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1. Description of Hardware

1.1 Modules and devices

Components utilized:

Designation	Explanation	Manufacturer
PS 307	Load power supply	SIEMENS
CPU 315-2 DP	CPU with PROFIBUS DP Master/Slave Interface	SIEMENS
CP 341 RS 232 C	Communications processor	SIEMENS
PG 740PII	Programming device	SIEMENS
STEP7 V5.0	Programming software	SIEMENS
U-P3-RX	Substructure for Read/write station	Pepperl+Fuchs GmbH
IPT-FP	Read/write station	Pepperl+Fuchs GmbH

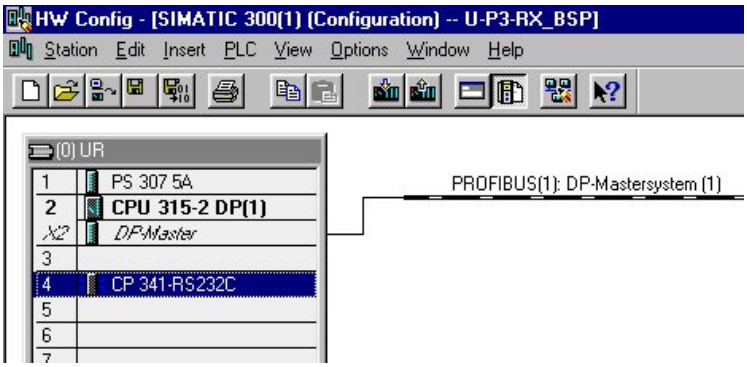
1.2 Set-up and Installation

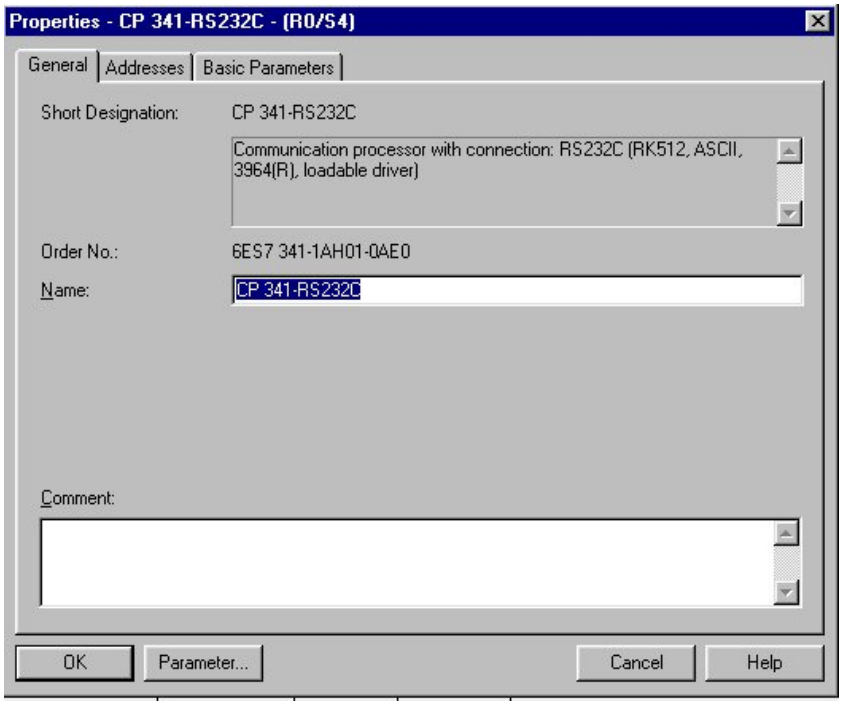
Please see the handbook entitled "Automation System S7-300, Set-up, CPU data" by Siemens for information regarding the connection of the S7 components and their supply. The components used here are to be operated with a voltage of 20 - 30 V DC (connection in the terminal room of substructure). The read/write station is attached and bolted to the substructure. More detailed information regarding the connection and installation of the device can be found in the handbook of Pepperl+Fuchs GmbH.

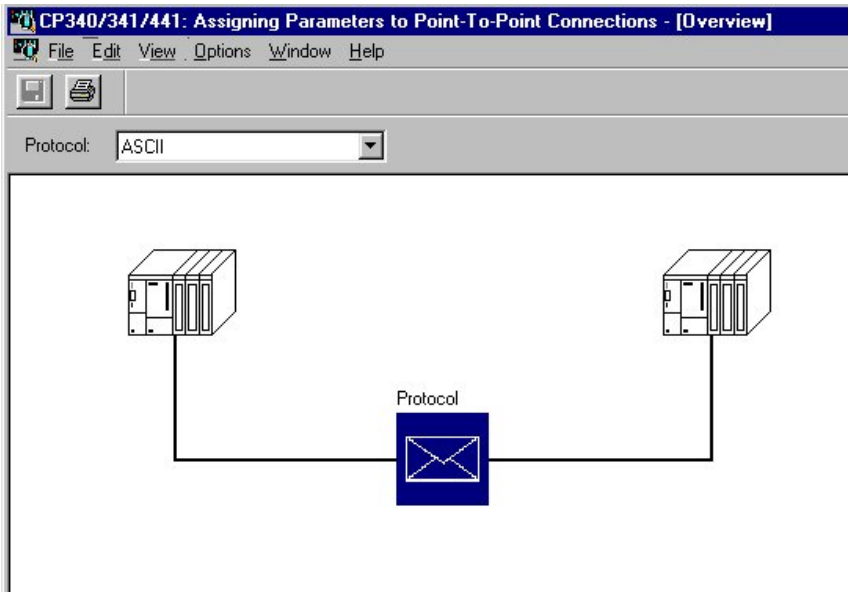
2. Setting up Parameters

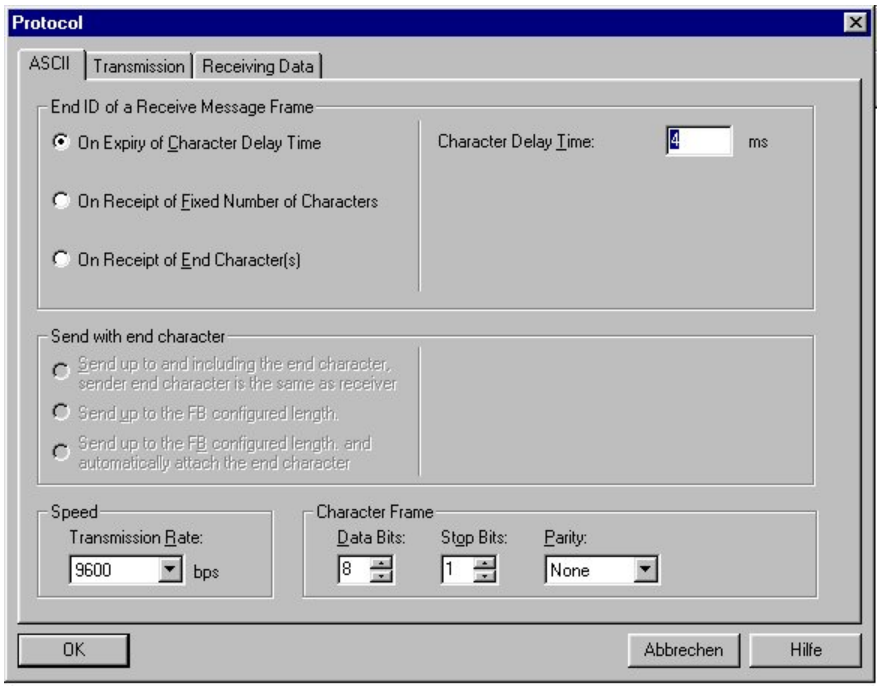
2.1 Setting up parameters in accordance with protocol

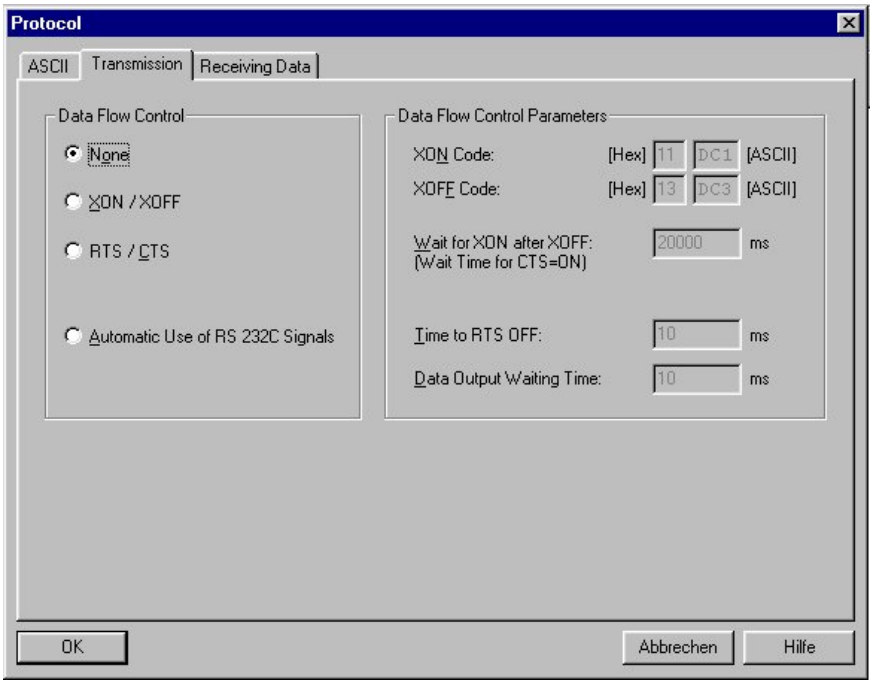
By clicking on the order number CP 341 in the configuration table, a dialog box containing "Properties - CP 341"appears. With the aid of the "Parameter" switching screen, the window to the protocol selection is opened. In this example the ASCII protocol was used. An envelope is the symbol for the transfer protocol. By double clicking on it, you will get to the dialog regarding setting up the parameters in accordance with protocol.


HW Config - [SIMATIC 300(1) (Configuration) -- U-P3-RX_BSP]
Station Edit Insert PLC View Options Window Help
(0) UR
1 PS 307 5A
2 CPU 315-2 DP(1)
X2 DP-Master
3
4 CP 341-RS232C
5
6
PROFIBUS(1): DP-Mastersystem (1)


Properties - CP 341-RS232C - (R0/S4)
General Addresses Basic Parameters
Short Designation: CP 341-RS232C
Communication processor with connection: RS232C (RK512, ASCII, 3964(R), loadable driver)
Order No.: 6ES7 341-1AH01-0AE0
Name: CP 341-RS232C
Comment:
OK Parameter... Cancel Help

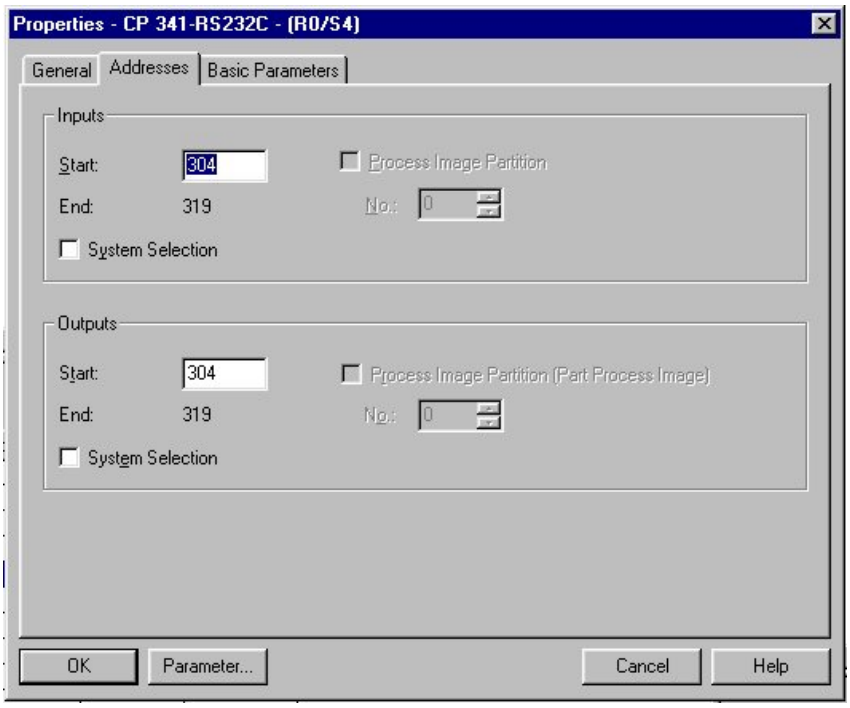

CP340/341/441: Assigning Parameters to Point-To-Point Connections - [Overview]
File Edit View Options Window Help
Protocol: ASCII
Protocol





2.2 Organization of data / addresses

The I/O addresses of the series module are automatically put on the next free periphery addresses by the STEP7 software. The user can change these addresses in the dialog box "Properties-addresses". In the example presented here, the input and output addresses lie between 304 – 319.



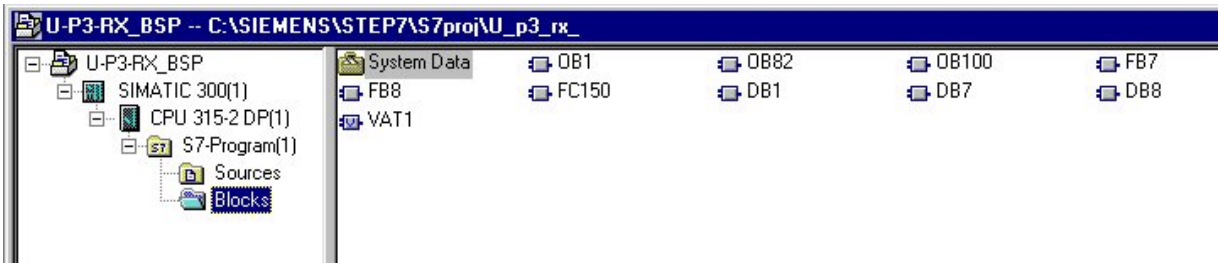
3. Software

3.1 Modules and their function

Modules utilized:

Module	Designation	Description
FB 7	Function module	Receiving data
FB 8	Function module	Sending data
OB 82	Organization module	Called up when a diagnosis alarm of a module appears, so that CPU does not switch into STOP status
OB 100	Organization module	Startup-OB, sets all relevant markers back upon start-up of a program
DB 1	Data module	Stores read data of the IPT-FP with U-P3-RX, contains the data and commands being transmitted
DB 7	Instance data module	Necessary for internal startup of FB 7
DB 8	Instance data module	Necessary for internal startup

		of FB 8
OB 1	Organization module	Cyclical call-up of FC 150
FC 150	Function	Formulation of check sum, communication to IPT-FP with U-P3-RX
VAT 1	Variables table	Online control of the ID system



3.2 Data exchange

It's possible to run the IPT-FP with U-P3-RX in various modes. Three modes are presented in the example: read Fixcodes, read in data from arbitrary addresses on the data carrier and write data to arbitrary addresses on the data carrier. The read/write station must be initialized for the respective mode of operation. In this sample program, the desired command is input with the aid of the variables table. The commands and respective parameters must be written in the DB 1 starting at byte 0.
The command to be transmitted for reading of Fixcodes is compiled in the following manner:

Command	Syntax
Buffered Read Fixcode	"bf"

The read Fixcodes are stored in the DB 1 starting at byte 127. More extensive explanations on setting up the commands and their exact meanings can be found in the handbook.
The command for reading-in of data is described in the following:

Command	Syntax
Buffered Read	"br"<WordAdr><WordAnz>

- <WordAdr> determines the start address of the words to be read on the data carrier. For data carriers of the type IPC03, the address range lies between 0000...001C.
- <WordAnz> indicates the number of 32-Bit words which are to be read. A maximum of 1Dhex (decimal 29) 32-Bit words can be read at the same time.

Please note that the number values are also to be considered as signs from the CHAR type (without a sign, 0...255) and may not be input as hexadecimals. The read data is stored in the DB 1 after byte 127.

The following command is to be transmitted for describing data carriers:

Command	Syntax
Buffered Write	"bw"<WordAdr><WordAnz><Daten>

- The parameters <WortAdr> and <WortAnz> have the same meaning as in the "Buffered Read" command. For this command, as well, a maximum of 1Dhex (decimal 29) 32-bit words may be written to the data carrier.
- All other parameters with regard to the Reading of Data command remain unchanged.

Please note that the number values are also to be considered as signs from the CHAR type (without a sign, 0...255), and may not be input as hexadecimals.
The check sum of the particular commands is automatically formed in the FC 150, and attached to the command or data set together with the end-of-text sign. The complete command to be transmitted thus appears as follows:

Command	Syntax
General	Command/parameter/write data<CHK><ETX>

For the output of commands, word addresses and write data to the IPT-FP with U-P3-RX, FB 8 is called up from the function module of the FC 150. A required parameter is the start address of the outputs of the communications processor CP 341. The transmittal of data is initiated by means of a positive flank at the input REQ. With a marker set at input R, the transmittal to the CP 341 is interrupted. DB_NO indicates the number of the data module, DBB_NO the data bit, from which the data is transferred. LEN is the length of the data in bytes. DONE and ERROR indicate wither the data transmittal has taken place and whether or not errors have occurred. The markers occupied in this case do not need to be re-set by the user, since it takes place automatically upon the next run cycle of the FB 8. The return value STATUS contains an error code. If no error has occurred during the transfer, the return value contains the sequence 0000. You can find a more detailed description of the error codes in the reference handbook entitled "SIMATIC CP 341 Point-to-Point Coupling" by Siemens.

```
Netzwerk 3 : Senden
Kommentar:

      CALL  "P_SND_RK" , DB8            // Sende FB
       SF      :='S'
       REQ     :=M201.1
       R       :=M201.7
       LADDR   :=304
       DB_NO   :=1
       DBB_NO  :=0
       LEN     :=MW250
       R_CPU_NO:=0
       R_TYP   :=
       R_NO    :=0
       R_OFFSET:=0
       R_CF_BYT:=0
       R_CF_BIT:=0
       DONE    :=M201.2
       ERROR   :=M201.3
       STATUS  :=#Status_Send
```

In any event, the impulse to send data (setting of REQ marker) should be given after **(!)** the function call-up. This assures that the network will run cycle without a function call-up before a new command to be sent. The DONE and ERROR marker is thus re-set through function FB 8.

```
U     #Start_Send
S     M    201.1
R     #Start_Send

U     M    201.3
S     #Error

O     M    201.2
O     M    201.3
R     M    201.1
```

FB 7 is used for reading-in of data from the read/write station. The required start address of the inputs corresponds to that of the outputs. A static high-signal must be present at the input EN_R so that the FB becomes active. Input R stops the reading-in process. The goal of the data and the return values is to be occupied analogously to the FB 8. The input NDR has the same meaning as the input DONE for FB 8. It indicates the completion of a read job. Here, too, the markers occupied by DONE and NDR are automatically re-set upon the next cycle (run) of the FB 7. The length of the telegram received is reported at the output LEN.

Netzwerk 1: Empfangen

Kommentar:

```
U     #Start_Receive
S     M    203.1
R     #Start_Receive

CALL  "P_RCV_RK" , DB7            // Empfangs FB
 EN_R    :=M203.1
 R       :=M203.7
 LADDR   :=304
 DB_NO   :=1
 DBB_NO  :=126
 L_TYP   :=
 L_NO    :=
 L_OFFSET:=
 L_CF_BYT:=
 L_CF_BIT:=
 NDR     :=M203.2
 ERROR   :=M203.3
 LEN     :=MW208
 STATUS  :=#Status_Receive

U     M    203.3
S     #Error
```

The DB1 data module must be set up ahead of time in a byte structure and at the proper length. In the first 126 bytes are stored the command to be sent, the word address (for read/write commands), the word quantity (for read/write commands), the write data (for write commands), the check sum and the end-of-text sign.
After byte 126 are the confirmed status, the read Fixcode or the read data, the check sum and the end-of-text sign.

	Meaning
Byte 0, Byte 1	Command code, e.g. "bf", "bw", "br"
Byte 2	Check sums for Fixcode commands First sign word address for read/write commands
Byte 3	End-of-text sign (ETX) for Fixcode commands Second sign word address for read/write commands
Byte 4, Byte 5	Third and fourth sign word addresses for read/write commands
Byte 6, Byte 7	Number of words for read/write commands
Byte 8	Check sum for read commands First sign write data for write commands
Byte 9	End-of-text sign (ETX) for read commands Second sign write data for write commands
Byte 10...Byte 123	Write data for write commands (the check sum and end-of-text sign are contained in the 2 bytes which follow)
Byte 124	Check sum for write commands with 1Dhex (29 decimals) 32-Bit data words
Byte 125	End-of-text sign (ETX) for write commands with 1Dhex (29 decimals) 32-Bit data words
Byte 126	Confirmed status by the IPT-FP with U-P3-RX
Byte 127...Byte 242	Read Fixcodes and data (the check sum and end-of-text sign are contained in the 2 bytes which follow)
Byte 243	Check sum for read commands with 1Dhex (29 decimals) 32-Bit data words
Byte 244	End-of-text sign (ETX) for read commands with 1Dhex (29 decimals) 32-Bit data words

The illustration inserted on the next page clarifies the total set-up of data module DB1.

LAD/STL/FBD - [DB1 -- U-P3-RX_BSP\SIMATIC 300(1)\CPU 315-2 DP(1)]

File Edit Insert PLC Debug View Options Window Help

Address	Name	Type	Initial value	Actual value
0.0	Byte0	BYTE	B#16#0	B#16#0
1.0	Byte1	BYTE	B#16#0	B#16#0
2.0	Byte2	BYTE	B#16#0	B#16#0
3.0	Byte3	BYTE	B#16#0	B#16#0
4.0	Byte4	BYTE	B#16#0	B#16#0
5.0	Byte5	BYTE	B#16#0	B#16#0
6.0	Byte6	BYTE	B#16#0	B#16#0
7.0	Byte7	BYTE	B#16#0	B#16#0
8.0	Byte8	BYTE	B#16#0	B#16#0
9.0	Byte9	BYTE	B#16#0	B#16#0
10.0	Byte10	BYTE	B#16#0	B#16#0
11.0	Byte11	BYTE	B#16#0	B#16#0
12.0	Byte12	BYTE	B#16#0	B#16#0
13.0	Byte13	BYTE	B#16#0	B#16#0
14.0	Byte14	BYTE	B#16#0	B#16#0
15.0	Byte15	BYTE	B#16#0	B#16#0
16.0	Byte16	BYTE	B#16#0	B#16#0
17.0	Byte17	BYTE	B#16#0	B#16#0
18.0	Byte18	BYTE	B#16#0	B#16#0
19.0	Byte19	BYTE	B#16#0	B#16#0
20.0	Byte20	BYTE	B#16#0	B#16#0

LAD/STL/FBD - [DB1 -- U-P3-RX_BSP\SIMATIC 300(1)\CPU 315-2 DP(1)]

File Edit Insert PLC Debug View Options Window Help

120.0	Byte120	BYTE	B#16#0	B#16#0
121.0	Byte121	BYTE	B#16#0	B#16#0
122.0	Byte122	BYTE	B#16#0	B#16#0
123.0	Byte123	BYTE	B#16#0	B#16#0
124.0	Byte124	BYTE	B#16#0	B#16#0
125.0	Byte125	BYTE	B#16#0	B#16#0
126.0	Byte_Ein0	BYTE	B#16#0	B#16#0
127.0	Byte_Ein1	BYTE	B#16#0	B#16#0
128.0	Byte_Ein2	BYTE	B#16#0	B#16#0
129.0	Byte_Ein3	BYTE	B#16#0	B#16#0
130.0	Byte_Ein4	BYTE	B#16#0	B#16#0
131.0	Byte_Ein5	BYTE	B#16#0	B#16#0
132.0	Byte_Ein6	BYTE	B#16#0	B#16#0
133.0	Byte_Ein7	BYTE	B#16#0	B#16#0
134.0	Byte_Ein8	BYTE	B#16#0	B#16#0
135.0	Byte_Ein9	BYTE	B#16#0	B#16#0
136.0	Byte_Ein10	BYTE	B#16#0	B#16#0
137.0	Byte_Ein11	BYTE	B#16#0	B#16#0
138.0	Byte_Ein12	BYTE	B#16#0	B#16#0
139.0	Byte_Ein13	BYTE	B#16#0	B#16#0
140.0	Byte_Ein14	BYTE	B#16#0	B#16#0
141.0	Byte_Ein15	BYTE	B#16#0	B#16#0
142.0	Byte_Ein16	BYTE	B#16#0	B#16#0
143.0	Byte_Ein17	BYTE	B#16#0	B#16#0
144.0	Byte_Ein18	BYTE	B#16#0	B#16#0

The call-up of function FC 150 occurs cyclically from OB 1. The required parameters, such as the data modules to be used, are turned over to the function. Errors during sending or receiving are indicated as re-confirmed values and the respective error status word is transmitted.

```
OB1 : Kommunikation mit U-P3-RX
Kommentar:

Netzwerk 1: FC Aufruf
Checksummenbildung,
Sende- und Empfangs FB's werden im FC 150 aufgerufen

      CALL  FC   150
       Send_DB       :="DB1"
       Start_Send    :=M1.0
       Start_Receive :=M3.0
       Error         :="Fehler"
       Status_Send   :=MW4
       Status_Receive:=MW6
```

The check sum of the submitted commands and data is calculated inside the FC 150. Thus the function distinguishes between Fixcode, read and write commands. Following this, the length of the command or the respective parameters is communicated. The check sum and the end-of-text sign (ETX) are automatically attached to the command and/or data set. Both signs are written into the DB1 in the two bytes which follow the command or the data words.

3.3 Formation of the check sum

Since there are several variables in the formation of the check sum, the process used for determining it here should be briefly explained at this point.
The IPT-FP with U-P3-RX needs the check sum for controlling the command which is received. The hexadecimal values of all signs (see ASCII table), which are contained in the command and all respective parameters (e.g. word address, number of words), are added up. Care must be taken that the number values are also viewed as signs of the CHAR type (without a sign, 0 ...255).
Only the last two places are considered from the result in hexadecimal form. The respective ASCII sign or its hexadecimal value is the check sum. It may only be one sign or one byte in size.
In the following example, the check sum of the "Buffered Read" command is formed starting at the address 0004hex with a length of two 32-bit words.

Command sign	Hexadecimal value
b	62hex
r	72hex
0	30hex
0	30hex
0	30hex
4	34hex
0	30hex
2	32hex
Sum	1FAhex
Check sum	**FAhex**

3.4 Program control using the variables table

By means of a previously determined variables table, communication with the ID system can be tested.
By setting bit 0 in the marker byte MB1, the one-time sending of a previously determined command is instigated. The continuing read-readiness of the CP 341 is created by means of the set bit 0 of marker byte MB 3.
DB1.DBB0 to DB1.DBB125 contain, as already described, the command which is transmitted to the IPT-FP with U-P3-RX. Here, beginning with byte 0, the user can input "byte-wise" the desired command code, the word address (for read/write commands), the number of words (for read/write commands) and the write data (for write commands). Please note that letters used for hexadecimal numbers (word address, number of words) are always written in capital letters and must be input as a sign from the CHAR type (without a sign, 0...255). The check sum and the end-of-text sign (ETX) are attached from the program independently.
DB1.DBB126 to DB1.DBB244 contain the confirmed status, the read Fixcodes or data, the check sum and the end-of-text sign (ETX).
The marker words MW4 and MW 6 contain the error codes already described, which re-confirm the STATUS outputs of the function modules FB 7 and FB 8.

VAT1 -- U-P3-RX_BSP\SIMATIC 300(1)\CPU 315-2 DP(1)

Address	Symbol	Monitor Format	Monitor Value	Modify Value
MB 1	---	BIN		2#0000_0001
DB1.DBW 0	---	CHAR		'bw'
DB1.DBD 2	---	CHAR		'0008'
DB1.DBW 6	---	CHAR		'09'
DB1.DBD 8	---	CHAR		'P+F '
DB1.DBD 12	---	CHAR		'BSP '
DB1.DBD 16	---	CHAR		'U-P3'
DB1.DBD 20	---	CHAR		'RX '
DB1.DBD 24	---	CHAR		'an '
DB1.DBD 28	---	CHAR		'S7- '
DB1.DBD 32	---	CHAR		'300 '
DB1.DBD 44	---	HEX		
MW 4	---	CHAR		
MB 3	---	BIN		//2#0000_0001
DB1.DBB 126	"DB1".Byte_Ein0	CHAR		
DB1.DBD 127	---	CHAR		
DB1.DBD 131	---	CHAR		
DB1.DBD 135	---	CHAR		
DB1.DBD 139	---	CHAR		
DB1.DBD 143	---	CHAR		
DB1.DBD 147	---	CHAR		
DB1.DBD 151	---	CHAR		
DB1.DBD 155	---	CHAR		
MW 6	---	HEX		

3.5 Additional Information

In a program which is to take over the evaluation of the extracted data, there are a few basic considerations which are very meaningful.
The status indicator, which is transmitted along with the newly read data in each case, is also very important. As an example, the status indicator could identify a command which was not correctly transmitted or a failed reader head immediately. Pepperl+Fuchs GmbH describes the meaning of the individual status signs in detail in the handbook.
Care must be taken that several data or Fixcode carriers are not read in at very short time intervals. In this case, the data in the data module would overwrite itself and thus be lost to the user.