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	

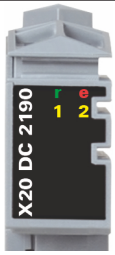
Table 2: X20DC2190, X20cDC2190 - Technical data

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

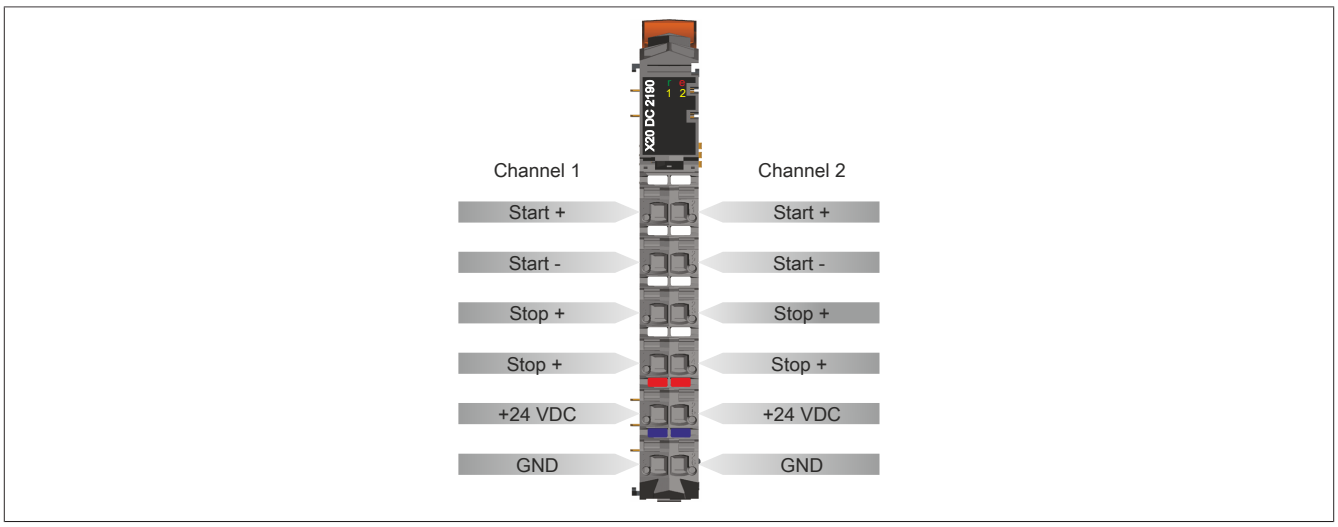
2.2 LED status indicators

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

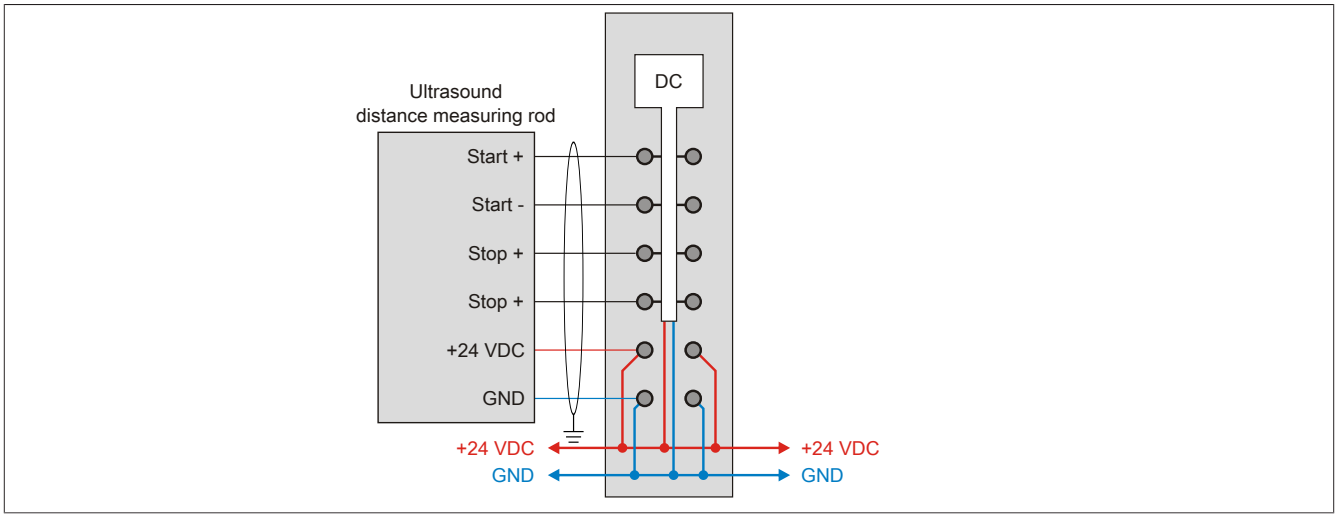
1) Depending on the configuration, a firmware update can take up to several minutes.

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.