Integration of a SINAMICS S120 into SIMATIC PCS 7 via PROFINET

SIMATIC PCS 7 V9.0

Warranty and liability

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Introduction

Objective of the documentation

The application example describes how to configure a SINAMICS S120 drive system in SIMATIC PCS 7 V9.0 via PROFINET. The drive system is connected to the AS 410-5H automation system via single PROFINET configuration S1 and system redundancy S2. Furthermore, the CMT engineering description of the S120 is based on a ready-made and tested template whereas the drive is operated and monitored via the OS runtime.

Core contents

- Integration of a SINAMICS S120 in PCS 7 via PROFINET
- Integration of the solution Template
- Engineering with the Solution Template
- Operator control and monitoring of the drive system

Validity

This application example is valid for:

- SIMATIC PCS 7 CPU 410-5H Process Automation, as of firmware V8.2
- SIMATIC PCS 7 V9.0
- SINAMICS S120, as of firmware version V4.8
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1 Task and solution

1.1 The task

When choosing the communication protocol for the connection of drive systems to the automation system, it is very important to have a simple and fast connection as well as high availability. Downtime, e.g. due to extensions and maintenance, should be reduced to a minimum.

The use of the PROFINET communication standard at the field level meets these requirements and offers flexibility with regard to the network structure and system connections of IO devices.

In the field of drive technology, the use of PROFINET increases the performance and productivity of process plants and their drives.

1.2 Solution

With the frequency converters SINAMICS S120, S150, G130 and G150 together with the Control Units CU310-2 PN and CU320-2 PN, Siemens offers a flexible drive system for connection to PROFINET, which provides:

- Single PROFINET configuration S1
- System redundancy S2 for connection to a redundant automation system (as of firmware V4.8)
- Media redundancy with MRP

In this application example, all engineering steps for the integration of the S120 are described as single PROFINET configuration S1 and system redundancy S2 in SIMATIC PCS 7. The automation program is created on the basis of the Advanced Process Library (APL) V9.0 and monitored and controlled with the relevant block icons and faceplates in the Operator Station.
2 Hardware and software components used

This application example was created using the following components:

Software components

Table 2-1: Software components

<table>
<thead>
<tr>
<th>Component</th>
<th>Note</th>
</tr>
</thead>
<tbody>
<tr>
<td>SIMATIC PCS 7 V9.0</td>
<td></td>
</tr>
<tr>
<td>APL Library V9.0</td>
<td>Component of SIMATIC PCS 7 V9.0</td>
</tr>
<tr>
<td>Solution Template &quot;DRIVE_SINAS120&quot;</td>
<td>Download</td>
</tr>
<tr>
<td>GSDML file SINAMICS S CU3x0-20160531</td>
<td>V225, V231, V232</td>
</tr>
</tbody>
</table>

Hardware components

Table 2-2: Hardware components

<table>
<thead>
<tr>
<th>Component</th>
<th>Note</th>
</tr>
</thead>
<tbody>
<tr>
<td>CPU 410-5H (Redundant)</td>
<td>Firmware V8.2 Part number: 6ES7 410-5HX08-0AB0</td>
</tr>
<tr>
<td>SINAMICS S120 CU320-2 PN</td>
<td>Firmware V4.8 Part number: 6SL3040-1MA01-0AA0</td>
</tr>
</tbody>
</table>

Note

Manual "SINAMICS S120 Control Units and Additional System Components":

Function Manual "SINAMICS S120 Function Manual Drive Functions":
# 3 Hardware configuration

## Requirements

To configure the SINAMICS S120, you need a prepared PCS 7 multiproject with the following configuration state:

- The Automation System (standard or redundant) is configured with CPU 410-5H
- The connection between the Automation System (AS) and Engineering System (ES) has been created

### Note

You can find information on creating a PCS 7 multiproject in the manual "SIMATIC Process Control System PCS 7 Engineering System (V9.0)":


### Note

You can find information on configuring an automation system and setting up a network connection in the manual "Compendium Part A - Configuration Guidelines":

http://www.siemens.com/onlinesupport/pcs7

## 3.1 Installing the GSDML file

To integrate the SINAMICS S120 frequency converter as a node in a PROFINET system, you need a GSDML (General Station Description Markup Language) file. The GSDML file contains all the necessary information about the functions of a PROFINET IO device for a higher-level control.

The GSDML file announces the HW Config of the SIMATIC Manager to the SINAMICS S120 and can thus be operated as a node in the PROFINET system.

The required GSDML file is assigned to the respective part number of the Control Unit (CU). In this application example: CU320-2 PN, 6SL3040-1MA01-0AA0.

### Note

The GSDML file for the Control Unit in this application example can be found in the download article "SINAMICS S120: PROFINET GSD file": "SINAMICS S120: PROFINET GSD file"


### Installing the GSDML file

1. Download the GSDML file at the link above and extract the file.
2. Open the SIMATIC Manager and the prepared multiproject.
3. Open the HW Config of the SIMATIC Station.
4. Click "Options > Install GSD File..." in the HW Config.

5. Click "Browse".

6. Select the extracted folder with the GSDML files of the SINAMICS S120 from the directory and click the "OK" button to confirm.

7. Click "Select All".
8. Click "Install".

![Installation dialog box]

9. Close the window by clicking the "Close" button.

When the installation finishes, you will find the S120 together with the CU320-2 PN V4.8 in the hardware catalog, at "PROFINET IO > Drives > SINAMICS > SINAMICS S120 / S150 CU320-2 PN V4.8".

![Hardware catalog screenshot]
3.2 Connection via single PROFINET configuration S1

In this section, the SINAMICS S120 is connected to the standard automation system via single PROFINET configuration S1. The SINAMICS S120 only establishes a communication connection to the CPU via PROFINET. In case of a single PROFINET configuration S1, if the automation system or the communication string fails, the underlying drive system fails as well.

Note

Note
You can find further information on system connections and PROFINET architectures in the document "PROFINET in Process Automation with SIMATIC PCS 7": https://support.industry.siemens.com/cs/ww/en/view/72887082
3 Hardware configuration

Procedure

1. Open the HW Config of the CPU 410-5H.
2. Select the interface (X5 or X8) of the controller to which the drive is physically connected.
3. Right click to open the shortcut menu and select the "Add PROFINET IO system" (in this application example: "Interface X5: PN-IO-X5").

After installing the GSDML file in Section 3.1, the SINAMICS S120 becomes available in the "PROFINET IO" category of the module catalog.

4. Add the "SINAMICS S120/S150 CU320-2 PN V4.8" from the module catalog to the PROFINET system via drag-and-drop.
5. In the object properties of the SINAMICS S120, assign a plant-wide unique device name in the "General" tab (in this application example: "SINAMICS-S120-01").

![Image of SINAMICS S120 properties window]

6. Select the check box "Assign IP address via IO controller".

![Image of PROFINET IP assignment]

**Note**

In PROFINET networks, changing the IP address is an optional feature. The IP address is assigned automatically when the SINAMICS S120 is added in the PROFINET system.
7. Click on "Ethernet" and select the subnet in which the SINAMICS S120 is located (in this application example: "Fieldbus").

8. Drag the module "DO VECTOR" from the module catalog in the "SINAMICS S120/S150 CU320-2 PN V4.8" list and drop it onto slot 1 of the SINAMICS S120.
3 Hardware configuration

9. Drag the telegram used from the “DO VECTOR” list and drop it onto slot 1.3 of the module “DO VECTOR”. This application example uses the standard telegram 20.

10. Allocate the input and output addresses.

   **Note**  
   The input and output word must start with the same initial value.

11. Save and compile your hardware configuration and download it to the controller.
12. Edit the symbol table and then skip to section 4.1 "Automatic commissioning via topology configuration" to assign the device name configured in HW Config to the device.
3.3 Connection via system redundancy S2

In this section, the SINAMICS S120 is connected to the high-availability automation system (H system) via system redundancy S2. The H system consists of a master and a standby CPU, which are connected to each other via fiber-optic cables and kept constantly synchronized. If the master CPU fails, the standby CPU takes over automatically.

The SINAMICS S120 establishes a communication connection to both CPUs via PROFINET. Therefore, the failure of an automation system does not lead to a failure of the drive system, since the standby CPU takes over control.

Note


Note

3 Hardware configuration

Procedure

1. Open the HW Config of the H system.
2. Select the interface (X5 or X8) of a controller to which the drive is physically connected.
3. Right click to open the shortcut menu and select the "Add PROFINET IO system" (in this application example: "Interface X5: PN-IO-X5").
4. Add a PROFINET system with the name "Fieldbus".
5. Repeat this step for the redundant controller. The PROFINET systems of both controllers must be on the same subnet.

After installing the GSDML file in Section 3.1, the SINAMICS S120 becomes available in the "PROFINET IO" category of the module catalog.
6. Add the "SINAMICS S120/S150 CU320-2 PN V4.8" from the module catalog to the PROFINET system via drag-and-drop.
7. In the object properties of the SINAMICS S120, assign a plant-wide unique device name (in this application example: "SINAMICS-S120-01").
8. Select the check box "Assign IP address via IO controller".

Note: In PROFINET networks, changing the IP address is an optional feature. The IP address is assigned automatically when the SINAMICS S120 is added in the PROFINET system.

9. Click on "Ethernet". Select the subnet in which the SINAMICS S120 is located (in this application example: "Fieldbus").

10. Switch to the "Redundancy" tab and select the "Rack 1, CPU 410-5H-02, PN-IO-X5-02" check box.
11. Drag the module "DO VECTOR" from the module catalog from the "SINAMICS S120/S150 CU320-2 PN V4.8" list and drop it onto slot 1 of the SINAMICS S120.

12. Drag the telegram used from the "DO VECTOR" list and drop it onto slot 1.3 of the module "DO VECTOR". This application example uses the standard telegram 20.

13. Allocate the input and output addresses.

**Note**  
The input and output word must start with the same initial value.

14. Save and compile your hardware configuration and download it to the controller.

15. Edit the symbol table and then skip to Section 4.1 "Automatic commissioning via topology configuration" to assign the names configured in HW Config to the device.
3.4 Symbol table

1. Edit the symbol table as follows:

<table>
<thead>
<tr>
<th>Address</th>
<th>Symbol</th>
<th>Data type</th>
<th>Comment</th>
</tr>
</thead>
<tbody>
<tr>
<td>IW 512</td>
<td>IW512_M1</td>
<td>WORD</td>
<td>Status word 1</td>
</tr>
<tr>
<td>IW 514</td>
<td>IW514_M1</td>
<td>WORD</td>
<td></td>
</tr>
<tr>
<td>IW 516</td>
<td>IW516_M1</td>
<td>WORD</td>
<td></td>
</tr>
<tr>
<td>IW 518</td>
<td>IW518_M1</td>
<td>WORD</td>
<td></td>
</tr>
<tr>
<td>IW 520</td>
<td>IW520_M1</td>
<td>WORD</td>
<td></td>
</tr>
<tr>
<td>IW 522</td>
<td>IW522_M1</td>
<td>WORD</td>
<td>Message NAMUR</td>
</tr>
<tr>
<td>QW 512</td>
<td>QW512_M1</td>
<td>WORD</td>
<td></td>
</tr>
<tr>
<td>QW 514</td>
<td>QW514_M1</td>
<td>WORD</td>
<td>Control word 1</td>
</tr>
</tbody>
</table>

2. Save and compile your hardware configuration and download it to the controller.
4 Configuring the device name

The following options are available for configuring or assigning the device name:

- Automatic commissioning through the Topology Editor (recommended)
- Manual device name assignment in the hardware configuration
- Compact Flash Card of the Control Unit

This application example describes the automatic commissioning process via the topology editor (chapter 4.1) and how to assign the device name manually in the hardware configuration (chapter 4.2).

4.1 Automatic commissioning via topology configuration

To carry out the first commissioning or to assign the device names of your IO devices, it is recommended to perform automatic commissioning by means of topology configuration via the Topology Editor.

During automatic commissioning, the device is assigned by specifying a target topology in the Topology Editor. The target topology is configured offline according to the actual topology of your plant and then uploaded to the controller.

Through the specified target topology, the controller identifies the IO devices via proximity relationships and assigns them the configured device name.

This chapter describes the automatic commissioning of the SINAMICS S120 with a standard automation system.

Note: You can find detailed information and notes on topology configuration in the document "PROFINET in Process Automation with SIMATIC PCS 7": https://support.industry.siemens.com/cs/ww/en/view/72887082

Requirements for automatic commissioning

- The IO controllers and drive system are configured in the hardware configuration
- The IO controllers and drive system must support the PROFINET functionality "Device replacement without exchangeable medium/PG"
- The drive system must be reset to factory settings before initial use / device replacement

Performing the automatic commissioning

1. Open the object properties of the CPU interface to which the SINAMICS S120 drive system is connected (in this application example: "Interface X5").
2. Go to the "General" tab and select the check box "Support device replacement without exchangeable medium".

3. Right-click on the interface of the CPU to which the drive system is connected and open the Topology Editor ("PROFINET IO Topology...").

4. Switch to the "Graphic view" tab.
5. Connect the individual component interfaces corresponding to the physical connection of your plant via drag-and-drop.

![Topology Editor](image)

6. Click the "OK" button to confirm your topology configuration.
7. Save and compile your hardware configuration and download it to the controller.
8. You can check whether the name has been transferred correctly via Online mode in the hardware configuration.

**Note**
To check whether the setpoint and actual topology are identical, you have to access the PG/PC interface and select the Ethernet network card with access to the fieldbus. You can then check the setpoint and actual topology in the Topology Editor using the "Online" button.

**Note**
Topology planning is only possible within a sub-project, i.e. the stations on a shared PROFINET network must be within the same sub-project.

### 4.2 Manual device name assignment

The device name can be transferred manually to the drive system. To be able to access the drive directly, the ES and the drive system must be in the same physical network. The following options are available:
- Deploying a Service Bridge
- Reconnecting the PROFINET interface for direct access by the ES to the drive system

**Manual device name assignment with Service Bridge**

In order to ensure the logical separation of plant bus and fieldbus at any time, it makes sense to use a Service Bridge for temporary access to IO devices. The Service Bridge
makes it possible to access an IO device without switching round network connections. The Service Bridge is SCALANCE XC200 switch, which has been specially set up and configured with firmware V3.0.1.

Note
For further information about the Service Bridge, see the application example “Service Bridge – Setting-up and Configuration”: https://support.industry.siemens.com/cs/ww/en/view/109747975
4 Configuring the device name

Manual assignment of the device name through direct connection between ES and drive system

If you do not use a Service Bridge in your plant, you have to switch round your PROFINET connections.
The following options are available:

- Direct connection of the ES with the PROFINET interface of the CPU via the plant bus
- Direct connection of the ES with the CU of the drive via Ethernet interface

Note

The control unit of the SINAMICS S120 has an X127 LAN interface (Ethernet interface) for commissioning and servicing purposes.

In this application example, the ES is connected to the PROFINET interface of the CPU via the plant bus.

Assigning the device name manually

1. In the SIMATIC Manager, click on "Options > Set PG/PC interface..." in the menu.
2. Select the Ethernet network card. In this application example: "CP 1623.RFC1006.1".
3. If you are using a Service Bridge, skip to step 4.
   If you do not use a service bridge, connect the ES to the internal PROFINET interface of the CPU via the plant bus.
4. Select the drive system in the hardware configuration. Then click on "PLC > Ethernet > Assign Device Name".

5. In the drop down menu "Device name" select the configured name of the drive system in chapter 3.2 or 3.3 (in this application example: SINAMICS-S120-01).
4 Configuring the device name

6. Select in the list "Available devices" the drive system you would like to name and then click on the button "Assign name".

Hinweis

You can filter the list of available devices. For this select the check box "Show only devices of the same type" or "Display only devices without names".

7. To close window click the button "close".

8. Go to the menu "Accessible nodes" in the SIMATIC Manager and check whether the name has been correctly transferred to the drive.

9. If you do not use a Service Bridge, reconnect the ES to the CP 443-1 interface of your AS via the plant bus.
   Select the "PC Internal (Local)" PG/PC interface.
5 General information on the Solution Template

To control the drive, this application example uses a tested Solution Template in the form of a CMT based on the blocks and standard functions of APL V9.0. The template can be used in new projects as well as in existing projects.

The CMT supports the connection of frequency converters via the standard telegram 1 and 20.

This application example uses the standard telegram 20.

Functions of the Solution Template with telegram 1

- APL-Faceplate
- Operating modes
- Control commands
- Interlock
- Actual value and setpoint

Additional functions of the Solution Template with telegram 20

- Local switchover with monitoring
- Torque display [Nm]
- Power display (actual value) [kW]
- Motor current display and monitoring of selectable motor current limits
- NAMUR messages

This section describes the most important blocks and their functions when using standard telegram 20.
FbDrive

Table 5-1

<table>
<thead>
<tr>
<th>Terminal designation</th>
<th>Function description</th>
</tr>
</thead>
</table>
| Telegram             | The "FbDrive" block integrates any compact drives that support the following telegram types:  
|                      | - Telegram type 1  
|                      |  Two input words and two output words  
|                      | - Telegram type 20  
|                      |  Six input words and two output words  |
| Status word          | The inputs "PZDIn1" to "PZDIn6" provide the following information:  
|                      | - State  
|                      | - Status  
|                      | - Actual value  
|                      | - Error messages  |
| Control word         | The outputs "PZDOut1" and "PZDOut2" specify control word STW1 and setpoint to the controller of the frequency converter  |
| On / Off Feedback    | The output "F_N_Reach" indicates if a frequency is present in the motor or if the motor is stopped.  |
| Reset                | Input "Ackn" and output "Fault" are logically interconnected with the motor block "MotSpCL". This allows the frequency converter to be reset in the faceplate. |
### Terminal designation | Function description
---|---
P2DIn2Un | Unit of the readback value of engine speed
P2DIn2Sc | Scaling of the readback value of engine speed
P2DIn3Un | Unit of the readback value of current
P2DIn3Sc | Scaling of the readback value of current
P2DIn4Un | Unit of the readback value of torque
P2DIn4Sc | Scaling of the readback value of torque
P2DIn5Un | Unit of the readback value of power
P2DIn5Sc | Scaling of the readback value of power
P2DIn6Un | Unit of the setpoint of engine speed
P2DIn6Sc | Scaling of the setpoint of engine speed

**FeatureBit 5**
- **Scaling disabled (standard)**
  - FeatureBit 5 = 0
    - (scaling in percent)
- **Scaling enabled**
  - FeatureBit 5 = 1

**FeatureBit 6**
- Error Handling on device failure
  - FeatureBit 6 = 0
    - Only "Local" and "Ackn" commands are active
  - FeatureBit 6 = 1
    - All commands are active

**FeatureBit 28**
- NAMUR messages
  - FeatureBit 28 = 0
    - Freely configurable analog value
  - FeatureBit 28 = 1
    - NAMUR messages display (only with Standard Telegram 20)

### Note
You can find further information on the "FBDrive" block in the chapter "FbDrive - Channel block for compact drives" of the manual "SIMATIC Process Control System PCS 7 Advanced Process Library (V9.0)":

### Scaling of the process value
The following inputs must be also configured if scaling is enabled:
- PZDInXScale.HIGH
- PZDInXScale.LOW

The scaling must be normalized for the following limits:
- Current
- Torque
- Power
5 General information on the Solution Template

Note
You can find the limit calculation for the process value in the chapter "FbDrive - Channel block for compact drives" of the manual "SIMATIC Process Control System PCS 7 Advanced Process Library (V9.0)":

MotSpdCL
Block for controlling the motor with
- Two directions of rotation (right/left rotation)
- Various speeds

Sheet 2

Event16Ts
Message block for the generation of acknowledgment messages for time-stamped signals.
In this application example, all the status and error messages of the actual value data word 6 "PZD 6" are read and reported.
The error number output by the "FbDrive" channel block (in hex format) at the "MsgNamur" output is converted into a message text via the preconfigured NAMUR message list and displayed in the OS runtime through the "Event16Ts" block.

NAMUR messages
In order to obtain the preconfigured NAMUR messages of the solution template at the "PZDOut1" output of the "FbDrive" block, the Feature Bit 28 = 0 must be set.
If the Feature Bit 28 = 0 is set, the messages are read as a freely configurable process value.
The feature bit is only used if telegram type 20 and the parameter "PZD6" are enabled.
6 Engineering of the Solution Template

The available solution template is configured for integration via the standard telegram 20.

**Note**
The Solution Template is available for download on the article page of this application example: "SINA_S120_lib.zip":

**Requirements**
- Hardware configuration completed and loaded in the AS
- Symbol table edited
- Device names assigned
- Drive system configured according to NAMUR guidelines

**Assigning drive system parameters**
The assignment of drive system parameters via the commissioning Tool Starter is not part of this application example.
For successful connection and correct communication, the frequency converter must be configured according to the NAMUR guidelines. The standard telegram 20 must be also configured in the converter.

**Procedure**
1. Copy the CMT "DRIVE_SINAS120" from the example project and paste it into the master data library of your project.
2. Copy the CMT from the master data library into the provided hierarchy folder (in this application example: "Function") and adjust the name of the CMT.
3. Open the CFC and connect input "PZDIn1" on the "FbDrive" block with the first input word (here: IW512_M1).
4. Double click the "FeatureBit" input in the "FbDrive" block. Enter the following values for the respective Feature Bit:

<table>
<thead>
<tr>
<th>Input</th>
<th>Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>FeatureBit 5</td>
<td>0</td>
</tr>
<tr>
<td>FeatureBit 6</td>
<td>1</td>
</tr>
<tr>
<td>FeatureBit 28</td>
<td>1</td>
</tr>
</tbody>
</table>

5. Enter the value "20" in the "Telegram" input of the "FbDrive" block.
6. Adjust the scaling of the following inputs to match the parameters of your drive:
   a. Current
   b. Torque
   c. Power
   You can take the scaling conversion index of the parameterization software (e. g. Starter).
   For instance, if the conversion index is -2, you have to multiply the normalized value by $10^{-2}$, e. g. $16384.0 \cdot 10^{-2} = 163.84$ (for a resolution of 14 Bit)
   The setpoint is specified in percent. You can adapt the setpoint specification to your drive’s assigned parameter.

   NOTICE
   The scaling has to match the parametrized scaling value of the unit. Otherwise the drive system can not be controlled correctly via the OS Runtime.

7. Install the blocks in a cyclic watchdog interrupt OB (OB30 to OB38).
8. The remaining inputs and outputs ("PZDIn" / "PZDOut") are automatically interconnected after saving and compilation.
9. Save and compile the program and download it to the AS.
7 OS runtime

The faceplate and block icon of the Solution Template are generated automatically after the OS is compiled.

Operator control and monitoring

The SINAMICS S120 is operated and monitored via the faceplate of the APL. Besides the motor state, the faceplate also displays other measured values, such as:

- Feedback
- Torque
- Power
- Motor current

Error messages

The error messages are forwarded from the channel block to the motor block. The motor block allows the error messages to be displayed both in the motor symbol and in the faceplate of the OS runtime.
The "FbDrive" channel block evaluates the error and outputs the number of the corresponding Namur message. The preconfigured message is displayed on the OS runtime via the block "Event16T".
8 Appendix

8.1 Service and Support

Industry Online Support
Do you have any questions or need assistance? Siemens Industry Online Support offers round the clock access to our entire service and support know-how and portfolio. The Industry Online Support is the central address for information about our products, solutions and services. Product information, manuals, downloads, FAQs, and application examples – all the information you need is accessible with just a few mouse clicks at: https://support.industry.siemens.com

Technical Support
The Technical Support of Siemens Industry provides you fast and competent support regarding all technical queries with numerous tailor-made offers – ranging from basic support to individual support contracts. You send queries to Technical Support via Web form: www.siemens.com/industry/supportrequest

Service offer
Our range of services includes, inter alia, the following:
- Product trainings
- Plant data services
- Spare parts services
- Repair services
- On-site and maintenance services
- Retrofitting and modernization services
- Service programs and contracts
You can find detailed information on our range of services in the service catalog: https://support.industry.siemens.com/cs/sc

Industry Online Support app
You will receive optimum support wherever you are with the "Siemens Industry Online Support" app. The app is available for Apple iOS, Android and Windows Phone: https://support.industry.siemens.com/cs/ww/en/sc/2067
8.2 Links and Literature

Table 8-1

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8.3 Change documentation

Table 8-2

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<td>11/2017</td>
<td>First version</td>
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<tr>
<td>V1.1</td>
<td>12/2017</td>
<td>Proceeding in section 4.2 optimized</td>
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