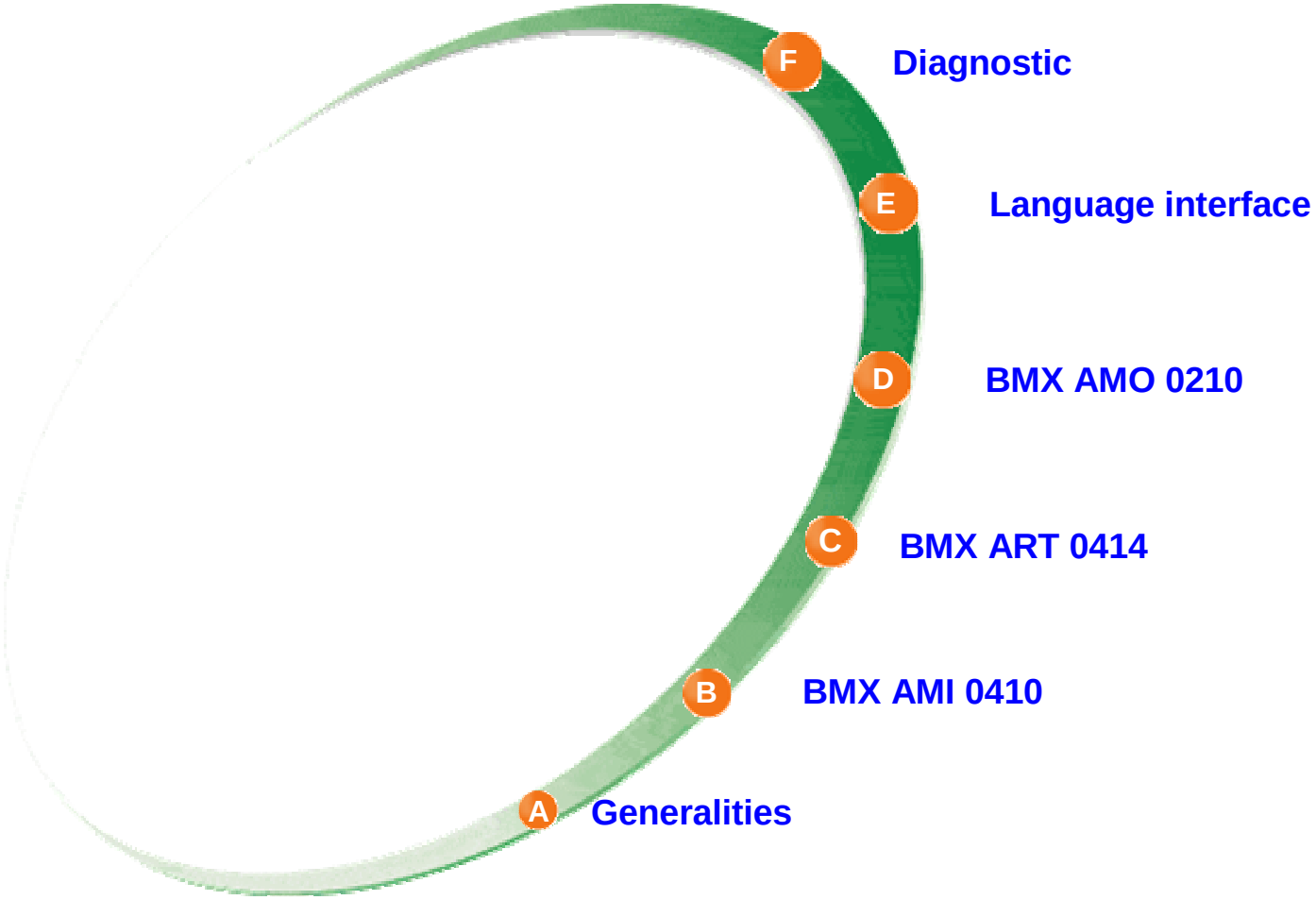
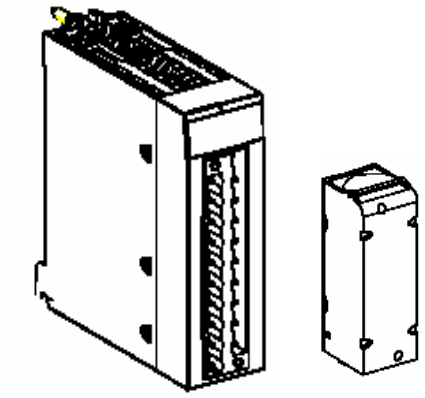
M6 - MODICON M340 : Analog Offer



A – Generalities

Analog input module

- **At a Glance :**
- Analog modules are standard format modules, this offer is made up of two Input modules :
  - 4 channels for the **BMX AMI 0410** module



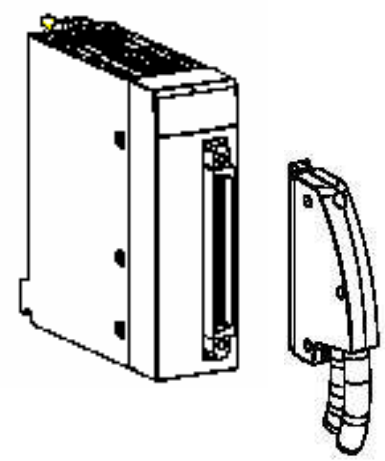
BMX AMI 0410

The BMX AMI 0410 module offers the following range for each input :

1. +/-10 V
2. 0..10 V
3. 0..5 V / 0..20 mA
4. 1..5 V / 4..20 mA
5. +/- 5 V +/- 20 mA

Analog input module

- **At a Glance :**
- Analog modules are standard format modules, this offer is made up of two Input modules :
  - 4 channels for the **BMX ART 0414** module



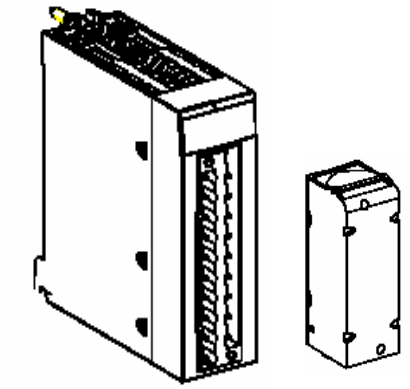
BMX ART 0414

BMX ART 0414 module is a multi-range acquisition device with four inputs isolated from each other. This module offers the following ranges for each :

1. Thermocouple B, E, J, K, L, N, R, S, T, U
2. Resistor 0 – 400 Ohms (2/3 wires, 4 wires)
3. 0 – 3850 Ohms (2/3 wires, 4 wires)
4. +/-40mV, +/-80mV, +/-160mV, +/-320mV, +/-640mV, 1280mV
5. Pt100 / Pt1000 (CEI or JIS) (2/3 wires, 4 wires)
6. Ni100 / Ni 1000 (CEI or JIS) (2/3 wires, 4 wires)
7. Cu 10 (2/3 wires, 4 wires)

Analog output module

- **At a Glance :**
- Analog modules are standard format modules, this offer is made up of one output Input module :
  - 2 channels for the **BMX AMO 0210** module



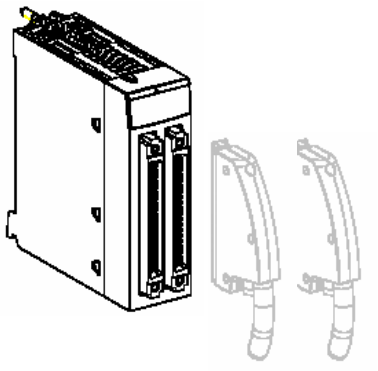
BMX AMO 0210

The BMX AMO 0210 is a module with two analog outputs isolated from one other. It offers the following ranges for each output:

1. Voltage +/-10 V
2. Current 0..20 mA
3. Current 4..20 mA

Analog input module

Module available in the launch L12A.



BMX ART 0814

At a Glance :

Analog modules are standard format modules, this offer is made up of two Input modules :

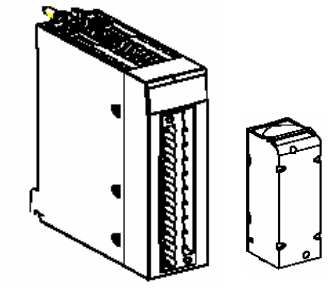
8 channels for the **BMX ART 0814** module

BMX ART 0414 module is a multi-range acquisition device with four inputs isolated from each other. This module offers the following ranges for each input,according to the selection made at configuration:

RTD IEC Pt100/Pt1000 in 2,3 or 4 wires
US/JIS Pt100/Pt1000 in 2, 3 or 4 wires
Cu10, Ni100/Ni1000 in 2, 3 or 4 wires
thermocouple B, E, J, K, L, N, R, S, T, U
Voltage +/- 40 mV at +/- 1.28 V.

Analog output module

Module available in the launch L12A.



BMX AMM 0600

■At a Glance :

■Analog modules are standard format modules, this offer is made up of one output Input module :

2 Analog Output and 4 Analog Input for the **BMX AMM 0600** module

- **2 analog output** not isolated from one other. It offers the following ranges for each output:

  Voltage +/-10 V

  Current 0..20 mA and 4..20 mA

- 4 analog input offers the following range for each input:

  +/-10 V,0..10 V,

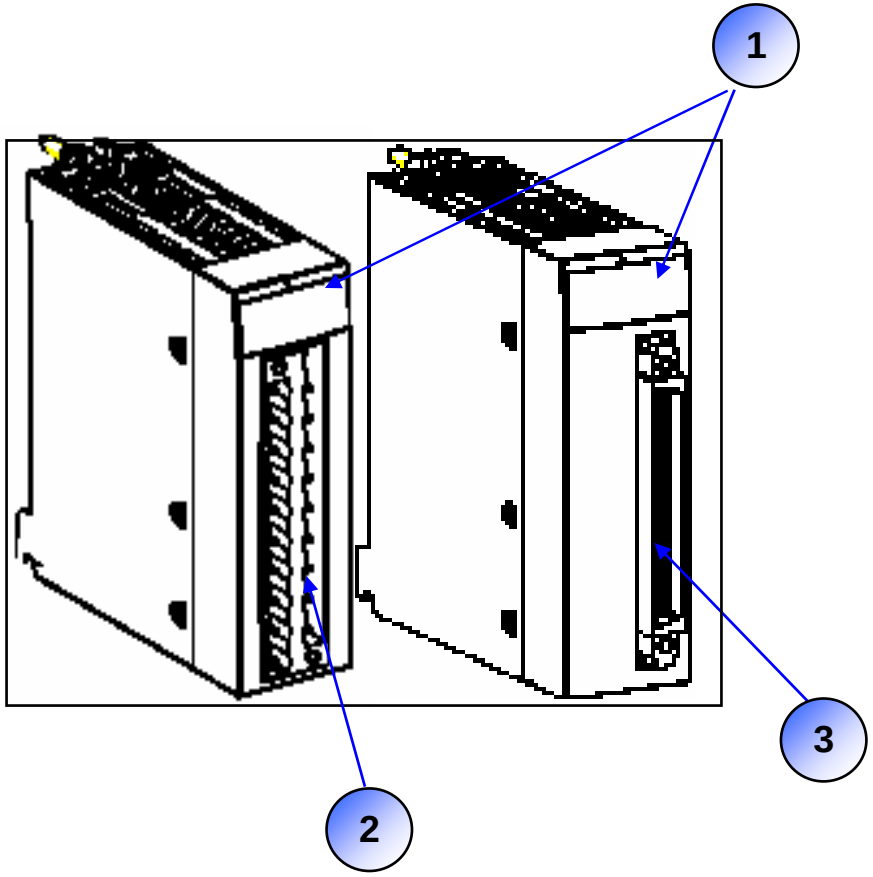
  0..5 V / 0..20 mA,

  1..5 V / 4..20 mA,

  +/- 5 V +/- 20 mA

BMX AMI 0410
BMX ART 0414
BMX AMO 0210

Analog Module Hardware



	Description
1	**Module and channels state.**
2	**20-pin connector** -**BMX AMI 0410** -**BMX AMO 0210**
3	**40-pin connector** - **BMX ART 0414**

- The display in front of the module allows a quick diagnostic of the module, it is shared in two part :
  - General information
  - State of the I/Os

BMX AMI 0410
BMX ART 0414
BMX AMO 0210

Display of Analog Module States

LEDs	RUN	ERR	I / O	0	1	2	3
Operationnal mode **OK**	⊗	●	●				
Module out of service	●						
Channel not configured	S ●	●	●				
Internal fault	●	⊗	●				
Not calibrated	●	⊗	⊗	●			
Communication fault with CPU	⊗	S ●	●	●			
Module not configured	●	S ●	●	●			
Fault over range	⊗	●	⊗	S ●	S ●	S ●	S ●
Sensor fault	⊗	●	⊗	F ●	F ●	F ●	F ●

BMX AMO 0210 only =>

BMX ART 0414 only =>

On ⊗ **Quick Flashing** ● **Slow Flashing** ● **Off** ●

BMX AMI 0410
BMX ART 0414
BMX AMO 0210

Specific function

Sensor Alignment

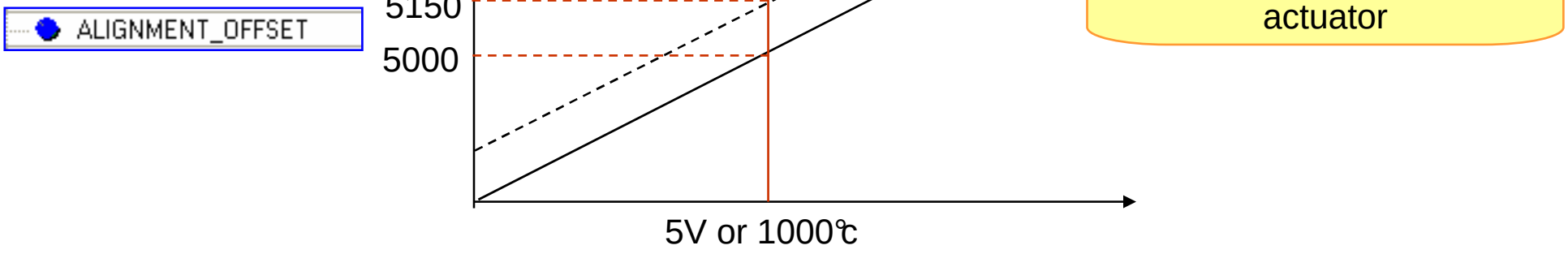
Is the process of elimating a systematic offset observed with a given sensor, around a specific operating point, this value can be stored in the (IODDT) variable.

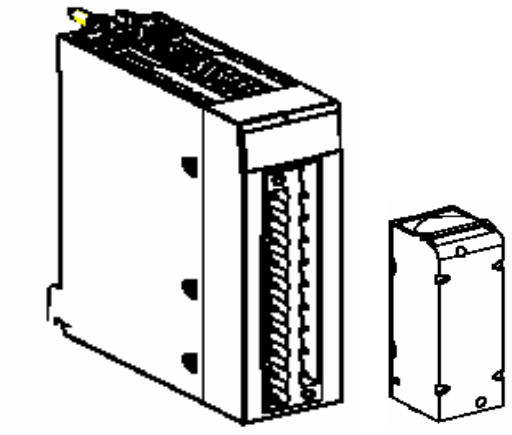
XXX.ALIGNMENT_OFFSET

This operation compensates for an error linked to the process.

- Replacing a module does not therefore require a new alignment.
- However, replacing the sensor or changing the sensor's operating point does require a new alignment.

Conversion lines are as follows:





B – BMX AMI 0410

BMX AMI 0410: Hardware

BMX AMI 0410

General Characteristics

Module type	BMX AMI 0410	4 Analog isolated input high level
Input		**Voltage and current input (Internal resistor protected until +/- 30Vdc)**
Channel number		**4**
periodic acquisition for the declared channels used		**1 ms + 1 ms for each channel used**
Resolution		**16 bits**
Numeric filter		**1st Order**
Isolation	**Between channel**	**+/- 300 Vdc**
	Between channel and bus	**2000 Vdc**
	Between channel anf ground	**2000 Vdc**
Max tension		**+ / - 30 Vdc**
Max Current		**+ / - 30 mA**

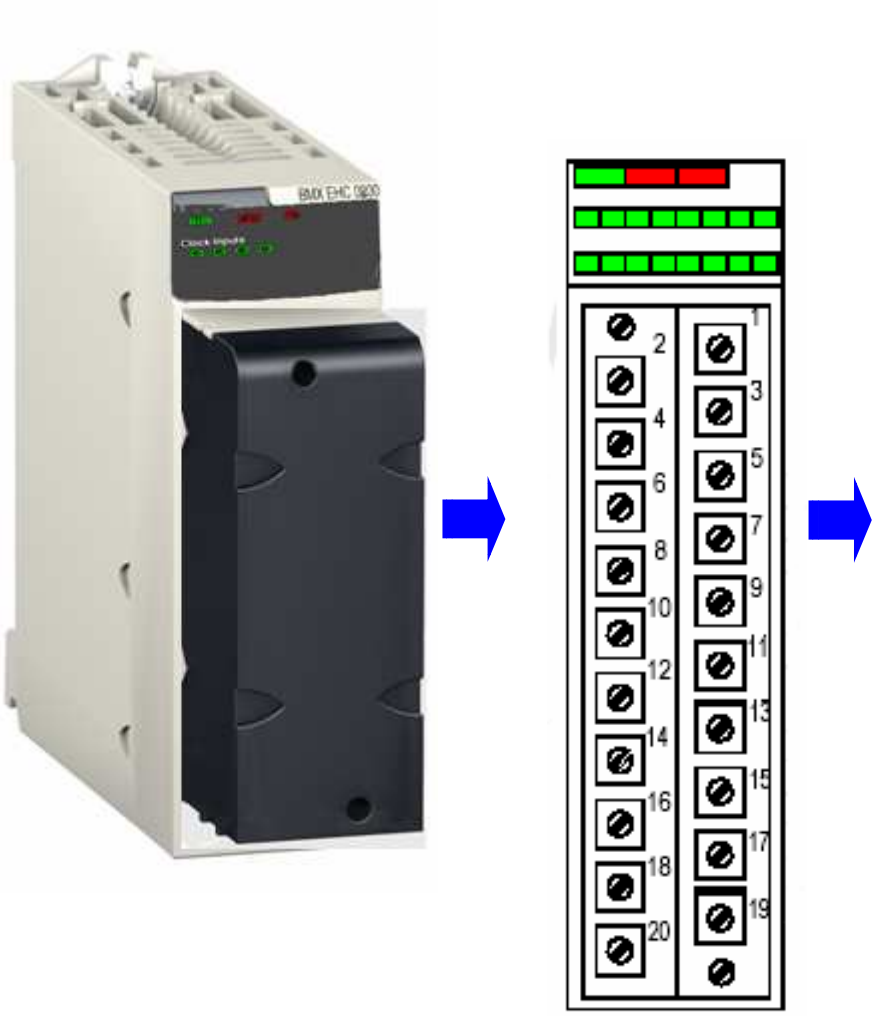
BMX AMI 0410

measure Characteristics

Measurement range	+/-10 V, 0..10 V, 0..5 V / 1..5 V, +/- 5 V	0..20 mA, 4..20 mA, +/- 20 mA
Max value	**+ / - 11,4V**	**+ / - 30 mA**
Resolution (16 bits)	**0,35 mV**	**0,92 µA**
Internal resistor	**-**	**250 Ohms**
Resistor occurancy	**-**	**0.1% - (25 ppm/℃)**
Measurement error: 1. at 25℃ 2. Maximum in the range (0..60℃)	 **0,05 % de Full Scale** **0,1 % de Full Scale**	 **0,15 % de Full Scale** **0,3 % de Full Scale**
Drift in temperature	**15 ppm / ℃**	**30 ppm / ℃**

BMX AMI 0410

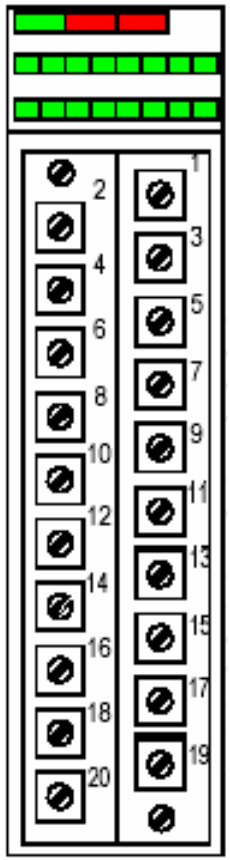
Wiring



COM 0	2	1	IN_Voltage Channel 0
NC	4	3	IN_Current channel 0
NC	6	5	NC
COM 1	8	7	IN_Voltage Channel 1
NC	10	9	IN_Current channel 1
COM 2	12	11	IN_Voltage Channel 2
NC	14	13	IN_Current Channel 2
NC	16	15	NC
COM 3	18	17	IN_Voltage Channel 1
NC	20	19	IN_Current Channel 1

BMX AMI 0410

Wiring



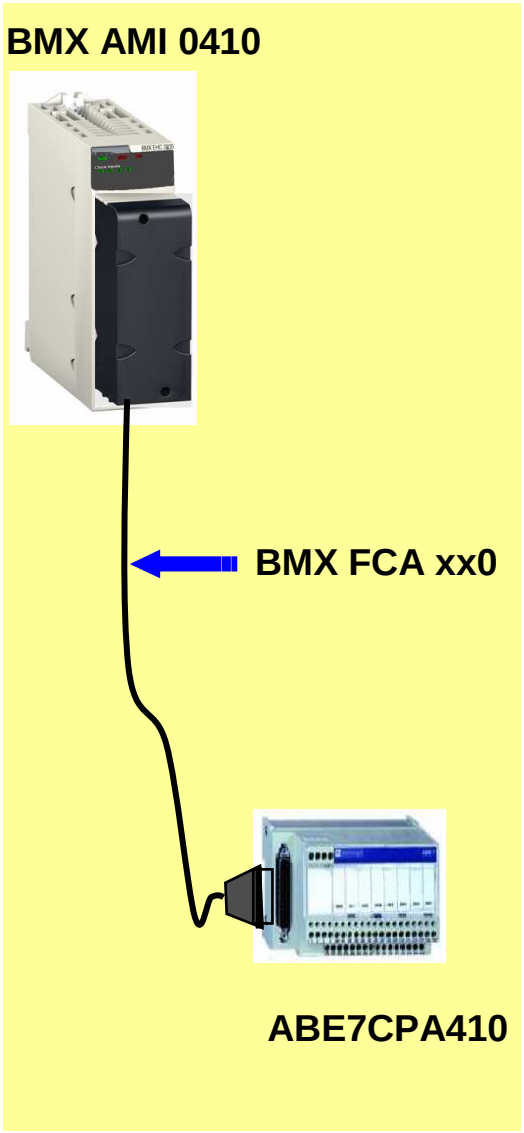
The TERMINAL block is provided with accessories for Keying.

Example

COM 0	2	1	IN_V Ch 0
NC	4	3	IN_I ch 0
NC	6	5	NC
COM 1	8	7	IN_V Ch 1
NC	10	9	IN_I Ch 1
COM 2	12	11	IN_V Ch 2
NC	14	13	IN_I Ch 2
NC	16	15	NC
COM 3	18	17	IN_V Ch 1
NC	20	19	IN_I Ch 1

BMX AMI 0410

Wiring



- At a Glance :

The TELEFAST ABE-7CPA410 accessory is a base unit used for the connection of sensors. It has the following functions :

- Supply, channel by channel, the 4 to 20 mA sensors with a protected 24 V voltage, limited in current to 25 mA, while maintaining isolation between the channels.
- Protect current reading resistors that are integrated in TELEFAST against overvoltage.

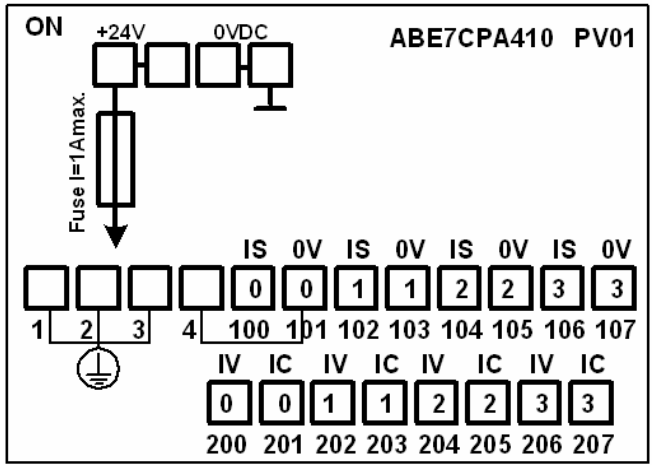
BMX AMI 0410

Wiring

BMX AMI 0410

BMX FCA xx0

ABE7CPA410

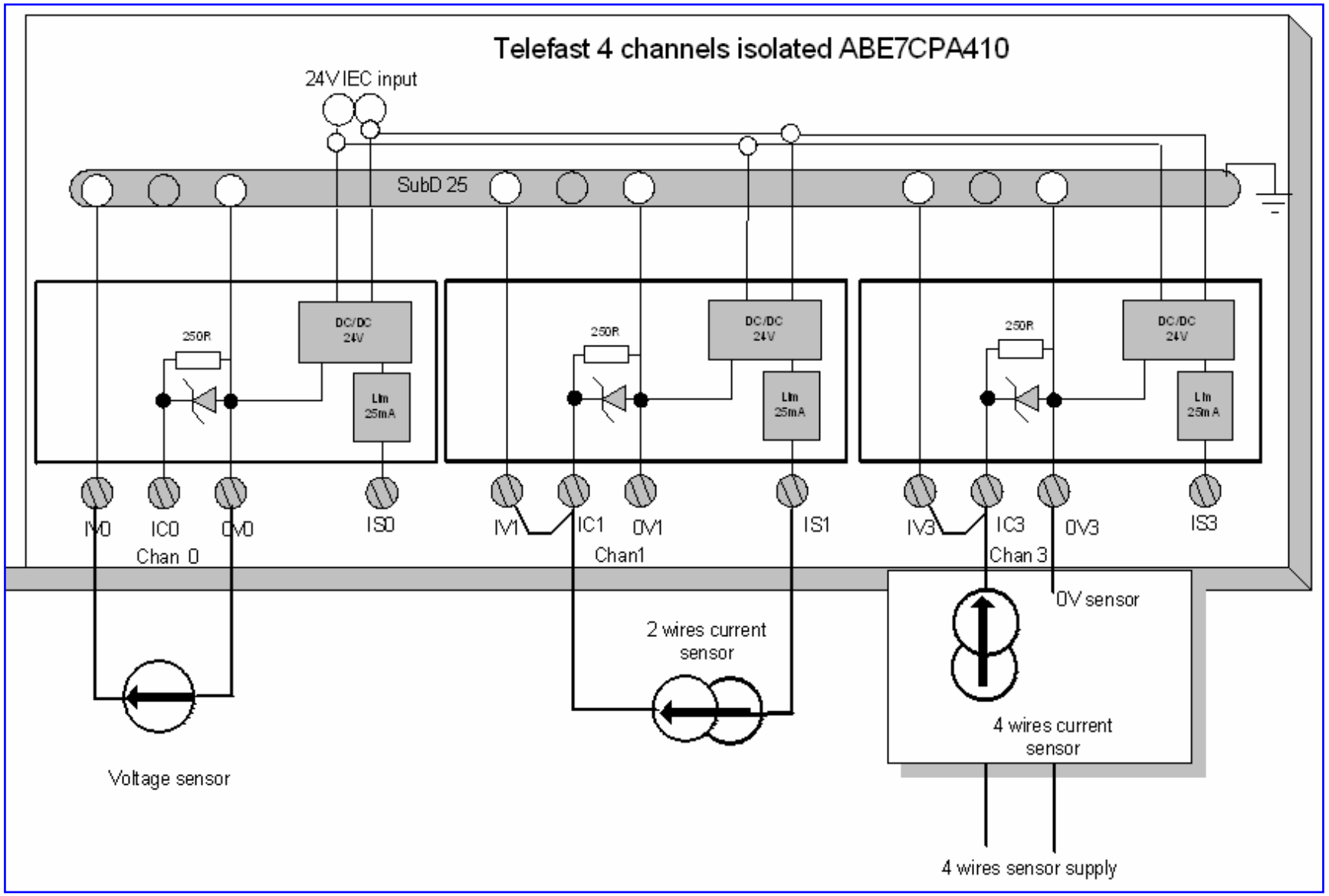


N° bornes TELEFAST	N° broches Connecteur SubD 25 pts	Nature des signaux
1	/	Terre
2	/	Terre
3	/	Terre
4	/	Com 0
100		Sortie IS V0
102		Sortie IS V1
104		Sortie IS V2
106		Sortie IS V3
200	1 (SUBD0)	Entrée U V0
202	15 (SUBD0)	Entrée U V1
204	4 (SUBD0)	Entrée U V2
206	18 (SUBD0)	Entrée U V3

N° borne TELEFAST	N° broche Connecteur SubD 25 pts	Nature des signaux
	/	Entrée alim iso 24VDC
	/	Entrée alim iso 24VDC
	/	Entrée alim 0V24
	/	Entrée alim 0V24
101	14 (SUBD0)	COM V0
103	3 (SUBD0)	COM V1
105	17 (SUBD0)	COM V2
107	6 (SUBD0)	COM V3
201		Entrée I V0
203		Entrée I V1
205		Entrée I V2
207		Entrée I V3

BMX AMI 0410

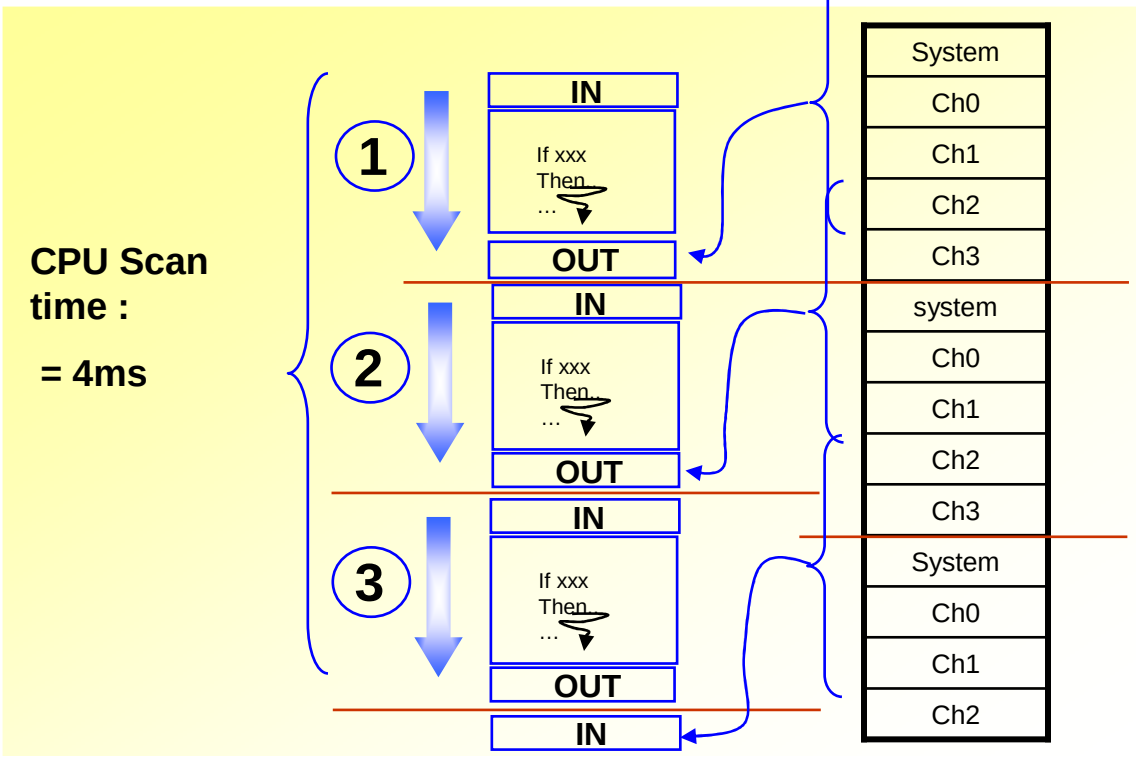
Wiring



Measurement Timing

- The cycle time values are based on the channel used according with the configuration done (by default all the channel are used)
  - Module cycle is not synchronized with the PLC cycle. at the beginning of each PLC cycle, each channel value is taken into account.

If the MAST/FAST task cycle time is less than the module's, some values will not have changed.



- Example :

In our application the scan time of the CPU is 4 ms and we use 4 Channels on the BMX AMI 0410.

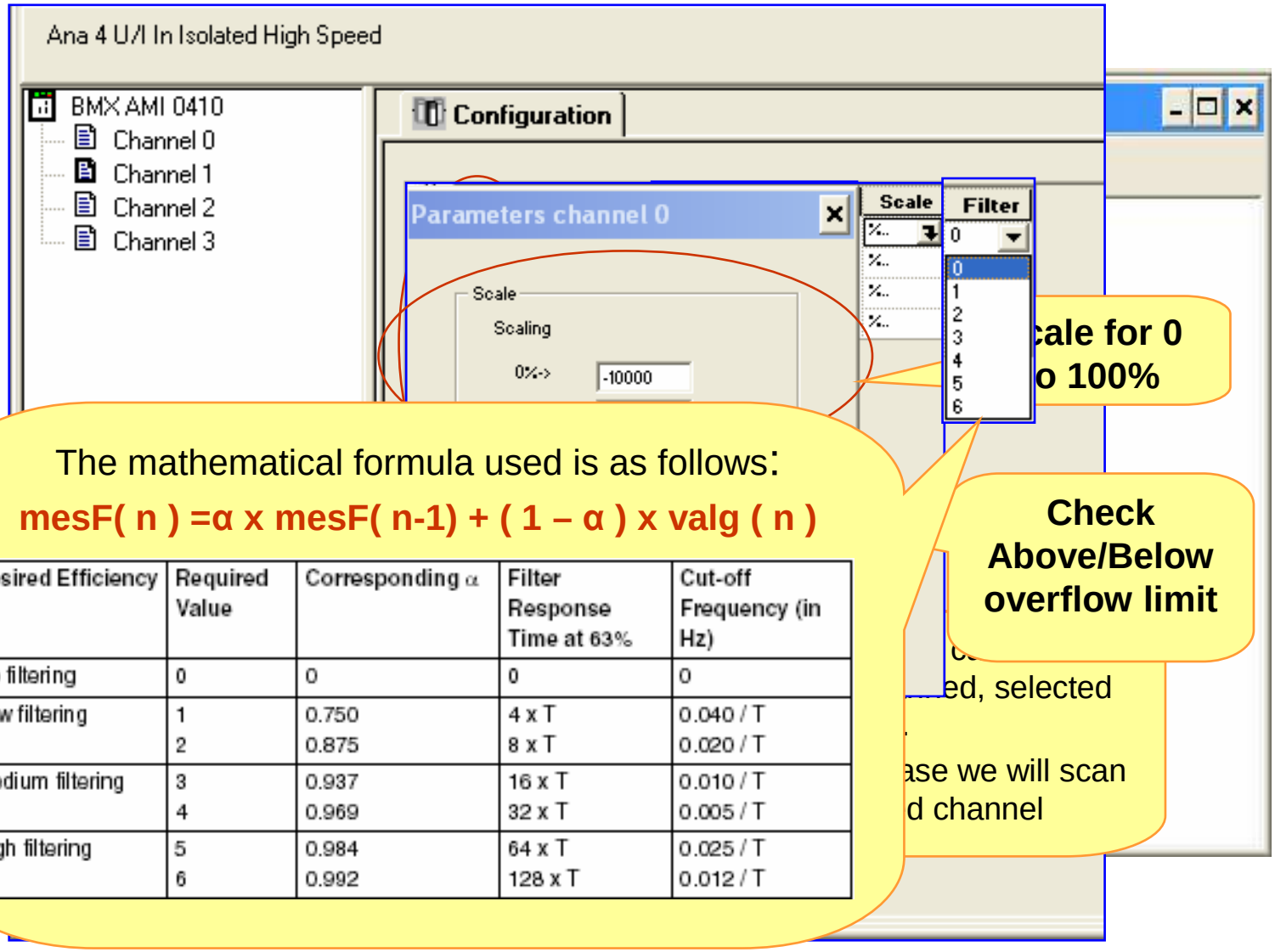
1. In the first scan time we obtain the value read in one scan time of the module.
2. Like the cycles are not synchronized, not all channel information will be read in the scan

- PLC scan time should be long enough to read all the channels used.

BMX AMI 0410: Software

BMX AMI 0410

Configuration



The mathematical formula used is as follows:

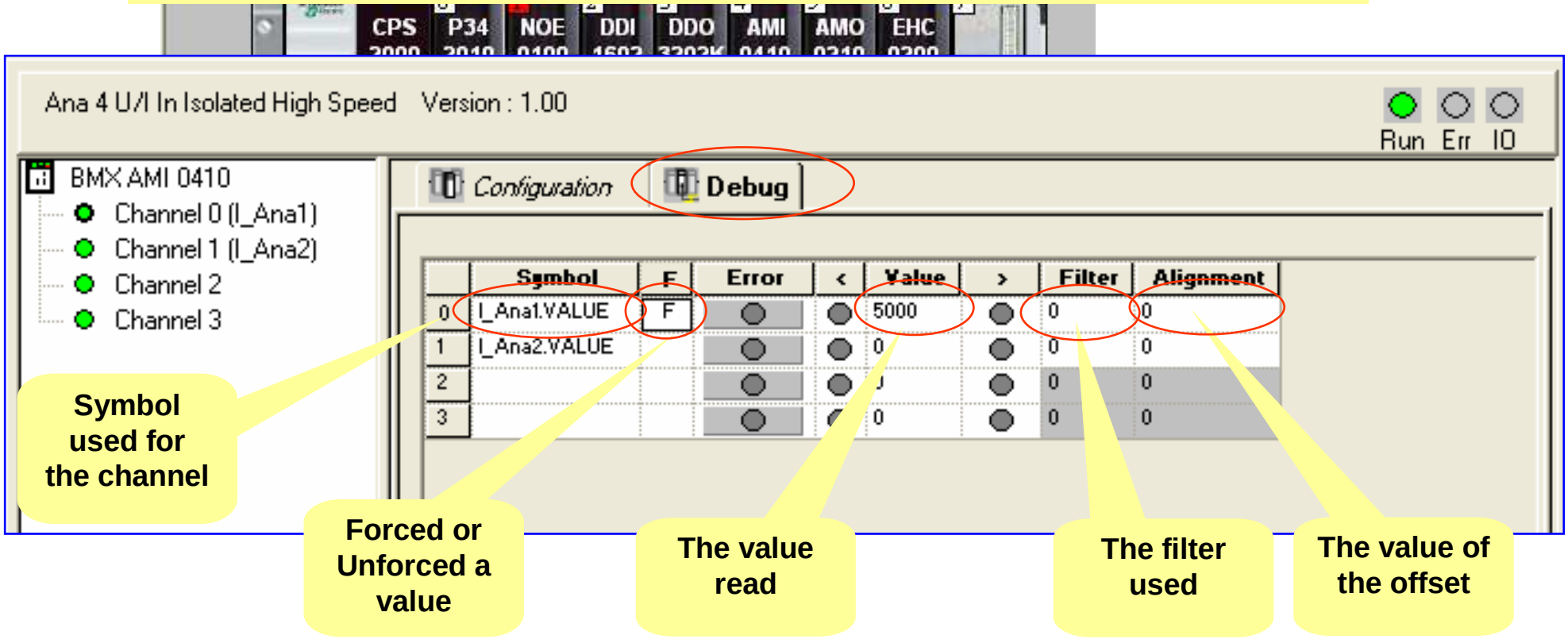
mesF(n) =α x mesF(n-1) + (1 – α) x valg (n)

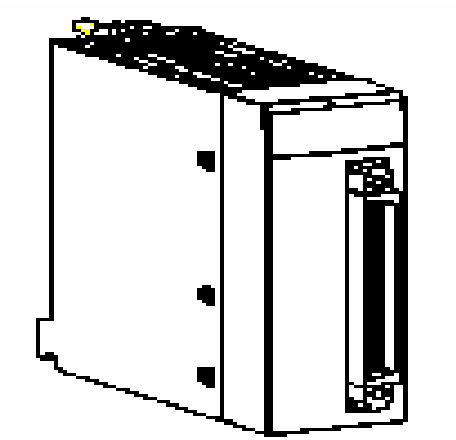
Desired Efficiency	Required Value	Corresponding α	Filter Response Time at 63%	Cut-off Frequency (in Hz)
No filtering	0	0	0	0
Low filtering	1 2	0.750 0.875	4 x T 8 x T	0.040 / T 0.020 / T
Medium filtering	3 4	0.937 0.969	16 x T 32 x T	0.010 / T 0.005 / T
High filtering	5 6	0.984 0.992	64 x T 128 x T	0.025 / T 0.012 / T

BMX AMI 0410

Debug screen

- **The debug screen displays the following parameters :**





C – BMX ART 0414

BMX ART 0414: Hardware

BMX ART 0414

General Characteristics

Module type BMX ART 0414		4 Analog isolated input
Input		**RTD, thermocouple, voltage and resistor**
Channel number		**4**
periodic acquisition		**400 ms if one channel use RTD** **200 ms if we use only the Thermocouple**
Resolution		**15 bits + sign**
Numeric filter		**1st order**
Cold junction compensation without TELEFAST		■**Channel 0 configured in RTD** ■**Channel 0 configured in Termocouple and a RTD (2 wires) connected also on the channel 0.**
Cold junction compensation with a TELEFAST (**ABE 7CPA 412)**		■**Specific input dedicated for the cold junction compensation if we use the telefast ABE 7CPA 412 (with the sensor integrated)**
Isolation	**Between channel**	**750 Vdc**
	Between channel and bus	**1500 Vdc**
	Between channel anf ground	**750 Vdc**

BMX ART 0414

measure Characteristics : Voltage

Measurement range	+/- 40mV, +/- 80mV, +/- 160mV, +/- 320mV, +/- 640mV, +/- 1280mV,	400 Ohms (2 or 3 wires) 3850 Ohms (2 or 3 wires)
Max value	+ / - 102 %	+ / - 100 %
Resolution	V range / 2 exp 14	V range / 2 exp 14
Internal resistor	10 M ohms	
Resistor occurancy	-	
Measurement error: 1. at 25℃ 2. Maximum in the range (0..60℃)	 0,05 % de Full Scale 0,15 % de Full Scale	 0,12 % de Full Scale 0,2 % de Full Scale
Drift in temperature	30 ppm / ℃	25 ppm / ℃

BMX ART 0414

measure Characteristics : RTD

Measurement range	Pt100	Pt1000	Cu10	Ni100	Ni1000
	CEI : -200 + 850℃ US/JIS : -100 +450℃		-100 + 260℃	-60 + 180℃	
Resolution	0.1 ℃				
Detection type	Open circuit / Out range value				
Measurement error: 1. at 25℃ 2. Maximum in the range (0..60℃)	 +/- 1 ℃ +/- 2 ℃	 +/- 1 ℃ +/- 2 ℃	 +/- 4 ℃ +/- 4 ℃	 +/- 1 ℃ +/- 1 ℃	 +/- 1 ℃ +/- 1 ℃

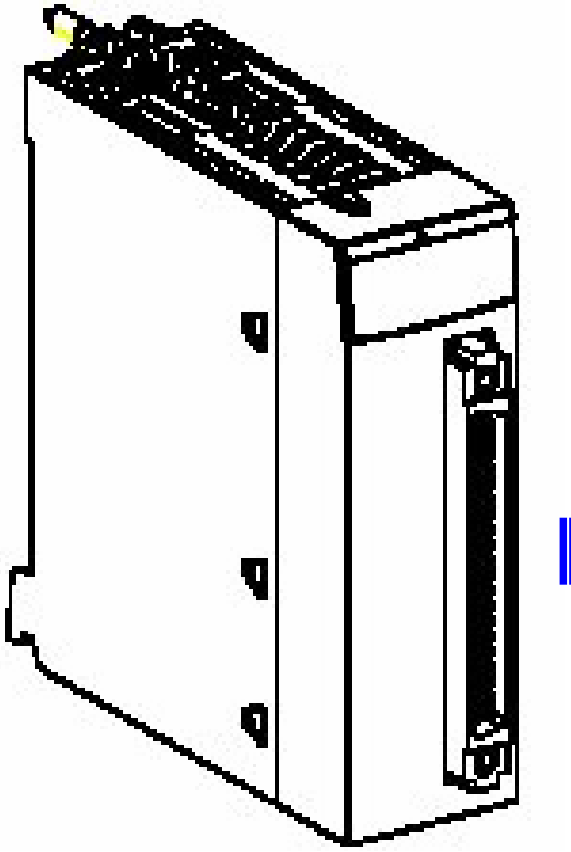
BMX ART 0414

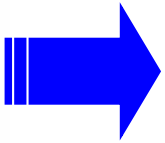
Measure Characteristics : Thermocouple

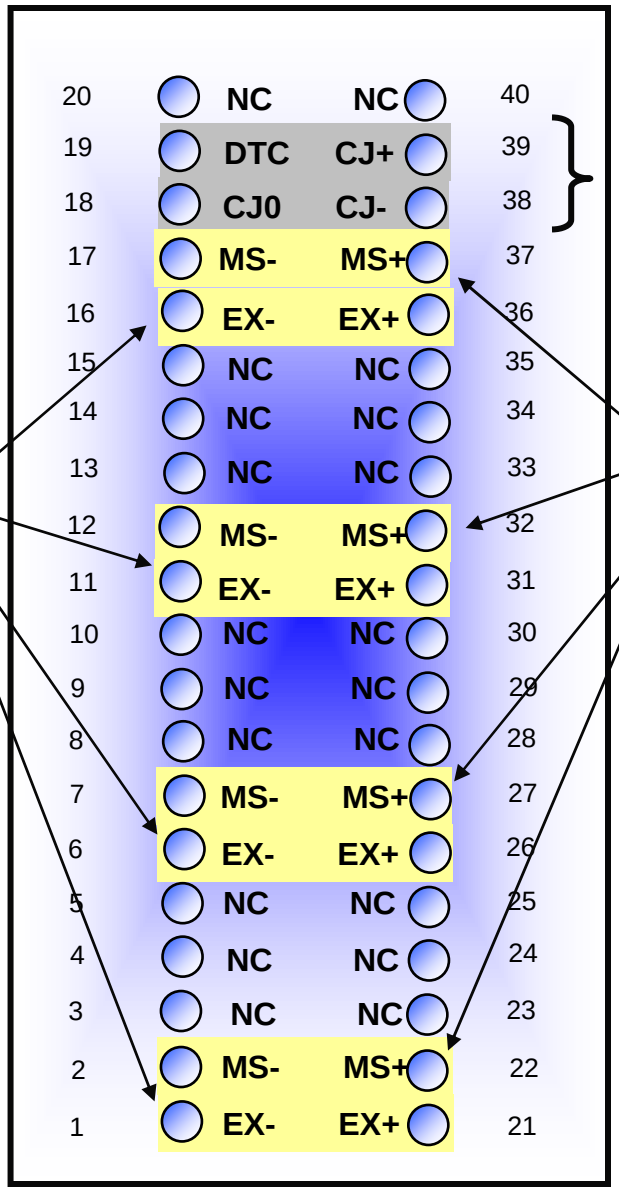
Measurement range	B	E	J	K	L
	-130 +1820℃	-270 +1000℃	-200 +760℃	-270 + 1370℃	-200 + 900℃
Measurement range	**N**	**R**	**S**	**T**	**U**
	-270 +1300℃	-50 +1665℃	-50 + 1665℃	-270 + 400℃	-200 + 600℃
Resolution	0.1 ℃				
Detection type	Open circuit				
Measurement error: 1. at 25℃ 2. Maximum in the range (0..60℃)	+/-3 ℃ (J,K,E,T,U) +/-5℃ (S,R,B,N,L) +/-5 ℃ (J,K,E,T,U) +/-8℃ (S,R,B,N,L) This error is given with the TELEFAST Cold junction compensation **Eg** : If we use the PT100 input on the channel 0 the error will be divise by 2				

BMX ART 0414

Wiring







Cold junction connection when using TELEFAST

EX- EX+

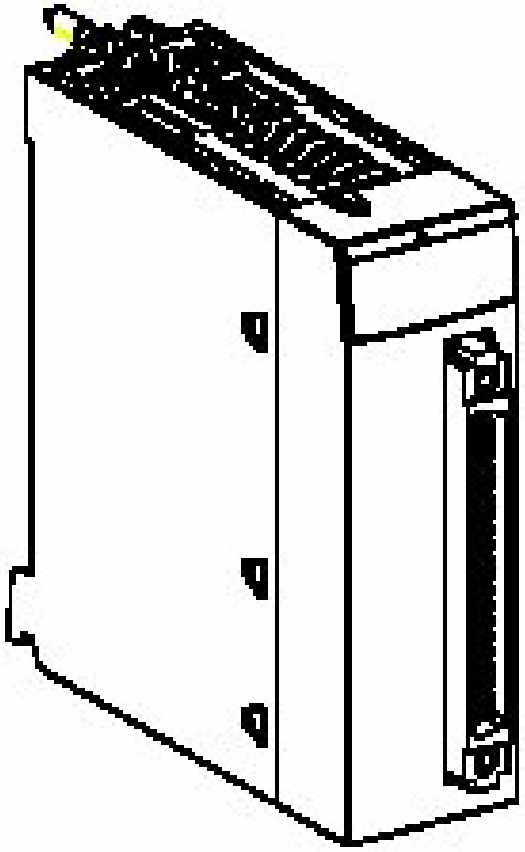
current generator

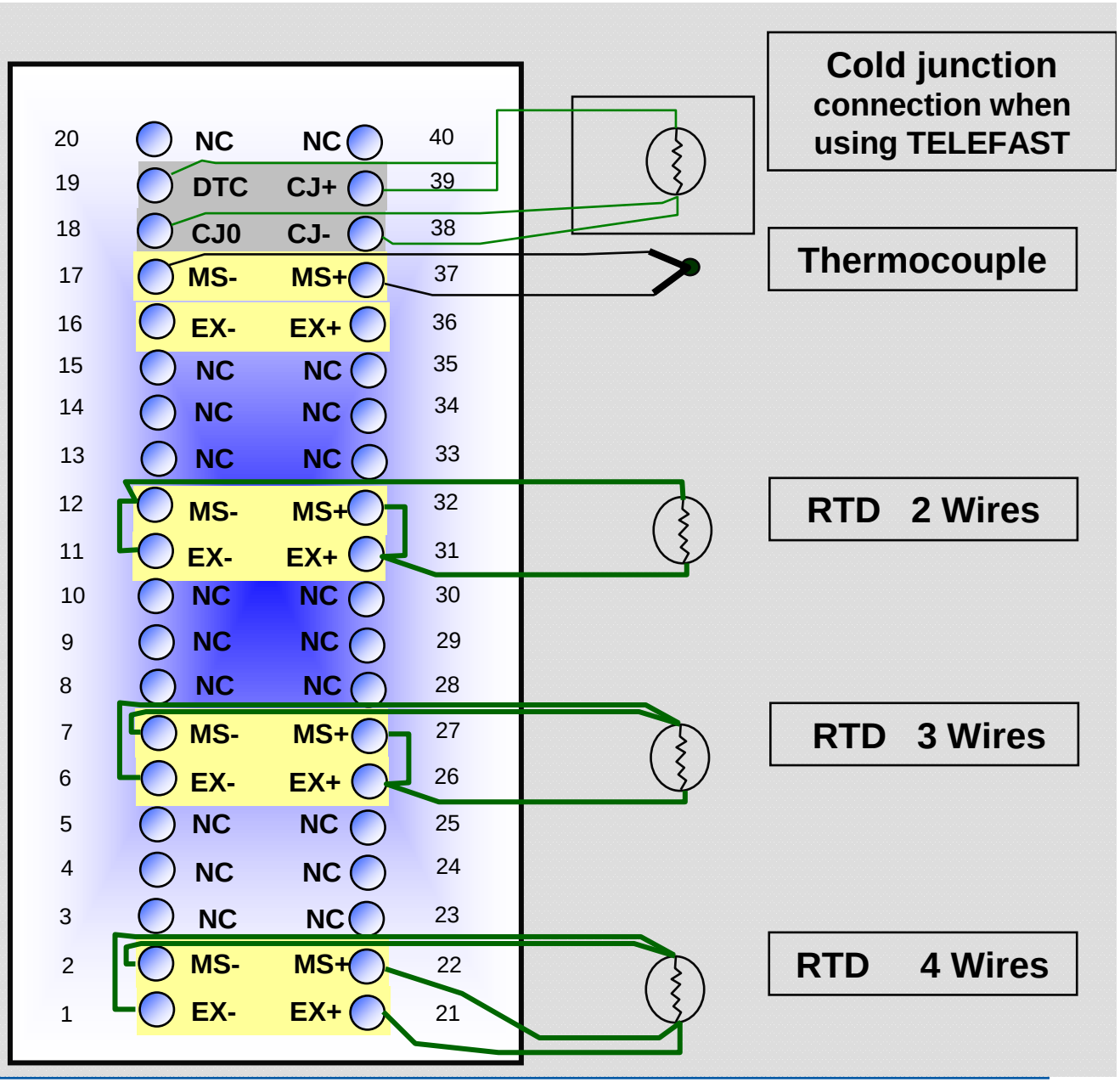
MS- MS+

thermocouple input

BMX ART 0414

Wiring

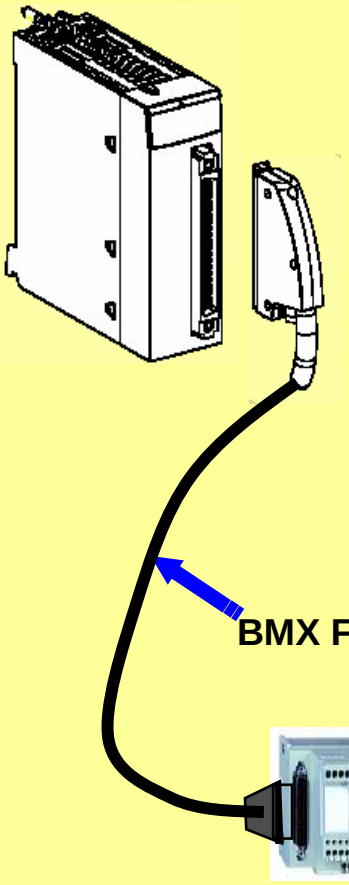


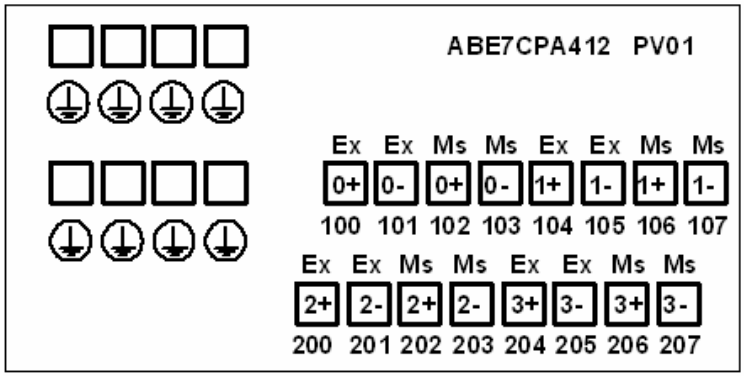


BMX ART 0414

Wiring

BMX ART 0414





Cold junction connection is provided by a specific device in SUBD0

(pin 21, 22, 23, 24)

N° bornes TELEFAST	N° broches Connecteur SubD 25 pts	Nature des signaux
1	/	Terre
2	/	Terre
3	/	Terre
4	/	Terre
100	2 (SUBD0)	Entrée Exit+ V0
102	4 (SUBD0)	Entrée Mes+ V0
104	6 (SUBD0)	Entrée Exit+ V1
106	8 (SUBD0)	Entrée Mes+ V1
200	10 (SUBD0)	Entrée Exit+ V2
202	14 (SUBD0)	Entrée Mes+ V2
204	16 (SUBD0)	Entrée Exit+ V3
206	18 (SUBD0)	Entrée Mes+ V3
N° borne TELEFAST	**N° broche Connecteur SubD 25 pts**	**Nature des signaux**
11	/	Terre
12	/	Terre
13	/	Terre
14	/	Terre
101	3 (SUBD0)	Entrée Exit- V0
103	5 (SUBD0)	Entrée Mes- V0
105	7 (SUBD0)	Entrée Exit- V1
107	9 (SUBD0)	Entrée Mes- V1
201	11 (SUBD0)	Entrée Exit- V2
203	15 (SUBD0)	Entrée Mes- V2
205	17 (SUBD0)	Entrée Exit- V3
207	19 (SUBD0)	Entrée Mes- V3

COLD JUNCTION

Compensation:

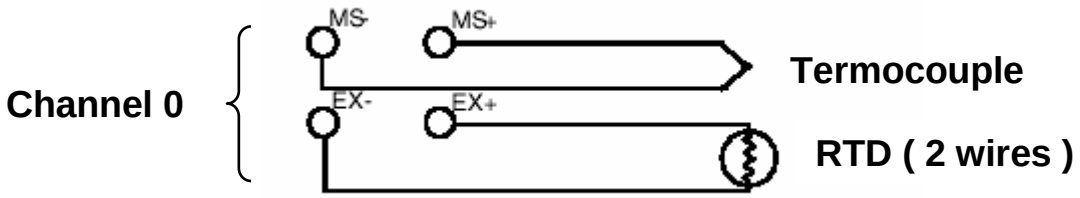
The module give three methods of Cold junction compensation.

1. The external compensation of the module is performed in the TELEFAST ABE-7CPA412 accessory.

2. It is possible to increase the precision of the compensation by using a 3-wire Pt100 probe directly connected to channel 0 on the module or connected to the TELEFAST terminal blocks. Channel 0 is thus dedicated to the cold junction compensation of channels 1, 2 and 3.

3. It is equally possible, to maintain channel 0 as a thermocouple input by using a 2-wire Pt100 probe.

   The wiring would then look like this:



Why we need a cold junction compensation with the thermocouple ?

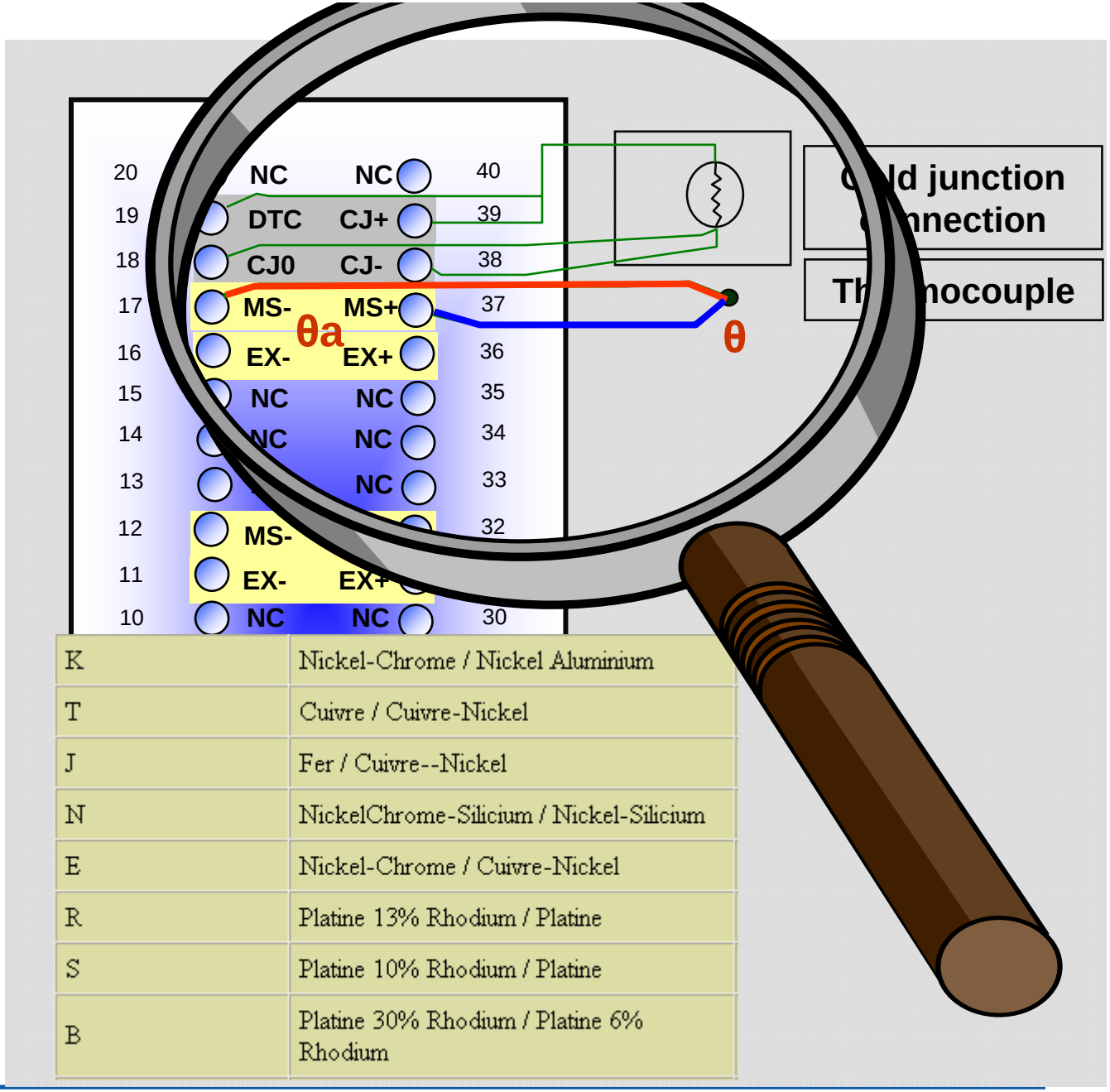
A thermocouple is made with the association with two metallic conductor

This association provide a FEM according with the temperature.

This temperature **e(θ,0)** is known if the cold junction **θa** egal 0℃. But in our case the cold junction is never egal to 0℃ so we must measure and apply a correction called :

cold junction compensation This compensation is applied according with the formula :

e(θ,0) = e(θ, θa) + e(θa,0)



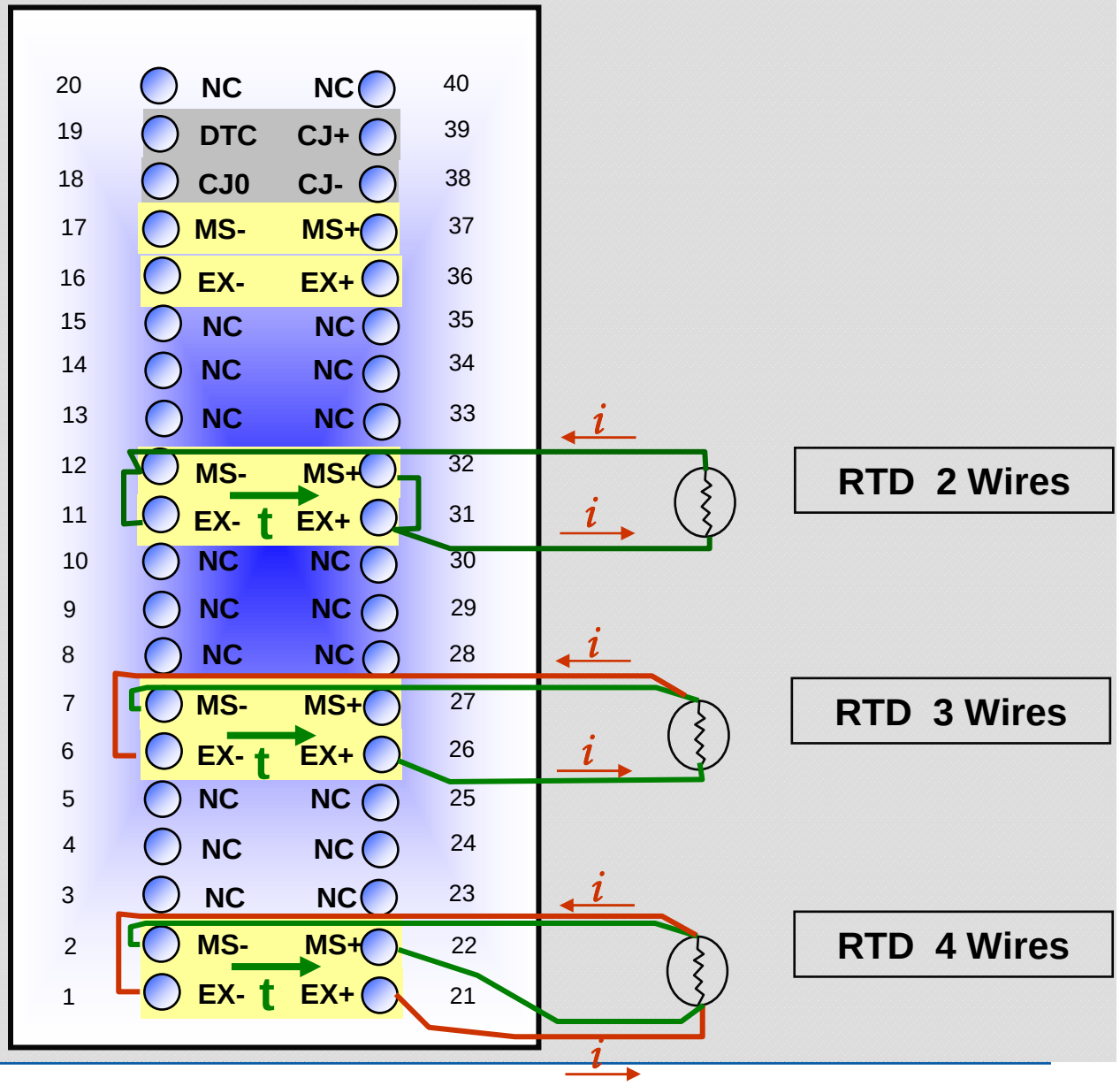
K	Nickel-Chrome / Nickel Aluminium
T	Cuivre / Cuivre-Nickel
J	Fer / Cuivre--Nickel
N	NickelChrome-Silicium / Nickel-Silicium
E	Nickel-Chrome / Cuivre-Nickel
R	Platine 13% Rhodium / Platine
S	Platine 10% Rhodium / Platine
B	Platine 30% Rhodium / Platine 6% Rhodium

What is the difference between :

- 2 wires / 3 wires / 4 wires RTD ?

4 wires : In this case the current generator and the measure are separate

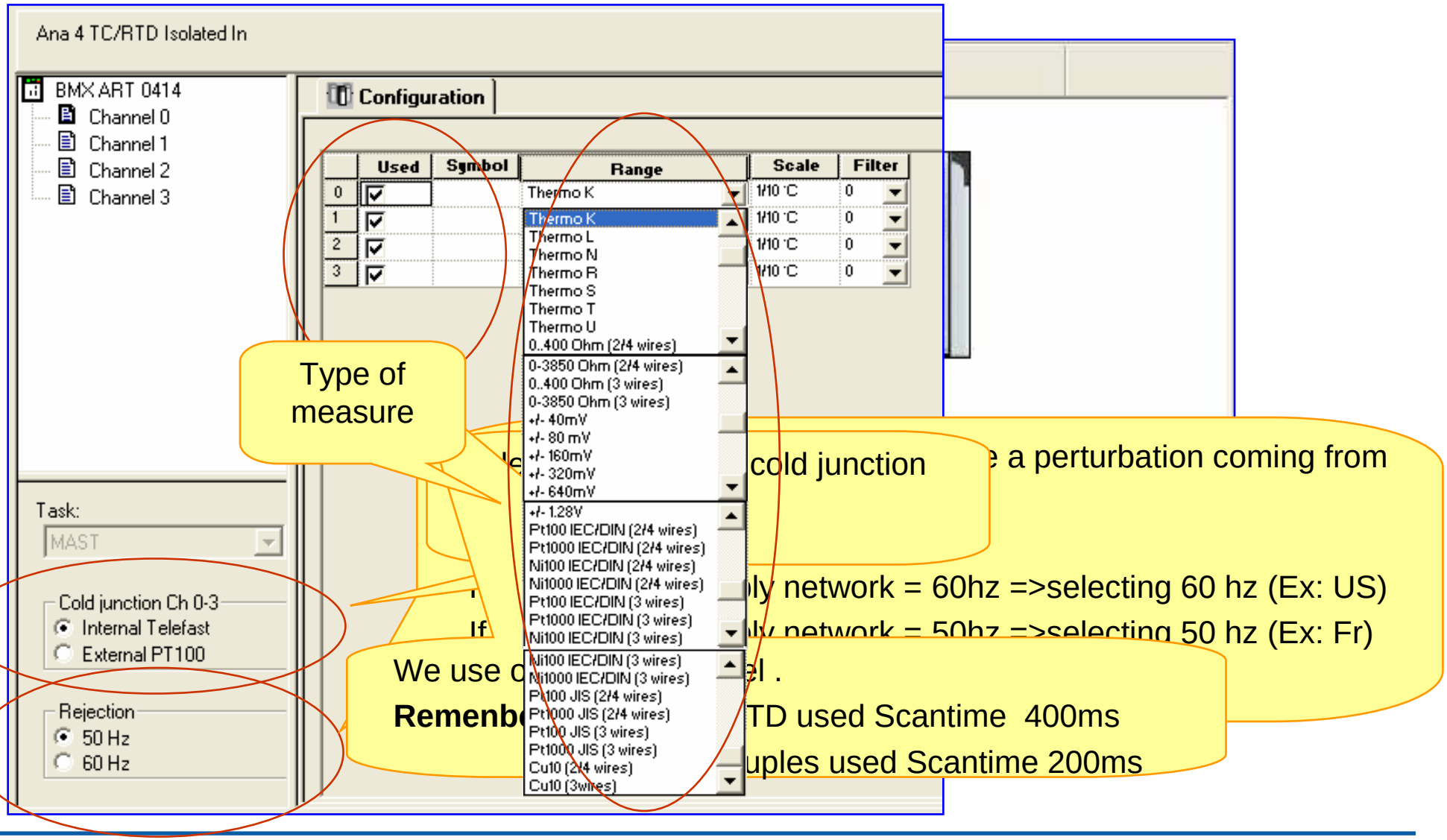
The measure is given without error.



BMX ART 0414: Software

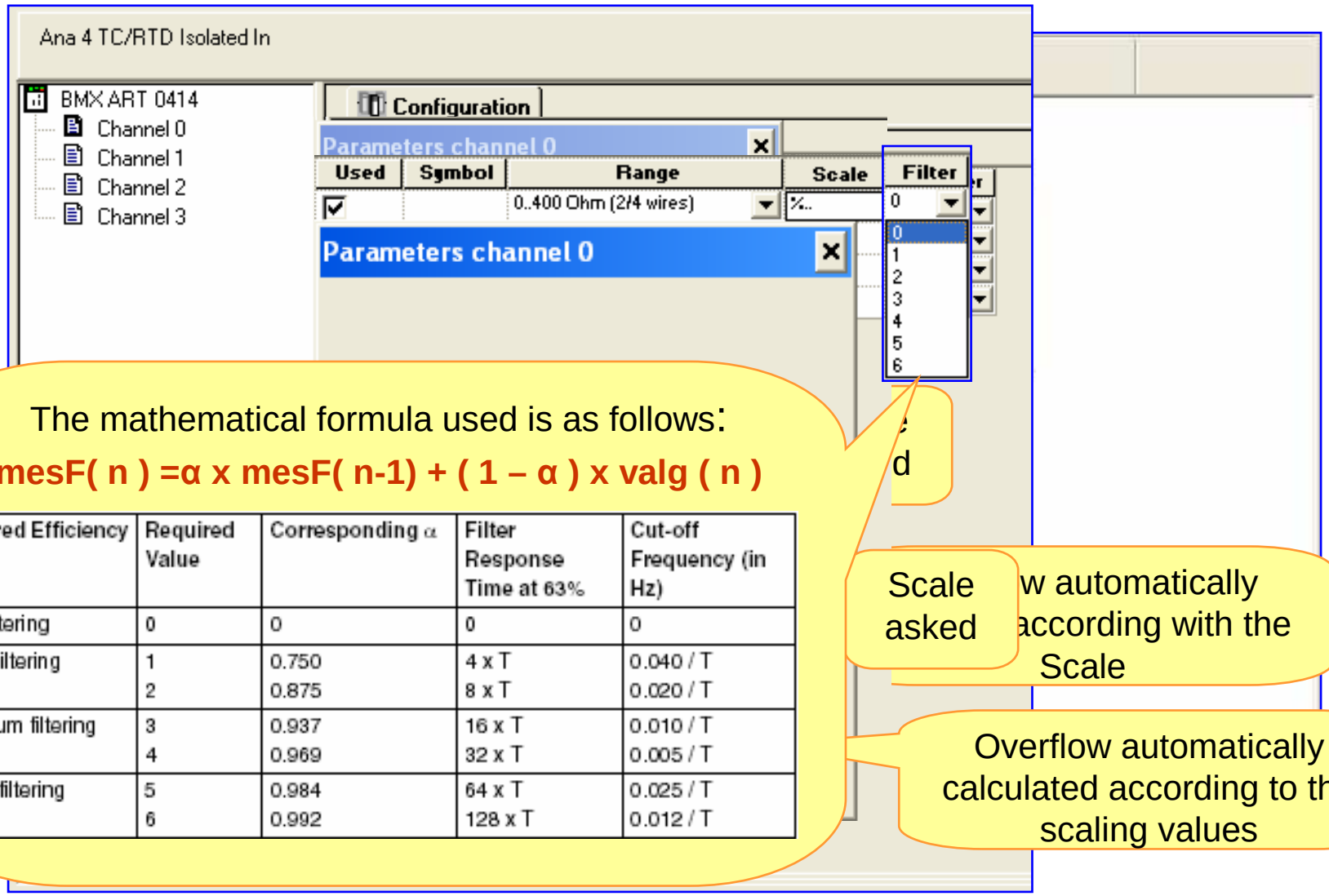
BMX ART 0414

Configuration



BMX ART 0414

Configuration

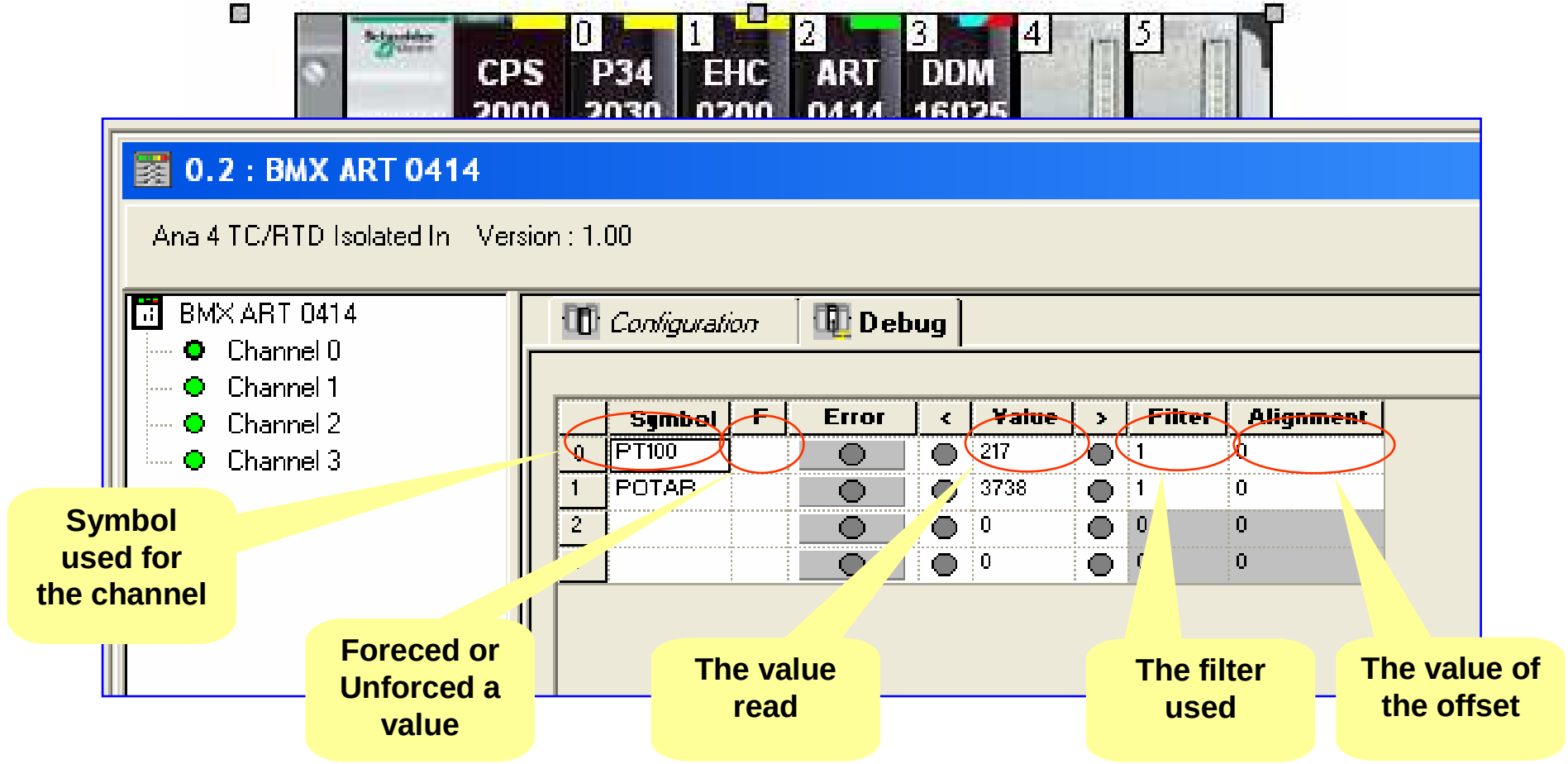


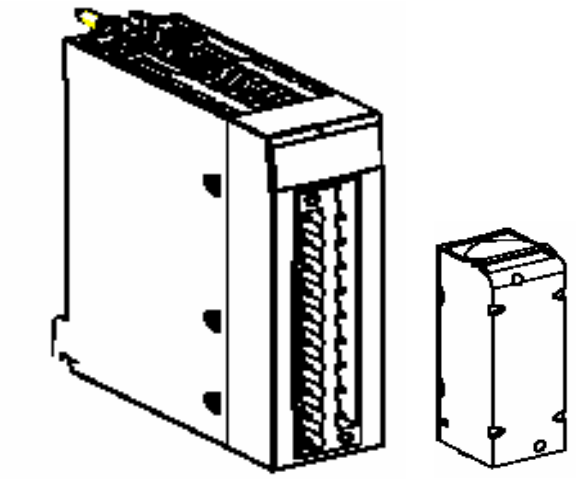
Desired Efficiency	Required Value	Corresponding α	Filter Response Time at 63%	Cut-off Frequency (in Hz)
No filtering	0	0	0	0
Low filtering	1 2	0.750 0.875	4 x T 8 x T	0.040 / T 0.020 / T
Medium filtering	3 4	0.937 0.969	16 x T 32 x T	0.010 / T 0.005 / T
High filtering	5 6	0.984 0.992	64 x T 128 x T	0.025 / T 0.012 / T

BMX ART 0414

Debug screen

- The debug screen displays the following parameters :





D – BMX AMO 0210

BMX AMO 0210: Hardware

BMX AMO 0210

General Characteristics

Module type	BMX AMI 0210	2 Analog isolated output high level
output		**Voltage and current output**
Channel number		**2**
Response time		**Less than 1ms**
Resolution		**15 bits + Signe**
Power supply for Output		**Internal power supply**
Protected		**Short circuit and overload**
Isolation	**Between channel**	**1400 Vdc**
	Between channel and bus	**2000 Vdc**
	Between channel anf ground	**2000 Vdc**
Measurement error: 1.at 25℃ 2.Maximum in the range (0..60℃)		**0,15% de Full Scale** **0,25 % de Full Scale**

BMX AMO 0210

Measure Characteristics

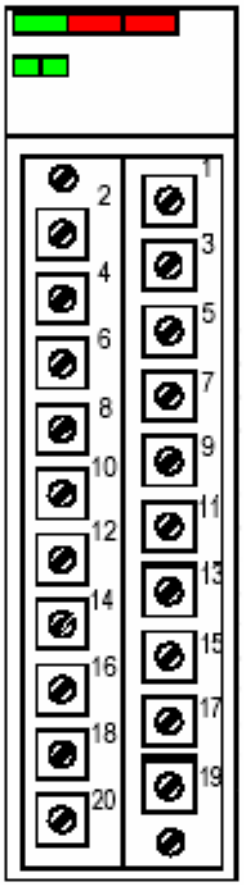
Measurement range	+/-10 V	0..20 mA, 4..20 mA,
Max value	+ / - 11,25V	- 0.4 mA / 24 Ma (+/-20%)
Resolution	0,68 mV	0,6 µA
Load impedance	1 KΩ mini	600 Ω max
Detection	Short circuit	Open circuit

Overflow control

	ERR hard	soft	Nominal range		soft	ERR hard
+/-10V	-11 250	-11 000	-10 000	10 000	11 000	11 250
0..20 mA	-2000	-1000	0	10 000	11 000	12 000
4 .. 20 mA	-1600	-800	0	10 000	10 800	11 600

BMX AMO 0210

Wiring



NC	2	1	NC
COM 0	4	3	OUT ch 0 U_I
NC	6	5	NC
NC	8	7	NC
NC	10	9	NC
NC	12	11	NC
NC	14	13	NC
NC	16	15	NC
COM 1	18	17	OUT ch 1 U_I
NC	20	19	NC

+ -

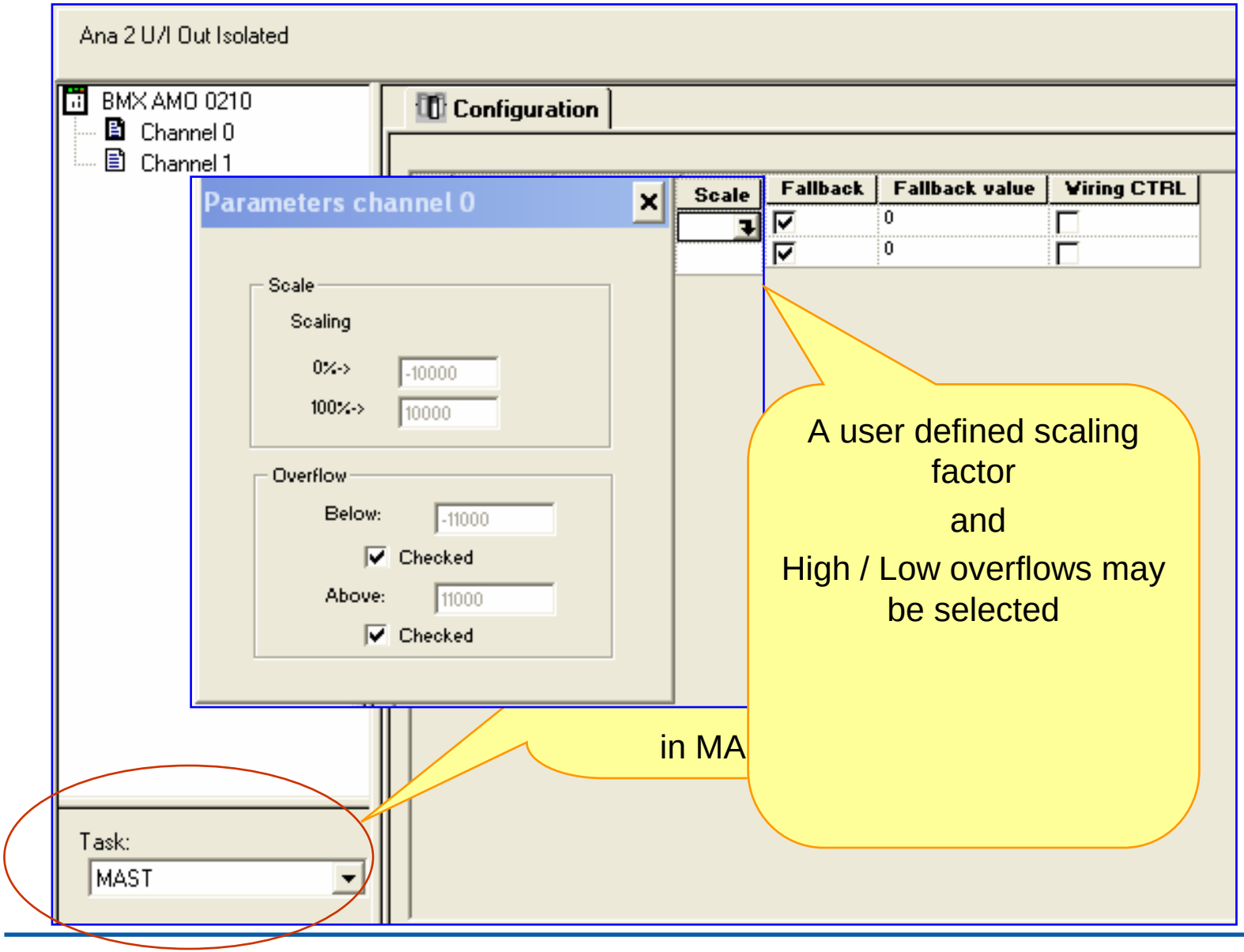
+ -

The TERMINAL block is provided with accessories for keying

BMX AMO 0210: Software

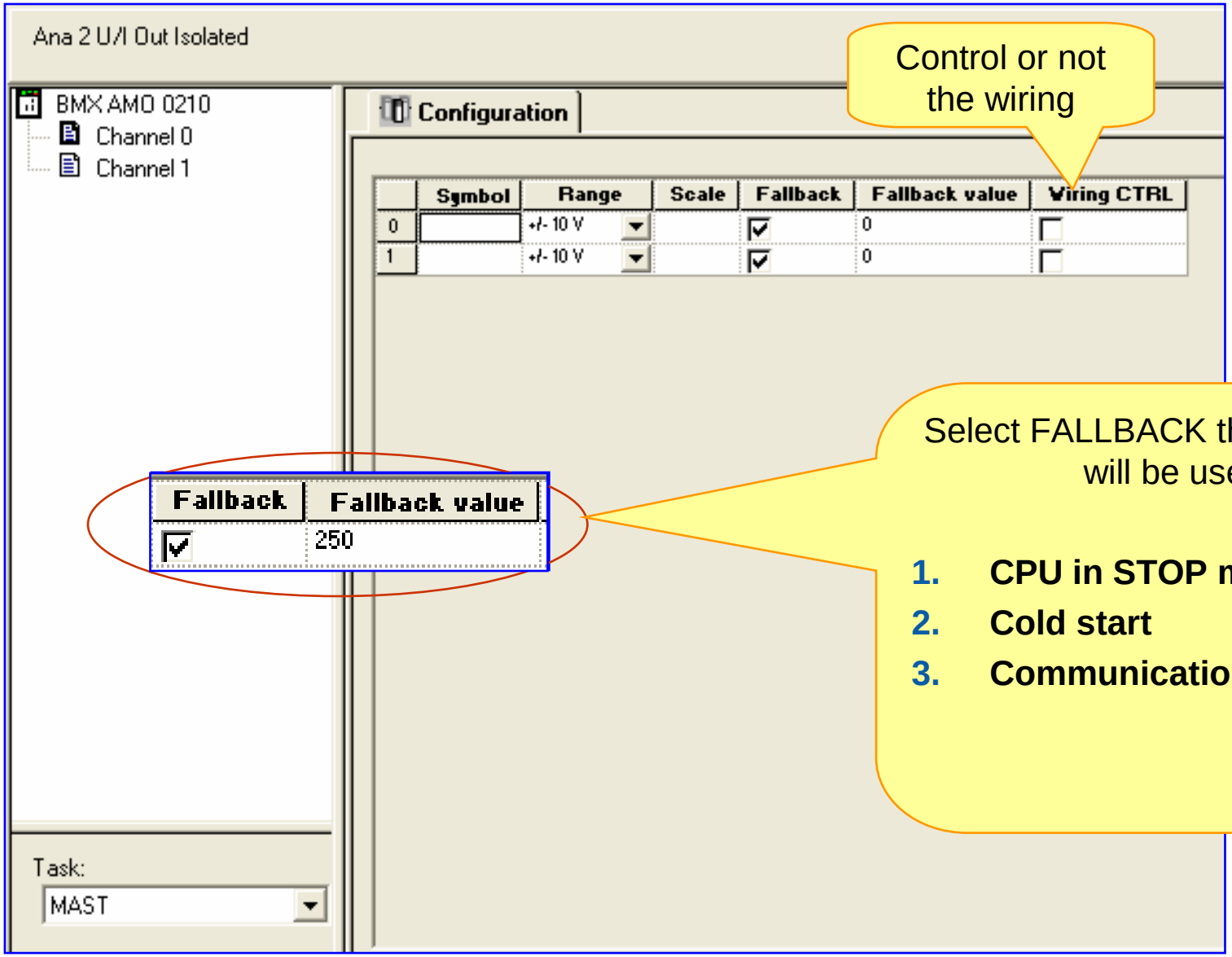
BMX AMO 0210

Configuration



BMX AMO 0210

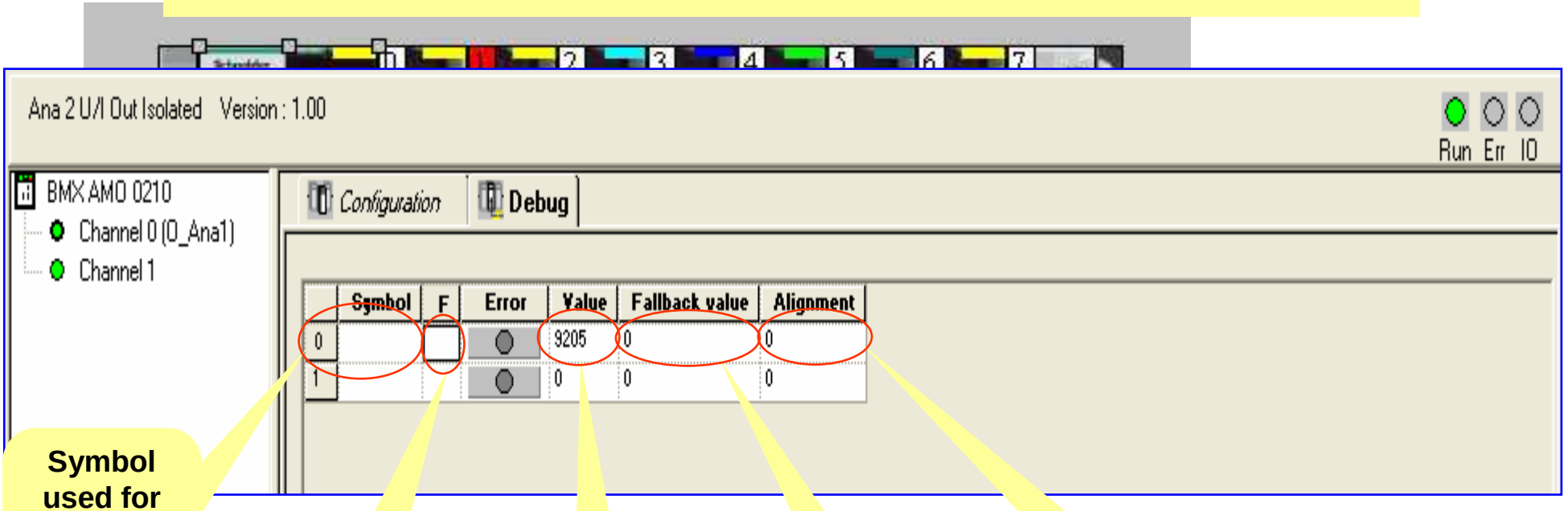
Configuration



BMX AMO 0210

Debug screen

- **The debug screen displays the following parameters :**



Symbol used for the channel

Forced or Unforced a value

The value Write

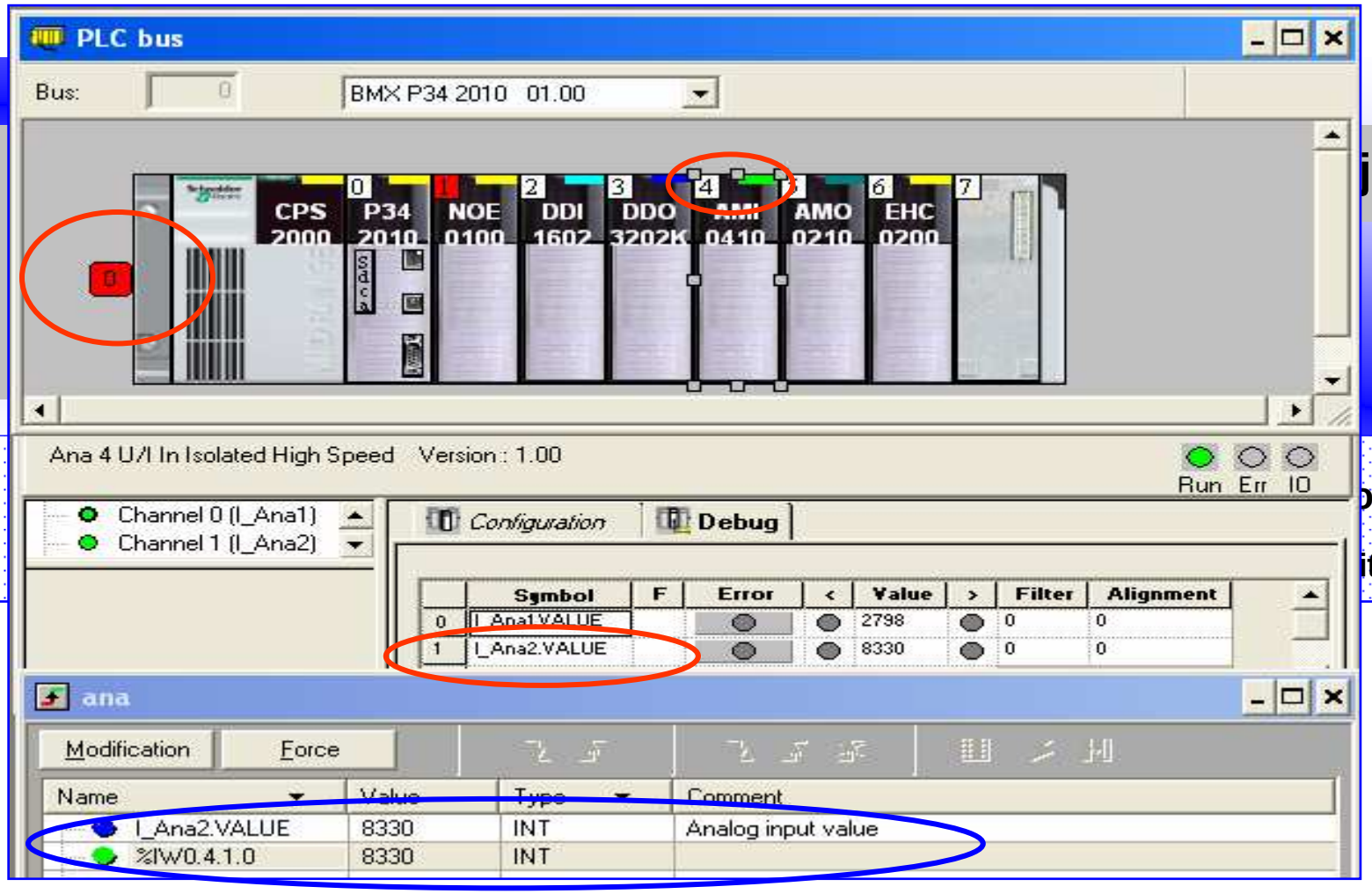
Fallback value used on fault

The value for the alignement

E – Language interface

BMX AMI 0410
BMX ART 0414
BMX AMO 0210

Addressing



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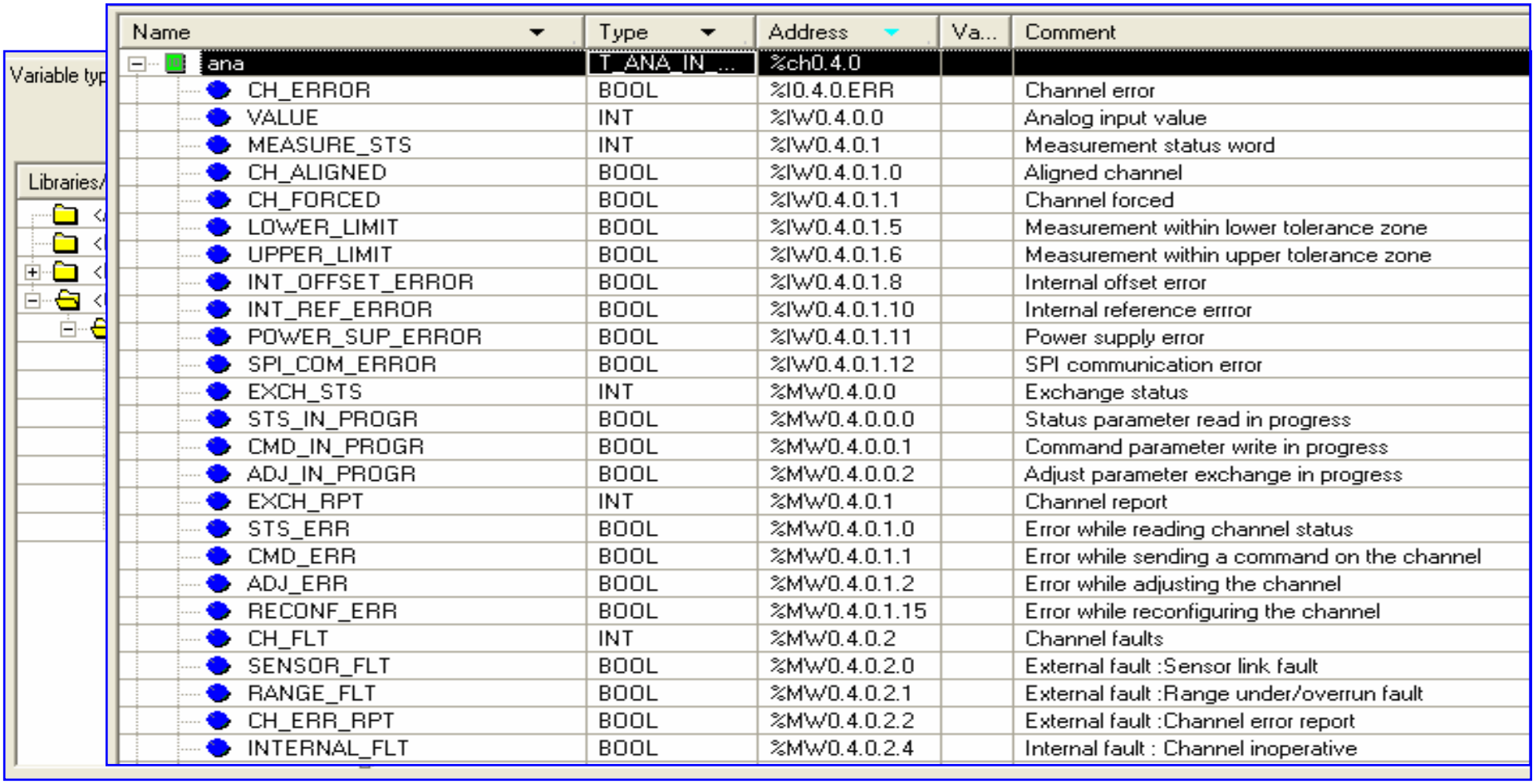
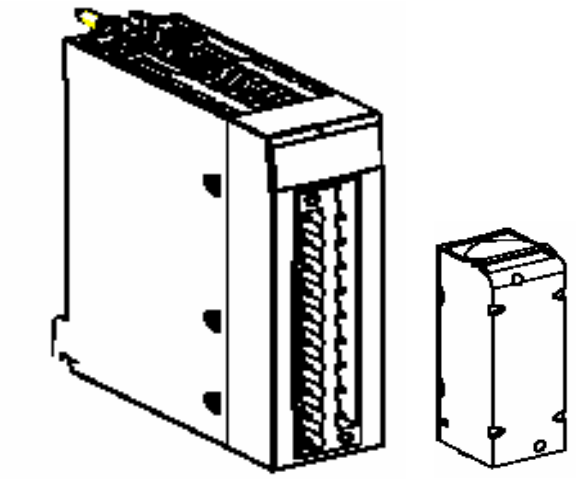
BMX AMO 0210

IODDT on the analog module



Name	Type	Address	Va...	Comment
ana	T_ANA_IN_...	%ch0.4.0		
CH_ERROR	BOOL	%I0.4.0.ERR		Channel error
VALUE	INT	%IW0.4.0.0		Analog input value
MEASURE_STS	INT	%IW0.4.0.1		Measurement status word
CH_ALIGNED	BOOL	%IW0.4.0.1.0		Aligned channel
CH_FORCED	BOOL	%IW0.4.0.1.1		Channel forced
LOWER_LIMIT	BOOL	%IW0.4.0.1.5		Measurement within lower tolerance zone
UPPER_LIMIT	BOOL	%IW0.4.0.1.6		Measurement within upper tolerance zone
INT_OFFSET_ERROR	BOOL	%IW0.4.0.1.8		Internal offset error
INT_REF_ERROR	BOOL	%IW0.4.0.1.10		Internal reference errror
POWER_SUP_ERROR	BOOL	%IW0.4.0.1.11		Power supply error
SPI_COM_ERROR	BOOL	%IW0.4.0.1.12		SPI communication error
EXCH_STS	INT	%MW0.4.0.0		Exchange status
STS_IN_PROGR	BOOL	%MW0.4.0.0.0		Status parameter read in progress
CMD_IN_PROGR	BOOL	%MW0.4.0.0.1		Command parameter write in progress
ADJ_IN_PROGR	BOOL	%MW0.4.0.0.2		Adjust parameter exchange in progress
EXCH_RPT	INT	%MW0.4.0.1		Channel report
STS_ERR	BOOL	%MW0.4.0.1.0		Error while reading channel status
CMD_ERR	BOOL	%MW0.4.0.1.1		Error while sending a command on the channel
ADJ_ERR	BOOL	%MW0.4.0.1.2		Error while adjusting the channel
RECONF_ERR	BOOL	%MW0.4.0.1.15		Error while reconfiguring the channel
CH_FLT	INT	%MW0.4.0.2		Channel faults
SENSOR_FLT	BOOL	%MW0.4.0.2.0		External fault :Sensor link fault
RANGE_FLT	BOOL	%MW0.4.0.2.1		External fault :Range under/overrun fault
CH_ERR_RPT	BOOL	%MW0.4.0.2.2		External fault :Channel error report
INTERNAL_FLT	BOOL	%MW0.4.0.2.4		Internal fault : Channel inoperative

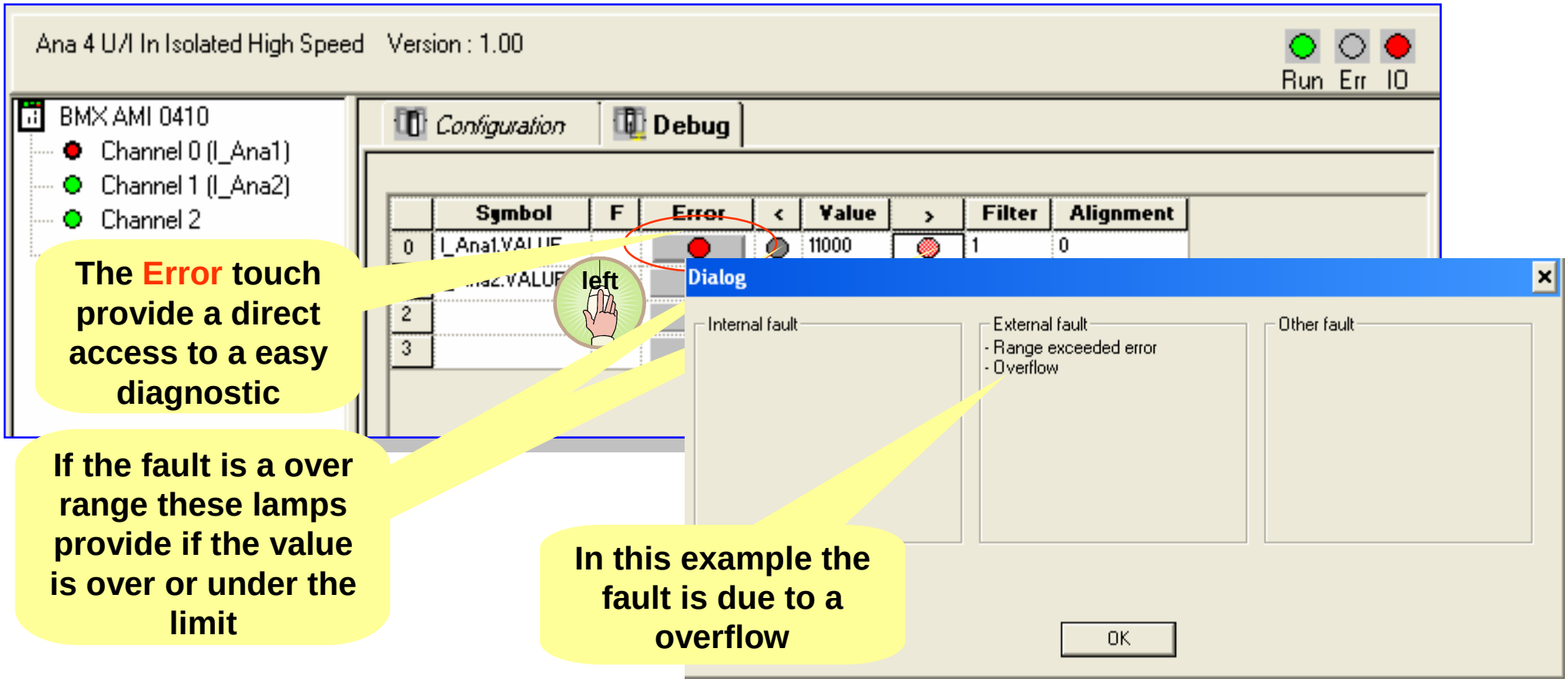


F – Analog modules diagnostics

BMX AMI 0410

Diagnostic screen

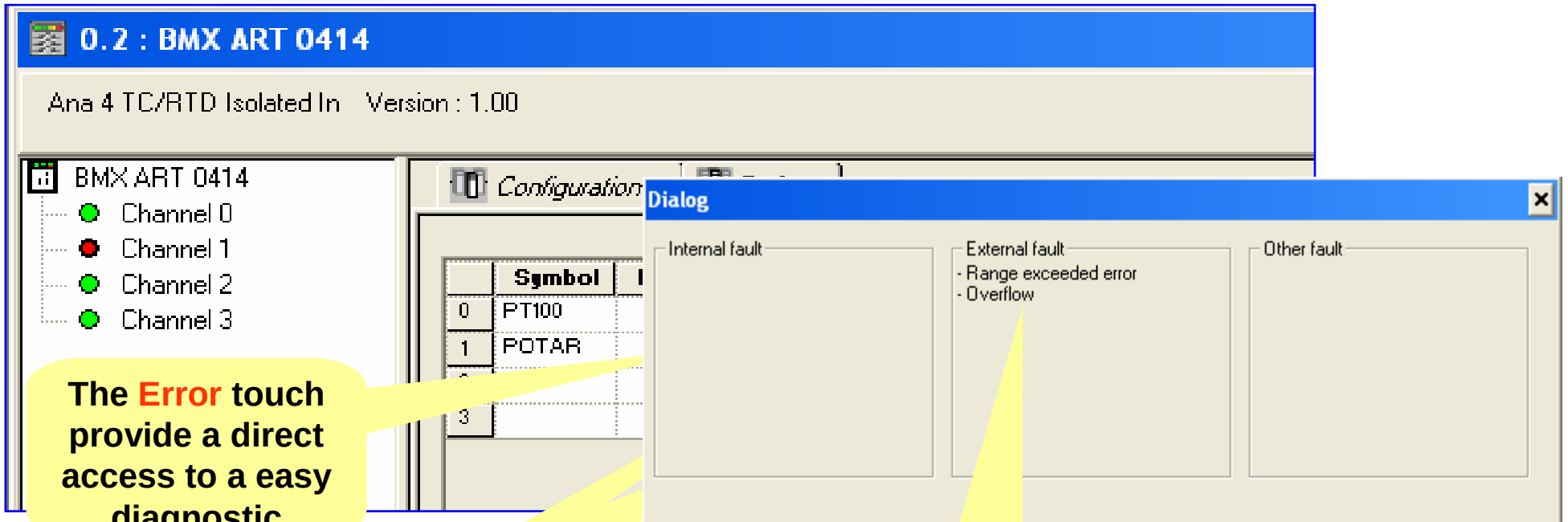
- The debug screen provides information to diagnose a problem.



BMX ART 0414

Diagnostic screen

- The debug screen provides information to diagnose a problem.



The Error touch provide a direct access to a easy diagnostic

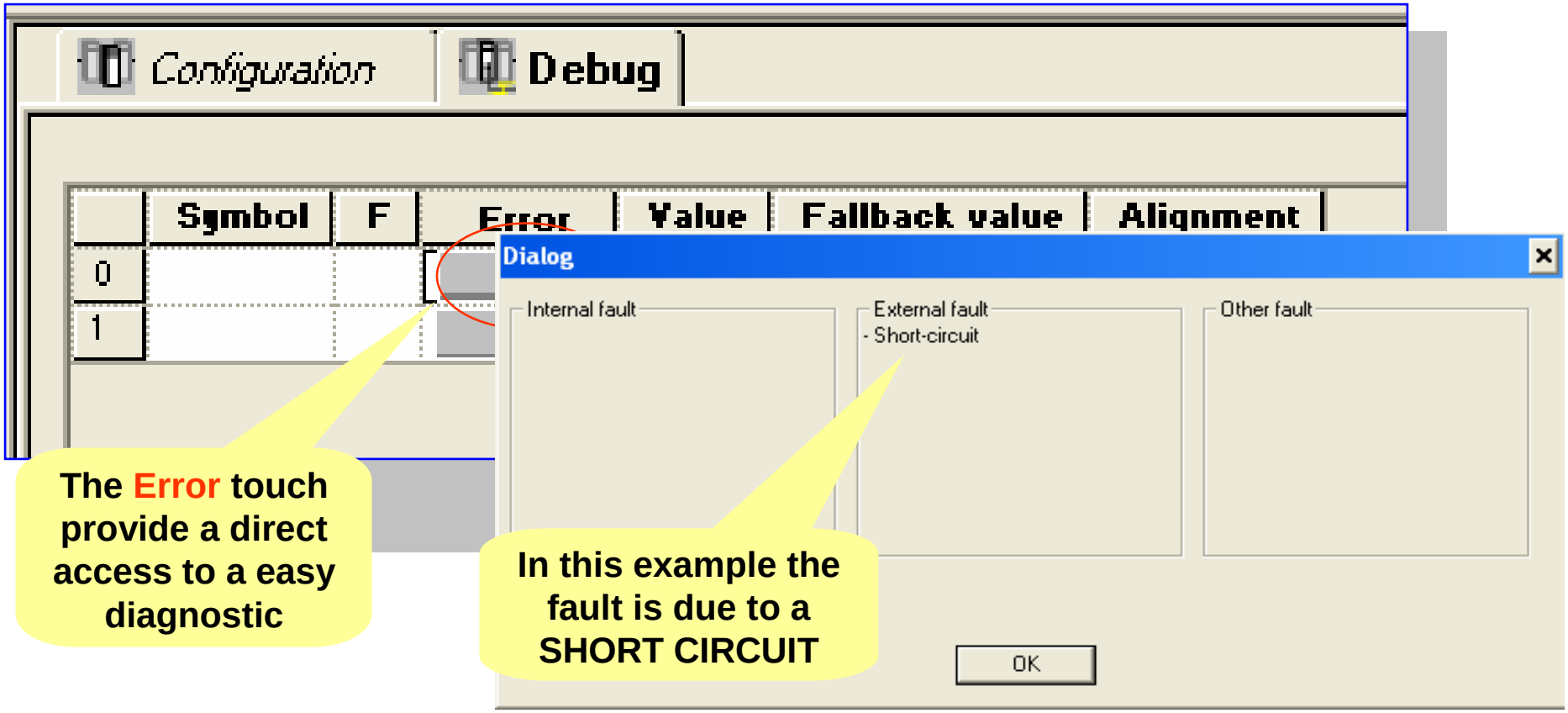
If the fault is a over range these lamps provide if the value is over or under the limit

In this example the fault is due to a overflow

BMX AMO 0210

Diagnostic screen

- The debug screen provides information to diagnose a problem.



Analog offer