FAQ on Distributed I/O

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Consistent Data, Overview and Application in Distributed I/O

SIEMENS

FAQ

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http://support.automation.siemens.com/WW/view/en/28991143

1 Definition of terms

1.1 What is consistent data?

Definition:

Data which belong together in terms of content and which describe a process status at a defined point in time are termed as consistent data. These data may not be changed or updated during processing or transmission in order to maintain consistency.

Description:

The size of the data area which cannot simultaneously be changed by competing processes is referred to as consistent data area. Hence, a data area larger than the consistent data area could be falsified as a whole.

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You want to determine the average of a series of numbers. The following boundary conditions shall apply for this example:

- The elements of the series of numbers are only determined at the beginning of the calculation.
- The source data are stored in a buffer and have to be passed to a second buffer.
- The source data are transmitted serially between the buffers.
- The amount of time this can take varies.

If you carry out the calculation in a constant cycle, some elements may not include the most up-to-date value and you will obtain an incorrect average as a result. If the entire series of numbers is treated as one unit or structure, the calculation will only be started when all elements of the series of numbers have assumed a valid value. It is irrelevant in this context in which sequence the elements are determined or how much time is needed. This series of numbers is then consistent.

2 Reading data consistently from a DP standard slave and writing them consistently to a DP standard slave

2.1 Address assignment

The SFC 14 "DPRD_DAT" (read consistent data of a DP standard slave) enables you to consistently read out the data of a DP standard slave/PROFINET IO device. If no error occurred during data transmission, the read data are entered in the target area defined by RECORD. The target area must have the same length as configured for the selected module with STEP 7. By calling SFC 14, you can only access the data of one module/DP id under the configured start address.

SFC 15 "DPWR_DAT" (write consistent data to a DP standard slave) allows you to transmit the data in RECORD consistently to the addressed DP standard slave/PROFINET IO device. The source area must have the same length as configured for the selected module with STEP 7.

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Maximum upper limits for transmitting consistent data to a DP slave

The Profibus DP standard defines upper limits for transmitting consistent data to a DP slave. Therefore, up to 64 words = 128 bytes of user data can be transmitted consistently in one block.

During configuration you can define how large the consistent area should be. For this purpose, a maximum length of the consistent data of 64 words = 128 bytes (128 bytes for inputs and 128 bytes for outputs) can be set in the special identifier format. A greater length is not possible.

This upper limit applies only to pure user data. Diagnostics and parameter data are bundled to form entire data records and as such they are generally transmitted consistently.

The length of the consistent data in the general identifier format is limited to 16 words = 32 bytes (32 bytes for inputs and 32 bytes for outputs), a greater length is not possible.

General identifier format and special identifier format

The special identifier format is an expansion of the general identifier format. It offers more flexibility to enable manufacturer-specific functions.

Note

Please note in this context that a 41x / 31x CPU as DP slave at an external master (connected via GSD) must be configurable via the general identifier format. For this reason the transmission buffer of a 41x / 31x CPU as DP slave to PROFIBUS DP has a maximum size of 16 words = 32 bytes.

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Maximum upper limits for transmitting consistent user data to an IO device

For transmitting consistent user data to an IO device, the upper limit is 255 bytes (254 bytes user data + 1 byte associated value). Even if more than 255 bytes could be transmitted to an IO device, the maximum amount of data that can be transmitted consistently is 255 bytes.

The following upper limits apply for the communication processes listed below:

Table 2-1

CP	MLFB	Upper limit
CP 343-1 [1)]	6GK7343-1EX21-0XE0	128 bytes
CP 343-1 [1)]	6GK7343-1EX30-0XE0	240 bytes
CP 343-1 Advanced [1)]	6GK7343-1GX21-0XE0	128 bytes
CP 443-1	6GK7443-1EX20-0XE0	240 bytes
CP 443 -1 Advanced	6GK7443-1EX40-0XE0	128 bytes
CP 443 -1 Advanced	6GK7443-1EX41-0XE0	240 bytes

[1)] Use the communication blocks FC11 "PNIO_SEND" and FC12 "PNIO_RECV" to consistently exchange data via the industrial Ethernet communication processors of the S7-300.

Note

The Profibus DP standard defines upper limits for the transmission of consistent user data. Standard DP slaves comply with these upper limits. With older CPUs (<1999) there were certain CPU-specific limitations for the transmission of consistent user data.

For these CPUs the maximum length of data which the CPU can consistently read out from/ write to a DP standard slave is indicated in the technical data under the keyword “DP master user data per DP slave”. In newer CPUs this value exceeds the length of data which a DP standard slave provides or receives.

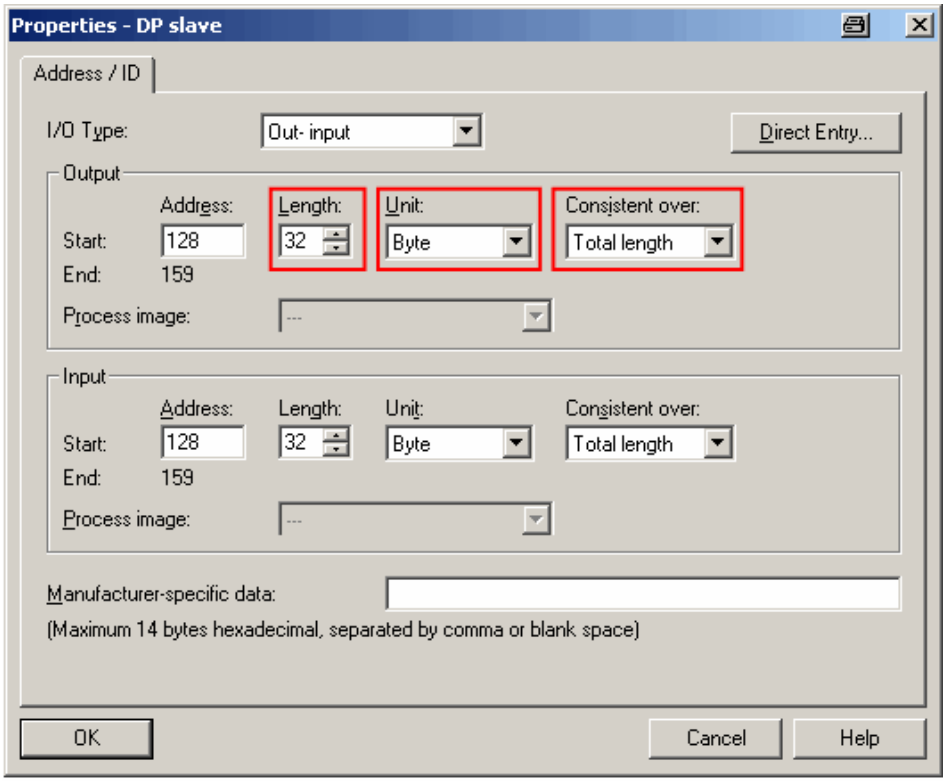
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2.2 Access to consistent data

Configuring consistent data areas > 4 bytes

In the STEP7 Hardware Configuration you can define the area of consistency in the “Properties - DP slave” dialog box -> „Address / ID” tab by specifying the corresponding values for “Length”, “Unit” and “Consistent over”.

Figure 2-1



Data areas and access method in the program supported consistently by all CPUs.

Table 2-2

Length of data area	Read / write access	Consistency of the data
1 byte	Load / transfer	Consistency over unit
2 bytes	Word load / word transfer	Consistency over entire length
3 bytes	SFC14 / SFC15	Consistency over entire length
4 bytes	Double-word load / double-word transfer	Consistency over entire length
>4 bytes	SFC14 / SFC15	Consistency over entire length

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Example

```
CALL SFC 14     ("DPRD_DAT")          // Call
 LADDR := W#16#80                     // Configured start address
                                         corresponds to decimal 128
 RECORD := P#DB1.DBX0.0 byte 32       // Stores the periphery data in
                                         the data block for further
                                         processing


CALL SFC 15     ("DPWR_DAT")          // Call
 LADDR := W#16#80                     // Configured start address
                                         corresponds to decimal 128
 RECORD := P#DB1.DBX32.0 byte 32      // Writes the periphery data from
                                         the data block into the output
                                         address of the periphery
 RET_VAL := MW2                       // Feedback about the success of
                                         the job
```

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Possible sources of errors

- ANY pointer at parameter RECORD:
  A length of 1, 2 or 4 is specified for the ANY pointer at the parameter RECORD.
  Data lengths 3 or greater than 4 are recommended here, since these data lengths are supported by all CPUs.
- Different data types at the ANY pointer and in HW-Config:
  At the two SFC 14 "DPRD_DAT" and SFC 15 "DPWR_DAT", only the type BYTE is allowed in the ANY pointer.
- Incorrect consistency configured in HW-Config:
  The consistency must always be set over the entire range!

2.3 Access to consistent data without SFC14 "DPRD_DAT" and SFC 15 "DPWR_DAT"

Description

Consistent data access > 4bytes is now also possible without the system functions SFC14 "DPRD_DAT" and SFC 15 "DPWR_DAT". This option of consistently accessing data > 4 bytes using load/transfer commands is a particularly comfortable and powerful method of gaining access (low runtime load).

The data area of a DP slave or IO device which is to be transmitted consistently is transferred to a process image or partial process image. The information in this area is then always consistent. You can then access the process image or partial process image via load or transfer commands (e.g. L EW 1). There is no range limitation concerning the address assignment.

- Updating the process image is initiated automatically by the operating system.
- The partial process image is updated either by the user via SFCs or automatically by the system via a link to an OB.
- In case of direct access (e.g. L PEW or T PAW) there is no periphery access error.

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Overview

The following CPUs can be used for configuration without SFC14 "DPRD_DAT" and SFC 15 "DPWR_DAT":

Table 2-2

MLFB	S7 CPU	from firmware version
6ES7 31..	CPU 31x	2.5
6ES7 41..	CPU 41x	3.0

Note

Do not use the system function and the process image function simultaneously. The consistency between process image values and the values of the SFC14 "DPRD_DAT" system function is not guaranteed, because the process image is not updated when reading with the SFC14 "DPRD_DAT" system function. Although the process image is generally updated when reading with the SFC15 "DPWR_DAT" system function but not when writing with it. This means that the consistency between process image values and the values of the SFC14 "DPRD_DAT" system function is not guaranteed.

If you are using a CP 443-5 extended, the simultaneous use via system functions and via the process image will result in the following messages: No reading/writing into the process image is possible and/or reading/writing by SFC 14 "DPRD_DAT" and SFC 15 "DPWR_DAT" is no longer possible.

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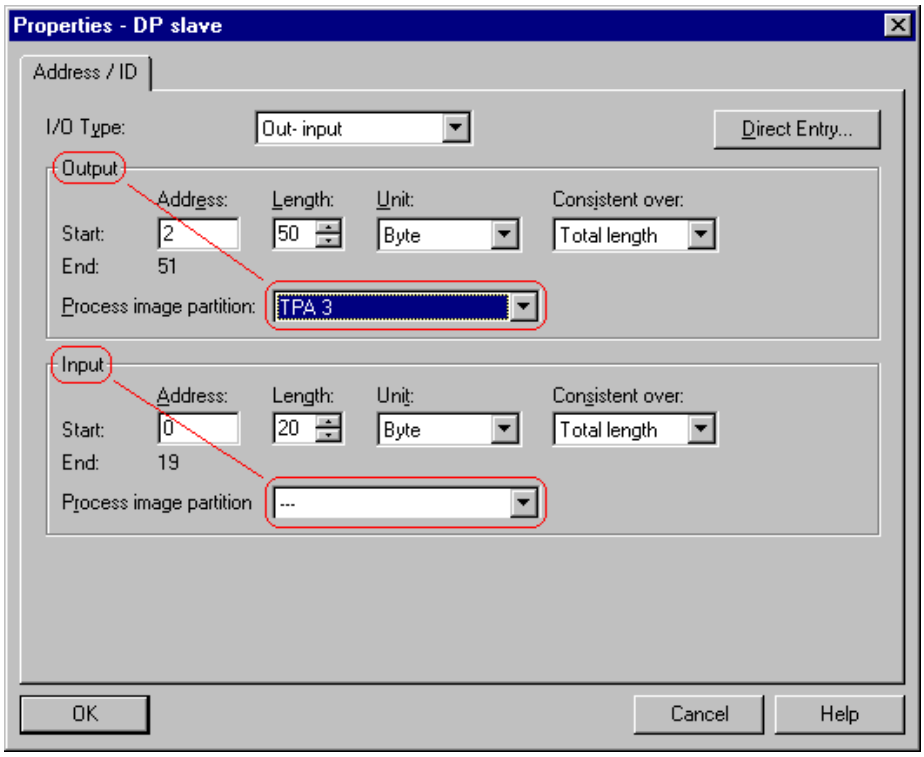
Example

The following example (for the partial process image 3 “TPA 3” of a S7-400 CPU) shows a possible configuration in HW-Config.

The output was consistently configured in the partial process image „TPA 3“. The 50 bytes can be written using normal load/transfer commands.

The input was not configured in the process image. Only handling with the system functions SFC14 "DPRD_DAT" and SFC 15 "DPWR_DAT" is possible.

Figure 2-2



Updating the process image

The process image is updated automatically during the cyclic program processing of the CPU: You can disable the updating of the process image for the S7-400 CPUs and for the CPU 318 if you want to

- access the periphery directly instead or
- update one or more process images of the inputs and outputs later using the SFC 26 "UPDAT_PI" and SFC 27 "UPDAT_PO" system functions.

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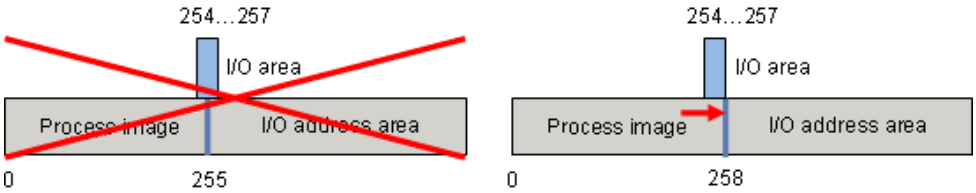
2.4 Boundary conditions for the assignment of addresses

When assigning the addresses in the hardware configuration, please note that a data area that has been created (e.g. a double word) must not be configured on the boundary of the process image (i.e. one part of the area inside and the remaining area outside the process image).

Example

If in case of a process image sized 256 bytes (address range 0 to 255) you want to configure an input double word to the addresses 254 to 257, you have to adjust the size of the process image (configurable in the properties of the CPU).

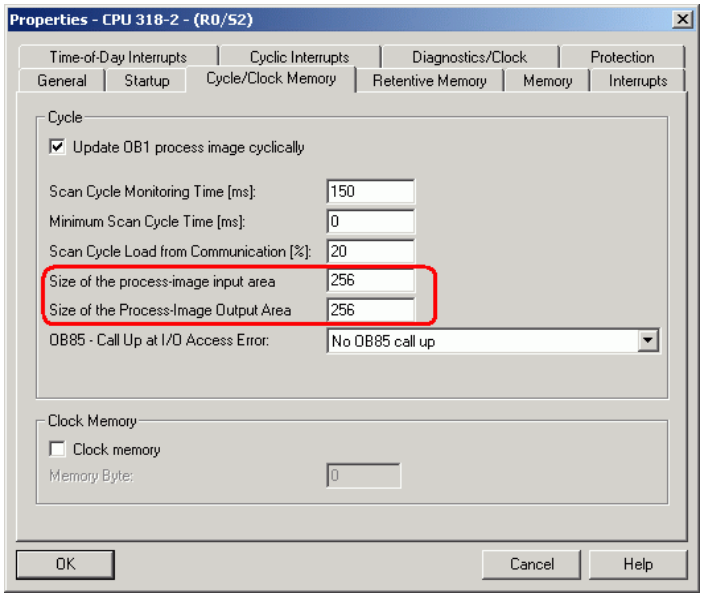
Figure 2-3



2.4.1 Configuring the process image

The process image can be configured in the STEP 7 Hardware Configuration in the CPU's Properties dialog box in the "Cycle/Clock Memory" tab.

Figure 2-4



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Overview

The following tables list the S7-CPUs that support a variable process image.

Table 2-3

S7-300 CPU	Order number	Restriction
CPU 315-2 PN/DP	6ES7 315-2EH13-0AB0	firmware version 2.5 and higher
CPU 317-2	6ES7 317-2AJ10-0AB0	firmware version 2.5 and higher
CPU 317-2 PN/DP	6ES7 317-2EK13-0AB0	firmware version 2.3 and higher
CPU 317-2 PN/DP	6ES7 317-2EJ10-0AB0	firmware version 2.3 and higher
CPU 318-2 DP	6ES7 318-2AJ00-0AB0	-
CPU 319-3 PN/DP	6ES7318-3EL00-0AB0	-
IM154-8 CPU	6ES7 154-8AB00-0AB0	firmware version 2.5 and higher

Table 2-4

S7-400 CPU	Order number	Restriction
CPU 4xx..	6ES7 41..	firmware version 1.1 and higher
CPU 416-2	6ES7 416-2XK00-0AB0	selection possible only between 512 and 1024 bytes
	6ES7 416-2XK01-0AB0	
	6ES7 416-2XL00-0AB0	
	6ES7 416-2XL01-0AB0	

Note The correct configuration of the IO addresses is checked from STEP 7 V5.3 on.

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2.5 Treatment of consistent data when using the CP342-5 communication processor

Instructions

You need the communication blocks FC1 „DP_SEND“ and FC2 „DP_RECV“ to transmit distributed data with the CP342-5. These blocks will always transmit the data consistently (taking into consideration the evaluation of the block parameters DONE / NDR).

For additional information on configuring these blocks, please refer to the following link:
http://support.automation.siemens.com/WW/view/en/23905010

Note The system functions SFC14 "DPRD_DAT" and SFC15 "DPWR_DAT" can not be used. These system functions are only available for integrated DP interfaces for the S7-300.

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3 History

Table 3-1 History

Version	Date	Modifications
V1.0	09.04.2008	First edition