



# HEIDENHAIN



Product Information

## **ECA 4000V**

Absolute Modular Angle  
Encoder for Application in  
High Vacuum

# ECA 4412V, ECA 4492V

Absolute angle encoder with high accuracy for use in high vacuum

- Steel scale drum with three-point centering
- Consists of scanning head and scale drum



ECA 4000

<b>Scanning head</b>	
<b>Interface</b>	
Ordering designation	
Clock frequency/Processing time $t_{cal}$	
<b>Electrical connection</b>	
Cable length <sup>1)</sup>	
Power supply	
Power consumption (max.)	
Current consumption (typical)	
<b>Vibration</b> 55 Hz to 2000 Hz	
<b>Shock</b> 6 ms	
<b>Operating temperature</b>	
<b>Baking temperature</b>	
<b>Vacuum class</b>	
<b>Protection</b> EN 60529	
<b>Mass</b>	
<b>Scale drum</b>	
<b>Measuring standard</b>	
Coefficient of expansion	
<b>Drum inside diameter*</b>	
<b>Drum outside diameter*</b>	
Mechanically permissible speed	
Electrically permissible speed	
Moment of inertia of rotor	
Permissible axial movement	
<b>Positions per revolution</b>	
Measuring step	
Signal periods	
<b>Accuracy of graduation</b>	
<b>Position error per signal period</b>	
RMS ( $1\sigma$ )	
<b>Protection</b> EN 60529	
<b>Mass</b>	Scale drum

\* Please select when ordering  
Product Information ECA 4000V 07/2018

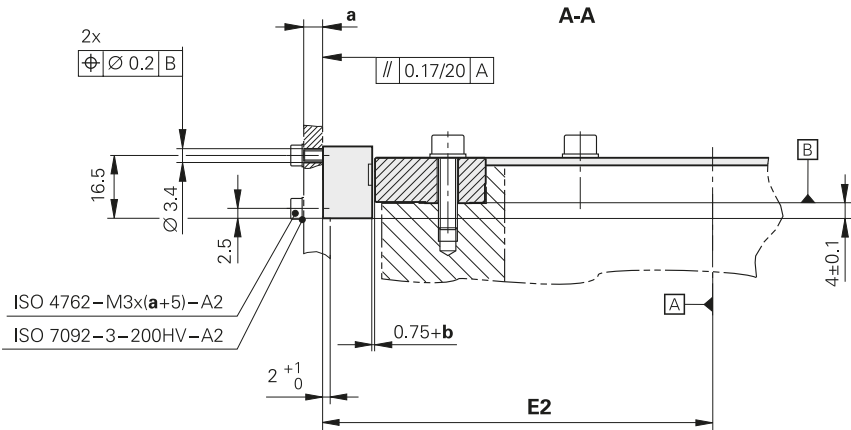
AK ECA 4410 V		AK ECA 4490F V		AK ECA 4490M V		AK ECA 4490P V	
EnDat 2.2		Fanuc Serial Interface; $\alpha$ i Interface		Mitsubishi high speed interface		Panasonic Serial Interface	
EnDat22		Fanuc05		Mit03-4		Pana01	
$\leq 16$ MHz/ $\leq 5$ $\mu$ s		-					
Cable, 1 m or 3 m, with 15-pin D-sub connector (female)							
$\leq 100$ m		$\leq 50$ m		$\leq 30$ m		$\leq 50$ m	
DC 3.6 V to 14 V							
At 3.6 V: 700 mW; at 14 V: 800 mW		At 3.6 V: 850 mW; at 14 V: 950 mW					
At 5 V: 90 mA (without load)		At 5 V: 100 mA (without load)					
$\leq 500$ m/s <sup>2</sup> (EN 60068-2-6) $\leq 1000$ m/s <sup>2</sup> (EN 60068-2-27)							
-10 °C to 50 °C							
100 °C							
High vacuum up to $10^{-7}$ mbar							
IP40							
Scanning head: 18 g (without cable); cable: 21 g/m; connector (D-sub): 64 g							

TTR ECA 4402									
Steel drum $\alpha_{\text{therm}} \approx 10.4 \cdot 10^{-6} \text{ K}^{-1}$									
70 mm	80 mm	120/150 mm	130 mm	150/185 mm	180/210 mm	270 mm	425 mm	512 mm	
104.63 mm	127.64 mm	178.55 mm	148.20 mm	208.89 mm	254.93 mm	331.31 mm	484.07 mm	560.46 mm	
$\leq 8500$ rpm	$\leq 6250$ rpm	$\leq 4500$ rpm	$\leq 5250$ rpm	$\leq 4250$ rpm	$\leq 3250$ rpm	$\leq 2500$ rpm	$\leq 1800$ rpm	$\leq 1500$ rpm	
$\leq 7000$ rpm	$\leq 5750$ rpm	$\leq 3000$ rpm	$\leq 4400$ rpm	$\leq 2550$ rpm	$\leq 2100$ rpm	$\leq 900$ rpm	$\leq 600$ rpm	$\leq 550$ rpm	
$0.83 \cdot 10^{-3}$ kgm <sup>2</sup>	$2.0 \cdot 10^{-3}$ kgm <sup>2</sup>	$7.1/4.5 \cdot 10^{-3}$ kgm <sup>2</sup>	$1.7 \cdot 10^{-3}$ kgm <sup>2</sup>	$12/6.5 \cdot 10^{-3}$ kgm <sup>2</sup>	$28/20 \cdot 10^{-3}$ kgm <sup>2</sup>	$59 \cdot 10^{-3}$ kgm <sup>2</sup>	$199 \cdot 10^{-3}$ kgm <sup>2</sup>	$263 \cdot 10^{-3}$ kgm <sup>2</sup>	
$\leq \pm 0.4$ mm (scale drum relative to the scanning head)									
134217728 (27 bits)					268435456 (28 bits)		536870912 (29 bits)		
0.0097"					0.0048"		0.0024"		
8195	10010	14003	11616	16379	19998	25993	37994	44000	
$\pm 3$ "	$\pm 2.5$ "	$\pm 2$ "	$\pm 2.3$ "	$\pm 1.9$ "	$\pm 1.8$ "	$\pm 1.7$ "	$\pm 1.5$ "	$\pm 1.5$ "	
$\pm 0.20$ " 0.040"	$\pm 0.16$ " 0.032"	$\pm 0.12$ " 0.023"	$\pm 0.14$ " 0.028"	$\pm 0.10$ " 0.020"	$\pm 0.08$ " 0.016"	$\pm 0.06$ " 0.012"	$\pm 0.04$ " 0.009"	$\pm 0.04$ " 0.007"	
Complete encoder in mounted condition: IP00									
$\approx 0.42$ kg	$\approx 0.69$ kg	$\approx 1.2/0.66$ kg	$\approx 0.35$ kg	$\approx 1.5/0.66$ kg	$\approx 2.3/1.5$ kg	$\approx 2.6$ kg	$\approx 3.8$ kg	$\approx 3.7$ kg	

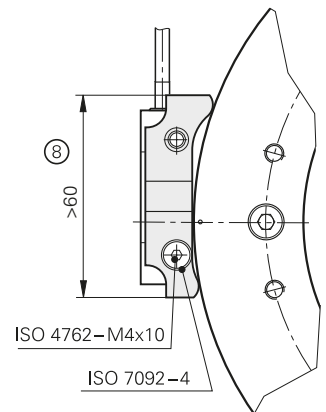
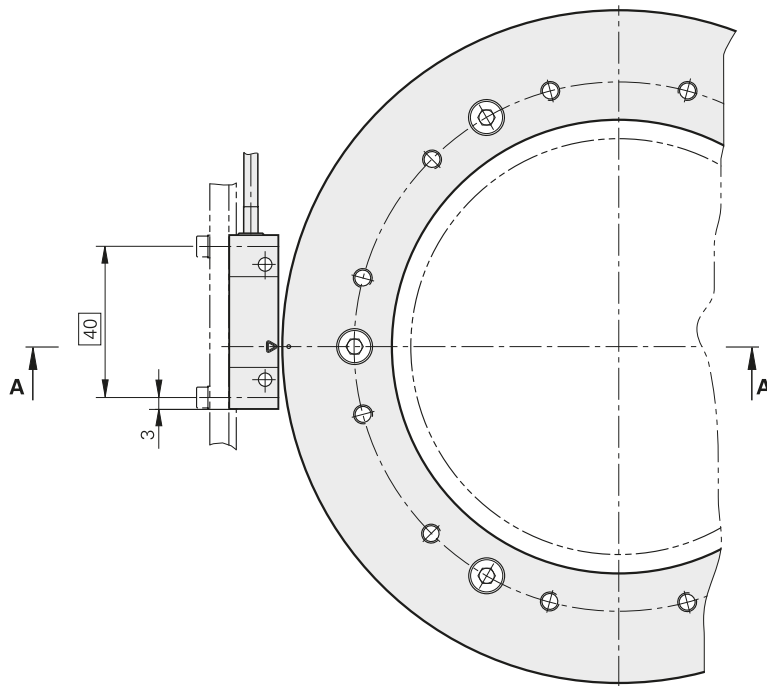
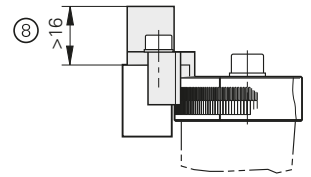
<sup>1)</sup> With HEIDENHAIN cable



II



Accessory: Mounting aid



D1	⊙	D2	D3	E1	E2	$\alpha$	M	G	b [mm]	c [mm]
$\varnothing 70 +0.05/+0.07$	$\varnothing \leq 70$	$\varnothing 85$	$\varnothing 104.63$	56.57	66.07	$6 \times 60^\circ = 360^\circ$	6x M5	/	$\pm 0.07$	0.3
$\varnothing 80 +0.05/+0.07$	$\varnothing \leq 80$	$\varnothing 95$	$\varnothing 127.64$	68.07	77.57	$6 \times 60^\circ = 360^\circ$	6x M5	/	$\pm 0.07$	0.3
$\varnothing 120 +0.05/+0.07$	$\varnothing \leq 120$	$\varnothing 140$	$\varnothing 178.55$	93.52	103.02	$6 \times 60^\circ = 360^\circ$	6x M5	/	$\pm 0.10$	0.3
$\varnothing 130 +0.05/+0.07$	$\varnothing \leq 130$	$\varnothing 139$	$\varnothing 148.20$	78.35	87.85	$12 \times 30^\circ = 360^\circ$	12x M3	/	$\pm 0.07$	0.3
$\varnothing 150 +0.05/+0.07$	$\varnothing \leq 150$	$\varnothing 163$	$\varnothing 178.55$	93.52	103.02	$12 \times 30^\circ = 360^\circ$	12x M3	/	$\pm 0.10$	0.3
$\varnothing 150 +0.05/+0.07$	$\varnothing \leq 150$	$\varnothing 165$	$\varnothing 208.89$	108.69	118.19	$6 \times 60^\circ = 360^\circ$	6x M5	/	$\pm 0.12$	0.5
$\varnothing 180 +0.05/+0.07$	$\varnothing \leq 180$	$\varnothing 200$	$\varnothing 254.93$	131.71	141.21	$6 \times 60^\circ = 360^\circ$	6x M5	/	$\pm 0.12$	0.5
$\varnothing 185 +0.05/+0.07$	$\varnothing \leq 185$	$\varnothing 197$	$\varnothing 208.89$	108.69	118.19	$12 \times 30^\circ = 360^\circ$	12x M3	/	$\pm 0.12$	0.5
$\varnothing 210 +0.05/+0.07$	$\varnothing \leq 210$	$\varnothing 230$	$\varnothing 254.93$	131.71	141.21	$12 \times 30^\circ = 360^\circ$	12x M3	/	$\pm 0.12$	0.5
$\varnothing 270 +0.05/+0.07$	$\varnothing \leq 270$	$\varnothing 290$	$\varnothing 331.31$	169.90	179.40	$12 \times 30^\circ = 360^\circ$	12x M5	/	$\pm 0.15$	1.0
$\varnothing 425 +0.05/+0.07$	$\varnothing \leq 425$	$\varnothing 445$	$\varnothing 484.07$	246.29	255.79	$12 \times 30^\circ = 360^\circ$	12x M6	12x M6	$\pm 0.15$	1.0
$\varnothing 512 +0.05/+0.07$	$\varnothing \leq 512$	$\varnothing 528$	$\varnothing 560.46$	284.48	293.98	$18 \times 20^\circ = 360^\circ$	18x M6	12x M8	$\pm 0.15$	1.0

For CAD data go to [cad.heidenhain.de](http://cad.heidenhain.de)

# Encoders for application in a vacuum

The vacuum-compatible encoders are distinguished by the following features:

- Air vents
- Production in a clean room
- Specialized cleaning and packaging
- Cable with PTFE insulation and tin-plated copper braiding

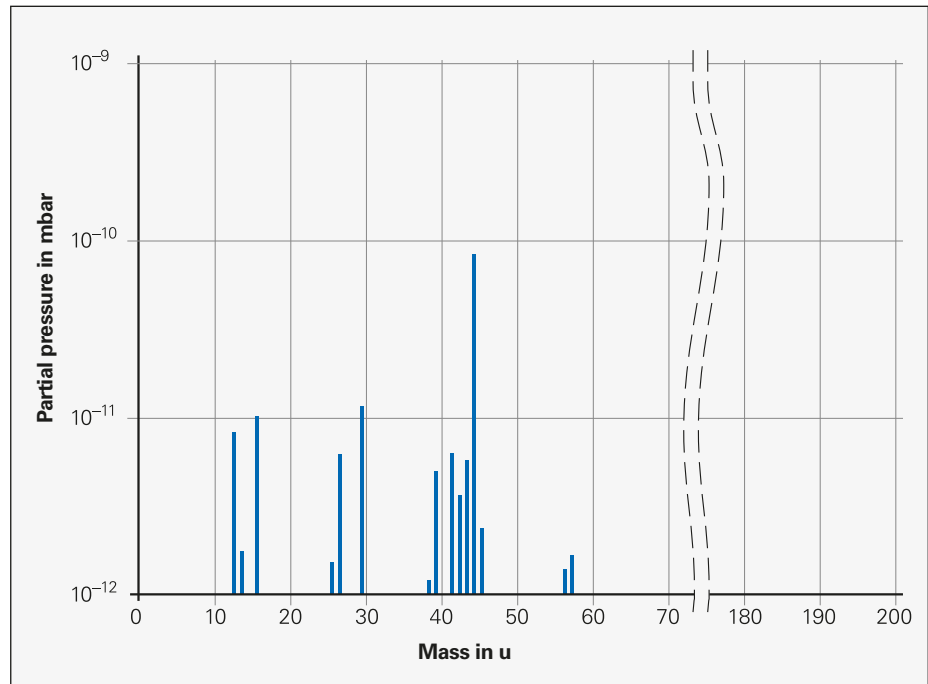
## Residual gas analysis

The influence of encoders on the quality of the vacuum can be determined through residual gas analyses. In such an analysis, a sample in a vacuum chamber is pumped out at least to  $10^{-6}$  mbar (turbomolecular pump, pumping speed 15 l/s to 200 l/s) whereby the residual gases are measured with a mass spectrometer (Pfeiffer QMA 200) and an absolute pressure sensor (VACOM ATMION). If the typical residual gases of the empty chamber are then subtracted, the outgassing behavior of the examined sample can be deduced.

The amount of remaining residual gases depends not only on the cleanliness of the sample and the materials tested, but also on the pump type used and its suction power. The higher the pumping speed used for the measurement is, and the longer the gas is pumped out, the lower the quantity of residual gases is.

To attain the lowest possible outgassing values, HEIDENHAIN recommends baking at 100 °C for 48 hours under high vacuum conditions.



The figure shows the spectrum of the residual gas analysis of an AK ECA 4410 V scanning head with 1 m cable and D-sub connector. The scanning head was baked in a high vacuum at 100 °C for 48 hours. The outgases from the scale drum were hardly measurable or depictable.





Residual gas analysis of an AK ECA 4410V scanning head with 1 m cable (with pumping speed of 107 l/s, pressure  $6 \cdot 10^{-8}$  mbar)

# Electrical connection



## EnDat pin layout

15-pin D-sub connector								
	Power supply				Serial data transfer			
	5	12	7	14	4	11	1	9
	<b>U<sub>P</sub></b>	<b>Sensor</b> U <sub>P</sub>	<b>0V</b>	<b>Sensor</b> 0V	<b>DATA</b>	<b>DATA</b>	<b>CLOCK</b>	<b>CLOCK</b>
	Brown	Turquoise	White	Beige	Gray	Pink	Violet	Black



## Fanuc pin layout

15-pin D-sub connector								
	Power supply				Serial data transfer			
	5	12	7	14	4	11	1	9
	<b>U<sub>P</sub></b>	<b>Sensor</b> U <sub>P</sub>	<b>0V</b>	<b>Sensor</b> 0V	<b>Serial Data</b>	<b>Serial Data</b>	<b>Request</b>	<b>Request</b>
	Brown	Turquoise	White	Beige	Gray	Pink	Violet	Black

## Mitsubishi pin layout

15-pin D-sub connector								
	Power supply				Serial data transfer			
	5	12	7	14	4	11	1	9
	<b>U<sub>P</sub></b>	<b>Sensor</b> U <sub>P</sub>	<b>0V</b>	<b>Sensor</b> 0V	<b>Serial Data</b>	<b>Serial Data</b>	<b>Request Frame</b>	<b>Request Frame</b>
	Brown	Turquoise	White	Beige	Gray	Pink	Violet	Black

## Panasonic pin layout

15-pin D-sub connector								
	Power supply				Serial data transfer			
	4	12	2	10	5	13	8	15
	<b>U<sub>P</sub></b>	<b>Sensor</b> U <sub>P</sub>	<b>0V</b>	<b>Sensor</b> 0V	<b>Vacant</b> <sup>1)</sup>	<b>Vacant</b> <sup>1)</sup>	<b>Request Data</b>	<b>Request Data</b>
	Brown	Turquoise	White	Beige	Gray	Pink	Violet	Black

**Cable shield** connected to housing; **U<sub>P</sub>** = Power supply voltage

**Sensor:** The sense line is connected in the encoder with the corresponding power line.

Vacant pins or wires must not be used.

<sup>1)</sup> Required for adjustment/inspection by PWM 21


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This Product Information supersedes all previous editions, which thereby become invalid. The basis for ordering from HEIDENHAIN is always the Product Information document edition valid when the order is made.



**For more information:**

Comply with the requirements described in the following documents to ensure the correct operation of the encoder:

- Brochure: *Modular Angle Encoders with Optical Scanning* 1222041-xx
- Brochure: *Interfaces of HEIDENHAIN Encoders* 1078628-xx

For brochures and product information sheets, visit [www.heidenhain.de](http://www.heidenhain.de).