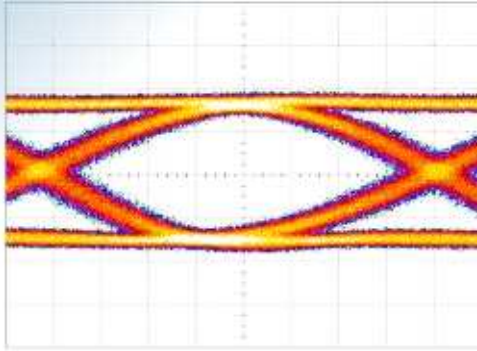




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## Data sheet EC-AIN8





# Data sheet EC-AIN8

## Contents

1.	Application range .....	3
2.	Connectable analog signals .....	3
3.	Hardware description .....	3
3.1.	Analog input circuit.....	3
3.2.	Microcontroller.....	4
3.3.	EtherCAT®-connection .....	4
3.4.	Power supply .....	4
4.	Programming and memory mapping of the EtherCAT®-slave controller.....	4
4.1.	Summary .....	4
4.1.1.	Programming of SyncManagers.....	4
4.1.2.	Data fields .....	5
4.2.	Channel registers .....	6
4.2.1.	Format of the AD-values.....	6
4.2.2.	Description of the control word .....	6
5.	Connector pin assignment .....	7
6.	Technical data .....	8
7.	Ordering information.....	9



## 1. Application range

The EC-AIN8 module was developed for the acquisition of analog signals. The analog values are transmitted by the EtherCAT®<sup>1</sup> fieldbus. The module is designed for DIN rail assembly.

The module has eight analog inputs. Four different input ranges can be chosen independently for each channel.

The resolution is 13bit at a conversion time of 25µs.

## 2. Connectable analog signals

The module has the following possible input ranges:

- ±10V
- ±5V
- ±2,5V
- 0..10V
- 0(4) - 20mA (with an external load resistance)

The determination of the input ranges is made by the control word (s. chapter 4.2.2)

The resistance of the analog sources connected has to be adapted to the input resistance of the input differential amplifier (s. chapter 6) for avoiding corruption of the analog value.

## 3. Hardware description

The module is made of four functional hardware blocks. These are:

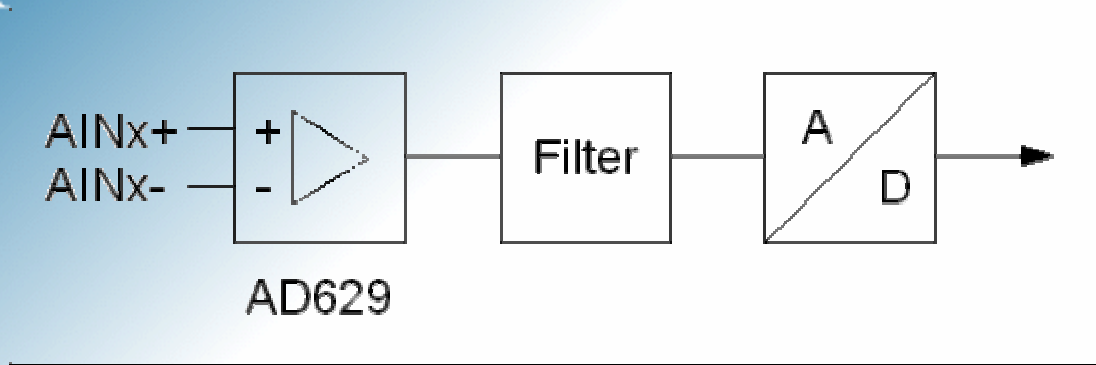
- Analog input circuit
- microcontroller
- EtherCAT®-connection
- Power supply.

### 3.1. Analog input circuit

The module has 8 analog inputs. These inputs are equipped with differential amplifiers AD629 from Analog Devices. The common mode voltage allowed is ±220V while operation. The inputs are protected until ±500V. But an operation without high common mode voltages is recommended to ensure accurate as possible conversion results. The outputs of the differential amplifiers are lead over a low pass filter of first order to the AD-converter. The input range is determined by control word for each channel independently (s. chapter 4.2.2).

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<sup>1</sup> EtherCAT® is registered trademark and patented technology, licensed by Beckhoff Automation GmbH, Germany



### 3.2. Microcontroller

The AD-converter is read out by a microcontroller over the SPI interface. There is a galvanic isolation between AD-converter and microcontroller. It can be implemented digital filters on the microcontroller on request. Afterwards the AD-values are transmitted to the EtherCAT®-slave controller.

The parameterization of the AD-converter is made in the other direction, i.e. the control word (s. chapter 4) sent via Ethernet by the host is written over the SPI-interface into the AD-converter.

The software of the microcontroller is programmed into the flash by the producer.

### 3.3. EtherCAT®-connection

The module has two Ethernet interfaces each with one yellow and one green LED. The yellow LED signalizes an Ethernet connection with 100MB, the green data transfer.

One interface serves as an input, the other as output to the next EtherCAT® slave or is unconnected if the module is the last inside the chain. Both interfaces support auto crossover (MDI/MDIX).

Furthermore there is a green LED at the front side displaying the EtherCAT® state with different blink sequences.

### 3.4. Power supply

The module is powered by  $24V \pm 30\%$ . All supply voltages necessary for the different functional blocks are generated internally. The power needed is about 3W.

## 4. Programming and memory mapping of the EtherCAT®-slave controller

### 4.1. Summary

#### 4.1.1. Programming of SyncManagers

The integrated circuit ET1100 of Beckhoff Automation GmbH is used as the EtherCAT® – slave controller. It is responsible for the data exchange between application layer and microcontroller reading the analog values from the AD-converter. There for two SyncManagers (SM) of the ET1100 are used. One serves for the output of data (control word). The other is used for reading analog values. Both SMs operate in 3 buffer mode ensuring data consistency. The SM for data output activates the interrupt line of the process data interface if there new output data were transmitted with the last frame. The micro controller will serve the interrupt by reading the new output data. The analog values are written into the slave controller by the microcontroller cyclically. That's why the input data are maximal  $25\mu s$  old at the beginning of data frame.



SM	address	value	explanation
SM0	0x800	0x2000	Start address of analog values
	0x802	0x0010	Length of analog values in Byte
	0x804	0x0010	read, 3buffer, ECAT IRQ
	0x806	0x0001	Enable (set after 0x800..804 are programmed)
SM1	0x808	0x2100	Start address of control word
	0x80A	0x0002	Length of control word in Byte
	0x80C	0x0024	write, 3buffer, PDI IRQ
	0x80E	0x0001	Enable (set after 0x808..80C are programmed)

#### 4.1.2. Data fields

##### Input data:

Address	content
0x2000	analog value, channel0
0x2002	analog value, channel1
0x2004	analog value, channel2
0x2006	analog value, channel3
0x2008	analog value, channel4
0x200A	analog value, channel5
0x200C	analog value, channel6
0x200E	analog value, channel7

##### 2. Output data:

address	content
0x2100	control word



## 4.2. Channel registers

### 4.2.1. Format of the AD-values

The AD-values are straight binary coded and stored right aligned. It results in the following coding depending on the input voltage range chosen:

- $\pm 10V$

-10V	0V	+10V-1LSB
0x0000	0x1000	0x1FFF

- $\pm 5V$

-5V	0V	+5V-1LSB
0x0000	0x1000	0x1FFF

- $\pm 2,5V$

-2,5V	0V	+2,5V-1LSB
0x0000	0x1000	0x1FFF

- 0..10V

0V	5V	+10V-1LSB
0x0000	0x1000	0x1FFF

### 4.2.2. Description of the control word

The module EC\_AIN8 is parameterized by a control word. It includes 2bit per channel serving for the determination of the input range. If there should be connected a 0(4)..20mA-signal, an external load resistance of 500Ohm must be added to the channel concerned. And an input range of 0..10V has to be chosen.

Control word:

D15	D14	D13	D12	D11	D10	D9	D8	D7	D6	D5	D4	D3	D2	D1	D0
R71	R70	R61	R60	R51	R50	R41	R40	R31	R30	R21	R20	R11	R10	R01	R00

Rx(1..0)                      x = channel number

00:  $\pm 10V$

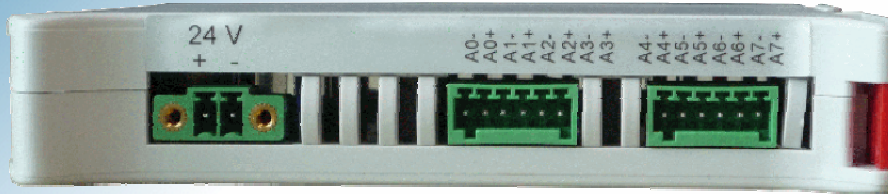
01:  $\pm 5V$

10:  $\pm 2,5V$

11: 0..10V



## 5. Connector pin assignment



24V+	Power supply +
24V-	Power supply ground
A0-	analog input 0, negative
A0+	analog input 0, positive
A1-	analog input 1, negative
A1+	analog input 1, positive
A2	analog input 2, negative
A2+	analog input 2, positive
A3-	analog input 3, negative
A3+	analog input 3, positive
A4-	analog input 4, negative
A4+	analog input 4, positive
A5-	analog input 5, negative
A5+	analog input 5, positive
A6-	analog input 6, negative
A6+	analog input 6, positive
A7-	analog input 7, negative
A7+	analog input 7, positive



## 6. Technical data

### EtherCAT®-connection:

2 x RJ45 with LED yellow and green  
Every connection with MDI/MDIX (auto crossover)  
1 x state-LED, green

### Analog inputs:

Number of channels: 8  
Type: differential input  
Resolution: 13bit  
Conversion time: = 25µs  
Input signal: ±10V or  
±5V or  
±2,5V or  
0-10V or  
0(4)..20mA (with an external load resistance)  
Cut-off-frequency (-3dB): ca. 2600Hz  
Input resistance: >=200kOhm (common mode)  
>=800kOhm (differential)  
Common mode voltage: ±220V  
±500V (input protected)  
Common mode rejection: >=77dB  
Galvanic isolation: yes  
Isolation voltage: 1000Vrms (analog inputs - digital electronic)  
1500Vrms (digital electronic - Ethernet)

### Power supply:

Input voltage: 24V +-30%  
Power consumption: <3W

### Housing:

Dimensions: 120 x 101 x 22,5 mm  
Material: Blend PC/ABS self-extinguishing  
Color: grey (other on request)  
Assembly: DIN rail  
Weight: 135 g incl. connectors

### Connector for power supply:

Type: Phoenix FK-MC 1,5/2-STF-3,5  
Type of connection: screw connection  
Color: green  
o. of positions: 2  
Conductor cross-section: 0.14 - 1.5mm<sup>2</sup>  
Stripped insulation length: 7 mm



### Connectors for peripheral signals:

Type:	Phoenix FK-MC 0,5/12-ST-2,5
Type of connection:	spring-cage
Color:	green
No. of positions:	8
Conductor cross-section:	0.14 - 0.5mm <sup>2</sup>
Stripped insulation length:	8 mm

### Ambient conditions

Humidity:	5% until 95% without condensation
Operating temperature:	0°C to + 55° C
Storage temperature:	-40°C to +85° C

### Electromagnetic compatibility

Emissions:	EN61000-6-2:2001
Immunity:	EN61000-6-4:2001

## 7. Ordering information

EC-AIN8: **100 43 10**

All necessary connectors are included.