# X20(c)DM9324

## 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 |
| MAEMV | Installation / EMC guide |

### 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 |
|---|---|---|
| | **Digital inputs/outputs** | |
| X20DM9324 | X20 digital mixed module, 8 inputs, 24 VDC, sink, configurable input filter, 4 outputs, 24 VDC, 0.5 A, source, 1-wire connections | |
| X20cDM9324 | X20 digital mixed module coated, 8 inputs, 24 VDC, sink, configurable input filter, 4 outputs, 24 VDC, 0.5 A, source, 1-wire connections | |
| | **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: X20DM9324, X20cDM9324 - Order data

## 1.4 Module description

This module is equipped with 8 inputs and 4 outputs for 1-wire connections. The inputs are designed for sink connections, the outputs for source connections.

Functions:

- Digital inputs
- Digital outputs

**Digital inputs**

The digital inputs are equipped with an input filter with a configurable input delay.

**Monitoring status of the digital outputs**

The output signal of the digital outputs is monitored for short circuit or overload, as is the state of the power supply.

# 2 Technical description

## 2.1 Technical data

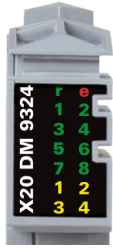| Order number | X20DM9324 | X20cDM9324 |
|---|---|---|
| **Short description** | | |
| I/O module | 8 digital inputs 24 VDC for 1-wire connections, 4 digital outputs 24 VDC for 1-wire connections | |
| **General information** | | |
| Nominal voltage | 24 VDC | |
| B&R ID code | 0x20B9 | 0xE225 |
| Status indicators | I/O function per channel, operating state, module status | |
| Diagnostics | | |
| Module run/error | Yes, using LED status indicator and software | |
| Outputs | Yes, using LED status indicator and software (output error status) | |
| Power consumption | | |
| Bus | 0.21 W | |
| Internal I/O | 0.5 W | |
| Additional power dissipation caused by actuators (resistive) [W] [1] | +0.21 | |
| 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 | |
| EAC | Yes | |
| KC | Yes | - |
| **Digital inputs** | | |
| Input characteristics per EN 61131-2 | Type 1 | |
| Input voltage | 24 VDC -15% / +20% | |
| Input current at 24 VDC | Typ. 3.75 mA | |
| Input circuit | Sink | |
| Input filter | | |
| Hardware | ≤100 µs | |
| Software | Default 1 ms, configurable between 0 and 25 ms in 0.2 ms increments | |
| Connection type | 1-wire connections | |
| Input resistance | Typ. 6.4 kΩ | |
| Switching threshold | | |
| Low | <5 VDC | |
| High | >15 VDC | |
| Insulation voltage between channel and bus | 500 $V_{eff}$ | |
| **Digital outputs** | | |
| Variant | Current-sourcing FET | |
| Switching voltage | 24 VDC -15% / +20% | |
| Nominal output current | 0.5 A | |
| Total nominal current | 2 A | |
| Connection type | 1-wire connections | |
| Output circuit | Source | |
| Output protection | Thermal shutdown in the event of overcurrent or short circuit (see value "Short-circuit peak current") Internal freewheeling diode for switching inductive loads (see section "Switching inductive loads") | |
| Diagnostic status | Output monitoring with 10 ms delay | |
| Leakage current when the output is switched off | 5 µA | |
| $R_{DS(on)}$ | 210 mΩ | |
| Peak short-circuit current | <12 A | |
| Switch-on in the event of overload shutdown or short-circuit shutdown | Approx. 10 ms (depends on the module temperature) | |
| Switching delay | | |
| 0 → 1 | <300 µs | |
| 1 → 0 | <300 µs | |
| Switching frequency | | |
| Resistive load | Max. 500 Hz | |
| Inductive load | See section "Switching inductive loads". | |
| Braking voltage when switching off inductive loads | Typ. 50 VDC | |
| Insulation voltage between channel and bus | 500 $V_{eff}$ | |
| **Electrical properties** | | |
| Electrical isolation | Channel isolated from bus Channel not isolated from channel | |

Table 2: X20DM9324, X20cDM9324 - Technical data

| Order number | X20DM9324 | X20cDM9324 |
|---|---|---|
| **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 | 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: X20DM9324, X20cDM9324 - Technical data

1)     Number of outputs x $R_{DS(on)}$ x Nominal output current[2]

## 2.2 Status LEDs

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 |
| | | | 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 - 8 | Green | | Input status of the corresponding digital input |
| | 1 - 4 | Orange | | Output status of the corresponding digital output |

## 2.3 Pinout
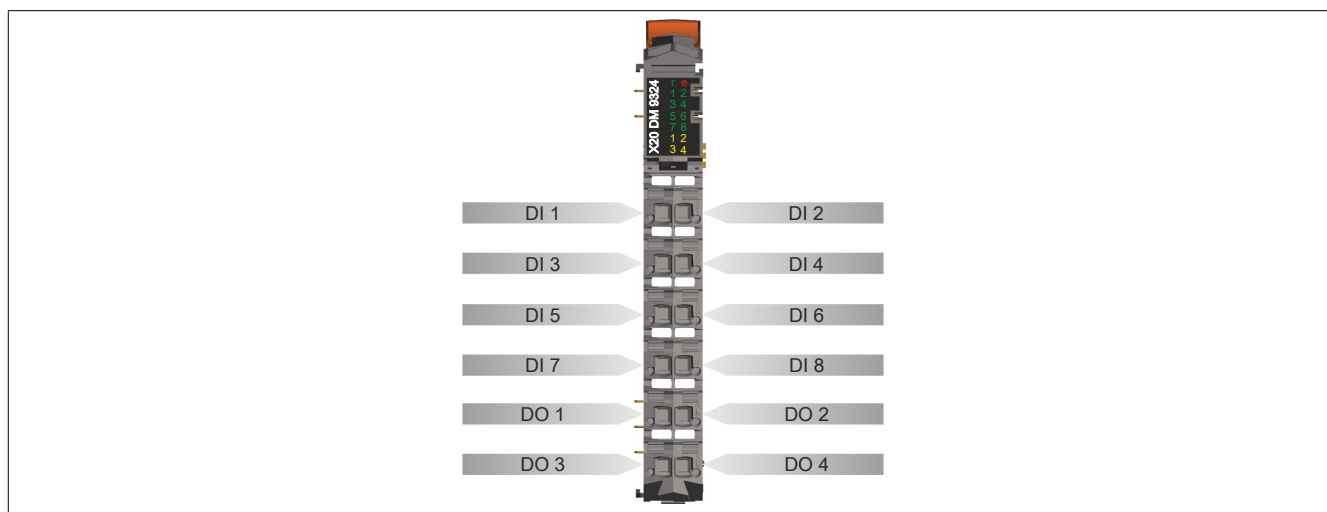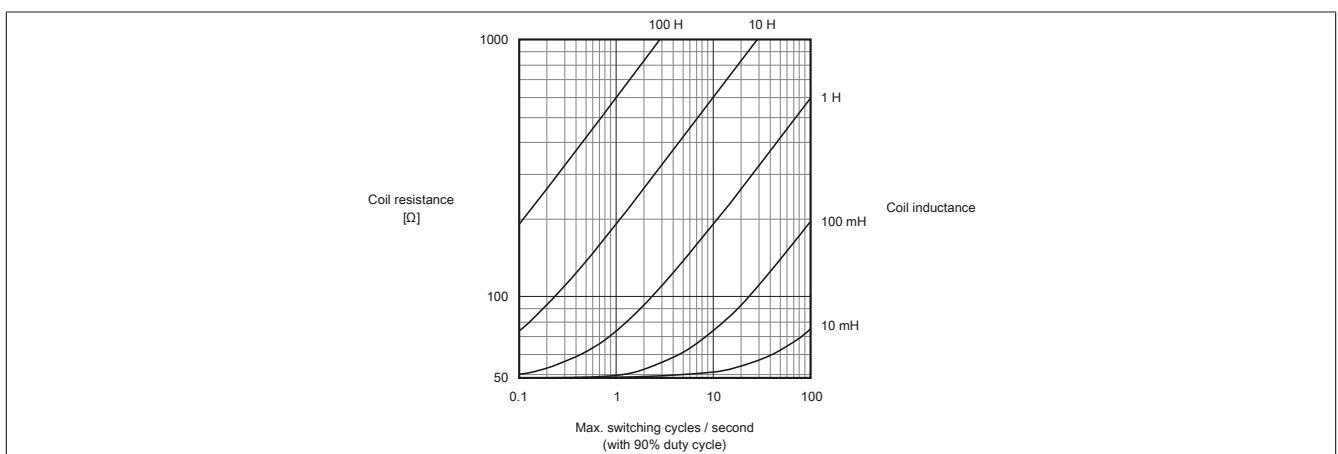
## 2.4 Connection example
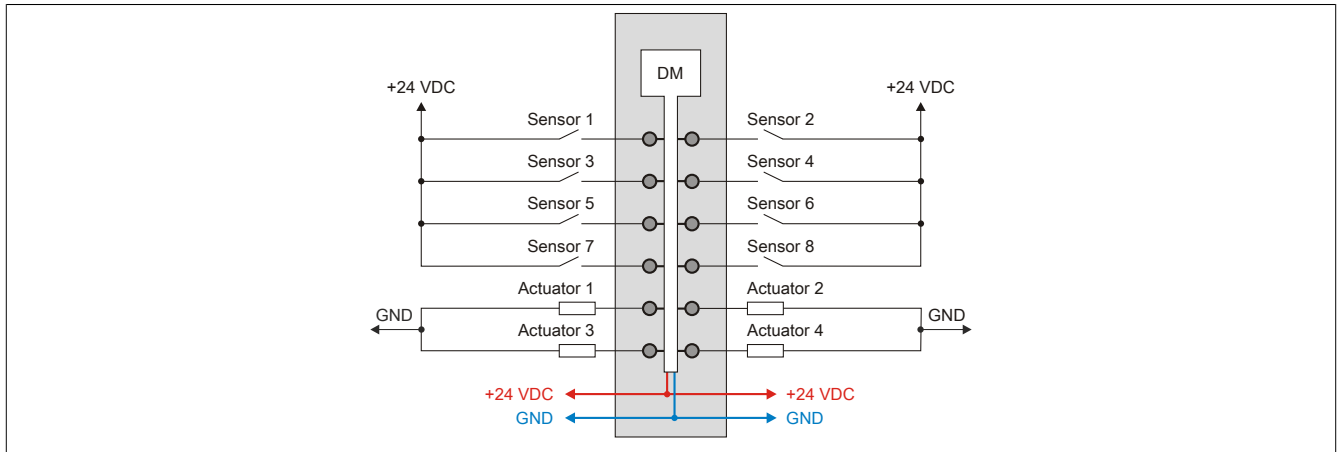


## 2.5 Input circuit diagram
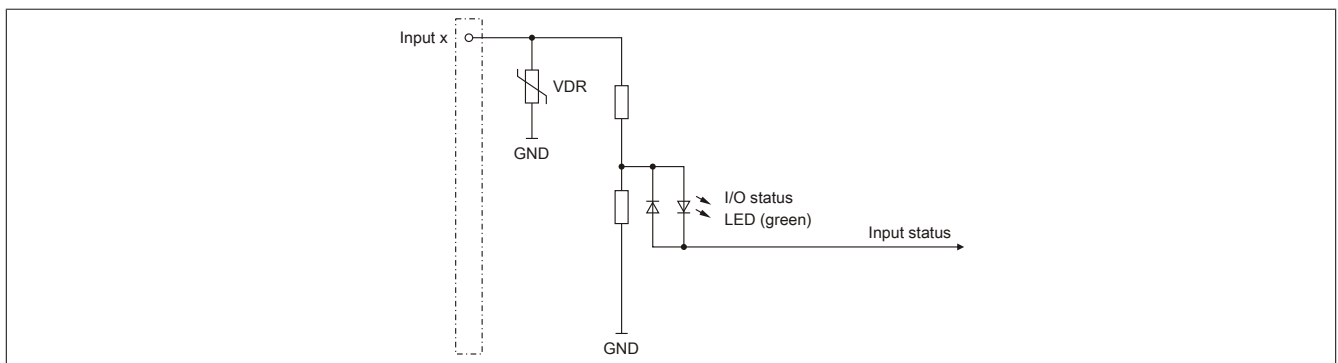


## 2.6 Output circuit diagram
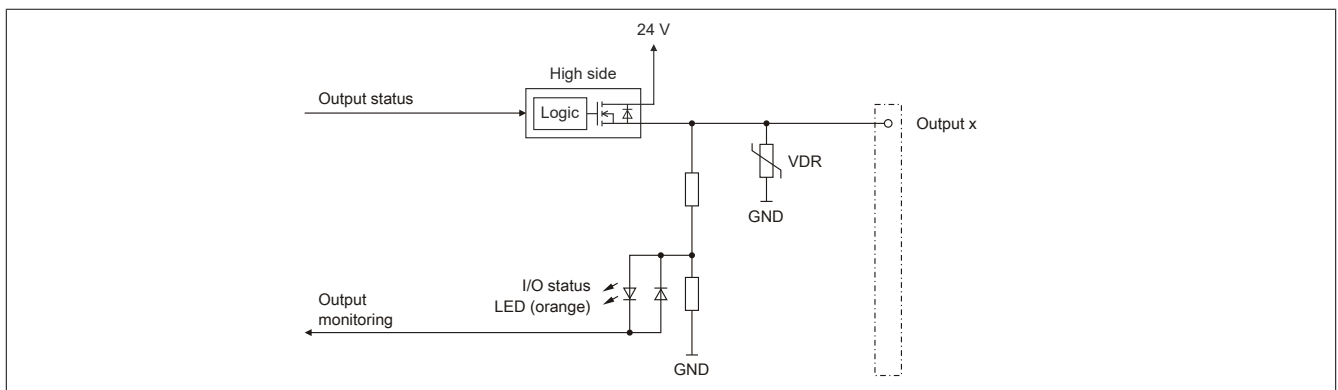


## 2.7 Switching inductive loads

# 3 Function description

## 3.1 Digital inputs

The module is equipped with 8 digital input channels.

### 3.1.1 Recording the input state

**Unfiltered**

The input state is collected with a fixed offset to the network cycle and transferred in the same cycle.

**Filtered**

The filtered state is collected with a fixed offset to the network cycle and transferred in the same cycle. Filtering takes place asynchronously to the network in multiples of 200 μs with a network-related jitter of up to 50 μs.

**Packed outputs** (only function model 0 - Standard)

Setting "Packed inputs" in the Automation Studio I/O configuration can be used to determine whether all bits of the register should be applied as individual data points in the Automation Studio I/O mapping ("DigitalInput01 to DigitalInputxx") or whether the register should be displayed as a single USINT data point ("DigitalInput").

> **Information:**
>
> **The register is described in "Input state of digital inputs 1 to 8" on page 10.**

### 3.1.2 Input filter

An input filter is available for each input. Disturbance pulses that are shorter than the input delay are suppressed by the input filter.
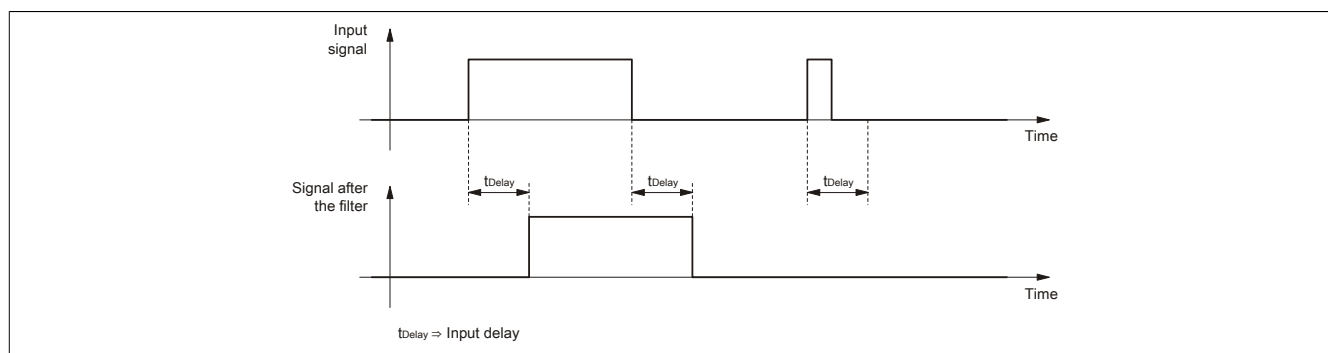


The input delay can be set in steps of 100 μs. It makes sense, however, to enter values in steps of 2 since the input signals are sampled in an interval of 200 μs.

| Values | Filter |
|---|---|
| 0 | No software filter |
| 2 | 0.2 ms |
| ... | ... |
| 250 | 25 ms - Higher values are limited to this value. |

> **Information:**
>
> **The register is described in "Digital input filter" on page 10.**

## 3.2 Digital outputs

The module is equipped with 4 digital outputs.

The output state is transferred to the output channels with a fixed offset (<60 µs) in relation to the network cycle (SyncOut).

**Packed outputs** (only function model 0 - Standard)

Setting "Packed outputs" in the Automation Studio I/O configuration can be used to determine whether all bits of the register should be applied as individual data points in the Automation Studio I/O mapping (e.g. "DigitalOutput01 to DigitalOutputxx") or whether the register should be displayed as a single USINT data point (e.g. "DigitalOutput").

> **Information:**
>
> **The register is described in "Switching state of digital outputs 1 to 4" on page 10.**

### 3.2.1 Monitoring status of the outputs

On the module, the output states of the outputs are compared to the target states. The control of the output driver is used for the target state.

A change in the output state resets monitoring for that output. The status of each individual channel can be read out. A change in the monitoring status is actively transmitted as an error message.

| Supervision status | Description |
|---|---|
| 0 | Digital output channel: No error |
| 1 | Digital output channel:<br>• Short circuit or overload<br>• Channel switched on and missing I/O power supply<br>• Channel switched off and external voltage applied to channel |

> **Information:**
>
> **The register is described in "Status of digital outputs 1 to 4" 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 digital 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 | Fixed offset | Name | Data type | Read | | Write | |
|---|---|---|---|---|---|---|---|
| | | | | Cyclic | Acyclic | Cyclic | Acyclic |
| Configuration | | | | | | | |
| 18 | - | ConfigOutput01 (input filter) | USINT | | | | ● |
| Communication | | | | | | | |
| 0 | 1 | DigitalInput | USINT | ● | | | |
| | | DigitalInput01 | Bit 0 | | | | |
| | | ... | ... | | | | |
| | | DigitalInput08 | Bit 7 | | | | |
| 2 | 0 | DigitalOutput | | | | ● | |
| | | DigitalOutput01 | Bit 0 | | | | |
| | | ... | ... | | | | |
| | | DigitalOutput04 | Bit 3 | | | | |
| 30 | 2 | StatusInput01 | USINT | ● | | | |
| | | StatusDigitalOutput01 | Bit 0 | | | | |
| | | | ... | | | | |
| | | StatusDigitalOutput04 | Bit 3 | | | | |

Fixed modules require their data points to be in a specific order in the X2X frame. Cyclic access occurs according to a predefined offset, not based on the register address.

Acyclic access continues to be based on the register numbers.

## 5.3 Function model 254 - Bus controller

| Register | Offset[1] | Name | Data type | Read | | Write | |
|---|---|---|---|---|---|---|---|
| | | | | Cyclic | Acyclic | Cyclic | Acyclic |
| Configuration | | | | | | | |
| 18 | - | ConfigOutput01 (input filter) | USINT | | | | ● |
| Communication | | | | | | | |
| 0 | 0 | Input state of digital inputs 1 to 8 | USINT | ● | | | |
| | | DigitalInput01 | Bit 0 | | | | |
| | | ... | ... | | | | |
| | | DigitalInput08 | Bit 7 | | | | |
| 2 | 0 | Switching state of digital outputs 1 to 4 | | | | ● | |
| | | DigitalOutput01 | Bit 0 | | | | |
| | | ... | ... | | | | |
| | | DigitalOutput04 | Bit 3 | | | | |
| 30 | - | Status of digital outputs 1 to 4 | USINT | | ● | | |
| | | StatusDigitalOutput01 | Bit 0 | | | | |
| | | | ... | | | | |
| | | StatusDigitalOutput04 | Bit 3 | | | | |

1) The offset specifies where the register is within the CAN object.

## 5.4 Digital inputs

### 5.4.1 Input state of digital inputs 1 to 8

Name:
DigitalInput or
DigitalInput01 to DigitalInput08

This register is used to indicate the input state of digital inputs 1 to 8.

| Data type | Value | Information[1] |
|---|---|---|
| USINT | 0 to 255 | Packed inputs = On<br>Data point: "DigitalInput" |
| | See the bit structure. | Packed inputs = Off or function model ≠ 0 - Standard<br>Data points: "DigitalInput01" to "DigitalInput08" |

1)    See "Digital inputs - Record input status" on page 6.

Bit structure:

| Bit | Name | Value | Information |
|---|---|---|---|
| 0 | DigitalInput01 | 0 or 1 | Input state - Digital input 1 |
| ... | | ... | |
| 7 | DigitalInput08 | 0 or 1 | Input state - Digital input 8 |

### 5.4.2 Digital input filter

Name:
ConfigOutput01

The filter value for all digital inputs can be configured in this register.

| Data type | Values | Filter |
|---|---|---|
| USINT | 0 | No software filter (bus controller default setting) |
| | 2 | 0.2 ms |
| | ... | ... |
| | 250 | 25 ms - Higher values are limited to this value. |

## 5.5 Digital outputs

### 5.5.1 Switching state of digital outputs 1 to 4

Name:
DigitalOutput
DigitalOutput01 to DigitalOutput04

This register is used to store the switching state of digital outputs 1 to 4.

| Data type | Values | Information[1] |
|---|---|---|
| USINT | 0 to 15 | Packed outputs = On<br>Data point: "DigitalOutput" |
| | See the bit structure. | Packed outputs = Off or function model ≠ 0 - Standard.<br>Data points: "DigitalOutput01" to "DigitalOutput04" |

1)    See "Digital outputs" on page 7.

Bit structure:

| Bit | Description | Value | Information |
|---|---|---|---|
| 0 | DigitalOutput01 | 0 | Digital output 01 reset |
| | | 1 | Digital output 01 set |
| ... | | ... | |
| 3 | DigitalOutput04 | 0 | Digital output 04 reset |
| | | 1 | Digital output 04 set |

## 5.6 Monitoring status of the digital outputs

On the module, the output states of the outputs are compared to the target states.

### 5.6.1 Status of digital outputs 1 to 4

Name:
StatusInput01
StatusDigitalOutput01 to StatusDigitalOutput04

This register contains the state of digital outputs 1 to 4.

| Data type | Values | Information[1] |
|---|---|---|
| USINT | 0 to 15 | Packed outputs = On<br>Data point: "StatusInput01" |
| | See the bit structure. | Packed outputs = Off or function model ≠ 0 - Standard.<br>Data points: "StatusDigitalOutput01" to "StatusDigitalOutput04" |

1)    See "Digital outputs" on page 7.

Bit structure:

| Bit | Name | Value | Information |
|---|---|---|---|
| 0 | StatusDigitalOutput01 | 0 | Channel 01: No error |
| | | 1 | Channel 01:<br>• Short circuit or overload<br>• Channel switched on and missing I/O power supply<br>• Channel switched off and external voltage applied to channel |
| ... | | ... | |
| 3 | StatusDigitalOutput04 | 0 | Channel 04: No error |
| | | 1 | Channel 04: For an error description, see channel 01. |

## 5.7 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 | |
|---|---|
| Without filtering | 100 µs |
| With filtering | 150 µs |

## 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 | |
|---|---|
| Without filtering | 100 µs |
| With filtering | 200 µs |