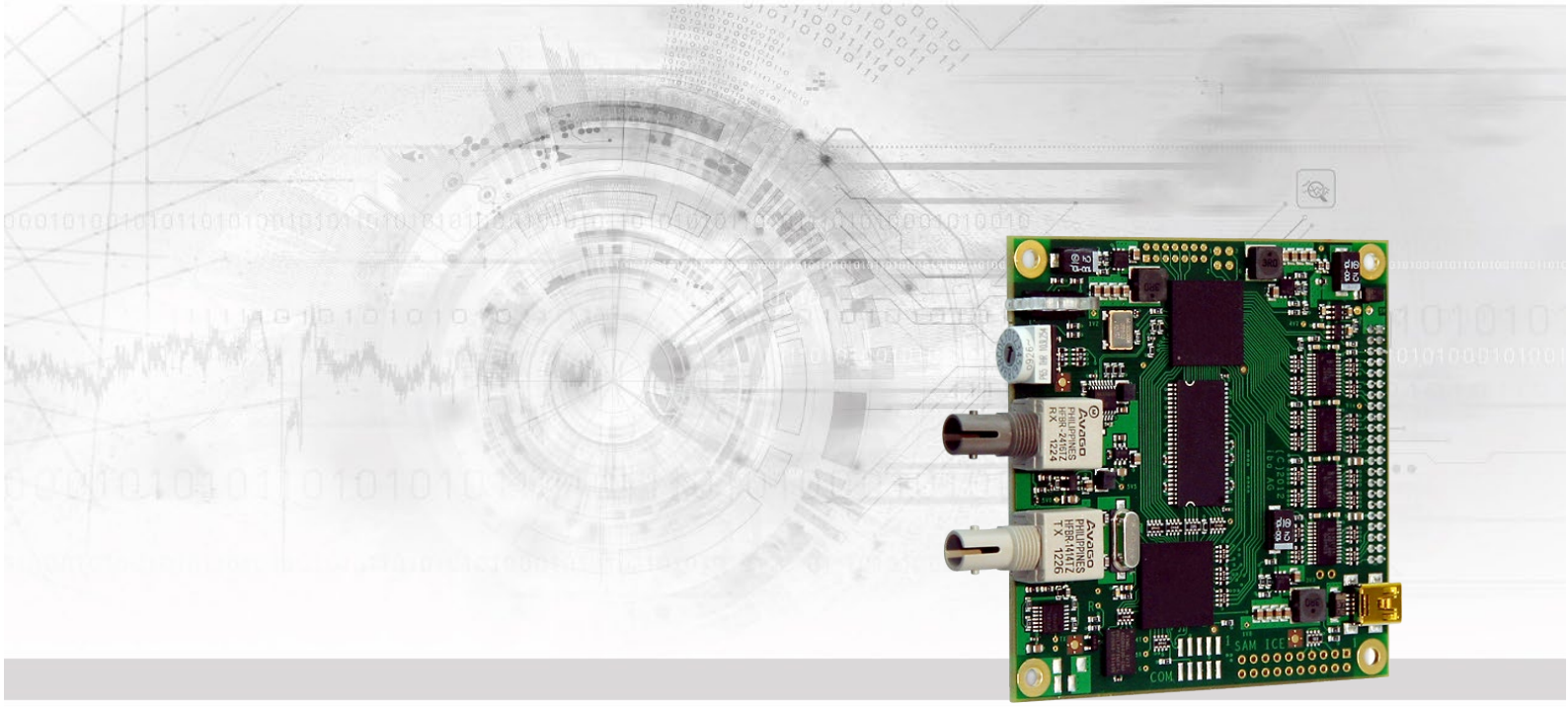

ibaLink-io-embedded

Integrated system interface for OEM systems

Designer's Guide

Issue 1.7

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The content of this publication has been checked for compliance with the described hardware and software. Nevertheless, deviations cannot be excluded completely so that the full compliance is not guaranteed. However, the information in this publication is updated regularly. Required corrections are contained in the following regulations or can be downloaded on the Internet.

The current version is available for download on our web site http://www.iba-ag.com.

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Issue	Date	Revision	Chapter	Author	Version HW / FW
1.7	03-2024	FO budget			

Table of contents

1 About this manual

This manual describes the design and the use of the ibaLink-io-embedded module.

1.1 Target group

This manual addresses in particular developers who are familiar with developing electrical and electronic modules as well as communication and measurement technology. A person is regarded to as professional if he/she is capable of assessing safety and recognizing possible consequences and risks on the basis of his/her specialist training, knowledge and experience and knowledge of the standard regulations.

1.2 Notations

The following designations are used in this manual:

Action	Notations
Menu command	Menu „Logic diagram“
Call of menu command	„Step 1 – Step 2 – Step 3 – Step x” Example: Select menu „Logic diagram – Add – New logic diagram”
Keys	<Key name> Example: <Alt>; <F1>
Press keys simultaneously	<Key name> + <Key name> Example: <Alt> + <Ctrl>
Buttons	<Button name> Example: <OK>; <Cancel>
File names, Paths	„File name“, „Path” Example: „Test.doc“

1.3 Used symbols

If safety instructions or other notes are used in this manual, they mean:

⚠ DANGER

The non-observance of this safety information may result in an imminent risk of death or severe injury:

- By an electric shock!
- Due to the improper handling of software products which are coupled to input and output procedures with control function!

If you do not observe the safety instructions regarding the process and the system or machine to be controlled, there is a risk of death or severe injury!

⚠ WARNING

The non-observance of this safety information may result in a potential risk of death or severe injury!

⚠ CAUTION

The non-observance of this safety information may result in a potential risk of injury or material damage!

Note

A note specifies special requirements or actions to be observed.

Tip

Tip or example as a helpful note or insider tip to make the work a little bit easier.

Other documentation

Reference to additional documentation or further reading.

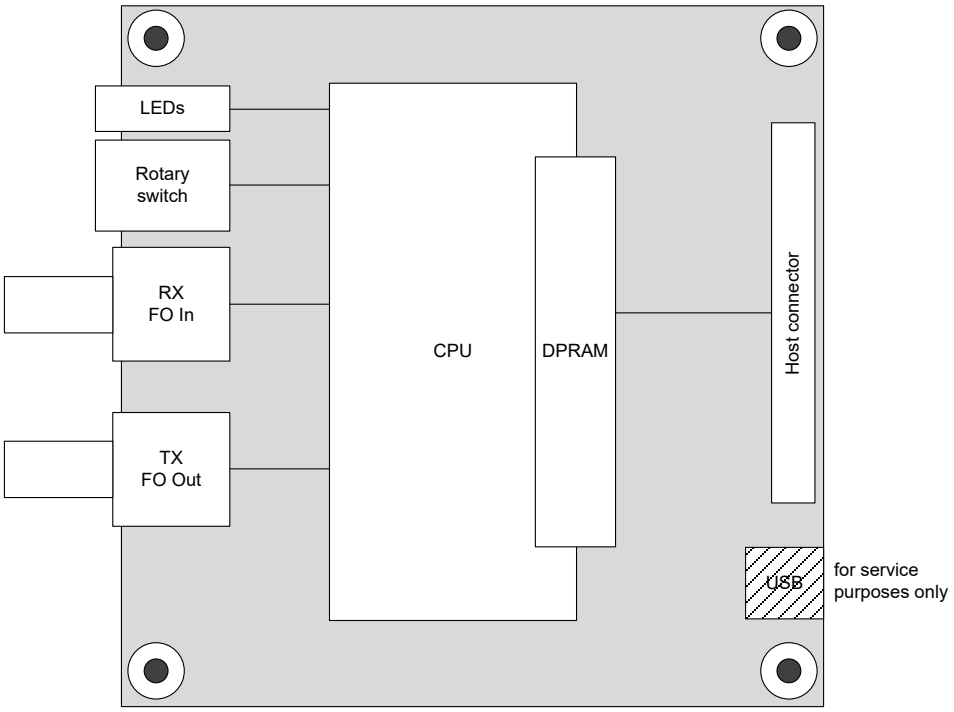
2 Introduction

ibaLink-io-embedded is an embedded module for OEM customers, that allows to exchange data over fiber optic (FO) with iba measuring systems. The module can be interfaced via DPRAM.

When integrating the ibaLink-io-embedded module into an application, the system integrator is responsible for the CE/EMC conformity of the entire device.

A brief overview:

- ❑ Integrated connection to iba measuring systems in OEM solutions
- ❑ Fast 8/16 bit Dual Port RAM data interface
- ❑ Dimensions 80 mm x 80 mm
- ❑ Power supply 5 V (± 5%) DC
- ❑ Current consumption max. 0.4 A (2 W)
- ❑ Connector male 44 pin header (2 x 22 pins, 2 mm pitch)
- ❑ Bidirectional fiber optic link for analog and digital inputs and outputs
- ❑ Supported ibaNet protocols: 32Mbit, 32Mbit Flex
- ❑ Flexible setting of data rate, data size and formatting with 32Mbit Flex
- ❑ Different operation modes (cascading, point-to-point)
- ❑ Rotary switch for address
- ❑ 4 LEDs indicate operating status



3 Scope of delivery

After unpacking check the completeness and intactness of the delivery.

The scope of delivery of "HDK ibaLink-io-embedded" (order no. 60.700204) includes:

- ibaLink-io-embedded module (order no. 14.132400)
- 2nd ibaLink-io-embedded module as test board (modified)
- Ribbon cable (2x22 pin, RM 2.0 mm)
- 2 pin cable for power supply
- Data medium "iba Software & Manuals"

4 Safety instructions

⚠ CAUTION

The ESD standards for handling electrostatic sensitive devices must be followed.

Use a ground line or discharge any electrostatic charge from yourself before touching the card.

Avoid direct contact with the connectors.

Warning!

This is a Class A device. This equipment may cause radio interference in residential areas. In this case, the operator will be required to take appropriate measures.

5 Hardware

5.1 Mechanics

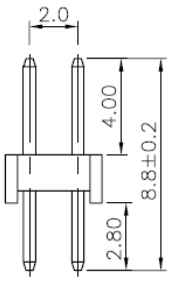
Mechanical characteristics

- ❑ Dimensions 80 mm x 80 mm (± 0.12 mm)
- ❑ 4 mounting holes M3
- ❑ Max. component height on the bottom side (excluding connector area): 2 mm

Note

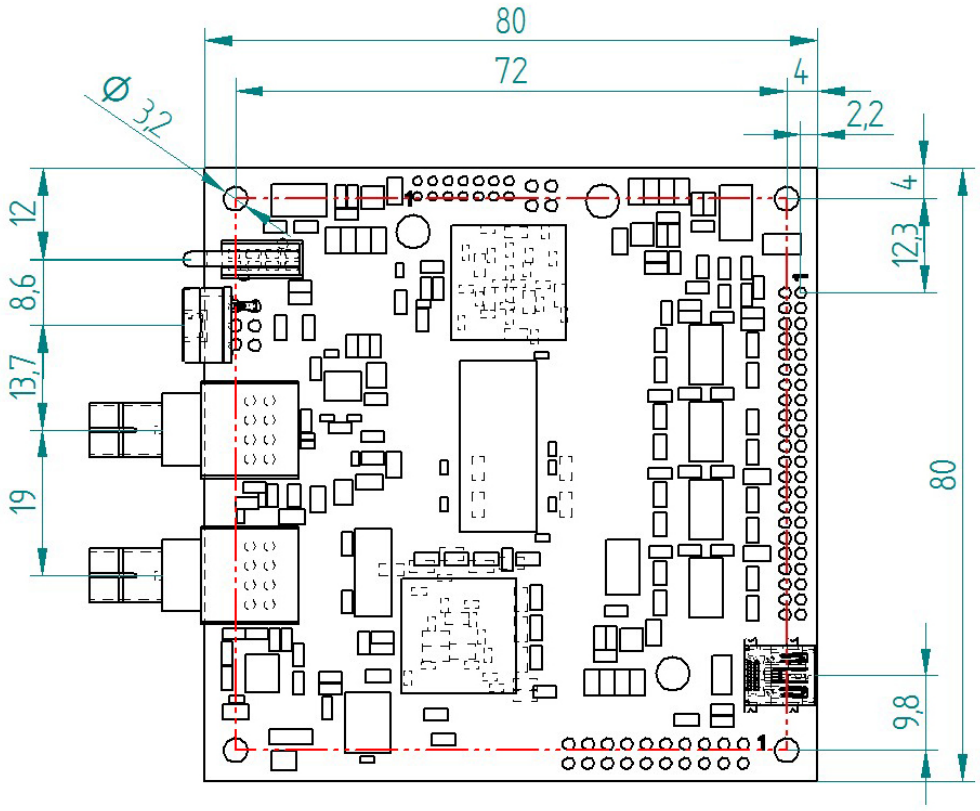
No conducting material (metal) is allowed at 2 mm distance from bottom to avoid shorts on components mounted on the bottom side.

- ❑ Max. component height on the top side: 12 mm
- ❑ PCB thickness 1.5 mm
- ❑ Connector: double row 2 mm pin header (Würth 62004421121) mounted **on the bottom side** of the PCB. Allows direct mounting or use of a flat ribbon cable.

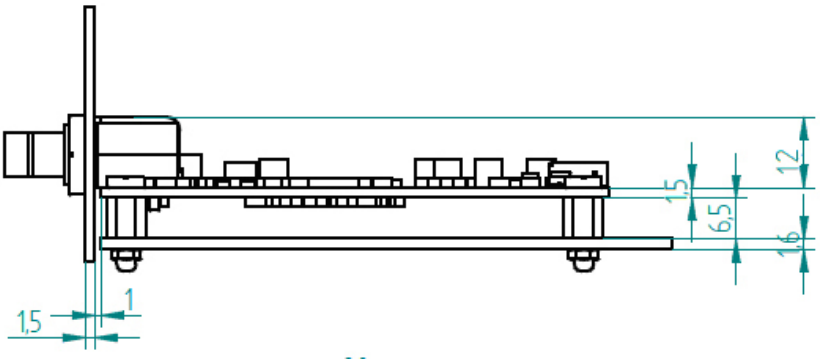


Dimension drawings

Dimensions in mm, not to scale.



Dimensions top view



Dimensions mounting example, side view

5.2 Connections

5.2.1 FO interface

The module communicates with compatible devices over the fiber-optic RX and TX interface ports. RX realizes the fiber-optic receiver while TX realizes the fiber-optic transmitter.

Maximum distance of fiber optic connections

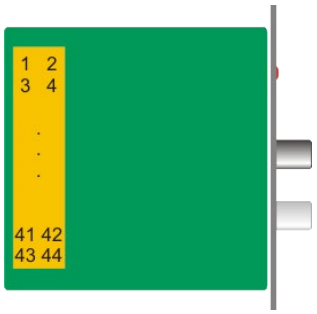
The maximum distance of fiber optic connections between 2 devices depends on various influencing factors. This includes, for example, the specification of the fiber (e.g. 50/125 µm, 62.5/125 µm, etc.), or the attenuation of other components in the fiber optic cable plant such as couplers or patch panels.

However, the maximum distance can be estimated on the basis of the output power of the transmitting interface (TX) or the sensitivity of the receiving interface (RX). A model calculation can be found in chapter 10.2.

The specification of the transmitter's output power and the receiver's sensitivity of the fiber optic components installed in the device can be found in chapter 10 "Technical data" under "ibaNet interface".

5.2.2 Baseboard connector

Pin assignment (as seen on the bottom)



Pin	Type	Function	Description
1	Power	+5V	5 V ±5% DC Power supply
2	Power	+5V	5 V ±5% DC Power supply
3		GND	Ground
4		GND	Ground
5	Input	MODE16#	8 bit / 16 bit mode
6	Output	INT#	Interrupt (for synchronous mode)
7	Input	RST#	Reset
8	Input	CS#	Chip select
9	Input	OE#	Output enable
10	Input	WR0#	Write strobe for D[7…0] in all modes
11	Input	A0/WR1#	Address bus in 8 bit mode / Write strobe for D[15…8] in 16 bit mode
12	Input	A1	Address bus
13	Input	A2	Address bus
14	Input	A3	Address bus
15		GND	Ground
16	Input	A4	Address bus
17	Input	A5	Address bus
18	Input	A6	Address bus
19	Input	A7	Address bus
20	Input	A8	Address bus
21	Input	A9	Address bus
22	Input	A10	Address bus
23	Input	A11	Address bus
24	Input	A12	Address bus
25		GND	Ground
26	Power	$+V_{io}$	I/O lines power supply
27	I/O	D0	Data bus
28	I/O	D8	Data bus
29	I/O	D1	Data bus
30	I/O	D9	Data bus
31	I/O	D2	Data bus
32	I/O	D10	Data bus

Pin	Type	Function	Description
33	I/O	D3	Data bus
34	I/O	D11	Data bus
35		GND	Ground
36	Power	$+V_{io}$	I/O lines power supply
37	I/O	D4	Data bus
38	I/O	D12	Data bus
39	I/O	D5	Data bus
40	I/O	D13	Data bus
41	I/O	D6	Data bus
42	I/O	D14	Data bus
43	I/O	D7	Data bus
44	I/O	D15	Data bus

The hash sign ("#") behind the signal name indicates an active-low signal.

Mode setting:
16 bit mode: connect pin 5 "MODE16#" to GND
8 bit mode: leave MODE16# open and connect D[8…15] to GND.

The provided bus voltage V_{io} can be 1.8 V, 2.5 V, 3.3 V or 5 V. There is no power sequencing requirement, i.e. $+V_{io}$ can be present before or after +5 V supply voltage.

It is important that the CS# input is never left floating (to avoid random invalid accesses). A 10 K pullup resistor to V_{io} is recommended.

Important note

RST# is an optional asynchronous active low reset signal which can be used to reboot the board and bring it in a known state.

RST# shall not be driven low during the power on sequence of the board! Wait at least 2 s after power on before asserting it.

After deassertion of RST# wait at least 2 s before accessing the DPRAM.

Tip

For a compact overview of the pin assignment refer to chapter 10 "Technical Data".

5.2.3 Rotary switch

The switch is used to set the device address for ring topology operation modes:

- ❑ 32Mbit Flex: 1 – F (device address in a ring topology)
- ❑ 32Mbit P2P: not used
- ❑ 32Mbit: 0 – F (device address in a ring topology)

See also chapter 5.4 "Operation modes".

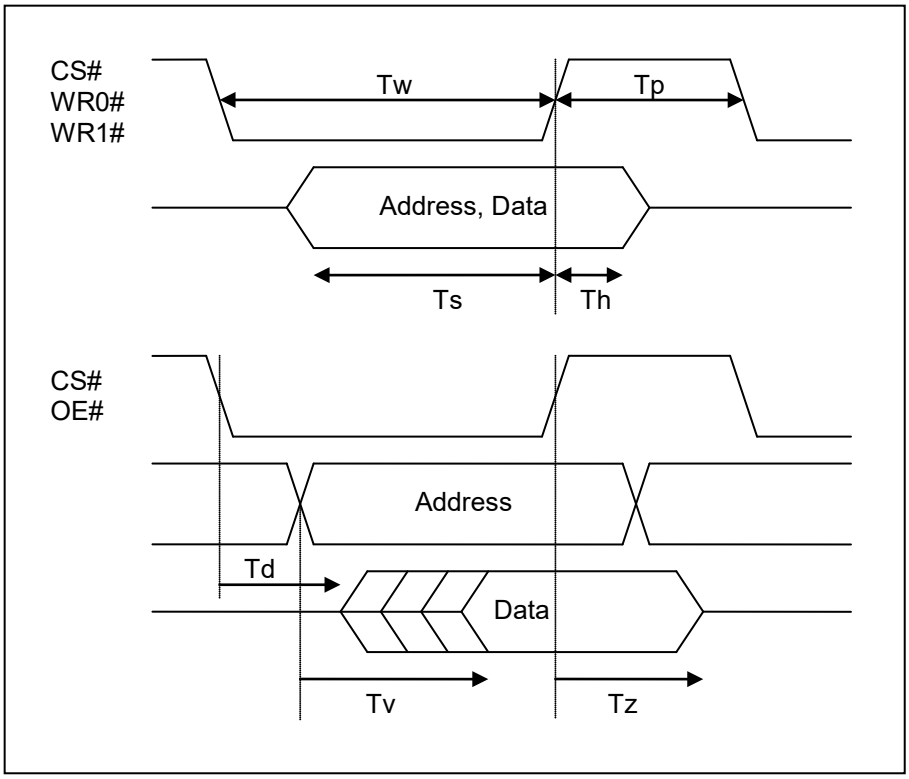
5.2.4 LEDs

LED	Status	Description
RUN (green)	on	Module is booting
	blinking	Module is running
	fast blinking	System programming mode
ACC (yellow)	on	Access to DPRAM
LINK (white)	on	Signal reception ok
	blinking	Link error
	off	No signal
ERR (red)	on	Hardware error
	blinking	Configuration error

Note

Output signals aren't supported by the "Fob Fast module" in ibaPDA. Therefore the white LED will not be set in 32Mbit P2P mode with ibaPDA even if the connection is OK.

5.3 Bus signal timing (based on SRAM)



Para-meter	Description	Min (ns)	Max (ns)
Tw	Write cycle duration	40	/
Tp	Pause after write	25	/
Ts	Address and write data setup time	20	/
Th	Address and write data hold time	5	/
Td	Bus driven to low impedance	20	60*
Tv	Read data valid	/	70*
Tz	Bus released to high impedance	5	25*

*= Maximum is increased by 20 ns, when using V_{io}=1.8 V

5.4 Operation modes

The operation mode is determined by an entry in the mode register (address 0x0FEA), see also chapter 6 "Dual Port RAM". The value must be set by the application, default value is 15 (32Mbit Flex).

Register value	ibaLink-io mode	ibaLink-io data length	Period	ibaPDA	ibaLogic
15	32Mbit Flex	Set by ibaPDA, up to 4060 Bytes	Selectable >= 10 µs	ibaLink-io-embedded autodetect	not supported
0	32Mbit P2P	136 Bytes	50 µs	Fob Fast module 64 Int / 64 Dig. (50µs)	32 Mbit 50 µs 64 Integer
1		280 Bytes	100 µs	Fob Fast module 128 Int / 128 Dig. (100µs)	32 Mbit 100 µs 128 Integer
2		568 Bytes	200 µs	Fob Fast module 256 Int / 256 Dig. (200µs)	not supported
3		1144 Bytes	400 µs	Fob Fast module 512 Int / 512 Dig. (400µs)	not supported
4		2296 Bytes	800 µs	Fob Fast module 1024 Int / 1024 Dig. (800µs)	32 Mbit 1000 µs 1024 Integer
5		2872 Bytes	1000 µs	Fob Fast module 2872 bytes (1000µs)	not supported
6		4024 Bytes	1400 µs	Fob Fast module 4024 bytes (1400µs)	not supported
8	32Mbit	8 Int + 8 Digital	100 µs	not supported	32 Mbit 100 µs 128 Integer
9		64 Int + 64 Dig	1000 µs	not supported	32 Mbit 1000 µs 1024 Integer
10		32 Real + 32 Di-gital	1000 µs	not supported	32 Mbit 1000 µs 512 Real
7, 11..14	Reserved (do not use)	undefined	undefined	undefined	undefined

Note

Firmware update is only possible in 32Mbit Flex mode.

5.4.1 32Mbit Flex mode

32Mbit Flex is the preferred mode for data acquisition applications with ibaPDA. ibaLink-io-embedded has to be configured at least once, see chapter 7 "Software". The ibaPDA application reads the configuration and displays the configured signals. The user can select the signals to be measured and adjust the cycle time. The cycle time can be faster for small amounts of data, up to 10 µs with 17 Bytes. The maximum amount of data is 4060 Bytes at 1.4 ms. The data format and size can freely be set. The application can use the complete RX and TX buffer (4060 Bytes).

32Mbit Flex requires a bidirectional FO connection to a card of the ibaFOB-D type for communication. With 32Mbit Flex, it is possible to connect up to 15 devices in a ring topology.

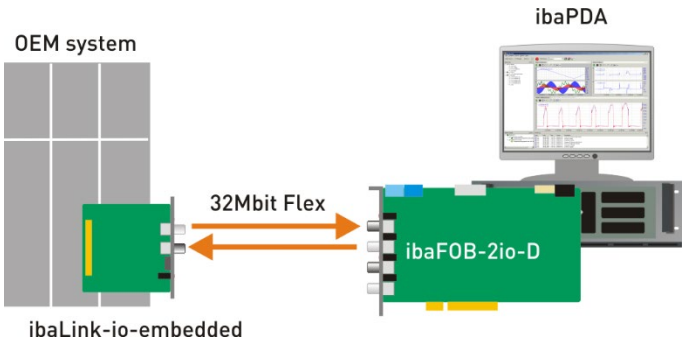
Note

Please note, that it is not possible to work synchronously at a timebase higher than 2 ms.

The address of the module in a ring is set by the rotary switch.

Device number within the cascade	Rotary switch position
not allowed in 32Mbit Flex mode	0
Device 1	1
Device 2	2
⋮	⋮
Device 14	E
Device 15	F

Application example



ibaLink-io-embedded with ibaPDA in 32Mbit Flex mode

5.4.2 32Mbit P2P mode

You should use 32Mbit P2P mode, if

- ❑ there is only a single fiber optic cable available or
- ❑ you want to connect two ibaLink-io-embedded modules or
- ❑ you want to connect an ibaLink-io-embedded module to ibaLogic.

In this mode, the module has to be configured as described in chapter 7 "Software" and the user has to ensure that the complete signal configuration of the application is also set up correctly in the 2nd device (ibaLink-io-embedded, ibaPDA or ibaLogic).

All data is captured with a fixed sampling rate. The sampling rate and the data size are set through a DPRAM control register (address 0x0FEA), see also chapter 6 "Dual Port RAM":

Register value	ibaLink-io mode	ibaLink-io data length	Period	ibaPDA	ibaLogic
0	32Mbit P2P	136 Bytes	50 µs	Fob Fast module 64 Int / 64 Dig. (50µs)	32 Mbit 50 µs 64 Integer
1		280 Bytes	100 µs	Fob Fast module 128 Int / 128 Dig. (100µs)	32 Mbit 100 µs 128 Integer
2		568 Bytes	200 µs	Fob Fast module 256 Int / 256 Dig. (200µs)	not supported
3		1144 Bytes	400 µs	Fob Fast module 512 Int / 512 Dig. (400µs)	not supported
4		2296 Bytes	800 µs	Fob Fast module 1024 Int / 1024 Dig. (800µs)	32 Mbit 1000 µs 1024 Integer
5		2872 Bytes	1000 µs	Fob Fast module 2872 bytes (1000µs)	not supported
6		4024 Bytes	1400 µs	Fob Fast module 4024 bytes (1400µs)	not supported

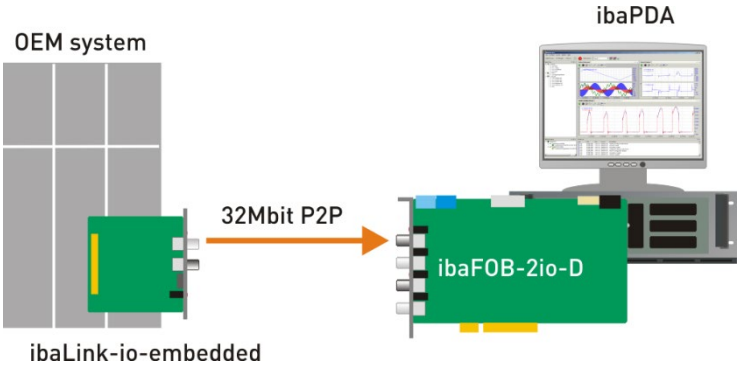
For 32Mbit P2P mode, only the start of the RX and TX buffers are used for the fiber-optic. E.g. mode 0 (136 Bytes payload, 50 µs period) uses only the first 136 Bytes of the RX and TX buffers.

The rotary switch is not used in this mode.

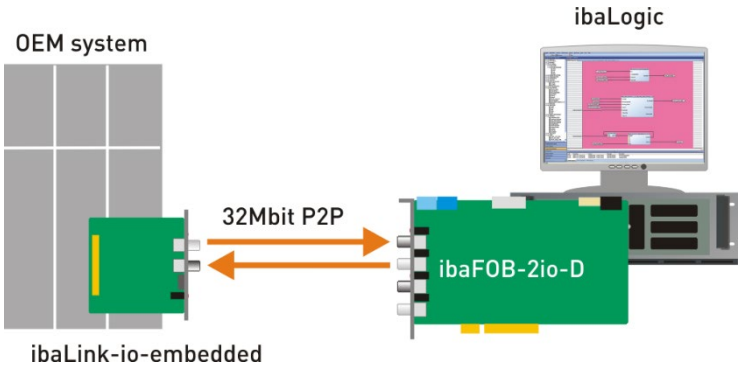
Application examples

The configuration in ibaPDA (or ibaLogic) has to be done manually and must be identical with the module configuration.

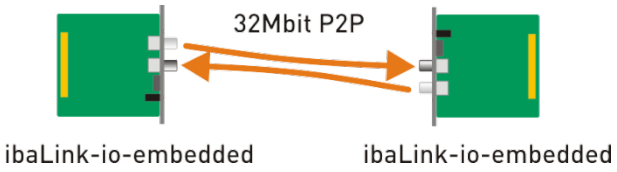
ibaLink-io-embedded with ibaPDA with a unidirectional FO cable:



ibaLink-io-embedded with ibaLogic with a bidirectional FO connection:



The configuration of two modules working in peer-to-peer mode has to be the same in order to exchange data:



5.4.3 32Mbit mode

In 32Mbit mode, up to 16 ibaLink-io-embedded modules can be connected in a ring with ibaLogic. ibaLogic can read and write process data to all devices in the ring. The devices can read all data which is currently on the fiber optic link, but can only write data on their parts of the fiber optic link.

The application has to ensure, that only the allowed signals at the correct location in the fiber optic buffer are used. The configuration of the ibaLink-io-embedded module will check this. If the configuration is wrong, it will not be applied and the red LED is blinking.

The rotary switch of the ibaLink-io-embedded is used to select the device number (0 to F). It is not allowed to have two devices in the ring with the same number.

Note

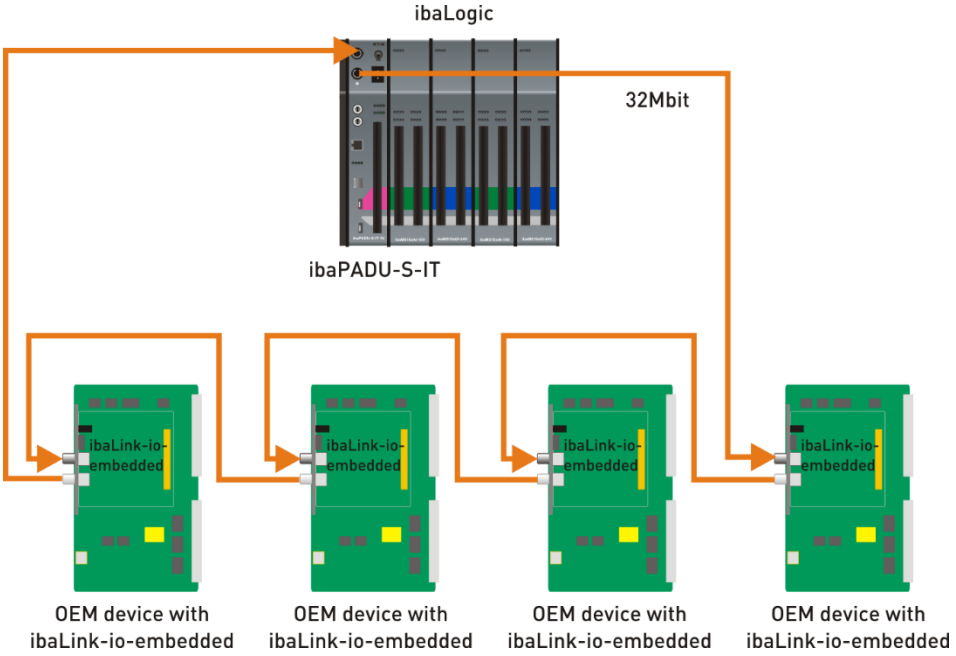
The 32Mbit mode allows only to chain several ibaLink-io-embedded devices with one ibaLogic system (running on a PC with ibaFOB-D card or running on an ibaPADU-S-IT-16). It is not possible to add any other measurement devices in this ring.

The sampling rate and the data size are set through a DPRAM control register (address 0x0FEA), see also chapter 6 "Dual Port RAM". The control registers of all devices in a ring must be set to the same value.

Register value	ibaLink-io mode	ibaLink-io data length	Period	ibaPDA	ibaLogic
8	32Mbit	8 Int + 8 Digital	100 µs	not supported	32 Mbit 100 µs 128 Integer
9		64 Int + 64 Dig.	1000 µs	not supported	32 Mbit 1000 µs 1024 Integer
10		32 Real + 32 Dig.	1000 µs	not supported	32 Mbit 1000 µs 512 Real

Application example:

ibaLink-io-embedded modules in 32Mbit mode with ibaPADU-S-IT



The usage of the RX and TX buffer depends on the mode and the module address. The address is set by the user with the rotary switch and can be read by the application in the register 0x0FEA, bit 4 to 7. The following table contains the used ranges in the RX and TX buffer for the different devices:

Address	Mode 8: 8 Int + 8 Dig		Mode 9: 64 Int + 64 Dig		Mode 10: 32 Float + 32 Dig	
	Analog	Digital	Analog	Digital	Analog	Digital
0	0..15	256	0..127	2048..2055	0..127	2048..2051
1	16..31	257	128..255	2056..2063	128..255	2052..2055
2	32..47	258	256..383	2064..2071	256..383	2056..2059
3	48..63	259	384..511	2072..2079	384..511	2060..2063
4	64..79	260	512..639	2080..2087	512..639	2064..2067
5	80..95	261	640..767	2088..2095	640..767	2068..2071
6	96..111	262	768..895	2096..2103	768..895	2072..2075
7	112..127	263	896..1023	2104..2111	896..1023	2076..2079
8	128..143	264	1024..1151	2112..2119	1024..1151	2080..2083
9	144..159	265	1152..1279	2120..2127	1152..1279	2084..2087
A	160..175	266	1280..1407	2128..2135	1280..1407	2088..2091
B	176..191	267	1408..1535	2136..2143	1408..1535	2092..2095
C	192..207	268	1536..1663	2144..2151	1536..1663	2096..2099
D	208..223	269	1664..1791	2152..2159	1664..1791	2100..2103
E	224..239	270	1792..1919	2160..2167	1792..1919	2104..2107
F	240..255	271	1920..2047	2168..2175	1920..2047	2108..2111

The table above shows the data offsets of the devices within the RX and TX buffer. The RX buffer will contain all data received on the fiber optic input (not only the own data). For TX, only the two areas (analog and digital) for the own device will be transmitted, all other data in the TX buffer is ignored.

Example: If you use mode 9 and the address is set to 6, then your analog signals are located in the RX and TX buffer at address range 768 to 895, the digital signals are located at the address range 2096 to 2103.

The following tables show the data offsets of the signals used in ibaLogic:

Mode 8 **8 Int + 8 Dig**	
Addr.	Analog / Digital
0	0.. 7
1	8..15
2	16..23
3	24..31
4	32..39
5	40..47
6	48..55
7	56..63
8	64..71
9	72..79
A	80..87
B	88..95
C	96..103
D	104..111
E	112..119
F	120..127

Mode 9 **64 Int + 64 Dig**	
Addr.	Analog / Digital
0	0..63
1	64..127
2	128..191
3	192..255
4	256..319
5	320..383
6	384..447
7	448..511
8	512..575
9	576..639
A	640..703
B	704..767
C	768..831
D	832..895
E	896..959
F	960..1023

Mode 10 **32 Float + 64 Dig**	
Addr.	Analog / Digital
0	0..31
1	32..63
2	64..95
3	96..127
4	128..159
5	160..191
6	192..223
7	224..255
8	256...287
9	288..319
A	320..351
B	352..383
C	384..415
D	416..447
E	448..479
F	480..511

6 Dual Port RAM

Note: after RST# wait at least 2 s before accessing the DPRAM

Offset	Bits	RW	Default	Explanation
0x0000… 0x0FDF	**Fiber optic receive buffer (RX)** Contents are only updated when writing 1 to address 0x0FE6			
	7:0	R		Receive buffer
0x0FE0	**Control/Status Registers**			
0x0FE0	**Module Status**			
	0	R	0	Ready for configuration 0=Module busy 1=Module ready for new configuration
	1	R	0	Configuration valid 0=Current configuration invalid 1=Current configuration valid
	7:2	R	0	Reserved
0x0FE1	**Firmware Version** – not valid as long as module is initializing Example: 0x01 0x00 0x0C = Version 1.0.12			
0x0FE1	7:0	R	0x01	Major version
0x0FE2	7:0	R	0x00	Minor version
0x0FE3	7:0	R	0x00	Release version
0x0FE4	**Configuration Block Size + Last Block Flag**			
0x0FE4	7:0	RW	0	Size in bytes of current configuration block (bits[7:0])
0x0FE5	4:0	RW	0	Size in bytes of current configuration block (bits[12:8])
	6:5	RW	0	Reserved
	7	RW	0	1=Last configuration block
0x0FE6	**Buffer control**			
	0	W		Write 1 to update the RX buffer with the most recently received fiber optic telegram.
	1	W		Write 1 to commit the TX buffer (TX buffer contents will be transmitted in the next fiber optic telegram)
	2	W		Write 1 to clear the RX buffer
	3	W		Write 1 to clear the TX buffer
	4	W		Write 1 to commit a configuration data block
	4	R	0	1=Configuration data block transfer busy
	7:5	R	0	Reserved
0x0FE7	**Reserved**			
0x0FE8	**Interrupt**			
	0	R	0	1=TX Interrupt pending(Previous Message transmitted)
		W		Write 1 to clear the pending TX interrupt
	1	R	0	1=RX Interrupt pending (New Message received)
		W		Write 1 to clear the pending RX interrupt
	3:2	R	0	Reserved
	4	RW	0	0=TX Interrupt Disabled 1=Interrupt line driven low when TX interrupt pending
	5	RW	0	0=RX Interrupt Disabled 1=Interrupt line driven low when RX interrupt pending
	7:6	R	0	Reserved
0x0FE9	**Reserved**			
0x0FEA	**32Mbit Protocol configuration**			
	3:0	RW	15	Fiber optic mode: 0=32Mbit P2P mode, 50 µs, 136 Bytes 1=32Mbit P2P mode, 100 µs, 280 Bytes 2=32Mbit P2P mode, 200 µs, 568 Bytes 3=32Mbit P2P mode, 400 µs, 1144 Bytes 4=32Mbit P2P mode, 800 µs, 2296 Bytes 5=32Mbit P2P mode, 1000 µs, 2872 Bytes 6=32Mbit P2P mode, 1400 µs, 4024 Bytes

				7=reserved 8=32Mbit mode, 100µs, 8Int+8Digital per Device 9=32Mbit mode, 1000µs, 64Int+64Digital per Device 10=32Mbit mode, 1000µs, 32Real+32Digital per Device 11=reserved 12=reserved 13=reserved 14=reserved 15=Flex mode (default)
	7:4	R		Address switch
0x0FEB … 0x0FFF	**Reserved**			
0x1000… 0x1FFF	**Fiber optic transmit buffer (TX) / Configuration transmit buffer** FO contents are only transmitted when committed by writing 2 to address 0x0FE6 Configuration contents are committed by writing 16 to address 0x0FE6			
	7:0	RW		4096 bytes transmit buffer

7 Software

A typical application may work in the following steps:

- Initialization of the application and IO
- Endless loop (application in progress)
  - Wait for the next cycle (see chapter 7.2.1)
  - Get input data (see chapter 7.2.2)
  - Process data (user's responsibility)
  - Send output data (see chapter 7.2.3)

Example Code

An example application with C source code is available on the supplied data medium. The application consists of the following files:

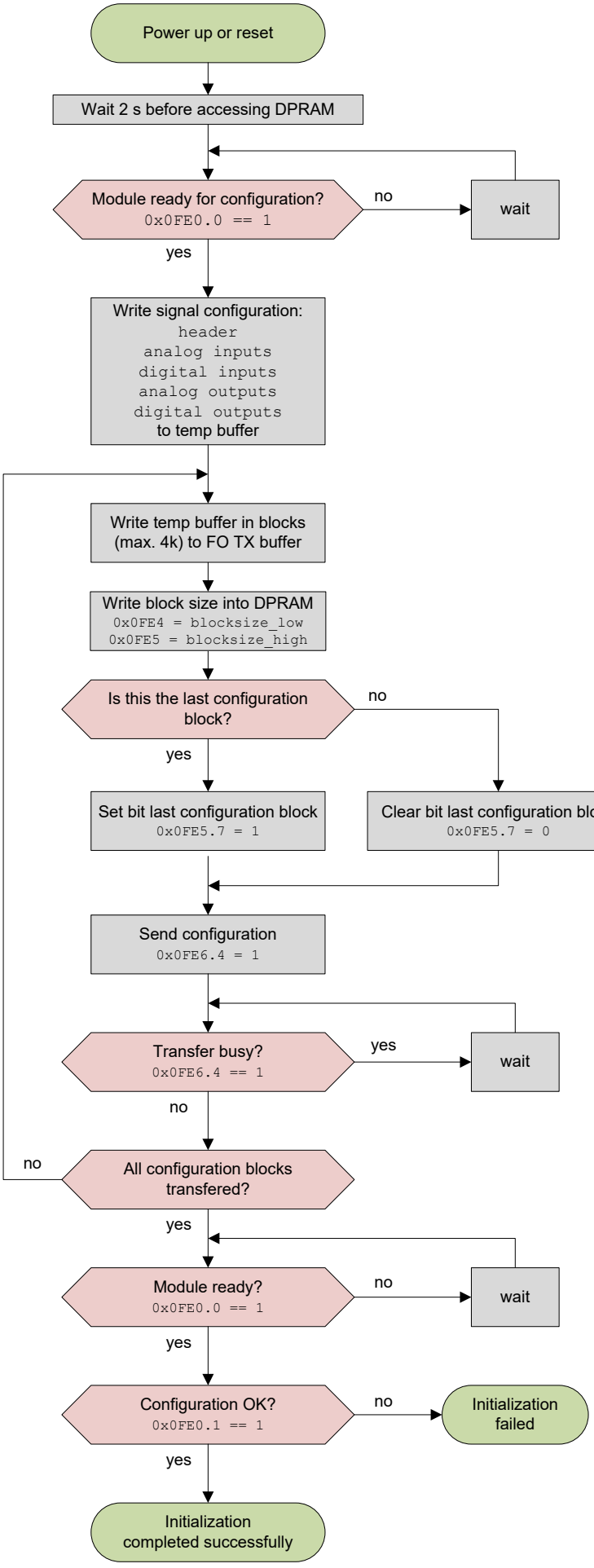
- **`IoEmbCfg.h`** (configuration structures)
- **`IoEmbFcn.h`** (definition of configuration functions)
- **`IoEmb.c`** (configuration functions)
- **`IoEmbExample.h`** (example application)
- **`IoEmbExample.c`** (example application with main functions and endless loop)

7.1 Initialization

All signals received or transmitted via the fiber optic link have to be defined in order to be displayed in the signal list in the I/O Manager of ibaPDA and to correctly write the data in the measuring file (*.dat).

All definitions shown in this chapter are also available in the file **`IoEmbCfg.h`** (written for C or C++). The file can be used as template for signal configuration.

The following diagram shows the typical initialization sequence:


Power up or reset
Wait 2 s before accessing DPRAM
Module ready for configuration?
0x0FE0.0 == 1
no
wait
yes
Write signal configuration:
header
analog inputs
digital inputs
analog outputs
digital outputs
to temp buffer
Write temp buffer in blocks
(max. 4k) to FO TX buffer
Write block size into DPRAM
0x0FE4 = blocksize_low
0x0FE5 = blocksize_high
Is this the last configuration
block?
no
yes
Set bit last configuration block
0x0FE5.7 = 1
Clear bit last configuration block
0x0FE5.7 = 0
Send configuration
0x0FE6.4 = 1
Transfer busy?
0x0FE6.4 == 1
yes
wait
no
All configuration blocks
transfered?
no
yes
Module ready?
0x0FE0.0 == 1
no
wait
yes
Configuration OK?
0x0FE0.1 == 1
no
Initialization
failed
yes
Initialization
completed successfully

Proceeding:

- ❑ After module reset wait at least 2 s before accessing any DPRAM registers.
- ❑ Wait, until bit 0 of address 0x0FE0 is set to 1.
  Boot time after reset or power up is approx. 15 sec.
- ❑ Setup the fiber optic mode register as described in chapter 5.4 "Operation modes".
- ❑ Write signal configuration:
  If there is enough memory, you can generate the complete configuration in the RAM and then copy the data in blocks of 4 kByte into the FO TX buffer.
  If there is not enough RAM available, the FO TX buffer can be used directly.
  - Write configuration header (see chap. 7.1.1 "Configuration structures").
  - Write signal description for all analog input signals.
    Analog input signals are all signals with more than one bit, which run from the application towards ibaPDA.
    If there are no analog input signals, skip this part.
    A data block as described in chap. 7.1.1 "Configuration structures" has to be written for each signal.
  - Write signal description for all digital input signals.
    Digital input signals are all signals with just one bit, which run from the application towards ibaPDA.
    If there are no digital input signals, skip this part.
    A data block as described in chap. 7.1.1 "Configuration structures" has to be written for each signal.
  - Write signal description for all analog output signals.
    Analog output signals are all signals with more than one bit, which run from ibaPDA towards the application.
    If there are no analog output signals, skip this part.
    A data block as described in chap. 7.1.1 "Configuration structures" has to be written for each signal.
  - Write signal description for all digital output signals.
    Digital output signals are all signals with just one bit, which run from ibaPDA towards the application.
    If there are no digital output signals, skip this part.
    A data block as described in chap. 7.1.1 "Configuration structures" has to be written for each signal.
- ❑ The configuration has to be written to the FO TX buffer. When or before the buffer is full, follow these steps to send it to the configuration firmware of ibaLink-io-embedded:
  - Write the block size to address 0x0FE4 and 0x0FE5. If this is the last block, then set bit 7 of register 0x0FE5 to 1.
  - Write the value 0x10 to address 0x0FE6 to send the current configuration buffer.
  - Wait until bit 4 in register 0x0FE6 is reset to 0.
- ❑ After the last block, bit 0 in the register 0x0FE0 is cleared while the configuration is processed.
  Wait, until bit 0 in register 0x0FE0 is set. Then check bit 1 to see, if there was an error (bit 1 = 0), or if the configuration is OK (bit 1 = 1).
  Configuration takes effect as soon as bit 0 in 0x0FE0 is set to 1. Please note that ibaPDA will only recognize changes when the new configuration was sent to ibaPDA. For this purpose open the "I/O Manager" in ibaPDA and execute either an

auto detection with a right-click on the FO Link module or read the configuration from the ibaLink-io-embedded module with a click on "Update signals".

The configuration needs some time to be completely transferred: approx. 1.6 ms per signal, or about 600 signals per second.

Error handling

The new configuration is only used, if there were no errors.

Important note

Please note, that the configuration will be cleared in case of errors.

Most errors occur because the configuration limits are not observed, see paragraph "Configuration limits".

Configuration limits

- The number of signals is not limited, but the total length of configuration data must be less than 262145 Bytes.
- The length per configuration block must be less than 4097 Bytes.
- The length of text strings in the signal descriptions (like name and unit) is not limited. But we recommend to test whether longer texts are truncated in ibaPDA.
- Offset for so called "output signals" (located in the Fiber optic RX buffer) must be between 0 and 4063.
  In 32Mbit P2P mode, the maximum length is shown in chapter 5.4.2 "32Mbit P2P mode". In 32Mbit mode, the position of the signals needs to match with the protocol, see chapter 5.4.3 "32Mbit mode".
- Offset for so called "input signals" (located in the Fiber optic TX buffer) must be between 0 and 4095.
  In 32Mbit P2P mode, the maximum length is shown in chapter 5.4.2 "32Mbit P2P mode". In 32Mbit mode, the position of the signals needs to match with the protocol, see chapter 5.4.3 "32Mbit mode".

7.1.1 Configuration structures

Configuration header

Offset	C Type	Description
0x00..0x03	char [4]	Identification, fixed "IOE\0" (=0x49, 0x4F, 0x45, 0x00)
0x04..0x05	UINT16	Number of analog input signals
0x06..0x07	UINT16	Number of digital input signals
0x08..0x09	UINT16	Number of analog output signals
0x0A..0x0B	UINT16	Number of digital output signals
0x0C..0x2B	char [32]	Module name (NULL-terminated)
0x2C..0xFB	char [208]	Module description (NULL-terminated)
0xFC..0xFD	UINT16	Minimum fiber optic period in µs, e.g. 1000 for a 1 ms minimum fiber optic period. In asynchronous mode (see chapter 7.2.1 „Wait for the next cycle"), this value can be set to 0.
0xFE..0xFF	UINT16	Reserved for future extensions (has to be set to 0)

Signal description for analog input and output signals

RX and TX buffer are separate buffers, i.e. the same addresses can be used in both buffers.

Offset	C Type	Description
0x00..0x01	UINT16	Bit 15..12: Signal type: 0 = reserved (do not use) 1 = Byte (unsigned 8 bit) 2 = Int (unsigned 16 bit) in little endian 3 = Word (signed 16 bit) in little endian 4 = DInt (unsigned 32 bit) in little endian 5 = DWord (signed 32 bit) in little endian 6 = Real (float 32 bit) in little endian 7..9 = reserved (do not use) 10 = Int (unsigned 16 bit) in big endian 11 = Word (signed 16 bit) in big endian 12 = Dint (unsigned 32 bit) in big endian 13 = DWord (signed 32 bit) in big endian 14 = Real (float 32 bit) in big endian 15 = reserved (do not use) Bit 11..0: Byte offset in fiber optic transmit buffer (only the lower 12 bits)
0x02..0x05	INT32	Minimum physical value * 1000. Example: With a ±10 V signal, set here -10 * 1000. This value is used in ibaPDA to show physical values instead of digital numbers (e.g. 9.75 V i.s.o. 31949). If you do not want a conversion in ibaPDA set 0 for minimum and maximum value. (*see note below)
0x06..0x09	INT32	Maximum physical value * 1000. Example: With a ±10 V signal, set here 10 * 1000. This value is used in ibaPDA to show physical values instead of digital numbers (e.g. 9.75V i.s.o. 31949). If you do not want a conversion in ibaPDA set 0 for minimum and maximum value. (*see note below)
0x0A..0x??	char []	Signal unit: NULL-terminated character array. Example: With a ±10 V signal, set here "V" (including the NULL byte at the end). If no unit shall be used, just add a NULL byte here.
0x??..0x??	char []	Signal name: NULL-terminated character array. Example: "Voltage motor 3" (including the NULL byte at the end). If no name shall be used, just add a NULL byte here.

***Note**

Please note, that values for minimum and maximum physical value will only influence ibaPDA inputs. These values are ignored in ibaLogic and for ibaPDA outputs.

Signal description for digital input and output signals

Offset	C Type	Description
0x00..0x01	UINT16	Bit 15: always 0 Bit 14..12: Bit position (within the byte, see next line) Bit 11..0: Byte offset in fiber optic buffer (only the lower 12 bits)
0x02..0x??	char []	Signal name: NULL terminated character array. Example: "Switch 7" (including the NULL byte at the end). If you have no name, just add a NULL byte here.

7.1.2 Configuration debugging

After the configuration is uploaded, the module will check if the configuration is valid and creates two files for debugging:

- **`ConfigLog.txt`** contains a list of all signal names and possible errors
- **`config.bin`** contains the binary data which was transmitted

The files can only be downloaded via FTP, when ibaPDA is connected in 32Mbit Flex mode to the module. Therefore it is recommended to start application development in 32Mbit Flex mode.

You find the IP address in the I/O Manager:

Select the module in the signal tree and you see the IP address in the "General" tab in the "Connection" section.

The IP address typically starts with "172.".

Use FTP with an anonymous login in passive mode.

Recommended approach for application development:

1. Write application for 32Mbit Flex mode (do not set rotary switch to 0)
2. Check debug files in case of an error (ConfigLog.txt, config.bin)
3. Check signals with ibaPDA
4. Change application to actual mode
5. Test application again

7.2 Application in progress

7.2.1 Wait for the next cycle

You can choose one of the following modes:

- **Asynchronous** to fiber optic: The application has its own timer to trigger the main loop. In this case, the ibaLink-io-embedded module will transmit always the latest data via the fiber optic link.
- **Synchronous to the fiber optic receiver**: The ibaLink-io-embedded module has an interrupt line, which is asserted as soon as the fiber optic has received a new message. Choose this mode when the fiber optic input is used, even if the fiber optic output is used. Do not use this mode when no fiber optic input is connected or when no valid data is received.
- **Synchronous to the fiber optic transmitter:** The ibaLink-io-embedded module has an interrupt line, which is asserted as soon as the fiber optic has transmitted (or repeated) the last committed message. So this interrupt will occur on a regular basis. The only exception is in 32Mbit mode when there is no incoming telegram (and thus also no outgoing telegram). Choose this mode when the fiber optic input is not used.

	async	sync to RX	sync to TX
only fiber optic input of the module is used (ibaPDA output data)	✓	✓	
only fiber optic output of the module is used (ibaPDA input data)	✓		✓
fiber optic input and fiber optic output are used	✓	✓	

7.2.2 Get input data

You get the latest RX data (noted as analog and digital output signals in the configuration, see chapter 7.1 "Initialization") by writing 0x01 to address 0x0FE6. Then you can read the data starting at address 0x0000.

7.2.3 Send output data

You have to write your TX data (noted as analog and digital input signals in the configuration, see chapter 7.1 "Initialization") in the fiber optic TX buffer starting at address 0x1000. After this, write the value 0x02 to address 0x0FE6 to forward the buffer to the fiber optic output block. The buffer is available for the next data immediately after writing to register 0x0FE6.

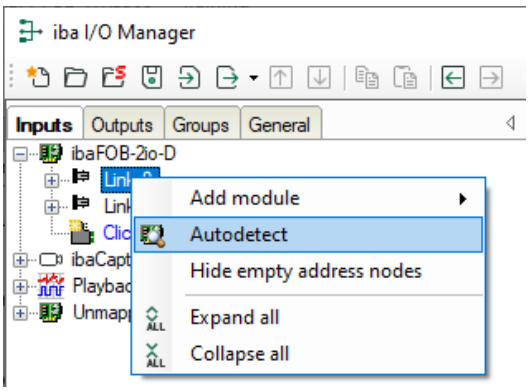
The new data is sent via fiber optic when the next fiber optic frame starts. This ensures block consistent data on the fiber optic link.

8 ibaPDA application

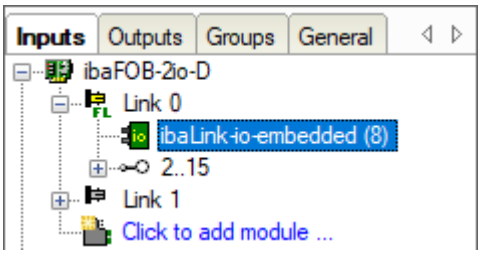
The ibaLink-io-embedded module is supported by ibaPDA version 6.30 or higher.

8.1 Configuration in 32Mbit Flex mode

1. Start the ibaPDA client and open the I/O Manager.
2. Choose the correct ibaFOB-D input card in the signal tree (on the left hand side) and mark the link ibaLink-io-embedded is connected to. Right-click on the link and choose "Autodetect".



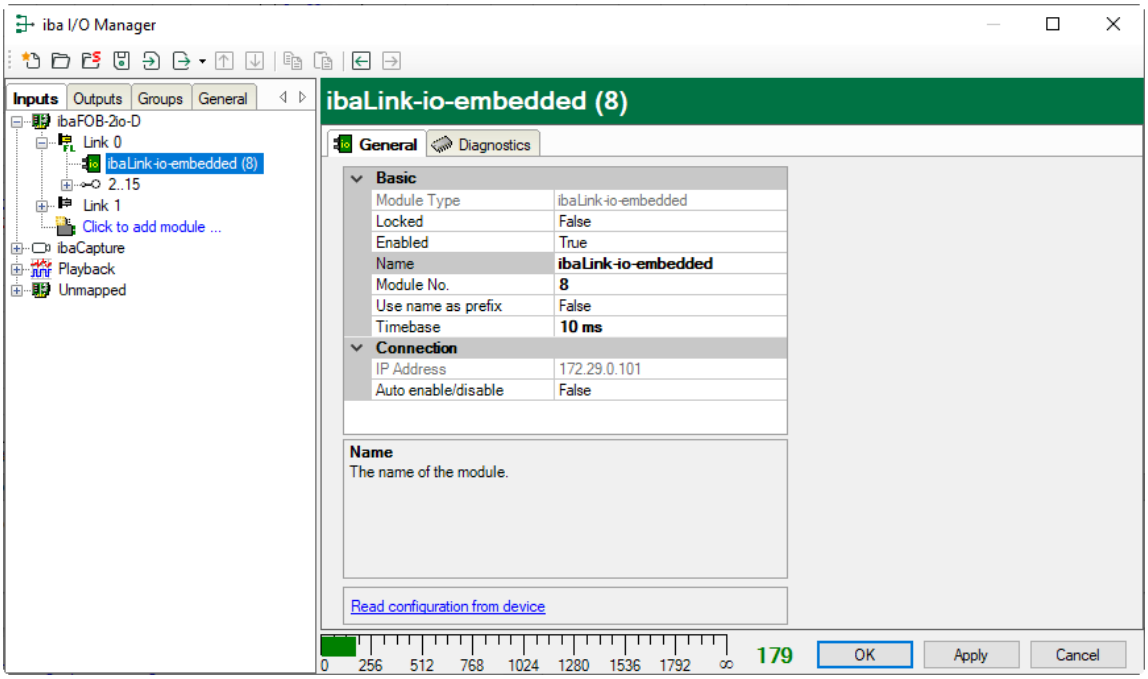
3. ibaPDA recognizes the device automatically. The device will be listed in the signal tree.



The links 1 – 15 below the ibaFOB card correspond to the device address the rotary switch is set to. Position 1 – F refers to address 1 – 15.

4. Make your settings in the ibaLink-io-embedded modules of the I/O Manager:

ibaLink-io-embedded – General tab



Basic settings

❑ Module type (read only)
Displays the module type

❑ Locked
A locked module can only be changed by an authorized user.

❑ Enabled
Here, you can activate data capturing for this module (True).

❑ Name
ibaPDA recognizes automatically the module name, but the name can be modified.

❑ Module No.
Logical module number for clearly referencing the signals, e.g. when printing and for ibaAnalyzer. The ibaPDA gives numbers in chronological order, but the number can be modified by the user.

❑ Use name as prefix
The module name is placed in front of the signal name as prefix.

❑ Timebase
Timebase that is used for the device, given in ms. Cycle times down to 10 µs are possible, depending on the number of signals.

Connection

❑ IP Address
IP address or host name of the device (read only).

❑ Auto enable/disable
If this option is enabled and ibaPDA cannot connect to this device during the start of the acquisition then it will disable this module and start the acquisition without it. During the acquisition it will try to reconnect the device. When it succeeds it will automatically restart

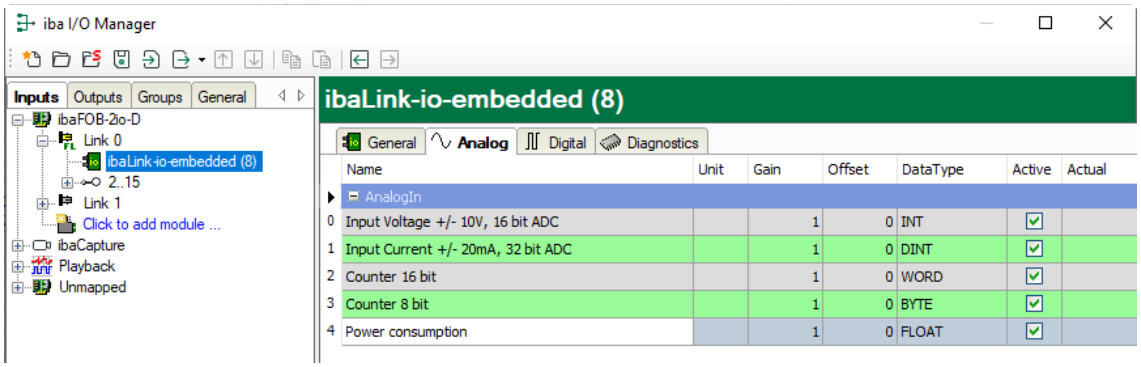
the acquisition with this module enabled.
If this option is not enabled then ibaPDA will not start the acquisition when it cannot connect to the device.

Further functions

❑ Read configuration from the device
Reading the signal configuration from the device.

The changed settings become valid by clicking on <OK> or <Apply>.

ibaLink-io-embedded – Analog tab



ibaPDA recognizes automatically the signal configuration and displays the appropriate values in the signal list. The columns in the signal list have got the following meaning:

❑ AnalogIn
Signal name, you can enter additionally two comments when clicking on the symbol in the field "AnalogIn".

❑ Unit
Physical unit of the analog value.

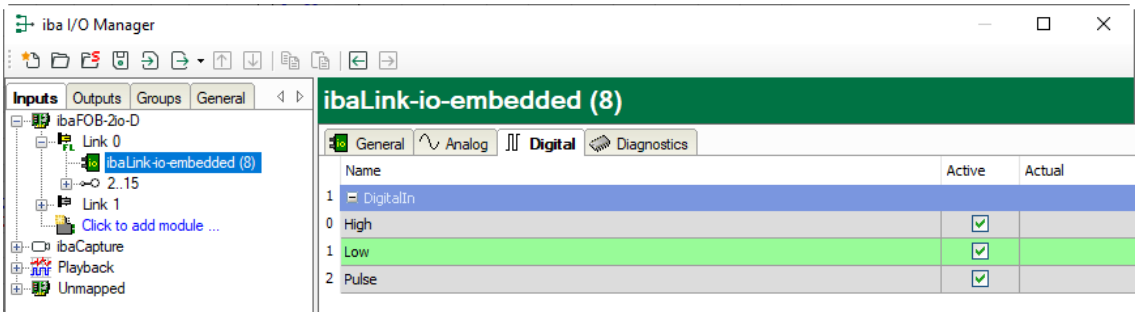
❑ Gain / Offset
Gradient (Gain) and y axis intercept (Offset) of a linear equation. You can convert a standardized value transferred without a unit into a physical value.

❑ DataType
Data type of the signals.

❑ Active
Here, you can select the signals to be measured.

❑ Actual
Displays the actual value of the signal (only available when the measurement is already running with the specified configuration).

ibaLink-io-embedded – Digital tab



❑ DigitalIn

Signal name is automatically detected, you can enter additionally two comments when clicking on the symbol in the field "DigitalIn".

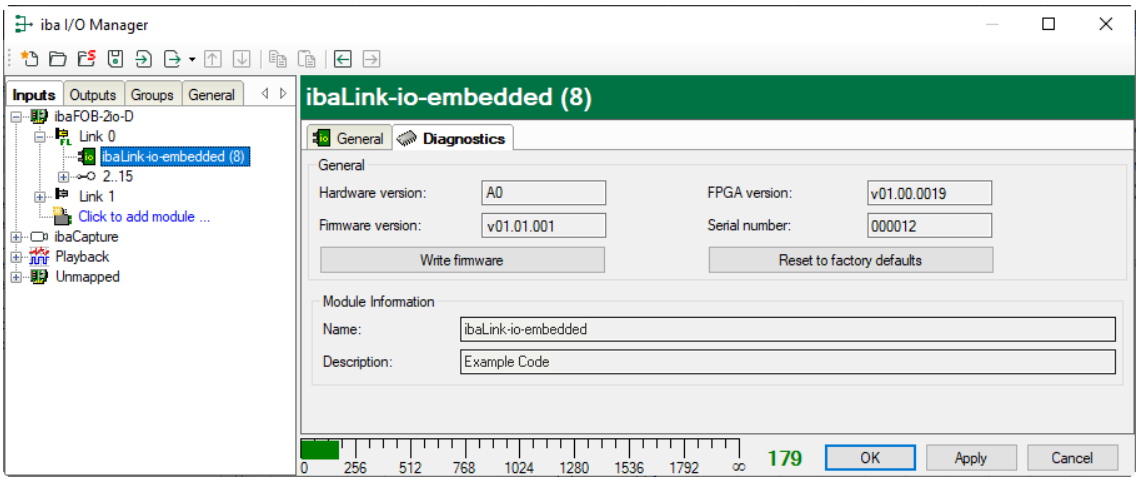
❑ Active

Here, you can select the signals to be measured.

❑ Actual

Displays the actual value of the signal (only available when the measurement is already running with the specified configuration).

ibaLink-io-embedded – Diagnostics tab



❑ General

The "General" section gives information about the Hardware version, Firmware version, FPGA version and serial number.

❑ Module information

The "Module information" section gives information about the module name and a description which are specified within the code.

❑ Write firmware

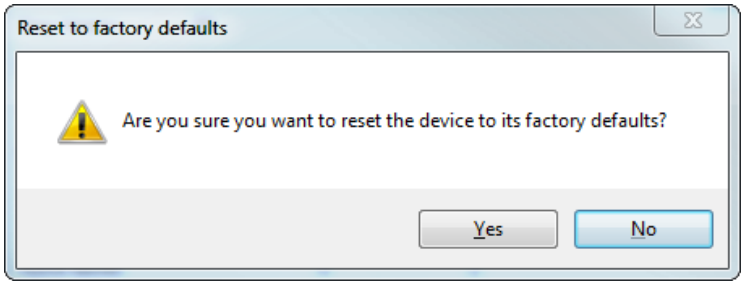
With the <Write firmware> button, you can install firmware updates. Please select the update file „linkio_v[xx.yy.zzz].iba" in the browser and start the update with <OK>.

Important note

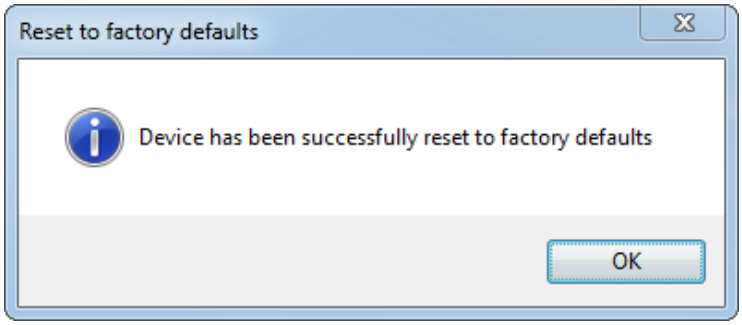
This procedure might take some minutes and must not be interrupted.

❑ Reset to factory defaults

Having opened the following dialog by clicking on the button <Reset to factory de-faults>, all settings are reset to factory settings by confirming with <Yes>.

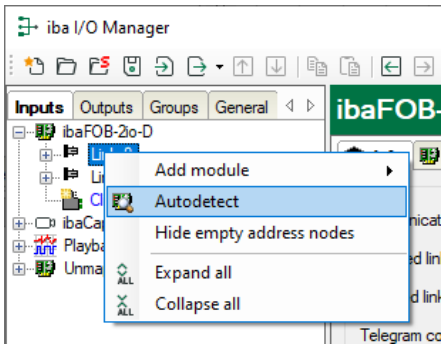


Finally, the following message is shown:

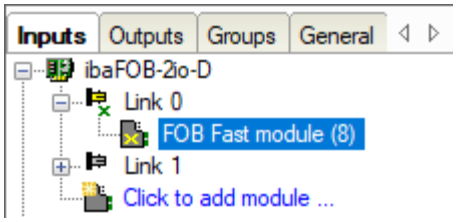


8.2 Configuration in 32Mbit P2P mode

1. Start the ibaPDA client and open the I/O Manager
2. Choose the correct ibaFOB-D input card in the signal tree (on the left hand side) and mark the link ibaLink-io-embedded is connected to. Right-click on the link and choose "Autodetect".



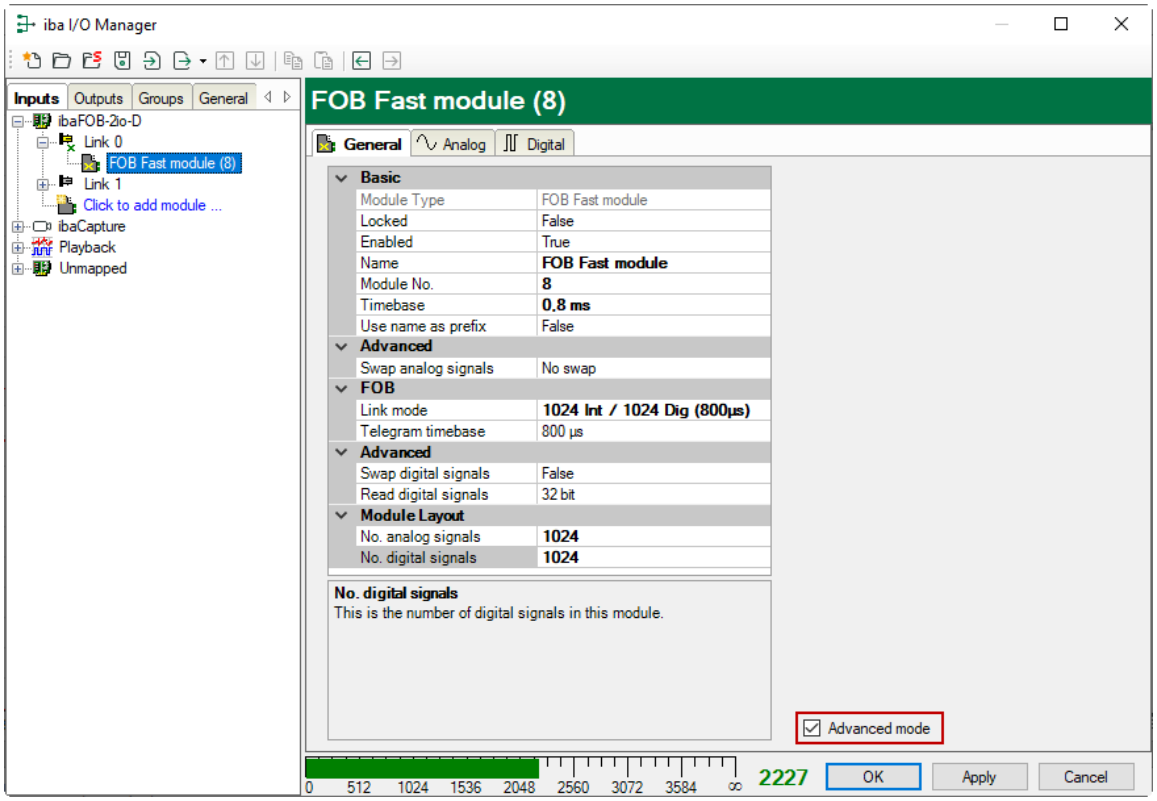
Link protocol and telegram counter will be detected automatically. A "Fob Fast module" will be listed in the signal tree.



3. Make your settings in the Fob Fast module of the I/O Manager.

Outputs from ibaPDA to ibaLink-io-embedded are not supported in 32Mbit P2P mode.

Fob Fast module – General tab



Basic

❑ Locked, Enabled, Name, Module No.
see ibaLink-io-embedded module, *General* tab.

Advanced

❑ Swap mode: must be set to "No swap".

FOB

❑ Link mode
Specifies the link mode, which corresponds to the module configuration. It will be automatically detected.

❑ Telegram timebase
is adjusted automatically according to the link mode.

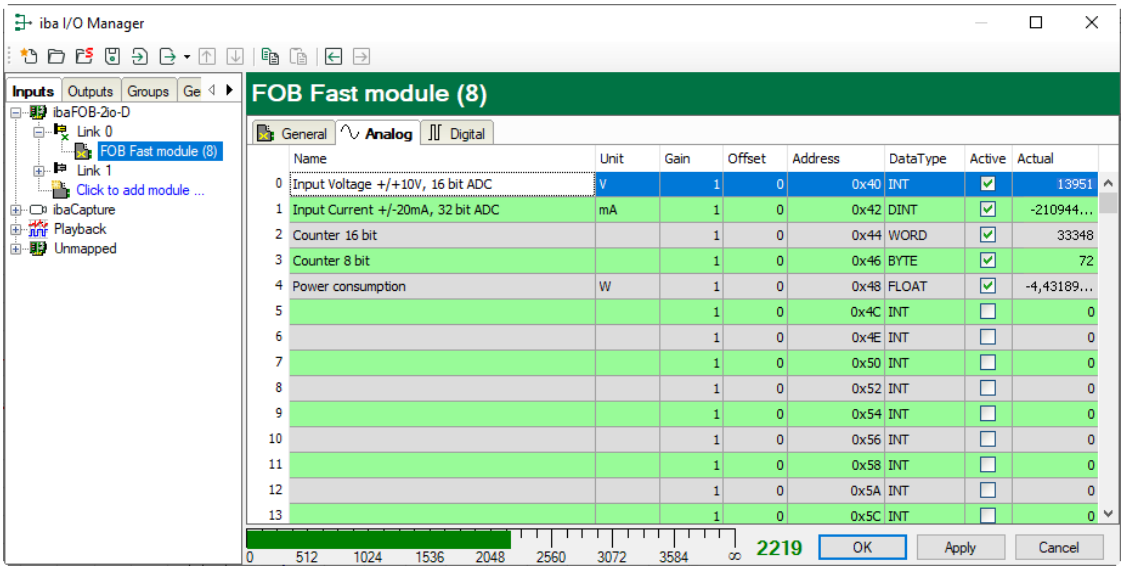
Module Layout

❑ No. analog signals
The number of analog signals for this module is adjusted automatically.

❑ No. digital signals
The number of digital signals for this module is adjusted automatically.

❑ Advanced mode
"Advanced mode" must be activated with the checkbox in the *General* tab.

Fob Fast module – Analog tab



Enter here the analog signals to be recorded sequentially. The signal configuration must match the configuration of the application. The columns in the signal list have got the following meaning:

❑ Name

Name of the signal, you can enter additionally two comments when clicking on the  symbol in the field "Name".

❑ Unit

Physical unit of the analog value.

❑ Gain / Offset

Gradient (Gain) and y axis intercept (Offset) of a linear equation. You can convert a standardized value transferred without a unit into a physical value.

❑ Address

Byte offset of the signal within the telegram (address of the first Byte is 0x40).

❑ DataType

Data type of the signals, can be selected from a dropdown menu:

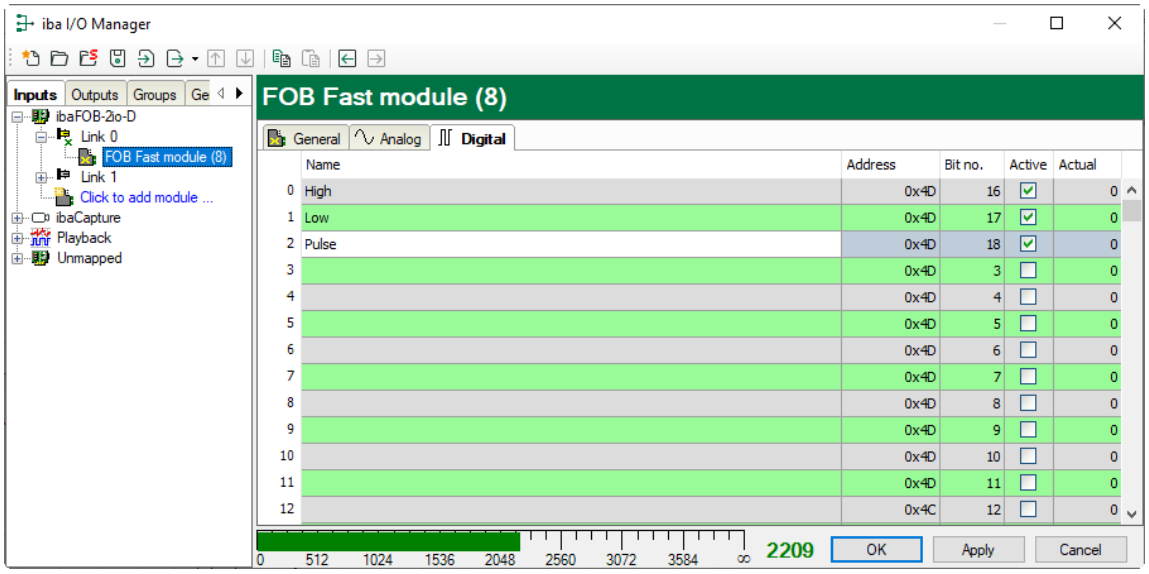
❑ Active

Here, you can select the signals to be measured.

❑ Actual

Displays the actual value of the signal (only available when the measurement is already running with the specified configuration).

Fob Fast module – Digital tab



Enter here the digital signals to be recorded sequentially. The signal configuration must match the configuration of the application. The columns in the signal list have got the following meaning:

❑ Name, Active, Actual
see Fob Fast module, Analog tab.

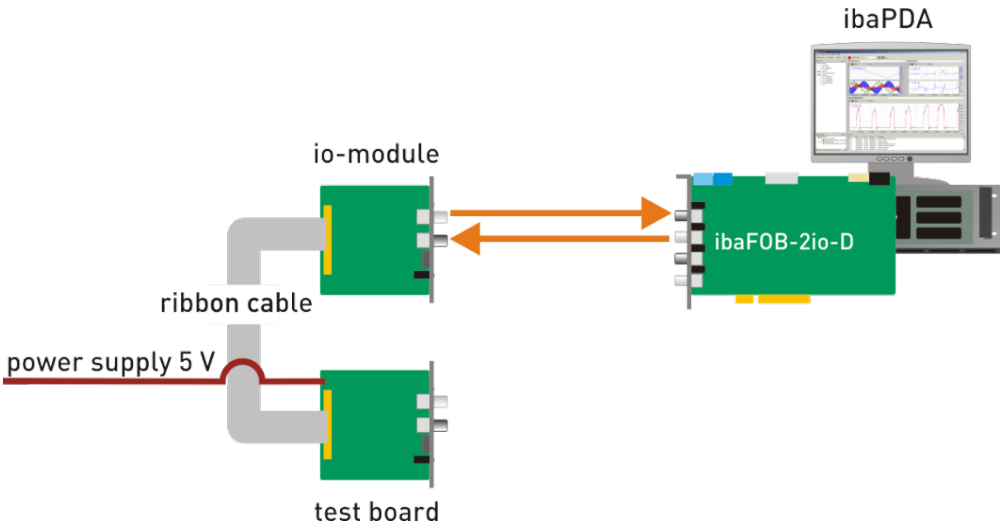
❑ Address
Byte offset of the signal within the telegram (address of the first Byte is 0x40).

❑ Bit no.
Bit number within the specified Byte.

9 Evaluation Setup (test board)

One ibaLink-io-embedded module is modified as test board. This test board can be used to test ibaLink-io-modules during development and operation. The test board simulates the host system. The second unmodified ibaLink-io-embedded module (referred to as "io-module") can be addressed by the test board.

The firmware installed on the test board provides a demo application. Due to the firmware, the io-module will be automatically configured and hence generate output data, which is sent to the PC via the io-module and displayed by ibaPDA. The demo application code complies with the example code on the supplied data medium (description see chapter 7).



9.1 Requirements

- ❑ 1 ibaLink-io-embedded module
- ❑ 1 ibaLink-io-embedded test board
- ❑ 3.0 inch 44 Conductor Ribbon Cable (e.g. SAMTEC TCSD-22-D-03.00-01)
- ❑ Power Supply (5 V; 1A)
- ❑ ibaPDA System, with ibaPDA version 6.30.0 or higher
  At least one fiber optic card of ibaFOB-D type in the ibaPDA system:
  - ibaFOB-io-D
  - ibaFOB-2io-D
  - ibaFOB-2i-D optional with extension module ibaFOB-4o-D
  - ibaFOB-4i-D optional with extension module ibaFOB-4o-D
  - ibaFOB-io-ExpressCard
- ❑ Demo application firmware (linkio_v99*.iba), already installed on test board in delivery state

9.2 Power supply and jumper for I/O voltage on test board

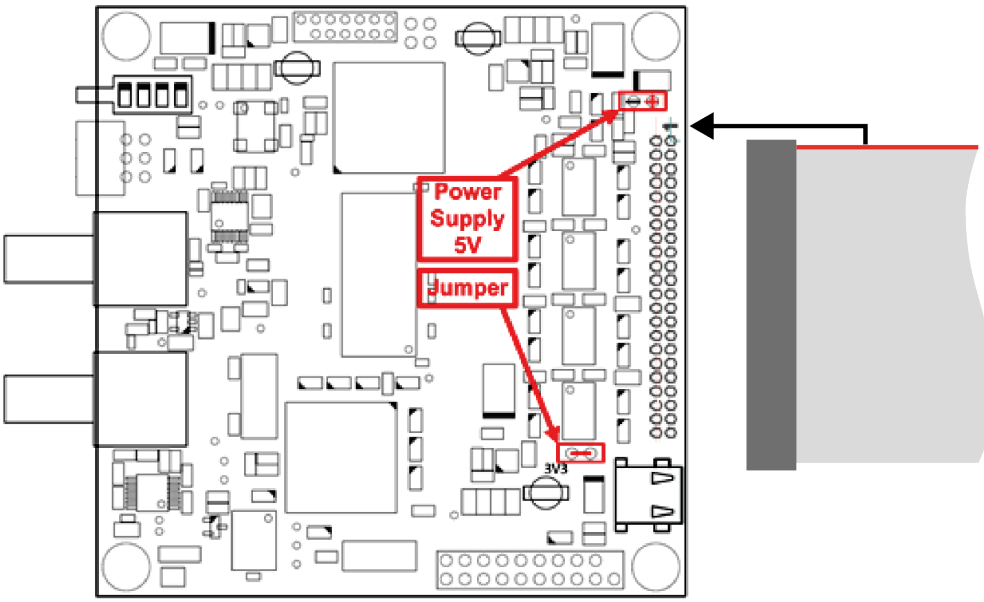
Power Supply

Both modules can be powered from one power supply (5 V; 1 A) connected to the test board. The io-module will draw the power over the ribbon cable from the test board.

I/O Voltage

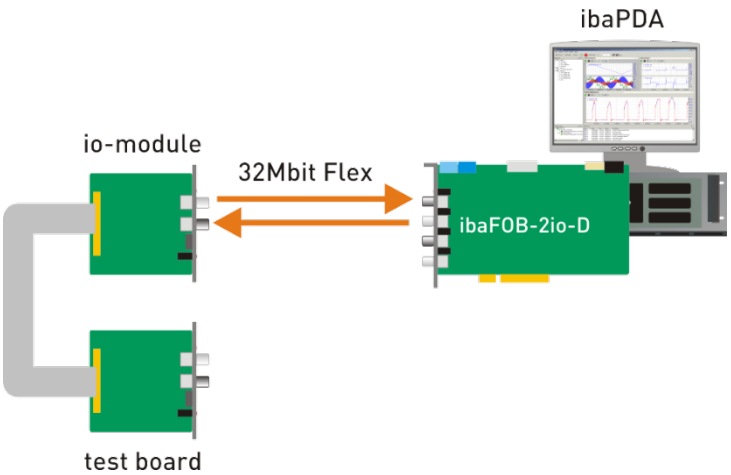
To power the I/O lines of the io-module with 3.3 V from the test board a short circuit (between 3V3 and +Vio) on the test board is required.

For this purpose, the jumper is closed (default delivery state).

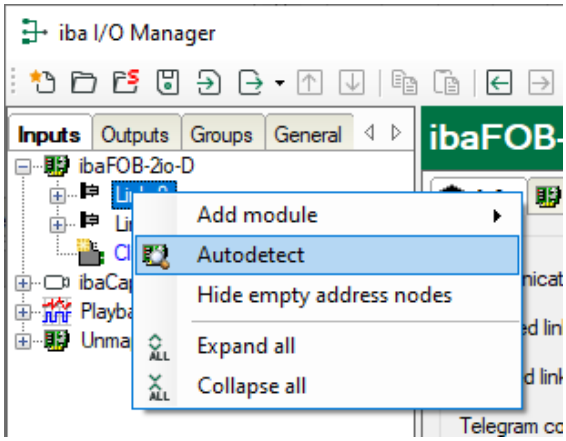


9.3 Data acquisition with ibaPDA

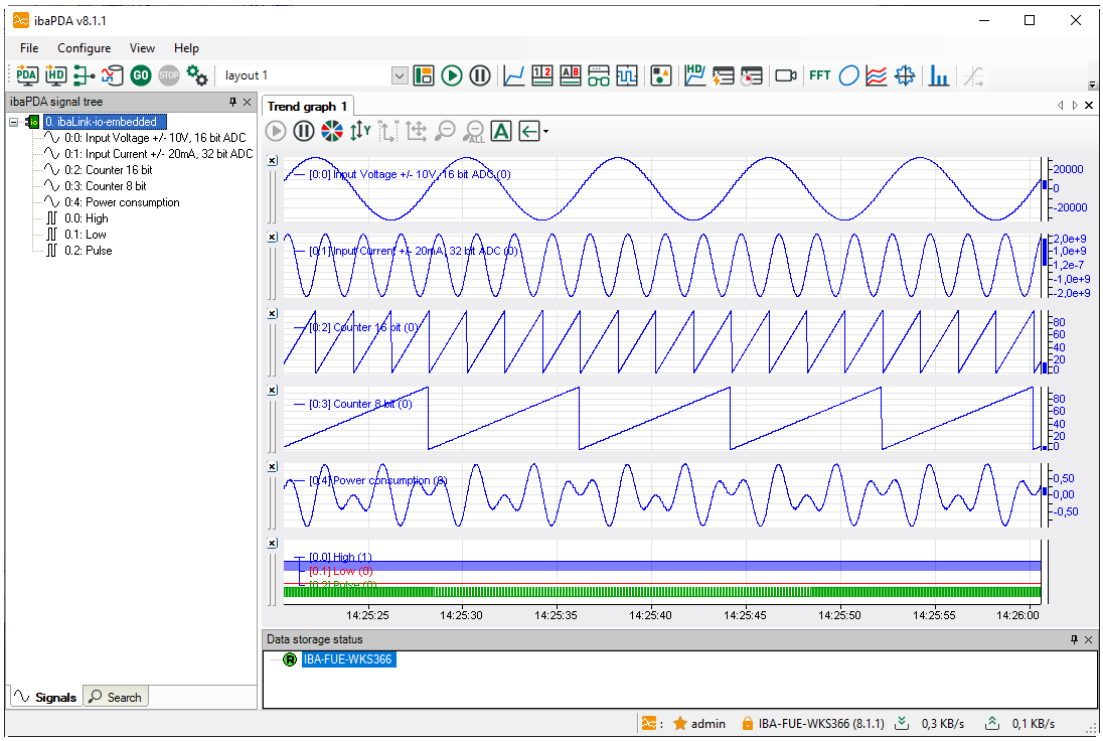
1. Connect the io-module with bidirectional fiber optic cable to ibaFOB card.



2. Supply modules with power.
3. Start ibaPDA and start I/O Manager.
4. Choose the correct ibaFOB-D input card in the signal tree (on the left hand side) and mark the link the test board is connected to. Right-click on the link and choose "Autodetect".



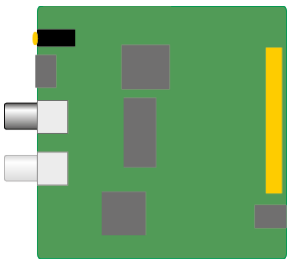
5. Select the signals to be measured as described in chapter 8 "ibaPDA application".
6. Apply the configuration and close the I/O Manager with a click on <OK>.
7. Now you can select the signals from the signal tree on the left side and display them in the trend graph.



9.4 Download debug files via FTP connection

Proceed the following steps to establish a FTP connection to the device:

1. Connect the device to the PC via an USB cable.
   The USB interface is located on the top side next to the host connector.



USB

   A USB cable of A/Mini-B type is required.
   A suitable cable is available at iba on request.

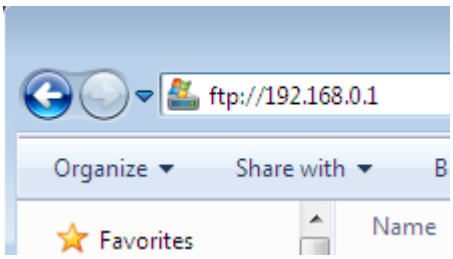
2. As soon as the computer is connected for the first time to the device, the "Found New Hardware Wizard" will show up and the driver for the USB connection has to be installed.
   You find the driver on the data medium delivered with the device in this directory:
   \02_iba_Hardware\ibaLink-io-embedded\USB_Driver\

3. After having installed successfully, an additional network connection is available with the device name „IBA AG USB Remote NDIS Network Device".

4. A fixed IP address must be assigned to this interface. The address has to be from this range: 192.168.0.n with n = 2…254 and the subnetmask 255.255.255.0.
   Example:
   IP: 192.168.0.2
   SubNet: 255.255.255.0

5. Now, you can establish a FTP connection to the device. You may use a FTP client or the Windows File Explorer.
   In both cases, the address is „192.168.0.1" and the user is „anonym" without any password.

   Example: Windows File Explorer:



   Several files are displayed in the file window.

6. Examine files e.g. ConfigLog.txt

```
1  Header OK
2  Signal AI#0: Input Voltage +/- 10V, 16 bit ADC: OK
3  Signal AI#1: Input Current +/- 20mA, 32 bit ADC: OK
4  Signal AI#2: Counter 16 bit: OK
5  Signal AI#3: Counter 8 bit: OK
6  Signal AI#4: Analog Output Signal: OK
7  Signal DI#0: High: OK
8  Signal DI#1: Low: OK
9  Signal DI#2: Pulse: OK
10 Signal DI#3: Digital Output Signal: OK
11 Signal AO#0: Analog Output Signal: OK
12 Signal DO#0: Digital Output Signal: OK
13 Configuration OK
14
```

10 Technical Data

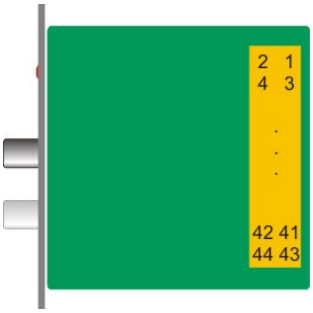
Short description		
Manufacturer	iba AG, Germany	
Order no.	14.132400	
Description	Integrated system interface for OEM systems	
Interfaces		
ibaNet interface (fiber optics)		
Number	1 (e. g. for the connection to ibaPDA)	
ibaNet protocols	32Mbit, 32Mbit Flex	
Data transmission rate	32 Mbit/s	
Connector type	2 ST connectors for RX and TX; iba recommends the use of FO with multimode fibers of type 50/125 µm or 62.5/125 µm; For information on cable length, see chap. 10.2.	
Transmitting interface (TX)		
Output power	50/125 µm FO cable	-19.8 dBm to -12.8 dBm
	62.5/125 µm FO cable	-16 dBm to -9 dBm
	100/140 µm FO cable	-12.5 dBm to -5.5 dBm
	200 µm FO cable	-8.5 dBm to -1.5 dBm
Temperature range	-40 °F to 185 °F (-40 °C to 85 °C)	
Light wavelength	850 nm	
Laser class	Class 1	
Receiving interface (RX)		
Sensitivity[1]	100/140 µm FO cable	-33.2 dBm to -26.7 dBm
Temperature range	-40 °F to 185 °F (-40 °C to 85 °C)	
Baseboard connector	Connector male 44 pin header (2 x 22 pins, 2 mm pitch)	
Power supply		
Power supply	5 V (±5%) DC	
Current consumption	Max. 0.4 A (2 W)	
Indicators and operating element		
Indicators	4 LEDs for operating status	
Rotary switch	Setting the device address in 32Mbit Flex and 32Mbit mode	
Operating and environment conditions		
Cooling	Passive	
Operating temperature	32 °F…149 °F (0 °C…+65 °C)	
Storage temperature	-13 °F…158 °F (-25 °C…+70 °C)	

[1] Data for other FO cable diameters not specified

Transport temperature	-13 °F…158 °F (-25 °C…+70 °C)
MTBF[2]	11,976,783 hours / 1,367 years
Dimensions	
Dimensions (Width x Depth x Height)	80 mm x 80 mm x 16 mm (without connector)

10.1 Pin assignment compact

Function	Pin		Function
+5V	**2**	**1**	+5V
GND	**4**	**3**	GND
INT#	**6**	**5**	MODE16#
CS#	**8**	**7**	RST#
WR0#	**10**	**9**	OE#
A1	**12**	**11**	A0/WR1#
A3	**14**	**13**	A2
A4	**16**	**15**	GND
A6	**18**	**17**	A5
A8	**20**	**19**	A7
A10	**22**	**21**	A9
A12	**24**	**23**	A11
$+V_{io}$	**26**	**25**	GND
D8	**28**	**27**	D0
D9	**30**	**29**	D1
D10	**32**	**31**	D2
D11	**34**	**33**	D3
$+V_{io}$	**36**	**35**	GND
D12	**38**	**37**	D4
D13	**40**	**39**	D5
D14	**42**	**41**	D6
D15	**44**	**43**	D7

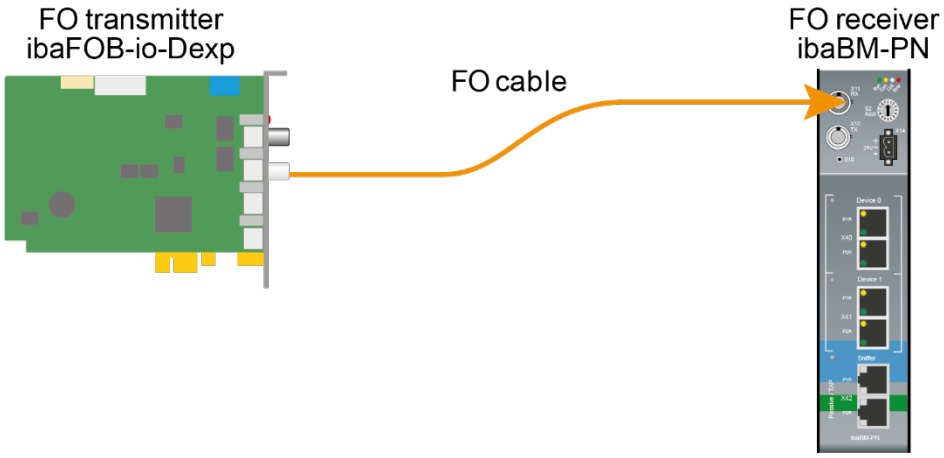


View from the top

[2] MTBF (mean time between failure) according to Telcordia Issue 4 SR332 (Reliability Prediction Procedure of Electronic Equipment; Issue Mar. 2016) and NPRD (Non-electronic Parts Reliability Data 2011).

10.2 Example for FO budget calculation

As an example, an FO connection from an ibaFOB-io-Dexp card (FO transmitter) to an ibaBM-PN device (FO receiver) is used.



The example refers to a point-to-point connection with an FO cable of type 62.5/125 µm. The light wavelength used is 850 nm.

The range of the minimum and maximum values of the output power or receiver sensitivity depends on the component and, among other things, on temperature and aging.

For the calculation, the specified output power of the transmitting device and on the other side the specified sensitivity of the receiving device must be used in each case. You will find the corresponding values in the respective device manual in the chapter "Technical data" under "ibaNet interface".

Specification ibaFOB-io-Dexp:

Output power of FO transmitting interface		
FO cable in µm	Min.	Max.
62.5/125	-16 dBm	-9 dBm

Specification ibaBM-PN:

Sensitivity of FO receiving interface		
FO cable in µm	Min.	Max.
62.5/125	-30 dBm	

Specification FO cable

To be found in the data sheet of the fiber optic cable used:

FO cable	62.5/125 µm
Connector loss	0.5 dB connector
Cable attenuation at 850 nm wavelength	3.5 dB / km

Equation for calculating the FO budget (A_{Budget}):

$$A_{Budget} = |(P_{Receiver} - P_{Sender})|$$

$P_{Receiver}$ = sensitivity of FO receiving interface

P_{Sender} = output power of FO transmitting interface

Equation for calculating the fiber optic cable length (l_{Max}):

$$l_{Max} = \frac{A_{Budget} - (2 \cdot A_{Connector})}{A_{Fiberoptic}}$$

$A_{Connector}$ = connector loss

$A_{Fiberoptic}$ = cable attenuation

Calculation for the example ibaFOB-io-Dexp -> ibaBM-PN in the best case:

$$A_{Budget} = |(-30\ dBm - (-9\ dBm))| = 21dB$$

$$l_{Max} = \frac{21dB - (2 \cdot 0.5dB)}{3.5\ \frac{dB}{km}} = 5.71\text{km}$$

Calculation for the example ibaFOB-io-Dexp -> ibaBM-PN in the worst case:

$$A_{Budget} = |-30\ dBm - (-16\ dBm)| = 14dB$$

$$l_{Max} = \frac{14dB - (2 \cdot 0.5dB)}{3.5\ \frac{dB}{km}} = 3.71\text{km}$$

Note

When connecting several devices as daisy chain (e.g. ibaPADU-8x with 3Mbit) or as ring (e.g. ibaPADU-S-CM with 32Mbit Flex), the maximum distance applies to the section between two devices. The FO signals are re-amplified in each device.

Note

When using fiber optics of the 50/125 µm type, a distance reduction of approx. 30-40% must be expected.

Note

In addition to conventional multimode cable types OM1 (62.5/125 µm) and OM2 (50/125 µm), the other cable types OM3, OM4 and OM5 of the 50/125 µm fiber can also be used.

11 Support and contact

Support

Phone: +49 911 97282-14

E-Mail: support@iba-ag.com

Note

If you require support, specify the serial number (iba-S/N) of the product.

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