MOSAIC FIELDBUS MODULES

INTRODUCTION

This technical sheet describes the operation of the fieldbus modules of the MOSAIC series:

MBP (PROFIBUS DP-V1); MBD (DeviceNet); MBC (CANOpen), MBEC (ETHERCAT),
MBEI (ETHERNET/IP); MBEP (PROFINET); MBU (USB).

ELECTRICAL CONNECTIONS

Each module is provided with four connectors (Figure 1):

1) 5 way connector MSC   --> to the system MOSAIC
2) USB miniB connect   --> to the PC
3) BUS connector   --> to the fieldbus (not present on MBU)
4) Front terminal   --> power supply

TERMINAL BLOCK (SIDE A - TOP)	
TERMINAL	**SIGNAL**
1	+24VDC $\pm$ 20%
2	-
3	-
4	GND

Table 1

⚡ Install safety units in an enclosure with a protection class of at least IP54.

⚡ The supply voltage to the units must be 24Vdc $\pm$20%
(PELV, in compliance with the standard EN 60204-1).

⚡ Do not use MOSAIC to supply external devices.

⚡ The same ground connection (0VDC) must be used for all system components.
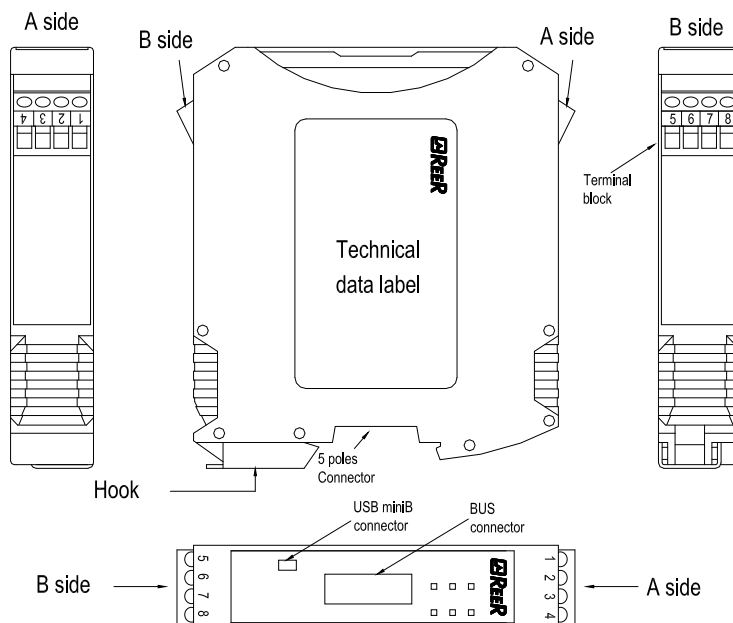

Figure 1

PROTOCOL DATA PACKAGE COMPOSITION

The bus module exports the system status and the status and diagnostic elements of all I/Os configured on the Mosaic and enables 8 single fieldbus inputs to be imported.

The input and output memory maps are described in the tables at page 3.

The input map is made up by a single byte representing the fieldbus inputs.

The output map is made up by a status byte, a variable number of bytes for the Mosaic input status, a byte representing the copy of the fieldbus inputs, a variable number of bytes to represent the probes status, a variable number of bytes to represent the Mosaic OSSD status, two bytes to represent the Mosaic diagnostics.

The system status is shown as one byte in which the bit 0 indicates whether the Mosaic is online/offline and bit 1 indicates the presence of diagnostic elements.

Each input and each output (OSSD) configured on the Mosaic system is associated with two information elements: *status* and *diagnostic*.

Status is a binary value, 0 or 1, diagnostic is a code indicating the condition of the I/O, which can be OK or indicate a problem on the I/O.

Each module with inputs has a number of bits corresponding to the number of physical inputs that are present; thus modules *M1, MI8, MI8O2 are associated with 1 byte (8 bit)* and module *MI16, MI12T8 with 2 bytes (16 bit)* for the inputs status.

All *safety outputs are summarised in 1 or 2 bytes*.

The inputs location varies according to the type of modules that are installed, in the following order: **M1, MI8O2, MI16, MI8, MI12T8.** If several modules of the same type are installed the order follows the node number.

Diagnostic elements are in the form of 2 bytes which indicate the number of the I/O with the problem and the value of the diagnostic element. If there is more than one diagnostic element, the relative values alternate every 500 ms.

Each set of information:
- input status,
- input diagnostics,
- fieldbus input status,
- probe status,
- safety output status,
- safety output diagnostics

can be enabled/disabled in order to control the information and thus the number of bytes exported to the fieldbus.

The fieldbus inputs are 8 independent bits through which 8 different states can be injected into the electrical panel.

For the fieldbuses in which the mapping position is mandatory (i.e. PROFIBUS) the input byte must be mapped before the output bytes.
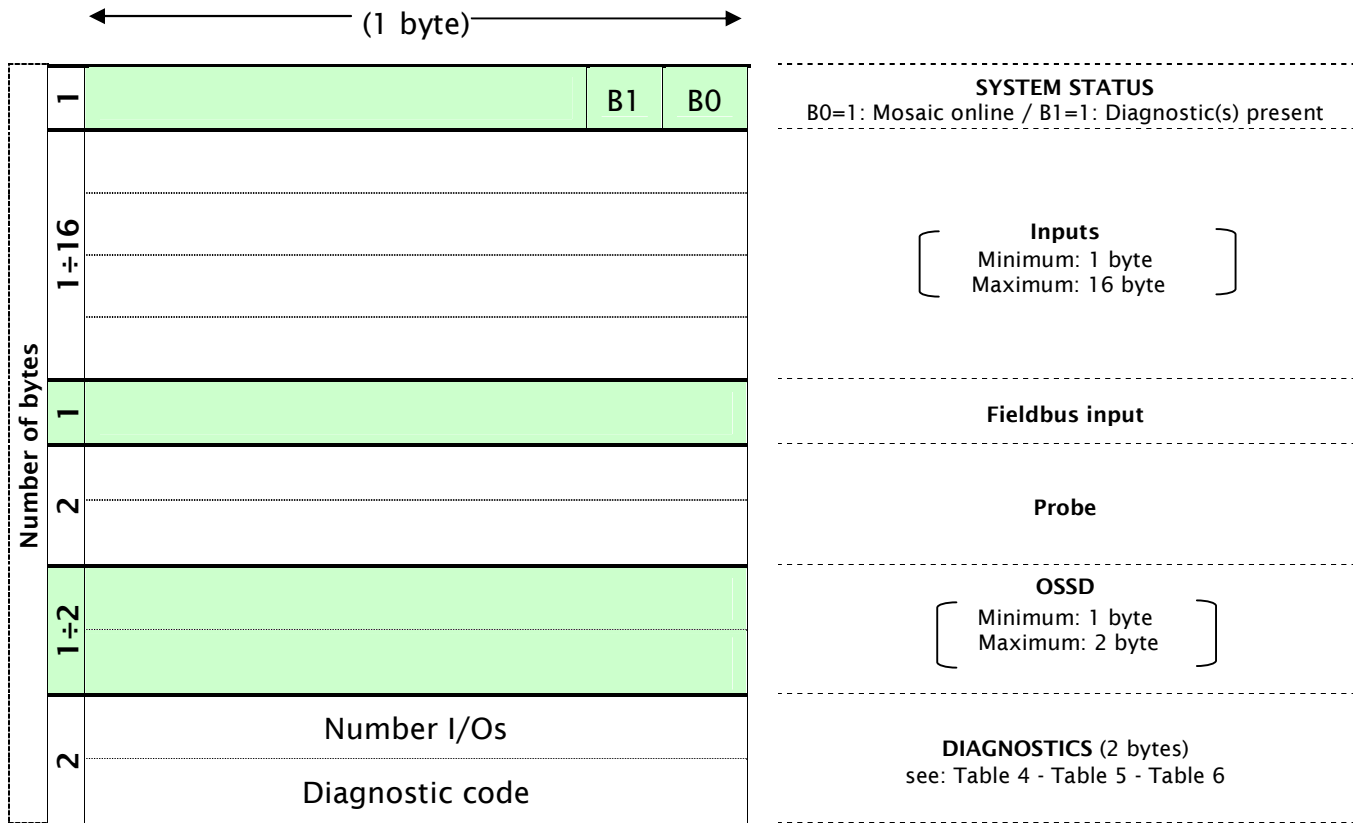For the fieldbuses based on CANOpen the data can be accessed only via PDO. The SDO access is not supported.

The following table describes the input map of the Mosaic:

B7	B6	B5	B4	B3	B2	B1	B0

Fieldbus input

The following table describes the output map of the Mosaic:

(1 byte)

Number of bytes			
1		B1	B0

SYSTEM STATUS
B0=1: Mosaic online / B1=1: Diagnostic(s) present

1÷16

Inputs
Minimum: 1 byte
Maximum: 16 byte

1	

Fieldbus input

2	

Probe

1÷2

OSSD
Minimum: 1 byte
Maximum: 2 byte

2	Number I/Os
	Diagnostic code

DIAGNOSTICS (2 bytes)
see: Table 4 - Table 5 - Table 6

➔ If the Mosaic system includes a fieldbus module, the MSDesigner report will include a table with the I/O index for all the inputs, fieldbus input, probe and safety outputs in the electric circuit.

DIAGNOSTICS

Each input and each safety output is associated with a relative diagnostic code.
When the I/O is connected correctly the diagnostic code is OK and is not exported to the fieldbus;
if there is a problem on the I/O, the system exports 2 bytes to the fieldbus with:

- the index of the I/O in question
- the relative diagnostic code

The "I/O index" field

This field indicates the number used to identify the I/O with a diagnostic code other than OK.
Possible values for this field are shown in Table 2.

TYPE OF SIGNAL	I/O INDEX
Input	1-128
Output	192-255

Table 2

The "Diagnostic code" field

The "*Diagnostic code*" field indicates the diagnostics for the I/O. Possible values for this field are shown in Tables 4, 5 and 6.

Input diagnostics		
128 (0x80)	Input diagnostics OK	-
1	Not moved from zero	Both switches have to go to rest condition
2	Concurrent failed	Both switches have to change state simultaneously
3	Concurrent failed hand1	Wrong connection on one side of a two-hands switch
4	Concurrent failed hand2	Wrong connection on one side of a two-hands switch
7	Switch inconsistent	The selector should not have more than one input set
8	Switch disconnected	The selector should have at least one input set
10	OUT_TEST error	OUT_TEST diagnostics present on this input
11	Second input KO	Redundancy check failed on input
12	OUT_TEST diagnostics OK	
13	Output connected to other inputs	Test output not connected to the right input
14	Output OK but input connected to 24VDC	Stucked input
15	Short circuit between photocell test and photocell input	Photocell response time too low
16	No response from photocell	The test signal on the photocell emitter is not seen on the receiver
17	Short circuit between photocells	The test signal is present on two different photcells
18	MAT disconnected	Wrong mat connection
19	Output inconsistent with feedback	The test signal on input is present on more than one OUT_TEST
20	Connection incorrect	The test signal is present on more than one input
21	Output stuck	The test signal on the input is not present on the OUT_TEST
22	Second OUT_TEST KO	Redundancy check failed on OUT_TEST
133 (0x85) [1]	TWO-HAND concurrent failed	Two-hands switch has to change state simultaneously
134 (0x86) [2]	Not started	Start test failed
137 (0x89) [3]	Waiting for restart	The input has manual reset and has not been restarted

Table 3

OSSD Diagnostics		
0	OSSD DIAGNOSTICS OK	
1	ENABLE MISSING	
2	WAITING FOR RESTART OSSD	
3	FEEDBACK K1/K2 MISSING	
4	WAITING FOR OTHER MICRO	Redundancy check failed on OSSD

Table 4

➔ If there are diagnostics for more than one I/O, the **I/O index** and **diagnostic code** signals are sent in turn every 500ms.

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[1] **The diagnostic 133, 134 and 137 do not provide visual error message on the LED Mosaic**
[2] **The diagnostic 133, 134 and 137 do not provide visual error message on the LED Mosaic**
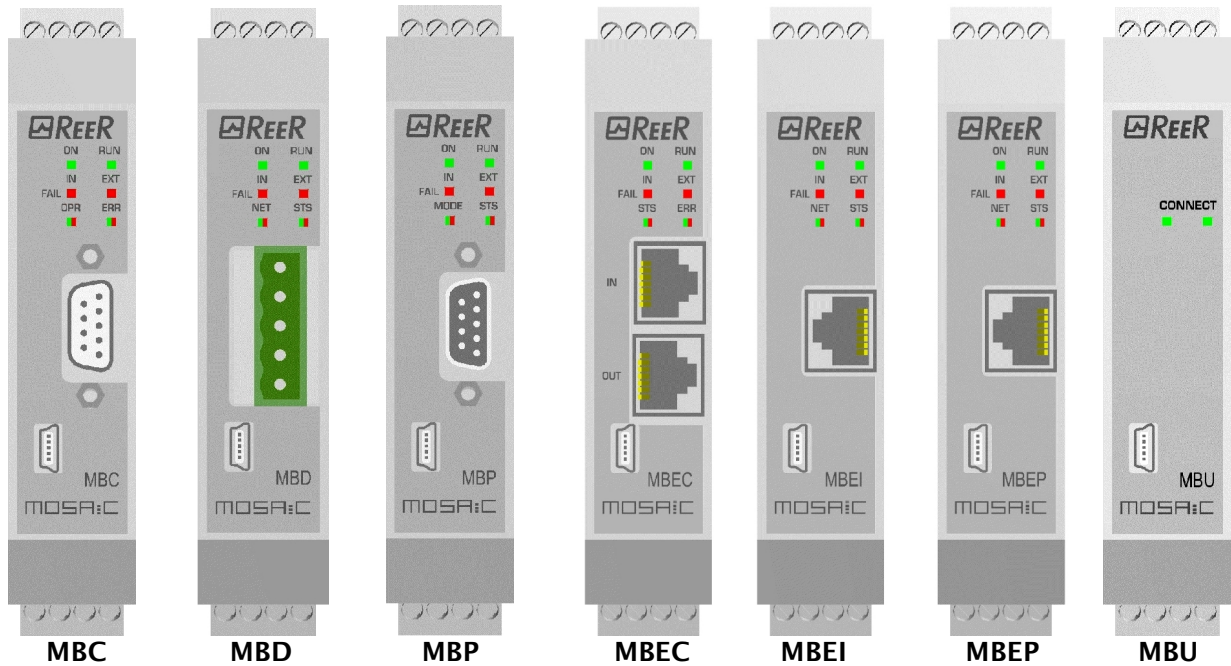[3] **The diagnostic 133, 134 and 137 do not provide visual error message on the LED Mosaic**

SIGNALS

MBC **MBD** **MBP** **MBEC** **MBEI** **MBEP** **MBU**

Figure 2

MEANING	LED					
	ON	**RUN**	**IN FAIL**	**EXT FAIL**	**LED1**	**LED2**
	GREEN	**GREEN**	**RED**	**RED**	**RED/GREEN**	**RED/GREEN**
Startup - Initial test	ON	ON	ON	ON	ON	ON
Waiting for configuration from EPB	ON	blinking	OFF	OFF	OFF	OFF
Received configuration from EPB	ON	ON	OFF	OFF	see the modules tables	

Table 5 - Initial / Dynamic signals

MODULE MBC					
LED OPR			**LED ERR**		
STATUS	**INDICATION**	**DESCRIPTION**	**STATUS**	**INDICATION**	**DESCRIPTION**
GREEN	OPERATIONAL	OPERATIONAL status	**OFF**	-	Normal operation
GREEN blinking slow	PRE-OPERATIONAL	PRE-OPERATIONAL status	**RED 1 flash**	Warning level	A bus error counter has reached the warning level
GREEN 1 flash	STOPPED	STOPPED status	**RED blinking fast**	LSS	LSS service operative
GREEN blinking fast	Autobaud	Baudrate detection	**RED 2 flashes**	Event Control	Detected **Node Guarding** (NMT master or slave) or **Heartbeat** (Consumer)
RED	EXCEPTION	EXCEPTION status	**RED**	Lack of BUS	BUS not working

Table 6

MODULE MBD						
LED NET			**LED STS**			
STATUS	**INDICATION**	**DESCRIPTION**	**STATUS**	**INDICATION**	**DESCRIPTION**	
GREEN	On-line connected	1 or more connections established	**GREEN**	-	Normal operation	
GREEN blinking (1Hz)	On-line non connected	No connection established	**GREEN blinking (1Hz)**	Pending	Configuration incomplete, MBD waiting for activation	
RED	Critical connection error	MBD unable to communicate	**RED**	Fatal error	One or more unrecoverable errors detected	
RED blinking (1Hz)	Time-out of 1 or more connection	One or more I/O device in time-out	**RED blinking (1Hz)**	Error	One or more recoverable errors detected	
GREEN/RED alternate	TEST	MBD in Test	**GREEN/RED alternate**	TEST	MBD in Test	

Table 7

MODULE MBP						
LED MODE			**LED STS**			
STATUS	**INDICATION**	**DESCRIPTION**	**STATUS**	**INDICATION**	**DESCRIPTION**	
GREEN	On-line	data exchange	**OFF**	MBP not initialized	STATUS **SETUP** o **NW_INIT**	
GREEN blinking	On-line	CLEAR	**GREEN**	Initialized	End of initialization **NW_INIT**	
RED blinking (1 flash)	Parameterization error	rif. IEC 61158-6	**GREEN blinking**	Initialized with diagnostic active	**EXTENDED DIAGNOSTIC** bit set	
RED blinking (2 flashes)	PROFIBUS configuration error	configuration data MASTER or MBP wrong	**RED**	Exception error	**EXCEPTION** STATUS	

Table 8

MBEC MODULE						
STS LED			**ERR LED**			
STATE	**INDICATES**	**DESCRIPTION**	**STATE**	**INDICATES**	**DESCRIPTION**	
OFF	INIT	INIT or no power	**OFF**	No error	No error or no power	
Green	OPERATIONAL	OPERATIONAL state	**Flashes red**	Configuration not valid	Status change requested by master not possible	
Flashes green	PRE-OPERATIONAL	PRE-OPERATIONAL state	**Flashes red twice**	Watchdog timeout	Synch manager watchdog timeout	
Flashes green once	SAFE-OPERATIONAL	SAFE-OPERATIONAL state	**Red**	Controller fault	Anybus module in EXCEPTION state	
Red	(Fatal Event)	System locked	**-**	-	-	

Table 9

MBEI MODULE					
NET LED		**STS LED**			
STATE	**INDICATES/DESCRIPTION**	**STATE**	**INDICATES**	**DESCRIPTION**	
OFF	No power or no IP address	**OFF**	No power	-	
Green	On-line, connected	**Green**	RUN state	-	
Flashes green	On-line, not connected	**Flashes green**	Not configured	-	
Red	Duplicate IP address	**Red**	Fatal error	One or more non-recoverable errors detected	
Flashes red	Connection timeout	**Flashes red**	Error	One or more recoverable errors detected	

Table 10

MBEP MODULE					
NET LED			**STS LED**		
STATE	**INDICATES**	**DESCRIPTION**	**STATE**	**INDICATES**	**DESCRIPTION**
OFF	Offline	No power Connection with IO controller not present	**OFF**	Not initialised	
Green	Online (Run)	Established connection with IO controller IO controller in RUN state	**Green**	Normal operation	
Flashes green	Online (stop)	Established connection with IO Controller IO Controller in STOP state	**Flashes green once**	Diagnostic event (i)	
			Flashes green twice	Blink	Used to identify the network node
			Red	Exception	Module in EXCEPTION state
			Flashes red once	Configuration error	Identification error
			Flashes red twice	IP address error	IP address not configured
			Flashes red 3 times	Station name error	Station name not configured
			Flashes red 4 times	Internal error	

Table 11

MODULO MBU		
LED CONNECT		
STATO	**INDICAZIONE**	**DESCRIZIONE**
Green	USB connected	Module connected to Pc via USB
OFF	USB not connected	Module not connected

Table 12

FAULT DIAGNOSIS						
MEANING	**LED**					
	ON	**RUN**	**IN FAIL**	**EXT FAIL**	**LED1**	**LED2**
	GREEN	**GREEN**	**RED**	**RED**	**RED/GREEN**	**RED/GREEN**
Internal fault microcontroller	ON	OFF	2 flashes*	OFF		
Internal board fault	ON	OFF	3 flashes*	OFF		
Configurazione Error	ON	OFF	5 flashes*	OFF	see the modules tables	
BUS communication Error	ON	OFF	5 flashes*	OFF		
BUS communication interruption	ON	OFF	ON	OFF		
Detected an identical module	ON	OFF	5 flashes*	5 flashes		

Table 13

* The LED frequency of flashing is: ON for 300ms and OFF for 400ms, with an interval between two sequences of 1s.

EXAMPLES OF DIAGNOSTICS

Example 1

In the example shown in Figure 3, Input 1 (connected to module M1) is tested with the M1-T1 test signal.
During wiring, the 24Vdc is connected to input 1 instead of the M1-T1 test signal.

- The I/O index and Diagnostic code fields assume the following values: 1 - 20 to indicate the diagnostics on input 1 of module M1 *(Connection error).*
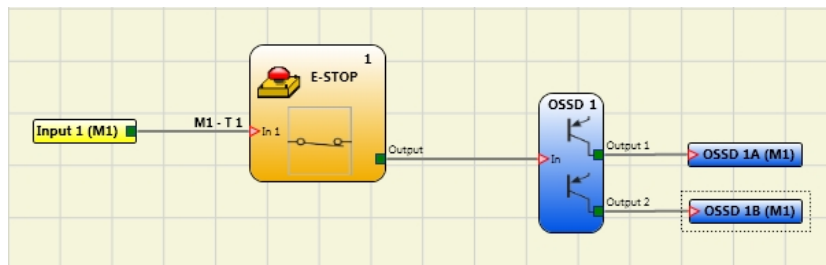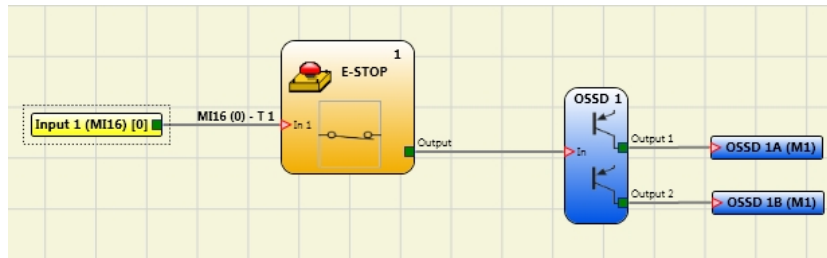

Figure 3

Example 2

In this example, the I/O index corresponds to the logical block and not to the physical terminal on module M1.
In Figure 4 for example, the two-hand element connected to the Input 1 and Input 2 physical terminals corresponds to *I/O index No. 1* and the emergency stop connected to the Input 3 and Input 4 terminals corresponds to *I/O index No. 2.*
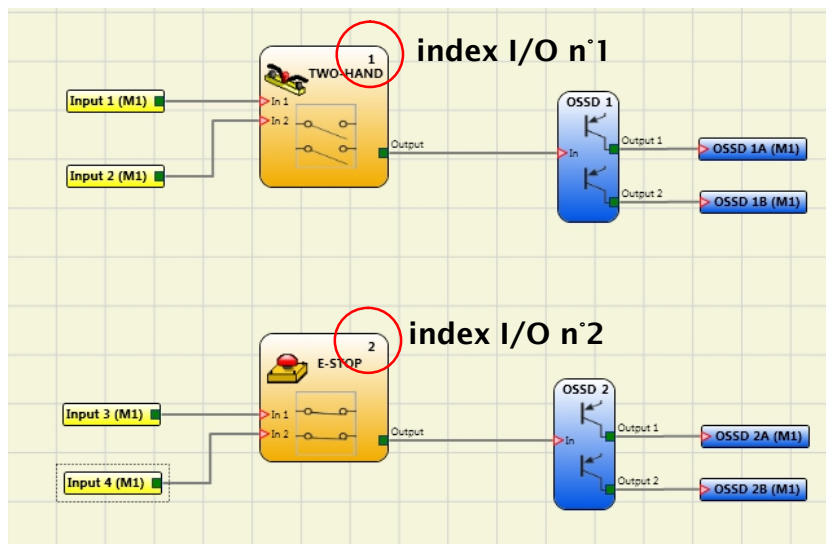
Figure 4

Example 3

The example in Figure 5 is similar to example 1, except in this case Input1 is connected to module MI16 and is tested with the MI16-T1 test signal.
During wiring, the 24Vdc is connected to input 1 instead of the MI16-T1 test signal.
Input 1 has diagnostic code 10 (OUT_TEST error) and OUT_TEST MI16-T1 has diagnostic code 8 (Connection error).

- The I/O index and Diagnostic code fields assume the following values: ⟨1 - 20⟩ to indicate the diagnostics on input 1 of module MI16.

Figure 5

In the example shown in Figure 6 the manual reset function is enabled on OSSD 1.
The pushbutton connected to input 1 is pressed without sending a reset command.

- The I/O index and Diagnostics code fields assume the following values: ⟨192 - 2⟩
- to indicate the diagnostics on OSSD 1A/1B *(Table 2: 192 = first output)*.
- to indicate the diagnostic code *(Table 4: 2 = Waiting for OSSD to restart)*.
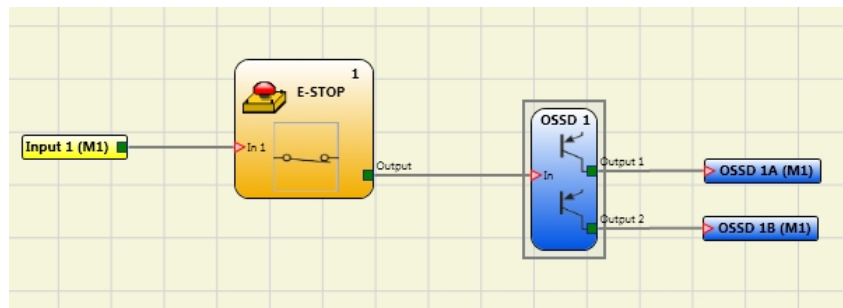
Figure 6

BUS CONFIGURATOR USER INTERFACE

The bus module is configured using the USB miniB interface on the front panel and "BUS CONFIGURATOR" SW installed on the MSDESIGNER CD ROM disk.

This SW can be used for configuration/communication of the MOSAIC system with a PC (using an MBU module) or to display data transmitted via bus (via connection to the USB port of a bus module).
The diagram below is helpful for understanding possible connections:

EXAMPLES OF CONNECTION

M1   MBx (bus)   **M1   MBU (USB)**
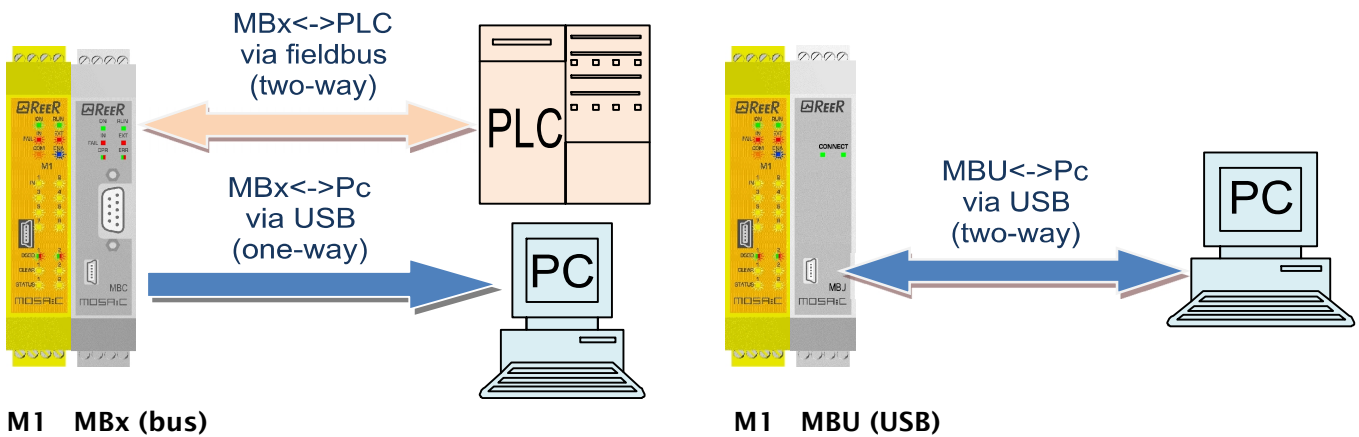
It is important to note that the BUS CONFIGURATOR behaves differently, depending on whether communication is with an MBx module or an MBU module:

- MBx MODULE: THE SOFTWARE ONLY ALLOWS DATA TRANSMITTED VIA BUS TO BE DISPLAYED.
- MBU MODULE: THE SOFTWARE ALLOWS TWO-WAY DATA TRANSMISSION MBU↔PC
  (in this case the programmer can set the Fieldbus input directly via computer).

The data sets to be transmitted, any modular I/Os, the Fieldbus input, the address of the module in the fieldbus network and, where applicable, the baud rate are all settable parameters.
The address field range depends on the type of fieldbus that is installed.

Graphic interface

Figure 7

➔ **Module configuration must be performed with the system switched off (outputs OFF).**

You can query module configuration at any time while the module is in use. To configure the MBx module, proceed as follows:

1. connect the module to the 24VDC+20% power supply via the terminal block;
2. connect the USB cable to the PC and to the MBx (or MBU) module;
3. click on the "**BUS CONFIGURATOR – USER INTERFACE**" desktop icon.

The configuration window shown at the side is displayed *(Figure 7).*
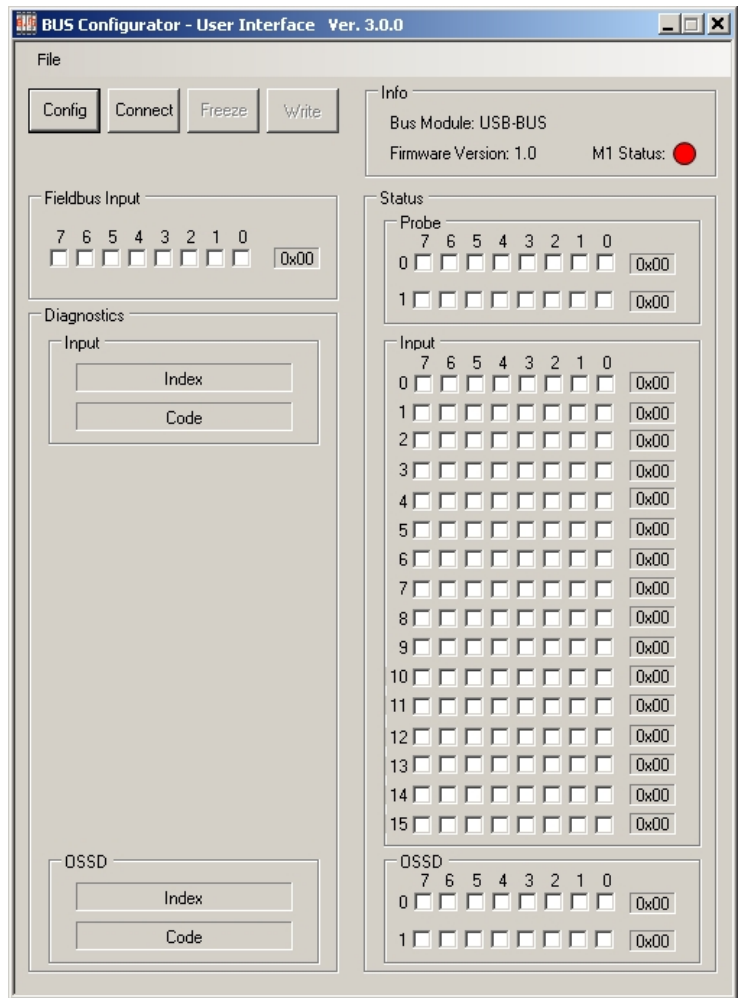
4. Press the "CONNECT" key.

The program recognises that a bus module is connected *(Figure 8);* the fieldbus model, firmware version and Master M1 status are displayed:

- green=M1 active (RUN);
- red=M1 not active (e.g. communication with Designer).
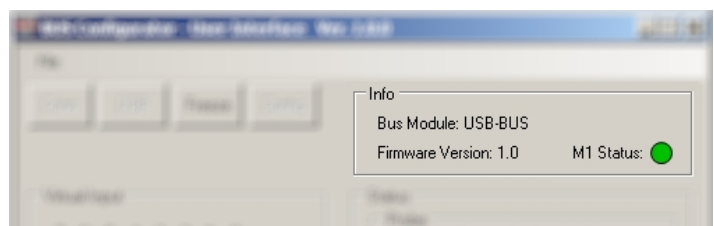
Figure 8

Once the module is connected it is recognised and you can configure the parameters by selecting the different cards shown in figures 9 to 11 (*CONFIG key- figure 7*); press the *WRITE* key to send the configuration data to the module.
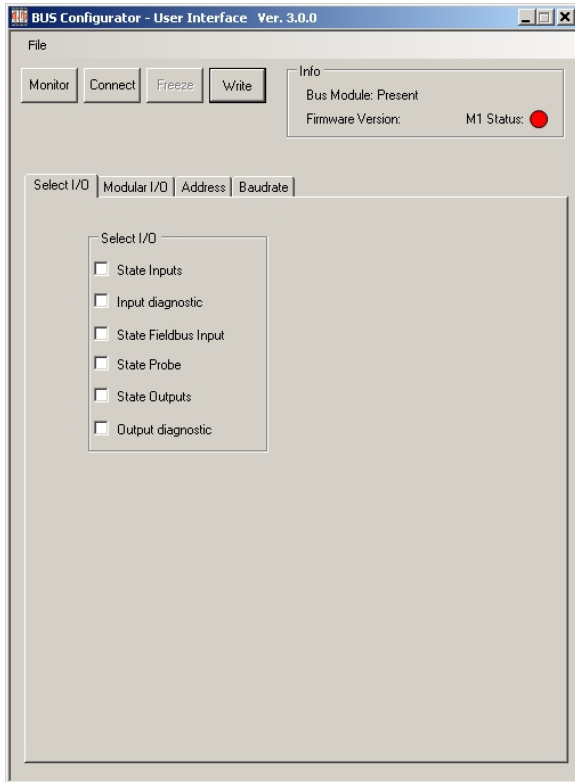
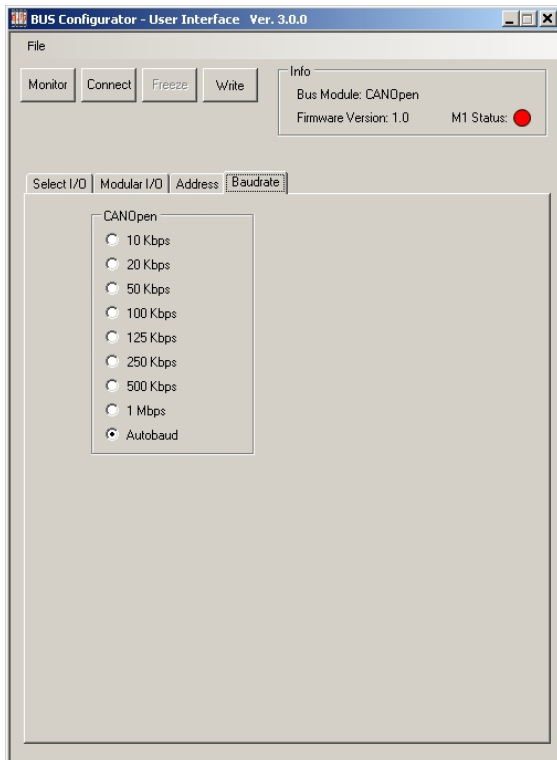*Figure 9 - I/O selection*
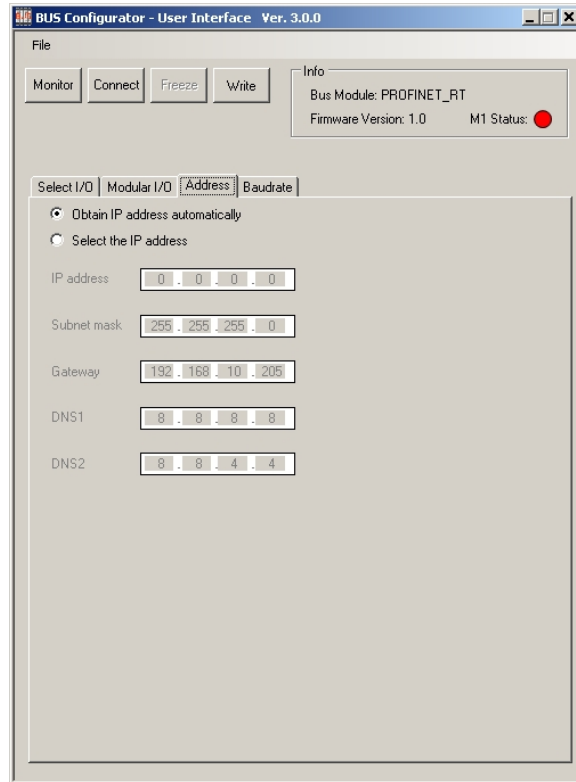
Figure 10 - Address

Figure 11 - Baud rate

	ADDRESS	BAUDRATE	DATA SETS
MBC	127	AUTO	input status, fieldbus input status, probe status, output status
MBD	63	AUTO	input status, fieldbus input status, probe status, output status
MBP	126	N/A	input status, fieldbus input status, probe status, output status
MBEC	0	N/A	input status, fieldbus input status, probe status, output status
MBEI	0.0.0.0	AUTO	input status, fieldbus input status, probe status, output status
MBEP	0.0.0.0	N/A	input status, fieldbus input status, probe status, output status

Table 14 - Default values

After setting the parameters, click on the "MONITOR" key.
- As soon as the bus module receives the data, the configurator enters the ***dynamic status screen*** condition.
- The input and output status and relative diagnostics (displayed cyclically if one or more incorrect events occur) are illustrated in Figure 12 and Figure 13.
- The Fieldbus input whose logical status can be changed freely by the programmer (with the MBU module only) or via the fieldbus are illustrated in Figure 14.

Input/output status
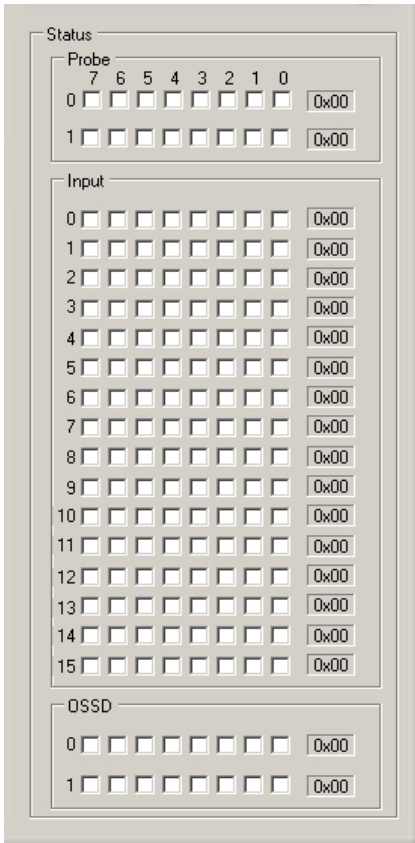
Input/output diagnostics
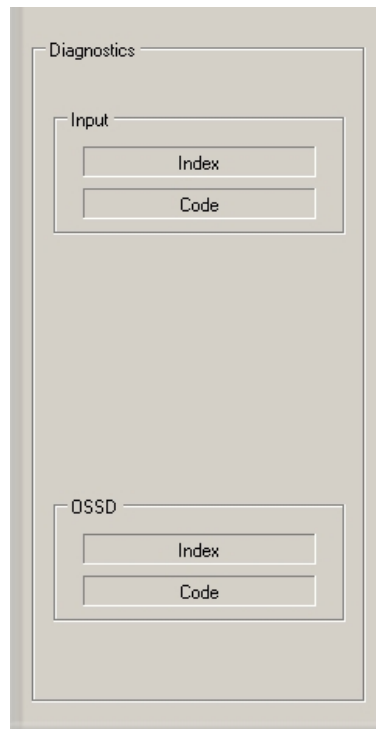
Fieldbus input (MBU only)
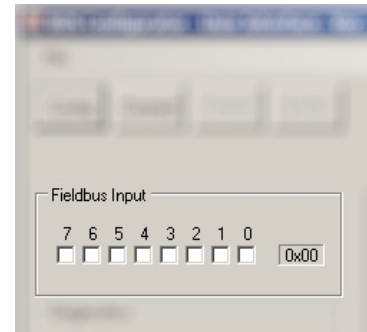

Figure 14

Figure 13

Figure 12

PLEASE REFER TO THE EXAMPLE IN Figure 15 AND Figure 16 SHOWING A PROJECT CREATED USING DESIGNER AND HOW THIS IS PRESENTED BY THE CONFIGURATOR TO SEE HOW THE PARAMETERS ARE SHOWN.

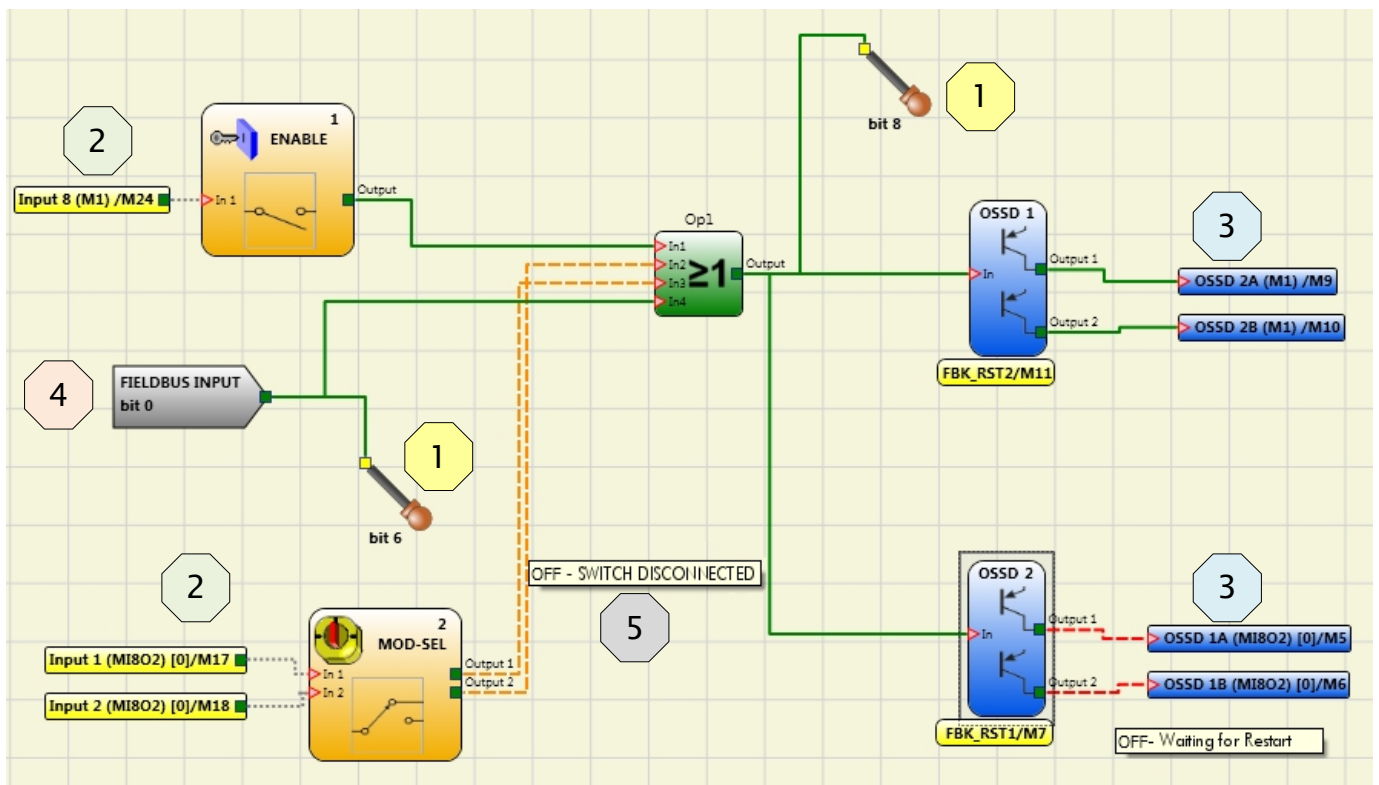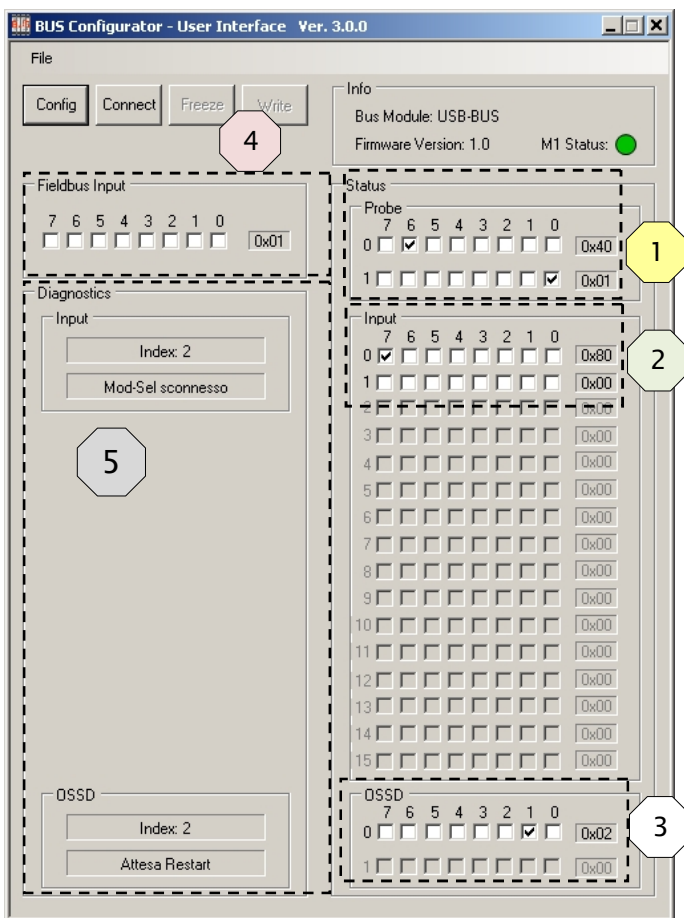## EXAMPLES OF MSD CONFIGURATION AS PRESENTED BY THE BUS CONFIGURATOR

Figure 15 – Example of project on MSD

- Input 1 ENABLE is connected to terminal 8 on M1. Its status (zero or one) is shown on bit 7 of byte 0 reserved for inputs.
- Input 2 MOD-SEL is connected to screws 1 and 2 on MI802 with diagnostics indicating Mod-sel disconnected. Its status is shown on the pair of bits 0 and 1 of byte 1 reserved for inputs. Diagnostics are shown in the section reserved for input diagnostics with the index field showing 2 and the relative diagnostics.
- The probes on bit 6 and bit 8 are green and the relative bits on the screen are checked. Bit 8 is shown as bit 0 of the second byte.
- OSSD 1 is ON and connected to the second pair of M1 outputs. Its status is shown on bit 1 of byte 0 reserved for outputs.
- OSSD 2 is OFF with diagnostics indicating wait for Restart and is connected to the second pair of MI802 outputs. Its status is shown on bit 3 of byte 0 reserved for outputs. Diagnostics are shown in the section reserved for OSSD diagnostics with the index field showing 2 and the relative diagnostics.
- In the Virtual Input section, bit 0 has been selected and the fieldbus input bit 0 is green in the MSD project.

Figure 16