AXL F UTH8 1F

Axioline F temperature module, 8 inputs for connection of thermocouple sensors



Data sheet
8267_en_04

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1 Description

The module is designed for use within an Axioline F station.

It is used to acquire signals from standard thermocouples in industrial applications.

The module supports various types of thermocouple conforming to DIN EN 60584-1 and DIN 46710 as well as linear voltages from -100 mV to +100 mV.

It also offers a voltage input from -5 V to +5 V. Heating currents can be monitored here, for example, using a measuring transducer.

The four Pt 100 inputs (CJ1 ... CJ4) can each be used as a sensor input or as an external cold junction.

Features

- 8 analog input channels to connect thermocouples or linear voltages from -100 mV to +100 mV
- 1 analog input channel to connect voltages from -5 V to +5 V
- Connection of sensors in 2-wire technology
- Internal detection and compensation of cold junction temperature (can be parameterized)
- External connection of Pt 100 cold junction sensors possible
- Easy to use due to internal linearization of the sensor characteristic curves
- High level of accuracy (typically ±0.01% sensor type K)
- High level of accuracy, even in various mounting positions, thanks to built-in space compensation of the internal cold junction
- High temperature stability (typically 5 ppm/K)
- High level of immunity to EMI (Class A)
- "Channel scout" function
- Device type label stored
- Diagnostic and status indicators
- Installation monitoring with indication via diagnostic LED for each channel

This data sheet is only valid in association with the UM EN AXL F SYS INST user manual.

Make sure you always use the latest documentation.
It can be downloaded from the product at phoenixcontact.net/products.

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3 Ordering data

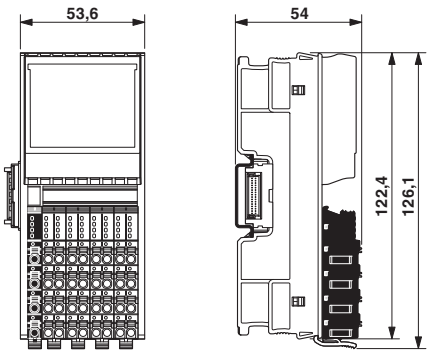
Description	Type	Order No.	Pcs./Pkt.
Axioline?F temperature module, 8 inputs for connection of thermocouple sensors (including bus base module and connectors)	AXL F UTH8 1F	2688417	1

Accessories	Type	Order No.	Pcs./Pkt.
Axioline F bus base module for housing type F (Replacement item)	AXL F BS F	2688129	5
Axioline F connector set (for e.g., AXL F AI8 1F, AXL F AO8 1F) (Replacement item)	AXL CNS 4L-O/D/UA/E1/E2	2700984	1
Axioline shield connection set (contains 2 busbar holders and 2 SK 5 shield connection clamps)	AXL SHIELD SET	2700518	1
Zack marker strip for Axioline F (device labeling), in 2 x 20.3 mm pitch, unprinted, 25-section, for individual labeling with B-STIFT 0.8, X-PEN, or CMS-P1-PLOTTER (Marking)	ZB 20,3 AXL UNPRINTED	0829579	25
Zack marker strip, flat, in 10 mm pitch, unprinted, 10-section, for individual labeling with M-PEN 0,8, X-PEN, or CMS-P1-PLOTTER (Marking)	ZBF 10/5,8 AXL UNPRINTED	0829580	50
Thermoelectric voltage terminal block, cross section: 0.2 - 2.5 mm², width: 10.4 mm, color: gray	MTKD-CU/CUNI	3100059	50
Thermoelectric voltage terminal block, cross section: 0.2 - 2.5 mm², width: 10.4 mm, color: gray	MTKD-FE/CUNI	3100046	50
Thermoelectric voltage terminal block, cross section: 0.2 - 2.5 mm², width: 10.4 mm, color: gray	MTKD-NICR/CUNI	3100075	50
Thermoelectric voltage terminal block, cross section: 0.2 - 2.5 mm², width: 10.4 mm, color: gray	MTKD-NICR/NI	3100062	50
Thermoelectric voltage terminal block, cross section: 0.2 - 2.5 mm², width: 10.4 mm, color: gray	MTKD-E-CU/A-CU	3100091	50
Thermoelectric voltage terminal block, cross section: 0.2 - 2.5 mm², width: 10.4 mm, color: gray	MTKD-S-CU/E-CU	3100101	50
Insert label, Roll, white, unlabeled, can be labeled with: THERMOMARK ROLL, THERMOMARK ROLL X1, THERMOMARK X, THERMOMARK S1.1, Mounting type: snapped into marker carrier, Lettering field: 35 x 46 mm (Marking)	EMT (35X46)R	0801604	1

Documentation	Type	Order No.	Pcs./Pkt.
User manual, English, Axioline F: System and installation	UM EN AXL F SYS INST	-	-
User manual, English, Axioline F: Diagnostic registers, and error messages	UM EN AXL F SYS DIAG	-	-

4 Technical data

Dimensions (nominal sizes in mm)



Width	53.6 mm
Height	126.1 mm
Depth	54 mm
Note on dimensions	The depth is valid when a TH 35-7.5 DIN rail is used (according to EN 60715).

General data

Color	traffic grey A RAL 7042
Weight	203 g (with connectors and bus base module)
Ambient temperature (operation)	-25 °C ... 60 °C
Ambient temperature (storage/transport)	-40 °C ... 85 °C
Permissible humidity (operation)	5 % ... 95 % (non-condensing)
Permissible humidity (storage/transport)	5 % ... 95 % (non-condensing)
Air pressure (operation)	70 kPa ... 106 kPa (up to 3000 m above sea level)
Air pressure (storage/transport)	70 kPa ... 106 kPa (up to 3000 m above sea level)
Degree of protection	IP20
Protection class	III, IEC 61140, EN 61140, VDE 0140-1
Mounting position	Any (no temperature derating; Parameterize the mounting position using the object 0080_{hex} ParaTable!)

Connection data

Designation	Axioline F connector
Connection method	Push-in connection
Conductor cross section solid / stranded	0.2 mm² ... 1.5 mm² / 0.2 mm² ... 1.5 mm²
Conductor cross section [AWG]	24 ... 16
Stripping length	8 mm

Please observe the information provided on conductor cross sections in the “Axioline F: system and installation” user manual.

Interface Axioline F local bus

Connection method	Bus base module
Transmission speed	100 MBit/s

Communications power	
Communications power U_{Bus}	5 V DC (via bus base module)
Current consumption from U_{Bus}	typ. 115 mA, max. 180 mA
Power consumption at U_{Bus}	typ. 0.55 W, max. 0.9 W

I/O supply	
Supply for analog modules U_A	24 V DC
Maximum permissible voltage range	19.2 V DC ... 30 V DC (including all tolerances, including ripple)
Current consumption from U_A	typ. 45.3 mA max. 70 mA
Power consumption at U_A	typ. 1.09 W, max. 1.68 W
Surge protection of the supply voltage	Electronic (35 V, 0.5 s)
Polarity reversal protection of the supply voltage	Polarity protection diode
Transient protection	Suppressor diode

Total power consumption of the module	
Power consumption	typ. 1.63 W (entire device), max. 2.58 W (entire device)

Analog inputs	
Number of inputs	8 +1 (8 inputs for thermocouples or linear voltage, plus 1 input -5 V to +5 V)
Connection method	Spring-cage connection with direct connector-in method
Connection method	2-wire (shielded, twisted pair)
Sensor types that can be used (TC)	U, T, L, J, E, K, N, S, R, B, C, W, HK
Sensor types (RTD) that can be used	Pt 100 (4 external cold junctions, can also be used as a sensor input)
Resolution A/D	24 bit
Measuring principle	Sigma/Delta process
Measured value representation	16 bits (15 bits + sign bit)
Input filter time	40 ms, 60 ms, 100 ms, 120 ms (adjustable)
Relative accuracy	typ. 0.01 % (Thermocouple type K, NiCr-Ni; see tables under tolerance values)
Absolute accuracy	typ. ± 0.19 K (Thermocouple type K, plus tolerance of cold junction)
Short-circuit protection, overload protection of the inputs	yes
Transient protection of inputs	yes
Crosstalk attenuation	typ. 110.7 dB (Channel/channel, sensor type K) typ. 110.5 dB (Channel/channel, sensor type linear voltage ±100 mV) typ. 109.1 dB (Channel/channel, external Pt 100 connection)
Common mode rejection (CMR): TC inputs/linear voltage	min. 100 dB (Sensor type K)
Common mode rejection (CMR): TC inputs/linear voltage	typ. 152 dB (Sensor type K)
Common mode rejection (CMR): TC inputs/linear voltage	min. 100 dB (Sensor type linear voltage ±100 mV)
Common mode rejection (CMR): TC inputs/linear voltage	typ. 154 dB (Sensor type linear voltage ±100 mV)
Input resistance: TC inputs/linear voltage	typ. 20 MΩ (With 24 V I/O supply voltage present)
Input resistance: Voltage input -5 V ... +5 V	typ. 5 MΩ (With 24 V I/O supply voltage present)
Voltage at the TC input	max. 40 V DC (1 min.)

Configuration and parameter data in a PROFIBUS system	
Required parameter data	27 Byte (20 bytes for configuration with GSD AXL UTH 8 (packed))
Need for configuration data	7 Byte

Electrical isolation/isolation of the voltage areas	
Test section	**Test voltage**
5 V communications power (logic), 24 V supply (I/O)	500 V AC, 50 Hz, 1 min
5 V supply (logic)/functional earth ground	500 V AC, 50 Hz, 1 min
24 V supply (I/O) / functional earth ground	500 V AC, 50 Hz, 1 min

Mechanical tests	
Vibration resistance in acc. with EN 60068-2-6/IEC 60068-2-6	5g
Shock in acc. with EN 60068-2-27/IEC 60068-2-27	30g
Continuous shock according to EN 60068-2-27/IEC 60068-2-27	10g

Conformance with EMC Directive 2004/108/EC	
Noise immunity test in accordance with EN 61000-6-2	
Electrostatic discharge (ESD) EN 61000-4-2/IEC 61000-4-2	Criterion B; 6 kV contact discharge, 8 kV air discharge
Electromagnetic fields EN 61000-4-3/IEC 61000-4-3	Criterion A; Field intensity: 10 V/m
Fast transients (burst) EN 61000-4-4/IEC 61000-4-4	Criterion A for shielded cables; 2 kV
Transient surge voltage (surge) EN 61000-4-5/IEC 61000-4-5	Criterion B; supply lines DC: ±0.5 kV/±0.5 kV (symmetrical/asymmetrical); ±1 kV to shielded I/O cables
Conducted interference EN 61000-4-6/IEC 61000-4-6	Criterion A; Test voltage 10 V
Noise emission test according to EN 61000-6-3	
Radio interference properties EN 55022	Class B

Approvals

For the latest approvals, please visit phoenixcontact.net/products.

5 Additional technical data

5.1 Maximum permissible cable lengths

Connecting cable and maximum cable length specifications				
Maximum permissible cable length	**Sensor type**	**Connection method**	**Sensor cable**	**Cable type**
10 m	TC inputs channel 1 ... 8	2-wire	Unshielded, twisted	TC sensor cable or equalizing conductor (according to DIN EN 60584–3, IEC 60584–3, DIN 43722)
250 m	TC inputs channel 1 ... 8	2-wire	Shielded, twisted	TC sensor cable or equalizing conductor (according to DIN EN 60584–3, IEC 60584–3, DIN 43722)
10 m	Inputs channel 1 ... 8, -100 mV ... +100 mV	2-wire	Unshielded, twisted	Reference cable type LiYY (TP) 2 x 2 x 0.5 mm^2
250 m	Inputs channel 1 ... 8, -100 mV ... +100 mV	2-wire	Shielded, twisted	Reference cable type LiYCY (TP) 2 x 2 x 0.5 mm^2
2 m	Pt 100 external cold junction sensor	2-wire	Unshielded, twisted	Reference cable type LiYY (TP) 2 x 2 x 0.5 mm^2
10 m	Pt 100 external cold junction sensor	2-wire	Shielded, twisted	Reference cable type LiYCY (TP) 2 x 2 x 0.5 mm^2
5 m	-5 V ... +5 V input	2-wire	Shielded, twisted	Reference cable type LiYCY (TP) 2 x 2 x 0.5 mm^2

TC inputs: select the appropriate TC equalizing conductors for TC sensors (according to DIN EN 60584–3, IEC 60584–3, and DIN 43722).

Other inputs: the values are valid when reference cable type LiYCY (TP) 2 x 2 x 0.5 mm^2 is used in accordance with the Axioline F installation instructions.

The maximum cable length specification is valid from the sensor to the connection terminal block and includes the maximum specified tolerances.

Observe the cable resistance values when operating the externalPt 100 cold junction. Long cables and/or small cable cross sections increase measuring tolerances.

The measuring tolerances of all channels will only be observed if the permissible cable types are used.

Using the Axioline shield connection set (AXL SHIELD SET), connect the braided shield of long sensor cables at one end to the functional earth ground potential upstream of the AXL F UTH8 1F module.

5.2 Measuring ranges of the TC inputs

No.	**Input**	**Sensor type**	**Standard**	**Measuring range**		**Average basic value for sensitivity**	**Voltage level at measuring range final value**
				Lower limit	**Upper limit**		
1	Thermocouples	B	DIN EN 60584	+50 °C	+1820 °C	6 µV/K	13.820 mV
2		E	DIN EN 60584	-270 °C	+1000 °C	65 µV/K	76.373 mV
3		J	DIN EN 60584	-210 °C	+1200 °C	54 µV/K	69.553 mV
4		K	DIN EN 60584	-270 °C	+1372 °C	42 µV/K	54.886 mV
5		N	DIN EN 60584	-270 °C	+1300 °C	27 µV/K	47.513 mV
6		R	DIN EN 60584	-50°C	+1768 °C	10 µV/K	21.101 mV
7		S	DIN EN 60584	-50°C	+1768 °C	10 µV/K	18.693 mV
8		T	DIN EN 60584	-270 °C	+400 °C	40 µV/K	20.872 mV
9		C		-18 °C	+2316 °C	15 µV/K	37.07 mV
10		W		-18 °C	+2316 °C	12 µV/K	38.56 mV
11		HK		-200 °C	+800 °C	69 µV/K	66.42 mV
12		L	DIN 43710	-200 °C	+900 °C	54 µV/K	53.14 mV
13		U	DIN 43710	-200 °C	+600 °C	40 µV/K	34.31 mV

5.3 Tolerances of the measuring inputs at T_A = +25°C

No.	Input	Sensor type	Measuring range		Absolute tolerance		Relative tolerance (with reference to MRFV)	
			Lower limit	Upper limit	Typical	Maximum	Typical	Maximum
1	Thermocouples	B	+500°C	+1820 °C	±0.5 K	±4.17 K	±0.03%	±0.23 %
2		E	-226 °C	+1000 °C	±0.15 K	±1.38 K	±0.02%	±0.19%
3		J	-210 °C	+1200 °C	±0.19 K	±1.67 K	±0.02%	±0.14 %
4		K	-200 °C	+1372 °C	±0.19 K	±0.71 K	±0.01%	±0.05 %
5		N	-200 °C	+1300 °C	±0.39 K	±3.15 K	±0.03%	±0.23 %
6		R	-50°C	+1768 °C	±0.8 K	±2.5 K	±0.05 %	±0.14 %
7		S	-50°C	+1768 °C	±0.8 K	±2.5 K	±0.05 %	±0.14 %
8		T	-270 °C	+400 °C	±0.18 K	±0.63 K	±0.04 %	±0.16 %
9		C	-18 °C	+2316 °C	±0.53 K	±0.81 K	±0.02%	±0.03%
10		W	+250°C	+2316 °C	±1.33 K	±2.5 K	±0.06%	±0.11 %
11		HK	-200 °C	+800 °C	±0.16 K	±1.3 K	±0.02%	±0.16 %
12		L	-200 °C	+900 °C	±0.15 K	±1.67 K	±0.02%	±0.19%
13		U	-200 °C	+600 °C	±0.15 K	±0.75 K	±0.03%	±0.13%
14	Internal cold junction	Pt DIN	-70°C	+150 °C	±0.25 K	±1.6 K	±0.13%	±1.03 %
15	External external cold junction sensor	Pt DIN	-100°C	+400 °C	±0.25 K	±0.8 K	±0.06%	±0.21 %
16	Voltage input	Linear voltage	-100 mV	+100 mV	±10 µV	±100 µV	±0.01%	±0.10%
			-30 mV	+30 mV	±7 µV	±30 µV	±0.007 %	±0.03%
			-10 mV	+10 mV	±5 µV	±25 µV	±0.005 %	±0.025 %
17	5 V DC voltage input channel	Linear voltage	-5 V	+5 V	±1 mV	±10 mV	±0.02%	±0.20 %

MRFV= Measuring range final value

The tolerances of the thermocouple inputs (TC sensors) are based on differential temperature recording plus the tolerances due to cold junction compensation during nominal operation in the preferred mounting position.

Please observe the notes in the "Notes on the tolerance tables" section.

5.4 Temperature and drift response

	Measuring range	Drift	
		Typ.	Max.
External Pt 100	-100 °C ... +400 °C	±10 ppm/K	±25 ppm/K
	-100°C ... +100° C	±7 ppm/K	±25 ppm/K
Linear voltage	-10 mV ... +10 mV	±4 ppm/K	±12 ppm/K
	-30 mV ... +30 mV	±4 ppm/K	±15 ppm/K
	-100 mV ... +100 mV	±7 ppm/K	±20 ppm/K
±5 V voltage input		±8 ppm/K	±20 ppm/K
TC inputs	Type K	±5 ppm/K	±20 ppm/K

1. The data refers to nominal operation (U_A = 24 V) in the preferred mounting position (horizontal).
2. The measurement is performed within an Axioline F-station in which another AXL F UTH8 1F module is located to the right and left of the module in question.
3. The drift values refer to the full measuring range final value, i.e., 1372°C in the case of TC sensor type K, +400°C in the case of the external Pt 100, and +100 mV in the case of the linear voltage.

5.5 Tolerances for TC sensor type K with internal cold junction compensation

No.	Temperature	Absolute tolerance		Relative tolerance (with reference to MRFV)	
		Typ.	Max.	Typ.	Max.
1	+25°C	±0.4 K	±2.5 K	±0.03%	±0.18 %
2	-25 °C ... +60 °C	±1.2 K	±3.8 K	±0.09 %	±0.27%

MRFV= Measuring range final value

The tolerances of the thermocouple inputs (TC sensors) are based on absolute temperature recording during nominal operation in the preferred mounting position.

Please observe the notes in the "Notes on the tolerance tables" section.

5.6 Notes on the tolerance tables

The following notes apply for the tables:

– Tolerances of the measuring inputs at T_A = +25°C
– Tolerances for TC sensor type K with internal cold junction compensation

1. The measurement is performed within an Axioline F-station in which another AXL F UTH8 1F module is located to the right and left of the module in question.
2. In order to achieve optimum accuracy in the various mounting positions of the station, different installation positions can be configured.
3. The tolerance values for the TC inputs are based on the average basic values for sensitivity (see table for measuring ranges of the TC inputs).
4. The typical values were determined from the maximum tolerances of the measured practical values.
5. The maximum tolerances represent the worst-case measurement inaccuracy. They contain the theoretical maximum possible tolerances in the measuring ranges as well as the theoretical maximum possible tolerances of the test and calibration equipment. The data is valid for at least 24 months from delivery of the module. Thereafter the modules can be recalibrated by the manufacturer at any time.
6. An additional path calibration function for maximum accuracy is possible at any time in the application (see object 008F_{hex} path calibration values). Using the temperature offset, you can finely tune the tolerances for each channel by means of the connecting cables and the sensors. The specified tolerances are then reduced accordingly.
7. The tolerances increase slightly for a short time immediately after power up (see switch-on behavior section).
8. In the -100 mV ... +100 mV linear voltage input range, smaller measuring windows with closer tolerances were also specified. The reference value of the relative tolerance value is always based on +100 mV.
9. Please note when using linear voltage signals: for voltages above +32.7 mV and below -32.7 mV, parameterize the process data resolution as 10 µV/LSB (instead of 1 µV/LSB) in order to prevent overrange or underrange messages from occurring.
10. Always position temperature modules at the end of the station. For modules that must be positioned next to a bus coupler, the typical measuring tolerance can be increased by up to 0.9 K.
11. The maximum tolerances are observed even in the event of electromagnetic interference (see also Table "Tolerances influenced by electromagnetic interference"). They apply for both shielded and unshielded I/O cables.

5.7 Switch-on behavior of TC inputs with internal cold junction compensation

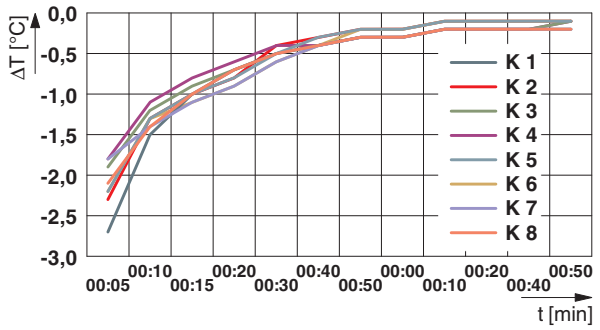


Figure 1 Typical switch-on behavior of type K TC sensors with internal cold junction compensation

K1 ... K8 Channel 1 ... channel 8

Transient period	Typical tolerance
5 minutes	-1.5 K
10 minutes	-1.0 K
35 minutes	-0.5 K
45 minutes	-0.3 K

1. The switch-on behavior must only be taken into consideration for TC measurements with internal cold junction temperature, it does not apply for differential measurements or measurements with external compensation.
2. The typical characteristic curves of the TC inputs after power up were recorded in the preferred mounting position (horizontal), in nominal operation (U_A = 24 V, T_A = 25°C), and with unobstructed ventilation ducts (free air flow).
3. The measurement is performed within an Axioline F-station in which another AXL F UTH8 1F module is located to the right and left of the module in question.
4. Different installation positions or arrangements where the module is affected by external sources of heat can result in a different thermal switch-on behavior.
5. The measuring probes of the type K TC sensors were kept at a constant temperature.

In the event of sudden changes in the ambient temperature of the temperature module (e.g., from T_A = +25°C to T_A = +60°C), the time curve for the transient response is comparable with that of the switch-on behavior.

5.8 Switch-on behavior of TC inputs with external cold junction compensation

The module supports the connection of up to four external Pt 100 cold junction sensors.

Connection example: Figure 7

If you use this function, use copper cables from the isothermal cold junction up to the module connector.

The advantage of this is the very fast warm-up behavior of just a few seconds.

Even in the event of extreme temperature fluctuations in the environment where the Axioline F station is located, the system operates very quickly and precisely. There is also the option of adjusting all sensor and cable tolerances in the application via an additional path calibration function.

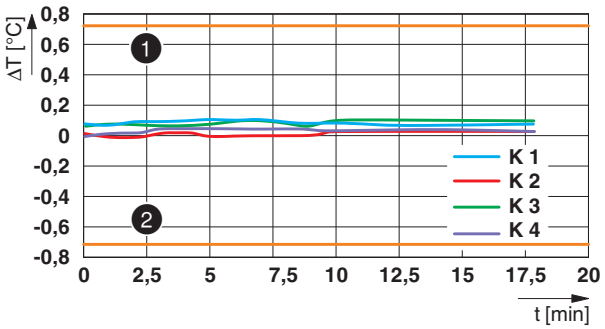


Figure 2 Typical switch-on behavior of type K TC sensors with external Pt 100 cold junction compensation and path calibration function for the cold junction at connector 1 at an ambient temperature of +25°C

1 Maximum tolerance limit

2 Minimum tolerance limit

K1 ... K4 Channel 1 ... channel 4

The behavior is similar for channel 5 to channel 8.

5.9 Technical data for cold junctions

Internal cold junctions

Simple cold junction compensation can be implemented for the thermocouple inputs using the internal cold junctions.

To read the temperature of each internal cold junction for TC channels, parameterize the sensor type as "Cold Junction".

For the accuracy, please refer to the tables of the tolerance values.

Internal cold junction	
Connection method	2-wire connection
Sensor type	Pt 100 DIN
R_0 (sensor resistance at T_A = 0°C)	100 Ω
Measuring range	-70°C ... +150°C
Resolution (process data)	0.1 K/LSB
Resolution (floating point object)	< 0.001 K
Filter time	120 ms

Compensation of the mounting position of the internal cold junction

In order that maximum accuracy is also achieved when installed in various different mounting positions, it is possible to compensate the mounting position of the internal cold junction.

Parameterize this compensation using the ParaTable object, data format, mounting position.

Tolerances of the internal cold junction

No.	Tolerance structure	Temperature	Tolerances	
			Typ.	Max.
1	Tolerance medium for all inputs	+25°C	±0.05 K	±0.95 K
2	Temperature distribution error for channel 1 ... 8*	+25°C	±0.20 K	±0.81 K
3	Temperature distribution error for channel 1 ... 8*	-25 °C ... +60 °C	±0.60 K	±1.35 K
4	Cold junction temperature drift	-25 °C ... +60 °C	10 ppm/K	25 ppm/K
5	Total tolerance of the internal cold junction	+25°C	±0.25 K	±1.76 K
6	Total tolerance of the internal cold junction	-25 °C ... +60 °C	±0.85 K	±2.4 K

* Thermally steady system without external heat influence

1. The data refers to nominal operation (U_A = 24 V) in the preferred mounting position (horizontal).
2. The measurement is performed within an Axioline F-station in which another AXL F UTH8 1F module is located to the right and left of the module in question.

ExternalPt 100 cold junctions

When using external isothermal blocks or distributed terminal boxes, an external cold junction is recommended. The advantage of this is an improved switch-on behavior and the very fast thermal transient period in the event of sudden changes to the ambient temperature of the measuring station.

You can connect up to four Pt 100 sensors to the AXL F UTH8 1F module.

You can also use the inputs for the external cold junction sensors as sensor inputs for any applications with Pt 100 and connection with 2-wire technology. To do so, parameterize the sensor type as “Cold junction” and the cold junction type as “External Pt 100” on the corresponding connector.

ExternalPt 100 cold junctions	
Connection method	2-wire connection
Sensor type	Pt 100 DIN
R_0 (sensor resistance at T_A = 0°C)	100 Ω
Measuring range	-100 °C ... +400 °C
Resolution (process data)	0.1 K/LSB
Resolution (floating point object)	< 0.001 K
Filter time	120 ms

Tolerances of the external Pt 100 cold junction inputs

No.		Ambient temperature	Tolerances	
			Typ.	Max.
1	Tolerances	+25°C	±0.3 K	±0.8 K
2	Drift	-25 °C ... +60 °C	±10 ppm/K	±25 ppm/K

The data contains the offset error, gain error, and linearity error in its respective setting.

The data is valid for nominal operation (preferred mounting position, U_A = 24 V).

The documented typical tolerances were determined for reference cable type LiYCY (TP) 2 x 2 x 0.5 mm² with a connection length < 1 m.

The drift data and the tolerances specified as a percentage refer to the measuring range final value of +400°C.

The typical data has been determined in an example Axioline F station.

Typical tolerance values are measured application values that are based on the maximum variance of all test objects.

The **maximum tolerance values** represent the worst-case measurement inaccuracy. They contain the theoretical maximum possible tolerances in the corresponding measuring ranges as well as the theoretical maximum possible tolerances of the calibration and test equipment. The data is valid for at least 24 months from delivery of the module. Thereafter the modules can be recalibrated by the manufacturer at any time.

To achieve maximum accuracy (< ±0.1 K, it is possible to calibrate a measuring section. To do so, carry out fine adjustment of the tolerances of the connecting cables and the external Pt 100 sensor with object 008F_{hex}: local adjust values.

The advantages of external cold junction compensation are, on the one hand, immediate measuring accuracy without thermal switch-on behavior and, on the other hand, high temperature stability.

For maximum accuracy, path calibration is possible. This can be carried out channel-specific using object 008F_{hex}. You can therefore calibrate the tolerances of the entire measuring section including the sensor and connecting cable.

5.10 Technical data for the ±5 V DC voltage input

This input is used to acquire additional voltage signals.

Connect a signal converter to the input. This can be used to acquire any AC or DC currents which are converted by the converter into an electrically isolated ±5 V signal. This ±5 V signal is processed by the module.

Connection example: Figure 12

±5 V voltage input	
Connection method	2-wire connection
Measuring range	-5 V ... +5 V
Format	IB IL
Resolution	16-bit
Quantization	166.7 µV/LSB
Filter time	120 ms
Input resistance	typ. 5 MΩ

Tolerances of the voltage input

No.		Temperature	Absolute		Relative	
			Typ.	Max.	Typ.	Max.
1	Tolerance	+25°C	±1 mV	±10 mV	±0.02%	±0.20 %
2	Tolerance	-25 °C ... +60 °C	±3 mV	±15 mV	±0.06%	±0.30%
3	Drift	-25 °C ... +60 °C	±8 ppm/K	±20 ppm/K		

Typical tolerance values are measured application values that are based on the maximum variance of all test objects.

The **maximum tolerance values** represent the worst-case measurement inaccuracy. They contain the theoretical maximum possible tolerances in the corresponding measuring ranges as well as the theoretical maximum possible tolerances of the calibration and test equipment. The data is valid for at least 24 months from delivery of the module. Thereafter the modules can be recalibrated by the manufacturer at any time.

Use an isolating amplifier to decouple from the field the sensor signals which go to the sensor input. The MCR range from Phoenix Contact offers various solutions (see also connection example "Universal AC and DC current acquisition by means of combination with a current transducer").

5.11 Cycle times

Filter time	Channel conversion time for TC operation with internal compensation
120 ms	120 ms
100 ms	100 ms
60 ms	60 ms
40 ms	40 ms

Filter time	Typical scan repeat time for all eight measuring channels
	TC operation with internal cold junction compensation
120 ms	1430 ms
100 ms	1350 ms
60 ms	1180 ms
40 ms	1100 ms

5.12 Tolerances influenced by electromagnetic interference

Type of electromagnetic interference	Standard	Level	Additional tolerances of measuring range final value	Criterion
Electromagnetic fields	EN 61000-4-3/IEC 61000-4-3	10 V/m	None	A
Fast transients (burst)	EN 61000-4-4/IEC 61000-4-4	1.1 kV	None	A
Conducted interference	EN 61000-4-6/IEC 61000-4-6	150 kHz ... 80 MHz, 10 V, 80% (1 kHz)	None	A

The values determined apply for both shielded and unshielded twisted sensor cables. The maximum cable lengths should be taken into consideration.

For all tested electromagnetic interferences (see table), the measured values were within the maximum tolerances.

The values were determined under nominal conditions with the following sensor settings and sensor circuits:

– Thermocouple type K (NiCr-Ni) with internal cold junction compensation, filter = 120 ms
– External RTD sensor type Pt 100 as sensor input, filter = 120 ms
– -100 mV ... +100 mV linear voltage signals, 1 µV/LSB resolution, filter = 120 ms



No additional tolerances occur due to the influence of high-frequency interference caused by wireless transmission systems in the near vicinity.

The specifications refer to nominal operation. The modules are directly exposed to interference without the use of additional shielding measures (e.g., steel cabinet).

6 Internal circuit diagram

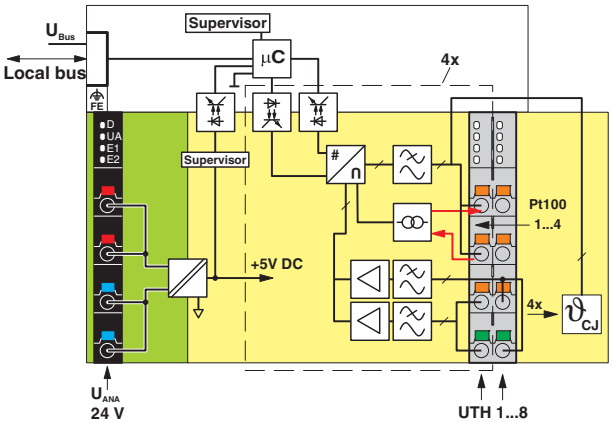


Figure 3 Internal wiring of the terminal points

Key:

Local bus	Axioline F local bus (hereinafter referred to as local bus)
µC	Microcontroller
	Optocoupler
	Power supply unit with electrical isolation
# n	Analog/digital converter
	Low pass filter
Supervisor	Hardware monitoring
	Constant current source
	Difference amplifier
	Reference ground of I/O devices
	Noiseless ground
	Electrically isolated areas
CJ	Cold junction (CJ)

7 Terminal point assignment

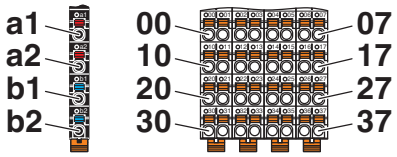


Figure 4 Terminal point assignment

Terminal point	Color	Assignment	
Supply voltage input			
a1, a2	Red	24 V DC (U_A)	Supply for analog modules (bridged internally)
b1, b2	Blue	GND	Reference potential of the supply voltage (internally jumpered)
Analog inputs			
00, 02, 04, 06	Orange	CJ1+ ... CJ4+	External external cold junction sensor (+)
01, 03, 05	Orange	-	Not used
10, 12, 14, 16	Orange	CJ1- ... CJ4-	External external cold junction sensor (-)
11, 13, 15	Orange	-	Not used
07	Orange	U+	Voltage input 5 V (+)
17	Orange	U-	Voltage input 5 V (-)
20 ... 27	Orange	TC1+ ... TC8+	Thermocouple (+)
30 ... 37	Orange	TC1- ... TC8-	Thermocouple (-)

8 Connection examples

8.1 Absolute temperature measurement with internal cold junction compensation

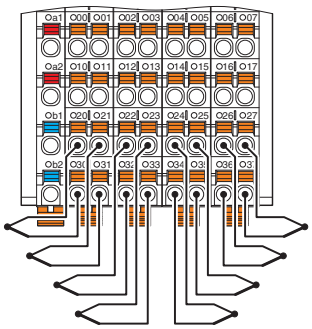


Figure 5 Connection example: absolute temperature measurement

A thermocouple sensor is connected to each of the eight channels.

For example, sensor type J (TC1) and sensor type K (TC2) are used at channels 1 and 2.

The measuring temperature of TC1 and TC2 is automatically determined by the module by means of internal cold junction compensation.

Parameterize the cold junction type as "Internal" (preset by default).

This application is the simple standard application for temperature recording with thermocouples.

8.2 Differential temperature measurement

Precise differential temperature recording is a special application, e.g., in process engineering and process technology. You can determine the exact differential temperature, e.g., between an inlet and return temperature, by connecting two thermocouples in series to one channel of the module.

Parameterize the cold junction type as "Disabled".

The pure differential temperature between the measuring points will therefore be recorded.

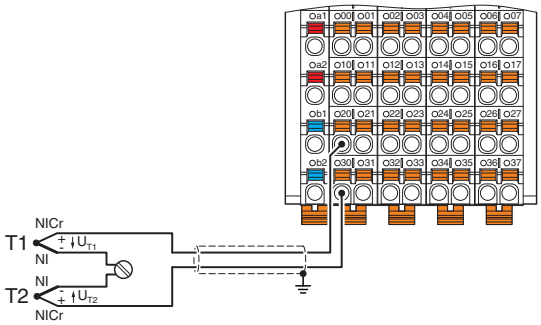


Figure 6 Differential temperature measurement

By linking the two thermocouples (here type K, NiCr-Ni), the temperature difference between both thermoelectric voltages is determined.

$$T_D = T1 - T2$$
$$U_M = UT1 - UT2$$

Where:

T_D	Temperature difference
T1/T2	Temperature at sensor 1/2
U_M	Differential thermoelectric voltage
U_{T1}/U_{T2}	Thermoelectric voltage sensor 1/2

The advantage of this application is the high degree of precision without a waiting time to warm up.

8.3 Thermocouple detection with external cold junction compensation

For applications with a high degree of precision, the module offers the option of compensation using an external cold junction.

Each connector has a connection for an external Pt 100 cold junction sensor.

External cold junction compensation is implemented for each channel.

Proceed as follows:

- Route the sensor cables of the thermocouple to an isothermal block.
- For each channel, wire a copper (Cu) connecting cable from the isothermal block to the input terminals of the module.
- Connect the external Pt 100 cold junction sensor to the isothermal block using a Pt 100 input of connector 1 to 4 (connector 1 in the example).
- Parameterize the cold junction type of the desired input channel as "External, Pt 100, connector x" (x = 1, 2, 3 or 4; channel 1 in the example)

The advantage of this application is the improved warm-up behavior in the first few minutes after the module is switched on.

As an input is available at each connector for an external Pt 100 cold junction sensor, you can operate up to four external cold junction sensors. If you have connected four cold junction sensors, you can then select any cold junction type, i.e., you can use the Pt 100 of connector 1, 2, 3 or 4.

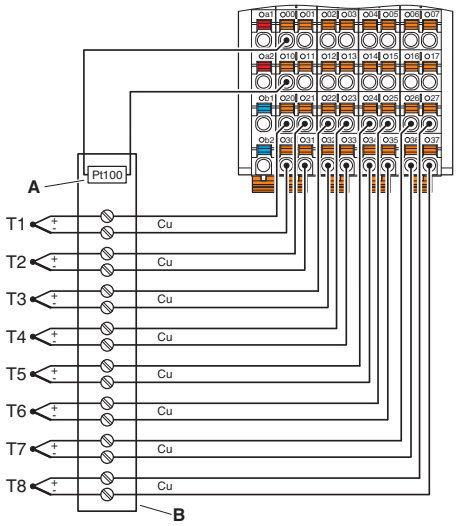


Figure 7 Thermocouple detection with external cold junction compensation at channel 1

A Pt 100 external cold junction sensor

B Isothermal block

8.4 Thermocouple detection with cold junction temperature specification via process data

Another option for compensating the cold junction temperature externally is to specify the cold junction temperature via process data.

In this way, the temperature of the external cold junction can be recorded at the isothermal block via any system and used for compensation.

Proceed as follows:

- Route the sensor cables of the thermocouple to an isothermal block.
- For each channel, wire a copper (Cu) connecting cable from the isothermal block to the input terminals of the module.
- Write the cold junction temperature recorded externally by the isothermal block to the first process data output word of the module in your application (IB IL format).
- Parameterize the cold junction type of the desired input channel as "Process data".

For each module, you can use a digital external process data value for cold junction compensation.

OUT0 = T_{CJ}	0	0	0	0	0	0	0	0

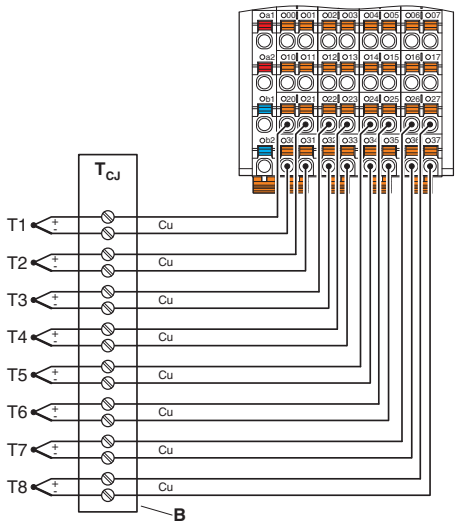


Figure 8 Thermocouple detection with cold junction temperature specification via process data

T_{CJ} Cold junction temperature
B Isothermal block

8.5 Measurement of linear mV voltage signals

You can connect sensors to each channel which supply a linear voltage in the mV range, e.g., pressure or Hall sensors.

- Parameterize the corresponding channel as sensor type “Linear voltage ±100 mV”.

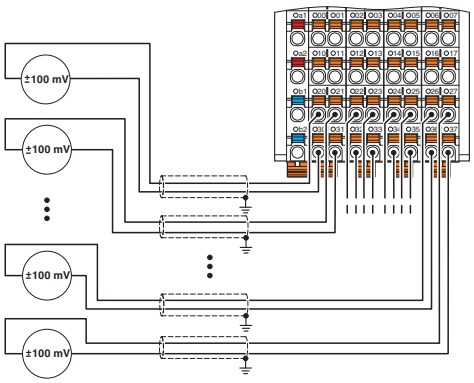


Figure 9 Measurement of linear voltages ±100 mV

A cable break on the sensor cables is monitored and detected.

The ±10 mV and ±30 mV ranges are more accurate than the entire ±100 mV range and have therefore also been specified.

For mV sensors, cable lengths of up to 250 m are possible. Please note the cable length specifications and suitable sensor cable types.

For voltages above +32.7 mV and below -32.7 mV, parameterize the process data resolution as 10 µV/LSB (instead of 1 µV/LSB) in order to prevent overrange or underrange messages from occurring.

8.6 Pt 100 detection

You can also use the inputs for external Pt 100 cold junction sensors as Pt 100 sensor inputs.

To do this, proceed as follows:

- Connect the Pt 100 sensor with 2-wire technology to connector 1, 2, 3 or 4.
- Parameterize a desired channel as sensor type "Cold junction (CJ)" and parameterize the cold junction type as "External,Pt 100, connector x" (x = 1, 2, 3 or 4).
- Record the temperature value of the external Pt 100 sensor at the parameterized channel with a resolution of 0.1 K/LSB.

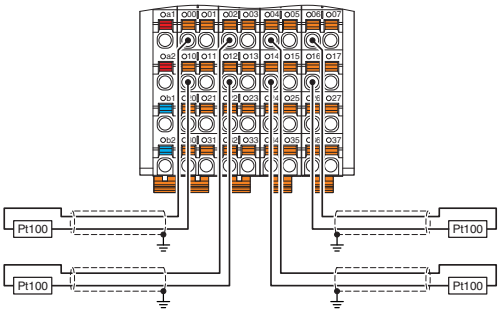


Figure 10 Pt 100 detection

Make sure that the sensor cable is no more than 10 m in length.

To achieve maximum accuracy (< ±0.1 K, it is possible to calibrate a measuring section. To do so, carry out fine adjustment of the tolerances of the connecting cables and the external Pt 100 sensor with object 008F_{hex}: local adjust values.

8.7 Measurement of a ±5 V signal

A -5 V ... +5 V input is available for acquisition from a wide range of signal sources.

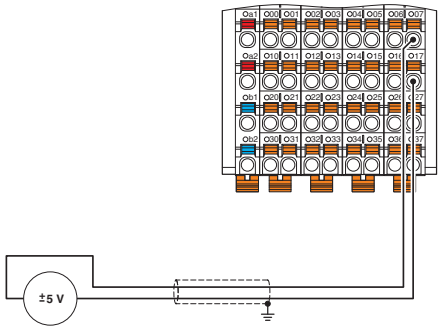


Figure 11 Measurement of a linear voltage ±5 V DC

Make sure that the shielded twisted sensor cable is no more than 5 m in length at the ±5 V input.

If longer cable lengths are required, connect appropriate converters or signal conditioners upstream.

The MCR range from Phoenix Contact offers a comprehensive range of products for this.

In this way, you can acquire isolated Pt 100 signals, for example, from very remote areas (> 100 m) with a temperature transducer (e.g., MCR-T-UI-E) in 4-wire technology and read them in via the -5 V ... +5 V input. You can use this for external cold junction compensation of very remote control boxes, if copper TC sensor cables need to be used.

8.8 Universal AC and DC current acquisition in combination with a current transducer

Any AC or DC currents with 300 V AC safe isolation according to EN 50178, EN 61010, such as heating currents, can be acquired via the 5 V voltage input (terminal points 07 and 17) using a current transducer.

For signal conditioning, use the MCR-S-1-5-UI(-SW)-DCI current transducer from Phoenix Contact, for example.

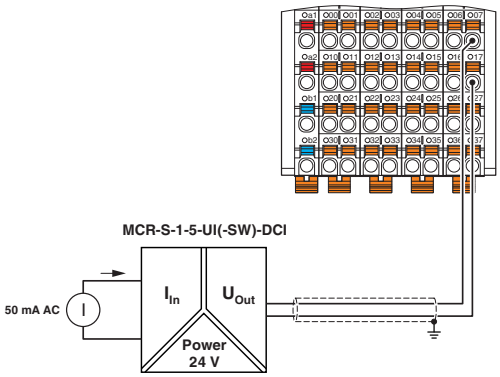


Figure 12 Measurement of an AC or DC current signal at the -5 V voltage input ... +5 V DC in combination with a current transducer (heating current acquisition)

I_{In}	AC/DC input current, 0 mA ... 200 mA up to 0 A ... 11 A, 15 Hz ... 400 Hz
U_{Out}	-5 V DC ... +5 V DC output voltage
MCR-S-1-5-UI(-SW)-DCI	Current transducer

Make sure that the shielded twisted sensor cable is no more than 5 m in length from the current transducer to the temperature module.

If longer cable lengths are required, connect appropriate converters or signal conditioners upstream.

The MCR range from Phoenix Contact offers a comprehensive range of products for this.

9 Connection notes

Use encapsulated thermocouples.

Always connect the thermocouples using twisted pair equalizing conductors.

Use shielded twisted pair equalizing conductors for a cable length from 10 m.

For mV sensors in environments prone to interference as well as for sensor cables which are longer than 10 m. use shielded twisted connecting cables (e.g., LiYCY (TP) 2 x 2 x 0.5 mm^2).

For TC sensors, use the corresponding shielded TC connecting cable according to DIN EN 60584-3/ISO 60584-3.

For optimum shield connection directly before the module, use the AXL SHIELD SET Axioline shield connection set (see ordering data).
Please refer to the UM EN AXL SYS INST user manual for information on how to install the set and connect the shield.

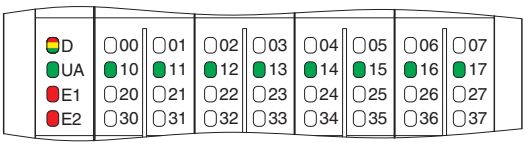
For installation in a control cabinet: connect the cable shield to functional earth ground immediately after the cables enter the control cabinet. Route the shield as far as the Axioline F temperature module without interruption.

For further information on shielding, please refer to the UM EN AXL SYS INST user manual.

10 Configuration notes

Always position temperature modules at the end of the station. For modules that must be positioned next to a bus coupler, the typical measuring tolerance can be increased by up to 0.9 K.

11 Local status and diagnostic indicators



Channel errors are errors that can be associated with a channel.
Periphery errors are errors that affect the entire module.

Figure 13 Local status and diagnostic indicators

Designation	Color	Meaning	State	Description
D	Red/yellow/green	Diagnostics of local bus communication		
		Run	Green ON	The device is ready for operation, communication within the station is OK. All data is valid. There are no faults.
		Active	Green flashing	The device is ready for operation, communication within the station is OK. The data is **not** valid. Valid data from the controller/higher-level network not available. There is no fault in the module.
		Device application not active	Flashing green/yellow	The device is ready for operation, communication within the station is OK. Output data **cannot** be outputted and/or input data **cannot** be read. There is a fault on the periphery side of the module..
		Ready	Yellow ON	The device is ready for operation but did not detect a valid cycle after power-on.
		Connected	Yellow flashing	The device is not (yet) part of the active configuration.
		Reset	Red ON	The device is ready for operation but has lost the connection to the bus head.
		Not connected	Red flashing	The device is ready for operation but there is no connection to the previously existing device.
		Power down	OFF	Device in (power) reset.
UA	Green	U_{Analog}	ON	Supply for analog modules U_A present.
			OFF	Supply for analog modules U_A not present.
E1	Red	Supply voltage error	ON	Supply for analog modules U_A is faulty.
			OFF	Supply for analog modules U_A is OK.
E2	Red	Error	ON	I/O or channel error has occurred.
			OFF	No error

Designation	Color	Meaning	State	Description
10 ... 17	Red/ orange/ green	Channel Scout/error message		
		Channel Scout	Flashing orange	Channel searched for
		Error message	Red ON	Open circuit, overrange or underrange or supply for analog modules U_A not present
				Errors which affect the entire device (e.g., parameter table invalid); Such errors are only displayed on active channels.
		OK	Green ON	Normal operation, installation OK
		Inactive	OFF	Channel is parameterized as inactive.

Error code and status of the E1 and E2 LEDs

Error	E1 LED	E2 LED
No error	OFF	OFF
Underrange	OFF	ON
Overrange	OFF	ON
Open circuit	OFF	ON
Supply voltage faulty (supply for analog modules U_A)	ON	ON
Parameter table invalid	OFF	ON
Device error	OFF	ON
Flash format error	OFF	ON

12 Process data

The module uses nine words of IN process data and nine words of OUT process data.

12.1 Input words IN0 to IN8

The measured values of the TC channels are transmitted to the controller board or the computer using process data input words IN0 to IN7.

IN8 is used to transmit the measured value for the voltage input.

The measured values are depicted in IB IL or S7-compatible format. In both cases, the measured value is displayed in 16 bit format. The data type is Integer 16 from a technical programming point of view.

IN0: measured value channel 1
:
IN7: measured value channel 8
IN8: measured value voltage input

15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
Analog value															

In the IB IL format a diagnostic code is mapped to the input data in the event of an error.

Code (hex)	Cause
8001	Measuring range exceeded (overrange)
8002	Open circuit
8004	Measured value invalid/no valid measured value available
8008	Cold junction defective
8010	Parameter table invalid
8020	Supply voltage faulty (supply for analog modules U_A)
8040	Device faulty
8080	Below measuring range (underrange)

Note regarding code 8008_{hex}:in the event of a cold junction error, code 8008_{hex} is indicated for the channel to which the affected cold junction is assigned.
In order to determine the exact cause of the error, select the "Cold junction" sensor type via the parameterization. The detailed error message is then output for this channel (8080_{hex}, 8001_{hex} or 8002_{hex}).

12.2 Output words OUT0 to OUT8

OUT0: cold junction temperature specification
OUT1: -
:
OUT8: -

13 Open circuit

13.1 Channels 1 to 8 (TC/linear voltage)

Channels 1 to 8 have open circuit detection.

As soon as an open circuit occurs, this is indicated in the process data and in PDI object 0018_{hex}.

In addition, the corresponding diagnostic LED for the channel lights up red.

13.2 Voltage input ±5 V

In the event of an error, the voltage input value goes to 0.

A diagnostic message is not generated, this error is not indicated at the diagnostic LEDs either.

14 Significant values in various formats

14.1 Significant values in IB IL format

Input data		Temperature sensors		Linear voltage ±100 mV	
Resolution		1°C or 1°F	0.1°C or 0.1°F	1 µV	10 µV
hex	dec	°C or °F	°C or °F		
8001	Overrange	> Limit value	> Limit value	> 32.512 mV	> 100 mV
03E8	1000	+1000.0	+100.0	+1 mV	+10 mV
0001	1	+1.0	+0.1	+1 µV	+10 µV
0000	0	0	0	0 µV	0 µV
FFFF	-1	-1	-0.1	-1 µV	-10 µV
FC18	-1000	-1000.0	-100.0	-1 mV	-10 mV
8080	Underrange	< Limit value	< Limit value	< -32.512 mV	< -100 mV

14.2 Significant values in S7-compatible format

Input data		Temperature sensors		Linear voltage ±100 mV	
Resolution		1°C or 1°F	0.1°C or 0.1°F	1 µV	10 µV
hex	dec	°C or °F	°C or °F		
8000	Overrange	> Limit value	> Limit value	> 32.512 mV	> 100 mV
03E8	1000	+1000.0	+100.0	+1 mV	+10 mV
0001	1	+1.0	+0.1	+1 µV	+10 µV
0000	0	0	0	0	0
FFFF	-1	-1	-0.1	-1 µV	-10 µV
FC18	-1000	-1000.0	-100.0	-1 mV	-10 mV
7FFF	Underrange	< Limit value	< Limit value	< -32.512 mV	< -100 mV

15 Parameter, diagnostics and information (PDI)

Parameter and diagnostic data as well as other information is transmitted via the PDI channel of the Axioline F station.

The standard and application objects stored in the module are described in the following section.

The following applies to all tables below:

Please refer to the UM EN AXL F SYS INST for an explanation of the object codes and data types.

Abbreviation	Meaning
A	Number of elements
L	Length of the elements in bytes
R	Read
W	Write

Every visible string is terminated with a zero terminator (00_{hex}). The length of a visible string element is therefore one byte larger than the amount of user data.

For detailed information on PDI and the objects, please refer to the
UM EN AXL F SYS INST user manual.

16 Standard objects

16.1 Objects for identification (device rating plate)

Index (hex)	Object name	Object type	Data type	A	L	Rights	Meaning	Contents
Manufacturer								
0001	VendorName	Var	Visible String	1	16	R	Vendor name	Phoenix Contact
0002	VendorID	Var	Visible String	1	7	R	Vendor ID	00A045
0003	VendorText	Var	Visible String	1	49	R	Vendor text	Components and systems for industrial automation
0012	VendorURL	Var	Visible String	1	23	R	Vendor URL	www.phoenixcontact.com
Module - general								
0004	DeviceFamily	Var	Visible String	1	14	R	Device family	I/O analog IN
0006	ProductFamily	Var	Visible String	1	6	R	Product family	AXL F
000E	CommProfile	Var	Visible String	1	4	R	Communication profile	633
000F	DeviceProfile	Var	Visible String	1	5	R	Device profile	0010
0011	ProfileVersion	Record	Visible String	2	11; 20	R	Profile version	2011-12-07; Basis - Profil V2.0
003A	VersionCount	Array	Unsigned 16	4	4 * 2	R	Version counter	e. g., 0007 0001 0001 0001_{hex}
Module - special								
0005	Capabilities	Array	Visible String	1	8	R	Features	Nothing
0007	ProductName	Var	Visible String	1	14	R	Product name	AXL F UTH8 1F
0008	SerialNo	Var	Visible String	1	11	R	Serial number	xxxxxxxxxx (e. g., 1234512345)
0009	ProductText	Var	Visible String	1	24	R	Product text	8 analog input channels
000A	OrderNumber	Var	Visible String	1	8	R	Order No.	2688417
000B	HardwareVersion	Record	Visible String	2	11; 3	R	Hardware version	e. g., 2010-06-21; 01
000C	FirmwareVersion	Record	Visible String	2	11; 6	R	Firmware version	e. g., 2010-06-21; V1.10
000D	PChVersion	Record	Visible String	2	11; 6	R	Parameter channel version	2010-01-08; V1.00
0037	DeviceType	Var	Octet string	1	8	R	Module identification	00 20 00 12 00 00 00 $A2_{hex}$
Use of the device								
0014	Location	Var	Visible String	1	59	R/W	Location	Can be filled out by the user.
0015	EquipmentIdent	Var	Visible String	1	59	R/W	Equipment identifier	Can be filled out by the user.
0016	ApplDeviceAddr	Var	Unsigned 16	1	2	R/W	Application device address	Can be filled out by the user.

16.2 Object for multilingual capacity

Index (hex)	Object name	Object type	Data type	A	L	Rights	Meaning	Contents
0017	Language	Record	Visible String	2	6; 8	R	Language	en-us; English

16.3 Object descriptions

Index (hex)	Object name	Object type	Data type	A	L	Rights	Meaning
0038	ObjDescrReq	Record		2	3	Read, write	Object description request
0039	ObjDescr	Record		16	36	Read	Object description



These objects are only important for tools and are therefore not described in more detail here.

Please refer to the basic profile for comprehensive information.

16.4 Diagnostics objects

Index (hex)	Object name	Object type	Data type	A	L	Rights	Assignment
0018	DiagState	Record		6	2; 1; 1; 2; 1; 14	R	Diagnostic state
0019	ResetDiag	Var	Unsigned 8	1	1	W	Reset diagnostics

16.4.1 Diagnostics state (0018_{hex}: DiagState)

This object is used for a structured message of an error.

0018_{hex}: DiagState (Read)					
Subindex	**Data type**	**Length in bytes**	**Meaning**	**Contents**	
0	Record	21	Diagnostic state	Complete diagnostics information	
1	Unsigned 16	2	Error number	0 ... 65535_{dez}	
2	Unsigned 8	1	Priority	00_{hex}	No error
				01_{hex}	Error
				02_{hex}	Warning
				81_{hex}	Error removed
				82_{hex}	Warning eliminated
3	Unsigned 8	1	Channel/group/module	00_{hex}	No error
				01_{hex}	Channel 1
				:	:
				08_{hex}	Channel 8
				09_{hex}	±5 V voltage input
				FF_{hex}	entire device
4	Unsigned 16	2	Error code	See table below	
5	Unsigned 8	1	More follows	00_{hex}	
6	Visible String	14	Text (14 characters)	See table below	

The message with the priority 81_{hex} or 82_{hex} is a one-time internal message to the bus coupler that is implemented onto the error mechanisms of the higher-level system by the bus coupler.

Once the malfunction has been eliminated, it is automatically reset.

Error and status of the local status and diagnostics indicators

Subindex	2	3	4	6						
Error	Priority	Channel/ group/ module	Error code	Text	Process data	LED				
	hex	hex	hex			D	UA	E1	E2	10 ... 17
No error	00	00	0000	Status OK	xxxx	Green ON	ON	OFF	OFF	X
Cold junction invalid	01	01 ... 08	5120	Cold junction (CJ)	8008	Green ON	ON	OFF	ON	Red ON
Supply voltage faulty (supply for analog modules U_A)	01	FF	5160	Supply fail	8020	Flashing green/yellow	OFF	ON	ON	Red ON
Device error	01	FF	6301	CS FLASH	8040	Green ON	ON	OFF	ON	Red ON
Flash format error	01	FF	6302	FO FLASH	8040	Green ON	ON	OFF	ON	Red ON
Parameter table invalid	01	FF	6320	Invalid para	8010	Green ON	ON	OFF	ON	Red ON
Open circuit	01	01 ... 08	7710	Open circuit	8002	Green ON	ON	OFF	ON	Red ON
Overrange	02	01 ... 09	8910	Overrange	8001	Green ON	ON	OFF	ON	Red ON
Underrange	02	01 ... 09	8920	Underrange	8080	Green ON	ON	OFF	ON	Red ON

X The LED is not affected by this error.

An error on one channel (channel = 01 ... 08) is displayed via LED 10 ... 17.

An overrange or underrange at the ±5 V voltage input (channel = 09) is not indicated by an LED.

An error which affects the entire device (channel = FF), is only displayed on active channels via LEDs 10 ... 17. The corresponding LED is not lit up for inactive channels.

16.4.2 Reset diagnostic mesages (0019_{hex}: ResetDiag)

You can delete the diagnostics memory and acknowledge the diagnostic messages with this object.

0019_{hex}: ResetDiag (Write)					
Subindex	**Data type**	**Length in bytes**	**Meaning**	**Contents**	
0	Unsigned 8	1	Reset diagnostics	00_{hex}	All diagnostic messages approved
				02_{hex}	Deletes and acknowledges all pending diagnostic messages that have not been read out
				06_{hex}	Deletes and acknowledges all the diagnostic messages, resets the error counter, and allows no further diagnostic messages
				Other	Reserved

16.5 Objects for process data management

Index (hex)	Object name	Object type	Data type	A	L	Rights	Assignment
0025	PDIN	Var	Octet string	1	18	R	Input process data
0026	PDOUT	Var	Octet string	1	18	R/W	Output process data
0027	GetExRight	Var	Simple variable	1	1	R/W	Get exclusive process data write rights
003B	PDIN_Descr	Record		3	12	R	Description of the IN process data
003C	PDOUT_Descr	Record		6	24	R	Description of the output process data

Objects $003B_{hex}$ and $003C_{hex}$ are only applicable to tools and are therefore not described in more detail here.

Please refer to the basic profile for comprehensive information.

16.5.1 IN process data (0025_{hex}: PDIN)

You can read the IN process data of the module with this object.

The structure corresponds to the representation in the "Process data" section.

0025_{hex}: PDIN (Read)			
Subindex	**Data type**	**Length in bytes**	**Meaning**
0	Octet string	18	Input process data

There are 2 bytes available for each channel, starting with channel 1.

There are also 2 bytes available to transmit the heater voltage measured value.

16.5.2 OUT process data (0026_{hex}: PDOUT)

You can read and write the OUT process data of the module with this object.

The structure corresponds to the representation in the "Process data" section.

Output data can be written in order to specify the temperature as an external cold junction, in you do not want to use the process data for this.
If you use the first word (specification of the cold junction temperature), reset the remaining words to 0.

0026_{hex}: PDOUT (read, write)			
Subindex	**Data type**	**Length in bytes**	**Meaning**
0	Octet string	18	Output process data

Observe the notes in the section "Writing the analog values via the PDI channel".

16.5.3 Request exclusive write access (0027_{hex}: GetExRight)

This object allows you to determine which channel (process data channel or PDI channel) gets the rights for writing the outputs.

0027_{hex}: GetExRight (read, write)					
Subindex	**Data type**	**Length in bytes**	**Meaning**	**Contents**	
0	Simple variable	1	Get exclusive process data write rights	00_{hex}	Rights for writing output data over the PD channel (process data channel)
				01_{hex}	Rights for writing output data via the PDI channel

16.6 Objects for device management

Index (hex)	Object name	Object type	Data type	A	L	Rights	Meaning
001D	Password	Simple variable	Octet string	1	9	W	Password

Password ($001D_{hex}$: Password)

By entering the "Superuser" password you permit writing to the "Exclusiv right received" object. These rights are required to transmit process data over the PDI channel.

$001D_{hex}$: password (Write)			
Subindex	**Data type**	**Length in bytes**	**Meaning**
0	Simple variable	9	Password

17 Application objects

Index (hex)	Object name	Object type	Data type	A	L	Rights	Assignment
0080	ParaTable	Array	Unsigned 16	10	10 * 2	R/W	Parameter table
0082	Measured Value Float	Array	Octet string	8	8 * 6	R	Measured values in the extended float format
0083	PD Min	Array	Integer 16	9	9 * 2	R	Minimum process data value
0084	PD Max	Array	Integer 16	9	9 * 2	R	Maximum process data value
008F	Local adjust value	Var	Octet string	1	16	R/W	Local adjust values
0090	Channel Scout	Var	Unsigned 8	1	1	R/W	Channel Scout

17.1 Parameter table (0080_{hex}: ParaTable)

Parameterize the module using this object.

In the case of valid parameters, the parameterization is stored in the module permanently.

After resetting, the module works with the last permanently stored data. Upon delivery, the module works with the default data (default settings).

0080_{hex}: ParaTable (read, write)				
Subindex	**Data type**	**Length in bytes**	**Meaning**	**Default value**
0	Array of Unsigned 16	10 * 2	Read/write all elements	See subindices
1	Unsigned 16	2	Parameterization of channel 1	$001F_{hex}$
:	Unsigned 16	2	:	
8	Unsigned 16	2	Parameterization of channel 8	$001F_{hex}$
9	Unsigned 16	2	Data format, mounting position	0000_{hex}
10	Unsigned 16	2	Reserved	0000_{hex}

Parameterization of channel 1 ... channel 8

Parameterization word

15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
0	0	Filter		Cold junction type				Resolution		0	Sensor type				

The values displayed in bold are pre-settings.

Filter		Code (bin)	Code (hex)
120 ms	**8.3 Hz**	**00**	**0**
100 ms	10 Hz	01	1
60 ms	16.6 Hz	10	2
40 ms	25 Hz	11	3

Cold junction type			Code (bin)	Code (hex)
Internal			**0000**	**0**
Switched off			0001	1
External	Pt 100	Connector 1	0010	2
External	Pt 100	Connector 2	0011	3
External	Pt 100	Connector 3	0100	4
External	Pt 100	Connector 4	0101	5
Process data			0110	6
Reserved			Other	

Internal — There are several internal cold junction sensors in the module.
When you select the "Internal" cold junction type for a channel, the corresponding cold junction for this channel is automatically assigned to it.

External — You can connect a Pt 100 sensor to every connector as an external cold junction sensor. Up to four external cold junctions are therefore available. One of these four external cold junctions can be assigned to each of the eight channels.

Process data — This parameterization offers the following option:
Determine the temperature of the cold junction via an additional device.
Transfer this temperature to the temperature module via the first process data output word. Use IB IL format with a resolution of 0.1°C.

Resolution	Code (bin)	Code (hex)
0.1°C (or 1 µV for sensor type linear voltage ±100 mV)	**00**	**0**
1°C (or 10 µV for sensor type linear voltage ±100 mV)	01	1
0.1°F	10	2
1°F	11	3

Sensor type	Code (bin)	Code (hex)
K	00000	0
J	00001	1
E	00010	2
R	00011	3
S	00100	4
T	00101	5
B	00110	6
N	00111	7
U	01000	8
L	01001	9
C	01010	A
W	01011	B
HK	01100	C
Reserved	01101	D
Reserved	01110	E
Cold junction (CJ)	01111	F
Linear voltage ±100 mV	10000	10
Channel inactive	**11111**	**1F**
Reserved	Other	

Data format, mounting position

15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
0	0	Mount-ing po-sition		0	0	Data format		0	0	0	0	0	0	0	0

Data format	Code (bin)	Code (hex)
IB IL	**00**	**0**
S7-compatible	10	2
Reserved	Other	

Mounting position	Code (bin)	Code (hex)
Horizontal (preferred mounting position)	**00**	**0**
Vertical, bus coupler above	01	1
Vertical, bus coupler below	10	2
Lying	11	3

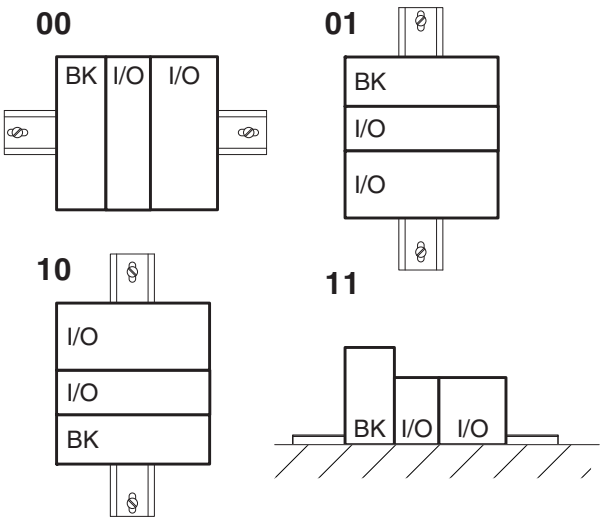


Figure 14 Mounting position

BK Bus coupler
I/O I/O module

17.2 Measured value in extended float format (0082_{hex}: Measured Value Float)

You can read the IN process data in IB IL or S7-compatible format with the 0025_{hex} object.

The 0082_{hex} object is also available.

This object provides the measured value in the highest internal accuracy of the terminal in the float format.

0082_{hex}: Measured Value Float (Read)			
Subindex	**Data type**	**Length in bytes**	**Meaning**
0	Array of Records	8 * 6	Read all elements
1	Record	6	Measured value for channel 1
:	:	:	:
8	Record	6	Measured value for channel 8

Channel 1 ... channel 8 measured value

Element	Data type	Length in bytes	Meaning
1	Float 32	4	Measured value in float format according to IEEE 754
2	Unsigned 8	1	Status
3	Unsigned 8	1	Unit

Structure of the float format according to IEEE 754 in the bit representation:

VEEE EEEE	EMMM MMMM	MMMM MMMM	MMMM MMMM

V 1 sign bit, 0: positive, 1: negative

E 8 bits exponent with offset $7F_{hex}$

M 23 bits mantissa

Some example values for conversion from floating point to hexadecimal representation:

Floating point	Hexadecimal representation
1.0	3F 80 00 00
10.0	41 20 00 00
1.03965528	3F 85 13 6D
- 1.0	BF 80 00 00

Extended Float Format

Extended Float Format is a specially defined format. It consists of the measured value in float format, a status, and a unit.

Status is necessary because the float format defines no patterns providing information on the status of the numerical value.

The status corresponds to the LSB of the diagnostic code in IB IL format (e.g., overrange: status = 01, diagnostic code = 8001_{hex}). If status = 0, the measured value is valid.

Unit	Code
°C	32 (20_{hex})
°F	33 (21_{hex})
Millivolts (mV)	36 (24_{hex})

Status	Code
Measured value is valid	00_{hex}
Measured value is invalid	Other

17.3 Minimum process data value (0083_{hex}: PD Min)

Object 0083_{hex} can be used to read the minimum IN process data values.

The values are initialized after each parameterization. The highest value is assigned for the minimum process data value.

PD Min = 7FFF 7FFF 7FFF 7FFF 7FFF 7FFF 7FFF 7FFF $7FFF_{hex}$

On every analog conversion, the PD Min value is compared with the current measured values and overwritten if necessary.

0083_{hex}: PD Min (Read)			
Subindex	**Data type**	**Length in bytes**	**Meaning**
0	Array of Integer 16	9 * 2	Read all elements
1	Integer 16	2	Minimum process data value channel 1
:	:	:	:
8	Integer 16	2	Minimum process data value channel 8
9	Integer 16	2	Minimum process data value voltage input

17.4 Maximum process data value (0084_{hex}: PD Max)

Object 0084_{hex} can be used to read the maximum IN process data values.

The values are initialized after each parameterization. The lowest value is assigned for the maximum process data value.

PD Max = 8000 8000 8000 8000 8000 8000 8000 8000 8000_{hex}

On every analog conversion, the PD Max value is compared with the current measured values and overwritten if necessary.

0084_{hex}: PD Max (Read)			
Subindex	**Data type**	**Length in bytes**	**Meaning**
0	Array of Integer 16	9 * 2	Read all elements
1	Integer 16	2	Maximum process data value channel 1
:	:	:	:
8	Integer 16	2	Maximum process data value channel 8
9	Integer 16	2	Maximum process data value voltage input

17.5 Local adjust values ($008F_{hex}$)

This object supports a channel-specific path calibration function for maximum accuracy. This means, for example, that you can finely tune the tolerances by means of the TC connecting cables and the sensors.

The calibration data is permanently stored on the module.

The object contains the temperature offset of the cold junction with reference to each channel in IB IL format with a resolution of 0.1°C.

$008F_{hex}$: local adjust values (read, write)					
Subindex	**Data type**	**Length in bytes**	**Meaning**	**Contents**	**Default value**
0	Var	8 * 2	Local adjust values		

Element	Data type	Length in bytes	Meaning	Contents	Default value
1	Var	2	Temperature offset channel 1	-20.0 °C ... +20.0 °C (-200_{dec} ... $+200_{dec}$)	0000_{hex}
:	:	:	:	:	:
8	Var	2	Temperature offset channel 8	-20.0 °C ... +20.0 °C (-200_{dec} ... $+200_{dec}$)	0000_{hex}

Example:

Channel 1 is measuring +2.0°C too high.

A negative offset of -2.0°C is required to correct this error.

In IB IL format, -2 °C corresponds to a value of $-20_{dec} = FFEC_{hex}$.

17.6 Channel Scout (0090_{hex})

This object is used to quickly find a channel.

0090_{hex}: channel scout (read, write)					
Subindex	**Data type**	**Length in bytes**	**Meaning**	**Contents**	
0	Var	1	Channel Scout	0	Disable all channel scout processes
				1 ... 8	Green LED of the channel is flashing at 0.5 Hz (1 second ON, 1 second OFF)

The function is terminated automatically after five minutes if you do not deactivate the Channel Scout processes. The flashing overrides all diagnostic messages of the selected channel. When a channel is parameterized, the Channel Scout function is aborted.

18 Writing the analog values over the PDI channel

PDI = Parameters, Diagnostics and Information

To set the temperature of the external cold junction via the PDI channel rather than in the process data, you must change the exclusive right first.

To do this, proceed as follows:

- Write the ASCII string "Superuser" to the "Password" ($001D_{hex}$) object.
- Write the value 01_{hex} to the “Request exclusive write access” object (0027_{hex}).

You may now write to the "Output process data" (0026_{hex}) object.

19 Device descriptions

The device is described in the device description files.
The device descriptions for controllers from Phoenix Contact are included in PC Worx and the corresponding service packs.
The device description files for other systems are available for download at phoenixcontact.net/products in the download area of the bus coupler used.