X20(c)DC2190

Data sheet
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Version history

B&R makes every effort to keep documents as current as possible. The most current versions are available for download on the B&R website (www.br-automation.com).

1 General information

1.1 Other applicable documents

For additional and supplementary information, see the following documents.

Other applicable documents

Document name	Title
MAX20	X20 System user's manual

1.2 Coated modules

Coated modules are X20 modules with a protective coating for the electronics component. This coating protects X20c modules from condensation and corrosive gases.
The modules' electronics are fully compatible with the corresponding X20 modules.

For simplification purposes, only images and module IDs of uncoated modules are used in this data sheet.

The coating has been certified according to the following standards:

- Condensation: BMW GS 95011-4, 2x 1 cycle
- Corrosive gas: EN 60068-2-60, method 4, exposure 21 days

1.3 Order data

Order number	Short description	Figure
	Counter functions	
X20DC2190	X20 digital counter module, ultrasonic path measurement module, interfaces: EP start/stop, DPI/IP, 2 path measurement rods, 4 path recorders	
X20cDC2190	X20 digital counter module coated, ultrasonic path measurement module, interfaces: EP start/stop, DPI/IP, 2 path measurement rods, 4 path recorders	
	Required accessories	
	Bus modules	
X20BM11	X20 bus module, 24 VDC keyed, internal I/O power supply connected through	
X20BM15	X20 bus module, with node number switch, 24 VDC keyed, internal I/O power supply connected through	
X20cBM11	X20 bus module, coated, 24 VDC keyed, internal I/O power supply connected through	
	Terminal blocks	
X20TB12	X20 terminal block, 12-pin, 24 VDC keyed	

Table 1: X20DC2190, X20cDC2190 - Order data

1.4 Module description

The module is designed for connecting 2 transducer rods with a total of up to 4 paths. That means, for example, that 2 ultrasonic transducers with 2 magnets each or one with 4 magnets can be used. The combination 3/1 is also possible. The module provides 24 VDC as an external supply for the sensor.

Functions:

- Linear position sensor
- Monitoring the measuring rods

Linear position sensor

The module provides 4 channels for ultrasonic linear position sensors. This allows both distance and speed measurements to be performed.

Monitoring the linear position sensor

The status of the linear position sensor is monitored for supply voltage and protocol errors.

2 Technical description

2.1 Technical data

Order number	X20DC2190	X20cDC2190
Short description		
I/O module	Ultrasonic path measurement module, 2 path measurement rods, 4 path recorders, speed measurement	
General information		
B&R ID code	0x2188	0xEE9D
Status indicators	I/O function per channel, operating state, module status	
Diagnostics		
Module run/error	Yes, using LED status indicator and software	
Power consumption		
Bus	0.01 W	
Internal I/O	1.1 W	
Additional power dissipation caused by actuators (resistive) [W]	-	
Certifications		
CE	Yes	
UKCA	Yes	
ATEX	Zone 2, II 3G Ex nA nC IIA T5 Gc IP20, Ta (see X20 user's manual) FTZÚ 09 ATEX 0083X	
UL	cULus E115267 Industrial control equipment	
HazLoc	cCSAus 244665 Process control equipment for hazardous locations Class I, Division 2, Groups ABCD, T5	
KC	Yes	-
Channels for path and speed measurements		
Quantity	2	
Supported encoder types	Start/Stop interface EP start/stop interface DPI/IP interface	
Encoder power supply		
Voltage	24 VDC, module-internal, max. 150 mA	
Monitoring	Configurable overvoltage/undervoltage monitoring (±10%, ±15%, ±20%, ±25%)	
Short-circuit proof	Rev. D0 and later	
Input and output level	RS422 differential level	
Multi-magnet measurement	Yes, in combination per rod, max. 4 magnets total	
Outputs	1.6 µs durational initialization pulse	
Inputs		
Path measurement	Resolution = 0.01 mm, measurement range = ±5.2 m	
Speed measurement	Resolution = 0.1 mm/s, measurement range = ±3.2 m/s	
Accuracy	±50 ppm ±5 ppm/year	
Short-circuit protection	No	
Electrical properties		
Electrical isolation	Channel isolated from bus Channel not isolated from channel	
Operating conditions		
Mounting orientation		
Horizontal	Yes	
Vertical	Yes	
Installation elevation above sea level		
0 to 2000 m	No limitation	
>2000 m	Reduction of ambient temperature by 0.5°C per 100 m	
Degree of protection per EN 60529	IP20	
Ambient conditions		
Temperature		
Operation		
Horizontal mounting orientation	-25 to 60°C	
Vertical mounting orientation	-25 to 50°C	
Derating	-	
Storage	-40 to 85°C	
Transport	-40 to 85°C	

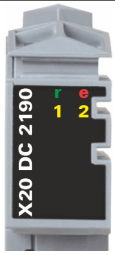
Table 2: X20DC2190, X20cDC2190 - Technical data

Order number	X20DC2190	X20cDC2190
Relative humidity		
Operation	5 to 95%, non-condensing	Up to 100%, condensing
Storage	5 to 95%, non-condensing	
Transport	5 to 95%, non-condensing	
Mechanical properties		
Note	Order 1x terminal block X20TB12 separately. Order 1x bus module X20BM11 separately.	Order 1x terminal block X20TB12 separately. Order 1x bus module X20cBM11 separately.
Pitch	12.5$^{+0.2}$ mm	

Table 2: X20DC2190, X20cDC2190 - Technical data

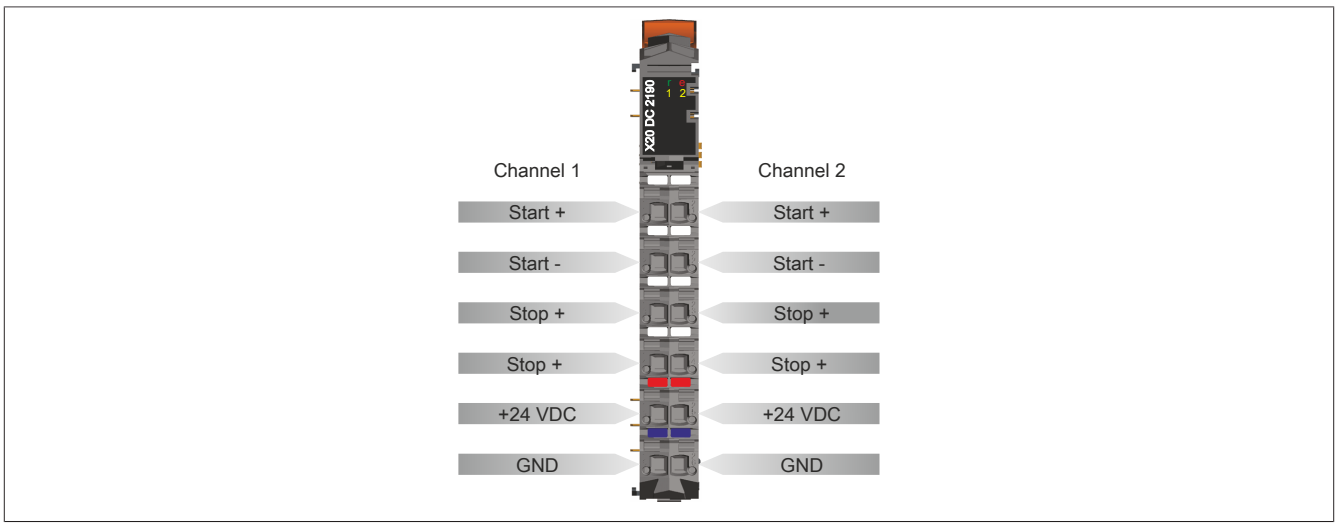
2.2 LED status indicators

For a description of the various operating modes, see section "Additional information - Diagnostic LEDs" in the X20 System user's manual.

Figure	LED	Color	Status	Description
	r	Green	Off	No power to module
			Single flash	Reset mode
			Double flash	Boot mode (during firmware update)[1)]
			Blinking	PREOPERATIONAL mode
			On	RUN mode
	e	Red	Off	No power to module or everything OK
			On	Error or reset status
	1 - 2	Yellow	Off	No transducer rod connected
			On	Transducer rod is connected to the respective measurement channel

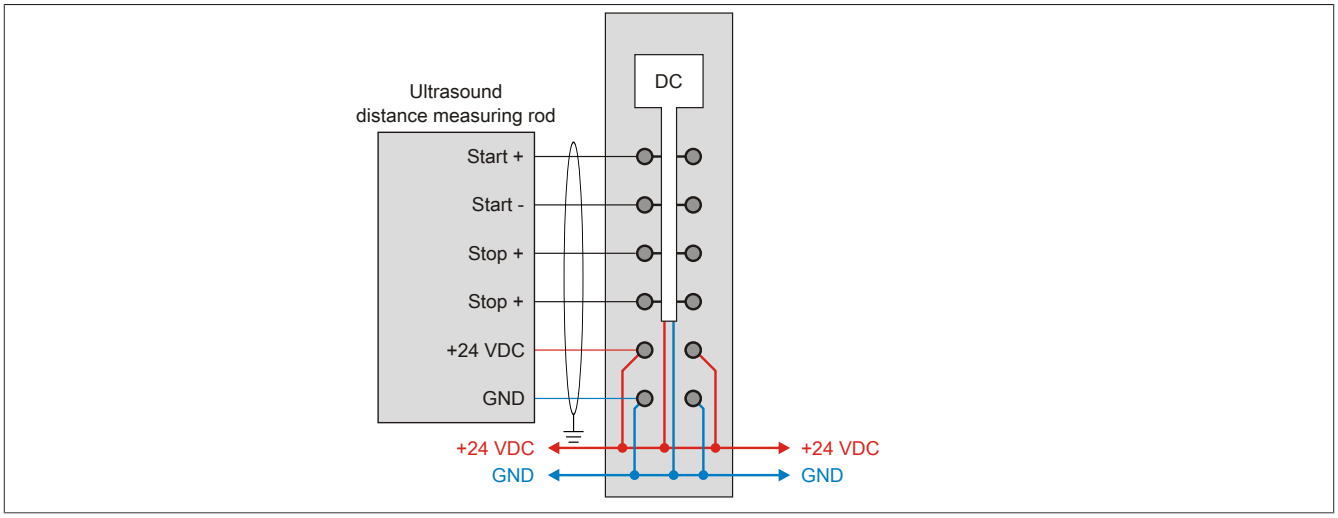
1) Depending on the configuration, a firmware update can take up to several minutes.

2.3 Pinout



The ultrasonic displacement transducer must be connected using shielded cables. The encoder cable shielding is connected to ground potential via the shielding connection in the X20 bus module.

2.4 Connection example



3 Function description

3.1 Linear position sensor

The module is designed for the connection of linear position sensors with a total of up to 4 paths. 1, 2, 3 and 4-magnetic rod measurements are possible. This means, for example, that 2 ultrasonic encoders can be operated with 2 magnets each or one with 4 magnets. The combination 3 and 1 is also possible.

The module can be used to determine distances and calculate speeds at the same time. A resolution of 0.1 mm/s is achieved by calculating the speed from 2 position values that are 100 ms apart.

The ultrasonic linear position sensors are connected directly to the RS422 interface. Start/stop signals are used to communicate with the measuring rod.

The DPI/IP protocol can also be used to directly read running differences in the rod, for example. In the event of servicing (when replacing a rod), the machine can be returned to operation quickly and without additional configuration.

3.1.1 DPI/IP protocol (BALLUFF) / EP protocol (MTS)

For dipsticks with DPI/IP protocol or EP protocol, the data read is stored in the status registers after the parameter upload has been completed. For a measuring rod with EP protocol, registers "StatusInput19" to "StatusInput36" remain empty (0x0000).

Requirements for successfully uploading the measuring rod parameters to the module:

1. Selection of the communication protocol (DPI/IP or EP). See "Channel configuration" on page 19
2. Transducer rod must support the respective protocol.
3. If the transducer rod does not support the selected protocol, the module will detect this after a time-out of approx. 300 ms and will treat the rod as a "normal" transducer rod.

After the module is started or after a transducer rod is connected, the parameter upload should be complete within 200 to 400 ms.

A communication error causes the data upload to cancel. A new upload attempt can be initiated by the user by deactivating and reactivating the communication protocol using asynchronous access.

All rod parameters can be read to the controller using asynchronous access. The read parameters "rod length" and "ultrasonic speed" are **NOT** automatically uploaded to the module.

It is left up to the application whether the upload values for rod length 1 and rod length 2 or for ultrasonic speed 1 and ultrasonic speed 2 are uploaded.

Information:

Keep in mind that no position measurements can be performed on a rod while parameters are being uploaded. The module freezes all existing position/speed data for all magnets on the rod while the parameters are uploading. Parameters should therefore only be uploaded with the machine stopped, and this should be ensured by the application.

3.2 Monitoring the measuring rods

3.2.1 Error messages

The error state is displayed for each channel. These can be:

- **Plausibility error:**
  If a plausibility error occurs, the plausibility error counter counts up and, depending on the configuration, either the last plausible measured value or the implausible measured value is forwarded to the controller.
- **Incorrect measurements:**
  No valid measurement could be performed on the channel in question.

Reasons for plausibility errors can be:

- Configured maximum or minimum path limit of the respective magnets exceeded
- Exceeding the configured maximum magnet speed

Reasons for incorrect measurements can be:

- Exceeding the configured rod length
- Rod failure
- Missing measuring magnet

Information:

If registers "USSpeed01 and USSpeed02" on page 18 are not equal to 0 after startup of the module, the respective error counters may count up until the module is fully configured with slow fieldbuses (e.g. CAN I/O). The reason for this is that the standard configuration may not be suitable for the respective connected rod.

Information:

The register is described in "Error status" on page 17.

3.2.2 Status messages

The status of each measuring rod is recorded.

Name	Value	Information
Supply voltage too low	0	Supply voltage OK
	1	Supply voltage too low
Supply voltage too high	0	Supply voltage OK
	1	Supply voltage too high
Rod OK	0	OK
	1	Disabled or not initialized
Rod 2	0	OK
	1	Disabled or not initialized
Protocol error	0	Protocol error (data invalid)
	1	Protocol OK (data valid)

Note about bit "Protocol error"

If this bit is set to "1", configuration data could be read from the rod using the DPI/IP or EP protocol. This data can now be read into the application using asynchronous access.

Information:

The register is described in "Status information about the transducer rods" on page 17.

4 Commissioning

4.1 Using the module on the bus controller

Function model 254 "Bus controller" is used by default only by non-configurable bus controllers. All other bus controllers can use other registers and functions depending on the fieldbus used.

For detailed information, see section "Additional information - Using I/O modules on the bus controller" in the X20 user's manual (version 3.50 or later).

4.1.1 CAN I/O bus controller

The module occupies 4 analog logical slots on CAN I/O.

4.2 Commissioning a linear position sensor

To initialize an ultrasonic linear position sensor and obtain valid measured values, 2 registers must be configured. The length corresponding to the rod must first be entered (see "Rod length 1 and 2" on page 19). After configuration, the wave propagation speed corresponding to the rod must be configured (see "Ultrasonic speed specification" on page 18). Both specifications can usually be found directly on the linear position sensor or in its data sheet.

If the plausibility limits remain set to 0 (default value), one of the respective ErrorStatus registers will now indicate faulty readings or plausibility errors. If this is the case, plausibility mode can be disabled using the "ConfigOutput01" register (see "Module configuration" on page 18). This will cause the positions of the magnets to be displayed on the rod.

4.2.1 Defining ultrasonic speed and recovery time

As long as the registers for the ultrasonic speed have the value 0, the module does not perform any measurements on the rod in question. The following are disabled:

- The automatic check whether a rod is connected
- Parameter upload via DPI/IP or EP protocol

If a value >0 but <1000 cm/s is transferred, the module freezes all measured values and error counters of the affected measuring rod, regardless of the plausibility mode configuration. Based on the standard ultrasonic speed of 280,000 cm/s however, the formula continues to generate periodic measurement start pulses under recovery time. This also means that the rod control is still active (connected/disconnected or parameter upload).

As soon as a valid value (≥1000) is transferred, the module recalculates the measurement rate and starts the position/speed measurement.

Recovery time

Ultrasonic transducer position sensors require a certain recovery time between 2 measuring processes so that the ultrasonic wave can decay sufficiently. Otherwise, there is a risk that the next measurement will be falsified (especially if there is more than 1 magnet on the rod).

Depending on the setting, the module waits at least 2 or 3 times (standard setting) the transit time of the ultrasonic wave in the measuring rod. With the standard function model, the next measurement is triggered synchronously with the next X2X Link cycle.

The runtime calculation is based on the settings for the rod length plus a safety margin of 100 mm and the ultrasonic speed:

- Ultrasonic transducer runtime = (sensor length + 100 mm) / ultrasonic speed

BALLUFF recommends a waiting time for its rods that corresponds to 3 times the maximum runtime of the ultrasonic wave in the measuring rod. This is also the default setting of the module.

Switching to twice the runtime can be useful if the measuring rate is otherwise too slow. However, this is only permitted after consulting the rod manufacturer!

Information:

The registers are described in "Ultrasonic speed specification" on page 18 and "Channel configuration" on page 19.

4.2.2 Defining the zero position

An offset position (zero position) must be assigned to the displacement transducer for each magnet. The maximum and minimum magnet paths (see "Plausibility check configuration" on page 20) refer to this offset specification. If the offset is recalculated, this is the new zero position. The content of the offset register remains unaffected.

Instead of defining the offset position using configuration registers, the offset position can also be defined using register StatusOutput01. If the respective bit changes from 0 to 1 in "StatusOutput01", the current mechanical position of the respective magnet then becomes the calculated zero position Register ("Position0x" = 0).
From that moment, the current mechanical position will be subtracted from all future measured positions. This is essentially a type of referencing. The maximum and minimum magnet paths (see "Plausibility check configuration" on page 20) are now based on the new zero position.
This process can be repeated at any time by setting the bit again.

Information:

An offset position determined in this manner is NOT **readable. The offset position register ConfigOutput0xRead can only ever be used to read the current content of register ConfigOutput0x.**

Information:

The registers are described in "Offset position on the transducer" on page 19 and "Applying new magnet offsets" on page 18.

4.2.3 Defining dead time

To prevent the multiple pulses generated by some encoders from affecting the measurement, all pulses received in a configurable time range after starting the measurement are not evaluated. The dead time range is between 0 and 255 µs. The following figure provides an overview of the effects of defining a dead time:

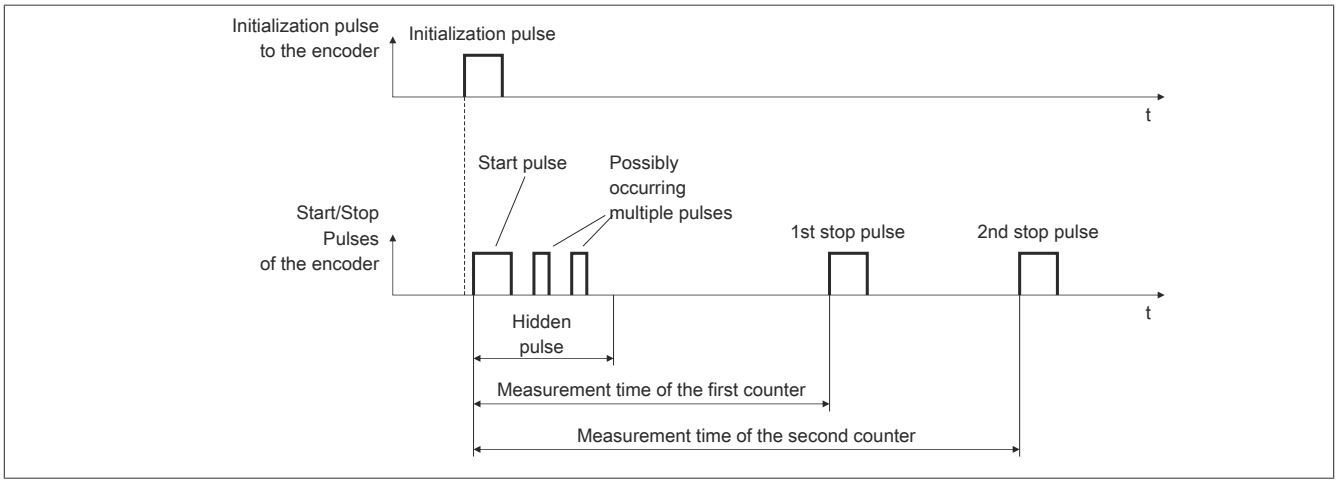


Figure 1: Pulse Ignored after Start Pulse

Information:

The register is described in "Dead time for rods 1 and 2" on page 20.

5 Register description

5.1 General data points

In addition to the registers described in the register description, the module has additional general data points. These are not module-specific but contain general information such as serial number and hardware variant.

General data points are described in section "Additional information - General data points" in the X20 System user's manual.

5.2 Function model 0 - Standard

Register	Name	Data type	Read		Write	
			Cyclic	Acyclic	Cyclic	Acyclic
Synchronous register						
0	Position01	DINT	•			
4	Position02	DINT	•			
8	Position03	DINT	•			
12	Position04	DINT	•			
16	Speed01	INT	•			
18	Speed02	INT	•			
20	Speed03	INT	•			
22	Speed04	INT	•			
24	ErrorStatus01	USINT	•			
25	ErrorStatus02	USINT	•			
26	ErrorStatus03	USINT	•			
27	ErrorStatus04	USINT	•			
28	StatusInput01	USINT	•			
30	USSpeed01	UDINT			•	
34	USSpeed02	UDINT			•	
68	StatusOutput01	USINT			•	
Configuration registers						
38	ConfigOutput01 (module configuration)	USINT				•
40	ConfigOutput02 (channel configuration)	UINT				•
60	ConfigOutput03 (rod length 1)	UDINT				•
64	ConfigOutput04 (rod length 2)	UDINT				•
134	ConfigOutput07 (offset position for magnet 1)	DINT				•
72	ConfigOutput08 (offset position for magnet 2)	DINT				•
84	ConfigOutput09 (minimum path for magnet 1)	DINT				•
88	ConfigOutput10 (minimum path for magnet 2)	DINT				•
92	ConfigOutput11 (maximum path for magnet1)	DINT				•
96	ConfigOutput12 (maximum path for magnet 2)	DINT				•
100	ConfigOutput13 (maximum speed for magnet 1)	UDINT				•
104	ConfigOutput14 (maximum speed for magnet 2)	UDINT				•
76	ConfigOutput15 (offset position for magnet 3)	DINT				•
80	ConfigOutput16 (offset position for magnet 4)	DINT				•
138	ConfigOutput17 (minimum path for magnet 3)	DINT				•
142	ConfigOutput18 (minimum path for magnet 4)	DINT				•
146	ConfigOutput19 (maximum path for magnet 3)	DINT				•
150	ConfigOutput20 (maximum path for magnet 4)	DINT				•
154	ConfigOutput21 (maximum speed for magnet 3)	UDINT				•
158	ConfigOutput22 (maximum speed for magnet 4)	UDINT				•
42	ConfigOutput23 (dead time 1)	USINT				•
44	ConfigOutput24 (dead time 2)	USINT				•
Read configuration register						
38	ConfigOutput01Read	USINT		•		
40	ConfigOutput02Read	UINT		•		
60	ConfigOutput03Read	UDINT		•		
64	ConfigOutput04Read	UDINT		•		
134	ConfigOutput07Read	DINT		•		
72	ConfigOutput08Read	DINT		•		
84	ConfigOutput09Read	DINT		•		
88	ConfigOutput10Read	DINT		•		
92	ConfigOutput11Read	DINT		•		
96	ConfigOutput12Read	DINT		•		
100	ConfigOutput13Read	UDINT		•		

Register description

Register	Name	Data type	Read		Write	
			Cyclic	Acyclic	Cyclic	Acyclic
104	ConfigOutput14Read	UDINT		•		
76	ConfigOutput15Read	DINT		•		
80	ConfigOutput16Read	DINT		•		
138	ConfigOutput17Read	DINT		•		
142	ConfigOutput18Read	DINT		•		
146	ConfigOutput19Read	DINT		•		
150	ConfigOutput20Read	DINT		•		
154	ConfigOutput21Read	UDINT		•		
158	ConfigOutput22Read	UDINT		•		
42	ConfigOutput23Read	USINT		•		
44	ConfigOutput24Read	USINT		•		
Status register						
108	StatusInput09	UDINT		•		
112	StatusInput10	UDINT		•		
116	StatusInput11	UDINT		•		
120	StatusInput12	UDINT		•		
162	StatusInput13	UDINT		•		
166	StatusInput14	UDINT		•		
170	StatusInput15	UDINT		•		
174	StatusInput16	UDINT		•		
178	StatusInput17	UDINT		•		
182	StatusInput18	UDINT		•		
186	StatusInput19	UDINT		•		
190	StatusInput20	UDINT		•		
194	StatusInput21	UDINT		•		
198	StatusInput22	UDINT		•		
202	StatusInput23	UDINT		•		
206	StatusInput24	UDINT		•		
210	StatusInput25	UDINT		•		
214	StatusInput26	UDINT		•		
218	StatusInput27	UDINT		•		
222	StatusInput28	UDINT		•		
226	StatusInput29	UDINT		•		
230	StatusInput30	UDINT		•		
234	StatusInput31	UDINT		•		
238	StatusInput32	UDINT		•		
242	StatusInput33	UDINT		•		
246	StatusInput34	UDINT		•		
250	StatusInput35	UDINT		•		
254	StatusInput36	UDINT		•		

5.3 Function model 254 - Bus controller

Register	Offset[1)]	Name	Data type	Read		Write	
				Cyclic	Acyclic	Cyclic	Acyclic
Synchronous register							
0	0	Position01	DINT	•			
4	8	Position02	DINT	•			
8	16	Position03	DINT	•			
12	24	Position04	DINT	•			
30	4	Speed01	INT	•			
32	12	Speed02	INT	•			
34	20	Speed03	INT	•			
36	28	Speed04	INT	•			
38	-	LB: Error status of Magnet 1 HB: Module status	UINT	•			
	6	ErrorStatus01	USINT	•			
	7	StatusInput01	USINT	•			
40	14	ErrorStatus02	USINT	•			
42	22	ErrorStatus03	USINT	•			
44	30	ErrorStatus04	USINT	•			
100	0	USSpeed01	UDINT			•	
109	8	USSpeed02	UDINT			•	
150	16	StatusOutput01	USINT			•	
Configuration registers							
2200	-	ConfigOutput01 (module configuration)	USINT				•
2100	-	ConfigOutput02 (channel configuration)	UINT				•
2000	-	ConfigOutput03 (rod length 1)	UDINT				•
2004	-	ConfigOutput04 (rod length 2)	UDINT				•
2008	-	ConfigOutput07 (offset position for magnet 1)	DINT				•
2012	-	ConfigOutput08 (offset position for magnet 2)	DINT				•
2024	-	ConfigOutput09 (minimum path for magnet 1)	DINT				•
2028	-	ConfigOutput10 (minimum path for magnet 2)	DINT				•
2040	-	ConfigOutput11 (maximum path for magnet 1)	DINT				•
2044	-	ConfigOutput12 (maximum path for magnet 2)	DINT				•
2056	-	ConfigOutput13 (maximum speed for magnet 1)	UDINT				•
2060	-	ConfigOutput14 (maximum speed for magnet 2)	UDINT				•
2016	-	ConfigOutput15 (offset position for magnet 3)	DINT				•
2020	-	ConfigOutput16 (offset position for magnet 4)	DINT				•
2032	-	ConfigOutput17 (minimum path for magnet 3)	DINT				•
2036	-	ConfigOutput18 (minimum path for magnet 4)	DINT				•
2048	-	ConfigOutput19 (maximum path for magnet 3)	DINT				•
2052	-	ConfigOutput20 (maximum path for magnet 4)	DINT				•
2064	-	ConfigOutput21 (maximum speed for magnet 3)	UDINT				•
2068	-	ConfigOutput22 (maximum speed for magnet 4)	UDINT				•
2201	-	ConfigOutput23 (dead time 1)	USINT				•
2202	-	ConfigOutput24 (dead time 2)	USINT				•
Read configuration register							
2200	-	ConfigOutput01Read	USINT		•		
2100	-	ConfigOutput02Read	UINT		•		
2000	-	ConfigOutput03Read	UDINT		•		
2004	-	ConfigOutput04Read	UDINT		•		
2008	-	ConfigOutput07Read	DINT		•		
2012	-	ConfigOutput08Read	DINT		•		
2024	-	ConfigOutput09Read	DINT		•		
2028	-	ConfigOutput10Read	DINT		•		
2040	-	ConfigOutput11Read	DINT		•		
2044	-	ConfigOutput12Read	DINT		•		
2056	-	ConfigOutput13Read	UDINT		•		
2060	-	ConfigOutput14Read	UDINT		•		
2016	-	ConfigOutput15Read	DINT		•		
2020	-	ConfigOutput16Read	DINT		•		
2032	-	ConfigOutput17Read	DINT		•		
2036	-	ConfigOutput18Read	DINT		•		
2048	-	ConfigOutput19Read	DINT		•		
2052	-	ConfigOutput20Read	DINT		•		
2064	-	ConfigOutput21Read	UDINT		•		
2068	-	ConfigOutput22Read	UDINT		•		
2201	-	ConfigOutput23Read	USINT		•		
2202	-	ConfigOutput24Read	USINT		•		
Status register							
2500	-	StatusInput09	UDINT		•		
2556	-	StatusInput10	UDINT		•		
2504	-	StatusInput11	UDINT		•		
2560	-	StatusInput12	UDINT		•		
2508	-	StatusInput13	UDINT		•		

Register description

Register	Offset[1)]	Name	Data type	Read		Write	
				Cyclic	Acyclic	Cyclic	Acyclic
2564	-	StatusInput14	UDINT		•		
2512	-	StatusInput15	UDINT		•		
2568	-	StatusInput16	UDINT		•		
2516	-	StatusInput17	UDINT		•		
2572	-	StatusInput18	UDINT		•		
2520	-	StatusInput19	UDINT		•		
2524	-	StatusInput20	UDINT		•		
2528	-	StatusInput21	UDINT		•		
2532	-	StatusInput22	UDINT		•		
2536	-	StatusInput23	UDINT		•		
2540	-	StatusInput24	UDINT		•		
2576	-	StatusInput25	UDINT		•		
2580	-	StatusInput26	UDINT		•		
2584	-	StatusInput27	UDINT		•		
2588	-	StatusInput28	UDINT		•		
2592	-	StatusInput29	UDINT		•		
2596	-	StatusInput30	UDINT		•		
2544	-	StatusInput31	UDINT		•		
2548	-	StatusInput32	UDINT		•		
2552	-	StatusInput33	UDINT		•		
2600	-	StatusInput34	UDINT		•		
2604	-	StatusInput35	UDINT		•		
2608	-	StatusInput36	UDINT		•		

1) The offset specifies the position of the register within the CAN object.

The measurements of the module are not synchronized with the X2X Link network in the bus controller function model. The time between 2 measurements corresponds to the set recovery time of the rod (see "Channel configuration" on page 19, but not to the smallest multiple of the X2X Link cycle time, which is greater than the set recovery time, as in the standard function model.

5.4 Reading the magnet position

Name:
Position01 - Position04

These registers contain the position of the individual magnets on the transducer rods.

Data type	Value	Information
DINT	-2,147,483,648 to 2,147,483,647	Resolution 1 µm

5.5 Reading the magnet speed

Name:
Speed01 to Speed04

These registers contain the speed of the individual magnets on the transducer rods. A resolution of 0.1 mm/s is achieved by calculating the speed from 2 position values within a 100 ms interval.

Data type	Value	Information
INT	-32768 to 32767	Resolution 0.1 mm/s

5.6 Error status

Name:
ErrorStatus01 to ErrorStatus04

These registers can be used to indicate the error status for individual channels.

Data type	Values
USINT	See the bit structure.

Bit structure

Bit	Description
0 - 3	Counter for plausibility errors (cyclic)
4 - 7	Counter for mis-measurements (cyclic)

5.7 Status information about the transducer rods

Name:
StatusInput01

This register displays the status information for the transducer rods.

Data type	Values
USINT	See the bit structure.

Bit structure:

Bit	Name	Value	Information
0	Supply voltage too low	0	Supply voltage OK
		1	Supply voltage too low
1	Supply voltage too high	0	Supply voltage OK
		1	Supply voltage too high
2	Transducer Rod 1	0	Ok
		1	Deactivated or not initialized
3	Transducer Rod 2	0	Ok
		1	Deactivated or not initialized
4	Transducer Rod 1	0	Protocol error (invalid data)
		1	Protocol OK (valid data)
5	Transducer Rod 2	0	Protocol error (invalid data)
		1	Protocol OK (valid data)
6 - 7	Reserved		

5.8 Ultrasonic speed specification

Name:
USSpeed01 to USSpeed02

The ultrasonic speed of the measuring rods is set in centimeters/second in these registers. As long as or as soon as these registers have the value 0, the module performs no measurements on the relevant rod. As soon as a valid value (≥1000) is transferred, the module recalculates the measurement rate (see "Channel configuration" on page 19) and starts the position/speed measurement.

Data type	Value	Information
UDINT	0 to 4,294,967,296	Resolution 1 cm/s

5.9 Applying new magnet offsets

Name:
StatusOutput01

This register is used to quickly and easily define new offsets (zero positions) for the individual magnets.

Data type	Values
USINT	See the bit structure.

Bit	Name	Value	Information
0	Magnet 1	0	No effect
		1	Apply offset magnet 1
...		...	
3	Magnet 4	0	No effect
		1	Apply offset magnet 4
4 - 7	Reserved		

5.10 Module configuration

Name:
ConfigOutput01

This register configures the module.

Data type	Values	Bus controller default setting
USINT	See the bit structure.	0

Bit structure:

Bit	Name	Value	Information
0	Plausibility mode	0	The plausibility error counter is incremented with each implausible measurement, and the last plausible measured value is "frozen" (bus controller default setting).
		1	The plausibility error counter is incremented with each implausible measurement and the implausible measurement value is forwarded to the controller
1	Reserved		
2 - 3	Tolerance for monitoring the supply voltage	00	25% (bus controller default setting)
		01	20%
		10	15%
		11	10%
4 - 7	Magnet number	0000	4 magnets on channel 1, channel 2 not available (bus controller default setting)
		0001	3 magnets on channel 1, 1 magnet on channel 2
		0010	2 magnets on channel 1, 2 magnets on channel 2
		0011	1 magnet on channel 1, 0 magnets on channel 2
		0100	2 magnets on channel 1, 0 magnets on channel 2
		0101	3 magnets on channel 1, 0 magnets on channel 2
		0110	2 magnets on channel 1, 1 magnet on channel 2
		0111	1 magnet on channel 1, 1 magnet on channel 2
		1xxx	Reserved

5.11 Channel configuration

Name:
ConfigOutput02

This register can be used to configure the individual channels.

Data type	Values	Bus controller default setting
UINT	See the bit structure.	0

Bit structure:

Bit	Description	Value	Information
0 - 2	Transducer Rod 1	000	User parameter (bus controller default setting)
		001	DPI/IP (Balluf)
		010	EP Start/Stop (MTS)
		011	Reserved
		1xx	Reserved
3 - 4	Rod 1: Start/Stop IF type	00	Start/Stop signal: Rising edge - rising edge (bus controller default setting)
		01	Start/Stop signal: Falling edge - falling edge
		10	Start/Stop signal: Rising edge - falling edge (gate time)
		11	Stop signal only: Start with signal triggering (Init pulse)
5	Bar 1: Recovery time factor, minimum time between 2 measurements	0	3 x Ultrasonic transducer runtime in the sensor (bus controller default setting)
		1	2 x Ultrasonic transducer runtime in the sensor
6 - 7	Reserved		
8 - 10	Transducer Rod 2	000	User parameter (bus controller default setting)
		001	DPI/IP (Balluf)
		010	EP Start/Stop (MTS)
		011	Reserved
		1xx	Reserved
11 - 12	Rod 2: Start/Stop IF type	00	Start/Stop signal: Rising edge - rising edge (bus controller default setting)
		01	Start/Stop signal: Falling edge - falling edge
		10	Start/Stop signal: Rising edge - falling edge (gate time)
		11	Stop signal only: Start with signal triggering (Init pulse)
13	Bar 2: Recovery time factor, minimum time between 2 measurements	0	3 x Ultrasonic transducer runtime in the sensor (bus controller default setting)
		1	2 x Ultrasonic transducer runtime in the sensor
14 - 15	Reserved		

5.12 Rod length 1 and 2

Name:
ConfigOutput03 to ConfigOutput04

These registers are used to configure the length of the respective rod.

- Rod length 1: ConfigOutput03
- Rod length 2: ConfigOutput04

Data type	Value	Information
UDINT	0 to 4,294,967,29	Resolution 1 mm. Bus controller default setting: 0

5.13 Offset position on the transducer

Name:
ConfigOutput07 to ConfigOutput08
ConfigOutput15 to ConfigOutput16

These registers are used to assign an offset position (zero position) on the displacement transducer to the respective magnet.

- Offset magnet 1: ConfigOutput07
- Offset magnet 2: ConfigOutput08
- Offset magnet 3: ConfigOutput15
- Offset magnet 4: ConfigOutput16

Data type	Value	Information
DINT	-2,147,483,648 to 2,147,483,647	Resolution 1 µm. Bus controller default setting: 0

5.14 Plausibility check configuration

These registers are used to configure the plausibility check (also see "Error status" on page 17).

5.14.1 Minimum plausible magnet position

Name:
ConfigOutput09 to ConfigOutput10
ConfigOutput17 to ConfigOutput18

These registers are used to assign the minimum plausible magnet position in relation to the applicable offset.

- Minimum distance magnet 1: ConfigOutput09
- Minimum distance magnet 2: ConfigOutput10
- Minimum distance magnet 3: ConfigOutput17
- Minimum distance magnet 4: ConfigOutput18

Data type	Value	Information
DINT	-2,147,483,648 to 2,147,483,647	Resolution 1 µm. Bus controller default setting: 0

5.14.2 Maximum plausible magnet position

Name:
ConfigOutput11 to ConfigOutput12
ConfigOutput19 to ConfigOutput20

These registers are used to assign the maximum plausible magnet position in relation to the applicable offset.

- Maximal distance magnet 1: ConfigOutput11
- Maximal distance magnet 2: ConfigOutput12
- Maximal distance magnet 3: ConfigOutput19
- Maximal distance magnet 4: ConfigOutput20

Data type	Values	Information
DINT	-2,147,483,648 to 2,147,483,647	Resolution 1 µm. Bus controller default setting: 0

5.14.3 Maximum plausible magnet speed

Name:
ConfigOutput13 to ConfigOutput14
ConfigOutput21 to ConfigOutput22

These registers are used to assign the maximum plausible magnet speed.

- Maximal speed magnet 1: ConfigOutput13
- Maximal speed magnet 2: ConfigOutput14
- Maximal speed magnet 3: ConfigOutput21
- Maximal speed magnet 4: ConfigOutput22

Data type	Values	Information
UDINT	0 to 4,294,967,296	Resolution 0.1 mm/s. Bus controller default setting: 0

5.15 Dead time for rods 1 and 2

Name:
ConfigOutput23 to ConfigOutput24

These registers configure the dead time of the respective rod.

Data type	Values	Information
USINT	0 to 255	1 µs resolution. Bus controller default setting: 0

5.16 Read configuration register

Name:
ConfigOutput01Read to ConfigOutput04Read
ConfigOutput07Read to ConfigOutput24Read

These registers are used to read the states of the corresponding configuration registers.

5.17 Status register

Name:
StatusInput09 to StatusInput36

These registers are used to store the data read after a parameter upload from transducer rods with DPI/IP protocol or EP protocol. The registers "StatusInput19" to "StatusInput36" remain empty (0x0000) on transducer rods with EP protocol.

5.17.1 Parameter overview

The following parameters are stored in the status registers:

Register	Description	Supported by the protocol	
		DP/IP	EP
StatusInput09	Rod length 1 [mm]	•	•
StatusInput10	Rod length 2 [mm]	•	•
StatusInput11	Ultrasonic speed 1	•	•
StatusInput12	Ultrasonic speed 2	•	•
StatusInput13	Rod 1: Zero point offset [µm]	•	•
StatusInput14	Rod 2: Zero point offset [µm]	•	•
StatusInput15	Rod 1: Vendor ID (see transducer rod data sheet)	•	•
StatusInput16	Rod 2: Vendor ID (see transducer rod data sheet)	•	•
StatusInput17	Rod 1: Serial number (Hex coded)	•	•
StatusInput18	Rod 2: Serial number (Hex coded)	•	•
StatusInput19	Rod 1: Type ID 1 (MSB = letter 1)	•	0x0000
StatusInput20	Rod 1: Type ID 2 (MSB = letter 5)	•	0x0000
StatusInput21	Rod 1: Type ID 3 (MSB = letter 9)	•	0x0000
StatusInput22	Rod 1: Type ID 4 (MSB = letter 13)	•	0x0000
StatusInput23	Rod 1: Type ID 5 (MSB = letter 17)	•	0x0000
StatusInput24	Rod 1: Type ID 6 (MSB = letter 21)	•	0x0000
StatusInput25	Rod 2: Type ID 1 (MSB = letter 1)	•	0x0000
StatusInput26	Rod 2: Type ID 2 (MSB = letter 5)	•	0x0000
StatusInput27	Rod 2: Type ID 3 (MSB = letter 9)	•	0x0000
StatusInput28	Rod 2: Type ID 4 (MSB = letter 13)	•	0x0000
StatusInput29	Rod 2: Type ID 5 (MSB = letter 17)	•	0x0000
StatusInput30	Rod 2: Type ID 6 (MSB = letter 21)	•	0x0000
StatusInput31	Rod 1: Serial number ASCII 1 (MSB = letter 1)	•	0x0000
StatusInput32	Rod 1: Serial number ASCII 2 (MSB = letter 5)	•	0x0000
StatusInput33	Rod 1: Serial number ASCII 3 (MSB = letter 9)	•	0x0000
StatusInput34	Rod 2: Serial number ASCII 1 (MSB = letter 1)	•	0x0000
StatusInput35	Rod 2: Serial number ASCII 2 (MSB = letter 5)	•	0x0000
StatusInput36	Rod 2: Serial number ASCII 3 (MSB = letter 9)	•	0x0000

5.18 Minimum cycle time

The minimum cycle time specifies how far the bus cycle can be reduced without communication errors occurring. It is important to note that very fast cycles reduce the idle time available for handling monitoring, diagnostics and acyclic commands.

Minimum cycle time
250 µs