Whistle
Digital Servo Drive
Installation Guide

September 2005 (Ver. 1.2)

Elmo
Motion Control

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Document No. MAN-WHISIG

Whistle Catalog Number	**WHI-AXX/YYYR** **Version**: Blank = Standard A = Advanced Continuous Current (Amps) Maximum DC Operating Voltage **Feedback**: Blank = Incremental Encoder and/or Halls R = Resolver I = Interpolated Analog Encoder T = Tachometer & Potentiometer

Related Products:

Evaluation Board Catalog Number	WHI-EVLBRD-1 (available upon request)
Evaluation Board User Manual	MAN-EVLBRD-WHI (available on our web site)

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Chapter 1: Safety Information

In order to achieve the optimum, safe operation of the 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 Whistle and accompanying equipment.

Please read this chapter carefully before you begin the installation process.

Before you start, ensure that all system components are connected to earth ground. Electrical safety is provided through a low-resistance earth connection.

Only qualified personnel may install, adjust, maintain and repair the servo drive. A "qualified person" has the knowledge and authorization to perform tasks such as transporting, assembling, installing, commissioning and operating motors.

The 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.
	**Note:** This is auxiliary information that ensures the correct operation of the equipment.

1.1 Warnings

	To avoid electric arcing and hazards to personnel and electrical contacts, never connect/disconnect the servo drive while the power source is on.
	Power cables can carry a high voltage, even when the motor is not in motion. Disconnect the Whistle from all voltage sources before it is opened for servicing.
	The 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 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 Whistle to an approved 11~95V 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 Whistle, verify that all safety precautions have been observed and that the installation procedures in this manual have been followed.

1.3 Directives and Standards

The Whistle conforms to the following industry safety standards:

Safety Standard	**Item**
In compliance with **UL508c**	Power Conversion Equipment
In compliance with **UL840**	Insulation Coordination, Including Clearance and Creepage Distances of Electrical Equipment
In compliance with **UL60950-1** (formerly UL1950)	Safety of Information Technology Equipment, Including Electrical Business Equipment
In compliance with **EN60204-1**	Low Voltage Directive, 73/23/EEC

The 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 Mark Conformance

The 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 EN60204-1 and EN292-2 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 Whistle meets the provisions outlined in Council Directive 73/23/EEC. The party responsible for ensuring that the equipment meet the limits required by EMC regulations is the manufacturer of the end product.

1.5 Warranty Information

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

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Chapter 2: Introduction

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

2.1 Drive Description

The Whistle series of digital servo drives was designed to deliver "the highest density of power and intelligence". The Whistle can deliver up to **500 W** of **continuous power** or 1000 W of peak power in a 2 in^3 (55 X 15 x 46.5 mm or 2" x 0.6" x 1.8") 38cc package.

The Whistle is designed for OEM's. 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. The Whistle is designed for use with any type of sinusoidal and trapezoidal commutation, with vector control. The 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 Whistle 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 Whistle, as part of the *SimplIQ* product line, is fully programmable with Elmo *Metronome* motion control language.

Power to the Whistle is provided by a 12 ~ 95 VDC isolated DC power source (not included with the Whistle). A "smart" control-supply algorithm enables the Whistle to operate with only one power supply with no need for an auxiliary power supply for the logic.

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

Note: This back-up power supply can operate from any voltage source within the 12 ~ 95 VDC range. This is much more flexible than a standard 24VDC power supply requirement.

If back-up power is not needed, 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.

The Whistle is a PCB mounted device which enables efficient and cost saving implementation.

The Whistle is available in two models:

- The Standard Whistle is a basic servo drive which operates in current, velocity and position modes includes PT & PVT. It operates simultaneously via RS-232 and CANopen DS 301, DSP 305, DSP 402 communications and features a third-generation programming environment.

- The Advanced Whistle 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.

Both versions operate with 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
- Position follower mode for monitoring the motion of the slave axis relative to a master axis, via an auxiliary encoder input
- Pulse-and-direction inputs
- Sample rate four times current loop sample time
- Fast event capturing inputs

2.2.4 Advanced Position Control *(in 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
- PT and PVT motion modes
- Dual (position/velocity) loop
- Fast output compare (OC)

2.2.5 Communication Options

Depending on the application, Whistle users can select from 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
  - Auxiliary emulated, unbuffered, single-ended, encoder output
- Resolver
  - Programmable 10~15 bit resolution
  - Up to 512 Revolution Per Second (RPS)
  - Auxiliary emulated, unbuffered, single-ended, encoder output
- Tachometer, Potentiometer
- Elmo drives provide supply voltage for all the feedback options

2.2.7 Fault Protection

The Whistle 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

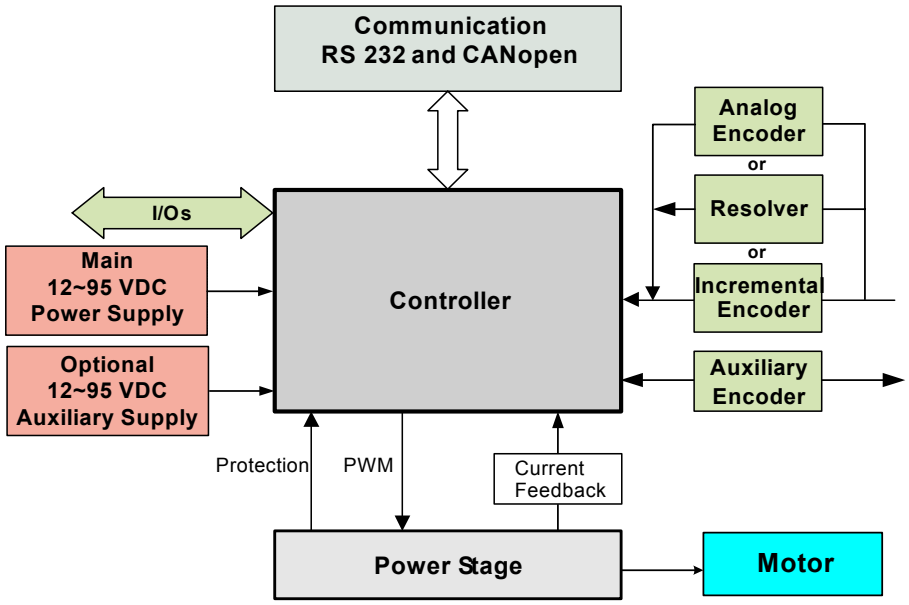

Figure 2-1 Whistle System Block Diagram

2.4 How to Use this Guide

In order to install and operate your Elmo 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 Whistle.

The Appendix, *Technical Specifications*, lists all the drive ratings and specifications.

Upon completing the instructions in this guide, your 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.

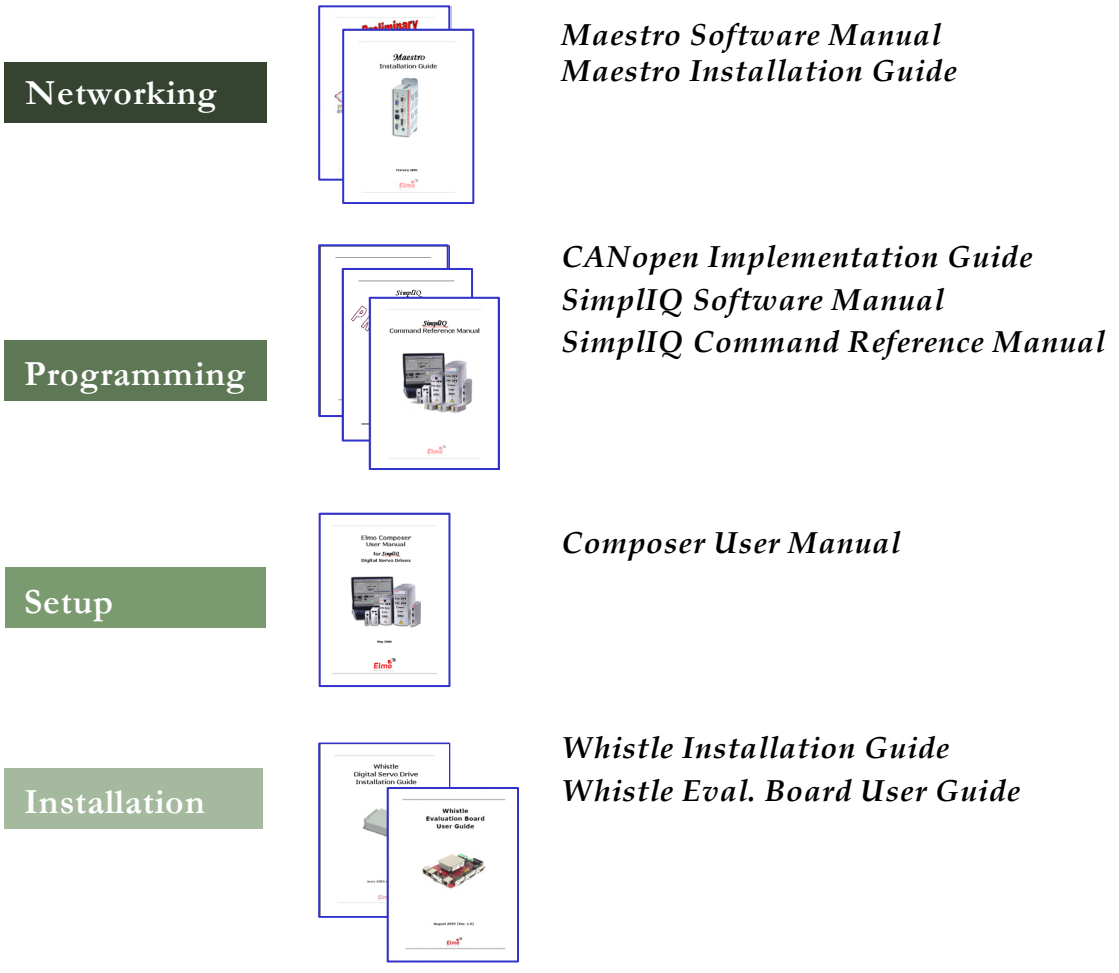

Figure 2-2: **Elmo Digital Servo Drive Documentation Hierarchy**

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

- The Whistle Evaluation Board User Guide contains information about how to use the Whistle Evaluation Board and Cable Kit.
- 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 Whistle motion controller.
- The *SimplIQ Software Manual,* which describes the comprehensive software used with the Whistle.

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Chapter 3: Installation

3.1 Site Requirements

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

Feature	Value
Ambient operating temperature	0° to 40°C (32° 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.	

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

3.2 Unpacking the Drive Components

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

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

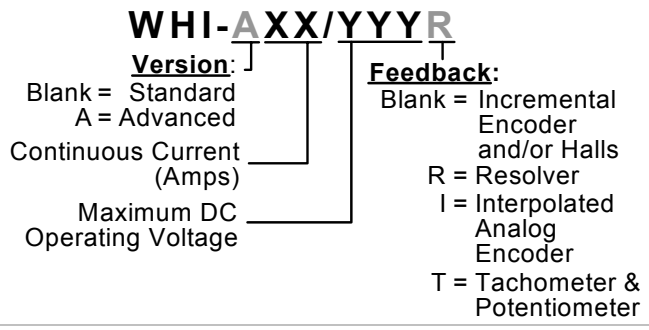
The Whistle is shipped in a cardboard box with styrofoam protection.

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

WHI008A

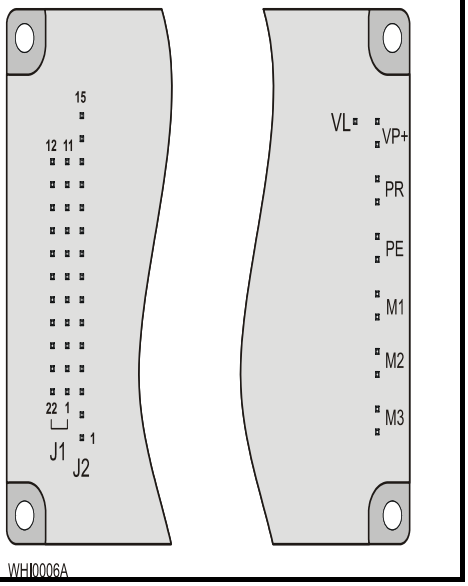
The part number at the top gives the type designation as follows:



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

3.3 Pinouts

3.3.1 Connector Types

No. Pins	Type	Port	Function	Connector Location
2x11	2 mm Pitch 0.51 mm SQ	J1	I/O, COMM, Auxiliary Feedback	
15	2 mm Pitch 0.51 mm SQ	J2	Main Feedback, Analog Input, LED	
2	2 mm Pitch 0.51 mm SQ	M1	Motor power output 1	
2		M2	Motor power output 2	
2		M3	Motor power output 3	
2		PE	Protective earth	
2		PR	Power input return	
2		VP+	Positive power input	
1		VL	Auxiliary power input	

3.3.2 Connector J1

Pin	Signal	Function
J1/1	RS232_RX	RS232 receive
J1/2	RS232_TX	RS232 Transmit
J1/3	RS232_COMRET	Communication return
J1/4	SUPRET	Supply return
J1/5	AUX PORT CHA	AUX PORT CHA (bidirectional)
J1/6	SUPRET	Supply return
J1/7	OUT1	Programmable Digital output 1
J1/8	OUT2	Programmable Digital output 2
J1/9	IN1	Programmable Digital input 1
J1/10	IN2	Programmable Digital input 2
J1/11	IN3	Programmable Digital input 3
J1/12	IN4	Programmable Digital input 4
J1/13	IN5	Programmable Digital input 5
J1/14	IN6	Programmable Digital input 6
J1/15	INRET	Programmable Digital input return
J1/16	OUTRET2	Programmable Digital output 2 return
J1/17	OUTRET1	Programmable Digital output 1 return
J1/18	AUX PORT CHB	AUX PORT CHB (bidirectional)
J1/19	AUX PORT INDEX	AUX PORT INDEX (bidirectional)
J1/20	CAN_COMRET	Communication return
J1/21	CAN_L	CAN_L busline (dominant low)
J1/22	CAN_H	CAN_H busline (dominant high)

3.3.3 Connector J2

Pin	Signal	Function
J2/1	+5V	Encoder/Hall +5V supply voltage. Maximum output current: 200mA.
J2/2	SUPRET	Supply return
J2/3	ANALIN1+	Analog input 1+
J2/4	ANALIN1-	Analog input 1-
J2/5	CHA	Channel A input
J2/6	CHA-	Channel A input complement
J2/7	CHB	Channel B input
J2/8	CHB-	Channel B input complement
J2/9	INDEX+	Index input
J2/10	INDEX-	Index input complement
J2/11	HA	Hall sensor A input
J2/12	HB	Hall sensor B input
J2/13	HC	Hall sensor C input
J2/14	LED_2_OUT	Bi-color indication output 2 (Cathode)
J2/15	LED_1_OUT	Bi-color indication output 1 (Anode)

3.4 Mounting the Whistle

The Whistle was designed for mounting on a printed circuit board (PCB). It is connected by 2mm pitch 0.51 mm square pins. When designing the Whistle into a device, be sure to leave about 1 cm (0.4") outward from the heatsink to enable free air convection around the Whistle. We recommend that the Whistle be soldered directly to the board. Alternatively, the Whistle can be attached to socket connectors mounted on the PCB. If the PCB is enclosed in a metal chasis, we recommend that the Whistle be screw-mounted to it as well to help with heat dissipation. The Whistle has screw-mount holes on each corner of the heatsink for this purpose.

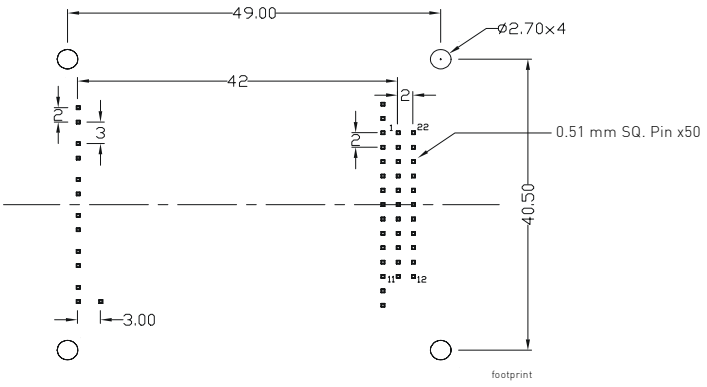


Figure 3-1: Whistle Footprint

3.5 Integrating the Whistle on a PCB

The Whistle is designed to be mounted on a PCB, either by soldering its pins directly to the PCB or by using suitable socket connectors. In both cases the following rules apply:

3.5.1 Traces

1. The **size of the traces** on the PCB (thickness and width) is determined by the current carrying capacity required by the application.
   - The rated continuous current limit (Ic)of the Whistle is the current used for sizing the motor traces (M1, M2, M3 and PE) and power traces (VP+, PR and PE).
   - For control, feedbacks and Inputs/ outputs conductors the actual current is very small but "generous" thickness and width of the conductors will contribute to a better performance and lower interferences.
2. The **traces should be as short as possible** to minimize EMI and to minimize the heat generated by the conductors.
3. The **spacing** between the high voltage conductors (VP+, PR, M1, M2, M3, VL) must be at least:
   - Surface layer: 1.5 mm
   - Internal layer: 0.10 mm

Complying with the rules above will help satisfy UL safety standards, MIL-STD-275 and the IPC-D-275 standard for non-coated conductors, operating at voltages lower than 100VDC and at "unlimited altitudes" (above 10,000 meters – 30,000 feet).

3.5.2 Grounds and Returns

The "Returns" of the Whistle are structured internally in a star configuration. The returns in each functional block are listed below:

Functional Block	**Return Pin**
Power	PR (Power Return)
Internal Switch Mode P.S.	PR (Power Return)
RS232 Communications	RS232_COMRET (J1/3)
CAN Communications	CAN_COMRET (J1/20)
Control section	Internal, not accessible
Main Feedback	SUPRET (J2/2)
Aux. Feedback	SUPRET (J1/4)
Analog input	ANLRET (J2/2)

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

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

5. **Inputs**: The 6 inputs are optically isolated from the other parts of the Whistle. All 6 inputs share a single common "Return" (INRET - J1/15). To retain isolation, the Input Return pin, as well as other conductors on the input circuit, must be laid out separately.

6. **Outputs**: The 2 outputs are optically isolated from the other parts of the Whistle. Each output has a separate floating return (OUTRET1 - J1/17 for output 1 and OUTRET2 J1/16 for output 2). To retain isolation, the Output Return pins, as well as other conductors on the output circuit, must laid out separately.

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

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

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

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

Follow these instructions to ensure safe and proper implementation. Failure to meet any of the above-mentioned requirements can result in drive/controller/host failure.

3.6 The Whistle Connection Diagram

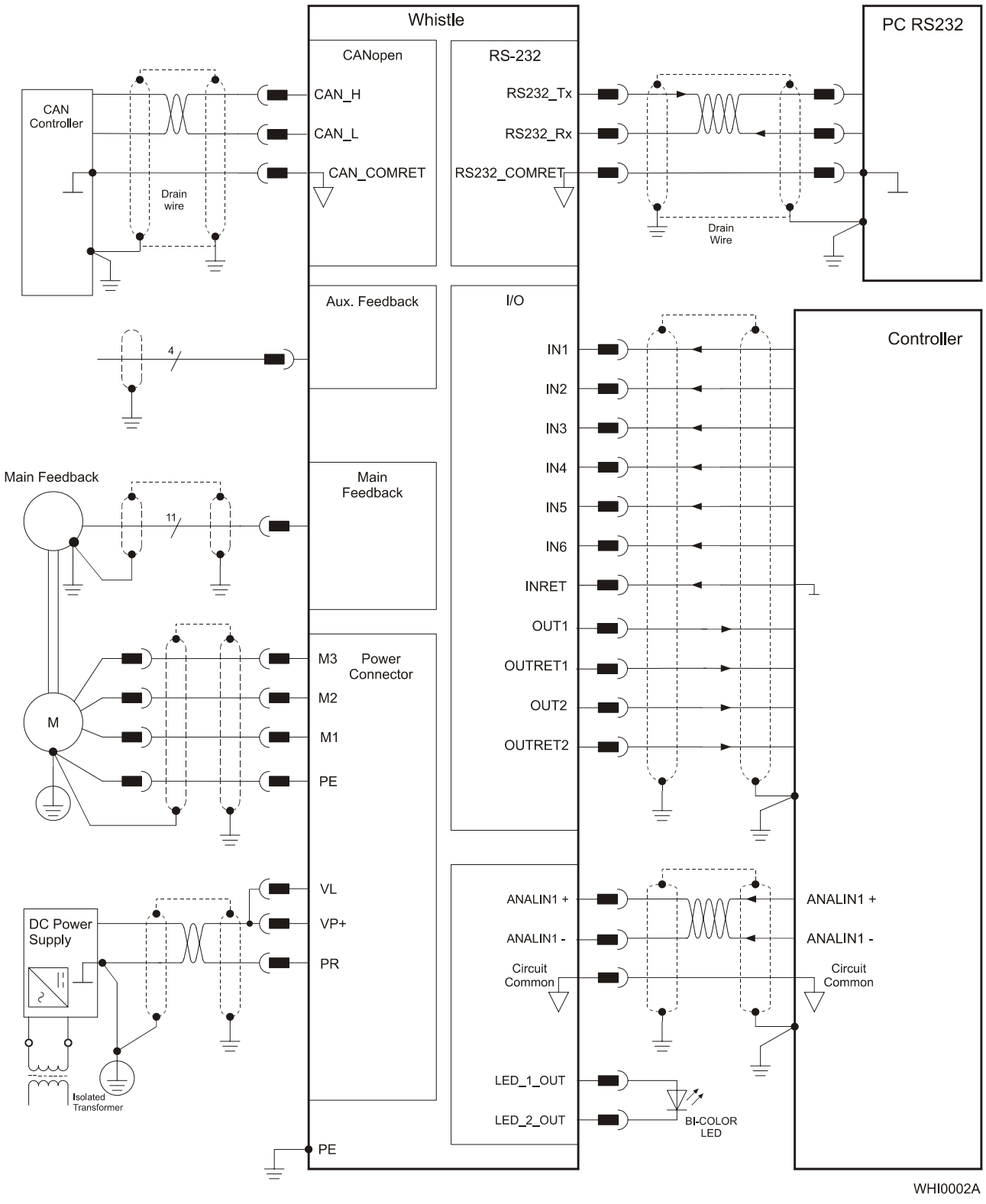


Figure 3-2: Whistle Connection Diagram

3.7 Main Power and Motor Power

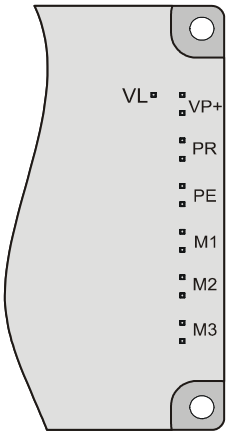
Pin	Function	Cable		Pin Positions
VP+	Pos. Power input	Power		
PR	Power return	Power		
PE	Protective earth	Power		
		AC Motor	**DC Motor**	
PE	Protective earth	Motor	Motor	
M1	Motor phase	Motor	N/C	
M2	Motor phase	Motor	Motor	
M3	Motor phase	Motor	Motor	
	When connecting several whistles to several motors, all should be wired in an identical manner. This will enable the same SimplIQ program to run on all drives.			

Table 3-1: ***Connector for Main Power and Motor***

3.7.1 Connecting Motor Power

Connect the M1, M2, M3 and PE pins on the Whistle in the manner described in section 3.5 (Integrating the Whistle on a PCB). 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.

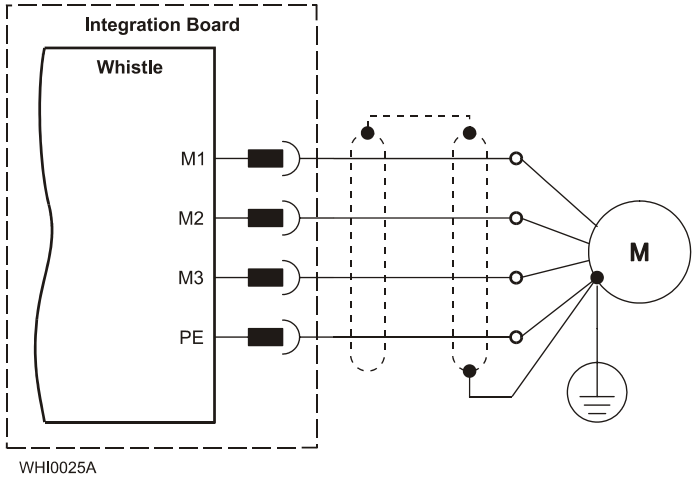


Figure 3-3: AC ***Motor Power Connection Diagram***

3.7.2 Connecting Main Power

Connect the VP+, PR and PE pins on the Whistle in the manner described in section 3.5 (Integrating the Whistle on a PCB).

- ***The source of the 12 ~ 95 VDC Main Power Supply must be isolated.***

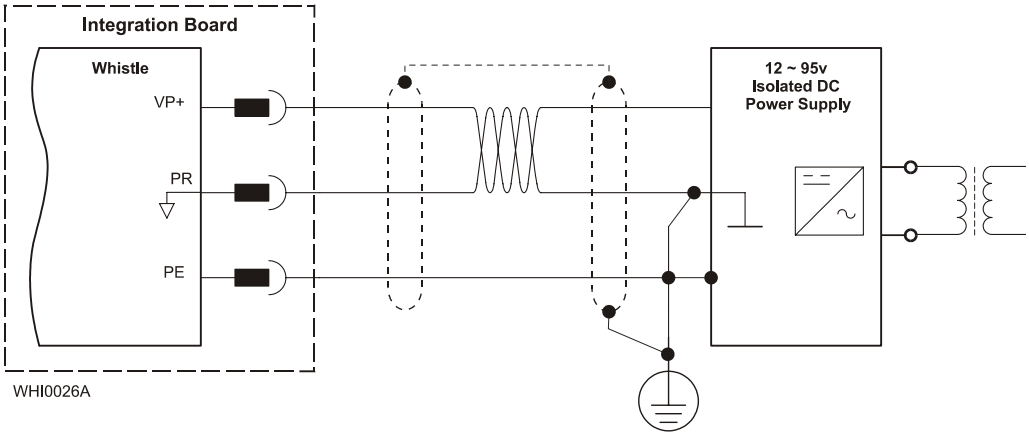


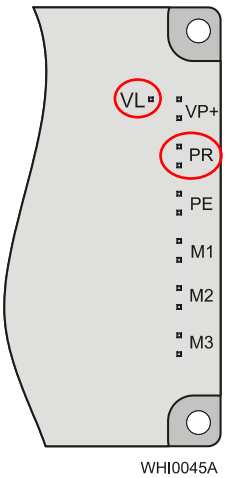
Figure 3-4: ***Main Power Supply Connection Diagram (no Auxiliary Supply)***

3.8 Auxiliary Supply (for drive logic)

Notes for 12 ~ 95 VDC auxiliary supply connections:

- ***The source of the 12 ~ 95 VDC Auxiliary Supply must be isolated.***

Connect the VL and PR pins on the Whistle in the manner described in section 3.5 (Integrating the Whistle on a PCB).

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

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

Table 3-2: ***Auxiliary Supply Pins***

3.8.1 Single Supply

A single isolated DC power supply can provide power for both the main power and the Auxiliary (Drive Logic) Supply. The drawing below shows how a single supply is connected.

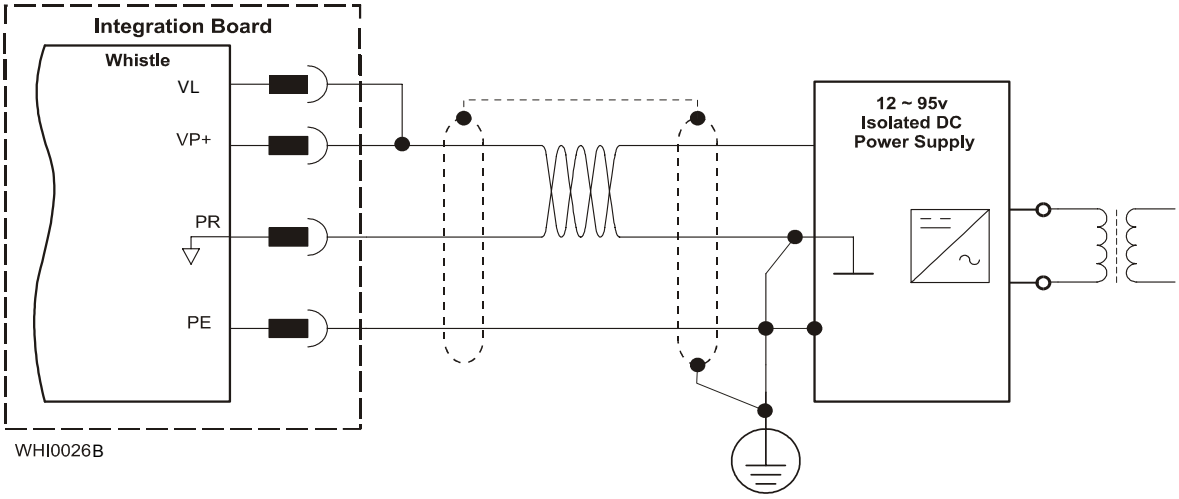


Figure 3-5: ***Single Supply for both the Main Power Supply and the Auxiliary Supply***

3.8.2 Separate Auxiliary Supply

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

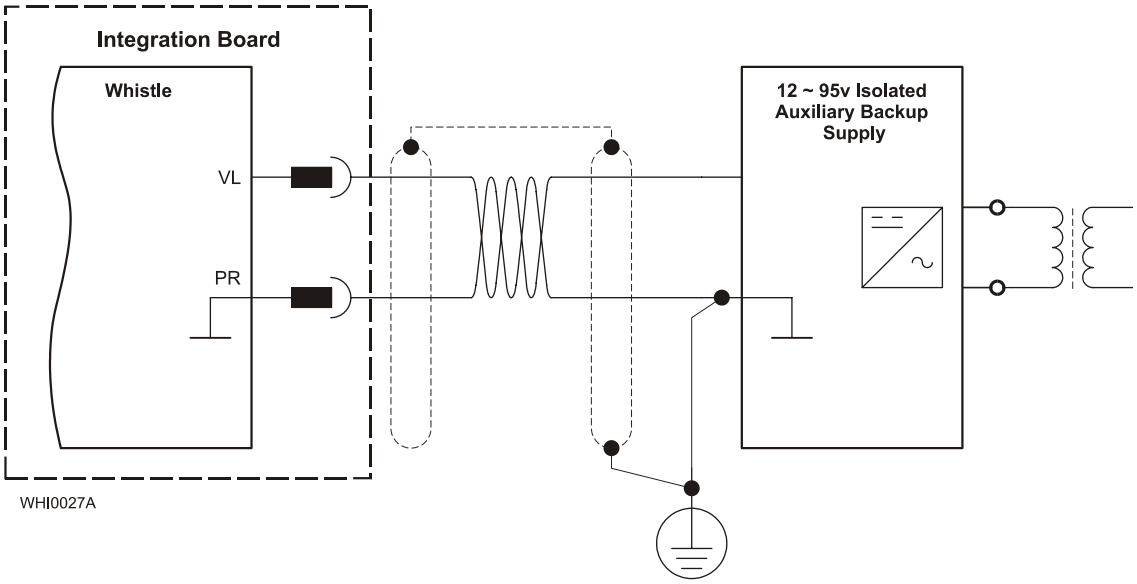


Figure 3-6: ***Separate Auxiliary Supply Connection Diagram***

3.8.3 Shared Supply

A "Main" DC Power Supply can be designed to supply power to the Whistle's Logic as well as to the Whistle's Main Power (see Figure 3-5 and the upper portion of Figure 3-7). If backup functionality is required (for storing control parameters in case of power-outs) a backup supply can be connected (see the Aux. Backup Supply in Figure 3-7).

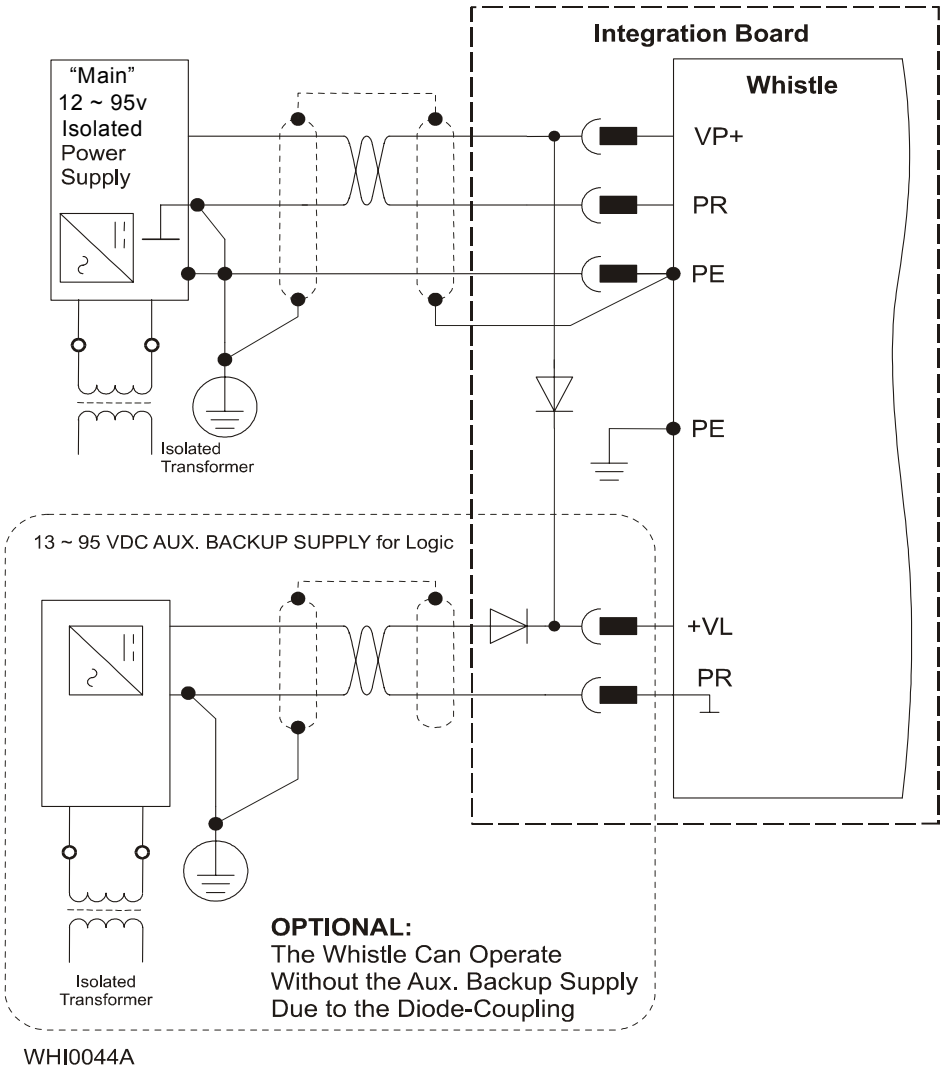


Figure 3-7: ***Shared Supply Connection Diagram***

3.9 Main Feedback

The Main Feedback port is used to transfer feedback data from the motor to the drive.

The Whistle can accept any one 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**	
	WHI XX/YYY_		WHI XX/YYY**I**		WHI XX/YYY**R**		WHI XX/YYY**T**	
Pin	**Signal**	**Function**	**Signal**	**Function**	**Signal**	**Function**	**Signal**	**Function**
J2/13	HC	Hall sensor C input	NC	-	NC	-	HC	Hall sensor C input
J2/11	HA	Hall sensor A input	NC	-	NC	-	HA	Hall sensor A input
J2/2	SUPRET	Supply return	SUPRET	Supply return	SUPRET	Supply return	SUPRET	Supply return
J2/1	+5V	Encoder/Hall +5V supply	+5V	Encoder/Hall +5V supply	+5V	Encoder/Hall +5V supply	+5V	Encoder/Hall +5V supply
J2/6	CHA-	Channel A complement	A-	Sine A complement	S3	Sine A complement	Tac 1-	Tacho Input 1 Neg. (20V max)
J2/5	CHA	Channel A	A+	Sine A	S1	Sine A	Tac 1+	Tacho Input 1 Pos. (20V max)
J2/10	INDEX-	Index complement	R-	Reference complement	R2	Vref complmnt f= 1/TS, 50mA Maximum	NC	-
J2/9	INDEX	Index	R+	Reference	R1	Vref f=1/TS, 50mA Max.	POT	Potentiometer Input (5V Max)
J2/12	HB	Hall sensor B input	NC	-	NC	-	HB	Hall sensor B input
J2/8	CHB-	Channel B complement	B-	Cosine B complement	S4	Cosine B complement	Tac 2-	Tacho Input 2 Neg. (50V max)
J2/7	CHB	Channel B	B+	Cosine B	S2	Cosine B	Tac 2+	Tacho Input 2 Pos. (50V max)
J2/3	ANALIN+ is used for Analog Input							
J2/4	ANALIN- is used for Analog Input							
J2/14	LED_2_OUT (AOKLED cathode) is used for LED indication							
J2/15	LED_1_OUT (AOKLED anode) is used for LED indication							

Table 3-3: Main Feedback Pin Assignments

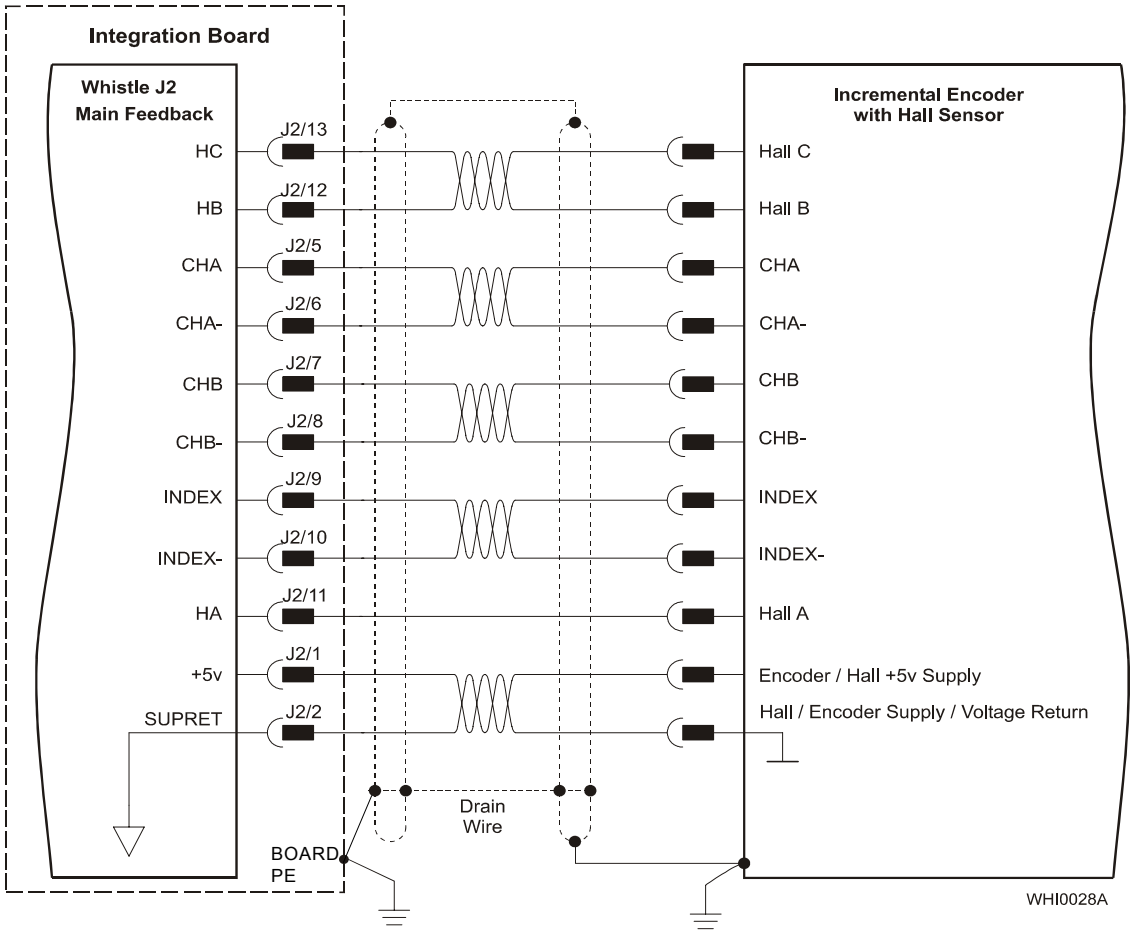


Figure 3-8: Main Feedback- Incremental Encoder Connection Diagram

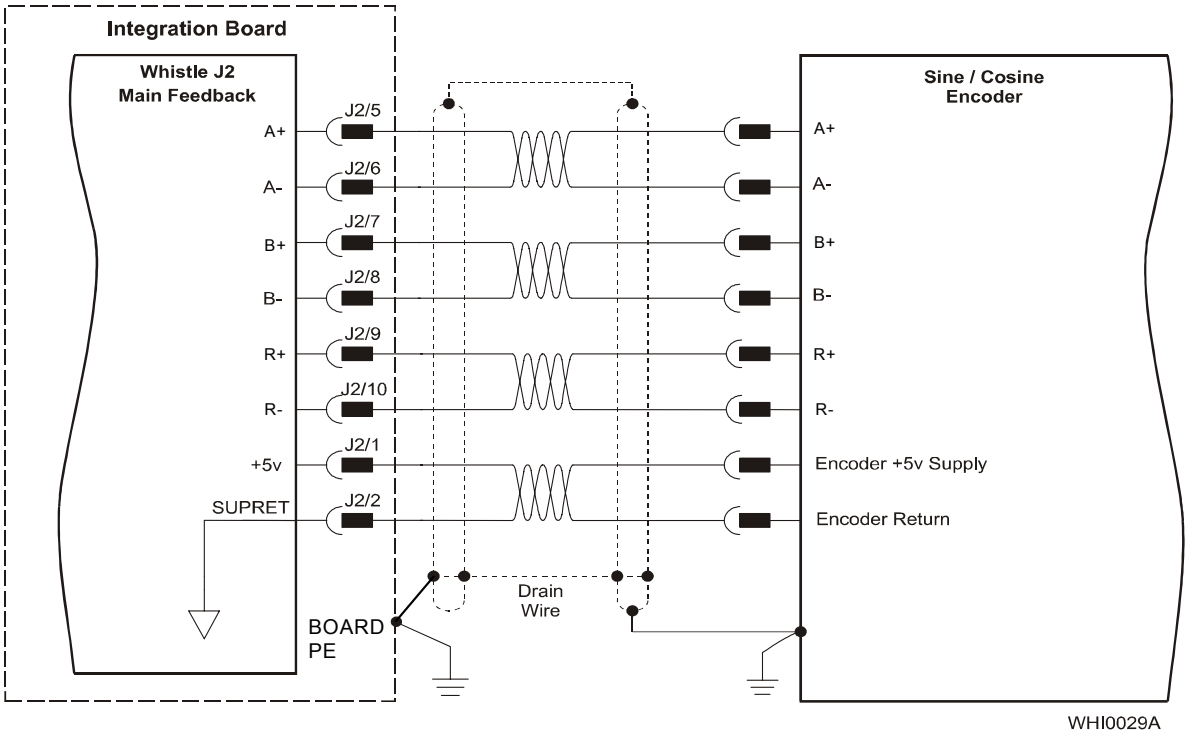


Figure 3-9: Main Feedback – Interpolated Analog Encoder Connection Diagram

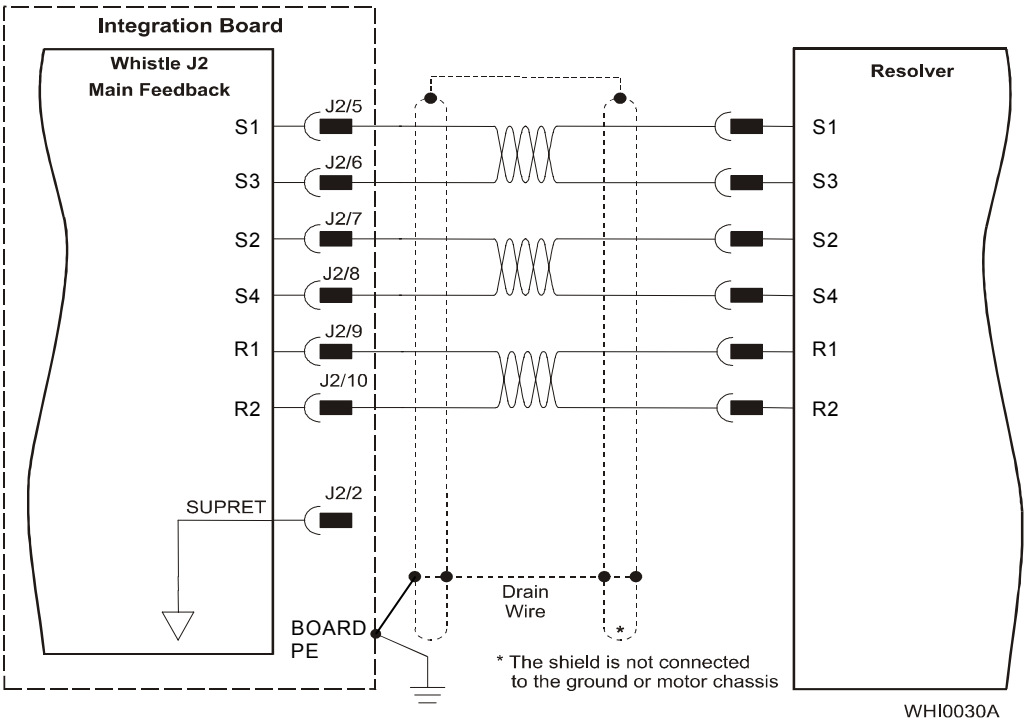


Figure 3-10: Main Feedback – Resolver Connection Diagram

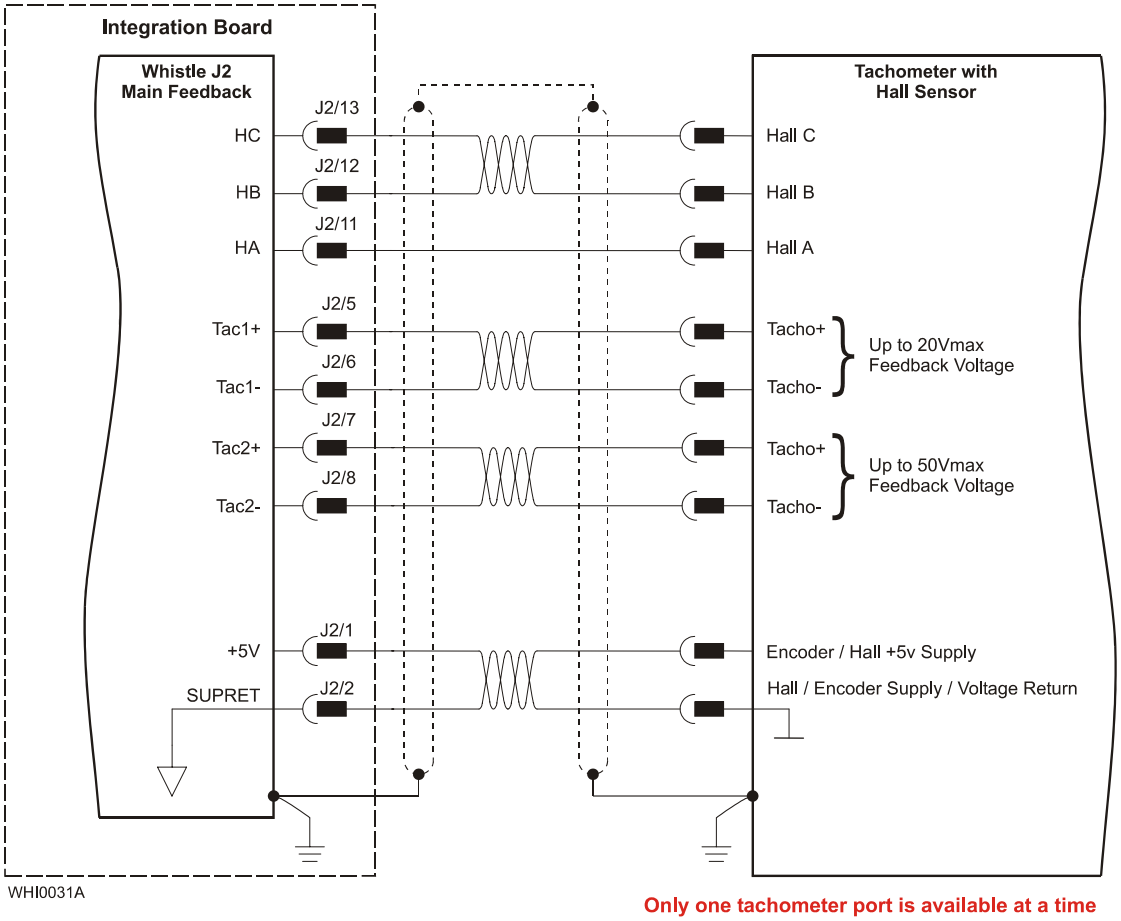


Figure 3-11: Main Feedback – Tachometer Feedback with Digital Hall Sensor Connection Diagram for Brushless Motors

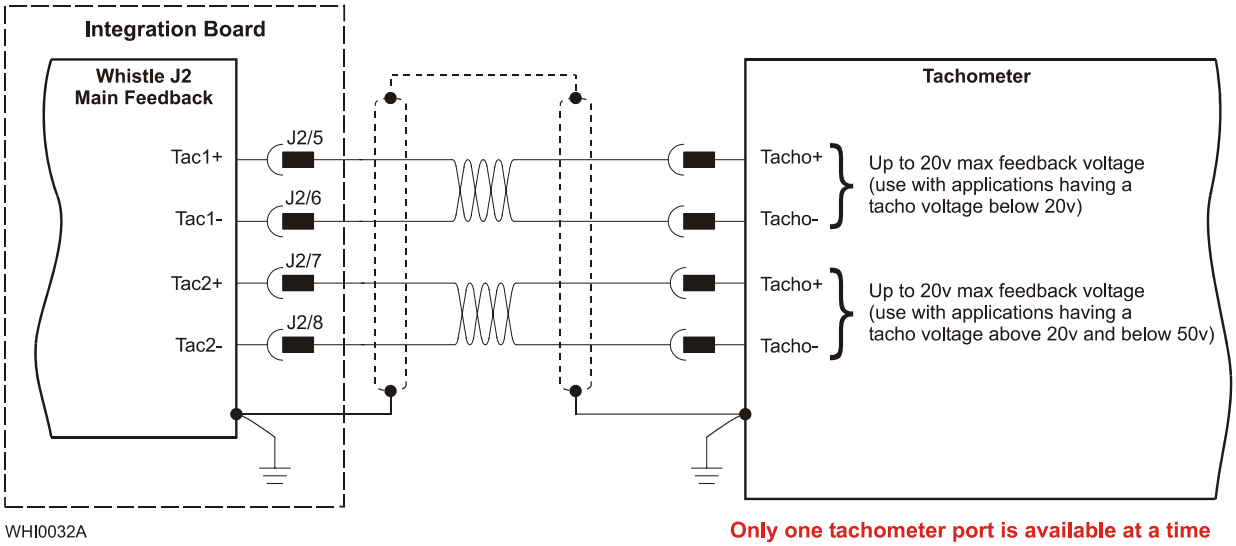


Figure 3-12: ***Main Feedback – Tachometer Feedback Connection Diagram for Brush Motors***

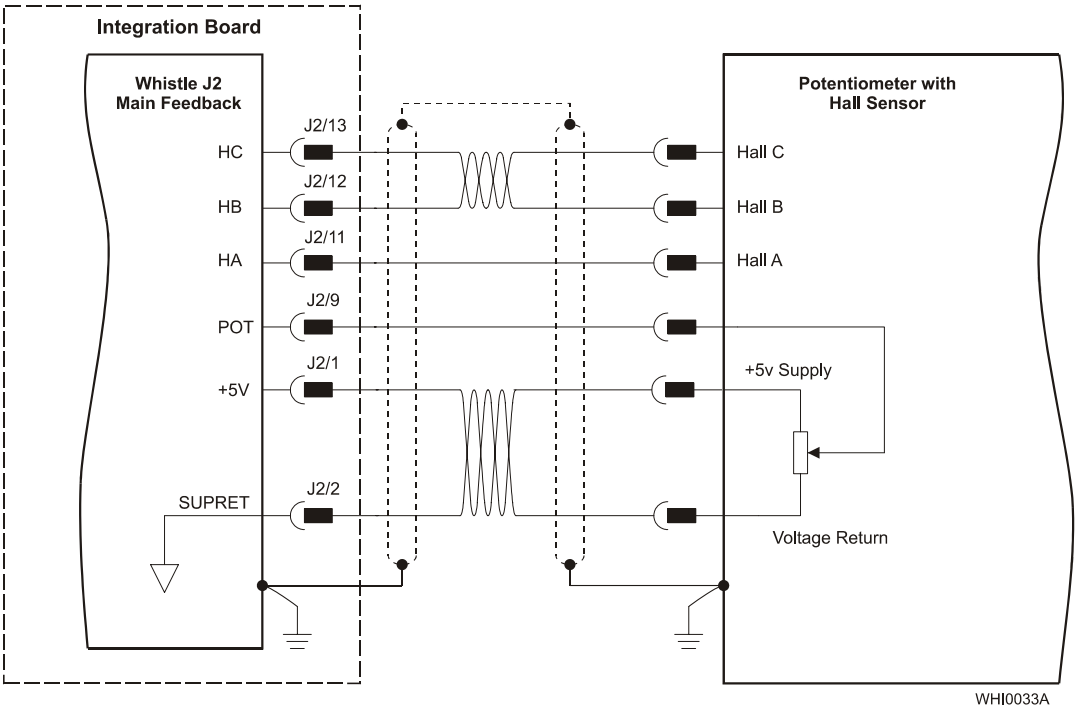


Figure 3-13: ***Main Feedback – Potentiometer Feedback with Digital Hall Sensor Connection Diagram for Brushless Motors***

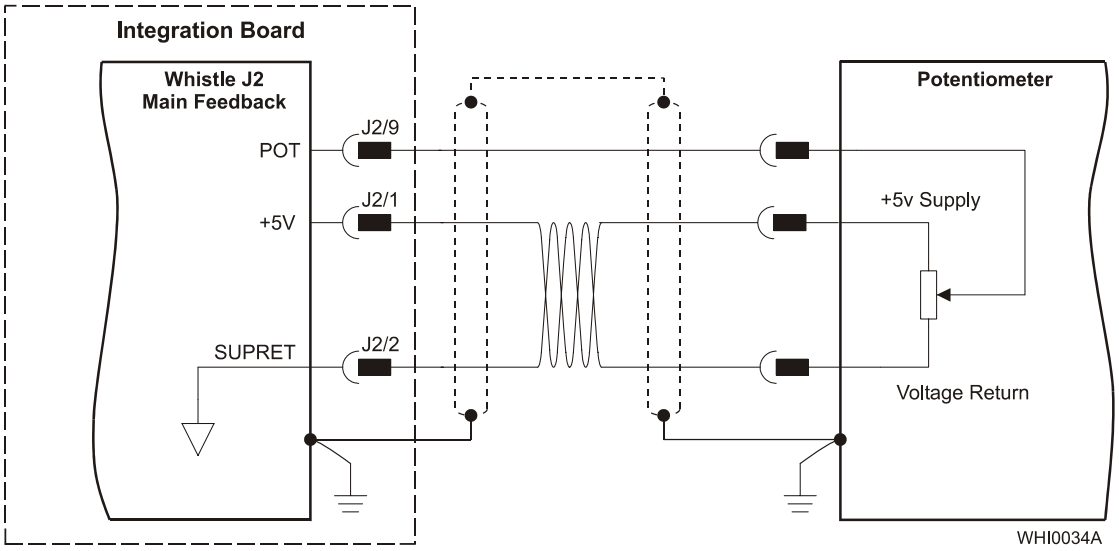


Figure 3-14: ***Main Feedback – Potentiometer Feedback Connection Diagram for Brush Motors and Voice Coils***

3.10 Auxiliary Feedback

For auxiliary feedback, select one of the following options:

a. **Single-ended emulated encoder outputs**, 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 Whistle is used as a current amplifier to provide position data to the position controller.
   - The Whistle is used in velocity mode, to provide position data to the position controller.
   - The Whistle is used as a master in follower or ECAM mode.

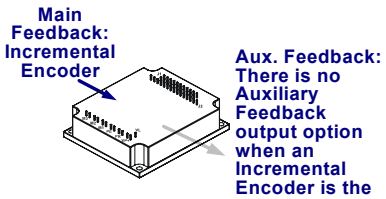
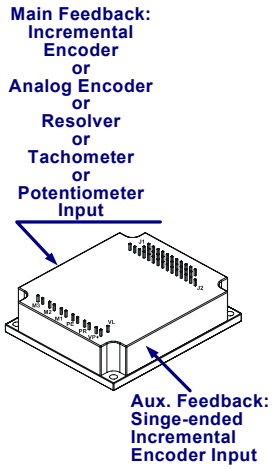
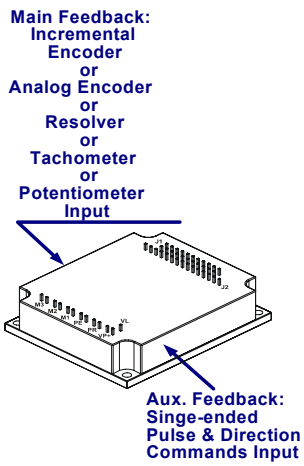
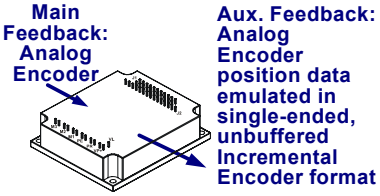
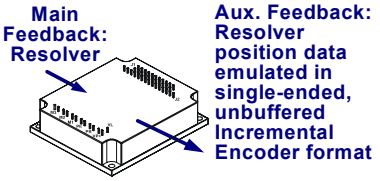
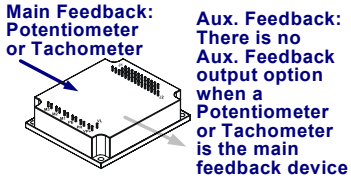
b. **Single-ended auxiliary encoder input**, for the input of position data of the master encoder in follower or ECAM mode.

c. **Pulse-and-direction input**, for single-ended input of pulse-and-direction position commands.

When using one of the auxiliary feedback options, the relevant functionality is software selected for that option. Refer to the *SimplIQ Command Reference Manual* for detailed setup information.

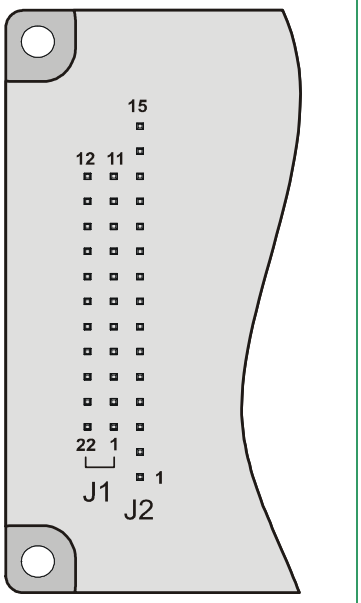
3.10.1 Main and Auxiliary Feedback Combinations

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 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 rowspan="2">SW Setting
Main Feedback</th><th colspan="3">Auxiliary Feedback</th></tr>
<tr><th>YA[4] = 4
(Aux. Feedback: output)</th><th>YA[4] = 2
(Aux. Feedback: input)</th><th>YA[4] = 0
(Aux. Feedback: input)</th></tr>
<tr><td>Incremental Encoder Input</td><td>★
 
</td><td rowspan="4"> 
</td><td rowspan="4"> 
</td></tr>
<tr><td>Interpolated Analog (Sin/Cos) Encoder Input</td><td>★
 
</td></tr>
<tr><td>Resolver Input</td><td>✸
 
</td></tr>
<tr><td>Potentiometer Tachometer Input</td><td> 
</td></tr>
<tr><td>Typical Applications</td><td>★ Any application where the main encoder is used, not only for the drive, but also for other purposes such as position controllers and/or other drives.
★ Analog Encoder applications where position data is required in the Encoder's quadrature format.
✸ Resolver applications where position data is required in the Encoder's quadrature format.</td><td>Any application where two feedbacks are used by the drive.
The Auxilliary Feedback port serves as an input for the auxiliary incremental encoder.
For applications such as Follower, ECAM, or Dual Loop.</td><td>Any application where two feedbacks are used by the drive.
The Auxilliary Feedback port serves as an input for Pulse & Direction Commands.</td></tr>
</table>

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

Pin	Signal	Function
J1/4	SUPRET	Supply return
J1/19	INDEX+	Index output
J1/18	CHBO	Channel B output
J1/5	CHAO	Channel A output



Note: The Emulated Encoder Output Option is only available when using a Resolver or Analog Encoder as the main feedback device.

Note: The Whistle's Auxiliary Feedback is single-ended. When mounted on an integration board, circuitry can be added to make it differential.

Table 3-4: Emulated Single-Ended Encoder Output Pin Assignments

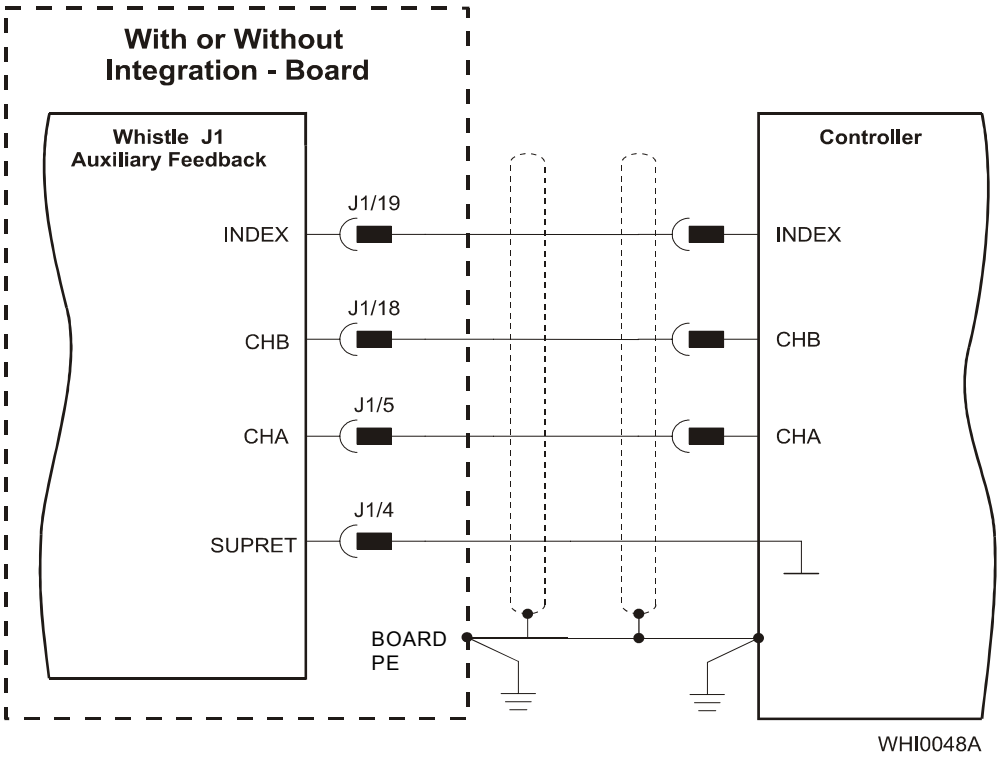


Figure 3-15: Emulated Encoder Direct Output – Acceptable Connection Diagram

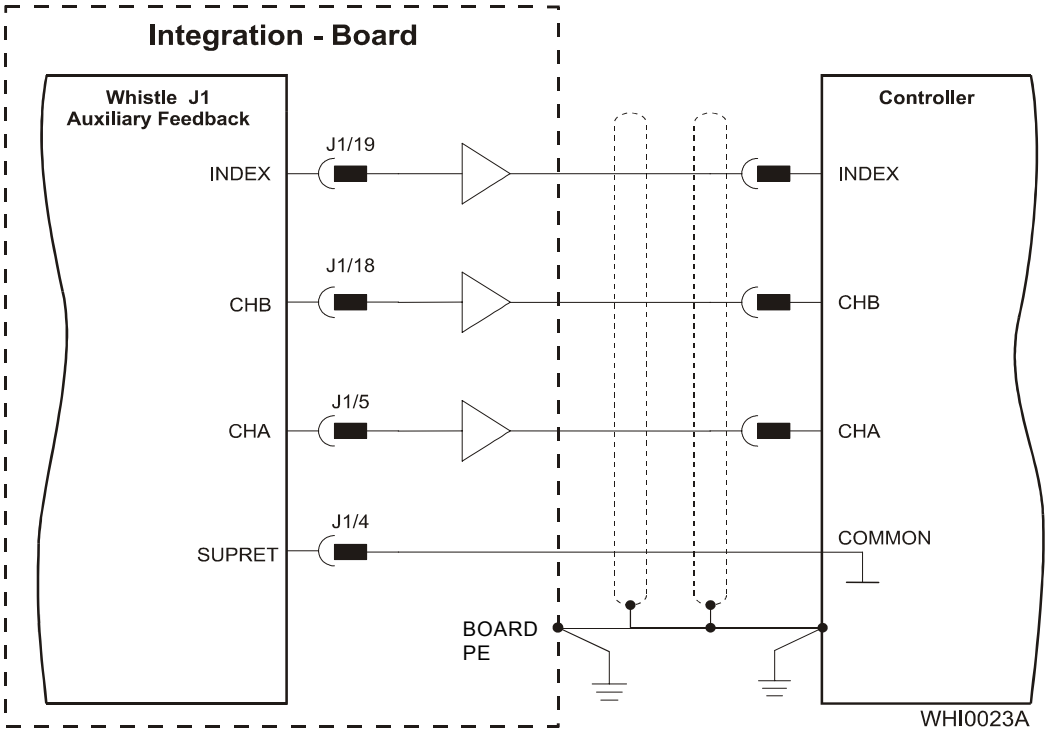


Figure 3-16: Emulated Encoder Buffered Output – Recommended Connection Diagram

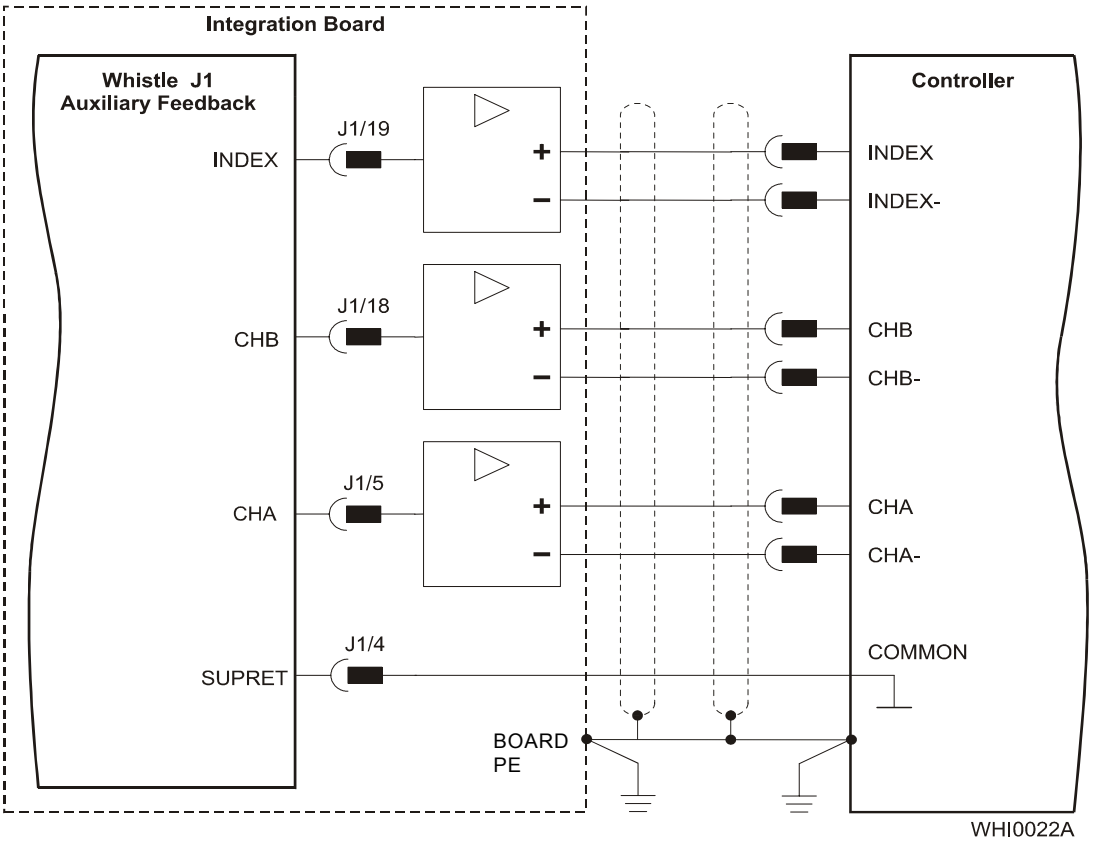
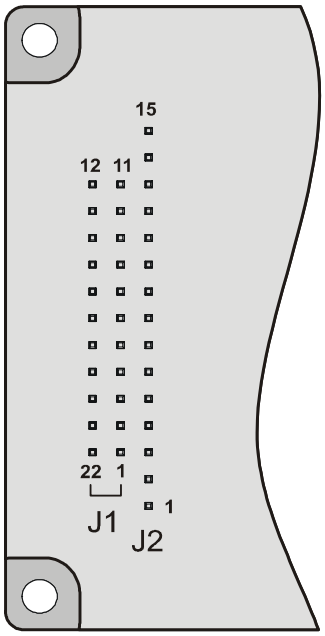


Figure 3-17: Emulated Encoder Differential Output – Highly Recommended Connection Diagram

3.10.3 Auxiliary Feedback: Single-Ended Encoder Input Option (YA[4]=2)

Pin	Signal	Function	Pin Position
J1/4	SUPRET	Supply return	
J1/19	INDEX	Auxiliary index input	
J1/18	CHB	Auxiliary channel B input	
J1/5	CHA	Auxiliary channel A input	

Note: The Whistle's Auxiliary Feedback is single-ended. When mounted on an integration board, circuitry can be added to make it differential.

Table 3-5: Single-Ended Auxiliary Encoder Pin Assignment

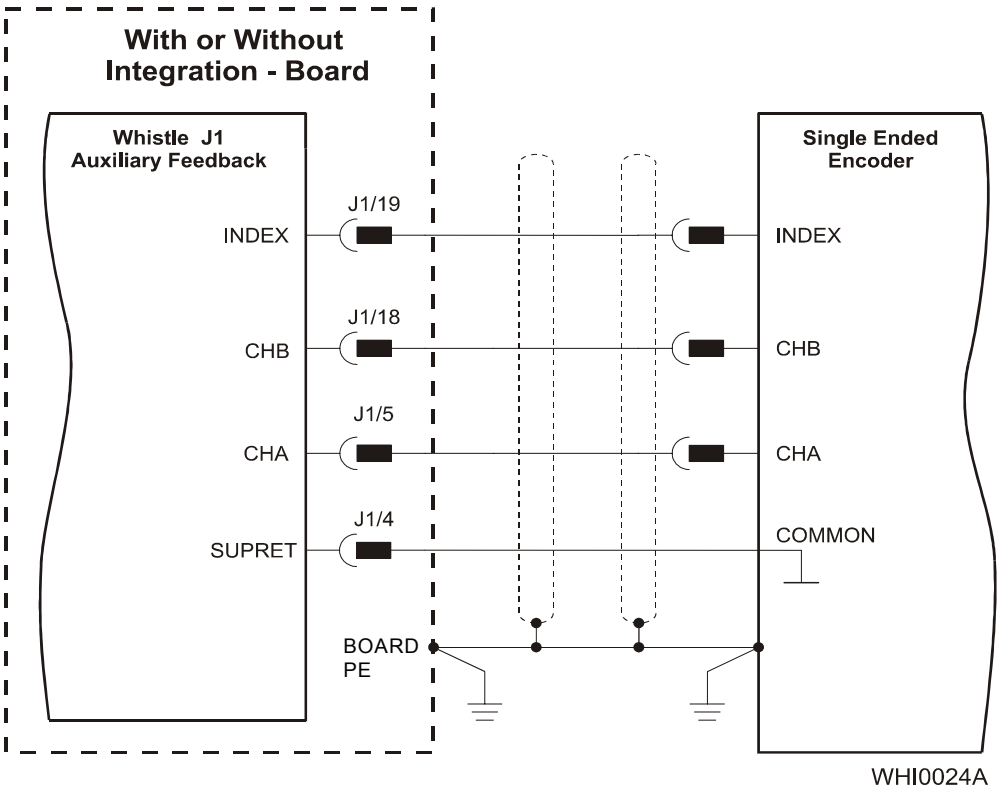


Figure 3-18: Single-ended Auxiliary Encoder Input - Acceptable Connection Diagram

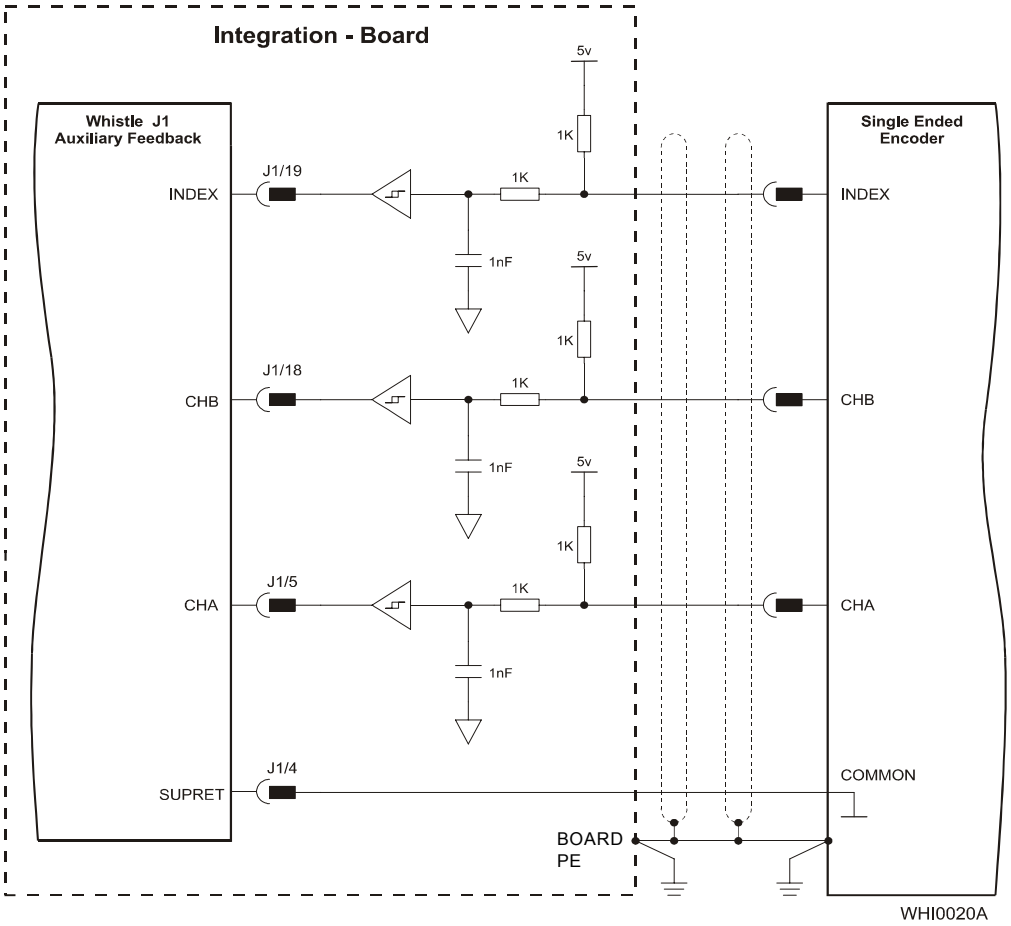


Figure 3-19: Single-ended Auxiliary Encoder Input - Recommended Connection Diagram

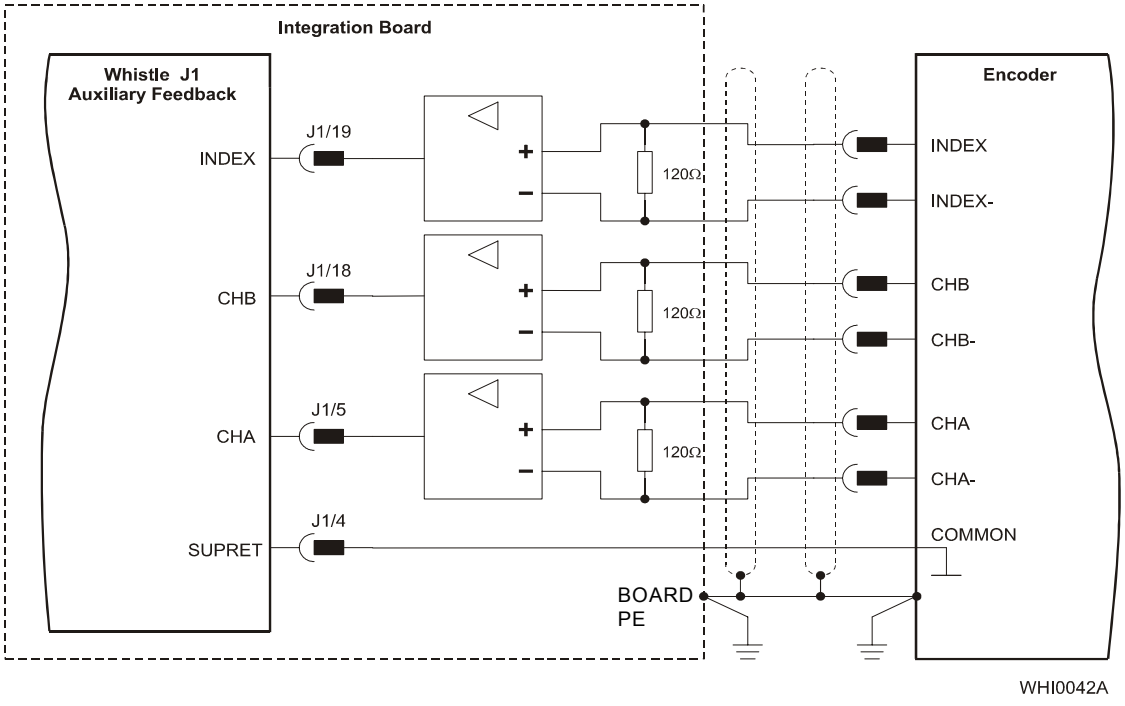
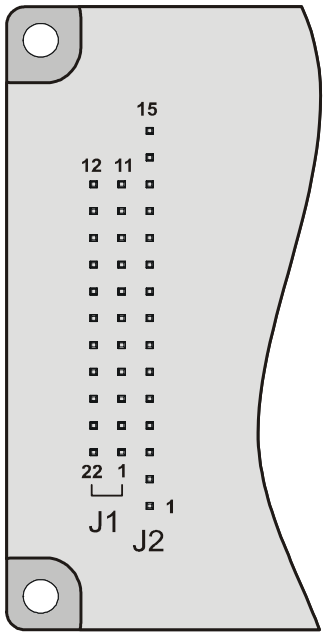


Figure 3-20: Differential Auxiliary Encoder Input – Highly Recommended Connection Diagram

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

Pin	Signal	Function	Pin Position
J1/4	SUPRET	Supply return	
J1/18	DIR/CHB	Direction input (push/pull 5 V or open collector)	
J1/5	PULS/CHA	Pulse input (push/pull 5 V or open collector)	

Note: The Whistle's Auxiliary Feedback is single-ended. When mounted on an integration board, circuitry can be added to make it differential.

Table 3-6: Pulse-and-Direction Pin Assignments

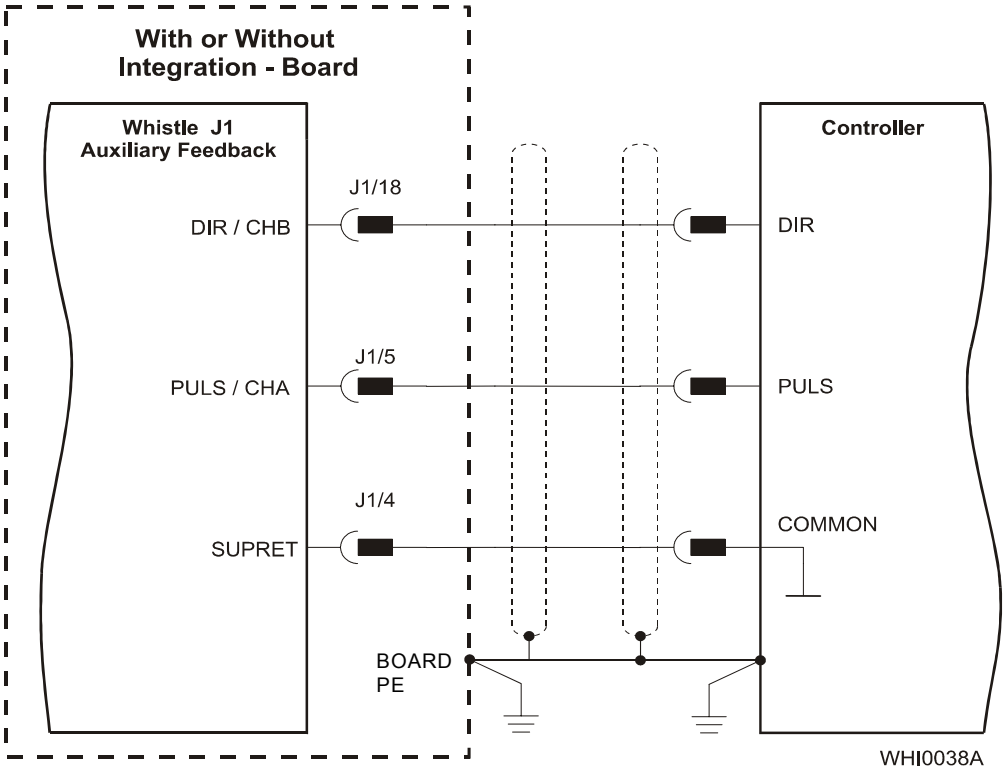


Figure 3-21: Pulse-and-Direction Auxiliary Encoder Input – Direct Connection Diagram

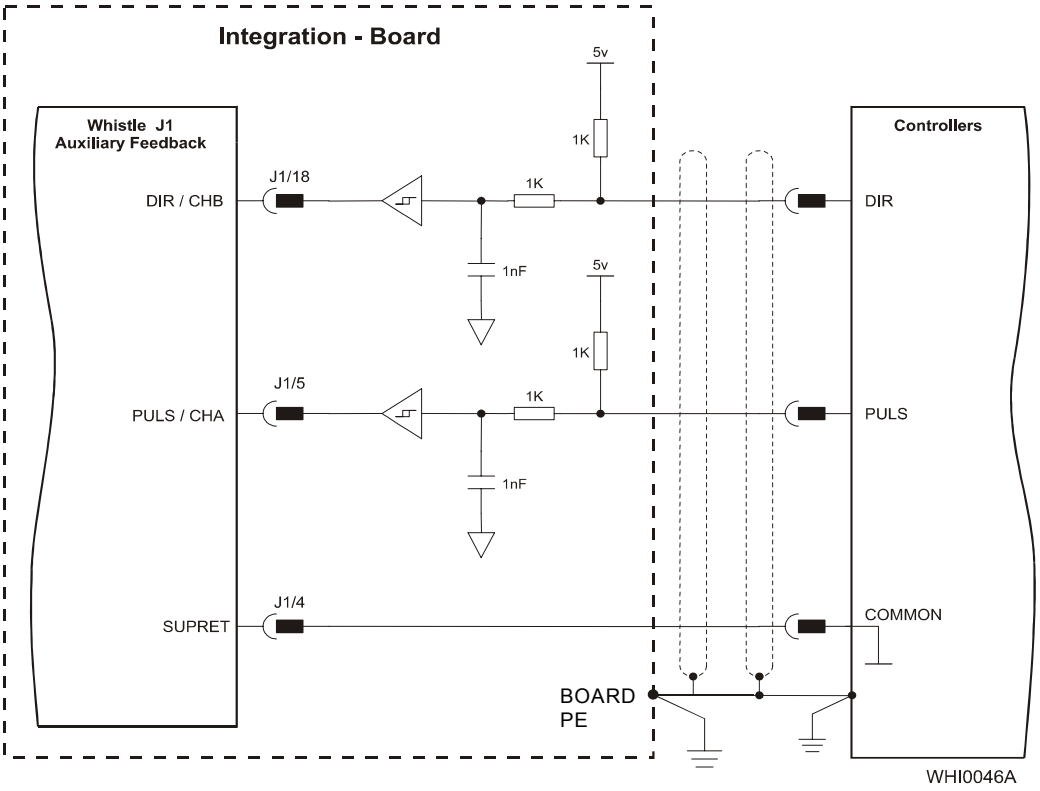


Figure 3-22: Pulse-and-Direction Auxiliary Encoder Input – Buffered Connection Diagram

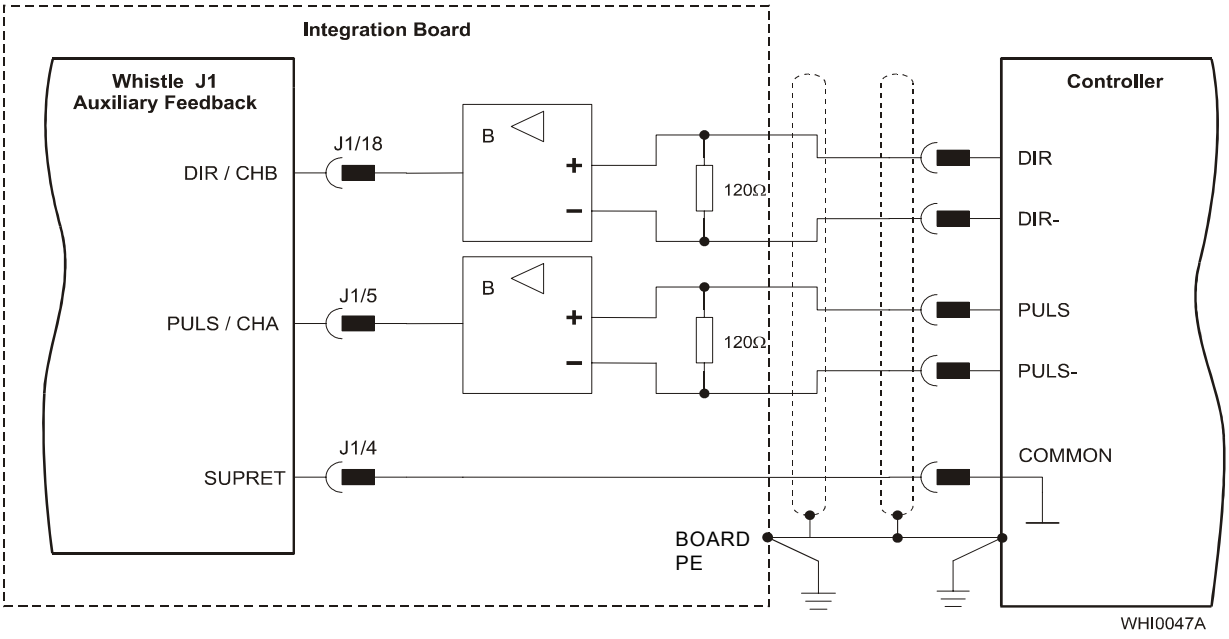


Figure 3-23: Pulse-and-Direction Auxiliary Encoder Input – Differential Connection Diagram

3.11 I/O's

The Whistle has 6 Digital Inputs, 2 Digital Outputs and 1 Analog Input.

I/O	J1	J2	Total
Digital Input	6	-	6
Digital Output	2	-	2
Analog Input	-	1	1

3.11.1 Digital Input

Each of the pins below can function as an independent input.

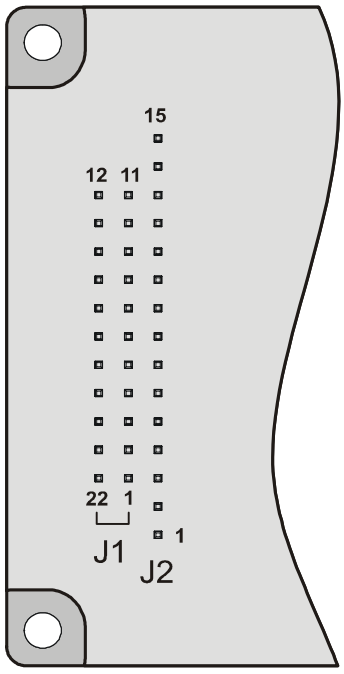
Pin	Signal	Function	Pin Position
J1/9	IN1	Programmable input 1 (general purpose, RLS, FLS, INH)	
J1/10	IN2	Programmable input 2 (general purpose, RLS, FLS, INH)	
J1/11	IN3	Programmable input 3 (general purpose, RLS, FLS, INH)	
J1/12	IN4	Programmable input 4 (general purpose, RLS, FLS, INH)	
J1/13	IN5	Hi-Speed Programmable input 5 (event capture, Main Home, general purpose, RLS, FLS, INH)	
J1/14	IN6	Hi-Speed Programmable input 6 (event capture, Auxiliary Home, general purpose, RLS, FLS, INH)	
J1/15	INRET	Programmable input return	

Table 3-7: ***Digital Input Pin Assignments***

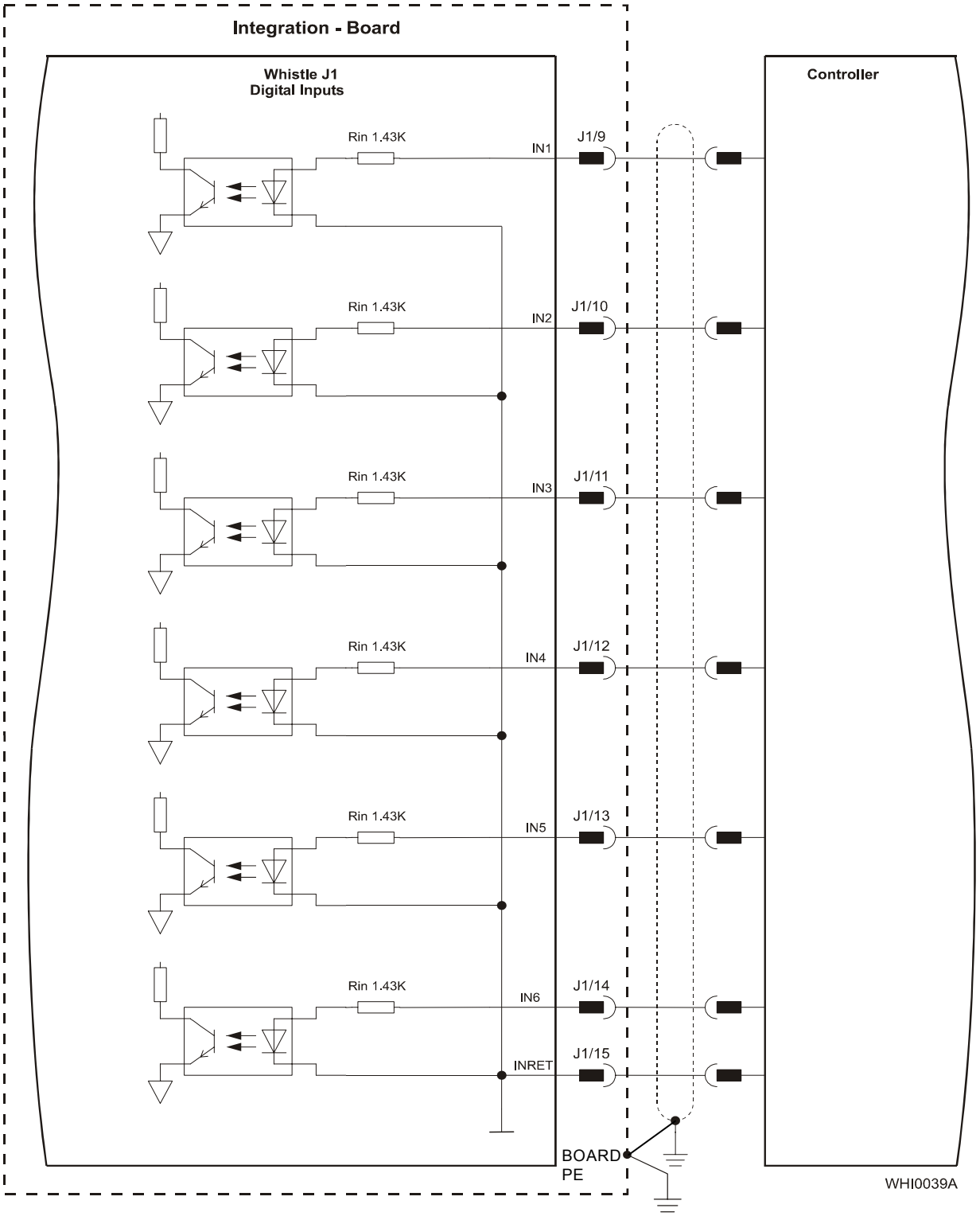


Figure 3-24: ***Digital Input Connection Diagram***

3.11.2 Digital Output

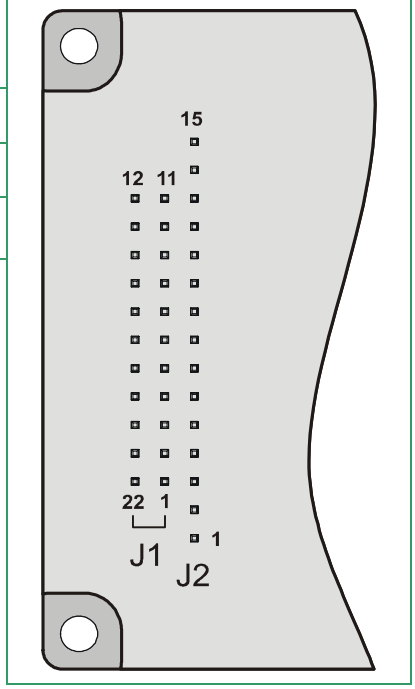
Pin	Signal	Function	Pin Position
J1/7	OUT1	High-Speed Programmable digital output 1	
J1/17	OUTRET1	Programmable digital output return 1	
J1/8	OUT2	Programmable digital output 2	
J1/16	OUTRET2	Programmable digital output return 2	

Table 3-8: ***Digital Output Pin Assignment***

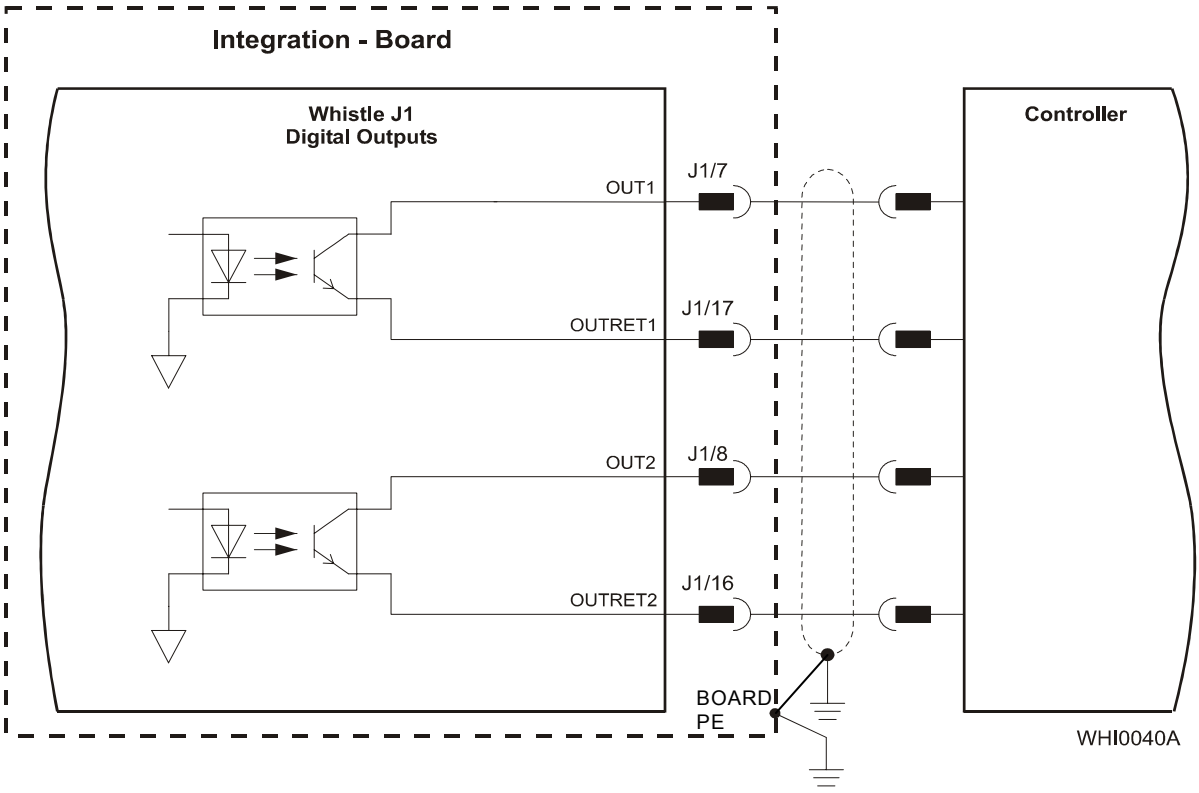


Figure 3-25: ***Digital Output Connection Diagram***

3.11.3 Analog Input

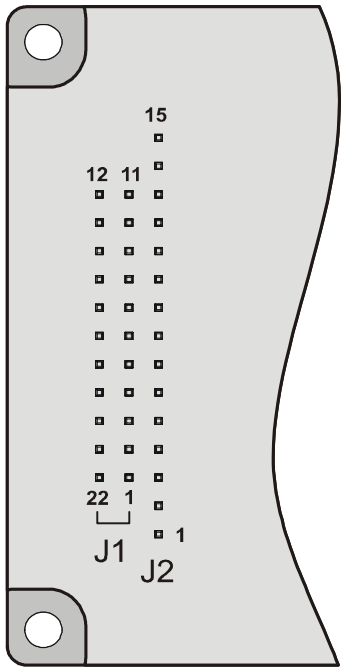
Pin	Signal	Function	Pin Position
J2/3	ANLIN1+	Analog input 1+	
J2/4	ANLIN1-	Analog input 1-	
J2/2	ANLRET	Analog ground	

Table 3-9: ***Analog Input Pin Assignments***

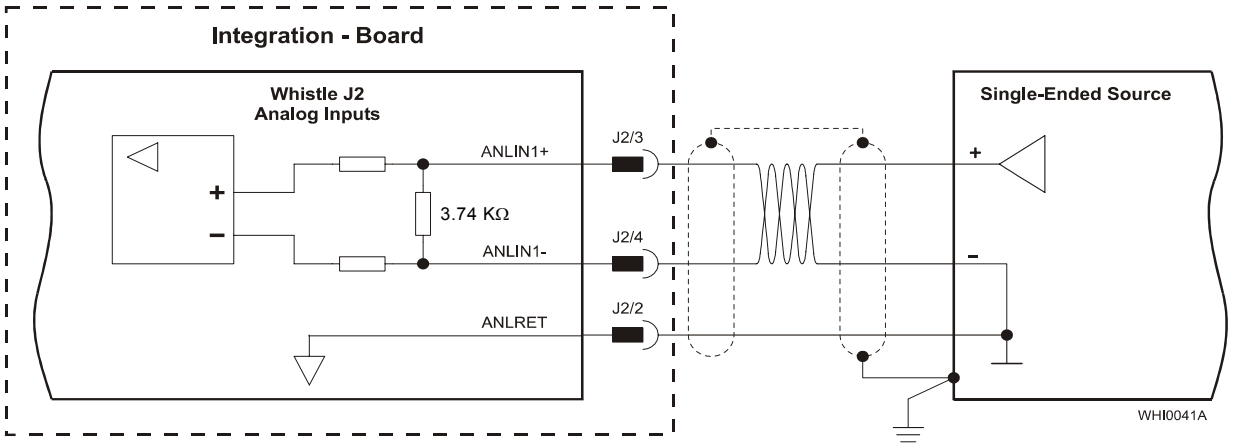


Figure 3-26: ***Analog Input with Single-ended Source***

3.12 Communications

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

a. RS-232, full duplex
b. CANopen

RS-232 communication requires a standard, commercial 3-core null-modem cable connected from the 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.

3.12.1 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**.
- Ensure that the shield of the cable is connected to the shield of the connector used for RS-232 communications. The drain wire can be used to facilitate the connection.

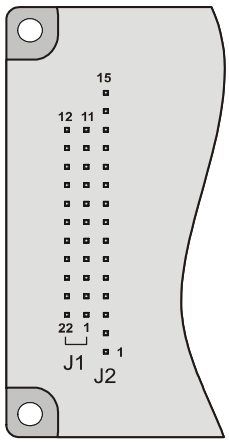
Pin	Signal	Function	Pin Location
J1/1	RS232_Rx	RS-232 receive	
J1/2	RS232_Tx	RS-232 transmit	
J1/3	RS232_COMRET	Communication return	

Table 3-10: ***RS-232 Pin Assignments***

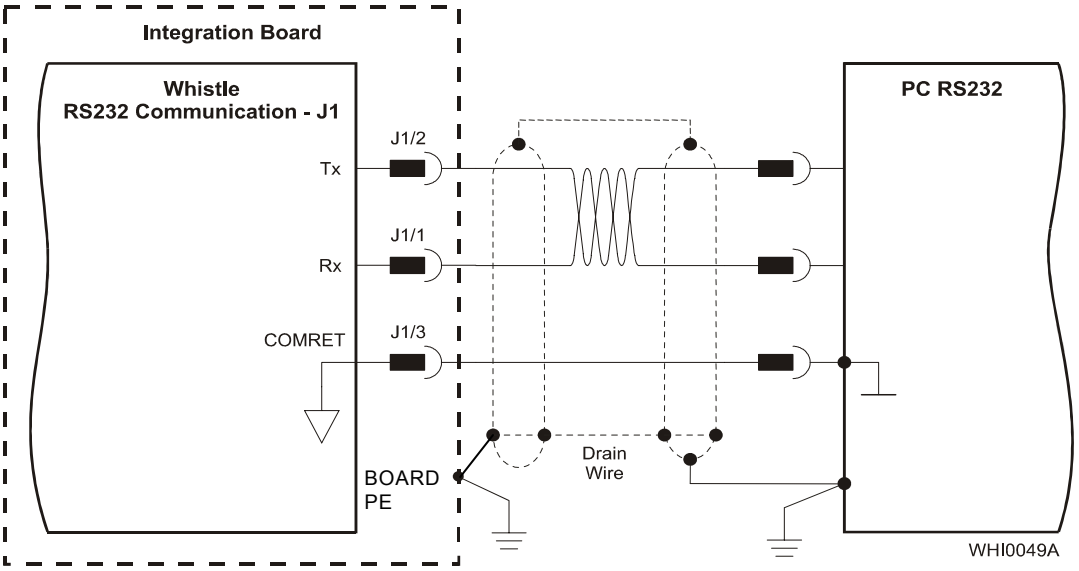


Figure 3-27: ***RS-232 Connection Diagram***

3.12.2 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.
- Ensure that the shield of the cable is connected to the shield of the connector used for communications. The drain wire can be used to facilitate the connection.
- Make sure to have a 120-ohm resistor termination at each of the two ends of the network cable.
- The Whistle's CAN ports are **non-isolated**.

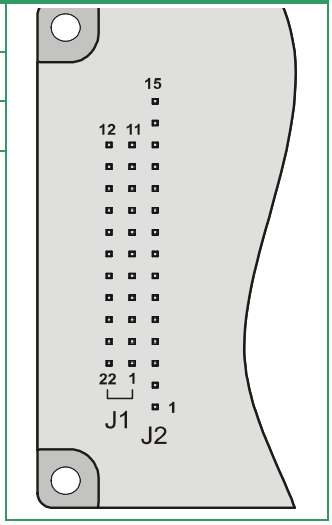
Pin	Signal	Function	Pin Position
J1/20	CAN_GND	CAN ground	
J1/21	CAN_L	CAN_L busline (dominant low)	
J1/22	CAN_H	CAN_H busline (dominant high)	

Table 3-11: ***CANopen - Pin Assignments***

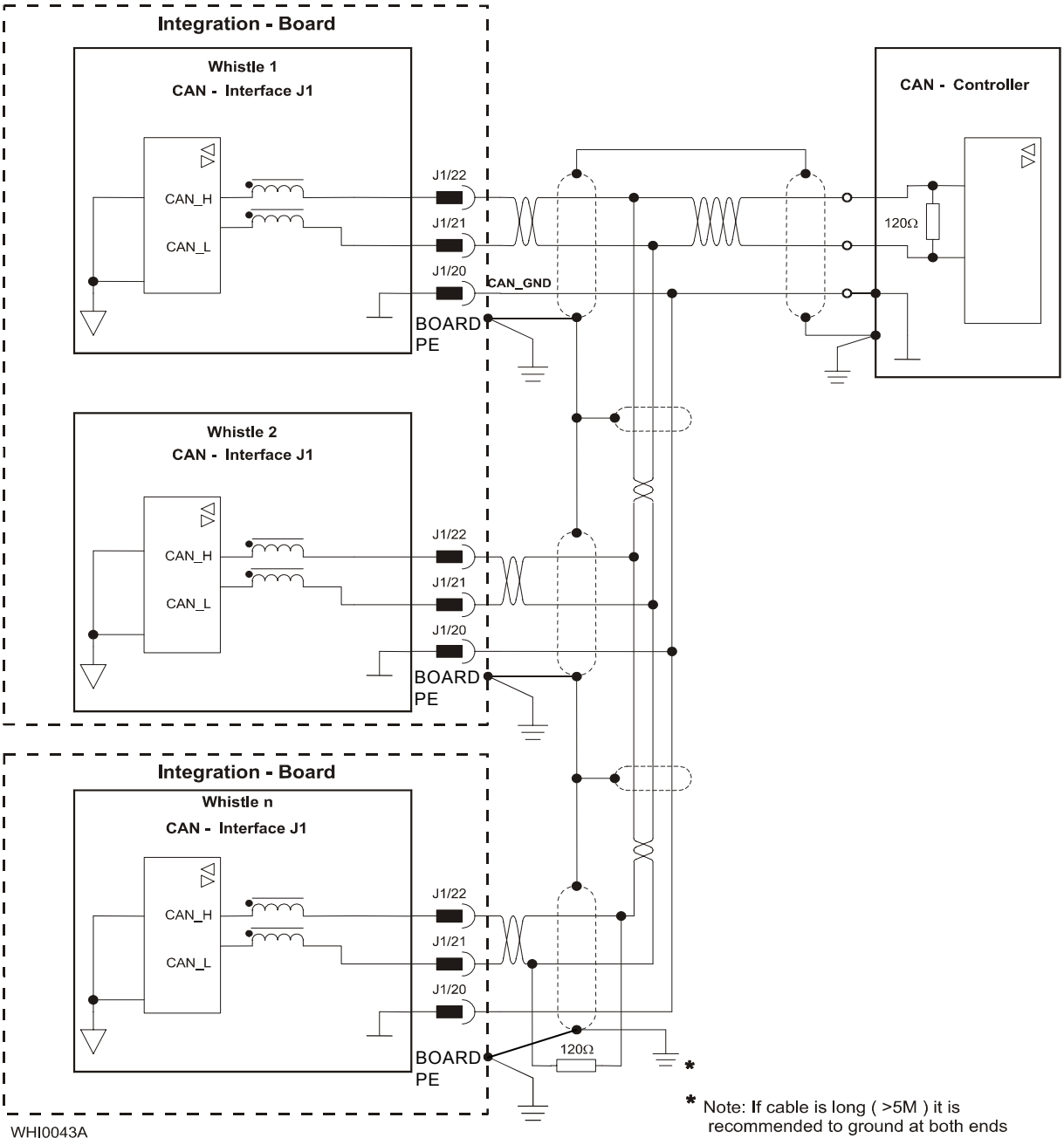


Figure 3-28: ***CANopen Network Diagram***

Caution:

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

3.13 Powering Up

After the Whistle is connected to its devices, the Whistle 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.

3.14 Initializing the System

After the 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*.

3.15 Heat Dissipation

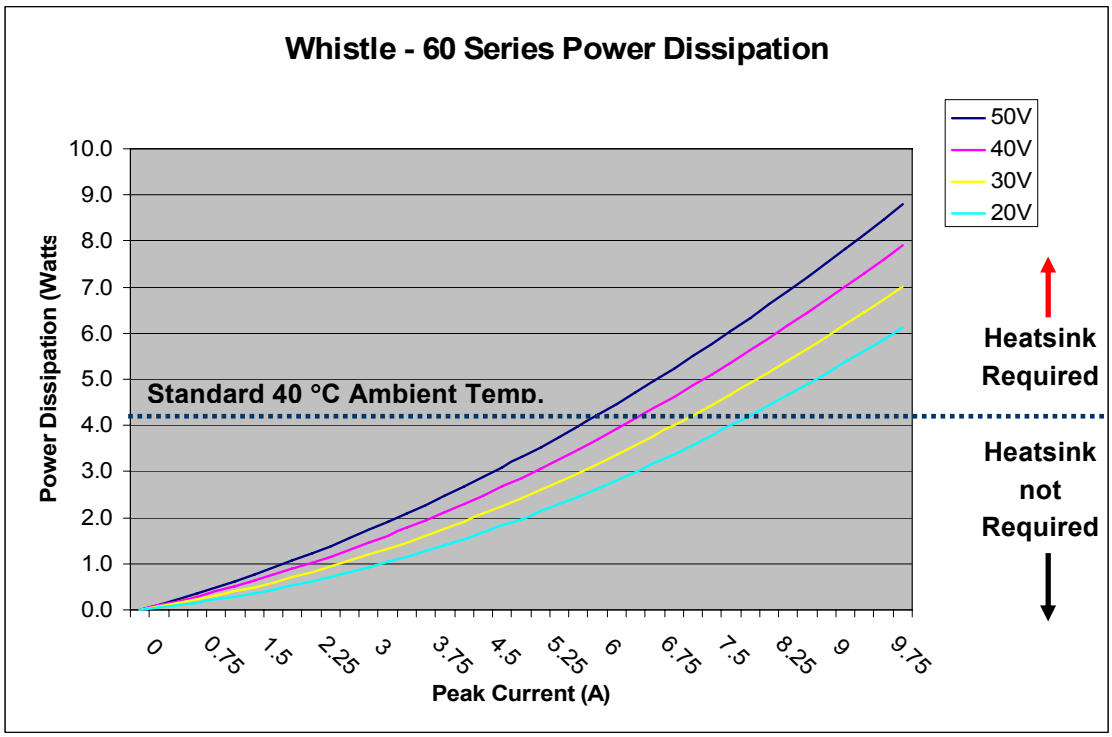
The best way to dissipate heat from the Whistle is to mount it so that its heatsink faces up. For best results leave approximately 10 mm of space between the Whistle's heatsink and any other assembly.

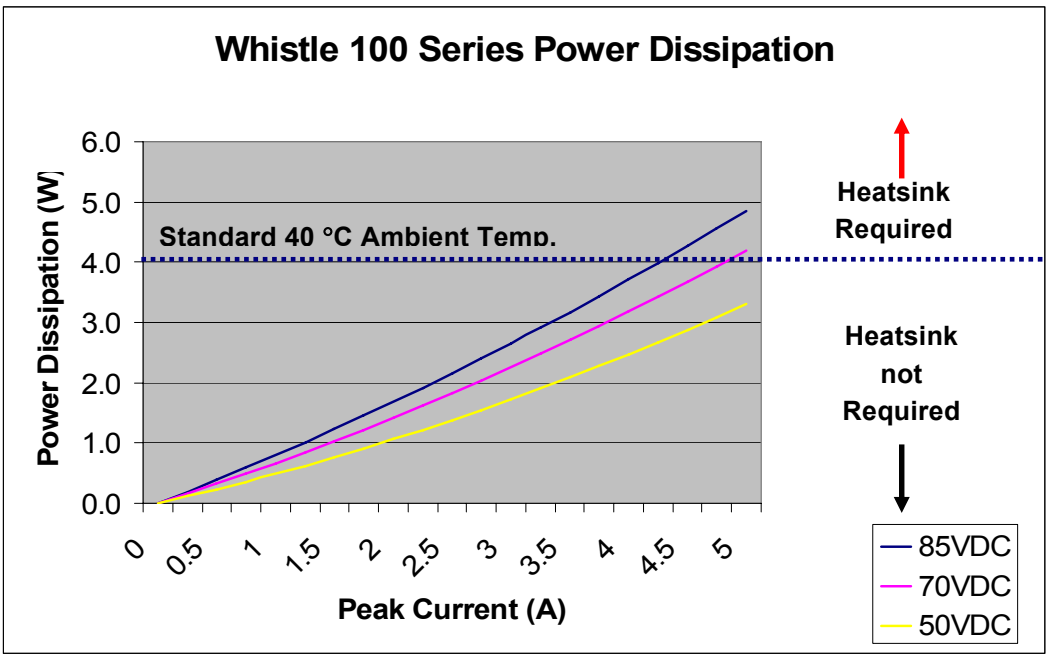
3.15.1 Whistle Thermal Data

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

3.15.2 Heat Dissipation Data.

Heat Dissipation is shown in graphically below:





3.15.3 How to Use the Charts

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

To determine if your application needs a heatsink:

1. Allow maximum heatsink temperature to be 80°C or less.
2. Determine the ambient operating temperature of the 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 4W the Whistle will need no additional cooling.

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

3.16 Evaluation Board and Cable Kit

A circuit board is available for evaluating the Whistle. It comes with standards terminal blocks for power connections and D-sub plugs/sockets for signals connections. The Evaluation Board is provided with a cable kit.

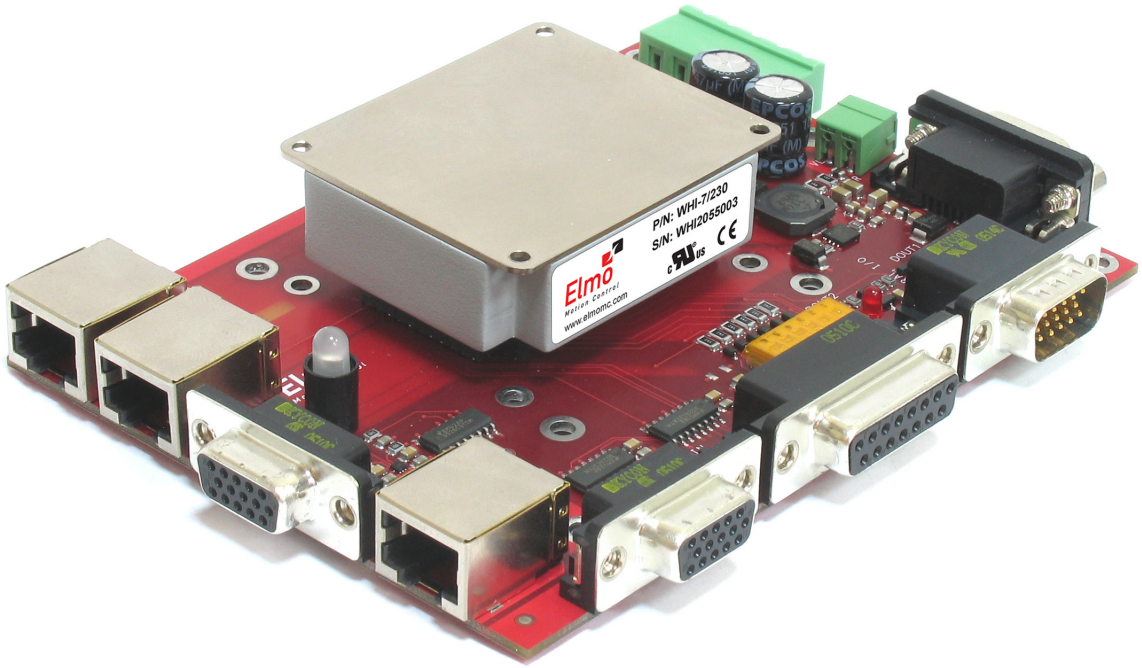


Figure 3-29: **The Whistle Mounted on an Evaluation Board (available upon request)**

Evaluation Board Catalog Number	WHI-EVLBRD-1
Evaluation Board User Manual	MAN-EVLBRD-WHI (available on our web site)

Appendix: Whistle Technical Specifications

A.1 Features

A.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

A.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, PWM current and velocity, digital (SW) and Pulse and Direction

A.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

A.1.4 Fully Programmable

- Third generation programming structure with motion commands - "Metronome"
- Event capturing interrupts
- Event triggered programming

A.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, single-ended, unbuffered of the Analog encoder
- Analog Hall Sensor
- Resolver
  - Programmable 10~15 bit resolution
  - Up to 512 Revolution Per Second (RPS)
  - Emulated encoder outputs, single-ended, unbuffered of the Resolver.
- Auxiliary Encoder inputs (ECAM, follower, etc.) single-ended, unbuffered.
- Tachometer & Potentiometer
- The Whistle can provide power (5V, 200mA max) for one Encoder, Resolver or Hall.

A.1.6 Input/Output

- One **Analog Input** – up to 14-bit resolution
- Six programmable **Digital Inputs**, 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 (open collector) one with fast output compare (OC)
    - Brake Control
    - Amplifier fault indication
    - General-purpose
    - Servo enable indication
- Pulse and Direction inputs (single-ended)
- PWM current command output for torque and velocity

A.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
    - Failure of internal power supplies
    - Over temperature
        - Cont. temperature measurement. Temp 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

A.1.8 Accessories

- Heat sinks (TBD)
- Evaluation Board/Cable Kit

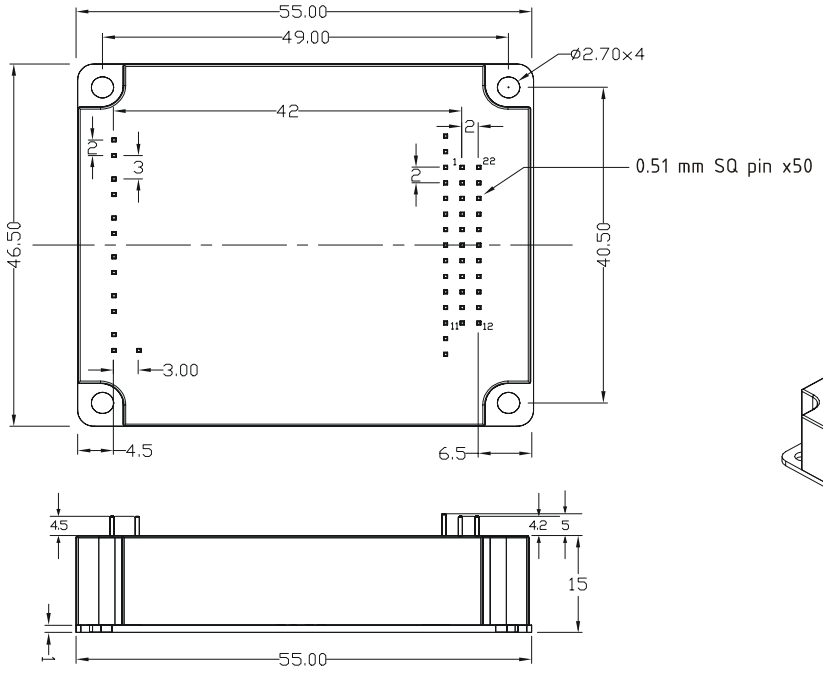
A.1.9 Status Indication

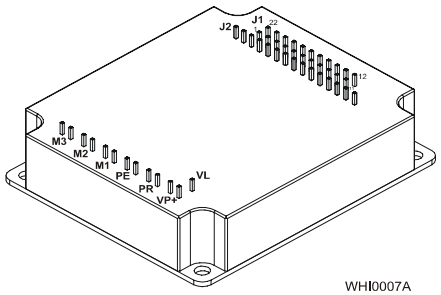
- Output for a bi-color LED

A.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

A.2 Whistle Dimensions





A.3 Power Ratings

Feature	Unit	1/60	2.5/60	5/60	10/60	1/100	2.5/100	5/100
Minimum supply voltage	VDC	7.5				12		
Nominal supply voltage	VDC	48				85		
Maximum supply voltage	VDC	59				95		
Max. output power from the drive without heatsink	W	50	120	240	480	75	180	400
Efficiency at rate power	%	> 99						
Output Voltage	%	> 95% of supply VDC at f=22 KHz						
DC and Trapezoidal Commutation Continuous Current Limit (Ic)	A	1	2.5	5	10	1	2.5	5
Sinusoidal Commutation Continuous RMS Current Limit (Ic)	A	0.7	1.8	3.6	7	0.7	1.8	3.6
Peak current limit (RMS)	A	2 x Ic						
PWM Switching Frequency	KHz	22 +/-5% default on the motor						
Switching Method		Advanced Unipolar PWM						
Weight		~ 50 grams (1.8 ounces)						
Dimensions		55 x 15 x 46.5 mm (2 x 0.6" x 1.8")						
Digital In / Digital Out / Analog In		6 / 2 / 1						
Mounting Method		PCB Mount or soldered pins						

A.4 Environmental Conditions

Feature	Details
Operating ambient temperature	0° ~ 40° C (32° ~ 104° F)
Storage temperature	-20° ~ +85° C (-4° ~ +185° F)
Humidity	90% maximum non-condensing
Maximum Operating Altitude	"Unlimited" (above 10,000m - 30,000 feet)
Protection level	IP20

A.4.1 Auxiliary Supply

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

A.5 Control Specifications

A.5.1 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 sampling time	Programmable 70 - 100 µsec
Current sampling rate	up to 16 KHz

A.5.2 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 (sin/cos) 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 sampling time	140 - 200 µsec (x2 current loop sample time)
Velocity sampling Rate	up to 8 KHz
Velocity command options	▪ Analog ▪ Internally calculated by either jogging or step **Note:** All software-calculated profiles support on-the-fly changes.

A.5.3 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 sampling time	280 - 400 µsec (x 4 current loop sample time)
Position sampling rate	up to 4 KHz

A.6 Feedbacks

A.6.1 Feedback Supply Voltage

The Whistle has two feedback ports (Main and Auxiliary). The Whistle supplies voltage only to the main feedback device. The user must provide a separate power supply for auxiliary feedback devices if needed.

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

A.6.2 Main Feedback Options

A.6.2.1 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 ns
Maximum encoder input voltage range	Common mode: ±7V Differential mode: ±7V

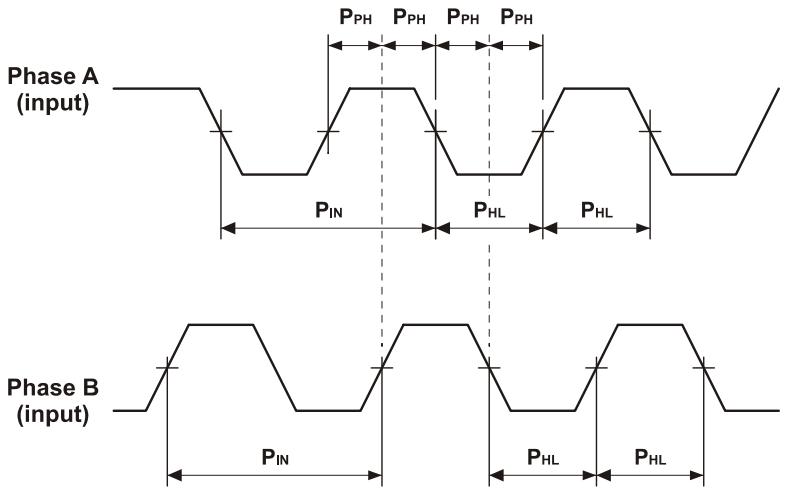


Figure A-1: Main Feedback - Encoder Phase Diagram

A.6.2.2 Digital Halls

Feature	Details
Halls inputs	▪ H_A, H_B, H_C. ▪ Single ended inputs ▪ Built in hysteresis of 1V for noise immunity
Input voltage	Nominal operating range: $0V < V_{In\_Hall} < 5V$ Maximum absolute: $-1V < V_{In\_Hall} < 15V$ High level input voltage: $V_{InHigh} > 2.5V$ Low level input voltage: $V_{InLow} < 1V$
Input current	Sink current (when input pulled to the common): 3ma Source current: 1.5 ma (designed to also support open collector Halls)
Maximum frequency	f_{MAX} : 2 KHz

A.6.2.3 Interpolated Analog Encoder (Sine/Cosine)

Feature	Details
Analog encoder format	Sine and Cosine signals
Analog input signal level	▪ Offset voltage: 2.2 V – 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 (A.6.3)

A.6.2.4 Resolver

Feature	Details
Resolver format	▪ Sine/Cosine ▪ Differential
Input resistance	Differential 2.49 KΩ
Resolution	Programmable: 10 ~ 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 Whistle
Reference current	up to ±50 mA
Encoder outputs	See Auxiliary Encoder Output specifications (A.6.3)

A.6.2.5 Tachometer*

Feature	Details
Tachometer format	Differential
Maximum operating differential voltage for TAC1+, TAC1-	+/- 20V
Maximum absolute differential input voltage for TAC1+, TAC1-	+/-25V
Maximum operating differential voltage for TAC2+, TAC2-	+/- 50V
Maximum absolute differential input voltage for TAC2+, TAC2-	+/- 60V
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 20V.
TAC2+/TAC2- is used in applications with having a Tachometer of between 20V and 50V.

A.6.2.6 Potentiometer

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

A.6.3 Auxiliary Feedback Port (output mode YA[4]= 4)

Feature	Details
Emulated output	▪ A, B, Index ▪ Single ended
Output current capability	Maximum output current: I_{OH} (max) = 2 mA High level output voltage: V_{OH} > 3.0 V Minimum output current: I_{OL} = 2 mA Low level output voltage:V_{OL} < 0.4 V
Available as options	▪ Emulated encoder outputs of analog encoder ▪ Emulated encoder outputs of the resolver
Maximum frequency	f_{MAX} : 5 MHz pulses/output
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

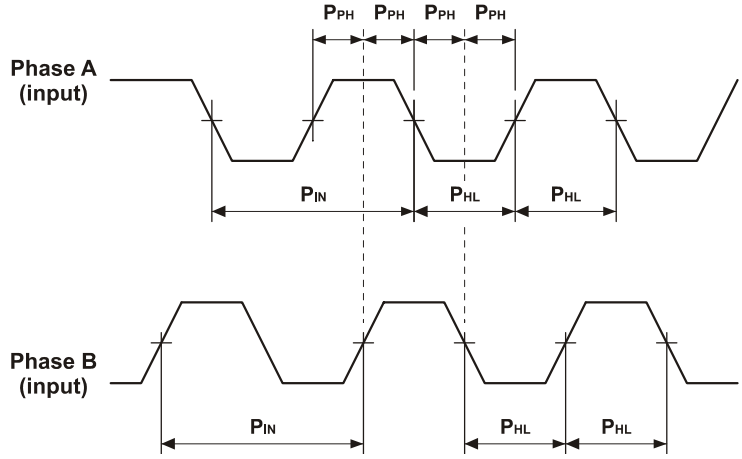


Figure A-2: Auxiliary Feedback - Encoder Phase Diagram

A.6.4 Auxiliary Feedback Port (input mode YA[4]= 2, 0)

Feature	Details
Encoder input, pulse and direction input	▪ A, B, Index ▪ Single ended
Output current capability	V_{In} Low: 0V < V_{IL} < 0.8V V_{In} High: 2V < V_{IH} < 5V Maximum absolute voltage: 0 < V_{In} < 5.5V Input current: ±1μA
Available as options	▪ Single-ended Encoder inputs ▪ 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

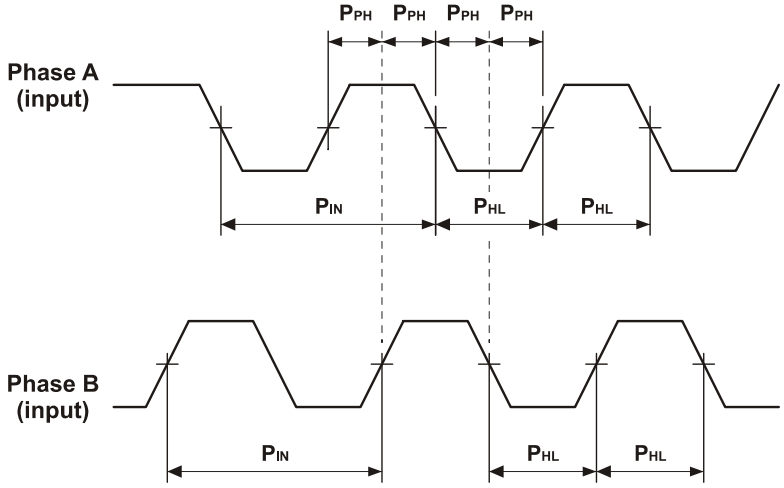
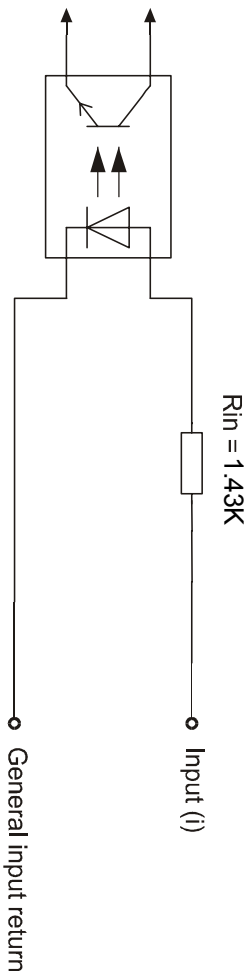


Figure A-3: Auxiliary Feedback - Encoder Phase Diagram

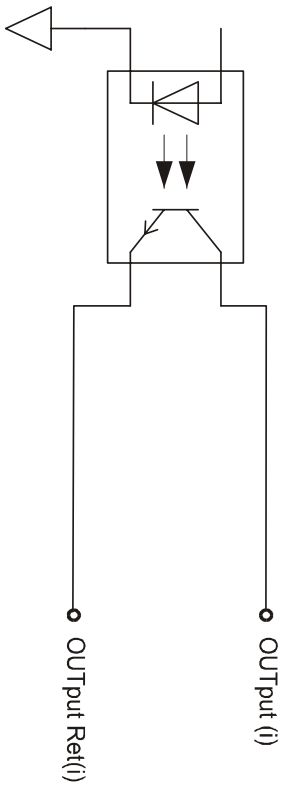
A.7 I/O's

The Whistle has: 6 Digital Inputs 2 Digital Outputs 1 Analog Input

A.7.1 Digital Input Interfaces

Feature	Details	Connector Location
Type of input	▪ Optically isolated ▪ All six inputs share one signal return line	 **Digital Input Schematic**
Input current for all inputs	Iin = 2.4 mA @ Vin = 5 V	
High-level input voltage	2.5V < Vin < 10 V, 5 V typical	
Low-level input voltage	0V < Vin < 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.	

A.7.2 Digital Output Interface

Feature	Details	Connector Location
Type of output	▪ Optically isolated ▪ Open collector and open emitter	 **Digital Output Schematic**
Maximum supply output (Vcc)	30 V	
Max. output current Iout (max) (Vout = Low)	Iout (max) ≤ 10 mA	
VOL at maximum output voltage (low level)	Vout (on) ≤ 0.3 V	
RL	External resistor RL must be selected to limit output current to no more than 10 mA. $R_L = \frac{Vcc - VOL}{Io(\max)}$	
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.	

A.7.3 Analog Input

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

A.8 Communications

Specification	Details
RS-232	**Signals:** ▪ RxD , TxD , Gnd ▪ Full duplex, serial communication for setup and control. ▪ Baud Rate of 9,600 ~ 57,600 bit/sec.
CANopen	**CANbus 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:** ▪ DSP 305 **Device Profile** (drive and motion control)**:** ▪ DSP 402

A.9 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)

A.10 Standards Compliance

A.10.1 Quality Assurance

Specification	Description
ISO 9001:2000	Quality Management

A.10.2 Design

Specification	Description
MIL-HDBK- 217F	Reliability prediction of electronic equipment (rating, de-rating, stress, etc.)
▪ **IPC-D-275** ▪ **IPC-SM-782** ▪ **IPC-CM-770** ▪ **UL508c** ▪ **UL840**	Reliability prediction of electronic equipment (rating, de-rating, stress, etc.) Printed wiring for electronic equipment (clearance, creepage, spacing, conductors sizing, etc.)
In compliance with **VDE0160-7 (IEC68)**	Type testing

A.10.3 Safety

Specification	Description
In compliance with **UL508c**	Power conversion equipment
In compliance with **UL840**	Insulation coordination, including clearance and creepage distances of electrical equipment
In compliance with **UL60950**	Safety of information technology equipment, including electrical business equipment
In compliance with **EN60204-1**	Low voltage directive, 72/23/EEC

A.10.4 EMC

Specification	Description
In compliance with **EN55011** and **EN61000**	Limits and methods of measurement of radio disturbance characteristics of industrial, scientific and medical (ISM) radio-frequency equipment. Electromagnetic compatibility (EMC)

A.10.5 Workmanship

Specification	Description
In compliance with **IPC-A-610**, level 3	Acceptability of electronic assemblies

A.10.6 PCB

Specification	Description
In compliance with **IPC-A-600**, level 2	Acceptability of printed circuit boards

A.10.7 Packing

Specification	Description
In compliance with **EN100015**	Protection of electrostatic sensitive devices

A.10.8 WEEE*

Specification	Description
In compliance with **2002/96/EC**	Waste Electrical and Electronic Equipment regulations

* Please send out-of-service Elmo drives to the nearest Elmo sales office.

A.10.9 RoHS

Specification	Description
In compliance with **2002/95/EC** (effective July 2006)	Restrictions on Application of Hazardous Substances in Electric and Electronic Equipment

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