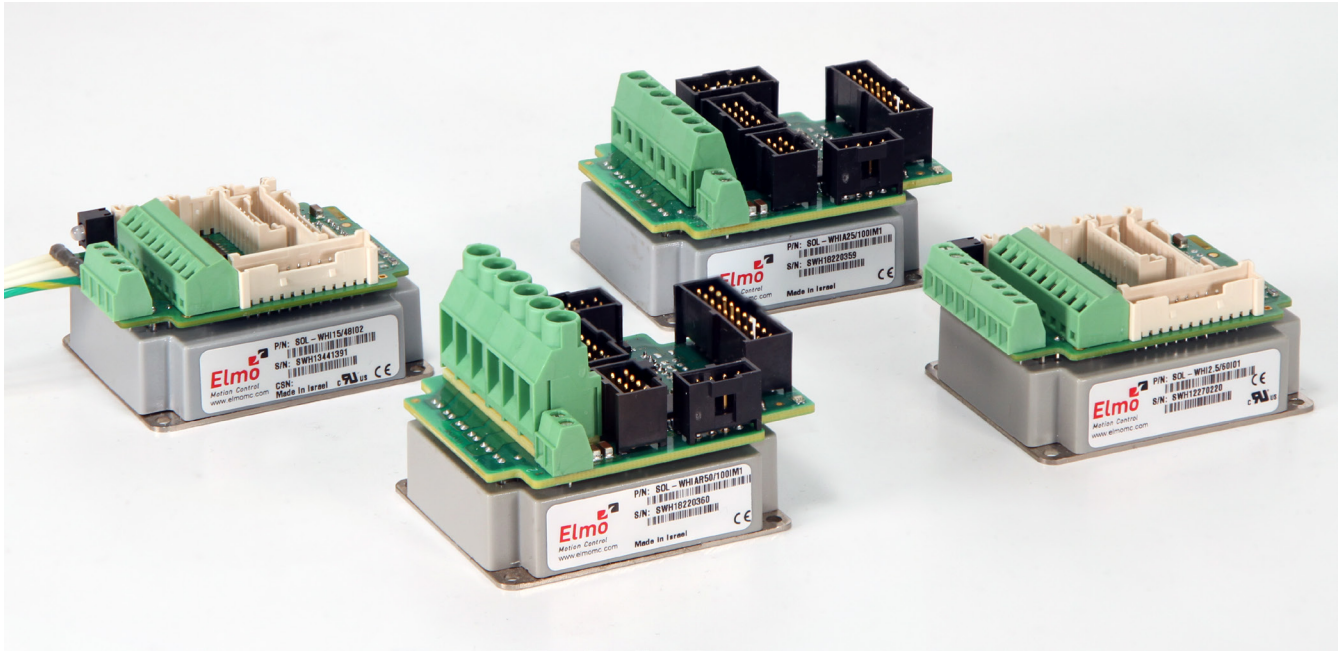
SimpIIQ Line

Solo Whistle
Digital Servo Drive
Installation Guide



August 2018 (Ver. 2.000)

Elmo Motion Control

www.elmomc.com

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Document no. MAN-SOLWHIIG (Ver. 2.000)

Catalog Number

SOL-WHI ARXX/YYYR01

Whistle + Interface Board

Whistle

[ ] - Standard
A - Advanced

Output Current Profile:
Blank = Standard
R = No peak current

Current & Voltage:

Feedbacks:
E - Std incremental Encoder + Halls
R - Resolver
I - Interpolated Analog Encoder Sin/Cos
T - Tacho / Potentiometer

01 - 24 VDC (Digital Inputs), Motor Phase **Connector**, Network Position + Velocity (CANOpen)

02 - 24 VDC (Digital Inputs), Motor Phase **Wires**, Network Position + Velocity (CANOpen)

03 - 5 VDC (Digital Inputs), Motor Phase **Connector**, Network Position + Velocity (CANOpen)

04 – 5 VDC (Digital Inputs), Motor Phase **Wires**, Network Position + Velocity (CANOpen)

05 – 24 VDC (Digital Inputs), Motor Phase **Connector**, Follower, ECAM, Pulse and Direction

06 – 24 VDC (Digital Inputs), Motor Phase **Wires**, Follower, ECAM, Pulse and Direction

07 – 5 VDC (Digital Inputs), Motor Phase **Connector**, Follower, ECAM, Pulse and Direction

08 – 5 VDC (Digital Inputs), Motor Phase **Wires**, Follower, ECAM, Pulse and Direction

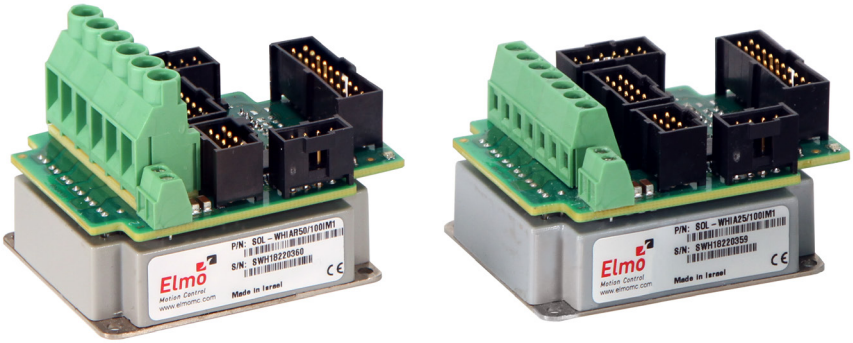
M1 - 24 VDC IO+Brake, 2.54 Control **Connectors**, Network Position + Velocity (CANOpen)

M2 - 5 VDC IO, 2.54 Control **Connectors**, Network Position + Velocity (CANOpen)

Note for Suffix Number M1, M2 above:

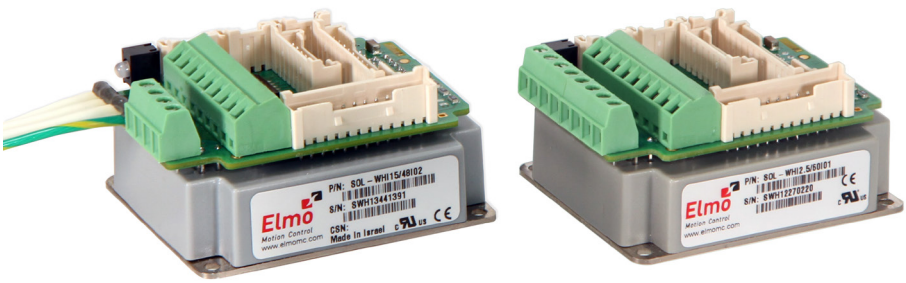
Suffix M1, M2 is recommended for new designs

Power Terminal Blocks connectors, up to 25A (50A peak) and R50A models, Brake option, 2.54 mm control connectors, mating cable kit



Note for Suffix Number from 01 to 08 above:

The odd numbers are models with connectors, and the even numbers are models with wires. For currents of 10 A or less, both models are available; for currents of 15 A or more, only a wires model is available. The Control Connectors are 2.0 mm pitch.



Revision History

Version	Date	Details
1.0	June 2008	Initial Release
1.1	November 2008	Changed: Front matter, P/N explanations, sticker & schematics in Section 4.2, Figure 14, Figure 15, Figure 16, Section 5.5 and Section 5.6. Added information for auxiliary input features in Chapters 2 and 3 and in Section 5.5. MTCR 00-100-33: Weight of product changed to 68.4 grams in Section 5.9
1.2	February 2009	MTCR 01-009-39: Section 5.5.1: Advanced not mandatory therefore in Mode 1 catalog number, "A" was removed.
1.3	March 2009	MTCR 01-009-41: Clarifications regarding models with connectors and wires on the Notice page (above) and on Pages 16, 18. 4-Pin option added to table on Page 18.
1.4	March 2010	MTCR 04-009-48: Section 5.3: Pin J1/2 renamed to PR.
1.5	Sept. 2012	Formatted according to the new template "Metronome" was replaced by the "Composer" software.
1.501	Jan. 2013	Updated the auxiliary power supply value. Updated the 200 V power ratings table. Section 5.9: Physical Specifications, was added. Added a caution and recommendation on the type of cleaning solution to use for the Elmo unit.
1.502	Dec. 2013	General document update
1.503	July 2014	General updates
1.504	Oct 2017	Updated the Warranty Information section 1.5 and the part number label in section 3.2.
2.000	Aug 2018	Addition of multiple options; 25/100, R50/100, Breaks, and 2.54 mm pitch control connectors.

Table of Contents

Chapter 1: Safety Information

In order to achieve the optimum, safe operation of the Solo 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 Solo Whistle as well as the 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 Solo 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

- Power cables can carry a high voltage, even when the motor is not in motion. Disconnect the Solo Whistle from all voltage sources before it is opened for servicing.
- The Solo 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 Solo 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 Solo Whistle to an approved 11 to 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 Solo 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 Solo 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 Solo Whistle drives conform 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 Solo 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 Solo 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 Solo Whistle drive 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 date of shipment. No other warranties, expressed or implied — and including a warranty of merchantability and fitness for a particular purpose — extend beyond this warranty.

Chapter 2: Introduction

The Solo Whistle is an integrated solution designed to simply and efficiently connect Elmo's Whistle servo drive directly to the application. The solution consists of the Whistle together with a convenient connection interface which either eliminates or reduces development time and resources when designing an application's PCB board.

This installation guide describes the Solo Whistle servo drive and the steps for its wiring, installation and power-up. Following these guidelines ensures maximum functionality of the drive and the systems to which it is connected.

2.1. Drive Description

The Solo Whistle series of digital servo drives is designed to deliver "the highest density of power and intelligence". The Solo Whistle is a lightweight and highly compact solution which can be used whenever reduced size and weight are essential to the application. The Solo Whistle delivers up **to 4000 W of continuous power** in a 77.19 cc/4.55 in³ (58.25 x 28.5 x 46.5 mm or 2.3" x 1.1" x 1.8") package.

The Solo Whistle drive is designed for OEMs. It operates from a DC power source in current, velocity, position and advanced position modes, in conjunction with a permanent-magnet synchronous brushless motor, DC brush motor, linear motor or voice coil. It is designed for use with any type of sinusoidal and trapezoidal commutation, with vector control. The Solo Whistle 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 drive is easily set up and tuned using Elmo's *Composer* software tools. This Windows-based application enables users to quickly and simply configure the servo drive for optimal use with their motor. The Solo Whistle, as part of the *SimplIQ* product line, is fully programmable with Elmo's *Composer* motion control language.

Power to the drive is provided by a 12 to 195 VDC isolated DC power source (not included with the Solo Whistle). A "smart" control-supply algorithm enables the Solo Whistle to operate with only one power supply in up to 100 V models with no need for an auxiliary power supply for the logic. For 200 V models, auxiliary power supply in the range of 12 to 95 V is always required.

If backup functionality is required for storing control parameters in case of power-loss, an external 12 to 95 VDC isolated supply should be connected (via the +VL terminal on the Solo Whistle) providing maximum flexibility and backup functionality when needed.

Note: This backup functionality can operate from any voltage source within the 12 to 95 VDC range. This is much more flexible than to be restricted by only using a standard 24 VDC power supply.

If backup power is not needed in up to 100 V models, two terminals (VP and VL) are shorted so that the main power supply will also power the control/logic supply. In this way there is no need for a separate control/logic supply.

200 V models require two separate power supplies.

The Solo Whistle drive is available in two models:

- The standard model is a basic servo drive which operates in current, velocity and position modes including PT & PVT. It operates simultaneously via RS-232 and CANopen DS 301, DS 305, DS 402 communications and features a third-generation programming environment.
- The advanced model includes all the motion capabilities and communication options included in the standard model, as well as advanced positioning capabilities – ECAM, Follower and Dual Loop-and increased program size.

The two models operate with both RS-232 and CANopen communication.

2.2. Product Features

2.2.1. Current Control

- Fully digital
- Sinusoidal commutation with vector control or trapezoidal commutation with encoder and/or digital Hall sensors
- 12-bit current loop resolution
- Automatic gain scheduling, to compensate for variations in the DC bus power supply

2.2.2. Velocity Control

- Fully digital
- Programmable PI and FFW (feed forward) control filters
- Sample rate two times current loop sample time
- “On-the-fly” gain scheduling
- Automatic, manual and advanced manual tuning and determination of optimal gain and phase margins

2.2.3. Position Control

- Programmable PIP control filter
- Programmable notch and low-pass filters
- Sample time: four times that of the current loop
- Fast event capturing inputs
- PT and PVT motion modes
- Fast output compare (OC)

2.2.4. Advanced Position Control

This relates to the Advanced model only.

- Position-based and time-based ECAM mode that supports a non-linear follower mode, in which the motor tracks the master motion using an ECAM table stored in flash memory
- Dual (position/velocity) loop

2.2.5. Communication Options

Solo Whistle users can use two communication options:

- RS-232 serial communication
- CANopen for fast communication in a multi-axis distributed environment

2.2.6. Feedback Options

- Incremental Encoder – up to 20 Mega-Counts (5 Mega-Pulse) per second
- Digital Halls – up to 2 kHz
- Incremental Encoder with Digital Halls for commutation – up to 20 Mega-Counts per second for encoder
- Interpolated Analog (Sine/Cosine) Encoder – up to 250 kHz (analog signal)
  - Internal Interpolation - up to x4096
  - Automatic Correction of amplitude mismatch, phase mismatch, signals offset
  - Emulated encoder outputs
- Resolver
  - Programmable 10 to 15 bit resolution
  - Up to 512 revolutions per second (RPS)
  - Emulated encoder outputs
- Tachometer, Potentiometer
- Elmo drives provide supply voltage for all the feedback options

2.2.7. Fault Protection

The Solo Whistle drive includes built-in protection against possible fault conditions, including:

- Software error handling
- Status reporting for a large number of possible fault conditions
- Protection against conditions such as excessive temperature, under/over voltage, loss of commutation signal, short circuits between the motor power outputs and between each output and power input/return
- Recovery from loss of commutation signals and from communication errors

2.3. System Architecture

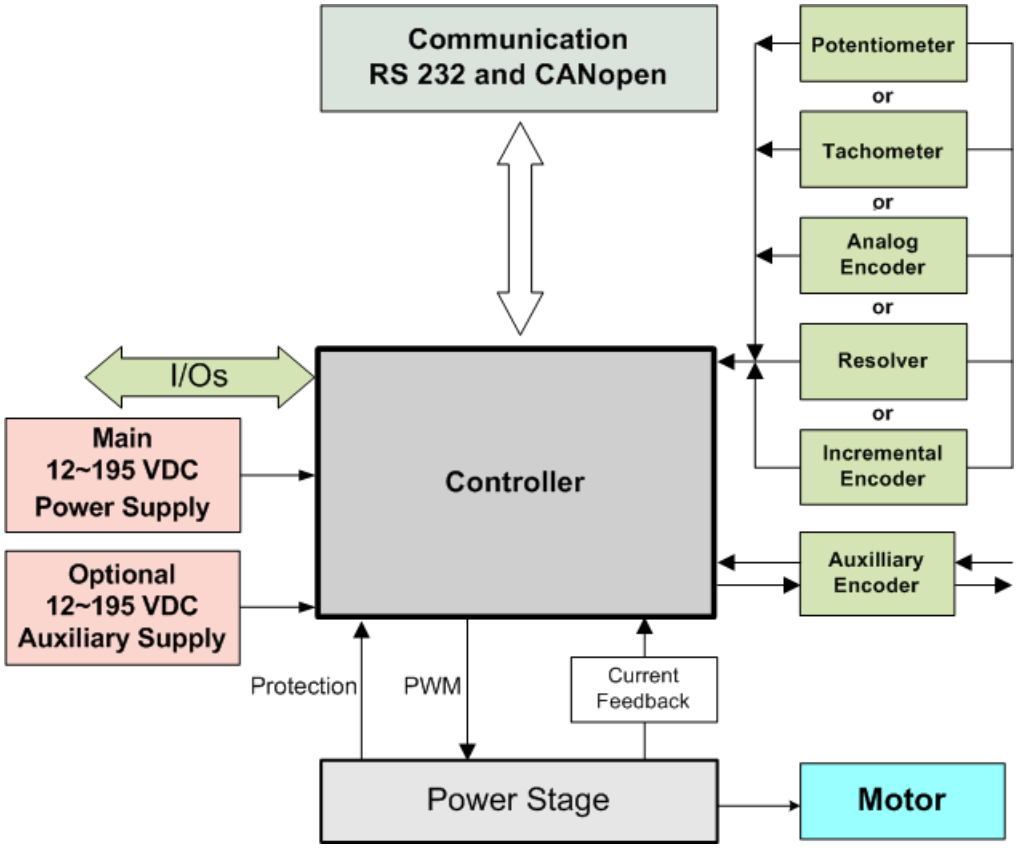


Figure 1: Solo Whistle System Block Diagram

2.4. How to Use this Guide

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

Upon completing the instructions in this guide, your Solo 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 following figure describes the accompanying documentation that you will require.

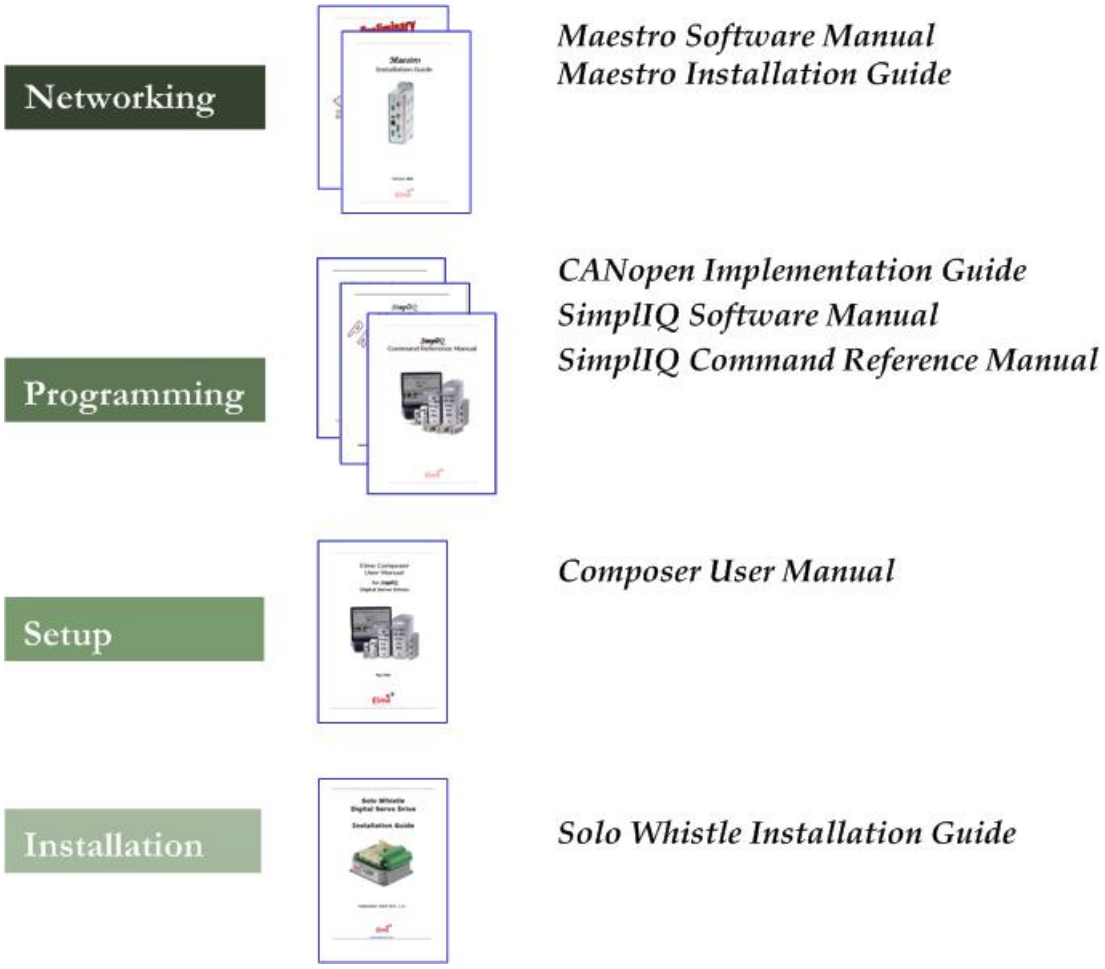


Figure 2: Elmo Digital Servo Drive Documentation Hierarchy

As depicted in the previous figure, this installation guide is an integral part of the Solo Whistle documentation set, comprising:

- The Composer *Software Manual,* which includes explanations of all the software tools that are part of Elmo's Composer software environment.
- The *SimplIQ Command Reference Manual,* which describes, in detail, each software command used to manipulate the Solo Whistle motion controller.
- The *SimplIQ Software Manual,* which describes the comprehensive software used with the Solo Whistle.

Chapter 3: Installation

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

3.1. Site Requirements

You can guarantee the safe operation of the Solo Whistle drive 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 relative humidity	90% non-condensing
Operating area atmosphere	No flammable gases or vapors permitted in area
Models for extended environmental conditions are available.	

Caution:
The Solo Whistle drive dissipates heat by convection. The maximum operating ambient temperature of 0 °C to 40 °C (32 °F to 104° F) must not be exceeded.

3.2. Unpacking the Drive

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

- The Solo Whistle servo drive
- The Composer software and software manual

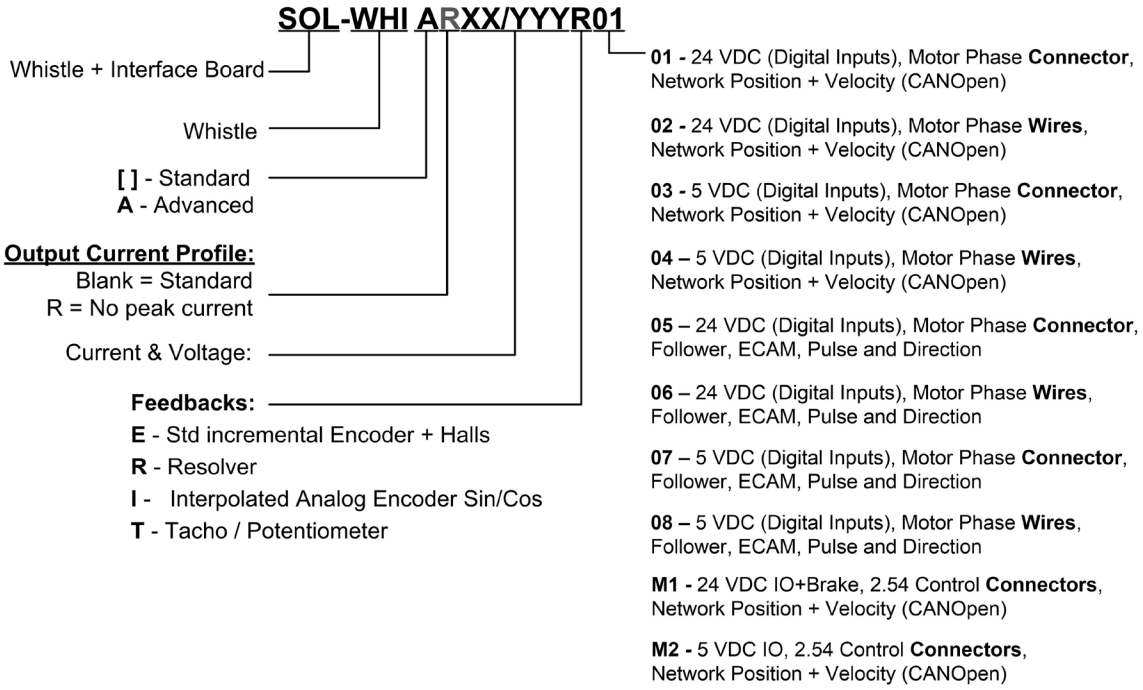
The Solo Whistle is shipped in a cardboard box with Styrofoam protection.

To unpack the Solo 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 Solo Whistle drive you have unpacked is the appropriate type for your requirements, locate the part number sticker on the side of the Solo Whistle.

SOLW-106A

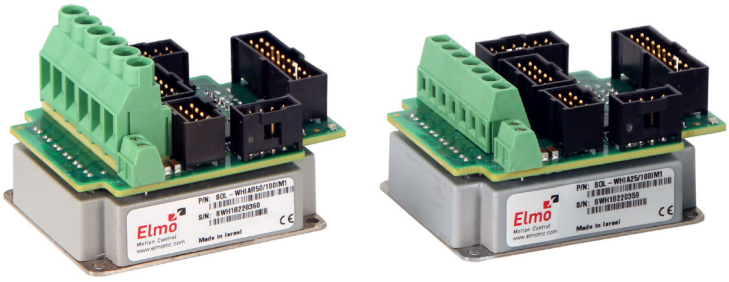
The part number at the top gives the type designation as follows:



Note for Suffix Number M1, M2 above:

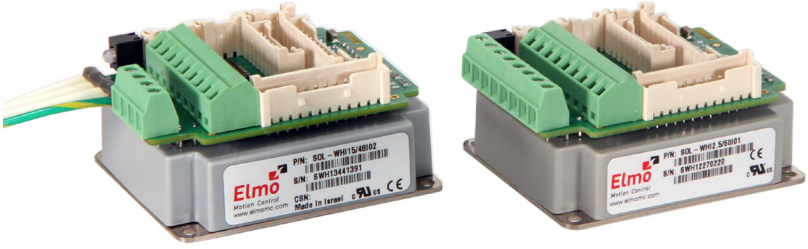
Suffix M1, M2 is recommended for new designs

Power Terminal Blocks connectors, up to 25A (50A peak) and R50A models, Brake option, 2.54 mm control connectors, mating cable kit. For details of the wiring refer to Chapter 6: Wiring for Models with Suffix M1, M2.



Note for Suffix Number from 01 to 08 above:

The odd numbers are models with connectors, and the even numbers are models with wires. For currents of 10 A or less, both models are available; for currents of 15 A or more, only a wires model is available. The Control Connectors are 2.0 mm pitch. For details of the wiring refer to Chapter 5: Wiring for Models with Suffix Number from 01 to 08.



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

Chapter 4: Power Ratings

4.1. Solo Whistle (Up to 60V)

Feature	Units	15/48	20/48	1/60	2.5/60	5/60	10/60	15/60	20/60
Minimum supply voltage	VDC	6		7.5					
Nominal supply voltage	VDC	42		50					
Maximum supply voltage	VDC	48		59					
Maximum continuous power output	W	600	800	50	120	240	480	720	960
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 2.5 VA inc. 5 V/200 mA for encoder)							
Amplitude sinusoidal/DC continuous current	A	15	20	1	2.5	5	10	15	20
Sinusoidal continuous RMS current limit (Ic)	A	10.6	14.1	0.7	1.8	3.5	7	10.6	14.1
Peak current limit	A	2 x Ic							
Digital in/Digital out/ Analog in		6/2/1							

4.2. Solo Whistle (100V)

Feature	Units	1/100	2.5/100	5/100	10/100	15/100	20/100	25/100	R50/100
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	2000	4000
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 2.5 VA inc. 5 V/200 mA for encoder)							
Amplitude sinusoidal/DC continuous current	A	1	2.5	5	10	15	20	25	50
Sinusoidal continuous RMS current limit (Ic)	A	0.7	1.8	3.5	7	10.6	14.1	17.7	35.4
Peak current limit	A	2 x Ic							No Peak
Digital in/Digital out/ Analog in		6/2/1							

4.3. Solo Whistle (200V)

Feature	Units	3/200	6/200	10/200
Minimum supply voltage	VDC	24		
Nominal supply voltage	VDC	170		
Maximum supply voltage	VDC	195		
Maximum continuous power output	W	480	960	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 2.5 VA inc. 5 V/200 mA for encoder)		
Amplitude sinusoidal/DC continuous current	A	3	6	10
Sinusoidal continuous RMS current limit (Ic)	A	2.12	4.24	7.07
Peak current limit	A	2 x Ic		
Digital in/Digital out/Analog in		6/2/1		

4.4. Auxiliary Supply

Feature	Details
Auxiliary power supply	*Isolated DC source only*
Auxiliary supply input voltage	12 VDC to 95 VDC
Auxiliary supply input power	<2.5 VA (this includes the 5 V/200 mA load for the main encoder only)

Chapter 5: Wiring for Models with Suffix Number from 01 to 08

This chapter decsribes the wiring for the Solo Whistle models with PN whose suffix number is numbered from 01 to 08. It should be noted that these suffix numbers are catogorized as follows:

- Odd numbers are models with connectors
- Even numbers are models with wires.

For currents of 10 A or less, both models are available; for currents of 15 A or more, only a wires model is available. The Control Connectors are 2.0 mm pitch.

5.1. Connector Types

The Solo Whistle has eight connectors (in the connectors version).

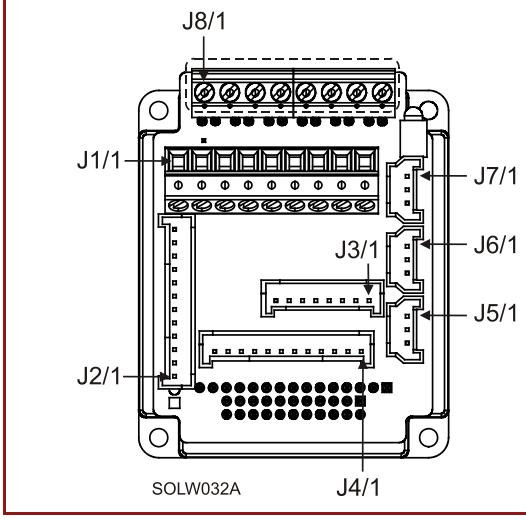
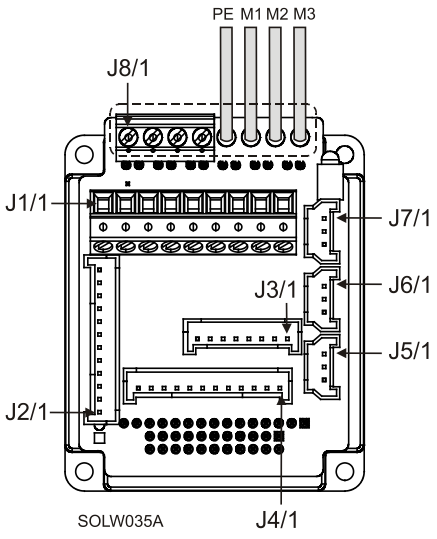
Pins	Type	Port	Function
9	3.5 mm Pitch	J1	Power Connector
12	2 mm Pitch	J2	I/O
8	2 mm Pitch	J3	Auxiliary Feedback
12	2 mm Pitch	J4	Main Feedback
3	2 mm Pitch	J5	RS232
3	2 mm Pitch	J6	CANIN
3	2 mm Pitch	J7	CANOUT
8	3.81 mm Pitch	J8	Motor Connection
4	16 AWG (M1, M2, M3) 18 AWG (PE)	Wires	Motor Connection
Connector Locations			
			

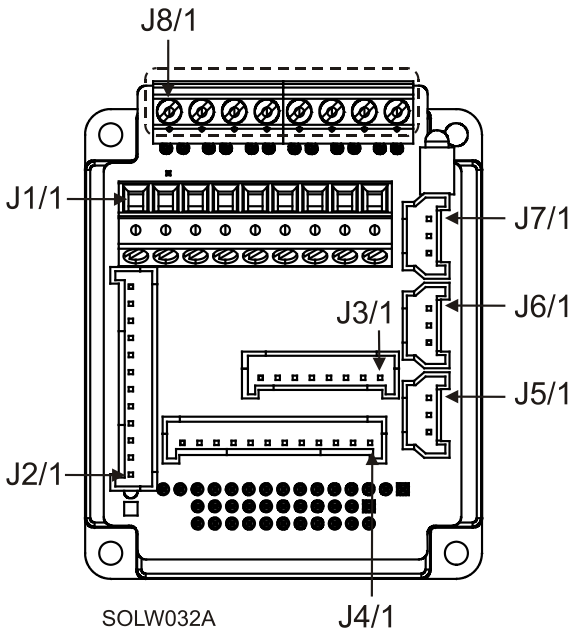
Table 1: Connector Types

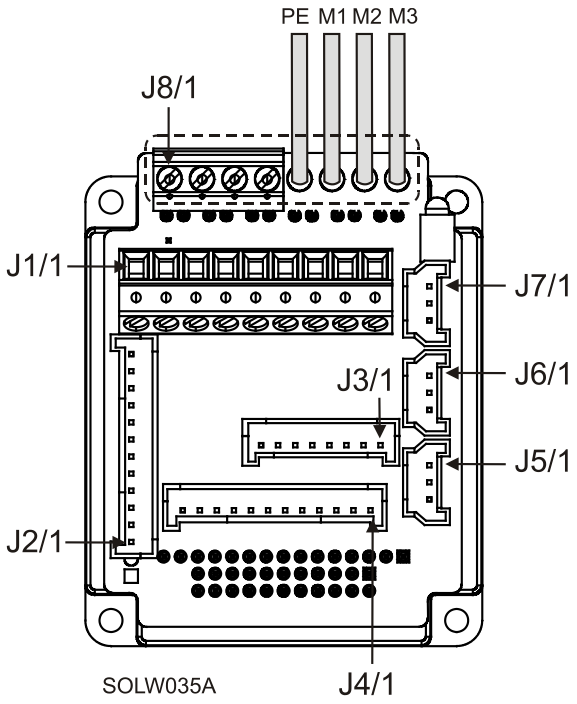
Note: Throughout this chapter there are pairs of diagrams of the Solo Whistle. The diagram on the left is the Solo Whistle with connectors, and the diagram on the right shows the product with wires.

5.2. Motor Power – J8

Pin (J8)	Signal	Function		
1	PTC	Positive Temperature Coefficient		
2	PTC	Positive Temperature Coefficient		
3	N/C	Not Connected		
4	N/C	Not Connected		
			AC Motor	**DC Motor**
5	PE	Protective earth	Motor	Motor
6	M1	Motor phase	Motor	N/C
7	M2	Motor phase	Motor	Motor
8	M3	Motor phase	Motor	Motor

Pin Positions





Note: When connecting several drives to several motors, all should be wired in the same motor phases and feedback sequences. This will enable the same ***SimplIQ*** program to run on all drives.

5.2.1. Connecting Motor Power

Connect the M1, M2, M3 and PE pins on the Solo Whistle. The phase connection is arbitrary as the Composer will establish the proper commutation automatically during setup. However, if you plan to copy the setup to other drives, then the phase order on all copy drives must be the same.

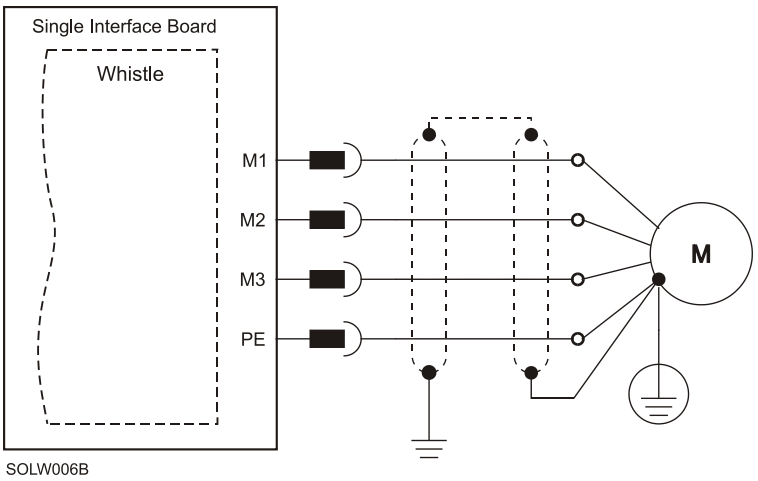
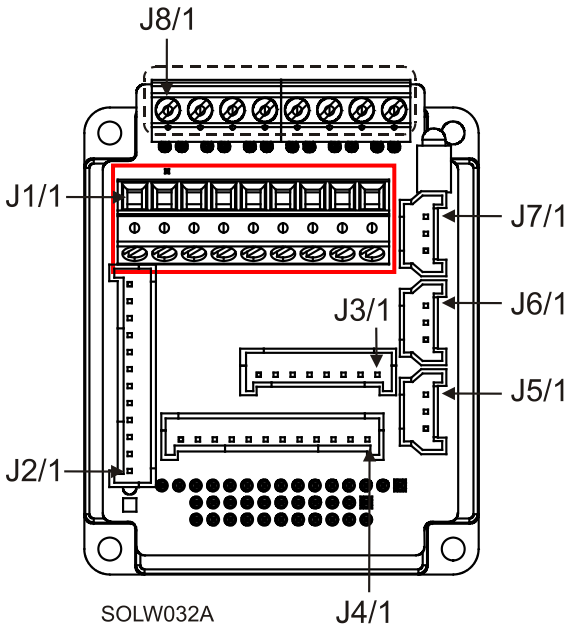


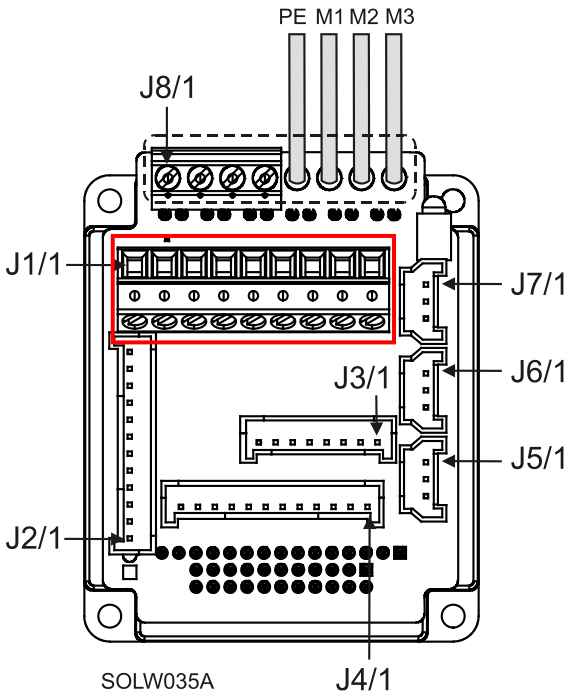
Figure 3: AC Motor Power Connection Diagram

5.3. Main & Auxiliary Power – J1

Pin (J1)	Signal	Function
1	VL+	Auxiliary supply input
2	PR	Auxiliary supply input return
3	VP+	Pos. power input
4	VP+	Pos. power input
5	PR	Power return
6	PR	Power return
7	PE	Protective earth
8	N/C	Not connected
9	N/C	Not connected

Pin Positions





5.3.1. Connecting Main & Auxiliary Power

Power to the Solo Whistle is provided by a 12 to 195 VDC source. A smart control-supply algorithm enables the Solo Whistle to operate with the power supply only for up to 100 V models, with no need for an auxiliary 24 volt supply.

200 V models always require two separate power supplies.

If backup functionality is required (for storing control parameters in case of power-outs) an additional backup supply can be connected by implementing "diode coupling" to the VL+.

Note: The source of the 12 to 195 VDC Main Power Supply must be isolated.

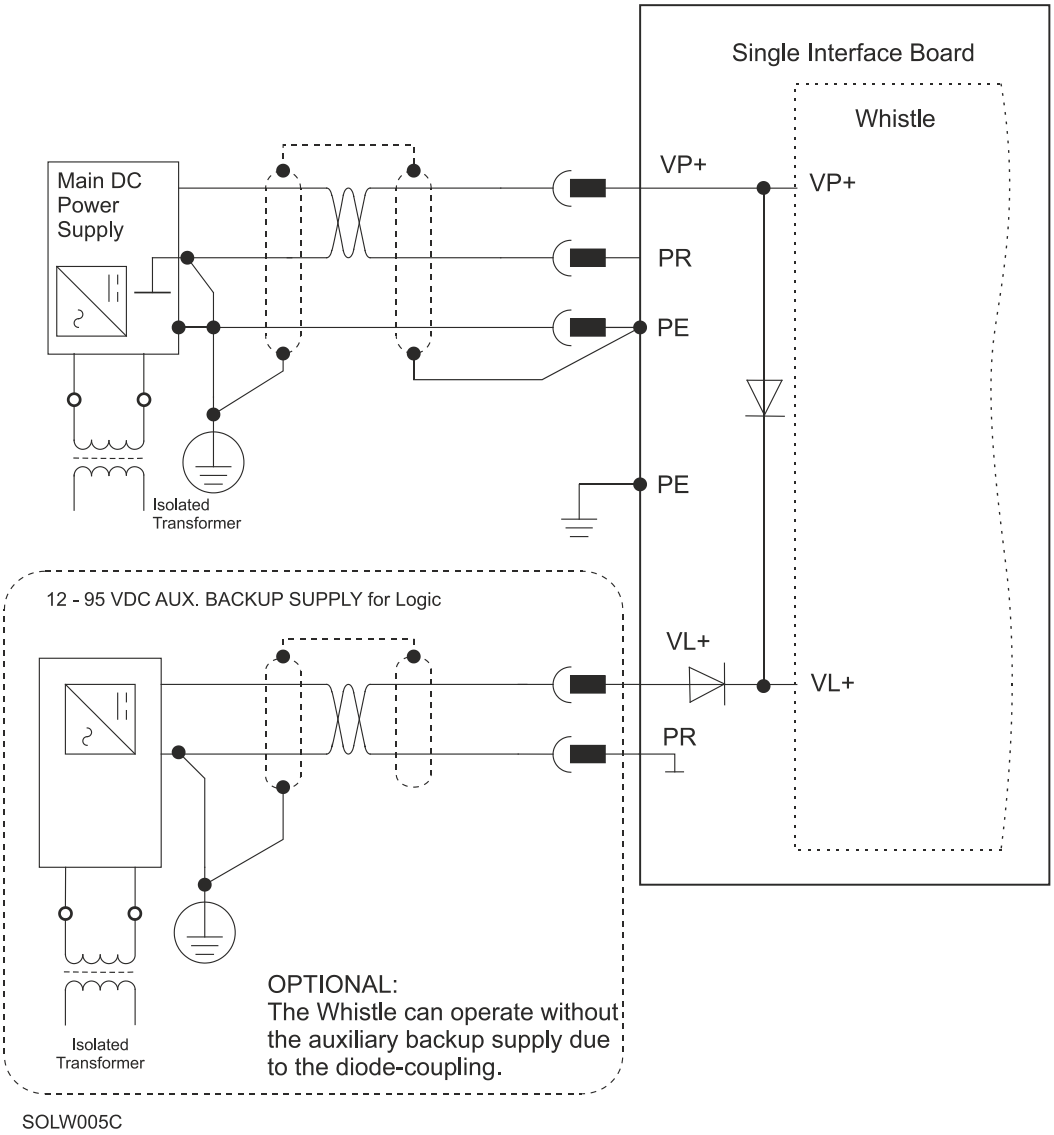


Figure 4: Main & Auxiliary Power Supply Connection Diagram

5.4. Main Feedback – J4

The Main Feedback port is used to transfer feedback data from the motor to the drive. In order to copy the setup to other drives, the phase order on all copy drives must be the same.

The Solo Whistle can accept any one of the following devices as a main feedback mechanism:

- Incremental encoder only
- Incremental encoder with digital Hall sensors
- Digital Hall sensors only
- Incremental Analog (Sine/Cosine) encoder (option)
- Resolver (option)
- Tachometer (option)
- Potentiometer (option)

	Incremental Encoder		Interpolated Analog Encoder		Resolver		Tachometer and Potentiometer	
	SOL-WHIAXX/YYYEZZ		SOL-WHIAXX/YYYIZZ		SOL-WHIAXX/YYYRZZ		SOL-WHIAXX/YYYTZZ	
Pin (J4)	Signal	Function	Signal	Function	Signal	Function	Signal	Function
1	HC	Hall sensor C input	HC	Hall sensor C input	NC	-	HC	Hall sensor C input
3	HA	Hall sensor A input	HA	Hall sensor A input	NC	-	HA	Hall sensor A input
4	PE	Protective Earth	PE	Protective Earth	PE	Protective Earth	PE	Protective Earth
5	SUPRET	Supply return	SUPRET	Supply return	SUPRET	Supply return	SUPRET	Supply return
6	+5V	Encoder/Hall +5V supply	+5V	Encoder/Hall +5V supply	+5V	Encoder/Hall +5V supply	+5V	Encoder/Hall +5V supply
11	CHA-	Channel A complement	A-	Sine A complement	S3	Sine A complement	Tac 1-	Tacho Input 1 Neg. (20 V max)
12	CHA	Channel A	A+	Sine A	S1	Sine A	Tac 1+	Tacho Input 1 Pos. (20 V max)
7	INDEX-	Index complement	R-	Reference complement	R2	Vref complement f= 1/TS, 50 mA Maximum	NC	-
8	INDEX	Index	R+	Reference	R1	Vref f=1/TS, 50 mA Max.	POT	Potentiometer Input (5 V Max)
2	HB	Hall sensor B input	HB	Hall sensor B input	NC	-	HB	Hall sensor B input
9	CHB-	Channel B complement	B-	Cosine B complement	S4	Cosine B complement	Tac 2-	Tacho Input 2 Neg. (50 V max)
10	CHB	Channel B	B+	Cosine B	S2	Cosine B	Tac 2+	Tacho Input 2 Pos. (50 V max)

Pin Positions

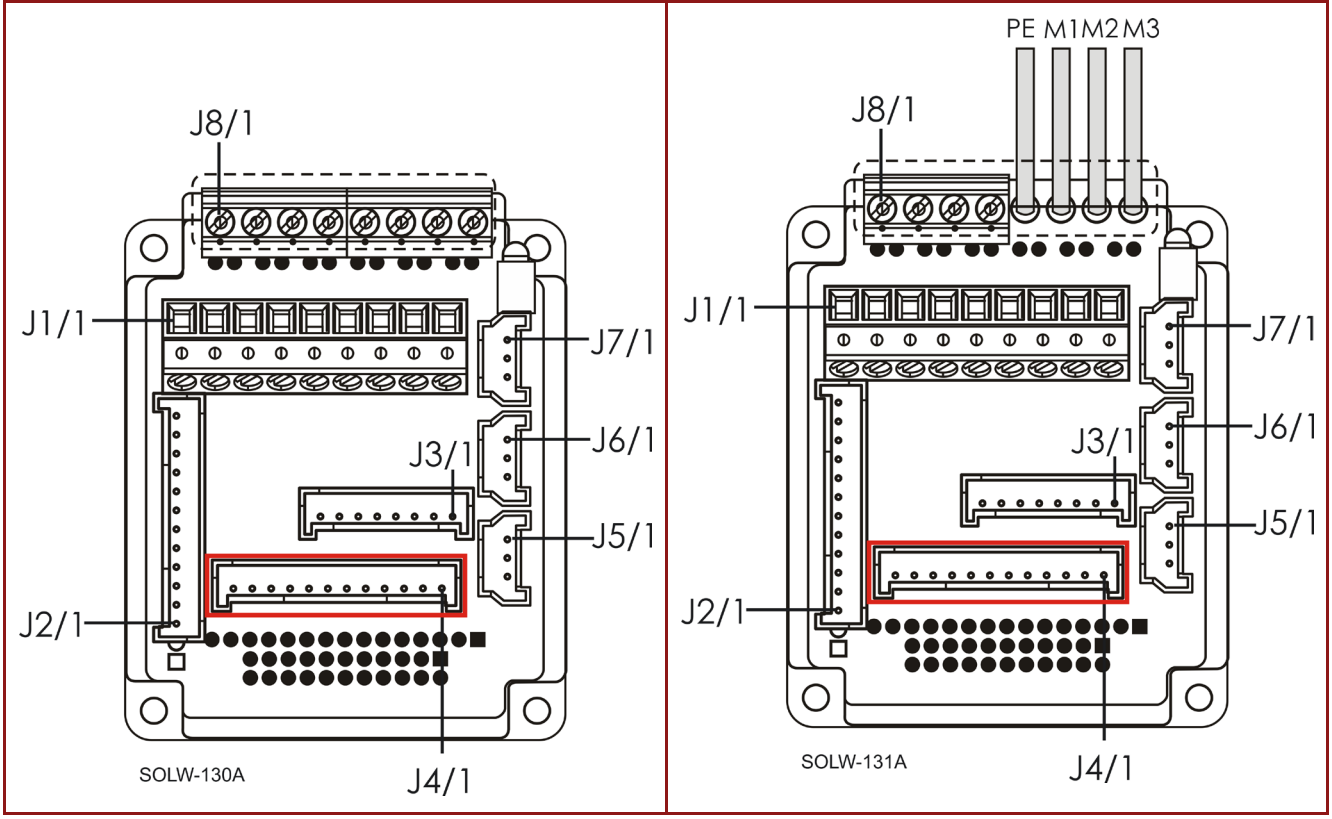


Table 2: Main Feedback Pin Assignments

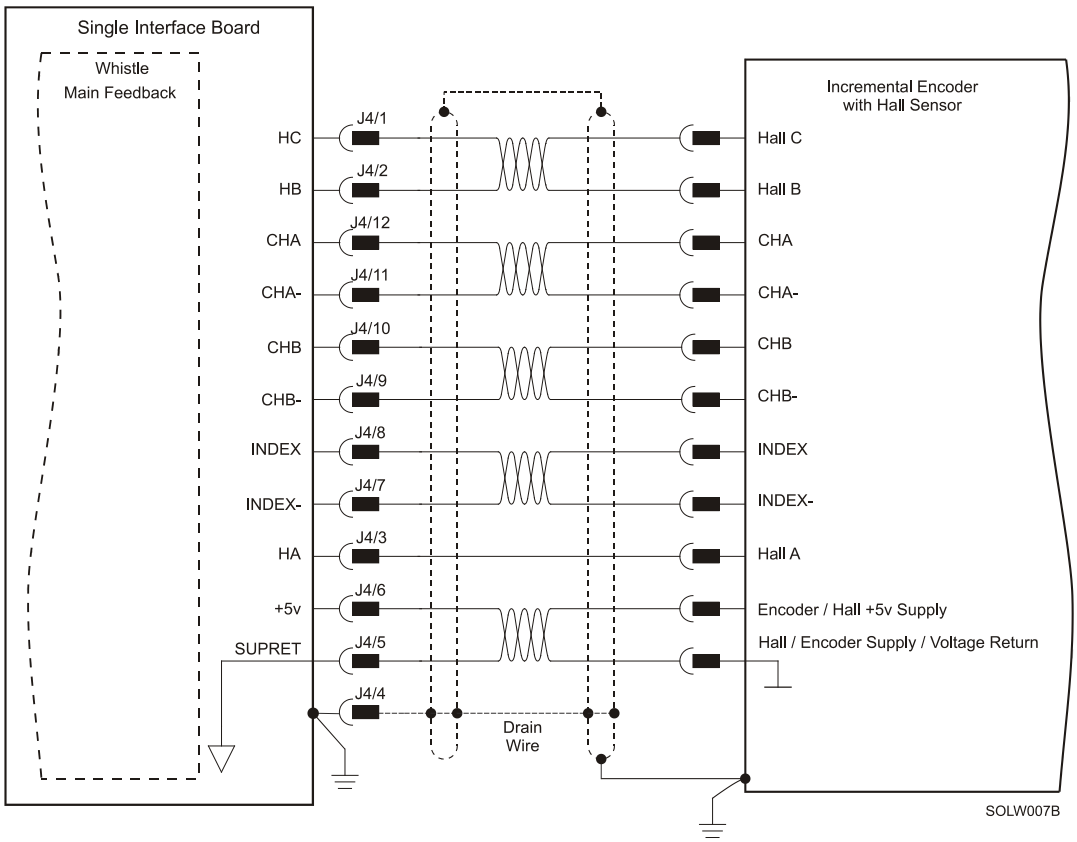


Figure 5: Main Feedback- Incremental Encoder with *Digital Hall Sensor* Connection Diagram

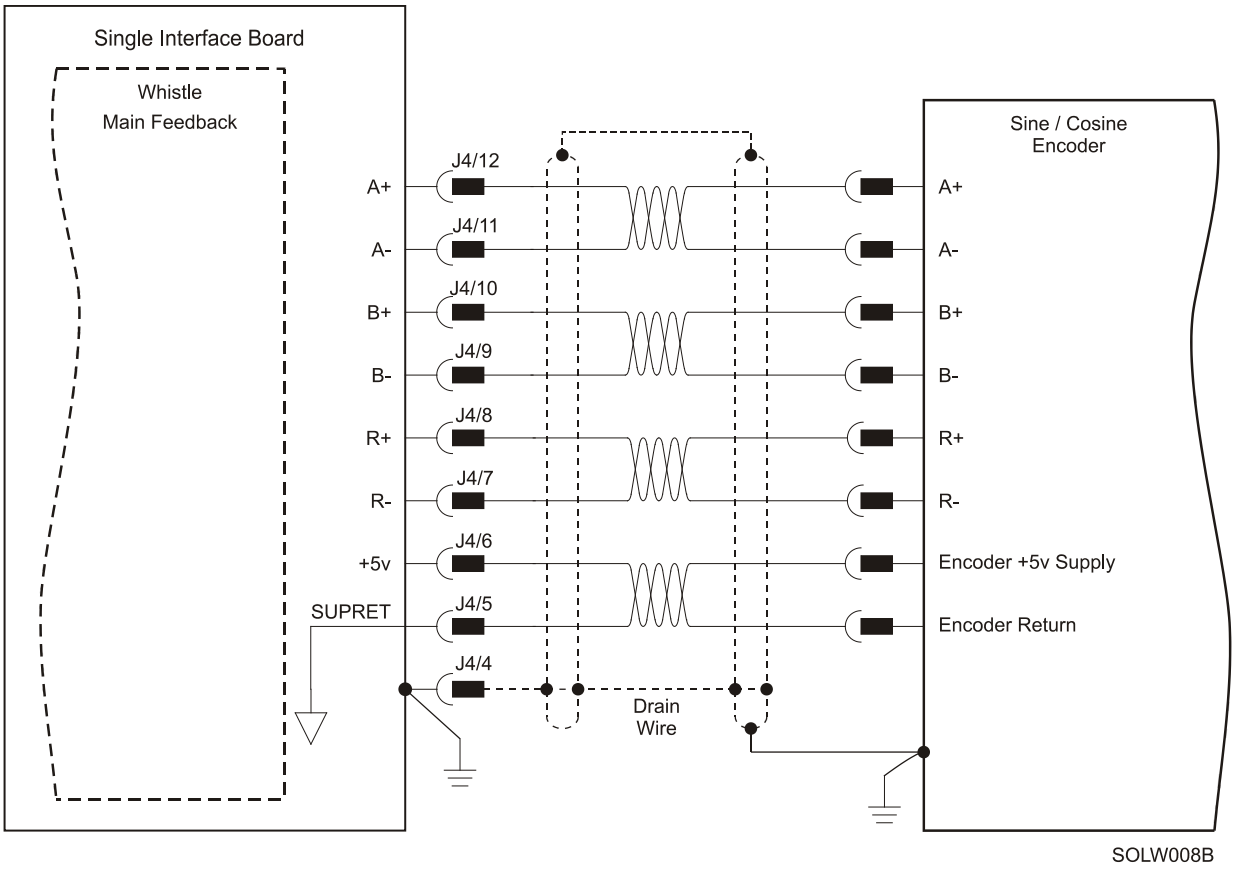


Figure 6: Main Feedback – Interpolated Analog (Sine/Cosine) Encoder Connection Diagram

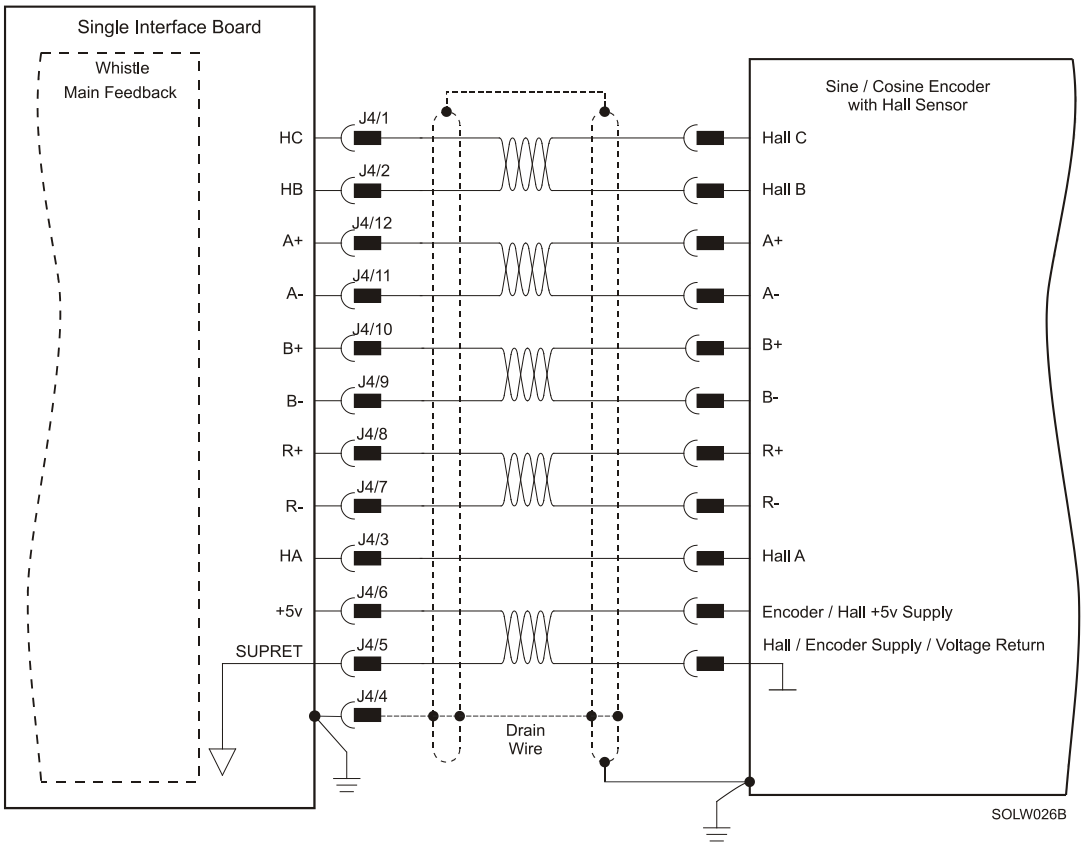


Figure 7: Main Feedback – Interpolated Analog (Sine/Cosine) Encoder with Digital Hall Sensor Connection Diagram

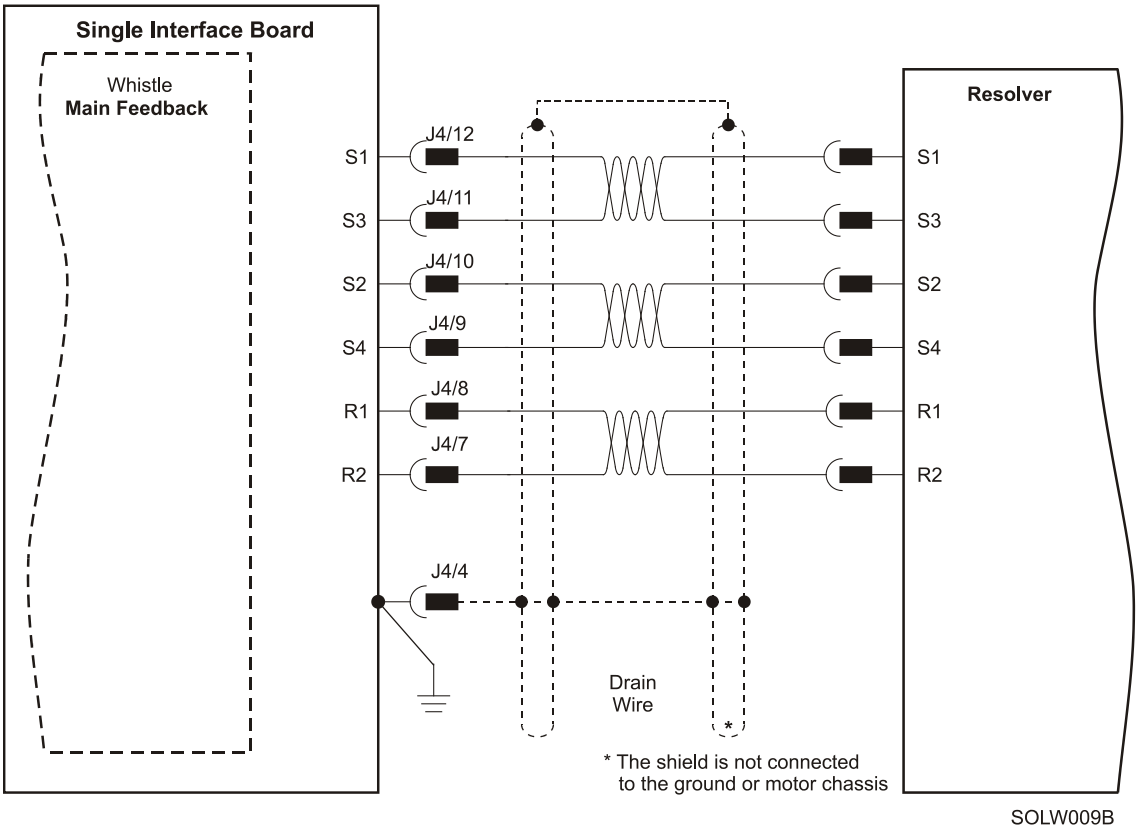


Figure 8: Main Feedback – Resolver Connection Diagram

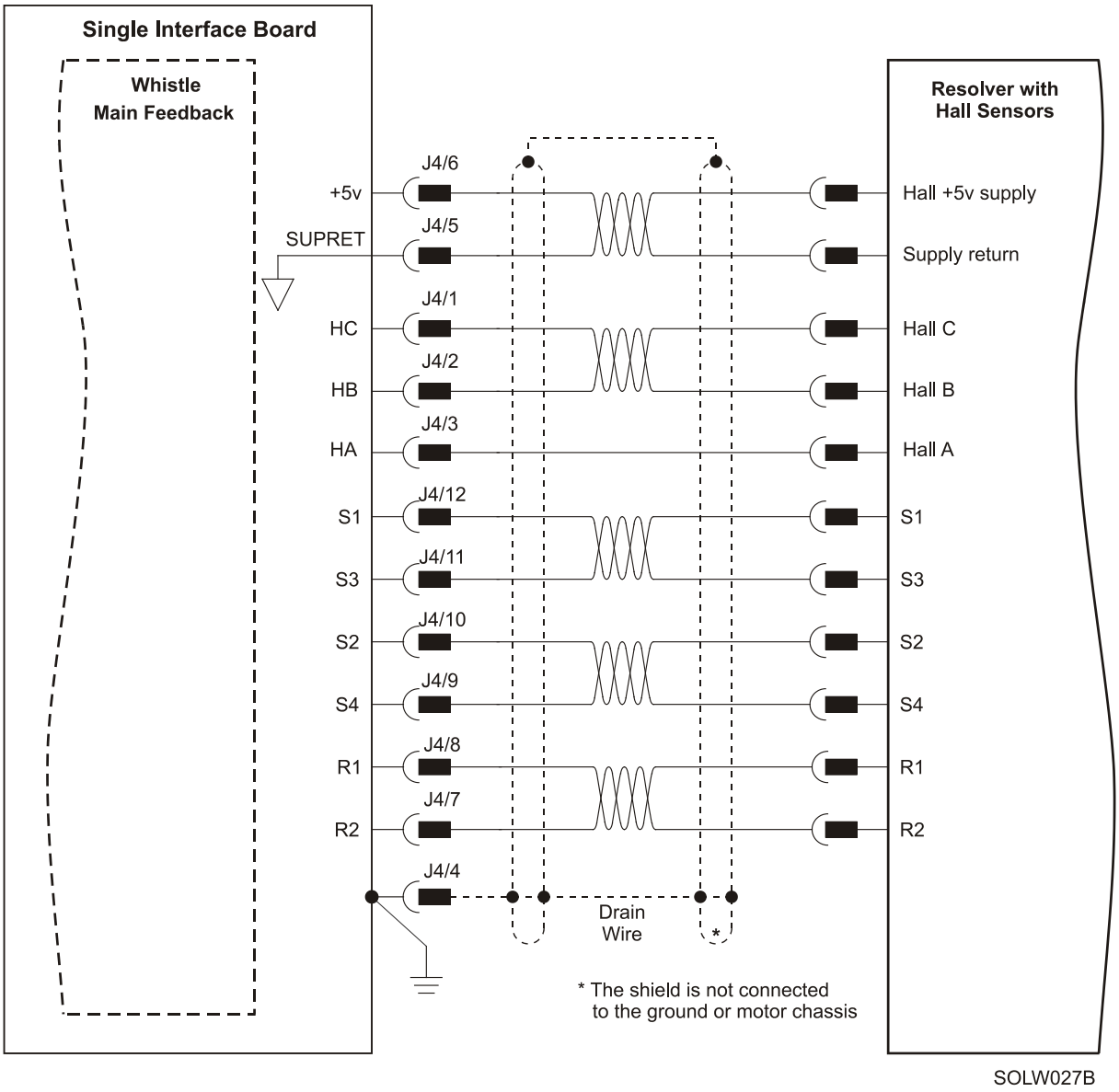


Figure 9: Main Feedback – Resolver with Digital Hall Sensor Connection Diagram

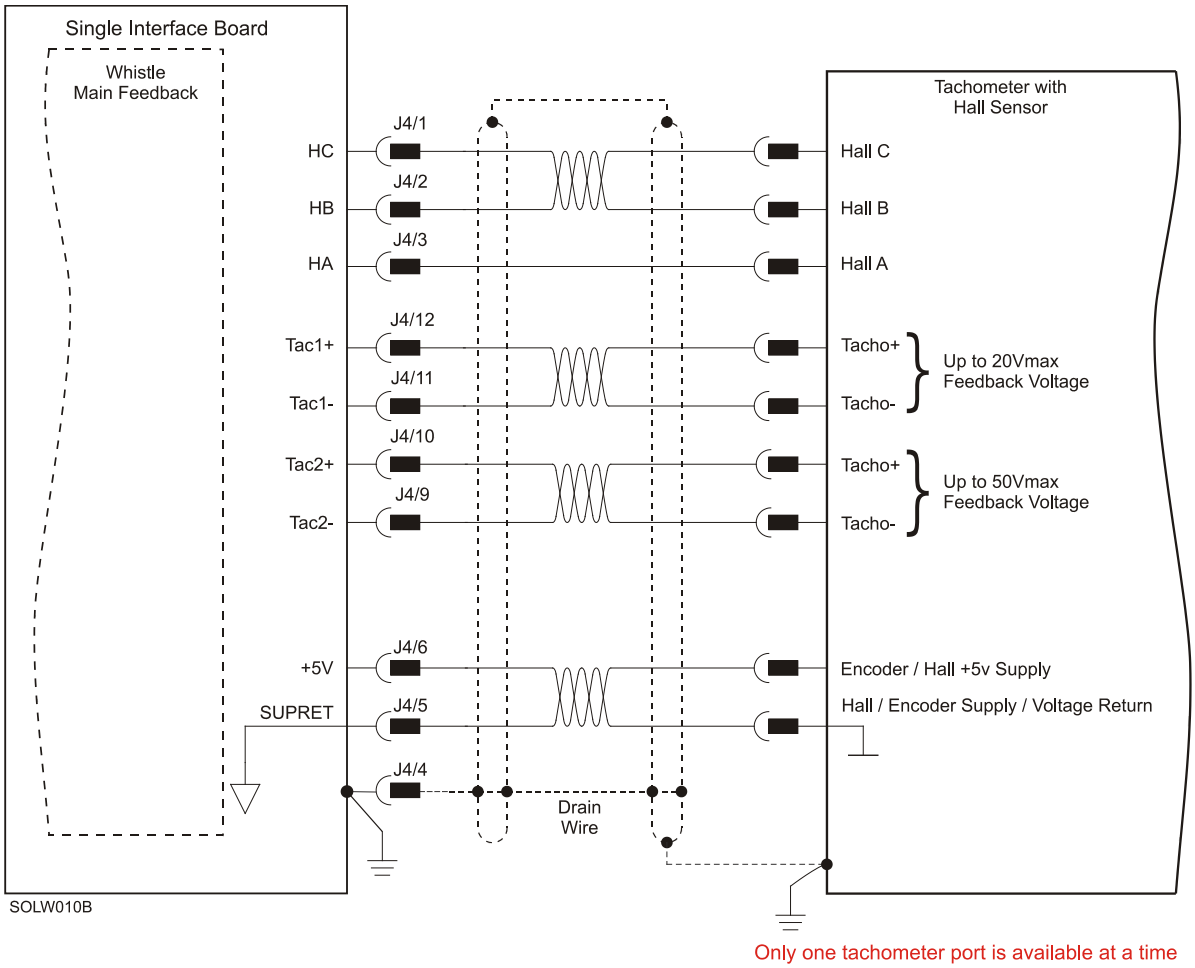


Figure 10: Main Feedback – Tachometer Feedback with Digital Hall Sensor Connection Diagram for Brushless Motors

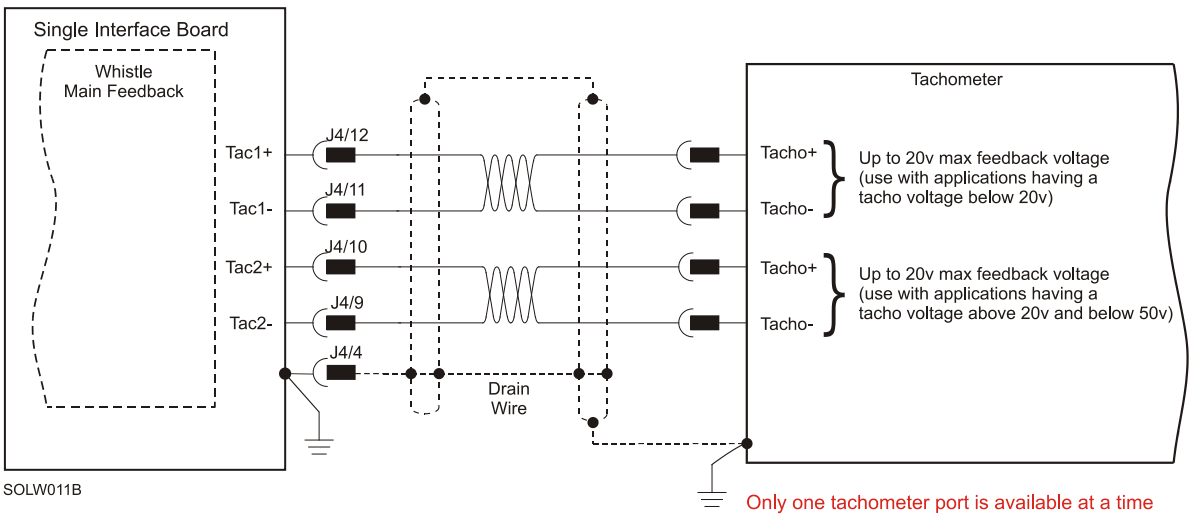


Figure 11: Main Feedback – Tachometer Feedback Connection Diagram for Brush Motors

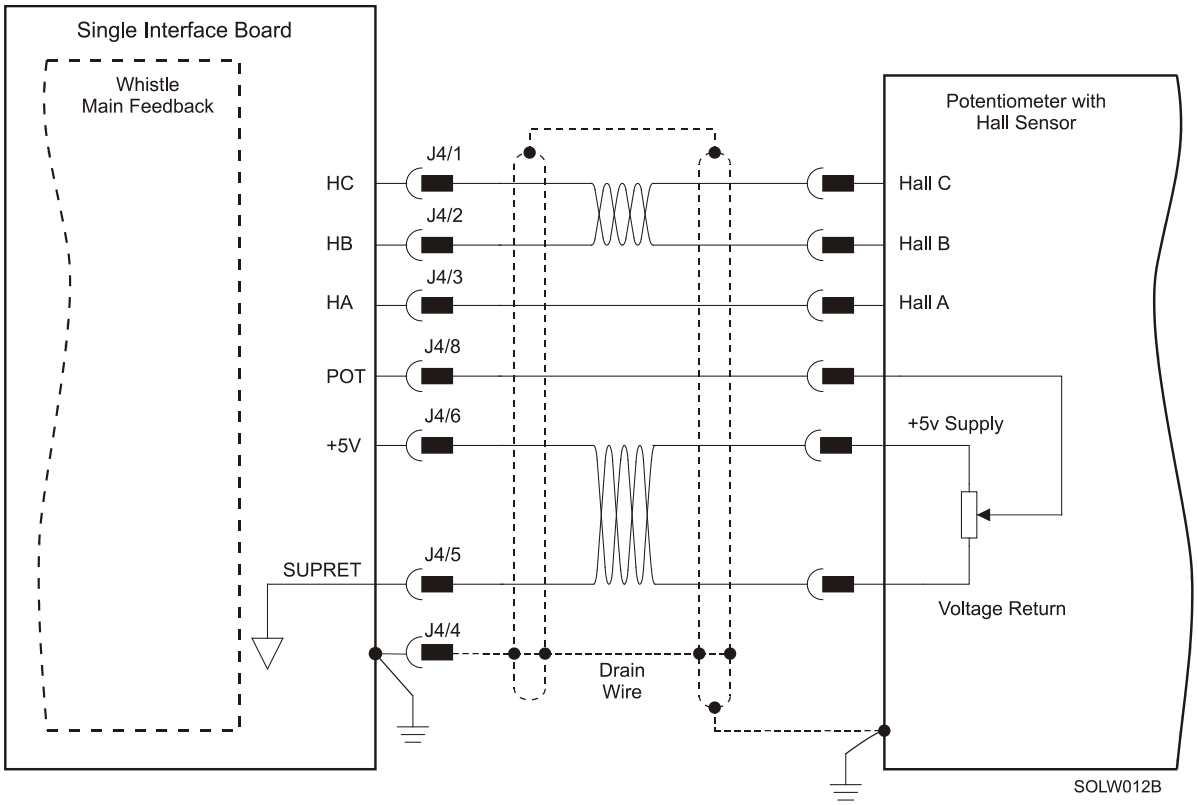


Figure 12: Main Feedback – Potentiometer Feedback with Digital Hall Sensor Connection Diagram for Brushless Motors

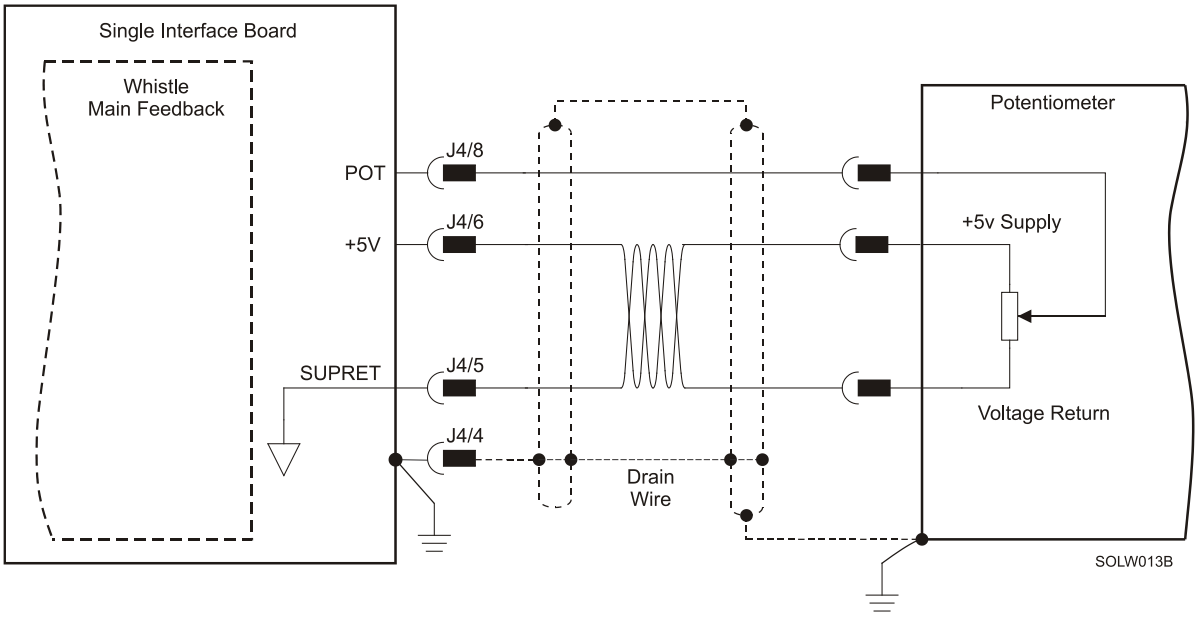


Figure 13: Main Feedback –
Potentiometer Feedback Connection Diagram for Brush Motors and Voice Coils

5.5. Auxiliary Feedback – J3

When using one of the Auxiliary Feedback options, the relevant functionality of the Auxiliary Feedback's ports are software- and hardware-selected for that option. Refer to the SimplIQ Command Reference Manual for detailed information about Auxiliary Feedback setup.

5.5.1. Auxiliary Feedback Operation Modes

There are two modes of operation for the Solo Whistle:

- **Mode 1**: Auxiliary output (Composer command: YA[4]=4) – see Section 5.5.2
  Only for SOL-WHIXXX/YYYY01 to SOL-WHIXXX/YYYY04

  Differential emulated encoder outputs are used to provide emulated encoder signals to another controller or drive. The emulated encoder output option is only available when using a resolver or analog encoder as the main feedback device.

  This option can be used when:

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

- **Mode 2**: Auxiliary input (Composer command: YA[4]=2 or YA[4]=0) - see Sections 5.5.3 and 5.5.4
  Only for SOL-WHIAXXX/YYYY05 to SOL-WHIAXXX/YYYY08

  Differential auxiliary inputs, for the input of position data of the master encoder in follower or ECAM mode. This mode can also be used for differential pulse-and-direction position commands.

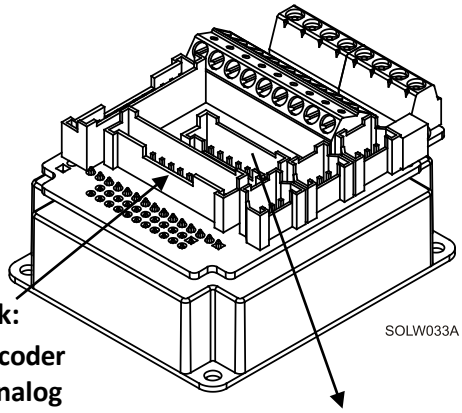
5.5.2. Main and Auxiliary Feedback Combinations

The Main Feedback is always used in motion control devices whereas Auxiliary Feedback is often, but not always used. The Auxiliary Feedback connector on the Solo Whistle has three bi-directional pins (CHA, CHB and INDEX). When used in combination with Main Feedback, the Auxiliary Feedback can be set, by software, as follows:

<table>
<tr><th>Main Feedback</th><th>Auxiliary Feedback: Output</th></tr>
<tr><td>Software Setting</td><td>YA[4] = 4
(Auxiliary Feedback: output)</td></tr>
<tr><td>Incremental Encoder Input

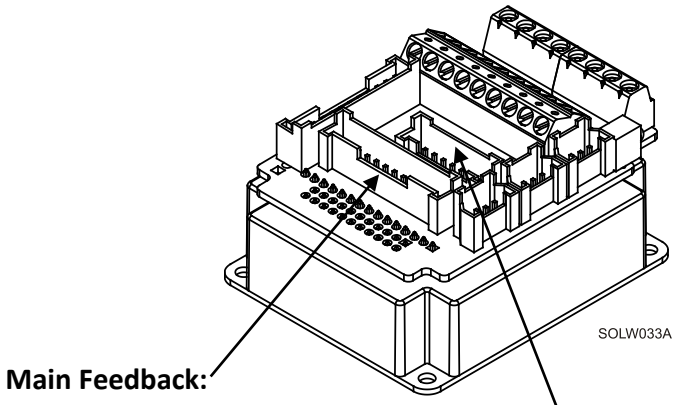
✦Interpolated Analog (Sine/Cosine) Encoder Input

★Resolver Input

✶Potentiometer/ Tachometer Input</td><td> 

Main Feedback:
Incremental Encoder
Interpolated Analog (Sin/Cos) Encoder
OR Resolver
OR Potentiometer
OR Tachometer

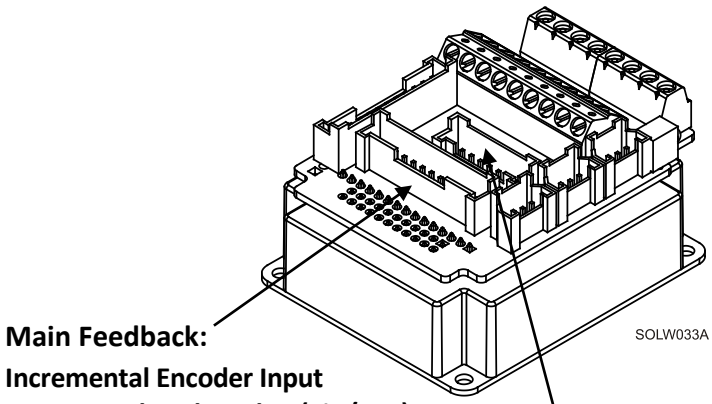
Auxiliary Feedback:
Emulated Differential
Buffered Encoder Output</td></tr>
<tr><td>Typical Applications</td><td>✦ Analog Encoder applications where position data is required, in the Encoder’s quadrature format, for other purposes such as position controllers and/or other drives.
★ Resolver applications where position data is required in the Encoder’s quadrature format, for other purposes such as position controllers and/or other drives.
✶ Potentiometer and Tachometer applications where position data is required, in the Encoder’s quadrature format, for other purposes such as position controllers and/or other drives.</td></tr>
</table>

Main Feedback	Auxiliary Feedback: Input
Software Setting	**YA[4] = 2** (Auxiliary Feedback: input)
Incremental Encoder Input **Interpolated Analog (Sine/Cosine) Encoder Input** **Resolver Input** **Potentiometer Tachometer Input**	 **Main Feedback:** **Incremental Encoder Input** **OR Interpolated Analog (Sin/Cos) Encoder Input** **OR Resolver** **OR Potentiometer** **OR Tachometer** **Auxiliary Feedback:** **Differential Auxiliary Encoder Input**
Typical Applications	Any application where two Feedbacks are used by the drive. The Auxiliary Feedback port serves as an input for the Auxiliary incremental encoder. For applications such as Follower, ECAM, or Dual Loop.

<table>
<tr><th>Main Feedback</th><th>Auxiliary Feedback: Input</th></tr>
<tr><td>Software Setting</td><td>YA[4] = 0
(Auxiliary Feedback: input)</td></tr>
<tr><td>Incremental Encoder Input

Interpolated Analog (Sine/Cosine) Encoder Input

Resolver Input

Potentiometer Tachometer Input</td><td> 

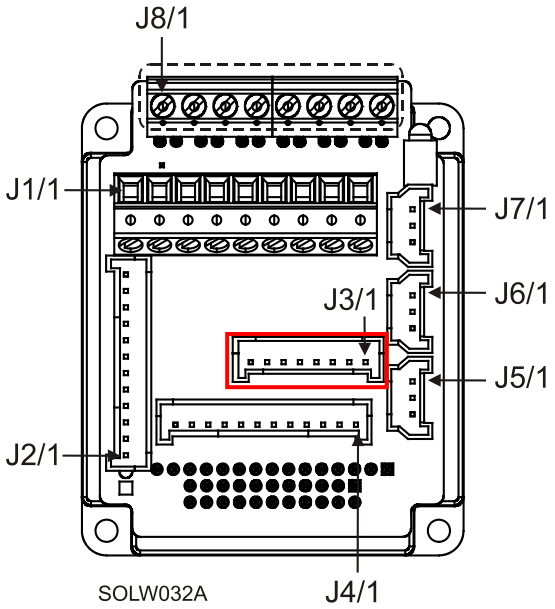
Main Feedback:
Incremental Encoder Input
OR Interpolated Analog (Sin/Cos) Encoder Input
OR Resolver
OR Potentiometer
OR Tachometer

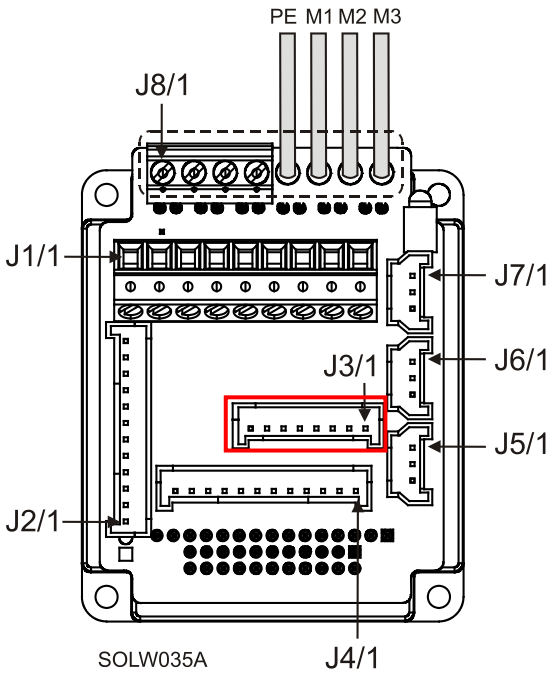
Auxiliary Feedback:
Differential
Pulse & Direction
Commands Input</td></tr>
<tr><td>Typical Applications</td><td>Any application where two Feedbacks are used by the drive.
The Auxiliary Feedback port serves as an input for Pulse & Direction Commands.</td></tr>
</table>

5.5.3. Auxiliary Feedback: Emulated Encoder Output Option (YA[4]=4)

Pin (J3)	Signal	Function
1	PE	Protective Earth
2	COMRET	Common Return
3	INDEXO-	Buffered Index complement output
4	INDEXO	Buffered Index output
5	CHBO-	Buffered Channel B complement output
6	CHBO	Buffered Channel B output
7	CHAO-	Buffered Channel A complement output
8	CHAO	Buffered Channel A output

Pin Positions





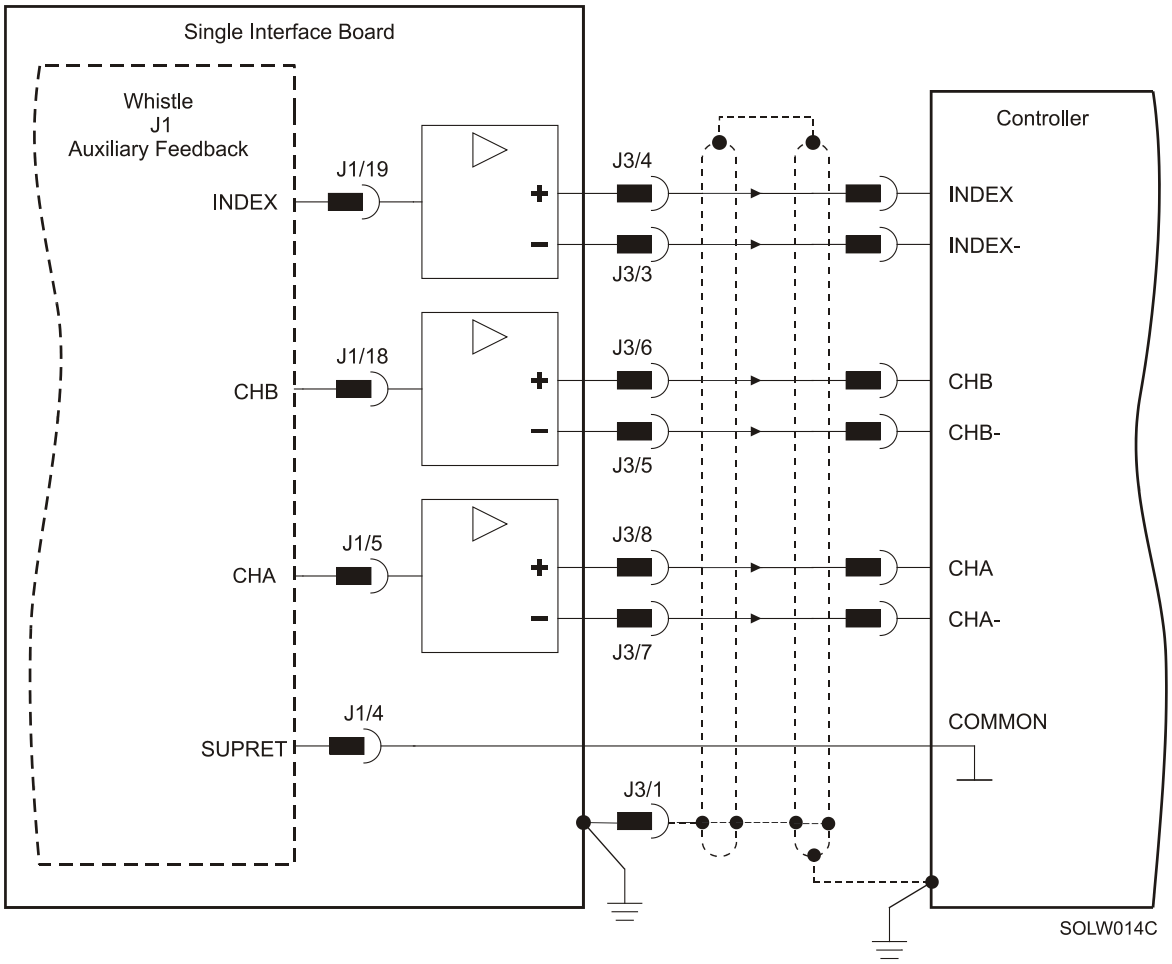
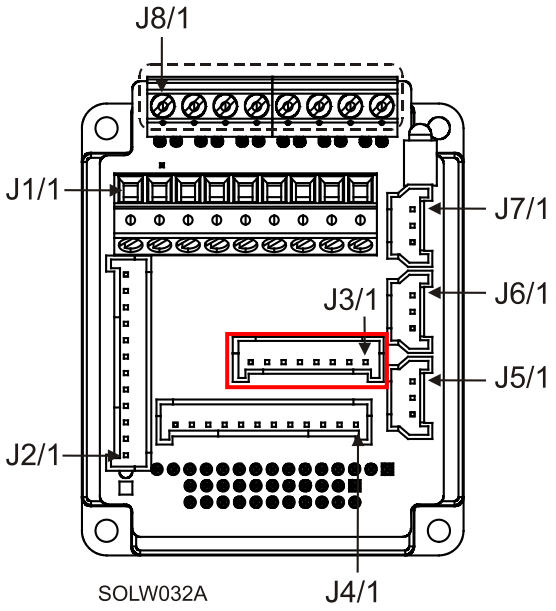


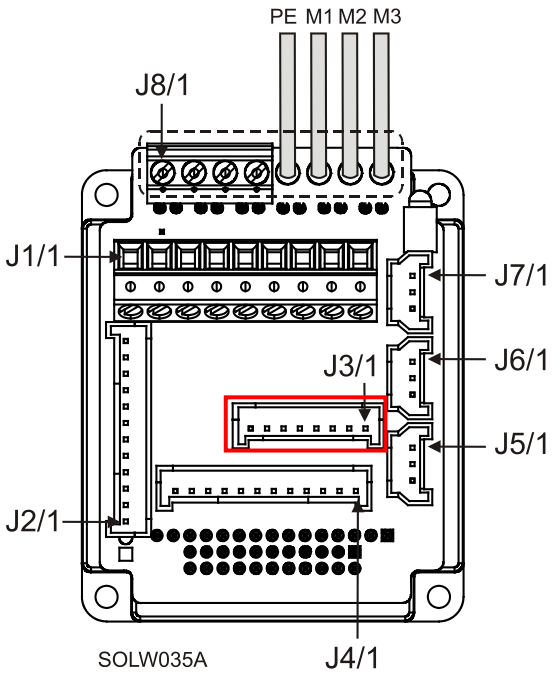
Figure 14: Emulated Encoder Differential Output Diagram

5.5.4. Auxiliary Feedback: Differential Encoder Input Option (YA[4]=2)

Pin (J3)	Signal	Function
1	PE	Protective Earth
2	COMRET	Common Return
3	INDEX-	Auxiliary Index complement Input
4	INDEX	Auxiliary Index Input
5	CHB-	Auxiliary channel B complement input
6	CHB	Auxiliary channel B *input*
7	CHA-	Auxiliary channel A complement input
8	CHA	Auxiliary channel A *input*

Pin Positions





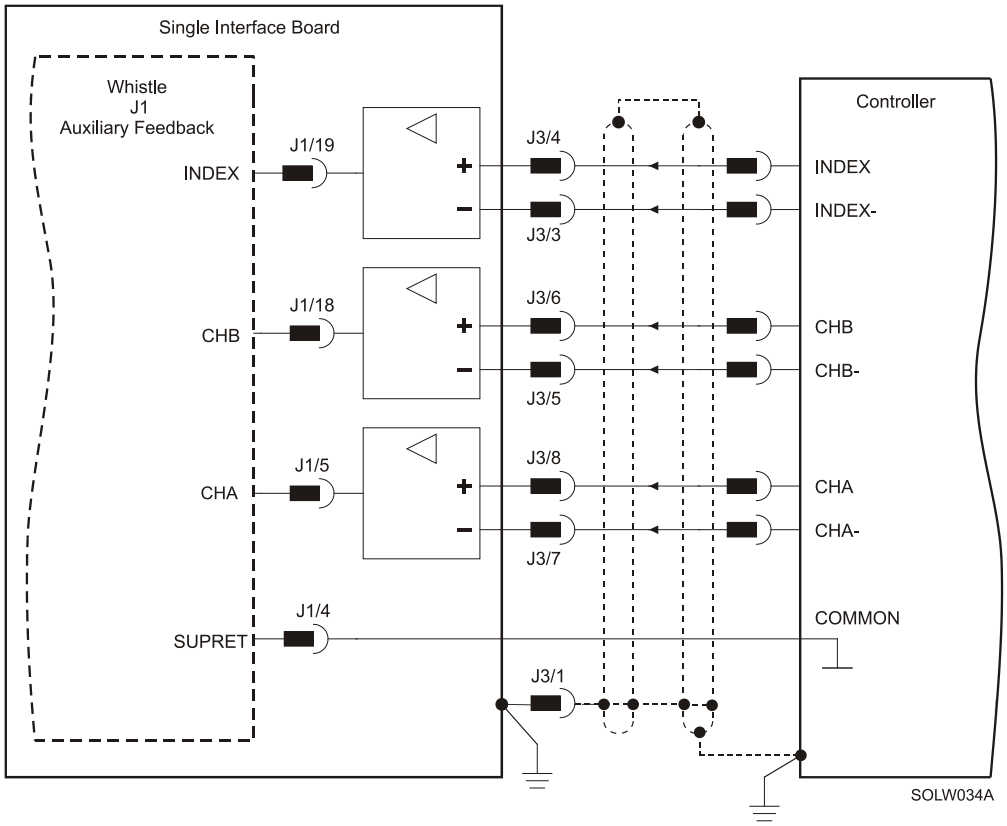


Figure 15: Differential Auxiliary Encoder Input Option Diagram

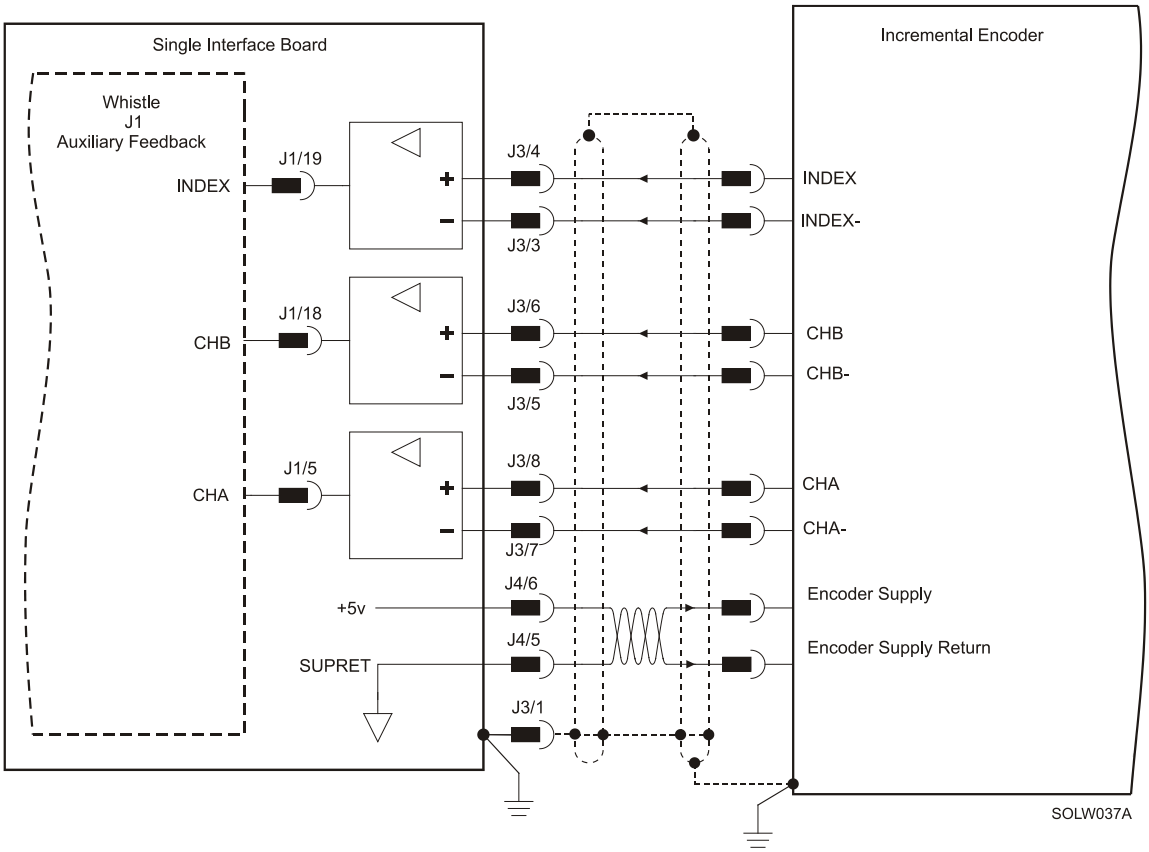
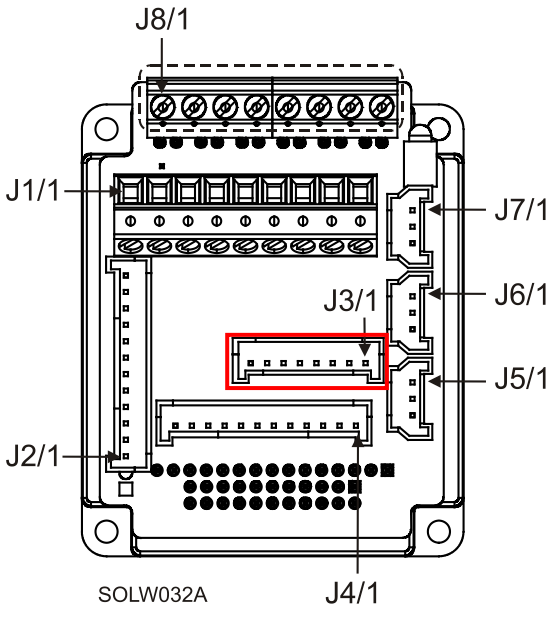


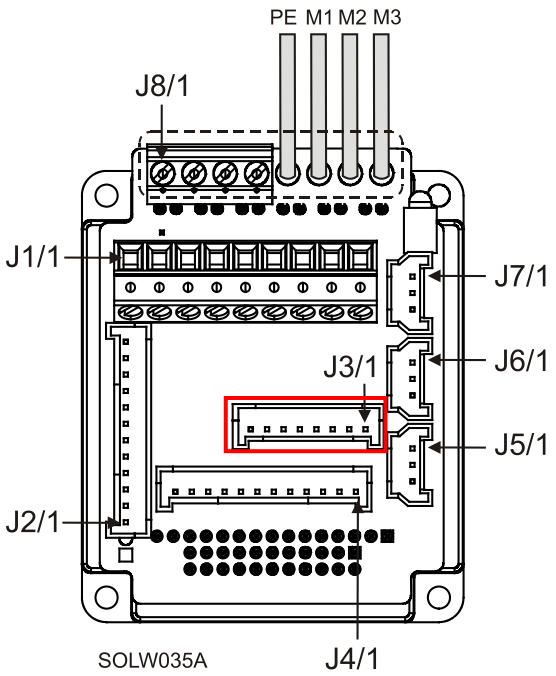
Figure 16: Differential Auxiliary Encoder Input Option Diagram

5.5.5. Auxiliary Feedback: Differential Pulse-and-Direction Input Option (YA[4]=0)

Pin (J3)	Signal	Function
1	PE	Protective Earth
2	COMRET	Common Return
3	NA	Do not connect this pin
4	NA	Do not connect this pin
5	CHB-	Auxiliary Direction complement *input*
6	CHB	Auxiliary Direction *input*
7	CHA-	Auxiliary Pulse complement *input*
8	CHA	Auxiliary Pulse *input*

Pin Positions





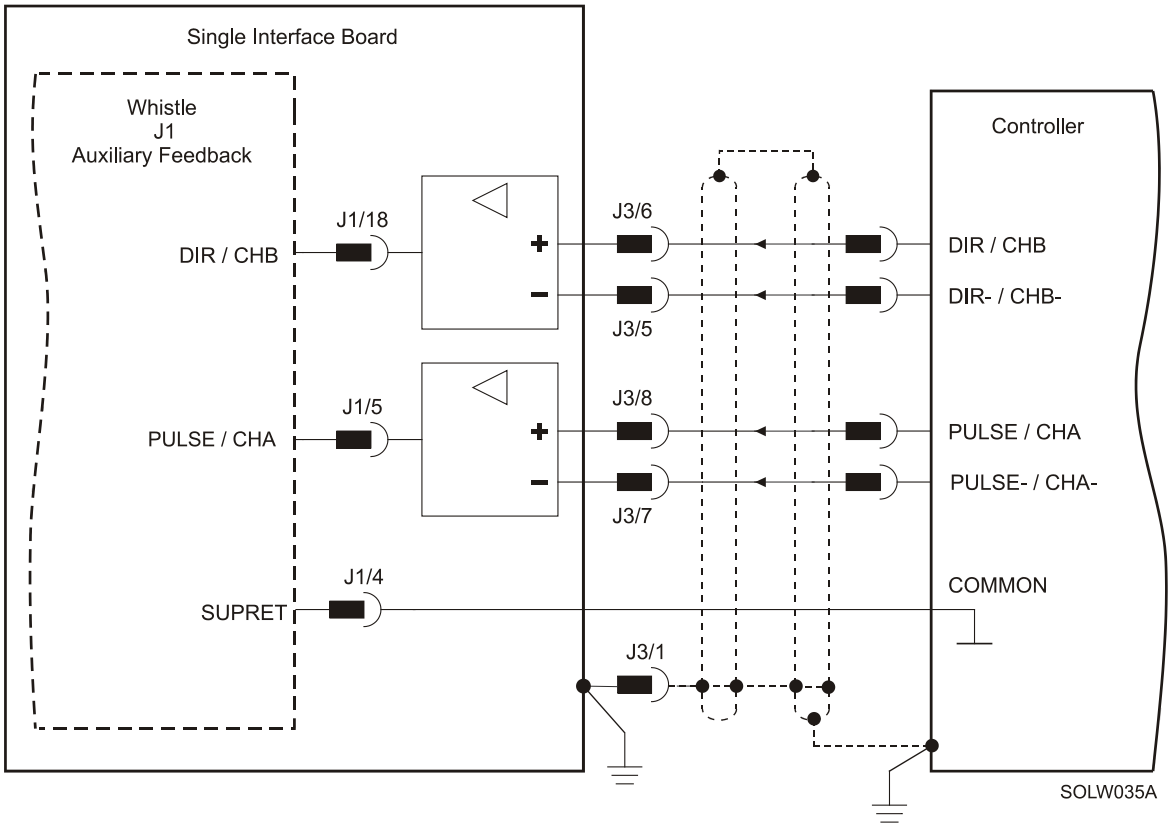


Figure 17: Pulse-and-Direction Diagram

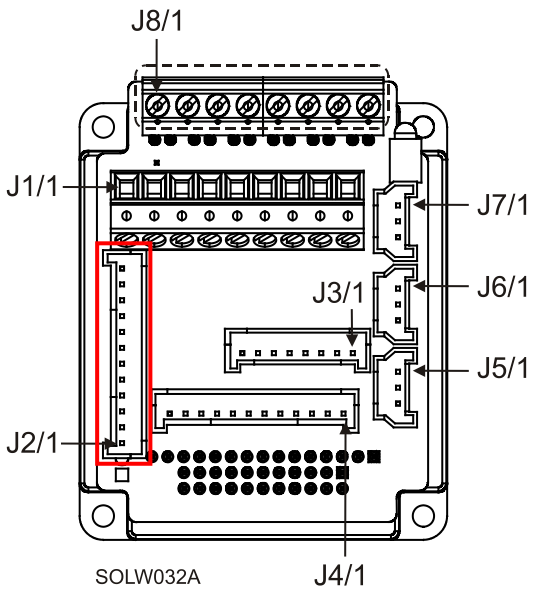
5.6. I/Os – J2

The Solo Whistle has four digital inputs, two digital outputs and one analog input.

5.6.1. Digital Input

The digital input level signal can be 5 V (TTL) or 24 V (PLC).

Pin (J2)	Signal	Function
1	IN3	Programmable input 3 (general purpose, RLS, FLS, INH)
2	IN4	Programmable input 4 (general purpose, RLS, FLS, INH)
3	IN5	Hi-Speed Programmable input 5 (event capture, Main Home, general purpose, RLS, FLS, INH)
4	IN6	Hi-Speed Programmable input 6 (event capture, Auxiliary Home, general purpose, RLS, FLS, INH)
5	INRET	Programmable input return
Pin Positions		



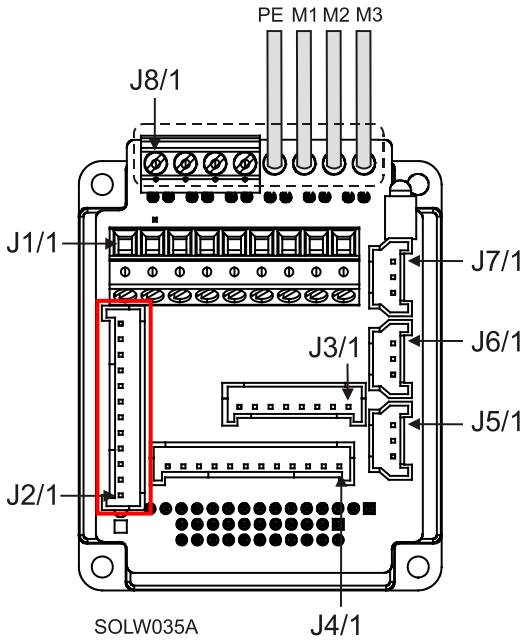


Table 3: Digital Input Pin Assignments

5.6.1.1. Digital Input 5 V (TTL)

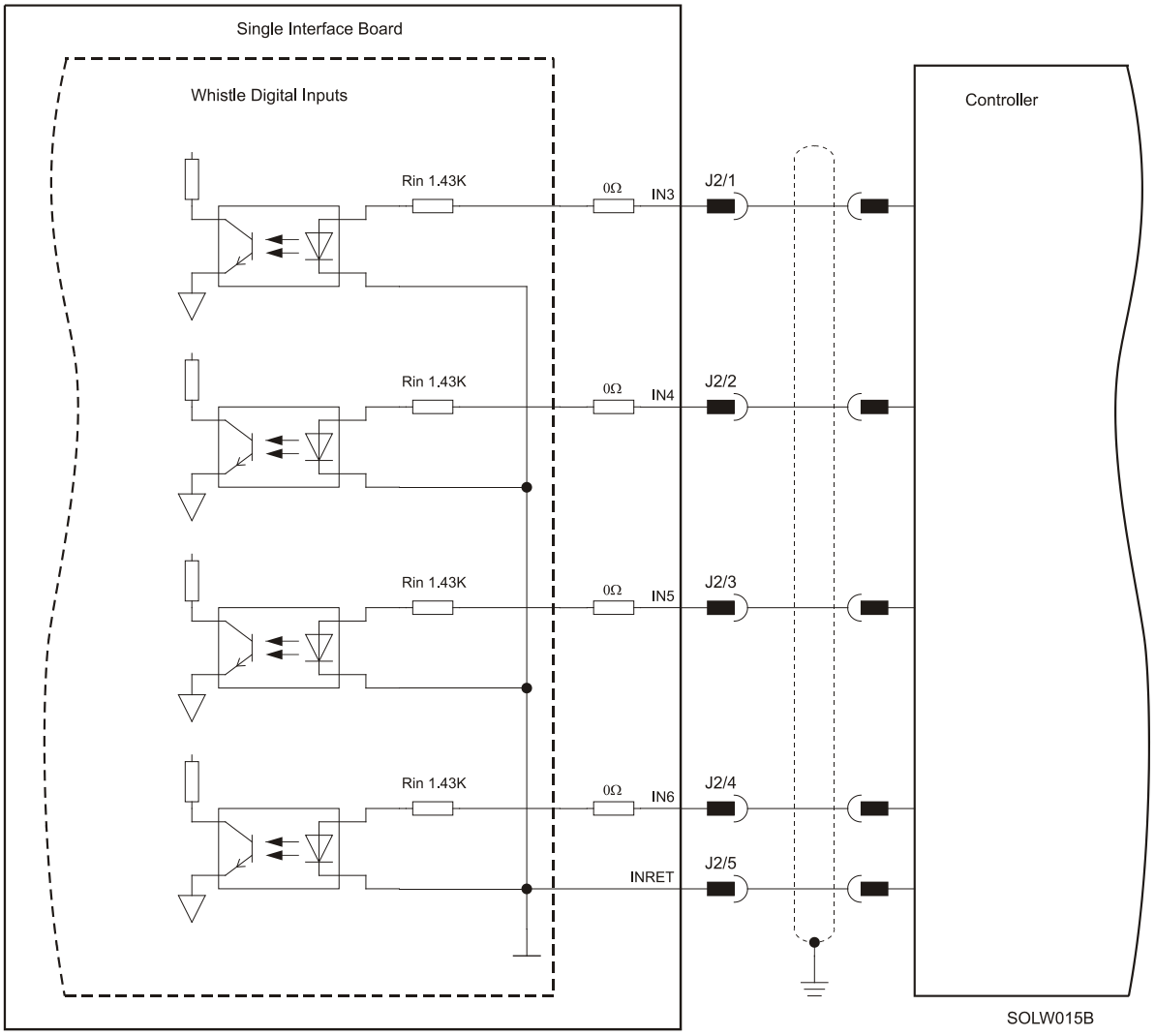


Figure 18: Digital Input 5 V Connection Diagram

5.6.1.2. Digital Input 24 V (PLC)

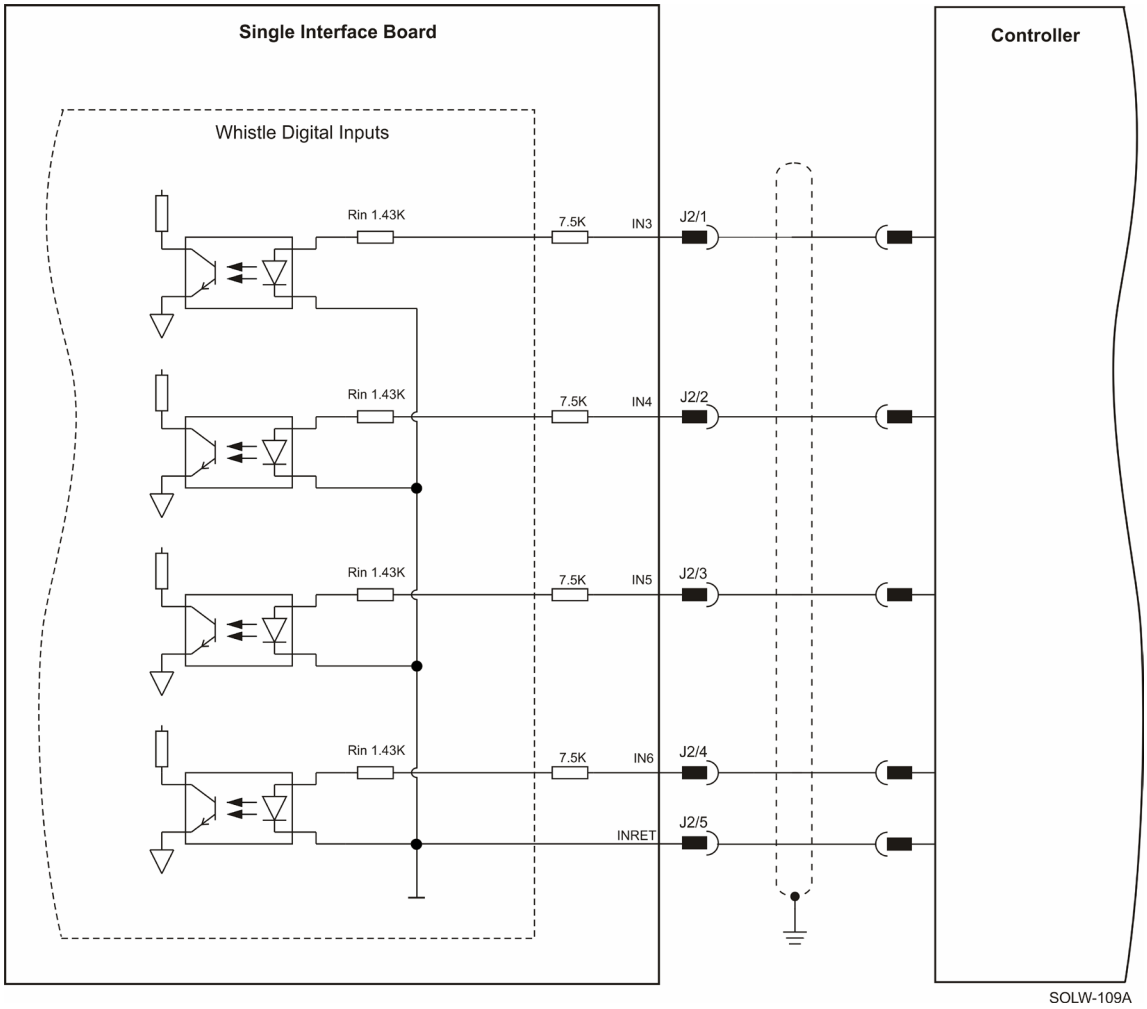


Figure 19: Digital Input 24 Connection Diagram

5.6.1.3. Digital Input Interfaces

Feature	Details
Type of input	• Optically isolated • All four inputs share one signal return line
Input current for 5 V DI level	R_{in}=1.43K, I_{in} = 2.8 mA @ V_{in} = 5 V
Input current for 24 V DI level	R_{in}=8.93k, I_{in} = 2.5 mA @ V_{in} = 24 V
High-level input voltage	5 V < V_{in} < 24 V
Low-level input voltage	0 V < V_{in} < 1 V
Minimum pulse width	> 4 x TS, where TS is sampling time
Execution time (all inputs): the time from application of voltage on input until execution is complete	If input is set to one of the built-in functions — Home, Inhibit, Hard Stop, Soft Stop, Hard and Soft Stop, Forward Limit, Reverse Limit or Begin — execution is immediate upon detection: 0<T<4xTS If input is set to General input, execution depends on program. Typical execution time: ≅ 0.5 msec.
High-speed inputs – 5 & 6 minimum pulse width, in high-speed mode	T < 5 µsec **Notes:** • Home mode is high-speed mode and can be used for fast capture and precise homing. • High speed input has a digital filter set to same value as digital filter (EF) of main encoder. • Highest speed is achieved when turning on optocouplers.

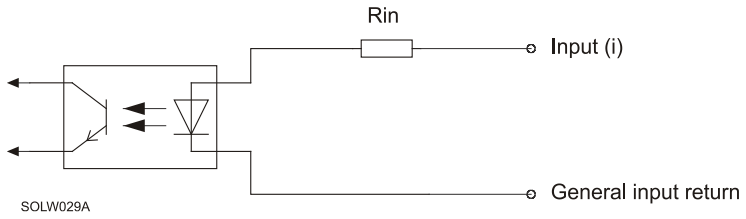
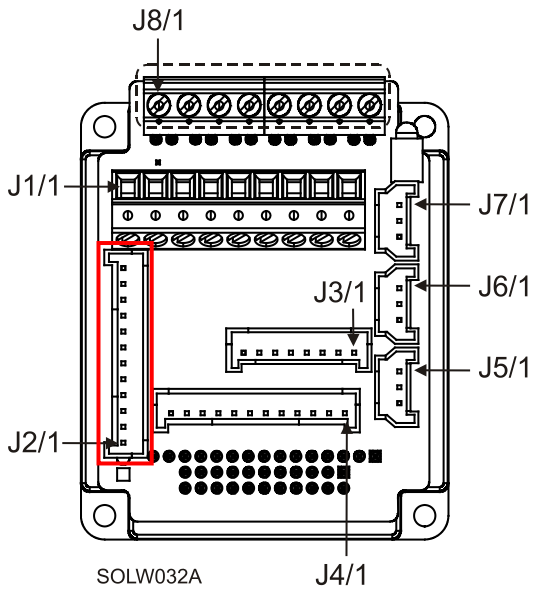


Figure 20: Digital Input Schematic

5.6.2. Digital Output

Pin (J2)	Signal	Function
8	OUT1	Programmable digital output 1
9	OUTRET1	Programmable digital output return 1
6	OUT2	Programmable digital output 2
7	OUTRET2	Programmable digital output return 2
Pin Positions		



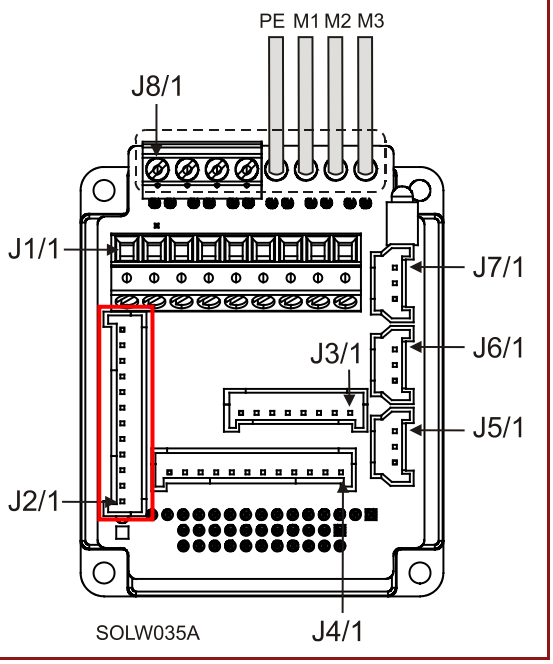


Table 4: Digital Output Pin Assignment

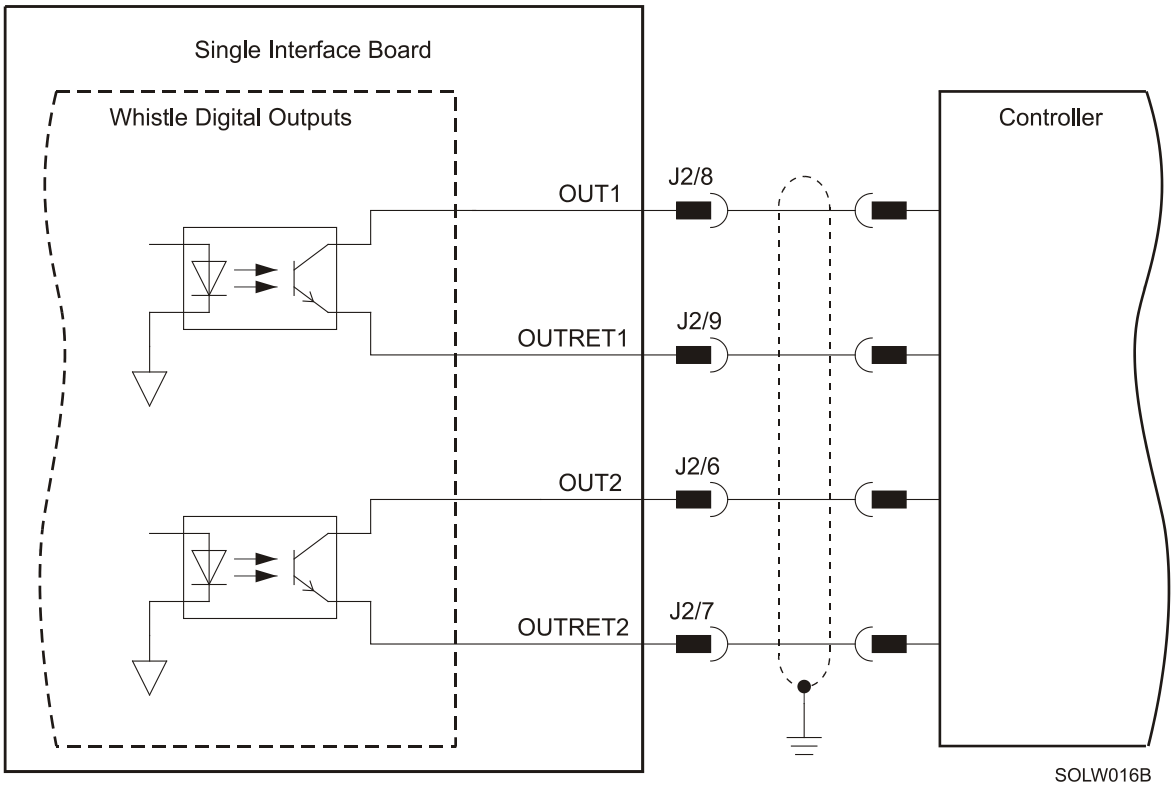


Figure 21: Digital Output Connection Diagram

Feature	Details
Type of output	• Optically isolated • Open collector and open emitter
Maximum supply output (VCC)	30 V
Max. output current I_{out} (max) (V_{out} = Low)	I_{out} (max) ≤ 10 mA
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 10 mA. $R_L = \frac{VCC - VOL}{I_{out}(max)}$
Executable time	If output is set to one of the built-in functions — Home flag, Brake or AOK — execution is immediate upon detection: 0 < T < 4 x TS If output is set to General output and is executed from a program, the typical time is approximately 0.5 msec.

Figure 22: Digital Output Schematic

5.6.3. Analog Input

Pin (J2)	Signal	Function
10	ANLIN1+	Analog input 1+
11	ANLIN1-	Analog input 1-
12	ANLRET	Analog return
Pin Positions		

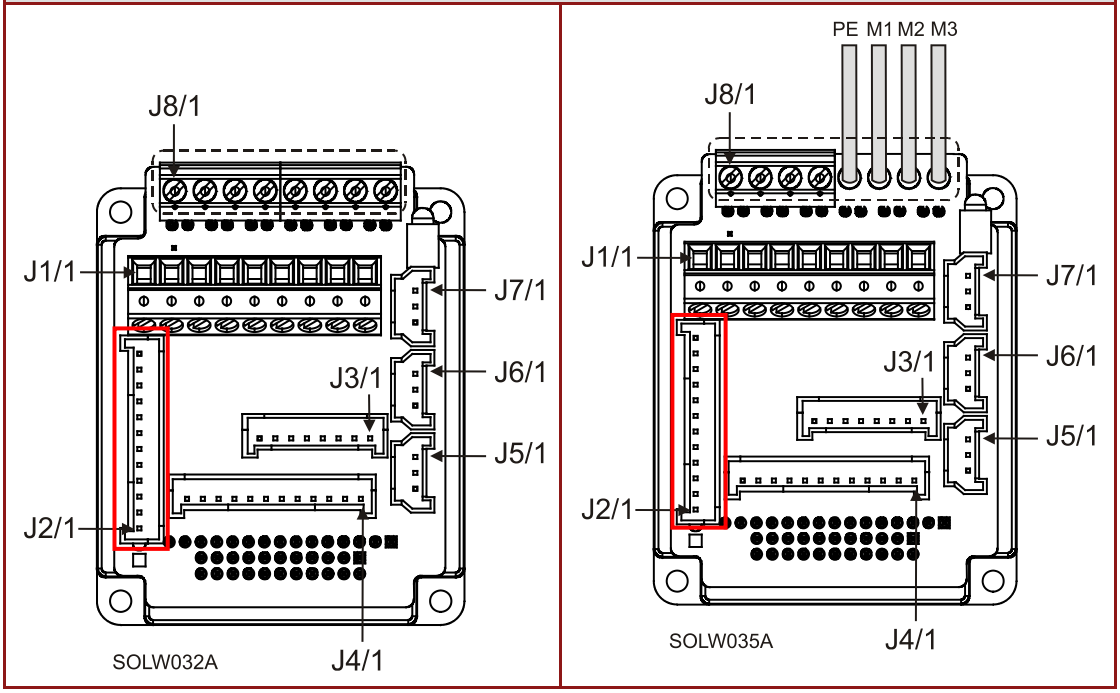


Table 5: Analog Input Pin Assignments

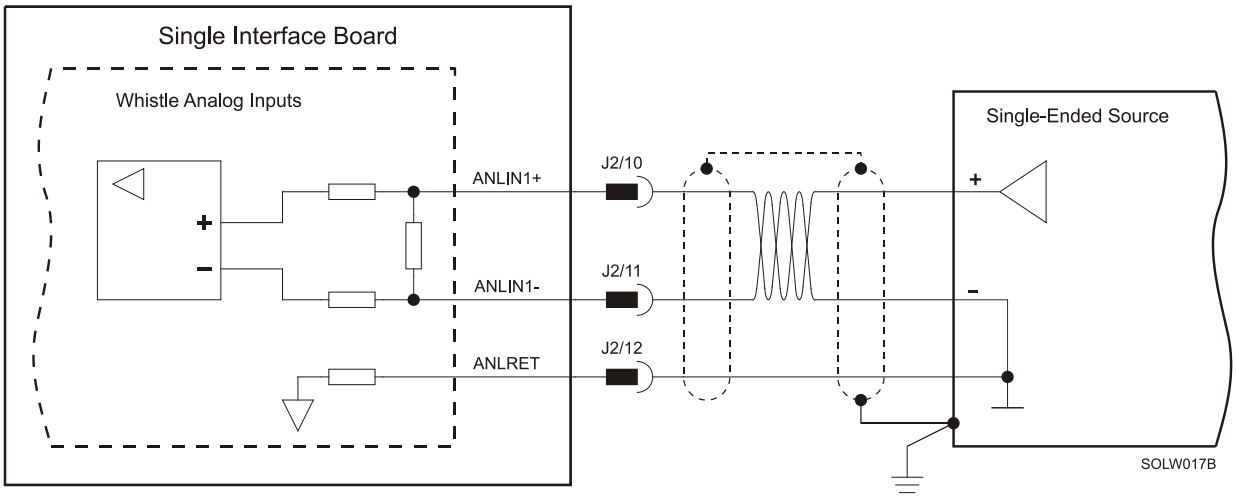


Figure 23: Analog Input with Single-Ended Source

5.7. Communications

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

- RS-232, full duplex
- CANopen

RS-232 communication requires a standard, commercial 3-core null-modem cable connected from the Solo Whistle to a serial interface on the PC. The interface is selected and set up in the Composer software.

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

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

5.7.1. RS-232 Communication

Notes for connecting the RS-232 communication cable:

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

Pin (J5)	Signal	Function
1	RS232_Rx	RS-232 receive
2	RS232_Tx	RS-232 transmit
3	RS232_COMRET	Communication return
Pin Positions		

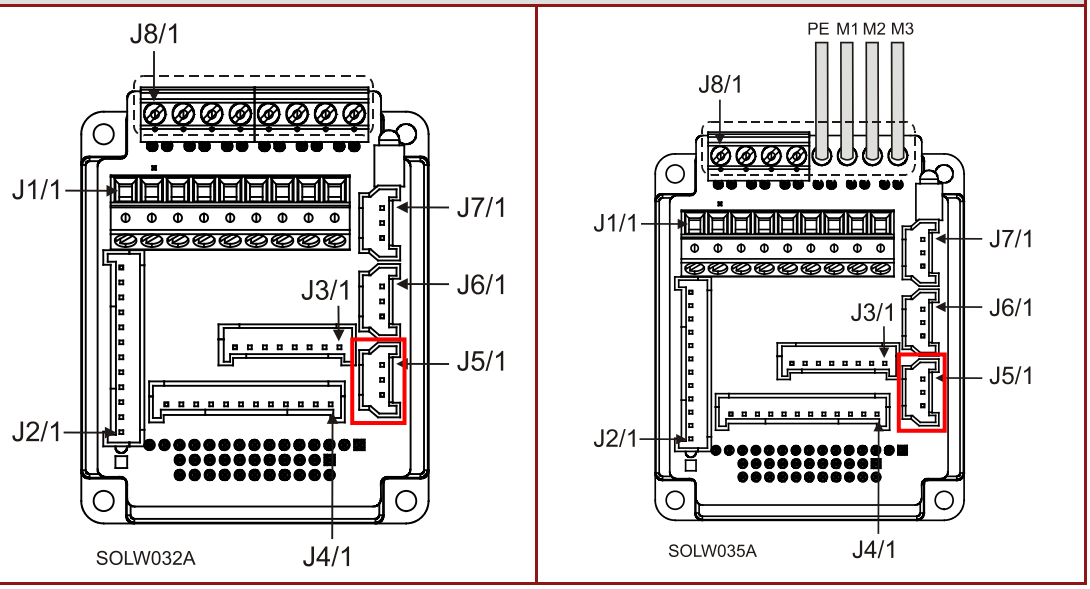


Table 6: RS-232 Pin Assignments

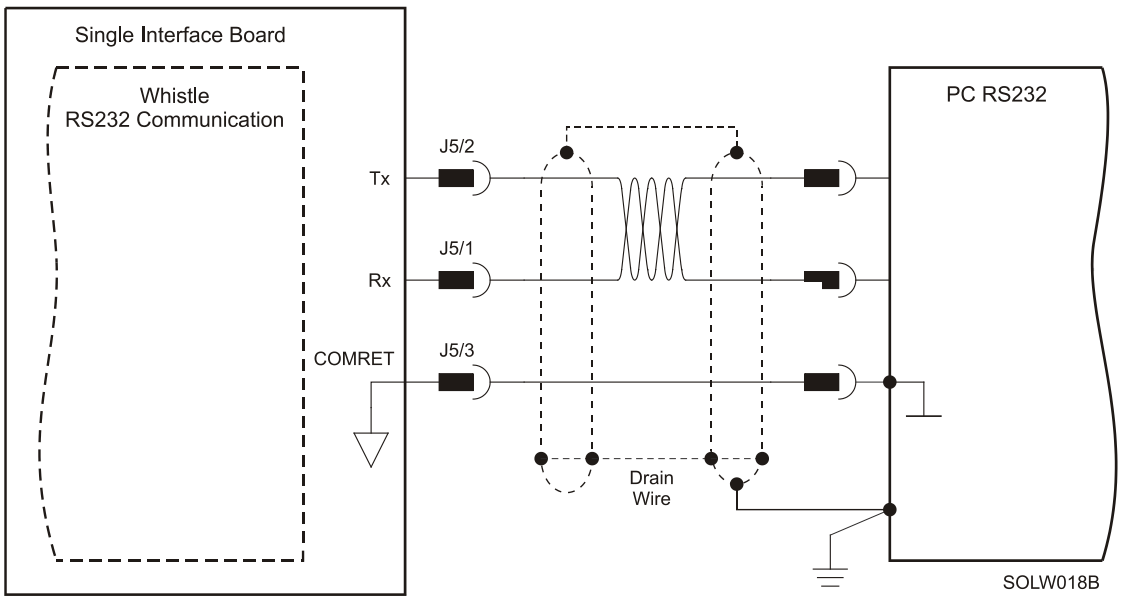


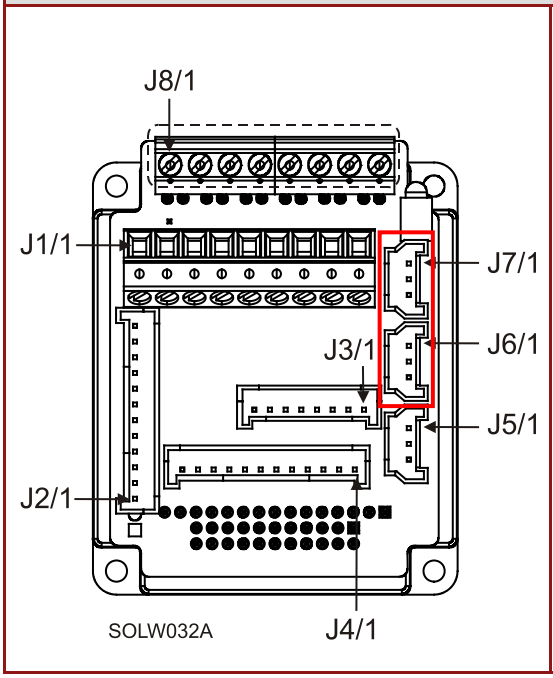
Figure 24: RS-232 Connection Diagram

5.7.2. CANopen Communication

Notes for connecting the CANopen communication cable:

- Connect the shield to the ground of the host (PC). Usually, this connection is soldered internally inside the connector at the PC end. You can use the drain wire to facilitate connection.
- Make sure to have a 120-Ω resistor termination at each of the two ends of the network cable.
- The Solo Whistle's CAN ports are **non-isolated**.

Pin CANIN	Pin CANOUT	Signal	Function
J6/1	J7/1	CAN_GND	CAN ground
J6/2	J7/2	CAN_L	CAN_L busline (dominant low)
J6/3	J7/3	CAN_H	CAN_H busline (dominant high)
Pin Positions			



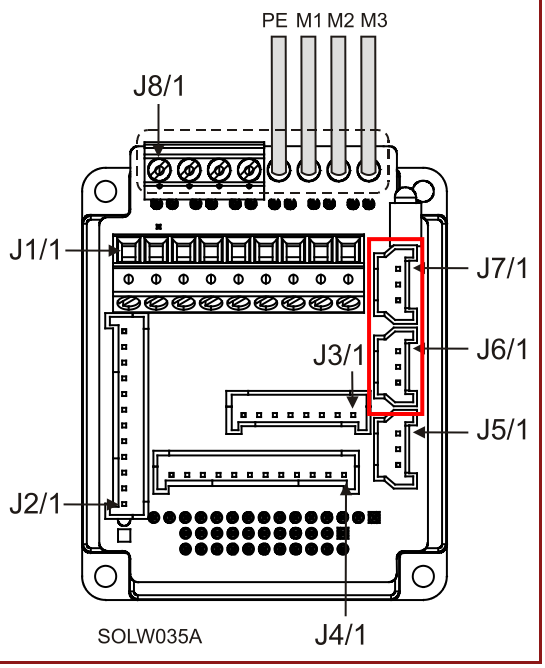


Table 7: CANopen - Pin Assignments

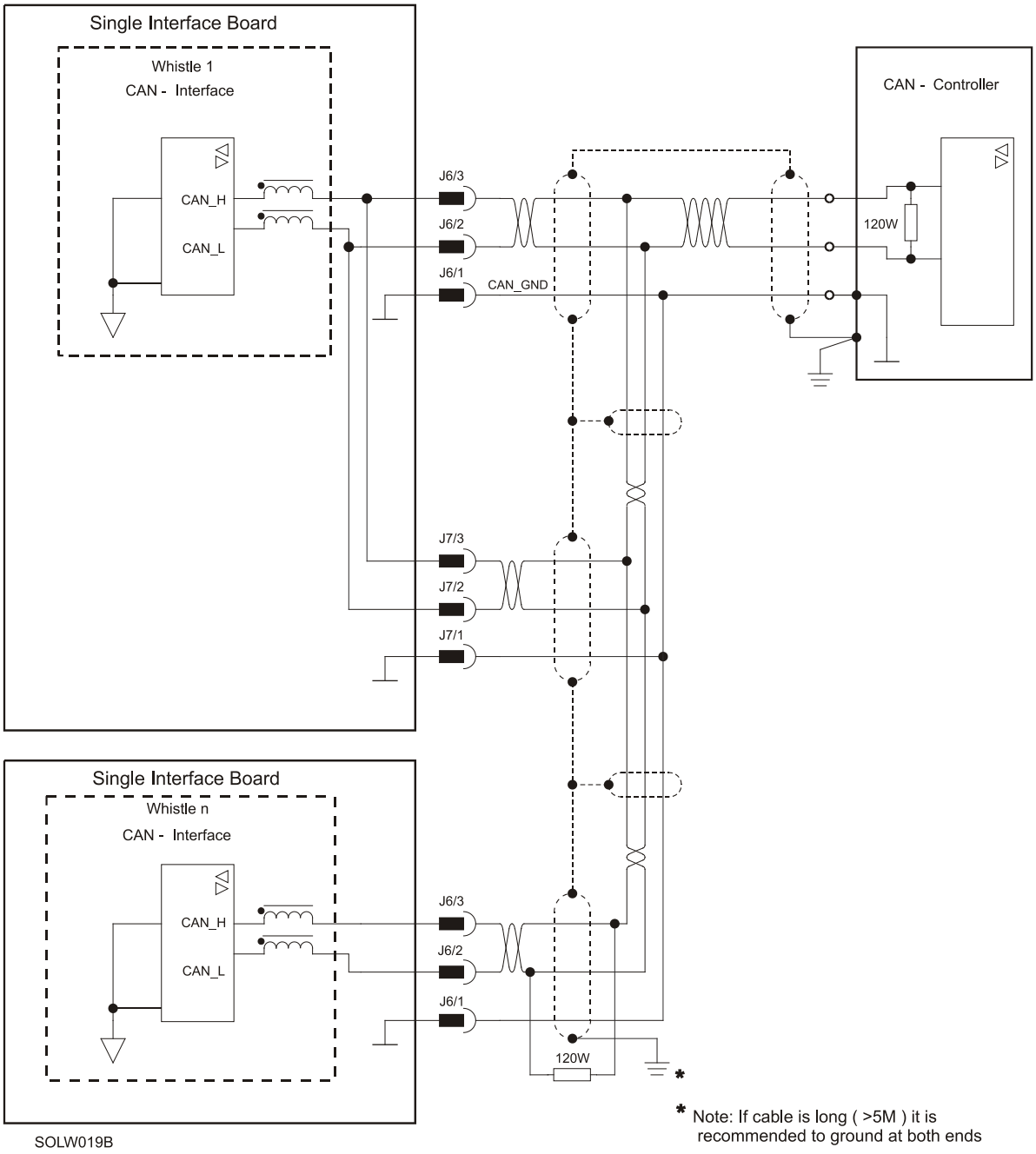
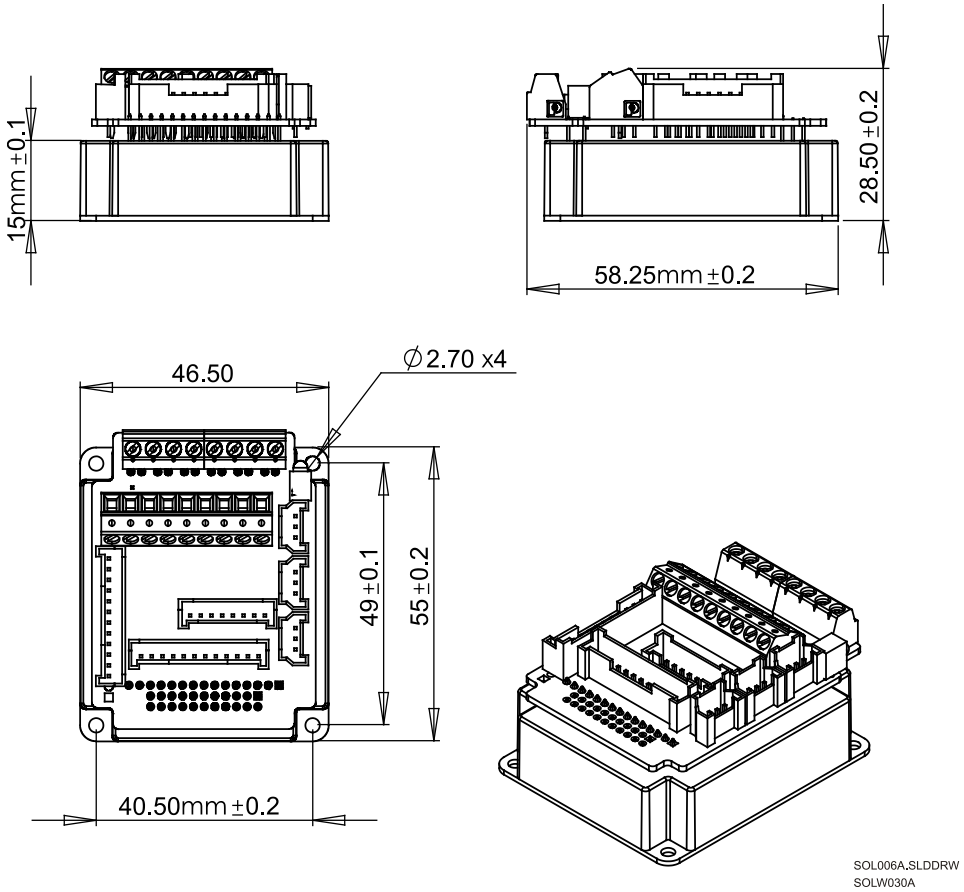


Figure 25: CANopen Network Diagram

Caution:

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

5.8. Dimensions



5.9. Physical Specifications

Feature	Units	
Weight	g (oz)	68.4 g (2.4 oz)
Dimensions	mm (in)	58.25 x 46.5 x 28.5 (2.3" x 1.8" x 1.1")
Mounting method		PCB mount

Chapter 6: Wiring for Models with Suffix M1, M2

This chapter decsribes the wiring for the Solo Whistle models with PN whose suffix is M1, M2. It should be noted that all models up to 50A use a motor powered connector. The Control Connectors are 2.54 mm pitch.

6.1. Connector Types

The Solo Whistle has seven connectors.

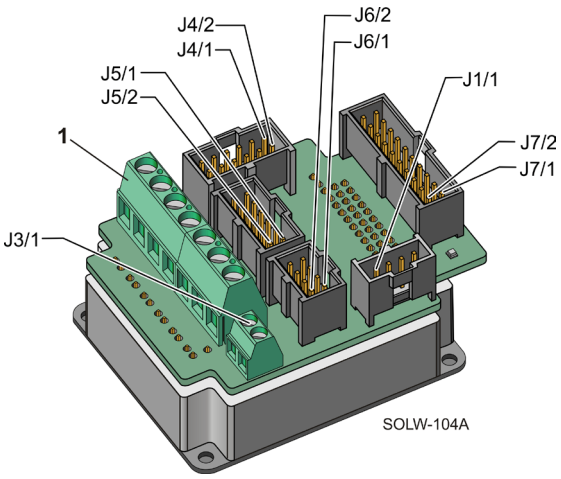
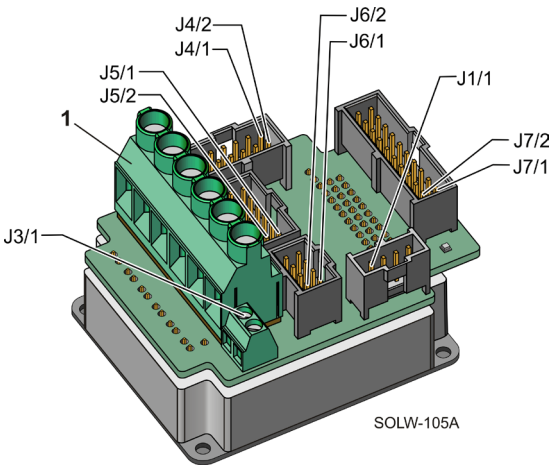
Pins	Type	Port	Function
7 or 6	5.08 mm Pitch for 14-18AWG Wires		Power connector
	6.35 mm Pitch for 10-12AWG Wires		Power connector
2	3.5 mm Pitch	J3	VL
4	2.54 mm Pitch	J1	PTC and Brake
20	2.54 mm Pitch	J7	I/O
12	2.54 mm Pitch	J4	Communication (RS232+CAN)
12	2.54 mm Pitch	J5	Main Feedback
8	2.54 mm Pitch	J6	Main Feedback Buffered Output
Connector Locations			
 **5.08 mm Pitch Power Connector**			 **6.35 mm Pitch Power Connector**	

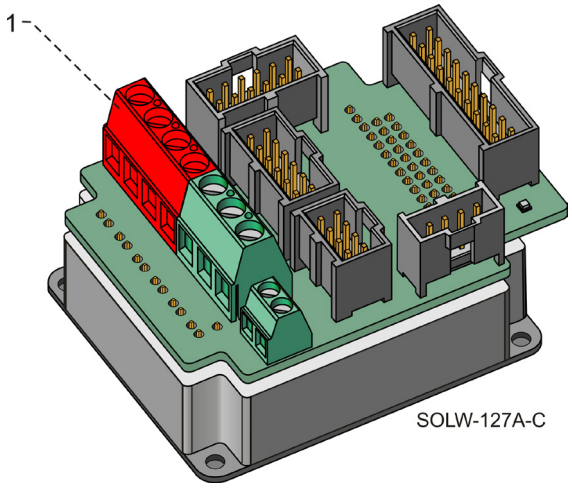
Table 8: Connector Types

Note: Throughout this chapter there are pairs of diagrams of the Solo Whistle. The diagram on the left is the Solo Whistle with a main power connector for up to 25 A. The diagram on the right shows the product with a main power connector for more than 25 A.

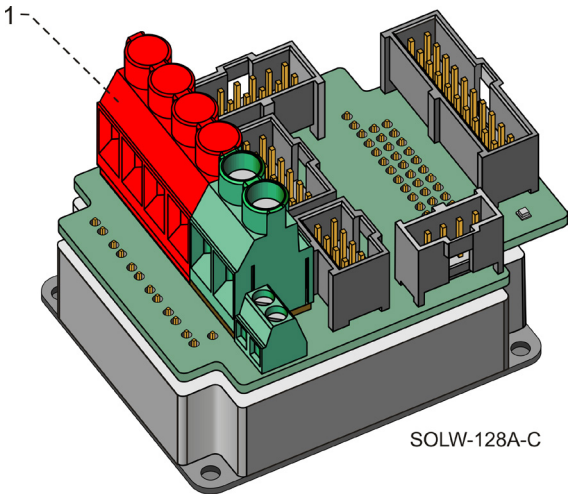
6.2. Motor Power

Pin	Signal	Function		
			AC Motor	DC Motor
1	M1	Motor phase	Motor	N/C
2	M2	Motor phase	Motor	Motor
3	M3	Motor phase	Motor	Motor
4	PE	Protective earth	Motor	Motor

Pin Positions



5.08 mm Pitch Power Connector



6.35 mm Pitch Power Connector

Note: When connecting several drives to several motors, all should be wired in the same motor phases and feedback sequences. This will enable the same ***SimplIQ*** program to run on all drives.

6.2.1. Connecting Motor Power

Connect the M1, M2, M3 and PE pins on the Solo Whistle. The phase connection is arbitrary as the Composer will establish the proper commutation automatically during setup. However, if you plan to copy the setup to other drives, then the phase order on all copy drives must be the same.

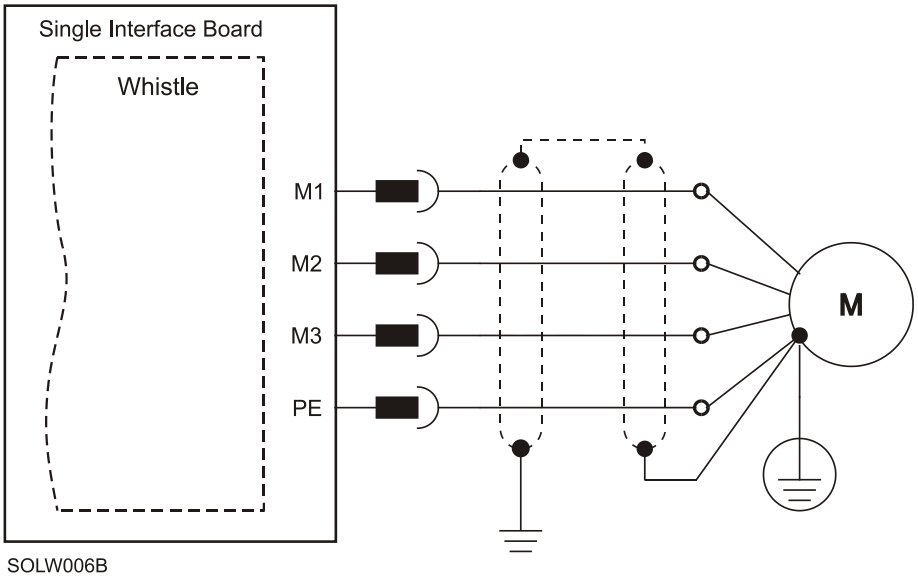
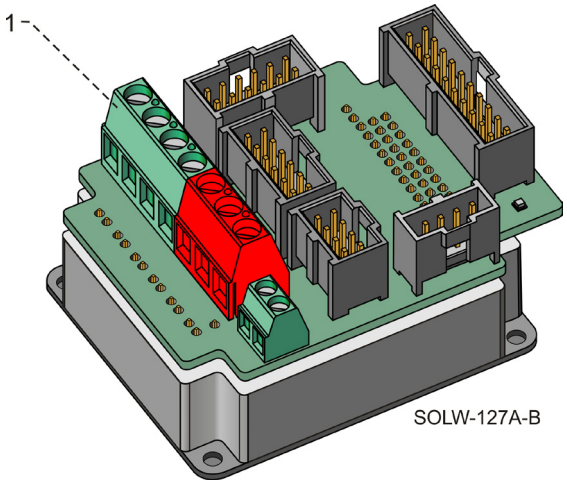


Figure 26: AC Motor Power Connection Diagram

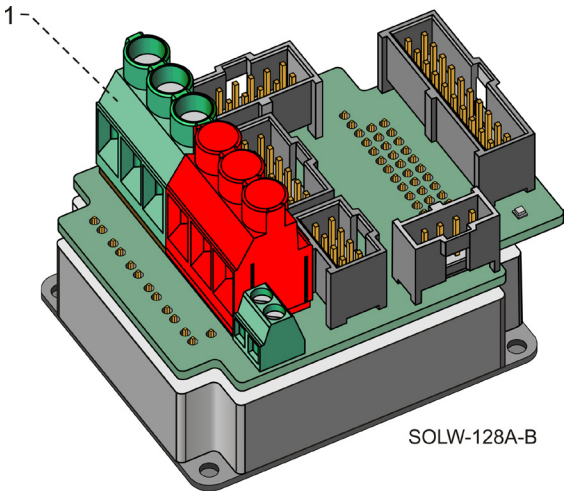
6.3. Main Power

Pitch Connector	Pin	Signal	Function
5.08 mm	5	PE	Protective earth
	6	PR	Power return
	7	VP+	Pos. power input
6.35 mm	4	PE	Protective earth
	5	PR	Power return
	6	VP+	Pos. power input

Pin Positions



5.08 mm Pitch Power Connector

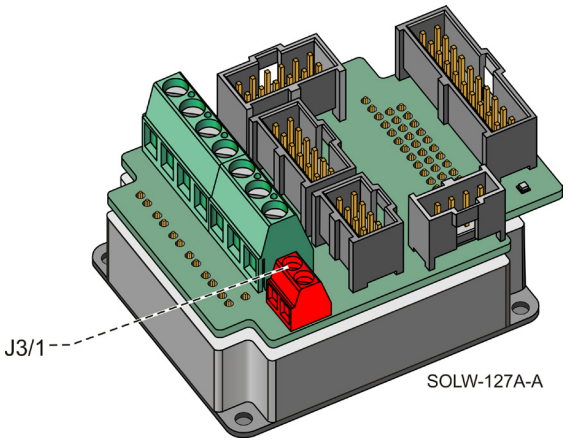


6.35 mm Pitch Power Connector

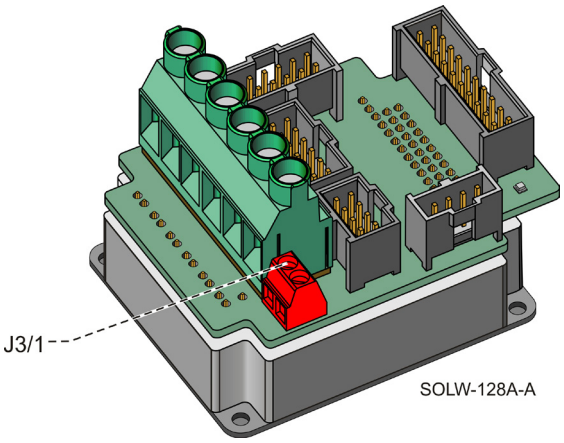
6.3.1. Auxiliary Power Supply – J3

Pin (J3)	Signal	Function
1	VL+	Auxiliary supply input
2	PR	Auxiliary supply input return

Pin Positions



5.08 mm Pitch Power Connector



6.35 mm Pitch Power Connector

6.3.2. Connecting Main & Auxiliary Power

Power to the Solo Whistle is provided by a 12 to 195 VDC source. A smart control-supply algorithm enables the Solo Whistle to operate with the power supply only for up to 100 V models, with no need for an auxiliary 24 volt supply.

200 V models always require two separate power supplies.

If backup functionality is required (for storing control parameters in case of power-outs) an additional backup supply can be connected by implementing "diode coupling" to the VL+.

Note: The source of the 12 to 195 VDC Main Power Supply must be isolated.

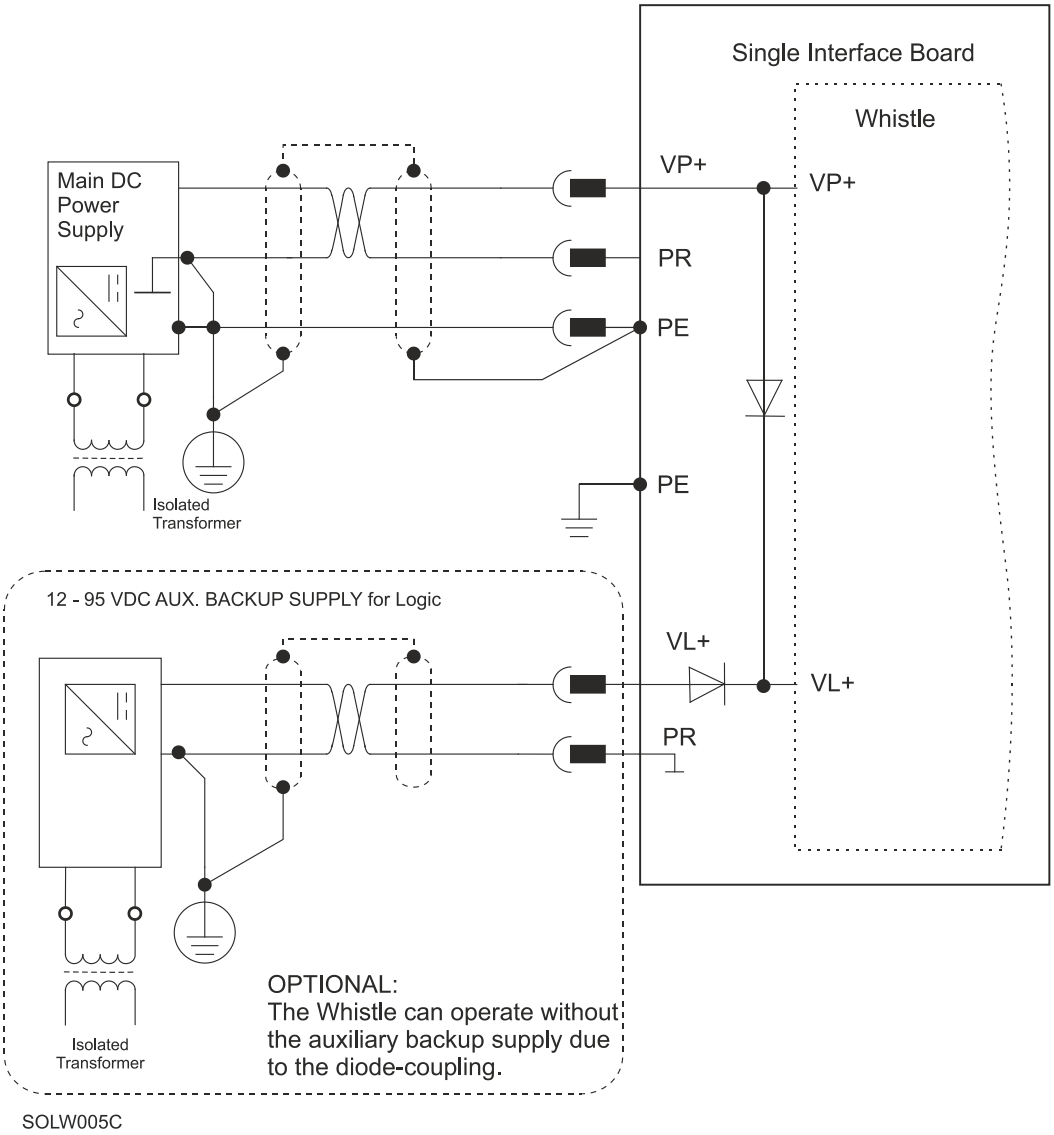


Figure 27: Main & Auxiliary Power Supply Connection Diagram

6.4. Motor (Brake, PTC) – J1

Brake functionality is only applicable for the M1 Suffixed part number.

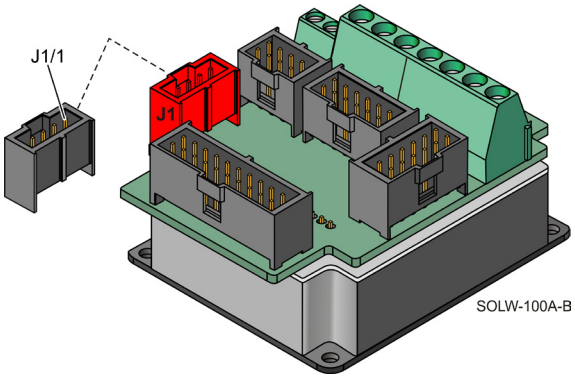
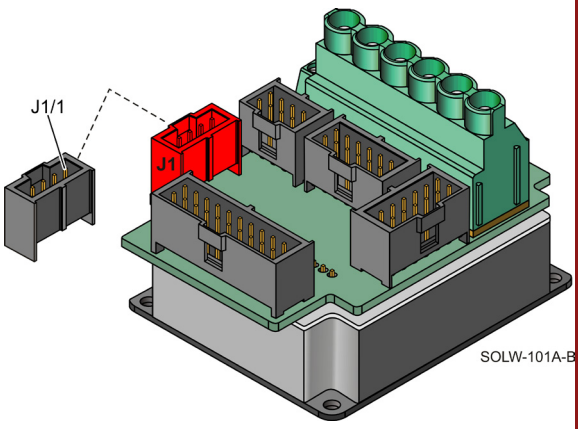
Pin (J1)	Signal	Function
1	BRAKE –(VDD_RET)	Brake (-) (coming from the motor)
2	BRAKE +($D_{out}1$)	Brake (+) (coming from the motor)
3	PTC	Motor Protection Sensor (coming from the motor)
4	PTC	Motor Protection Sensor (coming from the motor)
Pin Positions		
 **5.08 mm Pitch Power Connector**		 **6.35 mm Pitch Power Connector**

Table 9: The Motor Brake and PTC Connector

Note: **For models with suffix M1, the Brake Pin from J1 is limited to 1.0 A whereas $D_{out}1$ Pin from J7 is limited to 250 mA.**
The Brake and $D_{out}1$ are connected internally in parallel.
Do not use both the Brake and $D_{out}1$ pins simultaneously.

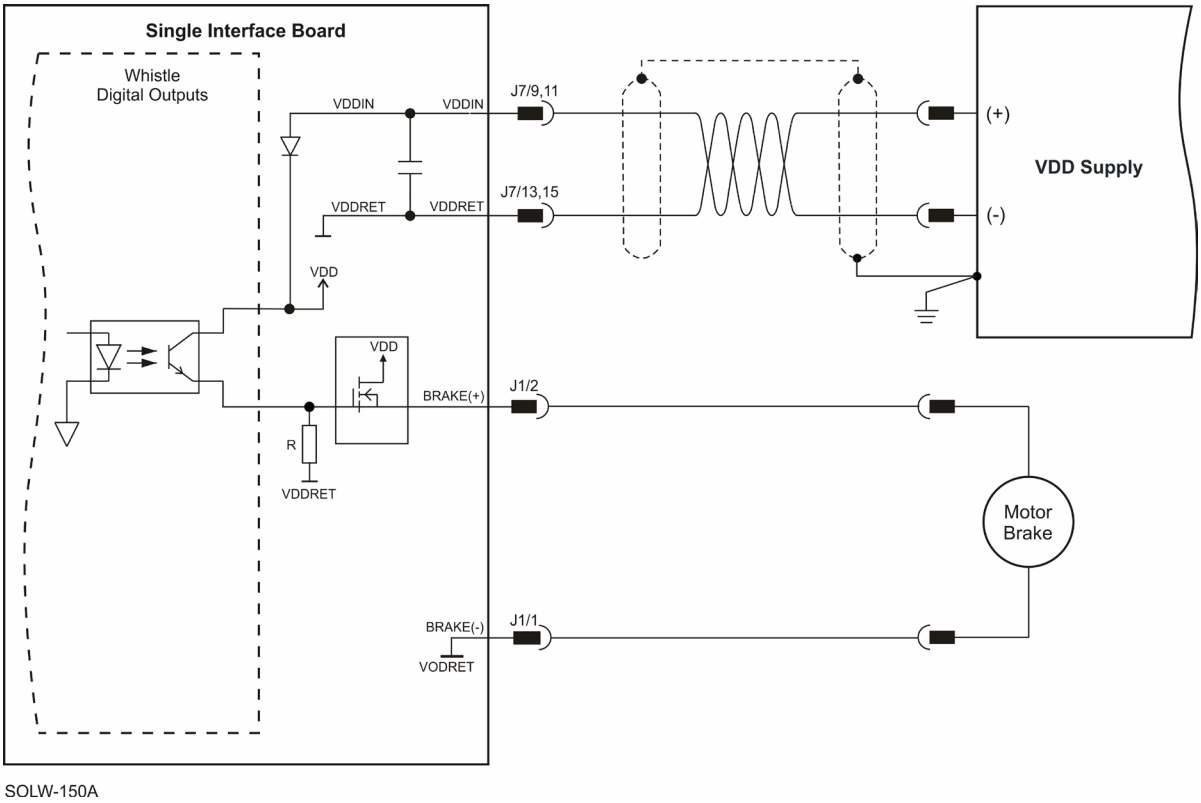
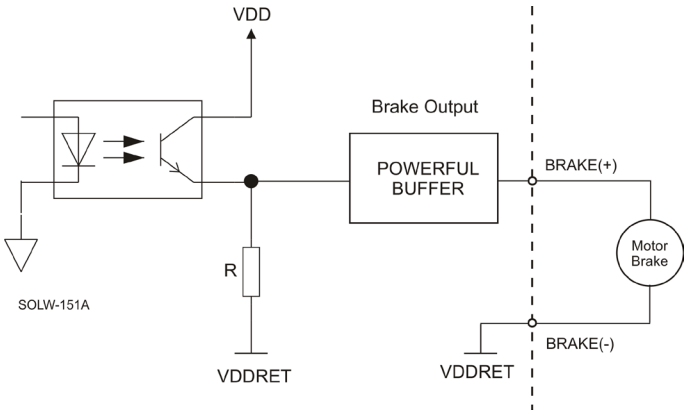


Figure 28: Motor Brake Connection Diagram

6.4.1.1. Motor Brake Interface

Feature	Details
Type of output	• Optically isolated • Powerful Source capability
VDD Supply Range	15 V to 30 V
Max. output current Iout (max)	Iout Brake (max) ≤ 1 A
VOH	VDD≥VOH ≥ VDD-(Ix0.1)
VOL	VOL ≤ 1 V
RL	External RL must be selected to limit output current. $RL=\frac{VDD-Ix0.1}{I_{out\ (max)}}$
Executable time	If output is set to one of the built-in functions - Home flag, Brake or AOK - execution is immediate upon detection: 0 < T < 4 x TS If output is set to General output and is executed from a program, the typical time is approximately 0.5 msec.
Schematic Diagram	
SOURCE  	

6.5. Main Feedback – J5

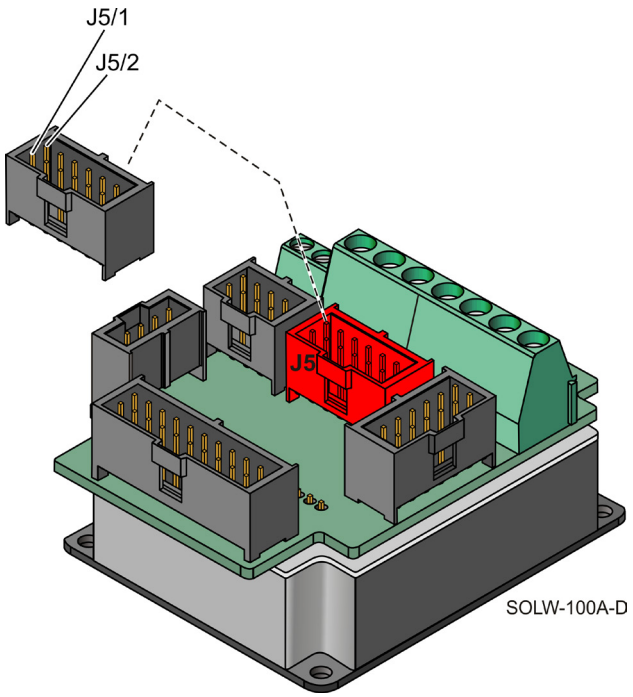
The Main Feedback port is used to transfer feedback data from the motor to the drive. In order to copy the setup to other drives, the phase order on all copy drives must be the same.

The Solo Whistle can accept any one of the following devices as a main feedback mechanism:

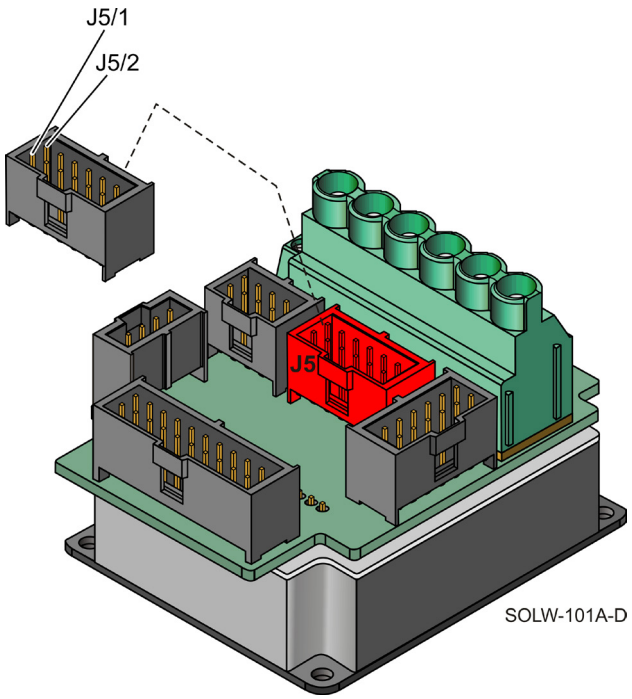
- Incremental encoder only
- Incremental encoder with digital Hall sensors
- Digital Hall sensors only
- Incremental Analog (Sine/Cosine) encoder (option)
- Resolver (option)
- Tachometer (option)
- Potentiometer (option)

	Incremental Encoder		Interpolated Analog Encoder		Resolver		Tachometer and Potentiometer	
	SOL-WHIAXX/YYYEZZ		SOL-WHIAXX/YYYIZZ		SOL-WHIAXX/YYYRZZ		SOL-WHIAXX/YYYTZZ	
Pin (J5)	Signal	Function	Signal	Function	Signal	Function	Signal	Function
11	HC	Hall sensor C input	HC	Hall sensor C input	NC	-	HC	Hall sensor C input
9	HA	Hall sensor A input	HA	Hall sensor A input	NC	-	HA	Hall sensor A input
12	PE	Protective Earth	PE	Protective Earth	PE	Protective Earth	PE	Protective Earth
2	SUPRET	Supply return	SUPRET	Supply return	SUPRET	Supply return	SUPRET	Supply return
1	+5V	Encoder/Hall +5V supply	+5V	Encoder/Hall +5V supply	+5V	Encoder/Hall +5V supply	+5V	Encoder/Hall +5V supply
4	CHA-	Channel A complement	A-	Sine A complement	S3	Sine A complement	Tac 1-	Tacho Input 1 Neg. (20 V max)
3	CHA	Channel A	A+	Sine A	S1	Sine A	Tac 1+	Tacho Input 1 Pos. (20 V max)
8	INDEX-	Index complement	R-	Reference complement	R2	Vref complement f= 1/TS, 50 mA Maximum	NC	-
7	INDEX	Index	R+	Reference	R1	Vref f=1/TS, 50 mA Max.	POT	Potentiometer Input (5 V Max)
10	HB	Hall sensor B input	HB	Hall sensor B input	NC	-	HB	Hall sensor B input
6	CHB-	Channel B complement	B-	Cosine B complement	S4	Cosine B complement	Tac 2-	Tacho Input 2 Neg. (50 V max)
5	CHB	Channel B	B+	Cosine B	S2	Cosine B	Tac 2+	Tacho Input 2 Pos. (50 V max)

Pin Positions



5.08 mm Pitch Power Connector



6.35 mm Pitch Power Connector

Table 10: Main Feedback Pin Assignments

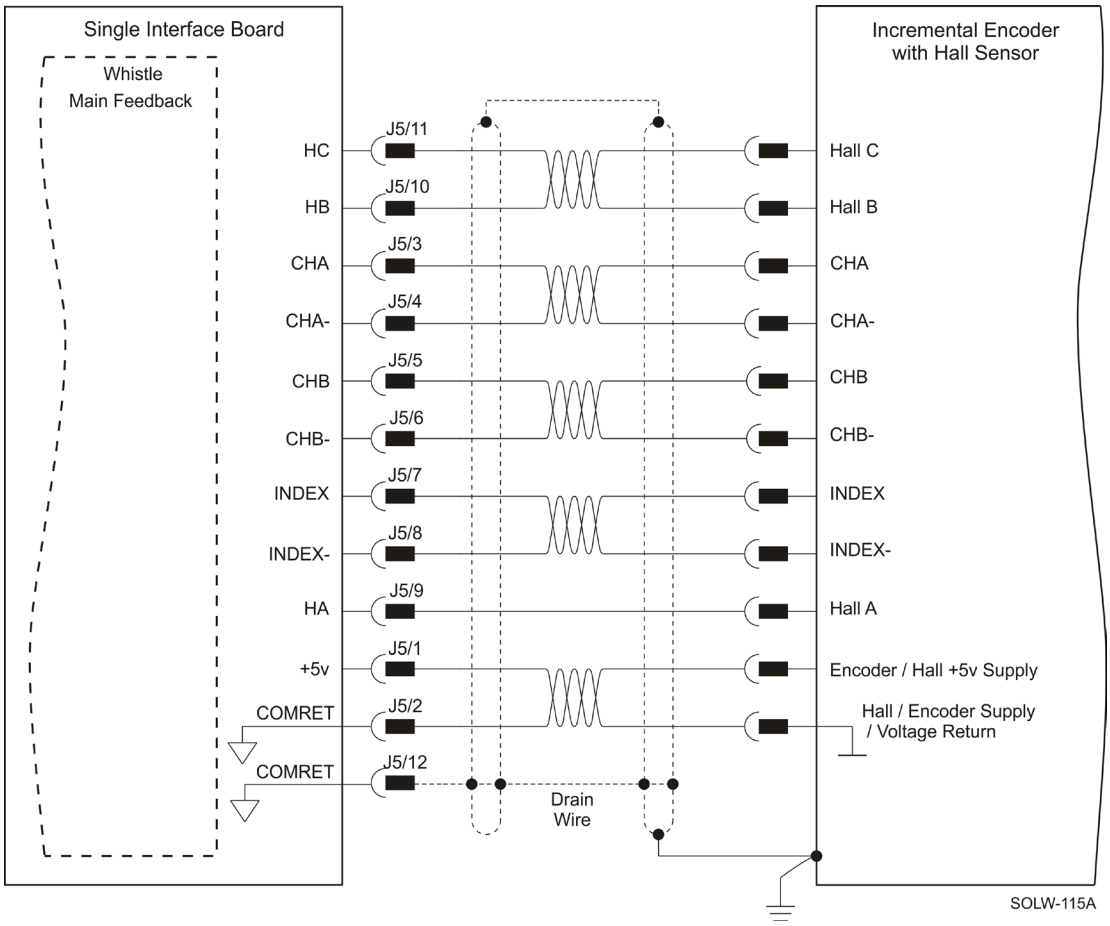


Figure 29: Main Feedback- Incremental Encoder with Digital Hall Sensor Connection Diagram

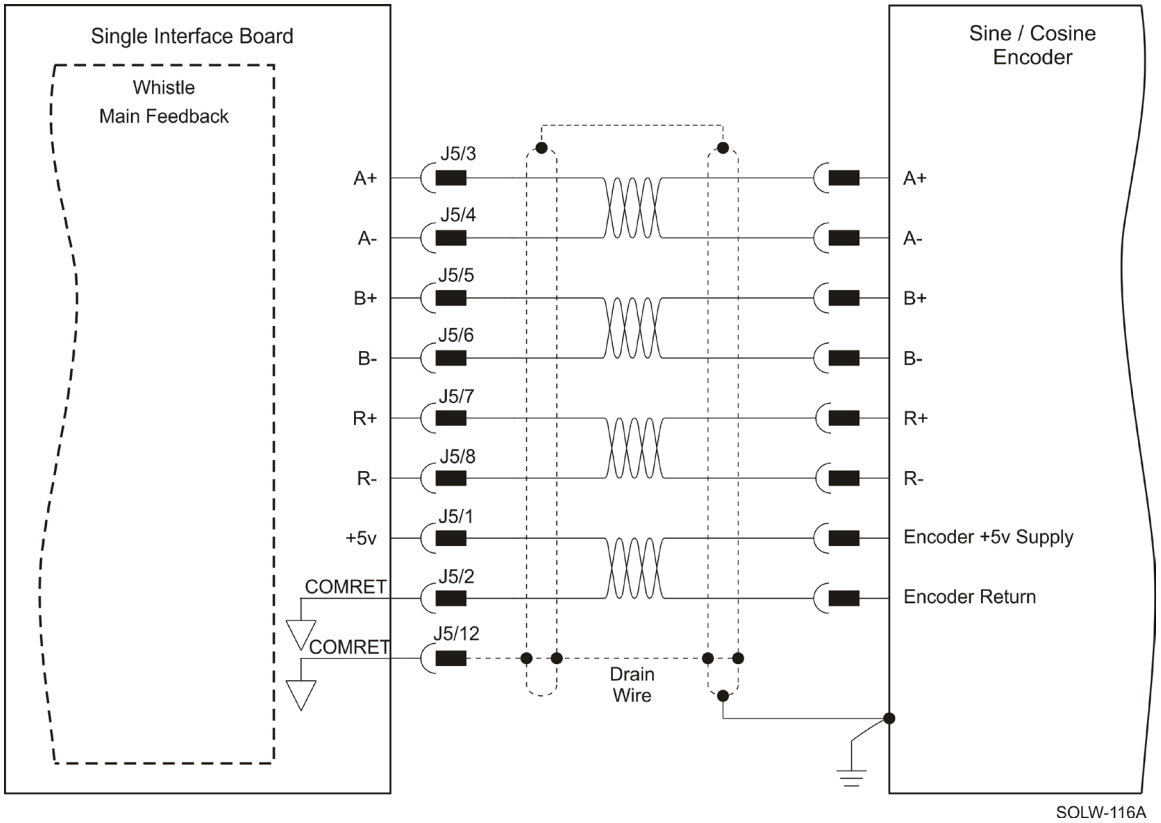


Figure 30: Main Feedback – Interpolated Analog (Sine/Cosine) Encoder Connection Diagram

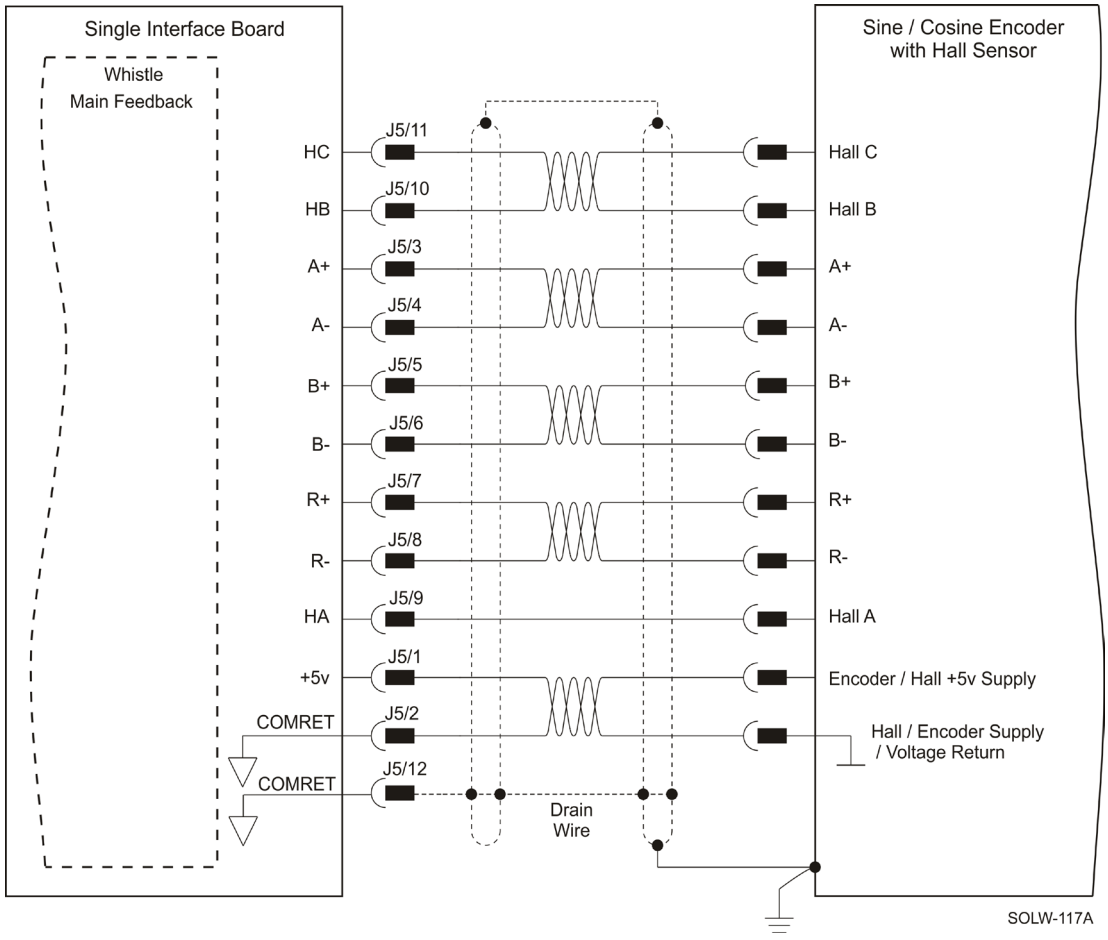


Figure 31: Main Feedback – Interpolated Analog (Sine/Cosine) Encoder with Digital Hall Sensor Connection Diagram

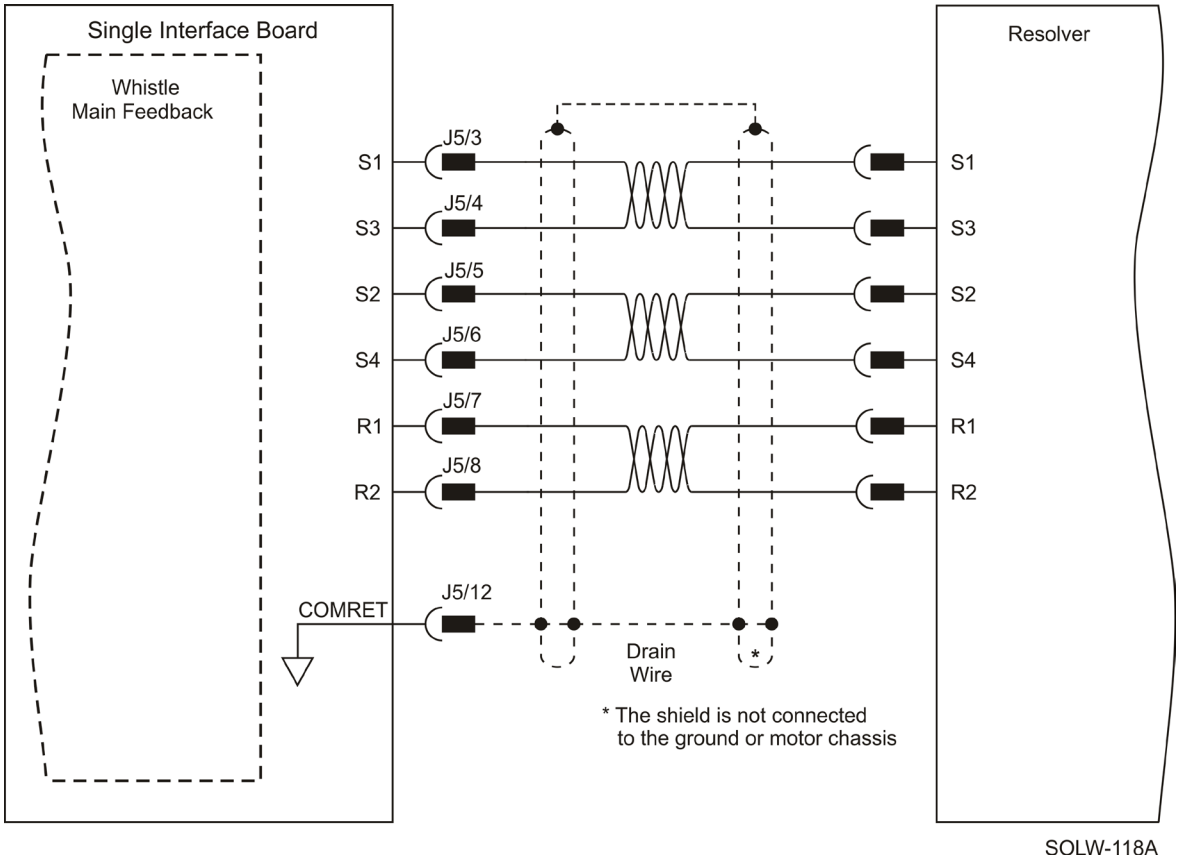


Figure 32: Main Feedback – Resolver Connection Diagram

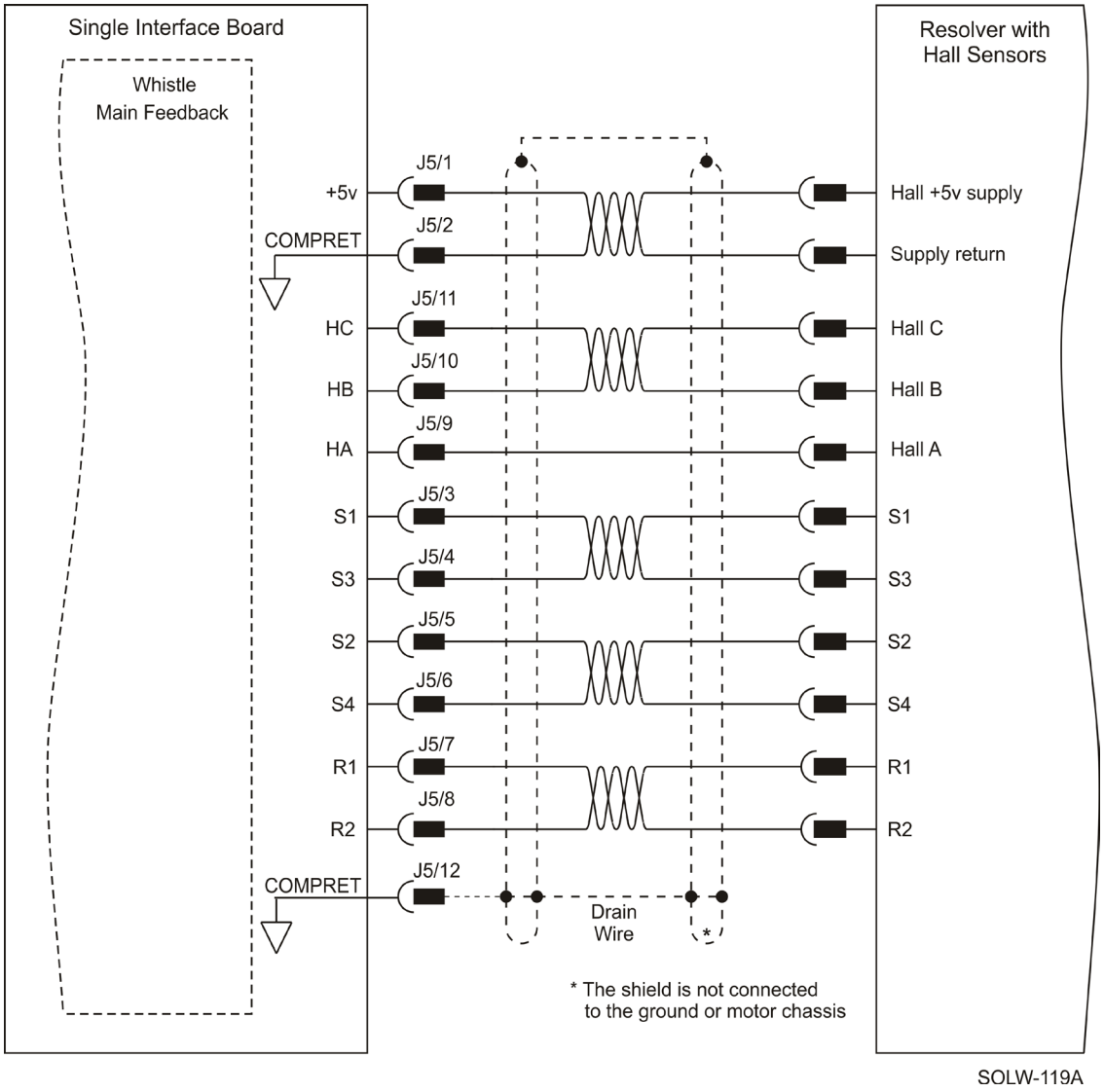


Figure 33: Main Feedback – Resolver with Digital Hall Sensor Connection Diagram

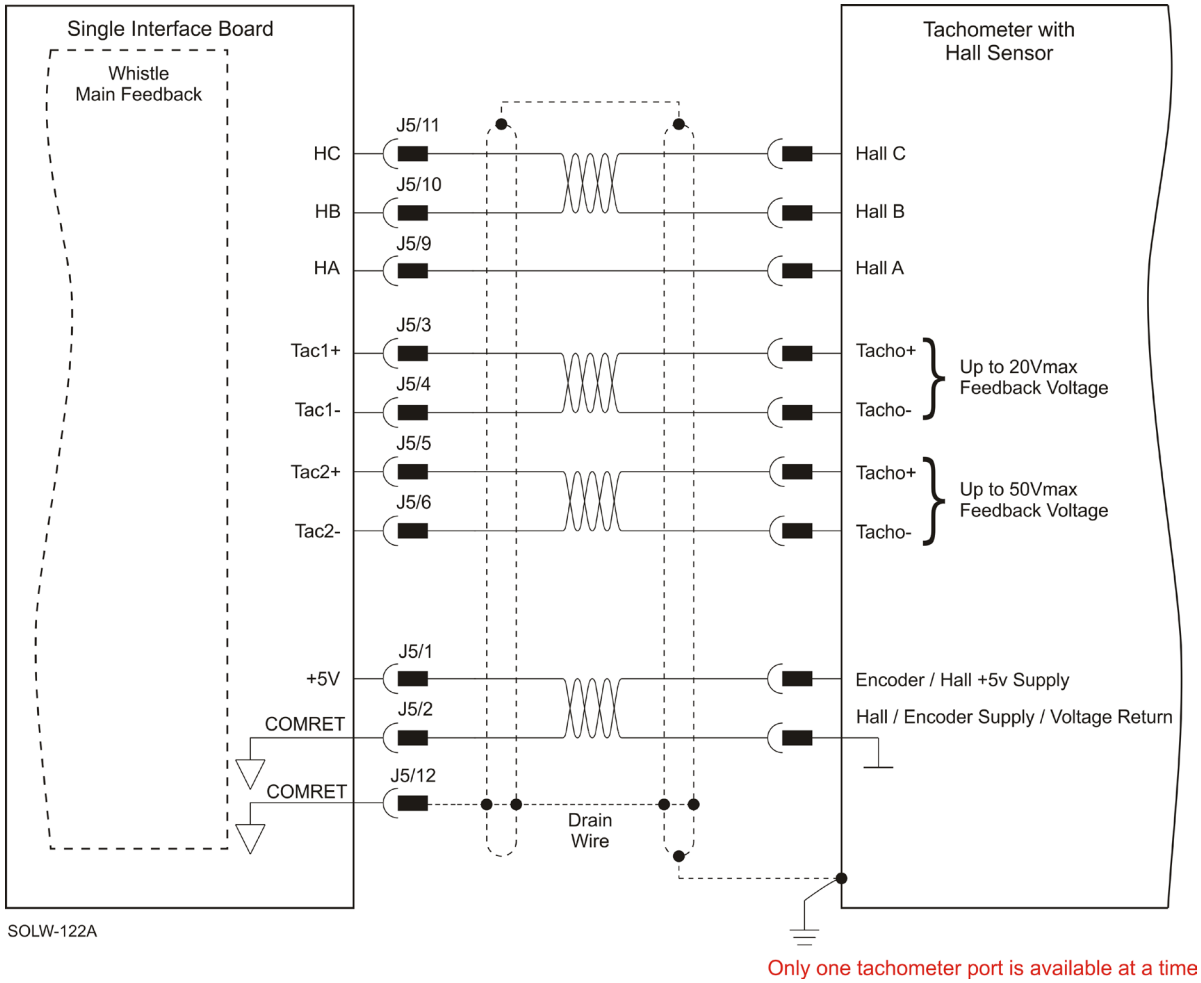


Figure 34: Main Feedback – Tachometer Feedback with Digital Hall Sensor Connection Diagram for Brushless Motors

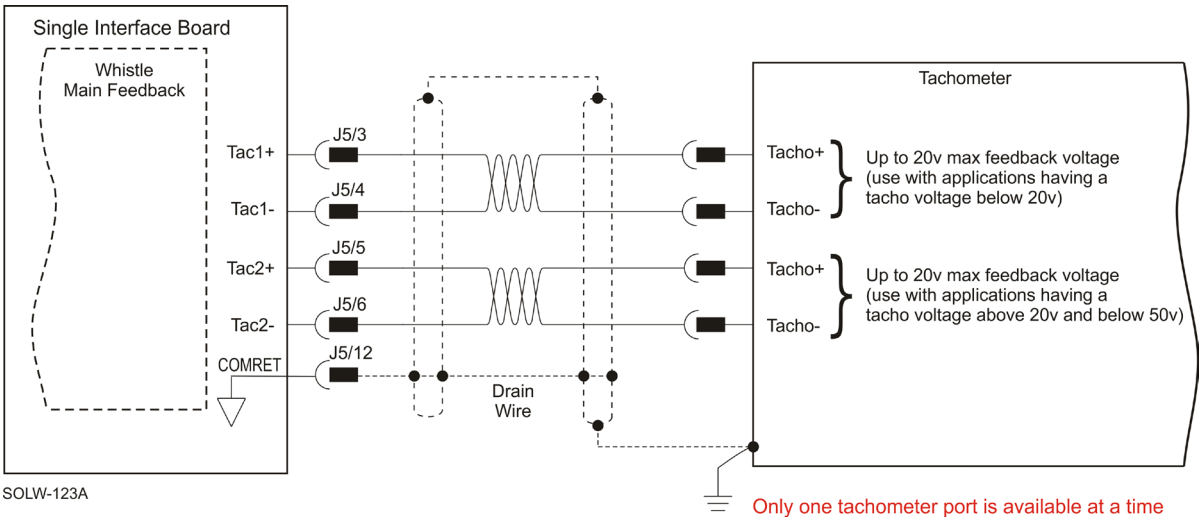


Figure 35: Main Feedback – Tachometer Feedback Connection Diagram for Brush Motors

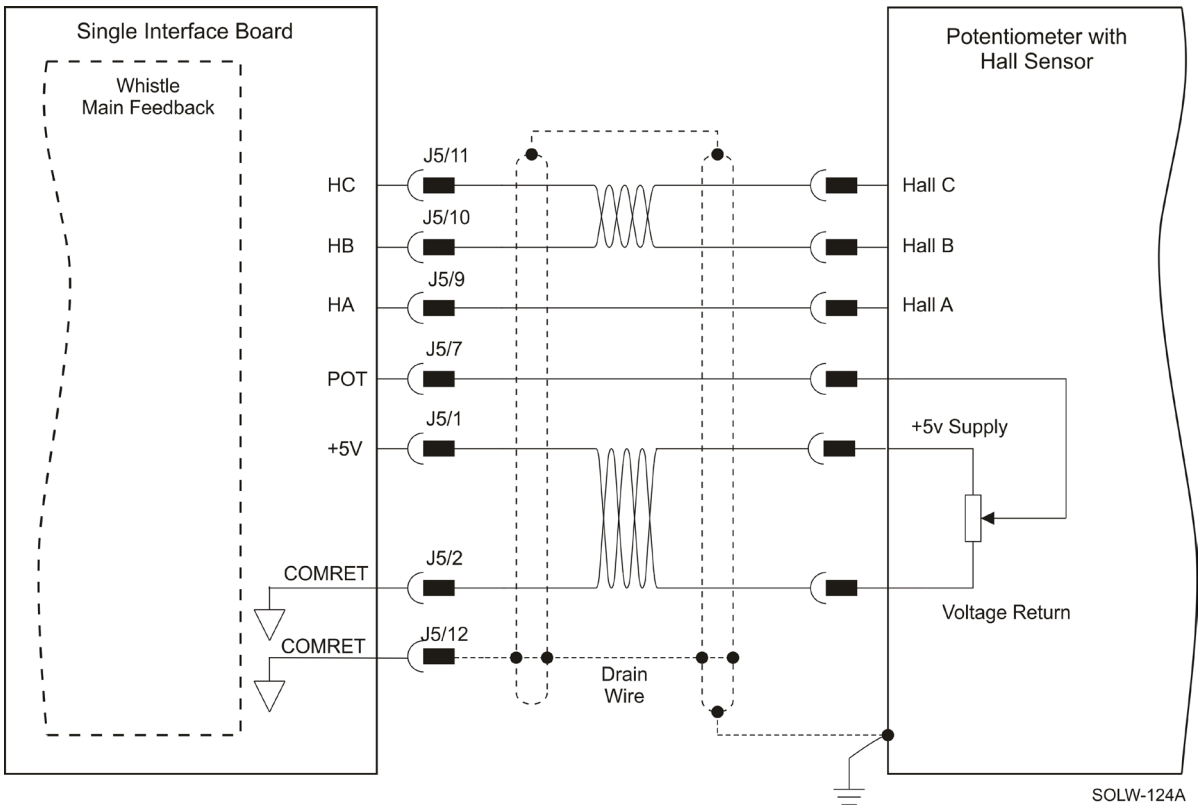


Figure 36: Main Feedback – Potentiometer Feedback with Digital Hall Sensor Connection Diagram for Brushless Motors

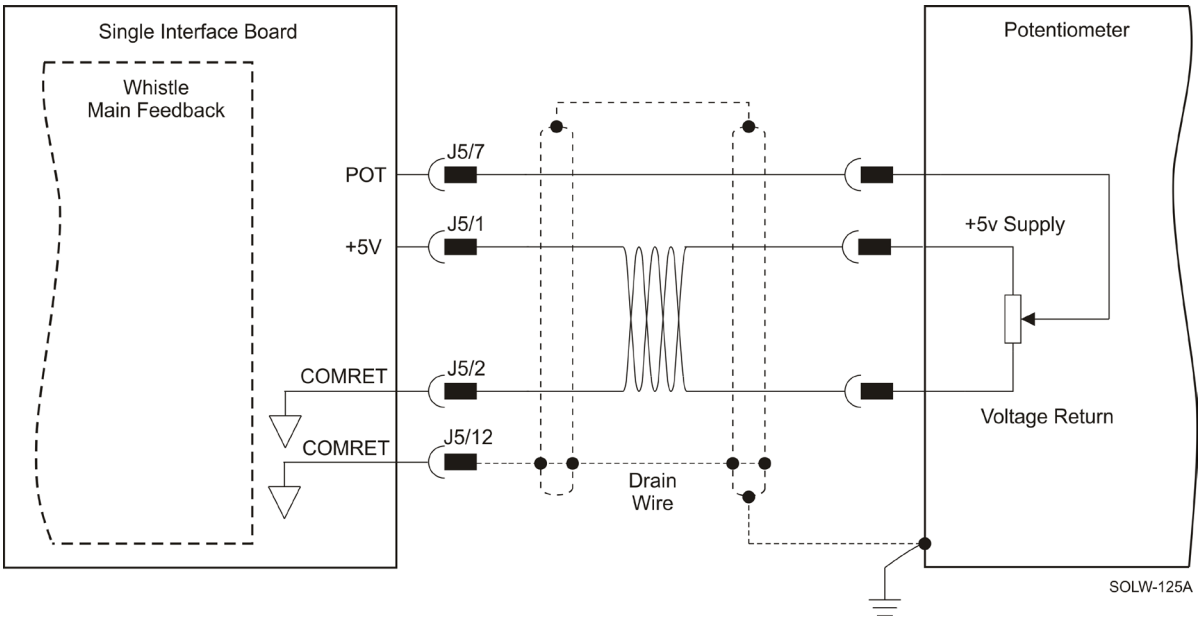


Figure 37: Main Feedback –
Potentiometer Feedback Connection Diagram for Brush Motors and Voice Coils

6.6. Auxiliary Feedback – J6

When using one of the Auxiliary Feedback options, the relevant functionality of the Auxiliary Feedback's ports are software- and hardware-selected for that option. Refer to the *SimplIQ Command Reference Manual* for detailed information about Auxiliary Feedback setup.

6.6.1. Auxiliary Feedback Operation Mode

The mode of operation for the Solo Whistle is the Auxiliary output
(Composer command: **YA[4]=4**) – see next section 6.6.1.1.

Differential emulated encoder outputs are used to provide emulated encoder signals to another controller or drive. The emulated encoder output option is only available when using a resolver or analog encoder as the main feedback device.

This option can be used when:

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

The Main Feedback is always used in motion control devices whereas Auxiliary Feedback is often, but not always used. The Auxiliary Feedback connector on the Solo Whistle has three bi-directional pins (CHA, CHB and INDEX). The Auxiliary Feedback can be set by software as follows:

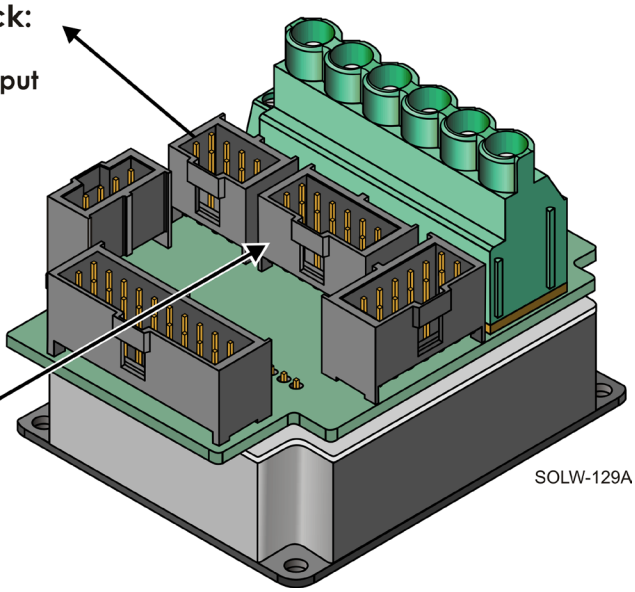
<table>
<tr><th>Main Feedback</th><th colspan="2">Auxiliary Feedback: Output</th></tr>
<tr><td>Software Setting</td><td colspan="2">YA[4] = 4
(Auxiliary Feedback: output)</td></tr>
<tr><td>Incremental Encoder Input

✦Interpolated Analog (Sine/Cosine) Encoder Input

★Resolver Input

✶Potentiometer/ Tachometer Input</td><td colspan="2">Auxiliary Feedback:
Emulated Differential
Buffered Encoder Output

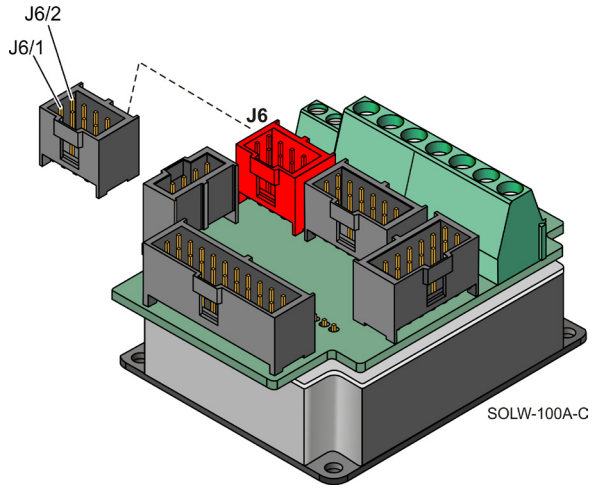
Main Feedback:
Incremental Encoder
Interpolated Analog
(Sin/Cos) Encoder
OR Resolver
OR Potentiometer
OR Tachometer

 
SOLW-129A</td></tr>
<tr><td>Typical Applications</td><td colspan="2">✦ Analog Encoder applications where position data is required, in the Encoder's quadrature format, for other purposes such as position controllers and/or other drives.
★ Resolver applications where position data is required in the Encoder's quadrature format, for other purposes such as position controllers and/or other drives.
✶ Potentiometer and Tachometer applications where position data is required, in the Encoder's quadrature format, for other purposes such as position controllers and/or other drives.</td></tr>
</table>

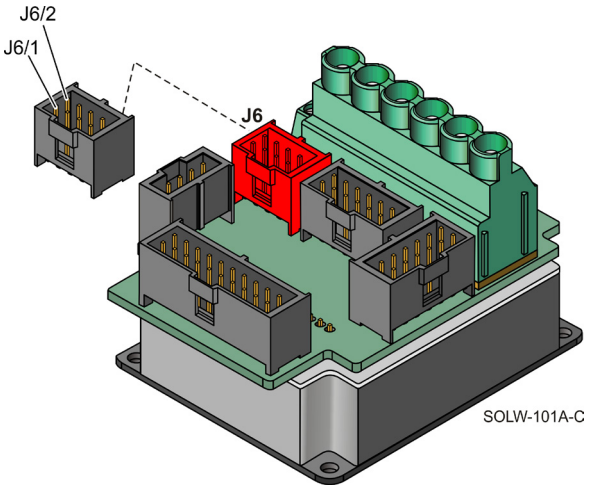
6.6.1.1. Emulated Encoder Output Option (YA[4]=4)

Pin (J6)	Signal	Function
1	CHAO	Buffered Channel A output
2	CHAO-	Buffered Channel A complement output
3	CHBO	Buffered Channel B output
4	CHBO-	Buffered Channel B complement output
5	INDEXO	Buffered Index output
6	INDEXO-	Buffered Index complement output
7	COMRET	Common return
8	COMRET	Common return

Pin Positions



5.08 mm Pitch Power Connector



6.35 mm Pitch Power Connector

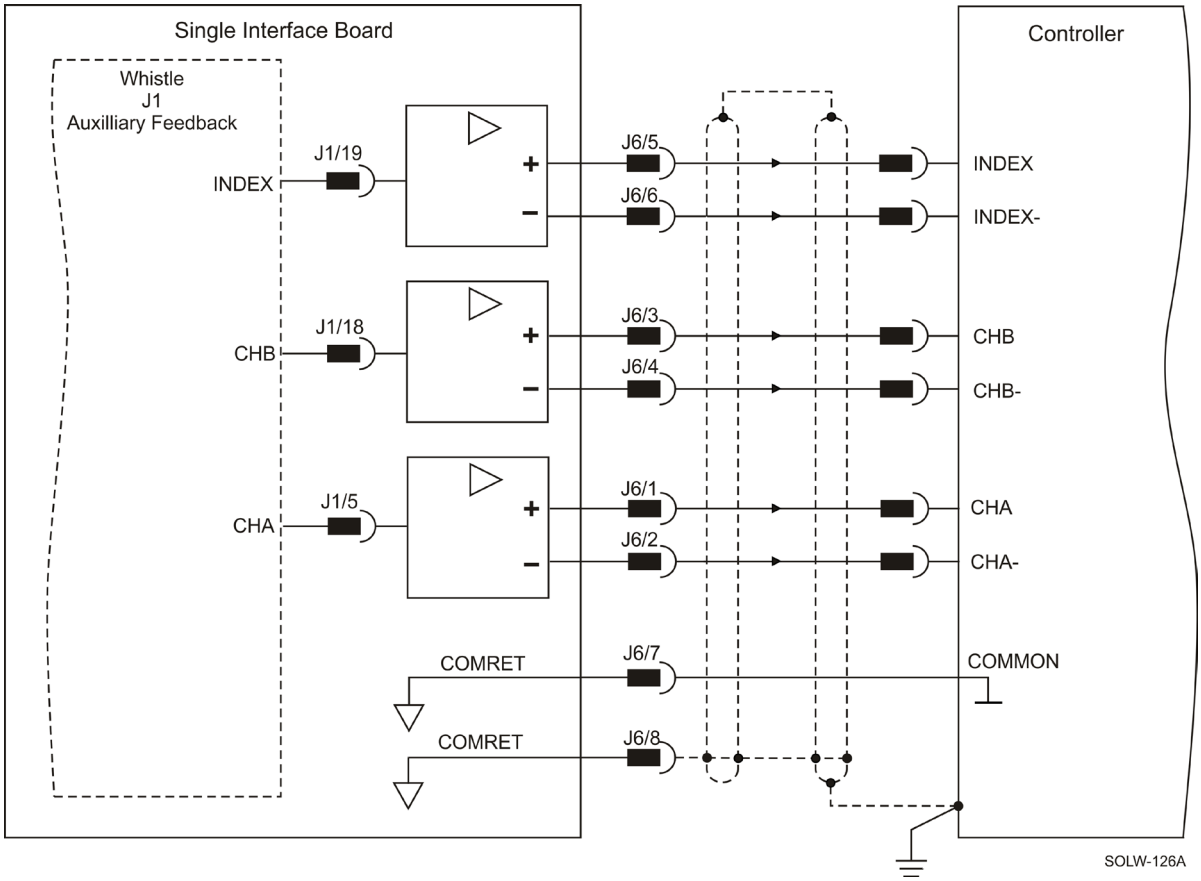


Figure 38: Emulated Encoder Differential Output Diagram

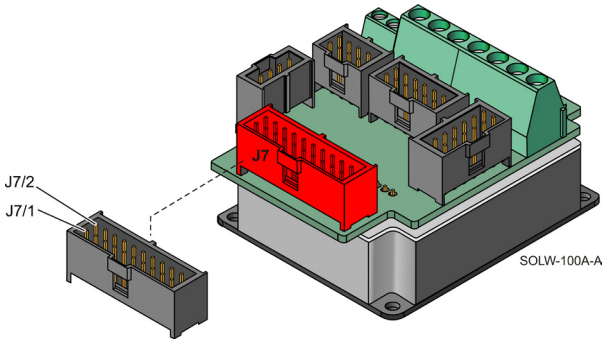
6.7. I/Os –J7

The Solo Whistle has four digital inputs, two digital outputs and one analog input.

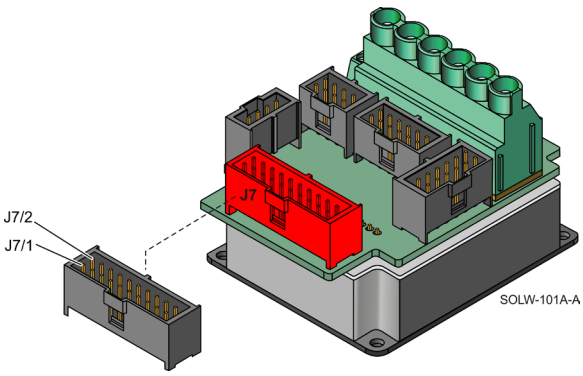
6.7.1. Digital Input

The digital input level signal can be 5 V (TTL) or 24 V (PLC).

Pin (J7)	Signal	Function
1	IN2	Programmable input 2 (general purpose, RLS, FLS, INH)
2	INRET	Programmable input return
3	IN4	Programmable input 4 (general purpose, RLS, FLS, INH)
4	IN3	Programmable input 3 (general purpose, RLS, FLS, INH)
5	IN5	Hi-Speed Programmable input 5 (event capture, Main Home, general purpose, RLS, FLS, INH)
6	INRET	Programmable input return
7	IN6	Hi-Speed Programmable input 6 (event capture, Auxiliary Home, general purpose, RLS, FLS, INH)
8	INRET	Programmable input return
Pin Positions		



5.08 mm Pitch Power Connector



6.35 mm Pitch Power Connector

Table 11: Digital Input Pin Assignments

6.7.1.1. Digital Input 5 V (TTL)

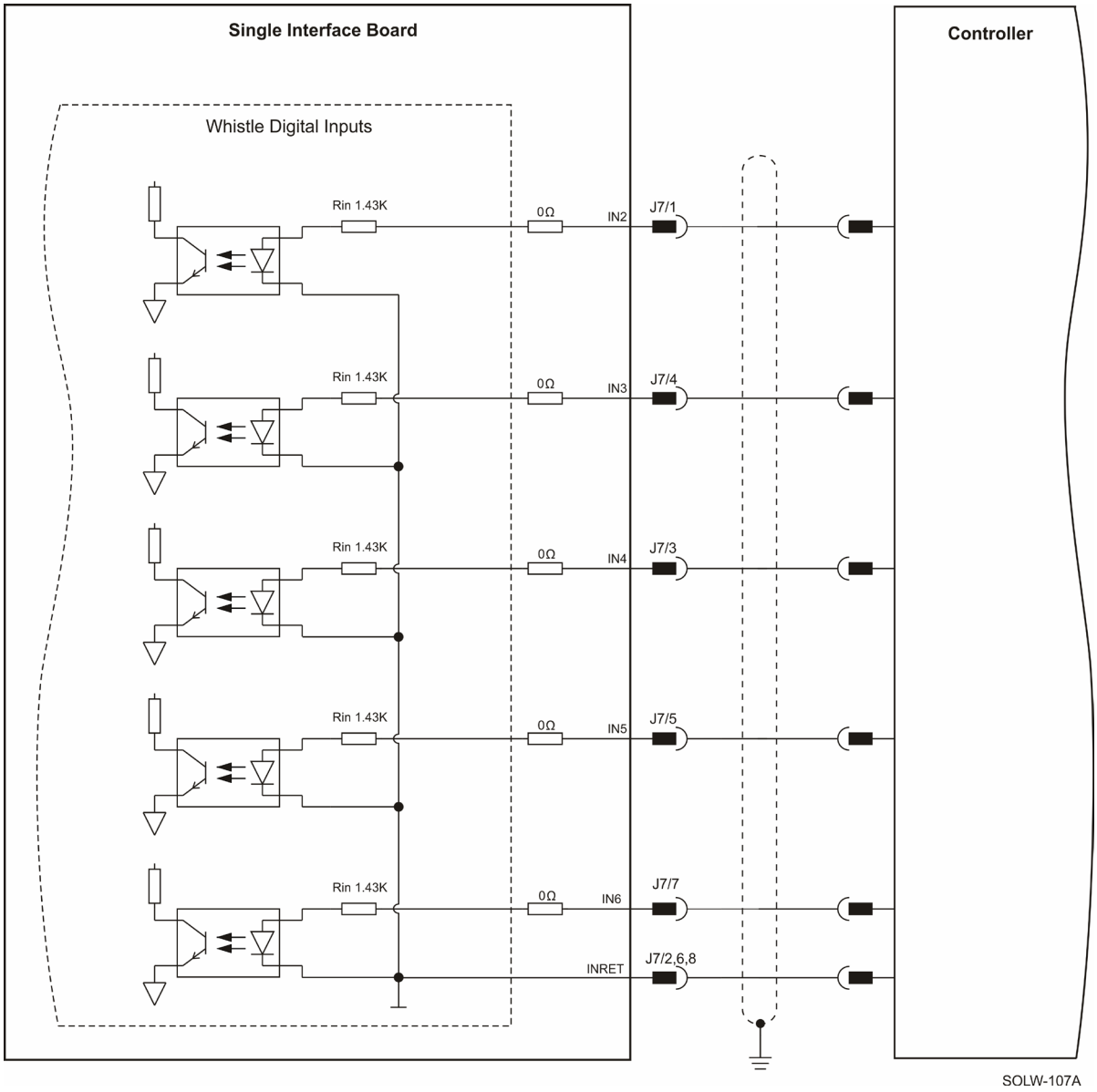


Figure 39: Digital Input 5 V Connection Diagram

6.7.1.2. Digital Input 24 V (PLC)

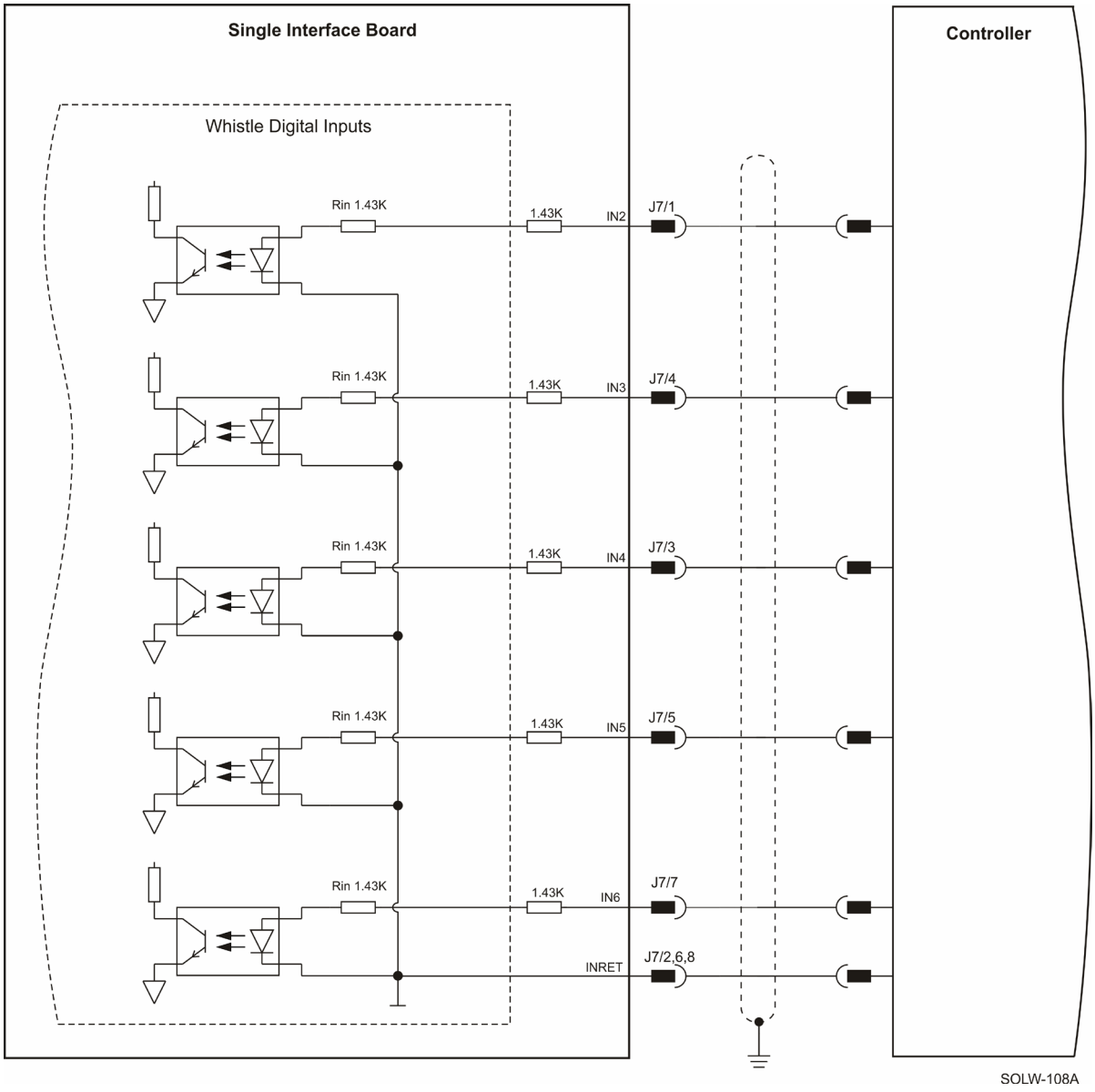


Figure 40: Digital Input 24 Connection Diagram

6.7.1.3. Digital Input Interfaces

Feature	Details
Type of input	• Optically isolated • All four inputs share one signal return line
Input current for 5 V DI level	R_{in}=1.43K, I_{in} = 2.8 mA @ V_{in} = 5 V
Input current for 24 V DI level	R_{in}=2.86k, I_{in} = 8.0 mA @ V_{in} = 24 V
High-level input voltage	5 V < V_{in} < 24 V
Low-level input voltage	0 V < V_{in} < 1 V
Minimum pulse width	> 4 x TS, where TS is sampling time
Execution time (all inputs): the time from application of voltage on input until execution is complete	If input is set to one of the built-in functions — Home, Inhibit, Hard Stop, Soft Stop, Hard and Soft Stop, Forward Limit, Reverse Limit or Begin — execution is immediate upon detection: 0<T<4xTS If input is set to General input, execution depends on program. Typical execution time: ≅ 0.5 msec.
High-speed inputs – 5 & 6 minimum pulse width, in high-speed mode	T < 5 µsec **Notes:** • Home mode is high-speed mode and can be used for fast capture and precise homing. • High speed input has a digital filter set to same value as digital filter (EF) of main encoder. • Highest speed is achieved when turning on optocouplers.

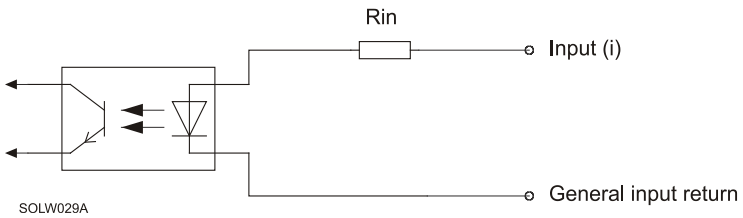
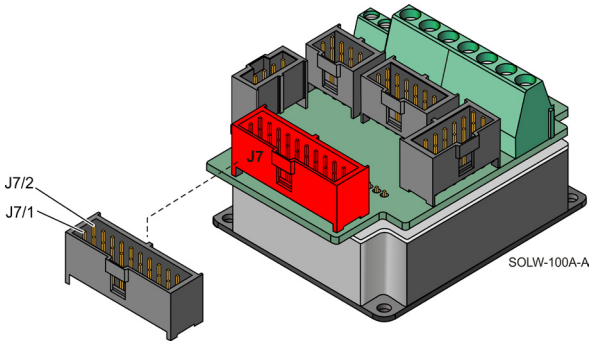


Figure 41: Digital Input Schematic

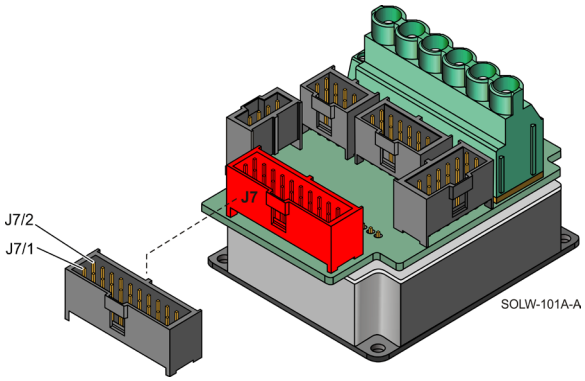
6.7.2. Digital Output

Pin (J7)	Signal	Function
9	VDDIN	Digital output supply
10	OUT1	Programmable digital output 1
11	VDDIN	Digital output supply
12	OUT2	Programmable digital output 2
13	VDDRET	Digital output supply return
15	VDDRET	Digital output supply return

Pin Positions



5.08 mm Pitch Power Connector



6.35 mm Pitch Power Connector

Table 12: Digital Output Pin Assignment

Note: **For models with suffix M1, the Brake Pin from J1 is limited to 1.0 A whereas $D_{out}1$ and $D_{out}2$ Pins from J7 are each limited to 250 mA.**
The Brake and $D_{out}1$ are connected internally in parallel.
Do not use both the Brake and $D_{out}1$ pins simultaneously.

6.7.2.1. Digital Output 24 V (PLC)

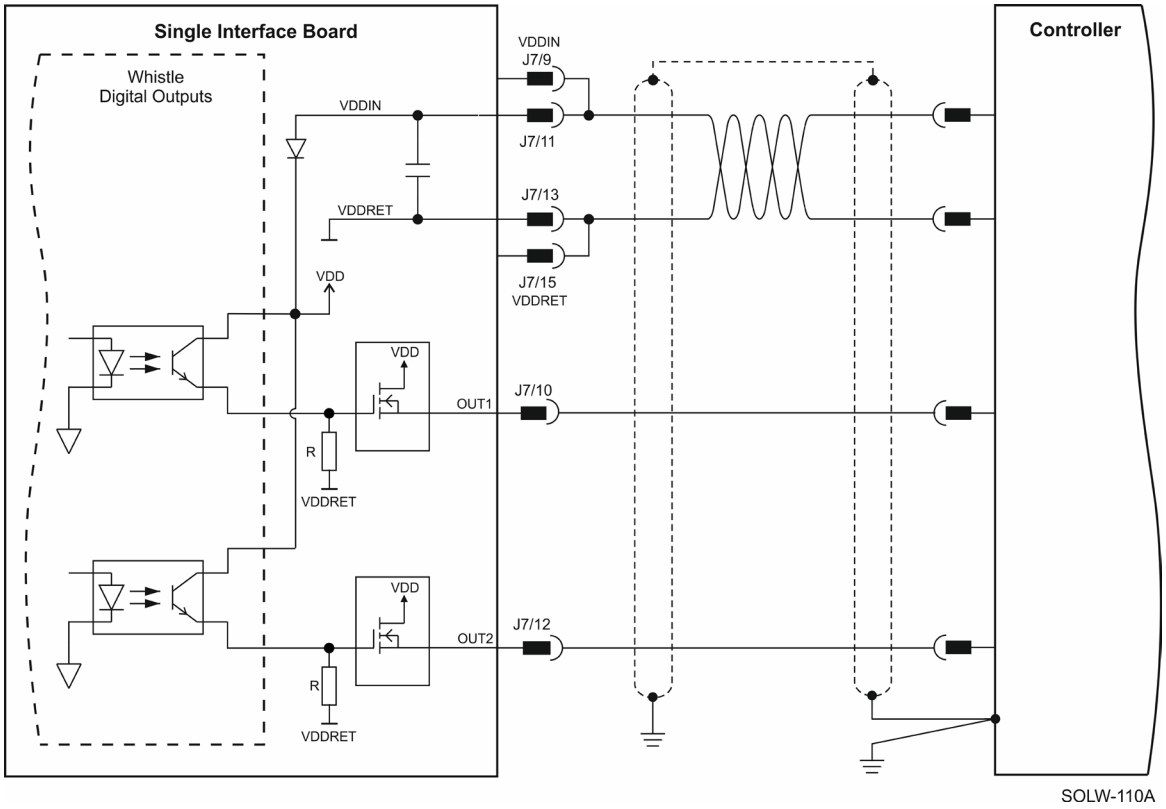
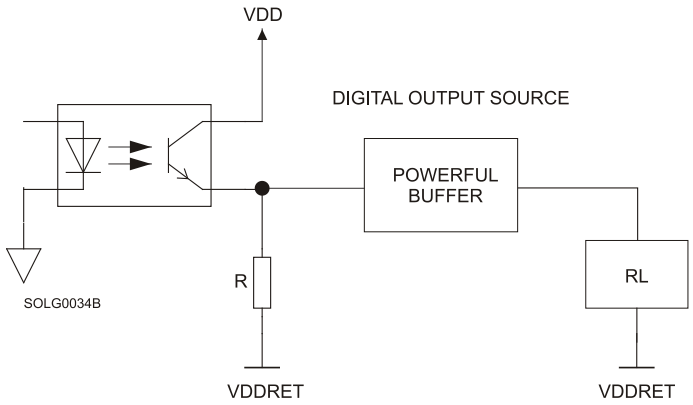


Figure 42: Digital Output 24 V Connection Diagram

6.7.2.2. Digital Output 24V (PLC) Interfaces

Feature	Details
Type of output	• Optically isolated • Powerful Source capability
VDD Supply Range	15 V to 30 V
Max. output current Iout (max)	Iout1, 2 (max) ≤ 250 mA
VOH	VDD≥VOH ≥ VDD-(Ix0.15)
VOL	VOL ≤ 1 V
RL	External RL must be selected to limit output current. $RL=\frac{VDD-Ix0.15}{I_{out\ (max)}}$
Executable time	If output is set to one of the built-in functions - Home flag, Brake or AOK - execution is immediate upon detection: 0 < T < 4 x TS If output is set to General output and is executed from a program, the typical time is approximately 0.5 msec.
Schematic Diagram	
SOURCE  	

6.7.2.3. Digital Output 5 V (TTL)

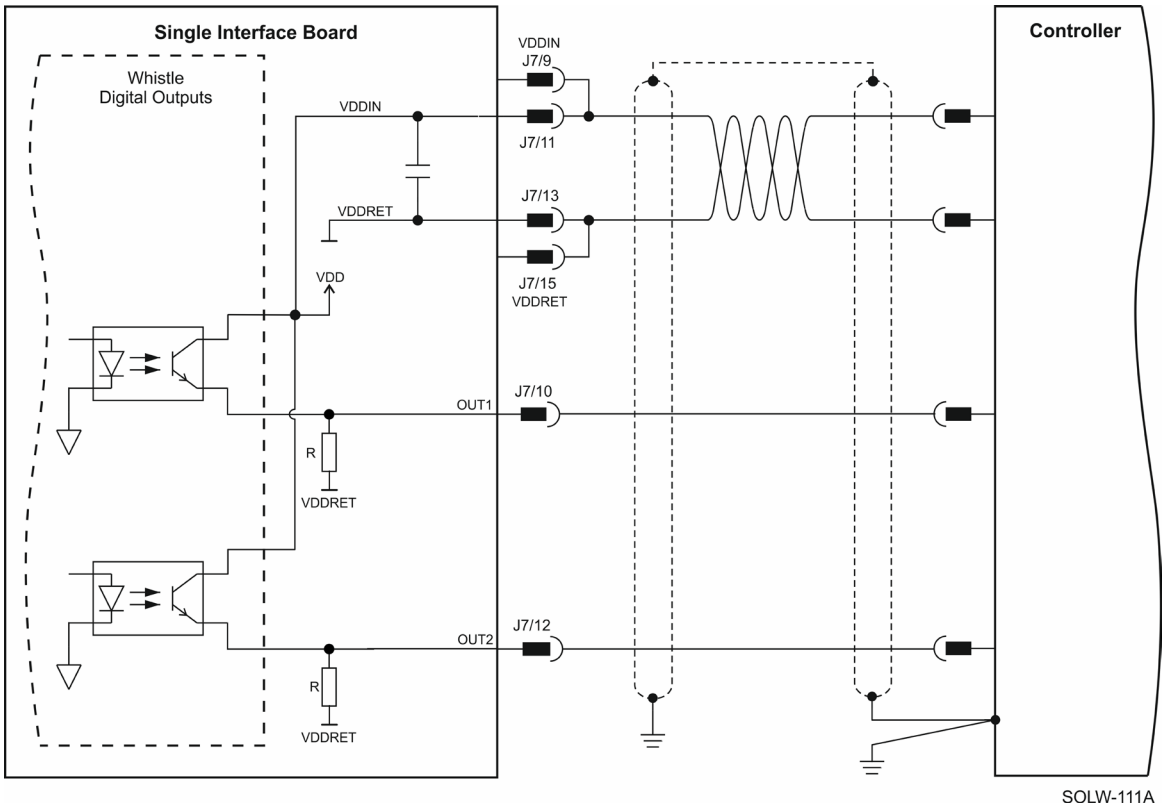
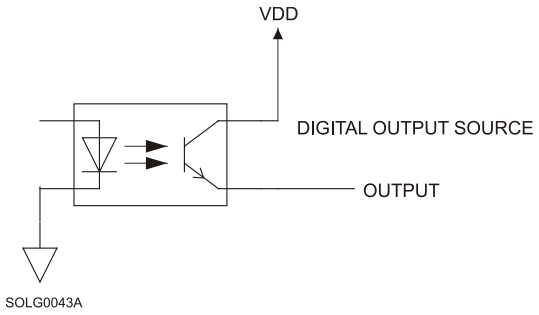


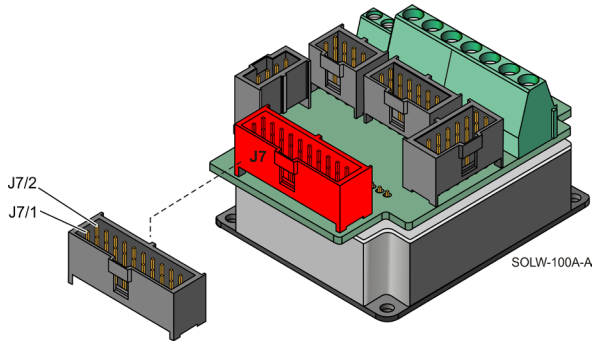
Figure 43: Digital Output 5 V Connection Diagram

6.7.2.4. Digital Output 5V (TTL) Interfaces

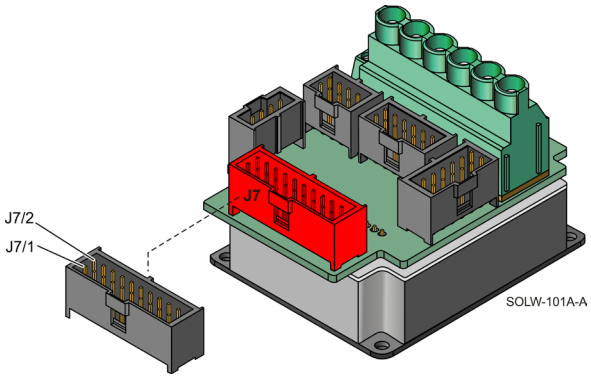
Feature	Details
Type of output	• Optically isolated • Open emitter
VDD Supply Range	2.5 V to 30 V
Max. output current Iout (max)	I_{out} (max) ≤ 8 mA
VOL	VOL ≤ 0.3 V
RL	External RL must be selected to limit output current. $RL=\frac{VDD-VOL}{I_{out\ (max)}}$
Executable time	If output is set to one of the built-in functions - Home flag, Brake or AOK - execution is immediate upon detection: 0 < T < 4 x TS If output is set to General output and is executed from a program, the typical time is approximately 0.5 msec.
Schematic Diagram	
SOURCE  	

6.7.3. Analog Input

Pin (J7)	Signal	Function
18	ANLIN1+	Analog input 1+
20	ANLIN1-	Analog input 1-
17	ANLRET	Analog return
Pin Positions		



5.08 mm Pitch Power Connector



6.35 mm Pitch Power Connector

Table 13: Analog Input Pin Assignments

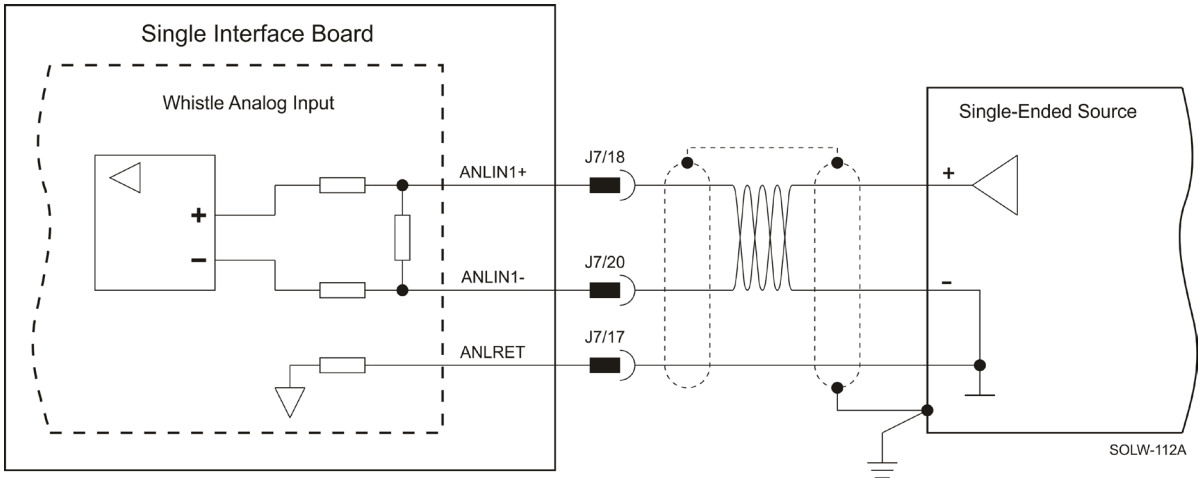


Figure 44: Analog Input with Single-Ended Source

6.8. Communications – J4

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

- RS-232, full duplex
- CANopen

RS-232 communication requires a standard, commercial 3-core null-modem cable connected from the Solo Whistle to a serial interface on the PC. The interface is selected and set up in the Composer software.

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

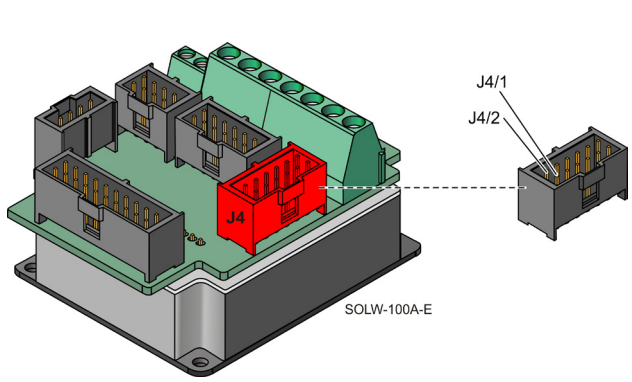
For ease of setup and diagnostics of CAN communication, RS-232 and CANopen can be used simultaneously.

6.8.1. RS-232 Communication

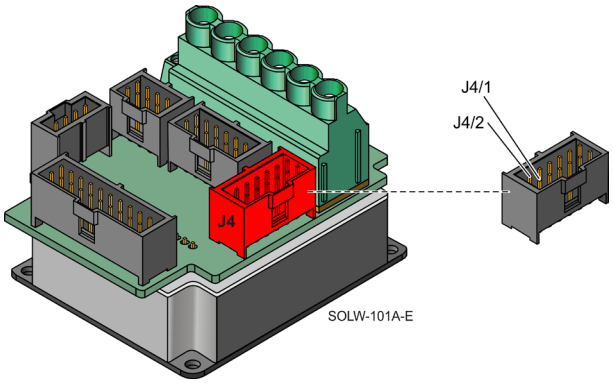
Notes for connecting the RS-232 communication cable:

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

Pin (J4)	Signal	Function
9	RS232_Tx	RS-232 transmit
10	RS232_Rx	RS-232 receive
11	RS232_COMRET	Communication return
Pin Positions		



5.08 mm Pitch Power Connector



6.35 mm Pitch Power Connector

Table 14: RS-232 Pin Assignments

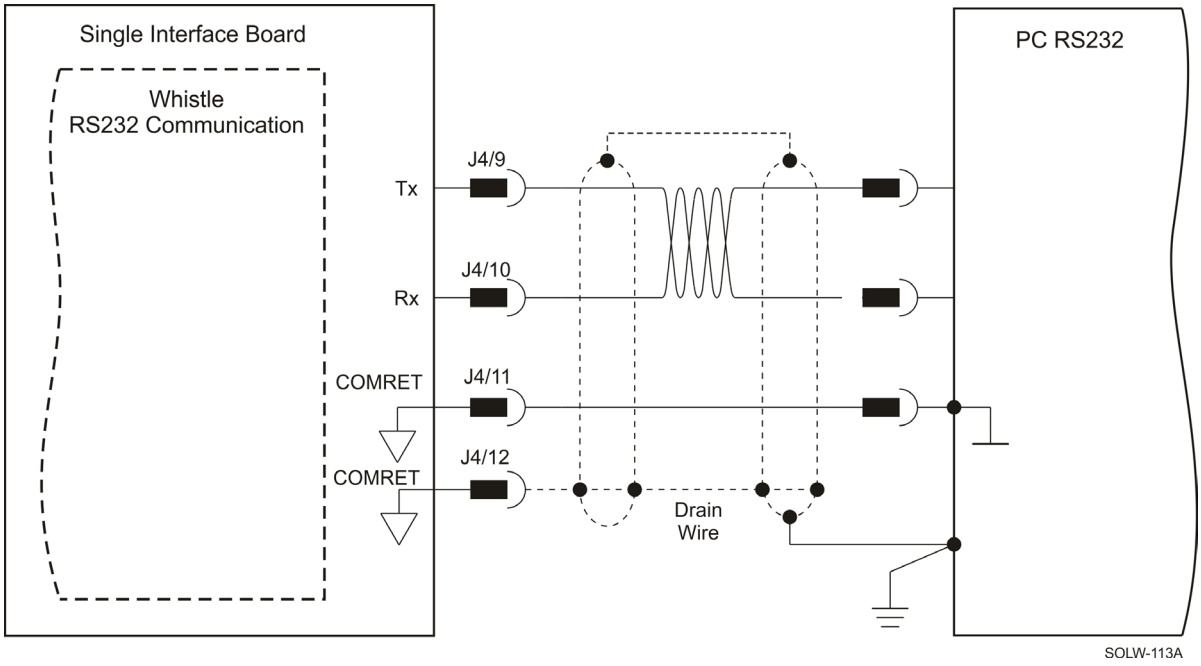


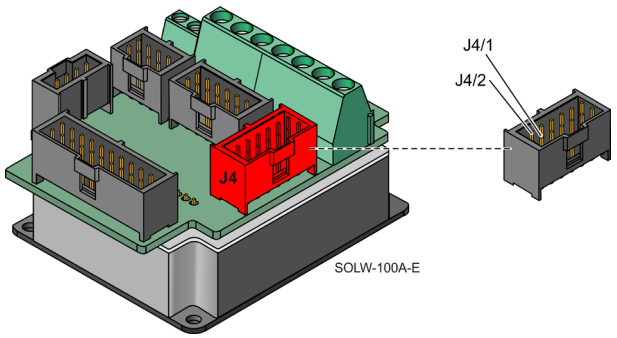
Figure 45: RS-232 Connection Diagram

6.8.2. CANopen Communication

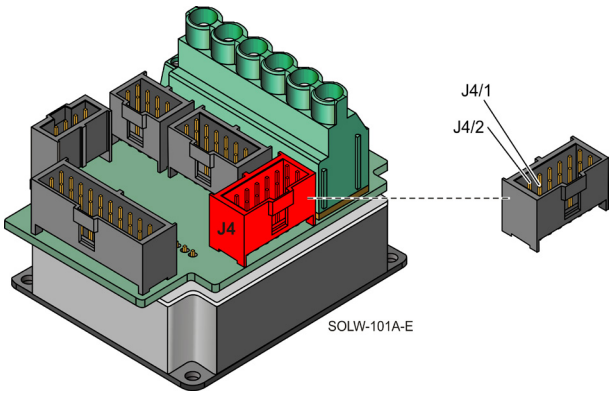
Notes for connecting the CANopen communication cable:

- Connect the shield to the ground of the host (PC). Usually, this connection is soldered internally inside the connector at the PC end. You can use the drain wire to facilitate connection.
- Make sure to have a 120-Ω resistor termination at each of the two ends of the network cable.
- The Solo Whistle's CAN ports are **non-isolated**.

Pin (J4) CANIN	Pin (J4) CANOUT	Signal	Function
1	5	CAN_L	CAN_L busline (dominant low)
2	6	CAN_H	CAN_H busline (dominant high)
3	7	CAN_GND	CAN ground
Pin Positions			



5.08 mm Pitch Power Connector



6.35 mm Pitch Power Connector

Table 15: CANopen - Pin Assignments

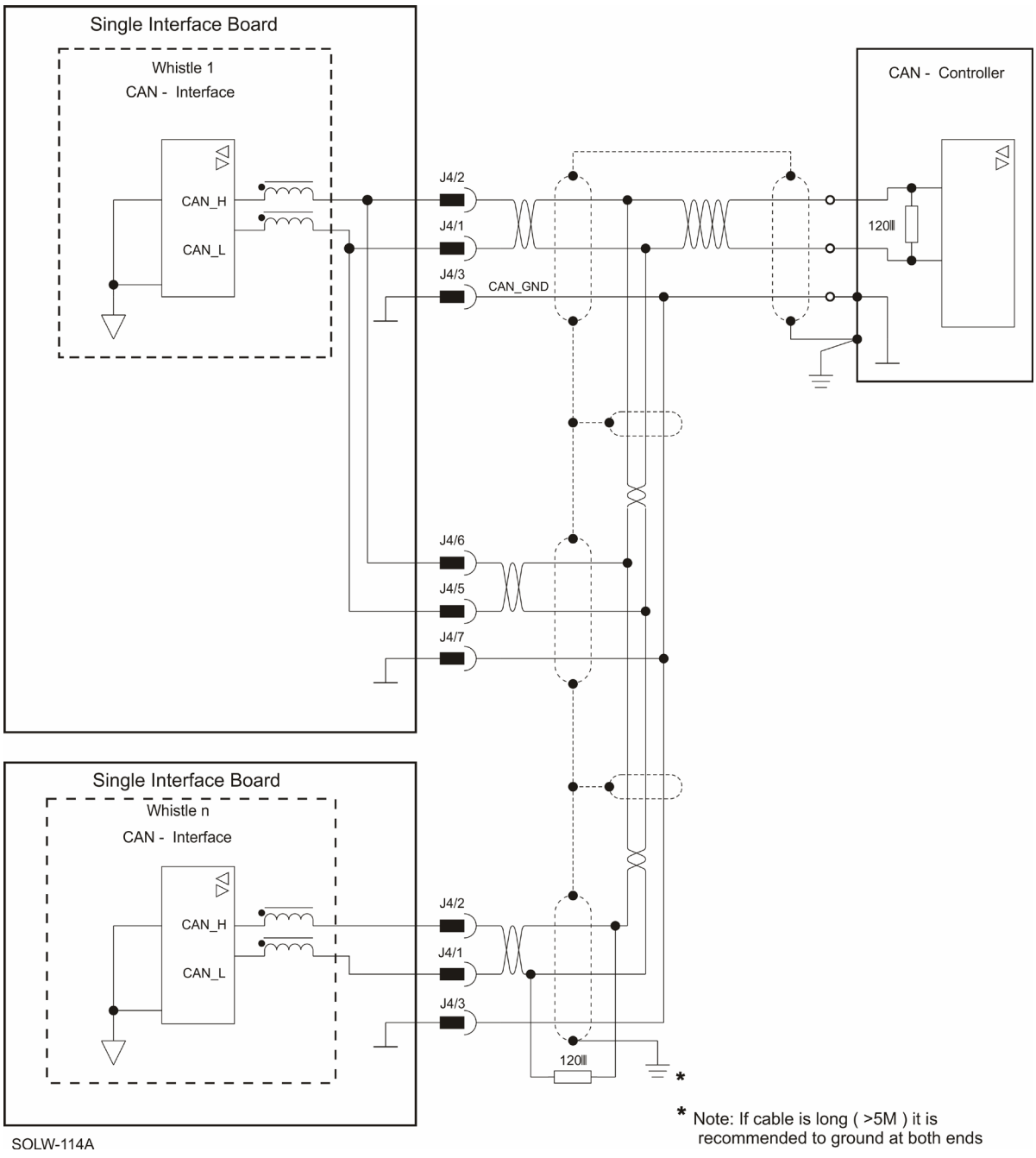
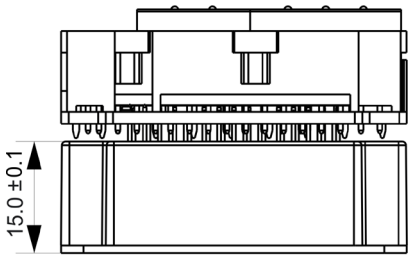


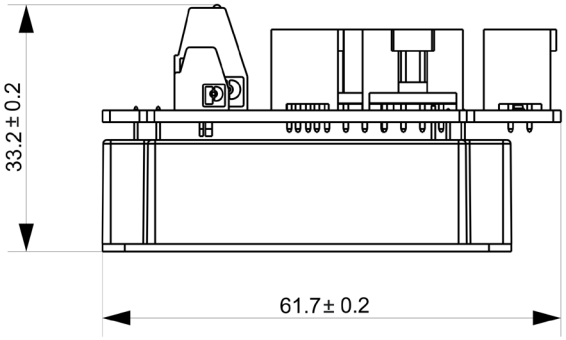
Figure 46: CANopen Network Diagram

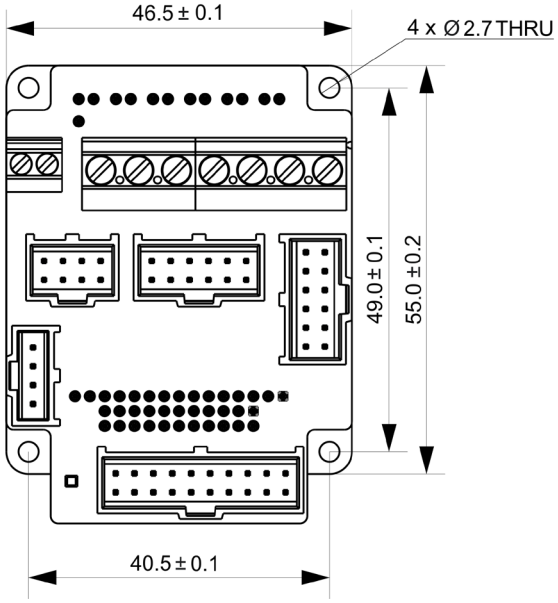
Caution:
When installing CANopen communication, ensure that each servo drive is allocated a unique ID. Otherwise, the CANopen network may hang.

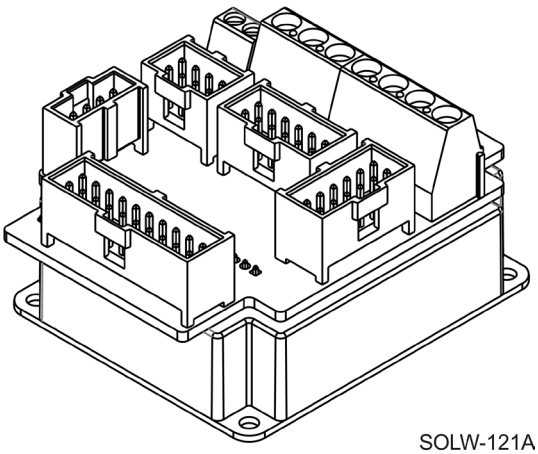
6.9. Dimensions

6.9.1. Solo Whistle 5.08 mm Pitch Power Connector Dimensions

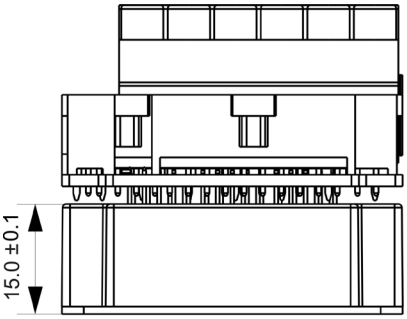


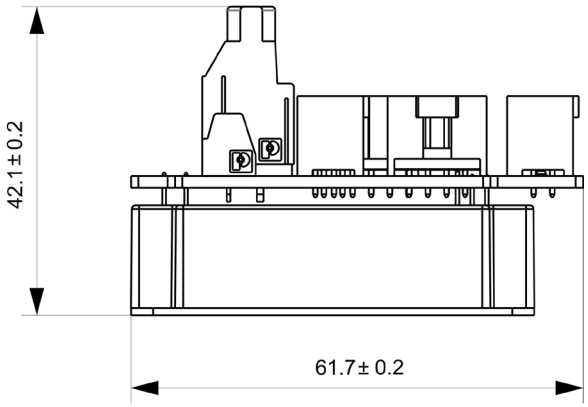


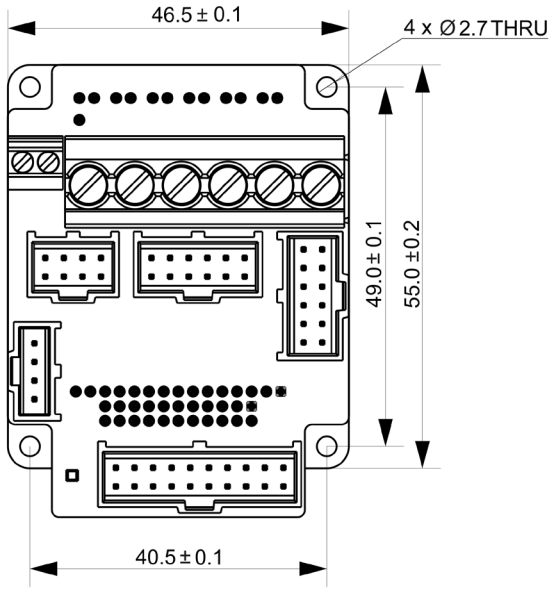


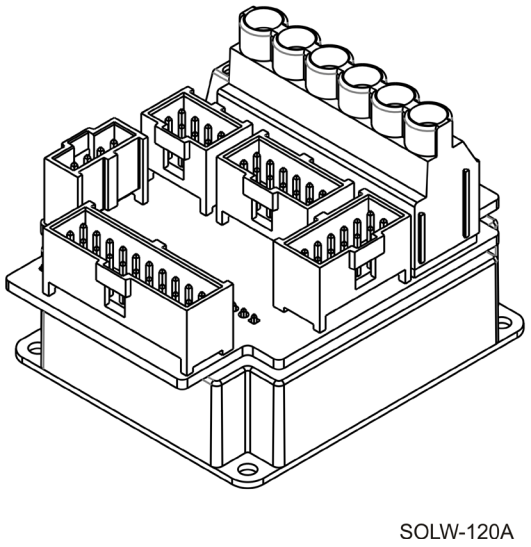


6.9.2. Solo Whistle 6.35 mm Pitch Power Connector Dimensions









6.9.3. Physical Specifications

Feature	Solo Whistle Model Pitch Power Connector	Units	
Weight	5.08 mm	g (oz)	79.0 g (2.8 oz)
	6.35 mm		87.0 g (3.1 oz)
Dimensions	5.08 mm	mm (in)	61.7 x 46.5 x 33.2 (2.43" x 1.83" x 1.31")
	6.35 mm		61.7 x 46.5 x 42.1 (2.43" x 1.83" x 1.66")
Mounting method	5.08 mm	PCB mount	
	6.35 mm		

Chapter 7: Powering Up

After the Solo 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.

7.1. Initializing the System

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

Chapter 8: Heat Dissipation

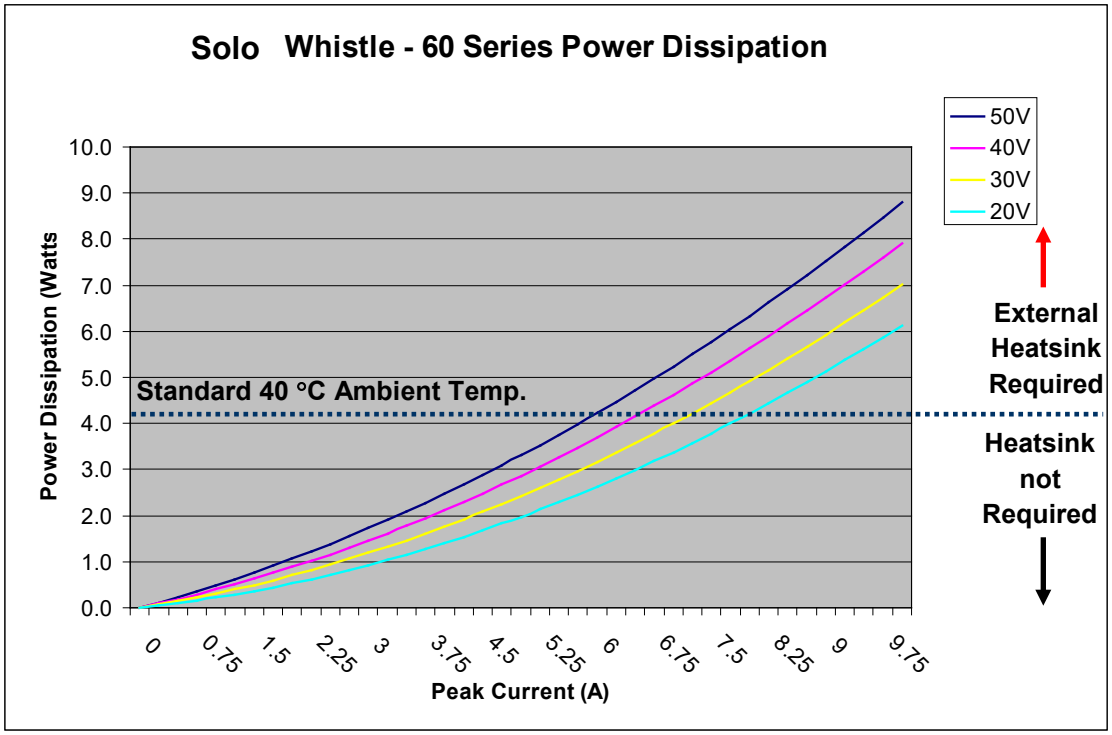
The best way to dissipate heat from the Solo Whistle is to mount it so that its heat sink faces up. For best results leave approximately 10 mm of space between the Solo Whistle's heat sink and any other assembly.

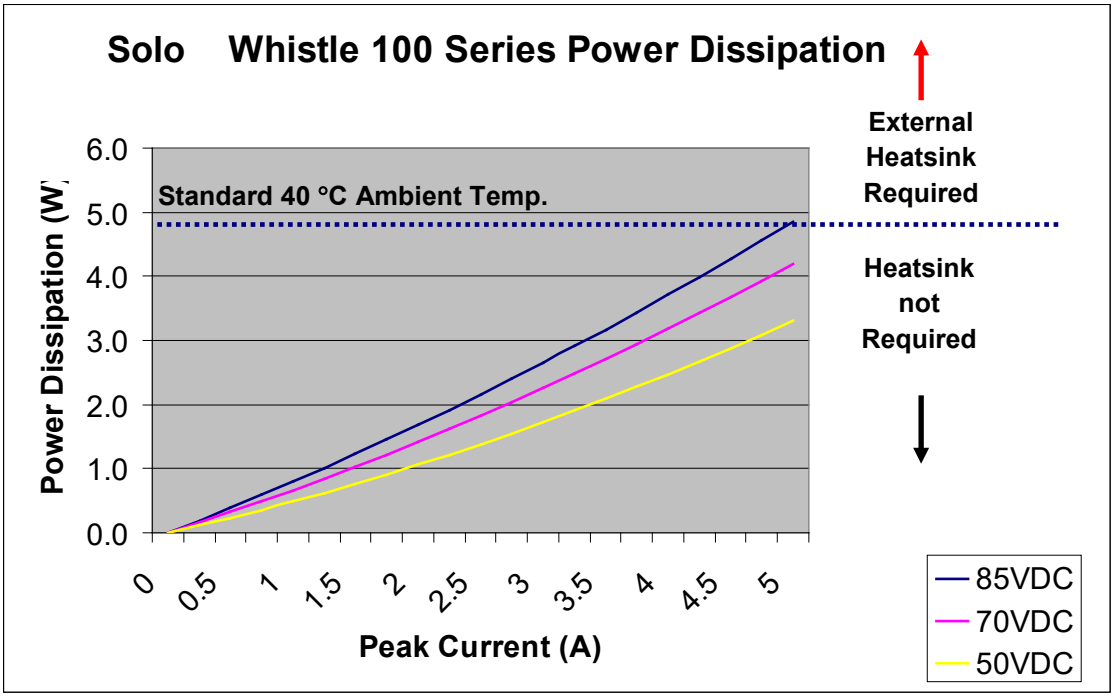
8.1.1. Solo Whistle Thermal Data

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

8.1.2. Heat Dissipation Data

Heat dissipation is shown in graphically below:





8.1.3. How to Use the Charts

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

To determine if your application needs a heat sink:

1. Allow maximum heat sink temperature to be 80 °C or less.
2. Determine the ambient operating temperature of the Solo Whistle.
3. Calculate the allowable temperature increase as follows:
   - For an ambient temperature of 40 °C , ΔT= 80°C – 40 °C = 40 °C
4. Use the chart to find the actual dissipation power of the drive. Follow the voltage curve to the desired output current and then find the dissipated power.
5. If the dissipated power is below 4 W the Solo Whistle will need no additional cooling.

Note: The chart above shows that no heat sink is needed when the heat sink temperature is 80 °C, ambient temperature is 40 °C and heat dissipated is 4 Watts.

Chapter 9: Technical Specifications

This chapter provides detailed technical information regarding the Solo 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.

9.1.1. Features

The Solo Whistle's features determine how it controls motion, as well as how it processes host commands, feedback and other input.

9.1.1.1. Motion Control Modes

- Current/Torque - up to 14 kHz sampling rate
- Velocity - up to 7 kHz sampling rate
- Position - up to 3.5 kHz sampling rate

9.1.1.2. Advanced Positioning Control Modes

- PTP, PT, PVT, ECAM, Follower, Dual Loop, Current Follower
- Fast event capturing inputs
- Fast output compare (OC)
- Motion Commands: Analog current and velocity, pulse-width modulation (PWM) current and velocity

9.1.1.3. Advanced Filters and Gain Scheduling

- “On-the-fly” gain scheduling of current and velocity
- Velocity and position with “1-2-4” PIP controllers
- Automatic commutation alignment
- Automatic motor phase sequencing

9.1.1.4. Fully Programmable

- Third generation programming structure with motion commands – “Composer”
- Event capturing interrupts
- Event triggered programming

9.1.1.5. Feedback Options

- Incremental Encoder – up to 20 Mega-Counts (5 Mega-Pulse) per second
- Digital Halls – up to 2 kHz
- Incremental Encoder with Digital Halls for commutation – up to 20 Mega-Counts per second for encoder

- Interpolated Analog (Sine/Cosine) Encoder – up to 250 kHz (analog signal)
  - Internal Interpolation - up to x4096
  - Automatic Correction of amplitude mismatch, phase mismatch, signal offset
  - Emulated encoder outputs
- Analog Hall Sensor
- Resolver
  - Programmable 10 to 15 bit resolution
  - Up to 512 revolutions per second (RPS)
  - Emulated encoder outputs
- Tachometer & Potentiometer
- Provide power (5 V, 200 mA max) for one Encoder, Resolver or Hall.

9.1.1.6. Input/Output

- One **Analog Input** – up to 14-bit resolution
- Four programmable **Digital Inputs for Models 01 to 08**, and five programmable **Digital Inputs for Models M1 to M2**, optically isolated (two of which are fast event capture inputs).
  - Inhibit/Enable motion
  - Software and analog reference stop
  - Motion limit switches
  - Begin on input
  - Abort motion
  - Homing
  - General-purpose
- Two programmable **Digital Outputs**, optically isolated, one with fast output compare (OC)
  - Brake Control
  - Amplifier fault indication
  - General-purpose
  - Servo enable indication
- PWM current command output for torque and velocity

9.1.1.7. 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 output and power input/return
  - Failure of internal power supplies
  - Over temperature - Continuous temperature measurement; temperature can be read on the fly; warning can be initiated x degrees before temp disable is activated.

- Over/Under voltage
- Loss of feedback
- Following error
- Current limits

9.1.1.8. Accessories

- Heat sinks

9.1.1.9. Status Indication

- Output for a bi-color LED

9.1.1.10. 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

Chapter 10: Environmental Conditions

Feature	Details
Operating ambient temperature according to IEC60068-2-2	0 °C to 40 °C (32 °F to 104 °F)
Storage temperature	-20 °C to +85 °C (-4 °F to +185 °F)
Maximum non-condensing humidity according to IEC60068-2-78	95%
Maximum Operating Altitude	2,000 m (6562 feet)
Mechanical Shock according to IEC60068-2-27	15g / 11ms Half Sine
Vibration according to IEC60068-2-6	5 Hz ≤ f ≤ 10 Hz: ±10mm 10 Hz ≤ f ≤ 57 Hz: 4G 57 Hz ≤ f ≤ 500 Hz:5G

Chapter 11: Control Specifications

11.1. 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	< 2.5 kHz
Current loop sampling time	Programmable 70 to 120 μsec
Current sampling rate	Up to 6 kHz; default 11 kHz

11.2. Velocity Loop

Feature	Details
Controller type	PI
Velocity control	• Fully digital • Programmable PI and FFW control filters • "On-the-fly" gain scheduling • Automatic, manual and advanced manual tuning
Velocity and position feedback options	• Incremental Encoder • Digital Halls • Interpolated Analog (Sine/Cosine) Encoder (optional) • Resolver (optional) • Tachometer and Potentiometer (optional) **Note:** With all feedback options, 1/T with automatic mode switching is activated (gap, frequency and derivative).
Velocity loop bandwidth	<350 Hz
Velocity loop sampling time	140 to 240 µsec (2x current loop sample time)
Velocity loop sampling rate	Up to 8 kHz; default 5.5 kHz
Velocity command options	• Analog • Internally calculated by either jogging or step **Note:** All software-calculated profiles support on-the-fly changes.

11.3. Position Loop

Feature	Details
Controller type	“1-2-4” PIP
Position command options	• Software • Pulse and Direction • Analog Potentiometer
Position loop bandwidth	<80 Hz
Position loop sampling time	280 to 480 µsec (4x current loop sample time)
Position loop sampling rate	Up to 4 kHz; default 2.75 kHz

11.4. Feedbacks

11.4.1. Feedback Supply Voltage

The Solo Whistle has two feedback ports (Main and Auxiliary). The drive supplies voltage to the main feedback device only.

Feature	Details
Main encoder supply voltage	5 V ±5% @ 200 mA maximum

11.4.2. Main Feedback Options

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

11.4.2.1. Incremental Encoder Input

Feature	Details
Encoder format	• A, B and Index • Differential • Quadrature
Interface	RS-422
Input resistance	Differential: 120 Ω (TBD)
Maximum incremental encoder frequency	Maximum absolute: 5 MHz pulses
Minimum quadrature input period (P_{IN})	112 nsec
Minimum quadrature input high/low period (P_{HL})	56 nsec
Minimum quadrature phase period (P_{PH})	28 nsec
Maximum encoder input voltage range	Common mode: ±7 V Differential mode: ±7 V

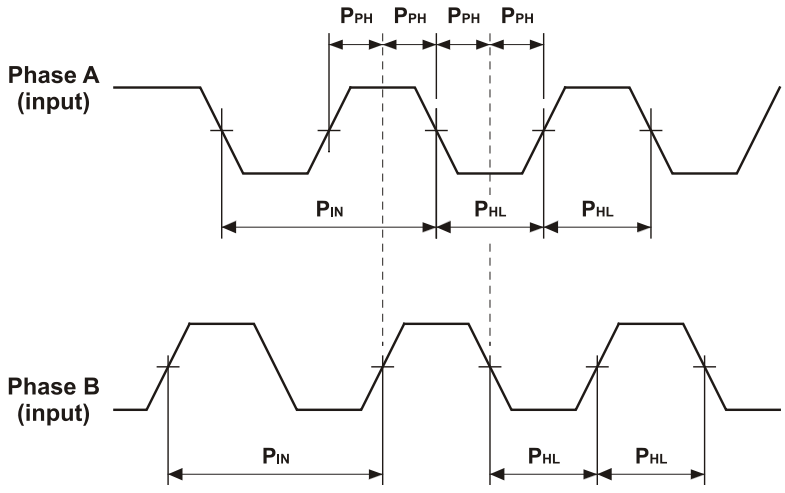


Figure 47: Main Feedback - Encoder Phase Diagram

11.4.2.2. 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): 3 mA Source current: 1.5 mA (designed to also support open collector Halls)
Maximum frequency	f_{MAX} : 2 kHz

11.4.2.3. 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} : 250 kHz
Interpolation multipliers	Programmable: x4 to x4096
Maximum “counts” frequency	80 mega-counts/sec “internally”
Automatic errors correction	Signal amplitudes mismatch Signal phase shift Signal offsets
Encoder outputs	See Auxiliary Encoder Outputs specifications (11.4.3 Auxiliary Feedback Port (output mode YA[4]= 4))

11.4.2.4. 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 Solo Whistle
Reference current	Up to ±50 mA
Encoder outputs	See Auxiliary Encoder Output specifications (11.4.3 Auxiliary Feedback Port (output mode YA[4]= 4))

11.4.2.5. Tachometer

Feature	Details
Tachometer format	Differential
Maximum operating differential voltage for TAC1+, TAC1-	±20 V
Maximum absolute differential input voltage for TAC1+, TAC1-	±25 V
Maximum operating differential voltage for TAC2+, TAC2-	±50 V
Maximum absolute differential input voltage for TAC2+, TAC2-	±60 V
Input resistance for TAC1+, TAC1-	46 kΩ
Input resistance for TAC2+, TAC2-	100 kΩ
Resolution	14 bit

* Only one Tachometer port can be used at a time (either TAC1+/TAC1- or TAC2+/TAC2-).
TAC1+/TAC1- is used in applications with having a Tachometer of less than 20 V.
TAC2+/TAC2- is used in applications with having a Tachometer of between 20 V and 50 V.

11.4.2.6. Potentiometer

Feature	Details
Potentiometer Format	Single-ended
Operating Voltage Range	0 to 5 V supplied by the Solo Whistle
Potentiometer Resistance	100 Ω to 1 kΩ … above this range, linearity is affected detrimentally
Input Resistance	100 kΩ
Resolution	14 bit

11.4.3. Auxiliary Feedback Port (output mode YA[4]= 4)

Feature	Details
Encoder output and main buffered output	• A, B, Index • Differential outputs • Quadrature
Interface	RS-422
Output current capability	▪ Driving differential loads of 200 Ω on INDEX/INDEX-, CHB/CHB- and CHA/CHA- pairs
Available as options	• Simultaneous buffered outputs of main-incremental encoder input • Simultaneous emulated encoder outputs of analog encoder input • Simultaneous emulated encoder outputs of resolver input
Maximum frequency	f_{MAX} : 5 MHz pulses/output
Index (marker)	Length of pulse is one quadrature (one quarter of an encoder cycle) and synchronized to A&B

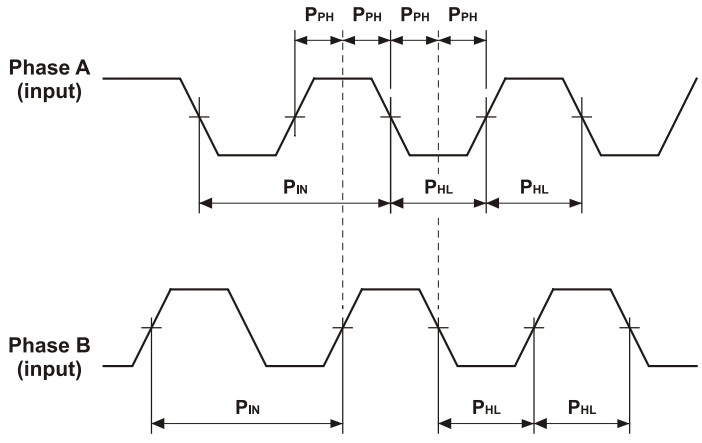


Figure 48: Auxiliary Feedback - Encoder Phase Diagram

11.4.4. Auxiliary Feedback Port (input mode YA[4]= 2, 0)

Feature	Details
Encoder input, pulse and direction input	• A, B, Index • Differential
Input voltage	V_{in} Low: 0 V < V_{IL} < 0.8 V V_{in} High: 2 V < V_{IH} < 5 V Maximum absolute voltage: 0 < V_{in} < 5.5 V Input current: ±1 µA
Available as options	• Differential Buffered Encoder inputs • Differential Buffered Pulse and Direction inputs
Edge separation between A & B	Programmable number of clocks to allow adequate noise filtering at remote receiver of emulated encoder signals
Index (marker):	Length of pulse is one quadrature (one quarter of an encoder cycle) and synchronized to A&B

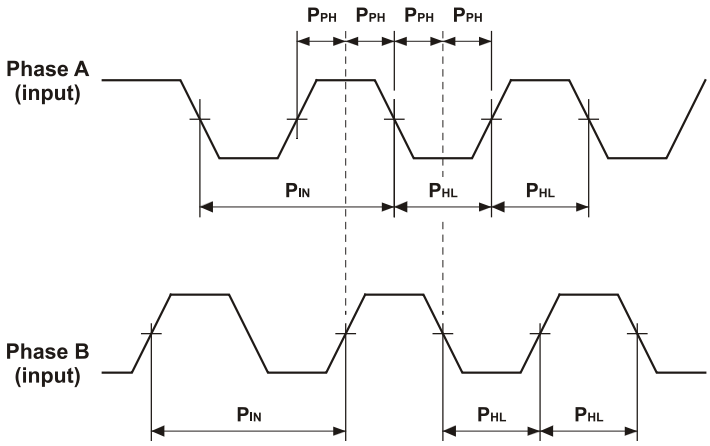


Figure 49: Auxiliary Feedback - Encoder Phase Diagram

11.5. Analog Input Features

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

11.6. Communications

Specification	Details
RS-232	**Signals:** • RxD , TxD , Gnd • Full duplex, serial communication for setup and control. • Baud Rate of 9,600 to 57,600 bit/sec.
CANopen	**CAN bus Signals:** • CAN_H, CAN_L, CAN_GND • 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

11.7. Pulse-Width Modulation (PWM)

Feature	Details
PWM resolution	12-bit
PWM switching frequency on the load	2/Ts (factory default 22 kHz on the motor)

Chapter 12: 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.)
• **UL 60950** • **IPC-D-275** • **IPC-SM-782** • **IPC-CM-770** • **UL 508C** • **UL 840**	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)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