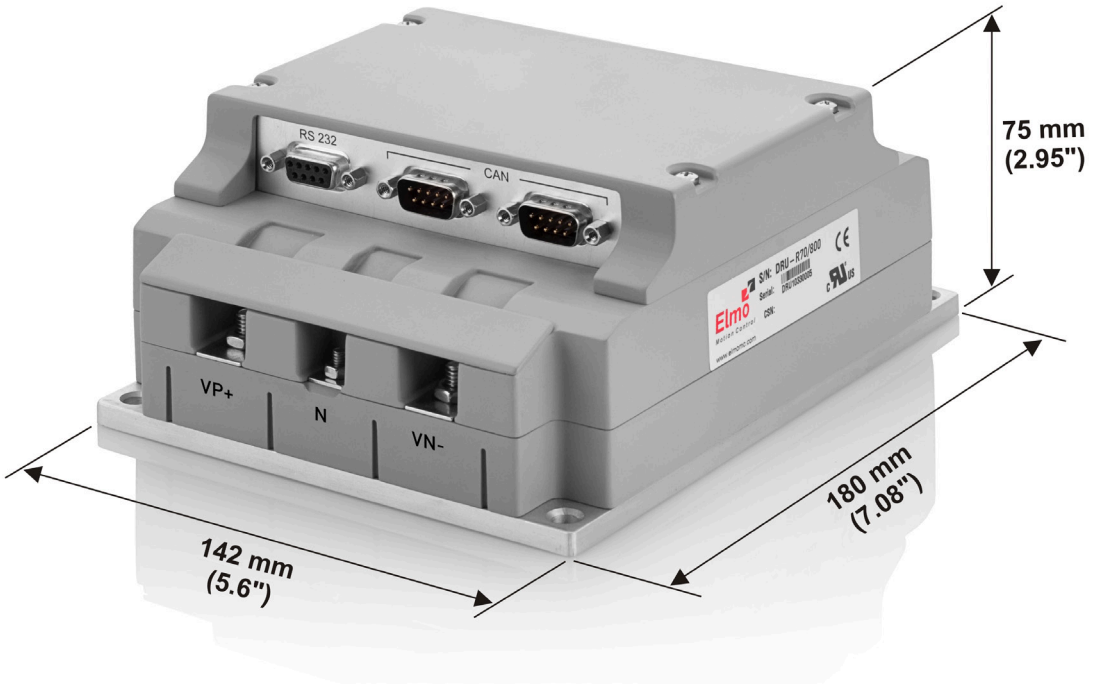
SimpIIQ Line

Drum HV (High Voltage) Servo Drive Installation Guide



October 2017 (Ver. 1.701)

Elmo Motion Control

www.elmomc.com

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- This guide contains proprietary information belonging to Elmo Motion Control Ltd. Such information is supplied solely for the purpose of assisting users of the Drum HV (High Voltage) servo drive in its installation.
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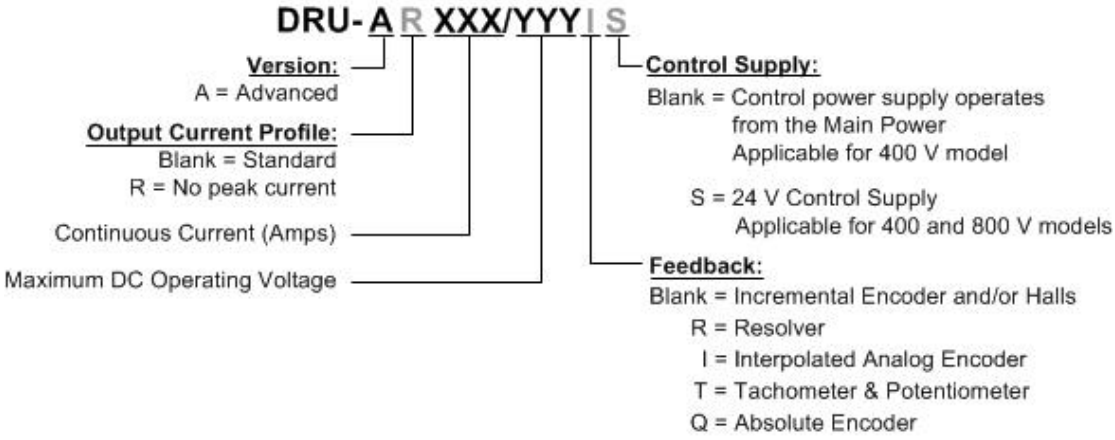
Catalog Number



Revision History

Version	Date	Details
1.0		Initial release
1.1		Formatted according to new template, Catalog Number updated
1.2		Catalog Number updated, references to Standard version removed.
1.3		Added section on High Voltage Thermal data. Sections 4.3 and 4.3.1: Auxiliary Supply Voltage range: 18 V to 30 V
1.4		Removed the 800 V without 24 V auxiliary option
1.500		Added a caution and recommendation on the type of cleaning solution to use for the Elmo unit. Updated Figure 3, Figure 4 and Figure 25. Updated Section 4.7.1, Section 3.5.9 and Section 4.7.2.
1.501		Section 3.5.10: Communication Cables – updated Section 3.5.10.1: RS-232 Communication – updated Section 3.5.10.2: CAN Communication – updated
1.600	Nov 2013	Changes to connection instructions regarding motor power and main power.
1.601	Jan 2014	Updated Section 3.5.3.3: Direct-to-Mains Power Source (Non-Isolated Rectifier)
1.602	July 2014	General format updates
1.700	May 2016	Removal of Rectified voltage in section 3.7.3
1.701	October 2017	Updated the Warranty Information section 1.5 and the part number label in section 3.2

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Chapter 1: Safety Information

In order to operate the Drum HV (High Voltage) servo drive safely, 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 Drum HV (High Voltage) and accompanying equipment.

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

Before you start, make sure 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 Drum HV (High Voltage) servo drive contains electrostatic-sensitive components that can be damaged if handled incorrectly. To prevent any electrostatic damage, avoid contact with highly insulating materials, such as plastic film and synthetic fabrics. Place the product on a conductive surface and ground yourself in order to discharge any possible static electricity build-up.

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

The following safety symbols are used in this manual:

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

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

1.1. Warnings

- To avoid electric arcing and hazards to personnel and electrical contacts, never connect/disconnect the servo drive while the power source is on.
- Disconnect the Drum HV (High Voltage) from all voltage sources before it is opened for servicing.
- The Drum HV (High Voltage) 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). It is recommended to measure the electrical contact points with a meter before touching the equipment.

1.2. Cautions

- The Drum HV (High Voltage) 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 to Drum HV (High Voltage) to an approved isolated 24 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 Drum HV (High Voltage), 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 Drum HV (High Voltage) 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 Drum HV (High Voltage) conforms to the following industry safety standards:

Safety Standard	Item
In compliance **IEC/EN 61800-5-1, Safety**	Adjustable speed electrical power drive systems
In compliance **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 Drum HV (High Voltage) servo drive has been developed, produced, tested and documented in accordance with the relevant standards. Elmo Motion Control is not responsible for any deviation from the configuration and installation described in this documentation. Furthermore, Elmo is not responsible for the performance of new measurements or ensuring that regulatory requirements are met.

1.4. CE Marking Conformance

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

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

1.5. Warranty Information

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

Chapter 2: Product Description

This installation guide describes the Drum HV (High Voltage) servo drive and the steps for its wiring, installation and power-up. Following these guidelines ensures optimal performance of the drive and the system to which it is connected.

2.1. Drive Description

The Drum HV (High Voltage) series of digital servo drives are highly resilient and designed to deliver the highest density of power and intelligence. The Drum HV (High Voltage) delivers up to **65 kW of continuous power** in a compact package.

The digital drives are based on Elmo's advanced SimplIQ motion control technology. They operate 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. They are designed for use with any type of sinusoidal and trapezoidal commutation, with vector control. The Drum HV (High Voltage) 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 drives are 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 Drum HV (High Voltage), as part of the SimplIQ product line, is fully programmable with Elmo's Metronome motion control language.

Power to the drives is provided by a DC power source (not included with the Drum HV (High Voltage)).

Since the power stage is fully isolated from the control stage, the DC rectifier can be fed directly from the mains, without the need for a bulky and expensive transformer.

If backup functionality is required to store control parameters in the event of a mains power outage, then an S-model Drum HV (High Voltage) should be used, with an external 24 VDC isolated supply connected to it.

Note: The backup functionality can operate from an isolated voltage source within the range of 18 to 30 VDC.

Whenever backup functionality is not required, Drum HV (High Voltage) models that do *not* have the S suffix in the catalog number (only for the 400 V model -see page 18) can be used, i.e., they do not have a 24 V control supply. In these models, a smart control-supply algorithm enables the Drum HV (High Voltage) to operate with only the main power supply VP+ and VN-, with no need for a 24 VDC auxiliary power supply for the logic.

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 time: four times that of the current loop
- Fast event capturing inputs
- PT and PVT motion modes
- Fast output compare (OC)

The Drum HV (High Voltage) has the following advanced position control features:

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

2.2.4. Communication Options

Depending on the application, Drum HV (High Voltage) users can select from two communication options:

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

2.2.5. Feedback Options

- Incremental Encoder – up to 20 Megacounts (5 Megapulses) per second
- Digital Halls – up to 2 kHz
- Incremental Encoder with Digital Halls for commutation – up to 20 Megacounts 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 revolutions per second (RPS)
  - Auxiliary emulated, unbuffered, single-ended, encoder output
- Tachometer, Potentiometer
- Absolute Encoder
  - Heidenhain 2.1
  - Stegmann
- Elmo drives provide supply voltage for all the feedback options

2.2.6. Fault Protection

The Drum HV (High Voltage) 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

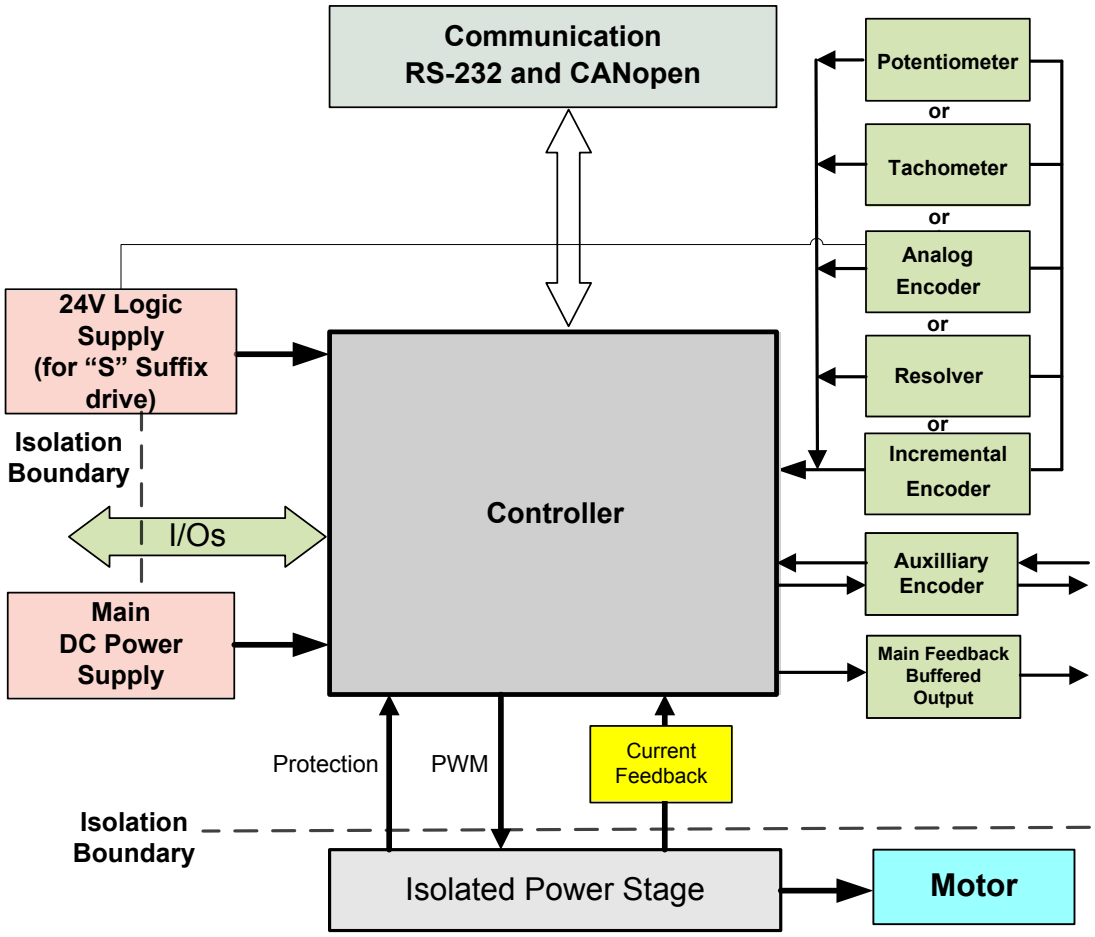


Figure 1: Drum HV (High Voltage) System Block Diagram

2.4. How to Use this Guide

In order to install and operate the Drum HV (High Voltage) 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 Drum HV (High Voltage).
- Chapter 4 - *Technical Specifications*, lists all the drive ratings and specifications.

Upon completing the instructions in this guide, the Drum HV (High Voltage) 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 SimplIQ Software Manual, which describes the comprehensive software used with the Drum HV (High Voltage)
- The SimplIQ Command Reference Manual, which describes, in detail, each software command used to manipulate the Drum HV (High Voltage) motion controller
- The Composer Software Manual, which includes explanations of all the software tools that are part of Elmo's Composer software environment

Chapter 3: Installation

The Drum HV (High Voltage) must be installed in a suitable environment and properly connected to its voltage supplies and the motor.

3.1. Before You Begin

3.1.1. Site Requirements

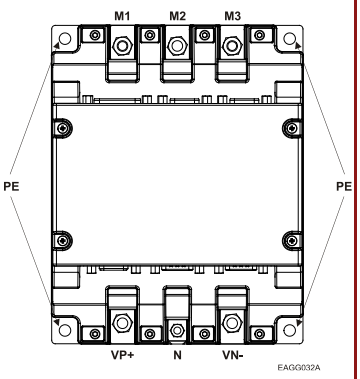
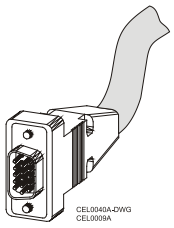
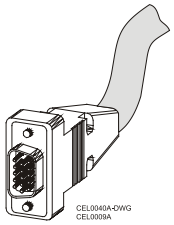
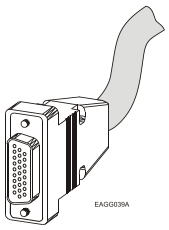
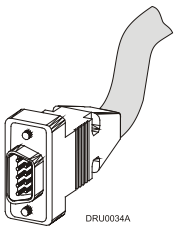
You can guarantee the safe operation of the Drum HV (High Voltage) by ensuring that it is installed in an appropriate environment.

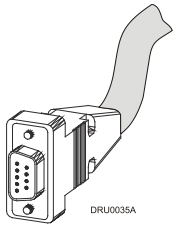
Feature	Value
Ambient operating temperature	0 °C to 40 °C (32 °F to 104 °F)
Maximum operating altitude	2,000 m (6562 feet)
Maximum non-condensing humidity	90%
Operating area atmosphere	No flammable gases or vapors permitted in area
Models for extended environmental conditions are available.	

Caution:
The Drum HV (High Voltage) dissipates its heat by natural convection. The maximum ambient operating temperature of 0 °C to 40 °C (32 °F to 104 °F) must not be exceeded.

3.1.2. Hardware Requirements

The components that you will need to install your Drum HV (High Voltage) are:

Component	Connector	Section	Drawing
Main Power Cable	**VP+ N VN-**	3.5.3	
Motor Cable	**M3 M2 M1 PE**	3.5.3	
Main Feedback Cable	**Main Feedback (Feedback A)** Connects to Port A	3.5.6	
Auxiliary Feedback Cable (if needed)	**Aux. Feedback (Feedback B)** Connects to Port B	3.5.8	
Digital I/O Cable (if needed)	**General I/O** Connects to the I/O Port	3.5.9	
RS232 Communication Cable	**RS-232**	3.5.10.1	

Component	Connector	Section	Drawing
CAN Communication cable(s) (if needed)	**CAN (in)** **CAN (out)**	3.5.10.2	

3.2. Unpacking the Drive Components

Before you begin working with the Drum HV (High Voltage) system, verify that you have all of its components, as follows:

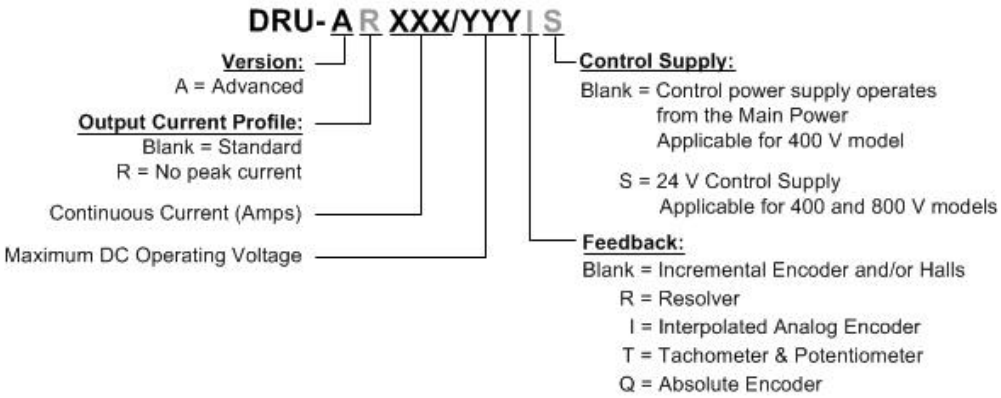
- The Drum HV (High Voltage) servo drive
- The Composer software and software manual

The Drum HV (High Voltage) is shipped in a cardboard box with Styrofoam protection.

To unpack the Drum HV (High Voltage):

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 Drum HV (High Voltage) you have unpacked is the appropriate type for your requirements, locate the part number sticker on the side of the Drum HV (High Voltage). It looks like this:

The catalog number (P/N) at the top gives the type designation as follows:



4. Verify that the Drum HV (High Voltage) type is the one that you ordered, and ensure that the voltage meets your specific requirements.

3.3. Connectors

The Drum HV (High Voltage) has nine connectors.

3.3.1. Connector Types

The Drum HV (High Voltage) has the following types of connectors:

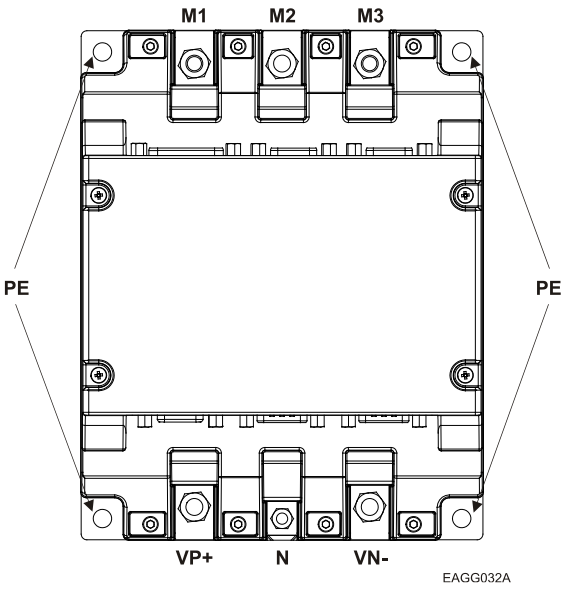
Type	Function	Port	Connector Location
N/A	N/A	N	
Barrel Connector + M6 Spring Washer + M6 Nut	Power	VP+, VN-	
	Motor	M1, M2, M3	
Barrel Connector + M5 Flat Washer + M5 Spring Washer + M5 screw	Ground	PE, PE, PE, PE	

Table 1: Power Connectors on the Drum HV (High Voltage)

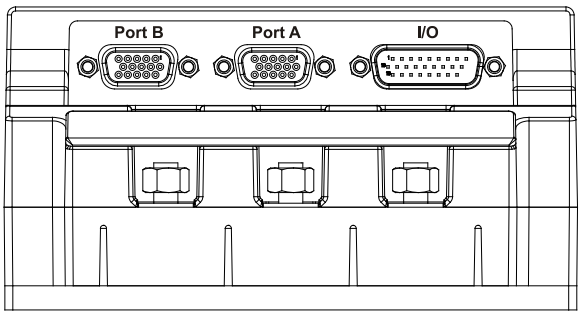
Type	Function	Port	Connector Location
15-Pin High-Density Female D-Sub Connector	Aux. Feedback	FEEDBACK B (Port B)	
15-Pin Female High-Density D-Sub Connector	Main Feedback	FEEDBACK A (Port A)	
26-Pin Male High-Density D-Sub Connector	Analog Input and General I/O	I/O	

Table 2: Feedback and I/O Connectors on the Drum HV (High Voltage)

Note: Throughout this manual FEEDBACK A and FEEDBACK B refer to the connectors labeled Port A and Port B on the Drum HV (High Voltage) and the cables connected to them.

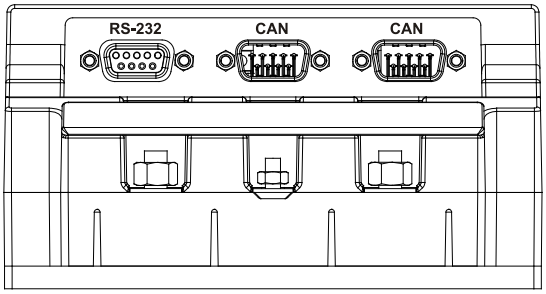
Type	Function	Port	Connector Location
9-Pin D-Sub male	CAN & Optional Backup Supply	CAN	 EAGG029A
9-Pin D-Sub male	CAN & Optional Backup Supply	CAN	
9-Pin D-Sub female	RS-232	RS-232	

Table 3: Communication and Backup Connectors on the Drum HV (High Voltage)

Note: The Drum HV (High Voltage) has two CAN connectors. These connectors are functionally identical, and either of them can be used for input or output and for connecting the optional backup supply.

3.4. Mounting the Drum HV (High Voltage)

The Drum HV (High Voltage) 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 Drum HV (High Voltage) (see the diagram below).

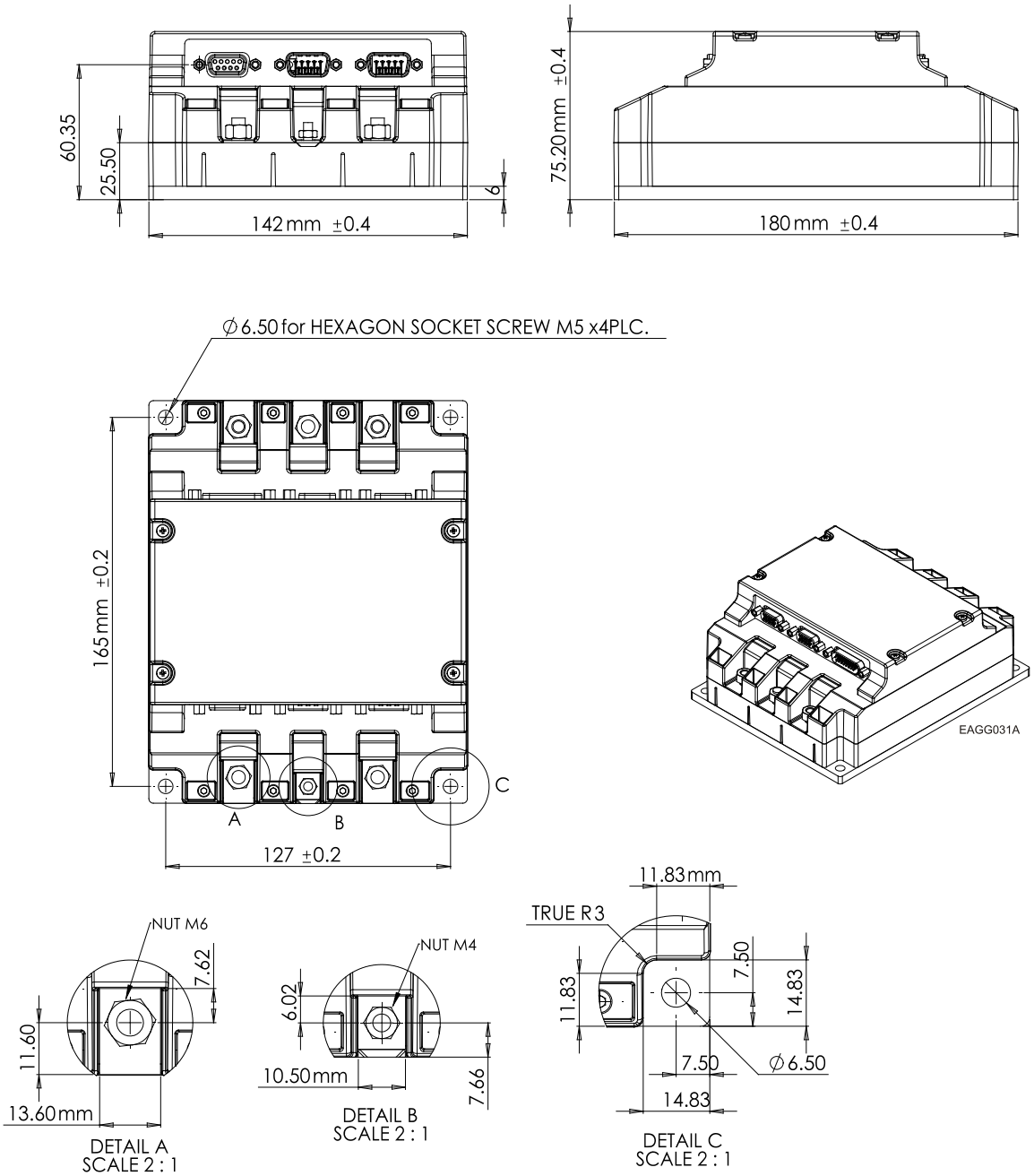


Figure 2: Mounting the Drum HV (High Voltage)

3.5. Connecting the Cables

The Drum HV (High Voltage) has nine connectors.

3.5.1. Wiring the Drum HV (High Voltage)

Once the Drum HV (High Voltage) 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 Drum HV (High Voltage).

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

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

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

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

3.5.2. Connection Diagrams

The various Drum HV (High Voltage) models connection diagrams differ from one another.

The following diagrams depict the two different possibilities for power supply connections:

- 400 V & 800 V S-models that feature power supply backup functionality, needing an Aux. 24 V backup supply (The drive will not be operative, without having the external 24 VDC supply).
- 400 V model without power supply backup functionality (The drive's internal DC/DC converter is fed from the VP+ and VN- , of the internal drive's bus line).

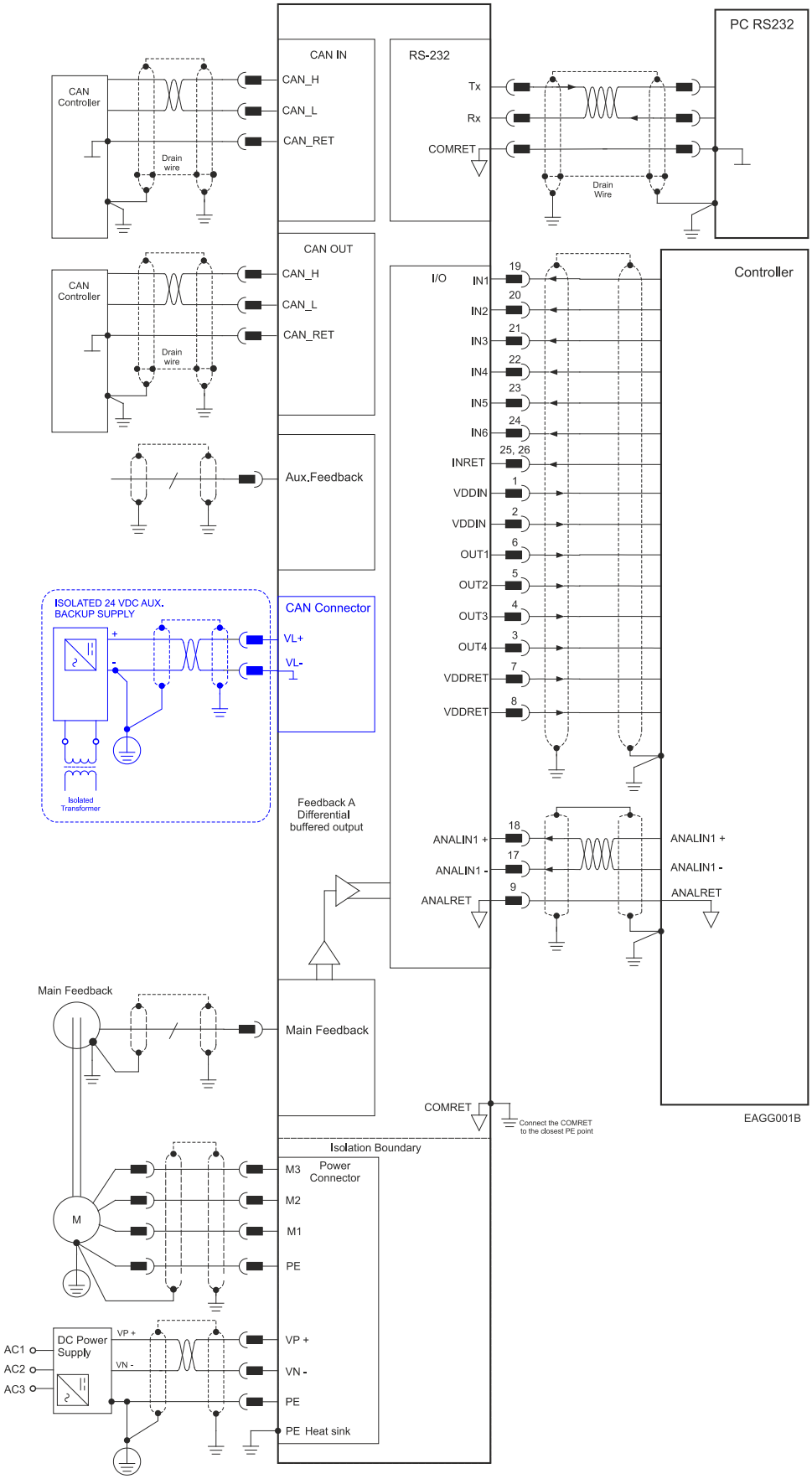


Figure 3: Drum HV (High Voltage) Connection Diagram – with Power Supply Backup Functionality (an S Type Drive)

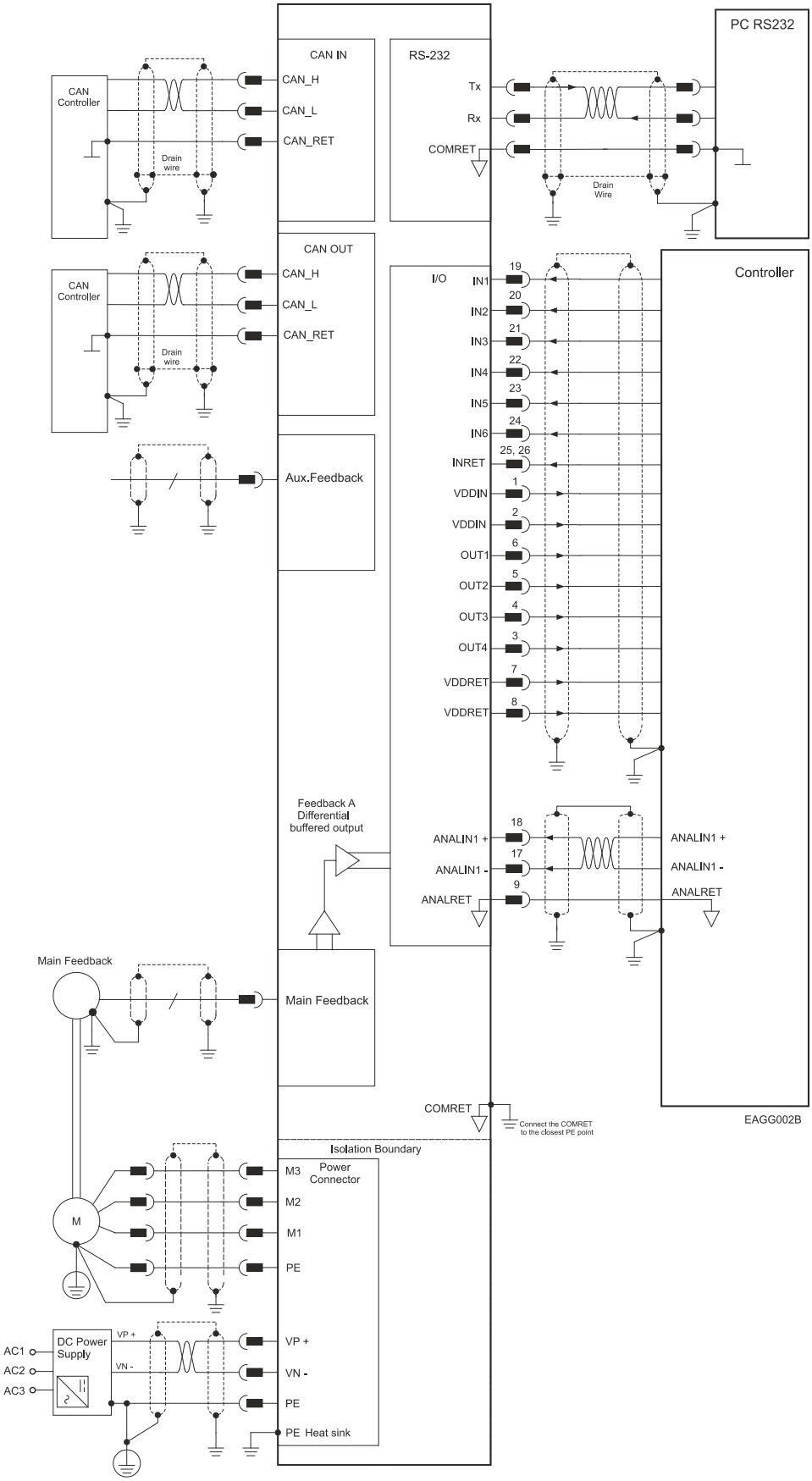


Figure 4: Drum HV (High Voltage) Connection Diagram – 400 V without Power Supply Backup Functionality

3.5.3. Connecting the Power Cables

The power connectors of the Drum HV (High Voltage) are located as follows:

For S type drives:

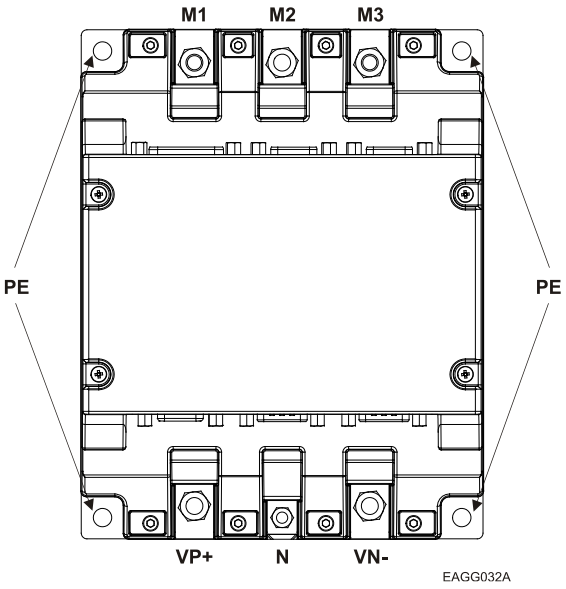
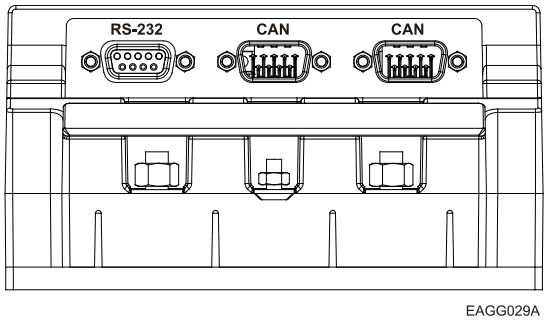
Pin	Function	Cable		Pin Positions
VP+	Pos. Power input	DC Power		
VN-	Neg. Power input	DC Power		
N	N/A	N/A		
PE	Protective earth	DC Power		
		AC Motor Cable	**DC Motor Cable**	
PE	Protective earth	Motor	Motor	
M1	Motor phase	Motor	N/C	
M2	Motor phase	Motor	Motor	
M3	Motor phase	Motor	Motor	
Auxiliary 24 VDC Backup Supply (CAN connector)				
VL-	Neg. Aux. input	Backup Power		
VL+	Pos. Aux. input	Backup Power		

Table 4: Connectors for Main DC Power, Backup Supply and Motor Cable – S Type Drives

Note: When connecting several motors, all the motor phases must be connected in an identical sequence.

For non-S 400 VDC type drives:

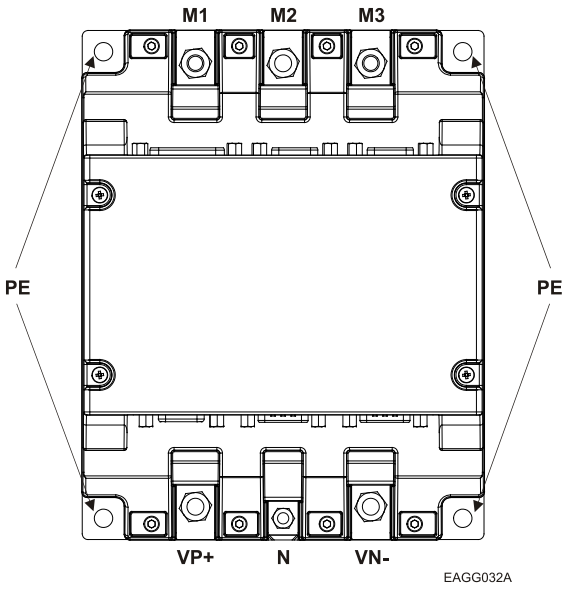
Pin	Function	Cable		Pin Positions
VP+	Pos. Power input	DC Power		
VN-	Neg. Power input	DC Power		
N	N/A	N/A		
PE	Protective earth	DC Power		
		AC Motor Cable	**DC Motor Cable**	
PE	Protective earth	Motor	Motor	
M1	Motor phase	Motor	N/C	
M2	Motor phase	Motor	Motor	
M3	Motor phase	Motor	Motor	
Auxiliary 24 VDC Backup Supply (CAN connector)				
VL-	N.C.			
VL+	N.C.			

Table 5: Connectors for Main DC Power and Motor Cable – in Non-S 400 VDC Type Drives

Note: When connecting several motors, all the motor phases must be connected in an identical sequence.

Step 1: PE Connection

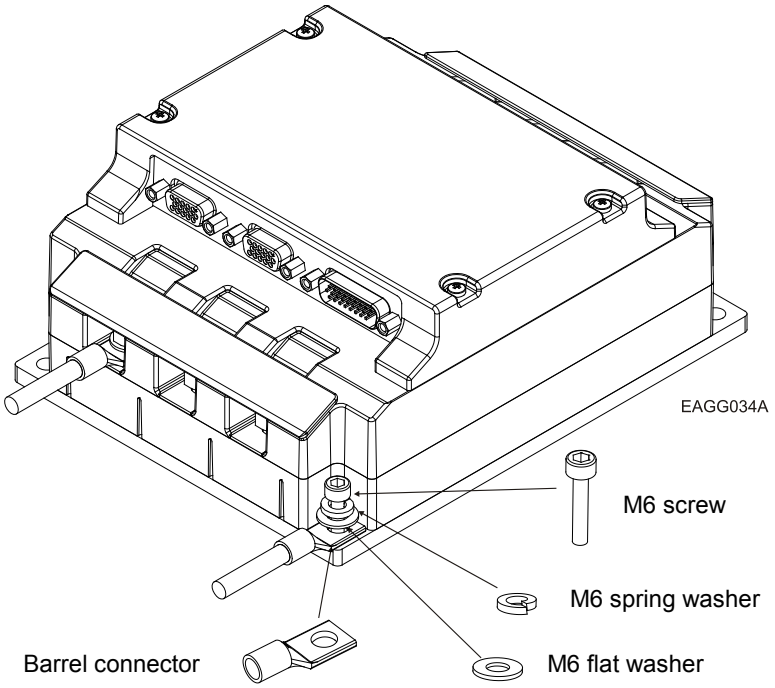


Table 6: Connecting the PE Cables

Step 2: Power and Motor Connection

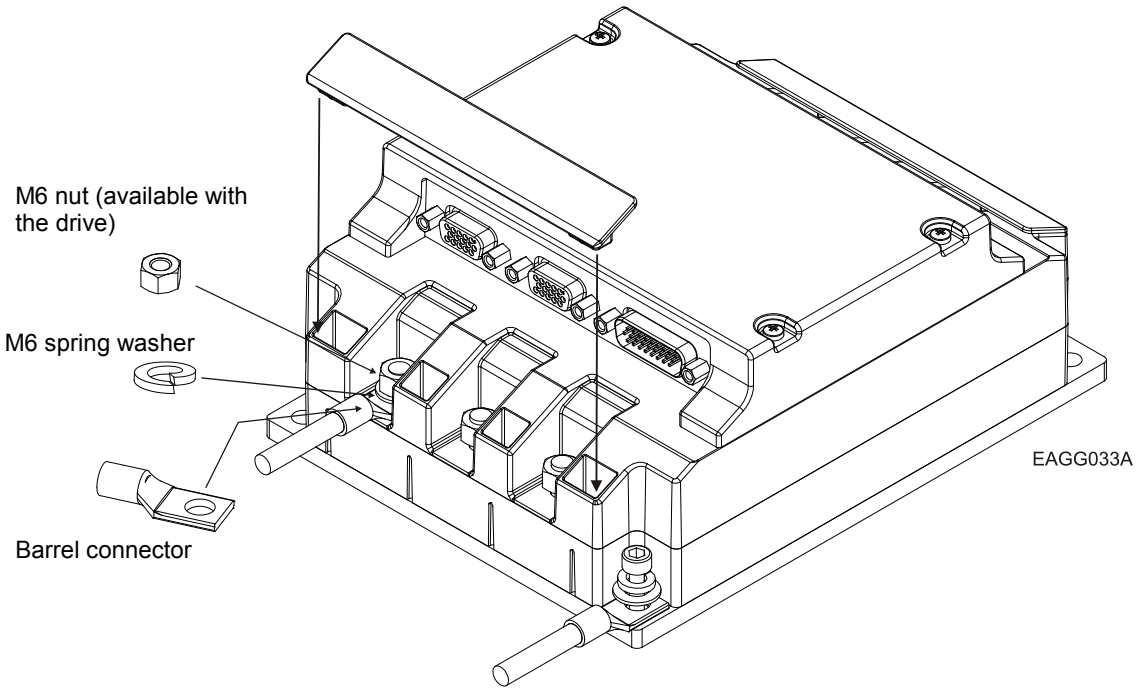


Table 7: Connecting the Main Power and Motor Cables

3.5.3.1. Connecting the Motor Cable

Connect the motor power cable to the M3, M2, M1 and the PE (motor chassis) terminals of the motor connector (see diagram below). The phase connection order is arbitrary because the Composer will establish the proper commutation automatically during setup. However, if you are willing to avoid from tuning each drive separately, and you plan to copy this setup file to other drives – then, the motor-phase order, on all copy drives, must be kept the same as in the first drive.

Notes for connecting the motor cables:

- For best 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.
- Connect the shield of the cable to the closest ground connection at the motor end.
- Connect the shield of the cable to the PE terminal in the drive's motor-connector.
- Be sure that the motor chassis is properly grounded.
- To close the motor cable into the drive, use the barrel connector, M6 spring washer and M6 nut (in the drive). The required torque is 3 to 4 Nm.
- To close the PE wire into the drive, use the barrel connector, M6 flat washer, M6 spring washer and M6 screw to the heat sink. The required torque is 3 to 4 Nm.

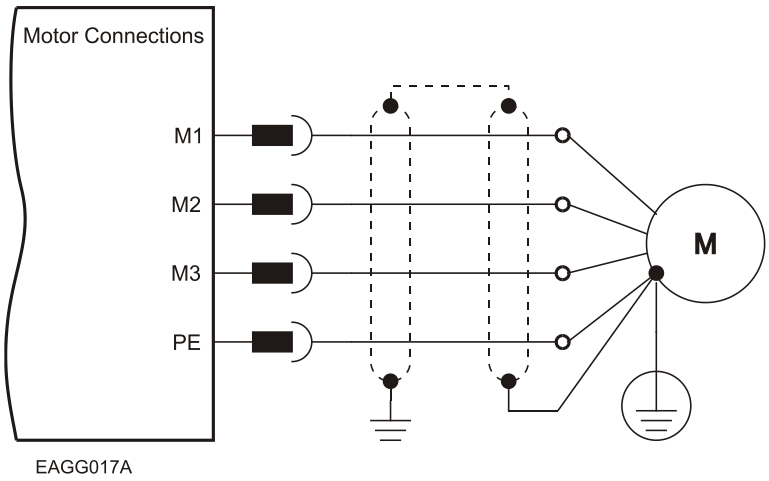


Figure 5: AC Motor Power Connection Diagram

3.5.3.2. Connecting the DC Power

The DC power to the Drum HV (High Voltage) is delivered from a separated rectifying-unit (supplied by the user). Following are topology recommendations, of how to implement a 3x phases and a supply chain.

The Power-stage of the Drum HV (High Voltage) is fully isolated from other sections of the Drum HV (High Voltage), such as the control-stage and the heat sink. This isolation allows the user to connect the common of the control-section to the PE, a connection which significantly contributes to proper functionality, safety and EMI immunity, leading to better performance of the Drum HV (High Voltage).

In addition, this isolation simplifies the requirements of the DC power supply that is used to power the DC bus of the Drum HV (High Voltage), by allowing the operation with a non-isolated DC power source, a direct-to-mains connection, eliminating the need in a bulky and expensive isolation transformer.

However, the Drum HV (High Voltage) can operate from either non-isolated/direct-to-mains DC power supply, or isolated DC power supply / batteries.

When rectifying the AC voltage source, the AC voltage-level must be limited to 270 VAC not to exceed the max 390 VDC in the case of a 400 VDC drive, or limited to 528 VAC not to exceed the max 747 VDC in the case of an 800 VDC drive.

3.5.3.3. Direct-to-Mains Power Source (Non-Isolated Rectifier)

This section relates to the configuration of the power supply and drive, which are connected directly to the mains.

To connect the non-isolated DC power supply:

1. For best immunity, it is highly recommended to use twisted 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.
2. Connect both ends of the cable shield to the closest PE connections.
3. Tie one end to the power supply's PE terminal, and tie the other end either to one of the four mounting screws of the drive's heat sink-PE.
4. To close the power supply cable into the drive, use the barrel connector, M6 spring washer and M6 nut (in the drive). The required torque is 3 to 4 Nm.
5. To close the PE wire into the drive, use the barrel connector, M6 flat washer, M6 spring washer and M6 screw to the heat sink. The required torque is 3 to 4 Nm.

3.5.3.3.a Three-Phase Direct-to-Mains Connection Topology

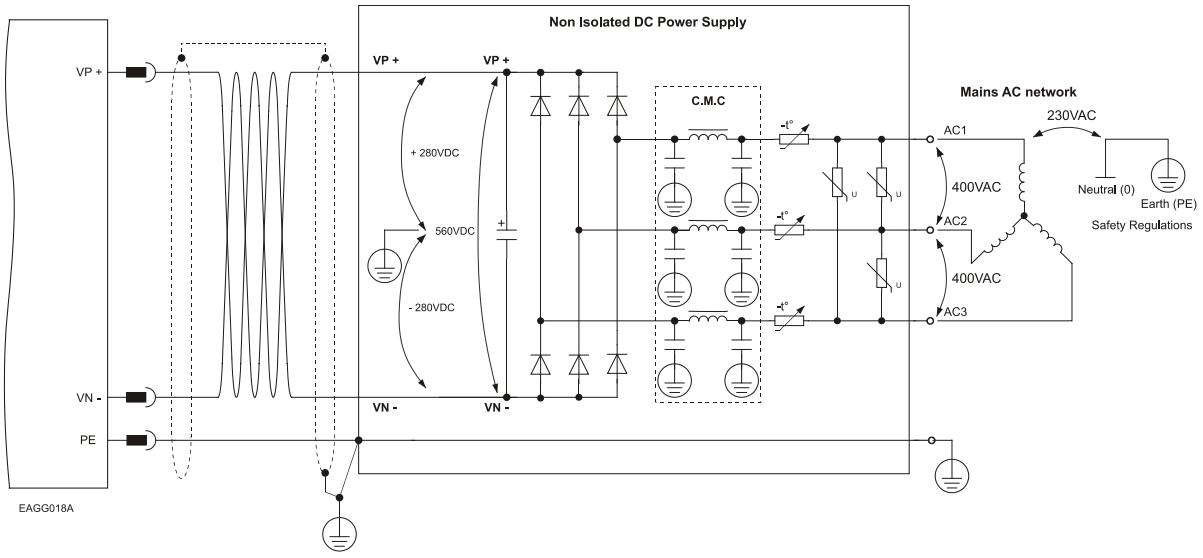


Figure 6: Non-Isolated Three-Phase Connection Topology

Caution:

- **Do not connect VN- to PE. In a direct-to-mains connection the VN- must *not* be connected to the PE.** Connecting the VN- to the PE will cause irreparable damage to the system.
- Be careful and note that in a direct-to-mains connection the Neutral point is *not* the most negative voltage level. It is the mid-point level of the rectified DC bus.

3.5.3.3.b Multiple Connections Topology

In a multi-axis application it is likely that a single power supply can feed several drives in parallel.

This topology is efficient and cost saving, by reducing the number of power supplies and the amount of wiring. Most importantly it utilizes an energy sharing environment among all the drives that share the same DC bus network.

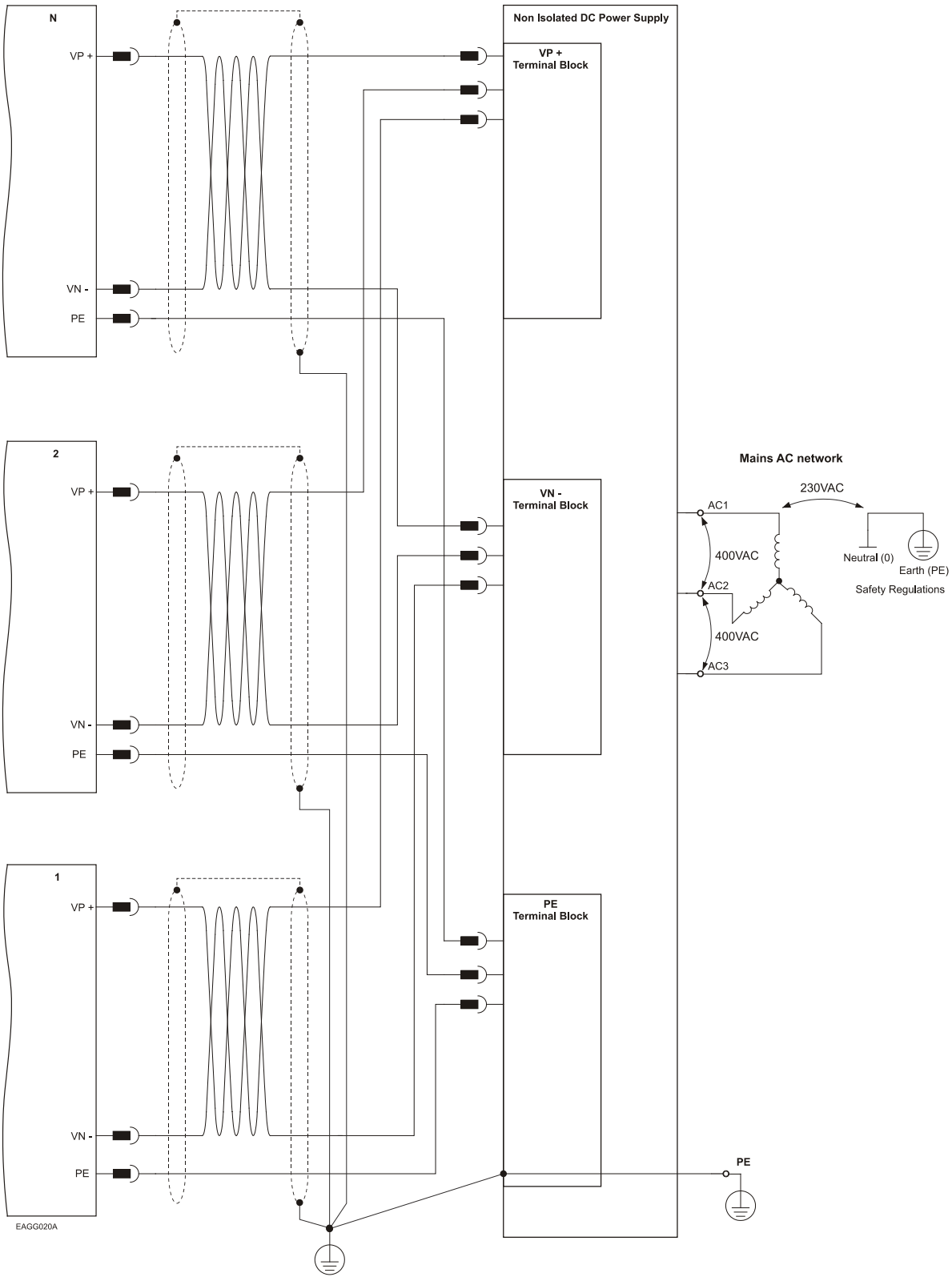


Figure 7: Non-Isolated Three-Phase Multiple Connection Topology

The Power Supply is connected directly to the mains AC line and it feeds more than one drive.

3.5.3.4. Battery Supply

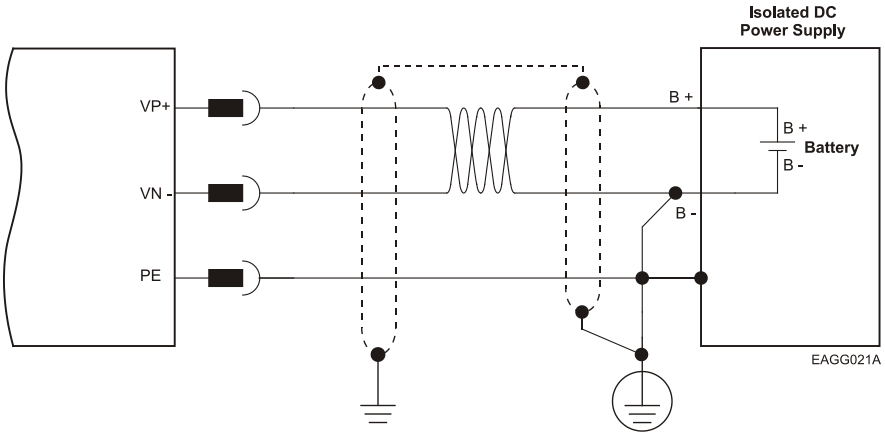


Figure 8: Battery Connection Topology

Caution:
When using batteries, it is recommended to connect the negative pole to the PE.
When doing so, the charger of the battery **must** be isolated from the mains by an isolation transformer.

3.5.4. Connecting the Control and Backup Supply (24 V)

In a non-S type Drum HV (High Voltage) drive (a drive without having the suffix S in its part number), a “smart” control-supply algorithm enables the Drum HV (High Voltage) to operate with the main power supply only, *with no need for an auxiliary supply voltage for supplying the drive's logic section*.

Note that in such model - there is no backup ability at all.

If backup functionality is required to store control parameters in the event of a mains power outage, then an S-model Drum HV (High Voltage) should be used, with an external 24 VDC isolated supply connected to it.

Note that the S type Drum HV (High Voltage) always requires an external 24 VDC power supply, regardless if backup functionality in required or not.

Connect the Aux. 24 VDC power supply as described below.

Notes for 24 VDC backup supply connections:

- Use a 24 AWG twisted pair shielded cable. The shield should have copper braid.
- The source of the 24 VDC backup supply must be isolated, by using an isolation transformer.
- For safety and EMI reasons, connect the return of the 24 VDC backup supply, to the closest ground (PE).
- Connect the cable shield to the closest ground (PE) near the power source.
- Before applying power, first verify the correct polarity of the connection.

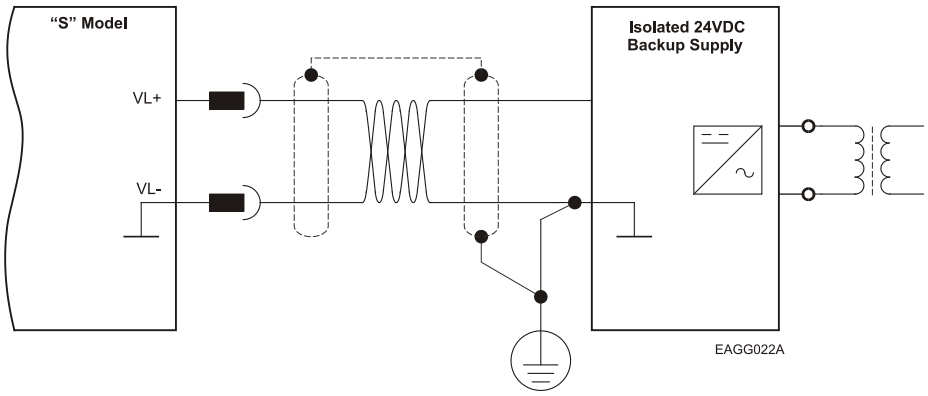


Figure 9: Aux. 24 VDC Backup Supply Connection Diagram

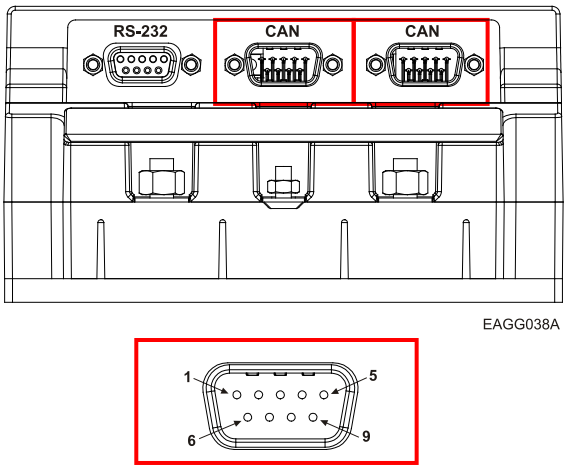
Pin	Signal	Function	Pin Positions
9	VL+	VDC+ backup supply	
8	VL-	Return (common) of the backup supply	
Note: The backup cable can be connected to either CAN connector.			

Table 8: Backup Cable Plug

3.5.5. Feedback and Control Assemblies

The Drum HV (High Voltage) features easy-to-use D-Sub type connections for all Control and Feedback cables. Instructions and diagrams describing how to assemble those cables are presented below.

6. Use 24, 26 or 28 AWG twisted-pair shielded cables (24 AWG cable is recommended). For best results, the shield should have aluminum foil covered by copper braid.
7. Use only a D-Sub connector with a **metal housing**.
8. Ideally, solder the drain wire to the connector body as shown in Figure 10.
   However, the shield may also be attached without soldering, as long as the braid shield is in tight contact with the metal housing of the D-type connector.
9. On the motor side connections, ground the shield to the motor chassis.
10. On controller side connections, follow the controller manufacturer's recommendations concerning the shield.

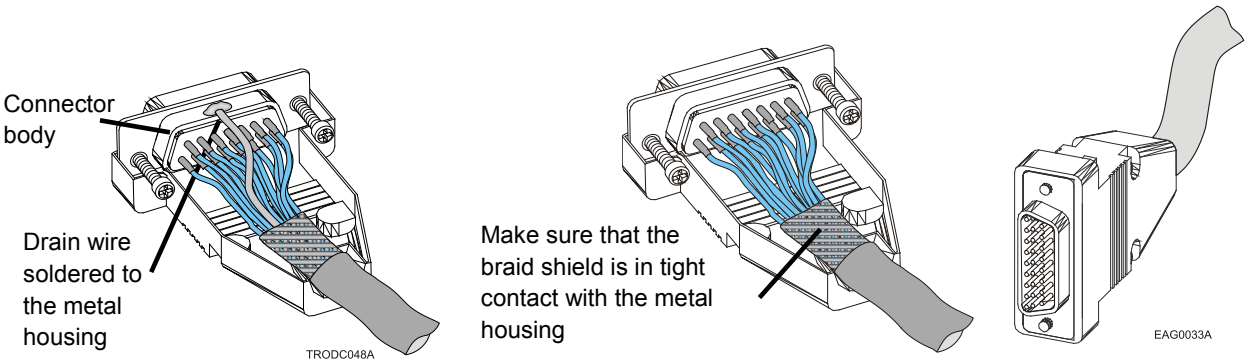


Figure 10: Feedback and Control Cable Assemblies

Note: All D-Sub type connectors, used with the Drum HV (High Voltage), should be assembled in this way.

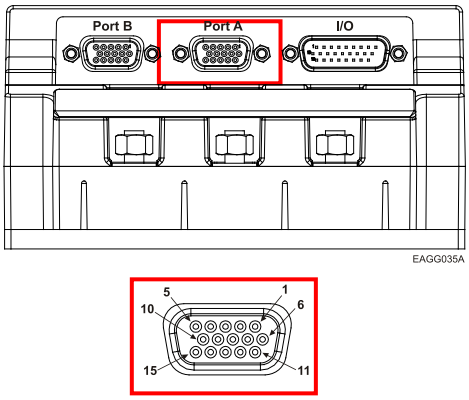
3.5.6. Main Feedback Cable (FEEDBACK A)

The main feedback cable is used to transfer feedback data from the motor to the drive.

The Drum HV (High Voltage) 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
- Interpolated Analog (Sine/Cosine) encoder (option)
- Resolver (option)
- Tachometer (option)
- Potentiometer (option)
- Absolute Encoder

FEEDBACK A of the Drum HV (High Voltage) has a high density 15-pin D-Sub socket. Connect the Main Feedback cable from the motor to FEEDBACK A using a 15-pin, D-Sub plug with a metal housing. When assembling the Main Feedback cable, follow the instructions in Section 3.5.5 (Feedback and Control Assemblies).



	Incremental Encoder		Interpolated Analog Encoder		Resolver		Tachometer and Potentiometer	
	DRU-AXXX/YYY_		DRU-AXXX/YYYI		DRU-AXXX/YYYR		DRU-AXXX/YYYT	
Pin	Signal	Function	Signal	Function	Signal	Function	Signal	Function
1	CHA	Channel A	A+	Sine A	S1	Sine A	Tac 1+	Tacho Input 1 Pos. (20 V max)
2	CHA-	Channel A complement	A-	Sine A complement	S3	Sine A complement	Tac 1-	Tacho Input 1 Neg. (20 V max)
3	CHB	Channel B	B+	Cosine B	S2	Cosine B	Tac 2+	Tacho Input 2 Pos. (50 V max)
4	CHB-	Channel B complement	B-	Cosine B complement	S4	Cosine B complement	Tac 2-	Tacho Input 2 Neg. (50 V max)
5	INDEX	Index	R+	Reference	R1	Vref f=1/TS, 50 mA Max.	POT	Potentiometer Input
6	CLK+	CLOCK	CLK+	CLOCK	CLK+	CLOCK	CLK+	CLOCK
7	CLK-	CLOCK complement	CLK-	CLOCK complement	CLK-	CLOCK complement	CLK-	CLOCK complement
8	+5V	Encoder/Hall +5V supply	+5V	Encoder/Hall +5V supply	+5V	Encoder/Hall +5V supply	+5V	Encoder/Hall +5V supply
9	SUPRET	Supply return	SUPRET	Supply return	SUPRET	Supply return	SUPRET	Supply return
10	INDEX-	Index complement	R-	Reference complement	R2	Vref complement f= 1/TS, 50 mA Maximum	NC	-
11	DATA+	DATA	DATA+	DATA	DATA+	DATA	DATA+	DATA
12	DATA-	Data complement	DATA-	Data complement	DATA-	Data complement	DATA-	Data complement
13	HC	Hall sensor C input	HC	Hall sensor C input	NC	-	HC	Hall sensor C input
14	HB	Hall sensor B input	HB	Hall sensor B input	NC	-	HB	Hall sensor B input
15	HA	Hall sensor A input	HA	Hall sensor A input	NC	-	HA	Hall sensor A input

Table 9: Main Feedback Cable Pin Assignments (Part A)

Absolute Encoders			
	DRU-AXXX/YYYQ		
Pin	**Signal**	**Heidenhain**	**Stegmann**
1	A+	Sine A	Sine A complement
2	A-	Sine A complement	Sine A
3	B+	Cosine B	Cosine B
4	B-	Cosine B complement	Cosine B complement
5	INDEX	–	–
6	CLK+	CLOCK	–
7	CLK-	CLOCK complement	–
8	+5V	Encoder/Hall +5V supply	Halls supply +5V
9	SUPRET	Supply return	Supply return
10	INDEX-	–	–
11	DATA+	DATA	DATA
12	DATA-	Data complement	Data complement
13	HC	Hall C	Hall C
14	HB	Hall B	Hall B
15	HA	Hall A	Hall A

Table 10: Main Feedback Cable Pin Assignments (Part B)

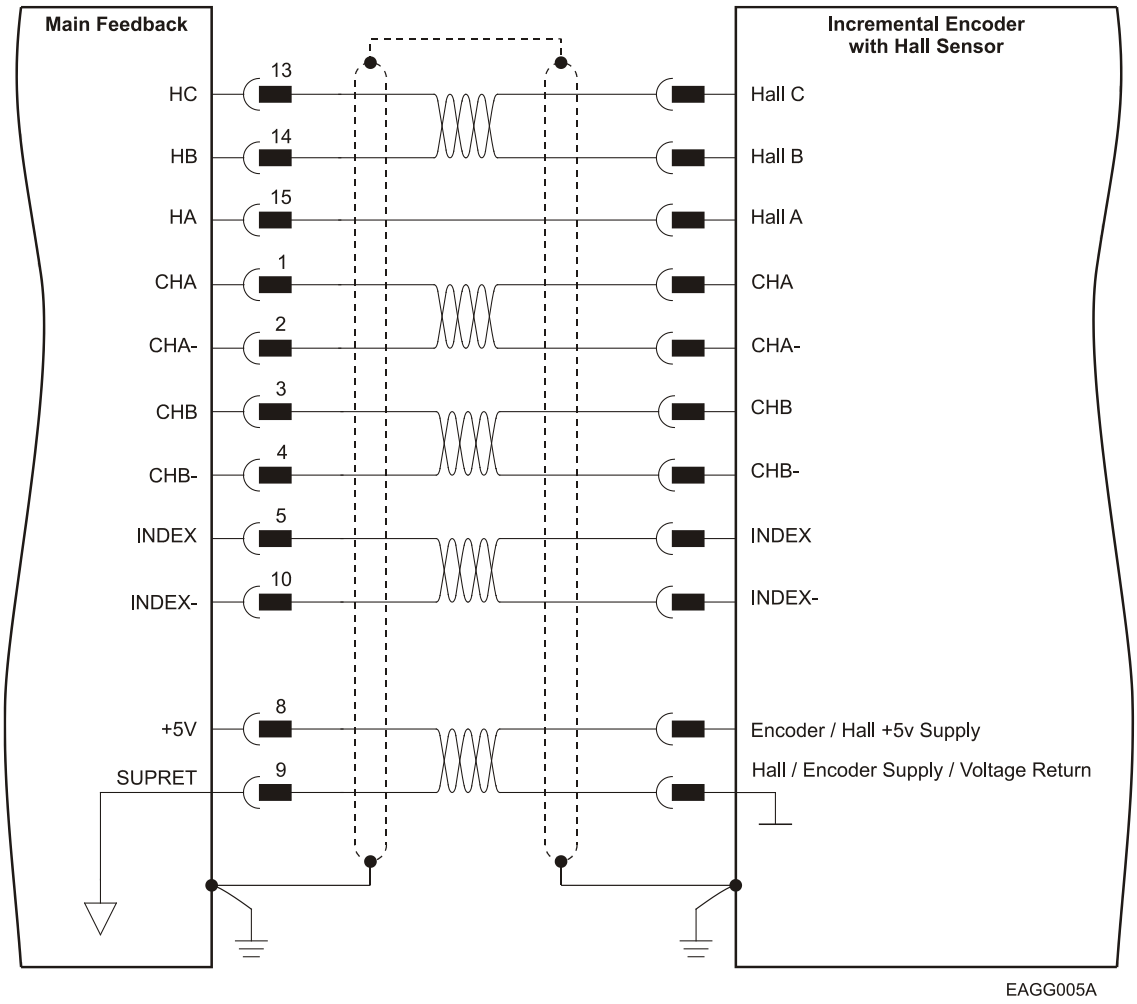


Figure 11: Main Feedback – Incremental Encoder Connection Diagram

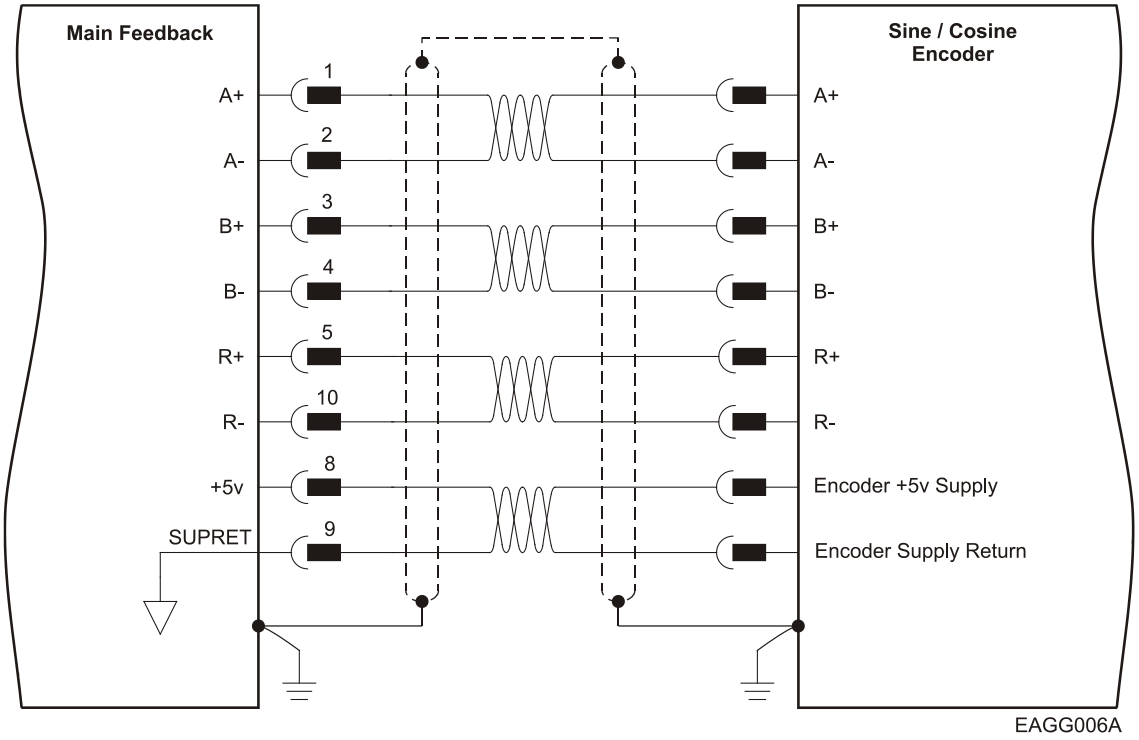


Figure 12: Main Feedback – Interpolated Analog (Sine/Cosine) Encoder Connection Diagram

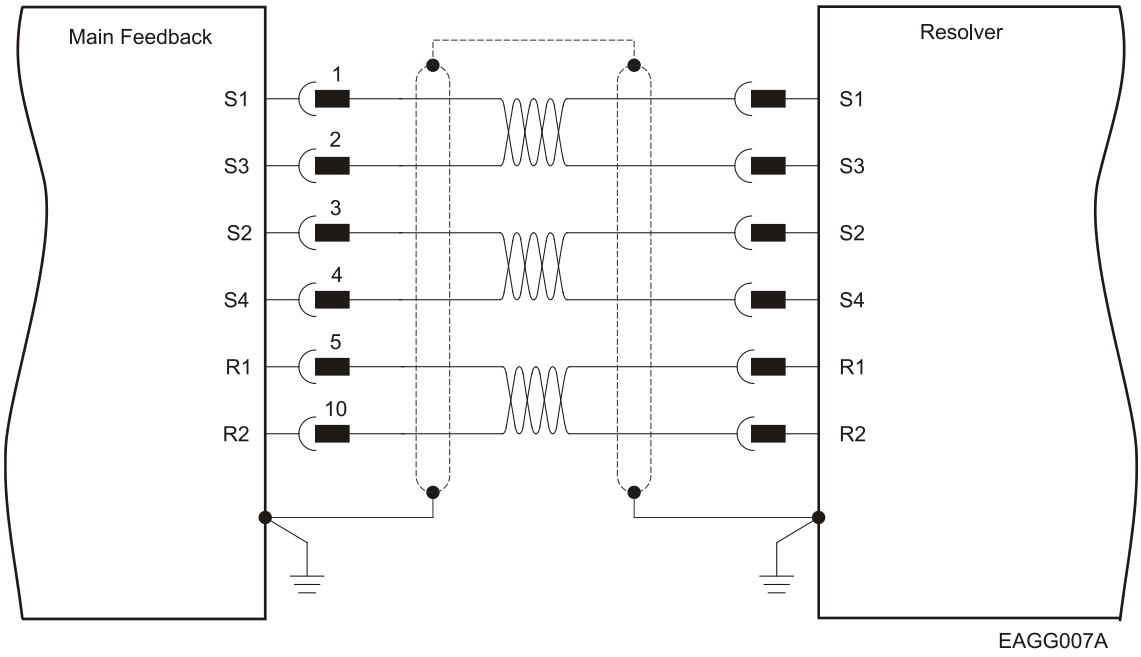


Figure 13: Main Feedback – Resolver Connection Diagram

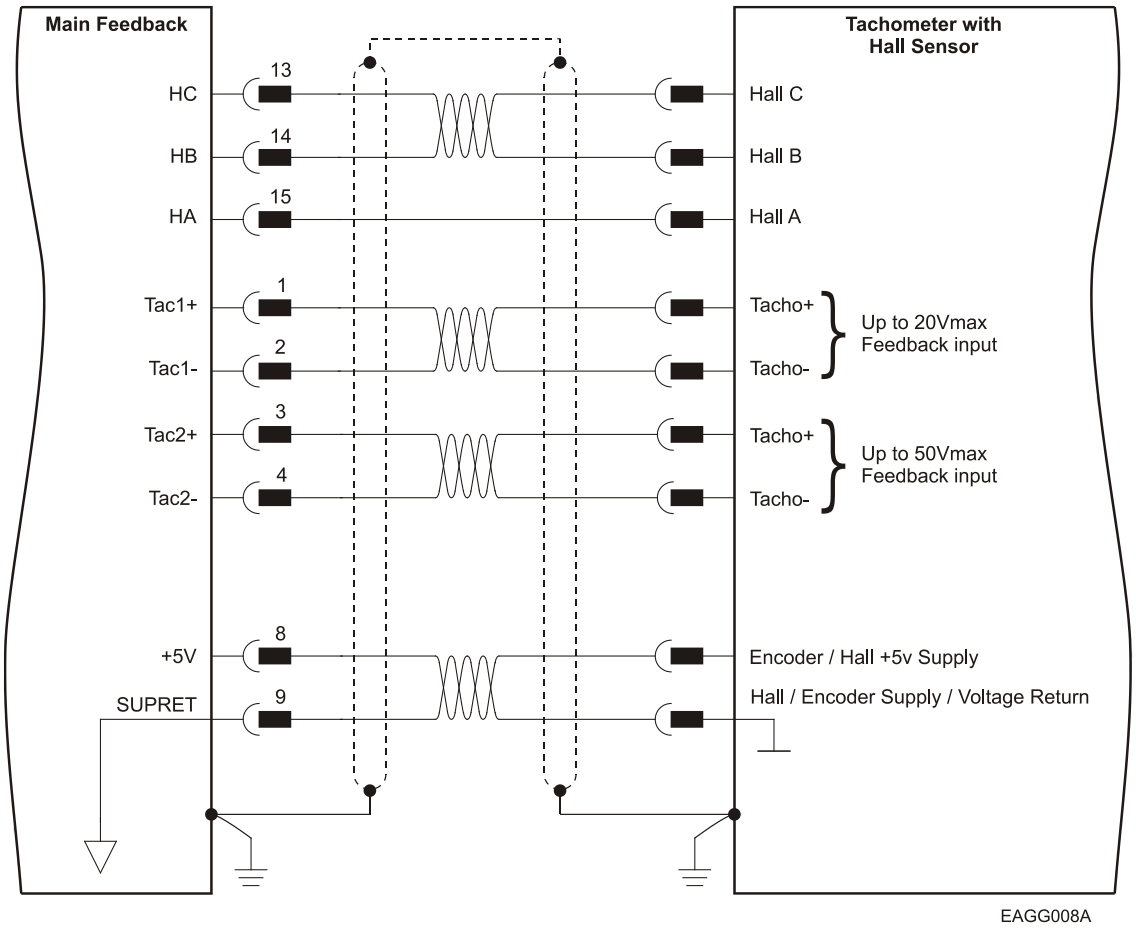


Figure 14: Main Feedback – Tachometer Feedback with Digital Hall Sensor Connection Diagram for Brushless Motors

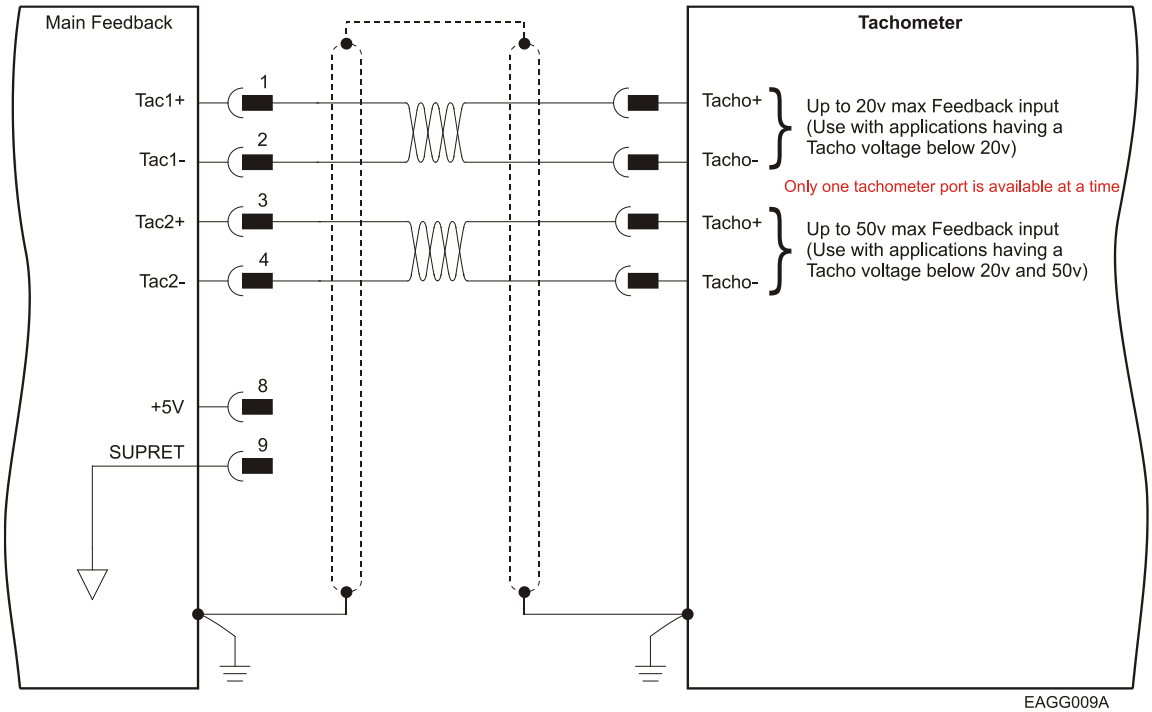


Figure 15: Main Feedback – Tachometer Feedback Connection Diagram for Brush Motors

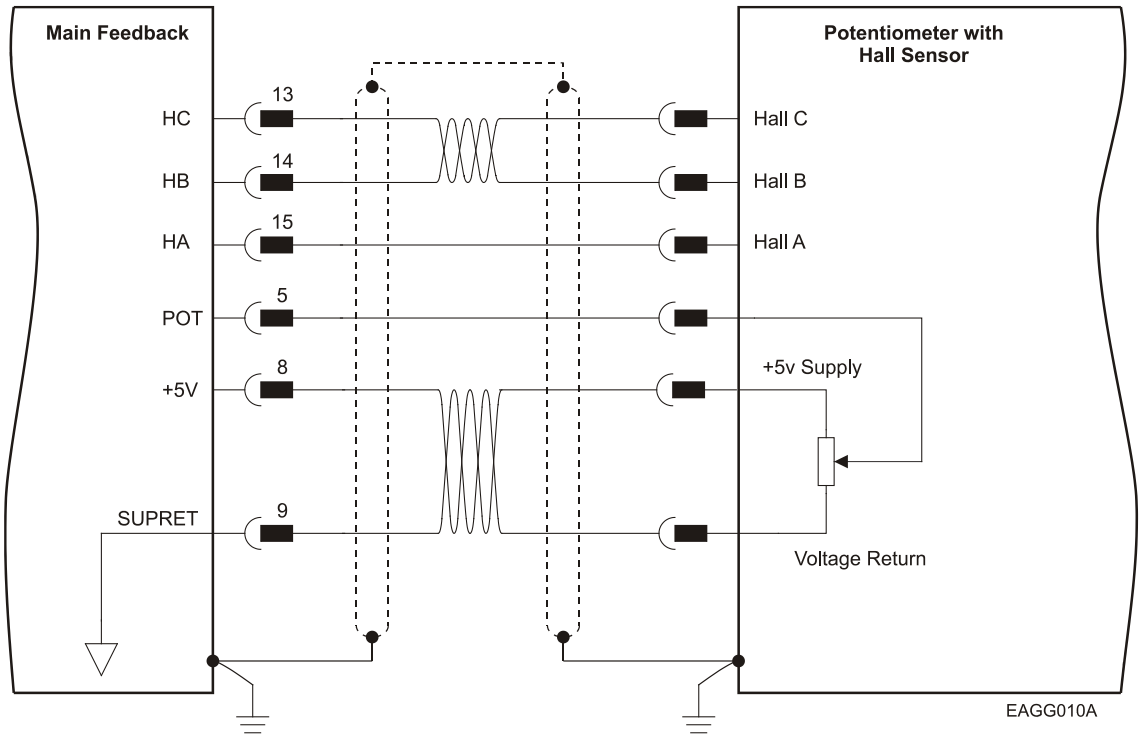


Figure 16: Main Feedback – Potentiometer Feedback with Digital Hall Sensor Connection Diagram for Brushless Motors

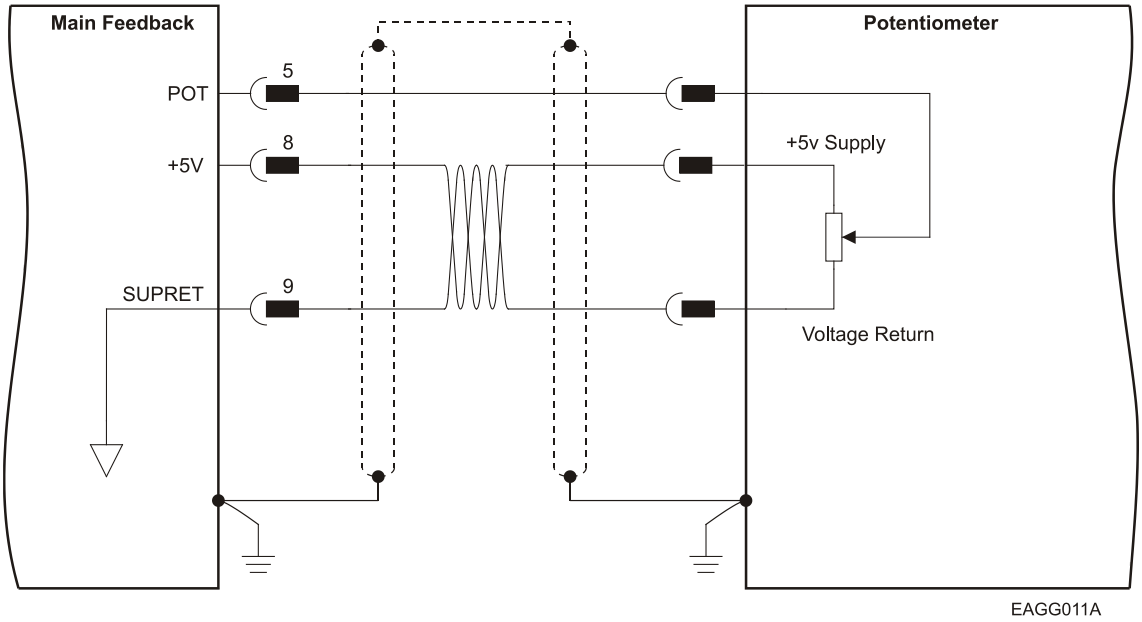


Figure 17: Main Feedback –
Potentiometer Feedback Connection Diagram for Brush Motors and Voice Coils

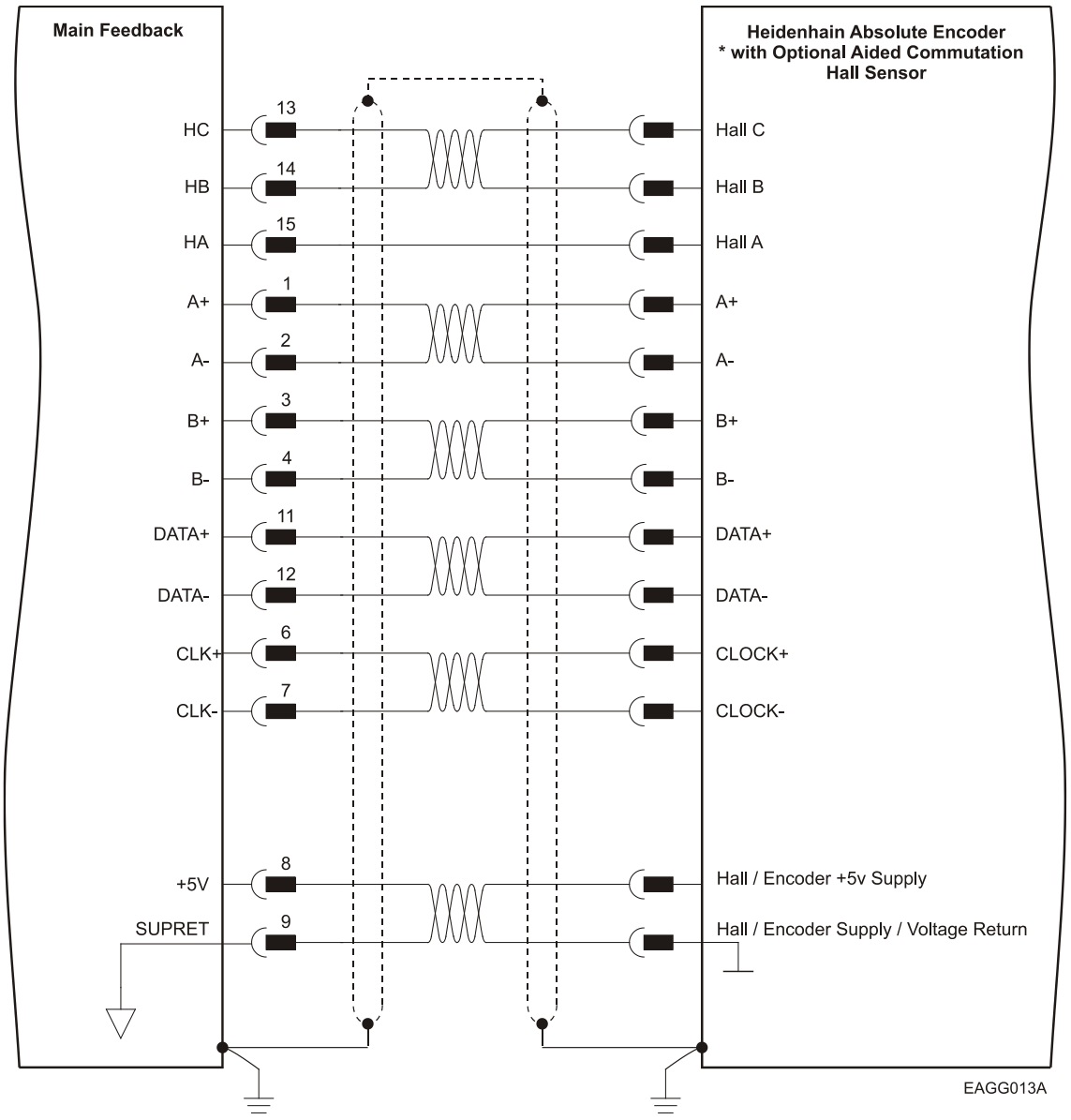


Figure 18: Main Feedback – Heidenhain Absolute Encoder Feedback Connection Diagram

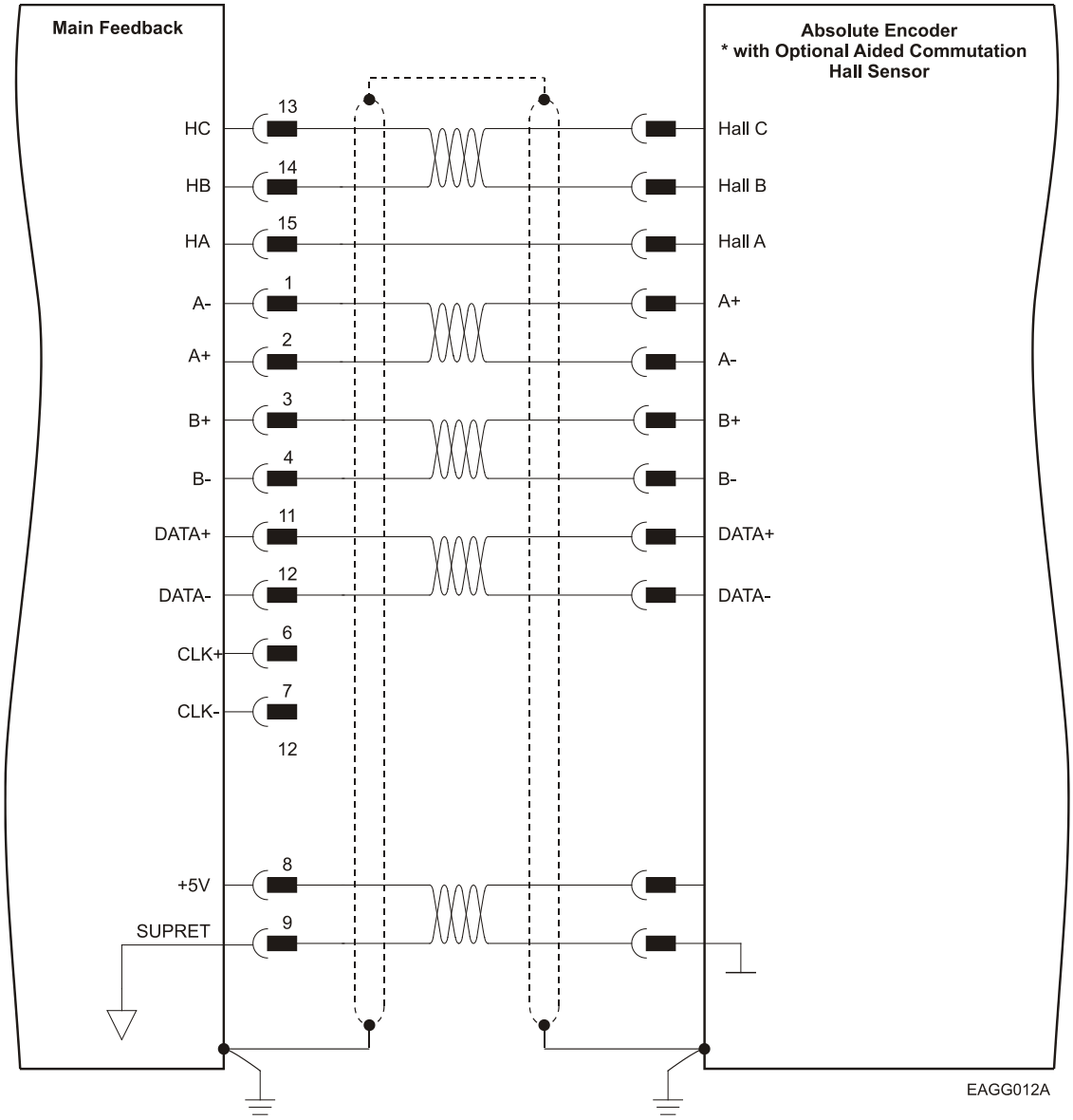
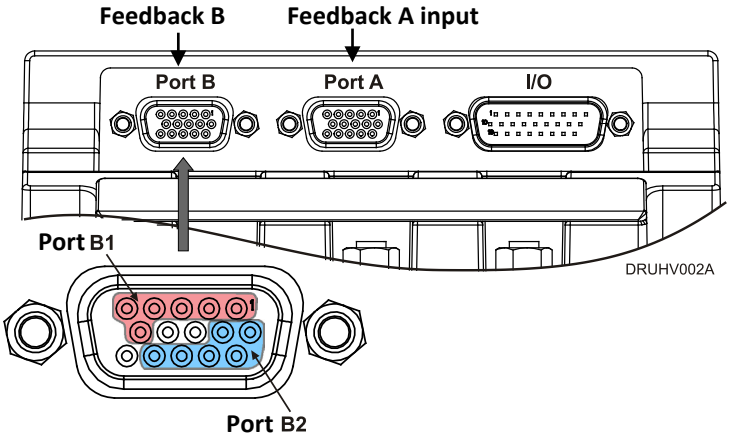


Figure 19: Main Feedback – Stegmann Absolute Encoder Feedback Connection Diagram (NRZ types, e.g., Panasonic/ Mitutoyo/etc.)

3.5.7. Main and Auxiliary Feedback Combinations

The Main Feedback is always used in motion control devices, whereas the Auxiliary Feedback is often, but not always used. The Auxiliary Feedback connector on the Drum HV (High Voltage), Feedback B, has two ports, Port B1 and Port B2. When used in combination with the Main Feedback port, Feedback A, these ports can be set, by the software, as follows:



Feedback A	Feedback B Ports B1 and B2		
Software Setting	**YA[4] = 4**	**YA[4] = 2**	**YA[4] = 0**
Incremental Encoder Input	★ **Feedback A input:** Incremental Encoder **Port B1 output:** Differential and Buffered Main Encoder Signal **Port B2 output:** Same as B1	**Feedback A input:** Incremental Encoder or Analog Encoder or Resolver or Tachometer or Potentiometer **Port B1 output:** Differential or Single-Ended Auxiliary Encoder **Port B2 output:** Differential and Buffered Auxiliary Encoder Signal	**Feedback A input:** Analog Encoder **Port B1 output:** Differential or Single-Ended Auxiliary Incremental Encoder **Port B2 output:** Differential and Buffered Auxiliary Encoder Signal
Interpolated Analog (sin/cos) Encoder Input	★ **Feedback A input:** Analog Encoder **Port B1 output:** Analog Encoder Position Data Emulated in Incremental Encoder Format (signals are quadrature, differential and buffered) **Port B2 output:** Same as B1		
Resolver Input	✷ **Feedback A input:** Resolver **Port B1 output:** Resolver Position Data Emulated in Incremental Encoder Format (signals are quadrature, differential and buffered) **Port B2 output:** Same as B1		
Tachometer Input	✱ **Feedback A input:** Tachometer **Port B1 output:** Tachometer Position Data Emulated in Incremental Encoder Format (signals are quadrature, differential and buffered) **Port B2 output:** Differential and Buffered Auxiliary Encoder Signal		

Feedback A	Feedback B Ports B1 and B2		
Software Setting	**YA[4] = 4**	**YA[4] = 2**	**YA[4] = 0**
Potentio-meter Input	✧ **Feedback A input:** Potentiometer **Port B1 output:** Potentiometer Position Data Emulated in Incremental Encoder Format (signals are quadrature, differential and buffered) **Port B2 output:** Same as B1	**Feedback A input:** Incremental Encoder or Analog Encoder or Resolver or Tachometer or Potentiometer **Port B1 output:** Differential or Single-Ended Auxiliary Encoder **Port B2 output:** Differential Buffered Auxiliary Encoder Signal	**Feedback A input:** Incremental Encoder or Analog Encoder or Resolver or Tachometer or Potentiometer **Port B1 output:** Differential or Single-Ended Pulse and Direction Commands **Port B2 output:** Differential Buffered Pulse and Direction Signal
Typical Applications	★ 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. ✧ Tachometer applications where velocity data is required in the Encoder's quadrature format. ✻ Absolute Encoder applications where position data is required in the Encoder's quadrature format.	Any application where two feedbacks are used by the drive. Port B1 serves as an input for the auxiliary incremental encoder (differential or single-ended). Port B2 is used to output differential buffered Auxiliary Incremental Encoder signals. For applications such as Follower, ECAM, or Dual Loop.	Port B1 serves as an input for Pulse & Direction commands (differential or single-ended). Port B2 is used to output differential buffered Pulse & Direction signals.

3.5.8. Auxiliary Feedback (FEEDBACK B)

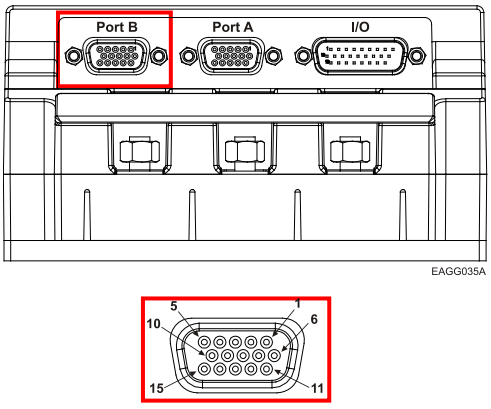
When using one of the auxiliary feedback options, the relevant functionality of the "Aux. feedback" ports are software selected for that option. Refer to the *SimplIQ Command Reference Manual* for detailed information about FEEDBACK B setup.

3.5.8.1. Main Encoder Buffered Outputs or Emulated Encoder Outputs Option on FEEDBACK B (YA[4]=4)

Through FEEDBACK B (Ports B1 and B2) the Drum HV (High Voltage) can provide **two simultaneous buffered main, or emulated, encoder signals** to other controllers or drives. This option can be used when:

- The Drum HV (High Voltage) is used as a current amplifier to provide position data to the position controller.
- The Drum HV (High Voltage) is used in velocity mode, to provide position data to the position controller.
- The Drum HV (High Voltage) is used as a master in Follower or ECAM mode.

Below are the signals on the Auxiliary Feedback ports when set up to run as a buffered outputs or emulated outputs of the main encoder (on FEEDBACK A):



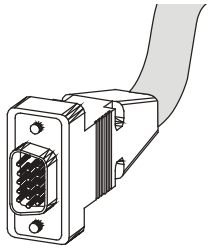
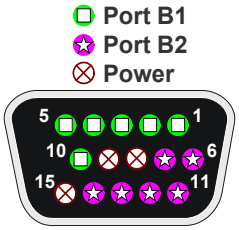
Port	Pin	Signal	Function	Pin Positions
B1	1	CHA	Auxiliary channel A high *output*	 **15-Pin High Density D-Sub Plug**
B1	2	CHA-	Auxiliary channel A low *output*	
B1	3	CHB	Auxiliary channel B high *output*	
B1	4	CHB-	Auxiliary channel B low *output*	
B1	5	INDEX	Auxiliary Index high *output*	
B2	6	CHAO	Buffered channel A output	
B2	7	CHAO-	Buffered channel A complement output	
PWR	8	+5V	Encoder supply voltage	
PWR	9	SUPRET	Encoder supply voltage return	 **15-Pin High Density D-Sub Socket**
B1	10	INDEX-	Auxiliary Index low *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	SUPRET	Supply return	

Table 11: Main Encoder Buffered Outputs or Emulated Encoder Outputs on FEEDBACK B - Pin Assignments

AUX. FEEDBACK on the Drum HV (High Voltage) has a 15-pin high density D-Sub socket. Connect the Auxiliary Feedback cable, from the controller or other device, to AUX. FEEDBACK using a 15-pin, high density D-Sub plug with a metal housing. When assembling the Auxiliary Feedback cable, follow the instructions in Section 3.5.5 (Feedback and Control Assemblies).

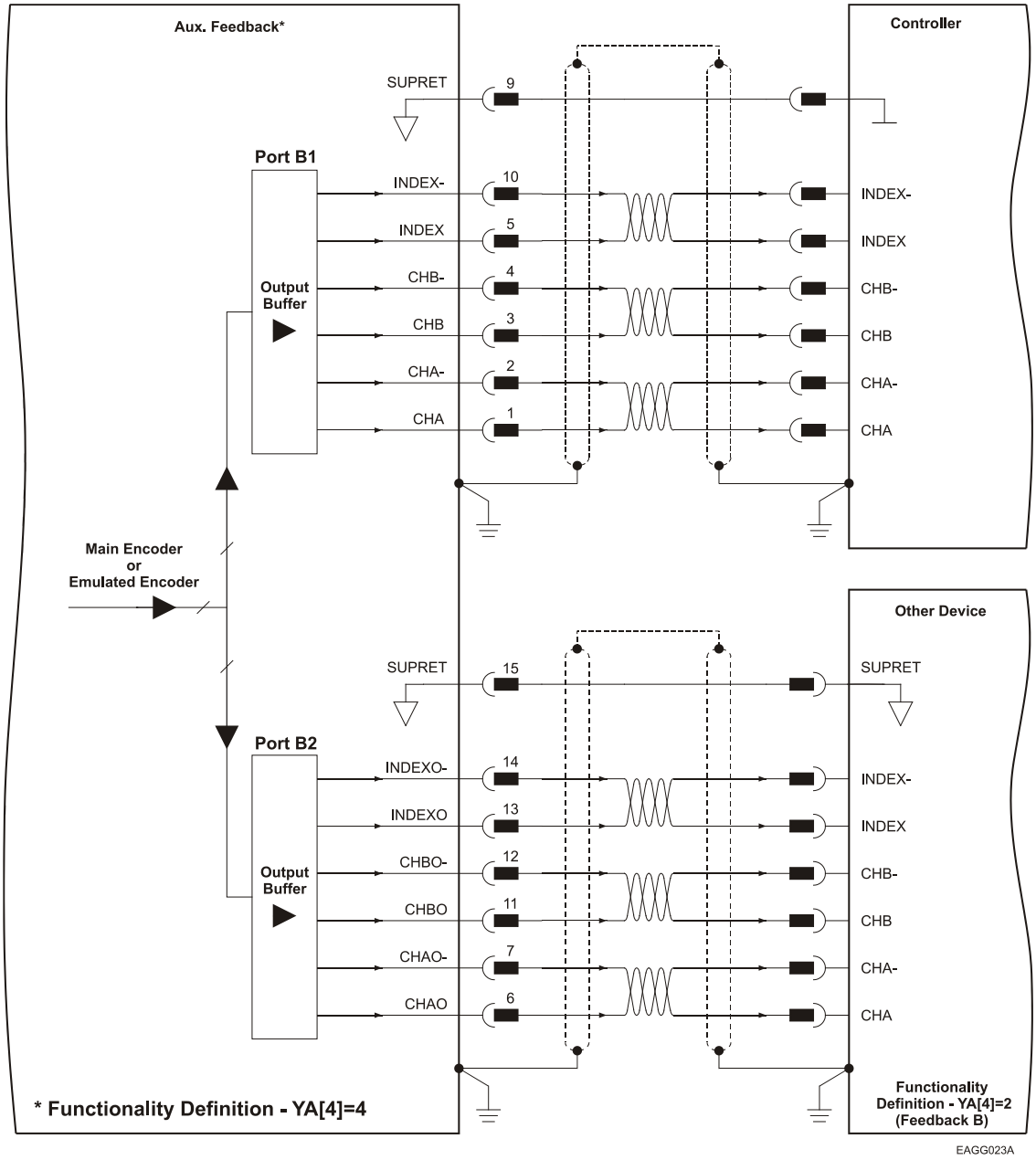


Figure 20: Main Encoder Buffered Output or Emulated Encoder Output on AUX. FEEDBACK - Connection Diagram

3.5.8.2. Differential Auxiliary Encoder Input Option on FEEDBACK B (YA[4]=2)

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

Below are the signals on the Auxiliary Feedback port when set up to run as a differential auxiliary encoder input:

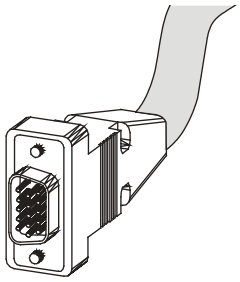
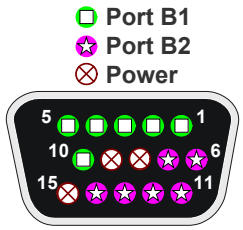
Port	Pin	Signal	Function	Pin Positions
B1	1	CHA	Auxiliary channel A high *input*	 **15-Pin High Density D-Sub Plug**
B1	2	CHA-	Auxiliary channel A low *input*	
B1	3	CHB	Auxiliary channel B high *input*	
B1	4	CHB-	Auxiliary channel B low *input*	
B1	5	INDEX	Auxiliary Index high *input*	
B2	6	CHAO	Buffered channel A output	
B2	7	CHAO-	Buffered channel A complement output	
PWR	8	+5V	Encoder supply voltage	
PWR	9	SUPRET	Encoder supply voltage return	 **15-Pin High Density D-Sub Socket**
B1	10	INDEX-	Auxiliary Index low *input*	
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	SUPRET	Supply return	

Table 12: Differential Auxiliary Encoder Input Option on AUX. FEEDBACK Pin Assignments

AUX. FEEDBACK on the Drum HV (High Voltage) has a 15-pin high density D-Sub socket. Connect the Auxiliary Feedback cable from the feedback device to AUX. FEEDBACK using a 15-pin, high density D-Sub plug with a metal housing. When assembling the Auxiliary Feedback cable, follow the instructions in Section 3.5.5 (Feedback and Control Assemblies).

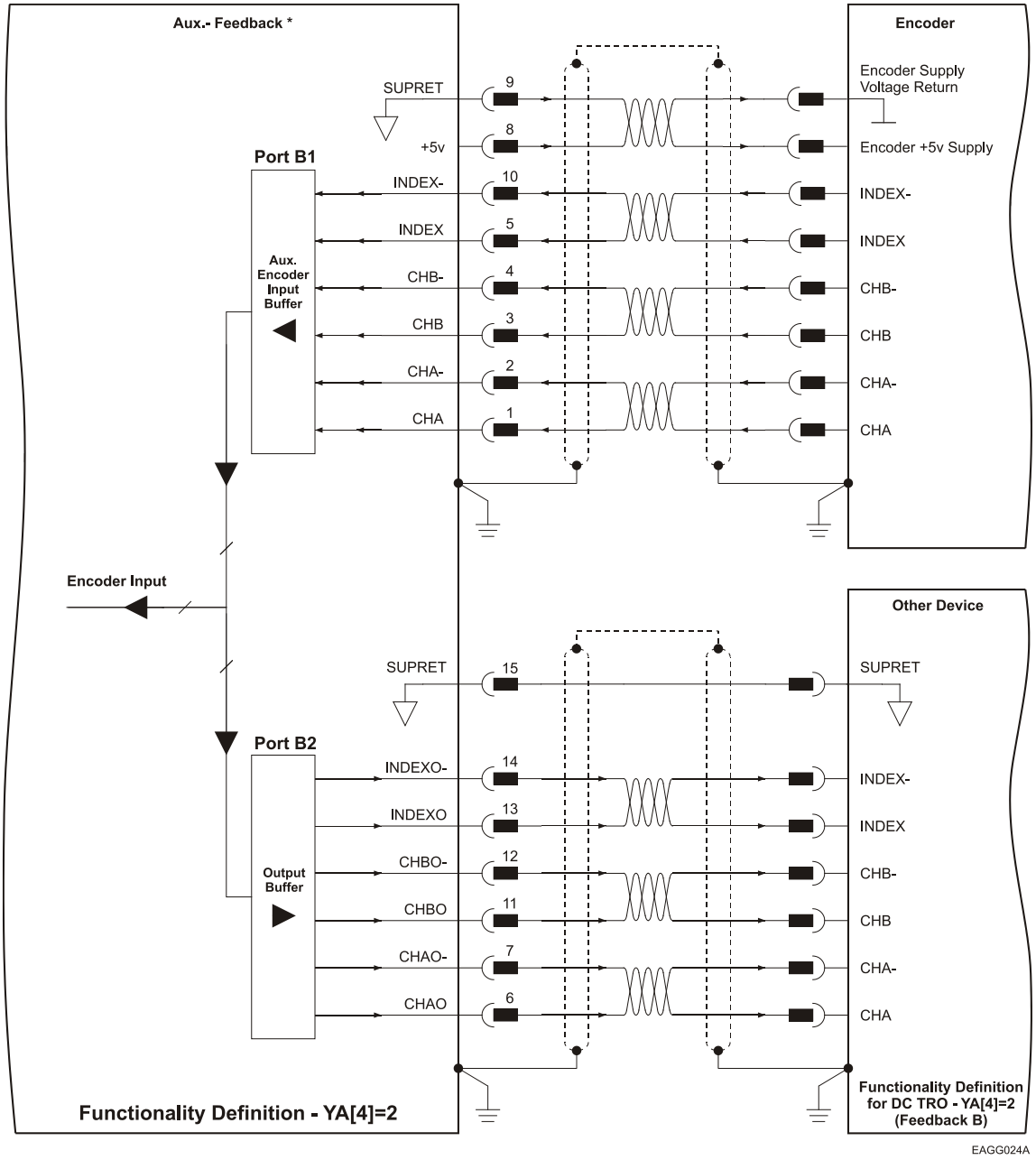


Figure 21: Differential Auxiliary Encoder Input Option on AUX. FEEDBACK - Connection Diagram

3.5.8.3. Single-Ended Auxiliary Input Option on FEEDBACK B (YA[4]=2)

The Drum HV (High Voltage) 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** for the next slave axis in Follower or ECAM mode.

Below are the signals on the Auxiliary Feedback ports when set up to run as a single-ended auxiliary input:

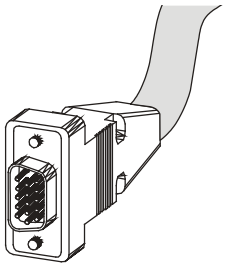
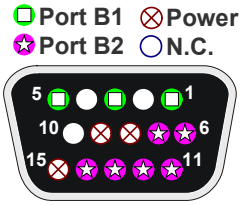
Port	Pin	Signal	Function	Pin Positions
B1	1	CHA	Auxiliary channel A high input	 **15-Pin High Density D-Sub Plug**
	2	NC	Do not connect this pin	
B1	3	CHB	Auxiliary channel B high input	
	4	NC	Do not connect this pin	
B1	5	INDEX	Auxiliary Index high input	
B2	6	CHAO	Channel A output	
B2	7	CHAO-	Channel A complement output	
PWR	8	+5V	Encoder supply voltage	
PWR	9	SUPRET	Encoder supply voltage return	 **15-Pin High Density D-Sub Socket**
	10	NC	Do not connect this pin	
B2	11	CHBO	Channel B output	
B2	12	CHBO-	Channel B complement output	
B2	13	INDEXO	Index output	
B2	14	INDEXO-	Index complement output	
PWR	15	SUPRET	Supply return	

Table 13: Single-Ended Auxiliary Encoder Option on FEEDBACK B - Pin Assignments

AUX. FEEDBACK on the Drum HV (High Voltage) has a 15-pin high density D-Sub socket. Connect the Auxiliary Feedback cable from the feedback device to AUX. FEEDBACK using a 15-pin, high density D-Sub plug with a metal housing. When assembling the Auxiliary Feedback cable, follow the instructions in Section 3.5.5 (Feedback and Control Assemblies).

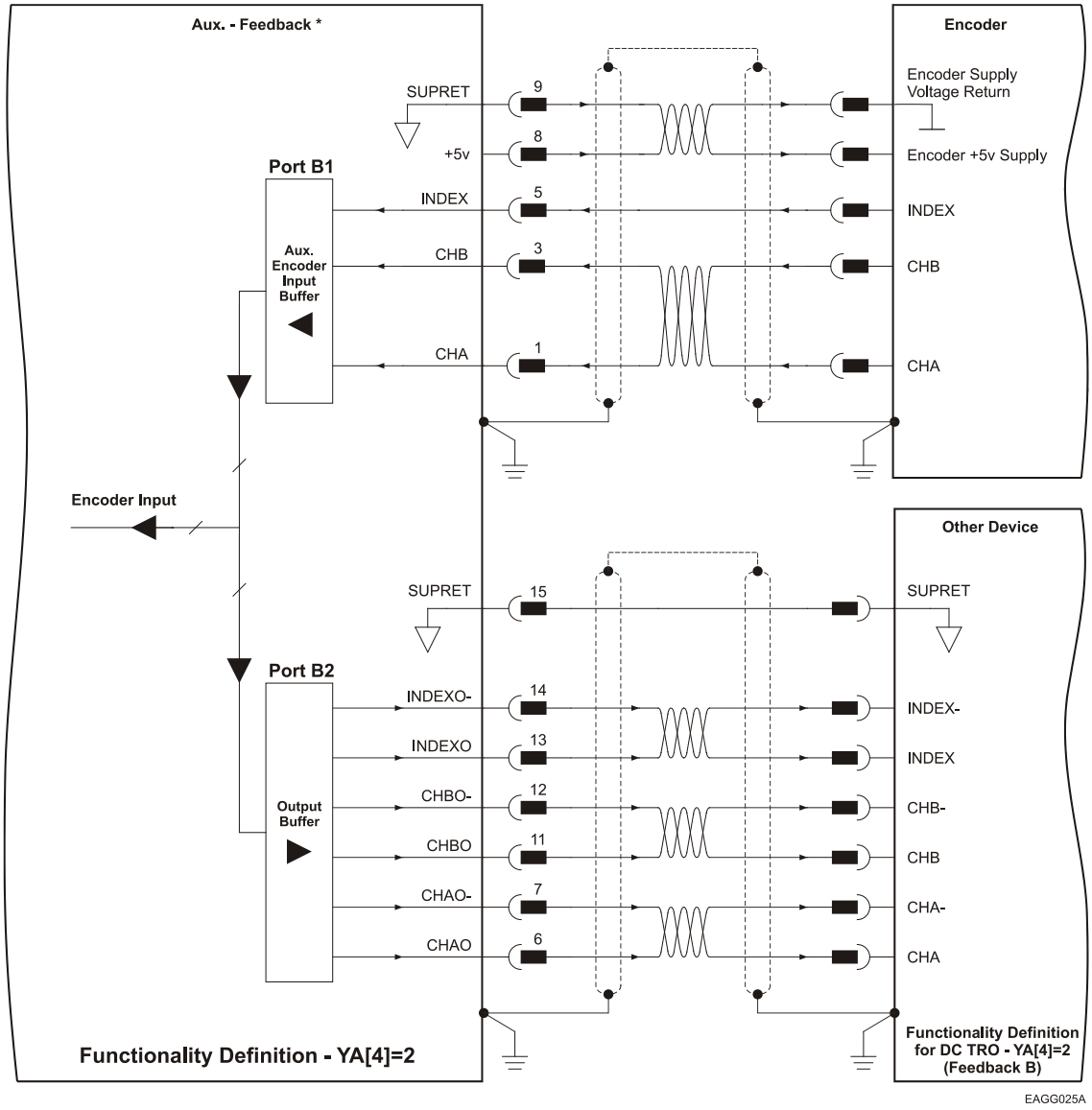


Figure 22: Single-Ended Auxiliary Input Option on AUX. FEEDBACK - Connection Diagram

3.5.8.4. Pulse-and-Direction Input Option on FEEDBACK B (YA[4]=0)

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

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

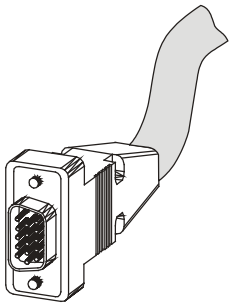
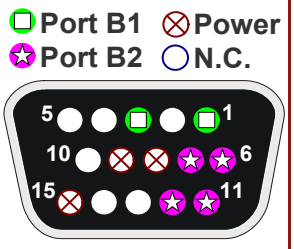
Port	Pin	Signal	Function	Pin Positions
B1	1	PULS/CHA	Pulse/Auxiliary channel A high input	 15-Pin D-Sub Plug
	2	NC	Do not connect this pin	
B1	3	DIR/CHB	Direction/Auxiliary channel B high input	
	4	NC	Do not connect this pin	
	5	NC	Do not connect this pin	
B2	6	CHAO	Channel A output	
B2	7	CHAO-	Channel A complement output	
PWR	8	+5V	Encoder supply voltage	
PWR	9	SUPRET	Encoder supply voltage return	 15-Pin D-Sub Socket
	10	NC	Do not connect this pin	
B2	11	CHBO	Channel B output.	
B2	12	CHBO-	Channel B complement output	
	13	NC	Do not connect this pin	
	14	NC	Do not connect this pin	
PWR	15	SUPRET	Supply return	

Table 14: Pulse-and-Direction Auxiliary Encoder Pin Assignment on AUX. FEEDBACK

AUX. FEEDBACK on the Drum HV (High Voltage) has a 15-pin high density D-Sub socket. Connect the Auxiliary Feedback cable from the Pulse and Direction Controller to AUX. FEEDBACK using a 15-pin, high density D-Sub plug with a metal housing. When assembling the Auxiliary Feedback cable, follow the instructions in Section 3.5.5 (Feedback and Control Assemblies).

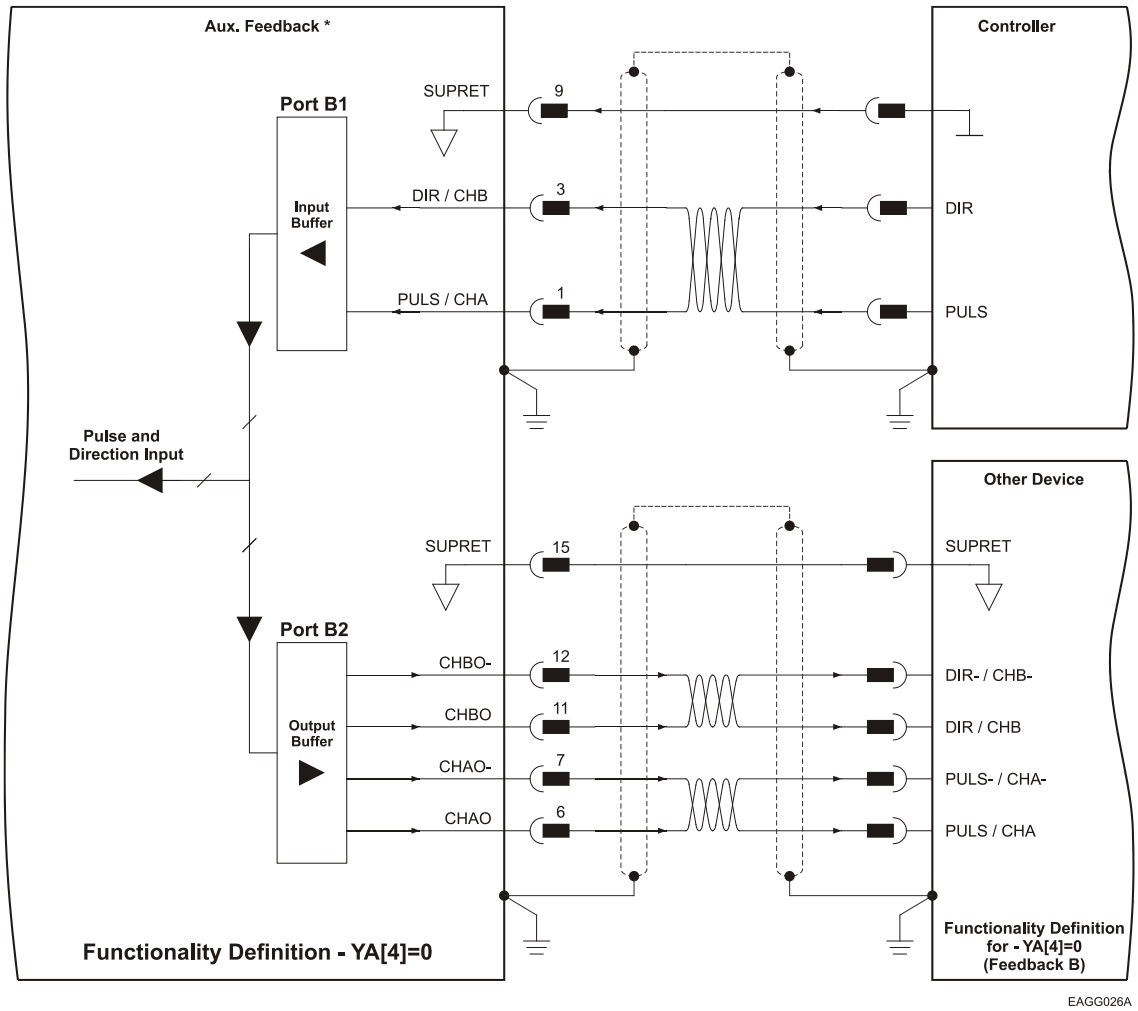


Figure 23: Pulse-and-Direction Input Option on AUX. FEEDBACK - Connection Diagram

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

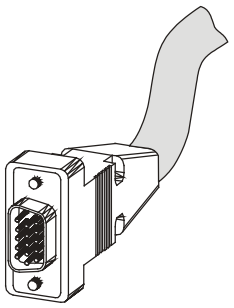
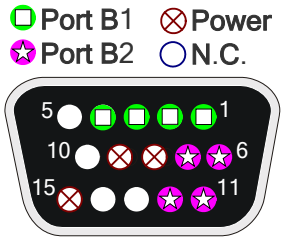
Port	Pin	Signal	Function	Pin Positions
B1	1	PULS/CHA	Pulse/Auxiliary channel A high *input*	 15-Pin D-Sub Plug
B1	2	PULS-/CHA-	Pulse-/Auxiliary channel A low *input*	
B1	3	DIR/CHB	Direction/Auxiliary channel B high *input*	
B1	4	DIR-/CHB-	Direction-/Auxiliary channel B low *input*	
	5	NC	Do not connect this pin	
B2	6	CHAO	Channel A output	
B2	7	CHAO-	Channel A complement output	
PWR	8	+5V	Encoder supply voltage	
PWR	9	SUPRET	Encoder supply voltage return	 15-Pin D-Sub Socket
	10	NC	Do not connect this pin	
B2	11	CHBO	Channel B output.	
B2	12	CHBO-	Channel B complement output	
	13	NC	Do not connect this pin	
	14	NC	Do not connect this pin	
PWR	15	SUPRET	Supply return	

Table 15: Differential Pulse-and-Direction Auxiliary Encoder Pin Assignment on AUX. FEEDBACK

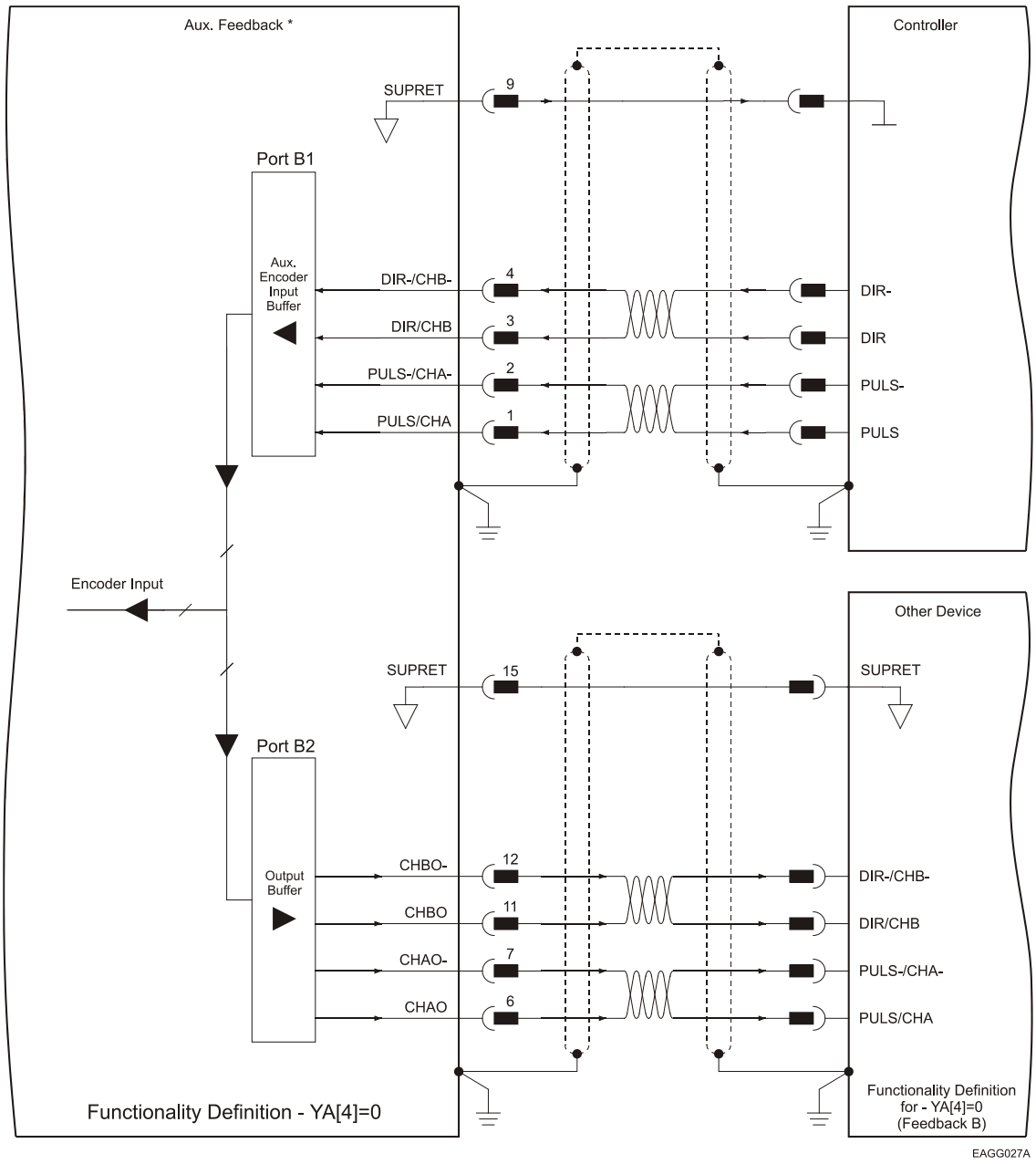


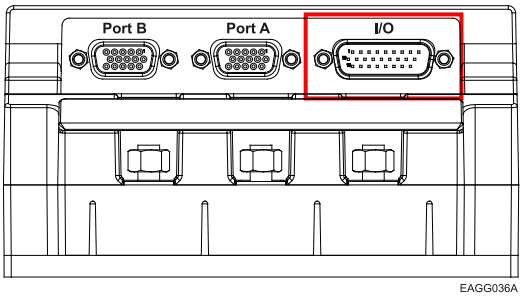
Figure 24: Differential Pulse-and-Direction Input Option on AUX. FEEDBACK - Connection Diagram

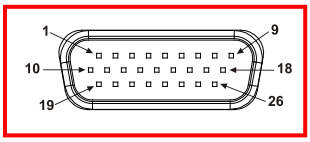
3.5.9. I/O Port

The Drum HV (High Voltage) has a general I/O port which can be used to connect 6 digital inputs, 4 digital outputs, 1 analog input and 1 fast differential output with a response time of less than 0.5 µsec. The fast differential output is active in parallel to the OUT1

I/O	P1 Port	Total
Digital Input	6	6
Digital Output	4	4
Analog Input	1	1

General I/O port has a 26-pin high density D-Sub plug. When assembling this I/O cable, follow the instructions in Section 3.5.5 (Feedback and Control Assemblies) using a 26-pin high density metal case D-Sub female connector (socket).





Pin	Signal	Function
1	VDDIN	External 24 VDC supply pos. input
2	VDDIN	External 24 VDC supply pos. input
3	OUT4	Programmable output 4
4	OUT3	Programmable output 3
5	OUT2	Programmable output 2
6	OUT1	Programmable output 1
7	VDDRET	Supply return for out 1-4
8	VDDRET	Supply return for out 1-4
9	ANARET	Analog ground
10–13	N/A	
14	OUT1_fast+	Differential output 1+

Pin	Signal	Function
15	OUT1_fast-	Differential output 1-
16	N.C	
17	ANALOG1-	Analog input 1-
18	ANALOG1+	Analog input 1+
19	IN1	Programmable input 1
20	IN2	Programmable input 2
21	IN3	Programmable input 3
22	IN4	Programmable input 4
23	IN5	Programmable input 5
24	IN6	Programmable input 6
25	INRET1-6	Programmable input 1-6 return
26	INRET1-6	Programmable input 1-6 return

Table 16: General I/O Connector - Pin Assignments

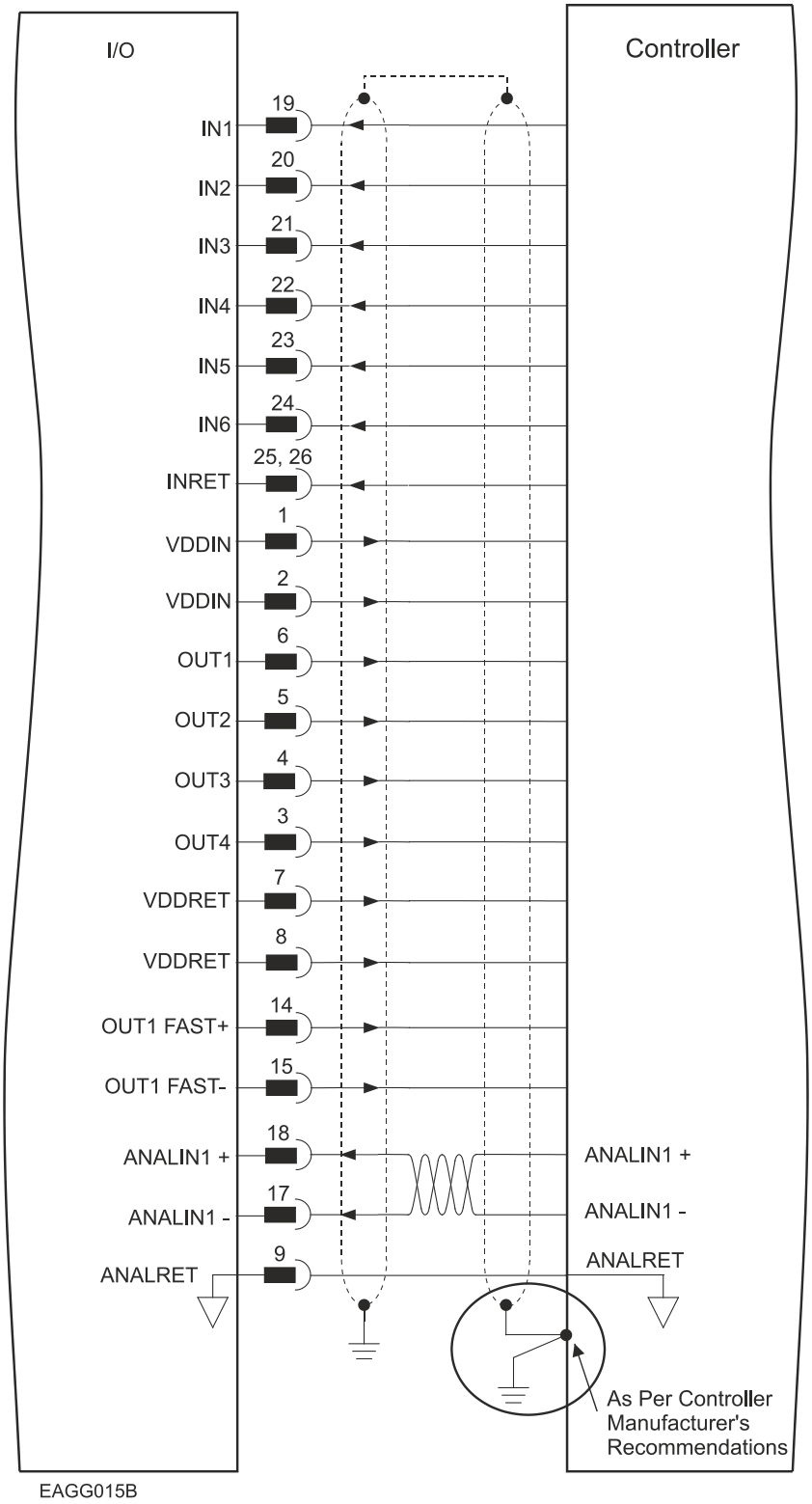


Figure 25: General I/O - Connection Diagram

3.5.10. Communication Cables

The communication cables use a 9-pin D-sub plug that connects to the RS-232 and a 9-pin D-sub socket that connects to the CAN ports of the Drum HV (High Voltage).

The communication interface may differ according to the user's hardware. The Drum HV (High Voltage) can communicate using the following options:

a. RS-232, full duplex

b. CAN

RS-232 communication requires a standard, commercial 3-core null-modem cable connected from the Drum HV (High Voltage) 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.

The CAN interface is not isolated.

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

3.5.10.1. RS-232 Communication

Notes for connecting the RS-232 communication cable:

- Use a 26 or 28 AWG twisted pair shielded cable. The shield should have aluminum foil covered by copper braid with a drain wire.
- Connect the shield to the ground of the host (PC). Usually, this connection is soldered internally inside the connector at the PC end. You can use the drain wire to facilitate connection.
- The D-sub plug must have a shield cover.
- Ensure that the shield of the cable is connected to the shield of the D-sub plug. The drain wire can be used to facilitate the connection.

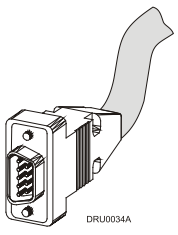
Pin	Signal	Function	Drawing
1	N/A		
2	RS232_Tx	RS-232 transmit	
3	RS232_Rx	RS-232 receive	
4	N/A		
5	COMRET	Communication return	
6, 7, 8, 9	N/A		

Table 17: RS-232 Cable - Pin Assignments

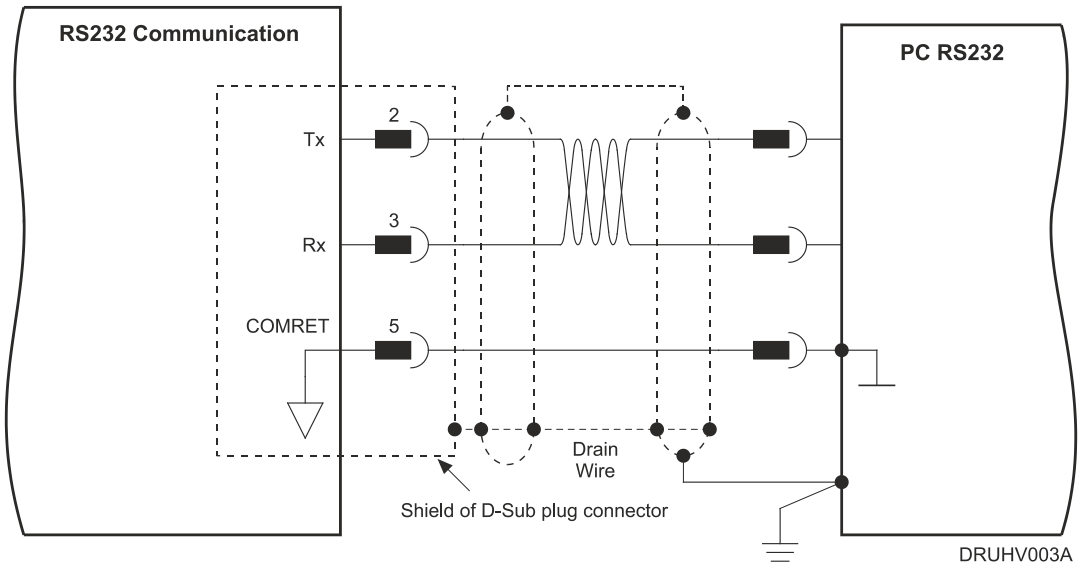


Figure 26: RS-232 Connection Diagram

3.5.10.2. CAN Communication

Notes for connecting the CAN communication cable:

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

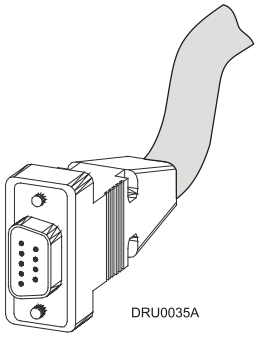
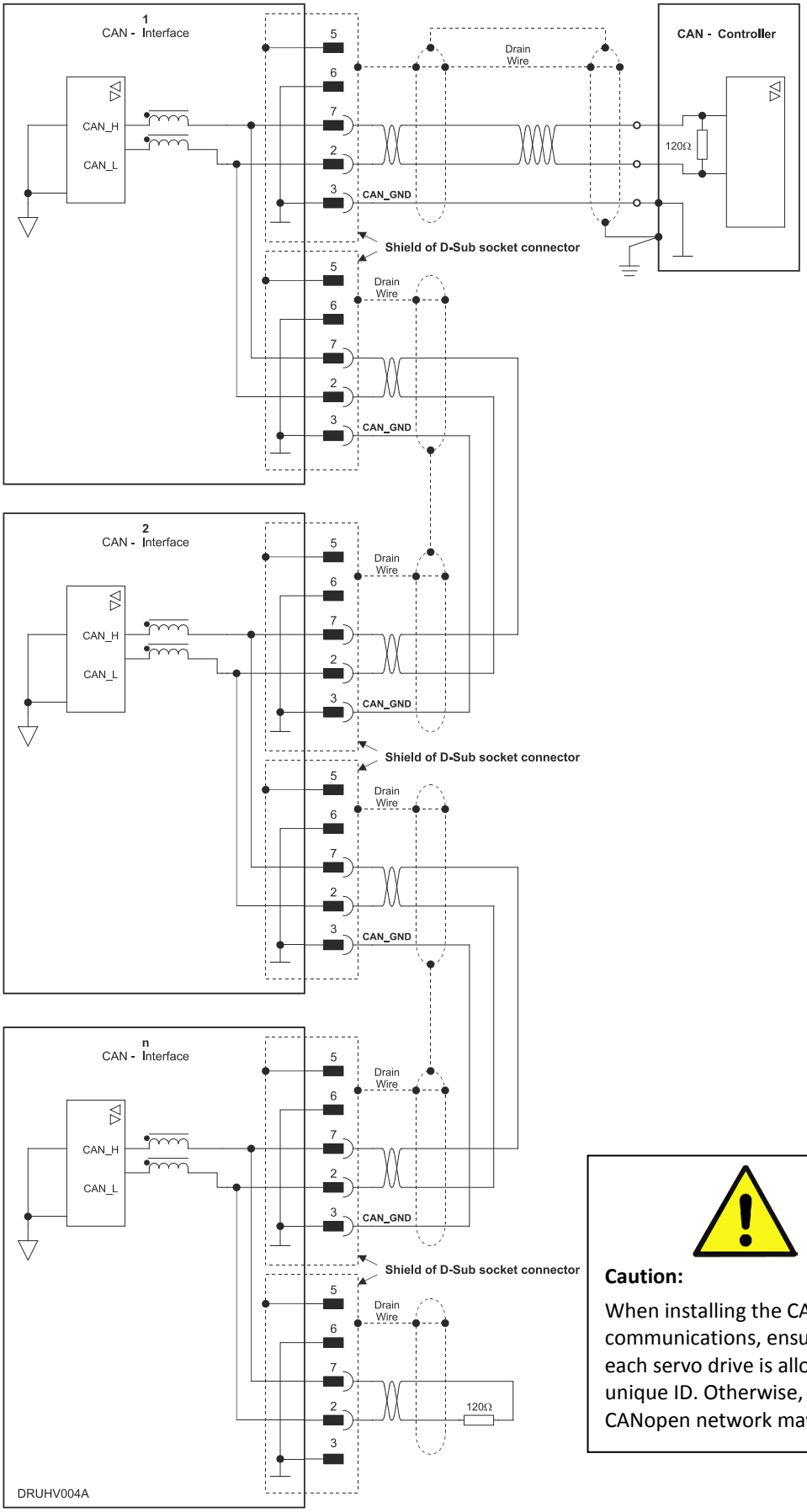
Pin	Signal	Function	Drawing
1	—	—	
2	CAN_L	CAN_L bus line (dominant low)	
3	CAN_RET	CAN Return	
4	—	—	
5	CAN_SHLD	Shield, connected to the metal housing of the D-type	
6	CAN_RET	CAN Return	
7	CAN_H	CAN_H bus line (dominant high)	
8	VL-	Aux. supply– see Section 3.5.4.	
9	VL+	Aux. supply + see Section 3.5.4.	

Table 18: CAN Cable - Pin Assignments



Caution:

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

Figure 27: CAN - Connection Diagram

3.6. Powering Up

After the Drum HV (High Voltage) has been mounted, check that the cables are intact.

The Drum HV (High Voltage) servo drive is then ready to be powered up.

Caution:
Before applying power, ensure that the DC supply is within the range specified for your specific type of Drum HV (High Voltage) and that the proper plus-minus connections are in order.

3.7. Heat Dissipation

For full power output capability the Drum is designed to be mounted on an external heatsink. It is highly recommended that the "Wall" on which the Drum is mounted will have heat dissipation capabilities. The Drum at "free air convection" (without an additional heatsink) can dissipate around 12 W for 40 °C ambient temperature and not exceeding 80 °C on the heat sink.

When "Free Air Convection" is sufficient for the application it is recommended to leave approximately 10 mm of space between the Drum's heat sink and any other assembly.

3.7.1. Drum HV Thermal Data

- Free air convection thermal resistance (θ): Approximately 7 to 8°C/W.
- Thermal time constant: Approximately 40 minutes/ 2400 seconds (thermal time constant means that the Drum will reach 2/3 of its final temperature after 40 minutes).
- Self-heat dissipation capability (no external heat sink): 20 W for 40°C/W temperature rise.
- Shut-off temperature: 86 to 88°C (measured on the heat sink).
- The thermal resistance when connecting to an external heat sink using a thermal conductive compound/foil. By proper smearing of the surface a significant improvement of the thermal resistance is achieved: 0.06°C/W.

3.7.2. Heat Dissipation Data

Heat Dissipation is shown graphically below:

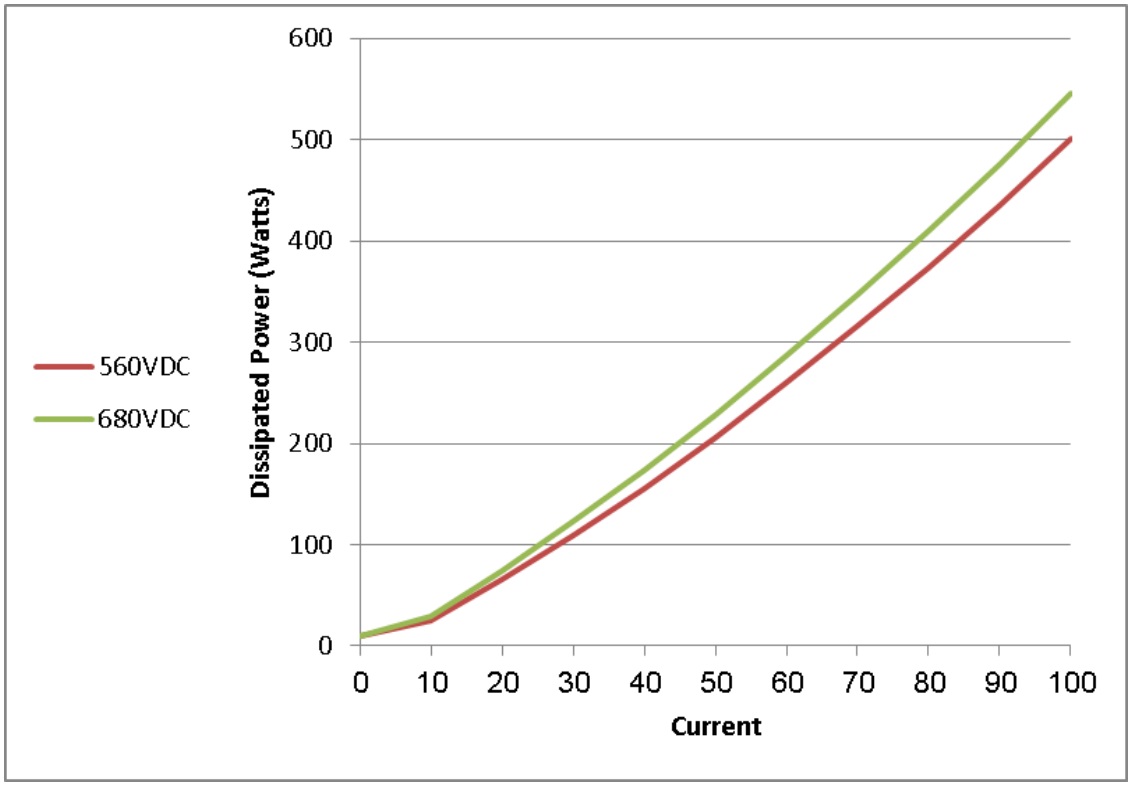


Figure 28: Dissipation versus Current Graph for 560 and 680 VDC

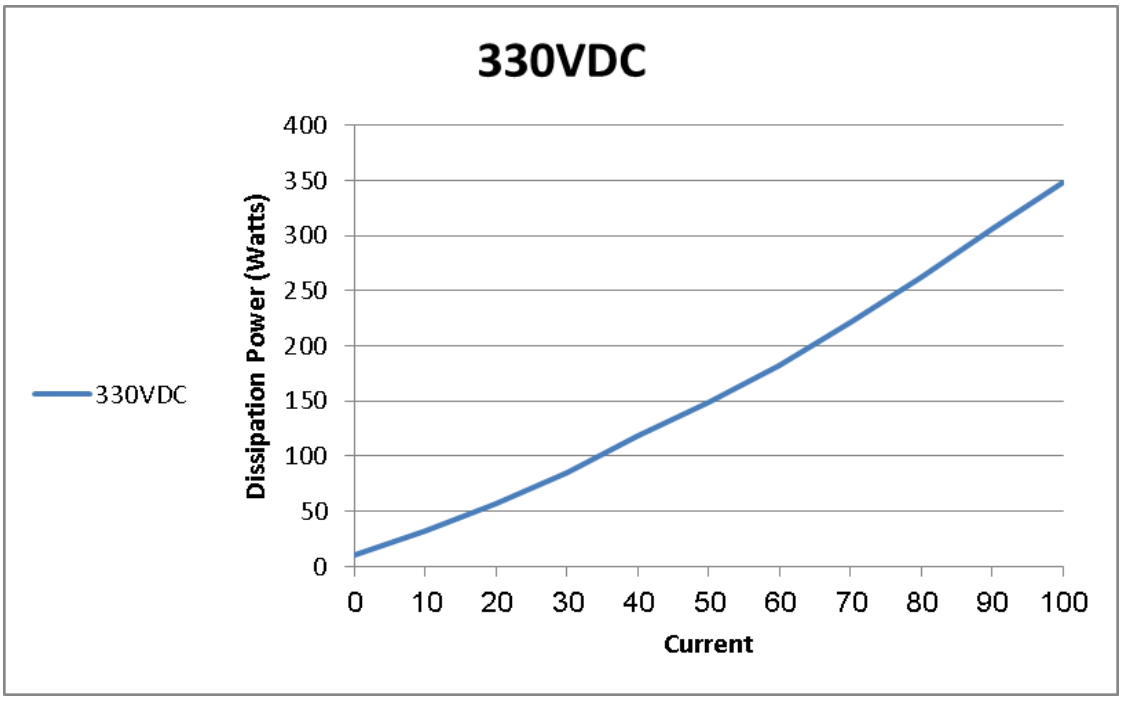


Figure 29: Dissipation versus Current Graph for 330 VDC

3.7.3. How to Use the Charts

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

To determine if your application needs a heat sink:

1. Allow maximum heat sink temperature to be 80 °C or less (shunt down is 6 °C to 8 °C higher).
2. Determine the ambient operating temperature of the Drum HV (High Voltage) as ≤ 40 °C.
3. Calculate the allowable temperature increase according to the following example: For an ambient temperature of 40 °C, ΔT = 80 to 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.

3.8. Initializing the System

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

Chapter 4: Technical Specifications

This chapter provides detailed technical information regarding the Drum HV (High Voltage). 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 Drum HV (High Voltage)'s features determine how it controls motion, as well as how it processes host commands, feedback and other input.

4.1.1. 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

4.1.2. Advanced Positioning Control Modes

- PTP, PT, PVT, ECAM, Follower, Dual Loop, Current Follower
- Fast event capturing inputs
- Fast output compare (OC)
- Motion Commands: Analog, Pulse-Width Modulation (PWM), digital (SW) and Pulse and Direction

4.1.3. 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

4.1.4. Fully Programmable

- Third generation programming structure with motion commands – “Metronome”
- Event capturing interrupts
- Event triggered programming
- 32 KB memory

4.1.5. Feedback Options

- Incremental Encoder – up to 20 Megacounts (5 Megapulses) per second
- Digital Halls – up to 2 kHz
- Incremental Encoder with Digital Halls for commutation – up to 20 Megacounts 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, differential, buffered of the Analog encoder
- Absolute Encoder
- Analog Hall Sensor
- Resolver
  - Programmable 10 to 15 bit resolution
  - Up to 512 revolutions per second (RPS)
  - Emulated encoder outputs, differential, buffered of the Resolver.
- Auxiliary Encoder inputs (ECAM, follower, etc.) differential, buffered.
- Tachometer & Potentiometer
- The Drum HV (High Voltage) can provide power (5 V, 2x200 mA max) for Encoders, Resolver or Halls.

4.1.6. Input/Output

- 1 **Analog Input** – up to 14-bit resolution
- 6 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
- 4 programmable **Digital Outputs**:
  - Brake Control with output-current of 0.25 A
  - Amplifier fault indication
  - General-purpose
  - Servo enable indication
- Buffered and differential outputs of the main encoder with up to 5 MHz pulses

- Buffered and differential outputs of the auxiliary encoder
- Emulated Buffered and differential outputs of resolver or analog encoder
- Pulse and Direction inputs (Differential)
- PWM current command output for torque and velocity

4.1.7. 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 outputs and power input/return
  - Failure of internal power supplies
  - Over-heating
    - Continuous temperature measurement. Temperature can be read on the fly; a warning can be initiated x degrees before temperature disable is activated.
  - Over/Under voltage
  - Loss of feedback
  - Following error
  - Current limits

4.1.8. Accessories

- Heat sinks (TBD)

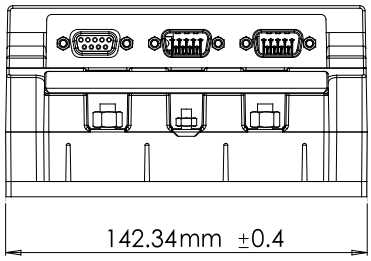
4.1.9. Status Indication

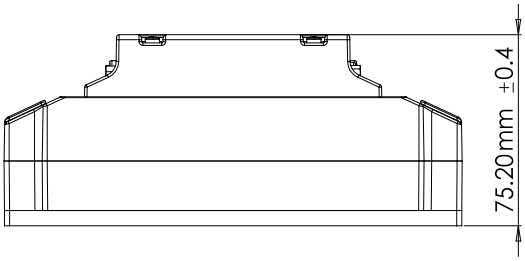
- Bi-color LED

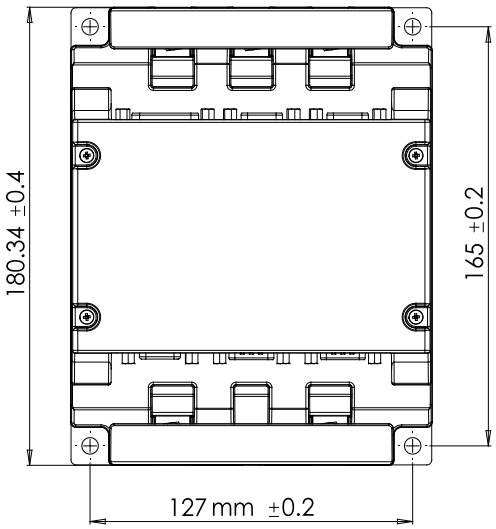
4.1.10. Automatic Procedures

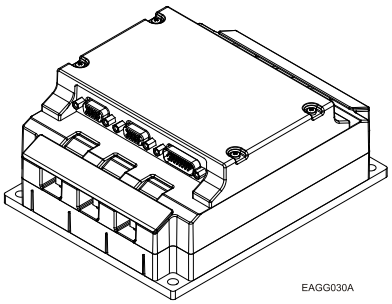
- Commutation alignment
- Phase sequencing
- Current loop offset adjustment
- Current loop gain tuning
- Current gain scheduling
- Velocity loop offset adjustment
- Velocity gain tuning
- Velocity gain scheduling
- Position gain tuning

4.2. Dimensions









4.3. Power Ratings

Feature	Units	50/400	R100/400	35/800	R70/800	R100/800
Minimum supply voltage	VDC	*For S suffix type = 50 For 0 or 1 suffix type = 100		*For S suffix type = 100		
Nominal supply voltage	VDC	325		560 for 400 VAC 680 for 480 VAC		
Maximum supply voltage	VDC	400		780		
Maximum continuous power output	kW	16	33	22	45	65
Efficiency at rated power (at nominal conditions)	%	> 98				
Auxiliary supply option, for S drives	VDC	18 to 30				
Auxiliary power supply (external option)	VA	≤3 VA without external loading ≤7 VA with full external loading				
Continuous current limit (Ic) amplitude of sinusoidal/DC trapezoidal commutation	A	50	100	35	70	100
Sinusoidal continuous RMS current limit (Ic)	A	35	71	25	50	71
Peak current limit	A	100	No peak	70	No peak	No peak
Weight	kg (oz)	1.623 kg (57.25 oz)				
Dimensions	mm (in)	180 x 142 x 75.2 (7.08" x 5.59" x 2.96")				
Digital in/Digital out/ Analog in		6/4/1				
Mounting method		Panel / Wall Mounted				

*See page 18 for details on the part number. The S suffix appears in models where there is a 24 V control supply. If there is no S suffix, the control power supply operates from the main power.

Note on current ratings: The current ratings of the Drum HV (High Voltage) 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.

4.3.1. Auxiliary Supply (Only for S type drive)

Feature	Details
Auxiliary power supply	*Isolated DC source only*
Auxiliary supply input voltage	18 VDC to 30 VDC
Auxiliary supply input power	≤7 VA (this includes the 5 V/2x200 mA load for the main and auxiliary encoders)

Note: An S type drive can only operate if it has an auxiliary supply.

4.4. 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

4.5. Control Specifications

4.5.1. 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 100 to 200 µsec
Current sampling rate	Default 10 kHz

4.5.2. 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 • Absolute encoder (optional) • Digital Halls • Interpolated Analog (Sine/Cosine) Encoder (optional) • Resolver (optional) • Tachometer and Potentiometer (optional) **Note:** With all feedback options, 1/T with automatic mode switching is activated (gap, frequency and derivative).
Velocity loop bandwidth	< 350 Hz
Velocity sampling time	140 to 200 µsec (2x current loop sample time)
Velocity sampling rate	Up to 8 kHz; default 5.5 kHz
Velocity command options	• Analog • Internally calculated by either jogging or step **Note:** All software-calculated profiles support on-the-fly changes.

4.5.3. 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 to 400 µsec (4x current loop sample time)
Position sampling rate	Up to 4 kHz; default 2.75 kHz

4.6. Feedbacks

The Drum HV (High Voltage) can receive and process feedback input from diverse types of devices.

4.6.1. Feedback Supply Voltage

The Drum HV (High Voltage) has two feedback ports (Main and Auxiliary). The Drum HV (High Voltage) supplies voltage only to the main feedback device and to the auxiliary feedback device if needed.

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

4.6.2. Main Feedback Options

4.6.2.1. Incremental Encoder Input

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

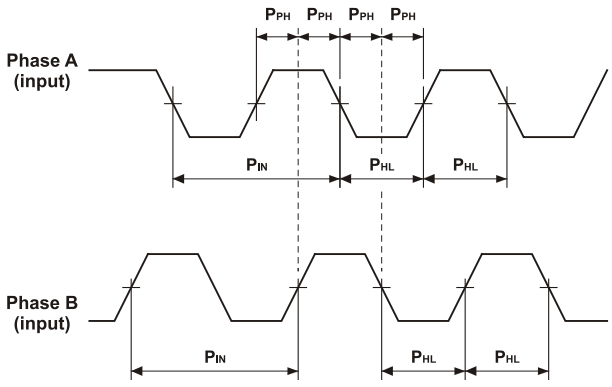


Figure 30: Main Feedback - Encoder Phase Diagram

4.6.2.2. Digital Halls

Feature	Details
Halls inputs	• H_A, H_B, H_C. • Single ended inputs • Built in hysteresis of 1 V for noise immunity
Input voltage	Nominal operating range: 0 V < V_{In_Hall} < 5 V Maximum absolute: -1 V < V_{In_Hall} < 15 V High level input voltage: V_{InHigh} > 2.5 V Low level input voltage: V_{InLow} < 1 V
Input current	Sink current (when input pulled to the common): 5 mA
Maximum frequency	f_{MAX} : 2 kHz

4.6.2.3. Interpolated Analog (Sine/Cosine) Encoder

Feature	Details
Analog encoder format	Sine and Cosine signals
Analog input signal level	• Offset voltage: 2.2 V to 2.8 V • Differential, 1 V peak to peak
Input resistance	Differential 120 Ω
Maximum analog signal frequency	f_{MAX} : 250 kHz
Interpolation multipliers	Programmable: x4 to x4096
Maximum “counts” frequency	80 Megacounts/sec “internally”
Automatic errors correction	Signal amplitudes mismatch Signal phase shift Signal offsets
Encoder outputs	See Auxiliary Encoder Outputs specifications (4.6.3)

4.6.2.4. Resolver

Feature	Details
Resolver format	• Sine/Cosine • Differential
Input resistance	Differential 2.49 kΩ
Resolution	Programmable: 10 to 15 bits
Maximum electrical frequency (RPS)	512 revolutions/sec
Resolver transfer ratio	0.5
Reference frequency	1/Ts (Ts = sample time in seconds)
Reference voltage	Supplied by the Drum HV (High Voltage)
Reference current	up to ±50 mA
Encoder outputs	See Auxiliary Encoder Output specifications (4.6.3)

4.6.2.5. Tachometer *

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

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

4.6.2.6. Potentiometer

Feature	Details
Potentiometer Format	Single-ended
Operating Voltage Range	0 to 5 V supplied by the Drum HV (High Voltage)
Potentiometer Resistance	100 Ω to 1 kΩ Above this range, linearity is affected detrimentally
Input Resistance	100 kΩ
Resolution	14 bit

4.6.3. Main Encoder Buffered Output

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

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

Feature	Details
Emulated output	• A, B, Index • Differential outputs
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 • Emulated encoder outputs of the tachometer • Emulated encoder outputs of the potentiometer
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

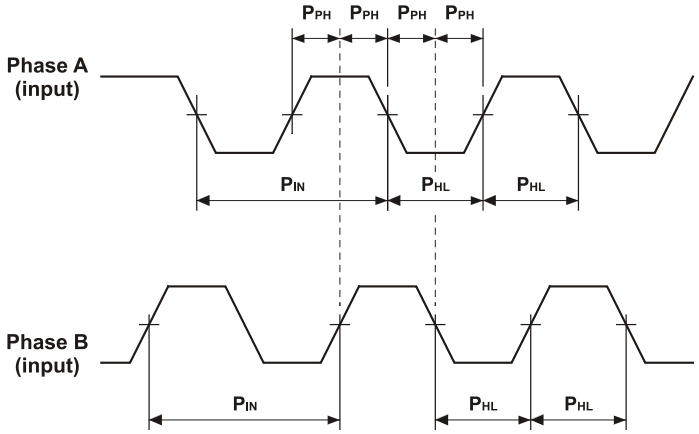


Figure 31: Auxiliary Feedback - Encoder Phase Diagram

4.6.5. Auxiliary Feedback Port (Input Mode YA[4]= 2, 0)

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

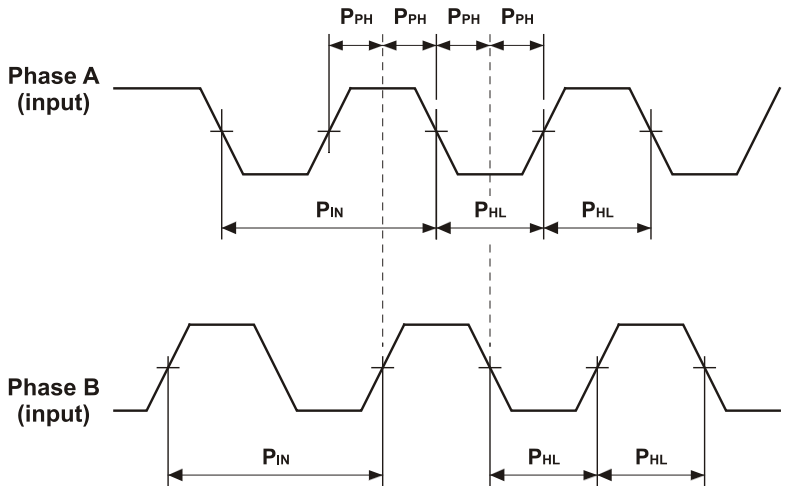


Figure 32: Auxiliary Feedback - Encoder Phase Diagram

4.7. I/Os

The Drum HV (High Voltage) has:

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

4.7.1. Digital Input Interfaces

Feature	Details
Type of input	• Optically isolated • PLC level as default or TTL option upon request
Input current for all inputs	Rin=3.43K, Iin = 1.2 mA @ Vin = 5 V Rin=3.43K, Iin = 6.7 mA @ Vin = 24 V
High-level input voltage	5 V < Vin < 24 V
Low-level input voltage	0 V < 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.

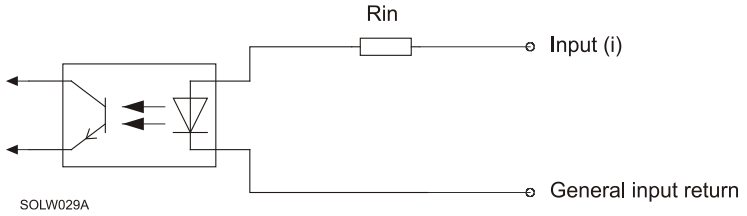
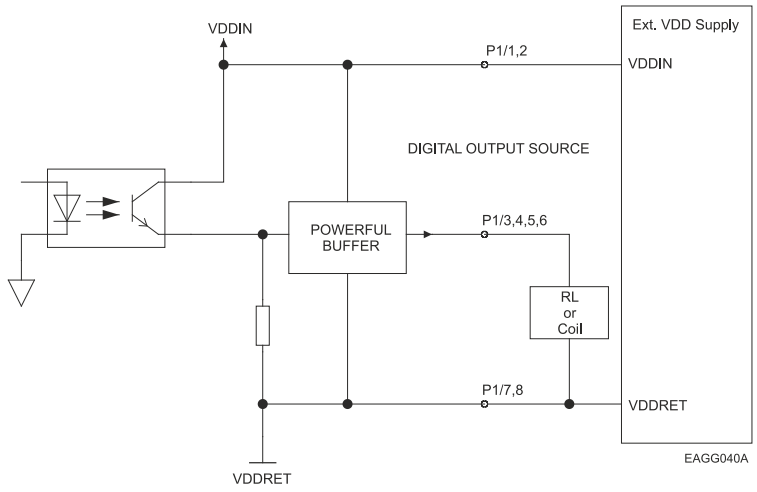


Figure 33: Digital Input Schematic

4.7.2. Digital Output Interface

Feature	Details
Type of output	• Optically isolated • Powerful Source capability
Maximum external supply (VDD)	30 V
Max. allowable output current draw I_{out} (max) (V_{out} = Low)	• I_{out} (max) ≤ 250 mA for output 1 to 3 • I_{out} (max) ≤ 500 mA for output 4
VOH maximum output voltage (Source mode)	VDD ≥ VOH ≥ (VDD – 1.25) *1.25 V is the typical internal V_{Drop} @ 250 mA
R_L (inductive or resistive)	The external load R_L must be selected to limit the output current to no more than 250 mA. $RL = \frac{VDD - 1.25}{I_{out}}$
Executable time	If output is set to one of the built-in functions — Home flag, Brake or AOK — execution is immediate upon detection: 0 < T < 4 x TS If output is set to General output and is executed from a program, the typical time is approximately 0.5 msec.
Schematic Diagram	
	

4.7.3. 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

4.8. Communications

Specification	Details
RS-232	**Signals:** • RxD , TxD , Gnd • Full duplex, serial communication for setup and control. • Baud Rate of 9,600 to 57,600 bit/sec.
CAN	**CAN bus Signals:** • CAN_H, CAN_L, CAN_GND • Maximum Baud Rate of 1 Mbit/sec. **Version:** • DS 301 V4.01 **Layer Setting Service and Protocol Support:** • DS 305 **Device Profile** (drive and motion control)**:** • DS 402

4.9. 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)

4.10. Compliance with Standards

Specification	Details
Quality Assurance	
ISO 9001:2008	Quality Management
Design	
In compliance **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	
In compliance **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
In compliance **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	
In compliance **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)