

## Installation Instructions

# VLT<sup>®</sup> Encoder Option MCB 102

# VLT<sup>®</sup> AutomationDrive FC 301/FC 302

## Introduction

The VLT<sup>®</sup> Encoder Option MCB 102 can be used as feedback source for closed-loop control or as master source for synchronizing control. Configure the encoder option in *parameter group 17-\*\* Feedback Option*, see the *VLT<sup>®</sup> AutomationDrive FC 301/FC 302 Programming Guide*.

Signal type	5 V TTL, RS422 1 Vpp, SinCos
Maximum resolution	16.384 pulses/revolution
Maximum frequency	410 kHz

**Table 1.1 Supported Incremental Encoder Types**

SSI without incremental track	Data length 13–32 bits, clock rate 100–260 kHz
SSI with SinCos	
SSI with TTL	
Hiperface with incremental track	Resolution 8192–1.073.741.824 positions/revolution, multiturn 1–16,777,216 revolutions, Baudrate 600–38400
EnDat 2.1 and 2.2 without incremental track	Maximum data length 64 bit, Clock rate 100–260 kHz
EnDat 2.1 and 2.2 with SinCos	
EnDat 2.1 and 2.2 with TTL	

**Table 1.2 Supported Absolute Single and Multi-turn Encoder Types**

Maximum cross-section, flexible/rigid wire without cable end sleeves	1.5 mm <sup>2</sup> /16 AWG
Maximum cross-section, flexible wire with cable end sleeves with collar	0.75 mm <sup>2</sup> /18 AWG
Minimum cross-section	0.2 mm <sup>2</sup> /26 AWG

**Table 1.3 Supported Wire Dimensions**

## Items Supplied

- VLT<sup>®</sup> Encoder Option MCB 102

### Ordering numbers

- 130B1115 (uncoated)
- 130B1203 (coated)

## Safety

### **⚠ WARNING**

#### DISCHARGE TIME

The frequency converter contains DC-link capacitors, which can remain charged even when the frequency converter is not powered. High voltage can be present even when the warning LED indicator lights are off. Failure to wait the specified time after power has been removed before performing service or repair work can result in death or serious injury.

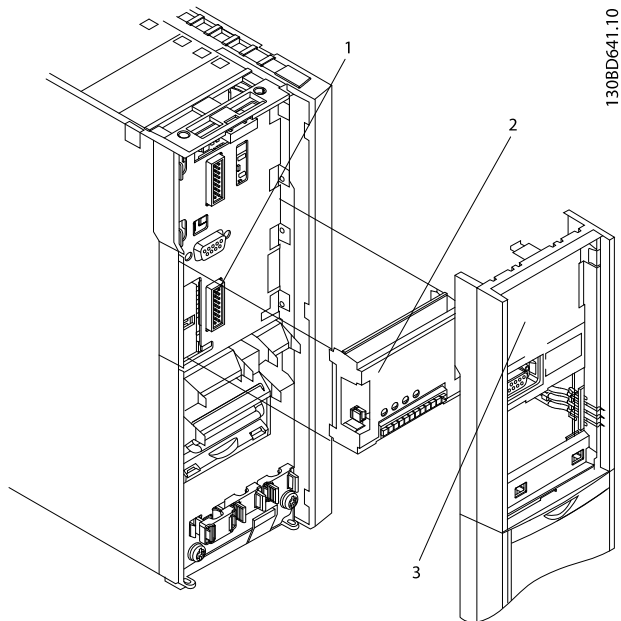
- Stop the motor.
- Disconnect AC mains and remote DC-link power supplies, including battery back-ups, UPS, and DC-link connections to other frequency converters.
- Disconnect or lock PM motor.
- Wait for the capacitors to discharge fully. The minimum duration of waiting time is specified in *Table 1.4* and is also visible on the product label on top of the frequency converter.
- Before performing any service or repair work, use an appropriate voltage measuring device to make sure that the capacitors are fully discharged.

Voltage [V]	Minimum waiting time (minutes)		
	4	7	15
200–240	0.25–3.7 kW (0.34–5 hp)	–	5.5–37 kW (7.5–50 hp)
380–500	0.25–7.5 kW (0.34–10 hp)	–	11–75 kW (15–100 hp)
525–600	0.75–7.5 kW (1–10 hp)	–	11–75 kW (15–100 hp)
525–690	–	1.5–7.5 kW (2–10 hp)	11–75 kW (15–100 hp)

**Table 1.4 Discharge Time**

## Mounting

Mount the option according to *Illustration 1.1*.



1	Slot B
2	Option
3	LCP frame

**Illustration 1.1 Mounting**

## Electrical Installation

### NOTICE

Supply the encoder through the VLT® Encoder Option MCB 102. Avoid using external supply for the encoder.

#### Encoder monitor

The 4 encoder channels (A, B, Z, and D) are monitored, open, and short circuits can be detected. There is a green LED for each channel which lights up when the channel is OK.

### NOTICE

To view the LEDs on the option, remove the cover. Select response to encoder errors in *parameter 17-61 Feedback Signal Monitoring*.

### NOTICE

Maximum cable length for incremental encoder 150 m [492 ft].

Connector designation X31	Incremental (TTL and SinCos)	Hiperface®	EnDat	SSI	Description
1	–	–	–	–	24 V output (21–25 V, I <sub>max</sub> : 125 mA)
2	–	8 V <sup>1)</sup>	–	–	8 V output (7–12 V, I <sub>max</sub> : 200 mA)
3	5 V <sup>1)</sup>	–	5 V <sup>1)</sup>	5 V <sup>1)</sup>	5 V output (5 V ±5%, I <sub>max</sub> : 200 mA)
4	GND	GND	GND	GND	GND
5	A input	A input	A input	A input	A input
6	A inv input	A inv input	A inv input	A inv input	A inv input
7	B input	B input	B input	B input	B input
8	B inv input	B inv input	B inv input	B inv input	B inv input
9	Z input	+Data RS485	Clock out	Clock out	Z input OR +Data RS485 OR clock
10	Z inv input	-Data RS485	Clock out inv.	Clock out inv.	Z input OR -Data RS485 OR clock-
11	NC	NC	Data in	Data in	Data
12	NC	NC	Data in inv.	Data in inv.	Data-
Maximum 5 V on X31.5-12					

Table 1.5 Encoder Connections

1) Typical supply voltage for the encoder: Check encoder data.

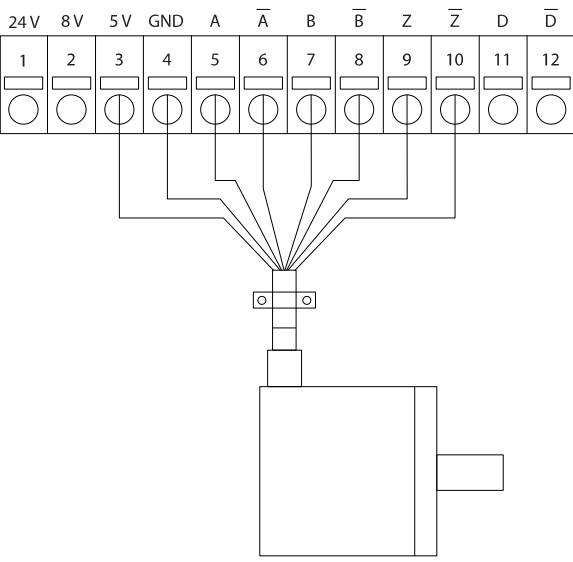
## Set-up and Connection

VLT® AutomationDrive FC 301/FC 302 with VLT® Encoder Option MCB 102 supports multiple encoder configurations which can be used as speed and/or position feedback for closed-loop flux motor control, closed-loop speed control, and closed-loop position control:

- Select [2] MCB 102 as "Flux Motor Feedback Source" in *parameter 1-02 Flux Motor Feedback Source*.
- Select [0] Motor feedb. P1-02 or [2] MCB 102 as "Speed PID Feedback Source" in *parameter 7-00 Speed PID Feedback Source*.
- Select [0] Motor feedb. P1-02 or [2] MCB 102 as "Position PI Feedback Source" in *parameter 7-90 Position PI Feedback Source*

## Incremental Encoders

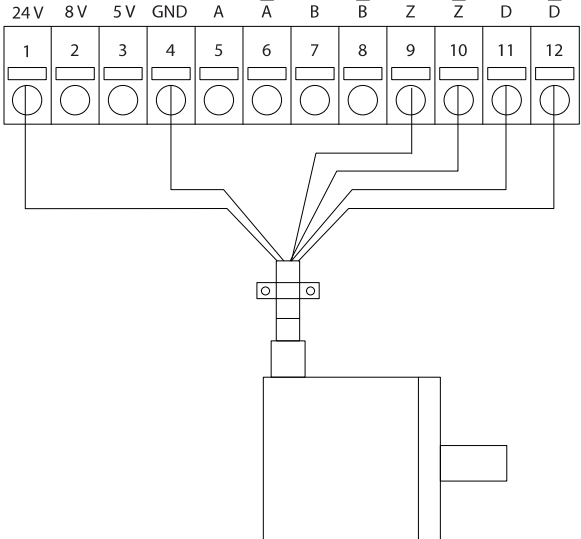
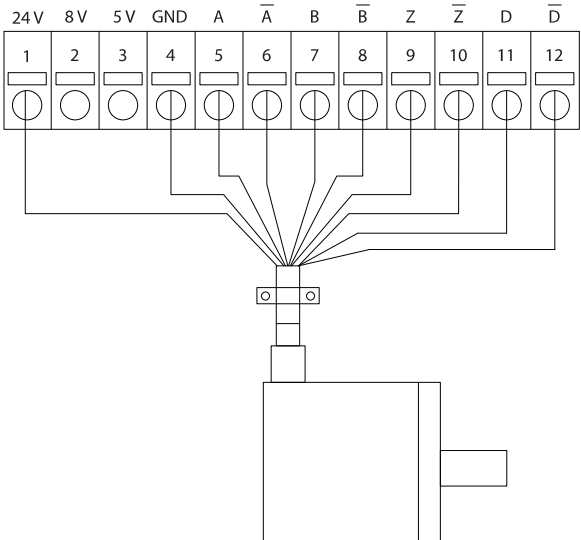
With TTL and SinCos Incremental encoder, the actual position is 0 after power-up and encoder pulses are counted to increment/decrement actual position. For improved resolution with TTL encoders, both the positive and negative edges of A and B pulses are detected giving 4 quad counts per encoder pulse. With SinCos encoders, the signal is sampled 1024 times per sine-cosine period meaning that the resulting resolution is 1024 times periods per revolution.

Connection	Parameter	Description
 <p>Illustration 1.2 Incremental Encoder</p>	<i>Parameter 17-10 Signal Type</i>	Select the signal type for the encoder: [1] RS 422 (5V TTL) [2] Sinusoidal 1Vpp
	<i>Parameter 17-11 Resolution (PPR)</i>	Set the resolution of the encoder. Pulses per revolution for TTL or periods per revolution for SinCos.
	<i>Parameter 17-60 Feedback Direction</i>	Select [1] Counter clockwise if actual position ( <i>parameter 16-06 Actual Position</i> ) counts negative when the frequency converter is running forward. Alternative is to swap A and B track on the encoder connection.
	<i>Parameter 17-61 Feedback Signal Monitoring</i>	The signal level is monitored by hardware when using TTL encoders. Select the reaction when a problem is detected: [0] Disabled = No reaction [1] Warning = Warning 90, Feedback monitor is issued when the signal level is too high or too low. [2] Trip = The frequency converter trips with alarm 90, Feedback monitor when the signal level is too high or too low. There is no hardware monitoring of SinCos encoders.
	<i>Parameter groups 4-3* Motor Speed Monitoring and 4-4* Speed Monitoring</i>	Offer possibility to activate and adjust further monitoring of speed tracking.

## SSI Encoders

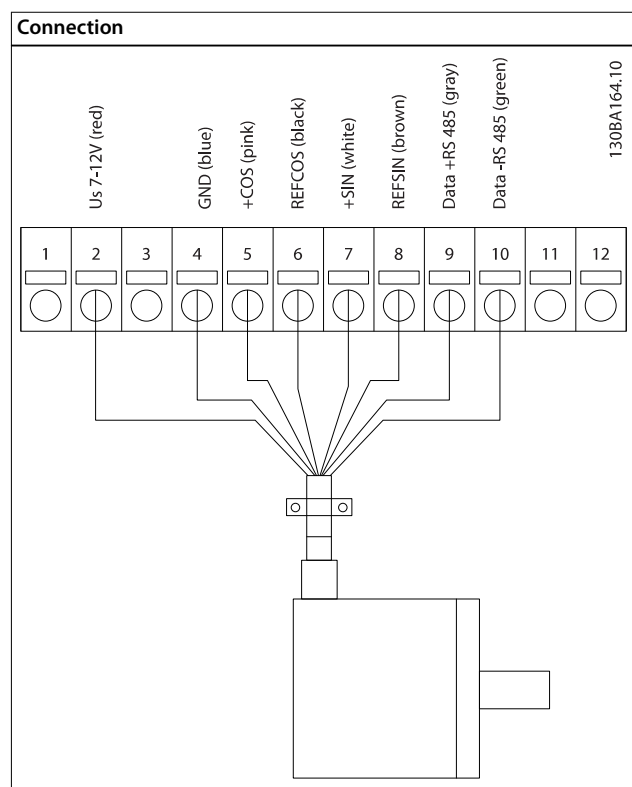
Absolute position is read from the encoder and used to set the actual position after power-up. Thereafter, the absolute position is read every 1 ms and used to track any movements. If the absolute position read from the encoder changes more than half an encoder revolution from the previous position, it is considered to be invalid and the position value is not used. Up to 4 consecutive invalid positions are skipped, 5 consecutive invalid positions trigger an error, the reaction to this error depends on the setting of *parameter 17-61 Feedback Signal Monitoring*. If no reaction or only warning is selected, up to 10 consecutive invalid positions are skipped where after the position is considered valid and thus used.

When an incremental track is added, it is used for tracking movements while the absolute position readings are used to monitor, and if needed, correct any deviations between the 2 tracks. A warning is issued when the actual position based on the incremental track deviates more than 3 qc from the absolute position.

Connection	Parameter	Description
 <p><b>Illustration 1.2 SSI Absolute only</b></p>	<i>Parameter 17-10 Signal Type</i>	Select the incremental signal type for the encoder: [0] None = no incremental track [1] RS 422 (5V TTL) [2] Sinusoidal 1Vpp
	<i>Parameter 17-11 Resolution (PPR)</i>	Set the incremental resolution of the encoder. Pulses per revolution for TTL or periods per revolution for SinCos.
	<i>Parameter 17-20 Protocol Selection</i>	Select [4] SSI
	<i>Parameter 17-21 Resolution (Positions/Rev)</i>	Set the absolute resolution in positions per revolution.
	<i>Parameter 17-22 Multiturn Revolutions</i>	Set number of multi turn revolutions.
	<i>Parameter 17-24 SSI Data Length</i>	Set the data length for the absolute position in number of bits.
 <p><b>Illustration 1.2 SSI Absolute and Incremental</b></p>	<i>Parameter 17-25 Clock Rate</i>	Set the frequency for the clock signal generated by the VLT® Encoder Option MCB 102. Default is 260 kHz. It should be reduced in case of long encoder cable or electrical noise issues.
	<i>Parameter 17-26 SSI Data Format</i>	Select the SSI data format: [0] Gray code [1] Binary code
	<i>Parameter 17-60 Feedback Direction</i>	Select [1] Counter clockwise if the actual position ( <i>parameter 16-06 Actual Position</i> ) counts negative when the frequency converter is running forward.
	<i>Parameter 17-61 Feedback Signal Monitoring</i>	The signal level is monitored by hardware when using TTL encoders. Select the reaction when a problem is detected: [0] Disabled = No reaction [1] Warning = Warning 90, Feedback monitor is issued when the signal level is too high or too low. [2] Trip = The frequency converter trips with alarm 90, Feedback monitor when the signal level is too high or too low. There is no hardware monitoring of SinCos encoders.
	<i>Parameter groups 4-3* Motor Speed Monitoring and 4-4* Speed Monitoring</i>	Offer possibility to activate and adjust further monitoring of speed tracking.

## Hiperface Encoders

Absolute position is read from the encoder and used to set the actual position after power-up. Thereafter, the incremental track is used for tracking movements while the absolute position readings are used to monitor and if needed correct any deviations between the 2 tracks. A warning is issued when the actual position based on the incremental track deviates more than 3 qc from the absolute position.

Connection	Parameter	Description
	Parameter 17-10 Signal Type	Select [2] Sinusoidal 1Vpp
	Parameter 17-11 Resolution (PPR)	Set the incremental resolution of the encoder in sine – cosine periods per revolution.
	Parameter 17-20 Protocol Selection	Select [1] HIPERFACE
	Parameter 17-21 Resolution (Positions/Rev)	Set the absolute resolution in positions per revolution.
	Parameter 17-22 Multiturn Revolutions	Set number of multi turn revolutions.
	Parameter 17-34 HIPERFACE Baudrate	Set the baud rate for the Hiperface data channel. Default is 9600 and there is normally no reason to change it.
	Parameter 17-60 Feedback Direction	Select [1] Counter clockwise if actual position (parameter 16-06 Actual Position) counts negative when the frequency converter is running forward.
	Parameter groups 4-3* Motor Speed Monitoring and 4-4* Speed Monitoring	Offers possibility to activate and adjust further monitoring of speed tracking.

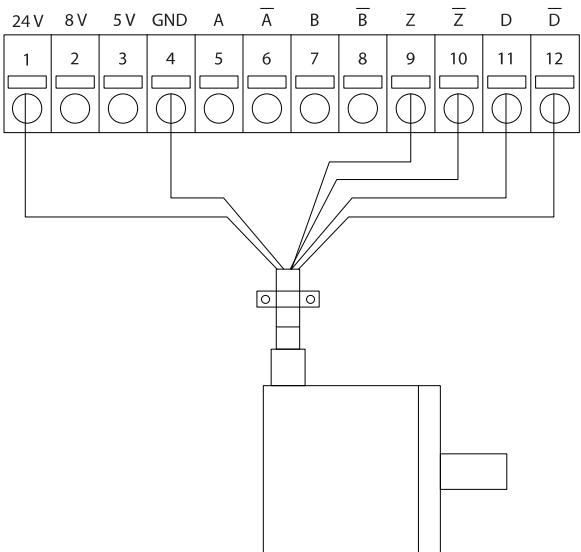
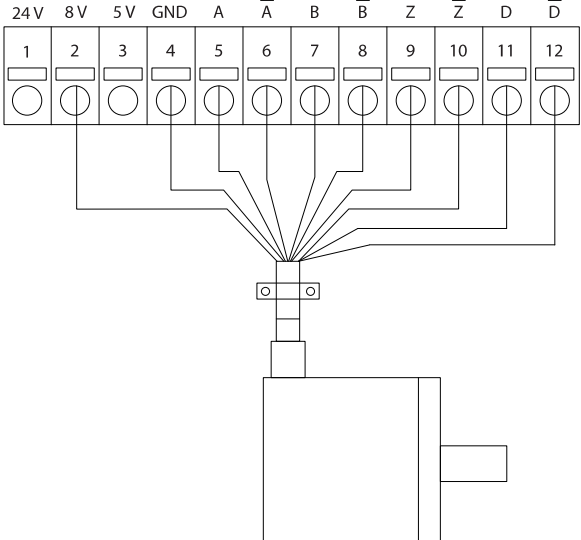
## EnDat Encoders

### Absolute only

Absolute position is read from the encoder and used to set the actual position after power-up. Thereafter, the absolute position is read every 1 ms and used to track any movements.

### Absolute and incremental

Absolute position is read from the encoder and used to set the actual position after power-up. Thereafter, the incremental track is used for tracking movements while the absolute position readings are used to monitor, and if needed, correct any deviations between the 2 tracks. A warning is issued when the actual position based on the incremental track deviates more than 3 qc from the absolute position.

Connection	Parameter	Description
 <p><b>Illustration 1.2 EnDat Absolute</b></p>	Parameter 17-10 Signal Type	Select the incremental signal type for the encoder: [0] None = no incremental track [1] RS 422 (5V TTL) [2] Sinusoidal 1Vpp
	Parameter 17-11 Resolution (PPR)	Set the resolution of the encoder. Pulses per revolution for TTL or periods per revolution for SinCos.
	Parameter 17-20 Protocol Selection	Select [2] EnDat
	Parameter 17-22 Multiturn Revolutions	Set number of multi turn revolutions.
	Parameter 17-25 Clock Rate	Set the frequency for the clock signal generated by the VLT® Encoder Option MCB 102. Default is 260 kHz. It should be reduced in case of long encoder cable or electrical noise issues.
	Parameter 17-60 Feedback Direction	Select [1] Counter clockwise if the actual position (parameter 16-06 Actual Position) counts negative when the frequency converter is running forward.
 <p><b>Illustration 1.2 EnDat Absolute and Incremental</b></p>	Parameter 17-61 Feedback Signal Monitoring	The signal level is monitored by hardware when using TTL encoders. Select the reaction when a problem is detected: [0] Disabled = No reaction. [1] Warning = Warning 90, Feedback monitor is issued when the signal level is too high or too low. [2] Alarm = The frequency converter trips with alarm 90, Feedback monitor when the signal level is too high or too low. There is no hardware monitoring of SinCos encoders.
	Parameter groups 4-3* Motor Speed Monitoring and 4-4* Speed Monitoring	Offer possibility to activate and adjust further monitoring of speed tracking.

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