X20(c)DC1396

1 General information

The module is equipped with 1 input for an ABR incremental encoder with 24 V encoder signal.

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

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

3 Order data

Model number	Short description	Figure
	Counter functions	
X20DC1396	X20 digital counter module, 1 ABR incremental encoders, 24 V, 100 kHz input frequency, 4x evaluation	
X20cDC1396	X20 digital counter module, coated, 1 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	
X20cBM11	X20 bus module, coated, 24 VDC keyed, internal I/O supply continuous	
	Terminal blocks	
X20TB12	X20 terminal block, 12-pin, 24 VDC keyed	

Table 1: X20DC1396, X20cDC1396 - Order data

4 Technical data

Product ID	X20DC1396		X20cDC1396
Short description			
I/O module	1 ABR incremental encoder 24 V		
General information			
Input voltage	24 VDC -15% / +20%		
B&R ID code	0x1BAC		0xE502
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	1.4 W		
Additional power dissipation caused by the actuators (resistive) [W]	-		
Electrical isolation			
Encoder - Bus	Yes		
Reference enable switch - Bus	Yes		
Reference enable switch - Encoder	No		
Type of signal lines	Shielded cables must be used for all signal lines.		
Certification			
CE	Yes		
cULus	Yes		
cCSAus HazLoc Class 1 Division 2	Yes		-
ATEX Zone 2 [1)]	Yes		
KC	Yes		-
GL	Yes		
GOST-R	Yes		
Home enable switch			
Quantity	1		
Nominal voltage	24 VDC		
Input filter			
Hardware	≤2 µs		
Software	-		
Connection type	3-wire connections		
Input circuit	Sink		
Input current at 24 VDC	Approx. 3.3 mA		
Input resistance	7.19 kΩ		
Isolation voltage between home enable switch and bus	500 V_{eff}		
Switching threshold			
Low	<5 VDC		
High	>15 VDC		
ABR incremental encoder			
Encoder inputs	24 V, asymmetrical		
Counter size	16/32-bit		
Input frequency	Max. 100 kHz		
Evaluation	4x		
Encoder 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 behavior of the encoder supply	Short circuit protection, overload protection		
Isolation voltage between encoder and bus	500 V_{eff}		
Operating conditions			
Mounting orientation			
Horizontal	Yes		
Vertical	Yes		
Installation at elevations above sea level			
0 to 2000 m	No limitations		
>2000 m	Reduction of ambient temperature by 0.5°C per 100 m		
EN 60529 protection	IP20		

Table 2: X20DC1396, X20cDC1396 - Technical data

Product ID	X20DC1396	X20cDC1396
Environmental conditions		
Temperature		
Operation		
Horizontal installation	-25 to 60°C	
Vertical installation	-25 to 50°C	
Derating	-	
Storage	-40 to 85°C	
Transport	-40 to 85°C	
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 characteristics		
Note	Order 1x X20TB12 terminal block separately Order 1x X20BM11 bus module separately	Order 1x X20TB12 terminal block separately Order 1x X20cBM11 bus module separately
Spacing	12.5 $^{+0.2}$ mm	

Table 2: X20DC1396, X20cDC1396 - Technical data

1)   Ta min.: 0°C
   Ta max.: See environmental conditions

5 LED status indicators

For a description of the various operating modes, see the section "re LEDs" in chapter 2 "System characteristics" 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	Green		Input state of counter input A
	B1	Green		Input state of counter input B
	R1	Green		Input state of reference pulse R
	1	Green		Input state - Digital input

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

6 Pinout

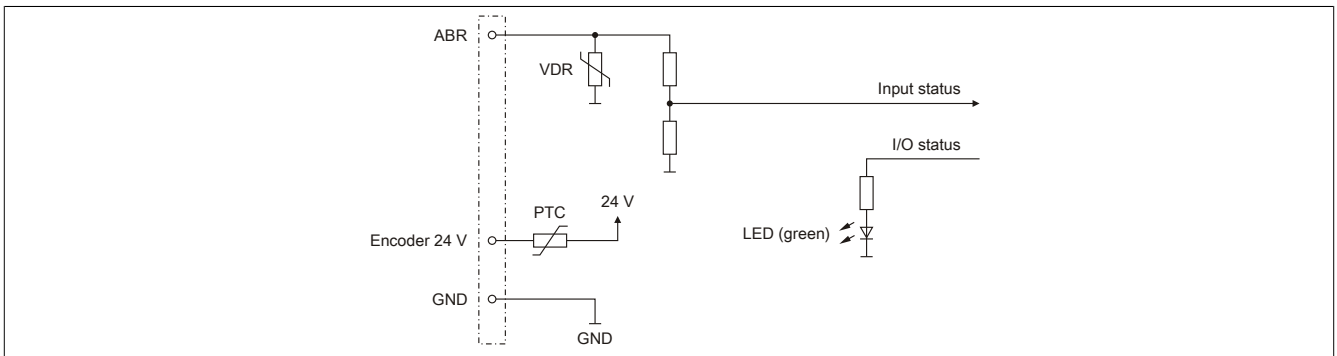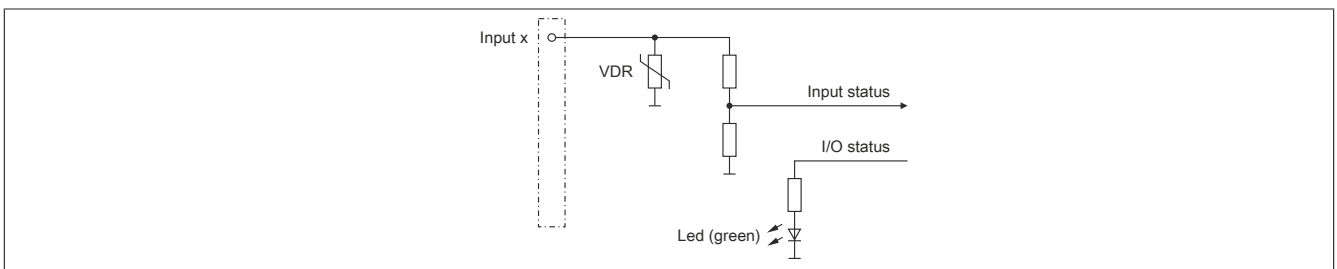Shielded cables must be used for all signal lines.
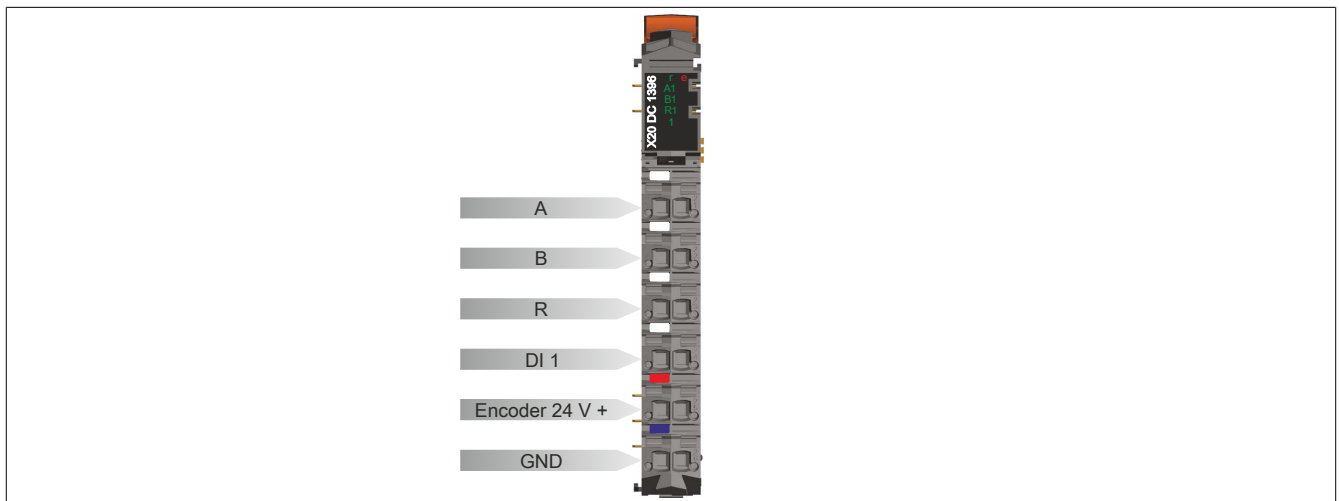
7 Connection example
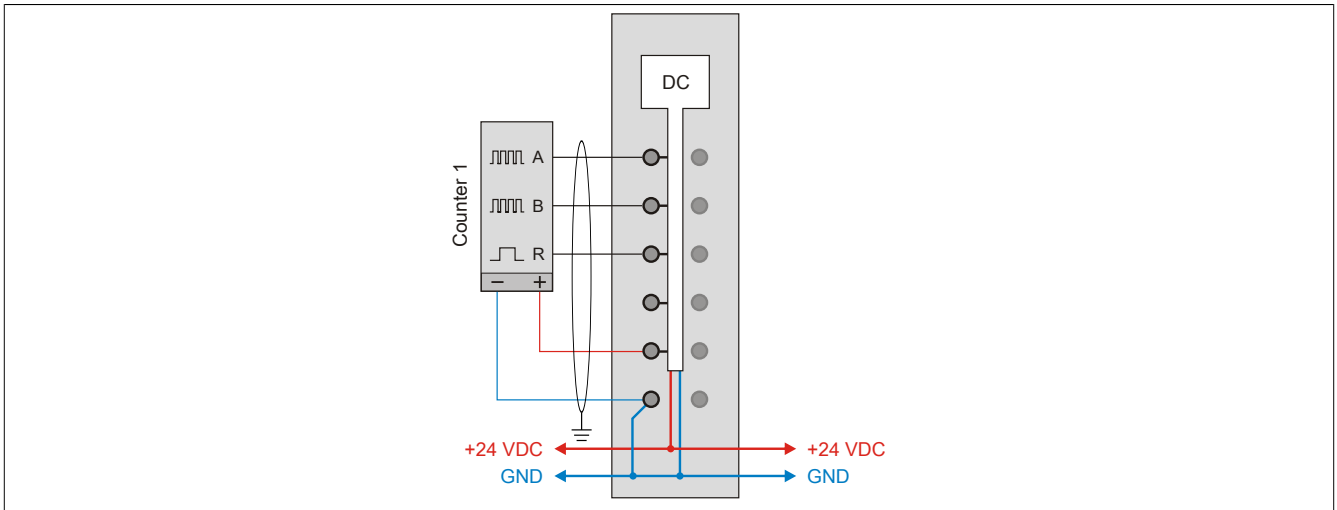
8 Input circuit diagram

Counter inputs

Standard input

9 Register description

9.1 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.

These general data points are listed in the "General data points" section of chapter 4 "X20 system modules" in the X20 system user's manual.

9.2 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				●
512	ConfigOutput24	UINT				●
522	ConfigOutput26	USINT				●
520	ConfigOutput27	USINT				●
Communication						
2116	ReferenceModeEncoder01	USINT			●	
2080	Encoder01	(D)INT	●			
264	Input state of the digital input	USINT	●			
	DigitalInput01	Bit 3				
2118	StatusInput01	USINT	●			
40	Status of encoder supply	USINT	●			
	PowerSupply01	Bit 0				

9.3 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				●
512	-	ConfigOutput24	UINT				●
522	-	ConfigOutput26	USINT				●
520	-	ConfigOutput27	USINT				●
Communication							
2116	0	ReferenceModeEncoder01	USINT			●	
2080	0	Encoder01	INT	●			
264	2	Input state of the digital input	USINT	●			
		DigitalInput01	Bit 3				
2118	4	StatusInput01	USINT	●			
40	3	Status of encoder supply	USINT	●			
		PowerSupply01	Bit 0				

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

9.4 ABR encoder - Configuration registers

9.4.1 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)

9.4.1.1 Constant register "CfO_EdgeDetectFalling"

Name:

CfO_EdgeDetectFalling

Data type	Value	Filter
USINT	0x00	Configuration value for rising edge
	0x04	Configuration value for falling edge

9.4.1.2 Constant register "CfO_EdgeDetectRising"

Name:

CfO_EdgeDetectRising

Data type	Value	Filter
USINT	0x04	Configuration value for rising edge
	0x00	Configuration value for falling edge

9.4.1.3 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

9.4.2 Setting the home position

Name:
Cfo_PresetABR01_1 to Cfo_PresetABR01_2

CfO_PresetABR01_1_32Bit to CfO_PresetABR01_2_32Bit (only in function model 1)

It is possible to specify two home positions 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
INT	-32,768 to 32,767
DINT[1]	-2,147,483,648 to 2,147,483,647

1)   Only in function model 1

9.4.3 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 9.5.2 "Input state of the digital input": bit 3). The desired setting can be configured by a one-off acyclic write.

9.4.3.1 Voltage level for reference enable activation

Name:

ConfigOutput26

This register is used to configure the active voltage level of the digital input for the reference enable.

Data type	Value	Filter
USINT	0x00	Reference enable is active at 0 VDC
	0x08	Reference enable is active at 24 VDC

9.4.3.2 Reference enable of the input

Name:

ConfigOutput27

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

Data type	Value	Filter
USINT	0x00	Reference enable input OFF (default)
	0x08	Reference enable input activated

9.5 ABR encoder - Configuration registers

9.5.1 Counter state of the encoder

Name:
Encoder01

The encoder values are represented as 16-bit or 32-bit counter values 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

9.5.2 Input state of the digital input

Name:
DigitalInput01

This register displays the input status of the encoder and the digital input.

Data type	Value
USINT	See bit structure.

Bit	Name	Value	Information
0	Encoder A	0 or 1	Input state
1	Encoder B	0 or 1	Input state
2	Encoder A + B	0 or 1	Input state of reference pulse
3	DigitalInput01	0 or 1	Input state - Digital input 1
4 - 7	Reserved	-	

9.5.3 Reading the referencing mode

Name:
ReferenceModeEncoder01

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.

It is important to know how the optional reference enable is configured. See section 9.4.3 "Homing with reference enable input"

9.5.4 Status of the homing procedure

Name:
StatusInput01

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.

It is important to know how the optional reference enable (see section 9.4.3 "Homing with reference enable input" on page 7) is configured.

9.5.5 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	Value
USINT	See 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	-	

9.6 Minimum cycle time

The minimum cycle time defines how far the bus cycle can be reduced without communication errors occurring. It should be noted that very fast cycles decrease the idle time available for handling monitoring, diagnostics and acyclic commands.

Minimum cycle time
128 µs

9.7 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

9.8 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