Modicon X80

Analog Input/Output Modules

User Manual

Original instructions

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www.se.com

Schneider Electric

Legal Information

Table of Contents

Safety Information

Important Information

Read these instructions carefully, and look at the equipment to become familiar with the device before trying to install, operate, service, 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.

Before You Begin

Do not use this product on machinery lacking effective point-of-operation guarding. Lack of effective point-of-operation guarding on a machine can result in serious injury to the operator of that machine.

⚠WARNING

UNGUARDED EQUIPMENT

- Do not use this software and related automation equipment on equipment which does not have point-of-operation protection.
- Do not reach into machinery during operation.

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

This automation equipment and related software is used to control a variety of industrial processes. The type or model of automation equipment suitable for each application will vary depending on factors such as the control function required, degree of protection required, production methods, unusual conditions, government regulations, etc. In some applications, more than one processor may be required, as when backup redundancy is needed.

Only you, the user, machine builder or system integrator can be aware of all the conditions and factors present during setup, operation, and maintenance of the machine and, therefore, can determine the automation equipment and the related safeties and interlocks which can be properly used. When selecting automation and control equipment and related software for a particular application, you should refer to the applicable local and national standards and regulations. The National Safety Council's Accident Prevention Manual (nationally recognized in the United States of America) also provides much useful information.

In some applications, such as packaging machinery, additional operator protection such as point-of-operation guarding must be provided. This is necessary if the operator's hands and other parts of the body are free to enter the pinch points or other hazardous areas and serious injury can occur. Software products alone cannot protect an operator from injury. For this reason the software cannot be substituted for or take the place of point-of-operation protection.

Ensure that appropriate safeties and mechanical/electrical interlocks related to point-of-operation protection have been installed and are operational before placing the equipment into service. All interlocks and safeties related to point-of-operation protection must be coordinated with the related automation equipment and software programming.

NOTE: Coordination of safeties and mechanical/electrical interlocks for point-of-operation protection is outside the scope of the Function Block Library, System User Guide, or other implementation referenced in this documentation.

Start-up and Test

Before using electrical control and automation equipment for regular operation after installation, the system should be given a start-up test by qualified personnel to verify correct operation of the equipment. It is important that arrangements for such a check are made and that enough time is allowed to perform complete and satisfactory testing.

⚠WARNING

EQUIPMENT OPERATION HAZARD

- Verify that all installation and set up procedures have been completed.
- Before operational tests are performed, remove all blocks or other temporary holding means used for shipment from all component devices.
- Remove tools, meters, and debris from equipment.

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

Follow all start-up tests recommended in the equipment documentation. Store all equipment documentation for future references.

Software testing must be done in both simulated and real environments.

Verify that the completed system is free from all short circuits and temporary grounds that are not installed according to local regulations (according to the National Electrical Code in the U.S.A, for instance). If high-potential voltage testing is necessary, follow recommendations in equipment documentation to prevent accidental equipment damage.

Before energizing equipment:

- Remove tools, meters, and debris from equipment.

- Close the equipment enclosure door.
- Remove all temporary grounds from incoming power lines.
- Perform all start-up tests recommended by the manufacturer.

Operation and Adjustments

The following precautions are from the NEMA Standards Publication ICS 7.1-1995:

(In case of divergence or contradiction between any translation and the English original, the original text in the English language will prevail.)

- Regardless of the care exercised in the design and manufacture of equipment or in the selection and ratings of components, there are hazards that can be encountered if such equipment is improperly operated.
- It is sometimes possible to misadjust the equipment and thus produce unsatisfactory or unsafe operation. Always use the manufacturer’s instructions as a guide for functional adjustments. Personnel who have access to these adjustments should be familiar with the equipment manufacturer’s instructions and the machinery used with the electrical equipment.
- Only those operational adjustments required by the operator should be accessible to the operator. Access to other controls should be restricted to prevent unauthorized changes in operating characteristics.

About the Book

Document Scope

This manual describes the hardware and software implementation of Modicon X80 analog modules.

Validity Note

This documentation is valid for EcoStruxure™ Control Expert 15.0 or later.

The technical characteristics of the devices described in the present document also appear online. To access the information online, go to the Schneider Electric home page www.se.com/ww/en/download/.

The characteristics that are described in the present document should be the same as those characteristics that appear online. In line with our policy of constant improvement, we may revise content over time to improve clarity and accuracy. If you see a difference between the document and online information, use the online information as your reference.

Related Documents

Title of documentation	Reference number
Electrical installation guide	EIGED306001EN (English)
Modicon M580, M340, and X80 I/O Platforms, Standards and Certifications	EIO0000002726 (English), EIO0000002727 (French), EIO0000002728 (German), EIO0000002730 (Italian), EIO0000002729 (Spanish), EIO0000002731 (Chinese)
EcoStruxure™ Control Expert, Operating Modes	33003101 (English), 33003102 (French), 33003103 (German), 33003104 (Spanish), 33003696 (Italian), 33003697 (Chinese)
EcoStruxure™ Control Expert, Program Languages and Structure, Reference Manual	35006144 (English), 35006145 (French), 35006146 (German), 35013361 (Italian), 35006147 (Spanish), 35013362 (Chinese)
EcoStruxure™ Control Expert, Communication, Block Library	33002527 (English), 33002528 (French), 33002529 (German), 33003682 (Italian), 33002530 (Spanish), 33003683 (Chinese)

Title of documentation	Reference number
EcoStruxure™ Control Expert, I/O Management, Block Library	33002531 (English), 33002532 (French), 33002533 (German), 33003684 (Italian), 33002534 (Spanish), 33003685 (Chinese)
EcoStruxure™ Control Expert, Concept Application Converter, User Manual	33002515 (English), 33002516 (French), 33002517 (German), 33003676 (Italian), 33002518 (Spanish), 33003677 (Chinese)

You can download these technical publications, the present document and other technical information from our website www.se.com/en/download/.

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.

Physical Implementation of Analog Modules

What's in This Part

In this Part

This part is devoted to the physical implementation of the Modicon X80 analog input and output modules, as well as of dedicated TELEFAST cabling accessories.

General Rules for the Physical Implementation of Analog Modules

What's in This Chapter

Subject of this Chapter

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

Installing Analog Input/Output Modules

At a Glance

The analog input/output modules are powered by the rack bus. The modules may be installed and uninstalled without turning off power supply to the rack, without causing any potential hazards and without there being any potential risk of damage or disturbance to the PLC.

Fitting operations (installation, assembly and disassembly) are described below.

Installation Precautions

The Modicon X80 analog modules may be installed in any of the positions in the rack except:

- the positions reserved for the rack power supply modules (marked PS, PS1, and PS2)
- the positions reserved for extended modules (marked XBE)
- the positions reserved for the CPU in the main local rack (marked 00 or marked 00 and 01 depending on the CPU)
- the positions reserved for the (e)X80 adapter module in the main remote drop (marked 00)

Power is supplied by the bus at the bottom of the rack (3.3 V and 24 V).

Before installing a module, remove the protective cap from the module connector located on the rack.

DANGER

HAZARD OF ELECTRIC SHOCK, EXPLOSION, OR ARC FLASH

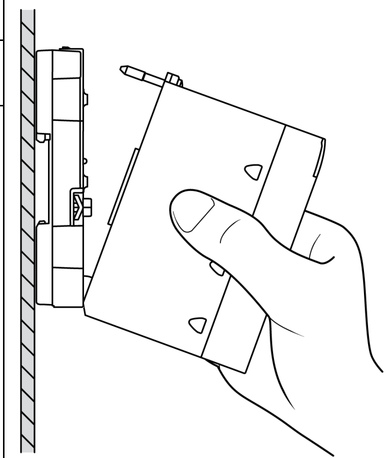
While mounting / removing the modules, make sure that the terminal block is still connected to the shield bar and disconnect the voltage of sensors and pre-actuators.

Failure to follow these instructions will result in death or serious injury.

NOTE: All modules are calibrated at factory before being shipped. Generally it is not necessary to calibrate the module. However, for certain applications or because of standard requirements (e.g. in pharmaceuticals), it may be advisable or even necessary to re-calibrate the module in specified time intervals.

Module Installation

The following table presents the procedure for mounting the analog input/output modules on the rack:

<table>
<tr><th>Step</th><th colspan="2">Action</th></tr>
<tr><td>1</td><td colspan="2">Remove the protective cover from the connector of the module slot on the Modicon X80 rack.</td></tr>
<tr><td>2</td><td>Position the locating pins situated at the rear of the module (on the bottom part) in the corresponding slot in the rack.</td><td rowspan="3"></td></tr>
<tr><td>3</td><td>Swivel the module towards the top of the rack so that the module sits flush with the back of the rack.</td></tr>
<tr><td>4</td><td>Tighten the mounting screw on top of the module to hold in place on the rack.

Tightening torque: 0.4...1.5 N•m (0.30...1.10 lbf-ft).</td></tr>
</table>

WARNING

UNINTENDED EQUIPMENT OPERATION

Check that the mounting screw is securely tightened to ensure the module is firmly attached to the rack.

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

How to Connect Analog Input/Output Modules

Introduction

Analog input/output modules are connected to sensors, pre-actuators or terminals using:

- a removable terminal block, or
- a pre-assembled cord sets, or
- TELEFAST pre-wired system for rapid connection to operative parts.

Removable Terminal Blocks Compatibility

The following table gives the compatibility between analog modules and removable terminal blocks:

Removable terminal blocks		20-pin BMX FTB 20•0	28-pin BMX FTB 28•0
Input modules	BMX AMI 0410(H)	Yes	No
	BMX AMI 0800	No	Yes
	BMX AMI 0810(H)	No	Yes
	BMX ART 0414(H)	No	No
	BMX ART 0814(H)	No	No
Output modules	BMX AMO 0210(H)	Yes	No
	BMX AMO 0410(H)	Yes	No
	BMX AMO 0802(H)	Yes	No
Mixed input/output module	BMX AMM 0600(H)	Yes	No

NOTE: The BMX ART •••• modules need of pre-assembled cord sets or TELEFAST accessories to connect sensors to the 40-pin FCN type connectors.

Pre-assembled Cord sets Compatibility

The following table gives the compatibility between analog modules and pre-assembled cord sets:

Pre-assembled cord set		BMX FCW •01S	BMX FTW •01S	BMX FTW •08S
Input modules	BMX AMI 0410(H)	No	Yes	No
	BMX AMI 0800	No	No	Yes
	BMX AMI 0810(H)	No	No	Yes
	BMX ART 0414(H)	Yes	No	No
	BMX ART 0814(H)	Yes	No	No

Pre-assembled cord set		BMX FCW •01S	BMX FTW •01S	BMX FTW •08S
Output modules	BMX AMO 0210(H)	No	Yes	No
	BMX AMO 0410(H)	No	Yes	No
	BMX AMO 0802(H)	No	Yes	No
Mixed Input/output module	BMX AMM 0600(H)	No	Yes	No

TELEFAST Wiring Accessories

The following table gives the compatibility between analog modules and TELEFAST wiring accessories:

TELEFAST accessories		Connecting cables	Interface Sub-Base
Input modules	BMX AMI 0410(H)	BMX FCA ••0	ABE-7CPA410
	BMX AMI 0800	BMX FTA ••0	Any one of: • ABE-7CPA02 • ABE-7CPA03 • ABE-7CPA31 • ABE-7CPA31E
	BMX AMI 0810(H)	BMX FTA ••0	Any one of: • ABE-7CPA02 • ABE-7CPA31 • ABE-7CPA31E
	BMX ART 0414(H)	BMX FCA ••2	ABE-7CPA412
	BMX ART 0814(H)	BMX FCA ••2	ABE-7CPA412
Output modules	BMX AMO 0210(H)	BMX FCA ••0	ABE-7CPA21
	BMX AMO 0410(H)	BMX FCA ••0	ABE-7CPA21
	BMX AMO 0802(H)	BMX FTA ••2	ABE-7CPA02
Mixed Input/output module	BMX AMM 0600(H)	-	-

NOTE: The BMX AMM 0600 input/output module can not be connected to TELEFAST wiring accessories.

20-pin Terminal Blocks: BMX FTB 20•0

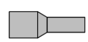
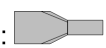
At a Glance

There are three types of 20-pin terminal blocks:

- BMX FTB 2010 screw clamp terminal blocks
- BMX FTB 2000 caged terminal blocks
- BMX FTB 2020 spring terminal blocks

Cable Ends and Contacts

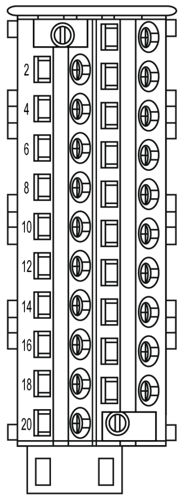
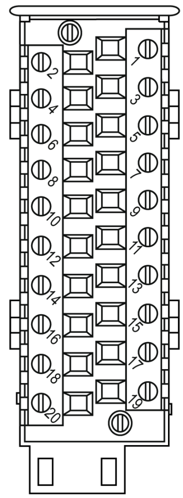
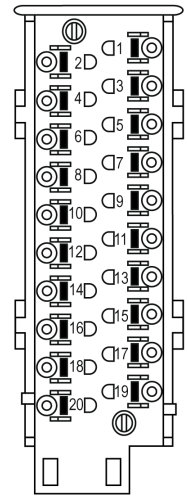
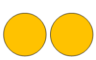
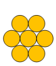
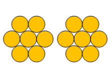
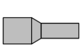
Each terminal block can accommodate:

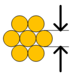
- Bare wires
- Wires with:
  - DZ5-CE (ferrule) type cable ends: 
  - AZ5-DE (twin ferrule) type cable ends: 

NOTE: When using stranded cable, Schneider Electric strongly recommends the use of wire ferrules which are fitted with an appropriate crimping tool.

Description of the 20-pin Terminal Blocks

The following table describes the type of wires that fit each terminal block and the associated gauge range, wiring constraints, and tightening torque:

	Screw Clamp Terminal Blocks **BMX FTB 2010**	**Caged Terminal Blocks** **BMX FTB 2000**	**Spring Terminal Blocks** **BMX FTB 2020**
Illustration			
1 solid conductor 	• AWG: 22...16 • mm²: 0.34...1.5	• AWG: 22...18 • mm²: 0.34...1	• AWG: 22...18 • mm²: 0.34...1
2 solid conductors 	2 conductors of the same size: • AWG: 2 x 22...16 • mm²: 2 x 0.34...1.5	Only possible with twin ferrule: • AWG: 2 x 24...20 • mm²: 2 x 0.24...0.75	Only possible with twin ferrule: • AWG: 2 x 24...20 • mm²: 2 x 0.24...0.75
1 stranded cable 	• AWG: 22...16 • mm²: 0.34...1.5	• AWG: 22...18 • mm²: 0.34...1	• AWG: 22...18 • mm²: 0.34...1
2 stranded cables 	2 conductors of the same size: • AWG: 2 x 22...16 • mm²: 2 x 0.34...1.5	Only possible with twin ferrule: • AWG: 2 x 24...20 • mm²: 2 x 0.24...0.75	Only possible with twin ferrule: • AWG: 2 x 24...20 • mm²: 2 x 0.24...0.75
1 stranded cable with ferrule 	• AWG: 22...16 • mm²: 0.34...1.5	• AWG: 22...18 • mm²: 0.34...1	• AWG: 22...18 • mm²: 0.34...1
2 stranded cables with twin ferrule 	• AWG: 2 x 24...18 • mm²: 2 x 0.24...1	• AWG: 2 x 24...20 • mm²: 2 x 0.24...0.75	• AWG: 2 x 24...20 • mm²: 2 x 0.24...0.75

	Screw Clamp Terminal Blocks **BMX FTB 2010**	**Caged Terminal Blocks** **BMX FTB 2000**	**Spring Terminal Blocks** **BMX FTB 2020**
Minimum individual wire size in stranded cables when a ferrule is not used 	• AWG: 30 • mm^2: 0.0507	• AWG: 30 • mm^2: 0.0507	• AWG: 30 • mm^2: 0.0507
Wiring constraints	Screw clamps have slots that accept: • Flat-tipped screwdrivers with a diameter of 5 mm. • Pozidriv PZ1 or Philips PH1 cross-tipped screwdrivers. Screw clamp terminal blocks have captive screws. On the supplied blocks, these screws are not tightened.	Caged terminal blocks have slots that accept: • Flat-tipped screwdrivers with a diameter of 3 mm. Caged terminal blocks have captive screws. On the supplied blocks, these screws are not tightened.	The wires are connected by pressing the button located next to each pin. To press the button, use a flat-tipped screwdriver with a maximum diameter of 3 mm.
Screw tightening torque	0.5 N•m (0.37 lbf-ft)	0.4 N•m (0.30 lbf-ft)	Not applicable

Connection of 20-pin Terminal Blocks

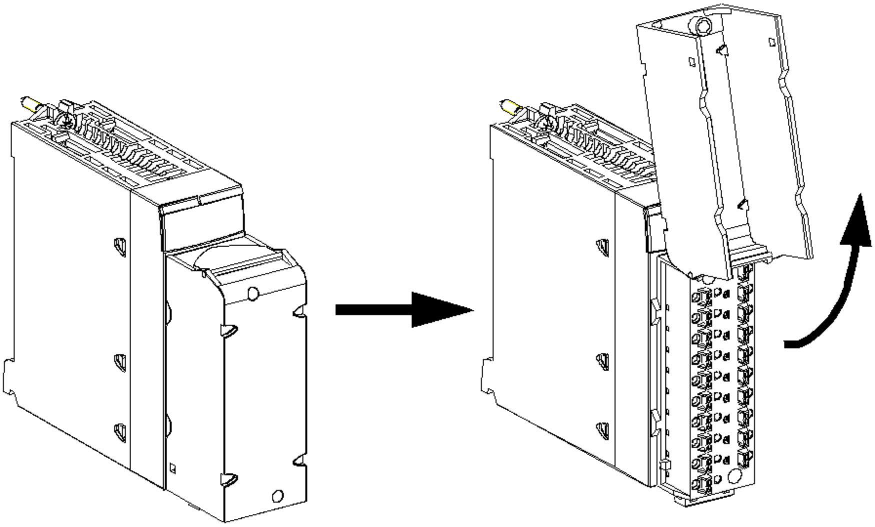
DANGER

HAZARD OF ELECTRIC SHOCK

Turn off all power to sensor and pre-actuator devices before connection or disconnection of the terminal block.

Failure to follow these instructions will result in death or serious injury.

The following diagram shows the method for opening the 20-pin terminal block door so that it can be wired:



NOTE: The connection cable is installed and held in place by a cable clamp positioned below the 20-pin terminal block.

Labeling of 20-pin Terminal Blocks

Labels for the 20-pin terminal blocks are supplied with the module. They are to be inserted in the terminal block cover by the customer.

Each label has two sides:

- One side that is visible from the outside when the cover is closed. This side features the commercial product references, an abbreviated description of the module, as well as a blank section for customer labeling.
- One side that is visible from the inside when the cover is open. This side shows the terminal block connection diagram.

28-Pin Terminal Blocks: BMX FTB 28•0

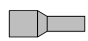
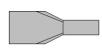
At a Glance

There are two types of 28-pin terminal blocks:

- BMX FTB 2800 caged terminal blocks
- BMX FTB 2820 spring terminal blocks

Cable Ends and Contacts

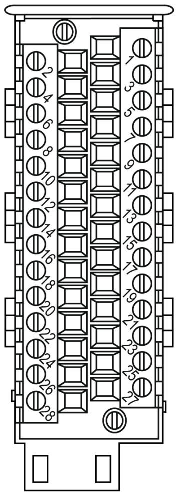
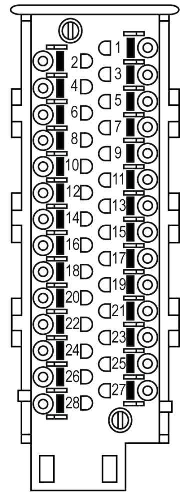
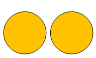
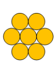
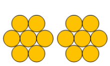
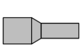
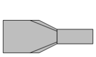
Each terminal block can accommodate:

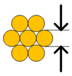
- Bare wires:
  - Solid conductor
  - Stranded cable
- Wires with ferrules:
  - DZ5CE•••• single type cable ends: 
  - AZ5DE•••• twin type cable ends: 

  NOTE: When using stranded cable, Schneider Electric strongly recommends the use of wire ferrules which are fitted with an appropriate crimping tool.

Description of the 28-pin Terminal Blocks

The following table describes the type of wires that fit each terminal block and the associated gauge range, wiring constraints, and tightening torque:

	Caged terminal blocks **BMX FTB 2800**	**Spring terminal blocks** **BMX FTB 2820**
Illustration		
1 solid conductor 	• AWG: 22...18 • mm²: 0.34...1	• AWG: 22...18 • mm²: 0.34...1
2 solid conductors 	Only possible with twin ferrule: • AWG: 2 x 24...20 • mm²: 2 x 0.24...0.75	Only possible with twin ferrule: • AWG: 2 x 24...20 • mm²: 2 x 0.24...0.75
1 stranded cable 	• AWG: 22...18 • mm²: 0.34...1	• AWG: 22...18 • mm²: 0.34...1
2 stranded cables 	Only possible with twin ferrule: • AWG: 2 x 24...20 • mm²: 2 x 0.24...0.75	Only possible with twin ferrule: • AWG: 2 x 24...20 • mm²: 2 x 0.24...0.75
1 stranded cable with ferrule 	• AWG: 22...18 • mm²: 0.34...1	• AWG: 22...18 • mm²: 0.34...1
2 stranded cables with twin ferrule 	• AWG: 2 x 24...20 • mm²: 2 x 0.24...0.75	• AWG: 2 x 24...20 • mm²: 2 x 0.24...0.75
Minimum individual wire size in stranded cables when a ferrule is not used	• AWG: 30 • mm²: 0.0507	• AWG: 30 • mm²: 0.0507

	Caged terminal blocks **BMX FTB 2800**	**Spring terminal blocks** **BMX FTB 2820**
		
Wiring constraints	Caged terminal blocks have slots that accept: • Flat-tipped screwdrivers with a diameter of 3 mm. Caged terminal blocks have captive screws. On the supplied blocks, these screws are not tightened.	The wires are connected by pressing the button located next to each pin. To press the button, you have to use a flat-tipped screwdriver with a maximum diameter of 3 mm.
Screw tightening torque	0.4 N•m (0.30 lbf-ft)	Not applicable

Connection of the 28-pin Terminal Blocks

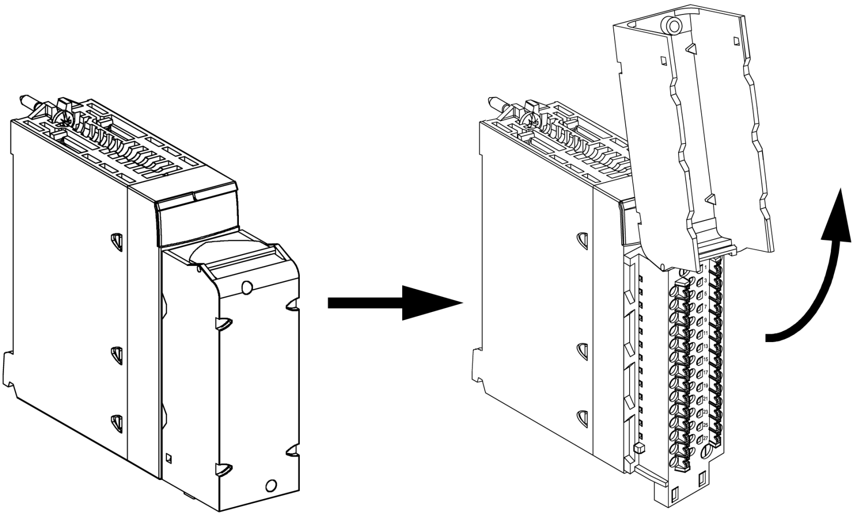
DANGER

HAZARD OF ELECTRIC SHOCK

Turn off all power to sensor and pre-actuator devices before connection or disconnection of the terminal block.

Failure to follow these instructions will result in death or serious injury.

The following diagram shows the method for opening the terminal block cover so that it can be wired:



NOTE: The connection cable is installed and held in place by a cable clamp positioned below the 28-pin terminal block.

Labeling the Terminal Blocks

The labels for the terminal blocks are supplied with the module. They are to be inserted in the terminal block cover by the customer.

Each label has two sides:

- One side that is visible from the outside when the cover is closed. This side features the commercial product references, an abbreviated description of the module, as well as a blank section for customer labeling.
- One side that is visible from the inside when the cover is open. This side shows the terminal block connection diagram.

BMX FTW •01S Cable

Introduction

20-pin connector modules are connected to sensors, pre-actuators or terminals using a cable designed to enable direct wire to wire transition of the module's inputs/outputs.

⚠ WARNING

UNEXPECTED EQUIPMENT OPERATION

Use only a connector that is designed for a specific module. Plugging the wrong connector can cause unexpected application behavior.

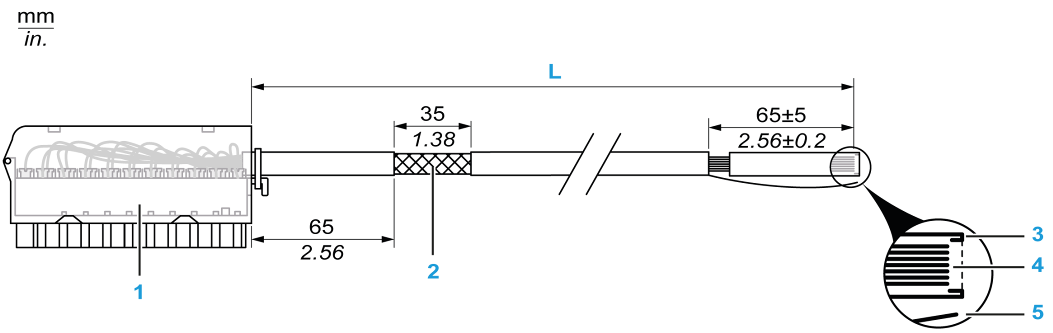
Failure to follow these instructions can result in death, serious injury, or equipment damage.

Cable Description

The BMX FTW •01S cables are pre-assembled cord set, made up of:

- At one end, a compound-filled 20-pin terminal block from which extend 1 cable sheath containing 20 wires,
- At the other end, free wire ends differentiated by color code.

The figure below shows the BMX FTW •01S cables:



1 BMX FTB 2020 Terminal block

2 Cable shielding

3 First of external sheath

4 Wires not stripped

5 Strand of nylon allowing the cable sheath to be stripped easily.

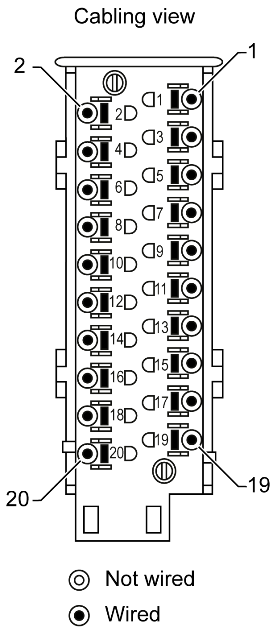
L Length according to the part number.

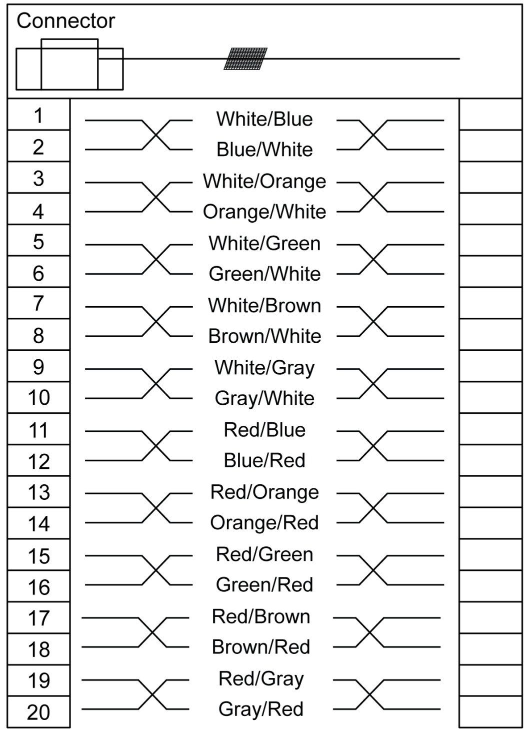
The cable comes in 2 different lengths:

- 3 m (9.84 ft): BMX FTW 301S;
- 5 m (16.40 ft): BMX FTW 501S;

Pin Assignment

The diagram below shows the connection of BMX FTW •01S cable:





Characteristics

The following table gives the characteristics of the BMX FTW •01S cables:

Characteristic		**Value**
Cable	Sheath material	PVC
	LSZH status	No
Conductor description	Number of conductors	20
	Conductor cross section (Gauge)	0.22 mm² (24 AWG)
Environmental	Operating temperature	-25...70 °C (-13...158 °F)
Applicable standards		DIN47100

Cable Installation

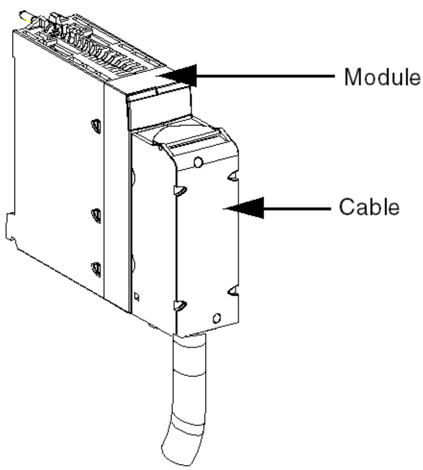
DANGER

HAZARD OF ELECTRIC SHOCK, EXPLOSION, OR ARC FLASH

Turn off all power to sensor and pre-actuator devices before connection or disconnection of the terminal block.

Failure to follow these instructions will result in death or serious injury.

The following diagram shows the pre-assembled cable connected to the module:



For detailed information, refer to the *Fitting a 20-pin Terminal Block to a Module topic*, page 40.

BMX FTW •08S Cable

Introduction

28-pin connector modules are connected to sensors, pre-actuators or terminals using a cable designed to enable trouble-free direct wire to wire transition of the module’s inputs/ outputs.

WARNING

UNEXPECTED EQUIPMENT OPERATION

Take every precaution at the installation to prevent any subsequent mistake in the connectors. Plugging the wrong connector would cause an unexpected behavior of the application.

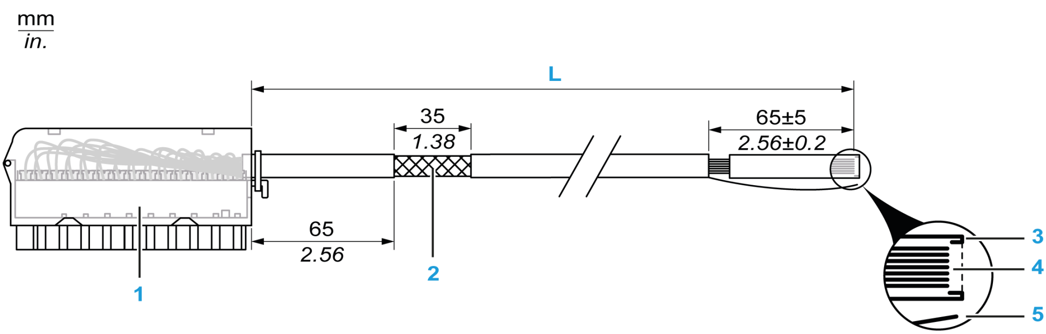
Failure to follow these instructions can result in death, serious injury, or equipment damage.

Cable Description

The BMX FTW •08S cables are pre-assembled cord set, made up of:

- At one end, a compound-filled 28-pin connector from which extend 1 cable sheath, containing 24 wires,
- At the other end, free wire ends differentiated by color code.

The figure below shows the BMX FTW •08S cables:



1 BMX FTB 2820 Terminal block

2 Cable shielding

3 First of external sheath

4 Wires not stripped

5 Strand of nylon allowing the cable sheath to be stripped easily.

L Length according to the part number.

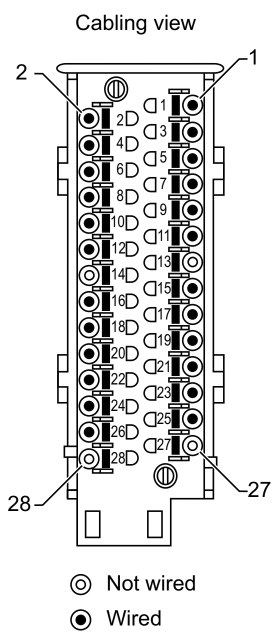
The cable comes in 2 different lengths:

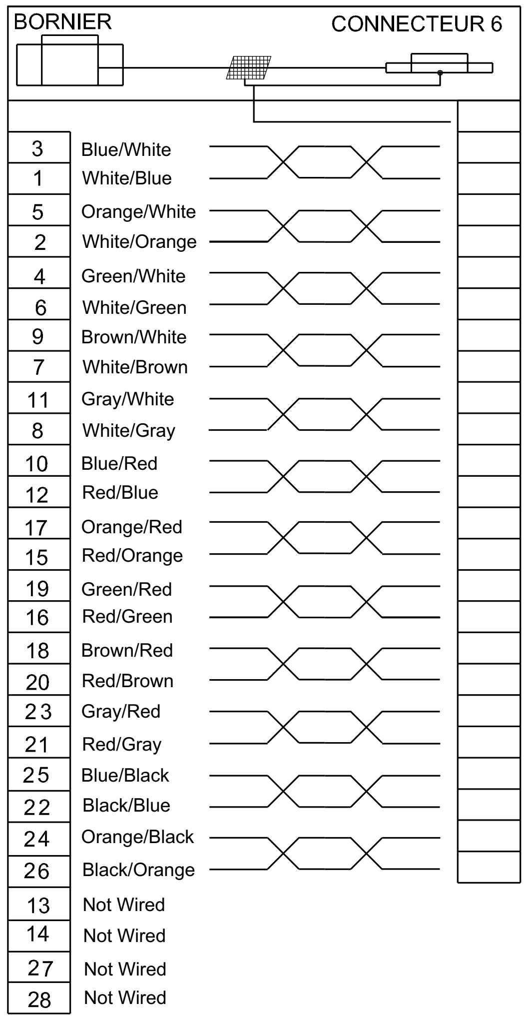
- 3 meters: BMX FTW 308S;

- 5 meters: BMX FTW 508S;

Pin Assignment

The diagram below shows the connection of BMX FTW •08S cable:





Characteristics

The following table gives the characteristics of the BMX FTW •08S cables:

Characteristic		**Value**
Cable	Sheath material	PVC
	LSZH status	No
Conductor description	Number of conductors	24
	Conductor cross section (Gauge)	0.22 mm^2 (24 AWG)
Environmental	Operating temperature	-25...70 °C (-13...158 °F)
Applicable standards		DIN47100

Cable Installation

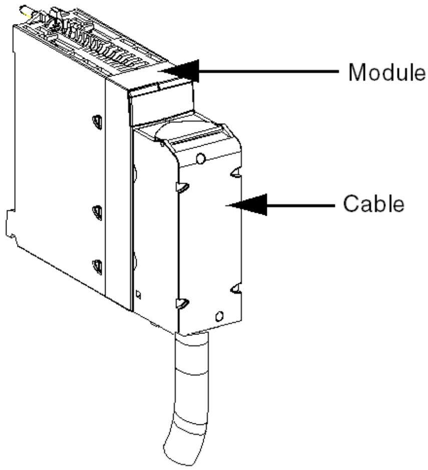
DANGER

HAZARD OF ELECTRIC SHOCK

Turn off all power to sensor and pre-actuator devices before connection or disconnection of the terminal block.

Failure to follow these instructions will result in death or serious injury.

The following diagram shows the connection of the cable to the module:



For more detailed information, refer to the topic *Fitting a 28-pin Terminal Block to a Module*, page 45.

BMX FCW •01S Cables

Introduction

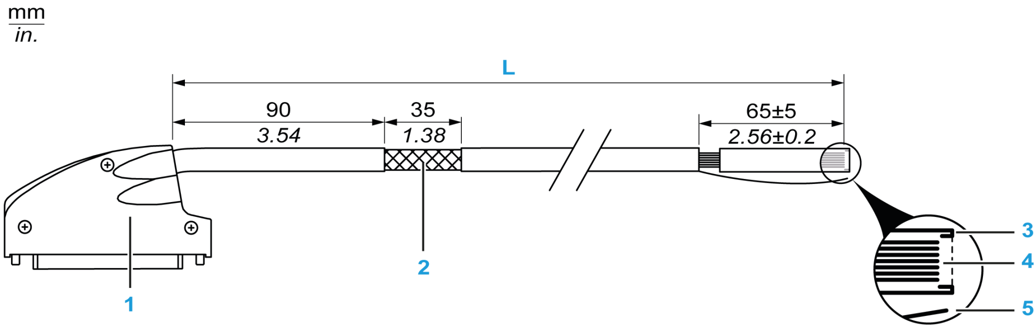
40-pin connector modules are connected to sensors, pre-actuators or terminals using a cable designed to enable direct wire to wire transition of the module's inputs/outputs.

Cable Description

The BMX FCW •01S cables are pre-assembled cord set, made up of:

- At one end, a compound-filled 40-pin connector from which extend 1 cable sheath, containing 20 wires,
- At the other end, free wire ends differentiated by color code.

The figure below shows the BMX FCW •01S cables:



1 40-pin connector, FCN type

2 Cable shielding

3 First of external sheath

4 Wires not stripped

5 Strand of nylon allowing the cable sheath to be stripped easily.

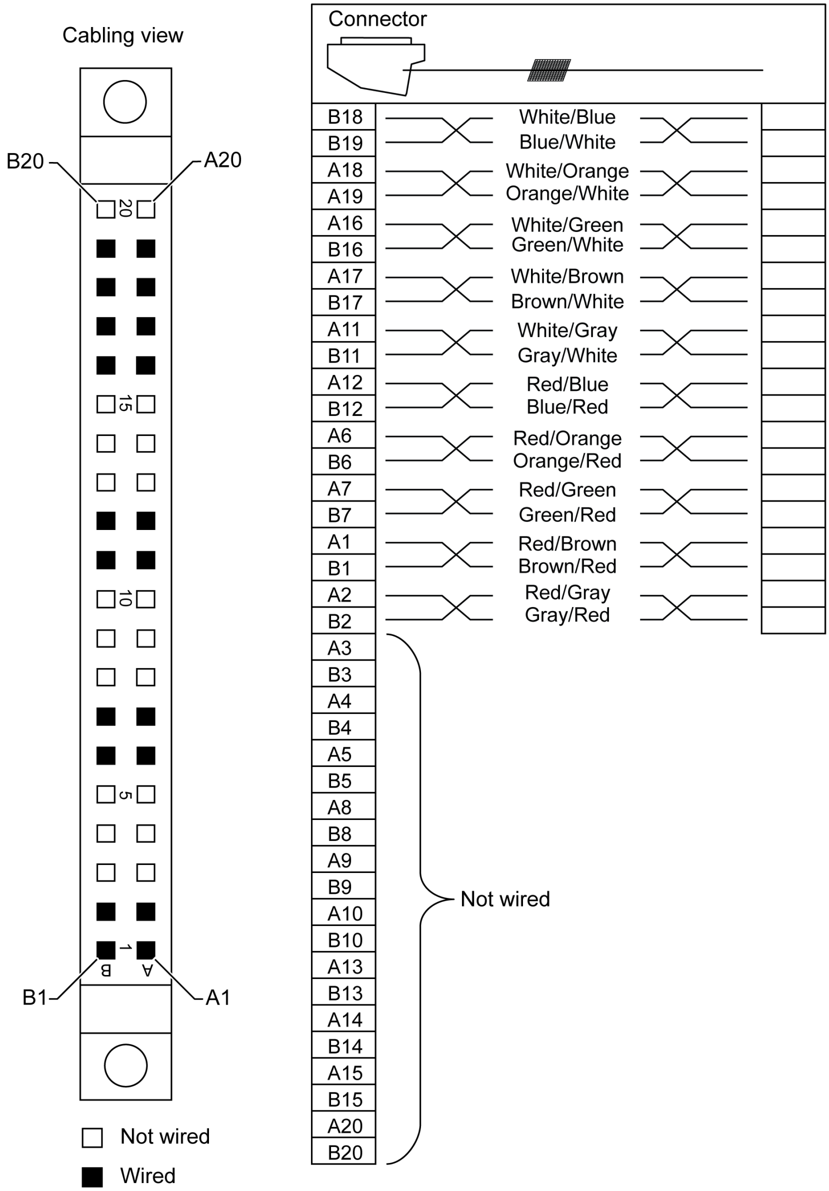
L Length according to the part number.

The cable comes in 2 different lengths:

- 3 meters: BMX FCW 301S,
- 5 meters: BMX FCW 501S.

Pin Assignment

The diagram below shows the connection of the BMX FCW •01S cables:



Characteristics

The following table gives the characteristics of the BMX FCW •01S cables:

Characteristic		Value
Cable	Sheath material	PVC
	LSZH status	No
Conductor description	Number of conductors	20
	Conductor cross section (Gauge)	0.22 mm^2 (24 AWG)
Environmental	Operating temperature	-25...70 °C (-13...158 °F)
Applicable standards		DIN47100

Cable Installation

DANGER

HAZARD OF ELECTRIC SHOCK

Turn off all power to sensor and pre-actuator devices before connection or disconnection of the terminal block.

Failure to follow these instructions will result in death or serious injury.

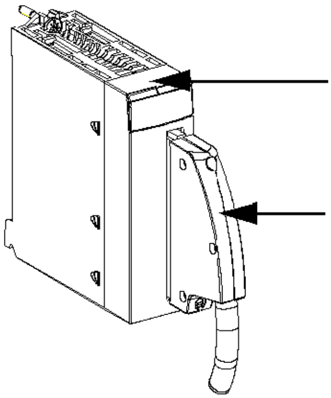
WARNING

UNEXPECTED EQUIPMENT OPERATION

Take every precaution at the installation to prevent any subsequent mistake in the connectors. Plugging the wrong connector would cause an unexpected behavior of the application.

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

The following diagram shows the connection of the cable to the module:



For more detailed information, refer to the topic *Fitting a 40-pin FCN Type to a Module*, page 49.

Fitting a 20-pin Terminal Block to a Module

At a Glance

The modules with 20-pin terminal block connections require the terminal block to be connected to the module. These fitting operations (assembly and disassembly) are described below.

DANGER

HAZARD OF ELECTRICAL SHOCK, EXPLOSION OR ARC FLASH

Terminal block must be connected or disconnected with sensor and pre-actuator voltage switched off.

Failure to follow these instructions will result in death or serious injury.

CAUTION

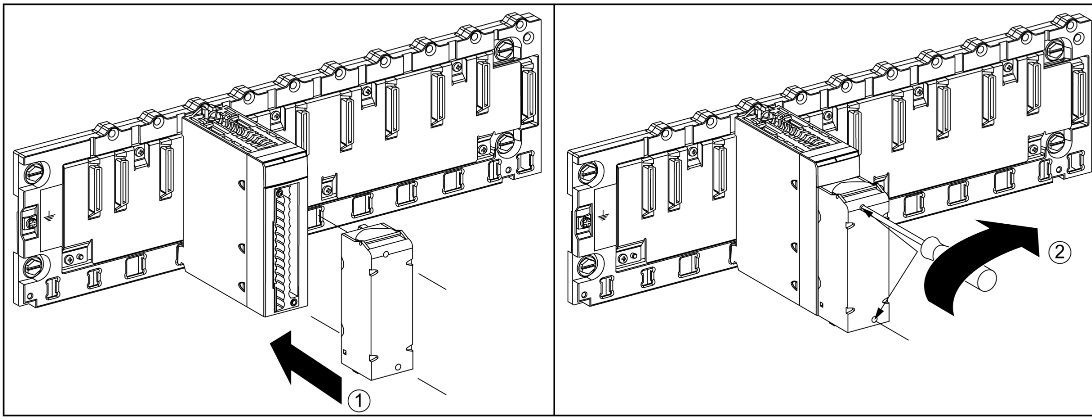
EQUIPMENT DAMAGE

Do not plug an AC terminal block into a DC module. This will cause damage to the module.

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

Installing the Terminal Block

The following table shows the procedure for assembling the 20-pin terminal block onto a discrete input/output module.



Assembly Procedure

Step	Action
1	Once the module is in place on the rack, install the terminal block by inserting the terminal block encoder (the rear lower part of the terminal) into the module's encoder (the front lower part of the module), as shown above. **NOTE:** The module connector have indicators which show the proper direction to use for terminal block installation.
2	Fix the terminal block to the module by tightening the 2 mounting screws located on the lower and upper parts of the terminal block. Tightening torque: 0.4 N•m (0.30 lbf-ft).

NOTE: If the screws are not tightened, there is a potential risk that the terminal block will not be properly fixed to the module.

Coding the 20-Pin Terminal Block

⚠ CAUTION

UNEXPECTED APPLICATION BEHAVIOR

Code the terminal block as described below to prevent the terminal block from being mounted on another module. Plugging the wrong connector could cause unexpected application behavior.

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

NOTICE

MODULE DESTRUCTION

Code the terminal block as described below to prevent the terminal block from being mounted on another module. Plugging the wrong connector could cause the module to be destroyed.

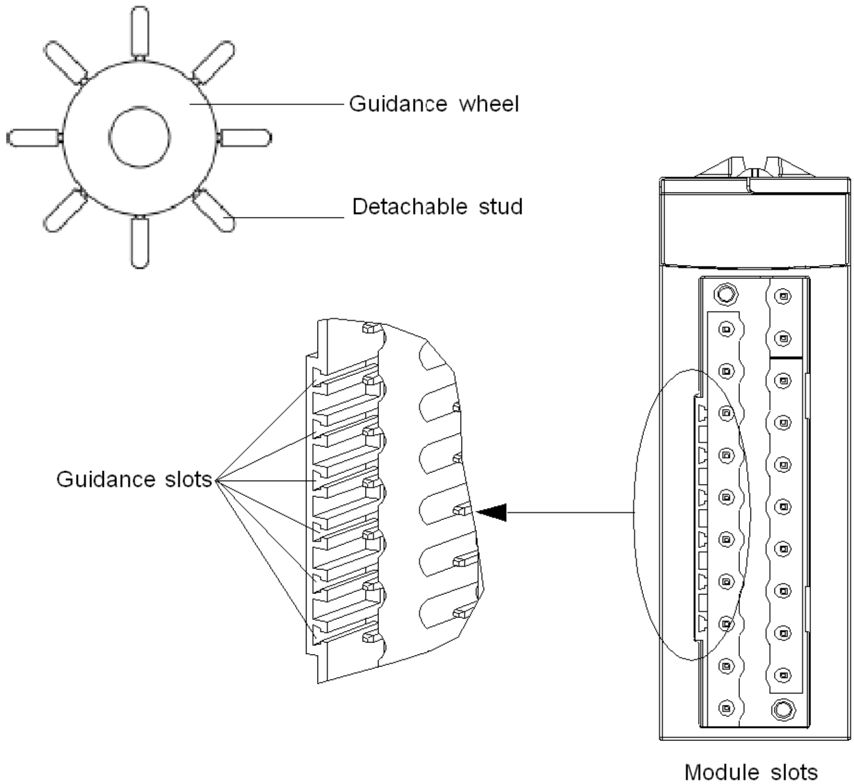
Failure to follow these instructions can result in equipment damage.

When a 20-pin terminal block is installed on a module dedicated to this type of terminal block, you can code the terminal block and the module using studs. The purpose of the studs is to help prevent the terminal block from being mounted on another module. Incorrect insertion can then be potentially avoided when replacing a module.

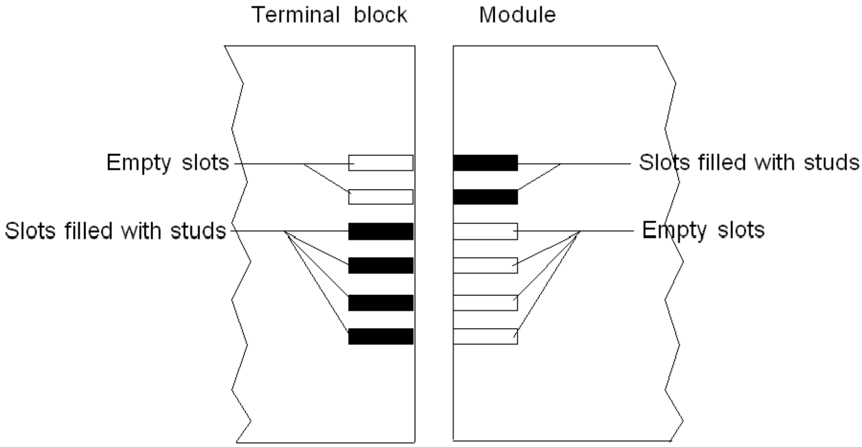
Coding is done by the user with the STB XMP 7800 guidance wheel’s studs. You can only fill the 6 slots in the middle of the left side (as seen from the wiring side) of the terminal block, and can fill the module’s 6 guidance slots on the left side.

To fit the terminal block to the module, confirm that a module slot with a stud corresponds to an empty slot in the terminal block, or a terminal block with a stud corresponds to an empty slot in the module. You can fill up to and including either of the 6 available slots as desired.

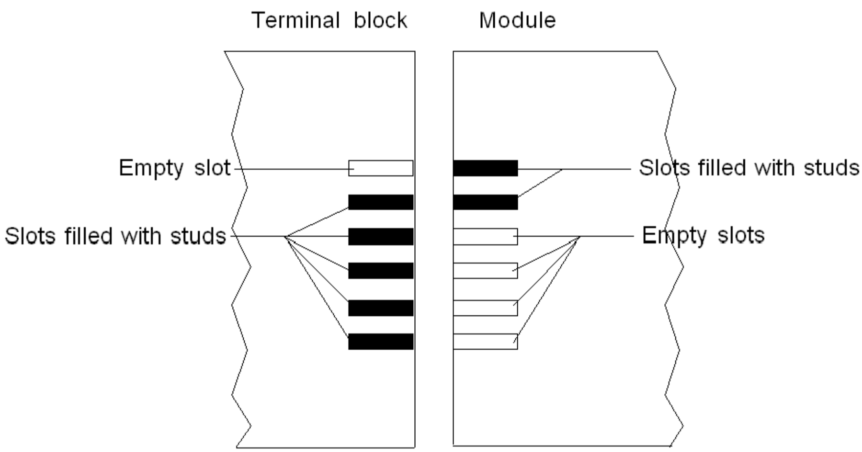
The diagram below shows a guidance wheel as well as the slots on the module used for coding the 20-pin terminal blocks.



The diagram below shows an example of a coding configuration that makes it possible to fit the terminal block to the module.



The diagram below shows an example of coding configuration with which it is not possible to fit the terminal block to the module.



Fitting a 28-pin Terminal Block to a Module

At a Glance

The modules with 28-pin terminal block connections require the latter to be connected to the module. These fitting operations (assembly and disassembly) are described below.

DANGER

ELECTRICAL SHOCK

Terminal block must be connected or disconnected with the sensor and pre-actuator voltage switched off.

Failure to follow these instructions will result in death or serious injury.

CAUTION

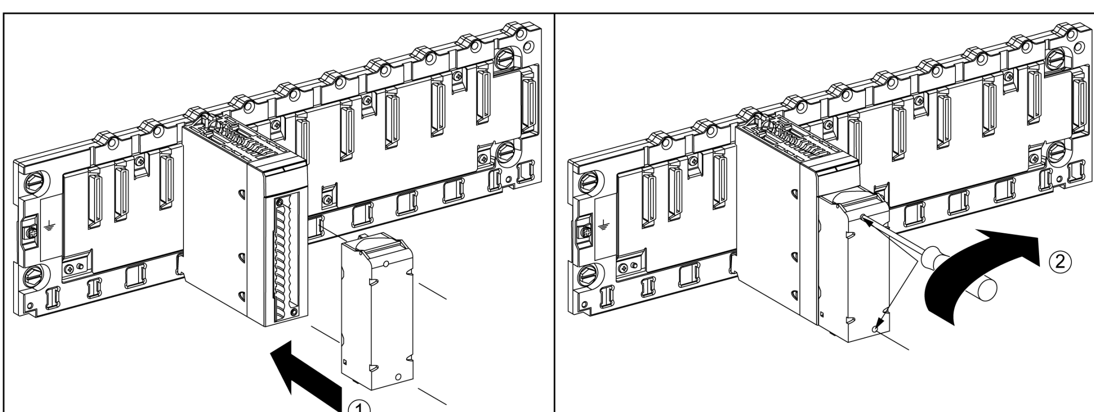
EQUIPMENT DAMAGE

Do not plug an AC terminal block into a DC module. This will cause damage to the module.

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

Installing the Terminal Block

The following table shows the procedure for assembling the 28-pin terminal block onto modules:



Assembly procedure:

Step	Action
1	Once the module is in place on the rack, install the terminal block by inserting the terminal block encoder (the rear lower part of the terminal) into the module's encoder (the front lower part of the module), as shown above.
2	Fix the terminal block to the module by tightening the 2 mounting screws located on the lower and upper parts of the terminal block. Tightening torque: 0.4 N•m (0.30 lbf-ft).

NOTE: If the screws are not tightened, there is a potential risk that the terminal block will not be properly fixed to the module.

Coding the Terminal Block

⚠ CAUTION

UNEXPECTED APPLICATION BEHAVIOR

Code the terminal block as described above to prevent the terminal block from being mounted on another module. Plugging the wrong connector could cause unexpected application behavior.

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

NOTICE

MODULE DESTRUCTION

Code the terminal block as described above to prevent the terminal block from being mounted on an incorrect module. Plugging the wrong connector could cause the module to be destroyed.

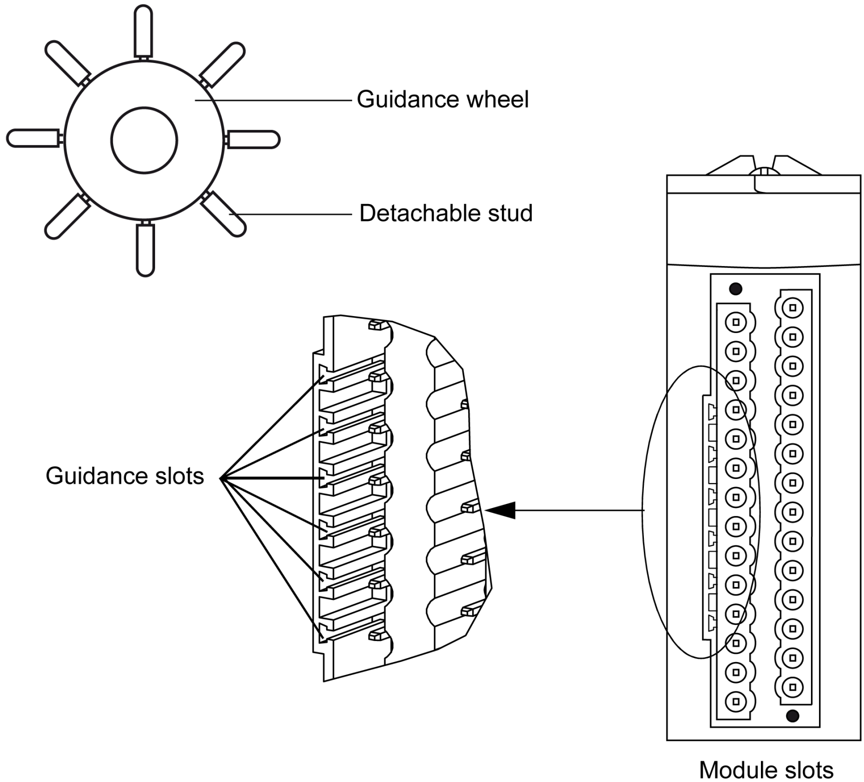
Failure to follow these instructions can result in equipment damage.

When a terminal block is installed on a module dedicated to this type of terminal block, you can code the terminal block and the module using studs. The purpose of the studs is to help prevent the terminal block from being mounted on another module. Handling detected errors can then be potentially avoided when replacing a module.

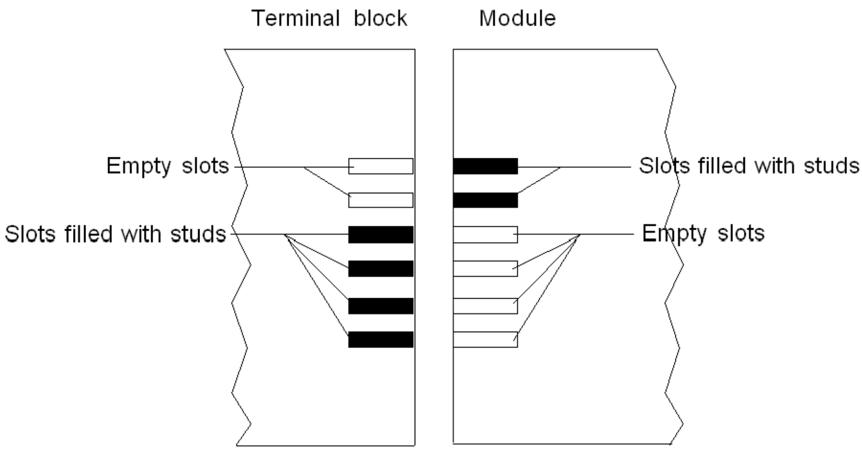
Coding is done by the user with the STB XMP 7800 guidance wheel’s studs. You can only fill the 6 slots in the middle of the left side (as seen from the wiring side) of the terminal block, and can fill the module’s 6 guidance slots on the left side.

To fit the terminal block to the module, confirm that a module slot with a stud corresponds to an empty slot in the terminal block, or a terminal block with a stud corresponds to an empty slot in the module. You can fill up to and including either of the six available slots as desired.

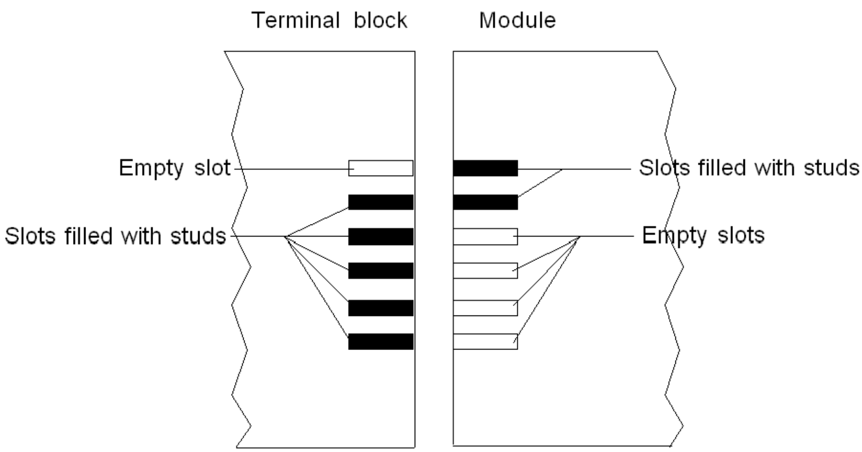
The following diagram shows a guidance wheel as well as the slots on the module used for coding a 28-pin terminal block:



The diagram below shows an example of a coding configuration that makes it possible to fit the terminal block to the module:



The diagram below shows an example of coding configuration with which it is not possible to fit the terminal block to the module:



NOTE: The module connector have indicators which show the proper direction to use for terminal block installation.

Fitting a 40-pin FCN Type Connector to a Module

At a Glance

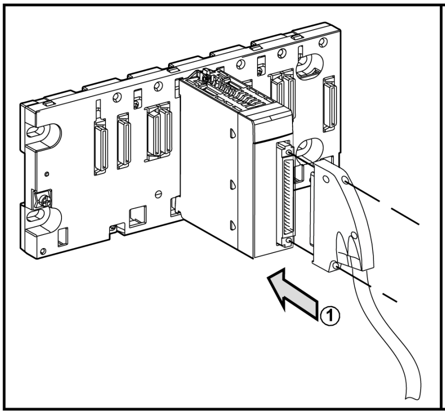
The modules with 40-pin FCN type connections require the latter to be connected to the module. These fitting operations (assembly and disassembly) are described below.

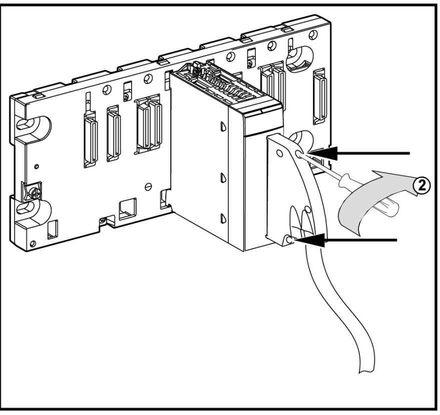
⚠⚠ DANGER
ELECTRICAL SHOCK
FCN type connector must be connected or disconnected with sensor and pre-actuator voltage switched off.
Failure to follow these instructions will result in death or serious injury.

⚠ CAUTION
EQUIPMENT DAMAGE
Do not plug an AC connector on a DC module. This would cause equipment damage.
Failure to follow these instructions can result in injury or equipment damage.

Installing the Connector

The following table shows the procedure for assembling the connector onto modules:





Assembly procedure:

Step	Action
1	Once the module is in place on the rack, insert the FCN connector of the cable into the module's connector, as shown above.
2	Fix the connector to the module by tightening the 2 mounting screws located on the lower and upper parts of the terminal block. Tightening torque: 0.4 N•m (0.30 lbf-ft).

NOTE: If the screws are not tightened, there is a potential risk that the terminal block will not be properly fixed to the module.

Shielding Connection Kit

Introduction

The BMXXSP•••• shielding connection kit allows to connect the cable shielding directly to the ground and not to the module shielding to help protect the system from electromagnetic perturbations.

Connect the shielding on the cordsets for connecting:

- Analog module,
- Counter module,
- Encoder interface module,
- Motion control module,
- An XBT console to the processor (via shielded USB cable).

Kit References

Each shielding connection kit includes the following components:

- A metal bar
- Two sub-bases

The shielding connection kit reference is dependent on the size of the Modicon X80 rack::

X bus racks/Dual Ethernet and X bus racks	Number of slots	Shielding Connection Kit
BMXXBP0400(H)	4	BMXXSP0400
BMEXBP0400(H)		
BMXXBP0600(H)	6	BMXXSP0600
BMXXBP0800(H)	8	BMXXSP0800
BMEXBP0800(H)		
BMXXBP1200(H)	12	BMXXSP1200
BMEXBP1200(H)		
BMXXBP1600(H)	16	BMXXSP1600
BMEXBP1600(H)		

Redundant power supply racks	Number of slots	Shielding Connection Kit
BMEXBP0602(H)	6	BMXXSP0800
BMEXBP1002(H)	10	BMXXSP1200
BMEXBP1402(H)	14	BMXXSP1600

Clamping Rings

Use clamping rings to connect the shielding on cordsets to the metal bar of the kit.

NOTE: The clamping rings are not included in the shielding connection kit.

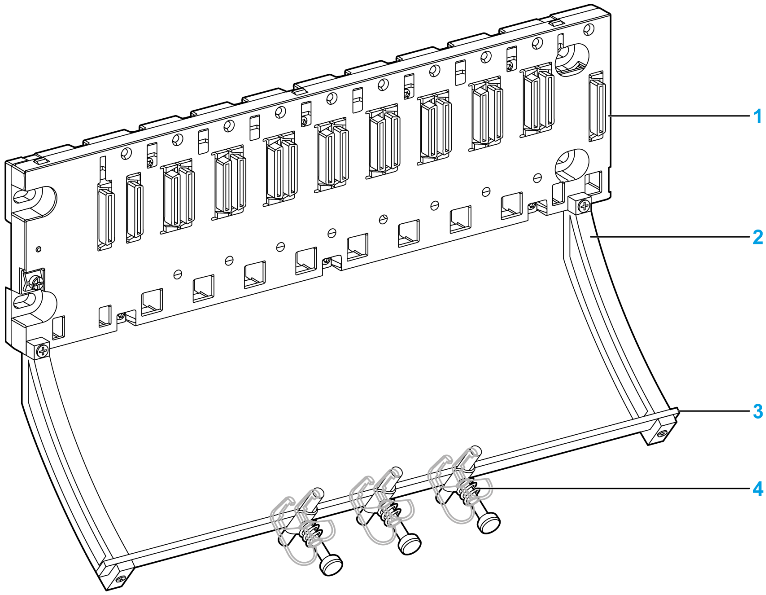
Depending on the cable diameter, the clamping rings are available under the following references:

- STBXSP3010: small rings for cables with cross-section 1.5...6 mm^2 (AWG16...10).
- STBXSP3020: large rings for cables with cross-section 5...11 mm^2 (AWG10...7).

Kit Installation

Installation of the shielding connection kit to the rack can be done with module already installed on the rack except for the BMXXBE0100 rack extender module.

Fasten the sub-bases of the kit at each end of the rack to provide a connection between the cable and the ground screw of the rack:



1 rack

2 sub-base

3 metallic bar

4 clamping ring

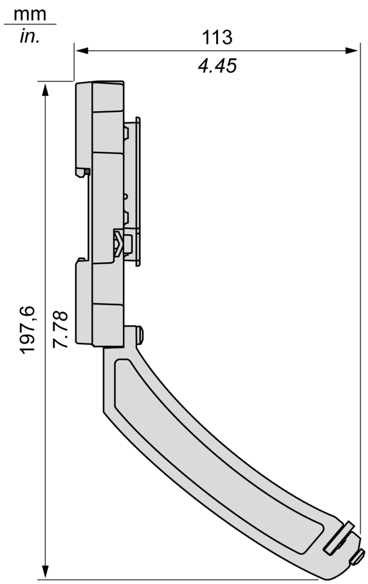
Tightening torques to install the shielding connection kit:

- For the screws fixing the sub-base to the Modicon X80 rack: Max. 0.5 N•m (0.37 lbf-ft)
- For the screws fixing the metallic bar to the sub-bases: Max. 0.75 N•m (0.55 lbf-ft)

  NOTE: A shielding connection kit does not modify the volume required when installing and uninstalling modules.

Kit Dimensions

The following figure gives the dimensions (height and depth) of a Modicon X80 rack with its shielding connection kit:

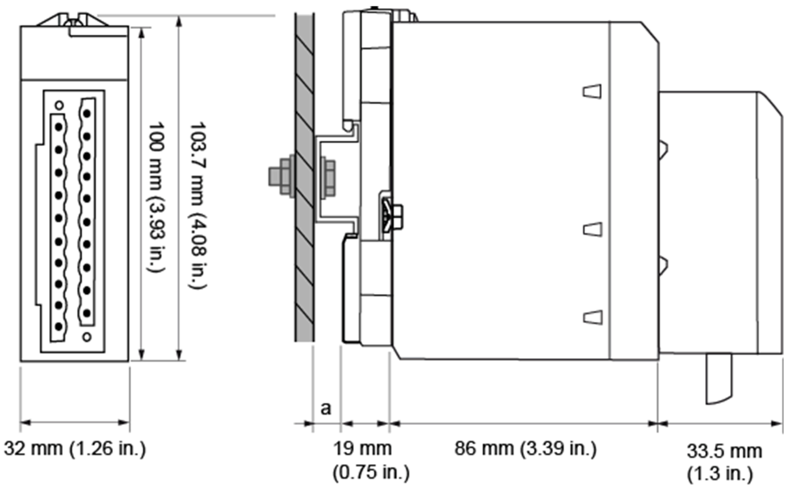


NOTE: The overall width equals to the width of the Modicon X80 rack.

Dimensions of X80 Analog I/O Modules

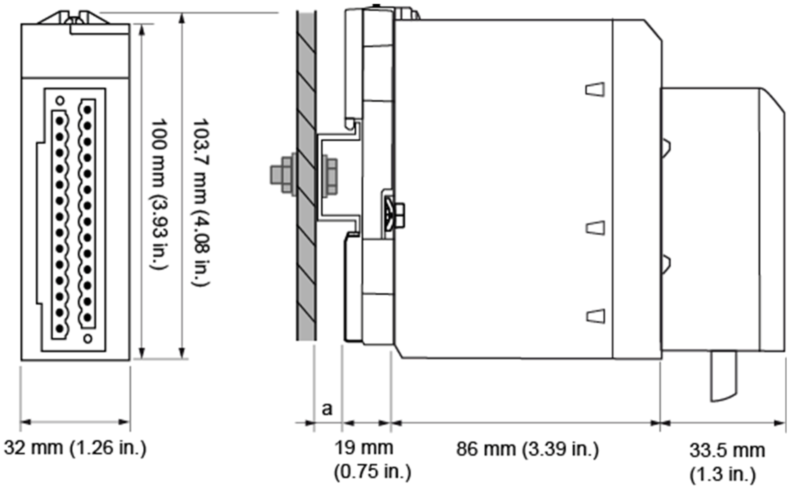
General Presentation of X80 Analog I/O Modules

X80 Analog I/O Module with a 20-pin removable terminal blocks :



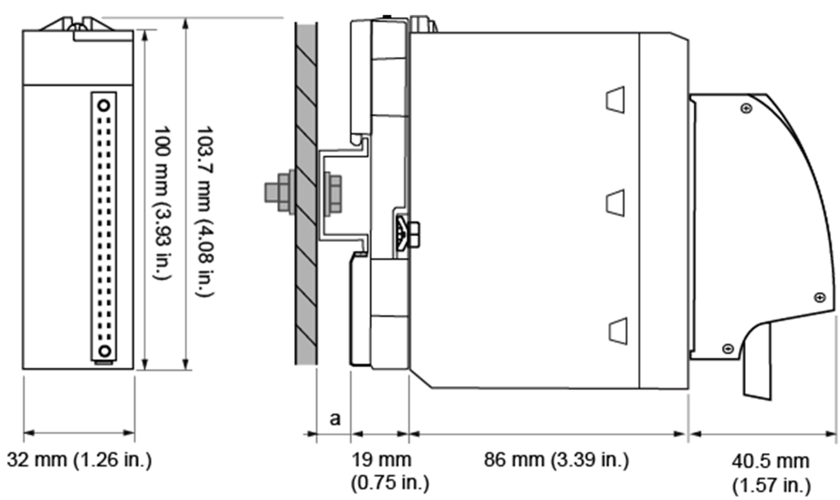
a DIN-rail depth: the value depends on the DIN-rail type used in your platform.

X80 Analog I/O Module with a 28-pin removable terminal blocks :



a DIN-rail depth: the value depends on the DIN-rail type used in your platform. Refer to *Mounting the Racks* (see Modicon X80, Racks and Power Supplies, Hardware Reference Manual).

X80 Analog I/O Module with a 40-pin FCN-type connector



a DIN-rail depth: the value depends on the DIN-rail type used in your platform.

Dimensions of X80 Analog Modules

Module reference	Module dimensions			Installation depth[1]
	Width	Height	Depth	
X80 Analog I/O Module with a 20-pin removable terminal block				
BMXAMI0410(H)	32 mm (1.26 in.)	103.7 mm (4.08 in.)	86 mm (3.39 in.)	119.5 mm (4.69 in.)[1]
BMXAMO0210(H)				
BMXAMO0410(H)				
BMXAMO0802(H)				
BMXAMM0600(H)				
X80 Analog I/O Module with a 28-pin removable terminal block				
BMXAMI0800(H)	32 mm (1.26 in.)	103.7 mm (4.08 in.)	86 mm (3.39 in.)	119.5 mm (4.69 in.)[1]
BMXAMI0810(H)				
X80 Analog I/O Module with a 40-pin FCN-type connector				
BMXART0414(H)	32 mm (1.26 in.)	103.7 mm (4.08 in.)	86 mm (3.39 in.)	126.5 mm (4.96 in.)[1]
BMXART0814(H)				
(1) DIN-rail depth (a) is not included.				

NOTE: Connectors that are delivered with the X80 Analog I/O modules (20-pin and 28-pin removable terminal blocks, and 40-pin FCN-type connector) and the corresponding pre-assembled cordsets (BMXFTW*01S, BMXFTW*08S, and BMXFCW*01S) have the same dimensions.

NOTE: Consider clearance for cable installation and spacing around the racks.

Standards and Certifications

Download

Click the link that corresponds to your preferred language to download standards and certifications (PDF format) that apply to the modules in this product line:

Title	Languages
Modicon M580, M340, and X80 I/O Platforms, Standards and Certifications	• English: EIO0000002726 • French: EIO0000002727 • German: EIO0000002728 • Italian: EIO0000002730 • Spanish: EIO0000002729 • Chinese: EIO0000002731

Diagnostics for Analog Modules

What's in This Chapter

Subject of this Section

This section explains the processing of hardware detected faults related to analog input and output modules.

Analog Input/Output Module States

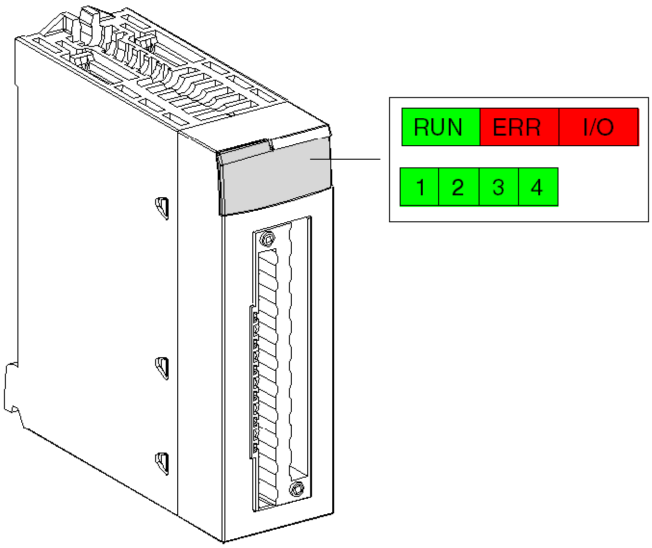
At a Glance

Analog modules have LEDs which show the module's status and the status of the channels. These are:

- Module status LEDs: RUN, ERR and I/O.
- Channels status LEDs: IN • (for input modules), OUT • (for output modules).

Description

The modules have several LEDs that indicate their status:



Description of the LEDs:

LED	Meaning
RUN (green)	Module operating status
ERR (red)	Internal detected error in the module or a conflict between the module and the remainder of the configuration.
I/O (red)	External error is detected

Analog Input/Output Module Diagnostics

At a Glance

The status of the analog input/output module is indicated by the lighting up or flashing of the RUN, ERR, I/O and channel LEDs.

Description

The following table allows you to perform diagnostics of the module status according to the LEDs: RUN, ERR, I/O and channels:

Module status	Status LEDs			
	RUN	**ERR**	**I/O**	**IN • or OUT •**
Operating normally	●	○	○	●
Module is running with channels in stopped state	●	○	○	○
Module is inoperative or switched off	○	○	○	○
Module not configured or channel configuration in progress	⊗	○	○	○
Internal error in module is detected	○	●	○	○
Module not calibrated to factory settings (1)	●	○	●	○
Module is experiencing difficulties communicating with the CPU (1)	●	⊗	○	●
Module not configured	○	⊗	○	○
External error is detected:				
• Range under/overflow error is detected.	●	○	●	⊛(2)
• Sensor or actuator link error is detected.	●	○	●	⊗(2)
Legend:				
○LED off				
⊗LED flashing				
⊛LED flashing rapidly				
●LED on				
(1) only on the BMX AMO 0210 module				
(2) one or more LEDs				

BMX AMI 0410 Analog Input Module

What's in This Chapter

Subject of this Chapter

This chapter presents the BMX AMI 0410 module, its characteristics, and explains how it is connected to the various sensors.

Presentation

Function

The BMX AMI 0410 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.

The BMX AMI 0410 module offers the following range for each input, according to the selection made during configuration:

- Voltage +/-10 V/0..5 V/0..10 V/1..5 V/+/- 5 V
- Current 0..20 mA/4..20 mA/+/- 20 mA

The module operates with voltage inputs. It includes four read resistors connected to the terminal block to perform current inputs.

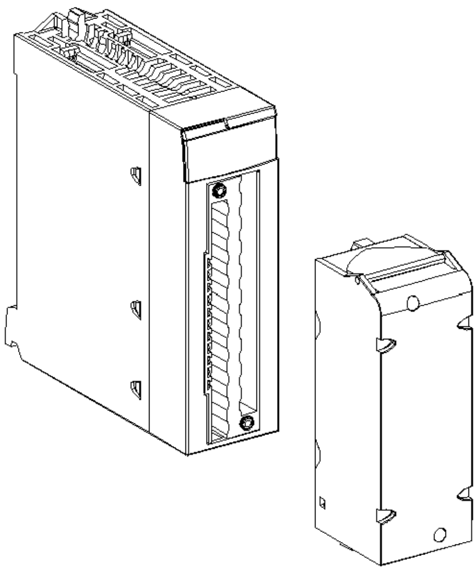
Ruggedized Version

The BMX AMI 0410H (hardened) equipment is the ruggedized version of the BMX AMI 0410 (standard) equipment. It can be used at extended temperatures and in harsh chemical environments.

For more information, refer to chapter *Installation in More Severe Environments* (see Modicon M580, M340, and X80 I/O Platforms, Standards and Certifications).

Illustration

BMX AMI 0410 analog input module looks like this.



NOTE: The terminal block is supplied separately.

Characteristics

Altitude Operating Conditions

The characteristics in the tables below apply to the modules BMX AMI 0410 and BMX AMI 0410H for use at altitude up to 2000 m (6560 ft). When the modules operate above 2000 m (6560 ft), apply additional derating.

For detailed information, refer to chapter *Operating and Storage Conditions* (see Modicon M580, M340, and X80 I/O Platforms, Standards and Certifications).

General Characteristics

The general characteristics for the BMX AMI 0410 and BMX AMI 0410H modules are as follows:

Operating temperature	BMX AMI 0410	0...60 ºC (32...140 ºF)
	BMX AMI 0410H	-25...70 ºC (-13...158 ºF)
Type of inputs		Isolated high level inputs
Nature of inputs		Voltage / Current
Number of channels		4
Acquisition cycle time:		
• Fast (periodic acquisition for the declared channels used)		1 ms + 1 ms x number of channels used
• Default (periodic acquisition for all channels)		5 ms
Display resolution		16-bit
Digital filtering		First order
Isolation: • Between channels • Between channels and bus • Between channels and ground		 +/-300 VDC 1400 VDC 1400 VDC
Maximum overload authorized for inputs:		Voltage inputs: +/- 30 VDC Current inputs: +/- 90 mA Protected for accidental: -19.2 - 30 VDC wiring
Power consumption (3.3 V)	**Typical**	0.32 W
	Maximum	0.48 W
Power consumption (24 V)	**Typical**	0.82 W
	Maximum	1.30 W

Measurement Range

The BMX AMI 0410 and BMX AMI 0410H analog inputs have the following measurement range characteristics:

Measurement range	**+/-10 V; +/-5 V** **0...10 V; 0...5 V; 1...5 V**	**+/- 20 mA** **0...20 mA; 4...20 mA**
Maximum conversion value	+/-11.4 V	+/-30 mA
Conversion resolution	0.35 mV	0.92 µA
Input impedance	10 MΩ	Internal conversion resistor (250 Ω) + Internal protection resistor (see note)
Precision of the internal conversion resistor	-	0.1% - 15 ppm/°C
Detected measurement errors for standard module BMX AMI 0410:		
• At 25 °C • Maximum in the temperature range 0...60 °C (32...140 °F)	0.075% of FS(1) 0.1% of FS(1)	0.15% of FS(1)(2) 0.3% of FS(1)(2)
Detected measurement errors for Hardened module BMX AMI 0410H:		
• At 25 °C • Maximum in the temperature range -25...70 °C (-13...158 °F)	0.075% of FS(1) 0.2% of FS(1)	0.15% of FS(1)(2) 0.55% of FS(1)(2)
Temperature drift	15 ppm/°C	30 ppm/°C
Monotonicity	Yes	Yes
Common mode rejection (50/60 Hz)	90 dB	90 dB
Crosstalk between channels DC and AC 50/60Hz	> 80 dB	> 80 dB
Non-linearity	0.001% of FS(1)	0.001% of FS(1)
Repeatability @25 °C of 10 min. stabilization time	0.005% of FS(1)	0.007% of FS(1)
Long term stability after 1000 hours	< 0.004% of FS(1)	< 0.004% of FS(1)
(1) FS: Full Scale **(2)** Detected conversion resistor error		

NOTE: The internal protection resistor has a typical impedance of 25 Ω (min 3.6 Ω and max 50 Ω). The precision of the protection resistor does not impact the measured value.

NOTE: If nothing is connected on a BMX AMI 0410 and BMX AMI 0410H analog modules and if channels are configured (range 4...20 mA or 1...5 V), a broken wire causes a detected I/O error.

Functional Description

Function

The BMX AMI 0410 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.

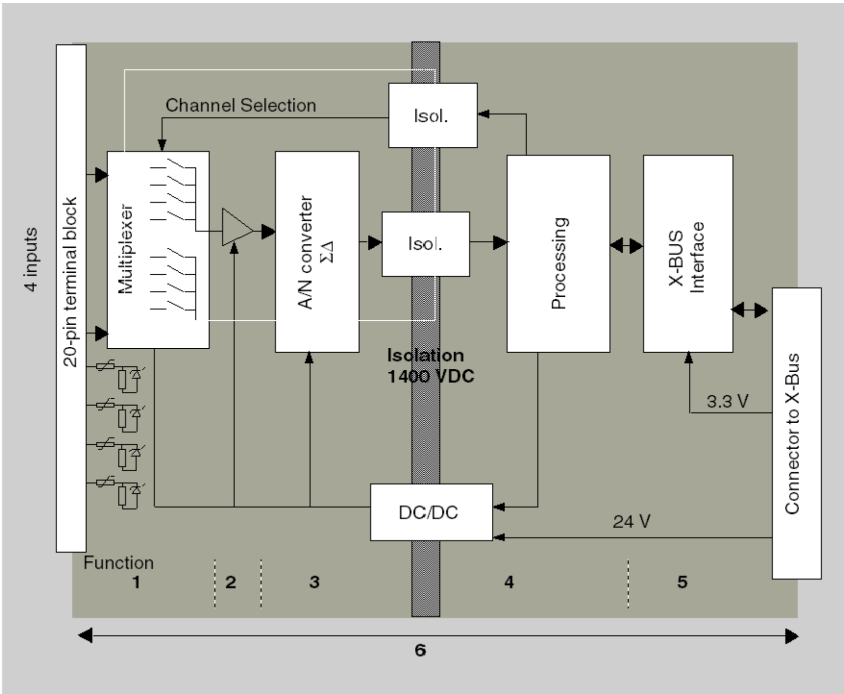
The BMX AMI 0410 module offers the following range for each input, according to the selection made during configuration:

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

The module operates with voltage inputs. It includes four read resistors connected to the terminal block to perform current inputs.

Illustration

The BMX AMI 0410 module's illustration is as follows.



Description.

No.	Process	Function
1	**Adapting the Inputs and Multiplexing**	• Physical connection to the process through a 20-pin screw terminal block. • Protection of the module against overvoltages. • Protection of the current reading resistors using limiters and resettable fuses. • Input signal analog filtering. • Scan input channels using static multiplexing through opto-switches, in order to provide the possibility of common mode voltage of +/- 300 VDC.
2	**Amplifying Input Signals**	• Gain selecting, based on characteristics of input signals, as defined during configuration (unipolar or bipolar range, in voltage or current). • Compensation of drift in amplifier device.
3	**Converting**	• Conversion of analog Input signal into digital 24-bit signal using a ΣΔ converter.

No.	Process	Function
4	**Transforming incoming values into workable measurements for the user.**	• Takes into account recalibration 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	**Communicating with the Application**	• Manages exchanges with CPU. • topological addressing. • Receives configuration parameters from module and channels. • Sends measured values, as well as module status, to application.
6	**Module monitoring and sending detected error notification back to application.**	Conversion string test. Testing for range overflow on channels. Watchdog test.

Measurement Timing

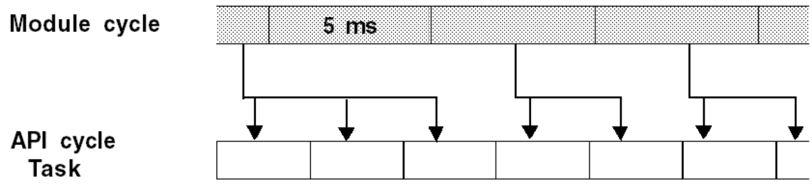
The timing of measurements is determined by the cycle selected during configuration: Normal or Fast Cycle.

- 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.

The cycle time values are based on the cycle selected.

Module	Normal Cycle	Fast Cycle
BMX AMI 0410	5 ms	1 ms + (1 ms x N) 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 bus cycle time is less than the module's cycle time, some values will not have changed.

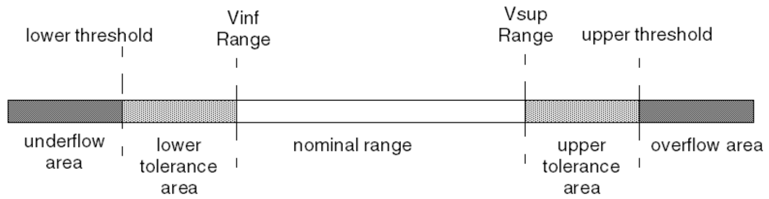


Overflow/Underflow Control

Module BMX AMI 0410 allows the user to select between 6 voltage or current ranges for each input.

This option for each channel have to be configured in configuration windows. Upper and lower tolerance detection are always active regardless of overflow/underflow control.

Depending on the range selected, the module checks for overflow: it verifies that the measurement falls between a lower and an upper threshold.



Description:

Designation	Description
Nominal range	measurement range corresponding to 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

Designation	Description
Overflow Area	area located beyond the upper threshold
Underflow Area	area located below the lower threshold

The values of the thresholds are configurable independently from one another. They may assume integer values between the following limits.

Range	BMX AMI 0410 Range									
	Underflow Area		Lower Tolerance Area		Nominal Range		Upper Tolerance Area		Overflow Area	
Unipolar										
0...10 V	-1,400	-1,001	-1,000	-1	0	10,000	10,001	11,000	11,001	11,400
0...5 V / 0...20 mA	-5,000	-1,001	-1,000	-1	0	10,000	10,001	11,000	11,001	15,000
1...5 V / 4...20 mA	-4,000	-801	-800	-1	0	10,000	10,001	10,800	10,801	14,000
Bipolar										
+/- 10 V	-11,400	-11,001	-11,000	-10,001	-10,000	10,000	10,001	11,000	11,001	11,400
+/- 5 V, +/- 20 mA	-15,000	-11,001	-11,000	-10,001	-10,000	10,000	10,001	11,000	11,001	15,000
User										
+/- 10 V	-32,768				User-defined	User-defined				32,767
0...10 V	-32,768				User-defined	User-defined				32,767

Measurement Display

Measurements may be displayed using standardized display (in %, to two decimal places).

Type of Range	Display
Unipolar range 0...10 V, 0...5 V, 1...5 V, 0...20mA, 4...20mA	from 0 to 10,000 (0 % at +100.00 %)
Bipolar range +/- 10 V, +/- 5 mV +/- 20 mA	from -10,000 to 10,000 (-100.00 % at +100.00 %)

It is also possible to define the range of values within which measurements are expressed, by selecting:

- the lower threshold corresponding to the minimum value for the range: 0 % (or -100.00 %).
- the upper threshold corresponding to the maximum value for the range (+100.00 %).

Confirm that the lower and upper thresholds are integers between -32,768 and +32,767.

For example, imagine a conditioner providing pressure data on a 4-20 mA loop, with 4 mA corresponding to 3,200 millibar and 20 mA corresponding to 9,600 millibar. You have the option of choosing the User format, by setting the following lower and upper thresholds:

3,200 for 3,200 millibar as the lower threshold

9,600 for 9,600 millibar as the upper threshold

Values transmitted to the program vary between 3,200 (= 4 mA) and 9,600 (= 20 mA).

Measurement Filtering

The type of filtering performed by the system is called "first order filtering". The filtering coefficient can be modified from a programming console or via the program.

The mathematical formula used is as follows:

$Meas_{f(n)} = \alpha \times Meas_{f(n-1)} + (1-\alpha) \times Val_{b(n)}$

where:

α = efficiency of the filter

$Meas_{f(n)}$ = measurement filtered at moment n

$Meas_{f(n-1)}$ = measurement filtered at moment n-1

$Val_{b(n)}$ = gross value at moment n

You may configure the filtering value from 7 possibilities (from 0 to 6). This value may be changed even when the application is in RUN mode.

NOTE: Filtering may be accessed in Normal or Fast Cycle.

The filtering values depend on the T configuration cycle (where T = cycle time of 5 ms in standard mode):

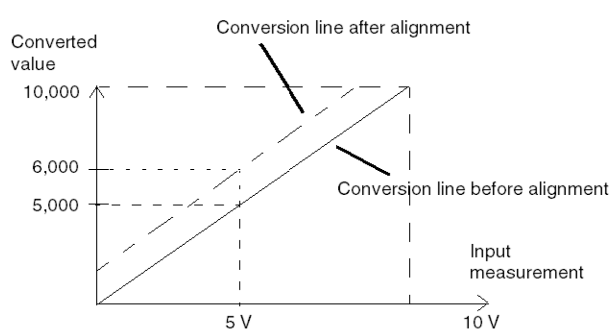
Desired Efficiency	Required Value	Corresponding α	Filter Response Time at 63%	Cut-off Frequency (in Hz)
No filtering	0	0	0	0
Low filtering	1	0.750	4 x T	0.040 / T

Desired Efficiency	Required Value	Corresponding α	Filter Response Time at 63%	Cut-off Frequency (in Hz)
	2	0.875	8 x T	0.020 / T
Medium filtering	3	0.937	16 x T	0.010 / T
	4	0.969	32 x T	0.005 / T
High filtering	5	0.984	64 x T	0.0025 / T
	6	0.992	128 x T	0.0012 / T

Sensor Alignment

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

Conversion lines are as follows:



The alignment value is editable from a programming console, even if the program is in RUN Mode. For each input channel, you can:

- 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.

The maximum offset between measured value and desired (aligned) value may not exceed +/-1,500.

NOTE: To align several analog channels on the BMX ART/AMO/AMI/AMM modules, we recommend proceeding channel by channel. Test each channel after alignment before moving to the next channel in order to apply the parameters correctly.

Wiring Precautions

Introduction

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

Cable Shielding

Connect the cable shielding to the grounding bar. Clamp the shielding to the grounding bar on the module side. Use the shielding connection kit BMXXSP••••, page 50 to connect the shielding.

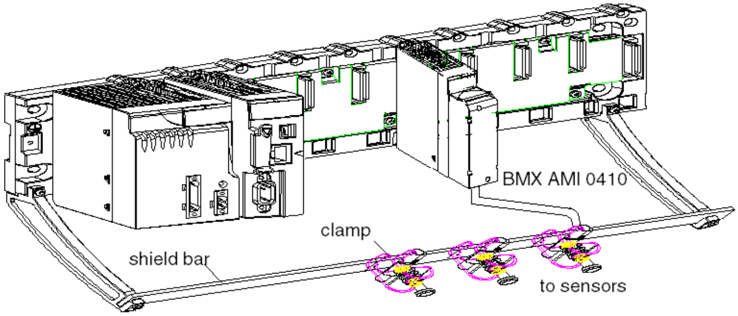
DANGER

HAZARD OF ELECTRIC SHOCK, EXPLOSION, OR ARC FLASH

While mounting / removing the modules:

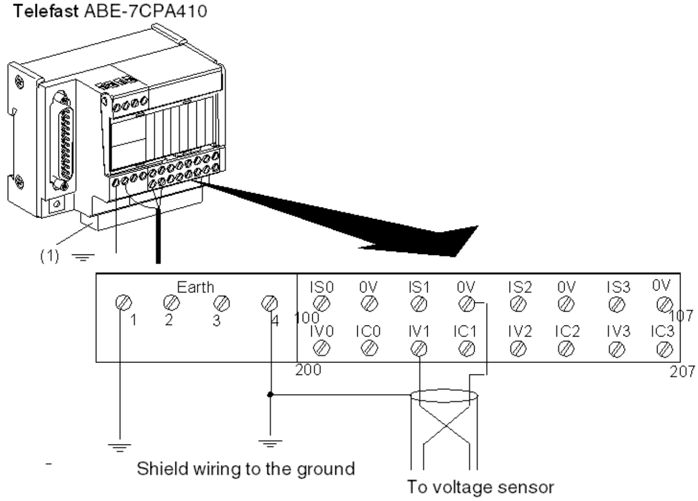
- Make sure that each terminal block is still connected to the shield bar.
- Disconnect voltage supplying sensors and pre-actuators.

Failure to follow these instructions will result in death or serious injury.



- TELEFAST connection:

  Connect the sensor cable shielding to the terminals provided and the whole assembly to the cabinet ground.



(1) The grounding of cables is facilited using the ABE-7BV10 accessory.

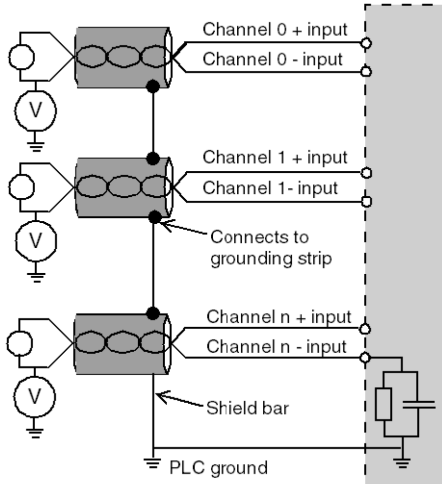
Reference of Sensors in Relation to the Ground

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

- Confirm that sensors are close together (a few meters).
- Confirm that all sensors are referenced to a single point, which is connected to the PLC's ground.

Using the Sensors Referenced in Relation to the Ground

The sensors are connected as indicated in 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 block. Follow these rules:

- Confirm that the potential is less than the permitted low voltage: for example, 30 Vrms or 42.4 VDC.
- Setting a sensor point to a reference potential generates a leakage current. Check that all leakage currents generated do not disturb the system.

NOTE: Sensors and other peripherals may be connected to a grounding point some distance from the module. Such remote ground references may carry considerable potential differences with respect to local ground.

DANGER

HAZARD OF ELECTRIC SHOCK, EXPLOSION, OR ARC FLASH

Ensure that:

- sensors and other peripherals are not exposed through grounding points to voltage potential greater than acceptable limits.
- potentials greater than permitted low limits do not exist.
- induced currents do not affect the measurement or integrity of the system.

Failure to follow these instructions will result in death or serious injury.

Electromagnetic Hazard Instructions

Electromagnetic perturbations may lead to an unexpected behavior of the application.

⚠ CAUTION
UNEXPECTED APPLICATION BEHAVIOR To reduce electromagnetic perturbations, use the shielding connection kit BMXXSP••••, page 50 to connect the shielding. **Failure to follow these instructions can result in injury or equipment damage.**

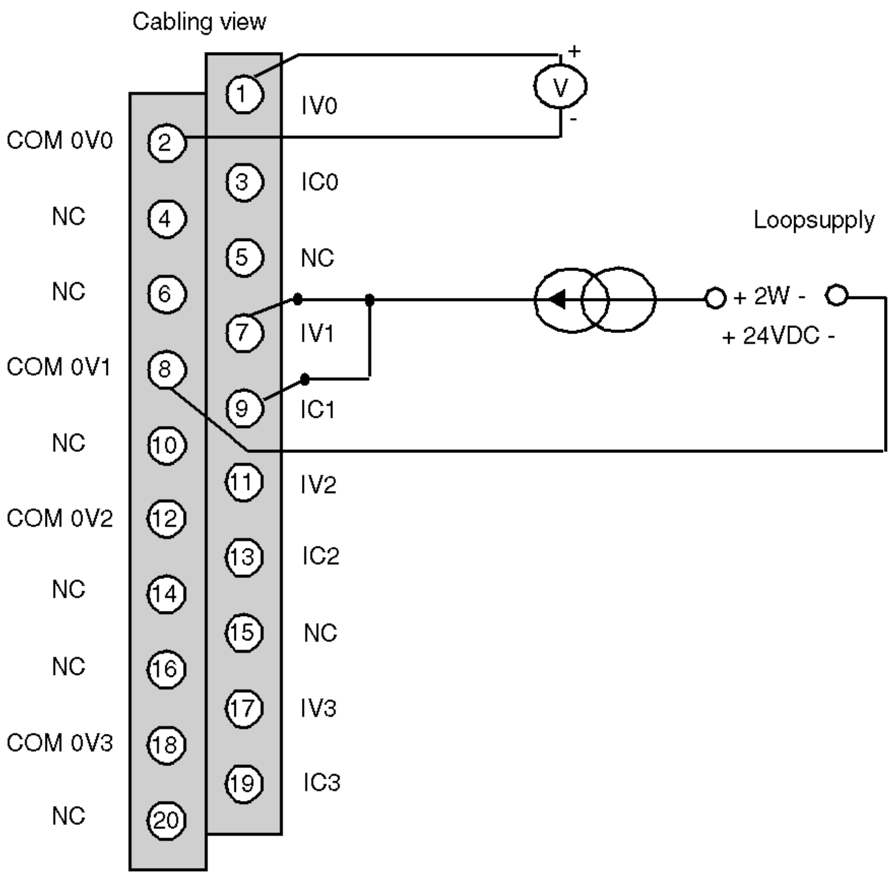
Wiring Diagram

Introduction

Module BMX AMI 0410 is connected using the 20-point terminal block.

Illustration

The terminal block connection and the sensor wiring are as follows.



IVx + pole input for channel x

COM 0Vx - pole input for channel x

ICx current reading resistor + input

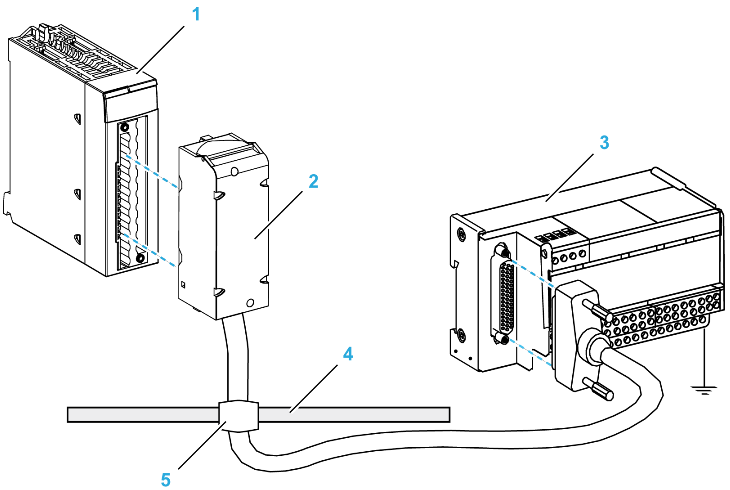
Channel 0 voltage sensor

Channel 1 2-wire current sensor

Use of the TELEFAST Wiring Accessories

At a Glance

The TELEFAST pre-wired system consists of connecting cables and interface sub-bases as shown below:



1 BMX AMI 0410 module

2 BMX FCA ••0 connecting cable

3 ABE-7CPA410 interface sub-base

4 Shield bar

5 Clamp

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

- Extend the input terminals in voltage mode.
- Supply, channel by channel, the 0-20 mA or 4-20 mA sensors with a protected 24 V voltage, limited in current to 25 mA, while maintaining isolation between the channels.
- Help protect current reading resistors that are integrated in TELEFAST against overvoltage.

Channels to channels isolation	750 Vdc
Channels to 24Vdc supply isolation	750 Vdc
Overvoltage protection on current inputs	By Zener diodes 8,2V

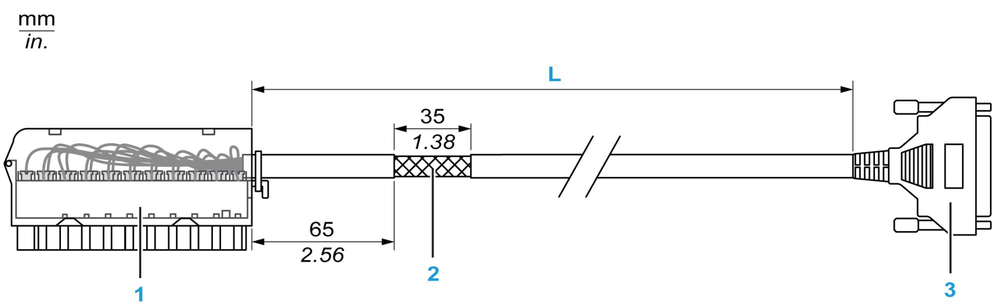
NOTE: When using current inputs, the TELEFAST 250 Ohm resistors are used, as opposed to those of the module. The BMX AMI 0410 module operates in voltage mode.

BMX FCA ••0 Connecting Cables

The BMX FCA ••0 cables are pre-assembled cord set, made up of:

- At one end, a compound-filled 20-pin terminal block from which extend 1 cable sheath containing 20 wires,
- At the other end a 25-pin Sub-D connector.

The figure below shows the BMX FCA ••0 cables:



1 BMX FTB 2020 Terminal block

2 Cable shielding

3 25-pin Sub-D connector

L Length according to the part number.

The cable comes in 3 different lengths:

- 1.5 m (4.92 ft): BMX FCA 150
- 3 m (9.84 ft): BMX FCA 300
- 5 m (16.40 ft): BMX FCA 500

The following table gives the characteristics of the BMX FCA ••0 cables:

Characteristic		Value
Cable	Sheath material	PVC
	LSZH status	No
Environmental	Operating temperature	-25...70 °C (-13...158 °F)

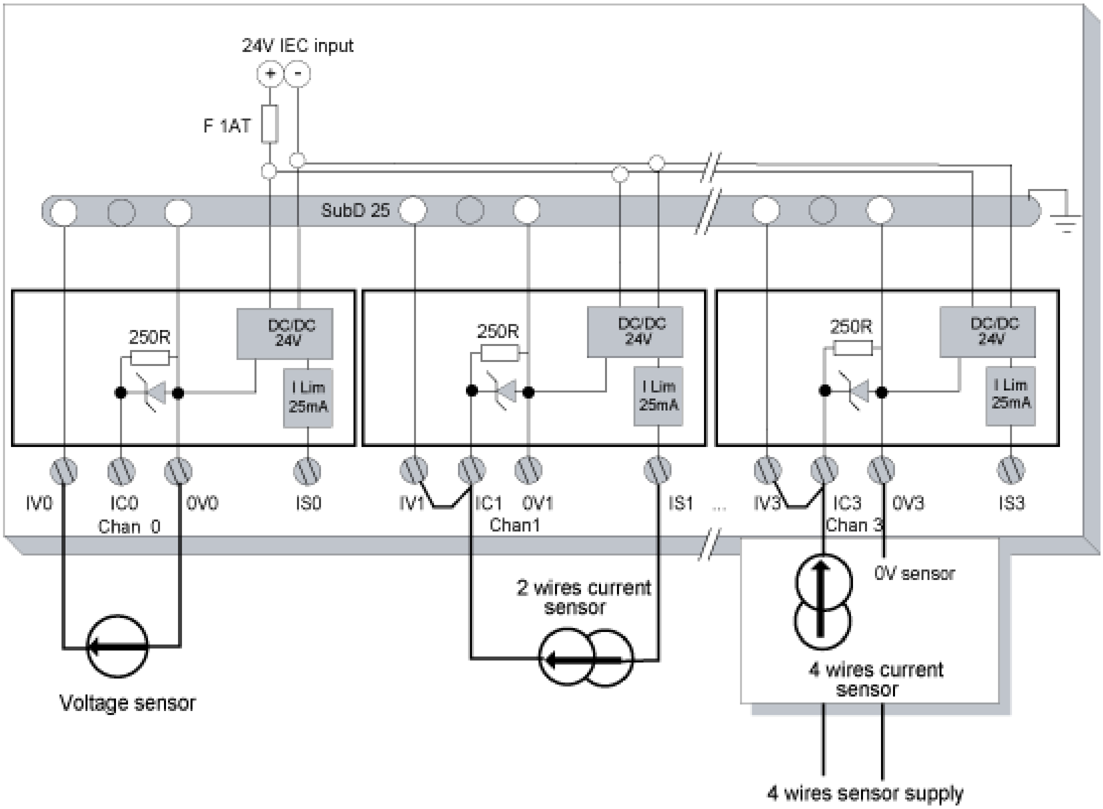
Connecting Sensors

Sensors may be connected to the ABE-7CPA410 accessory as shown in the illustration., page 72

The following table shows the ABE7-CPA410 and SUBD25 terminal numbers:

TELEFAST terminal block number	25-pin Sub-D connector pin number	Signal type	TELEFAST terminal block number	25-pin Sub-D connector pin number	Signal type
1	/	Earth	/		24 VDC Input
2	/	Earth	/		24 VDC Input
3	/	Earth	/		0V24 Input
4	/	COM 0	/		0V24 Input
100		Output IS 0	101	14	COM 0V0
102		Output IS 1	103	3	COM 0V1
104		Output IS 2	105	17	COM 0V2
106		Output IS 3	107	6	COM 0V3
200	1	Output IV 0	201		Input IC 0
202	15	Output IV 1	203		Input IC 1
204	4	Output IV 2	205		Input IC 2
206	18	Output IV 3	207		Input IC 3

Wiring diagram:



BMX AMI 0800 Analog Input Module

What's in This Chapter

Subject of this Chapter

This chapter presents the BMX AMI 0800 module, its characteristics, and explains how it is connected to the various sensors.

Presentation

Function

The BMX AMI 0800 is a high density input analog module with 8 non-isolated channels.

This module is used in conjunction with sensors or transmitters; it performs monitoring, measurement, and continuous process control functions.

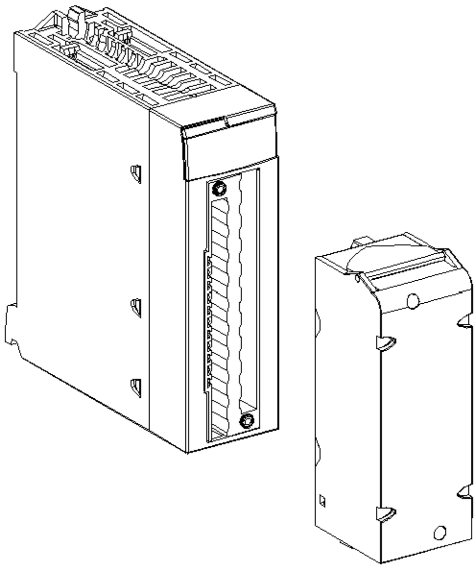
The BMX AMI 0800 module offers the following range for each input according to the selection made during configuration:

- Voltage +/-5 V/+/-10 V/0..5 V/0..10 V/1..5 V
- Current +/-20 mA/0..20 mA/4..20 mA

The module operates with voltage inputs. It includes eight read resistors connected to the terminal block to perform current inputs.

Illustration

The following graphic shows the BMX AMI 0800 analog input module:



NOTE: The terminal block is supplied separately.

Characteristics

Altitude Operating Conditions

The characteristics in the tables below apply to the BMX AMI 0800 module for use at altitude up to 2000 m (6560 ft). When the module operates above 2000 m (6560 ft), apply additional derating.

For detailed information, refer to chapter *Operating and Storage Conditions* (see Modicon M580, M340, and X80 I/O Platforms, Standards and Certifications).

General Characteristics

This table shows the general characteristics for the BMX AMI 0800 module:

Operating temperature		0...60 ºC (32...140 ºF)
Type of inputs		High level Fast inputs with common point
Nature of inputs		Voltage / Current
Number of channels		8
Acquisition cycle time: • Fast (periodic acquisition for the declared channels used) • Default (periodic acquisition for all channels)		 1 ms + 1 ms x number of channels used 9 ms
Display resolution		16-bit
Digital filtering		First order
Isolation: • Between channels • Between channels and bus • Between channels and ground		 Non-isolated 1400 VDC 1400 VDC
Maximum overload authorized for inputs:		Voltage inputs: +/- 30 VDC Current inputs: +/- 30 mA
Power consumption (3.3 V)	**Typical**	0.32 W
	Maximum	0.48 W
Power consumption (24 V)	**Typical**	0.90 W
	Maximum	1.10 W

Measurement Range

The BMX AMI 0800 analog inputs have the following measurement range characteristics:

Measurement range	**+/- 10 V; +/- 5 V** **0...10 V; 0...5 V; 1...5 V**	**+/- 20 mA** **0...20 mA; 4...20 mA**
Maximum conversion value	+/-11.4 V	+/-30 mA
Conversion resolution	0.36 mV	1.4 µA
Input impedance	10 MΩ	250 Ω Internal conversion resistor

Measurement range	**+/- 10 V; +/- 5 V** **0...10 V; 0...5 V; 1...5 V**	**+/- 20 mA** **0...20 mA; 4...20 mA**
Precision of the internal conversion resistor	-	0.1% - 15 ppm/°C
Detected measurement errors: • At 25°C • Maximum in the temperature range 0...60°C (32...140°F)	0.075% of FS(1) 0.1% of FS(1)	Typical 0.15% of FS(1)(2) 0.3% of FS(1)(2)
Temperature drift	30 ppm/°C	50 ppm/°C including conversion resistance
Monotonicity	Yes	Yes
Common mode rejection (50/60 Hz)	100 dB	100 dB
Crosstalk between channels DC and AC 50/60Hz	> 80 dB	> 80 dB
Non-linearity	0.001%	0.001%
Repeatability @25 °C of 10 min. stabilization time	0.005% of FS(1)	0.007% of FS(1)
Long term stability after 1000 hours	< 0.004% of FS(1)	< 0.004% of FS(1)
(1) FS: Full Scale **(2)** Detected conversion resistor error		

NOTE: If nothing is connected on a BMX AMI 0800 analog module and if channels are configured (range of 4...20 mA or 1...5 V), there is a detected I/O error as if a wire is broken.

Functional Description

Function

The BMX AMI 0800 module is a high density input analog module with 8 non-input channel.

This module is used in conjunction with sensors or transmitters; it performs monitoring, measurement, and continuous process control functions.

The BMX AMI 0800 module offers the following range for each input according to the selection made during configuration:

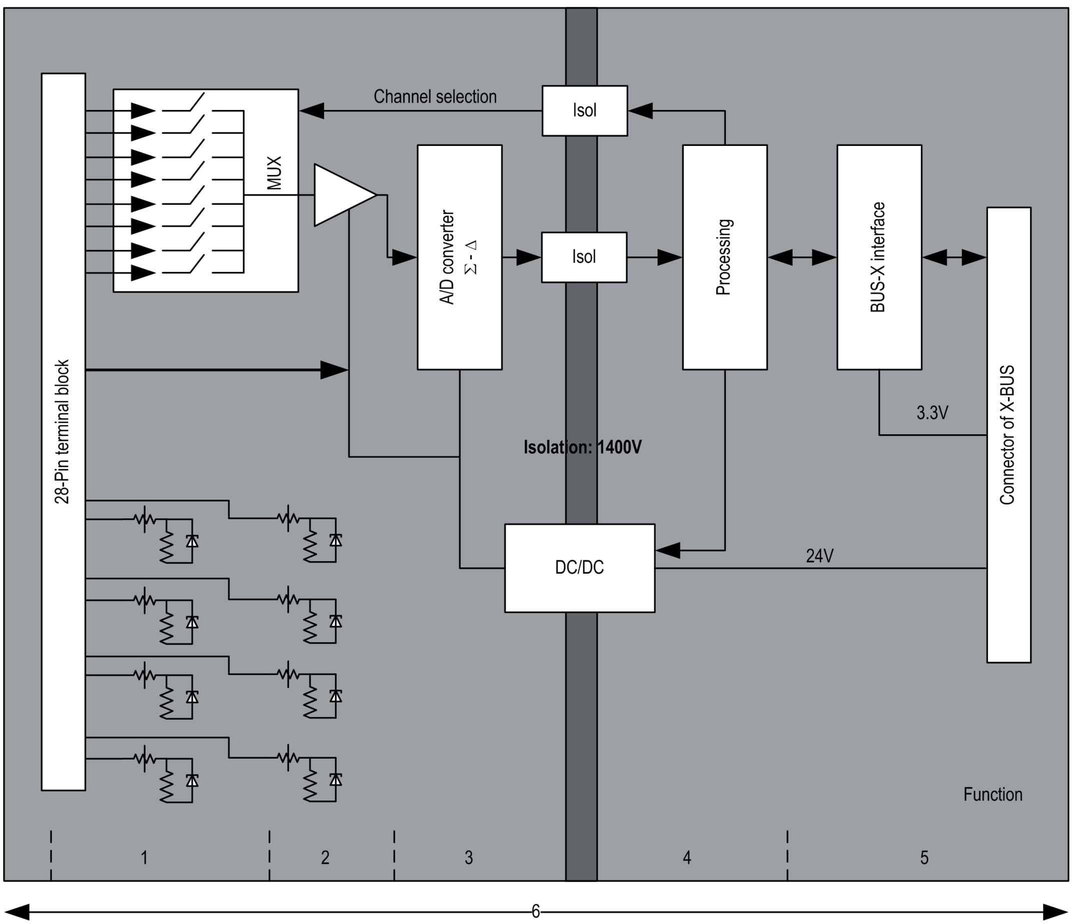
- +/-10 V
- 0..10 V

- 0..5 V / 0..20 mA
- 1..5 V / 4..20 mA
- +/-5 V / +/-20 mA

The module operates with voltage inputs. It includes eight read resistors connected to the terminal block to perform current inputs.

Illustration

The BMX AMI 0800 module's illustration:



Description:

No.	Process	Function
1	**Adapting the Inputs and Multiplexing**	• Physical connection to the process through a 28-pin screw terminal block • Protection of the module against overvoltages • Input signal analog filtering
2	**Amplifying Input Signals**	• Gain selecting, based on characteristics of input signals, as defined during configuration (unipolar or bipolar range, in voltage or current) • Compensation of drift in amplifier device
3	**Converting**	• Conversion of analog Input signal into digital 24-bit signal using a ΣΔ converter
4	**Transforming incoming values into workable measurements for the user.**	• Takes into account recalibration and alignment coefficients to be applied to measurements, as well as the module's self-calibration coefficients • (Numeric) filtering for measurements, based on configuration parameters • Scaling of measurements, based on configuration parameters
5	**Communicating with the Application**	• Manages exchanges with CPU • Topological addressing • Receives configuration parameters from module and channels • Sends measured values, as well as module status, to application
6	**Module monitoring and sending detected error notification back to application.**	Conversion string test Testing for range overflow on channels Watchdog test

Measurement Timing

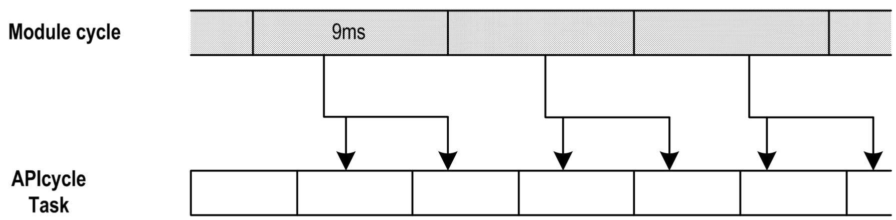
The timing of measurements is determined by the cycle selected during configuration (Normal or Fast Cycle):

- 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.

The cycle time values are based on the cycle selected:

Module	Normal Cycle	Fast Cycle
BMX AMI 0800	9 ms	1 ms + (1 ms x N) 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 bus cycle time is less than the module's cycle time, some values will not have changed.

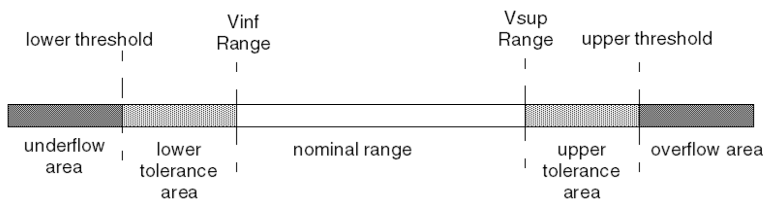


Overflow/Underflow Control

Module BMX AMI 0800 allows the user to select between 6 voltage or current ranges for each input.

This option for each channel have to be configured in configuration windows. Upper and lower tolerance detection are always active regardless of overflow/underflow control.

Depending on the range selected the module checks for overflow, it verifies that the measurement falls between a lower and an upper threshold:



Description:

Designation	Description
Nominal range	measurement range corresponding to 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

Designation	Description
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

The values of the thresholds are configurable independently from one another. They may assume integer values between the following limits:

Range	BMX AMI 0800 Range									
	Underflow Area		Lower Tolerance Area		Nominal Range		Upper Tolerance Area		Overflow Area	
Unipolar										
0...10 V	-1,400	-1,001	-1,000	-1	0	10,000	10,001	11,000	11,001	11,400
0...5 V / 0...20 mA	-5,000	-1,001	-1,000	-1	0	10,000	10,001	11,000	11,001	15,000
1...5 V / 4...20 mA	-4,000	-801	-800	-1	0	10,000	10,001	10,800	10,801	14,000
Bipolar										
+/- 10 V	-11,400	-11,001	-11,000	-10,001	-10,000	10,000	10,001	11,000	11,001	11,400
+/- 5 V, +/- 20 mA	-15,000	-11,001	-11,000	-10,001	-10,000	10,000	10,001	11,000	11,001	15,000
User										
+/- 10 V	-32,768				User-defined	User-defined				32,767
0...10 V	-32,768				User-defined	User-defined				32,767

Measurement Display

Measurements may be displayed using standardized display (in %, to two decimal places):

Type of Range	Display
Unipolar range 0...10 V, 0...5 V, 1...5 V, 0...20mA, 4...20mA	from 0 to 10,000 (0 % at +100.00 %)
Bipolar range +/- 10 V, +/- 5 mV +/- 20 mA	from -10,000 to 10,000 (-100.00 % at +100.00 %)

It is also possible to define the range of values within which measurements are expressed, by selecting:

- the lower threshold corresponding to the minimum value for the range: 0% (or -100.00 %).
- the upper threshold corresponding to the maximum value for the range (+100.00%).

Confirm that the lower and upper thresholds are integers between -32,768 and +32,767.

For example, imagine a conditioner providing pressure data on a 4-20 mA loop, with 4 mA corresponding to 3,200 millibar and 20 mA corresponding to 9,600 millibar. You have the option of choosing the User format, by setting the following lower and upper thresholds:

3,200 for 3,200 millibar as the lower threshold

9,600 for 9,600 millibar as the upper threshold

Values transmitted to the program vary between 3,200 (= 4 mA) and 9,600 (= 20 mA).

Measurement Filtering

The type of filtering performed by the system is called "first order filtering". The filtering coefficient can be modified from a programming console or via the program.

The mathematical formula used is as follows:

$Meas_{f(n)} = \alpha \times Meas_{f(n-1)} + (1-\alpha) \times Val_{b(n)}$

where:

α = efficiency of the filter

$Meas_{f(n)}$ = measurement filtered at moment n

$Meas_{f(n-1)}$ = measurement filtered at moment n-1

$Val_{b(n)}$ = gross value at moment n

You may configure the filtering value from 7 possibilities (from 0 to 6). This value may be changed even when the application is in RUN mode.

NOTE: Filtering may be accessed in Normal or Fast Cycle.

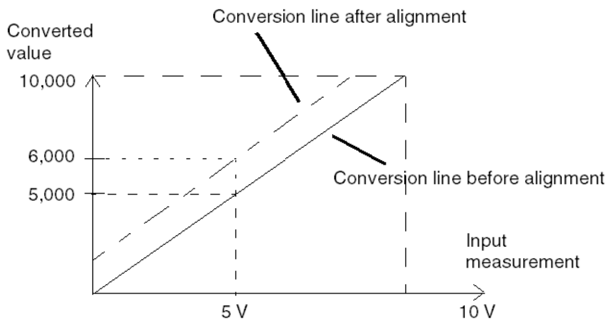
The filtering values depend on the T configuration cycle (where T = cycle time of 5 ms in standard mode):

Desired Efficiency	Required Value	Corresponding α	Filter Response Time at 63%	Cut-off Frequency (in Hz)
No filtering	0	0	0	0
Low filtering	1	0.750	4 x T	0.040 / T
	2	0.875	8 x T	0.020 / T
Medium filtering	3	0.937	16 x T	0.010 / T
	4	0.969	32 x T	0.005 / T
High filtering	5	0.984	64 x T	0.0025 / T
	6	0.992	128 x T	0.0012 / T

Sensor Alignment

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

Conversion lines are as follows:



The alignment value is editable from a programming console, even if the program is in RUN Mode. For each input channel, you can:

- 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.

The maximum offset between measured value and desired (aligned) value may not exceed +/-1.500.

NOTE: To align several analog channels on the BMX ART/AMO/AMI/AMM modules, we recommend proceeding channel by channel. Test each channel after alignment before moving to the next channel in order to apply the parameters correctly.

Wiring Precautions

Introduction

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

Cable Shielding

Connect the cable shielding to the grounding bar. Clamp the shielding to the grounding bar on the module side. Use the shielding connection kit BMXXSP••••, page 50 to connect the shielding.

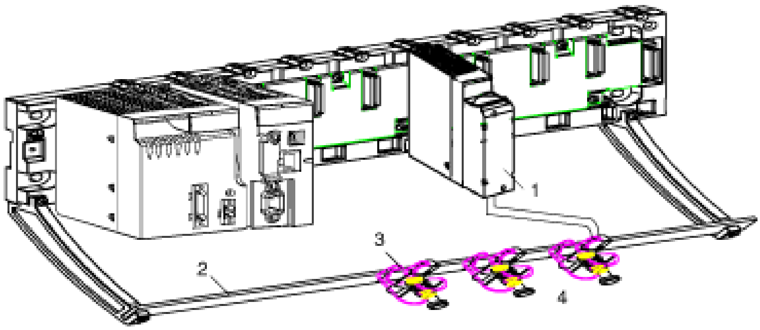
DANGER

HAZARD OF ELECTRIC SHOCK, EXPLOSION, OR ARC FLASH

While installing / removing the modules:

- Make sure that each terminal block is still connected to the shield bar.
- Disconnect voltage supplying sensors and pre-actuators.

Failure to follow these instructions will result in death or serious injury.



1 BMX AMI 0800

2 Shield bar

3 Clamp

4 To sensors

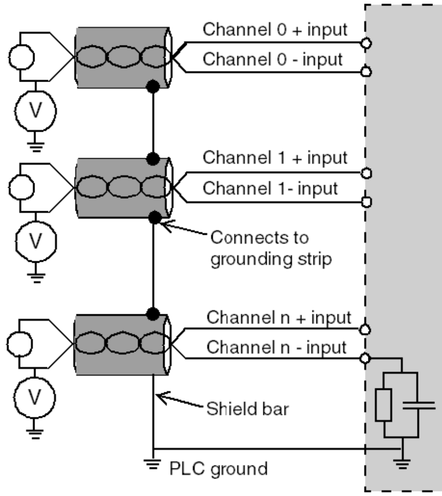
Reference of Sensors in Relation to the Ground

In order for the acquisition system to operate correctly, It is recommended to take in account the following precautions:

- Confirm that the sensors are close together (a few meters).
- Confirm that all sensors are referenced to a single point, which is connected to the PLC’s ground.

Using the Sensors Referenced in Relation to the Ground

The sensors are connected as indicated in the following diagram:



If the sensors are referenced in relation to the ground, in some cases this may return a remote ground potential to the terminal block. Follow these rules:

- Confirm that the potential is less than the permitted low voltage: for example, 30 Vrms or 42.4 VDC.
- Check that all leakage currents generated do not disturb the system. Setting a sensor point to a reference potential generates a leakage current.

NOTE: Sensors and other peripherals may be connected to a grounding point some distance from the module. Such remote ground references may carry considerable potential differences with respect to local ground.

DANGER

HAZARD OF ELECTRIC SHOCK, EXPLOSION, OR ARC FLASH

Ensure that:

- sensors and other peripherals are not exposed through grounding points to voltage potential greater than acceptable limits.
- potentials greater than permitted low limits do not exist.
- induced currents do not affect the measurement or integrity of the system.

Failure to follow these instructions will result in death or serious injury.

Electromagnetic Hazard Instructions

Electromagnetic perturbations may lead to an unexpected behavior of the application.

⚠ CAUTION

UNEXPECTED APPLICATION BEHAVIOR

To reduce electromagnetic perturbations, use the shielding connection kit BMXXSP••••, page 50 to connect the shielding.

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

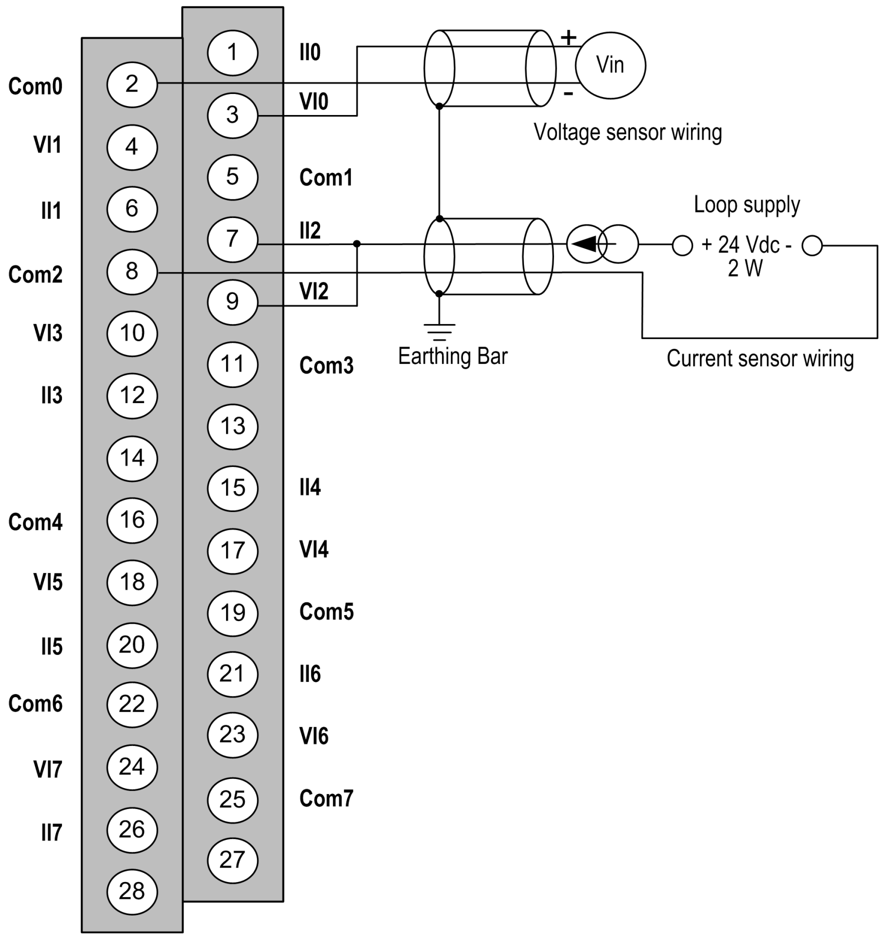
Wiring Diagram

Introduction

Module BMX AMI 0800 is connected using the 28-pin terminal block.

Illustration

The terminal block connection and the sensor wiring are as follows:



VIx + pole input for channel x.

COMx - pole input for channel x, COMx are connected together internally.

IIx current reading resistor + input.

Channel 0 voltage sensor.

Channel 1 2-wire current sensor.

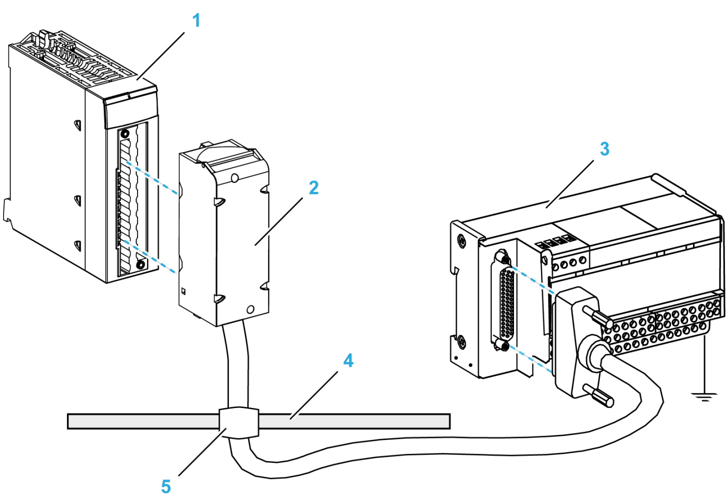
Wiring Accessories

For rapid connection to operative parts, the module can be connected to a TELEFAST pre-wired system, page 96.

Use of the TELEFAST Wiring Accessories

Introduction

The TELEFAST pre-wired system consists of connecting cables and interface sub-bases as shown below:



1 BMX AMI 0800 module

2 BMXFTA••0 connecting cables

3 Interface sub-base

4 Shield bar

5 Clamp

The BMX AMI 0800 module can be connected to the following interface sub-bases references:

- ABE-7CPA02
- ABE-7CPA03

- ABE-7CPA31
- ABE-7CPA31E

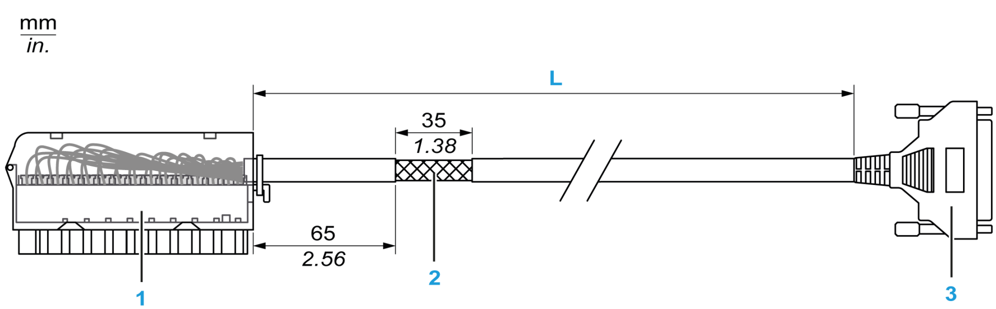
  NOTE: In case HART information is part of the signal to be measured, an ABE-7CPA31E interface sub-base has to be used in order to filter this information that would disrupt the analog value.

BMX FTA ••0 Connecting Cables

The BMX FTA ••0 cables are pre-assembled cord set, made up of:

- At one end, a compound-filled 28-pin terminal block from which extend 1 cable sheath containing 24 wires,
- At the other end a 25-pin Sub-D connector.

The figure below shows the BMX FTA ••0 cables:



1 BMX FTB 2820 Terminal block

2 Cable shielding

3 25-pin Sub-D connector

L Length according to the part number.

The cable comes in 2 different lengths:

- 1.5 m (4.92 ft): BMX FTA 150
- 3 m (9.84 ft): BMX FTA 300

The following table gives the characteristics of the BMX FTA ••0 cables:

Characteristic		Value
Cable	Sheath material	PVC
	LSZH status	No
Environmental	Operating temperature	-25...70 °C (-13...158 °F)

ABE-7CPA02 Sensor Connection

The following table shows the distribution of analog channels on TELEFAST terminal blocks with the interface sub-base ABE-7CPA02:

TELEFAST terminal block number	**25-pin Sub-D connector pin number**	**BMXA-MI0800 pin out**	**Signal type**	**TELEFAST terminal block number**	**25-pin Sub-D connector pin number**	**BMXA-MI0800 pin out**	**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	3	+IV0	200	14	2	COM0
101	2	1	+IC0	201	/		Ground
102	15	4	+IV1	202	3	5	COM1
103	16	6	+IC1	203	/		Ground
104	4	9	+IV2	204	17	8	COM2
105	5	7	+IC2	205	/		Ground
106	18	10	+IV3	206	6	11	COM3
107	19	12	+IC3	207	/		Ground
108	7	17	+IV4	208	20	16	COM4
109	8	15	+IC4	209	/		Ground
110	21	18	+IV5	210	9	19	COM5
111	22	20	+IC5	211	/		Ground
112	10	23	+IV6	212	23	22	COM6
113	11	21	+IC6	213	/		Ground
114	24	24	+IV7	214	12	25	COM7

TELEFAST terminal block number	25-pin Sub-D connector pin number	BMXA-MI0800 pin out	Signal type	TELEFAST terminal block number	25-pin Sub-D connector pin number	BMXA-MI0800 pin out	Signal type
115	25	26	+IC7	215	/		Ground

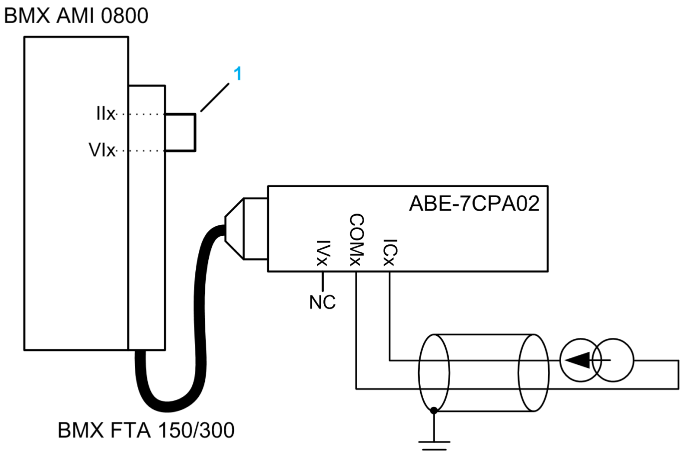
NOTE: On the ABE-7CPA02, the strap position is between pin 1 and pin 2.

+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 current sensors connected on the TELEFAST ABE-7CPA02, confirm that a strap is made on the BMX AMI 0800 terminal block between the current input and the voltage input as illustrated below.



1 Strap on the terminal block.

NOTE: For the ground connection use the additional terminal block ABE-7BV10/20.

ABE-7CPA03 Sensor Connection

The negative current is not supported by ABE-7CPA03

NOTICE

EQUIPMENT DAMAGE

Do not apply a negative current when BMX AMI 0800 is associated with ABE-7CPA03.

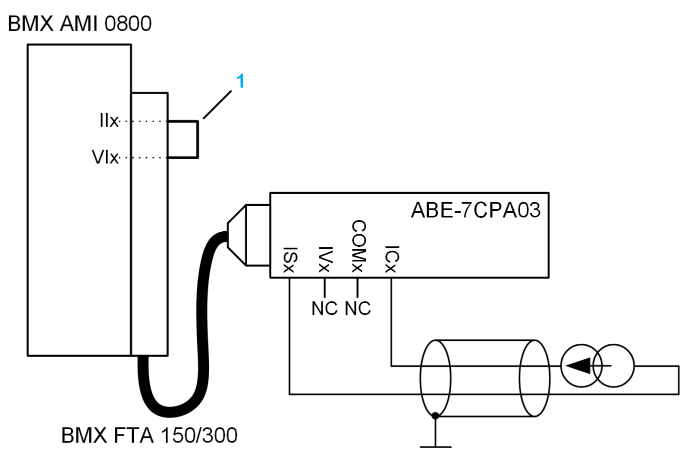
Failure to follow these instructions can result in equipment damage.

The following table shows the distribution of analog channels on TELEFAST terminal blocks with the reference ABE-7CPA03:

TELEFAST terminal block number	25-pin Sub-D connector pin number	BMXA-MI0800 pin out	Signal type	TELEFAST terminal block number	25-pin Sub-D connector pin number	BMXA-MI0800 pin out	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	4	+IV1	201	1	3	+IV0
102	16	6	+IC1	202	2	1	+IC0
103	/		Ground	203	14/3	2/5	COM0/ COM1
104	/		+IS3	204	/		+IS2
105	18	10	+IV3	205	4	9	+IV2
106	19	12	+IC3	206	5	7	+IC2
107	/		Ground	207	17/6	8/11	COM2/ COM3
108	/		+IS5	208	/		+IS4
109	21	18	+IV5	209	7	17	+IV4
110	22	20	+IC5	210	8	15	+IC4
111	/		Ground	211	20/9	16/19	COM4/ COM5

TELEFAST terminal block number	25-pin Sub-D connector pin number	BMXA-MI0800 pin out	Signal type	TELEFAST terminal block number	25-pin Sub-D connector pin number	BMXA-MI0800 pin out	Signal type
112	/		+IS7	212	/		+IS6
113	24	24	+IV7	213	10	21	+IV6
114	25	26	+IC7	214	11	23	+IC6
115	/		Ground	215	23/12	22/25	COM6/ COM7
+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 current sensors connected on the TELEFAST ABE-7CPA03, confirm that a strap is made on the BMX AMI 0800 terminal block between the current input and the voltage input as illustrated below.



1 Strap on the terminal block.

NOTE: For the ground connection use the additional terminal block ABE-7BV10/20.

ABE-7CPA31 Sensor Connection

The following table shows the distribution of analog channels on TELEFAST terminal blocks with the reference ABE-7CPA31:

TELEFAST terminal block number	**25-pin Sub-D connector pin number**	**BMXA-MI0800 pin out**	**Signal type**	**TELEFAST terminal block number**	**25-pin Sub-D connector pin number**	**BMXA-MI0800 pin out**	**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	3	+IV0	117	7	17	+IV4
102	2	1	+IC0	118	8	15	+IC4
103	14	2	0 V	119	20	16	0 V
104	/		+IS1	120	/		+IS5
105	15	4	+IV1	121	21	18	+IV5
106	16	6	+IC1	122	22	20	+IC5
107	3	5	0 V	123	9	19	0 V
108	/		+IS2	124	/		+IS6
109	4	9	+IV2	125	10	23	+IV6
110	5	7	+IC2	126	11	21	+IC6
111	17	8	0 V	127	23	22	0 V
112	/		+IS3	128	/		+IS7
113	18	10	+IV3	129	24	24	+IV7
114	19	12	+IC3	130	25	26	+IC7
115	6	11	0 V	131	12	25	0 V

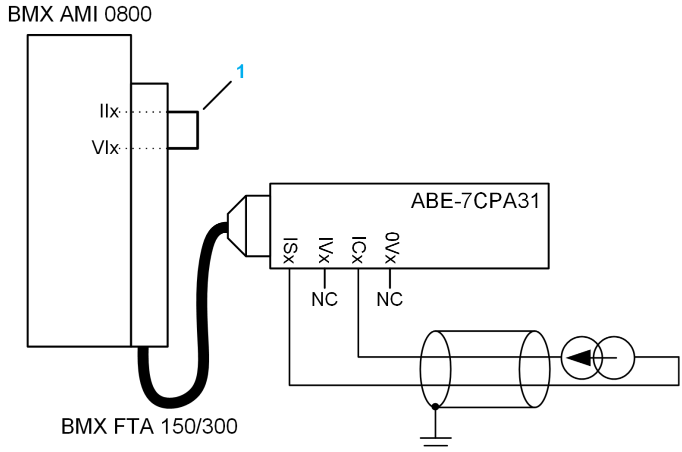
+ISx: 24 V channel power supply

+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 current sensors connected on the TELEFAST ABE-7CPA31, confirm that a strap is made on the BMX AMI 0800 terminal block between the current input and the voltage input as illustrated below.



1 Strap on the terminal block.

NOTE: For the ground connection use the additional terminal block ABE-7BV10/20.

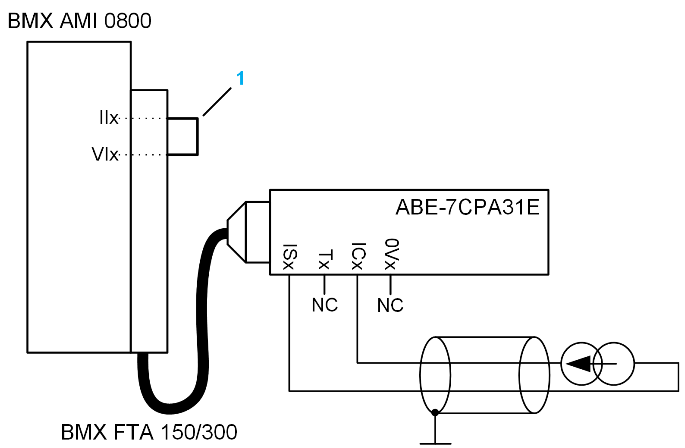
ABE-7CPA031E Sensor Connection

The following table shows the distribution of analog channels on TELEFAST terminal blocks with the reference ABE-7CPA31E:

TELEFAST terminal block number	Terminal	Signal type	TELEFAST terminal block number	Terminal	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	/	T0	117	/	T4
102	/	+IC0	118	/	+IC4

TELEFAST terminal block number	Terminal	Signal type	TELEFAST terminal block number	Terminal	Signal type
103	/	0V0	119	/	0V4
104	/	+IS1	120	/	+IS5
105	/	T1	121	/	T5
106	/	+IC1	122	/	+IC5
107	/	0V1	123	/	0V5
108	/	+IS2	124	/	+IS6
109	/	T2	125	/	T6
110	/	+IC2	126	/	+IC6
111	/	0V2	127	/	0V6
112	/	+IS3	128	/	+IS7
113	/	T3	129	/	T7
114	/	+IC3	130	/	+IC7
115	/	0V3	131	/	0V7
+ISx: 24 V channel power supply **Tx:** Reserved test pin for HART function, it's internally connected with +ICx **+ICx:** + pole current input for channel x **COMx:** - pole voltage or current input for channel x					

NOTE: For current sensors connected on the TELEFAST ABE-7CPA31E, confirm that a strap is made on the BMX AMI 0800 terminal block between the current input and the voltage input as illustrated below.



1 Strap on the terminal block.

NOTE: For the ground connection use the additional terminal block ABE-7BV10/20.

BMX AMI 0810 Analog Input Module

What's in This Chapter

Subject of this Chapter

This chapter presents the BMX AMI 0810 module, its characteristics, and explains how it is connected to the various sensors.

Presentation

Function

The BMX AMI 0810 is a high density input analog module with 8 isolated channels.

This module is used in conjunction with sensors or transmitters; it performs monitoring, measurement, and continuous process control functions.

The BMX AMI 0810 module offers the following range for each input according to the selection made during configuration:

- Voltage +/-5 V/+/-10 V/0..5 V/0..10 V/1..5 V
- Current +/-20 mA/0..20 mA/4..20 mA

The module operates with voltage inputs. It includes eight read resistors connected to the terminal block to perform current inputs.

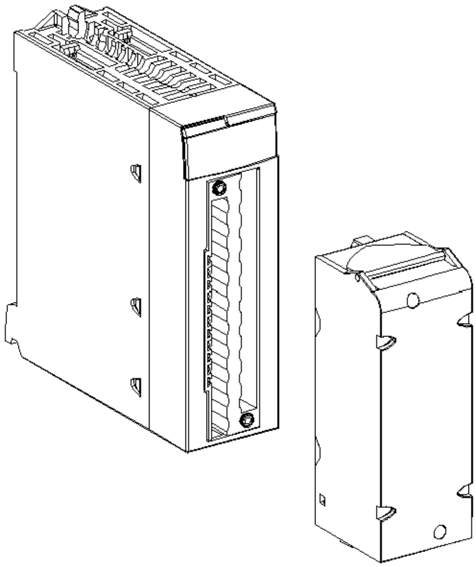
Ruggedized Version

The BMX AMI 0810H (hardened) equipment is the ruggedized version of the BMX AMI 0810 (standard) equipment. It can be used at extended temperatures and in harsh chemical environments.

For more information, refer to chapter *Installation in More Severe Environments* (see Modicon M580, M340, and X80 I/O Platforms, Standards and Certifications).

Illustration

The following graphic shows the BMX AMI 0810 analog input module:



NOTE: The terminal block is supplied separately.

Characteristics

Altitude Operating Conditions

The characteristics in the tables below apply to the modules BMX AMI 0810 and BMX AMI 0810H for use at altitude up to 2000 m (6560 ft). When the modules operate above 2000 m (6560 ft), apply additional derating.

For detailed information, refer to chapter *Operating and Storage Conditions* (see Modicon M580, M340, and X80 I/O Platforms, Standards and Certifications).

General Characteristics

The general characteristics for the BMX AMI 0810 and BMX AMI 0810H modules are as follows:

Operating temperature	BMX AMI 0810	0...60 ºC (32...140 ºF)
	BMX AMI 0810H	-25...70 ºC (-13...158 ºF)
Type of inputs		High level isolated fast inputs
Nature of inputs		Voltage / Current
Number of channels		8
Acquisition cycle time: • Fast (periodic acquisition for the declared channels used) • Default (periodic acquisition for all channels)		1 ms + 1 ms x number of channels used 9 ms
Display resolution		16-bit
Digital filtering		First order
Isolation: • Between channels • Between channels and bus • Between channels and ground		+/-300 VDC 1400 VDC 1400 VDC
Maximum overload authorized for inputs:		Voltage inputs: +/- 30 VDC Current inputs: +/- 30 mA Protected against accidental wiring: -19.2 to 30VDC **NOTE:** The **Protected for accidental wiring** function is not supported when the module works with any Telefast interface.
Power consumption (3.3 V)	**Typical**	0.32 W
	Maximum	0.48 W
Power consumption (24 V)	**Typical**	1.06 W
	Maximum	1.50 W

Measurement Range

The BMX AMI 0810 and BMX AMI 0810H analog inputs have the following measurement range characteristics:

Measurement range	**+/- 10 V; +/- 5 V** **0...10 V; 0...5 V; 1...5 V**	**+/- 20 mA;** **0...20 mA; 4...20 mA**
Maximum conversion value	+/-11.4 V	+/-30 mA
Conversion resolution	0.36 mV	1.4 µA
Input impedance	10 MΩ	Internal conversion resistor (250 Ω) + Internal protection resistor (see note)
Precision of the internal conversion resistor	-	0.1% - 15 ppm/°C
Detected measurement errors for standard module :		
• At 25°C • Maximum in the temperature range 0...60°C (32...140°F)	0.075% of FS(1) 0.1% of FS(1)	Typical 0.15% of FS(1)(2) 0.3% of FS(1)(2)
Detected measurement errors for Hardened module:		
• At 25°C • Maximum in the temperature range -25...70°C (-13...158°F)	0.075% of FS(1) 0.2% of FS(1)	Typical 0.15% of FS(1)(2) 0.55% of FS(1)(2)
Temperature drift	30 ppm/°C	50 ppm/°C
Monotonicity	Yes	Yes
Common mode rejection (50/60 Hz)	80 dB	80 dB
Crosstalk between channels DC and AC 50/60Hz	> 80 dB	> 80 dB
Non-linearity	0.001%	0.001%
Repeatability @25°C of 10 min. stabilization time	0.005% of FS(1)	0.007% of FS(1)
Long term stability after 1000 hours	< 0.004% of FS(1)	< 0.004% of FS(1)
(1) FS: Full Scale **(2)** Detected conversion resistor error		

NOTE: The internal protection resistor has a typical impedance of 25 Ω (min 3.6 Ω and max 50 Ω). The precision of the protection resistor does not impact the measured value.

NOTE: If nothing is connected on a BMX AMI 0810 and BMX AMI 0810H analog module and if channels are configured (range 4...20 mA or 1...5 V), there is a detected I/O error as if a wire is broken.

Functional Description

Function

The is a high density input analog module with 8 isolated channels.

This module is used in conjunction with sensors or transmitters; it performs monitoring, measurement, and continuous process control functions.

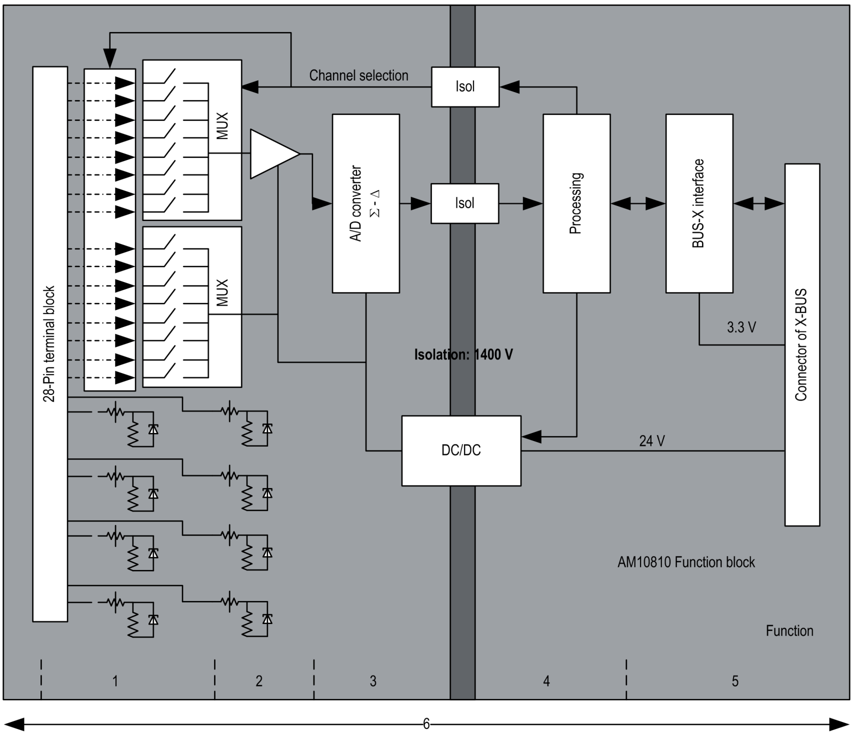
The module offers the following range for each input according to the selection made during configuration:

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

The module operates with voltage inputs. It includes eight read resistors connected to the terminal block to perform current inputs.

Illustration

The BMX AMI 0810 illustration:



Description:

No.	Process	Function
1	**Adapting the Inputs and Multiplexing**	• Physical connection to the process through a 28-pin screw terminal block • Protection of the module against overvoltages • Protection of the current reading resistors using limiters and resettable fuses • Input signal analog filtering • Scan input channels using static multiplexing through opto-switches, in order to provide the possibility of common mode voltage of +/- 300 Vdc
2	**Amplifying Input Signals**	• Gain selecting , based on characteristics of input signals, as defined during configuration (unipolar or bipolar range, in voltage or current) • Compensation of drift in amplifier device
3	**Converting**	• Conversion of analog Input signal into digital 24-bit signal using a ΣΔ converter

No.	Process	Function
4	**Transforming incoming values into workable measurements for the user.**	• Takes into account recalibration and alignment coefficients to be applied to measurements and the module's self-calibration coefficients • (Numeric) filtering fo measurements, based on configuration parameters • Scaling of measurements, based on configuration parameters
5	**Communicating with the Application**	• Manages exchanges with CPU • Topological addressing • Receives configuration parameters from module and channels • Sends measured values, as well as module status, to application
6	**Module monitoring and sending detected error notification back to application.**	Conversion string test Testing for range overflow on channels Watchdog test

Measurement Timing

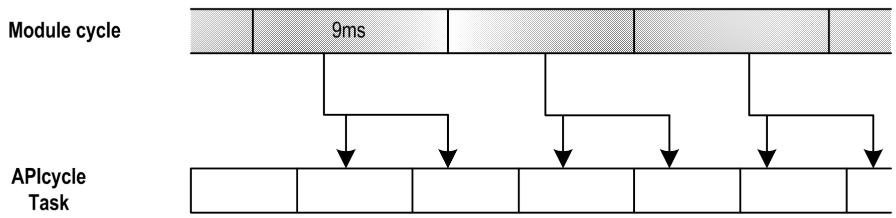
The timing of measurements is determined by the cycle selected during configuration (Normal or Fast Cycle):

- 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.

The cycle time values are based on the cycle selected:

Module	Normal Cycle	Fast Cycle
BMX AMI 0810	9 ms	1 ms + (1 ms x N) 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 bus cycle time is less than the module's cycle time, some values will not have changed.

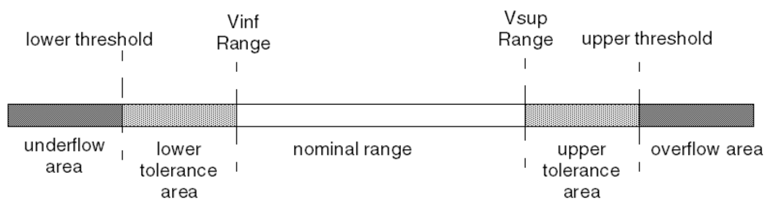


Overflow/Underflow Control

Module allows the user to select between 6 voltage or current ranges for each input.

This option for each channel have to be configured in configuration windows. Upper and lower tolerance detection are always active regardless of overflow/underflow control.

Depending on the range selected the module checks for overflow, it verifies that the measurement falls between a lower and an upper threshold:



Description:

Designation	Description
Nominal range	measurement range corresponding to 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

The values of the thresholds are configurable independently from one another. They may assume integer values between the following limits:

Range	**BMX AMI 0810 Range**									
	Underflow Area		**Lower Tolerance Area**		**Nominal Range**		**Upper Tolerance Area**		**Overflow Area**	
Unipolar										
0...10 V	-1,500	-1,001	-1,000	-1	0	10,000	10,001	11,000	11,001	11,400
0...5 V / 0...20 mA	-5,000	-1,001	-1,000	-1	0	10,000	10,001	11,000	11,001	15,000
1...5 V / 4...20 mA	-4,000	-801	-800	-1	0	10,000	10,001	10,800	10,801	14,000
Bipolar										
+/- 10 V	-11,500	-11,001	-11,000	-10,001	-10,000	10,000	10,001	11,000	11,001	11,400
+/- 5 V, +/- 20 mA	-15,000	-11,001	-11,000	-10,001	-10,000	10,000	10,001	11,000	11,001	15,000
User										
+/- 10 V	-32,768				User-defined	User-defined				32,767
0...10 V	-32,768				User-defined	User-defined				32,767

Measurement Display

Measurements may be displayed using standardized display (in %, to two decimal places):

Type of Range	**Display**
Unipolar range 0...10 V, 0...5 V, 1...5 V, 0...20mA, 4...20mA	from 0 to 10,000 (0 % at +100.00 %)
Bipolar range +/- 10 V, +/- 5 mV +/- 20 mA	from -10,000 to 10,000 (-100.00 % at +100.00 %)

It is also possible to define the range of values within which measurements are expressed, by selecting:

- the lower threshold corresponding to the minimum value for the range: 0 % (or -100.00 %).
- the upper threshold corresponding to the maximum value for the range (+100.00 %).

Confirm that the lower and upper thresholds are integers between -32,768 and +32,767.

For example, imagine a conditioner providing pressure data on a 4-20 mA loop, with 4 mA corresponding to 3,200 millibar and 20 mA corresponding to 9,600 millibar. You have the option of choosing the User format, by setting the following lower and upper thresholds:

3,200 for 3,200 millibar as the lower threshold

9,600 for 9,600 millibar as the upper threshold

Values transmitted to the program vary between 3,200 (= 4 mA) and 9,600 (= 20 mA).

Measurement Filtering

The type of filtering performed by the system is called "first order filtering". The filtering coefficient can be modified from a programming console or via the program.

The mathematical formula used is as follows:

$Meas_{f(n)} = \alpha \times Meas_{f(n-1)} + (1-\alpha) \times Val_{b(n)}$

where:

α = efficiency of the filter

$Meas_{f(n)}$ = measurement filtered at moment n

$Meas_{f(n-1)}$ = measurement filtered at moment n-1

$Val_{b(n)}$ = gross value at moment n

You may configure the filtering value from 7 possibilities (from 0 to 6). This value may be changed even when the application is in RUN mode.

NOTE: Filtering may be accessed in Normal or Fast Cycle.

The filtering values depend on the T configuration cycle (where T = cycle time of 5 ms in standard mode):

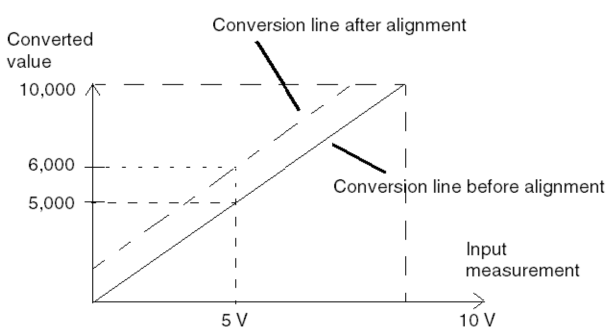
Desired Efficiency	Required Value	Corresponding α	Filter Response Time at 63%	Cut-off Frequency (in Hz)
No filtering	0	0	0	0
Low filtering	1	0.750	4 x T	0.040 / T
	2	0.875	8 x T	0.020 / T

Desired Efficiency	Required Value	Corresponding α	Filter Response Time at 63%	Cut-off Frequency (in Hz)
Medium filtering	3	0.937	16 x T	0.010 / T
	4	0.969	32 x T	0.005 / T
High filtering	5	0.984	64 x T	0.0025 / T
	6	0.992	128 x T	0.0012 / T

Sensor Alignment

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

Conversion lines are as follows:



The alignment value is editable from a programming console, even if the program is in RUN Mode. For each input channel, you can:

- 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.

The maximum offset between measured value and desired (aligned) value may not exceed +/-1.500.

NOTE: To align several analog channels on the BMX ART/AMO/AMI/AMM modules, we recommand proceeding channel by channel. Test each channel after alignment before moving to the next channel in order to apply the parameters correctly.

Wiring Precautions

Introduction

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

Cable Shielding

Connect the cable shielding to the grounding bar. Clamp the shielding to the grounding bar on the module side. Use the shielding connection kit BMXXSP••••, page 50 to connect the shielding.

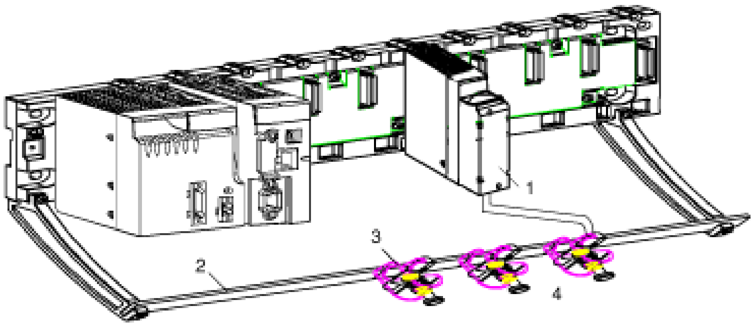
DANGER

HAZARD OF ELECTRIC SHOCK, EXPLOSION, OR ARC FLASH

While mounting / removing the modules:

- Make sure that each terminal block is still connected to the shield bar.
- Disconnect voltage supplying sensors and pre-actuators.

Failure to follow these instructions will result in death or serious injury.



1 BMX AMI 0810

2 Shield bar

3 Clamp

4 To sensors

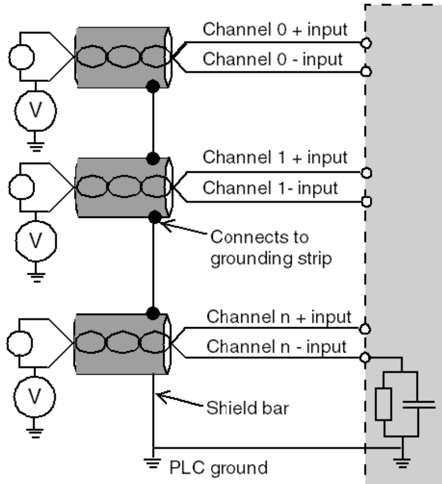
Reference of Sensors in Relation to the Ground

In order for the acquisition system to operate correctly, it is recommended to take in account the following precautions:

- Confirm that sensors are close together (a few meters).
- Confirm that all sensors are referenced to a single point, which is connected to the PLC's ground.

Using the Sensors Referenced in Relation to the Ground

The sensors are connected as indicated in the following diagram:



If the sensors are referenced in relation to the ground, in some cases this may return a remote ground potential to the terminal block. Follow these rules:

- Confirm that the potential is less than the permitted low voltage: for example, 30 Vrms or 42.4 VDC.
- Check that all leakage currents generated do not disturb the system. Setting a sensor point to a reference potential generates a leakage current.

NOTE: Sensors and other peripherals may be connected to a grounding point some distance from the module. Such remote ground references may carry considerable potential differences with respect to local ground. Induced currents do not affect the measurement or integrity of the system.

DANGER

HAZARD OF ELECTRIC SHOCK, EXPLOSION, OR ARC FLASH

Ensure that:

- sensors and other peripherals are not exposed through grounding points to voltage potential greater than acceptable limits.
- potentials greater than permitted low limits do not exist.
- induced currents do not affect the measurement or integrity of the system.

Failure to follow these instructions will result in death or serious injury.

Electromagnetic Hazard Instructions

Electromagnetic perturbations may lead to an unexpected behavior of the application.

⚠ CAUTION
UNEXPECTED BEHAVIOR OF APPLICATION
To reduce electromagnetic perturbations, use the shielding connection kit BMXXSP••••, page 50 to connect the shielding,
Failure to follow these instructions can result in injury or equipment damage.

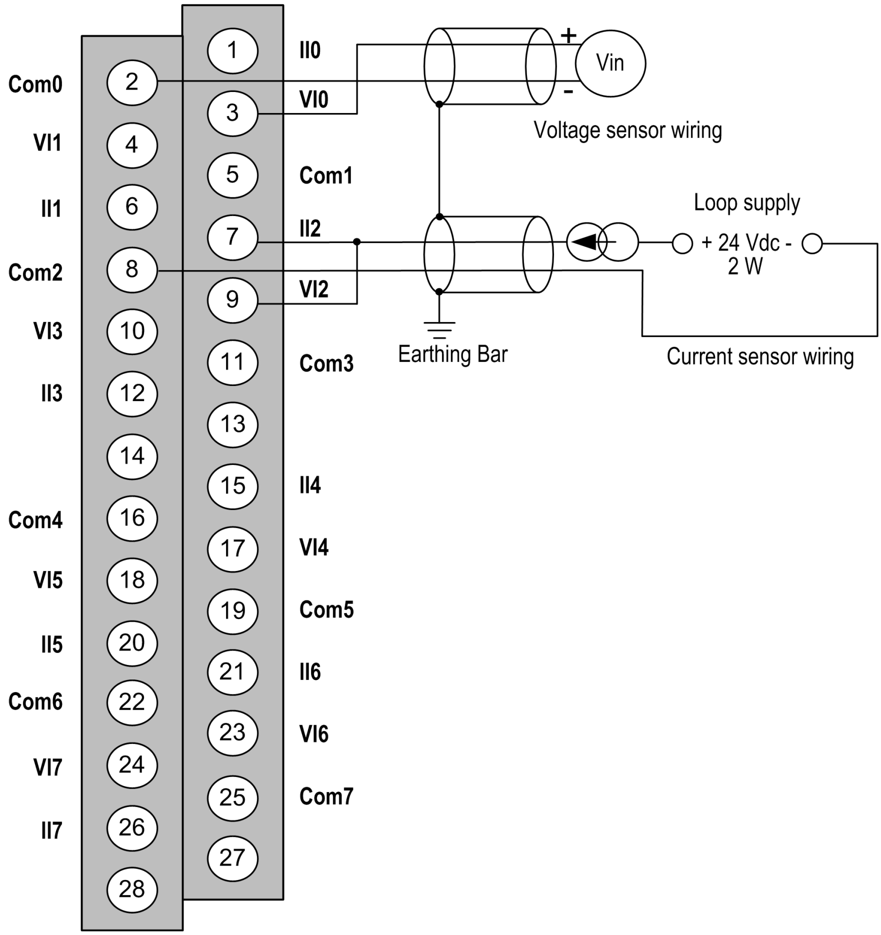
Wiring Diagram

Introduction

Module BMX AMI 0810 is connected using the 28-pin terminal block.

Illustration

The terminal block connection and the sensor wiring are as follows:



VIx + pole input for channel x

COM x - pole input for channel x

IIx current reading resistor + input

Channel 0 voltage sensor

Channel 1 2-wire current sensor

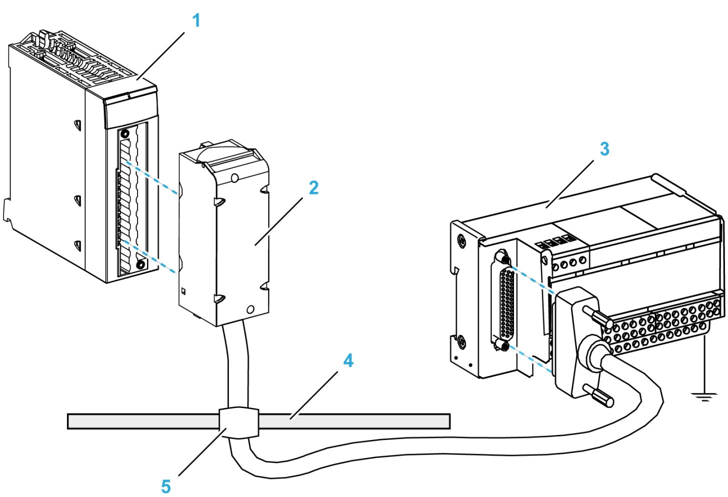
Wiring Accessories

For rapid connection to operative parts, the module can be connected to a TELEFAST pre-wired system, page 122.

Use of the TELEFAST Wiring Accessories

Introduction

The TELEFAST pre-wired system consists of connecting cables and interface sub-bases as shown below:



1 BMX AMI 0810 module

2 BMXFTA••0 connecting cable

3 Interface sub-base

4 Shield bar

5 Clamp

The BMX AMI 0810 module can be connected to the following interface sub-bases references:

- ABE-7CPA02
- ABE-7CPA31

- ABE-7CPA31E

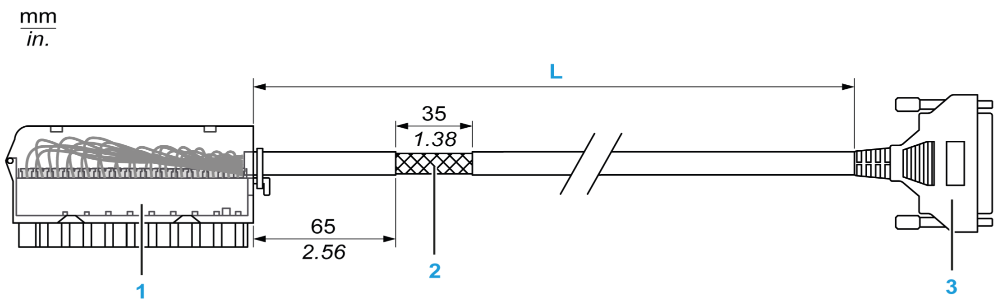
  NOTE: In case HART information is part of the signal to be measured, use an ABE-7CPA31E interface sub-base in order to filter this information that would disrupt the analog value.

BMX FTA ••0 Connecting Cables

The BMX FTA ••0 cables are pre-assembled cord set, made up of:

- At one end, a compound-filled 28-pin terminal block from which extend 1 cable sheath containing 24 wires,
- At the other end a 25-pin Sub-D connector.

The figure below shows the BMX FTA ••0 cables:



1 BMX FTB 2820 Terminal block

2 Cable shielding

3 25-pin Sub-D connector

L Length according to the part number.

The cable comes in 2 different lengths:

- 1.5 m (4.92 ft): BMX FTA 150
- 3 m (9.84 ft): BMX FTA 300

The following table gives the characteristics of the BMX FTA ••0 cables:

Characteristic		Value
Cable	Sheath material	PVC
	LSZH status	No
Environmental	Operating temperature	-25...70 °C (-13...158 °F)

ABE-7CPA02 Sensor Connection

The following table shows the distribution of analog channels on TELEFAST terminal blocks with the reference ABE-7CPA02:

TELEFAST terminal block number	25-pin Sub-D connector pin number	BMXA-MI0810 pin out	Signal type	TELEFAST terminal block number	25-pin Sub-D connector pin number	BMXA-MI0810 pin out	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	3	+IV0	200	14	2	COM0
101	2	1	+IC0	201	/		Ground
102	15	4	+IV1	202	3	5	COM1
103	16	6	+IC1	203	/		Ground
104	4	9	+IV2	204	17	8	COM2
105	5	7	+IC2	205	/		Ground
106	18	10	+IV3	206	6	11	COM3
107	19	12	+IC3	207	/		Ground
108	7	17	+IV4	208	20	16	COM4
109	8	15	+IC4	209	/		Ground
110	21	18	+IV5	210	9	19	COM5
111	22	20	+IC5	211	/		Ground
112	10	23	+IV6	212	23	22	COM6
113	11	21	+IC6	213	/		Ground
114	24	24	+IV7	214	12	25	COM7
115	25	26	+IC7	215	/		Ground

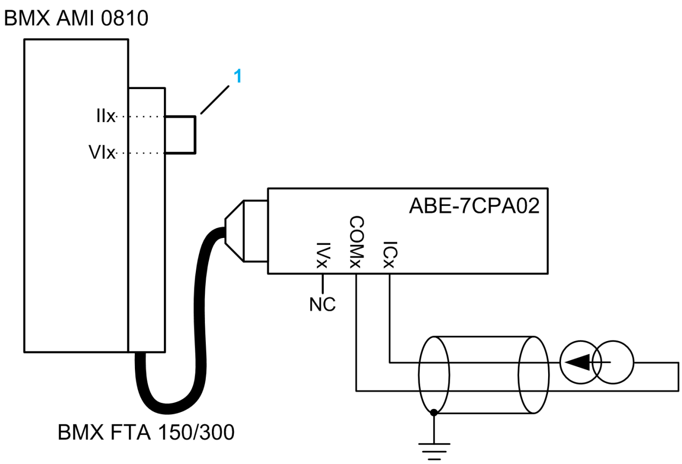
NOTE: On the ABE-7CPA02, the strap position is between pin 1 and pin 2.

+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 current sensors connected on the TELEFAST ABE-7CPA02, place a strap on the BMX AMI 0810 terminal block between the current input and the voltage input as illustrated below.



1 Strap on the terminal block.

NOTE: For the ground connection use the additional terminal block ABE-7BV10/20.

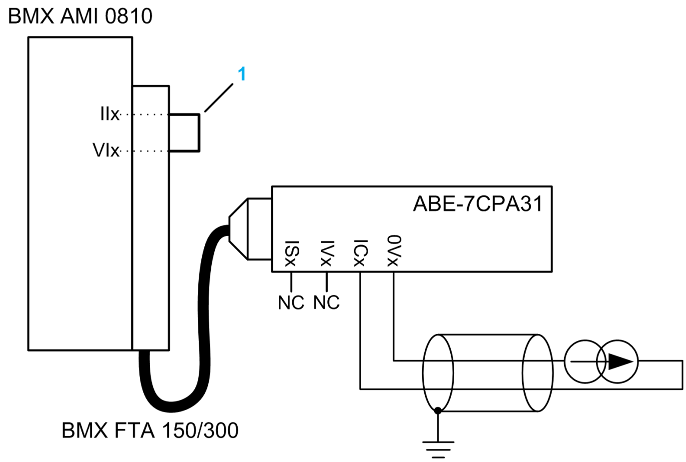
ABE-7CPA31 Sensor Connection

The following table shows the distribution of analog channels on TELEFAST terminal blocks with the reference ABE-7CPA31:

TELEFAST terminal block number	25-pin Sub-D connector pin number	BMXA-MI0810 pin out	Signal type	TELEFAST terminal block number	25-pin Sub-D connector pin number	BMXA-MI0810 pin out	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

TELEFAST terminal block number	25-pin Sub-D connector pin number	BMXA-MI0810 pin out	Signal type	TELEFAST terminal block number	25-pin Sub-D connector pin number	BMXA-MI0810 pin out	Signal type
101	1	3	+IV0	117	7	17	+IV4
102	2	1	+IC0	118	8	15	+IC4
103	14	2	0 V	119	20	16	0 V
104	/		+IS1	120	/		+IS5
105	15	4	+IV1	121	21	18	+IV5
106	16	6	+IC1	122	22	20	+IC5
107	3	5	0 V	123	9	19	0 V
108	/		+IS2	124	/		+IS6
109	4	9	+IV2	125	10	23	+IV6
110	5	7	+IC2	126	11	21	+IC6
111	17	8	0 V	127	23	22	0 V
112	/		+IS3	128	/		+IS7
113	18	10	+IV3	129	24	24	+IV7
114	19	12	+IC3	130	25	26	+IC7
115	6	11	0 V	131	12	25	0 V
+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 current sensors connected on the TELEFAST ABE-7CPA31, place a strap on the BMX AMI 0810 terminal block between the current input and the voltage input as illustrated below.



1 Strap on the terminal block.

NOTE: For the ground connection use the additional terminal block ABE-7BV10/20.

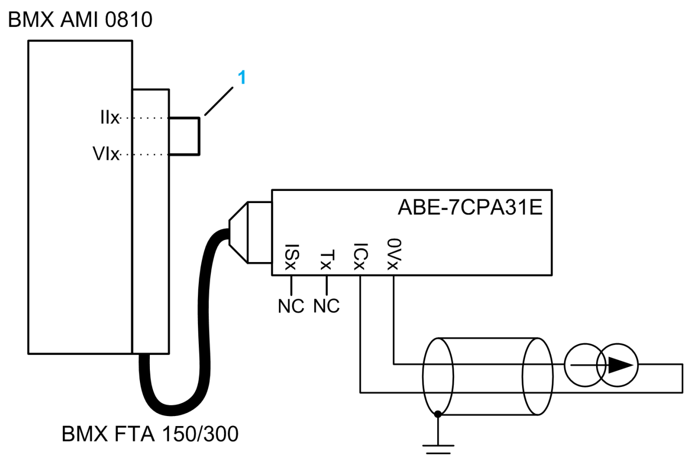
ABE-7CPA31E Sensor Connection

The following table shows the distribution of analog channels on TELEFAST terminal blocks with the reference ABE-7CPA31E:

TELEFAST terminal block number	Terminal	Signal type	TELEFAST terminal block number	Terminal	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	/	T0	117	/	T4
102	/	+IC0	118	/	+IC4
103	/	0V0	119	/	0V4
104	/	+IS1	120	/	+IS5
105	/	T1	121	/	T5

TELEFAST terminal block number	Terminal	Signal type	TELEFAST terminal block number	Terminal	Signal type
106	/	+IC1	122	/	+IC5
107	/	0V1	123	/	0V5
108	/	+IS2	124	/	+IS6
109	/	T2	125	/	T6
110	/	+IC2	126	/	+IC6
111	/	0V2	127	/	0V6
112	/	+IS3	128	/	+IS7
113	/	T3	129	/	T7
114	/	+IC3	130	/	+IC7
115	/	0V3	131	/	0V7
+ISx: 24 V channel power supply **Tx:** Reserved test pin for HART function, it's internally connected with +ICx. **+ICx:** + pole current input for channel x **COMx:** - pole voltage or current input for channel x					

NOTE: For current sensors connected on the TELEFAST ABE-7CPA31E, place a strap on the BMX AMI 0810 terminal block between the current input and the voltage input as illustrated below.



1 Strap on the terminal block.

NOTE: For the ground connection use the additional terminal block ABE-7BV10/20.

BMX ART 0414/0814 Analog Input Modules

What's in This Chapter

Subject of this Chapter

This chapter presents the BMX ART 0414/0814 modules, their characteristics and explains how they are connected to the various sensors.

Presentation

Function

The BMX ART 0414/0814 modules are multi-range acquisition devices with four inputs for the 0414 and eight inputs for the 0814. The inputs are isolated from each other. These modules offer the following ranges for each input, according to the selection made at configuration:

- RTD IEC Pt100/Pt1000, US/JIS Pt100/Pt1000, Cu10, Cu50, Cu100, Ni100/Ni1000 in 2, 3 or 4 wires
- thermocouple B, E, J, K, L, N, R, S, T, U
- voltage +/- 40 mV to 1.28 V.

Ruggedized Versions

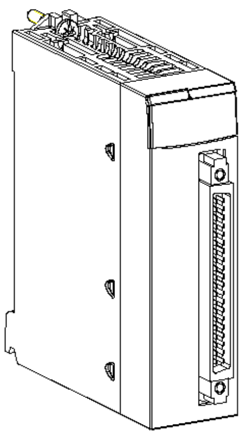
The BMX ART 0414H and BMX ART 0814H (hardened) equipment are respectively the ruggedized versions of the BMX ART 0414 and the BMX ART 0814 (standard) equipment. They can be used at extended temperatures and in harsh chemical environments.

For more information, refer to chapter *Installation in More Severe Environments* (see Modicon M580, M340, and X80 I/O Platforms, Standards and Certifications).

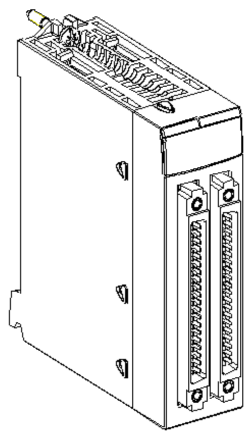
Illustration

The BMX ART 0414/0814 analog input modules looks like this:

BMX ART 0414



BMX ART 0814



Characteristics

Altitude Operating Conditions

The characteristics in the tables below apply to the modules BMX ART 0414(H) and BMX ART 0814(H) for use at altitude up to 2000 m (6560 ft). When the modules operate above 2000 m (6560 ft), apply additional derating.

For detailed information, refer to chapter *Operating and Storage Conditions* (see Modicon M580, M340, and X80 I/O Platforms, Standards and Certifications).

General Characteristics

The general characteristics of the BMX ART 0414(H) and BMX ART 0814(H) modules are as follows:

Type of inputs		Isolated, RTD, thermocouple and voltage inputs
Nature of inputs		+/- 40 mV; +/- 80 mV; +/- 160 mV; +/- 320 mV; +/- 640 mV; 1.28 V
Operating temperature	**BMX ART 0414** **BMX ART 0814**	0...60 ºC (32...140 ºF)
	BMX ART 0414H **BMX ART 0814H**	-25...70 ºC (-13...158 ºF)
Number of channels	**BMX ART 0414(H)**	4
	BMX ART 0814(H)	8
Acquisition cycle time	**BMX ART 0414(H)**	400 ms / 4 channels
	BMX ART 0814(H)	400 ms / 8 channels
Conversion method		ΣΔ
Resolution		15-bit + sign
Isolation: • **Between channels** • **Between channels and bus** • **Between channels and ground**		• 750 Vdc • 1400 Vdc • 750 Vdc
Maximum authorized over voltage for inputs		+/- 7.5 Vdc
Cold junction compensation		• Internal compensation using the dedicated TELEFAST ABE-7CPA412 wiring accessory, including a sensor. • External compensation dedicating channel 0 to a 2/3-wires Pt100 for CJC. • External compensation using the CJC values of channels 4/7 for channels 0/3. In this case, only one sensor is needed.
Input filter		Low pass filter (1st order numerical)
Rejection in differential mode (50/60 Hz)		Typical 60 dB
Common mode rejection (50/60 Hz)		Typical 120 dB
BMX ART 0414(H)		
Power consumption (3.3 V)	**Typical**	0.32 W
	Maximum	0.48 W
Power consumption (24 V)	**Typical**	0.47 W
	Maximum	1.20 W
BMX ART 0814(H)		

Power consumption (3.3 V)	**Typical**	0.32 W
	Maximum	0.48 W
Power consumption (24 V)	**Typical**	1.00 W
	Maximum	1.65 W

Voltage Input Characteristics

The characteristics of the voltage inputs of the BMX ART 0414(H) and BMX ART 0814(H) modules are as follows:

Voltage range:	+/- 40 mV; +/- 80 mV; +/- 160 mV; +/- 320 mV; +/- 640 mV; 1.28 V
Input impedance:	Typical 10 MOhms
Maximum converted value:	+/- 102.4%
Maximum resolution:	2.4 µV in the range +/- 40 mV
Detected measurement error for standard module:	
• **At 25 °C (77 °F)**	0.05% of FS (1)
• **Maximum in the temperature range 0...60 °C (32...140 °F)**	0.15% of FS (1)
Detected measurement error for Hardened module:	
• **At 25 °C (77 °F)**	0.05% of FS (1)
• **Maximum in the temperature range -25...70 °C (-13...140 °F)**	0.20% of FS (1)
Temperature drift:	
	30 ppm/°C
Legend: (1) FS: Full Scale	

RTD Input Characteristics

The characteristics of the RTD inputs of the BMX ART 0414(H) and BMX ART 0814(H) modules are as follows:

RTD	Pt100	Pt1000	Ni100	Ni1000	Cu10	CU50	CU100
Measurement range	According to IEC -175... +825°C (-347...+1517°F) According to US/JIS: -87 +437°C (-125...+819°F)		-54...+174°C (-65...+345°F)		-91...+251°C (-132...+484°F)	-200...+200°C (-328...+392)	
Resolution	0.1°C (0.2°F)						
Detection type	Open circuit (detection on each channel)						
Detected error at 25 °C (77 °F) (1)	+/- 2.1 °C (+/- 3.8°F)		+/- 2.1 °C (+/- 3.8°F)	+/- 0.7°C (+/- 1.3°F)	+/- 4 °C (+/- 7.2°F)	+/- 2.1°C (+/- 3.8°F)	
Maximum detected error for standard modules in the temperature range 0...60° C (32...140 °F) (2)	+/- 3 °C (+/- 5.4°F)		+/- 3 °C (+/- 5.4°F)	+/- 0.7°C (+/- 1.3°F)	+/- 4 °C (+/- 7.2°F)	+/- 3°C (+/- 5.4°F)	
Maximum detected error for hardened modules in the temperature range -25...70 °C (-13...140 °F) (2)	+/- 3 °C (+/- 5.4°F)		+/- 3.5°C (+/- 6.3°F)	+/- 1.15°C (+/- 2.1°F)	+/- 4.5°C (+/- 8.1° F)	+/- 3.5°C (+/- 6.3°F)	
Maximum wiring resistance:							
• **4-wire**	50 Ω	500 Ω	50 Ω	500 Ω	50 Ω	50 Ω	
• **2/3-wire**	20 Ω	200 Ω	20 Ω	200 Ω	20 Ω	20 Ω	
Temperature drift:							
	30 ppm/°C						

Legend

(1) detected errors caused by the wiring, +/- 1°C (0.2°F) in the range -100...+200°C (-148...+392°F) for Pt100

(2) See detailed detected errors at temperature point, page 350.

Thermocouple Input Characteristics

This table presents the general characteristics of the thermocouple inputs of the BMX ART 0414(H) and BMX ART 0814(H) modules:

Thermocouples	**B**	**E**	**J**	**K**	**L**
Measurement range	+171... +1,779°C (340... 3234°F)	-240... +970°C (-400... 1778°F)	-177... +737°C (-287... 1359°F)	-231... +1,331°C (-384... 2428°F)	-174... +874°C (-281... 1605°F)
Thermocouples	**N**	**R**	**S**	**T**	**U**
Measurement range	-232 +1,262°C (-386... 2304°F)	-9... +1,727° C (16... 3234°F)	-9... +1,727° C (-16... 141°F)	-254... +384°C (-425... 723° F)	-181... +581°C (-294... 1078°F)
Resolution	0.1°C (0.2°F)				
Detection type	Open circuit (detection on each channel)				
Detected error at 25°C	+/- 3.2°C for J, L, R, S and U types (see Thermocouple Ranges, page 352 for detailed detected errors at temperature point for each type); +/- 3.7°C for B, E, K, N and T types				
Maximum detected error for standard modules in the temperature range 0...60°C (32...140°F) (2)	+/- 4.5°C (+/-8.1°F) for types: J, L, R, S and U; +/- 5°C (+/-9°F) for types: B, E, K, N and T (using the TELEFAST accessory with its internal cold junction compensation).				
Maximum detected error for hardened modules in the temperature range -25...70 °C (-13...140 °F) (2)	+/- 5.5°C (+/-9°F) for types: J, L, R, S and U; +/- 6°C (+/-10.8°F) for types: B, E, K, N and T (using the TELEFAST accessory with its internal cold junction compensation).				
Temperature drift	30 ppm/°C				

Resistive Input Characteristics

The characteristics of the resistive inputs of the BMX ART 0414(H) and BMX ART 0814(H) are as follows:

Range	400 Ω; 4000 Ω
Type measurement	2, 3, 4 wires
Maximum resolution	12.5 mΩ in the range 400 Ω

	125 mΩ in the range 4000 Ω
Detected measurement error for standard module: • **At 25 °C (77 °F)** • **Maximum in the temperature range 0...60 °C (32...140 °F)**	0.12% of FS (1) 0.2% of FS (1)
Detected measurement error for ruggedized module: • **At 25 °C (77 °F)** • **Maximum in the temperature range -25...70 °C (-13...140 °F)**	0.12% of FS (1) 0.3% of FS (1)
Temperature drift	25 ppm/°C
Legend: (1) FS: Full Scale	

Analog Input Values

Description

For RTD and TC sensors, the data is a multiple of 10 of the real temperature in °C or °F. The last digit represents 0.1°C or 0.1°F.

For millivoltmeter, the data ranges from 40 mV, 320 mV to 1280 mV and is also a multiple of 10 of the real measurement. The last digit represents 10 nV.

For millivoltmeter, the data range of 640 mV is a multiple of 100 of the real measurement. The last digit represents 100 nV.

RTD Ranges

The table below presents the ranges for the RTD sensors (values in brackets are in 1/10°F).

Range	Under flow	Lower scale	Upper scale	Over flow	Broken wire detected
Pt100 IEC 751-1995, JIS C1604-1997 (2/4 wires)	-1990 (-3260)	-1750 (-2830)	8250 (15170)	8490 (15600)	0 (0)
Pt1000 IEC 751-1995, JIS C1604-1997 (2/4 wires)	-1990 (-3260)	-1750 (-2830)	8250 (15170)	8490 (15600)	0 (0)
Ni100 DIN43760-1987 (2/4 wires)	-590 (-750)	-540 (-660)	1740 (3460)	1790 (3550)	0 (0)
Ni1000 DIN43760-1987 (2/4 wires)	-590 (-750)	-540 (-660)	1740 (3460)	1790 (3550)	0 (0)
Pt100 IEC 751-1995, JIS C1604-1997 (3 wires)	-1990 (-3260)	-1750 (-2830)	8250 (15170)	8490 (15600)	0 (0)
Pt1000 IEC 751-1995, JIS C1604-1997 (3 wires)	-1990 (-3260)	-1750 (-2830)	8250 (15170)	8490 (15600)	0 (0)
Ni100 DIN43760-1987 (3 wires)	-590 (-750)	-540 (-660)	1740 (3460)	1790 (3550)	0 (0)
Ni1000 DIN43760-1987 (3 wires)	-590 (-750)	-540 (-660)	1740 (3460)	1790 (3550)	0 (0)
JPt100 JIS C1604-1981, JIS C1606-1989 (2/4 wires)	-990 (-1460)	-870 (-1240)	4370 (8180)	4490 (8400)	0 (0)
JPt1000 JIS C1604-1981, JIS C1606-1989 (2/4 wires)	-990 (-1460)	-870 (-1240)	4370 (8180)	4490 (8400)	0 (0)
JPt100 JIS C1604-1981, JIS C1606-1989 (3 wires)	-990 (-1460)	-870 (-1240)	4370 (8180)	4490 (8400)	0 (0)
JPt1000 JIS C1604-1981, JIS C1606-1989 (3 wires)	-990 (-1460)	-870 (-1240)	4370 (8180)	4490 (8400)	0 (0)
Cu10 (2/4 wires)	-990 (-1460)	-910 (-1320)	2510 (4840)	2590 (4980)	0 (0)
Cu10 (3 wires)	-990 (-1460)	-910 (-1320)	2510 (4840)	2590 (4980)	0 (0)

TC Ranges

The table below presents the ranges for the TC sensors (values in brackets are in (1/10°F).

Range	Under flow	Lower scale	Upper scale	Over flow	Broken wire detected
Type J	-1980 (-3260)	-1770 (-2870)	7370 (13590)	7580 (13980)	0 (0)
Type K	-2680 (-4500)	-2310 (-3830)	13310 (24270)	13680 (24940)	0 (0)
Type E	-2690 (-4510)	-2400 (-3990)	9700 (17770)	9990 (18290)	0 (0)
Type T	-2690 (-4520)	-2540 (-4250)	3840 (7230)	3990 (7500)	0 (0)
Type S	-500 (-540)	-90 (160)	17270 (29550)	17680 (30250)	0 (0)
Type R	-500 (-540)	-90 (160)	17270 (29550)	17680 (30250)	0 (0)
Type B	1320 (2700)	1710 (3390)	17790 (32000)	18170 (32000)	1320 (2700)
Type N	-2670 (-4500)	-2320 (-3860)	12620 (23040)	12970 (23680)	0 (0)
Type U	-1990 (-3250)	-1810 (-2930)	5810 (10770)	5990 (11090)	0 (0)
Type L	-1990 (-3250)	-1740 (-2800)	8740 (16040)	8990 (16490)	0 (0)

Voltage Ranges

The table below presents the voltage ranges default values.

Range	Under flow	Lower scale	Upper scale	Over flow
+/- 40 mV	-4192	-4000	4000	4192
+/- 80 mV	-8384	-8000	8000	8384
+/- 160 mV	-16768	-16000	16000	16768
+/- 320 mV	-32000	-32000	32000	32000
+/- 640 mV	-6707	-6400	6400	6707
+/- 1280 mV	-13414	-12800	12800	13414

Resistance Ranges

The table below presents the resistance ranges default values.

Range	Under flow	Lower scale	Upper scale	Over flow
0-400 Ohms 2/4 wires	0	0	4000	4096
0-4000 Ohms 2/4 wires	0	0	4000	4096
0-400 Ohms 3 wires	0	0	4000	4096
0-4000 Ohms 3 wires	0	0	4000	4096

Functional Description

Introduction

The BMXART0414/814 modules are multi-range acquisition devices with:

- four inputs for the BMXART0414 module
- eight inputs for the BMXART0814 module

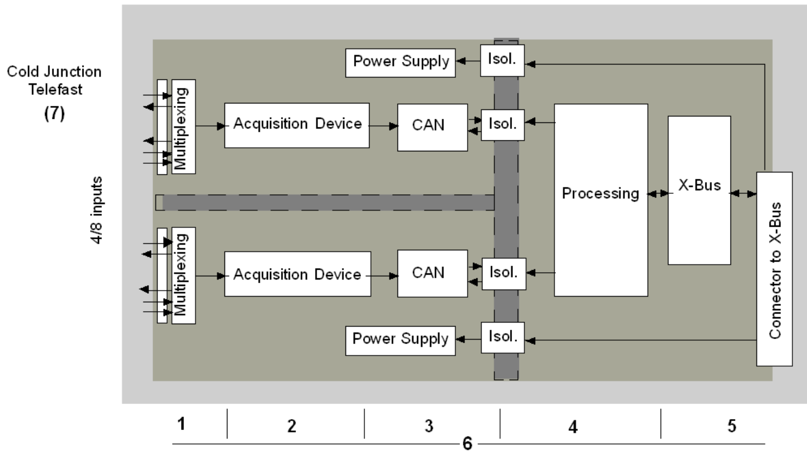
Both modules offer the following ranges for each input, according to the selection made during configuration:

- RTD: IEC Pt100, IEC Pt1000, US/JIS Pt100, US/JIS Pt1000, Copper CU10, Ni100 or Ni1000
- thermocouple: B, E, J, K, L, N, R, S, T, or U
- voltage: +/- 80 mV, +/- 80 mV, +/- 160 mV, +/- 320 mV, +/- 640 mV, +/- 1.28 V
- ohms: 0..400 Ω, 0..4000 Ω

NOTE: The TELEFAST2 accessory referenced **ABE-7CPA412** facilitates connection and provides a cold junction compensation device.

Illustration

The BMXART0414/0814 input modules perform the following functions.



Details of the functions are as follows.

Address	Element	Function
1	Adapting the inputs	Adaptation consists in a common mode and differential mode filter. Protection resistors on the inputs can withstand voltage spikes of up to +/- 7.5 V. A layer of multiplexing allows 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	Amplifying input signals	Built around a weak-offset amplifier internal to the A/N converter. A current generator helps ensure the RTD resistance measurement.
3	Conversion	The converter receives the signal issued from an input channel or from the cold junction compensation. Conversion is based on a Σ Δ 16 -bit converter. There is a converter for each input.
4	Transforming incoming values into workable measurements for the user	• recalibration 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	Communicating with the application	• manages exchanges with CPU

Address	Element	Function
		• topological addressing • receiving configuration parameters from module and channels • sending measured values, as well as module status, to the application
6	Module monitoring and sending detected error notification back to application	• conversion string test • range under/overflow on channels and cold junction compensation process test • watchdog test
7	Cold junction compensation	• internal compensation using the TELEFAST ABE-7CPA412 • external compensation by Pt100 • external compensation using the CJC values of channels 4/7 for channels 0/3. In this case, only one sensor is needed

Display of Electrical Range Measurements

Measurements may be displayed using standardized display (in %, to two decimal places).

Type of Range	Display
Bipolar range	from -10,000 to +10,000 (-100.00 % to +100.00 %)

It is also possible to define the range of values within which measurements are expressed, by selecting:

- the lower threshold corresponding to the minimum value for the range -100.00 %
- the upper threshold corresponding to the maximum value for the range +100.00 %

These lower and upper thresholds are integers between -32,768 and 32,768.

Display of Temperature Range Measurements

Measurements provided to the application are directly usable. It is possible to choose either "In Temperature" Display or Standardized Display:

- for "In Temperature" display mode, values are provided in tenths of a degree (Celsius or Fahrenheit, depending on the unit you have selected).
- for the user-specified display, you may choose a Standardized Display 0...10,000 (meaning from 0 to 100.00 %), by specifying the minimum and maximum temperatures as expressed in the 0 to 10,000 range.

Measurement Filtering

The type of filtering performed by the system is called *first order filtering*. The filtering coefficient can be modified from a programming console or via the program.

The mathematical formula used is as follows:

$Meas_{f(n)} = \alpha \times Meas_{f(n-1)} + (1-\alpha) \times Val_{b(n)}$

where:

α = efficiency of the filter

$Meas_{f(n)}$ = measurement filtered at moment n

$Meas_{f(n-1)}$ = measurement filtered at moment n-1

$Val_{b(n)}$ = gross value at moment n

You may configure the filtering value from seven possibilities (from 0 to 6). **This value may be changed even when the application is in RUN mode**.

NOTE: Filtering may be accessed in normal or fast cycle.

The filtering values are as follows. They depend on the sensor type. T is a cycle time of 200 ms for TC and mV. T is also a cycle time of 400 ms for RTD and Ohms.

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

The values may be displayed using standardized display (in %, to two decimal places).

Type of Range	Display
Unipolar	from 0 to 10,000 (0 % at +100.00 %)
Bipolar	from -10,000 to 10,000 (-100.00 % to +100.00 %)

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

- the lower threshold corresponding to the minimum value for the range -100.00 %
- the upper threshold corresponding to the maximum value for the range +100.00 %.

These lower and upper thresholds are integers between -32,768 and +32,767.

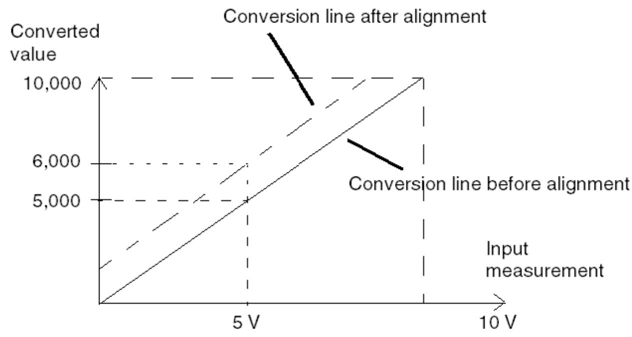
Frequency 50/60 Hz Rejection

Depending on the country, the user can configure the frequency rejection of main power harmonics by adapting the speed of sigma delta converter.

Sensor Alignment

The process of *alignment* consists of helping eliminate a systematic offset observed with a given sensor, around a specific operating point. This operation compensates for a detected 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.

Conversion lines are as follows:



The alignment value is editable from a programming console, even if the program is in RUN Mode. For each input channel, you can:

- 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.

The maximum offset between measured value and desired (aligned) value may not exceed +/-1,500.

NOTE: To align several analog channels on the BMX ART/AMO/AMI/AMM modules, we recommend proceeding channel by channel. Test each channel after alignment before moving to the next channel in order to apply the parameters correctly.

Wiring Precautions

Introduction

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

Cable Shielding

- Connection at the FCN connectors:

  Given that there are a large number of channels, a cable of at least 10 twisted pairs is used, with general shielding (outside diameter 10 mm maximum), fitted with one or two male 40-pin FCN connectors for direct connection to the module.

  Connect the cable shielding to the grounding bar. Clamp the shielding to the grounding bar on the module side. Use the shielding connection kit BMXXSP••••, page 50 to connect the shielding.

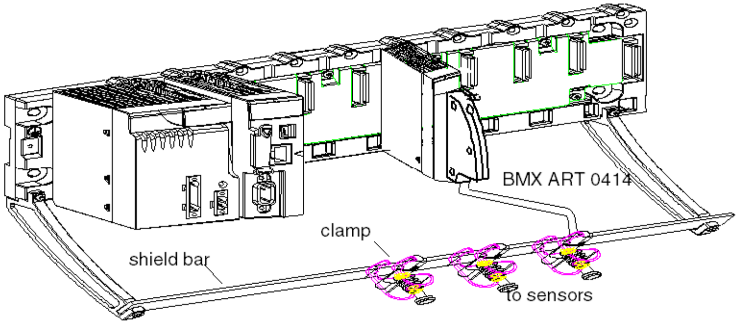
DANGER

HAZARD OF ELECTRIC SHOCK, EXPLOSION, OR ARC FLASH

While mounting / removing the modules:

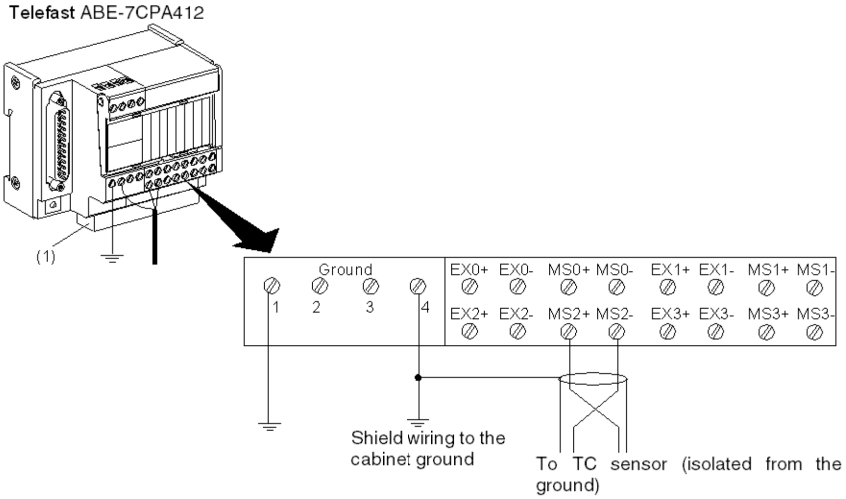
- Make sure that each terminal block is still connected to the shield bar.
- Disconnect voltage supplying sensors and pre-actuators.

Failure to follow these instructions will result in death or serious injury.

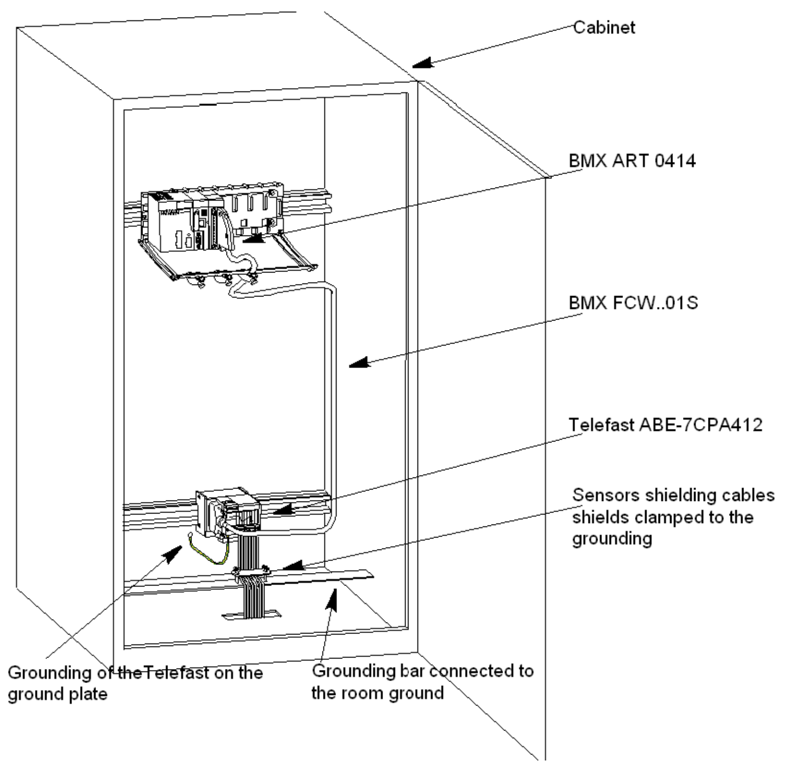


- TELEFAST connection:

  Connect the sensor cable shielding to the terminals provided and the whole assembly to the cabinet ground.



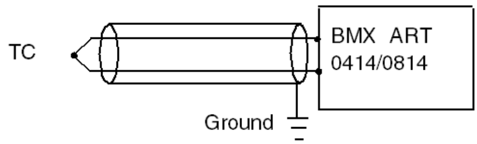
(1) The grounding of cables is facilited using the ABE-7BV10 accessory.



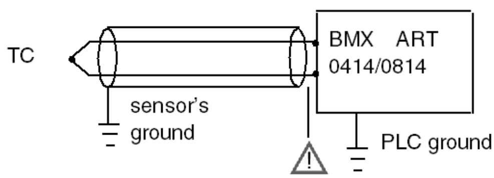
Sensors shielding

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

- If sensors are isolated from ground, confirm that all the shields of the sensor cables are referenced to the Telefast/PLC ground.

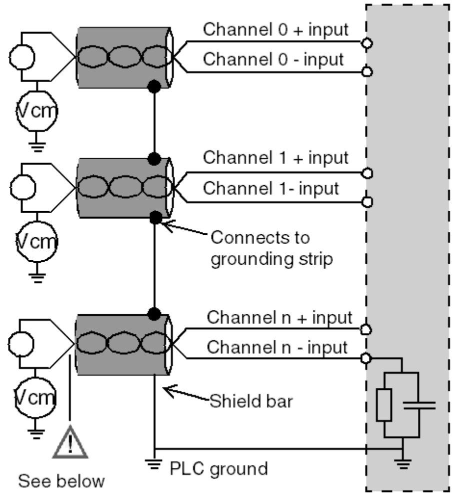


- if sensors are referenced to the sensor ground which is far from PLC ground, confirm that all the shields of the sensor cables are referenced to the sensors ground to eliminate the ground loop path.



Using the Sensors Isolated from 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 terminals or the FCN connector. Follow these rules:

- Confirm that the potential is less than the permitted low voltage: for example, 30 Vrms or 42.4 VDC.
- Setting a sensor point to a reference potential generates a leakage current. Check that all leakage currents generated do not disturb the system.

NOTE: Sensors and other peripherals may be connected to a grounding point some distance from the module. Such remote ground references may carry considerable potential differences with respect to local ground. Induced currents do not affect the measurement or integrity of the system.

DANGER

HAZARD OF ELECTRIC SHOCK, EXPLOSION, OR ARC FLASH

Ensure that sensors and others peripherals are not exposed through grounding points to voltage potential greater than acceptable limits.

Failure to follow these instructions will result in death or serious injury.

Electromagnetic Hazard Instructions

NOTE: Electromagnetic perturbations may lead to an unexpected behavior of the application.

CAUTION

UNEXPECTED BEHAVIOR OF APPLICATION

To reduce electromagnetic perturbations, use the shielding connection kit BMXXSP••••, page 50 to connect the shielding.

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

Wiring Diagram

Introduction

The BMX ART 0414 input module consists of a 40-pin FCN connector.

The BMX ART 0814 input module consists of two 40-pin FCN connectors.

WARNING

UNEXPECTED EQUIPMENT OPERATION

Take every precaution at the installation to prevent any subsequent mistake in the connectors. Plugging the wrong connector would cause an unexpected behavior of the application.

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

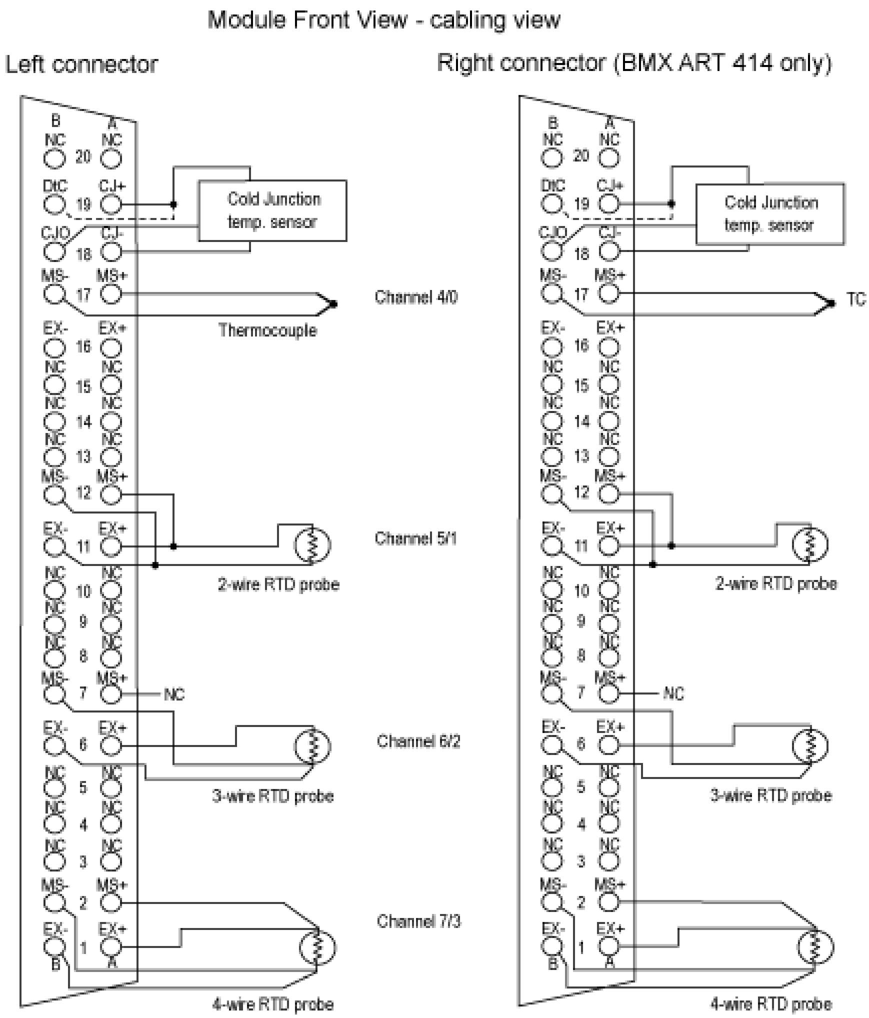
Connector Pin Assignment and Sensors Wiring

This example uses a probe configuration with:

- Channel 0/4: Thermocouple
- Channel 1/5: 2-wires RTD
- Channel 2/6: 3-wires RTD

- Channel 3/7: 4-wires RTD

The pin assignment for the 40-pin FCN connector and the sensors wiring is shown below:



MS+: RTD Measure + input / Thermocouple + input

MS-: RTD Measure - input / Thermocouple - input

EX+: RTD probe current generator + output

EX-: RTD probe current generator - output

NC: Not connected

DtC: The CJC sensor detection input is connected to CJ+ if the sensor type is DS600. It is not connected (NC) if the sensor type is LM31.

NOTE: The CJC sensor is needed for TC only.

Cold Junction Compensation

For each block of 4 channels (channels 0 to 3 and channels 4 to 7), the external compensation of the module is performed in the TELEFAST ABE-7CPA412 accessory. This device provides a voltage in mV corresponding to:

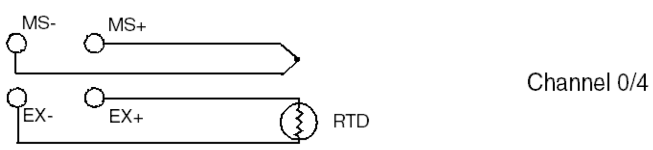
Voltage = (6.45 mV * T) + 509 mV (where T = temperature in °C).

The overall margin of detected error when using this device is reduced to 1.2°C in the -5°C to +60°C temperature range.

It is possible to increase the precision of the compensation by using a 2/3-wires Pt100 probe directly connected to channels 0 and 4 (only for the BMX ART0814) on the module or connected to the TELEFAST terminal blocks. Channel 0 is thus dedicated to the cold junction compensation of channels 1, 2 and 3. channel 4 is thus dedicated to channels 4 to 7.

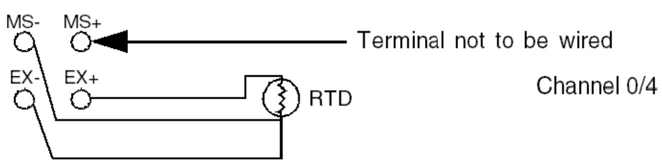
It is also possible, by using a 2-wire Pt100 probe, provided the initial length of the probe is limited, to maintain channel 0 as a thermocouple input.

The wiring would then look like this:



The wiring is only valid if the channel 0 is used. If the channel 0 is not used, select a cold junction with external Pt100. The range of the channel 0 is changed to a 3-wires Pt100 probe.

The wiring would then look like this:

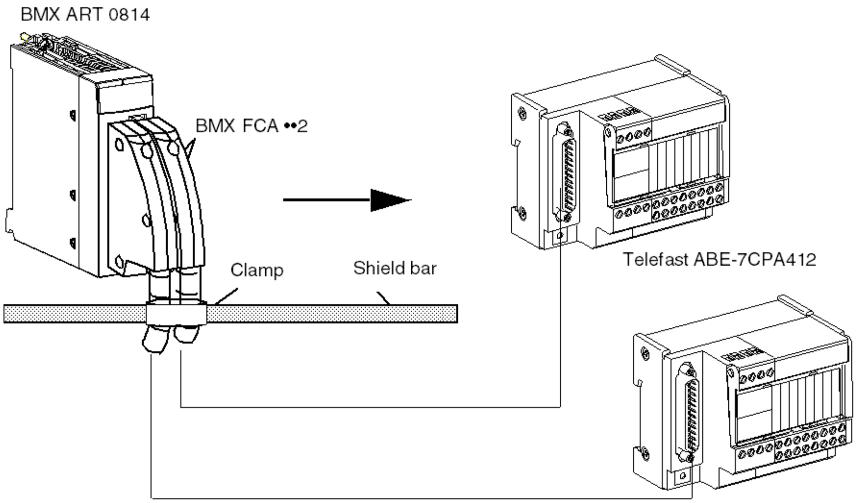


NOTE: For the BMX ART 0814 Module, the CJC values of channels 4 to 7 can also be used for channels 0 to 3. Therefore, only one external CJC, page 154 sensor is wired on channel 4.

Use of the TELEFAST Wiring Accessories

At a Glance

The TELEFAST pre-wired system consists of connecting cables and interface sub-bases as shown below:



The TELEFAST ABE-7CPA412 accessory is a base unit used to connect 4-channel analog modules to screw terminal blocks.

NOTE: When the cabinet where the TELEFAST ABE-7CPA412 accessory is located and powered up, wait at least 45mn to achieve full precision of the CJC compensation. It is not necessary to wait 45 min if the compensation is performed by an external Pt100 probe.

When using the TELEFAST ABE-7CPA412's cold junction compensation, in order to make sure you achieve the indicated level of precision, confirm that the movement of air around the TELEFAST ABE-7CPA412 does not exceed 0.1 m/s. Confirm that temperature variations do not exceed 10°C/hour and the TELEFAST ABE-7CPA412 is placed at least 100mm away from all heat sources.

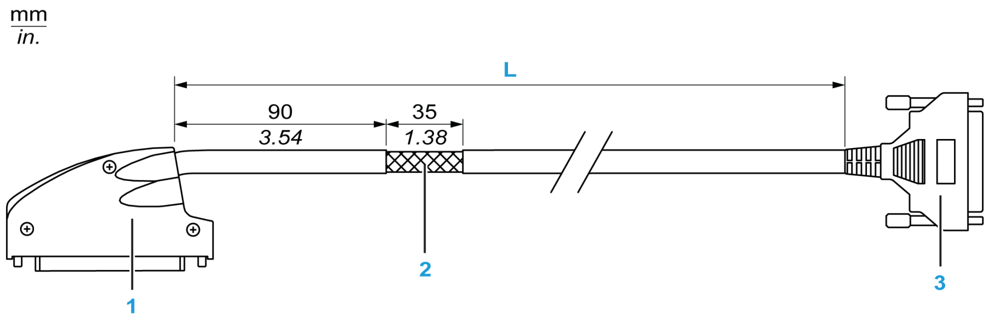
The TELEFAST ABE-7CPA412 can be operated from -40°C to +80°C external temperature.

BMX FCA ••2 Connecting Cables

The BMX FCA ••2 cables are pre-assembled cord set, made up of:

- At one end, a 40-pin connector (FCN type) from which extend 1 cable sheath containing 20 wires,
- At the other end a 25-pin Sub-D connector.

The figure below shows the BMX FCA ••2 cables:



1 40-pin connector, FCN type

2 Cable shielding

3 25-pin Sub-D connector

L Length according to the part number.

The cable comes in 3 different lengths:

- 1.5 m (4.92 ft): BMX FCA 152
- 3 m (9.84 ft): BMX FCA 302
- 5 m (16.40 ft): BMX FCA 502

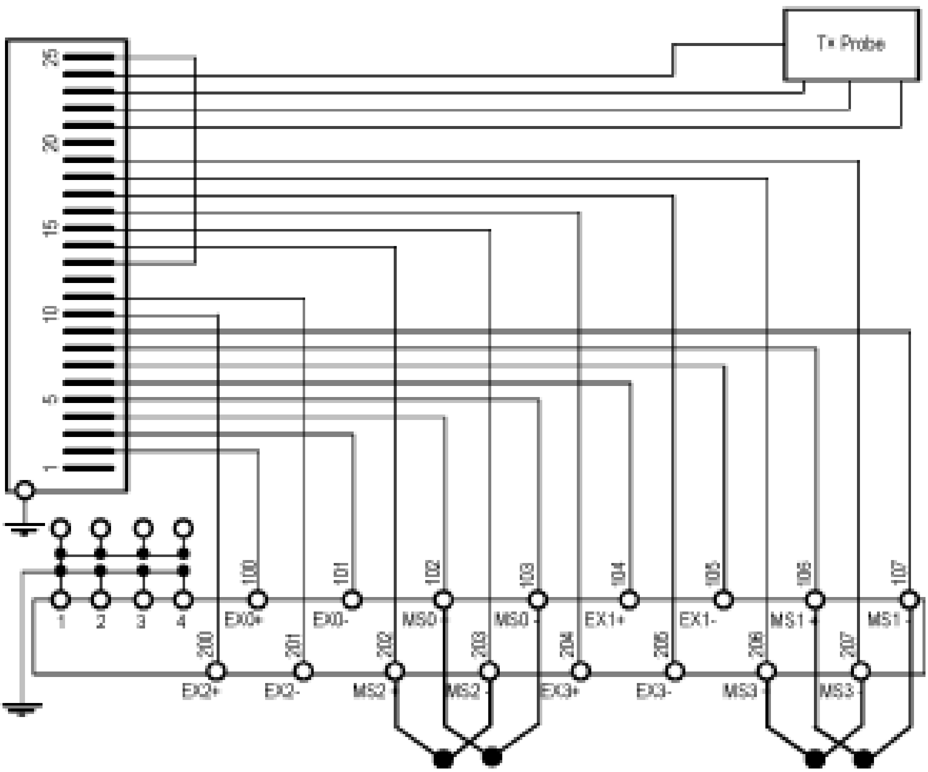
The following table gives the characteristics of the BMX FCA ••2 cables:

Characteristic		Value
Cable	Sheath material	PVC
	LSZH status	No
Environmental	Operating temperature	-25...70 °C (-13...158 °F)

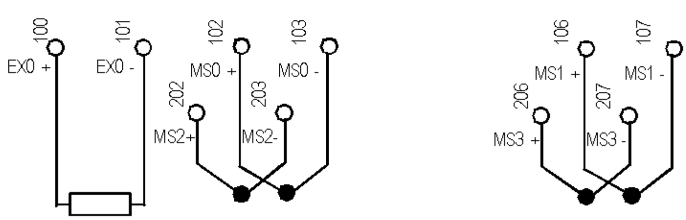
Connecting Sensors

Sensors may be connected to the TELEFAST ABE-7CPA412 accessory as shown in this illustration, page 143.

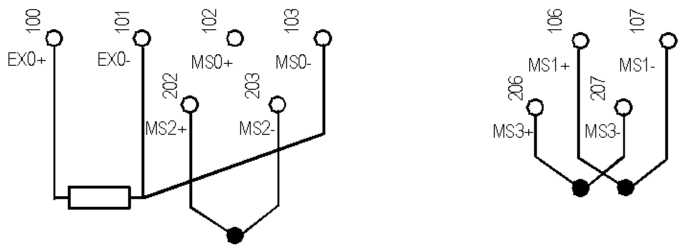
Wirings



Legend: Operating in TC mode with Telefast internal cold junction compensation.



Legend: Operating in TC mode with cold junction compensation using a 2-wire PT100 probe.



Legend: Operating in TC mode with cold junction compensation using a 3-wire PT100 probe.

BMX AMO 0210 Analog Output Module

What's in This Chapter

Subject of this Chapter

This chapter presents the BMX AMO 0210 module, its characteristics, and explains how it is connected to the various pre-actuators and actuators.

Presentation

Function

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

- Voltage +/-10 V
- Current 0..20 mA and 4..20 mA

The range is selected during configuration.

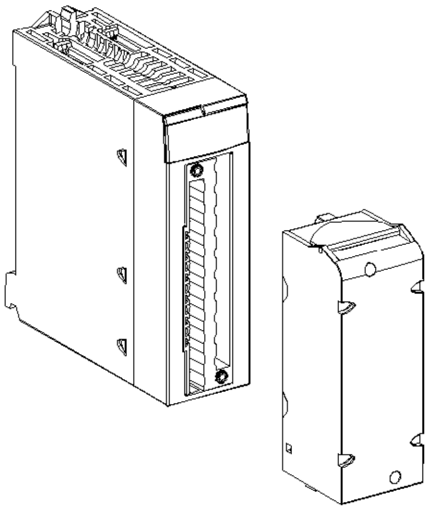
Ruggedized Version

The BMX AMO 0210H (hardened) equipment is the ruggedized version of the BMX AMO 0210 (standard) equipment. It can be used at extended temperatures and in harsh chemical environments.

For more information, refer to chapter *Installation in More Severe Environments* (see Modicon M580, M340, and X80 I/O Platforms, Standards and Certifications).

Illustration

The BMX AMO 0210 analog output module looks like this.



NOTE: The terminal block is supplied separately.

Characteristics

Altitude Operating Conditions

The characteristics in the tables below apply to the modules BMX AMO 0210 and BMX AMO 0210H for use at altitude up to 2000 m (6560 ft). When the modules operate above 2000 m (6560 ft), apply additional derating.

For detailed information, refer to chapter *Operating and Storage Conditions* (see Modicon M580, M340, and X80 I/O Platforms, Standards and Certifications).

General Characteristics

The general characteristics for the BMX AMO 0210 and BMX AMO 0210H modules are as follows.

Operating temperature	BMX AMO 0210	0...60 ºC (32...140 ºF)
	BMX AMO 0210H	-25...70 ºC (-13...158 ºF)
Type of outputs		Isolated high level outputs
Nature of outputs		Voltage or Current configured by software
Number of channels		2
Analog/Digital converter resolution		15 bits + sign
Output refresh time		≤ 1 ms
Power supply for outputs		by the module
Types of protection		From short circuits and overloads (Voltage output)
Isolation: • Between channels • Between channels and bus • Between channels and ground		 750 VDC 1400 VDC 1400 VDC
Detected measurement error for standard module BMX AMO 0210: • At 25°C (77°F) • Maximum in the temperature range 0..60°C (32...140°F)		 0.10% of FS(1) 0.20% of FS(1)
Detected measurement error for ruggedized BMX AMO 0210H: • At 25°C (77°F) • Maximum in the temperature range - 25...70°C (-13...158°F)		 0.10% of FS(1) 0.45% of FS(1)
Temperature drift		30 ppm/°C
Monotonicity		Yes
Common mode rejection (50/60 Hz)		100 dB
Crosstalk between channels DC and AC 50/60Hz		> 90 dB
Non linearity		0.1% of FS(1)
AC output ripple		2 mV rms on 50 Ω
Power consumption (3.3 V)	**Typical**	0.35 W
	Maximum	0.48 W
Power consumption (24 V)	**Typical**	2.1 W

	Maximum	2.8 W
(1) FS: Full Scale		

Voltage Output

The BMX AMO 0210 and BMX AMO 0210H voltage outputs have the following characteristics.

Nominal variation range	+/-10 V
Maximum variation range	+/- 11.25 V
Analog resolution	0.37 mV
Load impedance	1 KΩ minimum
Detection type	Short circuits

Current Output

The BMX AMO 0210 and BMX AMO 0210H current outputs have the following characteristics.

Nominal variation range	0..20 mA, 4..20 mA
Available maximum current	24 mA
Analog resolution	0.74 µA
Load impedance	600 Ω maximum
Detection type	Open circuit(1)(2)
(1) The open circuit detection is physically detected by the module if the target current value is different of 0 mA. **(2)** Open circuit detection is enabled with the Wiring CTRL parameter.	

Response time of Outputs

The maximum delay between transmission of the output value on the PLC bus and its effective positioning on the terminal block is less than 2 ms:

- internal cycle time = 1 ms for the two channels

- digital/analog conversion response time = 1 ms maximum for a 0-100% step.

  NOTE: If nothing is connected on the BMX AMO 0210 analog module and the channels are configured in the range 4..20 mA, there is a detected I/O error as if a wire is broken.

  For the 0..20 mA range, there is a detected I/O error as if a wire is broken only when the current is greater than 0 mA.

⚠ CAUTION

RISK OF INCORRECT DATA

If a signal wire is broken or disconnected, the last measured value is kept.

- Ensure that this does not cause a hazardous situation.
- Do not rely on the value reported. Check the input value at the sensor.

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

Functional Description

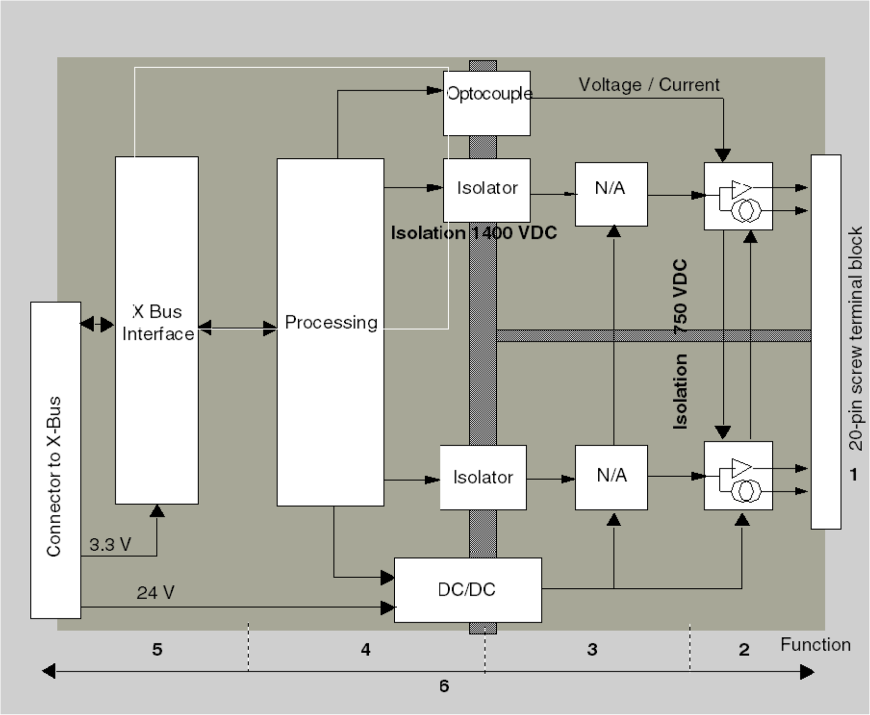
Function

The BMX AMO 0210 is a module with 2 analog outputs isolated from each other. This module offers the following ranges for each output, according to the selection made during configuration:

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

Illustration

The BMX AMO 0210 module's illustration is as follows.



Description.

Address	Process	Characteristics
1	Adapting the outputs	• physical connection to the process through a 20-pin screw terminal block • helps protect the module against voltage spikes
2	Adapting the signal to the Actuators	• performed on voltage or current via software configuration
3	Converting	• performed on 15 bits with a polarity sign • 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 digital/analog converter	• use of factory calibration parameters

Address	Process	Characteristics
5	Communicating with the Application	• manages exchanges with CPU • topological 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 monitoring and sending detected error notifications back to the application	• output power supply test • testing for range overflow on channels • testing for output open circuits and short-circuits • watchdog test • Programmable fallback capabilities

Writing Outputs

Confirm that the application provides the outputs with values in the standardized format:

- -10,000 to +10,000 for the +/-10 V range
- 0 to +10,000 in 0-20 mA and 4-20 mA ranges

Digital/Analog Conversion

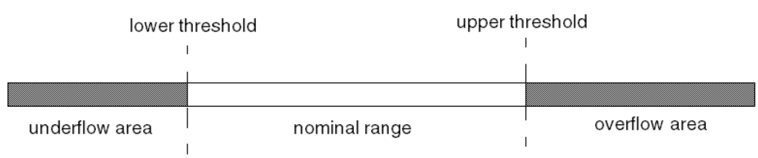
The digital/analog conversion is performed on:

- 16-bit for the +/-10 V range
- 15-bit in 0-20 mA and 4-20 mA ranges

Overflow Control

Module BMX AMO 0210 allows an overflow control on voltage and current ranges.

The measurement range is divided in three areas.



Description:

Designation	Description
Nominal range	measurement range corresponding to the chosen range
Overflow Area	area located beyond the upper threshold
Underflow Area	area located below the lower threshold

Overflow values for the various ranges are as follows.

Range	BMX AMO 0210					
	Underflow Area		Nominal Range		Overflow Area	
+/- 10V	-11,250	-11,001	-11,000	11,000	11,001	11,250
0..20mA	-2,000	-1,001	-1,000	11,000	11,001	12,000
4..20mA	-1,600	-801	-800	10800	10801	11,600

You may also choose the flag for an overflow of the range upper value, for an underflow of the range lower value, or for both.

NOTE: Range under/overflow detection is optional.

Fallback/Maintain or Reset Outputs to Zero

In case an error is detected, and depending on its seriousness, the outputs:

- switch to Fallback/Maintain position individually or together
- are forced to 0 (0 V or 0 mA).

Various Behaviors of Outputs:

Detected Error	Behavior of Voltage Outputs	Behavior of Current Outputs
Task in STOP mode, or program missing	Fallback/Maintain (channel by channel)	Fallback/Maintain (channel by channel)
Communication interruption		
Configuration Error	0 V (all channels)	0 mA (all channels)
Internal Error in Module		
Output Value out-of-range (range under/ overflow)	Value saturated at the defined limit (channel by channel)	Saturated value (channel by channel)
Output short or open circuit	Short-circuit: Maintain (channel by channel)	Open circuit: Maintain (channel by channel)

Detected Error	Behavior of Voltage Outputs	Behavior of Current Outputs
Module Hot swapping (processor in STOP mode)	0 V (all channels)	0 mA (all channels)
Reloading Program		

Fallback or Maintain at current value is selected during the configuration of the module. The fallback value may be modified through a program.

⚠ WARNING

UNEXPECTED EQUIPMENT OPERATION

The fallback position should not be used as the sole safety method. If an uncontrolled position can result in a hazard, an independent redundant system must be installed.

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

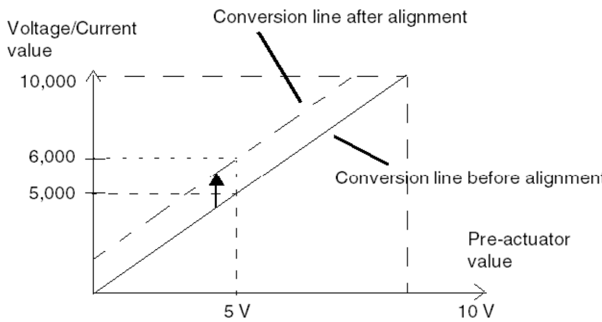
Behavior at Initial Power-Up and When Switched Off.

When the module is switched on or off, the outputs are set to 0 (0 V or 0 mA).

Actuator Alignment

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

Conversion lines are as follows:



The alignment value is editable from a programming console, even if the program is in RUN Mode. For each output channel, you can:

- view and modify the initial output target value
- save the alignment value
- determine whether the channel already has an alignment

The maximum offset between the measured value and the corrected output value (aligned value) may not exceed +/- 1.500.

NOTE: To align several analog channels on the BMX AMO/AMI/AMM/ART modules, we recommend proceeding channel by channel. Test each channel after alignment before moving to the next channel in order to apply the parameters correctly.

Wiring Precautions

Introduction

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

Cable Shielding

Connect the cable shielding to the grounding bar. Clamp the shielding to the shield bar on the module side. Use the shielding connection kit BMXXSP••••, page 50 to connect the shielding.

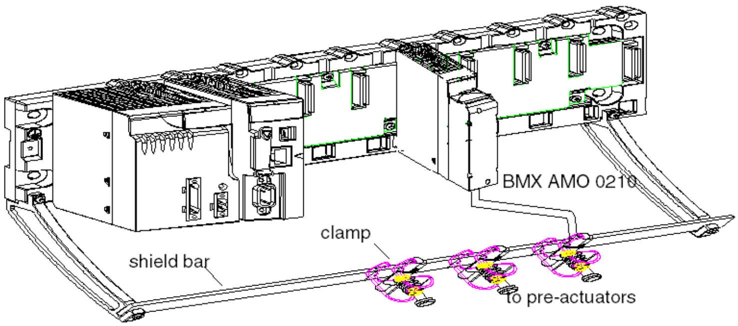
DANGER

HAZARD OF ELECTRIC SHOCK, EXPLOSION, OR ARC FLASH

While mounting / removing the modules:

- Make sure that each terminal block is still connected to the shield bar.
- Disconnect voltage supplying sensors and pre-actuators.

Failure to follow these instructions will result in death or serious injury.



Using Pre-Actuators Referenced in Relation to the Ground

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

NOTE: Sensors and other peripherals may be connected to a grounding point some distance from the module. Such remote ground references may carry considerable potential differences with respect to local ground. Induced currents do not affect the measurement or integrity of the system

DANGER

HAZARD OF ELECTRIC SHOCK, EXPLOSION, OR ARC FLASH

Ensure that sensors and others peripherals are not exposed through grounding points to voltage potential greater than acceptable limits.

Failure to follow these instructions will result in death or serious injury.

Electromagnetic Hazard Instructions

NOTE: Electromagnetic perturbations may lead to an unexpected behavior of the application.

⚠ CAUTION

UNEXPECTED BEHAVIOR OF APPLICATION

Follow those instructions to reduce electromagnetic perturbations, use the shielding connection kit BMXXSP••••, page 50 to connect the shielding without programmable filtering.

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

Wiring Diagram

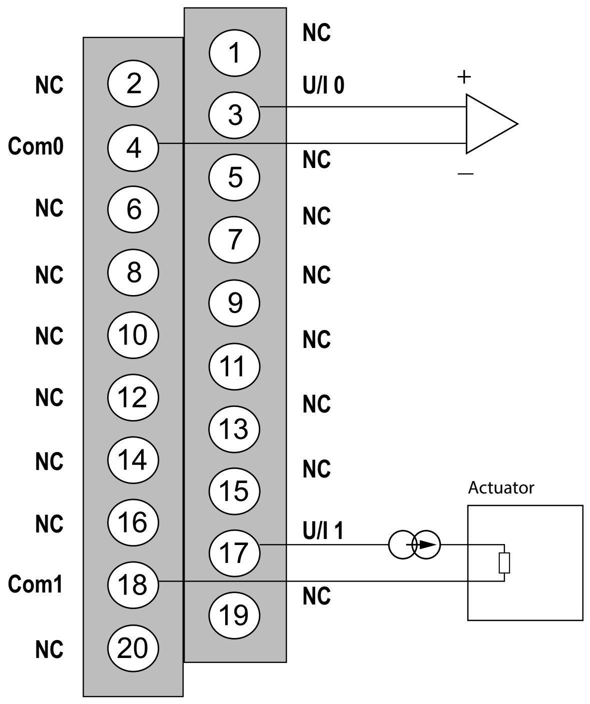
Introduction

The actuators are connected using the 20-point terminal block.

Illustration

The current loop is self-powered by the output and does not request any external supply. The terminal block connection and the actuators wiring are as follows.

Cabling view



U/Ix + pole output for channel x

COMx - pole output for channel x

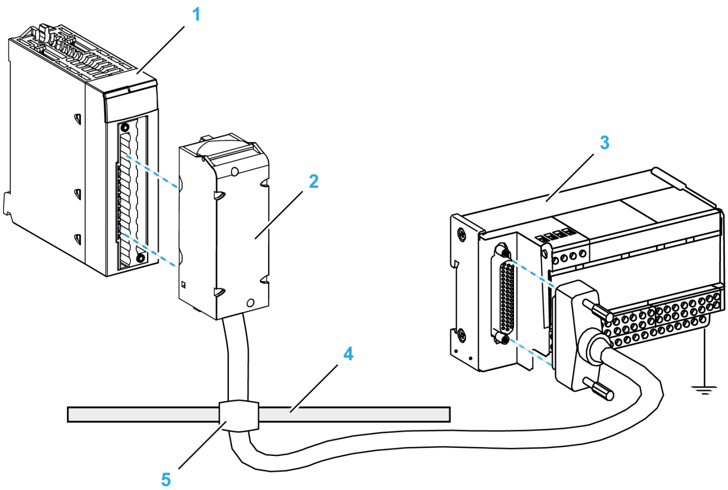
Channel 0: Voltage actuator

Channel 1: Current actuator

Use of the TELEFAST Wiring Accessories

Introduction

The TELEFAST pre-wired system consists of connecting cables and interface sub-bases as shown below:



1 BMX AMO 0210 module

2 BMXFCA••0 connecting cable

3 ABE-7CPA21 interface sub-base

4 Shield bar

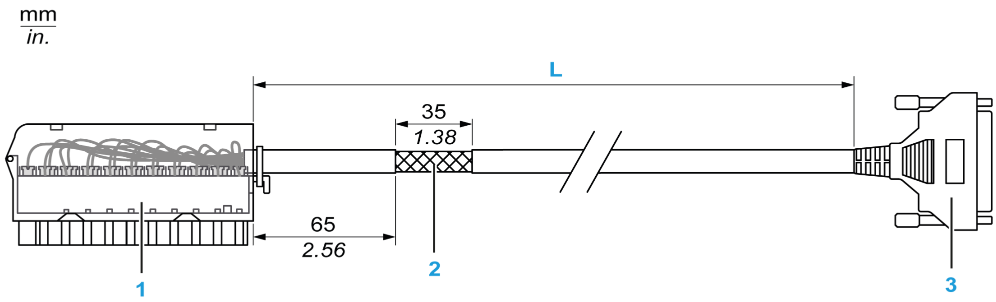
5 Clamp

BMX FCA ••0 Connecting Cables

The BMX FCA ••0 cables are pre-assembled cord set, made up of:

- At one end, a compound-filled 20-pin terminal block from which extend 1 cable sheath containing 20 wires,
- At the other end a 25-pin Sub-D connector.

The figure below shows the BMX FCA ••0 cables:



1 BMX FTB 2020 Terminal block

2 Cable shielding

3 25-pin Sub-D connector

L Length according to the part number.

The cable comes in 3 different lengths:

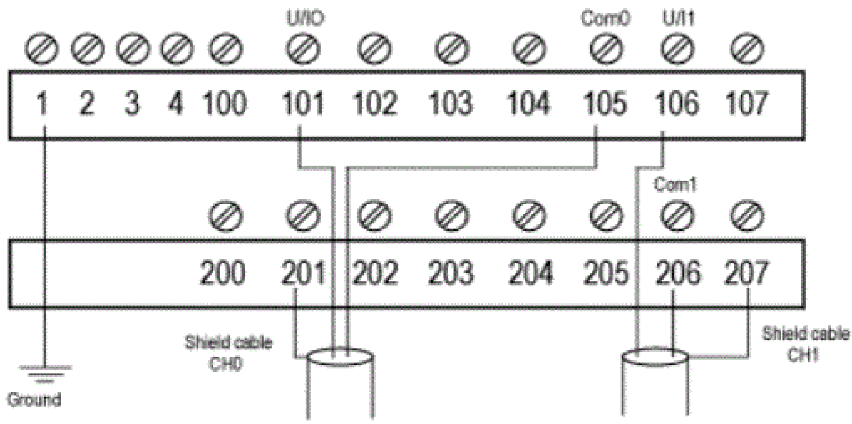
- 1.5 m (4.92 ft): BMX FCA 150
- 3 m (9.84 ft): BMX FCA 300
- 5 m (16.40 ft): BMX FCA 500

The following table gives the characteristics of the BMX FCA ••0 cables:

Characteristic		**Value**
Cable	Sheath material	PVC
	LSZH status	No
Environmental	Operating temperature	-25...70 °C (-13...158 °F)

Connecting Actuators

The BMX AMO 0210 analog outputs are accessible on the terminal block of the TELEFAST ABE-7CPA21 as follows:



The following table shows the distribution of analog outputs on the TELEFAST ABE-7CPA21 terminal block with a BMX FCA ••0 cable:

TELEFAST terminal block number	25-pin SubD connector pin number	BMXA-MO0210 pin out	Signal type	TELEFAST terminal block number	25-pin SubD connector pin number	BMXA-MO0210 pin out	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			200	14		
101	2	3	U/I0	201	/		Ground
102	15		NC	202	3		
103	16		NC	203	/		Ground
104	4		NC	204	17		NC
105	5	4	COM 0	205	/		Ground
106	18	17	U/I1	206	6	18	Com 1

TELEFAST terminal block number	25-pin SubD connector pin number	BMXA-MO0210 pin out	Signal type	TELEFAST terminal block number	25-pin SubD connector pin number	BMXA-MO0210 pin out	Signal type
107	19		NC	207	/		Ground
NC: Not Connected							

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

BMX AMO 0410 Analog Output Module

What's in This Chapter

Subject of this Chapter

This chapter presents the BMX AMO 0410 module, its characteristics, and explains how it is connected to the various pre-actuators and actuators.

Presentation

Function

The BMX AMO 0410 is a high density output analog module fitted with four isolated channels. It offers the following ranges for each output:

- Voltage +/-10 V
- Current 0..20 mA and 4..20 mA

The range is selected during configuration.

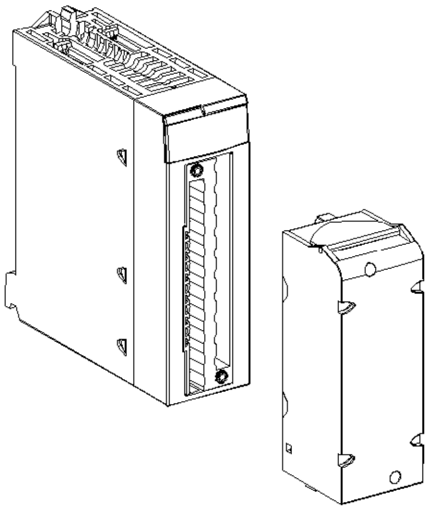
Ruggedized Version

The BMX AMO 0410H (hardened) equipment is the ruggedized version of the BMX AMO 0410 (standard) equipment. It can be used at extended temperatures and in harsh chemical environments.

For more information, refer to chapter *Installation in More Severe Environments* (see Modicon M580, M340, and X80 I/O Platforms, Standards and Certifications).

Illustration

The following graphic shows the BMX AMO 0410 analog output module:



NOTE: The terminal block is supplied separately.

Characteristics

Altitude Operating Conditions

The characteristics in the tables below apply to the modules BMX AMO 0410 and BMX AMO 0410H for use at altitude up to 2000 m (6560 ft). When the modules operate above 2000 m (6560 ft), apply additional derating.

For detailed information, refer to chapter *Operating and Storage Conditions* (see Modicon M580, M340, and X80 I/O Platforms, Standards and Certifications).

General Characteristics

The general characteristics for the BMX AMO 0410 and BMX AMO 0410H modules are as follows:

Operating temperature	BMX AMO 0410	0...60 ºC (32...140 ºF)
	BMX AMO 0410H	-25...70 ºC (-13...158 ºF)
Type of outputs		High level Fast outputs
Nature of outputs		Voltage or Current configured by software
Number of channels		4
Digital/Analog converter resolution		16 bits
Output refresh time		1 ms
Power supply for outputs		by the module
Types of protection		From short circuits and overloads (Voltage output)
Isolation: • Between channels • Between channels and bus • Between channels and ground		750 VDC 1400 VDC 1400 VDC
Detected measurement error for standard module: • At 25°C (77°F) • Maximum in the temperature range 0...60°C (32...140°F)		0.10% of FS(1) 0.20% of FS(1)
Detected measurement error for hardened module: • At 25°C (77°F) • Maximum in the temperature range -25...70°C (-13...158°F)		0.10% of FS(1) 0.45% of FS(1)
Temperature drift		45 ppm/°C
Monotonicity		Yes
Common mode rejection (50/60 Hz)		100 dB
Crosstalk between channels DC and AC 50/60Hz		> 80 dB
Non linearity		0.1% of FS(1)
AC output ripple		2 mV rms on 50 Ω
Power consumption (3.3 V)	**Typical**	0.45 W
	Maximum	0.51 W

Power consumption (24 V)	**Typical**	3.0 W
	Maximum	3.6 W
(1) FS: Full Scale		

Voltage Output

The BMX AMO 0410 and BMX AMO 0410H voltage outputs have the following characteristics:

Nominal variation range	+/-10 V
Maximum variation range	+/- 10.50 V
Analog resolution	0.37 mV
Load impedance	1 KΩ minimum
Detection type	Short circuits

Current Output

The BMX AMO 0410 and BMX AMO 0410H current outputs have the following characteristics:

Nominal variation range	0..20 mA, 4..20 mA
Available maximum current	21 mA
Analog resolution	0.74 µA
Load impedance	500 Ω maximum
Detection type	Open circuit(1)(2)
(1) The open circuit detection is physically detected by the module if the target current value is different from 0 mA. **(2)** Open circuit detection is enabled with the Wiring CTRL parameter.	

Response time of Outputs

The maximum delay between transmission of the output value on the PLC bus and its effective positioning on the terminal block is less than 2 ms:

- Internal cycle time = 1 ms for the four channels
- Digital/Analog conversion response time = 1 ms maximum for a 0-100% step.

NOTE: If nothing is connected on the BMX AMO 0410 analog module and the channels are configured in the range 4...20 mA, there is a detected I/O error as if a wire is broken.

For the 0...20 mA range, there is a detected I/O error as if a wire is broken only when the current is greater than 0 mA.

⚠ CAUTION

RISK OF INCORRECT DATA

If a signal wire is broken or disconnected, the last measured value is kept.

- Ensure that this does not cause a hazardous situation.
- Do not rely on the value reported. Check the input value at the sensor.

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

Functional Description

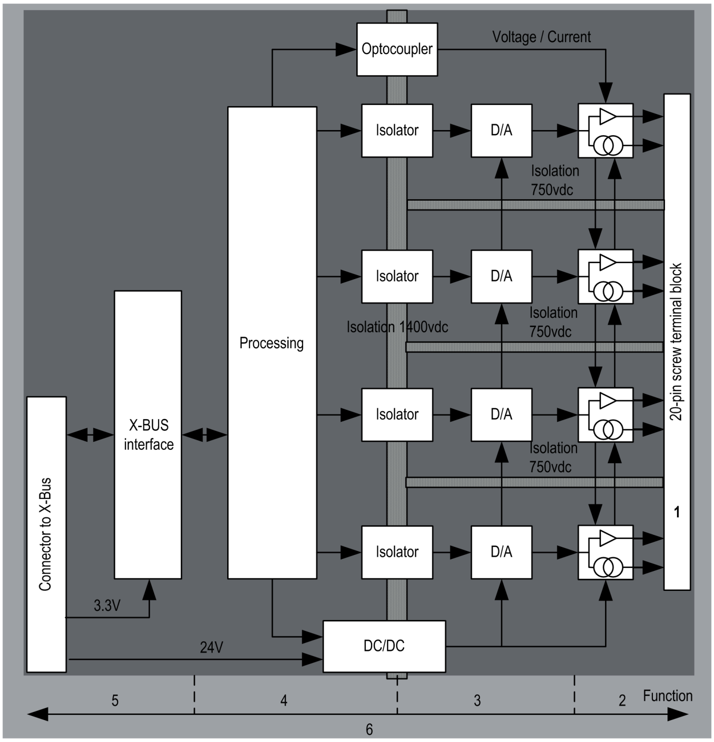
Function

The BMX AMO 0410 is a high density output analog module fitted with four isolated channels. This module offers the following ranges for each output, according to the selection made during configuration:

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

Illustration

The BMX AMO 0410 module's illustration is as follows:



Description:

Address	Process	Characteristics
1	Adapting the outputs	• physical connection to the process through a 20-pin screw terminal block • protecting the module against voltage spikes
2	Adapting the signal to the Actuators	• the adaptation is performed on voltage or current via software configuration
3	Converting	• this conversion is performed on 15 bits with a polarity sign • 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 digital/analog converter	• use of factory calibration parameters

Address	Process	Characteristics
5	Communicating with the Application	• manages exchanges with CPU • topological addressing • from the application, receiving the configuration parameters for the module and channels as well as numeric set points from the channels • sending module status back to application
6	Module monitoring and sending error notifications back to the application	• output power supply test • testing for range overflow on channels • testing for output open circuits and short-circuits • watchdog test • Programmable fallback capabilities

Writing Outputs

Confirm that the application provides the outputs with values in the standardized format:

- -10,000 to +10,000 for the +/-10 V range
- 0 to +10,000 in 0-20 mV and 4-20 mA ranges

Digital/Analog Conversion

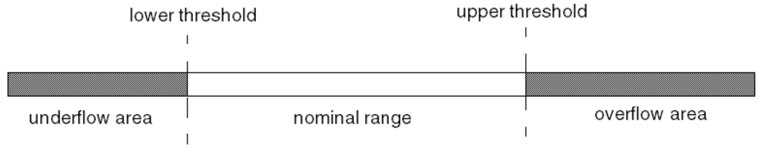
The digital/analog conversion is performed on:

- 16-bit for the +/-10 V range
- 15-bit in 0-20 mA and 4-20 mA ranges

Overflow Control

Module BMX AMO 0410 allows an overflow control on voltage and current ranges.

The measurement range is divided in three areas:



Description:

Designation	Description
Nominal range	measurement range corresponding to the chosen range
Overflow Area	area located beyond the upper threshold
Underflow Area	area located below the lower threshold

Overflow values for the various ranges are as follows:

Range	BMX AMO 0410					
	Underflow Area		Nominal Range		Overflow Area	
+/- 10V	-10,500	-10,301	-10,300	10,300	10,301	10,500
0..20mA	-2,000	-1,001	-1,000	10,300	10,301	10,500
4..20mA	-1,600	-801	-800	10,300	10,301	10,500

You may also choose the flag for an overflow of the range upper value, for an underflow of the range lower value, or for both.

NOTE: Range under/overflow detection is optional.

Fallback/Maintain or Reset Outputs to Zero

If an error is detected, and depending on its seriousness, the outputs:

- switch to Fallback/Maintain position individually or together,
- are forced to 0 (0 V or 0 mA).

Various Behaviors of Outputs:

Error	Behavior of Voltage Outputs	Behavior of Current Outputs
Task in STOP mode, or program missing	Fallback/Maintain (channel by channel)	Fallback/Maintain (channel by channel)
Communication interruption		
Configuration Error	0 V (all channels)	0 mA (all channels)
Internal Error in Module		
Output Value out-of-range (range under/ overflow)	Value saturated at the defined limit (channel by channel)	Saturated value (channel by channel)
Output short or open circuit	Short-circuit: Maintain (channel by channel)	Open circuit: Maintain (channel by channel)

Error	Behavior of Voltage Outputs	Behavior of Current Outputs
Module Hot swapping (processor in STOP mode)	0 V (all channels)	0 mA (all channels)
Reloading Program		

Fallback or Maintain at current value is selected during the configuration of the module.

⚠ WARNING

UNEXPECTED EQUIPMENT OPERATION

Do not use the fallback position as the sole safety method. If an uncontrolled position can result in a hazard, install an independent redundant system.

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

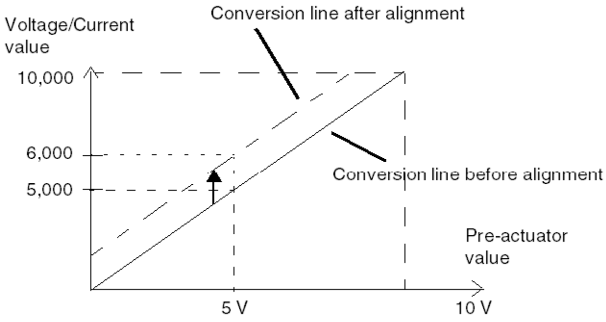
Behavior at Initial Power-Up and When Switched Off.

When the module is switched on or off, the outputs are set to 0 (0 V or 0 mA).

Actuator Alignment

The process of "alignment" consists in eliminating a systematic offset observed with a given actuator, 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 actuator or changing the sensor's operating point does require a new alignment.

Conversion lines are as follows:



The alignment value is editable from a programming console, even if the program is in RUN Mode. For each output channel, you can:

- view and modify the initial output target value
- save the alignment value
- determine whether the channel already has an alignment

The maximum offset between the measured value and the corrected output value (aligned value) may not exceed +/- 1.500.

NOTE: To align several analog channels on the BMX AMO/AMI/AMM/ART modules, we recommend proceeding channel by channel. Test each channel after alignment before moving to the next channel in order to apply the parameters correctly.

Wiring Precautions

Introduction

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

Cable Shielding

Connect the cable shielding to the grounding bar. Clamp the shielding to the shield bar on the module side. Use the shielding connection kit BMXXSP••••, page 50 to connect the shielding.

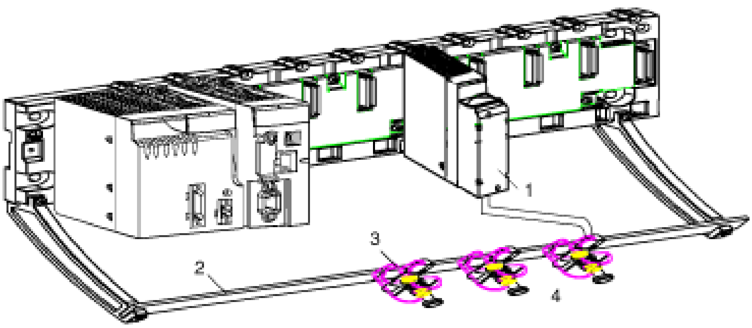
DANGER

HAZARD OF ELECTRIC SHOCK, EXPLOSION, OR ARC FLASH

While mounting / removing the modules:

- Make sure that each terminal block is still connected to the shield bar.
- Disconnect voltage supplying sensors and pre-actuators.

Failure to follow these instructions will result in death or serious injury.



1 BMX AMO 0410

2 Shield bar

3 Clamp

4 To pre-actuators

Using Pre-Actuators Referenced in Relation to the Ground

There are no specific technical constraints for referencing pre-actuators to the ground. It is nevertheless preferable to avoid returning a remote ground potential to the terminal that may be different to the ground potential close by.

NOTE: Sensors and other peripherals may be connected to a grounding point some distance from the module. Such remote ground references may carry considerable potential differences with respect to local ground.

⚠⚠DANGER

HAZARD OF ELECTRIC SHOCK, EXPLOSION, OR ARC FLASH

Ensure that:

- Potentials greater than safety limits do not exist.
- Induced currents do not affect the measurement or integrity of the system.

Failure to follow these instructions will result in death or serious injury.

Electromagnetic hazard instructions

Electromagnetic perturbations may lead to an unexpected behavior of the application.

⚠CAUTION

UNEXPECTED BEHAVIOR OF APPLICATION

To reduce electromagnetic perturbations, use the shielding connection kit BMXXSP••••, page 50 to connect the shielding without programmable filtering.

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

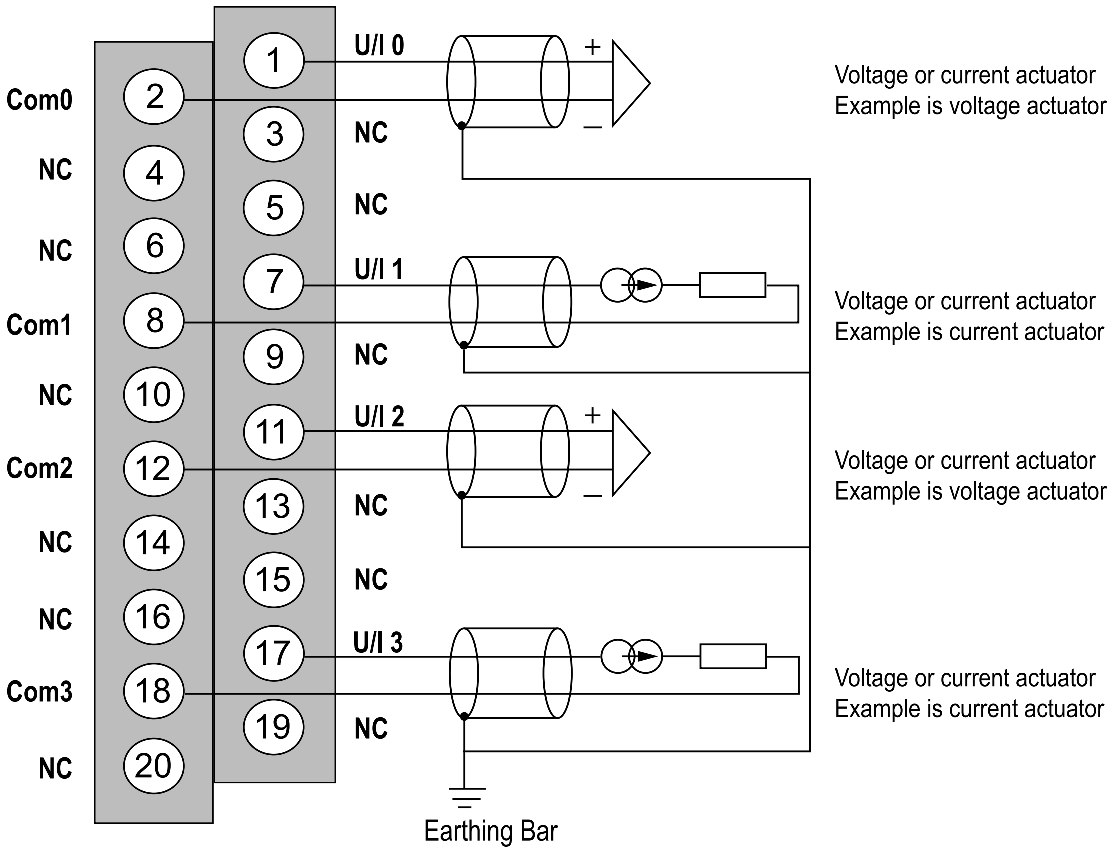
Wiring Diagram

Introduction

The actuators are connected using the 20-pin terminal block.

Illustration

The current loop is self-powered by the output and does not request any external supply. The terminal block connection and the actuators wiring are as follows:



U/Ix + pole output for channel x

COMx - pole output for channel x

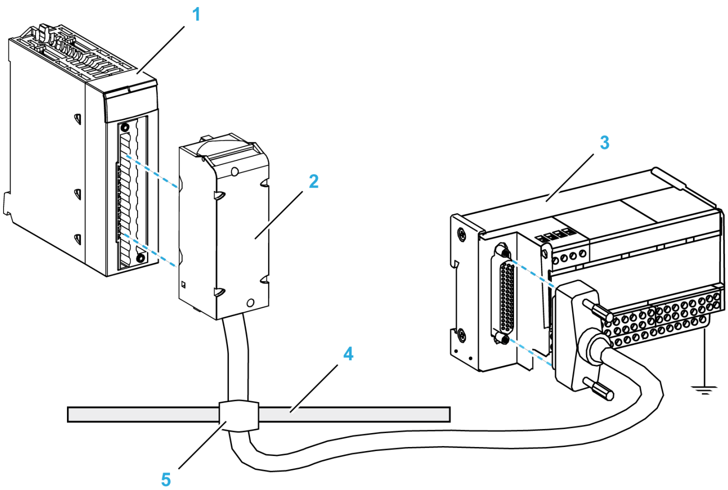
Channel 0: Voltage actuator

Channel 1: Current actuator

Use of the TELEFAST Wiring Accessories

Introduction

The TELEFAST pre-wired system consists of connecting cables and interface sub-bases as shown below:



1 BMX AMO 0410 module

2 BMXFCA••0 connecting cable

3 ABE-7CPA21 interface sub-base

4 Shield bar

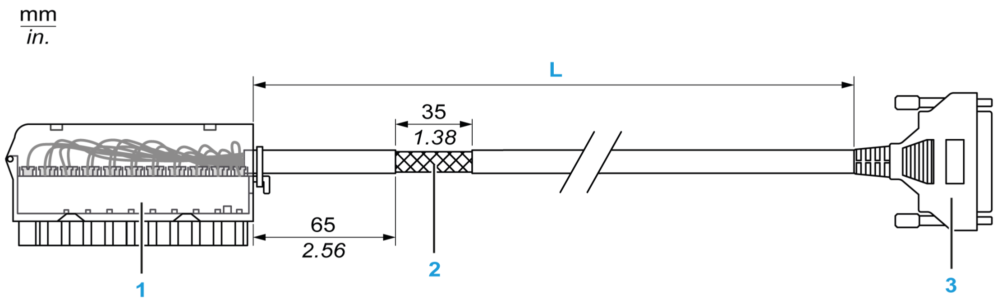
5 Clamp

BMX FCA ••0 Connecting Cables

The BMX FCA ••0 cables are pre-assembled cord set, made up of:

- At one end, a compound-filled 20-pin terminal block from which extend 1 cable sheath containing 20 wires,
- At the other end a 25-pin Sub-D connector.

The figure below shows the BMX FCA ••0 cables:



1 BMX FTB 2020 Terminal block

2 Cable shielding

3 25-pin Sub-D connector

L Length according to the part number.

The cable comes in 3 different lengths:

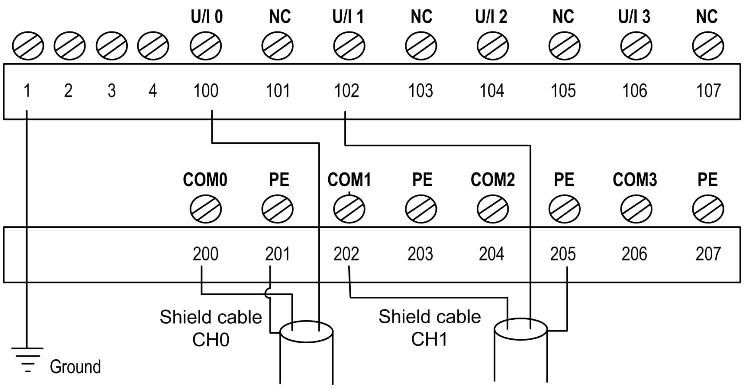
- 1.5 m (4.92 ft): BMX FCA 150
- 3 m (9.84 ft): BMX FCA 300
- 5 m (16.40 ft): BMX FCA 500

The following table gives the characteristics of the BMX FCA ••0 cables:

Characteristic		Value
Cable	Sheath material	PVC
	LSZH status	No
Environmental	Operating temperature	-25...70 °C (-13...158 °F)

Connecting Actuators

The analog outputs are accessible on the terminals of the TELEFAST ABE-7CPA21 as follows:



The following table shows the distribution of analog channels on the TELEFAST ABE-7CPA21 terminal block with a BMX FCA ••0 cable:

TELEFAST terminal block number	25-pin Sub-D connector pin number	BMXA-MO0410 pin out	Signal type	TELEFAST terminal block number	25-pin Sub-D connector pin number	BMXA-MO0410 pin out	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	1	U/I0	200	14	2	Com 0
101	2		NC	201	/		Ground
102	15	7	U/I1	202	3	8	Com 1
103	16		NC	203	/		Ground
104	4	11	U/I2	204	17	12	Com 2
105	5		NC	205	/		Ground
106	18	17	U/I3	206	6	18	Com 3
107	19		NC	207	/		Ground
NC: Not Connected							

NOTE: Remove the strap with the ABE-7CPA21 from the terminal, otherwise the signal ground of channel 0 will be connected to earth.

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

BMX AMO 0802 Analog Output Module

What's in This Chapter

Subject of this Chapter

This chapter presents the BMX AMO 0802 module, its characteristics, and explains how it is connected to the various pre-actuators and actuators.

Presentation

Function

The BMX AMO 0802 is a high density output analog module fitted with 8 non-isolated channels. It offers the following current ranges for each output:

- 0..20 mA
- 4..20 mA

The range is selected during configuration.

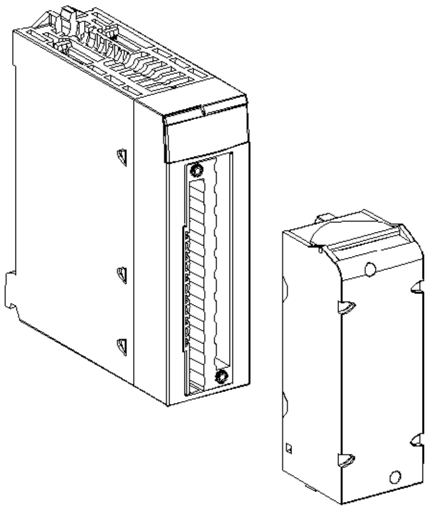
Ruggedized Version

The BMX AMO 0802H (hardened) equipment is the ruggedized version of the BMX AMO 0802 (standard) equipment. It can be used at extended temperatures and in harsh chemical environments.

For more information, refer to chapter *Installation in More Severe Environments* (see Modicon M580, M340, and X80 I/O Platforms, Standards and Certifications).

Illustration

The following graphic shows the BMX AMO 0802 analog output module:



NOTE: The terminal block is supplied separately.

Characteristics

Altitude Operating Conditions

The characteristics in the tables below apply to the modules BMX AMO 0802 and BMX AMO 0802H for use at altitude up to 2000 m (6560 ft). When the modules operate above 2000 m (6560 ft), apply additional derating.

For detailed information, refer to chapter *Operating and Storage Conditions* (see Modicon M580, M340, and X80 I/O Platforms, Standards and Certifications).

General Characteristics

The general characteristics for the BMX AMO 0802 and BMX AMO 0802H modules are as follows:

Operating temperature	BMX AMO 0802	0...60 ºC (32...140 ºF)
	BMX AMO 0802H	-25...70 ºC (-13...158 ºF)
Type of outputs		Non-isolated high level outputs with common point
Nature of outputs		Current
Number of channels		8
Digital/Analog converter resolution		16 bits
Output refresh time		4 ms
Power supply for outputs		by the module
Types of protection		Outputs help protect against to short circuits and permanent overloads
Isolation: • Between channels • Between channels and bus • Between channels and ground		 Non-isolated 1400 VDC 1400 VDC
Detected measurement error for standard module: • At 25 °C (77 °F) • Maximum in the temperature range 0...60 °C (32...140 °F)		 0.10% of FS(1) 0.25% of FS(1)
Detected measurement error for ruggedized: • At 25 °C (77 °F) • Maximum in the temperature range -25...70 °C (-13...158 °F)		 0.10% of FS(1) 0.45% of FS(1)
Temperature drift		45 ppm/°C
Monotonicity		Yes
Common mode rejection (50/60 Hz)		80 dB
Crosstalk between channels DC and AC 50/60Hz		> 80 dB
Non linearity		0.1% of FS(1)
AC output ripple		2 mV rms on 50 Ω
Power consumption (3.3 V)	**Typical**	0.35 W
	Maximum	0.48 W

Power consumption (24 V)	**Typical**	3.60 W
	Maximum	3.90 W
(1) FS: Full Scale		

Current Output

The BMX AMO 0802 and BMX AMO 0802H current outputs have the following characteristics:

Nominal variation range	0...20 mA, 4...20 mA
Available maximum current	21 mA
Analog resolution	0.74 µA
Load impedance	350 Ω maximum
Detection type	Open circuit(1)(2)
(1) The open circuit detection is physically detected by the module if the target current value is different from 0 mA. **(2)** Open circuit detection is enabled with the Wiring CTRL parameter.	

Response time of Outputs

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

- Internal cycle time = 4 ms for the eight channels
- Digital/Analog conversion response time = 1 ms maximum for a 0-100% step.

NOTE: If nothing is connected on the BMX AMO 0802 analog module and the channels are configured in the range 4...20 mA, there is a detected I/O error as if a wire is broken.

For the 0...20 mA range, there is a detected I/O error as if a wire is broken only when the current is greater than 0 mA.

⚠ CAUTION

RISK OF INCORRECT DATA

If a signal wire is broken or disconnected, the last measured value is kept.

- Ensure that this does not cause a hazardous situation.
- Do not rely on the value reported. Check the input value at the sensor.

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

Functional Description

Function

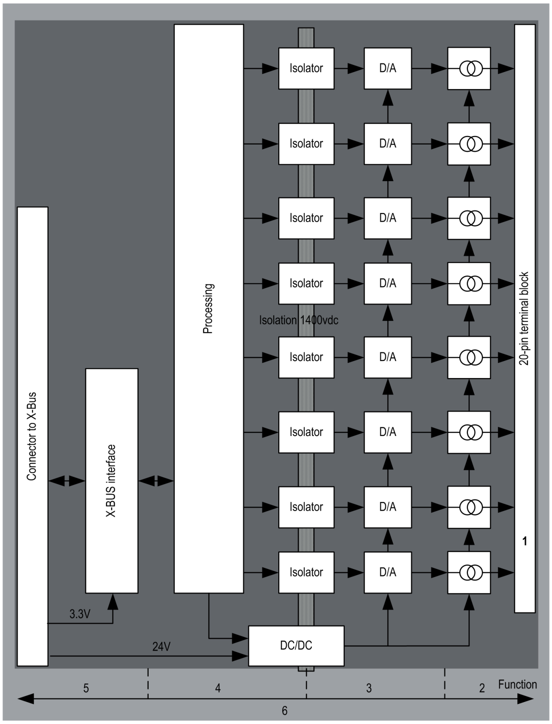
The BMX AMO 0802 is a high density output analog module fitted with 8 non-isolated channels. It offers the following current ranges for each output:

- 0..20 mA
- 4..20 mA

The range is selected during configuration.

Illustration

The BMX AMO 0802 module's illustration is as follows:



Description:

Address	Process	Characteristics
1	Adapting the outputs	• physical connection to the process through a 20-pin screw terminal block • protecting the module against voltage spikes
2	Adapting the signal to the Actuators	• the adaptation is performed on current via software configuration
3	Converting	• this conversion is performed on 15 bits with a polarity sign • 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 digital/analog converter	• use of factory calibration parameters

Address	Process	Characteristics
5	Communicating with the Application	• manages exchanges with CPU • topological addressing • from the application, receiving the configuration parameters for the module and channels as well as numeric set points from the channels • sending module status back to application
6	Module monitoring and sending error notifications back to the application	• output power supply test • testing for range overflow on channels • testing for output open circuits and short-circuits • watchdog test • Programmable fallback capabilities

Writing Outputs

Confirm that the application provides the outputs with values in the standardized format: 0 to +10,000 in 0..20 mV and 4..20 mA ranges.

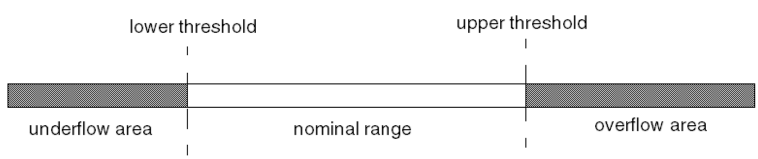
Digital/Analog Conversion

The digital/analog conversion is performed on: 15-bit in 0..20 mA and 4..20 mA ranges.

Overflow Control

Module BMX AMO 0802 only allows an overflow control on current ranges.

The measurement range is divided in three areas:



Description:

Designation	Description
Nominal range	measurement range corresponding to the chosen range
Overflow Area	area located beyond the upper threshold
Underflow Area	area located below the lower threshold

Overflow values for the various ranges are as follows:

Range	BMX AMO 0802					
	Underflow Area		Nominal Range		Overflow Area	
0..20mA	-2,000	-1,001	-1,000	10,300	10,301	10,500
4..20mA	-1,600	-801	-800	10,300	10,301	10,500

You may also choose the flag for an overflow of the range upper value, for an underflow of the range lower value, or for both.

NOTE: Range under/overflow detection is optional.

Fallback/Maintain or Reset Outputs to Zero

If an error is detected, and depending on its seriousness, the outputs:

- switch to Fallback/Maintain position individually or together,
- are forced to 0 mA.

Various Behaviors of Outputs:

Error	Behavior of Outputs
Task in STOP mode, or program missing	Fallback/Maintain (channel by channel)
Communication interruption	
Configuration Error	0 mA (all channels)
Internal Error in Module	
Output Value out-of-range (range under/overflow)	Saturated value (channel by channel)
Output open circuit	Maintain (channel by channel)
Module Hot swapping (processor in STOP mode)	0 mA (all channels)
Reloading Program	

Fallback or Maintain at current value is selected during the configuration of the module.

⚠ WARNING

UNEXPECTED EQUIPMENT OPERATION

Do not use the fallback position as the sole safety method. If an uncontrolled position can result in a hazard, install an independent redundant system.

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

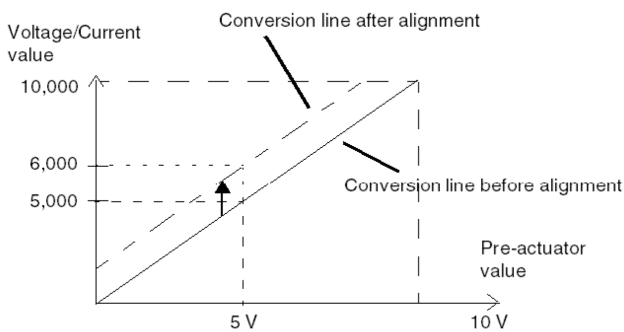
Behavior at Initial Power-Up and When Switched Off.

When the module is switched on or off, the outputs are set to 0 mA.

Actuator Alignment

The process of "alignment" consists in eliminating a systematic offset observed with a given actuator, 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 actuator or changing the sensor's operating point does require a new alignment.

Conversion lines are as follows:



The alignment value is editable from a programming console, even if the program is in RUN Mode. For each output channel, you can:

- view and modify the initial output target value

- save the alignment value
- determine whether the channel already has an alignment

The maximum offset between the measured value and the corrected output value (aligned value) may not exceed +/- 1.500.

NOTE: To align several analog channels on the BMX AMO/AMI/AMM/ART modules, we recommend proceeding channel by channel. Test each channel after alignment before moving to the next channel in order to apply the parameters correctly.

Wiring Precautions

Introduction

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

Cable Shielding

Connect the cable shielding to the grounding bar. Clamp the shielding to the shield bar on the module side. Use the shielding connection kit BMXXSP••••, page 50 to connect the shielding.

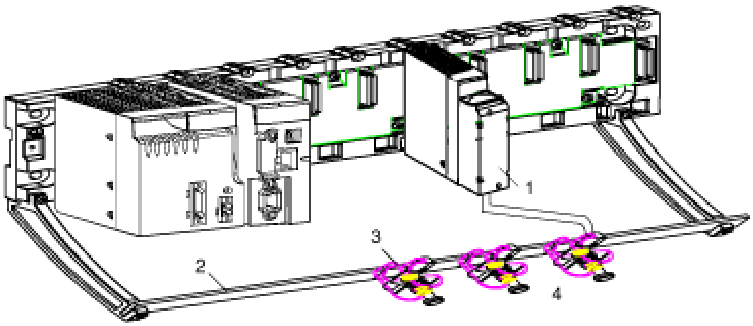
⚠⚠DANGER

HAZARD OF ELECTRIC SHOCK, EXPLOSION, OR ARC FLASH

While mounting / removing the modules:

- Make sure that each terminal block is still connected to the shield bar.
- Disconnect voltage supplying sensors and pre-actuators.

Failure to follow these instructions will result in death or serious injury.



1 BMX AMO 0802

2 Shield bar

3 Clamp

4 To pre-actuators

Using Pre-Actuators Referenced in Relation to the Ground

There are no specific technical constraints for referencing pre-actuators to the ground. It is nevertheless preferable to avoid returning a remote ground potential to the terminal that may be different to the ground potential close by.

NOTE: Sensors and other peripherals may be connected to a grounding point some distance from the module. Such remote ground references may carry considerable potential differences with respect to local ground. Induced currents do not affect the measurement or integrity of the system.

DANGER

HAZARD OF ELECTRIC SHOCK, EXPLOSION, OR ARC FLASH

Ensure that sensors and other peripherals are not exposed through grounding points to voltage potential greater than acceptable limits.

Failure to follow these instructions will result in death or serious injury.

Electromagnetic hazard instructions

Electromagnetic perturbations may lead to an unexpected behavior of the application.

⚠ CAUTION
UNEXPECTED BEHAVIOR OF APPLICATION To reduce electromagnetic perturbations, use the shielding connection kit BMXXSP••••, page 50 to connect the shielding without programmable filtering. **Failure to follow these instructions can result in injury or equipment damage.**

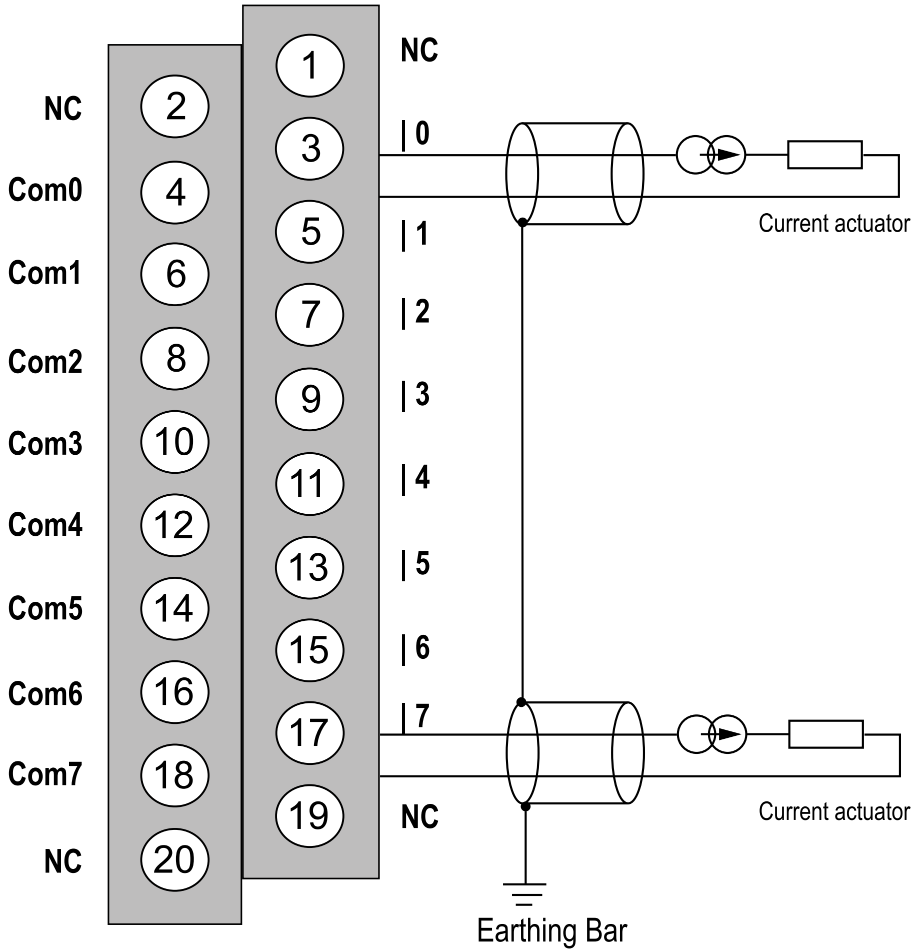
Wiring Diagram

Introduction

The actuators are connected using the 20-pin terminal block.

Illustration

The current loop is self-powered by the output and does not request any external supply. The terminal block connection and the actuators wiring are as follows:



Ix + pole output for channel x.

COMx - pole output for channel x, COMx are connected together internally.

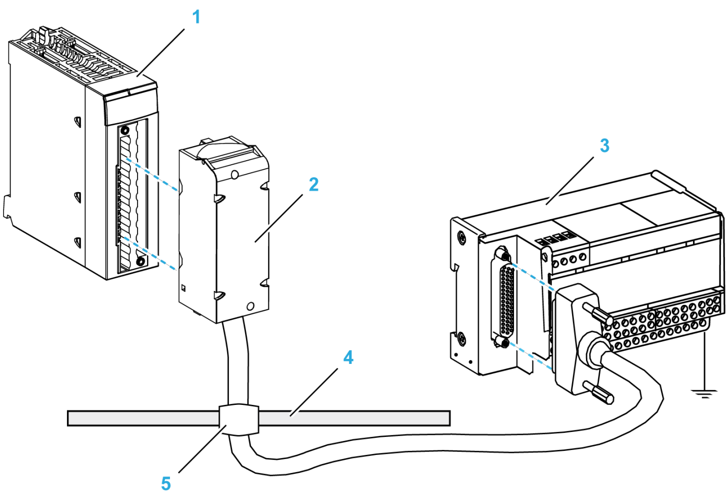
Wiring Accessories

Two cords BMX FTA 152/302 are provided in two lengths (1.5m (4.92 ft), 3m (9.84 ft)) to connect the module to a Telefast interface ABE7CPA02, page 203.

Use of the TELEFAST Wiring Accessories

Introduction

The TELEFAST pre-wired system consists of connecting cables and interface sub-bases as shown below:



1 BMX AMO 0802 module

2 BMXFTA••2 connecting cable

3 ABE-7CPA02 interface sub-base

4 Shield bar

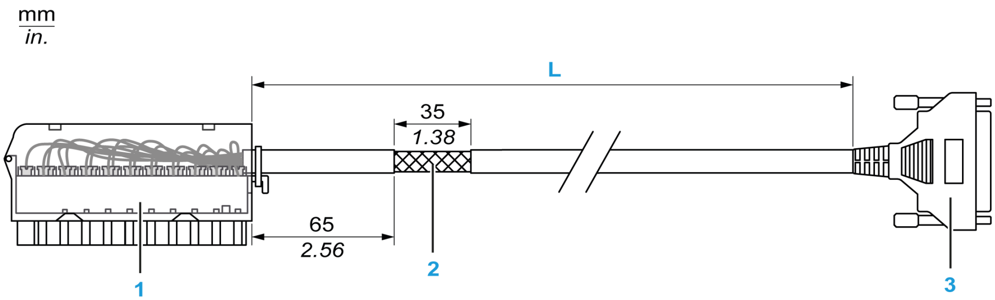
5 Clamp

BMX FTA ••2 Connecting Cables

The BMX FTA ••2 cables are pre-assembled cord set, made up of:

- At one end, a compound-filled 20-pin terminal block from which extend 1 cable sheath containing 20 wires,
- At the other end a 25-pin Sub-D connector.

The figure below shows the BMX FTA ••2 cables:



1 BMX FTB 2020 Terminal block

2 Cable shielding

3 25-pin Sub-D connector

L Length according to the part number.

The cable comes in 3 different lengths:

- 1.5 m (4.92 ft): BMX FTA 152
- 3 m (9.84 ft): BMX FTA 302

The following table gives the characteristics of the BMX FTA ••2 cables:

Characteristic		**Value**
Cable	Sheath material	PVC
	LSZH status	No
Environmental	Operating temperature	-25...70 °C (-13...158 °F)

Connecting Actuators

Actuators may be connected to the ABE-7CPA02 accessory as shown in the illustration, page 202.

The following table shows the distribution of analog channels on TELEFAST terminal blocks with the reference ABE-7CPA02:

TELEFAST terminal block number	**25 pin Sub-D connector pin number**	**BMXA-MO0802 pin out**	**Signal type**	**TELEFAST terminal block number**	**25 pin Sub-D connector pin number**	**BMXA-MO0802 pin out**	**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	3	I0	200	14	4	COM0
101	2		NC	201	/		Ground
102	15	5	I1	202	3	6	COM1
103	16		NC	203	/		Ground
104	4	7	I2	204	17	8	COM2
105	5		NC	205	/		Ground
106	18	9	I3	206	6	10	COM3
107	19		NC	207	/		Ground
108	7	11	I4	208	20	12	COM4
109	8		NC	209	/		Ground
110	21	13	I5	210	9	14	COM5
111	22		NC	211	/		Ground
112	10	15	I6	212	23	16	COM6
113	11		NC	213	/		Ground
114	24	17	I7	214	12	18	COM7
115	25		NC	215	/		Ground
Ix: + pole voltage input for channel x COMx: - pole voltage or current input for channel x NC: Not Connected							

NOTE: Remove the strap from the ABE-7CPA02 terminal, otherwise the signal ground of channels will be connected with earth.

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

BMX AMM 0600 Analog Input/Output Module

What's in This Chapter

Subject of this Chapter

This chapter presents the BMX AMM 0600 module, its characteristics, and explains how it is connected to the various sensors and pre-actuators.

Presentation

Function

The BMX AMM 0600 Input/Output module combines 4 non-isolated analog inputs with 2 non-isolated analog outputs.

The BMX AMM 0600 module offers the following range, according to the selection made during configuration:

- Voltage input range +/-10 V/0..10 V/0..5 V/1..5 V
- Current input range 0...20 mA/4...20 mA
- Voltage output range +/-10 V
- Current output range 0...20 mA/4...20 mA

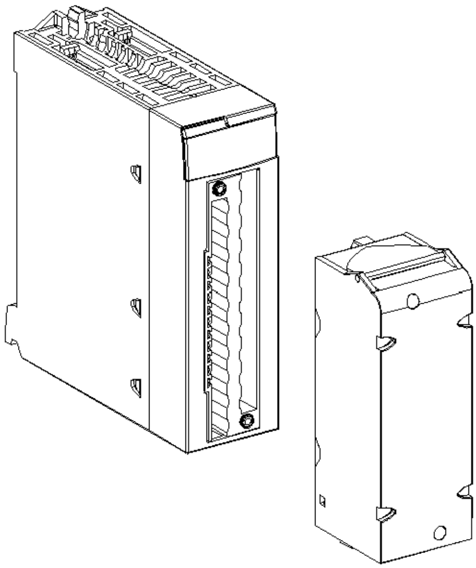
Ruggedized Version

The BMX AMM 0600H (hardened) equipment is the ruggedized version of the BMX AMM 0600 (standard) equipment. It can be used at extended temperatures and in harsh chemical environments.

For more information, refer to chapter *Installation in More Severe Environments* (see Modicon M580, M340, and X80 I/O Platforms, Standards and Certifications).

Illustration

BMX AMM 0600 analog input/output module looks like this.



NOTE: The 20-pin terminal block is supplied separately.

Characteristics

Altitude Operating Conditions

The characteristics in the tables below apply to the modules BMX AMM 0600 and BMX AMM 0600H for use at altitude up to 2000 m (6560 ft). When the modules operate above 2000 m (6560 ft), apply additional derating.

For detailed information, refer to chapter *Operating and Storage Conditions* (see Modicon M580, M340, and X80 I/O Platforms, Standards and Certifications).

General Inputs Characteristics

The BMX AMM 0600 and BMX AMM 0600H general input characteristics are as follows:

Operating temperature	BMX AMM 0600	0...60 ºC (32...140 ºF)
	BMX AMM 0600H	-25...70 ºC (-13...158 ºF)
Type of inputs		Non-isolated single ended inputs
Nature of inputs		Voltage / Current
Number of channels		4 inputs
Acquisition cycle time:		
• fast (periodic acquisition for the declared channels used)		1 ms + 1 ms x number of channels used
• default (periodic acquisition for all channels)		5 ms
Resolution		14-bit in +/- 10 V 12-bit in 0...5 V
Digital filtering		First order
Isolation: • between inputs channels group and output channels group • between channels and bus • between channels and ground		 750 VDC 1400 VDC 1400 VDC
Maximum overload authorized for inputs:		Voltage inputs: +/- 30 VDC Current inputs: +/- 90 mA
Power consumption (3.3 V)	**Typical**	0.35 W
	Maximum	0.48 W
Power consumption (24 V)	**Typical**	2.6 W
	Maximum	3.2 W

Input Measurement Range

The BMX AMM 0600 and BMX AMM 0600H have the following input measurement range characteristics:

Measurement range	**+/-10 V** **0...10 V; 0...5 V; 1...5 V**	**0...20 mA; 4...20 mA**
Maximum conversion value	+/-11.25 V	0...30 mA
Resolution	1.42 mV	5.7 µA

Measurement range	**+/-10 V** **0...10 V; 0...5 V; 1...5 V**	**0...20 mA; 4...20 mA**
Input impedance	10 MΩ	250 Ω internal conversion resistor
Precision of the internal conversion resistor	-	0.1%-15 ppm/°C
Detected measurement error for inputs for standard modules:		
• At 25 °C (77 °F) • Maximum in the temperature range 0...60 °C (-32...140 °F)	0.25% of FS(1) 0.35% of FS(1)	0.35% of FS(1)(2) 0.50% of FS(1)(2)
Detected measurement error for inputs for hardened modules:		
• At 25 °C (77 °F) • Maximum in the temperature range -25...70 °C (-13...158 °F)	0.25% of FS(1) 0.40% of FS(1)	0.35% of FS(1)(2) 0.60% of FS(1)(2)
Input temperature drift	30 ppm/°C	50 ppm/°C
Monotonicity	Yes	Yes
Common mode rejection (50/60 Hz)	80 dB	80 dB
Crosstalk between channels DC and AC 50/60 Hz	> 70 dB	> 70 dB
Non linearity	0.10% of FS(1)	0.10% of FS(1)(2)
(1) FS: Full Scale **(2)** Detected conversion resistor error		

NOTE: If nothing is connected on BMX AMM 0600 and BMX AMM 0600H analog input/output module and if channels are configured (range 4...20 mA or 1...5 V) a broken wire causes a detected I/O error.

General Output Characteristics

The BMX AMM 0600 and BMX AMM 0600H general output characteristics are as follows:

Type of Outputs	2 Non-isolated Outputs
Range configuration	Voltage or self-powered current range selection by firmware

Voltage range

The BMX AMM 0600 and BMX AMM 0600H voltage range has the following characteristics:

Nominal variation range	+/-10 V
Maximum variation range	+/- 11.25 V
Voltage resolution	12 bits
Detected measurement error for standard module:	
• At 25 °C (77 °F) • Maximum in the temperature range 0...60 °C (-32...140 °F)	0.25% of FS(1) 0.60% of FS(1)
Detected measurement error for hardened module:	
• At 25 °C (77 °F) • Maximum in the temperature range -25...70 °C (-13...158 °F)	0.25% of FS(1) 0.80% of FS(1)
Temperature drift	100 ppm/°C
Monotonicity	Yes
Common mode rejection (50/60 Hz)	80 dB
Crosstalk between channels DC and AC 50/60 Hz	> 70 dB
Non linearity	0.1% of FS
AC output ripple	2 mV rms on 50 Ω BW < 25MHz
Load impedance	1 KΩ minimum
Detection type	Short circuits and overloads
(1) FS: Full Scale	

Current Range

The BMX AMM 0600 and BMX AMM 0600H current range has the following characteristics.

Nominal variation range	0...20 mA / 4...20 mA
Available maximum current	24 mA
Current resolution	11 bits

Detected measurement error: • at 25 °C (77 °F) • maximum in temperature range	0.25% of FS(1) 0.60% of FS(1)
Temperature drift	100 ppm/°C
Monotonicity	Yes
Non linearity	0.1% of FS(1)
Common mode rejection (50/60 Hz)	80 dB
Crosstalk between channels DC and AC 50/60 Hz	> 70 dB
AC output ripple	2 mV rms on 50 Ω BW < 25MHz
Load impedance	600 Ω maximum
Detection type	Open circuit(2)(3)
(1) FS: Full Scale **(2)** The open circuit detection is physically detected by the module in range 4...20 mA. It is also detected if the target current value is different from 0 mA in range 0...20 mA. **(3)** Open circuit detection is enabled with the Wiring CTRL parameter.	

Response time of Outputs

The maximum delay between transmission of the output value on the PLC bus and its effective positioning on the terminal block is less than 2 ms:

- internal cycle time = 1 ms for the two outputs
- digital/analog conversion response time = 1ms maximum for a 0-100% step.

Functional Description

Function

The Input/Output module combines 4 non-isolated analog inputs with 2 non-isolated analog outputs. However, input and output blocks are isolated.

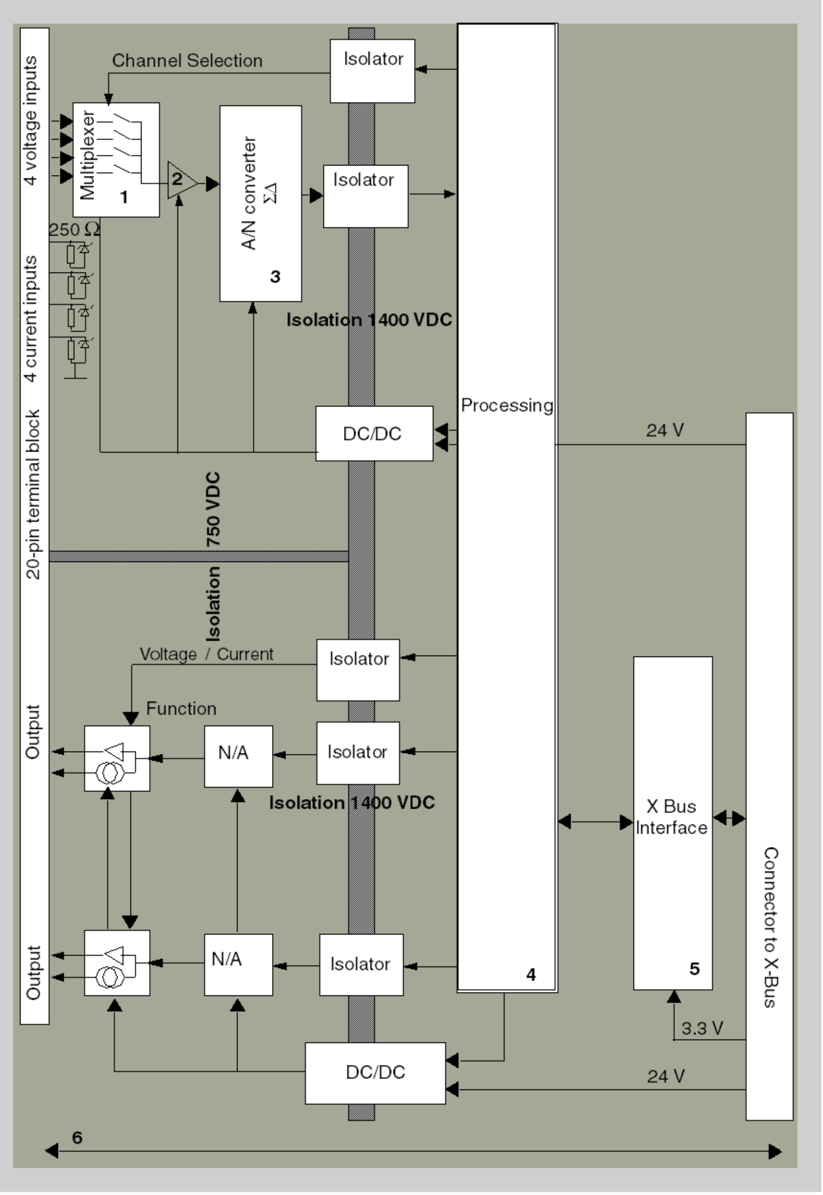
The module offers the following range, according to the selection made during configuration:

- Voltage input range +/-10 V/0...10 V/0...5 V/1...5 V

- Current input range 0...20 mA/4...20 mA
- Voltage output range +/-10 V
- Current output range 0...20 mA/4...20 mA

Illustration

The module's illustration is as follows.



Description.

Address	Process	Characteristics
1	Adaptation	• physical connection to the process through a 20-pin screw terminal block • helps protect the module against voltage spikes
2	Adapting the signal	• performed on voltage or current via software configuration
3	Converting	• performed on 13 bits with a polarity sign • 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 digital/ analog converter	• use of factory calibration parameters
5	Communicating with the Application	• manages exchanges with CPU • topological addressing • receiving, from the application, configuration parameters for the module and channels, as well as numeric set points from the channels • sending module status back to application
6	Module monitoring and sending detected error notifications back to the application	• testing for range overflow on channels • testing for output open circuits or short-circuits • watchdog test • Programmable fallback capabilities

Input functions: Measurement Timing

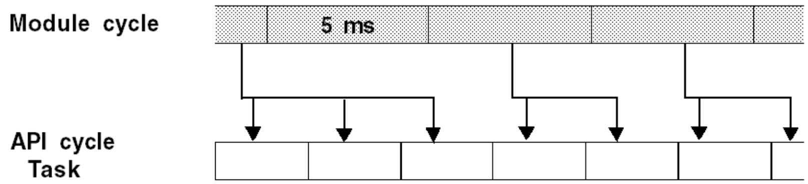
The timing of measurements is determined by the cycle selected during configuration: Normal or Fast Cycle.

- 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.

The cycle time values are based on the cycle selected.

Module	Normal Cycle	Fast Cycle
	5 ms	1 ms + (1 ms x N) 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 bus cycle time is less than the module's cycle time, some values will not have changed.

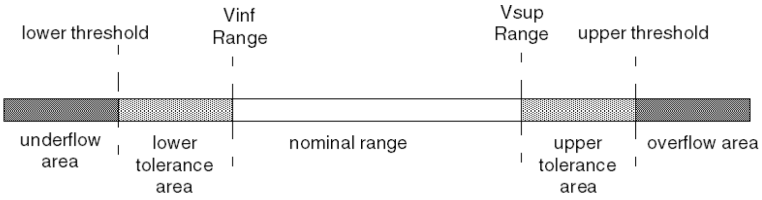


Input functions: Overflow/Underflow Control

Module allows the user to select between 6 voltage or current ranges for each input.

This option for each channel have to be configured in configuration windows. Upper and lower tolerance detection are always active regardless of overflow/underflow control.

Depending on the range selected, the module checks for overflow: it helps ensure that the measurement falls between a lower and an upper threshold.



Description:

Designation	Description
Nominal range	measurement range corresponding to 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

The values of the thresholds are configurable independently from one another. They may assume integer values between the following limits.

	Range	BMX AMM 0600 Inputs									
		Underflow Area		**Lower Tolerance Area**		**Nominal Range**		**Upper Tolerance Area**		**Overflow Area**	
Unipolar	0...10 V	-1,250	-1,001	-1,000	-1	0	10,000	10,001	11,000	11,001	11,250
	0...5 V / 0...20 mA	-5,000	-1,001	-1,000	-1	0	10,000	10,001	11,000	11,001	15,000
	1...5 V / 4...20 mA	-4,000	-801	-800	-1	0	10,000	10,001	10,800	10,801	14,000
Bipolar	+/- 10 V	-11,250	-11,001	-11,000	-10,001	-10,000	10,000	10,001	11,000	11,001	11,250
User	+/- 10 V	-32,768				User-defined	User-defined				32,767
	0...10 V	-32,768				User-defined	User-defined				32,767

Input functions: Measurement Display

Measurements may be displayed using standardized display (in %, to two decimal places).

Type of Range	Display
Unipolar range 0...10 V, 0...5 V, 1...5 V, 0...20 mA, 4...20 mA	from 0 to 10,000 (0 % at +100.00 %)
Bipolar range +/- 10 V, +/- 5 mV +/- 20 mA	from -10,000 to 10,000 (-100.00 % at +100.00 %)

It is also possible to define the range of values within which measurements are expressed, by selecting:

- the lower threshold corresponding to the minimum value for the range: 0 % (or -100.00 %).
- the upper threshold corresponding to the maximum value for the range (+100.00 %).

Confirm that the lower and upper thresholds are integers between -32,768 and +32,767.

For example, imagine a conditioner providing pressure data on a 4-20 mA loop, with 4 mA corresponding to 3,200 millibar and 20 mA corresponding to 9,600 millibar. You have the option of choosing the User format, by setting the following lower and upper thresholds:

3,200 for 3,200 millibar as the lower threshold

9,600 for 9,600 millibar as the upper threshold

Values transmitted to the program vary between 3,200 (= 4 mA) and 9,600 (= 20 mA).

Input functions: Measurement Filtering

The type of filtering performed by the system is called "first order filtering". The filtering coefficient can be modified from a programming console or via the program.

The mathematical formula used is as follows:

The mathematical formula used is as follows:

$Meas_{f(n)} = \alpha \times Meas_{f(n-1)} + (1-\alpha) \times Val_{b(n)}$

where:

α = efficiency of the filter

$Meas_{f(n)}$ = measurement filtered at moment n

$Meas_{f(n-1)}$ = measurement filtered at moment n-1

$Val_{b(n)}$ = gross value at moment n

You may configure the filtering value from 7 possibilities (from 0 to 6). This value may be changed even when the application is in RUN mode.

NOTE: Filtering may be accessed in Normal or Fast Cycle.

The filtering values depend on the T configuration cycle (where T = cycle time of 5 ms in standard mode):

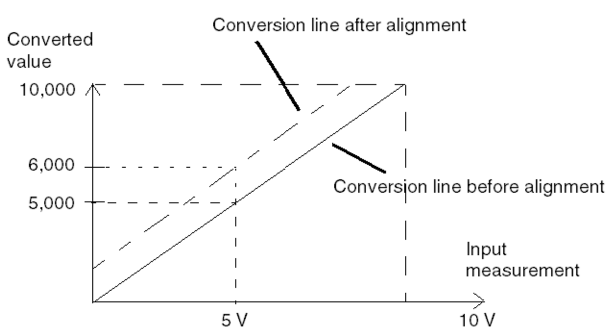
Desired Efficiency	Required Value	Corresponding α	Filter Response Time at 63%	Cut-off Frequency (in Hz)
No filtering	0	0	0	0
Low filtering	1	0.750	4 x T	0.040 / T
	2	0.875	8 x T	0.020 / T

Desired Efficiency	Required Value	Corresponding α	Filter Response Time at 63%	Cut-off Frequency (in Hz)
Medium filtering	3	0.937	16 x T	0.010 / T
	4	0.969	32 x T	0.005 / T
High filtering	5	0.984	64 x T	0.0025 / T
	6	0.992	128 x T	0.0012 / T

Input functions: Sensor Alignment

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

Conversion lines are as follows.



The alignment value is editable from a programming console, even if the program is in RUN Mode. For each input channel, you can:

- 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.

The maximum offset between measured value and desired (aligned) value may not exceed +/-1,500.

NOTE: To align several analog channels on the BMX AMO/AMI/AMM/ART modules, we recommend proceeding channel by channel. Test each channel after alignment before moving to the next channel to apply the parameters correctly.

Output Functions: Writing Outputs

Confirm that the application provides the outputs with values in the standardized format:

- -10,000 to +10,000 for the +/-10 V range
- 0 to +10,000 in 0-20 mV and 4-20 mA ranges

Digital/Analog Conversion

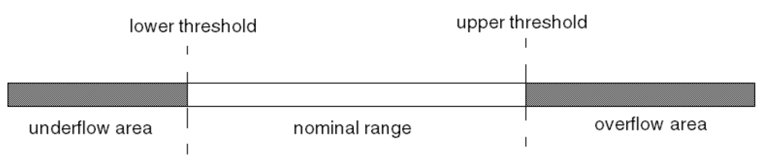
The digital/analog conversion is performed on:

- 12-bit in 0-20 mA, 4-20 mA ranges and for the +/-10 V range

Output Functions: Overflow Control

Module allows an overflow control on voltage and current ranges.

The measurement range is divided in three areas.



Description:

Designation	Description
Nominal range	measurement range corresponding to the chosen range
Overflow Area	area located beyond the upper threshold
Underflow Area	area located below the lower threshold

Overflow values for the various ranges are as follows.

Range	BMX AMM 0600 outputs					
	Underflow Area		Nominal Range		Overflow Area	
+/- 10V	-11,250	-11,001	-11,000	11,000	11,001	11,250
0..20mA	-2,000	-1,001	-1,000	11,000	11,001	12,000
4..20mA	-1,600	-801	-800	10,800	10,801	11,600

You may also choose the flag for an overflow of the range upper value, for an underflow of the range lower value, or for both.

NOTE: Range under/overflow detection is optional.

Output Functions: Fallback/Maintain or Reset Outputs to Zero

In case an error is detected, and depending on its seriousness, the outputs:

- switch to Fallback/Maintain position individually or together,
- are forced to 0 (0 V or 0 mA).

Various Behaviors of Outputs.

Detected Error	Behavior of Voltage Outputs	Behavior of Current Outputs
Task in STOP mode, or program missing	Fallback/Maintain (channel by channel)	Fallback/Maintain (channel by channel)
Communication interruption		
Configuration Error	0 V (all channels)	0 mA (all channels)
Internal Error in Module		
Output Value out-of-range (range under/overflow)	Value saturated at the defined limit (channel by channel)	Saturated value (channel by channel)
Output short circuit or open circuit	Short-circuit: Maintain (channel by channel)	Open circuit: Maintain (channel by channel)
Module Hot swapping (processor in STOP mode)	0 V (all channels)	0 mA (all channels)
Reloading Program		

Fallback or maintain at current value is selected during the module configuration. Fallback value may be modified through a program.

⚠ WARNING

UNEXPECTED EQUIPMENT OPERATION

The fallback position should not be used as the sole safety method. If an uncontrolled position can result in a hazard, install an independent redundant system.

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

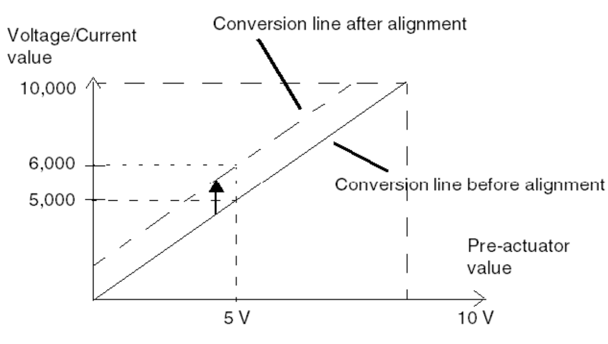
Output Functions: Behavior at Initial Power-Up and When Switched Off.

When the module is switched on or off, the outputs are set to 0 (0 V or 0 mA).

Output Functions: Actuator Alignment

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

Conversion lines are as follows:



The alignment value is editable from a programming console, even if the program is in RUN Mode. For each output channel, you can:

- view and modify the initial output target value

- save the alignment value
- determine whether the channel already has an alignment

The maximum offset between the measured value and the corrected output value (aligned value) may not exceed +/- 1.500.

NOTE: To align several analog channels on the BMX AMO/AMI/AMM/ART modules, we recommend proceeding channel by channel. Test each channel after alignment before moving to the next channel to apply the parameters correctly.

Wiring Precautions

Introduction

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

Cable Shielding

Connect the cable shielding to the grounding bar. Clamp the shielding to the grounding bar on the module side. Use the shielding connection kit BMXXSP••••, page 50 to connect the shielding.

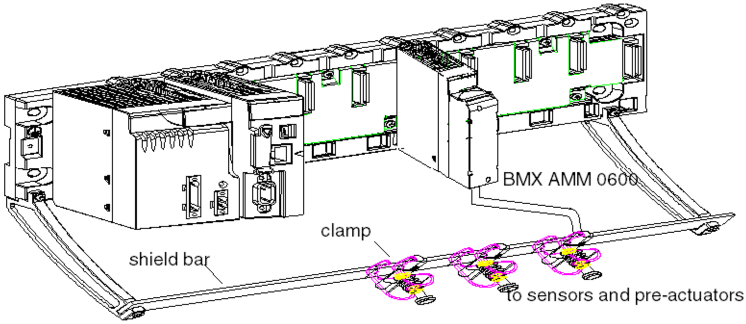
DANGER

HAZARD OF ELECTRIC SHOCK, EXPLOSION, OR ARC FLASH

While mounting / removing the modules:

- Make sure that each terminal block is still connected to the shield bar.
- Disconnect voltage supplying sensors and pre-actuators.

Failure to follow these instructions will result in death or serious injury.



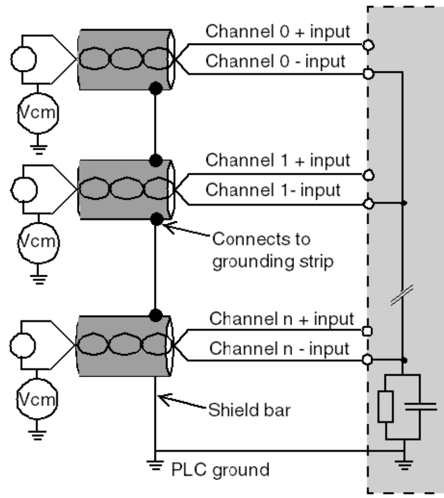
Reference of Sensors in Relation to the Ground

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

- Confirm that sensors are close together (a few meters).
- Confirm that all sensors are referenced to a single point, which is connected to the PLC's ground.

Using Sensors with non Isolated Inputs

The inputs of the module are not isolated between them and single ended type. They do not admit any common mode voltage. The sensors are connected as indicated in the following diagram:



If one or more sensors are referenced in relation to the ground, this may in some cases return a remote ground current to the terminal block and disturbs the measures. Follow these rules:

- Use isolated from ground sensors if distance from sensors is > 30 meters or if power equipment is located near PLC.
- Confirm that the potential is less than the permitted low voltage: for example, 30 Vrms or 42.4 VDC between sensors and shield.
- Setting a sensor point to a reference potential generates a leakage current. 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 help avoid returning a remote ground potential to the terminal; this may be very different to the ground potential close by.

NOTE: Sensors and other peripherals may be connected to a grounding point some distance from the module. Such remote ground references may carry considerable potential differences with respect to local ground. Induced currents do not affect the measurement or integrity of the system.

DANGER

HAZARD OF ELECTRIC SHOCK, EXPLOSION, OR ARC FLASH

Ensure that sensors and others peripherals are not exposed through grounding points to voltage potential greater than acceptable limits.

Failure to follow these instructions will result in death or serious injury.

Electromagnetic Hazards Instructions

Electromagnetic perturbations may cause the application to operate in an unexpected manner.

WARNING

UNEXPECTED EQUIPEMENT OPERATION

Follow these instructions to reduce electromagnetic perturbations:

- Adapt the programmable filtering to the frequency applied at the inputs,
- Use the shielding connection kit BMXXSP••••, page 50 to connect the shielding,
- Use a specific 24 VDC supply to sensors and a shielded cable for connecting the sensors to the module.

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

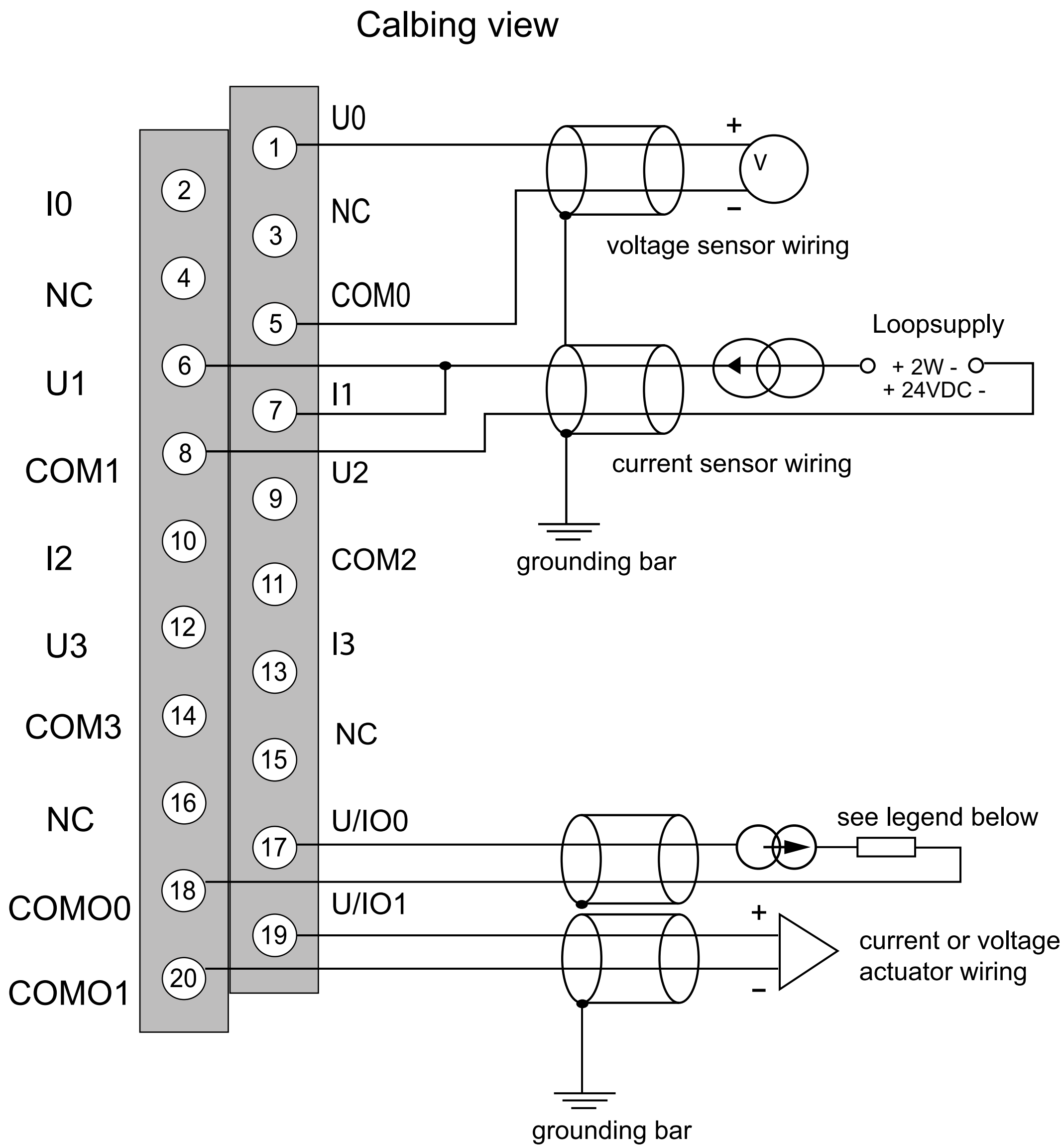
Wiring Diagram

Introduction

The actuators are connected using the 20-point terminal block.

Illustration

The terminal block connection, the sensors, and the actuators wiring are as follows.



Ux + pole input for channel x

COMx - pole input for channel x

U/IOx : + pole output for channel x

COMOx - pole output for channel x

* The current loop is self-powered by the output and does not request any external supply.

Software Implementation of Analog Modules

What's in This Part

In this Part

This part sets forth general rules for implementing analog input/output modules with the Control Expert Software program.

General Overview of Analog Modules

What's in This Chapter

Subject of this Chapter

This chapter presents the software installation of the analog modules.

Introduction to the Installation Phase

Introduction

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

- in Offline mode,
- in Online mode.

If you do not have a processor to which you can connect, Control Expert allows you to carry out an initial test using a simulator. In this case, the installation is different.

You are advised to follow the designated order of the installation phases. You may however change this order (by starting with the configuration phase, for example).

Installation Phases When Using a Processor

The following table presents the various installation phases when using a processor.

Phase	Description	Mode
Declaration of variables	declaration of IODDT-type variables for the application-specific modules and the project variables	Offline(1)
Programming	project programming	Offline(1)
Configuration	declaration of modules	Offline
	module channel configuration	
	entry of configuration parameters	

Phase	Description	Mode
Association	association of IODDT variables with the configured channels (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 and animation tables	Online
	modifying the program and adjustment parameters	
Documentation	creating a documentation file and printing of the miscellaneous information relating to the project	Online
Operation/ Diagnostics	display of the miscellaneous information required to supervise the project	Online
	diagnostics of the project and modules	
(1) These phases may also be performed online.		

Installation Phases When Using a Simulator

The following table presents the various installation phases when using a simulator.

Phase	Description	Mode
Declaration of variables	declaration of IODDT-type variables for the application-specific modules and the project variables	Offline(1)
Programming	project programming	Offline(1)
Configuration	declaration of modules	Offline
	module channel configuration	
	entry of configuration parameters	
Association	association of IODDT variables with the configured modules (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 and animation tables	Online
	modifying the program and adjustment parameters	
(1) These phases may also be performed online.		

Configuration of Modules

The configuration parameters may only be modified from the Control Expert software.

Adjustment parameters may be modified either from the Control Expert software (in debugging mode) or from the application.

Configuring Analog Modules

What's in This Chapter

Subject of this Chapter

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

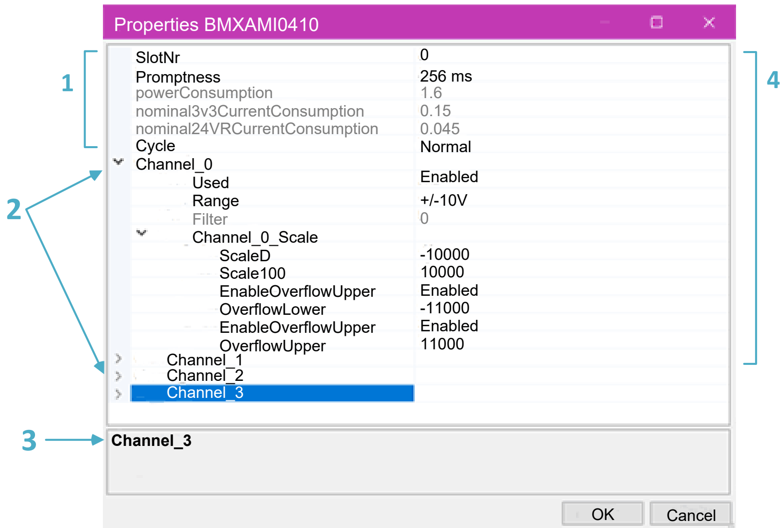
Configuring Analog Modules: Overview

Introduction

This section describes the basic operations required to configure Modicon X80 analog modules.

Description of the Configuration Screen of an Analog Module

Configuration Screen



Configuration Window

The following table presents the various parts of the preceding screenshot:

Num-ber	Element	Function
1	Module configuration	Configurable parameters regarding rack placement and power for the specific analog module you selected.
2	Channel configuration	Configuration parameters for the various channels. The parameters vary depending on the analog module you selected
3	Parameter description	Description of the highlighted parameter you want to configure within the dialog box
4	Parameter values	Configurable parameter values that correspond to the analog module you selected. Some of the parameter values have drop-down lists from which you choose a value. Populate other parameter values with respective integers.

Configuration Parameters

Parameter	Description	Value
SlotNr	Slot position number on the rack	Enter a numeric value
Promptness[1]	Promptness of the module (delay in ms to fallback state in case of communication loss), default value = 256 ms[1]	Select an option from the list:[1] • No promptness • 16 ms • 32 ms • 64 ms • 256 ms (default) • 1 s • 4 s • 16 s • 64 s
powerConsumption[2]	Power consumption of the module (watts)[2]	Enter a numeric value[2]
nominal3VCurrentConsumption[2]	Maximum nominal current consumption in 3V3_BAC output (Amper)[2]	Enter a numeric value.[2]
nominal24VRCurrentConsumption[2]	Maximum nominal current consumption in 24V_BAC output (Amper)[2]	Enter a numeric value.[2]
Cycle	Select the outputs/channels to sample.	Select an option from the list: • Normal All channels are sampled • Fast Only those inputs declared to be in use are sampled.
Channel_0		
Used	Select whether the analog channel is enabled/sampled.	Select an option from the list: • Enabled (default) • Disabled
Range	Select the input range.	Select an option from the list: • +/-10V (default) • 0...10V • 0...5V / 0...20mA • 1...5V / 4...20mA • +/-5V / +/-20mA
Filter[2]	Select the level of filtering.[2]	Select an option from the list:[2] • 0: No filtering (default)

Parameter	Description	Value
		• 1,2: Low filtering • 3,4: Medium filtering • 5,6: High filtering
Channel_0_Scale		
Scale0		Set scale value for 0% PV. • For ranges with +/-, use —10000. • For other ranges, use 0.
Scale100	Set scale value for 100% PV.	
EnableOverflowLower	Select whether the lower overflow is enabled or disabled.	Select an option from the list: • Enabled (default) • Disabled
OverflowLower		Set the lower overflow value (-11000 default)
EnableOverflowUpper	Select whether the upper overflow is enabled or disabled.	Select an option from the list: • Enabled (default) • Disabled
OverflowUpper	Set upper overflow value.	Enter a numeric value (11000 default).
..... (Subsequent channels are configured similarly hereafter.)		
[1] .The promptness auto value, which allows the system to compute the promptness according to the number of modules and their weights, is **not** available in this release.		
[2] This field is typically grayed out, disabled for configuration		

Parameters for Analog Input/Output Channels

Subject of this Section

This section describes the various input/output channel parameters for an analog module.

Parameters for Analog Input Modules

At a Glance

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

Reference

The available parameters for each analog input module are as follows (parameters indicated in bold characters are part of the default configuration).

Parameter	BMX AMI 0410	BMX AMI 0800	BMX AMI 0810
Number of input channels	4	8	8
Channel used (1)	**Active** / Inactive	**Active** / Inactive	**Active** / Inactive
Scan Cycle	**Normal** Fast	**Normal** Fast	**Normal** Fast
Range	**+/-10 V** 0..0.10 V 0..5 V / 0..20 mA 1..5 V / 4..20 mA +/- 5V +/- 20mA	**+/-10 V** 0..10 V 0..5 V / 0..20 mA 1..5 V / 4..20 mA +/- 5V +/- 20mA	**+/-10 V** 0..10 V 0..5 V / 0..20 mA 1..5 V / 4..20 mA +/- 5V +/- 20mA
Filter	**0**..6	**0**..6	**0**..6
Display	**%..** / User	**%..** / User	**%..** / User
Task associated to Channel	**MAST** / FAST	**MAST** / FAST	**MAST** / FAST
Group of channels affected by the task change	2 contiguous channels	2 contiguous channels	2 contiguous channels
Rejection	-	-	-
Wiring Control (1)	-	-	-
Cold junction compensation: channels 0-3	N/A	N/A	N/A
Lower Range Overflow Control (1)	**Active** / Inactive	**Active** / Inactive	**Active** / Inactive
Upper Range Overflow Control (1)	**Active** / Inactive	**Active** / Inactive	**Active** / Inactive
Lower Threshold Range Overflow (1)	-11,400	-11,400	-11,400

Parameter	BMX AMI 0410	BMX AMI 0800	BMX AMI 0810
Upper Threshold Range Overflow (1)	11,400	11,400	11,400
(1) This parameter is available as a checkbox.			

Parameter	BMX AMM 0600	BMX ART 0414	BMX ART 0814
Number of input channels	4	4	8
Channel used (1)	**Active** / Inactive	**Active** / Inactive	**Active** / Inactive
Scan Cycle	**Normal** Fast	-	-
Range	**+/-10 V** 0..0.10 V 0..5 V / 0..20 mA 1..5 V / 4..20 mA	**Thermo K** Thermocouple B Thermocouple E Thermo J Thermo L Thermo N Thermo R Thermo S Thermo T Thermo U 0..400 Ohms 0..4000 Ohms Pt100 IEC/DIN Pt1000 IEC/DIN Pt100 US/JIS Pt1000 US/JIS Cu10 Copper Ni100 IEC/DIN Ni1000 IEC/DIN +/- 40 mV +/- 80 mV	**Thermo K** Thermocouple B Thermocouple E Thermo J Thermo L Thermo N Thermo R Thermo S Thermo T Thermo U 0..400 Ohms 0..4000 Ohms Pt100 IEC/DIN Pt1000 IEC/DIN Pt100 US/JIS Pt1000 US/JIS Cu10 Copper Ni100 IEC/DIN Ni1000 IEC/DIN +/- 40 mV +/- 80 mV

Parameter	BMX AMM 0600	BMX ART 0414	BMX ART 0814
		+/- 160 mV +/- 320 mV +/- 640 mV +/- 1.28 V	+/- 160 mV +/- 320 mV +/- 640 mV +/- 1.28 V
Filter	**0**..6	**0**..6	**0**..6
Display	**%..** / User	**1/10 °C** / 1/10 °F / %.. / User	**1/10 °C** / 1/10 °F / %.. / User
Task associated to Channel	**MAST** / FAST	**MAST**	**MAST**
Group of channels affected by the task change	2 contiguous channels	2 contiguous channels	2 contiguous channels
Rejection	-	**50 Hz** / 60 Hz	**50 Hz** / 60 Hz
Wiring Control (1)	-	Active / **Inactive**	Active / **Inactive**
Cold junction compensation: channels 0-3	N/A	• Internal by TELEFAST, • External by PT100.	• Internal by TELEFAST, • External by PT100, • Using the CJC values of channels 4/7 for channels 0/3.
Lower Range Overflow Control (1)	**Active** / Inactive	**Active** / Inactive	**Active** / Inactive
Upper Range Overflow Control (1)	**Active** / Inactive	**Active** / Inactive	**Active** / Inactive
Lower Threshold Range Overflow (1)	-11,250	-2,680	-2,680
Upper Threshold Range Overflow (1)	11,250	13,680	13,680
(1) This parameter is available as a checkbox.			

Parameters for Analog Output Modules

At a Glance

The analog output module includes channel-specific parameters displayed in the module configuration screen.

Reference

The following table shows the available parameters (default configuration is indicated in bold).

Module	**BMX AMO 0210**	**BMX AMO 0410**	**BMX AMO 0802**	**BMX AMM 0600**
Number of output channels	2	4	8	2
Range	**+/-10 V** 0...20 mA 4...20 mA	**+/-10 V** 0...20 mA 4...20 mA	**0...20 mA** 4...20 mA	**+/-10 V** 0...20 mA 4...20 mA
Task associated to Channel	**MAST** / FAST	**MAST** / FAST	**MAST** / FAST	**MAST** / FAST
Group of channels affected by the task change	All channels	All channels	All channels	All channels
Fallback	**Fallback to 0** / Maintain / Fallback to value	**Fallback to 0** / Maintain / Fallback to value	**Fallback to 0** / Maintain / Fallback to value	**Fallback to 0** / Maintain / Fallback to value
Lower Range Overflow Control (1)	**Active** / Inactive	**Active** / Inactive	**Active** / Inactive	**Active** / Inactive
Upper Range Overflow Control (1)	**Active** / Inactive	**Active** / Inactive	**Active** / Inactive	**Active** / Inactive
Wiring CTRL (1)(2)	Active / **Inactive**	Active / **Inactive**	Active / **Inactive**	Active / **Inactive**
(1) This parameter is available as a checkbox. **(2)** The Wiring CTRL function detects for a broken wire.				

Entering Configuration Parameters Using Control Expert

Subject of this Section

This section presents the entry of various configuration parameters for analog input/output channels using Control Expert.

NOTE: For the communication between the channels and the CPU there is the logical nodes. Each logical node includes two channels. So when you modify the configuration of analog modules, the new parameters are applied for both channels of the logical node, Control Expert messages will inform you of this modification.

Selecting the Range for an Analog Module's Input or Output

At a Glance

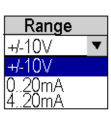
This parameter defines the range for the input or output channel.

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

- voltage
- current
- a thermocouple
- a RTD

Procedure

The procedure to define the range assigned to an analog module's channels is as follows.

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

Selecting 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 series of 2 or 4 contiguous channels.

The possible choices are as follows:

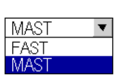
- the **MAST** task
- the **FAST** task

NOTE: The BMX ART 0414/0814 modules run only in Mast task.

WARNING
UNEXPECTED EQUIPMENT OPERATION Do not assign more than 2 analog modules to the **FAST** task (each with all four channels in use). Using more than 2 modules may trigger system timing conflicts. **Failure to follow these instructions can result in death, serious injury, or equipment damage.**

Procedure

The procedure to define the type of task assigned to an analog module's channels is as follows:

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** pull-down menu in the **General Parameters** area. **Result**: The following scrolldown list appears: 
3	Select the appropriate task.
4	Validate the change by clicking **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**.

Selecting the Display Format for a Current or Voltage Input Channel

At a Glance

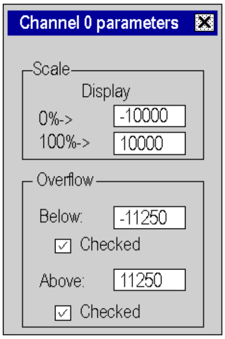
This parameter defines the display format for the measurement of an analog module channel whose range is configured for voltage or current.

The display format may be:

- standardized (**%..**):
  - unipolar range: 0 to +10,000
  - bipolar range : -10,000 to +10,000
- user-defined (**User**).

Procedure

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.  **Note**: The display modification change only concerns the **Scale** area. The **Overflow** area enables the modification of the overflow control, page 247.
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 **%..**. Otherwise it will show **User** (user display).
6	Validate the change by clicking **Edit > Validate**.

Selecting the Display Format for a Thermocouple or RTD Input Channel

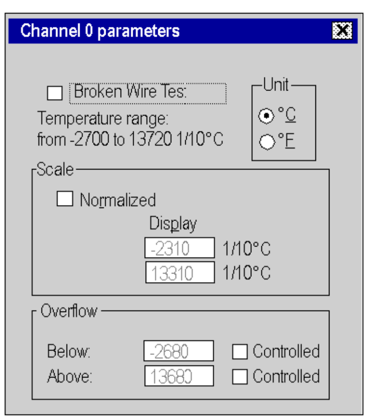
At a Glance

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

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

Procedure

The procedure for defining the display scale assigned to an analog module channel whose range is configured as a Thermocouple or RTD is as follows:

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. **Results** : The **Channel Parameters** dialog box appears. 
4	Check the **Broken Wire Test** box is you want to activate this function.
5	Select the temperature unit by checking **°C** or **°F**.
6	Check the **Standardized** box for a standardized display.

Step	Action
7	Validate the choice by closing the dialog box.
8	Validate the change by clicking **Edit > Validate**.

Selecting the Input Channels’ Filter Value

At a Glance

This parameter defines the type of filtering for the input channel selected for analog modules (see the Measurement Filtering topic, page 70).

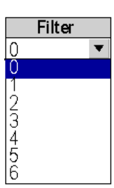
The available filtering values are:

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

NOTE: Filtering is taken into account in both fast scan and normal cycles.

Procedure

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	In the **Filter** column, click the arrow of the pull-down menu pertaining to the channel you want to configure. **Results**: the pull-down menu appears. 
3	Select the filter value you want to assign to the selected channel.
4	Click **Edit > Validate** to validate the change.

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**.

Selecting the Overflow Control Function

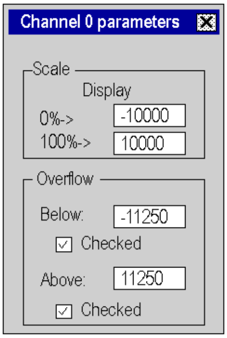
At a Glance

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

Procedure

The procedure for modifying the Overflow Control parameters assigned to an analog module channel is as follows.

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.

Step	Action
	Result: an arrow appears.
3	Click on the arrow in the cell of the **Scale** column for the channel you wish to configure. **Results** : The **Channel Parameters** dialog box appears. 
4	Check the **Checked** box of the **Underflow** field to specify an underflow threshold.
5	Check 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 by clicking **Edit > Validate**.

Overflow Flags

If under/overflow control is required, indications are provided by the following bits.

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 value currently read falls within one of the two unauthorized ranges: • %MWr.m.c.3.6 denotes an underflow • %MWr.m.c.3.7 denotes an overflow
%Ir.m.c.ERR	Channel Error.

Selecting the Cold Junction Compensation

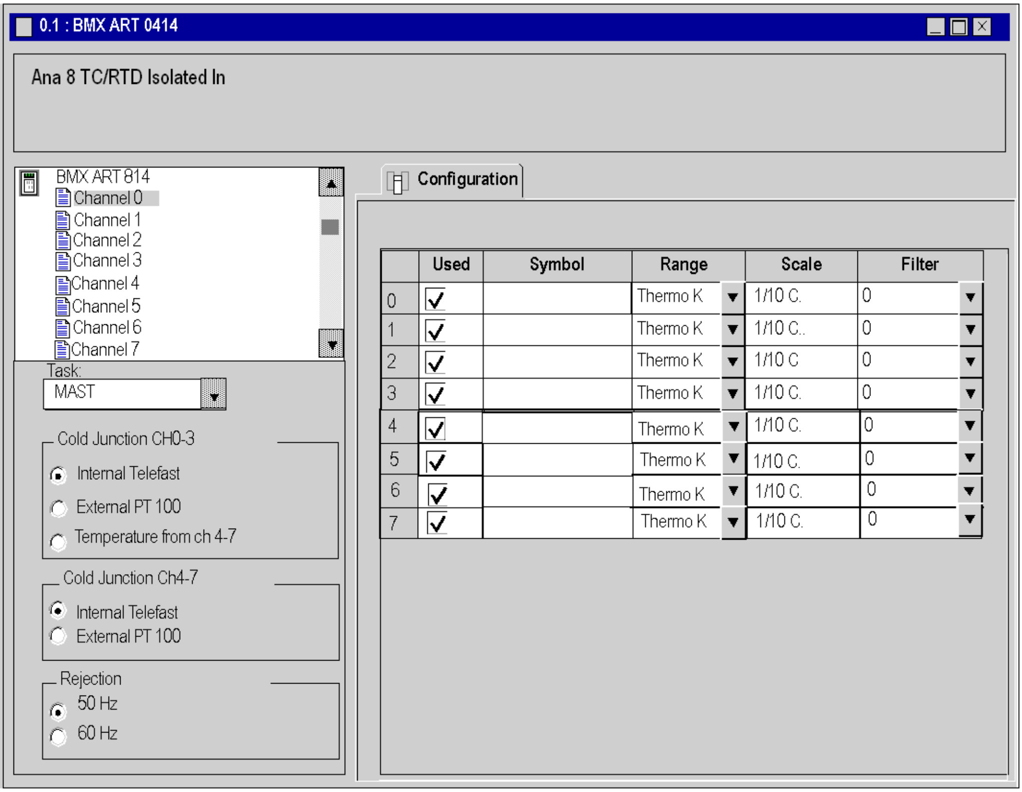
At a Glance

This function is available on the BMX ART 0414/814 analog input modules. It is carried out either by TELEFAST or by a Pt100 probe. An internal compensation by TELEFAST is proposed by default.

BMX ART 0414/0814 Module

The procedure for modifying the cold junction compensation of the BMX ART 0414/814 modules is as follows.

Step	Action
1	Access the hardware configuration screen for the appropriate module.
2	Check the Internal by TELEFAST, the External by Pt100 or the Temperature from Ch4-7 bloc box in the Cold Junction Channel 0-3 field.
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 detected communication error.

The possible behavior types are:

- **Fallback**: Outputs are set to an editable value between scale0 and scale100 (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 of the **Fallback** for the output you want to configure
3	Enter the desired value in the cell of the **Fallback Value**. **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**for the channel in question. **Result**: The maintain value behavior will be assigned to the selected output.
5	Validate the change by clicking in **OK.**

IODDTs and Device DDTs for Analog Modules

What's in This Chapter

Subject of this Chapter

This chapter presents the various language objects, IODDTs and Device DDTs associated with analog input/output modules.

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 to call any EF using this channel.

Detailed Description of T_ANA_IN_BMX-type IODDT Objects

At a Glance

The following tables describe the `T_ANA_IN_BMX`-type IODDT objects applicable to **BME AHI 0812**, **BMX AMI 0410**, **BMX AMI 0800**, and **BMX AMI 0810**, and to **the inputs of the BMX AMM 600 mixed module**.

Input Measurement

The analog input measurement object is as follows.

Standard symbol	Type	Access	Meaning	Address
VALUE	INT	R	Analog input measurement.	%IWr.m.c.0

%Ir.m.c.ERR error bit

The `%Ir.m.c.ERR` error bit is as follows.

Standard symbol	Type	Access	Meaning	Address
CH_ERROR	BOOL	R	Detected error bit for analog channel.	%Ir.m.c.ERR

MEASURE_STS Measurement Status Word

The meaning of the `MEASURE_STS` (%IWr.m.c.1) measurement status word bits is as follows.

Standard symbol	Type	Access	Meaning	Address
CH_ALIGNED	BOOL	R	Aligned channel.	%IWr.m.c.1.0
CH_FORCED	BOOL	R	Forced channel.	%IWr.m.c.1.1
LOWER_LIMIT	BOOL	R	Measurement within lower tolerance area.	%IWr.m.c.1.5
UPPER_LIMIT	BOOL	R	Measurement within upper tolerance area.	%IWr.m.c.1.6
INT_OFFSET_ERROR	BOOL	R	Internal offset detected error.	%IWr.m.c.1.8
INT_REF_ERROR	BOOL	R	Internal reference detected error.	%IWr.m.c.1.10
POWER_SUP_ERROR	BOOL	R	Not used.	%IWr.m.c.1.11
SPI_COM_ERROR	BOOL	R	SPI communication detected error.	%IWr.m.c.1.12

Explicit Exchange Execution Flag: EXCH_STS

The meaning of the exchange control bits of the channel `EXCH_STS` (%MWr.m.c.0) is as follows.

Standard symbol	Type	Access	Meaning	Address
STS_IN_PROGR	BOOL	R	Read channel status words in progress.	%MWr.m.c.0.0
CMD_IN_PROGR	BOOL	R	Command parameter exchange in progress.	%MWr.m.c.0.1
ADJ_IN_PROGR	BOOL	R	Adjustment parameter exchange in progress.	%MWr.m.c.0.2

Explicit Exchange Report: EXCH_RPT

The meaning of the `EXCH_RPT` (%MWr.m.c.1) report bits is as follows.

Standard symbol	Type	Access	Meaning	Address
STS_ERR	BOOL	R	Read error detected for channel status words.	%MWr.m.c.1.0
CMD_ERR	BOOL	R	Error detected during command parameter exchange.	%MWr.m.c.1.1
ADJ_ERR	BOOL	R	Error detected while exchanging adjustment parameters.	%MWr.m.c.1.2
RECONF_ERR	BOOL	R	Error detected while reconfiguring the channel.	%MWr.m.c.1.15

Standard Channel Status: CH_FLT

The following table explains the meaning of the `CH_FLT` (%MWr.m.c.2) status word bits. Reading is performed by a `READ_STS` (`IODDT_VAR1`).

Standard symbol	Type	Access	Meaning	Address
SENSOR_FLT	BOOL	R	Sensor connection detected error.	%MWr.m.c.2.0
RANGE_FLT	BOOL	R	Range under/overflow detected error.	%MWr.m.c.2.1
CH_ERR_RPT	BOOL	R	Channel detected error report.	%MWr.m.c.2.2
INTERNAL_FLT	BOOL	R	Inoperative channel.	%MWr.m.c.2.4
CONF_FLT	BOOL	R	Different hardware and software configurations.	%MWr.m.c.2.5
COM_FLT	BOOL	R	Problem detected communicating with the PLC.	%MWr.m.c.2.6
APPLI_FLT	BOOL	R	Application error detected (adjustment or configuration error).	%MWr.m.c.2.7
NOT_READY	BOOL	R	Channel not ready.	%MWr.m.c.3.0
CALIB_FLT	BOOL	R	Calibration detected error.	%MWr.m.c.3.2

Standard symbol	Type	Access	Meaning	Address
INT_OFFS_FLT	BOOL	R	Internal calibration offset detected error.	%MWr.m.c.3.3
INT_REF_FLT	BOOL	R	Internal calibration reference detected error.	%MWr.m.c.3.4
INT_SPI_PS_FLT	BOOL	R	Internal serial link or power supply detected error.	%MWr.m.c.3.5
RANGE_UNF	BOOL	R	Recalibrated channel or range underflow.	%MWr.m.c.3.6
RANGE_OVF	BOOL	R	Aligned channel or range overflow.	%MWr.m.c.3.7

Command Controls

The following table explains the meaning of the `COMMAND_ORDER` (%MWr.m.c.4) status word bit. Reading is performed by a `READ_STS`:

Standard symbol	Type	Access	Meaning	Address
FORCING_ORDER	BOOL	R/W	Forcing/unforcing command.	%MWr.m.c.4.13

Parameters

The following table presents the meaning of the `%MWr.m.c.5`, `%MWr.m.c.8` and `%MWr.m.c.9` words. Queries used are those associated with parameters (`READ_PARAM`, `WRITE_PARAM`):

Standard symbol	Type	Access	Meaning	Address
CMD_FORCING_VALUE	INT	R/W	Forcing value to be applied.	%MWr.m.c.5
FILTER_COEFF	INT	R/W	Value of filter coefficient.	%MWr.m.c.8
ALIGNMENT_OFFSET	INT	R/W	Alignment offset value. **NOTE:** Offset=Target value - Measured value, for instance, if you want to see a value of 3000 when the measured value is 2400 you have to set an offset of 600.	%MWr.m.c.9
THRESHOLD0	INT	None	Reserved for evolution.	%MWr.m.c.10
THRESHOLD1	INT	None	Reserved for evolution.	%MWr.m.c.11

NOTE: In order to force a channel, you have to use the `WRITE_CMD (%MWr.m.c.5)` instruction and set the `%MWr.m.c.4.13` bit to 1.

NOTE: To unforce a channel and use it normally, you have to set the `%MWr.m.c.4.13` bit to 0.

Detailed Description of T_ANA_IN_T_BMX-type IODDT Objects

At a Glance

The following tables describe the `T_ANA_IN_T_BMX`-type IODDT objects applicable to **BMX ART 0414/0814** analog input modules.

Input Measurement

The analog input measurement object is as follows:

Standard symbol	Type	Ac-cess	Meaning	Address
VALUE	INT	R	Analog input measurement.	%IWr.m.c.0

%Ir.m.c.ERR error bit

The %Ir.m.c.ERR error bit is as follows:

Standard symbol	Type	Ac-cess	Meaning	Address
CH_ERROR	BOOL	R	Error bit for analog channel.	%Ir.m.c.ERR

MEASURE_STS Measurement Status Word

The various meanings of the `MEASURE_STS` (%IWr.m.c.1) measurement status word bits are as follows:

Standard symbol	Type	Ac-cess	Meaning	Address
CH_ALIGNED	BOOL	R	Aligned channel.	%IWr.m.c.1.0
CH_FORCED	BOOL	R	Forced channel.	%IWr.m.c.1.1
LOWER_LIMIT	BOOL	R	Measurement within lower tolerance area.	%IWr.m.c.1.5
UPPER_LIMIT	BOOL	R	Measurement within upper tolerance area.	%IWr.m.c.1.6
INT_OFFSET_ERROR	BOOL	R	Internal offset error.	%IWr.m.c.1.8
INT_REF_ERROR	BOOL	R	Internal reference error.	%IWr.m.c.1.10
POWER_SUP_ERROR	BOOL	R	Not used.	%IWr.m.c.1.11
SPI_COM_ERROR	BOOL	R	SPI communication error.	%IWr.m.c.1.12

Cold Junction Compensation

The value of the cold junction compensation is as follows:

Standard symbol	Type	Ac-cess	Meaning	Address
CJC_VALUE	INT	R	Cold junction compensation value (1/10°C).	%IWr.m.c.2

Explicit Exchange Execution Flag: EXCH_STS

The meaning of the exchange control bits of the channel `EXCH_STS` (%MWr.m.c.0) is as follows:

Standard symbol	Type	Ac-cess	Meaning	Address
STS_IN_PROGR	BOOL	R	Read channel status words in progress.	%MWr.m.c.0.0
CMD_IN_PROGR	BOOL	R	Command parameter exchange in progress.	%MWr.m.c.0.1
ADJ_IN_PROGR	BOOL	R	Adjustment parameter exchange in progress.	%MWr.m.c.0.2

Explicit Exchange Report: EXCH_RPT

The meaning of the `EXCH_RPT` (%MWr.m.c.1) report bits is as follows:

Standard symbol	Type	Access	Meaning	Address
STS_ERR	BOOL	R	Read error for channel status words.	%MWr.m.c.1.0
CMD_ERR	BOOL	R	Error during command parameter exchange.	%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 Status: CH_FLT

The following table explains the meaning of the CH_FLT (%MWr.m.c.2) status word bits. Reading is performed by a READ_STS (IODDT_VAR1).

Standard symbol	Type	Access	Meaning	Address
SENSOR_FLT	BOOL	R	Sensor connection error.	%MWr.m.c.2.0
RANGE_FLT	BOOL	R	Range under/overflow error.	%MWr.m.c.2.1
CH_ERR_RPT	BOOL	R	Channel error report.	%MWr.m.c.2.2
INTERNAL_FLT	BOOL	R	Inoperative channel.	%MWr.m.c.2.4
CONF_FLT	BOOL	R	Different hardware and software configurations.	%MWr.m.c.2.5
COM_FLT	BOOL	R	Problem communicating with the PLC.	%MWr.m.c.2.6
APPLI_FLT	BOOL	R	Application error (adjustment or configuration error).	%MWr.m.c.2.7
NOT_READY	BOOL	R	Channel not ready.	%MWr.m.c.3.0
COLD_JUNCTION_FLT	BOOL	R	Cold junction compensation error.	%MWr.m.c.3.1
CALIB_FLT	BOOL	R	Calibration error.	%MWr.m.c.3.2
INT_OFFS_FLT	BOOL	R	Internal calibration offset error.	%MWr.m.c.3.3
INT_REF_FLT	BOOL	R	Internal calibration reference error.	%MWr.m.c.3.4
INT_SPI_PS_FLT	BOOL	R	Internal serial link or power supply error.	%MWr.m.c.3.5
RANGE_UNF	BOOL	R	Range underflow.	%MWr.m.c.3.6
RANGE_OVF	BOOL	R	Range overflow.	%MWr.m.c.3.7

Command Controls

The following table explains the meaning of the COMMAND_ORDER (%MWr.m.c.4) status word bit. Reading is performed by a READ_STS:

Standard symbol	Type	Access	Meaning	Address
FORCING__UNFORCING_ORDER	BOOL	R/W	Forcing/unforcing command.	%MWr.m.c.4.13

Parameters

The table below presents the meaning of the %MWr.m.c.5, %MWr.m.c.8 and %MWr.m.c.9 status words. Queries used are those associated with parameters (READ_PARAM, WRITE_PARAM).

Standard symbol	Type	Access	Meaning	Address
CMD_FORCING_VALUE	INT	R/W	Forcing value to be applied.	%MWr.m.c.5
FILTER_COEFF	INT	R/W	Value of filter coefficient.	%MWr.m.c.8
ALIGNMENT_OFFSET	INT	R/W	Alignment offset value. **NOTE:** Offset=Target value - Mesured value, for instance, if you want to see a value of 3000 when the measured value is 2400 you have to set an offset of 600.	%MWr.m.c.9

NOTE: In order to force a channel, you have to use the WRITE_CMD (%MWr.m.c.5) instruction and set the %MWr.m.c.4.13 bit to 1.

NOTE: To unforce a channel and use it normally, you have to set the %MWr.m.c.4.13 bit to 0.

Detailed Description of T_ANA_OUT_BMX-type IODDT Objects

At a Glance

The following tables describe the `T_ANA_OUT_BMX`-type IODDT objects applicable to the **BME AHO 0412**, **BMX AMO 0210**, **BMX AMO 0410** and **BMX AMO 0802** analog output modules and the outputs of the **BMX AMM 600** mixed module.

Value of the Output

The analog output measurement object is as follows.

Standard symbol	Type	Ac-cess	Meaning	Address
VALUE	INT	R	Analog output measurement.	%QWr.m.c.0

%Ir.m.c.ERR error bit

The %Ir.m.c.ERR error bit is as follows.

Standard symbol	Type	Ac-cess	Meaning	Address
CH_ERROR	BOOL	R	Error bit for analog channel.	%Ir.m.c.ERR

Value Forcing

The value forcing bit is as follows.

Standard symbol	Type	Ac-cess	Meaning	Address
FORCING_VALUE	INT	R	Forcing of the value.	%IWr.m.c.0

Channel forcing indicator.

The meaning of the forcing control bits of the channel (%IWr.m.c.1) is as follows.

Standard symbol	Type	Ac-cess	Meaning	Address
CHANNEL_FORCED	BOOL	R	Forcing of the channel.	%MWr.m.c.1.1

Explicit Exchange Execution Flag: EXCH_STS

The meaning of the exchange control bits of the channel `EXCH_STS` (%MWr.m.c.0) is as follows:

Standard symbol	Type	Ac-cess	Meaning	Address
STS_IN_PROGR	BOOL	R	Read channel status words in progress.	%MWr.m.c.0.0
CMD_IN_PROGR	BOOL	R	Command parameter exchange in progress.	%MWr.m.c.0.1
ADJ_IN_PROGR	BOOL	R	Adjustment parameter exchange in progress.	%MWr.m.c.0.2

Explicit Exchange Report: EXCH_RPT

The meaning of the `EXCH_RPT` (%MWr.m.c.1) report bits is as follows:

Standard symbol	Type	Ac-cess	Meaning	Address
STS_ERR	BOOL	R	Read error detected for channel status words.	%MWr.m.c.1.0
CMD_ERR	BOOL	R	Error detected during command parameter exchange.	%MWr.m.c.1.1
ADJ_ERR	BOOL	R	Error detected while exchanging adjustment parameters.	%MWr.m.c.1.2
RECONF_ERR	BOOL	R	Error detected while reconfiguring the channel.	%MWr.m.c.1.15

Standard Channel Status: CH_FLT

The following table explains the meaning of the `CH_FLT` (%MWr.m.c.2) status word bits. Reading is performed by a `READ_STS` (`IODDT_VAR1`).

Standard symbol	Type	Ac-cess	Meaning	Address
ACT_WIRE_FLT	BOOL	R	Actuator wire open or short.	%MWr.m.c.2.0
RANGE_FLT	BOOL	R	Range under/overflow detected error.	%MWr.m.c.2.1
SHORT_CIRCUIT	BOOL	R	Short-circuit.	%MWr.m.c.2.2
CAL_PRM_FLT	BOOL	R	Calibration parameters not configured.	%MWr.m.c.2.3
INTERNAL_FLT	BOOL	R	Inoperative channel.	%MWr.m.c.2.4
CONF_FLT	BOOL	R	Different hardware and software configurations.	%MWr.m.c.2.5
COM_FLT	BOOL	R	Problem detected communicating with the PLC.	%MWr.m.c.2.6
APPLI_FLT	BOOL	R	Application detected error (adjustment or configuration detected error).	%MWr.m.c.2.7
ALIGNED_CH	BOOL	R	Aligned channels.	%MWr.m.c.3.0
INT_CAL_FLT	BOOL	R	Calibration parameters not defined.	%MWr.m.c.3.2
INT_PS_FLT	BOOL	R	Internal power supply detected error.	%MWr.m.c.3.3
INT_SPI_FLT	BOOL	R	Serial link detected error.	%MWr.m.c.3.4
RANGE_UNF	BOOL	R	Range underflow.	%MWr.m.c.3.6
RANGE_OVF	BOOL	R	Range overflow.	%MWr.m.c.3.7

Command Control

The following table explains the meaning of the `COMMAND_ORDER` (%MWr.m.c.4) status word bit. Reading is performed by a `READ_STS`:

Standard symbol	Type	Ac-cess	Meaning	Address
FORCING_ UNFORCING_ORDER	BOOL	R/W	Forcing/unforcing command.	%MWr.m.c.4.13

Parameters

The following table shows the meaning of the words %MWr.m.c.5 to %MWr.m.c.8. The requests used are those associated with the parameters (`READ_PARAM` and `WRITE_PARAM`).

Standard symbol	Type	Access	Meaning	Address
CMD_FORCING_VALUE	INT	R/W	Forcing value to be applied.	%MWr.m.c.5
FALLBACK	INT	R/W	Fallback value.	%MWr.m.c.7
ALIGNMENT	INT	R/W	Alignment value.	%MWr.m.c.8

NOTE: In order to force a channel, you have to use the `WRITE_CMD (%MWr.m.c.5)` instruction and set the `%MWr.m.c.4.13` bit to 1.

NOTE: To unforce a channel and use it normally, you have to set the `%MWr.m.c.4.13` bit to 0.

Detailed Description of T_ANA_IN_GEN-type IODDT Objects

At a Glance

The tables below present the `T_ANA_IN_GEN`-type IODDT objects that are applicable to the **BME AHI 0812**, **BMX AMI 0410**, **BMX AMI 0800** and **BMX AMI 0810** input modules, to the inputs of the **BMX AMM 600** mixed module and to the **BMX ART 0414/0814** analog input module.

Input Measurement

The analog input measurement object is as follows.

Standard symbol	Type	Access	Meaning	Address
VALUE	INT	R	Analog input measurement.	%IWr.m.c.0

%Ir.m.c.ERR Error Bit

The `%Ir.m.c.ERR` error bit is as follows:

Standard symbol	Type	Ac-cess	Meaning	Address
CH_ERROR	BOOL	R	Detected error bit for analog channel.	%Ir.m.c.ERR

Detailed Description of T_ANA_OUT_GEN-type IODDT Objects

At a Glance

The following tables describe the `T_ANA_OUT_GEN`-type IODDT objects applicable to the **BME AHO 0412**, **BMX AMO 0210**, **BMX AMO 0410** and **BMX AMO 0802** analog output modules and to the output of the **BMX AMM 600** mixed module.

Input Measurement

The analog output measurement object is as follows.

Standard symbol	Type	Access	Meaning	Address
VALUE	INT	R	Analog output measurement.	%IWr.m.c.0

%Ir.m.c.ERR Error Bit

The `%Ir.m.c.ERR` error bit is as follows.

Standard symbol	Type	Access	Meaning	Address
CH_ERROR	BOOL	R	Detected error bit for analog channel.	%Ir.m.c.ERR

Details of the Language Objects of the IODDT of Type T_GEN_MOD

Introduction

The Modicon X80 modules 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.

Some bits are not used.

List of Objects

The table below presents the objects of the IODDT.

Standard Symbol	Type	Access	Meaning	Address
MOD_ERROR	BOOL	R	Module detected 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	Event when reading module status words	%MWr.m.MOD.1.0
MOD_FLT	INT	R	Internal detected errors word of the module	%MWr.m.MOD.2
MOD_FAIL	BOOL	R	module inoperable	%MWr.m.MOD.2.0
CH_FLT	BOOL	R	Inoperative channel(s)	%MWr.m.MOD.2.1
BLK	BOOL	R	Terminal block incorrectly wired	%MWr.m.MOD.2.2
CONF_FLT	BOOL	R	Hardware or software configuration anomaly	%MWr.m.MOD.2.5
NO_MOD	BOOL	R	Module missing or inoperative	%MWr.m.MOD.2.6
EXT_MOD_FLT	BOOL	R	Internal detected errors word of the module (Fipio extension only)	%MWr.m.MOD.2.7

Standard Symbol	Type	Ac-cess	Meaning	Address
MOD_FAIL_EXT	BOOL	R	Internal detected error, module unserviceable (Fipio extension only)	%MWr.m.MOD.2.8
CH_FLT_EXT	BOOL	R	Inoperative channel(s) (Fipio extension only)	%MWr.m.MOD.2.9
BLK_EXT	BOOL	R	Terminal block incorrectly wired (Fipio extension only)	%MWr.m.MOD.2.10
CONF_FLT_EXT	BOOL	R	Hardware or software configuration anomaly (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

Analog Device DDT

Introduction

This topic describes the Control Expert **Analog Device DDT**. The instance default naming is described in Device DDT Instance Naming Rule (see EcoStruxure™ Control Expert, Program Languages and Structure, Reference Manual).

Regarding the device DDT, its name contains the following information:

- platform with:
  - U for unified structure between Modicon X80 module and Quantum
- device type (ANA for analog)
- function (STD for standard)
  - STD for standard
  - TEMP for temperature
- direction:
  - IN
  - OUT
- max channel (2, 4, 8)

Example: For a Modicon X80 module with 4 standard inputs and 2 outputs the Device Derived Data Type is T_U_ANA_STD_IN_4_OUT_2

Adjustment Parameter limitation

In Quantum EIO and M580 RIO, adjustment parameters cannot be changed from the PLC application during operation (no support of READ_PARAM, WRITE_PARAM, SAVE_PARAM, RESTORE_PARAM).

The concerned analog input parameters are:

- `FILTER_COEFF`

  Value of filter coefficient

- `ALIGNMENT_OFFSET`

  Alignment offset value

The concerned analog output parameters are:

- `FALLBACK`

  Fallback value

- `ALIGNMENT`

  Alignment value

List of Implicit Device DDT

The following table shows the list of device DDT and their **X80** modules:

Device DDT Type	Modicon X80 Devices
T_U_ANA_STD_IN_4	BMX AMI 0410
T_U_ANA_STD_IN_8	BME AHI 0812 BMX AMI 0800 BMX AMI 0810
T_U_ANA_STD_OUT_2	BMX AMO 0210
T_U_ANA_STD_OUT_4	BME AHO 0412 BMX AMO 0410
T_U_ANA_STD_OUT_8	BMX AMO 0802
T_U_ANA_STD_IN_4_OUT_2	BMX AMM 0600
T_U_ANA_TEMP_IN_4	BMX ART 0414
T_U_ANA_TEMP_IN_8	BMX ART 0814

Implicit Device DDT Description

The following table shows the T_U_ANA_STD_IN_x and the T_U_ANA_STD_OUT_y status word bits:

Standard Symbol	Type	Meaning	Access
MOD_HEALTH	BOOL	0 = the module has a detected error	read
		1 = the module is operating correctly	
MOD_FLT	BYTE	internal detected errors byte, page 273 of the module	read
ANA_CH_IN	ARRAY [0...x-1] of T_U_ANA_STD_CH_IN	array of structure	–
ANA_CH_OUT	ARRAY [0..y-1] of T_U_ANA_STD_CH_OUT	array of structure	–

The following table shows the T_U_ANA_STD_IN_x_OUT_y status word bits:

Standard Symbol	Type	Meaning	Access
MOD_HEALTH	BOOL	0 = the module has a detected error	read
		1 = the module is operating correctly	
MOD_FLT	BYTE	internal detected errors byte, page 273 of the module	read
ANA_CH_IN	ARRAY [0..x-1] of T_U_ANA_STD_CH_IN	array of structure	–
ANA_CH_OUT	ARRAY [x..x+y-1] of T_U_ANA_STD_CH_OUT	array of structure	–

The following table shows the T_U_ANA_TEMP_IN_x status word bits:

Standard Symbol	Type	Meaning	Access
MOD_HEALTH	BOOL	0 = the module has a detected error	read
		1 = the module is operating correctly	
MOD_FLT	BYTE	internal detected errors byte, page 273 of the module	read
ANA_CH_IN	ARRAY [[0..x-1] of T_U_ANA_TEMP_CH_IN	array of structure	–

The following table shows the T_U_ANA_STD_CH_IN[0..x-1] structure status word bits:

Standard Symbol		Type	Bit	Meaning	Access
FCT_TYPE		WORD	–	0 = channel is not used	read
				1 = channel is used	
CH_HEALTH		BOOL	–	0 = the channel has a detected error	read
				1 = the channel is operating correctly	
CH_WARNING		BOOL	–	not used	–
ANA		STRUCT	–	T_U_ANA_VALUE_IN	read
MEASURE_STS [INT]	CH_ALIGNED	BOOL	0	aligned channel	read
	LOWER_LIMIT	BOOL	5	measurement within lower tolerance area	read
	UPPER_LIMIT	BOOL	6	measurement within upper tolerance area	read
	INT_OFFSET_ERROR	BOOL	8	internal offset detected error	read
	IN_REF_ERROR	BOOL	10	internal reference detected error	read
	POWER_SUP_ERROR	BOOL	11	not used	read
	SPI_COM_ERROR	BOOL	12	SPI communication detected error	read

The following table shows the T_U_ANA_STD_CH_OUT[0..y-1] status word bits:

Standard Symbol	Type	Meaning	Access
FCT_TYPE	WORD	0 = channel is not used	read
		1 = channel is used	
CH_HEALTH	BOOL	0 = the channel has a detected error	read
		1 = the channel is operating correctly	
ANA	STRUCT	T_U_ANA_VALUE_OUT	read

The following table shows the T_U_ANA_VALUE_IN[0..x-1] and T_U_ANA_VALUE_OUT[0..y-1] structure status word bits:

Standard Symbol	Type	Bit	Meaning	Access
VALUE	INT	–	if FORCE_CMD = 1 then VALUE = FORCED_VALUE	read(1)
			if FORCE_CMD = 0 then VALUE = TRUE_VALUE	

Standard Symbol	Type	Bit	Meaning	Access
FORCED_VALUE	INT	–	forced value of the channel	read / write
FORCE_CMD	BOOL	–	0 = Un-force command	read / write
			1 = force command	
FORCE_STATE	BOOL	–	0 = value is not forced	read
			1 = value is forced	
TRUE_VALUE[2]	INT	–	True value of the channel (from the sensor)	read
1 `VALUE` of the `T_U_ANA_VALUE_OUT` structure word can be accessed in read / write				
2 `TRUE_VALUE` of the `T_U_ANA_VALUE_OUT` is the value calculated from the application.				

The following table shows the `T_U_ANA_TEMP_CH_IN`[0..x-1] structure status word bits:

Standard Symbol	Type	Bit	Meaning	Access
FCT_TYPE	WORD	–	0 = channel is not used	read
			1 = channel is used	
CH_HEALTH	BOOL	–	0 = the channel has a detected error	read
			1 = the channel is operating correctly	
CH_WARNING	BOOL	–	not used	–
ANA	STRUCT	–	`T_U_ANA_VALUE_IN`	read
MEASURE_STS	INT	–	measurement status	read
CJC_VALUE	INT	–	Cold junction compensation value (1/10 °C)	read

Use and Description of DDT for Explicit Exchange

The following table shows the DDT type used for the variables connected to dedicated EFB parameter to perform an explicit exchange:

<table>
<tr><th>DDT</th><th colspan="2">Description</th></tr>
<tr><td>T_M_ANA_STD_CH_STS</td><td>Structure to read the channel status of an analog module.</td><td rowspan="2">Depending on the I/O module location, the DDT can be connected to the STS output parameter of the EFB:
READ_STS_QX when the module is located in Quantum EIO.
READ_STS_MX when the module is located in a M580 local rack or in M580 RIO drops.</td></tr>
<tr><td>T_M_ANA_STD_CH_IN_STS</td><td>Structure to read the channel status of an analog output module.</td></tr>
</table>

<table>
<tr><th>DDT</th><th colspan="2">Description</th></tr>
<tr><td>T_M_ANA_STD_CH_OUT_STS</td><td>Structure to read the channel status of an analog output module.</td><td rowspan="2"></td></tr>
<tr><td>T_M_ANA_TEMP_CH_STS</td><td>Structure to read the channel status of an analog temperature input module.</td></tr>
<tr><td>T_M_ANA_STD_CH_IN_PRM</td><td>Structure for adjustment parameters of a channel of an analog input module in a M580 local rack.</td><td rowspan="2">The DDT can be connected to the PARAM output parameter of the EFB:
READ_PARAM_MX to read module parameters.
WRITE_PARAM_MX to write module parameters.
SAVE_PARAM_MX to save module parameters.
RESTORE_PARAM_MX to restore the new parameters of the module.</td></tr>
<tr><td>T_M_ANA_STD_CH_OUT_PRM</td><td>Structure for adjustment parameters of a channel of an analog output module in a M580 local rack.</td></tr>
<tr><td colspan="3">NOTE: Targeted channel address (ADDR) can be managed with ADDMX EF (connect the output parameter OUT to the input parameter ADDR of the communication functions).</td></tr>
</table>

NOTE: For more details about EF and EFB, refer to *EcoStruxure™ Control Expert, I/O Management, Block Library* and *EcoStruxure™ Control Expert, Communication, Block Library*.

The following table shows the DDT structure for T_M_ANA_STD_CH_STS, T_M_ANA_STD_CH_IN_STS, T_M_ANA_STD_CH_OUT_STS and T_M_ANA_TEMP_CH_STS:

Standard Symbol		Type	Bit	Meaning	Access
CH_FLT [INT]	SENSOR_FLT	BOOL	0	detected sensor faults	read
	RANGE_FLT	BOOL	1	detected range fault	read
	CH_ERR_RPT	BOOL	2	channel detected error report	read
	INTERNAL_FLT	BOOL	4	internal detected error: module out of order	read
	CONF_FLT	BOOL	5	detected configuration fault: different hardware and software configurations	read
	COM_FLT	BOOL	6	detected problem communicating with the PLC	read
	APPLI_FLT	BOOL	7	detected application fault	read
	COM_FLT_ON_EVT(1)	BOOL	8	detected communication fault on event	read
	OVR_ON_CH_EVT(1)	BOOL	9	detected overrun fault on CPU event	read

Standard Symbol		Type	Bit	Meaning	Access
	OVR_ON_CH_EVT(1)	BOOL	10	detected overrun fault on channel event	read
CH_FLT_2 [INT]	NOT_READY	BOOL	0	Channel not ready	read
	COLD_JUNCTION_FLT(2)	BOOL	1	Cold junction compensation detected error	read
	CALIB_FLT	BOOL	2	detected calibration fault	read
	INT_OFFS_FLT	BOOL	3	detected internal offset error	read
	IN_REF_FLT	BOOL	4	detected internal reference fault	read
	INT_SPI_PS_FLT	BOOL	5	detected internal serial link or power supply error	read
	RANGE_UNF	BOOL	6	recalibrated channel or range underflow	read
	RANGE_OVF	BOOL	7	aligned channel or range overflow	read
(1) Only available with T_M_ANA_STD_CH_IN_STS and T_M_ANA_STD_CH_OUT_STS. **(2)** Only available with T_M_ANA_TEMP_CH_STS.					

The following table shows the T_M_ANA_STD_CH_IN_PRM DDT structure:

Standard Symbol	Type	Bit	Meaning	Access
FILTERCOEFF	INT	–	Value of filter coefficient	read/write
ALIGNMENT_OFFSET	INT	–	Alignment offset value	read/write
THRESHOLD0	INT	–	Reserved for evolution.	–
THRESHOLD1	INT	–	Reserved for evolution.	–

The following table shows the T_M_ANA_STD_CH_OUT_PRM DDT structure:

Standard Symbol	Type	Bit	Meaning	Access
FALLBACK	INT	–	fallback value	read/write
ALIGNMENT	INT	–	alignment value	read/write

MOD_FLT Byte Description

MOD_FLT Byte in Device DDT

MOD_FLT byte structure:

Bit	Symbol	Description
0	MOD_FAIL	• **1:** Internal detected error or module failure detected. • **0:** No detected error
1	CH_FLT	• **1:** Inoperative channels. • **0:** Channels are operative.
2	BLK	• **1:** Terminal block detected error. • **0:** No detected error. **NOTE:** This bit may not be managed.
3	–	• **1:** Module in self-test. • **0:** Module not in self-test. **NOTE:** This bit may not be managed.
4	–	Not used.
5	CONF_FLT	• **1:** Hardware or software configuration detected error. • **0:** No detected error.
6	NO_MOD	• **1:** Module is missing or inoperative. • **0:** Module is operating. **NOTE:** This bit is managed only by modules located in a remote rack with a BME CRA 312 10 adapter module. Modules located in the local rack do not manage this bit that remains at 0.
7	–	Not used.

Analog Device Ethernet Remote I/O Forcing Mode

Introduction

Input and output values of Modicon X80 analog modules can be forced through the device DDT value.

NOTE: Modicon X80 discrete modules values are forced using the `EBOOL` mechanism, refer to chapter ***Force Mode*** (see EcoStruxure™ Control Expert, Operating Modes). This does not apply to BMEAH•0•12 modules.

Forcing input and output values in a running controller can have serious consequences to the operation of a machine or process. Only those who understand the implications in the controlling logic, and who understand the consequences of forced I/O on the machine or process, should attempt to use this function.

⚠ WARNING
UNINTENDED EQUIPMENT OPERATION You must have prior knowledge of the process, the controlled equipment and the modified behavior in Control Expert before attempting to force analog inputs or outputs. **Failure to follow these instructions can result in death, serious injury, or equipment damage.**

Modicon X80 Analog Device T_U_ANA_VALUE_•• Structure

The following table shows the content of analog devices DDT, page 266 type used to force a value:

Standard Symbol	Type	Meaning
VALUE	INT	Channel value. It represents the value used in the application and is either the FORCED_VALUE or the TRUE_VALUE depending on the FORCED_STATE.
FORCED_VALUE	INT	Value applied to an output or interpreted as an input during forcing. If FORCED_STATE = 1 then VALUE = FORCED_VALUE
FORCE_CMD	BOOL	Parameter used to force or unforce an analog output or input value
FORCED_STATE	BOOL	Forcing status: • 0: value is not forced • 1: value is forced
TRUE_VALUE	INT	Represents the true value of the analog output or input whatever the state of the forcing command

Forcing a Value with the Animation Tables

To force a DDT value in an animation table proceed as follows:

Step	Action
1	Select the chosen analog channel.
2	Set the FORCED_VALUE parameter value of the selected channel to the chosen value, for details on how to set a value, refer to chapter ***Modification Mode*** (see EcoStruxure™ Control Expert, Operating Modes).
3	Set the FORCE_CMD parameter to 1.
4	**Result**: • Check that forcing is applied: FORCED_STATE needs to be equal to 1 • VALUE = FORCED_VALUE

Unforcing a Value with the Animation Tables

To unforce a DDT value in an animation table proceed as follows:

Step	Action
1	Select the chosen analog channel.
2	Set the FORCE_CMD parameter to 0.
3	**Result**: • Check that forcing is released: FORCED_STATE needs to be equal to 0 • VALUE = TRUE_VALUE

Analog Module Debugging

What's in This Chapter

Subject of this Chapter

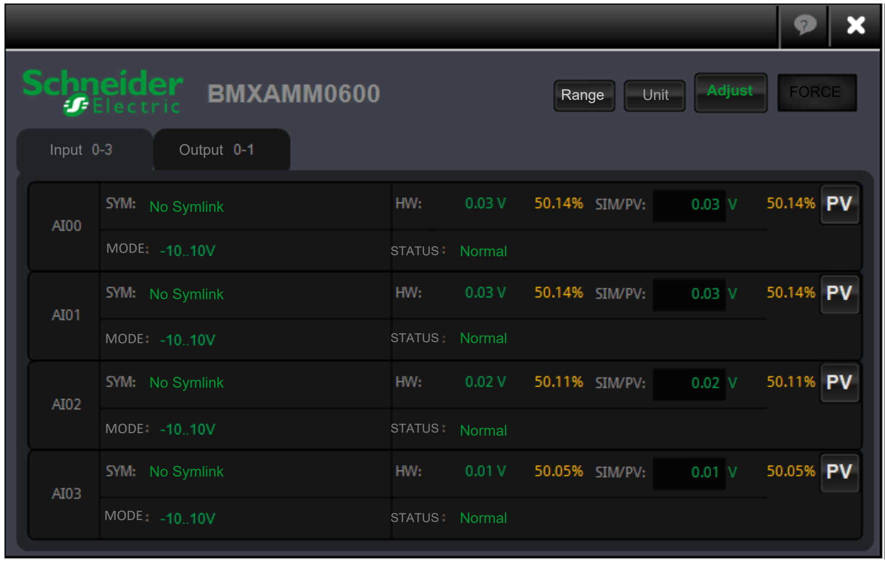
This chapter describes the debugging aspect of the analog modules.

Forcing Analog Modules

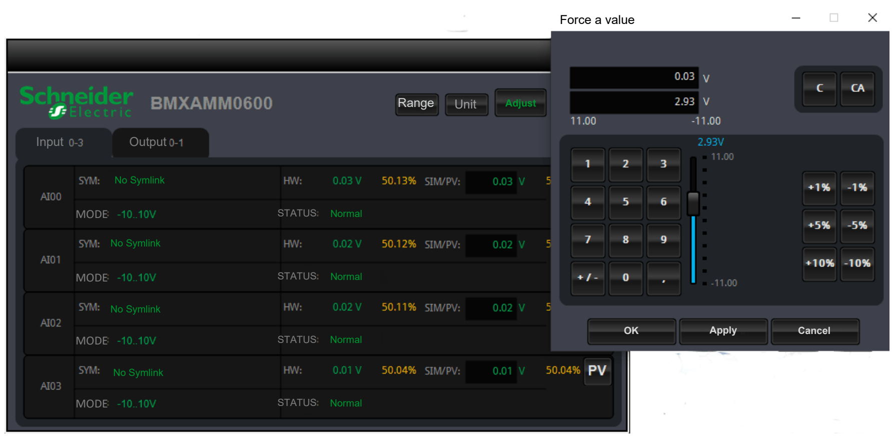
Forcing

The procedure to force a value is as follows:

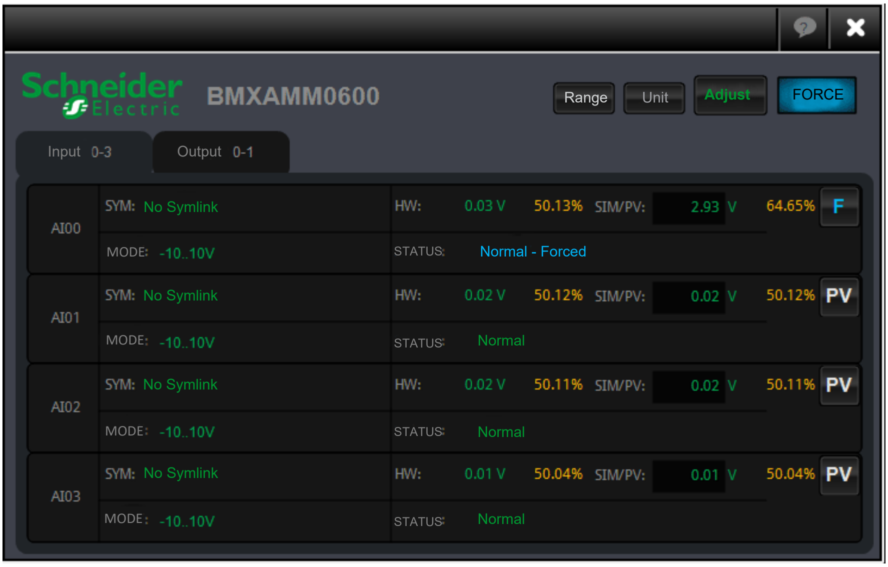
Step	Action
1	Open the HMI.

<table>
<tr><td></td><td>


</td></tr>
<tr><td>2</td><td>
Click on the indicator FORCE. Result: The Force value window is displayed.



</td></tr>
</table>

3	Result: The HMI is updated with the new value and status. The FORCE indicator flashes. 

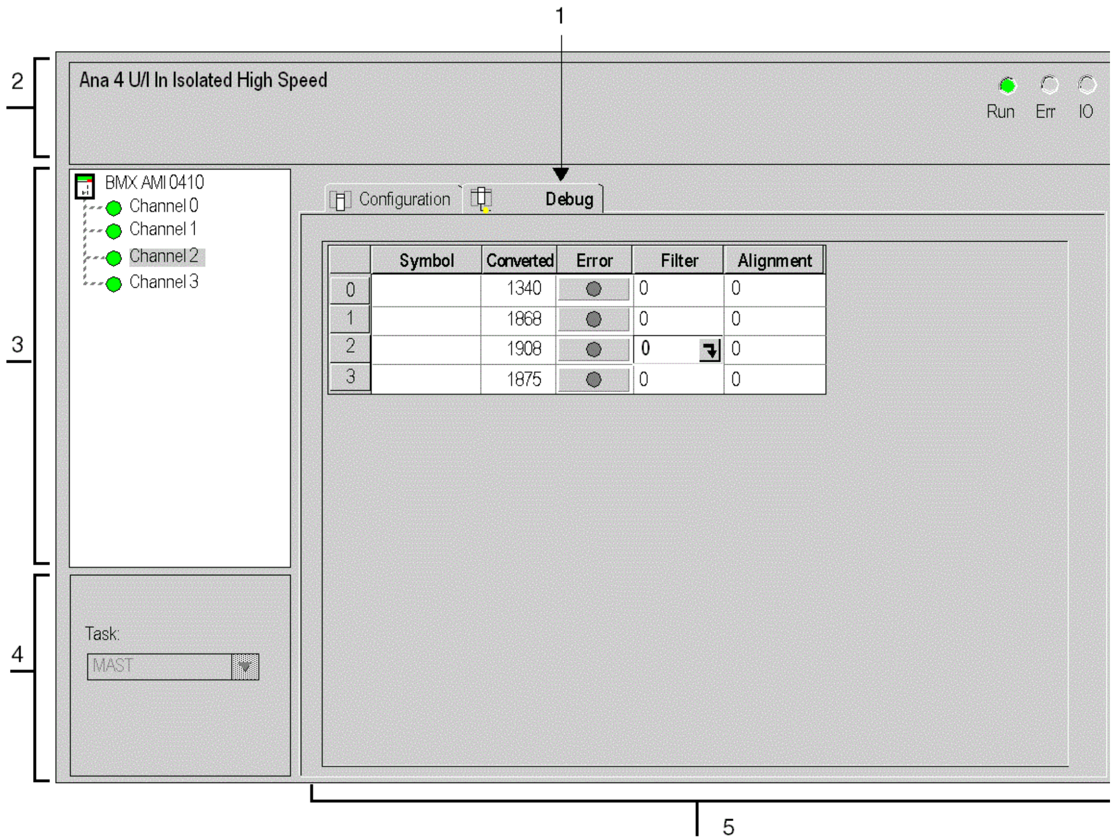
Description of the Analog Module Debug Screen

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 debugging screen.



Description

The table below shows the different elements of the debug screen and their functions.

Address	Element	Function
1	Tabs	The tab in the foreground indicates the mode in progress (**Debug** in this example). Each mode can be selected by the corresponding tab. The available modes are: • **Debug** which can be accessed only in online mode. • **Configuration**.
2	**Module** area	Specifies the shortened name 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 detected error in the module, • **I/O** indicates an event from outside the module or an application error.
3	**Channel** area	Is used: • 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** or **FAST** task configured. This information cannot be modified.
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 area provides direct access to channel by channel diagnostics when these are inoperative (indicated by error column LED ,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: LEDs and commands not available appear grayed out.

Selecting the Adjustment Values for the Input Channels and Measurement Forcing

At a Glance

This function is used to modify the filter, alignment and forcing value of one or more channels of an analog module.

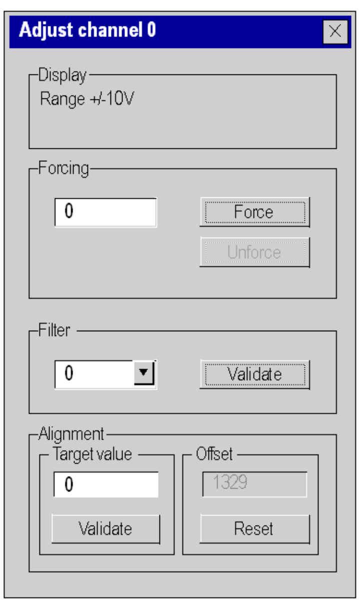
The available commands are:

- forcing
- filter
- alignment

To align several analog channels on the BMX AMO/AMI/AMM/ART modules, we recommand proceeding channel by channel. Test each channel after alignment before moving to the next channel, in order toapply the parameters correctly.

Procedure

The table below summarizes the procedure for modifying the filter, forcing and alignment values.

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. **Result**: The **Adjust channel** dialog box appears. 
3	Click on the text field in the **Forcing** field. Enter the forcing value. Send the forcing order by clicking on the **Forcing** button.

Step	Action for a channel
4	Click on the drop-down menu in the **Filter** field, and define the new selected filter value. Confirm this selection by clicking **OK**.
5	In the **Alignment** field click on the text field and define the target value. Confirm this selection by clicking **OK**.
6	Close the **Adjust channel** dialog box. **Results**: The new filter, forcing or alignment value then appears in the box corresponding to the selected channel in the **Filter**, **Forcing** or **Alignment** column of the **Display** area.

Modification of Output Channels Adjustment Values

At a Glance

This function is used to modify the forcing, fallback and alignment values for one or several output channels of an analog module.

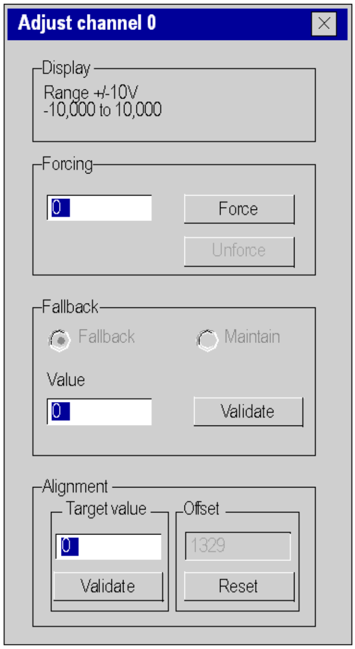
The available commands are:

- forcing
- fallback
- alignment

Procedure

The table below summarizes the procedure for modifying the values to be applied at the output channels:

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.

Step	Action for a channel
	Result: The **Adjust channel** dialog box appears. 
3	Click on the text field in the **Forcing** field of the **Adjust channel** dialog box. Enter the forcing value. Send the forcing order by clicking on the **Forcing** button.
4	Click on the box in the **Value** field of the **Fallback** dialog box and enter the new fallback value. Confirm this new value by clicking **OK**.
5	Click on the text field in the **Alignment** field of the **Adjust channel** dialog box and define the target value. Confirm this selection by clicking **OK**.
6	Close the **Adjust channel** dialog box.

Diagnostics of Analog Input/Output Modules

What's in This Chapter

Introduction

This chapter describes the diagnostics analog input/output modules.

Diagnostics of an Analog Module

At a Glance

The Module diagnostics function displays errors when they occur, classified according to category:

- **Internal detected error**:
  - module malfunction
  - self-testing error
- **External events**:
  - Wiring control (broken-wire, overload or short-circuit)
  - Under range/over range
- **Other errors**:
  - configuration error
  - module missing or off
  - inoperative channel

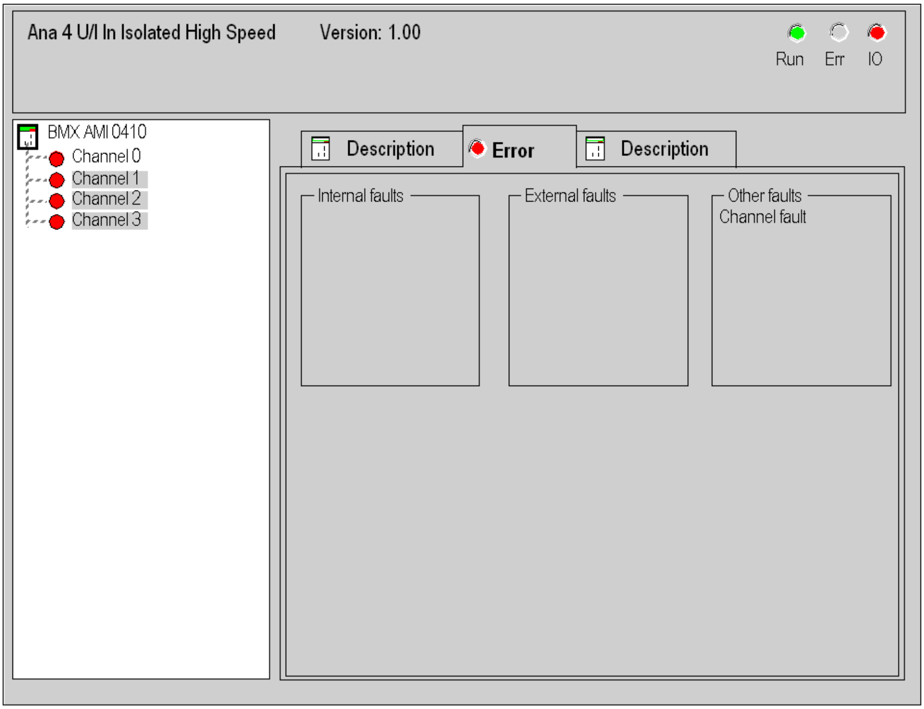
A module error is indicated by a number of LEDs changing to red, such as:

- 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

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 zone 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 then appears on the screen: " `The module is missing or different from that configured for this position`."

Detailed Diagnostics by Analog Channel

At a Glance

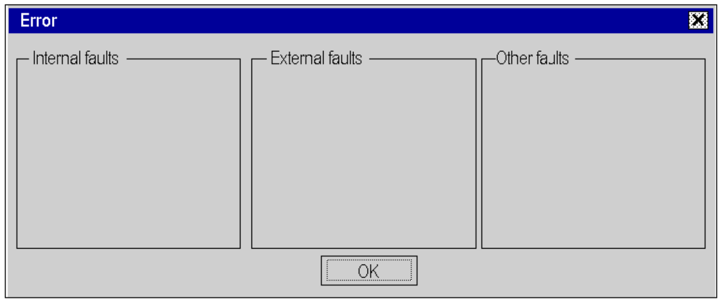
The channel Diagnostics function displays errors when they occur, classified according to category:

- **Internal errors**
  - inoperative channel
  - calibration error
- **External events**
  - sensor link event
  - range overflow/underflow
  - cold junction compensation error
- **Other errors**
  - configuration error
  - communication loss
  - application error
  - value outside range (output channel)
  - channel not ready

A channel error is indicated in the **Debug** tab when the  LED, located in the **Error** column, turns 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 inoperative 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).

Operating Modules from the Application

What's in This Chapter

Subject of this Chapter

This chapter explains how to operate the analog input/output modules from an application.

Access to the Measurements and Statuses

Subject of this Section

This section indicates how to configure an analog module in order to be able to access the input/outputs measurements and the various statuses.

Addressing of the Analog Module Objects

At a Glance

The addressing of the main bit and word objects of the analog input/output modules depends upon:

- the rack address
- the physical position of the module in the rack
- the module channel number

NOTE: You can access the modules either via topological or State RAM addresses (see EcoStruxure™ Control Expert, Operating Modes).

Description

Addressing is defined in the following way.

%	I, Q, M, K	X, W, D, F	r	.	m	.	c	.	i	.	j
Symbol	Object type	Format	Rack		Module position		Channel no.		Rank		Word bit

The table below describes the different elements that make up addressing.

Family	Element	Meaning
Symbol	%	-
Object type	I Q	Image of the physical input of the module. Image of the physical output of the module. This information is exchanged automatically for each cycle of the task to which they are attached.
	M	Internal variable. This read or write information is exchanged at the request of the application.
	K	Internal constant. This configuration information is available as read only.
Format (size)	X	Boolean. For Boolean objects the X can be omitted.
	W	Single length.
	D	Double length.
	F	Floating point.
Rack address	r	Rack address.
Module position	m	Module position number in the rack.
Channel no.	c	Channel no. 0 to 127 or MOD (MOD: channel reserved for managing the module and parameters common to all the channels).
Rank	i	Word rank. 0 to 127 or ERR (ERR: indicates an error in the word).
Word bit	j	Position of the bit in the word.

Examples

The table below shows some examples of analog object addressing.

Object	Description
%I1.3.MOD.ERR	Error information for the analog input module located in position 3 on rack 1.
%I1.4.1.ERR	Channel 1 error information for the analog input module located in position 4 on rack 1.
%IW1.2.2	Image word for the analog input 2 of the module located in position 2 on rack 1.
%QW2.4.1	Image word for the analog output 1 of the module located in position 4 on rack 2.

Module Configuration

At a Glance

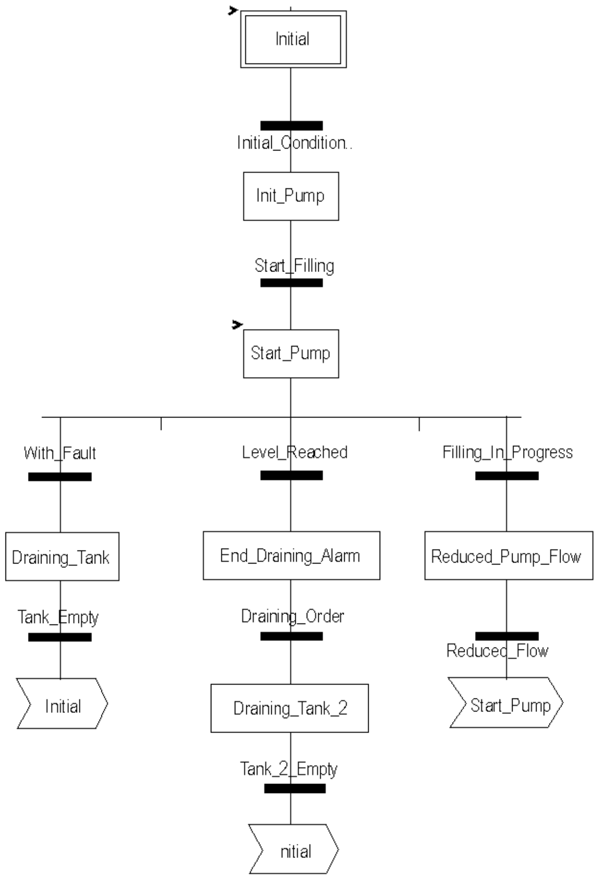
The application used here as an example manages liquid levels in a tank. The tank is filled by a pump and drained using a valve. The different levels of the tank are measured with sensors placed above the tank. The tank should not be filled with more than 100 liters of liquid.

Once the tank is full, the pump stops, and the operator drains the tank manually.

This application requires the use of a BMX AMI 0410 analog input module and a BMX AMO 0210 analog output module. This application may also require a BMX AMM 0600 input/ output module.

Tank Management Grafcet

The application's grafcet is as follows:



Using the Measurements

We are going to configure the BMX_AMI_0410 analog input module so that we can retrieve the level of the liquid in the tank.

Step	Action
1	In the `Project browser` and in `Variables & FB instances`, double-click on `Elementary variables`.
2	Create the `INT`-type variable, `Level`.
3	In the `Address` column, enter the address associated with this variable. In our example, we consider that the sensor is connected to channel 0 of the BMX AMI 0410 module. This module is in turn connected to slot 1 of rack 0. We therefore have the following address: %IW0.1.0. Illustration: 

This variable can be used to check whether the level of liquid in the tank has reached maximum level.

To do this, the following line of code can be associated with the `Level_Reached` transition of the grafcet.

If the level of liquid in the tank reaches or exceeds the maximum level, the `Level_Reached` transition is enabled.

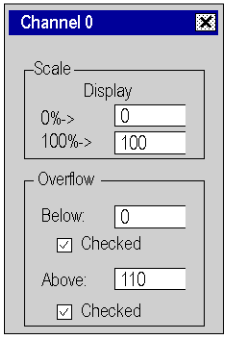
Using the Statuses

We will need to program the `With_fault` transition so that we can stop the pump in three cases:

- the maximum liquid level has been reached
- the pump has been stopped manually
- the measurement falls beyond the upper tolerance area

Before we can use the bit, which will indicate whether the measure still falls within the upper tolerance area (%IWr.m.c.1.6), we need to define the display format and scale of the channel used.

Step	Action
1	Access the hardware configuration screen for the appropriate module.
2	Select the range 0...10 V, page 241 for channel 0.
4	Access the Parameters dialog box, page 243 for the channel in order to input the following parameters:

Step	Action
	 The upper tolerance area will be between 100 and 110 liters.
5	Confirm your changes by closing the dialog box.
6	Validate the change with **Edit->Validate**.

The code associated with the fault control transition looks like this:

Additional Programming Features

Subject of this Section

This section presents some useful additional features for the programming of applications that use analog input/output modules.

Presentation of Language Objects Associated with the Analog Modules

General

Analog modules are associated with different IODDTs.

The IODDTs are predefined by the manufacturer. They contain input/output language objects belonging to a channel of an analog module.

There are several distinct IODDT types for the analog module:

- `T_ANA_IN_BMX` specific to analog input modules such as the BME AHI 0812 and BMX AMI 0410, and specific to the inputs of the BMX AMM 600 mixed module
- `T_ANA_IN_T_BMX` specific to analog input modules such as the BMX ART 0414/0814
- `T_ANA_OUT_BMX` specific to analog output modules such as the BME AHO 0412 and BMX AMO 0210, and specific the outputs of the BMX AMM 600 mixed module
- `T_ANA_IN_GEN` specific to all analog input modules such as the BME AHI 0812, BMX AMI 0410, BMX ART 0414/0814, and the inputs of the BMX AMM 600 mixed module

NOTE: IODDT variables may be created in 2 ways:

- by using the **I/O Objects** tab,
- by using the data editor.

Types of Language Objects

In each IODDT, there exists a set of language objects you can use to control the modules and check their correct operation.

There are 2 types of language objects:

- **Implicit Exchange Objects**, which are automatically exchanged at each cycle of the task assigned to the module. They concern the inputs/outputs of the module (measurement results, information, commands, and so forth).
- **Explicit Exchange Objects**, which are exchanged at the application request, using explicit exchange instructions. They are used to set the module and perform diagnostics.

Implicit Exchange Language Objects Associated with Analog Modules

At a Glance

An integrated 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 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.

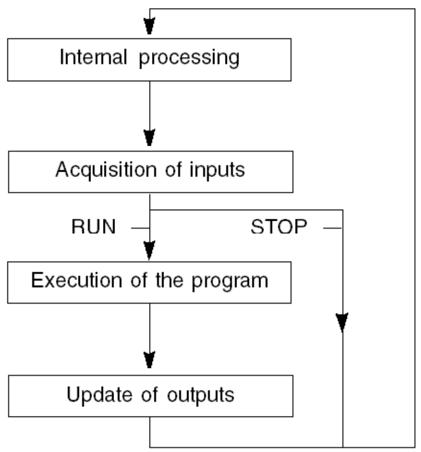
The outputs (`%Q` and `%QW`) are updated at the end of the task, only when the PLC is in RUN mode.

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).

Illustration

The operating cycle of a PLC task (cyclical execution) looks like this:



Explicit Exchange Language Objects Associated with Analog Modules

Introduction

Explicit exchanges are performed at the user program's request, using the following instructions:

- `READ_STS`: read status words
- `WRITE_CMD`: write command words
- `WRITE_PARAM`: write adjustment parameters
- `READ_PARAM`: read adjustment parameters
- `SAVE_PARAM`: save adjustment parameters
- `RESTORE_PARAM`: restore adjustment parameters

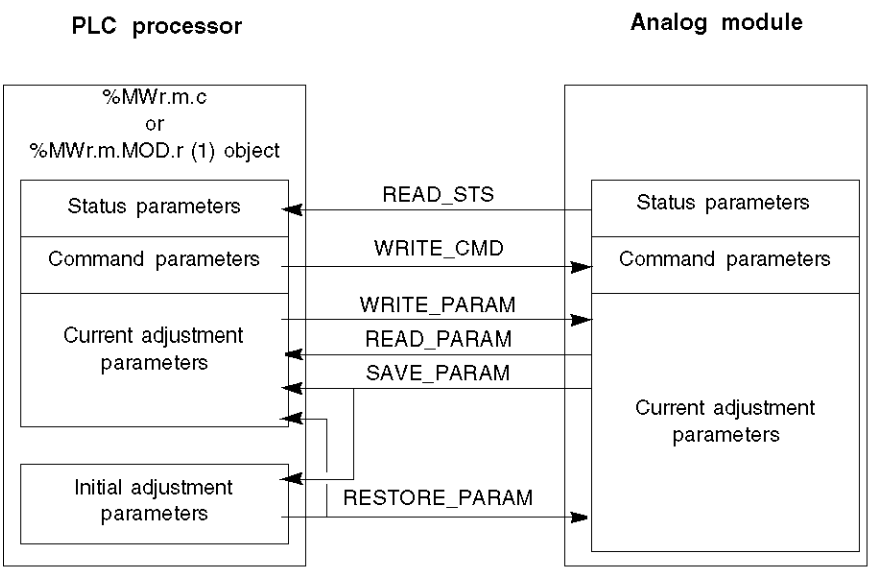
These exchanges apply to a set of `%MW` objects of the same type (status, commands, or parameters) that belong to a channel.

NOTE: These objects provide information about the module (e.g.: error type for a channel, etc.) and can be used to command them (e.g.: switch command) and to define their operating modes (save and restore currently applied adjustment parameters).

NOTE: You can not send the WRITE_PARAM and RESTORE_PARAM requests at the same time to the channels managed by the same logical nodes, The logical node can only process one request, the other request will generate an error.To avoid this kind of errors you have to manage the exchange for each channel with %MWr.m.c.0.x and %MWr.m.c.1.x.

General Principle for Using Explicit Instructions

The diagram below shows the different types of explicit exchanges that can be made between the processor and module.



(1) Only with READ_STS and WRITE_CMD instructions.

Example of Using Instructions

READ_STS instruction:

The READ_STS instruction is used to read SENSOR_FLT (%MWr.m.c.2) and NOT_READY (%MWr.m.c.3) words. It is therefore possible to determine with greater precision the errors which may have occurred during operation.

Performing a READ_STS of all the channels would result in overloading of the PLC. A less burdensome method would be to test the error bit of all the modules in each cycle, and then the channels of the modules in question. You would then only need to use the `READ_STS` instruction on the address obtained.

The algorithm could look like this:

```
WHILE (%I0.m.ERR <> 1) OR (m <= Number of modules) THEN

m=m+1

Loop

END WHILE


WHILE (%I0.m.c.ERR <> 1) OR (c <= Number of channels) THEN

c=c+1

Loop

END WHILE


READ_STS (%I0.m.c)
```

WRITE_PARAM instruction:

The `WRITE_PARAM` instruction is used to modify certain configuration parameters for the modules during operation.

All you need to do is to assign the new values to the relevant objects and use the `WRITE_PARAM` instruction on the required channel.

For example, you can use this instruction to modify the fallback value by program (only for output analog modules). Assign the required value to the `Fallback` (`%MWr.m.c.7`) word and then use the `WRITE_PARAM` instruction.

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. All IODDTs use two words to manage exchanges:

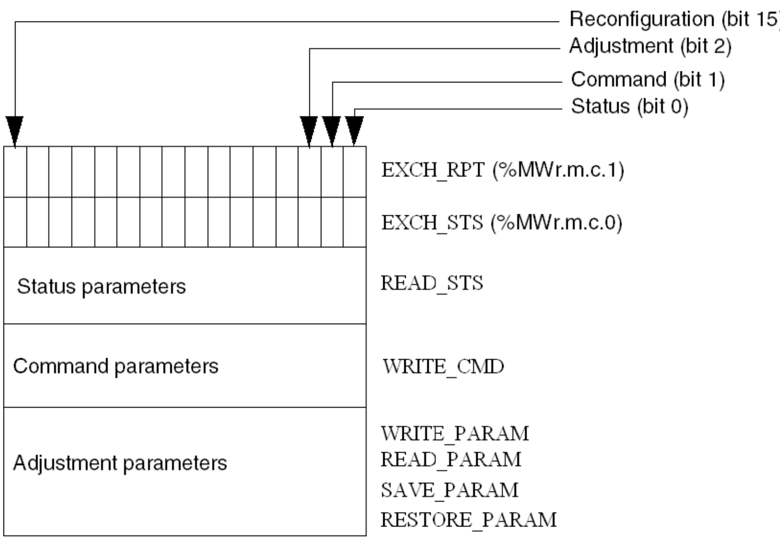
- EXCH_STS (%MWr.m.c.0) : exchange in progress
- EXCH_RPT (%MWr.m.c.1) : report

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 doneimmediately on the local PLC Bus and are finished before the end of the executon task, so the READ_STS, for example, is always 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

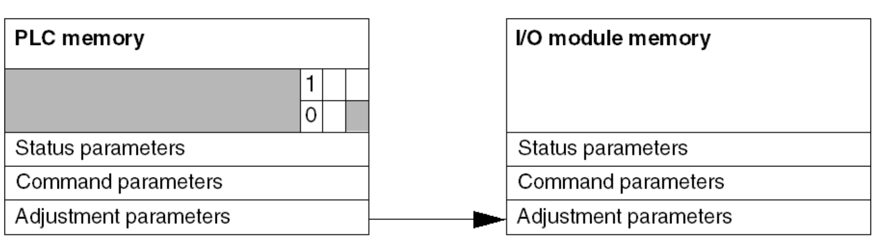
Each bit of the EXCH_STS (%MWr.m.c.0) and EXCH_RPT (%MWr.m.c.1) words is associated with a type of parameter:

- 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 and cold start-up of the channel).
- Bits r, m, and c indicate the following slots:
  - Bit r represents the rack number.
  - Bit m represents the position of the module in the rack.
  - Bit c represents the channel number in the module.

NOTE: Exchange and report words also exist at the level of EXCH_STS (%MWr.m.MOD.0) and EXCH_RPT (%MWr.m.MOD.1) modules, as per T_ANA_IN_BMX, T_ANA_IN_T_BMX and T_ANA_OUT_BMX-type IODDTs.

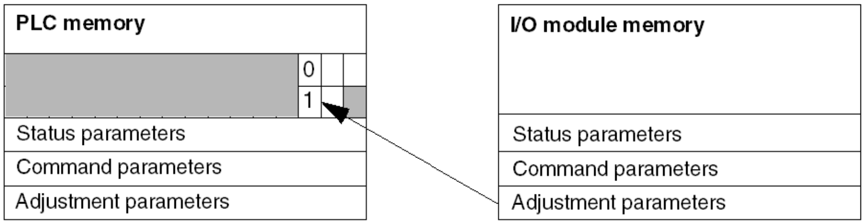
Example

Phase 1: Sending data by using the WRITE_PARAM instruction:



When the instruction is scanned by the PLC processor, the `Exchange in progress` bit is set to 1 in `%MWr.m.c`.

Phase 2: Analysis of the data by the input/output module and report:



When data is exchanged between the PLC memory and the module, acknowledgement by the module is managed by the `ADJ_ERR` (`%MWr.m.c.1.2`) bit which, depending on its value, gives the following report:

- **0:** correct exchange.
- **1:** error in exchange.

NOTE: There is no adjustment parameter at module level.

Explicit Exchange Execution Flag: EXCH_STS

The table below shows the `EXCH_STS` (`%MWr.m.c.0`) explicit exchange control bits.

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 presents the `EXCH_RPT` (`%MWr.m.c.1`) report bits.

Standard symbol	Type	Access	Meaning	Address
STS_ERR	BOOL	R	Error reading channel status words (1 = error)	%MWr.m.c.1.0
CMD_ERR	BOOL	R	Error during a command parameter exchange (1 = error)	%MWr.m.c.1.1
ADJ_ERR	BOOL	R	Error while exchanging adjustment parameters (1 = error)	%MWr.m.c.1.2
RECONF_ERR	BOOL	R	Error during reconfiguration of the channel (1 = error)	%MWr.m.c.1.15

Language Objects Associated with Configuration

At a Glance

The configuration of an analog module is stored in the configuration constants (`%KW`).

The parameters r, m, and c shown in the following tables represent the topologic addressing of the module. Each parameter had the following signification:

- **r:** represents the rack number
- **m:** represents the position of the module on the rack
- **c:** represents the channel number

BME AHI 0812, BMX AMI 0410, BMX AMI 0800, and BMX AMI 0810 Configuration Objects and Inputs of BMX AMM 0600

The process control language objects associated to the configuration of the BME AHI 0812, BMX AMI 0410, BMX AMI 0800, and BMX AMI 0810 modules include the following:

Addresses	Description	Bits Meaning
%KWr.m.c.0	Channel range configuration	**Bit 0 to 5:** electric range (hexadecimal value) **Bit 7:** 0=electrical range (always 0)
%KWr.m.c.1	Scale/User scaling min value	-
%KWr.m.c.2	Scale/User scaling max value	-
%KWr.m.c.3	Over range below value	-
%KWr.m.c.4	Over range above value	-
%KWr.m.c.5	Channel treatment configuration	**Bit 0:** 0=Mast mode, 1=Fast mode **Bit 1:** 0=channel disabled, 1=channel enabled **Bit 2:** 0=sensor monitor off, 1=sensor monitor on **Bit 7:** 0=Manufacturer scale, 1=user scale **Bit 8:** over range lower threshold enabled **Bit 9:** over range upper threshold enabled

BMX ART 0414/0814 Configuration Objects

The process control language objects associated to the configuration of the BMX ART 0414/0814 modules include the following:

Addresses	Description	Bits Meaning
%KWr.m.c.0	Channel range configuration	**Bit 0 to 5:** Temperature range (hexadecimal value) **Bit 6:** Temperature range (0=°C, 1=F°) **Bit 7:** 1=Temperature range **Bit 8:** 0=rejection 50 Hz, 1=rejection 60 Hz
%KWr.m.c.1	Scale/User scaling min value	-
%KWr.m.c.2	Scale/User scaling max value	-
%KWr.m.c.3	Over range below value	-

Addresses	Description	Bits Meaning
%KWr.m.c.4	Over range above value	-
%KWr.m.c.5	Channel treatment configuration	**Bit 0:** 0=Standard mode (always 0) **Bit 1:** 0=channel disabled (only in Fast mode), 1=channel enabled **Bit 2:** 0=sensor monitor off, 1=sensor monitor on **Bits 3 to 6:** CJC Configuration Mode for channels 0/3: • Bit 3=0 and Bit 4=0: Int. Telefast, • Bit 3=1 and Bit 4=0: External RTD, • Bit 3=0 and Bit 4=1: CJC on channels 4/7. **Bits 3 to 6:** CJC Configuration Mode for channels 4/7: • Bit 5=0 and Bit 6=0: Int. Telefast, • Bit 5=1 and Bit 6=0: External RTD. **Bit 7:** 0=Manufacturer scale, 1=user scale **Bit 8:** Over range lower threshold enabled **Bit 9:** Over range upper threshold enabled

BME AHO 0412, BMX AMO 0210, BMX AMO 0410, and BMX AMO 0802 Configuration Objects and Outputs of BMX AMM 0600

The process control language objects associated to the configuration of the BME AHO 0412, BMX AMO 0210, BMX AMO 0410, and BMX AMO 0802 modules include the following:

Addresses	Description	Bits Meaning
%KWr.m.c.0	Channel range configuration	**Bit 0 to 5:** Electric range (hexadecimal value) **Bit 8:** Fallback mode (0=Fallback, 1=Maintain) **Bit 11:** Actuator wiring control (0=disabled, 1=enabled) **Bit 14:** Output lower overshoot below range valid (0= disabled, 1=enabled) **Bit 15:** Output upper overshoot above range valid (0= disabled, 1=enabled)
%KWr.m.c.1	Scale/User scaling min value	-
%KWr.m.c.2	Scale/User scaling max value	-

Addresses	Description	Bits Meaning
%KWr.m.c.3	Overshoot below value	-
%KWr.m.c.4	Overshoot above value	-

Quick Start: Example of Analog I/O Module Implementation

What's in This Part

In this Part

This part presents an example of implementation of the analog input/output modules.

Description of the Application

What's in This Chapter

Subject of this Chapter

This chapter states the application specifications and illustrates the end result to be obtained using the example of an operator screen.

Overview of the Application

At a Glance

The application described in this document is used to manage the level of a liquid in a tank. The tank is filled by a pump, and drained using a valve.

The level of the tank is measured with an ultrasonic sensor placed below of the tank.

The volume of the tank is shown by a digital display.

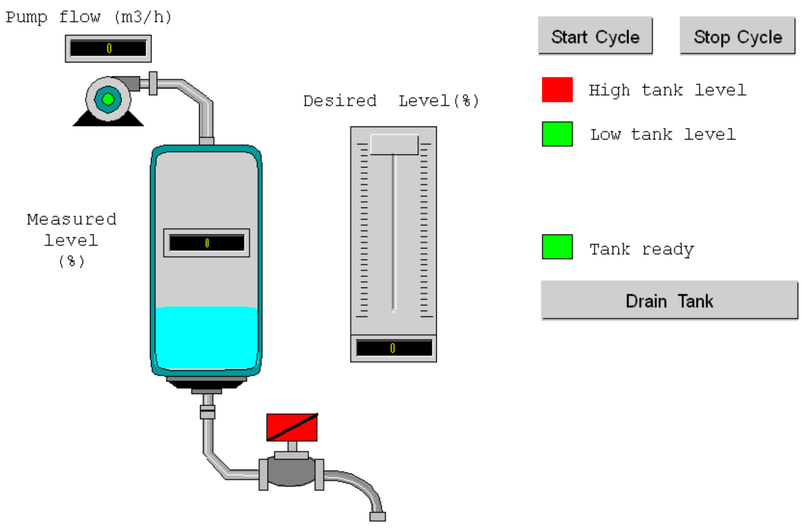
The desired level of liquid is defined by the operator, using a potentiometer

The application's operation control resources are based on an operator screen, which shows the status of the various sensors and actuators, as well as the level of the tank.

The high tank level is defined through the operator screen.

Illustration

This is the application's final operator screen:



Operating Mode

The operating mode is as follows:

- A potentiometer is used to defined the desired level.
- A **Start Cycle** button is used to start the filling.
- When the desired level of the tank is reached, the pump stops and the **Tank ready** led lights up.
- A **Drain tank** button is used to start the tank draining.
- When the low level of the tank is reached, the valve closes. The **Start Cycle** button is used to restart the filling.
- A **Stop Cycle** button is used to interrupt the filling. Pressing this button allows you to set the system to a safe level. The pump stops and the valve opens until the low level is reached (tank empty). The valve closes.
- The pump has a variable flow rate, the value of which can be accessed by the operator screen. The more the level of liquid is raised, the more the flow is reduced.

  The flow rate of the valve is fixed.

- A safety measure must be installed. If the high level is exceeded, a safety measure is activated and the system is set to failsafe. The pump then stops and the valve opens until the low level is reached (tank empty). The valve closes.
- For failsafe mode, an error message must be displayed.
- The time that the valve is open and closed is monitored, with an error message being displayed if either of these is exceeded.

Installing the Application Using Control Expert

What's in This Chapter

Subject of this Chapter

This chapter describes the procedure for creating the application described. It shows, in general and in more detail, the steps in creating the different components of the application.

Presentation of the Solution Used

Subject of this Section

This section presents the solution used to develop the application. It explains the technological choices and gives the application's creation timeline.

Technological Choices Used

At a Glance

There are several ways of writing an application. The one proposed here allows you to structure the application to facilitate its creation and debugging.

Technological Choices

The following table shows the technological choices used for the application.

Objects	Choices used
Use of the pump	Creation of a user function block (DFB) to facilitate management of the pump in terms of entering a program and speed of debugging. The programming language used to develop this DFB is a function block diagram (FBD)-based graphic language.
Use of the valve	Creation of a user function block (DFB) to facilitate management of the valve in terms of entering a program and speed of debugging. The programming language used to develop this DFB is a function block diagram (FBD)-based graphic language.
Supervision screen	Use of elements from the library and new objects.
Main supervision program	This program is developed using a sequential function chart (SFC), also called GRAFCET. The various sections are created in Ladder Diagram (LD) language, and use the different DFBs created.
Fault display	Use of the ALRM_DIA DFB to control the status of the variables linked with the detected errors.

NOTE: Using a DFB function block in an application enables you to:

- simplify the design and entry of the program
- increase the legibility of the program
- facilitate debugging the application
- reduce the volume of generated code

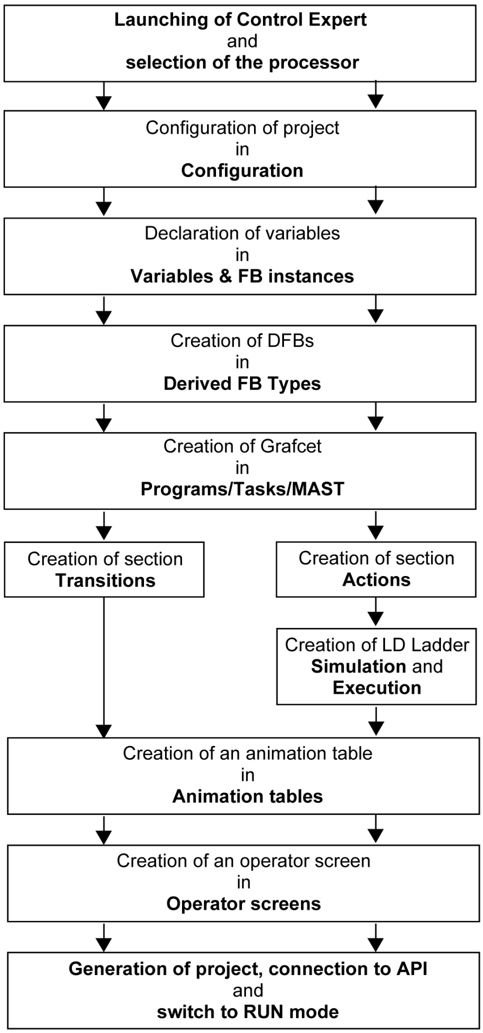
The Application Process

At a Glance

The following logic diagram shows the different steps to follow to create the application. Respect the chronological order to correctly define all of the application elements.

Description

Description of the different types:



Developing the Application

Subject of this Section

This section gives a step-by-step description of how to create the application using Control Expert.

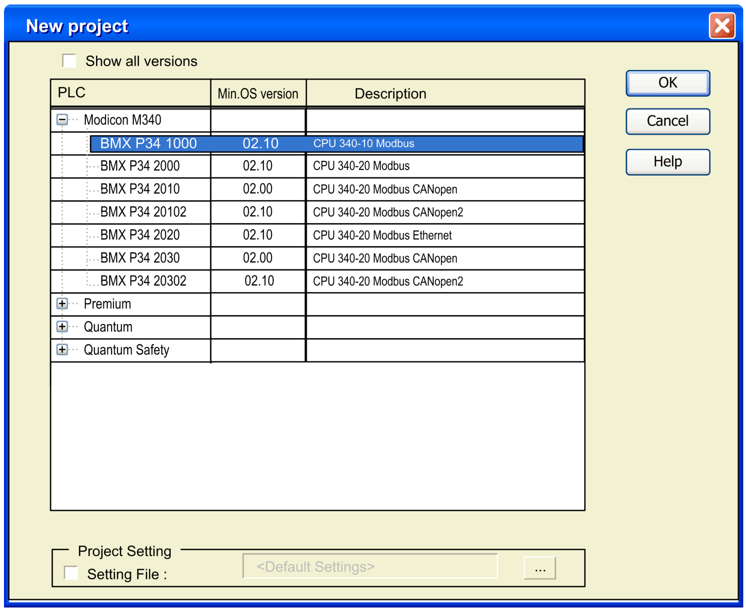
Creating the Project

At a Glance

Developing an application involves creating a project associated with a PLC.

Procedure for Creating a Project

The following table shows the procedure for creating the project:

Step	Action
1	Launch the software.
2	Click File —> New to select a PLC. 
3	To see all PLC versions, select the Show all versions check box.
4	Select the processor you wish to use from those proposed.
5	To create a project with specific values of project settings, select the Settings File check box and use the browser button to localize the .XSO file (Project Settings file). It is also possible to create a new one. If the **Settings File** check box is not selected, default values of project settings are used.
6	Confirm with OK.

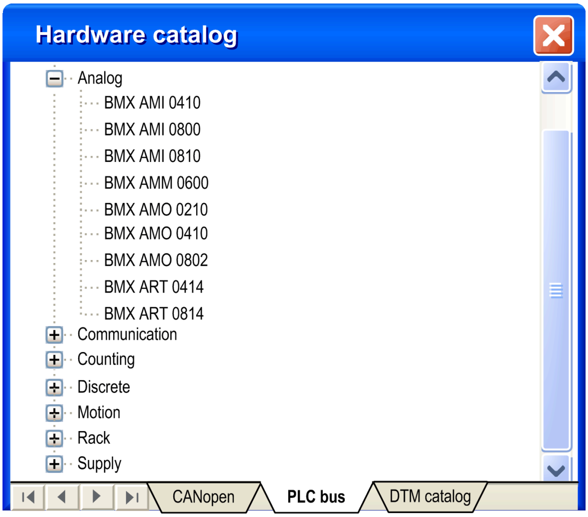
Selection of the Analog Module

At a Glance

Developing an analog application involves choosing the right module and appropriate configuration.

Module Selection

The table below shows the procedure for selecting the analog module.

Step	Action
1	In the `Project browser` double-click `Configuration`, `0:PLC bus`, `0:BMX ••• •••` (Where 0 is the rack number) and double-click a slot.
2	In the `Hardware Catalog` window, select the `BMX AMI 0410` input module then drag and drop it in the `PLC bus` window. 
3	Do the same for the BMX AMO 0210 output module.

Declaration of Variables

At a Glance

Declare all of the variables used in the different sections of the program.

Undeclared variables cannot be used in the program.

Procedure for Declaring Variables

The following table shows the procedure for declaring application variables.

Step	Action
1	In Project browser / Variables & FB instances, double-click on Elementary variables
2	In the Data editor window, select the box in the Name column and enter a name for your first variable.
3	Now select a Type for this variable.
4	When all your variables are declared, you can close the window.

Variables Used for the Application

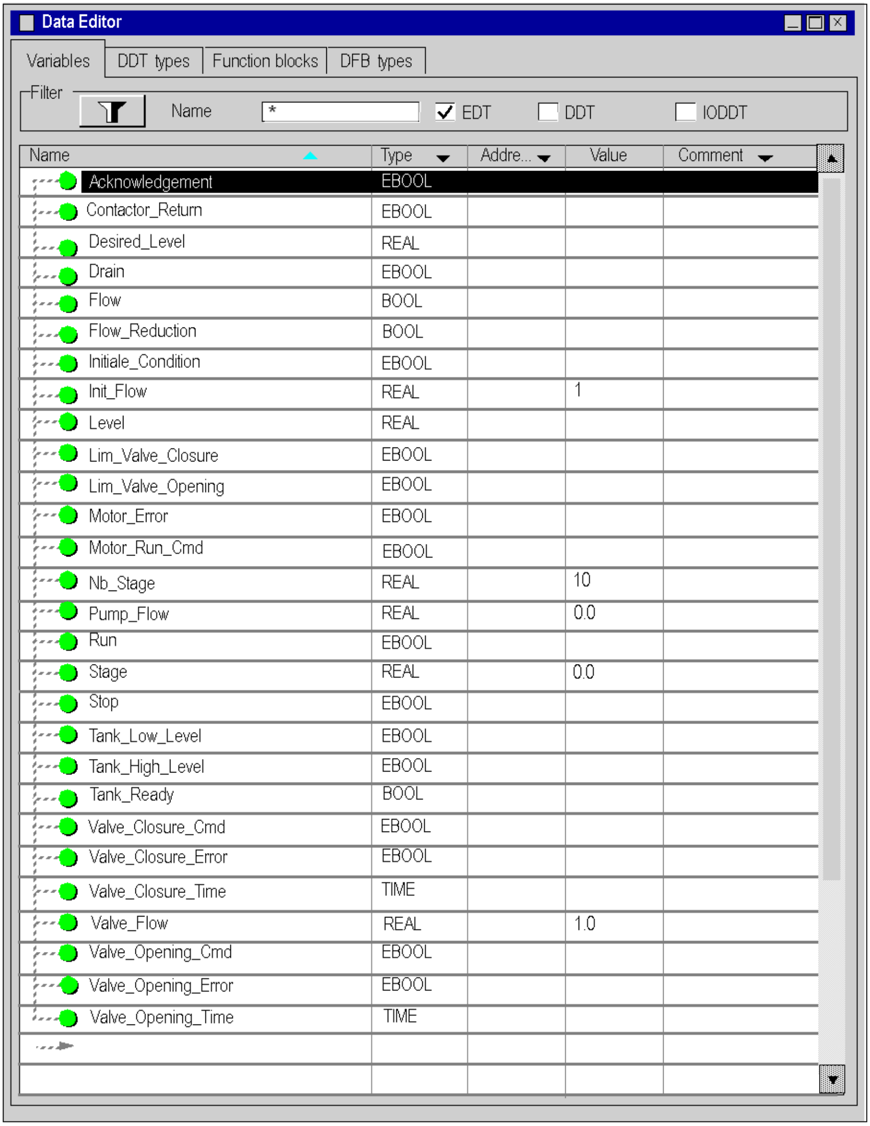
The following table shows the details of the variables used in the application.

Variable	Type	Definition
Acknowledgement	EBOOL	Acknowledgement of an error (Status 1).
Stop	EBOOL	Stop cycle at end of draining (Status 1).
Valve_Opening_Cmd	EBOOL	Opening of the valve (Status 1).
Motor_Run_Cmd	EBOOL	Startup request for filling cycles (Status 1).
Valve_Closing_Cmd	EBOOL	Closing of the valve (Status 1).
Initiale_condition	EBOOL	Transition that starts the pump.
Desired_Level	REAL	Desired level of liquid.
Tank_ready	BOOL	Tank is full, ready to be drained.
Flow	BOOL	Intermediate variable for simulating the application.
Init_Flow	REAL	Pump initial flow rate.
Flow_Reduction	BOOL	Pump flow rate after reduction.
Pump_Flow	REAL	Pump flow rate.
Valve_Flow	REAL	Valve flow rate.
Motor_Error	EBOOL	Error returned by the motor.
Valve_Closure_Error	EBOOL	Error returned by the valve on closing.
Valve_Opening_Error	EBOOL	Error returned by the valve on opening.
Lim_Valve_Closure	EBOOL	Valve in closed position (Status 1).
Lim_Valve_Opening	EBOOL	Valve in opened position (Status 1)
Run	EBOOL	Startup request for filling cycles (Status 1).
Nb_Stage	REAL	Number of tank filling stage.

Variable	Type	Definition
Level	REAL	Level of liquid in the tank.
Tank_low_level	EBOOL	Tank volume at low level (Status 1).
Tank_high_level	EBOOL	Tank volume at high level (Status 1).
Stage	REAL	Stage incrementation value.
Contactor_Return	EBOOL	Error returned by the contactor in the event of motor error.
Valve_closure_time	TIME	Valve closure time.
Valve_opening_time	TIME	Valve opening time.
Drain	EBOOL	Drain command

NOTE: EBOOL types can be used for I/O modules, unlike BOOL types.

The following screen shows the application variables created using the data editor:



Creation and Use of the DFBs

At a Glance

DFB types are function blocks that can be programmed by the user ST, IL, LD or FBD. Our example uses a motor DFB and a valve DFB.

We will also be using existing DFB from the library for monitoring variables. Particularly "safety" variables for tank levels, and "error" variables returned by the valve. The status of these variables will be visible in Diagnostics display.

NOTE: Function blocks can be used to structure and optimize your application. They can be used whenever a program sequence is repeated several times in your application, or to set a standard programming operation (for example, an algorithm that controls a motor).

Once the DFB type is created, you can define an instance of this DFB via the variable editor or when the function is called in the program editor.

Procedure for Creating a DFB

The following table shows the procedure for creating application DFBs.

Step	Action
1	In the `Project browser`, right click `Derived FB types` and select `Open`.
2	In the `Data editor` window, select the box in the `Name` column and enter a name for your DFB and confirm with `Enter`. The name of your DFB appears with the sign "Works" (unanalyzed DFB).
3	Open the structure of your DFB (see figure next page) and add the inputs, outputs and other variables specific to your DFB.
4	When the variables of the DFB are declared, analyze your DFB (the sign "Works" must disappear). To analyze your DFB, select the DFB and, in the menu, click `Build` then `Analyze`. You have created the variables for your DFB, and must now create the associated section.
5	In the `Project browser`, double-click on `Derived FB types` then on your DFB. Under the name of your DFB, the `Sections` field will appear.
6	Right click on `Sections` then select `New section`.
7	Give your section a name, then select the language type and confirm with `OK`. Edit your section using the variables declared in step 3. Your DFB can now be used by the program (DFB Instance).

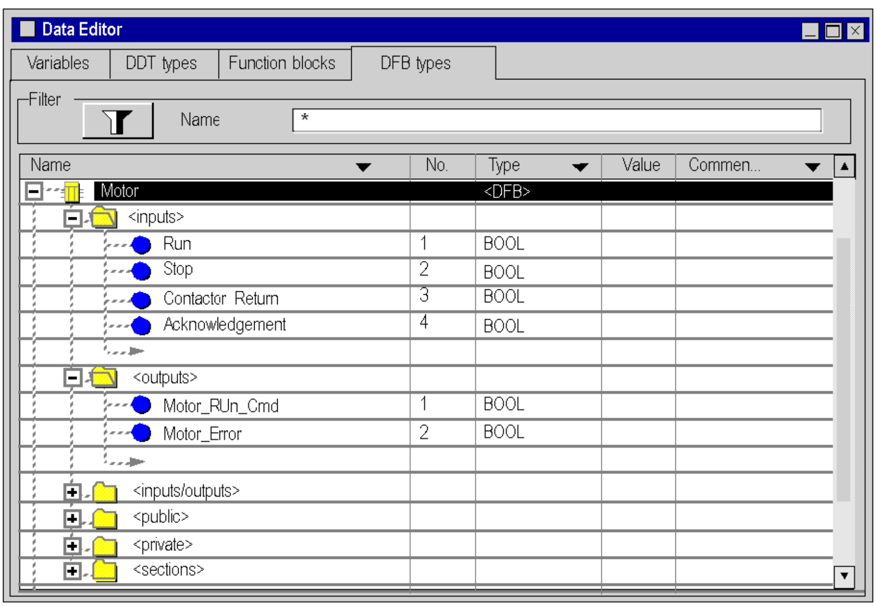
Variables Used by the Motor DFB

The following table lists the variables used by the Motor DFB.

Variable	Type	Definition
Run	Input	Motor run command.
Stop	Input	Motor stop command.
Contactor_Return	Input	Contactor feedback in the event of motor run problem.
Acknowledgement	Input	Acknowledgement of the Motor_error output variable.
Motor_Run_Cmd	Output	Start of motor.
Motor_Error	Output	Display in the "Diagnostics display" window of an alarm linked to a problem with the motor.

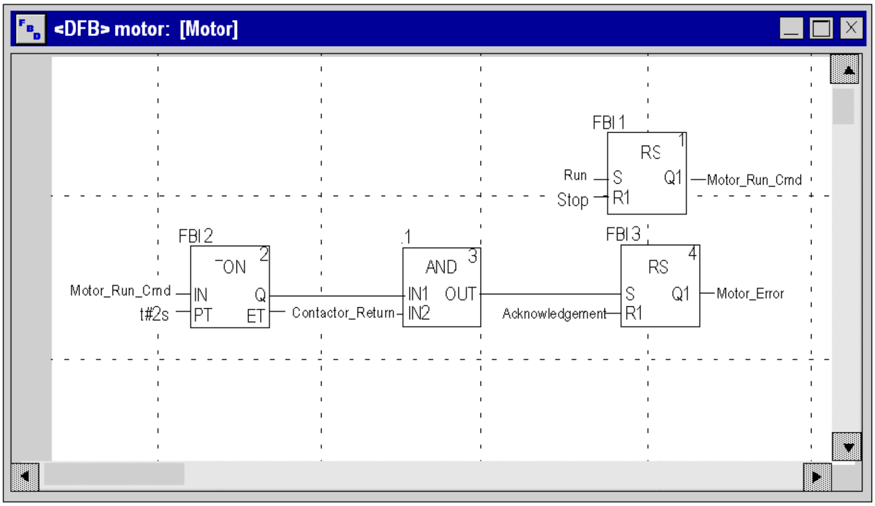
Illustration of the Motor DFB Variables Declared in the Data Editor

The following screen shows the Motor DFB variables used in this application to control the motor.



Operating Principle of the Motor DFB

The following screen shows the Motor DFB program written by the application in FBD for controlling the motor.



When Run = 1 and Stop = 0, the motor can be controlled (Motor_Run_Cmd = 1). The other part monitors the Contactor_return variable. If Contactor_return is not set to "1" after the Discrete counter counts two seconds, the Motor_error output switches to "1".

Variables Used by the Valve DFB

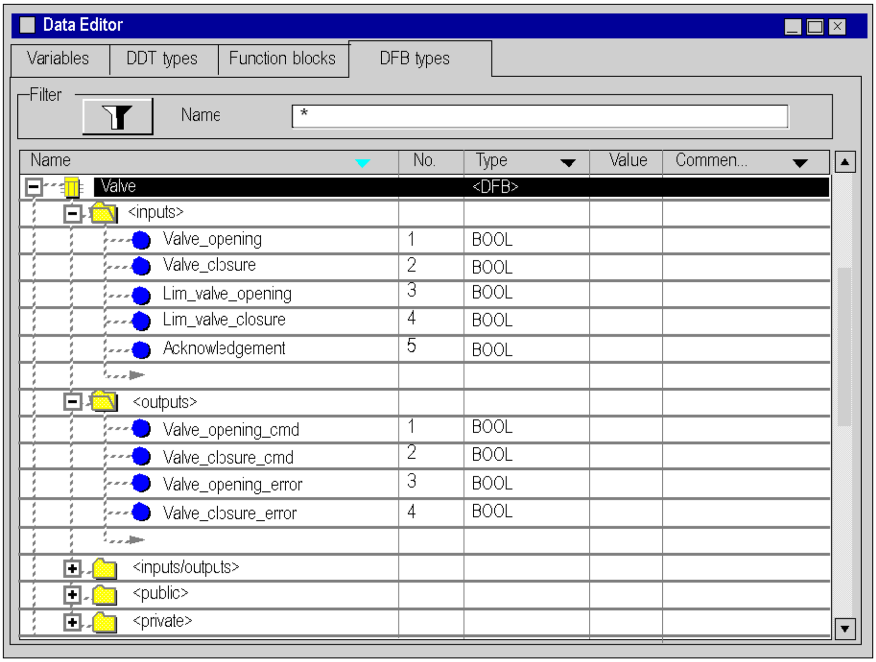
The following table lists the variables used by the Valve DFB.

Variable	Type	Definition
Valve_opening	Input	Valve opening command.
Valve_closure	Input	Valve closure command.
Lim_valve_opening	Input	Status of valve limit.
Lim_valve_closure	Input	Status of valve limit.
Acknowledgement	Input	Acknowledgement of variables Valve_closure_error or Valve_opening_error.
Valve_opening_cmd	Output	Opening of the valve.
Valve_closure_cmd	Output	Closure of the valve.

Variable	Type	Definition
Valve_opening_error	Output	Display in the "Diagnostics display" window of an alarm linked to a problem with the valve opening.
Valve_closure_error	Output	Display in the "Diagnostics display" window of an alarm linked to a problem with the valve closure.

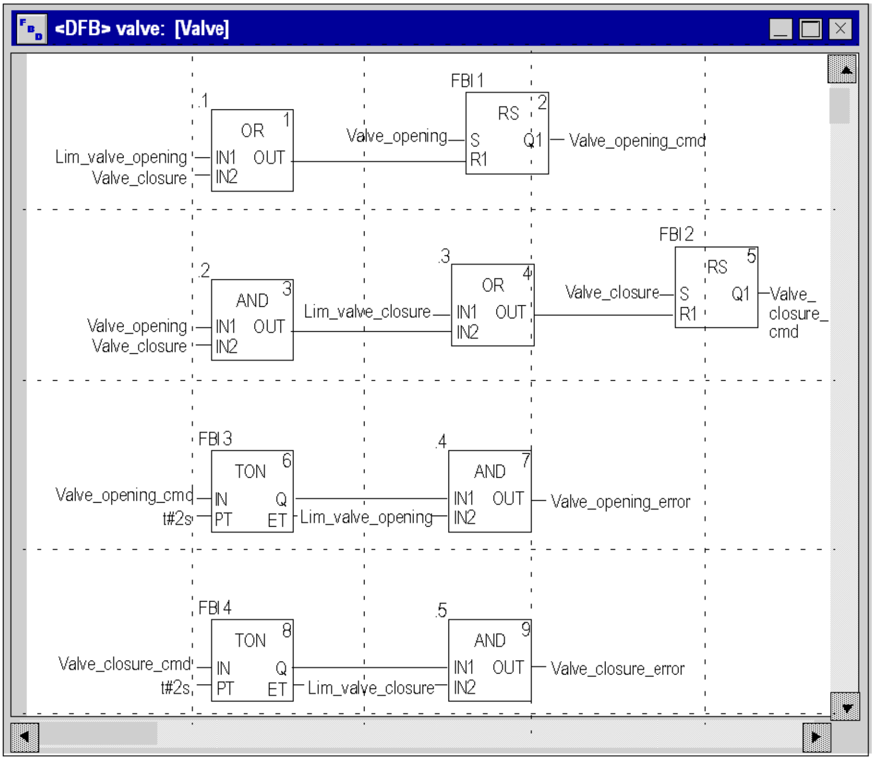
Illustration of the Valve DFB Variables Declared in the Data Editor

The following screen shows the Valve DFB variables used in this application to control the valve.



Operating Principle of the Valve DFB

The following screen shows the Valve DFB written in FBD language.



This DFB authorizes the command to open the valve (Valve_opening_cmd) when the inputs Valve_closure and Lim_valve_opening are set to "0". The principle is the same for closure, with an additional safety feature if the user requests the opening and closing of the valve at the same time (opening takes priority).

In order to monitor opening and closing times, we use the TON timer to delay the triggering of an error condition. Once the valve opening is enabled (Valve_opening_cmd = 1), the timer is triggered. If Lim_valve_opening does not switch to "1" within two seconds, the output variable Valve_opening_error switches to "1". In this case a message is displayed.

NOTE: Adjust the PT time according to your equipment.

Creating the Program in SFC for Managing the Tank

At a Glance

The main program is written in SFC (Grafcet). The different sections of the grafcet steps and transitions are written in LD. This program is declared in a MAST task, and will depend on the status of a Boolean variable.

The main advantage of SFC language is that its graphic animation allows us to monitor in real time the execution of an application.

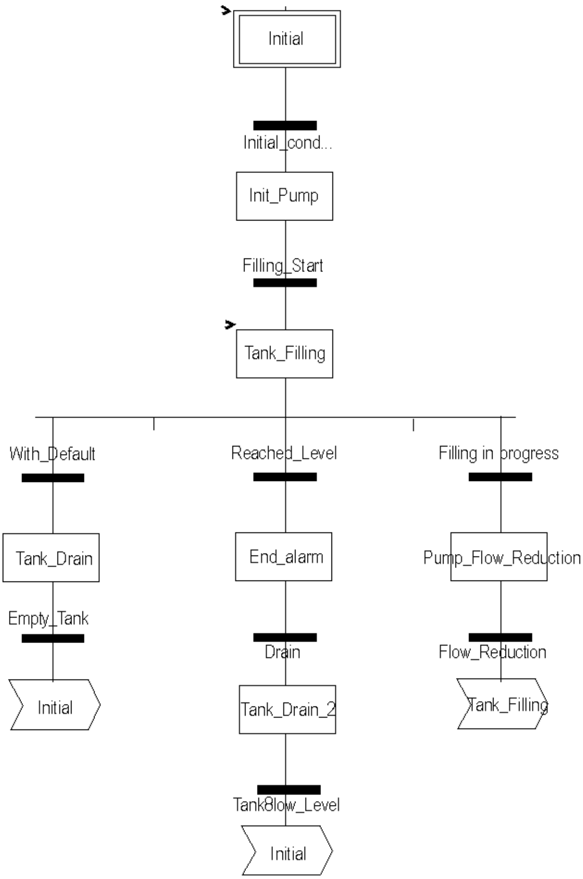
Several sections are declared in the MAST task:

- The **Tank_management**, page 325 (written in SFC and describing the operate mode,
- The **Execution**, page 327 (written in LD, which executes the pump start-up using the motor DFB, as well as the opening and closure of the valve.
- The **Simulation**, page 329 (written in LD, which simulates the application. This section must be deleted in the case of connection to a PLC.

NOTE: The LD, SFC and FBD-type sections used in the application must be animated in online mode, page 336, with the PLC in RUN

Illustration of the Tank_management Section

The following screen shows the application Grafcet:



For actions and transitions used in the grafcet, refer to chapter *Actions and transitions*, page 344.

NOTE: For more information on creating an SFC section, refer to chapter *SFC Editor* (see EcoStruxure™ Control Expert, Operating Modes).

Description of the Tank_management Section

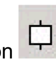
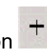
The following table describes the different steps and transitions of the Tank_management Grafcet:

Step / Transition	Description
Initial	This is the initial step.
Initial_condition	This is the transition that starts the pump. The transition is valid when the variables: • Stop = 0, • Run = 1, • Tank_High_Level = 0, • Lim_valve_closure = 1 • Desired_Level > 0
Init_Pump	This is the step initiate the pump flow rate.
Filling_Start	This transition is active when the pump flow rate is initialized.
Tank_Filling	This is the step that starts the pump and filling of the tank until the high level is reached. This step activates the motor DFB in the Application section, which controls the activation of the pump.
Reached_Level	This transition is active when the tank's desired level is reached.
End_Alarm	This is the step that lights the **Tank ready** led
Drain	This transition is active when the operator click on the **Drain Tank** button (Drain = 1).
Tank_Drain_2	This step is identical to Tank_Drain.
Tank_Low_Level	This transition is active when the low level of the tank is reached (Tank_Low_Level = 1).
With_fault	This transition is active when High_Safety_Alarm = 1 or the Stop_cycle button has been activated (Stop_cycle = 1).
Tank_Drain	This step activates the valve DFB in the Application section, which controls the opening of the valve.
Empty_Tank	This transition is valid when the tank is empty (Tank_Low_Level = 1 and Pump_Flow = 0.0).
Filling in progress	This transition is valid when the filling of the tank is in progress.
Pump_Flow_Reduction	This is the step that reductes the pump flow rate.
Flow_Reduction	This is the value of the flow rate after reduction.

NOTE: You can see all the steps and actions and transitions of your SFC by clicking on  in front of the name of your SFC section.

Procedure for Creating an SFC Section

The table below shows the procedure for creating an SFC section for the application.

Step	Action
1	In `Project Browser\Program\Tasks`, double-click on `MAST`.
2	Right click on `Section` then select `New section`. Give your section a name (Tank_management for the SFC section) then select SFC language.
3	The name of your section appears, and can now be edited by double clicking on it.
4	The SFC edit tools appear in the window, which you can use to create your Grafcet. For example, to create a step with a transition: • To create the step, click on  then place it in the editor, • To create the transition, click on  then place it in the editor (generally under the preceding step).

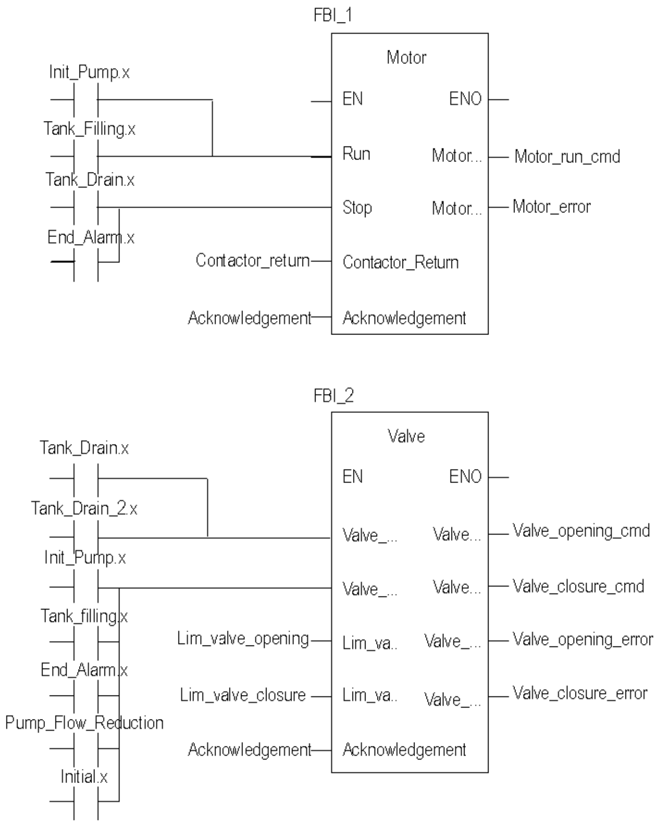
Creating a Program in LD for Application Execution

At a Glance

This section controls the pump and the valve using the DFBs created, page 319 earlier.

Illustration of the Execution Section

The section below is part of the MAST task. It has no temporary condition defined for it so it is permanently executed.



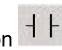
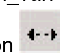
Description of the Application Section

When the Pump step is active, the Run input of the motor DFB is at 1. The `Motor_run_cmd` switches to "1" and the pump supply is activated.

The same principle applies to the rest of the section.

Procedure for Creating an LD Section

The table below describes the procedure for creating part of the **Application** section.

Step	Action
1	In `Project Browser\Program\Tasks`, double-click on `MAST`.
2	Right click on `Section` then select `New section`. Name this section Application, then select the language type LD. The edit window opens.
3	To create the contact Init_Pump.x, click on  then place it in the editor. Double-click on this contact then enter the name of the step with the suffix ".x" at the end (signifying a step of an SFC section) and confirm with `OK`.
4	To use the motor DFB you must instantiate it. Right click in the editor then click on `Select data` and on  . Click on the `Function and Function Block Types` tab and select your DFB then confirm with `OK` and position your DFB. To link the Open_valve1.x contact to the stop input of the DFB, align the contact and the input horizontally, click on  and position the link between the contact and the input.

NOTE: For more information on creating an LD section, refer to chapter *LD Editor* (see EcoStruxure™ Control Expert, Operating Modes).

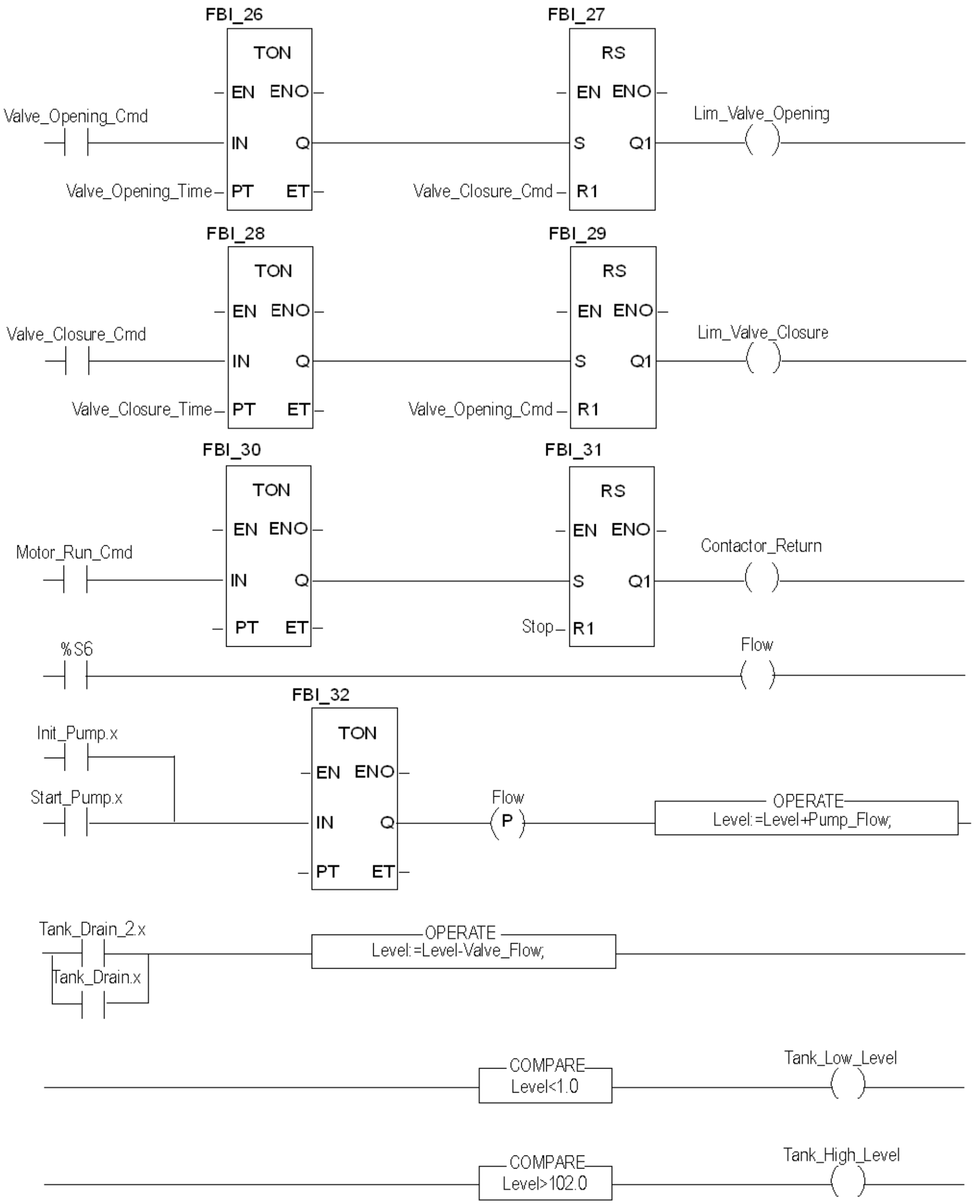
Creating a Program in LD for Application Simulation

At a Glance

This section is used for application simulation only. It should not be used if a PAC is connected.

Illustration of the Simulation Section

The section below is part of the MAST task. It has no condition defined so it is permanently executed:



Description of the Simulation Section

- The first line of the illustration is used to simulate the value of the Lim_valve_opening variable. If the valve opening command is given (`Valve_opening_cmd` = 1), a TON timer is triggered. When the PT time is reached, the TON output switches to "1" and increments the `Lim_valve_opening` output to "1" unless the valve closure command is given at the same time.
- Same principle applies to the `Lim_valve_closure` and `Contactor_return` outputs.
- The last part of the section is used for the simulation of the tank level and for triggering the different tank levels. The OPERATE and COMPARE blocks from the library can be used to do this.

Creating an Animation Table

At a Glance

An animation table is used to monitor the values of variables, and modify and/or force these values. Only those variables declared in `Variables & FB instances` can be added to the animation table.

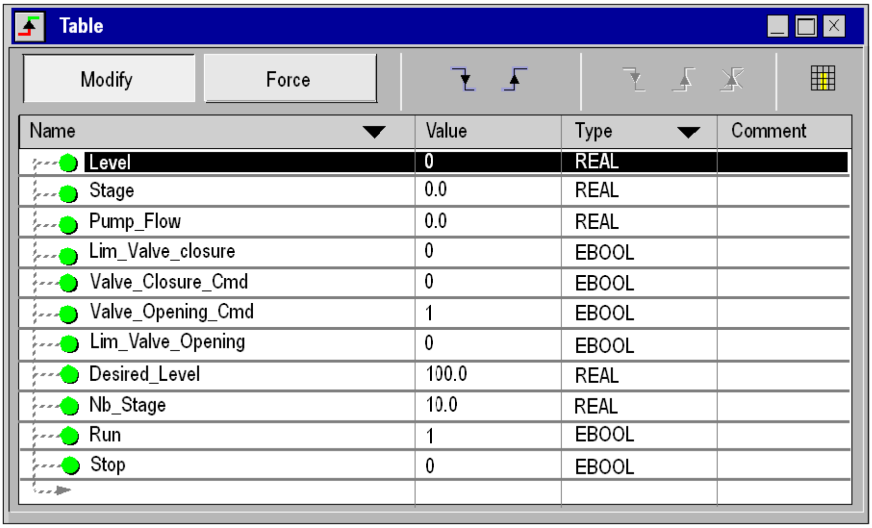
Procedure for Creating an Animation Table

The following table shows the procedure for creating an animation table.

Step	Action
1	In the `Project browser`, right click on `Animation tables`. The edit window opens.
2	Click on first cell in the Name column, then on the button, and add the variables you require.

Animation Table Created for the Application

The following screen shows the animation table used by the application:



Name	Value	Type	Comment
Level	0	REAL	
Stage	0.0	REAL	
Pump_Flow	0.0	REAL	
Lim_Valve_closure	0	EBOOL	
Valve_Closure_Cmd	0	EBOOL	
Valve_Opening_Cmd	1	EBOOL	
Lim_Valve_Opening	0	EBOOL	
Desired_Level	100.0	REAL	
Nb_Stage	10.0	REAL	
Run	1	EBOOL	
Stop	0	EBOOL	

NOTE: The animation table is dynamic only in online mode (display of variable values).

Creating the Operator Screen

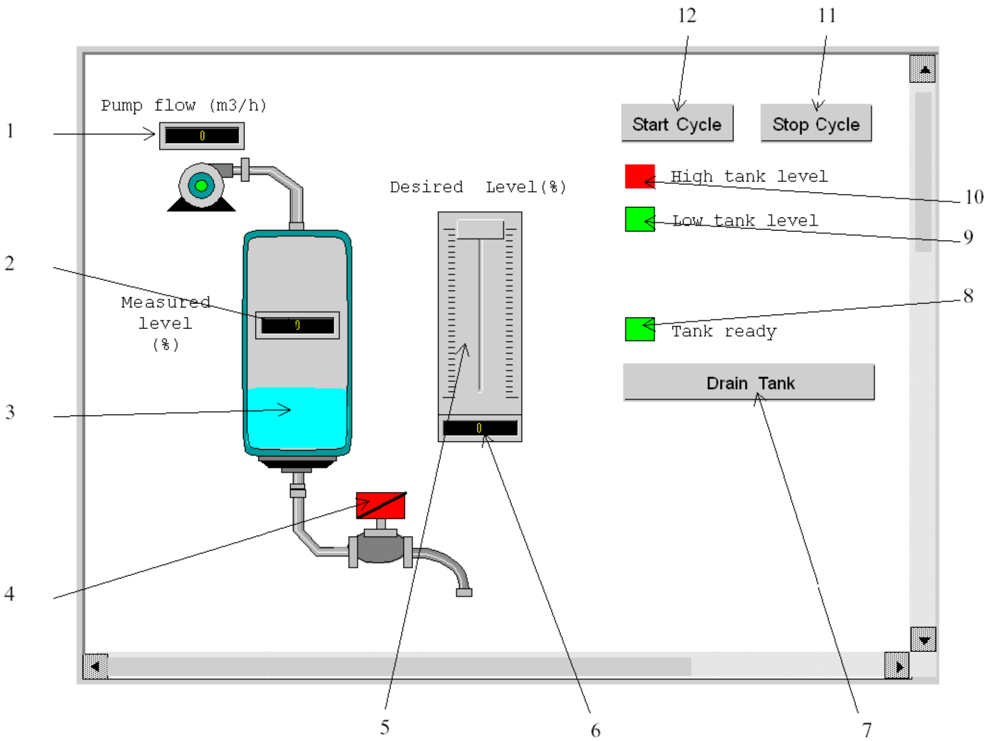
At a Glance

The operator screen is used to animate graphic objects that symbolize the application. These objects can belong to the Control Expert library, or can be created using the graphic editor.

NOTE: For more information, refer to *Operator Screens* (see EcoStruxure™ Control Expert, Operating Modes).

Illustration of the Operator Screen

The following illustration shows the application operator screen:



The associated variables are presented in the table below:

N°	Description	Associated variable
1	Pump flow indicator	Pump_Flow
2	Mesured level indicator	Level
3	Representation of the level in the tank	Level
4	Valve	Lim_Valve_Closure
5	Scale indicator	Desired_Level
6	Desired level indicator	Desired_Level
7	Tank Draining button	Drain
8	"Tank ready" indicator light	Tank_Ready
9	"Low tank level" indicator light	Tank_Low_Level

N°	Description	Associated variable
10	"High tank level" indicator light	Tank_High_Level
11	Stop button	Stop
12	Start button	Run

NOTE: To animate objects in online mode, you must click on . By clicking on this button, you can validate what is written.

Procedure for Creating an Operator Screen

The table below shows the procedure for inserting and animating the tank.

Step	Action
1	In the `Project browser`, right click on `Operator screens` and click on `New screen`. The operator screen editor appears.
2	• In the `Tools` menu, select `Operator Screen Library`. The window opens. Double click on `Fluids` then `Tank`. Select the dynamic tank from the runtime screen, and `Copy` (Ctrl + C) then `Paste` (Ctrl + V) it into the drawing in the operator screen editor (to return to your screen, click on `Window` then `Screen`). • The tank is now in your operator screen. You now need a variable to animate the level. In the `Tools` menu, click on `Variables Window`. The window appears to the left, and in the `Name` column we see the word %MW0. To obtain the animated part of the graphic object (in this case the tank), double click on %MW0. A part of the tank is selected. Right click on this part, then click on `Characteristics`. Select the `Animation` tab and enter the variable concerned by clicking the  button (in the place of %MW0). In our application, this will be Tank_vol. • You must define the tank's minimum and maximum values. In the `Type of animation` tab, click `Bar chart` then the  button, and fill in the entry fields according to the tank. • Confirm with `Apply` and `OK`.
3	Click on  to select the other lines one by one and apply the same procedure.

The table below shows the procedure for creating the Start button.

Step	Action
1	In the Project browser, right click on Operator screens and click on New screen. The operator screen editor appears.
2	Click on the [button icon] and position the new button on the operator screen. Double click on the button and in the Control tab, select the Run variable by clicking the button ... and confirm with OK. Then, enter the button name in the text zone.

NOTE: In the Instance Selection, tick the IODDT checkbox and click on + to access the I/O objects list.

Starting the Application

What's in This Chapter

Subject of this Chapter

This chapter shows the procedure for starting the application. It describes the different types of application executions.

Execution of Application in Simulation Mode

At a Glance

You can connect to the API simulator which enables you to test an application without a physical connection to the PLC and other devices.

NOTE: For more information, refer to EcoStruxure™ Control Expert, PLC Simulator

Application Execution

The table below shows the procedure for launching the application in simulation mode:

Step	Action
1	In the `PLC` menu, click on `Simulation Mode`,
2	In the `Build` menu, click on `Rebuild All Project`. Your project is generated and is ready to be transferred to the simulator. When you generate the project, you will see a results window. If there is an error in the program, Control Expert indicates its location if you double-click on the highlighted sequence.
3	In the `PLC` menu, click on `Connection`. You are now connected to the simulator.
4	In the `PLC` menu, click on `Transfer project to PLC`. The `Transfer project to PLC` window opens. Click on `Transfer`. The application is transferred to the PLC simulator.
5	In the `PLC`, click on `Execute`. The `Execute` window opens. Click on `OK`. The application is now being executed (in RUN mode) on the PLC simulator.

Execution of Application in Standard Mode

At a Glance

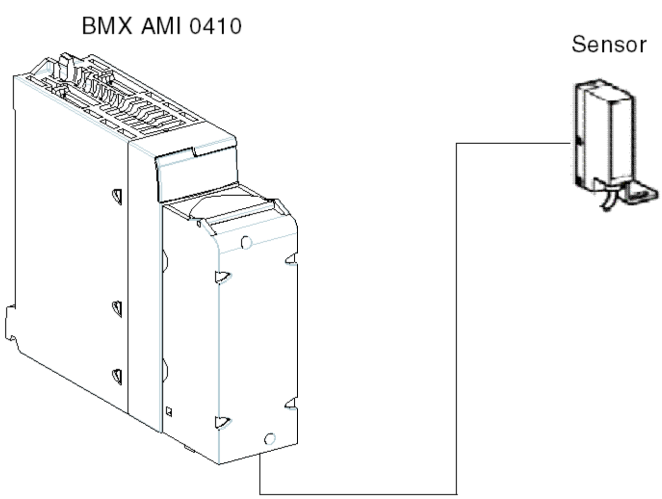
To work in standard mode you need to use a PLC and Analog I/O modules to assign outputs to different sensors and actuators.

The variables used in simulation mode must be modified. In standard mode, variables must be located to be associated to physical I/Os.

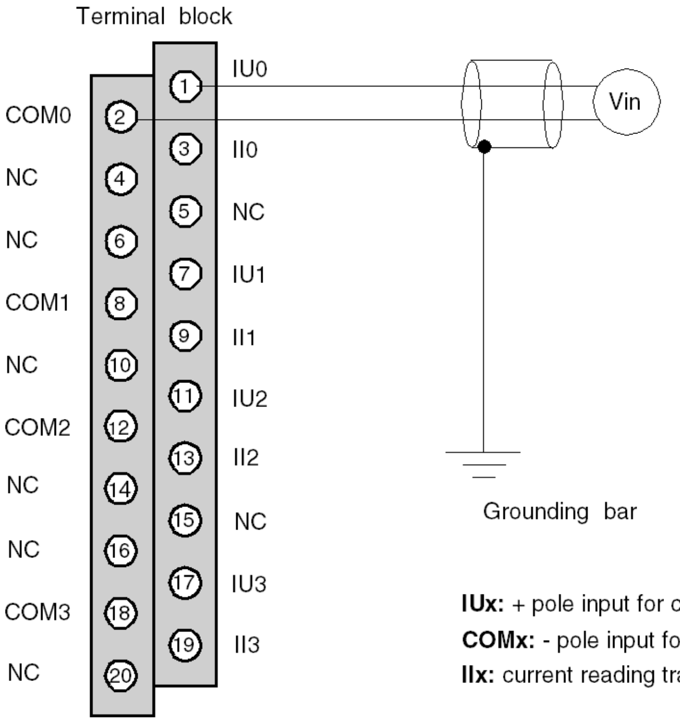
NOTE: For more information on addressing, refer to chapter *Data Instances*

Input Wiring

The sensor is connected as follows.



The assignment of the 20 pins terminal block is as follows.



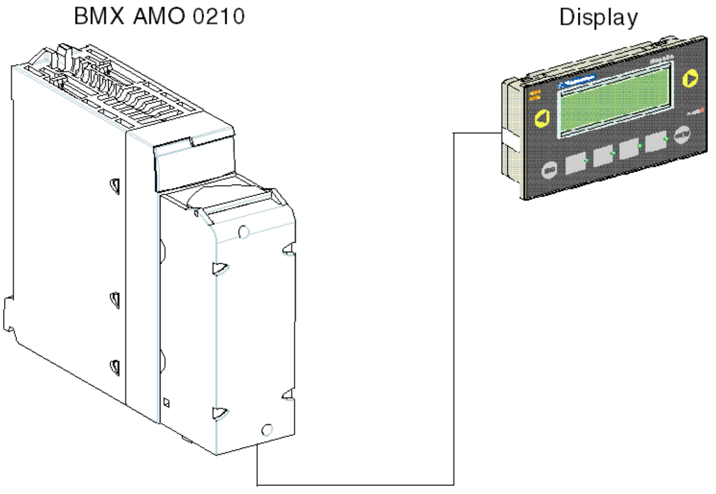
IUx: + pole input for channel x

COMx: - pole input for channel x

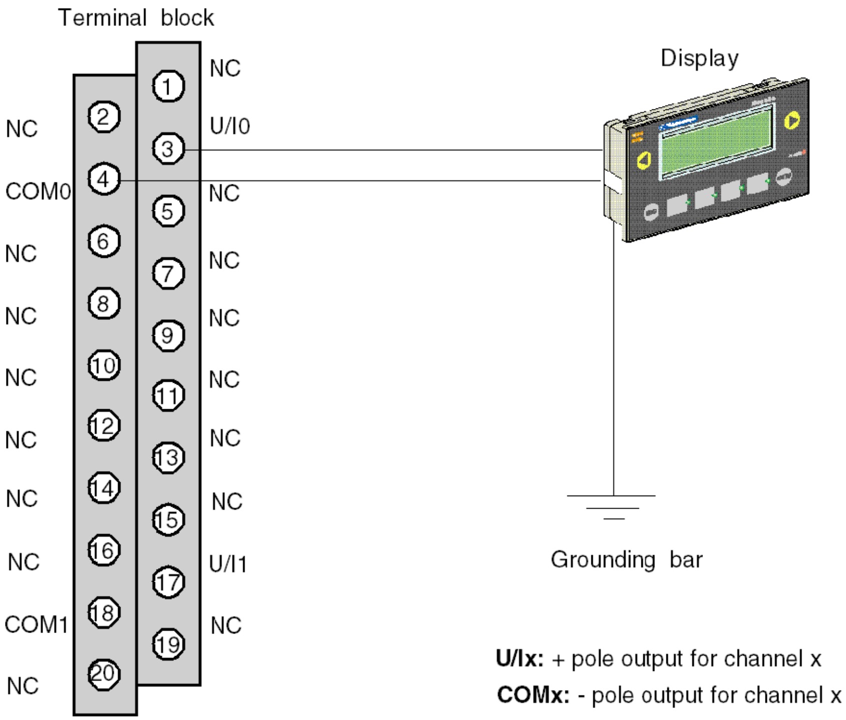
IIx: current reading transistor + input

Output Wiring

The display is connected as follows.



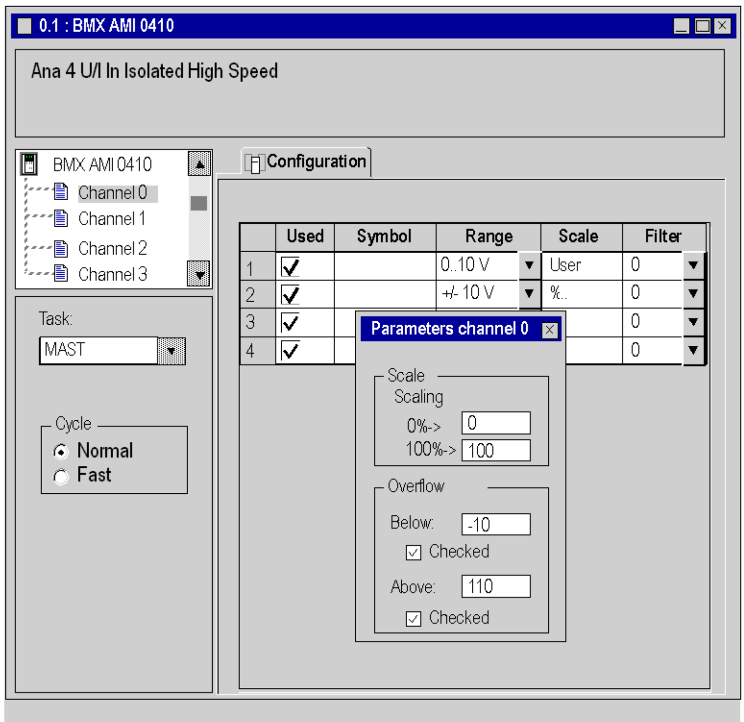
The assignment of the 20 pins terminal block is as follows.



Application Hardware Configuration

The table below shows the procedure for configuring the application.

Step	Action
1	In the `Project browser` double-click on Configuration then on `0:Bus X` and on `0:BMX XBP •••` (where 0 is the rack number).
2	In the `Bus X` window, select a slot, for example 3 and double-click on it.
3	Insert an analog input module, for example `BMX AMI 0410` The module appears on th ePLC Bus; Double-click on it..

Step	Action
4	In the `0.1 : BMX 0410` window, it's possible to configure the range and the scale of the used channels. For this application, configure the channel 0 to range `0..10V`
5	Click in the channel 0 `Scale zone`. A windows opens. Define the different values as shown in the the figure below: 

Assignment of Variables to Input Module

The table below shows the procedure for direct addressing of variables.

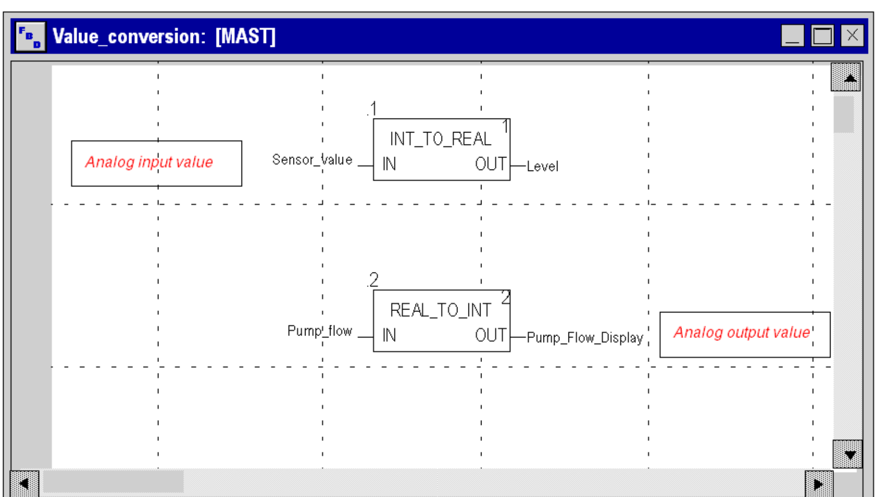
Step	Action
1	In the `Project browser` and in `Variables & FB instances`, double-click on `Elementary variables`.
2	In the `Data editor` window, select the box in the `Name` column and enter a name (`Sensor_value` for example). Select an `INT` type for this variable.
3	In the Address column, enter the analog value address associated with the variable. For this example, associate the Sensor_value variable with configured analog input channel by entering the address %IW0.1.0. Illustration: 

NOTE: Repeat the same procedure for declaring and configuring the analog output module BMX AMO 0210.

Input/Output Values Conversion

In this application, the level and the pump value are REAL type and the analog modules use integers. So Integer/Real conversions must be applied in a MAST task.

The screen below shows the I/O conversion section, written in DFB, using the Library Function BLock.



Application Execution

The table below shows the procedure for launching the application in standard mode.

Step	Action
1	In the PLC menu, click on Standard Mode,
2	In the Build menu, click on Rebuild All Project. Your project is generated and is ready to be transferred to the PLC. When you generate the project, you will see a results window. If there is an error in the program, Control Expert indicates its location if you click on the highlighted sequence.
3	In the PLC menu, click on Connection. You are now connected to the PLC.
4	In the PLC menu, click on Transfer project to PLC. The Transfer project to PLC window opens. Click on Transfer. The application is transferred to the PLC.
5	In the PLC, click on Execute. The Execute window opens. Click on OK. The application is now being executed (in RUN mode) on the PLC.

Actions and transitions

What's in This Chapter

Subject of this chapter

This chapter contains the actions and the transitions used in the grafcet (See Illustration of the Tank_management Section, page 325)

Transitions

At a glance

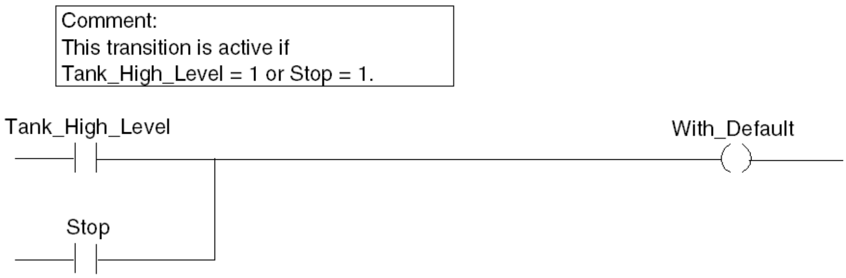
The next tasks are used in different transitions of the grafcet.

FIlling_Start transition

The action associated to the **Filling_Start** transition is as follows:

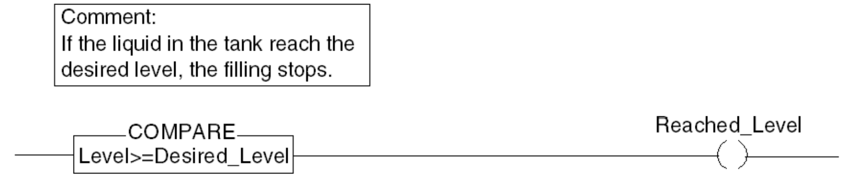
With_Default transition

The action associated to the **With_Default** transition is as follows:



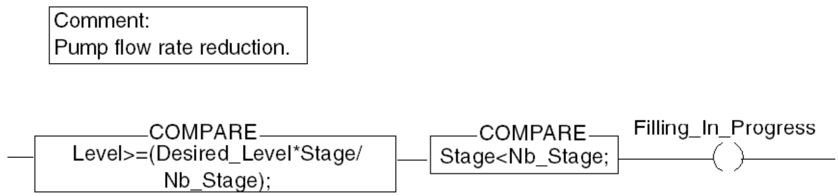
Reached_Level transition

The action associated to the **Reached_Level** transition is as follows:



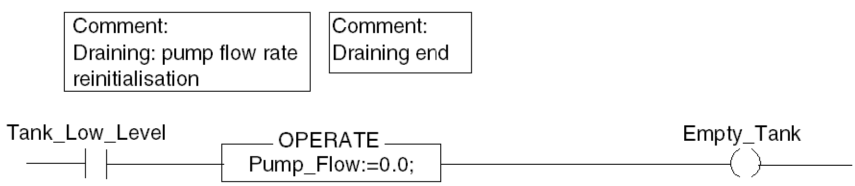
Filling_In_Progress transition

The action associated to the **Filling_In_Progress** transition is as follows:



Empty_Tank transition

The action associated to the **Empty_Tank** transition is as follows:



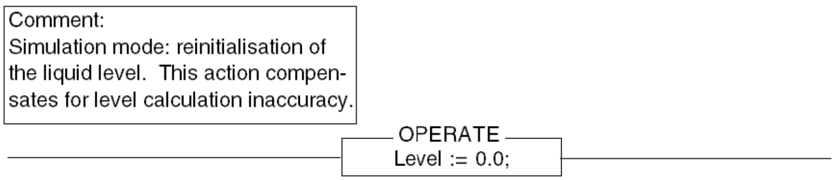
Actions

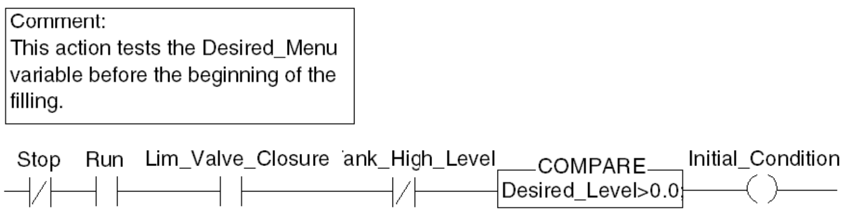
At a glance

The next tasks are used in different steps of the grafcet.

Initial step

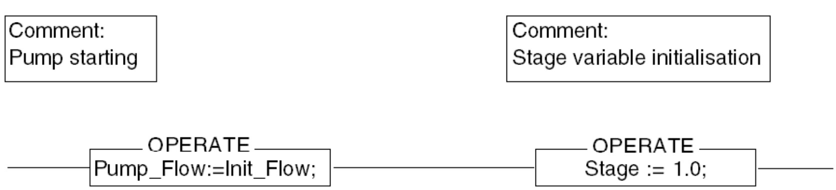
The action associated to the **Initial** step is as follows:





Init_Pump step

The action associated to the **Init_Pump** step is as follows:

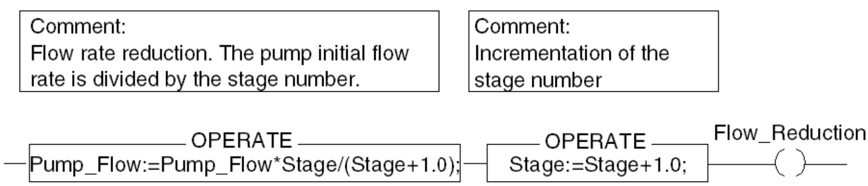


End_Alarm step

The action associated to the **End_Alarm** step is as follows:

Pump_Flow_Reduction step

The action associated to the **Pump_Flow_Reduction** step is as follows:



Appendices

What's in This Part

Overview

These appendices contain information that should be useful for programming the application.

Characteristics of the BMX ART 0414/0814 RTD and Thermocouple Ranges

What's in This Chapter

Subject of this Section

This section presents the characteristics of the RTD and thermocouple ranges for the BMX ART 0414/0814 analog modules.

Characteristics of the RTD Ranges for the BMX ART 0414/0814 Modules

At a Glance

The table below presents the maximum margin of error, at 25°C, of the Pt100, Pt1000, and Ni1000 RTD ranges.

Temperature		Pt100 RTD	Pt1000 RTD	Ni1000 RTD
Display resolution		**0.1°C**	**0.1°C**	**0.1°C**
Maximum error at 25°C (1)				
Operating point	**-100°C**	0.8°C	1.6°C	0.4°C
	0°C	0.8°C	1.6°C	0.5°C
	100°C	0.8°C	1.6°C	0.7°C
	200°C	1.0°C	2°C	0.6°C
	300°C	1.2°C	2.4°C	
	400°C	1.3°C	2.8°C	

Temperature		**Pt100 RTD**	**Pt1000 RTD**	**Ni1000 RTD**
Display resolution		**0.1°C**	**0.1°C**	**0.1°C**
Maximum error at 25°C (1)				
	500°C	1.5°C	3.3°C	
	600°C	1.7°C	3.6°C	
	700°C	1.9°C	4.1°C	
	800°C	2.1°C	4.5°C	
Input dynamic		-175..825°C -283..1,517°F	-175..825°C -283..1,517°F	-54..174°C -66..346°F
Legend:				
(1) Ambient temperature				

NOTE: The precision values are provided for a 3/4-wire connection and include the errors and drift of the 1.13 mA (Pt100) or 0.24 mA (Pt1000 or Ni1000) current source.

The effects of self-heating do not introduce any significant error to the measurement, whether the probe is in the air or under water.

The table below presents the maximum margin of error, between 0 and 60°C, of the Pt100, Pt1000, and Ni1000 RTD ranges.

Temperature		**Pt100 RTD**	**Pt1000 RTD**	**Ni1000 RTD**
Display resolution		**0.1°C**	**0.1°C**	**0.1°C**
Maximum error from 0 to 60°C				
Operating point	**-100°C**	1°C	2°C	0.8
	0°C	1°C	2°C	0.9°C
	100°C	1°C	2°C	1.1°C
	200°C	1.2°C	2.4°C	1.3°C
	300°C	1.5°C	3°C	
	400°C	1.8°C	3.6°C	
	500°C	2°C	4°C	
	600°C	2.3°C	4.6°C	
	700°C	2.5°C	5°C	
	800°C	2.8°C	5.6°C	
Input dynamic		-175..825°C -283..1,517°F	-175..825°C -283..1,517°F	-54..174°C -66..346°F

NOTE: The precision values are provided for 4-wire connection and include the errors and drift of the 1.13 mA (Pt100) or 0.24 mA (Pt1000 or Ni1000) current source.

The effects of self-heating do not introduce any significant error to the measurement, whether the probe is in the air or under water.

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:

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

Reference standards:

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

Characteristics of Thermocouple Ranges in Degrees Celsius

Introduction

The following tables describe the measuring device errors that are detected for the various thermocouples B, E, J, K, N, R, S and T **in degrees Celsius**.

- 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 25°C.
- The resolution is given with a mid-range operating point.
- The precision values include:
  - Detected electrical errors on the acquisition system for input channels and cold junction compensation, detected software errors, and interchangeability errors detected on the cold junction compensation sensors.
  - Detected thermocouple sensor errors are not taken into account.

Thermocouples B, E, J, and K

The following table describes the maximum detected error values for thermocouples B, E, J, and K at 25°C.

Temperature		Thermocouple B		Thermocouple E		Thermocouple J		Thermocouple K	
Maximum detected error at 25°C (1)		TFAST	Pt100	TFAST	Pt100	TFAST	Pt100	TFAST	Pt100
Operating point	-200°C			3.7°C	2.5°C			3.7°C	2.5°C
	-100°C			2.6°C	2.4°C	2.6°C	2.4°C	2.6°C	2.4°C
	0°C			2.5°C	2.3°C	2.5°C	2.3°C	2.5°C	2.3°C
	100°C			2.6°C	2.4°C	2.6°C	2.4°C	2.6°C	2.4°C
	200°C	3.5°C	3.4°C	2.6°C	2.4°C	2.6°C	2.4°C	2.6°C	2.5°C
	300°C	3.2°C	3.0°C	2.7°C	2.5°C	2.7°C	2.5°C	2.6°C	2.4°C
	400°C	3.0°C	2.8°C	2.7°C	2.5°C	2.7°C	2.5°C	2.7°C	2.5°C
	500°C	3.0°C	2.8°C	2.8°C	2.6°C	2.8°C	2.6°C	2.8°C	2.6°C
	600°C	3.0°C	2.8°C	2.8°C	2.6°C	2.8°C	2.6°C	2.8°C	2.6°C
	700°C	3.0°C	2.8°C	2.8°C	2.6°C	2.8°C	2.6°C	2.9°C	2.7°C
	800°C	3.0°C	2.8°C	2.9°C	2.7°C			2.9°C	2.7°C
	900°C	3.0°C	2.8°C	2.9°C	2.7°C			3.0°C	2.8°C
	1,000°C	3.0°C	2.8°C					3.0°C	2.8°C
	1,100°C	3.0°C	2.8°C					3.1°C	2.9°C
	1,200°C	3.0°C	2.8°C					3.2°C	3.0°C
	1,300°C	3.0°C	2.8°C					3.3°C	3.1°C
	1,400°C	3.1°C	2.9°C						
	1,500°C	3.1°C	2.9°C						
	1,600°C	3.1°C	2.9°C						
	1,700°C	3.2°C	3.0°C						
	1,800°C	3.3°C	3.1°C						
Input dynamic		1710..17,790°C		-2,400..9,700°C		-7,770..7,370°C		-23,100..13.310°C	

Legend:

(1) TFAST: Internal compensation by TELEFAST

PT100: External compensation by Pt100 3 wires

Reference standards: IEC 584-1, first edition, 1977 and IEC 584-2, second edition, 1989

Thermocouples L, N, R, and S

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

Temperature		Thermocouple L		Thermocouple N		Thermocouple R		Thermocouple S	
Maximum detected error at 25°C (1)		TFAST	Pt100	TFAST	Pt100	TFAST	Pt100	TFAST	Pt100
Operating point	-200°C			3.7°C	2.5°C				
	-100°C			2.6°C	2.4°C				
	0°C	2.5°C	2.3°C	2.5°C	2.3°C	2.5°C	2.3°C	2.5°C	2.3°C
	100°C	2.6°C	2.4°C	2.6°C	2.4°C	2.6°C	2.4°C	2.6°C	2.4°C
	200°C	2.6°C	2.4°C	2.6°C	2.4°C	2.6°C	2.4°C	2.6°C	2.4°C
	300°C	2.6°C	2.4°C	2.6°C	2.4°C	2.6°C	2.4°C	2.6°C	2.4°C
	400°C	2.7°C	2.5°C	2.7°C	2.5°C	2.7°C	2.5°C	2.7°C	2.5°C
	500°C	2.7°C	2.5°C	2.7°C	2.5°C	2.7°C	2.5°C	2.7°C	2.5°C
	600°C	2.8°C	2.6°C	2.8°C	2.6°C	2.8°C	2.6°C	2.7°C	2.5°C
	700°C	2.8°C	2.6°C	2.8°C	2.6°C	2.8°C	2.6°C	2.8°C	2.6°C
	800°C	2.9°C	2.7°C	2.9°C	2.7°C	2.8°C	2.6°C	2.8°C	2.6°C
	900°C	2.9°C	2.7°C	2.9°C	2.7°C	2.9°C	2.7°C	2.9°C	2.7°C
	1,000°C			3.0°C	2.8°C	2.9°C	2.7°C	2.9°C	2.7°C
	1,100°C			3.0°C	2.8°C	2.9°C	2.7°C	3.0°C	2.8°C
	1,200°C			3.1°C	2.9°C	3.0°C	2.8°C	3.0°C	2.8°C
	1,300°C					3.0°C	2.8°C	3.1°C	2.9°C
	1,400°C					3.1°C	2.9°C	3.1°C	2.9°C
	1,500°C					3.1°C	2.9°C	3.2°C	3.0°C
	1,600°C					3.2°C	3.0°C	3.2°C	3.0°C
	1,700°C					3.2°C	3.0°C	3.2°C	3.0°C
Input dynamic		-1,740..8,740°C		-2,320..12,620°C		-90..16,240°C		-90..16,240°C	

Temperature	Thermocouple L		Thermocouple N		Thermocouple R		Thermocouple S	
Maximum detected error at 25°C (1)	TFAST	Pt100	TFAST	Pt100	TFAST	Pt100	TFAST	Pt100
Legend: (1) TFAST: Internal compensation by TELEFAST. PT100: External compensation by Pt100 3 wires.								

Reference standards:

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

Thermocouples T and U

The following table describes the maximum detected precision error values for thermocouples T and U at 25°C.

Temperature		Thermocouple T		Thermocouple U	
Maximum detected error at 25°C (1)		**TFAST**	**Pt100**	**TFAST**	**Pt100**
Operating point	**-200°C**	3.7°C	2.5°C		
	-100°C	3.6°C	2.4°C		
	0°C	3.5°C	2.3°C	2.5°C	2.3°C
	100°C	2.6°C	2.4°C	2.6°C	2.4°C
	200°C	2.6°C	2.4°C	2.6°C	2.4°C
	300°C	2.6°C	2.4°C	2.6°C	2.4°C
	400°C	2.7°C	2.5°C	2.7°C	2.5°C
	500°C			2.7°C	2.5°C
	600°C			2.7°C	2.5°C
Input dynamic		-2,540..3,840°C		-1,810..5,810°C	
Legend: (1) TFAST: Internal compensation by TELEFAST PT100: External compensation by Pt100 3 wires					

Reference standards:

- Thermocouple U: DIN 43710, December 1985 edition
- Thermocouple T: IEC 584-1, first edition, 1977 and IEC 584-2, second edition, 1989

Characteristics of the BMX ART 0414/814 Thermocouple Ranges in Degrees Fahrenheit

Introduction

The following tables show the detected errors of the measuring device for the various thermocouples B, E, J, K, N, R, S and T **in degrees Fahrenheit**.

- The precision values given below are valid for all 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:
  - detected electrical errors on the acquisition system for input channels and cold junction compensation, detected software errors and interchangeability errors detected on the cold junction compensation sensors.
  - detected thermocouple sensor errors are not taken into account.

Thermocouples B, E, J and K

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

Temperature		**Thermocouple B**		**Thermocouple E**		**Thermocouple J**		**Thermocouple K**	
Maximum detected error at 77°F (1)		**TFAST**	**Pt100**	**TFAST**	**Pt100**	**TFAST**	**Pt100**	**TFAST**	**Pt100**
Operating point	**-300°F**			6.7°F	4.5°F			6.7°F	4.5°F
	-100°F			4.7°F	4.3°F	4.7°F	4.3°F	4.7°F	4.3°F
	0°F			4.5°F	4.1°F	4.5°F	4.1°F	4.5°F	4.1°F
	200°F			4.7°F	4.3°F	4.7°F	4.3°F	4.7°F	4.3°F
	400°F	6.3°F	6.1°F	4.7°F	4.3°F	4.7°F	4.3°F	4.7°F	4.3°F

Temperature		Thermocouple B		Thermocouple E		Thermocouple J		Thermocouple K	
Maximum detected error at 77°F (1)		TFAST	Pt100	TFAST	Pt100	TFAST	Pt100	TFAST	Pt100
	600°F	5.8°F	5.4°F	4.9°F	4.5°F	4.9°F	4.5°F	4.9°F	4.5°F
	700°F	5.4°F	5.0°F	4.9°F	4.5°F	4.9°F	4.5°F	4.9°F	4.5°F
	900°F	5.4°F	5.0°F	5.0°F	4.7°F	5.0°F	4.7°F	5.0°F	4.7°F
	1,100°F	5.4°F	5.0°F	5.0°F	4.7°F	5.0°F	4.7°F	5.0°F	4.7°F
	1,300°F	5.4°F	5.0°F	5.0°F	4.7°F	5.0°F	4.7°F	5.2°F	4.9°F
	1,500°F	5.4°F	5.0°F	5.2°F	4.9°F			5.2°F	4.9°F
	1,700°F	5.4°F	5.0°F	5.2°F	4.9°F			5.4°F	5.0°F
	1,800°F	5.4°F	5.0°F					5.4°F	5.0°F
	2,000°F	5.4°F	5.0°F					5.4°F	5.0°F
	2,200°F	5.4°F	5.0°F					5.4°F	5.0°F
	2,400°F	5.4°F	5.0°F					5.4°F	5.0°F
	2,600°F	5.6°F	5.2°C						
	2,700°F	5.6°F	5.2°C						
	2,900°F	5.6°F	5.2°C						
	3,100°F	5.8°F	5.4°F						
	3,200°F	6.0°F	5.6°F						
Input dynamic		3,390..32,000°F		-3,990..17,770°F		-2,870..13,950°F		-3,830..24,270°F	

Legend:

(1) TFAST: Internal compensation by TELEFAST.

PT100: External compensation by Pt100 3 wires.

Thermocouples L, N, R and S

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

Temperature		**Thermocouple L**		**Thermocouple N**		**Thermocouple R**		**Thermocouple S**	
Maximum detected error at 77°F (1)		**TFAST**	**Pt100**	**TFAST**	**Pt100**	**TFAST**	**Pt100**	**TFAST**	**Pt100**
Operating point	**-300°F**			6.7°F	4.5°F				
	-100°F			4.7°F	4.3°F				
	0°F	4.5°F	4.1°F	4.5°F	4.1°F	4.5°F	4.1°F	4.5°F	4.1°F
	200°F	4.7°F	4.3°F	4.7°F	4.3°F	4.7°F	4.3°F	4.7°F	4.3°F
	400°F	4.7°F	4.3°F	4.7°F	4.3°F	4.7°F	4.3°F	4.7°F	4.3°F
	600°F	4.7°F	4.3°F	4.7°F	4.3°F	4.7°F	4.3°F	4.7°F	4.3°F
	700°F	4.9°F	4.5°F	4.9°F	4.5°F	4.9°F	4.5°F	4.9°F	4.5°F
	900°F	4.9°F	4.5°F	4.9°F	4.5°F	4.9°F	4.5°F	4.9°F	4.5°F
	1,100°F	5.0°F	4.7°F	5.0°F	4.7°F	5.0°F	4.7°F	4.9°F	4.5°F
	1,300°F	5.0°F	4.7°F	5.0°F	4.7°F	5.0°F	4.7°F	5.0°F	4.7°F
	1,500°F	5.2°F	4.9°F	5.2°F	4.9°F	5.2°F	4.9°F	5.2°F	4.9°F
	1,700°F	5.2°F	4.9°F	5.2°F	4.9°F	5.2°F	4.9°F	5.2°F	4.9°F
	1,800°F					5.2°F	4.9°F	5.2°F	4.9°F
	2,000°F					5.2°F	4.9°F	5.4°F	5.0°F
	2,200°F					5.4°F	5.0°F	5.4°F	5.0°F
	2,400°F					5.4°F	5.0°F	5.6°F	5.2°F
	2,600°F					5.6°F	5.2°F	5.6°F	5.2°F
	2,700°F					5.6°F	5.2°F	5.8°F	5.4°F
	2,900°F					5.8°F	5.4°F	5.8°F	5.4°F
	3,000°F					5.8°F	5.4°F	5.8°F	5.4°F
Input dynamic (2)		-2,800..16,040°F		-3,860..23,040°F		-160..29,950°F		-160..29,950°F	

Legend:

(1) TFAST: Internal compensation by TELEFAST.

PT100: External compensation by Pt100 3 wires.

(2) Internal compensation: ambient temperature = 68°F.

External compensation: ambient temperature = 86°F.

Thermocouples T and U

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

Temperature		Thermocouple T		Thermocouple U	
Maximum detected error at 77°F (1)		**TFAST**	**Pt100**	**TFAST**	**Pt100**
Operating point	**-300°F**	6.7°F	4.5°F		
	-100°F	6.5°F	4.3°F		
	0°F	6.3°F	4.1°F	4.5°F	4.1°F
	200°F	4.7°F	4.3°F	4.7°F	4.3°F
	400°F	4.7°F	4.3°F	4.7°F	4.3°F
	600°F	4.7°F	4.3°F	4.7°F	4.3°F
	700°F	4.9°F	4.5°F	4.9°F	4.5°F
	900°F			4.9°F	4.5°F
	1,100°F			4.9°F	4.5°F
Input dynamic (2)		-4,250..7,230°F		-2,930..10,770°F	

Legend:

(1) TFAST: Internal compensation by TELEFAST.

PT100: External compensation by Pt100 3 wires.

Topological/State RAM Addressing of the Modules

What’s in This Chapter

Topological/State RAM Addressing of Modicon X80 Analog Modules

Analog Modules

The following table shows the Modicon X80 analog module objects that can be mapped to topological or State RAM addresses.

NOTE: State RAM does not apply to BMEAH•0•12 modules.

Module reference	Topological address	State RAM address
BME AHI 0812	%IW rack.slot.channel, channel [0,7]	-%IWStart address ... %IWStart address + 7
BME AHO 0412	%QW rack.slot.channel, channel [0,3]	-%MWStart address ... %MWStart address + 3
BMX AMI 0410	%IW rack.slot.channel, channel [0,3]	-%IWStart address ... %IWStart address + 3
BMX AMI 0800	%IW rack.slot.channel, channel [0,7]	-%IWStart address ... %IWStart address + 7
BMX AMI 0810	%IW rack.slot.channel, channel [0,7]	-%IWStart address ... %IWStart address + 7
BMX AMM 0600	%IW rack.slot.channel, channel [0,3] %QW rack.slot.channel, channel [4,5]	-%IWStart address ... %IWStart address + 3 and -%MWStart address ... %MWStart address + 1
BMX AMO 0210	%QW rack.slot.channel, channel [0,1]	-%MWStart address ... %MWStart address +1
BMX AMO 0410	%QW rack.slot.channel, channel [0,3]	-%MWStart address ... %MWStart address + 3
BMX AMO 0802	%QW rack.slot.channel, channel [0,7]	-%MWStart address ... %MWStart address + 7

Module reference	Topological address	State RAM address
BMX ART 0414	%IW rack.slot.channel, channel [0,3]	-Value: -%IWStart address ... %IWStart address + 3 -Cold junction: -%IWStart address + 4
BMX ART 0814	%IW rack.slot.channel, channel [0,7]	-%IWStart address ... %IWStart address + 7 -Cold junction, ch 0-3: %IWStart address + 8 -Cold junction, ch 4-7: %IWStart address + 9

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Glossary

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Schneider Electric
35 rue Joseph Monier
92500 Rueil Malmaison
France

+ 33 (0) 1 41 29 70 00

www.se.com

As standards, specifications, and design change from time to time, please ask for confirmation of the information given in this publication.

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