X20DC2398

Data sheet

3.20 (October 2024)

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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	
X20DC2398	X20 digital counter module, 2 SSI absolute encoders, 24 V, 125 kbit/s, 32-bit	
	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: X20DC2398 - Order data

1.3 Module description

This module is equipped with two inputs for SSI absolute encoders with 24 V encoder signal.

Functions:

- SSI absolute encoder
- Monitoring the encoder power supply

SSI absolute encoder

The module provides 2 SSI absolute encoders that are directly supported by the hardware.

Absolute encoders are linear or angular encoders used as position encoders on machine tools, in handling and automation technology, and on measuring and testing equipment. The absolute measured value is available without referencing immediately after switching on.

Monitoring the supply voltage

The encoder power supply voltage is monitored.

2 Technical description

2.1 Technical data

Order number	X20DC2398
Short description	
I/O module	2 SSI absolute encoder 24 V
General information	
Input voltage	24 VDC -15% / +20%
B&R ID code	0x1BAD
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	1.4 W
Additional power dissipation caused by actuators (resistive) [W]	-
Type of signal lines	Shielded lines must be used for all signal lines.
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
DNV	Temperature: **B** (0 to 55°C) Humidity: **B** (up to 100%) Vibration: **B** (4 g) EMC: **B** (bridge and open deck)
CCS	Yes
LR	ENV1
KR	Yes
ABS	Yes
BV	**EC33B** Temperature: 5 - 55°C Vibration: 4 g EMC: Bridge and open deck
KC	Yes
Digital inputs	
Quantity	2
Nominal voltage	24 VDC
Input characteristics per EN 61131-2	Type 1
Input current at 24 VDC	Approx. 3.3 mA
Input circuit	Sink
Input filter	
Hardware	≤2 μs
Software	-
Connection type	3-wire connections
Input resistance	7.19 kΩ
Switching threshold	
Low	<5 VDC
High	>15 VDC
Insulation voltage between channel and bus	500 V_{eff}
SSI absolute encoder	
Encoder inputs	24 V, asymmetrical
Counter size	32-bit
Max. transfer rate	125 kbit/s
Encoder power supply	Module-internal, max. 600 mA
Coding	Gray/Binary
CLK: Output current	Max. 100 mA
DATA: Input resistance	18.4 kΩ
Insulation voltage between encoder and bus	500 V_{eff}

Table 2: X20DC2398 - Technical data

Order number	X20DC2398
Overload characteristics of encoder power supply	Short-circuit proof, overload-proof
Switching threshold	
Low	<5 VDC
High	>15 VDC
Electrical properties	
Electrical isolation	Bus isolated from encoder and channel Channel not isolated from channel and encoder Encoder not isolated from encoder
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
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: X20DC2398 - 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
	D1, D2	Green		Input state of data signal 1 or 2
	1 - 2	Green		Input state of the corresponding digital input

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

2.3 Pinout
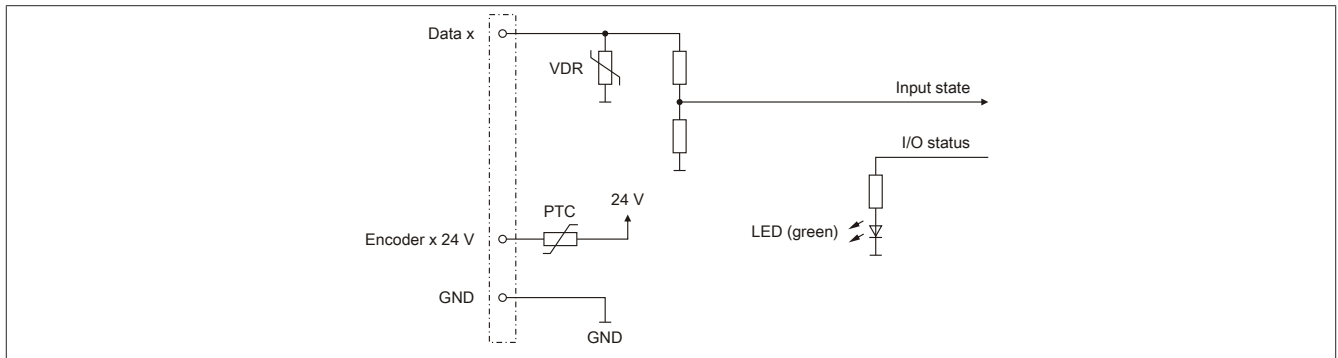
Shielded cables must be used for all signal lines.
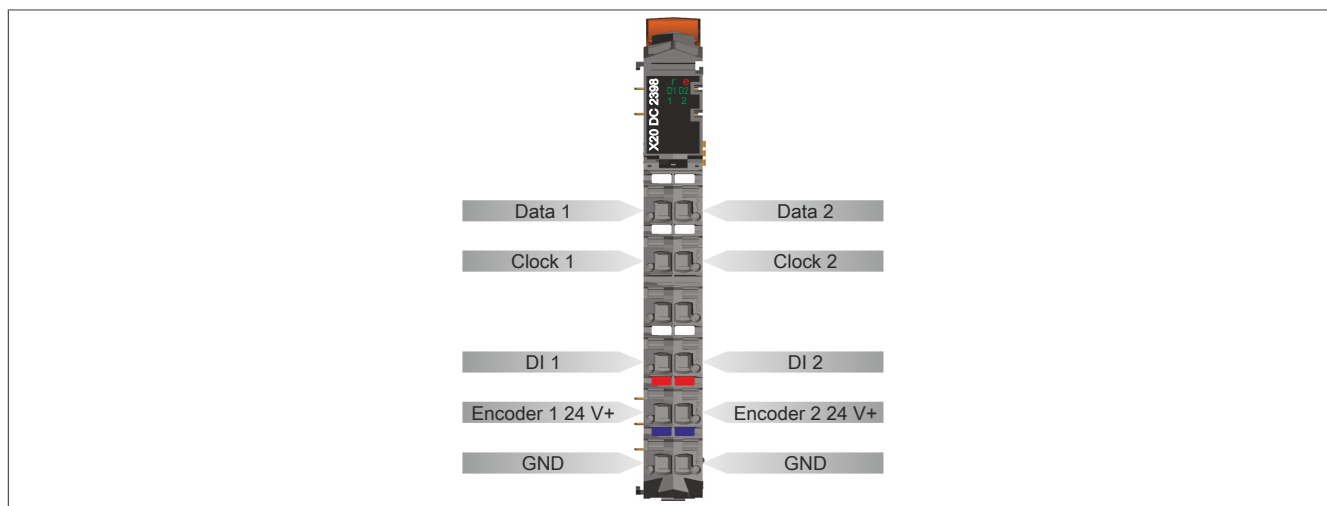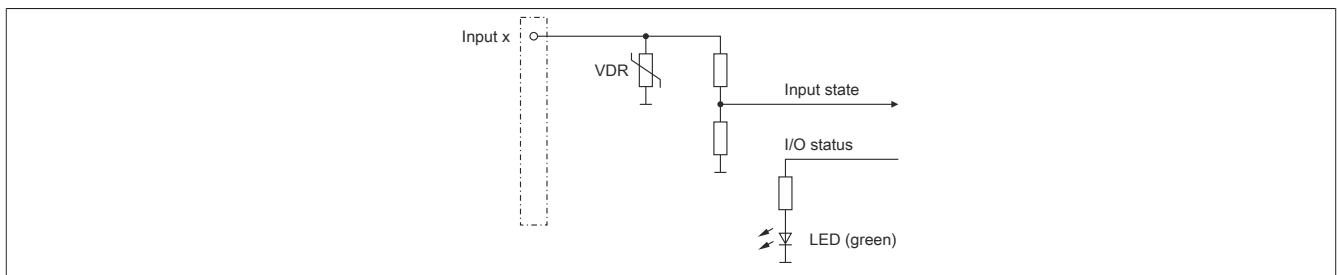

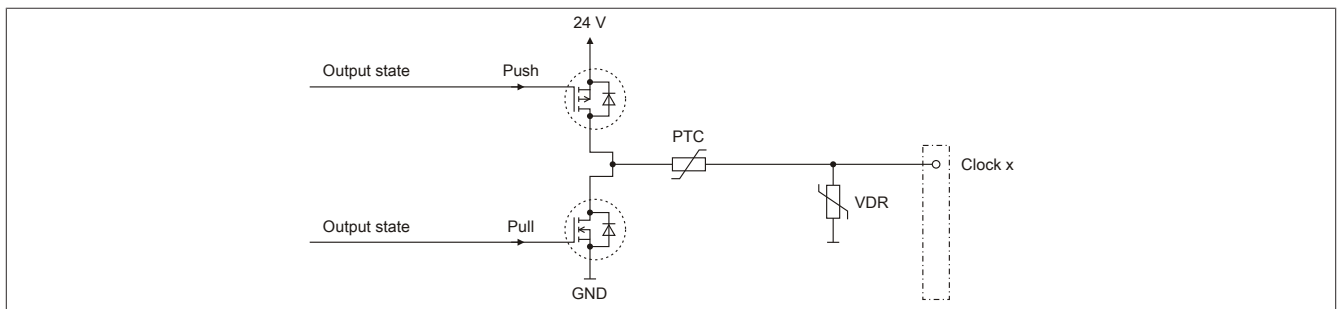## 2.4 Connection example
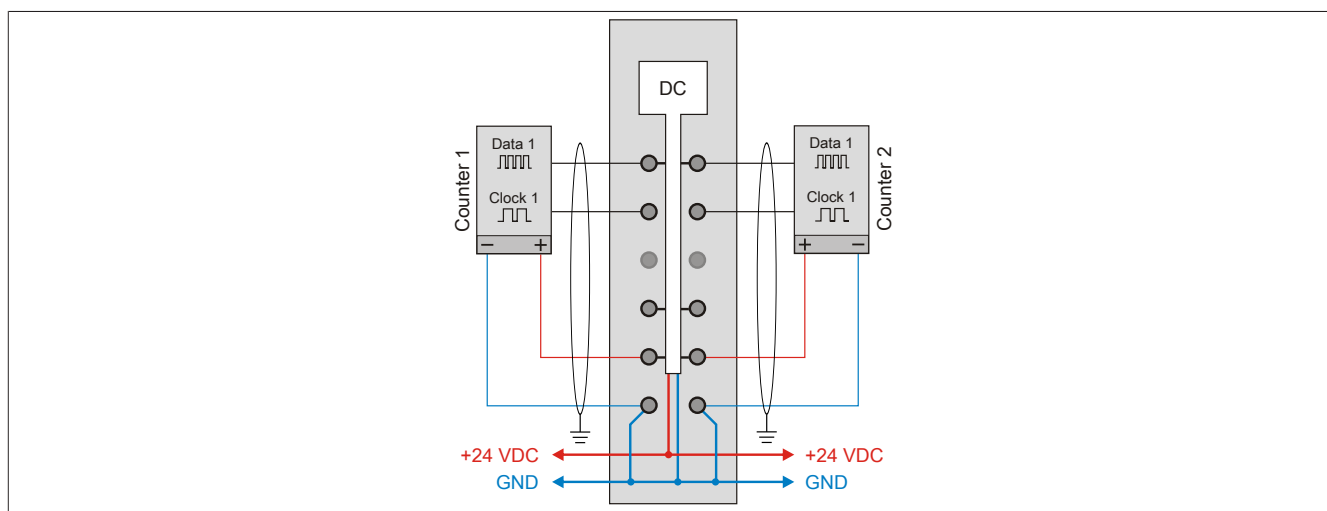
2.5 Input circuit diagram

Counter inputs

Standard inputs

2.6 Output circuit diagram

3 Function description

3.1 SSI absolute encoder

This module is equipped with 2 inputs for SSI incremental encoders.

3.1.1 General information

Absolute encoders output the position information in the form of a digital numerical value. Since this numerical value is unique over the entire triggering area of the absolute encoder, no initial homing procedure such as is required for incremental encoders. The absolute values are transferred from the encoder to the module through a synchronous serial interface (SSI).

3.1.2 Setting the operating parameters

For proper operation, the operating parameters of the SSI absolute encoder must be set in order to correctly evaluate the data received from the encoder.

- **Monostable multivibrator testing**
  With the monoflop, the encoder indicates that it is ready to accept a new clock cycle.
- **Data coding**
  Binary or Gray coding of the data bits
- **Clock rate**
  Clock rate is permanently set to 125 kHz.

3.1.3 Transferring using Synchronous Serial Interface

Transferring using Synchronous Serial Interface
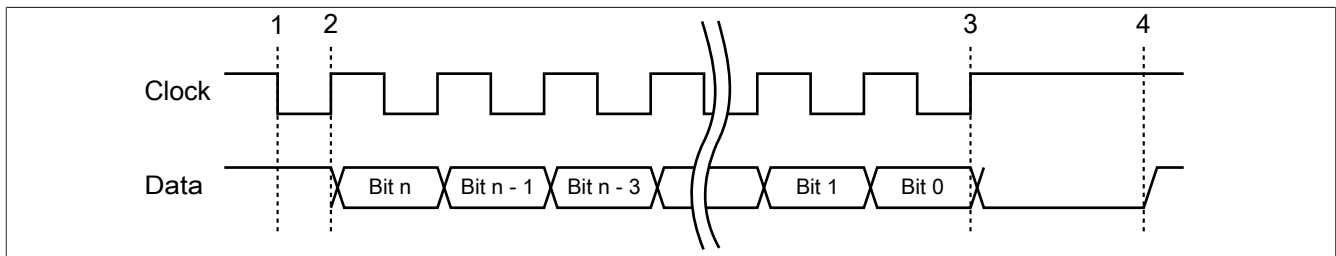
Processing the measured value

1) Start bit ... The measured value is saved.
2) Output of the first data bit
3) All data bits are transferred; the monostable multivibrator time starts to run.
4) The monostable multivibrator returns to its initial state; a new transfer can be started.

> **Information:**
>
> **The registers are described in "SSI encoder configuration registers" on page 12.**

3.2 Monitoring the encoder power supply

Monitoring the encoder power supply

The status of the integrated encoder power supply can be read.

Bit	Description
0	24 VDC encoder supply voltage OK
1	24 VDC encoder supply voltage faulty

Information:

The register is described in "Status of encoder power supply" on page 13.

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 2 analog logical slots 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						
7176	ConfigOutput15	UINT				●
7432	ConfigOutput16	UINT				●
7172	ConfigAdvanced01	UDINT				●
7428	ConfigAdvanced02	UDINT				●
Communication						
7184	Encode01	UDINT	●			
7440	Encoder02	UDINT	●			
264	Input state of digital inputs 1 to 2	USINT	●			
	DigitalInput01	Bit 3				
	DigitalInput02	Bit 7				
40	Status of encoder power supply	USINT	●			
	PowerSupply01	Bit 0				

5.3 Function model 254 - Bus controller

Register	Offset[1]	Name	Data type	Read		Write	
				Cyclic	**Acyclic**	**Cyclic**	**Acyclic**
Configuration							
7176	-	ConfigOutput15	UINT				●
7432	-	ConfigOutput16	UINT				●
7172	-	ConfigAdvanced01	UDINT				●
7428	-	ConfigAdvanced02	UDINT				●
Communication							
7184	0	Encode01	UDINT	●			
7440	8	Encoder02	UDINT	●			
264	4	Input state of digital inputs 1 to 2	USINT	●			
		DigitalInput01	Bit 3				
		DigitalInput02	Bit 7				
40	5	Status of encoder power supply	USINT	●			
		PowerSupply01	Bit 0				

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

5.4 SSI encoder configuration registers

5.4.1 Standard configuration

Name:
ConfigOutput15 to ConfigOutput16

This configuration register sets the encoding, clock rate and number of bits. Default = 0. This must be set once using an acyclic write command.

"ConfigOutput15": Configuration register for SSI encoder 01 and
"ConfigOutput16": Configuration register for SSI encoder 02

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

Bit structure:

Bit	Description	Value	Information
0 - 5	SSI value valid bits	x	Bus controller default setting: 0
6 - 7	Clock rate	11	125 kHz. Bus controller default setting: 0
8 - 13	SSI number of bits	x	Number of bits including leading zeros. Bus controller default setting: 0
14	Reserved	0	
15	Keying	0	Binary encoding (bus controller default setting)
		1	Gray encoding

5.4.2 Extended configuration

Name:
ConfigAdvanced01 to ConfigAdvanced02

This register only differs from register by data length and additional monostable multivibrator testing.

Data type	Values	Bus controller default setting
UDINT	See the bit structure.	65536

Bit structure:

Bit	Description	Value	Information
0 - 5	SSI value valid bits	x	Bus controller default setting: 0
6 - 7	Clock rate	11	125 kHz. Bus controller default setting: 0
8 - 13	SSI number of bits	x	Number of bits including leading zeros. Bus controller default setting: 0
14	Reserved	0	
15	Keying	0	Binary encoding (bus controller default setting)
		1	Gray encoding
16 - 17	Monostable multivibrator testing	00	Check OFF, no additional clock bit
		01	Check set to high level (bus controller default setting)
		10	Check set to low level
		11	Level is clocked but ignored.
18 - 31	Reserved	0	

5.5 SSI encoder communication registers

5.5.1 SSI position values

Name:
Encoder01 to Encoder02

The two SSI encoder values are displayed as 32-bit position values. The SSI position values are calculated synchronously with the X2X cycle.

Data type	Values	Information
UDINT	0 to 4,294,967,729	SSI position

5.5.2 Input state of digital inputs 1 to 2

Name:
DigitalInput01 to DigitalInput02

This register contains the input state of digital inputs 1 to 2.

Data type	Values
USINT	See the bit structure.

Bit structure:

Bit	Description	Value	Information
3	DigitalInput01	0 or 1	Input state - Digital input 1
7	DigitalInput02	0 or 1	Input state - Digital input 2

5.5.3 Status of encoder power supply

Name:
PowerSupply01

This register indicates the status of the integrated encoder power supply. A faulty encoder supply voltage is output as a warning.

Data type	Values
USINT	See the bit structure.

Bit structure:

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

5.6 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
128 µs

5.7 Maximum cycle time

The maximum cycle time specifies the time up to which the bus cycle can be increased without internal counter overflows causing module malfunctions.

Maximum cycle time
16 ms

5.8 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
128 µs