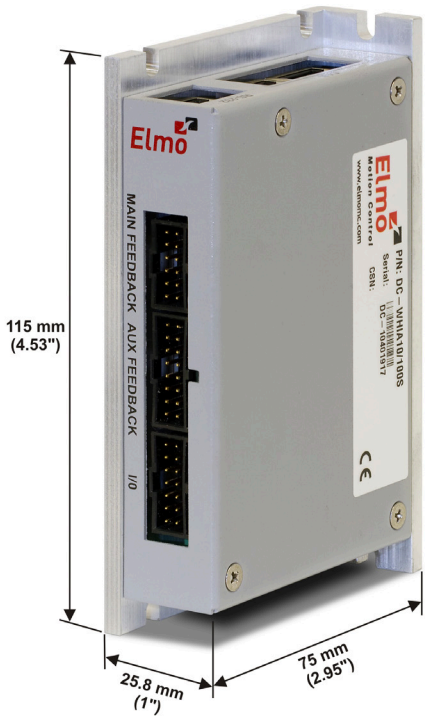
SimpIIQ Line

DC Whistle
Digital Servo Drive
Installation Guide



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Elmo
Motion Control

www.elmomc.com

Notice

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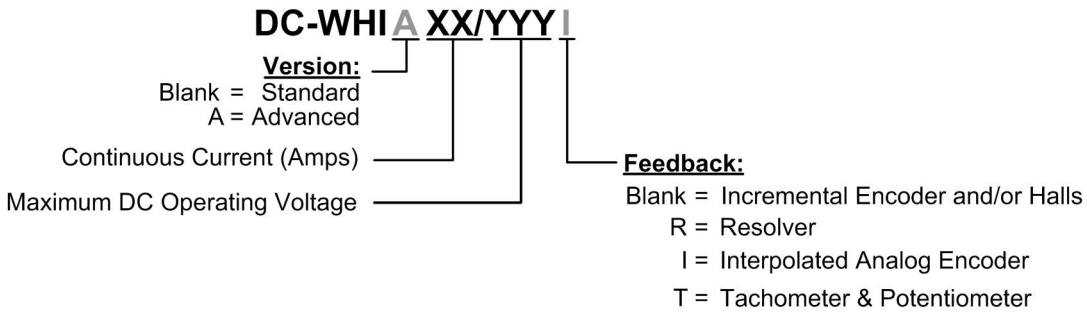
Catalog Number



Cable Kit

Catalog number: CBL-DCWHIKIT-01 (can be ordered separately). For further details, see the documentation for this cable kit in Chapter 5.

Revision History

Version	Date	Details
Ver. 1.00	Sep 2012	Initial release
Ver. 1.001	Jan 2013	Updated the Power Ratings tables Updated the auxiliary voltage value Section 4.4: Physical Specifications, was added. Added a caution and recommendation on the type of cleaning solution to use for the Elmo unit.
Ver. 1.002	Feb 2013	Updated the table heading in Section 4.4: Physical Specifications.
Ver. 1.100	June 2014	Updates to document
Ver. 1.101	July 2014	General format updates
Ver. 1.102	Aug 2017	Correction to tables in section 4.5 Power Ratings

Version	Date	Details
1.103	Oct 2017	Updated the Warranty Information section 1.5 and the part number label in section 3.2

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Table of Contents

1 Safety Information

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

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

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

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

The DC Whistle contains electrostatic-sensitive components that can be damaged if handled incorrectly. To prevent any electrostatic damage, avoid contact with highly insulating materials, such as plastic film and synthetic fabrics. Place the product on a conductive surface and ground yourself in order to discharge any possible static electricity build-up.

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

The following safety symbols are used in this manual:

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

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

1.1 Warnings

- To avoid electric arcing and hazards to personnel or electrical damage, never connect/disconnect any plug or cable from 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 DC Whistle from all voltage sources before it is opened for servicing.
- The DC Whistle 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 DC Whistle contains hot surfaces and electrically-charged components during operation.
- The maximum AC/DC power supply connected to the instrument must comply with the parameters outlined in this guide. Furthermore, the power supply must be isolated from hazardous live voltages using reinforced or double insulation in accordance to approved safety standards.
- When connecting the DC Whistle to an approved 11 to 95 VDC (8.5 to 67 VAC) auxiliary power supply, connect it through a line that is isolated from hazardous live voltages using reinforced or double insulation in accordance with approved safety standards.
- Before switching on the DC Whistle, verify that all safety precautions have been observed and that the installation procedures in this manual have been followed.
- Do not clean any of the DC Whistle drive's soldering with solvent cleaning fluids of pH greater than 7 (8 to 14). The solvent corrodes the plastic cover causing cracks and eventual damage to the drive's PCBs.

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

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

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

1.3 Directives and Standards

The DC Whistle conforms to the following industry safety standards:

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

The DC Whistle 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 DC Whistle 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 DC Whistle meets the provisions outlined in Council Directive 73/23/EEC. The party responsible for ensuring that the equipment meets the limits required by EMC regulations is the manufacturer of the end product.

1.5 Warranty Information

The products covered in this manual are warranted to be free of defects in material and workmanship and conform to the specifications stated either within this document or in the product catalog description. All Elmo drives are warranted for a period of 12 months from the 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

2 Introduction

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

2.1 Product Description

The DC Whistle series of servo drives enhances Elmo's range of digital servo drives, recognized for having the highest power density and intelligence. The DC Whistle is a highly compact integrated solution containing a single drive.

The DC Whistle integrates Elmo's advanced "Elmo First Control" technology, which contributes to the product's excellent control performance, wide range of functionalities and high efficiency and reliability. The solution includes one fully separated digital motion controller featuring:

- CANopen-based networking operating simultaneously via RS-232 and CANopen DS 301, DSP 305, DSP 402 communications and featuring a third-generation programming environment
- Current, velocity and position control loops including PT and PVT
- Commutation types
- Position feedbacks

The benefits are high dynamics and increased precision for single axis automated machines such as robots, feeders, up- and down-loaders, conveyor belts and production lines.

Power to the various DC Whistle models is provided by a 11 to 95 VDC source. A "smart" control-supply algorithm enables the DC Whistle to operate with only one power supply and there is no need for an auxiliary power supply for the logic.

If backup functionality is required for storing control parameters in case of power-loss, an external 11 to 95 VDC supply should be connected (via the VL+ terminal on the DC Whistle) providing maximum flexibility and backup functionality when needed.

Note: **This backup power supply can operate from any voltage source within the range from 11 to 95 VDC. This is much more flexible than a standard 24 VDC power supply requirement.**

The DC Whistle series fully complies with all relevant **safety** and **EMC** regulations.

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, DC 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 to 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 DC 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

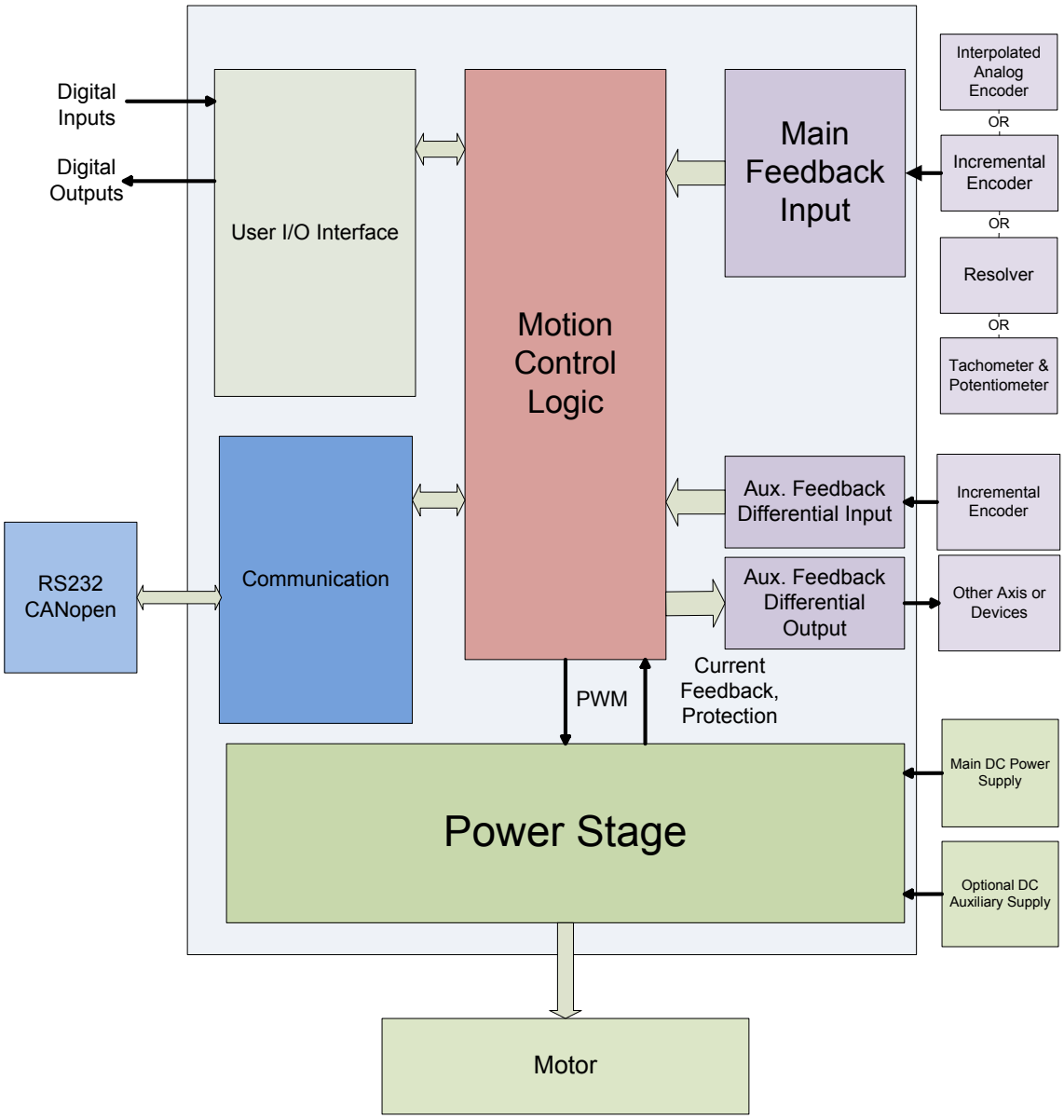


Figure 1: DC Whistle System Block Diagram

2.4 How to Use this Guide

In order to install and operate your Elmo DC Whistle, 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 DC Whistle.
- Chapters 4 and 5 list all the drive ratings and specifications as well as information on the relevant cables.

Upon completing the instructions in this guide, your DC Whistle 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 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 DC Whistle motion controllers
- The SimplIQ Software Manual, which describes the comprehensive software used with the DC Whistle

3 Installation

The DC 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 DC Whistle by ensuring that it is installed in an appropriate environment.

Feature	Value
Ambient operating temperature	0 °C to 40 °C (32 °F to 104 °F)
Maximum operating altitude	2,000 m (6562 feet)
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 Whistle on the DC Whistle dissipates its heat by convection. The maximum operating ambient temperature of 0 °C to 40 °C (32 °F to 104 °F) must not be exceeded. Refer to the Heat Dissipation section of the Whistle/Tweeter Installation Guide for more information.

3.2 Unpacking the Drive Components

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

- The DC Whistle.
- The Composer software and software manual.

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

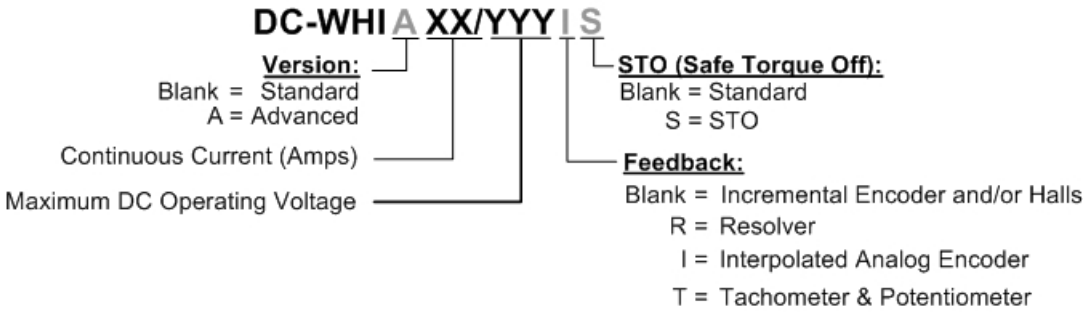
To unpack the DC Whistle:

Carefully remove the DC Whistle from the box and the Styrofoam.

Check the DC Whistle 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 DC Whistle.

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

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



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

3.3 Mounting the DC Whistle

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

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

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

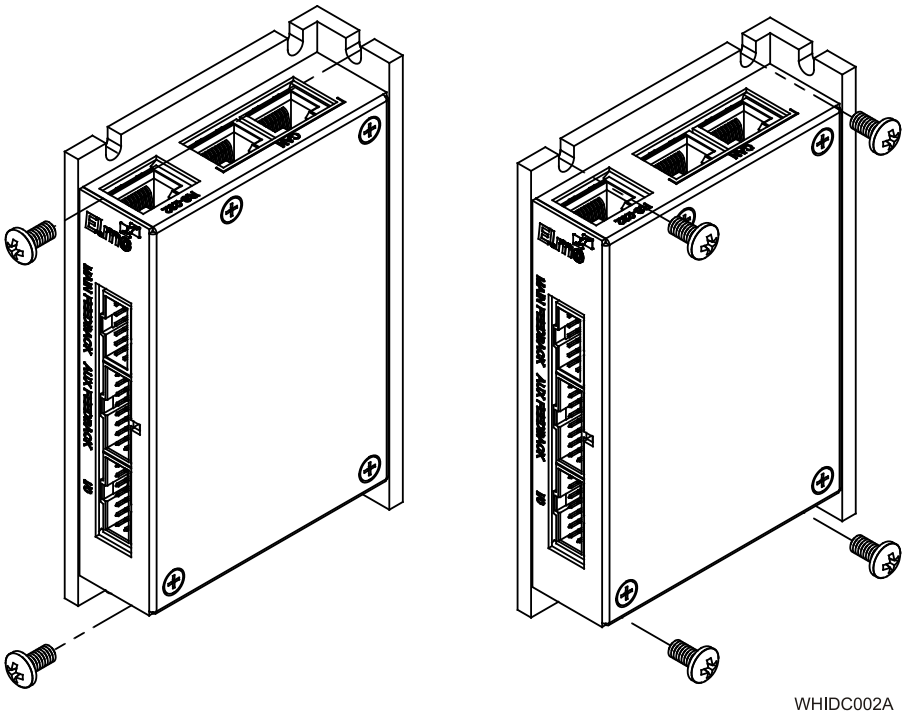


Figure 2: Mounting the DC Whistle

3.4 Connecting the Cables

3.4.1 Wiring the DC Whistle

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

Caution:
Perform the following instructions to ensure safe and proper wiring.

1. Use twisted pair shielded cables for control, Feedback and communication connections. For best results, the cable should have an aluminum foil shield covered by copper braid, and should contain a drain wire.

   The drain wire is a non-insulated wire that is in contact with parts of the cable, usually the shield. It is used to terminate the shield and as a grounding connection.

The impedance of the wire must be as low as possible. The size of the wire must be thicker than actually required by the carrying current. A 26 or 28 AWG wire for control and Feedback cables is satisfactory although 26 AWG is recommended.

Use shielded wires for motor connections as well. If the wires are long, ensure that the capacitance between the wires is not too high: C < 30 nF is satisfactory for most applications.

Keep all wires and cables as short as possible.

Keep the motor wires as far away as possible from the Feedback, control and communication cables.

Ensure that in normal operating conditions, the shielded wires and drain *carry no current.* The only time these conductors carry current is under abnormal conditions, when electrical equipment has become a potential shock or fire hazard while conducting external EMI interferences directly to ground, in order to prevent them from affecting the drive. Failing to meet this requirement can result in drive/controller/host failure.

After completing the wiring, carefully inspect all wires to ensure tightness, good solder joints and general safety.

The following connectors are used for wiring the DC Whistle:

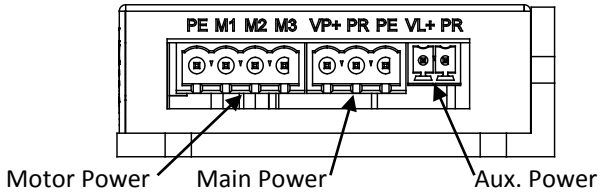
Type	Function
Main Power	VP+, PR, PE
Motor Power	PE, M1, M2, M3
Aux. Power	VL+, PR
Connectors Location	
	

Table 1: Connectors on the "Power Connectors side" of the DC Whistle

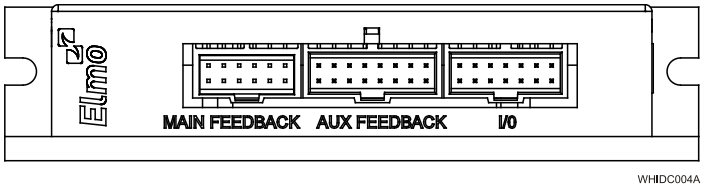
Type	Function
Main Feedback	Feedback
I/O	I/O
Auxiliary Feedback	Auxiliary Feedback
Connectors Location	
	

Table 2: Connectors on the "Feedback and I/O side" of the DC Whistle

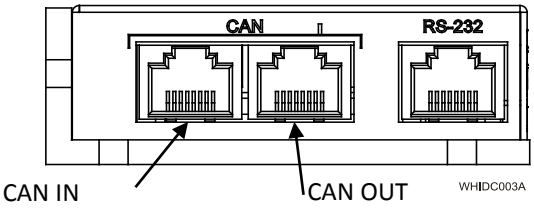
Type	Function
CAN	CAN IN
CAN	CAN OUT
RS-232	RS-232
Connectors Location	
	

Table 3: Connectors on the "Communication side" of the DC Whistle

3.5 DC Whistle Connector Types

The DC Whistle has 9 connectors.

Type	Qty Conn.	On Board Connector
Main Power	1	Phoenix 3-pin Header
Motor Power	1	Phoenix 4-pin Header
Auxiliary Power	1	Phoenix 2-pin Header
Main Feedback	1	12-Pin Molex Header
I/O	1	14-Pin Molex Header
Auxiliary Feedback	1	16-Pin Molex Header
CAN Comm.	2	8-Pin RJ-45 Socket
RS-232 Comm.	1	8-Pin RJ-45 Socket
Connector Location		

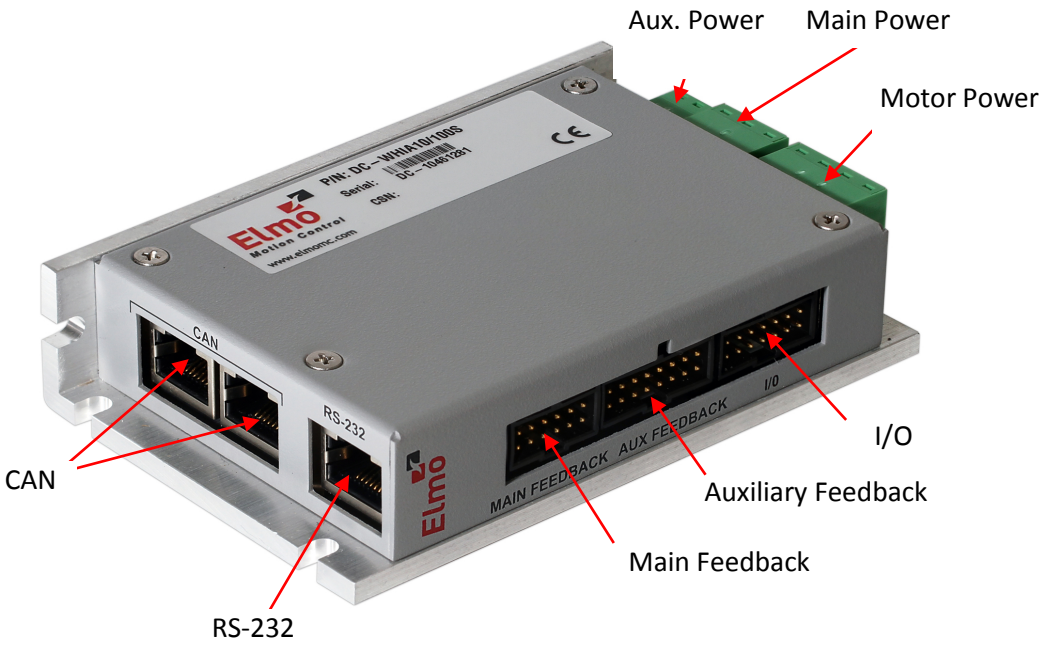


Table 4: Connector Types

3.6 Hardware Requirements

The components that you will need to install your DC Whistle are:

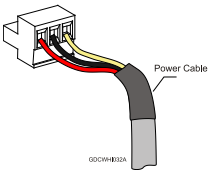
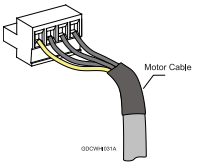
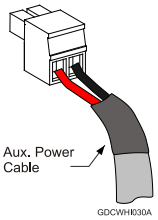
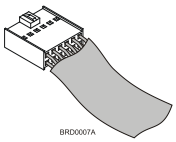
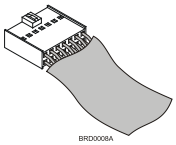
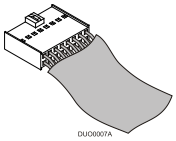
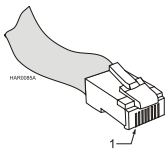
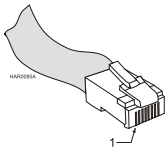
Component	Qty Conn.	Mating Connector	Function	Cable Drawing
Main Power	1	Phoenix 3-pin Plug	VP+, PR, PE	
Motor Power	1	Phoenix 4-pin Plug	PE, M1, M2, M3	
Aux. Power	1	Phoenix 2-pin Plug	VL+, PR	
Main Feedback	1	12-Pin Molex Plug	Feedback	
I/O	1	14-Pin Molex Plug	I/O	
Auxiliary Feedback	1	16-Pin Molex Plug	Auxiliary feedback	
RS-232 Comm.	1	8-Pin RJ-45 Plug	RS-232	
CAN Comm.	2	8-Pin RJ-45 Plug	CAN IN CAN OUT	

Table 5: Connector Cross Reference

3.7 DC Whistle Connection Diagram

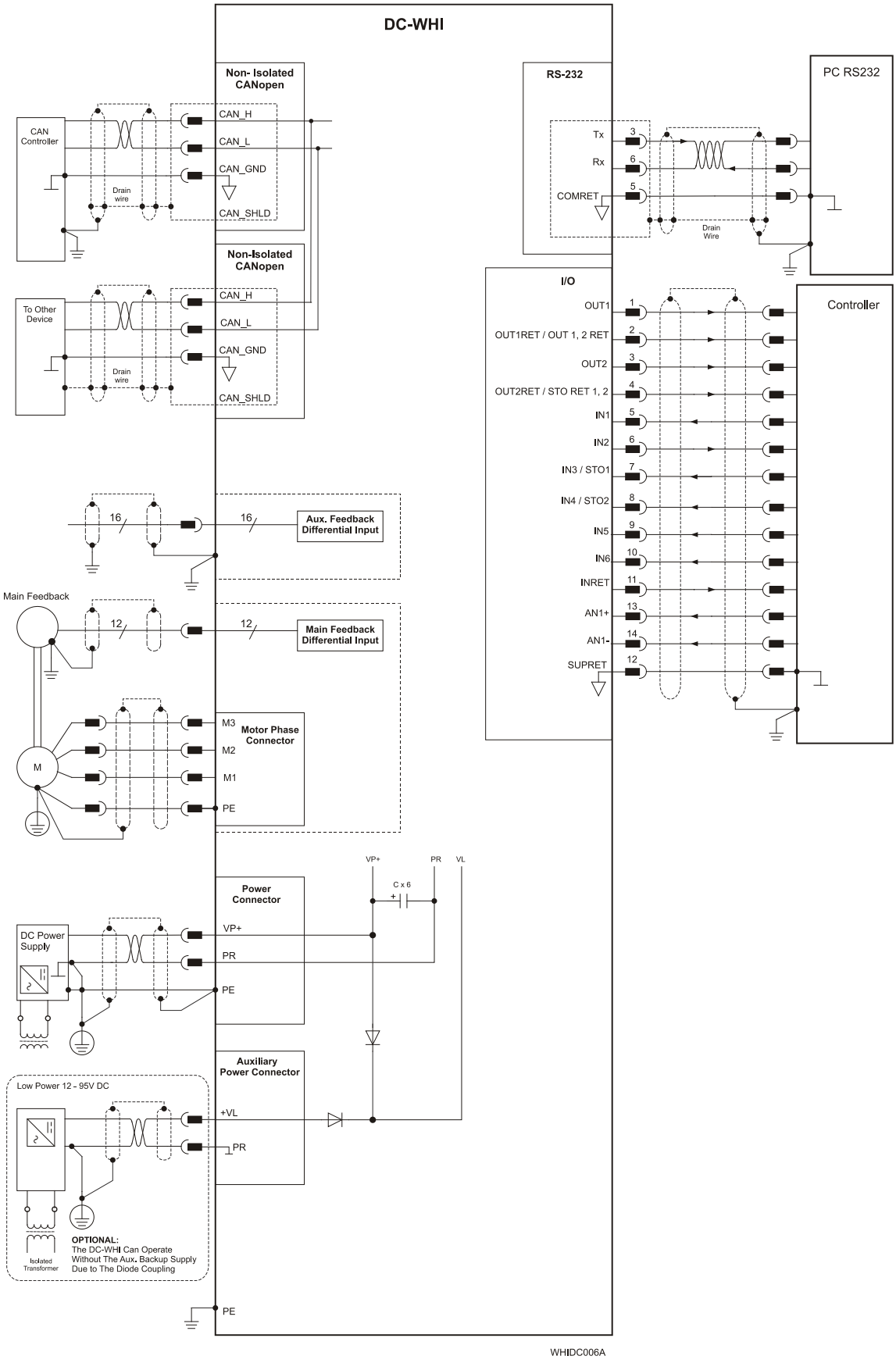


Figure 3: DC Whistle Connection Diagram

3.8 The Main Power and Motor Power Connectors

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

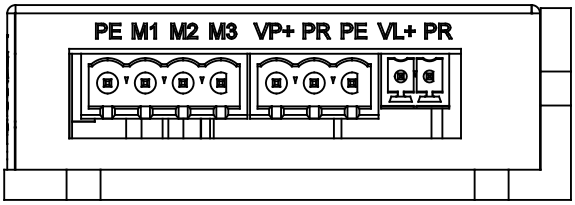
Pin	Function	Cable	
Main Power			
PE	Protective earth	Power	
PR	Power return	Power	
VP+	Pos. Power input	Power	
Aux. Supply			
PR	Aux. Supply Input Return	Auxiliary	
VL+	Aux. Supply Input	Auxiliary	
		AC Motor Cable	**DC Motor Cable**
M3	Motor phase	Motor	Motor
M2	Motor phase	Motor	Motor
M1	Motor phase	Motor	N/C
PE	Protective earth	Motor	Motor
Pins Location			
 WHIDC005A			

Table 6: Connectors for Main Power and Motors

3.8.1 Connecting Motor Power

Connect the motor power cable to the M1, M2, M3 and PE terminals of the relevant axis. The phase connection order is arbitrary because the Composer will establish the proper commutation automatically during setup. If several motor/drive combinations are designed to operate in an identical manner, it is recommended to download the program into all the drives and connecting them in the same way.

Notes for connecting the motor cables:

1. For the greatest immunity, it is highly recommended to use a shielded (not twisted) cable for the motor connection. A 4-wire shielded cable should be used. The gauge is determined by the actual current consumption of the motor.
2. Connect the shield of the cable to the closest ground connection at the motor end.
3. Be sure that the motor chassis is properly grounded.

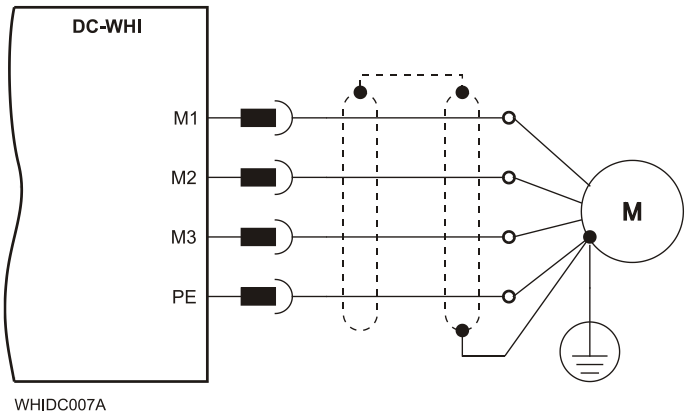


Figure 4: AC Motor Power Connection Diagram

3.8.2 Connecting Main Power

Connect the DC power supply cable to the VP+ and PR terminals of the Main power connector.

Notes for connecting the DC power supply:

1. The source of the 0 to 95 VDC Power Supply must be isolated.
2. For the greatest immunity, it is highly recommended to use twisted and shielded cables for the DC power supply cable. A 3-wire shielded cable should be used. The gauge is determined by the actual current consumption of the motor.
3. Connect the cable shield to the closest ground connection near the power supply.
4. Connect the PE to the closest ground connection near the power supply.
5. Connect the PR to the closest ground connection near the power supply.
6. Before applying power, first verify the polarity of the connection.

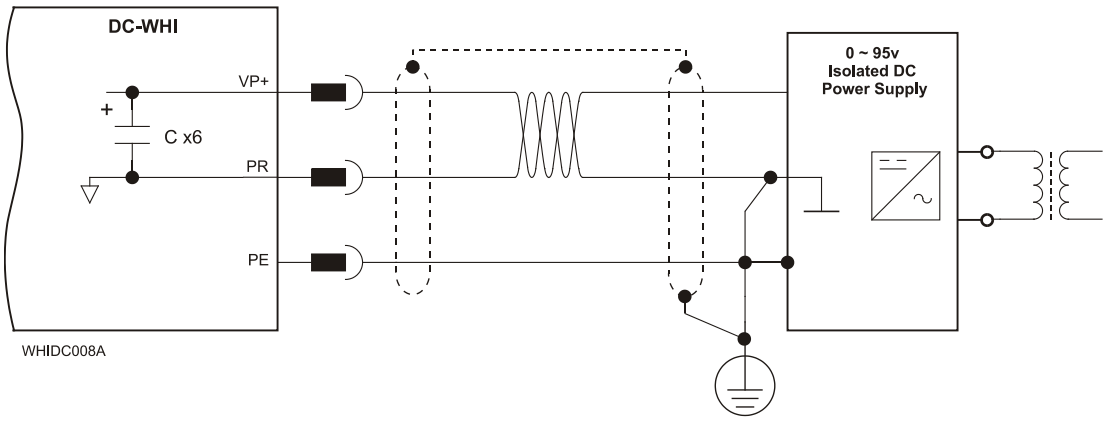


Figure 5: Main Power DC Supply Connection Diagram

3.8.3 Low-Power Auxiliary Supply (optional)

Notes for 11 to 95 VDC Auxiliary Supply connections:

1. The source of the 11 to 95 VDC Auxiliary Supply must be isolated from the Main.
2. For safety reasons, connect the return (common) of the Auxiliary Supply source to the closest ground near the Auxiliary Supply source.
3. Connect the cable shield to the closest ground near the Auxiliary Supply source.
4. Before applying power, first verify the polarity of the connection.

Caution:

Power to each Whistle and motor must come from the Main Supply and NOT from the Auxiliary Supply.

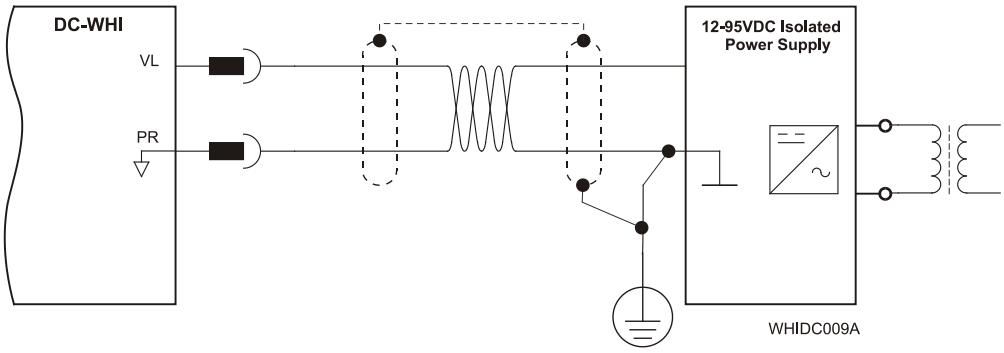


Figure 6: Auxiliary Supply Connection Diagram

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

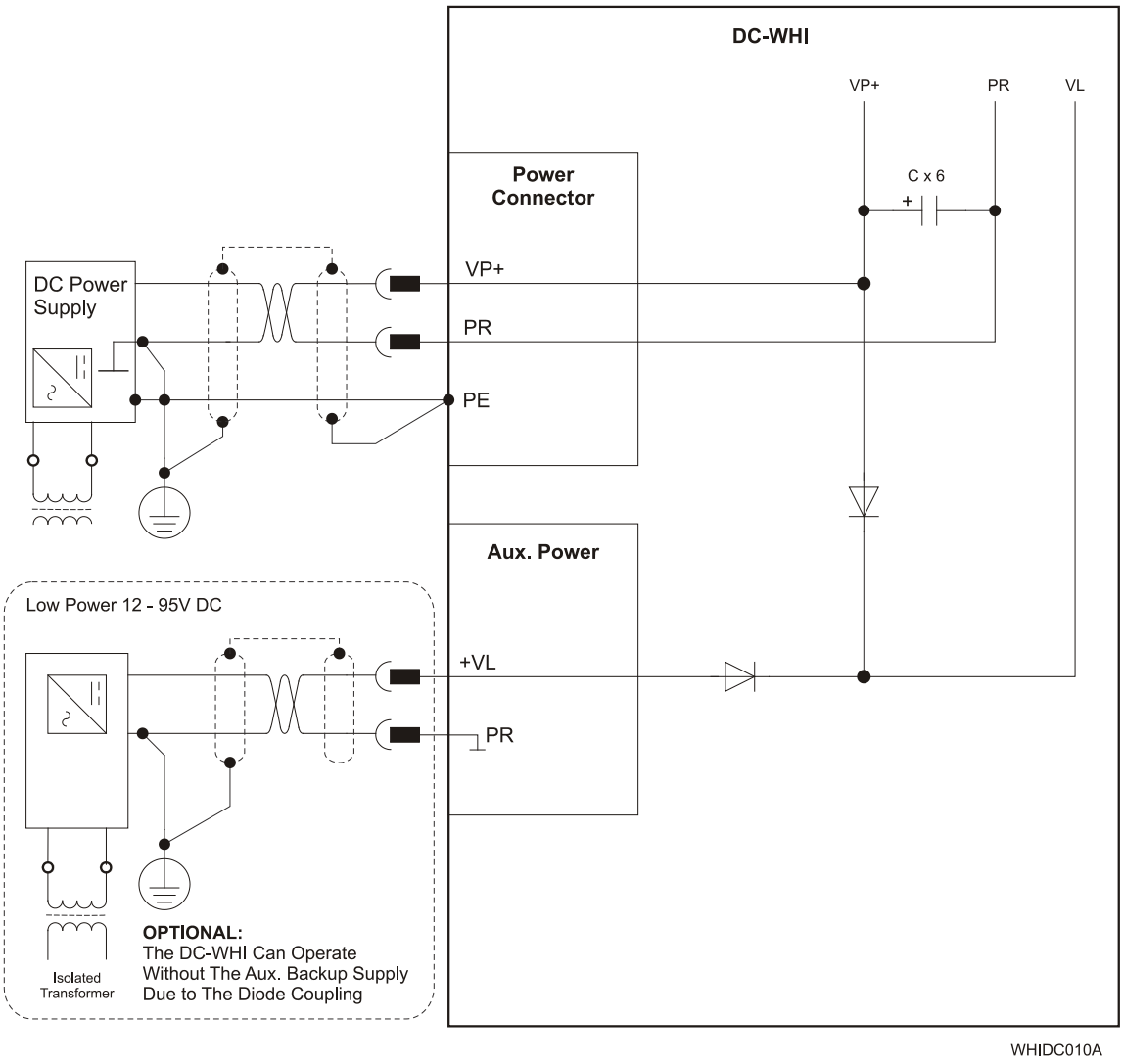


Figure 7: Shared Supply Connection Diagram

3.9 Main Feedback

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

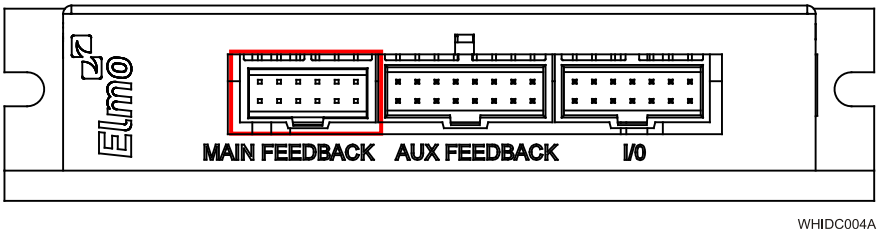


Figure 8: Main Feedback Port

The Main Feedback port on the DC Whistle has a 12-pin Molex Header plug. The DC Whistle accepts the following as a Main Feedback mechanism:

- Incremental encoder only
- Incremental encoder with digital hall sensors
- Digital hall sensors only
- Interpolated analog (sine/cosine) encoder (option)
- Resolver (option)
- Tachometer and potentiometer (option)
- Analog Halls

	Incremental Encoder		Interpolated Analog Encoder	
	DC-WHI-XX/YYY		DC-WHI-XX/YYYI	
Pin	**Signal**	**Function**	**Signal**	**Function**
1	+5V	Encoder/Hall +5V supply	+5V	Encoder/Hall +5V supply
2	SUPRET	Supply return	SUPRET	Supply return
3	CHA	Channel A	A+	Sine A
4	CHA-	Channel A complement	A-	Sine A complement
5	CHB	Channel B	B+	Cosine B
6	CHB-	Channel B complement	B-	Cosine B complement
7	INDEX	Index	R+	Reference
8	INDEX-	Index complement	R-	Reference complement
9	HA	Hall sensor A input	HA	Hall sensor A input
10	HB	Hall sensor B input	HB	Hall sensor B input
11	HC	Hall sensor C input	HC	Hall sensor C input
12	SUPRET	Supply return	SUPRET	Supply return

Table 7: Main Feedback Cable Pin Assignment for Incremental and Interpolated Analog Encoder

	Resolver		Tachometer and Potentiometer	
	DC-WHI-XX/YYYR		DC-WHI XX/YYYT	
Pin	**Signal**	**Function**	**Signal**	**Function**
1	+5V	Encoder/Hall +5V supply	+5V	Encoder/Hall +5V supply
2	SUPRET	Supply return	SUPRET	Supply return
3	S1	Sine A	Tac 1+	Tacho Input 1 Pos. (20 V max)
4	S3	Sine A complement	Tac 1-	Tacho Input 1 Neg. (20 V max)
5	S2	Cosine B	Tac 2+	Tacho Input 2 Pos. (50 V max)
6	S4	Cosine B complement	Tac 2-	Tacho Input 2 Neg. (50 V max)
7	R1	Vref f=1/TS, 50 mA Max.	POT	Potentiometer Input
8	R2	Vref complement f= 1/TS, 50 mA Max	NC	-
9	NC	-	HA	Hall sensor A input
10	NC	-	HB	Hall sensor B input
11	NC	-	HC	Hall sensor C input
12	SUPRET	Supply return	SUPRET	Supply return

Table 8: Main Feedback Cable Pin Assignment for Resolver, Tachometer &Potentiometer

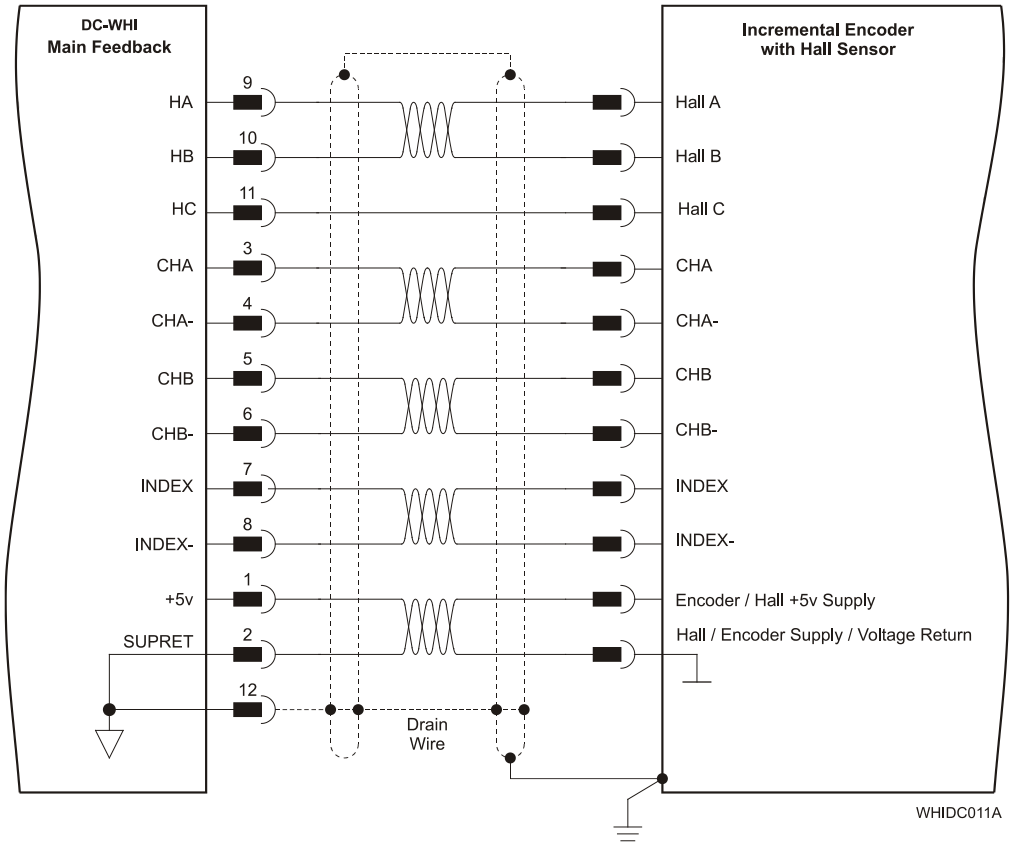


Figure 9: Main Feedback- Incremental Encoder with Digital Halls Sensors Connection Diagram

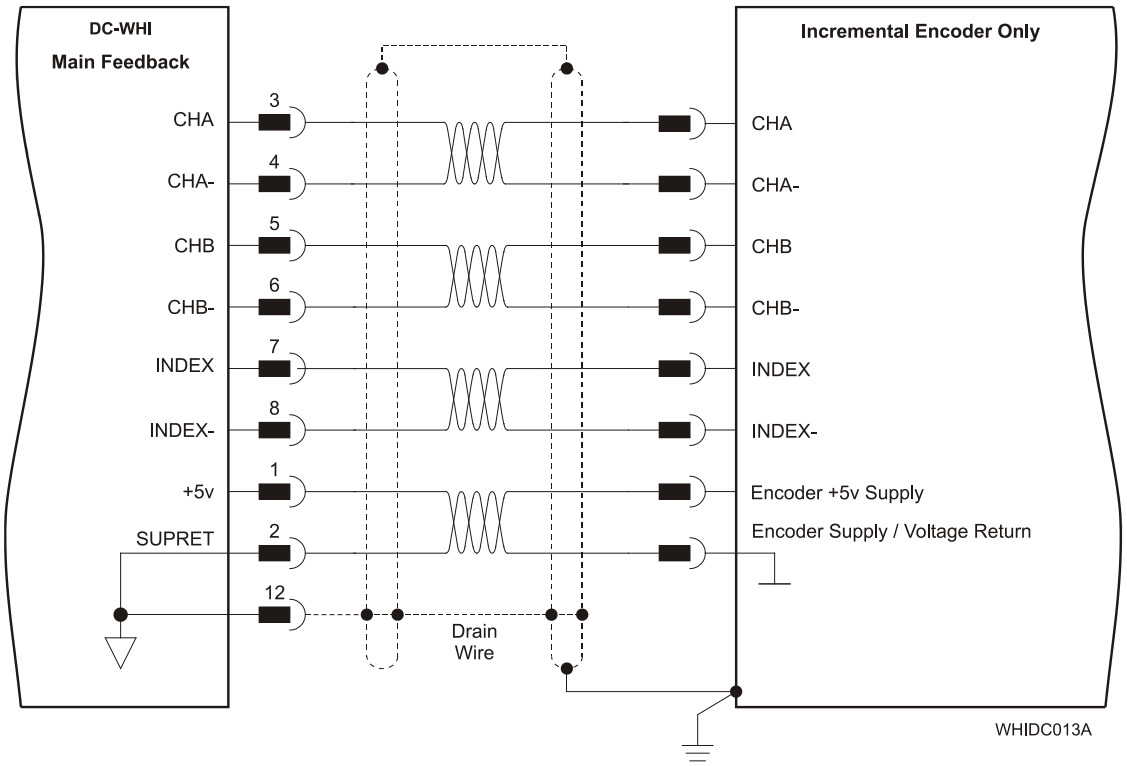


Figure 10: Main Feedback- Incremental Encoder Only Connection Diagram

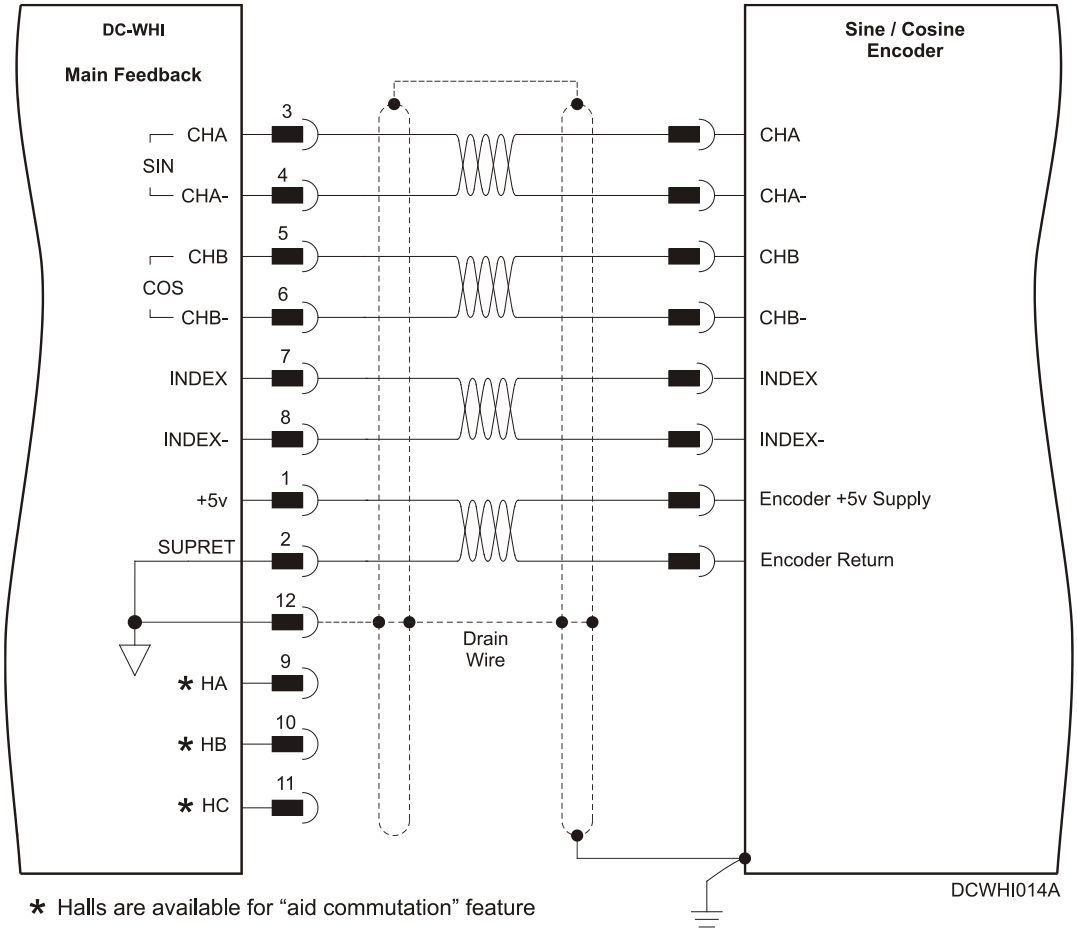


Figure 11: Main Feedback – Interpolated Analog (Sine/Cosine) Encoder Connection Diagram

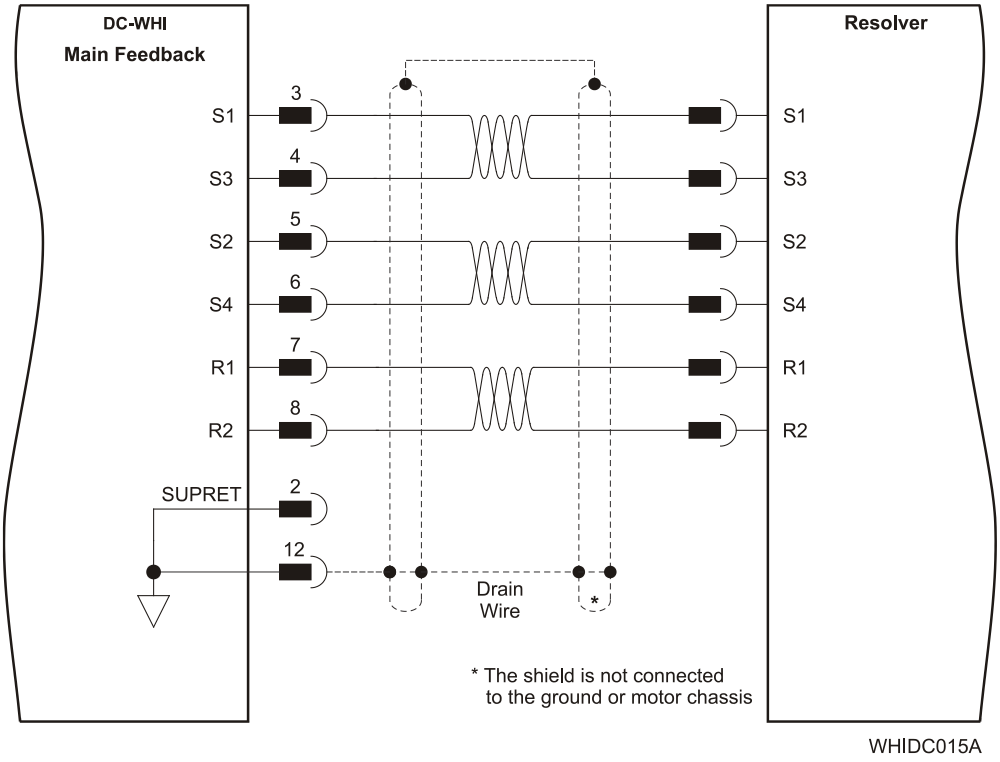


Figure 12: Main Feedback– Resolver Connection Diagram

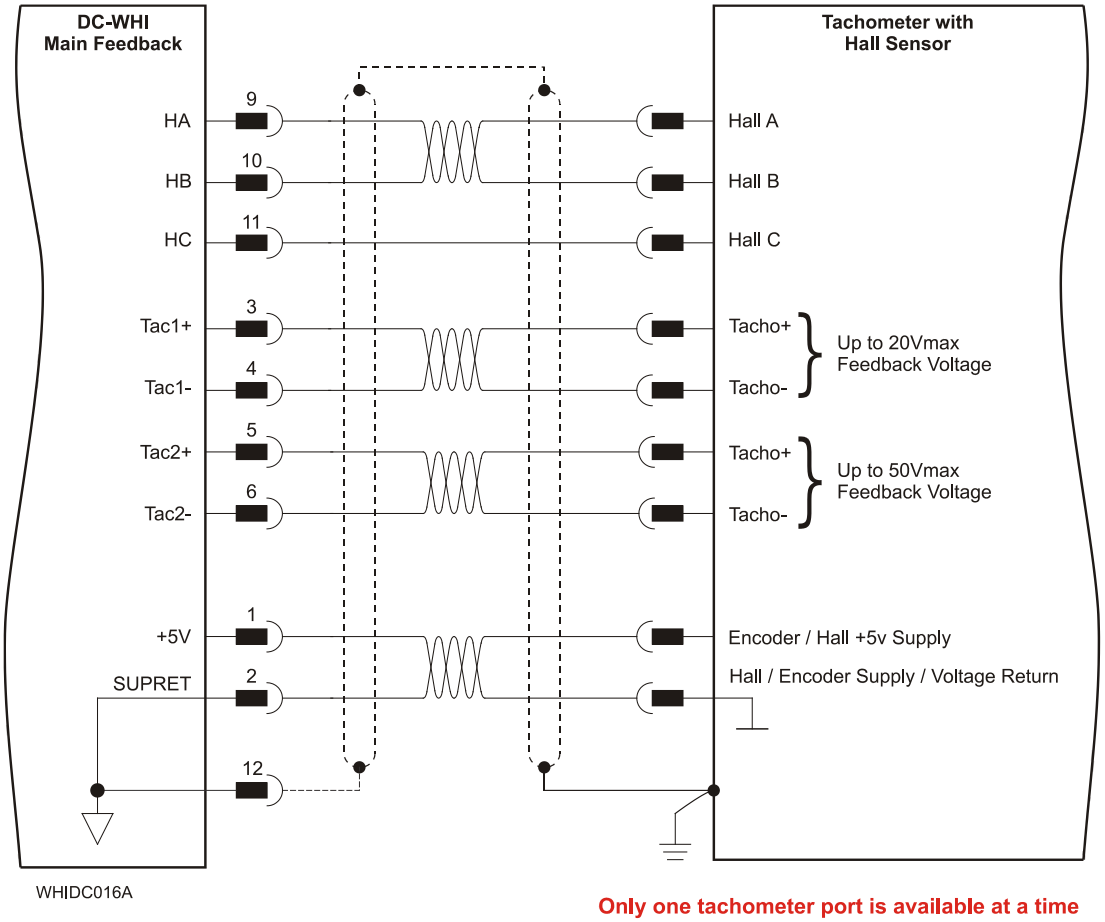
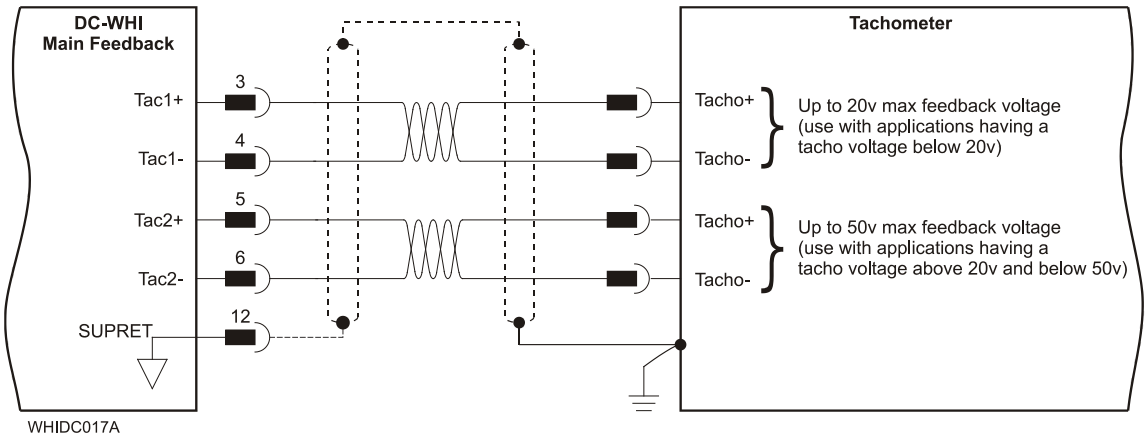


Figure 13: Main Feedback – Tachometer Feedback with Digital Hall Sensor - Connection Diagram for Brushless Motors



Only one tachometer port is available at a time

Figure 14: Main Feedback – Tachometer Feedback Connection Diagram for Brush Motors

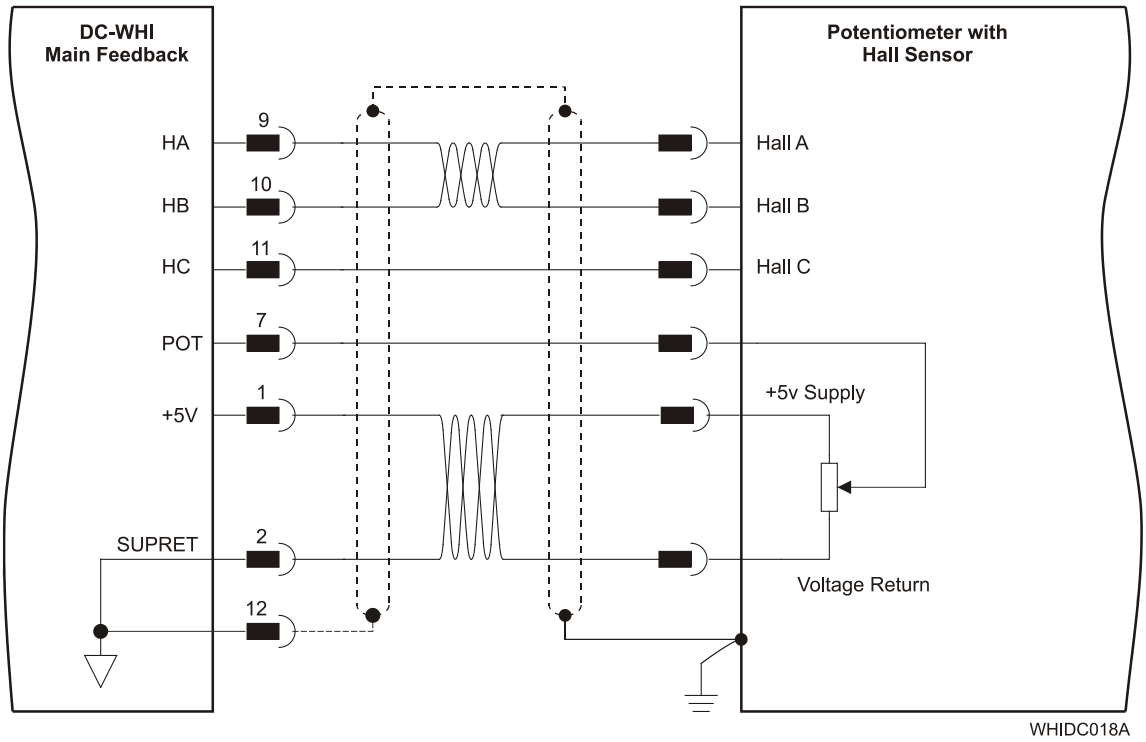


Figure 15: Main Feedback – Potentiometer Feedback with Digital Hall Sensor - Connection Diagram for Brushless Motors

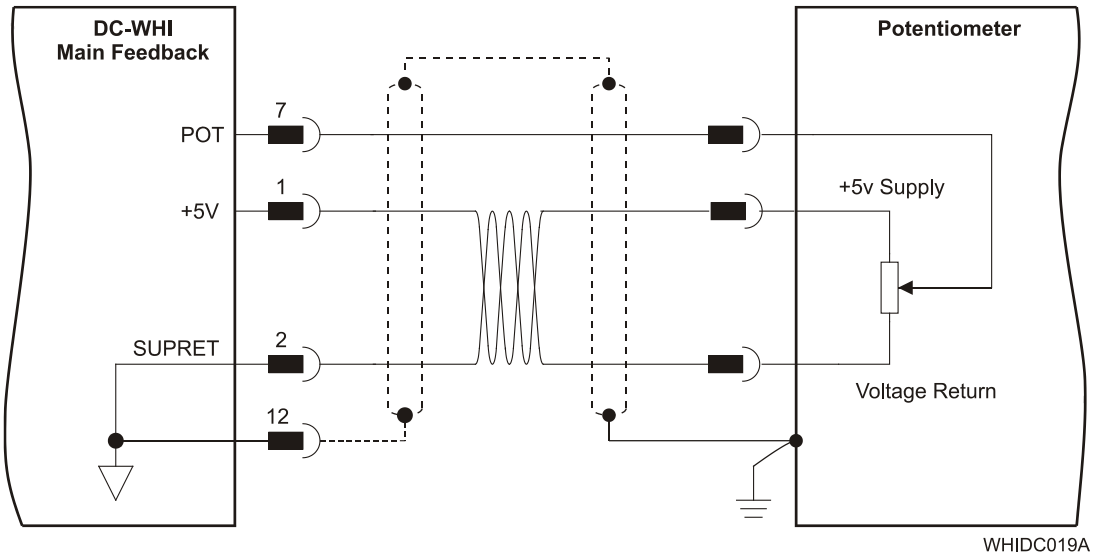


Figure 16: Main Feedback – Potentiometer Feedback Connection Diagram for Brush Motors and Voice Coils

3.10 Auxiliary Feedback (bi-directional)

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

The Auxiliary Feedback connector has two ports – B1 and B2.

- **Port B1** has three pairs of differential buffered inputs
- **Port B2** has three pairs of differential buffered outputs

There are two modes of operation for this interface:

- **Mode 1 (Composer Command: YA[4]=4) see Section 3.10.2**

  When the Auxiliary port of the Whistle is set by the software to act as an emulated encoder output (this is practical only when using a Resolver or Analog Encoder as the Main Feedback):

  - B1 input becomes inactive.
  - B2 presents emulated differential buffered encoder output signals of the Main Feedback.

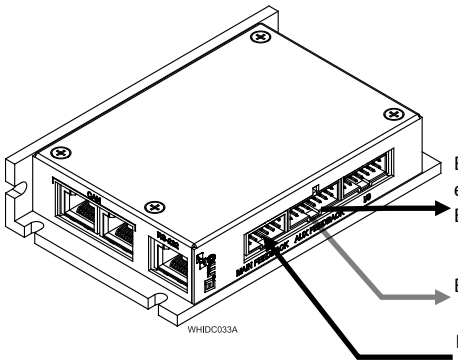
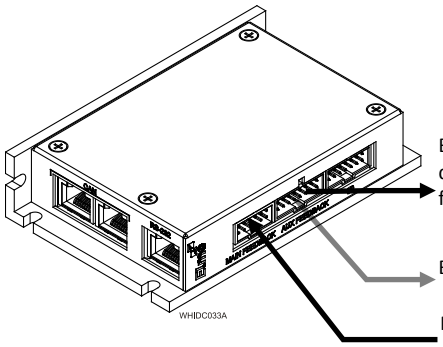
- **Mode 2 (Composer Command: YA[4]=2 or YA[4]=0) see Sections 3.10.3 and 3.10.4**

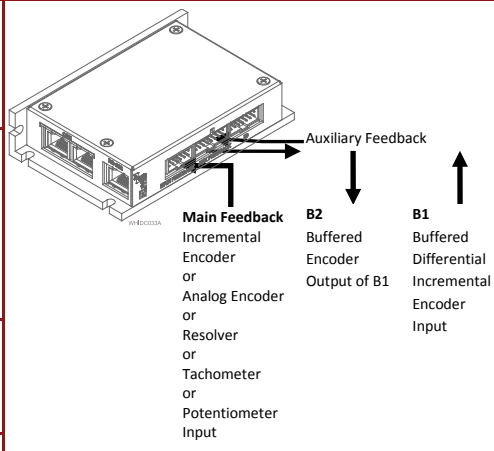
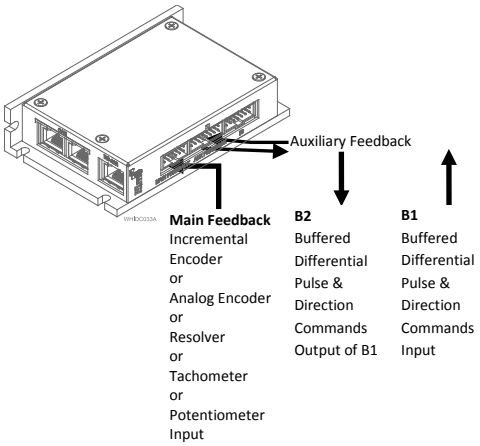
  When the Auxiliary port of the Whistle is set by software to act as an input:

  - B1 becomes an active differential buffered input.
  - B2 presents differential buffered encoder output signals of B1.

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 has two ports (B1 and B2). When used in combination with Main Feedback, the Auxiliary Feedback can be set, by software, as follows:

Main Feedback	Auxiliary Feedback: Output
Software Setting	**YA[4] = 4** (Auxiliary Feedback: output)
Incremental Encoder Input	N/A
Interpolated Analog (Sine/Cosine) Encoder Input	✶ 
Resolver Input	✸ 
Potentiometer Tachometer Input	N.A
Typical Applications	✶ 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.

Main Feedback	Auxiliary Feedback: Input	
Software Setting	**YA[4] = 2** (Auxiliary Feedback: input)	**YA[4] = 0** (Auxiliary Feedback: input)
Incremental Encoder Input **Interpolated Analog (Sine/Cosine) Encoder Input** **Resolver Input** **Potentiometer Tachometer 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.	Any application where two Feedbacks are used by the drive. The Auxiliary Feedback port serves as an input for Pulse & Direction Commands.

3.10.2 Auxiliary Feedback – Emulated, Differential Buffered Encoder Output Option (YA[4]=4)

The Auxiliary Feedback's B2 port can provide **emulated encoder signals** to other controllers or drives. This option can be used when:

- A Resolver or Analog Encoder is used as a Main Feedback device.
- The DC Whistle is used as a current amplifier to provide position data to the position controller.
- The DC Whistle is used in velocity mode, to provide position data to the position controller.
- The DC Whistle is used as a master in Follower or ECAM mode.

Below are the signals on the Auxiliary Feedback ports when the Whistle Auxiliary Feedback port is set up for emulated output of the Main Feedback device (Resolver or Analog Incremental Encoder only).

The Auxiliary Feedback on the DC Whistle has a 16-pin Molex Header plug.

Port	Pin	Signal	Function
PWR	1	+5V	Encoder supply voltage
PWR	2	SUPRET	Supply Return
B1	3	NA	When YA[4]=4 the B1 port is not available
B1	4	NA	When YA[4]=4 the B1 port is not available
B1	5	NA	When YA[4]=4 the B1 port is not available
B1	6	NA	When YA[4]=4 the B1 port is not available
B1	7	NA	When YA[4]=4 the B1 port is not available
B1	8	NA	When YA[4]=4 the B1 port is not available
B2	9	CHAO	Buffered Channel A output
B2	10	CHAO-	Buffered Channel A complement output
B2	11	CHBO	Buffered channel B output
B2	12	CHBO-	Buffered channel B complement output
B2	13	INDEXO	Buffered Index output
B2	14	INDEXO-	Buffered Index complement output
PWR	15	+5V	Encoder supply voltage
PWR	16	SUPRET	Supply Return
Pin Positions			

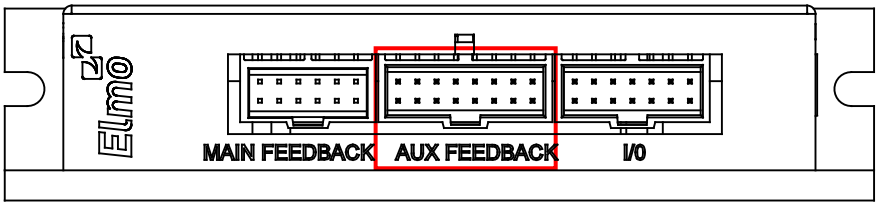


Table 9: Emulated Encoder Output on the Auxiliary Feedback Port B2 - Pin Assignments

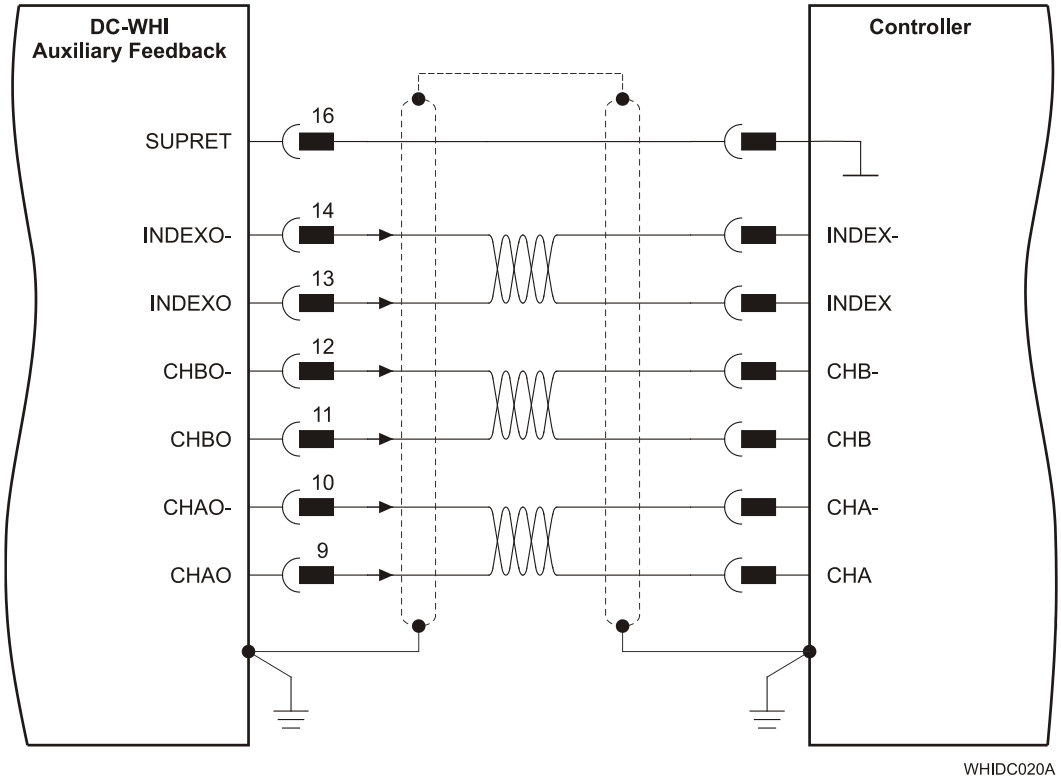


Figure 17: Emulated Encoder Outputs of the Resolver or Analog Encoder - Connection Diagram

3.10.3 Auxiliary Feedback - Differential Encoder Input Option (YA[4]=2)

The Whistle can be used as a slave by receiving the position data (on Port B1) of the master encoder in Follower or ECAM mode. In this mode Port B2 provides **differential buffered Auxiliary outputs of B1** for the next slave axis in Follower or ECAM mode.

Below are the signals on the Auxiliary Feedback ports when the Whistle Auxiliary Feedback port is set up to run as a differential Auxiliary input:

Port	Pin	Signal	Function
PWR	1	+5V	Encoder supply voltage
PWR	2	COMRET	Common return
B1	3	CHA	Auxiliary channel A input
B1	4	CHA-	Auxiliary channel A complement input
B1	5	CHB	Auxiliary channel B input
B1	6	CHB-	Auxiliary channel B complement input
B1	7	INDEX	Auxiliary Index Input
B1	8	INDEX-	Auxiliary Index complement Input
B2	9	CHAO	Buffered Channel A output
B2	10	CHAO-	Buffered Channel A complement output
B2	11	CHBO	Buffered channel B output
B2	12	CHBO-	Buffered channel B complement output
B2	13	INDEXO	Buffered Index output
B2	14	INDEXO-	Buffered Index complement output
PWR	15	+5V	Encoder supply voltage
PWR	16	COMRET	Common return
Pin Positions			

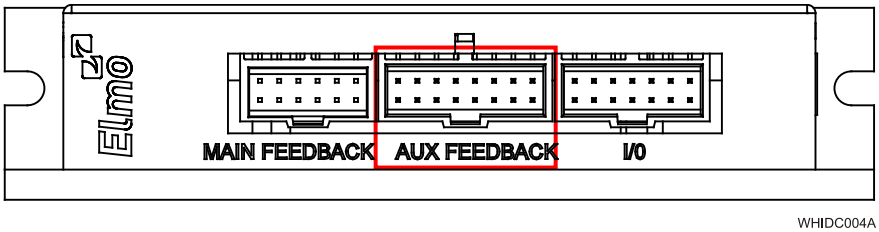


Table 10: Differential Auxiliary Encoder Input Option along with Differential Encoder Outputs on Auxiliary Feedback - Pin Assignments

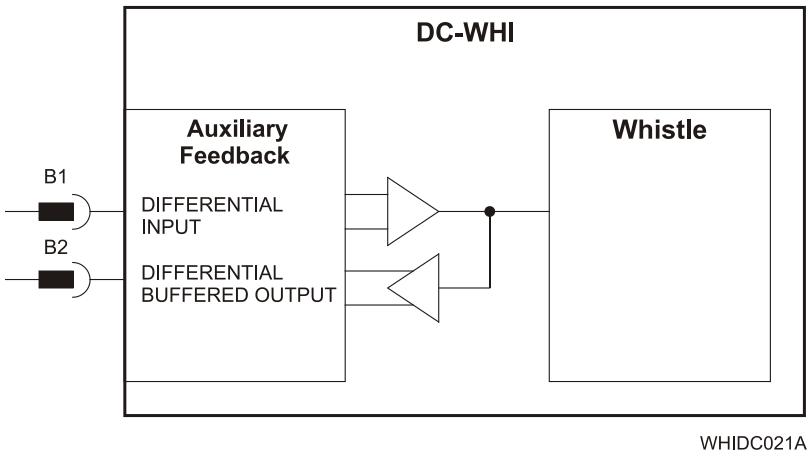


Figure 18: Differential Auxiliary Input Option - Block Diagram

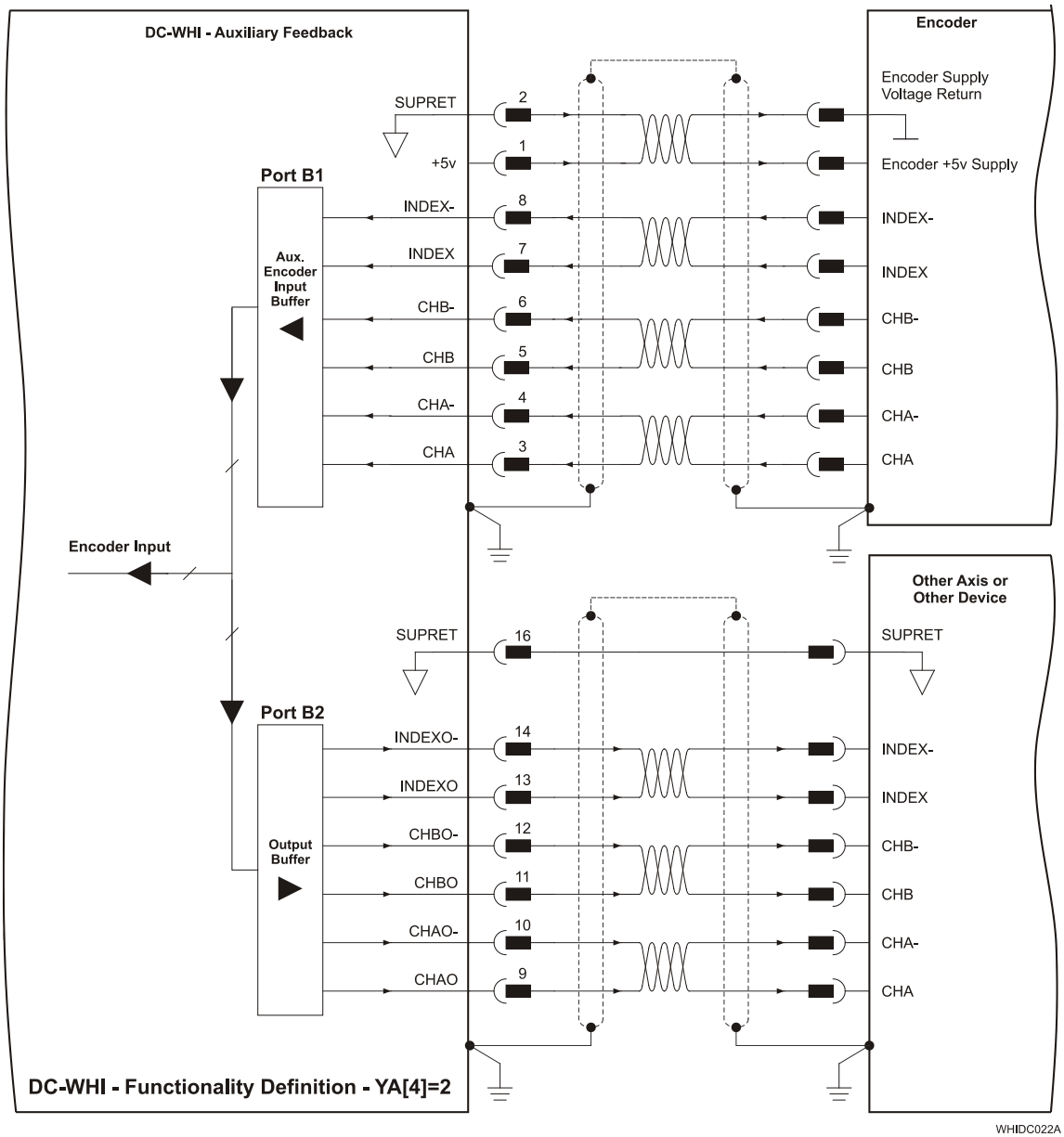


Figure 19: Differential Auxiliary Input Option on Auxiliary Feedback - Connection Diagram

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

This mode is used for input of differential pulse-and-direction position commands on Port B1. In this mode Port B2 provides **differential buffered pulse-and-direction outputs of B1** for another axis.

Below are the signals on the Auxiliary Feedback ports when set up to run as a differential pulse-and-direction input:

Port	Pin	Signal	Function
PWR	1	+5V	Encoder supply voltage
PWR	2	COMRET	Common return
B1	3	CHA	Auxiliary Pulse input
B1	4	CHA-	Auxiliary Pulse complement input
B1	5	CHB	Auxiliary Direction input
B1	6	CHB-	Auxiliary Direction complement input
B1	7	NA	Do not connect this pin
B1	8	NA	Do not connect this pin
B2	9	CHAO	Buffered Pulse output
B2	10	CHAO-	Buffered Pulse complement output
B2	11	CHBO	Buffered Direction output
B2	12	CHBO-	Buffered Direction complement output
B2	13	NA	Do not connect this pin
B2	14	NA	Do not connect this pin
PWR	15	+5V	Encoder supply voltage
PWR	16	COMRET	Common return
Pin Positions			

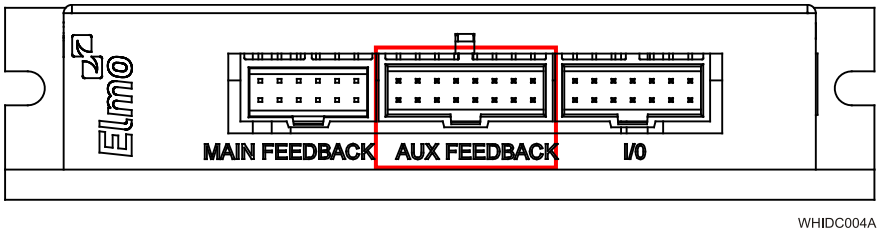


Table 11: Pulse-and-Direction Pin Assignment on Auxiliary Feedback

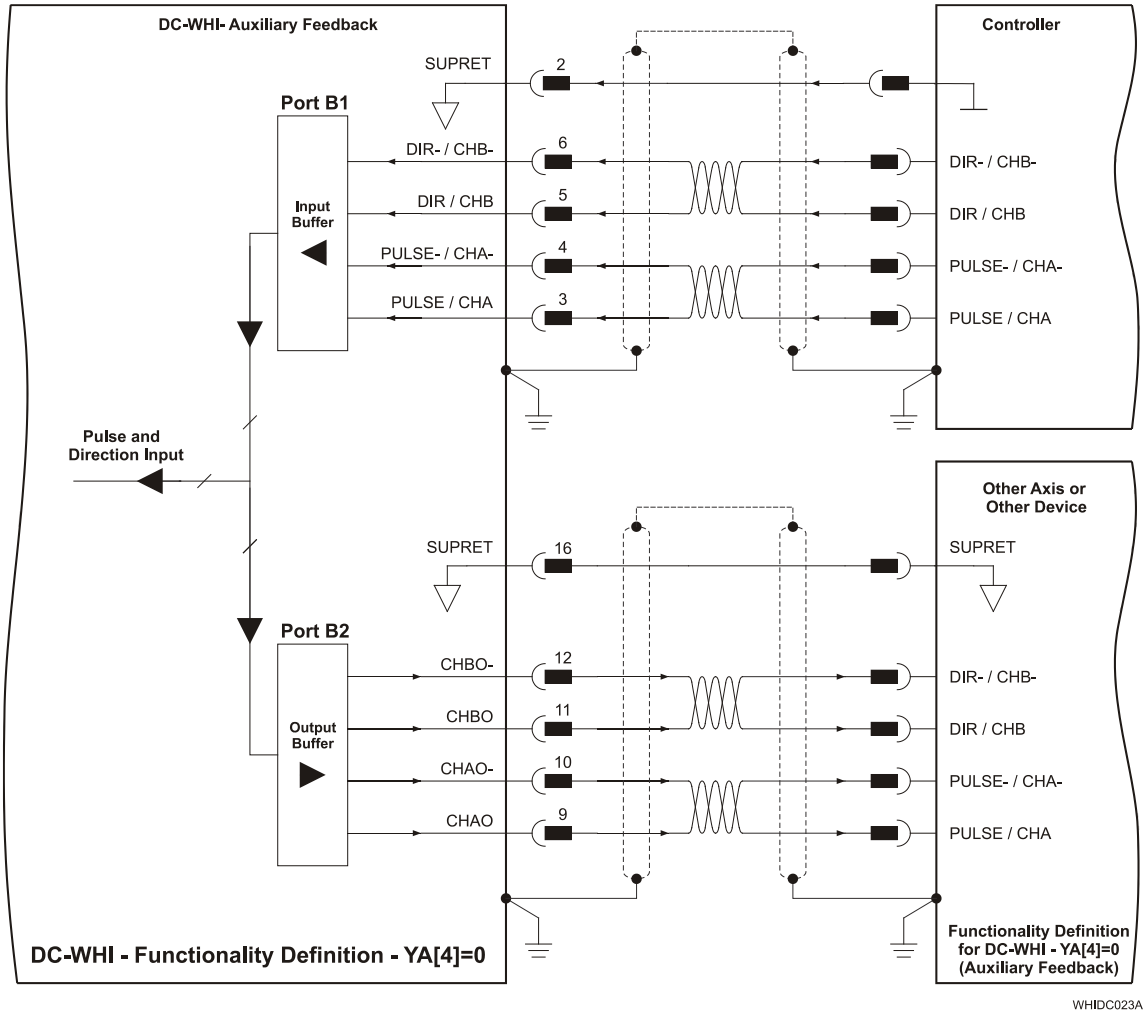


Figure 20: Pulse-and-Direction Input Option on Auxiliary Feedback - Connection Diagram

3.11 I/O

3.11.1 I/O

The DC Whistle has 6 digital inputs, 2 digital outputs and a single analog input.

The I/O port has a 14-pin Molex Header plug with the following pin-outs.

Pin	Signal	Function
1	OUT1	Programmable Digital output 1
2	OUTRET1	Programmable Digital output 1 return
3	OUT2	Programmable Digital output 2
4	OUTRET2	Programmable Digital output 2 return
5	IN1	Programmable Digital input 1
6	IN2	Programmable Digital input 2
7	IN3	Programmable Digital input 3
8	IN4	Programmable Digital input 4
9	IN5	Programmable Digital input 5
10	IN6	Programmable Digital input 6
11	INRET	Programmable Digital input return
12	COMRET	Common return
13	ANALOGIN1+	Analog input 1+
14	ANALOGIN1-	Analog input 1-
Pin Positions		

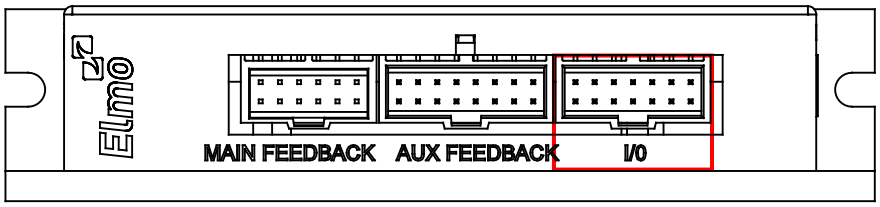


Table 12: I/O Port and Cable - Pin Assignment

3.11.1.1 Digital Input

Note: **The Default Digital Input level Signal is set to 24 V (PLC).**

5 V is also available (TTL).

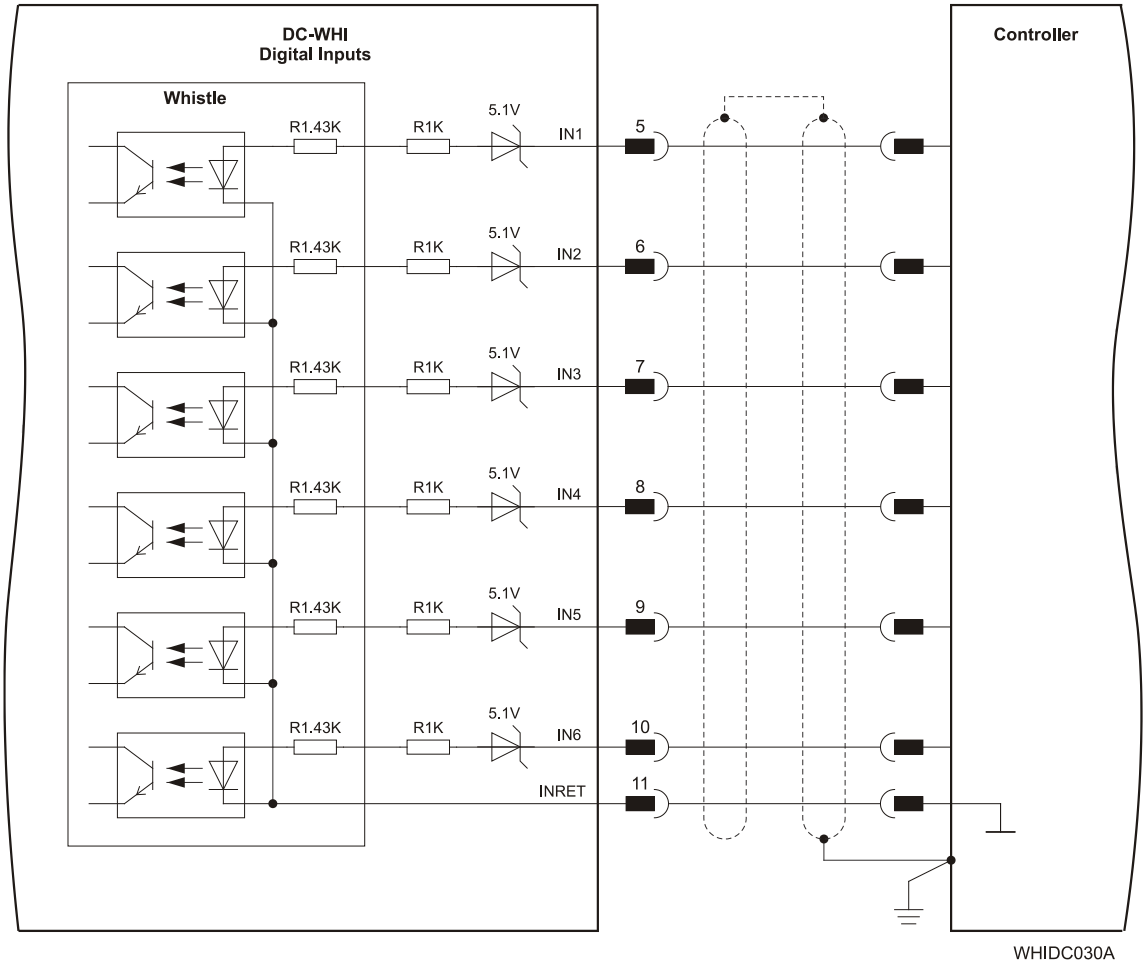


Figure 21: Digital Input Connection Diagram

3.11.1.2 Digital Output

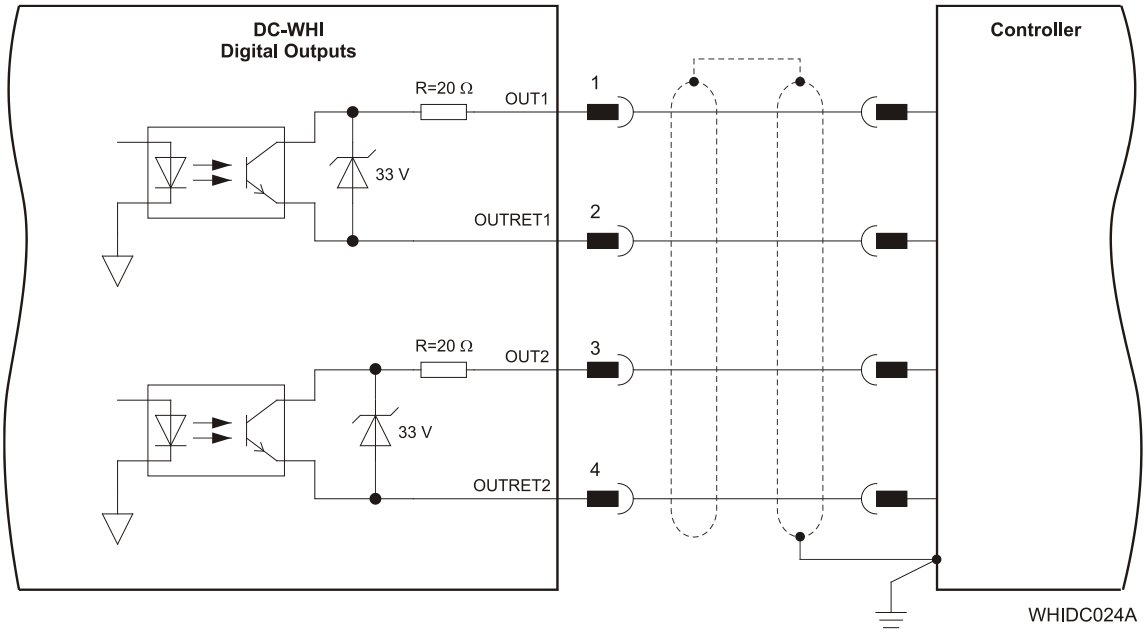


Figure 22: Digital Output Connection Diagram

3.11.2 Analog Input

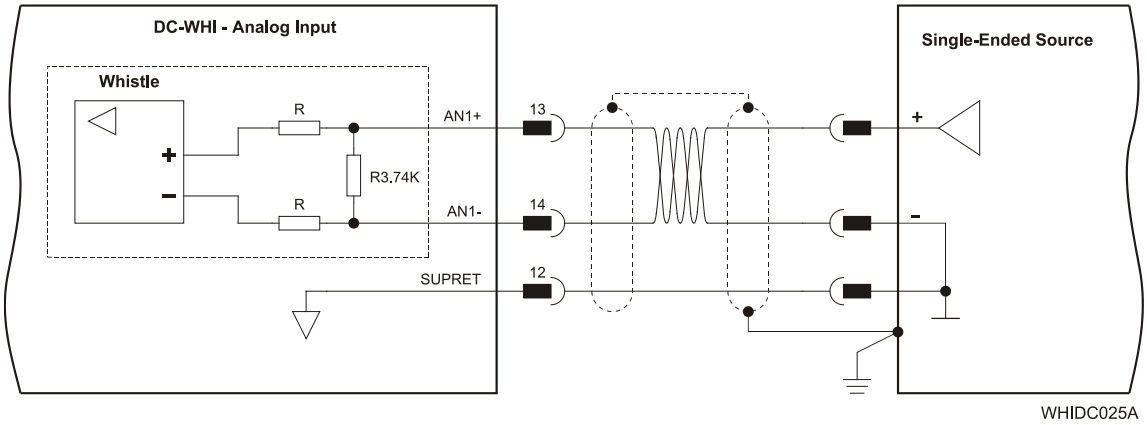


Figure 23: Analog Input with Single-Ended Source

3.12 Communications

The communication cables use an 8-pin RJ-45 plug that connect to the RS-232 and CAN ports on the DC Whistle.

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

- RS-232, full duplex
- CAN

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

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

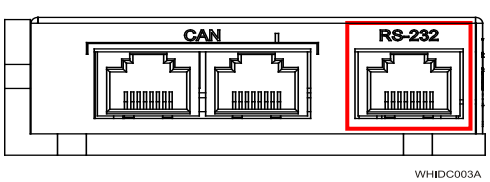
For ease of setup and diagnostics of CAN communication, RS-232 and CAN can be used simultaneously.

3.12.1 RS-232 Communication

Notes for connecting the RS-232 communication cable:

1. 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.
2. The RS-232 communication port is **non-isolated**.
3. The male RJ plug must have a shield cover.
4. Ensure that the shield of the cable is connected to the shield of the RJ plug.
5. The drain wire can be used to facilitate the connection.

Pin	Signal	Function
1, 2	—	—
3	Tx	RS-232 transmit
4	—	—
5	COMRET	Communication return
6	Rx	RS-232 receive
7, 8	—	—
Body	Drain Wire	shield
Pin Positions		



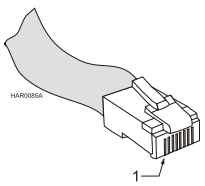


Table 13: RS-232 Cable - Pin Assignments

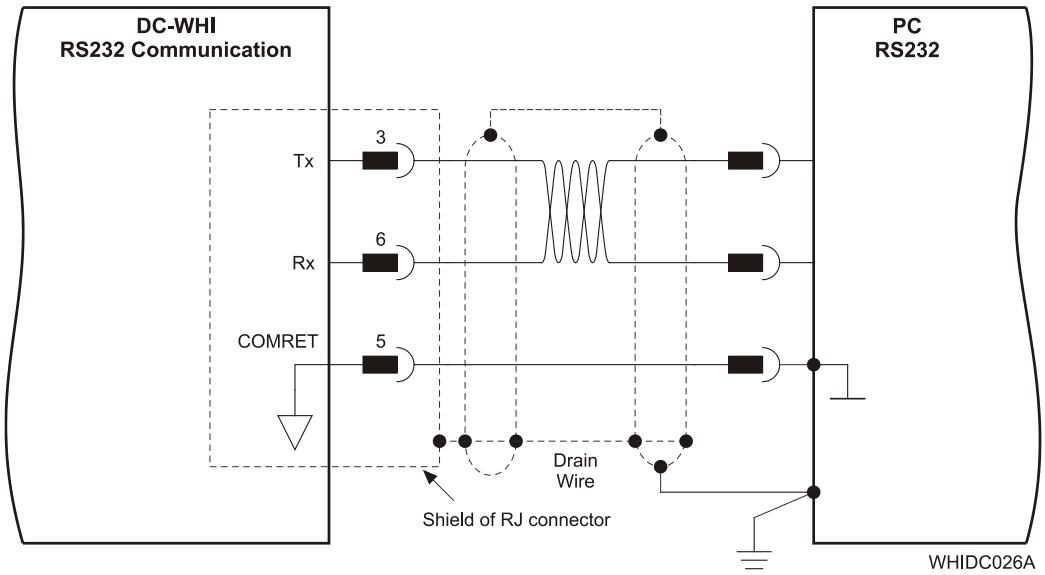


Figure 24: RS-232 Connection Diagram

3.12.2 CAN Communication

Notes for connecting the CAN communication cable:

1. Use 26 or 28 AWG twisted pair shielded cables. For best results, the shield should have aluminum foil and be covered by copper braid with a drain wire
2. 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.
3. The CAN communication port is **non-isolated**.
4. The male RJ plug must have a shield cover.
5. Ensure that the shield of the cable is connected to the shield of the RJ plug. The drain wire can be used to facilitate the connection.
6. For "daisy-chain" connections, connect a termination 120-Ω resistor at each of the two ends of the network cable.

Pin	Signal	Function
1	CAN_H	CAN_H busline (dominant high)
2	CAN_L	CAN_L busline (dominant low)
3	CAN_GND	CAN ground
4, 5	N/A	—
6	CAN_SHLD	Shield, connected to the RJ plug cover
7	CAN_GND	CAN Ground
8	N/A	—
body	Drain Wire	shield
Pin Positions		

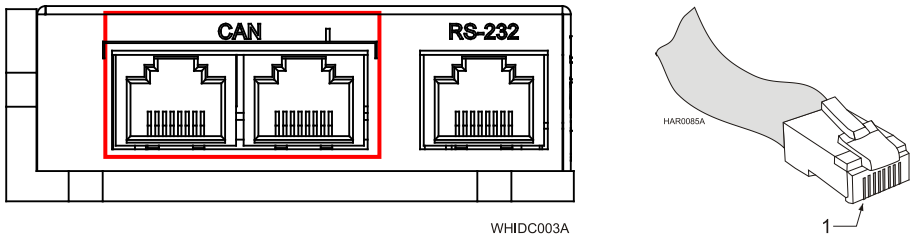
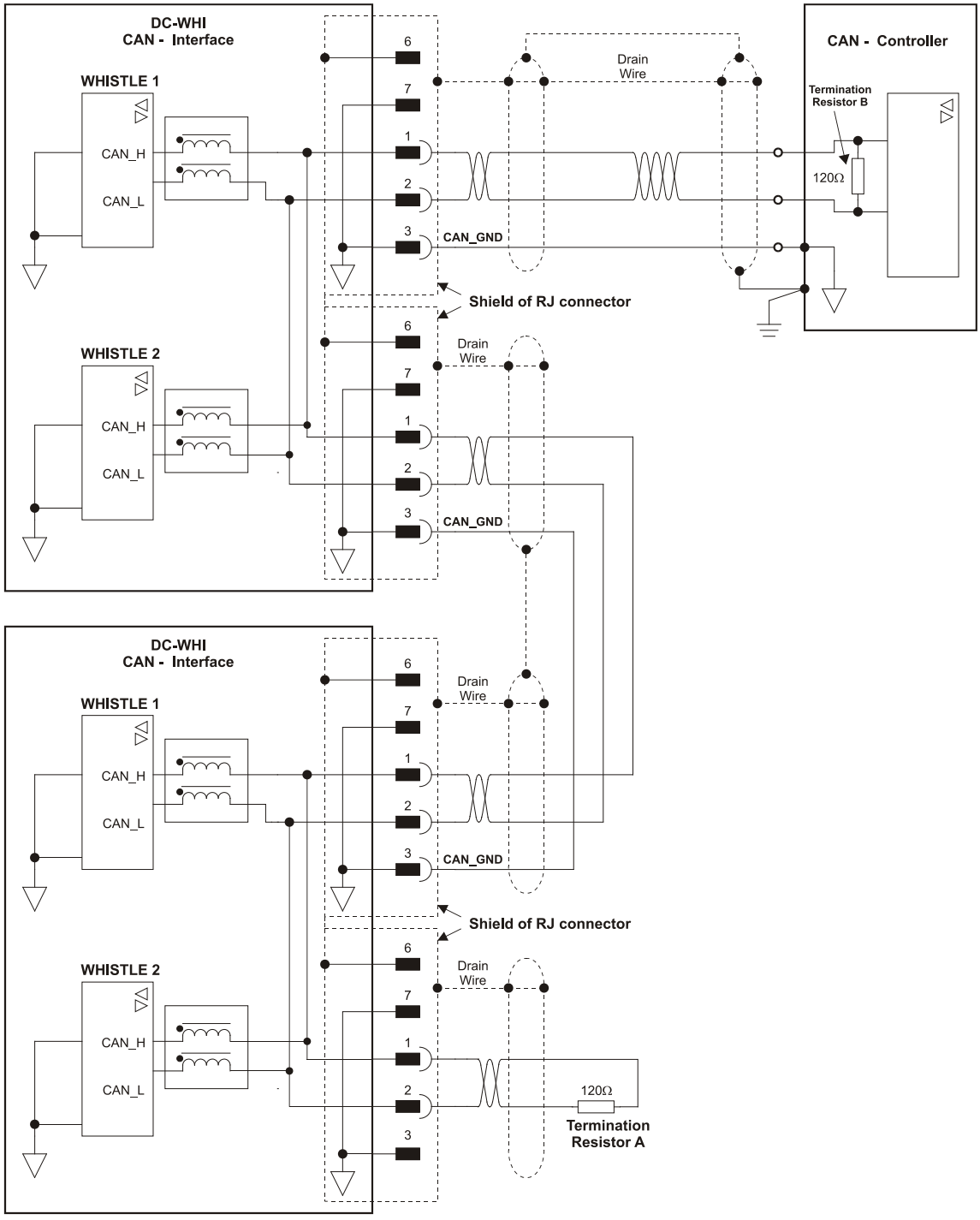


Table 14: CAN Cable - Pin Assignments



WHIDC027A

Figure 25: CAN Network Connection Diagram

3.13 Powering Up

After the cables have been connected to their devices, the DC Whistle is ready to be powered up.

Caution:
Before applying power, ensure that the DC supply is within the range specified and that the proper plus-minus connections are in order.

3.14 Initializing the System

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

4 Technical Specifications

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

4.1 Features

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

- Operating power
  - DC power supply: 11 to 95 VDC source
- DC BUS
  - DC power supply
- Control supply
  - A separate DC power supply 11 to 95 VDC serves as both the auxiliary supply *and* the backup supply (Option)
- Operating modes
  - Current, velocity and position
- Commutation alternatives
  - Sinusoidal vector control
  - Trapezoidal
  - DC brush
- Feedback alternatives
  - Incremental encoder + digital Halls
  - Incremental encoder only
  - Digital Halls
  - Resolver
  - Sin / Cos
  - Sin / Cos + Digital Halls
  - Analog Halls
  - Tachometer
  - Potentiometer
- Communication
  - Simultaneous operation of RS-232 and CAN DS 402 User programming
- User Programming
  - Third-generation programming environment (language and Elmo Studio)

- Encoder Input
- Event capturing inputs
- Event triggered programming structure
- Analog inputs
  - 1 differential inputs with 12-bit resolution
- Enable input, limit switches and emergency stop handling
- Smart multi-purpose inputs
  - Programmable as Enable, Forward and Reverse Limit Switches, Home, Capture
- Uncommitted programmable inputs
  - 4 Inputs sharing one single common
  - 6 Inputs sharing one single common
- Uncommitted, programmable outputs
  - 2 separated outputs
- Storage memory
  - Large, non-volatile storage of controller parameters and user programs
- Setup, startup and tuning software
  - Windows-based Composer
- Automatic analysis of kinematics
- Status indication
  - Bi-color LED
- 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
- Motion modes
  - Point-to-point (PTP)
  - Jogging
  - Position-Velocity-Time (PVT)
  - Position-Time (PT)
  - Pulse-and-direction

4.2 Built-In Protection

- Software error handling
  - Software-based
- Status reporting
  - Available for a large number of fault conditions
- Protection against:
  - Short circuit between motor power outputs
  - Short circuit between each motor power output and DC bus return
  - Failure of internal power supply
  - Heatsink over-temperature
  - Under/over voltage
  - Loss of commutation signals
  - Loss of velocity feedback
  - "Bad" commutation
  - Communication error

4.3 DC Whistle Dimensions

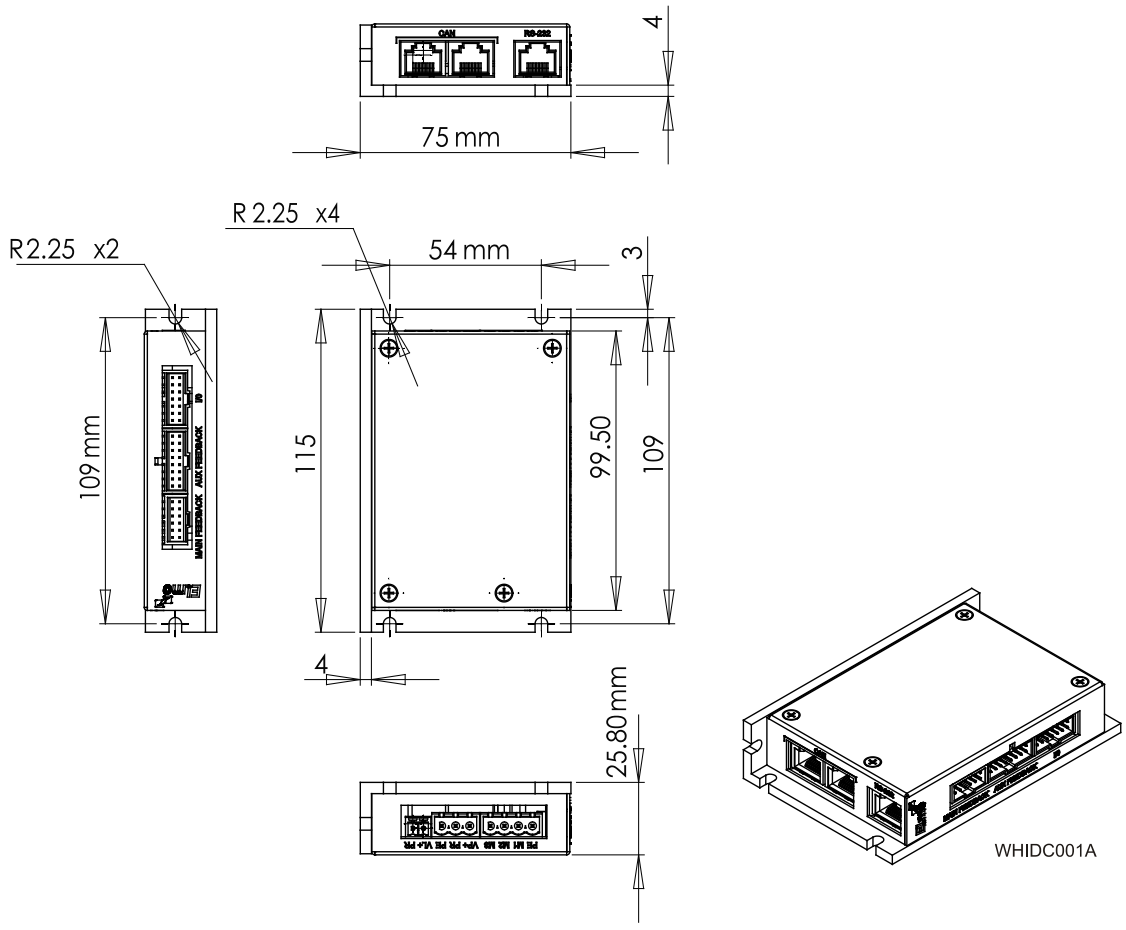


Figure 26 DC Whistle dimensions

4.4 Physical Specifications

Feature	Units	All Types
Weight	g (oz)	55 g (1.94 oz)
Dimensions	mm (in)	115 x 75 x 25.8 mm (4.53" x 2.95" x 1.02")
Mounting method		PCB mount

4.5 Power Ratings

Note: **Current Ratings:**

The current ratings of the DC Whistle are given in units of DC amperes (ratings that are used for trapezoidal commutation or DC motors). The RMS (sinusoidal commutation) value is the DC value divided by 1.41.

Feature	Units	1/60	2.5/60	5/60	10/60	15/60	1/100	2.5/100	5/100	10/100	15/100	20/100
Minimum supply voltage	VDC	8.5					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	720	75	180	400	800	1200	1600
Efficiency at rate power	%	> 99										
Output Voltage	%	> 95% of DC bus voltage at f=22 kHz										
Auxiliary Power supply	VDC	11 – 95 VDC (up to 2.5 VA inc. 5 V/200 mA for encoder)										
DC and Trapezoidal Commutation Continuous Current Limit (Ic)	A	1	2.5	5	10	15	1	2.5	5	10	15	20
Sinusoidal Commutation Continuous RMS Current Limit (Ic)	A	0.7	1.8	3.6	7	10.7	0.7	1.8	3.6	7	10.7	14.1
Peak current limit (RMS)	A	2 x Ic										
Digital in/Digital out/Analog in		6/2/1										
Pulse-Width Modulation (PWM) Switching Frequency	kHz	22 ± 5% default on the motor										
Switching Method		Advanced Unipolar PWM										

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

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	11 – 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		
Pulse-Width Modulation (PWM) Switching Frequency	kHz	22 ± 5% default on the motor		
Switching Method		Advanced Unipolar PWM		

4.6 Control Specifications

4.6.1 Current Loop

Feature	Details
Controller type	Vector, digital
Current sampling time	70 to 100 µsec
Current loop bandwidth	1400 to 2500 Hz
Compensation for bus voltage variations	Gain scheduling
Motor types	AC brushless (sinusoidal) DC brushless (trapezoidal) DC brush Linear brushless motor
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 step response (including settling time)	300 to 400 µsec
Current rise time	150 to 200 µsec

4.6.2 Velocity Loop

Feature	Details
Controller type	PI
Speed sampling time	140 to 200 µsec (x2 current loop sample time)
Velocity loop bandwidth	< 350 MHz
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 Incremental encoder only Digital Halls Resolver Sin / Cos Sin / Cos+ Digital Halls Analog Halls Tachometer Potentiometer **Note:** With all feedback options, 1/T with automatic mode switching is activated (gap, frequency and derivative).
Velocity command options	Analog Internally calculated by either jogging or step **Note:** All software-calculated profiles support on-the-fly changes.

4.6.3 Position Loop

Feature	Details
Controller type	124 PIP
Position sampling time	280 to 400 µsec (x 4 current loop sample time)
Analog input command resolution	12-bit inputs
PWM resolution	12-bit
PWM switching frequency on the load	2/ Ts (factory default 22 kHz on the motor)
Control inputs	PLC or +5V level

4.7 Feedbacks

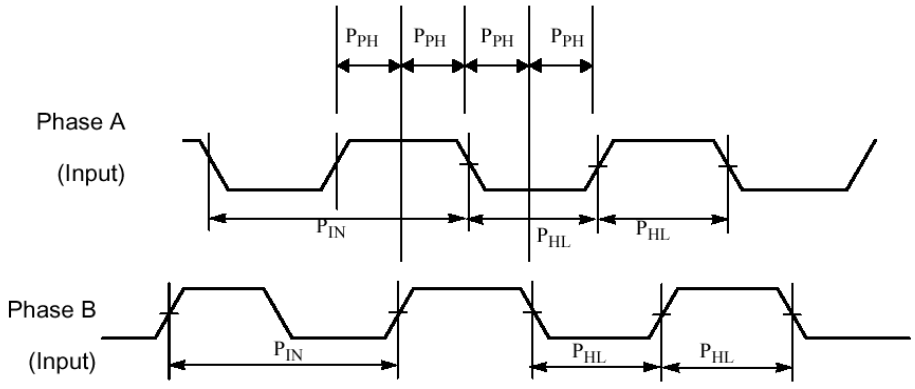
The DC Whistle can receive and process feedback input from diverse types of devices.

4.7.1 Incremental Encoder

Feature	Details
Encoder format	A, B and Index Differential Quadrature
Interface:	RS-422
Input resistance:	Differential: 120 Ω
Maximum incremental encoder frequency:	Maximum absolute: 5 MHz single, 20 MHz quadrature
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: ±7 V Differential mode: ±7 V

4.7.2 Feedback Supply Voltage

Feature	Details
Encoder/Hall supply voltage	5 V ±5%
Maximum encoder supply current	200 mA (For the main encoder only)



4.7.3 Digital Halls

Feature	Details
Halls inputs	HA, HB, HC

Feature	Details
	Single ended inputs Built in hysteresis for noise immunity
Input voltage	Nominal operating range: 0 V < VIn_Hall < 5 V Maximum absolute: -1 V < VIn_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

4.7.4 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

4.7.5 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 DC Whistle
Reference current	Up to ±50 mA

4.7.6 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.

4.7.7 Potentiometer

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

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

Feature	Details
Emulated output	A, B, Index Differential
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 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

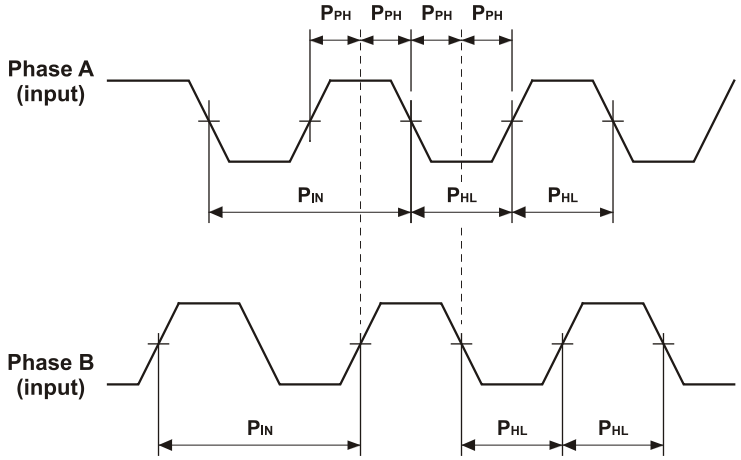


Figure 27: Auxiliary Feedback - Encoder Phase Diagram

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

Feature	Details
Encoder input, pulse and direction input	A, B, Index Differential
Output current capability	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
Encoder/Hall supply voltage	5 V + 5%
Maximum encoder supply current	200 mA
Available as options	Differential Encoder inputs Differential 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

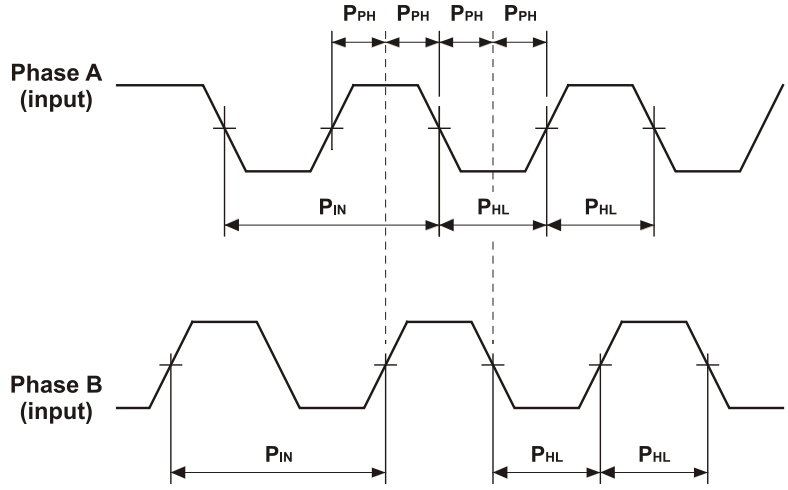


Figure 28: Auxiliary Feedback - Encoder Phase Diagram

4.8 I/Os

4.8.1 Digital Input Interface – 4/6 Digital Inputs

Feature	Details
Type of input	Optically isolated All inputs share one signal return line
Input current for all inputs	Iin = 7.35 mA @ Vin = 24 V
Input voltage level	24 V **Note:** 5 V level is also available.
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.

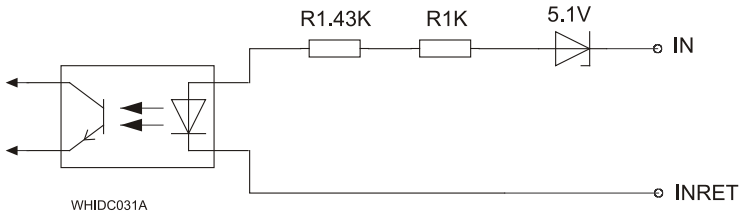


Figure 29: Digital Input Schematic (PLC)

4.8.2 Digital Output Interface – 2 Digital Outputs

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.

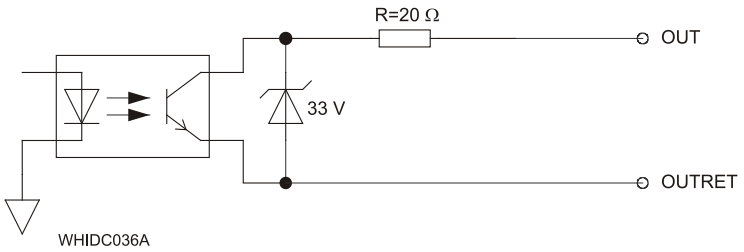


Figure 30: Digital Output Schematic

4.8.3 Analog Inputs – 1 Analog Input

Feature	Details
Analog input - maximum differential mode voltage	+ 20 V
Analog input - maximum common mode voltage	+ 10 V
Input resistance	3.74 kΩ

4.9 Mechanical Specifications

Feature	Details
Mounting	The DC Whistle designed for two standard mounting options: Wall Mount, along the back (can also be mounted horizontally on a metal surface) Book Shelf, along the side
Overall dimensions	115 x 75 x 25.8 mm (4.53" x 2.95" x 1")
Weight	273 grams (9.6 oz.)

4.10 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

4.11 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)

5 Cables (Optional)

5.1 Cable Photos

Main Feedback: CBL- HDRFB-001

Auxiliary Feedback: CBL- HDRAUX-001

I/O: CBL- HDRIO-001

RS-232 Com.: CBL-RJ452321

CAN Com.: CBL-RJ45CAN1

5.2 Cable Kit

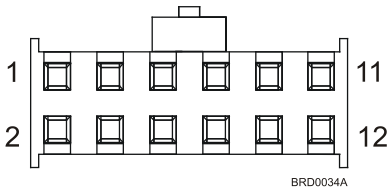
The cables are all 2 m in length. Each set contains the cables listed below. Additional cable kit and/or individual cables (in multiples of 10 each) are available from Elmo.

Cable Application	Cable Part. No.	QTY
Main Feedback	CBL-HDRFB-001	1
Auxiliary Feedback	CBL-HDRAUX-001	1
I/O	CBL-HDRIO-001	1
RS-232 Communications	CBL-RJ452321	1
CAN Communications	CBL-RJ45CAN1	2

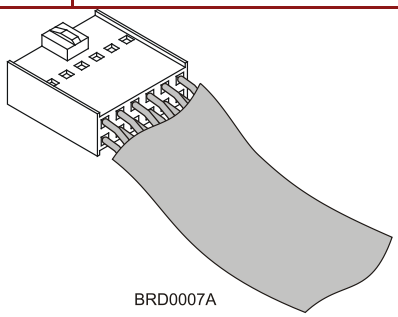
5.3 Main Feedback Cable (CBL-HDRFB-001)

The Main Feedback cable (CBL-HDRFB-001) is made of a 24-AWG shielded cable with a 12-pin Molex Header socket. It connects to the Main Feedback port on the DC Whistle. It is open on its other side so that it can be connected to customer-specific motor connector.

Pin	Color	Signal	Pairs
1	Brown	+5V	pair
2	White	COMRET	
3	Cyan	CHA	pair
4	Orange	CHA-	
5	Purple	CHB	pair
6	Black	CHB-	
7	Red	INDEX	pair
8	Blue	INDEX-	
9	Green	HA	pair
10	Yellow	HB	
11	Pink	HC	pair
12	Drain wire	COMRET	



Front View



12 pin Molex Header Socket

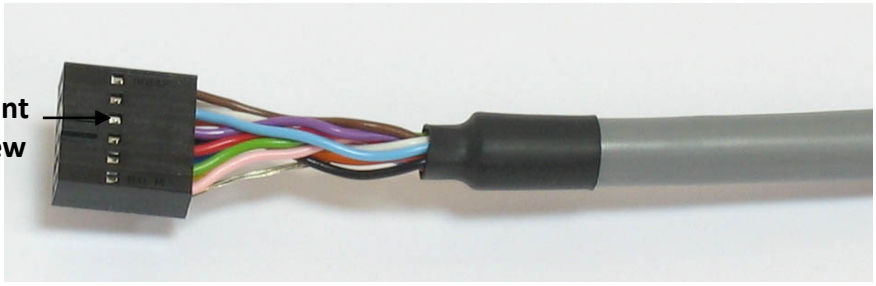
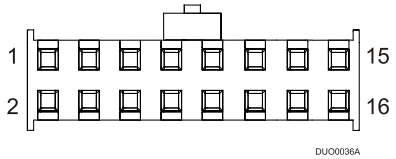


Figure 31: Single-Sided Main Feedback Cable (Part No. CBL-HDRFB-001)

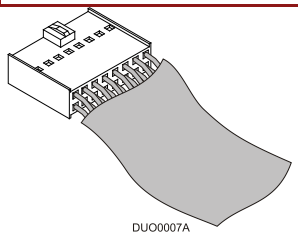
5.4 Auxiliary Feedback (CBL-HDRAUX-001)

The Auxiliary Feedback cable (CBL-HDRAUX-001) is made of a 24-AWG shielded cable with a 16-pin Molex Header socket. It connects to the Auxiliary Feedback port on the DC Whistle.

Pin	Color	Signal	Pairs
1	Brown	+5V	pair
2	White	COMRET	
3	Cyan	CHA	pair
4	Orange	CHA-	
5	Purple	CHB	pair
6	Black	CHB-	
7	Red	INDEX	pair
8	Blue	INDEX-	
9	Pink	CHAO	pair
10	Grey	CHAO-	
11	Yellow	CHBO	pair
12	Green	CHBO-	
13	White-Red	INDEXO	pair
14	White-Black	INDEXO-	
15	White-Green	+5V	pair
16	White- Yellow	COMRET	



Front View



16 pin Molex Header Socket

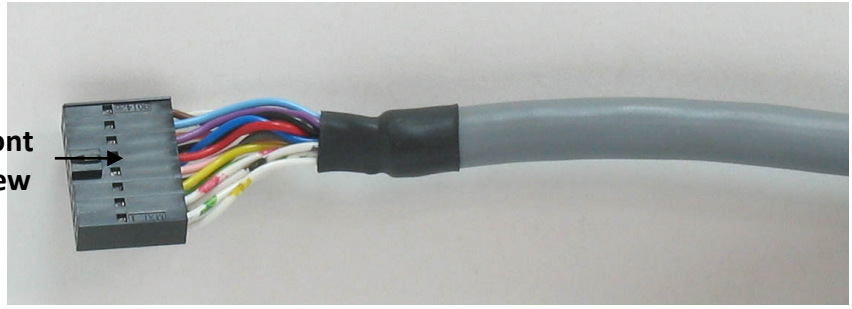
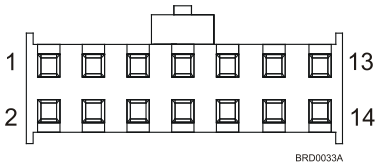


Figure 32: Single-Sided Auxiliary Feedback Cable (Part No. CBL-HDRAUX-001)

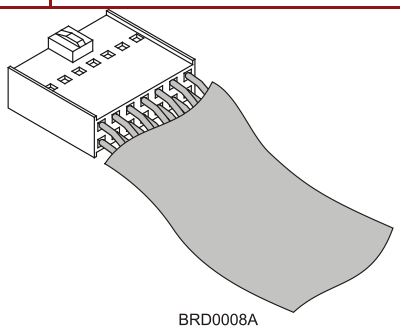
5.5 I/O (CBL-HDRIO-001)

The I/O cable (CBL-HDRIO-001) is made of a 24-AWG shielded cable with a 14-pin Molex Header socket. It connects to the I/O port on the DC Whistle.

Pin	Color	Signal	Pairs
1	Orange	OUT1	pair
2	Cyan	OUTRET1/OUTRET 1,2	
3	Black	OUT2	pair
4	Purple	OUTRET2	
5	Brown	IN1	pair
6	White	IN2	
7	Green	IN3	pair
8	Yellow	IN4	
9	Gray	IN5	pair
10	Pink	IN6	
11	Blue	INRET	pair
12	Red	COMRET	
13	White-Black	ANALIN1+	pair
14	White-Red	ANALIN1-	



Front View



14 pin Molex Header Socket

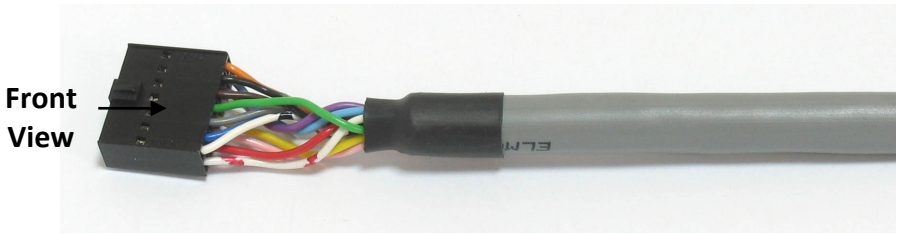


Figure 33: Single-Sided I/O Cable (Part No. CBL-HDRIO-001)

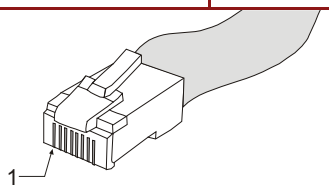
5.6 Communication Cables

The communication cables use 26-AWG twisted pair shielded cable. They are connected using an 8-pin RJ-45 plug. Elmo drives can communicate using the following options:

- RS-232 full duplex
- CAN

5.6.1 RS-232 Option (CBL-RJ452321)

RJ-45 Pin No.	Color	D-type Female Pin No.	Signal	Description
1	—	—	—	—
2	—	—	—	—
3	Brown	2	Tx	RS-232 Transmit
4	—	—	—	—
5	White	5	COMRET	Communication Return
6	Green	3	Rx	RS-232 Receive
7	—	—	—	—
8	—	—	—	—
body	Drain Wire	body	shield	cable shield



Note: **The shields of the RJ-45 and D-type plugs are connected to each other through the cable braid.**

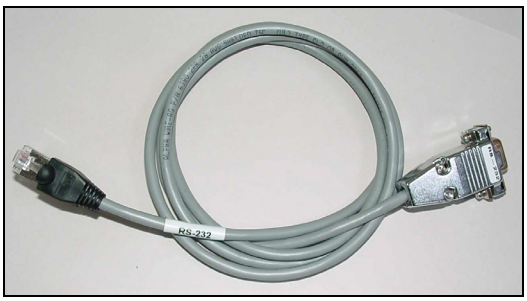
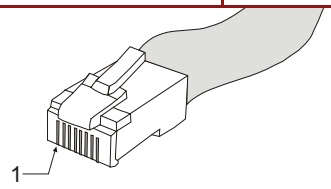


Figure 34: RS-232 Communications Cable (Part No. CBL-RJ452321)

5.6.2 CAN (CBL-RJ45CAN1)

RJ-45 Pin No.	Color	D-type Female Pin No.	Signal	Description
1	Green	7	CAN-H	CAN_H bus line
2	Yellow	2	CAN_L	CAN_L bus line
3	White	3	CAN_GND	CAN ground
4	—	—	—	—
5	—	—	—	—
7	—	—	—	—
8	—	—	—	—
body	Drain Wire	body	shield	cable shield



Note: The shields of the RJ-45 and D-type plugs are connected to each other through the cable braid.

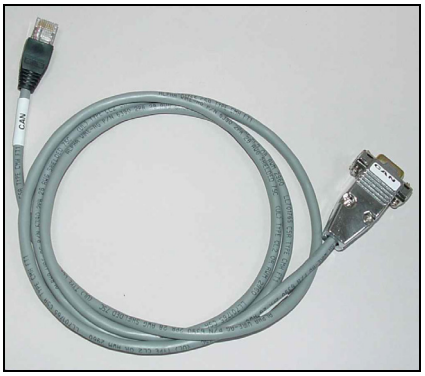


Figure 35: CAN Cable (Part No. CBL-RJ45CAN1)

5.7 Guidelines for Making Your Own Cables

Proper wiring, grounding and shielding are essential for ensuring safe, immune and optimal servo performance of the DC Whistle. If you do not plan to use cables provided by Elmo, follow the instructions below carefully.

Caution:
Perform the following instructions to ensure safe and proper wiring.

1. Use twisted pair shielded cables for control, feedback and communication connections. For best results, the cable should have an aluminum foil shield covered by a copper braid and should contain a drain wire.

   The drain wire is a non-insulated wire that is in contact with parts of the cable, usually the shield. It is used to terminate the shield and as a grounding connection.

The impedance of the wire must be as low as possible. The size of the wire must be thicker than actually required by the carrying current. A 24, 26 or 28 AWG wire for control and feedback cables is satisfactory although 24 AWG is recommended.

Use shielded wires for motor connections as well. If the wires are long, ensure that the capacitance between the wires is not too high: C < 30 nF is satisfactory for most applications.

Keep all wires and cables as short as possible.

Keep the motor wires as far away as possible from the feedback, control and communication cables.

Ensure that in normal operating conditions, the shielded wires and drain *carry no current.* The only time these conductors carry current is under abnormal conditions, when electrical equipment has become a potential shock or fire hazard while conducting external EMI interferences directly to ground, in order to prevent them from affecting the drive. Failing to meet this requirement can result in drive/controller/host failure.

After completing the wiring, carefully inspect all wires to ensure tightness, good solder joints and general safety.

5.7.1 Recommended Wire Cross Sections

Function	Connection	Details
Motor	PE, M1, M2, M3	14 AWG
Feedback and Control	Main Feedback Auxiliary Feedback I/O	24 AWG twisted pair shielded cables
Communications	RS-232 CAN	26 AWG twisted pair shielded cables