Preface

The TSX AEM 811 analog input module offers a number of functions that are identical to those of the TSX AEM 411 module but with some operating variations.

The table below lists the main functions of the TSX AEM 811 and its main differences from the TSX AEM 411 module, thus allowing experienced users to benefit from their knowledge of the TSX AEM 411.

The Sub-sections listed below are essential reading but this doesn't mean that the rest of the manual shouldn't be read!

Functions	Principles	Details	Differences
	Refer to Sub-section		
Measurement sampling	2.2-4	4.1 4.2	The 8 measurements are multiplexed in 4 register words. The 8 measurements can be acquired in message mode (Text Block).
Sampling period	2.2-4	4.1 3.2-1.	2 sampling modes: • **normal mode:** period defined in the configuration. • **accelerated mode:** successive sampling of enabled channels.
Acquisition task	4.1	4.1	The period of the task in which period the module is configured must be less than 400 ms.
Input range	*	*	9 ranges
Related processing	*	*	Square root extraction
Measurement scaling	*	*	3 types of scaling
Threshold detection	2.3-5	4.3	2 thresholds per channel → 16 threshold detection bits. Threshold values are transferred through the message interface (Text Block).

(*) Identical to TSX AEM 411 module.

Functions	Principles	Details	Differences
Software configuration	*	3.2-2	. 1 sampling mode (mode 0), . 800 ms minimum period, . Continuity test possible if sampling period greater than 2.4 sec.
Reading the configuration	4.4-3	4.4-3	The configuration of a single channel can be read.
Additional requests			An additional request: reading threshold values.
Application	*	6.1-3 6.2 6.3	Hardware & software code 648 (62) User's label with word table containing the measurement results. Connection of the 8 inputs. Operation with TSX 47-20 software version V3.1 or higher.

(*) Identical to TSX AEM 411 module.

General Contents

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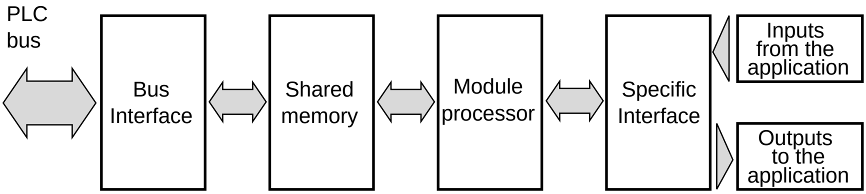
1.1 Intelligent Modules

1.1-1 General

The TSX AEM analog input modules form part of the TSX Series 7 range of intelligent I/O modules. These modules are pre-programmed to perform complete processing tasks, such as measurement, communication, positioning, etc., in applications using the TSX 47-20(*), TSX 47-30, TSX 67 or TSX 87 programmable controllers.

Structure of an intelligent I/O module



These modules incorporate a processor and specialized software which enable them to process the required function independently of the PLC processor.
The data exchanges between the PLC and an intelligent I/O module are ensured by with the PLC the full I/O bus interface, which comprises:

- A Discrete interface, which is identical to the interface of the discrete I/O modules and is used to exchange bits (control, monitoring or fault bits).
  These bits are systematically updated on each scan cycle.
- A Register interface, which is used to exchange words during each scan cycle. These words are used to transmit commands or to monitor the operation of the module. Their addresses depend on the location of the module in the rack.
  Example: for a module in rack 2 and located in slot number 3 of this rack:
  - IW23,0 is an input register word,
  - OW23,5 is an output register word.

- A Message interface, which is used to exchange word tables. These exchanges are initiated by the user program using Text Blocks. The word tables are used to transmit the specific configuration to the module (number of channels used, etc.), and also for the exchange of large amounts of data.

1.1-2 Advantages

The use of intelligent I/O modules simplifies the user program and reduces the scan time of the PLC, since the specific function of the module is entirely pre-programmed and is processed independently of the PLC processor and the program scan. The user program simply has to command the module and monitor its operation through the bits, words and function blocks mentioned above, which are common to all PL7-2 and PL7-3 programming languages (Ladder, Literal and Grafcet).

Note: Intelligent I/O modules are also sometimes called «couplers».
(*) The AEM 811 module will operate in TSX 47-20 PLCs using software version V3.1 or higher.

1.2 The TSX AEM 811 Analog Input Module

1.2-1 Description

General

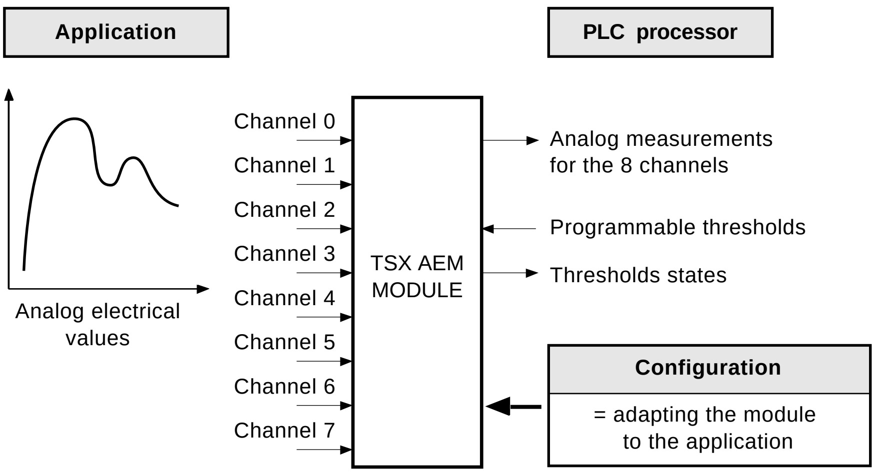
The TSX AEM 811 module has 8 independent high-level channels and is designed to receive analog values from external sensors and to convert them into measurements that can be directly used by the user program.

Functions

This module provides the following functions, in addition to analog/digital conversion:

- A choice of input ranges: voltage, current,
- Acquisition of eight channels with choice of sampling rates,
- Monitoring of input value limits within the declared range,
- Processing of the digital values obtained: square root extraction,
- Scaling of measured values, expressed in user-selected engineering units,
- Detection of open connections to sensors,
- Detection of two programmable threshold levels per channel with hysteresis compensation.

Data exchanges



Data received from the application

The module receives the analog electrical values from sensors and transmitters.

Data transmitted to the PLC

- The digital measurements, converted from the analog input values,
- The threshold level detection data and synchronization bits,
- The status words, containing the module operation and sensor monitoring data.

Data received from the PLC

- The configuration, which defines the operating characteristics of the module and must be declared by the user before the measurements can be acquired,
- The threshold levels programmed by the user,
- The measurement sampling commands.

Characteristics

The main characteristics of the TSX AEM 811 module are:

Characteristics	Values
Number of channels	8
Input type	Voltage Current
Sensors	High level sensors
Input range	+/- 10 V
Extended input range	+/- 11 V
Maximum resolution	11000/32768 mV = 0.33 mV
Input resistance	over 10 Mohms
Isolation	500 VDC between channels and 500 VAC between channels and bus
Sampling	1 to 8 channels
Sampling rate	min: 100 ms(*) max: 3200 sec.
Specific measurement processing	Square root extraction Scaling calculation
Threshold detection	2 thresholds per channel
Configuration	Software defined

(*) 100 ms in accelerated mode, 800 ms in normal mode.

Security of operation

The inputs are protected against industrial noise and are electrically isolated from each other and from the internal PLC voltages. A ground network is available on each channel.

Convenience of use

The module requires no external power supply. The software defined configuration, pre-programmed functions and the reading of measurements in directly usable engineering units make the module particularly easy to use.

Operation without risk

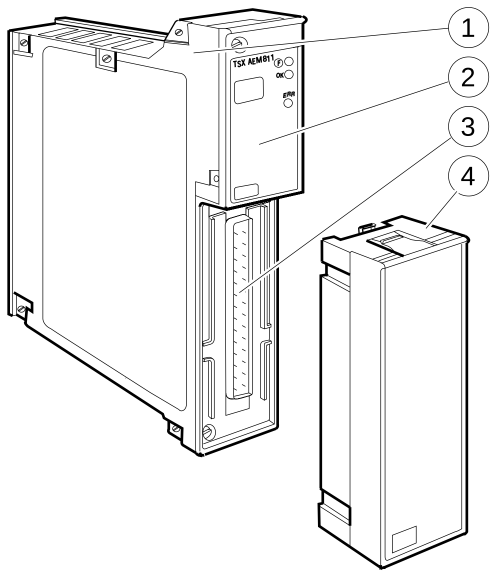
The modules and the terminal blocks can be inserted and removed with the PLC powered up. The processor is continuously informed of the operating status of the module and the user program can access this status information at all times for module operation monitoring purposes.

1.2-2 Hardware Presentation

The TSX AEM 811 module is the same size as a discrete I/O module and can be inserted in any slot of the TSX 67/87 PLC racks equipped with the full I/O bus, or in the first 4 slots of a TSX 47-20 basic configuration (software version V3.1 or higher).

The module comprises:

1. A metal case to protect the module electronics and provide protection against radiated electrical noise.
2. A front panel (described below).
3. A terminal block connector.
4. A removable terminal block with 32 screw terminals.



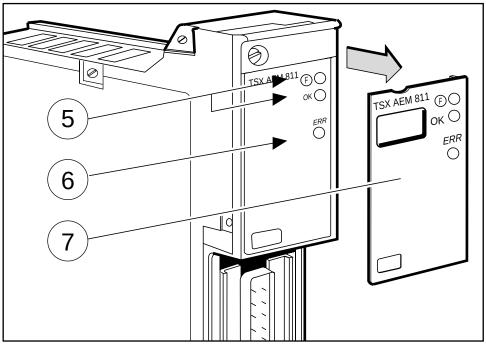
Note: The terminal block must be ordered separately.

The front panel comprises:

5 Two indicator LEDs that show the operating status of the module.

6 A LED that shows an application
fault on any of the channels.

7 A transparent label holder and an identification label.



The back panel of the module is fitted with coded locating devices:

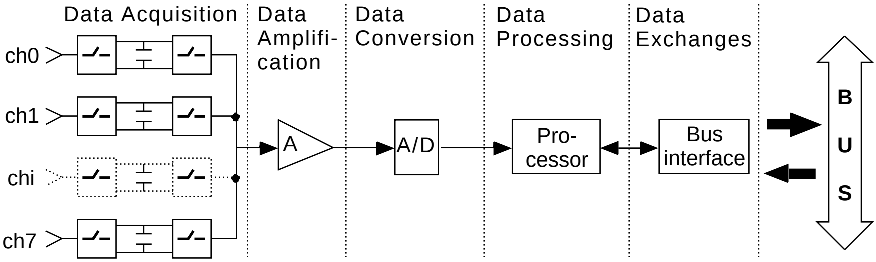
- The standard factory coded locating devices prevent any risk of error when installing or changing a module.
- An optional user-coded locating device.

Sub-section	Page

2.1 Hardware Structure

General

The diagram below shows the hardware structure of the TSX AEM 811 module:

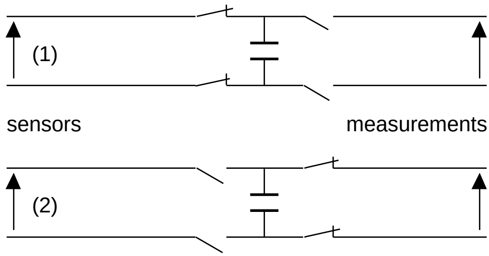


Input acquisition

Input acquisition is made through relays by capacitive transfer:

(1) The capacitor is charged with the voltage delivered by the sensor,

(2) The input value is sampled when the relay contacts are open on the sensor side and closed on the process side.



This design ensures electrical isolation between the channels, and between each channel and the process.

Amplification

The specific amplification stage provides an input range of +/- 10 V.

Analog to digital conversion

This is done by an analog to digital converter with double ramp integration. A self-correcting circuit ensures the accuracy and the stability of the measurement by making automatic correction for:

- Offset and gain errors,
- Temperature drift and ageing.

Processing

The processing unit of the module transforms the digital values received from the analog to digital converter into measurements expressed in the required engineering values, as selected by the user during the configuration procedure.

Exchanges with the PLC processor

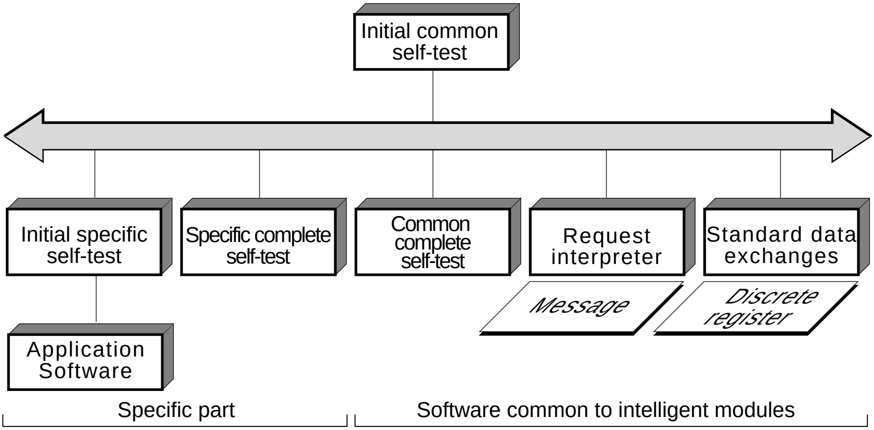
The bus interface controls the exchanges between the module and the PLC processor. These exchanges include reception of the configuration and threshold levels, and transmission of the measurements and operating status information.

2.2 Software Structure

2.2-1 General

The TSX AEM 811 module software structure can be divided into two parts:

- **A common part** (common to all intelligent I/O modules), which processes the standard data exchanges with PLC, in the form of bits, words, and word tables.
- **A specific part** (specific to the module), which performs the necessary measurement processing and test functions.



2.2-2 Exchanges with the PLC Processor

This software processes the standard exchanges with the PLC through:

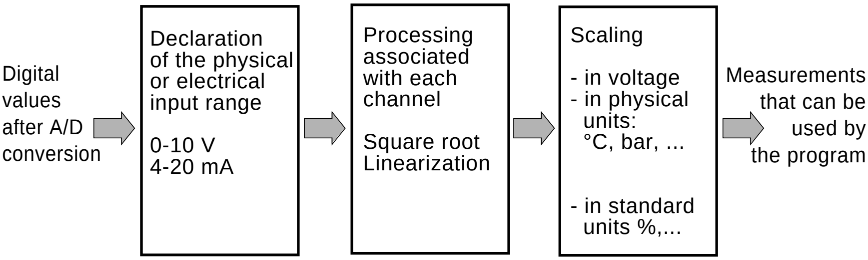
- **The Discrete I/O interface**, which is used to transmit threshold detection and synchronization data to the PLC in the form of bits,
- **The Register interface**, which is used to transmit the measurement data to the PLC in the form of words,
- **The Message interface**, which is used to write the configuration of the module, write the thresholds, read the measurements or read fault bit strings etc., in the form of word tables.

2.2-3 Measurement Processing

This software processes the measurements (linearization, measurement scaling) according to the selected configuration:

• Channel sampling mode and sampling rate,

• Software processing linked to the channel:
  - declaration of the sensor or input range,
  - continuity test,
  - measurement processing linked to the channel,
  - measurement scaling (expressing the measurement value).



2.2-4 Measurement Sampling

The time required by the module to acquire an analog input value on one channel and make the necessary conversions and corrections is 100 ms.
The user (or the user program) can access the measurements through register words or the message mode.
The use of these different modes by program is described in the Programming section (refer to Section 4).

Access by register words

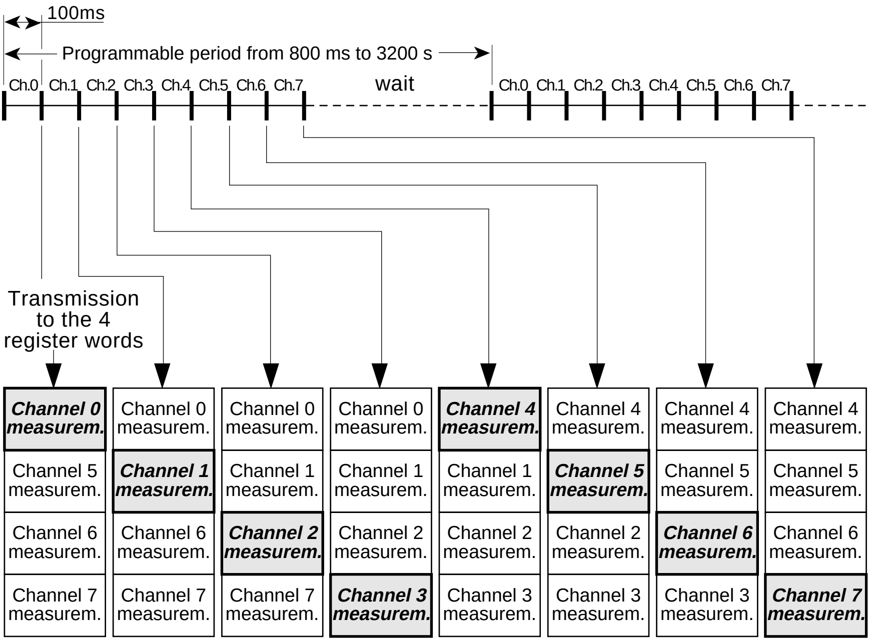
The measurements are transmitted to 4 register words in the processor of the PLC. As the module has 8 channels, the measurements are transmitted alternately to these 4 registers.

Measurement ch. 0 or ch. 4
Measurement ch. 1 or ch. 5
Measurement ch. 2 or ch. 6
Measurement ch. 3 or ch. 7

There are two measurement sampling modes:

Normal mode

Using this mode the eight channels are sampled in succession by the module. The period of the cycle is defined in the software configuration. The measurement value is transmitted as soon as its acquisition is completed by the module.



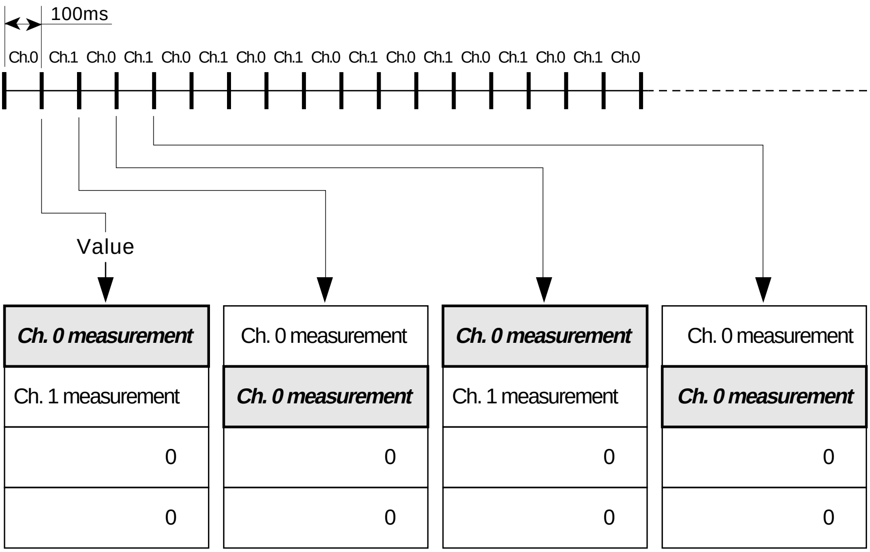
Four of the bits of a register word identify for each register, which channel is being transmitted.

Guideline: In this mode when a channel is inhibited its acquisition is replaced by a 100 ms delay. The cycle time is not affected and the measurement for the inhibited channel is forced to 0 and is not available in the register word (e.g. if channel 5 is inhibited, only the value of channel 1 will remain available in the corresponding register word).

Accelerated mode

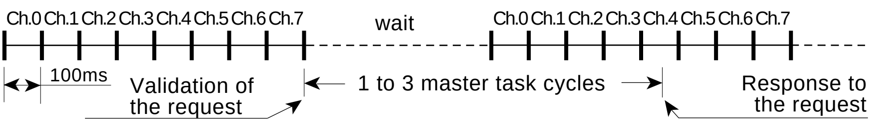
In this mode, when some of the channels are inhibited, the acquisition of each of the inhibited channels is not replaced by a delay time; the sampling cycle is therefore shorter.
Only the channels that are in use (not inhibited) are sampled. In the example below channels 2, 3, 4, 5, 6 and 7 are inhibited. The shaded areas in the diagram below identify the measurements that are updated.

Note: In this mode the programmable sampling period is automatically overridden. The minimum sampling period is therefore 100 ms multiplied by the number of non-inhibited channels.



Access in message mode

In the message mode, the eight measurements are transmitted in response to a request and programmed by the user (CPL text block) in eight internal words (Wi) of the PLC.



Channel 0 measurement (t)
Channel 1 measurement (t)
Channel 2 measurement (t)
Channel 6 measurement (t)
Channel 7 measurement (t)

The measurement values are, of course, all sampled within the same scan cycle so as to ensure their coherence within the same sampling period.
The measurement values of the inhibited chan-

2.3 Processing Measurements

2.3-1 Selecting the Input Range

The input range defines the normal operating limits of the sensor connected to the module.

Declaring the input range has two main functions:

- It positions the error detection limits so as to ensure that input range overruns are detected,
- In the Input Range scaling mode (see Sub-section 2.3-3), it determines the units in which the measurement values will be expressed (mV, µA, °C or °F).

Selecting the input range

The table below show the possible input ranges for each module.

Range number	Normal range	Extended range limits	
		ELL	EHL
0	-10/+10 V	- 11 V	+ 11 V
1	- 5/+ 5 V	- 5.5 V	+ 5.5 V
2	0/10 V	- 0.2 V	+ 11 V
3	2/10 V	+ 1.84 V	+ 10.8 V
4	0/5 V	- 0.1 V	+ 5.5 V
5	0/2 V	- 0.04 V	+ 2.2 V
6	0.4/2 V	+ 0.368 V	+ 2.16 V
7(*)	0/20 mA	- 0.4 mA	+ 22 mA
8(*)	4/20 mA	+ 3.68 mA	+ 21.6 mA

(*) For the two current input ranges, a 100 ohm (0.1% accuracy) resistor must be fitted in the terminal block.

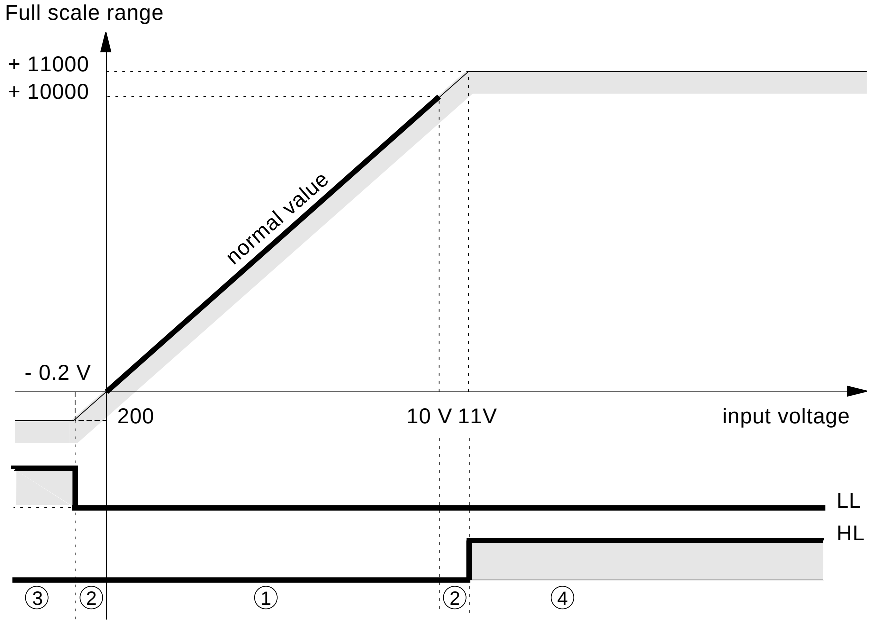
Positioning the error detection limits

Declaring the input range positions the error detection limits. These limits correspond to the conversion capacity of the module and define the extended range, between the Extended range Lower Limit (ELL) and Extended range Higher Limit (EHL). The extended range allows for possible overflows from the normal range, defined between its Lower Limit (LL) and Higher Limit (HL), to compensate for differences between the nominal and tolerance values of the sensors.

- When the value of the input signal is within the normal range, between limits LL and HL, the conversion is made normally,
- When the signal exceeds these limits but remains within the ELL and EHL extended range limits, the conversion is also made normally,
- When the signal exceeds the limits of the extended range (ELL or EHL), the data sent to the user corresponds to these limits (ELL or EHL) and the appropriate fault bit for ELL or EHL is set to 1 (refer to Sub-section 4.4-1 Fault Processing).

Example: Declared range 0/10 V.

Scaling in mV, giving a measurement value between 0 and 10000.



(1) Normal situation, the measured value is within the declared range:
ELL = 0 The module gives an exact value between 0 and +10000.
EHL = 0

(2) The measured value is within the extended range:
ELL = 0 The module gives an exact value between -200 and -1,
EHL = 0 or between +10001 and +11000.

(3) If the measured value is below ELL (-200 mV) an overrun fault occurs that is indicated by a LED on the front panel and a fault bit:
ELL = 1 The module delivers a limit value of -200.
EHL = 0

(4) If the measured value is above EHL (+11 V) an overrun fault occurs that is indicated by a LED on the front panel and a fault bit:
ELL = 0 The module delivers a limit value of +11000.
EHL = 1

2.3-2 Square Root Extraction

The TSX AEM 811 module can extract the square root from the measurements made. The operation used is not quite a mathematical square root, as the following conventions are used:

• If the measurement value is positive:

Square root of "measurement" = 100 x $\sqrt{|Measurement|}$

• If the measurement value is negative:

Square root of "measurement" = - 100 x $\sqrt{|Measurement|}$

The type of scaling selected (see Sub-section 2.3-3) determines the way the square root is extracted:

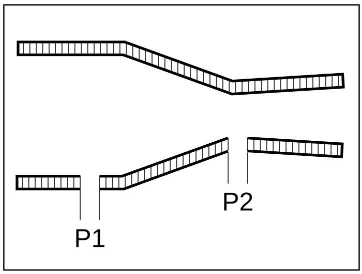
- In Input range scaling, the square root cannot be extracted,
- In Standard range scaling, the square root is extracted after standardizing the inputs,
- In User range scaling, the square root is extracted before the scaled measurement value is calculated.

Application example: Flow measurement.

A reduction in the diameter of a water pipe causes a difference in pressure dp = p2-p1 that depends on the flow Q with a relation of:

$Q = K \times \sqrt{2\ dp/l}$

where K is a constant that is a function of the shape of the pipe and l the volume of fluid.



A differential pressure gauge can therefore be used to measure the flow, since the square root extraction by the module permits scaling of the value and its expression in flow units.

2.3-3 Measurement Scaling

After analog to digital conversion, the values acquired by the TSX AEM 811 module are scaled so as to provide measurement values expressed in units that can be directly used by the user program. The user can choose between 3 types of scaling, this choice is made during the software configuration of the module.

- Input range scaling:
  The scale is determined by the selected input range. The module supplies the CPU with measurement values expressed in mV or mA for the voltage or current ranges, or expressed in 1/10 °C or 1/10 °F for the temperature ranges.

- Standard range scaling:
  The module supplies the processor with measurement values expressed as percentages of the full scale range.

- User range scaling:
  The module supplies the processor with measurement values expressed in engineering units selected by the user within the required range.

Input range scaling

The expression of the digital values of the measurements transmitted by the module to the processor is determined by the selected input range.

The selected input range defines:
- The measurement unit used to express the digital values,
- The upper and lower limits of the digital values.

Depending on the module and the selected input range, the tables below show:
- The limits within which the measurement is expressed, i.e. the normal zone.
- The units in which the measurement is expressed,
- The permitted overrun limits: i.e. the extended zone.

Nbr.	Range	Normal zone	Unit	Extended zone
0	-10/+10V	-10000/+10000	mV	-11000/+11000
1	-5/+5V	- 5000/+5000	mV	-5500/+5500
2	0/+10V	0/+10000	mV	-200/+11000
3	+2/+10V	+2000/+10000	mV	+1840/+10800
4	0/+5V	0/+5000	mV	-100/+5500
5	0/+2V	0/+2000	mV	-40/+2200
6	+0.4/+2V	+400/+2000	mV	+368/+2160
7	0/20mA	0/+20000	µA	-400/+22000
8	4/20mA	+4000/+20000	µA	+3680/+21600

Measurement value = Electrical value (in mV or in µA)

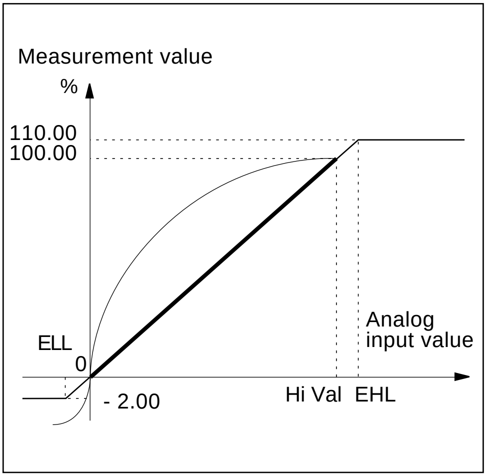
Standard range scaling

Standard range scaling provides the user program with measurements expressed as a percentage of the input range, with the following conventions:

Unipolar range

The measurements provided by the module are between 0 and 10000, or 0 to 100% of the normal input range (0 to Hi.Val).

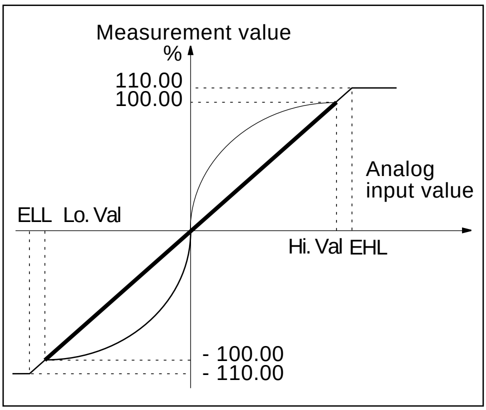
The overrun permitted between the error detection limits ELL and EHL enables the processing of digital values in the extended zone.
Extended zone:
-200 and +11000 without square root,
-1414 ($-\sqrt{200 \times 100}$) and +10488 ($\sqrt{11000 \times 100}$) with square root.



Bipolar range

The measurements provided by the module are between -10000 and +10000, or from -100% of the negative input range to +100% of the positive input range (Lo.Val to Hi.Val).

Extended range:
-11000 to +11000 without square root,
-10488 to +10488 with square root.



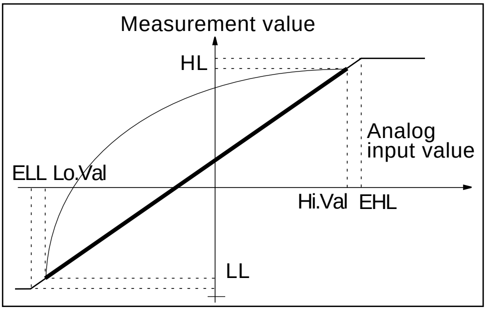
Note: The curves drawn in thin lines show the square root function.

User range scaling

In this type of scaling, the module expresses the measurements in engineering units selected by the user. To do this, the user must define the higher and lower limits between which the measurement values may vary.

The higher and lower limits set by the user define the range in which the readings are expressed:

- The relation between the input range and the scale is linear,
- The value of the limits can be selected between -32768 and +32767.

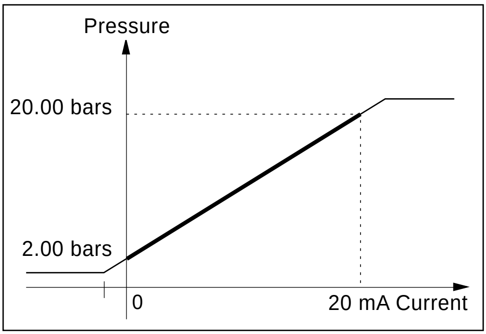


Extended range:
With a unipolar input range, the digital values can be between LL-2%x(HL-LL) and HL+10%x(HL-LL).
With a bipolar input range, the digital values can be between LL-5%x(HL-LL) and HL+5%x(HL-LL).

Example: Use of a 2-20 bar pressure transducer that has a 0-20 mA output with linear characteristics.

The user requires a pressure reading and not a current value.

Defining the limits:
2 bar corresponds to 0 mA,
20 bar corresponds to 20 mA.



The PLC processes 16-bit signed integers that represent values from -32768 to +32767. The best resolution is obtained by selecting the limit values in multiples of 10 as close as possible to the maximum value.

In this example, 2 to 20 bars can be represented by any of the following:

Limits	Resolution
2 - 20	1 bar
20 - 200	0.1 bar
200 - 2000	10 mbars
2000 - 20000	1 mbar

The last solution gives the best resolution:

EHL = 20000

ELL = 2000

Taking into account the permitted overruns, the measurement value can vary between 1640 and 21800.

2.3-4 Continuity Test

Purpose of the test

This test is designed to detect a break in the continuity of the external circuit that connects the module to the sensor.

The module will detect a fault if:
• A wiring fault occurs (if a wire is cut for example),
• A sensor failure occurs,
• The input signal varies suddenly.

Enabling the test

The continuity test is optional. For the voltage ranges, it can be enabled separately for each channel during the configuration procedure, provided that the channel scan time is greater than 2.4 seconds.

The test cannot be enabled for current ranges. If it is selected, the module will refuse the configuration.

In the 4/20 mA current input mode there is automatic failure detection, since if the line is cut the current falls below 4 mA and the module detects an overrun of the declared range.

In the 0/20 mA current input mode the module cannot differentiate between an open line and a zero current level (the test is not run).

Test principle

The module checks all of the active inputs to ensure that the connected sensors are voltage generators with a low output impedance.
The principle of the test consists in charging the capacitor used for the capacitive transfer with a voltage that is different from the sensor voltage and then retransmitting to the sensor.

If a sensor is connected, the capacitor is discharged and returns to its original value. If not (line cut, sensor not connected) the capacitor will retain its charged value.

If a fault is detected, the test circuit automatically:
• sets the continuity fault bit to 1 (see Sub-section 4.4-1 - Fault Processing),
• sets the channel fault bit to 1 in the additional status word register,
• turns on the ERR fault LED on the front of the module.

Recommended use

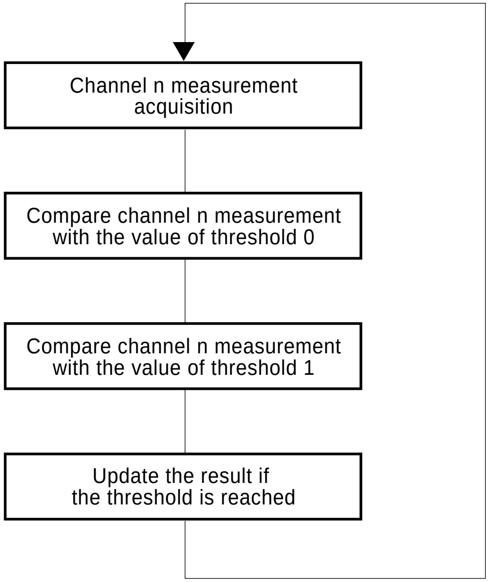
Users are strongly recommended to take advantage of the optional continuity test for the following reasons:

- When an input to the module is open, due to a sensor failure or a broken connection, the module nevertheless acquires an input reading which is the higher limit value (EHL) of the selected input range.
- To prevent this false value from being acquired, the channel fault bit (which is set to 1 by the continuity test if a fault is detected) should be used in the program to check the validity of the input readings.

2.3-5 Threshold Detection

Digital threshold detection

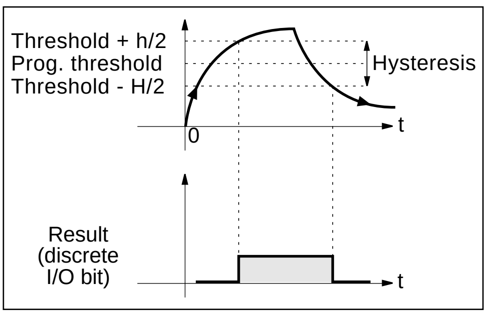
Two thresholds are defined for each channel.
The thresholds are digital values (expressed in measurement units that correspond to the selected type of scaling) that are programmed by the user and transmitted to the module through the message interface.
The result of a threshold detection is indicated by a bit that is available to the user program. This bit is set to 1 when the measurement is greater than the threshold (refer to Sub-section 4.3).
The comparison between the channel measurement and the threshold is made each time a new input value is received.
When a channel is inhibited, the result of the comparison is forced to 0.



Hysteresis

The comparison automatically compensates for hysteresis (h) equal to 0.5% of the declared scale. The value with which the measurement is compared therefore depends on the whether the analog input signal is rising or falling:

- Threshold not reached, the detection bit is set to 1 when the measurement value is equal to or greater than the threshold plus h/2.
- Threshold reached, the detection bit is set to 1 when the measurement value is equal to or less than the threshold minus h/2. The following table gives the hysteresis values depending on the selected input range and scale.



Scale	-10/10V	-5/5V	0/10V	2/10V	0/5V	0/2V	0.4/2V	0/20mA	4/20m
Input range	100mV	50mV	50mV	40mV	26mV	10mV	8mV	100µA	80µA
Standard range	50								
User range	2 x(Integer of (EHL-ELL) x 25.10^{-4}) + 1)								

2.4 Data Exchanges with the PLC

2.4-1 General

Once installed and wired, the TSX AEM 811 module is ready to exchange data with the PLC. Data exchanges with the PLC are made through the full I/O bus which comprises:

- A discrete I/O interface, which is used to exchange bits,
- A register interface, which is used to exchange words,
- A message interface, which is used to exchange word tables.

2.4-2 Discrete I/O Interface

This interface is identical to the interface of the discrete I/O modules. In the TSX AEM 811 module, the user has access to 16 “Input” bits and one fault bit which are updated on each scan cycle of the PLC:

16 threshold detection bits

Ixy,0	threshold 0 detection ch. 0,	Ixy,8	threshold 1detection ch. 0,
Ixy,1	threshold 0 detection ch. 1,	Ixy,9	threshold 1detection ch. 1,
Ixy,2	threshold 0 detection ch. 2,	Ixy,A	threshold 1 detection ch. 2,
Ixy,3	threshold 0 detection ch. 3,	Ixy,B	threshold 1 detection ch. 3,
Ixy,4	threshold 0 detection ch. 4,	Ixy,C	threshold 1 detection ch. 4,
Ixy,5	threshold 0 detection ch. 5,	Ixy,D	threshold 1 detection ch. 5,
Ixy,6	threshold 0 detection ch. 6,	Ixy,E	threshold 1 detection ch. 6,
Ixy,7	threshold 0 detection ch. 7,	Ixy,F	threshold 1 detection ch. 7.

1 module fault bit Ixy,S.

2.4-3 Register Interface

This interface permits the exchange of 8 input register words and 8 output register words, which are updated on each scan cycle of the PLC (TSX 47-30/67/87) or on every second cycle of the PLC (TSX 47-20).

The 8 input register words are:

- 3 status words that contain the operating status of the module (operating modes, types of faults, etc.).
- 4 words that contain the measurement values obtained on each channel (1 word for 2 channels).
- 1 word that is not used.

IWxy,0	Standard status word
IWxy,1	Complementary status word 1
IWxy,2	Complementary status word 2
IWxy,3	Measurement ch. 0 or ch. 4
IWxy,4	Measurement ch. 1 or ch. 5
IWxy,5	Measurement ch. 2 or ch. 6
IWxy,6	Measurement ch. 3 or ch. 7
IWxy,7	

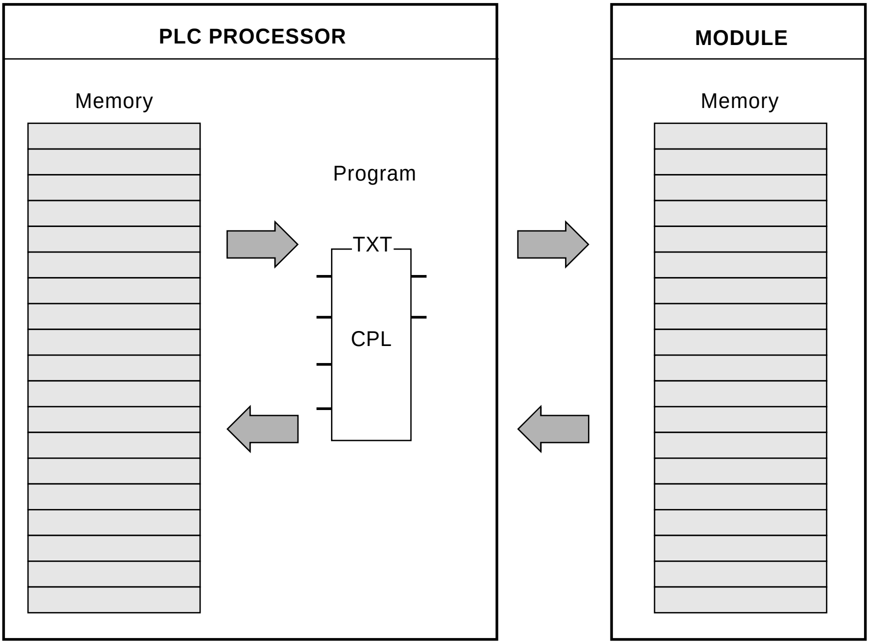
The 8 output register words are:

- 2 command words that are used to switch the module and each of the channels to Run or Stop.
- 6 words that are not used.

OWxy,0	Standard command word
OWxy,1	Complementary command word
OWxy,2	
OWxy,3	
OWxy,4	
OWxy,5	
OWxy,6	
OWxy,7	

2.4-4 Message Interface

This interface permits the exchange of word tables which can be read and written in the program by using a Text Block of the "CPL" (Coupler) type. The exchanges are initiated by the user program.



This type of exchange enables:

- Writing the configuration,
- Reading the configuration,
- Reading the measurements,
- Writing thresholds,
- Other commands (refer to Sub-section 4.4-2).

The data specific to each of these exchanges can be stored in:

- Internal words Wi or constant words CWi for transfers from the PLC to the module (transmission),
- Internal words Wi only for transfers from the module to the PLC (reception).

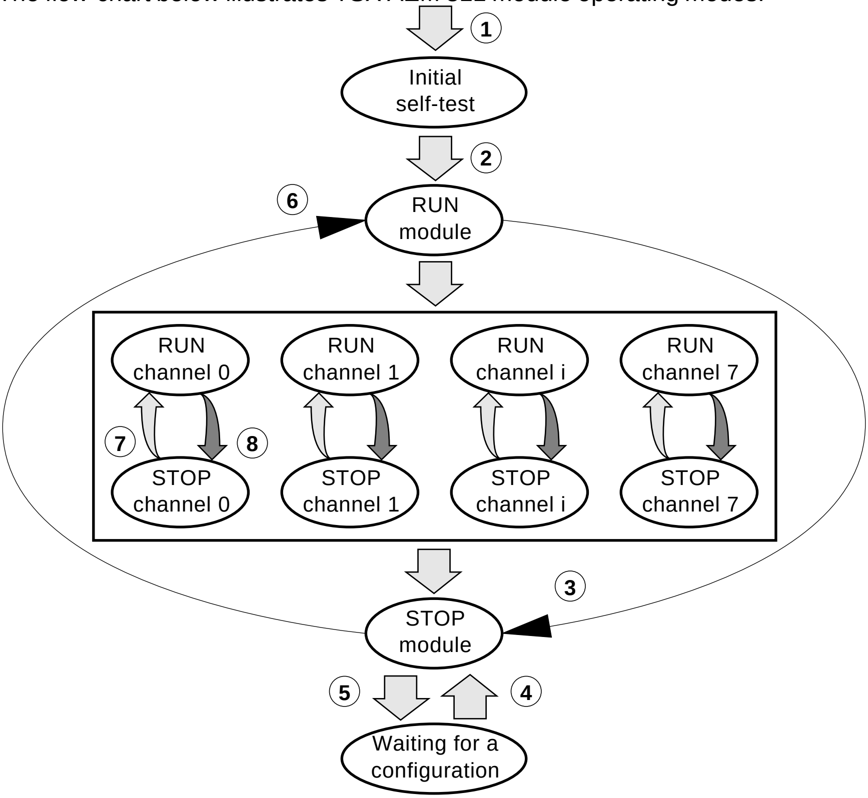
The programming of exchanges using the Text Block is described in the Sub-sections dealing with the type of data to be exchanged:

- Configuration (Section 3),
- Read measurement values (Sub-sections 4.1 and 4.2),
- Write thresholds (Section 4.3),
- Fault processing (Sub-section 4.4-1),
- Additional requests (Sub-section 4-4-2).

2.5 Operating Modes

2.5-1 Description

The flow-chart below illustrates TSX AEM 811 module operating modes.



When powered-up, on initialization or after a power break, the module runs an initial self-test procedure (1). If the self-test is OK, the module goes to Run (2) or Stop (3) (depending on the value of the standard command word) using the default configuration.

To adapt the module to the application, it must be configured. To configure the module, the user program must:

- Check that the module is stopped,
- Transmit the configuration by using a Text Block,
- Set the module to Run.

If the configuration received by the module includes errors or omissions, it waits until a valid configuration is received (5).

Once the module is configured and set to Run (module Run and channel Run), it is ready to detect thresholds (bits), acquire measurements (words), and receive or transmit messages (word tables).
The module is continuously monitored by internal self-tests which detect all operating faults, whether the module is running or stopped.
Each channel can be set to Run (7) or Stop (8) independently, depending on whether or not it is used.

2.5-2 Controlling the Operating Modes

The operating modes of the module are controlled by the command register words which enable the user to select the required operating mode:

- Module Run/Stop,
- Each channel Run/Stop.

The status register words allow the user to check the current operating mode of the module (the numbers refer to the flow-chart on page 28):

- Initial self-test (1) ,
- Module Run/Stop (2) (3) ,
- Waiting for the configuration (4) ,
- Channel Run/Stop (7) (8) ,
- Operating with the default configuration.

Note: To avoid premature failure of the input relays (input relay life is 3 10^8 operations), it is necessary to follow the guidelines below:

- Select the sampling period that is most appropriate for the application,
- Inhibit the channels that are not used,
- Limit the use of accelerated sampling.

2.5-3 Effect of a Power Break on the Operating Modes

The TSX AEM 811 module does not have a protected memory, all stored data is lost (including the configuration and the values of the thresholds) when the module is disconnected from the PLC power supply.

The module must therefore be reconfigured in the case of:

- A cold restart (SY0 = 1),
- A hot restart, when the power supply reserve is exhausted,
- Insertion of the module into the rack.

The different types of restart are described in detail in the appropriate programming terminal user's manuals.

On power return, the module will again operate with the default configuration. This state is indicated by a additional status word bit (IWxy,2,D) which is set to 1 when the module is operating with the default configuration. This bit can therefore be used in the program to indicate the loss of the user's configuration and to command a new transfer (by Text Block) of the application configuration, as shown in the example given in Sub-section 3.5.

2.5-4 Effect of Faults on the Operating Mode

When an acquisition or conversion fault is detected, the module goes to Stop until the fault disappears.

When an application fault (sensor or wiring) is detected, the module continues running.

Configuration Section 3

3.1 Principle

3.1-1 General

The TSX AEM 811 module requires configuration data to prepare it for a given type of operation. This data defines the operating mode of the module and of each of its channels. Selection of the most suitable configuration therefore simplifies the amount of programming required to make use of the measurements provided by the module.
Configuration of the module comprises:
• Defining the operating characteristics of the module,
• Coding these characteristics in hexadecimal codes or decimal values,
• Transferring these codes to the module by program.

3.1-2 Configuration Data

The configuration data comprises :
• For channel sampling (Zone 1):
  - The sampling mode,
  - The sampling period,
  - The sampling period identifier H'00A0.
• For each channel's operating mode (Zones 2 to 9):
  - The input range,
  - The type of processing,
  - The type of scaling,
  - The optional continuity test.
• And if User Range scaling is selected:
  - The higher and lower limits.

Zone 1	Period identifier
	Sampling period
Zones 2 to 9	Channel number
	Operating mode
	Higher limit
	Lower limit

3.1-3 Coding

The configuration data should be coded in a word table located:
• in the W zone when entered by program, and
• in the CW zone when entered by the terminal.
The configuration of the module is divided into nine zones, each of which has an identification code. These nine zones can be sent to the module together if they occupy a continuous memory space in the W or CW zones. Otherwise they can be sent separately, in which case the identifcation code of each zone ensures that it is recognized by the module. The coding of each zone is described in Sub-section 3.2-2.

Zone 1	Channel sampling
Zone 2	Channel 0 configuration
Zone 3	Channel 1 configuration
Zone n + 2	Channel n configuration
Zone 9	Channel 7 configuration

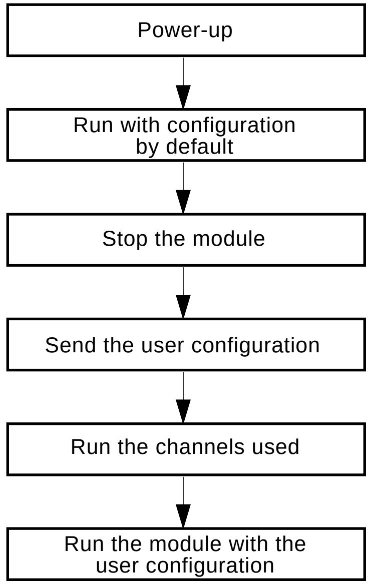
3.1-4 Transmission of Configuration Data

After the configuration data has been coded and entered in the PLC memory, the data must be transmitted to the module.

The transmission of configuration data from the PLC memory to the module memory is done by program through the CPL Text Block.

To transmit the configuration, proceed as follows:
- Stop the module,
- Transmit the configuration by using the CPL Text Block,
- Set the channels to be used to Run,
- Set the module to Run.

> **Note**: A power break or removing the module from the rack can cause the configuration to be lost. If this occurs, send the configuration again.



3.1-5 Default Configuration

The TSX AEM 811 module has a default configuration that allows it to operate as soon as it is powered up.

The main function of the default configuration is to test the wiring. It is described in Sub-section 3.3.

The default configuration is replaced by the user's configuration as soon as the latter is transmitted by program.

3.1-6 Configuration Related Bits

Two bits from the standard and additional status words can be accessed by the program to obtain information concerning the status of the configuration:

IWxy,0,B = 1: Indicates that the module is waiting for a configuration (if the configuration transmitted contained errors or omissions),

IWxy,2,D = 1: Indicates that the module is operating with the default configuration.

3.2 Channel Sampling

3.2-1 Operating Mode

Coding

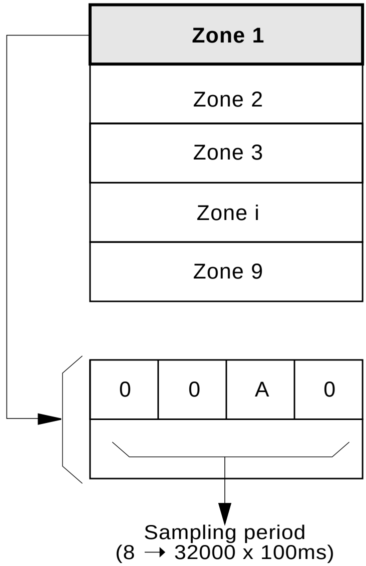
Channel sampling is coded by using two words (zone 1).

- The first word contains the identifier H '00A0',
- The second word contains the sampling period (decimal code).

Sampling period (decimal value)

This word must contain a number N with a value between 8 and 32000.

The value of N equals the sampling period in hundreds of milliseconds.



Example:

CW0 = H'00A0'
CW1 = 50
The sampling period is 50 x 100 milliseconds or 5 seconds.

Reminders:

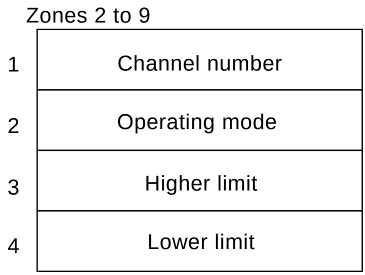
- The cycle time is unchanged in normal mode even with one or more channels inhibited (a delay of 100 ms per inhibited channel is included in the cycle time).
- In accelerated mode this period is not significant (refer to Sub-section 2.3).
- A period value of less than 24 (2.4 seconds) is incompatible with the continuity test.
- Only the period value can be sent with the configuration. It can therefore be changed during program execution. The module must still be stopped however, to allow the transfer.

3.2-2 Configuring a Channel

Coding

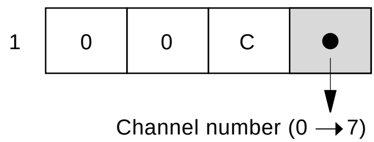
The configuration of a channel (in zones 2 to 9) is coded in 2 or 4 words:

- The first word contains the identifier (00C) followed by the channel number (hexadecimal code),
- The second word contains the code for the channel operating mode (range, processing, etc.) (hexadecimal code),
- The third and fourth words contain the higher and lower limits (decimal code) if the User Range mode is selected.



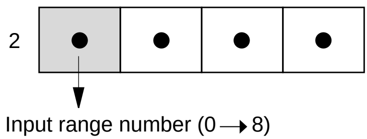
Channel number

This number (from 0 to 7) identifies the channel affected by the configuration.



Input range

The input range is coded in the fourth 4-bit byte of the second word.

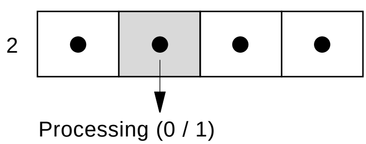


Range Nbr.	Scale
0	-10/+10 V
1	- 5/+ 5 V
2	0/10 V
3	2/10 V
4	0/5 V
5	0/2 V
6	0.4/2 V
7	0/20 mA
8	4/20 mA

Processing

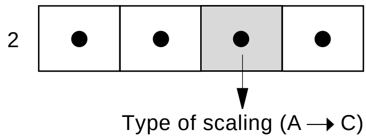
The processing is coded in the third 4-bit byte:

- 0 = no processing,
- 1 = processing.



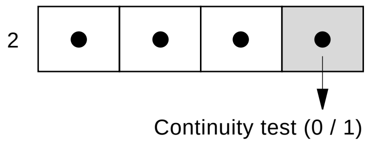
Type of scaling

The type of scaling is coded in the second 4-bit byte:
A = Input range scaling,
B = Standard range scaling,
C = User range scaling.



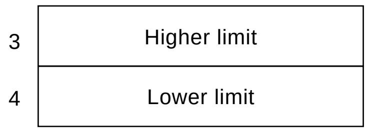
Continuity test

The continuity test is selected by coding the first 4-bit byte to 1.



Higher and lower limits

These limits should only be defined when User range scaling is selected.



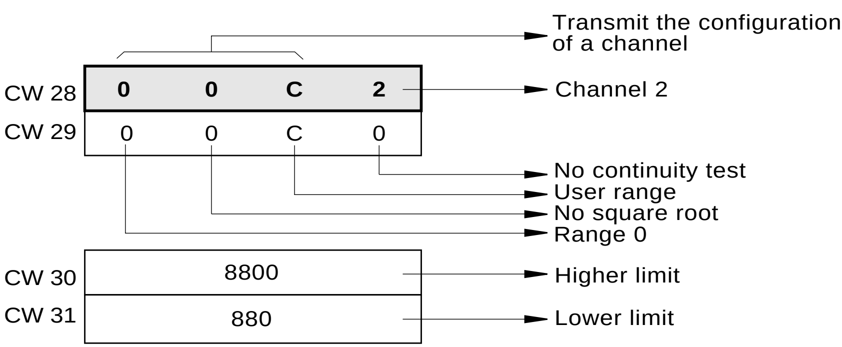
The higher and lower limits are coded in decimal in the third and fourth words with values between -32768 and +32767.

3.2-3 Example

To configure channel 2 of the module as follows:

- Input range : -10/+10 V
- Processing : no square root extraction.
- Type of scaling : user range
- Continuity test : none
- Higher limit : 8800
- Lower limit : 880

The coding would be:



3.3 Default Configuration

Each module has a default configuration that permits a check to made for correct operation and connection. This configuration is operative as soon as the module is powered up.

A additional status word bit IWxy,2,D indicates when the module is operating with this configuration:

IWxy,2,D = 1 → default configuration

- 10 : 10 x 100 milliseconds, sampling of the 8 channels every second,
- Each channel is configured in the same way:

  Code: H'00A0'

  - 0 : input range - 10/+ 10 V,
  - 0 : no square root extraction,
  - A : input range scaling:
    -10000 to +10000
    (implicit limits set by the input range).
  - 0 : no continuity test.

On power break or if the module is removed from its location and reinstalled, the configuration that was transferred is lost. It is replaced by the default configuration.

If the default configuration on one of the channels is adequate, a new configuration need not be transferred for that channel.

Zone 1	0	0	A	0
				10
Channel 0	0	0	C	0
	0	0	A	0
Channel 1	0	0	C	1
	0	0	A	0
Channel 2	0	0	C	2
	0	0	A	0
Channel 3	0	0	C	3
	0	0	A	0
Channel 4	0	0	C	4
	0	0	A	0
Channel 5	0	0	C	5
	0	0	A	0
Channel 6	0	0	C	6
	0	0	A	0
Channel 7	0	0	C	7
	0	0	A	0

3.4 Storing the Configuration

3.4-1 Data Entry

After defining the module configuration data and determining the corresponding codes, these codes must be stored in the PLC memory before they can be transferred to the module memory.

There are two possible solutions:
• Storing the codes in constant words (CW) using a terminal,
• Storing the codes in internal words (W) by program or in Data or Adjust modes.

Storing the configuration in the constant memory

Select the Constant mode on the mode selection display of the terminal and enter the module configuration codes into the CW words.

A configuration example is shown opposite.

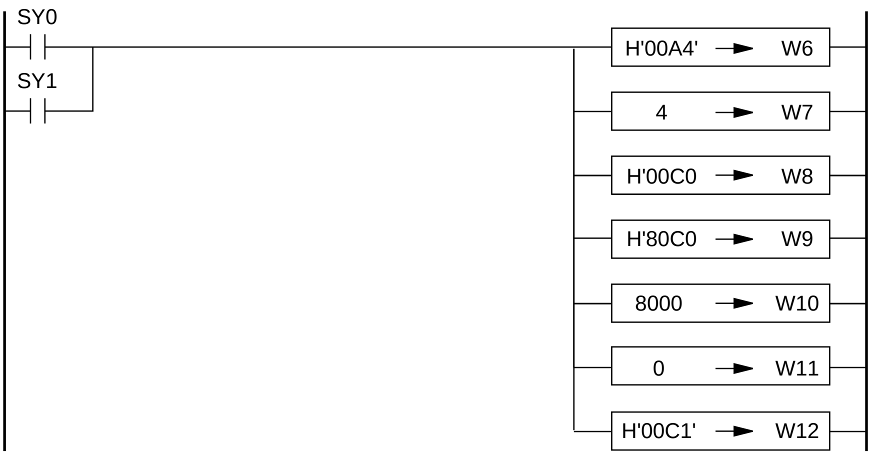
The hexadecimal codes are preceded by the letter H.

```
2/ 5/ 86 0 :0  CNST  TERMINAL T607 2      VAT SUPERVISION
    CW NB CONFIGURED   :   128

CONSTANT  VALUE     MNEMONIC     CONSTANT  VALUE     MNEMONIC
  CW0    =H'00A0'                  CW16   =10000
  CW1    =30                       CW17   =0
  CW2    =H'00C0'                  CW18   =H'00C4'
  CW3    =H'50C0'                  CW19   =H'21C0'
  CW4    =10000                    CW20   =20000
  CW5    =0                        CW21   =0
  CW6    =H'00C1'                  CW22   =H'00C5'
  CW7    =H'20C0'                  CW23   =H'21C0'
  CW8    =10000                    CW24   =20000
  CW9    =0                        CW25   =0
  CW10   =H'00C2'                  CW26   =H'00C6'
  CW11   =H'20C0'                  CW27   =H'21C0'
  CW12   =10000                    CW28   =20000
  CW13   =0                        CW29   =0
  CW14   =H'00C3'                  CW30   =H'00C7'
  CW15   =H'20C0'                  CW31   =H'21C0'
                   DISPLAY CONSTANTS
 CWi |  | BOT | MODIF |  |  | CDW EVEN | CDW ODD |
```

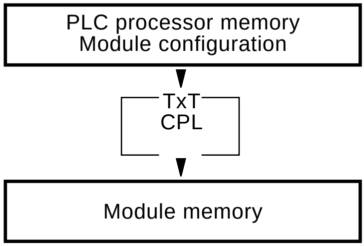
Storage in the data memory

The words corresponding to the selected configuration are stored in the internal words (Wi) by the program by using operation blocks to transfer the values. It is also possible to use Data or Adjust modes to enter the code values into the internal words.



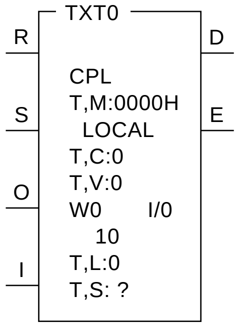
3.4-2 Transferring the Configuration

Once the configuration data is stored in the PLC memory, it must be transferred to the module memory. To do this the Text Block must be programmed for transmission/reception in order to make the transfer.



Text Block characteristics

The Text Block must have the following characteristics:



Text Block

- **CPL type**: Enables the exchange between the user program and the module,

- **Type of communication**:
  - LOCAL: If the module to be configured is in the same PLC.
  - NET: If the module is in another PLC connected by a Telway network.

- **Addressing mode**:
  - Direct or indirect: indirect addressing can be used if the configuration is sent in parts or if it may require changing during operation.

Transmission table

Wi	0	0	A	0
Wi + 1			1	0
Wi + 2	0	0	C	0
Wi + n				

- **Start of table address**:
  - If the direct mode is selected, this corresponds to the starting address of the table containing the configuration data.
  - If the indirect mode is selected, this address defines an addressing table.

- **Reception length = 0**

The above data must be entered by using the terminal in Configuration mode. The data cannot be modified by program.

```
08/ 08/ 86 00 :00   CONF                                TELEMECANIQUE
   NUMBER OF TEXT BLOCKS   N/MAX : 4 /64

N0   NET/LOCAL  TYPE    ADDRESSING MODES  ADDR  RECEPTION
                                          BUFFER   LENGTH (byte)
0      LOCAL     CPL        DIRECT        CW22        0
1      NET       CPL        INDIRECT      W20
2      LOCAL     TER        DIRECT        W100        20
3      LOCAL     TER        DIRECT        CW50        0
```

The other characteristics must be defined by program:

• TXTi, M : H' . . 63' Module address,

Slot number,

Rack number.

• TXTi, C: H'0040' Request code informing the module that configuration data is being sent.

• TXTi, L: Transmission table length. This corresponds to the number of bytes that contain configuration data: 4 to 68 bytes.

The transfer report word TXTi,V (or TXTi,R for the TSX 47-20) sent back by the module can be used to check that the data was transferred correctly. It equals H'FE' if the exchange was correct or H'FD' if the exchange was incorrect.

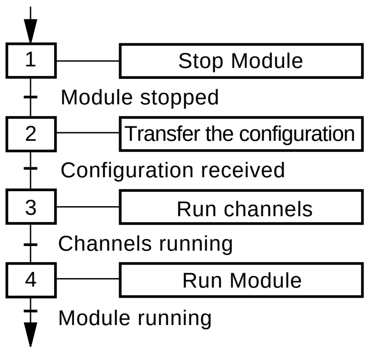
Configuration transfer with the TSX 47-20

The TXTi,M, TXTi,C and TXTi,L parameters can be defined when the Text Block is entered.

As the transmission table cannot exceed 30 bytes, a configuration of more than 30 bytes must be sent in two or three parts for configurations of more than 60 bytes.

Programming the transfer

The transfer must be programmed as shown below:



- Set the module to Stop by setting the command register bit OWxy,0,C to 0.
- Check that the module is stopped by testing that status word IWxy,0,C is at 0.
- Then transfer the configuration. To do this, generate a rising edge on the start input (S) of the Text Block.
- Check that the transfer was made correctly, as follows:
  - Check that TXTi,E is at 0,
  - Check that TXTi,V equals H'FE'.
- If the configuration was correctly received, reset the module to Run by setting command register word OWxy,0,C to 1.

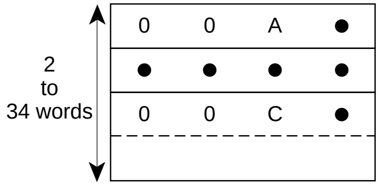
Bit IWxy,0,C should then go to 1.

An example of configuration transfer programming in PL7-3 language is given in Sub-section 3.5.

3.4-3 Checking the Configuration

The configuration is not accepted by the module if:
• There is a configuration length error (number of words),
• The syntax is incorrect,
• The selections made in the configuration are incompatible.

Configuration length
Minimum configuration length:
• 2 words (4 bytes).
Maximum configuration length:
• 34 words (68 bytes).
The entire configuration can be sent at one time, or separately by zone. The zones cannot be split.



A zone is 2 or 4 words long (in the case of User range scaling, the limits must be defined and are sent as two additional words). If a configuration zone that is already stored in the module is satisfactory (for example the default configuration), then this zone need not be sent.

Syntax errors
There is a code corresponding to every item of configuration data, as already described. If a undefined code is sent, the configuration is rejected. (See "Transmission of an incorrect configuration" below). Some of the configuration selections that can be made are not compatible with each other.

The list of incompatible selections is given below:
• Channel sampling period:
  - The continuity test on a channel is incompatible with a sampling period of less than 2.4 seconds
• Channel configuration:
  - Square root processing is incompatible with "Input range" scaling,
  - The continuity test is incompatible with current inputs,
  - The higher and lower limits must be transmitted only for User range scaling (type C), and these limits must be different from each other,
  - The configuration codes must correspond to those given in this manual, and the digital values must be within the limits given.

Transmission of an incorrect configuration
Transmission of an incorrect configuration sets the standard status word bit IWxy,0,B to 1. The module then waits for a new configuration. The previous correct configuration remains stored in memory.

3.5 Configuration Example

To configure five channels of a TSX AEM 811 module according to the table below (configuration column), follow the procedure described below:

3.5-1 Coding

The table below shows the codes corresponding to the configuration data and the addresses of the words used to store the data.

	Configuration		Code	Address
Sampling	. Identification code . Sampling period	 3000 ms	H'00A0' 30	CW22 CW23
Channel 0	. Channel number . Input range . Processing . Type of scaling . Continuity test . Higher limit . Lower limit	0 4/20mA No square root User range None 80.00°C 0.00°C	H'00C0' H'80C0' 8000 0	CW24 CW25 CW26 CW27
Channel 1	. Channel number . Input range . Processing . Type of scaling . Continuity test	1 0/5 V No square root Standard None	H'00C1' H'40B0'	CW28 CW29
Channel 2	. Channel number . Input range . Processing . Type of scaling . Continuity test . Higher limit . Lower limit	2 -10/+10V No square root User range None 100.00°C 0.00°C	H'00C2' H'00C0' 1000 0	CW30 CW31 CW32 CW33
Channel 3	. Channel number . Input range . Processing . Type of scaling . Continuity test . Higher limit . Lower limit	3 4/20mA No square root User range None 50.00 min 0.00 min	H'00C3' H'80C0' 5000 0	CW34 CW35 CW36 CW37
Channel 7	. Channel number . Input range . Processing . Type of scaling . Continuity test	7 0/5 V No square root Input range Yes	H'00C7' H'50A1'	CW38 CW39

Entering the codes

To enter the coded data into the PLC memory, select the Configuration mode on the terminal and enter each code separately into the constant words (CW).

3.5-2 Programming (for TSX 67/87)

The program shown below is written in Ladder language, but could also be written in Literal language (refer to the example in Sub-section 5.1).

First the CPL Text Block is configured:

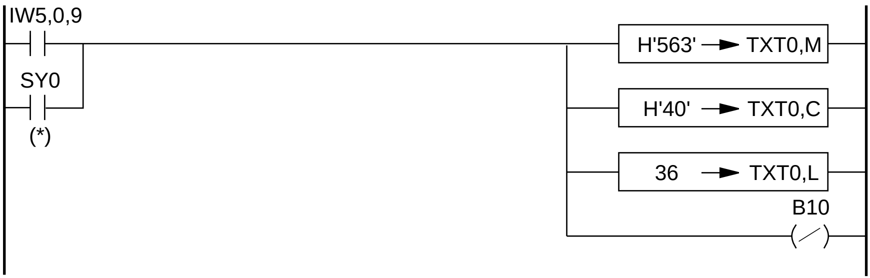
Local: The module is located in the same PLC as the program.

Direct, CW22: The data is stored in the constant words (CW).
Number of bytes in the reception table: 0.

```
2/ 5/ 86 0 :0     CONF    TERMINAL T607 2      TELEMECANIQUE
     NUMBER OF TEXT BLOCKS  N/MAX : 2 /64

N0   NET/LOCAL  TYPE    ADDRESSING MODES  ADDR RECEPTION
                                          BUFFER   LENGTH (byte)
0     LOCAL     CPL         DIRECT        CW22          0
1     LOCAL     CPL         INDIRECT      W20
```

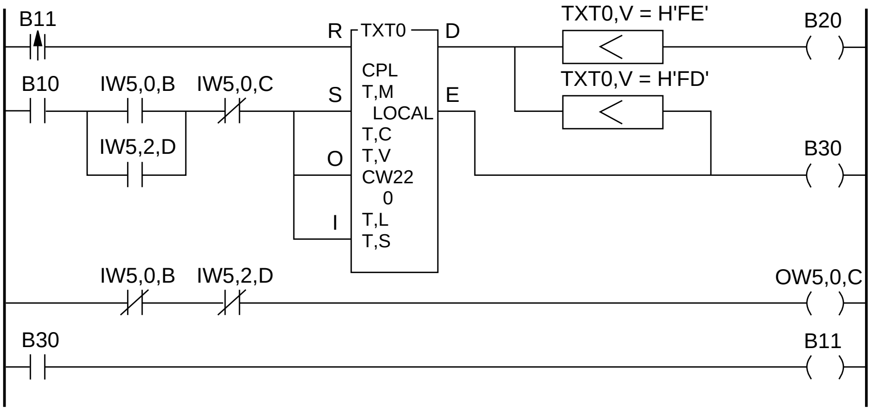
Programming text block characteristics



- H'563 : The module is located in slot 5 of rack 0 in the basic configuration,
- H'40' : Transmission of the configuration,
- 36 : 36 bytes have to be sent (18 configuration words).

(*) Internal bit B0 is the image of the cold restart system bit SY0. Bit B0 must be set to 1 at the start of the program after processing the cold restart.

Transfer the configuration



B10 = 1: Initial self-test period is over and the Text Block parameters have been programmed,
IW5,0,B = 1 or IW5,1,D = 1: The module is either waiting for a configuration or is operating with the default configuration,
IW5,0,C = 0: The module is stopped.

When the configuration has been correctly received by the module (report word TXT0,V = H'FE'), the module and the channels used are set to Run and the measurements can be used. If a transmission or configuration error occurs, the Text Block is reinitialized (B11).

4.1 Reading the Measurements in Register Words

4.1-1 Access to the Measurements

The digital values representing the analog input values, can be read by the program in four input register words (2 channels per word):

IWxy,3	**Ch. 0 or 4 measur.**	Ch. 0 if IWxy,2,0 = 0 Ch. 4 if IWxy,2,0 = 1
IWxy,4	**Ch. 1 or 5 measur.**	Ch. 1 if IWxy,2,1 = 0 Ch. 5 if IWxy,2,1 = 1
IWxy,5	**Ch. 2 or 6 measur.**	Ch. 2 if IWxy,2,2 = 0 Ch. 6 if IWxy,2,2 = 1
IWxy,6	**Ch. 3 or 7 measur.**	Ch. 3 if IWxy,2,3 = 0 Ch. 7 if IWxy,2,3 = 1

The first 4 bits of status register word IWxy,2 determine which channel measurement is present in the corresponding register word.

The measurements can then be stored in 8 internal words, as shown in the example below.

Example of access to measurements by program.
The module is located in slot 5. The measurements are stored in words W0 to W7 that correspond to the measurement values of channels 0 to 7.

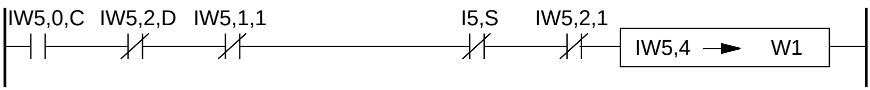
```
! IF NOT IW5,2,0   THEN IW5,3-> W0
                   ELSE IW5,3-> W4
! IF NOT IW5,2,1   THEN IW5,4-> W1
                   ELSE IW5,4-> W5
! IF NOT IW5,2,2   THEN IW5,5-> W2
                   ELSE IW5,5-> W6
! IF NOT IW5,2,3   THEN IW5,6-> W3
                   ELSE IW5,6-> W4
```

4.1-2 Measurement Validity Conditions

These digital values effectively represent the measurement of the analog input levels if the following conditions are met:

Conditions	State	Remarks
Module in Run	IWxy,0,C = 1	If the module is stopped, the values received are the last values received before the module was stopped.
Module configured	IWxy,2,D = 0	If the module is not configured it will use the default configuration. The measurements are not in the expected measurement units.
Channels not inhibited	IWxy,1,i = 0	An inhibited channel is not sampled (i = 0 to 7) by the module and the measurement value is forced to 0.
Analog input values within the extended input range with sensor and wiring correct,	IWxy,1,i = 0 (i = 8 to F)	When any one of these bits are at 1, measurement values of the corresponding channels are erroneous.
Module operation correct and terminal block locked	Ixy,S = 0	When this bit is at 1 the module is stopped.

Example: Channel 1 measurement validation. The use of bit I1,S prevents validation of the measurement when a module fault appears.



4.1-3 Analog-Digital Correspondence

The correspondence between the analog input values and the digital values sent to the PLC depend on the configuration selected (refer to Section 3): Input range, processing, type of scaling and limit values if user range mode is selected.

Examples:

- 0/10 V input range without processing and "Input range" scaling mode. A 5 V level will have a digital value of 5000, i.e. 5000 mV.
- 0/10 V input range without processing and "Standard" scaling mode. A 5 V level will have a digital value of 5000, i.e. 50.00/100.00 or 50%.
- 0/10 V input range without processing and "User range" scaling mode with a higher limit of 1000 and a lower limit of 200. A 5 V level will have a digital value of 5 x (1000 - 200)/10 + 200 = 600.

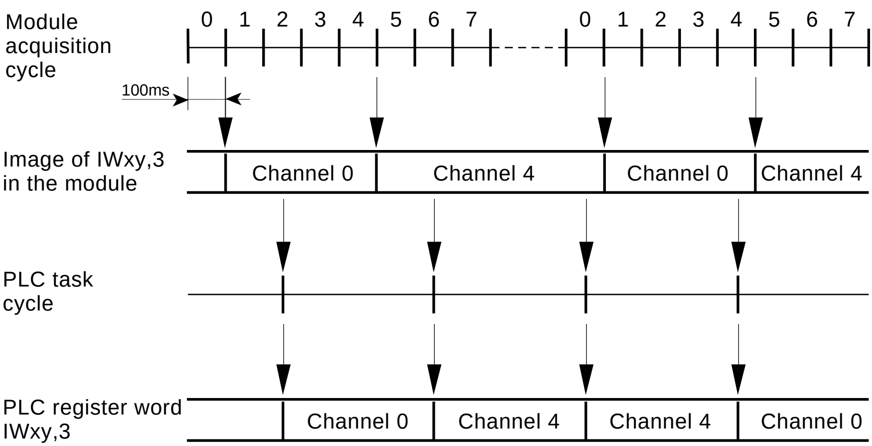
4.1-4 Measurement Acquisition

The principle of measurement acquisition and sampling is described in Sub-section 2.2-4. To use the measurements in the program it is necessary to allow for:
• measurement acquisition by the module,
• updating of register words by the PLC processor, carried out on each cycle.

Reminder:

Using a TSX 47-20:
• The master task is not periodical and the task period is less than 150 ms,
• Register words are updated by the PLC processor every second cycle.
Using a TSX 67/87:
• The master and auxiliary tasks are periodical,
• Register words are updated by the processor every cycle.

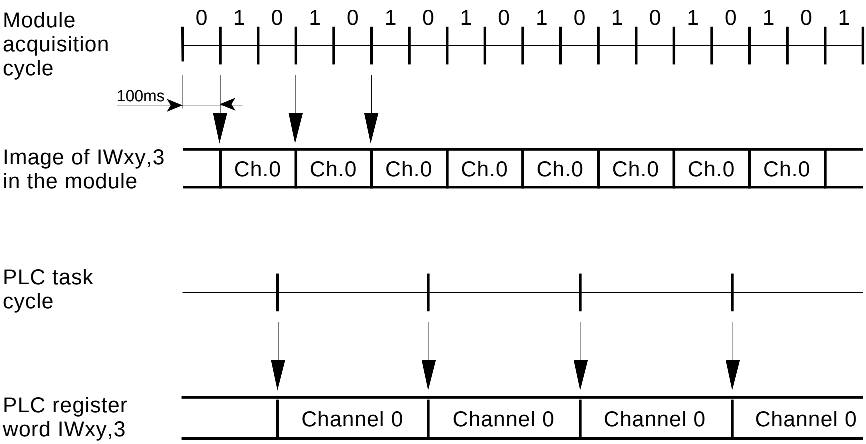
Access in normal mode: selected by setting bit OWxy,1,8 to 0.



The timing of measurement acquisition by the module depends on the length of the sampling period P defined in the configuration. Each measurement value in the module is updated 100 ms after its acquisition. This value is available in the module memory image of the corresponding register word for 400 ms (channels 0, 1, 2, 3) and P - 400 ms (channels 4, 5, 6, 7).

The PLC processor updates register words at the start of the cycle of the task in which the module is configured. To read all of the measurement values **the task period should therefore be less than 400 ms.**

Access in accelerated mode: Selected by setting bit OWxy,1,8 to 1.



In accelerated mode, the sampling period is no longer that defined in the configuration, but is equal to n x 100 ms with n the number of enabled channels.

Only the enabled channels are acquired and the channels are scanned in succession. It is recommended to use channels that do not use the same register words in order to simplify programming and to have the measurement available in the register word for the maximum length of time.

- *In a case where the number of enabled channels n is less than 5 and where none of the channels uses the same register:*
  The holding time in the register word is equal to n x 100 ms. The period of the task in which the module is configured must be less than this time if the user wishes to acquire all of the measurements. In the example above the task period is too long and only every second measurement will be processed by the program.
- *In other cases:*
  The period of the task in which the module is configured must be less than 100 ms.

Note:

Whatever the mode, the maximum time between acquisition and program access to the measurement is 100 ms (module acquisition time) + the period of the task.

The rising edges of bits IWxy,2,0(1,2,3) can be used as synchronization for access by program to the measurements. **For this to be possible, the two channels assigned to the same register must be active.**

Example

In the same application four channels of a TSX AEM 811 module are used to process temperature measurements every 20 seconds and the other four channels are used to process flow measurements every 3 seconds.
The sampling period must therefore be set to 3 seconds (the minimum value for the two periods). In order to acquire all of the measurements the period of the task in which the module is configured should be less than 400 ms.

The program must therefore transfer the input register words containing the measurements into a table of 8 internal words (refer to the example in Literal language at the start of this Sub-section) and then acquire measurements from this table:
• every 3 seconds for flow measurements,
• every 20 seconds for temperature measurements.

4.2 Reading the Measurements in Message Mode

4.2-1 Access to Measurements

In the message mode the measurements are transmitted to 8 internal words (Wi) in response to a "Read measurements" request.
This request is programmed by using a CPL type Text Block in the transmission/ reception mode with the following characteristics:

- Request code : TXTi,C = 1,
- Address : TXTi,M = H'xy00' (where x = Rack no. and y = Slot no.),
- Reception table : Wi(8) 8 word table (16 bytes) comprising the 8 measurements with Wi = channel 0 measurement, Wi+1 = channel 1 measurement, etc. to Wi+7 = channel 7 measurement),
- No transmission table need be defined (Remember for TSX 47-20, TXTi,L = 0).

Reports : TXTi,V = H'81' : correct exchange, H'FD': incorrect exchange,
TXTi,S = 16 bytes if the exchange is correct (TXTi,E = 0).

Note: The request will operate with the module in running or stopped. If the module is stopped, the measurements sent are not the true values but the last measurements acquired before the module was stopped.

The validity conditions and the digital-analog correspondence of the values are the same as those for access to measurements in register mode (refer to sub-section 4.1).

4.2-2 Access Time

The principle of access to measurements in message mode is described in Sub-section 2.2-4.

In normal mode : The measurement sampling period is that defined in the configuration,

In accelerated mode : The sampling period depends on the number of enabled channels (refer to the previous page). In this mode however, data for all channels is still sent to the module but inhibited channels are forced to 0.

The measurement access time after the request is validated is 1 master task cycle (Reminder: The request is validated at the end of the master task when the outputs are updated).

Reminder: The measurements for the different channels are taken from the same cycle.

4.2-3 Example

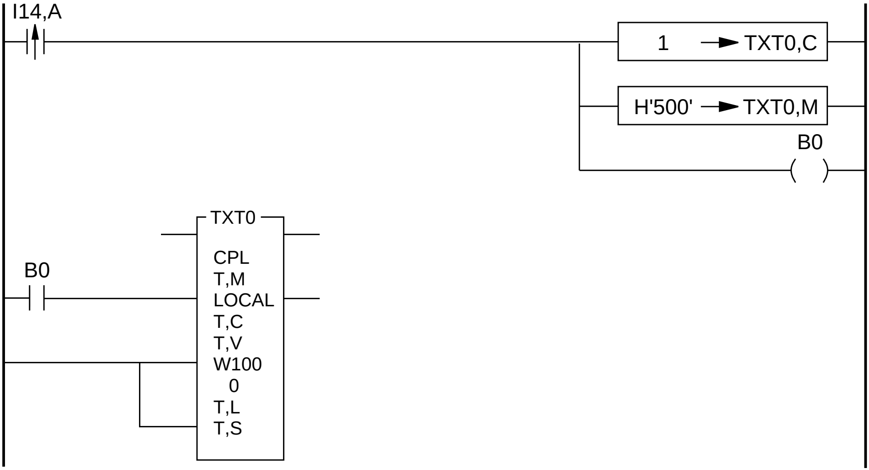
In the example opposite, a CPL type Text Block is used with direct addressing.

```
2/ 5/ 86 0 :0     CONF    TERMINAL T607 2      TELEMECANIQUE
      NUMBER OF TEXT BLOCKS  N/MAX : 2 /64

N0   NET/LOCAL  TYPE    ADDRESSING MODES  ADDR RECEPTION
                                          BUFFER   LENGTH (byte)
0       LOCAL    CPL          DIRECT         W100          16
1       LOCAL    CPL          INDIRECT       W20
```

The measurement reception table W100[8] is defined in the Configuration mode.

The measurements are transferred each time input I14,A goes from 0 to 1.



4.3 Threshold Detection

The TSX AEM 811 module can be used for detecting two programmable thresholds per channel (refer to Sub-section 2.3-5). There are two phases in the use of this function:
• Transmitting threshold values to the module,
• Processing threshold detection results.

4.3-1 Transmitting Threshold Values to the Module

The threshold values must be transmitted to the module through the message interface using two requests:
• Request "Write 0 thresholds" (channels 0 to 7),
• Request "Write 0 thresholds" (channels 0 to 7).

These two requests are programmed by using a CPL Text Block in the transmission/ reception mode with the following characteristics:
• Request code : TXTi,C = 2 (thresholds 0), TXTi,C = 4 (thresholds 1),
• Address : TXTi,M = H'xy00' (where x = Rack no. and y = Slot no.)
• Reception table : CWi[8] or Wi[8] containing the threshold values to be entered by the user in the Constant or Data modes or by program (using Wi for channel 0 threshold, Wi+1 channel 1 threshold, etc. to Wi+7 = channel 7 threshold).
• No reception table need be defined.

The response to the request (TXTi,V = H'FE' if the exchange is correct or H'FD' if incorrect) is given by the module when it has made the comparison with the transmitted threshold values. Therefore a request sent when the module is stopped will be acknowledged when the module goes to Run mode.

Threshold values

Threshold values must be between -32768 and +32767. They are expressed in the measurement units defined by the type of scaling selected. These values can be entered in Data or Constant modes or defined by program. By default or after a power break the values of thresholds 0 and 1 for each channel are set to 0.

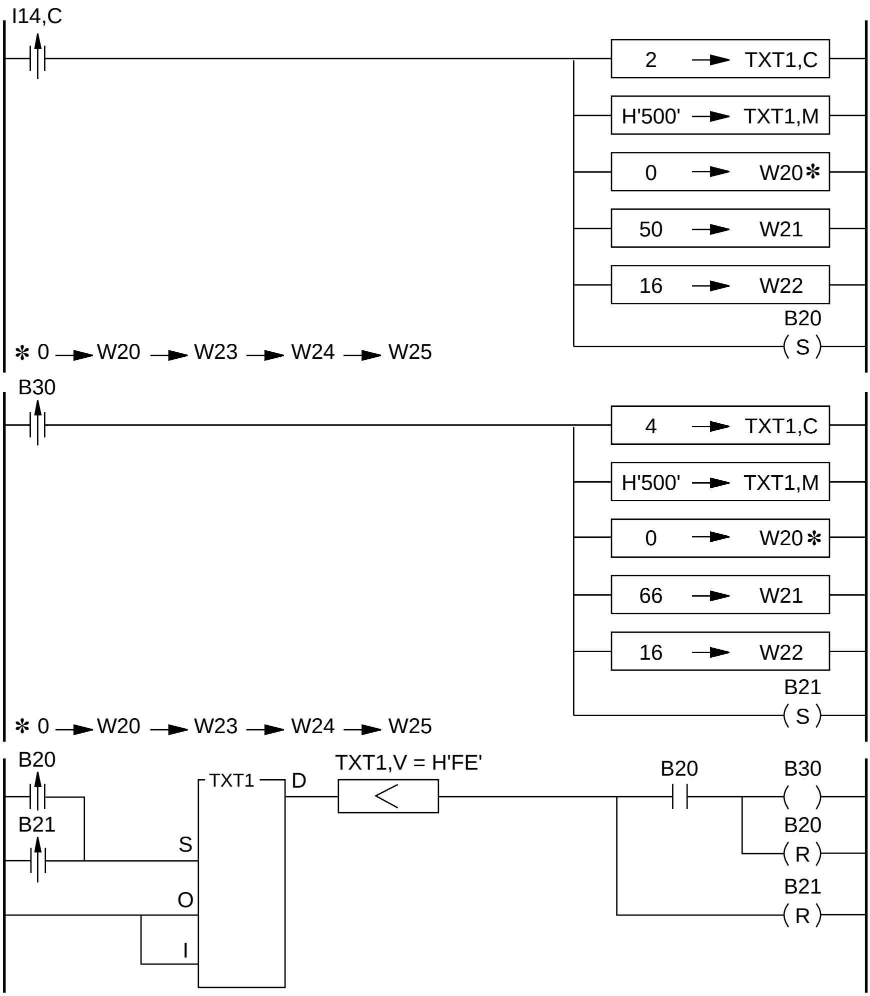
Example

In the example below, a Text Block with indirect addressing is used.

The thresholds are programmed using two successive transfers. The first corresponds to threshold 0 and the second to threshold 1.

The thresholds are transferred each time input I14,A goes from 0 to 1.

The threshold values have been defined beforehand in the Data mode, in table W50[16].



4.3-2 Threshold Detection Results

The user has access by program to the 16 threshold detection result bits:

Ixy,0	threshold 0 detection ch. 0,	Ixy,8	threshold 1 detection ch. 0,
Ixy,1	threshold 0 detection ch. 1,	Ixy,9	threshold 1 detection ch. 1,
Ixy,2	threshold 0 detection ch. 2,	Ixy,A	threshold 1 detection ch. 2,
Ixy,3	threshold 0 detection ch. 3,	Ixy,B	threshold 1 detection ch. 3,
Ixy,4	threshold 0 detection ch. 4,	Ixy,C	threshold 1 detection ch. 4,
Ixy,5	threshold 0 detection ch. 5,	Ixy,D	threshold 1 detection ch. 5,
Ixy,6	threshold 0 detection ch. 6,	Ixy,E	threshold 1 detection ch. 6,
Ixy,7	threshold 0 detection ch. 7,	Ixy,F	threshold 1 detection ch. 7.

- Bits at state 1: These bits are set to 1 when the corresponding measurement value is greater than the programmed threshold value plus half the hysteresis value.

- Bits at state 0: They are reset to 0 when the measurement value of the channel is less than the programmed threshold value minus half the hysteresis value.

The hysteresis value depends on the type of scaling selected (refer to Sub-section 2.3-5).

Note: When a channel is inhibited, its threshold detection bits are forced to 0.

4.3-3 Modifying Threshold Values

The threshold values can be modified with the module stopped or running, as follows:

- Module stopped: When the application allows it, this procedure is recommended as it avoids errors of interpretation concerning the thresholds detected (i.e. between new or old threshold values).
- Module running: In this case, the detection of thresholds with new values will not be completed until:
  - the acknowledgement of the request transmitted by Text Block is received, comprising TXTi,D reset to 1 and report TXTi,V = H’FE’,
  - a complete sampling cycle of all 8 channels has been completed.

4.4 Additional Programming Information

4.4-1 Fault Processing

General

The user can determine by program the types of faults that occur in the TSX AEM 811 module or in its associated input devices.

Three types of fault

These faults can be classed in three types depending on their severity and their effects on the operation of the module.

Blocking faults:

This type of fault is caused by a failure in the module processor or bus interface. The module processor is inhibited and no exchanges are possible on the bus.

Module acquisition and conversion faults:

These faults are caused by the module electronics used for measurement acquisition and conversion. The measurements are no longer valid and the module is forced to stop.

Application faults:

These faults are caused by external factors (open input connections, failed sensors, etc.). They may occur on only one channel, while the others continue to operate correctly. The user is informed of the faulty channel.

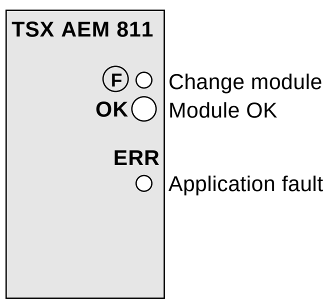
Fault indicators

A number of different fault indicators are available to the user.

- Indicator lights,
- Fault bits,
- Status words,
- The fault bit string.

Indicator lights

Indicator	State	Fault TSX AEM 811
F	On	Blocking fault.
OK	On	No fault.
	Off	Module acquisition or conversion fault.
ERR	On	Application fault on one of the channels.



Fault bits:

Fault bits	Accessible	State	Fault
Ixy,S(*)	by program	1	. Module fault (blocking or acquisition/conversion fault), . PLC exchange fault, . Code declared is incorrect, not 62 or 649, . Module absent.
Status word bit B	in Diagnostic mode	1	Module fault.
Status word bit D	in Diagnostic mode	1	Blocking fault.

(*): This bit informs the PLC (its I/O indicator comes on), that a module fault has occurred. The bit is set to 1 as soon as the fault occurs, and returns to 0 when the fault ends.

Status words:
The different types of fault are coded in the status register words.

	F	E	D	C	B	A	9	8	7	6	5	4	3	2	1	0
Standard status word IWxy,0																

The following bits of the standard status word indicate faults:

Address	Function
IWxy,0,4	General fault, combines IWxy,0,6 and IWxy,0,7.
IWxy,0,6	Module acquisition and conversion fault.
IWxy,0,7	Application fault (of sensors or wiring).
IWxy,0,8	Blocking fault, or module absent or incorrectly coded.
IWxy,0,A	Terminal block fault: terminal block not locked or absent.

Unlike the LEDs, or the bits below, these three bits remain at 1 when the fault disappears, so that transient faults are memorized. They are reset to 0 only when the fault bit string is read by the program.

		F	E	D	C	B	A	9	8	7	6	5	4	3	2	1	0
Complementary status word	IWxy,1																

Fault bit	Fault
IWxy,1,8(*)	Channel 0 application fault.
IWxy,1,9(*)	Channel 1 application fault.
IWxy,1,A(*)	Channel 2 application fault.
IWxy,1,B(*)	Channel 3 application fault.
IWxy,1,C(*)	Channel 4 application fault.
IWxy,1,D(*)	Channel 5 application fault.
IWxy,1,E(*)	Channel 6 application fault.
IWxy,1,F(*)	Channel 7 application fault.

(*) These bits do not store the faults.

Fault bit string:

The fault bit string gives detailed information on module faults. The data is internal to the module and can be accessed only by using a CPL type Text Block.

The fault bit string comprises 64 bits, equivalent to four 16 bit words.

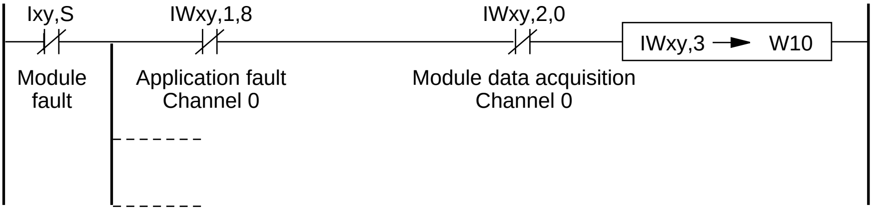
Fault Bit Nbr.	Fault	
0 to 15	Reserved	
16	Terminal block	
17	Analog to digital converter	
18	Relay fault	
32,36,40,44,48,52,56,60	Lower limit exceeded	Channel 0,1,2,3,4,5,6,7
33,37,41,45,49,53,57,61	Continuity fault	Channel 0,1,2,3,4,5,6,7
34,38,42,46,50,54,58,62	Calculation err. (overflow)	Channel 0,1,2,3,4,5,6,7
35,39,43,47,51,55,59,63	Higher limit exceeded	Channel 0,1,2,3,4,5,6,7

Programming

The fault detection bits described above provide the user with a wide range of programming options.
The fault bits can be used simply to validate or invalidate the measurements; on the other hand, they can be used for detailed fault location and processing, as required.

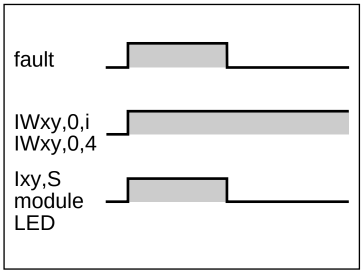
Examples of use:

The measurement is not acquired unless the channel (sensor, wiring) is operating correctly.
In this case or when the type of fault does not need to be precisely defined or located, it is not necessary to read the fault bit string.



Programming without reading the fault bit string

Although the fault is no longer present, bits IWxy,0,4 and IWxy,0,i (i = 6 or 7) remain at 1. The fault is stored until the module is reinitialized. However the fault LEDs and fault bit Ixy,S are reset as soon as the fault disappears.



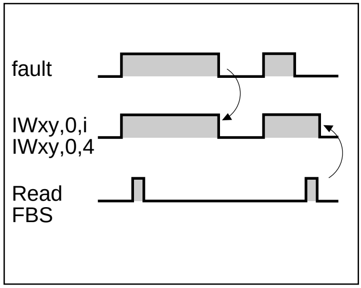
In this case, the bits IWxy,0,4 and IWxy,0,i (i = 6 or 7) can be used to indicate a fault, but cannot thereafter be used to check the operation of the module since they remain at 1 after the fault has disappeared.

Programming with reading of the fault bit string

Reading the fault bit string is optional, its main purpose being to locate and define the type of fault that has occurred. It is read by programming a CPL type Text Block.

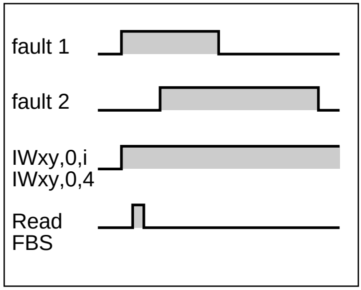
The significance of the bit string is described on previous pages.

Reading the fault bit string has the effect of acknowledging a fault detected by bit IWxy,0,4 or IWxy,0,i (i = 6 or 7) after the fault has disappeared, whether the reading was made before or after the disappearance of the fault.



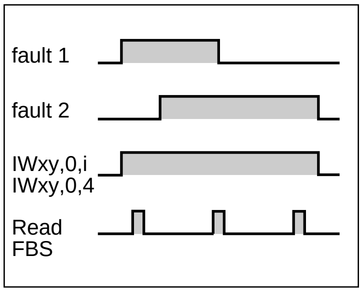
IWxy,0, bits 4,6 and 7 go to zero:
- when the fault ends if the fault bits were reset by being read,
- on reading fault bits after the fault has disappeared.

The message read after detection of fault nbr. 1 will not contain fault nbr. 2.



Fault nbr. 2 will only be acknowledged after a new reading of the fault bit string, but the user will not be informed of the second fault since IWxy,0,4 and IWxy,0,i (i = 6 or 7) are at 1 until fault nbr. 1 disappears.

It is therefore necessary to read the fault bit string continuously to detect the appearance or disappearance of new faults.



The use made of the fault bit string received through the Text Block depends on the user's requirements. The bits can be simply stored in internal words so that they can be read by the terminal in the Adjust or Data modes. Alternatively, they can be stored in word tables so that the evolution of the faults can be displayed.

Reading the fault bit string

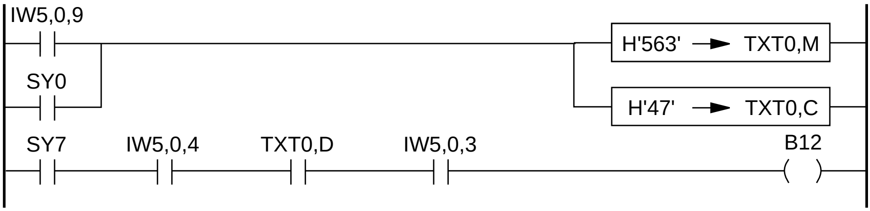
The fault bit string is read by using a CPL type Text Block.
The Text Block has to be programmed for transmission and reception with the specific characteristics listed below:
- Reception length: 8 bytes, to receive the 64 bits of the bit string.
- Request code: TXTi,C = H'47',

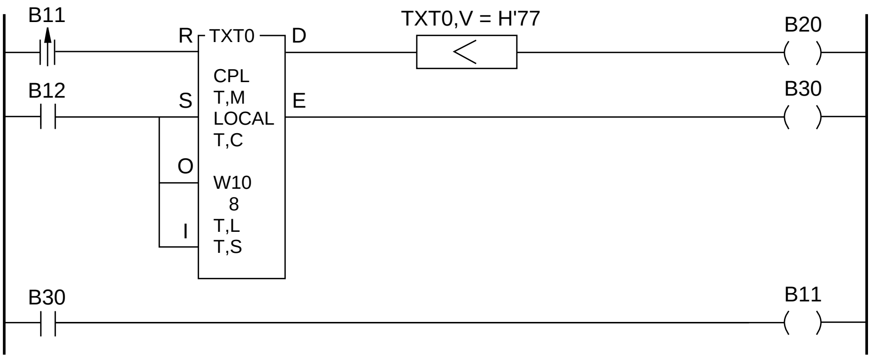
The transfer report sent by the module is TXTi,V = H'77' when the exchange is correct.

Example:

In the program below, the fault bit string is read whenever a fault is detected.

The Text Block characteristics are entered in the Configuration mode:
• Local, CPL type,
• Addr Buffer: W10 is the first word containing the first 16 bits of the string,
• Length: 8 bytes (64 bits).





The 1st contact network transfers the characteristics of Text Block TXT0 during the initial module self-test or after a cold restart.

In the 2nd network, bit B12 starts the reading of the fault bit string when the general fault bit IW5,0,4 is at 1.

This request is repeated every minute (SY7) as long as the fault is present.

The comparison blocks check that the exchange is correct.

If the exchange is not correct, bit B30 reinitializes the Text Block.

4.4-2 Additional Requests

In addition to transferring and reading the configuration, reading measurements, writing threshold values and acquiring the fault bit string, the module can also send other data or execute certain other requests through the CPL type Text Block programmed for transmission and reception with the PLC processor.

List of request codes

Request function	TXTi,C (Hex.)	TXTi,M (Hex.)	TXTi,V (Hex.)	Number of bytes written	Number of bytes read	Module status
Write configuration	40	xy63	FE/FD	4 to 68	0	Stop
Read configuration	41	xy63	71/FD	0	4 to 68	Run/Stop
Read threshold 0	3	xy00	83/FD	0	16	Run
Read threshold 1	5	xy00	85/FD	0	16	Run
Read fault bit string	47	xy63	77/FD	0	10	Run
Write application name	49	xy63	FE/FD	1 to 20	0	Run/Stop
Read application name	4A	xy63	7A/FD	0	1 to 20	Run/Stop
Read module version	F	xy63	3F/FD	0	27	Run/Stop

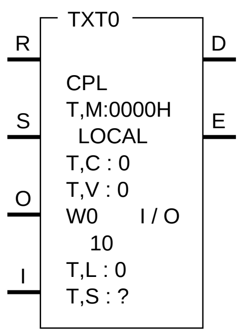
4.4-3 Reading the Configuration

Reading the configuration consists in transferring the configuration data from the module memory to the PLC memory. The configuration can be read in full or by zone. Zone 1 (sampling period) is systematically transferred. To read the configuration the user must program a Text Block for transmission and reception.

Text Block characteristics (TSX 67/87)

The Text Block must have the following characteristics:

- CPL type: Permitting exchanges between the user program and the module.
- Request code TXTi,C = H'41'
- Address and channel number TXTi,M = H'xy63'



Reading the complete configuration

- No transmission table need be defined (*),
- The transmission table length must be set as high as possible (68 bytes) to be able to receive the complete configuration.

Reading the configuration of a channel

- TXTi,L = 2, 1 transmission word (2 bytes) that defines the channel whose configuration needs to be known.
  Coding: H'00Ci' where 1 is the channel number.
- The reception table length should equal 6 words (12 bytes).

Reception table

Wi	0	0	A	0
Wi + 1			1	0
Wi + 2	0	0	C	0
Wi + 5				

Transmission table

Wi + 6	0	0	C	3

After command execution this table contains:

- H'00A0' (zone 1 identifier),
- Sampling period,
- H'00C1' Channel number,
- Channel operating mode,
- Higher limit (for type C scaling),
- Lower limit (for type C scaling).

Reception table

Wi	0	0	A	0
Wi + 1			1	0
Wi + 2	0	0	C	3
Wi + 3	0	0	A	0

(*) The contents of the first word after the reception table should be different from codes H'XXC0' to H'XXC7' (X = any value), if a transmission length is defined.
The transfer report word TXTi,V (or TXTi,R for the TSX 47-20) sent back by the module can be used to check that the data was transferred correctly. It equals H'FE' if the exchange was correct or H' FD' if the exchange was incorrect.

Reading the configuration with TSX 47-20

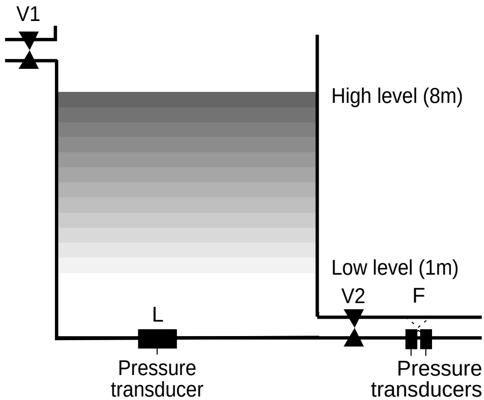
Reading the complete configuration with a TSX 47-20 PLC is not possible (30 byte exchange length limit). If a read request is made without specifying the contents of the transmission table, then only the sampling period is sent by the module.
However reading the configuration one channel at a time is possible (refer to previous page) using the TSX 47-20 PLC.

5.1 TSX 47-30/67/87 Application Example

Description

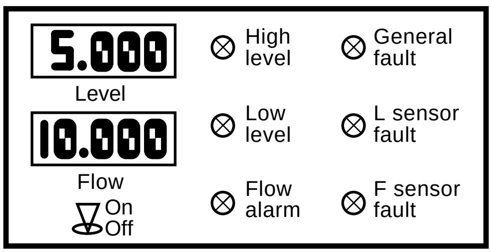
This example uses pressure transducers to measure the level of a liquid in four different tanks and to monitor the flow through the four outlet pipes.

Level detection and measurement
A pressure transducer at the bottom of the tank measures the height of liquid in the tank. This information is continuously displayed.
If the level falls below a predefined lower level, a green indicator light comes on and valve V1 is opened until the higher level is reached. If the level rises above a predefined maximum level, a red indicator light comes on and valve V2 is opened.



Flow monitoring
Another pressure transducer is used to measure the flow in the outlet pipe. The flow information is permanently displayed. If the flow exceeds a threshold value (15 litres/min) the flow alarm indicator comes on.

A control panel for each tank combines the various controls and indicators.



Preparation
A TSX 87 PLC with a TSX AEM 811 module is used for this application. Four channels of the TSX AEM 811 module are used for level measurement and the other four channels for flow measurement.

TSX AEM 811 module location:

- The module is located in slot 5 of the basic configuration. The measurement values are available in input words IW5,3 to IW5,6.

I/O module location:

- The application also uses a TSX DET 805 input module in slot 14 and two TSX DST 1635 output modules in slots 16 and 17 for dialog with the operator and to control the actuators.

Address	Function	Address	Function
O16,0(,1,2,3)	V1 control tank 0(,1,2,3)	O17,0(,1,2,3)	Flow alarm indicators
O16,4(,5,6,7)	V2 control tank 0(,1,2,3)	O17,4(,5,6,7)	L sensor fault ind.
O16,8(,9,A,B)	HL indicator tank 0(,1,2,3)	O17,8(,9,A,B)	F sensor fault ind.
O16,C(,D,E,F)	LL indicator tank 0(,1,2,3)	O17,F	Module fault
I14,0	Run/Stop		

TSX AEM 811 module configuration

In this application the 8 channels are used with User Range scaling and the maximum configuration of 34 words (68 bytes).
The channel assignment has channels 0 to 3 assigned to level measurement in the 4 tanks (0 to 3) and 4 to 7 assigned to flow measurement in the 4 output pipes.

Channel sampling

The sampling period for each channel is set to 3 seconds (30 x 100 milliseconds).

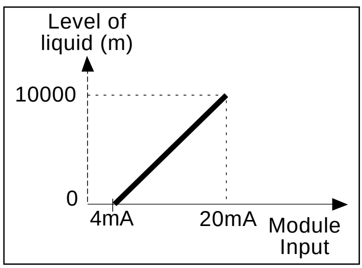
0	0	A	0
		3	0

Configuration of channels 0 to 3

0	0	C	●
8	0	C	0
			10000
			0

- The pressure transducers provide an output current of 4 to 20mA:
  Channels 0 to 3 must therefore be configured for 4 to 20 mA, i.e. range 8, and a 100 ohm resistor must be connected to each of the 8 input terminals,
- No processing (no square root extraction needed),
- Type of scaling:
  The type of scaling must be selected to provide a direct read-out of the level in millimeters from 0 to10000 mm.
  User range scaling must therefore be selected: type C.
- Selecting the limits:
  Correspondence between the pressure and the output current from the transducer:
  4 mA → 0 bar (0 mm),
  20 mA → 5 bar (10000 mm),

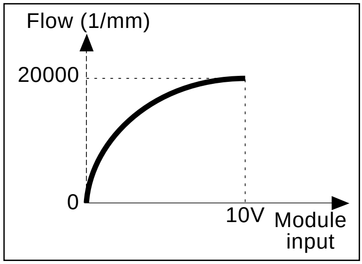
The correspondence between level and current is linear.
  Higher Limit: 10000 Lower Limit : 0
- There is no continuity test (current input).



Configuring channels 4 to 7:

0	0	C	●
2	1	C	0
			20000
			0

- The pressure transducers provide an output voltage of between 0 and 10 V. The module must therefore be configured for 0/10 V, i.e. range 2,
- Square root extraction is required, since the flow is proportional to the square root of the pressure,
- Type of scaling:
  The type of scaling must be selected to provide a direct read out in liters per minute. User range scaling must therefore be selected: type C,
- Selecting the limits:
  The correspondence between the flow and the transducer output voltage is:
  0 V → 0 l/min,
  10 V → 20 l/min,
  Higher limit: 20000 Lower limit : 0
- The continuity test is selected so as to monitor the operation of the pressure transducer.



Preparation phase

- Configuring the I/O of the application:

Rack 2								
Rack 1				56	56	56	52	52
Rack 0			24			648		54
MODULE	0	1	2	3	4	5	6	7

Enter the codes given below: code 648 is used for the TSX AEM 811 module.
- Text Block characteristics:
  Only one Text Block is used for all exchanges between the module and the PLC processor (indirect addressing is used).

```
Number: 0     LOCAL         TYPE: CPL     Addressing: indirect
ADDR BUFFER: W20
```

- Entering the configuration:
  The configuration should be entered in Constant mode in table CW0[34].

```
CWO :  H'00A0'       CW8  :  20 000       CW16 :  20 000
CW1 :       30       CW9  :       0       CW17 :       0
CW2 :  H'00C0'       CW10 : H'00C2'       CW18 : H'00C4'
CW3 :  H'80C0'       CW11 : H'80C0'       CW19 : H'80C0'
CW4 :   10 000       CW12 :  10 000       CW20 :  10 000
CW5 :        0       CW13 :       0       CW21 :       0
CW6 :  H'00C1'       CW14 : H'00C3'       CW22 : H'00C5'
CW7 :  H'21C0'       CW15 : H'21C0'       CW23 : H'21C0'
```

CW5 : 0	CW13 : 0	CW21 : 0
CW6 : H'00C1'	CW14 : H'00C3'	CW22 : H'00C5'
CW7 : H'21C0'	CW15 : H'21C0'	CW23 : H'21C0'
CW24 : 20 000	CW28 : 10 000	CW31 : H'21C0'
CW25 : 0	CW29 : 0	CW32 : 20 000
CW26 : H'00C6'	CW30 : H'00C7'	CW33 : 0
CW27 : H'80C0'		

- Entering the threshold values
  The values of the 16 thresholds must be entered in Constant mode in table CW100[16]. (High levels: 8000, Low levels: 1000, Maximum flow: 15000).

CW100 : 1 000	CW105 : 15 000	CW111 : 8 000
CW101 : 1 000	CW106 : 15 000	CW112 : 8 000
CW102 : 1 000	CW107 : 15 000	CW113 : 0
CW103 : 1 000	CW108 : 8 000	CW114 : 0
CW104 : 15 000	CW109 : 8 000	CW115 : 0

Assigning variables

- **Internal words:**
  - *Constants*
    CW0[34] configuration table
    CW100[16] thresholds
  - *Variables*
    W0[8] measurement value table channels 0 to 7
    W20[6] addressing table, Text Block TXT0
    W50[8] table comprising the fault bit string.

- **Internal bits**
  - B1 = configuration transfer in progress,
  - B2 = threshold 0 transfer command,
  - B3 = processing of enabled measurement values,
  - B5 = transfer of threshold 0 in progress,
  - B6 = threshold 1 transfer command,
  - B7 = transfer of threshold 1 in progress,
  - B8 = reading of fault bits in progress.

Programming

The program below is written in Literal language and can therefore be programmed in an auxiliary task. The task period should be less than 400 ms to ensure that all the measurements can be processed.

The program is divided into subroutines for ease of understanding:
- SR0, loading the configuration,
- SR1, writing the threshold value,
- SR2, processing the measurement value,
- SR3, fault processing.

The main program

```
<COLD  RESTART  PROCESSING

!      IF SY0. NOT IW5,2,D THEN SET B3

<INITIAL  SELF-TEST/INITIALIZATION
!L1   :IF IW5,0,3 THEN JUMP L2
                  ELSE 0->B1[8];0->OW5,0->OW5,1; RESET TXT0;JUMP L6

<TRANSFERT  THE  CONFIGURATION
!L2   :IF B1+IW5,2,D THEN CALL SR0

<WRITE  THE  THRESHOLD
!L3   :IF B2 THEN CALL SR1

<PROCESSING  THE  MEASUREMENTS
!L4   :IF B3.I14,0.NOT I5,S THEN CALL SR2

<PROCESSING  THE  FAULTS
!L5   :IF (I5,S+IW5,0,4+B4).B3 THEN CALL SR3

<END  OF  PROCESSING
!L6   :IF (NOT I14,0+I5,S).B3 THEN RESET OW5,0,C

!EOP
```

Initialization of the module should be programmed at the start of the task and comprise:

- processing of a cold restart (setting system bit SY0 to 1),
- processing of a hot restart or removal of the module from its slot (testing the self-test bit IW5,0,9 that goes to 1 when the power returns to the module).

Loading the configuration

This subroutine is run when the module is operating with the default configuration or when processing is in progress (B1 = 1).

Note: The program is not affected by an unsuccessful completion. If this occurs bit B1 will stay at 1.

```
<TRANSFER IN PROGRESS
!L1   :IF B1 THEN JUMP L4

<STOP MODULE
!L2   :RESET OW5,0,C

<TRANSFER
!L3   :IF  NOT  IW5,0,C  THEN  H'563'->TXT0,M;H'40'->TXT0,C;1->W20;0-
      >W21;
                         68->W22;0->W23->W24->W25;EXCHG TXT0; SET B1

<TEST THE TRANSFER
!L4   :IF TXT0,D.[TXT0,V=H'FE'].NOT IW5,0,B.NOT IW5,2,D THEN RESET B1;
                                                               SET B2

<RETURN TO MAIN PROGRAM
!L5   :RET

!EOP
```

SR1,writing the thresholds

This subroutine is run when a configuration has been sent to the module (B2 = 1). It successively transfers thresholds 0 and 1 for each channel.

```
<TRANSFER OF THRESHOLD 0 IN PROGRESS
!L1   :IF B5 THEN JUMP L5

<TRANSFER OF THRESHOLD 1 IN PROGRESS
!L2   :IF B7 THEN JUMP L7

<RUN THE MODULE
!L3   :SET OW5,0,C

<WRITE THRESHOLD 0
!L4   :IF  IW5,0,C  THEN  H'500'->TXT0,M;H'2'->TXT0,C;1->W20;100->W21;

            16->W22;0->W23->W24->W25;EXCHG  TXT0;  SET  B5

<TEST TRANSFER OF THRESHOLD 0
!L5   :IF  TXT0,D.[TXT0,V=H'FE'].B5  THEN  RESET  B5;SET  B6

<WRITE THRESHOLD 1
!L6   :IF  B6  THEN  H'500'->TXT0,M;H'4'->TXT0,C;1->W20;108->W21;16-
>W22;
               0->W23->W24->W25;EXCHG TXT0;SET B7; RESET B6

<TEST TRANSFER OF THRESHOLD 1
!L7   :IF  TXT0,D.[TXT0,V=H'FE'].B7  THEN  RESET  B7;RESET  B2;
                                           SET B3

<RETURN TO MAIN PROGRAM
!L8   :RET

!EOP
```

SR2, measurement processing

Measurement processing (B3 = 1) is enabled when the module is configured and when the threshold values are set. Processing comprises transferring the measurements into internal words W0 to W7 and transferring the threshold states to the corresponding outputs.

```
<ACTIVATE THE CHANNELS
!L1   :0->OW5,1

<TEST FOR MODULE IN RUN
!L3   :IF NOT IW5,0,C THEN JUMP L13

<LEVEL TANK 0
!L4   :IF IW5,2,0.NOT IW5,1,8 THEN IW5,3->W0

<FLOW TANK 0
!L5   :IF IW5,2,0.NOT IW5,1,C THEN IW5,3->W4

<LEVEL TANK 1
!L6   :IF NOT IW5,2,1.NOT IW5,1,9 THEN IW5,4->W1

<FLOW TANK 1
!L7   :IF IW5,2,1.NOT IW5,1,D THEN IW5,4->W5

<LEVEL TANK 2
!L8   :IF NOT IW5,2,2.NOT IW5,1,A THEN IW5,5->W2

<FLOW TANK 2
!L9   :IF IW5,2,2.NOT IW5,1,E THEN IW5,5->W6

<LEVEL TANK 3
!L10  :IF NOT IW5,2,3.NOT IW5,1,B THEN IW5,6->W3

<FLOW TANK 3
!L11  :IF IW5,2,3.NOT IW5,1,D THEN IW5,6->W7

<THRESHOLD DETECTION
!L12  :I5,0[4]->O16,0[4]->O16,C[4];I5,8[4]->O16,4[4]->O16,8[4];
       I5,4[4]->O17,0[4]

<RETURN TO MAIN PROGRAM
!L13  :RET

!EOP
```

SR3, fault processing

This function is enabled as soon as measurement processing is validated and a fault is encountered.

```
<READ IN PROCESS
!L1   :IF B8 THEN JUMP L3

<READ FAULT BITS
!L2   :IF NOT B1.NOT B5.NOT B7 THEN H'563'-> TXT0,M;H’47'-> TXT0,C;
0->W20->W21->W22->W23;50->W24;8->W25;EXCHG  TXT0;SET  B8

<TEST FOR READING COMPLETED
!L3   :IF TXT0,D. [TXT0,V=H'77'] THEN RESET B8

<INIDCATE MODULE FAULT
!L4   :I5,S->O17,F

<INDICATE SENSOR FAULT
!L5   :SHR 8(IW5,1)->O17,4[8]

<END OF PROCESSING
!L6   :I5,S+[IW5,1<>0]->B4

<RETURN TO MAIN PROGRAM
!L7   :RET

!EOP
```

5.2 TSX 47-20 Application Example

Description

This example, the same as the previous one, but uses a TSX 47-20 PLC. The program is written in Ladder diagram language.

Preparation

The TSX AEM 811 module is located in slot 1 of the basic configuration. The measurements are available in input words IW1,3 to IW1,6.
The application also uses a TSX DET 805 input module in slot 4 and two TSX DST 1635 output modules in slots 6 and 7 for dialog with the operator and control of the actuators.

The outputs used are listed below:

Address	Function	Address	Function
O 6,0(,1,2,3)	V1 control tank 0(,1,2,3)	O7,0(,1,2,3)	Flow alarm indicators
O 6,4(,5,6,7)	V2 control tank 0(,1,2,3)	O7,4(,5,6,7)	L sensor fault ind.
O 6,8(,9,A,B)	HL indicator tank 0(,1,2,3)	O7,8(,9,A,B)	F sensor fault ind.
O 6,C(,D,E,F)	LL indicator tank 0(,1,2,3)	O7,F	module fault I4,0 Run/Stop
I 4,0	On/Off switch		

Preparation phase

- Configuring the I/O:
  Enter the appropriate module codes for the corresponding slots. Code 62 is used for the TSX AEM 811 module.

- Text Block characteristics:
  Four CPL type Text Blocks are used for all exchanges between the module and the PLC processor.

All parameters are entered when the Text Blocks are programmed.

Nbr.	Function	TXTi,M	TXTi,C	TXTi,L	Address
TXT0	Configuration	H'0163'	H'0040'	20	W10
TXT1	Threshold 0	H'0100'	H'0002'	16	CW100
TXT2	Threshold 1	H'0100'	H'0004'	16	CW108
TXT3	Fault bit	H'0163'	H'0047'	1	W50[8]

• Entering the configuration:
The configuration should be entered in table CW0[34] (refer to the previous example for the contents of the table).

• Entering the threshold values:
The values of the 16 thresholds must be entered in table CW100[16].
- High levels: 8000, Low levels: 1000, Maximum flow: 15000 (the values are the same as those used in the TSX 47-30/67/87 example).

Assigning the variables

• internal words

Constants

CW0[34]	configuration table
CW100[16]	thresholds

Variables

W0[8]	measurement value table channels 0 to 7
W20[12]	addressing table, Text Block TXT0
W40	"configuration transfer" counter
W50[8]	table containing the fault bit string

• Internal bits

- B1 = configuration transfer in progress,
- B2 = threshold 0 transfer command,
- B3 = processing of validated measurements,
- B4 = Stop state of bit IW1,0,3,
- B10 = W40 incrementation bit,
- B11 = configuration transfer command,
- B12 = threshold 1 transfer command,
- B13 = measurement processing command.

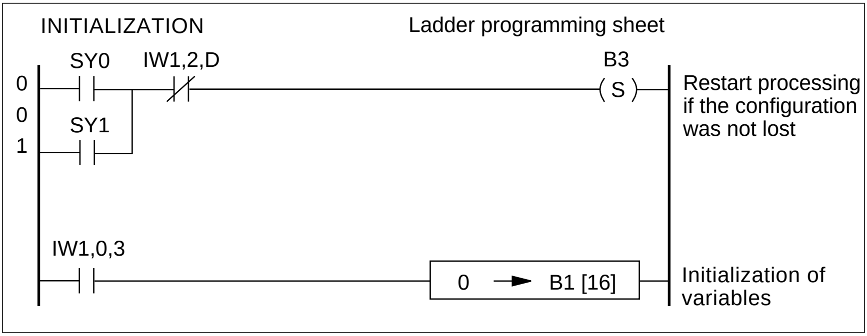
Programming

The program is divided into four parts:
• Loading the configuration,
• Writing the thresholds,
• Processing the measurements,
• Processing faults.

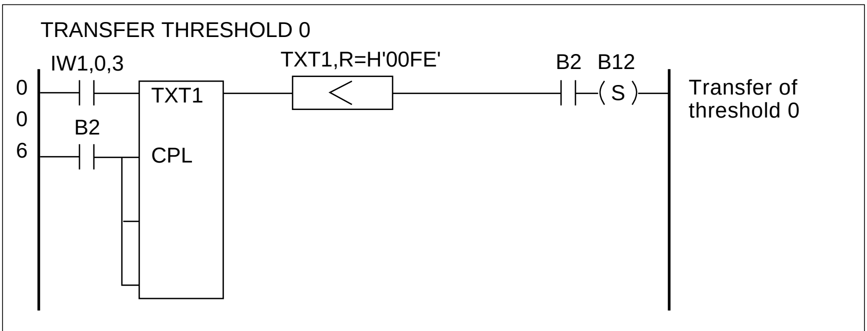
Initialization Processing

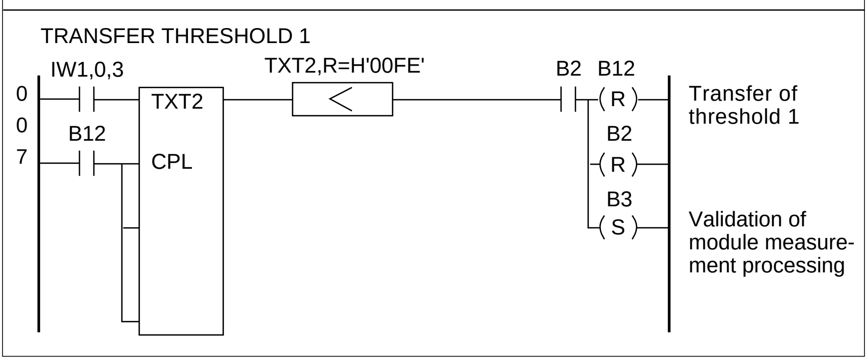
Initialization of the module should be programmed at the start of the task and the task and comprises processing of:

• A cold restart caused by loading the PLC program for the first time or,
• The user setting system bit SY0 to 1. Once the PLC program has been loaded, the procedure for processing cold restarts (caused by a break in the mains power supply to the PLC) or hot restarts or removal of the module from its slot need only test the module ready bit when self-tests are complete.



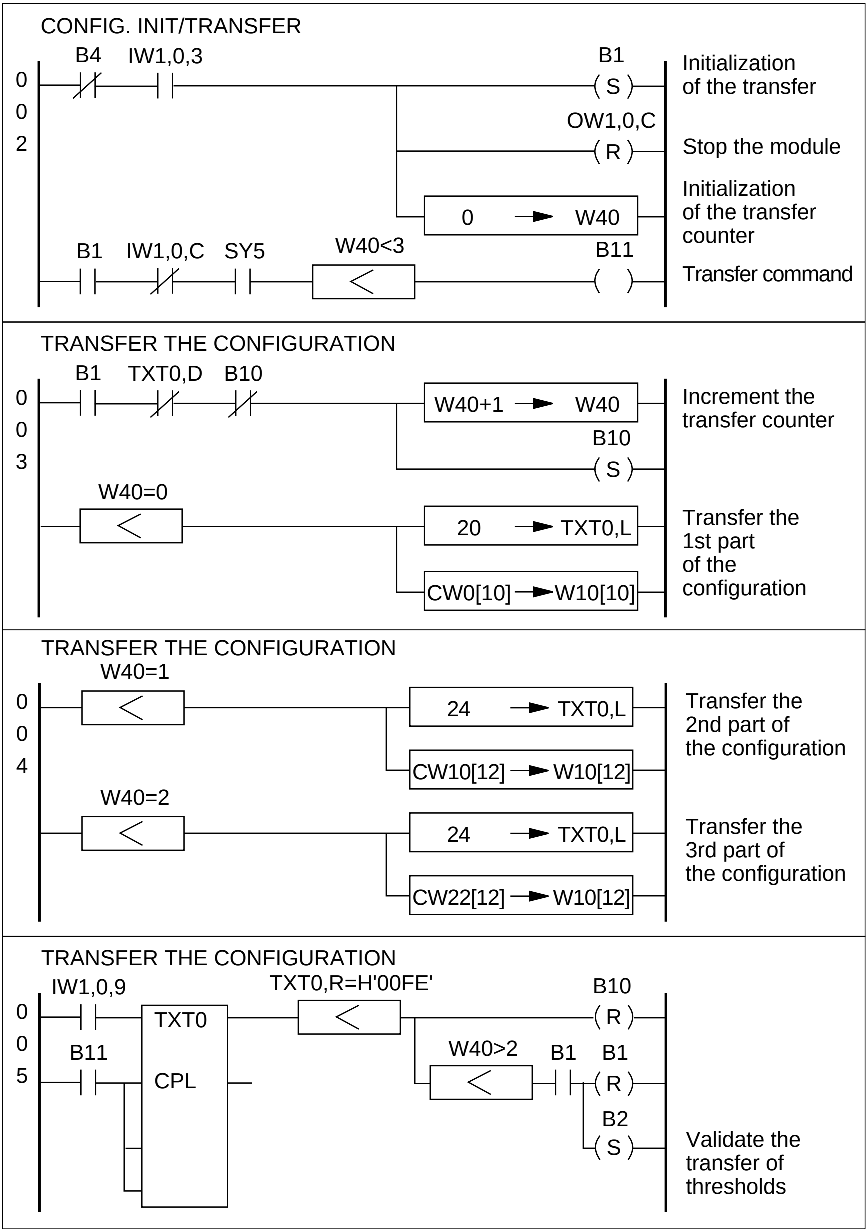
Writing the thresholds



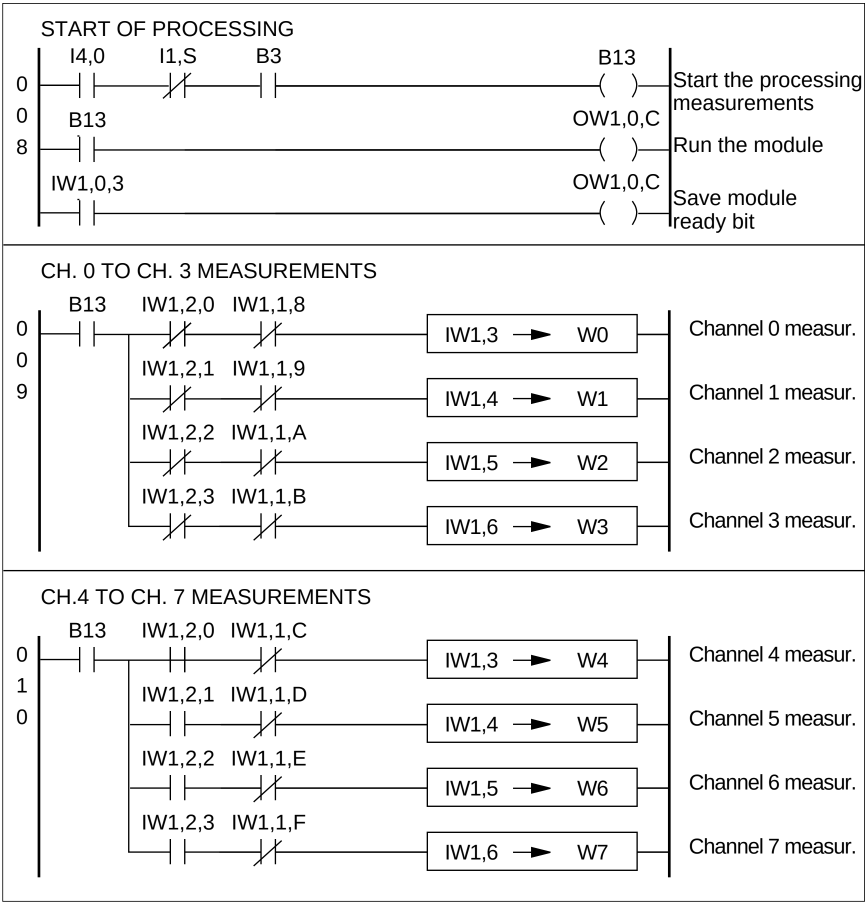


Transferring the configuration

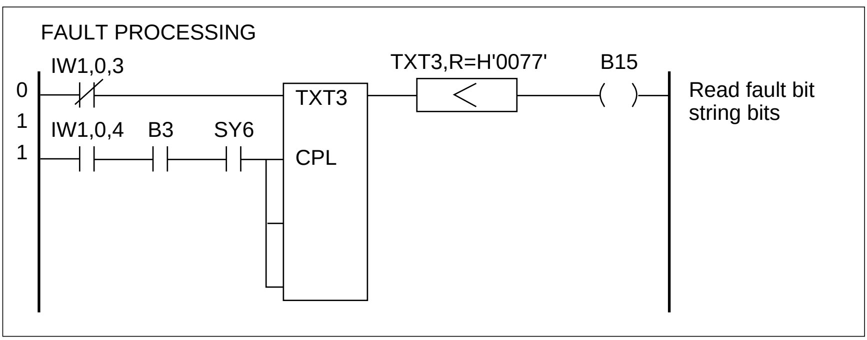
In this example the maximum configuration length (68 bytes) is used. Transfer of the complete configuration therefore requires three exchanges.



Processing the measurements



Processing faults



6.1 Locating the Module

6.1-1 Possible Module Locations

The TSX AEM 811 modules can be installed as shown in the table below.

Basic configuration	TSX 47 20..	
Basic configuration (single rack)	TSX 47 300 TSX 67 200	Any slot, 5 intelligent modules max.
Basic configuration (double rack)	TSX 67 300 TSX 87 120 TSX 87 200 TSX 87 300	Slots 0 to 7 of the lower rack.
Local extension racks (single)	TSX RCE 860	Any slot.
Remote extension racks (single)	TSX RCF 860	Any slot (*).
Local extension racks (double)	TSX RDE 880	Slots 0 to 7 of the lower rack.

Restrictions: (*) The TSX 67-300 and TSX 87-120/200 cannot accept intelligent modules in remote extension racks.

6.1-2 General Rules

For best performance, the module should be located away from all sources of radiated electrical interferrence. It is therefore preferable to locate them away from high voltage contactors, power supply modules, and all module that receive or supply high voltages.

Warning:

The TSX AEM 811 module should never be installed in the upper half of a double rack (wiring impossible and risk of damage).

6.1-3 Configuration Code

The TSX AEM 811 has two types of configuration codes:

	TSX47-20	TSX 47-30/67/87
Hardware configuration code A three figure decimal code which is coded on the locating devices on the back of the module, only figures are used in TSX 47-20 PLCs.	64	648
Software configuration code A two or three figure decimal code which is entered on the terminal during the configuration of inputs and outputs.	62	648

6.2 Module Identification

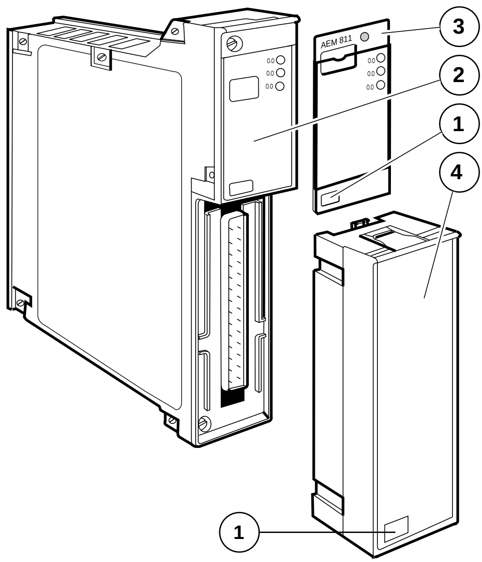
6.2-1 Description

① **On each module there is:**
a location for slot-in characters that can be used to identify the module and the terminal block.

② **A module label that shows:**
- the module type,
- the channel fault lights,
- the type of input conditioner

③ **A double sided user's label that:**
allows the user to indicate:
- on the front: the type of module: e.g. HVL for High Voltage Level.
- on the back: the default configuration, and the list of internal words containing the measurement results.

④ **A wiring label:**
A self-adhesive wiring label is supplied with the module. It is designed to be affixed inside the cover of the TSX BLK 4 terminal block (supplied separately).



6.3 Connecting the Module

6.3-1 Description

The TSX AEM 811 module uses the TSX BLK 4 terminal block, which must be ordered separately. This removable terminal block has 32 screw terminals which are connected according to the selected configuration and the user's requirements.

Connecting the TSX AEM 811 module

Signals	Terminal block label						Signals
Analog input Channel 0	Ch 0	+	A8	C1	+	Ch 4	Analog input Channel 4
		-	A7	C2	-		
		⏚	A6	C3	⏚		
Analog input Channel 1	Ch 1	+	A5	C4	+	Ch 5	Analog input Channel 5
		-	A4	C5	-		
		⏚	A3	C6	⏚		
Analog input Channel 2	Ch 2	+	A2	C7	+	Ch 6	Analog input Channel 6
		-	A1	C8	-		
		⏚	B8	D1	⏚		
Analog input Channel 3	Ch 3	+	B7	D2	+	Ch 7	Analog input Channel 7
		-	B6	D3	-		
		⏚	B5	D4	⏚		
		▽	B4	D5	▽		
		▽	B3	D6	▽		
		▽	B2	D7	▽		
		▽	B1	D8	▽		

Terminals shown with a ▽ should not be used

6.3-2 Connection Requirements

To protect the signal from induced outside noise in serial mode and from noise in common mode, the following precautions should be observed concerning:

Selecting the type of wire:

Use shielded twisted pairs with a wire section of at least 0.22 mm^2 (AWG 23).

Shielding the cables:

Connect the cable shields to the PLC ground through grounding strip TSX RAC 20, which must be fitted to the PLC rack.

Referencing the sensors to ground:

The use of floating sensors (with no reference to ground) is recommended.

Grouping the wires into cables:

Grouping a number of twisted pairs in the same cable is possible with signals of the same type that have the same reference to ground.

Routing the cables:

- Keep the measurement wires away from discrete I/O wiring (especially relay output wires) and "power" lines,
- Avoid parallel routing (ensure a space of at least 20 cm between cables) and make the crossings at right angles.

6.3-3 Referencing Sensors to Ground

The TSX AEM 811 module has eight inputs that are isolated from the PLC bus and from each other.

This double isolation permits the use of sensors with different voltage levels.

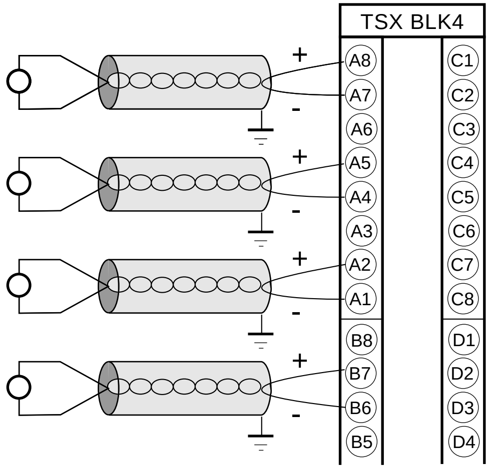
For safety reasons a grounding network (10 M ohms, 10 nf) is provided for each channel. The presence of this grounding network implies that a leakage current is generated when the sensor is referenced to ground.

Use of "Floating" sensors

(Not referenced to ground)

An internal network for each channel provides the grounding for the cold junctions of the sensors.

Example opposite: the wiring of four "floating" sensors.

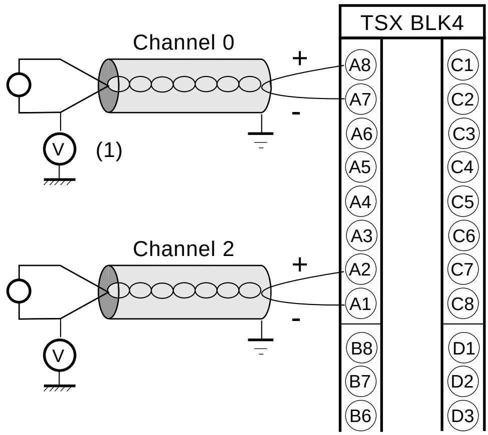


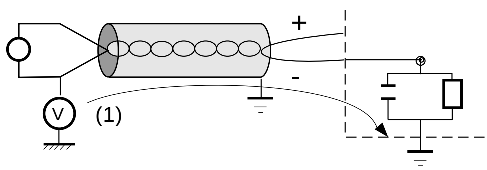
Use of sensors referenced to ground

It is possible to reference each of the sensors to ground if the following characteristics are observed:

- The common mode voltages must be less than the safety voltage (48 V max.).
- Connecting one sensor point to a reference voltage generates a leakage current. If a number of analog modules are used, the total leakage current must be measured to ensure that it does not disturb the application.

The RC ground network has a value of 10 Mohms, 10 nf. With a reference voltage of 48 V in relation to ground, there is a leakage current of 4.8 µA. to ground.





(1) Voltage induced by the sensor referenced to ground

6.3-4 Specific Connections

When the input signal is a 0/20 mA or 4/20 mA current, a 100 ohm resistor with an accuracy of 0.1% should be connected to the input terminals (these resistors are supplied in sets of four in the TSX AAK 1 kit).

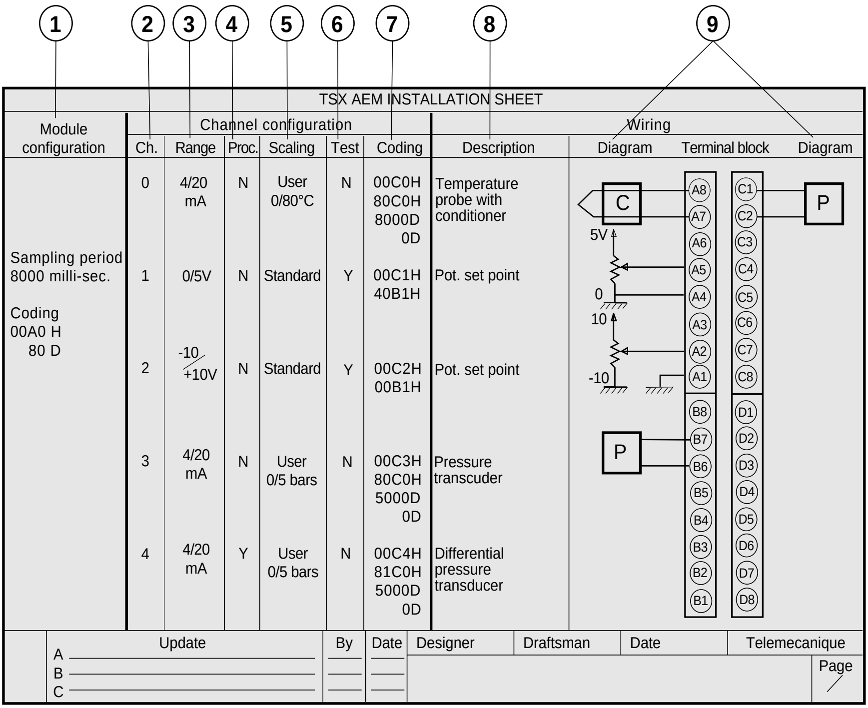
6.4 Using the TSX AEM Installation Sheet

This sheet is used to group all the information necessary for the operation of the TSX AEM 811 module.

The sheet is divided into three parts:
- Configuration of the module,
- Configuration of the channels,
- Wiring.

A full-size example of the Installation Sheet is shown at the end of Section 8 (and may be reproduced by the user).

Example:



1. Module configuration
2. Channel number
3. Input range
4. Measurement processing (square root extraction, linearization)
5. Type of scaling
6. Optional continuity test
7. Coding of the configuration
8. Description and/or reference numbers of the input devices used
9. Wiring diagrams

7.1 Module Self-Tests

The TSX AEM 811 module carries out self-tests on initialization and during operation. These self-tests enable module operating faults to be detected.

7.1-1 Initial Self-Test

This self-test is run systematically:

- On Power-up,
- On power return if the duration of the power break was greater than the power reserve of the PLC.

The initial self-test checks the electronic circuits of the module. If a fault is detected, the corresponding bit in the fault bit string is set to 1. This self-test includes:

- Tests of the processing and dialog circuits: If a fault is detected, the module is no longer operational, the F LED comes on and IWxy,0,8 = 1.
- The following tests of the acquisition and conversion circuits:

Type of test	Bit number in the fault bit string
Terminal block test	16
Analog-Digital converter test	17
Relay test	18

The detection of one of these faults stops the module: the OK LED goes out.
The initial self-test lasts 10 seconds, during which time the ERR and OK LEDs are on. During the initial self-test, the measurements are not valid and bit IWxy,0,9 of the status register word is set to 1.
At the end of the self-tests, the bit IWxy,0,3 is set to 1 to indicate that the module is ready for operation.

7.1-2 Continuous Self-test

Unlike the initial self-test, this self-test is run continuously whether the module is running or stopped. It includes the following tests:

Type of test	Bit number in the fault bit string
Terminal block test	16
Analog-digital converter test	17

7.2 Testing the Module

Purpose of the tests

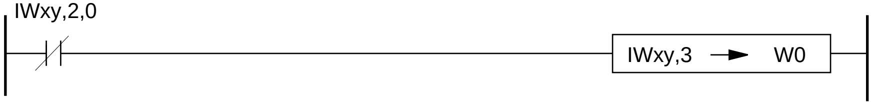
These tests check the validity of the measurements delivered by the TSX AEM 811 module. If the module does not deliver measurements with sufficient accuracy, it should be recalibrated. A module calibration check every 6 months is recommended.
Testing requires a voltage generator supplying 10 V with an accuracy of 0.01%.

Test conditions

The following conditions must be present to obtain correct measurements:

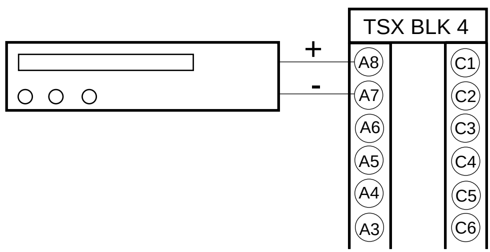
- Equipment powered-up for at least 2 minutes (module and PLC),
- PLC running,
- Module running (OWxy,0,C = 1),
- Channels running (0 → OWxy,1),
- Module operating with the default configuration.

The test can be made on a single channel. In this description channel 0 has been selected.
Enter the program shown below. The measurement for channel 0 is stored in internal word W0.



Testing the gain

- Connect the voltage generator to the terminals of channel 0: A8(+) - A7(-),
- Select a voltage level of 10000 V on the voltage generator,
- Read the measurement in internal word W0. Check that the measurement value is within the following limits:
  W0 = 10000 ± 20.



7.3 Recalibrating the Module

General

The module needs to be recalibrated when the measurement error is more than twice the limit values given in Sub-section 8.2, or when a module test shows that the measurements are outside the tolerance limits.

Test equipment

The recalibration test requires:
- A voltage generator supplying 10 Volts with an accuracy of 0.01%,
- A TSX MNC 41 extension board,
- A screwdriver.

Recalibration conditions

The following conditions must be present to obtain correct measurements:
- The module is fitted to an extension board located in the PLC rack,
- The module side cover is open,
- The equipment (module and PLC) has been powered-up for over two minutes,
- The PLC is running,
- The module is running (OWxy,0,C = 1),
- The channels are running,
- The module is operating with the default configuration.

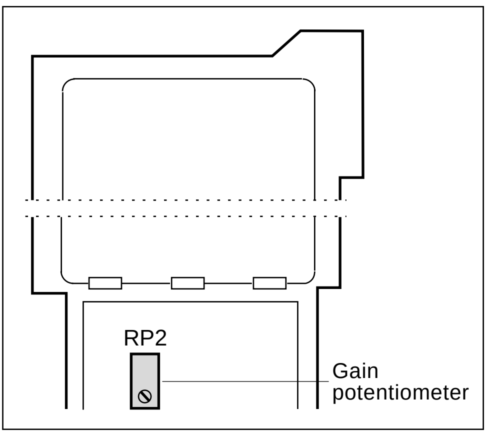
The program described on the previous page must be entered in the Program mode.

Recalibration is done on a single channel (Channel 0) as the converter used is common to all 8 channels.

A terminal connected to the PLC is used to read the measurements stored in internal word W0.

Recalibrating the gain

- Connect the voltage generator to channel 0 of the module: A8(+), A7(-),
- Select a voltage value of 10.000 V on the voltage generator,
- Remove the locking varnish from the potentiometer adjustment screw RP2,
- Read the measurement in internal word W0 and turn the gain potentiometer until the measurement is equal to 10000.
- Apply locking varnish to the potentiometer adjustment screw.



8.1 Power Consumption

The power supply to the modules is provided by the PLC power supply.

Supply	Max. power consumption
+ 5 VL	400 mA
+ 12 VL	16 mA
- 12 VL	0 mA
+ 12 VP	130 mA

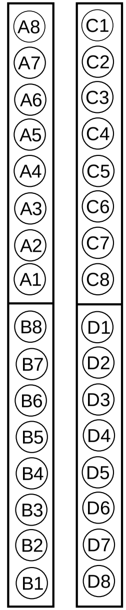
8.2 Input Characteristics

The TSX AEM 811 module has 8 analog inputs with the following characteristics:

Input range		± 11 V
Max. permissible input voltage		± 30 V
DC Input impedance		> 10 M ohms
Max. resolution (*)		11000/32768 = 0.33 mV
Gain error at 25 °C		0.1 %
Gain drift at 25 °C		45 ppm/°C
Offset error (0-60 °C)		± 60 µV
Bandwidth		4 Hz ± 1 Hz (6db/octave)
Delay on input edge		< 150 ms
50 Hz input rejection		22 dB typical
Common mode rejection (50 Hz)		100 dB
Measurement noise		< 1 mV
Min. sampling rate for a channel		100 ms
Input relay life		3 . 10^8 operations
RC ground network	.R	10 M ohms
	.C	10 nf
Isolation	. between channels	500 V DC
	. between channels and bus	500 V 50 Hz

(*) The resolution depends on the limits selected. The resolution of 0.3 mV corresponds to limits of - 32768 and + 32767.

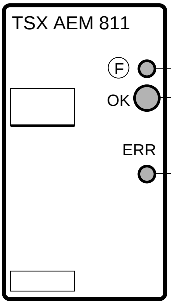
TSX AEM INSTALLATION SHEET

Module configuration	Channel configuration						Wiring			
	Channel	Range	Proces	Scaling	Test	Coding	Description	Diagram	Terminal block TSX BLK 4	Diagram
										

Update	By	Date	Designer	Draftsman	Date	Telemecanique
A						Page
B						
C						

9.1 Index

Indicator LEDs



- Red "F" LED: module failure
- Green "OK" LED: module powered-up and operating correctly
- Red "ERR" LED: channel error indicator, indicates an application error on one channel (signal out of range, sensor failure, calculation overflow).

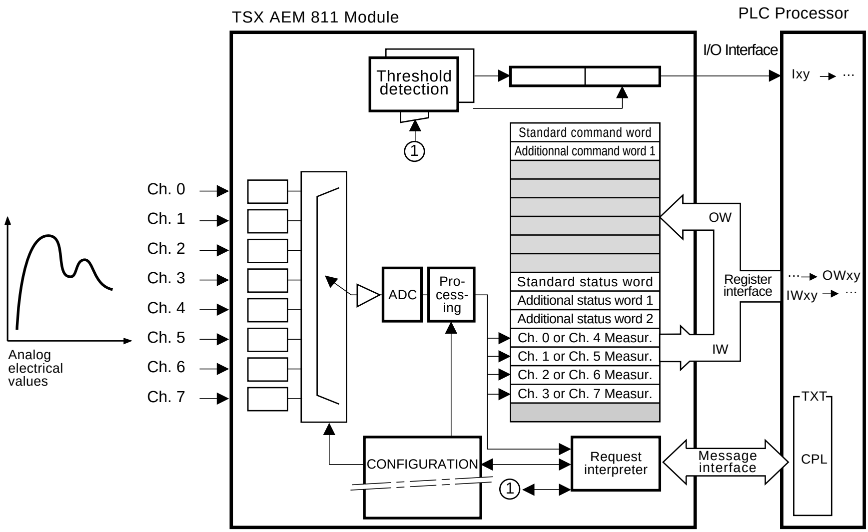
General Characteristics

- Location: Any rack equipped with a full I/O bus (TSX 47-30/67/87 and extension racks) or the first 4 slots of a TSX 47-20 PLC (software version 3.1 or higher).
- Hardware configuration code: 648 on TSX 47-30/67/87 or 64 on TSX 47-20.
- Software configuration code: 648 on TSX 47-30/67/87 or 62 on TSX 47-20.
- Effect of a power break/return (longer than the autonomy of the power supply):
  - configuration and threshold values are lost,
  - restart with the default configuration and threshold values at 0.

Connecting the Module

Signals	Terminal block label					Signals
Analog input Channel 0	Ch 0 +	A8	C1	+ Ch 4		Analog input Channel 4
	Ch 0 -	A7	C2	- Ch 4		
	⏚	A6	C3	⏚		
Analog input Channel 1	Ch 1 +	A5	C4	+ Ch 5		Analog input Channel 5
	Ch 1 -	A4	C5	- Ch 5		
	⏚	A3	C6	⏚		
Analog input Channel 2	Ch 2 +	A2	C7	+ Ch 6		Analog input Channel 6
	Ch 2 -	A1	C8	- Ch 6		
	⏚	B8	D1	⏚		
Analog input Channel 3	Ch 3 +	B7	D2	+ Ch 7		Analog input Channel 7
	Ch 3 -	B6	D3	- Ch 7		
	⏚	B5	D4	⏚		
	▽	B4	D5	▽		
	▽	B3	D6	▽		
	▽	B2	D7	▽		
	▽	B1	D8	▽		

Exchange Diagram



Standard Requests

Request function	TXTi,C (Hex.)	Ch. nbr. (Hex.)	TXTi,V (Hex.)	Nbr. bytes written	Nbr. bytes read	Module status
Write configuration	40	63	FE(FD)	4 to 68	0	Stop
Read configuration	41	63	71(FD)	0 or 2	4 to 48	Stop / Run
Read configuration	1	00	81(FD)	0	16	Stop / Run
Write thresholds (level 0)	2	00	FE(FD)	16	0	Stop / (Run)
Write thresholds (level 1)	4	00	FE(FD)	16	0	Stop / (Run)
Read thresholds (level 0)	3	00	83(FD)	0	16	Stop / Run
Read thresholds (level 1)	5	00	85(FD)	0	16	Stop / Run
Read fault bit string	47	63	77	0	10	Stop / Run
Write application name	49	63	FE(FD)	20	0	Stop/ Run
Read application name	4A	63	7A(FD)	0	20	Stop / Run
Read application name	0F	63	3F(FD)	0	27	Stop / Run

Transfer Characteristics

- CPL type Text BLock in reception and transmission modes.
- TXTi,M = H'xy..' where x = rack nbr., y = slot nbr., .. = Ch. nbr. 00 or 63.
- TXTi,C = request code
- TXTi,V (R) = report sent by the module, FD = incorrect transfer.
- TXTi,S = number of bytes received during the transfer (if transfer OK).

Addressing

I/O Bits

I x y , i

- Input: read by the PLC → I
- x → Rack nbr.
- y → Slot nbr.
- i → Bit nbr.

Register words

IW or OW x y, i

- Input: read by PLC → IW
- Output: written by PLC → OW
- x → Rack nbr.
- y → Slot nbr.
- i → Word nbr.

Threshold detection bits

	F	E	D	C	B	A	9	8	7	6	5	4	3	2	1	0
Ixy,																

Ixy,8	Threshold 1 Ch. 0 detect.	Ixy,0	Threshold 0 Ch. 0 detect.	
Ixy,9	Threshold 1 Ch. 1 detect.	Ixy,1	Threshold 0 Ch. 1 detect.	
Ixy,A	Threshold 1 Ch. 2 detect.	Ixy,2	Threshold 0 Ch. 2 detect.	
Ixy,B	Threshold 1 Ch. 3 detect.	Ixy,3	Threshold 0 Ch. 3 detect.	
Ixy,C	Threshold 1 Ch. 4 detect.	Ixy,4	Threshold 0 Ch. 4 detect.	
Ixy,D	Threshold 1 Ch. 5 detect.	Ixy,5	Threshold 0 Ch. 5 detect.	
Ixy,E	Threshold 1 Ch. 6 detect.	Ixy,6	Threshold 0 Ch. 6 detect.	
Ixy,F	Threshold 1 Ch. 7 detect.	Ixy,7	Threshold 0 Ch. 7 detect.	

Bit at 0	Bit at 1
Meas. < Thres.	Meas. ≥ Thres.

8 Input register words
(read by the PLC)

8 Output register words
(written by the PLC)

	Input register words (bits F … 0)		Output register words (bits F … 0)
IWxy,0	Standard status word	OWxy,0	Standard command word
IWxy,1	Additional status word 1	OWxy,1	Additional command
IWxy,2	Additional status word 2	OWxy,2	
IWxy,3	Ch. 0/4 measurement	OWxy,3	
IWxy,4	Ch. 1/5 measurement	OWxy,4	
IWxy,5	Ch. 2/6 measurement	OWxy,5	
IWxy,6	Ch. 3/7 measurement	OWxy,6	
IWxy,7		OWxy,7	

Input Register Words: Sent by the module, read by the PLC

IWxy,0,

Bit	
2	1 = Ongoing exchange cancelled and OWxy 0,2 = 1
3	1 = Module available (self-test complete).
4	1 = General fault or storage of general fault.
6	1 = Acquisition or conversion fault or storage of this fault
7	1 = Application fault or storage of this fault
8	1 = Blocking fault (module failure)
9	1 = Initial self-test in progress
A	1 = Terminal block open or not fitted
B	1 = Waiting for a configuration
C	1 = Module/Run/Stop state (0 = Stop)
D	Reserved

IWxy,1,

Bit	
0	1 = Inhibit Channel 0
1	1 = Inhibit Channel 1
2	1 = Inhibit Channel 2
3	1 = Inhibit Channel 3
4	1 = Inhibit Channel 4
5	1 = Inhibit Channel 5
6	1 = Inhibit Channel 6
7	1 = Inhibit Channel 7
8	1 = Channel 0 Fault
9	1 = Channel 1 Fault
A	1 = Channel 2 Fault
B	1 = Channel 3 Fault
C	1 = Channel 4 Fault
D	1 = Channel 5 Fault
E	1 = Channel 6 Fault
F	1 = Channel 7 Fault

IWxy,2,

Bit			
0	0 = Value Channel 0	1 = Value Channel 4	in IWxy,3
1	0 = Value Channel 1	1 = Value Channel 5	in IWxy,4
2	0 = Value Channel 2	1 = Value Channel 6	in IWxy,5
3	0 = Value Channel 3	1 = Value Channel 7	in IWxy,6
D	1 = Default configuration		

Output Register Words: Sent by the PLC, read by the module

Output Register Words: Sent by the PLC, read by the module OWxy,0

	F	E	D	C	B	A	9	8	7	6	5	4	3	2	1	0
OWxy,0,																

2	Cancel ongoing message exchange (Text Block)
C	Module Run / Stop command (1 = Run) (0 = Stop),

OWxy,1 additional command word

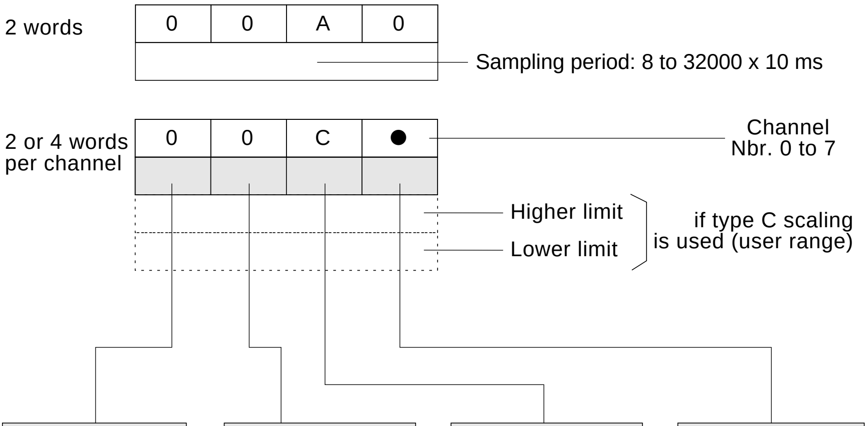
	F	E	D	C	B	A	9	8	7	6	5	4	3	2	1	0
OWxy,0,																

0	1 = Channel 0 inhibited
1	1 = Channel 1 inhibited
2	1 = Channel 2 inhibited
3	1 = Channel 3 inhibited
4	1 = Channel 4 inhibited
5	1 = Channel 5 inhibited
6	1 = Channel 6 inhibited
7	1 = Channel 7 inhibited
8	1 = Change to accelerated mode command

Fault bit string

Bit number	Type of fault	
0 to 15	Reserved	
16 17 18	Terminal block Analog/digital converter Input relays	
32,36,40,44,48,52,56,60 33,37,41,45,49,53,57,61 34,38,42,46,50,54,58,62 35,39,43,47,51,55,59,63	ELL lower limit exceeded Continuity fault Calculation fault EHL higher limit exceeded	Ch. 0,1,2,3,4,5,6,7 Ch. 0,1,2,3,4,5,6,7 Ch. 0,1,2,3,4,5,6,7 Ch. 0,1,2,3,4,5,6,7

Configuration table = 2 to 34 words



Input range	
0	-10 /+10 V
1	- 5 / +5 V
2	0 / 10 V
3	2 / 10 V
4	0 / 5 V
5	0 / 2 V
6	0.4 / 2 V
7	0 / 20mA
8	4 / 20mA

Processing
0 no square root
1 square root

Scaling	
A	Input range
B	Standard range
C	User range

Continuity test
0 no test
1 test

Default Configuration

Sampling period = 10 x 100 ms
Channel configurations are shown by the shading in the figure above (H'00A0').

Transfer Characteristics

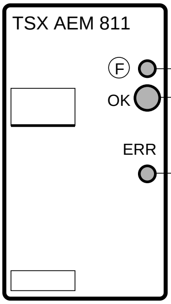
- CPL type Text Block programmed for transmission/reception,
- TXTi,M = H'xy63' where x = Rack nbr., y = Slot nbr.,
- TXTi,C = H'40',
- Transmission table length: 4 to 68 bytes,
- Report sent by the module TXTi,V = H'FE' if transfer correct,
  H'FD' if transfer incorrect,
- Once the module is configured the "Default Configuration" bit IWxy,2,D should go to 0,
- If a configuration error occurs the "Awaiting configuration" bit IWxy,0,B stays at1.

Instructions for Use

- Each part of the configuration (shown by the identifier) must be transferred complete,
- Compatibility rules:
  - the continuity test can only be used with sampling periods of more than 2.4 seconds,
  - the continuity test is incompatible with current inputs,
  - square root conversion is incompatible with input range scaling,
  - user defined limits can only be used with type C scaling and the selected limits must be different from each other.

Notes

Indicator LEDs



Red "F" LED: module failure
Green "OK" LED: module powered-up and operating correctly
Red "ERR" LED: channel error indicator, indicates an application error on one channel (signal out of range, sensor failure, calculation overflow).

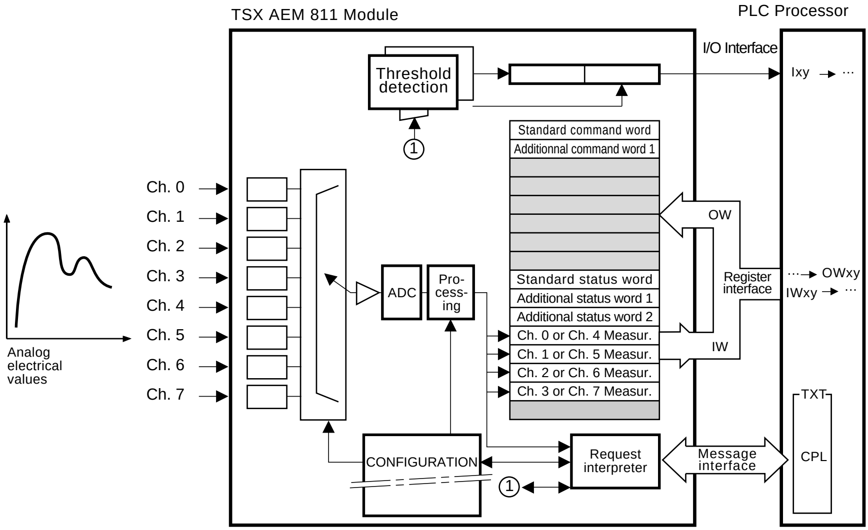
General Characteristics

- Location: Any rack equipped with a full I/O bus (TSX 47-30/67/87 and extension racks) or the first 4 slots of a TSX 47-20 PLC (software version 3.1 or higher).
- Hardware configuration code: 648 on TSX 47-30/67/87 or 64 on TSX 47-20.
- Software configuration code: 648 on TSX 47-30/67/87 or 62 on TSX 47-20.
- Effect of a power break/return (longer than the autonomy of the power supply):
  - configuration and threshold values are lost,
  - restart with the default configuration and threshold values at 0.

Connecting the Module

Signals		Terminal block label			Signals
Analog input Channel 0	Ch 0 +	A8	C1	+ Ch 4	Analog input Channel 4
	Ch 0 -	A7	C2	- Ch 4	
	⏚	A6	C3	⏚	
Analog input Channel 1	Ch 1 +	A5	C4	+ Ch 5	Analog input Channel 5
	Ch 1 -	A4	C5	- Ch 5	
	⏚	A3	C6	⏚	
Analog input Channel 2	Ch 2 +	A2	C7	+ Ch 6	Analog input Channel 6
	Ch 2 -	A1	C8	- Ch 6	
	⏚	B8	D1	⏚	
Analog input Channel 3	Ch 3 +	B7	D2	+ Ch 7	Analog input Channel 7
	Ch 3 -	B6	D3	- Ch 7	
	⏚	B5	D4	⏚	
	▽	B4	D5	▽	
	▽	B3	D6	▽	
	▽	B2	D7	▽	
	▽	B1	D8	▽	

Exchange Diagram



Standard Requests

Request function	TXTi,C (Hex.)	Ch. nbr. (Hex.)	TXTi,V (Hex.)	Nbr. bytes written	Nbr. bytes read	Module status
Write configuration	40	63	FE(FD)	4 to 68	0	Stop
Read configuration	41	63	71(FD)	0 or 2	4 to 48	Stop / Run
Read configuration	1	00	81(FD)	0	16	Stop / Run
Write thresholds (level 0)	2	00	FE(FD)	16	0	Stop / (Run)
Write thresholds (level 1)	4	00	FE(FD)	16	0	Stop / (Run)
Read thresholds (level 0)	3	00	83(FD)	0	16	Stop / Run
Read thresholds (level 1)	5	00	85(FD)	0	16	Stop / Run
Read fault bit string	47	63	77	0	10	Stop / Run
Write application name	49	63	FE(FD)	20	0	Stop/ Run
Read application name	4A	63	7A(FD)	0	20	Stop / Run
Read application name	0F	63	3F(FD)	0	27	Stop / Run

Transfer Characteristics

- CPL type Text BLock in reception and transmission modes.
- TXTi,M = H'xy..' where x = rack nbr., y = slot nbr., .. = Ch. nbr. 00 or 63.
- TXTi,C = request code
- TXTi,V (R) = report sent by the module, FD = incorrect transfer.
- TXTi,S = number of bytes received during the transfer (if transfer OK).

Addressing

I/O Bits

I x y , i

- Input: read by the PLC
- Rack nbr.
- Slot nbr.
- Bit nbr.

Register words

IW or OW x y, i

- Input: read by PLC
- Output: written by PLC
- Rack nbr.
- Slot nbr.
- Word nbr.

Threshold detection bits

	F	E	D	C	B	A	9	8	7	6	5	4	3	2	1	0
Ixy,																

Ixy,8	Threshold 1 Ch. 0 detect.
Ixy,9	Threshold 1 Ch. 1 detect.
Ixy,A	Threshold 1 Ch. 2 detect.
Ixy,B	Threshold 1 Ch. 3 detect.
Ixy,C	Threshold 1 Ch. 4 detect.
Ixy,D	Threshold 1 Ch. 5 detect.
Ixy,E	Threshold 1 Ch. 6 detect.
Ixy,F	Threshold 1 Ch. 7 detect.

Ixy,0	Threshold 0 Ch. 0 detect.
Ixy,1	Threshold 0 Ch. 1 detect.
Ixy,2	Threshold 0 Ch. 2 detect.
Ixy,3	Threshold 0 Ch. 3 detect.
Ixy,4	Threshold 0 Ch. 4 detect.
Ixy,5	Threshold 0 Ch. 5 detect.
Ixy,6	Threshold 0 Ch. 6 detect.
Ixy,7	Threshold 0 Ch. 7 detect.

Bit at 0
Meas. < Thres.
Bit at 1
Meas. ≥ Thres.

8 Input register words
(read by the PLC)

8 Output register words
(written by the PLC)

IWxy,0	Standard status word (F … 0)	OWxy,0	Standard command word (F … 0)
IWxy,1	Additional status word 1 (F … 0)	OWxy,1	Additional command (F … 0)
IWxy,2	Additional status word 2 (F … 0)	OWxy,2	
IWxy,3	Ch. 0/4 measurement	OWxy,3	
IWxy,4	Ch. 1/5 measurement	OWxy,4	
IWxy,5	Ch. 2/6 measurement	OWxy,5	
IWxy,6	Ch. 3/7 measurement	OWxy,6	
IWxy,7		OWxy,7	

Input Register Words: Sent by the module, read by the PLC

	F	E	D	C	B	A	9	8	7	6	5	4	3	2	1	0
IWxy,0,																

2	1 = Ongoing exchange cancelled and OWxy 0,2 = 1
3	1 = Module available (self-test complete).
4	1 = General fault or storage of general fault.
6	1 = Acquisition or conversion fault or storage of this fault
7	1 = Application fault or storage of this fault
8	1 = Blocking fault (module failure)
9	1 = Initial self-test in progress
A	1 = Terminal block open or not fitted
B	1 = Waiting for a configuration
C	1 = Module/Run/Stop state (0 = Stop)
D	Reserved

	F	E	D	C	B	A	9	8	7	6	5	4	3	2	1	0
IWxy,1,																

0	1 = Inhibit Channel 0
1	1 = Inhibit Channel 1
2	1 = Inhibit Channel 2
3	1 = Inhibit Channel 3
4	1 = Inhibit Channel 4
5	1 = Inhibit Channel 5
6	1 = Inhibit Channel 6
7	1 = Inhibit Channel 7
8	1 = Channel 0 Fault
9	1 = Channel 1 Fault
A	1 = Channel 2 Fault
B	1 = Channel 3 Fault
C	1 = Channel 4 Fault
D	1 = Channel 5 Fault
E	1 = Channel 6 Fault
F	1 = Channel 7 Fault

	F	E	D	C	B	A	9	8	7	6	5	4	3	2	1	0
IWxy,2,																

0	0 = Value Channel 0	1 = Value Channel 4	in IWxy,3
1	0 = Value Channel 1	1 = Value Channel 5	in IWxy,4
2	0 = Value Channel 2	1 = Value Channel 6	in IWxy,5
3	0 = Value Channel 3	1 = Value Channel 7	in IWxy,6
D	1 = Default configuration		

Output Register Words: Sent by the PLC, read by the module

Output Register Words: Sent by the PLC, read by the module OWxy,0

	F	E	D	C	B	A	9	8	7	6	5	4	3	2	1	0
OWxy,0,																

2	Cancel ongoing message exchange (Text Block)
C	Module Run / Stop command (1 = Run) (0 = Stop),

OWxy,1 additional command word

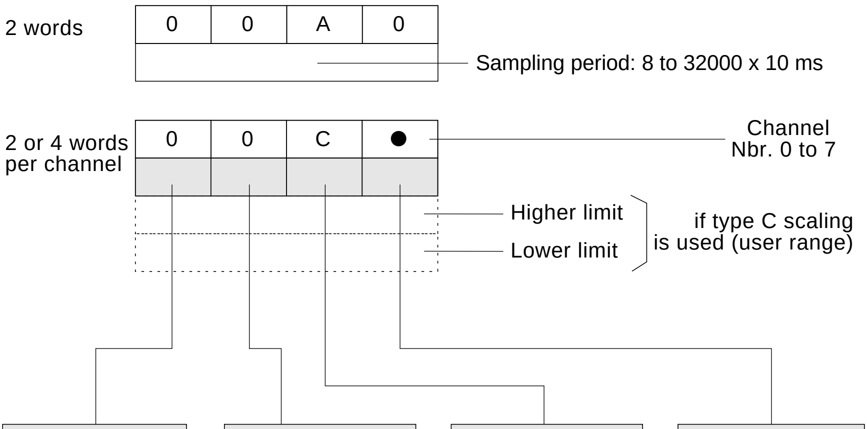
	F	E	D	C	B	A	9	8	7	6	5	4	3	2	1	0
OWxy,0,																

0	1 = Channel 0 inhibited
1	1 = Channel 1 inhibited
2	1 = Channel 2 inhibited
3	1 = Channel 3 inhibited
4	1 = Channel 4 inhibited
5	1 = Channel 5 inhibited
6	1 = Channel 6 inhibited
7	1 = Channel 7 inhibited
8	1 = Change to accelerated mode command

Fault bit string

Bit number	Type of fault	
0 to 15	Reserved	
16 17 18	Terminal block Analog/digital converter Input relays	
32,36,40,44,48,52,56,60 33,37,41,45,49,53,57,61 34,38,42,46,50,54,58,62 35,39,43,47,51,55,59,63	ELL lower limit exceeded Continuity fault Calculation fault EHL higher limit exceeded	Ch. 0,1,2,3,4,5,6,7 Ch. 0,1,2,3,4,5,6,7 Ch. 0,1,2,3,4,5,6,7 Ch. 0,1,2,3,4,5,6,7

Configuration table = 2 to 34 words



Input range

- 0 -10 /+10 V
- 1 - 5 / +5 V
- 2 0 / 10 V
- 3 2 / 10 V
- 4 0 / 5 V
- 5 0 / 2 V
- 6 0.4 / 2 V
- 7 0 / 20mA
- 8 4 / 20mA

Processing

0 no square root
1 square root

Scaling

A Input range
B Standard range
C User range

Continuity test

0 no test
1 test

Default Configuration

Sampling period = 10 x 100 ms
Channel configurations are shown by the shading in the figure above (H'00A0').

Transfer Characteristics

- CPL type Text Block programmed for transmission/reception,
- TXTi,M = H'xy63' where x = Rack nbr., y = Slot nbr.,
- TXTi,C = H'40',
- Transmission table length: 4 to 68 bytes,
- Report sent by the module TXTi,V = H'FE' if transfer correct,
  H'FD' if transfer incorrect,
- Once the module is configured the "Default Configuration" bit IWxy,2,D should go to 0,
- If a configuration error occurs the "Awaiting configuration" bit IWxy,0,B stays at1.

Instructions for Use

- Each part of the configuration (shown by the identifier) must be transferred complete,
- Compatibility rules:
  - the continuity test can only be used with sampling periods of more than 2.4 seconds,
  - the continuity test is incompatible with current inputs,
  - square root conversion is incompatible with input range scaling,
  - user defined limits can only be used with type C scaling and the selected limits must be different from each other.