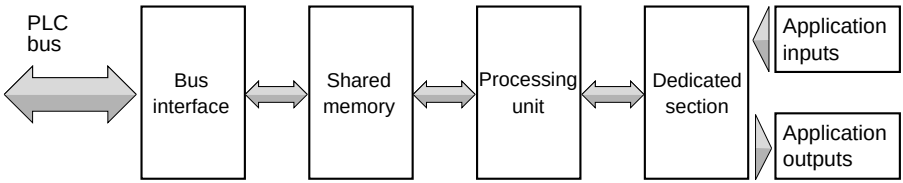
1.1 Intelligent modules

1.1-1 Introduction

Intelligent modules are pre-programmed processing units designed by Telemecanique for distributed processing of applications.

These modules are designed in the following way :

Structure of an intelligent module



They comprise :

. A bus interface using standard methods of communication between the PLC processor and the module :
  - Discrete interface
  - Register interface
  - Message interface

. A shared memory where data which can be accessed by the module or the PLC processor are stored.

. A processing unit which comprises a processor (two in the case of the time-stamping module) and the operating software.

. I/O dedicated to the module.

1.1-2 Use

Using a processor and pre-programmed functions, intelligent modules simplify the user program.

These functions are configured by the user, and operation of these modules requires expertise in using PL7-3 software. It may therefore be necessary to refer to the language manuals, for additional information.
Time-stamping modules are programmed using a later version of PL7-3 than V4.

1.2 TSX DEM 2412 and TSX DEM 2413 modules

1.2-1 Description

The time-stamping module is available in 2 versions, one for 24 V DC inputs, the other for 48 V DC inputs.

General

TSX DEM 2412 and DEM 2413 modules can read type 1 discrete inputs, and time-stamp the changes of state of these channels.
The DEM 2412 module comprises 24 x 24V DC discrete input channels.
The DEM 2413 module comprises 24 x 48V DC discrete input channels.

Note :
In the remainder of this document, the name TSX DEM 24 is used instead of the above references.

The module has an internal clock set to the correct time by the application program. The reference time can be from the CPU real-time clock or from a source external to the PLC, transmitted to the CPU via a communication interface. The various time-stamping modules are synchronized via the dedicated input on each module (this is the synchronization pulse).

Functions

The module performs the following functions :
- Acquisition of the state of the inputs and transmission to the CPU.
- Detection and time-stamping of changes of state in milliseconds.
- Recording a series of changes of state with an indication of the state of the message stack.
- Detection and indication of oscillating inputs (indicating faulty inputs).
- Monitoring of external power supply and presence of terminal block.
- Transmission to the CPU of all data relating to :
  - the input which has changed
  - the new state of the input
  - the time of change
  - the state of the message stack
- Programming the periodic message logging which shows the state of the channels.
- Dynamic selection of channels to log.

I/O

- 24 discrete inputs.
- 1 input for synchronizing the module clock.
- 1 synchronization output for controlling other time-stamping modules.

Exchanges from the process to the module

- The module reads the inputs.

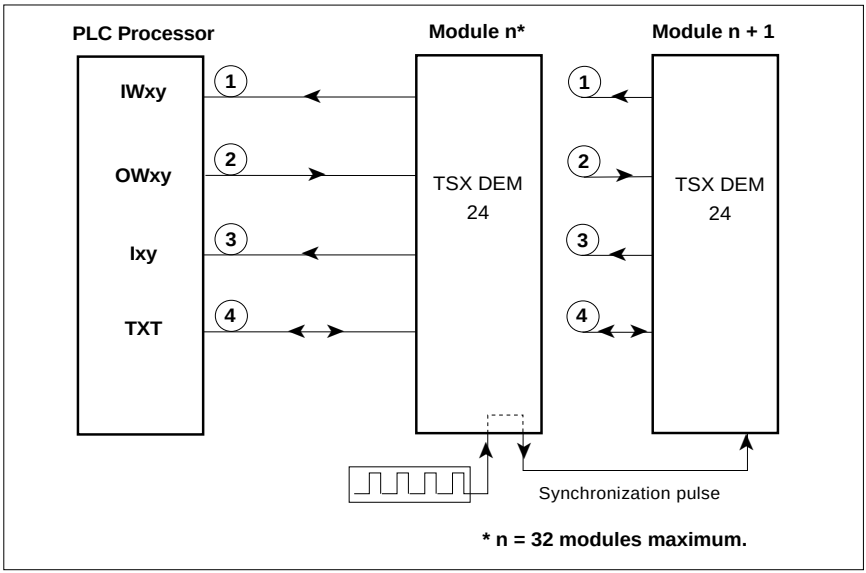
• The module transmits a synchronization pulse to other modules (maximum of 32). This signal is an amplification of the synchronization input.

Exchanges from the module to the PLC processor

The module gives information on :
- The state of the inputs.
- The presence of the terminal block and power supply, the state of logging.
- Information relating to the change of state : State, time of change.
- Information relating to the message stack : saturated, 70 % full, empty.
- Information relating to synchronization of the clocks (local or external) : synchronization fault.
- Pulse image.

Exchanges from the PLC processor to the module

The module waits for :
- The configuration which is programmed by the user. It sets the operating characteristics for the module (channels to monitor, digital filtering selected, etc).
- The time reference for setting the time of its local timer.
- Operating commands : channels to time-stamp, message purge, etc.



① Input interface registers
② Output interface registers
③ Discrete interface
④ Text block

Safety

The inputs are protected against industrial interference (500 microsecond filtering), against reversed polarity and are electrically isolated from the internal voltages.
The synchronization input and output are electrically isolated via an isolated block of discrete inputs and associated logic. The synchronization input is filtered at 500 microseconds.
The modules and terminal blocks can be inserted and removed while the PLC is powered up.

Ease of use

The PLC processor is continuously informed of the state of the module and the user program can access all the data for use if required.

1.2-2 Physical appearance

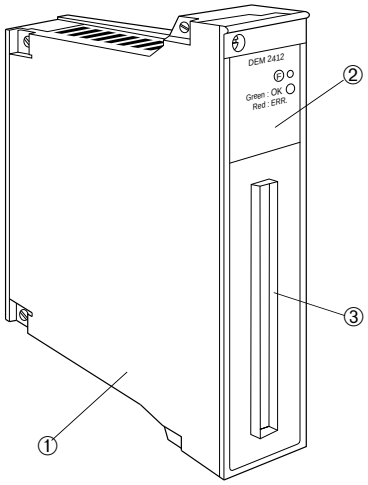
The TSX DEM 24 module is a single format module. It must be inserted in equipped I/O racks which have a complete bus.

This module is composed of the following elements :

① A metal case which mechanically protects the electronic circuits of the module and provides protection from electromagnetic interference.

② Front panel.

③ A 32-pin connector for connection using the TSX BLK 4 terminal block.



Front panel

This has 3 indicator lamps :

- Green OK lamp :
  - on when the module is operational,
  - off when the module is faulty (terminal absent or external power absent, if monitoring for this has been configured).
- Red ERR lamp :
  - on when there is an application fault (loss of synchronization, message stack full, configuration or time not accepted).
- (F) lamp indicates a "blocking" fault (communication interrupted by the CPU, etc).

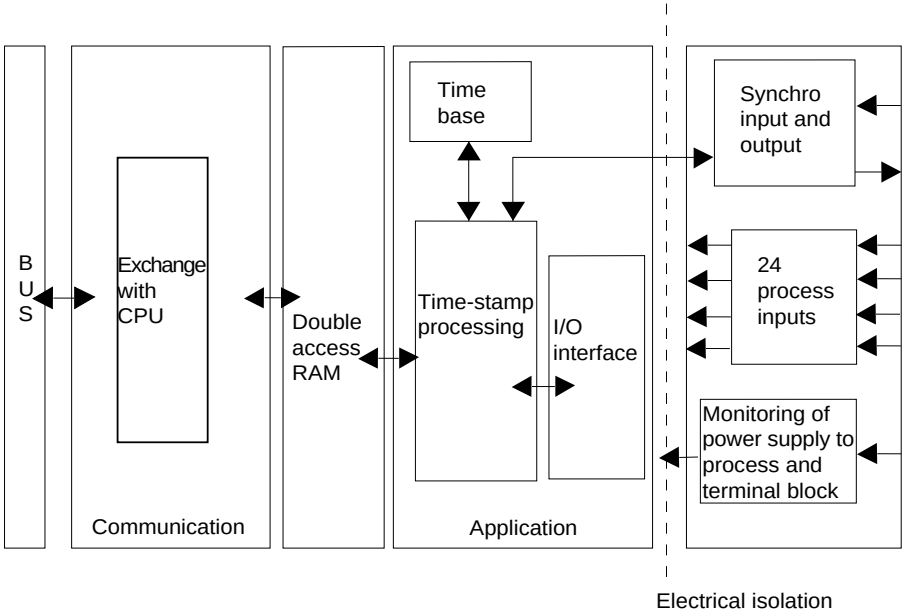
Rear panel

This has :

- Standard mechanical locating devices to prevent the risk of any error occurring when installing or changing the module.
- Optional mechanical locating device.

2.1 Hardware structure

The following diagram shows the hardware structure of TSX DEM 24 modules :



The elements of this diagram show the various logical links which process the input data, from the front panel dedicated to the process, to the PLC bus.

2.1-1 Power section

Discrete input interface

The data from the process is electrically isolated then filtered by the module. An initial filtering of 500 microseconds eliminates high-frequency interference. The time-stamping card has a second filter which is digital and can be programmed.

2.1-2 Time-stamping section

The time-stamping block detects, records and time-stamps changes in the state of the discrete inputs.
An internal clock manages the time in milliseconds with a precision of 25 ppm. This clock is used as a time base for time-stamping changes of state.

2.1-3 Dialog section

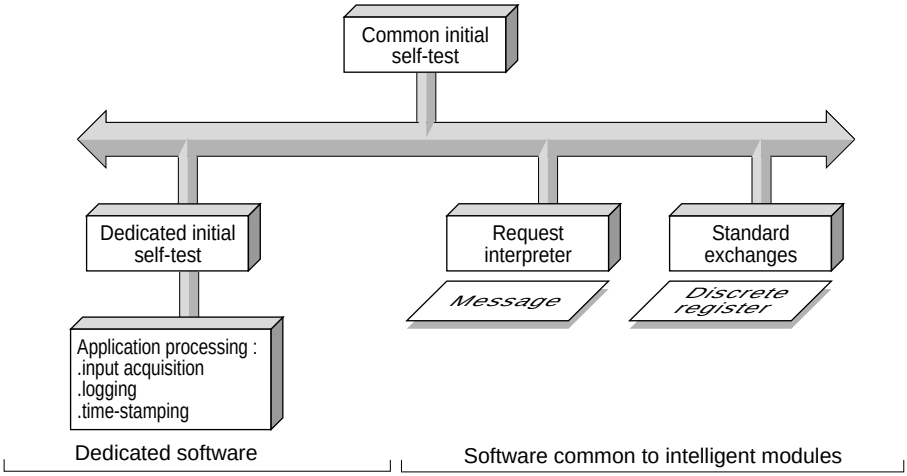
This element manages the exchanges between the CPU and the module. The following data is exchanged :

- Transmission of the state of inputs
- Logging messages
- Reception of configuration
- Reception of commands
- Reception of reference time.

2.2 Software structure

The software structure of TSX DEM 24 modules is made up of two parts :

- A common section, identical on all intelligent modules, which performs the exchanges with the PLC processor.
- A dedicated section which manages acquisition of the inputs, logging of changes of state as well as the dedicated module self-tests.



2.3 Time-stamp processing

2.3-1 Setting the module time

The module time is set from the CPU, using data from the integral real-time clock, which is precise to 100 ppm, or from an external device.

The module starts logging changes of state at the **first** synchronization **pulse** which follows reception of the time. (When the module is powered up a second pulse is required).

2.3-2 Time-stamping changes of state

On each change of state a message is created which contains the following information :

- The time the input changed state
- The channel affected
- The new channel state (zero, one or oscillating)
- The faults
- The state of the message stack.

The following are considered to be a change of state :

- Change of state of one of the 24 inputs on the card (change to zero, one or oscillating)
- Connection or removal of the terminal block
- Appearance and disappearance of the external power supply
- Appearance and disappearance of a synchronization fault.

2.3-3 Detecting oscillating inputs

The objective of this is to prevent saturation of the message buffer. When an input is faulty it is indicated by uncontrolled changes of state.
The user configures a monitoring period and a maximum number of transitions for this period. The parameters are common to all 24 module inputs. When an input has more changes of state than the configured number, the input is then shown to be oscillating. Its transitions will no longer be indicated as long as the number of changes remains above the defined limit.

2.3-4 Management of a message buffer

All messages to be sent to the CPU are handled in a buffer which can take up to 200 messages. Communication is performed using a protocol which exchanges messages via text blocks.

Two types of message are exchanged :

- Change of state of a channel
- Overall status of the module.

2.4 Dialog with the PLC

2.4-1 General

There are 3 types of exchange with the PLC processor via the complete I/O bus :

- Discrete interface, Ixy,i addressing
- Register interface, I/OWxy,i addressing
- Message interface, TXT,i addressing

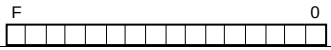
x = rack number
y = position in the rack
i = number of bit or word as appropriate

For each of these exchanges there are corresponding objects which are available to the user program.

2.4-2 Discrete interface

The interface provides important indicators for time-stamping. Exchanges are performed at each cycle of the task for which the module has been configured.

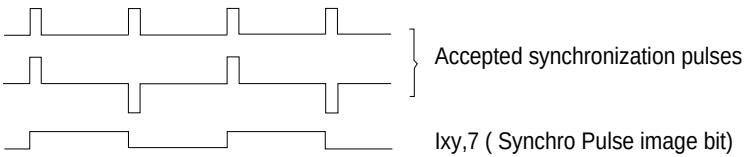
Ixy



Ixy,0	Module ready to log (1)
Ixy,1	Message stack not empty
Ixy,2	Stack 70 % full
Ixy,3	Stack full
Ixy,4	Synchronization fault
Ixy,5	Not used
Ixy,6	Not used
Ixy,7	Image of synchronization pulse
Ixy,8 to Ixy,F not used	

(1) Date set and synchronization pulses received.

Note :
The state of Ixy,7 changes at each pulse.



2.4-3 Register interface

TSX DEM 24 modules have eight input register words and eight output register words. The exchanges are performed systematically at each PLC cycle.
The following table describes both the input register words and the output register words.

8 input register words (read by the CPU)	**8 output register words** (written by the CPU)
IWxy,0 - Standard status word	OWxy,0 - Standard command word
IWxy,1 - Not used	OWxy,1 - Additional command word
IWxy,2 - Additional status word	OWxy,2 - Cmd word, channels to stamp (0 to 15)
IWxy,3 - Not used	OWxy,3 - Cmd word, channels to stamp (16 to 23)
IWxy,4 - Not used	OWxy,4
IWxy,5 - Number of messages in the stack	OWxy,5
IWxy,6 - Discrete input image word channels 0 to 15	OWxy,6
IWxy,7 - Discrete input image word channels 16 to 23	OWxy,7

Detail of status words IWxy,0 and IWxy,2

IWxy,0 Standard status word	IWxy,2 Additional status word
0 - Not used	0 = Logging active 1 = No logging
1 - Not used	1 = Filtering incorrectly configured **(1)**
2 - 1 = RESET message system (txt block)	1 = Oscillating inputs incorrectly configured **(1)**
3 - 1 = Module available (self-test complete)	1 = Pulses incorrectly configured **(1)**
4 - 1 = Module fault or recording fault	1 = Drift incorrectly configured **(1)**
5 - Reserved	1 = Incorrect periodic logging period **(1)**
6 - 1 = Logging fault / recording fault	- Not used
7 - 1 = Application fault or recording fault	1 = Module ready to log (same as Ixy,o)
8 - 1 = Module off (blocking fault)	1 = External supply fault
9 - 1 = Initial self-test running	- Not used
A - 1 = Terminal block fault	- Not used
B - 1 = Awaiting configuration. 0 = Configured	- Not used
C - 1 = Module running. 0 = stopped	- Not used
D - Not used	1 = Default configuration
E - Not used	- Not used
F - Not used	- Not used

(1) Coding bits for configuration fault (IWxy,2)

Description of status word IWxy,5

Status word IWxy,5	Number of messages

The module indicates the **number** of **messages** in the stack in the **IWxy,5** register. The number can **vary** from **0** to **200**.

Detail of status words IWxy,6 and IWxy,7

IWxy,6 State of discrete channels	IWxy,7 State of discrete channels
0 - State of channel 0	State of channel 16
1 - State of channel 1	State of channel 17
2 - State of channel 2	State of channel 18
3 - State of channel 3	State of channel 19
4 - State of channel 4	State of channel 20
5 - State of channel 5	State of channel 21
6 - State of channel 6	State of channel 22
7 - State of channel 7	State of channel 23
8 - State of channel 8	
9 - State of channel 9	
A- State of channel 10	
B- State of channel 11	
C- State of channel 12	
D- State of channel 13	
E- State of channel 14	
F- State of channel 15	

Detail of command words

OWxy,0 Standard command word	OWxy,1 Additional command word
0 - Not used	1= Stop logging 0= Logging
1 - Not used	Rising edge Purge message stack
2 - 1= RESET message system (txt block)	Rising edge Request logging of overall state
3 to B - Not used	Not used
C- 1 = Change to RUN. 0 = Change to STOP	Not used
D to F - Not used	Not used

Detail of status words OWxy,2 and OWxy,3

OWxy,2 Command word, channels to be time-stamped from 0 to 15	
0 to F - Channels 0 to 15 to be time-stamped if = 1,	stop logging if = 0

OWxy,3 Additional status word, channels to be time-stamped from 16 to 23	
0 to 7 - Channels 16 to 23 to time-stamp if = 1	stop logging if = 0

2.4-4 Message interface

The message interface transfers data tables between the module and the PLC processor. This transfer is programmed using a CPL type text function block and is executed at the initiative of the user program.
This type of dialog is used for :

- Writing the configuration
- Reading the configuration
- Setting the module time
- Reading the logging data
- Reading the fault string.

Data specific to each of these transfers is stored in internal words Wi or constant words CWi (only when transmitting, for example the configuration).

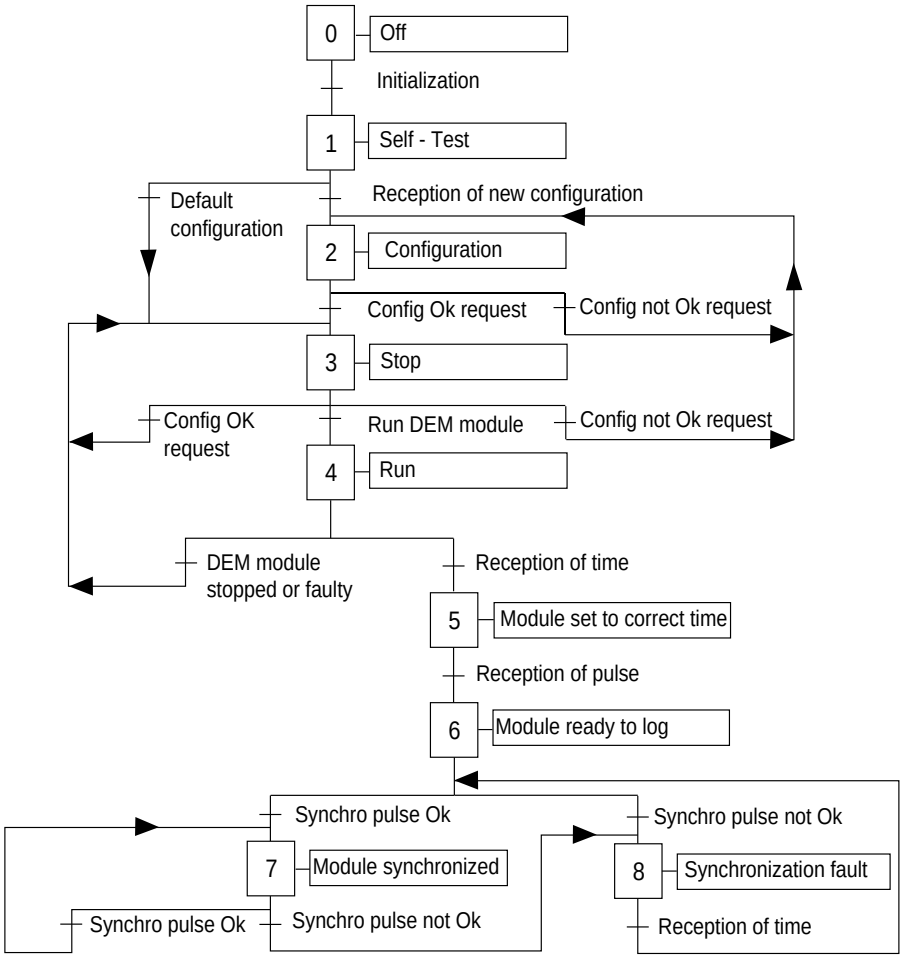
Programming using the message interface is described in detail in each section relating to the following exchanges :

- Logging (Section 3)
- Setting the time of the modules (Section 4)
- Reading messages (Section 4)
- Additional requests (Section 4.4).

2.5 Module operating modes

2.5-1 Description

The chart below shows the TSX DEM 24 module operating modes :



When powered up, at initialization request or after a power break, the module starts a self-test routine (bit IWxy,0 - 9 = 1).
If no fault is detected, the module operates in RUN mode or in STOP mode (depending on the value of the standard command word) with the default configuration.
To use the module in the application conditions, it must be configured. To do this the user must use the program to :

- Set the module to STOP mode.

- Transmit the configuration via the message interface.
- Reset the module to RUN mode.

If the configuration received is incorrect or incomplete the module waits for configuration and remains in waiting mode until it receives a coherent configuration.
Once it has been configured and is in RUN mode, the module can acquire discrete signals.
Status logging will only start after :

- The reference time has been received (if the reference time is not accepted the module continues in "Time not set" mode), bits IWxy,2,7 = 0 and Ixy,0 =0.
- Reception of a synchronization pulse.

The module is then ready to log, bits IWxy,2,7 and Ixy,0 = 1. Logging can be inhibited by setting bit OWxy,1,0 to 1.

2.5-2 Actions on operating modes

The user has access to a command register word which forces the module to the required operating mode.

The status register words inform the user of the module operating mode :

- Initial self-test
- Awaiting configuration
- RUN/STOP
- Operating with default configuration
- Module ready to log
- Logging active or not active.

2.5-3 Behaviour on power breaks and power returns

TSX DEM 24 modules do not have a protected memory. They lose all data, in particular the configuration and the reference time, when they are disconnected from the power supply provided by the PLC.
It is therefore necessary to reconfigure the module and reprogram the reference time :

- On a cold restart (SY0 = 1)

- On a warm restart, when the power reserve has been exhausted (SY1 = 1)
- When the module is installed in the PLC.

2.5-4 Behaviour in STOP mode

When the module is stopped, logging and time-stamping continue in the same way as before changing to STOP, until the stack is full (200 messages). No further logging then takes place.

2.5-5 Behaviour when PLC is stopped

Logging and time-stamping continue until the stack is full (200 messages). No further logging then takes place.

2.5-6 Effect of faults on operating modes

If the terminal block is absent or when an external power supply fault is detected, and monitoring is requested, the module changes to STOP until the fault disappears. The state of the inputs is that defined in the configuration (Maintain or default to 0).

When an application fault (synchronization fault, message stack saturated) is detected, the module remains in RUN mode.

When there is a synchronization fault the module continues logging using its internal clock for reference. The fault is fed back to the processor. Bit Ixy,4 enables this state to be read.

3.1 Principle

3.1-1 General

The configuration data is used to adapt the module operation to the target application. This data determines the operating mode for the module and each of its channels.

Module configuration consists of :

- Determining the module operating characteristics
- Coding these characteristics, in binary code or decimal values
- Transferring this code and these values to the module via the program.

TSX DEM 24 modules have a default configuration, which enables operation on power-up. It is replaced by the user configuration once this has been transferred.

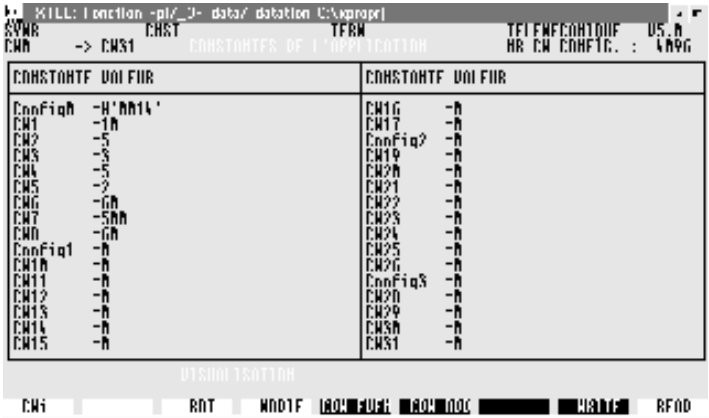
3.1-2 Configuration data

The configuration data affects :

- The operating mode
- The operating mode for each channel.

The configuration data must be coded in a word table in zone W (internal words) via the program or in zone CW (constant words).

Example of configuration table (constant words CW0 to CW8) :



3.1-3 Bits associated with the configuration

Two bits can be accessed via the program, which are extracted from standard and additional status words, and are associated with the module configuration :

- IWxy,0,B : this bit changes to 1 on reception of an incorrect configuration. It indicates that the module is awaiting configuration.
- IWxy,2,D : this bit at 1 indicates that the module is operating with its default configuration.
- Diagnostic bits identify the reasons for refusal in the event of a configuration fault :

IWxy,2,1 : Incorrect discrete I/O filtering value
IWxy,2,2 : Incorrect configuration of oscillating inputs
IWxy,2,3 : Incorrect synchronization pulse period value
IWxy,2,4 : Incorrect value of the maximum drift tolerated on the synchronization pulse period
IWxy,2,5 : Incorrect periodic logging period

Note :
The system stops at the first error found.
IWxy,2,3 and IWxy,2,4 at 1 indicate a drift value which is incompatible with the chosen pulse period.

3.2 Parameters

3.2-1 Channel configuration

The channel configuration is coded on 9 words. The first word is entered in binary, the others are entered in decimal mode.

Words	**Word bits**										
Address	15	9	8	7	6	5	4	3	2	1	0
W(i) - CW(i)				**DEF**		**LOG**		**OSC**		**AI. EXT**	
(i+1)	**FILT**										
(I+2)	**T-MAX**										**1**
(i+3)	**N-MAX**										**1**
(i+4)	**T-MIN**										**1**
(i+5)	**N-MIN**										**1**
(i+6)	**T-SYN**										**2**
(i+7)	**DRIFT**										**2**
(i+8)	**PER**										

"1- Parameters for detecting the oscillating inputs."
"2- Monitoring the internal clock."

Description of the data words

These words CWi or Wi indicate :

Word (i)

bit 0 = 1	AI EXT	external supply monitoring active
bit 2 = 1	OSC	oscillating inputs active
bit 4 = 1	LOG	periodic logging active
bit 6 = 1	DEF	fallback value of inputs on terminal block fault, or on supply fault if supply monitoring is configured. Value "0" : force inputs to 0. Value "1" : maintain inputs.

Words

(i+1) :	FILT	software filter time constant. Values : 0, 10, 20, 50 ms.
(i+2) :	T-MAX	maximum count time. 1 to 240 seconds.
(i+3) :	N-MAX	maximum number of status changes. 1 to 9.
(i+4) :	T-MIN	minimum count time. 1 to 240 seconds.
(i+5) :	N-MIN	minimum number of status changes. 1 to 9.
(i+6) :	T-SYN	synchronization pulse period. Values : 1, 30, 60 seconds.
(i+7) :	DRIFT	configurable drift for the time base (between 2 pulses). Values : 2, 10, 50, 100, 500 ms. Warning ! Do not configure 500, if T-SYN = 1 second.

(i+8) : PER - logging period of TSX DEM 24 module overall status.
Values : 1 to 240 minutes.

Configuring the default positions

These are the values seen by the PLC in the event of a type 3 fault (terminal block missing or external supply fault if supply monitoring is programmed).

Configuring oscillating inputs

Detection of oscillating inputs operates on the principle of the hysteresis cycle. The user does not have to select this detection.

- Maximum count time : 1 to 240 seconds.
- Maximum number of status changes in the window before declaring an oscillating input : 1 to 9.
- Minimum count time : 1 to 240 seconds.
- Minimum number of status changes in the window before declaring an oscillating input as no longer oscillating : 1 to 9.

Example : If programmed for a maximum of 8 status changes in 60 seconds and a minimum of 5 status changes in 120 seconds, an input will be declared as oscillating if it changes more than 8 times in 1 minute. This input will be considered normal again only if it changes less than 5 times in 2 minutes.
By default this option is not active. If the user chooses this detection, all 4 values must be programmed.

Synchronization fault

This parameter indicates the time base drifts, relative to the external time reference. The value of this drift is set at approximately 2 ms by default.
The possible values are 2, 10, 50, 100, 500 ms.

Synchronization pulse

The user chooses the frequency at which the card must receive the synchronization pulse : 1 second, 30 seconds, 60 seconds.

Periodic logging

The user can request the module to regularly record a message giving the overall state of the card in the message stack. This checks that the logging is working. This period can vary from 0 to 240 minutes.

3.2-2 Selection of channels to be logged

The user can select those channels whose status changes he wishes to log from the 24 channels available.
This choice is not made during configuration, but with the register words OWxy,2 and OWxy,3, so that it can be modified by the application.
Channels which are not logged behave like discrete inputs. Their status is transmitted to the IWxy,6 and IWxy,7 registers.
By default, the values of the OWxy,2 and OWxy,3 words are 0, which indicates a **change of status of inputs which have not been logged.**
When bit OWxy,1,0 is at 0, **logging is active**.

3.3 Default configuration

Default configuration is as follows :

- No external power monitoring
- No detection of oscillating inputs
- No periodic logging activation
- Input fallback to 0 when faulty (terminal block missing)
- No input software filtering
- Synchronization pulse every 60 seconds
- Synchronization fault with drift value of approximately 2 ms
- No periodic logging.

Configuration table description :

Words	CWi=0
	CWi+1=0
	CWi+2=0
	CWi+3=0
	CWi+4=0
	CWi+5=0
	CWi+6=60
	CWi+7=2
	CWi+8=0

3.4 Loading 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.
This can be done either in zone W via the program, or preferably in zone CW.

3.4-2 Transferring the configuration to the module

Once coded and stored, the configuration data must be sent from the PLC memory to the module by the user program. This is done using a text block.

To send the configuration, proceed as follows :

- Stop module
- Wait for module STOP status
- Transmit configuration via CPL text block (intelligent module)
- Check module acceptance of the configuration parameters
- Set module to run.

Text block characteristics

- **TXTi,M : H' . . 63'** The configuration addresses the module system
  - Position nbr
  - Rack nbr
- **TXTi,C : H'0040'** Request code indicating configuration transmission
- **TXTi,L : 18** Length of table to be transmitted. This corresponds to the number of bytes in the table containing the configuration data : 18 bytes.

The confirmation of transfer sent by the TXTi,V module can be used after the exchange to check correct data transmission : it equals H'FE' if the exchange is correct and H'FD' if it is incorrect.

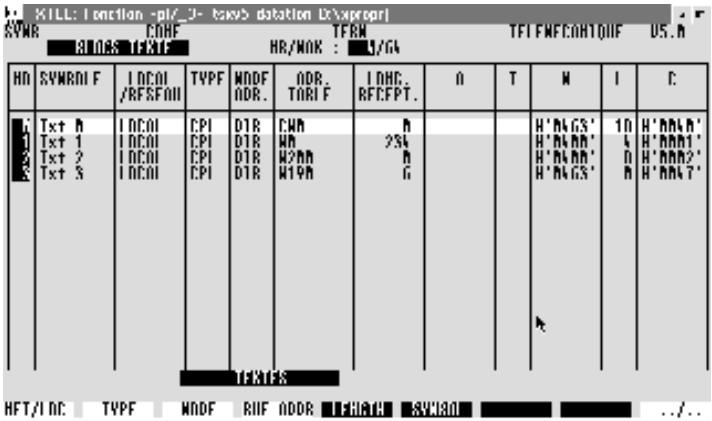
Programming the transfer

To program the transfer, proceed as follows :

- Stop module by positioning bit OWxy,0,C at 0.
- Check that the module has stopped by testing status word bit IWxy,0,C which should be at 0.

- Transfer the configuration using a text block.
- Check that transfer has been performed successfully :
  - test TXTi,E which should be at 0
  - test TXTi,V which should equal H'FE'.
- If the configuration has been successfully received, place the module in RUN mode by positioning OWxy,0,C command register word bit at 1.
  Bit IWxy,0,C should then change to 1.

Type of text block exchanged :



3.4-3 Configuration check

The configuration is not accepted by the module when :

- The configuration length is incorrect.
- The syntax is wrong (code not defined).
- Choices made in defining the configuration result in incompatibilities.
- The module is running.

Sending an incorrect configuration

Sending an incorrect configuration changes the IWxy,0,B "awaiting configuration" status word bit to 1. The error coding is performed on additional status word bits (IWxy,2 - bits 1 to 5).
The module then waits for a correct configuration, and ceases time-stamping.

4.1 Setting the time

4.1-1 Principle

The time is sent from the CPU or an external source (via a communication card), and the time reference data is stored via the program in a table. This table must be transferred to the module on initialization, or each time a synchronization fault is indicated by the module.
This time reference must be transmitted to all the PLC TSX DEM 24 modules, via a table of 4 words.

Words	MSBs	LSBs
Wi	Year (0 to 99)	Month (1 to 12)
Wi+1	Days (01 to 31)	Hour (0 to 23)
Wi+2	Minutes (0 to 59)	Seconds (0 to 59)
Wi+3	Reserved	Modification indicator

Modification indicator :

This byte handles an interruption to the time continuum, such as the changeover from summer time to winter time.
Its value is between 0 and 255.
It must be modified (for example increased by 1 whenever the time is set).

4.1-2 Transferring the time reference to the module

Time-related data is stored in the PLC memory, and has to be transferred to the module memory using a transmission text block.

Text block characteristics

- **TXTi,M : H' . . 00'** The configuration addresses the module system
  - Position nbr
  - Rack nbr
- **TXTi,C : 2** Request code indicating time reference transmission.
- **TXTi,L : 8** Length of table to be transmitted. This corresponds to the number of bytes in the table containing the time data : 8 bytes.
- No reception table needs to be defined.

Confirmation of the transfer **TXTi,V** sent by the module can be used after the exchange to verify data transmission : equals H'FE' if the exchange is correct and H'FD' if it is incorrect.

Programming the transfer

To program the transfer, proceed as follows :

- Prepare the time setting table by changing the seconds to the value due at the next pulse.
- Transfer the data using the text block.
- Check that the transfer has been performed :
  - test the TXTi,E output bit which indicates an invalid transfer. It should be at 0.
  - test the TXTi,V which should equal H'FE'.
- If the time reference has been successfully received, bit IWxy,2,7 should change to 1 at the next synchronization pulse (the module is ready to log, IWxy,2,7 = 1 and IWxy,0 = 1).

4.1-3 Acceptance of the time reference by the module

The module time is set after the first external synchronization pulse following reception of the time reference.
Each time a synchronization pulse is received, the module compares its own current time with the system time. If the difference between the two is greater than the precision required at the time of configuration (DRIFT parameter), the module indicates a synchronization fault. In order to prevent this happening on a sudden change of reference such as the switch from summer time to winter time or a voluntary adjustment to the time, the application program indicates the interruption by activating the modification indicator.
On reception of the new system time, the modules will reset themselves to the distributed time, at the next synchronization pulse, without checking the difference between the local time and the time received.

A synchronization fault can be due to :

- Loss of synchronization pulse.
- Module clock fault.
- A drift greater than the one programmed in the configuration.

To correct a synchronization fault, the reference time must be transmitted to the module. The fault will disappear two synchronization pulses after time reception.

Example
The synchronization pulses are configured at 30 second intervals;
Time reference : "15 July 1994 at 18h 5min 33 sec";
The following table indicates the time reference data :

Wi	5E	07
Wi+1	0F	12
Wi+2	05	21
Wi+3	00	01

- Wi word indicates in hexadecimal : 94 - 07 i.e. July 1994,
- Wi+1 gives day and hour : 15 - 18 i.e. the 15th at 18.00 hrs
- Wi+2 indicates minutes, seconds : 5 min - 33 seconds,
- Wi+3 identifies milliseconds : 1 ms.

The time picked up on the next pulse is : 15 July 94 18h 06min 00 sec.
The time in the table is taken into account on the synchronization pulse, and the processor therefore adds the time between the 2 pulses.

4.2 Time-stamp operation

4.2-1 Principle

The application initiates handling of exchanges between the CPU and the module. This handling uses the additional status word (OWxy,1 output register) which is transmitted to the module at each PLC cycle.

- Bit 0 of OWxy,1 at 1 causes a global stop of logging of changes in state.
- Bit 1 of OWxy,1 at 1 causes a purge of the module message stack, the messages are deleted and the stack is emptied.
- Bit 2 of OWxy,1 at 1 requests logging of the overall state of the card.

- Word IWxy,5 indicates the number of messages available in the stack. These messages are read via a text block (1 to 9 messages).

Note :
The term **message** refers to all of the data connected with a change of status.

4.2-2 Description of data

Contents of message caused by a change of channel state

Words	F	E	D	C	B	A	9	8	7	6	5	4	3	2	1	0
Wi	Number of messages involved in exchange								Exchange number							
Wi+1				Stack		Type		H	Modification indicator							
Wi+2	Year								Month							
Wi+3	Day								Hour							
Wi+4	Minutes								Seconds							
Wi+5	Milliseconds															
Wi+6	Rack nbr								Position nbr							
Wi+7	Channel nbr								Channel state							
Wi+8	Reserved								Reserved							
Wi+9	Reserved								Reserved							
Wi+10	Reserved								Reserved							
Wi+11	Reserved								Reserved							
Wi+12	Reserved								Reserved							

Number of messages returned in the exchange : This item indicates the number of messages returned and thus the length of the usable data. This number varies from 1 to 9. (The text block exchange has the capacity to read up to 9 messages at each cycle).

Exchange number : These 8 bits give the exchange number transmitted by the module. It corresponds to the one requested by the application program.

Type : Determines the type of message :
0 : Transmission indicating change of an input state.
1 : Transmission specifying the general state of the inputs.

Stack : Indicates the state of the message stack :
0 : stack is in normal state.
1 : stack overflow with loss of at least one message.

H : Indicates a synchronization problem :
0 : correct operation.
1 : clock synchronization fault.

Modification indicator : Gives the number of the last modification indicator.

Channel nbr :
0 to 23 indicates the discrete input number
24 loss of synchronization
25 terminal block missing
26 external supply fault if monitoring has been requested.

Channel state for inputs 0 to 23 :
0 = channel at 0,
1 = channel at 1,
2 = oscillating input.

Channel state for inputs 24 to 26 :
1 for channel 24, indicates loss of synchronization,
1 for channel 25, denotes a missing terminal block,
1 for channel 26, indicates faulty external power supply.

Contents of message giving overall state of the card

Words	F	E	D	C	B	A	9	8	7	6	5	4	3	2	1	0
Wi	Number of messages created in exchange								Exchange number							
Wi+1				Stack		Type		H	Modification indicator							
Wi+2	Year								Month							
Wi+3	Day								Hour							
Wi+4	Minutes								Seconds							
Wi+5	Milliseconds															
Wi+6	Rack nbr								Position nbr							
Wi+7	Monitoring of channel 8 to 15 on or off								Monitoring of channel 0 to 7 on or off							
Wi+8									Monitoring of channel 16 to 23 on or off							
Wi+9	State of channel 8 to 15 oscillating or not								State of channel 0 to 7 oscillating or not							
Wi+10	Insignificant = 0								State of channel 16 to 23 oscillating or not							
Wi+11	State of channel 8 to 15								State of channel 0 to 7							
Wi+12						26	25	24	State of channel 16 to 23							

Words 0 to 6 inclusive : Same meaning as for message table "Change of state".

Words 7 and 8 : Bits indicating whether channel is time-stamped or not :
0 : channel not time-stamped.
1 : channel time-stamped.

Words 9 and 10 : Bits representing channel oscillating or not :
0 : channel not declared oscillating, normal operation.
1 : channel oscillating.

Words 11 and 12 : (LSB) indicates state of channels at the moment of logging :
0 : channel at 0.
1 : channel at 1.

Word 12 : (MSB) shows module status :
bit 24 : indicates synchronization fault.
bit 25 : denotes a missing terminal block.
bit 26 : indicates external supply fault.

4.2-3 Data processing

At the first pulse following time reception, the TSX DEM 24 module logs the first message giving the overall state of the module inputs.
The user can acquire this information and process it in the application.

Using logging data

Logs are transmitted in Wi internal words in response to a "Log read" request. Several messages can be sent after a single request.
The application program analyses whether the stack is empty, if not Ixy,1=1.
The number of messages in the stack can be found by reading IWxy,5. The user can request to see messages via the program, with a limit of 9 messages at one time.
The exchange number is included in the message contents; this enables the user to **check** the **coherence** of the request in relation to the response.
Data transmitted to the CPU is deleted from the message stack.

Handling message listing must be carried out carefully so as not to lose messages.
If the number of messages requested is greater than the stack contents, only the number of messages available is shown. If the stack is empty, the module returns the exchange number and zero for the number of messages.
Programming this request is performed via the CPL type text block programmed for transmission and reception with the following characteristics :

- Request code : TXTi,C = 1.
- Address : TXTi,M = H'xy00' with x = Rack nbr and y = Position nbr.

- Reception table : ①
  W[117] table of 117 words (234 bytes) containing the status change messages or the overall module state messages.

	Wi	
	Wi+1	
	...	
①	Wi+116	
②	Wi+117	Exchange nbr
	Wi+118	Nbr of messages requested

- In the transmission table the user defines (2 words) : ②
  the exchange number (0 to 9)
  the number of messages expected (1 to 9)
- The messages are sent to the CPU in chronological order of appearance, starting with the oldest.

Confirmation :
TXTi,V = H'81' if the exchange is correct or H'FD' if the exchange is incorrect
TXTi,S = (number of message bytes) x (26 bytes) if the exchange is correct (TXTi,E = 0). TXTi,S = 2 if the stack is empty.

Monitoring

- **Deactivate / reactivate logging of all module channels.**
  The CPU can stop logging all module channels at any time by setting a OWxy,1,0 bit. The message stack is no longer filled, the module no longer monitors the changes of state. Bit IWxy,2,0 indicates that the module has accepted the command.
- **Deactivate or activate globally or channel by channel, using command words OWxy,2 and OWxy,3**
- **Purge message stack**
  On the rising edge of bit OWxy,2,1, all stack messages are deleted.
- **Request logging of overall card state**
  The user can request logging of the overall module state by positioning the OWxy,2,2 bit at 1. If the user wishes to repeat a new request, bit OWxy,2,2 must be positioned to 0 then 1 (the module detects a rising edge).

4.3 Diagnostics : fault processing

Via the program the user can precisely determine any faults which occur on the TSX DEM 24 module or on its external environment.

Types of fault :

Faults can be classified in three categories according to their seriousness and their effect on module operation.

- "Blocking" faults : these are faults which prevent exchanges with the PLC processor.
- Module/processor faults : these faults include a missing terminal block or an external supply fault.
- Application faults : these faults relate to logging, loss of synchronization, message stack saturation, refusal of time or configuration.

Fault detection :

Several indicators are available to the user :

- Indicator lamps.

INDICATOR	STATUS	FAULT
F	on	"Blocking" fault. The module is not working.
OK	on	No fault. The module is powered up and operating correctly.
OK	off	Module fault (missing terminal block or external supply fault).
ERR	on	Logging or synchronization application fault. Parameter refusal, refusal to accept time.

- Fault bit.
  This bit informs the PLC (processor I/O lamp) that there is a fault on the module. It changes to 1 when a fault appears and changes back to 0 when the fault disappears.

FAULT BIT	ACCESS	STATE	FAULT
Ixy,s	program	1	Module fault (blocking or module/processor) Exchange fault with PLC processor Module missing Code declared in I/O configuration other than 777 or 778

- Status word.

FAULT BIT	FAULT
IWxy,0,4	Fault or recording of general fault, covers IWxy,0,6 and IWxy,0,7
IWxy,0,6	Fault or recording of logging fault
IWxy,0,7	Fault or recording of module/processor fault
IWxy,0,8	Blocking fault, module missing or incorrect code
IWxy,0,A	Terminal block fault
IWxy,2,8	External supply fault (if monitoring requested)

The terminal block fault is caused if the TSX BLK4 connector is unscrewed.

- BDEF fault bit string
  This 96-bit string is accessed via the message interface (request code H'47').

Description :

- 0 to 15 Reserved
- 16 Terminal block fault
- 18 to 31 Reserved
- 32 Synchronization fault
- 33 Stack full
- 34 Time reference refused
- 35 Configuration refused
- 35 to 95 Not used.

4.4 Additional requests

In addition to loading the configuration, setting the module time and recovering logging messages, the PLC processor can exchange miscellaneous data with the module via the CPL type text block.

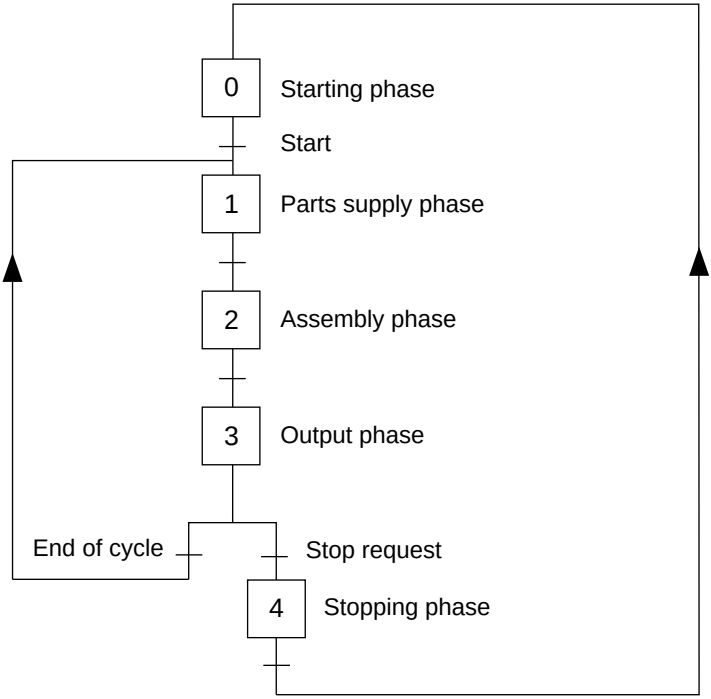
Request code list :

Request role	TXTi,C (hex)	TXTi,M (hex)	TXTi,V (hex)	Number of bytes written	Number of bytes read	Module status
Logging read	1	xy00	81/FD	4	234 max	RUN/STOP
Time write	2	xy00	FE/FD	8	0	RUN/STOP
Configuration write	40	xy63	FE/FD	18	0	STOP
Configuration read	41	xy63	71/FD	0	18	RUN/STOP
Application name write	49	xy63	FE/FD	1 to 20	0	RUN/STOP
Application name read	4A	xy63	7A/FD	0	1 to 20	RUN/STOP
Module version read	F	xy63	3F/FD	0	27	RUN/STOP
Fault string read	47	xy63	77/FD	0	12	RUN/STOP

Note :
When parameter value "TXTi,V = FD", the exchange is incorrect.

5.1 Application description

An assembly line is controlled as shown in the following macro-Grafcet chart :



A TSX DEM 2412 module logs the state of the inputs, depending on the current phase, as in the table below :

Current phase	Inputs to be logged
Starting	-
Supply	0 to 7
Assembly	0 to 15
Output	12 to 19
Stopping	16 to 19

In order to avoid oscillation of the inputs an input cannot change state more than 4 times in 5 seconds. If an input passes this threshold, logging will be interrupted and will only continue when the transition rate drops to less than 2 changes in 5 seconds.

Whichever the current phase, logging of the general state of the card will be performed every hour as well as on user request via a discrete input.

The status changes logged by the module will be processed by the CPU so that they can be used for print/display.

Time setting :

The module time will be set each time the power returns according to the time supplied by the CPU, with synchronization every minute from the CPU.

Behaviour on power-up :

After the self-test phase the module will be reconfigured and the time set from the CPU. The message stack will be purged to avoid accumulation of incoherent messages. Operating commands will be effective once the module initialization phase is complete (Macro-step 0).

Operator commands :

The operator can use commands to :

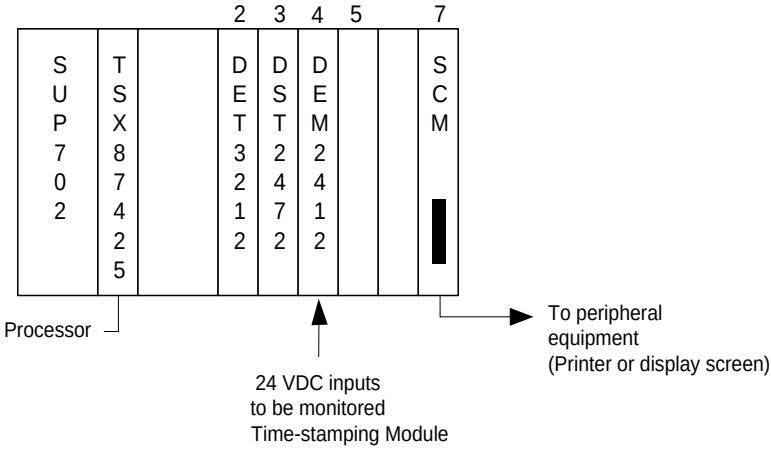
- Log the general state of the card.
- Purge the message stack.
- Stop channel logging.
- Reset the module time.

Monitoring :

An alarm is triggered when any time-stamping module malfunction, logging fault or synchronization fault occurs.

5.2 Hardware configuration

TSX I/O rack :



Position 2 : TSX DET 3212 discrete input module which handles :

- processor commands :
  - Input 0 : START command.
  - Input 1 : End of supply phase.
  - Input 2 : End of assembly phase.
  - Input 3 : End of evacuation phase.
  - Input 4 : Stop request.

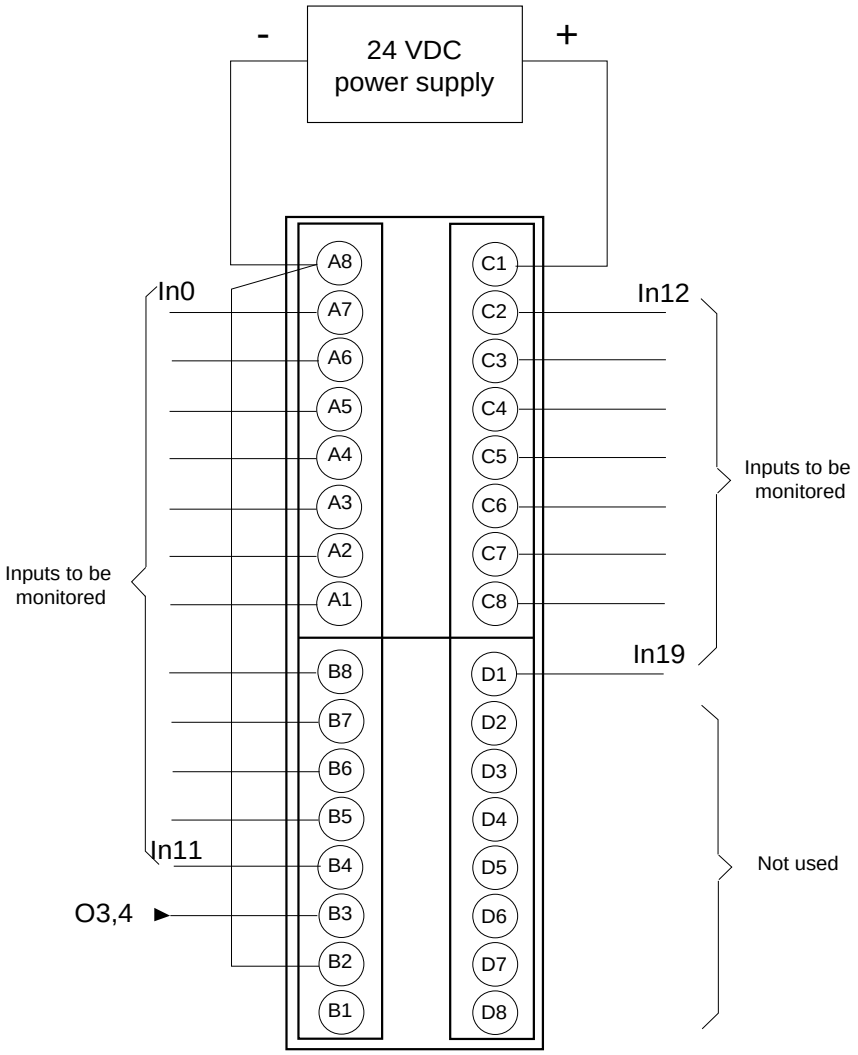
- operator commands - DEM module :
  - Input 8 : stop logging.
  - Input 9 : purge message stack.
  - Input A : log global status.
  - Input B : set time.
  - Input C : acknowledge faults.

Position 3 : TSX DST 2472 discrete output module.
- Output 0 : synchronization fault.
- Output 1 : logging fault.
- Output 2 : TSX DEM 2412 module fault.
- Output 4 : Synchronization pulse (every minute).

Position 4 : TSX DEM 2412 time-stamping module.

Position 7 : TSX SCM 21xx communication module for connection to peripheral equipment.

TSX BLK4 terminal block wiring



5.3 Implementation

5.3-1 Assignment of variables

The I/O variables are defined in the hardware configuration.

The Text Blocks perform the following functions :

Block nbr	Associated buffer	Role
TXT0	CW0 (9)	Loading the configuration
TXT1	Rec. W0 (117) Trans. W117 (2)	Reading logging data
TXT2	W200 (4)	Setting the module time
TXT3	W190 (6)	Acknowledgement of module faults (reading BDEF string)

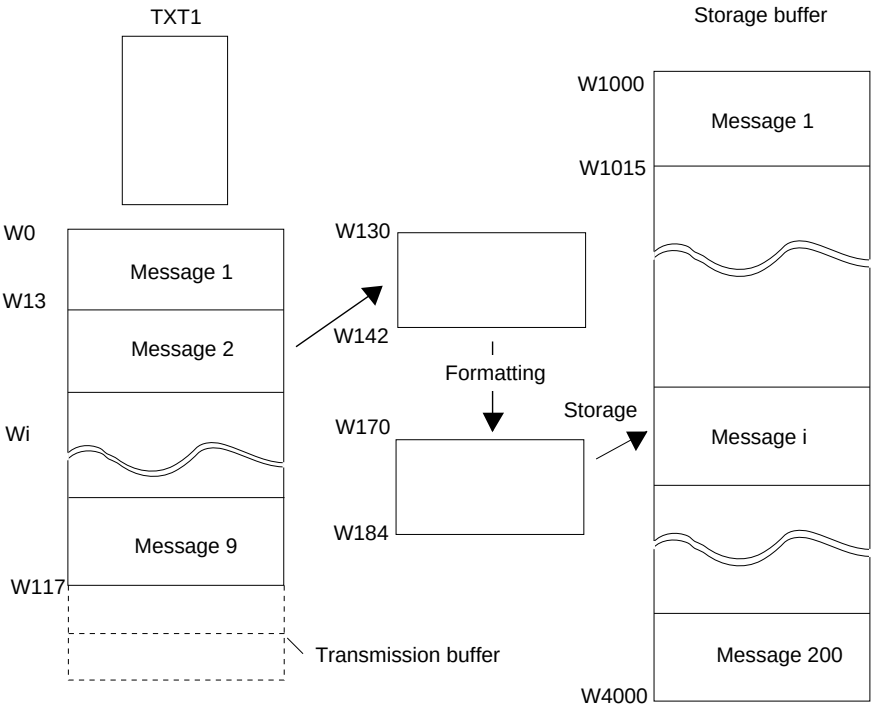
Internal words :

W0 (117) : TXT1 reception buffer
W117 (2) : TXT1 transmission buffer
W120 : Number of messages received
W121 : Number of messages being processed
W122 : Start address of message being processed in TXT1 buffer
W123 : Pointer in intermediate buffer
W124 : Pointer in TXT1 buffer
W130 (13) : Intermediate buffer (unformatted messages)
W150 : Working variable
W160 (3) : Buffer used for binary - ASCII conversion
W170 (15) : Intermediate buffer (formatted messages)
W185 : Intermediate buffer pointer
W186 : Storage buffer pointer
W190 (6) : Fault string
W200 (4) : Date and time formatting buffer
W1000 (3000) : Storage buffer (200 message capacity)

SW 51 to 56 : Data supplied by PLC real-time clock
B7 : SY7 recording
SY7 : "Minutes" system bit
B11 : Command to set module time during initialization phase.

Note :
Bits B7 and SY7 are used to generate the synchronization pulse.

5.3-2 Message processing illustration



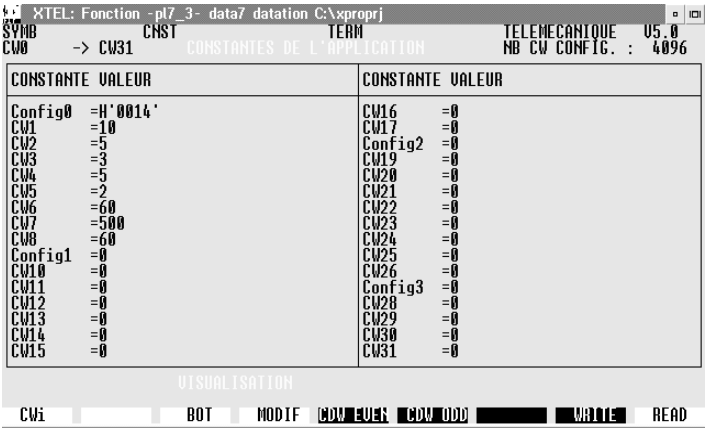
Messages from the text blocks are processed and formatted according to the above diagram.

5.3-3 TSX DEM 2412 module configuration

The configuration is coded on 9 constant words starting at CW0 according to the following information :

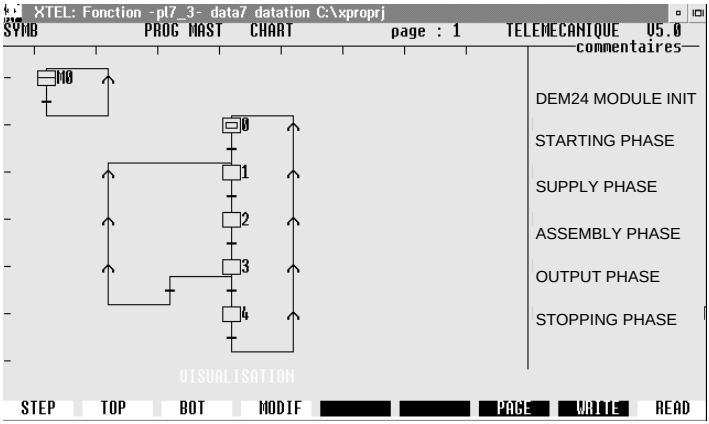
- CW0 : Performs periodic logging and detection of oscillating inputs.
- CW1 : Filter at 10 ms intervals.
- CW2 : Parameter linked to the oscillating inputs.
- CW3 : Refers to the number status changes for the oscillating inputs.
- CW4 : Oscillating state if more than 4 changes every 5 seconds.
- CW5 : Parameter linked to the detection of oscillating inputs. In example below, non-oscillating state if less than 2 changes every 5 seconds.
- CW6 : Synchronization pulse period = 60 seconds.
- CW7 : Permissible drift = 500 ms.
- CW8 : Logging period = 60 min.

The window below shows the configuration of these constant words :



5.3-4 Programming

Global operation of the process is linked to a graph from the **CHART** program. This graph appears as follows :



Description of the PRE module MAST Task application program

```
< RESET address pointer of the message storage buffer on cold start
!L10  : IF SY0
            THEN 0 -> W186
```

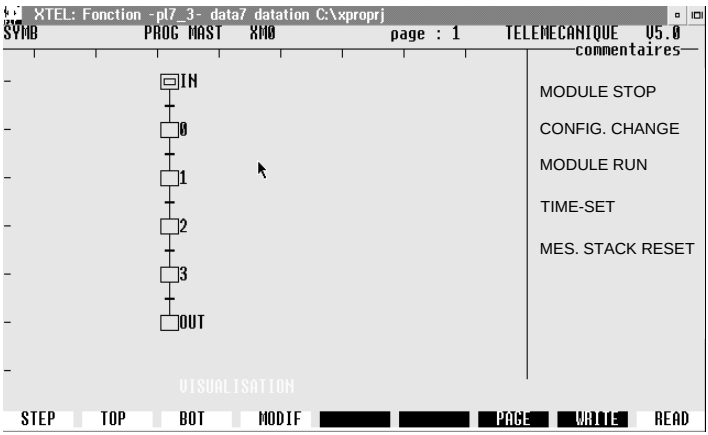
CHART transition and step processing program

```
                          CHART T: M0 > M0
!     IW4,2,D+IW4,0,B
                          CHART S(A)0
< no logging in this phase
!     0->OW4,2->OW4,3
                          T: 0>1
!     I2,0
                          CHART S(A)1
<logging request for inputs 0 to 7
!     H(FF(->OW4,2;0->OW4,3
                          T: 1>2
!     I2,1
                          CHART S(A)2
<logging request for inputs 0 to 15
!     H(FFFF(->OW4,2;0->OW4,3
                          T: 2>3
!     I2,2
```

```
                        CHART S(A)3
<logging request for inputs 12 to 19
!     H(F000(->OW4,2;H (F(->OW4,3
                        T: 3>1
!     I2,3.NOT I2,4
                        T: 3>4
!     I2,3.I2,4
                        CHART S(A)4
<logging request for inputs 16 to 19
!     0->OW4,2;H (F(->OW4,3
                                                T: 4>0
!     I2,0
```

XM0 macro-step

The following window shows these different phases :
Detail of macro-step 0 (DEM 24 module initialization)



Description of macro-step XMO

```
                        XM0 S(A) IN
<Module stopped for configuration loading
!     RESET OW4,0,C
<logging stopped
!     SET OW4,1,0
XM0 T: IN>0
!     NOT IW4,0,C
                              XM0  S(A) 0
<module configuration loading
!     H(463(->TXT0,M;H(40(->TXT0,C;18->TXT0,L;EXCHG TXT0
                              XM0 T: 0>1
!     TXT0,D
                              XM0 S(A) 1
<module set to run
!     SET OW4,0,C
                              XM0 T: 1>2
!     IW4,0,C
                              XM0 S(A) 2
<request for module time-setting (dealt with in post-processing)
!     SET B11
                              XM0 T: 2>3
!     TXT2,D
                              XM0 S(A) 3
<stack purge bit set to 1
!     SET OW4,1,1
                              XM0 S(D) 3
<RESET stack purge bit
!     RESET OW4,4,1
                              XM0 T: 3>OUT
!     (IW4,5=0)
```

Description of POST program

Task management :

- Setting time on time-stamping module
- Taking operator commands into account

```
<********** SETTING THE MODULE TIME **********
!L10   :

<synchronization pulse generation every minute
!L11   :IF SY7.NOT B7
                THEN SET 03,4
                ELSE RESET 03,4

!       SY7→B7

<setting the time on operator command or during initialization sequence
!L12   :IF NOT (RE(I2,B)+RE(B11))
                THEN JUMP L20
                ELSE RESET B11

<formatting PLC date / time
!       SHL 8(SW56 REM 100)OR SW55→W200

!       SHL 8(SW54)OR SW53→W201

!       SHL 8(SW52)OR SW51→W202

<transferring date / time to module
!       INC W203;H'FF' AND W203→W203

!       H'400'→Txt_2,M;2→Txt_2,C;8→Txt_2,L;EXCHG Txt_2

<**********  RECOGNITION OF USER COMMANDS  **********
!L20   :

< general stop logging command
!       I2,8→OW4,1,0

< purge module message stack command
!       I2,9→OW4,1,1

<log general card state command
!       I2,A→OW4,1,2
```

Managing the module message stack :

```
<--------- PROCESSING MESSAGES ACQUIRED DURING PREVIOUS CYCLE---------
!L31    :

<! was message acquisition requested on previous cycle?
!         IF NOT B1
                  THEN JUMP L32

<! yes; acquisition performed ?
!         IF NOT Txt_1,D THEN JUMP L40
                  ELSE RESET B1

<! how many messages have been acquired ?
!         SHR 8(W0)→W120;0→W121

<! message processing loop
!         WHILE [W121<W120]
                  DO CALL SR0;INC W121
```

Request to read messages logged in the stack :

```
<---------          REQUEST TO READ MESSAGES IN THE STACK    --------
!L32    :

< check for messages in the stack
!         IF [IW4,5=0]
                  THEN JUMP L40

<! request to read messages in the stack
!         1→W117;IW4,5→W118;
          H'400'→Txt_1,M;1→Txt_1,C;4→Txt_1,L;EXCHG Txt_1;SET B1
```

Alarm management :

```
<***************** ALARM MANAGEMENT **********************************
!L40    :

<! synchronization fault
!         I4,4→U3,0

<! logging fault
!         NOT I4,0+I4,3→U3,1

<! DEM module faulty
!         IW4,0,8+NOT IW4,0,C+IW4,0,6+IW4,0,A→U3,2

<! acknowledgement of module faults
!         IF RE(12,C)
                  THEN H'463'→Txt_3,M;H'47'→Txt_3,C;6→Txt_3,L;EXCHG Txt_3

<***************** END OF PROCESSING **********************************
!L90    :
```

Description of subroutine SR0 :

Formatting of messages for their eventual use.

```
!<********** SUBROUTINE FOR FORMATTING MESSAGES *********
!
!<recover message using its order number
!       W121*13→W122;0→W123
!
!       WHILE [W123<13]
!               DO W122+W123→W124;W0(W124)→W130(W123);INC W123
!
!<prepare for display
!
!<day
!       SHR 8(W133)→W150;BTA(W150)→W160[3];W162→W170
!
!<month
!       H'FF' AND W132→W150;BTA(W150)→W160[3];W162→W171
!
!< year
!       SHR 8(W132)→W150;BTA(W150)→W160[3];W162→W172
!
!< hour
!       H'FF' AND W133→W150;BTA(W150)→W160[3];W162→W173
!
!<minutes
!       SHR 8(W134)→W150;BTA(W150)→W160[3];W162→W174
!
!< seconds
!       H'FF' AND W134→W150;BTA(W150)→W160[3];W162→W175
!
!< milliseconds
!       BTA(W135)→W160[3];W161 AND H'FF00'→W176;W162→W177
!
!< rack number
!       SHR 8(W136)→W150;BTA(W150)→W160[3];W162→W178
!
!<slot number
!       H'FF' AND W136→W150;BTA(W150)→W160[3];W162 AND H'FF00'→W179
!
!< message type identification (change channel state or overall card state)
!       IF W131,A
!               THEN M'DG'→W180;W139[4]→W181[4];JUMP L20
!
!< channel number
!       SHR 8(W137)→W150;BTA(W150)→W160[3];W162→W180
!
!<channel state
!       IF [H'3' AND W137=0]
!               THEN M'of'→W181;JUMP L20
!
!       IF [H'3' AND W137=1]
!               THEN M'on'→W181;JUMP L20
```

```
!       IF [H'3' AND W137=2]
                THEN M'ba'→W181
                ELSE M'??'→W181

< transfer message to storage zone for eventual listing
!L20    :

!       0→W185

!       WHILE [W185<15]
                DO W170(W185)→W1000(W186);INC W185;INC W186

!       IF [W186>=3000]
                THEN 0→W186

!       RET
```

6.1 Selection of slot and locating device

TSX DEM 24 modules can be installed in all racks comprising a complete bus. The time-stamping modules have two types of locating device :

Locating device	TSX DEM 2412	TSX DEM 2413
Mechanical : Via 3-figure locating devices at back of module.	777	778
Program : Entered during configuration.	777	778

6.2 Configuring the module under X-TEL

6.2-1 PLC version V4 or earlier

I/O configuration performed with PL7-3 software in configuration mode, under item " 2 - INPUTS/OUTPUTS ".
For modules TSX DEM 2412 and TSX DEM 2413, enter codes :
- 777 for DEM 2412 module,
- 778 for DEM 2413 module.

6.2-2 PLC version V5 or later

I/O configuration performed with XTEL-CONF tool.
There are two options, depending on the software workshop version :

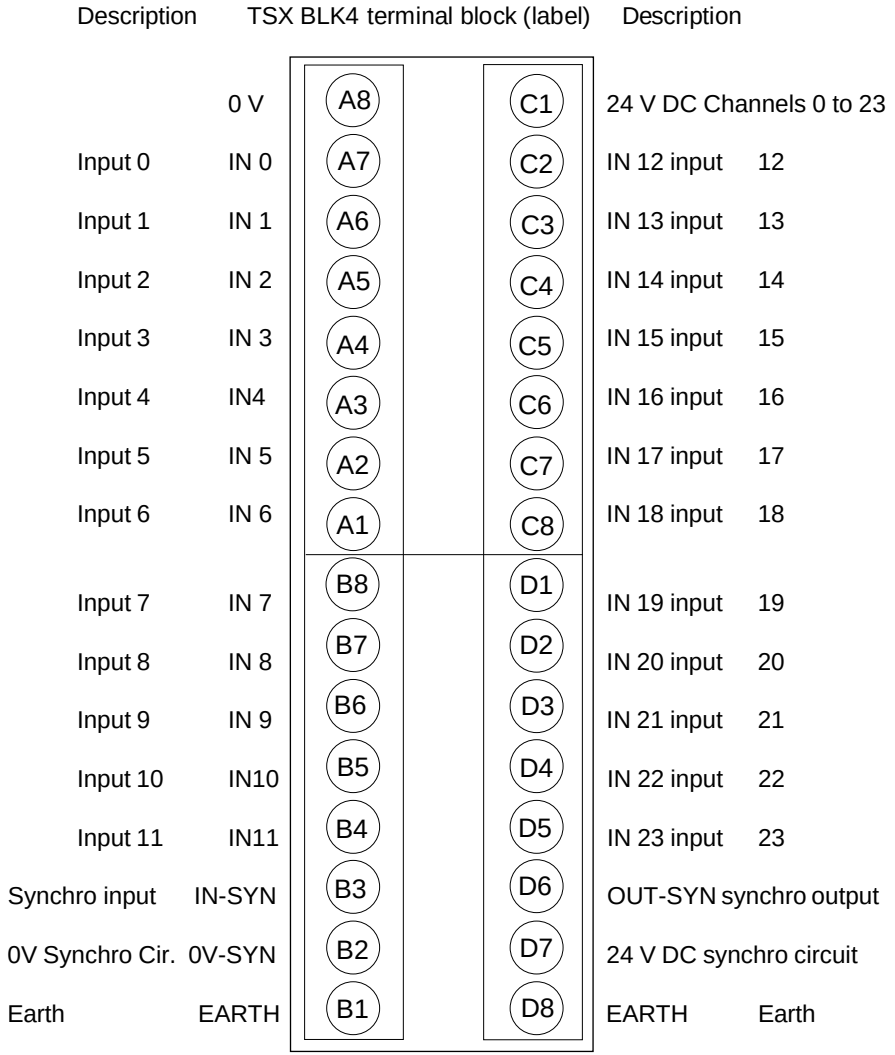
. V5 software workshop (V5.0 < or = "Version" < V5.5) :
- access to codes 777 (DEM 2412) and 778 (DEM 2413) is via the RESERVE family,

. V5.2 software workshop ("Version" > or = V5.5) :
- access to codes 777 (DEM 2412) and 778 (DEM 2413) is via the TIME-STAMPING family.

Note :
The number of time-stamping **modules** is **limited** to **32** in a single PLC configuration.

6.3 Connection

The modules are connected via a TSX BLK4 terminal block equipped with 32 screw terminals.



The interface of input channels 0 to 23 and the synchronization circuit interface are electrically isolated to 2.5 KV in order to protect the synchronization signals from induced external noises in series and common mode. It is advisable to respect this isolation and to use shielded or twisted cables with a minimum cross-section of 0.22 mm^2 for synchronization signals.

7.1 Consumption

The electrical consumption of the TSX DEM 24 time-stamping modules is 130 mA at 5V DC voltage.

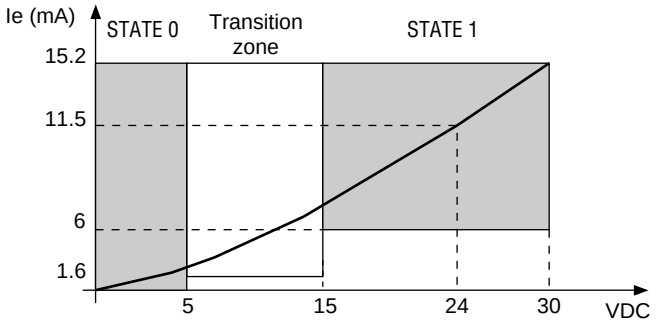
7.2 Input characteristics

The main characteristics of TSX DEM 24 modules are as follows :

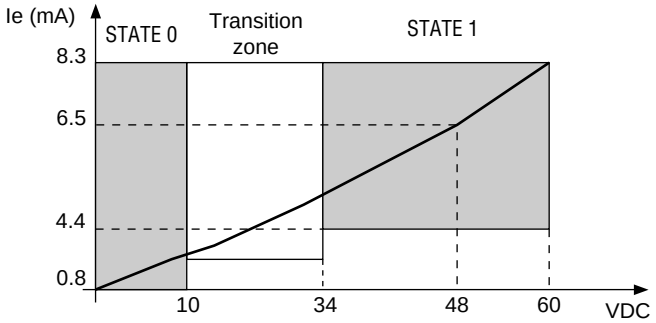
Characteristics	**TSX DEM 2412**
Number of discrete input channels	24
Nominal operating voltage	24V DC - 15%, +20% Maximum residual ripple : 500 mV peak to peak
Current consumed on rated voltage	11.5 mA per channel - Type 1
Protection against reversed polarity	Yes
Module cycle time	Less than a millisecond
Module time base precision	25 ppm (0.0025 %)
Discrete input digital filtering	0 to 50 milliseconds
Isolation between inputs and PLC	2.5 kV
Synchronization input	Identical characteristics to 24-Input modules
Synchronization output	Open collector. Maximum 32 modules
Operating temperature	5 to 55°C
Storage temperature	-25 to + 70°C
Operation relative humidity	< or = 90% without condensation
Standard	IEC 1131 - EN 63 850
Approvals	UL

Characteristics	**TSX DEM 2413**
Number of discrete input channels	24
Nominal operating voltage	48V DC - 15%, +20% Maximum residual ripple : 500 mV peak to peak
Current consumed at nominal voltage	6.5 mA per channel - Type 1
Protection against reversed polarity	Yes
Module cycle time	Less than a millisecond
Module time base precision	25 ppm (0.0025 %)
Discrete input digital filtering	0 to 50 milliseconds
Isolation between inputs and PLC	2.5 kV
Synchronization input	Identical characteristics to 24-Input modules
Synchronization output	Open collector. Maximum 32 modules
Operating temperature	5 to 55°C
Storage temperature	-25 to + 70°C
Relative operating humidity	< or = 90% without condensation
Standard	IEC 1131 - EN 63 850

TSX DEM 2412 module input characteristics :



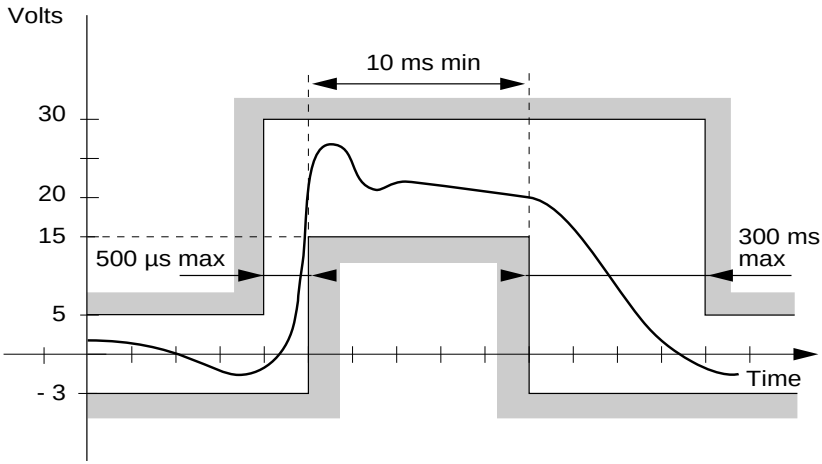
TSX DEM 2413 module input characteristics :



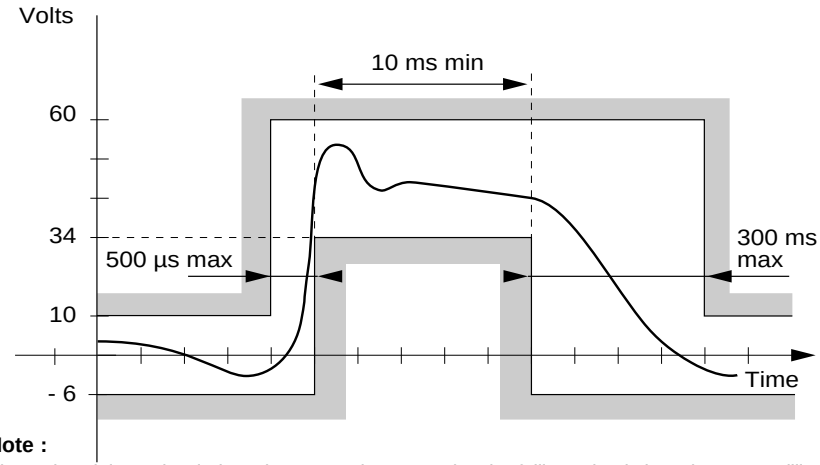
Synchronization input

This is used to reset the card internal clock. This input accepts a positive or negative pulse, and its filtering is less than 500 microseconds for a 2.8 Kohm impedance. This input is electrically isolated from the "discrete input and logic" interfaces.
Synchronization pulses must conform to the following patterns :

Signal relating to synchronization pulse for TSX DEM 2412 module :



Signal relating to synchronization pulse for TSX DEM 2413 module :



Note :
The pulse rising edge is less than 500 microseconds ; the falling edge is less than 300 milliseconds ; the synchronization pulse time is less than 10 ms.

Synchronization output

This output is used when the external clock is incapable of supplying several time-stamping modules.
It transmits synchronization pulses to other time-stamping modules. It is an open collector type output which can be used to control up to 32 modules.

Monitoring terminal block presence

Terminal block presence is monitored automatically via a mechanical contact activated by the TSX BLK4 connector.

Monitoring external voltage

This is optional. The aim of this monitoring is to detect loss of external power supply before the state of the inputs becomes insignificant.