ctrlX I/O

Digital Input Module XI141202
2-channel, DC 24 V, Counter, 10 kHz

DOK-XIO***-XI141202***-DA02-EN-P

R911424708
Edition 02

1 Functional description

The digital input module XI141202 is an up and down counter (32 bit) and used to detect binary 24 V control signals in a ctrlX I/O station.

The module is designed with two separate counters, each with its own control input. This control input determines the counter direction or is used as Gate input. The two outputs are switched depending on the counter reading and can be used as fast control signals.

The signal state of the inputs and outputs is shown at the channel LED on the removable peripheral plug.

The logic and peripheral supply as well as the EtherCAT-based module communication are routed through the module.

ℹ For an application manual of the ctrlX I/O modules, refer to the media directory ➦ www.boschrexroth.com/mediadirectory and enter the search term ➦ "R911423458".

ℹ Ensure that the current documentation is consulted. For the current documentations, go to ➦ www.boschrexroth.com/mediadirectory and enter the module type as search term.

ℹ For the integration into the parent system, the respective ESI files are available. For the ESI files, go to ➦ http://www.boschrexroth.com/electrics, search term "➦ ESI-Files".

2 Ordering data

Type	Part number	Description
XI141202	R911421639	Digital input module, 2-channel, DC 24 V, counter, 10 kHz

ℹ For further ordering data (accessories), refer to the application manual for the ctrlX I/O modules, see media directory ➦ www.boschrexroth.com/mediadirectory. Use the search term ➦ "R911423458".

3 Technical data

3.1 General technical data

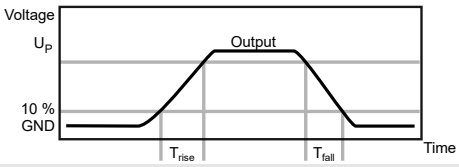
Number of channels	2
Inputs per channel	1 × counter input 1 × configuration input
Outputs per channel	1 × control output
Connection method	Push-in terminal
Nominal voltage (U_L/U_P)	DC 24 V (19.2 V to 30 V, including tolerance and residual ripple) PELV/SELV (safety extra-low voltage)
Process data update	Max. 53.603 µ (typ. 46 µs)
Current consumption U_L	35 mA
Current consumption U_P	36 mA + load U_{OUT} 24 V
Max. power consumption of the module	1.949 W
Bit width in the process data image (incl. fill bits)	4 byte output, 12 byte input
Configuration	No address or configuration setting required
Dimensions	12 mm × 105 mm × 99 mm (Width × height × depth)
Weight	88 g (module including connector)
Electrical isolation	DC 1200 V U_P to U_L, DC 707 V U_P/U_L to FE, tested for 60 s each (not evaluated by UL)
EMC resistance	Acc. to EN 61000-6-2 and EN 61000-6-4
Mounting position	Vertical, on a horizontal mounting rail
Labeling, approvals	CE, UKCA, UL

3.1.1 Digital inputs

Specification	EN 61131-2, type 1/3
Counting frequency	10 kHz max.
Input filter	Adjustable: 25 µs, 100 µs, 500 µs, 1 ms, 3 ms
Connection technique	2-wire (counter input), 1-wire (configuration input), unshielded cable
Signal voltage "0"	-3 V to 5 V
Signal voltage "1"	11 V to 30 V
Input current	Typically 2.4 mA
Max. Output current per clamping point U_{OUT} 24 V	1 A
Max. total current U_{OUT} 24 V	2 A

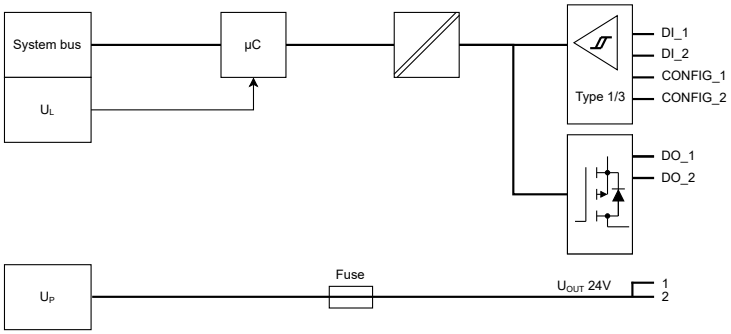
3.1.2 Digital outputs

Connection technique	1-wire, unshielded cable
Output current max.	0.5 A per channel
Total current of channels	1 A
Nominal load	Ohmic, 12 W max. (48 Ω; at nominal voltage)
Minimum load	10 kΩ



Rising time (T_{Rise})	Without load: 27.3 µs on the digital input 25.1 µs at 240 Ω, 100 mA Ohmic nominal load: 28.9 µs at 48 Ω, 500 mA
Fall time (T_{FALL})	Without load: 1.18 ms on the digital input 17.9 µs at 240 Ω, 100 mA Ohmic nominal load: 18.6 µs at 48 Ω, 500 mA
Inductive switch-off energy	150 mJ max. per channel
Overload response	Granular switch-off with automatic restart
Feedback voltage resistance	Not resistant to feedback, external measures required

3.2 Internal schematic diagram



3.3 Ambient conditions

Ambient temperature	
≤ 2,000 m	-25 to +55 °C
2,000 m to 3,000 m	-25 to +50 °C
3,000 m to 4,000 m	-25 to +45 °C
4,000 m to 5,000 m	-25 to +40 °C
Maximum operating altitude Acc. to DIN 60204	5,000 m
Ambient temperature (storage and transport)	-40 to +70 °C
Permitted air humidity according to DIN EN 61131-2 (Operation, storage, transport)	10 to 95 %
Degree of protection Acc. to DIN EN 60 529	IP20 (not evaluated by UL)
Protection class Acc. to DIN EN 61010-2-201	III
Overvoltage category Acc. to IEC 60664-1	2
Contamination level Acc. to EN 61010-1	2, no condensation

NOTICE

Defective device due to contaminated air!

- The ambient air must not contain acids, alkaline solutions, corrosive agents, salts, metal vapors and other electrically conductive contaminants in high concentrations.
- The devices to be installed into the housings and installation compartments must at least comply with the degree of protection IP 54 according to DIN EN 60529.
- The device shall be provided in a suitable fire enclosure in the end-use application.

NOTICE

Defective device due to gases jeopardizing functions

Due to the risk of corrosion, avoid sulphureous gases (e.g. sulphur dioxide (SO_2) and hydrogen sulphide (H_2S)). The device is not resistant against these gases.

NOTICE

Defective device due to overheating

To avoid overheating and to ensure a trouble-free operation of the device, the ambient air has to circulate. Also refer to the section “Installation notes”.

3.4 Mechanical tests

Vibration resistance Acc. to DIN EN 60068-2-6	Oscillations, sinusoidal in all three axes, 5 Hz - 8,4 Hz with 3.5 mm amplitude 8.4 Hz -150 Hz with 1 g peak acceleration
Shock test Acc. to DIN EN 60068-2-27	Shock stress: Shock resistance in all three axes 11 ms semi-sinusoidal 15 g
Broadband noise Acc. to DIN EN 60068-2-64	20-500 Hz with 1.22 g RMS (Root Mean Square), 30 min in all three axes

For the current approvals, go to
➥ www.boschrexroth.com/electrics.

4 For your safety

4.1 Intended use

Use the module only as specified in the data sheet.

4.2 User qualification

The product use described in this data sheet is only intended for qualified electricians and staff trained by these qualified electricians. The user has to be familiar with the known safety concepts on automation technology, applicable standards and other guidelines.

4.3 Electrical safety

NOTICE

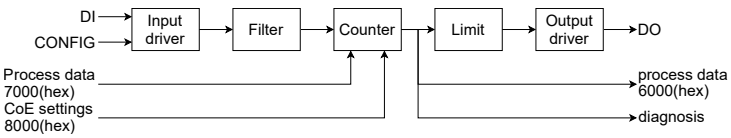
Loss of electric safety

Unintended handling can affect the device safety! Observe the notes in the present data sheet during installation, commissioning and operation.

5 Signal processing

5.1 General information on signal processing

The module is used for precise, signed counting of events or pulses at the counter inputs. It has two completely independent counter channels.



Each counter is designed with a 32-bit data width. Counter value and status information are provided to the parent automation device via process data.

The function of the configuration pin can be set via the object 80x0:06(hex) "Config pin mode". This can be used to select either the counting direction or the Gate function. Both can also be selected via process data: The counting direction with object 70x0:03(hex) "Up/Down" and the Gate function with 70x0:02(hex) "Gate".
If the counting direction is selected via the configuration pin, the "Up/Down" process data bit has no function. If the gate is set via the configuration pin, the gate can still be set via process data. If the gate is set, the counter is frozen.

Defined filter times of the counter input between 25 µs and 3 ms is adjustable via the object 80x0:08(hex) "Filter settings".

5.2 Distinctive values

The following limit values cannot be exceeded or it cannot be fallen below them:

Maximum value: 2.147.483.647
Minimum value: -2.147.483.648

When these limits are exceeded, the counter is stopped, the respective status bit is set in the process data and a diagnostics is sent. Diagnostics are "8910(hex) Overrange at channel x" and "8920(hex) Underrange at channel x".

To enable the counter function again, reset he counter via the"Reset counter" bit in the process data to the value defined in the object 80x0:01(hex) "Reset value".

5.3 Synchronizing the application

The application is synchronized in the "SM synchronous" mode.

New process data values are applied to the module with each EtherCAT cycle.

5.4 Limit value check

The limit value check (limit) with adjustable hysteresis checks the value of the counter. The check is carried out individually for each counter channel.

The object 80x0:04(hex) "Enable Limit" can be used to enable the optional limit value check and can be configured via 80x0:02(hex) "Limit upper threshold" and 80x0:03(hex) "Limit lower threshold". If the counter value is greater than "Limit upper threshold", the limit status bit is set. Only when the counter value falls below "Limit lower threshold ", the limit status bit is reset again.

The digital output returns the value of the limit value check. It can be configured as low- or high-active via the object 80x0:05(hex) "Output pin mode". If the output is enabled, it switches according to the limit status. The output issues this status immediately irrespective of the EtherCAT cycle or a user application on the control.

6 Object directory

6.1 CoE standard objects

The object directory of the module contains objects that can be triggered via SDO services. These are defined in the ETG standards:

Index (hex)	Name
1000	Device type
1001	Error register
1008	Device name
1009	Hardware version
100A	Software version
1018	Identify
10F1	Error settings
10F3	Diagnosis history
10F8	Timestamp object
16nn	PDO mapping RxPDO
1Ann	PDO mapping TxPDO
1C00	Sync manager type
1C12	Sync manager 2 assignment
1C13	Sync manager 3 assignment
1C32	SM output parameter
1C33	SM input parameter
F000	Modular device profile
F100	Device state

6.2 Module-specific CoE objects

Objects with a module-specific design are described in the following table.

Index (hex)	Object name	Data type	Access	Description
A000	**ModuleIdentification**			
A000:0	Material number	String(20)	RO	Part number of the module
A010:0	Full serial number	String(20)	RO	Complete serial number of the module
F100	**Module diagnostics and information**			
F100:01	Periphery voltage OK	BIT1	RO	Indicates the peripheral voltage state, 1 = OK; 0 = Not OK
F100:02	Error	BIT1	RO	General module error

6.3 COE objects for parameterization

The module can be parameterized using these objects. Each channel can be freely parameterized. To do so, use the start parameters. The Engineering provides user-friendly support.

ℹ The module does not remanently store the parameter values. To automatically load the settings required upon each bus start, set the values in the start parameters of the Engineering.

Index (hex)	Object name	Data type	Access	Description	Default (hex)
8000 8010	**Channel 1, 2 settings**				
80x0:01*	Reset value	Int32	RW	Reset value The reset value is applied via the object 70x0:01(hex) "Reset"	0
80x0:02*	Limit upper threshold	Int32	RW	Upper limit vale The limit values for the check are applied via the object 70x0:04(hex) "Limit"	0
80x0:03*	Limit lower threshold	Int32	RW	Lower limit value The limit values for the check are applied via the object 70x0:04(hex) "Limit"	0
80x0:04	Enable limit	Bit1	RW	Enables the limit value check of the channel 0: Disabled 1: Enabled	0
80x0:05	Output pin mode	BIT2 ENUM	RW	Defines the mode of the output pin 0: Disabled 1: high active – The result of the limit value check is output directly 2: low active – The result of the limit value check is output invertedly	0
80x0:06	Config pin mode	BIT3 ENUM	RW	Defines the function of the Config pins 0: Disabled 1: up/down counter 2: down/up counter 3: gate high active 4: gate low active	0
80x0:07	–	BIT2	–	Fill bits	
80x0:08	Filter settings	BIT3 ENUM	RW	Defines the filter time of the counter input 1: 25 µs 2: Reserved 3: 100 µs 4: Reserved 5: 500 µs 6: 1 ms 7: 3 ms	1: 25 µs
80x0:09	–	BIT5	–	Fill bits	

* = It can also be written to these objects in the states "SafeOP" and "OP".

In the "PreOP" state, it can be written to all objects for parameterization. "Reset Value", "Limit upper threshold" and "Limit lower threshold" can also be written in the "SafeOp" and "Op" states. For activation in these two states, there has to be a rising edge of the process data "Reset Counter" or "Limit".

7 Process data

7.1 General process data

7.1.1 Input process data

Index (hex)	Object name	Data type	Digit	Description	Default (hex)
6000	**Channel 1, 2 counter**				
6020					
60x0:01	Value	INT32	RO	Counter value of the channel	0
6010	**Channel 1, 2 state**				
6030					
60x0:01	Input pin value	BOOL	RO	State of the frequency input	0
60x0:02	Limit	BOOL	RO	Result of limit value check 0: Limit value not reached 1: Limit value reached	0
60x0:03	Gate	BOOL	RO	Status of the Gate function 0: Counter disabled 1: Counter disabled	0
60x0:04	Up/down	BOOL	RO	Counting direction of the counter 0: Up 1: Down	0
60x0:05	Overflow	BOOL	RO	Exceeding the upper range limit 1: Counter left counting range at upper limit	0
60x0:06	Underflow	BOOL	RO	Exceeding the lower range limit 1: Counter left counting range at lower limit	0
60x0:07	–	BIT10	–	Fill bits	–

7.1.2 Output process data

Index (hex)	Object name	Data type	Access	Description	Default (hex)
7000	**Channel 1, 2 control**				
7010					
70x0:01	Reset counter	BOOL	RW	Switching from 0 to 1 resets the counter to the "Reset Value"	0
70x0:02	Gate	BOOL	RW	Control of the Gate function by the application 0: Disabled 1: Enabled, counter stopped	0
70x0:03	Up/down	BOOL	RW	Specification of the counting direction. This value is not evaluated if the counting direction is specified by the Config pin, see object 80x0:06(hex) "Config pin mode". 0: Up counter 1: Down counter	0
70x0:04	Limit	BOOL	RW	When switching from 0 to 1, the new values from the CoE object 80x0:02(hex) and 80x0:03(hex) are applied for the limit value check.	0
70x0:05	–	BIT12	–	Fill bits	–

7.2 Disabling channels

The individual objects of the process data can be disabled individually. If the counter values of a channel, i.e. object 6000(hex) or 6020(hex) or respectively PDO assignment 1A00(hex) or 1A02(hex) are disabled, the channel is no longer refreshed. Thus, the other channel data in the process data and in the CoE objects are no longer up-to-date.

8 Diagnostic strategy

8.1 Mechanisms

Different mechanisms are used for the diagnostics of the module.

Mechanism	Diagnostics
EtherCAT state machine	EtherCAT system diagnostics
EtherCAT hardware watchdog	
Diagnostic objects in the CoE object directory	Extended diagnostics, e.g. peripheral errors
10F1(hex)	Error settings
Diagnosis history object	20 diagnostic messages can be stored
10F3(hex)	Diagnosis history
Module status LED	Shows the general module status
Channel status LED	Signals the channel status or the error states

8.2 Diagnosis history

The object 10F3(hex) is implemented as ring memory into the "Overwrite mode". The latest 20 diagnostic messages are stored. Older messages are deleted.

The following table shows the structure of the Diagnosis History object.

Index (hex)	Sub-index	Object name	Data type	Rights	Meaning
10F3		Diagnosis history			Diagnostic statistics
	01	Maximum messages	UINT8	R	Maximum number of messages
	02	Newest message	UINT8	R	Latest message
	03	Newest acknowledged message	UINT8	R/W	Latest confirmed message. Writing "0" deletes the messages in the ring memory.
	04	New messages available	Boolean	R	New message available
	05	Flags	UINT16	R/W	Setting of the object response. Refer to ETG.1020
	06 - 26	Diagnosis message	String	R	Diagnostic message according to ETG.1020

8.3 Status codes

Text ID (hex)	Type	Description
1000	Error	Module error <opt. info>
1020	Warning	Error during update, data corrupted, please update again
3400	Error	Periphery supply voltage (U_P) missing
6820	Warning	Complete Access of subindex <index>:<subindex> not allowed
8910	Warning	Overrange at channel <channel nb>
8920	Warning	Underrange at channel <channel nb>

8.4 Module status LED

Device state	LED flashing pattern
Booting	BU BU BU BU BU -- -- -- -- -- ⮌
Initialization	BU BU BU BU BU BU BU BU BU BU ⮌
It is currently configured. Module not yet ready.	GN GN GN GN GN -- -- -- -- -- ⮌
Process data transmission, outputs inactive.	GN GN GN GN GN GN GN GN GN -- ⮌
Module in "Run" state	GN GN GN GN GN GN GN GN GN GN ⮌
Error and warning states	
Logic or peripheral voltage error	RD RD RD RD RD RD RD RD RD RD ⮌
Communication or configuration error	RD RD RD RD RD -- -- -- -- -- ⮌

ℹ One square corresponds to a period of 200 ms.
The arrow represents the end of a cycle.

-- LED is not on.

BU LED is blue.

GN LED is green.

RD LED is red.

ℹ A new status is only displayed after the previous flashing cycle has elapsed. A change in status can thus be delayed up to two seconds.

8.5 Channel status LED

Each input and output of the module is provided with a channel status LED at the respective signal pin of the plug. Refer to ➦Chapter 9.1 “Clamping point assignment” on page 5.

LED	Logic signal state
Off	0
Green	1

9 Installation

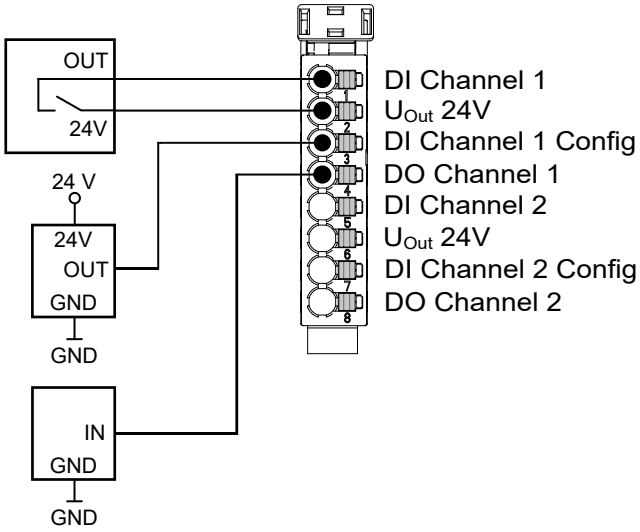
9.1 Clamping point assignment

Clamping point	Signal	LED	Pusher
1	DI channel 1	Green	Grey
2	U_{OUT} 24 V	None	Grey
3	DI channel 1 Config	Green	Grey
4	DO channel 1	Green	Grey
5	DI channel 2	Green	Grey
6	U_{OUT} 24 V	None	Grey
7	DI channel 2 Config	Green	Grey
8	DO channel 2	Green	Grey

ℹ Connection notes:

- The U_P 24 V outputs are only to be used as switching potential to the respective input.
- These outputs may not be used as peripheral voltage supply.
- To supply the connected actuators, use the potential distribution terminals, e.g. XI822116.

9.2 Wiring example



9.3 Mounting and installation

The application manual for the ctrlX I/O modules contains notes on installation, mounting and dismounting. For the application description, go to:

- ➦www.boschrexroth.com/MediaDirectory,
  Search term: ➦"R911423458"
  or
- ➦https://docs.automation.boschrexroth.com/doc/4126711705/ctrx-i-o-anwendungsbeschreibung/latest/en/.

NOTICE

Destruction of the device due to non-compliance with the application manual

Follow the mounting instructions in the application manual to ensure a correct mounting and to prevent damage to the device.

10 Firmware update via FoE

⚠ WARNING

Risk of injury due to unsafe machine states

The machine has to be in a safe state before updating.

The firmware of the module can be updated via FoE. For new firmware files, go to ➦ www.boschrexroth.com/mediadirectory and search for the type code of the module.

A firmware module can be updated with all EtherCAT masters supporting the file download via FoE. The module has to be in the BOOTSTRAP state. Entering a password or a file name is not required.

If the update has been completed successfully, the module is restarted as soon as the module state changes from BOOTSTRAP to another state. The reloaded firmware is started.

ℹ Do not disconnect the voltage supply of the module during the file transfer.
Please note that the logic voltage supply is temporarily interrupted for the following modules when completing the firmware update of the bus coupler and a subsequent restart.

ℹ If switching to INIT is not possible, disconnect the ctrlX I/O from the power supply and connect it again.

ℹ The new firmware version might require an updated description file in the Engineering to use new functions. For details, refer to the release notes.
Check whether the latest version of the description file is installed.

10.1 ctrlX I/O Engineering

Within the ctrlX I/O Engineering, the required user interface is only displayed for modules supporting a firmware update.

1. Switch the EtherCAT master of the ctrlX CORE to the "INIT" state.

2. First change to the active state in the ctrlX I/O Engineering by enabling “Show online data”.
   ➡ This is the requirement to update the firmware. The corresponding user interface tab is only displayed if the requirement is met.
3. To open the device editor, double-click on the module in the ctrlX I/O Engineering device tree and select the “FoE”. tab.
4. In the “Download” section, select the firmware file (*.EFW) under “Local file name”. Ensure that this is the correct file for the module to be updated.
5. Check that the option “Required state” is active under “Details” and that "BOOTSTRAP" is selected.
6. Use the “Download” button to start the firmware update.

11 License information

11.1 EtherCAT®

The ctrlX I/O modules use EtherCAT® technology. "EtherCAT®" is a registered trademark and patented technology licensed by the Beckhoff Automation GmbH, Germany. EtherCAT is an open, internationally standardized standard and developed further by the "EtherCAT Technology Group" (ETG).

11.2 Libhydrogen

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11.3 Ring-buffer

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