

X20(c)DO4332-1

1 General information

The module is equipped with 4 outputs for 3-wire connections. The nominal output current is 2 A.

- 4 digital outputs with 2 A
- Source circuit
- 3-wire connections
- 24 VDC and GND for actuator power supply
- Integrated output protection
- OSP mode
- PWM mode

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

Order number	Short description	Figure
	Digital outputs	
X20DO4332-1	X20 digital output module, 4 outputs, 24 VDC, 2 A, source, 3-wire connections, PWM output	
X20cDO4332-1	X20 digital output module, coated, 4 outputs, 24 VDC, 2 A, source, 3-wire connections, PWM output	
	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 power supply connected through	
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: X20DO4332-1, X20cDO4332-1 - Order data

4 Technical data

Order number	X20DO4332-1	X20cDO4332-1
Short description		
I/O module	4 digital outputs 24 VDC for 3-wire connections	
General information		
B&R ID code	0xF5F9	0x2A01

Table 2: X20DO4332-1, X20cDO4332-1 - Technical data

Order number	X20DO4332-1	X20cDO4332-1
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	0.16 W	
Internal I/O	0.49 W	
Additional power dissipation caused by actuators (resistive) [W] ¹⁾	+1.6	
Certifications		
CE	Yes	
DNV GL	Temperature: B (0 - 55°C) Humidity: B (up to 100%) Vibration: B (4 g) EMC: B (bridge and open deck)	
EAC	Yes	-
Digital outputs		
Variant	Current-sourcing FET	
Nominal voltage	24 VDC	
Switching voltage	24 VDC -15% / +20%	
Nominal output current	2 A	
Total nominal current	8 A	
Connection type	3-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	
Actuator power supply	0.5 A in total for output-independent actuator power supply	
Diagnostic status	Output monitoring with 10 ms delay	
Leakage current when the output is switched off	5 µA	
R _{DS(on)}	100 mΩ	
Peak short-circuit current	<4 A	
Switch-on in the event of overload shutdown or short-circuit shutdown	Approx. 10 ms (depends on the module temperature)	
Switching delay ²⁾		
0 → 1	<300 µs	
1 → 0	<300 µs	
Switching frequency		
Resistive load ²⁾	Max. 500 Hz	
Braking voltage when switching off inductive loads	0.6 V ³⁾	
Insulation voltage between channel and bus	500 V _{eff}	
Additional functions	Outputs can be connected in parallel to increase the output current. ⁴⁾	
PWM output		
Quantity	4	
Nominal voltage	24 VDC	
Nominal current	2 A	
PWM frequency	15.25 to 1000 Hz	
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	
Variant	Current-sourcing FET	
Configurable dither	0 to 250 Hz, 1 to 25% of the period duration	
Period duration resolution	1000 to 65535 µs in 1 µs steps	
Insulation voltage between channel and bus	500 V _{eff}	
Actuator power supply		
Voltage	Module power supply minus voltage drop for short-circuit protection	
Voltage drop for short-circuit protection at 500 mA	Max. 2 V	
Short-circuit proof	Yes	
Power consumption		
Actuator power supply	Max. 12 W ⁵⁾	
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	

Table 2: X20DO4332-1, X20cDO4332-1 - Technical data


Order number	X20DO4332-1	X20cDO4332-1
Ambient conditions		
Temperature		
Operation		
Horizontal mounting orientation	-25 to 60°C	
Vertical mounting orientation	-25 to 50°C	
Derating	See section "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: X20DO4332-1, X20cDO4332-1 - Technical data

- 1) Number of outputs x $R_{DS(on)}$ x Nominal output current². For a calculation example, see section "Mechanical and electrical configuration" in the X20 system user's manual.
- 2) At loads ≤ 1 k Ω
- 3) Due to the freewheeling diode integrated in the module.
- 4) A parallel connection is not possible in PWM mode.
- 5) The power consumption of the sensors connected to the module is not permitted to exceed 12 W.

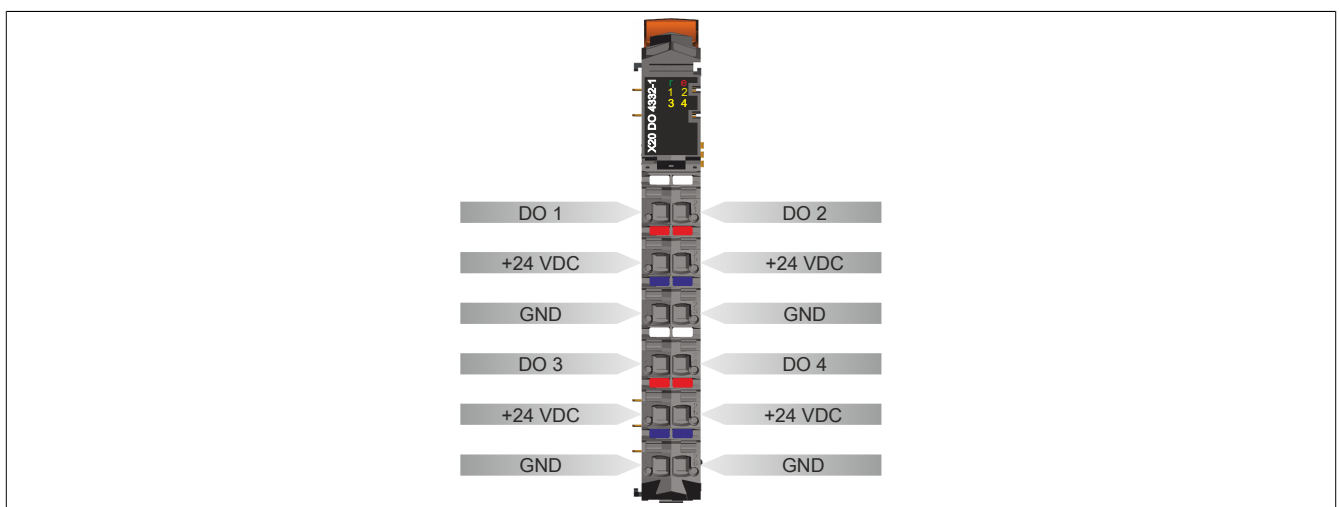
5 LED status indicators

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

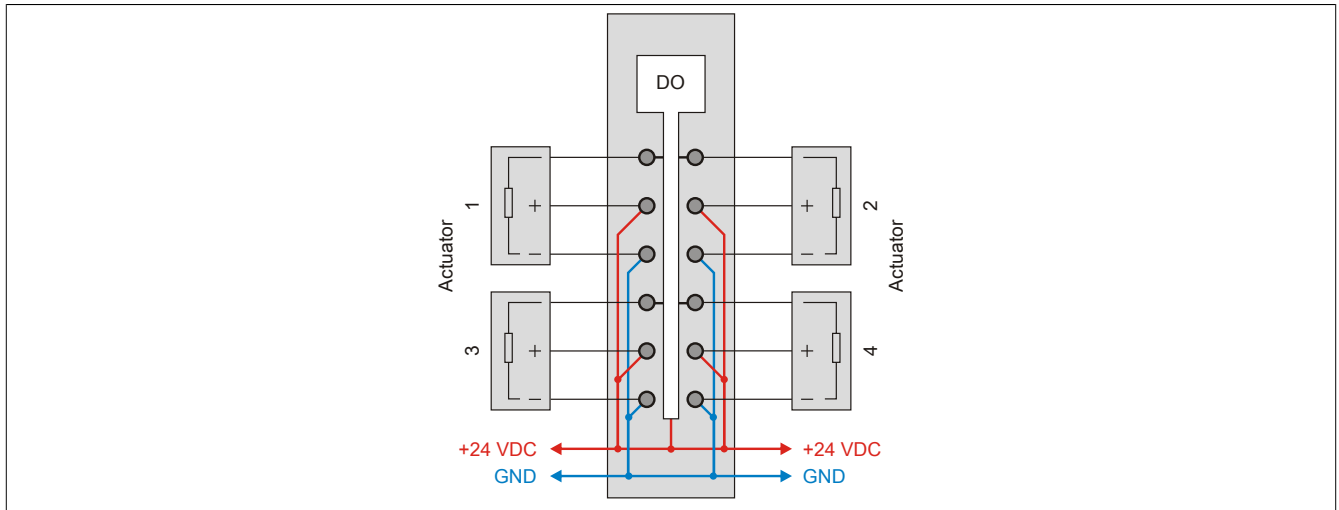
Figure	LED	Color	Status	Description	
	r	Green	Off	No power to module	
			Single flash	Mode RESET	
			Blinking	Mode PREOPERATIONAL	
			On	Mode RUN	
			Flickering (approx. 10 Hz)	The module is in the OSP state.	
	e	Red	Off	Module not supplied with power or everything OK	
			Single flash	Warning/Error on an I/O channel. Level monitoring for digital outputs has been triggered.	
	e + r		Solid red / Single green flash	Invalid firmware	
	1 - 4		Orange		Output state of the corresponding digital output. ¹⁾

- 1) Die Helligkeit der Anzeige kann sich im PWM-Modus abhängig von Frequenz und Tastverhältnis ändern.

6 Pinout



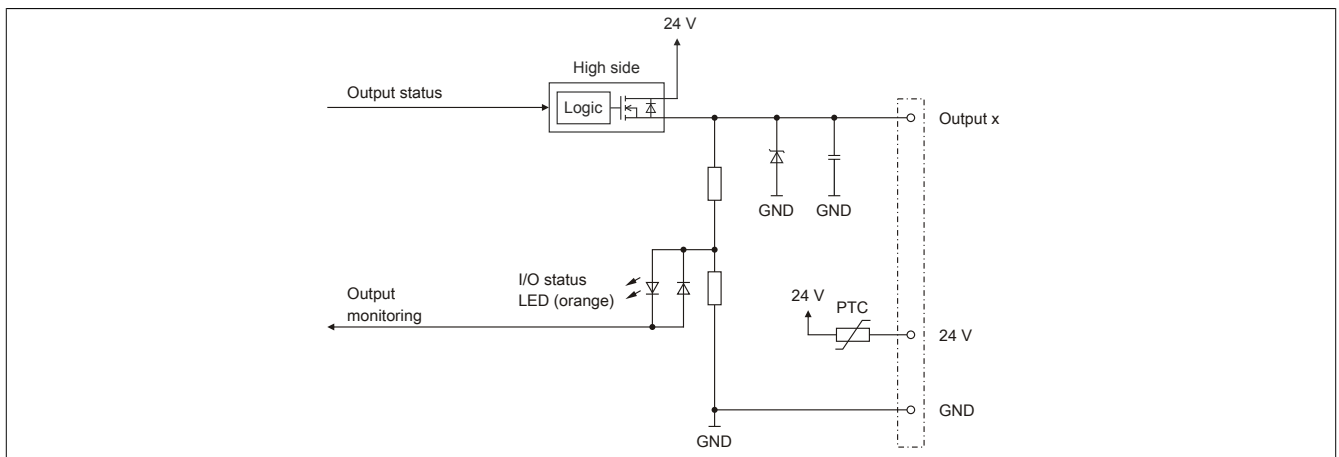
7 Connection example



8 OSP hardware requirements

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

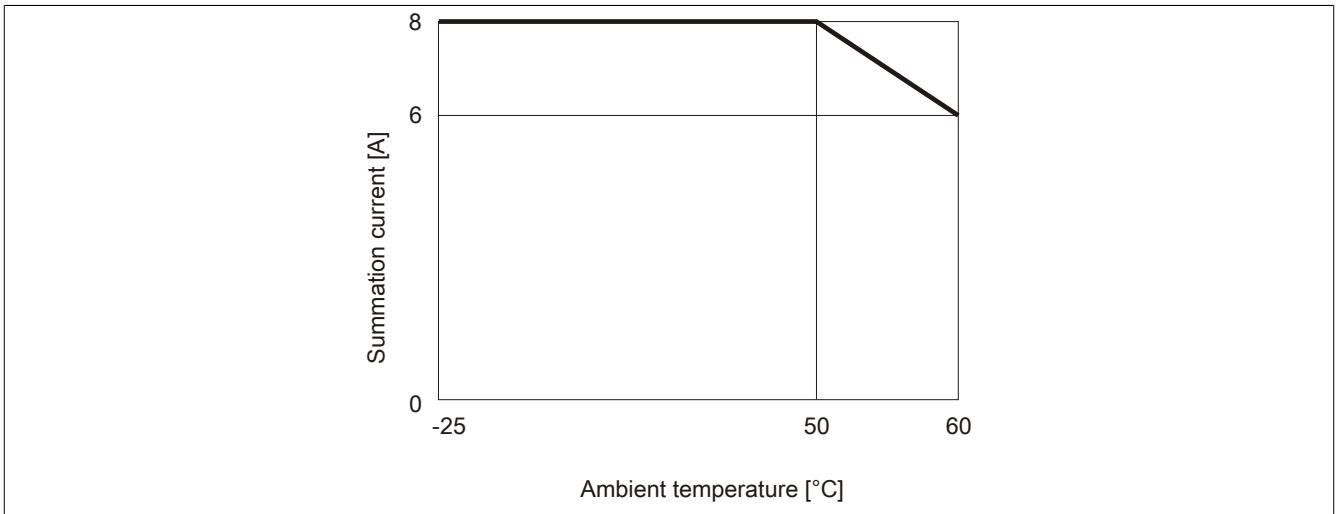
9 Output circuit diagram



10 Derating

During operation over 55°C, the power dissipation of the modules to the left and right of this module is not permitted to exceed 1.15 W!

For an example of calculating the power dissipation of I/O modules, see section "Mechanical and electrical configuration - Power dissipation of I/O modules" in the X20 user's manual.



11 Register description

11.1 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.

11.2 Function model 0 - Standard

Register	Name	Data type	Read		Write	
			Cyclic	Acyclic	Cyclic	Acyclic
Communication						
2	DigitalOutput	USINT			•	
	DigitalOutput01	Bit 0				
				
	DigitalOutput04	Bit 3				
30	StatusInput01	USINT	•			
	StatusDigitalOutput01	Bit 0				
				
	StatusDigitalOutput04	Bit 3				

11.3 Function model 1 - OSP

Register	Name	Data type	Read		Write	
			Cyclic	Acyclic	Cyclic	Acyclic
Configuration						
32	CfgOSPMode	USINT		(•)		•
36	CfgOSPValue	USINT		(•)		•
Communication						
2	Switching state of digital outputs 1 to 4	USINT			•	
	DigitalOutput01	Bit 0				
				
	DigitalOutput04	Bit 3				
30	Status of digital outputs 1 to 4	USINT	•			
	StatusDigitalOutput01	Bit 0				
				
	StatusDigitalOutput04	Bit 3				
34	Enabling OPS output in the module	USINT			•	
	OSPValid	Bit 0				

11.4 Function model 3 - PWM

Register	Name	Data type	Read		Write	
			Cyclic	Acyclic	Cyclic	Acyclic
Configuration						
26	CfgDitherFrequency	USINT				•
28	CfgDitherAmplitude	USINT				•
Communication						
2 * N + 2	PwmOutput0N (index N = 1 to 4)	INT			•	
12	PwmPeriode	UINT			•	
30	StatusInput01	USINT	•			
	StatusDigitalOutput01	Bit 0				
				
	StatusDigitalOutput04	Bit 3				

11.5 Function model 254 - Bus controller

Register	Offset ¹⁾	Name	Data type	Read		Write	
				Cyclic	Acyclic	Cyclic	Acyclic
Configuration							
12	-	PwmPeriode	UINT				•
26	-	CfgDitherFrequency	USINT				•
28	-	CfgDitherAmplitude	USINT				•
Communication							
2 * N + 2	2 * N	PwmOutput0N (index N = 1 to 4)	INT			•	
30	-	StatusInput01	USINT		•		
		StatusDigitalOutput01	Bit 0				
					
		StatusDigitalOutput04	Bit 3				

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

11.5.1 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).

11.5.2 CAN I/O bus controller

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

11.6 Digital outputs

The output status is transferred to the output channels with a fixed offset in relation to the network cycle (SyncOut).

11.6.1 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.

Only function model 0 - Standard:

Setting "Packed outputs" in the Automation Studio I/O configuration determines whether all bits of this register should be applied individually as data points in the Automation Studio I/O assignment ("DigitalOutput01" to "DigitalOutput0x") or whether this register should be displayed as a single USINT data point ("DigitalOutput").

Data type	Values	Information
USINT	0 to 15	Packed outputs = On
	See the bit structure.	Packed outputs = Off or function model ≠ 0 - Standard.

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

11.7 Monitoring status of the digital 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. A change in the monitoring status is actively transmitted as an error message.

11.7.1 Status of digital outputs 1 to 4

Name:

StatusInput01

StatusDigitalOutput01 to StatusDigitalOutput04

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

Only function model 0 - Standard:

Setting "Packed outputs" in the Automation Studio I/O configuration determines whether all bits of this register should be applied individually as data points in the Automation Studio I/O assignment ("StatusDigitalOutput01" to "StatusDigitalOutput0x") or whether this register should be displayed as a single USINT data point ("StatusInput01").

Data type	Values	Information
USINT	0 to 15	Packed outputs = On
	See the bit structure.	Packed outputs = Off or function model ≠ 0 - Standard.

Bit structure:

Bit		Value	Information
0	StatusDigitalOutput01	0	Channel 01: No error
		1	Channel 01: <ul style="list-style-type: none"> • Short circuit or overload • Channel switched on and missing I/O power supply • Channel switched off and external voltage applied on channel
...		...	
3	StatusDigitalOutput04	0	Channel 04: No error
		1	Channel 04: For an error description, see channel 01.

11.8 Function model "OSP"

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

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.

11.8.1 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.

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 stand-by)
		1	Request normal operation
1 - 7	Reserved	0	

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".

If an OSP event occurs, e.g. communication between the module and master CPU 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" on page 10.

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 CPU is restarted, bit OSPValid bit is reinitialized in the master CPU. 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 CPU(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 CPU, however. During the next successful transfer, the module-internal OSPValid bit is set again and the module automatically returns to normal operation.

If the task in the master CPU 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 CPU. Nevertheless, output is made depending on the configuration of the OSP replacement value.

11.8.2 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

11.8.3 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 operation.

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!

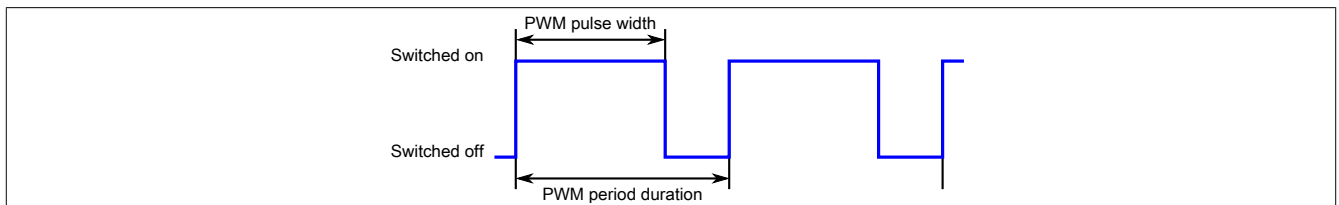
"OSPValue" is only applied by the module if bit "OSPValid" has been set in the module.

11.9 Function model "PWM"

11.9.1 Pulse width

Name:
PwmOutput01 to PwmOutput04

In this register, the PWM pulse width is specified as a percentage of the period duration. At the beginning of each period, the output is switched on for the percentage of time set in this register.



Data type	Values	Information
INT	0 to 32767	0 to 100% of the period duration

11.9.2 Period duration

Name:
PwmPeriode

In this register, the PWM period duration is specified in μs .

Data type	Values	Information
UINT	0	PWM disabled
	1000 to 65535	Period duration in μs

11.9.3 Dither

When the position setpoint for valves remains constant for a long period of time, especially in fluids, there is a risk that a valve will stick. This is normally prevented using "dithering". When doing so, the value is permitted to slightly oscillate around the position setpoint.

By default, dither is active for all outputs as soon as the following conditions are met:

- **Dither amplitude** and **dither frequency** are set to a value greater than 0.
- **Pulse width** is set to a value greater than 0 and less than 32767.

Dither is enabled or disabled for all outputs together.

11.9.3.1 Dither frequency

Name:

CfgDitherFrequency

The dither frequency for all 4 channels can be specified together in this register.

Data type	Values	Information
USINT	0 to 250	Corresponds to 0 to 250 Hz

11.9.3.2 Dither amplitude

Name:

CfgDitherAmplitude

In this register, the change of the **pulse width** caused by the dither can be specified for all 4 channels together as a percentage. The change takes place in both the positive and negative direction.

If the **pulse width** is adjusted, the dithering is reset and reapplied in the direction of the change.

Example

Set **period duration**: 2000 μ s

DitherAmplitude: 10%

Result: The set pulse width oscillates by $\pm 100 \mu$ s (200μ s / 2).

Data type	Values	Information
USINT	0	No dither
	1 to 25	1 to 25% of the period duration

11.10 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
250 μ s

11.11 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