

# Series 3

ABSOLUTE ANGULAR ENCODER



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# H3B-D200i100 series



## Model description:

H3B: Absolute angular encoders with SSI protocol for FAGOR and others.

H3BS: Absolute angular encoders with SSI protocol for SIEMENS® (Solution Line).

H3BF: Absolute angular encoders with FANUC® ( $\alpha$  and  $\alpha i$ ) protocol.

H3BM: Absolute angular encoders with MITSUBISHI® CNC protocol.

H3BP: Absolute angular encoders with PANASONIC® (Matsushita) protocol.

H3BD: Absolute angular encoders with FeeDat® protocol for FAGOR and others.

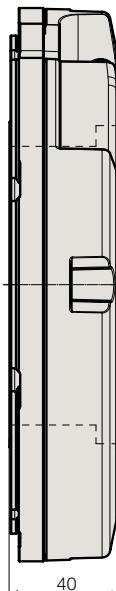
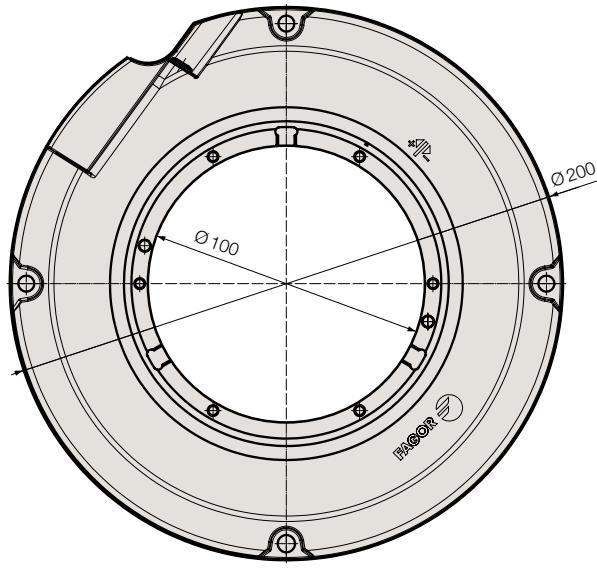
H3BD + EC-PA-DQ1-M:  
Absolute angular encoders with DRIVE-CLiQ® protocol, for SIEMENS® (Solution Line and Sinumerik One) (\*).

H3BBC: Absolute angular encoders with BiSS® C protocol.

(\*) Pending approval.

## Characteristics

	H3B	H3BS	H3BF
<b>Measurement</b>	By means of graduated glass disk		
<b>Accuracy</b>	$\pm 1$ arc-second $\pm 2$ arc-seconds		
<b>Output signals</b>	$\sim 1$ Vpp		—
<b>Resolution / Maximum number of positions per turn</b>	27 bits (134 217 728 positions) 1 Vpp: 32 768 pulses/turn		$\alpha i$ : 29 bits (536 870 912 positions) $\alpha$ : 27 bits (134 217 728 positions)
<b>Maximum frequency</b>	400 kHz for 1 Vpp signal		—
<b>Maximum electrical speed</b>	$< 750$ min $^{-1}$		$< 1500$ min $^{-1}$
<b>Natural frequency</b>		$> 1000$ Hz	
<b>Supply</b>	3.8 to 14 V DC; $< 250$ mA (at 5V without load)		
<b>Maximum cable length</b>	75 m (1)	100 m	50 m
<b>Maximum mechanical speed</b>		1000 min $^{-1}$ non-mechanical fault exclusion	
<b>Inertia</b>		Rotor: $2.5 \cdot 10^{-3}$ kgm $^2$	
<b>Starting torque (at 20 °C)</b>		$< 0.5$ Nm	
<b>Vibration</b>		100 m/s $^2$ (55...2000 Hz) IEC 60068-2-6	
<b>Shock</b>		200 m/s $^2$ (6 ms) IEC 60068-2-27	
<b>Operating temperature</b>		0 °C...50 °C	
<b>Storage temperature (in its packaging)</b>		-20 °C...60 °C	
<b>Weight</b>		2.6 kg	
<b>Protection</b>	IP 64 DIN 40050 (standard) > IP 64 (DIN 40050) using pressurized air at 0.8 $\pm 0.2$ bar in angular encoders (3)		
<b>Connection</b>	With built-in connector		



Dimensions in mm

Additional information can be found in the technical documentation and installation manual available on the website [www.fagorautomation.com](http://www.fagorautomation.com)

## Order identification

Example of Angular Encoder: H3BF-29-D200i100-1

H3	B	F	29	D200	i100	1
Type of shaft: • H3: Hollow shaft	Letter identifying the absolute encoder	Type of communications protocol: • Blank space: SSI protocol (FAGOR) • D: FeedDat® protocol (FAGOR) (1) • S: SSI SIEMENS® (SL) protocol • F: FANUC® ( $\alpha$ and $\alpha i$ ) protocol • M: MITSUBISHI® CNC protocol • P: PANASONIC® (Matsushita) protocol • BC: BISS® C protocol	Absolute positions per turn: • 29 bits (536 870 912 positions) (2) • 27 bits (134 217 728 positions)	Outside diameter: • D200: 200 mm	Inside diameter: • i100: 100 mm	Accuracy: • 2: $\pm 2$ arc-seconds • 1: $\pm 1$ arc-second

(1) Plus EC-PA-DQ1-M with DRIVE-CLiQ® protocol for SIEMENS® (Solution Line and Sinumerik One).

(2) Only for purely digital models, not available for SSI models.

Notes: Not all protocol, positions per turn and accuracy combinations are possible.

H3BM	H3BP	H3BD	H3BD + EC-PA-DQ1-M	H3BBC
By means of graduated glass disk				
		±1 arc-second ±2 arc-seconds		(2)
		-		
		29 bits (536 870 912 positions)		
		-		
		< 1500 min⁻¹		
		-		
		> 1000 Hz		
		3.8 to 14 V DC; < 250 mA (at 5V without load)		
30 m		100 m	Up to 100 m (4)	50 m
		1000 min⁻¹ non-mechanical fault exclusion		
		Rotor: $2.5 \cdot 10^{-3}$ kgm²		
		-		
		< 0.5 Nm		
		-		
		100 m/s² (55...2000 Hz) IEC 60068-2-6		
		-		
		200 m/s² (6 ms) IEC 60068-2-27		
		-		
		0 °C...50 °C		
		-		
		-20 °C...60 °C		
		-		
		2.6 kg		
		-		
		IP 64 DIN 40050 (standard)		
		> IP 64 (DIN 40050) using pressurized air at 0.8 ±0.2 bar in angular encoders (3)		
		With built-in connector		

(1) Contact Fagor Automation for maximum cable length.  
(2) Consult Fagor Automation for analog output signals.

(3) For more information consult the AI-1000 Filter Unit catalog.  
(4) Depending on CNC model. Consult SIEMENS® documentation.

# H3B-D110 series



## Model description:

H3B: Absolute angular encoders with SSI protocol for FAGOR and others.

H3BS: Absolute angular encoders with SSI protocol for SIEMENS® (Solution Line).

H3BF: Absolute angular encoders with FANUC® ( $\alpha$  and  $\alpha i$ ) protocol.

H3BM: Absolute angular encoders with MITSUBISHI® CNC protocol.

H3BP: Absolute angular encoders with PANASONIC® (Matsushita) protocol.

H3BD: Absolute angular encoders with FeeDat® protocol for FAGOR and others.

H3BD + EC-PA-DQ1-M: Absolute angular encoders with DRIVE-CLiQ® protocol, for SIEMENS® (Solution Line and Sinumerik One).

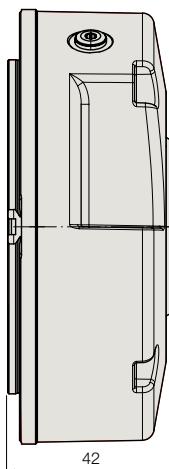
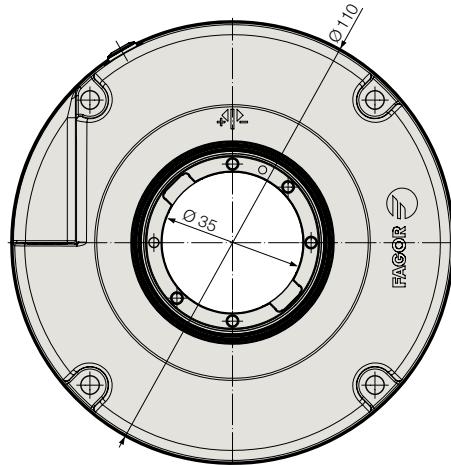
H3BD-FS + EC-PA-DQS-M: Absolute angular encoders with DRIVE-CLiQ® protocol, for SIEMENS® (Solution Line and Sinumerik One) with Functional Safety (\*).

H3BBC: Absolute angular encoders with BiSS® C protocol.

(\*) Pending approval.

## Characteristics

	H3B	H3BS	H3BF	H3BM
Measurement	By means of graduated glass disk			
Accuracy	$\pm 2.5$ arc-seconds $\pm 5$ arc-seconds		$\pm 2$ arc-seconds $\pm 4$ arc-seconds	
Output signals	$\sim 1$ Vpp		–	–
Maximum resolution / Maximum number of positions per turn	23 bits (8 388 608 positions) 1 Vpp: 16 384 pulses/turn		$\alpha i$ : 28 bits (268 435 456 positions) $\alpha$ : 27 bits (134 217 728 positions)	28 bits (268 435 456 positions)
Maximum frequency	400 kHz for 1 Vpp signal		–	
Maximum electrical speed	$< 1500$ min $^{-1}$		$< 3000$ min $^{-1}$	
Natural frequency			$> 1200$ Hz	
Supply			3.8 to 14 V DC; $< 250$ mA (at 5 V without load)	
Maximum cable length	75 m (1)	100 m	50 m	30 m
Maximum mechanical speed			1500 min $^{-1}$ / 3000 min $^{-1}$ (for a limited time)	
Inertia			Rotor (hollow shaft) $93 \cdot 10^{-6}$ kgm $^2$ Stator (housing/flange) $780 \cdot 10^{-6}$ kgm $^2$	
Starting torque (at 20°C)			$< 0.2$ Nm	
Vibration			200 m/s $^2$ (55...2000 Hz) IEC 60068-2-6	
Shock			200 m/s $^2$ (6 ms) IEC 60068-2-27	
Operating temperature			0°C...60°C	
Storage temperature (in its packaging)			-20°C...60°C	
Weight			0.65 kg	
Protection			IP 64 DIN 40050 (standard) > IP 64 (DIN 40050) using pressurized air at 0.8 $\pm 0.2$ bar in angular encoders (3)	
Connection			With built-in connector	



Dimensions in mm

Additional information can be found in the technical documentation and installation manual available on the website [www.fagorautomation.com](http://www.fagorautomation.com)

## Order identification

Example of Angular Encoder: H3BF-28-D110-2

H3	B	F	28	D110	2	
<b>Type of shaft:</b> • H3: Hollow shaft	<b>Letter identifying the absolute encoder:</b> • H3: Hollow shaft	<b>Type of communications protocol:</b> • Blank space: SSI protocol (FAGOR) • D: FeeDat® protocol (FAGOR) (1) • S: SSI SIEMENS® (SL) protocol • F: FANUC® (c. and cii) protocol • M: MITSUBISHI® CNC protocol • P: PANASONIC® (Matsushita) protocol • BC: BISS® C protocol	<b>Absolute positions per turn:</b> • 23 bits (8 388 608 positions) • 26 bits (67 108 864 positions) (2) • 28 bits (268 435 456 positions) (3)	<b>Outside diameter:</b> • D110: 110 mm	<b>Accuracy:</b> • Blank space: ± 4 arc-seconds (± 5 arc-seconds for SSI models) • 2: ± 2 arc-seconds (± 2.5 arc-seconds for SSI models)	<b>Safety:</b> • <b>Blank space:</b> No • FS: Functional Safety (4)

(1) Plus EC-PA-DQ1-M with DRIVE-CLiQ® protocol for SIEMENS® (Solution Line and Sinumerik One).

(2) Only for purely digital models, not available for SSI models.

(3) Not available for SSI or BISS® C models.

(4) Only for H3BD-FS + EC-PA-DQS-M with DRIVE-CLiQ® protocol for SIEMENS® (Solution Line and Sinumerik One) with Functional Safety.

Notes: Not all protocol, positions per turn and accuracy combinations are possible. Please consult with Fagor Automation for a list models.

H3BP	H3BD	H3BD + EC-PA-DQ1-M	H3BD-FS + EC-PA-DQS-M	H3BBC
By means of graduated glass disk				
		±2 arc-seconds ±4 arc-seconds		
		–		(2)
		28 bits (268 435 456 positions)		26 bits (67 108 864 positions)
		–		
		< 3000 min⁻¹ > 1200 Hz	< 1500 min⁻¹	< 3000 min⁻¹
		3.8 to 14 V DC; < 250 mA (at 5V without load)	5±10 % V DC; <300 mA	3.8 to 14 V DC; < 250 mA (at 5V without load)
30 m	100 m	Up to 100 m (4)	Up to 100 m (4)	50 m
		1500 min⁻¹ / 3000 min⁻¹ (for a limited time)	1500 min⁻¹	1500 min⁻¹ / 3000 min⁻¹ (for a limited time)
Rotor (hollow shaft) $93 \cdot 10^{-6}$ kgm² Stator (housing/flange) $780 \cdot 10^{-6}$ kgm²				
< 0.2 Nm				
200 m/s² (55...2000 Hz) IEC 60068-2-6				
200 m/s² (6 ms) IEC 60068-2-27				
0 °C...60 °C				
-20 °C...60 °C				
0.65 kg				
IP 64 DIN 40050 (standard) > IP 64 (DIN 40050) using pressurized air at 0.8 ±0.2 bar in angular encoders (3)				
With built-in connector				

(1) Contact Fagor Automation for maximum cable length.  
 (2) Consult Fagor Automation for analog output signals.

(3) For more information consult the AI-1000 Filter Unit catalog.  
 (4) Depending on CNC model. Consult SIEMENS® documentation.

# H3B-D90 series



## Model description:

H3B: Absolute angular encoders with SSI protocol for FAGOR and others.

H3BS: Absolute angular encoders with SSI protocol for SIEMENS® (Solution Line).

H3BF: Absolute angular encoders with FANUC® ( $\alpha$  and  $\alpha i$ ) protocol.

H3BM: Absolute angular encoders with MITSUBISHI® CNC protocol.

H3BP: Absolute angular encoders with PANASONIC® (Matsushita) protocol.

H3BD: Absolute angular encoders with FeeDat® protocol for FAGOR and others.

H3BD + EC-PA-DQ1-M: Absolute angular encoders with DRIVE-CLiQ® protocol, for SIEMENS® (Solution Line and Sinumerik One).

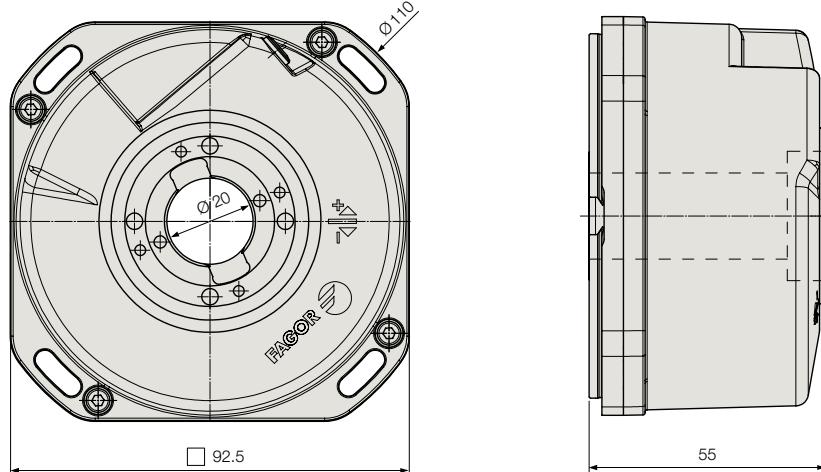
H3BD-FS + EC-PA-DQS-M: Absolute angular encoders with DRIVE-CLiQ® protocol, for SIEMENS® (Solution Line and Sinumerik One) with Functional Safety

H3BBC: Absolute angular encoders with BiSS® C protocol.

H3BK: Absolute angular encoders with YASKAWA® protocol.

## Characteristics

	H3B	H3BS	H3BF	H3BM
Measurement	By means of graduated glass disk			
Accuracy	$\pm 2.5$ arc-seconds $\pm 5$ arc-seconds		$\pm 2$ arc-seconds $\pm 4$ arc-seconds	
Output signals	$\sim 1$ Vpp		–	–
Maximum resolution / Maximum number of positions per turn	23 bits (8 388 608 positions) 1 Vpp: 16384 pulses/turn		$\alpha i$ : 28 bits (268 435 456 positions) $\alpha$ : 27 bits (134 217 728 positions)	28 bits (268 435 456 positions)
Maximum frequency	400 kHz for 1 Vpp signal		–	
Maximum electrical speed	$< 1500$ min $^{-1}$		$< 3000$ min $^{-1}$	
Natural frequency			$> 1500$ Hz	
Supply			3.8 to 14 V DC; $< 250$ mA (at 5 V without load)	
Maximum cable length	75 m (1)	100 m	50 m	30 m
Maximum mechanical speed			3000 min $^{-1}$	
Inertia			Rotor (hollow shaft) $82 \cdot 10^{-6}$ kgm $^2$ Stator (housing/flange) $480 \cdot 10^{-6}$ kgm $^2$	
Starting torque (at 20 °C)			$< 0.08$ Nm	
Vibration			200 m/s $^2$ (55...2000 Hz) IEC 60068-2-6	
Shock			200 m/s $^2$ (6 ms) IEC 60068-2-27	
Operating temperature			0 °C...60 °C	
Storage temperature (in its packaging)			-20 °C...60 °C	
Weight			0.75 kg	
Protection			IP 64 DIN 40050 (standard) > IP 64 (DIN 40050) using pressurized air at 0.8 ±0.2 bar in angular encoders (3)	
Connection			With built-in connector	



Dimensions in mm

Additional information can be found in the technical documentation and installation manual available on the website [www.fagorautomation.com](http://www.fagorautomation.com)

## Order identification

Example of Angular Encoder: H3BF-28-D90-2

H3	B	F	28	D90	2	
<b>Type of shaft:</b> • H3: Hollow shaft	<b>Letter identifying the absolute encoder:</b> • Letter identifying the absolute encoder	<b>Type of communications protocol:</b> • Blank space: SSI protocol (FAGOR) • D: FeedDat® protocol (FAGOR) (1) • S: SSI SIEMENS® (SL) protocol • F: FANUC® ( $\alpha$ and $\alpha$ i) protocol • M: MITSUBISHI® CNC protocol • P: PANASONIC® (Matsushita) protocol • BC: BISS® C protocol • K: YASKAWA® protocol	<b>Absolute positions per turn:</b> • 23 bits (8388 608 positions) • 26 bits (67 108 864 positions) (2) • 27 bits (134 217 728 positions) (3) • 28 bits (268 435 456 positions) (4)	<b>Outside diameter:</b> • D90: 90 mm	<b>Accuracy:</b> • Blank space: $\pm 4$ arc-seconds (± 5 arc-seconds for SSI models) • 2: $\pm 2$ arc-seconds (± 2.5 arc-seconds for SSI models)	<b>Safety:</b> • Blank space: No • FS: Functional Safety (5)

(1) Plus EC-PA-DQ1-M with DRIVE-CLiQ® protocol for SIEMENS® (Solution Line and Sinumerik One).

(2) Only for purely digital models, not available for SSI models.

(3) Only for compatibility with legacy products.

(4) Not available for SSI, YASKAWA® or BISS® C models.

(5) Only for H3BD-FS + EC-PA-DQS-M with DRIVE-CLiQ® protocol for SIEMENS® (Solution Line and Sinumerik One) with Functional Safety.

Notes: Not all protocol, positions per turn and accuracy combinations are possible. Please consult with Fagor Automation for a list models.

H3BP	H3BD	H3BD + EC-PA-DQ1-M	H3BD-FS + EC-PA-DQS-M	H3BBC	H3BK
By means of graduated glass disk					
			±2 arc-seconds ±4 arc-seconds		
		–		(2)	–
		28 bits (268 435 456 positions)		26 bits (67 108 864 positions)	
			–		
	< 3000 min <sup>-1</sup>		< 1500 min <sup>-1</sup>		< 3000 min <sup>-1</sup>
			> 1500 Hz		
	3.8 to 14 V DC; < 250 mA (at 5V without load)		5±10% V DC; <300 mA		3.8 to 14 V DC; < 250 mA (at 5V without load)
30 m	100 m	Up to 100 m (4)	1500 min <sup>-1</sup>	50 m	30 m
	3000 min <sup>-1</sup>				
			Rotor (hollow shaft) $82 \cdot 10^{-6}$ kgm <sup>2</sup> Stator (housing/flange) $480 \cdot 10^{-6}$ kgm <sup>2</sup>		
			< 0.08 Nm		
			200 m/s <sup>2</sup> (55...2000 Hz) IEC 60068-2-6		
			200 m/s <sup>2</sup> (6 ms) IEC 60068-2-27		
			0 °C...60 °C		
			-20 °C...60 °C		
			0.75 kg		
			IP 64 DIN 40050 (standard)		
			> IP 64 (DIN 40050) using pressurized air at 0.8 ±0.2 bar in angular encoders (3)		
			With built-in connector		

(1) Contact Fagor Automation for maximum cable length.  
 (2) Consult Fagor Automation for analog output signals.

(3) For more information consult the AI-1000 Filter Unit catalog.  
 (4) Depending on CNC model. Consult SIEMENS® documentation.

# S3B-D170 series



## Model description:

S3B: Absolute angular encoders with SSI protocol for FAGOR and others.

S3BS: Absolute angular encoders with SSI protocol for SIEMENS® (Solution Line).

S3BF: Absolute angular encoders with FANUC® ( $\alpha$  and  $\alpha i$ ) protocol.

S3BM: Absolute angular encoders with MITSUBISHI® CNC.

S3BP: Absolute angular encoders with PANASONIC® (Matsushita) protocol.

S3BD: Absolute angular encoders with FeeDat® protocol for FAGOR and others.

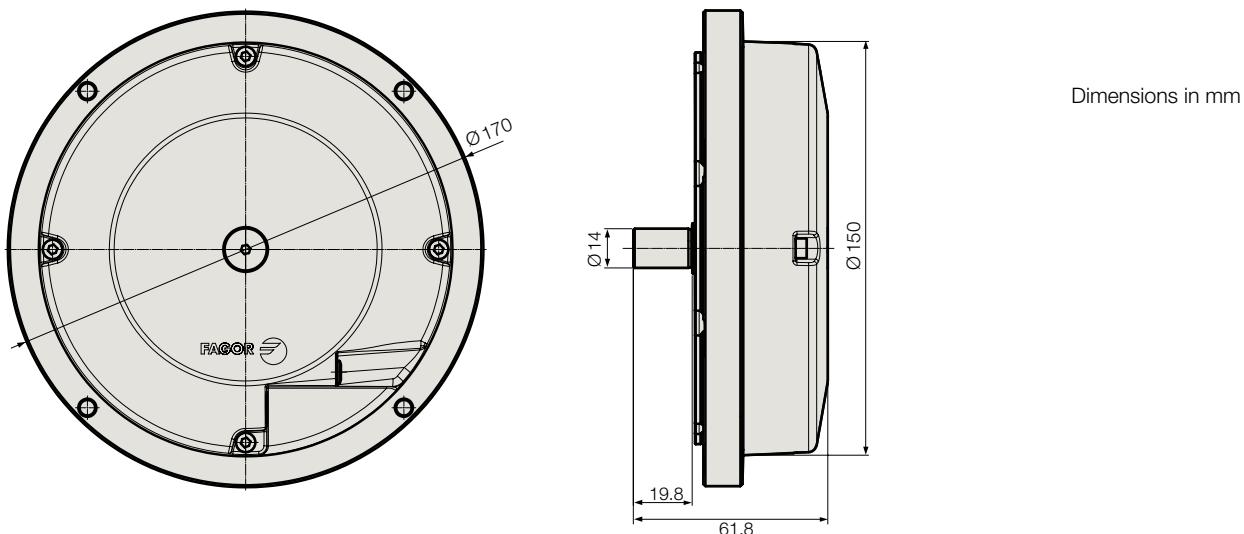
S3BD + EC-PA-DQ1-M:  
Absolute angular encoders with DRIVE-CLiQ® protocol, for SIEMENS® (Solution Line and Sinumerik One) (\*).

S3BBC: Absolute angular encoders with BiSS® C protocol.

(\*) Pending approval.

## Characteristics

	S3B	S3BS	S3BF
Measurement		By means of graduated glass disk	
Accuracy		$\pm 2$ arc-seconds	
Output signals	$\sim 1$ Vpp		–
Resolution / Maximum number of positions per turn	23 bits (8 388 608 positions) 1 Vpp: 16 384 pulses/turn		$\alpha i$ : 28 bits (268 435 456 positions) $\alpha$ : 27 bits (134 217 728 positions)
Maximum frequency	400 kHz for 1 Vpp signal		–
Maximum electrical speed	$< 1500$ min $^{-1}$		$< 3000$ min $^{-1}$
Supply	3.8 to 14 V DC; $< 250$ mA (at 5V without load)		
Maximum cable length	75 m (1)	100 m	50 m
Maximum mechanical speed		10000 min $^{-1}$	
Inertia		Rotor: $35 \cdot 10^{-6}$ kgm $^2$ Stator: $5 \cdot 10^{-3}$ kgm $^2$	
Starting torque (at 20°C)		$< 0.01$ Nm	
Load on the shaft		Axial: 10 N Radial: 10 N	
Vibration		100 m/s $^2$ (55...2000 Hz) IEC 60068-2-6	
Shock		200 m/s $^2$ (6 ms) IEC 60068-2-27	
Operating temperature		0 °C ... 60 °C	
Storage temperature (in its packaging)		-20 °C ... 60 °C	
Weight		1.6 kg	
Protection		IP 64 DIN 40050 (standard) > IP 64 (DIN 40050) using pressurized air at $0.8 \pm 0.2$ bar in angular encoders (3)	
Connection		With built-in connector	



Additional information can be found in the technical documentation and installation manual available on the website [www.fagorautomation.com](http://www.fagorautomation.com)

## Order identification

Example of Angular Encoder: S3BF-28-D170-2

S3	B	F	28	D170	2
<b>Type of shaft:</b> • S3: Solid shaft	<b>Letter identifying the absolute encoder</b> • Blank space: SSI protocol (FAGOR)	<b>Type of communications protocol:</b> • Blank space: SSI protocol (FAGOR) • D: FeeDat® protocol (FAGOR) (1) • S: SSI SIEMENS® (SL) protocol • F: FANUC® ( $\alpha$ and $\alpha_l$ ) protocol • M: MITSUBISHI® CNC protocol • P: PANASONIC® (Matsushita) protocol • BC: BiSS® C protocol	<b>Absolute positions per turn:</b> • 23 bits (8 388 608 positions) • 26 bits (67 108 864 positions) (2) • 27 bits (134 217 728 positions) (3) • 28 bits (268 435 456 positions) (4)	<b>Outside diameter:</b> • D170: 170 mm	<b>Accuracy:</b> • 2: $\pm 2$ arc-seconds

(1) Plus EC-PA-DQ1-M with DRIVE-CLIQ® protocol for SIEMENS® (Solution Line and Sinumerik One).

(2) Only for purely digital models, not available for SSI models.

(3) Only for compatibility with legacy products.

(4) Not available for SSI or BiSS® C models.

Notes: Not all protocol, positions per turn and accuracy combinations are possible.

S3BM	S3BP	S3BD	S3BD + EC-PA-DQ1-M	S3BBC		
By means of graduated glass disk						
			$\pm 2$ arc-seconds			
—						
				(2)		
28 bits (268 435 456 positions)			26 bits (67 108 864 positions)			
—						
$< 3000 \text{ min}^{-1}$						
3.8 to 14 V DC; $< 250 \text{ mA}$ (at 5 V without load)						
30 m	100 m	Up to 100 m (4)		50 m		
$10000 \text{ min}^{-1}$						
Rotor: $35 \cdot 10^{-6} \text{ kgm}^2$ Stator: $5 \cdot 10^{-3} \text{ kgm}^2$						
$< 0.01 \text{ Nm}$						
Axial: 10 N Radial: 10 N						
$100 \text{ m/s}^2$ (55...2000 Hz) IEC 60068-2-6						
$200 \text{ m/s}^2$ (6 ms) IEC 60068-2-27						
$0 \text{ }^\circ\text{C} \dots 60 \text{ }^\circ\text{C}$						
$-20 \text{ }^\circ\text{C} \dots 60 \text{ }^\circ\text{C}$						
1.6 kg						
IP 64 DIN 40050 (standard)						
> IP 64 (DIN 40050) using pressurized air at $0.8 \pm 0.2$ bar in angular encoders (3)						
With built-in connector						

(1) Contact Fagor Automation for maximum cable length.  
 (2) Consult Fagor Automation for analog output signals.

(3) For more information consult the AI-1000 Filter Unit catalog.  
 (4) Depending on CNC model. Consult SIEMENS® documentation.

# S3B-D90 series



## Model description:

S3B: Absolute angular encoders with SSI protocol for FAGOR and others.

S3BS: Absolute angular encoders with SSI protocol for SIEMENS® (Solution Line).

S3BF: Absolute angular encoders with FANUC® ( $\alpha$  and  $\alpha i$ ) protocol.

S3BM: Absolute angular encoders with MITSUBISHI® CNC.

S3BP: Absolute angular encoders with PANASONIC® (Matsushita) protocol.

S3BD: Absolute angular encoders with FeeDat® protocol for FAGOR and others.

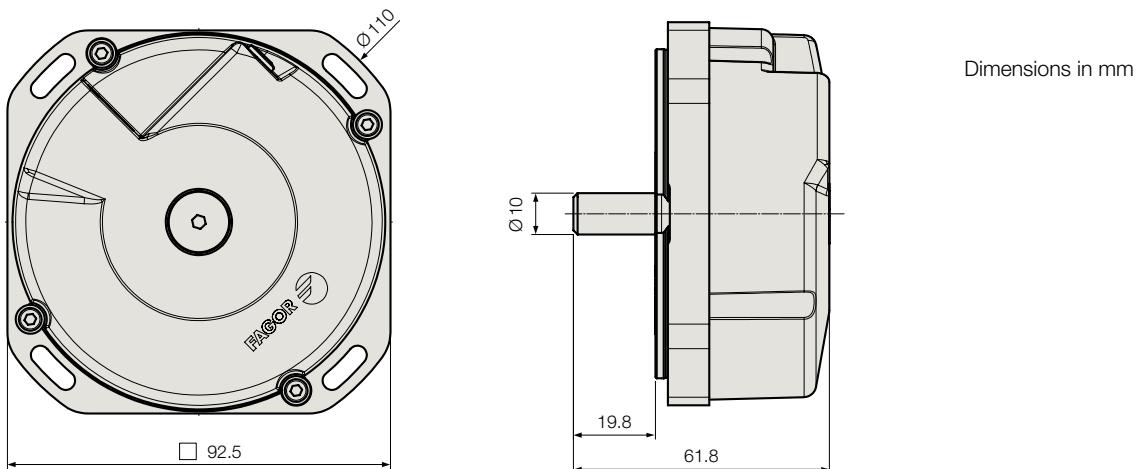
S3BD + EC-PA-DQ1-M: Absolute angular encoders with DRIVE-CLiQ® protocol, for SIEMENS® (Solution Line and Sinumerik One) (\*).

S3BBC: Absolute angular encoders with BiSS® C protocol.

(\*) Pending approval.

## Characteristics

	S3B	S3BS	S3BF
Measurement		By means of graduated glass disk	
Accuracy	$\pm 2.5$ arc-seconds $\pm 5$ arc-seconds		$\pm 2$ arc-seconds $\pm 4$ arc-seconds
Output signals	$\sim 1$ Vpp		—
Resolution / Maximum number of positions per turn	23 bits (8 388 608 positions) 1 Vpp: 16 384 pulses/turn		$\alpha i$ : 28 bits (268 435 456 positions) $\alpha$ : 27 bits (134 217 728 positions)
Maximum frequency	400 kHz for 1 Vpp signal		—
Maximum electrical speed	$< 1500$ min $^{-1}$		$< 3000$ min $^{-1}$
Supply	3.8 to 14 V DC; $< 250$ mA (at 5 V without load)		
Maximum cable length	75 m (1)	100 m	50 m
Maximum mechanical speed		10000 min $^{-1}$	
Inertia		Rotor: $22 \cdot 10^{-6}$ kgm $^2$ Stator: $570 \cdot 10^{-6}$ kgm $^2$	
Starting torque (at 20 °C)		$< 0.01$ Nm	
Load on the shaft		Axial: 10 N Radial: 10 N	
Vibration		100 m/s $^2$ (55...2000 Hz) IEC 60068-2-6	
Shock		200 m/s $^2$ (6 ms) IEC 60068-2-27	
Operating temperature		0 °C ... 60 °C	
Storage temperature (in its packaging)		-20 °C ... 60 °C	
Weight		0.57 kg	
Protection		IP 64 DIN 40050 (standard) > IP 64 (DIN 40050) using pressurized air at $0.8 \pm 0.2$ bar in angular encoders (3)	
Connection		With built-in connector	



Additional information can be found in the technical documentation and installation manual available on the website [www.fagorautomation.com](http://www.fagorautomation.com)

## Order identification

Example of Angular Encoder: S3BF-28-D90-2

S3	B	F	28	D90	2
<p><b>Type of shaft:</b></p> <ul style="list-style-type: none"> <li>• S3: Solid shaft</li> </ul>	<p><b>Letter identifying the absolute encoder:</b></p> <ul style="list-style-type: none"> <li>• Blank space: SSI protocol (FAGOR)</li> <li>• D: FeeDat® protocol (FAGOR) (1)</li> <li>• S: SSI SIEMENS® (SL) protocol</li> <li>• F: FANUC® (<math>\alpha</math> and <math>\alpha i</math>) protocol</li> <li>• M: MITSUBISHI® CNC protocol</li> <li>• P: PANASONIC® (Matsushita) protocol</li> <li>• BC: BISS® C protocol</li> </ul>	<p><b>Type of communications protocol:</b></p> <ul style="list-style-type: none"> <li>• Blank space: SSI protocol (FAGOR)</li> <li>• D: FeeDat® protocol (FAGOR) (1)</li> <li>• S: SSI SIEMENS® (SL) protocol</li> <li>• F: FANUC® (<math>\alpha</math> and <math>\alpha i</math>) protocol</li> <li>• M: MITSUBISHI® CNC protocol</li> <li>• P: PANASONIC® (Matsushita) protocol</li> <li>• BC: BISS® C protocol</li> </ul>	<p><b>Absolute positions per turn:</b></p> <ul style="list-style-type: none"> <li>• 23 bits (8 388 608 positions)</li> <li>• 26 bits (67 108 864 positions) (2)</li> <li>• 27 bits (134 217 728 positions) (3)</li> <li>• 28 bits (268 435 456 positions) (4)</li> </ul>	<p><b>Outside diameter:</b></p> <ul style="list-style-type: none"> <li>• D90: 90 mm</li> </ul>	<p><b>Accuracy:</b></p> <ul style="list-style-type: none"> <li>• Blank space: <math>\pm 4</math> arc-seconds (<math>\pm 5</math> arc-seconds for SSI models)</li> <li>• 2: <math>\pm 2</math> arc-seconds (<math>\pm 2.5</math> arc-seconds for SSI models)</li> </ul>

(1) Plus EC-PA-DQ1-M with DRIVE-CLiQ® protocol for SIEMENS® (Solution Line and Sinumerik One).

(2) Only for purely digital models, not available for SSI models.

(3) Only for compatibility with legacy products.

(4) Not available for SSI or BISS® C models.

Notes: Not all protocol, positions per turn and accuracy combinations are possible.

S3BM	S3BP	S3BD	S3BD + EC-PA-DQ1-M	S3BBC
By means of graduated glass disk				
			±2 arc-seconds ±4 arc-seconds	
			-	(2)
		28 bits (268 435 456 positions)		26 bits (67 108 864 positions)
			-	
			< 3000 min <sup>-1</sup>	
			3.8 to 14 V DC; < 250 mA (at 5V without load)	
30 m	100 m	Up to 100 m (4)	50 m	
		10000 min <sup>-1</sup>		
			Rotor: $22 \cdot 10^{-6}$ kgm <sup>2</sup> Stator: $570 \cdot 10^{-6}$ kgm <sup>2</sup>	
			< 0.01 Nm	
			Axial: 10 N Radial: 10 N	
			100 m/s <sup>2</sup> (55...2000 Hz) IEC 60068-2-6	
			200 m/s <sup>2</sup> (6 ms) IEC 60068-2-27	
			0 °C ... 60 °C	
			-20 °C ... 60 °C	
			0.57 kg	
			IP 64 DIN 40050 (standard)	
			> IP 64 (DIN 40050) using pressurized air at 0.8 ±0.2 bar in angular encoders (3)	
			With built-in connector	

(1) Contact Fagor Automation for maximum cable length.  
(2) Consult Fagor Automation for analog output signals.

(3) For more information consult the AI-1000 Filter Unit catalog.  
(4) Depending on CNC model. Consult SIEMENS® documentation.

# FUNCTIONAL SAFETY

## SYMBOLS THAT MAY APPEAR IN THIS CATALOG



### WARNING or caution symbol

It warns about a potentially dangerous situation. Ignoring this warning may cause serious injuries (even fatal) or damages to the unit.

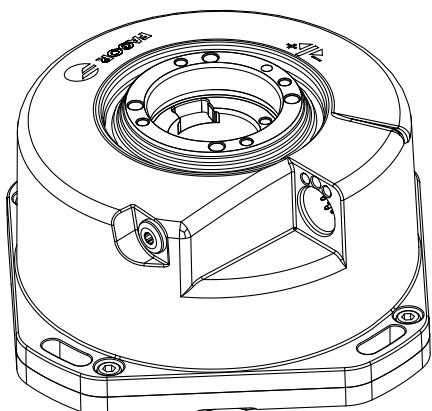


### MANDATORY symbol

It warns about actions and operations that MUST BE carried out. THEY ARE NOT RECOMMENDATIONS. Ignoring this warning may mean non-compliance of some safety regulation.

### Mounting

- ! In the application, the encoder must be protected against solids and liquids ingress. Do not orient the sealing rings against pollution sources. See other protection considerations in the Protection section.



### Mechanical fault exclusion for the fixation to the machine



- ! In a safety application the fault of loosening or losing of attachment of the encoder to the machine must be eliminated because it cannot be guaranteed that these faults will be detected by the control. For this reason the mounting instructions in the mounting manual must be strictly followed and an adhesive screw lock (medium strength adhesive) must be used for the screws to fix the encoder shaft and the encoder flange to the machine. Also, the specified maximum acceleration and vibration must not be exceeded.

## Parts subject to wear

The encoders have a service life of 20 years. Maintenance is not required. However, several components may suffer from wear or degradation.

! These include in particular the following parts:

- Cables with frequent flexing
- For encoders with an integral bearing, additionally:

  - Bearings
  - Shaft sealing rings

## Installation manual

! There is important information in the installation manual to ensure the correct installation of the encoder.

- Installation manual: ANGULAR ENCODER MODEL H3BD-D90-FS: 14460391

## Electrical Safety

! The power supply must be SELV (Safety Extra Low Voltage) or PELV (Protective Extra Low Voltage).

## System Test

! The encoder is a component for integration in a larger system. The specifications in this catalog only apply to the specific encoder, not to the whole system. Installation or operation of the encoder outside of the specified conditions is at the user's own risk.

**Comprehensive tests of the whole system** must be carried out in order to ensure that the encoder works in the range of specified conditions. In particular, **vibration** conditions depend on the whole system, so the whole system must be tested to ensure operation within the limits specified for vibration.

## Fault reaction time

The fault reaction time for the encoder system is the time elapsed from the occurrence of a fault in the encoder and the corresponding reaction takes place in the control Unit.

It can be calculated as:

- Time to communicate the fault to the Control Unit + Time needed for the Control Unit to react.
- Time to communicate the fault to the Control Unit  $\leq 2$  s
  - \* The DRIVE-CLiQ® cycle time used to operate the encoder.
- Time needed for the Control Unit to react: This is competence of the builder of the Control Unit or the machine.

! The overall fault reaction time for the encoder system may be suitable or not depending on the application or safety concept of the overall machine.

## Startup time

The encoder is ready to answer to DRIVE-CLiQ® requests 2s after power supply of the encoder.

## Site Acceptance Test

! The Site Acceptance Test is mandatory in order to guarantee the safety capability of the installed encoder system. The following points must be additionally checked in order to pass the Site Acceptance Test:

- The encoder serial number displayed in the Control Unit matches the serial number printed in the encoder label.
- The encoder resolution parameter shown in the Control Unit matches the values in the encoder label.

## Safety functions

The safety functions of the encoder are:

– **Safe Absolute Position:** The encoder always provides a safe absolute position value. This means that the encoder always provides an absolute value for the position that is correct within the safe position tolerance when the error bits are not activated.

– **Safe Communication:** The encoder communicates two independently generated position values and error bits.

This allows a wide range of safety functions to be implemented in the control.

## Functional Safety

### Safety Capability

The encoder system with Functional Safety has the following characteristics related to the safety according to ISO13849-1:2015 and IEC61508:2010 norms.

Safety Capability according ISO 13849-1: 2015 and IEC61508: 2010

EC-PA-DQS + H3BD-D90-FS	
MTTFd (years) (2000 m above sea level)	66.75 years
DC (%)	99
Category	3
Performance level, PL	d
PFH (2000 m above sea level)	$20.15 \cdot 10^{-9}$
Safe Position Tolerance	$+0.44^\circ, -0.44^\circ$ (safety-related measuring step $0.176^\circ$ )
For applications up to	SIL 2

The encoder system also complies with IEC61800-5-2:2017 and IEC61800-5-3:2021

## Protection

! Enclosed **angular encoders** meet the protection requirements IP 64 of the **IEC 60529** standard when mounted so water splashes don't hit the sealing lips directly. For further protection, a separate protection guard must be mounted.

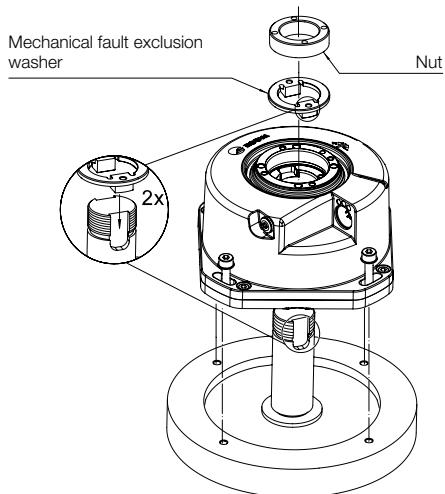
! If an ingress protection greater than IP 64 is needed compressed air may be used. For these cases, Fagor Automation recommends their Air Filter unit AI-1000.

! The **quality of air** supplied to the encoder must be 1/4/1 according to **ISO 8573-1:2010**. To achieve this air class, the air supplied to the AI-1000 unit must fulfil class 5/6/4 according to ISO 8573-1:2010. For more information see the AI-1000 catalog and manual.

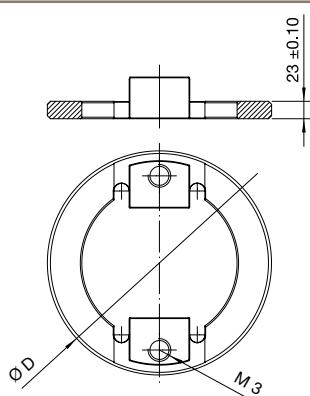
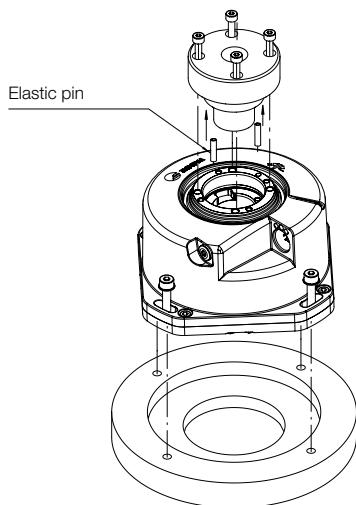
! **Safety switch**  
In order to guarantee the air flux it is necessary to install a **safety switch** capable of activating an alarm when the pressure gets below 60 % of the nominal pressure.

# ! MECHANICAL FAULT EXCLUSION

Shaft coupling with nut and mechanical fault exclusion washer



Front end shaft coupling with pins



Drawings representing the hollow shaft angular encoder of 90 mm diameter (H3-D90).

For the H3-D90 and H3-D110 angular encoders, a mechanical connection between the measuring system and the drive can be made, which excludes failures due to the possibility of loosening and undoing of the connection. To make a mechanical fault exclusion connection, it is essential that the assembly be made by either using an additional washer (mechanical fault exclusion washer) or alternatively with additional elastic pins.

It must also be taken into account that there are limitations with the following aspects:

- The materials used: it is essential that the shaft of the machine and the fastening components are made of steel
- The maximum turning speed and acceleration
- The operating temperature

Specific information is indicated in the product characteristics tables.

The part numbers and characteristics for the various models of mechanical fault exclusion washer and nut are:

Model	Washer code	Nut code	Moment of Inertia Nut and washer
H3B-D200i100	82620157	82600152	$550 \cdot 10^{-6} \text{ kgm}^2$
H3-D110	82620158	82620153	$24 \cdot 10^{-6} \text{ kgm}^2$
H3-D90	82620155	82620150	$4.8 \cdot 10^{-6} \text{ kgm}^2$

Permissible angular acceleration of the rotor when acceleration is applied via the hollow shaft, and the shaft is coupled with a ring nut and mechanical fault exclusion washer:

- H3-D90 series: 20000 rad/s<sup>2</sup>

Permissible angular acceleration of the rotor when acceleration is applied via the hollow shaft, and the shaft is front coupled with pins:

- H3-D90 series: 5500 rad/s<sup>2</sup>

Permissible angular acceleration of the stator when acceleration is applied via the mounting flange:

- H3-D90 series: 4000 rad/s<sup>2</sup>

Model	Diameter Ø (mm)
H3B-D200i100	114
H3-D110	45.8
H3-D90	29.6

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