

Using the IM174 at the isochrone PROFIBUS of an FM458-1DP

SIMATIC FM458-1DP and IM174

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Question

How can you operate an IM174 at the isochrone PROFIBUS of an FM458-1DP?

Answer

The instructions and notes listed in this document provide a detailed answer to this question.

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1 Introduction

This description shall illustrate that it takes only a few steps to operate the IM174 at an FM458-1 DP.

Using an IM174 at an FM458-1 DP offers the following advantages:

- IM174 is the cost-efficient solution for the simple connection of 4 step motors or 4 drives with analog setpoint interface with incremental/absolute value encoders per slave via a isochrone PROFIBUS DP.
- The IM174 works on the PROFIdrive profile and uses its standard frames 3 and 81. Both frame types can be read/written with the FM458-1DP.

To be able to operate the IM174 at the isochrone PROFIBUS of an FM458-1 DP (not at the connections of an EXM 448), the settings or configurations described below must be made.

2 Settings in the HW Configuration

Starting point is the hardware configuration of a SIMATIC S7-400 system with an FM458-1 DP and isochrone PROFIBUS. For configuring an FM458-1 DP a D7-SYS installation with CFC is required in addition to STEP7.

Figure 2-1: Configuration of the example

The screenshot shows the HW Config interface for a SIMATIC S7-400 system. The main window displays the rack configuration for (0) UR2. The modules are:

- Slot 1: PS 407 10A
- Slot 3: CPU 412-1 (MPI/DP)
- Slot 4: CP 443-1 (Port 1, Port 2)
- Slot 5: 4581DP (DP)

The IM174 module is connected to the DP-Mastersystem (1) via the DP port of the CP 443-1 module. The IM174 module is shown as (3) IM174.

Below the main window, a detailed table shows the configuration of the modules:

Slot	Module	Order number	Fir...	M...	I address	Q address
1	PS 407 10A	6ES7 407-0KA01-0AA0				
3	CPU 412-1	6ES7 412-1XJ05-0AB0	V5.2	2		
X1	MPI/DP			2	4095*	
4	CP 443-1	6GK7 443-1EX20-0XE0	V2.0		4094*	
5	4581DP	6DD1607-0AA2	V2.1		512...639	512...639
X3	DP				8191*	

For the program of the FM458-1DP to run clock-synchronized with the PROFIBUS DP, the following settings must be made.

- The basic cycle T0 is not created by the FM, but synchronizes to the "PROFIBUS DP: Receive data ready" source. The "Equiv. sampling time" to be specified must here agree with the bus cycle time.
- The sampling time of task T1 must be equal to the basic sampling time T0.

The IM174 works on the PROFIdrive profile and uses the standard frames 3 or 81 for one axis/encoder each.

Note

Details on the configuration of IM174 is available in the device manual "Distributed I/O PROFIBUS module IM 174"

3 Calculating the Frame Structure

3.1 General information

A PROFIdrive standard frame 3 consists of 5 words in send direction and 9 words in receive direction. Frame 81 consists of 2 words in send direction and 6 words in receive direction. Additionally 1 word each is transferred in both directions (Master \leftrightarrow Slave) for digital inputs/outputs.

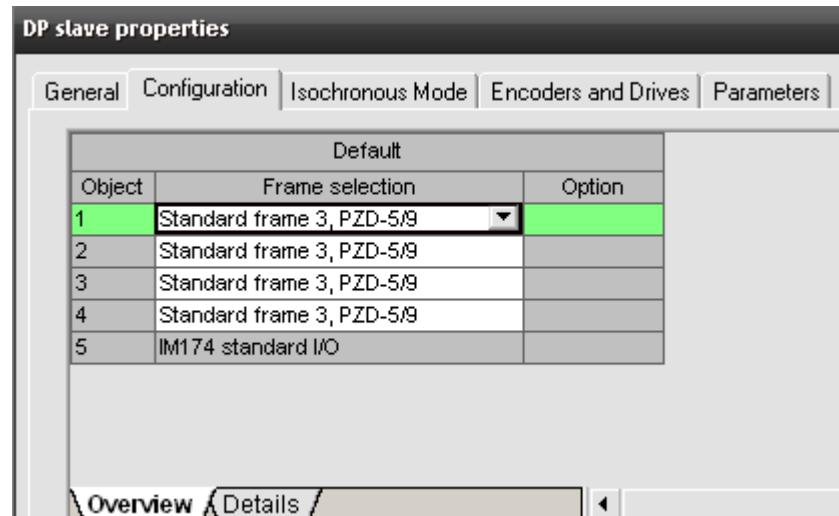
According to the configuration the IM174 is configured in the hardware configuration. Usage of the frames is defined in the settings of IM174 at point "Configuration" (prerequisite is standard frame 3 for all 4 axes). From the combination of these frames different PROFIBUS - DP frame lengths of IM174 result.

The values calculated below are important for configuring the FM458-1DP in CFC, to be able to implement a stable master-slave communication.

3.2 Example 1 on the frame structure

In this example 4 frames of the standard frame 3 type and a digital I/O are used.

Figure 3-1: Frame selection example 1



Calculating the frame length occurs as follows:

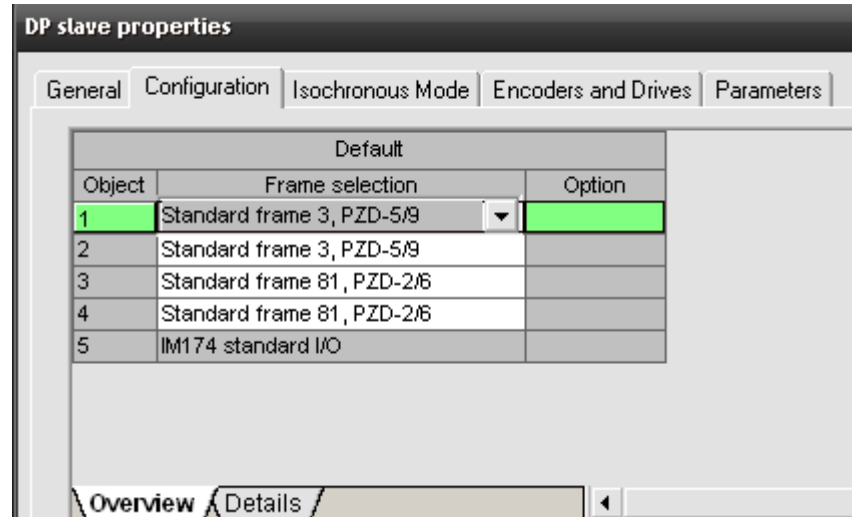
- Frame length send direction (setpoint values/control words/digital outputs):
 $4 * 5 \text{ words} + 1 \text{ word} = 21 \text{ words} (42 \text{ bytes})$
- Frame length receive direction (actual values/status words/digital inputs)
 $4 * 9 \text{ words} + 1 \text{ word} = 37 \text{ words} (74 \text{ bytes})$

Send/receive direction = 42 bytes/74 bytes

3.3 Example 2 on the frame structure

In this example axes 1 and 2 with the standard frame 3 and axis 3 and 4 with standard frame 81 (external encoder) are configured. Additionally a digital I/O also exists here.

Figure 3-2: Frame selection example 2



- Frame length send direction: $2 * 2 \text{ words} + 2 * 5 \text{ words} + 1 \text{ word} = 15 \text{ words}$ (30 bytes)
- Frame length receive direction: $2 * 6 \text{ words} + 2 * 9 \text{ words} + 1 \text{ word} = 31 \text{ words}$ (62 bytes)

Send/receive direction = 30 bytes/62 bytes

3.4 Excel – document

The Excel - document (41483629_IM174_PROFIdrive_Telegram.xls) added in this FAQ calculates all relevant parameters of the selected frames (offset receive, offset send, start address digital inputs/outputs). It should be considered the tool only provides correct values in case of an initial configuration of an IM174 slave. Should the configuration be changed in HW Config it is possible that the axis frames are not in the order of axis numbering in the IM174 frame.

Selecting the table sheet you can set the language (German/ English) in the Excel file.

4 Configuring the Communication of the Block Folder of the FM458-1 DP

4.1 Setting up the PROFIBUS - DP interface (X3) of the FM458-1 DP

In the FM458-1 DP an extra block "@PRODP" takes on the initialization and monitoring of the PROFIBUS at interface X3.

Inserting block "SpezKomm" → "@PRODP" into a task with a sampling time (TA) of $32 \text{ ms} \leq \text{TA} \leq 256 \text{ ms}$.

4.2 Configuring the delayed synchronization

To configure the delayed synchronization to the PROFIBUS DP cycle, blocks "PDE" (ON delay) and "DTS" (delay time of synchronization) must be used. (see figure 4-1)

- Inserting and configuring the "PDE" block
- Inserting and configuring the "DTS" block

Note

Without synchronization the IMs switch off cyclically. Synchronization must be repeated after failure and restoring the source as otherwise the "Equiv. sampling time" is processed in "emergency mode".

4.3 Implementing the IM174 frame traffic

Inserting and configuring the "CRV_P" block at the beginning of task T1 ($T1 = T0$)

- CTS connection to "FM4581DP.X3" (consisting of the assigned name of the FM458-1DP module in HW Config and the interface)
- AR = 'READ.3.0'
"READ" is a channel name (maximal 6-digit) – one unique channel name must be assigned per slave!
"3" corresponds to the PROFIBUS address of the IM174
2. address stage "0" or "1" (must exist, however it is not evaluated)
- MOD = 'I'
- EN = 1
- NBY = 74 (example 1) or 62 (example 2)

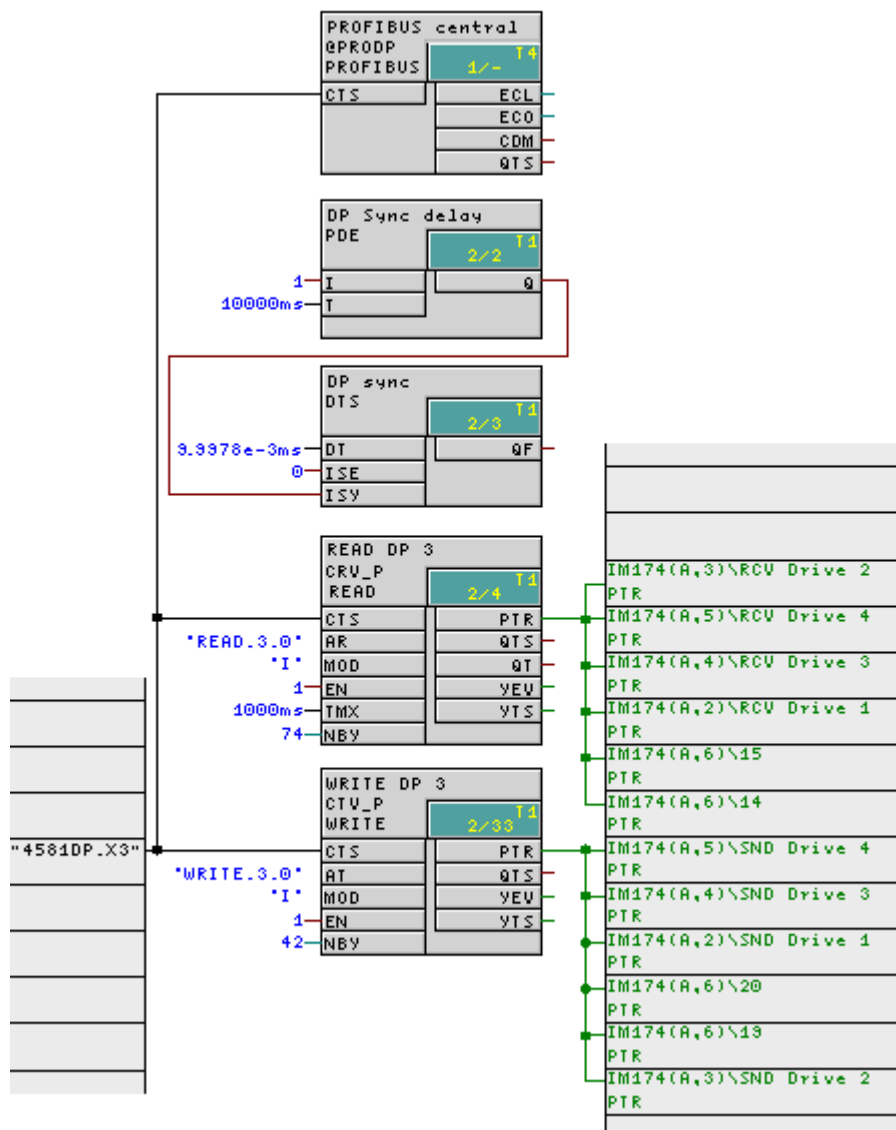
Inserting and configuring block "CTV_P" at the end of task T1

- CTS connection to "FM4581DP.X3"
- AR = 'WRITE.3.0'

- MOD = 'I'
- EN = 1
- NBY = 42 (example 1) or 30 (example 2)

In the following figure the last 3 steps are stored as CFC example.

Figure 4-1: CFC example of implementing the IM174 frame traffic



- The function block “PROFIBUS central” initializes and monitors the PROFIBUS-DP coupling
- Blocks “DP Sync delay” and “DP sync” represent an ON-delay synchronization of the basic sampling time to the isochrone PROFIBUS DP cycles.
- The “READ DP 3” block serves for reading the 74 bytes large IM174 frame of slave 3.
- The “WRITE DP 3” block serves for sending the 42 bytes large IM174 frame to slave 3.

4.4 Reading/writing the axis-specific standard frames

The following blocks must be inserted and configured individually for each drive/encoder. The offset details result from the position of the axis/encoder in the IM174 frame. The according values can be determined via the provided Excel document.

Inserting and configuring the block "RCVDP" for axis x (x = 1..4) in T1

- Connect PTR with "CRV_P" → "PTR"
- OFF = 18 (example 1 and 2 → axis 2)
- TLG = 3 (example 1)

Inserting and configuring the block "DRVIF2" in T1

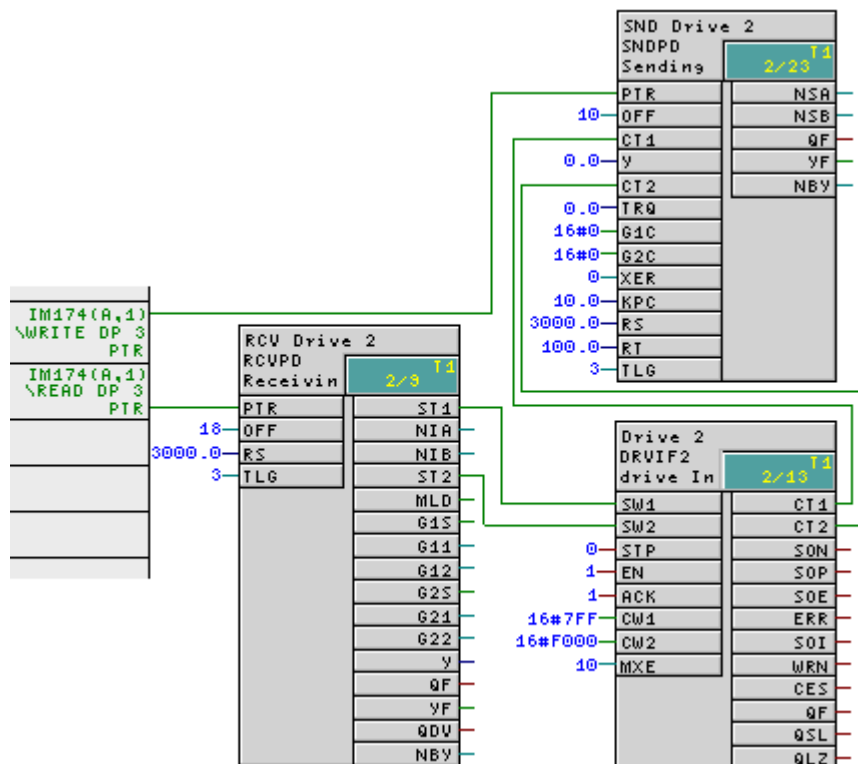
- Connect SW1 with RCVDP → ST1
- Connect SW2 with RCVDP → ST2

Inserting and configuring the block "SNDPD" for axis x (x = 1..4) in T1

- Connect PTR with "CTV_P" → "PTR"
- Connect CT1 with "DRVIF2" → "CT1"
- Connect CT2 with "DRVIF2" → "CT1"
- OFF = 10 (example 1 → axis 2)
- TLG = 3 (example 1)

In the following figure the CFC configuration for axis 2 (example 1 and 2) is shown.

Figure 4-2: CFC configuration for axis 2

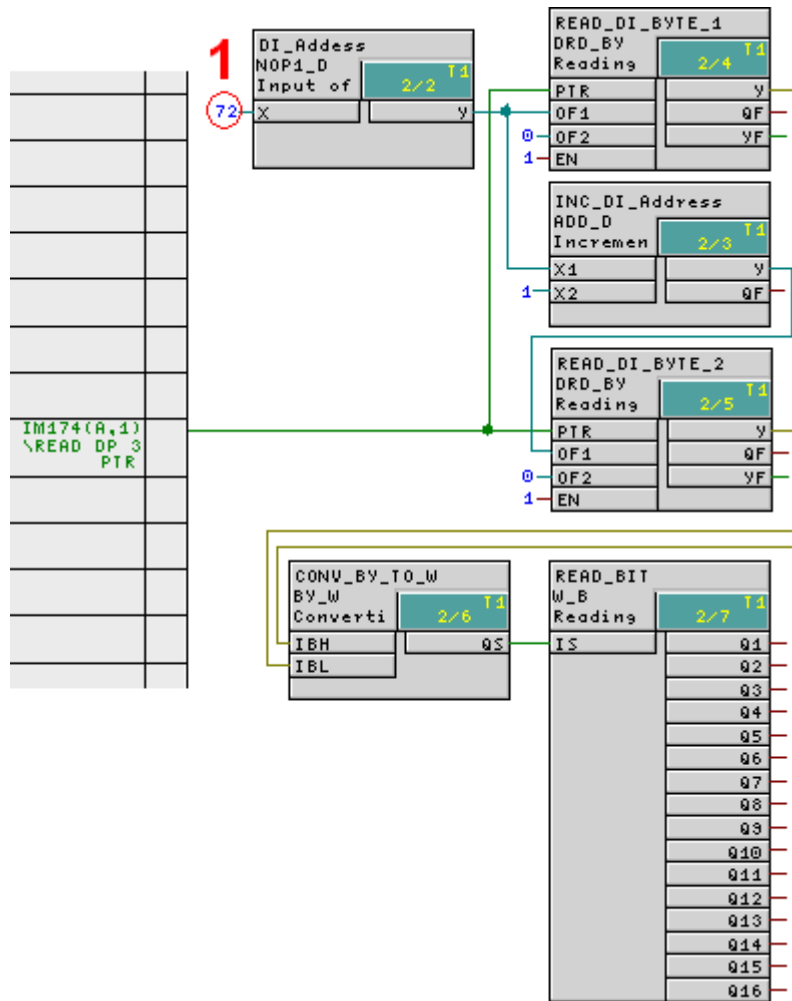


- Block “RCV Drive 2” serves for reading the PROFIdrive standard frame 3 from the IM174 PROFIBUS-DP frame as of address 18. Output G11 specifies the current encoder position and output y (optional) the speed value.
- Block “Drive 2” is the drive interface. This function block serves the connection of drives according to the specification of the PROFIdrive profile.
- Block “SND Drive 2” serves for writing the PROFIdrive standard frame 3 into the IM174 PROFIBUS-DP frame as of address 10. The setpoint speed value is transferred to the drive via variable y.

4.5 Setting up the digital inputs/outputs

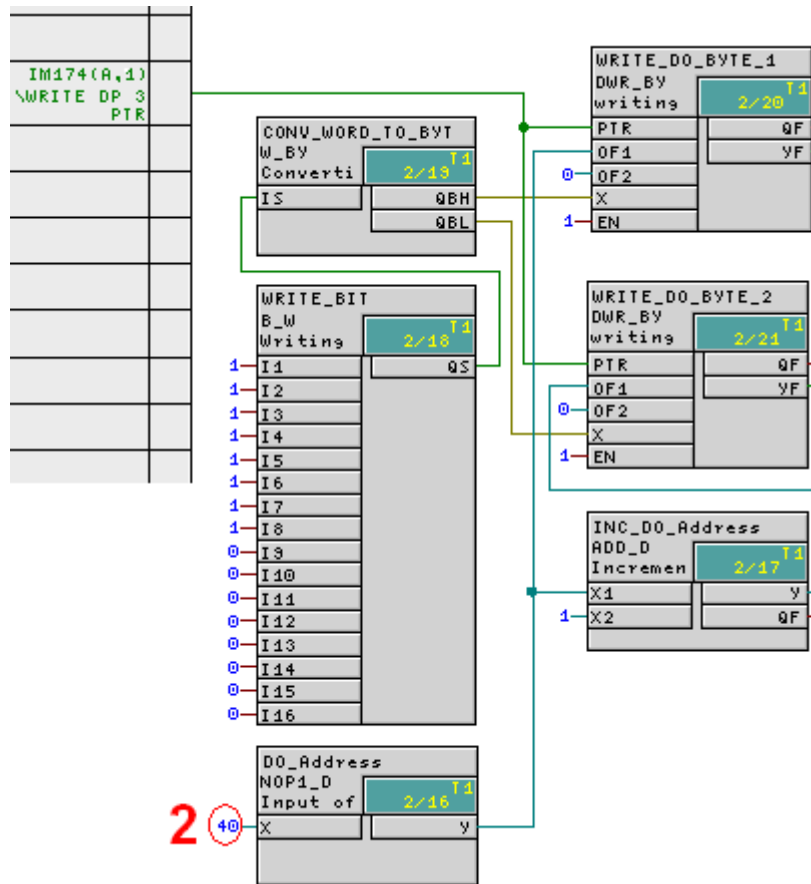
The last two bytes of the IM174 frame form the digital input or outputs. The following figure displays a possible CFC configuration for writing or reading the digital I/Os. Parameters **1** and **2** in the following figures are taken from the excel document "PROFIdrive frame structure → I/O".

Figure 4-3: Reading the digital inputs



- Blocks “READ_DI_BYTE_1” and “READ_DI_BYTE_2” serve for reading the digital inputs from the last two bytes of the IM174 frame
- The final “READ_BIT” block edits the bit by bit reading of the digital inputs

Figure 4-4: writing the digital outputs



- The “WRITE_BIT” block serves for the input of digital outputs
- The blocks “WRITE_DO_BYTE_1” and “WRITE_DO_BYTE_2” serve for writing the outputs to the last two bytes of the IM174 frame

4.6 Interpreting the data

The receive data received from a IM174 per axis/encoder are

- the actual value of the encoder position (designation in the PROFIdrive frame 3/81 "G1_XIST1")
- Actual speed value (optional when activating the calculation in HW Config)
- 10 digital inputs

The following values can be sent to an IM174

- a setpoint speed value (only for PROFIdrive frame 3 named "NSOLL_B")
- 8 digital outputs