RAFI

IO-Link
PLUG. SET. PLAY.

E-BOX IO-LINK

IO-Link Interface Description

Version 2.0, 11/2023

Table of contents

1 Product variants 3

2 Communication 4

3 Parameter overview 5

4 System commands 7

5 Identification 8

6 Process data 9

6.1 Process data in (PDin) 9

6.2 Process data out (PDout) 10

7 Parameter data 11

8 Diagnosis 12

8.1 Status LED 12

8.2 Events 13

8.3 Error Types 14

8.4 Diagnosis Parameter 15

9 Firmware-Update 16

9.1 Updating scenario 16

9.2 Manual disabling of the update capability / interface 16

10 Support 17

11 Disclaimer 18

1 Product variants

Product ID + Device ID	Product Name + Description	Picture
1.24.100.001/0000 0x010011 (hex.) 65553 (dec.)	E-BOX IO-LINK 1.01MP001 1x Pushbutton 1 NO tactile feedback & RGB LED	
1.24.200.001/0000 0x010021 (hex.) 65569 (dec.)	E-BOX IO-LINK 2.01MP001 2x Pushbutton each 1 NO tactile feedback & RGB LED	

You will find more technical datas or drawings in our eCatalog for the specified products. Downloads such as the IODD or IO-Link manufacturer's declaration of conformity and more are also available there.

2 Communication

Vendor ID	1343 (dec.), 0x053F (hex.)
Vendor Name	RAFI GmbH and Co. KG
Vendor URL	www.rafi-group.com
Device ID	see Product Variants
IO-Link Revision	1.1.2
Bit rate	COM2 / 38,4 kBaud
Minimum cycle time	5 ms
Data length of Process Data	PDIN 1 byte / PDOUT 2 byte
SIO mode supported	No
Block parameterization	Yes
Data storage	Yes
IO-Link Application Profiles	Common Profile: Identification & Diagnosis Firmware-Update Profile
IO-Link Function Classes	Common Profile: Device Identification, Process Data Variable, Device Diagnosis, Extended Identification
Connection type	M12 – 4 pole

3 Parameter overview

Name	Index	Sub-index	Data type	Default value
Direct Parameter Page 1	0	0	RecordT	
Direct Parameter Page 2	1	0	RecordT	
System Command	2	0	UIntegerT (8 Bit)	
Data Storage Index	3	0	RecordT	
Device-Access-Locks	12	0	RecordT (16 Bit)	
Profile-Characteristic	13	0	ArrayT of UIntegerT16	
PDInput-Descriptor	14	0	ArrayT of OctetStringT3	
PDOutput-Decriptor	15	0	ArrayT of OctetStringT3	
Vendor Name	16	0	StringT (64 Byte)	RAFI GmbH and Co. KG
Vendor Text	17	0	StringT (64 Byte)	www.rafi-group.com
Product Name	18	0	StringT (64 Byte)	
Product ID	19	0	StringT (64 Byte)	
Product Text	20	0	StringT (64 Byte)	
Serial Number	21	0	StringT (16 Byte)	
Hardware Revision	22	0	StringT (64 Byte)	
Firmware Revision	23	0	StringT (64 Byte)	
Application Specific Tag	24	0	StringT (32 Byte)	***
Functiontag	25	0	StringT (32 Byte)	***
Locationtag	26	0	StringT (32 Byte)	***
Error Count	32	0	UIntegerT (16 Bit)	
Device Status	36	0	UIntegerT (8 Bit)	
Detailed Device Status	37	0	ArrayT	
Process Data IN	40	0	RecordT (8 Bit)	
Process Data OUT	41	0	RecordT (16 Bit)	
Button 1				
Brightness Night Mode	100	0	UIntegerT (8 Bit)	1 (50%)
Blink Mode	120	0	UIntegerT (8 Bit)	0 (1 Hz / 50% Duty Cycle)
Button 2				
Brightness Night Mode	101	0	UIntegerT (8 Bit)	1 (50%)
Blink Mode	121	0	UIntegerT (8 Bit)	0 (1 Hz / 50% Duty Cycle)

Name	Index	Sub-index	Data type	Default value
Variable Colour 1				Orange
R-Value Colour 1	140	0	UIntegerT (8 Bit)	255
G-Value Colour 1	141	0	UIntegerT (8 Bit)	140
B-Value Colour 1	142	0	UIntegerT (8 Bit)	0
Variable Colour 2				Cyan
R-Value Colour 2	143	0	UIntegerT (8 Bit)	135
G-Value Colour 2	144	0	UIntegerT (8 Bit)	206
B-Value Colour 2	145	0	UIntegerT (8 Bit)	250
Variable Colour 3				Magenta
R-Value Colour 3	146	0	UIntegerT (8 Bit)	255
G-Value Colour 3	147	0	UIntegerT (8 Bit)	0
B-Value Colour 3	148	0	UIntegerT (8 Bit)	255
Firmware-Update Configuration	190	0	UIntegerT (8 Bit)	0 (FW-Update enabled)

4 System commands

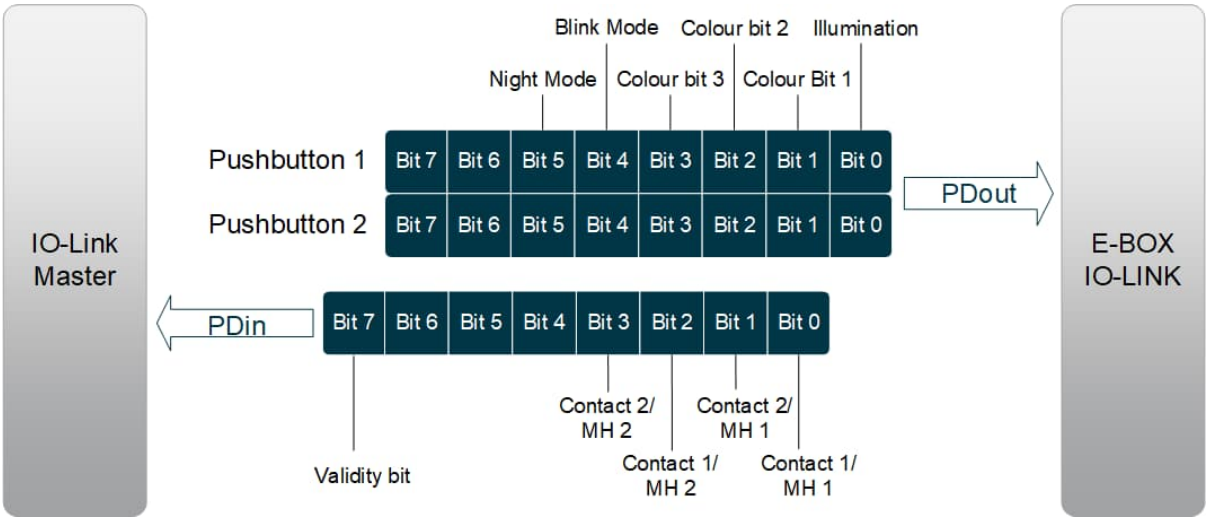
Adress	Index 2, Subindex 0
Datatype	UIntegerT (8 Bit)
AccessRight	Write Only

Commands (hex.)	Commands (dec.)	Text	Description
0x01	1	ParamUploadStart	Start block parameter upload
0x02	2	ParamUploadEnd	End block parameter upload
0x03	3	ParamDownloadStart	Start block parameter download
0x04	4	ParamDownloadEnd	Stop block parameter download
0x05	5	ParamDownloadStore	Finalize block parameterization and start Data Storage
0x06	6	ParamBreak	Cancel block parameterization
0x82	130	Restore Factory Settings	Restore default parameters
0xA0	160	Disable Firmware-Update Feature	Permanently disables the FW-Update Feature

5 Identification

Name	Index	Sub-index	Data type	R/W	Default value	Description
Vendor Name	16	0	StringT (64 Byte)	ReadOnly	RAFI GmbH and Co. KG	
Vendor Text	17	0	StringT (64 Byte)	ReadOnly	www.rafi-group.com	
Product Name	18	0	StringT (64 Byte)	ReadOnly		
Product ID	19	0	StringT (64 Byte)	ReadOnly		
Product Text	20	0	StringT (64 Byte)	ReadOnly		Additional product information for the device
Serial Number	21	0	StringT (16 Byte)	ReadOnly		
Hardware Revision	22	0	StringT (64 Byte)	ReadOnly		xx
Firmware Revision	23	0	StringT (64 Byte)	ReadOnly		x.x.x
Application Specific Tag	24	0	StringT (32 Byte)	ReadOnly	***	Possibility to mark a device with user-specific application identification
Functiontag	25	0	StringT (32 Byte)	ReadOnly	***	Possibility to mark a device with user-specific function identification
Locationtag	26	0	StringT (32 Byte)	ReadOnly	***	Possibility to mark a device with user-specific location identification
Hardware Identification Key	17342	0	StringT	ReadOnly		Unique hardware identifier

6 Process data



6.1 Process data in (PDin)

Name	Bit 7	Bit 6	Bit 5	Bit 4	Bit 3	Bit 2	Bit 1	Bit 0
Validity	1/0							
Contact 1 Mounting Hole 1								1/0
Contact 2 Mounting Hole 1							1/0	
Contact 1 Mounting Hole 2						1/0		
Contact 2 Mounting Hole 2					1/0			

Validity

This bit is used to communicate errors of the product via process data. If a „0“ is sent failures are pending and it does not work properly. If a „1“ is sent, no failures are pending.

Contacts

The use of the contacts in the corresponding mounting holes depends on the variant and is specified in the IODD. The individual characteristics are described in the product descriptions. If a „1“ is sent, the pushbutton and contact is actuated. If a „0“ is sent it is vice versa.

MH 1 = mounting hole 1 = Button 1 → directly after the M12 connector

MH 2 = mounting hole 2 = Button 2 → in opposite to the M12 connector

Attention for E-BOX IO-LINK 1.01MP001 → the only pushbutton is named Button 2 in IODD

6.2 Process data out (PDout)

The displayed byte is identical for all pushbuttons in its mounting holes.

Name	Bit 7	Bit 6	Bit 5	Bit 4	Bit 3	Bit 2	Bit 1	Bit 0
Illumination								1/0
Colour Red					0	0	0	
Colour Green					0	0	1	
Colour Blue					0	1	0	
Colour White					0	1	1	
Colour Yellow					1	0	0	
Variable Colour 1					1	0	1	
Variable Colour 2					1	1	0	
Variable Colour 3					1	1	1	
Blink Mode				1/0				
Night Mode			1/0					

Illumination

This bit is used to activate the illumination of the pushbuttons. If a "0" is sent, the pushbutton is not illuminated. If a "1" is sent, the pushbutton lights up.

Colours

This bit combination of 3 bits is used to set the color of the pushbutton. The respective coding can be taken from the table above. Depending on which bit combination is sent, the pushbutton illuminates in a different colour. The colours red, green, blue, white and yellow are fixed. Default values are set for the variable colours, but these can be changed via the parameter data. For these 3 colors, the RGB values are freely configurable. If the parameters of the variable colours are not changed, the colours orange, cyan and magenta are additionally available as default values.

Blink Mode

This mode determines whether the illumination of the pushbutton flashes or not. If a "0" is sent, the pushbutton is illuminated continuously and does not flash. If a "1" is sent, the pushbutton flashes with the blink mode configured in the parameter data.

Night Mode

The night mode is used to dim the illumination of the key. If a "0" is sent, the pushbuttons light up with 100%. If a "1" is sent, the keys light up with the brightness set in the parameter data.

7 Parameter data

Datatype UIntegerT (8 Bit)

Name	Index	Code (hex.)	Meaning	Default Code (hex.)	Default Meaning
Brightness Night Mode Button 1	100	0x00 0x01 0x02	25% 50% 75%	0x01	50%
Blink Mode Button 1	101	0x00 0x01 0x10 0x11	1 Hz / 50% Duty Cycle 2 Hz / 50% Duty Cycle 1 Hz / 80% Duty Cycle 2 Hz / 80% Duty Cycle	0x00	1 Hz / 50% Duty Cycle
Brightness Night Mode Button 2	120	0x00 0x01 0x02	25% 50% 75%	0x01	50%
Blink Mode Button 2	121	0x00 0x01 0x10 0x11	1 Hz / 50% Duty Cycle 2 Hz / 50% Duty Cycle 1 Hz / 80% Duty Cycle 2 Hz / 80% Duty Cycle	0x00	1 Hz / 50% Duty Cycle
R-Value Colour 1	140	0x00 – 0xFF	RGB-Value in hexadecimal	0xFF	Orange
G-Value Colour 1	141	0x00 – 0xFF	RGB-Value in hexadecimal	0x8C	
B-Value Colour 1	142	0x00 – 0xFF	RGB-Value in hexadecimal	0x00	
R-Value Colour 2	143	0x00 – 0xFF	RGB-Value in hexadecimal	0x36	Cyan
G-Value Colour 2	144	0x00 – 0xFF	RGB-Value in hexadecimal	0xCC	
B-Value Colour 2	145	0x00 – 0xFF	RGB-Value in hexadecimal	0xCC	
R-Value Colour 3	146	0x00 – 0xFF	RGB-Value in hexadecimal	0xFF	Magenta
G-Value Colour 3	147	0x00 – 0xFF	RGB-Value in hexadecimal	0x00	
B-Value Colour 3	148	0x00 – 0xFF	RGB-Value in hexadecimal	0xFF	
Firmware-Update Configuration	190	0x00 0x01 0x02	FW-Update enabled Disable FW-Update FW-Updates disabled	0x00	FW-Update enabled

8 Diagnosis

8.1 Status LED

The status LED of the E-BOX IO-LINK is used to visualize and detect the current status of the individual device. More detailed error messages can be obtained from the event code and its meaning in the event overview.

State of the status LED	Meaning
Red	Device has an error event and is not working properly.
Yellow	There is IO-Link communication, but at the same time there is an error event during the boot up/power up process.
Orange	There is no active IO-Link connection to the device in COM mode.
Green	Device has an active and functioning IO-Link connection in COM mode and no failures are pending.

8.2 Events

If no IO-Link event code is specified, no error message can be transmitted via IO-Link itself. A visual display via status LED is nevertheless provided.

Error text	EventCode (hex.)	Validity Bit	Status LED	Meaning
Illumination error	0x1810	0	red	The illumination is not working properly and fails
Primary supply voltage overrun: Check valid voltage range	0x5110	0	red	The voltage measurement results in a value that is above the permitted range.
Primary supply voltage underrun: Check valid voltage range	0x5111	0	red	The voltage measurement results in a value that is below the permitted range.
Temperature fault - overload	0x4000	0	red	The temperature measurement results in a value that is above the permitted range.
Device temperature under-run	0x4220	0	red	The temperature measurement results in a value that is below the permitted range (insulate device)
General malfunction: Unknown error	0x1000	0	red	Device has a failure event and is not working properly. Please exchange the device.
-	-	0	yellow	A contact is high during the boot up/power up process.
-	-	0	orange	There is no active IO-Link connection to the device in COM mode.

Validity

This bit is used to communicate errors of the product via process data. If a „0“ is sent failures are pending and it does not work properly. If a „1“ is sent, no failures are pending.

8.3 Error Types

Error Types (used for the ISDU response) consist of two octets, the main error cause "ErrorCode" and more specific information "AdditionalCode".

Name	Error Code (hex.)	Additional Code (hex.)	Description
Device application (error – no details)	0x80	0x00	Service has been refused by the device application and no detailed information of the incident is available
Index not available	0x80	0x11	Access occurs to a not existing index
Subindex not available	0x80	0x12	Access occurs to a not existing subindex
Service temporarily not available	0x80	0x20	Parameter is not available due to the current state of the device application
Service temporarily not available – local control	0x80	0x21	Parameter is not available due to the current state of the device application – local operating unit has control
Service temporarily not available – device control	0x80	0x22	Parameter is not available due to the current state of the device application – local device has control
Access denied	0x80	0x23	Write access on a read-only parameter
Parameter value out of range	0x80	0x30	Written parameter value is outside its permitted value range
Parameter value above limit	0x80	0x31	Written parameter value is above its permitted value limit
Parameter value below limit	0x80	0x32	Written parameter value is below its permitted value limit
Parameter length overrun	0x80	0x33	Written parameter length is above its predefined length
Parameter length underrun	0x80	0x34	Written parameter length is below its predefined length
Function not available	0x80	0x35	Written command is not supported by the device application
Function temporarily unavailable	0x80	0x36	Written command is not available due to the current state of the device application

Name	Error Code (hex.)	Additional Code (hex.)	Description
Invalid parameter set	0x80	0x40	Written single parameter collides with other actual parameter settings
Inconsistent parameter set	0x80	0x41	Parameter inconsistencies were found at the end of block parameter transfer, device plausibility check failed
Application not ready	0x80	0x82	Read or write service is refused due to a temporarily unavailable application

8.4 Diagnosis Parameter

Name	Index	Sub-index	Data type	R/W	Value & Meaning
Device Status	36	0	UIntegerT (8 Bit)	Read Only	0: Device is OK 1: Maintenance required 2: Out of specification 3: Functional check 4: Failure
Detailed Device Status Detailed Device Status [1] Detailed Device Status [2] Detailed Device Status [3] Detailed Device Status [4]	37	0	ArrayT (length 4) each element with OctetStringT (3 Byte)	Read Only	Per ArrayT element: Octet 1: EventQualifier Octet 2+3: EventCode in hex. contains identifier of event Dynamic list is implemented to get all present errors (up to 4)
Error Count	32		UIntegerT (2 Byte)	Read Only	Counts all occurred error events since the boot up / power up process

9 Firmware-Update

All product variants are supporting and are equipped with the IO-Link Application Profile Firmware-Update Profile. Therefore the installed E-BOX IO-LINK with its Firmware is updatable.
To ensure the highest safety requirements, the following two sections must always be considered.

9.1 Updating scenario

RAFI proactively contacts all affected customers when a firmware update is necessary. It is also recommended that only IO-Link firmware update files (.iolfw) obtained directly from RAFI are used and installed on the devices. Furthermore, a 64-digit password is required for the update process, which will then be provided by your known RAFI contact.

9.2 Manual disabling of the update capability / interface

If in your planned application for the E-BOX IO-LINK the firmware update interface is considered and evaluated critical from a security point of view, there is the possibility of a shutdown function. If this process is performed manually by the user, this update capability is physically deleted and no longer possible with this product. This means that these products can also be used in security-critical environments.

To disable the firmware update feature finally and irreversibly, you first have to set the parameter Index 190 "Firmware Update Configuration" to 0x01 "Disable FW Update". Then the function can be deleted by executing the system command (Index 2, Subindex 0) 0xA0 "Disable Firmware-Update Feature". Now it is no longer possible to perform a firmware update for this product. This can also be recognized via the "Firmware Update Configuration" parameter, as this is now set to 0x02 "FW updates disabled". It should be explicitly noted that this technical and deliberate deactivation of the update function and thus also interface cannot be reversed in the executed product.

Thus this possibility represents another feature for a user of the E-BOX IO-LINK products. Please note, however, that an IO-Link engineering tool will display the update function even if this is no longer physically possible.

10 Support

If you have any questions regarding the IO-Link products of RAFI, please contact the technical hotline:

E-mail: info.headquarters@rafi-group.com
Phone: +49 751 / 89-6500

Our technical hotline will be happy to answer any questions you may have at the following times (local time Germany):

Monday to Thursday

- 08:00 am to 12:00 am
- 01:00 pm to 05:00 pm

Friday

- 08:00 am to 12:00 am
- 01:00 pm to 03:00 pm

Furthermore you will find more technical datas or drawings in our eCatalog for the specified products. Downloads such as the IODD or IO-Link manufacturer's declaration of conformity are also available there.

11 Disclaimer

Publisher

RAFI GmbH & Co. KG

Ravensburger Str. 128-134, D-88276 Berg / Ravensburg

Tel.: +49 751 89-0, Fax: +49 751 89-1300

www.rafi-group.com, info.headquarters@rafi-group.com

Exclusion of liability

All necessary steps have been taken to ensure that this document is complete and correct. If questions arise regarding specific points despite this, please contact RAFI GmbH & Co. KG or an authorized representative.

The information in this document may be changed without prior notification and does not represent any binding obligation on RAFI GmbH & Co. KG. RAFI GmbH & Co. KG accepts no liability for any errors in this document.