Premium and Atrium using Unity Pro

Analog Input/Output Modules User Manual

04/2015

35010447.11

www.schneider-electric.com

All pertinent state, regional, and local safety regulations must be observed when installing and using this product. For reasons of safety and to help ensure compliance with documented system data, only the manufacturer should perform repairs to components.

When devices are used for applications with technical safety requirements, the relevant instructions must be followed.

Failure to use Schneider Electric software or approved software with our hardware products may result in injury, harm, or improper operating results.

Failure to observe this information can result in injury or equipment damage.

Table of Contents

Safety Information

Important Information

NOTICE

Read these instructions carefully, and look at the equipment to become familiar with the device before trying to install, operate, or maintain it. The following special messages may appear throughout this documentation or on the equipment to warn of potential hazards or to call attention to information that clarifies or simplifies a procedure.

The addition of this symbol to a “Danger” or “Warning” safety label indicates that an electrical hazard exists which will result in personal injury if the instructions are not followed.

This is the safety alert symbol. It is used to alert you to potential personal injury hazards. Obey all safety messages that follow this symbol to avoid possible injury or death.

DANGER
DANGER indicates a hazardous situation which, if not avoided, **will result in** death or serious injury.

WARNING
WARNING indicates a hazardous situation which, if not avoided, **could result in** death or serious injury.

CAUTION
CAUTION indicates a hazardous situation which, if not avoided, **could result** in minor or moderate injury.

NOTICE
NOTICE is used to address practices not related to physical injury.

PLEASE NOTE

Electrical equipment should be installed, operated, serviced, and maintained only by qualified personnel. No responsibility is assumed by Schneider Electric for any consequences arising out of the use of this material.

A qualified person is one who has skills and knowledge related to the construction and operation of electrical equipment and its installation, and has received safety training to recognize and avoid the hazards involved.

About the Book

At a Glance

Document Scope

This manual describes the hardware and software implementation of analog modules for Premium and Atrium PLCs.

Validity Note

This documentation is valid for Unity Pro 10.0 or later.

Product Related Information

⚠WARNING

UNINTENDED EQUIPMENT OPERATION

The application of this product requires expertise in the design and programming of control systems. Only persons with such expertise should be allowed to program, install, alter, and apply this product.

Follow all local and national safety codes and standards.

Failure to follow these instructions can result in death, serious injury, or equipment damage.

Part I
Physical Implementation of Analog Modules

In this Part

This part is devoted to the physical implementation of the Premium family of PLC analog input and output modules, as well as of dedicated TELEFAST 2 pre-cabling accessories.

What Is in This Part?

This part contains the following chapters:

Chapter 1
General introduction to analog modules

Aim of this Chapter

This chapter gives a general introduction to analog input/output modules.

What Is in This Chapter?

This chapter contains the following topics:

General description of analog modules

General

There are two types of Premium analog modules available:

- high level voltage/current, thermocouple and thermowell input. The input modules offer :
  - 16 channels for the TSX AEY 16••,
  - 8 channels for the TSX AEY 8••,
  - 4 channels for the TSX AEY 4••.
- high level voltage/current outputs on individual or shared channels. The output modules offer :
  - 8 channels for the TSX ASY 800,
  - 4 channels for the TSX ASY 410.

They are equipped with a 25 pin Sub-D connector (TSX AEY 420/800/810 and TSX ASY 800), and two 25 pin Sub-D connectors (TSX AEY 1600/1614) or a screw terminal block (TSX AEY 414 and TSX ASY 410).

They are standard format modules, which occupy a single position in the TSX RKY••• racks. They can be installed in all positions on the rack except for the first two (PS and 00) which are reserved for the rack power supply module (TSX PSY•••) and the processor module (TSX 57•••) respectively.

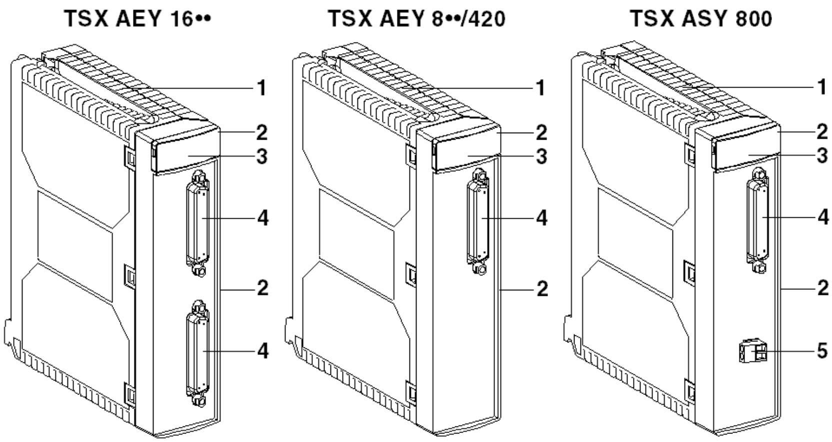
Physical description of analog modules with Sub-D connector(s)

At a Glance

The physical description of the analog modules with connector(s) is given below. These modules include the references:TSX AEY 16••/8••/420 and TSX ASY 800.

Illustration

The following diagrams show the different modules with Sub-D connector(s) :



Elements

The following table describes the different elements of the analog modules with Sub-D connector(s):

Number	Description
1	Rigid body supports and protects the electronic card.
2	Reference label for the module (visible on the front and right-hand side of the module).
3	Display panel showing operating modes and faults.
4	25 pin Sub-D connector, for connecting sensors or pre-actuators.
5	24 VDC external power supply terminal block.

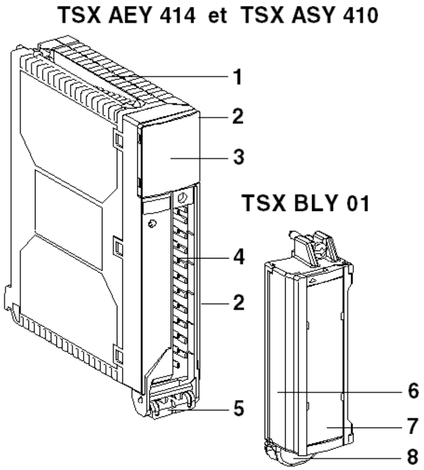
Physical description of the analog modules with terminal block TSX BLY 01

At a Glance

The physical description of the terminal block analog modules is given below. These modules include the references: TSX AEY 414 and TSX ASY 410.

Illustration

The diagram below shows the different screw terminal block modules :



Elements

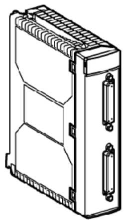
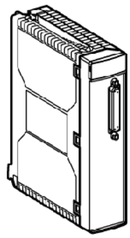
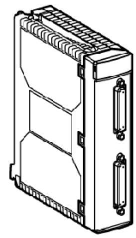
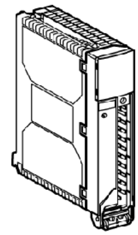
The following table describes the different elements of the screw terminal block analog modules :

Number	Description
1	Rigid body supports and protects the electronic card.
2	Reference label for the module (visible on the front and right-hand side of the module).
3	Display panel showing operating modes and faults.
4	Connector receiving the TSX BLY 01 screw terminal block.
5	Module encoder.
6	Pull-out screw terminal block (TSX BLY 01), for connecting sensors or pre-actuators.
7	Screw terminal block access panel; also where you will find the terminal block cabling label and channel label.
8	Terminal block encoder.

Catalog of Analog Input Modules

Analog Input Modules

The following table shows the catalog of analog input modules:

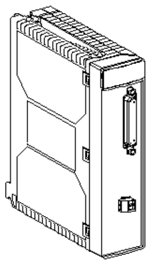
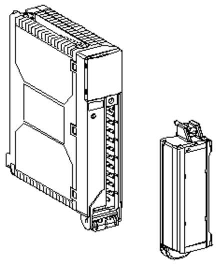
Module type	Inputs					
						
Number of channels	16	8		4	16	4
Range	+/- 10 V 0..10 V 0..5 V 1..5 V 0..20 mA 4..20 mA				+/- 80 mV Thermocouple	+/- 10 V 0..10 V +/- 5 V 0..5 V 1..5 V 0..20 mA 4..20 mA -13..+63 mV 0..400 Ohms 0..3850 Ohms Thermowell Thermocouple
Current consumed at 24 VR	0 mA					
Current consumed at 5 V	270 mA (typ.) 380 mA (max.)		475 mA (typ.) 630 mA (max.)	500 mA (typ.) 800 mA (max.)	300 mA (typ.) 400 mA (max.)	660 mA (typ.) 940 mA (max.)
Voltage shared channel mode	Shared		+/- 200 VDC	Shared	+/- 100 VDC	+/- 200 VDC
Resolution	12 bits		16 bits			
Connections	2 x Sub-D 25 pin	1 x Sub-D 25 pin			2 x Sub-D 25 pin	20 pin screw terminal block
TSX•• reference	AEY 1600	AEY 800	AEY 810	AEY 420	AEY 1614	AEY 414

Dedicated TELEFAST 2	ABE-7CPA 02 ABE-7CPA 03	ABE-7CPA 02 ABE-7CPA 03	ABE-7CPA 02 ABE-7CPA 31	ABE-7CPA 02 ABE-7CPA 03 ABE-7CPA 21	ABE-7CPA 12	-
TSX•• reference	AEY 1600	AEY 800	AEY 810	AEY 420	AEY 1614	AEY 414

Catalog of Analog Output Modules

Analog Output Modules

The following table shows the catalog of analog output modules:

Module type	**Analog outputs**	
		
Number of channels	8	4
Range	+/- 10 V 0..20 mA 4..20 mA	
Current consumed at 24 VR	300 mA (typ.) (1) 455 mA (max.)	0 mA
Current consumed at 5 V	200 mA (typ.) 300 mA (max.)	990 mA (typ.) (2) 1220 mA (max.) (2)
Voltage shared channel mode	Shared	1500 Vrms insulation
Resolution	14 bits in voltage 13 bits in current	11 bits + sign
Connections	1 x 25 pin Sub-D 2 pin screw terminal block	20 pin screw terminal block
Dedicated TELEFAST 2	ABE-7CPA 02	ABE-7CPA 21
TSX•• reference	ASY 800	ASY 410
Key:		
(1)	Only when internal 24 V is used (0 mA if an external power supply is used).	
(2)	+20 mA per active channel.	

Chapter 2
General Rules for Analog Module Implementation

Aim of this Chapter

This chapter presents the general rules for implementation of analog input/output modules.

What Is in This Chapter?

This chapter contains the following topics:

Installing Analog Modules

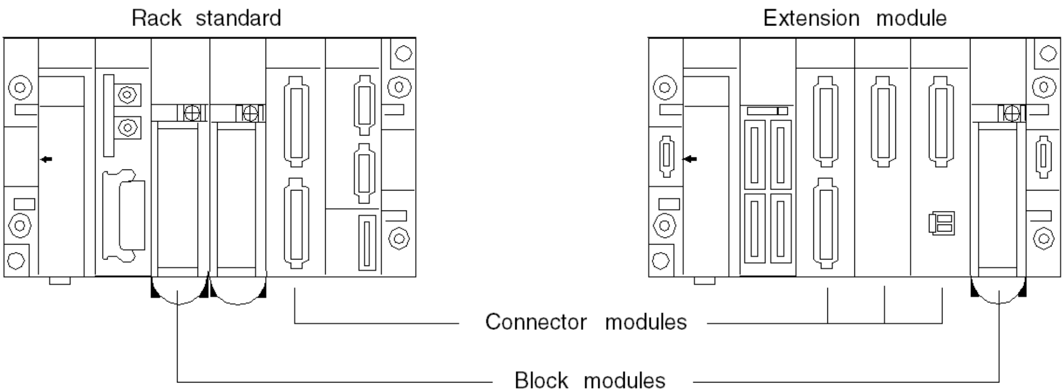
Introduction

The method and precautions relating to the installation analog modules are detailed below.

Installation

All Premium input/output analog modules are standard format and therefore occupy a single position on the TSX RKY••• racks.

They can be installed in all positions on the rack except for the first two (PS and 00) which are reserved for the power supply module of the rack (TSX PSY•••) and the processor module (TSX 57•••) respectively. They are powered by the rack back bus, and can be positioned equally on the standard rack or on an extendable rack.



Installation Precaution

The Analog modules can be handled when the rack’s power supply is ON (ie: there is no damage or disturbance of the PLC).

When detecting terminal block presence using a shunt placed in the upper part of the terminal block, the shunt must always be screwed as tightly as possible. The terminal block must always be dismantled before dismantling the module. This avoids restoring the potential for inputs on the terminal block (up to 1700 V) during a module insulation fault.

⚠ CAUTION

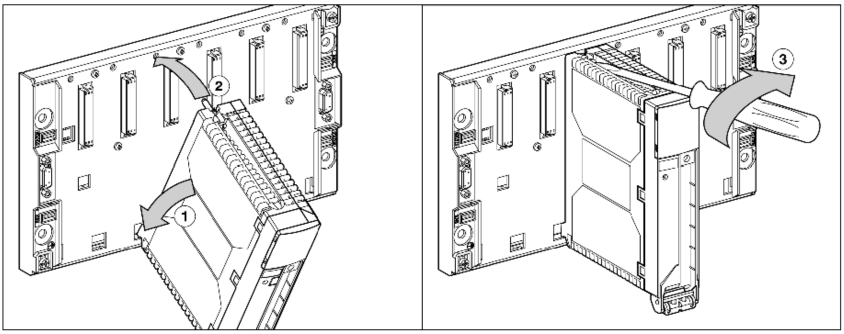
MODULE DAMAGE

Installation and dismantling of modules must be done with terminal block TSX BLY 01 disconnected. Similarly, the external 24 V terminal block of module TSX ASY 800 must be disconnected.

Failure to follow these instructions can result in injury or equipment damage.

Installing the Module on the Rack

Intallation of the analog input/output modules is done on the rack in the following way :

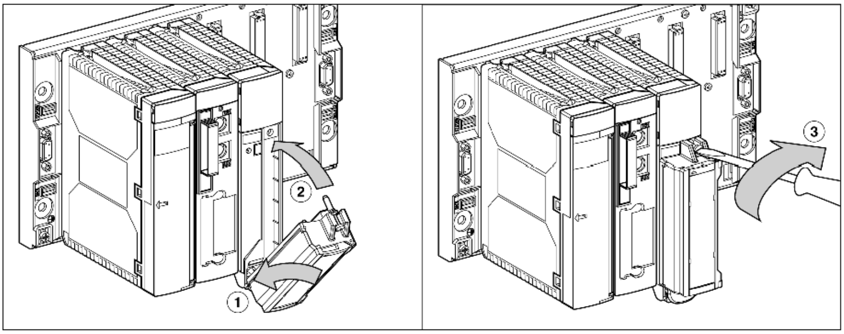


Step	Action
1	Position the two lugs at the rear of the module (the lower part of the module) in the centring holes located on the lower part of the rack.
2	Pivot the module upwards so as to pin it to the back connector of the rack.
3	Fix the module to the rack by tightening the screw located on the upper part of the module.

NOTE: If this screw is not tightened, the module will not stay in the position of the rack.

Installing the Screw Terminal Block

The TSX AEY 414 and TSX ASY 410 modules are completed with a screw terminal block referenced TSX BLY 01. Installing the screw terminal blocks in the corresponding analog modules is done in the following way:



Step	Action
1	Once the module is in place on the rack, install the terminal block by inserting the encoder of the terminal block (lower rear part) into that of the module (lower front part) as shown below.
2	Pivot the terminal block to bring it into position to pin it on the module.
3	Fix the terminal block to the module by tightening the screw located on the upper part of the terminal block on the module.

NOTE: If this screw is not tightened, the terminal block will not stay in the position of the module.

Coding the Screw Terminal Block

The first installation of a screw terminal block on a module, dedicated to this type of connectivity involves coding the terminal block. This coding is done by transferring 2 contacts from the module to the terminal block. These contacts are indexors. They are designed to stop the terminal block being installed on another module This avoids manipulation errors during replacement of a module and guarantees electric compatibility by module type.

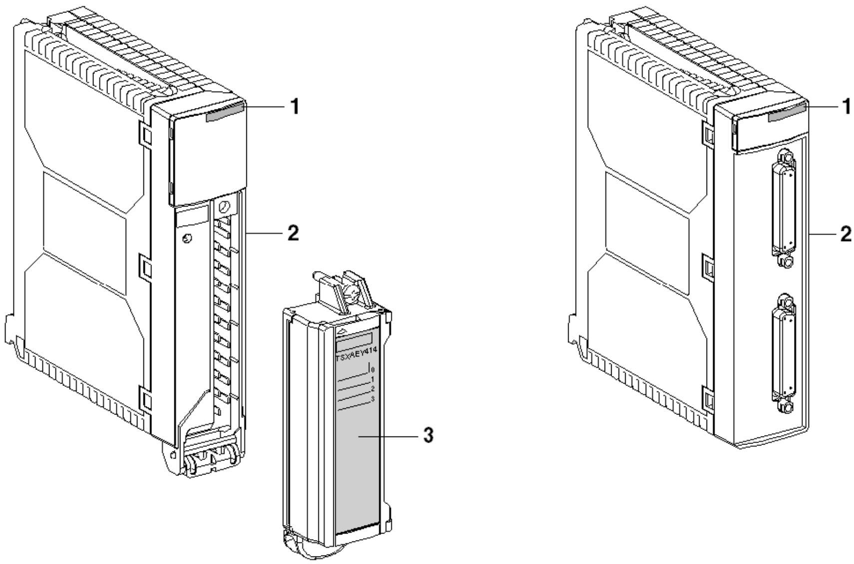
Labeling Analog Modules

At a Glance

Modules are labeled with marks on the front cover and on the right-hand side of the module.

Illustration

The following diagram shows the different elements for labeling analog modules :



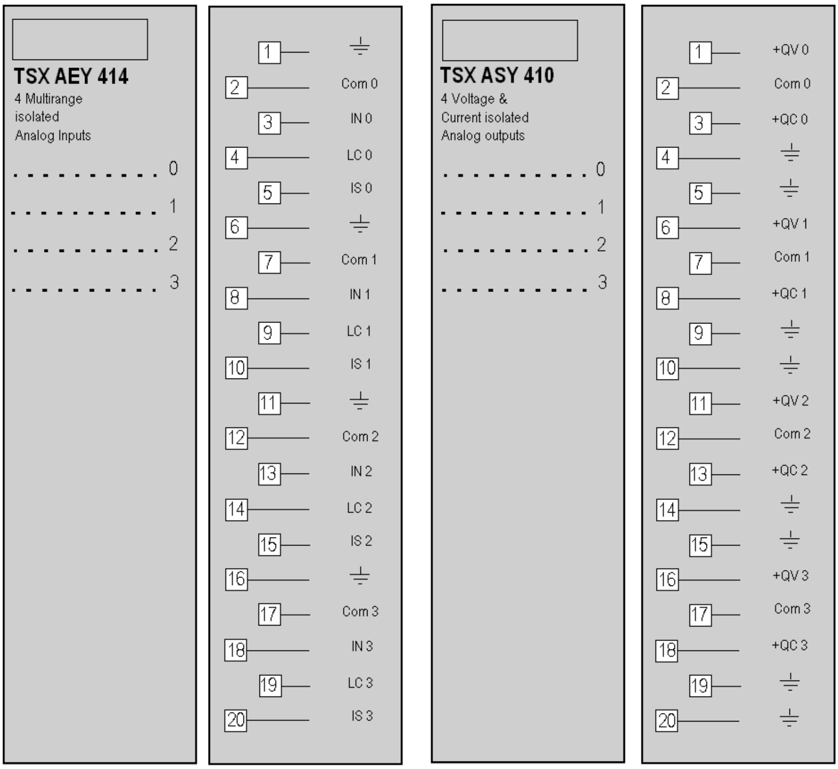
Elements

The following table describes the different labels on analog modules:

Number	Description
1	Badge engraved with the module reference.
2	Mark showing the module reference and type.
3	Terminal block label. This label is positioned inside the panel, and repeats the reference and type of the module which provides terminal block cabling. It can be supplemented with user information on the front and back.

Terminal block label

The following diagram shows the different labels of the screw terminal block analog modules TSX AEY 414 and TSX ASY 410 :



Wiring Precautions for Analog Modules

Introduction

In order to protect the signal from outside noises induced in series mode and noises in common mode, we recommend you take the following precautions.

Type of Conductors

Use twisted shielded pairs with a minimum diameter of 0.28 mm^2 (AWG24 gage).

Cable Shielding

- For modules fitted with a screw terminal block (TSX AEY 414 and TSX ASY 410):
  Connect the each end of the cable shields to the shield continuation terminals (ground terminals).
- For modules fitted with Sub-D connector(s) (TSX AEY 16••/8••/420 and TSX ASY 800):
  - Connection at the Sub-D connectors:
    Given that there are a large number of channels, a cable of at least 13 twisted pairs is used, with general shielding (outside diameter 15 mm maximum), fitted with a male 25 pin Sub-D connector for direct connection to the module.
    Connect the cable shielding to the cover of the male Sub-D connector. The controller is then grounded by the small tightening columns of the Sub-D connector. For this reason, it is required to screw the male Sub-D connector to its female base-plate.
  - TELEFAST connection:
    Connect the cable shielding to the terminals provided and the whole assembly to the cabinet ground.

Cable Connector Association

Multiple pairs of cables can be grouped for signals of the same type and with the same reference in relation to the ground.

Routing Cables

Separate as far apart as possible the measuring wires of the discrete input / output cables (especially relay outputs) and cables that transmit "power" signals.

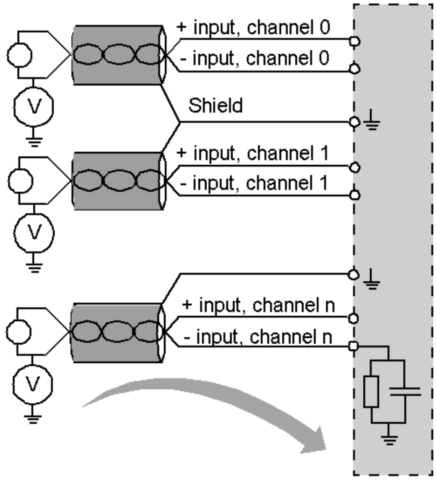
Reference of Sensors in Relation to the Ground

In order for the acquisition system to operate correctly, we recommend you follow the following precautions:

- the sensors must be close together (a few meters),
- all sensors must be referenced for a single point, which is connected to the ground of the module.

Using the Sensors Referenced in Relation to the Ground

The sensors are connected according to the following diagram:



If the sensors are referenced in relation to the ground, this may in some cases return a remote ground potential to the terminal or the Sub-D connector(s). It is therefore necessary to follow the following rules:

- this potential must be less than the safety voltage: for example, 48 V peak for France,
- setting a sensor point to a reference potential generates a leakage current. You must therefore check that all leakage currents generated do not disturb the system.

Using Pre-Actuators Referenced in Relation to the Ground

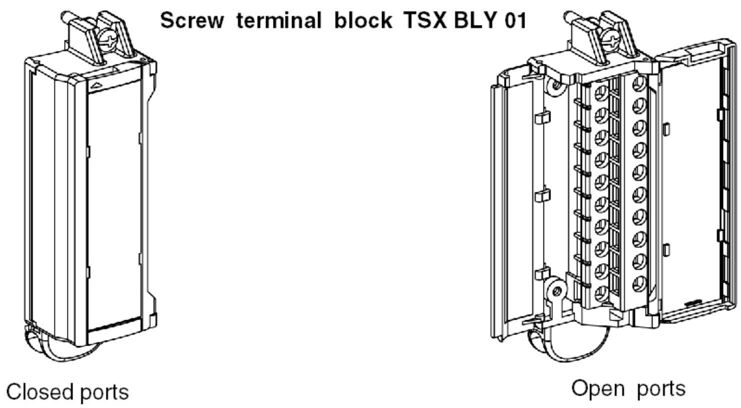
There are no specific technical constraints for referencing pre-actuators to the ground. For safety reasons, it is nevertheless preferable to avoid returning a remote ground potential to the terminal; this may be very different to the ground potential close by.

Wiring the TSX BLY 01 Screw Terminal Block

General

Screw connecting terminal blocks are fitted with captive screws. They are supplied with the screws unscrewed.

The diagram below shows the screw terminal block TSX BLY 01:



The Wire-End Ferrules and Terminals

Each terminal block may receive bare wires, fitted with wire-end ferrules and open terminals.

The capacity of each terminal is:

- minimum: 1 wire of 0.2 mm^2 (AWG 24) with no wire-end ferrule;
- maximum: 1 wire of 2 mm^2 with no wire-end ferrule or 1 wire of 1.5 mm^2 with a wire-end ferrule.

Illustration of the wire-end ferrule and the open terminal:

(1) 5.5 mm maximum.

The maximum capacity of the terminal block is 16 wires of 1 mm^2 (AWG) + 4 wires of 1.5 mm^2 (AWG).

The U-shaped screws are molded at the end to accept screwdrivers :

- cross-shape Pozidriv N° 1,
- flat, with a diameter = 5 mm.

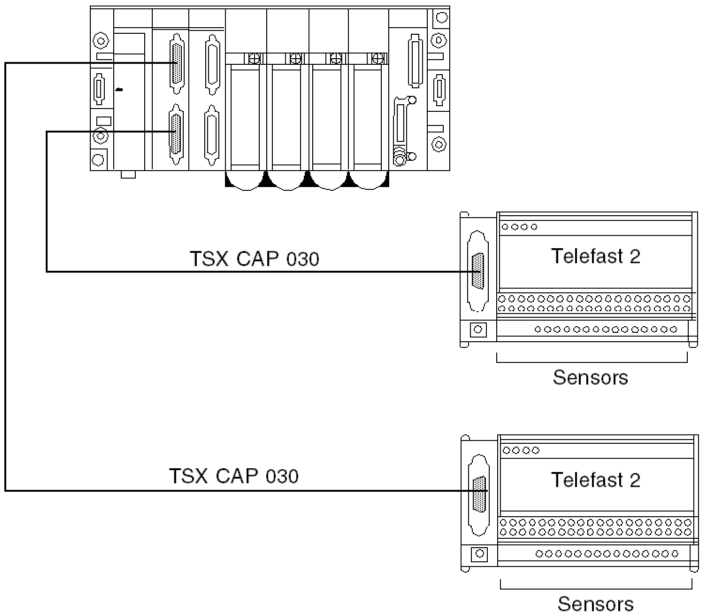
NOTE: The maximum tightening torque for the connecting terminal block screws is 0.8 N.m

TELEFAST 2 Wiring Accessories Dedicated to Analog Modules

Introduction

The use of TELEFAST 2 wiring accessories facilitates the implementation of analog modules TSX AEY 420/800/810/1600/1614 and TSX ASY 800, by providing access to the I/O through screw-type wiring terminals.

The analog module is connected to the TELEFAST 2 accessories with a 3-meter shielded cable, which is referenced TSX CAP 030 and fitted with 25-pin Sub-D connectors.



List of Accessories

There are 5 types of analog TELEFAST 2 wiring accessories:

- ABE-7CPA02 distributes 8 channels from one 25 pin Sub-D connector , on the screw-type wiring terminals,
- ABE-7CPA03 distributes 8 channels from one 25 pin Sub-D connector, on screw-type wiring terminals, but also:
  - provides, channel by channel, the 2- and 4-wire sensors with a protected 24 V voltage, limited in current (to 30 mA),
  - ensures continuity of the current loops even when the 25 pin Sub-D connector is pulled out,
  - protecting current shunts contained in the modules against voltage surges.
- ABE-7CPA21 distributes 4 channels from one 25-pin Sub-D connector, on screw-type wiring terminal,
- ABE-7CPA31 distributes 8 channels from one Sub-D 25 pin connector, on screw-type wiring terminals, but also:
  - supplies, channel by channel, the 2- and 4-wire sensors with a protected 24 V voltage, limited in current to 25 mA/channel, while maintaining insulation between the module’s channels,
  - protecting current shunts contained in the modules against voltage surges.
- ABE-7CPA12 distributes 8 channels from one 25 pin Sub-D connector, on screw-type wiring terminals for connecting thermocouples. This unit, which is fitted with a built-in silicon temperature probe, carries out cold junction compensation at the level of the connection terminal block. The number of connectable channels is:
  - 16 thermocouple channels in internal cold junction compensation mode via TELEFAST 2,
  - 14 thermocouple channels in external cold junction compensation mode with wiring of a 4-wire Pt100 probe on channels 0 and 8.

The following table lists the usable TELEFAST 2 for each module:

Module	ABE-7CPA02	ABE-7CPA03	ABE-7CPA31	ABE-7CPA12	ABE-7CPA21
TSX AEY 420	X (1)	X (1)			X
TSX AEY 800	X	X			
TSX AEY 810	X		X		
TSX AEY 1600	X	X			
TSX AEY 1614				X	
TSX ASY 410					X (2)
TSX ASY 800	X				
Legend					
(1) Only the first 4 channels are used					
(2) Requires a ABF Y25S••• link cable which includes a TSX BLY 01 terminal block					

Chapter 3
Analog Module Fault Diagnostics

Aim of this Chapter

This chapter introduces the processing of hardware faults linked to analog input/output modules.

What Is in This Chapter?

This chapter contains the following topics:

Display of Analog Module Faults

At a Glance

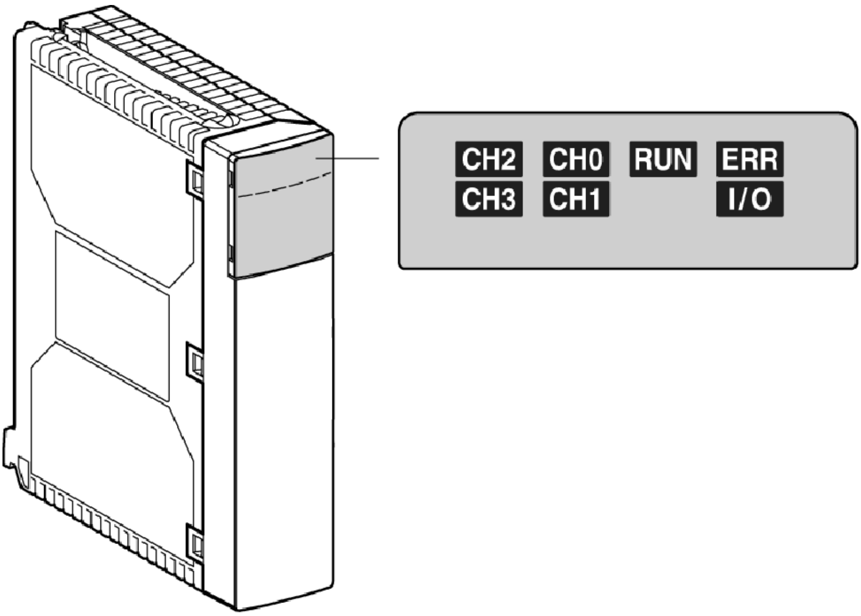
Analog modules have LEDs which show the module’s status and the status of the channels.

There are:

- Module status LEDs: RUN, ERR and I/O,
- Channels status LEDs: CH•.

Illustration

The following diagram shows the analog modules display screen:



Description

Three LEDs situated on each module indicate, according to their status (indicator on, flashing or off), the operating status of the module:

- The green RUN indicator: indicates the operating status of the module
- The red ERR indicator: indicates an internal fault in the module or a fault between the module and the remainder of the configuration.
- The red I/O indicator: indicates an external fault.

NOTE: The CH• status LEDs are not used on analog modules.

The various possible faults are listed together in the following table:

Indicator	On ●	Flashing ⊗	Off ○
RUN (green)	Operating normally	-	Module is faulty or off
ERR (red)	Internal fault, module unserviceable	Communication fault	No internal fault
I/O (red)	External faults: ● Overload or underload fault during calibration ● Range under/overflow fault.	Terminal block fault	No external fault
CH•	No channel status LED		

Analog module diagnostics

At a Glance

A faulty module makes itself evident by means of lit or flashing RUN, ERR and I/O LEDs.

Faults are classed in three groups : external errors, internal errors and other faults.

External errors

There are two types of external errors which make the **I/O LED light up**:

- **Measurement range overrun fault**
  This fault occurs when the measurement taken on the input line is outside the user-defined limits.
- **Sensor link fault (only on TSX AEY 414/1614)**
  This occurs when there is a connectivity problem between the module and one or more sensors.

Internal errors

Each module carries out a series of self-tests (watchdog, memory, analog/digital conversion string, etc.).

When an error occurs during these tests, an internal error is signaled. The **ERR LED lights up**.

The table below shows the various self-tests performed by the modules and whether the processor sees a possible error :

Self-test performed	Status of LED ERR when an error occurs	Fault returned to the processor
Watchdog test	Permanently lit	no
EPROM memory checksum		
X Bus interface test		
External RAM test		
EEPROM memory test		
Converters test (1)		yes
Internal references test (2)		
Key :		
(1) for the modules TSX AEY 414/1614		
(2) for the modules TSX AEY 800/810/1600		

If a module is inoperative and can no longer communicate with the processor, the latter is still informed about it by detection :

- either by the absence of the module,
- or by the fact that the module is switched off.

Other faults

The other faults include :

- **Terminal block fault**
  The terminal block fault occurs when at least one channel is used whilst the corresponding Sub-D connector or terminal block is missing.
- **External supply fault of the outputs (only with the TSX ASY 800)**
  The output supply fault occurs when an external supply is used to supply the module TSX ASY 800 and when this supply is detected as missing.
- **Communication fault**
  It can be caused by a hardware fault at rack back bus level, by a processor fault or extension cable fault.

NOTE: When there is a communication fault with the processor, the channel value images (at PLC processor level) are frozen at the last value present prior to the fault.

Fault diagnostics

The following table can be used to diagnose faults relating to the three LEDs: RUN, ERR and I/O :

Module status	Status LEDs		
	RUN	**ERR**	**I/O**
Normal operation	●	○	○
Module faulty or switched off	○	⊗	○
External errors: ● range under/overshoot ● external 24 V power supply fault	●	○	●
Internal error (module broken down): ● communication with CPU possible ● communication with CPU impossible	● ○	● ●	○ ○
Other faults: ● communication fault ● terminal block fault	● ●	⊗ ○	○ ⊗
Key :			
○ LED unlit			
⊗ LED flashing:			
● LED lit:			

NOTE: When a range under/overshoot fault occurs at the same time as a terminal block fault, the LEDs behave in the same way as for range under/overshoot (the I/O is lit).

Chapter 4
Analog Input Module TSX AEY 414

Aim of this Chapter

This chapter introduces the TSX AEY 414 module, its characteristics and its connection to different sensors.

What Is in This Chapter?

This chapter contains the following topics:

Introducing the TSX AEY 414 module

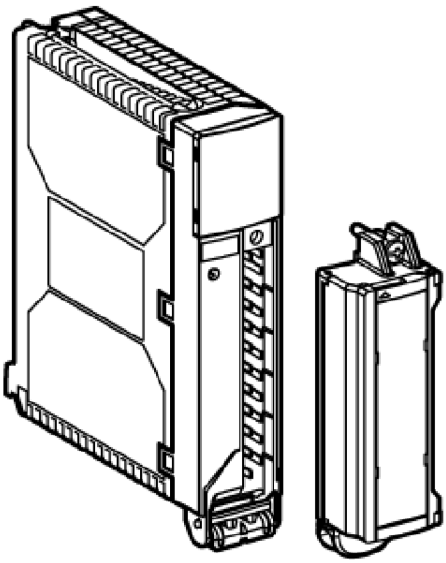
At a Glance

The TSX AEY 414 module is a multi-range acquisition device with four inputs isolated from each other. This module offers the following ranges for each of its inputs according to the selection made at configuration :

- thermocouple B, E, J, K, L, N, R, S, T, U or electrical range -13..63 mV,
- thermowell Pt100, Pt1000, Ni1000 in 2- or 4-wire or ohmic range: 0..400 Ohms and 0..3850 Ohms,
- high level +/- 10 V, 0..10 V, +/- 5 V, 0..5 V (0..20 mA with external shunt), or 1..5 V (4..20 mA with external shunt). It should be noted that the external shunts are supplied with the product.

Illustration

The following diagram shows the analog input module TSX AEY 414 :



NOTE: The terminal block is supplied separately under the reference TSX BLY 01.

Characteristics of the TSX AEY 414 Module

Introduction

This part presents general characteristics for the TSX AEY 414 module.

General Characteristics

This table presents the general characteristics for the TSX AEY 414 module:

Type of inputs	Isolated inputs, low and high level, thermocouples and thermoprobes
Type of inputs	Multi-range
Number of channels	4
Acquisition cycle time	550 ms for the 4 channels
Analog / Digital converter	16 bits (0..65535 pulses)
Digital filtering	1st order (Time constant = 0 to 68.5 s)
Insulation: ● **between channels** ● **between channels and bus** ● **between channels and ground**	 2830 V rms 1780 V rms 1780 V rms
Isolation resistance under 500VDC between channel and ground	> 10 mOhms
Maximum over-voltage in differential mode authorized for inputs	+/- 30 VDC (switched on, without 250 Ω external shunt) +/-15 VDC (switched off, without 250 Ω external shunt)
Maximum over-voltage authorized for inputs	+/-25 mA (switched on/off, with 250 Ω external shunt)
Linearization	Automatic
Common mode voltage acceptable in operation: ● **between channels** ● **between channels and ground**	 200 VDC or 415 VAC 100 VDC or 240 VAC
Cold junction compensation ● **internal** ● **external class A Pt100 on channel 0**	 Automatic Between -5 and +85° C
Thermoprobe current	2.5 mA DC at 100 Ω 0.559 mA DC at 1000 Ω
Maximum power dissipation	4.7 W
PLC Standards	IEC1131, IEC801, IEC68, UL508, UL94
Sensor Standards	IEC584, IEC751, DIN43760, DIN43710, NFC42-330

Input Characteristics

This table presents the general characteristics for the current / voltage inputs of the TSX AEY 414 module:

Measurement range	Input impedance)	Full scale (FS)	Maximum error at 25° C (2)	Maximum error from 0 to 60° C (2)
+/- 10 V	10 MΩ	10 V	0.27 % of FS	0.50 % of FS
0..10 V	10 MΩ	10 V	0.16 % of FS	0.39 % of FS
+/- 5 V	10 MΩ	5 V	0.27 % of FS	0.50 % of FS
0..5 V (1)	10 MΩ	5 V	0.22 % of FS	0.45 % of FS
1..5 V (1)	10 MΩ	5 V	0.27 % of FS	0.56 % of FS
0..20 mA (1)	250 Ω	20 mA	0.36 % of FS	0.69 % of FS
4..20 mA (1)	250 Ω	20 mA	0.45 % of FS	0.86 % of FS
-13.+63 mV	10 MΩ	63 mV	0.19 % of FS	0.44 % of FS
0..400 Ω		400 Ω	0.13 % of FS	0.27 % of FS
0..3850 Ω		3850 Ω	0.22 % of FS	0.48 % of FS
Legend:				
(1)		The 0..5 V and 0..20 mA or 1..5 V and 4..20 mA ranges are configured in the same manner, with the only difference being whether or not a 250 Ω shunt is installed.		
(2)		For electric ranges, the precision values encompass the entire input dynamic.		

Thermoprobe Input Characteristics

This table presents the general characteristics for the thermoprobe inputs of the TSX AEY 414 module:

Measurement range	Maximum error at 25° C	Maximum error from 0 to 60° C
Pt100 according to IEC	1.2° C	2.4° C
Pt1000 according to IEC	2.5° C	5.0° C
Ni1000 according to DIN	1.1° C	2.0° C

NOTE: For thermoprobe ranges, precision values are taken from the middle of the standardized range with a 2 or 4-wire configuration, after a 30 minutes stabilization period. These values comply with the connection requirements described in the chapter Connecting the TSX AEY 414 sensors *(see page 66)*.

Thermocouple Input Characteristics

This table presents the general characteristics for the thermocouple inputs of the TSX AEY 414 module:

Measurement range	Maximum error at 25° C		Maximum error from 0 to 60° C	
	IC	EC	IC	EC
B	3.5° C	/	8.1° C	/
E	6.1° C	1.5° C	8.1° C	3.2° C
J	7.3° C	1.9° C	9.5° C	4.0° C
K	7.8° C	2.3° C	10.5° C	4.7° C
L	7.5° C	2.0° C	9.8° C	4.2° C
N	6.0° C	2.0° C	8.7° C	4.3° C
R	6.0° C	3.2° C	11.0° C	7.7° C
S	6.6° C	3.4° C	12.0° C	8.5° C
T	6.6° C	1.5° C	8.8° C	3.3° C
U	5.4° C	1.5° C	7.3° C	3.1° C
Legend:				
IC	With internal cold junction compensation:			
EC	With internal cold junction compensation: Values in this column were obtained from across channel 0 using a class A Pt100 probe.			

NOTE: Precision values include internal or external cold junction compensation after a 30-minute stabilization period, and are taken from the middle of the standardized range.

Detailed Characteristics of TSX AEY 414 Module Inputs

At a Glance

The TSX AEY 414 module proposes 23 ranges for each of its inputs, which can be configured channel by channel.

Precision

Precision for each input is shown by the formula:

$$\text{Precision} = C + K \times M$$

Equation parameters:

Parameter	Meaning
C	Constant for the range in question
K	Coefficient of proportionality
M	Absolute value of the measurement

A measurement error is therefore made up of a constant value C and a value proportional to the measurement K, which can be different depending on measurement polarity.

For thermocouple ranges, measurement error also takes into account cold junction compensation and linearization errors, and for current ranges, external resistance error (shunt).

Diaphony

Diaphony is expressed in dB and is shown in the formula:

$$\text{Diaphony} = 20 \times Log_{10}(V_M / V_m)$$

Equation parameters:

Parameter	Meaning
$\mathbf{V}_M$	Full scale voltage in the least sensitive range
$\mathbf{V}_m$	Voltage error on the following channel, configured in the most sensitive range (due to the presence of V_M)

In the example, V_M equals +10 V and V_m is the error due to the presence of +10 V on the following channel configured in +/- 20 mV.

Common Mode Rejection

Common mode rejection between channel and ground is expressed in dB and is shown in the formula:

$$\text{CM Rejection} = 20 \times Log_{10}(V_{MC}/V_{em})$$

Equation parameters:

Parameter	Meaning
$\mathbf{V}_{MC}$	Common mode voltage expressed in VDC or VAC (50 / 60 Hz)
$\mathbf{V}_{em}$	Voltage error on the measurement (reduced by the conversion resolution) expressed in VDC

For a current range, common mode rejection can naturally be deduced from this formula.

For thermoprobe or thermocouple ranges, common mode rejection is not applicable.

Series Mode Rejection at 50 / 60 Hz

Series mode rejection at 50 / 60 Hz is expressed in dB and is shown in the formula:

$$\text{SM Rejection} = 20 \times Log_{10}(V_{MS}/V_{em})$$

Equation parameters:

Parameter	Meaning
$\mathbf{V}_{MS}$	Series mode voltage expressed in peak to peak volts
$\mathbf{V}_{em}$	Voltage error on the measurement (reduced by the conversion resolution) expressed in VDC

For a current range, series mode rejection can naturally be deduced from this formula.

For thermoprobe or thermocouple ranges, series mode rejection is not applicable.

Characteristics of the +/- 10 V Range

The following table presents the characteristics of the +/- 10 V range:

Full scale (FS)	10 V	
Conversion resolution	0.570 mV	
View resolution	1 mV	0.01 % of FS
Maximum error at 25° C ● **For the 0..10 V range** ● **For the -10..0 V range**	 + 2 mV + 0.0014 x M -2 mV +0.0025 x M	 0.27 % of FS
Maximum error from 0 to 60° C	0.50 % of FS	
Input dynamic	+/-10 V	+/- 10000
Range overrun	+/-10.5 V	+/- 10500
CM rejection channel / ground ● **with VDC voltage** ● **with VAC 50 / 60 Hz voltage**	 95 dB 105 dB	
SM rejection at 50 / 60 Hz	35 dB	

Characteristics of the 0..10 V Range

The following table presents the characteristics of the 0..10 V range:

Full scale (FS)	10 V	
Conversion resolution	0.570 mV	
View resolution	1 mV	0.01 % of FS
Maximum error at 25° C	+ 2 mV + 0.0014 x M	0.16 % of FS
Maximum error from 0 to 60° C	0.39 % of FS	
Input dynamic	0..10 V	0..10000
Range overrun	-0.5..10.5 V	-500..10500
CM rejection channel / ground ● **with VDC voltage** ● **with VAC 50 / 60 Hz voltage**	 95 dB 105 dB	
SM rejection at 50 / 60 Hz	35 dB	

An error at a given temperature T can be deduced by linear extrapolation of the errors defined at 25 and 60° C according to the formula:

$$\varepsilon_T = \varepsilon_{25} + |T - 25| \times [\varepsilon_{60} - \varepsilon_{25}]/35$$

Characteristics of the +/- 5 V Range

The following table presents the characteristics of the +/- 5 V range:

Full scale (FS)	5 V	
Conversion resolution	0.570 mV	
View resolution	0.5 mV	0.01 % of FS
Maximum error at 25° C ● **For the 0..5 V range** ● **For the -5..0 V range**	 +1.5 mV +0.0019 x M -1.5 mV +0.0024 x M	 0.27 % of FS
Maximum error from 0 to 60° C	0.50 % of FS	
Input dynamic	+/- 5 V	+/- 10000
Range overrun	+/-5.25 V	+/- 10500
CM rejection channel / ground ● **with VDC voltage** ● **with VAC 50 / 60 Hz voltage**	 100 dB 110 dB	
SM rejection at 50 / 60 Hz	35 dB	

Characteristics of the 0.. 5 V Range

The following table presents the characteristics of the 0..5 V range:

Full scale (FS)	5 V	
Conversion resolution	0.570 mV	
View resolution	0.5 mV	0.01 % of FS
Maximum error at 25° C	+1.5 mV +0.0019 x M	0.22 % of FS
Maximum error from 0 to 60° C	0.45 % of FS	
Input dynamic	0..5 V	0..10000
Range overrun	-0.25..5.25 V	-500..10500
CM rejection channel / ground ● **with VDC voltage** ● **with VAC 50 / 60 Hz voltage**	 100 dB 110 dB	
SM rejection at 50 / 60 Hz	35 dB	

An error at a given temperature T can be deduced by linear extrapolation of the errors defined at 25 and 60° C according to the formula:

$$\varepsilon_T = \varepsilon_{25} + |T - 25| \times [\varepsilon_{60} - \varepsilon_{25}]/35$$

Characteristics of the 1.. 5 V Range

The following table presents the characteristics of the 1..5 V range:

Scale range (FSR)	4 V	
Conversion resolution	0.570 mV	
View resolution	0.4 mV	0.01 % of FSR
Maximum error at 25° C	+3.2 mV +0.0019 x M	0.27 % of FSR
Maximum error from 0 to 60° C	0.56 % of FSR	
Input dynamic	1..5 V	0..10000
Range overrun	0.8..5.2 V	-500..10500
CM rejection channel / ground ● **with VDC voltage** ● **with VAC 50 / 60 Hz voltage**	 100 dB 110 dB	
SM rejection at 50 / 60 Hz	35 dB	

Characteristics of the 0.. 20 mA Range

The following table presents the characteristics of the 0..20 mA range:

Full scale (FS)	20 mA	
Conversion resolution	2.28 microA	
View resolution	0.002 mA	0.01 % of FS
Maximum error at 25° C	+ 0.006 mA + 0.0033 x M	0.36 % of FS
Maximum error from 0 to 60° C	0.69 % of FS	
Input dynamic	0..20 mA	0..10000
Range overrun	-1..21 mA	-500..10500
CM rejection channel / ground ● **with VDC voltage** ● **with VAC 50 / 60 Hz voltage**	 100 dB 110 dB	
SM rejection at 50 / 60 Hz	35 dB	

An error at a given temperature T can be deduced by linear extrapolation of the errors defined at 25 and 60° C according to the formula:

$$\varepsilon_T = \varepsilon_{25} + |T - 25| \times [\varepsilon_{60} - \varepsilon_{25}] / 35$$

The value includes the shunt (250 Ω - 0.1% - 25 ppm/° C). Influence of the shunt on precision can be reduced by using a more precise resistance (0.01% - 10 ppm/° C).

Characteristics of the 4.. 20 mA Range

The following table presents the characteristics of the 4..20 mA range:

Scale range (FSR)	16 mA	
Conversion resolution	2.28 microA	
View resolution	1.6 microA	0.01 % of FSR
Maximum error at 25° C	+0.0192 mA + 0.0033 x M	0.45 % of FSR
Maximum error from 0 to 60° C	0.86 % of FSR	
Input dynamic	4..20 mA	0..10000
Range overrun	3.2..20.8 mA	-500..10500
CM rejection channel / ground ● **with VDC voltage** ● **with VAC 50 / 60 Hz voltage**	 100 dB 110 dB	
SM rejection at 50 / 60 Hz	35 dB	

Characteristics of the -13..63 mV Range

The following table presents the characteristics of the -13..63 mA range:

Range	-13...63V	
Full scale (FS)	63 mV	
Conversion resolution	0.00202 mV	
View resolution	0.0063 mV	0.01 % of FS
Maximum error at 25° C ● **For the 0..63 mV range** ● **For the -13..0 mV range**	 +0.018 mV +0.001581 x M -0.018 mV +0.004581 x M	0.19 % of FS
Maximum error from 0 to 60° C	0.45 % of FS	
Input dynamic	-13..63 mV	-2064..10000
Range overrun	-13..63 mV	-2064..10000
CM rejection channel / ground ● **with VDC voltage** ● **with VAC 50 / 60 Hz voltage**	 > 140 dB > 150 dB	
SM rejection at 50 / 60 Hz	> 35 dB	

An error at a given temperature T can be deduced by linear extrapolation of the errors defined at 25 and 60° C according to the formula:

$$\varepsilon_T = \varepsilon_{25} + |T - 25| \times [\varepsilon_{60} - \varepsilon_{25}]/35$$

Characteristics of the 0..400 Ohms Range

The following table presents the characteristics of the 0..400 Ohms range:

Full scale (FS)	400 Ohms	
Conversion resolution	31 mOhms	
View resolution	40 mOhms (1)	0.01 % of FS
Maximum error at 25° C	63 mOhms + 0.001180 x M	0.13 % of FS
Maximum error from 0 to 60° C	0.27 % of FS	
Input dynamic	0..400 Ohms	0..10000
Range overrun	0..400 Ohms	0..10000
CM rejection channel / ground ● **with VDC voltage** ● **with VAC 50 / 60 Hz voltage**	> 110 dB > 120 dB	
SM rejection at 50 / 60 Hz	> 35 dB	

Characteristics of the 0..3,850 Ohms Range

The following table presents the characteristics of the 0..3,850 Ohms range:

Full scale (FS)	3,850 Ohms	
Conversion resolution	139 mOhms	
View resolution	385 mOhms (1)	0.01 % of FS
Maximum error at 25° C	2.114 mOhms +0.001647 x M	0.22 % of FS
Maximum error from 0 to 60° C	0.48 % of FS	
Input dynamic	0..3850 Ohms	0..10000
Range overrun	0..3850 Ohms	0..10000
CM rejection channel / ground ● **with VDC voltage** ● **with VAC 50 / 60 Hz voltage**	> 110 dB > 120 dB	
SM rejection at 50 / 60 Hz	> 35 dB	

An error at a given temperature T can be deduced by linear extrapolation of the errors defined at 25 and 60° C according to the formula:

$$\varepsilon_T = \varepsilon_{25} + |T - 25| \times [\varepsilon_{60} - \varepsilon_{25}] / 35$$

(1) Redefine the terminals with the User scale to obtain the converter resolution.

Characteristics of the Thermowell Ranges for the TSX AEY 414

At a Glance

The table below shows the maximum error of accuracy values, at 25° C, of the thermowell ranges Pt100, Pt1000 and Ni1000 :

Temperature		Thermowell Pt100	Thermowell Pt1000	Thermowell Ni1000
Conversion resolution (1)		**0.09° C**	**0.04° C**	**0.02° C**
Display resolution		**0.1° C**	**0.1° C**	**0.1° C**
Max. error at 25° C (2)				
Operating point	**-200° C**	0.3° C	0.4° C	
	-100° C	0.5° C	0.8° C	
	0° C	0.6° C	1.2° C	0.9° C
	100° C	0.8° C	1.6° C	1.1° C
	200° C	1.0° C	2.1° C	1.2° C
	300° C	1.2° C	2.5° C	
	400° C	1.4° C	3.0° C	
	500° C	1.7° C	3.4° C	
	600° C	1.8° C	4.0° C	
	700° C	2.1° C	4.5° C	
	800° C	2.3° C	5.1° C	
Input dynamic		-200..850° C -328..1562° F	-200..800° C -328..1472° F	-60..250° C -76..482° F
Key:				
(1)	These values are given in the middle of the thermowell range.			
(2)	Ambient temperature of TSX AEY 414			

NOTE: Accuracies are given for 4-wire connections and include the errors and drifts of the source of the current, 2.5 mA (Pt100) or 0.55903 mA (Pt1000 or Ni1000).
The self-heating effect introduces no significant error to the measurement, whether the probe is in the air or in the water.

The table below shows the maximum error of accuracy values, from 0 to 60° C, of the thermowell ranges Pt100, Pt1000 and Ni1000 :

Temperature		Thermowell Pt100	Thermowell Pt1000	Thermowell Ni1000
Conversion resolution (1)		**0.09° C**	**0.04° C**	**0.02° C**
Display resolution		**0.1° C**	**0.1° C**	**0.1° C**
Max. error of 0 to 60° C				
Operating point	**-200° C**	0.5° C	0.5° C	
	-100° C	0.8° C	1.4° C	
	0° C	1.2° C	2.2° C	1.6° C
	100° C	1.6° C	3.1° C	2.0° C
	200° C	2.0° C	4.0° C	2.3° C
	300° C	2.4° C	4.9° C	
	400° C	2.9° C	5.9° C	
	500° C	3.3° C	7.0° C	
	600° C	3.8° C	8.0° C	
	700° C	4.4° C	9.1° C	
	800° C	5.0° C	10.3° C	
Input dynamic		-200..850° C -328..1562° F	-200..800° C -328..1472° F	-60..250° C -76..482° F
Key:				
(1)	These values are given in the middle of the thermowell range.			

NOTE: Accuracies are given for 4-wire connections and include the errors and drifts of the source of the current, 2.5 mA (Pt100) or 0.55903 mA (Pt1000 or Ni1000).
The self-heating effect introduces no significant error to the measurement, whether the probe is in the air or in the water.

The error at any temperature T can be deduced by linear extrapolation of the errors defined at 25 and 60° C following the formula :

$$\varepsilon_T = \varepsilon_{25} + |T - 25| \times [\varepsilon_{60} - \varepsilon_{25}] / 35$$

Reference standards:

- thermowell Pt100/Pt1000: NF C 42–330 June 1983 and IEC 751, 2nd edition 1986,
- thermowell Ni1000: DIN 43760 September 1987.

Characteristics of the TSX AEY 414 Thermocouple Range in Degrees Celsius

At a Glance

The following tables show the measuring chain errors for the different thermocouples B, E, J, K, N, R, S and T in degrees Celsius. These values take into account:

- The values given below are valid regardless of the type of cold junction compensation: TELEFAST or Pt100 class A.
- The cold junction temperature considered in the precision calculation is 25° C.
- The resolution is given with a mid-range operating point.
- The values include: electrical errors on the acquisition system for input channels and cold junction compensation, software errors and interchangeability errors on the cold junction compensation sensors. Thermocouple sensor errors are not taken into account.

Thermocouples B, E, J and K

The table below shows the maximum precision error values for thermocouples B, E, J and K at 25° C.

Temperature		**Thermocouple B**	**Thermocouple E**		**Thermocouple J**		**Thermocouple K**	
Conversion resolution (1)		**0.24° C**	**0.026° C**		**0.037° C**		**0.048° C**	
View resolution		**0.1° C**	**0.1° C**		**0.1° C**		**0.1° C**	
Maximum error at 25° C (2)		**IC / EC (3)**	**IC**	**EC**	**IC**	**EC**	**IC**	**EC**
Operating point	**-200° C**		16.8° C	2.7° C			18.7° C	3.3° C
	-100° C		9.5° C	1.7° C			9.5° C	1.8° C
	0° C		7.5° C	1.5° C	7.4° C	1.5° C	7.5° C	1.6° C
	100° C		6.7° C	1.4° C	7.1° C	1.5° C	7.4° C	1.7° C
	200° C		6.2° C	1.5° C	7.1° C	1.7° C	7.8° C	1.9° C
	300° C		6.1° C	1.5° C	7.3° C	1.8° C	7.6° C	2.0° C
	400° C		6.1° C	1.7° C	7.4° C	2.0° C	7.6° C	2.1° C
	500° C		6.2° C	1.8° C	7.5° C	2.1° C	7.8° C	2.3° C
Input dynamic (4)		0..1802° C	-270..812° C		-210..1065° C		-270..1372° C	

Legend:	
(1)	These values appear in the middle of the thermocouple range.
(2)	IC: ambient temperature of the TSX AEY 414 (20° C) and automatic internal compensation. EC: ambient temperature of the TSX AEY 414 (30° C) and class A Pt100 automatic external compensation.
(3)	With thermocouple B, the type of cold junction compensation (internal or external) is not taken into account, as this has no effect on precision.
(4)	Internal compensation: ambient temperature = 20 ° C External compensation: ambient temperature = 30 ° C.

Temperature		Thermocouple B	Thermocouple E		Thermocouple J		Thermocouple K	
Conversion resolution (1)		**0.24° C**	**0.026° C**		**0.037° C**		**0.048° C**	
View resolution		**0.1° C**	**0.1° C**		**0.1° C**		**0.1° C**	
Maximum error at 25° C (2)		**IC / EC (3)**	**IC**	**EC**	**IC**	**EC**	**IC**	**EC**
Operating point	**600° C**	4.7° C	6.4° C	2.0° C	7.3° C	2.2° C	7.9° C	2.4° C
	700° C	4.0° C	6.6° C	2.1° C	7.0° C	2.2° C	8.2° C	2.6° C
	800° C	4.0° C	6.8° C	2.3° C			8.6° C	2.8° C
	900° C	3.8° C					8.9° C	3.1° C
	1,000° C	3.6° C					9.3° C	3.3° C
	1,100° C	3.5° C					9.8° C	3.6° C
	1,200° C	3.6° C					10.3° C	3.8° C
	1,300° C	3.6° C						
	1,400° C	3.5° C						
	1,500° C	3.5° C						
	1,600° C	3.7° C						
	1,700° C	3.9° C						
Input dynamic (4)		0..1802° C	-270..812° C		-210..1065° C		-270..1372° C	
Legend:								
(1)	These values appear in the middle of the thermocouple range.							
(2)	IC: ambient temperature of the TSX AEY 414 (20° C) and automatic internal compensation. EC: ambient temperature of the TSX AEY 414 (30° C) and class A Pt100 automatic external compensation.							
(3)	With thermocouple B, the type of cold junction compensation (internal or external) is not taken into account, as this has no effect on precision.							
(4)	Internal compensation: ambient temperature = 20 ° C External compensation: ambient temperature = 30 ° C.							

Reference standards: IEC 584-1, 1st edition 1977 and IEC 584-2, 2nd edition 1989.

Thermocouple L, N, R and S

The table below shows the maximum precision error values for thermocouples L, N, R and S at 25° C.

Temperature		Thermocouple L		Thermocouple N		Thermocouple R		Thermocouple S	
Conversion resolution (1)		**0.036° C**		**0.05° C**		**0.16° C**		**0.19° C**	
View resolution		**0.1° C**		**0.1° C**		**0.1° C**		**0.1° C**	
Maximum error at 25° C (2)		**IC**	**EC**	**IC**	**EC**	**IC**	**EC**	**IC**	**EC**
Operating point	**-200° C**			19.6° C	4.0° C				
	-100° C			9.5° C	2.1° C				
	0° C	7.5° C	1.5° C	7.8° C	1.8° C	11.4° C	4.8° C	11.2° C	4.7° C
	100° C	7.1° C	1.5° C	7.0° C	1.8° C	8.1° C	3.5° C	8.3° C	3.5° C
	200° C	7.2° C	1.7° C	6.5° C	1.7° C	7.1° C	3.2° C	7.4° C	3.3° C
	300° C	7.3° C	1.9° C	6.2° C	1.8° C	6.5° C	2.9° C	6.9° C	3.1° C
	400° C	7.5° C	2.0° C	6.0° C	1.9° C	6.3° C	3.0° C	6.8° C	3.2° C
	500° C	7.4° C	2.1° C	6.0° C	2.0° C	6.2° C	3.0° C	6.8° C	3.3° C
	600° C	7.4° C	2.2° C	6.1° C	2.1° C	6.1° C	3.1° C	6.8° C	3.4° C
	700° C	7.1° C	2.2° C	6.2° C	2.2° C	6.1° C	3.1° C	6.6° C	3.3° C
	800° C	6.8° C	2.3° C	6.3° C	2.4° C	6.0° C	3.2° C	6.6° C	3.4° C
	900° C	6.7° C	2.3° C	6.5° C	2.6° C	6.0° C	3.2° C	6.6° C	3.5° C
	1,000° C			6.8° C	2.7° C	5.9° C	3.3° C	6.6° C	3.6° C
	1,100° C			7.0° C	2.9° C	5.9° C	3.3° C	6.6° C	3.7° C
	1,200° C			7.4° C	3.2° C	5.9° C	3.4° C	6.7° C	3.8° C
	1,300° C					6.0° C	3.5° C	6.8° C	3.9° C
	1,400° C					6.1° C	3.7° C	6.9° C	4.1° C
	1,500° C					6.3° C	3.8° C	7.2° C	4.3° C
	1,600° C					6.5° C	4.0° C	7.5° C	4.5° C
Input dynamic (3)		-200..900° C		-270..1300° C		-50..1769° C		-50..1769° C	
Legend:									
(1)	These values appear in the middle of the thermocouple range.								
(2)	IC: ambient temperature of the TSX AEY 414 (20° C) and automatic internal compensation. EC: ambient temperature of the TSX AEY 414 (30° C) and class A Pt100 automatic external compensation.								
(3)	Internal compensation: ambient temperature = 20 ° C, External compensation: ambient temperature = 30 ° C.								

Reference standards:

- Thermocouple L: DIN 43710, December 1985 edition
- Thermocouple N: IEC 584-1, 2nd edition 1989 and IEC 584-2, 2nd edition 1989,
- Thermocouple R: IEC 584-1, 1st edition 1977 and IEC 584-2, 2nd edition 1989,
- Thermocouple S: IEC 584-1, 1st edition 1977 and IEC 584-2, 2nd edition 1989.

Thermocouple T and U

The table below shows the maximum precision error values for thermocouples T and U at 25° C.

Temperature		Thermocouple T		Thermocouple U	
Conversion resolution (1)		**0.046° C**		**0.038° C**	
View resolution		**0.1° C**		**0.1° C**	
Maximum error at 25° C (2)		**IC**	**EC**	**IC**	**EC**
Operating point	**-200° C**	18.3° C	3.2° C		
	-150° C	13.0° C	2.4° C		
	-100° C	10.3° C	2.0° C		
	-50° C	8.7° C	1.7° C		
	0° C	7.7° C	1.6° C	7.7° C	1.6° C
	50° C	7.1° C	1.5° C		
	100° C	6.6° C	1.5° C	6.7° C	1.5° C
	150° C	6.2° C	1.5° C		
	200° C	5.9° C	1.5° C	5.8° C	1.5° C
	250° C	5.7° C	1.5° C		
	300° C	5.6° C	1.5° C	5.4° C	1.5° C
	350° C	5.5° C	1.6° C		
	400° C			5.4° C	1.6° C
	500° C			5.2° C	1.6° C
	600° C			5.0° C	1.7° C
Input dynamic (3)		-270..400° C		-200..600° C	
Legend:					
(1)	These values appear in the middle of the thermocouple range.				
(2)	IC: ambient temperature of the TSX AEY 414 (20° C) and automatic internal compensation. EC: ambient temperature of the TSX AEY 414 (30° C) and class A Pt100 automatic external compensation.				
(3)	Internal compensation: ambient temperature = 20 ° C, External compensation: ambient temperature = 30 ° C.				

Reference standards:

- Thermocouple U: DIN 43710, December 1985 edition,
- Thermocouple T: IEC 584-1, 1st edition 1977 and IEC 584-2, 2nd edition 1989.

Characteristics of the TSX AEY 414 Thermocouple Range in Degrees Fahrenheit

At a Glance

The following tables show the errors of the measuring chain for the different thermocouples B, E, J, K, N, R, S and T in degrees Fahrenheit. These values take into account:

- The precision values given below are valid regardless of the type of cold junction compensation: TELEFAST or Pt100 class A.
- The cold junction temperature considered in the precision calculation is 77° F.
- The resolution is given with a mid-range operating point.
- The precision values include: electrical errors on the acquisition system for input channels and cold junction compensation, software errors and interchangeability errors on the cold junction compensation sensors. Thermocouple sensor errors are not taken into account.

Thermocouples B, E, J and K

The table below shows the maximum precision error values for thermocouples B, E, J and K at 77° F:

Temperature		Thermocouple B	Thermocouple E		Thermocouple J		Thermocouple K	
Maximum error at 77° F (1)		IC / EC (2)	IC	EC	IC	EC	IC	EC
Operating point	-300° F		26.4° F	4.3° F			28.5° F	5.1° F
	-100° F		15.8° F	2.9° F			15.7° F	3.1° F
	0° F				13.6° F	2.7° F		
	100° F		12.8° F	2.6° F			13.2° F	2.9° F
	200° F				12.7° F	2.8° F		
	300° F		11.6° F	2.6° F			13.7° F	3.2° F
	400° F				12.8° F	3.0° F		
	500° F		11.0° F	2.7° F			13.8° F	3.5° F
	600° F				13.1° F	3.3° F		
	700° F		10.9° F	2.9° F			13.8° F	3.7° F
	800° F				13.4° F	3.6° F		
Input dynamic		32..3276° F	-454..1493° F		-346..1949° F		-454..2502° F	
Legend:								
(1)	IC: ambient temperature of the TSX AEY 414 (68° F) and automatic internal compensation. EC: ambient temperature of the TSX AEY 414 (86° F) and class A Pt100 automatic external compensation.							
(2)	With thermocouple B, the type of cold junction compensation (internal or external) is not taken into account, as this has no effect on precision.							
(3)	Internal compensation: Ambient temperature = 68° F External compensation: Ambient temperature = 86° F							

Temperature		Thermocouple B	Thermocouple E		Thermocouple J		Thermocouple K	
Maximum error at 77° F (1)		**IC / EC (2)**	**IC**	**EC**	**IC**	**EC**	**IC**	**EC**
Operating point	**900° F**		11.1° F	3.2° F			13.9° F	4.0° F
	1000° F				13.4° F	3.9° F		
	1100° F	8.5° F	11.4° F	3.5° F			14.3° F	4.3° F
	1200° F				12.9° F	4.0° F		
	1300° F	7.3° F	11.8° C	3.9° F			14.7° F	4.7° F
	1400° F				12.5° F	4.0° F		
	1500° F	7.0° F	12.4° F	4.3° F			15.5° F	5.1° F
	1700° F	6.8° F					16.3° F	5.6° F
	1900° F	6.6° F					17.1° F	6.1° F
	2100° F	6.2° F					18.0° F	6.6° F
	2300° F	6.2° F					19.1° F	7.2° F
	2500° F	6.3° F						
	2700° F	6.4° F						
	2900° F	6.6° F						
	3100° F	7.0° F						
Input dynamic		32..3276° F	-454..1493° F		-346..1949° F		-454..2502° F	
Legend:								
(1)	**IC: ambient temperature of the TSX AEY 414 (68° F) and automatic internal compensation. EC: ambient temperature of the TSX AEY 414 (86° F) and class A Pt100 automatic external compensation.**							
(2)	**With thermocouple B, the type of cold junction compensation (internal or external) is not taken into account, as this has no effect on precision.**							
(3)	**Internal compensation: Ambient temperature = 68° F External compensation: Ambient temperature = 86° F**							

Thermocouple L, N, R and S

The table below shows the maximum precision error values for thermocouples L, N, R and S at 77° F:

Temperature		Thermocouple L		Thermocouple N		Thermocouple R		Thermocouple S	
Maximum error at 77° F (1)		IC	EC	IC	EC	IC	EC	IC	EC
Operating point	-300° F			29.4° F	6.0° F				
	-100° F			15.7° F	3.4° F				
	0° F	14.9° F	2.8° F			21.9° F	8.8° F	21.2° F	8.6° F
	100° F			13.5° F	3.3° F				
	200° F	13.1° F	2.7° F			14.8° F	6.4° F	15.1° F	6.5° F
	300° F			12.0° F	3.1° F				
	400° F	12.7° F	2.9° F			12.8° F	5.7° F	13.3° F	6.0° F
	500° F			11.2° F	3.2° F				
	600° F	13.0° F	3.2° F			11.9° F	5.6° F	12.3° F	5.5° F
	700° F			10.9° F	3.3° F				
	800° F	13.3° F	3.5° F			11.2° F	5.3° F	12.1° F	5.7° F
	900° F			10.9° F	3.5° F				
	1000° F	12.4° F	3.8° F			11.0° F	5.3° F	12.1° F	5.9° F
	1100° F			10.9° F	3.8° F				
	1200° F	12.3° F	4.0° F			10.8° F	5.4° F	12.1° F	6.0° F
	1300° F			11.1° F	4.0° F				
	1400° F	12.8° F	4.0° F			10.7° F	5.5° F	12.0° F	6.2° F
	1500° F	12.2° F	4.0° F	11.5° F	4.3° F				
	1600° F					10.5° F	5.6° F	11.9° F	6.3° F
	1700° F			11.9° F	4.7° F				
	1800° F					10.7° F	5.7° F	11.9° F	6.4° F
	1900° F			12.3° F	5.1° F				
	2000° F					10.6° F	6.0° F	3.9° F	2.3° F
	2100° F			13.0° F	5.5° F				
Input dynamic (2)		-328..1652° F		-454..2372° F		-58..3216° F		-58..3216° F	
Legend:									
(1)	IC: ambient temperature of the TSX AEY 414 (68° F) and automatic internal compensation. EC: ambient temperature of the TSX AEY 414 (86° F) and class A Pt100 automatic external compensation.								
(2)	Internal compensation: Ambient temperature = 68° F External compensation: Ambient temperature = 86° F								

Temperature		Thermocouple L		Thermocouple N		Thermocouple R		Thermocouple S	
Maximum error at 77° F (1)		**IC**	**EC**	**IC**	**EC**	**IC**	**EC**	**IC**	**EC**
Operating point	**2200° F**					10.5° F	6.1° F	3.9° F	2.3° F
	2300° F			13.7° F	6.0° F				
	2400° F					10.5° F	6.2° F	4.0° F	2.4° F
	2600° F					10.4° F	6.3° F	4.1° F	2.5° F
	2800° F					10.4° F	6.4° F	4.2° F	2.6° F
	3000° F					10.7° F	6.7° F	4.4° F	2.8° F
Input dynamic (2)		-328..1652° F		-454..2372° F		-58..3216° F		-58..3216° F	
Legend:									
(1)	**IC: ambient temperature of the TSX AEY 414 (68° F) and automatic internal compensation.** **EC: ambient temperature of the TSX AEY 414 (86° F) and class A Pt100 automatic external compensation.**								
(2)	**Internal compensation: Ambient temperature = 68° F** **External compensation: Ambient temperature = 86° F**								

Thermocouple T and U

The table below shows the maximum precision error values for thermocouples T and U at 77° F:

Temperature		Thermocouple T		Thermocouple U	
Maximum error at 77° F (1)		**IC**	**EC**	**IC**	**EC**
Operating point	**-300° F**	29.2° F	5.3° F		
	-200° F	21.1° F	4.0° F		
	-100° F	16.9° F	3.3° F		
	0° F	14.4° F	3.0° F	14.3° F	2.9° F
	100° F	13.0° F	2.8° F		
	200° F	11.9° F	2.7° F	12.3° F	2.8° F
	300° F	11.2° F	2.7° F		
	400° F	10.6° F	2.7° F	10.5° F	2.6° F
	500° F	10.3° F	2.7° F		
	600° F	10.0° F	2.7° F	9.8° F	2.7° F
	700° F	9.8° F	2.8° F		
	800° F			9.7° F	2.9° F
	1000° F			9.2° F	3.0° F
Input dynamic (2)		-454..752° F		-328..1112° F	
Legend:					
(1)	**IC: ambient temperature of the TSX AEY 414 (68° F) and automatic internal compensation.** **EC: ambient temperature of the TSX AEY 414 (86° F) and class A Pt100 automatic external compensation.**				
(2)	**Internal compensation: Ambient temperature = 68° F** **External compensation: Ambient temperature = 86° F**				

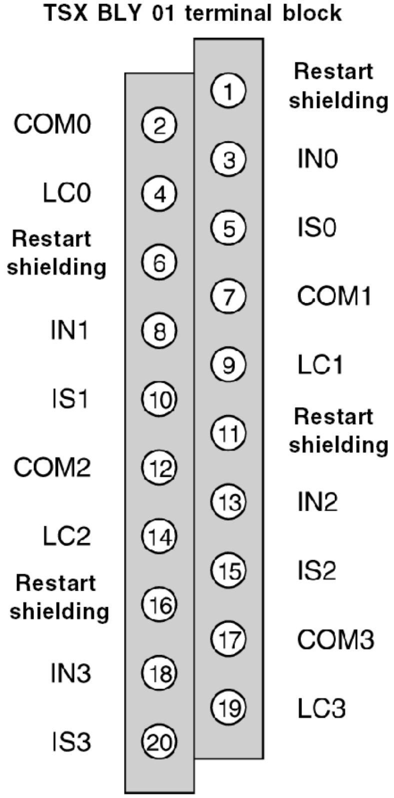
TSX AEY 414 Screw Terminal Block TSX BLY 01

At a Glance

The module TSX AEY 414 is connected using the screw terminal block TSX BLY 01.

Terminal Block Pins

The connections of theTSX BLY 01 screw terminal block are shown below:



INx + Pole input of channel x
COMx - Pole input of channel x
ISx + Pole supply of the probe
LCx Line compensation

Connecting Sensors on the TSX AEY 414

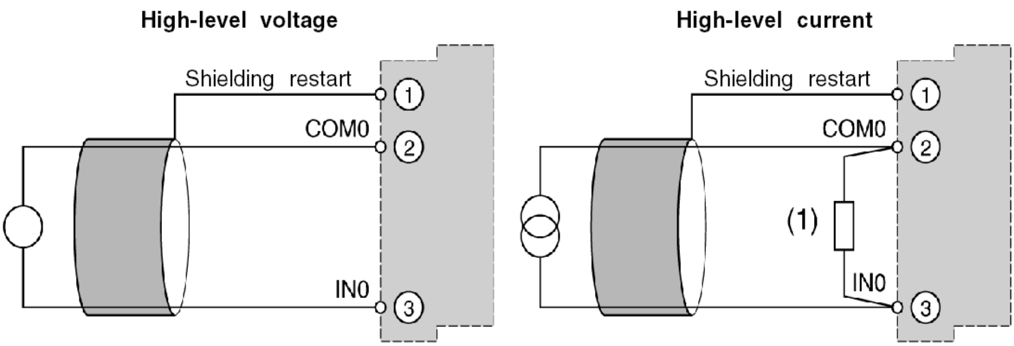
General

General recommendations:

- use shielded cables and link their shields to the terminals provided for this (Restart shielding),
- for high-level inputs and thermocouples, the "power source + wiring" resistance must be less than 100 Ohms so that the module performance is not impaired,
- for thermowell inputs (four threads installed), each of the threads must have a resistance less than 50 Ohms, which matches a brass wire of 0.6 mm diameter^2 and a maximum run, total length, of 3000 m,
- for Pt100 thermowell inputs, cabled as two wires, each of the wires must have a resistance lower than 50 mOhms (so that a measurement error due to Ohms loss in the cables is not introduced).

High-Level Sensors

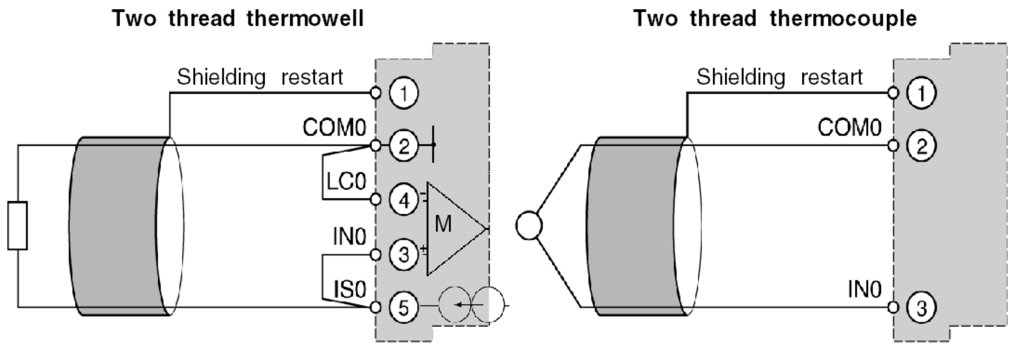
Wiring example for a high-level voltage and current sensor on channel 0:



(1) Using range 0.20 mA or 4.20 mA requires the recording of an external shunt of 250 Ohms – 0.1 % - 1/2 W - 25 ppm/° C, parallel on the input limits. This shunt provided with the module in the form of a batch of four, which can also be separately supplied under the reference TSX AAK2.

2 Thread Thermowell and 2 Thread Thermocouple

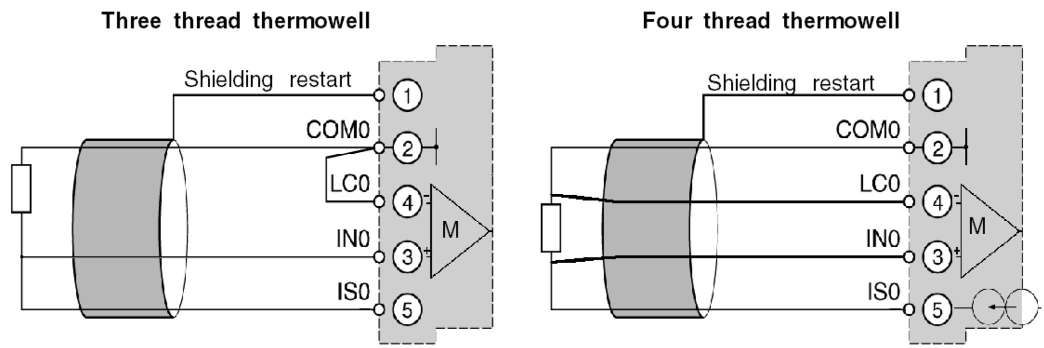
Wiring example for a 2 thread thermowell and a 2 thread thermocouple on channel 0:



M Measurement

3 and 4 Thread Thermowells

Wiring example for 3 and 4 thread thermowells on channel 0:



M Measurement

NOTE: The module TSX AEY 414 was not designed to interface with the three thread Pt100 probes (no compensation effect), but it is nevertheless possible to connect this type of probe according to the diagram above. The precision obtained is therefore the same as in a 2 thread installment.

Guidelines for Installing Thermocouples for the TSX AEY 414

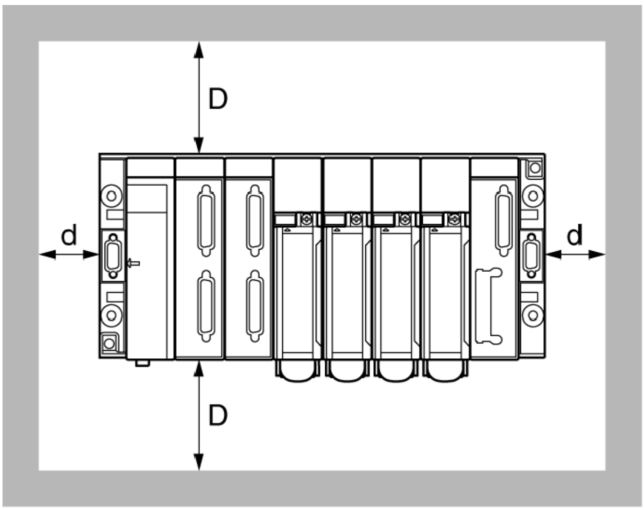
At a Glance

This section consists of guidelines for using a thermocouple with both internal and external cold junction compensation.

Using Internal Cold Junction Compensation

When measurements are made by thermocouple with cold junction compensation (and only in this case), it is advisable to abide by the following installation rules:

- PLC must not be directly ventilated, as there must be natural convection,
- Variations in ambient temperature may not exceed 5° C per hour,
- Contiguous modules must dissipate between 2.2 W and 3.3 W, which matches the most commonly used modules (TSX P57, TSX DEY 16D2, TSX DEY 32DK, TSX DEY 16FK, TSX DSY 16R5, TSX AEY 414, etc.),
- The TSX AEY 414 module must be installed in a PLC with a height clearance (D) of a minimum of 150 mm, and a width clearance (d) of 100 mm.



If these guidelines are followed, the module may be installed in the open, in a cabinet or case.

Failure to abide by the above installation guidelines will not prevent the module from functioning. However, the accuracy of the measurements on the configured inputs in the thermocouple range will be altered. In conditions of stable ventilation and with a set configuration, the measurement will simply be offset ny a stable value, for which you will be able to compensate, by proceeding to a "sensor alignment." See the Map Sensor Alignment for TSX AEY 414 *(see page 199)*

NOTE: Because thermocouple B is not affected by the cold junction compensation of 0 to 70° C, these installation constraints do not apply.

Using External Cold Junction Compensation

The use of a thermocouple with external cold junction compensation requires that the temperature of the cold junction compensation is acquired with a Pt100 class A probe on channel 0 (probe not provided). Channels 1, 2 and 3 of the module can then be used for thermocouple measurement.

In this configuration, there are no particular installation constraints for module TSX AEY 414. The Pt100 probe, however, must be located close to the wiring terminal.

Chapter 5
Analog Input Module TSX AEY 420

Aim of this Chapter

This chapter introduces the TSX AEY 420 module, its characteristics and its connection to different sensors.

What Is in This Chapter?

This chapter contains the following topics:

Introducing the TSX AEY 420 Module

At a Glance

The TSX AEY 420 module is a high level 4-input industrial measurement device.

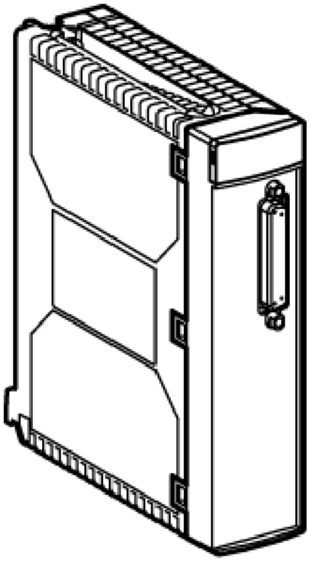
Used in conjunction with sensors or transmitters, it performs monitoring, measurement and continuous process control functions.

For each input, the TSX AEY 420 module provides a range of +/-10 V, 0..10 V, 0..5 V, 1..5 V, 0..20 mA or 4..20 mA, depending on selections made during configuration.

Illustration

The diagram below shows the TSX AEY 420 analog input module:

TSX AEY 420



Characteristics of the TSX AEY 420 Module

Introduction

This part presents general characteristics for the TSX AEY 420 module and characteristics of its analog inputs.

General characteristics

This table presents the general characteristics for the TSX AEY 420 module:

Type of inputs	High level inputs with common pulse
Type of inputs	Voltage / Current
Number of channels	4
Acquisition cycle time	1 ms for the 4 channels
Analog / Digital converter	16 bits (52,400 voltage pulses / 13,100 current pulses)
Monotonicity	Yes (for 15 bits)
Input filter	2nd order (Over-voltage coefficient = 0.5 V / Outage frequency at -6 dB = 3.4 kHz)
Insulation: ● **between channels** ● **between channels and bus** ● **between channels and ground**	 Common pulse 500 V rms 500 V rms
Isolation resistance under 500VDC between channel and ground	> 10 mOhms
Maximum over-voltage authorized for inputs	+/- 30 V in voltage +/- 30 mA in current
Common mode voltage between the channels and ground that is acceptable in operation	240 VAC rms 150 VDC
Rejection of common mode channel / ground (DC, 50 Hz, 60 Hz)	80 dB
Diaphony between channels	80 dB
Detection of cut wire	No (except for 4..20 mA range)
Maximum power dissipation	4 W
Standards	IEC 1131, CSA22.2, UL508

Input characteristics

This table presents the general characteristics for the analog inputs of the TSX AEY 420 module:

Electric range	**+/- 10 V and 0..10 V**	**+/0.5 V and 1..5 V**	**0..20 mA and 4..20 mA**
Full scale (FS)	10 V	5 V	20 mA
Resolution (1)	0.4 mV	0.4 mV	0.0015 mA
Input impedance: ● **switched on** ● **switched off**	 2.2 MOhms 10 kOhms	 2.2 MOhms 10 kOhms	 250 Ohms +/-0.1% 250 Ohms +/-0.1%
Maximum error at 25 °C	0.1 % of FS	0.2 % of FS	0.2 % of FS
Maximum error from 0 to 60 °C	0.2 % of FS	0.4 % of FS	0.4 % of FS
Temperature drift	30 ppm/°C	30 ppm/°C	60 ppm/°C
Range overrun	+/- 12.5V (+/-10V range) -2.5V..12.5V (0...10V range)	0..6.25V (0..5V range) 0..6V (1..5V range)	0..25mA (0..20mA range) 0..24mA (4..20mA range)
Precision of the conversion internal resistance	-	-	0.1 % -25 ppm/°C
Legend			
(1)	**Pulse resolution:** ● **52,400 pulses for the +/- 10 V range,** ● **26,200 pulses for the 0..10 V range,** ● **13,100 pulses for the 0..5 V and 0..20 mA ranges,** ● **10,400 pulses for the 1..5 V and 4..20 mA ranges**		

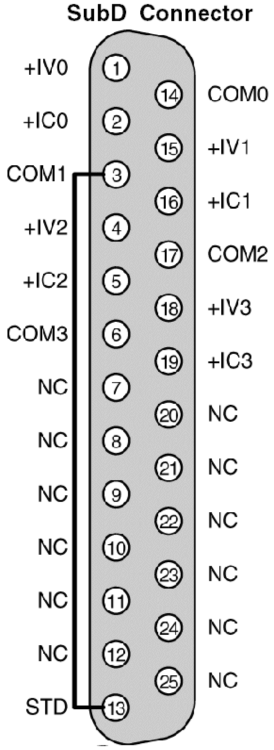
TSX AEY 420 Connector Pins

At a Glance

The TSX AEY 420 input module consists of a 25-pin Sub-D connector.

Connector Pins

The connector pins are shown below:



NC Pin not connected
+IVx + Pole voltage input of channel x
+ICx + Pole current input of channel x
COMx - Pole current or voltage input of channel x
STD The "strap" between pins 3 and 13 detects the unplugging of the connector.

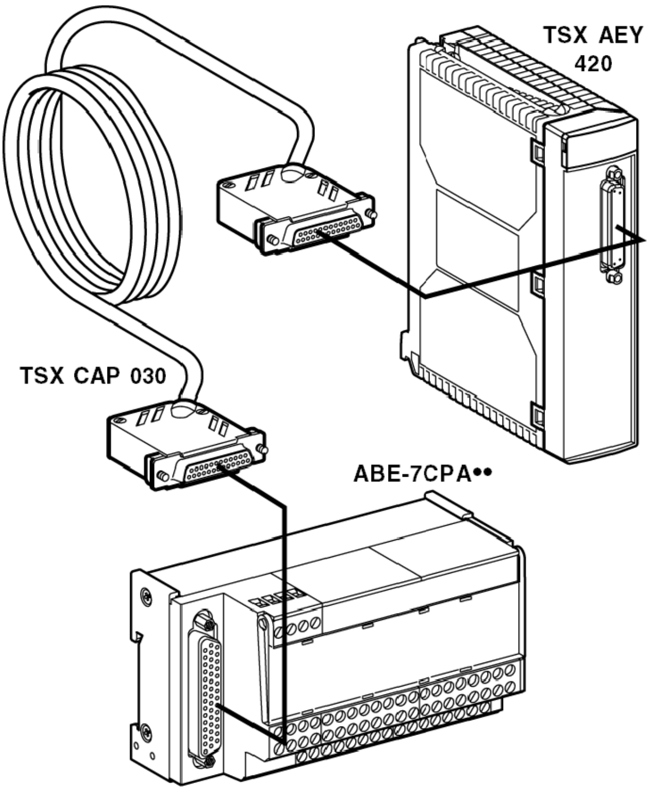
NOTE: The COM0, COM1, COM2, and COM3 pins are linked internally in the module.

TELEFAST 2 Pin Assignment for the TSX AEY 420 Module

At a Glance

The TSX AEY 420 analog module is connected to a TELEFAST 2 accessory using the TSX CAP 030 cable, which guarantees continuous shielding. There are several types of connection base:

- ABE-7CPA02 for connecting current or voltage inputs to a screw connector terminal block,
- ABE-7CPA03 with a 4-20 mA sensor loop power supply and a 25 mA limiter per channel,
- ABE-7CPA21 for connecting 4-channel analog modules to a screw connector terminal block.



ABE-7CPA02

The distribution of analog channels on TELEFAST 2 terminal blocks with the reference ABE-7CPA02 is as follows:

TELEFAST 2 terminal block number	25 pin SubD connector pin number	Signal type	TELEFAST 2 terminal block number	25 pin SubD connector pin number	Signal type
1	/	Ground	**Supp 1**	/	Ground
2	/	STD (1)	**Supp 2**	/	Ground
3	/	STD (1)	**Supp 3**	/	Ground
4	/	STD (2)	**Supp 4**	/	Ground
100	1	+IV0	**200**	14	COM0
101	2	+IC0	**201**	/	Ground
102	15	+IV1	**202**	3	COM1
103	16	+IC1	**203**	/	Ground
104	4	+IV2	**204**	17	COM2
105	5	+IC2	**205**	/	Ground
106	18	+IV3	**206**	6	COM3
107	19	+IC3	**207**	/	Ground
108	7	NC	**208**	20	NC
109	8	NC	**209**	/	Ground
110	21	NC	**210**	9	NC
111	22	NC	**211**	/	Ground
112	10	NC	**212**	23	NC
113	11	NC	**213**	/	Ground
114	24	NC	**214**	12	NC
115	25	NC	**215**	/	Ground
Legend					
NC	**Terminal not connected**				
+IVx	**+ pole voltage input for channel x**				
+ICx	**+ pole current input for channel x**				
COMx	**- pole voltage or current input for channel x**				

NOTE: Removal of the connector is detected by a strap linking terminal blocks STD (1) and STD (2).

NOTE: For the ground connection use the additional terminal block ABE-7BV20.

ABE-7CPA03

The distribution of analog channels on TELEFAST 2 terminal blocks with the reference ABE-7CPA03 is as follows:

TELEFAST 2 terminal block number	25 pin SubD connector pin number	Signal type	TELEFAST 2 terminal block number	25 pin SubD connector pin number	Signal type
1	/	0 V	**Supp 1**	/	24 V (sensor supply)
2	/	0 V	**Supp 2**	/	24 V (sensor supply)
3	/	0 V	**Supp 3**	/	0 V (sensor supply)
4	/	0 V	**Supp 4**	/	0 V (sensor supply)
100	/	IS1	**200**	/	IS0
101	15	+IV1	**201**	1	+IV0
102	16	+IC1	**202**	2	+IC0
103	/	Ground	**203**	14/3	COM0 / COM1
104	/	IS3	**204**	/	IS2
105	18	+IV3	**205**	4	+IV2
106	19	+IC3	**206**	5	+IC2
107	/	Ground	**207**	17/6	COM2 / COM3
108	/	NC	**208**	/	IS4 or IS12
109	21	NC	**209**	7	NC
110	22	NC	**210**	8	NC
111	/	Ground	**211**	20/9	NC
112	/	NC	**212**	/	NC
113	24	NC	**213**	10	NC
114	25	NC	**214**	11	NC
115	/	Ground	**215**	23/12	NC
Legend					
NC	**Terminal not connected**				
ISx	**24 V power supply for channel x**				
+IVx	**+ pole voltage input for channel x**				
+ICx	**+ pole current input for channel x**				
COMx	**- pole voltage or current input for channel x**				

NOTE: For the ground connection use the additional terminal block ABE-7BV10.

ABE-7CPA21

The distribution of analog channels on TELEFAST 2 terminal blocks with the reference ABE-7CPA21 is as follows:

TELEFAST 2 terminal block number	25 pin SubD connector pin number	Signal type	TELEFAST 2 terminal block number	25 pin SubD connector pin number	Signal type
1	/	Ground	**Supp 1**	/	Ground
2	/	STD (1)	**Supp 2**	/	Ground
3	/	STD (1)	**Supp 3**	/	Ground
4	/	STD (2)	**Supp 4**	/	Ground
100	1	+IV0	**200**	14	COM0
101	2	+IC0	**201**	/	Ground
102	15	+IV1	**202**	3	COM1
103	16	+IC1	**203**	/	Ground
104	4	+IV2	**204**	17	COM2
105	5	+IC2	**205**	/	Ground
106	18	+IV3	**206**	6	COM3
107	19	+IC3	**207**	/	Ground
Legend					
+IVx		**+ pole voltage input for channel x**			
+ICx		**+ pole current input for channel x**			
COMx		**- pole voltage or current input for channel x**			

NOTE: Removal of the connector is detected by a strap linking terminal blocks STD (1) and STD (2).

NOTE: For the ground connection use the additional terminal block ABE-7BV10.

Chapter 6
Analog Input Module TSX AEY 800

Aim of this Chapter

This chapter introduces the TSX AEY 800 module, its characteristics and its connection to different sensors.

What Is in This Chapter?

This chapter contains the following topics:

Introduction to the TSX AEY 800 module

At a Glance

The TSX AEY 800 module is a high level 8 input industrial measurement device. Associated with sensors or transmitters.

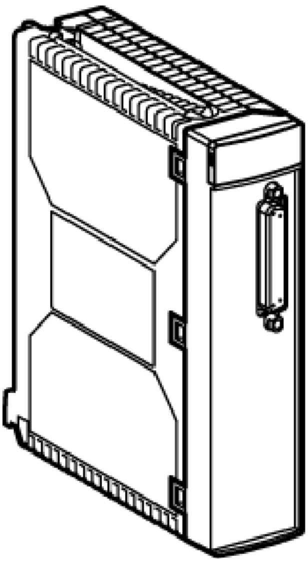
It performs monitoring, measurement and continuous processes control functions.

For each of its inputs, the TSX AEY 800 module offers the range +/-10 V, 0..10 V, 0..5 V, 1..5 V, 0..20 mA or 4..20 mA, according to the selection made at configuration.

Illustration

The following diagram shows the analog input module TSX AEY 800 :

TSX AEY 800



Characteristics of the TSX AEY 800 Module

Introduction

This part presents general characteristics for the TSX AEY 800 module and characteristics of its analog inputs.

General Characteristics

This table presents the general characteristics for the TSX AEY 800 module:

Type of inputs	High level inputs with common pulse
Type of inputs	Voltage / Current
Number of channels	8
Acquisition cycle time: ● **Fast (periodic acquisition for the declared channels used)** ● **Normal (periodic acquisition for all channels)**	(Number of channels used + 1) x 3 ms) 27 ms
Analog / Digital converter	12 bits (3719 voltage pulses / 3836 current pulses)
Digital filtering	1^{st} order (time constant from 0 to 3.44s)
Insulation: ● **between channels** ● **between channels and bus** ● **between channels and ground**	Common pulse 1000 V rms 1000 V rms
Isolation resistance under 500VDC between channel and ground	> 10 mOhms
Maximum over-voltage authorized for inputs	+/- 30 V in voltage +/- 30 mA in current
Maximum power dissipation	1.9 W
Standards	IEC 1131

Measurement Range

This table shows the measurement range processed by the TSX AEY 800 module analog inputs:

Measurement range	+/- 10 V and 0..10 V	+/0.5 V and 1..5 V	0..20 mA and 4..20 mA
Full scale (FS)	10 V	5 V	20 mA
Resolution	5.38 mV	1.34 mV	0.00521 mA
Voltage input impedance	10 MOhms	10 MOhms	250 Ohms
Maximum error at 25 °C	0.19 % of FS	0.15 % of FS	0.25 % of FS
Maximum error from 0 to 60 °C	0.22 % of FS	0.22 % of FS	0.41 % of FS
Temperature drift	20 ppm/°C	20 ppm/°C	45 ppm/°C

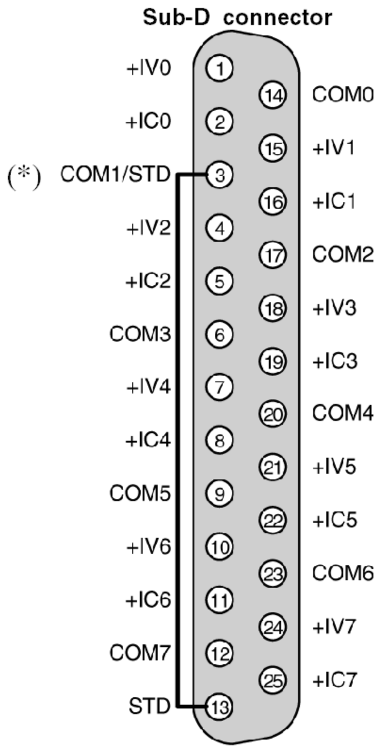
Pin Assignment for the TSX AEY 800 Connector

At a Glance

The TSX AEY 800 input module is composed of a Sub-D 25 pin connector.

Connector Pin Assignment

The pin assignment of the connector is shown below:



+IVx + pole voltage input for channel x
+ICx + pole current input for channel x
COMx - pole voltage or current input for channel x
(*) STD The strap between pins 3 and 13 enables any removal of the connector to be detected.

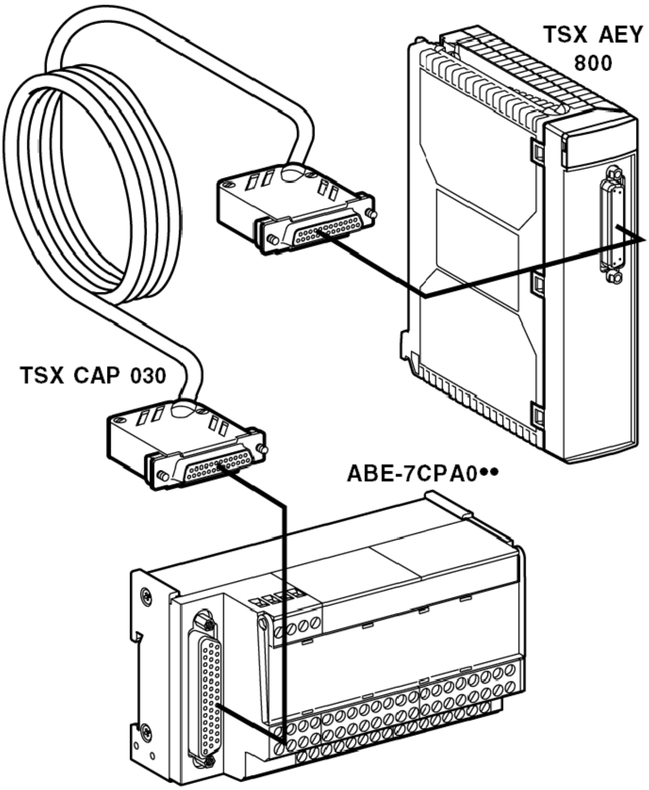
NOTE: The COMx pins are connected internally in the module.

TELEFAST 2 Pin Assignment for the TSX AEY 800 Module

At a Glance

The TSX AEY 800 analog module is connected to a TELEFAST 2 accessory through the TSX CAP030 cable which guarantees continuous shielding. There are several types of connection base:

- ABE-7CPA02 for connecting current and voltage inputs to a screw connector terminal block,
- ABE-7CPA03 with a 4-20 mA sensor loop power supply and a 25 mA limiter per channel.



ABE-7CPA02

The distribution of analog channels on TELEFAST 2 terminal blocks with the reference ABE-7CPA02 is as follows:

TELEFAST 2 terminal block number	25 pin SubD connector pin number	Signal type	TELEFAST 2 terminal block number	25 pin SubD connector pin number	Signal type
1	/	Ground	**Supp 1**	/	Ground
2	/	STD (1)	**Supp 2**	/	Ground
3	/	STD (1)	**Supp 3**	/	Ground
4	/	STD (2)	**Supp 4**	/	Ground
100	1	+IV0	**200**	14	COM0
101	2	+IC0	**201**	/	Ground
102	15	+IV1	**202**	3	COM1
103	16	+IC1	**203**	/	Ground
104	4	+IV2	**204**	17	COM2
105	5	+IC2	**205**	/	Ground
106	18	+IV3	**206**	6	COM3
107	19	+IC3	**207**	/	Ground
108	7	+IV4	**208**	20	COM4
109	8	+IC4	**209**	/	Ground
110	21	+IV5	**210**	9	COM5
111	22	+IC5	**211**	/	Ground
112	10	+IV6	**212**	23	COM6
113	11	+IC6	**213**	/	Ground
114	24	+IV7	**214**	12	COM7
115	25	+IC7	**215**	/	Ground
Legend					
+IVx	+ pole voltage input for channel x				
+ICx	+ pole current input for channel x				
COMx	- pole voltage or current input for channel x				

NOTE: Removal of the connector is detected by a strap linking terminal blocks STD (1) and STD (2).

NOTE: For the ground connection use the additional terminal block ABE-7BV20.

ABE-7CPA03

The distribution of analog channels on TELEFAST 2 terminal blocks with the reference ABE-7CPA03 is as follows:

TELEFAST 2 terminal block number	25 pin SubD connector pin number	Signal type	TELEFAST 2 terminal block number	25 pin SubD connector pin number	Signal type
1	/	0 V	**Supp 1**	/	24 V (sensor supply)
2	/	0 V	**Supp 2**	/	24 V (sensor supply)
3	/	0 V	**Supp 3**	/	0 V (sensor supply)
4	/	0 V	**Supp 4**	/	0 V (sensor supply)
100	/	IS1	**200**	/	IS0
101	15	+IV1	**201**	1	+IV0
102	16	+IC1	**202**	2	+IC0
103	/	Ground	**203**	14/3	COM0 / COM1
104	/	IS3	**204**	/	IS2
105	18	+IV3	**205**	4	+IV2
106	19	+IC3	**206**	5	+IC2
107	/	Ground	**207**	17/6	COM2 / COM3
108	/	IS5	**208**	/	IS4
109	21	+IV5	**209**	7	+IV4
110	22	+IC5	**210**	8	+IC4
111	/	Ground	**211**	20/9	COM4 / COM5
112	/	IS7	**212**	/	IS6
113	24	+IV7	**213**	10	+IV6
114	25	+IC7	**214**	11	+IC6
115	/	Ground	**215**	23/12	COM6 / COM7
Legend					
ISx	24 V channel power supply				
+IVx	+ pole voltage input for channel x				
+ICx	+ pole current input for channel x				
COMx	- pole voltage or current input for channel x				

NOTE: For the ground connection use the additional terminal block ABE-7BV10.

Chapter 7
Analog Input Module TSX AEY 810

Aim of this Chapter

This chapter introduces the TSX AEY 810 module, its characteristics and its connection to different sensors.

What Is in This Chapter?

This chapter contains the following topics:

Introducing the TSX AEY 810 module

At a Glance

The TSX AEY 810 module is a high level 8 isolated input industrial measurement device.

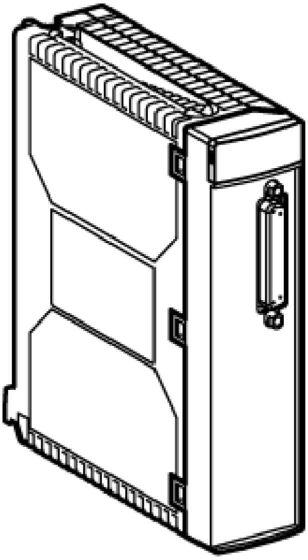
It is associated with sensors or transmitters, and performs monitoring, measurement and continuous process functions.

For each of its inputs, the TSX AEY 810 module offers the ranges +/-10 V, 0..10 V, 0..5 V, 1..5 V, 0..20 mA or 4..20 mA, according to the selection made in configuration.

Illustration

The following diagram shows the analog input module TSX AEY 810 :

TSX AEY 810



Characteristics of the TSX AEY 810 Module

Introduction

This part presents general characteristics for the TSX AEY 810 module and characteristics of its analog inputs.

General Characteristics

This table presents the general characteristics for the TSX AEY 810 module:

Type of inputs	High level isolated inputs
Type of inputs	Voltage / Current
Number of channels	8
Acquisition cycle time: ● **Fast (periodic acquisition for the declared channels used)** ● **Normal (periodic acquisition for all channels)**	(Number of channels used + 1) x 3.3 ms) 29.7 ms
Analog / Digital converter	16 bits (49090 voltage pulses / 24545 current pulses)
Digital filtering	1st order (time constant from 0 to 3.82s)
Insulation: ● **between channels** ● **between channels and bus** ● **between channels and ground**	+/- 200 VDC 1000 V rms 1000 V rms
Isolation resistance under 500VDC between channel and ground	> 10 mOhms
Maximum over-voltage authorized for inputs	+/- 30 V in voltage +/- 30 mA in current
Maximum power dissipation	3.15 W
Standards	IEC1131, CSA222, UL508

Measurement Range

This table shows the measurement range processed by the TSX AEY 810 module analog inputs:

Measurement range	+/- 10 V and 0..10 V	+/0.5 V and 1..5 V	0..20 mA and 4..20 mA
Full scale (FS)	10 V	5 V	20 mA
Resolution	0.406 mV	0.203 mV	812 mA
Voltage input impedance	10 MOhms	10 MOhms	250 Ohms
Maximum error at 25 °C	0.244 % of FS	0.13 % of FS	0.142 % of FS
Maximum error from 0 to 60 °C	0.305 % of FS	0.191 % of FS	0.212 % of FS
Temperature drift	15.3 ppm/°C	15.3 ppm/°C	17.5 ppm/°C

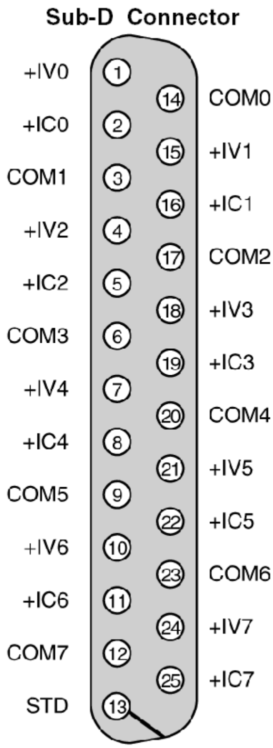
Pin Assignment for the TSX AEY 810 Connector

At a Glance

The TSX AEY 810 input module consists of a 25-pin Sub-D connector.

Connector Pins

The connector pins are shown below:



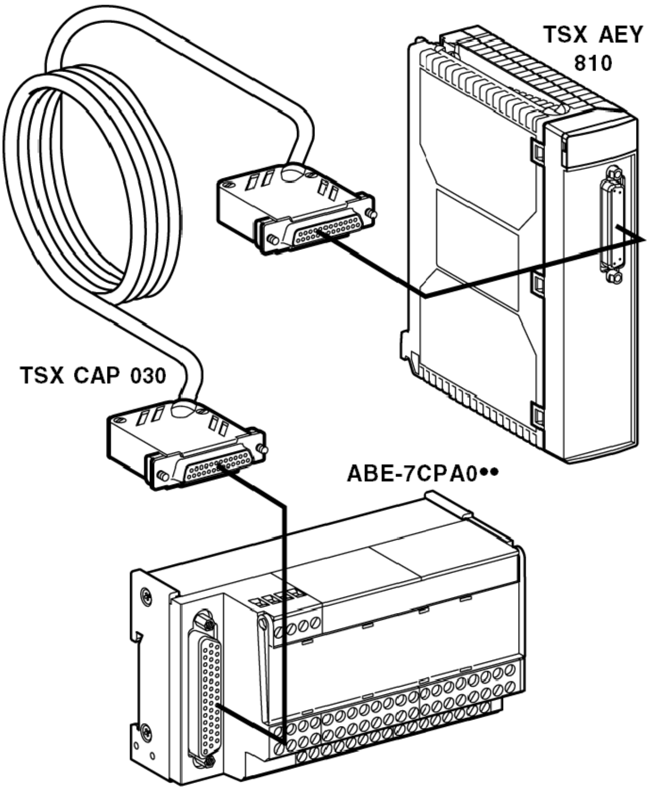
+IVx + Pole voltage input of channel x
+ICx + Pole current input of channel x
COMx - Pole current or voltage input of channel x
STD The "strap" between pin 13 and the ground (using a cover) is used to detect connector unpinning.

TELEFAST 2 Pin Assignment for the TSX AEY 810 Module

At a Glance

The TSX AEY 810 analog module is connected to a TELEFAST 2 accessory through the TSX CAP 030 which guarantees continuous shielding. There are several types of connection base:

- ABE-7CPA02 for connecting current, voltage inputs to a screw connector terminal block,
- ABE-7CPA31 with isolated power supply for 4..20 mA sensor loops for 8 isolated input channels.



ABE-7CPA02

The distribution of analog channels on TELEFAST 2 terminal blocks with the reference ABE-7CPA02 is as follows:

TELEFAST 2 terminal block number	25 pin SubD connector pin number	Signal type	TELEFAST 2 terminal block number	25 pin SubD connector pin number	Signal type
1	/	Ground	**Supp 1**	/	Ground
2	/	STD (1)	**Supp 2**	/	Ground
3	/	STD (1)	**Supp 3**	/	Ground
4	/	STD	**Supp 4**	/	Ground
100	1	+IV0	**200**	14	COM0
101	2	+IC0	**201**	/	Ground
102	15	+IV1	**202**	3	COM1
103	16	+IC1	**203**	/	Ground
104	4	+IV2	**204**	17	COM2
105	5	+IC2	**205**	/	Ground
106	18	+IV3	**206**	6	COM3
107	19	+IC3	**207**	/	Ground
108	7	+IV4	**208**	20	COM4
109	8	+IC4	**209**	/	Ground
110	21	+IV5	**210**	9	COM5
111	22	+IC5	**211**	/	Ground
112	10	+IV6	**212**	23	COM6
113	11	+IC6	**213**	/	Ground
114	24	+IV7	**214**	12	COM7
115	25	+IC7	**215**	/	Ground
Legend					
+IVx	**+ pole voltage input for channel x**				
+ICx	**+ pole current input for channel x**				
COMx	**- pole voltage or current input for channel x**				

NOTE: Removal of the connector pin is detected by a strap linking terminal block STD (1) and the ground (TELEFAST 2 terminal block No. 1).

NOTE: For the ground connection use the additional terminal block ABE-7BV20.

ABE-7CPA31

The distribution of analog channels on TELEFAST 2 terminal blocks with the reference ABE-7CPA31 is as follows:

TELEFAST 2 terminal block number	25 pin SubD connector pin number	Signal type	TELEFAST 2 terminal block number	25 pin SubD connector pin number	Signal type
1	/	Ground	**Supp 1**	/	24 V (sensor supply)
2	/	Ground	**Supp 2**	/	24 V (sensor supply)
3	/	Ground	**Supp 3**	/	0 V (sensor supply)
4	/	Ground	**Supp 4**	/	0 V (sensor supply)
100	/	IS0	**116**	/	IS4
101	1	+IV0	**117**	7	+IV4
102	2	+IC0	**118**	8	+IC4
103	14	0 V	**119**	20	0 V
104	/	IS1	**120**	/	IS5
105	15	+IV1	**121**	21	+IV5
106	16	+IC1	**122**	22	+IC5
107	3	0 V	**123**	9	0 V
108	/	IS2	**124**	/	IS6
109	4	+IV2	**125**	10	+IV6
110	5	+IC2	**126**	11	+IC6
111	17	0 V	**127**	23	0 V
112	/	IS3	**128**	/	IS7
113	18	+IV3	**129**	24	+IV7
114	19	+IC3	**130**	25	+IC7
115	6	0 V	**131**	12	0 V
Legend					
ISx	**24 V channel power supply**				
+IVx	**+ pole voltage input for channel x**				
+ICx	**+ pole current input for channel x**				
COMx	**- pole voltage or current input for channel x**				

NOTE: The TELEFAST 2 ABE-7CPA31 is pre-equipped with the strap necessary for detecting the terminal block.

NOTE: For the ground connection use the additional terminal block ABE-7BV10.

Chapter 8
Analog Input Module TSX AEY 1600

Aim of this Chapter

This chapter introduces the TSX AEY 1600 module, its characteristics and its connection to different sensors.

What Is in This Chapter?

This chapter contains the following topics:

Introducing the TSX AEY 1600 module

At a Glance

The TSX AEY 1600 module is a high level 16 input industrial measurement device.

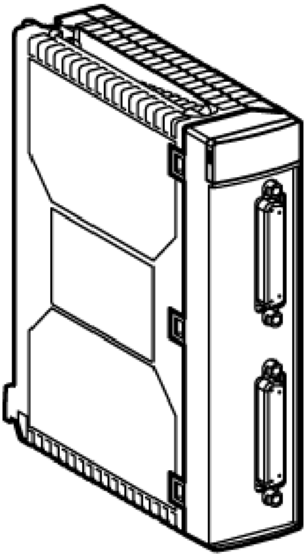
It is associated with sensors or transmitters, and performs monitoring, measurement and continuous process functions.

For each of its inputs, the TSX AEY 1600 module offers the range +/-10 V, 0..10 V, 0..5 V, 1..5 V, 0..20 mA or 4..20 mA, according to the selection made in configuration.

Illustration

The following diagram shows the analog input module TSX AEY 1600 :

TSX AEY 1600



Characteristics of the TSX AEY 1600 Module

Introduction

This part presents general characteristics for the TSX AEY 1600 module and characteristics of its analog inputs.

General Characteristics

This table presents the general characteristics for the TSX AEY 1600 module:

Type of inputs	High level inputs with common pulse
Type of inputs	Voltage / Current
Number of channels	16
Acquisition cycle time: ● **Fast (periodic acquisition for the declared channels used)** ● **Normal (periodic acquisition for all channels)**	(Number of channels used + 1) x 3 ms) 51 ms
Analog / Digital converter	12 bits (3719 voltage pulses / 3836 current pulses)
Digital filtering	1st order (time constant from 0 to 6.5s)
Insulation: ● **between channels** ● **between channels and bus** ● **between channels and ground**	Common pulse 1000 V rms 1000 V rms
Isolation resistance under 500VDC between channel and ground	> 10 mOhms
Maximum over-voltage authorized for inputs	+/- 30 V in voltage +/- 30 mA in current
Maximum power dissipation	1.9 W
Standards	IEC 1131

Measurement Range

This table shows the measurement range processed by the TSX AEY 1600 module analog inputs:

Measurement range	**+/- 10 V and 0..10 V**	**+/0.5 V and 1..5 V**	**0..20 mA and 4..20 mA**
Full scale (FS)	10 V	5 V	20 mA
Resolution	5.38 mV	1.34 mV	0.00521 mA
Voltage input impedance	10 MOhms	10 MOhms	250 Ohms
Maximum error at 25 ° C	0.1 % of FS	0.1 % of FS	0.16 % of FS
Maximum error from 0 to 60 ° C	0.13 % of FS	0.13 % of FS	0.32 % of FS
Temperature drift	20 ppm/° C	20 ppm/° C	45 ppm/° C

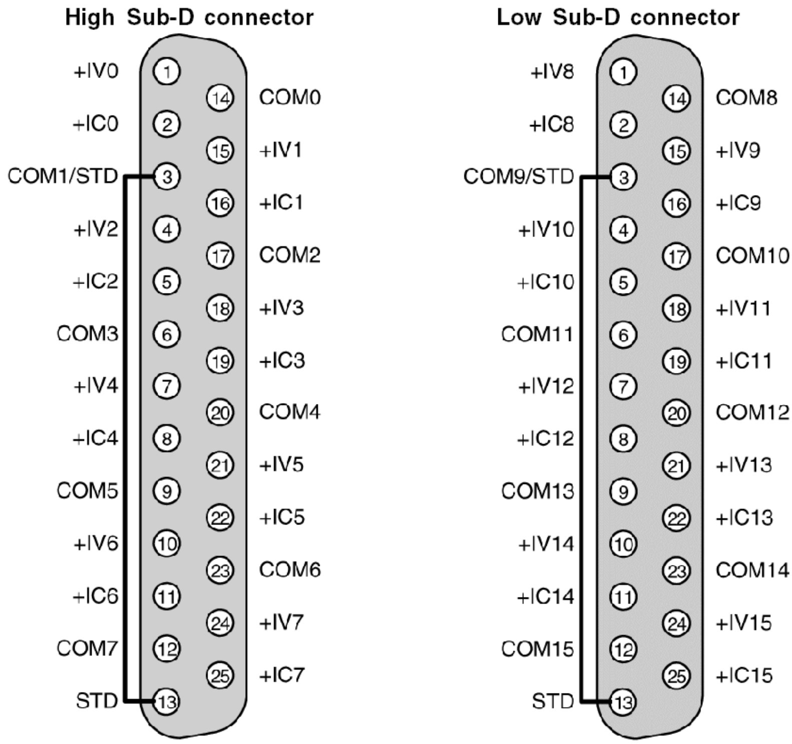
Pin Assignment for the TSX AEY 1600 Connector

At a Glance

The TSX AEY 1600 input module consists of two 25-pin Sub-D connectors.

Connector Pins

The connector pins are shown below:



+IVx + Pole voltage input of channel x
+ICx + Pole current input of channel x
COMx - Pole current or voltage input of channel x
STD The "strap" between pins 3 and 13 detects the unplugging of the connector.

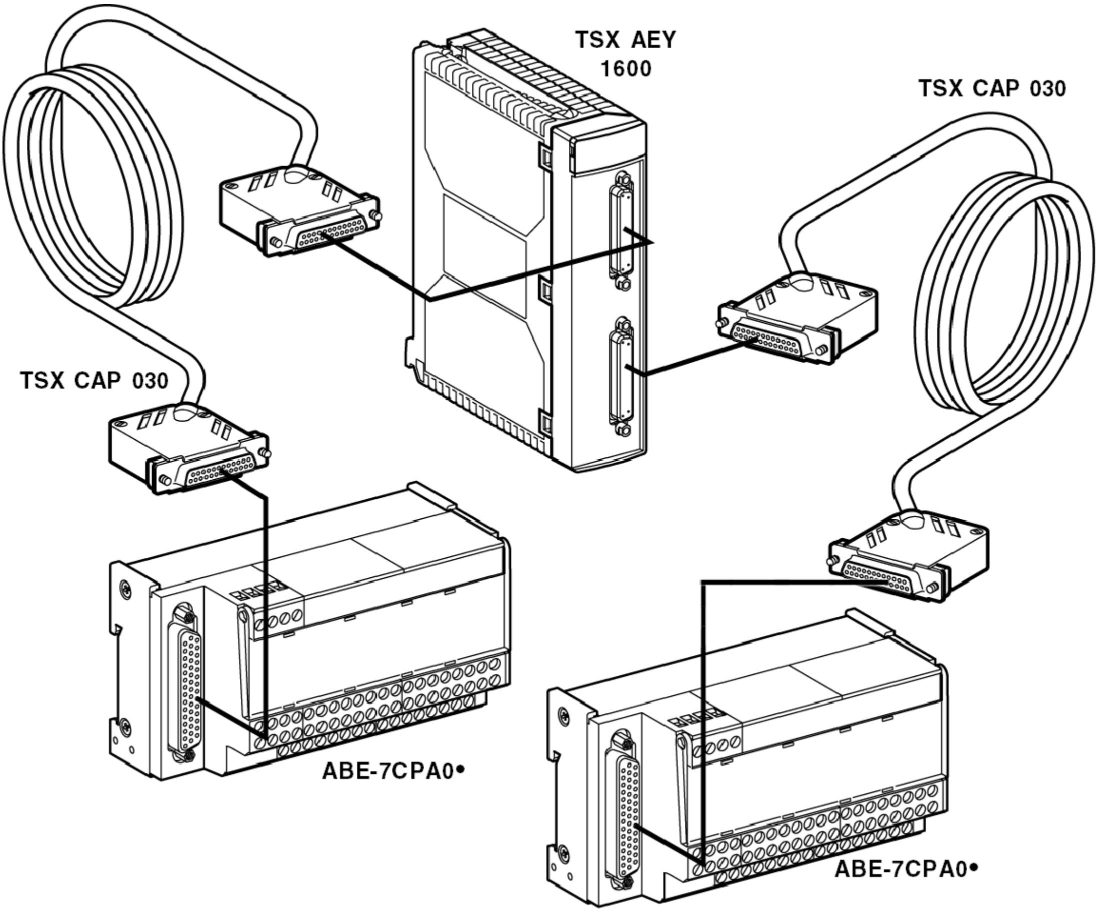
NOTE: The COMx pins are linked internally in the module.

TELEFAST 2 Pin Assignment for the TSX AEY 1600 Module

At a Glance

The TSX AEY 1600 analog module is connected to a TELEFAST 2 accessory through the TSX CAP 030 which guarantees continuous shielding. There are several types of connection base:

- ABE-7CPA02 for connecting current or voltage to a screw connector terminal block,
- ABE-7CPA03 with a 4-20 mA sensor loop power supply and a 25 mA limiter per channel.



ABE-7CPA02

The distribution of analog channels on TELEFAST 2 terminal blocks with the reference ABE-7CPA02 is as follows:

TELEFAST 2 terminal block number	25 pin SubD connector pin number	Signal type	TELEFAST 2 terminal block number	25 pin SubD connector pin number	Signal type
1	/	Ground	**Supp 1**	/	Ground
2	/	STD (1)	**Supp 2**	/	Ground
3	/	STD (1)	**Supp 3**	/	Ground
4	/	STD (2)	**Supp 4**	/	Ground
100	1	+IV0 or +IV8	**200**	14	COM0 or COM8
101	2	+IC0 or +IC8	**201**	/	Ground
102	15	+IV1 or +IV9	**202**	3	COM1 or COM9
103	16	+IC1 or +IC9	**203**	/	Ground
104	4	+IV2 or +IV10	**204**	17	COM2 or COM10
105	5	+IC2 or +IC10	**205**	/	Ground
106	18	+IV3 or +IV11	**206**	6	COM3 or COM11
107	19	+IC3 or +IC11	**207**	/	Ground
108	7	+IV4 or +IV12	**208**	20	COM4 or COM12
109	8	+IC4 or +IC12	**209**	/	Ground
110	21	+IV5 or +IV13	**210**	9	COM5 or COM13
111	22	+IC5 or +IC13	**211**	/	Ground
112	10	+IV6 or +IV14	**212**	23	COM6 or COM14
113	11	+IC6 or +IC14	**213**	/	Ground
114	24	+IV7 or +IV15	**214**	12	COM7 or COM15
115	25	+IC7 or +IC15	**215**	/	Ground
Legend					
+IVx	**+ pole voltage input for channel x**				
+ICx	**+ pole current input for channel x**				
COMx	**- pole voltage or current input for channel x**				

NOTE: Removal of the connector is detected by a strap linking terminal blocks STD (1) and STD (2).

NOTE: For the ground connection use the additional terminal block ABE-7BV20.

ABE-7CPA03

The distribution of analog channels on TELEFAST 2 terminal blocks with the reference ABE-7CPA03 is as follows:

TELEFAST 2 terminal block number	25 pin SubD connector pin number	Signal type	TELEFAST 2 terminal block number	25 pin SubD connector pin number	Signal type
1	/	0 V	**Supp 1**	/	24 V (sensor supply)
2	/	0 V	**Supp 2**	/	24 V (sensor supply)
3	/	0 V	**Supp 3**	/	0 V (sensor supply)
4	/	0 V	**Supp 4**	/	0 V (sensor supply)
100	/	IS1 or IS9	**200**	/	IS0 or IS8
101	15	+IV1 or +IV9	**201**	1	+IV0 or +IV8
102	16	+IC1 or +IC9	**202**	2	+IC0 or +IC8
103	/	Ground	**203**	14/3	COM0 / COM1 or COM8 / COM9
104	/	IS3 or IS11	**204**	/	IS2 or IS10
105	18	+IV3 or +IV11	**205**	4	+IV2 or +IV10
106	19	+IC3 or +IC11	**206**	5	+IC2 or +IC10
107	/	Ground	**207**	17/6	COM2 / COM3 or COM10 / COM11
108	/	IS5 or IS13	**208**	/	IS4 or IS12
109	21	+IV5 or +IV13	**209**	7	+IV4 or +IV12
110	22	+IC5 or +IC13	**210**	8	+IC4 or +IV12
111	/	Ground	**211**	20/9	COM4 / COM5 or COM12 / COM13
112	/	IS7 or IS15	**212**	/	IS6 or IS14
113	24	+IV7 or +IC15	**213**	10	+IV6 or +IV14
114	25	+IC7 or +IC15	**214**	11	+IC6 or +IC14
115	/	Ground	**215**	23/12	COM6 / COM7 or COM14 / COM15
Legend					
ISx	**24 V channel power supply**				
+IVx	**+ pole voltage input for channel x**				
+ICx	**+ pole current input for channel x**				
COMx	**- pole voltage or current input for channel x**				

NOTE: For the ground connection use the additional terminal block ABE-7BV10.

Chapter 9
Analog Input Module TSX AEY 1614

Aim of this Chapter

This chapter introduces the TSX AEY 1614 module, its characteristics and its connection to different sensors.

What Is in This Chapter?

This chapter contains the following topics:

Introducing the TSX AEY 1614 module

At a Glance

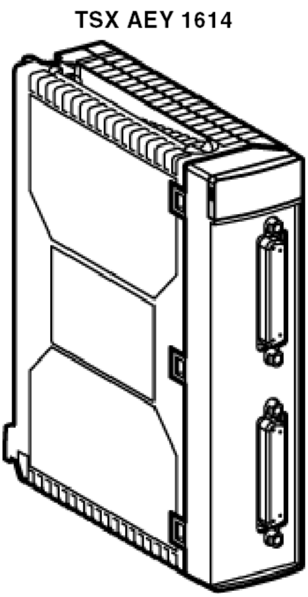
The TSX AEY 1614 module is a 16 thermocouple input industrial measurement device.

This module offers the following range for each of its inputs according to the selection made at configuration :

- thermocouple B, E, J, K, L, N, R, S, T or U,
- voltage +/-80 mV.

Illustration

The following diagram shows the analog input module TSX AEY 1614 :



NOTE: The TELEFAST 2 accessory referenced ABE-7CPA12 facilitates connection and provides an integrated cold junction compensation device.

Characteristics of the TSX AEY 1614 Module

At a Glance

This section describes the general characteristics of the TSX AEY 1614 module.

General Characteristics

The following table shows the general characteristics of the TSX AEY 1614 module:

Input types	Thermocouple inputs
Nature of inputs	Multi-range
Number of channels	16
Acquisition cycle time: ● **Fast (periodic acquisition of channels designated as being In Use)** ● **Normal (periodic acquisition of all channels)**	 Number of dual channels used x 70ms (1) 1120 ms
Analog / Digital converter	16 bits (0...65535 points)
Wiring test	8 ms
Digital filtering	1^{st} order (time constant = 0 to 128 x module cycle time)
Insulation: ● **between channels** ● **between channels and bus** ● **between channels and ground**	 100 V rms 1000 V rms 1000 V rms
Insulation resistance below 500VDC between channel and ground	> 10 mOhms
Input impedance	> 10 mOhms
Linearization	Automatic
Max. voltage surge allowed in differential mode on inputs	+/-30 VDC
Common mode voltage allowed in operation: ● **between channels** ● **between channels and ground**	 250 VDC or 280 VAC 240 VAC
Common mode rejection between channels and ground	110 dB (VDC-VAC 50/60 Hz)
Series mode rejection at 50/60 Hz	100 dB
Cold junction compensation: ● **on TELEFAST2** ● **external Pt100 class A on channel 0**	 between -5 and +60° C between -5 and +85° C

Max. line resistance for the wiring test	500 Ohms
Max. power dissipation	2 W
PLC standards	IEC1131, IEC801, IEC68, UL508, UL94
Electrical range	+/-80 mV
Sensor standards	IEC584, IEC751, DIN43760, DIN43710, NFC42-330
Legend:	
(1)	This calculation does not take any test into account. For further information, please refer to the following manual: *(see page 170)*

Characteristics of the Thermocouple Ranges for the TSX AEY 1614

At a Glance

The following tables show the measurement string errors for the different thermocouples B, E, J, K, N, R, S and T. These values take into account the following :

- The accuracies below are valid regardless of the type of cold junction compensation: TELEFAST 2 or Class A Pt100.
- The cold junction temperature is taken as 25° C in the accuracy calculations.
- Resolution is given with an operating point in the middle of the range.
- The accuracies include : electrical errors on the input channels and cold junction compensation acquisition string, software errors, interchangeability errors on the cold junction compensation sensors. The thermocouple sensor error is not taken into account.

To convert to degrees Fahrenheit, use the formula:

$$T_{\text{Farenheit}} = \frac{9}{5} \times T_{\text{Celcius}} + 32$$

Thermocouple B

Dynamic: 42.20° C to 1819.70° C

Resolution 0.088° C

Temperature		Error at 60° C High precision mode	Error at 60° C Normal mode	Error at 25° C
Operating point	**600° C**	5.7° C	24.8° C	3.6° C
	700° C	5.1° C	21.7° C	3.2° C
	800° C	4.7° C	19.6° C	3.0° C
	900° C	4.4° C	17.9° C	2.7° C
	1000° C	4.2° C	16.6° C	2.6° C
	1100° C	4.0° C	15.6° C	2.5° C
	1200° C	3.9° C	14.8° C	2.4° C
	1300° C	3.8° C	14.2° C	2.3° C
	1400° C	3.7° C	13.8° C	2.2° C
	1500° C	3.7° C	13.5° C	2.2° C
	1600° C	3.8° C	13.5° C	2.2° C
	1700° C	3.8° C	13.6° C	2.2° C

Thermocouple E

Dynamic: -260.60° C to 990.90° C

Resolution 0.031° C

Temperature		Error at 60° C High precision mode	Error at 60° C Normal mode	Error at 25° C
Operating point	**-200° C**	2.1° C	6.6° C	1.3° C
	-100° C	1.4° C	3.9° C	1.0° C
	0° C	1.1° C	3.1° C	0.9° C
	100° C	1.1° C	2.8° C	0.9° C
	200° C	1.2° C	2.7° C	0.8° C
	300° C	1.2° C	2.6° C	0.8° C
	400° C	1.2° C	2.7° C	0.8° C
	500° C	1.3° C	2.7° C	0.8° C
	600° C	1.4° C	2.8° C	0.8° C
	700° C	1.5° C	2.9° C	0.9° C
	1000° C	1.7° C	3.2° C	0.9° C

Thermocouple J

Dynamic: -270.70° C to 1199.40° C

Resolution: 0.044° C

Temperature		Error at 60° C High precision mode	Error at 60° C Normal mode	Error at 25° C
Operating point	**-200° C**	2.3° C	7.5° C	1.4° C
	-100° C	1.5° C	4.2° C	1.0° C
	0° C	1.2° C	3.5° C	0.9° C
	100° C	1.3° C	3.3° C	0.9° C
	200° C	1.3° C	3.4° C	0.9° C
	300° C	1.6° C	3.4° C	0.9° C
	400° C	1.4° C	3.5° C	0.9° C
	500° C	1.5° C	3.5° C	0.9° C
	600° C	1.5° C	3.5° C	0.9° C
	700° C	1.5° C	3.4° C	0.9° C
	1000° C	1.8° C	3.7° C	0.9° C
	1100° C	1.9° C	3.9° C	1.0° C
	1200° C	2.0° C	4.0° C	1.0° C

Thermocouple K

Dynamic: -263.90° C to 1371.30° C

Resolution: 0.036° C

Temperature		Error at 60° C High precision mode	Error at 60° C Normal mode	Error at 25° C
Operating point	**-200° C**	2.9° C	10.3° C	1.8° C
	-100° C	1.7° C	5.4° C	1.2° C
	0° C	1.4° C	4.1° C	1.0° C
	100° C	1.4° C	4.1° C	1.0° C
	100° C	1.5° C	4.3° C	1.0° C
	300° C	1.5° C	4.3° C	1.0° C
	400° C	1.6° C	4.3° C	1.0° C
	500° C	1.6° C	4.3° C	1.0° C
	600° C	1.7° C	4.4° C	1.0° C
	700° C	1.8° C	4.5° C	1.1° C
	800° C	1.9° C	4.7° C	1.1° C
	900° C	2.0° C	4.8° C	1.1° C
	1000° C	2.1° C	5.0° C	1.1° C
	1100° C	2.2° C	5.2° C	1.1° C
	1200° C	2.4° C	5.5° C	1.2° C

Thermocouple N

Dynamic: -245.90° C to 1298.60° C

Resolution: 0.04° C

Temperature		Error at 60° C High precision mode	Error at 60° C Normal mode	Error at 25° C
Operating point	**-200° C**	4.0° C	15.4° C	2.4° C
	-100° C	2.1° C	7.6° C	1.4° C
	0° C	1.8° C	6.1° C	1.3° C
	100° C	1.7° C	5.5° C	1.2° C
	100° C	1.6° C	5.1° C	1.1° C
	300° C	1.6° C	4.8° C	1.1° C
	400° C	1.7° C	4.7° C	1.1° C
	500° C	1.7° C	4.7° C	1.1° C
	600° C	1.7° C	4.7° C	1.1° C
	700° C	1.8° C	4.7° C	1.1° C
	800° C	1.9° C	4.8° C	1.1° C
	900° C	2.0° C	4.9° C	1.1° C
	1000° C	2.0° C	5.0° C	1.1° C
	1100° C	2.1° C	5.1° C	1.1° C
	1200° C	2.1° C	5.3° C	1.1° C

Thermocouple R

Dynamic: -48.30° C to 1768.90° C

Resolution: 0.061° C

Temperature		Error at 60° C High precision mode	Error at 60° C Normal mode	Error at 25° C
Operating point	**0° C**	6.1° C	27.6° C	4.0° C
	100° C	4.6° C	19.7° C	3.0° C
	100° C	4.0° C	16.8° C	2.6° C
	300° C	3.8° C	15.4° C	2.4° C
	400° C	3.6° C	14.6° C	2.3° C
	500° C	3.6° C	14.0° C	2.3° C
	600° C	3.5° C	13.5° C	2.2° C
	700° C	3.5° C	13.0° C	2.1° C
	800° C	3.4° C	12.6° C	2.1° C
	900° C	3.4° C	12.3° C	2.0° C
	1000° C	3.4° C	11.9° C	2.0° C
	1100° C	3.3° C	11.7° C	2.0° C
	1200° C	3.4° C	11.5° C	1.9° C
	1300° C	3.4° C	11.4° C	1.9° C
	1400° C	3.4° C	11.5° C	1.9° C
	1500° C	3.5° C	11.6° C	1.9° C
	1600° C	3.6° C	11.8° C	2.0° C

Thermocouple S

Dynamic: -48.60° C to 1768.10° C

Resolution: 0.069° C

Temperature		Error at 60° C High precision mode	Error at 60° C Normal mode	Error at 25° C
Operating point	**0° C**	6.0° C	27.0° C	3.9° C
	100° C	4.6° C	20.1° C	3.0° C
	200° C	4.2° C	17.6° C	2.7° C
	300° C	4.0° C	16.4° C	2.6° C
	400° C	3.9° C	15.7° C	2.5° C
	500° C	3.8° C	15.3° C	2.4° C
	600° C	3.8° C	14.9° C	2.4° C
	700° C	3.8° C	14.5° C	2.3° C
	800° C	3.7° C	14.2° C	2.3° C
	900° C	3.7° C	13.9° C	2.2° C
	1000° C	3.7° C	13.5° C	2.2° C
	1100° C	3.7° C	13.3° C	2.2° C
	1200° C	3.7° C	13.1° C	2.1° C
	1300° C	3.8° C	13.1° C	2.1° C
	1400° C	3.8° C	13.2° C	2.1° C
	1500° C	3.9° C	13.3° C	2.2° C
	1600° C	4.0° C	13.6° C	2.2° C

Thermocouple T

Dynamic: -265.70° C to 399.70° C

Resolution: 0.017° C

Temperature		Error at 60° C High precision mode	Error at 60° C Normal mode	Error at 25° C
Operating point	**-200° C**	2.7° C	9.9° C	1.7° C
	-100° C	1.7° C	5.7° C	1.2° C
	0° C	1.3° C	4.3° C	1.0° C
	100° C	1.3° C	3.7° C	1.0° C
	200° C	1.3° C	3.4° C	0.9° C
	300° C	1.3° C	3.2° C	0.9° C
	400° C	1.3° C	3.1° C	0.9° C

Characteristics of the +/-80 mV Range

At a Glance

The following table gives the measurement string errors for the +/-80 mV range.

Table of Measurement String Errors

Dynamic: -265.70° C to 399.70° C

Resolution: 0.017° C

Voltage	Error at 60° C High precision mode	Error at 60° C High precision mode in micro V	Error at 25° C in micro V
0 mV	30,637	144,037	19,262
1 mV	31,331	144,731	19,324
2 mV	32,025	145,425	19,386
3 mV	32,719	146,119	19,448
4 mV	33,413	146,813	19,510
5 mV	34,107	147,507	19,572
6 mV	34,801	148,201	19,634
7 mV	35,495	148,895	19,696
8 mV	36,189	149,589	19,758
9 mV	36,883	150,283	19,820
10 mV	37,577	150,977	19,882
11 mV	38,271	151,671	19,944
12 mV	38,965	152,365	20,006
13 mV	39,659	153,059	20,068
14 mV	40,353	153,753	20,130
15 mV	41,047	154,447	20,192
16 mV	41,741	155,141	20,254
17 mV	42,435	155,835	20,316
18 mV	43,129	156,529	20,378
19 mV	43,823	157,223	20,440
20 mV	44,517	157,917	20,502
21 mV	45,211	158,611	20,564
22 mV	45,905	159,305	20,626
23 mV	46,599	159,999	20,688
24 mV	47,293	160,693	20,750
25 mV	47,987	161,387	20,812

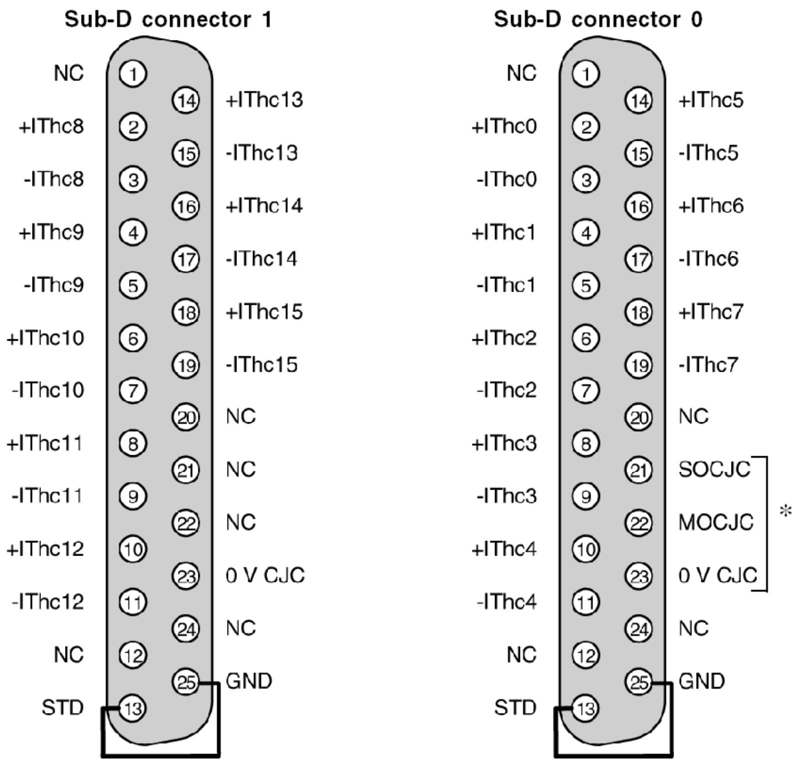
Pin Assignment for the TSX AEY 1614 Connector

At a Glance

The TSX AEY 1614 input module is composed of 2 x 25 point Sub-D connectors, the pin assignment of which is shown below:

Connector Pin Assignment

The connector pins are shown below:



NC Pin not connected
+IThcx + input of the thermocouple for channel x
-IThcx - input of the thermocouple for channel x
SOCJC Power supply output for internal cold junction compensation by TELEFAST
MOCJC Input for internal cold junction compensation measurement by TELEFAST
STD The strap between pins 13 and 25 enables any removal of the connector to be detected.
* For internal cold junction compensation

Connecting the TSX AEY 1614 Sensors

General

We recommend that shielded cables be used. The shielding is connected on one side, as close as possible to the terminal. Preferably, use terminal ABE-7BV10 or ABE-7BV20 to connect the shielding.

Use with TELEFAST

NOTE: For use with TELEFAST, reference number ABE-7CPA12, the terminal block detection strap is built in as standard in the TELEFAST.

Internal cold junction compensation:

is performed in the TELEFAST by a temperature probe (silicon).

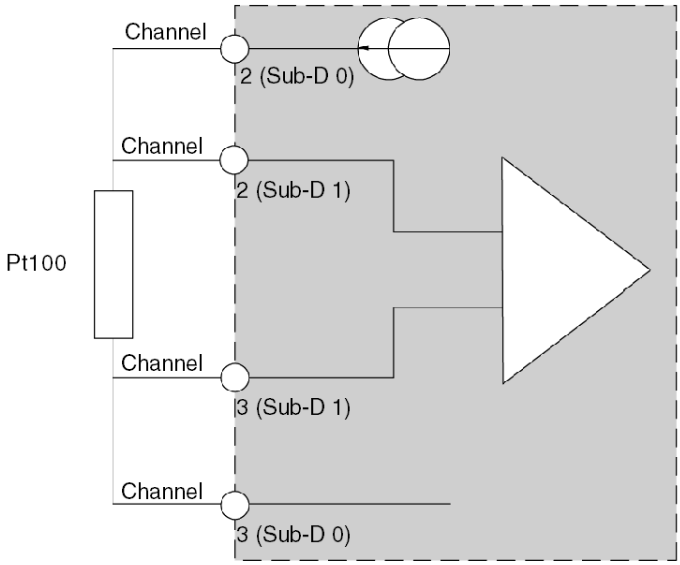
If this compensation mode is chosen, no specific wiring has to be performed. Simply connect the TELEFAST to the module using lead TSX CAP 030. In this case, the 16 channels can be wired as thermocouples.

Use Without TELEFAST

External cold junction compensation using an external Pt 100 probe:

when connecting directly to the SUB-D connectors, it is the user's responsibility to connect a Pt 100 probe (4 wires) to measure the terminal block temperature. In this case, the "external cold junction compensation" mode must be selected and channels 0 and 8 dedicated to this measurement. Channel 0 delivers the current to the Pt100 probe, and channel 8 performs the high impedance measurement.

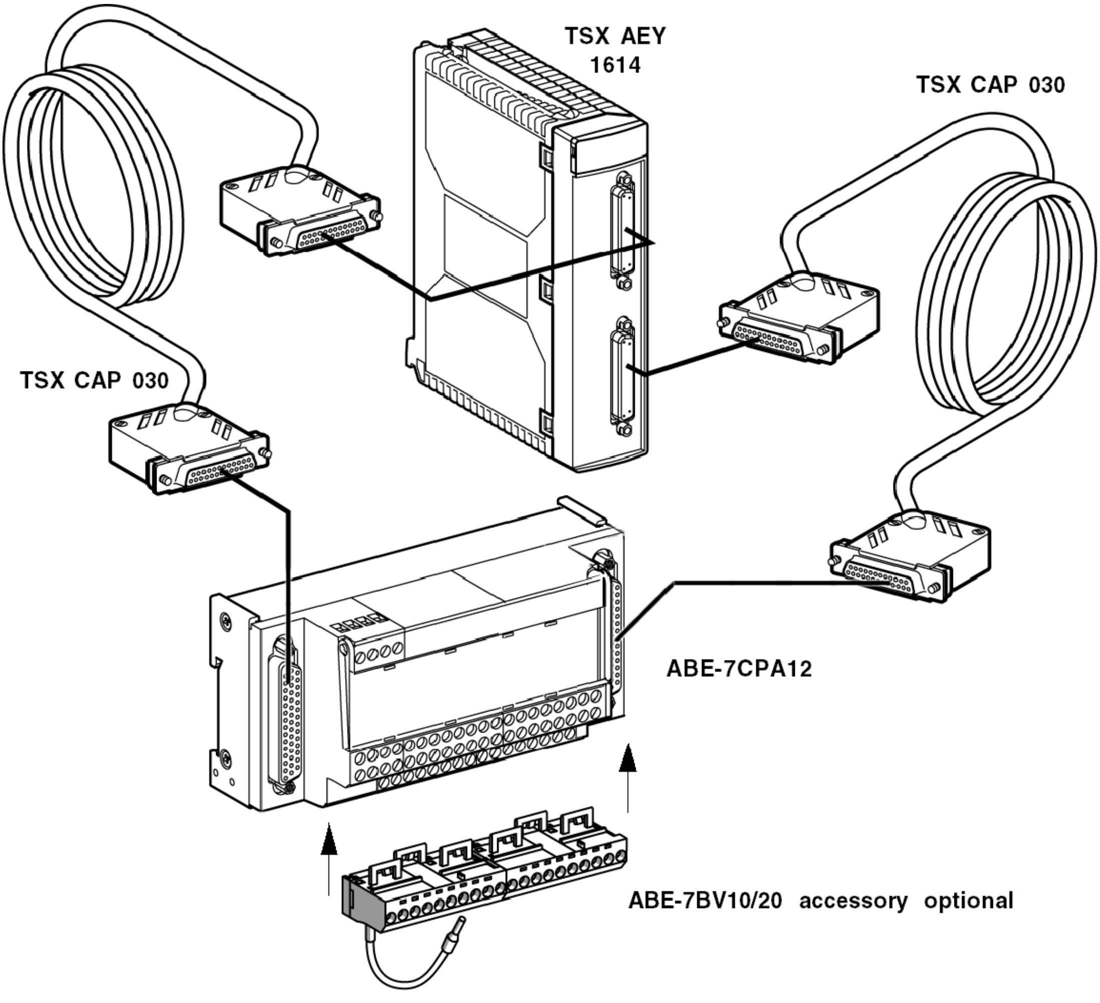
In this case, only 14 thermocouple channels can be wired. The wiring should be carried out as follows:



TELEFAST 2 Pin Assignment for the TSX AEY 1614 Module

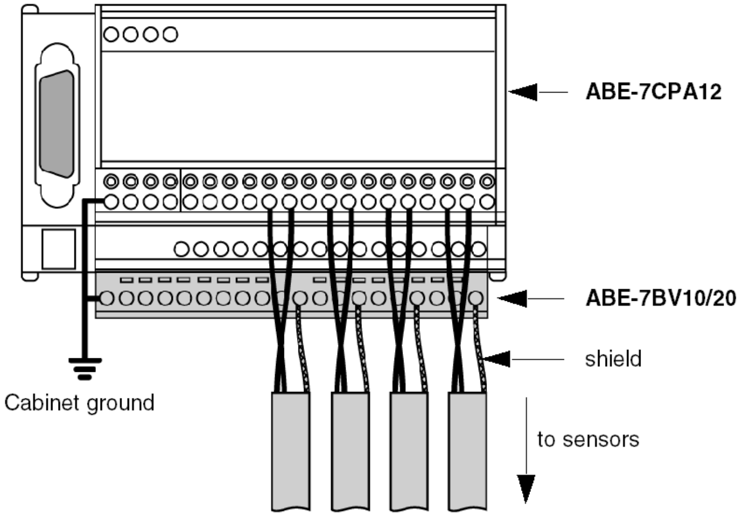
At a Glance

The TSX AEY 1614 analog module is connected to a TELEFAST 2 ABE-7CPA12 using a TSX CAP 030 cable which guarantees continuous shielding. This accessory is a connection base used for connecting 16 thermocouples.



Description of Cabling the ABE-7BV••

The diagram below describes how the cable shielding is linked to the terminal



NOTE: If you do not have the ABE-7BV10/20 connecting strip, the shielding must be connected to the TELEFAST ground terminals, and one of the terminals to the cabinet ground.

ABE-7CPA12

The distribution of analog channels on TELEFAST 2 terminal blocks with the reference ABE-7CPA12 is as follows:

TELEFAST 2 terminal block number	25 pin SubD connector pin number	Signal type	TELEFAST 2 terminal block number	25 pin SubD connector pin number	Signal type
1	/	Ground	**11**	/	Ground
2	/	Ground	**12**	/	Ground
3	/	Ground	**13**	/	Ground
4	/	Ground	**14**	/	Ground
100	2 (Sub D0)	IThc+ V0 / PT100_+supply	**200**	10 (Sub D0)	IThc+ V4
101	3 (Sub D0)	IThc- V0 / PT100_-supply	**201**	11 (Sub D0)	IThc- V4
102	4 (Sub D0)	IThc+ V1	**202**	14 (Sub D0)	IThc+ V5
103	5 (Sub D0)	IThc- V1	**203**	15 (Sub D0)	IThc- V5
104	6 (Sub D0)	IThc+ V2	**204**	16 (Sub D0)	IThc+ V6
105	7 (Sub D0)	IThc- V2	**205**	17 (Sub D0)	IThc- V6
106	8 (Sub D0)	IThc+ V3	**206**	18 (Sub D0)	IThc+ V7
107	9 (Sub D0)	IThc- V3	**207**	19 (Sub D0)	IThc- V7
108	2 (Sub D1)	IThc+ V8 / PT100_+measurement	**208**	10 (Sub D1)	IThc+ V12
109	3 (Sub D1)	IThc- V8 / PT100_-measurement	**209**	11 (Sub D1)	IThc- V12
110	4 (Sub D1)	IThc+ V9	**210**	14 (Sub D1)	IThc+ V13
111	5 (Sub D1)	IThc- V9	**211**	15 (Sub D1)	IThc- V13
112	6 (Sub D1)	IThc+ V10	**212**	16 (Sub D1)	IThc+ V14
113	7 (Sub D1)	IThc- V10	**213**	17 (Sub D1)	IThc- V14
114	8 (Sub D1)	IThc+ V11	**214**	18 (Sub D1)	IThc+ V15
115	9 (Sub D1)	IThc- V11	**215**	19 (Sub D1)	IThc- V15
Legend					
+IThcx	**+ input of the thermocouple for channel x**				
-IThcx	**- input of the thermocouple for channel x**				

Chapter 10
Analog Output Module TSX ASY 800

Aim of this Chapter

This chapter introduces the TSX ASY 800 module, its characteristics and its connection to different pre-actuators and actuators.

What Is in This Chapter?

This chapter contains the following topics:

Introducing the TSX ASY 800 module

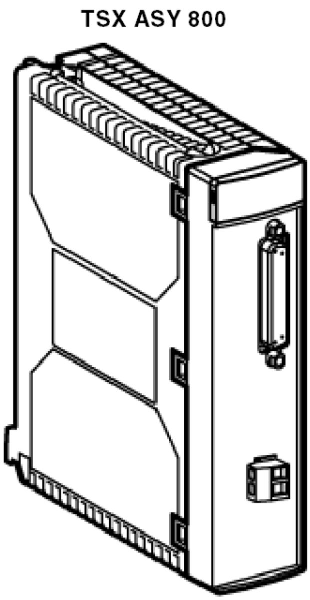
At a Glance

The TSX module ASY 800 is a module with 8 shared outputs. The following ranges are offered for each output:

- voltage +/- 10 V
- current 0..20 mA and 4.. 20 mA

Illustration

The following diagram shows the analog input module TSX ASY 800 :



NOTE: if the modules TSX ASY 800 are supplied by internal 24 V (TSX PSY •••), the number of modules is reduced to :
- 1 per rack with simple format or standard supply,
- 2 per rack with double format supply.

Characteristics of the TSX ASY 800 Module

Introduction

This part presents general characteristics for the TSX ASY 800 module and characteristics of its analog outputs.

General Characteristics

This table presents the general characteristics for the TSX ASY 800 module:

Type of outputs	Common pulse outputs
Nature of outputs	Voltage / Current
Number of channels	8
Output refresh time	5 ms
Power supply for outputs	provided by the PLC or external 24 V supply
Types of protection	Short circuits and overloads
Insulation: ● **between channels** ● **between channels and bus** ● **between channels and ground**	 Common pulse 1000 V rms 1000 V rms
Isolation resistance under 500VDC between channel and ground	> 10 mOhms
Diaphony between channels	-80 dB
Monotonicity	Yes
Non linearity	<= 1 LSB
RC network ground connection	R = 50 MOhms, C = 4.7 nF
Dissipated power: ● **typical** ● **maximum**	 5 W 6.1 W

Voltage Outputs

This table presents the general characteristics for the TSX ASY 800 module voltage outputs:

Voltage output dynamic	+/- 10.5 V
Full scale (FS)	10 V
Max voltage without damaging the voltage outputs	+/- 30 V
Load impedance	1 KOhm minimum
Capacitative load	< 100 nF
Maximum resolution:	1.28 mV to +/- 10 V
Measuring error: ● **at 25° C** ● **from 0 to 60° C**	 +/- 0.14 % of FS +/- 0.28 % of FS (26 ppm/° C)

Current Outputs

This table presents the general characteristics for the TSX ASY 800 module current outputs:

Current output dynamic	21 mA
Full scale (FS)	20 mA
Max voltage without damaging the voltage outputs	+/- 30 V
Load impedance	600 Ohms maximum
Inductance load	< 0.3 mH
Maximum resolution:	0.00256 mA
Measuring error: ● **at 25° C** ● **from 0 to 60° C**	 +/- 0.21 % of FS (1) +/- 0.52 % of FS (64 ppm/° C)
Maximum leakage current	0.033 mA
Legend	
(1) Precision calculated in a ventilated cabinet (in a non-ventilated cabinet, the precision is: 0.32 % of FS.	

External Supply

This table shows the characteristics needed for calculating an external supply:

Characteristics	24 V +/- 5 % ripple of 1 V maximum
Cable	Shielded cable
Power consumption: ● **typical** ● **maximum**	 300 mA 455 mA
Connection	Removable screw terminal block

NOTE: Important:
- If the ambient temperature is greater than 50° C, the TSX ASY 800 module must be ventilated.
- If an external power supply is used, it must be VLSV (very low safety voltage). Examples of VLSV power supply: TSX SUP 1011/1021/1051/1101 and TSX SUP A05.

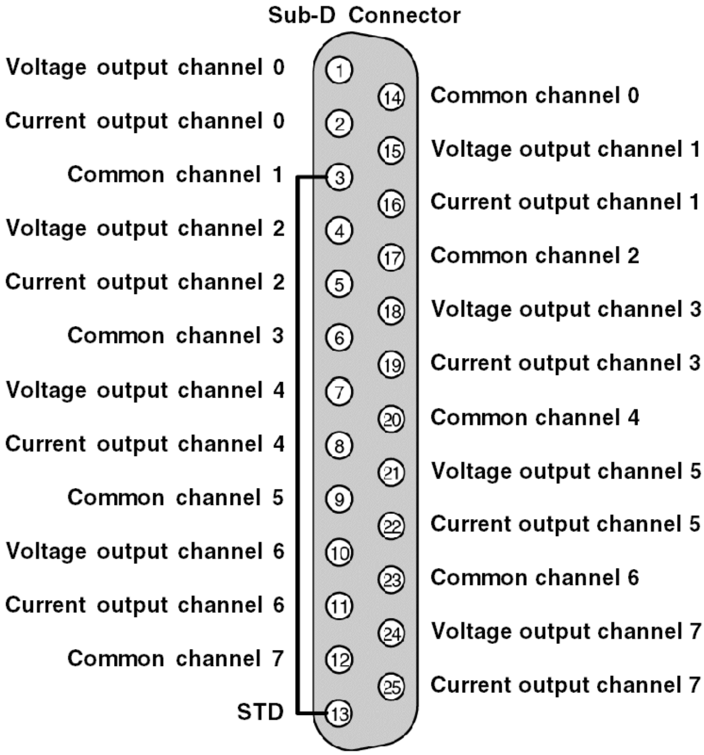
The TSX ASY 800 Connector and External Power Supply Terminal Block Pins

At a Glance

The TSX ASY 800 output module consists of a 25 pin Sub-D connector and an external supply terminal block.

25 Pin Sub-D Connector

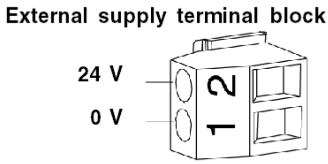
The Sub-D connection is shown below:



STD: The "strap" between pins 3 and 13 detects disconnection.

External Supply Terminal Block

The connection of the external supply terminal block is shown below:



Some recommendations:

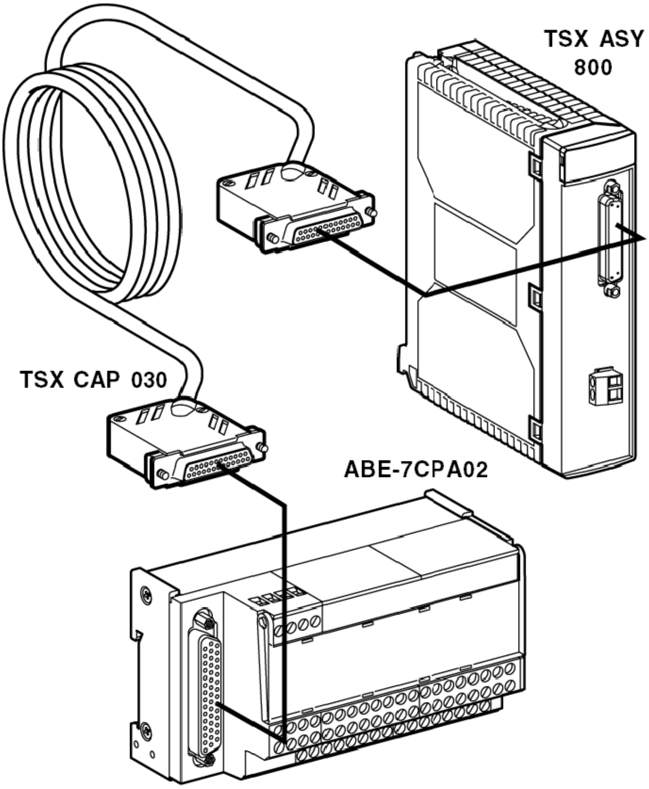
- External supply must be of the type VLVS (very low voltage for safety) 24 V +/- 5 %, ripple < 1 V.
- The connection lead must be a shielded cable (it is advised to connect the shielding braid on the supply side and as close as possible to the module, using ground clips).

Supplies that are suitable: TSX SUP 1011/1021/1051/1101 and TSX SUP A05.

TELEFAST 2 Pin Assignment for the TSX ASY 800 Module

At a Glance

Connecting the analog module TSX ASY 800 to a TELEFAST 2 ABE-7CPA02 is done using the cable TSX CAP 030, which guarantees shield continuity. This accessory is a connection base for the connection of current and voltage outputs to a screw terminal block.



ABE-7CPA02

The distribution of the analog channels to the terminals of the TELEFAST 2 ABE-7CPA02 is as follows:

TELEFAST 2 terminal number	Nature of the signals	TELEFAST 2 terminal number	Nature of the signals
1	Ground	**Supply 1**	Ground
2	STD (1)	**Supply 2**	Ground
3	STD (1)	**Supply 3**	Ground
4	STD (2)	**Supply 4**	Ground
100	Output voltage 0	**200**	Common channel 0
101	Current output 0	**201**	Ground
102	Voltage output 1	**202**	Common channel 1
103	Current output 1	**203**	Ground
104	Voltage output 2	**204**	Common channel 2
105	Current output 2	**205**	Ground
106	Voltage output 3	**206**	Common channel 3
107	Current output 3	**207**	Ground
108	Voltage output 4	**208**	Common channel 4
109	Current output 4	**209**	Ground
110	Voltage channel 5	**210**	Common channel 5
111	Current channel 5	**211**	Ground
112	Voltage output 6	**212**	Common channel 6
113	Current channel 6	**213**	Ground
114	Voltage channel 7	**214**	Common channel 7
115	Current channel 7	**215**	Ground

NOTE: Disconnections are detected by a link via a "strap" between terminals STD (1) and STD (2).

Chapter 11
Analog Output Module TSX ASY 410

Aim of this Chapter

This chapter introduces the TSX ASY 410 module, its characteristics and its connection to different pre-actuators and actuators.

What Is in This Chapter?

This chapter contains the following topics:

Introducing the TSX ASY 410 module

At a Glance

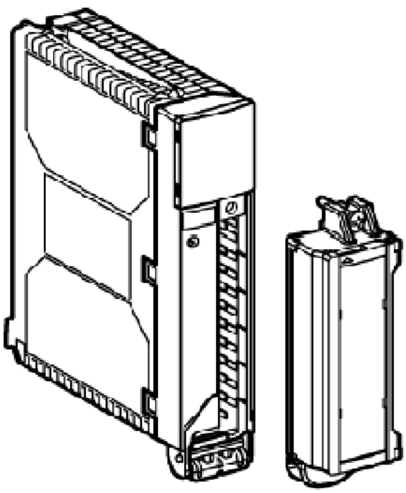
The TSX ASY 410 module is a module with 4 outputs isolated from each other. The following ranges are offered for each output:

- voltage +/- 10 V
- current 0..20 mA and 4.. 20 mA

Illustration

The following diagram shows the analog input module TSX ASY 410 :

TSX ASY 410



NOTE: The terminal block is supplied separately under the reference TSX BLY 01.

Characteristics of the TSX ASY 410 Module

Introduction

This part presents general characteristics for the TSX AEY 410 module and characteristics of its analog outputs.

General Characteristics

This table presents the general characteristics for the TSX AEY 410 module:

Type of outputs	Isolated inputs between channels
Nature of outputs	Voltage / Current
Number of channels	4
Output refresh time	2.5 ms
Power supply for outputs	by the PLC
Types of protection	Short circuits and overloads
Insulation: ● **between channels** ● **between channels and bus** ● **between channels and ground**	 1500 V rms 1500 V rms 500 VDC
Isolation resistance under 500VDC between channel and ground	> 10 mOhms
Diaphony between channels	-80 dB
Monotonicity	Yes
Non linearity	<= 1 LSB
RC network ground connection	R = 50 MOhms, C = 4.7 nF
Dissipated power: ● **typical** ● **maximum**	 8.2 W 12.2 W

Voltage Outputs

This table presents the general characteristics for the TSX AEY 410 module voltage outputs:

Variation range	+/- 10 V
Full scale (FS)	10 V
Max voltage without damaging the voltage outputs	+/- 30 V
Load impedance	1 KOhm minimum
Capacitative load	< 100 nF
Maximum resolution: ● **software version Sv or VL > 1.0** ● **software version Sv or VL = 1.0**	 5.12 mV to +/- 10 V 4.88 mV to +/- 10 V
Measuring error: ● **at 25° C** ● **from 0 to 60° C**	 0.45 % of FS 0.75 % of FS (35 ppm/° C)

Current Outputs

This table presents the general characteristics for the TSX AEY 410 module current outputs:

Variation range	20 mA
Full scale (FS)	20 mA
Max voltage without damaging the voltage outputs	+/- 30 V
Load impedance	600 Ohms maximum
Inductance load	< 0.3 mH
Maximum resolution: ● **software version Sv or VL > 1.0** ● **software version Sv or VL = 1.0**	 0.01025 mA 0.00977 mA
Measuring error: ● **at 25° C** ● **from 0 to 60° C**	 0.52 % of FS 0.98 % of FS (70 ppm/° C)
Maximum leakage current	0.05 mA

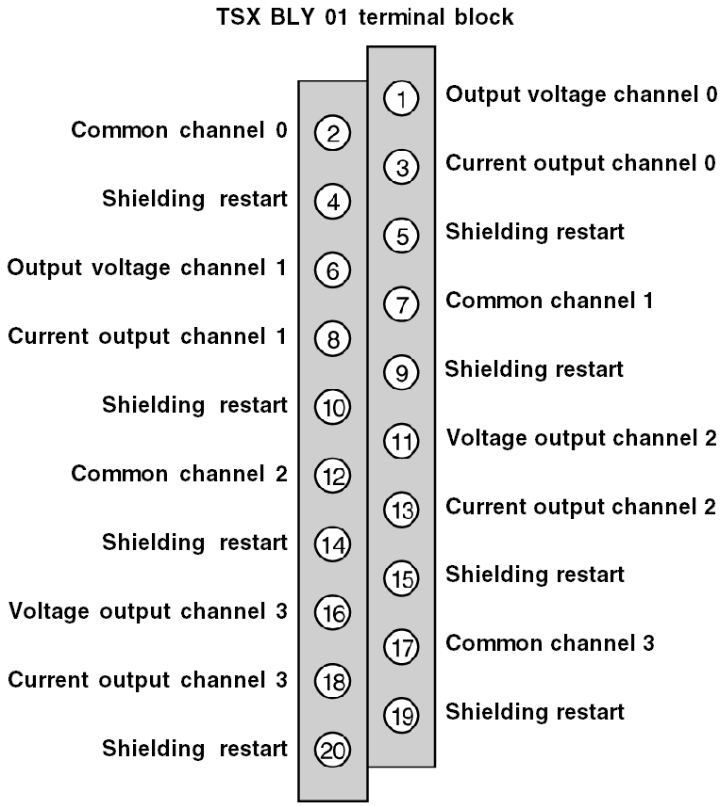
TSX ASY 410 Screw Terminal Block TSX BLY 01

At a Glance

The module TSX ASY 410 is connected using the screw terminal block TSX BLY 01.

Connector Pins

The connections of the TSX BLY 01 screw terminal block are shown below:

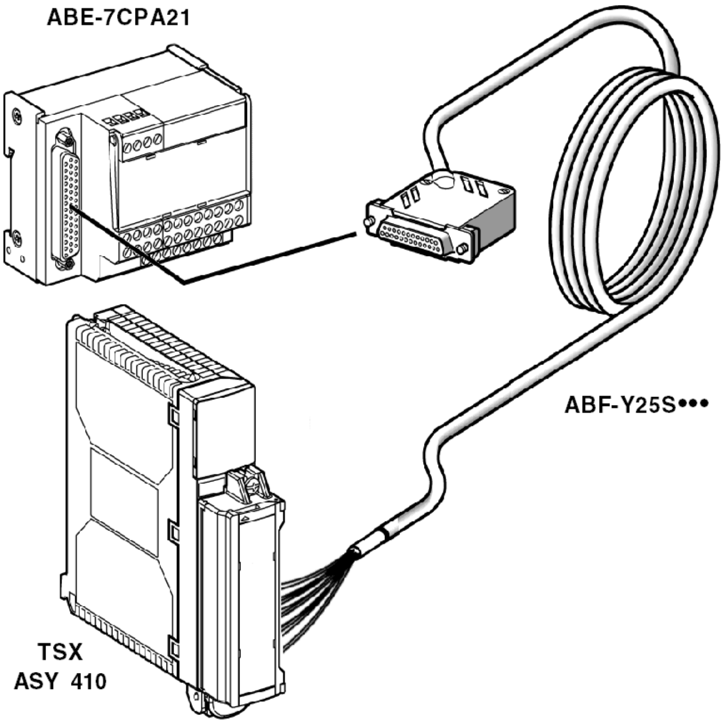


NOTE: Shielded cables should be used and their shields should be linked to the terminals provided for this (Restart shielding).

TELEFAST 2 Pin Assignment for the TSX ASY 410 Module

At a Glance

The TSX ASY 410 analog module is connected to a TELEFAST 2 accessory using the TSX ABF-Y25S••• cable, which guarantees continuous shielding. The accessory ABE-7CPA21 is a connection base for connecting 4-channel analog modules to a screw connector terminal block



ABE-7CPA21

The distribution of analog channels on TELEFAST 2 terminal blocks with the reference ABE-7CPA21 is as follows:

TELEFAST 2 terminal block number	25 pin SubD connector pin number	Signal type	TELEFAST 2 terminal block number	25 pin SubD connector pin number	Signal type
1	/	Ground	**Supp 1**	/	Ground
2	/	STD (1)	**Supp 2**	/	Ground
3	/	STD (1)	**Supp 3**	/	Ground
4	/	STD (2)	**Supp 4**	/	Ground
100	1	Voltage output 0	**200**	14	Common channel 0
101	2	Current output 0	**201**	/	Ground
102	15	Voltage output 1	**202**	3	Common channel 1
103	16	Current output 1	**203**	/	Ground
104	4	Voltage output 2	**204**	17	Common channel 2
105	5	Current output 2	**205**	/	Ground
106	18	Voltage output 3	**206**	6	Common channel 3
107	19	Current output 3	**207**	/	Ground

Connecting via the TSX ABF-Y25S••• Cable

Connection of the TSX ASY 410 analog module to the TELEFAST 2 ABE-7CPA21 accessory is carried out using one of the following cables:

- ABF-Y25S150: length 1.5m,
- ABF-Y25S200: length 2m,
- ABF-Y25S300: length 3m,
- ABF-Y25S500: length 5m.

These cables include the TSX BLY 01 terminal block.

Part II
Software Implementation of Analog Modules

In this Part

This part sets forth general rules for implementing analog input/output modules with Unity Pro.

What Is in This Part?

This part contains the following chapters:

Chapter 12
General Introduction to the Dedicated Analog Function

Installation Phase Overview

Introduction

The software installation of the application-specific modules is carried out from the various Unity Pro editors:

- in offline mode
- in online mode

If you do not have a processor to connect to, Unity Pro allows you to carry out an initial test using the simulator. In this case the installation *(see page 144)* is different.

The following order of installation phases is recommended but it is possible to change the order of certain phases (for example, starting with the configuration phase).

Installation Phases with Processor

The following table shows the various phases of installation with the processor:

Phase	Description	Mode
Declaration of variables	Declaration of IODDT-type variables for the application-specific modules and variables of the project.	Offline (1)
Programming	Project programming.	Offline (1)
Configuration	Declaration of modules.	Offline
	Module channel configuration.	
	Entry of configuration parameters.	
Association	Association of IODDTs with the channels configured (variable editor).	Offline (1)
Generation	Project generation (analysis and editing of links).	Offline
Transfer	Transfer project to PLC.	Online
Adjustment/Debugging	Project debugging from debug screens, animation tables.	Online
	Modifying the program and adjustment parameters.	
Documentation	Building documentation file and printing miscellaneous information relating to the project.	Online (1)

Phase	Description	Mode
Operation/Diagnostic	Displaying miscellaneous information necessary for supervisory control of the project.	Online
	Diagnostic of project and modules.	
Key:		
(1)	These various phases can also be performed in the other mode.	

Implementation Phases with Simulator

The following table shows the various phases of installation with the simulator.

Phase	Description	Mode
Declaration of variables	Declaration of IODDT-type variables for the application-specific modules and variables of the project.	Offline (1)
Programming	Project programming.	Offline (1)
Configuration	Declaration of modules.	Offline
	Module channel configuration.	
	Entry of configuration parameters.	
Association	Association of IODDTs with the modules configured (variable editor).	Offline (1)
Generation	Project generation (analysis and editing of links).	Offline
Transfer	Transfer project to simulator.	Online
Simulation	Program simulation without inputs/outputs.	Online
Adjustment/Debugging	Project debugging from debug screens, animation tables.	Online
	Modifying the program and adjustment parameters.	
Key:		
(1)	These various phases can also be performed in the other mode.	

NOTE: The simulator is only used for the discrete or analog modules.

Chapter 13
TSX AEY 800 and TSX AEY 1600 Modules

In This Chapter

This chapter is devoted to the TSX AEY 800 and TSX AEY 1600 rack-installable modules.

What Is in This Chapter?

This chapter contains the following topics:

Introducing the TSX AEY 800 and TSX AEY 1600 modules

Overview

Modules **TSX AEY 800** and **TSX AEY 1600** are high level 8/16 input industrial measurement devices.

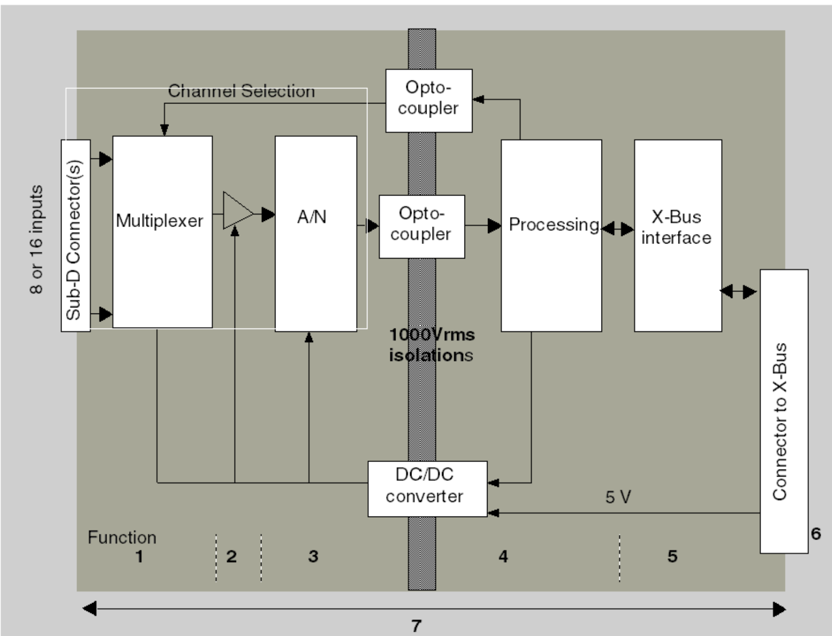
Used in conjunction with sensors or transmitters, they perform monitoring, measurement and continuous process control functions.

Modules **TSX AEY 800** and **TSX AEY 1600**, for each input, provide a range of +/-10 V, 0...10 V, 0...5 V, 1...5 V, 0...20 mA or 4...20 mA, depending on selections made during configuration *(see page 224)*.

The Debug Screen displays, in real time, the current value and status for each of the selected module’s channels. It is also used to access the settings of the filtering and alignment values.

Summary

The **TSX AEY 800** and **TSX AEY 1600** input modules perform the following functions:



Description

The following table lists various functions of the **TSX AEY 800** and **TSX AEY 1600** input modules.

Address	Component	Function
1	**Connection with process and Input Channels Scan**	• Hardware connection to process, through Sub-D connector(s), • protecting module against voltage spikes, using peak-suppressing diodes • adapting input signals through analog filtering, • scanning input channels, through static multiplexing
2	**Adaptation of Input Signals**	• gain selection, based on characteristics of input signals, as defined in configuration (unipolar or bipolar range, in voltage or current), • compensating for drift in amplifier device.
3	**Scanning of Analog Signals Measured at Input**	• 12-bit Analog/Digital converter
4	**Translating incoming values into workable measurements for the user**	• taking into account re-calibration and alignment coefficients to be applied to measurements, as well as the module's self-calibration coefficients, • (numeric) filtering of measurements, based on configuration parameters, • scaling of measurements, based on configuration parameters.
5	**Interface and Communications with Application**	• managing exchanges with CPU, • geographic addressing, • receiving configuration parameters from module and channels, • sending measured values, as well as module status, to application.
6	**Module Power Supply**	-
7	**Module monitoring and sending error warnings back to application**	• testing the conversion string, • testing for range overflow on channels, • verifying that terminal block is present, • watchdog test.

Measurement Timing

Introduction

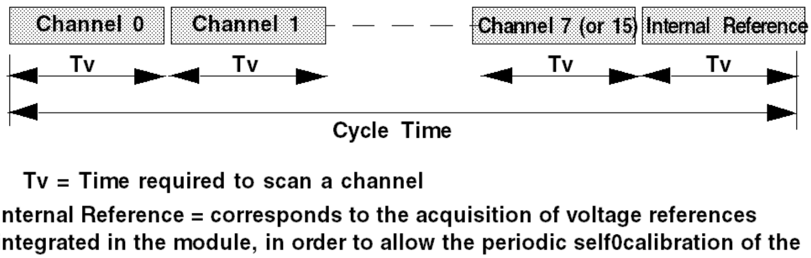
The timing of measurements is determined by the cycle selected during configuration: Normal or Fast Cycle:

- Normal Cycle means that the scan cycle duration is fixed.
- With the Fast Cycle, however, the system only scans the channels designated as being In Use. The scan cycle duration is therefore proportional to the number of channels in use.

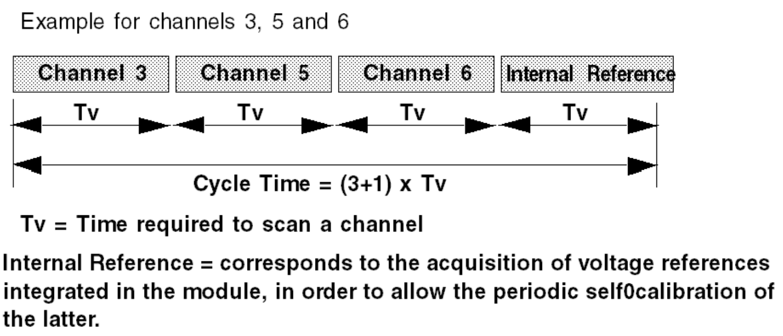
NOTE: Filtering is disabled in Fast Cycle mode.

Channel Scan Cycle

The Channel Scan Cycle used in **Normal Cycle** mode is the following:



The Channel Scan Cycle used in **Fast Cycle** mode is the following:



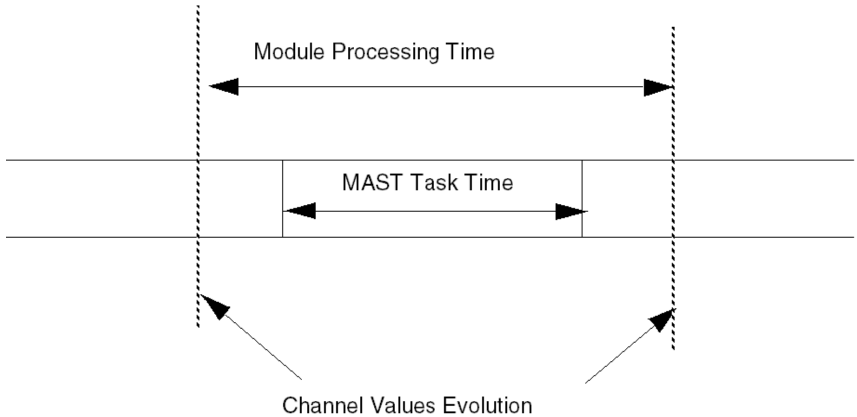
Calculating Cycle Duration

The following table provides Scan Cycle values, based on the type of cycle selected:

Module	Normal Cycle	Fast Cycle
TSX AEY 800	27 ms	(N+1) x 3 ms where N = number of channels in use.
TSX AEY 1600	51 ms	(N+1) x 3 ms where N = number of channels in use.

NOTE: 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 task cycle time is lower than the module's, some values will not have changed.

Figure:



Overshoot Monitoring

At a Glance

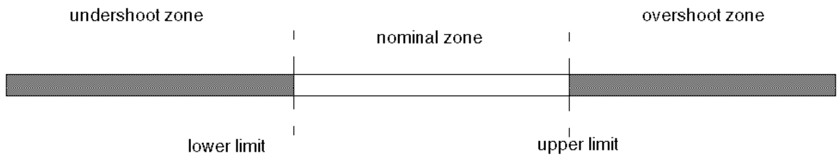
The TSX AEY 800 and TSX AEY 1600 modules give the choice of 6 ranges of voltage or current for each of their inputs. For the selected range, the module monitors over/undershoot: it checks that the measurement is between a lower and upper limit.

This check is always enabled.

Generally speaking, the modules will authorize an over/undershoot by 5% of the positive electrical part of the range.

Measurement zones

The measurement scale is divided into three zones:



nominal zone This is the measurement scale that corresponds to the range selected,
overshoot zone This is the zone above the upper limit,
undershoot zone This is the zone below the lower limit.

Over/undershoot indications

In the over/undershoot zones, there is a risk of saturation of the measurement string , which is signaled by:

Bit name	Meaning (when = 1)
%Ixy.i.ERR	Channel fault
%MWxy.i.2:X1	Range over/undershoot on the channel

Over/Undershoot limits

The over/undershoot limit values are as follows:

Range	Lower limit	Lower limit	Values available by default in standardized format	Minimum limit in user-defined format	Maximum limit in user-defined format
+/-10V	-10.5V	+10.5V	+/- 10500	Min-5%x(Max-Min)/2	Max+5%x(Max-Min)/2
0..10V	-0.5V	+10.5V	-500...10500	Min-5%x(Max-Min)/2	Max+5%x(Max-Min)/2
0..5V	0V	+5.25V	-500...10500	approx. -10mV	Max+5%x(Max-Min)/2
1..5V	0.8V	+5.25V	-500...10500	Min-5%x(Max-Min)/2	Max+5%x(Max-Min)/2
0..20mA	0mA	+21mA	0...10500	approx. -40 µA	Max+5%x(Max-Min)/2
4..20mA	+3.2mA	+20.8mA	-500...10500	Min-5%x(Max-Min)/2	Max+5%x(Max-Min)/2

NOTE: Min designates the minimum value indicated by the user. Max designates the maximum value indicated by the user.

Measurement Filtering

Introduction

The type of filtering performed by the system is called "first order filtering."

The filtering coefficient is editable *(see page 243)* from the Unity Pro screen or through programming.

Mathematical Formula

The applicable mathematical formula is as follows:

$$Mesf(n) = \alpha \times Mesf(n-1) + (1-\alpha) \times Valb(n)$$

where:

α = filter efficiency,

Mesf(n) = filtered measurement at time n,

Mesf(n-1) = filtered measurement at time n-1,

Valb(n) = raw value at time n.

User configures the filtering value from 7 possibilities. **This value may be changed even when application is in RUN mode**.

NOTE: Filtering is disabled in Fast Cycle mode.

Values for TSX AEY 800 module

Filtering values are as follows :

Desired Efficiency	Required Value	α corresponding	Filter Response Time at 63%	Cut-off Frequency (in Hz)
No filtering	0	0	0	0
Low filtering	1 2	0,750 0,875	100 ms 202 ms	1,591 0,788
Medium filtering	3 4	0,937 0,969	419 ms 851 ms	0,379 0,187
High filtering	5 6	0.984 0.992	1.714 ms 3.442 ms	0,093 0,046

Values for TSX AEY 1600 module

Filtering values are as follows :

Desired Efficiency	Required Value	α corresponding	Filter Response Time at 63%	Cut-off Frequency (in Hz)
No filtering	0	0	0	0
Low filtering	1 2	0,750 0,875	178 ms 382 ms	0,894 0,416
Medium filtering	3 4	0,937 0,969	791 ms 1.607 s	0,201 0,099
High filtering	5 6	0,984 0,992	3.239 s 6.502 s	0,049 0,024

Measurement Display

Introduction

Measurements provided to the application are directly usable by the user, who is able to choose between:

- using standardized display 0...10000 (or +/- 10000 for the +/-10 V range),
- personalizing display format by providing desired minimum and maximum values.

Standardized Display

Values are displayed in normalized measuring units (in percent format, with two decimal spaces, also symbolized‱).

Type of Range	Display
unipolar range: 0-10V, 0-5V, 0-20mA, 4-20mA	from 0 to 10000 (0 ‱ to 10000 ‱)
bipolar range : +/-10V	from -10000 to +10000 (-10.000 ‱ to +10.000 ‱)

User-Specified Display

The user may select the range of values *(see page 226)* within which measurements are expressed, by selecting :

- The lower threshold corresponding to the minimum value for the 0 ‱ range (or -10000 ‱),
- The upper threshold corresponding to the max. value for the + 10000 ‱ range.

These lower and upper thresholds are integers between - 30000 and + 30000.

Example:

Imagine a conditioner providing pressure data on a 4-20 mA loop, with 4 mA corresponding to 3200 mB and 20 mA corresponding to 9600 mB. User is able to choose the User format, by setting the following lower and upper thresholds:

3200 ‱ for 3200 mB as the lower threshold,

9600 ‱ for 9600 mB as the upper threshold,

Values transmitted to the program vary between 3200 (= 4 mA) and 9600 (= 20 mA).

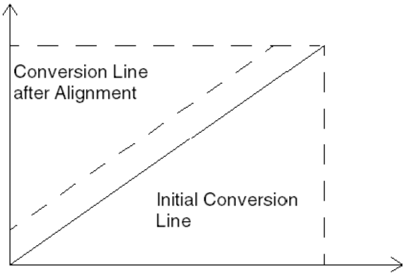
Therefore, matches are as follows:

Value transmitted to program	Current	Pressure
3200	4 mA	3200 mB
current value	between 4 and 20 mA	current value
9600	20 mA	9600 mB

Sensor Alignment

Introduction

The process of "alignment" consists in eliminating a systematic offset observed with a given sensor, around a specific operating point. This operation compensates for an error linked to the process. Therefore, replacing a module does not require a new alignment. However, replacing the sensor or changing the sensor's operating point does require a new alignment.



Example

Imagine we have a pressure sensor linked to a conditioner (1mV/mB), indicating 3200 mB, while we know the actual pressure to be 3210 mB.

The value measured by the module, in normalized scale, is 3200 (3,20 V). The user is able to align (or "map") his measurement to the desired value, namely 3200.

After the alignment procedure, the measurement channel will implement a systematic offset of +10. The alignment value you will need to capture is 3210.

Alignment Values

The alignment value is editable *(see page 244)* from the Unity Pro screen, even if program is in RUN Mode.

For each input channel, you may:

- View and modify the desired measurement value,
- save the alignment value,
- Determine whether the channel already has an alignment,

The alignment offset may also be modified through programming.

Channel alignment is performed in the Standard operating mode, without any effect on the module channels' operating modes. Maximum offset between measured value and desired (aligned) value may no exceed 1000.

The alignment offset is stored in the following word: `%MWr.m.c.8`.

Chapter 14
TSX AEY 810 Module

In This Chapter

This chapter is dedicated to the TSX AEY 810 rack-installable module.

What Is in This Chapter?

This chapter contains the following topics:

Introducing the TSX AEY 810 module

Overview

The **TSX AEY 810** module is a high level 8-input industrial measurement device.

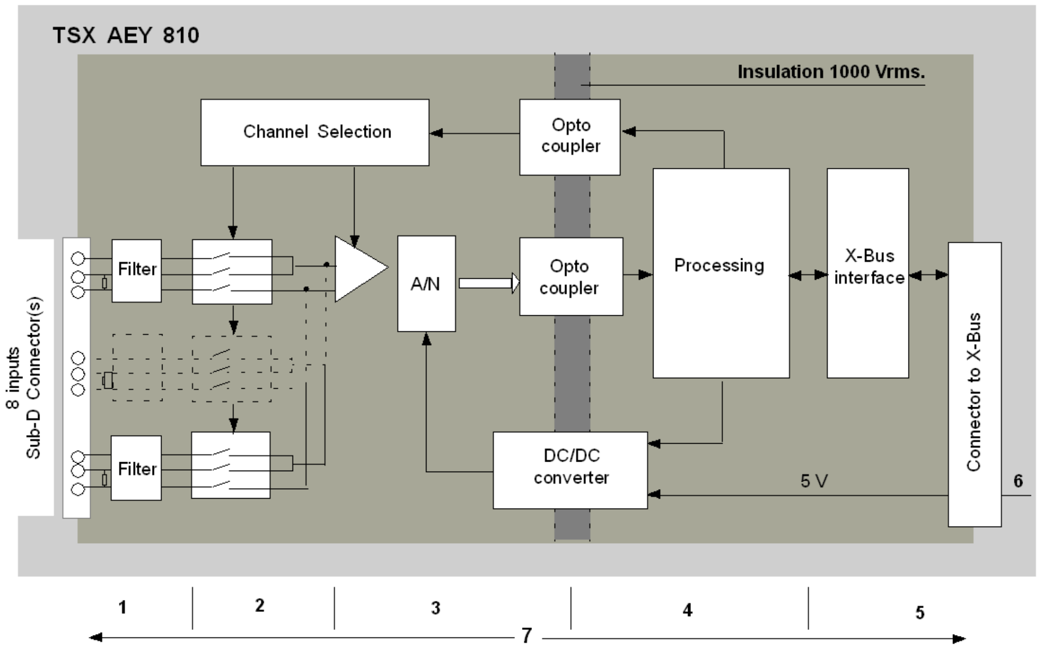
Used in conjunction with sensors or transmitters, it performs monitoring, measurement and continuous process control functions.

For each input, the **TSX AEY 810** module provides a range of +/-10 V, 0...10 V, 0...5 V, 1...5 V, 0...20 mA or 4...20 mA, depending on selections made during configuration *(see page 224)*.

The Debug Screen displays, in real time, the current value and status for each of the selected module's channels. It is also used to access the settings of the filtering values.

Summary

The **TSX AEY 810** input module performs the following functions:



Description

The following table describes the available functions :

Address	Component	Function
1	**Connection with process and Input Channels Scan**	• Hardware connection to process, through Sub-D connector(s), • protecting module against voltage spikes, using peak-suppressing diodes • adapting input signals through analog filtering, • scanning input channels, through static multiplexing, • isolation between channels insured by optical switches.
2	**Adaptation of Input Signals**	• gain selection, based on characteristics of input signals, as defined in configuration (unipolar or bipolar range, in voltage or current), • compensating for drift in amplifier device.
3	**Scanning of Analog Signals Measured at Input**	• 16-bit Analog/Digital converter
4	**Translating incoming values into workable measurements for the user**	• Taking into account re-calibration and alignment coefficients to be applied to measurements, as well as the module’s self-calibration coefficients, • (Numeric) filtering of measurements, based on configuration parameters, • Scaling of measurements, based on configuration parameters.
5	**Interface and Communications with Application**	• managing exchanges with CPU, • geographic addressing, • receiving configuration parameters from module and channels, • sending measured values, as well as module status, to application.
6	**Module Power Supply**	-
7	**Module monitoring and sending error warnings back to application**	• testing the conversion string, • testing for range overflow on channels, • verifying that terminal block is present, • watchdog test.

Measurement Timing

Introduction

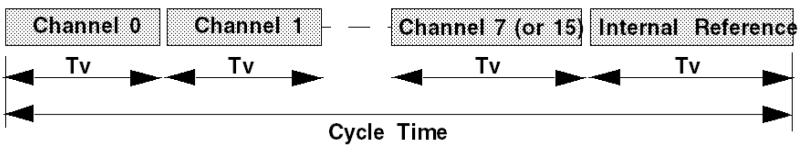
The timing of measurements is determined by the cycle selected during configuration (*see page 229*): Normal or Fast Cycle.

- Normal Cycle means that the scan cycle duration is fixed.
- With the Fast Cycle, however, the system only scans the channels designated as being In Use. The scan cycle duration is therefore proportional to the number of channels in use.

NOTE: Filtering is disabled in Fast Cycle mode.

Channel Scan Cycle

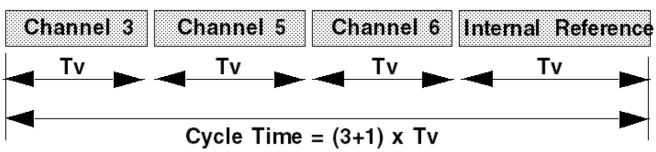
The Channel Scan Cycle used in **Normal Cycle** mode is the following:



Tv = Time required to scan a channel
Internal Reference = corresponds to the acquisition of voltage references integrated in the module, in order to allow the periodic self-calibration of the latter.

The Channel Scan Cycle used in **Fast Cycle** mode is the following:

Example for channels 3, 5 and 6



Tv = Time required to scan a channel

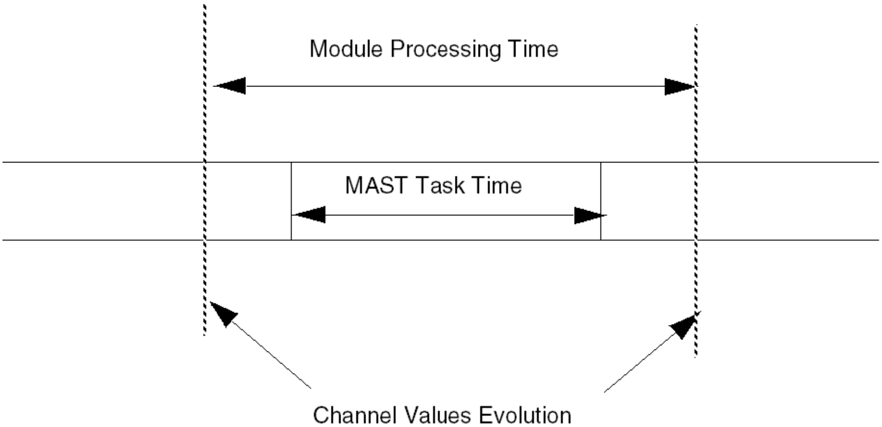
Internal Reference = corresponds to the acquisition of voltage references integrated in the module, in order to allow the periodic self-calibration of the latter.

Calculating Cycle Duration

The following table provides Scan Cycle values, based on the type of cycle selected:

Module	Normal Cycle	Fast Cycle
TSX AEY 810	29.7 ms	(N+1) x 3.3 ms where N: Number of channels in use.

NOTE: 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 task cycle time is lower than the module's, some values will not have changed.



Overflow Monitoring

Introduction

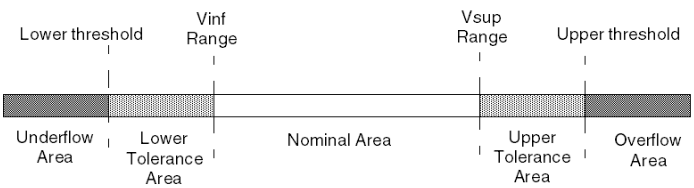
The TSX AEY 810 module allows the user to select between 6 voltage or current ranges for each input. Whichever range is selected, the module always checks for overflow: it ensures that the measurement falls between a lower and an upper threshold.

This control is optional.

The module typically tolerates a 5% overflow of the positive current range covered.

Measurement Areas

The measurement range is divided into 5 areas:



Nominal Area Measurement range matching the chosen range.
Upper Tolerance Area Values included between the maximum value for the range (for instance: + 10 V for the -10 V +10 V range) and the upper threshold.
Lower Tolerance Area Values included between the minimum value for the range (for instance: - 10 V for the -10 V +10 V range) and the lower threshold.
Overflow Area Area located beyond the upper threshold.
Underflow Area Area located below the lower threshold.

Overflow Flags

In over/underflow areas, there is a risk of saturating the measurement device. In order to counter this risk through the user program, error bits have been prepared:

Bit Name	Meaning (when = 1)
`%IWr.m.c.1.5`	Measurement in Lower Tolerance Area
`%IWr.m.c.1.6`	Measurement in Upper Tolerance Area
`%MWr.m.c.2.1`	If over/underflow control is required, this bit indicates any offending variation from range : ● %MWr.m.c.2.14 denotes an underflow, ● while %MWr.m.c.2.15 denotes an overflow.
`%Ir.m.c.ERR`	Channel Fault.

NOTE: During an under/overflow, peaks in the measured value are suppressed, so that said value meets the matching threshold.

Values for Under/Overflow Thresholds

Values for those thresholds are configurable *(see page 232)* independently from one another. They may assume integer values between the following limits:

- lower threshold = range lower value + Lower Tolerance Area,
- lower threshold = range lower value + Lower Tolerance Area,

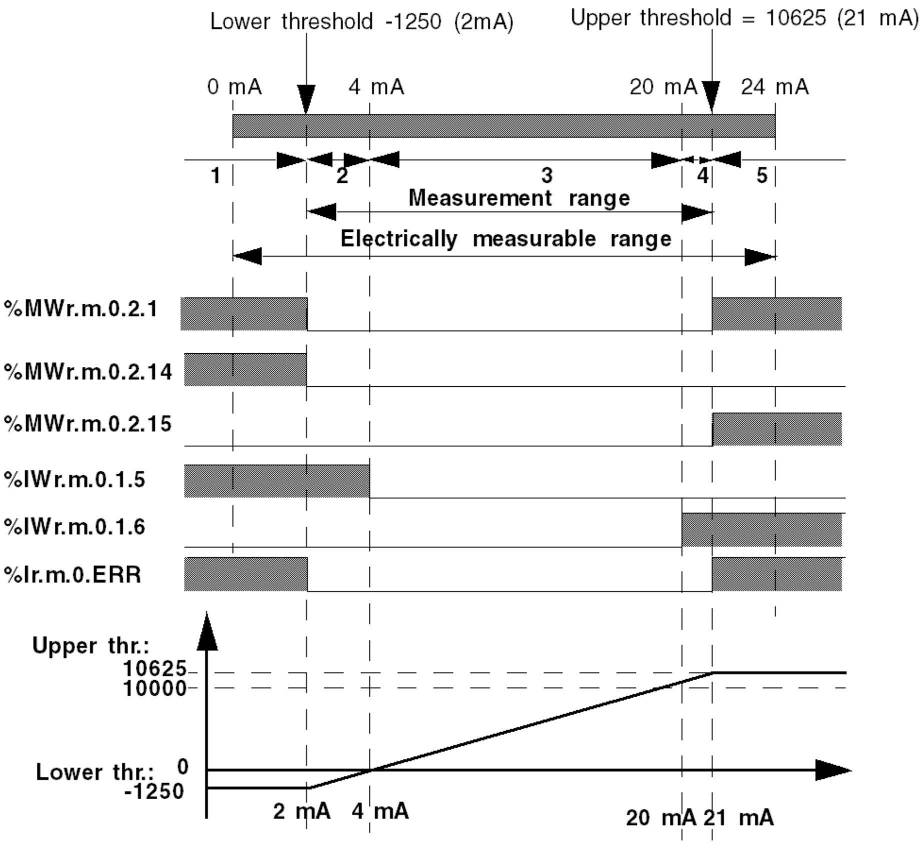
The following table provides Tolerance Area Values, based on the different ranges:

Range	Lower Tolerance Area			Upper Tolerance Area		
-	**Default Value**	**Maximum Value**	**Min. Value**	**Default Value**	**Min. Value**	**Maximum Value**
Bipolar	-0,125 x Δrange/2	0	-0,25 x Δrange/2	-0,125 x Δrange/2	0	0,25 x Δrange/2
Unipolar	-0,125 x Δrange	0	-0,25 x Δrange	0,125 x Δrange	0	0,25 x Δrange
Normalized Bipolar	-1250	0	-2500	1250	0	2500
Normalized Unipolar	-1250	0	-2500	1250	0	2500
User Bipolar	-0,125 x Δrange/2	0	-0,25 x Δrange/2	0,125 x Δrange/2	0	0,25 x Δrange/2
User Unipolar	-0,125 x Δrange	0	-0,25 x Δrange	0,125 x Δrange	0	0,25 x Δrange
Legend:						
Δrange	Range Upper Value - Range Lower Value					

NOTE: The bipolar range is the +/-10V range. Unipolar ranges are the following: 0...20mA, 0...10V, 0...5V, 1...5V, and 4...20mA.
Overflow Monitoring is enabled by default, but it may also be partially enabled (only for under- and overflows), or disabled.

Example

Overflow for the 4...20 mA range in normalized mode, on the 0 (zero) channel:



1 Underflow Area.
2 Lower Tolerance Area
3 Nominal Area.
4 Upper Tolerance Area
5 Overflow Area

Measurement Filtering

Introduction

The type of filtering performed by the system is called "first order filtering." The filtering coefficient is editable from a programming console or through the program *(see page 228)*.

Mathematical Formula

The applicable mathematical formula is as follows:

$$Mesf(n) = \alpha \times Mesf(n-1) + (1-\alpha) \times Valb(n)$$

where :

α = filter efficiency,

Mesf(n) = filtered measurement at time n,

Mesf(n-1) = filtered measurement at time n-1,

Valb(n) = raw value at time n.

User configures the filtering value from 7 possibilities. **This value may be changed even when application is in RUN mode**.

NOTE: Filtering is disabled in Fast Cycle mode.

Values for the TSX AEY 810 Module

Filtering values are as follows:

Desired Efficiency	Required Value	α corresponding	Filter Response Time at 63 %	Cut-off Frequency (in Hz)
No filtering	0	0	0	0
Low filtering	1 2	0,750 0,875	104.3 ms 224.7 ms	1,526 0,708
Medium filtering	3 4	0,937 0,969	464.8 ms 944.9 ms	0,342 0,168
High filtering	5 6	0,984 0,992	1.905 ms 3.825 ms	0,084 0,042

Measurement Display

Introduction

The measurements provided to the application is directly usable by the user, who is able to choose (see page 226) between:

- using standardized display 0...10000 (or +/-10000 for the +/-10 V range),
- personalizing display format by providing desired minimum and maximum values.

Standardized Display

Values are displayed in normalized measuring units (in percent format, with two decimal spaces, also symbolized as $^{\circ}/_{\circ\circ\circ}$):

Type of Range	Display
unipolar range : 0-10V, 0-5V, 0-20mA, 4-20mA	from 0 to 10000 (0 $^{\circ}/_{\circ\circ\circ}$ to 10000 $^{\circ}/_{\circ\circ\circ}$)
bipolar range : +/-10V	from -10000 to +10000 (-10.000 $^{\circ}/_{\circ\circ\circ}$ to +10.000 $^{\circ}/_{\circ\circ\circ}$)

User-Specified Display

The user may choose the range of values within which measurements are expressed, by selecting:

The lower threshold corresponding to the minimum value for the 0 $^{\circ}/_{\circ\circ\circ}$ range (or - 10000 $^{\circ}/_{\circ\circ\circ}$),

- The upper threshold corresponding to the maximum value for the + 10000$^{\circ}/_{\circ\circ\circ}$ range).

These lower and upper thresholds are integers between -30000 and +30000.

Example:

Imagine a conditioner providing pressure data on a 4-20 mA loop, with 4 mA corresponding to 3200 mB and 20 mA corresponding to 9600 mB. You have the option of choosing the User format, by setting the following lower and upper thresholds:

3200 $^{\circ}/_{\circ\circ\circ}$ for 3200 mB as the lower threshold,

9600 $^{\circ}/_{\circ\circ\circ}$ for 9600 mB as the upper threshold,

Values transmitted to the program vary between 3200 (= 4 mA) and 9600 (= 20 mA).

Therefore, matches are as follows:

Value transmitted to program	Current	Pressure
3200	4 mA	3200 mB
current value	between 4 and 20 mA	current value
9600	20 mA	9600 mB

Chapter 15
TSX AEY 1614 Module

In This Chapter

This chapter is dedicated to the TSX AEY 1614 rack-installable module.

What Is in This Chapter?

This chapter contains the following topics:

Introducing the TSX AEY 1614 module

Overview

The **TSX AEY 1614** module is a 16 thermocouple input industrial measurement device.

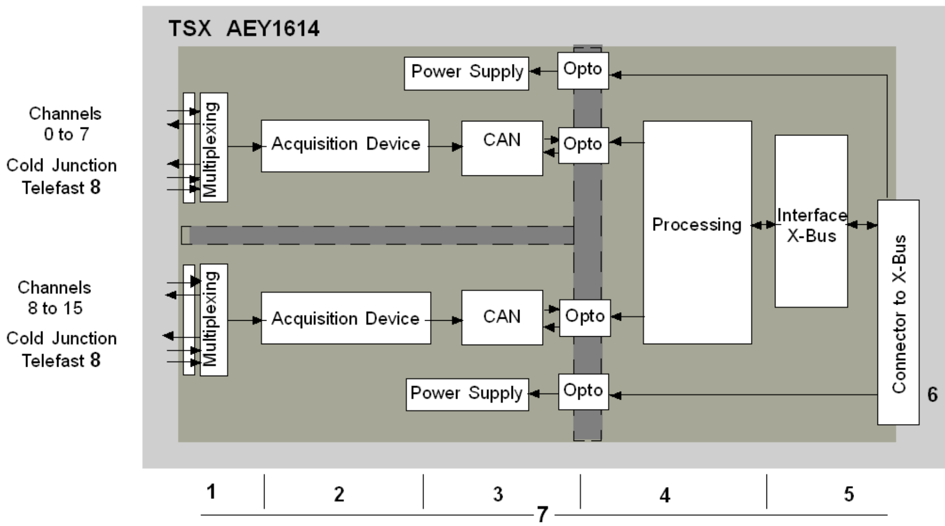
Module **TSX AEY 1614** offers the following ranges for each input, according to the selection made during configuration *(see page 224)* :

- thermocouple : B,E,J,K,L,N,R,S,T or U,
- Voltage : -80...+80 mV

NOTE: The TELEFAST2 accessory referenced **ABE 7CP A12** facilitates connection and provides a cold junction compensation device.

Summary

The **TSX AEY 1614** input module performs the following functions :



Description

Details of the functions are the following:

Address	Component	Function
1	**Adaptation and multiplexing**	"Adaptation" consists in a common mode and differential mode filter. It is followed by channel multiplexing through opto-switches, in order to provide the possibility of common mode voltage between channels (up to 400V). A second layer of multiplexing allows for self-calibration of the acquisition device offset, as close as possible to the input terminal, as well as selecting the cold junction compensation sensor included in the TELEFAST housing.
2	**Amplification**	Built around a weak-offset amplifier. Lopping (peak suppression) on the input to the amplifier allows it to withstand voltage spikes of up to 30V.
3	**Conversion**	The converter receives the signal issued from an input channel or from the cold junction compensation. Conversion is based on a $\Sigma \Delta$ 16 bits converter.
4	**Translating incoming values into workable measurements for the user**	• taking into account re-calibration and alignment coefficients to be applied to measurements, as well as the module’s self-calibration coefficients, • (numeric) filtering of measurements, based on configuration parameters, • scaling of measurements, based on configuration parameters.
5	**Interface and Communications with Application**	• managing exchanges with CPU, • geographic addressing, • receiving configuration parameters from module and channels, • sending measured values, as well as module status, to the application.
6	**Module Power Supply**	-
7	**Module monitoring and sending error warnings back to application**	• testing the conversion string, • testing for range overflow on channels, • verifying that terminal block is present, • watchdog test.
8	**Cold junction compensation:**	• integrated in the TELEFAST **ABE 7CP A12**, • must be provided by user if TELEFAST is not used.

Measurement Timing

Introduction

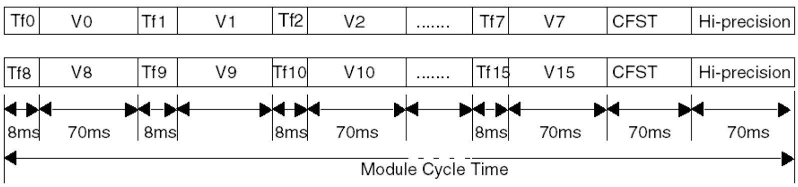
The cycle time for the TSX AEY 1614 module depends on the cycle selected (Normal or Fast), as defined in the configuration *(see page 229)*, as well as of other configured options:

- Normal Cycle means that the scan cycle duration is fixed.
- With the Fast Cycle, however, the system only scans the channels designated as being In Use. The scan cycle duration is therefore proportional to the number of channels in use.

NOTE: Channels are acquired simultaneously in pairs (channel 0 and channel 8, channel 1 and channel 9, ..., channel 7 and channel 15).

Normal Cycle

Example for a module whose options are all enabled:



Tf Wire Test (8 ms per channel requiring testing).
CSFT Cold junction compensation on TELEFAST (70 ms).
Hi-precision High-Precision Mode (corresponds to a self-calibrating procedure of module - 70 ms).

Fast Cycle

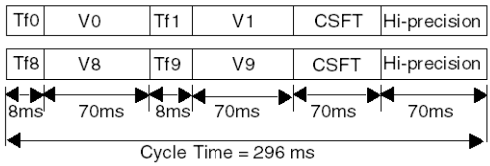
In order to shorten cycle time as much as possible, one should take into account the fact that channels are acquired simultaneously, in pairs.

Example of optimal wiring for 3 channels used with wiring test, Telefast cold junction compensation and in High Precision mode:

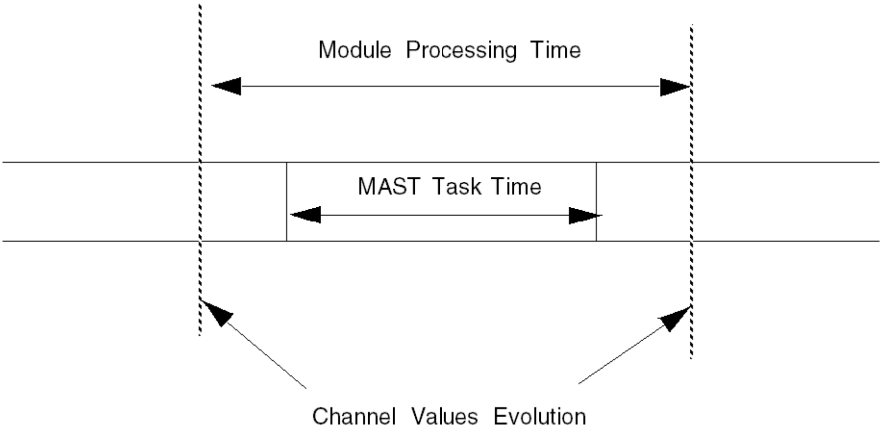
if you prefer to use only 3 channels and have a minimum cycle time, we advise using dual channels. In this manner, you will have only one elementary time for two channels. In our example, we've chosen dual channels 0 and 8, as well as channel 1.

Cycle time is therefore as follows:

$$2 \times 70ms + 2 \times 8ms + 70ms + 70ms = 296ms$$



NOTE: Module cycles are asynchronous with PLC cycles. At the beginning of each PLC cycle, each channel value is taken into account. If the MAST task cycle time is lower than the module's, some values will not have changed.



Overflow Monitoring

Introduction

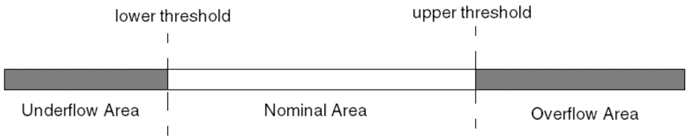
The TSX AEY 1614 module allows the user to select between 1 voltage range and 6 thermocouple ranges for each input.

The module always checks for overflow in the selected range: it ensures that the measurement falls between a lower and an upper threshold *(see page 232)*.

This monitoring is optional.

Measurement Areas

The measurement range is divided into 3 areas:



Nominal Area Measurement range matching the chosen range.
Overflow Area Area located beyond the upper threshold.
Underflow Area Area located below the lower threshold.

NOTE: Beyond these thresholds (overflow or underflow areas) that correspond to nominal values for the chosen range (threshold values of the thermocouples, or -80mV and +80mV for the electric range), one observes measurement saturation, even if over/underflow control was not selected.

Overflow Flags

In over/underflow areas, there is a risk of saturating the measurement device. In order to counter this risk through the user program, error bits have been prepared:

Bit Name	Meaning (when = 1)
%Ir.m.c.ERR	Channel Fault.
%MWr.m.c.2.1	Denotes a range overflow on the channel.
%MWr.m.c.2.14	Denotes a range underflow on the channel.
%MWr.m.c.2.15	Denotes an underflow on the channel.

NOTE: If the under/overflow monitoring is disabled, all of the above bits remain set to 0, whatever the masurement value.

"In Temperature" Range

The ranger under/overflow corresponds either to a dynamic under/overflow of the acquisition device, or to an under/overflow of the sensor’s normalized measurement area, or again to a dynamic under/overflow of the cold junction compensation temperature (from -5° C to +85° C).

Measurement Filtering

Introduction

The type of filtering performed by the system is called "first order filtering." The filtering coefficient (see page 243) is editable from a programming console or through the program.

Mathematical Formula

The applicable mathematical formula is as follows:

$$Mesf(n) = \alpha \times Mesf(n-1) + (1-\alpha) \times Valb(n)$$

where:

α = filter efficiency,

Mesf(n) = filtered measurement at time n,

Mesf(n-1) = filtered measurement at time n-1,

Valb(n) = raw value at time n.

You may configure the filtering value from 7 possibilities. This value may be changed even when the application is in RUN mode.

NOTE: Filtering is disabled in Fast Cycle mode.

Values for TSX AEY 1614 Module

Filtering values are as follows. They depend on the cycle time T:

Desired Efficiency	Required Value	α corresponding	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

Measurement Display

Introduction

This process allows you to choose the display format in which measurements are provided to the user application. It is important to differentiate between electrical ranges on the one hand, and thermocouple or thermowell ranges on the other hand.

-80...+80mV Range

Measurements provided to the application are directly usable : choose either Standardized Display or User-specified Display.

Standardized Display:

Values are displayed in normalized measuring units (in percent format, with two decimal spaces, also symbolized as ‱).

Display
from -10000 to +10000 (-10.000 ‱ to +10000 ‱)

User-specified Display:

You have the option of defining *(see page 226)* the range of values within which measurements are expressed, by selecting:

- the lower threshold corresponding to the minimum value for the range (-10000 ‱),
- the upper threshold corresponding to the maximum value for the range (+10000‱).

These lower and upper thresholds are integers between -30000 and -30000.

Thermocouple Ranges

Measurements provided to the application are directly usable: You may choose *(see page 227)* between two types of display: "In Temperature" Display, and Standardized Display.

In Temperature Display:

Values are provided in tenths of a degree (Celsius or Fahrenheit, depending on the unit selected during configuration).

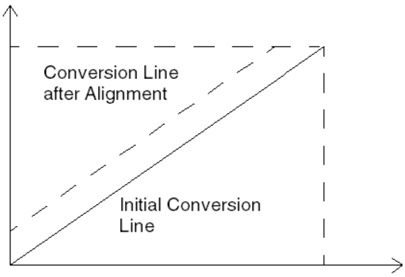
User-specified Display:

you may choose a Standardized Display 0...10000 (meaning from 0 to 10000 ‱), by specifying the minimum and maximum temperatures as expressed in the 0 to 10000 range.

Sensor Alignment for the TSX AEY 1614 Module

Introduction

The process of "alignment" consists in eliminating a systematic offset observed with a given sensor, around a specific operating point. This operation compensates for an error linked to the process. Therefore, replacing a module does not require a new alignment. However, replacing the sensor or changing the sensor's operating point does require a new alignment.



Alignment Values

The alignment value is editable *(see page 244)* from a programming console, even if program is in RUN Mode. For each input channel, you may:

- View and modify the desired measurement value,
- Save the alignment value,
- Determine whether the channel already has an alignment,

The alignment offset may also be modified through programming.

Channel alignment is performed on the channel in Standard operating mode, without any effect on the channel's operating modes.

Maximum offset between measured value and desired (aligned) value may no exceed 1500.

NOTE: The `%IWr.m.c.1.0` = 1 bit confirms that the channel is now aligned.

Chapter 16
TSX AEY 420 Module

In This Chapter

This chapter is dedicated to the TSX AEY 420 rack-installable module.

What Is in This Chapter?

This chapter contains the following topics:

Introducing the TSX AEY 420 module

Overview

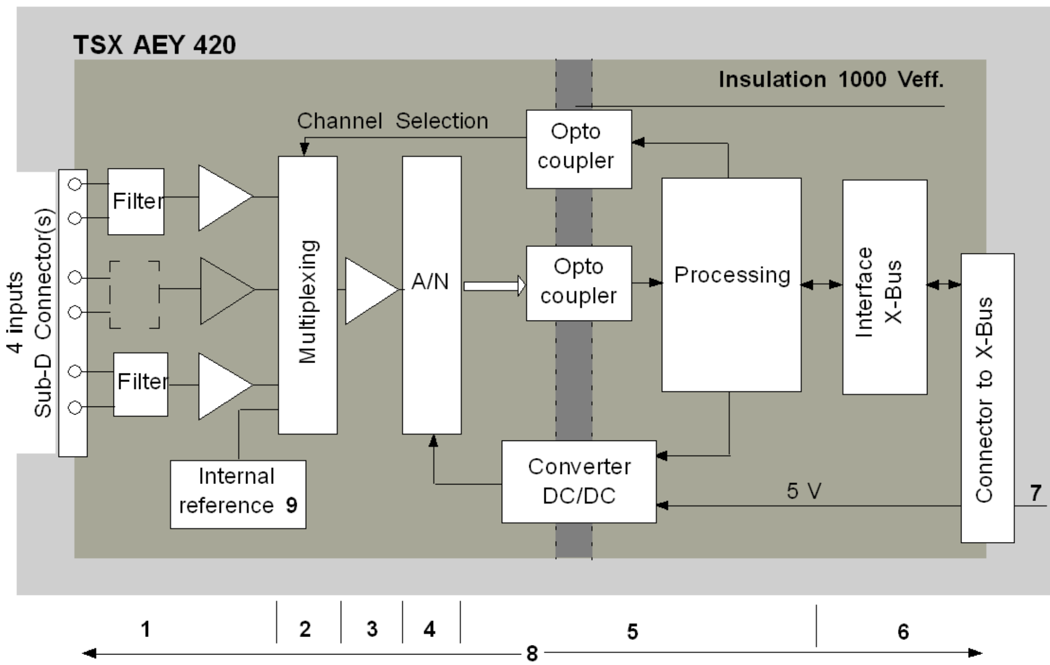
The **TSX AEY 420** module is a high-level, fast 4-input industrial measurement device.

Used in conjunction with sensors or transmitters, it performs monitoring, measurement and continuous process control functions.

For each input, the **TSX AEY 420** module provides a range of +/-10 V, 0...10 V, 0...5 V, 1...5 V, 0...20 mA or 4...20 mA, depending on selections made during configuration *(see page 224)*.

Summary

The **TSX AEY 420** input module performs the following functions :



Description

The following table describes the available functions :

Address	Component	Function
1	**Connection with process and Input Channels Scan**	• Hardware connection to process, through Sub-D connector(s), • Adapting input signals through analog filtering.
2	**Multiplexing of Input Signals**	• Scanning input channels, through static multiplexing.
3	**Adaptation of Input Signals**	• Adaptation of Input Signals
4	**Scanning of Analog Signals Measured at Input**	• 16-bit Analog/Digital converter
5	**Translating incoming values into workable measurements for the user**	• Taking into account re-calibration and alignment coefficients to be applied to measurements, as well as the module's self-calibration coefficients, • Scaling of measurements, based on configuration parameters.
6	**Interface and Communications with Application**	• managing exchanges with CPU, • geographic addressing, • receiving configuration parameters from module and channels, • sending measured values, as well as module status, to application.
7	**Module Power Supply**	-
8	**Module monitoring and sending error warnings back to application**	• testing the conversion string, • testing for range overflow on channels, • verifying that terminal block is present, • watchdog test.
9	**Internal Reference**	• Reading an internal reference to a standard voltage allows the module to calculate its self-calibration coefficients.

Measurement Timing

Introduction

If all event-related processes are disabled, cycle time for the TSX AEY 420 module is 1 ms. It is not affected by the number of inputs in use.

Measurements are chained in the following manner: channel 0, channel 1, channel 2 and channel 3.

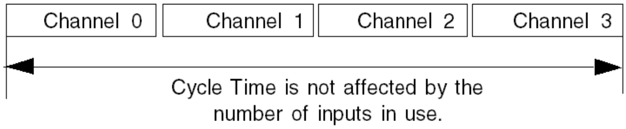
The scan cycle is prolonged by 0.15 ms per channel if event-related processing is enabled.

Breakdown of Cycle Duration

The following table describes the various cycle times:

Configuration	Cycle Time
No event processing	1 ms
1 channel with event processing	1.15 ms
2 channels with event processing	1.30 ms
3 channels with event processing	1.45 ms
4 channels with event processing	1.60 ms

Figure:



Overflow Monitoring

Introduction

The TSX AEY 420 module allows you to select between 6 voltage or current ranges for each input.

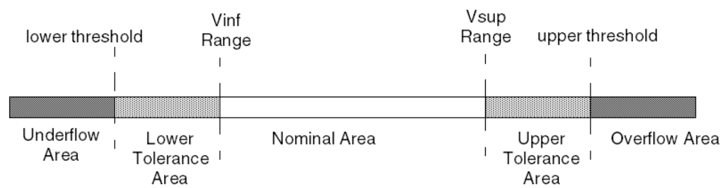
Whichever range is selected, the module always checks for overflow to verify that the measurement falls between a lower and an upper threshold.

This monitoring is optional.

The module typically tolerates a 5% overflow of the positive current range covered.

Measurement Areas

The measurement range is divided into 5 areas:



Nominal Area Measurement range matching the chosen range.
Upper Tolerance Area Varies between the values included between the maximum value for the range (for instance: +10 V for the +/-10 V range) and the upper threshold.
Lower Tolerance Area Varies between the values included between the minimum value for the range (for instance: -10 V for the +/-10 V range) and the lower threshold.
Overflow Area Area located beyond the upper threshold.
Underflow Area Area located below the lower threshold.

Overflow Flags

In over/underflow areas, there is a risk of saturating the measurement device. In order to counter this risk through the user program, detected error bits have been prepared:

Bit Name	Flag (when = 1)
`%IWr.m.c.1.5`	The value being read falls within the lower tolerance area.
`%IWr.m.c.1.6`	The value being read falls within the upper tolerance area.
`%IWr.m.c.2.1`	If over/underflow control is required, this bit indicates that the current value falls within one of the 2 unauthorized ranges: ● `%MWr.m.c.2.14` denotes an underflow, ● `%MWr.m.c.2.15` denotes an overflow.
`%Ir.m.c.ERR`	Detected channel fault.

NOTE: During an under/overflow, peaks in the measured value are suppressed so that the offending value conforms to the appropriate threshold.

Values for Under/Overflow Thresholds

Values for those thresholds are configurable *(see page 232)* independently from one another. They may assume integer values between the following limits:

Range	Lower Tolerance Area			Upper Tolerance Area		
	Default Value	**Maximum Value**	**Min. Value**	**Default Value**	**Min. Value**	**Maximum Value**
Bipolar +/-10V	-0.125 x $\Delta gamme$ /2	0	- 0.25 x $\Delta gamme$ /2	0.125 x $\Delta gamme$ /2	0	0.25 x $\Delta gamme$ /2
Unipolar 0...10V, 0...5V, 1...5V, 0...20 mA, 4...20 mA	-0.125 x $\Delta gamme$	0	-0.25 x $\Delta gamme$	0.125 x $\Delta gamme$	0	0.25 x $\Delta gamme$
Normalized	-1250	0	-2500	1250	0	2500
User bipolar +/-10V	-0.125 x $\Delta gamme$ /2	0	-0.25 x $\Delta gamme$ /2	0.125 x $\Delta gamme$ /2	0	0.25 x $\Delta gamme$ /2
User unipolar 0...10V, 0...5V, 1...5V, 0...20 mA, 4...20 mA	-0.125 x $\Delta gamme$	0	-0.25 x $\Delta gamme$	0.125 x $\Delta gamme$	0	0.25 x $\Delta gamme$
Legend:						
$\Delta gamme$	Range upper value - Range lower value					

Thresholds and Event Processing

At a Glance

The TSX AEY 420 module manages 2 thresholds per channel (thresholds 0 and 1).

When any one (or several) of these thresholds are crossed, the module may trigger event processing.

A neutral zone around the thresholds is used to avoid accidentally triggering the event if the analog measurement fluctuates around the thresholds.

Causes of the Event

You have the option of associating an event processing action to an analog channel during the module's software configuration *(see page 233)*.

The event is triggered if:

- measurement becomes less than (Threshold 0 – Neutral zone),
- measurement becomes greater than (Threshold 0 + Neutral zone),
- measurement becomes less than (Threshold 1 – Neutral zone),
- measurement becomes greater than (Threshold 1 + Neutral zone).

Masking the Event Causes

Event causes may be masked or validated through programming, using bits from the word `%QWr.m.c`:

Address	Function (0 = mask, 1 = validate)
`%QWr.m.c.1.0`	Crossing over (above) Threshold 0.
`%QWr.m.c.1.1`	Crossing over (below) Threshold 0.
`%QWr.m.c.1.2`	Crossing over (above) Threshold 1.
`%QWr.m.c.1.3`	Crossing over (below) Threshold 1.

Event Origination

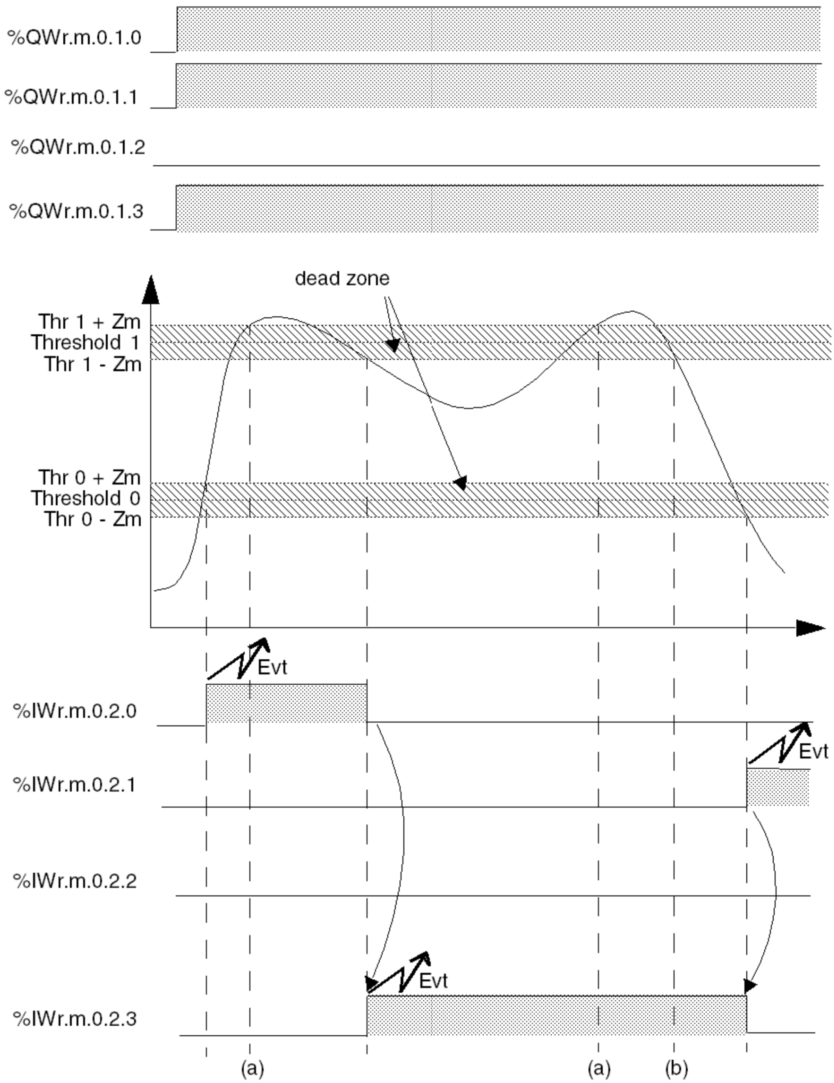
Bits from the `%IWr.m.c.2` word indicate the root cause of the event:

Address	Function (1 = event, 0 = no event).
`%IWr.m.c.2.0`	Crossing over (above) Threshold 0.
`%IWr.m.c.2.1`	Crossing over (below) Threshold 0.
`%IWr.m.c.2.2`	Crossing over (above) Threshold 1.
`%IWr.m.c.2.3`	Crossing over (below) Threshold 1.

Example

The following example shows detection on channel 0 of crossings:

- of threshold 0 by a greater or lower value,
- of threshold 1 by a greater value.



Additional Information

The crossing of threshold 1 when rising is masked. The triggering of the associated event is therefore not activated (case a).

The `%IWr.m.c.2` input word is updated only when a new event cause appears (case b).

When the measured value is equal to the threshold but does not cross over, no event is triggered.

Event processing may be enabled or disabled by configuring each channel.

An event number (from 0 to 63) is assigned to each channel. The choice of number determines the event priority (0 = maximum priority, 1 to 63 = lower priority).

Value of the Neutral Zone

The neutral zone is the area around each threshold (0 and 1). Its value depends on the configured measurement range and scale used. It cannot be modified by the user. The intervals of the neutral zone are:

- (+Zm) which is added to each of the thresholds (0 and 1),
- (-Zm) which is subtracted from each of the thresholds (0 and 1).

The following table shows the values (+/-Zm) of the neutral zone according to the measurement range and type of scale used:

	Range			
	+/- 10V	0..10V	0..5V and 0..20 mA	1..5V and 4..20mA
Standardized scale	3	3	6	7
User scale	(1) $\frac{\Delta gamme \times 3}{20000}$	(1) $\frac{\Delta gamme \times 3}{10000}$	(1) $\frac{\Delta gamme \times 6}{10000}$	(1) $\frac{\Delta gamme \times 7}{10000}$
Legend				
(1): Δrange = Upper range threshold – Lower range threshold				

Example of calculating the neutral zone:

For a 0..10 V range where the configured user scale is -5000/5000.

Δrange = 5000 -(-5000) =10000

The value of +Zm and -Zm will therefore be 3.

Measurement Display

Introduction

Measurements provided to the application are usable directly. You may choose between:

- using standardized display 0...10000 (or +/- 10000 for range +/- 10 V),
- customizing the display format by providing desired minimum and maximum values.

Standardized Display

Values are displayed in standardized measuring units (in percent format, with two decimal spaces, also symbolized as ‱):

Type of Range	Display
unipolar range	from 0 to 10000 (0 ‱ to +10000 ‱)
bipolar range	from -10000 to 10000 (-10.000 ‱ to +10000 ‱)

User-Specified Display

You have the option of defining the range of values *(see page 226)* within which measurements are expressed, by selecting:

- the lower threshold corresponding to the minimum value for the range: 0‱ (or -10000‱),
- the upper threshold corresponding to the maximum value for the range (+10000‱).

These lower and upper thresholds are integers between -30000 and +30000.

Example:

Imagine a conditioner providing pressure data on a 4-20 mA loop, with 4 mA corresponding to 3200 mB, and 20 mA corresponding to 9600 mB. You have the option of choosing the User format, by setting the following lower and upper thresholds:

3200‱ for 3200 mB as the lower threshold,

9600‱ for 9600 mB as the upper threshold.

Values transmitted to the program vary between 3200 (= 4 mA) and 9600 (= 20 mA).

Therefore, matches are as follows:

Value transmitted to program	Current	Pressure
3200	4 mA	3200 mB
current value	between 4 and 20 mA	current value
9600	20 mA	9600 mB

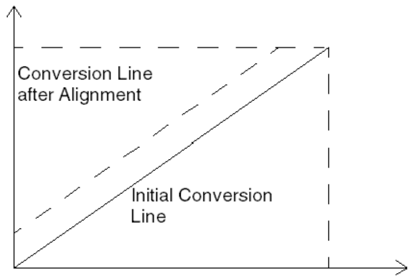
Sensor Alignment for the TSX AEY 420 Module

Introduction

The process of "alignment" consists in eliminating a systematic offset observed with a given sensor, around a specific operating point. This operation compensates for an error linked to the process. Therefore, replacing a module does not require a new alignment. However, replacing the sensor or changing the sensor’s operating point does require a new alignment.

Figure

Conversion lines are as follows:



Example

Imagine, for instance, that we have a pressure sensor linked to a conditioner (1mV/mB), indicating 3200 mB, while we know the actual pressure to be 3210 mB. The value measured by the module, in normalized scale, is 3200 (3.20 V). The user is able to align (or "map") his measurement to the desired value, namely 3200. After the alignment procedure, the measurement channel will implement a systematic offset of +10 for any new measurement. The alignment value you will need to capture is 3210.

Alignment Values

The alignment value is editable *(see page 244)* from the Unity Pro screens, even if the program is in RUN Mode.

For each input channel, you may:

- View and modify the desired measurement value,
- Save the alignment value,
- Determine whether the channel already has an alignment.

The alignment offset may also be modified through programming.

Channel alignment is performed in the Standard operating mode, without any effect on the channel's operating modes. Maximum offset between measured value and desired (aligned) value may not exceed 1000.

The alignment offset is stored in the word `%MWr.m.c.8`.

NOTE: The bit `%IWr.m.c.1.0 = 1` confirms that the channel is now aligned.

Chapter 17
TSX AEY 414 Module

In This Chapter

This chapter is dedicated to the TSX AEY 414 rack-installable module.

What Is in This Chapter?

This chapter contains the following topics:

Introducing the TSX AEY 414 module

Overview

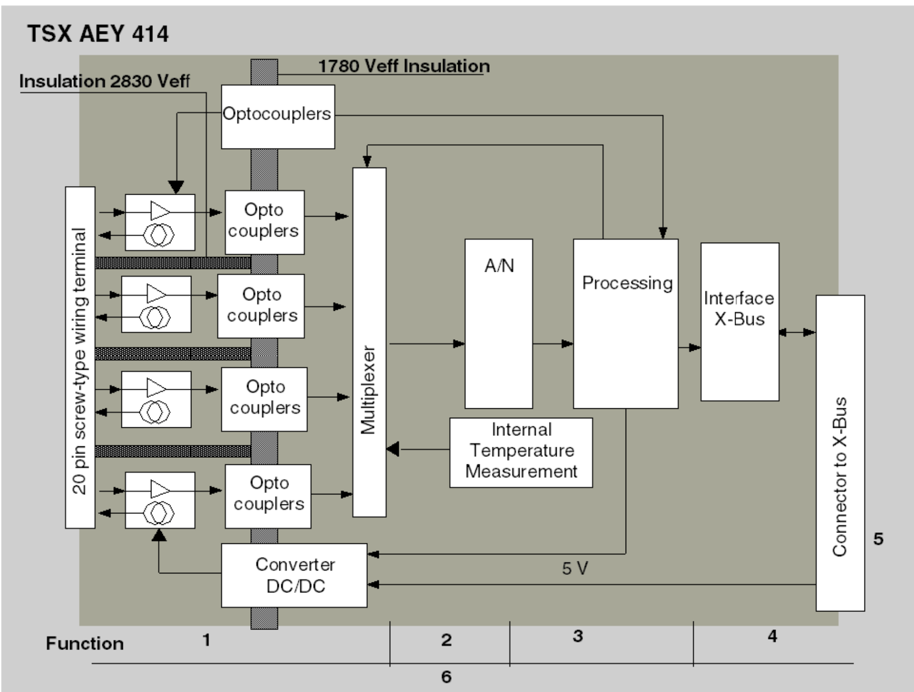
The **TSX AEY 414** module is a multi-range acquisition device with four inputs isolated from each other. This module offers the following ranges for each input, according to the selection made at configuration *(see page 224)* :

- thermocouple : B, E, J, K, L, N, R, S, T and U,
- voltage: -13...+63 mV,
- thermowell Pt100, Pt1000, Ni1000 in 2- or 4-wire, or Ohmic range : 0...400 Ohms, 0...3850 Ohms,
- high level +/-10 V, 0...10 V, +/-5 V, 0...5 V (0...20 mA with external shunt), or 1...5 V (4...20 mA with external shunt). It should be noted that external shunts are supplied with the product.

NOTE: The terminal block is supplied separately under the reference **TSX BLY 01**.

Summary

The **TSX AEY 414** input module performs the following functions :



Description

Details of the functions are the following :

Address	Component	Function
1	**Connection with process and Input Channels Scan**	• hardware connection to the process through a screw-type wiring terminal, • Gain selection, based on characteristics of input signals, as defined in configuration for each channel (high-level range, thermocoupe or thermowell), • multiplexing.
2	**Scanning of Analog Signals Measured at Input**	Scanning of Input Measurements Analog Signals
3	**Translating incoming values into workable measurements for the user**	• Taking into account recalibration and alignment coefficients to be applied to measurements (channel per channel, and range per range), as well as the module's self-calibration coefficients, • linearization of measurement provided by thermowells Pt or Ni, • linearization of measurmenet, and accounting for the internal or external cold junction compensation, in the case of thermowells, • scaling of measurements, based on configuration parameters (physical units or user-specified range).
4	**Interface and Communications with Application**	• managing exchanges with CPU, • geographic addressing, • receiving configuration parameters from module and channels, • sending measured values, as well as module status, to the application.
5	**Module Power Supply**	-
6	**Module monitoring and sending error warnings back to application**	• testing the conversion string, • testing for range overflow on channels, • verifying that terminal block is present, • testing of sensor connection [except for ranges +/-10 V, 0...10V, +/-5 V, 0...5V (0..20mA), • watchdog test.

Measurement Timing

Introduction

The cycle time for the TSX AEY 414 module is always 550 ms.

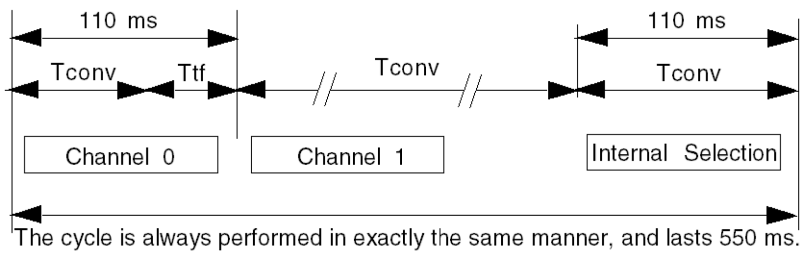
This value is not affected by the power supply frequency (50 or 60 Hz). Measurements are done in the following order: channel 0, channel 1, channel 2, channel 3 and internal selection.

Breakdown of Cycle Duration

The following table breaks down the various cycle times:

Type of Time	Breakdown of Cycle Times	Total
Scan Time for channel 0	• Wiring Test: 4 ms • Channel Conversion: 106 ms	110 ms
Scan Time for channel 1	• Wiring Test: 4 ms • Channel Conversion: 106 ms	110 ms
Scan Time for channel 2	• Wiring Test: 4 ms • Channel Conversion: 106 ms	110 ms
Scan Time for channel 3	• Wiring Test: 4 ms • Channel Conversion: 106 ms	110 ms
Scan Time for channel 4	• Wiring Test: 4 ms • Channel Conversion: 106 ms	110 ms
Internal Selection	• Internal Selection: 110 ms	110 ms
Total		550 ms

NOTE: internal selection corresponds either to the internal temperature, or to the internal references for module self-calibration, or again to line compensation for thermowell ranges.



Overflow Monitoring

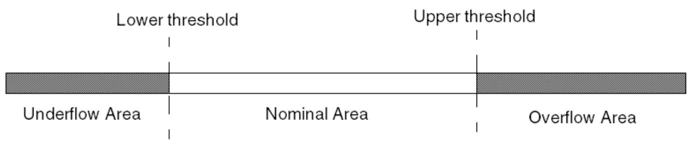
Introduction

The TSX AEY 414 module allows the user to select between several voltage ranges, thermocouple ranges and thermowell ranges for each input.

Whichever range is selected, the module always checks for overflow: it ensures that the measurement falls between a lower and an upper threshold.

Measurement Areas

The measurement range is divided into 3 areas:



Nominal Area Measurement range matching the chosen range.
Overflow Area Area located beyond the upper threshold.
Underflow Area Area located below the lower threshold.

Overflow Flags

In over/underflow areas, there is a risk of saturating the measurement device. In order to counter this risk through the user program, error bits have been prepared:

Bit Name	Flag (when = 1)
`%Ir.m.c.ERR`	Channel Fault.
`%MWr.m.c.2.1`	Denotes a range overflow on the channel.

Overflow Values for Voltage Ranges

For voltage ranges, the module allows a 5% overflow of the positive electric range covered. The following table lists the overflow values:

Range	Lower threshold	Upper threshold	Default Values	Min. threshold in User mode	Max. threshold in User mode
+/-10 V	-10.5 V	+10.5 V	+/- 10500	Min -5%(Max-Min)/2	Min +5%(Max-Min)/2

Range	Lower threshold	Upper threshold	Default Values	Min. threshold in User mode	Max. threshold in User mode
0..0.10 V	-0.5 V	+10.5 V	-500..+ 10500	Min -5%(Max-Min)	Min +5%(Max-Min)
+/-5 V	-5.25 V	+5.25 V	+/- 10500		
0...5 V	-0.25 V	+5.25 V	-500..+ 10500		
1...5 V	+0.8 V	+5.2 V			
0...20 mA	-1 mA	+21 mA			
4...20 mA	+3.2 mA	+20.8 mA			

Overflow Values for Thermal Ranges

The range under/overflow corresponds either to a dynamic under/overflow of the acquisition device, or to an under/overflow of the sensor's measurement normalized area, or again to a dynamic under/overflow of the cold junction compensation temperature (-5° C at +85° C). Using internal compensation at a normative ambient temperature (0° C at +60° C) is compatible with thresholds -5° C at +85° C. The following table lists these values:

Range	Lower threshold	Upper threshold	Default Values	Min. threshold in User mode	Max. threshold in User mode
Thermocouple B	0 °C (32 °F)	+1802 °C (+3276 °F)	°C or °F	0	+10000
Thermocouple E	-270 °C (-454 °F)	+812 °C (+1493 °F)			
Thermo J	-210 °C (-346 °F)	+1065 °C (+1949 °F)			
Thermo K	-270 °C (-454 °F)	+1372 °C (+2502 °F)			
Thermo L	-200 °C (-328 °F)	+900 °C (+1652 °F)			
Thermo N	-270 °C (-454 °F)	+1300 °C (+2372 °F)			
Thermo R	-50 °C (-58 °F)	+1769 °C (+3216 °F)			
Thermo S		+1769 °C (+3216 °F)			
Thermo T	-270 °C (-454 °F)	+400 °C (+752 °F)			
Thermo U	-200 °C (-328 °F)	+600 °C (+1112 °F)			
Pt100		+850 °C (+1562 °F)			
Pt1000		+800 °C (+1472 °F)			
Ni1000	-60 °C (-76 °F)	+250 °C (+482 °F)			
-13...+63 mV	-13 mV	+63 mV	-2064..+ 10000	Min	Max
0..400 Ω	0	400 Ω	0..+10000		
0..3850 Ω		3850 Ω			

Sensor Connection Monitoring

Resistance Values

Monitoring the sensor connection requires a maximum cumulative resistance value Rs for the sensors connected to the module’s inputs. This maximum value (Rs) is compatible with the normal operation of the TSX AEY 414 module.

The sensor connection fault may indicate a short-circuit or an open circuit, depending of the type of sensor in use. However, the error report is quite general and does not differentiate between a short-circuit and an open circuit.

Table of Resistance Values:

Sensor	Thermowells Pt1000/Ni1000	Thermowell Pt100	Thermocouples -15/60 mV, B, E, J, K, L, N, R, S, T and U
Max. Rs	-	0	100 Ohms
Open circuit	> 3850 Ohms	> 400 Ohms	100000 Ohms
Short-circuit	150 Ohms	15 Ohms	undetectable

NOTE: The module ensures consistency between the wiring terminal fault and the sensor connection fault. The sensor connection fault is not detected in range 0-5 V / 0-20 mA (this service is not offered to the user, and the wiring test is not performed).
In the 1-5 V / 4-20 mA range, the wiring test is meaningful only if the 250W shunt is connected. If the shunt is not connected, the wiring test may not be able to detect a fault, even is cables were cut.
In the case of thermowells, the sensor connection fault due to a line compensation anomaly may appear or disappear with a maximum delay of 12 s, from the occurrence of said anomaly.

Measurement Filtering

Introduction

The type of filtering performed by the system is called "first order filtering." The filtering coefficient is editable *(see page 243)* through the Unity Pro screen or through a program.

Mathematical Formula

The applicable mathematical formula is as follows:

$$Mesf(n) = \alpha \times Mesf(n-1) + (1-\alpha) \times Valb(n)$$

where:

α = filter efficiency,

Mesf(n) = filtered measurement at time n,

Mesf(n-1) = filtered measurement at time n-1,

Valb(n) = raw value at time n.

The user configures the filtering value from among 7 possibilities. This value may be changed even when the application is in RUN mode.

NOTE: Filtering is disabled in Fast Cycle mode.

Values for the TSX AEY 414 Module

Filtering values are as follows:

Desired Efficiency	Required Value	α corresponding	Filter Response Time at 63%	Cut-off Frequency (in Hz)
No filtering	0	0	0	0
Low filtering	1 2	0.750 0.875	1.91 s 4.12 s	0.083 0.039
Medium filtering	3 4	0.937 0.969	8.45 s 17.5 s	0.019 0.0091
High filtering	5 6	0.984 0.992	34.1 s 68.5 s	0.0046 0.0022

Measurement Display

Introduction

This process allows you to choose the display format in which measurements are provided to the user application. It’s important to differentiate between electrical ranges on the one hand, and thermocouple or thermowell ranges on the other hand.

Standardized Display of electrical ranges

Values are displayed in normalized measuring units (in percent format, with two decimal spaces, also symbolized as ‱).

Type of Range	Display
Unipolar range	from 0 to 10000 (0 ‱ to +10000 ‱)
Bipolar range	from -10000 to 10000 (-10.000 ‱ to +10000 ‱)

User-specified Display

The user may define the range of values *(see page 226)* within which measurements are expressed, by selecting:

- the lower threshold corresponding to the minimum value for the range: 0 ‱ (or -10000 ‱),
- the upper threshold corresponding to the maximum value for the range (+10000 ‱).

These lower and upper thresholds are integers between -30000 and +30000.

Example:

Imagine a conditioner providing pressure data on a 4-20 mA loop, with 4 mA corresponding to 3200 mB, and 20 mA corresponding to 9600 mB. You have the option of choosing the User format, by setting the following lower and upper thresholds:

- 3200 ‱ for 3200 mB as the lower threshold,
- 9600 ‱ for 9600 mB as the upper threshold,

Values transmitted to the program vary between 3200 (= 4 mA) and 9600 (= 20 mA).

Therefore, matches are as follows:

Value transmitted to program	Current	Pressure
3200	4 mA	3200 mB
current value	between 4 and 20 mA	current value
9600	20 mA	9600 mB

Display of Thermal Ranges

Measurements provided to the application are directly usable : you may choose *(see page 227)* either "In Temperature" Display or Standardized Display:

- for "In Temperature" display mode, values are provided in tenths of a degree (Celsius or Farenheit, depending on the unit you’ve selected).
- for the user-specified display, you may choose a Standardized Display 0...10000 (meaning from 0 to 10000 $^{\circ}/_{\circ\circ\circ}$), by specifying the minimum and maximum temperatures as expressed in the 0 to 10000 range.

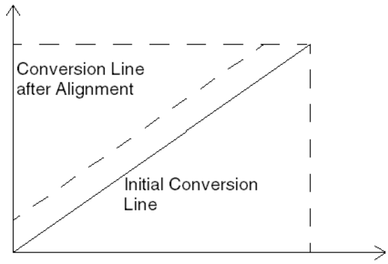
Sensor Alignment for the TSX AEY 414 Module

Introduction

The process of "alignment" consists in eliminating a systematic offset observed with a given sensor, around a specific operating point. It’s important to understand that one compensates for an error in the process, not for an error linked to automation (process control). Therefore, replacing a module does not require a new alignment. However, replacing the sensor or changing the sensor’s operating point does require a new alignment.

Figure

The following diagram shows conversion lines:



Example

Suppose that a Pt100 probe, immersed in melting ice (typical adjustment procedure for probes), indicates, after measurement and display, that the temperature is 10° C, instead of 0° C. You have the option of aligning (or "mapping") this measurement to the desired value, namely 0. After the alignment procedure, the measurement channel will implement a systematic offset of -10 for any new measurement.

Alignment Values

The alignment value is editable *(see page 244)* from a programming console, even if the program is in RUN Mode.

For each input channel, you may:

- View and modify the desired measurement value,
- Save the alignment value,
- Determine whether the channel already has an alignment.

The alignment offset may also be modified through programming. Channel alignment is performed in the Standard operating mode, without any effect on the channel’s operating modes.

The maximum offset between measured value and desired (aligned) value may not exceed +/-1000.

Cold Junction Compensation for the TSX AEY 414 Module

At a Glance

In the case of thermocouple ranges, the cold junction compensation process is performed by the module.

However, measuring cold junction temperature may be performed on the module's terminal block (using a probe internal to the module) or remotely using an external Pt100 (Class A) probe (not included), connected to channel 0 on the module *(see page 234)*.

Chapter 18
TSX ASY 410 and TSX ASY 800 Modules

In This Chapter

This chapter is dedicated to the TSX ASY 410 and TSX ASY 800 rack-installable modules.

What Is in This Chapter?

This chapter contains the following topics:

Introducing the TSX ASY 410 module

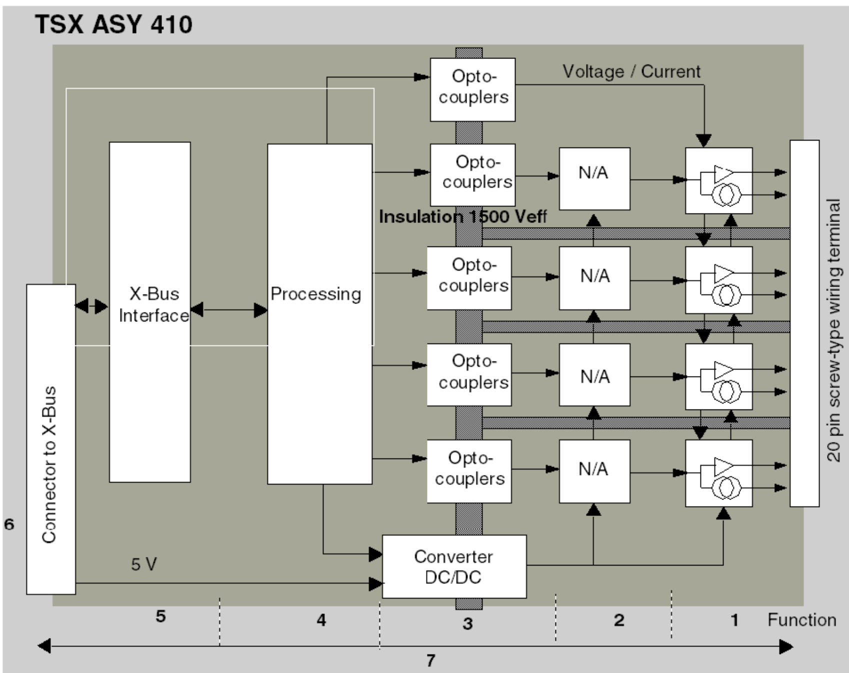
Overview

The TSX ASY 410 is a module with 4 analog outputs isolated from each other. This module offers the following ranges for each output, according to the selection made during configuration *(see page 224)* :

- +/-10 V,
- 0...20 mA,
- 4...20 mA.

Summary

The TSX ASY 410 output module performs the following functions :



Description

Details of the functions are the following :

Address	Function	Characteristics
1	**Connection to Process**	● hardware connection to the process through a 20-pin screw-type wiring terminal, ● Protecting the module against voltage spikes.
2	**Adaptation to Various Actuators**	● The adaptation is performed on voltage or current.
3	**Converting Digital Data to Analog Signals**	● This conversion is performed on 11 bits with a polarity sign (-2048 to 2047), ● Reframing the data provided by the program is performed automatically and dynamically by the converter,
4	**Transforming application data into data directly usable by the discrete/analog converter**	-
5	**Interfacing and Communications with Application**	● Managing exchanges with the CPU, ● Geographic addressing, ● receiving, from the application, configuration parameters for the module and channels, as well as numeric setpoints from the channels, ● sending module status back to application.
6	**Module Power Supply**	-
7	**Module monitoring and sending error warnings back to application**	● Converter Test, ● Testing for range overflow on channels, ● verifying that terminal block is present, ● Watchdog test.

Refreshing Outputs

The maximum delay between transmission of the output value on the PLC bus and its effective positioning on the terminal block is of 2.5 ms.

Outputs may be affected manually to the **MAST** task or to the **FAST** task from the application program.

Writing Outputs

The application must provide the outputs with values in the standardized format:

- -10000 to +10000 for the +/-10 V range,
- 0 to +10000 in ranges 4-20 V and 0.-20 mA,

These values must be written in the words `%QWr.m.c.0` to `3` for channels 0 to 3 of module.

Characteristics of Outputs

Writing Outputs

The application must provide the outputs with values in standardized format:

- -10000 to +10000 for the +/-10 V range,
- 0 to +10000 in ranges 4-20 V and 0.-20 mA.

These values must be written in the words `%QWr.m.c.0` to `3` for channels 0 to 3 of the module.

Discrete/Analog Conversion

This conversion is performed on 11 bits with the + polarity sign (-2048 to +2047).

The data provided by the program is reframed automatically and dynamically by the converter.

Under/Overflow Control for the TSX ASY 410 Module

Introduction

The type of under/overflow monitoring implemented for module TSX ASY 410 is determined by its software version. (The software version number is indicated on the label bearing the module reference, on the side of the housing. It is also accessible via Unity Pro in Online mode.)

If the Module Software Version is 1.0 (SV<=1.0)

If the values provided to the application are below -10000 or above +10000, outputs will be saturated at the following value:

- -10 V or +10 V in the +/-10 V range,
- 4 mA or 20 mA in the 4 to 20 mA range,
- 0 mA or 20 mA in the 0 to 20 mA range.

An overflow error is indicated by the following bits (usable in program):

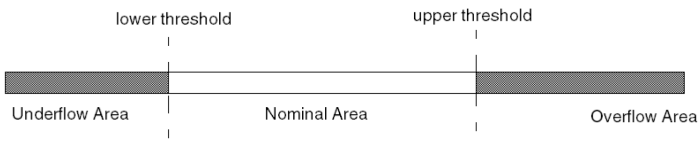
Bit Name	Meaning (when = 1)
`%Ir.m.c.ERR`	Denotes an error on the channel.
`%IWr.m.c.2.1`	Denotes a range overflow on the channel.

If the Module Software Version is 2.0 (SV>=2.0)

These modules allow the following overflow:

- +/-5 % on voltage ranges, and 4 to 20 mA,
- +5 % on the 0 to 20 mA range.

The measurement range is divided in three areas:



Nominal Area Measurement range matching the chosen range.
Overflow Area Area located beyond the upper threshold.
Underflow Area Area located below the lower threshold.

Under/Overflow Values Depending on the Range:

Range	Lower threshold	Upper threshold
+/-10V	-10500 (equals -10.5V)	+10500 (equals +10.5V)
0 to 20 mA	0 (i.e. 0 mA)	+10500 (equals +21 mA)
4 to 20 mA	-500 (equals 3.2 mA)	+10500 (equals +20.8 mA)

Range under/overflow detection is optional. You may also choose *(see page 232)* the flag for an overflow of the range upper value, for an underflow of the range lower value , or for both.

When the value transmitted falls beyond the overflow thresholds (and if overflow control is required), overflows are indicated by the following bits:

Address	Meaning (when = 1)
`%Ir.m.c.ERR`	Denotes an error on the channel.
`%MWr.m.c.2.1`	Denotes a range overflow on the channel: • `%MWr.m.c.2.3` = 1 denotes an overflow of the range upper threshold, • `%MWr.m.c.2.3` = 0 denotes an underflow of the range lower threshold.

Output Behaviors on the TSX ASY 410 Module

Fallback/Maintenance or Resetting Outputs to 0 (Zero)

In case of error, and depending on its seriousness, outputs switch individually or all together to the Fallback/Maintenance position, or else are forced to 0 (0 V ou 0 mA).

Various output behaviors:

Error	Behavior of Voltage Outputs	Behavior of Current Outputs
Task in STOP mode, or program missing	Fallback/Maintenance (channel per channel)	Fallback/Maintenance (channel per channel)
Communication Error		
Configuration Error	0 V (channel per channel)	0 mA (channel per channel)
Internal Error in Module		
Output Value out-of-range (range under/overflow) Software Version>=2.0	Value transmitted with saturation at +/- 10.5 V (channel per channel)	Value transmitted with saturation at 3.2/20.8 mA or 0/20 mA
Output Value out-of-range (range under/overflow) Sofware Version=1.0	+/- 10 V	4/20 mA or 0/20 mA
Terminal block fault	Maintenance at value (all channels)	Maintenance at value (all channels)
Pin connection under voltage (processor in STOP mode)	Outputs on 0 (all channels)	0 mA (all channels)
Reloading Program	0 V (all channels)	0(all channels)

Fallback or maintenance to the current value is selected during the module configuration. The fallback value may be modified from Debug *(see page 245)* in Unity Pro or through a program.

Introducing the TSX ASY 800 module

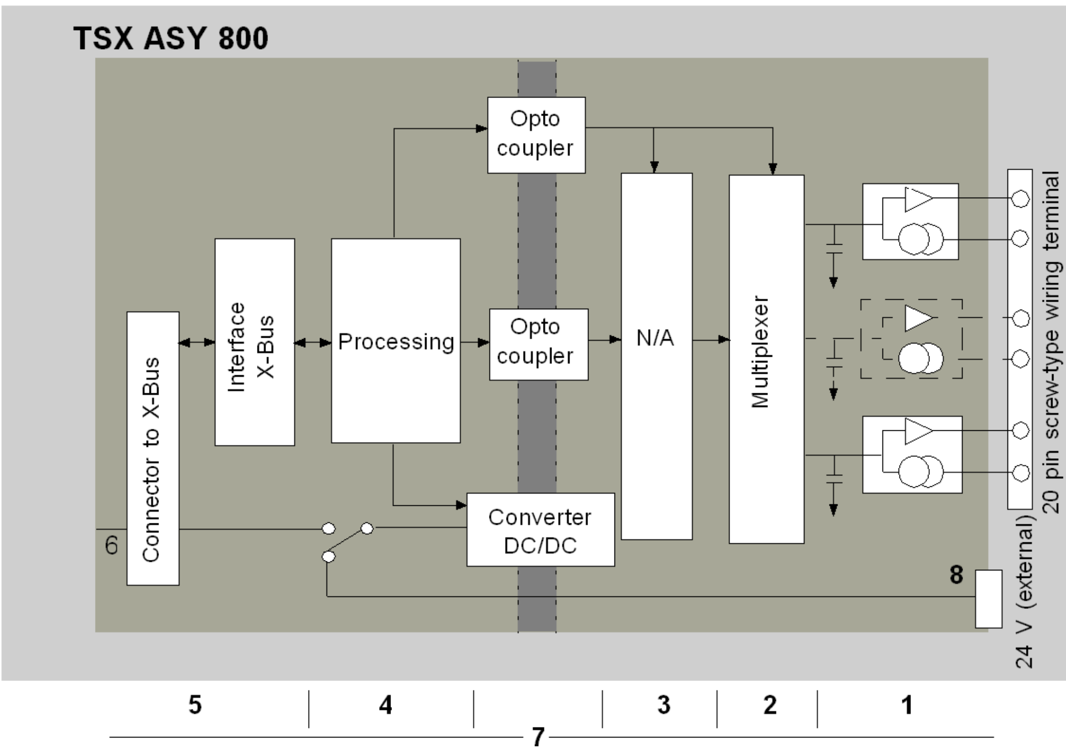
Overview

The **TSX ASY 800** is a module with 8 analog outputs not isolated from each other. This module offers the following ranges for each output, according to the selection made during configuration *(see page 224)* :

- +/-10 V,
- 0...20 mA,
- 4...20 mA.

Summary

The **TSX ASY 800** output module performs the following functions :



Description

Details of the functions are the following :

Address	Component	Function
1	**Connection to Process**	• hardware connection to the process through a 25-pin Sub-D connector, • Protecting the module against voltage spikes.
2	**Adaptation to Various Actuators**	• The adaptation is performed on voltage or current.
3	**Converting Digital Data to Analog Signals**	• For voltage, conversion is performed on 13 bits + polarity sign (-8192 to +8191), • For current, conversion is performed on 13 bits (0 to +8191),
4	**Transforming application data into data directly usable by the discrete/analog converter**	-
5	**Interfacing and Communications with Application**	• managing exchanges with CPU, • geographic addressing, • receiving, from the application, configuration parameters for the module and channels, as well as numeric setpoints from the channels, • sending module status back to application.
6	**Module Power Supply**	-
7	**Module monitoring and sending error warnings back to application**	• converter test, • testing for range overflow on channels, • verifying that terminal block is present, • watchdog test.
8	**External 24V Power Supply to Outputs**	-

Output refresh time

The maximum delay between transmission of the output value on the PLC bus and its effective positioning on the terminal block is 5 ms.

Behavior in case of fault in External Power Supply to Outputs

Should there be a fault in the external power supply to the outputs, all outputs for module **TSX ASY 800** switch to 0 (zero).

NOTE: Should there be a fault in the external power supply at the same time as a fault in the wiring terminal, only the power supply failure is reported.

Writing to Outputs

The application must provide the outputs with values in the standardized format:

- -10000 to +10000 for the +/-10 V range,
- 0 to +10000 in ranges 0 to 20 mA, and 4 to 20 mA.

These values must be written in the words **%QWr.m.c.0** to 7 for channels 0 to 7 of module.

Characteristics of Outputs

Writing Outputs

The application must provide the outputs with values in standardized format:

- -10000 to +10000 for the +/-10 V range,
- 0 to +10000 in ranges 4-20 V and 0.-20 mA.

These values must be written in the words `%QWr.m.c.0` to `7` for channels 0 to 7 of the module.

Discrete/Analog Conversion

The discrete/analog conversion is performed on:

- 13 bits + polarity sign (-8192 to +8191) for voltage,
- 13 bits (0 to +8191) for current.

Reframing the data provided by the program is performed automatically and dynamically by the converter.

Behavior in Case of Fault in External Power Supply to Outputs

Should there be a fault in the external power supply to the outputs, all module outputs switch to 0 (zero).

NOTE: Should there be a fault in the external power supply at the same time as a fault in the wiring terminal, only the power supply failure is reported.

Under/Overflow Monitoring for the TSX ASY 800 Module

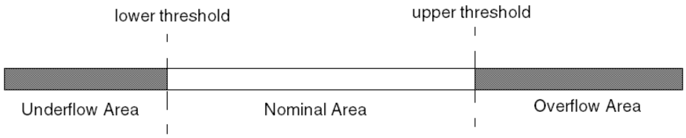
Introduction

The TSX ASY 800 module allows an overflow of +/- 5% on voltage ranges and of 4 to 20 mA and + 5% on the current range.

Range under/overflow detection is optional.

Measurement Areas

The measurement range is divided in three areas:



Nominal Area Measurement range matching the chosen range.
Overflow Area Area located beyond the upper threshold.
Underflow Area Area located below the lower threshold.

Overflow Flags

Overflow values for the various ranges are as follows:

Range	Lower threshold	Upper threshold
+/-10V	-10500 (equals -10.5V)	+10500 (equals +10.5V)
0 to 20 mA	0 (i.e. 0 mA)	+10500 (equals +21 mA)
4 to 20 mA	-500 (equals 3.2 mA)	+10500 (equals +20.8 mA)

You may also choose *(see page 232)* the flag for an overflow of the range upper value, for an underflow of the range lower value, or for both.

If under/overflow monitoring is required, indications are provided by the following bits:

Bit Name	Meaning (when = 1)
`%Ir.m.c.ERR`	Denotes an error on the channel
`%MWr.m.c.2.1`	Denotes a range overflow on the channel : ● `%MWr.m.c.2.3 = 1` denotes an overflow of the range upper threshold, ● `%MWr.m.c.2.3 = 0` denotes an underflow of the range lower threshold.

Output Behavior on the TSX ASY 800 Module

Fallback/Maintenance or Resetting Outputs to 0 (Zero)

In case of error, and depending on its criticality, outputs switch individually or simultaneously to the Fallback/Maintenance position, or else are forced to 0 (0 V or 0 mA).

Various output behaviors:

<table>
<tr><th>Error</th><th>Behavior of Voltage Outputs</th><th>Behavior of Current Outputs</th></tr>
<tr><td>Task in STOP mode, or program missing</td><td rowspan="2">Fallback/Maintenance (channel per channel)</td><td rowspan="2">Fallback/Maintenance (channel per channel)</td></tr>
<tr><td>Communication Error</td></tr>
<tr><td>Configuration Error</td><td rowspan="2">0 V (channel per channel)</td><td rowspan="2">0 mA (channel per channel)</td></tr>
<tr><td>Internal Error in Module</td></tr>
<tr><td>Output Value out-of-range (range under/overflow)</td><td>Value transmitted with saturation at +/- 10.5 V (channel per channel)</td><td>Value transmitted with saturation at 3.2/20.8 mA or 0/20 mA</td></tr>
<tr><td>Terminal block fault</td><td>Maintenance at value (all channels)</td><td>Maintenance at value (all channels)</td></tr>
<tr><td>Pin connection under voltage (processor in STOP mode)</td><td rowspan="2">0 V (all channels)</td><td rowspan="2">0 mA (all channels)</td></tr>
<tr><td>Reloading Program</td></tr>
</table>

Fallback or maintenance to the current value is selected during the module configuration. The fallback value may be modified from the Debug *(see page 245)* screen in Unity Pro or through a program.

Behavior at Power-Up

When power is first provided to the module (when rack is powered-up or during pin connection under voltage), all outputs are frozen at 0 V/0 mA for one second, before they become functional.

This delay is required in order to stabilize the power supply to the outputs.

Chapter 19
Configuring an Analog Module

In This Chapter

This chapter covers the configuration of a module with analog inputs/outputs.

What Is in This Chapter?

This chapter contains the following sections:

Section 19.1
Configuring an Analog Module: Overview

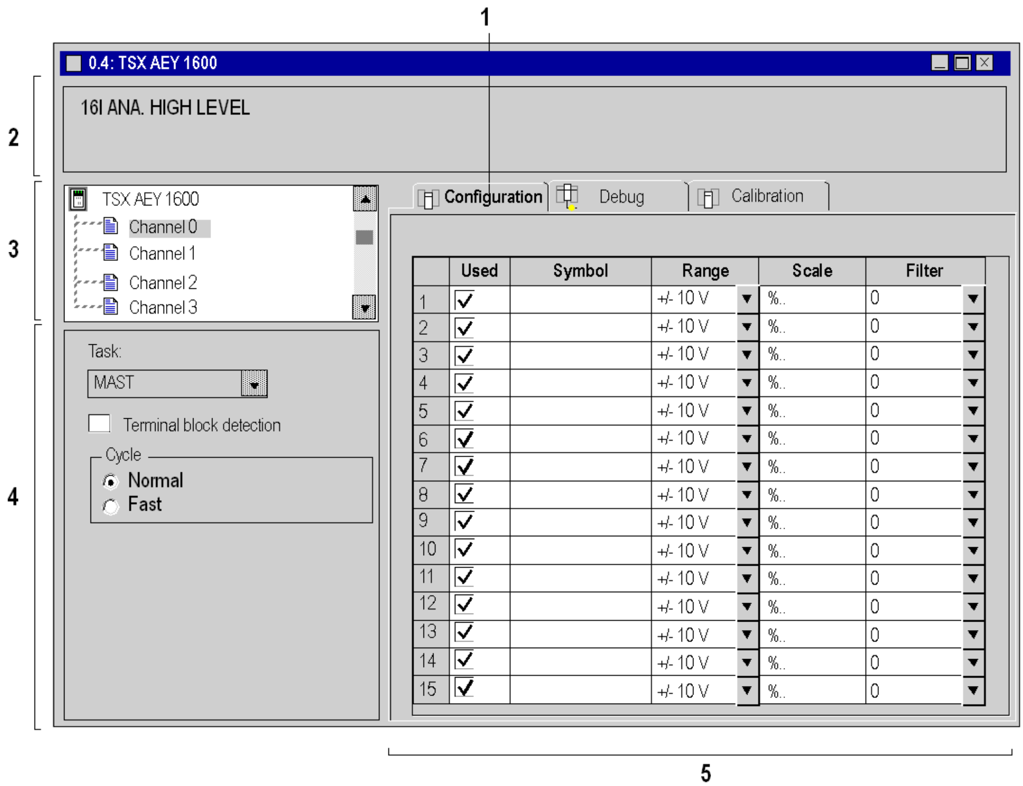
Description of the Configuration Screen for Rack-Installable Analog Modules

At a Glance

The Configuration *(see Unity Pro, Operating Modes)* screen for the analog module selected from the rack displays parameters associated with the module in question.

Illustration

This screen is used to display and modify parameters in offline mode.



Description

The following table shows the various elements of the configuration screen and their functions.

Number	Element	Function
1	Tabs	The tab in the foreground indicates the mode in progress (**Configuration** in this example). Select each mode by clicking on the corresponding tab. ● **Configuration**, ● **Calibration** which can be accessed only in online mode, ● **Debug**, accessible only in online mode.
2	**Module** area	Displays the abbreviated module indicator. In the same area there are 3 LEDs which indicate the status of the module in online mode: ● **RUN** indicates the operating status of the module. ● **ERR** signals a fault within the module. ● **I/O** indicates a fault from outside the module or an application fault.

3	**Channel** area	Allows you:
		● By clicking on the reference number, to display the tabs:
		  ● **Description** which gives the characteristics of the device.
		  ● **I/O Objects** *(see Unity Pro, Operating Modes)* which is used to presymbolize the input/output objects.
		  ● **Fault** which shows the device faults (in online mode).
		● To select a channel,
		● To display the **Symbol**, name of the channel defined by the user (using the variable editor).

4	**General parameters** area	Use this area to select the task associated with the channel: ● **Task**: defines the **MAST**, **FAST** or **AUX0/3** *(see Premium and Atrium using Unity Pro, Discrete I/O modules, User manual)* task through which the channel's implicit exchange objects will be exchanged. ● The **Terminal block detection** check box allows you to modify the terminal block detection function. ● The **Cycle** field allows you to define the scan cycle for inputs (only available on some analog modules).
5	**Configuration** area	Use this area to set configuration parameters for the various channels. This area includes several topics, whose display varies depending on the analog module you've selected. The **Symbol** column displays the symbol associated with the channel once it's been defined by the user (from the Variables Editor).

Section 19.2
Parameters for Analog Input/Output Channels

In This Section

This section describes various parameters associated with inputs/outputs for a rack-installable analog module.

What Is in This Section?

This section contains the following topics:

Parameters for Rack-Mounted Analog Input Modules

At a Glance

Analog input modules include channel-specific parameters displayed in the module configuration screen.

NOTE: Parameters indicated in bold characters are part of the default configuration.

Parameters

The following table shows the available parameters for each rack-mounted analog input module.

Parameter	TSX AEY 1600	TSX AEY 800	TSX AEY 810	TSX AEY 420
Number of input channels	16	8	8	4
Channel used (1)	**Yes** / No	**Yes** / No	**Yes** / No	**Yes** / No
Scan Cycle	**Normal** Fast	**Normal** Fast	**Normal** Fast	-
Range	**+/-10 V** 0..0,10 V 0...5 V 1...5 V 0...20 mA 4...20 mA	**+/-10 V** 0..0,10 V 0...5 V 1...5 V 0...20 mA 4...20 mA	**+/-10 V** 0..0,10 V 0...5 V 1...5 V 0...20 mA 4...20 mA	**+/-10 V** 0..0,10 V 0...5 V 1...5 V 0...20 mA 4...20 mA
Filter	**0**..6	**0**..6	**0**..6	-
Display	**%..** / User	**%..** / User	**%..** / User	**%..** / User
Task associated to Channel	**Mast** / Fast / AUXi	**Mast** / Fast / AUXi	**Mast** / Fast / AUXi	**Mast** / Fast / AUXi
Group of channels affected by the task change	4 contiguous channels	4 contiguous channels	4 contiguous channels	2 contiguous channels
Terminal Block Detection (1)	Yes / **No**	Yes / **No**	Yes / **No**	Yes / **No**
Lower Range Overflow Control	-	-	**Yes** / No	**Yes** / No
Upper Range Overflow Control	-	-	**Yes** / No	**Yes** / No
Lower Threshold Range Overflow	-	-	**min-12.5%**	**min-12.5%**
Upper Threshold Range Overflow	-	-	**max+12.5%**	**max+12.5%**
Threshold 0	-	-	-	**0**...127
Threshold 1	-	-	-	**0**...127

Parameter	TSX AEY 1600	TSX AEY 800	TSX AEY 810	TSX AEY 420
Event Processing	-	-	-	Yes / **No**
Legend :				
(1)	This parameter is available as a checkbox.			

The following table shows the available parameters for each rack-mounted analog input module (continued).

Parameter	TSX AEY 414	TSX AEY 1614
Number of input channels	4	16
Channel used (1)	-	**Yes** / No
Scan Cycle	-	**Normal** / Fast
Range	**+/-10 V** 0..10 V +/-5 V 0..5 V / 0...20 mA 1..5 V / 4...20 mA Ni1000 IEC/DIN Pt100 IEC/DIN Pt1000 IEC/DIN Thermo B Thermo E Thermo J Thermo K Thermo L Thermo N Thermo R Thermo S Thermo T Thermo U 0..400 Ohms 0..3850 Ohms -13..63 mV	**Thermo K** Thermo B Thermo E Thermo J Thermo L Thermo N Thermo R Thermo S Thermo T Thermo U -80..+80 mV
Filter	**0**..6	**0**..6
High-Level Display	**%..** / User	**%..** / User
Display thermocouples and thermowells	**1/10 °C** / 1/10 °F / %..	**1/10 °C** / 1/10 °F / %..
Task associated to Channel	**Mast** / Fast / AUXi	**Mast** / Fast / AUXi
Group of channels affected by the task change	1 channel	4 contiguous channels
Terminal Block Detection (1)	Yes / **No**	Yes / **No**
Wiring Control	Active / **Inactive**	Active / **Inactive**

Parameter	TSX AEY 414	TSX AEY 1614
Cold junction compensation	**Internal** / External	**Internal by TELEFAST** / External by Pt100 Read Cold junction
Lower Range Overflow Control (1)	-	**Yes** / No
Upper Range Overflow Control (1)	-	**Yes** / No
Lower Threshold Range Overflow	-	**min-12.5%**
Upper Threshold Range Overflow	-	**max+12.5%**
High Precision (1)	-	**Yes** / No
Legend :		
(1)	This parameter is available as a checkbox.	

Parameters for Rack-Mounted Analog Output Modules

At a Glance

Rack-mounted analog output modules include channel-specific parameters displayed in the module configuration screen.

NOTE: Parameters indicated in bold characters are part of the default configuration.

Parameters

The following table shows the available parameters for each rack-mounted analog output module.

Module	TSX ASY 410	TSX ASY 800
Number of output channels	4	8
Range	**+/-10 V** 0...20 mA 4...20 mA	**+/-10 V** 0...20 mA 4...20 mA
High-Level Display	**%..** (non modifiable)	**%..** (non modifiable)
Task associated to Channel	**Mast** / Fast / AUXi	**Mast** / Fast / AUXi
Group of channels affected by the task change	1 channel	2 contiguous channels
Terminal Block Detection (1)	Yes / **No**	Yes / **No**
Fallback	**Fallback to 0** / Maintenance / Fallback to value	**Fallback to 0** / Maintenance / Fallback to value
24V Power Supply Control (1)	-	Yes / **No**
Power Supply	-	Internal / **External**
Lower Range Overflow Control (1)	**Yes** / No	**Yes** / No
Upper Range Overflow Control (1)	**Yes** / No	**Yes** / No
Legend:		
(1)	This parameter is available as a checkbox.	

Section 19.3
Configuring Analog Parameters

In This Section

This section presents general rules for implementing various configuration parameters for analog input/output channels.

What Is in This Section?

This section contains the following topics:

Modifying the Range for an Analog Module’s Input or Output

At a Glance

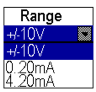
This parameter defines the range for the input or output channel.

Depending on the type of module, the input/output range may be:

- in electric voltage,
- in electric intensity,
- a thermocouple,
- a thermowell.

Instructions

The following table provides instructions to define the range assigned to an analog module’s channels.

Step	Procedure
1	Access the hardware configuration screen for the appropriate module.
2	Click on the arrow of the pull-down menu pertaining to the channel you wish to configure, in the **Range** column. **Results** : The following list appears. 
3	Select the appropriate range.
4	Validate the change with **Edit** →**Validate**.

Modifying a Task Associated to an Analog Channel

At a Glance

This parameter defines the task through which the acquisition of inputs and the update of outputs are performed.

Depending on the type of module, the task is defined for a channel or for a series of 2 or 4 contiguous channels.

The available options are:

- the MAST task,
- the FAST task,
- the AUX0/3 auxiliary tasks.

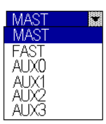
NOTE: The AUX0/3 tasks are only available with a TSX 57 5•4 processor.

⚠ WARNING
UNEXPECTED SYSTEM BEHAVIOR
Do not assign more than 2 analog modules to the FAST task, each with all 4 channels in use.
Failure to follow these instructions can result in death, serious injury, or equipment damage.

NOTE: The FAST task may be assigned to input channels only when in Fast Cycle scanning mode.

Instructions

The following table provides step-by-step instructions allowing you to define the type of task assigned to an analog module’s channels.

Step	Action
1	Access the hardware configuration screen for the appropriate module.
2	For the individual channel or group of channels you wish to configure, click on the **Task** scrolldown menu in the **General Parameters** area. **Results**: The following scrolldown list appears: 
3	Select the appropriate task.
4	Validate the change with **Edit** →**Validate**.

Modifying the Display Format for a Current or Voltage Input Channel

At a Glance

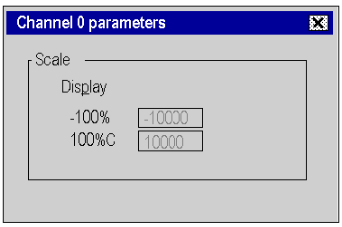
This parameter defines the display format for the measurement of an analog module channel whose range is configured for voltage or current.

The display format may be:

- standardized -10000% or +10000% (**%..**),
- user-defined (**User**).

Instructions

The following table provides step-by-step instructions defining the display scale assigned to an analog module channel.

Step	Action
1	Access the hardware configuration screen for the appropriate module.
2	Click in the cell of the **Scale** column for the channel you wish to configure. **Result**: an arrow appears.
3	Click on the arrow in the cell of the **Scale** column for the channel you wish to configure. **Result**: The **Channel Parameters** dialog box appears. 
4	Type in the values to be assigned to the channel in the two **Display** boxes situated in the **Scale** zone.
5	Confirm your changes by closing the dialog box **Note** : If default values have been selected (standardized display), the corresponding cell in the **Scale** column displays **%..**. If not, it displays the word **User** (user-defined display).
6	Validate the change with **Edit** →**Validate**.

Modifying the Display Format for a Thermocouple or Thermowell Channel

At a Glance

This parameter defines the display format for the measurement of an analog module channel whose range is configured as Thermocouple or Thermowell .

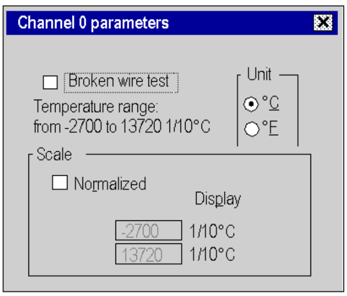
The available display formats are degrees Celsius (centigrade) or Fahrenheit, eventually with short-circuit or open circuit notification.

The display format may be:

- Standardized, which corresponds to the default scale of the selected thermocouple or thermowell, as defined in tenths of degrees (for instance : -600 to +1100 ° C for a Ni1000 probe) (**1/10 ° F** or **1/10 ° C**),
- user-defined (**User**).

Instructions

The following table provides step-by-step instructions defining the display scale assigned to an analog module channel whose range is configured as a Thermocouple or Thermowell.

Step	Action
1	Access the hardware configuration screen for the appropriate module.
2	Click in the cell of the **Scale** column for the channel you wish to configure. **Result**: an arrow appears.
3	Click on the arrow in the cell of the **Scale** column for the channel you wish to configure. **Result**: The **Channel Parameters** dialog box appears. 
4	If necessary, check the **Wiring Fault Control** box to enable this function.
5	Select the temperature measuring unit by clicking ° **C** or ° **F**.
6	Check the **Standardized** box to select the standardized (or "normalized") display.
7	Close the dialog box to confirm your selection. **Note** : If default values have been selected (standardized display), the corresponding cell in the **Scale** column displays **%..** whichever temperature unit was selected. If not, it displays the word **User** (user-defined display).
8	Validate the change with **Edit** →**Validate**.

Modifying the Filtering Value for an Analog Module’s Input Channels

At a Glance

This parameter defines the type of filtering for the input channel selected for analog modules.

The available filtering values are:

- **0**: No filtering,
- **1** and **2**: Low filtering,
- **3** and **4**: Medium filtering,
- **5** and **6**: High filtering.

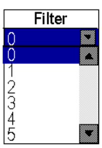
NOTE: If you’ve selected the Fast Scan Cycle, filtering is not taken into account.

5 modules manage this function:

- TSX AEY 800 module *(see page 152)*,
- TSX AEY 1600 module *(see page 152)*,
- TSX AEY 1614 module *(see page 174)*,
- TSX AEY 414 module *(see page 196)*,
- TSX AEY 810 module *(see page 165)*.

Instructions

The following table provides instructions for defining the filter value assigned to input channels for analog modules.

Step	Action
1	Access the hardware configuration screen for the appropriate module.
2	Click on the arrow of the pull-down menu pertaining to the channel you wish to configure, in the **Filter** column. **Result**: the pulldown menu appears. 
3	Select the filter value you wish to assign to the selected channel.
4	Validate the change with **Edit** →**Validate**.

Selecting the Input Channel Scan Cycle

At a Glance

This parameter defines the input channel scan cycle for analog modules.

The input scan cycle may be:

- **Normal**: Channels are sampled within the time period specified in the module's characteristics.
- **Fast**: Only those inputs declared to be **In Use** are sampled. The scan cycle is therefore determined by the number of channels in use and by the time period allocated for scanning one channel.

Input channel registers are updated at the beginning of the task to which the module is assigned.

NOTE: The **Normal** / **Fast** and **In Use** cycle parameters cannot be edited in online mode if the project has been transferred to the PLC with the default values specified for these parameters (i.e. Normal cycle and All channels in use).

Instructions

The following table provides step-by-step instructions allowing you to define the scan cycle assigned to an analog module's inputs.

Step	Action
1	Access the hardware configuration screen for the appropriate module.
2	For the group of input channels you wish to configure, check the appropriate box (**Normal** or **Fast**) for the **Cycle** field of the **General Parameters** area. **Result**: The selected scan cycle will be assigned to the channels.
3	Validate the change by clicking **Edit** →**Validate**.

Modifying the Terminal Block Detection Function for Analog Modules

At a Glance

This performs the Terminal Block Detection function to determine whether there is one or several Sub-D connectors or wiring terminals, and returns an error when the terminal block is missing.

NOTE: For modules equipped with 2 Sub-D connectors, a terminal block error is reported **if at least one channel is used** while the corresponding connector is missing.

Instructions

The following table provides specific instructions for selecting the type of Terminal Block Detection.

Step	Action
1	Access the hardware configuration screen for the appropriate module.
2	Check the box **Terminal block detection** in the **General parameters** area.
3	Validate the change with **Edit** →**Validate**.

Selecting Input Channel Usage

At a Glance

A channel is declared to be "In Use" in a task when the measured values are "sent back" to the task assigned to the channel in question.

If a channel is not in use, the corresponding line is grayed out, the 0 value is sent back to the application program, and status indications specified for this channel (range overflow, etc.) are inactive.

Instructions

The following table provides specific instructions for modifying the usage status of a channel.

Step	Action
1	Access the hardware configuration screen for the appropriate module.
2	Click in the cell of the **In Use** column for the channel you wish to modify, then select or deselect the channel.
3	Validate the change by clicking **Edit** →**Validate**.

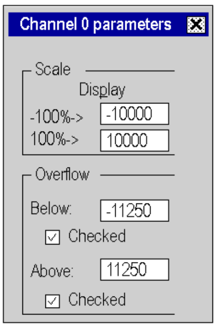
Modifying the Overflow Control Function

At a Glance

Overflow Control is defined by a monitored or unmonitored lower threshold, and by a monitored or unmonitored upper threshold.

Instructions

The following table provides step-by-step instructions for modifying the Overflow Control parameters assigned to an analog module channel.

Step	Action
1	Access the hardware configuration screen for the appropriate module.
2	Click in the cell of the **Scale** column for the channel you wish to configure. **Result**: an arrow appears.
3	Click on the arrow in the cell of the **Scale** column for the channel you wish to configure. **Result**: The **Channel Parameters** dialog box appears. 
4	Check or uncheck the **Checked** box of the **Underflow** field to specify an underflow threshold.
5	Check or uncheck the **Checked** box of the **Overflow** field to specify an overflow threshold.
6	Confirm your changes by closing the dialog box
7	Validate the change with **Edit** →**Validate**.

Selecting the Type of Event Processing for an Analog Input Channel

At a Glance

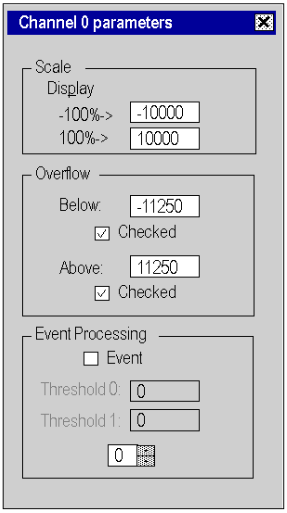
Selecting the type of event processing for an analog input channel is managed only by the TSX AEY 420 module *(see page 183)*.

An event is triggered if the input channel value crosses over one of the specified thresholds.

The type of event processing is defined by the number of the event processed.

Instructions

The following table provides specific instructions for selecting a type of event processing for an analog input channel.

Step	Action
1	Access the hardware configuration screen for the appropriate module.
2	Click in the cell of the **Scale** column for the channel you wish to configure. **Result**: an arrow appears.
3	Click on the arrow in the cell of the **Scale** column for the channel you wish to configure. **Result**: The **Channel Parameters** dialog box appears. 
4	Check the **Event** box of the **Event processing** field to specify an event trigger. The event trigger selected in this screen is activated upon overflow of one of the thresholds defined in **Threshold 0** and **Threshold 1**.
5	Confirm your changes by closing the dialog box.
6	Validate the change with **Edit** →**Validate**.

Cold Junction Compensation

At a Glance

This function is available on input modules. It may be internal or external. By default, internal compensation is suggested to the user.

NOTE: If you select external compensation, channel 0 of the module is forced – upon confirmation – to adopt the Pt100 range.

TSX AEY 414 Module

The following table provides a step-by-step procedure for modifying the Cold Junction Compensation behavior for the TSX AEY 414 module.

Step	Action
1	Access the hardware configuration screen for the appropriate module.
2	Check the **Internal by TELEFAST** or **External by Pt100** box in the **Cold Junction** field.
3	Validate the change with **Edit** →**Validate**.

TSX AEY 1614 Module

The following table provides a step-by-step procedure for modifying the Cold Junction Compensation behavior for the TSX AEY 1614 module.

Step	Action
1	Access the hardware configuration screen for the appropriate module.
2	Check the **Internal by TELEFAST** or **External by Pt100** box in the **Cold Junction** field, in the **General Parameters** area. These two check boxes determine the type of cold junction compensation : ● Internal by TELEFAST (default): Compensation is performed at the level of the Telefast terminal block. In this case it is possible to raise the cold junction temperature value through Channel 8, by checking the **Read Cold Junction** box, and after acknowledging the warning message, ● external, through a PT100 probe that needs to be wired on Channels 0 and 8. Channel 0 flows the current in the probe, and Channel 8 measures the temperature.
3	Validate the change with **Edit** →**Validate**.

High Precision Mode for the TSX AEY 1614 Module

At a Glance

This mode ensures a higher accuracy of temperature measurements, through a self-calibrating procedure.

NOTE: The self-calibration procedure adds, for each cycle *(see page 170)*, a delay of 70 ms.

Instructions

The following table provides specific instructions for enabling the High Precision Mode.

Step	Action
1	Access the hardware configuration screen for the appropriate module.
2	Check the **High Precision** box in the **General Parameters** area.
3	Validate the change with **Edit** →**Validate**.

Selecting the Fallback Mode for Analog Outputs

At a Glance

This parameter defines the behavior adopted by outputs when the PLC switches to STOP or when there is a communication error.

The possible behavior types are:

- **Fallback**: Outputs are set to an editable value between -10,000 and +10,000 (0 is the default).
- **Maintain value**: Outputs remain in the state they were in before the PLC switched to STOP.

Instructions

The following table provides instructions for defining the fallback behavior assigned to outputs of analog modules.

Step	Action
1	Access the hardware configuration screen for the appropriate module.
2	Check the box in the cell of the **Fallback** column for the output you want to configure.
3	Enter the desired value in the cell of the **Fallback Value** column. **Result**: The selected fallback mode will be assigned to the selected output.
4	To select the **Maintain** mode instead, uncheck the box in the cell of the **Fallback** column for the channel in question. **Result**: The maintain value behavior will be assigned to the selected output.
5	Validate the change by clicking **Edit** →**Validate**.

Modifying the Output Power Supply and Power Supply Fault Control parameters for the TSX ASY 800 module

At a Glance

The Output Power Supply parameter allows you to select the type of supply – internal or external to the module – powering the outputs for the TSX ASY 800 module.

⚠ WARNING
UNEXPECTED SYSTEM BEHAVIOR Do not power more than 2 TSX ASY 800 modules with the power supply from the same rack. **Failure to follow these instructions can result in death, serious injury, or equipment damage.**

When the Power Supply Fault Control parameter is enabled, the module checks to verify that there is indeed a 24V power supply, be they internal or external.

NOTE: These two parameters apply to the whole module.

Instructions

The following table provides specific instructions for selecting a type of power supply for the module's channels.

Step	Action
1	Access the hardware configuration screen for the appropriate module.
2	Check the **Internal** or **External** box in the **Supply** field of the **General Parameters** area. **Results** : The type of power supply selected shall be assigned to the module's channels.
3	Validate the change with **Edit** →**Validate**.

Instructions

The following table provides specific instructions for selecting a type of Power Supply Fault Control for the module's channels.

Step	Action
1	Access the hardware configuration screen for the appropriate module.
2	Check the **24V output supply monitoring** in the **General parameters** area. **Results** : Power Supply Fault Control is enabled.
3	Validate the change with **Edit** →**Validate**.

Chapter 20
Analog Module Debugging

Aim of this Chapter

This chapter describes the debugging aspect in the implementation of analog modules.

What Is in This Chapter?

This chapter contains the following topics:

Introducing the Debug Function of an Analog Module

Introduction

This function is only accessible in online mode. For each input/output module of the project, it can be used:

- to display the parameters of each of its channels (channel state, filtering value, etc.),
- to access the diagnostics and adjustment of the selected channel (masking the channel, etc.).

The function also gives access to the module diagnostics in the case of a fault.

Procedure

The table below shows the procedure for accessing the **Debugging** function:

Step	Action
1	Change to online mode.
2	In the rack configuration screen, double-click on the module.
3	Select the **Debugging** tab.

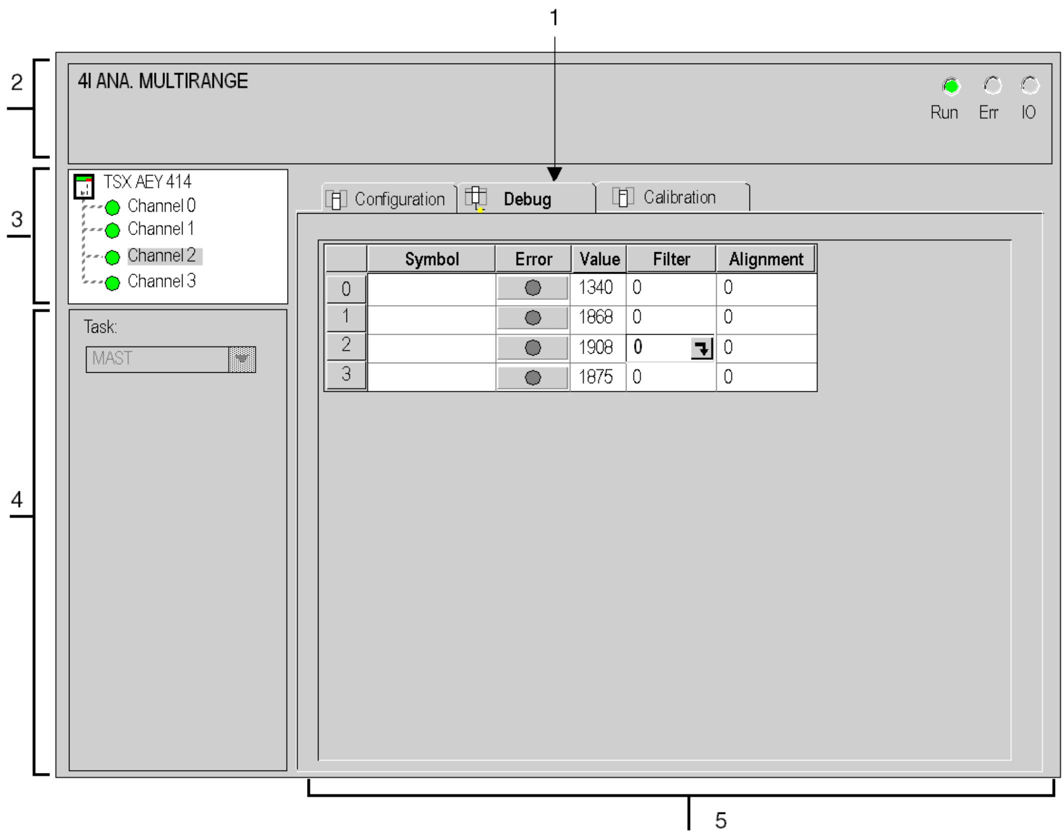
Description of the Analog Module Debug Screen

At a Glance

The Debug Screen displays, in real time, the current value and status for each of the selected module’s channels.

Illustration

The figure below shows a sample debug screen.



Description

The table below shows the different elements of the debug screen and their functions.

Number	Element	Function
1	Tabs	The tab in the foreground indicates the mode in progress (**Debug** in this example). Each mode can be selected using the respective tab. The available modes are: ● **Debug** which can be accessed only in online mode, ● **Calibration** which can be accessed only in online mode, ● **Configuration**.
2	**Module** area	Specifies the abbreviated heading of the module. In the same area there are 3 LEDs which indicate the status of the module in online mode: ● **RUN** indicates the operating status of the module, ● **ERR** indicates an internal fault in the module, ● **I/O** indicates a fault from outside the module or an application fault.

3	**Channel** area	Is used:
		● By clicking on the reference number, to display the tabs:
		  ● **Description** which gives the characteristics of the device.
		  ● **I/O Objects** *(see Unity Pro, Operating Modes)* which is used to presymbolize the input/output objects.
		  ● **Fault** which shows the device faults (in online mode).
		● To select a channel,
		● To display the **Symbol**, name of the channel defined by the user (using the variable editor).

4	**General parameters** area	Specifies the **MAST**, **FAST** or **AUXi** task configured. This heading is frozen.
5	**Viewing and control** area	Displays the value and status for each channel in the module in real-time. The symbol column displays the symbol associated with the channel when the user has defined this (from the variable editor). This provides direct access to channel by channel diagnostics when these are faulty (indicated by the LED built into the diagnostics access, which turns red). ● Access to the settings of the filtering, alignment and fallback values of the outputs, ● To channel-by-channel diagnostics when channels have an error (indicated by the LED built into the diagnostics access button, which turns red)

NOTE: All unavailable LEDs and commands appear in gray.

Modifying the Channel Filter Value

At a Glance

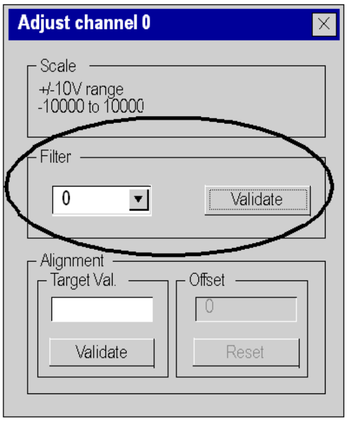
This function is used to modify the filter value of one or more channels of an analog module.

The available commands are:

- **0** : No filtering,
- **1** and **2**: Low filtering,
- **3** and **4**: Medium filtering,
- **5** and **6**: High filtering.

Procedure

The table below gives the procedure for changing a filter value.

Step	Action for a channel
1	Access the debug screen.
2	Select the channel to be modified in the **Display** zone and double-click in the corresponding box in the **Filter** column. **Results**: The **Adjust channel** dialog box appears. 
3	Click on the little arrow in the box in the **Filtering** field of the **Adjust channel** dialog box, and define the new selected filter value in the drop-down menu.
4	Confirm this selection by clicking **OK**.
5	Close the **Adjust channel** dialog box. **Results**: The new filter value then appears in the box corresponding to the selected channel in the **Filter** column of the **Display** area.

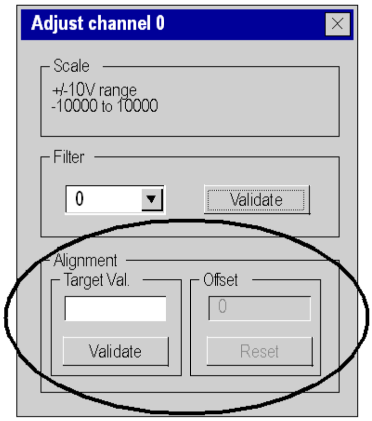
Aligning an Input Channel

At a Glance

The procedure for aligning an input is used to add an offset value to the value measured by this input, in order to compensate for a sensor shift (e.g. to adjust the measurement of a Pt100 probe immersed in a bucket of ice to 0° C for adjustment).

Procedure

The table below shows the procedure for aligning an input channel:

Step	Action for a channel
1	Access the debug screen.
2	Select the channel to be aligned in the **Display** zone and double-click in the corresponding box in the **Alignment** column. **Result**: The **Adjust channel** dialog box appears. 
3	Click on the box in the **Target value** field of the **Alignment** dialog box and enter the new alignment value.
4	Confirm this new alignment value by clicking on the **OK** button.
5	Close the **Adjust channel** dialog box.

Notes

NOTE: When the alignment offset is modified for each program with the `WRITE_PARAM` instruction, its value must be between +1500 and -1500.

NOTE: The calculated offset value only takes into account the "keyboard" commands given by the user. Running the program (RUN), which also controls the alignment, simultaneously, renders the offset invalid.

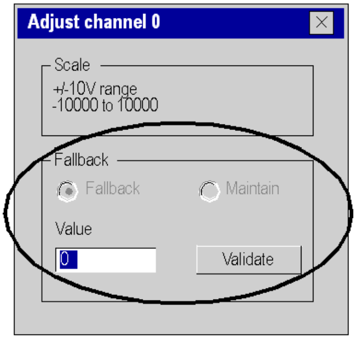
Modifying the Fallback Value of an Output

At a Glance

When an output is configured in **Fallback** mode, the corresponding button is valid but the **Fallback/Maintain** information is grayed out, because the fallback mode cannot be modified in Debugging mode. However, it is possible to change the fallback value by entering a new value.

Procedure

The table below summarizes the procedure for modifying the fallback value:

Step	Action for a channel
1	Access the debug screen.
2	Select the channel in the **Display** zone and double-click in the corresponding box in the **Fallback** column. **Result**: The **Adjust channel** dialog box appears. 

3	Click on the box in the **Value** field of the **Fallback** dialog box and enter the new fallback value.
	The value must be:
	● For TSX ASY 800 and ASY 410 software version modules < 1.0
	  ● between -10000 and 10000 in range 10 V
	  ● between 0 and 10000 in ranges 0..20 mA and 4..20 mA
	● For TSX ASY 800 and ASY 410 software version modules > 1.0
	  ● between -10500 and 10500 in range 10 V
	  ● between 0 and 10500 in ranges 0..20 mA and 4..20 mA

4	Confirm this new value by clicking **OK**.
5	Close the **Adjust channel** dialog box.

Notes

NOTE: The fallback value can also be modified for each program, with the `WRITE_PARAM` instruction.

NOTE: The fallback value cannot be modified on TBX modules.

Chapter 21
Calibration of Analog Modules

Aim of this Chapter

This chapter describes how to calibrate the various analog output/input modules.

What Is in This Chapter?

This chapter contains the following topics:

Calibration Function of an Analog Module

Introduction

This function is only accessible in online mode. It is used to recalibrate the channels of each analog input module of a project.

Calibration is used to correct the long-term module drift. It can also be used to optimize the precision of the measurement at ambient temperatures other than 25 degrees Celsius.

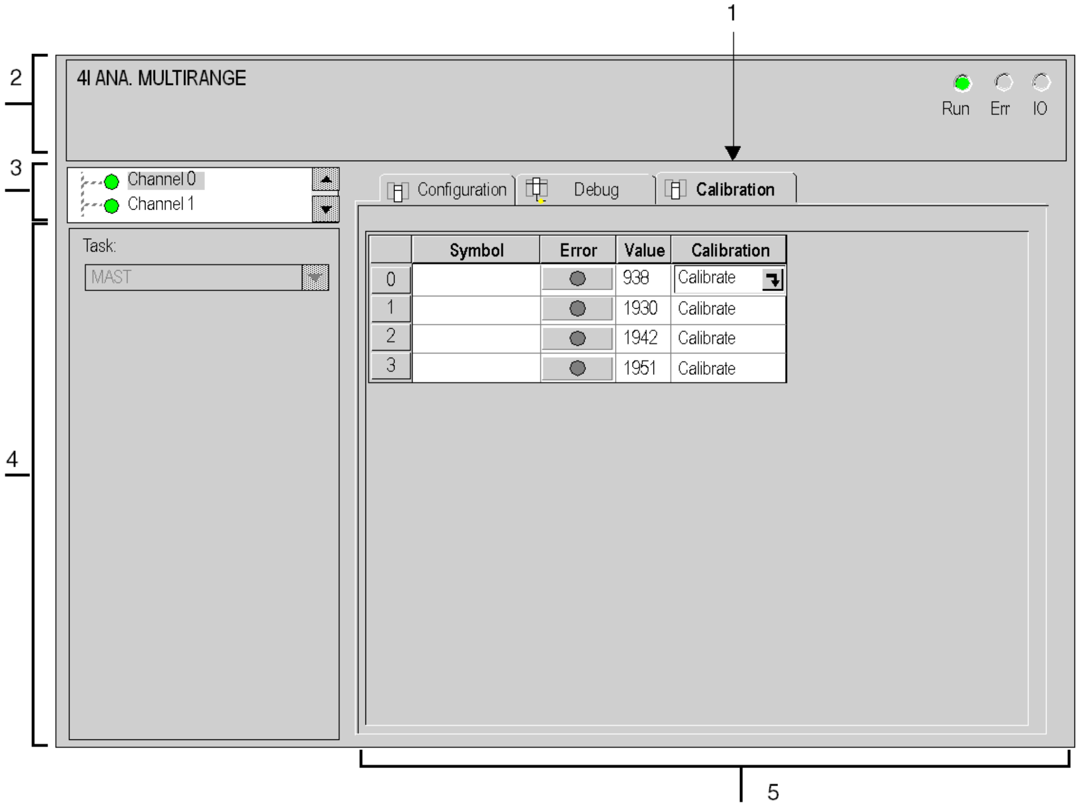
Procedure

Procedure for accessing the **Calibration** function:

Step	Action
1	Access the rack configuration screen.
2	Double-click the analog module to be calibrated.
3	Select the **Calibration** tab. **Result**: the **Calibration** screen appears.

Illustration

The figure below shows an example of a calibration screen.



Description

The table below shows the different elements of the calibration screen and their functions.

Number	Element	Function
1	Tabs	The tab in the foreground indicates the current mode (in this instance: **Calibration**). Every mode can be selected using the respective tab. The available modes are: ● **Calibration** which can be accessed only in online mode, ● **Debug** which can be accessed only in online mode, ● **Configuration**.
2	**Module** area	Specifies the abbreviated heading of the module. In the same area there are 3 LEDs which indicate the status of the module in online mode: ● **RUN** indicates the operating status of the module, ● **ERR** indicates an internal fault in the module, ● **I/O** indicates a fault from outside the module or an application fault.

3	**Channel** area	Is used:
		● By clicking on the reference number, to display the tabs:
		  ● **Description** which gives the characteristics of the device.
		  ● **I/O Objects** *(see Unity Pro, Operating Modes)* which is used to presymbolize the input/output objects.
		  ● **Fault** which shows the device faults (in online mode).
		● To select a channel,
		● To display the **Symbol**, name of the channel defined by the user (using the variable editor).

4	**General parameters** area	Specifies the **MAST**, **FAST** or **AUXi** task configured. This heading is frozen.
5	**Display** area	This zone at "channel" level displays the **ERR** information for each channel: all the measurements are invalid; filtering and alignment are inhibited.

NOTE: All unavailable LEDs and commands appear in gray.

Use

For TSX AEY 800/810/1600, TBX AES 400 and TBX AMS 620 modules, only channel 0 needs to be calibrated for all the module channels to be calibrated.

For the TSX AEY 1614 module, only channels 0 and 8 need to be calibrated for all the module channels to be calibrated.

For the TSX AEY 414 module, general channel calibration must be performed.

Calibration of the TSX AEY 800 and TSX AEY 1600 Modules

At a Glance

The calibration is performed globally for the module on channel 0. It is advisable to calibrate the module outside the application. Calibration can be performed with the PLC task linked to the channel in RUN or STOP modes.

Precautions

When in calibration mode, measurements for all channels in the module are declared invalid (`%Ir.m.c.ERR` bit = 1), filtering and alignment is prevented and channel acquisition cycles may be lengthened.

As inputs other than channel 0 will not be acquired during calibration, the value transmitted to the application for these other channels is the last value that was measured before switching to calibration.

Procedure

The following table gives the procedure for calibrating the module:

Step	Action
1	Access the calibration adjustment screen
2	Double click on channel 0. **Result**: A question appears 'Do you wish to switch to recalibration mode?'.
3	Reply to this question with **Yes**. **Result**: The calibration window appears.
4	According to the range to be calibrated, connect a reference voltage to the voltage input of channel 0: ● reference voltage = 10 V (20 ppm precision) in order to calibrate the module on the +/-10 V and 0..10 V ranges, ● reference voltage = 5 V (20 ppm precision) in order to calibrate the module on the 0..5 V, 1..5 V, 0..20 mA and 4..20 mA ranges, Caution: the 5 V reference is used to calibrate the whole measurement device for the 0..20 mA and 4..20 mA ranges, with the exception of the 250 Ohm current shunt situated on the current entry.
5	Once the reference has been connected to the voltage input (e.g. 10 V), use the **Reference** drop-down list box to select this value. Wait, if necessary, for the reference voltage connected to stabilize, then confirm the selection using the **OK** command button. The ranges linked to this reference (e.g. +/-10 V and 0..10 V) are then calibrated automatically.
6	Calibrate the module for other ranges, if applicable. The **Return to Factory Parameters** command button cancels all previous calibrations, and return to the original calibration settings configured in the factory.
7	Press the **Save** command button, in order to recognize and save the new calibration in the module. If you exit the calibration screen without saving, a message is displayed indicating that the new calibration values will be lost.

Calibrating the TSX AEY 810 Module

At a Glance

Calibration is performed globally for the module on channel 0. It is advisable to calibrate the module outside the application. Calibration can be performed with the PLC task linked to the channel in RUN or STOP modes.

Precautions

When in calibration mode, measurements for all channels in the module are declared invalid (`%IWr.m.c.1.2` bit = 1), filtering and alignments are prevented and channel acquisition cycles may be lengthened.

As inputs other than channel 0 will not be acquired during calibration, the value transmitted to the application for these other channels is the last value that was measured before switching to calibration.

Procedure

The following table shows the module calibration procedure:

Step	Action
1	Access the calibration adjustment screen
2	Double click on channel 0. **Result**: A question appears ‘Do you wish to switch to recalibration mode?’.
3	Reply to this question with **Yes**. **Result**: The calibration window appears.
4	Connect a reference voltage on the voltage input of channel 0, according to the range to be calibrated: ● reference voltage = 10 V (20 ppm precision) in order to calibrate the module on the +/-10 V and 0..10 V ranges, ● reference voltage = 5 V (20 ppm precision) in order to calibrate the module on the 0..5 V, 1..5 V, 0..20 mA and 4..20 mA ranges, Caution: the reference 5 V is used to recalibrate the whole measurement channel for ranges 0..20 mA and 4..20 mA, with the exception of the 250 Ohm current shunt situated on the current entry.
5	Once the reference has been connected to the voltage input (e.g. 10 V), use the **Reference** drop-down list box to select this value. Wait, if necessary, for the reference voltage connected to stabilize, then confirm the selection using the **OK** command button. The ranges linked to this reference (e.g. +/-10 V and 0..10 V) are then calibrated automatically.
6	Calibrate the module for other ranges, if applicable. the **Return to Factory Parameters** command button cancels all previous calibrations, and return to the original calibration settings configured in the factory.
7	Press the **Save** command button, in order to recognize and save the new calibration in the module. If you exit the calibration screen without saving, a message is displayed indicating that the new calibration values will be lost ..

Calibrating the TSX AEY 1614 Module

At a Glance

Calibration is performed on channels 0 and 8.

On channel 0, two types of calibration are possible:
- calibration of the measurement string for one channel,
- calibration of the current source necessary for the measurements from resistive probe sensors.

On channel 8, only calibration of the measurement string is possible.

Recommen-dations

It is advisable to calibrate the module outside the application. Calibration can be performed with the PLC task linked to the channel, in RUN or STOP modes.

NOTE: In the calibration screen, the values displayed on the left side of the screen (channels 0 and 8) indicate the value measured on the connected voltage reference. The display format in tenths of mV (16000 displayed for 1.6 V) is not intended to monitor the reference precision but simply to indicate the presence of this reference.

Procedure for Recalibrating the Measurement String

The following table shows the procedure for calibrating the measurement string:

Step	Action
1	Access the calibration adjustment screen
2	Double click on channel 0. **Result**: The system asks for confirmation ‘Do you wish to switch to recalibration mode?’
3	Reply to this question with Yes. **Result**: The recalibration window appears.
4	Connect a voltage reference to the voltage input to be calibrated, according to the range to be calibrated ● +25.000mV+/-0.039% for the ranges to be calibrated Thermocouples B, R, S, and T ● +55.000mV+/-0.026% for the ranges to be calibrated Thermocouples U, N, L, and K ● +80.000mV+/-0.023% for the ranges to be calibrated Thermocouples J and E ● +166.962mV+/-0.019% for the range Pt100
5	Once the reference has been connected to the voltage input (e.g. 10 V), use the **Reference** drop-down list box to select this value. Wait, if necessary, for the reference voltage connected to stabilize, then confirm the selection using the **OK** command button. The ranges linked to this reference (e.g. 10 V and 0..10 V) are then calibrated automatically.
6	Calibrate the module for other ranges, if applicable. The **Return to Factory Settings** command button will cancel all previous calibrations, and return the module to the calibration settings configured in the factory.
7	Press the **Save** command button, in order to recognize and save the new calibration in the module. If you exit the calibration screen without saving, a message is displayed indicating that the new calibration values will be lost .

Calibrating the 1.25 mA Current Source

The current source is used for cold junction compensation. The following table shows the procedure for calibrating the current source:

Step	Action
1	Access the calibration adjustment screen
2	Double click on channel 0. **Result**: A question appears ‘Do you wish to switch to recalibration mode?’.
3	Reply to this question with Yes. **Result**: The calibration window appears.
4	Using a precision multimeter (0.068% to 1.25mA), measure the current source value given by the channel to be calibrated. Note this value and convert it into micro-Amps
5	Use the **Reference** drop-down list box to select **Source**. Enter the converted value in the Source field (for example 12501 for 1.2501 mA) then confirm the selection with the **OK** command button.
6	Press the **Save** command button, in order to recognize and save the new calibration in the module. If you exit the calibration screen without saving, a message is displayed indicating that the new calibration values will be lost.

Calibrating the TSX AEY 414 Module

At a Glance

The calibration of the module allows you to correct long-term drifts in the module, and to optimize precision at ambient temperatures other than 25 ºCelsius. The TSX AEY 414 module is calibrated channel by channel.

Important

The calibration dynamic is limited to 1% of the full scale, as above this level the module considers there to be an acquisition channel anomaly.

Full scale calibration is done on each of the channels and in each of the ranges by placing a calibration source directly on the input terminal block.

Procedure for a Voltage Input

This procedure is performed from the recalibration screen.

Step	Action
1	Access the calibration adjustment screen
2	Select a channel and switch to calibration mode
3	Connect a voltage reference to the voltage input to be calibrated, according to the range to be calibrated ● +10.000V +/-0.018% for voltage ranges ● +60.000mV +/-0.028% for thermocouples B, E, J, K, L, N, R, S, T and U and the range 13..63 mV ● +2.500V +/-0.016% for the Pt100, Pt1000 Ni1000 thermowell ranges
4	Once the reference has been connected to the voltage input, select the reference value from the drop-down list
5	Wait, if necessary, for the reference voltage connected to stabilize, then confirm the selection using the "Confirm" button. The ranges linked to this reference are then calibrated automatically.

Procedure for Thermowell Current Source

This procedure is performed from the calibration screen

Step	Action
1	Access the calibration adjustment screen
2	Select a channel and switch to calibration mode
3	Connect a reference current channel-by-channel in order to calibrate ● +2.5mA +/-0.0328% for thermowell ranges
4	Read the value supplied, and give this value in units of x 100 nA

Acknowledg-ment

The calibration value is not acknowledged until it has been saved in the module using the "Save" button.

The "Return to Factory Parameters" button cancels all previous calibrations, and restores the module to its initial calibration (factory settings).

Selecting this button triggers a confirmation message. On the other hand, after confirmation, acknowledgment is immediate and does not need to be saved.

Leaving the screen without saving triggers a message which will remind the user that the save has not been performed. If the user chooses to exit the screen anyway, the new calibration coefficients are lost (the former values are restored).

NOTE:
- For the calibration voltages 10 V and 2.5 V, the expected read value after calibration is 10000 +/-2.
- For 60 mV calibration, the expected read value is 9523 +/-2 (10000 corresponds to the full scale, i.e. 63 mV.)

Chapter 22
Diagnosing Analog Input/Output Modules

Aim of this Chapter

This chapter describes diagnosis of analog modules.

What Is in This Chapter?

This chapter contains the following topics:

Diagnosing an Analog Module

At a Glance

The Module diagnostics function displays errors when they occur, classified according to category:

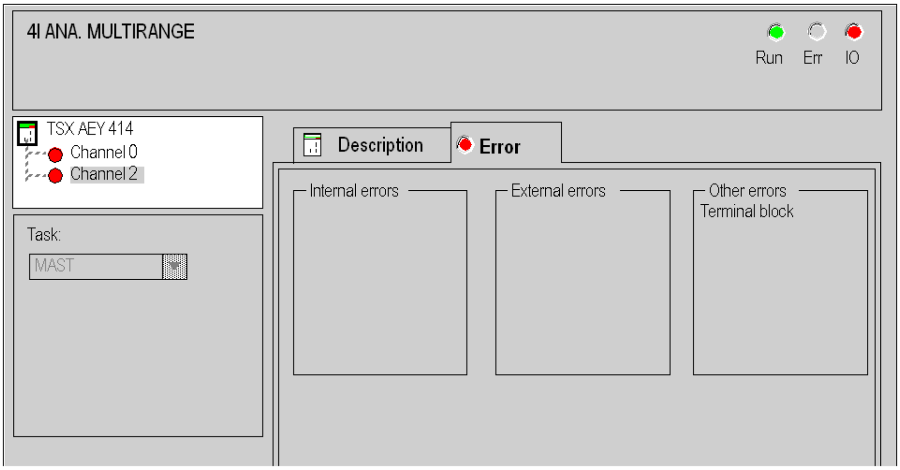
- **internal faults**:
  - module failures,
  - self-testing in progress,
- **external faults**:
  - terminal block fault,
- **other faults**:
  - configuration fault,
  - module missing or off,
  - Faulty channel *(see page 260)*.

A module error is indicated by a number of LEDs changing to red, such as:

- in the rack-level configuration editor:
  - the LED of the rack number,
  - the LED of the slot number of the module on the rack.
- in the module-level configuration editor:
  - the **Err** and **I/O** LEDs, depending on the type of error,
  - the **Channel** LED in the **Channel** field,
  - Select the **Fault** tab.

Procedure

The table below shows the procedure for accessing the module Fault screen.

Step	Action
1	Open the module debugging screen.
2	Click on the module reference in the channel area and select the **Fault** tab. **Result:** The list of module errors appears.  **Note:** It is not possible to access the module diagnostics screen if a configuration error, major breakdown error or module missing error occurs. The following message appears on the screen: " `The module is missing or different from that configured for this position.`"

Detailed Diagnosis of an Analog Channel

At a Glance

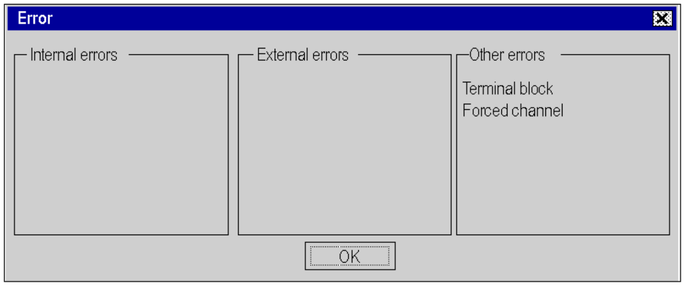
The channel Diagnostics function displays errors when they occur, classified according to category:

- **Internal faults:**
  - channel failure,
- **external errors:**
  - sensor link fault,
  - terminal block fault,
  - range overflow/underflow limit fault,
  - calibration fault,
  - cold junction compensation fault,
- **other errors**
  - terminal block fault,
  - configuration fault,
  - communication fault,
  - application fault,
  - 24V power supply fault,
  - Value outside range,
  - channel not ready.

A channel error is indicated in the **Debug** tab by the LED  situated in the **Err** column turning red.

Procedure

The table below shows the procedure for accessing the channel Fault screen.

Step	Action
1	Open the module debugging screen.
2	For the faulty channel, click on the button  situated in the **Error** column. **Result:** The list of channel errors appears.  **Note:** Channel diagnostics information can also be accessed by program (instruction `READ_STS`).

Chapter 23
Language Objects for Analog Modules

In this Chapter

This chapter describes the language objects associated with analog modules, along with their various uses.

What Is in This Chapter?

This chapter contains the following sections:

Section 23.1
Language Objects and IODDT for the Analog Function

In This Section

This section is an overview of the language objects and IODDT's associated with the Analog Function.

What Is in This Section?

This section contains the following topics:

Presentation of Language Objects Associated With the Analog Function

Overview

Analog modules are associated with different IODDT's.

These IODDT's are predefined by the manufacturer; they contain Input/Output Langage Objects belonging to an application-specific module's channel.

There are six distinct IODDT types for the Analog Function:

- `T_ANA_IN_GEN` specific to all analog input modules: TSX AEY 414/420/800/810/1600/1614,
- `T_ANA_IN_STD` applies to all analog input modules: TSX AEY 414/420/800/810/1600/1614,
- `T_ANA_IN_CTRL` specific to the TSX AEY 810 and TSX AEY 1614 modules,
- `T_ANA_IN_EVT` specific to the TSX AEY 420 module,
- `T_ANA_OUT_GEN` specific to all analog output modules: TSX ASY 410 and TSX ASY 800,
- `T_ANA_OUT_STD` specific to all analog output modules: TSX ASY 410 and TSX ASY 800.
- `T_ANA_OUT_STDX` specific to all analog output modules: TSX ASY 410 and TSX ASY 800.

NOTE: IODDT variables can be created in two different ways:
- Using the **I/O objects** *(see Unity Pro, Operating Modes)* tab,
- Data Editor.

Language Object Types

Each IODDT includes a series of language objects used to drive and monitor their operation.

There are two types of language objects:

- **Implicit Exchange Objects:** they are automatically exchanged at each cycle of the task assigned to the module,
- **Explicit Exchange Objects:** they are exchanged at the application's request, using explicit exchange instructions.

Implicit Exchanges pertain to the modules inputs and outputs: measurement results, data and commands.

Explicit Exchanges make it possible to configure and diagnose the module.

Implicit Exchange Language Objects Associated with the Application-Specific Function

At a Glance

An integrated application-specific interface or the addition of a module automatically enhances the language objects application used to program this interface or module.

These objects correspond to the input/output images and software data of the module or integrated application-specific interface.

Reminders

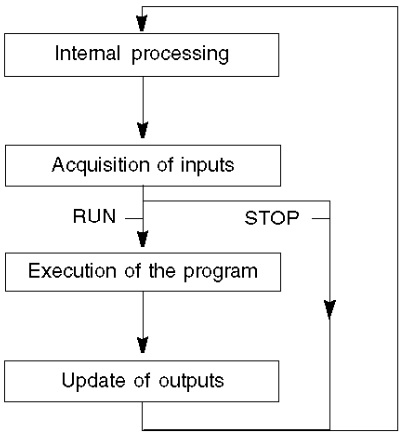
The module inputs (`%I` and `%IW`) are updated in the PLC memory at the start of the task, the PLC being in RUN or STOP mode.

The outputs (`%Q` and `%QW`) are updated at the end of the task, only when the PLC is in RUN mode.

NOTE: When the task occurs in STOP mode, either of the following are possible, depending on the configuration selected:
- outputs are set to fallback position (fallback mode)
- outputs are maintained at their last value (maintain mode)

Figure

The following diagram shows the operating cycle of a PLC task (cyclical execution).



Explicit Exchange Language Objects Associated with the Application-Specific Function

Introduction

Explicit exchanges are performed at the user program's request using these instructions:

- READ_STS *(see Unity Pro, I/O Management, Block Library)* (read status words)
- WRITE_CMD *(see Unity Pro, I/O Management, Block Library)* (write command words)
- WRITE_PARAM *(see Unity Pro, I/O Management, Block Library)* (write adjustment parameters)
- READ_PARAM *(see Unity Pro, I/O Management, Block Library)* (read adjustment parameters)
- SAVE_PARAM *(see Unity Pro, I/O Management, Block Library)* (save adjustment parameters)
- RESTORE_PARAM *(see Unity Pro, I/O Management, Block Library)* (restore adjustment parameters)

These exchanges apply to a set of %MW objects of the same type (status, commands or parameters) that belong to a channel.

These objects can:

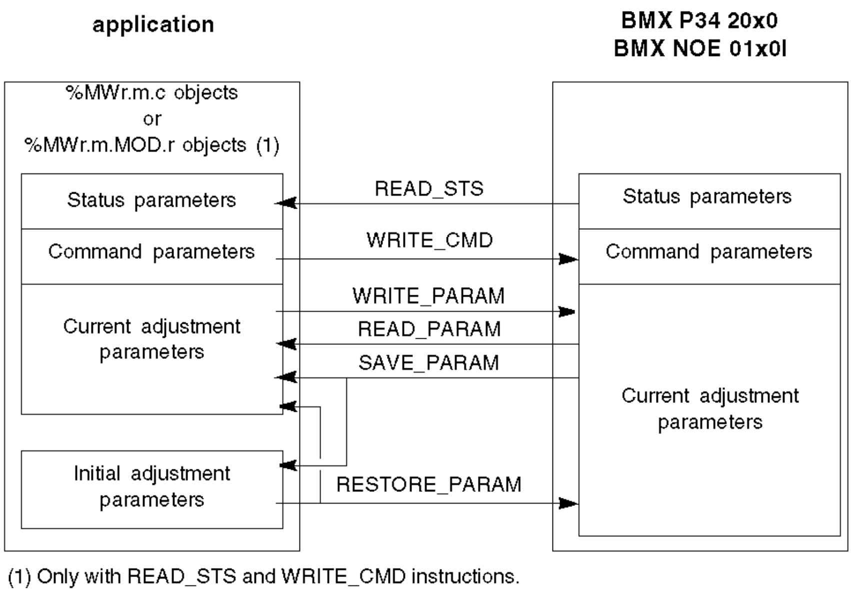
- provide information about the module (for example, type of error detected in a channel)
- have command control of the module (for example, switch command)
- define the module's operating modes (save and restore adjustment parameters in the process of application)

NOTE: To avoid several simultaneous explicit exchanges for the same channel, it is necessary to test the value of the word EXCH_STS (`%MWr.m.c.0`) of the IODDT associated to the channel before calling any EF addressing this channel.

NOTE: Explicit exchanges are not supported when M340 analog and digital I/O modules are configured through an M340 Ethernet RIO adapter module in a Quantum EIO configuration. You cannot set up a module's parameters from the PLC application during operation.

General Principle for Using Explicit Instructions

The diagram below shows the different types of explicit exchanges that can be made between the application and module.



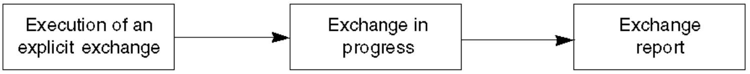
Managing Exchanges

During an explicit exchange, check performance to see that the data is only taken into account when the exchange has been correctly executed.

To do this, two types of information is available:

- information concerning the exchange in progress *(see page 272)*
- the exchange report *(see page 272)*

The following diagram describes the management principle for an exchange.



NOTE: In order to avoid several simultaneous explicit exchanges for the same channel, it is necessary to test the value of the word EXCH_STS (`%MWr.m.c.0`) of the IODDT associated to the channel before calling any EF addressing this channel.

Management of Exchanges and Reports with Explicit Objects

At a Glance

When data is exchanged between the PLC memory and the module, the module may require several task cycles to acknowledge this information. IODDTs use two words to manage exchanges:

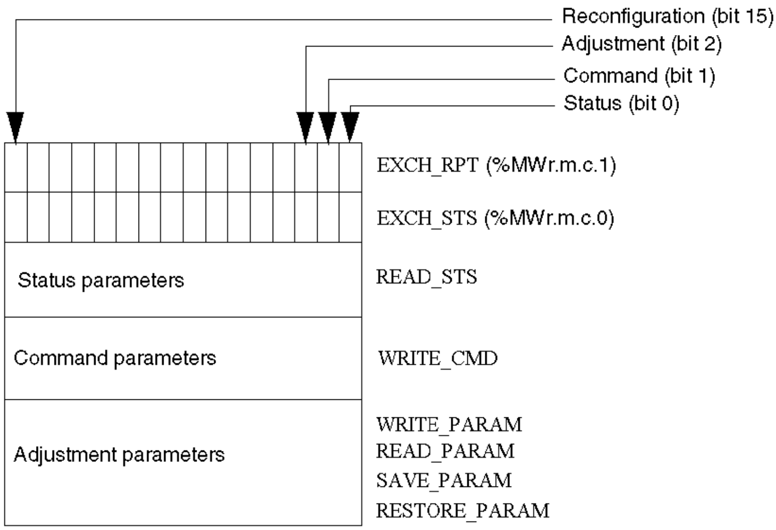
- EXCH_STS (%MWr.m.c.0): exchange in progress
- EXCH_RPT (%MWr.m.c.1): report

NOTE:
Depending on the localization of the module, the management of the explicit exchanges (%MW0.0.MOD.0.0 for example) will not be detected by the application:

- For in-rack modules, explicit exchanges are done immediately on the local PLC Bus and are finished before the end of the execution task. So, the READ_STS, for example, is finished when the %MW0.0.mod.0.0 bit is checked by the application.
- For remote bus (Fipio for example), explicit exchanges are not synchronous with the execution task, so the detection is possible by the application.

Illustration

The illustration below shows the different significant bits for managing exchanges:



Description of Significant Bits

Each bit of the words `EXCH_STS` (`%MWr.m.c.0`) and `EXCH_RPT` (`%MWr.m.c.1`) is associated with a type of parameter:

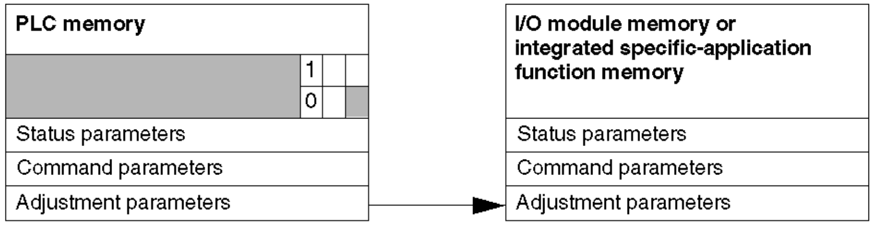
- Rank 0 bits are associated with the status parameters:
  - The `STS_IN_PROGR` bit (`%MWr.m.c.0.0`) indicates whether a read request for the status words is in progress.
  - The `STS_ERR` bit (`%MWr.m.c.1.0`) specifies whether a read request for the status words is accepted by the module channel.
- Rank 1 bits are associated with the command parameters:
  - The `CMD_IN_PROGR` bit (`%MWr.m.c.0.1`) indicates whether command parameters are being sent to the module channel.
  - The `CMD_ERR` bit (`%MWr.m.c.1.1`) specifies whether the command parameters are accepted by the module channel.
- Rank 2 bits are associated with the adjustment parameters:
  - The `ADJ_IN_PROGR` bit (`%MWr.m.c.0.2`) indicates whether the adjustment parameters are being exchanged with the module channel (via `WRITE_PARAM, READ_PARAM, SAVE_PARAM, RESTORE_PARAM`).
  - The `ADJ_ERR` bit (`%MWr.m.c.1.2`) specifies whether the adjustment parameters are accepted by the module. If the exchange is correctly executed, the bit is set to 0.
- Rank 15 bits indicate a reconfiguration on channel **c** of the module from the console (modification of the configuration parameters + cold start-up of the channel).
- The *r*, *m* and *c* bits indicates the following elements:
  - the **r** bit represents the rack number.
  - The **m** bit represents the position of the module in the rack.
  - The **c** bit represents the channel number in the module.

NOTE: **r** represents the rack number, **m** the position of the module in the rack, while **c** represents the channel number in the module.

NOTE: Exchange and report words also exist at module level `EXCH_STS` (`%MWr.m.MOD`) and `EXCH_RPT` (`%MWr.m.MOD.1`) as per IODDT type `T_GEN_MOD`.

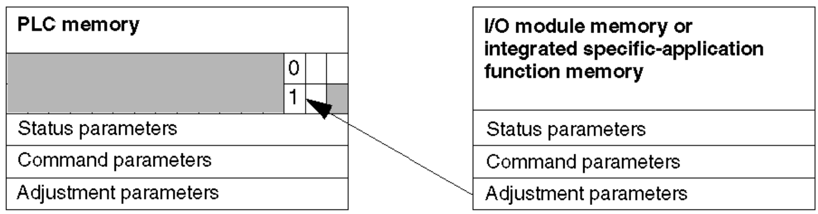
Example

Phase 1: Sending data by using the `WRITE_PARAM` instruction



When the instruction is scanned by the PLC, the **Exchange in progress** bit is set to 1 in `%MWr.m.c`.

Phase 2: Analysis of the data by the I/O module and report.



When the data is exchanged between the PLC memory and the module, acknowledgement by the module is managed by the `ADJ_ERR` bit (`%MWr.m.c.1.2`).

This bit makes the following reports:

- **0:** correct exchange
- **1:** incorrect exchange)

NOTE: There is no adjustment parameter at module level.

Execution Indicators for an Explicit Exchange: EXCH_STS

The table below shows the control bits of the explicit exchanges: `EXCH_STS` (`%MWr.m.c.0`)

Standard Symbol	Type	Access	Meaning	Address
STS_IN_PROGR	BOOL	R	Reading of channel status words in progress	%MWr.m.c.0.0
CMD_IN_PROGR	BOOL	R	Command parameters exchange in progress	%MWr.m.c.0.1
ADJ_IN_PROGR	BOOL	R	Adjust parameters exchange in progress	%MWr.m.c.0.2
RECONF_IN_PROGR	BOOL	R	Reconfiguration of the module in progress	%MWr.m.c.0.15

NOTE: If the module is not present or is disconnected, explicit exchange objects (`READ_STS` for example) are not sent to the module (`STS_IN_PROG` (%MWr.m.c.0.0) = 0), but the words are refreshed.

Explicit Exchange Report: EXCH_RPT

The table below shows the report bits: `EXCH_RPT` (`%MWr.m.c.1`)

Standard Symbol	Type	Access	Meaning	Address
STS_ERR	BOOL	R	Error detected while reading channel status words (1 = detected error)	%MWr.m.c.1.0
CMD_ERR	BOOL	R	Error detected during a command parameter exchange (1 = detected error)	%MWr.m.c.1.1
ADJ_ERR	BOOL	R	Error dectected during an adjust parameter exchange (1 = detected error)	%MWr.m.c.1.2
RECONF_ERR	BOOL	R	Error detected during reconfiguration of the channel (1 = detected error)	%MWr.m.c.1.15

Counting Module Use

The following table describes the steps realized between a couting module and the system after a power-on.

Step	Action
1	Power on.
2	The system sends the configuration parameters.
3	The system sends the adjust parameters by WRITE_PARAM method. **Note:** When the operation is finished, the bit %MWr.m.c.0.2 switches to 0.

If, in the begining of your application, you use a WRITE_PARAM command, wait until the bit %MWr.m.c.0.2 switches to 0.

Section 23.2
IODDTs for Analog Modules

In This Section

This section presents the various language objects and IODDTs associated with analog input/output modules.

What Is in This Section?

This section contains the following topics:

Detailed Description of Language Objects for the T_ANA_IN_GEN-type IODDT

At a Glance

The following tables list all of the Implicit Exchange Objects for the T_ANA_IN_GEN-type IODDT, applicable to all analog input modules.

Input Measurement

The following table shows the analog measurement.

Standard symbol	Type	Access	Meaning	Address
VALUE	INT	R	Analog Input Measurement.	%IWr.m.c.0

%Ir.m.c.ERR error bit

The following table describes the %Ir.m.c.ERR error bit.

Standard symbol	Type	Access	Meaning	Address
CH_ERROR	BOOL	R	Error bit for analog channel.	%Ir.m.c.ERR

Detailed Description of Implicit Exchange Objects for the T_ANA_IN_STD-type IODDT

At a Glance

The following table lists all of the `T_ANA_IN_STD`-type Implicit Exchange Objects applicable to all analog input modules.

Input Measurement

The following table shows the analog measurement object.

Standard symbol	Type	Access	Meaning	Address
VALUE	INT	R	Analog Input Measurement.	%IWr.m.c.0

%Ir.m.c.ERR error bit

The following table describes the %Ir.m.c.ERR error bit.

Standard symbol	Type	Access	Meaning	Address
CH_ERROR	BOOL	R	Error bit for analog channel.	%Ir.m.c.ERR

Detailed Description of Explicit Exchange Objects for the T_ANA_IN_STD-Type IODDT

At a Glance

This section describes all of the `T_ANA_IN_STD`-type Explicit Exchange Objects applicable to all analog input modules. This section gathers word objects whose bits have a specific meaning. These objects are described in detail below.

Sample Variable Declaration: `T_ANA_IN_STD`-type `IODDT_VAR1`.

NOTE: Generally speaking, the meaning of any bit is provided for State 1 of said bit. In some specific instances, we provide a meaning for each state of the bit.
Not all bits are utilized.

Implicit Exchange Execution Indicators: EXCH_STS

The following table explains the various meanings of `EXCH_STS` (`%MWr.m.c.0`) channel exchange control bits.

Standard symbol	Type	Access	Meaning	Address
STS_IN_PROGR	BOOL	R	Channel status words are in the process of being read.	%MWr.m.c.0.0
CMD_IN_PROGR	BOOL	R	The exchange of Command Parameters is in progress.	%MWr.m.c.0.1
ADJ_IN_PROGR	BOOL	R	The exchange of Adjustment Parameters is in progress.	%MWr.m.c.0.2

Explicit Exchange Report: EXCH_RPT

The following table explains the various meanings of `EXCH_RPT` (`%MWr.m.c.1`) reporting bits.

Standard symbol	Type	Access	Meaning	Address
STS_ERR	BOOL	R	Error while reading the channel status words.	%MWr.m.c.1.0
CMD_ERR	BOOL	R	Error while exchanging command parameters.	%MWr.m.c.1.1
ADJ_ERR	BOOL	R	Error while exchanging adjustment parameters.	%MWr.m.c.1.2
RECONF_ERR	BOOL	R	Error while reconfiguring the channel.	%MWr.m.c.1.15

Standard channel errors, CH_FLT

The following table explains the various meanings of the `CH_FLT` (`%MWr.m.c.2`) status word bits. Read operation is performed by `READ_STS` (`IODDT_VAR1`).

Standard symbol	Type	Access	Meaning	Address
SENSOR_FLT	BOOL	R	Sensor Connection Fault.	%MWr.m.c.2.0
RANGE_FLT	BOOL	R	Range under/overflow error.	%MWr.m.c.2.1
BLK	BOOL	R	Terminal Block Fault.	%MWr.m.c.2.2
EXT_PS_FLT	BOOL	R	External Power Supply Fault.	%MWr.m.c.2.3
INTERNAL_FLT	BOOL	R	Faulty Channel.	%MWr.m.c.2.4
CONF_FLT	BOOL	R	Conflicting HW and SW configurations.	%MWr.m.c.2.5
COM_FLT	BOOL	R	Error communicating with PLC.	%MWr.m.c.2.6
APPLI_FLT	BOOL	R	Application Error (configuration or adjustment error).	%MWr.m.c.2.7
NOT_READY	BOOL	R	Channel not ready.	%MWr.m.c.2.8
COLD_JUNCTION_FLT	BOOL	R	Cold junction compensation error.	%MWr.m.c.2.9
CALIB_FLT	BOOL	R	Calibration error.	%MWr.m.c.2.10
RANGE_UNF	BOOL	R	Recalibrated Channel or Lower Range Overflow.	%MWr.m.c.2.14
RANGE_OVF	BOOL	R	Aligned Channel or Upper Range Overflow.	%MWr.m.c.2.15

Parameters

The table below shows the meaning of the words (`%MWr.m.c.7` and `%MWr.m.c.8`). The requests used are those associated with the parameters (`READ_PARAM` and `WRITE_PARAM`).

Standard symbol	Type	Access	Meaning	Address
`FILTER_COEFF`	INT	R/W	Value of filter coefficient.	%MWr.m.c.7
`ALIGNMENT_OFFSET`	INT	R/W	Alignment offset value.	%MWr.m.c.8

Detailed Description of Implicit Exchange Objects for the T_ANA_IN_CTRL-Type IODDT

At a Glance

The following tables list all of the T_ANA_IN_CTRL-type Implicit Exchange Objects applicable to the TSX AEY 810 and TSX AEY 1614 analog input modules.

Input Measurement

The following table shows the analog measurement.

Standard symbol	Type	Access	Meaning	Address
VALUE	INT	R	Analog Input Measurement.	%IWr.m.c.0

%Ir.m.c.ERR Error Bit

The following table describes the %Ir.m.c.ERR error bit.

Standard symbol	Type	Access	Meaning	Address
CH_ERROR	BOOL	R	Error bit for analog channel.	%Ir.m.c.ERR

Measurement Status Word MEASURE_STS

The following table explains the various meanings of the MEASURE_STS (%IWr.m.c.1) measurement status word bits.

Standard symbol	Type	Access	Meaning	Address
LOWER_LIMIT	BOOL	R	Measurement in Lower Tolerance Area	%IWr.m.c.1.5
UPPER_LIMIT	BOOL	R	Measurement in Upper Tolerance Area	%IWr.m.c.1.6

Detailed Description of Explicit Exchange Objects for the T_ANA_IN_CTRL-Type IODDT

At a Glance

This section presents the `T_ANA_IN_CTRL`-type IODDT Explicit Exchange Objects applicable to the TSX AEY 810 and TSX AEY 1614 analog input modules. This section regroups word-type objects whose bits have a specific meaning. These objects are described in detail below.

Sample Variable Declaration: `T_ANA_IN_CTRL`-type `IODDT_VAR1`.

NOTE: Generally speaking, the meaning of any bit is provided for State 1 of said bit. In some specific instances, we provide a meaning for each state of the bit.
Not all bits are utilized.

Implicit Exchange Execution Indicators: EXCH_STS

The following table explains the various meanings of `EXCH_STS` (`%MWr.m.c.0`) channel exchange control bits.

Standard symbol	Type	Access	Meaning	Address
STS_IN_PROGR	BOOL	R	Channel status words are in the process of being read.	%MWr.m.c.0.0
CMD_IN_PROGR	BOOL	R	The exchange of Command Parameters is in progress.	%MWr.m.c.0.1
ADJ_IN_PROGR	BOOL	R	The exchange of Adjustment Parameters is in progress.	%MWr.m.c.0.2

Explicit Exchange Report: EXCH_RPT

The following table explains the various meanings of `EXCH_RPT` (`%MWr.m.c.1`) reporting bits.

Standard symbol	Type	Access	Meaning	Address
STS_ERR	BOOL	R	Error while reading the channel status words.	%MWr.m.c.1.0
CMD_ERR	BOOL	R	Error while exchanging command parameters.	%MWr.m.c.1.1
ADJ_ERR	BOOL	R	Error while exchanging adjustment parameters.	%MWr.m.c.1.2
RECONF_ERR	BOOL	R	Error while reconfiguring the channel.	%MWr.m.c.1.15

Standard Channel Errors, CH_FLT

The following table explains the various meanings of the `CH_FLT` (`%MWr.m.c.2`) status word bits. Read operation is performed by `READ_STS` (`IODDT_VAR1`).

Standard symbol	Type	Access	Meaning	Address
SENSOR_FLT	BOOL	R	Sensor Connection Fault.	%MWr.m.c.2.0
RANGE_FLT	BOOL	R	Range under/overflow error.	%MWr.m.c.2.1
BLK	BOOL	R	Terminal Block Fault.	%MWr.m.c.2.2
EXT_PS_FLT	BOOL	R	External Power Supply Fault.	%MWr.m.c.2.3
INTERNAL_FLT	BOOL	R	Faulty Channel.	%MWr.m.c.2.4
CONF_FLT	BOOL	R	Conflicting HW and SW configurations.	%MWr.m.c.2.5
COM_FLT	BOOL	R	Error communicating with PLC.	%MWr.m.c.2.6
APPLI_FLT	BOOL	R	Application Error (configuration or adjustment error).	%MWr.m.c.2.7
NOT_READY	BOOL	R	Channel not ready.	%MWr.m.c.2.8
COLD_JUNCTION_FLT	BOOL	R	Cold junction compensation error.	%MWr.m.c.2.9
CALIB_FLT	BOOL	R	Calibration error.	%MWr.m.c.2.10
RANGE_UNF	BOOL	R	Lower Range Overflow.	%MWr.m.c.2.14
RANGE_OVF	BOOL	R	Upper Range Overflow.	%MWr.m.c.2.15

Detailed Description of Implicit Exchange Objects for the T_ANA_IN_EVT-Type IODDT

At a Glance

The following tables describe the `T_ANA_IN_EVT`-type IODDT Implicit Exchange Objects applicable to the TSX AEY 420 analog input module.

Input Measurement

The following table shows the analog measurement.

Standard symbol	Type	Access	Meaning	Address
VALUE	INT	R	Analog Input Measurement.	%IWr.m.c.0

%Ir.m.c.ERR Error Bit

The following table describes the `%Ir.m.c.ERR` error bit.

Standard symbol	Type	Access	Meaning	Address
CH_ERROR	BOOL	R	Error bit for analog channel.	%Ir.m.c.ERR

Measurement Status Word MEASURE_STS

The following table explains the various meanings of the `MEASURE_STS` (`%IWr.m.c.1`) measurement status word bits.

Standard symbol	Type	Access	Meaning	Address
LOWER_LIMIT	BOOL	R	Measurement in Lower Tolerance Area	%IWr.m.c.1.5
UPPER_LIMIT	BOOL	R	Measurement in Upper Tolerance Area	%IWr.m.c.1.6
EVT_LOSS	BOOL	R	Event Loss.	%IWr.m.c.1.7

Event Source Status Word EVT_SCE

The following table explains the various meanings of the `EVT_SCE` (`%IWr.m.c.2`) event source status word bits.

Standard symbol	Type	Access	Meaning	Address
TH0_CROSS_UP	BOOL	R	Crossing over (above) Threshold 0.	%IWr.m.c.2.0
TH0_CROSS_DWN	BOOL	R	Crossing over (below) Threshold 0.	%IWr.m.c.2.1
TH1_CROSS_UP	BOOL	R	Crossing over (above) Threshold 1.	%IWr.m.c.2.2
TH1_CROSS_DWN	BOOL	R	Crossing over (below) Threshold 1.	%IWr.m.c.2.3

Event Source Status Word EVT_EN

The following table explains the various meanings of the `EVT_EN` (`%QWr.m.c.1`) event validation command word bits.

Standard symbol	Type	Access	Meaning	Address
TH0_CROSS_UP_EN	BOOL	R/W	Crossing over (above) Threshold 0. 0=mask, 1=validate.	%QWr.m.c.0.0
TH0_CROSS_DWN_EN	BOOL	R/W	Crossing over (below) Threshold 0. 0=mask, 1=validate.	%QWr.m.c.0.1
TH1_CROSS_UP_EN	BOOL	R/W	Crossing over (above) Threshold 1. 0=mask, 1=validate.	%QWr.m.c.0.2
TH1_CROSS_DWN_EN	BOOL	R/W	Crossing over (below) Threshold 1. 0=mask, 1=validate.	%QWr.m.c.0.3

Detailed Description of Explicit Exchange Objects for the T_ANA_IN_EVT-Type IODDT

At a Glance

This section describes the `T_ANA_IN_EVT`-type IODDT Explicit Exchange Objects applicable to the TSX AEY 420 analog input module. This section regroups word-type objects whose bits have a specific meaning. These objects are described in detail below.

Sample Variable Declaration: `T_ANA_IN_EVT`-type `IODDT_VAR1`.

NOTE: Generally speaking, the meaning of any bit is provided for State 1 of said bit. In some specific instances, we provide a meaning for each state of the bit.
Not all bits are utilized.

Implicit Exchange Execution Indicators: EXCH_STS

The following table explains the various meanings of `EXCH_STS` (`%MWr.m.c.0`) channel exchange control bits.

Standard symbol	Type	Access	Meaning	Address
STS_IN_PROGR	BOOL	R	Channel status words are in the process of being read.	%MWr.m.c.0.0
CMD_IN_PROGR	BOOL	R	The exchange of Command Parameters is in progress.	%MWr.m.c.0.1
ADJ_IN_PROGR	BOOL	R	The exchange of Adjustment Parameters is in progress.	%MWr.m.c.0.2

Explicit Exchange Report: EXCH_RPT

The following table explains the various meanings of `EXCH_RPT` (`%MWr.m.c.1`) reporting bits.

Standard symbol	Type	Access	Meaning	Address
STS_ERR	BOOL	R	Error while reading the channel status words.	%MWr.m.c.1.0
CMD_ERR	BOOL	R	Error while exchanging command parameters.	%MWr.m.c.1.1
ADJ_ERR	BOOL	R	Error while exchanging adjustment parameters.	%MWr.m.c.1.2
RECONF_ERR	BOOL	R	Error while reconfiguring the channel.	%MWr.m.c.1.15

Standard Channel Errors, CH_FLT

The following table explains the various meanings of the CH_FLT (%MWr.m.c.2) status word bits. Read operation is performed by READ_STS (IODDT_VAR1).

Standard symbol	Type	Access	Meaning	Address
SENSOR_FLT	BOOL	R	Sensor Connection Fault.	%MWr.m.c.2.0
RANGE_FLT	BOOL	R	Range under/overflow error.	%MWr.m.c.2.1
BLK	BOOL	R	Terminal Block Fault.	%MWr.m.c.2.2
EXT_PS_FLT	BOOL	R	External Power Supply Fault.	%MWr.m.c.2.3
INTERNAL_FLT	BOOL	R	Faulty Channel.	%MWr.m.c.2.4
CONF_FLT	BOOL	R	Conflicting HW and SW configurations.	%MWr.m.c.2.5
COM_FLT	BOOL	R	Error communicating with PLC.	%MWr.m.c.2.6
APPLI_FLT	BOOL	R	Application Error (configuration or adjustment error).	%MWr.m.c.2.7
NOT_READY	BOOL	R	Channel not ready.	%MWr.m.c.2.8
COLD_JUNCTION_FLT	BOOL	R	Cold junction compensation error.	%MWr.m.c.2.9
CALIB_FLT	BOOL	R	Calibration error.	%MWr.m.c.2.10
RANGE_UNF	BOOL	R	Lower Range Overflow.	%MWr.m.c.2.14
RANGE_OVF	BOOL	R	Upper Range Overflow.	%MWr.m.c.2.15

Threshold Command Word

The following table explains the various meanings of threshold command words. Queries used are those associated with parameters (READ_PARAM, WRITE_PARAM, for example: READ_PARAM (IODDT_VAR1)).

Standard symbol	Type	Access	Meaning	Address
THRESHOLD0	INT	R/W	Value of Threshold 0 assigned to channel.	%MWr.m.c.9
THRESHOLD1	INT	R/W	Value of Threshold 1 assigned to channel.	%MWr.m.c.10

Detailed Description of Language Objects for the T_ANA_OUT_GEN-Type IODDT

At a Glance

The following tables list all of the Implicit Exchange Objects for the `T_ANA_OUT_GEN`-type IODDT, applicable to all analog output modules.

Output Value

The following table presents the analog output.

Standard symbol	Type	Access	Meaning	Address
VALUE	INT	R	Analog output value.	%QWr.m.c.0

%Ir.m.c.ERR Error Bit

The following table describes the `%Ir.m.c.ERR` error bit.

Standard symbol	Type	Access	Meaning	Address
CH_ERROR	BOOL	R	Error bit for analog channel.	%Ir.m.c.ERR

Detailed Description of Implicit Exchange Objects for the T_ANA_OUT_STD and T_ANA_OUT_STDX IODDTs

At a Glance

The following tables list all of the Implicit Exchange Objects for the T_ANA_OUT_STD and T_ANA_OUT_STDX IODDT, applicable to all analog output modules.

Output Value

The following table presents the analog output.

Standard symbol	Type	Access	Meaning	Address
VALUE	INT	R	Analog output measurement.	%QWr.m.c.0

%Ir.m.c.ERR Error Bit

The following table describes the %Ir.m.c.ERR error bit.

Standard symbol	Type	Access	Meaning	Address
CH_ERROR	BOOL	R	Error bit for analog channel.	%Ir.m.c.ERR

Detailed Description of Explicit Exchange Objects for the T_ANA_OUT_STD and T_ANA_OUT_STDX IODDT

At a Glance

This section presents the Explicit Exchange Objects for the T_ANA_OUT_STD and T_ANA_OUT_STDX IODDT, applicable to all analog output modules. This section regroups word-type objects whose bits have a specific meaning. These objects are described in detail below.

Sample Variable Declaration: T_ANA_OUT_STD named IODDT_VAR1.

Sample Variable Declaration: T_ANA_OUT_STDX named IODDT_VAR2.

NOTE: Generally speaking, the meaning of any bit is provided for State 1 of said bit. In some specific instances, we provide a meaning for each state of the bit.
Not all bits are utilized.

Implicit Exchange Execution Indicators: EXCH_STS

The following table explains the various meanings of EXCH_STS (%MWr.m.c.0) channel exchange control bits.

Standard symbol	Type	Access	Meaning	Address
STS_IN_PROGR	BOOL	R	Channel status words are in the process of being read.	%MWr.m.c.0.0
CMD_IN_PROGR	BOOL	R	The exchange of Command Parameters is in progress.	%MWr.m.c.0.1
ADJ_IN_PROGR	BOOL	R	The exchange of Adjustment Parameters is in progress.	%MWr.m.c.0.2

Explicit Exchange Report: EXCH_RPT

The following table explains the various meanings of EXCH_RPT (%MWr.m.c.1) reporting bits.

Standard symbol	Type	Access	Meaning	Address
STS_ERR	BOOL	R	Error while reading the channel status words.	%MWr.m.c.1.0
CMD_ERR	BOOL	R	Error while exchanging command parameters.	%MWr.m.c.1.1
ADJ_ERR	BOOL	R	Error while exchanging adjustment parameters.	%MWr.m.c.1.2
RECONF_ERR	BOOL	R	Error while reconfiguring the channel.	%MWr.m.c.1.15

Standard Channel Errors, CH_FLT

The following table explains the various meanings of the CH_FLT (%MWr.m.c.2) status word bits. Read operation is performed by READ_STS (IODDT_VAR1).

Standard symbol	Type	Access	Meaning	Address
PS_FLT	BOOL	R	24 V power supply fault.	%MWr.m.c.2.0
RANGE_FLT	BOOL	R	Range under/overflow error.	%MWr.m.c.2.1
BLK	BOOL	R	Terminal Block Fault.	%MWr.m.c.2.2
RANGE_OVERRUN	BOOL	R	Upper threshold range overflow fault if %MWr.m.c.2.1 bit equals 1.	%MWr.m.c.2.3
INTERNAL_FLT	BOOL	R	Faulty Channel.	%MWr.m.c.2.4
CONF_FLT	BOOL	R	Conflicting HW and SW configurations.	%MWr.m.c.2.5
COM_FLT	BOOL	R	Error communicating with PLC.	%MWr.m.c.2.6
APPLI_FLT	BOOL	R	Application Error (configuration or adjustment error).	%MWr.m.c.2.7
NOT_READY	BOOL	R	Channel not ready.	%MWr.m.c.2.8

Channel Fallback value: FALLBACK

The following table explains the meaning of FALLBACK (%MWr.m.c.5) integer. Queries used are those associated with parameters (READ_PARAM, WRITE_PARAM, SAVE_PARAM, RESTORE_PARAM, for example: READ_PARAM(IODDT_VAR2)).

Standard symbol	Type	Access	Meaning	Address
FALLBACK	INT	R/W	Channel fallback value, this data is only available for T_ANA_OUT_STDX IODDT.	%MWr.m.c.5

Details of the Language Objects of the T_GEN_MOD-Type IODDT

At a Glance

All the modules of Premium PLCs have an associated IODDT of type `T_GEN_MOD`.

Observations

- In general, the meaning of the bits is given for bit status 1. In specific cases an explanation is given for each status of the bit.
- Not all bits are used.

List of Objects

The table below presents the objects of the IODDT:

Standard symbol	Type	Access	Meaning	Address
MOD_ERROR	BOOL	R	Module error bit	%Ir.m.MOD.ERR
EXCH_STS	INT	R	Module exchange control word.	%MWr.m.MOD.0
STS_IN_PROGR	BOOL	R	Reading of status words of the module in progress.	%MWr.m.MOD.0.0
EXCH_RPT	INT	R	Exchange report word.	%MWr.m.MOD.1
STS_ERR	BOOL	R	Fault when reading module status words.	%MWr.m.MOD.1.0
MOD_FLT	INT	R	Internal error word of the module.	%MWr.m.MOD.2
MOD_FAIL	BOOL	R	Internal error, module failure.	%MWr.m.MOD.2.0
CH_FLT	BOOL	R	Faulty channel(s).	%MWr.m.MOD.2.1
BLK	BOOL	R	Terminal block fault.	%MWr.m.MOD.2.2
CONF_FLT	BOOL	R	Hardware or software configuration fault.	%MWr.m.MOD.2.5
NO_MOD	BOOL	R	Module missing or inoperative.	%MWr.m.MOD.2.6
EXT_MOD_FLT	BOOL	R	Internal error word of the module (Fipio extension only).	%MWr.m.MOD.2.7
MOD_FAIL_EXT	BOOL	R	Internal fault, module unserviceable (Fipio extension only).	%MWr.m.MOD.2.8
CH_FLT_EXT	BOOL	R	Faulty channel(s) (Fipio extension only).	%MWr.m.MOD.2.9
BLK_EXT	BOOL	R	Terminal block fault (Fipio extension only).	%MWr.m.MOD.2.10
CONF_FLT_EXT	BOOL	R	Hardware or software configuration fault (Fipio extension only).	%MWr.m.MOD.2.13
NO_MOD_EXT	BOOL	R	Module missing or inoperative (Fipio extension only).	%MWr.m.MOD.2.14

Glossary

C

Configuration

The configuration gathers together the data which characterizes the machine (invariant) and which is necessary for the module to operate. All this information is stored in the constant PLC %KW zone. The PLC application cannot modify them.

CPU

Central Processing Unit: generic name used for Schneider Electric processors

D

Debugging

Debugging is a Unity Pro service used to check the module directly when it is online.

E

Explicit exchanges

Exchanges between the CPU and the application-specific modules that are performed at the initiative of the Unity Pro program for updating data specific to the module

I

I/O

Inputs/Outputs

M

Momentum

I/O modules using several open standard communication networks.

O

Operating mode

These are all the rules governing the behavior of the module during the transitional phases or on the appearance of a fault.

Index