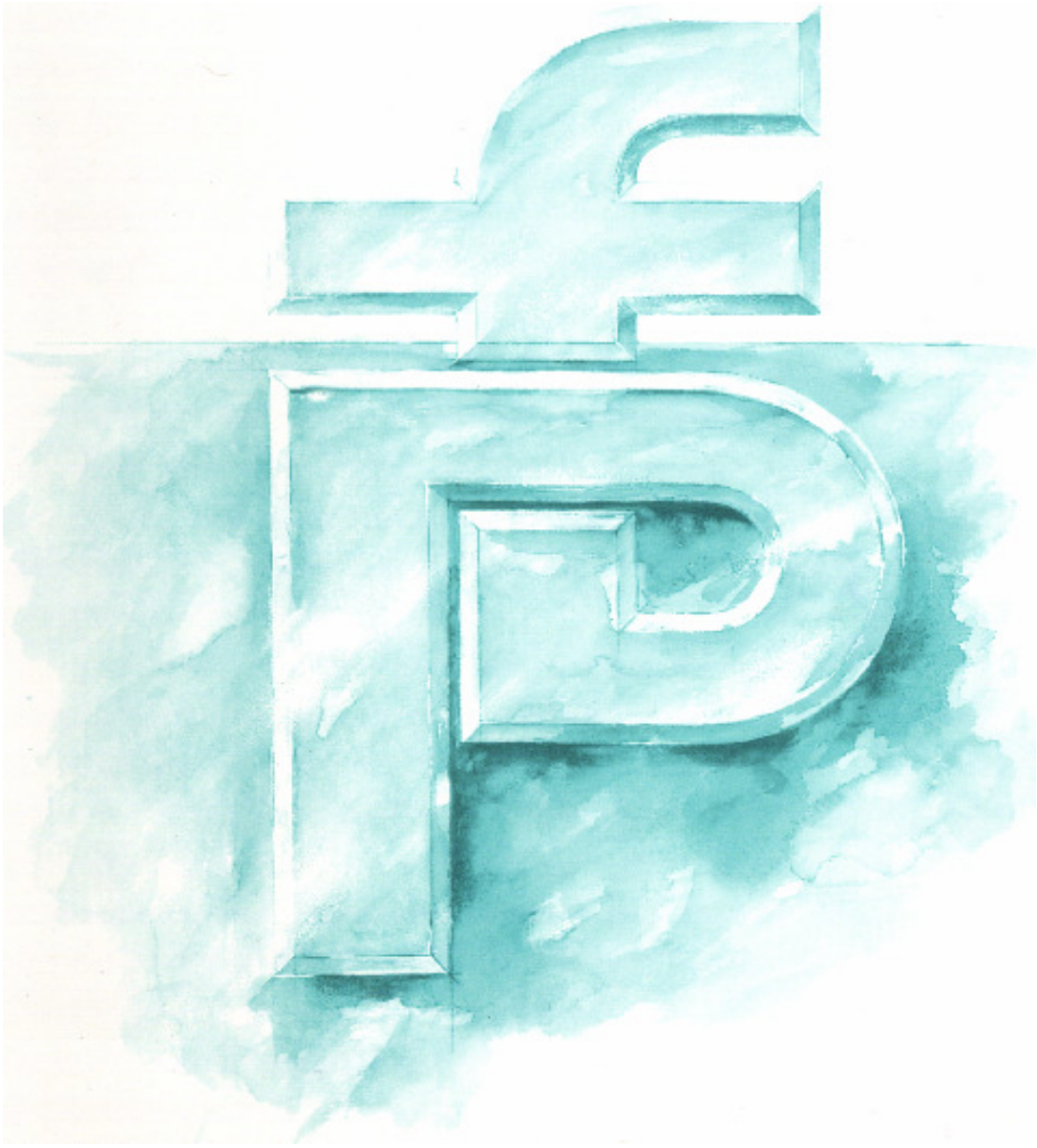
Implementation of the Identification System IRI-KHD2-4HB6 to a SIMATIC S-7 400 PLC



Contents

1 Hardware Specification

1.1 Equipment and Devices

NAME	EXPLANATION	PRODUCER
PS 407 4A	Power supply PLC	SIEMENS
CPU 412-2DP	CPU with Profibusinterface	SIEMENS
IRI-KHD2/A6-4HB6	Identification System with Profibusinterface	Pepperl+Fuchs Group
IVH-30GM-V1	Read-/Write head	Pepperl+Fuchs Group

Table 1: Hardware components

1.2 Configuration and Installation

The configuration and the connection of the S-7 PLC components is extracting from the appropriate SIEMENS manuals.

The Identification System IRI-KHD2-4HB6 is appropriate to DC power supply. The voltage has to be a value of U_{DC} = 18V – 32V. The Identification System has to be connected by wire on the terminals 47 (+ brown) and 48 (- blue) to the power supply. By using an alternating current you have to use a supply module. In this situation the usage of the supply module KFA6-STR-1.24.500 is approved.

On the top side of the device there is a 9-pole connector (SUBD). This terminal connects the Profibus system to the Identification System. A bus termination is necessary if the IRI is the last device in the bus thread. There are two different options to realise a bus termination. You can use an inside the IRI integrated bus terminator or an bus terminator inside the male connector. By using the terminator of the IRI you have to turn the rotary switch on the side of the device to the S 1 position.

→ Profibus terminator active: rotary switch to S 1 position

Also on the top side of the device there is a DIP-Switch rail. The rail is used to adjust the Profibus address of the IRI-KHD2-4HB6. By the adjustment of the Profibus address it is necessary to attend that the Profibus address is not occupied by other devices. The following chart shows the necessary settings for the correct parameterisation of the Profibus address.

PROFIBUS ADDRESS	S1	S2	S3	S4	S5	S6	S7	S8
0	OFF	OFF	OFF	OFF	OFF	OFF	OFF	OFF
1	ON	OFF	OFF	OFF	OFF	OFF	OFF	OFF
2	OFF	ON	OFF	OFF	OFF	OFF	OFF	OFF
……								
126	OFF	ON	ON	ON	ON	ON	ON	OFF

Table 2: Configuration of Profibus address

The Identification System IRI-KHD2-4HB6 is able to mount on a top hat rail or a wall. By mounting on a top hat rail you have to use a 35mm rail. If you mount the IRI on a wall you have to pull out the four brackets on the back side of the unit. The unit can be easily screwed onto the wall through the holes in the brackets. The screw pair spacing is 90mm and you can use screws with a dimension of M5. More information is available in the manual “IRI-KHD2-4HB6”.

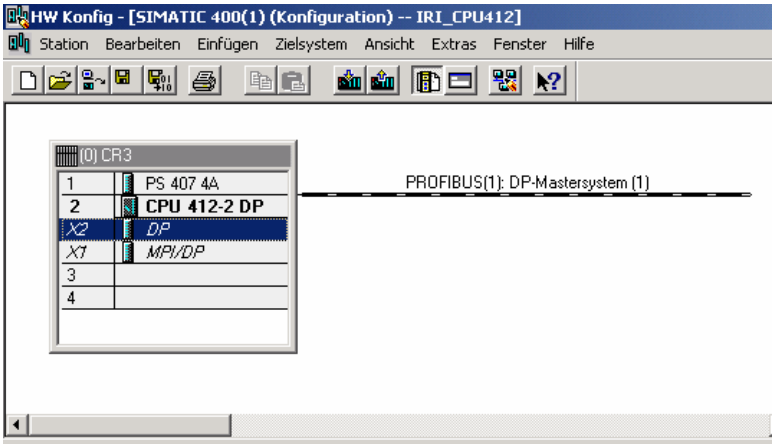
2 Hardware configuration

2.1 Installation GSD file

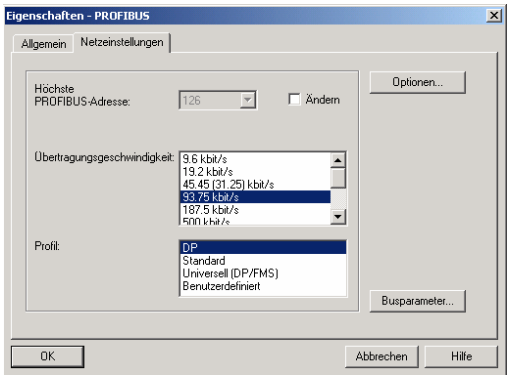
At first the provided GSD file is to installation. For this the Hardware configuration of the PLC is opened. With the menu item “Extra –GSD file installation…” you can integrate the GSD file into the STEP 7 Software. After the installation of the GSD file you have to refresh the Hardware index with the menu item “Extra – refresh index”.

2.2 Profibus configuration

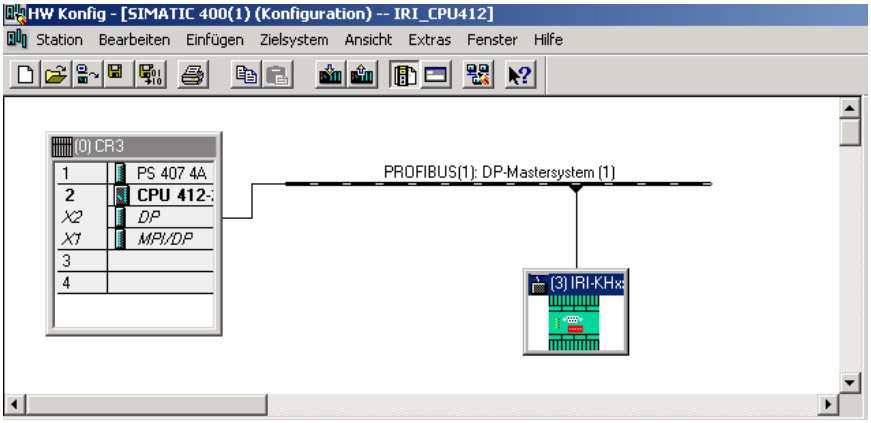
Firstly you have to implement the Hardware equipment. In addition you have to insert the necessary components from the Hardware index by using “drag and drop”.



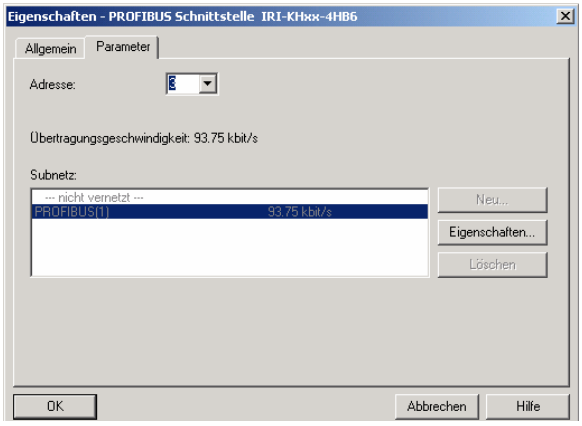
Closing you have to implement a “ProfibusDP-Mastersystem”. The Master system determines the transmission rate of the bus system. The maximum transmission rate of the IRI is 500kBit/s. After connecting to the power supply the IRI adjusts its transmission rate to the determined value. By the determination of the transmission rate you have to look that the length of the Profibus wire degrease by increasing transmission rate. You find a chart with the maximal wire length in the manual “IRI-KHD2-4HB6”.



In the next step the Identification System IRI-KHD2-4HB6 have to connect to the ProfibusDP-Mastersystem. For this you must transfer “IRI-KHxx-4HB6” out of the Hardware index into the Master system.



After that you have to determine the Profibus address. After double click on the symbol of the IRI a window will open. In this window you can configure the Profibus address.



This address must be the same as on the top side of the unit adjusted address. After this you must define the addresses of the Input and Output of the IRI. By transfer of the address modules out of the Hardware index into the slots of the chart.

(3) IRI-KHxx-4HB6

Steckplatz	DP-Kennung	Bestellnummer / Bezeichnung	E-Adresse	A-Adresse	Kommen...
1	217	10 Words Input	512...531		
2	224	1 Word Output		10...11	

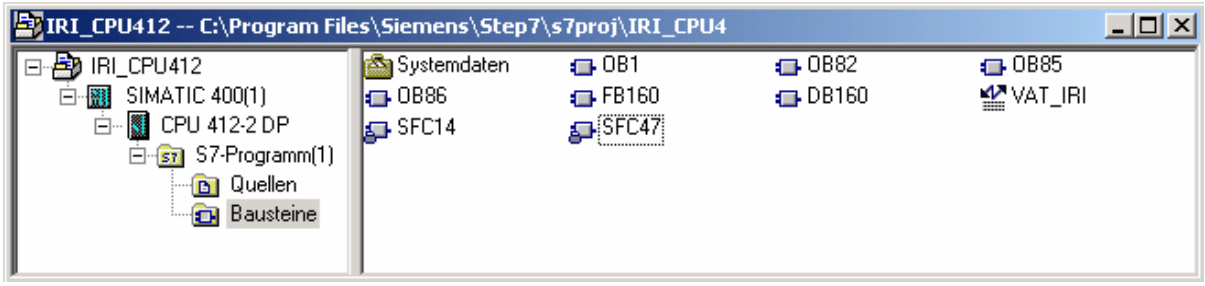
The IRI have got an Input data field with a length of 10 words (20 Bytes). The PLC put the start address of the input data field on the next free address area automatically. But you can change the start address. In the example the input data field starts at address 512(dez). This value must transfer in the IN-Variable #DP_AddressInput by call the FB inside the OB 1. But you have to transform the value into HEX format. The length of the Out data field is 1 word. The address of the output data field is defined by the PLC automatically. But the user can change the address. In this example the address is the Out data word AW10. This value is allocate to the variable #DP_AddressOutputWord.

3 Software

The program consists of different blocks. The following chart describes function of the several blocks.

NAME	FUNCTION	EXPLANATION
OB 1	Organisation block	Pass trough cyclical by the operating system of the CPU.
OB 82	Organisation block	Call by diagnostic alert.
OB 85	Organisation block	Call by an program error alert.
OB 86	Organisation block	Call by an equipment alert.
FB 160	Function block	Include the functionality of the IRI-KHD2-4HB6 to the PLC.
DB 160	Data block	Contained all necessary variables.
SFC 14	System function	Import Data of a DP slave.
VAT IRI	Variable chart	View all variables.

Table 3: Used Function Blocks and their Function



3.1 OB 1

The OB 1 pass trough cyclical by the operating system of the CPU. Inside the OB 1 the Function block FB 160 is called. At the same time the belonging Data block DB 160 is called. By calling the Function block the different parameters are transmitted. In the following chart the parameters are shown.

PARAMETER	PARAMETERTYPE	FUNCTION
HeadsConnected	IN : Byte	Declaration of the number of heads connected to the IRI.
TimerStartupTimer	IN : Timer	Timer to reject the Startup control.
TimerTimeout	IN : Timer	Timer to repeat a command.
DP_AddressInput	IN : Word	Start address of the Input and Output data field. → Hardware configuration
Initialize	OUT : Bool	Start of the initialisation.
StatusOK	OUT : Bool	Function block is ready.
DataHead_X	OUT : DWord	Data field for imported Fixcode.
Error	OUT : Bool	Error notice of the FB.
CommandNew	INOUT : Bool	Send a new command to the IRI.
NewDataHead_X	OUT : Bool	Signal that the Fixcode is readed.
DP_AddressOutputWord	INOUT : Word	Start address of the Output data field.

Table 4: Used Parameters and their Function

After the request of the FB 160 the variable #Initialize is reset, if an error existed (#Error = 1) or the execution of a command is finished (#StatusOK = 1).

3.2 FB 160

The Function block FB 160 is divided into different networks. In the following the functionality of the individual networks is described.

Network 1: "Program Start"

The task of this network is to initialise a program start. Firstly the variable #Initialize is checked if a positive edge existed. If a positive edge existed, the variable #InitializeGo is set. Then the program jump to NW11. Otherwise all important variables were reset. Also two timers were enabled in this part. The timers have the task to check the response time (#TimerTimeout) and to create a delay of the head control (#TimerStartupDelay).

At the point NW11 the function SFC 14 is called. The function import data from a connected DP-Slave. The source address is specifying by the parameter #LADDR. The source address is the start address of the IRI and defined by the variable #DP_AddressInput (see parameter in the hardware configuration). The parameter #RET_VAL contains an error code of the function. The error code is transmit to the variable #SFC14RET_VAL. The import data store at the parameter #RECORD. This parameter is defined by the variable #IRI_Input. The #IRI_Input is a data structure with the import data from the IRI.

Afterwards the execution of the SFC 14 is checked. Doing this the variable #SFC14RET_VAL is compared with the value 0. If both are identical the function is successful finished and the program jumps to the point NW12. Otherwise

(#SFC14RET_VAL is not 0) an error existed. Now the error notices (#Error and #ErrorSFC14) are set and the FB is finished (BEA). On the jump point the imported command response (#IRI_Input.IRICommand) memorised in the variable (#CommandResponse).

Annotation: The IRI send the received command code back to the PLC.

In the next step the status of the imported data separated. The status signalizes the current state of the command execution. To isolate the status information the lowest nipple of the variable #IRI_Input.IRIStatus masked. The isolated status information is transferred to the variable #Status. Afterwards the number of active heads is isolated. The number of active heads is inside the high nipple of the variable #IRI_Input.IRIStatus. The number of active heads transferred to the variable #HeadBits. The Bits which signalize active heads are only activated by the execution of an Enhanced Buffered Read Fixcode Command.

Network 2 “Analysis Status”:

Firstly the enable of the timer of the timeout control is checked. Otherwise the timer will be started. The time period is defined by the variable #TimeTimeoutCheck. This time define the time a command sends to the IRI. Afterwards the timer for the startup control is started. The time period is defined by the variable #TimeStartup.

In the next part the parameter #CommandResponse and #CommandSend compared. If the command execution is correct both parameter have to be identical. Otherwise the program jumps to the point NW21.

Furthermore the variable #HeadBits is compared with the value 0. If the value of the variable is 0 and no startup delay is active (#TimerStartupDelay = 0) the IRI interrupt the command execution. Now the error notices (#ErrorHead and #Error) are set and the program jump to the end of the network to the point End2.

If no error exist the variable #HeadBits is compared to the IN-Variable #HeadsConnected. When the variables are not identical an error existed and the failure notices (#ErrorHead and #Error) are set and the program jump to NW24.

In the next part all kinds of status values are checked. At first the value 0 is checked. If the variable #Status has the value 0 the command is successful finalised. Afterwards the variable #Status is compared to the value 5. This value signalize by the execution of an Enhanced Buffered Read Fixcode command that no data carrier is in front of the head. If other commands executed this value signalize an error and fail-

ure notices are set. Next the variable #Status is compared to the value 4. This value signalizes an incorrect command parameter. Then an error notice is set (#Error-WrongCommand). Finally the value 6 is checked. If the value is 6 then an hardware error existed and the notice #ErrorHardware is set.

Network 3 "Analyse of New Data":

The task of this network is to analyse the import data from the IRI. At the beginning those bits were reset which signalize that new data were imported from the IRI. Afterwards the status of the command execution of the IRI is checked. If the bit #StatusOK is set no failure is occurred in the command execution. But if the bit #StatusOK is not set, a error occurred and the program jumps to point End3 to the end of this network, because no analysis is necessary.

Afterwards the MSB of the variable #IRI_Input.IRIHead_1_Data is isolated. In the next step the bit is compared with the value 0. The bit is set if no data carrier is inside the field of the head while an enhanced buffered Fixcode command is executed. In this case no new data could be import from the fixcode carrier. Afterwards the variable is compared with the value #IRI_Input.IRIHead_1_Data with the value 0. Is the value of the variable is 0 than no data are imported from the head. Afterwards the imported data (Fixcode = 28 bit) transferred to the out data variable #DataHead_1. The same procedure is doing for the other heads.

Network 4 "Set command to send":

The task of network 4 is to allocate the command parameter for the execution of a command. In the first step the bit #CommandNew is checked. If the bit is set new command parameter has to be sending to the IRI. Afterwards the command parameter transferred to the variable #CommandSend. In the last step the toggle bit is checked. If the toggle bit is not set, the bit is now set by the program.

Network 5 "Write data to Profibus output":

In this network the command parameter (#CommandSend) will be transferred into the out data word #DP_AddressOutputWord. The out data word will be transferred to the IRI automatically.

4 Declaration of command parameter

The definition which command is executed on which head is decelerated by the command parameter inside the command telegram. Following chart shows the structure of a command telegram.

WORD 0																
Bit no.	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
name	B4	B3	B2	B1	DS	0	0	0	0	0	0	0	K3	K2	K1	T

B4/B3/B2/B1 → Command identification

The Command identification (B4…B1) defines the desired command.

B4	B3	B2	B1	DESTINATION
0	0	0	1	Single Read Fixcode
0	0	1	0	Auto Read Fixcode
0	0	1	1	Buffered Read Fixcode
1	1	0	1	Enhanced Buffered Read Fixcode

Table 5: Definition of Command Identification

- Single Read Fixcode:
  All active parameterised heads will be activated once. If the heads could successfully read the Fixcode, then all read data are transmitted.
- Auto Read Fixcode:
  All active parameterised heads are activated for such a time until one code carrier is read.
- Buffered Read Fixcode:
  All active parameterised heads are activated continuously.
- Enhanced Buffered Read (Write) Fixcode/Data:
  All active parameterised heads are activated continuously. If the code carrier leaves the reading area, Status 5 is transmitted.

DS → Double Side Mode

This function enables double-side reading/writing. If this bit is set (DS = 1), code/data carriers of the types ICC-50, IDC-50 can be read and write from both sides.

K3/K2/K1 → Head number

The parameters K3…K1 define which head shall be activated.

K3	K2	K1	HEAD
0	0	0	1
0	0	1	2
0	1	0	3
0	1	1	4
1	0	0	All
1	0	1	All
1	1	0	All
1	1	1	All

Table 6: Definition of head number of command telegram

T → Togglebit

The Togglebit serves to unambiguously identify a new command which is valid. A new command is only then accepted by the control interface unit and executed provided this flag does not have the same status as the preceding command, i.e. when it is toggled. In the acknowledgment from the IRI to the PLC, the Togglebit does not change and serves to indicate to the user that the command was received by the IRI and has been processed. But be careful if you send the command for the first time: Here is the Togglebit = 0!!!

5 Declaration of answer parameter

After transmission the command telegram to the IRI the IRI send the command parameter back to the PLC. The structure of the answer telegram is shown in the following chart.

WORD 0																
Bit no.	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
name	B4	B3	B2	B1	DS	0	0	0	0	0	0	0	K3	K2	K1	T

WORD 1																
Bit no.	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
name	0	K3	K2	K1	A4	A3	A2	A1	H4	H3	H2	H1	S4	S3	S2	S1

WORD	WORD 2/4/6/8															
Bit no.	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
name	ERR	L3	L2	L1	C28	C27	C26	C25	C24	C23	C22	C21	C20	C19	C18	C17

WORD	WORD 3/5/7/9															
Bit no.	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
name	C16	C15	C14	C13	C12	C11	C10	C9	C8	C7	C6	C5	C4	C3	C2	C1

The word 0 of the command telegram is unchanged send back to the PLC. The relevance is the same like before.

B4/B3/B2/B1 → Command identification

DS → Double Side Mode

K3/K2/K1 → Head number

T → Togglebit

The word 1 of the answer telegram shows the execution status of the command. In the following the relevance of the different bits are shown.

K3/K2/K1 → Head number

The parameters defines the head of that the telegram is.

K3	K2	K1	HEAD
0	0	0	1
0	0	1	2
0	1	0	3
0	1	1	4

Table 7: Definition of head number response telegram

A4/A3/A2/A1 → Execution counter

The execution counter is reset for command start and incremented each time as soon as new status values or data are available.

H4/H3/H2/H1 → Head activity

The parameter is used only by the execution of an Enhanced command to show the connected heads.

PARAMETER	RELEVANCE
H1 = 1	Head 1 active
H2 = 1	Head 2 active
H3 = 1	Head 3 active
H4 = 1	Head 4 active

Table 8: Definition of active heads execute an Enhanced Command

S4/S3/S2/S1 → Status indicator

General status and error messages are defined by the parameters S4…S1.

S4	S3	S2	S1	RELEVANCE
0	0	0	0	Error free execution of command
0	1	0	0	Invalid command parameter
0	1	0	1	Read or write error (no data carrier if Enhanced command)
0	1	1	0	Hardware fault

Table 9: Definition Status value

ERR → Read error flag

The read error flag is reset as soon as read data has been received from the IRI (status = 0). The read error flag is set when the data carrier leaves the field of the head. If single/block commands executed the ERR bit is not used (ERR = 0).

L3/L2/L1 → Read Number (head related)

The read numbers of all active heads are set to 0 at the start of instruction and are incremented with receive of data or a status massage of the respective head. In contrast to it the execution counter in word 1 is incremented with each data or status massage of the IRI, independently of the head number.

C28…C1 → 28 bit fixcode (hexadecimals packed)

The IRI transmits the fixcodes as ASCII strings with 7 characters (3.5 Bytes) length in data format “10”. Here the first three characters represent a hexadecimal number, the remaining four characters a decimal number. The first three characters are directly transferred into the bits C28 to C17 after ASCII/HEX transformation. The following four characters represent a hexadecimal number. Before comparing with the data format “10” they must converted to a four digit decimal number (0…9999).

6 Command examples

1. Enhanced Buffered Read Fixcode (execution on all 4 heads with Double Side Mode)

WORD 0	(D00E)HEX															
value	1	1	1	0	1	0	0	0	0	0	0	0	1	1	1	0
name	B4	B3	B2	B1	DS	0	0	0	0	0	0	0	K3	K2	K1	T

2. Singe Read Fixcode (execution on head 3 without Double Side Mode)

WORD 0	(1004)HEX															
value	0	0	0	1	0	0	0	0	0	0	0	0	0	1	0	0
name	B4	B3	B2	B1	DS	0	0	0	0	0	0	0	K3	K2	K1	T