X20DO6325

Data sheet
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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
MAEMV	Installations / EMV guide

1.2 Order data

Order number	Short description	Figure
	Digital outputs	
X20DO6325	X20 digital output module, 6 outputs, 24 VDC, 0.5 A, source, open circuit and overload detection, 2-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	
	Terminal blocks	
X20TB06	X20 terminal block, 6-pin, 24 VDC keyed	
X20TB12	X20 terminal block, 12-pin, 24 VDC keyed	

Table 1: X20DO6325 - Order data

1.3 Module description

This module is equipped with 6 outputs with 1- or 2-wire connections with diagnostic functions and GND for signal power supply. The outputs are designed for a source circuit.

For continuous 1-wire wiring, the 6x X20 terminal block can be used. 2-wire wiring can be implemented with the 12x terminal block.

Functions:

- Digital outputs
- Monitoring status of the digital outputs
- OSP mode

Monitoring status of the digital outputs

The output signal of the digital outputs is monitored for short circuit, open circuit, overload and overtemperature.

OSP mode

In mode "OSP" (Operator Set Predefined), the user defines a digital pattern. This OSP value is output as soon as the communication between the module and master is aborted.

2 Technical description

2.1 Technical data

Order number	X20DO6325
Short description	
I/O module	6 digital outputs 24 VDC for 1- or 2-wire connections with diagnostic function
General information	
B&R ID code	0xE284
Status indicators	I/O function per channel, diagnostics per channel, operating state, module status
Diagnostics	
Module run/error	Yes, using LED status indicator and software
Status outputs	Yes, using LED status indicator and software
Diagnostic outputs	Yes, using LED status indicator and software
Power consumption	
Bus	0.15 W
Internal I/O	0.4 W
Additional power dissipation caused by actuators (resistive) [W] [1)]	0.225
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
Digital outputs	
Variant	Current-sourcing FET
Nominal voltage	24 VDC
Switching voltage	24 VDC -15% / +20%
Nominal output current	0.5 A
Total nominal current	3 A
Connection type	1- or 2-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	
Open circuit	At <1 mA (typ.), detected if output OFF, delay approx. 10 ms
Short circuit to 24 VDC	Detected if output OFF, delay approx. 10 ms
Short circuit to GND	Detected if output ON, delay approx. 10 ms
Overload/Overtemperature	Detected if output ON, delay approx. 10 ms
Leakage current when the output is switched off	<160 µA
$R_{DS(on)}$	150 mΩ
Peak short-circuit current	<40 A
Switch-on in the event of overload shutdown or short-circuit shutdown	Depends on the module temperature
Switching delay [2)]	
0 → 1	<100 µs
1 → 0	<300 µs

Table 2: X20DO6325 - Technical data

Order number	X20DO6325
Switching frequency	
Resistive load [2]	Max. 2000 Hz
Inductive load	See section "Switching inductive loads".
Braking voltage when switching off inductive loads	45 to 52 VDC
Insulation voltage between channel and bus	510 V_{eff}
Electrical properties	
Electrical isolation	Channel isolated from bus Channel not isolated from channel and 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
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 X20TB06 or X20TB12 separately. Order 1x bus module X20BM11 separately.
Pitch	12.5$^{+0.2}$ mm

Table 2: X20DO6325 - Technical data

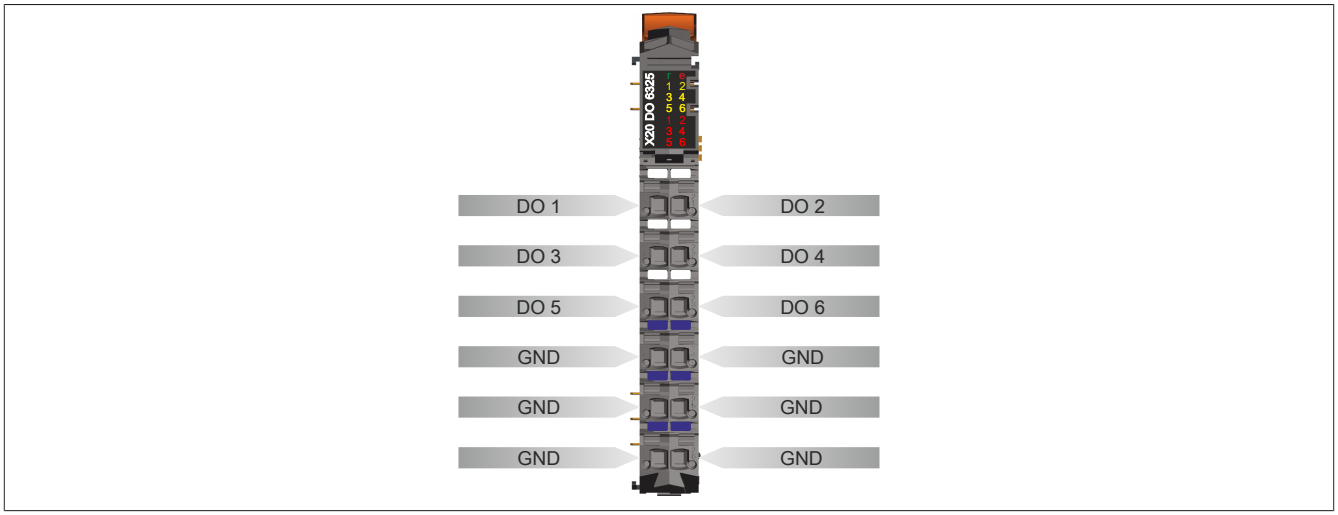
1) Number of outputs x $R_{DS(on)}$ x Nominal output current^2. For a calculation example, see section "Mechanical and electrical configuration" in the X20 system user's manual.
2) At loads ≤ 1 kΩ

2.2 LED status indicators

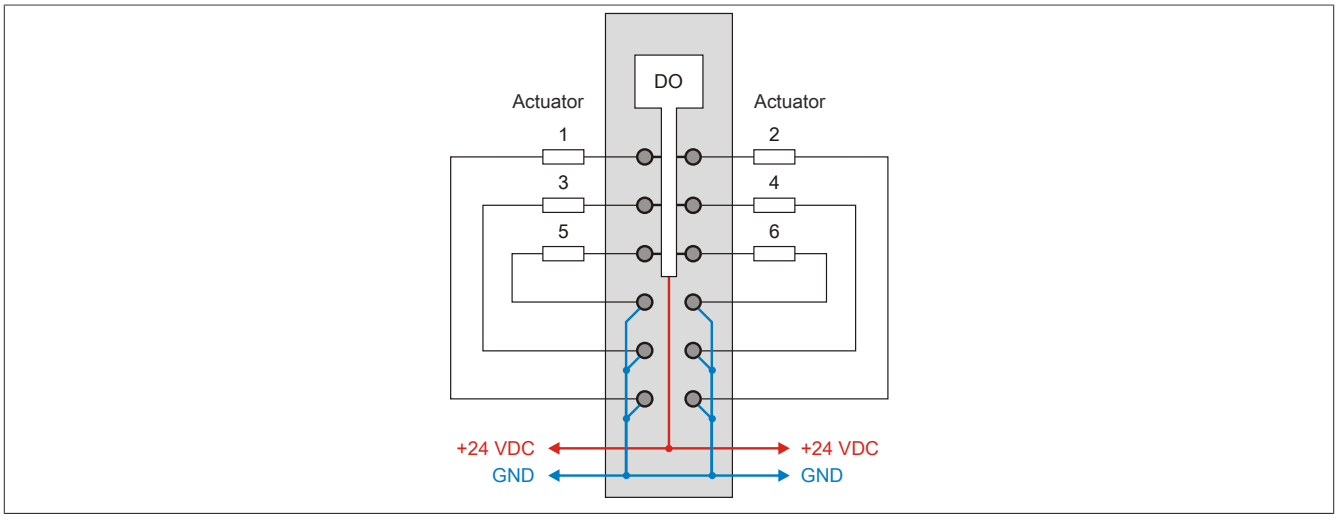
For a description of the various operating modes, see section "Additional information - Diagnostic LEDs" in the X20 System user's manual.

Figure	LED	Color	Status	Description
	r	Green	Off	No power to module
			Single flash	RESET mode
			Blinking	PREOPERATIONAL mode
			On	RUN mode
			Flickering (approx. 10 Hz)	Module is in OSP 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.
			Double flash	I/O power supply is outside the valid limits.
	e + r	Red on / Green single flash		Invalid firmware
	Channel 1 - 6	Orange		Output status of the corresponding digital output
	Diagnostics 1 - 6	Red		Monitoring of the corresponding digital output was tripped (short circuit, open line or overload)

2.3 Pinout



2.4 Connection example

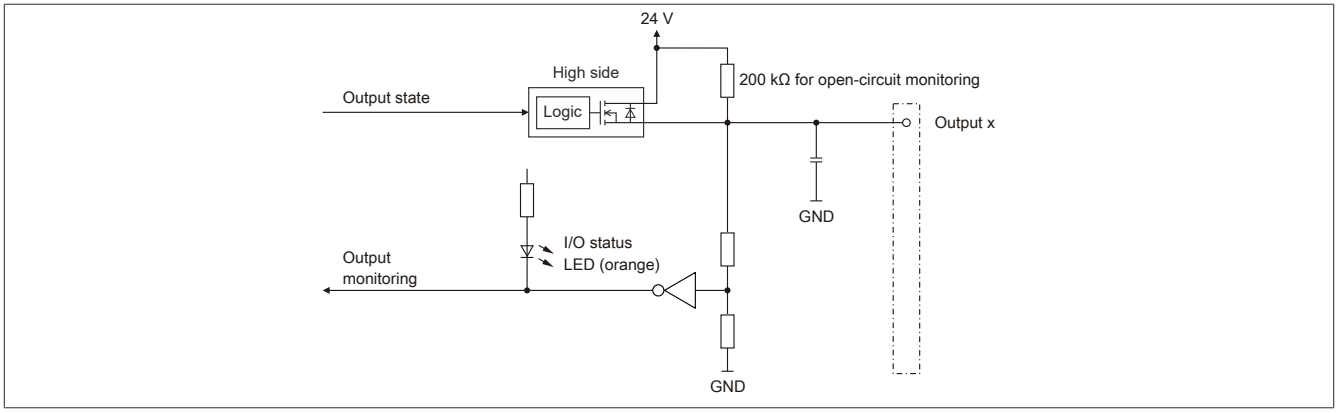


Caution!

If the module is operated outside specifications, the output current may rise above the maximum permissible nominal current. This applies both to individual channels and to the summation current of the module.

Appropriate cable cross-sections or external safety measures must therefore be provided.

2.5 Output circuit diagram



2.6 Open line detection

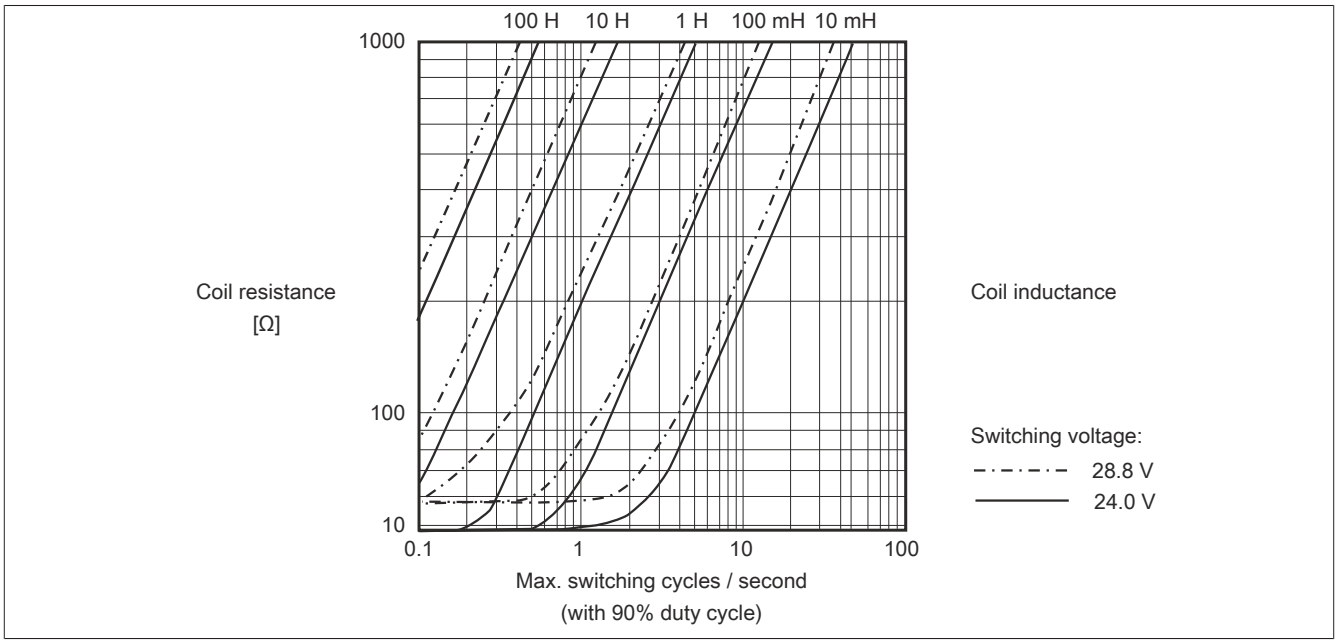
A 200 kΩ resistor to 24 V is mounted internally at each output for open-circuit detection.

If the load resistance at the terminal is greater than 25 to 100 kΩ (tolerance range), open circuit is therefore detected with a 24 V power supply. This corresponds to a current of 0.2 to 1 mA when the power is switched on. All tolerances have already been taken into account.

Supply voltage	Min. load	Max. load	Corresponds to load current when ON
24 V	100 kΩ	25 kΩ	0.2 to 1 mA

2.7 Switching inductive loads

Environmental temperature: 60°C, all outputs with the same load



Information:

If the maximum number of operating cycles per second is exceeded, an external inverse diode must be used.

Operating conditions outside of the area in the diagram are not permitted!

3 Function description

3.1 Digital outputs

The module is equipped with 6 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 6" on page 13.

3.2 Monitoring status of the digital outputs

The status of the outputs is determined on the module periodically every 4 ms. To suppress interference pulses on the feedback inputs, an adjustment is carried out via 2 read procedures.

The hardware diagnostics recognize the following states:

- **Short circuit to GND (if output ON) / Overload / Overtemperature**
  No distinction can be made between short circuit to GND and overload/overtemperature.
- **Short circuit to 24 VDC (if output OFF)**
- **Open circuit (if output OFF)**
  In the event of an open circuit, the error state is also indicated by an LED. This indicator can be disabled so that the open circuit indicator is hidden if the channel is open, i.e. not in use.

The error that has occurred is mapped in the corresponding status registers and in the summary status register.

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. "DigitalStatusGnd01 to DigitalStatusGnd06") or whether the register should be displayed as a single USINTUINT data point (e.g. "StatusInput01").

Information:

The registers are described in "Digital output status" on page 13.

3.3 OSP mode

In function model "OSP" (Operator Set Predefined), the user defines a digital pattern. This OSP value is output as soon as the communication between the module and master is aborted.

3.3.1 Hardware requirements

In order to use OSP mode sensibly, it should be ensured when setting up the application that the power supply of the output module and controller are designed to be independent of each other.

3.3.2 Functionality

The user has the choice between 2 OSP modes:

- Retain last valid value
- Replace with static value

In the first case, the module retains the last value recognized as a valid output status.

When selecting mode "Replace with static value", a plausible output value must be entered in the associated value register. When an OSP event occurs, this value is output instead of the value currently requested by the task.

If an OSP event occurs, e.g. communication between the module and master controller aborted, then bit OSPValid is reset on the module. The module enters the OSP state and output occurs according to the configuration in register OSPMode.

The following generally applies:

Even after regeneration of the communication channel, the OSP replacement value is still pending. The OSP state is only exited again when a set OSPValid bit is transferred.

When the master controller is restarted, bit OSPValid bit is reinitialized in the master controller. It must be set once more by the application and transferred via the bus.
In the event of brief communication errors between the module and master controller (e.g. due to EMC), the cyclic registers fail to refresh for several bus cycles. Within the module, bit OSPValid is reset; the set bit is retained in the controller, however. During the next successful transfer, the module-internal OSPValid bit is set again and the module automatically returns to normal mode.

If the task in the master controller needs the information about which output mode the module is currently in, bit ModulOK can be evaluated.

Warning!

If bit OSPValid bit is reset to "0" by the module, the output status no longer depends on the responsible task in the master controller. Nevertheless, output is made depending on the configuration of the OSP replacement value.

Information:

The registers are described in "Function model "OSP"" on page 15.

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	Name	Data type	Read		Write	
			Cyclic	Non-cyclic	Cyclic	Non-cyclic
Configuration						
4	CfgBwStatus	USINT				•
Communication						
2	DigitalOutput	USINT			•	
	DigitalOutput01	Bit 0				
	...	...				
	DigitalOutput06	Bit 5				
28	StatusInput01	USINT	•			
	DigitalStatusGnd01	Bit 0				
	...	...				
	DigitalStatusGnd06	Bit 5				
29	StatusInput02	USINT	•			
	DigitalStatusVcc01	Bit 0				
	...	...				
	DigitalStatusVcc06	Bit 5				
30	StatusInput03	USINT	•			
	DigitalStatusBw01	Bit 0				
	...	...				
	DigitalStatusBw06	Bit 5				
31	StatusInput04	USINT	•			
	DigitalStatusSum01	Bit 0				
	...	...				
	DigitalStatusSum06	Bit 5				
	PowerSupply01	Bit 7				

5.3 Function model 1 - OSP

Register	Name	Data type	Read		Write	
			Cyclic	Non-cyclic	Cyclic	Non-cyclic
Configuration						
4	CfgBwStatus	USINT				•
32	CfgOSPMode	USINT				•
Communication						
2	Switching state of digital outputs 1 to 6	USINT			•	
	DigitalOutput01	Bit 0				
	...	...				
	DigitalOutput06	Bit 5				
28	Short circuit to GND and overtemperature	USINT	•			
	DigitalStatusGnd01	Bit 0				
	...	...				
	DigitalStatusGnd06	Bit 5				
29	Short circuit to voltage	USINT	•			
	DigitalStatusVcc01	Bit 0				
	...	...				
	DigitalStatusVcc06	Bit 5				
30	Open circuit	USINT	•			
	DigitalStatusBw01	Bit 0				
	...	...				
	DigitalStatusBw06	Bit 5				
31	Cumulative status	USINT	•			
	DigitalStatusSum01	Bit 0				
	...	...				
	DigitalStatusSum06	Bit 5				
	PowerSupply01	Bit 7				
34	Enabling OPS output in the module	USINT			•	
	OSPValid	Bit 0				
36	CfgOSPValue	USINT			•	

5.4 Function model 254 - Bus controller

Register	Offset[1)]	Name	Data type	Read		Write	
				Cyclic	Non-cyclic	Cyclic	Non-cyclic
Configuration							
4	-	CfgBwStatus	USINT				•
Communication							
2	0	Switching state of digital outputs 1 to 6	USINT			•	
		DigitalOutput01	Bit 0				
		...	...				
		DigitalOutput06	Bit 5				
28	-	Short circuit to GND and overtemperature	USINT		•		
		DigitalStatusGnd01	Bit 0				
		...	...				
		DigitalStatusGnd06	Bit 5				
29	-	Short circuit to voltage	USINT		•		
		DigitalStatusVcc01	Bit 0				
		...	...				
		DigitalStatusVcc06	Bit 5				
30	-	Open circuit	USINT		•		
		DigitalStatusBw01	Bit 0				
		...	...				
		DigitalStatusBw06	Bit 5				
31	-	Cumulative status	USINT		•		
		DigitalStatusSum01	Bit 0				
		...	...				
		DigitalStatusSum06	Bit 5				
		PowerSupply01	Bit 7				

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

5.5 Digital outputs

5.5.1 Switching state of digital outputs 1 to 6

Name:
DigitalOutput
DigitalOutput01 to DigitalOutput06

This register stores the switching state of digital outputs 1 to 6.

Data type	Values	Information[1)]
USINT	0 to 63	Packed outputs = On Data point: "DigitalOutput"
	See the bit structure.	Packed outputs = Off or function model ≠ 0 - Standard. Data points: "DigitalOutput01" to "DigitalOutput06"

1) See "Digital outputs" on page 8.

Bit structure:

Bit	Name	Value	Information
0	DigitalOutput01	0	Digital output 01 reset
		1	Digital output 01 set
...		...	
5	DigitalOutput06	0	Digital output 06 reset
		1	Digital output 06 set

5.6 Digital output status

5.6.1 Enabling the status LED

Name:
CfgBwStatus

There is a corresponding enable bit for each output. The bit can be set in this register to determine whether the error state LED is switched on in the event of an open circuit. This can be used to hide unused channels. In function model "Bus controller", the default value is 0xBF.

Data type	Values	Bus controller default setting
USINT	See the bit structure.	191

Bit structure:

Bit	Name	Value	Information
0	Channel 01	0	Open line indicator 01 disabled
		1	Open circuit indicator 01 enabled (bus controller default setting)
...		...	
5	Channel 06	0	Open line indicator 06 disabled
		1	Open circuit indicator 06 enabled (bus controller default setting)
6	Reserved	0	
7	PowerSupply01	0	No error status indicators
		1	Monitor supply voltage (bus controller default setting)

5.6.2 Short circuit to GND and overtemperature

Name:
StatusInput01
DigitalStatusGnd01 to DigitalStatusGnd06

A short circuit or overtemperature that has occurred is indicated in this register by setting the corresponding channel bit.

Data type	Values	Information[1)]
USINT	0 to 63	Packed outputs = On Data point: "StatusInput01"
	See the bit structure.	Packed outputs = Off or function model ≠ 0 - Standard. Data points: "DigitalStatusGnd01" to "DigitalStatusGnd06"

1) See "Monitoring status of the digital outputs" on page 8.

Bit structure:

Bit	Name	Value	Information
0	DigitalStatusGnd01	0	No error
		1	Channel 1: Short circuit or overload
...		...	
5	DigitalStatusGnd06	0	No error
		1	Channel 6: Short circuit or overload
6 - 7	Reserved	0	

5.6.3 Short circuit to voltage

Name:
StatusInput02
DigitalStatusVcc01 to DigitalStatusVcc06

A short circuit that has occurred is indicated in this register by setting the corresponding channel bit.

Data type	Values	Information[1)]
USINT	0 to 63	Packed outputs = On Data point: "StatusInput02"
	See the bit structure.	Packed outputs = Off or function model ≠ 0 - Standard. Data points: "DigitalStatusVcc01" to "DigitalStatusVcc06"

1) See "Monitoring status of the digital outputs" on page 8.

Bit structure:

Bit	Name	Value	Information
0	DigitalStatusVcc01	0	No error
		1	Channel 1: Short circuit to voltage
...		...	
5	DigitalStatusVcc06	0	No error
		1	Channel 6: Short circuit to voltage
6 - 7	Reserved	0	

5.6.4 Open circuit

Name:
StatusInput03
DigitalStatusBw01 to DigitalStatusBw06

An open circuit that has occurred is indicated in this register by setting the corresponding channel bit.

Data type	Values	Information[1)]
USINT	0 to 63	Packed outputs = On Data point: "StatusInput03"
	See the bit structure.	Packed outputs = Off or function model ≠ 0 - Standard. Data points: "DigitalStatusBw01" to "DigitalStatusBw06"

1) See "Monitoring status of the digital outputs" on page 8.

Bit structure:

Bit	Name	Value	Information
0	DigitalStatusBw01	0	No error
		1	Channel 1: Open circuit
...		...	
5	DigitalStatusBw06	0	No error
		1	Channel 6: Open circuit
6 - 7	Reserved	0	

5.6.5 Cumulative status

Name:
StatusInput04
DigitalStatusSum01 to DigitalStatusSum06
PowerSupply01

This register also indicates any errors that are present in the other status registers. This makes it easy to check whether an error has occurred.
If the I/O power supply fails, bit 7 is set and all status bits in the other status registers are reset to the value 0.

Data type	Values	Information[1)]
USINT	0 to 63	Packed outputs = On Data point: "StatusInput04"
	See the bit structure.	Packed outputs = Off or function model ≠ 0 - Standard. Data points: "DigitalStatusSum01" to "DigitalStatusSum06"

1) See "Monitoring status of the digital outputs" on page 8.

Bit structure:

Bit	Name	Value	Information
0	DigitalStatusSum01	0	No error
		1	Channel 1: Error occurred
...		...	
5	DigitalStatusSum06	0	No error
		1	Channel 6: Error occurred
6	Reserved	0	
7	PowerSupply01	0	No error
		1	Pending supply voltage error

5.7 Function model "OSP"

In function model "OSP" (Operator Set Predefined), the user defines a digital pattern. This OSP value is output as soon as the communication between the module and master is aborted.

5.7.1 Enabling OPS output in the module

Name:
OSPValid

This data point makes it possible to start the output of the module and request the use of OSP during operation.

Bit OSPValid exists once on the module and is managed by the user task. It must be set to start the enabled channels. As long as bit OSPValid remains set in the module, the module behaves the same as in function model "Standard".

Data type	Values
USINT	See the bit structure.

Bit structure:

Bit	Description	Value	Information
0	OSPValid	0	Request OSP operation (after initial startup or module in standby)
		1	Request normal operation
1 - 7	Reserved	0	

5.7.2 Setting OSP mode

Name:
CfgOSPMode

This register controls the behavior of a channel when using OSP.

Data type	Values	Explanation
USINT	0	Replace with static value
	1	Retain last valid value

5.7.3 Defining an OSP-digital output value

Name:
CfgOSPValue

This register contains the digital output value that is output in "Replace with static value" mode during OSP mode.

Data type	Values
USINT	See the bit structure.

Bit structure:

Bit	Description	Value	Information
0		0 or 1	OSP output value for channel DigitalOutput00
...		...	
x		0 or 1	OSP output value for channel DigitalOutput0x

Warning!

"OSPValue" is only applied by the module if bit "OSPValid" has been set in the module.

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
150 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
Equal to the minimum cycle time