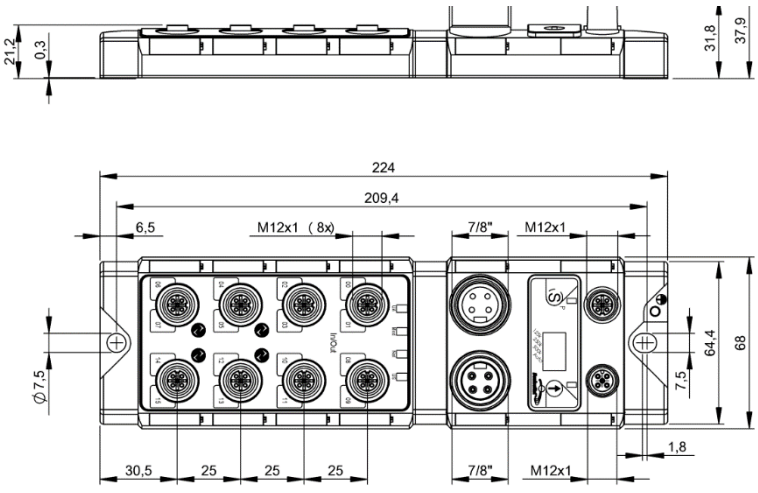
BNI DNT-502-100-Z001

DeviceNet™ IO-Link Master

User´s Guide



Contents

1 General

1.1. Structure of the Manual

The guide is organized so that the sections build on one another.

Chapter 2: Safety
Chapter 3: Connection overview
……

1.2. Typographical conventions

The following typographical conventions are used in this guide.

Enumerations

Enumerations are shown as a list with a dot.

- Entry 1,
- Entry 2.

Actions

Action instructions are indicated by a preceding triangle. The result of an action is indicated by an arrow.

➢ Action instruction 1.
↳ Action result.
➢ Action instruction 2.

Procedures can also be shown as numbers in brackets.

(1) Step no. 1
(2) Step no. 2

Syntax

Numbers:

- Decimal numbers are shown without additional indicators (e.g., 123),
- Hexadecimal numbers are shown with the additional indicator hex (e.g., 00hex), or with the prefix “0x” (e.g. 0x00)

Cross-references

Cross-references indicate where further information on the topic can be found.

1.3. Symbols

Attention!
This symbol indicates a security notice which must be observed.

Note
This symbol indicates general notes.

1.4. Abbreviations

BNI	Balluff Network Interface
DNT	DeviceNet™
EMC	Electromagnetic Compatibility
ESD	Electrostatic Discharge
FE/PE	Function Earth (or Ground) / Protective Earth
RF	Radio Frequency
IOL	IO-Link
SIO	Standard Input / Output (I/O)

1.5. Deviating views

Product views and illustrations in this manual may differ from the actual product. They are intended only as illustrative material.

2 Safety

2.1. Intended use

The Balluff BNI DNT-502-100-Z001 fieldbus module serves as a decentralized Input and Output module for connecting to a DeviceNet™ network. The implemented IO-Link ports enable simple linking of IO-Link capable sensors and actuators. The module may be used only for this purpose in an industrial environment corresponding to the EMC standards and directives.

2.2. Installation and Startup

Attention!
Installation and startup must only be carried out by trained technical personnel. Qualified personnel are people who are familiar with installation and operation of the product and have the necessary qualifications for these tasks. Any damage resulting from unauthorized tampering or improper use voids the manufacturer's guarantee and warranty. The operator must ensure that appropriate safety and accident prevention regulations are observed.

2.3. General safety notes

Commissioning and inspection
Before commissioning, carefully read the operating manual.
The system must not be used in applications in which the safety of persons is dependent on the function of the device.
Authorized Personnel
Installation and commissioning may only be performed by trained specialist personnel.
Intended use
Warranty and liability claims against the manufacturer are rendered void by:

- Unauthorized tampering
- Improper use
- Use, installation or handling contrary to the instructions provided in this operating manual

Obligations of the Operating Company
The device is a piece of equipment from EMC Class A. Such equipment may generate RF noise. The operator must take appropriate precautionary measures. The device may only be used with an approved power supply. Only approved cables may be used.
Malfunctions
In the event of defects and device malfunctions that cannot be rectified, the device must be taken out of operation and protected against unauthorized use.
Intended use is ensured only when the housing is fully installed.

2.4. Resistance to Aggressive Substances

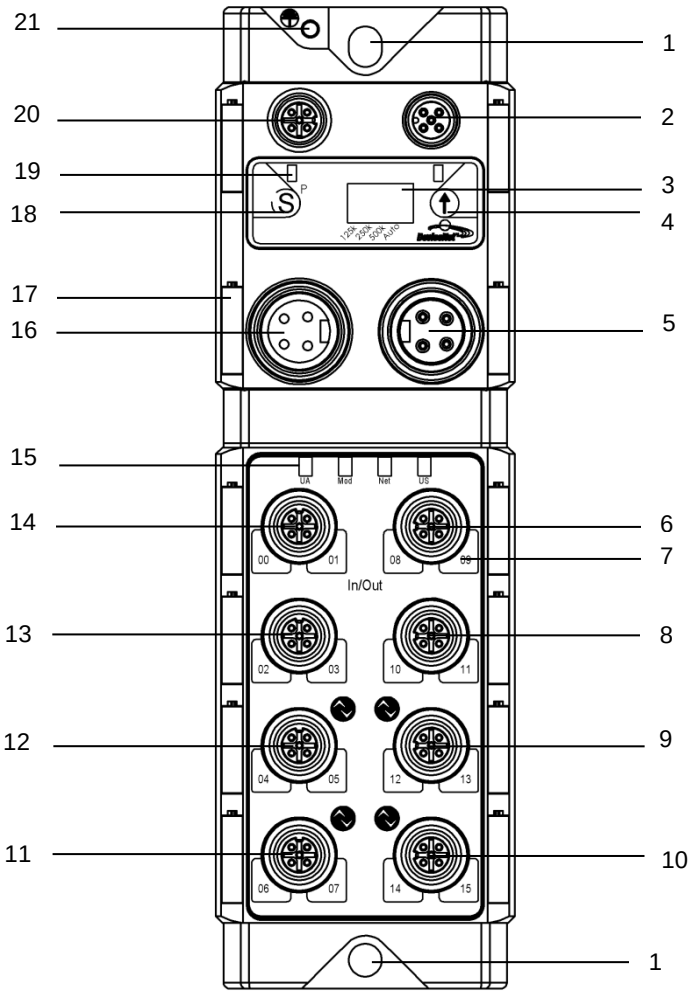
Attention!
The BNI modules always have good chemical and oil resistance. When used in aggressive media (such as chemicals, oils, lubricants and coolants, each in a high concentration (i.e. too little water content)), the material must first be checked for resistance in the particular application. No defect claims may be asserted in the event of a failure or damage to the BNI modules caused by such aggressive
media.

Note
In the interests of product improvement, Balluff GmbH reserves the right to change the technical data of the product and the content of this manual at any time without notice.

Attention!
Before maintenance, disconnect the device from the power supply.

3 Connection overview

3.1. Module overview



1	Mounting hole	12	Port 2 (IO-Link, Standard I/O)
2	DeviceNet bus IN	13	Port 1 (Standard I/O)
3	Display	14	Port 0 (Standard I/O)
4	Button (↑)	15	Module Status LEDs
5	Power Supply IN	16	Power Supply OUT
6	Port 4 (Standard I/O)	17	Label
7	Port Status LED	18	Button (S)
8	Port 5 (Standard I/O)	19	Feedback LED
9	Port 6 (IO-Link, Standard I/O)	20	DeviceNet bus OUT
10	Port 7 (IO-Link, Standard I/O)	21	Grounding connection
11	Port 3 (IO-Link, Standard I/O)		

3 Connection overview

3.2. Mechanical connection

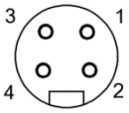
The module can be fixed using 2x M6 screws and 2x washers. Isolation pad as accessory is available.

3.3. Supply voltage connection

Power In (7/8 Mini- Change 4 pin, male)

Pin	Function	Description
1	+24V	Actuator Supply
2	+24V	Sensor / Module Supply
3	0V	Sensor / Module GND
4	0V	Actuator GND

Power Out (7/8 Mini- Change, 4 pin, female)



Pin	Function	Description
1	+24V	Actuator Supply
2	+24V	Sensor / Module Supply
3	0V	Sensor / Module GND
4	0V	Actuator GND

Note
Provide sensor/bus power and actuator power from separated power sources wherever possible to minimize noise susceptibility. Total current < 9A. The total current of all modules may not exceed 9A even when daisy chaining the actuator supply.

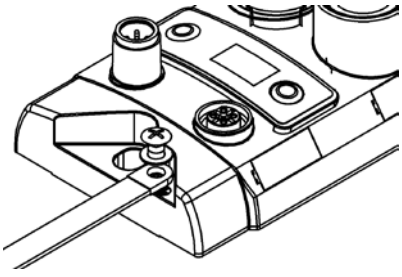
Note
Unused sockets must be fitted with cover caps to ensure the IP67 protection rating.

Note
Module and connected sensors are powered by the “module and sensor supply”, while the “actuator supply” powers all outputs. The only exception is pin 4 on all IO-Link ports, here the outputs are powered by the “sensor supply”.

3.4. Function ground

The ground connection of the BNI DNT-502-100-Z001 modul is located at the upper left next to the mounting hole.

Ground straps are preferred for the ground connection. Alternately a fine-strand PE wire with large cross-section may be used.



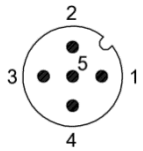
Note
The FE connection from the housing to the machine must be low-impedance and kept as short as possible.

3 Connection overview

3.5. DeviceNet connection

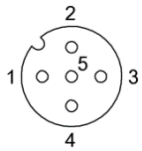
The DeviceNet connection is made using the M12 sockets Bus IN and Bus OUT (A-coded)

Bus IN: (M12, A-coded, male)



Pin	Function
1	Drain
2	CAN +24V
3	CAN GND
4	CAN H
5	CAN L

Bus OUT: (M12, A-coded, female)



Pin	Function
1	Drain
2	CAN +24V
3	CAN GND
4	CAN H
5	CAN L

Attention!
DeviceNet™ network should be grounded at ONE location. Grounding at more than one location may produce ground loops, while not grounding the network will increase sensitivity to ESD and outside noise sources.

Note
Both ends of the DeviceNet™ network must be terminated with a terminating resistor.

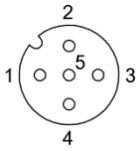
Note
Unused sockets must be fitted with cover caps to ensure the IP67 protection rating.

3 Connection overview

3.6. Connecting sensors / actuators

4 configurable SIO ports are provided for connecting actuators and sensors.

Standard I/O Port (M12, A-coded, female)



Pin	Function
1	+24V, 200mA
2	Input / Output 2A
3	0V
4	Input / Output 2A
5	FE

Note
For the digital sensor inputs, read the input guideline specified in EN 61131-2, Type-2.

Note
The transmission time of the digital inputs from sensor to control is max. 130 ms.

Note
Each output serves a maximum current of 2A. Total current of the module has to be lower than 9A.

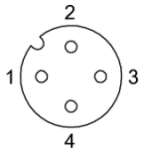
Note
Unused I/O port sockets must be fitted with cover caps to ensure IP67 protection rating.

3 Connection overview

3.7. Connecting IO-Link devices

4 configurable SIO + IOL ports are provided for connecting actuators / sensors / IO-Link devices.

Standard I/O and IO-Link Port (M12, A-coded, female)



Pin	Function
1	+24V, 1.6A
2	Input / Output 2A
3	0V
4	IO-Link / Input / Output 1.4A
5	-

Note
For the digital sensor inputs, read the input guideline specified in EN 61131-2, Type-2.

Note
Each output serves a maximum current of 2A. Except the IO-Link ports what serves a maximum current of 1.4A. Total current of the module has to be lower than 9A.

Note
Unused I/O or IOL port sockets must be fitted with cover caps to ensure IP67 protection rating.

Note
Due to limited CPU resources, only a maximum of three IO-Link-devices with COM3 speed can be reliably handled. It is therefore recommended not to use all 4 IO-Link-Ports for COM3 IO-Link Devices simultaneously.

Connection options for the DNT modules:

Module	Standard I-Port	Standard O-Port	IO-Link Port
BNI DNT-502-100-Z001	Max 16	Max 16	Max 4

3.8. Replacing BNI DNT modules

Attention!
Components may be damaged by electrostatic discharge.
- Observe rules for handling components that are sensitive to electrostatic discharge.

- De-energize the DeviceNet module.
- Remove connections.
- Remove the mounting screws.
- Replace the device.

4 Display

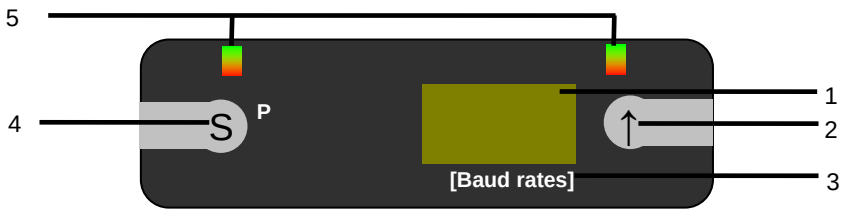
4.1. General

The display gives information about the Node Adress and the baud rate of the device. The Node Adress and the baud rate can be changed by the display only. To apply the new settings you must restart the module by power reset. Additionally the display shows information about the hardware and firmware version.
The display can be locked by the lock function what can be activated through a control bit (see Chapter 7, “I/O data details”), and there are two different colours feedback LEDs both side of the display what can be set through control bits too.

4.2. Default settings

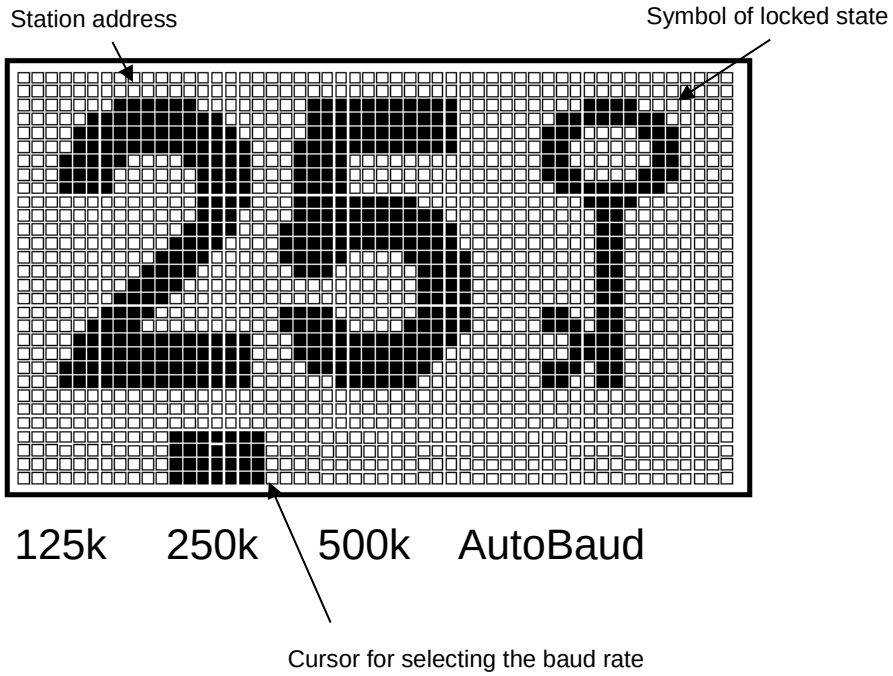
MAC ID / Node Address: 03
Baud rate: 125 kBaud

4.3. Controls and visualization



1	Display	4	„Set“ Key
2	„Arrow“ Key	5	Feedback LEDs
3	Available Baud rates		

4.4. Display information



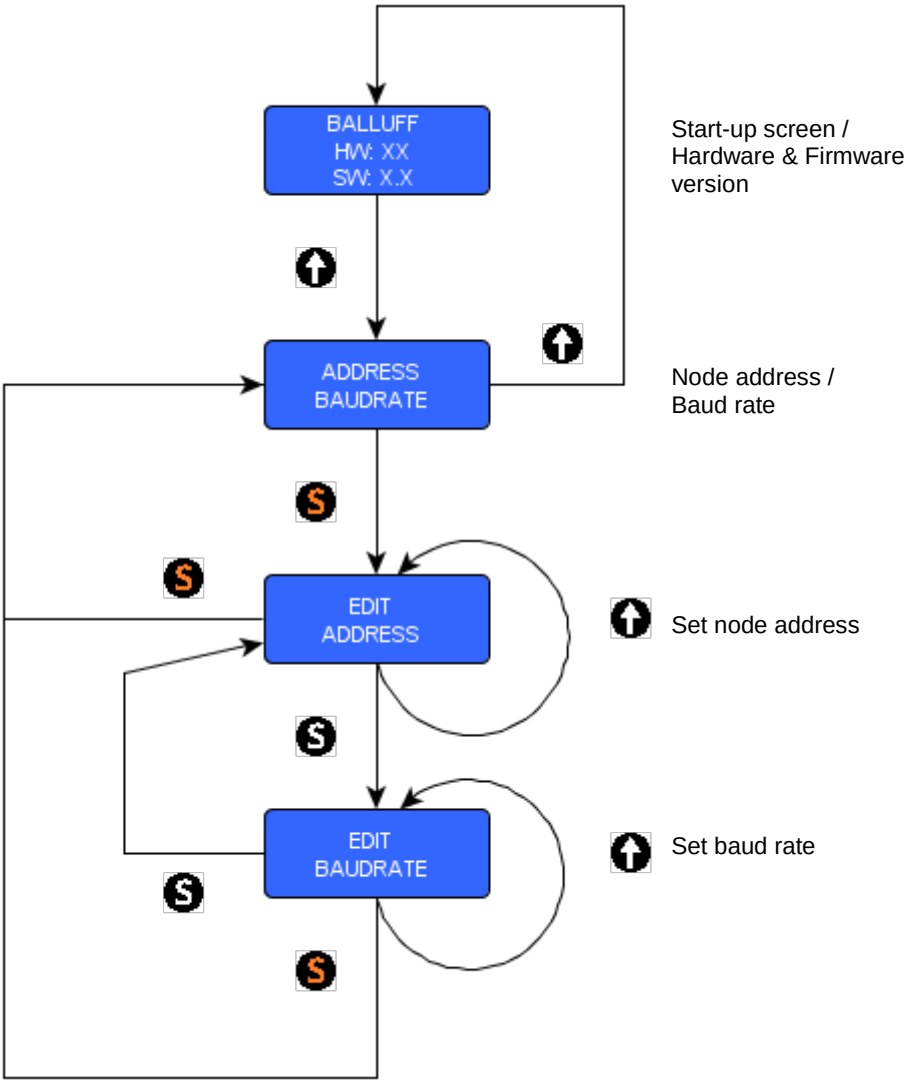
4.5. Menu structure

There are some symbols used in the following flow-chart to describe the display-functionality:

Condition: short-time key press on „Arrow“ key

Condition: short-time key press on „Set“ key

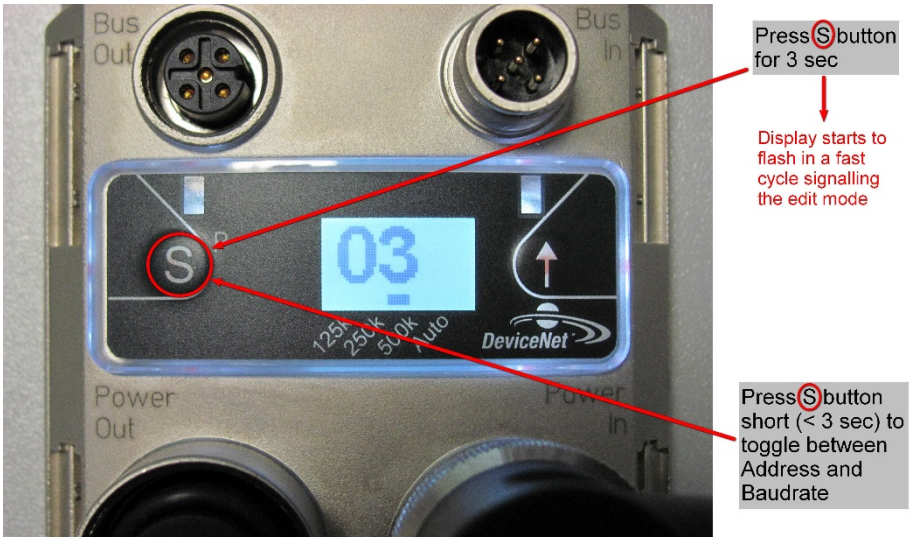
Condition: long-time key press on „Set“ key (min. 3 seconds)



- Press for short time the “Arrow” key to scroll in the menu and to increase the edited value
- Press for long time the “Set” key to enter or exit from the edit menu
- Press for short time the “Set” key to scroll in the edit menu

4 Display

4.6. Edit mode



- long push (>3s) on (**S**) → edit mode is activated, display information is flashing
- push on (**S**) → change between address and baud rate editing
- push on (↑) → increment value by one
- long push (>3s) on (**S**) → leave edit mode and save the changes
- after 10 seconds without any key press, the changes are discarded and display returns to normal mode

Note

When the Display Lock bit is set, the user is unable to modify settings via the display. In locked state a key symbol indicates that the status is active.

Note

Each DeviceNet™ node must have a unique address assigned to it and the entire bus participants must be assigned the same baud rate.

5 DeviceNet™

5.1. Node Adress, baud rate, I/O size

Parameter name	Value
Node Adress	0….63
Baud rate	125k, 250k, 500k, AutoBaud
Produced I/O size	8 ~ 136 bytes
Consumed I/O size	6 ~ 134 bytes

5.2. AutoBaud

The AutoBaud function is selectable only via the display. After the next power up, the module will try to find out the communication speed used on the channel by listening.
In case the used baud rate is one of the valid speeds /125k, 250k 500k/, DNT communication is going to be initialized using this setting. In case no valid baud rate could be detected, default baud rate will be used. This takes effect right after the detection. After the next start-up, the baud rate setting will be the detected baud rate. In case the detection has failed, AutoBaud will remain.

5.3. I/O Data

The I/O message size depends on the settings of the IO-Link channels. The minimum I/O message sizes are 8 bytes for Input and 6 bytes for Output with disabled IO-Link ports. The maximum I/O message sizes are 136 bytes for Input and 134 bytes for Output if all IO-Link channels are enabled and each channel port mode setting was set to 32/32 bytes.

I/O data produced by the module	
Byte	**Name**
0	Input Status
1	
2	Overload Status
3	
4	Short Circuit Status
5	Aux Power Status
6	IO-Link Status
7	
IOL CH1 (0~32) Bytes	IO-Link Channel 1 Input Data
IOL CH2 (0~32) Bytes	IO-Link Channel 2 Input Data
IOL CH3 (0~32) Bytes	IO-Link Channel 3 Input Data
IOL CH4 (0~32) Bytes	IO-Link Channel 4 Input Data

I/O data consumed by the module	
Byte	**Name**
0	Output State
1	
2	Output Reset
3	
4	Display
5	Empty
IOL CH1 (0~32) Bytes	IO-Link Channel 1 Output Data
IOL CH2 (0~32) Bytes	IO-Link Channel 2 Output Data
IOL CH3 (0~32) Bytes	IO-Link Channel 3 Output Data
IOL CH4 (0~32) Bytes	IO-Link Channel 4 Output Data

5 DeviceNet™

5.4. User specific objects

User specific DeviceNet™ objects are used to configure, control the module, and access ISDU IO-Link Data.

Gateway class

DeviceNet Gateway Class	
Class ID	**0x64**

Attributes				
Name	**Attribute ID**	**Size (Byte)**	**Data Type**	**Access**
Number of Attributes	1	1	USINT	R
Attribute List	2	8	BYTE	R
Produced I/O Size	3	1	USINT	R
Consumed I/O Size	4	1	USINT	R
Heartbeat	5	1	USINT	R/W
Quick Connect	6	1	BOOL	R/W
IOL Port Enable	7	1	BYTE	R/W
Settings Done	8	1	BOOL	R/W

Services	
Name	**Service ID**
GET_SINGLE_ATTR	0x0E
SET_SINGLE_ATTR	0x10

Instances
0

This class holds general configuration options of the BNI module. It supports only class level services, so only Instance 0 can be accessed.

IO-Link channel class

IO-Link Channel Class	
Class ID	**0x65**

Attributes				
Name	**Attribute ID**	**Size**	**Data Type**	**Access**
Number of Attributes	1	1	USINT	R
Attribute List	2	10	BYTE	R
Port Status	3	1	BYTE	R
Port Mode	4	1	USINT	R/W
Data Format	5	1	BOOL	R/W
Validation Type	6	1	USINT	R/W
Valid. Vendor ID (ASCII HEX)	7	4	SHORT_STRING	R/W
Valid. Device ID (ASCII HEX)	8	6	SHORT_STRING	R/W
Valid .SerNum (ASCII)	9	16	SHORT_STRING	R/W
Data Storage	10	1	USINT	R/W

Services	
Name	**Service ID**
GET_SINGLE_ATTR	0x0E
SET_SINGLE_ATTR	0x10

Instances
1….4

The IO-Link channel class holds the configuration options for the IO-Link channels. No class level (Instance 0) operations are enabled. Instances 1…4 are bound to the IO-Link channels of the module, respectively.

ISDU class

ISDU Class	
Class ID	**0x66**

Attributes				
Name	**Attribute ID**	**Size (Byte)**	**Data Type**	**Access**
Number of Attributes	1	1	USINT	R
Attribute List	2	11	BYTE	R
Status #1	3	4	BYTE	R
Status #2	4	4	BYTE	R
Status #3	5	4	BYTE	R
Action	6	1	USINT	R/W
Index	7	2	UINT	R/W
SubIndex	8	1	USINT	R/W
Data Length	9	1	USINT	R/W
Data	10	232	BYTE	R/W
Send Request	11	1	BOOL	R/W

Services	
Name	**Service ID**
GET_SINGLE_ATTR	0x0E
SET_SINGLE_ATTR	0x10

Instances
1….4

This class is for accessing ISDU Data of the IO-Link device on the corresponding IO-Link channel. There are no class level operations with instance 0 available.

ISDU class (ASCII)

ISDU Class (ASCII)	
Class ID	**0x67**

Attributes				
Name	**Attribute ID**	**Size (Byte)**	**Data Type**	**Access**
Number of Attributes	1	1	USINT	R
Attribute List	2	11	BYTE	R
Status #1 (ASCII HEX)	3	8	SHORT_STRING	R
Status #2 (ASCII HEX)	4	8	SHORT_STRING	R
Status #3 (ASCII HEX)	5	8	SHORT_STRING	R
Action	6	1	USINT	R/W
Index	7	2	UINT	R/W
SubIndex	8	1	USINT	R/W
Data Length	9	1	USINT	R/W
Data (ASCII HEX)	10	64	SHORT_STRING	R/W
Send Request	11	1	BOOL	R/W

Services	
Name	**Service ID**
GET_SINGLE_ATTR	0x0E
SET_SINGLE_ATTR	0x10

Instances
1….4

This class is for accessing ISDU Data of the IO-Link device on the corresponding IO-Link channel with limited size of data. There are no class level operations with instance 0 available.

5 DeviceNet™

Standard I/O class

Standard I/O Class	
Class ID	**0x69**

Attributes				
Name	**Attribute ID**	**Size (Byte)**	**Data Type**	**Access**
Number of Attributes	1	1	USINT	R
Attribute List	2	40	BYTE	R
Input Status	3	2	WORD	R
Output Status	4	2	WORD	R
Overload Status	5	2	WORD	R
Short Circuit Status	6	1	BYTE	R
Aux Power Status	7	1	BYTE	R
Output Reset Status	8	2	WORD	R
Fault State 00	9	1	USINT	R/W
Fault State 01	10	1	USINT	R/W
Fault State 02	11	1	USINT	R/W
Fault State 03	12	1	USINT	R/W
Fault State 04	13	1	USINT	R/W
Fault State 05	14	1	USINT	R/W
Fault State 06	15	1	USINT	R/W
Fault State 07	16	1	USINT	R/W
Fault State 08	17	1	USINT	R/W
Fault State 09	18	1	USINT	R/W
Fault State 10	19	1	USINT	R/W
Fault State 11	20	1	USINT	R/W
Fault State 12	21	1	USINT	R/W
Fault State 13	22	1	USINT	R/W
Fault State 14	23	1	USINT	R/W
Fault State 15	24	1	USINT	R/W
Idle State 00	25	1	USINT	R/W
Idle State 01	26	1	USINT	R/W
Idle State 02	27	1	USINT	R/W
Idle State 03	28	1	USINT	R/W
Idle State 04	29	1	USINT	R/W
Idle State 05	30	1	USINT	R/W
Idle State 06	31	1	USINT	R/W
Idle State 07	32	1	USINT	R/W
Idle State 08	33	1	USINT	R/W
Idle State 09	34	1	USINT	R/W
Idle State 10	35	1	USINT	R/W
Idle State 11	36	1	USINT	R/W
Idle State 12	37	1	USINT	R/W
Idle State 13	38	1	USINT	R/W
Idle State 14	39	1	USINT	R/W
Idle State 15	40	1	USINT	R/W

Services	
Name	**Service ID**
GET_SINGLE_ATTR	0x0E
SET_SINGLE_ATTR	0x10

Instances
0

This class holds configuration options for the standard inputs and outputs. It supports only class level services, so only Instance 0 can be accessed.

Event class

Event Class	
Class ID	**0x68**

Attributes				
Name	**Attribute ID**	**Size (Byte)**	**Data Type**	**Access**
Number of Attributes	1	1	USINT	R
Attribute List	2	5	BYTE	R
Event #1 (ASCII HEX)	3	6	SHORT_STRING	R
Event #2 (ASCII HEX)	4	6	SHORT_STRING	R
Event #3 (ASCII HEX)	5	6	SHORT_STRING	R

Services	
Name	**Service ID**
GET_SINGLE_ATTR	0x0E

Instances
1….4

This class gives access to the events recorded by the master on the corresponding IO-Link Channel. There are no class level operations with instance 0 available. All attributes of this class are Read Only.

5.5. Parameter object

Using parameter object is a way to store parameter data. However, it is not mandatory to implement. For the DNT-502-100-Z001 module no parameter object is implemented. All the parameter –configuration- data is stored in the user specific object instances.

6 Module configuration

6.1. Overview

Settings of the module can be accessed via the DeviceNet Gateway Class, Standard I/O Class and instances of the IO-Link related Classes.

Settings are stored in the non-volatile memory. After start-up, data is checked for a valid configuration. If no configuration is stored, default settings are going to be used.

Since configuration is read out at start-up sequence, any changes will only take effect after module reset what can be done by the “Settings Done” flag. The Standard I/O Class settings are handled separately from the others. Any changes in these settings will be applied immediately.

Bus related settings such as Node Adress and baud rate are handled separately too. The fact that configuration has been changed is displayed on the status LEDs to notify the user.

6.2. General settings

General /not IO-Link specific/ settings are stored in Instance 0 of class DeviceNet Gateway Class.

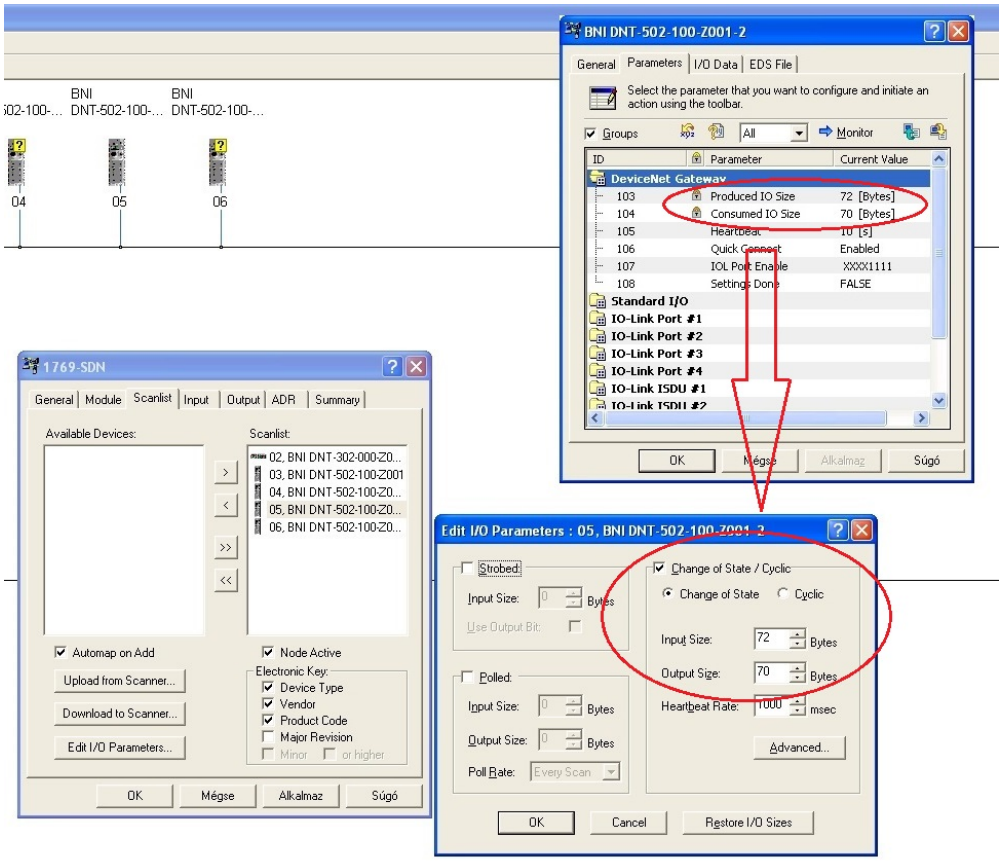
Produced I/O size

This shows the actual size of the produced I/O message. This size depends on the enabled number of the IO-Link channels and the settings of the channels. This value should be set in the scanner settings.

Consumed I/O size

This shows the actual size of the consumed I/O message. This size depends on the enabled number of the IO-Link channels and the settings of the channels. This value should be set in the scanner settings.

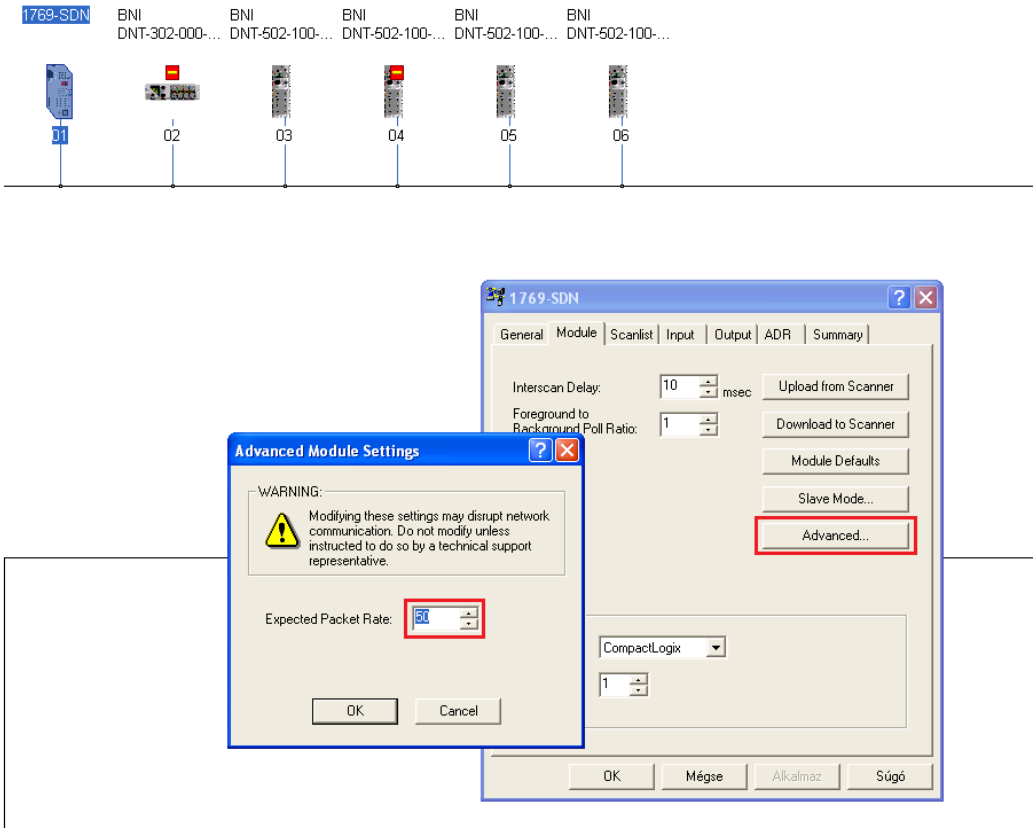
The following example shows the correct settings of the I/O parameters of a DeviceNet™ Scanner Card.



Error while parameter upload in RSNetworx

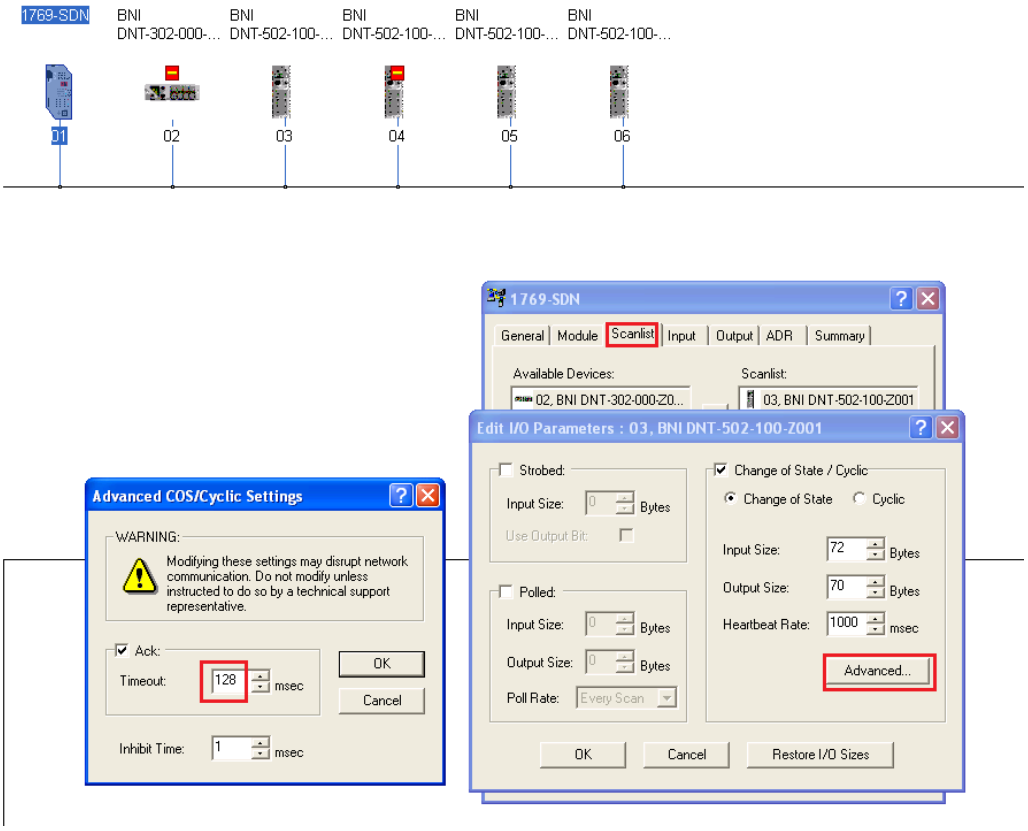
After scanning the devices in RSNetworx, you have to upload the Parameter data of the BNI DNT-502-100-Z001 to configure the device.
In case of a previous configuration, in can happen that the scannercard of the PLC is not able to upload the parameter data. This can happen, when IO-Message size on the Devicenet bus is too large (for example when all IO-Link ports were activated in a previous configuration). Here, the PLC cannot respond in time with ACK and sends a timeout.

To fix that Problem, you have to modify the expected packet rate:



6 Module configuration

The ACK timeout settings also have to be modified in case of an parameter upload error:



Note

Please change these two settings only in case of timeout problems while uploading the parameter data of the BNI DNT-502-100-Z001.

6 Module configuration

Heartbeat

Describes how often the module should send the Heartbeat signal on the DeviceNet™ network, the value is entered in seconds. 0 [sec] means that this function is disabled, the maximum value is 255 [sec].

Byte	Value	Description
0	0x00 ~ 0xFF	Second(s)

Quick connect

The Quick connect mechanism is recommended to use in highly dynamic systems with frequent device changes such as robots with exchangeable tools that contains active devices. By this mechanism the standard reconnecting time (between 4 and 10 seconds) can be bypassed and reduced to under 2 seconds

Byte	Value	Description
0	0	Disabled
	1	Enabled

IO-Link port enable

Controlling whether the corresponding IO-Link channel is configured as IO-Link or reverts to be a standard I/O channel. The Bits from 0…3 control the IO-Link channels 1…4. The Bits from 4…7 doesn't have any effect. IO-Link channels 1,2,3,4 use pin Input / Output 4,6,12,14 as IO-Link data lines.

The change of these bits will modify the I/O message size on the DeviceNet™ bus and needs a modification on I/O parameters of the DeviceNet™ PLC scannercard. When a channel is disabled, it will not appear in the I/O message.

Byte	Bit	Function	Description
0	0	IO-Link channel 1	0 - Disabled 1 - Enabled
	1	IO-Link channel 2	
	2	IO-Link channel 3	
	3	IO-Link channel 4	
	4	x	Does not care
	5	x	
	6	x	
	7	x	

Setting done

This flag controls the module configuration saving. A change from False (0) to True (1) will trigger the configuration saving mechanism and will restart the module.

Byte	Transition	Description
0	0 -> 1	Save settings and restart the module
	1 -> 0	Do nothing

6 Module configuration

6.3. IO-Link specific settings

Configuration data is stored in the instances of IO-Link Channel Class.

Port status

This shows the status of the selected IO-Link channel.

Byte	Bit	Function	Description
0	0	Connection established	0 - False 1 - True
	1	Process Data length mismatch	
	2	Validation failed	
	3	Event occurred	
	4	x	Reserved
	5	x	
	6	x	
	7	x	

Port mode

Values of the variable determine the number of bytes to be received from / transmitted to the IO-Link Device on the corresponding channel.

Byte	Value	Description
0	0x04	Input 1 [byte]
	0x05	Input 2 [bytes]
	0x06	Input 4 [bytes]
	0x07	Input 6 [bytes]
	0x08	Input 8 [bytes]
	0x09	Input 10 [bytes]
	0x0A	Input 16 [bytes]
	0x0B	Input 24 [bytes]
	0x0C	Input 32 [bytes]
	0x0D	Output 1 [byte]
	0x0E	Output 2 [bytes]
	0x0F	Output 4 [bytes]
	0x10	Output 6 [bytes]
	0x11	Output 8 [bytes]
	0x12	Output 10 [bytes]
	0x13	Output 16 [bytes]
	0x14	Output 24 [bytes]
	0x15	Output 32 [bytes]
	0x16	In/Out 1/1 [byte]
	0x17	In/Out 2/2 [bytes]
	0x18	In/Out 2/4 [bytes]
	0x19	In/Out 4/4 [bytes]
	0x1A	In/Out 4/2 [bytes]
	0x1B	In/Out 2/8 [bytes]
	0x1C	In/Out 4/8 [bytes]
	0x1D	In/Out 8/2 [bytes]
	0x1E	In/Out 8/4 [bytes]
	0x1F	In/Out 8/8 [bytes]
	0x20	In/Out 4/32 [bytes]
	0x21	In/Out 32/4 [bytes]
	0x22	In/Out 16/16 [bytes]
	0x23	In/Out 24/24 [bytes]
	0x24	In/Out 32/32 [bytes]

6 Module configuration

Data format

This setting determines the byte order of IO-Link data of the corresponding channel.

Byte	Value	Description
0	0	Normal byte order
	1	Reversed byte order

Validation type

This setting determines the validation of the IO-Link Device on the specific IO-Link channel.

Byte	Value	Description
0	0x00	No Check
	0x01	Compatible
	0x02	Identical
Compatible: Validation of Vendor ID and Device ID. **Identical**: Validation of Vendor ID, Device ID and Serialnumber.		

Validation Vendor ID (ASCII HEX)

If the validation is enabled (Validation type is Compatible or Identical) you must set up the Vendor ID of the used IO-Link slave device for a successful validation.

ASCII HEX means that the Vendor ID must be converted to hexadecimal string format.

When the Vendor ID of the device is (2 bytes) : *0x12 0xEF*
The converted value is (4 bytes) : *0x31 0x32 0x45 0x46*

The Explicit message will contain the following where the first byte (0x04) means the length of the string.

Explicit message : *0x04 0x31 0x32 0x45 0x46*

Validation Device ID (ASCII HEX)

If the validation is enabled (Validation type is Compatible or Identical) you must set up the Device ID of the used IO-Link slave device for a successful validation.

ASCII HEX means that the Device ID must be converted to hexadecimal string format.

When the Device ID of the device is (3 bytes) : *0xA0 0xC1 0x2F*
The converted value is (6 bytes) : *0x41 0x30 0x43 0x31 0x32 0x46*

The Explicit message will contain the following where the first byte (0x06) means the length of the string.

Explicit message : *0x06 0x41 0x30 0x43 0x31 0x32 0x46*

Validation SerNum (ASCII)

If the validation is enabled (when Validation type is Identical) you must set up the Serial Number of the used IO-Link slave device for a successful validation.

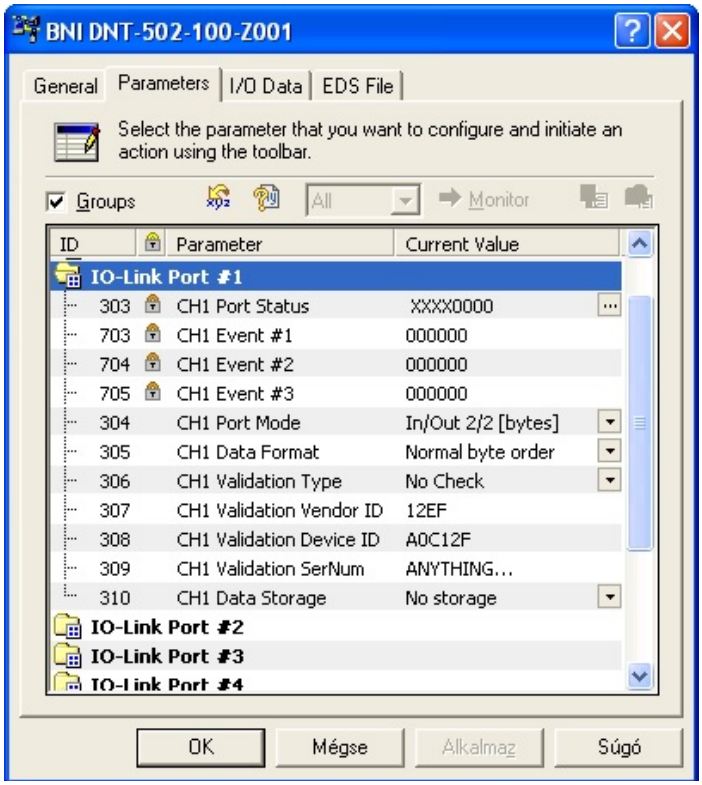
When the Serial Number of the device for example is “ANYTHING…” (11 bytes) the following must be send : *0x41 0x4E 0x59 0x54 0x48 0x49 0x4E 0x47 0x2E 0x2E 0x2E*

The Explicit message will contain the following where the first byte (0x0B) means the length of the string.

Explicit message : *0x0B 0x41 0x4E 0x59 0x54 0x48 0x49 0x4E 0x47 0x2E 0x2E 0x2E*

6 Module configuration

The following example shows the correct settings of the validation data (VID, DID, SerNum) in the RSNetworx.



Data storage Data storage parameter server settings for the specific IO-Link channel.

Byte	Value	Description
0	0x00	No storage
	0x81	Upload enabled
	0x82	Download enabled
	0x83	Up/Download enabled

Parameter server

No storage:
Data management functions disabled, saved parameter data of an IO-Link device data will be deleted.
Upload enabled:
If the upload is enabled, the master starts a parameter data upload as soon as a device requests an upload (upload flag set) or if there is no data saved in the master port (e.g. after data has been deleted or before the first data upload)
Enable download:
As soon as the saved parameter data in the parameter server of the port is differentiated from the connected IO-Link device and no upload request from the IO-Link device is present, a download is carried out.

Note
After the upload of the parameter data, the vendor ID and device ID of the connected IO-Link device is also still saved until the data record is deleted (Data storage option “no storage” will delete data record an deactivate data storage)
When the connected IO-Link device is started, a validation takes place. Therefore, only an IO-Link device of the same type can be used for the data management.
To use an IO-Link device of a different type, the contents of the parameter server must be deleted. Only IO-Link devices from IO-Link Revision 1.1 can support the data storage.

Upload flag on the IO-Link device

The upload flag is needed to overwrite already saved data in the parameter server with new parameter data of the same IO-Link device

To enable the upload flag of an IO-Link device,
the data value 0x05 must be entered in the ISDU index 0x02, subindex 0.
(To parameterize via ISDU, look at “ISDU Class” Parameterizing on Page 14)

6 Module configuration

6.4. ISDU specific settings

ISDU (Indexed Service Data Unit) is used for acyclic acknowledged transmission of parameters. It can convey everything from basic device information (e.g. versions, type) to much more advanced information (e.g. configuration, status).
There are two ISDU classes. One for large amount of data and the other for small amount of data exchange. The ISDU (ASCII) class can be accessed from the RSNetworx software because the EDS file contains the class instances.

Status #(n) and Status #(n) (ASCII HEX)

The Status #(n) attributes store the result of the ISDU request of the corresponding port. When a new request has been sent the result will be displayed in the first attribute.

In **non-ASCII HEX** format the status code will send in the following structure:

Byte	Function	Value	Description
0	Request	0x02	Write
		0x03	Read
1	Result	0x00	No error
		0x01	Error
2	Error code	0x00 ~ 0xFF	see in the IO-Link specification
3	Additional code	0x00 ~ 0xFF	see in the IO-Link specification

For example, the stored request result bytes: *0x03 0x01 0x80 0x11*
This means that there was a read request but the index not available.

When a Status attribute read out (GET_SINGLE_ATTR) happens, the Explicit message will contain the following: *0x30 0x01 0x80 0x11*

In **ASCII HEX** format the status code will send in the following structure:

Byte	Function	Value (normal HEX)	Description
0	Request	0x02	Write
1		0x03	Read
2	Result	0x00	No error
3		0x01	Error
4	Error code	0x00 ~ 0xFF	see in the IO-Link specification
5			
6	Additional code	0x00 ~ 0xFF	see in the IO-Link specification
7			

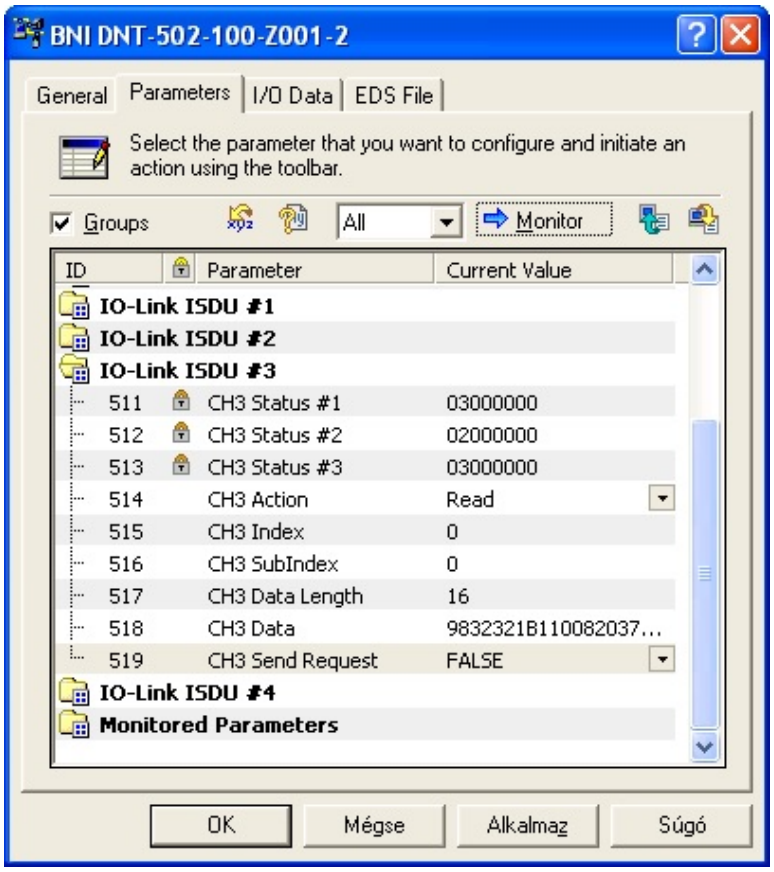
ASCII HEX means that the Event attribute will be send in hexadecimal string format.

For example, the stored request result bytes: *0x03 0x00 0x00 0x00*
This means that there was a read request with success.

When a Status attribute read out (GET_SINGLE_ATTR) happens, the Explicit message will contain the following where the first byte (0x08) means the length of the string.

Explicit message : *0x08 0x30 0x33 0x30 0x30 0x30 0x30 0x30 0x30*

The following image shows how the RSNetworx display the **ASCII HEX** example above.



Action

This setting determines the request operation.

Byte	Value	Description
0	0x02	Write
	0x03	Read

Index

Byte	Value	Description
0	0x0000 ~ 0xFFFF (0 ~ 65535)	Look at the user manual of the connected IO-Link Device
1		

SubIndex

Byte	Value	Description
0	0x00 ~ 0xFF (0 ~ 255)	Look at the user manual of the connected IO-Link Device

6 Module configuration

Data length

This setting determines the length of the ISDU message.

Byte	Value	Description
0	0 ~ 232	by non-ASCII HEX object
	0 ~ 32	by ASCII HEX object

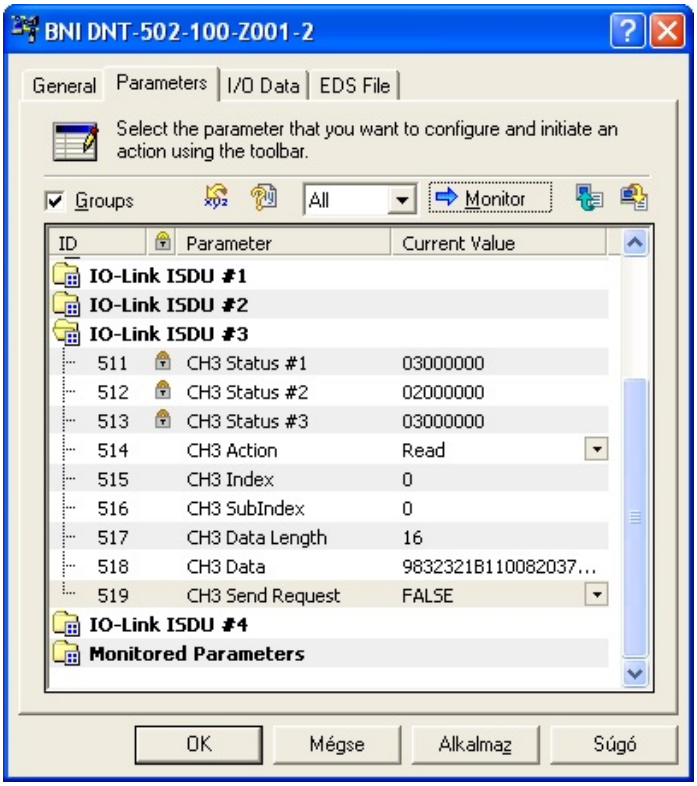
The Data length is described in the user manual of the connected IO-Link Device.

Data and Data (ASCII HEX)

These attributes are used to read and write ISDU parameter data. Before you do a write request, you must set the data length and this attribute. After a read request this attribute will contain the incoming bytes.
For parameter data look at the user manual of the connected IO-Link device.

By the **non-ASCII HEX** object class the whole ISDU area can be accessed, but the **ASCII HEX** has a limited size.

The following image shows how the RSNetworx display a success read request. In the example the Index 0 had been read out. The RSNetworx use the ASCII HEX object class.



Send request

It controls the IO-Link ISDU data exchange. A change from False (0) to True (1) will trigger the ISDU sending mechanism.

Byte	Transition	Description
0	0 -> 1	Send ISDU request
	1 -> 0	Do nothing

6.5. Events

IO-Link events allow a standard or vendor specific information about any alarms or informational messages to be delivered.

Event #(n) (ASCII HEX)

The Event #(n) attributes store the IO-Link events of the corresponding port. When an event is received from the slave the “Event occurred” flag will be set. The first attribute stores the last event. If an attribute has been read the “Event occurred” flag will be cleared.

Byte	Function	Value (normal HEX)	Description
0	Mode	0x00	Reserved
		0x40	Event single shot
		0x80	Event disappears
		0xC0	Event appears
1	Event code	0x0000 ~ 0xFFFF	see in the IO-Link specification
2			

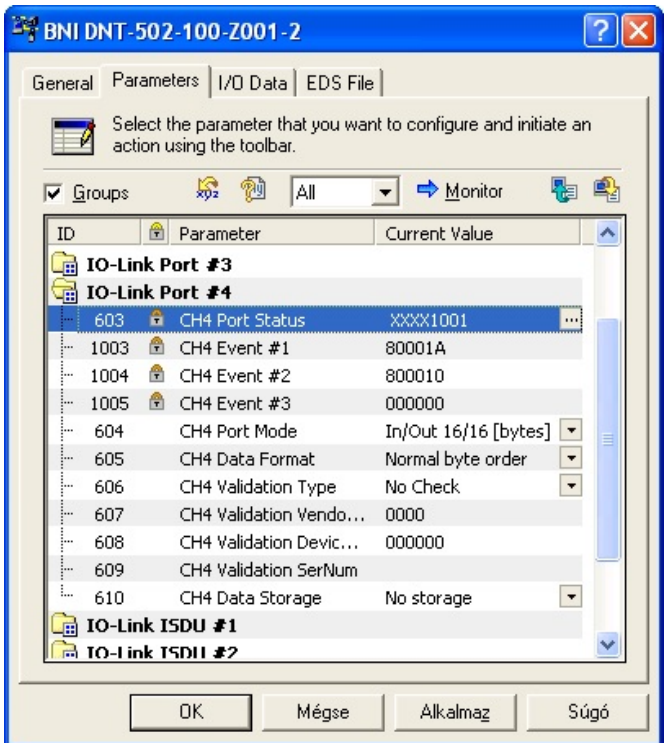
ASCII HEX means that the Event attribute will be send in hexadecimal string format.

For example, the stored event bytes: *0x80 0x00 0x1A (First byte Mode, last two is the Event code)*

When an Event attribute read out (GET_SINGLE_ATTR) happens, the Explicit message will contain the following where the first byte (0x06) means the length of the string.

Explicit message : *0x06 0x38 0x30 0x30 0x30 0x31 0x41*

The following image shows how the RSNetworx display the example above.



6 Module configuration

6.6. Standard I/O specific settings

The standard Input / Output settings are stored in this class. The writeable attributes are independent from the “Settings Done” flag. The applied values will be saved in the module immediately.

Input status

The Input status shows the state of the standard Inputs. Bit mapping corresponds to the pin number.

Byte	Bits			Description
0	7	….	0	Pin(n) value : 0 - Low 1 - High
1	15	….	8	

Output status

The Output status shows the state of the standard Outputs. Bit mapping corresponds to the pin number.

Byte	Bits			Description
0	7	….	0	Pin(n) value : 0 - Low 1 - High
1	15	….	8	

Overload status

The Overload status shows the state of the standard Outputs. Bit mapping corresponds to the pin number.

Byte	Bits			Description
0	7	….	0	Pin(n) value : 0 - Normal 1 - Overloaded
1	15	….	8	

Short circuit status

The Short circuit status shows the state of the port supply. Bit mapping corresponds to the pin number.

Byte	Bits			Description
0	7	….	0	Bit(n) value : 0 – No short circuit 1 - Short circuit on Port (n) (Pin1 to Pin3)

Aux power status

This shows the supply voltages level.

Byte	Bit	Function	Description
0	0	US – Low Voltage	0 - False 1 - True
	1	UA – Low Voltage	
	2	x	Does not care
	3	x	
	4	x	
	5	x	
	6	x	
	7	x	

Output reset status

The reset value is used for pin reset when it is in overloaded state. The bitmapping corresponds to the pin number.

Byte	Bits			Description
0	7	….	0	Pin(n) value : 0 -> 1 (reset pin) 1 -> 0 (do nothing)
1	15	….	8	

Fault state (00 ~ 15)

These settings will be used when the link between the DeviceNet™ master and the module lost. In this case the pins will be set into the selected state. Except that pins where the IO-Link function is enabled.

Byte	Value	Description
0	0x00	Output Off
	0x01	Output On
	0x02	Hold Last State

Idle state (00 ~ 15)

These settings will be used when there is no I/O message (control message) from the DeviceNet™ master. In this case the pins will be set into the selected state. Except that pins where the IO-Link function is enabled.

Byte	Value	Description
0	0x00	Output Off
	0x01	Output On
	0x02	Hold Last State

6.7. EDS file

The EDS (Electronic Data Sheet) contains device information about the communication parameters of the device and the available objects. During commissioning, it is used together with a configuration tool.

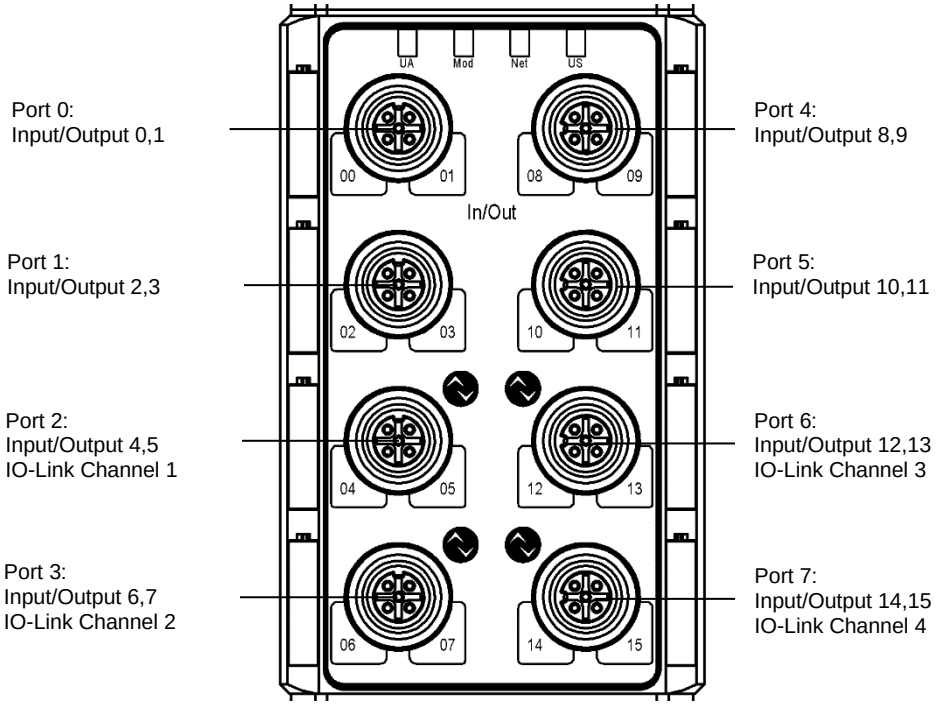
6.8. Baud rate, Node Adress

Baud rate and Node Adress settings are both settable on the interactive Display.
This two datas are saved independently of the other configuration data. There is no need to set the “Settings Done” attribute of the DeviceNet™ Gateway Class, changes are stored immediately.

In case the new value is different from the old one, change is displayed on the status LEDs. Any change will only be used after the next start-up.

7 Data mapping details

7.1. Port configuration



7 Data mapping details

7.2. I/O data details

This section describes the meaning of the bit fields of the I/O messages.

Fixed produced bytes

Name	Bit	Bit name	Description
Input Status (Low Byte)	0	Input 00	1: High 0: Low
	1	Input 01	
	2	Input 02	
	3	Input 03	
	4	Input 04	
	5	Input 05	
	6	Input 06	
	7	Input 07	
Input Status (High Byte)	8	Input 08	
	9	Input 09	
	10	Input 10	
	11	Input 11	
	12	Input 12	
	13	Input 13	
	14	Input 14	
	15	Input 15	

Name	Bit	Bit name	Description
Overload Status (Low Byte)	0	Pin 00	Pin (n) overloaded
	1	Pin 01	
	2	Pin 02	
	3	Pin 03	
	4	Pin 04	
	5	Pin 05	
	6	Pin 06	
	7	Pin 07	
Overload Status (High Byte)	8	Pin 08	
	9	Pin 09	
	10	Pin 10	
	11	Pin 11	
	12	Pin 12	
	13	Pin 13	
	14	Pin 14	
	15	Pin 15	

7 Data mapping details

Name	Bit	Bit name	Description
Short Circuit Status	0	Port 0	Short circuit on Port (n) (Pin1 to Pin3)
	1	Port 1	
	2	Port 2	
	3	Port 3	
	4	Port 4	
	5	Port 5	
	6	Port 6	
	7	Port 7	
Aux Power Status	0	US	US voltage is low
	1	UA	UA voltage is low
	2	0	Not used (Reserved)
	3	0	
	4	0	
	5	0	
	6	0	
	7	0	

Name	Bit	Bit name	Description
IO-Link Status (Low Byte)	0	IOL CH1 CE	Connection established on IOL CH (n)
	1	IOL CH2 CE	
	2	IOL CH3 CE	
	3	IOL CH4 CE	
	4	IOL CH1 PDL	PD length mismatch on IOL CH (n)
	5	IOL CH2 PDL	
	6	IOL CH3 PDL	
	7	IOL CH4 PDL	
IO-Link Status (High Byte)	8	IOL CH1 VS	Validation failed on IOL CH (n)
	9	IOL CH2 VS	
	10	IOL CH3 VS	
	11	IOL CH4 VS	
	12	IOL CH1 EO	Event occurred on IOL CH (n)
	13	IOL CH2 EO	
	14	IOL CH3 EO	
	15	IOL CH4 EO	

7 Data mapping details

Fixed consumed bytes

Name	Bit	Bit name	Description
Output State (Low Byte)	0	Output 00	1: High (Pin functional as Output) 0: Low (Pin functional as Input)
	1	Output 01	
	2	Output 02	
	3	Output 03	
	4	Output 04	
	5	Output 05	
	6	Output 06	
	7	Output 07	
Output State (High Byte)	8	Output 08	
	9	Output 09	
	10	Output 10	
	11	Output 11	
	12	Output 12	
	13	Output 13	
	14	Output 14	
	15	Output 15	

Name	Bit	Bit name	Description
Output Reset (Low Byte)	0	Output 00	0->1: Reset 1->0: Nothing
	1	Output 01	
	2	Output 02	
	3	Output 03	
	4	Output 04	
	5	Output 05	
	6	Output 06	
	7	Output 07	
Output Reset (High Byte)	8	Output 08	
	9	Output 09	
	10	Output 10	
	11	Output 11	
	12	Output 12	
	13	Output 13	
	14	Output 14	
	15	Output 15	

Name	Bit	Bit name	Description
Display	0	Red LEDs	LED control
	1	Green LEDs	
	2	Lock	Lock display
	3	x	Not used (Reserved)
	4	x	
	5	x	
	6	x	
	7	x	
Empty	0	x	Not used (Reserved)
	1	x	
	2	x	
	3	x	
	4	x	
	5	x	
	6	x	
	7	x	

7 Data mapping details

IO-Link bytes

Name	Byte	Byte name	Description
IO-Link CH(x) Input Bytes	0	Input Byte (0)	Normal byte order
	….	….	
	N-1	Input Byte (N-1)	

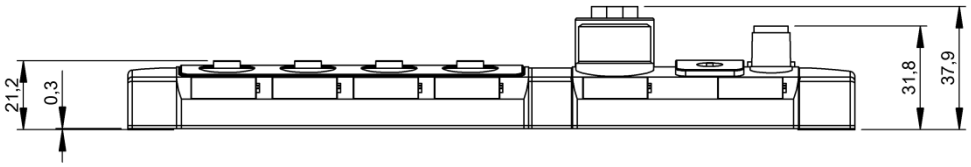
Name	Byte	Byte name	Description
IO-Link CH(x) Output Bytes	0	Output Byte (0)	Normal byte order
	….	….	
	M-1	Output Byte (M-1)	

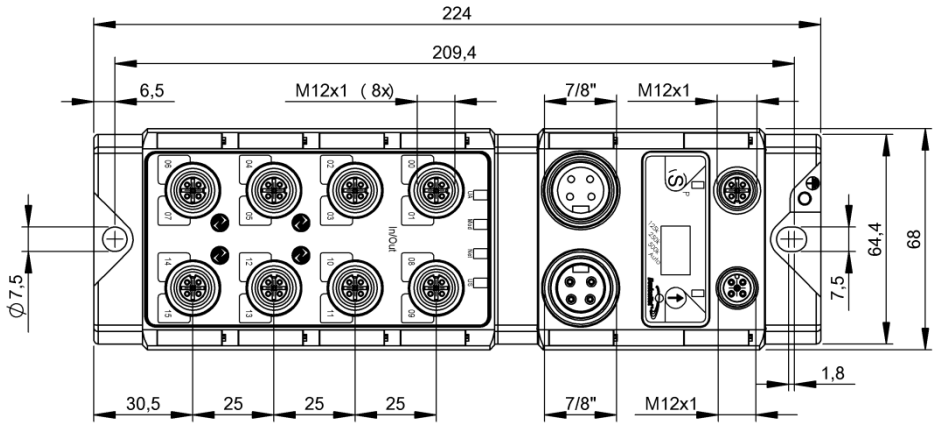
Name	Byte	Byte name	Description
IO-Link CH(x) Input Bytes	0	Input Byte (N-1)	Reversed byte order
	….	….	
	N-1	Input Byte (0)	

Name	Byte	Byte name	Description
IO-Link CH(x) Output Bytes	0	Output Byte (M-1)	Reversed byte order
	….	….	
	M-1	Output Byte (0)	

8 Technical data

8.1. Dimensions





8.2. Mechanical data

Housing material	Die-case zinc, matte nickel plated
Enclosure rating per IEC 60529	IP 67 (only when plugged-in and threaded-in)
Supply voltage	7/8” 4-pin male
Input ports / Output ports	M12, A coded (8 x female)
Dimensions (W x H x D in mm)	68 x 224 x 37.9
Mounting type	2-hole screw mount
Ground strap attachment	M4
Weight	Approx. 660 g

8.3. Operating conditions

Operating temperature T_a Storage temperature	-5 °C … 70 °C -25 C … 70 °C

8.4. Electrical data

Supply voltage	18…30.2 V DC, per EN 61131-2
Ripple	<1%
Supply input current without load (max.)	150mA @ 24V
DeviceNet™ bus input current (max.)	50mA @ 24V

8 Technical data

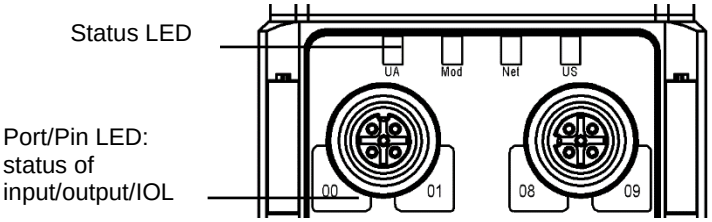
8.5. DeviceNet™ port

Data transmission rate	125 - 500 kBaud

8.6. DeviceNet™ default settings

Data transmission rate	125 kBaud
Node Address	03
Produced I/O size	8 Bytes
Consumed I/O size	6 Bytes

8.7. Function indicators



Status LED

LED	Status	Function
US	Green	Input voltage OK
	Red	Low input voltage (<18V)
UA	Green	Output voltage OK
	Red	Low output voltage (<18V)
Mod	Green	No error
	Green flashing	Wrong or no configuration
	Red	Unrecoverable fault
	Red flashing	Recoverable fault/Settings changed
	Red/Green flashing	Initial sequence
Net	Green	Connection established
	Green flashing	Connection in progress
	Red	Link failure
	Red flashing	Connection timeout
	Red/Green flashing	Communication fault

LED indicators input ports

Each M12 port (digital input/output, IO-Link) is assigned two Bi-colour LEDs which indicate the configuration or operating states.

LED	Function LED Pin 2 / Pin 4
Off	Input signal = 0
Orange	Input signal = 1
Red	Input signal = Short circuit / Overload

LED indicators output ports

LED	Function LED Pin 2 / Pin 4
Off	Output signal = 0
Orange	Output signal = 1
Red	Output signal = Short circuit / Overload

LED indicators IO-Link channels

LED	Function LED Pin 4
Green	IO-Link connection established
Green flashing	No IO-Link communication
Red	Short circuit
Red flashing	Validation failed
Off	IO-Link port not enabled

9 Appendix

9.1. Type code

BNI DNT-50x-100-Z001

Balluff Network Interface

DeviceNet™

Functions
502 = IP67 SIO+IOL module, max. 16 Inputs/Outputs, max. 4 IO-Link connections

Variants
100 = Display version

Mechanical configuration
Z001 = material: die-cast zinc housing
Bus In: 1x M12 x 1 external thread
Bus Out: 1x M12 x 1 internal thread
Power: 7/8" external thread
I/O Ports: 8 x M12 x 1 internal thread

9.2. Ordering information

Type	Ordering code
BNI DNT-502-100-Z001	BNI005A

Scope of delivery

The delivery includes the following components

- DeviceNet™ IO-Link Block
- Blind plugs 4x M12
- Ground strap
- Screw M4x6
- Lock washer
- 20 labels

Note

www.balluff.com

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