MAN 652-OM11

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Rev.	**Date**	**DESCRIPTION**	**Prepared**	**Approved**

Note:
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F02
OM11: xPx-Dnint DeviceNet Interface

Instruction and Operating Manual

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1. Introduction

The **xPx_DNint** is an electronic module that allows connecting the BIFFI electrical actuator F02 to a DeviceNet network. The module has its own microprocessor and acts as a pure bus interface without affecting the actuator control integrity.
The **xPx_DNint** is installed inside the actuator housing and takes the electrical power from the actuator power supply module. The DeviceNet network is fully isolated from the actuator electronics.

For details about F02 actuator the reference manual is:
"***F02 Quarter-turn Electric Actuator*** – Instruction Handbook MAN 652".

2. Operation and storage

The module is designed to work and to be stored in the same environment of the actuator.

3. Communication features

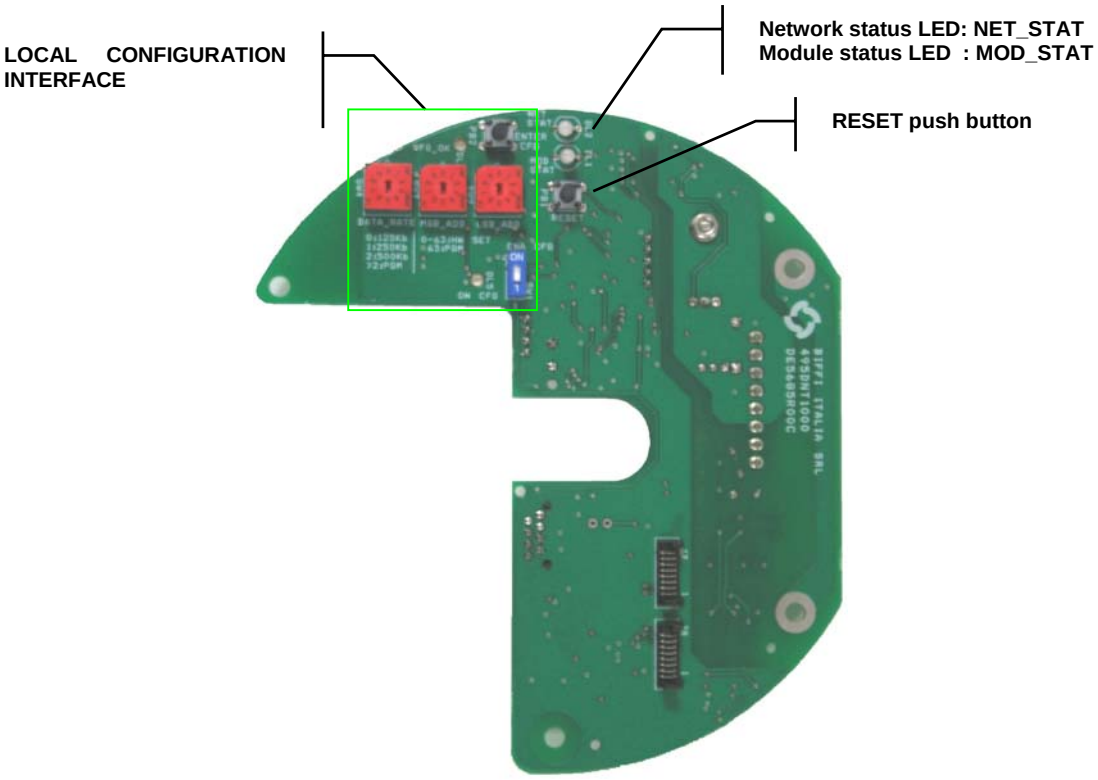
Communication protocol	CAN bus standard, 5 wires DeviceNet application
Network topology	Trunk-line / drop-line topology
Transmission medium	Specific cable for DeviceNet network: 1 twisted pair for power, 1 twisted pair for data and shield
Data rate	125 250 500 **Kbps**
Cable length	500 250 100 **m** (length may vary also with cable thickness)
Device number	64 devices per segment
Bus access	producer-consumer network
Bus termination	external bus terminators required

BIFFI implementation

Device type	Generic (00hex)
Group	Group 2 Only Slave
Physical Layer	Isolated node with Transceiver powered by the network
Current consumption	Current drawn from the network to power the transceiver: 29mA @24V; 27mA @17V; 25mA @11V
Communication	Predefined Master/Slave Connection: Explicit message and Polled I/O
Baud rate	125Kbps, 250 Kbps,500Kbps (default 125 Kbps). Network configurable or manual configurable via on-board rotary BCD switch
Addressing (MACID)	0-63 (default 63). Network configurable or manual configurable via on-board rotary BCD switches
Temperature	-40°C, +85°C
EMC protections	EN 50081-2 and EN 50082-2

4. DeviceNet Interface module

The module consists in a single PCB that is installed inside the actuator housing. It is connected to the F02 base card via flat cable. The internal wiring connects the DeviceNet data lines to the actuator terminal board.



4.1 On-board Indication

The DeviceNet interface **xPx_DNint** is equipped with some LEDs, pushbuttons and BCD rotary switches to offer a Local Operator interface on-board. This interface is useful for Field service while to the user is not normally requested to accede to this settings.

MOD_STAT: Module Status LED as defined in spec. Vol.3 'DeviceNet Adaptation for CIP', Chapter 9.

Condition	Indication	Description
No power	Off	There is no power applied to the device
Operational	Green	The device is operating in a normal condition
Standby	Flashing Green	The factory commissioning is not finished: Serial Number not yet assigned
Minor Fault	Flashing Red	Recoverable fault due to a non critical diagnostic indication
Unrecoverable Fault	Red	Device has an unrecoverable fault:: - HW alarm - Power failure alarm - Position sensor alarm - High temperature alarm

NET_STAT — Network Status LED as defined in spec. Vol.3 'DeviceNet Adaptation for CIP', Chapter 9.

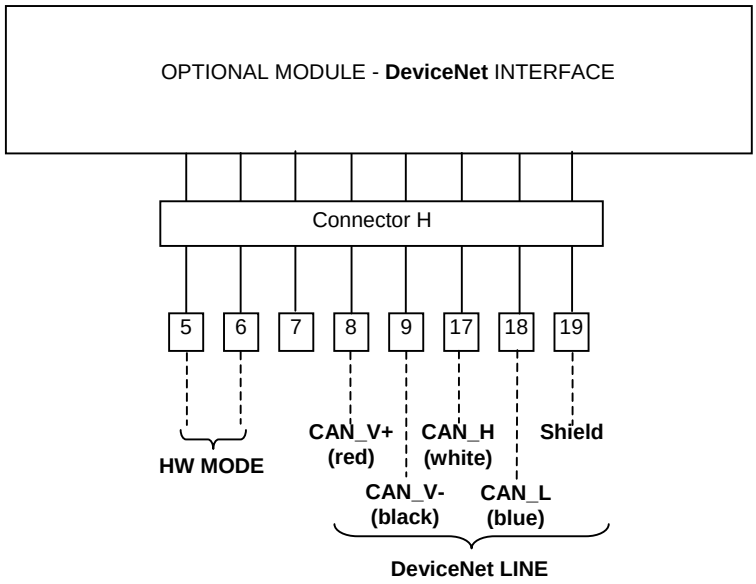
Condition	LED	Description
Not powered/ Not On-line	Off	Device is not on-line
On-line, Not Connected	Flashing Green	Device is on-line, but is not allocate to a Master
Link OK On-line Connected	Green	Device is on-line and is not allocate to a Master
Connection Time-Out	Flashing Red	One ore more I/O Connection are in Timed-Out state
Critical Link Failure	Red	Failed communication device. The device has detected an error that has rendered it incapable of communicating on the network (Duplicate MACID or Bus-Off)
Communication Faulted and Received an Identify Comm Fault Request –Long Protocol	Flashing Red & Green	A specific Communication Faulted device. The device has detected a Network Access error and is in the Communication Faulted state. The device has subsequently received and accepted an Identify Communication Faulted Request-Long Protocol message.

RESET: reset pushbutton

Local Configuration — On-board interface for Local configuration of MACID and Baud Rate. By default the board is set to accept MACID and Baud Rate from the network, but it is also possible to set these parameters by hardware setting. Detailed procedures are given in chapter 7: ***'Local setting'***

4.2 Wiring Diagram

The **xPx_DNint** is connected to the actuator terminal board by internal wiring as shown in figure:



4.3 Bus/Hardwired Mode Selection

The **xPx_DNint** board manages the Bus/Hardwired Mode selection by means of the input indicated with HW MODE.
The physical input accepts from 24 to 125V DC or AC, polarity insensitive.

When the input is left unconnected or no voltage is applied, the actuator is under bus control from which is possible to send commands and read status.

When an appropriate voltage is applied to the HW MODE input, the actuator turns under Hardwired control. In this condition the bus can only read actuator status while the actuator follows the Hardwired Open and Close controls connected to the terminal board.

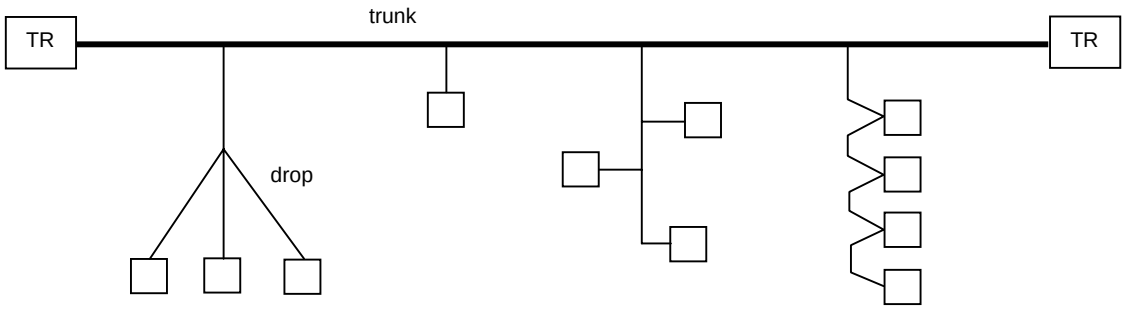
For further details see the relevant wiring diagram and the user's manual:
"***F02 Quarter-turn Electric Actuator*** – Instruction Handbook MAN 652".

5. Brief DeviceNet Description

DeviceNet is a low-level network that provides connection between industrial field devices (sensors and actuators) and higher-level devices (controllers). DeviceNet is based on the Common Industrial Protocol (CIP), and shares all the common aspect of CIP with adaptations to fit the message frame size of DeviceNet.

The majors Physical and Media characteristics of the DeviceNet are:

- Trunk-line / drop-line topology of the network;

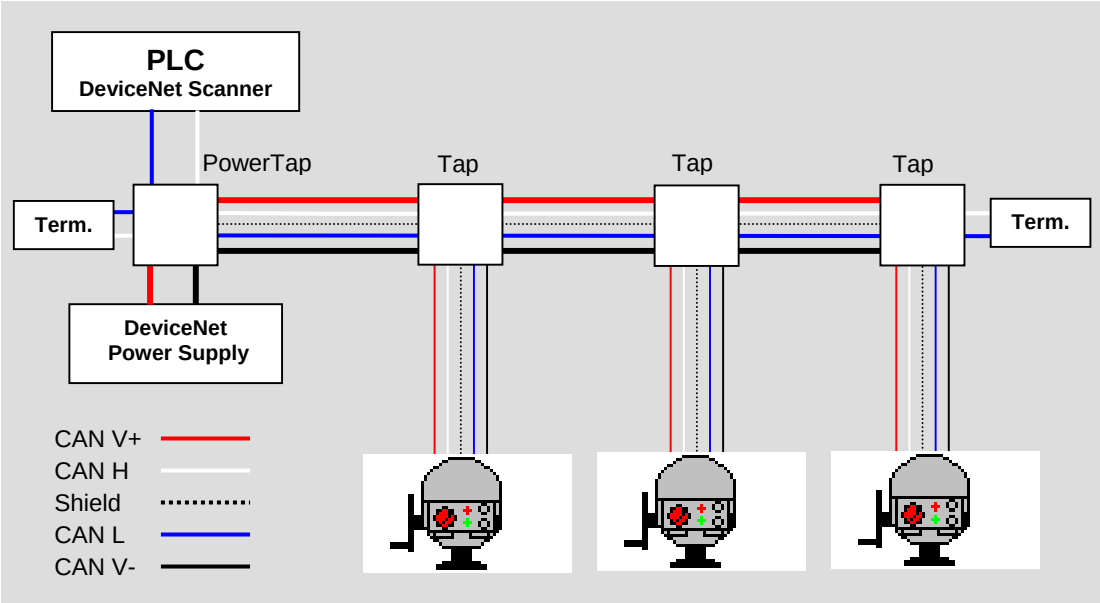


- Support for up to 64 devices in a network;
- Node removal without altering the network behaviour;
- Support of both network-powered and self-powered devices on the same network;
- Wiring error protection;
- Selectable data rate of 125k baud, 250k baud and 500k baud.

Data Rate	Trunk Distance	Drop length	
		Maximum	Cumulative
125 k baud	500 meters	6 meters	156 meters
250 k baud	250 meters		78 meters
500 k baud	100 meters		39 meters

- Adjustable power configuration to meet individual application needs;
- High current capability (up to 8A @ 24Vdc);
- Operation with off-the-shelf power supplies;
- Available power taps that allow the connection of several power suppliers;
- Build-in overload protection;
- Controller Area Network (CAN) technology for Media Access Control and Physical Signalling.

5.1 Network Cable



To obtain the expected performances from the communication network the suitable cable must be utilised.
DeviceNet requires a specific cable composed of a Power pair, a Data Pair and a shield with drain wire. DeviceNet defines different cables to be used in the different parts of the network:

- in the trunk line is normally used the thick cable.
  E.g. BELDEN 3082A: 1 pair 15 AWG 19x28 Tinned Copper – Power pair
  1 pair 18 AWG 19x30 Tinned Copper – Data pair
  inner shield 100% coverage

- in the drop line is normally used the thick cable. e.g. BELDEN 3084A
  E.g. BELDEN 3084A: 1 pair 22 AWG 19x34 Tinned Copper – Power pair
  1 pair 24 AWG 19x36 Tinned Copper – Data pair
  inner shield 100% coverage

5.2 Terminator

The DeviceNet network must be terminated to each end of the main trunk line with a 120ohm resistor across CAN_H and CAN_L data line.

6. Communication Interface

The following paragraph describes the input and output data available at **xPx_DNint** interface. In all cases it is called "**input signal**" a data flowing from actuator to bus, vice-versa it is called "**output signal**" a data flowing from bus to slave.

6.1 Actuator Commands

The commands are received from the DeviceNet network and are forwarded to the base card via the internal communication line.

Output Assembly Instance: Class 4; Instance 101; Attribute 3

Byte	b7	b6	b5	b4	b3	b2	b1	b0
0	Reserved	Reserved	Reserved	Reserved	Positioner Enable	Stop Command	Close Command	Open Command
1	Reserved	Reserved	Reserved	Reserved	Reserved	Reserved	Reserved	Reserved

2	LSB Set point
3	MSB Set point

Command	Description	Data Type	Range	E.U.
Open Command	When this bit is set to 1 an Open Command is issued to the actuator. The open command is maintained for all the duration on the movement since the receiving of the bus command until the Open Limit has reach. The open command is reset when a STOP Command is received from bus.	Boolean	0-1	-
Close Command	When this bit is set to 1 a Close Command is issued to the actuator. The close command is maintained for all the duration on the movement since the receiving of the bus command until the Close Limit has reach. The close command is reset when a Stop Command is received from bus.	Boolean	0-1	-
Stop Command	When this bit is set to 1 a Stop Command is issued to the actuator. The Stop Command received from bus cause the reset of both open and close commands.	Boolean	0-1	-
Positioner Enable	When this bit is set to 1 it is enabled the on-board positioner. The positioner is enabled until this bit is set to 1.	Boolean	0-1	-
Set point	The Set Point received from the bus is used to produce the open or close commands to the F02 actuator as defined in paragraph 6.2.1: '*Positioning algorithm*'.	Integer	0-1000	0,1%

6.2 Actuator Status And Indication

The status are received from the base card via the internal communication line and are reported to the DeviceNet network.

Input Assembly Instance: Class 4; Instance 100; Attribute 3

Byte	b7	b6	b5	b4	b3	b2	b1	b0
0	Positioner active	Intermediate position	Motor Stopped	Fully Close	Actuator Moving	Closing	Opening	Fully Open
1	Monitor Relay	Reserved	PDA Active	HW Mode Active	LOCAL selected	General ALARM	Not Oper Close	Not Oper Open
2	HW alarm	Mid travel alarm	Motor dir. alarm	Opt. loc. cnt. alarm	Strk. limit alarm	Torque CL alarm	Torque OP alarm	Pwr fail alarm
3	Reserved	Reserved	Reserved	Reserved	Reserved	Reserved	High temp alarm	Pos. Sen. alarm

4	LSB Current Position
5	MSB Current Position

6	Current Torque
7	Current Temperature

Indication	Description	Data Type	Range	E.U.
Fully Open	The Fully Open indication is set to 1 when the F02 actuator is at Fully Open position. This indication reflects the status of the open limit on the F02 actuator.	Boolean	0-1	-
Opening	The Opening indication is set to 1 when the F02 actuator is moving toward opening direction.	Boolean	0-1	-
Closing	The Closing indication is set to 1 when the F02 actuator is moving toward closing direction.	Boolean	0-1	-
Actuator Moving	This indication is set to 1 when the actuator is moving either in opening or in closing direction.	Boolean	0-1	-
Fully Close	The Fully Close indication is set to 1 when the F02 actuator is at Fully Close position. This indication reflects the status of the close limit on the F02 actuator.	Boolean	0-1	-
Motor Stopped	This indication is set to 1 when the actuator is not moving and the motor has stopped.	Boolean	0-1	-
Intermediate position	This indication is set to 1 when the valve is on an intermediate position.	Boolean	0-1	-
Positioner active	This indication is set to 1 when the on-board positioner is enabled.	Boolean	0-1	-
Not Operative in Open Direction	Open command not available due to current alarm trip in open direction. The diagnostic indication is cleared when the alarm that has generated the fault disappears.	Boolean	0-1	-
Not Operative in Close Direction	Close command not available due to current alarm trip in close direction. The diagnostic indication is cleared when the alarm that has generated the fault disappears.	Boolean	0-1	-
General Alarm	Bus can only read data due to alarm present. The diagnostic indication is cleared when all the alarm conditions are cleared.	Boolean	0-1	-
LOCAL selected	Not operation from bus because LOCAL operator interface has the control. The diagnostic indication is cleared when the selector is turned on REMOTE and the bus gives back the control.	Boolean	0-1	-
HardWired Mode selected	Not operation from bus because HARDWIRED operator interface has the control. The diagnostic indication is cleared when the input HW MODE is left open and the bus gives back the control.	Boolean	0-1	-

Indication	Description	Data Type	Range	E.U.
PDA Active	Not operation from bus because PDA operator interface has the control (only if this option is available). The diagnostic indication is cleared when the PDS control is released and the bus gives back the control.	Boolean	0-1	-
Monitor Relay	This indication is set to 1 when the actuator is available for bus control. Monitor Relay indication means that the local selector is on Remote position, no other remote interfaces have the control (Hardwired or PDA) and no alarms are present.	Boolean	0-1	-
Power failure alarm	This bit is set when the main supply is not in the proper range. The diagnostic indication is cleared at the next power up if the supply is corrected.	Boolean	0-1	-
Torque alarm in opening	This bit is set when the Torque has reached the programmed limit while the actuator was moving in opening direction. The diagnostic indication is cleared by a Close command	Boolean	0-1	-
Torque alarm in closing	This bit is set when the Torque has reached the programmed limit while the actuator was moving in closing direction. The diagnostic indication is cleared by an Open command.	Boolean	0-1	-
Stroke limit alarm	This bit is set when the current position is behind the Open or Close limit switches or as result of an incorrect Torque Set. The diagnostic indication is cleared when the position return within the limits or after a successful Torque Set procedure	Boolean	0-1	-
Optional local control Alarm	This bit is set when the optional Local Control does not work correctly. The diagnostic indication is cleared when the Local Control works without problems.	Boolean	0-1	-
Motor direction alarm	This bit is set when the motor drive has recognised an incorrect behaviour. The diagnostic indication is cleared by a command in the opposite direction.	Boolean	0-1	-
Mid travel alarm	This bit is set when the actuator detects a jammed valve condition. The diagnostic indication is cleared by any new command.	Boolean	0-1	-
HW alarm	This bit is set when the actuator detects a general hardware error. The diagnostic indication is cleared at the next power up under normal condition.	Boolean	0-1	-
Position sensor alarm	This bit is set when the actuator detects that executing a command the position sensor is not working properly.	Boolean	0-1	-
High temperature alarm	This bit is set when the internal temperature is out from the operational limits. The diagnostic indication is cleared when the internal is within the limits.	Boolean	0-1	-
Current position	The current position read from base card	Integer	0-1000	0,1%
Current torque	The current torque read from base card	Integer	0-100	%
Internal temperature	The current internal temperature	Integer	-45 +85	°C

6.2.1 Positioning algorithm

A positioning algorithm (position closed loop control) is implemented on the **xPx_DNint** interface card.
Positioning function consists in comparing the position, received from the base card, with the position request received from bus. If the difference between “position request and present position” is greater than “dead band” an Open or a Close command is send to base card. Dead band is configurable via bus from 0,3 to 2,0%.

6.3 Fail Safe Data

The Fail Safe Data define the behaviour of the actuator in case of network communication loss. The Fail Safe Data shall be modified from DeviceNet network.

Indication	Description	Direction	Data Type	Range	Default	E.U.
Parameter 1: Class 100; Instance 1; Attribute 100						
Safety action	The action to execute in case of loss of bus communication. 0= No action 1= Stop 2= Close 3= Open 4= Go to predefined position	R/W	Integer	0-4	0	-
Parameter 2: Class 100; Instance 1; Attribute 101						
Predef. Safety position	Safe predefined position	R/W	Integer	0-100	50	%
Parameter 3: Class 100; Instance 1; Attribute 102						
Delay on Bus Fail	Delay before to initiate the Safety Action	R/W	Integer	0-10	4	sec

6.4 Positioner Configuration Data

The Positioner Configuration data are received from DeviceNet network and are used on the interface to manage the positioning function as described in paragraph 6.2.1: '*Positioning algorithm*'.

Indication	Description	Direction	Data Type	Range	Default	E.U.
Parameter 4: Class 100; Instance 1; Attribute 103						
Dead Band	It defines in tenth of % the Dead band of the positioning function available on the modulating actuator. The movement is inhibited until the difference between current position and requested position (position error) is lower than Dead Band.	R/W	Integer	3- 20	15	0.1%

6.5 User Defined Data

The User Defined data are stored in the F02 actuator and are available on DeviceNet network for User's convenience.

Indication	Description	Direction	Data Type	Range	Default	E.U.
Parameter 5: Class 100; Instance 1; Attribute 104						
Actuator Serial Number	Actuator Serial Number	Only Read	Short String	12 bytes	-	-
Parameter 6: Class 100; Instance 1; Attribute 105						
Actuator Type	Actuator Type	Only Read	Short String	12 bytes	-	-
Parameter 7: Class 100; Instance 1; Attribute 106						
Valve Tag	Valve Tag	Only Read	Short String	12 bytes	-	-

6.6 Configuration Data

The Configuration Data are received from the base card via the internal communication line and are reported to the DeviceNet network. The Configuration Data shall also be modified from DeviceNet network and the interface will send the new values to the base card.

Indication	Description	Direction	Data Type	Range	Default	E.U.
Parameter 8: Class 100; Instance 1; Attribute 112						
Close direction	The direction the actuator drives the motor when it receives a Close command. 0= Clockwise (CW) 1= Clockwise (CCW)	R/W	Integer	0-1	1	-
Parameter 9: Class 100; Instance 1; Attribute 113						
Opening speed set	It defines the speed of the motor when opening.	R/W	Integer	0-9	7	-
Parameter 10: Class 100; Instance 1; Attribute 114						
Closing speed set	It defines the speed of the motor when closing.	R/W	Integer	0-9	7	-
Parameter 11: Class 100; Instance 1; Attribute 115						
Opening torque set	Opening torque.	R/W	Integer	0-9	7	-
Parameter 12: Class 100; Instance 1; Attribute 116						
Closing torque set	Closing torque.	R/W	Integer	0-9	7	-
Parameter 13: Class 100; Instance 1; Attribute 117						
Open limit	It defines the end of travel setting in Open direction: 0= open limit by torque 1= open limit by position	R/W	Integer	0-1	1	-
Parameter 14: Class 100; Instance 1; Attribute 118						
Close limit	It defines the end of travel setting in Close direction: 0= close limit by torque 1= close limit by position	R/W	Integer	0-1	1	-

Indication	Description	Direction	Data Type	Range	Default	E.U.
Parameter 15: Class 100; Instance 1; Attribute 119						
Nominal Torque	Nominal Torque of the motor: 0= 63 Nm 1= 125 Nm 2= 250 Nm 3= 500 Nm 4= 1000 Nm 5= 2000 Nm	Only Read	Integer	0-5	-	-
Parameter 16: Class 100; Instance 1; Attribute 120						
LED colour code	It defines the colour of the LED indicating the Fully Open and Fully Close position: 0: Open: LED=green; Close: LED=red 1: Open: LED= red; Close: LED= green	R/W	Integer	0-1	0	-

6.7 DeviceNet Configurable Parameters

The DeviceNet Configurable Parameters are used to set MACID and Baud Rate when the software configuration of these parameters is enabled.

Indication	Description	Direction	Data Type	Range	Default	E.U.
Parameter 17: Class 3; Instance 1; Attribute 1						
MACID	The MACID to assign to the device	R/W	Unsigned	0-63	63	-
Parameter 18: Class 3; Instance 1; Attribute 2						
Baud Rate	The Baud Rate to assign to the device	R/W	Unsigned	0-2	0	-

6.8 EDS File

The **xPx_DNint** interface card is provided of an Electronic Data Sheet (EDS) file.
The EDS file is DeviceNet specific and provide information about the device configuration data. The EDS file is used by the DeviceNet configuration tools to get all the information necessary to the device configuration and to the access and alter the configurable parameters of the F02 actuator.

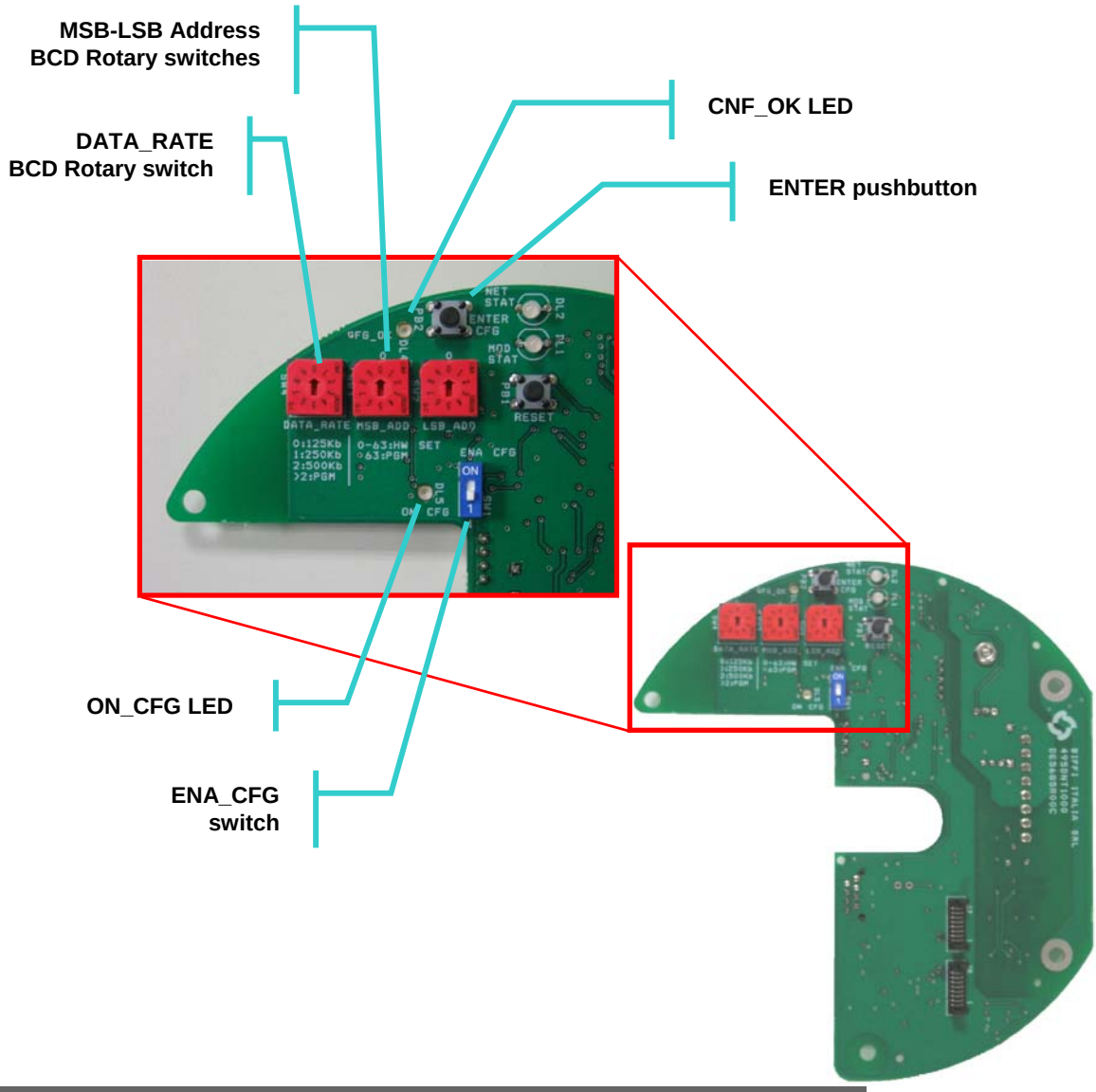
7. Local Settings

The **xPx_DNint** board is equipped with an on-board interface to allow the operator to configure both the MACID and the Baud Rate of DeviceNet communication.

To accede to on-board interface on the **xPx_DNint** module it is necessary to follows carefully the procedures explained in "***F02 Quarter-turn Electric Actuator*** – Instruction Handbook MAN 652" at Chapter 6: "ACTUATOR SETTINGS AND CONFIGURATION" and then follow the procedures described in the next paragraphs.

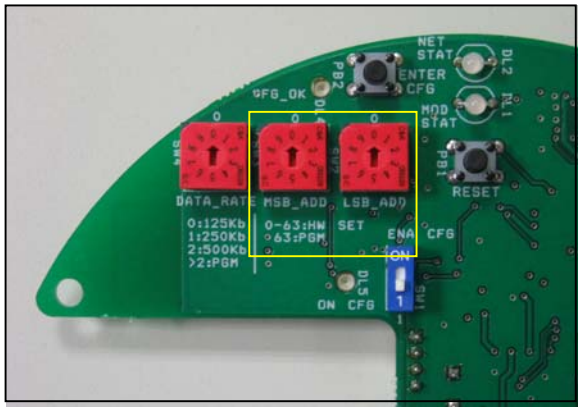
7.1 On-Boards Interface

The on-board interface is equipped with the following switches and indications.



7.2 DeviceNet MACID Setting

The **xPx_DNint** module allows MACID setting both for manual configuration or for software configuration by means of two ten-position BCD rotary switches as indicated in the figure.



The current setting is read in decimal representation:
MSB_ADD specifies the ten (1x, 2x, 3x, …);
LSB_ADD specifies the unit (x1, x2, x3, …).

Manual configuration

When BCD rotary switches specify a valid DeviceNet MACID, i.e. a value from 00 to 63, the module considers this value as the device MACID.

Software configuration

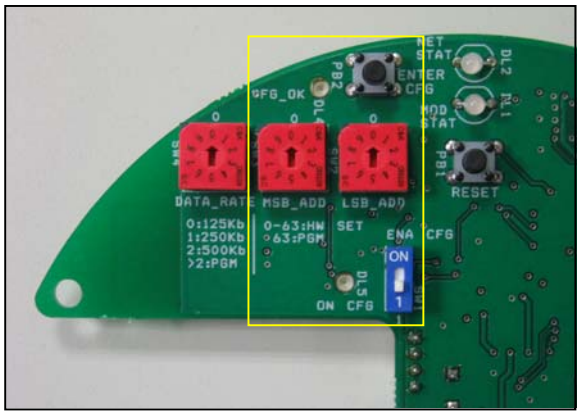
If the switches specify an invalid DeviceNet MACID, i.e. a value greater than 63, the module uses the value stored in non-volatile memory and is ready for software configuration of MACID via specific communication message.

Configuration Procedure

To change the current value of the BCD rotary switches to set a different MACID, the user shall follow this procedure:

- *Move the dip switch **ENA_CFG** on the ON position: the **ON_CFG** LED turns ON to indicate that the actuator is entered in Configuration Mode*

- *Set the new MACID on the rotary switches **MSB_ADD** and **LSB_ADD**.*
  E.g.: to set MACID = 28:
  MSB_ADD. on position 2
  LSB_ADD on position 8

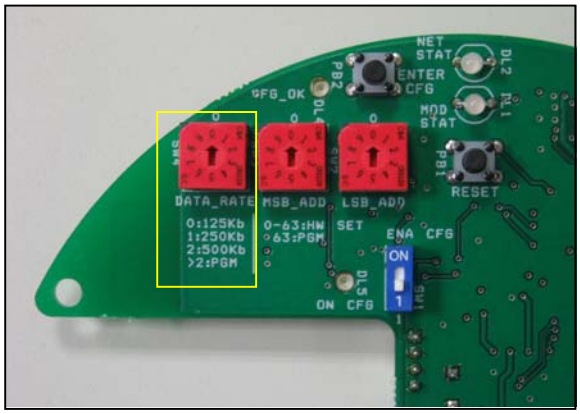


- *Press the pushbutton **ENTER** to confirm the new set: if the new MACID is correct the **CFG_OK** LED turns ON*

- *Move the dip switch **ENA_CFG** on the OFF position to exit from Configuration Mode: the **xPx_DNint** module is reset to activate the new setting.*

7.3 DeviceNet Date Rate Setting

The **xPx_DNint** module allows also Date Rate setting both for manual configuration or for software configuration by means of one ten-position BCD rotary switch DATA_RATE as indicated in the figure.



Manual configuration

When BCD rotary switch specify one of the following valid DeviceNet Data Rate:

0: 125Kbps
1: 250Kbps
2: 500Kbps

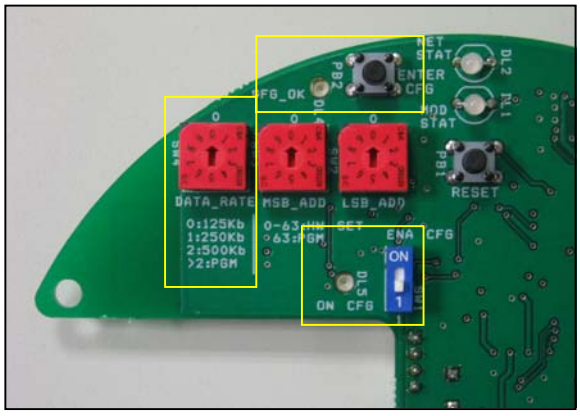
the module will work at the selected data rate.

Software configuration

If the switches specify any other invalid DeviceNet Data Rate, i.e. a value from 4 to 9, the module uses the value stored in non-volatile memory and is ready for software configuration of Data Rate via specific communication message.

Configuration Procedure

To change the current value of the BCD rotary switch to set a different Data Reate, the user shall follow this procedure:



- *Move the dip switch **ENA_CFG** on the ON position: the **ON_CFG** LED turns ON to indicate that the actuator is entered in Configuration Mode*
- *Set the new Data Rate on the rotary switches **DATA_**.*
- *Press the pushbutton **ENTER** to confirm the new set: if the new MACID is correct the **CFG_OK** LED turns ON*
- *Move the dip switch **ENA_CFG** on the OFF position to exit from Configuration Mode: the **xPx_DNint** module is reset to activate the new setting.*

8. DeviceNet Certificate

F02 actuators family equipped with **xPx_DNint** interface card have passed the DeviceNet Conformance Test and can be declared

DeviceNet CONFORMANCE TESTED ™.

Copy of the DeviceNet certificate can be viewed at ODVA web site: www.odva.org

COMPANY
WITH QUALITY SYSTEM
CERTIFIED BY DNV
=ISO 9001/2000=

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