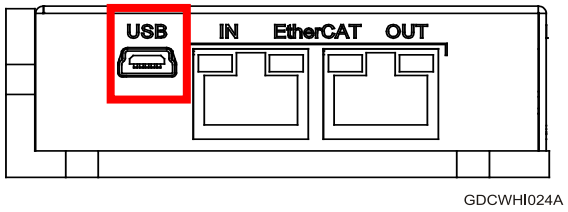
Pin	Signal	Function
1	USB VBUS	USB VBUS 5 V
2	USBD-	USB _N line
3	USBD+	USB _P line
5	USB COMRET	USB communication return
Connector Location		
		

Table 26: USB 2.0 - Pin Assignments

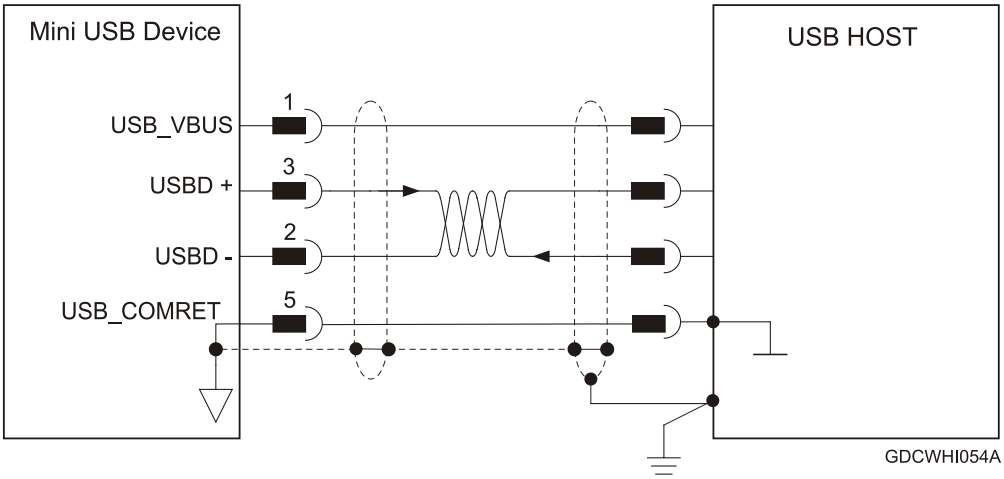


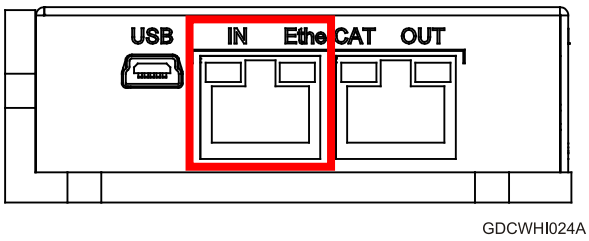
Figure 34: USB Network Diagram

4.11.2. EtherCAT Communication

Notes:

- The EtherCAT IN port can be configured as an Ethernet port for TCP/IP – see the EtherCAT Manual.
- It is recommended to use CAT5 cable. Category 5 cable is a high signal integrity cable with four twisted pairs.

Pin	Signal	Function
1	EtherCAT_IN_TX+	EtherCAT in transmit +
2	EtherCAT_IN_TX-	EtherCAT in transmit -
3	EtherCAT_IN_RX+	EtherCAT in receive +
4, 5	N/A	
6	EtherCAT_IN_RX-	EtherCAT in receive -
7, 8	N/A	



Pin	Signal	Function
1	EtherCAT_OUT_TX+	EtherCAT in transmit +
2	EtherCAT_OUT_TX-	EtherCAT in transmit -
3	EtherCAT_OUT_RX+	EtherCAT in receive +
4, 5	N/A	
6	EtherCAT_OUT_RX-	EtherCAT in receive -
7, 8	N/A	
Connector Location		

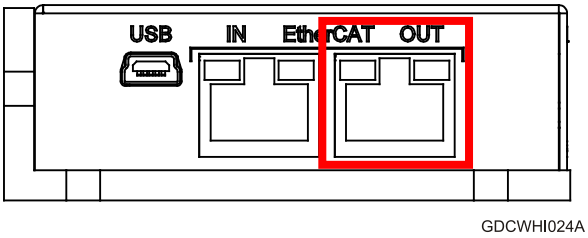


Table 27: EtherCAT - Pin Assignments

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.

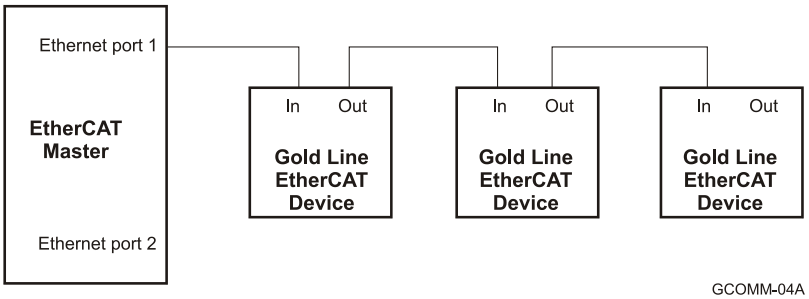


Figure 35: EtherCAT Network with No Redundancy

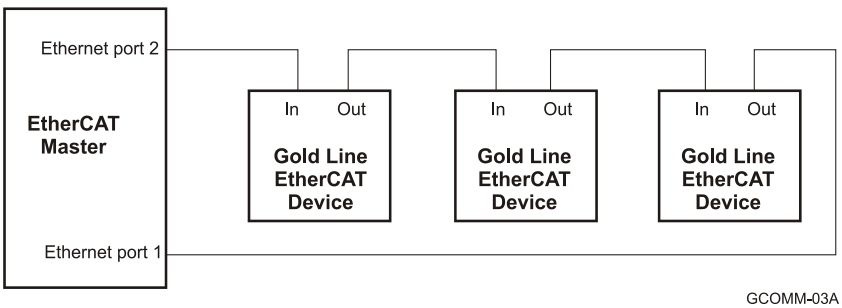


Figure 36: EtherCAT Network with Redundancy

4.11.3. Ethernet Communication

Notes:

- 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	Signal	Function
1	TX+	Ethernet in transmit
2	TX-	Ethernet in transmit Complement
3	RX+	Ethernet in receive
4,5	N/A	
6	RX-	Ethernet in receive Complement
8	N/A	
Connector Location		

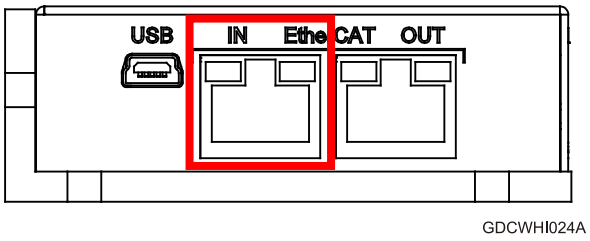


Table 28: Ethernet - Pin Assignments

4.11.4. CAN Communication Version

Notes for connecting the CAN communication cable:

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

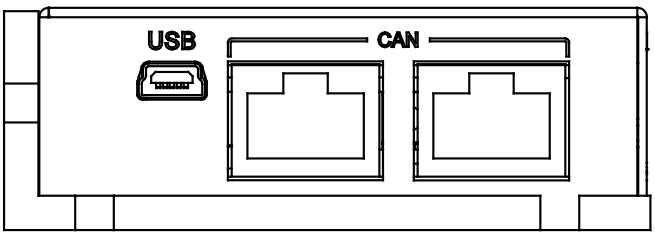
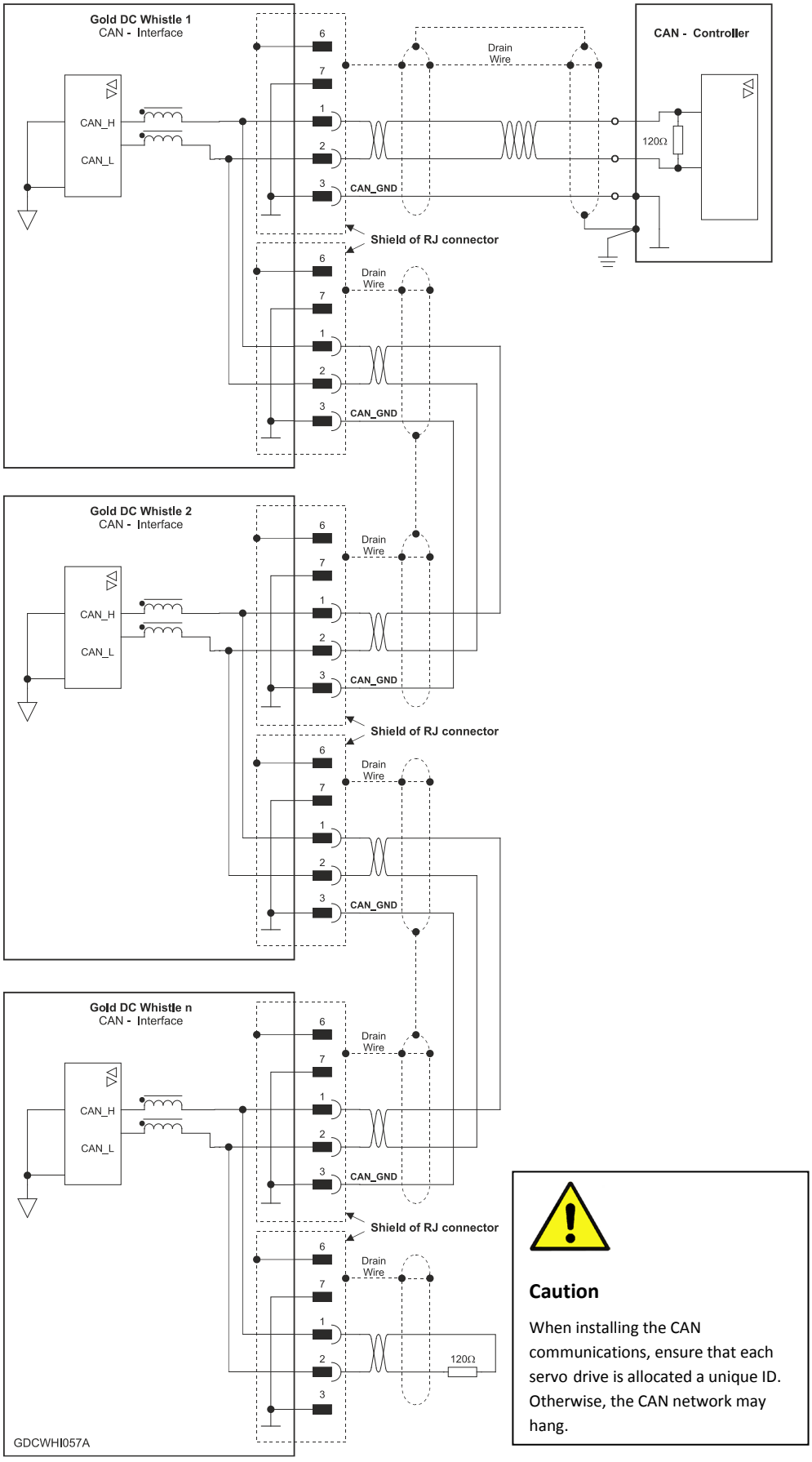
Pin	Signal	Function
1	CAN_H	CAN_H bus line (dominant high)
2	CAN_L	CAN_L bus line (dominant low)
3	CAN_RET	CAN Return
4, 5	N/A	—
6	CAN_SHLD	Shield, connected to the RJ plug cover
7	CAN_RET	CAN Return
8	N/A	—
Pin Position		
		

Table 29: CAN Connectors - Pin Assignments



Caution

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

Figure 37: Gold DC Whistle Connection Diagram - CAN

4.12. Powering Up

After the Gold DC 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.

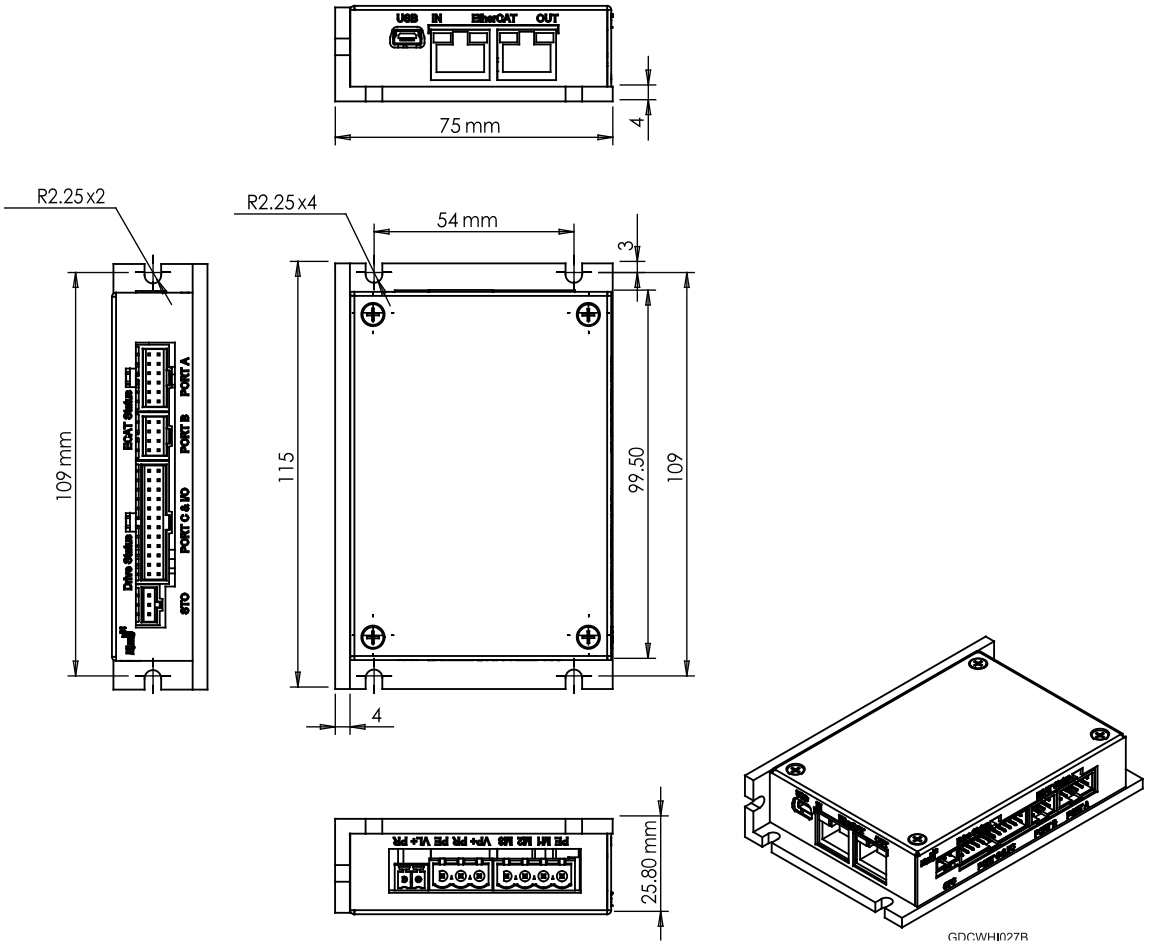
4.13. Initializing the System

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

Chapter 5: Technical Specifications

This chapter provides detailed technical information regarding the Gold DC 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
Operating ambient 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 – 30,000 feet)
Protection level	IP32

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 DC Whistle has two feedback ports (Main and Auxiliary). The Gold DC 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 DC 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

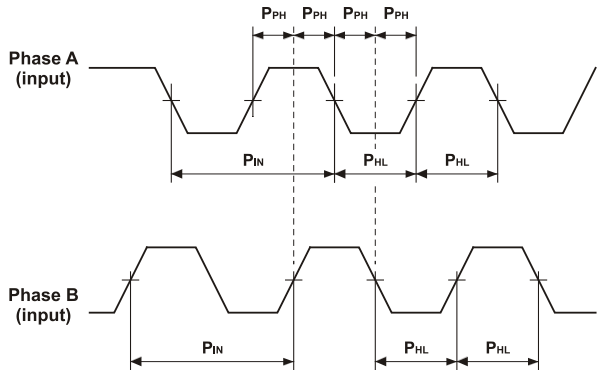


Figure 38: Main Feedback - Encoder Phase Diagram

5.4.2.2. Digital Halls

Feature	Details
Halls inputs	• H_A, H_B, H_C. • Single ended inputs • Built in hysteresis of 1 V for noise immunity
Input voltage	Nominal operating range: 0 V < V_{In_Hall} < 5 V Maximum absolute: -1 V < V_{In_Hall} < 15 V High level input voltage: V_{InHigh} > 2.5 V Low level input voltage: V_{InLow} < 1 V
Input current	Sink current (when input pulled to the common): 5 mA
Maximum frequency	f_{MAX} : 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 errors 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 DC Whistle
Reference current	up to ±50 mA
Encoder outputs	See Port C Encoder Outputs 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 DC Whistle has 6 Digital Inputs, 2 Digital Outputs and 1 Analog Input.

5.5.1. Digital Input Interfaces – TTL Mode

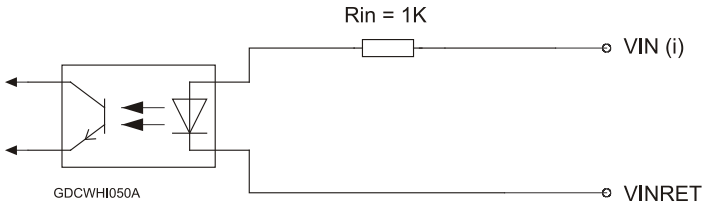
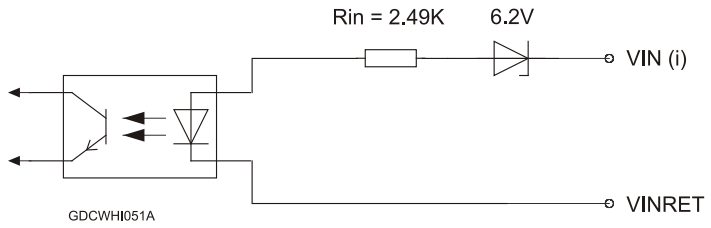
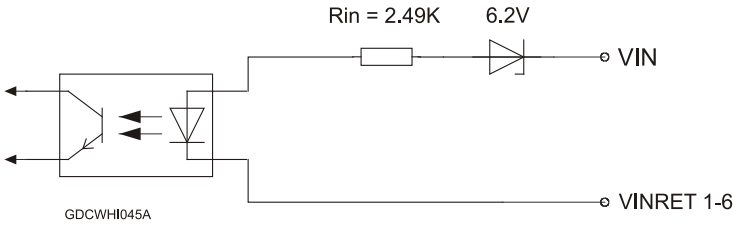
Feature	Details
Type of input	Optically isolated
Input current for all inputs	Iin = 3.8 mA @ Vin = 5 V
High-level input voltage	2.4 V < Vin < 15 V, 5 V typical
Low-level input voltage	0 V < Vin < 0.8 V
Minimum pulse width	> 250 µsec
Execution time (all inputs): the time from application of voltage on 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.
	
Capture with differential input Port A, Port B Index	T > 0.1 µsec if the differential input functionality is set to touch probe/capture (index/strobe).

Figure 39: Digital Input TTL Schematic

5.5.2. Digital Input Interfaces – PLC Mode

Feature	Details
Type of input	Optically isolated
Input current for all inputs	Iin = 2 mA @ Vin = 12 V
High-level input voltage	12 V < Vin < 30 V
Low-level input voltage	0 V < Vin < 7 V
Minimum pulse width	>250 µsec
Execution time (all inputs): the time from application of voltage on input until execution is complete	0 < T < 250 µsec
High-speed inputs – 1–6 minimum pulse width, in high-speed mode	T > 5 µsec if the input functionality is set to latch/capture (index/strobe). **Notes:** • Home mode is high-speed mode and can be used for fast capture and precise homing. • Highest speed is achieved when turning on optocouplers.
 **Figure 40: Digital Input PLC Schematic**	
 **Figure 41: Digital Input Sink 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).

5.5.3. Digital Output Interface – PLC Mode

Feature	Details
Type of output	Optically isolated source
Supply output (VDD)	12 V to 30 V
Maximum output current I_{out} (max) (V_{out} = Low)	I_{out} (max) ≤ 500 mA for output 4 I_{out}(max) ≤ 250 mA for outputs 1 to 3
VOL at maximum output voltage (low level)	V_{out} (on) ≤ 0.3 V
R_L	The external resistor R_L must be selected to limit the output current to no more than 500 mA (output 4) or 250 mA (outputs 1 to 3). $R_L = \frac{VDD - VOL}{I_{out}(max)}$
Executable time	0 < T < 250 µsec

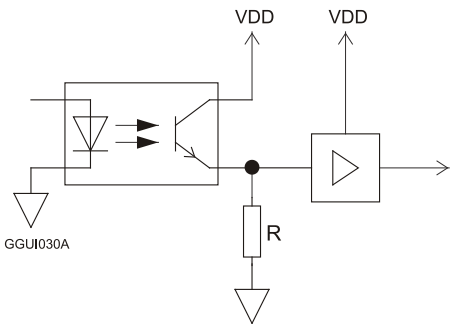


Figure 42: Digital Output PLC Schematic

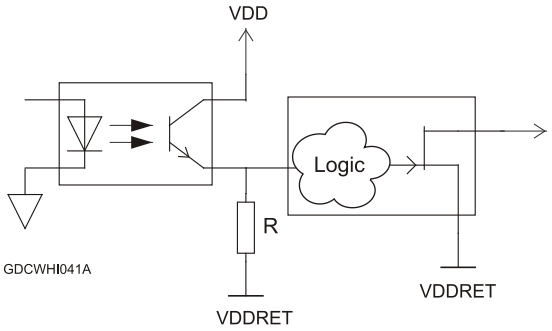


Figure 43: Digital Output Sink Schematic

5.5.4. Digital Output Interface – TTL Mode

Feature	Details
Type of output	• Optically isolated • Source/Sink
Supply output (VDD)	5 V to 15 V
Maximum output current Iout (max) (Vout = Low)	7 mA
VOL at maximum output voltage (low level)	V_{out} (on) ≤ 0.4 V
Executable time	0< T< 250 µsec

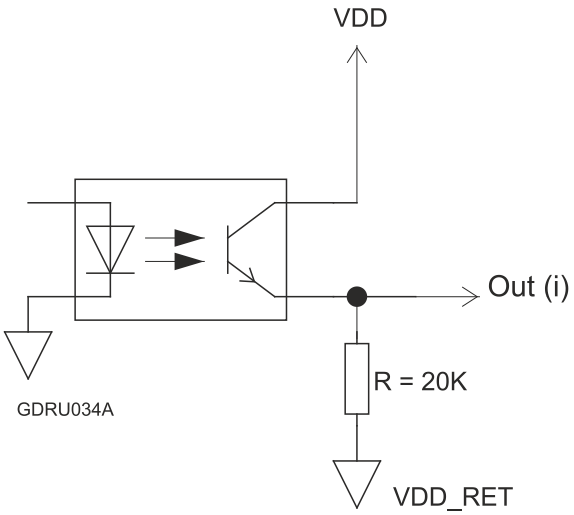


Figure 44: Digital Output TTL Schematic

5.5.5. 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 DC 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

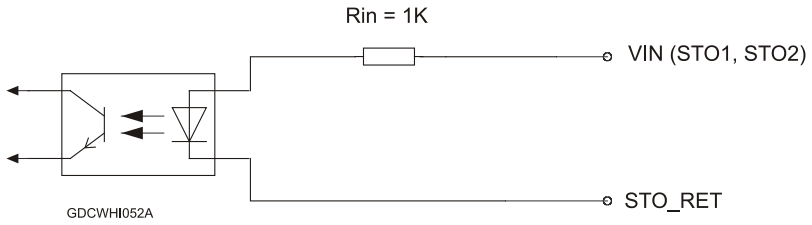


Figure 45: STO TTL Input Schematic

5.6.2. STO Input Interfaces – PLC Mode

Feature	Details
Type of input	Optically isolated
Input current for all inputs	Iin = 2 mA @ Vin = 12 V
High-level input voltage	12 V < Vin < 30 V
Low-level input voltage	0 V < Vin < 7 V
Minimum pulse width	>3 ms

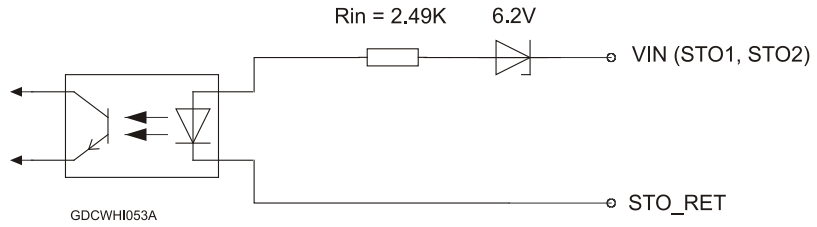


Figure 46: STO PLC Input Schematic

5.6.3. STO Input Interfaces – Sink Mode

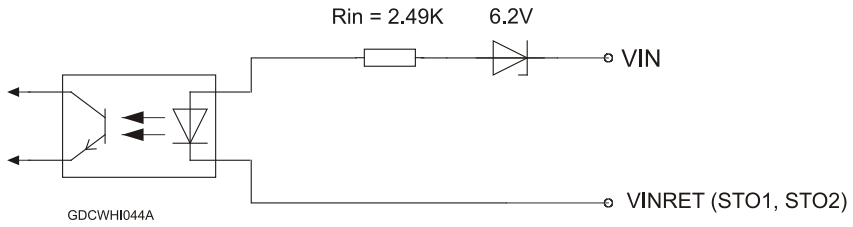


Figure 47: STO Sink Input Schematic

5.7. EtherCAT Communications Version

Specification	Details
EtherCAT	• 100base-T • Baud Rate: 100 Mbit/sec • CAT5 Cable • CoE, FoE, EoE
Ethernet	• 100base-T • Baud Rate: 100 Mbit/sec • CAT5 Cable • UDP, Telnet
USB	USB 2.0 Device mode

5.8. CAN Communications Version

Specification	Details
CAN	**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
Mini USB	• USB 2.0 Device mode

5.9. 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)

5.10. 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)