X67MM2436

1 Order data

Order number	Short description	Figure
	Motor modules	
X67MM2436	X67 PWM motor module, I/O power supply 24-38.5 VDC ±25%, 2 PWM motor bridges, 3 A continuous current, 5 A peak current, 2x 3 digital inputs 24 VDC, sink, configurable as incremental encoder	

Table 1: X67MM2436 - Order data

Required accessories
For a general overview, see section "Accessories - General overview" of the X67 system user's manual.

2 Module description

The motor bridge module is used to control 2 DC motors with a nominal voltage of 24 to 38.5 VDC ±25% at a nominal current of 3 A.

Functions:

- Digital counter inputs
- Operating modes
- Valve control
- Automatic shutdown

Digital counter inputs

The module is equipped with digital inputs that can additionally be used as incremental counters. In addition to AB(R) and event counters, period duration and gate measurements are also possible.

Operating modes

The PWM outputs of the module can be controlled in different operating modes. In addition to the standard PWM mode, a current operating mode is available. This allows the module to be adapted to a wide range of applications.

Valve control

This module can be used to control valves. To prevent the valves from sticking, a dither can be configured exactly according to the specifications of the valve manufacturer.

Automatic shutdown

The voltage of the I/O power supply, the motor current and the module temperature are monitored. If a value overshoots the predefined limit value, the module is automatically shut down. The outputs are automatically started up again as soon as the value is within the limit value again.

3 Technical data

Order number	X67MM2436
Short description	
I/O module	2-channel PWM output (H bridge) 2x 3 inputs for ABR incremental encoders
General information	
B&R ID code	0x2273
Sensor power supply	Max. 0.02 A per group
Status indicators	
Output	Per channel
Input	Per group (3 inputs)
Other	Supply voltage, bus function
Diagnostics	
Outputs	Yes, open circuit via software status
I/O power supply	Yes, using status LED and software
Connection type	
X2X Link	M12, B-keyed
Inputs/Outputs	4x M12, A-keyed
I/O power supply	M8, 4-pin
Power consumption	
Internal I/O	1 W
X2X Link power supply	0.75 W
Certifications	
CE	Yes
ATEX	Zone 2, II 3G Ex nA IIA T5 Gc IP67, Ta = 0 - Max. 60°C TÜV 05 ATEX 7201X
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
I/O power supply	
Nominal voltage	24 to 38.5 VDC ±25%
Power consumption	
Sensor power supply	Max. 1 W
Integrated protection	
Reverse polarity protection	No
Digital inputs	
Quantity	6
Nominal voltage	24 VDC
Input characteristics per EN 61131-2	Type 1
Input voltage	24 VDC (-15%/+20%)
Input current at 24 VDC	Approx. 4 mA
Input circuit	Sink
Input filter	
Hardware	<5 µs
Software	-
Input resistance	Typ. 5.4 kΩ
Additional functions	2x ABR incremental encoder (+24 VDC), 2x AB incremental encoder, 2x event counter, 2x period duration / gate measurement
Switching threshold	
Low	<5 VDC
High	>15 VDC
Insulation voltage between channel and bus	500 V_{eff}
ABR incremental encoder	
Quantity	2
Encoder inputs	24 VDC, asymmetrical
Counter size	16-bit
Input frequency	Max. 50 kHz
Evaluation	4x
Encoder power supply	Module-internal, max. 20 mA per encoder
Signal form	Square wave pulse
Counter 1	Inputs 1 to 3
Counter 2	Inputs 4 to 6
Counter frequency	Max. 200 kHz
Sensor power supply	
Supply voltage	24 VDC

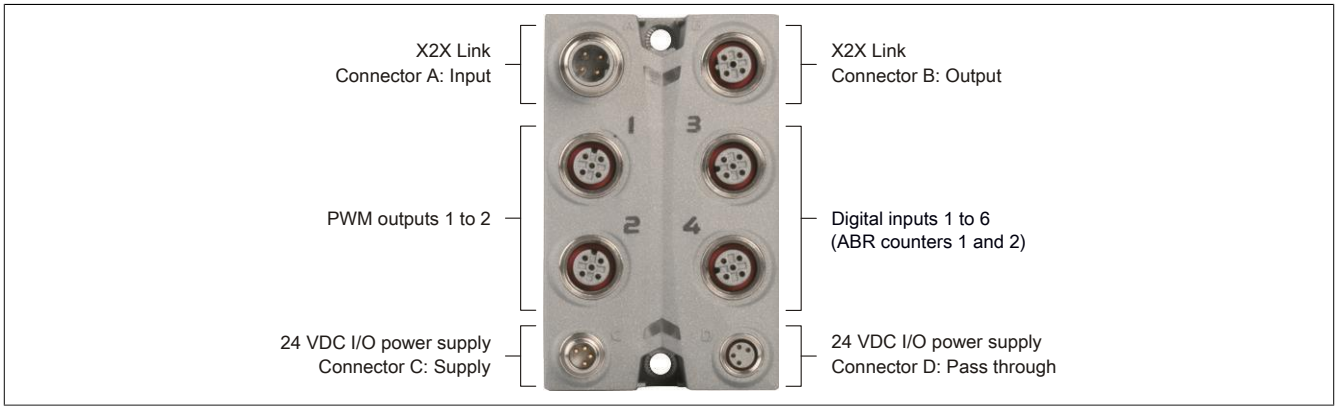
Table 2: X67MM2436 - Technical data

Order number	X67MM2436
Short-circuit proof	Yes
Supply voltage	
Min. voltage at 20 mA / group	20 VDC
PWM output	
Quantity	2
Type	H bridge
Nominal voltage	24 to 38.5 VDC ±25% 1)
PWM frequency	15 Hz to 50 kHz
Variant	H bridge
Configurable dither	Amplitude, frequency
Period duration resolution	16-bit, min. 20 µs
Phase shift PWM1 to PWM2	180°
DC bus capacitance	200 µF
Output current	
Nominal current	3 A
Max. current/output	5 A for 2 s (after a recovery time of at least 10 s at maximum 3 A)
Max. current/module	8 A
PWM pulse width	
PWM mode	15-bit + sign ≥10 ns
Current mode	15-bit + sign ≥10 ns
Electrical properties	
Electrical isolation	Channel isolated from bus Channel not isolated from channel
Operating conditions	
Mounting orientation	
Any	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	IP67
Ambient conditions	
Temperature	
Operation	-25 to 55°C
Derating	-
Storage	-40 to 85°C
Transport	-40 to 85°C
Mechanical properties	
Dimensions	
Width	53 mm
Height	85 mm
Depth	42 mm
Weight	225 g
Torque for connections	
M8	Max. 0.4 Nm
M12	Max. 0.6 Nm

Table 2: X67MM2436 - Technical data

1) The tolerance value is composed of the voltage tolerances and permissible total AC voltage component with a peak value of 5% of the rated voltage.

4 Connection elements



4.1 LED status indicators

Figure	LED	Color/Status		Description
Status indicator 1: Left: Green, Right: Red  Status indicator 2: Left: Green, Right: Red	**Status indicator 1**: Status indicator for X2X Link			
	LED	**Green (left)**	**Red (right)**	**Description**
	Left/Right	Off	Off	No supply via X2X Link
		On	Off	X2X Link supplied, communication is functioning
		Off	On	X2X Link supplied, but X2X Link communication is not functioning
		On	On	PREOPERATIONAL: X2X Link supplied, module not initialized
	I/O LEDs: Status indicator for the corresponding analog input			
	LED	**Color**	**Status**	**Description**
	1 - 2	Yellow	On	Output 1 or 2 is active
	3	Green	On	Input 1 to 3 (in)
	4	Green	On	Input 4 to 6 (in)
	Status indicator 2: Status indicator for module function			
	LED	**Color**	**Status**	**Description**
	Left	Green	Off	No power to module
			Single flash	RESET mode
			Double flash	BOOT mode (during firmware update)[1)]
			Blinking	PREOPERATIONAL mode
			On	RUN mode
	Right	Red	Off	No power to module or everything OK
			On	Error or reset status
			Single flash	Warning/Error on an I/O channel. Overflow in analog inputs.
			Double flash	Supply voltage not in the valid range

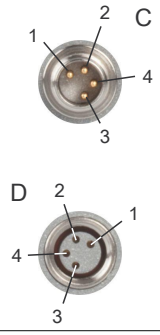
1) Depending on the configuration, a firmware update can take up to several minutes.

4.2 I/O power supply 24 to 38.5 VDC

The I/O power supply is connected using circular connectors (M8, 4-pin). The supply is connected via connector C (male). Connector D (female) is used to route the power supply to other modules.

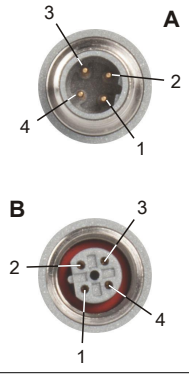
Information:

The maximum permissible current per supply is 4 A (in summation 8 A)!

Connection	Pinout	
	**Pin**	**Name**
	1	24 to 38.5 VDC ±25%
	2	24 to 38.5 VDC ±25%
	3	GND
	4	GND
	C → Connector (male) in module, supply D → Connector (female) in module, routing	

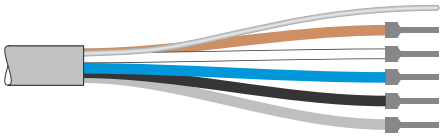
4.3 X2X Link

This module is connected to X2X Link using pre-assembled cables. The connection is made using M12 circular connectors.

Connection	Pinout	
	**Pin**	**Name**
	1	X2X+
	2	X2X
	3	X2X⊥
	4	X2X\
	Shield connection made via threaded insert in the module. A → B-coded (male), input B → B-coded (female), output	

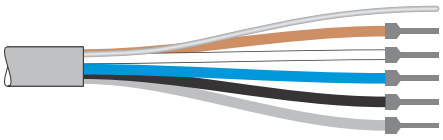
5 Pinout

X1 to X2
M12 ①



Shield	
1	PWM +
2	NC
3	NC
4	PWM -
5	Shield

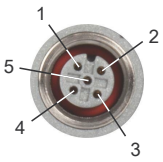
X3 to X4
M12 ①



Shield	
1	+24 VDC
2	A
3	GND
4	B
5	R

① X67CA0A41.xxxx: M12 sensor cable, straight
X67CA0A51.xxxx: M12 sensor cable, angled

5.1 Connections X1 and X2

M12, 5-pin	Pinout		
Connections 1 and 2	**Pin**	**connection 1**	**connection 2**
	1	PWM 1 +	PWM 2 +
	2	–	–
	3	–	–
	4	PWM 1 -	PWM 2 -
	5	Shield	Shield

Warning!

Circular connectors are not permitted to be plugged in or unplugged during operation.

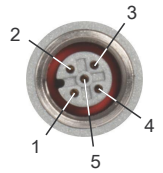
Information:

Shielded motor cables must be used in order to meet the limits according to the EN55011 standard (emissions).

5.2 Connections X3 and X4

Information:

The maximum permitted current for the digital inputs is 8 A (4 A per connection pin).

M12, 5-pin	Pinout		
Connections 3 and 4	**Pin**	**Connection 3**[1)]	**Connection 4**[1)]
	1	Supply for digital inputs (24 V, total current 0.02 A)	
	2	Digital input 1, ABR1 - A	Digital input 4, ABR2 - A
	3	GND	GND
	4	Digital input 2, ABR1 - B	Digital input 5, ABR2 - B
	5	Digital input 3, ABR1 - R, Latch_1	Digital input 6, ABR2 - R, Latch_2
	Shield connection made via threaded insert in the module		

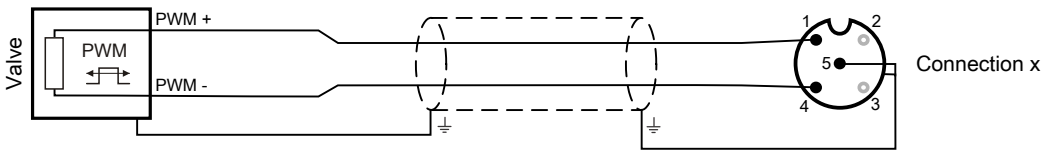
1) All digital inputs: 24 V / <4 µs

Warning!

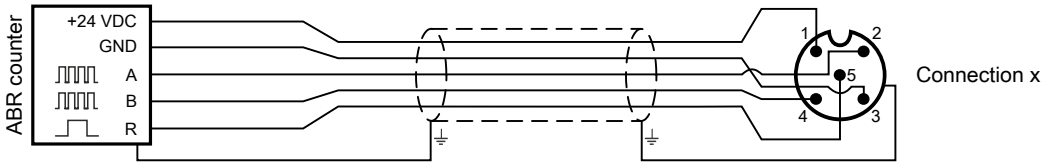
Circular connectors are not permitted to be plugged in or unplugged during operation.

6 Connection examples

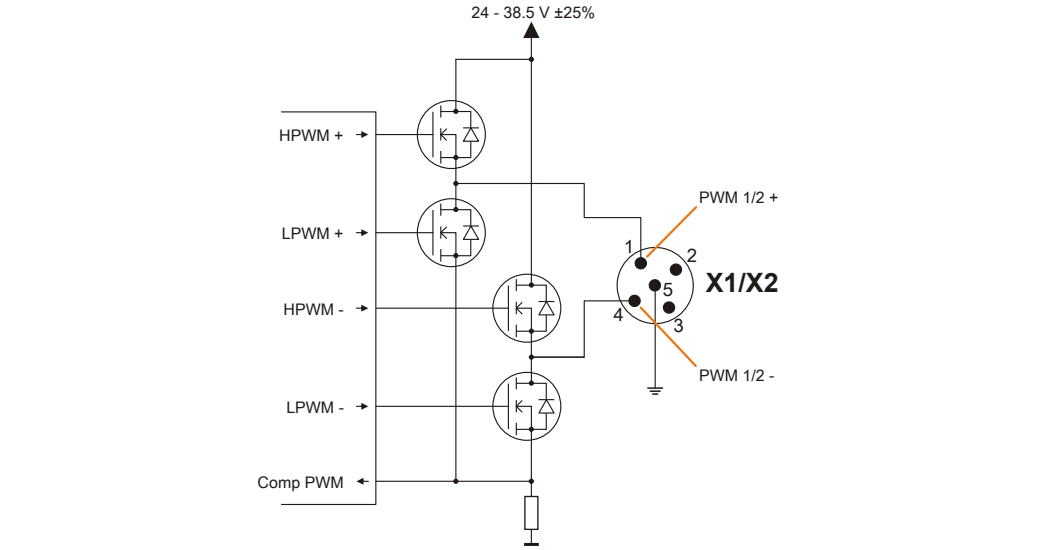
Connection 1 to 2: PWM output



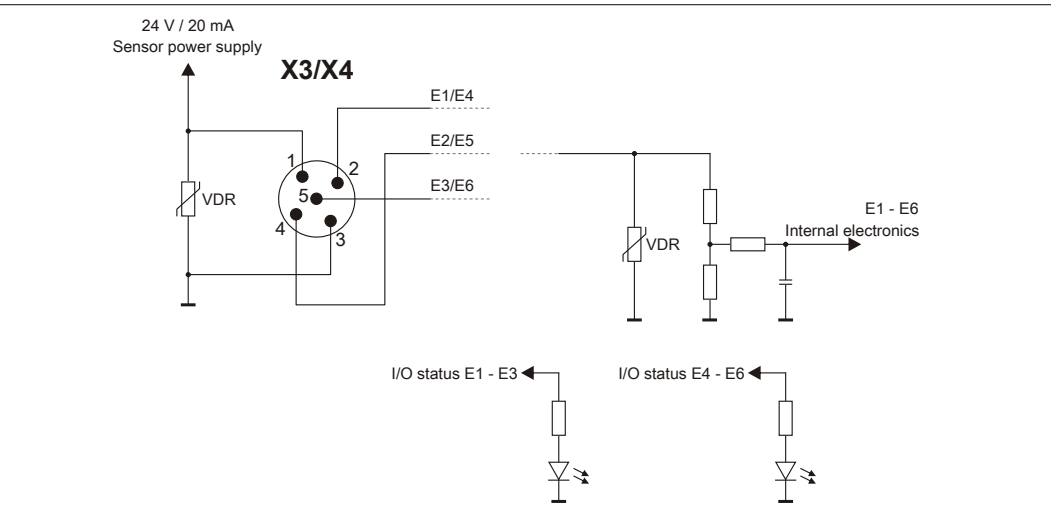
Connection 3 to 4: Digital inputs



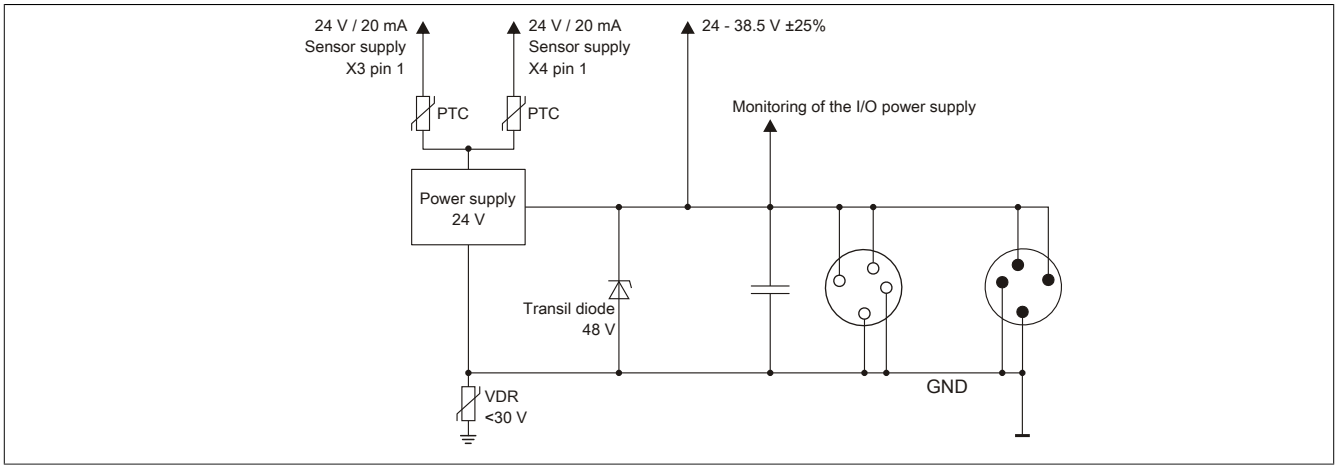
7 Output circuit diagram



8 Input circuit diagram



9 I/O power supply circuit diagram



10 Installation

Top-hat rail installation can only be recommended if the module is used for low power ratings.

In order to improve heat dissipation, it is recommended to install the module on a cooler machine part or on a base plate of at least 1 dm². A minimum distance of 1 cm must be maintained between X67 modules.

11 Function description

11.1 Digital counter inputs

This module is equipped with 6 digital inputs.

Every input always retains its function as a digital input. In addition, each input can also be used as a counter input or for measurements. In this case, dual use is even possible. For example input 3 can be used simultaneously as both limit switch 1 and a trigger input that starts the trigger counter.

The following counter types or measurements can be configured starting with firmware version 8:

- AB counters
- ABR counter ("single shot" or "continuous")
- Event counters
- Period measurement
- Gate measurement

Counter function - Assignment of the digital inputs:

Counter function	Counter number	A	B	R	Counter input	Period duration and gate signal	External measuring frequency
Incremental counter	1	DI 1	DI 2	DI 3			
	2	DI 4	DI 5	DI 6			
Event counters	1				DI 1		
	2				DI 4		
Period duration and gate measurement	1					DI 1	DI 3
	2					DI 4	DI 6

11.2 Operating modes

The module provides the following operating modes:

- PWM mode
- Current mode

The following graphics show how the voltage or current curve of the outputs is affected by registers "PWM period duration" on page 18 and "PWM pulse width" on page 19.

PWM mode

At the beginning of each period, the output is switched on for the percentage of time set in the PWM pulse width.

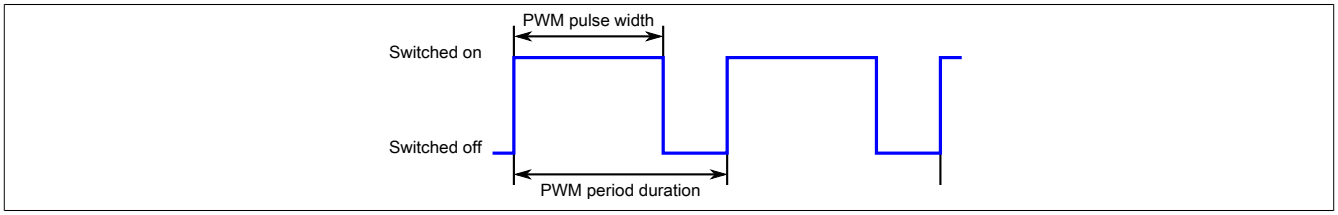


Figure 1: Voltage curve during PWM mode

Current mode

The current output is switched on at the beginning of each period. After reaching the value set in "PulseWidthCurrentPWM" on page 19, the output is switched off and the voltage drops according to the set decay configuration until it is next switched on.

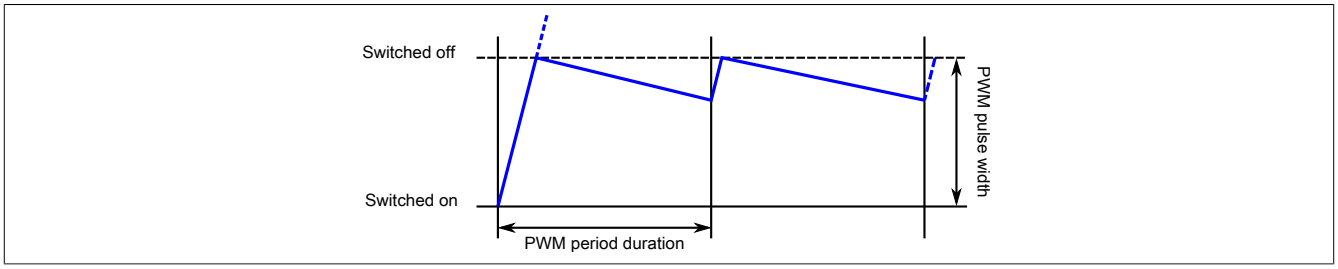


Figure 2: Current curve during current mode

11.3 Valve control

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.

In the module, this dithering is implemented in the form of a triangle wave.

- In PWM mode, the pulse width (duty cycle) of the PWM signal oscillates.
- In current mode, the current setpoint oscillates.

Concrete values for the dither amplitude and frequency to be set must be either taken from the valve data sheet or determined empirically.

By default, the dither is active for both outputs as soon as the dither amplitude and frequency are set to a value >0. If required, dither can be disabled individually and synchronously for each output (see "Error acknowledgment and dither switch-off" on page 20).

> **Information:**
>
> **For the configuration, see "Dither amplitude" on page 16 and "Dither frequency" on page 16.**

11.3.1 Dither example

The values specified in the data sheet for a valve should be used to calculate Dither amplitude and Dither frequency.

Data sheet for the valve

The data sheet for a valve manufacturer recommends the following dithering:

Dither height in percent (A_{Dither}): 20 to 35% (peak values) of the nominal valve current of 2 A

Dither frequency in Hertz (F_{Dither}): 40 to 70 Hz

Selected values

These values correspond to the average values on the valve data sheet.

A_{Dither} = 27% of the valve's nominal current (peak values)

F_{Dither} = 56 Hz

Formulas

Dither amplitude = (A_{Dither} / 2) * (Nominal current $_{Valve}$ / Nominal current$_{Module}$) * 10
Info: (A_{Dither} / 2) = Conversion of the peak values to amplitude, " * 10" = Scaling of the dither amplitude to 1/10%

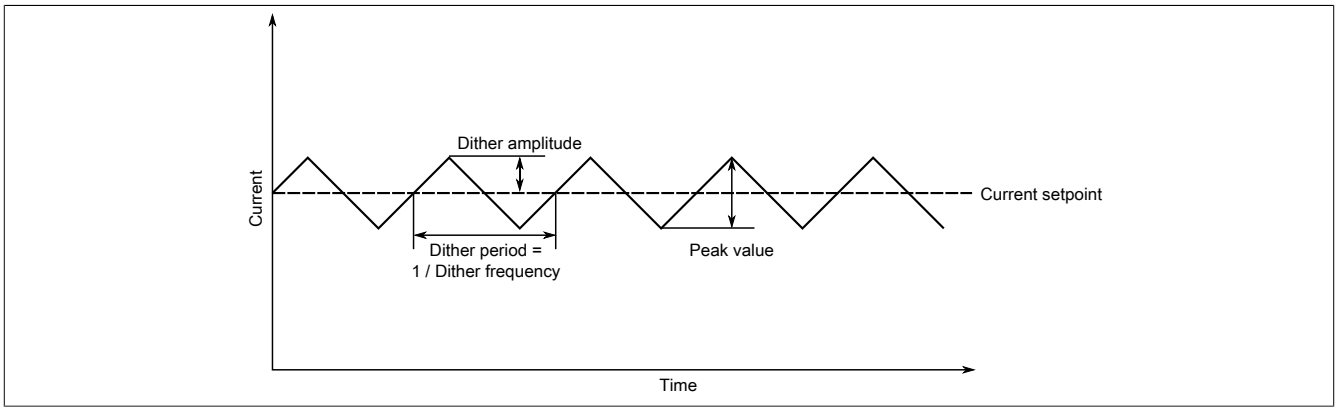
Dither frequency = F_{Dither} / 2 Hz
Info: Dither frequency is configured in 2 Hz steps.

Calculation

By using the selected values in the formulas.

Dither amplitude = 27% / 2 * (2 A / 3 A) * 10 = 90

Dither frequency = 56 Hz / 2 Hz = 28



11.4 Automatic shutdown

To prevent damage to the module or motor, both the voltage and current of the module power supply and the module temperature are monitored.

11.4.1 Overvoltage cutoff

The module power supply voltage is monitored. The Error status is returned in the event of a voltage greater or less than the limit values.

If the supply voltage in the module overshoots or undershoots the limit values (e.g. during regenerative operation), the motor output is cut off.

The outputs are enabled again as soon as the supply voltage is back in the permissible range. In current mode (depending on the current setpoint and inductance of the load), switching on the outputs again can result in an "open-load" error just like any other abrupt change in the current setpoint.

Limit values for the supply voltage

	Drive cut off
Lower limit	<18 V
Upper limit	>50 V

11.4.2 Shutdown in the event of overcurrent

The output current of the PWM outputs is monitored. An overcurrent error is reported in the following cases:

- The maximum output current of a PWM output is exceeded for at least 2 seconds.
  - Standard/PWM mode: ≥5 A
- The output current is ≥5 A for the PWM cycles set in register "ToleratedShortCyclesConfig" on page 15.

In each case, the pins of the PWM output are short-circuited and the PWM output concerned is disabled. The disabled PWM output can only be started up again by the user after error acknowledgment (see "Error acknowledgment and dither switch-off" on page 20).

11.4.3 Shutdown in the event of overtemperature

If the module temperature reaches or overshoots the limit value of 85°C, the module performs the following actions:

- Setting error bit Overtemperature.
- The outputs are cut off (short-circuited).

As soon as the temperature sinks below 83°C, the error bit is automatically cleared by the module and the outputs become operational again.

11.5 Decay mode

The decay configuration can be used to determine the method and dynamics of the current reduction of inductive loads or motors.

In default mode "Slow decay", the current is automatically reduced with resistance in the load. No energy is regenerated into the module.

Mode "Mixed decay" is for applications that require a dynamic and linear reduction of current. In this mode, energy is regenerated into the module during part of the PWM cycle (fast decay).

This function is available starting with firmware V≥6.

Information:

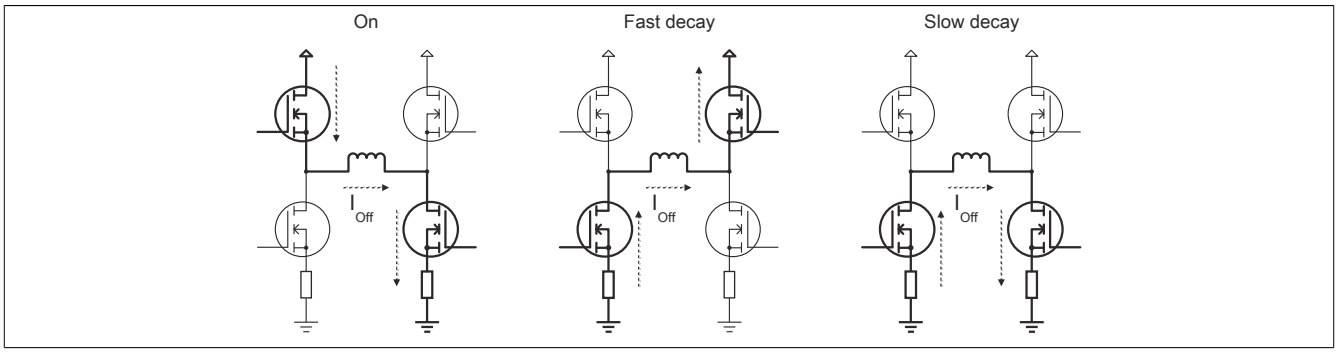
For the configuration, see "Decay configuration" on page 15.

Mixed decay

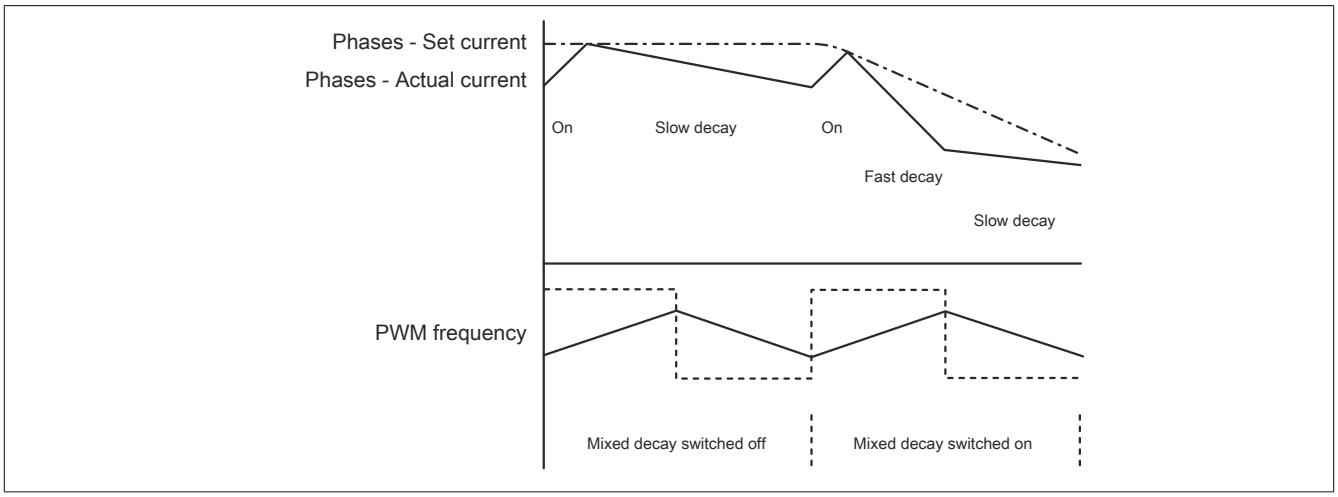
Mixed decay mode is a mix of "slow decay" and "fast decay".

A check is made at the beginning of each PWM cycle to determine if the actual current for the phases is below the current setpoint. If this is the case, PWM is enabled (on) until the current setpoint is reached. The system switches to fast decay mode for the rest of the first half of the PWM cycle. If the current setpoint has already been exceeded at the beginning of the PWM cycle (generator operation), the system immediately switches to fast decay mode. The second half of the PWM cycle always takes place in slow decay mode.

This also permits generator operation as long as the valid range for the supply voltage has not been exceeded due to the regeneration into the DC circuit.



Mixed decay - Current setpoint / Actual current, PWM frequency



Operating DC motors

In PWM mode, the motor current is limited to the maximum current (5 A), independent of the supply voltage.

However, the motor switches to generator operation when braking. Because of the counter EMF, which is dependent on the rotary speed, a current is generated in the module that is only limited by the internal resistance of the motor. This is not permitted to exceed 7 A (maximum 2 seconds).

The counter EMF closely corresponds to the voltage needed to achieve this speed. The maximum braking current can be calculated with the following formula.

$$I_{Brake} = U_e * \frac{PulseWidth}{100\%} * \frac{1}{R_{Motor}}$$

Example:

Module power supply	38 V
Pulse width	16364 (equal to 50%)
Internal resistance of motor	3.5 Ω

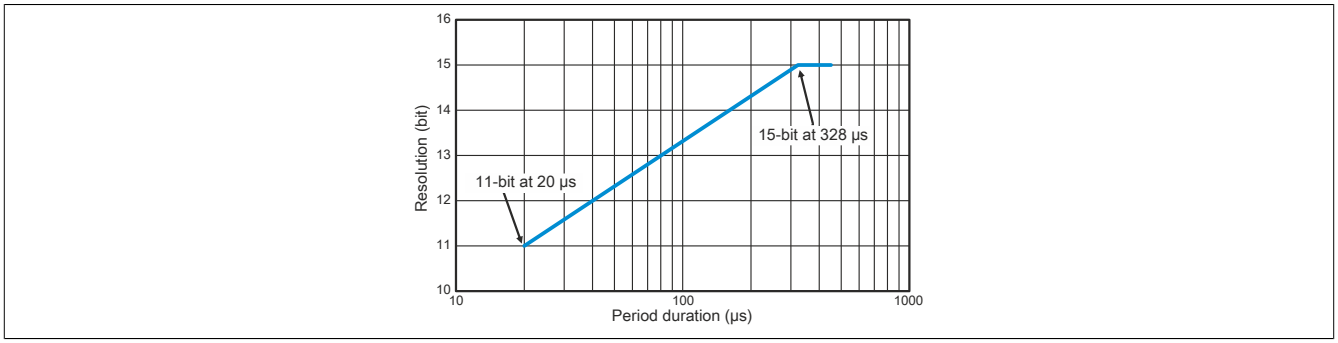
$$I_{Brake} = 38\ V * \frac{50}{100\%} * \frac{1}{3.5\Omega} = 5.4A$$

11.6 Bit resolutions of the PWM outputs

The bit resolution of the PWM outputs is 15 bits plus sign. This resolution cannot be maintained in all cases, however.

Depending on the length of the period duration, the bit resolution is subject to derating due to the minimum time resolution of PWM (10 ns).

The bit resolution is 15 bits up to a period duration of 328 µs. With the minimum PWM period duration of 20 µs, the resolution of PWM is only 11 bits.



12 Register description

12.1 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 X67 system user's manual.

12.2 Function model 0 - Standard

Register	Name	Data type	Read		Write	
			Cyclic	Acyclic	Cyclic	Acyclic
Configuration						
Module configuration						
30	ConfigOutput03 (Output / Limit switch configuration)	USINT				•
31	DecayConfig[1)]	USINT				•
40	ToleratedShortCyclesConfig[2)]	USINT				•
Counter configuration						
38	ConfigOutput05[3)] (counter 1)	USINT				•
39	ConfigOutput06[3)] (counter 2)	USINT				•
4	ConfigOutput04 (configuring the counter latch)	USINT				•
Valve control						
18	ConfigOutput01 (dither amplitude)	USINT				•
20	ConfigOutput02 (dither frequency)	USINT				•
Communication						
Inputs						
10	Input status	USINT	•			
	StatusInput01	Bit 0				
	...	...				
	StatusInput06	Bit 5				
Counter and latch						
0	Counter01	INT	•			
2	Counter02	INT	•			
6	CounterLatch01	INT	•			
8	CounterLatch02	INT	•			
26	Configure the counter latch	USINT			•	
	StartLatch01	Bit 0				
	StartLatch02	Bit 1				
	TriggerEdge	Bit 4				
	StartTrigger	Bit 5				
24	Counter and latch status	USINT	•			
	StatusInput07	Bit 0				
	LatchDone01	Bit 1				
	StatusInput08	Bit 2				
	LatchDone02	Bit 3				
	TriggerInput	Bit 4				
Motor control						
12	PeriodDurationPWM01PWM02	UINT			•	
14	PulseWidthCurrentPWM01	INT			•	
16	PulseWidthCurrentPWM02	INT			•	
Error handling						
24	Counter overflow	USINT	•			
	Overflow counter 1	Bit 6				
	Overflow counter 2	Bit 7				
32	Error status	USINT	•			
	UnderVoltageError	Bit 0				
	OverVoltageError	Bit 1				
	OvertemperaturError	Bit 2				
	OpenloadError01	Bit 4				
	OverCurrentError01	Bit 5				
	OpenloadError02	Bit 6				
	OverCurrentError02	Bit 7				
34	Error acknowledgment	USINT			•	
	ClearError01	Bit 0				
	ClearError02	Bit 1				
	CounterOverflowDetectEnable01[3)]	Bit 2				
	CounterOverflowDetectEnable02[3)]	Bit 3				
	CounterReset01[3)]	Bit 4				
	CounterReset02[3)]	Bit 5				

Register	Name	Data type	Read		Write	
			Cyclic	Acyclic	Cyclic	Acyclic
Valve control						
34	Dither shutdown	USINT			•	
	DitherDisable01	Bit 6				
	DitherDisable02	Bit 7				
22	usSinceTrigger	UINT	•			
Module information						
36	Temperature01	SINT		•		

1) Firmware version 6 or later
2) Firmware version 110 or later
3) Firmware version 8 or later

12.2.1 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 X67 user's manual (version 3.30 or later).

12.2.2 CAN I/O bus controller

The module occupies 2 analog logical slots on CAN I/O.

12.3 Configuration

12.3.1 Module configuration

12.3.1.1 Output and limit switch configuration

Name:
ConfigOutput03

The output control for each motor and the limit switches can be configured in this register.

Data type	Values
USINT	See the bit structure.

Bit structure:

Bit	Description	Value	Information
0	Output 1	0	PWM control
		1	Current control
1	Output 2	0	PWM control
		1	Current control
2 - 3	Limit switch 1	00	Limit switch disabled
		01	Trigger edge for limit switch: Rising edge on input 3
		10	Trigger edge for limit switch: Falling edge on input 3
		11	Reserved (limit switch disabled)
4 - 5	Limit switch 2	00	Limit switch disabled
		01	Trigger edge for limit switch: Rising edge on input 6
		10	Trigger edge for limit switch: Falling edge on input 6
		11	Reserved (limit switch disabled)
6 - 7	Reserved	-	

12.3.1.2 Decay configuration

Name:
DecayConfig

The decay configuration determines the method and dynamics of current reduction for inductive loads or motors.

This function is available beginning with firmware version ≥6.

Data type	Values
USINT	See the bit structure.

Bit structure:

Bit	Description	Value	Information
0 - 1	PWM 1	00	Slow decay
		01	Mixed decay
		10 to 11	Reserved
2 - 3	Reserved	0	
4 - 5	PWM 2	00	Slow decay
		01	Mixed decay
		10 to 11	Reserved
6 - 7	Reserved	0	

12.3.1.3 Overload shutdown

Name:
ToleratedShortCyclesConfig

This register can be used to set how many periods in a row overcurrent must be pending until it is recognized as an error.

This function is available starting with firmware version 110.

Data type	Values	Information
USINT	2 to 5	Number of periods

12.3.2 Counter configuration

12.3.2.1 Counter configuration

Name:
ConfigOutput05 to ConfigOutput06

This register can be used to configure the counters.

This function is available beginning with firmware version ≥8.

Data type	Value
USINT	See bit structure.

Counter	Name	E1	E2	E3
1	ConfigOutput05	DI 1	DI 2	DI 3
2	ConfigOutput06	DI 4	DI 5	DI 6

Bit structure:

Bit	Description	Value	Information
0 - 2	Sets the type of counter.	000	ABR counter with 4x evaluation (A = E1, B = E2, R = E3)
		001	Event counter (E1)
		010	Period measurement (E1)
		011	Gate measurement (E1)
		100	ABR counter with 4x evaluation (A = E1, B = E2).
		101 to 111	No counter. Counter is disabled and not shown in the I/O mapping.
3	Starts the counter	0	Start at rising edge on E1)
		1	Start at falling edge on E1)
4 - 5	Set the counter frequency for gate or period measurement	00	4 MHz
		01	Externally via E3
		10	31.25 kHz
		11	Reserved
6 - 7	Reserved	-	

12.3.2.2 Configure the counter latch

Name:
ConfigOutput04

The behavior of the latch and the trigger function is configured in this register.

Bits 0 to 1 or 4 to 5 are used to configure the time for the counters at which the latch event occurs for applying the counter value to register CounterLatch0x. This setting is only relevant if the latch function has been enabled in the configuration register (see "Configure the counter latch" on page 16).

Setting "Counter 1/2 latch unconditional" means that the latch event is triggered when the latch function is enabled.

Data type	Values
USINT	See the bit structure.

Bit structure:

Bit	Description	Value	Information
0 - 1	Counter 1 latch	00	Counter 1 latch unconditional
		01	Counter 1 latch on rising edge of input 3 (R pulse)
		10	Counter 1 latch on falling edge of input 3 (R pulse)
		11	Reserved
1	StartLatch02	0	The latch function for counter 2 is disabled on the negative edge of this bit.
		1	The latch function for counter 2 is enabled on the positive edge of this bit.
2	Latch mode counter 1	0	Single shot
		1	Continuous[1)]
3	Latch mode counter 2	0	Single shot
		1	Continuous[1)]
4 - 5	Counter latch 2	00	Counter 2 latch unconditional
		01	Counter 2 latch on rising edge of input 6 (R pulse)
		10	Counter 2 latch on falling edge of input 6 (R pulse)
		11	Reserved
6 - 7	Trigger input	00	No trigger input
		01	Input 3 used as trigger input
		10	Input 6 used as trigger input
		11	Reserved

1) Firmware version 8 or higher.

12.3.3 Valve control

12.3.3.1 Dither amplitude

Name:
ConfigOutput01

This register can be used to configure the amplitude value or pulse width.

Data type	Value	Information
USINT	0 to 255	Current mode: 0 to 25.5% of the module's nominal current[1)] PWM mode: 0 to 25.5% of the period duration.

1) See the technical data for the module.

12.3.3.2 Dither frequency

Name:
ConfigOutput02

This register can be used to set the frequency in 2 Hz steps.

Data type	Value	Information
USINT	0 to 255	Corresponds to 0 to 510 Hz.

12.4 Communication

12.4.1 Inputs

12.4.1.1 Input status

Name:
StatusInput01 to StatusInput06

This register is used to indicate the status of the inputs.

Data type	Values
USINT	See the bit structure.

Bit structure:

Bit	Description	Value	Information
0	StatusInput01	0 or 1	Logical state of input 1
...		...	
5	StatusInput06	0 or 1	Logical state of input 6
6 - 7	Reserved	-	

12.4.2 Counter and latch

12.4.2.1 Counter

Name:
Counter01 to Counter02

This register indicates the status of counters 1 and 2. The counter configuration is described in section "Counter configuration" on page 15.

Data type	Values
INT	-32768 to 32767

12.4.2.2 Counter latch

Name:
CounterLatch01 to CounterLatch02

The current value of the respective counter is saved in this register when a latch event occurs.

Data type	Values
INT	-32768 to 32767

12.4.2.3 Counter and latch status

Name:
StatusInput07 to StatusInput08
LatchDone01 to LatchDone02
TriggerInput

This register is used to indicate the status of the counter and latch function.

Data type	Values
USINT	See the bit structure.

Bit structure:

Bit	Description	Value	Information
0	StatusInput07	0	The latch function for counter 1 has been enabled (see "Configure the counter latch" on page 16). Register "counter latch 1" on page 17 does not contain a valid value.
		1	Counter 1 has been latched
1	LatchDone01	0 or 1	Bit state changes each time counter 1 is successfully latched (reset value = 0)
2	StatusInput08	0	The latch function for counter 2 has been enabled (see "Configure the counter latch" on page 16). Register "counter latch 1" on page 17 does not contain a valid value.
		1	Counter 2 has been latched
3	LatchDone02	0 or 1	Bit state changes each time counter 2 is successfully latched (reset value = 0)
4	TriggerInput	0 or 1	Trigger input state (level)
5	Reserved	-	
6[1)]	Counter overflow 1	0	Period duration or gate measurements of counter 1 are within the valid range (0x0 to 0xFFFF). The bit is only valid if overflow detection is enabled (bit 2 = 1 in the "Error acknowledgment and dither switch-off" on page 20 register).
		1	Overflow during period duration or gate measurement (reset with bit 2 = 0 in the "Error acknowledgment and dither switch-off" on page 20 register).
7[1)]	Counter overflow 2	0	Period duration or gate measurements of counter 2 are within the valid range (0x0 to 0xFFFF). The bit is only valid if overflow detection is enabled (bit 3 = 1 in the "Error acknowledgment and dither switch-off" on page 20 register).
		1	Overflow during period duration or gate measurement (reset with bit 3 = 0 in the "Error acknowledgment and dither switch-off" on page 20 register).

1) Supported starting with firmware version 8.

12.4.2.4 Time since trigger event

Name:
usSinceTrigger

This register indicates the time (in µs) that has passed since the trigger event occurred (see "Configure the counter latch" on page 16).

Data type	Values
UINT	0 to 65,535

12.4.3 Motor control

12.4.3.1 PWM period duration

Name:
PeriodDurationPWM01PWM02

In this register, the period duration can be set from 20 µs (50 kHz) to 65535 µs (15 Hz). See also "Operating modes" on page 8.

Data type	Value	Information
UINT	20 to 65535	Time in µs

12.4.3.2 PWM pulse width

Name:
PulseWidthCurrentPWM01 to PulseWidthCurrentPWM02

The PWM pulse width (PWM mode) or current setting (in current mode) is specified in this register according to the setting in the module configuration register (see also "Operating modes" on page 8). A negative value changes the output polarity.

PWM mode

Data type	Value	Output +	Output -
INT	32767	High	Low
	16384	PWM 50/50	Low
	0	Low	Low
	-16384	Low	PWM 50/50
	-32767	Low	High

Current mode

Data type	Value	Current mode
INT	19661 to 32767	3 to 5 A (max. 2 s)
	19660	3 A
	0	0 A
	-19660	-3 A
	-19661 to -32767	-3 to -5 A (max. 2 s)

12.4.4 Error handling

12.4.4.1 Error status

Name:
UnderVoltageError
OverVoltageError
OvertemperatureError
OpenloadError01 to OpenloadError02
OverCurrentError01 to OverCurrentError02

If an error is detected, the corresponding error bit remains set in this register until the error is acknowledged (see "Error acknowledgment and dither switch-off" on page 20).

Data type	Values
USINT	See the bit structure.

Bit structure:

Bit	Description	Value	Information
0	UnderVoltageError	0	No error
		1	Lower limit of I/O power supply <18 V
1	OverVoltageError	0	No error
		1	Upper limit of I/O power supply >50 V
2	OvertemperatureError	0	No error
		1	Overtemperature
3	Reserved	-	
4	OpenloadError01	0	No error
		1	Open load error Output 1
5	OverCurrentError01	0	No error
		1	Overcurrent error Output 1
6	OpenloadError02	0	No error
		1	Open load error Output 2
7	OverCurrentError02	0	No error
		1	Overcurrent error Output 2

Overcurrent error

An overcurrent error is reported if the current on the PWM input exceeds the set limit. For details, see "Shutdown in the event of overcurrent" on page 10.

Open load error

An open load error is only registered in current control mode (see "Output and limit switch configuration" on page 14) if the current setpoint is not reached. In some cases this can be caused by an open circuit, although usually the impedance of the load is too high.

12.4.4.2 Error acknowledgment and dither switch-off

Name:
ClearError01 to ClearError02
CounterOverflowDetectEnable01 to CounterOverflowDetectEnable02
CounterReset01 to CounterReset02
DitherDisable01 to DitherDisable02

This register can be used to acknowledge errors; to enable/disable overflow detection, counters and dither; and to set a prescaler for the frequency domains.

Data type	Values
USINT	See the bit structure.

Bit structure:

Bit	Description	Value	Information
0	ClearError01	0	No effect
		1	Error acknowledgment on output 1 (overcurrent or open load) or acknowledgment from limit switch 1
1	ClearError02	0	No effect
		1	Error acknowledgment on output 2 (overcurrent or open load) or acknowledgment from limit switch 2
2[1)]	CounterOverflowDetectEnable01	0	Overflow detection disabled. Bit 6 in the counter status register is reset (see section "Input status" on page 17)
		1	Counter 1: Overflow detection enabled
3[1)]	CounterOverflowDetectEnable02	0	Overflow detection disabled. Bit 7 in the counter status register is reset (see section "Input status" on page 17)
		1	Counter 2: Overflow detection enabled
4[1)]	CounterReset01	0	Counter 1 is enabled (default).
		1	Counter 1 is set to 0 and disabled. If counter 1 is configured as an ABR counter (see section "Counter configuration" on page 15), then counter latch 1 is also set to 0.
5[1)]	CounterReset02	0	Counter 2 is enabled (default).
		1	Counter 2 is set to 0 and disabled. If counter 2 is configured as an ABR counter (see section "Counter configuration" on page 15), then counter latch 2 is also set to 0.
6	DitherDisable01	0	Dither for PWM output 1 is enabled (default). The dither frequency and dither amplitude must be greater than 0 (see section "Valve control" on page 9).
		1	Dither for PWM output 1 is disabled.
7	DitherDisable02	0	Dither for PWM output 2 is enabled (default). The dither frequency and dither amplitude must be greater than 0 (see section "Valve control" on page 9).
		1	Dither for PWM output 2 is disabled.

1) Firmware version 8 or higher.

12.4.5 Module information

12.4.5.1 Temperature

Name:
Temperature01

The module temperature is displayed in this register.

Data type	Value	Information
SINT	-40 to 125	Module temperature in °C

12.5 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 µs

12.6 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
250 µs