X20DC2396

1 General information

The module is equipped with two inputs for an ABR incremental encoder with 24 V encoder signal.

- 2 ABR incremental encoder 24 V
- 2 additional inputs e.g. for home enable switch
- 24 VDC and GND for encoder supply

2 Order data

Model number	Short description	Figure
	Counter functions	
X20DC2396	X20 digital counter module, 2 ABR incremental encoders, 24 V, 100 kHz input frequency, 4x evaluation	
	Required accessories	
	Bus modules	
X20BM11	X20 bus module, 24 VDC keyed, internal I/O supply continuous	
X20BM15	X20 bus module, with node number switch, 24 VDC keyed, internal I/O supply continuous	
	Terminal blocks	
X20TB12	X20 terminal block, 12-pin, 24 VDC keyed	

Table 1: X20DC2396 - Order data

3 Technical data

Model number	X20DC2396
Short description	
I/O module	2 ABR incremental encoder 24 V
General information	
Input voltage	24 VDC -15 % / +20 %
B&R ID code	0x1BAB
Status indicators	I/O function per channel, operating state, module status
Diagnostics	
Module run/error	Yes, using status LED and software
Power consumption	
Bus	0.01 W
Internal I/O	1.5 W
Additional power dissipation caused by actuators (resistive) [W]	-
Type of signal lines	Shielded cables must be used for all signal lines
Certifications	
CE	Yes
KC	Yes
UL	cULus E115267 Industrial control equipment
HazLoc	cCSAus 244665 Process control equipment for hazardous locations Class I, Division 2, Groups ABCD, T5
ATEX	Zone 2, II 3G Ex nA nC IIA T5 Gc IP20, Ta (see X20 user's manual) FTZÚ 09 ATEX 0083X
DNV GL	Temperature: **B** (0 - 55°C) Humidity: **B** (up to 100%) Vibration: **B** (4 g) EMC: **B** (Bridge and open deck)
LR	ENV1
GOST-R	Yes
Digital inputs	
Quantity	2
Nominal voltage	24 VDC
Input current at 24 VDC	Approx. 3.3 mA
Input filter	
Hardware	≤2 µs
Software	-
Connection type	3-wire connections
Input circuit	Sink
Additional functions	Home enable switch
Input resistance	7.19 kΩ
Switching threshold	
Low	<5 VDC
High	>15 VDC
Isolation voltage between channel and bus	500 V_{eff}
ABR incremental encoder	
Encoder inputs	24 V, asymmetrical
Counter size	16/32-bit
Input frequency	Max. 100 kHz
Evaluation	4x
Encoder power supply	Module-internal, max. 600 mA
Input filter	
Hardware	≤2 µs
Software	-
Input current at 24 VDC	Approx. 1.3 mA
Input resistance	18.4 kΩ
Switching threshold	
Low	<5 VDC
High	>15 VDC
Overload characteristics of encoder power supply	Short circuit protection, overload protection
Isolation voltage between encoder and bus	500 V_{eff}
Electrical characteristics	
Electrical isolation	Bus isolated from encoder and reference enable switch Encoder not isolated from reference enable switch and each other
Operating conditions	
Mounting orientation	
Horizontal	Yes
Vertical	Yes

Table 2: X20DC2396 - Technical data

Model number	X20DC2396
Installation elevation above sea level	
0 to 2000 m	No limitations
>2000 m	Reduction of ambient temperature by 0.5°C per 100 m
Degree of protection per EN 60529	IP20
Environmental 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
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 X20TB12 terminal block separately Order 1x X20BM11 bus module separately
Spacing	12.5$^{+0.2}$ mm

Table 2: X20DC2396 - Technical data
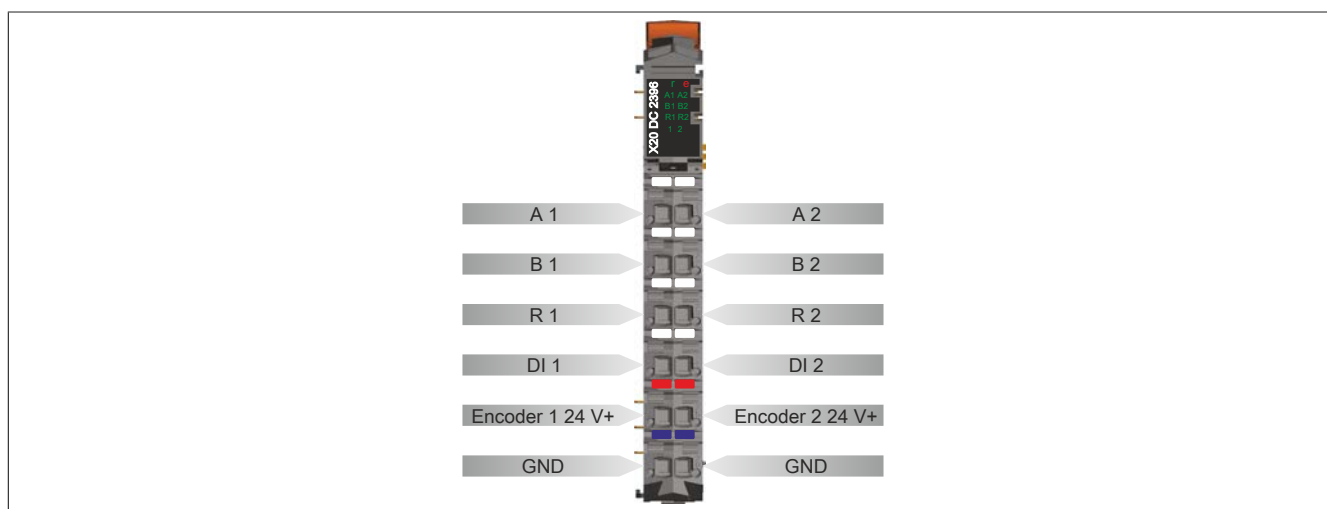
4 LED status indicators

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

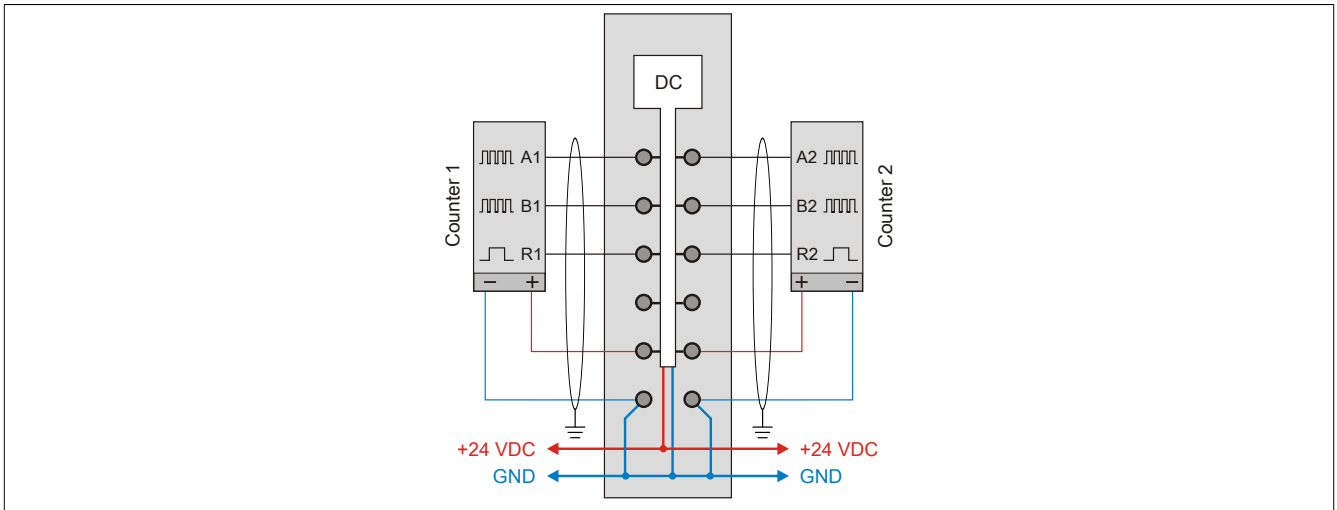| Figure	LED	Color	Status	Description
	r	Green	Off	No power to module
			Single flash	RESET mode
			Double flash	BOOT mode (during firmware update)[1]
			Blinking	PREOPERATIONAL mode
			On	RUN mode
	e	Red	Off	No power to module or everything OK
			On	Error or reset status
	A1, A2	Green		Input state of counter input A1 or A2
	B1, B2	Green		Input state of counter input B1 or B2
	R1, R2	Green		Input state of reference pulse R1 or R2
	1 - 2	Green		Input state of the corresponding digital input

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

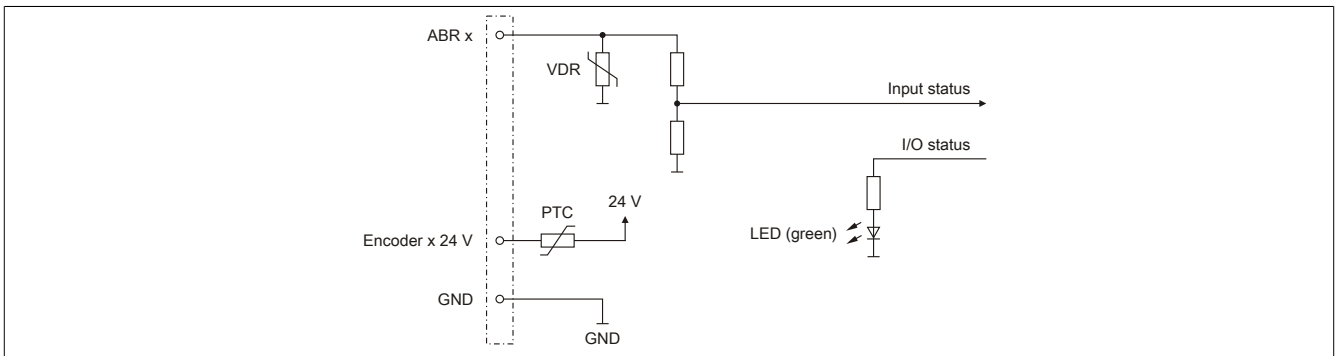# 5 Pinout

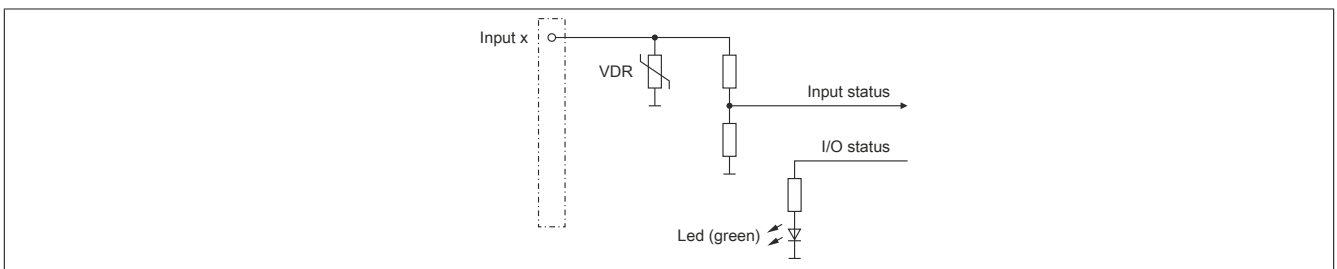Shielded cables must be used for all signal lines.

6 Connection example

7 Input circuit diagram

Counter inputs

Standard inputs

8 Register description

8.1 General data points

In addition to the registers listed in the register description, the module also has other more general data points. These registers are not specific to the module but contain general information such as serial number and hardware version.

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

8.2 Function model 0 - Standard and
Function model 1 - Standard with 32-bit encoder counter value

The difference between function model 0 and function model 1 is the size of the data type for some registers.

- Function model 0 uses data type INT
- Function model 1 uses data type DINT (specified in parentheses)

Register	Name	Data type	Read		Write	
			Cyclic	**Acyclic**	**Cyclic**	**Acyclic**
Configuration						
4104	CfO_EdgeDetectFalling	USINT				●
4106	CfO_EdgeDetectRising	USINT				●
2064	CfO_PresetABR01_1(_32Bit)	(D)INT				●
2068	CfO_PresetABR01_2(_32Bit)	(D)INT				●
2576	CfO_PresetABR02_1(_32Bit)	(D)INT				●
2580	CfO_PresetABR02_2(_32Bit)	(D)INT				●
512	ConfigOutput24	UINT				●
522	ConfigOutput26	USINT				●
520	ConfigOutput27	USINT				●
544	ConfigOutput32	UINT				●
554	ConfigOutput34	USINT				●
552	ConfigOutput35	USINT				●
Communication						
2116	ReferenceModeEncoder01	USINT			●	
2628	ReferenceModeEncoder02	USINT			●	
2080	Encoder01	(D)INT	●			
2592	Encoder02	(D)INT	●			
264	Input state of digital inputs 1 to 2	USINT	●			
	DigitalInput01	Bit 3				
	DigitalInput02	Bit 7				
2118	StatusInput01	USINT	●			
2630	StatusInput02	USINT	●			
40	Status of encoder supply	USINT	●			
	PowerSupply01	Bit 0				

8.3 Function model 254 - Bus controller

Register	Offset[1]	Name	Data type	Read		Write	
				Cyclic	Acyclic	Cyclic	Acyclic
Configuration							
4104	-	CfO_EdgeDetectFalling	USINT				●
4106	-	CfO_EdgeDetectRising	USINT				●
2064	-	CfO_PresetABR01_1	INT				●
2068	-	CfO_PresetABR01_2	INT				●
2576	-	CfO_PresetABR02_1	INT				●
2580	-	CfO_PresetABR02_2	INT				●
512	-	ConfigOutput24	UINT				●
522	-	ConfigOutput26	USINT				●
520	-	ConfigOutput27	USINT				●
544	-	ConfigOutput32	UINT				●
554	-	ConfigOutput34	USINT				●
552	-	ConfigOutput35	USINT				●
Communication							
2116	0	ReferenceModeEncoder01	USINT			●	
2628	1	ReferenceModeEncoder02	USINT			●	
2080	0	Encoder01	INT	●			
2592	4	Encoder02	INT	●			
264	2	Input state of digital inputs 1 to 2	USINT	●			
		DigitalInput01	Bit 3				
		DigitalInput02	Bit 7				
2118	6	StatusInput01	USINT	●			
2630	7	StatusInput02	USINT	●			
40	3	Status of encoder supply	USINT	●			
		PowerSupply01	Bit 0				

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

8.3.1 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" of the X20 user's manual (version 3.50 or later).

8.3.2 CAN I/O bus controller

The module occupies 1 analog logical slot on CAN I/O.

8.4 ABR encoder - Configuration registers

8.4.1 Reference pulse

The following registers must be configured by a single acyclic write with the listed values so that the homing procedure is completed on the edge of the reference pulse.

The homing procedure can take place on:

- Rising edge
- Falling edge (default configuration)

8.4.1.1 Constant register "CfO_EdgeDetectFalling"

Name:

CfO_EdgeDetectFalling

Data type	Value	Filter
USINT	0x00	Configuration value for rising edge
	0x04	Encoder 1 - Configuration value for falling edge
	0x40	Encoder 2 - Configuration value for falling edge
	0x44	Configuration value for falling edge on encoders 1 and 2 (bus controller default setting)

8.4.1.2 Constant register "CfO_EdgeDetectRising"

Name:

CfO_EdgeDetectRising

Data type	Value	Filter
USINT	0x00	Configuration value for falling edge (bus controller default setting)
	0x04	Encoder 1 - Configuration value for rising edge
	0x40	Encoder 2 - Configuration value for rising edge
	0x44	Encoders 1 and 2 - Configuration value for rising edge

8.4.1.3 Constant register "ConfigOutput24"

Name:

ConfigOutput24

This register contains the value for ABR encoder 1.

Data type	Value	Filter
UINT	0x1012	Configuration value for rising edge
	0x1002	Configuration value for falling edge (bus controller default setting)

8.4.1.4 Constant register "ConfigOutput32"

Name:
ConfigOutput32

This register contains the value for ABR encoder 2.

Data type	Value	Filter
UINT	0x1016	Configuration value for rising edge
	0x1006	Configuration value for falling edge (bus controller default setting)

8.4.2 Setting the home position

Name:
CfO_PresetABR01_1 to CfO_PresetABR01_2
CfO_PresetABR02_1 to CfO_PresetABR02_2

CfO_PresetABR01_1_32Bit to CfO_PresetABR01_2_32Bit
CfO_PresetABR02_1_32Bit to CfO_PresetABR02_2_32Bit (only in function model 1)

It is possible to specify two home positions for each encoder with these registers through a one-off acyclic write, for example (default = 0). The configured values are applied to the counter values after a completed homing procedure.

Data type	Value	Information
INT	-32,768 to 32,767	Bus controller default setting: 0
DINT[1]	-2,147,483,648 to 2,147,483,647	

1)   Only in function model 1

8.4.3 Homing with reference enable input

Regardless of the referencing mode, it is possible using this register to prevent the home position from being applied when the corresponding reference input voltage level occurs (see "Input state of digital inputs 1 to 2" on page 9: bit 7). The desired setting can be configured by a one-off acyclic write.

8.4.3.1 Voltage level for reference enable activation - ABR encoder 1

Name:

ConfigOutput26

The voltage level of the digital input 1 to activate reference enable is configured with this register.

Data type	Value	Filter
USINT	0x00	Reference enable is active at 0 VDC (bus controller default setting).
	0x08	Reference enable is active at 24 VDC

8.4.3.2 Reference enable of the input - ABR encoder 1

Name:
ConfigOutput27

This register can be used to define whether the reference enable is activated.

Data type	Value	Filter
USINT	0x00	Reference enable input disabled (bus controller default setting)
	0x08	Reference enable input activated

8.4.3.3 Voltage level for reference enable activation - ABR encoder 2

Name:

ConfigOutput34

The voltage level of the digital input 2 to activate reference enable is configured with this register.

Data type	Value	Filter
USINT	0x00	Reference enable is active at 0 VDC (bus controller default setting).
	0x80	Reference enable is active at 24 VDC

8.4.3.4 Reference enable of the input - ABR encoder 2

Name:
ConfigOutput35

This register can be used to define whether the reference enable is activated.

Data type	Value	Filter
USINT	0x00	Reference enable input disabled (bus controller default setting)
	0x80	Reference enable input activated

8.5 ABR encoder - Configuration registers

8.5.1 Counter state of the encoders

Name:
Encoder01 to Encoder02

The encoder values are displayed in this register.

Data type	Value
INT	-32,768 to 32,767
DINT[1]	-2,147,483,648 to 2,147,483,647

1)   Only in function model 1

8.5.2 Input state of digital inputs 1 to 2

Name:
DigitalInput01 to DigitalInput02.

This register displays the input status of the encoders and the digital inputs.

Data type	Value
USINT	See bit structure.

Bit structure:

Bit	Name	Value	Information
0	Encoder 1	0 or 1	Input state - Signal A
1		0 or 1	Input state - Signal B
2		0 or 1	Input state of reference pulse
3	DigitalInput01	0 or 1	Input state - Digital input 1
4	Encoder 2	0 or 1	Input state - Signal A
5		0 or 1	Input state - Signal B
6		0 or 1	Input state of reference pulse
7	DigitalInput02	0 or 1	Input state - Digital input 2

8.5.3 Reading the referencing mode

Name:
ReferenceModeEncoder01 to ReferenceModeEncoder02

This register determines the referencing mode.

Data type	Value
USINT	See bit structure.

Bit structure:

Bit	Name	Value	Information
0 - 1		00	Referencing OFF
		01	Single shot referencing
		11	Continuous referencing
2 - 5		0	Bits permanently set = 0
6 - 7		00	Referencing OFF
		11	Bits permanently set = 1

This results in the following values:

Binary	Hex	Function
00000000	0x00	Referencing OFF
11000001	0xC1	Single shot referencing

For a new start after the completed homing procedure:

- Write value 0x00
- Wait until bit 0 to bit 3 of the StatusInput01 register takes on the value 0. Counter bits 4 to 7 are not erased
- Switch homing procedure on again

| 11000011 | 0xC3 | Continuous referencing |

Referencing occurs at every reference pulse.

8.5.4 Status of the homing procedure

Name:
StatusInput01 (for encoder 1) to StatusInput02 (for encoder 2)

This register contains information regarding whether the referencing process is off, active or complete.

Data type	Value
USINT	See bit structure.

Bit structure:

Bit	Name	Value	Information
0	Reference pulse without homing[1]	0	No reference impulse without homing has occurred yet
		1	At least a reference impulse without homing has occurred
1	State change	0 or 1	Changes with each reference pulse without homing
2	Reference pulse with homing[1]	0	No homing has occurred yet
		1	At least one homing procedure has occurred
3	State change	0 or 1	Changes with each homing procedure that has taken place
4	Reference pulse	0	The last reference pulse didn't bring about a homing procedure
		1	The last reference pulse brought about a homing procedure
5 - 7	Counter	x	Free-running counter, increased with each reference pulse

1) Always 1 after the first reference pulse that has occurred

Examples of possible values:

Binary	Hex	Function
0x00000000	0x00	Referencing OFF or homing procedure already active
0x00111100	0x3CE	First homing procedure complete Reference value applied in the Encoder01 register
0xxxx11100	0xxB	Bits 5 to 7 are changed with each reference pulse
0xxxx1x100	0xxx	Continuously changing the bits with the "Continuous referencing" setting. The reference value is applied to the Encoder01 register on each reference pulse.

8.5.5 Status of encoder supply

Name:
PowerSupply01

This register shows the status of the integrated encoder supply. A faulty encoder power supply is displayed as a warning.

Data type	Values
USINT	See the bit structure.

Bit structure:

Bit	Name	Value	Information
0	PowerSupply01	0	24 VDC encoder power supply OK
		1	24 VDC encoder power supply faulty
1 - 7	Reserved	-	

8.6 Minimum cycle time

The minimum cycle time defines 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
128 µs

8.7 Maximum cycle time

The maximum cycle time defines how far the bus cycle can be increased without internal counter overflows causing module malfunctions.

Minimum cycle time
16 ms

8.8 Minimum I/O update time

The minimum I/O update time defines how far the bus cycle can be reduced while still allowing an I/O update to take place in each cycle.

Minimum I/O update time
128 µs