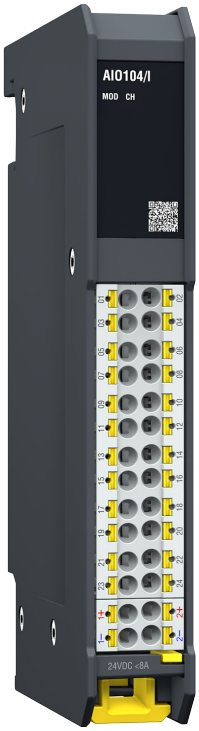

AIO104/I

Analog Input/Output Module

Plants extended over large distances, interference fields caused by power engineering systems, difficult grounding conditions or aggressive substances close to the measurement sensors – the challenges in analog measurement technology for industrial applications can be manifold.

Floating measurement circuits with differential circuits must be planned in order to exclude interference from the measurement chain as much as possible. To prevent interference and damage from being transmitted from one sensor circuit to all the others, the measuring and control circuits are galvanically isolated from each other.

For this purpose, the AIO104/I module type offers the benefits of an extremely versatile multi-signal analog input/output module combined with channel-wise galvanic isolation. Each of the 4 primary channels can be operated individually either as an analog input or output. The spectrum of the inputs ranges from current loops (4 mA to 20 mA, ±20 mA) to 4 high-impedance voltage measurement ranges (±10 V to ±10 mV), Pt100/Pt1000 temperature measurement in 2-wire, 3-wire, and 4-wire connection technology as well as thermocouples, and through to freely configurable resistance measurement. The integrated measuring range and measured value monitoring enable both sensor circuit faults as well as process alarms to be implemented easily.

Current loops can also be driven or 0 V to 10 V, ±10 V voltage signals can be output in 14 bits. Besides the 4 freely configurable primary channels, up to 4 additional I/O channels with restricted signal types are available.

Part type designation	Part number
AIO104/I	00028968-00
AIO104/I EC	00038808-00

Features

- 4-channel analog input/output module isolated
- Up to 4 additional analog channels depending on the required signal type
- Configurable by channel: signal type and direction
- AI current/voltage, Pt100, Pt1000, thermocouples (J, K, T, N, E, R, S, B)
- AO current/voltage
- Channel-wise galvanic isolation
- Oversampling
- Synchronous clocks

Common properties	
Basic function	4x (+4x) analog input voltage, current, resistance thermometers, thermo-couples / analog output voltage, current / channels isolated against each other
System	Bachmann system M100
Analog inputs – voltage	
Number of analog inputs	0 to 4 configurable
Signal standard	±10 V, ±1 V, ±100 mV, ±10 mV
Measurement range	±10.5 V; ±1.05 V; ±105 mV; ±10.5 mV (105 %)
Resolution (ADC)	16 bit
Accuracy at T_a = +25 °C	Measurement range ±10 V: 0.05 % FS Measurement range ±1 V: 0.05 % FS Measurement range ±100 mV: 0.05 % FS Measurement range ±10 mV: 0.2 % FS
Connections per input	2 (+/- differential, isolated)
Common mode voltage, max.	Measurement range ±10 V: ±1 V Measurement range ±1 V: ±1 V Measurement range ±100 mV: -1 V to +4 V Measurement range ±10 mV: ±3 V
Common mode rejection	±10 V ±0.04 % FS/V ±1 V ±0.08 % FS/V ±100 mV ±0.2 % FS/V ±10 mV ±0.25 % FS/V
Cross-talk rejection	> 60 dB
Internal scan rate, max.	40 kHz
Digital low pass filter cut-off frequency	3500 Hz to 0.875 Hz configurable
Digital low pass filter slope	> 80 dB/decade
Input impedance	> 100 kΩ
Signal cable length, shielded, max.	1000 m [1)]
Signal cable length, unshielded, max.	3 m
Interpolation	Yes (linearly interpolated intermediate values, delayed output)
Oversampling	Up to 128 values per cycle (6x)
Process data	Analog value Analog value with intermediate values Diagnostics channel quality information
Time stamps	No

[1)] *Depending on the measuring range used and the required accuracy, shorter line lengths must be provided.*

Analog inputs – current	
Number of analog inputs	0 to 4 configurable
Signal standard	4 mA to 20 mA, ±20 mA
Measurement range	At 4 mA to 20 mA: measurement range -13 mA to 21 mA At -20 mA to 20 mA: measurement range -21 mA to 21 mA
Resolution (ADC)	16 bit
Accuracy at T_a = +25 °C	Measurement range 4 mA to 20 mA: 0.2 % FS (typ.); 0.2 % FS (max.) Measurement range ±20 mA: 0.1 % FS (typ.); 0.1 % FS (max.)
Connections per input	2 (+/- current loop, isolated)
Common mode voltage, max.	±6 V
Common mode voltage, max.	Measurement range 4 mA to 20 mA: ±6 V Measurement range ±20 mA: ±6 V

Analog inputs – current	
Common mode rejection	±20 mA ±0.08 % FS/V 4 mA to 20 mA ±0.16 % FS/V
Cross-talk rejection	> 60 dB
Internal scan rate, max.	40 kHz
Digital low pass filter cut-off frequency	875 Hz to 0.875 Hz configurable
Digital low pass filter slope	> 80 dB/decade
Input impedance	≤ 270 Ω
Signal cable length, shielded, max.	1000 m
Signal cable length, unshielded, max.	3 m
Interpolation	Yes (linearly interpolated intermediate values, delayed output)
Oversampling	Up to 128 values per cycle (6x)
Process data	Analog value Analog value with intermediate values Diagnostics channel quality information
Time stamps	No
Analog inputs – resistance thermometer (RTD)	
Number of analog inputs	0 to 4 configurable
Signal standard	Pt100, Pt1000
Measurement range	-100 °C to +800 °C
Resolution (ADC)	16 bit
Accuracy at T_a = +25 °C	Measurement range Pt100: ±0.15 % FS Measurement range Pt1000: ±0.15 % FS
Connections per input	2-wire measurement (combined for current loop and resistance measurement) 3-wire measurement (current loop has a separate leg) 4-wire measurement (current loop and resistance measurement separated)
Common mode voltage, max.	±3 V
Cross-talk rejection	> 60 dB
Internal scan rate, max.	40 kHz
Digital low pass filter cut-off frequency	875 Hz to 0.875 Hz configurable
Digital low pass filter slope	> 80 dB/decade
Input impedance	> 10 MΩ
Signal cable length, shielded, max.	1000 m
Signal cable length, unshielded, max.	3 m
Interpolation	Yes (linearly interpolated intermediate values, delayed output)
Oversampling	Up to 128 values per cycle (6x)
Process data	Analog value Analog value with intermediate values Diagnostics channel quality information
Time stamps	No
Analog inputs – thermocouple	
Number of analog inputs	0 to 4 configurable
Signal standard	Thermocouples type J, K, T, N, E, R, S, B

Analog inputs – thermocouple	
Measurement range	Measurement range J: -100 °C to +1200 °C Measurement range K: -50 °C to +1370 °C Measurement range T: -30 °C to +400 °C Measurement range N: -50 °C to +1300 °C Measurement range E: -100 °C to +1000 °C Measurement range R: -30 °C to +1768 °C Measurement range S: -50 °C to +1768 °C Measurement range B: 600 °C to +1820 °C
Resolution (ADC)	16 bit
Accuracy at T_a = +25 °C	Measurement range J: ±0.15 % FS Measurement range K: ±0.15 % FS Measurement range T: ±0.3 % FS Measurement range N: ±0.15 % FS Measurement range E: ±0.15 % FS Measurement range R: ±0.25 % FS Measurement range S: ±0.25 % FS Measurement range B: ±0.25 % FS
Connections per input	2 (differential)
Cold junction compensation	Internal measuring point: ±5 °C Via set value (e.g. from external sensor). The use of an external cold junction reference is recommended.
Common mode voltage, max.	±3 V
Common mode rejection	Measurement range J: ±0.40 % FS/V Measurement range K: ±0.45 % FS/V Measurement range T: ±1.40 % FS/V Measurement range N: ±0.65 % FS/V Measurement range E: ±0.40 % FS/V Measurement range R: ±0.65 % FS/V Measurement range S: ±0.65 % FS/V Measurement range B: ±0.70 % FS/V
Cross-talk rejection	> 60 dB
Internal scan rate, max.	40 kHz
Digital low pass filter cut-off frequency	0.875 Hz to 875 Hz configurable
Digital low pass filter slope	> 80 dB/decade
Input impedance	> 100 kΩ
Signal cable length, shielded, max.	1000 m
Signal cable length, unshielded, max.	3 m
Interpolation	Yes (linearly interpolated intermediate values, delayed output)
Oversampling	Up to 128 values per cycle (6x)
Process data	Analog value Analog value with intermediate values Diagnostics channel quality information
Time stamps	No
Analog ouputs – voltage	
Number of analog outputs	0 to 4 configurable
Signal standard	±10 V 0 V to 10 V
Output range	±10.5 V 0 V to 10.5 V

Analog ouputs – voltage	
Output current per channel, nominal, continuous	±10 mA in ±10 V mode 20 mA in 0 V to 10 V mode
Resolution (DAC)	14 bit
Accuracy at T_a = +25 °C	Measurement range ±10 V: 0.1 % FS Measurement range 0 V to 10 V: 0.2 % FS
Connections per output	2 (+/- differential, isolated)
Cross-talk rejection	> 60 dB
Internal scan rate, max.	40 kHz
Load impedance, min.	Output range ±10 V: 1 kΩ Output range 0 V to 10 V: 500 Ω (20 mA max.)
Signal cable length, shielded, max.	1000 m
Signal cable length, unshielded, max.	3 m
Time triggered output	No
Process data	Analog value Analog value with intermediate values Diagnostics channel quality information
Analog ouputs – current	
Number of analog outputs	0 to 4 configurable
Signal standard	4 mA to 20 mA, 0 mA to 20 mA, 0 mA to 2 mA, 0 µA to 200 µA
Output range	4 mA to 21 mA, 0 mA to 21 mA, 0 mA to 2.1 mA, 0 µA to 210 µA
Resolution (DAC)	14 bit
Accuracy at T_a = +25 °C	Output range 4 mA to 20 mA: ±0.2 % FS Output range 0 mA to 20 mA: ±0.2 % FS Output range 0 mA to 2 mA: ±0.2 % FS Output range 0 µA to 200 µA: ±0.6 % FS
Connections per output	2 (+/- current loop)
Common mode rejection	> 60 dB
Cross-talk rejection	> 60 dB
Internal scan rate, max.	40 kHz
Load impedance, max.	600 Ω
Signal cable length, shielded, max.	1000 m
Signal cable length, unshielded, max.	3 m
Time triggered output	No
Process data	Analog value Analog value with intermediate values Diagnostics channel quality information
Sensor/actuator supply 0 V to 10 V DC	
Number of supply points 0-10 V DC	0 to 6 configurable (VAO function of the channel)
Output current per channel, nominal, continuous	20 mA
Output current per channel, short-term overload	20 mA
Output current per group, nominal, continuous	20 mA
Short-circuit protected, supply	Yes, continuously
Overvoltage protection	±27 V to GND
Module bus interface	
System	M100
Slot type	IO (1/E, 2, 3, 4, ...31)
Module data rate	Typ.: 0 Mbit/s to 33.6 Mbit/s depending on the configuration

Module bus interface	
Bus cycle time, min.	4.5 µs [1]

[1] *Depending on the fieldbus used and the respective configuration, lower data rates and longer cycle times can be expected.*

Synchronization/clocks	
Distributed clocks	Yes
Time resolution	1 ns (64 bit)
Time precision	25 ns within the station 100 ns via network (typ.) 1 µs via network (max.)
Synchronization functions	Synced operation Synced with oversampling operation
Field bus cycle time, min.	100 µs [1]

[1] *Depending on the fieldbus used and the respective configuration, lower data rates and longer cycle times can be expected.*

Diagnostics	
Electronic type plate	Yes (application interface and in the engineering tool)
Machine readable type plate	Yes (QR code with type and part information and internet link)
Environmental conditions sensor	Integrated (temperature)
Operational indications	LED "MOD" (red/green) module status LED "CH" (red/green) channel status summary
Error indications	Supply voltage too low Overload Cable break / open signal circuit Threshold value overshoot
Powerfail, logic supply	No
Powerfail, signal supply	Undervoltage < 15.0 V (fallback > 17.5 V)
Overload/short-circuit	Yes, per output channel
Open circuit	Yes, per channel (VI,CI,CO,RTD,TE) VO not supported
Measurement range monitoring	Yes, upper/lower limit (all analog input signals)
Configurable threshold monitoring	Yes, configurable upper/lower limit (all analog input signals)

Energy supply	
Supply voltage, nominal	24 V DC
Supply voltage, range	18 V DC to 32 V DC
Power consumption from 24 V signal supply	4.3 W
Maximum residual ripple 24 V signal supply	±2.4 V
Overcurrent protection required	No internal protection External protection with circuit breaker characteristic: B, C, D, Z or K Max. nominal current 8 A DC
Power dissipation, typ./max.	4.0 W / 4.9 W
Reverse polarity protection signal supply	Yes, continuously (up to -32 V)
Power consumption from backplane	690 mW
Supply terminal block bridge	Yes (1+ on to 2+, 1- on to 2-)

Product safety	
Galvanic isolation	850 V AC
Galvanic isolation between supply groups	Yes (single channel isolation)
Galvanic isolation between inputs	Yes (single channel isolation)
Permitted potential difference between analog channels	850 V AC between the 4 channel groups

Product safety	
Degree of protection acc. IEC 60529	IP40, terminal block IP30
Protection class acc. IEC 61010-1, IEC 61010-2-201	III
Overvoltage category acc. IEC 61010-1	II
Rated impulse withstand voltage acc. IEC 61000-4-5	Supply DC: • 500 V DM • 1000 V CM
Short-circuit protected, outputs	Yes, continuously
Keying of terminal block	Yes (6-fold per 4 contacts)
Environmental conditions	
Temperature range, operating	Standard: -30 °C to +60 °C Extended Climate: -30 °C to +70 °C
Temperature range, transport and storage	-40 °C to +85 °C
Installation altitude, max.	Up to 2000 m without temperature derating 2000 m to 4500 m: Reduction of the max. ambient temperature by 0.1 °C per 100 m elevation
Air pressure	106 kPa to 58 kPa (0 m to 4500 m)
Relative humidity, operation	Standard: 0 % to 100 % noncondensing Extended Climate: 0 % to 100 % with temporary condensation
Pollution degree acc. IEC 61010-1	Standard: 2, noncondensing Extended Climate: 2
Vibration	6 g (14.1 Hz to 500 Hz) 7.5 mm amplitude (2 Hz to 14.1 Hz) Test duration: 15 h
Shock	45 g max. (test scope 18 shocks) 20 g permanently (test scope 6000 shocks)
Approvals/certificates	
Product safety	CE, UKCA cULus (NRAQ, NRAQ7)
Hazard area operation	ATEX: Ex II 3G Ex ec IIC Gc
Maritime	ABS, BV, DNV, KR, LR, NK, RINA: in preparation
Hazardous substances and waste treatment	RoHS, RoHS China, REACH, WEEE
Quality management	ISO 9001 for development and production
Engineering	
Configuration tool	SolutionCenter (≥ V2.75)
Firmware package update	Yes (via SolutionCenter or console interface on the head module)
Mounting/installation	
Mounting type	Inserting and screwing onto the backplane with integrated M4 screw
Ground connection for protection class I	No
Dimensions	
Number of slots	1
Size unpacked W × H × D	23.3 mm × 152.5 mm × 95.7 mm
Mass unpacked	278 g

Order data

Part type designation	Part number	Description
AIO104/I	00028968-00	Analog input/output multitype module system M100 Fully isolated per channel, configurable: 4x analog In differential ±0.01 V, 0.1 V, 1 V, 10 V, ±20 mA, 4 mA to 20 mA; thermocouples (J, K, T, N, E, R, S, B), Pt100/Pt1000, 16 bit; analog Out ±10 V, ±20 mA, 4 mA to 20 mA, 14 bit; 0 to 4 additional channels depending on the signal type required; synchronization, oversampling, isolated from system, without terminal block
AIO104/I EC	00038808-00	Like AIO104/I with Extended Climate Range

Accessories

Part type designation	Part number	Description
BPR1nn	00039235-nn	Backplane for DIN-rail mounting Active backplane system M100: BPR1nn with nn = 04 to 16 slots in increments of 1, as well as 20, 24, 28, 32 slots, for DIN-rail mounting; delivery without backplane slot covers and without mounting rail
BPR1nn EC	00039236-nn	Like BPR1nn; Extended Climate Range
BPS1nn	00039237-nn	Backplane for direct screw mounting Active backplane system M100: BPS1nn with nn = 04 to 16 slots in increments of 1, as well as 20, 24, 28, 32 slots, for direct screw mounting; delivery without backplane slot covers and without screws
BPS1nn EC	00039238-nn	Like BPS1nn; Extended Climate Range
TPI100_W24_P5.0_Cgy_L1to24		Signal terminal block Completely removable terminal block, push-in spring connector for system M100, 24-way/contacts, pitch 5.0 mm, female, conductors flexible 0.2 mm² to 2.5 mm² (24 to 14 AWG), solid 0.2 mm² to 1.5 mm² (24 to 16 AWG), with wire end ferrules 0.25 mm² to 1.5 mm² (24 to 16 AWG), stripping length: 10 mm, rating: 300 V / 8 A per contact, connector color: gray, push-release: yellow, labeling: 1 to 24
TPI100_W4_P5.0_Cgy_Lsup		Supply terminal block Completely removable terminal block, push-in spring connector for system M100, 4-way/contacts, pitch 5.0 mm, female, conductors flexible 0.2 mm² to 2.5 mm² (24 to 14 AWG), solid 0.2 mm² to 1.5 mm² (24 to 16 AWG), with wire end ferrules 0.25 mm² to 1.5 mm² (24 to 16 AWG), stripping length: 10 mm, rating: 300 V / 8 A per contact, connector color: gray, push-release: yellow, labeling: 1+/1-/2+/2-
TKP106		Keying element Keying element for signal terminal blocks and supply terminal blocks TPI100 for system M100, plastic ring with 6 keying elements
TPI100_W24_W4_Set [1)]	00042412-00	Terminal block set for M100 standard modules: • 1x TPI100_W24_P5.0_Cgy_L1to24 • 1x TPI100_W4_P5.0_Cgy_Lsup • 2x TKP106

[1)] *All components of the set are also available in bulk packages.*