X20CM1941

Data sheet
3.10 (October 2024)

Translation of the original documentation

Publishing information

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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 Order data

Order number	Short description	Figure
	Counter functions	
X20CM1941	X20 resolver module, 14-bit resolver input, converter up to 12-bit ABR output	
	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	
	Terminal blocks	
X20TB12	X20 terminal block, 12-pin, 24 VDC keyed	

Table 1: X20CM1941 - Order data

1.3 Module description

The module is equipped with a resolver input and a configurable ABR output.

Functions:

- Converting resolver to ABR encoder signals
- Monitoring the encoder

Converting signals

The module can detect resolver signals and convert them into ABR encoder signals that can be evaluated by other modules, such as stepper motor modules.

Monitoring the encoder status

A possible open circuit between module and encoder is indicated.

2 Technical description

2.1 Technical data

Order number	X20CM1941
Short description	
I/O module	1 resolver input, 1 ABR output
General information	
B&R ID code	0x1E85
Status indicators	Input, output, operating state, module status
Diagnostics	
Module run/error	Yes, using LED status indicator and software
Resolver input (OK, open circuit)	Yes, using LED status indicator and software
Resolver input (counting direction)	Yes, using LED status indicator and software
Power consumption	
Bus	0.01 W
Internal I/O	1.5 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
Resolver inputs	
Resolver transformation ratio	0.5 (±10%)
Reference output	
Output voltage	3.4 V_{eff}
Output current	Max. 50 mA_{eff}
Frequency	10 kHz
Type	Differential
Angular position resolution	14-bit
Short-circuit protection (reference output)	Yes
Input impedance	10.4 kΩ - j 11.1 kΩ
Resolver type	BRX BRT with limitations
ABR output	
Encoder signal	RS422
Type	ABR differential
ABR output (starting with firmware version 5)	
8-bit to 12-bit	3500 revolutions/minute
ABR output (up to firmware version 4) [1)]	
8-bit	Max. 2343 revolutions/minute
9-bit	Max. 1171 revolutions/minute
10-bit	Max. 585 revolutions/minute
Short-circuit proof	Yes (reference output)
Electrical properties	
Electrical isolation	Bus isolated from input/output Channel not isolated from channel, and input/output not isolated from I/O power supply
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

Table 2: X20CM1941 - Technical data

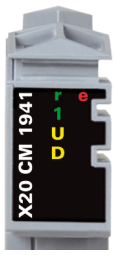
Order number	X20CM1941
Ambient conditions	
Temperature	
Operation	
Horizontal mounting orientation	0 to 55°C
Vertical mounting orientation	0 to 50°C
Derating	-
Storage	-25 to 70°C
Transport	-25 to 70°C
Relative humidity	
Operation	5 to 95%, non-condensing
Storage	5 to 95%, non-condensing
Transport	5 to 95%, non-condensing
Mechanical properties	
Note	Order 1x terminal block X20TB12 separately. Order 1x bus module X20BM11 separately.
Pitch	$12.5^{+0.2}$ mm

Table 2: X20CM1941 - Technical data

1) Configurable

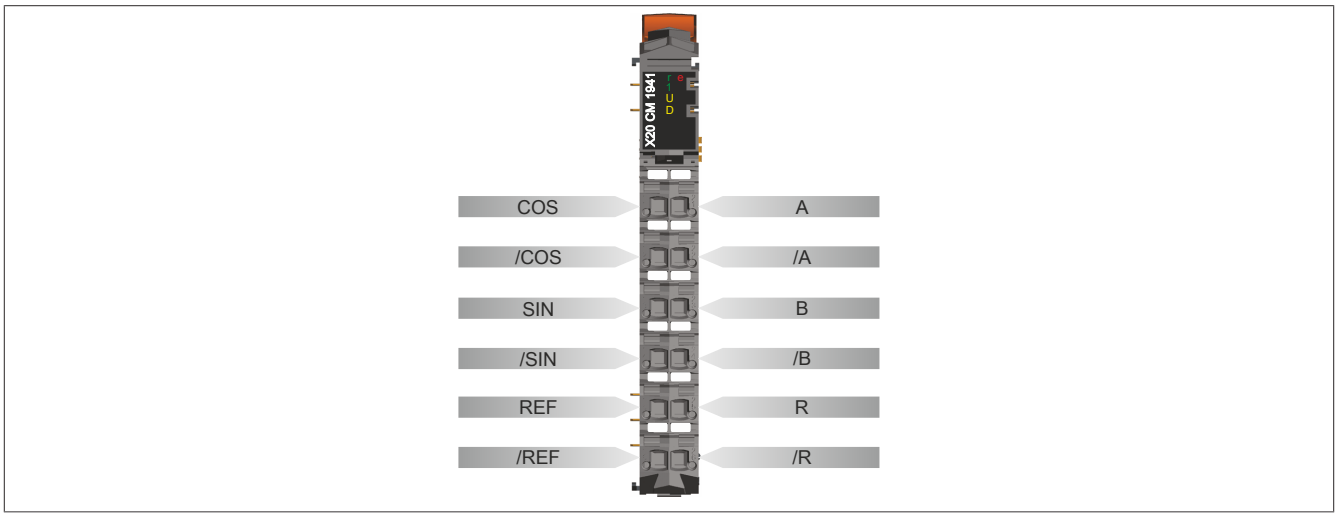
2.2 LED status indicators

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

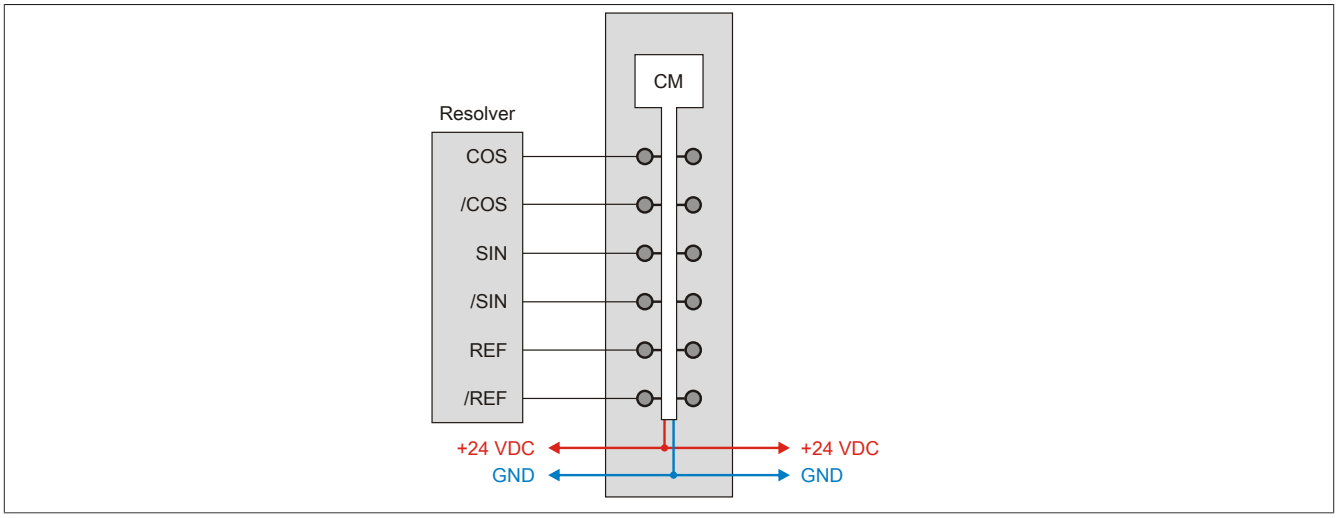
Figure	LED	Color	Status	Description
	r	Green	Off	No power to module
			Single flash	RESET mode
			Double flash	BOOT mode (during firmware update)[1)]
			Blinking	PREOPERATIONAL mode
			On	RUN mode
	e	Red	Off	No power to module or everything OK
			Single flash	Warning/Error on an I/O channel. Level monitoring for digital outputs has been triggered.
	e + r	Red on / Green single flash		Invalid firmware
	1	Green	On	Resolver connected and OK
			Off	Open line or no resolver connected
	U	Orange		UP: Counts up
	D	Orange		DOWN: Counts down

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

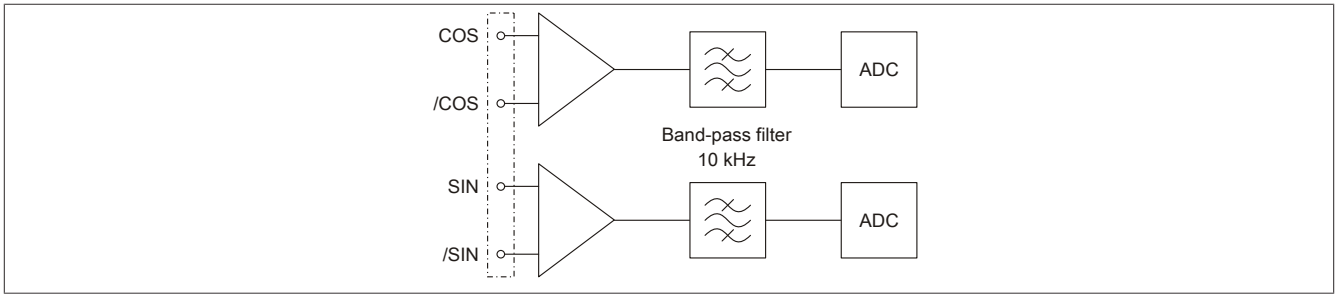
2.3 Pinout



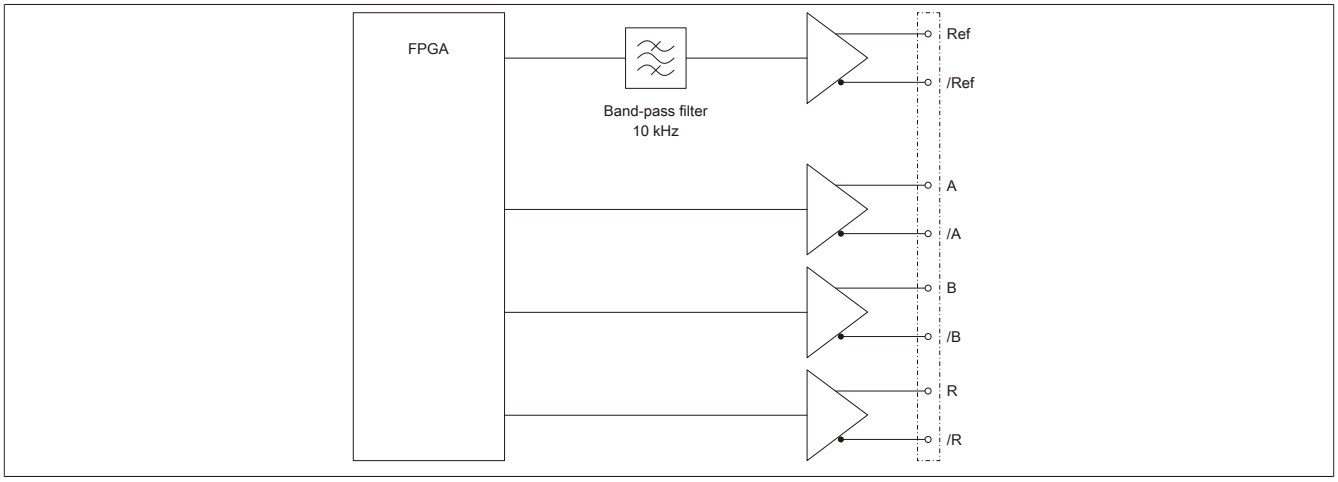
2.4 Connection example



2.5 Input circuit diagram



2.6 Output circuit diagram



3 Function description

3.1 Converting resolver to ABR encoder signals

The module is equipped with a resolver input and a configurable ABR output. The resolver signals can be read out directly or converted into ABR encoder signals.

3.1.1 Resolver signal

The resolver signal is recorded with a 14-bit resolution of the angular position and displayed within the module as a 4-byte value. This value contains both the angular position and the number of revolutions:

- The two upper bytes correspond to the number of revolutions, counted from -32768 (0x8000xxxx) to +32767 (0x7FFFxxxx)
- The two lower bytes correspond to the angular position within the current rotation.
  1 LSB = 360° / 65536

However, the position value can also be interpreted as a single 32-bit angle measurement value with a resolution of 1 / 65536 * 360°.

Values	Information
0x0000xxxx to 0xFFFFxxxx	Number of revolutions (cyclical)
0xxxxx0000 to 0xxxxxFFFF	Angular position within the current rotation

Example

0x7FFF0080 corresponds to 32767 revolutions and 128 / 65536 * 360 = 0.703°

Information:

The register is described in "Current encoder position" on page 11.

3.1.2 ABR encoder signal

The resolution of the emulated ABR encoder signals can be selected between 8 and 12 bits.

Number of bits	Resolution
8	256 increments/revolution
9	512 increments/revolution
10	1024 increments/revolution
11	2048 increments/revolution
12	4096 increments/revolution

Information:

The register is described in "Encoder emulation configuration" on page 11.

Comparison of the ABR output timing behavior between firmware version 4 and 5.

Up to firmware version 4

The module measures the current angular position of the resolver every 100 µs. The value for A, B or R is generated directly from the most significant bits (bits 8 to 10, depending on the configuration).

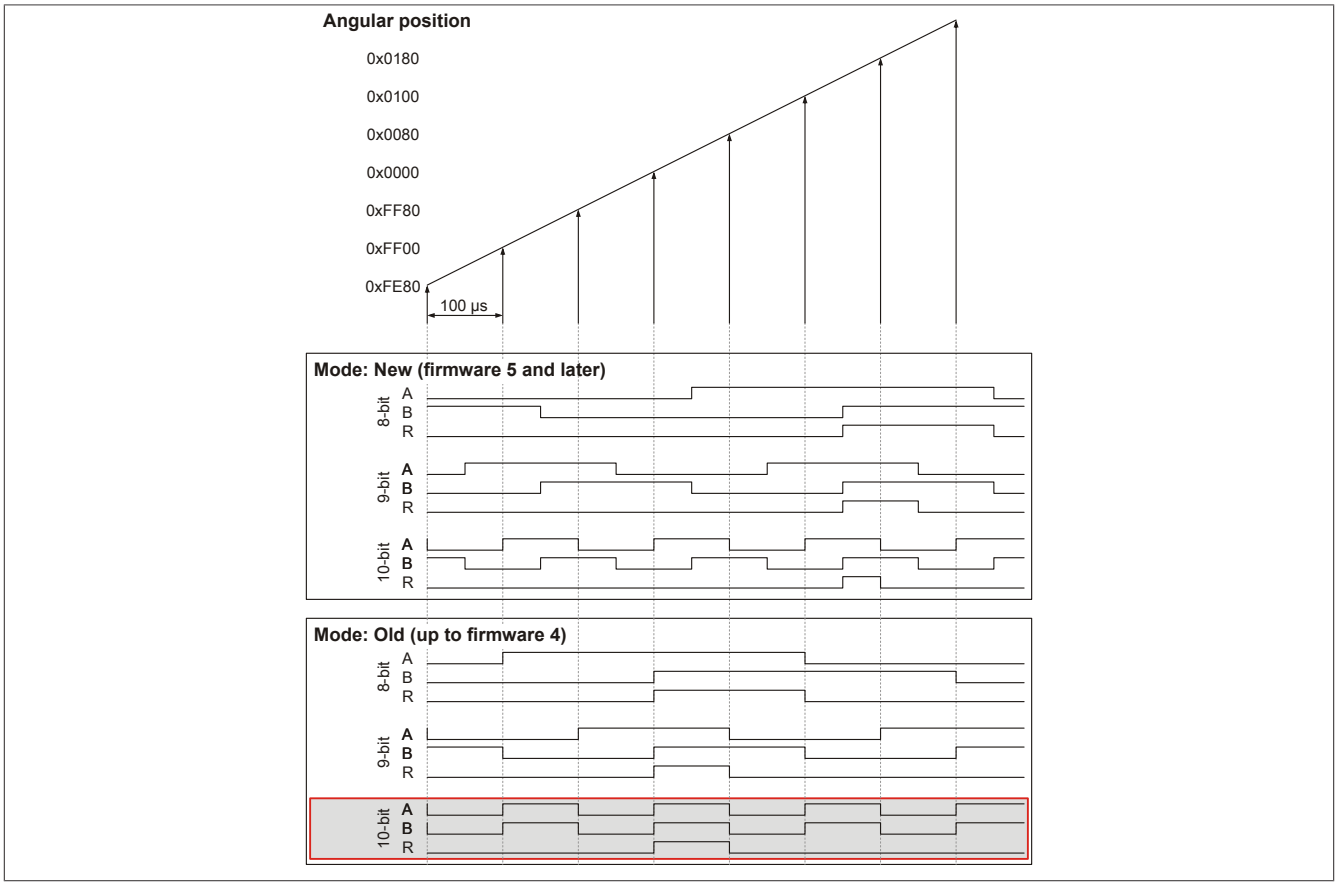
Starting with firmware version 5

The above procedure reaches its limits as soon as more than one LSB difference occurs from one position measurement to the next since only one edge at A or B is possible per 100 µs.

To achieve higher clock rates on the ABR encoder (and higher rotational speeds) while simultaneously improving the temporal jitter, the ABR signal is no longer derived directly from the most recent measured value, rather it is generated by interpolation between successive position measurements, each averaged over 100 µs.

Information:

Compared to firmware versions ≤4, the ABR outputs have a constant time offset of 250 µs.



3.2 Monitoring the encoder

The status of the signal line between the encoder and module can be read.

Bit	Description
0	No error
1	Open circuit

Information:

The register is described in "Connection status" on page 11.

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 1 analog logical slot on CAN I/O.

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
Configuration						
20	ConfigOutput01	UINT				•
22	ConfigOutput02	USINT				•
Communication						
0	Position	DINT	•			
10	StatusInput	USINT	•			

5.3 Function model 254 - Bus controller

Register	Offset[1)]	Name	Data type	Read		Write	
				Cyclic	Acyclic	Cyclic	Acyclic
Configuration							
20	-	ConfigOutput01	UINT				•
22	-	ConfigOutput02	USINT				•
Communication							
0	0	Position	DINT	•			
10	4	StatusInput	USINT	•			

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

5.4 Set the zero position

Name:
ConfigOutput01

"Offset" in the Automation Studio I/O configuration.

The zero position for the resolver can be defined or shifted in this register. The zero position/offset specification refers to the current resolver position.

Data type	Values	Information
UINT	0 to 65535	Bus controller default setting: 0

5.5 Encoder emulation configuration

Name:
ConfigOutput02

"ABR configuration" in the Automation Studio I/O configuration.

The resolution of ABR emulation can be configured in this register.

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

Bit structure:

Bit	Description	Value	Information
0 - 2	Number of bits	0	8 bits = 256 increments/rotation (bus controller default setting)
		1	9 bits = 512 increments/rotation
		2	10 bits = 1024 increments/rotation
		3	11 bits = 2048 increments/rotation
		4	12 bits = 4096 increments/rotation
		5 - 7	Not permitted
3 - 7	Reserved	-	

5.6 Current encoder position

Name:
Position

The current angle position of the resolver is shown in this register. For details, see "Resolver signal" on page 7.

Data type	Value	Information
DINT	0x0000xxxx to 0xFFFFxxxx	Number of rotations (cyclic)
	0xxxxx0000 to 0xxxxxFFFF	Angle position within the current rotation

5.7 Connection status

Name:
StatusInput

This register shows a potential open line between the module and the encoder.

Data type	Values
USINT	See the bit structure.

Bit structure:

Bit	Description	Value	Information
0	Open line	0	No open line
		1	Open line
1- 7	Reserved	-	

5.8 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
100 µs

5.9 Minimum I/O update time

The minimum I/O update time specifies how far the bus cycle can be reduced so that an I/O update is performed in each cycle.

Minimum I/O update time
200 µs