Universal-Parameter-Server (FB 24)

SIMATIC S7

Function Block Description • November 2010

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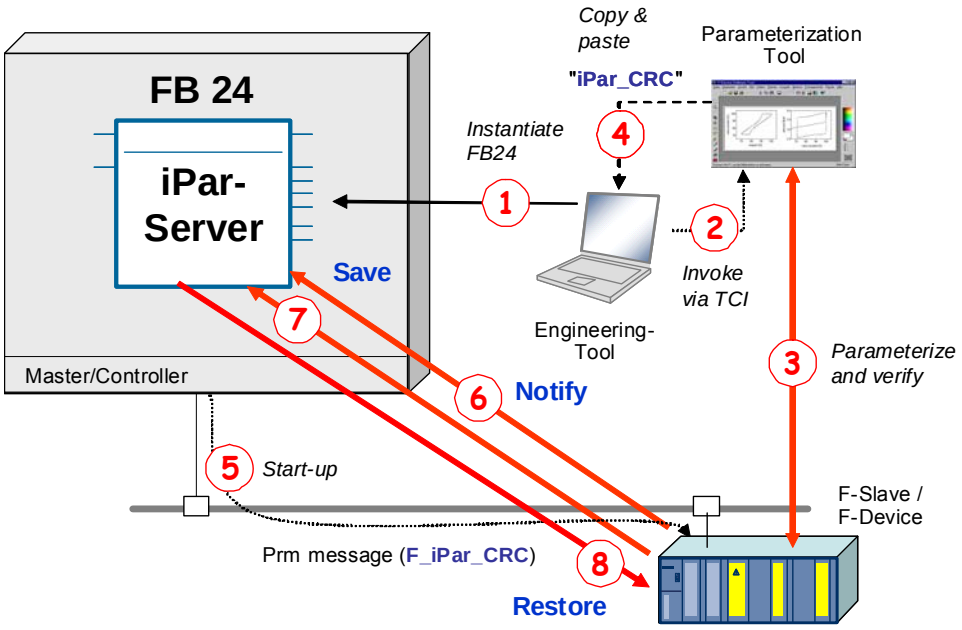
1 Description of functionality

It is the purpose of the function block FB24 "IPARSERV" to save (upload:⑦) individual technology related parameters ("iParameter") of any non-safety or safety PROFIBUS DP slave, PROFINET IO device, or module (herein called: component) within the same host controller that is maintaining the GSD based parameters and diagnosis messages. After for example the replacement of the component due to maintenance or repair, the function block can restore (download:⑧) the iParameter set to the component upon its request (notification:⑥).

Figure 1-1 demonstrates the principle; circled numbers are presenting the actions.

NOTE The designer of a slave/device/module is responsible to define the criteria for the triggering of the "save" or "restore" request, which is actually a special diagnosis message ("notification"). Details can be found in [3], [4].

Figure 1-1 The Universal-Parameter-Server principle



Per upload request ("save notification"), the function block reads the data record with the iParameter out of the component, creates a data block and stores the data record therein.

Per download request ("restore notifcation"), the function block uses the data block and writes a data record down to the component.

Safety

In case of F-Slaves/F-Devices/F-Modules (herein: F-Component), the Universal-Parameter-Server mechanism can be supplemented by a special protection against wrong or perturbed iParameter data.

This protection is achieved via the F-Parameter "F_iPar_CRC" defined by PROFIsafe [3]. It holds the CRC signature across all iParameters including necessary identification and type information of the F-Components.

The F_iPar_CRC is part of the F-Parameter block within for example the "Prm message" at PROFIBUS DP, transfered from the host controller to the F-Components at start-up (⑤). They then are able to check their local iParameter set against the received F_iPar_CRC.

NOTE The user is responsible to ensure enough memory space in the host controller for the successful storage of the complete amount of iParameters for all the configured components requiring the iPar-Server.

2 Deployment of the FB 24

The FB 24 can be used on existing S7-300 and S7-400 host controllers in the field. However, there are dependencies on the operating system versions (firmware) in respect to the activation of the "notifications". See 2.3.

The FB is instantiated once per component or as described in the user manual of the particular DP-Slave or IO-Device. It must be invoked within OB1 and additionally in OB 100 (the start-up OB).

In case a slave had already been connected to a host controller and will be reconnected via a PROFINET-Proxy while keeping the same node address, the host controller needs to be rebooted or the instance data block of the FB 24 "IPARSERV" needs to be reloaded in order to reinitialize the function block.

2.1 Notification via PROFIBUS DP

With PROFIBUS DP, a slave sends a request to "save" (upload) or "restore" (download) iParameter to the host controller via the new special "STATUS" diagnosis message type 7, called "iPar notification".

2.2 Notification via PROFINET IO

With PROFINET IO, a device sends a request to "save" (upload) or "restore" (download) iParameter to the host controller via a new "ALARM", called "Upload&Retrieval" (UserStructureIdentifier = 0x8201).

In case of a PROFINET IO device, the function block FB 24 must additionally be invoked within OB 56 (the "Update Alarm" OB).

2.3 Dependencies on operating system (firmware) versions of the CPUs

Since the "iPar notification" diagnosis status with PROFIBUS DP and the "Upload&Retrieval" diagnosis alarm with PROFINET IO are new functionalities, the various S7-300 and S7-400 CPUs in the field may not provide the minimum version of the firmware. Table 2-1 is showing the minimum required versions.

Table 2-1 required firmware for Universal-Parameter-Server

CPU	Firmware
S7-3xx DP	all
S7-4xx PN/DP	all
S7-319F-3PN/DP	≥ 2.7.0
S7-317F-2PN/DP	≥ 3.1.0
S7-315F-2PN/DP	≥ 3.1.0

3 Assignment and feedback of the FB 24

The user interface of the function block IPARSERV is defined by its input and output variables as shown in Table 3-1.

Table 3-1 Input and output variables of FB 24

Variable	Declaration	Data type	Memory	Description
LADDR	INPUT	INT (INT16)	I, O, M, D, L, Const.	Logical start address of the component from which iParameters are to be saved (uploaded)[1]
DB_NO	INPUT	INT (INT16)	I, O, M, D, L, Const.	Number of the data block to store the iParameters in.
OUT_MOD	INPUT	BOOL	I, O, M, D, L, Const.	• TRUE (1): This is an output module • FALSE (0): This is an input module[2]
DP_SLAVE	INPUT	BOOL	I, O, M, D, L, Const.	• TRUE (1): This is a PROFIBUS slave • FALSE (0): This is a PROFINET IO device (or a central component).
UPL_ACT	OUTPUT	BOOL	I, O, M, D, L	iParameter upload from component is active
DNL_ACT	OUTPUT	BOOL	I, O, M, D, L	iParameter download from component is active
ERR_CODE	OUTPUT	INT (INT16)	I, O, M, D, L	Error code (Table 4-1)
SF_RET	OUTPUT	WORD	I, O, M, D, L	Return value of an SFB or SFC invocation (Table 4-1)

NOTE 1 Logical start address is the number of the first input or output byte of a particular module as shown in Figure 3-1.

NOTE 2 In case of a mixed input/output module, the lower of both logical start addresses is dominant. The module is treated as an input module if the logical input start address is lower or equal (OUT_MOD = FALSE (0)). The module is treated as an output module if the logical output start address is lower (OUT_MOD = TRUE (1)).

3.1 Logical start address

A programmer does not need to handle the network path "node/slot/channel" to access a particular signal. The programmer is using a logical start address instead. The relationship between network addresses and logical start addresses is demonstrated in Figure 3-1. The engineering tool usually is assigning the logical start address unambiguously.

Figure 3-1 Relationship between network address and logical start address

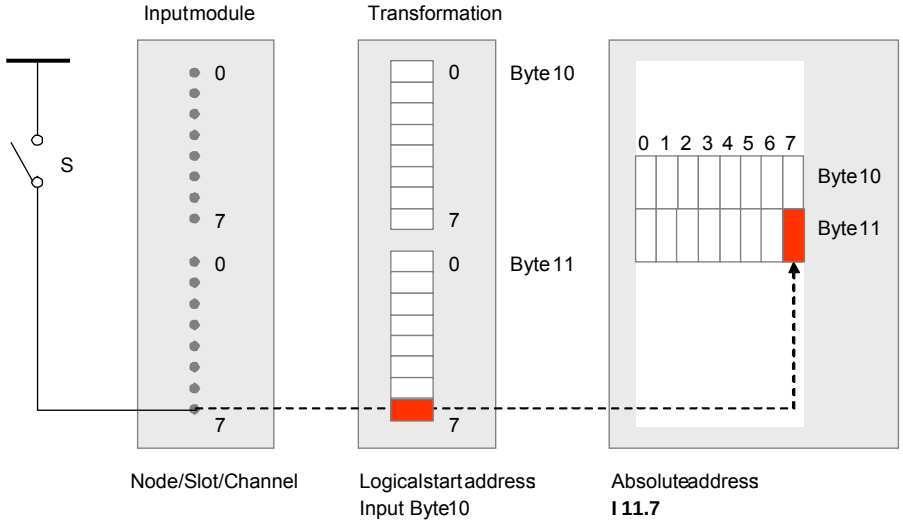
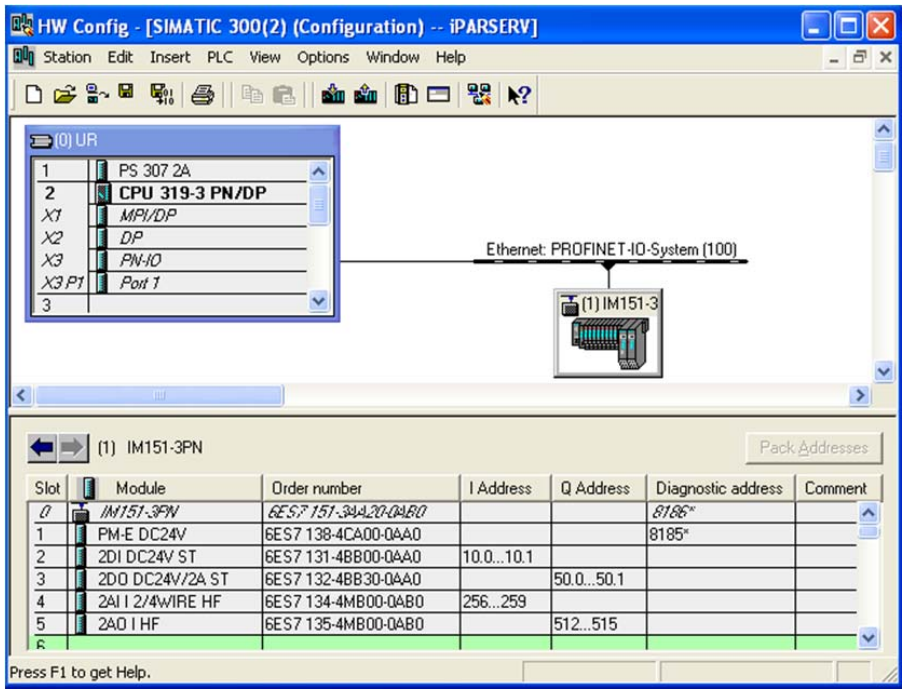


Figure 3-2 is showing exemplary the layout of a remote I/O with modules and their logical start addresses.

Figure 3-2 HW configuration of STEP7 with I and O logical start addresses



3.2 DB number

The user must reserve a unique DB number for each component from which iParameters are to be saved (uploaded). This number of the DB is to be assigned through the input variable DB_NO of the function block IPARSERV.

3.2.1 DB size

Upon its first invocation, the function block will create the assigned data block with 12 bytes administrative data (2 bytes version, 4 bytes length, and 6 bytes for the "Load Region" header) and store it in the memory of the host controller. It is the user's responsibility to provide enough memory space (DB-length) for all the possible data blocks.

- Rule for DB with non-segmented iParameters (read/write record):
  iParameter length (≤ 234 bytes) + 6 bytes (Table 3-2).
- Rule for DB with segmented iParameters (push/pull method):
  iParameter length + 6 bytes + 6 bytes + maximum segment size (Table 3-3).
  In this case additional "scratch pad" memory is needed for the segment handling.

3.2.2 DB structure

Table 3-2 and Table 3-3 are showing the DBs for non-segmented and segmented iParameter storage.

Table 3-2 Content of the DB with non-segmented iParameters

Byte	Explanation
0	Version identification for the structure of the data block
1	Reserved
2 … 5	Total length of the iParameter data (Total_iPar_Size)
6 …	iParameter (without the header for "Load Region“)
e.g. 64	

Table 3-3 Content of the DB with segmented iParameters

Byte	Explanation
0	Version identification for the structure of the data block
1	Reserved
2 … 5	Total length of the iParameter data (Total_iPar_Size)
6 …	iParameter (without the header for "Load Region“)
e.g. 64	
e.g. 65	With segmented read/write of data records via "PUSH“ and "PULL“ this additional memory space is needed as intermediate space for the handling of records including "Load Region“ headers: maximum segment length + 6 byte header "Load Region“.
…	
e.g. 96	

4 Error information of the FB 24

Table 4-1contains the possible error codes and an explanation or help information respectively. The function block IPARSERV internally is using several system function calls and system function blocks. The output variable SF_RET provides possible error codes from these second level operations. Table 4-1 is also showing the associated SFB/SFC. Online help is available in STEP7 for these codes.

Table 4-1 Error codes and their explanation

ERR_CODE	Explanation	SF_RET
0	No error	-
1	It was not possible to create the data block (DB_NO) for the iParameter storage The error code of the SFC85 CREA_DB is available on SF_RET	SFC 85
2	Data block (DB_NO) too small for the iParameter storage	-
3	Error occurred while reading additional ALARM information The error code of the SFB54 RALRM is available on SF_RET	SFB 54
4	Invalid request from the component. Possible reasons: • - No request for up- or download of iParameters • - Data size too big • - Maximum segment size more than 234 bytes (PROFIBUS only) • - Transfer index higher than 254 (PROFIBUS only)	-
5	Error occurred while reading data records from component The error code of the SFB52 RDREC is available on SF_RET	SFB 52
6	Wrong segment while reading segmented iParameters	-
7	Error occurred while writing data records to the component The error code of the SFB53 WRREC is available on SF_RET	SFB 53
8	Version identification within data block (DB_NO) invalid	-
9	Error occurred while checking whether the component is connected on PROFIBUS, PROFINET or locally. This error prevents the function block from completing the upload or download operation. The error code of the SFC 71 LOG_GEO is available on SF_RET	SFC 71
10	Error occurred while checking the existence of the DB with number DB_NO. The error code of the SFC24 TEST_DB is available on SF_RET	SFC 24
11	Error occurred while writing a data record: Data block with number DB_NO does not exist.	-
12	Error occurred while cyclically reading data records from slave or locally connected component. The error code of the SFC51 RDSYSST is available on SF_RET	SFC 51

An indicated ERR_CODE (except ERR_CODE = 9) has no influence on the ongoing execution of the FB. An error code is indicated as long as it will not be overwritten by another ERR_CODE or the ERR_CODE = 0 (no error) after a successful transfer of the iParameter from or to the component.
The request for reading or writing a data record is reset.

4.1 Diagnosis buffer of the S7-CPU

In case of the ERR_CODEs 1, 2, 4, 5, 6, 7, 8, 10, and 11 the FB24 is using SFC 52 "WR_USMSG" to enter the number 16#9145 (text: no reaction: coming) into the diagnosis buffer of the S7-CPU. The following values are entered in input INFO1 and INFO2 of the SFC 52 as additional information:

Table 4-2

	Data type	Value
INFO1	WORD	LADDR
INFO2	DWORD	ERR_CODE (high word), SF_RET (low word)

NOTE In the diagnosis buffer of the S7-CPU, the value of INFO2 is displayed in decimal form. Thus, conversion is needed to gather the error.

5 Appendix

5.1 Definitions

The terms and abbreviations used in this document are defined as follows.

Table 5-1 5.1 Definitions

Term	Description
Central component	Module connected locally to a host controller
Compact station	Field device that is not extensible by physical modules as opposed to a physically modular station
Component	Term used in this document for slave, device or module
DB	Data block
DAP	Device Access Point (from the PROFINET point of view)
Device (IO-Device)	Field device in a PROFINET IO network
F-Component	Term used in this document for F-Slave, F-Device or F-Module
F-Device	Functional safe IO-Device connected to PROFINET IO using the PROFIsafe protocol
F-Host	A (user) programmable unit such as a PLC, PCS or IPC with functional safety capability hosting a PROFIBUS master class 1 and/or a PROFINET IO controller
F-Module	Functional safe module inside a physically modular station (remote I/O) using the PROFIsafe protocol
F-Slave	Functional safe slave connected to PROFIBUS DP using the PROFIsafe protocol
Head station	Main module of a physically modular station that is connected to the fieldbus
Host controller	A (user) programmable unit such as a PLC, PCS or IPC hosting a PROFIBUS master class 1 and/or a PROFINET IO controller
iParameter	Individual technology related parameters of a component that may be safety related or not
IPC	Industrial Personal Computer
Logic start address	A symbolic address in PLC user programs representing the network path to a real I/O channel: node/slot/channel. Hence, the network configuration can be changed without changing the user program.
Module	Physical or virtual component that can be addressed via the fieldbus
Notification	Special diagnosis message type (PROFIBUS DP: Status message; PROFINET IO: Upload&Retrieval alarm)
PLC	Programmable Logic Controller
PCS	Process Control System
Remote I/O	Usually a fieldbus device with digital and/or analog input and/or output channels
SFB	System Function Block (term in STEP7)
SFC	System Function Call (term in STEP7)
Slave (DP-Slave)	PROFIBUS DP field device
Submodul	Hardware or logical component of a module

5.2 Related Literature

5.2.1 Bibliography

This list is not complete and only represents a selection of relevant literature.

[1] Manfred Popp: *The New Rapid Way to Profibus DP*, 2002, PNO Order No. 4.072;

[2] Manfred Popp: *Industrial communication with PROFINET*, 2007, PNO Order No. 4.182;

[3] *PROFIsafe - Profile for Safety Technology on PROFIBUS DP and PROFINET IO*, V2.4, March 2007, PNO Order No: 3.192b

[4] *Profile Guidelines, Part 4*, Parameter Server for PROFIBUS and PROFINET, V1.0, September 2010, PNO Order No: 3.532

This PNO literature can be ordered directly from the PNO \4\

5.2.2 Internet Link Specifications

This list is not complete and only represents a selection of relevant information.

Table 5-2

	Subject	Title
\1\	Reference to the entry	http://support.automation.siemens.com/WW/view/en/45841087
\2\	Siemens I IA/DT Customer Support	http://support.automation.siemens.com
\3\	PNO (PROFIBUS Nutzer Organisation)	http://www.profibus.com
\4\	PNO Literature List	http://www.profibus.com/nc/downloads/downloads/literature-list-order-form/display

5.3 History

Table 5-3

Version	Date	Modifications
V1.0	11/2010	First version