UDIHP/LT

Installation Guide

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ACS MOTION CONTROL

UDIhp/lt

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www.acsmotioncontrol.com

support@acsmotioncontrol.com

sales@acsmotioncontrol.com

Revision History

Date	Revision	Description
November 2017	12	Added notes concerning > Support for AB2 amplifiers > Support for brushless motors > PEG not supported by absolute encoders Added package contents, mating connector kit description, and din rail mounting kit
August 2016	11	Updated Absolute encoder schematic diagram.
May 2014	10	DC Brushless drive interface commands.

Conventions Used in this Guide

Text Formats

Format	Description
Bold	Names of GUI objects or commands.
BOLD+ UPPERCASE	ACSPL+ variables and commandss
Monospace + grey background	Code example.
Italic	Names of other documents.
Blue	Web pages, and e-mail addresses.
[ ]	In GUIs indicates optional item(s)
|	In GUIs indicates either/or items

Flagged Text

	**Note** - includes additional information or programming tips.
	**Caution** - describes a condition that may result in damage to equipment.
	**Warning** - describes a condition that may result in serious bodily injury or death.
	**Model** - highlights a specification, procedure, condition, or statement that depends on the product model.
	**Advanced** - indicates a topic for advanced users.

Related Documents

Documents listed in the following table provide additional information related to this document.

The most updated version of the documents can be downloaded by authorized users from www.acsmotioncontrol.com/downloads.

Online versions for all ACS software manuals are available to authorized users at ACS Motion Control Knowledge Center.

Document	Description
SPiiPlus Setup Guide	A guide providing step-by-step instructions for setting up a SPiiPlus system.
SPiiPlus Command Variable Reference Guide	Complete description of all variables and commands in the ACSPL+ programming language.
SPiiPlus C Library Reference	C++ and Visual Basic® libraries for host PC applications. This guide is applicable for all the SPiiPlus motion control products
SPiiPlus COM Library Reference	COM Methods, Properties, and Events for Communication with the Controller.
SPiiPlus .NET Library Reference	.NET Methods, Properties, and Events for Communication with the Controller.
EtherCAT Network Diagnostics	An application note describing how to perform diagnostics of the EtherCAT network.
SPiiPlus MMI Application Studio User Guide	A complete guide for using the SPiiPlus MMI Application Studio.
SPiiPlus Utilities User Guide	A guide for using the SPiiPlus User Mode Driver (UMD) for setting up communication with the SPiiPlus motion controller.
MC4U Control Module Hardware Guide	Technical description of the MC4U Control Module integrated motion control product line.
PEG and MARK Operations Application Notes	Provides details on using the PEG commands in SPiiPlus systems.
Safe Torque Off Function Application Notes	Provides details of the implementation of the STO function in SPiiPlus products.
NanoMotion Support in UDIHP	An application note describing support for Nanomotion motorsbased on Nanomotion servo algorithm.

Document	Description
SPiiPlus ADK Suite 2.40.01 Release Notes	Describes new features and changes that were introduced since the last SPiiPlus ADK Suite version 2.30 release.

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1. Product Overview

The SPiiPlus UDILT and UDIHP are advanced network based universal analog drive controllers which provide all required interfaces to control and monitor standalone analog drives.

Figure 1-1. SPiiPlus UDI

The UDI as function of ordered features, supports 2 and 4 drives of single, self-commutated, ±10V command, or 2 drives of dual ±10V commands for external commutation.

The drive interface modules are part of ACS line of EtherCAT® network devices which are controlled by ACS EtherCAT masters SPiiPlusNTM, SPiiPlusSC, MC4U/NT and CMnt-2- 320-xx. The products are panel or DIN rail mounted.

UDIHP is intended for down to sub-nanometer applications. In addition to the standard features available for the UDILT, it includes support for standard (250kHz) and high performance (5MHz) Sin-Cos encoders, available as an ordering option, and two analog inputs.

Cross-axis synchronization - All drives within the product are highly synchronized, and further synchronization to network axes is achieved by a network-wide distributed clock of less than 0.1 microsecond accuracy. The control algorithms are executed at a 20 kHz rate. The UDI supports 1 and 2kHz (and starting version release V2.30 also 4 and 5 kHz) EtherCAT profile update rates. The update rate is determined by the master controller.

UDI product line has the following features:

- Supply of 24Vdc in the range of 19-29Vdc
- Two and Four ±10V torque commands for self-commutated drives. Two interfaces (four commands altogether) for drives requiring external commutation are supported. UDILT commands are 10bit resolution, and UDIHP are of 16bit
- Enable output and Fault input per command (also termed 'motor-axis')
- Motor brake output per axis
- Emergency stop, and two limit switch inputs per axis
- Digital incremental encoder support per drive (A,B,I and P/D support)

- Sin-Cos encoder of 250kHz or 5MHz (UDIHP only) per axis, and two absolute encoders
- Two digital inputs per drive. One of the inputs can be used as Registration Mark
- One programmable PEG outpus

PEG does not work with absolute encoders.

- One Analog Output
- Two analog inputs (UDIHP only)
- Various control algorithms to ensure very high performance

AB2 amplifiers are not supported by SPiiPlus ADK Suite 2.40 and later. If AB2 amplifiers are used and there is not a need to upgrade the FW, it is recommended to continue using FW 2.30.03.

If an upgrade is needed, consult ACS Applications and the relevant DSP will be provided.

2. Product Configurations

The table below lists the features that differ between UDILT and UDIHP, 2 and 4 axis versions.

Feature	UDILT 2 axis	UDILT 4 axis	UDIHP 2 axis	UDIHP 4 axis	Comment
Number of Analog commands	2	4	2	4	
Analog Command resolution	10bit	10bit	16bit	16bit	
Digital incremental encoder	2 or 4	4	2 or 4	4	(*1)
Number of Sin-Cos encoder 250kHz	0	0	0/1/2	0/1/2/3/4	(*1) (*4)
Number of Sin-Cos encoder 5MHz	0	0	0/1/2	0/1/2/3/4	(*1) (*4)
Number of axes supporting software commutation	0	2	0	2	(*2)
Number of Analog Inputs	0	0	2	2	(*3)
Number of Absolute encoders	0	0	0/1/2	0/1/2	(*1)

(*1) Option specified when the product is ordered

(*2) Software Commutation for PM Brushless Motors:

UDIHP/LT 2-axis versions do not support commutation.

UDIHP/LT 4-axis versions support software commutation for 2 axes, axis 0 and axis 1.

When the UDI commutates axis 0, then axis 2 cannot be used.

When the UDI commutates axis 1, then axis 3 cannot be used.

(*3) Analog inputs are shared with Sin-Cos encoder inputs

(*4) Total number of Sin-Cos encoders (250kHz plus 5MHz) cannot exceed 4.

When dual commutation outputs are needed, the 4 axis version of the product must be ordered. This version consumes 4 network axes and the unit supports 2 axes of dual commutation outputs.

A unit cannot have a single axis of dual commutation outputs.

2.1 Package content

The UDIHP/LT package contains the following items:

- UDIHP/LT Module
- 24V control supply mating connector as shown below

Figure 2-1. 24V control supply mating connector

2.2 Accessory Kits

Ordering options for accessories:

Part Number	Description
UDIxx-ACC1	UDI mating connectors kit
UDIxx-ACC2	UDI din-rail mounting kit

2.2.1 UDIxx-ACC1

P/N: UDIxx-ACC1

Description: Mating connectors for drives, encoders and I/Os

Table 2-1. Mating connectors for drives, encoders and I/Os

Ref	P/N	Qty	Manufacturer	Description	Connector
1	CO-21114-000/LF	4	Phoenix	14-PIN PLUG P=3.81MM 8A 300V NPB	J14
2	CO-12609-000/LF	4	AMTEK, WEITRONIC, NELTRON	CON D-T 9p MALE SOLDER CUP NPB	J4 - J7
3	CO-13102-6HD/LF	1	AMPHENOL, AMTEK, McMurdo, NELTRON	D-TYPE CUP 26P HI-DNSTY ML NPB	J8
4	CO-13615-000/LF	4	CHANT SINCERE CO., LTD	CON D-TPE SOLDER CUP 15P H.D NPB	J3

Ref	P/N	Qty	Manufacturer	Description	Connector
5	CO-23615-000/LF	4	AMPHENOL	CON D-TYPE SOLDER CUP SOCKET 15P H.D NPB	J9 - J12
6	CO-H1510-000/LF	1	CHANT SINCERE CO., LTD	HOOD KELTRON HD-15-10; 15positio NPB	J8
7	CO-H0907-000/LF	9	CHANT SINCERE CO., LTD	HOOD HD-09-7; 9position RoHS	J4 - J7 J9 - J12

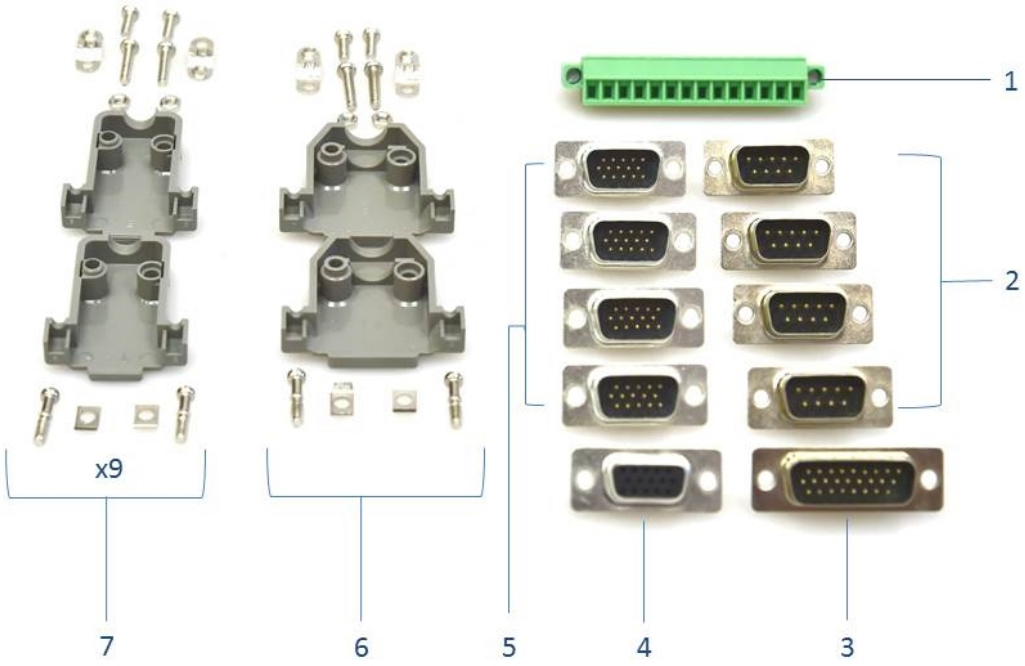


Figure 2-2. Mating connectors for drives, encoders and I/Os

2.2.2 UDIxx-ACC2

P/N: UDIxx-ACC2

Description: Din-rail mounting kit

Table 2-2. Din-rail mounting kit

Ref	P/N	Qty	Manufacturer	Description
1	GG-17010-001	1		Nylon 170mm X 100mm Closed Pass
2	GG-DNM15-000	2	Winford	DINM 15 DIN RAIL MOUNT CLIP
	SC-10404-040	3	BOSSARD, PALBOREG	SCR WN1413-ZP BN13576 KA40X10 RoHS

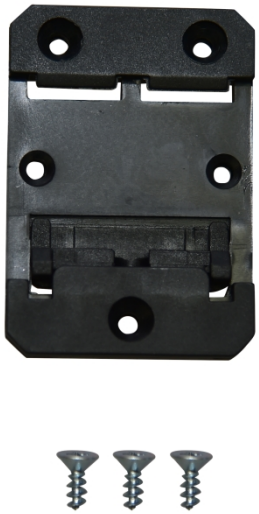


Figure 2-3. Din-rail mounting kit

3. Operation

3.1 Operating UDIHP/LT in an ACS Network

The UDIHP/LT operates as a network element within an ACS EtherCAT network. A minimum network consists of an ACS master and UDIHP/LT. In this configuration a single CAT5E cable is connected from the master's EtherCAT Out port to the UDIHP/LT EtherCAT In port. Host connection for configuration and control purposes connects from the host computer to the network master only. See Network (EtherCAT®) Communication for more information.

For any network configuration, a specific setup has to be provided: this is done by using the SPiiPlus MMI Application Studio configuration modules: System Setup (refer to ***SPiiPlus MMI Application Studio User Guide***).

For out-of-the-box operations follow the instructions detailed below, referring to the detailed information provided in this manual and to the referenced ACS documents. The product's operation depends on ordered features, as detailed below.

3.2 Setup of a Network Master

A network master must be purchased separately. To setup the network master:

1. Establish communication with the master using the SPiiPlus MMI Application Studio and SPiiPlus User Mode Driver, selecting either Ethernet or serial interface. Refer to SPiiPlusNT Setup Guide and SPiiPlus Utilities User Guide for details.
2. Setup the EtherCAT network using the SPiiPlus MMI Application Studio EtherCAT Configurator to define the network according to ordered elements and needed network configuration. Refer to the SPiiPlus MMI Application Studio User Guide for details.
3. Configure the network elements, axes, and IOs using the SPiiPlus MMI Application Studio System Setup, refer to the ***SPiiPlus MMI Application Studio User Guide*** for details.

3.3 UDIHP/LT Setup

UDIHP/LT set up consists of the following stages:

Please read the safety instruction in Personnel Safety Guidelines and closely adhere to them.

1. Prior to applying power, connect supply and control cables using pre-wired cables. For the cable pin-out description and connector details refer to UDIhp/lt Connectors .

   ACS specifies and tests this product using drive cable lengths of 3 m. Drive cables should be routed as far as possible from sensitive-signal carrying cables such as encoder cables. Encoder cables should be selected according to the manufacturer's recommendations.
2. Using instructions provided in this HW guide, apply control supply power, and setup an ACS network according to the instructions above.
3. For UDIHP/LT operational programming refer to the ***SPiiPlusNT Programmer's Guide***, and the ***SPiiPlus Command & Variable Reference Guide***.

4. UDIHP/LT Interfaces

The schematic below depicts the product's connectors and their functionality. Note that not all signals contained in a specific connector are mentioned: for accurate description of each connector you should refer to UDIhp/lt Connectors .

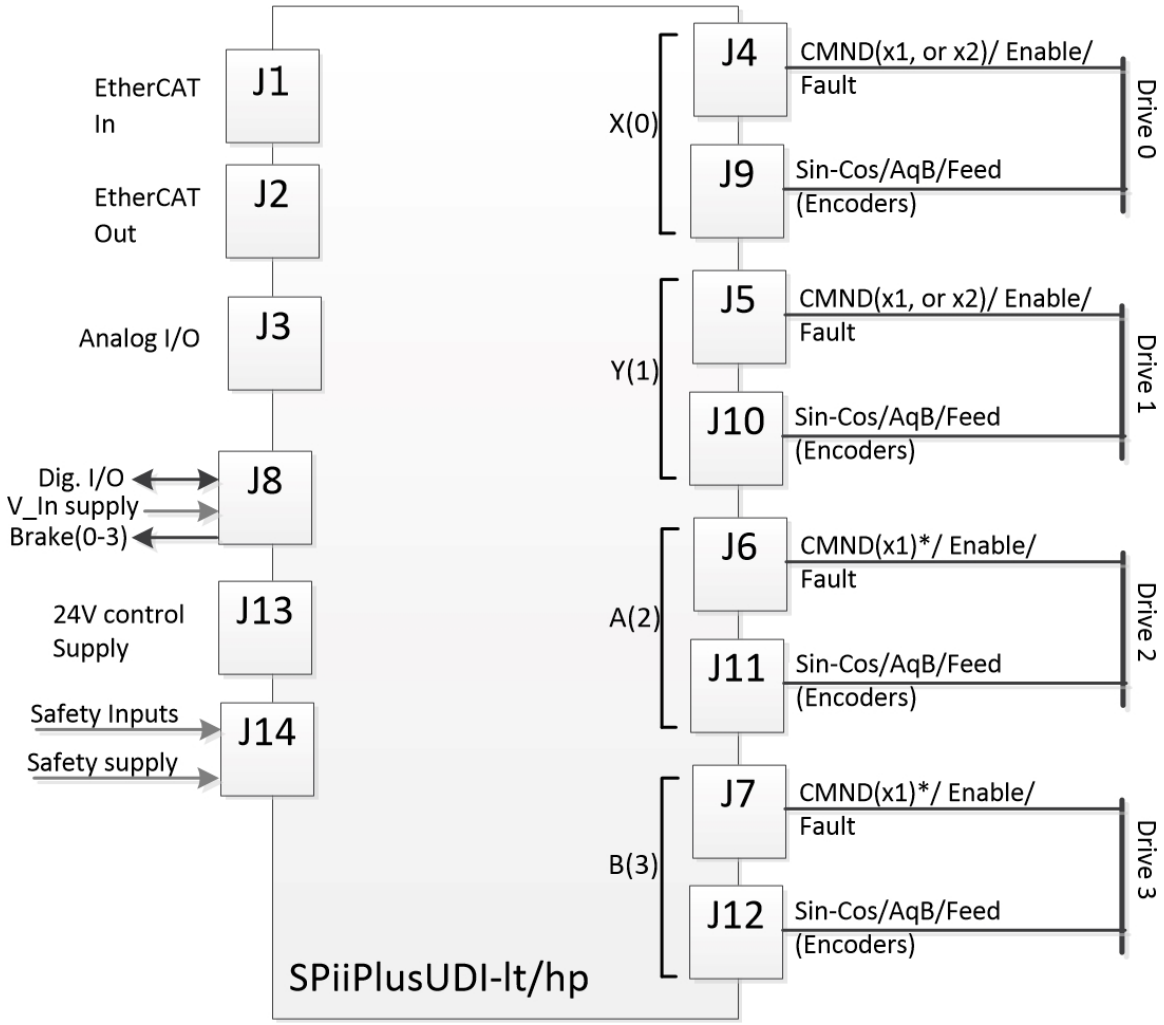


Figure 4-1. UDIHP/LT-2/4-048 Connectors Schematic

*Not used if axes 0 and 1 use x2 commands per axis

4.1 Drive Torque Commands

The UDI provides control to any third party drive with a ±10V analog command interface. The 4 axes version of the products supports software commutation for 2 drives.

A maximal offset of ±50mV is software adjustable. At power up the command's output is 0V.

Unused drive commands can be used as general purpose analog outputs. Single-ended and differential connection to drives is supported, as depicted in diagrams below.

Configuration and operational setting of parameters is done using the Adjuster Wizard of the SPiiPlus MMI Application Studio (refer to *SPiiPlus MMI Application Studio User Guide*).

5. Interfacing Drives

Drive interface consists of the following signals:

Signals per axis	To Drive	From Drive	Notes
Torque Command	√		*1
Enable	√		
Drive Fault		√	
Right and Left Limits		√	
Brake	√		
Incremental Encoder		√	1 or 2
Sin-Cos Encoder		√	UDIHP version only
Absolute Encoder		√	
E-STOP		√	*3

*1 Two commands are available for axes 0 and 1 only.

*2 Two encoders, available for axes 0 and 1 only.

*3 A single interface per product.

5.1 DC Brushless Drive Interface

Refer to the following diagrams for DC brushless motor drive interface.

For a ±10V differential interface to an external drive use signals CMND0+ CMND0- for axis 0, and CMND1+ and CMND1- for axis 1.

Each axis receives two commands. For a ±10V differential interface to an external drive use signals CMND0+ CMND0- and CMND1+ and CMND1- for each axis.

UDIHP/LT 4-axis versions support brushless motors for 2 axes, axis 0 and axis 1

For a connectivity scheme refer to Figure 5-1.

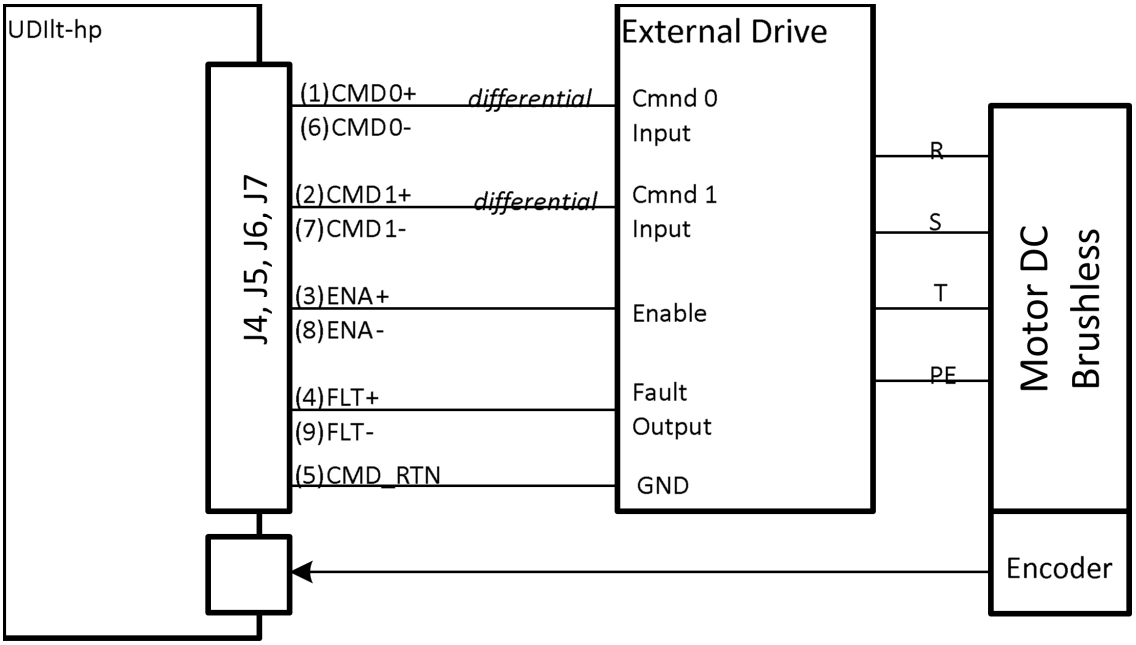


Figure 5-1. Brushless motor connectivity scheme, using differential command lines, axes 0 and 1

For a ±5V single ended interface to an external drive use signals CMND0+ and AGND for axis 0, and CMND1+ and AGND for axis 1.

For a connectivity scheme refer to Figure 5-2.

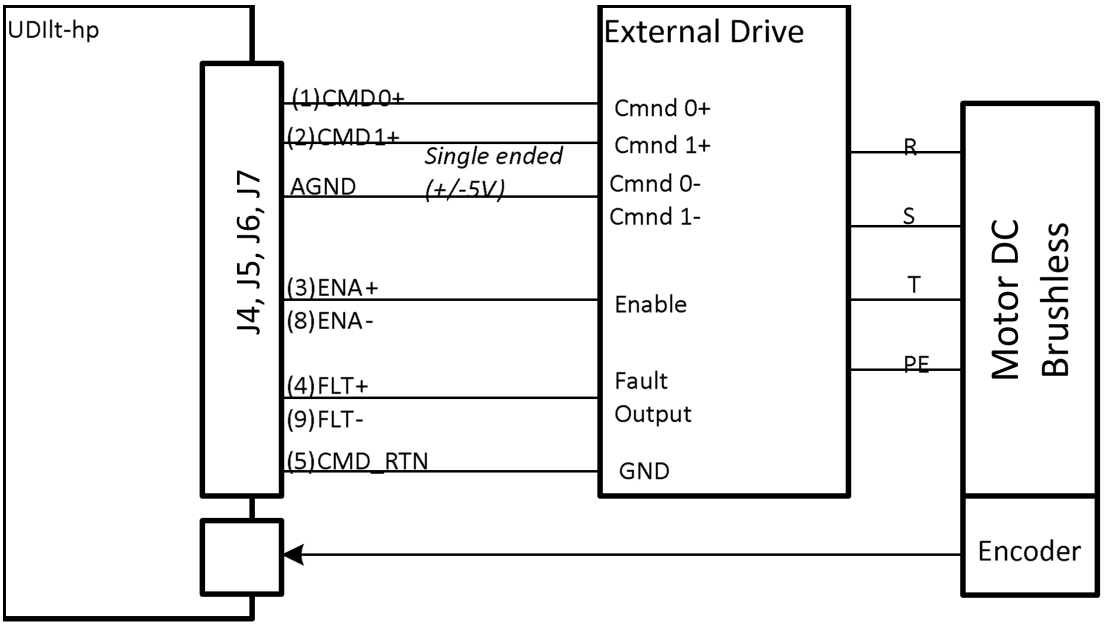


Figure 5-2. Brushless motor connectivity scheme, using single ended command lines, axes 0 and 1.

5.2 DC Brush Drive Interface

Refer to the following drawing for DC brush motor drive interface.

For a ±10V differential interface to an external drive use signals CMND0+ CMND0-.

For a ±5V single ended interface to an external drive use signals CMND0+ and AGND.

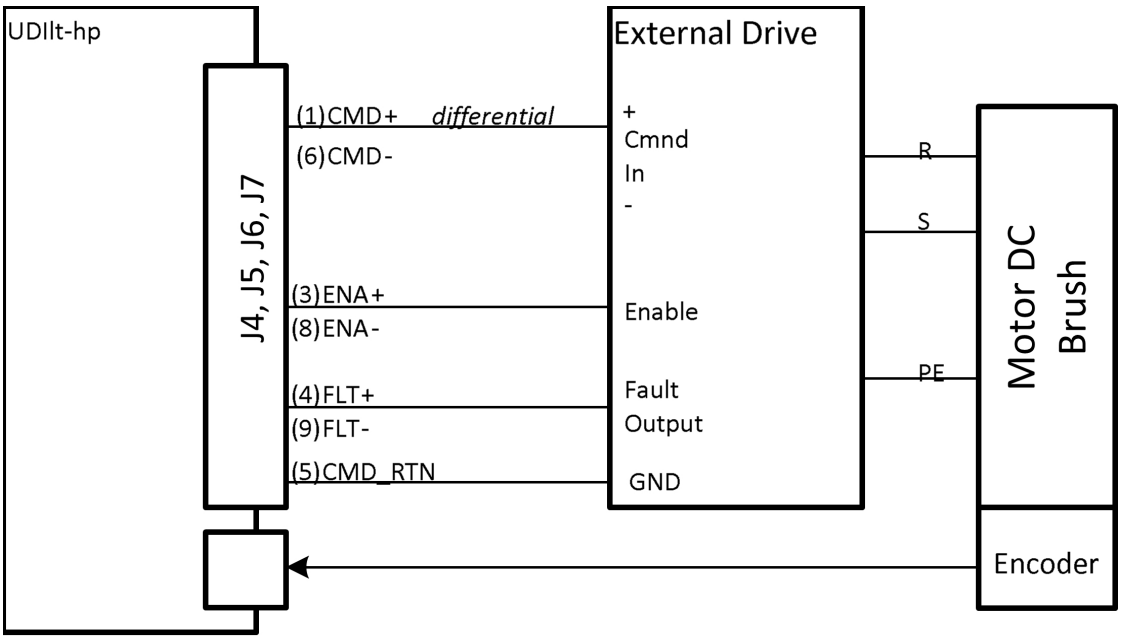


Figure 5-3. Brushless motor connectivity scheme, using differential command lines

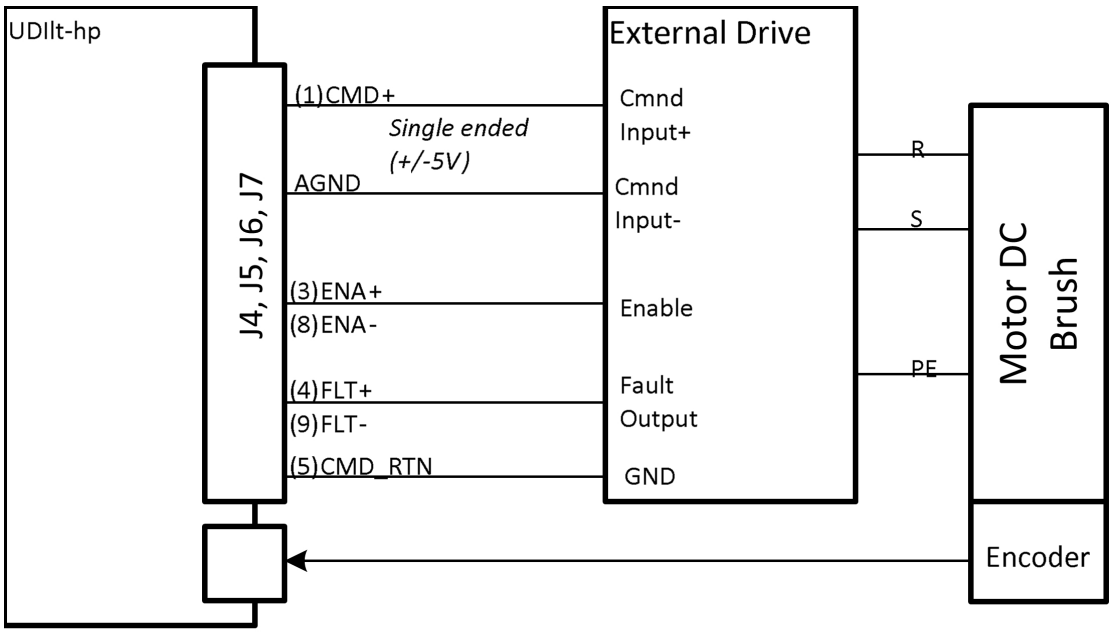


Figure 5-4. Brushless motor connectivity scheme, using single ended command lines

5.3 Drive Enable Interface

Drive Enable interfaces are opto-isolated two terminal signals, which can be externally configured as a 'source' or as a 'sink', as depicted below. As function of the 3rd party's drive, the DC supply source can be 5 or 24Vdc providing up to 20mA, and maximal voltage drop of 0.8V.

Upon power-up the interface is of high impedance that is with no current flowing through the output transistor.

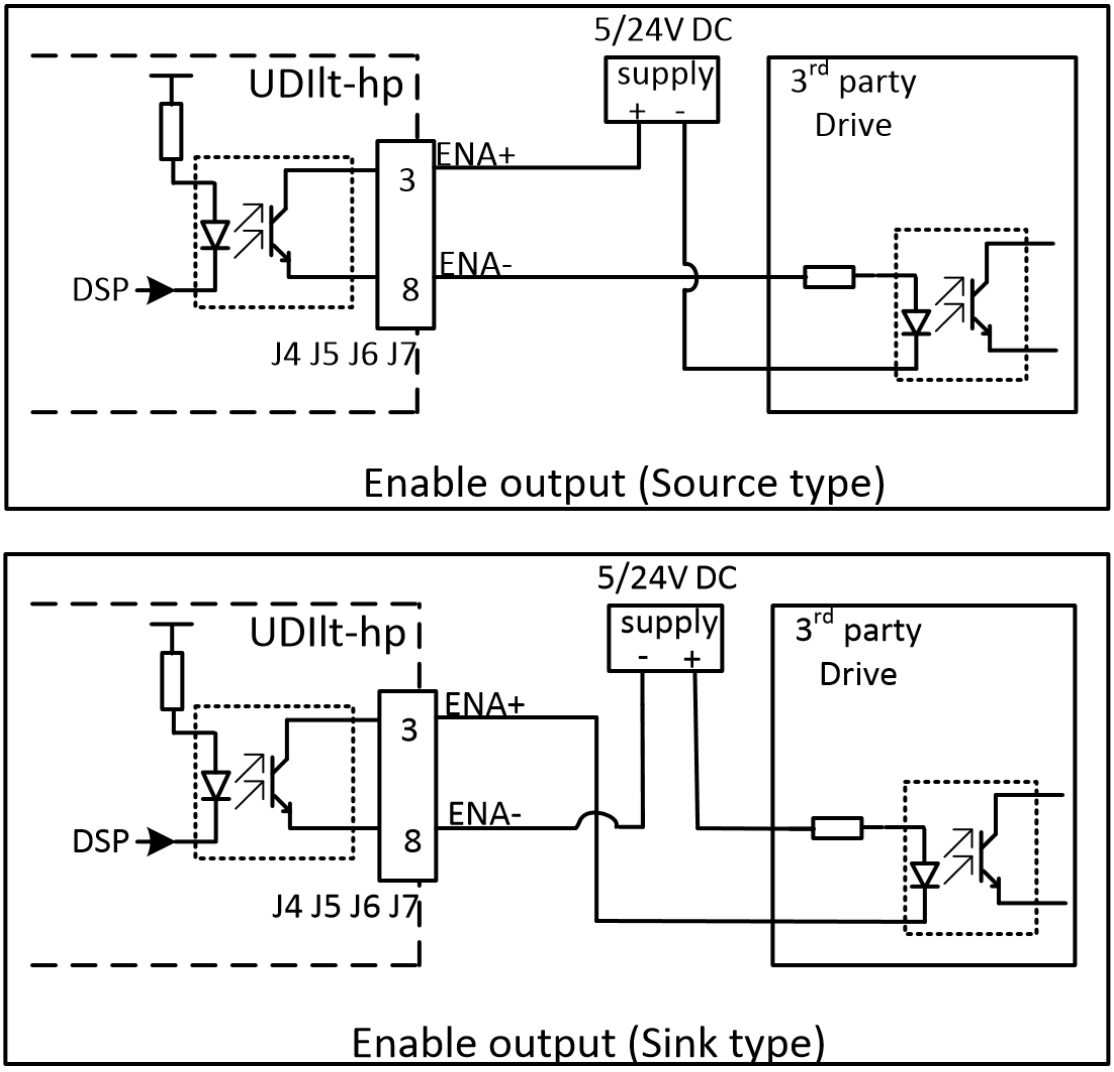


Figure 5-5. 'Enable' output schematic diagram for 'source' and 'sink' type interface

5.4 Fault Interface

Drive's fault inputs to UDIHP/LT can be externally configured as a 'source' or as a 'sink', as depicted in the following diagrams. The Fault interface has to be driven by a 24Vdc source of the drive, with current limited to 14mA. 5Vdc support requires a special factory setup and is not offered in the standard product.

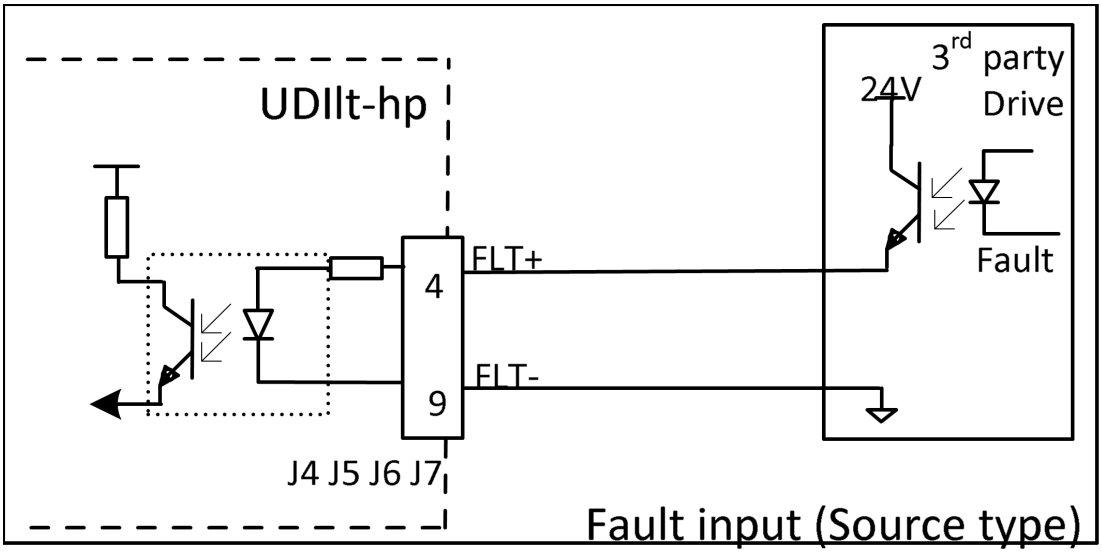


Figure 5-6. Fault input connectivity scheme, 'source'

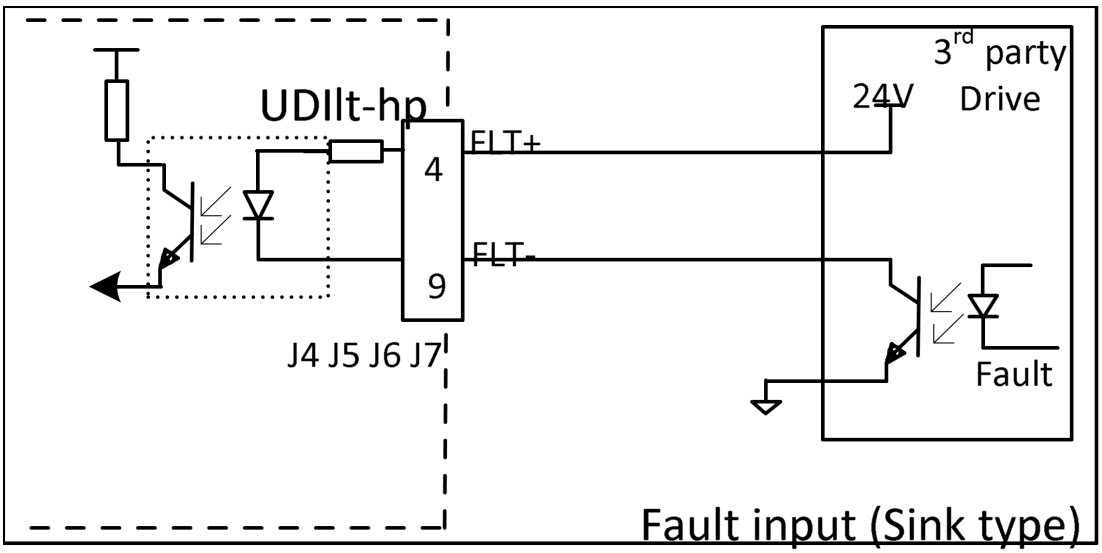


Figure 5-7. Fault input connectivity scheme, 'sink'

5.5 Mechanical Motor Braking

One motor brake control interface per axis is provided, supplying 0.2A. The interface is fed by an external a 5V or a 24V supply applied to **J8** The control circuit is opto-isolated, and protected against short circuits, over voltage, and reverse polarity. Refer to Figure 5-8 for a schematic description.

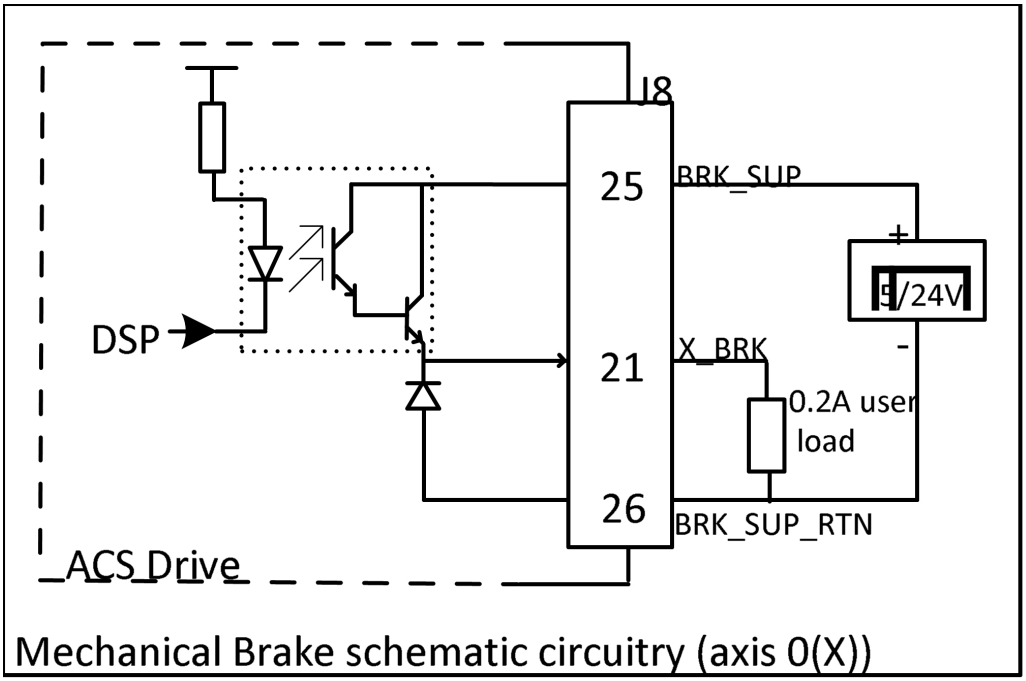


Figure 5-8. Mechanical Brake (axis 0(X) shown)

The outputs can be programmed to be used as General Purpose outputs.

6. Feedback

The UDILT 2/4 axes support the following feedback types: Incremental digital (1 per axis, differential or single ended – software configurable), and up to 2 absolute encoders (0(X) and 1(Y)). The absolute encoders are of same type, as detailed in the sections that follow. The type of absolute encoder has to be specified upon order, and cannot be modified at field level.

UDIHP 2/4 axes supports in addition a Sin-Cos encoder (Sin, Cos, Index), 1 per axis) Up to 1A at 5V is available as total encoder supply feed.

6.1 Dual Feedback (Dual Loop) Scheme

The 2 axes UDIHP/LT version as a function of the selected configuration may be ordered with four incremental encoders for dual loop control schemes. In this case four network-level axes have to be allocated.

The number of utilized network axes equals the number of digital encoders used. For example, when a dual feedback scheme is implemented for an axis, two network axes are consumed out of the total number of network axes supported for the specific master controller.

An absolute encoder can be used as the primary axis for axis 0(X) and 1(Y) only.

Refer to available configurations for dual loop schemes in the tables below.

6.2 Drive and Encoder Numbering and Assignments

Use Table 6-1 for single loop and for dual loop applications.

Table 6-1. Drive and Encoder Configurations

		Primary Encoder		Secondary Encoder
Axis	Encoder Deployment	Digital Incremental	Absolute	Digital Incremental
0(X)	Single loop	0(X)		
0(X)	Single loop		0(X)	
0(X)	Dual loop	0(X)		2(A)
0(X)	Dual loop		0(X)	2(A)
1(Y)	Single loop	1(Y)		
1(Y)	Single loop		1(Y)	
1(Y)	Dual loop	1(Y)		3(B)
1(Y)	Dual loop		1(Y)	3(B)
2(A)	Single loop	2(A)		
3(B)	Single loop	3(B)		

6.3 Incremental Digital AqB Encoder

The interface of Digital incremental CHA is depicted in Figure 6-1 for differential mode connection, and in Figure 6-2 for single-ended connection. The electrical interface for CHB and Index are identical.

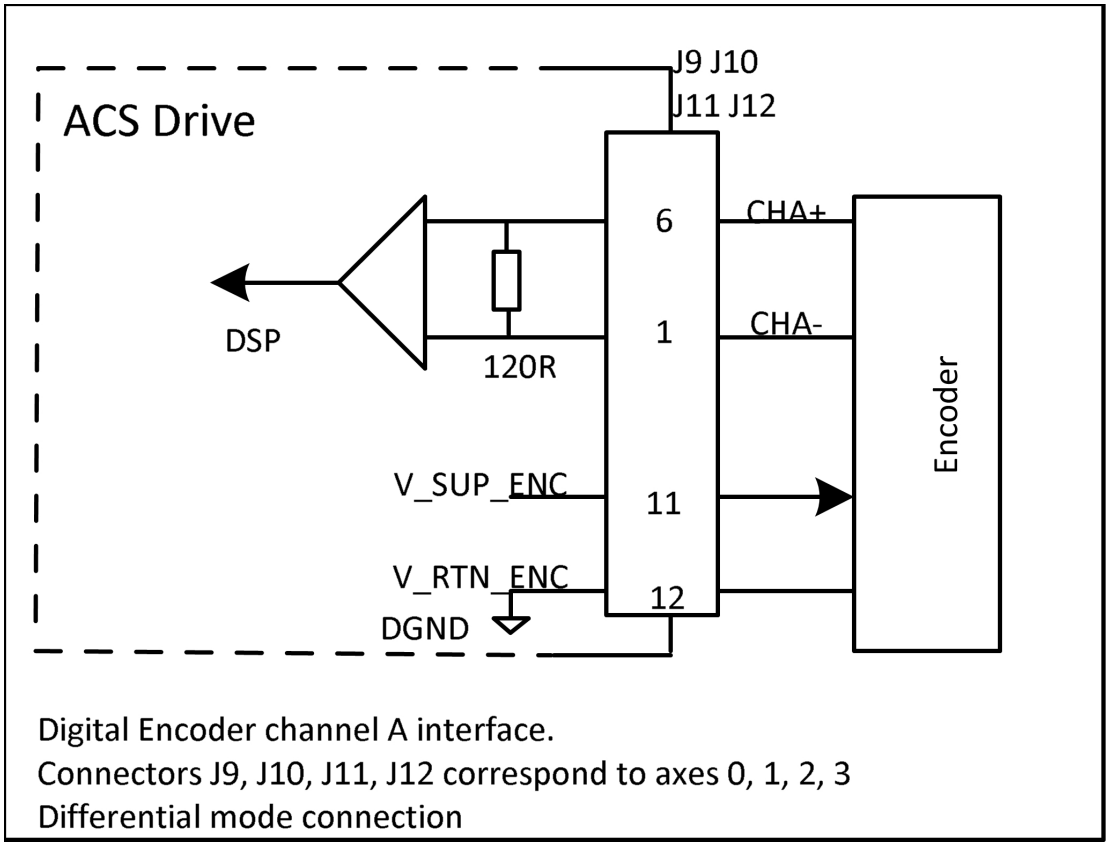


Figure 6-1. Incremental Digital AqB Encoder Connections, differential mode

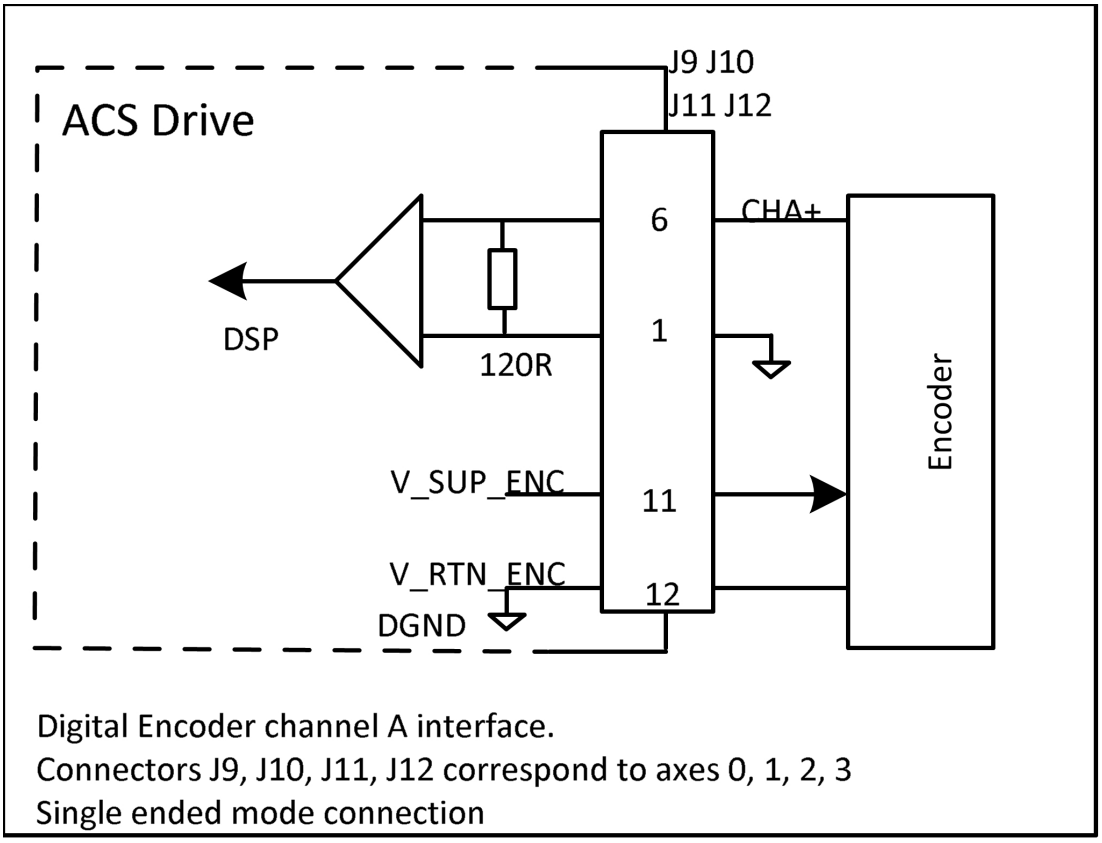


Figure 6-2. Incremental Digital AqB Encoder Connections, single-ended mode

The interface is a protected RS-422 differential line with 120Ω termination.

- Maximum rate: 12.5MHz or 50 million encoder counts/sec in differential mode, or 2 million encoder counts/sec in single-ended mode.
- Faults detected: Encoder error, and encoder disconnection.
- Selection of differential and single-ended interface: by software command that sets the interface to the specified encoder type.

Encoders are fed by a 5V±5% 1A supply (the total available current to all encoders) referenced to a digital ground.

6.4 Sin Cos Encoder

- Total of 4, one per axis, available for the UDIHP version only. Sin, Cos and Index are analog differential interface inputs, 1.25Vptp. 120Ohm termination.
- Encoder voltage range: 1Vptp±10% . SNR ≥ 52dB.
- Standard speed: 250kHz. Option for fast speed 5MHz.
- 12-bit internal ADC. Programmable multiplication range – 4 to 16384. Offset, gain, phase offset – PWM filtered analog signal
- Gain and phase offset compensation by SW using a PWM filtered analog signal.
- Encoder error, and Encoder not connected detection.

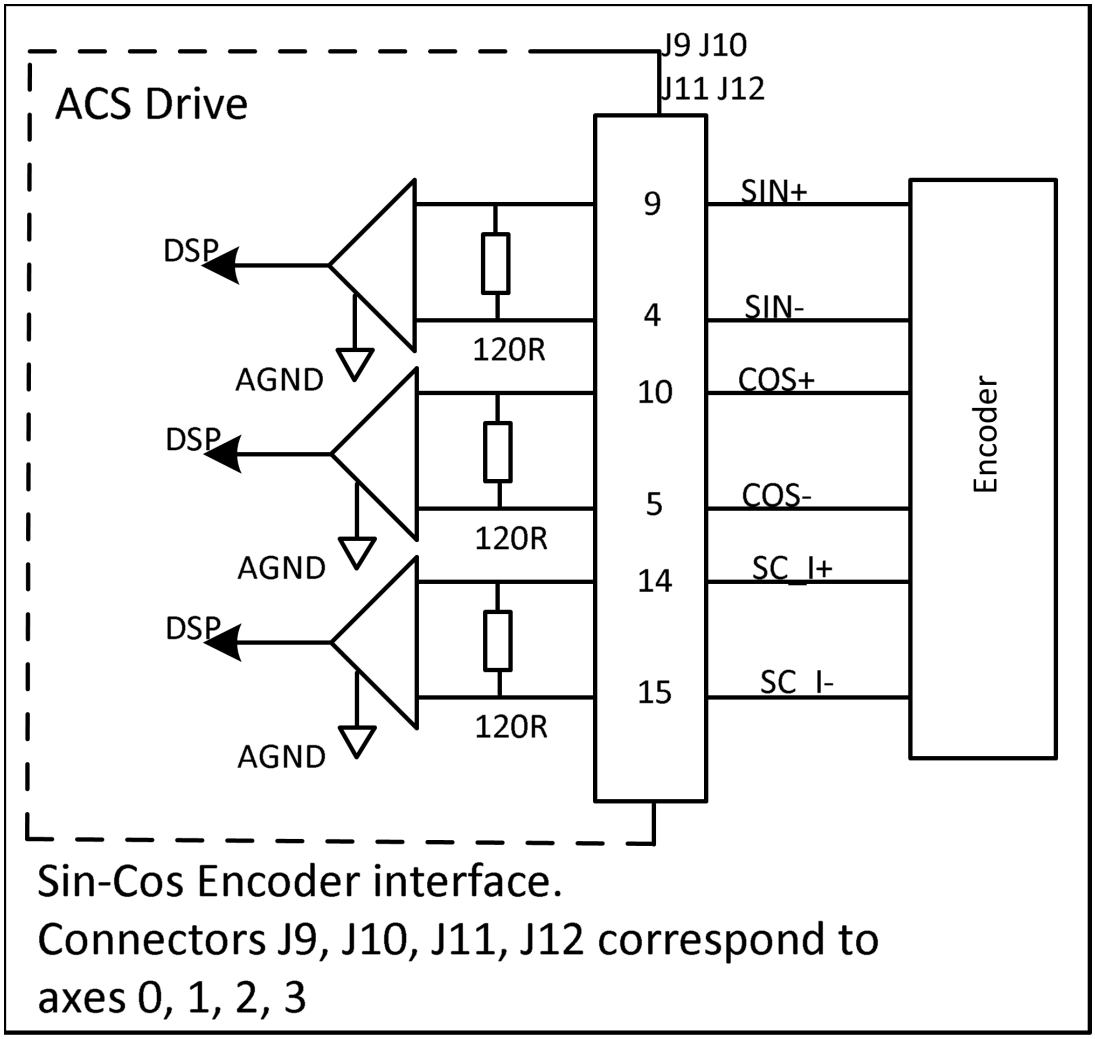


Figure 6-3. Sin Cos interface connectivity diagram

6.5 Absolute Encoder Support

For both UDILT and UDIHP, for axes 0 and 1: Endat2.2, Endat 2.1 , Tamagawa SmartABS, Panasonic and BiSS-C encoders are supported. The supported encoder type is factory preset according to order. Note that all absolute encoders are of same ordered type. Total available supply to encoders is 1A at 5V.

Refer to the connectivity diagram below: a bi-directional RS485 data channel uses CHA of the digital incremental encoder, and when clock is provided to the encoder, then CHB of the corresponding digital incremental encoder is used. The setting is performed automatically upon encoder type selection.

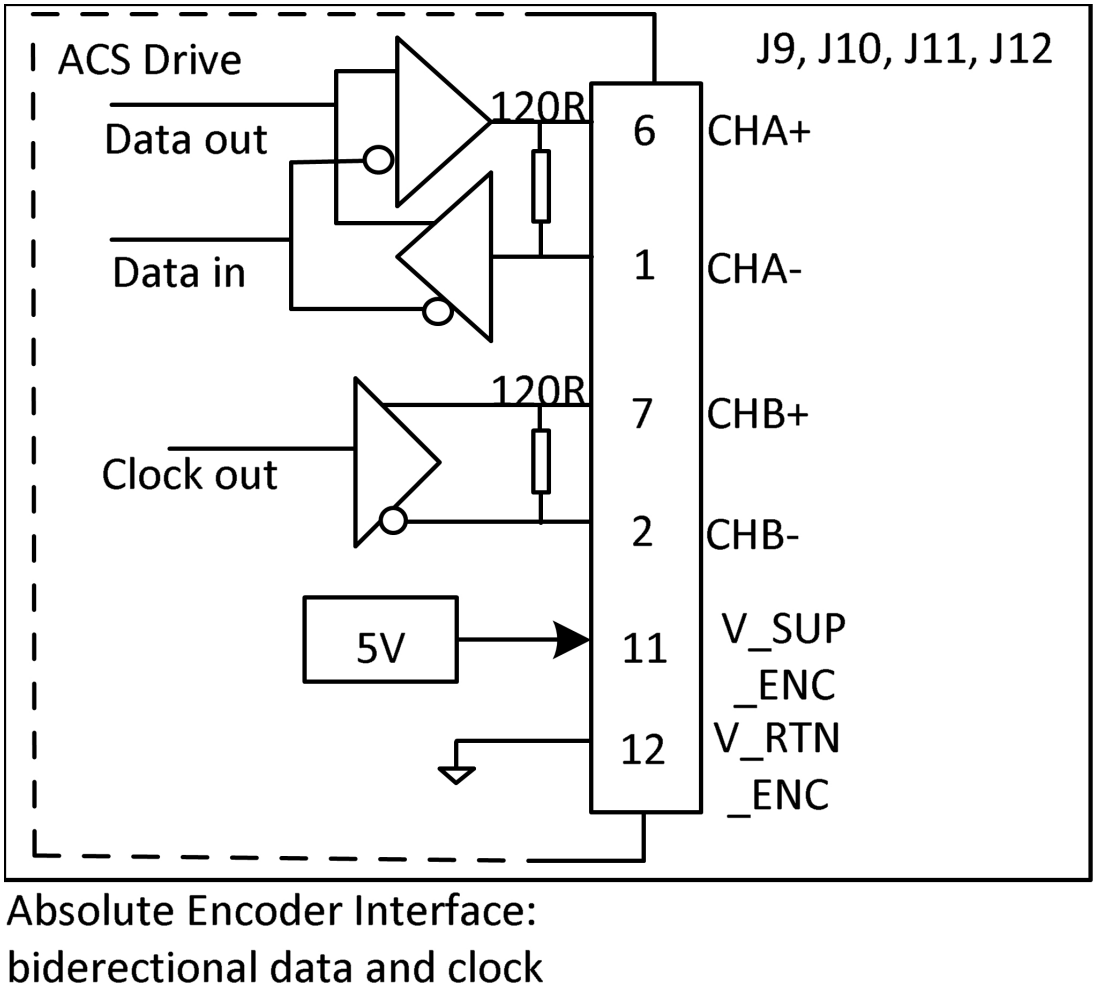


Figure 6-4. Absolute encoder schematic diagram

6.6 Position Event Generation (PEG) for Axis 0

The UDIHP/LT supports one advanced, differential RS-422 position dependent PEG output signal (also referred to as Output Compare) for synchronous random and incremental timing generation. The PEG pulse is assigned to the 0(X) drive encoder, and can be programmed for polarity and shape.

The Random PEG mode provides the ability to control a PEG pulse at pre-defined positions, which are stored as a 256 member user-defined array.

The Incremental PEG mode provides the ability to generate a fixed width pulse, starting and ending at pre-programmed points.

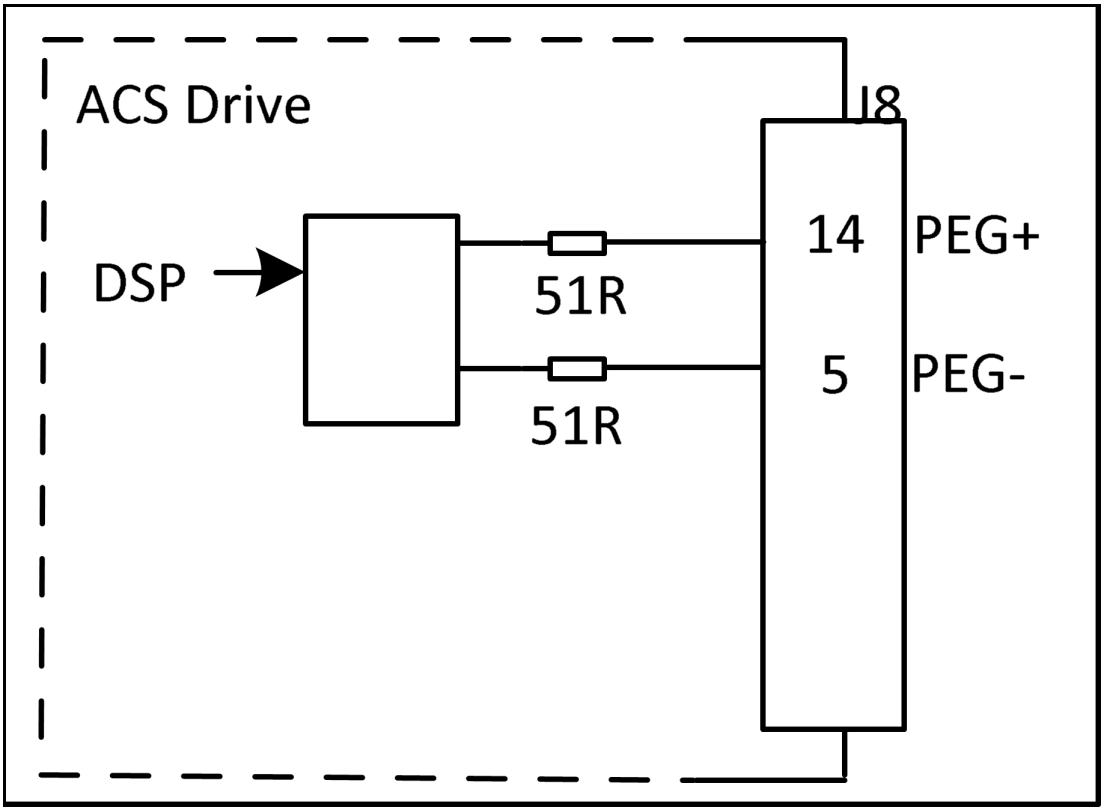


Figure 6-5. PEG output connectivity diagram

Alternate routing: The PEG output signal can be used as a General Purpose output (software configurable). Refer to the *SPiiPlusNT PEG and MARK Operations* Application Note for more details.

7. Power Supplies

The UDIHP/LT control supply is provided by 24V (19 to 29V), 15W, to connector **J13** (labeled as **CON_SUP** on the front panel).

In addition, dedicated supply pins are assigned for drive brake and for limit safety inputs.

- Control DC supply (CON_SUP): Maximal consumption of 15W (0.8A at 19Vdc)
- Mechanical brake supply: Maximum of 0.2A per drive (24V ±20%,opto isolated, source) is provided for drive mechanical brake activation. The brake supply is fed through dedicated pins in connector J8
- Safety supply: In order to maintain isolation, user supplied 24Vdc has to be provided to dedicated pins in J14.

7.1 Registration MARK Inputs

A total of 4 (one per drive) fast opto-isolated, 2-terminal pins, 24Vdc registration MARK signals are available. Alternatively, the inputs can be used as General Purpose Input signals.

Since the 2-terminal interface provides both the signal and its return, MARK can be configured both as 'sink' or 'source' as a function of the user selected connection.

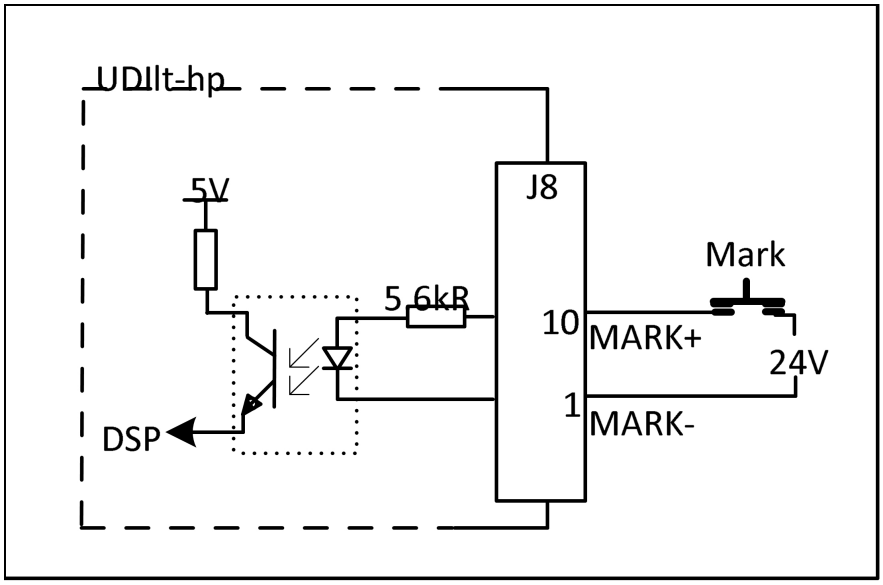


Figure 7-1. MARK Inputs for axis 0

The opto-isolated MARK inputs have a propagation delay of up to 200 ns. For MARK and GP Input assignment refer to the *SPiiPlus Command & Variable Reference Guide*.

7.2 Right and Left Limits

Right Limit and Left Limit inputs per axis are provided. The limit connections are shown in Figure 7-2.

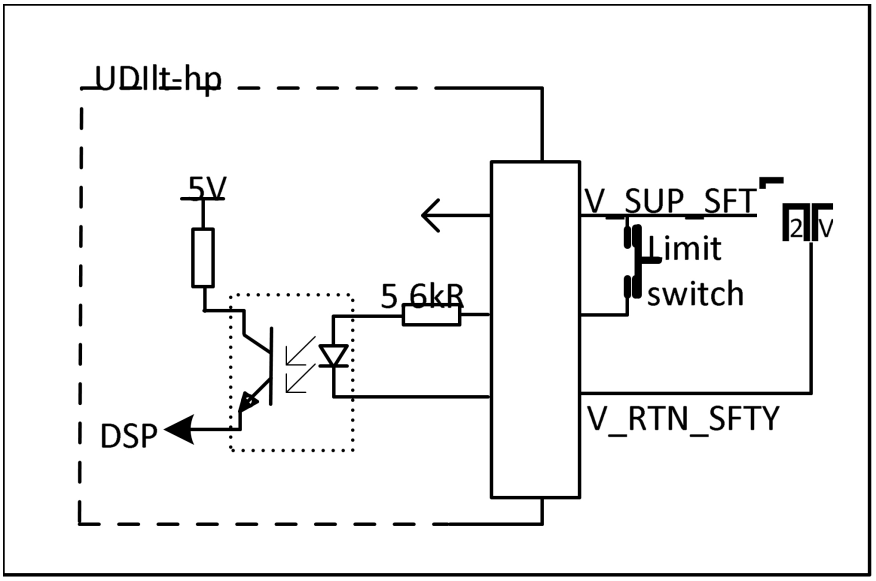


Figure 7-2. R/L Limit Connections

The inputs are single-ended, fed by a 24V ±20% driving 'source', referenced to a common return signal, and internally opto-isolated. The input current is limited to 14mA, with an internal resistor is 5.6kΩ. 'No current' is defined as the default inactive state of switch. 5V version is available by special factory order.

7.3 Emergency Stop

The Emergency Stop input is a two line, opto-isolated signal, fed from a user-provided 24V (at J14) supply and activated at above 14mA, as depicted in Figure 7-3 for 'source' and in Figure 7-4 for 'sink' connectivity configurations. 'No current' is defined as the default inactive state of switch.

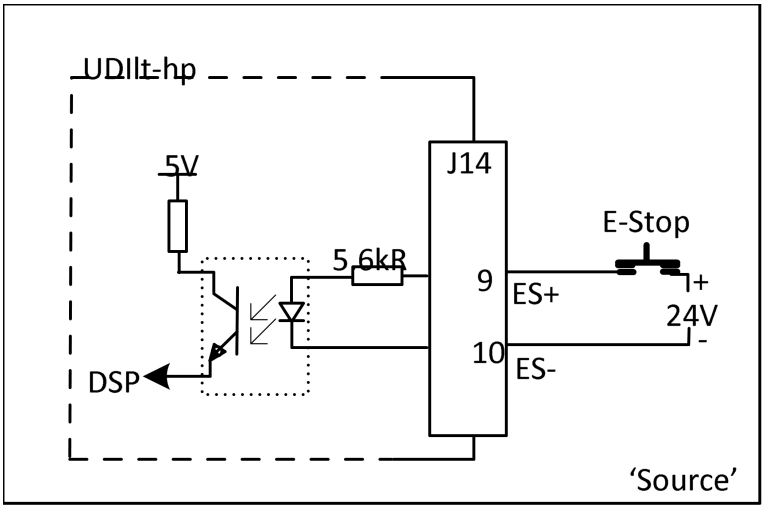


Figure 7-3. Emergency Stop Input ('source')

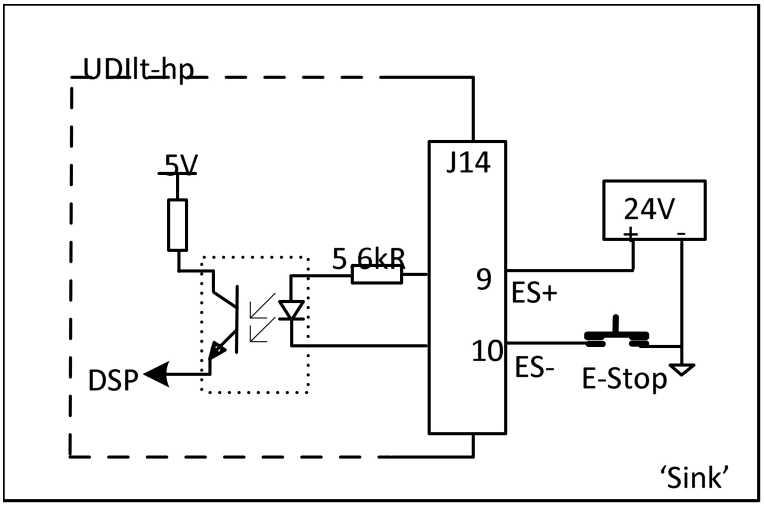


Figure 7-4. Emergency Stop Input ('sink')

8. Digital Inputs

Four Opto-isolated, single-ended, 24V±20%, source type inputs are available. Input current is limited to 14mA, refer to Figure 8-1

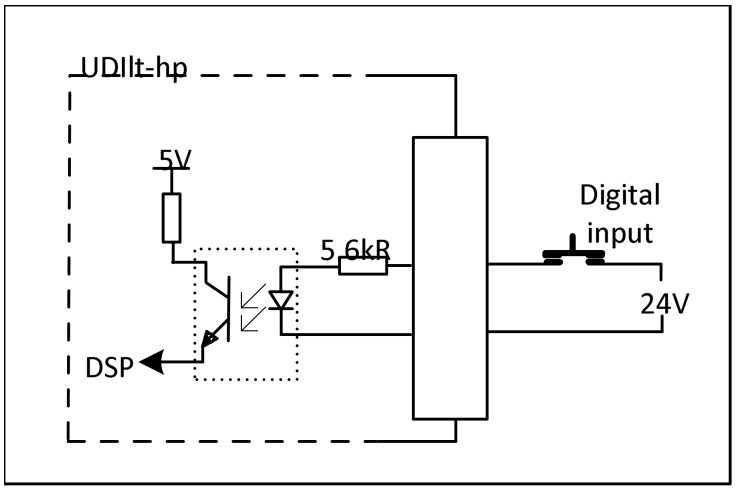


Figure 8-1. Digital Input connectivity scheme

Sink type interface and 5V support are available by a special factory order and approval.

9. Analog Inputs

Two Analog Inputs are provided in the UDIHP version only. The interface is of 12 bit differential, ±10V.

The interface is shared with Sin Cos inputs of axis 3: AIN0 is shared with 3_Sin and AIN1 is shared with 3_Cos.

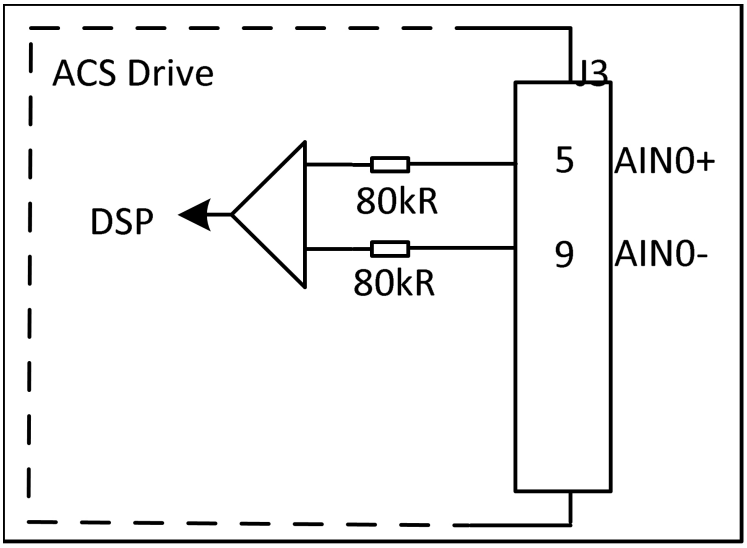


Figure 9-1. Analog Input 0 connectivity diagram

10. Analog Output

One output of 10bit differential ±10V interface is available. The output is PWM filtered. Maximal offset of ±50mV. Maximal ripple of 50mV p-p. Minimal required output load is 10kOhm. Non linearity is <1%.

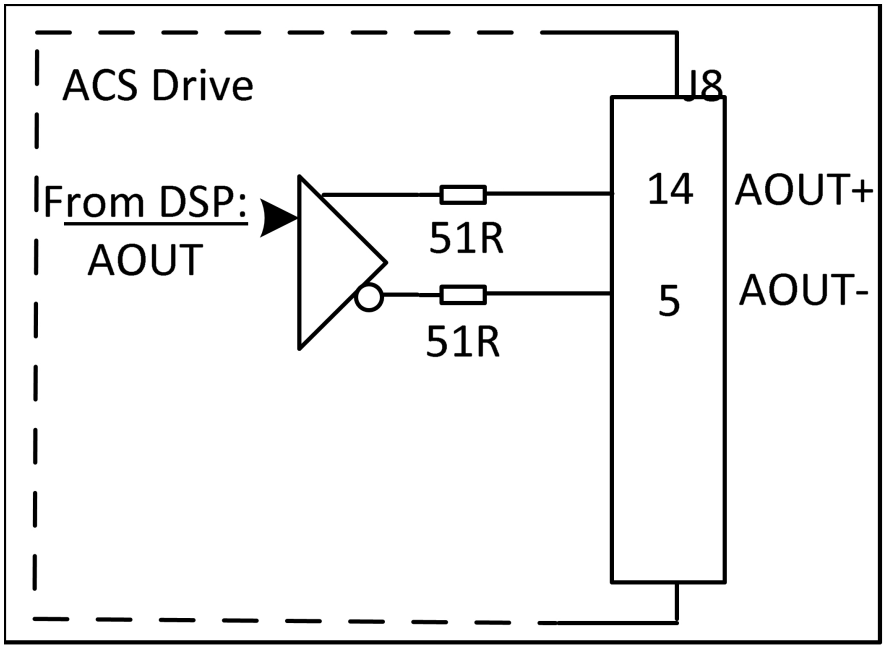


Figure 10-1. Analog Output 0 connectivity diagram

11. LED Indications

Table 11-1 summarizes the UDIHP/LT Fault LEDs and their meanings:

Table 11-1. Product LED Indicators

Indication	Description
Control Supply (on EtherCAT Out connector)	Yellow - when on – power is applied
Link/Activity (on EtherCAT In and Out connector)	Green - > Off – No link (cable disconnected) > On – Link exists, no data transferred Blinking – Data being transferred
Run (on EtherCAT In connector)	Yellow – software controlled. The LED reflects the state of the EtherCAT link. > Off –INIT state. > Blinking (slow) – PREOPERATIONAL state > Single Flash- SAFE- OPERATIONAL state > On –OPERATIONAL state > Flickering (fast) – BOOTSTRAP state
System (on panel)	Bicolor - > Red – System Fault (communication lost with master, loss of synchronization etc.) > Green – System ok > Blinking – transitional state, during command execution

12. Communication

12.1 Network (EtherCAT®) Communication

Being an EtherCAT® network element ("slave"), the UDIHP/LT has EtherCAT IN and EtherCAT OUT ports, for connection with the product's neighboring network devices. UDIHP/LT can be position anywhere in the network, including being the first device connected to the master. The following Schematic Connectivity Diagrams depict 2 sample configurations: in the upper diagram, UDILT/HP is connected to an ACS master which in turn is connected to a host computer. In the lower diagram, UDIHP/LT is connected to SPiiPlusSC, which combines an EtherCAT master functionality, host application and ACS motion controller.

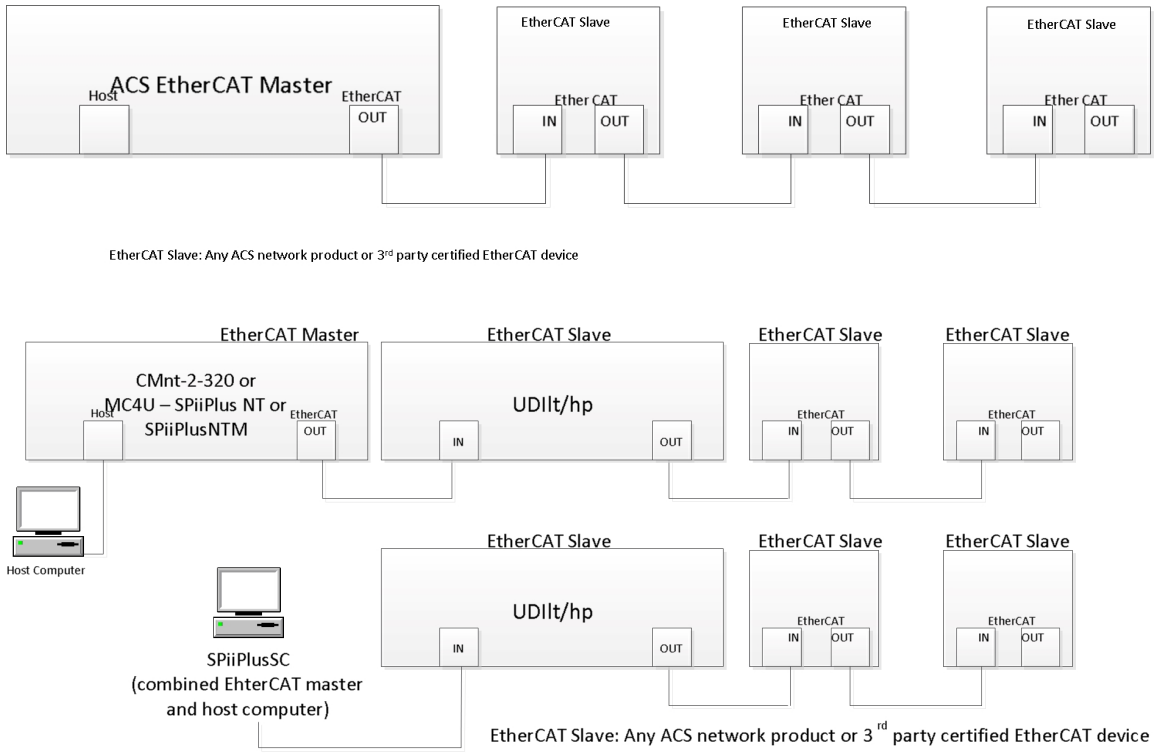


Figure 12-1. EtherCAT Network Connections

Cable type – use CAT5E or other high quality cables. ACS provides such cables at varying lengths from 30 cm to 50 m.

EtherCAT cable lengths – all ACS products have been tested with 50 m cables between adjacent nodes. At lengths of up to 100 m one should carefully test performance as a function of network complexity and operating environment.

When employing the UDIHP/LT in an EtherCAT network, the SPiiPlus MMI Application Studio EtherCAT Configurator tool is used for setting it up (refer to the SPiiPlus MMI Application Studio User Guide for details).

13. Thermal Considerations

The UDIHP/LT operates in 0°C to 50°C ambient temperatures with minimal air flow. If forced air flow is available in the cabinet or workspace where the product is mounted, for best cooling results it should be applied through the ventilation openings of the unit, in parallel to the connectors' top panel.

14. Personnel Safety Guidelines

Make sure that the following guidelines and procedures are addressed and observed prior to powering and while handling any of the network elements. Observing these procedures is crucial in order to achieve safe and optimal operation of ACS networking provisions.

The UDIHP/LT is not authorized for use in safety-critical applications (such as life supporting devices) where a failure of the product would reasonably be expected to cause severe personal injury or death.

Installation and maintenance must be performed by qualified personnel only who have been trained and certified to install and maintain high power electrical and electro-mechanical equipment, servo systems, power conversion equipment and distributed networks.

Prior to powering up the system, ensure that all network components are properly installed mechanically, properly grounded and that all attached power and signal cables are in good operating condition. Maintenance should be performed only after the relevant network element has been powered down, and all associated and surrounding moving parts have settled in their safe mode of operation. Certain drives require longer times in order to fully discharge.

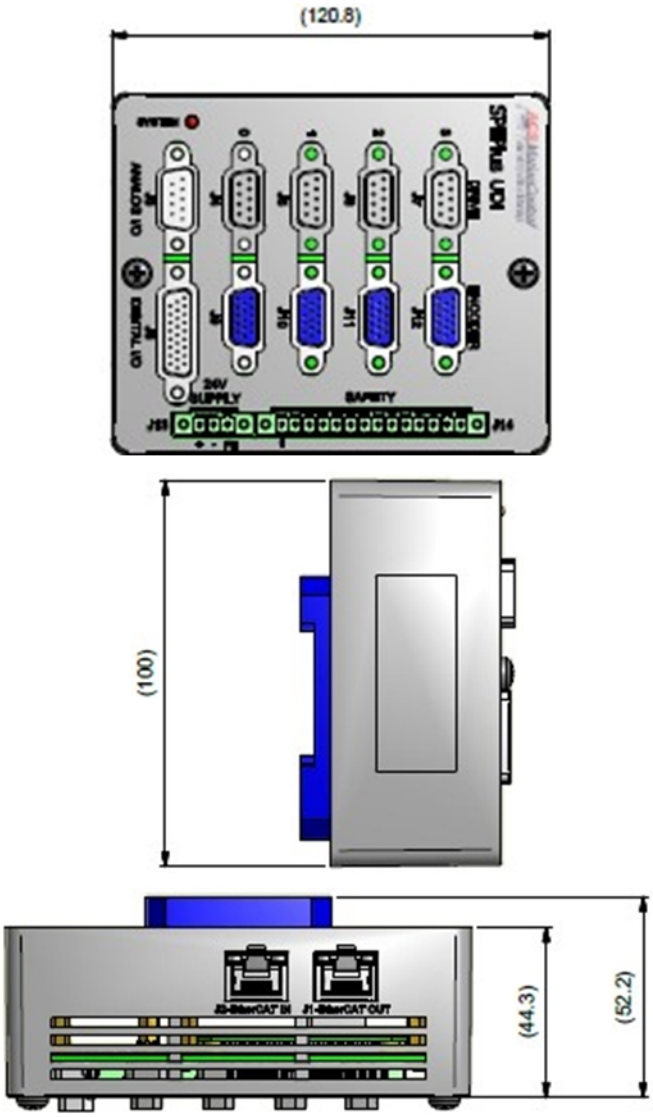
Follow the hardware guide of each element and observe the residual discharge time specified. Avoid contact with electrostatic-sensitive components and take the required precautions.

The UDIHP/LT is powered up as long as a live power inlet is connected to it. Therefore it is the responsibility of the user to provide an in-series switch or circuit breaker which is readily and rapidly accessible to the operator that disconnects all power-carrying signals.

The disconnecting device must meet the requirements of IEC60947-1 or IEC60947-3 and the current rating must not be more than 20% above the maximal current drawn by the product. The disconnecting device must be in close proximity to the equipment and within easy reach of the operator, and be clearly marked as a disconnecting device.

15. Dimensions and Installation

15.1 Dimensions



Length:	120.8 mm
Width:	100 mm
Height:	44.3 mm (52.2 mm including panel connectors).

15.2 Installation

The UDIHP/LT can be panel or DIN rail mounted.

Panel mounting: Use 2 long screws of M4X50 mm type, as shown in Figure 15-1.

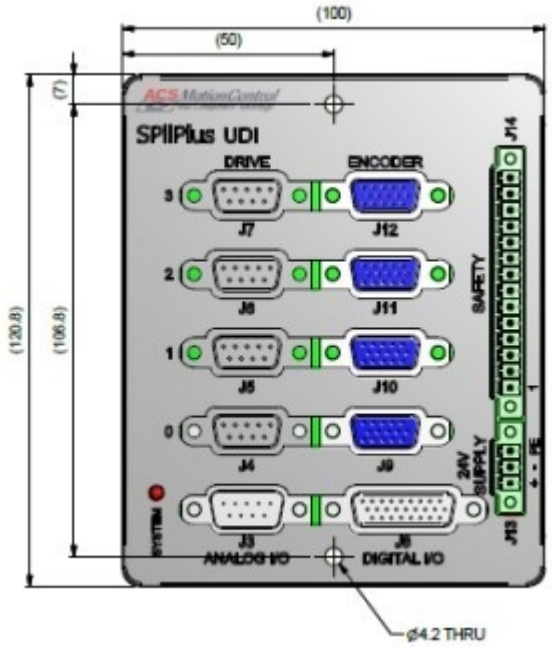


Figure 15-1. Retaining Screw Locations

DIN rail mounting: A DIN rail adaptor is part of the ordered UDIxx-ACC2 Din-rail mounting kit. Refer to Figure 15-2 and Figure 15-3 for mounting details and dimension.

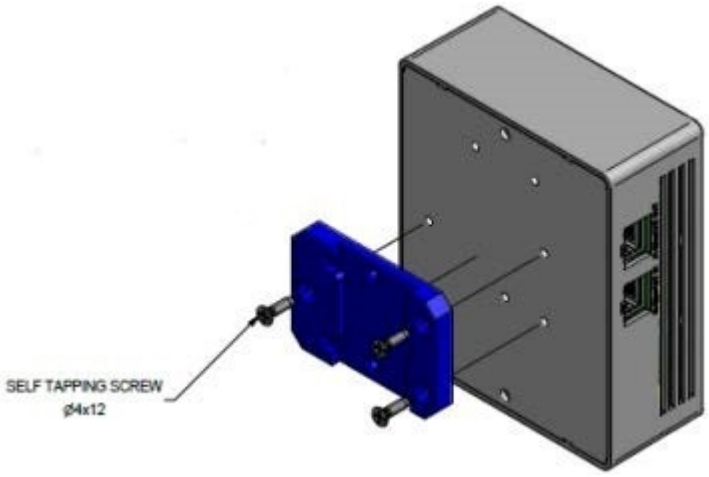


Figure 15-2. DIN Rail Mounting

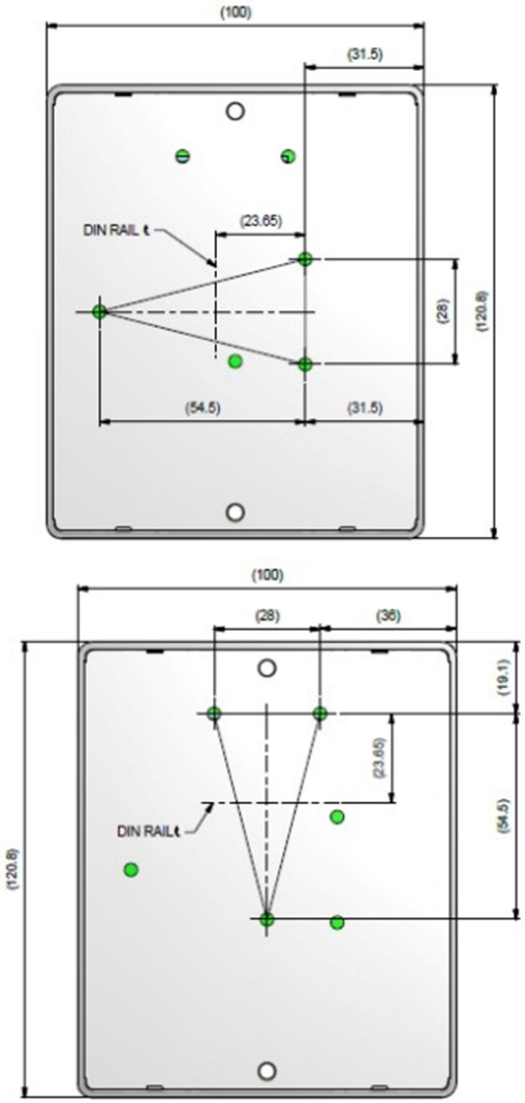


Figure 15-3. DIN Rail Mounting Dimensions (horizontal and vertical screw-hole selection)

Grounding screw: When installing the UDIHP/LT, an Earth ground must be connected to the PE pin in connector J8.

16. Product Specifications

This section details the UDIHP/LT product specifications.

16.1 General

	Details
Number of axes	UDILT: 2/4 UDIHP: 2/4
Supported control schemes	Single and Dual loop control schemes. Gantry.
Available options and configurations	> Number of axes: 2 or 4. > Number of digital encoders (2 and 4 axes): 2 or 4 > Number of absolute encoders (2 and 4 axes): 0/1/2 > Number of sin-cos encoders (hp only, 2 and 4 axes): 0/1/2/3/4
Weight	250 grams

16.2 Input Power

	Details
Control DC supply (CON_SUP)	19-29Vdc. Maximum input current 0.8A at 19Vdc.
Mechanical brake supply	24Vdc 0.8A to support 0.2A per axis.

16.3 Communication

	Details
EtherCAT	> 2 ports for node-to-node connectivity without redundancy. One port for connection in the direction of the master (IN), one port for connecting the next slave away from the master (OUT). > 100 Mbit/sec. > Up to 100m between adjacent nodes using standard CAT5E cables. Testing performed at 50m using ACS CAT5E cables.

16.4 Drive Torque Commands

	Details
Drive Torque Commands	> Total of 2/4, 1 per axis. ±10V with D/A resolution of 10bits for UDIlt and 16bits for UDIhp. 0V at power up. 2mA maximal load. Software adjustable ±50mV offset. Single ended and differential configuration. Short circuit protection. > 2/4 single torque commands are available for self-commuted drives. In a 4 axes configuration only, 2 sinusoidal commutation commands are available for axes 0 and 1.

16.5 Drive Enable

	Details
Drive Enable	> 4, 1 per drive. Opto-isolated two terminal interfaces, externally configured as a 'source' or as a 'sink'.5 or 24Vdc external supply, 20mA. Maximal voltage drop of 0.8V. > High impedance upon power up. Protected again overvoltage and against reverse polarity.

16.6 Drive Fault

	Details
Drive Fault	> 4, 1 per drive. Opto-isolated two terminal input, externally configured as a 'source' or as a 'sink'. 24Vdc ± 20%, <14mA. > 'No-current' is interpreted as a fault condition.

16.7 Encoders

	Details
Incremental Digital AqB	> 2 or 4 (option), one per axis. Supports A&B,I and Clk/Dir modes of operation. Differential RS-422 with 120Ω termination interface. > Max. rate: 12.5MHz for A and B, equivalent to 50 million encoder counts/sec. > Fault detection: Encoder error, and encoder not connected. Encoders are fed by a 5.1-5.25V, power supply (total available current to all encoders: 1A).
Sin Cos	> UDIhp only > Total of up to 4, one per axis. Analog Differential input, 1.25Vptp. 120Ohm termination. > Encoder voltage range: 1Vptp±10% . SNR ≥ 52dB.

	Details
	> Standard speed: 250kHz. Option for fast speed 5MHz. > 12-bit internal ADC. Programmable multiplication range of 4 to > 16384. Offset, gain, phase offset – PWM filtered analog signal Gain and phase offset compensation by SW using a PWM filtered analog signal. > Encoder error, and Encoder not connected detection.
Absolute	> Maximum 2 for axes 0 and 1. Certain assignment constraints apply as a function of axes and production configuration, (see Chapter 6). > Supported types: 2 Endat 2.2, Endat 2.1, Panasonic, SmartABS (version 2.15) and BiSS (version 2.20). Check availability with ACS.

16.8 Registration MARK Input

	Details
Registration MARK Inputs	> Four. Fast, 24V±5%, opto-isolated, two terminals available which can be configured as 'sink' or 'source'. 10mA maximum current required to activate. > The signals can be used as general purpose fast inputs, as function of software configuration.

16.9 General Purpose Digital Inputs

	Details
General Purpose Input	Four, Opto-isolated, single-ended, 24V±20%, source. 5V option is available by special factory order

16.10 Analog Inputs

	Details
Analog input	> UDIhp only. > Two, 12 bit differential, ±10V. > Shared with sin-cos interface.

16.11 Analog Output

	Details
Analog Output	> One, 10bit differential, ±10V, PWM filtered output. > Maximal offset of ±50mV. Maximal ripple of 50mV p-p. > Minimal output load of 10kOhm. Non linearity <1%

16.12 Motor (Mechanical) Brake

	Details
Mechanical Brake	One output per axis. 24V ±20%, opto-isolated. Source type, 0.2A each. Protection against: short current, over voltage and reverse polarity. Supply is from external 5 or 24Vdc source (J8 pins 25, 6). The signal can be programmed to be used as General Purpose output.

16.13 PEG Outputs

	Details
Dedicated PEG Signal	> One (assigned to axis 0(X)) pulse for incremental or random mode operation, differential RS-422 output. > One, differential, RS-422 output, can be used as general purpose output, as function of software configuration. > For further information on PEG operation, see SPiiPlusNT PEG and MARK Operations Application Notes.

16.14 Safety and Faults

	Details
Limits	> Right Limit and Left Limit per axis. > Opto-isolated, single-ended 24V± 20%, source type, referenced to a common return signal. Maximal input current is 14mA. > Software indication to user's application is provided. > 5V version is available by special factory order.
Emergency Stop	> One opto-isolated, 24V, 2-teminal signal. Maximal input current is 14mA. > 'No current' is defined as the default inactive state of switch. > Software indication to user's application is provided.

16.15 Environment

	Details
Temperature during operation	0 to +50°C Refer to Thermal Considerations .
Storage	-25 to +70°C
Humidity	5% to 90% non-condensing

16.16 Applicable Standards

The UDIHP/LT Dual Axis Control Module meets the requirements of the following standards.

Refer to ACS for formal certificate availability schedule

EN 61326-1:2006	Industrial locations equipment, class A standard, under article 6 (2) of EMC Directive 2004/108/EC (ACSEMC_EN.22513C)
IEC 61010-1:2001	Safety conformance, 2nd edition.
IEC 60068-2-6 Class 4M4 IEC 60068-2-29 Class 4M4 IEC 60068-2-56 Class 4K3	Sine vibration during operation (5-150 Hz, 3 axes, 10 m/s2) 600 shocks, 150 m/s2, 6 ms 93%, 30oC

17. UDIHP/LT Connectors

17.1 J1 – EtherCAT Output Connector

- Label: J1 EtherCAT OUT
- Connector Type: RJ-45 type 8 pin, socket
- Mating Type: RJ-45 type, 8 pin, plug

Table 17-1. J1 Connector Pinout

Pin	Name	Description
1	ETH_OUT_TX+	Positive transmit signal
2	ETH_OUT_TX -	Negative transmit signal
3	ETH_OUT_RX +	Positive receive signal
4	N/C	Not connected
5	N/C	Not connected
6	ETH_OUT_RX -	Negative receive signal
7	N/C	Not connected
8	N/C	Not connected

17.2 J2 – EtherCAT Input Connector

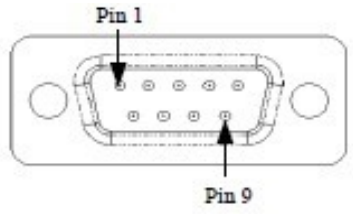
- Label: J2 EtherCAT IN
- Connector Type: RJ-45 type 8 pin, socket
- Mating Type: RJ-45 type, 8 pin, plug

Table 17-2. J2 Connector Pinout

Pin	Name	Description
1	ETH_IN_TX+	Positive transmit signal

Pin	Name	Description
2	ETH_IN_TX -	Negative transmit signal
3	ETH_IN_RX +	Positive receive signal
4	N/C	Not connected
5	N/C	Not connected
6	ETH_IN_RX -	Negative receive signal
7	N/C	Not connected
8	N/C	Not connected

17.3 J3 – Analog I/O Connector



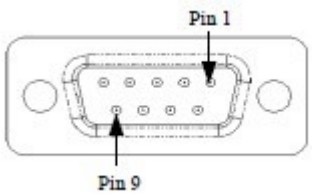
- Label: J3 ANALOG I/O
- Connector Type: 9-pin, D-SUB male
- Mating Type: 9-pin, D-SUB female

Table 17-3. J3 Connector Pinout

Pin	Name	Description
1	SHIELD	SHIELD
2	AGND	Analog ground
3	AOUT0+	Analog output 0 non-inverted
4	AIN1+	Analog input 1 non-inverted
5	AIN0+	Analog input 0 non-inverted
6	N/C	Not connected
7	AOUT0-	Analog output 0 inverted
8	AIN1-	Analog input 1 inverted
9	AIN0-	Analog input 0 inverted

The connector shell and front screw locks: M1, M2, thereby grounding the connector.

17.4 J4, J5, J6, and J7 Drive Connectors



- Label: J4 DRIVE 0, J5 DRIVE 1, J6 DRIVE 2, J7 DRIVE 3
- Connector Type: 9-pin, D-SUB female
- Mating Type: 9-pin, D-SUB male

In Table 17-4 and Table 17-5 the pound sign (#) stands for the axis designation, depending on the connector, where:

#= X (0)

= Y (1)

= A (2)

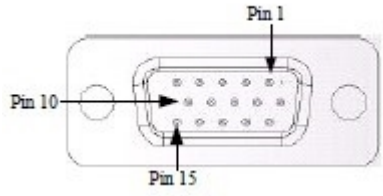
= B (3)

Table 17-4. J4, J5, J6 and J7 Connector Pinout

Pin	Name	Description
1	#_ CMD0+	Command 0 non-inverted
2	#_ CMD1+	Command 1 non-inverted
3	#_ ENA+	Drive # enabled non-inverted
4	#_FLT+	Drive # fault non-inverted
5	CMD_ RTN	Command signals return: > Connected to AGND (analog ground) when the analog commands are used (jumper JP3 in 2-3 position) > Connected to DGND (digital ground) when the PWM commands are used (jumper JP3 in 2-1 position)

Pin	Name	Description
6	#_ CMD0-	Command 0 inverted
7	#_ CMD1-	Command 1 inverted
8	#_ ENA-	Drive # enabled inverted
9	#_FLT-	Drive # fault inverted

17.5 J9, J10, J11, and J12 Encoder Connectors



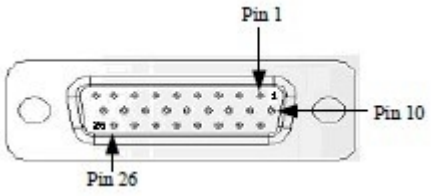
- Label: J9 Encoder 0, J10 Encoder 1, J11 Encoder 2, J12 Encoder 3
- Connector Type: 15-pin D-SUB HD-type female
- Mating Type: 15-pin D-SUB HD-type male

Table 17-5. J9, J10, J11 and J12 Connector Pinout

Pin	Name	Description
1	#_CHA-	# digital encoder, channel A inverted input
2	#_CHB-	# digital encoder, channel B inverted input
3	#_CHI-	# digital encoder, channel I (index) inverted input
4	#_SIN-	# SIN-COS encoder, SIN inverted input
5	#_COS-	# SIN-COS encoder, COS inverted input
6	#_CHA+	# digital encoder, channel A noninverted input
7	#_CHB+	# digital encoder, channel B noninverted input
8	#_CHI+	# digital encoder, channel I (index) non-inverted input
9	#_SIN+	# SIN-COS encoder, SIN noninverted input

Pin	Name	Description
10	#_COS+	# SIN-COS encoder, COS noninverted input
11	V_SUP_ ENC	Encoders 5V supply "+": Connected to 5VU when the digital encoders are used (JP1 in 2-1 position) Connected to 5VF when the SINCOS encoders are used (JP1 in 23 position)
12	V_RTN_ ENC	Encoders 5V supply return: Connected to DGND when the digital encoders are used (JP2 in 2-1 position) Connected to AGND when the SIN-COS encoders are used (JP2 in 2-3 position)
13	SHIELD	SHIELD
14	#_SC_HI+	# SIN-COS encoder, index noninverted input
15	#_SC_HI-	# SIN-COS encoder, index inverted input

17.6 J8 - Digital I/O & Brake Connector



- Label: J8 DIGITAL I/O & BRAKE
- Connector Type: 26-pin, female D-SUB HD Type
- Mating Type: 26-pin, male D-SUB HD Type

Table 17-6. J8 Connector Pinout

Pin	Name	Description
1	X_MARK-	Drive X(0) mark input inverted
2	Y_MARK-	Drive Y(1) mark input inverted
3	A_MARK-	Drive A(2) mark input inverted
4	B_MARK-	Drive B(3) mark input inverted

Pin	Name	Description
5	PEG0-	PEG 0 output inverted
6	N/C	Not connected
7	IN1	Digital Input 1
8	IN3	Digital Input 3
9	V_RTN_IN	Input supply return
10	X_MARK+	Drive X(0) mark input noninverted
11	Y_MARK+	Drive Y(1) mark input noninverted
12	A_MARK+	Drive A(2) mark input non- inverted
13	B_MARK+	Drive B(3) mark input non- inverted
14	PEG0+	PEG 0 output non-inverted
15	DGND	Digital ground
16	IN0	Digital Input 0
17	IN2	Digital Input 2
18	V_SUP_IN	Input supply "+"
19	SHIELD	SHIELD
20	N/C	Not connected
21	X_BRK	Drive X(0) motor brake output
22	Y_BRK	Drive Y(1) motor brake output
23	A_BRK	Drive A(2) motor brake output
24	B_BRK	Drive B(3) motor brake output
25	BRK_SUP	Motor brake supply "+"
26	BRK_RTN	Motor brake supply return

17.7 J13 - 24V Supply Connector

- Label: J13 24V SUPPLY
- Connector Type: Phoenix MCV 1.5/ 3-GF-3.81
- Mating Type: Phoenix MCV 1.5/ 3-STF-3.81

Table 17-7. J13 Connector Pinout

Pin	Name	Description
1	24V	+24 Vdc supply
2	24VRTN	24 Vdc supply return
3	SHIELD	SHIELD

17.8 J14 Safety Inputs and Supply Connector

- Label: J14 SAFETY INPUTS & SUPPLY
- Connector Type: Phoenix MCV 1,5/14-GF-3,81
- Mating Type: Phoenix MC 1,5/ 14-STF-3,81

Table 18-1. J14 Connector Pinout

Pin	Name	Description
1	X_RL	Axis X(0) right limit
2	X_LL	Axis X(0) left limit
3	Y_RL	Axis Y(1) right limit
4	Y_LL	Axis Y(1) left limit
5	A_RL	Axis A(2) right limit
6	A_LL	Axis A(2) left limit
7	B_RL	Axis B(3) right limit
8	B_LL	Axis B(3) left limit
9	ES+	Emergency stop non- inverted
10	ES-	Emergency stop inverted
11	V_SUP_SFTY	Safety Supply “+”
12	V_SUP_SFTY	Safety Supply “+”
13	V_RTN_SFTY	Safety Supply Return
14	V_RTN_SFTY	Safety Supply Return

Smarter Motion

1 Hataasia St
Ramat Gabriel Industrial Park
Migdal Ha'Emek 2307037 Israel
Tel: (+972) (4) 654 6440 Fax: (+972) (4) 654 6443