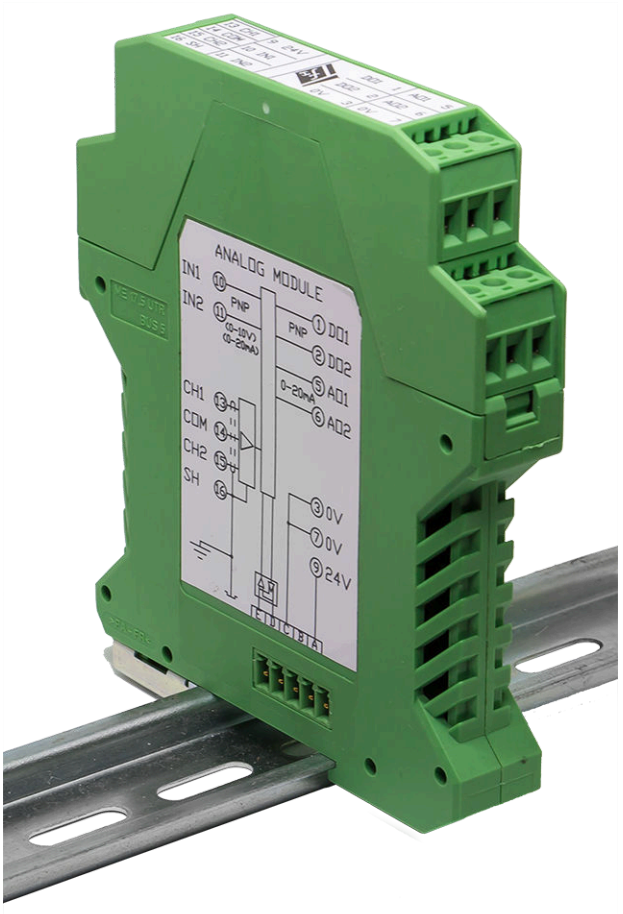
AM or BM Conditioning Module

For thermal sensor signal management

This module is a signal conditioner designed to be used as an autonomous control system. It can be used with heat flow sensors, thermocouples and has DIN rail fixture.



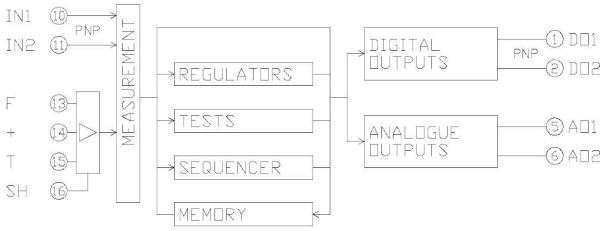
It has:

- 2 24-bit mV inputs
- 1 PNP (synchronization) input
- 1 PNP or analogue 0-10V or 0-20mA input
- 2 0-10V or 0-20mA analog outputs
- 2 PNP outputs with integrated controllers
- 2 realtime window tests
- 1 sequencer with 2 computed results
- 1 double bus connector allowing to link several modules together

Applications: this module constitutes an element of a process control and data acquisition chain. Its configuration fits to many projects.

- Acquisition of heat flux and temperature signals
- Signal conditioner for non-contact temperature sensor (radiative or conductive).
- Autonomous end-of-cure controller (for exothermic reactions like ones involved in RTM / SMC process)
- Anomaly detector in injection processes

Block diagram

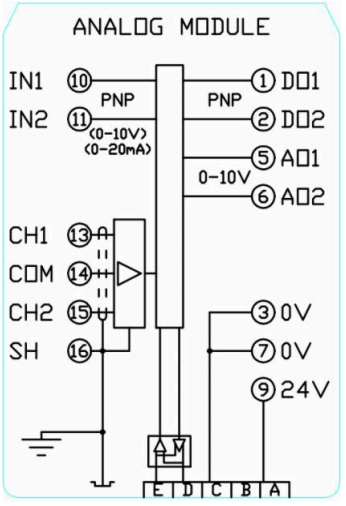


The analog module has 3 distinct operating groups:

- Measurements (PNP, 0-10V, 0-20mA or mV)
- Automation (controllers, tests, sequencer)
- The outputs (digital, analog)

The internal memory allows functions to access all available data.

Wiring diagram



The minimum commissioning consists of:

- Connect the sensor(s) to the inputs 13 to 16
- Wiring the outputs according to the application
- Connect the power supply between 24V and 0V (useless if the module is powered by the bus)
- If necessary, configure the analog module via the digital bus and the aDDa-V application.

If more than one module is used, the power supply must only be connected once because it is shared on the bus.

Ground is connected through DIN rail.

Power supply and communication

Electrical specifications

Name	Description	Min	Typ	Max	unit
Vcc	Power supply	22.5	24	30	V_{DC}
I_{IN}	Power consumption		15		mA

- protected against polarity errors

Pinout

Pin	Name	Description
9	24V	Positive supply
3.7	0V	Reference potential

For wires 0.2 - 2.5 mm² (AWG 24-12)

Communication,

RS-485 half duplex, with proprietary protocols

Name	Description	Min	Typ	Max	Unit
B_{rATE}	Transfer rate		38,400		bps
Address	Local Address	0x10	0x14	0xEF	

Integrated bus pinout

Pin	Name	Description
A	24V	Positive supply
B	DVCC	Communication supply
C	0V	Reference potential
D	D-	Differential communication RS485 Negative polarity
E	D +	Differential communication RS485 Positive polarity
Shield	Ground	Via DIN rail

mV Inputs

Electrical specifications

Name	Description	Min	Typ	Max	Unit
R_{IN}	Differential input impedance	200k			Ω
Step	Resolution		24		bit
$noise_{PP}$	Measurement noise, peak to peak		1		µV
CMRR	Common mode rejection		100		dB
F_{SAMPLE}	Sampling frequency				8.3Hz
$A_{IN +/-}$	Analog Input	-0.03		5	V
$A_{IN +}$-A_{IN-}	Differential voltage input	-2.5		2.5	V
CMA_{IN}	Common mode input		2.5		V

Pinout

PinPin	Name	Description
13	CH1	Negative input 1
14	COM	Positive common input
15	CH2	Negative input 2
16	SH	Shielding the cable

For 0.14 - 1.5 mm² wires (AWG 28 - 16)

PNP and 0-10V/ 0-20mA input specifications

Electrical Specifications of PNP Inputs

Name	Description	Min	Typ	Max	Unit
R_{IN}	Input impedance		50		kΩ
T_{DETECT}	Detection time		7.5		ms
F_{SAMPLE}	Sampling frequency		133		Hz
V_{IN}	Analog input mode	0		30	V
V_{HIGH}	High voltage detection		15.2		V

0-10V Input Electrical Specifications

Name	Description	Min	Typ	Max	Unit
R_{in}	Input impedance		50		kΩ
Step	Resolution		10-		bit
Noise	Measurement noise, Peak to Peak Mode		<20		mV
F_{SAMPLE}	Sample Rate		133		Hz
V_{IN}	Analog input mode	0		30	V
V_{SAT}	Saturation value		20		V

0-20mA Input Electrical specifications

Name	Description	Min	Typ	Max	Unit
R_{in}	Input impedance		500		Ω
Step	Resolution		10		bits
Noise	Measurement noise, fashion peak to peak		<40		uA
F_{SAMPLE}	Sampling frequency		133		Hz
I_{IN}	Analog input mode	0		60	mA
I_{SAT}	Saturation value		40		mA

Gain and offset settings

The analog input is converted to a digital signal in the user defined unit by applying offset and gain:

$$User\ signal\ =\ (Signal\ (V\ or\ mA)\ +\ Offset)\ \times Gain)$$

The calibration of the analog input can be performed with the aDDa-V software calibration wizard.

Pinout

Pin	Name	Description
10	IN1	Synchronization input PNP
11	IN2	Auxiliary input PNP / 0-10 V

For wires 0.2 - 2.5 mm² (AWG 24 - 12)

Analog outputs

AM modules have two outputs 0-10V, BM modules two outputs 0-20mA.

Electrical Specifications of Analog Outputs

Name	Description		Min	Type	Max	Unit
R_{OUT}	Output impedance			10		Ω
Step	Resolution			16		bits
F_{SAMPLE}	Output frequency			33		Hz
GND	Voltage reference			0		V
V_{OUT}	Output voltage	Type 0-10V	0		10	V
I_{MAX}	Max current	Type 0-10V		3		mA
I_{OUT}	Output current	Type 0-20mA	0		20	mA
R_{MAX}	Load loop	Type 0-20mA		500	800	Ω

Pinout

Pin	Name	Description
5	AO1	Output 1
6	AO2	Output 2

For wires 0.2 - 2.5 mm² (AWG 24 - 12)

The output range is defined relative to the selected signal in the aDDa-V software.

PNP outputs

Electrical specifications of PNP outputs

Default conditions: V_{DC} = 24V, R_L= 10kΩ

Name	Description	Min	Type	Max	Unit
I_{CMAX}	Maximum current		40		mA
Z	Impedance (PTC)		5		Ω
$V_{CE\ (SAT)}$	Collector-Emitter closed voltage		0.7	1	V_{DC}

Pinout

Pin	Name	Description
1	DO1	Output PNP 1
2	DO2	Output PNP 2

For wires 0.2 - 2.5 mm² (AWG 24 - 12)

Internal functions

Auxiliary measurements

2 further measurements are made in the module:

- Supply voltage
- Cold Junction Compensation (CJC)

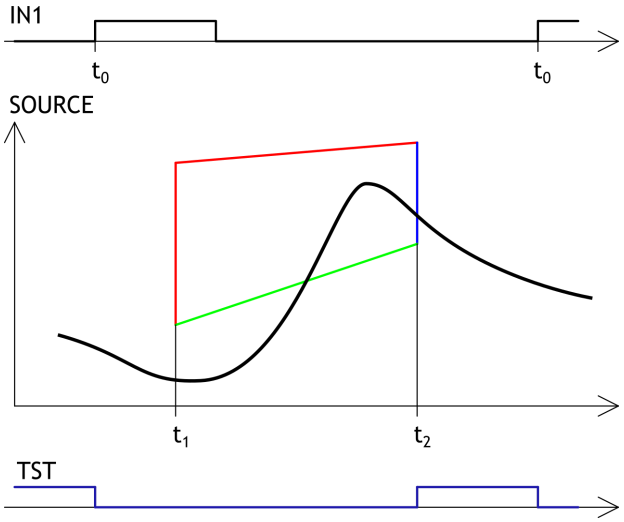
Mathematical functions

One of the following 3 operations is calculated for each mV signal:

- Lowpass filter, derivative, phase advance.
- Radiant target temperature (Stefan - Boltzmann law)
- Conductive target temperature

Window tests

Two window tests are implemented in the analog modules. Numerous options allows user to define from continuous detection, starting at a synchronization time to between two fixed instants related to synchronization.



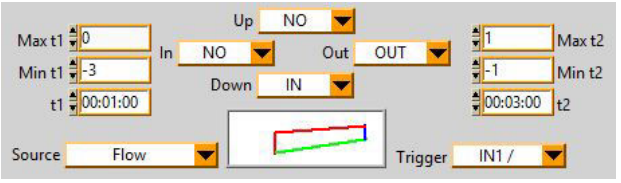
The test sequence follows the following procedure:

- Synchronization waiting on IN1
- At synchronization, RESET of the previous test
- At t_1, control of the input thresholds
- From t_1 to t_2, control at the high and low limits
- At t_2, control of the output thresholds and activation of the result if OK

If $t_1<0$, the limits are controlled from t_0 to t_2, at the value of t_2. If $t_2<0$, the control is permanent at the limits defined for t_2.

Inputs and outputs of the window can be allowed or prohibited on all four sides. The limits can be prohibited in input, output or input-output. Only one input and one output of the signal are allowed per cycle.

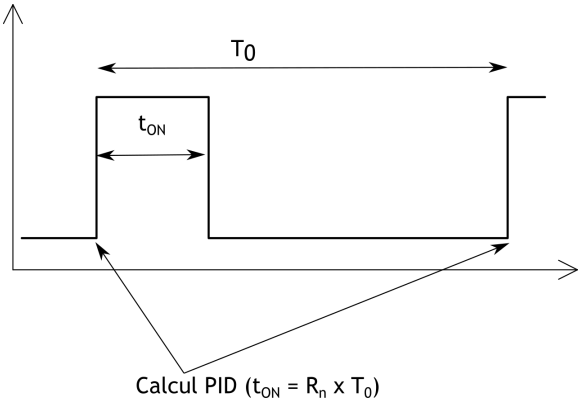
The aDDa-V software configuration wizard provides a graphical overview of the defined configuration and allows easy configuration of all test parameters.



In red, entry / exit prohibited. In green, entry allowed, blue exit allowed. In pink entry-exit allowed.

Regulators

Two regulators are running in the analog modules. The result can be sent on 0-10V analog or digital output. In the first case, the value is reproduced continuously. In the second case, the output is activated in modulated power (PWM): a pulse is generated by PID calculation loop, active first. The time T_0 is in seconds.



The controllers can be one of these 3 types:

- Constant output (control by the central system, aDDa-V software or sequencer)
- Digital PID controller with update every T_0 (local control)
- Hysteresis regulator (for regulation or local detection).

Sequencer

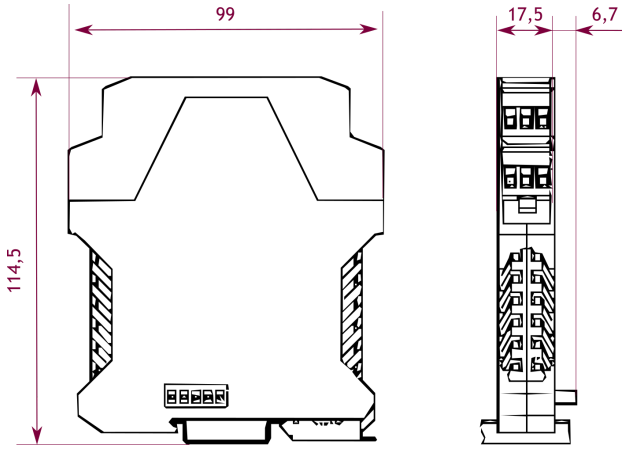
An internal sequencer is running in analog modules. Up to 4 simultaneous tasks can work with 26 instructions performing operations on all measurements, mathematical functions, automatisms, 16 temporary memories, 16 timers decrementing automatically to 0, 16 counters and 4 parameters.

The parameters can be changed with the calibration window of the aDDa-V software.

The results are stored in 2 variables that can be used by the other functions.

The design and programming of the sequences is performed by TFX via a dedicated application.

Module dimensions



Mounting on omega 35 mm DIN rail.

Product number

Code	Description
203.AM	**Analog module, analog output 0-10V**
203.BM	Analog module, analog output 0-20mA
203.AMI	Analog module, analog output 0-10V, isolated mV input
203.BMI	Analog module, analog output 0-20mA, isolated mV input
203.PS	Sequencer
203.PU	Factory programming (see form on last page)

Contents

- 1 AM module
- 3 Phoenix Contact connectors MSTBT 2.5 / 3
- 1 Phoenix Contact connector MSTBT 1.5 / 4 -ST-3.5

Optional accessories

- Replacement connectors
- Communication bus protection cap
- 5-pin bus connector
- Bus extension cable between modules (up to 100 meters)

Complements

- 204.BC USB interface with aDDa-V configuration software
- 215.EC Ethernet interface - with aDDa-V configuration software
- 218.IM Analog module - with 8 16-bits analog inputs
- Configuration tablet
- aDDa-V - 188 software with license for data acquisition
- TFX-Prod - 200 software with automated signal analysis and modules configuration associated with customer's recipes
- TFX-Lab - 201 software for production and trials parameters follow up
- 24V industrial power supply
- 24V laboratory power supply

Factory programming form

Customer: Serial no: Address:

Measurements

Data		CH1	CH2
Type			
Sensitivity [µV / (W / m2)]			
zero Factor			
Order	Fact. form		
Fc [Hz]	-		

IN2

Data	Value
Type	
Gain [IF / V]	
Offset [V]	

Tests

TST1

Data	Value
Source	
Side synchronization	
t1	
Max t1	
Min t1	
t2	
Max t2	
Min t2	
limit input (t1> = 0)	
Limit high (t2> 0)	
low limit (t2> 0)	
limit output	

TST2

Data	Value
Source	
Side synchronization	
t1	
Max t1	
Min t1	
t2	
Max t2	
Min t2	
limit input (t1> = 0)	
limit high (t2> 0)	
Low limit (t2> 0)	
Output limit	

Regulators

Data	Value
To (s)	

REG1

Data		Value
Mode		
Setpoint		
Setpoint		
Source		
Gain	Hysteresis	
Ti [s]	ON	
Td [s]	OFF	
Max	-	

REG2

Data		Value
Mode		
Setpoint		
Setpoint		
Source		
Gain	Hysteresis	
Ti [s]	ON	
Td [s]	OFF	
Max	-	

Sequencer

Data	Value	Data	Value
Parameter 1		Parameter 3	
Parameter 2		Parameter 4	
Program			

Analog Outputs

AO1

Data	Value
Source	
Value at 0V or 0mA (min)	
Value at 10V or 20mA (max)	

AO2

Data	Value
Source	
Value at 0V or 0mA (min)	
Value at 10V or 20mA (max)	

Digital outputs

DO1

Data	Value
Function	
BIT1	
BIT2	

DO2

Data	Va their
function	
BIT3	
BIT4	