ENGINEERING
TOMORROW

Danfoss

Operating Guide

Encoder/Resolver Option OC7M0

iC7 Series

Contents

1 Introduction

1.1 Purpose of the Operating Guide

This operating guide provides information for safe installation, commissioning, and operation of functional extensions used with iC7 drives.

This guide is intended for use by qualified personnel only. Read and follow the operating instructions to use the drive safely and professionally, and pay particular attention to the safety instructions and general warnings. Keep this operating guide available with the drive at all times.

1.2 Additional Resources

Additional resources are available to help understand the features, and safely install and operate the iC7 products:

- Safety guides, which provide important safety information related to installing iC7 drives.

- Installation guides, which cover the mechanical and electrical installation of drives, or functional extension options.

- Design guides, which provide technical information to understand the capabilities of the iC7 drives for integration into motor control and monitoring systems.

- Application guides, which provide instructions on setting up the drive for a specific end use.

- Supplemental publications, drawings, and manuals are available at www.danfoss.com.

Latest versions of Danfoss product manuals are available for download at http://drives.danfoss.com/downloads/portal/.

1.3 Version History

This guide is regularly reviewed and updated. All suggestions for improvement are welcome.

The original language of this guide is English.

Table 1: Version History

Version	Remarks
AQ390830267692, version 0401	Information on support for SinCos encoders added.
AQ390830267692, version 0301	Updates regarding electrical specifications and the default value and available selections of parameter *9.6.6 BiSS/SSI Clock Rate*.
AQ390830267692, version 0201	Updates regarding Encoder/Resolver Option OC7M0 features.
AQ390830267692, version 0101	First version. The information in this version is valid for Encoder/Resolver Option OC7M0 installed in iC7-Automation frequency converters.

2 Safety

2.1 Safety Symbols

The following symbols are used in this guide:

⚠ **D A N G E R** ⚠
Indicates a hazardous situation which, if not avoided, will result in death or serious injury.

⚠ **W A R N I N G** ⚠
Indicates a hazardous situation which, if not avoided, could result in death or serious injury.

⚠ **C A U T I O N** ⚠
Indicates a hazardous situation which, if not avoided, could result in minor or moderate injury.

N O T I C E
Indicates information considered important, but not hazard-related (for example, messages relating to property damage).

2.2 Safety and Installation Awareness

Before starting installation, read all safety guidelines and precautions related to installing functional extensions.

For more information on functional extension selection and functional extension slots in the drives, see the product-specific design guides. Supplemental information and other iC7 guides can be downloaded from www.danfoss.com/service-and-support.

3 Configuration

3.1 Configuration Overview

The parameters related to functional extensions are in parameter group 9, called **I/O**. Parameters are dependent on the mounting, and will appear in the parameter menu after the functional extension has been mounted and wired.

4 Encoder/Resolver Installation and Configuration

4.1 Encoder/Resolver Option OC7M0

The Encoder/Resolver option supports connecting various devices as speed/position feedback or reference. It also has a TTL encoder simulation output, which can be used to mirror the resolver input signal.

There are 4 channels (A, B, Z, and D) which can be configured in different combinations according to Table 2.

Table 2: Encoder/Resolver Option Configurations

Device	Tracks
Incremental TTL/HTL	A and B
Incremental TTL/HTL with zero pulse	A, B, and Z
Resolver	A and B
Resolver with encoder mirror out	A and B + Z and D
SinCos	A and B
SSI	Z and D
EnDat	Z and D
BiSS	Z and D
HIPERFACE DSL^Æ	D

Adjustable encoder voltage supply is available 5–24 V with the possibility of feedback enabling monitoring and compensation for cable voltage drop. The voltage level is set with parameter *9.4.4 Encoder supply voltage*.

> **N O T I C E**
>
> Setting the voltage too high can damage the connected encoder.

Resolver supply/excitation is available with adjustable voltage and frequency by parameters *9.7.1 Excitation Voltage* and *9.7.2 Excitation Frequency*.

4.2 Required Tools

- Torx 20 screwdriver for mounting EMC plate Slot C-E.

- Slotted screwdriver (maximum 3 mm) for releasing the spring-loaded terminals of the plug connector.

- Wire crimpers may be needed for certain encoder cable types.

4.3 Checking the Shipment

Make sure that the items supplied and the information on the product label correspond to the order confirmation. The product label is placed on the front and right side of the option casing.
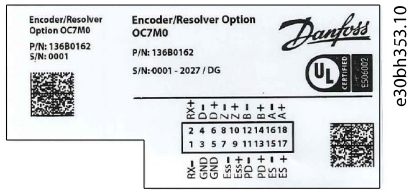

Illustration 1: Example of a Product Label

The labels contain the following information:

- Product name, code number, and serial number

- Company name

- A 2D code which can be used to access detailed product information via MyDrive® tools.

- Compliance and approval markings

- Identification of I/O connections on the option

4.4 Items Supplied

The Encoder/Resolver OC7M0 option can be ordered as a preinstalled option by using the dedicated model code, or as a separate option for field mounting by using the code number.

When the option is not mounted at the factory, the following items are included in the shipment:

- Encoder/Resolver OC7M0.

- Option connector.

- Cable clamps.

- Screws.

- Operating guide.

4.5 Installing Functional Extensions in Frequency Converters

The instructions in this chapter apply to frequency converters with an integrated control board.

⚠ D A N G E R ⚠

SHOCK HAZARD FROM THE AC DRIVE

Touching electrical parts of the drive can cause death or serious injury even after the equipment has been disconnected from AC power.

- Perform the following steps before touching any internal components:
  Disconnect the mains power.
  Disconnect the motor.
  Disconnect external connections to the DC terminals of the drive.
  Wait for the capacitors to discharge fully. Refer to the label on the drive for the correct discharge time.
  Ensure that the DC-link capacitors have discharged fully by measuring the DC link with a voltage meter.
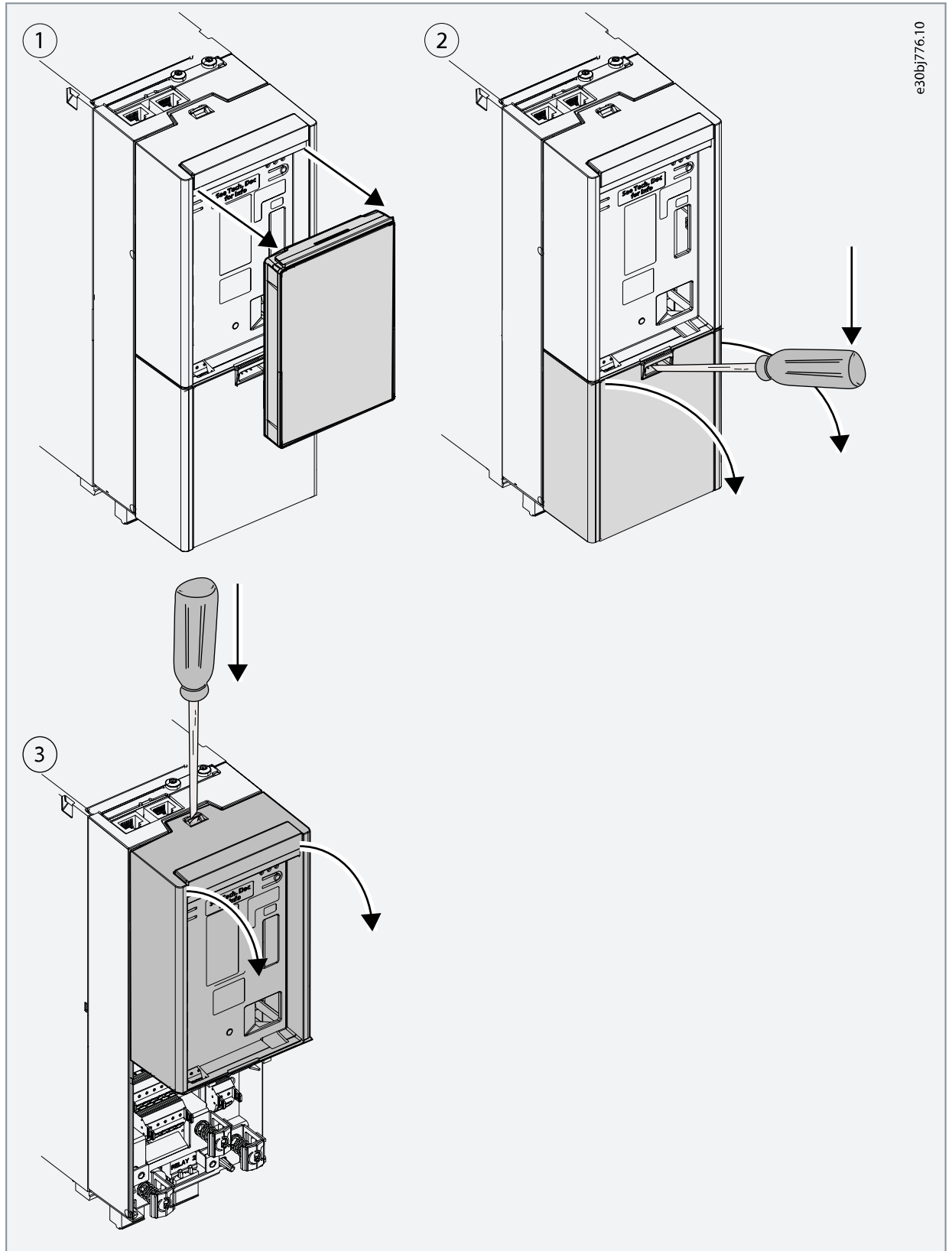

N O T I C E

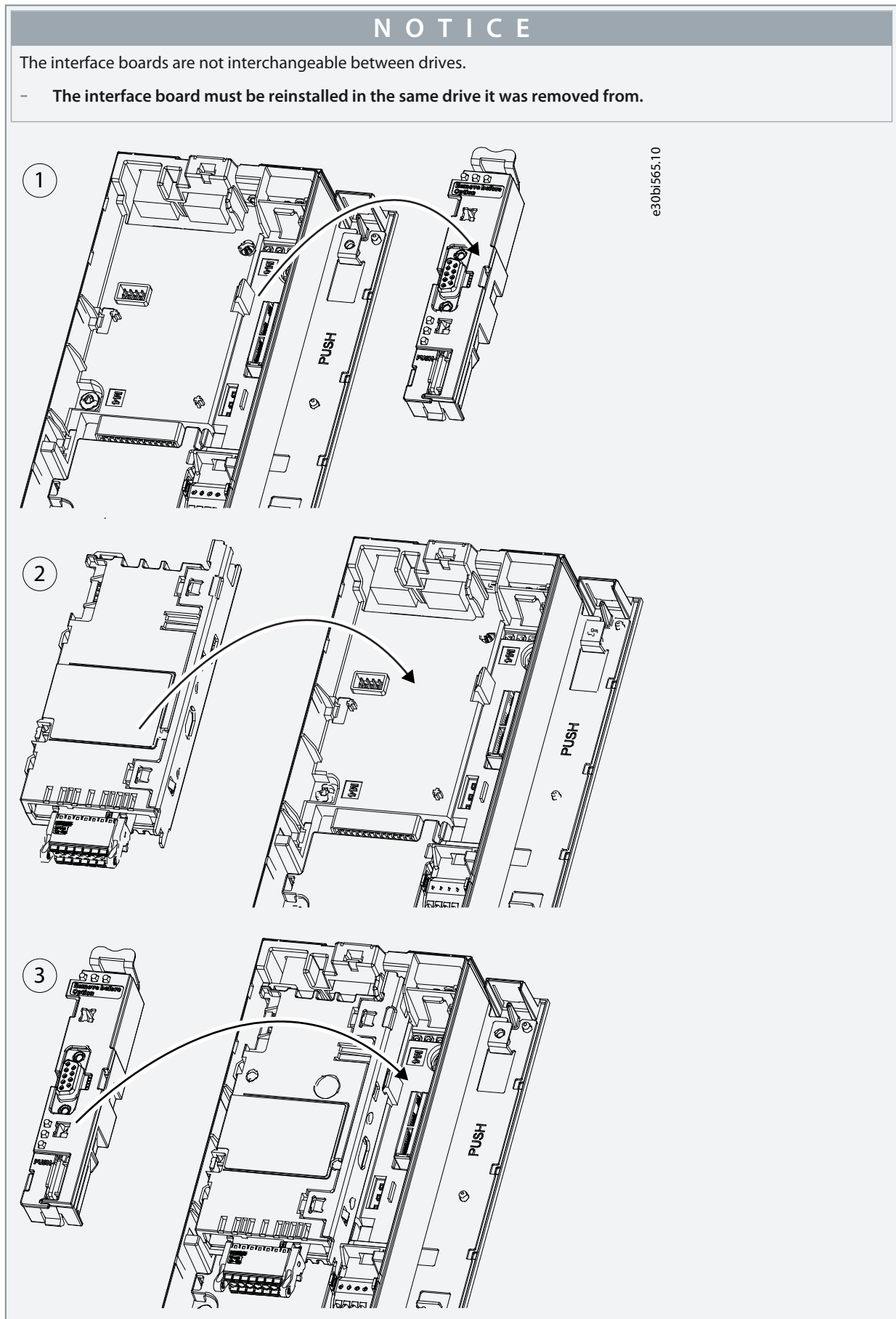The Encoder/Resolver Option OC7M0 must be installed in **option slot A**.

- For more information on option slot locations in frequency converters, refer to the design guide.

- For information on slot identification in software, refer to the application guide.

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1. Remove the control panel, terminal cover, and control panel cradle.

2. Remove the interface board, place the option board in the slot, and reinstall the interface board.

> **N O T I C E**
>
> The interface boards are not interchangeable between drives.
>
> – **The interface board must be reinstalled in the same drive it was removed from.**

4.6 Pin Assignment for Encoder/Resolver OC7M0

The **Plug detect** feature, which monitors that pins 11 and 13 are connected, detects the unintentional disconnection of the plug connector.

N O T I C E

If the Plug detect connection is missing while the interface is activated (parameter *9.4.1 Interface configuration* ≠ "Disabled"), the drive generates a fault.

- The fault is generated only when switching to closed-loop operation, not when selecting an encoder.
- The plug connector is delivered without a connection between pin 11 and 13.

Table 3: Pin Assignment and Function for Encoder/Resolver Option OC7M0

Numbering	Functions	Numbering	Functions
1	Resolver Excitation -	2	Resolver Excitation +
3	GND	4	Ch. D- (TTL, RS-485, HIPERFACE DSL®)
5	GND	6	Ch. D+ (TTL, RS-485, HIPERFACE DSL®)
7	Encoder Supply Sensor -	8	Ch. Z- (TTL, HTL, RS-485, R-)
9	Encoder Supply Sensor +	10	Ch. Z+ (TTL, HTL, RS-485, R+)
11	Plug Detect - (GND)	12	Ch. B- (TTL, HTL, RS-485, Analog B-)
13	Plug Detect +	14	Ch. B+ (TTL, HTL, RS-485, Analog B+)
15	Encoder Supply - (GND)	16	Ch. A- (TTL, HTL, RS-485, Analog A-)
17	Encoder Supply +	18	Ch. A+ (TTL, HTL, RS-485, Analog A+)

4.7 Encoder/Resolver Option OC7M0 Specifications

N O T I C E

Voltage can be up to 24 V. Setting the voltage too high can damage the connected encoder.

The voltage is configured in parameter *9.4.4 Encoder Supply Voltage*. For details, refer to .

Table 4: Electrical Specifications for Encoder/Resolver Option OC7M0

Encoder supply voltage [V DC]	Maximum current [mA]
24	125
15	150
12	150
8	225
5	300

If the available power is insufficient, it is possible to use an external power supply for the encoder.

Table 5: Device Type Specifications

Device type	Specifications		Additional information[1]
	Data	Value	
TTL (A, B, Z)	Signal level	0–5 V	Differential signals are preferred, but single signals are also supported. The trigger threshold is 0.33–0.4 times the encoder supply voltage.
	Maximum resolution	65535	
	Maximum frequency	750 kHz	
	Maximum cable length	Depends on signal frequency	
HTL (A, B, Z)	Signal level	0–24 V	
	Maximum resolution	65535	
	Maximum frequency	500 kHz	
SinCos	Signal level	1 V peak-peak	–
	Maximum resolution	65535	
	Maximum frequency	750 kHz	
SSI	Maximum resolution	31 bit	–
	Maximum data length	63 bit	
	Maximum clock frequency	2 MHz	
EnDat	Maximum resolution	31 bit	Both EnDat 2.1 and EnDat 2.2 are supported, but only with pure absolute channel, not with incremental channel.
	Maximum data length	63 bit	
	Maximum clock frequency	8.33 MHz	
HIPERFACE DSL®	Maximum resolution	31 bit	Baud rate is fixed.
	Maximum data length	63 bit	
	Baud rate	10 Mbps	
BiSS	Maximum resolution	31 bit	–
	Maximum data length	63 bit	
	Maximum clock frequency	8.33 MHz	
Resolver	Excitation voltage	2–8 V_{rms}	–
	Excitation frequency	2–20 kHz	
	Maximum number of poles	254	
	Maximum input voltage	8 V_{rms}	
	Maximum load	100 mA_{rms}	
Encoder simulation (TTL Output)	Voltage level	Minimum: 1.5 V Typical: 2 V differential	–

Device type	Specifications		Additional information[1]
	Data	Value	
	Maximum resolution	65535	
	Maximum frequency	750 kHz	
	Maximum load	60 mA	

[1] The limitations described in this guide apply to the current software version.

Table 6: Cable Specifications for Encoder/Resolver Option OC7M0

Cable type	Cross-section [mm^2 (AWG)]	Minimum stripping length [mm (in)]
Flexible/rigid wire without cable end sleeves	0.2–1.5 (26–16)	10 (0.4)
Flexible wire with cable end sleeves with collar	0.2–0.75 (26–18)	

A standard RS485 interface supports cable lengths up to 1200 m (3940 ft) depending on signal frequency and cable type. Consult the documentation for the respective encoder or resolver for details on allowed cable length.

4.8 Setup and Connection Examples for Encoder/Resolver OC7M0

4.8.1 Incremental Encoder

With TTL and HTL incremental encoder, the actual position is 0 after power-up, and encoder pulses are counted to increment or decrement the actual position. For improved resolution with TTL and HTL encoders, both the positive and negative edge of A and B pulses are detected giving 4 quad counts per encoder pulse.

Table 7: Parameters for Incremental Encoder

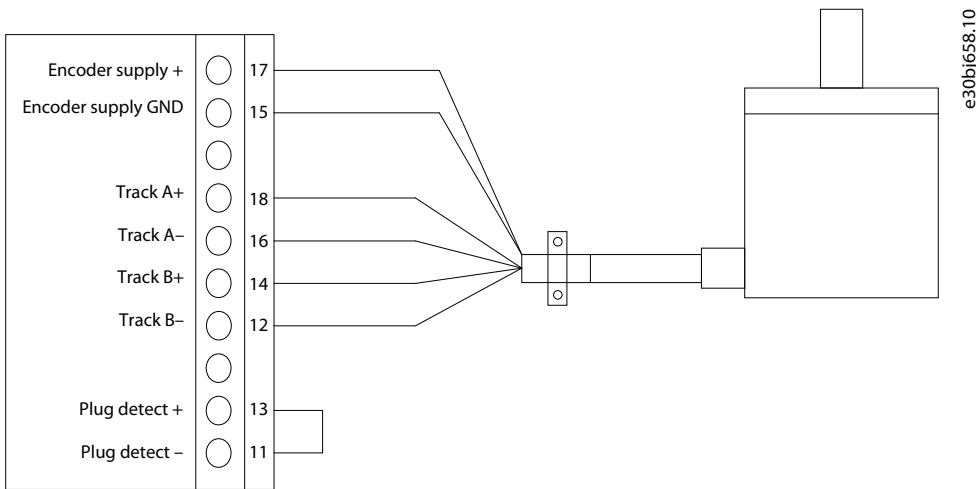| Parameter	Setting
9.4.1 Interface configuration	Set according to the type of connected encoder. TTL/HTL with 2 tracks: Select *[1] 2 track Incremental A, B*. TTL/HTL with 3 tracks: Select *[3] 3 track Incremental A, B, Z*.
9.4.4 Encoder Supply Voltage	Set the appropriate supply voltage for the connected encoder. **N O T I C E** Voltage can be up to 24 V. Setting the voltage too high can damage the connected encoder.
9.5.1 Resolution Device 1	Set the resolution of the encoder in pulses per revolution.

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Pin	Signal
Encoder supply +	17
Encoder supply GND	15
Track A+	18
Track A−	16
Track B+	14
Track B−	12
Plug detect +	13
Plug detect −	11

Illustration 2: Wiring Configuration for Incremental Encoder, 2 Differential Tracks (TTL, HTL)

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Pin	Signal
Encoder supply +	17
Encoder supply GND	15
Track A+	18
Track B+	14
Plug detect +	13
Plug detect −	11
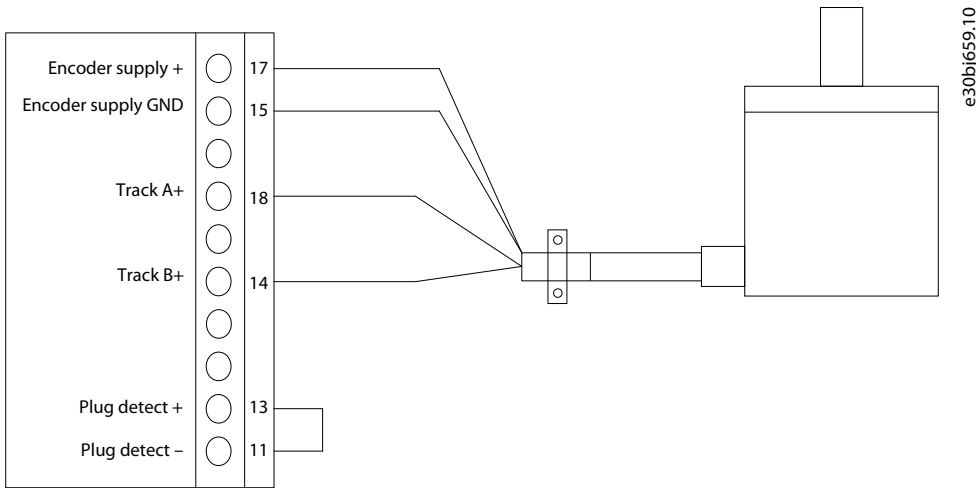
Illustration 3: Wiring Configuration for Incremental Encoder, 2 Single Tracks (TTL, HTL)

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Pin	Signal
Encoder supply +	17
Encoder supply GND	15
Track A+	18
Track A−	16
Track B+	14
Track B−	12
Track Z+	10
Track Z−	8
Plug detect +	13
Plug detect −	11

Illustration 4: Wiring Configuration for Incremental Encoder, 3 Differential Tracks (TTL, HTL)

Illustration 5: Wiring Configuration for Incremental Encoder, 3 Single Tracks (TTL, HTL)
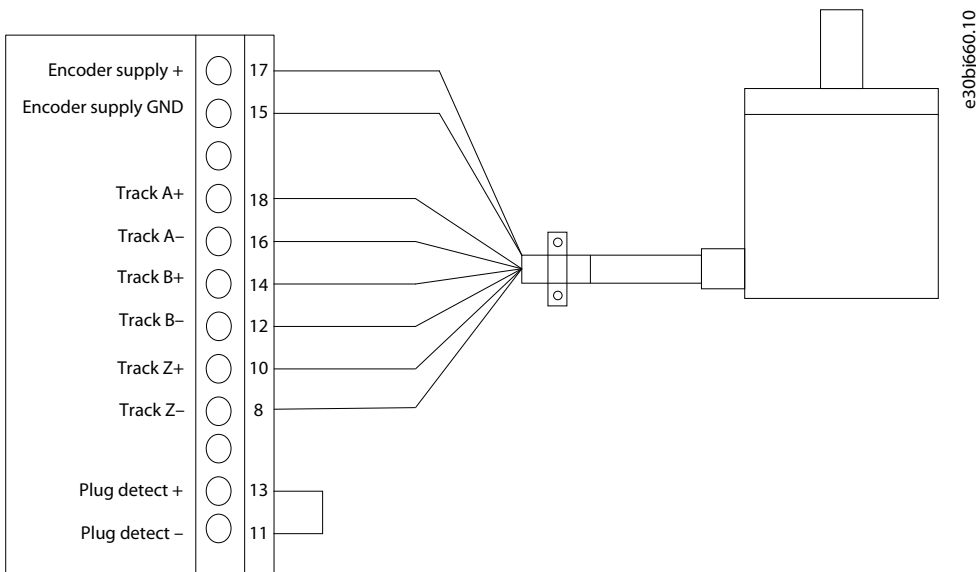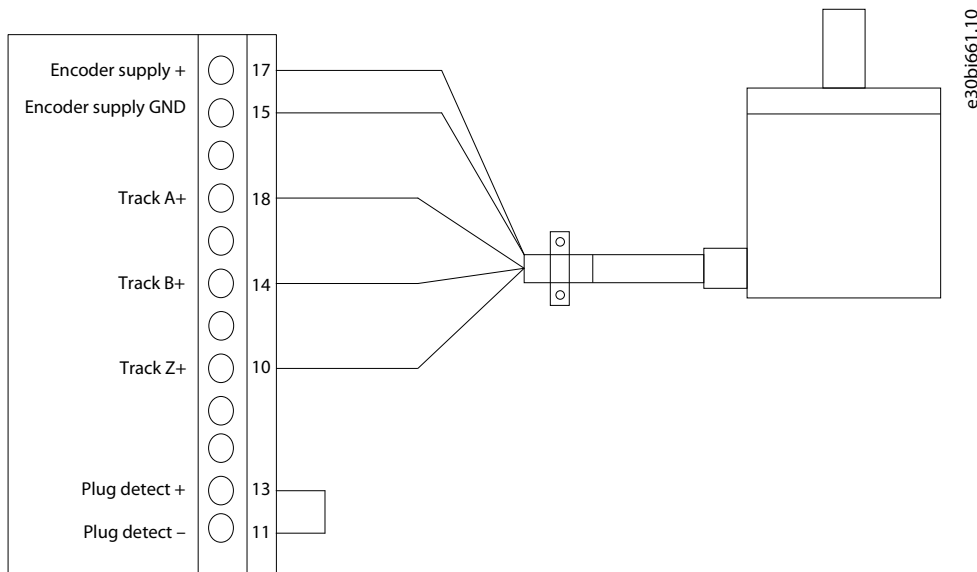
4.8.2 Two Incremental Encoders

It is possible to connect two 2-track incremental encoders where channel 1 (A, B) supports TTL and HTL, while channel 2 (Z, D) only supports TTL.

Table 8: Parameters for 2 Incremental Encoders

Parameter	Setting
9.4.1 Interface configuration	Select *[5] 2 track Incremental A,B + 2 track incremental Z,D.*
9.4.4 Encoder Supply Voltage	Set the appropriate supply voltage for the connected encoders. If the power requirement exceeds the maximum power of the internal supply, the 2nd encoder may require external supply. **N O T I C E** Voltage can be up to 24 V. Setting the voltage too high can damage the connected encoder.
9.5.1 Resolution Device 1	Set the resolution of the encoder connected to A and B in pulses per revolution.
9.5.2 Resolution Device 2	Set the resolution of the encoder connected to Z and D in pulses per revolution.

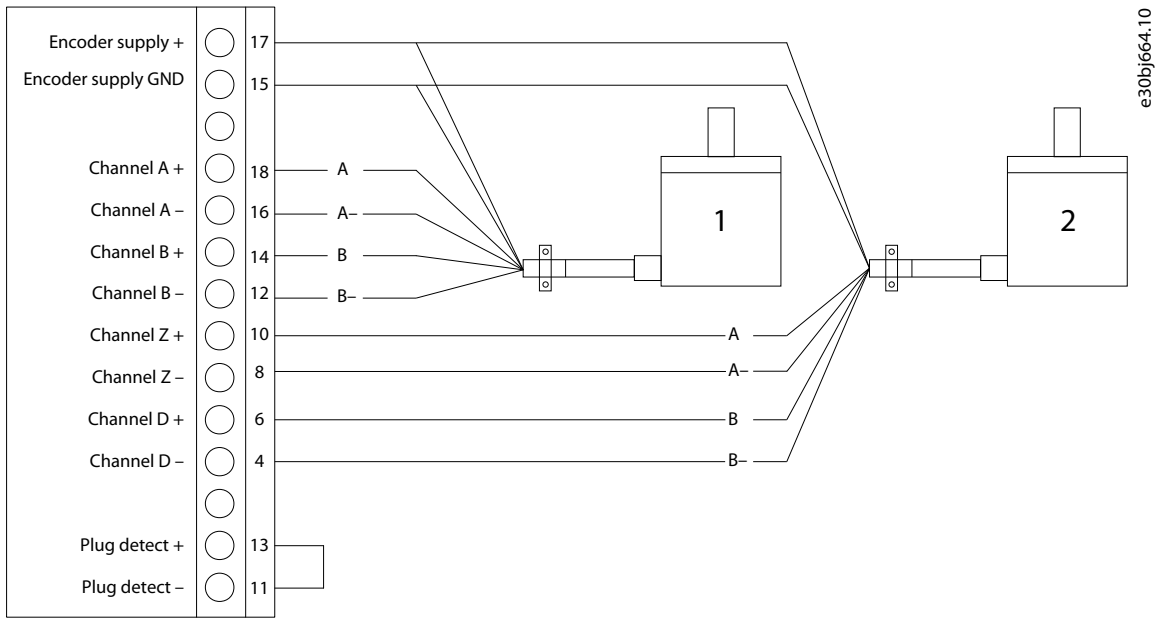**Illustration 6: Wiring Configuration for 2 Incremental Encoders**

1	Incremental encoder, 2 differential tracks (TTL, HTL)
2	Incremental encoder, 2 differential tracks (only TTL on Z and D).

> **N O T I C E**
>
> The incremental encoder connected to channels Z and D may require separate supply.

4.8.3 Resolver

With a resolver, the actual position is set to the absolute value within 1 resolver pole pair based on the analog value of the sine and cosine signals.

With a 2-pole resolver, this corresponds to the absolute position within 1 resolver revolution.

Table 9: Parameters for Resolver

| Parameter	Setting
9.4.1 Interface configuration	Set to *[7] Resolver A,B*.
9.7.1 Excitation Voltage	Set the excitation voltage according to the specification of the connected resolver.
9.7.2 Excitation Frequency	Set the excitation frequency according to the specification of the connected resolver.
9.7.3 Number of Poles	Set the number of poles of the connected resolver.
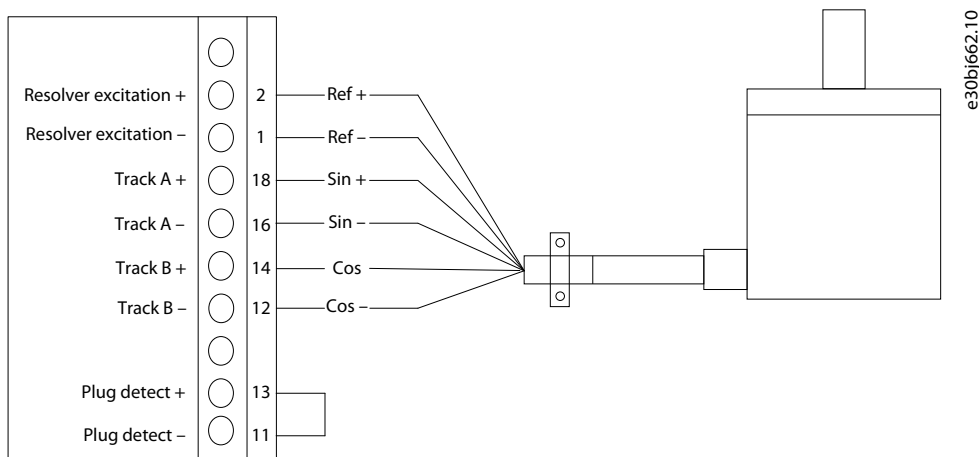
Illustration 7: Wiring Configuration for Resolver

4.8.4 Resolver with Mirror Out

When using a resolver, a TTL encoder signal can be generated to mirror the resolver signal. The mirroring enables transferring the shaft position to other devices for monitoring, or further control. The encoder output signal can be scaled by defining the number of pulses representing 1 rotation of the resolver.

Table 10: Parameters for Resolver with Mirror Out

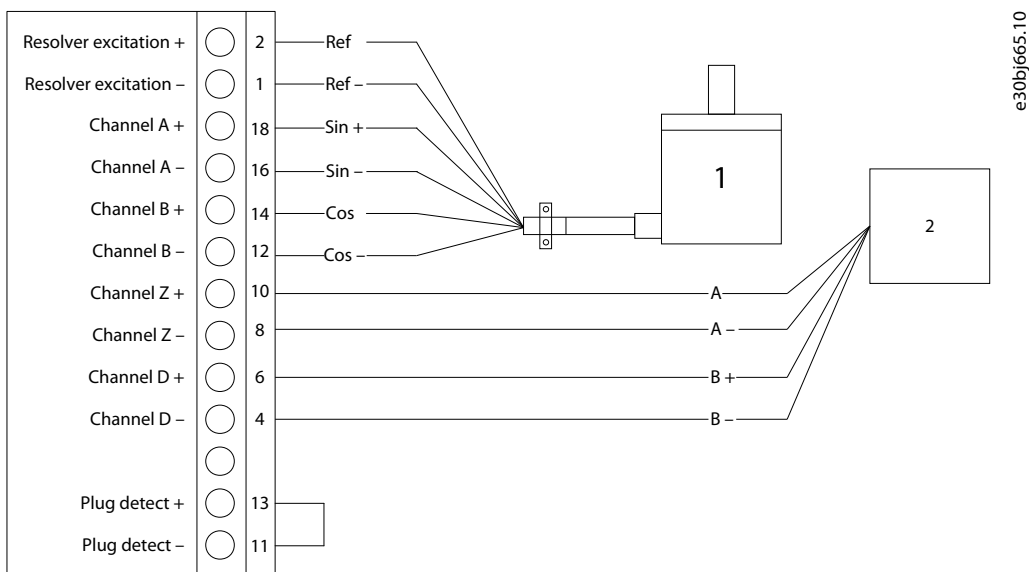| Parameter	Setting
9.4.1 Interface Configuration	Set to *[8] Resolver A,B + Mirror out Z,D*.
9.5.2 Resolution Channel 2	Set the required number of pulses for the encoder output representing 1 rotation of the resolver.
9.7.1 Excitation Voltage	Set the excitation voltage according to the specification of the connected resolver.
9.7.2 Excitation Frequency	Set the excitation frequency according to the specification of the connected resolver.
9.7.3 Number of Poles	Set the number of poles of the connected resolver.

Illustration 8: Wiring Configuration for Resolver with Mirror Out

1	Resolver
2	Controller, or other device

4.8.5 SinCos Encoder

Table 11: Parameters for SinCos Encoder

Parameter	Setting
9.4.1 Interface configuration	Select *[10] SinCos A,B*.
9.4.4 Encoder Supply Voltage	Set the appropriate supply voltage for the connected encoder. **N O T I C E** Voltage can be up to 24 V. Setting the voltage too high can damage the connected encoder.
9.5.1 Resolution Device 1	Set the resolution of the encoder in pulses per revolution.

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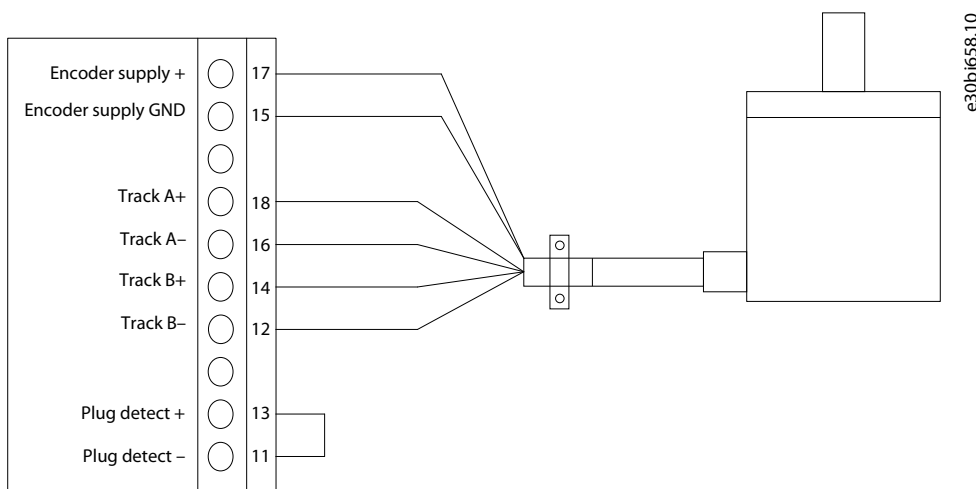|	
Encoder supply +	17
Encoder supply GND	15
Track A+	18
Track A–	16
Track B+	14
Track B–	12
Plug detect +	13
Plug detect –	11

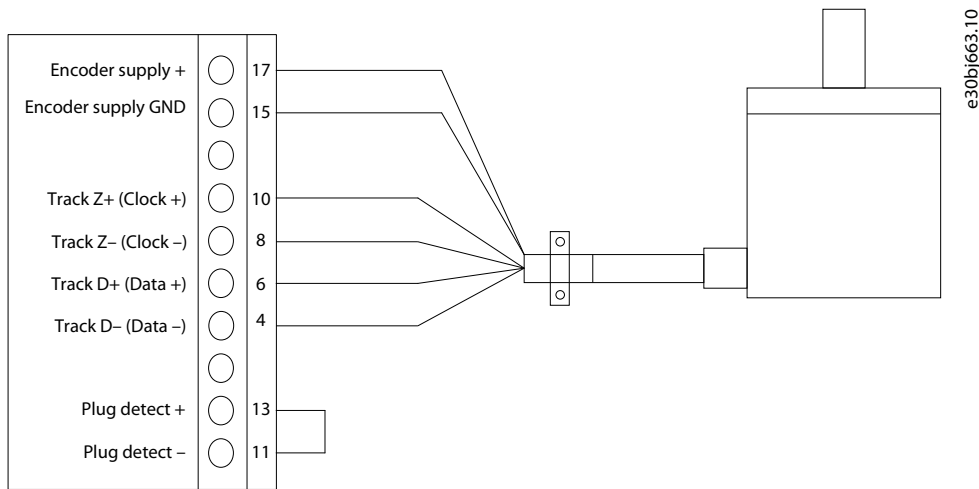**Illustration 9: Wiring Configuration for SinCos Encoder**

4.8.6 SSI Encoder

Absolute position is read from the encoder and used to set the actual position after power-up.

Table 12: Parameters for SSI Encoder

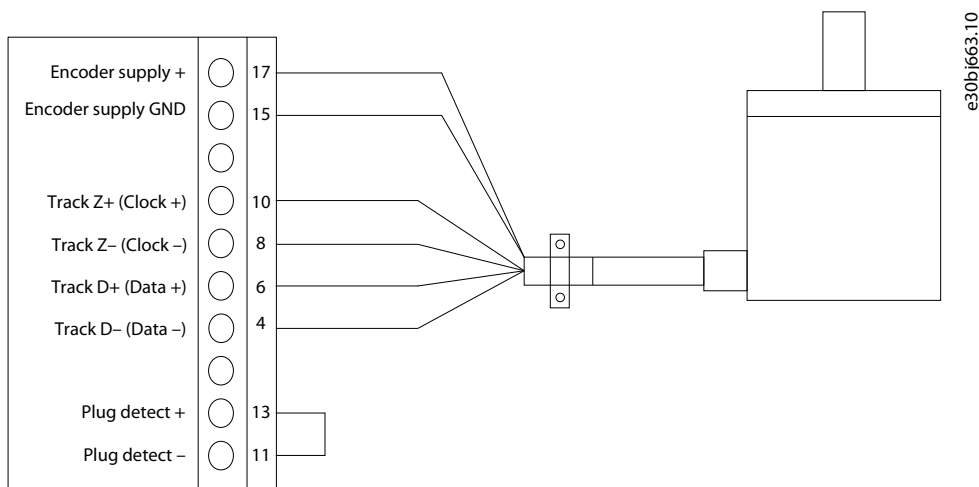| Parameter	Setting
9.4.1 Interface Configuration	Select *[17] SSI Z,D*.
9.4.4 Encoder Supply Voltage	Set the appropriate supply voltage for the connected encoder. **N O T I C E** Voltage can be up to 24 V. Setting the voltage too high can damage the connected encoder.
9.6.1 Singleturn Resolution	Set the number of bits used for 1 revolution.
9.6.2 Multiturn Resolution	Set the number of bits used for revolution count.
9.6.6 BiSS/SSI Clock Rate	Set the clock rate used for SSI or BiSS.

Illustration 10: Wiring Configuration for 2-Track SSI Encoder

4.8.7 EnDat Encoder

Absolute position is read from the encoder and used to set the actual position after power-up.

Table 13: Parameters for EnDat Encoder

Parameter	Setting
9.4.1 Interface configuration	Select *[22] EnDat Z,D*.
9.4.4 Encoder Supply Voltage	Set the appropriate supply voltage for the connected encoder. **N O T I C E** Voltage can be up to 24 V. Setting the voltage too high can damage the connected encoder.
9.6.1 Singleturn Resolution	Set the number of bits used for 1 revolution.
9.6.2 Multiturn Resolution	Set the number of bits used for revolution count.
9.6.3 EnDat Clock Rate	Set the rate for the clock signal according to the encoder specifications.

Illustration 11: Wiring Configuration for 2-Track EnDat Encoder

4.8.8 BiSS Encoder

Absolute position is read from the encoder and used to set the actual position after power-up.

Table 14: Parameters for BiSS Encoder

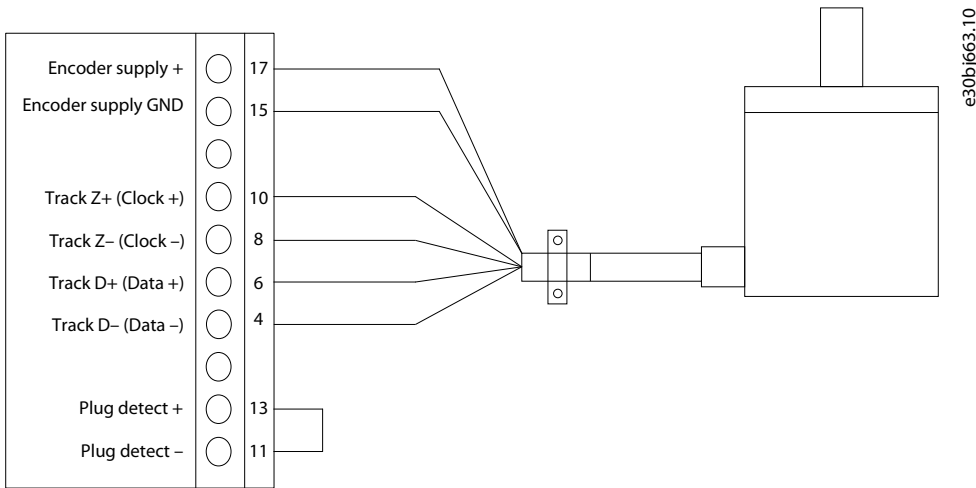| Parameter	Setting
9.4.1 Interface configuration	Select *[29] BiSS Z,D*.
9.4.4 Encoder Supply Voltage	Set the appropriate supply voltage for the connected encoder. **N O T I C E** Voltage can be up to 24 V. Setting the voltage too high can damage the connected encoder.
9.6.1 Singleturn Resolution	Set the number of bits used for 1 revolution.
9.6.2 Multiturn Resolution	Set the number of bits used for revolution count.
9.6.6 BiSS/SSI Clock Rate	Set the rate for the clock signal according to the encoder specifications.

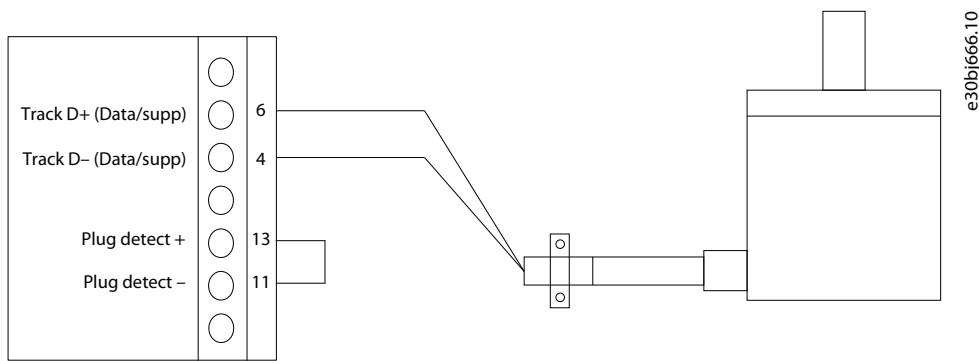**Illustration 12: Wiring Configuration for 2-Track BiSS Encoder**

4.8.9 HIPERFACE DSL

Absolute position is read from the encoder and used to set the actual position after power-up.

Table 15: Parameters for HIPERFACE DSL^Æ

Parameter	Setting
9.4.1 Interface configuration	Select *[26] Hiperface DSL D*.
9.4.4 Encoder Supply Voltage	Set the appropriate supply voltage for the connected encoder. **N O T I C E** Voltage can be up to 24 V. Setting the voltage too high can damage the connected encoder.
9.6.1 Singleturn Resolution	Set the number of bits used for 1 revolution.
9.6.2 Multiturn Resolution	Set the number of bits used for revolution count.

Illustration 13: Wiring Configuration for HIPERFACE DSL^Æ Encoder

4.9 Parameter Descriptions for Encoder/Resolver

4.9.1 Configuration (Menu Index 9.4)

P 9.4.1 Interface Configuration

Description: Select the required configuration of the interface consisting of 4 tracks A, B, Z, and D offering various combinations of 1 or 2 devices.

Default Value: 0 [Disabled]	**Parameter Type:** Selection	**Parameter Number:** 4000
Unit: –	**Data Type:** UINT	**Access Type:** Read/Write

The following are the selections for the parameter:

Selection number	Selection name
0	Disabled
1	2 track incremental A,B
3	3 track incremental A,B,Z
5	2 track incremental A,B + 2 track incremental Z,D
7	Resolver A,B
8	Resolver A,B + mirror out Z,D
9	Resolver A,B + 2 track incremental Z,D
10	SinCos A,B
17	SSI Z,D
19	SSI Z,D + 2 track incremental A,B
22	EnDat Z,D
23	EnDat Z,D + 2 track incremental A,B
26	Hiperface DSL D
27	Hiperface DSL D + 2 track incremental A,B
29	BiSS Z,D
30	BiSS Z,D + 2 track incremental A,B

P 9.4.4 Encoder Supply Voltage

Description: Set the supply voltage level according to the specification of the connected encoder.

Default Value: 5	Parameter Type: Range (3–24)	Parameter Number: 4002
Unit: V	Data Type: UINT	Access Type: Read/Write

P 9.4.5 Supply Sense
Description: Activate power supply cable drop compensation.

Default Value: 0	Parameter Type: Range (0–1)	Parameter Number: 4035
Unit: –	Data Type: BOOL	Access Type: Read/Write

4.9.2 Incremental Settings (Menu Index 9.5)

P 9.5.1 Resolution Channel 1
Description: Set the resolution of the incremental encoder connected to channel 1.

Default Value: 1024	Parameter Type: Range (1–65535)	Parameter Number: 4008
Unit: –	Data Type: UINT	Access Type: Read/Write

P 9.5.2 Resolution Channel 2
Description: Set the resolution of the incremental encoder connected to channel 2.

Default Value: 1024	Parameter Type: Range (1–65535)	Parameter Number: 4009
Unit: –	Data Type: UINT	Access Type: Read/Write

4.9.3 SSI/EnDat/BiSS/HIPERFACE Settings (Menu Index 9.6)

P 9.6.1 Singleturn Resolution
Description: Number of bits used for one revolution.

Default Value: 13	Parameter Type: Range (1–32)	Parameter Number: 4010
Unit: –	Data Type: UINT	Access Type: Read/Write

P 9.6.2 Multiturn Resolution
Description: Number of bits used for revolution count.

Default Value: 12	Parameter Type: Range (0–32)	Parameter Number: 4011
Unit: –	Data Type: UINT	Access Type: Read/Write

P 9.6.3 EnDat Clock Rate
Description: Set the Clock rate used for EnDat.

Default Value: 13 [1 MHz]	Parameter Type: Selection	Parameter Number: 4036
Unit: MHz	Data Type: UINT	Access Type: Read/Write

The following are the selections for the parameter:

Selection number	Selection name
0	8.33 MHz
6	4.16 MHz
12	2.08 MHz
13	1 MHz
14	0.2 MHz
15	0.1 MHz

P 9.6.5 SSI Data Format

Description: Select the SSI data coding according to the specifications of the connected SSI encoder.

Default Value: 1 [Gray]	Parameter Type: Selection	Parameter Number: 4034
Unit: –	Data Type: BOOL	Access Type: Read/Write

The following are the selections for the parameter:

Selection number	Selection name
0	Binary
1	Gray

P 9.6.6 BiSS/SSI Clock Rate

Description: Sets the clock rate used for SSI or BiSS.

Default Value: 18 [833 kHz]	Parameter Type: Selection	Parameter Number: 4037
Unit: -	Data Type: UINT	Access Type: Read/Write

The following are the selections for the parameter:

Selection number	Selection name
2	8.33 MHz
3	6.25 MHz
4	5.00 MHz
5	4.16 MHz
6	3.57 MHz
7	3.13 MHz
8	2.78 MHz
9	2.50 MHz
10	2.27 MHz
11	2.08 MHz
12	1.92 MHz
13	1.79 MHz
14	1.67 MHz
15	1.56 MHz
17	1.25 MHz
18	833 kHz
19	625 kHz
20	500 kHz
21	417 kHz
22	357 kHz

Selection number	Selection name
23	313 kHz
24	278 kHz
25	250 kHz
26	227 kHz
27	208 kHz
28	192 kHz
29	179 kHz
30	167 kHz
31	156 kHz

4.9.4 Resolver (Menu Index 9.7)

P 9.7.1 Excitation Voltage

Description: Set the Excitation voltage according to the specifications of the connected resolver (RMS).

Default Value: 5	**Parameter Type:** Range (2–8)	**Parameter Number:** 4005
Unit: V	**Data Type:** UINT	**Access Type:** Read/Write

P 9.7.2 Excitation Frequency

Description: Set the Resolver excitation frequency according to the specifications of the connected resolver.

Default Value: 5000	**Parameter Type:** Range (2000–20000)	**Parameter Number:** 4004
Unit: Hz	**Data Type:** UINT	**Access Type:** Read/Write

P 9.7.3 Number of Poles

Description: Set the number of poles of the connected resolver.

Default Value: 2	**Parameter Type:** Range (2–254)	**Parameter Number:** 4003
Unit: –	**Data Type:** USINT	**Access Type:** Read/Write