

SIMATIC

Process Control System PCS 7 10 ms Time Stamps

Manual

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Caution

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Preface

Purpose of the Documentation

This documentation provides you with an overview of the required components, the interaction between the components and the configuration of the components for use of 10 ms time stamps.

The first section outlines the possibilities and applications of 10 ms time stamps and is intended for:

- Future users of SIMATIC PCS 7
- Persons responsible for deciding on the use of a control system
- Marketing Departments and system configuration engineers either within Siemens or belonging to other companies

The other sections deal with the system design and configuration of 10 ms time stamps and are intended for people working in the following areas:

- Theoretical design of PCS 7 solutions
- Plant and system programming
- Configuration and commissioning
- Service

Basic Knowledge Required

To understand this manual, you should be familiar with automation engineering and process control engineering.

You should also have experience of using PCs and similar (for example programming devices) and the Windows 2000 operating system.

Scope of the Documentation

This manual is valid for the "Process Control System PCS 7 Toolset V6.0" software package.

Further Support

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- Information on field service, repairs, spare parts and more under "Services".

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1 Basic Information on Time Stamps

This documentation describes the function of time stamps for digital input signals. Users can activate time stamps in their system and display the time information in a monitoring system.

Definition

In the context of this manual, the term time stamp is used as follows:

The assignment

- of time information with a high degree of accuracy (10 ms)
- to the signal change of a detected process signal.

The detection of changes in the state of digital input signals and the assignment of time information is performed by SIMATIC components.

Application

Possible applications include:

- Accurate time information when detecting a problem in a processing plant. With time stamps, it is possible to identify signals that indicate the cause of the failure of a unit.
- Analysis of interrelationships within a plant
- Detection and reporting the sequence of time-critical signal changes

Requirement

Time stamps can only be used when the time-of-day is synchronized on all the devices belonging to the system. This requires a connection to a time master.

Accuracy

The following rule applies to time stamps with an accuracy of 10 ms:

- When signals from the process are detected on separate PROFIBUS DP chains, and events arrive **simultaneously** at the input modules, the difference in the time stamps of the resulting messages in the monitoring system will not exceed a **maximum of 10 ms**.
- Time stamps are valid regardless of whether the PROFIBUS DP chains are located in one or more SIMATIC stations.

Resolution

The displayed resolution of the time is 1 ms (regardless of the accuracy).

Advantage

The use of time stamps is not dependent on cycle times.

Properties

- The time stamp function can run parallel to the cyclic signal detection on an IM 153-2.
- Time stamps can only be used for digital signals.

1.1 Time Stamps for Signal Changes

Accurate Message Time Information

The use of time stamps makes it easier to analyze the causes of problems.

Example

If a tank used to produce steam fails, this event causes a flurry of messages:

- The temperature and pressure fall below a specified limit value, the flame monitor responds, the next unit signals "steam low" etc.
- To determine the actual cause of the failure, the first message in this flurry of messages must be identified (for example "gas pressure too low").
- Since a large number of messages will arrive following the failure of a unit, a resolution of one second for the message time is inadequate. If the signals leading to the shutdown of the tank are detected and given time stamps, evaluation of the cause of the shutdown is much easier.

Interrelationships within a Plant

A further aspect of 10 ms time stamps is the recognition of interrelationships between units in a plant.

Example

Time stamps are activated throughout the entire plant:

By comparing the time stamps of relevant signals throughout the plant, a brief loss of quality in a unit can be traced to a failure in another unit.

Application

Caution!

Time stamps should only be used for important selected signals relevant to the process and under no circumstances for all the digital signals that are read in.

This function is useful when large numbers of signals are reported at the same time (for example when a fault occurs). Applying this to all binary signals would increase the risk of messages being lost due to buffer overflow.

1.2 Sequence of Time Stamps

The following table describes the sequence leading to a time stamp.

The digital inputs of a module used in the distributed I/O station ET 200M are monitored for signal changes.

Action	Who / Where	What
1.	IM 153-2	The IM stores the change in a signal state.
2.	IM 153-2	The IM 153-2 in the ET 200M stores the information about an "event entering state" with the current time-of-day in a message list (on the IM 153-2). Features: • The resolution of the time stamps is 1 ms. • Special messages are also saved in the message list (events influencing message processing). • A maximum of 20 messages in a message list form one data record. • An IM 153-2 can store up to 15 data records.
3.	IM 153-2	The IM 153-2 triggers a hardware interrupt on the DP master (for example, SIMATIC Station S7-4xx) when: • A message list (data record) is full of messages on the IM 153-2. • There is at least one message in a message list after one second.
4.	CPU	The CPU reads the data record as a reaction to the hardware interrupt (OB40).
5.	IM_DRV	The "IM_DRV" driver block generates an Alarm_T (Alarm_8 block with a time stamp in the first associated value) from the hardware interrupt. The Alarm_T transfers the event message to the connected operator stations. During the configuration phase, the user specifies which signal change 0->1 or 1->0 is signaled as "ENTERING STATE". The "EXITING STATE" message is generated when the state indicated by "ENTERING STATE" is left. The signals with a time stamp are entered without gaps and in ascending chronological order in the message list of the operator station. Message texts are stored as default in IM_DRV (see Section "PLC Process Control Message - Problems (with Time Stamps)") and can be adapted (see Section "Configuration > assigning message texts").
6.	Synchro- nization	All the operator stations and SIMATIC stations used in the system must be supplied with the same time-of-day: • The time-of-day synchronization (for time stamps) is implemented using a time master. • Various time masters are available, for example: - "Time Transmitter for Industrial Ethernet" - "SICLOCK TM" - "Synchronization using a PLC as time-of-day master"

2 Structure

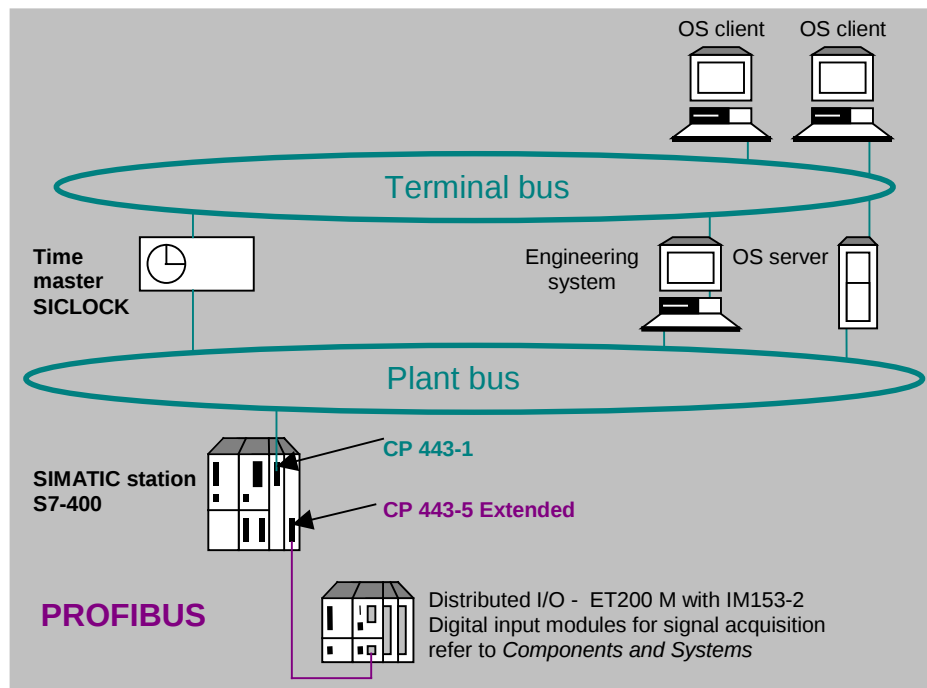
2.1 Hardware Structure

This section explains the hardware structure required for time stamps and includes information on the message buffer of the IM 153-2.

For further information on the IM153-2, refer to the manual *Distributed I/O Station ET 200M*.

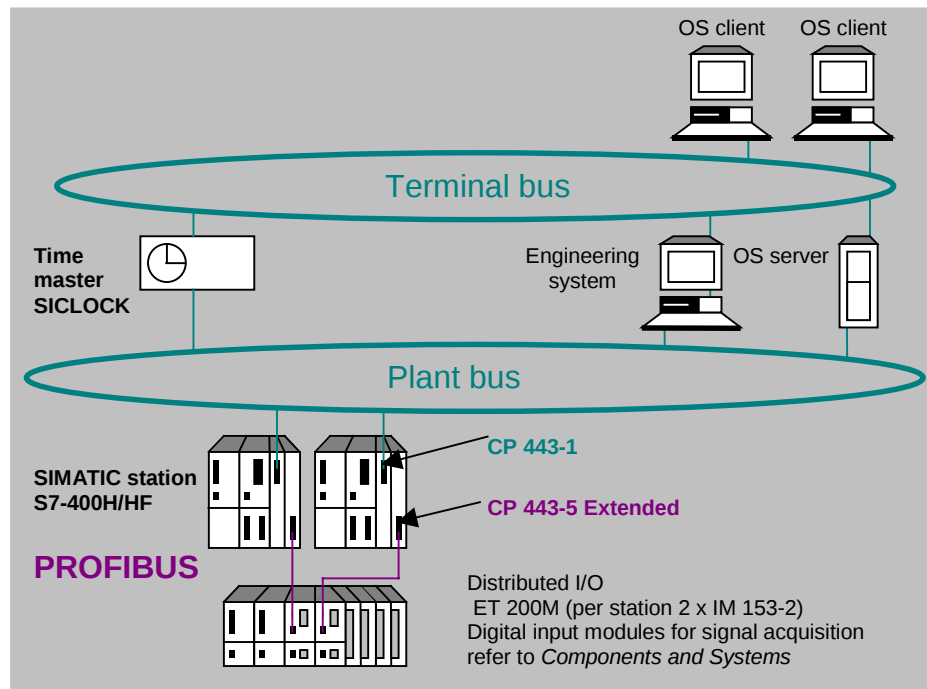
Example of a System with Time Stamps

The figure below illustrates the layout of a system with time stamps.



Example of a Redundant System with Time Stamps

You can also use the time stamp functionality in conjunction with an S7-400H and a redundantly configured ET 200M. The figure below is an example of a possible system.



Reaction to a Failover

- Both IM 153-2 modules store the message lists of the signals with time stamps.
- Following a failover or switchover from the active to the passive IM 153-2, the "new" active IM 153-2 sends the current message lists to the operator station.

For more detailed information on the messages, refer to the Section "PLC Process Control Message - Problems (with Time Stamps)".

2.2 Special Feature of the IM 153-2

Introduction

The message buffer of the IM153-2 can be overloaded by a flurry of signals or when too many signals are reported constantly. Such an overload would mean the loss of messages and must be taken into account when planning the system.

Flurry of Signals

When "unusual" events occur in a system (for example failure of part of the plant), signal states can change almost simultaneously.

This response can be explained by analyzing the technological relationships.

Example

Interpolations of the frequency of change of signals in a plant has shown the following:

- On average, approximately 2% of the signals change per second.
- In the worst case (for example failure of a plant section), up to 30% of the signals change state per second.

Loss of Messages

If all the time-stamped signals of a plant are collected on one ET 200M station, messages can be lost on the relevant IM153-2 when "unusual" events occur. The message loss is displayed using PLC process control messages depending on the cause (refer to the Section "PLC Process Control Message - Problems (with Time Stamps)").

Example with 10 ms Time Stamps

A system in its final configuration includes 1500 digital signals.

- According to the interpolation, in the worst case, 450 signals per second can change in this system.
- If there are 128 signals (max. 8 SM321 modules each with 16 inputs) on an ET 200M station, messages can be lost for the following reasons:
 - other system-internal messages are generated over and above the process messages (see Section "PLC Process Control Message - Problems (with Time Stamps)") and
 - the subsequent processing stages (IM 153-2, IM_DRV blocks, PLC message processing, OS message processing) require time to evaluate the process messages.

2.3 Planning and Configuring the Plant

Note

By implementing the steps listed below, you can avoid messages not being recorded in the archive due to a buffer overflow (for example if a fault occurs in the plant):

- When planning your system and during configuration, make sure that the relevant signals are distributed uniformly throughout the system.
 - If you modify the configuration, check the load on the SIMATIC station (in "Module Information - Online"). If you have SIMATIC stations with a heavy load, avoid configuring all signals with time stamps (see section: Basic Information on Time Stamps > Application).
 - If you want to configure a large number of signals with time stamps, it is advisable to separate analog and binary signals on a station basis.
 - You can configure up to a maximum of 128 digital inputs per station. Only digital inputs may be configured in the stations.
 - The delay times of the inputs must be identical.
-

3 Components and Systems

This section introduces you to the required components and systems.

Systems

To evaluate signals detected and assigned highly accurate time stamps, you must be able to display and archive these signals.

This is handled by the PCS 7 OS operator control and monitoring system in PCS 7.

Components

- SIMATIC station
- Communications modules
- Distributed I/O
- IM_DRV block
- Time master

3.1 SIMATIC Station

You process the messages and forward the messages to the operator station with a CPU 4xx.

3.2 Communications Modules

You can use the following communications modules for time stamps:

Properties	CP 443-1	CP 443-5 Extended
Used as...	Interface module system bus/plant bus	Interface module for the distributed I/O station ET 200M
Used to establish connection between ...	SIMATIC station and the operator station(s)	SIMATIC station and distributed I/O station ET 200M This module forwards the stamped messages transferred over PROFIBUS-DP (fieldbus) to the CPU.
Bus system	Industrial Ethernet / Fast Ethernet	PROFIBUS-DP (fieldbus)
Order no.	6GK7 443-1EX10-0XE0 6GK7 443-1EX02-0XE0 6GK7 443-1EX11-0XE0	6GK7 443-5DX02-0XE0 6GK7 443-5DX03-0XE0
Installation	In slots of the SIMATIC station in the universal rack (UR)	In slots of the SIMATIC station in the universal rack (UR)

Note:

Instead of the CP 443-5 Extended, you can also use the PROFIBUS DP interface of the CPU.

3.3 Distributed I/O

To detect signal changes, the following modules are used in the distributed I/O station ET 200M:

- Interface module for PROFIBUS-DP for preprocessing of signals:

Module	Product version	Order no.	Used as
IM 153-2	>=3	6ES7 153-2BA00-0XB0	Interface module
IM153-2 FO	>=3	6ES7 153-2BB00-0XB0	Interface module
IM 153-2	>=7	6ES7 153-2AA02-0XB0	Interface module
IM153-2 FO	>=6	6ES7 153-2AB01-0XB0	Interface module

Note:

For the modules with the order number 6ES7 153-2A..., a synchronization interval for the CPU is fixed to one second (increased CPU load). The synchronization interval for the CPU should be set to ten seconds for PCS 7.

- Digital input modules for detecting signal changes:

Module	Order no.	Used as
SM 321	6ES7 321-7BH00-0AB0	Module for acquiring the process signal with 16 floating inputs (24 V DC) and diagnostic messages.
SM 321	6ES7 321-7TH00-0AB0	Module for acquiring the process signal with 16 inputs (NAMUR)

Note:

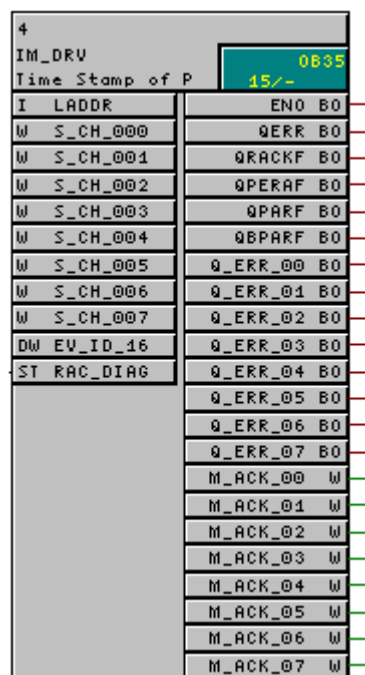
Signals can be compared when:

- uniform module types are used and
 - The parameter assignment of the modules is comparable (for example, the same delay time is set for inputs).
-

3.4 IM_DRV Block

If you use time stamps, the driver block **IM_DRV** (see figure below) is installed in a CFC chart by the system when the module drivers are generated:

- One **IM_DRV** is installed per IM 153-2 interface module in the system charts (the name of the system charts begins with the "@" character).
- The IM_DRV forms the interface between an IM153-2 and the operator station in a SIMATIC station.
- The IM_DRV reads the messages from the message buffer (maximum of 20 messages per buffer) of an IM153-2 and transfers them to the operator station.



3.5 Time Master

The time master is responsible for distributing the time signal to the stations that need to be synchronized (operator stations and SIMATIC stations).

The time master can be, for example a SICLOCK TM (for example, order no. 2XV9450-1AR00):

- The SICLOCK TM time master synchronizes the stations requiring synchronization that are connected to Industrial Ethernet/Fast Ethernet.
- The SICLOCK TM time master can be synchronized by a time signal, for example from a SICLOCK GPS decoder or a SICLOCK DCFRS receiver.

4 Configuring

This section describes the configuration of the time stamp functionality.

Note

Make sure that you only use modules that have been released for time stamp functionality (see Section "Components and Systems").

Overview of the Configuration Steps

Step	Action
1.	Configuring the CPs: • Configuring the CP 443-1 (Industrial Ethernet) • Configuring the PROFIBUS master
2.	Configuring the ET 200M station • Power supply (no configuration necessary) • Interface module: IM 153-2 • Digital input module: SM 321
3.	Configuring the CPU Properties
4.	Configuring Symbols
5.	Configuring the Input Signals
6.	Generating Module Drivers
7.	Assigning Message Texts
8.	Compiling and downloading the PLC
9.	Compiling the OS

4.1 Configuring the CPs

This section describes the following:

- Configuring the CP 443-1 (Industrial Ethernet)
- Configuring the PROFIBUS Master

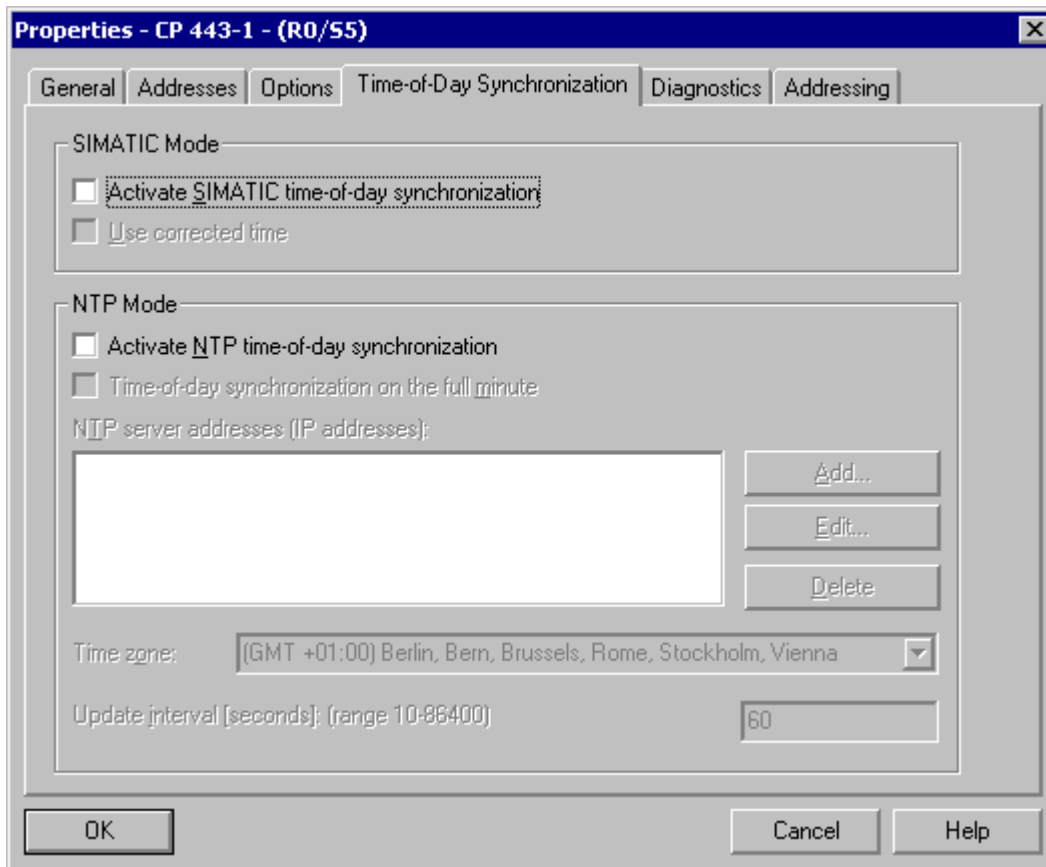
4.2 Configuring the CP 443-1 (Industrial Ethernet)

Introduction

A CP 443-1 must be configured in the configuration table of the SIMATIC station (type of CP: refer to the Section "Components and Systems > Communications Modules").

Parameter Assignment

1. Select the CP 443-1. Right-click and select "Object Properties" in the context-sensitive menu.
2. In the "Time-of-Day Synchronization" tab, select the "Activate SIMATIC time-of-day synchronization" option:



4.3 Configuring the PROFIBUS Master

Introduction

The PROFIBUS master is the component that distributes the system time on PROFIBUS.

Difference between the CP 443-5 Extended and PROFIBUS Interface of the CPU

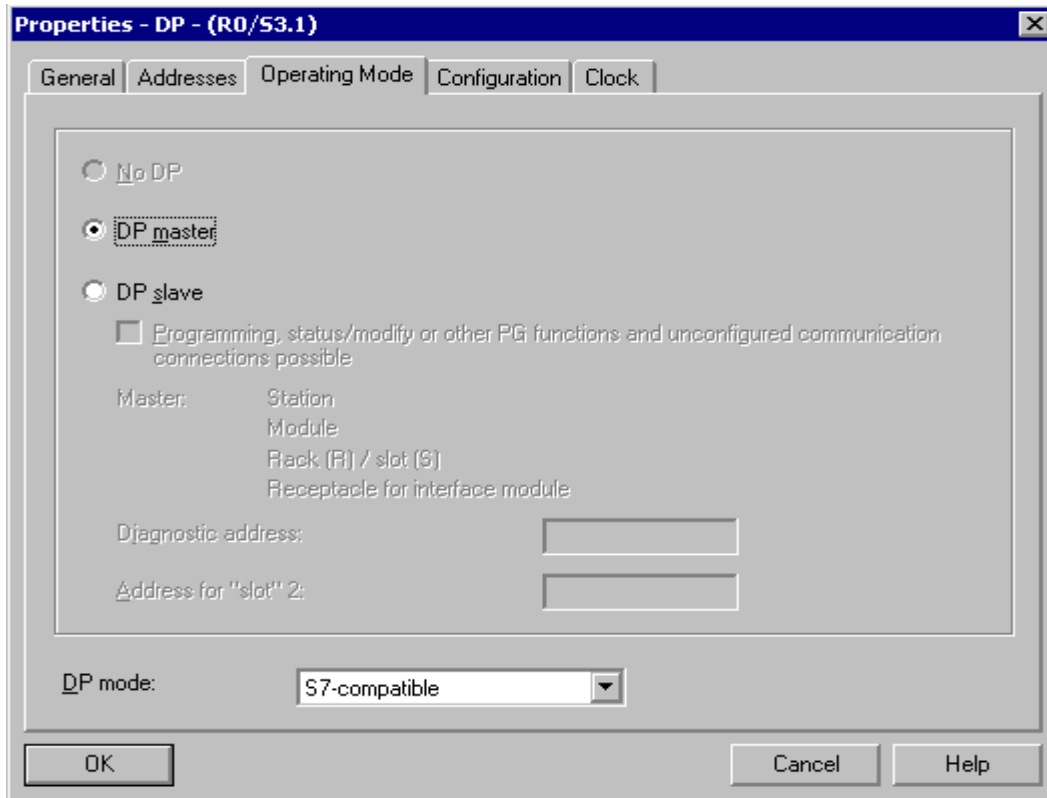
You can use the following components as the PROFIBUS master:

- A CP 443-5 Extended (parameter assignment CP 443-5 Extended)
- The internal PROFIBUS interface of the CPU (parameter assignment of the PROFIBUS interface of the CPU)

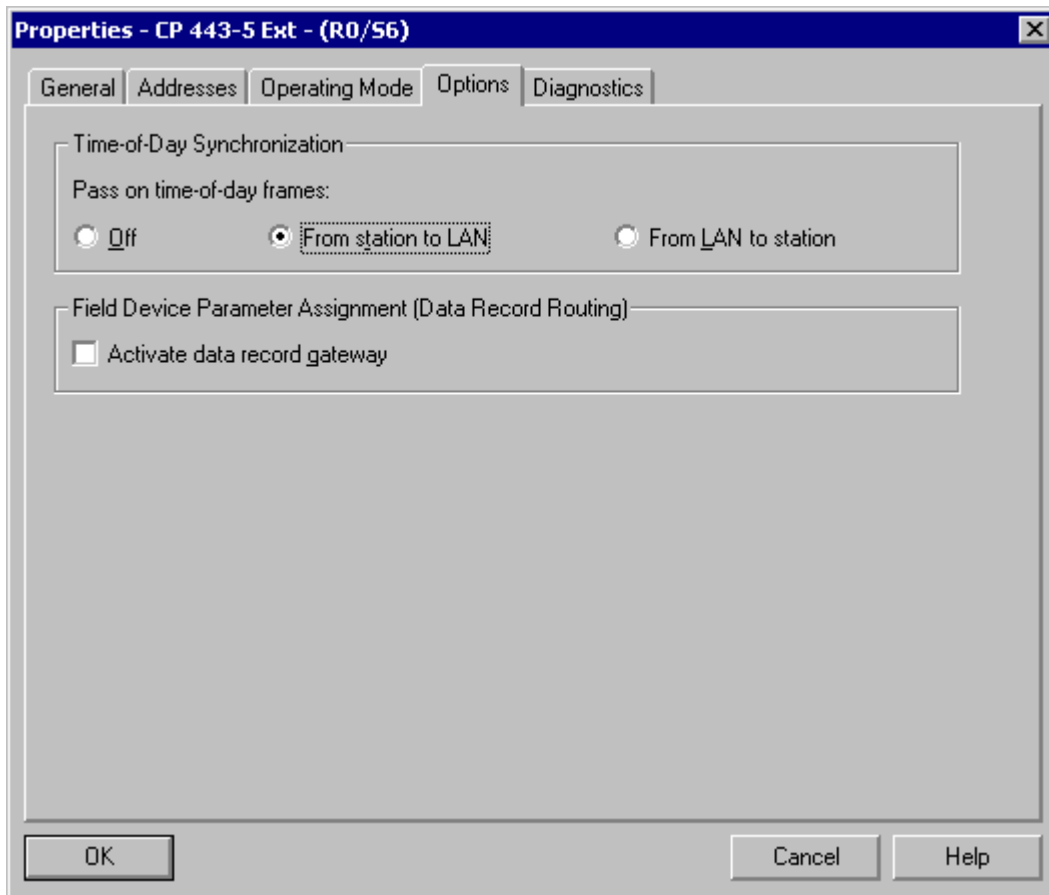
One of the components listed above must be configured in HW Config of the SIMATIC station (see Section "Components and Systems > Communications Modules").

4.3.1 Assigning Parameter Values to the CP 443-5 Extended

1. Select the CP 443-5 Extended in HW Config.
2. Right-click and select "Object Properties" in the context-sensitive menu.
3. Activate the "DP master" in the "Operating Mode" tab.



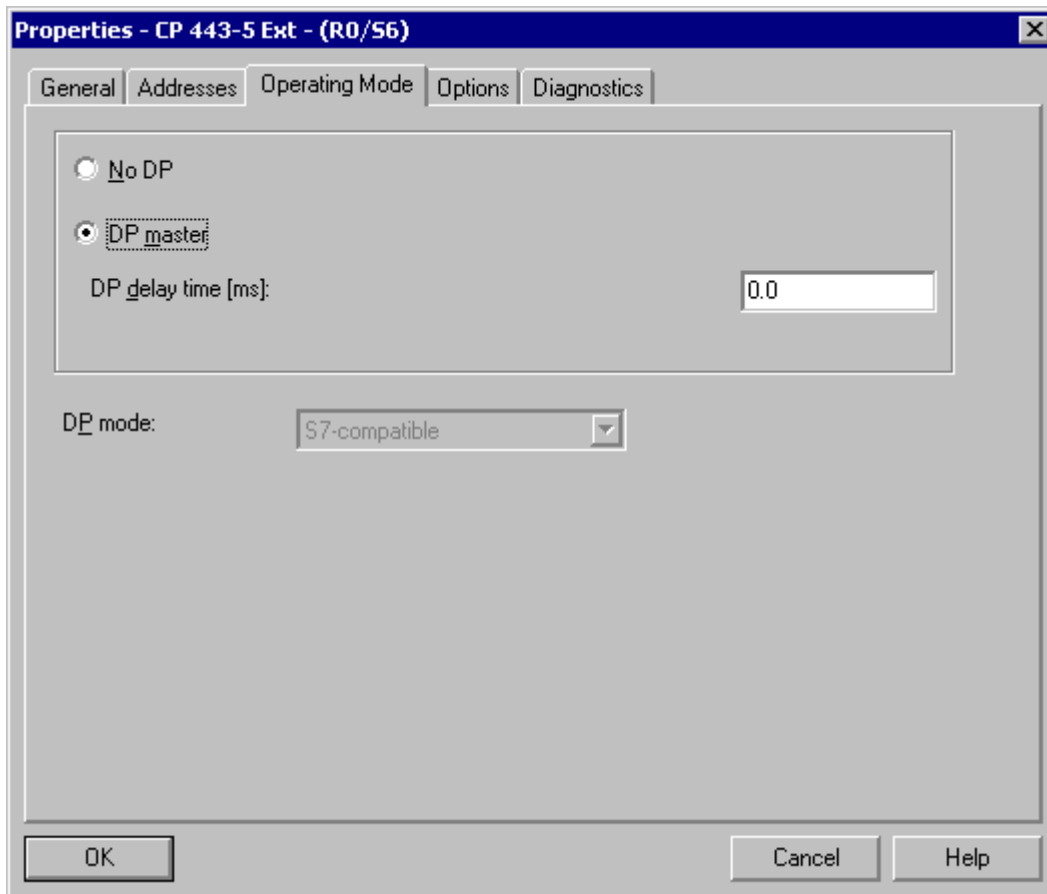
4. Select the "Options" tab.
5. In the "Time-of-Day Synchronization" area, activate the pass on time-of-day frames option "From station to LAN".
By activating this option, the time-of-day frames of the time master are forwarded to the PROFIBUS network.



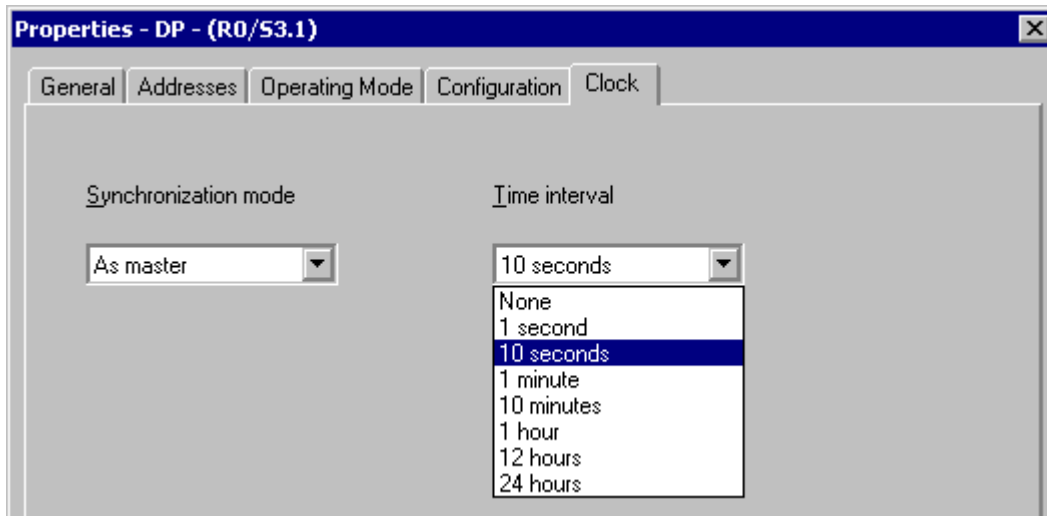
6. Confirm the settings by clicking on the "OK" button.

4.3.2 Assigning Parameter Values for the PROFIBUS Interface of the CPU

1. Select the PROFIBUS interface of the CPU in HW Config.
2. Right-click and select "Object Properties" in the context-sensitive menu.
3. Activate the "DP master" in the "Operating Mode" tab.



4. Select the "Clock" tab.
Select the type of synchronization "As slave".
By activating this option, the time-of-day frames of the time master are forwarded to the PROFIBUS network.



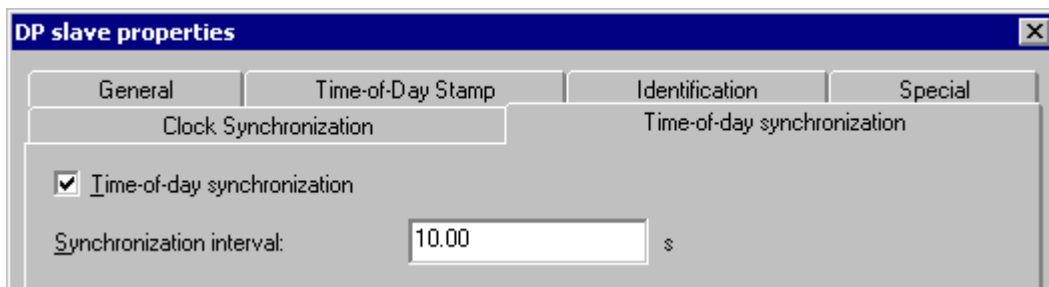
Note:

For the modules with the order number 6ES7 153-2A..., a synchronization interval for the CPU is fixed to one second (increased CPU load). The synchronization interval for the CPU should be set to ten seconds for PCS 7.

5. Note the following synchronization conditions relating to settings in the "Time interval" drop-down list box.

Dependency	Setting
Uniform IM types on the DP master system	Make the following setting for the synchronization of the DP slaves: - If all DP slaves on the DP master system expect a time interval of 1 second for the synchronization, set the value 1 second (for example IM153-2AA02). - If all DP slaves on the DP master system expect a time interval of 10 seconds for the synchronization, set the value 10 seconds (for example IM153-2BA00).
Different IM types on the DP master system	If you have mixed types (see uniform types on the DP master system) set the minimum necessary time interval for the chain.
Multiple synchronization	You can avoid multiple synchronization if you set the following time intervals to the same value: - The time interval for the synchronization of the DP slaves - The time interval with which the time master synchronizes the system.

Dependency	Setting
Minimizing the CPU load	If the DP slaves in the system expect a time interval of 1 second for synchronization, you can minimize the CPU load by making the following settings. • 10 seconds for the time master of the system • 1 second for the DP slaves
Variable time interval	Newer DP slaves (e.g. IM153-2BA00) support a variable time interval for synchronization. The value can be set in the parameters (see figure below).
Synchronization error	If the synchronization frame fails three times in succession, the IM 153-2 continues operation using the internal time and sends the following message to the operator station "Time-of day frame failure ENTERING STATE" (see section: PLC Process Control Message "Time-of day frame failure ENTERING STATE").



6. Confirm the settings by clicking on the "OK" button.

4.4 Configuring the ET 200M Station

Introduction

An ET 200M station with which time stamps can be implemented consists of the following components:

- Power supply (no configuration necessary)
- Interface module: IM 153-2
- Digital input module: SM 321

Hierarchical Setting Options

	Can be set in HW Config	Involves	Possible setting
Rack	Properties of the IM 153-2	All SM 321 modules in an ET 200M station	• Time stamps on/off • Rising or falling edge (refer to the examples of settings for the IM153-2 interface modules)
Module	Properties of the SM 321	All channels of an SM 321	• Time stamps on/off • Rising or falling edge (refer to the examples of settings for the SM 321 digital input module)
Channel	Properties of the SM 321	A single channel of an SM 321	• Time stamps on/off • Rising or falling edge (refer to the examples of settings for the SM 321 digital input module)

Note

By activating or deactivating higher up in the hierarchy (for example at the rack), settings at lower levels are overwritten.

4.5 Configuring the IM 153-2 Interface Module

Introduction

An IM 153-2 must be configured at the PROFIBUS interface of the CP 443-5 Extended with input modules for timestamping (type of IM: refer to the Section "Components and Systems > Distributed I/O").

Parameter Assignment

If you want to select the same settings for time stamps for all digital input modules of this ET 200M station, make these settings in the Object Properties of the IM 153-2 (otherwise you must make the settings in the Object Properties of each individual digital input module):

1. Select the IM 153-2. Right-click and select "Object Properties" in the context-sensitive menu.
2. In the "General" tab, assign a unique name for the IM 153-2 (see figure below). Using a unique name makes it easier to assign program blocks for further configuration steps and messages.

DP slave properties

General | Time-of-Day Stamp | Identification | Special

Module

Order Number: 6ES7 153-2BA00-0XB0

Family: ET 200M

DP Slave Type: IM 153-2

Designation: 10ms IM153-2

Addresses

Diagnostic Address: 16379

Node/Master system

PROFIBUS... 1

DP master system (1)

SYNC/FREEZE Capabilities

☒ SYNC ☒ FREEZE ☒ Watchdog

Comment:

1st station

OK Cancel Help

3. Select the "Time-of-Day Stamp" tab.

Note

The "Time-of-Day Stamp" tab only exists in the "Object Properties" dialog box of the IM 153-2 when at least one digital input module was configured in the ET 200M station that supports time stamps (digital module type: see Section "Components - Distributed I/O").

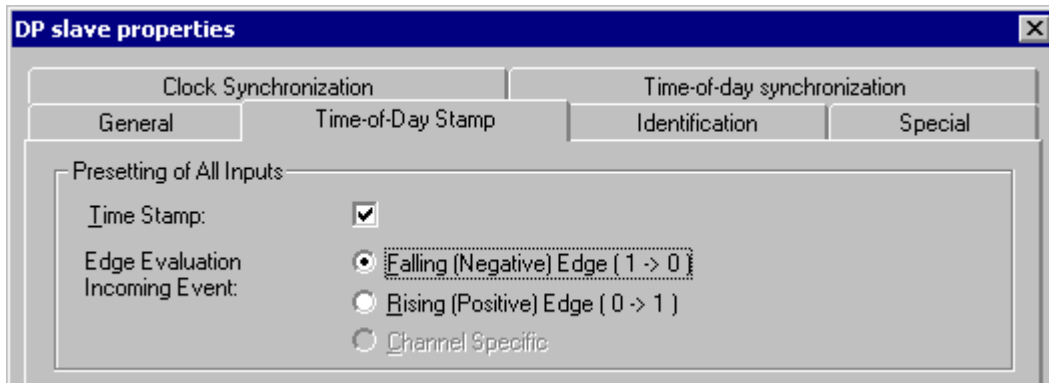
4. Activate the "Time-of-day stamp" check box below "Presetting of all inputs".
5. A message must be generated at the time at which the static state of a signal changes (in the value over time representation, a signal edge).
By activating the options for the "Edge Evaluation Incoming Event", you decide which edge of the process signal will be interpreted by the IM as an event entering the state - the opposite signal transition is interpreted as the signal exiting the state.
Select the option for the required signal change (examples in the Section "Configuring the ET 200M Station > Hierarchical Setting Options"):
 - for "Falling edge 1 -> 0" or
 - for "Rising edge 0 -> 1".
6. Confirm the settings by clicking on the "OK" button.

Caution!

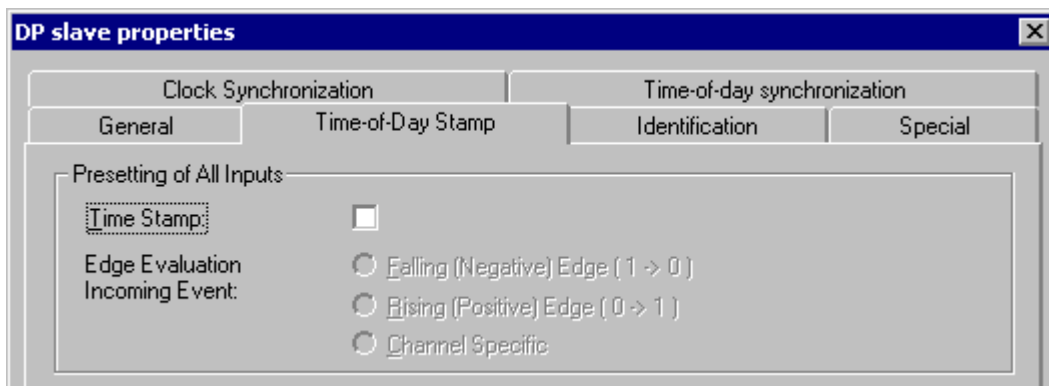
The settings in the "DP Slave Properties" dialog box apply to all channels on the digital input modules with time stamps used in this ET 200M station. If you make changes to the "Presetting of All Inputs", the setting affects **all** inputs of this ET 200M station.

4.5.1 Examples of Settings for the IM 153-2 Interface Module

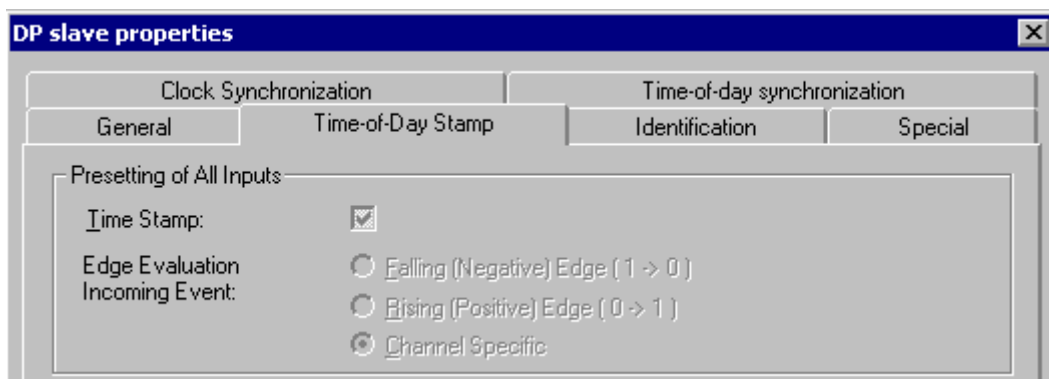
IM 153-2 - Time stamps Activated for the Entire ET 200M Station (or only one module with time stamps in this ET 200M station):



IM 153-2 - Time Stamps Deactivated for the ET 200M Station



IM 153-2 - Time Stamps Activated for (Individual) Modules or (Individual) Channels:



4.6 Configuring the SM 321 Digital Input Module

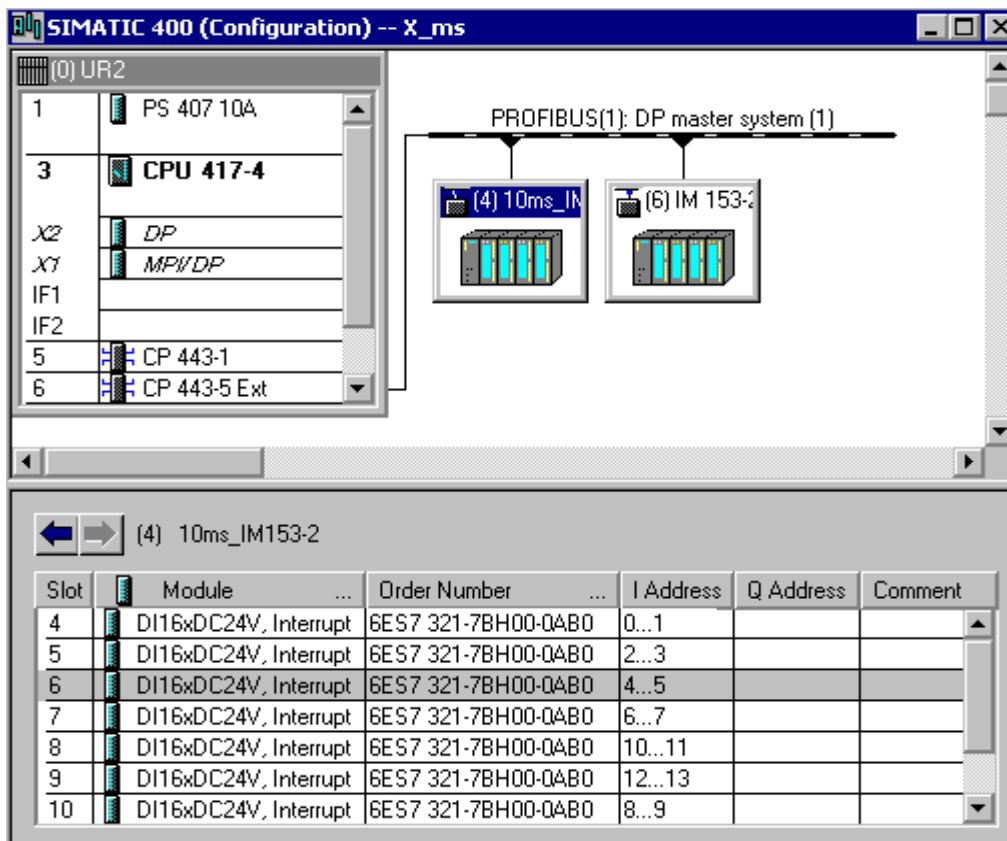
Introduction

- An SM 321 digital input module must be configured in one slot of the IM 153-2 (ET 200M station). For the type of digital module, refer to the section "Components and Systems > Distributed I/O".
- You make the settings relating to time-of-day synchronization for each module separately in the Object Properties of the digital input modules.

Parameter Assignment

If you want to make specific settings for the time stamps for individual inputs or selected digital input modules of this ET 200M station, you do this in the Object Properties of the SM 321, as follows:

1. Select the SM 321 digital input module in the IM 153-2 (see figure below), right-click and select the "Object Properties" in the context-sensitive menu.



2. In the "Time Stamp" tab, you can specify the time stamping and the edge evaluation (see: "Example of Settings on the Digital Input Module SM 321"):
 - for all inputs of a digital input module ("presetting of all inputs")
 - separately for each input of a digital input module ("individual setting of the inputs").

4.6.1 Example of Settings for the SM 321 Digital Input Module

Setting for the Module: Presetting of all Inputs Activated

Properties - DI16xDC24V, Interrupt - (R-/S6)

General | Addresses | **Inputs** | Time-of-Day Stamp

Presetting of All Inputs

Time stamp: ☒

Edge evaluation incoming event: 0 -> 1

Individual Setting of the Inputs

Input	0	1	2	3
Time stamp:	☒	☒	☒	☒
Edge evaluation incoming event:	0 -> 1	0 -> 1	0 -> 1	0 -> 1

Setting for the Module: Channel-Specific Individual Setting of the Inputs Activated

Properties - DI16xDC24V, Interrupt - (R-/S6)

General | Addresses | **Inputs** | Time-of-Day Stamp

Presetting of All Inputs

Time stamp: ☒

Edge evaluation incoming event: channel spec

Individual Setting of the Inputs

Input	0	1	2	3
Time stamp:	☒	☒	☐	☒
Edge evaluation incoming event:	0 -> 1	0 -> 1	...	1 -> 0

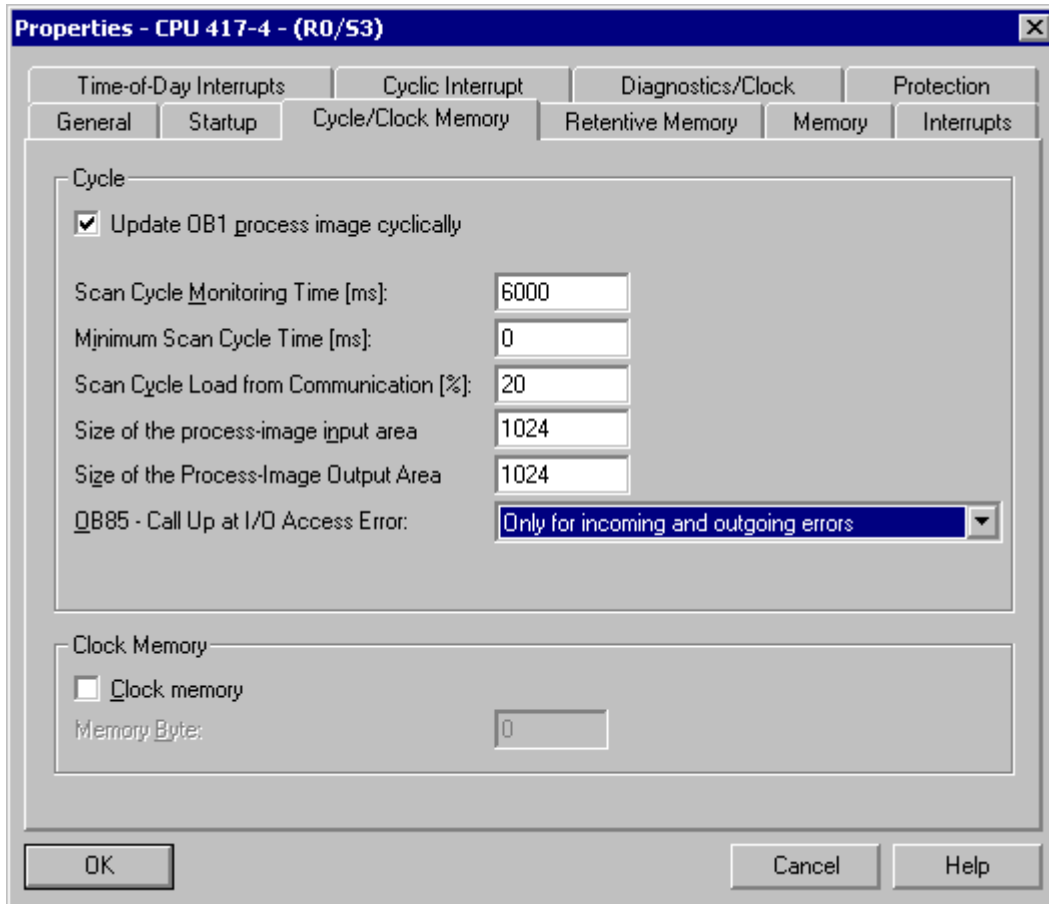
4.7 Configuring the CPU Properties

Introduction

The properties of the CPU must be set so that OB85 is called only be errors entering or exiting the state.

Parameter Assignment

1. Open HW Config.
2. Select the CPU. Right-click and select "Object Properties" in the context-sensitive menu.
3. Select the "Cycle/Clock Memory" tab
4. In the "OB85 - Call Up at I/O Access Error" combo box, select the setting "Only for incoming and outgoing errors".



5. Confirm the settings by clicking on the "OK" button.

4.8 Configuring Symbols

Introduction

You can assign symbolic names for the signals. Simple identification of the signals makes the interconnection of the driver blocks easier.

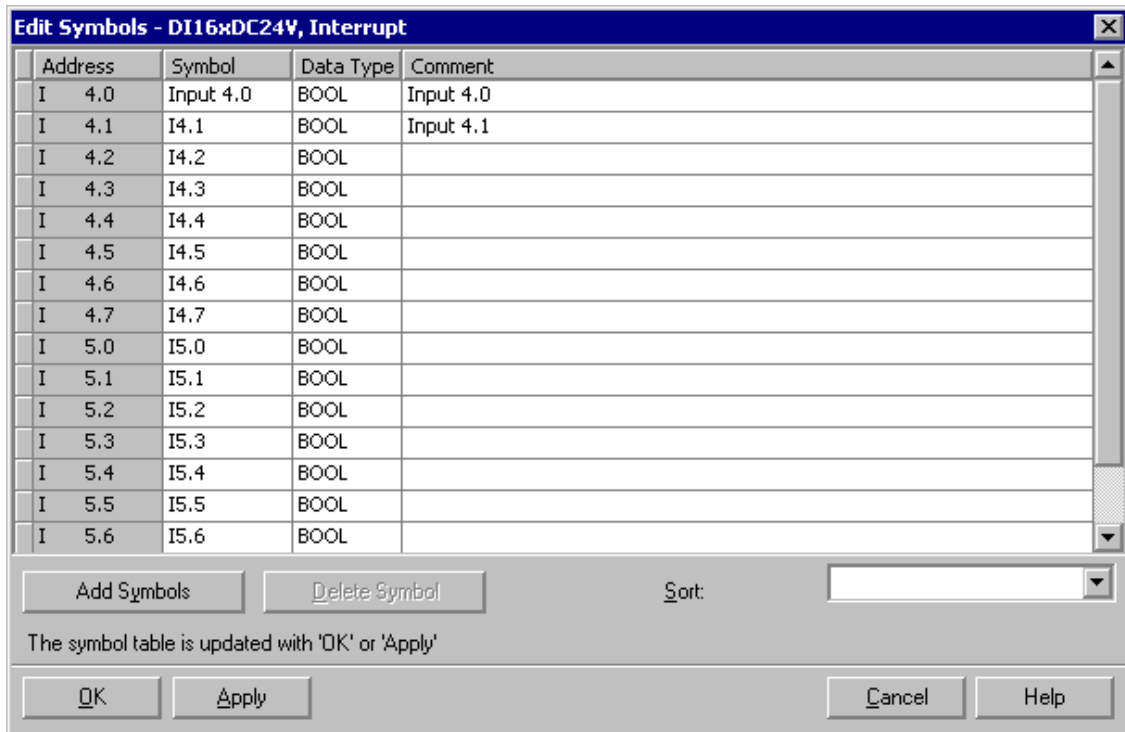
Preparations

1. Open the project in the **component view** in the SIMATIC Manager.
2. Set the path to the PLC and open HW Config.

Configuration

The following configuration must be made for all digital input modules.

1. Select an SM 321 digital input module.
2. In the configuration table of the module select a row in which an address of the process image is assigned.
3. Right-click and select "Edit Symbols" in the context-sensitive menu.
4. Enter the symbols (symbolic names) for the used inputs of the modules with time stamps in the hardware configuration (see figure below).
You adopt the addresses as a symbol using the "Add Symbol" button. The symbol name can be modified in the "Edit Symbols" dialog box or later in the symbol table (for example Symbol = "Chart_meas" - a maximum of 24 characters long).



4.9 Configuring the Input Signals

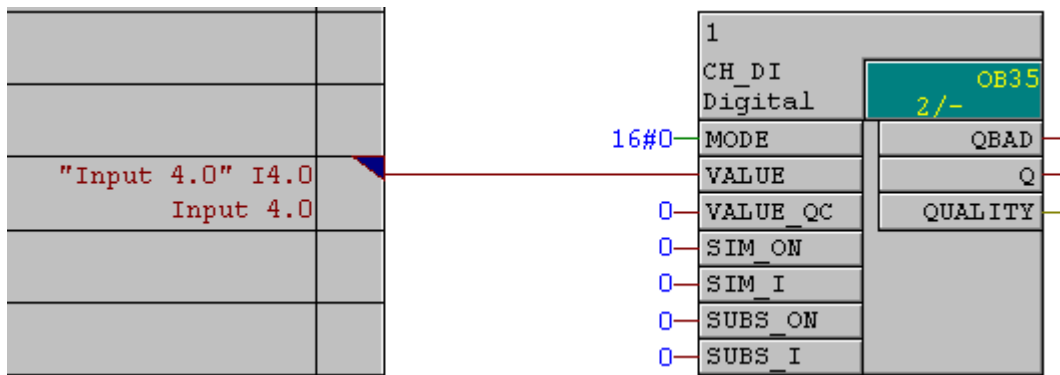
Configuration

1. In the CFC chart: Select the "VALUE" input of the CH_DI block.
2. Click on the menu command **Insert > Interconnection to Address**.
The "Insert Interconnection to Address" dialog box opens.
3. Select the row with the corresponding input and double-click on it (see figure below).

"Input 4.0"

I5.4	BOOL	I	5.4	
I5.5	BOOL	I	5.5	
I5.6	BOOL	I	5.6	
I5.7	BOOL	I	5.7	
Input 4.0	BOOL	I	4.0	Input 4.0

The input of the CH_DI block is interconnected (see figure below).



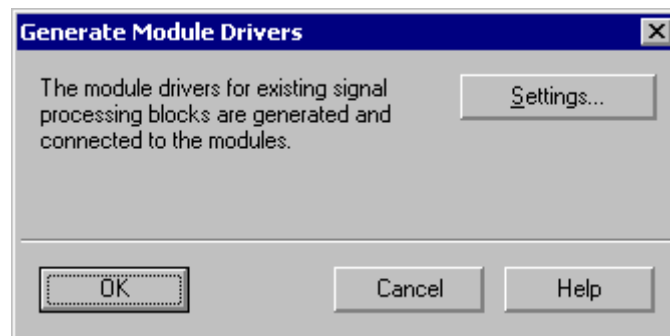
4.10 Generating Module Drivers

The module drivers in PCS 7 are special blocks for diagnostics and signaling errors that occur during the signal processing. With the "Generate Module Drivers" function, you can include these blocks in your charts automatically if the following conditions are met:

- The hardware is configured with HW Config and
- the technological functions are configured in CFC.

Steps

1. Open the project in the SIMATIC Manager: **View > Component View**.
2. Select the chart folder of the S7 program in the tree structure:
Project\SIMATIC Station\CPU\S7-Program\Charts.
3. Open the "Generate Module Drivers" dialog box using the menu command:
Options > Charts > Generate Module Drivers.
The "Generate Module Drivers" dialog box opens.



4. Click on the "Settings" button.
The "Settings - Generate Module Drivers" dialog box opens.
5. Check the library set in the "Library for module drivers" field.
 - If you only use the driver blocks supplied with PCS 7, the "Library for module drivers" is set by PCS 7.
 - If you use modified libraries or libraries you have created yourself, you will need to set the driver library.
Click the "Browse" button to select the folder.
6. Confirm the settings by clicking on the "OK" button.
7. Start the generation of the module drivers by clicking on the "OK" button (if the message "Drivers from earlier version" appears, confirm with "yes").

4.11 Assigning Message Texts

This section explains how you can modify the following message texts for signals with time stamps:

- The texts of the signal-specific user messages.
- the texts of the PLC process control messages (for a description of the messages refer to the section: "PLC Process Control Message - Problems (with Time Stamps)").

Note

These additional configuration steps are optional and are not necessary for time stamps.

Steps

1. Open the project in the SIMATIC Manager: **View > Component View**.
2. Select the station in which the IM 153-2 for time stamps is located.
3. In the detailed view, double click on "Hardware".
HW Config opens.
4. Select the IM153-2 and then select "Object Properties" in the context-sensitive menu.
The "DP Slave Properties" dialog box opens.
5. Change to the "General" tab and specify the name of the IM 153-2 in the "Module" area.
6. Open the project in the SIMATIC Manager: **View > Component View**.
7. Select the chart folder of the S7 program in the tree structure:
Project\SIMATIC Station\CPU\S7-Program\Charts.
8. Click on the menu command **Options > Charts > Chart Reference Data**.
The "Display Chart Reference Data" dialog box opens.
9. Select the menu command **View > Block Types**.
The "{S7 Program} (Block types)" dialog box opens.
10. Click on "Block Type" in the table header.
The entries are sorted alphabetically.
11. Search the list for the block for which the following entries apply:
 - Table column "Block Type" = IM_DRV and
 - table column "Block" = name of the IM 153-2 (see Step 5).
12. Double-click in the table row on the IM_DRV block type.
The CFC chart in which the IM_DRV block is located is opened and the IM_DRV is selected.

13. Select the menu command: **Edit > Object Properties**.
The "Properties - Block" dialog box opens.
14. Click on the "Messages" button in the "Special object properties" area.
The "PCS 7 Message Configuration" dialog box opens.
15. In the "Event" area you can modify the message texts:
 - For the message identifier range "EV_ID_00", the texts of the PLC process control messages, refer to the section: PLC Process Control Message - Problems (with Time Stamps).
 - For the message identifier range "EV_ID_01" to "EV_ID_16" the texts of the signal-specific user messages.
16. Confirm the settings by clicking on the "OK" button.

Further Information

For more detailed information on configuring messages, refer to the *Help on STEP 7*, topic "*Creating block-related messages (throughout a project)*".

4.12 Compiling and Downloading the PLC

There are several ways of compiling and downloading programs:

- You can run the functions for an individual SIMATIC station.
- You can compile and download several SIMATIC station with one function.

Further Information

For further information and detailed step-by-step instructions, refer to the Configuration Manual; *Process Control System PCS 7; Engineering System*.

4.13 Compiling the OS Data

4.13.1 Compiling the OS

There are several ways of compiling and downloading the operator stations:

- You can compile an individual operator station
- You can compile several operator stations at the same time.

Further Information

For further information and detailed step-by-step instructions, refer to the Configuration Manual; *Process Control System PCS 7; Operator Station*.

5 PLC Process Control Message - Problem (with Time Stamps)

5.1 Problems with Time Stamps

Introduction

The PLC process control messages that relate to time stamps are explained in this section.

For more detailed information on modifying message texts, refer to "Configuration > Assigning Message Texts".

Overview of the PLC Process Control Messages:

- Startup Data
- Time-of-day frame failure
- Time difference frame/internal clock jeopardizing accuracy
- Time stamp functionality stopped
- Loss of messages on IM (buffer overflow)

Additional Messages Relating to Redundancy in H Systems

- Failover in redundant system
- Loss of redundancy information

5.2 PLC Process Control Message - Startup data

Introduction

The "Startup data ..." PLC process control message indicates a cold or warm restart on the IM 153-2.

Messages

- "Startup data ENTERING state"
- "Startup data EXITING state"

Description

1. Following a warm or cold restart, the IM module sends the signal for the PLC process control message "Startup data ENTERING state" to the CPU.
2. The IM module then sends messages signaling the static state of all configured process signals.
Based on the process signal, the IM module derives the signal to be sent according to the configuration:

Status of Process Signal	Configured Edge Evaluation for Event Entering State:	IM Module (signal from startup)
0	0 -> 1	EXITING state
1	0 -> 1	ENTERING state
1	1 -> 0	EXITING state
0	1 -> 0	ENTERING state

3. Following this, the IM module sends the signal for the PLC process control message "Startup data exiting state".

PCS 7 message processing

1. The signal for "startup data ENTERING state" is detected and the PLC process control message "startup data ENTERING state" is entered in the message list.
2. On the CPU, the message block compares the signal messages representing the static state of the process signals with the last stored state of the signals. If there are signals whose states are different, messages are entered in the message list:

IM Module (signal from startup)	Value Stored on the CPU (message block)	Message in Message List and Archive
ENTERING state	ENTERING state	---
ENTERING state	EXITING state	EXITING state
EXITING state	EXITING state	----
EXITING state	ENTERING state	ENTERING state

3. The signal for "startup data EXITING state" is detected and the PLC process control message "startup data EXITING state" is entered in the message list.

5.3 PLC Process Control Message - Time-of-day frame loss

Introduction

The "time-of-day frame loss ..." PLC process control message indicates loss of time-of-day synchronization on the IM 153-2.

Messages

- "Time-of-day frame loss ENTERING state"
- "Time-of-day frame loss EXITING state"

Description

The IM 153-2 expects a time-of-day frame from the time master at the set interval (for example, every second).

If the time-of-day frame of the master is not received three times in succession, the IM 153-2 continues to operate with the internal time and sends the message "Time-of-day frame loss ENTERING state" to the operator station.

Once the next valid time-of-day frame arrives, the internal block of the IM 153-2 is synchronized and the message "Time-of-day frame loss EXITING state" is triggered.

5.4 PLC Process Control Message - Time difference frame/internal clock jeopardizing accuracy

Introduction

The "Time difference between frame and internal clock jeopardizing accuracy ..." PLC process control message indicates a time jump or time difference on the IM 153-2.

Messages

- "Time difference between frame and internal clock jeopardizing accuracy ENTERING state"
- "Time difference between frame and internal clock jeopardizing accuracy EXITING state"

Description

The two messages are sent one after the other in the following situation:

- When a signal arrives at the IM 153-2 and there is a difference between the synchronized time and the internal time on the IM 153-2.
- The difference between the times is greater than half the accuracy of the time stamp (in other words a difference > 5 ms).
The time on the IM 153-2 is then synchronized.
 - The "ENTERING state" message contains the time stamp prior to synchronization.
 - The message "EXITING state" contains the time stamp following synchronization.

Based on these messages, it is possible to check whether the internal clock of the IM 153-2 has been put forward or back.

5.5 PLC Process Control Message - Time stamp functionality stopped

Introduction

The "Time stamp functionality stopped ..." PLC process control message indicates a problem in the IM 153-2 time stamp.

Messages

- "Time stamp functionality ENTERING state"
- "Time stamp functionality EXITING state"

Description

If the connection between the DP master and the IM 153-2 breaks down (for example following failure of the CP or a break on the bus cable), signals are no longer given time stamps. An entry to this effect is entered in the internal message list.

- From the moment the "ENTERING state" message is sent, the signals no longer have a time stamp.
- Following the "EXITING state" message, the signals once again have time stamps.

After "Time stamp functionality stopped EXITING state", there is a warm restart on the IM 153-2.

5.6 PLC Process Control Message - Message loss on the IM (buffer overflow)

Introduction

The "Message loss on the IM (buffer overflow)" PLC process control message indicates the loss of messages due to overflow of the message buffer of the IM 153-2.

Messages

- "Message loss on the IM (buffer overflow) ENTERING state"
- "Message loss on the IM (buffer overflow) EXITING state"

Description

The PLC process control message is output in the two following situations:

Buffer overflow due to external causes	Buffer overflow due to internal causes
Examples of possible causes: • Failure of the operator station • Failure or overload of the system bus or fieldbus • Failure or overload of the DP master (CPU). Remedy: Eliminate the cause	Example of a possible cause: The signals in the I/O change so quickly that the signal changes can no longer be entered in the message lists. Remedy: Distribute the signals on several IM modules or reduce the number of signals with time stamps.

An entry to this effect is entered in the internal message list.

- From the moment the "ENTERING state" message is generated, incoming messages can no longer be stored.
- Following the "EXITING state" message, incoming messages can be stored again.

5.7 Additional PLC Process Control Messages on Redundancy in H Systems

In H systems with two IM 153-2 modules, redundant time stamps exist in the following situation:

- The updating of the active and passive IM 153-2 has been completed free of error and
- The two IM 153-2 modules are communicating with each other free of error (see table below).

LED	Color	Active IM153-2	Passive IM 153-2
SF	red	Permanently lit the LED is irrelevant, if the SF-LED flashes there is a redundancy problem. The LED flashes for approximately 20 seconds after changing to the redundant mode.	Permanently lit the LED is irrelevant, if the SF-LED flashes there is a redundancy problem. The LED flashes for approximately 20 seconds after changing to the redundant mode.
BF	red	off	off
ACT	yellow	on	off
ON	green	on	on

Loss of redundancy (failure of an IM 153-2) is reported outside IM_DRV using the SUBNET and RACK blocks.

5.8 PLC Process Control Message - Failover in redundant system

Introduction

The "Failover in redundant system ..." PLC process control message indicates a failover between the active and passive IM 153-2.

Messages

- "Failover in redundant system ENTERING state"
- "Failover in redundant system EXITING state"

Description

The "Failover in redundant system" PLC process control message indicates the period of the interruption.

Time stamps are not applied for the period of the failover.

- From the moment the "ENTERING state" message is generated (start of the failover of the active and passive IM 153-2), there are no time stamps.
- After the "EXITING state" message, the signals once again have time stamps.

5.9 PLC Process Control Message - Loss of redundancy information

Introduction

The "Loss of redundancy information" PLC process control message indicates a problem in the signal exchange between the passive IM 153-2 and the active IM 153-2.

Messages

- "Loss of redundancy information ENTERING state"
- "Loss of redundancy information EXITING state"

Description

During normal, error-free operation, the passive IM 153-2 receives information about the current status of the I/Os from the active IM 153-2:

- As of the moment when the "ENTERING state" message is generated, there is a problem in this signal exchange.
- As soon as the information about the status of the I/Os has been synchronized on the active and passive IM 153-2, the "EXITING state" message is output.

6 Diagnostics and Troubleshooting

6.1 Overview - Diagnostics and Troubleshooting

The following sections contain information on:

- Time Stamp Diagnostics
- Checking the Message Path
- Diagnostics on the IM 153-2
- CP Diagnostics
- Checking the Time of Day
- Notes on the IM_DRV Block

6.2 Time Stamp Diagnostics

Hardware Configuration for Time Stamps

The IM 153-2 with the "time stamp" function, can store the time at which an edge change occurred and provide the CPU with this information using data records.

The IM 153-2 informs the CPU that it wants to transfer a data record using a hardware interrupt OB.

More detailed information is included in the startup information (for example OB40).

Storing Signals

When the time stamp function is activated, among other things the DP slave sends the special message "time-of-day frame loss ENTERING/EXITING state" during startup.

This message indicates whether or not time-of-day synchronization has failed.

The message indicating failure of time-of-day synchronization can be signaled by the CPU during the transition between STOP and RUN (for example to the relevant OS).

Failure of the Main Time-of-day Synchronization

If the external time-of-day synchronization fails, all underlying systems continue to be synchronized assuming that the highest module in the hierarchy is capable of this function (for example the CPU).

- The valid value for the execution time of a program cycle (time interval T_{cyc}) is calculated from the configured value or from the value derived from an algorithm.
- The time slave detects the failure based on the following criterion:
Time slave: Failure of the time-of-day synchronization frame $> 3 * T_{cyc}$
- If the absence of the frame is detected by a module, the module itself sends frames to synchronize the time-of-day to the underlying buses assuming that it has this capability. On these buses, the module is the time master.
 - Local synchronization is maintained.
 - When local synchronization is used, the chronological sequence of signals can only be evaluated accurately for the signals belonging to the underlying subsystems.

Note

If no time interval is configured on the time slave, the default "Synchronization interval of the synchronization frames" is used.

6.3 Checking the Message Path

Caution!

The steps described here disturb the function of the chain involved.

Synchronization Check

1. If time-of-day synchronization is functioning, interrupt the connection to the clock.
2. The IM must signal the failure of the synchronization to the OS using the IM_DRV block after 3 seconds (refer to the section "PLC Process Control Message - Problems (with Time Stamps)"; PLC Process Control Message "Time-of-day frame loss ENTERING state").

Despite signal changes, no time stamp arrives

1. Turn off the CP 443-5 → WinCC must display a message indicating the chain failure.
2. Turn off the IM → WinCC must display a message indicating the chain failure.

6.4 Diagnostics on the IM 153-2

For further information on the IM153-2, refer to the manual *Distributed I/O Station ET 200M*.

6.5 CP Diagnostics

CP 443-1 cannot be synchronized

Remedy:

1. Open the project in the SIMATIC Manager: **View > Component View**.
2. Open HW Config.
3. Select the **Station > Open Online** menu command.
4. Select the CP 443-1.
5. Select the **PLC > Module Information** menu command.
6. Click the "Special Diagnostics" button in the dialog box.
NCM S7 Diagnostics is then opened. If NCM S7 diagnostics does not start, the connection between the programming device/PC and the CP 443-1 is not functioning correctly.
7. Under "Industrial Ethernet", note down the MAC address setting for the CP 443-1.
8. Compare the MAC address setting of the CP 443-1 with the required system address.

CP 443-5 Extended - no or corrupted signals

Remedy:

1. Open the project in the SIMATIC Manager: **View > Component View**.
2. Open HW Config.
3. Select the **Station > Open Online** menu command.
4. Select the CP 443-5 Extended.
5. Select the **PLC > Module Information** menu command.
6. Click the "Special Diagnostics" button in the dialog box.
NCM S7 Diagnostics is then opened.
If NCM S7 diagnostics does not start, the connection between the programming device/PC and the CP 443-5 Extended is not functioning correctly.
7. Select the diagnostic buffer.
8. Compare the time stamp of the diagnostic messages with the CPU time-of-day.
9. Take an action that will produce messages (for example starting up an IM).

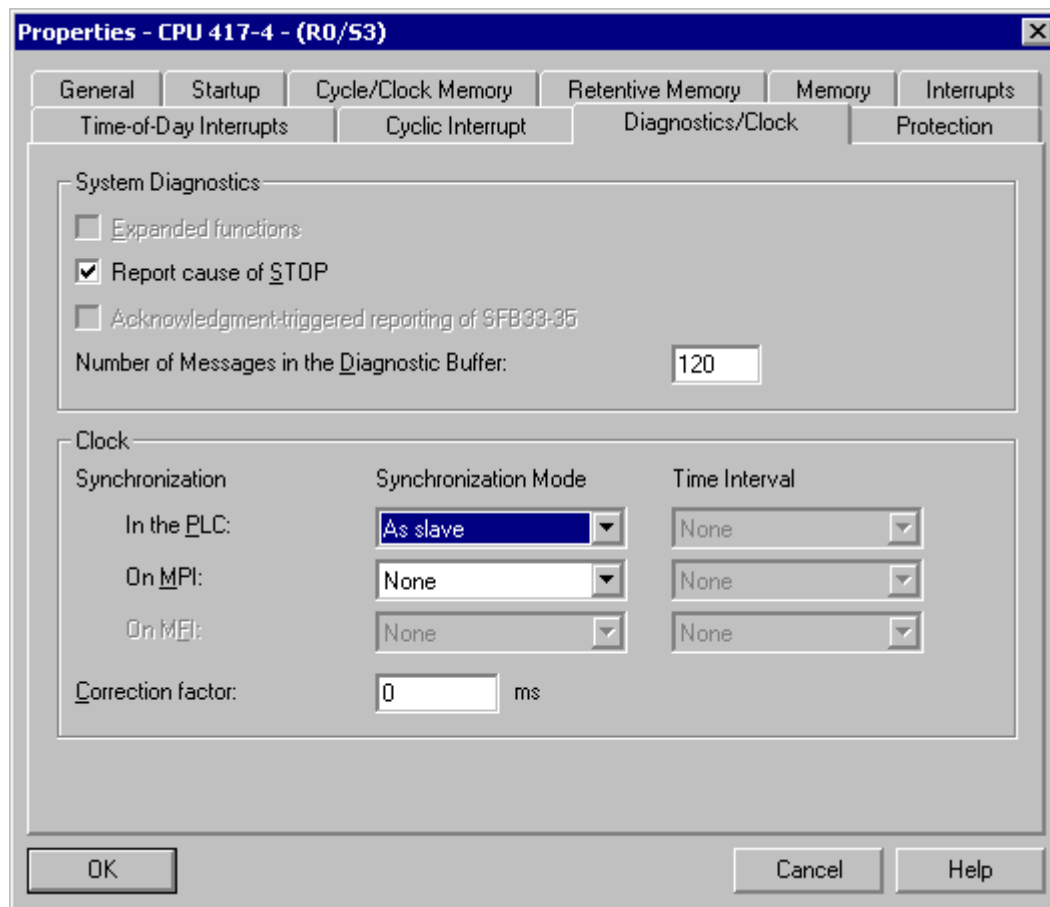
6.6 Checking the Time of Day

To check the time-of-day on the CPU, click on the menu command **PLC > Set Time-of-Day** in the SIMATIC Manager.

Possible results: Time-of-day running/time-of-day not running.

Time-of-Day Running

1. Select the CPU in HW Config.
2. Select the **Edit > Object Properties** menu command.
3. Select the "Diagnostics/Clock" tab.
4. In the "Clock" area for "Synchronization on the PLC", select the type of synchronization "As Slave" (see figure below)



1. Open the project in the SIMATIC Manager: **View > Component View**.
2. Select the following path in the tree structure: **Project\SIMATIC Station\CPU**.
3. Select the **PLC > Set Time of Day** menu command.
4. Attempt to put the time-of-day back (for example one hour).

Result:

- It is not possible to put the time back, the CPU is receiving a time-of-day signal.
The system is synchronized. The time transmitter and Ethernet CP are functioning correctly.
- It is possible to put the time-of-day back, the CPU is not receiving a time-of-day signal.
The system is not synchronized. The time master is possibly defective or has been removed from the bus.

Time-of-Day not Running

Possible cause: CPU set to STOP

1. Open the project in the SIMATIC Manager: **View > Component View**.
2. Select the following path in the tree structure: **Project\SIMATIC Station\CPU**.
3. To check the CPU and the operating mode of the CPU, select the menu command **PLC > Operating Mode**.

6.7 Notes on the IM_DRV Block

For more detailed information on the IM_DRV block, see "CFC Online Help" on the IM_DRV block.

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