X67UM1352

1 General information

This module enables the remote connection of a force gauge using a strain gauge with a converter resolution of up to 24-bit. The data rate can be set from 0.26 ms to 100 ms. This module concept requires compensation in the measurement system. This compensation eliminates the absolute uncertainty in the measurement circuit, such as component tolerances, effective bridge voltage or zero point offset. The measurement precision refers to the absolute (compensated) value, which will only change as a result of changes in the operating temperature. The module is also equipped with 4 digital inputs and 2 digital outputs.

- 1 strain gauge input with 24-bit resolution
- High data output rate (10 to 3,750 Hz)
- Adjustable gain
- 1 high-side output 24 VDC, 0.5 A
- 1 high-side output 24 VDC, 1.0 A

2 Order data

Model number	Short description	Figure
	Other functions	
X67UM1352	X67 universal mixed module, 1 input for full-bridge strain gauge evaluation, 24-bit, 4 digital inputs, 24 VDC, sink, 1 digital output, 0.5 A, source, 1 digital output, 1 A, source	

Table 1: X67UM1352 - Order data

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

3 Technical data

Model number	X67UM1352
Short description	
I/O module	4 digital inputs, 2 digital outputs, 1 input for full-bridge strain gauge
General information	
B&R ID code	0x1CDF
Status indicators	I/O function for each channel, supply voltage, bus function
Diagnostics	
Outputs	Yes, using status LED
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

Table 2: X67UM1352 - Technical data

Model number	X67UM1352
Certifications	
CE	Yes
KC	Yes
EAC	Yes
UL	cULus E115267 Industrial control equipment
HazLoc	cCSAus 244665 Process control equipment for hazardous locations Class I, Division 2, Groups ABCD, T5
ATEX	Zone 2, II 3G Ex nA IIA T5 Gc IP67, Ta = 0 - Max. 60°C TÜV 05 ATEX 7201X
I/O power supply	
Nominal voltage	24 VDC ±25%
Integrated protection	Reverse polarity protection
Power consumption	
Sensor power supply	Max. 12 W [1)]
Strain gauge supply	
Voltage	4.422 VDC / max. 60 mA
Voltage drop for short-circuit protection at 60 mA	Max. 0.36 VDC
Short-circuit proof	Yes
Sensor/Actuator power supply	
Voltage	I/O power supply minus voltage drop for short circuit protection
Voltage drop for short-circuit protection at 0.5 A	Max. 2 VDC
Summation current	Max. 0.5 A
Short-circuit proof	Yes
Full-bridge strain gauge	
Strain gauge factor	±15.625 to ±125 mV/V, configurable using software
Input type	Differential, used to evaluate a full-bridge strain gauge
Digital converter resolution	24-bit
Conversion time	Depends on the configured data output rate
Data output rate	10 to 3750 samples per second, configurable using software
Input filter	
Cutoff frequency	50 kHz
Order	1
Slope	20 dB
Operating range / Measurement sensor	75 to 5000 Ω
Influence of cable length	The shielded twisted pair cable should be as short as possible and run separately to the sensor (isolated from load circuit) without intermediate terminals
Input protection	RC protection
Input current	450 nA
Common-mode range	0 to 3 VDC Permissible input voltage range (with regard to the potential strain gauge GND) on the inputs "Input +" and "Input -"
Isolation voltage between input and bus	500 V_{Eff}
Gain	1 to 8, configurable using software
Conversion procedure	Sigma-delta
Output of digital value	
Broken bridge supply line	Value approaches 0
Broken sensor line	Value goes to ±limit
Valid range of values	0x7FFF FFFF to 0x8000 0001
Strain gauge supply	
Voltage	4.5 VDC / max. 60 mA
Connection	4-wire connections
Short-circuit and overload resistant	Yes
Quantization	
LSB value (16-bit)	
69 mV/V	9.31 µV
138 mV/V	18.6 µV
276 mV/V	37.3 µV
553 mV/V	74.6 µV
LSB value (24-bit)	
69 mV/V	36.4 nV
138 mV/V	72.8 nV
276 mV/V	146.0 nV
553 mV/V	251.0 nV
Temperature coefficient	50 ppm/°C
Digital inputs	
Quantity	4
Nominal voltage	24 VDC
Input voltage	24 VDC ±25%
Input current at 24 VDC	Typ. 5 mA
Input characteristics per EN 61131-2	Type 1

Table 2: X67UM1352 - Technical data

Model number	X67UM1352
Input filter	
Hardware	<1 ms
Software	-
Input circuit	Sink
Input resistance	Typ. 4.27 kΩ
Sensor power supply	0.5 A summation current
Switching threshold	
Low	<5 VDC
High	>15 VDC
Isolation voltage between channel and bus	500 V_{Eff}
Digital outputs	
Quantity	2
Nominal voltage	24 VDC
Switching voltage	24 VDC ±25%
Output circuit	Source
Output protection	Thermal cutoff for overcurrent and short circuit, integrated protection for switching inductances, reverse polarity protection for output power supply
Actuator power supply	External
Isolation voltage between output and bus	500 V_{Eff}
Nominal output current	
Output 1	0.5 A
Output 2	1 A
Output driver turn-on time	
Output 1	
Typical	50 µs
0 → 1 (90% V_{Out})	Max. 100 µs
Output 2	
Typical	60 µs
0 → 1 (90% V_{Out})	Max. 160 µs
Switch-off time for output driver	
Output 1	
Typical	75 µs
1 → 0 (90% V_{Out})	Max. 150 µs
Output 2	
Typical	15 µs
1 → 0 (90% V_{Out})	Max. 50 µs
Braking voltage when switching off inductive loads	
Output 1	-47 VDC
Output 2	Approx. 1 VDC
Max. frequency	
Output 1	100 Hz
Output 2	1 kHz
Electrical properties	
Electrical isolation	Channel isolated from bus and digital isolated from analog Digital not isolated from I/O power supply
Operating conditions	
Mounting orientation	
Any	Yes
Installation elevation above sea level	
0 to 2000 m	No limitations
>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 60°C
Storage	-40 to 85°C
Transport	-40 to 85°C
Mechanical properties	
Dimensions	
Width	53 mm
Height	85 mm
Depth	42 mm
Weight	200 g
Torque for connections	
M8	Max. 0.4 Nm
M12	Max. 0.6 Nm

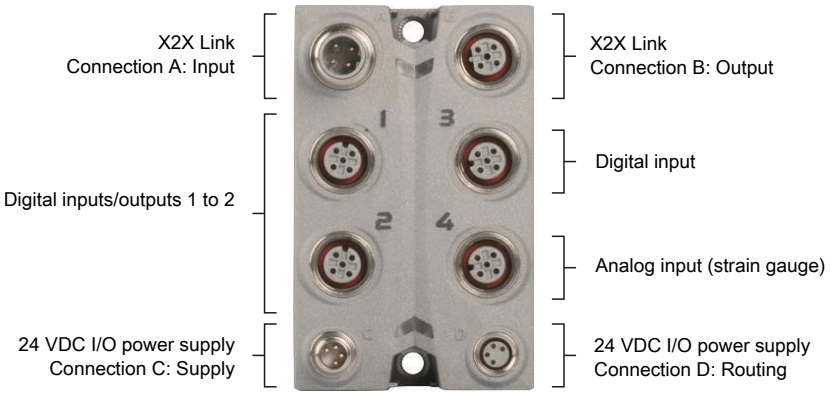
Table 2: X67UM1352 - Technical data

1) The power consumption of the sensors and actuators connected to the module is not permitted to exceed 12 W.

4 LED status indicators

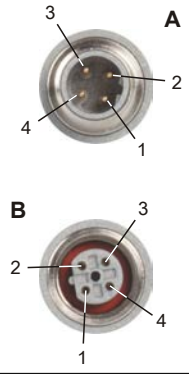
Figure	LED	Color/Status		Description
	**Status indicator 1**: Status indicator for X2X Link			
	Left/Right	**Green (left)**	**Red (right)**	**Description**
		Off	Off	No power supply via X2X Link
		On	Off	X2X Link supplied, communication OK
		Off	On	X2X Link supplied but X2X Link communication not functioning
		On	On	PREOPERATIONAL: X2X Link supplied, module not initialized
	I/O LEDs			
	1 - 2	**Color**	**Status**	**Description**
		Yellow	On	Digital output 1, 2 on
		Green	On	Digital input 1, 2 on
	3 - 4	**Color**	**Status**	**Description**
		Green	On	Digital input 3, 4 on
	Status indicator 2: Status indicator for module function			
	Left	**Color**	**Status**	**Description**
		Green	Off	No power to module
			Single flash	RESET mode
			Blinking	PREOPERATIONAL mode
			On	RUN mode
	Right	**Color**	**Status**	**Description**
		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

5 Connection elements



6 X2X Link

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

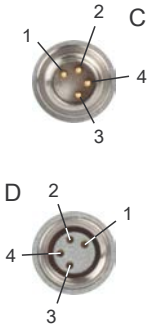
Connection	Pinout	
	**Pin**	**Description**
	1	X2X+
	2	X2X
	3	X2X⊥
	4	X2X\
	Shield connection made via threaded insert in the module. A → B-keyed (male), input B → B-keyed (female), output	

7 24 VDC I/O power supply

The I/O power supply is connected via M8 connectors C and D. The I/O power supply is connected via connector C (male). Connector D (female) is used to route the I/O power supply to other modules.

Information:

The maximum permissible current for the I/O power supply is 8 A (4 A per connection pin)!

Connection	Pinout	
	**Pin**	**Description**
	1	24 VDC
	2	24 VDC
	3	GND
	4	GND
	C → Connector (male) in module, feed for I/O power supply D → Connection (female) in module, routing of I/O power supply	

8 Pinout

X1 to X2
M12 ①

Shield	
1	+24 VDC
2	DI
3	GND
4	DO
5	NC

X3
M12 ①

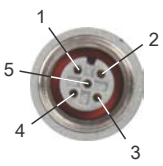
Shield	
1	+24 VDC
2	DI-3
3	GND
4	DI-4
5	GND

X4
M12 ①

Shield	
1	SG VCC
2	Input +
3	SG GND
4	Input -
5	Shield

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

8.1 Connections X1 to X2

M12, 5-pin	Pinout		
Connector 1/2 	**Pin**	**Connection 1**	**Connection 2**
	1	Supply for digital inputs (24 V, total current 0.5 A)	
	2	Digital input 1 (24 VDC / 1 ms)	Digital input 2 (24 VDC / 1 ms)
	3	GND	
	4	Digital output 1 (24 VDC / 0.5 A)	Digital output 2 (24 VDC / 1.0 A)
	5	Not connected	
	Shield connection made via threaded insert in the module		

8.2 Connections X3

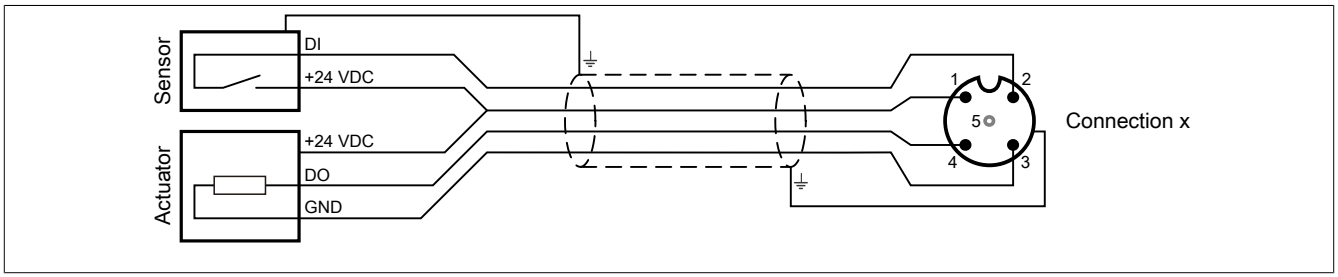
M12, 5-pin	Pinout	
Connection 3	**Pin**	**Connection 3**
	1	Supply for digital inputs (24 V, total current 0.5 A)
	2	Digital input 3 (24 VDC / 1 ms)
	3	GND
	4	Digital input 4 (24 VDC / 0.5 A)
	5	Not connected
	Shield connection made via threaded insert in the module	

8.3 Connection X4 (strain gauge)

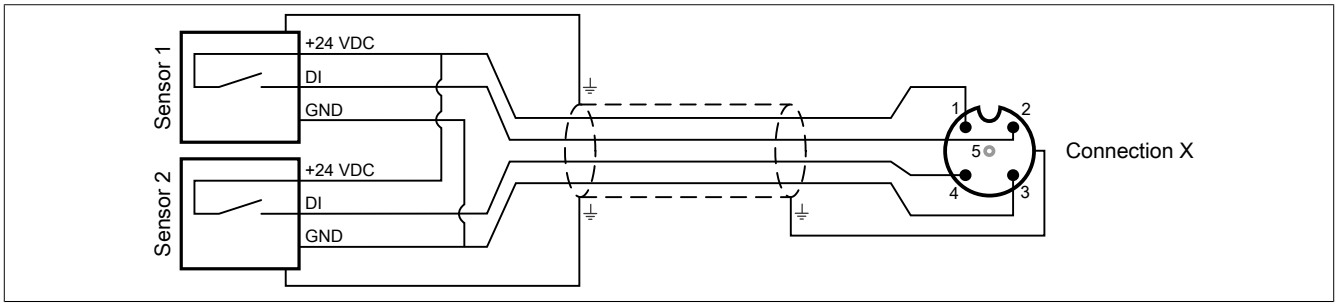
Connection	Pinout		
Connection 4	**Pin**	**Connection 4**	
	1	SG VCC	Power supply for strain gauge ca. 4.4 V (min. resistance 75 Ω)
	2	Input +	Differential input +
	3	SG GND	
	4	Input -	Differential input -
	5	Shield	
	Shielding also provided by threaded insert in the module		

9 Connection examples

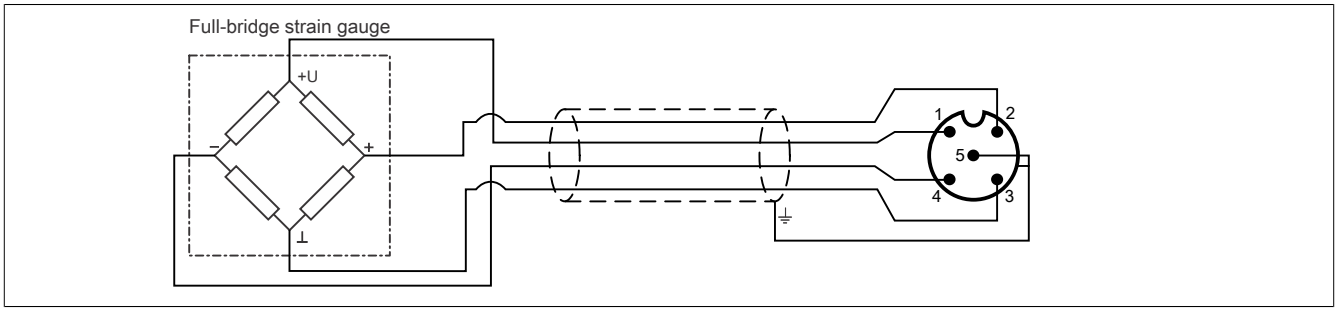
Connection X1 and X2: Digital input and output



Connection X3: Digital inputs

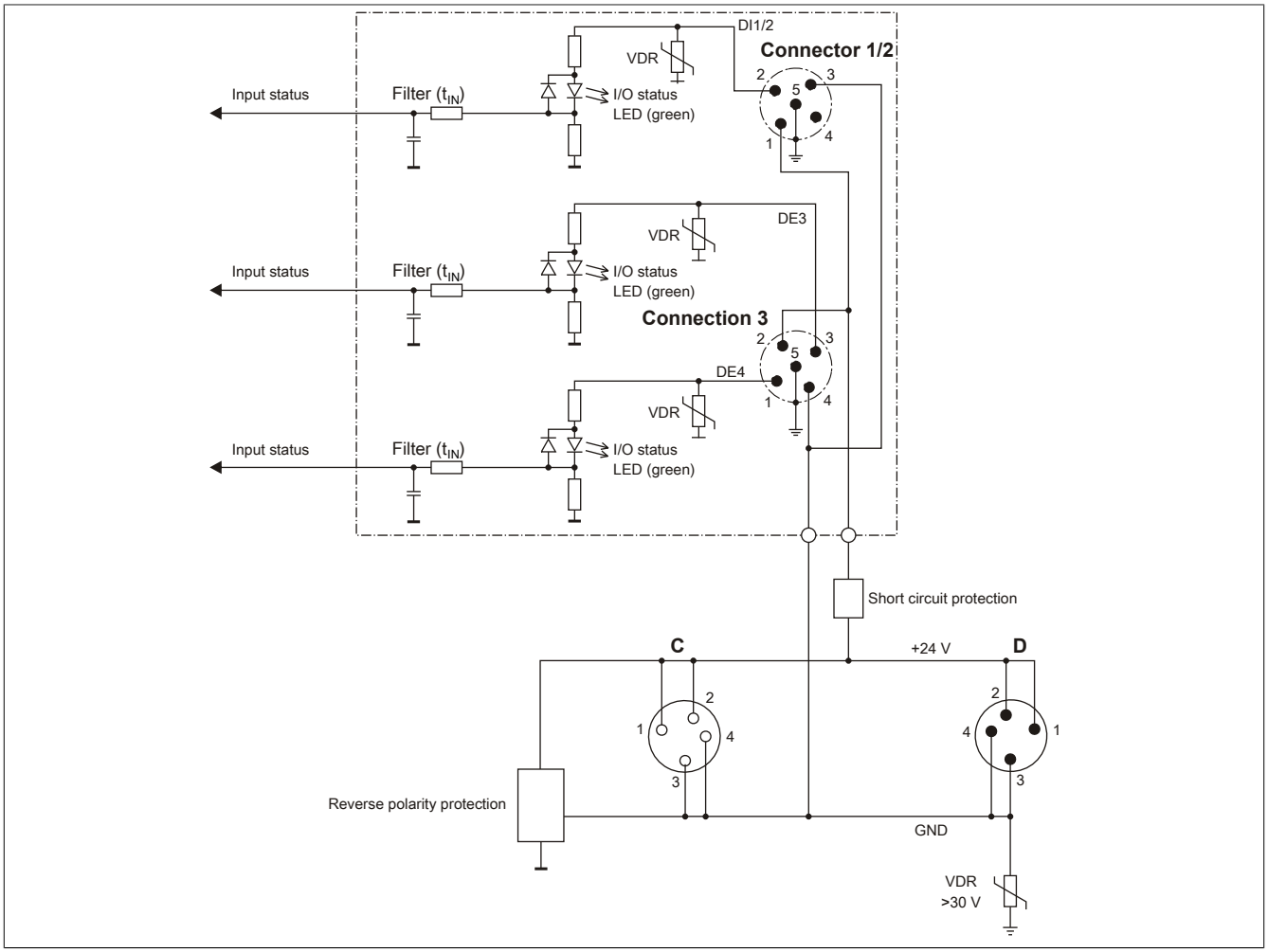


Connection 4: Strain gauge

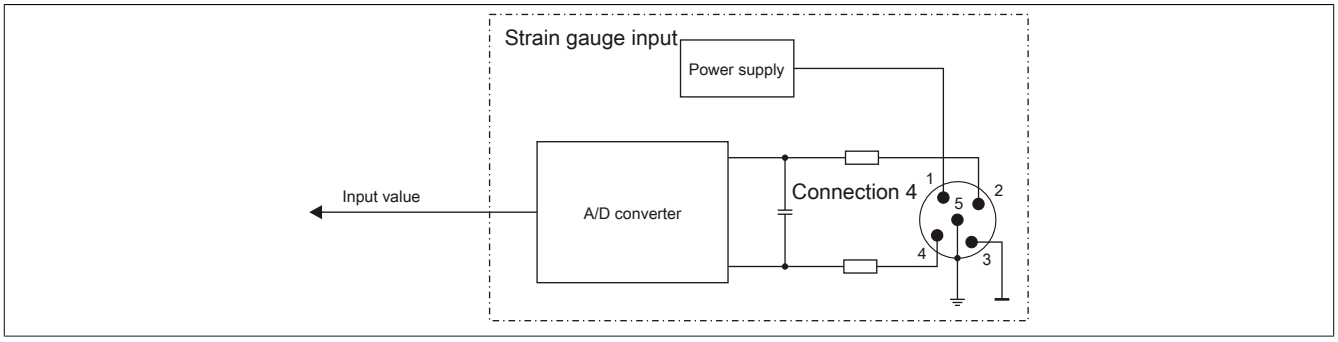


10 Input circuit diagram

Digital inputs

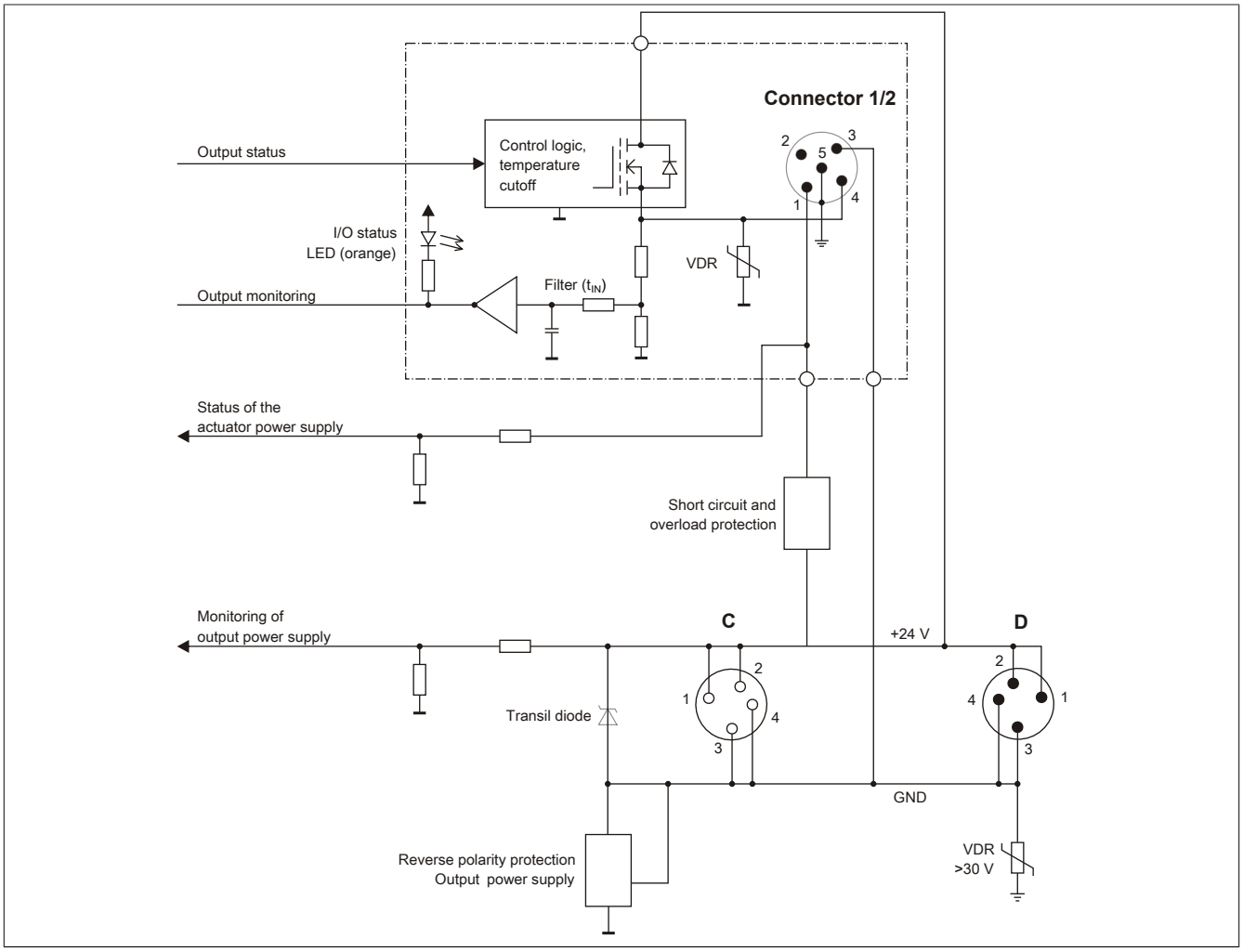


Analog strain gauge input



11 Output circuit diagram

Digital outputs



12 Register description

12.1 General data points

In addition to the registers listed in the register description, the module also has other more general data points. These registers are not specific to the module but contain general information such as serial number and hardware version.

These general data points are listed in section "Additional information - General data points" of the X67 system user's manual.

12.2 Function model 0 - Standard

Register	Name	Data type	Read		Write	
			Cyclic	Acyclic	Cyclic	Acyclic
Configuration						
26	ConfigOutput01 (A/D converter configuration)	USINT				•
Communication						
0	Input state of the digital inputs	USINT	•			
	DigitalInput01	Bit 0				
	...	...				
	DigitalInput04	Bit 3				
2	Output status of the digital outputs	USINT			•	
	DigitalOutput01	Bit 0				
	DigitalOutput02	Bit 1				
16	AnalogInput01	DINT	•			
28	Status of the A/D converter	USINT	•			
	OpenLine01	Bit 0				
30	Status of the digital outputs	USINT	•			
	OutputError01	Bit 0				
	OutputError02	Bit 1				

12.3 Function model 0 - Packed data points

Register	Name	Data type	Read		Write	
			Cyclic	Acyclic	Cyclic	Acyclic
Configuration						
26	ConfigOutput01 (A/D converter configuration)	USINT				•
Communication						
0	DigitalInput01	USINT	•			
2	DigitalOutput01	USINT			•	
26	StatusOutput01	USINT			•	
16	AnalogInput01	DINT	•			
28	StatusInput01	USINT	•			
30	StatusInput02	USINT	•			

12.4 Configuration

12.4.1 A/D converter configuration

Name:
ConfigOutput01

The gain and data rate of the A/D converter can be configured in this register.

Data type	Values
USINT	See the bit structure.

Bit structure:

Bit	Description	Value	Information
0 - 1	Gain	00	1
		01	2
		10	4
		11	8
2 - 4	Data rate (samples per second):	000	10
		001	50
		010	60
		011	100[1)]
		100	500[1)]
		101	1000
		111	2000
		111	3750
5 - 7	Reserved	-	

1) Automation Runtime H281 and later
An AR installer and installation package are needed for Automation Runtime 2.4.

Relationship between gain, measurement range and bridge voltage

Gain	Measurement range	Measurement range x bridge voltage
1	±125 mV/V	±0.553 V
2	±62.500 mV/V	±0.278 V
4	±31.250 mV/V	±0.136 V
8	±15.625 mV/V	±0.069 V

12.5 Communication

12.5.1 Input state of the digital inputs

Name:
DigitalInput01
DigitalInput01 to DigitalInput04

This register indicates the input state of digital inputs 1 to 4.

Data type	Values
USINT	See the bit structure.

Bit structure:

Bit	Name	Value	Information
0	DigitalInput01	0 or 1	Input status of digital input 1
...		...	
3	DigitalInput04	0 or 1	Input status of digital input 4

12.5.2 Output status of the digital outputs

Name:
DigitalOutput01
DigitalOutput01 to DigitalOutput02

This register is used to store the switching state of digital outputs 1 to 2.

Data type	Values
USINT	See the bit structure.

Bit structure:

Bit	Name	Value	Information
0	DigitalOutput01	0	Digital output 01 reset
		1	Digital output 01 set
1	DigitalOutput02	0	Digital output 02 reset
		1	Digital output 02 set

12.5.3 Strain gauge value

Name:

AnalogInput01

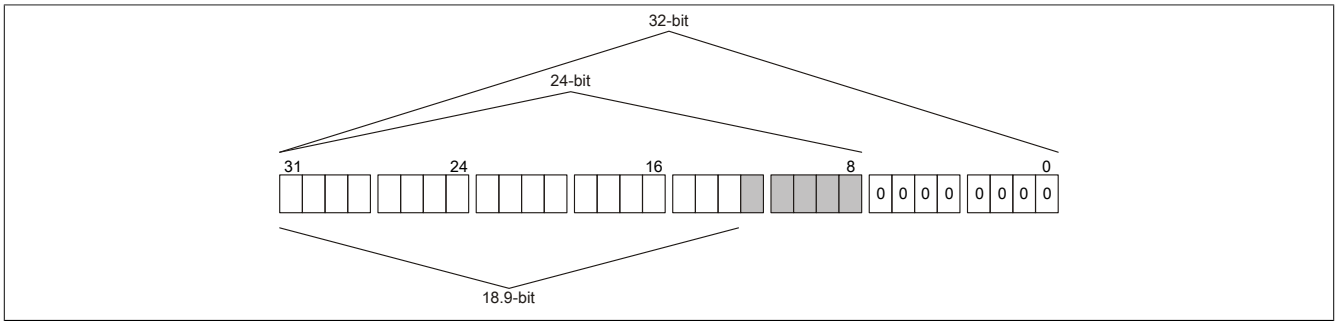
This register contains the raw value determined by the A/D converter for the full-bridge strain gauge with 24-bit resolution.

Data type	Value	Information
DINT	0x7FFF FFFF to 0x8000 0001	Valid range of values. 1 LSB = 0x0000 0100.
	0x7FFF FFFF	Overflow
	0x8000 0000	Underflow
	0x8000 0000	Invalid value

Resolution in bits

Through the sigma-delta conversion of the analog signals on the module, there is, in principal, an effective resolution of the displayed value. This means that even if the A/D converter on the module always outputs a 24-bit value, then the attainable resolution according to calculations is always smaller than the 24-bit converter resolution (see following example). The effective resolution depends on the data rate and measurement area (see section "A/D converter configuration" on page 10).

Because of the conversion method, a data rate of 10 Hz and a specified measurement area of 15.625 mV/V result in an effective resolution of 18.9 bits:



The amount of information in the low-order bits (marked in gray) can only be used to a certain extent and is subject to heavy disturbances.

The following table shows how the effective resolution (in bits), or the RMS value range of the strain gauge value depend on the module configuration (data rate, measurement area).

Data rate (Hz)	Gain / Resolution							
	1 ±125 mV/V		2 ±62.500 mV/V		4 ±31.250 mV/V		8 ±15.625 mV/V	
	Bits	Range of values	Bits	Range of values	Bits	Range of values	Bits	Range of values
10	21.0	±1,000,000	20.4	±691,800	19.9	±490,000	18.9	±244,000
50	19.9	±490,000	19.4	±346,000	18.8	±230,000	17.9	±122,000
60	19.8	±450,000	19.3	±320,000	18.8	±230,000	17.8	±114,000
100	19.6	±297,000	19.1	±280,000	18.5	±185,000	17.4	±86,000
500	18.6	±200,000	18.0	±130,000	17.3	±80,000	16.3	±40,000
1000	17.5	±92,000	17.2	±75,000	16.5	±46,000	15.6	±25,000
2000	17.0	±65,500	16.6	±49,600	16.1	±35,000	15.3	±20,000
3750	16.6	±49,600	16.2	±37,600	15.7	±26,600	14.7	±13,000

Resolution for 2 to 8 mV/V sensors

The setting 16 mV/V should be used for 2 to 8 mV/V sensors. This now results in the following resolution:

Data rate (Hz)	Gain / Resolution					
	8 ±1.953 mV/V		8 ±3.906 mV/V		8 ±7.8125 mV/V	
	Bits	Range of values	Bits	Range of values	Bits	Range of values
10	15.9	±30,500	16.9	±61,100	17.9	±122,000
50	14.9	±15,300	15.9	±30,500	16.9	±61,100
60	14.8	±14,300	15.8	±28,400	16.8	±57,000
100	14.4	±10,800	15.4	±21,600	16.4	±43,200
500	13.3	±5,000	14.3	±10,080	15.3	±20,100
1000	12.6	±3,100	13.6	±6,200	14.6	±12,400
2000	12.3	±2,500	13.3	±5,000	14.3	±10,000
3750	11.7	±1,660	12.7	±3,300	13.7	±6,600

12.5.4 Status of the A/D converter

Name:
StatusInput01

This register is used to indicate the status of the A/D converter.

Data type	Values
USINT	See the bit structure.

Bit structure:

Bit	Name	Value	Information
0	OpenLine 01	0	No error
		1	Open circuit of measuring bridge

12.5.5 Status of the digital outputs

Name:
OutputError01 to OutputError02

This register is used to indicate the status of digital outputs 1 to 2.

Data type	Values
USINT	See the bit structure.

Bit structure:

Bit	Name	Value	Information
0	OutputError01	0	Channel 01: No error
		1	Channel 01: Error occurred
1	OutputError02	0	Channel 02: No error
		1	Channel 02: Error occurred

12.6 Minimum cycle time

The minimum cycle time specifies the time up to which 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

12.7 Minimum I/O update time

The minimum I/O update time defines how far the bus cycle can be reduced while still allowing an I/O update to take place in each cycle.

Minimum I/O update time
250 µs