1 Application Engineering

The metsoDNA CR application in the PROFIBUS interface is similar to the one in a so-called standard I/O case. The only difference is the PROFIBUS I/O symbol used instead of the Standard I/O symbol.

Figure 1 The Standard I/O symbol and the PROFIBUS I/O symbol

When the parameters given in the Standard I/O module are the FBC card location, the PIC address, the I/O card location and channel, the corresponding parameters in the PROFIBUS I/O module are the FBC card location (the virtual slot of the PC node FBC application), the PROFIBUS slave address and offset. For each SST PROFIBUS interface card, a separate FBC application and a so-called virtual slot is reserved.
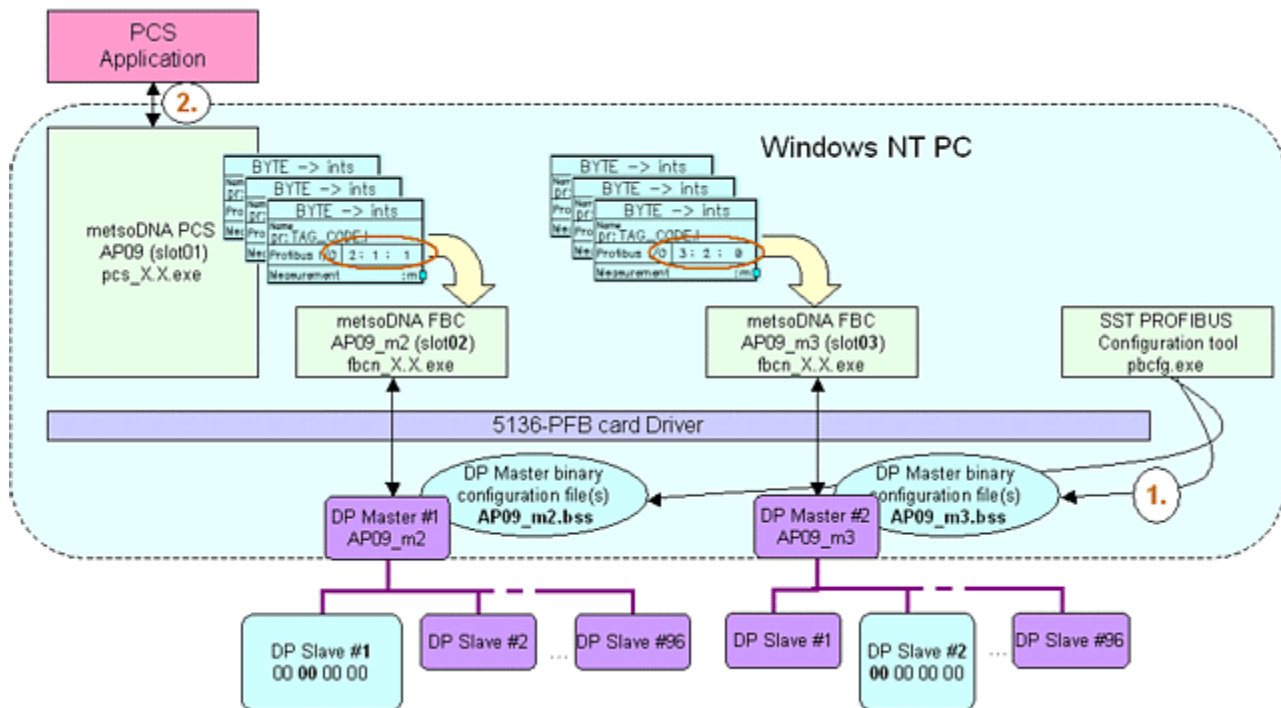
Figure 2 The principle of PROFIBUS DP data addressing using the metsoDNA CR I/O symbols

The PROFIBUS signals are converted into the types used in the metsoDNA CR automation language with the PROFIBUS I/O symbols (in the FbCAD tool menu Modules - PROFIBUS). The I/O symbols are available both with and without scaling. The scaling function blocks also have parameterable controls for a line and connection fault.

1.1 Members of the Non-scalable I/O Functions

INPUT MODULE NAME

The name of the I/O function (pr:TAG_CODE.I).

FBC SLOT PLACE (2 - 15)

The location of the FBC program, which is controlling the PROFIBUS master interface, in the Process Control Server (2).

The PCS software (e.g. pcs_4.2.exe, under the name AP09) is run in the first slot (slot 1) in the virtual frame. The FBC software (e.g. fbcn_6.73.exe, under the name AP09_m2, AP09_m3 etc.) connected to the PROFIBUS master interfaces with the same name (e.g. AP09_m2) by the metsoDNA CR Program Starter configuration, is run in the slots (in practice slots 2...5) of the virtual frame.

SLAVE ID

The slave address (0) of the PROFIBUS slave.

If an additional attribute S (e.g. S10) is given to the slave address, then with WORD and DWORD type I/O functions a byte swap is made for the signal in question.

OFFSET

The number (0) of skipped bytes.

The offset defines from which location of the PROFIBUS input or output area The I/O function in question reads the number of bytes defined by its type. E.g. five input bytes come from the PROFIBUS PA transmitter from which the four first ones include a measurement value in a real number form. The fifth byte is a so-called PROFIBUS PA status. If you wish to read the status byte in question as a separate byte, you must set the OFFSET value to 4, so that the fifth byte is read.

You can also define the bit of the read byte with the binary types (BOOL -> bin and BOOL -> binev). E.g. 0.3 (byte 0 bit 3).

EXTRA INFO

An additional parameter for the I/O address ( ) is generated from the member.

A value is assigned for the EXTRA INFO attribute only in separately defined cases (e.g. when using the SIEMENS ET200 for channel specific diagnostic definition). Otherwise it is left blank.

E.g. the value EXTRA INFO attribute value ch6.4 activates a channel specific diagnostics in channel 4 of card location 6.

COMMENT TEXT (18 char)

A comment text ( ) of 18 characters.

1.2 Members of the Scalable I/O Functions

The scalable I/O functions include, in addition to those members mentioned above, the following scaling and fault control parameters.

metsoDNA CR scale and unit

The signal scale and unit in a metsoDNA CR automation language variable (0.0 - 100.0 %).

DP slave scale

The value of the scalable signal in the PROFIBUS DP bus (0 - 32767).

Unsigned conversion in use

A signed conversion is used as a default. An unsigned conversion (0) is selected with a member.

Example: By default (0), the greatest value bit in an integer (WORD or DWORD) is interpreted as a signature. If the value in the PROFIBUS DP bus is 1000 0000 0000 1000, its value as a decimal number is -8. If the unsigned conversion is used (1), the value of the number in question as a decimal number is 32776.

metsoDNA CR analogue value limitation in use

The I/O function does not as a default limit its output to the upper limit (0) of the metsoDNA CR scale.

If the metsoDNA CR analogy value limitation is selected, minimum and maximum values can be assigned for the metsoDNA CR analogy value.

Application Engineering

file:///C:/Users/kuisar/OneDrive - JAMK/Valmet DNA/WWWRoot/ema...

EXT fault limits in use

metsoDNA CR fault bits (0) are not by default assigned based on the measuring signal value.

An EXT fault bit can be assigned based on the limits given to the EXT fault.

OVF fault limits in use

metsoDNA CR fault bits (0) are not by default assigned based on the measuring signal value.

An OVF fault bit can be assigned based on the limits given to the OVF fault.

Maximum value in metsoDNA CR analogue value limitation

The analogy value maximum value from the I/O function, if the metsoDNA CR analogy value limitation is set (0).

If the measurement value exceeds the upper limit, the measurement freezes in the upper value and the fault bit OLD is set.

EXT fault upper limit

The upper limit analogy value that sets the EXT fault bit, if the EXT fault limits are in use (0).

OVF fault upper limit

The upper limit analogy value that sets the OVF fault bit, if the OVF fault limits are in use (0).

OVF fault lower limit

The lower limit analogy value that sets the OVF fault bit, if the OVF fault limits are in use (0).

EXT fault lower limit

The lower limit analogy value that sets the EXT fault bit, if the EXT fault limits are in use (0).

Minimum value in metsoDNA CR analogue value limitation

The analogy value minimum value from the I/O function, if the metsoDNA CR analogy value limitation is set (0).

If the measurement value exceeds the lower limit, the measurement freezes in the lower value and the fault bit OLD is set.

Line fault control

In the case of a line fault, the measurement is by default frozen on the last reliable value and the fault bit EXT is set (0).

With the line fault control parameter, the function of the I/O function in case of line fault can be set as follows:

> 0 = The value is frozen on its last reliable value

1 = The value is set to its minimum value

2 = The value is set to its maximum value

3 = The value is set to a substitute value, which is set by a separate parameter

Replacement value during line fault

Replacement value in case of line fault, if the line fault control is set to value 3 (0).

Input fault control

In case of an input fault (the PROFIBUS DP connection to the slave is broken), the measurement is by default frozen to its last reliable value and the fault bit OLD is set (0).

With the input fault control parameter, the function of the I/O function in case of input fault can be set as follows:

0 = The value is frozen on its last reliable value

1 = The value is set to its minimum value

2 = The value is set to its maximum value

3 = The value is set to a substitute value, which is set by a separate parameter

Replacement value during input fault

Replacement value in case of input fault, if the input fault control is set to value 3 (0).

Additional parameter

Not used ( ).

1.3 I/O Functions

With the metsoDNA CR I/O functions type you can choose the amount of read or written data (bool, byte, word or dword). With the I/O function parameters you can define to which bus, slave and byte translation the operation is directed.

1.3.1 BOOL -> bin

The I/O function reads one bit from the DP slave and converts the signal into the bin metsoDNA CR type (binary).

Similarly the I/O function bin -> BOOL (output) writes to the DP slave's bit from the bin metsoDNA CR type.

1.3.2 BOOL -> binev

```
   BOOL  ->  binev
Name
pr: TAG_CODE.I
Profibus I/O   2 : 0 :  0.0
Measurement             : m
```

The I/O function reads one bit from the DP slave and converts the signal into the binev metsoDNA CR type (binary event).

The time of the binary event is not retrieved from the DP slave. By default the timestamp is created in the beginning of the execution cycle of the PCS application, so the accuracy of the timestamp depends on the execution interval of the PCS application. The frequency of the binary event update interval (which is also PROFIBUS read interval in FBC) can be increased using the startup parameter *-profibus_timestamp <accurancy>*. The accurancy value of the parameter is the logical timestamp update interval 10-1000 ms. Example: In the metsoDNA CR Program Starter configuration, enter the following row:

```
PARAMETERS=-profibus AP09_m2::s:AB01:AP09_m2.bss -profibus_timestamp 10
```

1.3.3 BYTE -> ints

```
   BYTE  ->  ints
Name
pr: TAG_CODE.I
Profibus I/O   2 : 0 :  0
Measurement             : m
```

The I/O function reads one byte from the DP slave and converts the signal into the ints metsoDNA CR type (short integer).

Similarly the I/O function ints -> BYTE (output) writes to the DP slave's byte from the ints metsoDNA CR type.

1.3.4 BYTE -> bin8

```
   BYTE  ->  bin8
Name
pr: TAG_CODE.I
Profibus I/O   2 : 0 :  0
Measurement             : m
```

The I/O function reads one byte from the DP slave and converts the signal into the bin8 metsoDNA CR type (8 element binary structure).

Similarly the I/O function bin8 -> BYTE (output) writes to the DP slave's byte from the bin8 metsoDNA CR type.

The desired bit (bin) is separated from the binary structure bin8 with extensions bit0 - bit7.

Binary input:
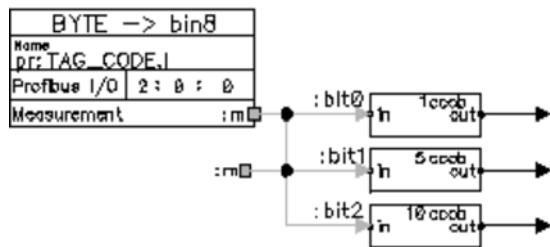
Binary output:

You can separate multiple binary signals (bit0...bit7) from one I/O function. Similarly you can write multiple binary signals to a DP slave with one I/O function. bin8 type I/O functions are useful when there are bits from the same byte used in the precedence diagram. If the precedence diagram handles single binaries, it is advisable to use the BOOL -> bin I/O functions.

NOTE!
Binary structure bin8 must be also connected to interface port of type any/bin8 (e.g. :m, :c or :cb).

1.3.5 WORD -> ints
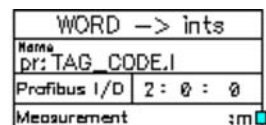
The I/O function reads one word (two bytes) from the DP slave and converts the signal into the ints metsoDNA CR type (short integer). The I/O function performs the byte swap on the word.

Similarly the I/O function ints -> WORD (output) writes to the DP slave's word (two bytes) from the ints metsoDNA CR type.
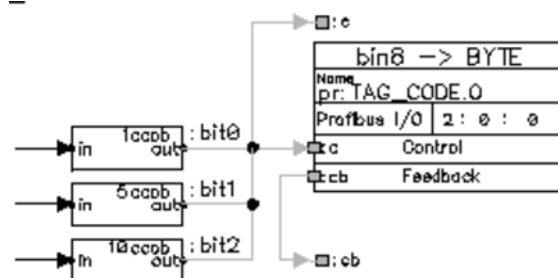
1.3.6 WORD -> intl
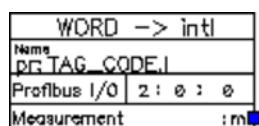
The I/O function reads one word (two bytes) from the DP slave and converts the signal into the intl metsoDNA CR type (long integer). The I/O function performs the byte swap on the word.

Similarly the I/O function intl -> WORD (output) writes to the DP slave's word (two bytes) from the intl metsoDNA CR type.

1.3.7 DWORD -> intl

The I/O function reads a double word (four bytes) from the DP slave and converts the signal into the intl metsoDNA CR type (long integer). The I/O function performs the byte swap on the word.

NOTE!
**The maximum possible 32 bit number is 4294967295 and the intl read area is**
-2147483648...2147483647.

Similarly the I/O function intl -> DWORD (output) writes to the DP slave's double word (four bytes) from the intl metsoDNA CR type.

1.3.8 WORD -> ana

The I/O function reads one word (two bytes) from the DP slave and converts the signal into the ana metsoDNA CR type (analogy). The I/O function performs the byte swap on the word.

Similarly the I/O function ana -> WORD (output) writes to the DP slave's word (two bytes) from the ana metsoDNA CR type.

1.3.9 DWORD -> ana

The I/O function reads a double word (four bytes) from the DP slave and converts the signal into the ana metsoDNA CR type (analogy). The I/O function performs the byte swap on the double word.

Similarly the I/O function ana -> DWORD (output) writes to the DP slave's double word (four bytes) from the ana metsoDNA CR type.

1.3.10 REAL -> ana

The I/O function reads a double word (four bytes) from the DP slave and transfers the signal into the ana metsoDNA CR type (analogy). The double word is a floating number (IEEE 754 float).

Similarly the I/O function ana -> REAL (output) writes to the DP slave's double word (four bytes) from the ana metsoDNA CR type.

Depending on the format of the DP slave numbers, a byte swap (changing the byte sequence of the double word) may have to be performed by adding "S" in the beginning of the slave address. In the example above, the Profibus I/O field would read 2:**S**0:0.

1.3.11 REAL + ST -> ana

The I/O function REAL + ST -> ana is used mainly with the PROFIBUS-PA devices.

The I/O function reads a double word (four bytes) from the DP slave and transfers the signal into the ana metsoDNA CR type (analogy). The double word is a float type. At the same time, the I/O function monitors the fifth byte (PA status). When the value of the fifth byte is interpreted as a faulty PROFIBUS-PA status, the metsoDNA CR fault bits are set in the analogy signal according to the table in chapter 1.4.1 "PROFIBUS PA status for metsoDNA CR fault bits".

Similarly the I/O function ana -> REAL + ST (output) writes to the DP slave's double word (four bytes) from the ana metsoDNA CR type, and sets the PA status according to the table in chapter 1.4.2 "metsoDNA CR fault bit for the PROFIBUS PA status byte".

1.4 Fault Bits

The metsoDNA CR fault bit OLD is set automatically, when the connection to the slave is broken. If the PROFIBUS I/O supports channel specific diagnostics compatible with the PROFIBUS DP standard (e.g. Siemens ET200), the fault bit EXT is set, if the channel fault is defined as active for the I/O symbol in question.

With scalable PROFIBUS I/O symbols you can also set fault bits from the limits of the measurement signal and to define the status of the measurement in line or connection fault situations.

The PROFIBUS PA status byte automatically sets the metsoDNA CR fault bits when the data type REAL + ST -> ana is in use.

1.4.1 PROFIBUS PA status for metsoDNA CR fault bits

Bit legend (left group columns):
- ext (external)
- ovf (overflow)
- dis (control disabled)
- inv (invalid data)
- old (old data)
- der (derived fault)
- sex (source exceptional)
- PROFIBUS bits

Bad (0 0)
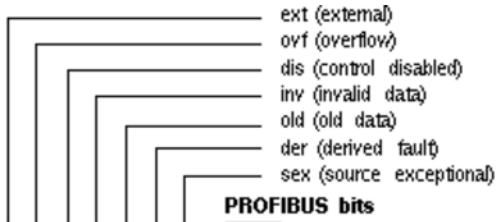
#	ext	ovf	dis	inv	old	der	sex							x	x	Description
0	0	0	0	0	1	0	0	0	0	0	0	0	0	x	x	Non-Specific
1	0	0	0	0	1	0	0	0	0	0	0	0	1	x	x	Configuration error
2	0	0	0	0	1	0	0	0	0	0	0	1	0	x	x	Not Connected
3	1	0	0	0	0	0	0	0	0	0	0	1	1	x	x	Device Failure
4	1	0	0	0	0	0	0	0	0	0	1	0	0	x	x	Sensor Failure
5	0	0	0	0	1	0	0	0	0	0	1	0	1	x	x	No Communication with last usable value
6	0	0	0	0	1	0	0	0	0	0	1	1	0	x	x	No Communication with no usable value
7	0	0	0	0	1	0	0	0	0	0	1	1	1	x	x	Out Of Service

Uncertain (0 1)

#	ext	ovf	dis	inv	old	der	sex							x	x	Description
0	0	1	0	0	0	0	0	0	1	0	0	0	0	x	x	Non-Specific
1	0	0	0	0	1	0	0	0	1	0	0	0	1	x	x	Last Usable Value
2	0	0	0	0	0	0	0	0	1	0	0	1	0	x	x	Substitute
3	0	0	0	0	0	0	0	0	1	0	0	1	1	x	x	Initial Value
4	0	1	0	0	0	0	0	0	1	0	1	0	0	x	x	Sensor Conversation Not Accurate
5	0	1	0	0	0	0	0	0	1	0	1	0	1	x	x	Engineering Unit Range Violation
6	0	1	0	0	0	0	0	0	1	0	1	1	0	x	x	Sub-Normal
7	0	1	0	0	0	0	0	0	1	0	1	1	1	x	x	Configuration error
8	0	0	0	0	0	0	1	0	1	1	0	0	0	x	x	Simulated value
9	0	1	0	0	0	0	0	0	1	1	0	0	1	x	x	Sensor Calibration

Good (Non-Cascade) (1 0)

#	ext	ovf	dis	inv	old	der	sex							x	x	Description
0	0	0	0	0	0	0	0	1	0	0	0	0	0	x	x	Ok
1	0	0	0	0	0	0	0	1	0	0	0	0	1	x	x	Active block alarm
2	0	0	0	0	0	0	0	1	0	0	0	1	0	x	x	Active advisory alarm
3	0	0	0	0	0	0	0	1	0	0	0	1	1	x	x	Active critical alarm
4	0	0	0	0	0	0	0	1	0	0	1	0	0	x	x	Unacknowledged block alarm
5	0	0	0	0	0	0	0	1	0	0	1	0	1	x	x	Unacknowledged advisory alarm
6	0	0	0	0	0	0	0	1	0	0	1	1	0	x	x	Unacknowledged critical alarm
8	0	0	0	0	0	0	0	1	0	1	0	0	0	x	x	Initiate Fail Save
9	0	0	0	0	0	0	0	1	0	1	0	0	1	x	x	Maintenance Required

Good (Cascade) (1 1)

#	ext	ovf	dis	inv	old	der	sex							x	x	Description
0	0	0	0	0	0	0	0	1	1	0	0	0	0	x	x	Ok
1	0	0	0	0	0	0	0	1	1	0	0	0	1	x	x	Initialization Acknowledge
2	0	0	0	0	0	0	0	1	1	0	0	1	0	x	x	Initialization Request
3	0	0	0	0	0	0	0	1	1	0	0	1	1	x	x	Not Invited
4	0	0	0	0	0	0	0	1	1	0	1	0	0	x	x	Reserved
5	0	0	0	0	0	0	0	1	1	0	1	0	1	x	x	Do Not Select
6	0	0	0	0	0	0	1	1	1	0	1	1	0	x	x	Local Override
7	0	0	0	0	0	0	0	1	1	0	1	1	1	x	x	Reserved
8	0	0	0	0	0	0	0	1	1	1	0	0	0	x	x	Initiate Fail Save

1.4.2 metsoDNA CR fault bit for the PROFIBUS PA status byte

```
                    ─── inv (invalid  data)
                    ─── ext (external)
                    ─── der (derived  fault)
                    ─── old (old  data)
                    ─── ovf (overflow)
                    ─── dis (control  disabled)
                    ─── sex (source  exceptional)

1  X  X  X  X  X  X     0  0  0  0  0  0  x  x     Bad Non-Specific
0  1  X  X  X  X  X     0  0  0  0  1  1  x  x     Bad Device  Failure
0  0  1  X  X  X  X     0  0  0  0  0  0  x  x     Bad Non-Specific
0  0  0  1  X  X  X     0  0  0  1  0  1  x  x     Bad No Communication   with last usable  value
0  0  0  0  1  X  X     0  1  0  0  0  0  x  x     Uncertain  Non-Specific
0  0  0  0  0  1  X     1  1  0  1  1  0  x  x     Good (Cascade)  Local  Override  (LO)
0  0  0  0  0  0  1     1  1  0  1  1  0  x  x     Good (Cascade)  Local  Override  (LO)
0  0  0  0  0  0  0     1  1  0  0  0  0  x  x     Good (Cascade)  Non-Specific
```

1.4.3 PROFIBUS DP standard channel diagnostics for the metsoDNA CR fault bits

Table 1 PROFIBUS DP standard channel diagnostics

Error Type B	D	Error Text	Meaning	What to Do
00001	1	Short circuit	Short circuit because, for example: D Sensor wiring to P potential short-circuited D Sensor wiring to M potential short-circuited D Output wiring to P potential short-circuited D Output wiring to ground short-circuited	Correct the process wiring
00010	2	Undervoltage	Supply voltage is below the tolerance range	Correct the power supply
00011	3	Overvoltage	Supply voltage is above the tolerance range	Correct the power supply
00100	4	Overload	The output level is overloaded	Correct the module/ actuator match
00101	5	Temperature rise	The output level is overloaded and is too hot	Correct the module/ actuator match
00110	6	Open circuit	Wire break because, for example: D The signal line to a sensor is interrupted D The signal line from an actuator is interrupted D Power cable of the sensor interrupted	Correct the process wiring.
00111	7	Upper limit violation	Value is above the overrange	Correct the module/ actuator match
01000	8	Lower limit violation	Value is below the underrange	Correct the module/ actuator match

| 01001 | 9 | Error | Error, for example, because: D Load voltage at the output

D Sensor supply

D Hardware error in the module

D Contactor is welded or jammed

D The switching element has reached the end of its life | Replace the module |

Table 2 Device manufacturer's (Siemens) channel diagnostics

Error Type		Error Text	Meaning	What to Do
B	D			
10000	16	Parameter assignment error	Parameter assignment error, for example, because: D The module cannot use the parameter (unknown, impermissible combination...) D Module is not parameterized	Correct the parameter assignment
10001	17	Sensor or load voltage missing	The following voltage may be missing.: D External supply voltage D Voltage to operate the module	Correct the process wiring
10010	18	Fuse defect	Failure of fuse that can be replaced by the user	Replace the fuse
10100	20	Ground fault	Ground fault, for example: D Permissible common-mode voltage in the case of non-isolated channels exceeded D M cable in the case of isolated channels ripped	Correct the process wiring
10101	21	Reference channel error	Error on the reference channel	Replace reference channel module
10110	22	Process inter rupt lost	Process interrupt is lost	Correct the program/process/m odule match
11001	25	Safety- related shutdown	Trigger/cause for safety-related shutdown exists	Eliminate the cause
11010	26	External fault	External (process-related) error, for example: D Sensor error D Actuator error D Sensor data is not correct	Replace the sensor/actuator; correct the process wiring

11011	27	Indefinable error	Indefinable errors are errors that cannot be further specified	Depends on cause

The metsoDNA CR PCS sets the fault bit EXT for all other channel specific fault information except for "Upper limit violation" or "Lower limit violation" information, for which the fault bit OVF is set. The setting of the fault bit requires that the physical location of the I/O channel (e.g. ch6.4) is shown in the EXTRA INFO parameter of the I/O symbol.