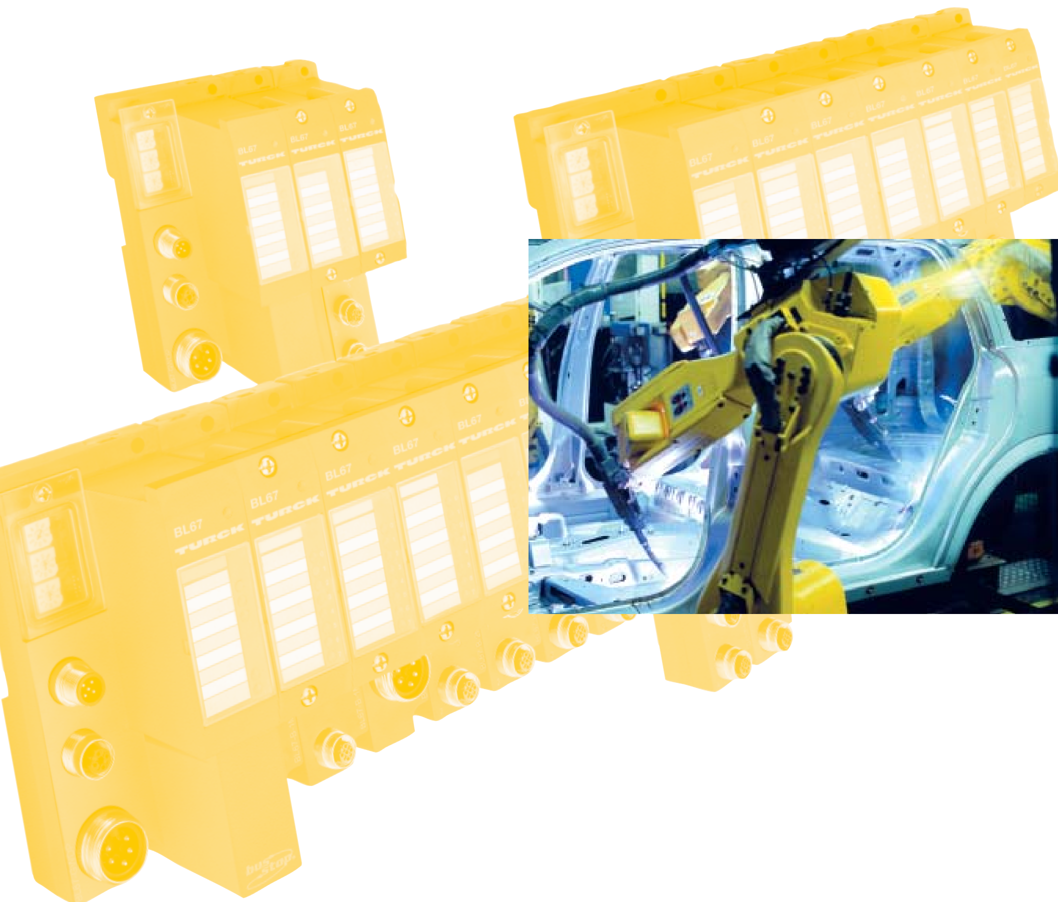
TURCK

Industrial Automation

BL67 –

USER MANUAL I/O MODULES



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Edition 01/2014

Industrial Automation

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1 About this manual

1.1 Documentation concept

This manual contains all information about the bus-independent I/O-modules for the modular BL67-system.

The following chapters contain a short BL67 system description, exact descriptions of the functionality and the technical data for the I/O-modules as well as all general information concerning the whole system as for example mounting/dismounting, labeling etc.

Furthermore, this manual contains a short description of the project planning and diagnostics software for TURCK I/O-systems, the software I/O-ASSISTANT.

The bus-specific BL67-gateways, the connection to the different automation devices, the maximum system extension as well as all other bus specific information are described in separate manuals.

1.2 Description of symbols used

Danger

This sign can be found next to all notes that indicate a source of hazards. This can refer to danger to personnel or damage to the system (hardware and software) and to the facility.

This sign means for the operator: work with extreme caution.

Attention

This sign can be found next to all notes that indicate a potential hazard.

This can refer to possible danger to personnel and damages to the system (hardware and software) and to the facility.

Note

This sign can be found next to all general notes that supply important information about one or more operating steps. These specific notes are intended to make operation easier and avoid unnecessary work due to incorrect operation.

1.3 General information

Attention
Please read this section carefully. Safety aspects cannot be left to chance when dealing with electrical equipment.

1.3.1 Prescribed use

Danger
The devices described in this manual must be used only in applications prescribed in this manual or in the respective technical descriptions, and only with certified components and devices from third party manufacturers.

Appropriate transport, storage, deployment and mounting as well as careful operating and thorough maintenance guarantee the trouble-free and safe operation of these devices.

1.3.2 Notes concerning planning /installation of this product

Danger
All respective safety measures and accident protection guidelines must be considered carefully and without exception.

1.4 List of revisions

In comparison to the previous manual edition, the following changes/ revisions have been made:

Table 1-1: List of revisions

Chapter	Subject/ Description	new	changed	deleted
5	Module description BL67-16DI-P (page 5-44)	X		
6	Module description BL67-4AI-V/I, voltage/ current (page 6-34): – Diagnostics via Software (page 6-37) – Module parameters (per channel) (page 6-38) – Measurement value representation (page 6-39)		 X X X	
	Module description BL67-4AI-TC, thermocouple (page 6-57)	X		
8	Module description BL67-2AO-I, 0/4...20mA (page 8-3): – Module parameters (per channel) (page 8-5) – Measurement value representation (page 8-6)		 X X	
15	Nominal current consumption and power loss of the modules (page 15-2)		X	
	Ident codes of the BL67-modules (page 15-26)		X	

Note
The publication of this manual renders all previous editions invalid.

2 BL67-philosophy

2.1 The basic concept

BL67 is a modular IP67 I/O-system for use in industrial automation. It connects the sensors and actuators in the field to the higher-level controller.

BL67 offers modules for practically all applications:

- Digital input and output modules
- Analog input and output modules
- Technology modules (RS232 interface, …)

A complete BL67 station counts as **one** station on the bus and therefore occupies **one** fieldbus address in any given fieldbus structure. A BL67 station consists of a gateway, power distribution modules and I/O modules.

The connection to the relevant fieldbus is made via the bus-specific gateway, which is responsible for the communication between the BL67 station and the other fieldbus stations.

The communication within the BL67 station between the gateway and the individual BL67 modules is regulated via an internal module bus.

Note
The gateway is the only fieldbus-dependent module on a BL67 station. All other BL67 modules are not dependent on the fieldbus used.

2.1.1 Flexibility

A BL67 station can contain modules in any combination, which means it is possible to adapt the system to practically all applications in automated industry.

2.1.2 Convenient handling

All BL67 modules, with the exception of the gateway, consist of a base module and an electronic module.

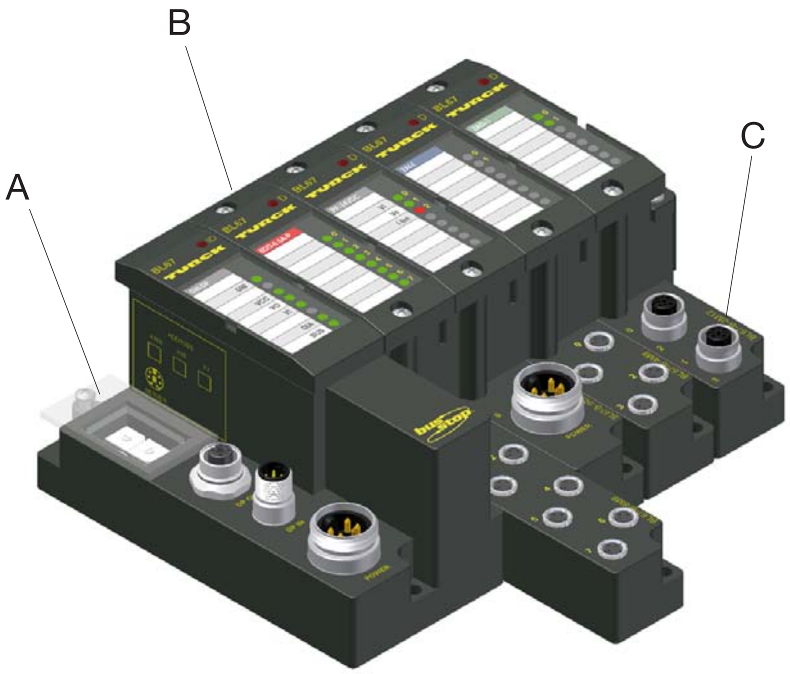
The gateway and the base modules are snapped onto a mounting rail or are directly mounted onto a mounting plate. The electronic modules are plugged onto the appropriate base modules.

After disconnection of the load, the electronic modules can be plugged or pulled when the station is being commissioned or for maintenance purposes, without having to disconnect the field wiring from the base modules.

2.2 BL67 components

Figure 2-1:
BL67-Station
PROFIBUS-DP

A gateway
B electronics module
C base module



2.2.1 Gateways

The gateway connects the fieldbus to the I/O modules. It is responsible for handling the entire process data and generates diagnostic information for the higher-level master and the software tool I/O-ASSISTANT.

Figure 2-2:
Gateway

2.2.2 Electronic modules

Electronic modules contain the I/O-functions of the BL67 modules (Power Feeding modules, digital and analog input/output modules and technology modules).

Electronic modules are plugged onto the base modules and are not directly connected to the wiring. They can be plugged or pulled when the station is being commissioned or for maintenance purposes, without having to disconnect the field wiring from the base modules.

Figure 2-3: Electronic module

Power Feeding modules

Power Feeding modules distribute the required 24 V DC field voltage to the I/O modules. They are necessary for building groups of modules with different potentials within a BL67 station, or if the rated supply voltage for the outputs cannot be guaranteed. Power Feeding modules are potentially isolated from the gateway, the adjoining power supply module and the I/O modules to the left side.

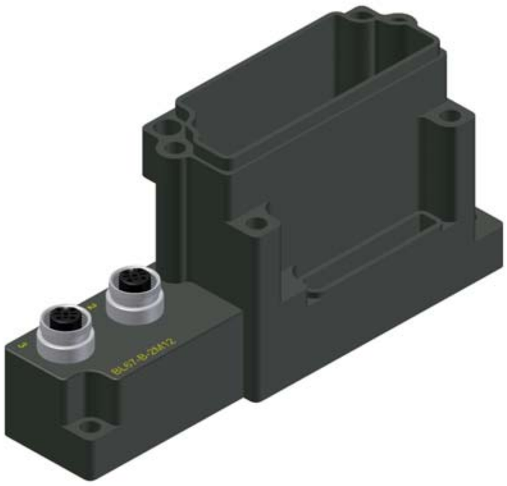
2.2.3 Base modules

The field wiring is connected to the base modules.

These are available in miscellaneous connection variations:

- 1 x M12, 2 x M12, 2 x M12-P, 4 x M12, 4 x M12-P
- 4 x M8, 8 x M8
- 1 x M12-8, 2M12-P
- 1 x 7/8'' (for Power Feeding modules)
- etc..

Figure 2-4: Base module



2.2.4 End plate

An end plate on the right-hand side physically completes the BL67 station. It protects the module bus contacts of the last base module in a station and guarantees the protection class IP67 when tightly screwed.

Figure 2-5: End plate

3 General technical data of BL67 modules

3.1 Introduction

The following chapters (chapter 3 to chapter 9) contain all information about the BL67 power supply and I/O modules.

This chapter describes the general technical data valid for all BL67 modules.

Note

The parameter and diagnosis information of the individual modules correspond to those determined in the bus configuration files (GSD- or EDS- files) which are described in the bus specific manuals for the BL67 gateways with PROFIBUS-DP (Turck Documentation-No.: German D300570/ English D300527), with DeviceNet (Turck Documentation-No.: German D300571/ English D300528).

Please refer to these manuals for the fieldbus-specific description of the diagnostic and parameter data of the individual BL67 modules.

Note

The gateway's technical data and the gateway's diagnostic options are also described in the bus-specific manuals for the BL67 gateways with PROFIBUS-DP (Turck Documentation-No.: German D300570/ English D300527), with DeviceNet (Turck Documentation-No.: German D300571/ English D300528).

An overview of all electronic modules and the appropriate base modules can be found in the „Appendix".

3.1 Module abbreviations

The module designations are explained in the following table:

Table 3-1: Module abbreviations

Abbr.	Designation	Example
AI	Analog input module	BL67-2**AI**-I
AO	Analog output module	BL67-2**AO**-V
B	Designation for the base modules.	**B**-2M12
DP	PROFIBUS-DP	BL67-GW-**DP**
I	Analog in- or output module for current signals sn(0/4 to 20 mA)	
P	Positive switching (sourcing)	BL67-8DO-0.5A-**P**
PF	Power Feeding Module	BL67-**PF**-24VDC
PT	Analog input module for connecting resistance thermometers with sensors PT100, PT200, PT500 and PT1000 in 2- or 3-wire measurement type	BL67-2AI-**PT**
RS232	Module with integrated RS232 interface	BL67-1**RS232**
TC	Analog input module for connecting thermocouples	BL67-2AI-**TC**
V	Analog in- or output module for voltage signals (-10/ 0 to 10 V)	BL67-2AO-**V**

3.2 Technical abbreviations

The following abbreviations are used in the technical data and wiring diagrams:

Table 3-2: Technical abbreviations

Abbr.	Designation
f_T	Transmission frequency
I_A	Output current
I_{Amax}	Maximum output current
I_{in}	Input current
I_K	Short circuit current
I_L	Nominal current consumption from power supply (field)
I_{MAX}	Maximum Input current (destruction limit)
I_{MB}	Nominal current consumption from the module bus (5 V DC)
I_{SENS}	Sensor supply fro V_I
PE	Protective earth
P_{MAX}	Maximum power loss of the modules
R_E	Input resistance
R_{LI}	Load resistance, inductive
R_{LK}	Load resistance, capacitive
R_{LL}	Lamp load
R_{LO}	Load resistance, ohmic
R_{ON}	Switch-on resistance
$t_{Ambient}$	Ambient temperature
T_K	Temperature coefficient
t_{Store}	Storage temperature
U_{Fe}	Isolation voltage (field/ functional earth)
U_{MAX}	Maximum input voltage (destruction limit)
U_{TMB}	Isolation voltage (module bus/ field)
V_I/U_B	Supply voltage for inputs/ operating voltage
V_O/U_L	Supply voltage for outputs/ load voltage
V_{sens}	Sensor supply

3.3 Station dimensions

Figure 3-1: Top view

A *Dimensions in mm [inch]*

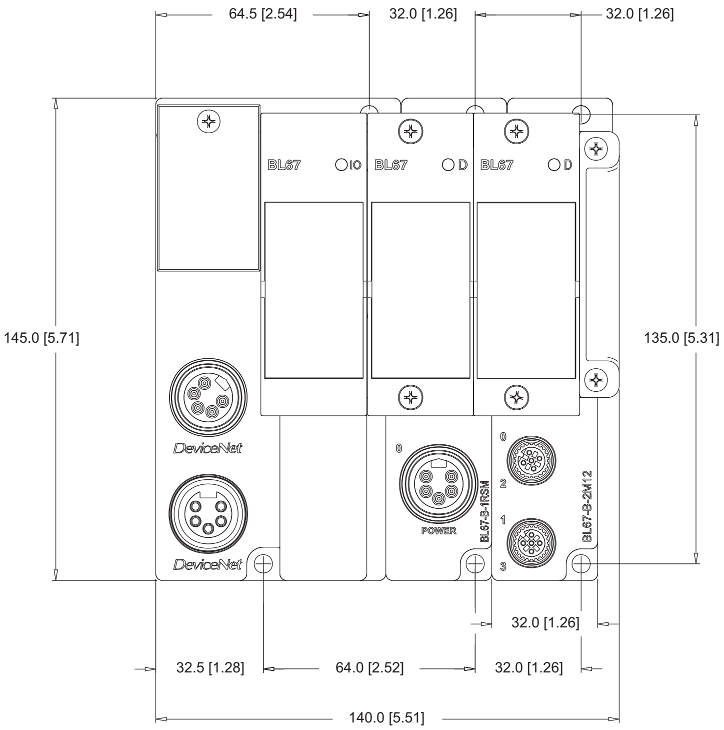


Figure 3-2: Side view

A *Dimensions in mm [inch]*

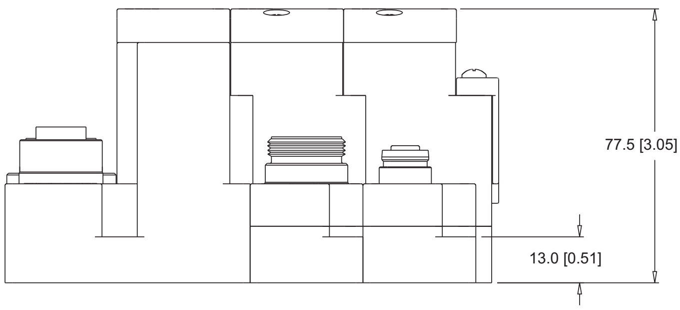
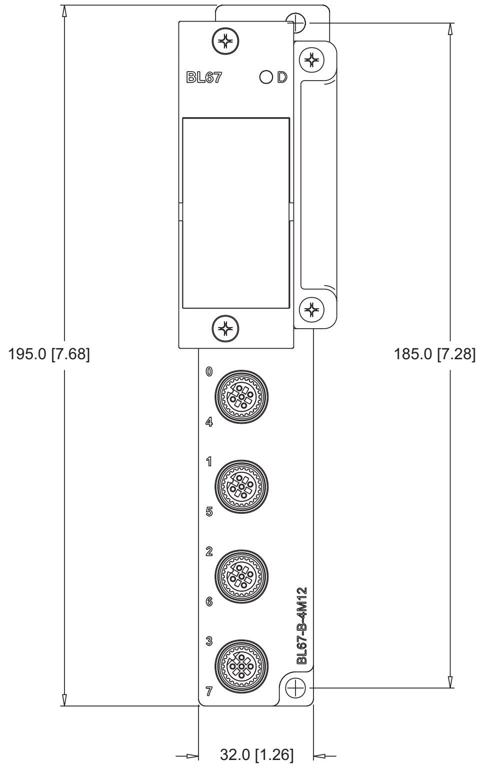


Figure 3-3: BL67-module (electronic - and base module)

A *Dimensions in mm [inch]*



3.4 General technical data

> **Note**
> The auxiliary power supply must comply with the stipulations of SELV (Safety Extra Low Voltage) according to IEC 364-4-41.

Table 3-3: General technical data relating to a station

Supply voltage/ auxiliary voltage	
Demands on the voltage supply acc. to EN 61131-2	
Nominal value (provision for other modules)	24 V DC
Permissible range	according to EN 61 131-2 (18 to 30 V DC)
Residual ripple	according to EN 61 131-2
Potential isolation	Yes, via optocoupler
Isolation voltage	
– field bus/(V_I/ V_O)	– PROFIBUS-DP: 500 V_{rms} – DeviceNet: no – Ethernet: 500 V_{rms}
– V_I/ V_O	no
– (V_I/ V_O**1**)/(V_I/ V_O**2**), with PF module for potential isolation	500 V_{rms}
– field bus/ (V_I/ V_O**2**)	500 V_{rms}
Ambient conditions	
Ambient temperature	
– $t_{Ambient}$	0 to +55 °C / 32 to 131 °F
– t_{Store}	- 25 to +85 °C / - 13 to 185 °F
Relative humidity	according to IEC 61131-2
Climatic tests	according to IEC 61131-2
Noxious gas	according to IEC 68068-42/43
Resistance to vibration	according to IEC 61131-2
Protection class	according to IEC 60529 IP 67
Shock resistant	according to IEC 61131-2
Topple and fall/ free fall	according to IEC 61131-2

Emitted interference	
High-frequency, radiated	according to EN 55011, Class A
Immunity to interference	
Static electricity	according to IEC 61131-2
Electromagnetic HF fields	according to IEC 61131-2
Fast transients (Burst)	according to IEC 61131-2
Conducted interferences induced by HF fields	according to IEC 61000-4-6 10 V Criteria A
High energy transients (Surge) **A** voltage supply	according to IEC 61000-4-5 0.5 kV CM, 12Ω/ 9 µF 0.5 kV DM, 2Ω/ 18 µF Criteria B
Reliability	
Operational life MTBF	min. 120 000 h
Electronic modules pull/ plug cycles	20

A *I/O-line-length ≤ 30 m*

Danger
This device can cause radio disturbances in residential areas and in small industrial areas (residential, business and trading). In this case, the operator can be required to take appropriate measures to suppress the disturbance at his own cost.

3.5 Approvals

Table 3-4: Approvals

Approvals
CE
CSA (in preparation)
UL (in preparation)

4 Power Feeding modules

4.1 Overview

Power Feeding modules supply an galvanically isolated 24 V DC field voltage to the I/O modules.

By using Power Feeding modules, it is not necessary to distribute power separately to each BL67 I/O module.

Power Feeding modules distribute two separately switchable voltages to the modules, one for the inputs (V_I) and one for the outputs (V_O). These two voltages refer to the same ground potential (GND).

A sensor current limitation of 4 A for the input supply V_I is integrated in the modules to detect possible short circuits in the sensor supply.

The 24 V DC field supply is connected to the Power Feeding module by a 7/8“- connector.

LED status indicators

Error signals and diagnostic statuses are indicated via LEDs on the module. The corresponding diagnostic information is transmitted to the gateway via diagnostic bits.

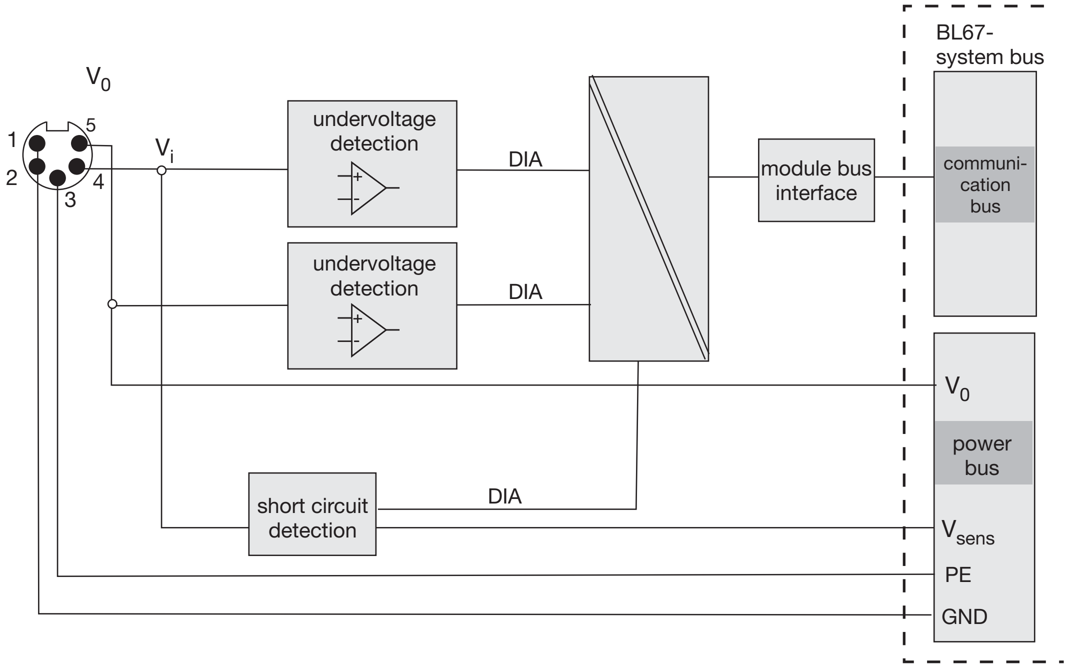
4.1.1 Module overview

- BL67-PF-24VDC

4.2 BL67-PF-24VDC, with diagnostics

Figure 4-1: BL67-PF-24VDC

Figure 4-2: Block diagram



4.2.1 Technical data

Table 4-1: Technical data

Designation	BL67-PF-24VDC
Field supply	
Output supply V_O/ U_L	24 V DC
– Permissible range	– 18 to 30 V DC
Input supply V_I/ U_B	24 V DC
– Permissible range	– 18 to 30 V DC
I_{MB} Nominal current from 5 V DC (module bus)	≤ 30 mA
Max. output current from V_O	10 A
Max. input current from V_I	4 A (limited by internal current limiter)
Isolation voltage module bus/ supply voltage	Max. 1000 VDC

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4.2.2 Diagnostic/ status messages

Diagnosis/ status via LEDs

Table 4-2: Diagnosis/ status via LEDs

LED	Display	Meaning	Remedy
D	Red, flashing, 0.5 Hz	Diagnostics pending	–
	Red	Module bus communication failure	Check if more than two adjoining electronic modules have been pulled. This applies to modules located between this module and the gateway.
	Off	No error messages or diagnostics	–
V_O	Green	Power supply for outputs ok	–
	Off	Power supply for outputs faulty	Check the wiring to the power supply. Check the external power supply unit.
V_I	Green	Power supply for inputs ok	–
	Off	Power supply for inputs faulty	Check the wiring to the power supply. Check the external power supply unit.
$I I_{im}$	Red	short circuit in sensor supply (V_I)	Check the sensor supply.
	Off	sensor supply (V_I) ok	-

Diagnosis via software

This module has the following diagnostic data:

Table 4-3: Diagnostic data

Diagnosis	Meaning
Current Overflow I_I	Current consumption too high (> 4 A).
Low voltage V_O	V_O < 18 VDC
Low voltage V_I	V_I < 18 VDC

4.2.3 Module parameters

none

4.2.4 Base modules/ pin assignment

- BL67-B-1RSM (7/8'')/ BL67-B-1RSM-4

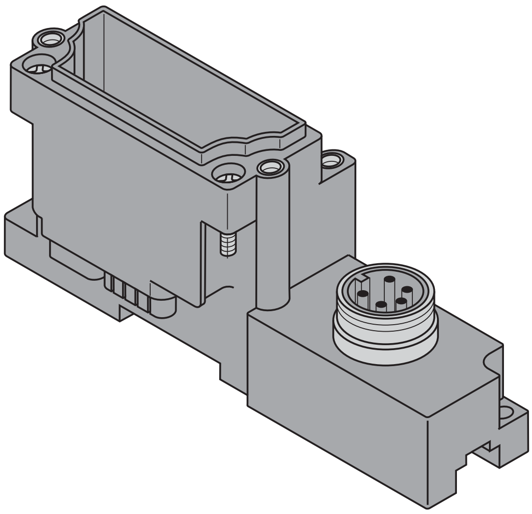


Figure 4-3: BL67-B-1RSM/ BL67-B-1RSM-4

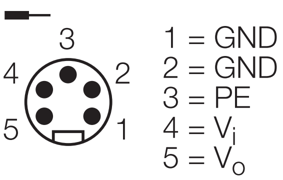


Figure 4-4: Pin assignment BL67-PF-24VDC with BL67-B-1RSM

module wiring diagram

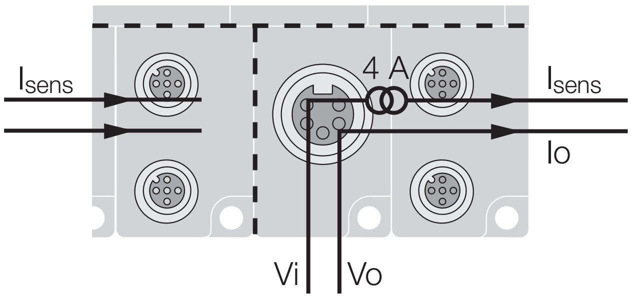
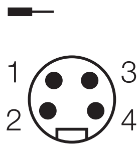


Figure 4-5: Pin assignment BL67-PF-24VDC with BL67-B-1RSM-4

Total current (Isens + Io) max. 10A



1 = V_O, V_i
2 = n.c.
3 = n.c.
4 = GND

module wiring diagram

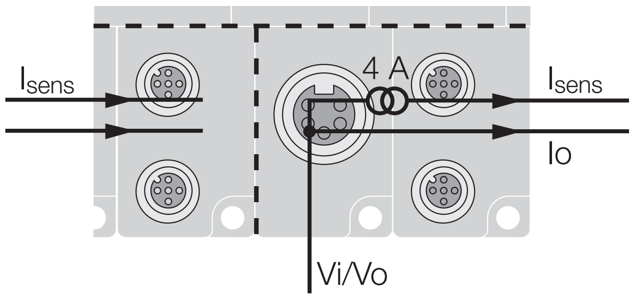
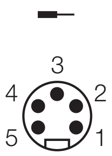


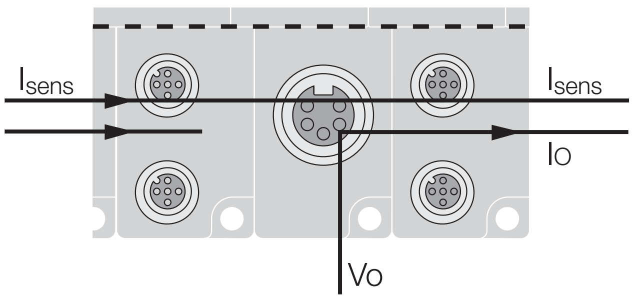
Figure 4-6: Pin assignment BL67-PF-24VDC with BL67-B-1RSM-VO

Only Vo (pin 1 and 5) supply, do not connect pin 2 and 4!



1 = GND
2 = d.n.c.
3 = PE
4 = d.n.c.
5 = V_O

module wiring diagram



5 Digital Input Modules

5.1 Overview

Digital input modules (DI) detect electrical high- and low-level values through the base module connections and transmit the corresponding digital value to the gateway.

The modules provide optically isolated inputs according to IEC 61131 Type 1.

The sensor supply (V_{sens}) is tapped from the internal voltage supply bus.

This voltage is supplied by the gateway or a Power Feeding module. Both contain a short circuit detection for the sensor supply voltage.

In the modules without diagnostic function a sensor short circuit is thus detected in the gateway or in the Power Feeding module.

The modules with diagnostic function (BL67-xDI-**PD**) provide a short circuit protection.

The modules provide reverse polarity protection.

LED status indicators

- modules without channel- or connector-diagnosis:
  The channel status is indicated via the channel LED. Error signals from the I/O level are indicated by each module via the “D” LED.
- modules with channel- or connector-diagnosis:
  The modules BL67-xDI-**PD** provide wether a channel- or a connector diagnosis function. Diagnosis information are indicated via the channel LED or via the "D" LED.

5.1.1 Module overview

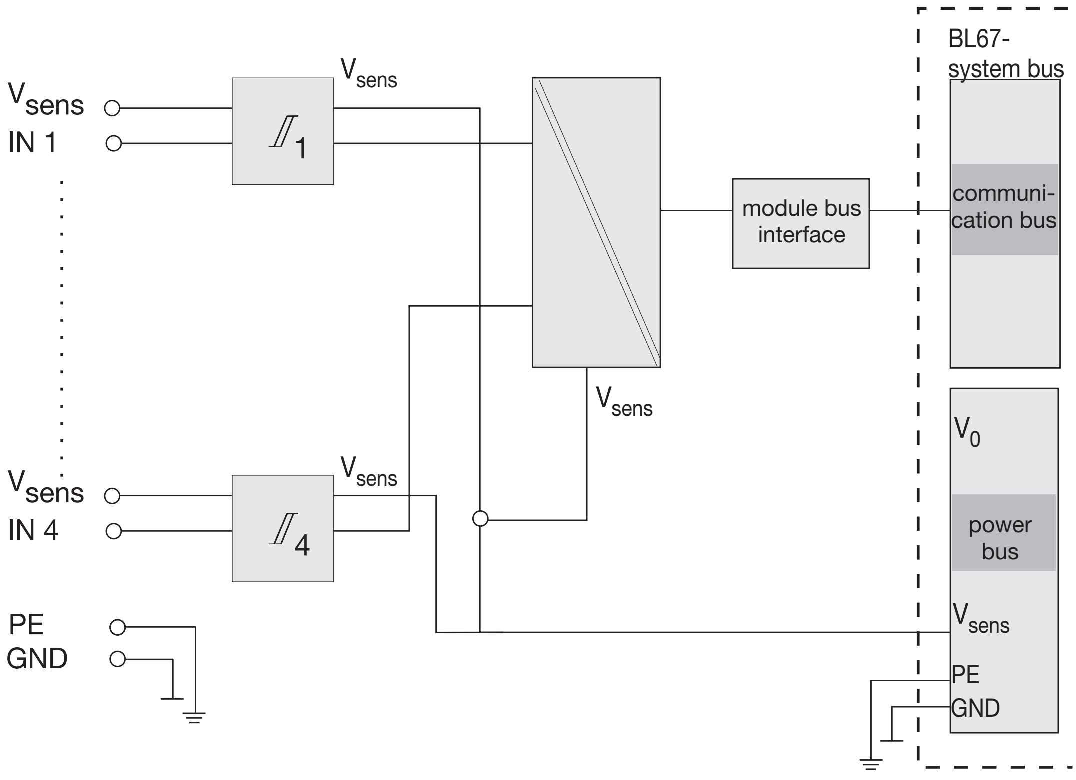
Table 5-1: Module overview

Module	Number of channels	positive switching, sinking
BL67-4DI-P	4	✓
BL67-8DI-P	8	✓
BL67-4DI-N	4	-
BL67-8DI-N	8	-
BL67-4DI-PD	4	✓
BL67-8DI-PD	8	✓
BL67-16DI-P	16	✓

5.2 BL67-4DI-P

Figure 5-1: BL67-4DI-P

Figure 5-2: Block diagram



5.2.1 Technical data

Table 5-2: Technical data

Designation	BL67-4DI-P
Number of channels	4
Input voltage, nominal value at 24 V DC	
Low level	< 4.5 V
High level	7 V < U_{in} < 9 V
Nominal current from 5 V DC (module bus) I_{MB}	≤ 30 mA
Nominal current from supply terminal I_L	≤ 40 mA
Power loss of the module	< 250 mW
Input current I_{in}	
Low level	< 0.5 mA
High level	> 3.7 mA
Isolation voltage	
U_{TMB} (module bus/ field)	max. 1000 V DC

5.2.2 diagnostic-/ status messagesDiagnostic/ status messages

Diagnosis/ status via LEDs

Table 5-3: Diagnosis/ status via LEDs

LED	Display	Meaning	Remedy
D	Red	Module bus communication failure	Check if more than two ad-joining electronic modules have been pulled. This concerns modules located between this module and the gateway.
	Off	No error messages	–
0 to 3	Green	Status of channel x = „1“	–
	Off	Status of channel x = „0“	-

5.2.3 Module parameters

None

5.2.4 Base modules/ pin assignment

- BL67-B-4M8

Figure 5-3: BL67-B-4M8

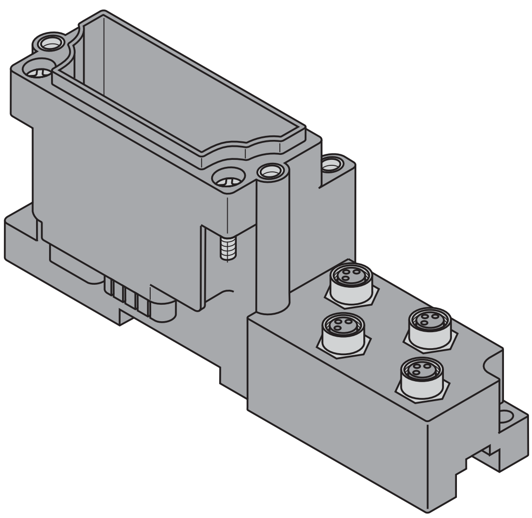


Figure 5-4: Pin assignment BL67-4DI-P with BL67-B-4M8

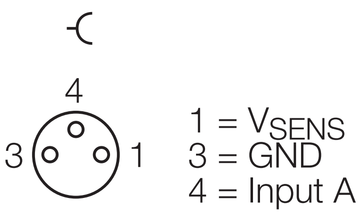
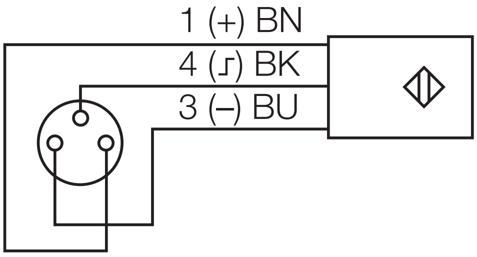


Figure 5-5: Wiring diagram BL67-4DI-P with BL67-B-4M8



- BL67-B-2M12/ BL67-B-2M12-P (paired)

Figure 5-6: BL67-B-2M12/ BL67-B-2M12-P

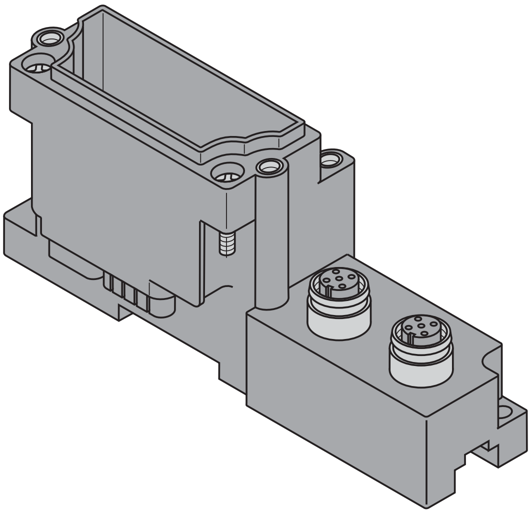


Figure 5-7: Pin assignment BL67-4DI-P with BL67-B-2M12/ BL67-B-2M12-P

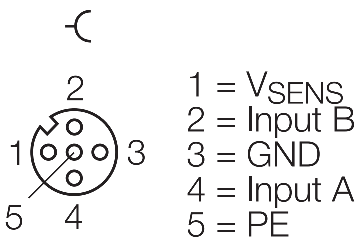
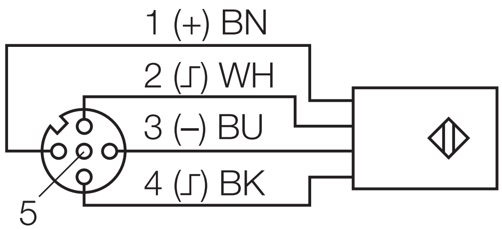
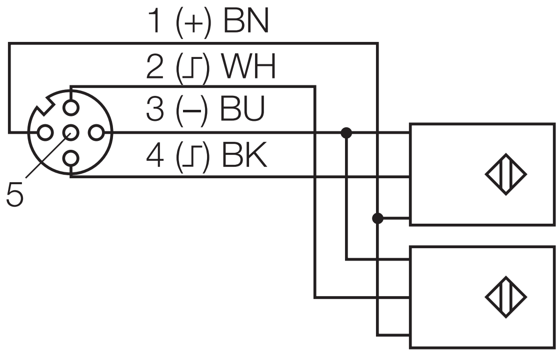


Figure 5-8: Wiring diagrams BL67-4DI-P with BL67-B-2M12/ BL67-B-2M12-P





- BL67-B-4M12

Figure 5-9: BL67-B-4M12

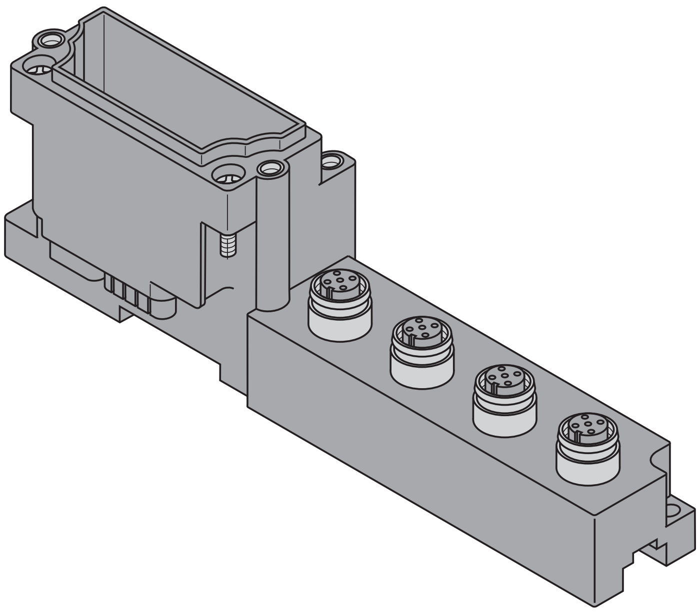
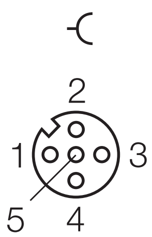
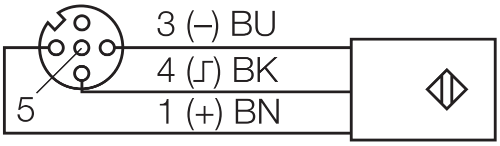


Figure 5-10: Pin assignment BL67-4DI-P with BL67-B-4M12



1 = V_{SENS}
2 = n.c.
3 = GND
4 = Input A
5 = PE

Figure 5-11: Wiring diagram BL67-4DI-P with BL67-B-4M12



- BL67-1M23

Figure 5-12: BL67-B-1M23

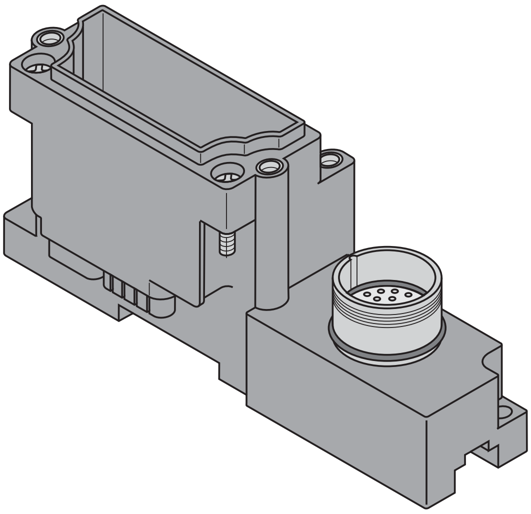
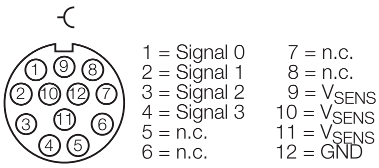


Figure 5-13: Pin assignment BL67-4DI-P with BL67-B-1M23



5.2.5 Signal assignment

Table 5-4: Signal assignment with BL67-B-4M8

	Byte	Bit 7	Bit 6	Bit 5	Bit 4	Bit 3	Bit 2	Bit 1	Bit 0
In	n	-	-	-	-	C3P4	C2P4	C1P4	C0P4

Table 5-5: Signal assignment with BL67-B-2M12

	Byte	Bit 7	Bit 6	Bit 5	Bit 4	Bit 3	Bit 2	Bit 1	Bit 0
In	n	-	-	-	-	C1P2	C0P2	C1P4	C0P4

Table 5-6: Signal assignment with BL67-B-2M12-P

	Byte	Bit 7	Bit 6	Bit 5	Bit 4	Bit 3	Bit 2	Bit 1	Bit 0
In	n	-	-	-	-	C1P2	C1P4	C0P2	C0P4

Table 5-7: Signal assignment with BL67-B-4M12

	Byte	Bit 7	Bit 6	Bit 5	Bit 4	Bit 3	Bit 2	Bit 1	Bit 0
In	n	-	-	-	-	C3P4	C2P4	C1P4	C0P4

Table 5-8: Signal assignment with BL67-B-1M23

	Byte	Bit 7	Bit 6	Bit 5	Bit 4	Bit 3	Bit 2	Bit 1	Bit 0
In	n	-	-	-	-	C0P4	C0P3	C0P2	C0P1

n = process data offset of the input data depending on station configuration and the corresponding fieldbus.

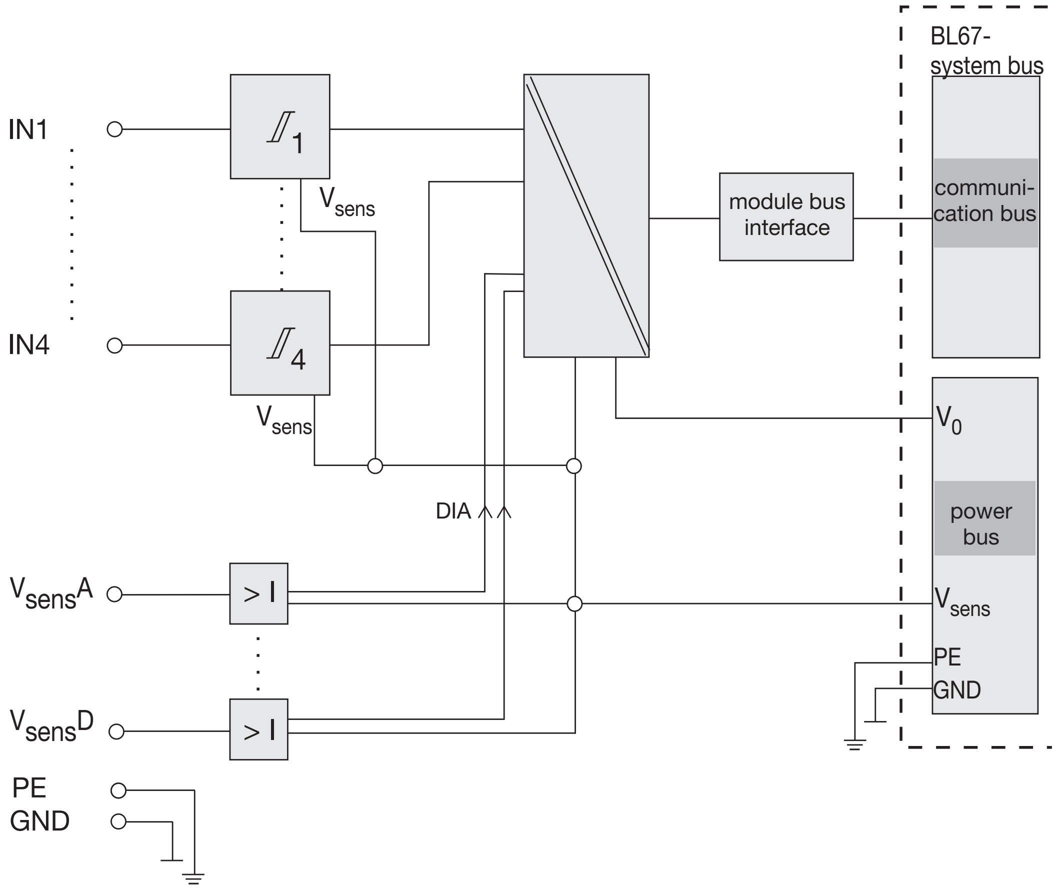
C… = slot no.

P… = pin no.

5.3 BL67-4DI-PD

Figure 5-14: BL67-4DI-PD

Figure 5-15: Block diagram



5.3.1 Technical data

Table 5-9: Technical data

Designation	BL67-4DI-PD
Number of channels	4
Input voltage, nominal value at 24 V DC	
Low level	< 4.5 V
High level	> 7 V (max. 30 V)
Nominal current from 5 V DC (module bus) I_{MB}	≤ 30 mA
Nominal current from supply terminal I_L	≤ 100 mA (all inputs low)
Power loss of the module	< 1.5 W
Input current I_{in}	
Low level	< 1.5 mA
High level	> 3.7 mA
Isolation voltage	
U_{TMB} (module bus/ field)	max. 2500 V DC
U_{FE}	max. 1000 V DC

5.3.2 Diagnostic/ status messages

Diagnosis/ status via LEDs

Table 5-10: Diagnosis via LEDs

LED	Display	Meaning	Remedy
D	Red	Module bus communication failure	Check if more than two ad-joining electronic modules have been pulled. This concerns modules located between this module and the gateway.
	Red	Error in field supply (LED V_I at Power Feeding module is „off“)	Check the power supply for the inputs (V_{sens}).
	Red, flashing, 0.5 Hz	Diagnosis pending	-
	Off	No error messages	–
0 to 3	Green	Status of channel x = „1“	Green
	Off	Status of channel x = „0“	Off
	Red flashing, 2 Hz	LED 0 to 3: Overload sensor supply x	– Check the sensor supply.
	Red	LED 0 and 1: open-circuit monitoring	– Check the wires for open-circuits.

Diagnosis via software

This module has the following diagnostic data available per channel:

Table 5-11: Diangosis

Diagnosis	
Overcurrent/ short circuit sensor x	Overcurrent at sensor supply (> 100 mA).
Open circuit Kx	Groupwise open-circuit monitoring: Group A (channel 0 and 2) Group B (channel 1 and 3).

5.3.3 Module parameters

Table 5-12: Module parameters

A*default setting*

Parameter name	Value	Meaning
Input filter x	deactivate **A**	Input filter: 0,25 ms.
	activate	Input filter: 2.5 ms
Digital input x	normal**A**	Input signal not inverted
	inverted	Input signal inverted, Conversion of the effective signal direction for sensors
Operation mode group x	normal**A**	
	open-circuit monitoring	open-circuit monitoring: Group A (channel 0 and 2) Group B (channel 1 and 3).

5.3.4 Base modules/ pin assignment

- BL67-B-4M8

Figure 5-16: BL67-B-4M8

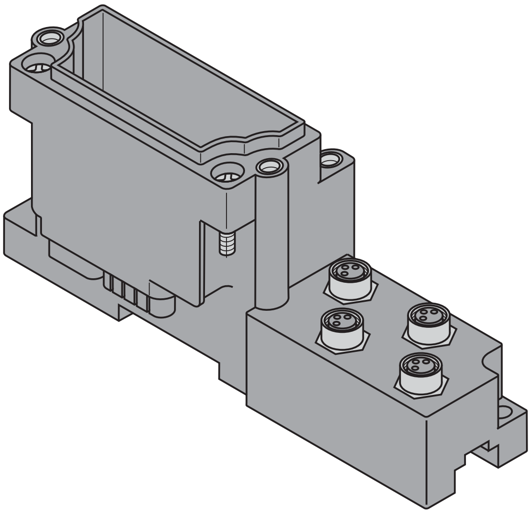


Figure 5-17: Pin assignment BL67-4DI-PD with BL67-B-4M8

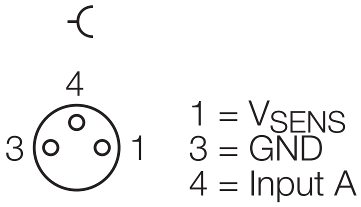
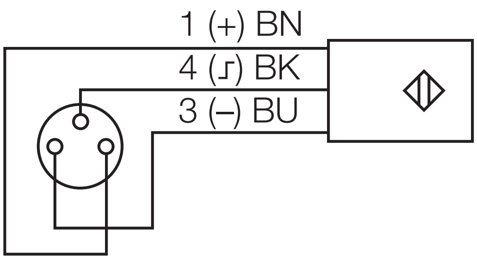


Figure 5-18: Wiring diagram BL67-4DI-PD with BL67-B-4M8



- BL67-B-2M12/ BL67-B-2M12-P (paired)

Figure 5-19: BL67-B-2M12/ BL67-B-2M12-P

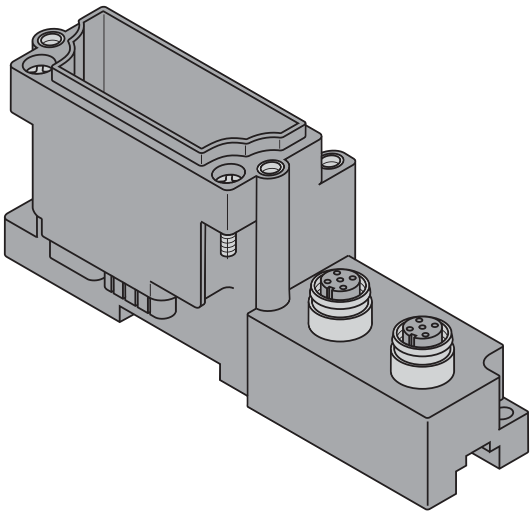


Figure 5-20: Pin assignment BL67-4DI-PD with BL67-B-2M12/ BL67-B-2M12-P

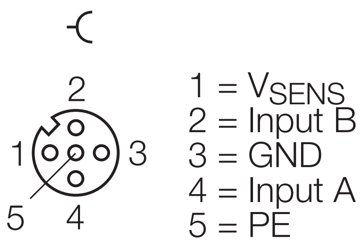


Figure 5-21: Wiring diagrams BL67-4DI-PD with BL67-B-2M12/ BL67-B-2M12-P

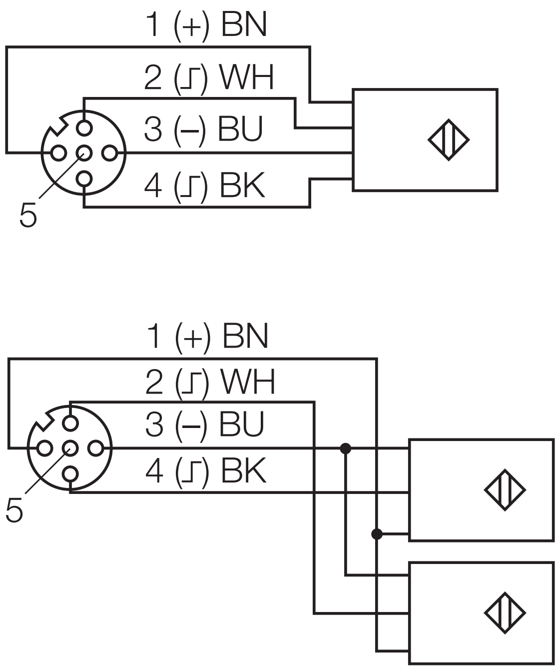
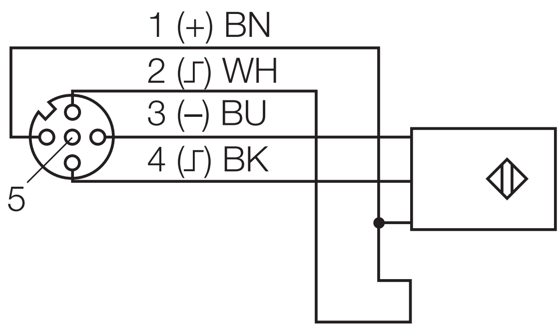


Figure 5-22: Wiring diagram for open circuit detection only with base module BL67-B-2M12

If the open circuit detection has been activated, a jumper between pin 1 (24 VDC) and pin 2 (diagnostics input) must be implemented on the sensor side for monitoring of wire-breaks.



- BL67-B-4M12

Figure 5-23: BL67-B-4M12

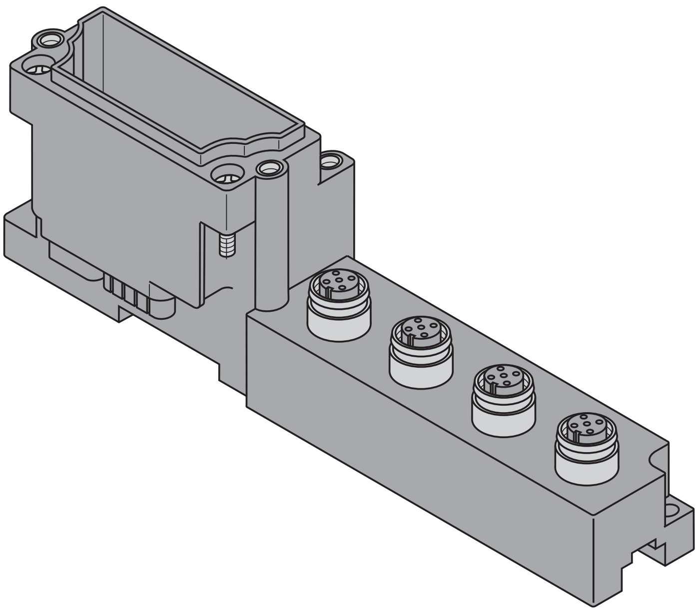


Figure 5-24: Pin assignment BL67-4DI-PD with BL67-B-4M12

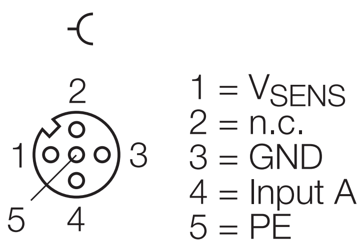
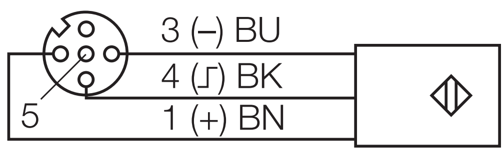


Figure 5-25: Wiring diagram BL67-4DI-PD with BL67-B-4M12



5.3.5 Signal assignment

Table 5-13: Signal assignment with BL67-B-4M8

	Byte	Bit 7	Bit 6	Bit 5	Bit 4	Bit 3	Bit 2	Bit 1	Bit 0
In	n	-	-	-	-	C3P4	C2P4	C1P4	C0P4

Table 5-14: Signal assignmen with BL67-B-2M12 incl. wire break diagnosis

	Byte	Bit 7	Bit 6	Bit 5	Bit 4	Bit 3	Bit 2	Bit 1	Bit 0
In	n	-	-	-	-	C1P2	C0P2	C1P4	C0P4
		-	-	-	-	wire break 1 + 2		Sensor signal 1 + 2	

Table 5-15: Signal assignmen with BL67-B-2M12-P

	Byte	Bit 7	Bit 6	Bit 5	Bit 4	Bit 3	Bit 2	Bit 1	Bit 0
In	n	-	-	-	-	C1P2	C1P4	C0P2	C0P4

Table 5-16: Signal assignmen with BL67-B-4M12

	Byte	Bit 7	Bit 6	Bit 5	Bit 4	Bit 3	Bit 2	Bit 1	Bit 0
In	n	-	-	-	-	C3P4	C2P4	C1P4	C0P4

n = process data offset of the input data depending on station configuration and the corresponding fieldbus.

C… = slot no.

P… = pin no.

5.3.6 Sensor supply

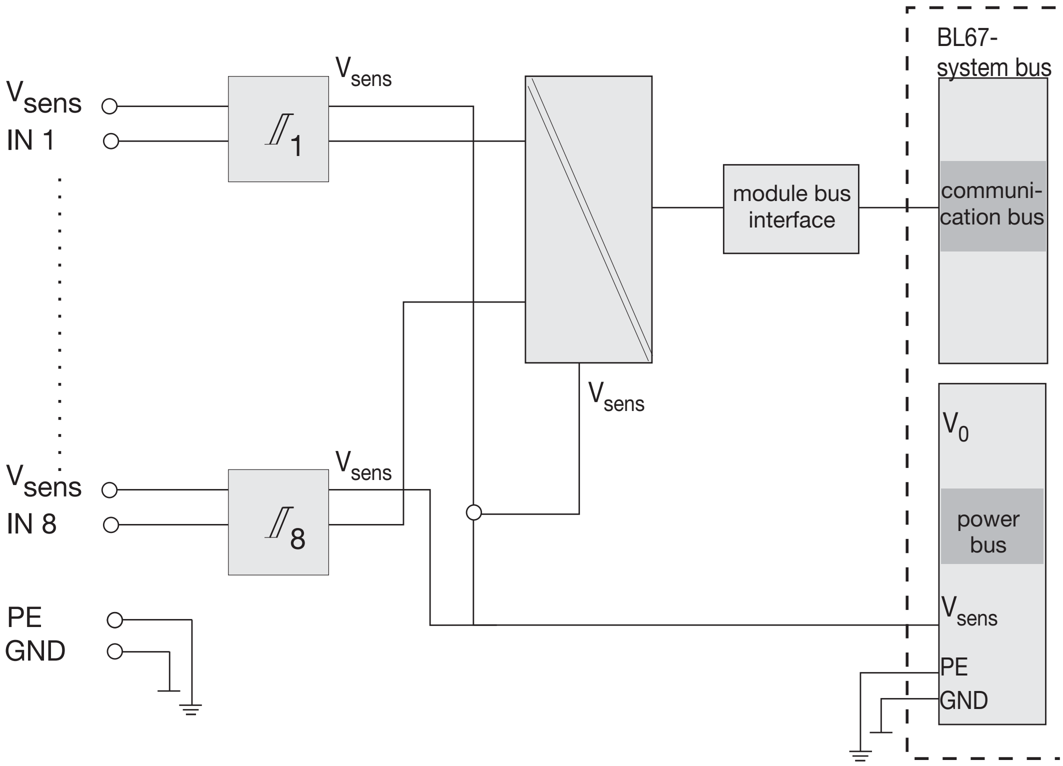
Table 5-17: Sensor supply

V_{sens}	A	B	C	D
BL67-B-2M12	C0P1	C1P1	-	-
BL67-B-2M12-P	C0P1	C1P1	-	-
BL67-B-4M12	C0P1	C1P1	C2P1	C3P1
BL67-B-4M8	C0P1	C1P1	C2P1	C3P1

5.4 BL67-8DI-P

Figure 5-26: BL67-8DI-P

Figure 5-27: Block diagram



5.4.1 Technical data

Table 5-18: Technical data

Designation	BL67-8DI-P
Number of channels	8
Input voltage, nominal value at 24 V DC	
Low level	< 4.5 V
High level	7 V < U_{in} < 9 V
Nominal current from 5 V DC (module bus) I_{MB}	< 30 mA
Nominal current from supply terminal I_L	≤ 40 mA
Power loss of the module	< 250 mW
Input current I_{in}	
Low level	< 0.5 mA
High level	> 3.7 mA
Isolation voltage	
U_{TMB} (module bus/ field)	max. 1000 V DC

5.4.2 Diagnostic/ status messages

Diagnosis/ status via LEDs

Table 5-19: Diagnosis/ status via LEDs

LED	Display	Meaning	Remedy
D	Red	Module bus communication failure	Check if more than two adjoining electronic modules have been pulled. This concerns modules located between this module and the gateway.
	Off	No error messages	–
0 to 7	Green	Status of channel x = „1“	–
	Off	Status of channel x = „0“	-

5.4.3 Module parameters

None

5.4.4 Base modules/ pin assignment

- BL67-B-8M8

Figure 5-28: BL67-B-8M8

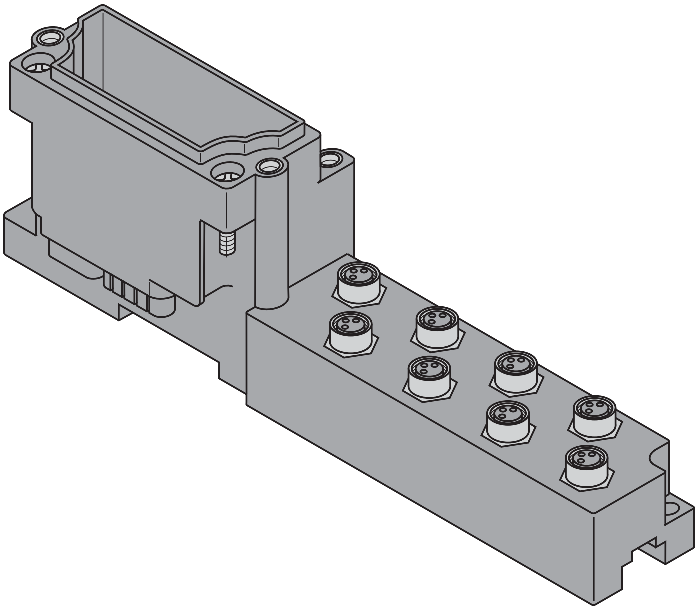


Figure 5-29: Pin assignment BL67-8DI-P with BL67-B-8M8

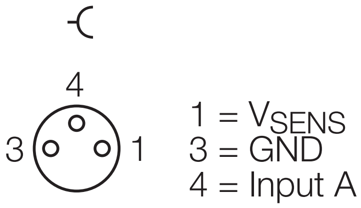
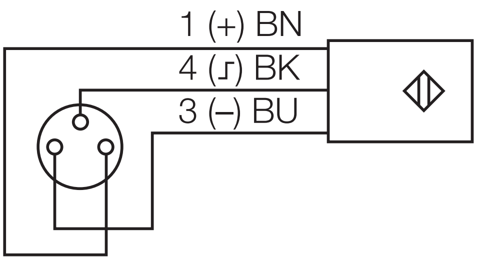


Figure 5-30: Wiring diagram BL67-8DI-P with BL67-B-8M8



- BL67-B-4M12/ BL67-B-4M12-P (paired)

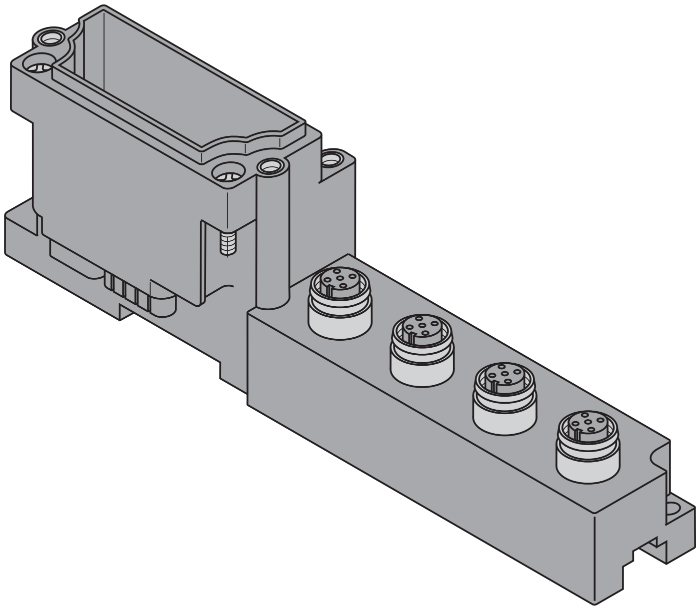


Figure 5-31: BL67-B-4M12/ BL67-B-4M12-P

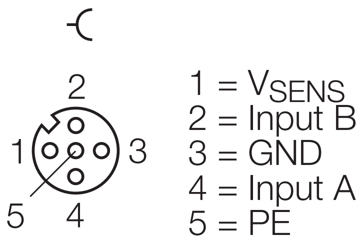


Figure 5-32: Pin assignment BL67-8DI-P with BL67-B-4M12/ BL67-B-4M12-P

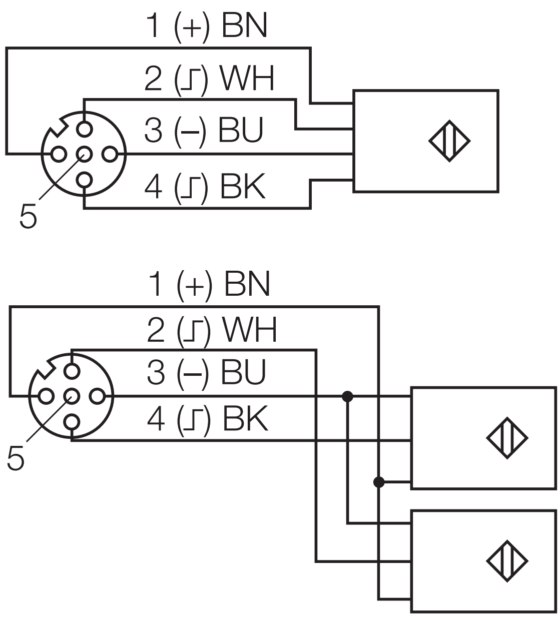


Figure 5-33: Wiring diagrams BL67-8DI-P with BL67-B-4M12/ BL67-B-4M12-P

- BL67-1M23

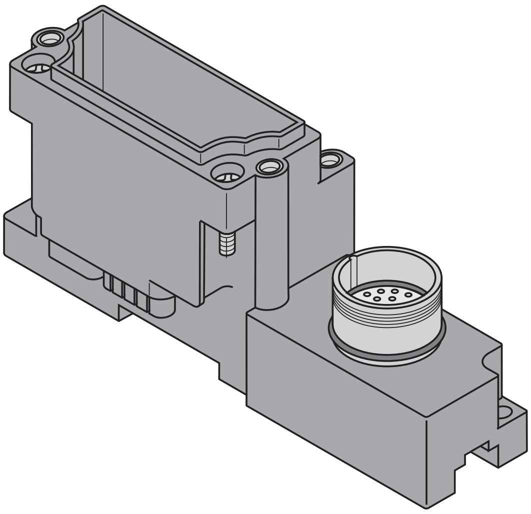


Figure 5-34: BL67-B-1M23

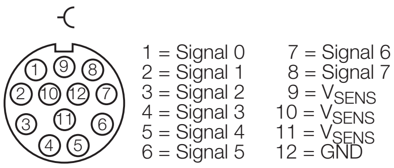


Figure 5-35: Pin assignment BL67-8DI-P with BL67-B-1M23

5.4.5 Signal assignment

Table 5-20: Signal assignment with BL67-B-8M8

	Byte	Bit 7	Bit 6	Bit 5	Bit 4	Bit 3	Bit 2	Bit 1	Bit 0
In	n	C7P4	C6P4	C5P4	C4P4	C3P4	C2P4	C1P4	C0P4

Table 5-21: Signal assignment with BL67-B-4M12

	Byte	Bit 7	Bit 6	Bit 5	Bit 4	Bit 3	Bit 2	Bit 1	Bit 0
In	n	C3P2	C2P2	C1P2	C0P2	C3P4	C2P4	C1P4	C0P4

Table 5-22: Signal assignment with BL67-B-4M12-P

	Byte	Bit 7	Bit 6	Bit 5	Bit 4	Bit 3	Bit 2	Bit 1	Bit 0
In	n	C3P2	C3P4	C2P2	C2P4	C1P2	C1P4	C0P2	C0P4

Table 5-23: Signal assignment with t BL67-B-1M23

	Byte	Bit 7	Bit 6	Bit 5	Bit 4	Bit 3	Bit 2	Bit 1	Bit 0
In	n	C0P8	C0P7	C0P6	C0P5	C0P4	C0P3	C0P2	C0P1

n = process data offset of the input data depending on station configuration and the corresponding fieldbus.

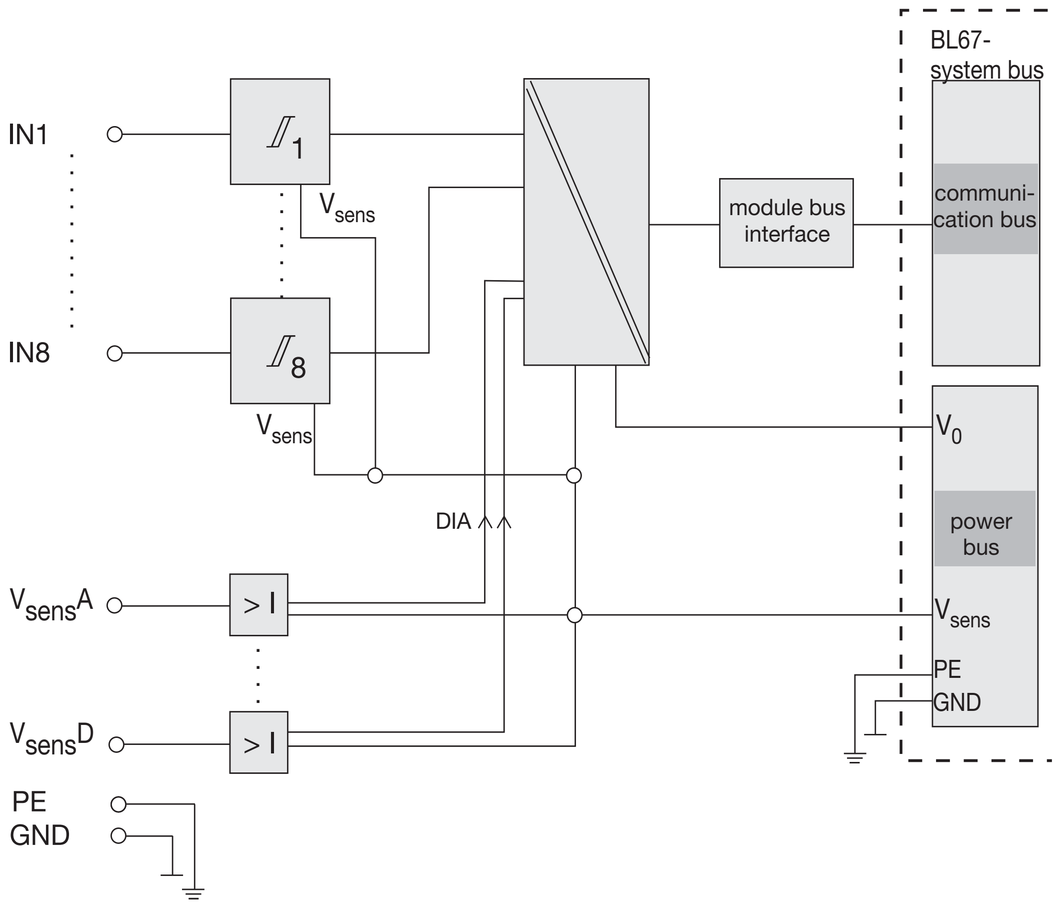
C… = slot no.

P… = pin no.

5.5 BL67-8DI-PD

Figure 5-36: BL67-8DI-PD

Figure 5-37: Block diagram



5.5.1 Technical data

Table 5-24: Technical data

Designation	BL67-8DI-PD
Number of channels	8
Input voltage, nominal value at 24 V DC	
Low level	< 4.5 V
High level	> 7 V (max. 30 V)
Nominal current from 5 V DC (module bus) I_{MB}	≤ 30 mA
Nominal current from supply terminal I_L	≤ 100 mA (all inputs low)
Power loss of the module	< 1.5 W
Input current I_{in}	
Low level	< 1.5 mA
High level	> 3.7 mA
Isolation voltage	
U_{TMB} (module bus/ field)	max. 2500 V DC
U_{FE}	max. 1000 V DC

5.5.2 Diagnostic/ status messages

Diagnosis/ status via LEDs

Table 5-25: Diagnosis via LEDs

LED	Display	Meaning	Remedy
D	Red	Module bus communication failure	Check if more than two ad-joining electronic modules have been pulled. This concerns modules located between this module and the gateway.
	Red	Error in field supply (LED V_I at Power Feeding module is „off“)	Check the power supply for the inputs (V_{sens}).
	Red, flashing, 0.5 Hz	Diagnosis pending	-
	Off	No error messages	–
0 to 7	Green	Status of channel x = „1“	Green
	Off	Status of channel x = „0“	Off
	Red flashing, 2 Hz	LED 0 to 7: Overload sensor supply x	– Check the sensor supply.
	Red	LED 0 to 3 open-circuit monitoring	– Check the wires for open-circuit.

Diagnosis via software

This module has the following diagnostic data available per channel:

Table 5-26: Diangosis

Diagnosis	
Overcurrent/ short circuit sensor x	Overcurrent at sensor supply (> 100 mA).
Open circuit Kx	Groupwise open-circuit monitoring: Group A (channel 0 and 4) Group B (channel 1 and 5) Group C (channel 3 and 6) Group D (channel 4 and 7).

5.5.3 Module parameters

Table 5-27: Module parameters

A*default setting*

Parameter name	Value	Meaning
Input filter x	deactivate **A**	Input filter: 0,25 ms.
	activate	Input filter: 2.5 ms
Digital input x	normal**A**	Input signal not inverted
	inverted	Input signal inverted, Conversion of the effective signal direction for sensors
Operation mode group x	normal	
	open-circuit monitoring	open-circuit monitoring: Group A (channel 0 and 4) Group B (channel 1 and 5) Group C (channel 3 and 6) Group D (channel 4 and 7).

5.5.4 Base modules/ pin assignment

- BL67-B-8M8

Figure 5-38: BL67-B-8M8

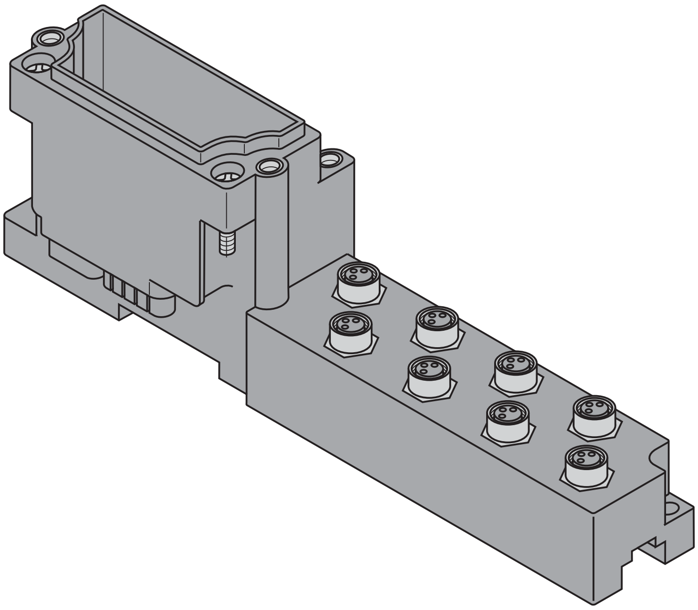


Figure 5-39: Pin assignment BL67-8DI-PD with BL67-B-8M8

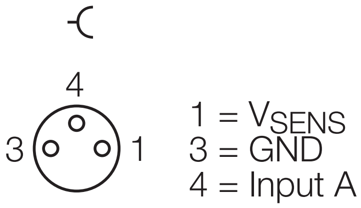
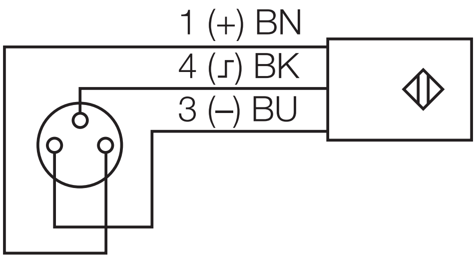


Figure 5-40: Wiring diagram BL67-8DI-PD with BL67-B-8M8



- BL67-B-4M12/ BL67-B-4M12-P (paired)

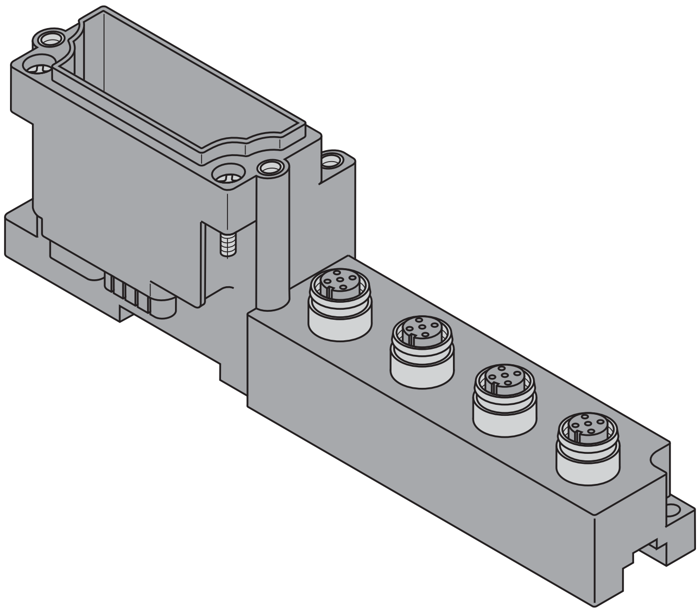


Figure 5-41: BL67-B-4M12/ BL67-B-4M12-P

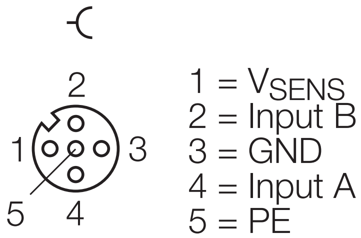


Figure 5-42: Pin assignment BL67-8DI-PD with BL67-B-4M12/ BL67-B-4M12-P

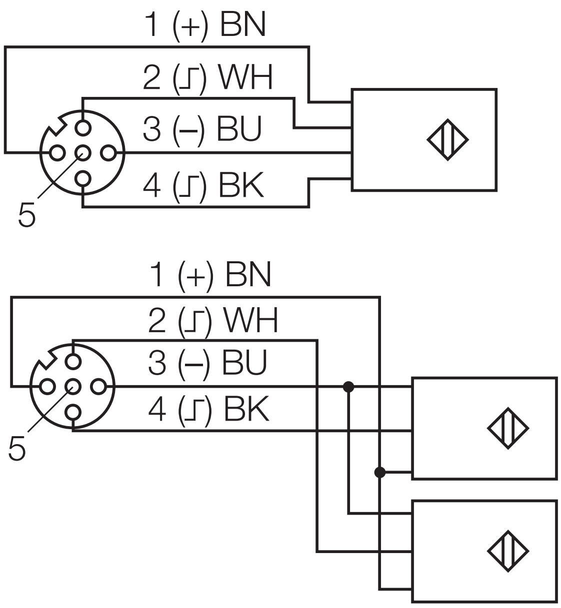


Figure 5-43: Wiring diagrams BL67-8DI-PD with BL67-B-4M12/ BL67-B-4M12-P

If the open circuit detection has been activated, a jumper between pin 1 (24 VDC) and pin 2 (diagnostics input) must be implemented on the sensor side for monitoring of wire-breaks.

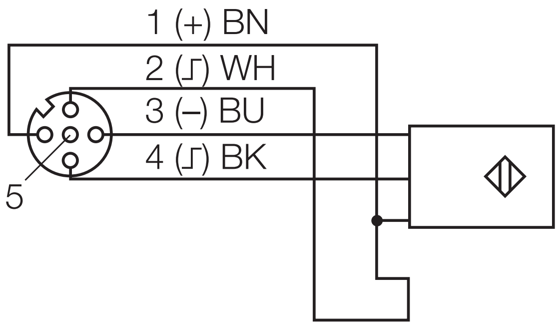


Figure 5-44: Wiring diagram for open circuit detection only with base module BL67-B-2M12

5.5.5 Signal assignment

Table 5-28: Signal assignment with BL67-B-8M8

	Byte	Bit 7	Bit 6	Bit 5	Bit 4	Bit 3	Bit 2	Bit 1	Bit 0
In	n	C7P4	C6P4	C5P4	C4P4	C3P4	C2P4	C1P4	C0P4

Table 5-29: Signal assignment with BL67-B-4M12

	Byte	Bit 7	Bit 6	Bit 5	Bit 4	Bit 3	Bit 2	Bit 1	Bit 0
In	n	C3P2	C2P2	C1P2	C0P2	C3P4	C2P4	C1P4	C0P4
		Wire break1 to 4				Sensor signal 1 to 4			

Table 5-30: Signal assignment with BL67-B-4M12-P

	Byte	Bit 7	Bit 6	Bit 5	Bit 4	Bit 3	Bit 2	Bit 1	Bit 0
In	n	C3P2	C3P4	C2P2	C2P4	C1P2	C1P4	C0P2	C0P4

n = process data offset of the input data depending on station configuration and the corresponding fieldbus.

C… = slot no.

P… = pin no.

5.5.6 Sensor Supply

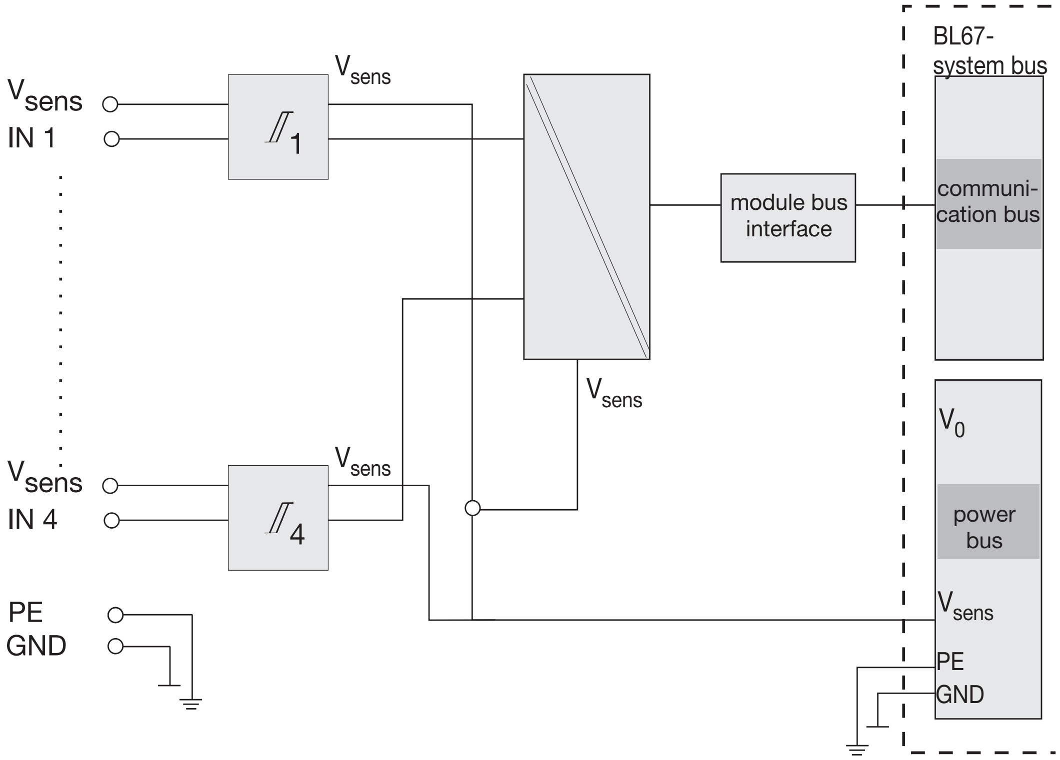
Table 5-31: Sensor Supply

V_{sens}	A	B	C	D
BL67-B-4M12	C0P1	C1P1	C2P1	C3P1
BL67-B-4M12-P	C0P1	C1P1	C2P1	C3P1
BL67-B-8M8	C0P1/ C1P1	C2P1/ C3P1	C4P1/ C5P1	C6P1/ C7P1

5.6 BL67-4DI-N

Figure 5-45: BL67-4DI-N

Figure 5-46: Block diagram



5.6.1 Technical data

Table 5-32: Technical data

Designation	BL67-4DI-N
Number of channels	4
Input voltage, nominal value at 24 V DC	
Low level	> 7 V (max. 30 V)
High level	< 5 V
Nominal current from 5 V DC (module bus) I_{MB}	≤ 30 mA
Nominal current from supply terminal I_L	≤ 1 mA (all inputs low)
Power loss of the module	< 1.3 W
Input current I_{in}	
Low level	< 2.5 mA
High level	> 3 mA
Isolation voltage	
U_{TMB} (module bus/ field)	max. 2500 V DC
U_{FE}	max. 1000 V DC

5.6.2 Diagnostic/ status messages

Diagnosis/ status via LEDs

Table 5-33: Diagnosis/ status via LEDs

LED	Display	Meaning	Remedy
D	Red	Module bus communication failure	Check if more than two ad-joining electronic modules have been pulled. This concerns modules located between this module and the gateway.
	Off	No error messages	–
0 to 3	Green	Status of channel x = „1“	–
	Off	Status of channel x = „0“	-

5.6.3 Modul Parameters

None

5.6.4 Base modules/ pin assignment

- BL67-B-4M8

Figure 5-47: BL67-B-4M8

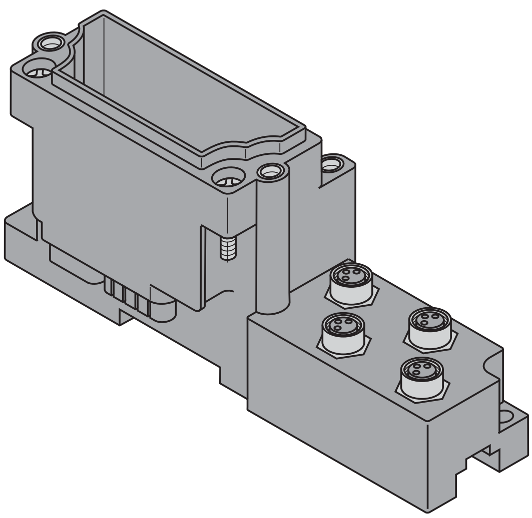


Figure 5-48: Pin assignment BL67-4DI-N with BL67-B-4M8

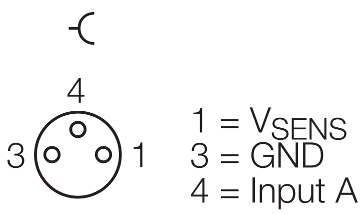
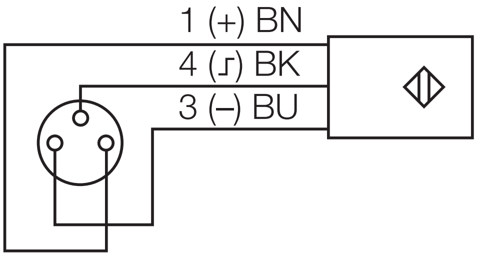


Figure 5-49: Wiring diagram BL67-4DI-N with BL67-B-4M8



- BL67-B-2M12/ BL67-B-2M12-P (paired)

Figure 5-50: BL67-B-2M12/ BL67-B-2M12-P

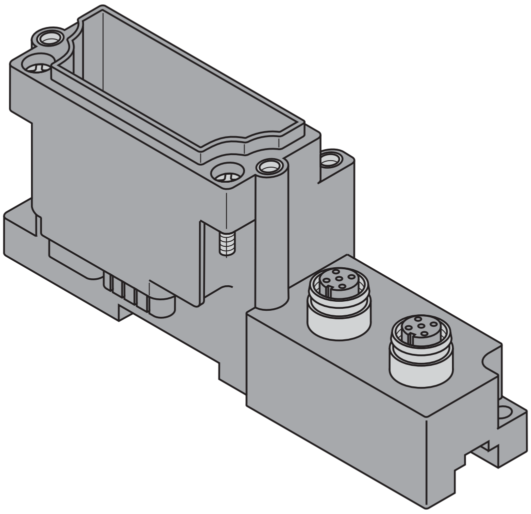


Figure 5-51: Pin assignment BL67-4DI-N with BL67-B-2M12/ BL67-B-2M12-P

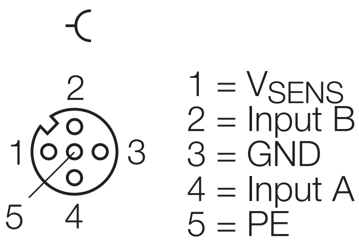
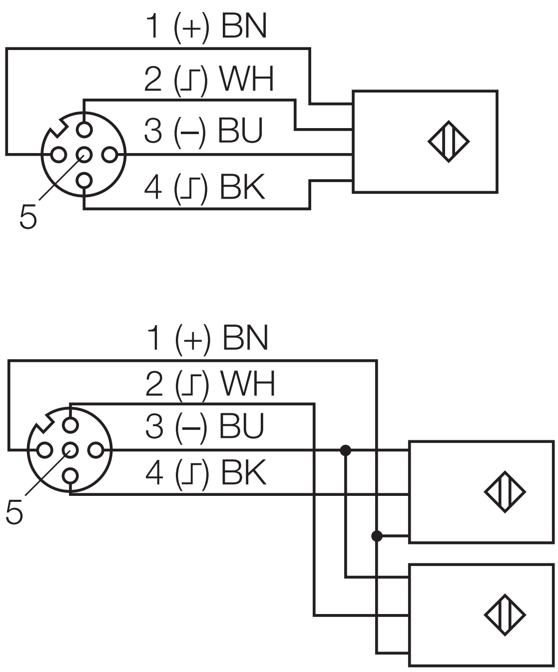


Figure 5-52: Wiring diagrams BL67-4DI-N with BL67-B-2M12/ BL67-B-2M12-P



- BL67-B-4M12

Figure 5-53: BL67-B-4M12

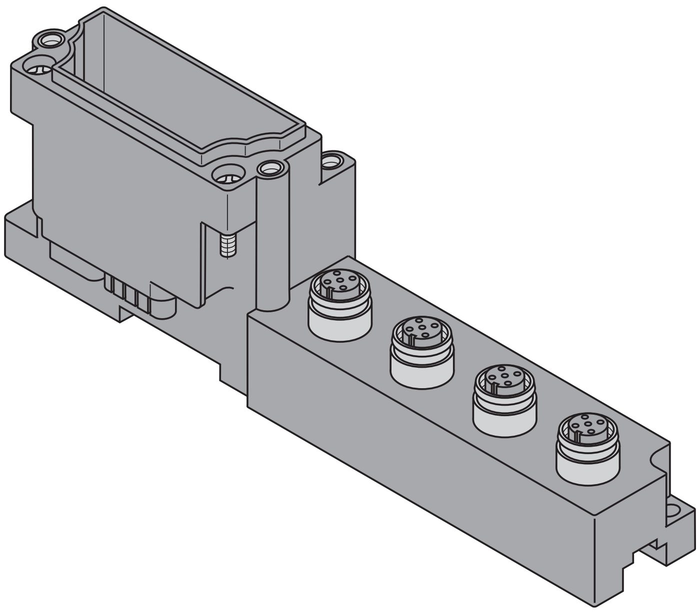
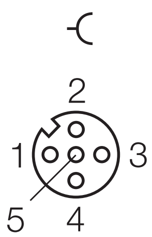
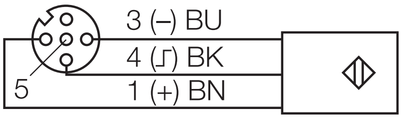


Figure 5-54: Pin assignment BL67-4DI-N with BL67-B-4M12



1 = V_{SENS}
2 = n.c.
3 = GND
4 = Input A
5 = PE

Figure 5-55: Wiring diagram BL67-4DI-N with BL67-B-4M12



- BL67-1M23

Figure 5-56: BL67-B-1M23

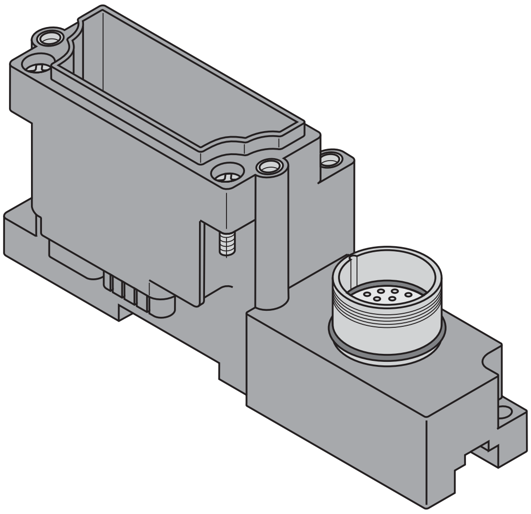
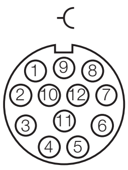


Figure 5-57: Pin assignment BL67-4DI-N with BL67-B-1M23



1 = Signal 0
2 = Signal 1
3 = Signal 2
4 = Signal 3
5 = n.c.
6 = n.c.
7 = n.c.
8 = n.c.
9 = V_{SENS}
10 = V_{SENS}
11 = V_{SENS}
12 = GND

5.6.5 Signal assignment

Table 5-34: Signal assignment with BL67-B-4M8

	Byte	Bit 7	Bit 6	Bit 5	Bit 4	Bit 3	Bit 2	Bit 1	Bit 0
In	n	-	-	-	-	C3P4	C2P4	C1P4	C0P4

Table 5-35: Signal assignment with BL67-B-2M12

	Byte	Bit 7	Bit 6	Bit 5	Bit 4	Bit 3	Bit 2	Bit 1	Bit 0
In	n	-	-	-	-	C1P2	C0P2	C1P4	C0P4

Table 5-36: Signal assignment with BL67-B-2M12-P

	Byte	Bit 7	Bit 6	Bit 5	Bit 4	Bit 3	Bit 2	Bit 1	Bit 0
In	n	-	-	-	-	C1P2	C1P4	C0P2	C0P4

Table 5-37: Signal assignment with BL67-B-4M12

	Byte	Bit 7	Bit 6	Bit 5	Bit 4	Bit 3	Bit 2	Bit 1	Bit 0
In	n	-	-	-	-	C3P4	C2P4	C1P4	C0P4

Table 5-38: Signal assignment with BL67-B-1M232 (-VI)

	Byte	Bit 7	Bit 6	Bit 5	Bit 4	Bit 3	Bit 2	Bit 1	Bit 0
In	n	-	-	-	-	C0P4	C0P3	C0P2	C0P1

n = process data offset of the input data depending on station configuration and the corresponding fieldbus.

C… = slot no.

P… = pin no.

5.7 BL67-8DI-N

Figure 5-58: BL67-8DI-N

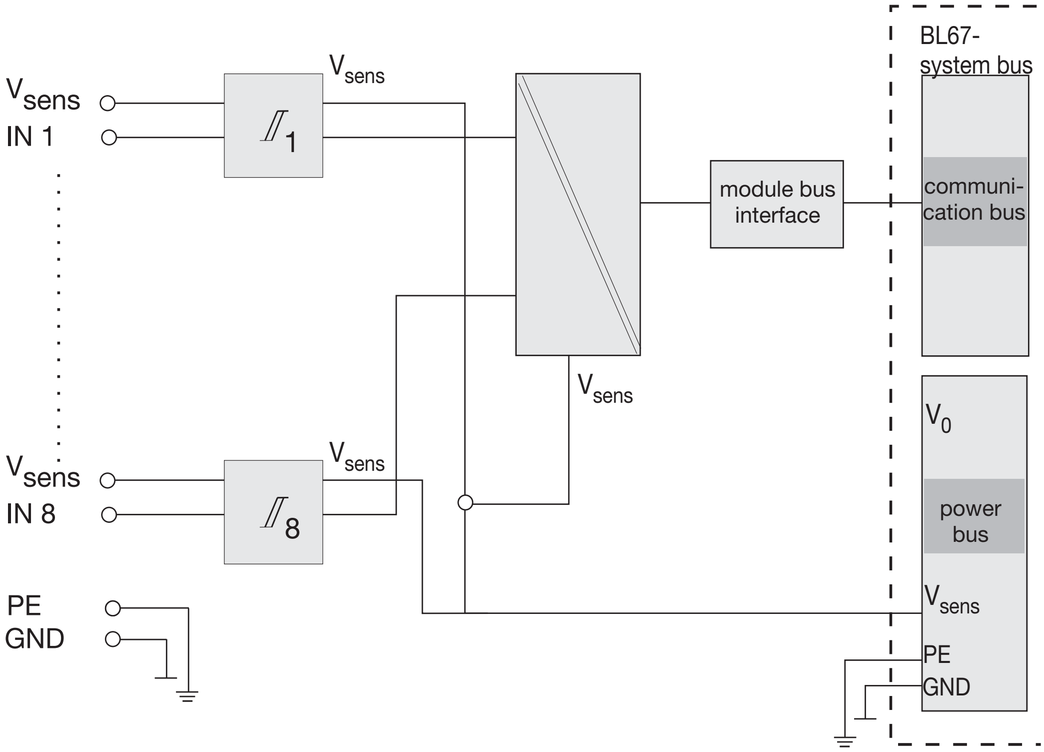


Figure 5-59: Block diagram

5.7.1 Technical data

Table 5-39: Technical data

Designation	BL67-8DI-N
Number of channels	8
Input voltage, nominal value at 24 V DC	
Low level	> 7 V (max. 30 V)
High level	< 5 V
Nominal current from 5 V DC (module bus) I_{MB}	≤ 30 mA
Nominal current from supply terminal I_L	≤ 1 mA (all inputs low)
Power loss of the module	< 1.3 W
Input current I_{in}	
Low level	< 1.2 mA
High level	> 1.5 mA
Isolation voltage	
U_{TMB} (module bus/ field)	max. 2500 V DC
U_{FE}	max. 1000 V DC

5.7.2 Diagnostic/ status messages

Diagnosis/ status via LEDs

Table 5-40: Diagnosis/ status via LEDs

LED	Display	Meaning	Remedy
D	Red	Module bus communication failure	Check if more than two ad-joining electronic modules have been pulled. This concerns modules located between this module and the gateway.
	Off	No error messages	–
0 to 7	Green	Status of channel x = „1“	–
	Off	Status of channel x = „0“	-

5.7.3 Module parameters

None

5.7.4 Base modules/ pin assignment

- BL67-B-8M8

Figure 5-60:
BL67-B-8M8

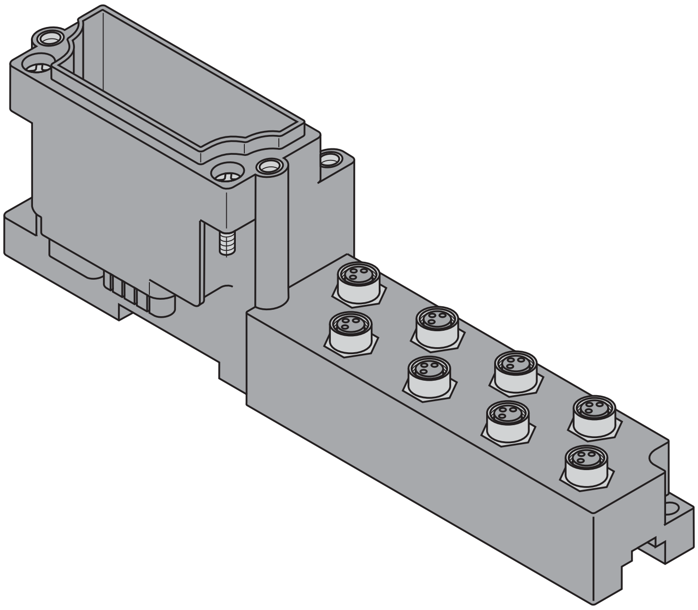


Figure 5-61:
Pin assignment BL67-8DI-N with BL67-B-8M8

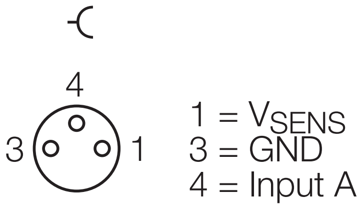
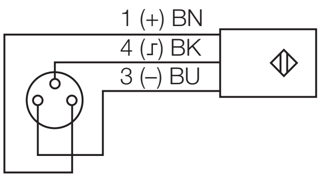


Figure 5-62:
Wiring diagram BL67-8DI-N with BL67-B-8M8



- BL67-B-4M12/ BL67-B-4M12-P (paired)

Figure 5-63: BL67-B-4M12/ BL67-B-4M12-P

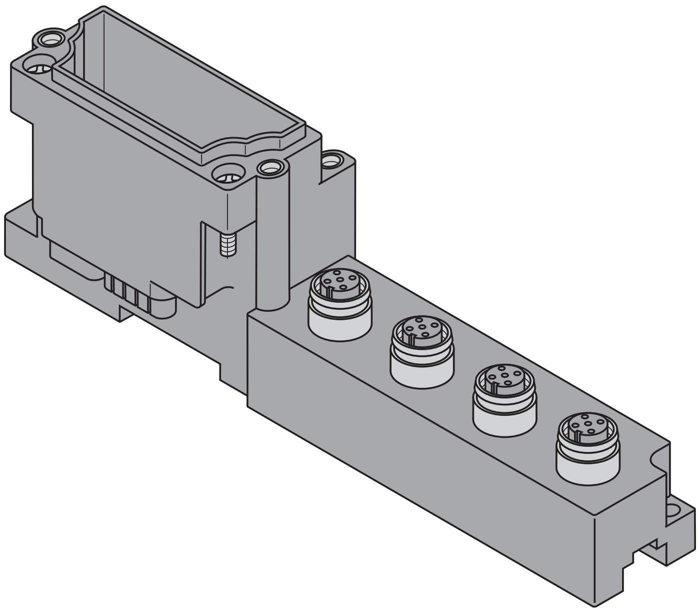


Figure 5-64: Pin assignment BL67-8DI-N with BL67-B-4M12/ BL67-B-4M12-P

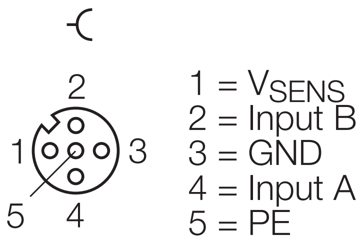
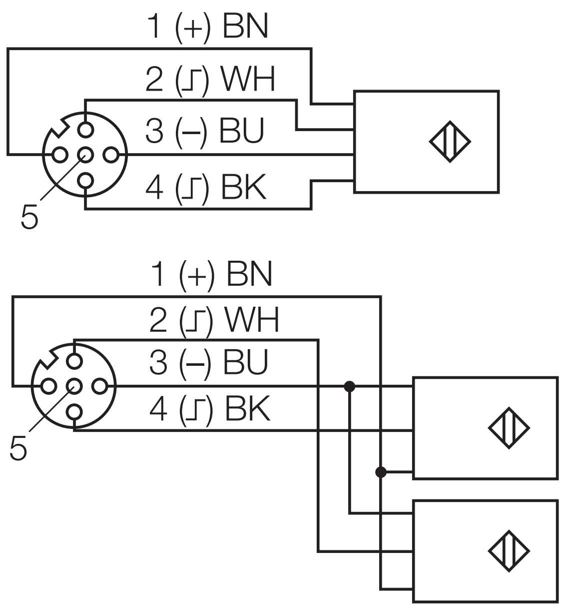


Figure 5-65: Wiring diagrams BL67-8DI-N with BL67-B-4M12/ BL67-B-4M12-P



- BL67-1M23

Figure 5-66: BL67-B-1M23

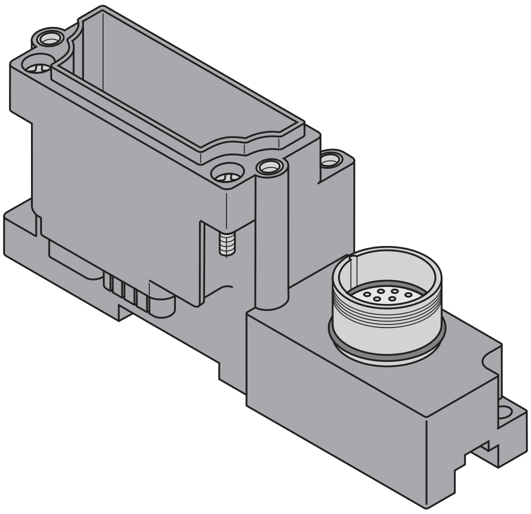
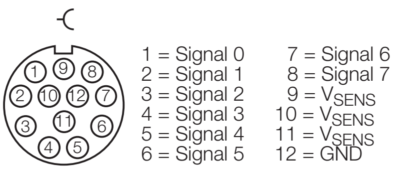


Figure 5-67: Pin assignment BL67-8DI-N with BL67-B-1M23



5.7.5 Signal assignment

Table 5-41: Signal assignment with BL67-B-8M8

	Byte	Bit 7	Bit 6	Bit 5	Bit 4	Bit 3	Bit 2	Bit 1	Bit 0
In	n	C7P4	C6P4	C5P4	C4P4	C3P4	C2P4	C1P4	C0P4

Table 5-42: Signal assignment with BL67-B-4M12

	Byte	Bit 7	Bit 6	Bit 5	Bit 4	Bit 3	Bit 2	Bit 1	Bit 0
In	n	C3P2	C2P2	C1P2	C0P2	C3P4	C2P4	C1P4	C0P4

Table 5-43: Signal assignment with BL67-B-4M12-P

	Byte	Bit 7	Bit 6	Bit 5	Bit 4	Bit 3	Bit 2	Bit 1	Bit 0
In	n	C3P2	C3P4	C2P2	C2P4	C1P2	C1P4	C0P2	C0P4

Table 5-44: Signal assignment with BL67-B-1M23(-VI)

	Byte	Bit 7	Bit 6	Bit 5	Bit 4	Bit 3	Bit 2	Bit 1	Bit 0
In	n	C0P8	C0P7	C0P6	C0P5	C0P4	C0P3	C0P2	C0P1

n = process data offset of the input data depending on station configuration and the corresponding fieldbus.

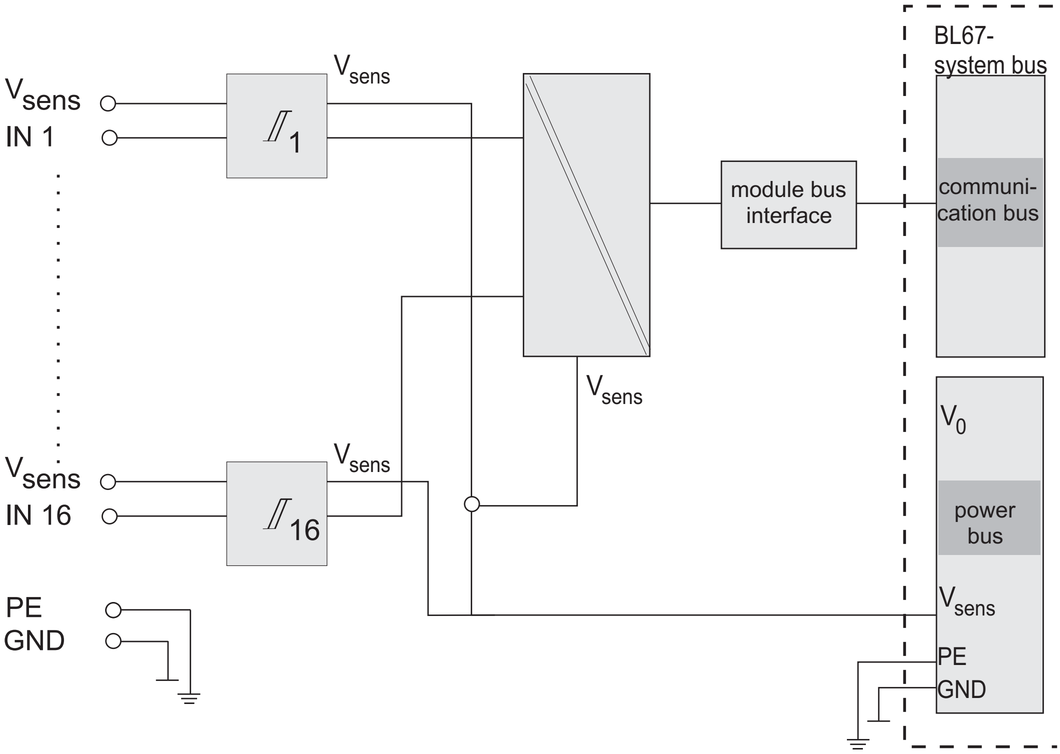
C… = slot no.

P… = pin no.

5.8 BL67-16DI-P

Figure 5-68: BL67-16DI-P

Figure 5-69: Block diagram



5.8.1 Technical data

Table 5-45: Technical data

Designation	BL67-16DI-P
Number of channels	16
Input voltage, nominal value at 24 V DC	
Low level	< 4,5 V
High level	> 7 V (max. 30 V)
Nominal current from 5 V DC (module bus) I_{MB}	≤ 30 mA
Nominal current from supply terminal I_L	≤ 3 mA, all inputs low
mMx. sensor supply I_{sens}	4 A, via gateway or Power-Feeding module, electronically short circuit limited
Power loss of the module	< 100 mW
Input current I_{in}	
Low level	< 0.5 mA
High level	2,1 to 3,7 mA
Isolation voltage	
U (module bus/ field)	max. 500 V DC

5.8.2 Diagnostic/ status messages

Diagnosis/ status via LEDs

Table 5-46: Diagnosis/ status via LEDs

LED	Display	Meaning	Remedy
D	Red	Module bus communication failure	Check if more than two adjoining electronic modules have been pulled. This concerns modules located between this module and the gateway.
	Off	No error messages	–
0 to 7	Green	Status of channel 0 to 7 = 1	–
	Orange	Status of channel 8 to 15 = 1	
	Off	Status of channel x = 0	-

5.8.3 Module parameters

None

5.8.4 Base modules/ pin assignment

- BL67-B-8M8-4-P

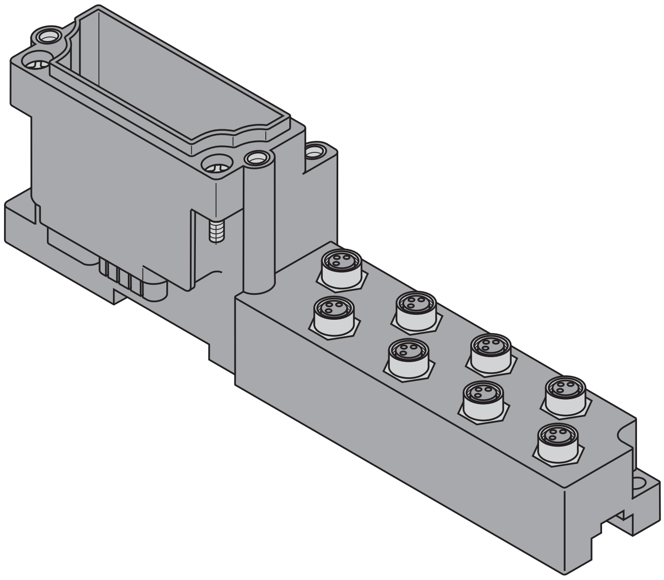


Figure 5-70: BL67-B-8M8-4-P

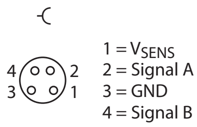


Figure 5-71: Pin assignment BL67-8DI-P with BL67-B-8M8-4-P

- BL67-1M23

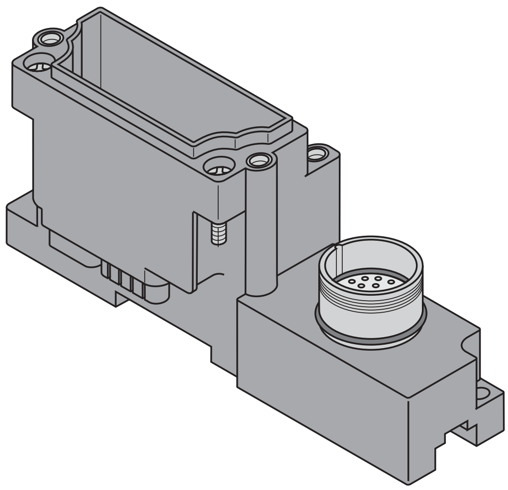


Figure 5-72: BL67-B-1M23-19

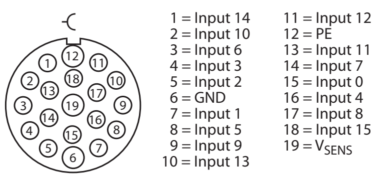


Figure 5-73: Pin assignment BL67-16DI-P with BL67-B-1M23-19

5.8.5 Signal assignment

Table 5-47: Signal assignment with BL67-B-8M8-4-P

	Byte	Bit 7	Bit 6	Bit 5	Bit 4	Bit 3	Bit 2	Bit 1	Bit 0
In	n	C3P2	C3P4	C2P2	C2P4	C1P2	C1P4	C0P2	C0P4
	Byte	**Bit 15**	**Bit 14**	**Bit 13**	**Bit 12**	**Bit 11**	**Bit 10**	**Bit 9**	**Bit 8**
	n	C7P2	C7P4	C6P2	C6P4	C5P2	C5P4	C4P2	C4P4

Table 5-48: Signal assignment with BL67-B-1M23-19

	Byte	Bit 7	Bit 6	Bit 5	Bit 4	Bit 3	Bit 2	Bit 1	Bit 0
In	n	C0P14	C0P3	C0P8	C0P16	C0P4	C0P5	C0P7	C0P15
	Byte	**Bit 15**	**Bit 14**	**Bit 13**	**Bit 12**	**Bit 11**	**Bit 10**	**Bit 9**	**Bit 8**
	n	C0P18	C0P1	C0P10	C0P11	C0P13	C0P2	C0P9	C0P17

n = process data offset of the input data depending on station configuration and the corresponding fieldbus.

C… = slot no.

P… = pin no.

6 Analog Input Modules

6.1 Overview

Analog input modules (AI) detect standard electrical signals, digitalize them and transmit the corresponding measurement values to the gateway via the internal module bus.

The sensor supply (VI) is tapped from the internal voltage supply bus.

This voltage is supplied by the gateway or a Power Feeding module. Both contain a short circuit detection for the sensor supply voltage.

A sensor short circuit is thus also detected in the gateway or in the Power Feeding module.

The module bus electronic of the analog input modules are galvanically isolated from the field level via an optocoupler and provide reverse polarity protection.

Supported signal ranges

- BL67-2AI-I:
  0 to 20 mA
  4 to 20 mA
- BL67-2AI-V:
  0 to 10 V DC
  -10 to 10 V DC

Connectable sensors

- BL67-2AI-PT
  platinum sensors (PT100, PT200, PT500, PT1000)
  nickel sensor (Ni100, Ni1000)
- BL67-2AI-TC
  thermo elements (of types B, E, J, K, N, R, S, T)

LED status indicators

Error signals from the I/O level are indicated by each module via the “D” LED. The corresponding diagnostic information is transmitted to the gateway via diagnostic bits.

6.1.1 Analog value representation

The analog values can either be represented with16 bit or 12 bit. The two's-complement representation allows the representation of positive as well as negative values.

16-bit-representation

The 16-bit-representation is realizes as a two's-complement. 2 byte of process data are completely occupied.:

Figure 6-1: 16 bit representation

analog value	16 bit representation															
byte	byte 1								byte 0							
bit	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
meaning	±	measurement value														

12 bit representation

In the voltage measurement/ output and in the temperature measurement, the value is represented as a two's-complement. In the current measurement/ output and in the resistance measurement, the value is represented as a dual number. The 12 bit value is **left-justified** and occupies bit 15 to 4 of the process data.

Figure 6-2: 12 bit representation

analog value	12 bit representation															
byte	byte 1								byte 0							
bit	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
meaning	measurement value (without sign)												diagnostic data			

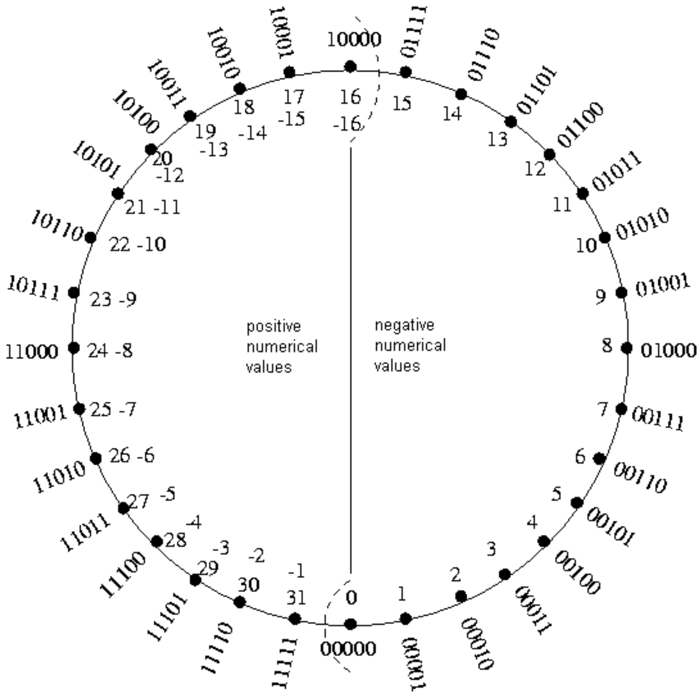
The diagnosis information is integrated in the process input data and occupies 4 bit (right-justified).

Note

A detailed description of the measurement value representation for the analog input modules in 16 or 12 bit can be found in the "appendix" of this manual, page 15-1.

The figure shows a 5-digit binary code in the outer circuit. The inner circuit shows the respective dual number, if the binary code is interpreted as binary number (positive numerical values) and as two's complement.

Figure 6-3: Binary code as binary number and two's complement



6.1.2 Module overview

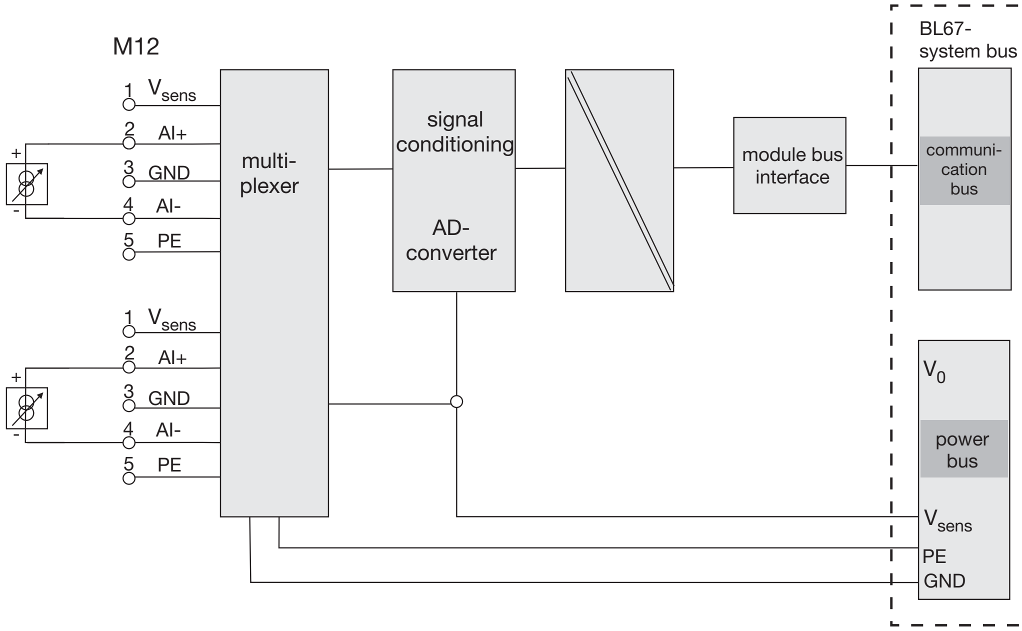
Table 6-1: Module overview

Module	Number of channels
BL67-2AI-I	2
BL67-2AI-V	2
BL67-2AI-PT	2
BL67-2AI-TC	2
BL67-4AI-V/I	4
BL67-4AI-TC	4

6.2 BL67-2AI-I, 0/4...20 mA

Figure 6-4: BL67-2AI-I

Table 6-2: Block diagram



6.2.1 Technical data

Table 6-3: Technical data

Designation	BL67-2AI-I
Number of channels	2
Nominal voltage from supply terminal	24 V DC
voltage range	18 to 30 VDC
Nominal current from 5 V DC (module bus) I_{MB}	≤ 35 mA
Nominal current from supply terminal I_L	≤ 12 mA
Power loss of the module, typical P_{MAX}	< 1 W
Input current	0/4 to 20 mA
Max. input current	50 mA
Isolation voltage	
U_{TMB} (module bus/ field)	min. 500 V_{rms}
U_{Fe} (field/ functional earth)	min. 50 V_{AC}
channel/channel	no
channel/field supply	no
channel/system supply	500 V_{rms}
Input resistance (burden)	< 125 Ω
Cutoff frequency (-3 dB)	≥ 50 Hz
Basic error at 23 °C/ 73.4 °F	0.2 %
Repeat accurancy	0.05 %
Temperature coefficient	≤ 300 ppm/°C
Resolution of the A/D converter	16 Bit
Measuring principle	Delta Sigma
Measurement value representation	16 Bit Signed Integer / 2 Bit Full Range left-justified
I_{SENS} (sensor supply from Vi)	≤ 250 mA; short-circuit protection in gateway or Power Feeding module

6.2.2 Diagnostic/ status messages

Diagnosis/ status via LEDs

Table 6-4: Diagnosis via LED

LED	Display	Meaning	Remedy
D	Red, flashing, 0.5 Hz	Diagnostics pending	-
	Red	Module bus communication failure	Check if more than two ad-joining electronic modules have been pulled. This applies to modules located between this module and the gateway.
	Off	No error messages or diagnostics	–

Diagnosis via software

This module has the following diagnostic data available per channel:

Table 6-5: Diagnosis

Diagnosis	
Measurement value range error	Indicates an over- or undercurrent of 1 % of the set current range; „Undercurrent“ is only detected when the current range is set from 4 to 20 mA.
– Overcurrent: I_{max} (I > 20.2 mA)	
– Undercurrent: I_{min} (I < 3.8 mA)	
Open circuit (I < 3 mA)	Indicates an open circuit in the signal line for the operating mode 4 to 20 mA

Note
If the measurement value representation is parameterized as „12bit (left-justified)“ the diagnostic data will be transferred with the process data bits 0 to 3 of the respective channel.

6.2.3 Module parameters (per channel)

Table 6-6: Module parameters

Adefault settings

Parameter name	Value
Value representation	integer (15bit + sign)**A**
	12bit (left-justified)
Current mode	0…20mA **A**
	4…20mA
Channel	activate**A**
	deactivate
Diagnostic	release **A)**
	block

6.2.4 Base modules/ pin assignment

- BL67-B-2M12

Figure 6-5: BL67-B-2M12

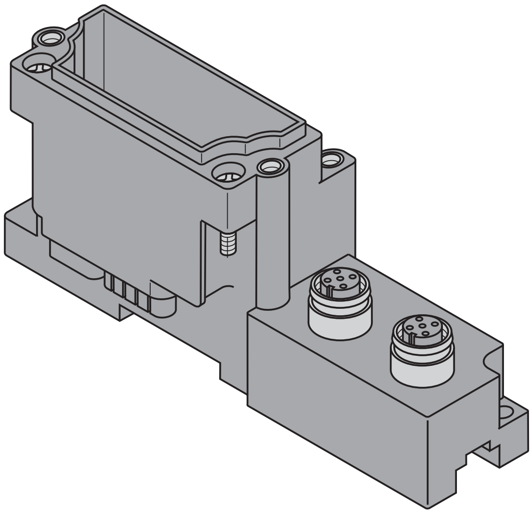


Figure 6-6: Pin assignment BL67-2AI-I

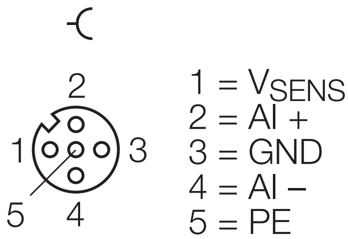
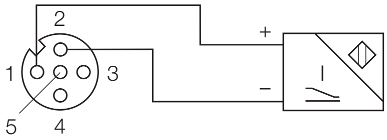
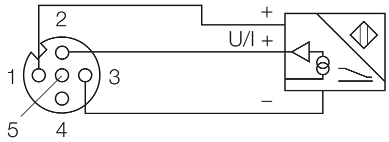


Figure 6-7: Wiring diagrams BL67-2AI-I

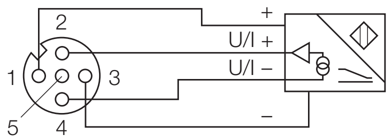
2-wire sensor with power supply via base module:



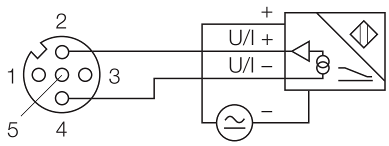
3-wire sensor with power supply via base module:



4-wire sensor with power supply via base module:



4-wire sensor with external power supply:



6.2.5 Measurement value representation

16 bit value representation

- Current values from 0 to 20 mA

  The value range
  0 mA to 20 mA
  is displayed as follows:
  0000_{hex} to $7FFF_{hex}$ (decimal: 0 to 32767)

- Current values from 4 to 20 mA

  The value range
  4 mA to 20 mA
  is displayed as follows:
  0000_{hex} to $7FFF_{hex}$ (decimal: 0 to 32767)

12 bit value representation (left-justified)

- Current values from 0 to 20 mA

  The value range
  0 mA to 20 mA
  is displayed as follows:
  000(0)$_{hex}$ **to FFF(0)**$_{hex}$ (decimal: 0 to 4095)

- Current values from 4 to 20 mA

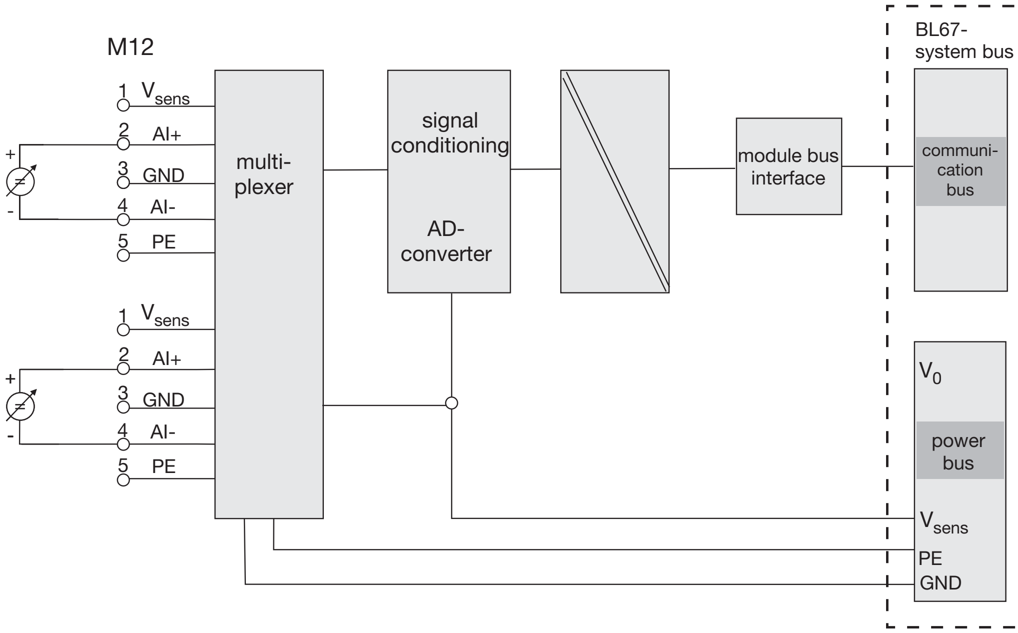
  The value range
  4 mA to 20 mA
  is displayed as follows:
  000(0)$_{hex}$ **to FFF(0)**$_{hex}$ (decimal: 0 to 4095)

Note
A detailed description of the measurement value representation for the analog input modules in 16 or 12 bit can be found in the "appendix" of this manual, page 15-1.

6.3 BL67-2AI-V, -10/0...+10 V DC

Figure 6-8: BL67-2AI-V

Figure 6-9: Block diagram



6.3.1 Technical data

Table 6-7: Technical data

Designation	BL67-2AI-V
Number of channels	2
Nominal voltage from supply terminal	24 V DC
voltage range	18 to 30 VD
Nominal current from 5 V DC (module bus) I_{MB}	≤ 35 mA
Nominal current from supply terminal I_L	≤ 12 mA
Power loss of the module, typical P_{MAX}	< 1 W
Input voltage	-10/0 to 10 VDC
Max. input voltage	35 V continuous
Isolation voltage	
U_{TMB} (module bus/ field)	min. 500 V_{rms}
U_{Fe} (field/ functional earth)	min. 50 V_{AC}
channel/channel	no
channel/field supply	no
channel/system supply	500 V_{rms}
Input resistance (burden)	≥ 98.5 kΩ
Cutoff frequency (-3 dB)	≥ 50 Hz
Basic error at 23 °C/ 73.4 °F	0.2 %
Repeat accurancy	0.05 %
Temperature coefficient	≤ 150 ppm/°C
Resolution of the A/D converter	16 Bit
Measuring principle	Delta Sigma
Measurement value representation	16 Bit Signed Integer / 12 Bit Full Range left-justified
I_{SENS} (sensor supply from V_I)	≤ 250 mA; short circuit protection in gateway or Power Feeding module

6.3.2 Diagnostic/ status messages

Diagnosis/ status via LEDs

Table 6-8: Diagnosis via LED

LED	Display	Meaning	Remedy
D	Red, flashing, 0.5 Hz	Diagnostics pending	-
	Red	Module bus communication failure	Check if more than two ad-joining electronic modules have been pulled. This applies to modules located between this module and the gateway.
	Off	No error messages or diagnostics	–

Diagnosis via software

This module has the following diagnostic data available per channel:

Table 6-9: Diagnosis

Diagnosis	
Measurement value range error	Indicates an over- or undervoltage of 1 % of the set voltage range;
Overvoltage: – U_{max} (U > 10.1 V)	
Undervoltage: – U_{min} (U < -10.1 V) at -10 to +10 V DC – U_{min} (U < -0.1 V) at 0 to +10 V DC	

Note

If the measurement value representation is parameterized as „12bit (left-justified)" the diagnostic data will be transferred with the process data bits 0 to 3 of the respective channel.

6.3.3 Module parameters (per channel)

Table 6-10: Module parameters

***A**default settings*

Parameter name	Value
Value representation	integer (15bit + sign)**A**
	12bit (left-justified)
Voltage mode	-10…+10V
	0…10V **A**
Channel	activate**A**
	deactivate
Diagnostic	release **A**
	block

6.3.4 Base modules/ pin assignment

- BL67-B-2M12

Figure 6-10: BL67-B-2M12

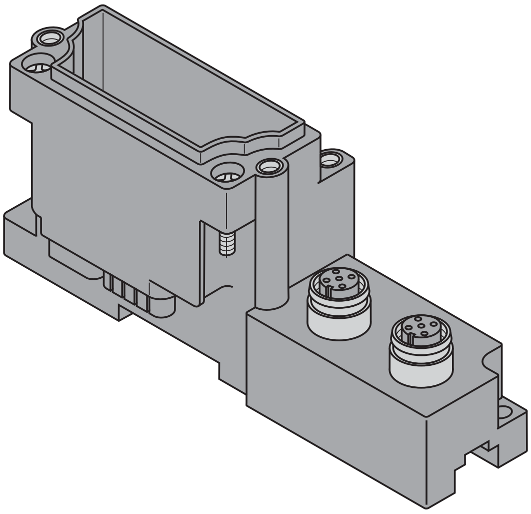


Figure 6-11: Pin assignment BL67-2AI-V

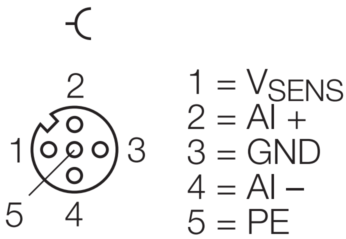
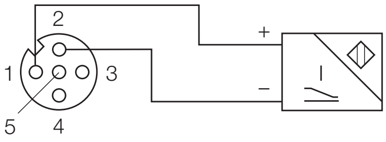
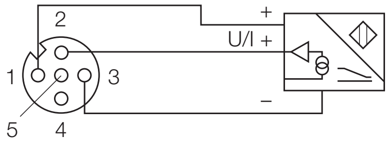


Figure 6-12: Wiring diagrams BL67-2AI-V

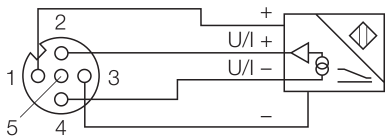
2-wire sensor with power supply via base module:



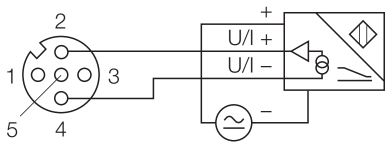
3-wire sensor with power supply via base module:



4-wire sensor with power supply via base module:



4-wire sensor with external power supply:



6.3.5 Measurement value representation

16-bit-representation

- Voltage values from 0 to 10 V DC

  The value range
  0 V DC to 10 V DC
  is displayed as follows:
  0000_{hex} to $7FFF_{hex}$ (decimal: 0 to 32767)

- Voltage values from -10 to 10 V DC

  The value range
  -10 V to -3.052 10^{-4} V
  is displayed as follows:
  8000_{hex} to $FFFF_{hex}$ (decimal:-32768 to -1)

  The value range
  0 V to 10 V
  is displayed as follows:
  0000_{hex} to $7FFF_{hex}$ (decimal: 0 to 32767)

12 bit representation (left-justified)

- Voltage values from 0 to 10 V DC

  The value range
  0 V to 10 V
  is displayed as follows:
  000(0)$_{hex}$ to FFF(0)$_{hex}$ (decimal: 0 to 4095)

- Voltage values from -10 to 10 V DC

  The value range
  0 V to 10 V
  is displayed as follows:
  000(0)$_{hex}$ to **7FF(0)**$_{hex}$ (decimal: 0 to 2047)

Note
A detailed description of the measurement value representation for the analog input modules in 16 or 12 bit can be found in the "appendix" of this manual, page 15-1.

6.4 BL67-2AI-PT, Pt-/Ni-sensors

Figure 6-13: BL67-2AI-PT

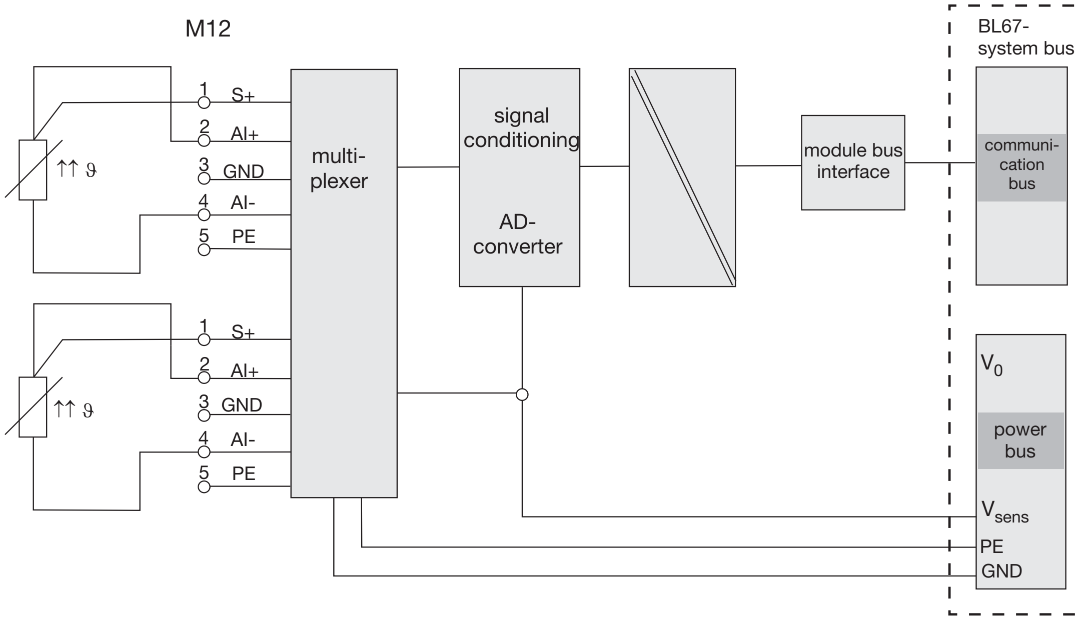


Figure 6-14: Block diagram

6.4.1 Technical data

Table 6-11: Technical data

Designation	BL67-2AI-PT
Number of channels	2
Nominal voltage from supply terminal	24 V DC
voltage range	18 to 30 VDC
Nominal current from 5 V DC (module bus) I_{MB}	≤ 45 mA
Nominal current from supply terminal I_L	< 30 mA
Power loss of the module, typical P_{MAX}	< 1 W
Measurement current	< 1 mA
Max. input voltage U_{MAX} (Destruction limit)	> 30 VDC
Isolation voltage	
U_{TMB} (module bus/ field)	min. 500 V_{rms}
U_{Fe} (field/ functional earth)	min. 50 V_{AC}
channel/channel	no
channel/field supply	no
channel/system supply	500 V_{rms}
Measurement value representation	16 Bit signed integer / 12 Bit full range left-justified
Offset error	≤ 0.1 %
Linearity	< 0.1 %
Basic error at 23 °C / 73.4 °F	< 0.2 % from end value
Repeat accuracy	0.05 %
Temperature coefficient	≤ 300 ppm/°C from end value
t_{CYCL} (Cycle time)	≤ 130 ms per channel
Connectable sensors	
Platinum sensors	PT100, PT200, PT500, PT1000
Nickel sensors	Ni100, Ni1000

6.4.2 Diagnostic/ status messages

Diagnosis/ status via LEDs

Table 6-12: Diagnosis via LED

LED	Display	Meaning	Remedy
D	Red, flashing, 0.5 Hz	Diagnostics pending	-
	Red	Module bus communication failure	Check if more than two ad-joining electronic modules have been pulled. This applies to modules located between this module and the gateway.
	Off	No error messages or diagnostics	–

Diagnosis via software

This module has the following diagnostic data available per channel:

Table 6-13: Diagnosis

Diagnosis	Meaning
Overflow/ Underflow	Threshold: 1 % of positive measurement range end value. Underflow diagnostic only in the temperature measurement range.
Open circuit	
Short-circuit	Threshold: 5 Ω (loop resistance) Only with temperature measurements.

Note
3-wire measurements with PT100 sensors cannot differentiate between a short-circuit and an open circuit at temperatures below -177 °C. In this case, the diagnostic “Short-circuit“ is generated.

6.4.3 Module parameters (per channel)

Table 6-14: Module parameters

***A**default settings*

Parameter name	Value
Mains suppression	50 Hz **A**
	60 Hz
Value representation	Integer (15Bit + sign)**A**
	12 Bit (left-justified)
Diagnostic	release **A**
	block
Channel	activate **A**
	deactivate
Element	PT100, -200…850°C **A** PT100, -200…150°C NI100, -60…250°C NI100, -60…150°C PT200, -200…850°C PT200, -200…150°C PT500, -200…850°C PT500, -200…150°C PT1000, -200…850°C PT1000, -200…150°C NI1000, -60…250°C NI1000, -60…150°C Resistance, 0…100Ω Resistance, 0…200Ω Resistance, 0…400Ω Resistance, 0…1000Ω
Measurement mode	2-wire **A**
	3-wire

6.4.4 Base modules/ pin assignment

- BL67-B-2M12

Abbildung 7: BL67-B-2M12

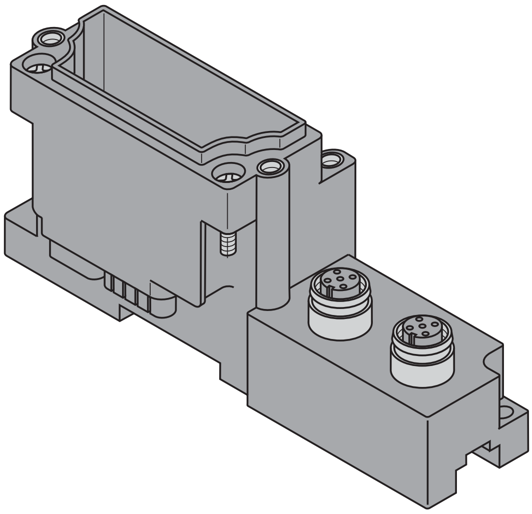


Table 6-15: Pinbelegung BL67-2AI-PT

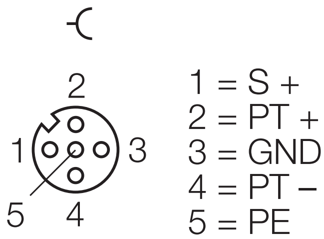
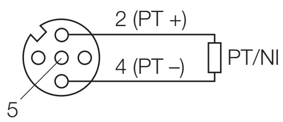
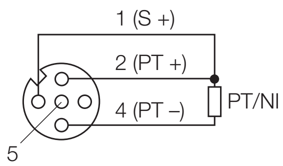


Table 6-16: Anschlussbilder BL67-2AI-PT

2-wire-connection technology:



3-wire-connection technology:



6.4.5 Measurement value representation

16-bit-representation

- For the parameterization
  "PT100, -200…850°C"
  "NI100, -60…250°C"
  "PT200, -200…850°C"
  "PT500, -200…850°C"
  "PT1000, -200…850°C"
  "NI1000, -60…250°C"

  The value range
  -200 °C to -0.1°C
  is displayed as follows:
  F830$_{hex}$ **to FFFF**$_{hex}$ (decimal: -2000 to -1)

  The value range
  0 °C to 850°C
  is displayed as follows:
  0000$_{hex}$ **to 2134**$_{hex}$ (decimal: 0 to 8500)
- For the parameterization
  "PT100, -200…150°C"
  "NI100, -60…150°C"
  "PT200, -200…150°C"
  "PT500, -200…150°C"
  "PT1000, -200…150°C"
  "NI1000, -60…150°C"

  The value range
  -200 °C to -0,01°C
  is displayed as follows:
  B1E0$_{hex}$ **to FFFF**$_{hex}$ (decimal: -20000 to -1)

  The value range
  0 °C to 150°C
  is displayed as follows:
  0000$_{hex}$ **to 3A98**$_{hex}$ (decimal: 0 to 15000)
- For representation of resistance values only positive numbers (hexadecimal/binary) are used. The positive values can easily be converted into decimal ones.

  The value range
  0 to 100 Ω; 0 to 200 Ω; 0 to 400 Ω; 0 to 1000 Ω
  is displayed as follows:
  0000$_{hex}$ **to 7FFF**$_{hex}$ (decimal: 0 to 32767)

12 bit representation (left-justified)

- For the parameterization:
  "PT100, -200…850°C"
  "NI100, -60…250°C"
  "PT200, -200…850°C"
  "PT500, -200…850°C"
  "PT1000, -200…850°C"
  "NI1000, -60…250°C

  The value range
  -200 °C to -0.5°C
  is displayed as follows:
  E70(0)$_{hex}$ **to FF(0)F**$_{hex}$ (decimal: -400 to -1)

  The value range
  0 °C to 850°C
  is displayed as follows:
  00(0)0$_{hex}$ **to 6A4(0)**$_{hex}$ (decimal: 0 to 1700)

- For the parameterization:
  "PT100, -200…150°C"
  "NI100, -60…150°C"
  "PT200, -200…150°C"
  "PT500, -200…150°C"
  "PT1000, -200…150°C"
  "NI1000, -60…150°C"

  The value range
  -200 °C to -0.1°C
  is displayed as follows:
  830(0)$_{hex}$ **to FFF(0)**$_{hex}$ (decimal: -2000 to -1)

  The value range
  0 °C to 150°C
  is displayed as follows:
  000(0)$_{hex}$ **to 5DC(0)**$_{hex}$ (decimal: 0 to 1500)

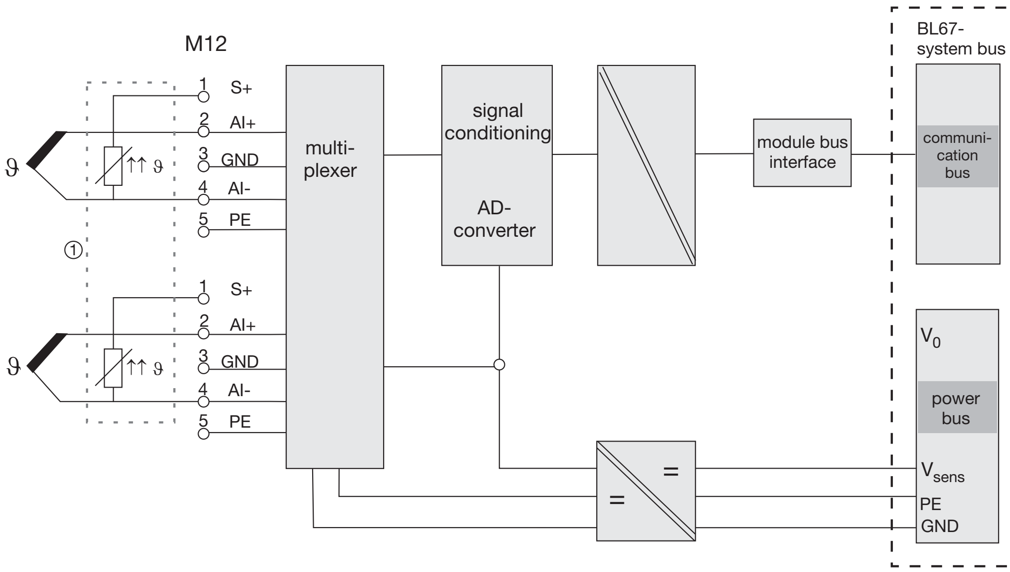
  The value range
  0 Ω to 100 Ω;
  0 Ω to 200 Ω;
  0 Ω to 400 Ω;
  0 Ω to 1000 ΩW;
  is displayed as follows:
  000(0)$_{hex}$ **to FFF(0)**$_{hex}$ (decimal: 0 to 4095)

Note
A detailed description of the measurement value representation for the analog input modules in 16 or 12 bit can be found in the "appendix" of this manual, page 15-1.

6.5 BL67-2AI-TC, thermocouple

Figure 6-1: BL67-2AI-TC

Figure 6-2: Block diagram



① cold junction compensation resistance (Pt1000) in male connector

6.5.1 Technical data

Table 6-17: Technical data

Designation	BL67-2AI-TC
Number of channels	2
Nominal voltage from supply terminal	24 V DC
voltage range	18 to 30 VDC
Nominal current from 5 V DC (module bus) I_{MB}	≤ 35 mA
Nominal current from supply terminal I_L	< 30 mA
Power loss of the module, typical P_{MAX}	< 1 W
Input voltage	≥ 10 VDC (continuous)
Isolation voltage	
U_{TMB} (module bus/ field)	min. 500 V_{rms}
U_{Fe} (field/ functional earth)	min. 50 V_{AC}
channel/channel	no
channel/field supply	500 V_{rms}
channel/system supply	500 V_{rms}
Sensors	according to DIN IEC 584 Class 1. 2, 3
Temperature ranges	
Type B Type E Type J Type K Type N Type R Type S Type T	100 to 1820.0 °C -270 to 1000.0 °C -210 to 1200.0 °C -270 to 1370.0 °C -270 to 1300.0 °C -50 to 1760.0 °C -50 to 1540.0 °C -270 to 400.0 °C
Voltage measurements (resolution)	
± 50 mV ± 100 mV ± 500 mV ± 1 V	< 2 µV < 4 µV < 20 µV < 50 µV
Measurement value representation	16 Bit signed integer / 12 Bit full range left-justified
Basic error at 23 °C / 73.4 °F	Please refer to Table 6-18 below

Crosstalk suppression	≥ 80 dB
Repeat accuracy	Please refer to Table 6-19: below
Temperature coefficient T_K	≤ 300 ppm/°C from end value
Cycle time	Voltage measurement: – 70 ms/ channel Temperature measurement: – 130 ms/ channel

Table 6-18: Basic errors

Thermocouple	Temperature range/ °C	Basic error at 23°C /% of positive end value
Type K	-200…1370	0.2
Type J	-210…1200	0.2
Type B	500…1820	0.2
Type N	-150…1300	0.2
Type E	-180…1000	0.2
Type R	0…1760	0.2
Type S	0…1540	0.2
Type T	-200…0 0…400	0.6 0.2
Voltage measurement	all measurement ranges	0.2

Table 6-19: Repeat accuracies

Thermocouple	Repeat accuracy/ % of positive end value	Error due to cold junction compensation/ % of positive end value
Type K	0.05	0.15
Type J	0.05	0.17
Type B	0.05	0.11
Type N	0.05	0.16
Type E	0.05	0.20
Type R	0.05	0.12
Type S	0.05	0.13
Type T	0.1 0.075	– 0.50
Voltage measurement	0.05	–

Note
In the lower measurement range, wider deviations for the cold junction compensation have to be expected.

6.5.2 Diagnostic/ status messages

Diagnosis/ status via LEDs

Table 6-20: Diagnosis via LED

LED	Display	Meaning	Remedy
D	Red, flashing, 0.5 Hz	Diagnostics pending	-
	Red	Module bus communication failure	Check if more than two ad-joining electronic modules have been pulled. This applies to modules located between this module and the gateway.
	Off	No error messages or diagnostics	–

Diagnosis via software

This module has the following diagnostic data available per channel:

Table 6-21: Diagnosis

Diagnosis	
Measurement value range error – Overflow – Underflow	Threshold: 1 % of positive measurement range end value
Open circuit Threshold: negative transformer end value	Only with temperature measurements.
No PT1000 sensor (cold junction compensation)	A cold junction temperature of 23°C is automatically presumed.

6.5.3 Module parameters (per channel)

Table 6-22: Module parameters

A default settings

Parameter name	Value
Mains suppression	50 Hz **A**
	60 Hz
Value representation	Integer (15Bit + sign) **A**
	12Bit (left-justified)
Diagnostic	release **A**
	block
Channel	activate**A**
	deactivate
Element	type K, -270…1370°C **A** type B, +100…1820°C type E, -270…1000°C type J, -210…1200°C type N, -270…1300°C type R, -50…1760°C type S, -50…1540°C type T, -270…400°C +/-50mV +/-100mV +/-500mV +/-1000mV

6.5.4 Base modules/ pin assignment

- BL67-B-2M12

Figure 6-3: BL67-B-2M12

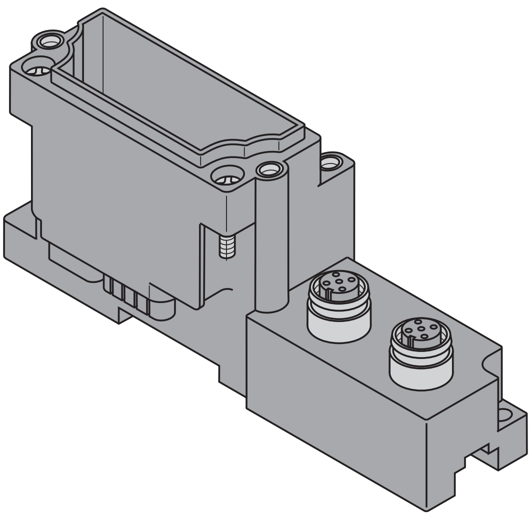
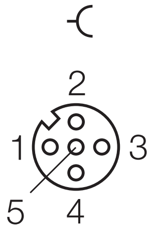


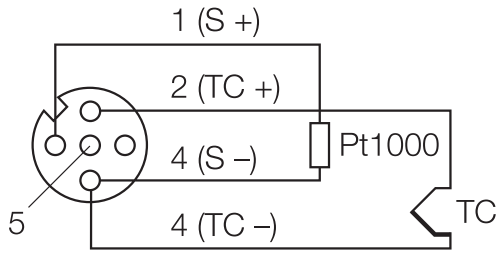
Table 6-23:
Pin assignment
BL67-2AI-TC



1 = S +
2 = TC +
3 = GND
4 = TC – / S –
5 = PE

S = PT1000-sensor for cold junction compensation
TC = thermo element

Table 6-24:
Wiring diagram
BL67-2AI-TC



6.5.5 Measurement value representation

16-bit-representation

- For the parameterization
  "Typ K, -270…1370°C"
  "Typ B, +100…1820°C"
  "Typ E, -270…1000°C"
  "Typ J, -210…1200°C"
  "Typ N, -270…1300°C"
  "Typ R, -50…1760°C"
  "Typ S, -50…1540°C"
  "Typ T, -270…400°C"

  The value range
  -270 °C to -0.1°C
  is displayed as follows:
  F574$_{hex}$ **to FFFF**$_{hex}$ (decimal: -2700 to -1)

  The value range
  0 °C to 1820°C
  is displayed as follows:
  0000$_{hex}$ **to 4718**$_{hex}$ (decimal: 0 to 18200)

  The value range
  -50 mV to -0,002 mV;
  -100 mV to -0,003 mV;
  -500 mV to -0,015 mV;
  -1000 mV to -0,031 mV
  is displayed as follows:
  8000$_{hex}$ **to FFFF**$_{hex}$ (decimal: -32768 to -1)

The value range
0 mV to 50 mV;
0 mV to 100 mV;
0 mV to 500 mV;
0 mV to 1000 mV;
is displayed as follows:
0000$_{hex}$ **to7FFF**$_{hex}$ (decimal: 0 to 32767)

12 bit representation (left-justified)

- For the parameterization
"Typ K, -270…1370°C"
"Typ B, +100…1820°C"
"Typ E, -270…1000°C"
"Typ J, -210…1200°C"
"Typ N, -270…1300°C"
"Typ R, -50…1760°C"
"Typ S, -50…1540°C"
"Typ T, -270…400°C"

The value range
-270 °C to 1820°C
is displayed as follows:
EF2(0)$_{hex}$ **to 71C(0)**$_{hex}$ (decimal: -270 to 1820)

The value range
-50 mV to -0.024mV;
-100 mV to -0.049mV;
-500 mV to -0.244mV;
-1000 mV to -0.489mV;
is displayed as follows:
800(0)$_{hex}$ **to FFF(0)**$_{hex}$ (decimal: -2048 to -1)

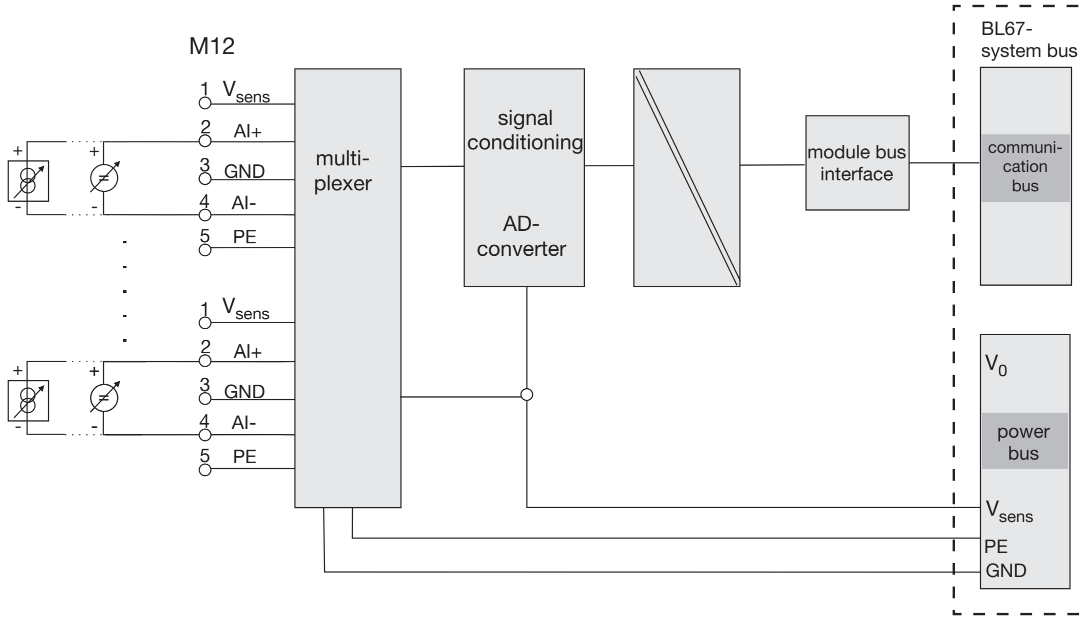
The value range
0 mV to 50 mV;
0 mV to 100 mV;
0 mV to 500 mV;
0 mV to 1000 mV;
is displayed as follows:
0008(0)$_{hex}$ **to 7FF(0)**$_{hex}$ (decimal: 0 to 2047)

Note
A detailed description of the measurement value representation for the analog input modules in 16 or 12 bit can be found in the "appendix" of this manual, page 15-1.

6.6 BL67-4AI-V/I, voltage/ current

Figure 6-4:
BL67-4AI-V/I

Figure 6-5:
Block diagram



Industrial Automation

6.6.1 Technical data

Table 6-25: Technical data

Designation	BL67-4AI-V/I
Number of channels	4
Nominal voltage from supply terminal	24 V DC
voltage range	18 to 30 VDC
Nominal current from 5 V DC (module bus) I_{MB}	≤ 35 mA
Nominal current from supply terminal I_L	< 12 mA
Power loss of the module, typical P_{MAX}	< 1 W
Input signal (current mode)	
Input resistance (burden)	< 125 Ω
Input current (range which can be evalutated by the A/D-converter)	0 to 20 mA 4 to 20 mA
Input current (maximum - an „measurement value range error“ is shown if the current is ≤ 20.2 mA)	50 mA
Cutoff frequency (-3 dB)	20 Hz
Input signal (voltage mode)	
Input resistance (burden)	> 98.5 kΩ
Input voltage (range which can be evalutated by the A/D-converter)	-10 to 10 V DC 0 to 10 V DC
Input voltage (maximum - an „measurement value range error“ is shown if the deviation from the evaluable measuremnt range is 1%)	35 V DC
Cutoff frequency (-3 dB)	20 Hz
Isolation voltage	
U_{TMB} (module bus/ field)	min. 500 V_{rms}
U_{Fe} (field/ functional earth)	min. 50 V_{AC}
channel/channel	no
channel/field supply	no
channel/system supply	500 V_{rms}
Accuracy of input signal	
Basic error at 23 °C	< 0.3 %
Temperature coefficient	≤ 300 ppm/°C from end value

Representation of the converted input signal	
Resolution of A/D converter	16 Bit
Measuring principle	Delta Sigma
Measurement value representation	– 16 Bit: two's complement or – 12 Bit left justified: two's complement (even negative values possible) Dual number without coding (only positive values possible)

6.6.2 Diagnostic/ status messages

Table 6-26: LED indicators

LED	Display	Meaning	Remedy
DIA	Red, flashing, 0.5 Hz	Diagnostics pending	-
	Red	Module bus communication failure	Check if more than two adjoining electronics modules have been pulled. Check the power supply to the module bus.
	Off	No error messages or diagnostics	–
0 to 4	Green	Channel x active	-
	Green, flashing 0.5 Hz	Underflow in measuring range	
	Green, flashing 4 Hz	Overflow in measuring range	
	Off	Channel x inactive	

6.6.3 Diagnostics via Software

This module has the following diagnostic data:

Note
The "12-bit-representation (left-justified)" the diagnostic data are transferred with the lower of the process data of the respective channel.

Table 6-27: Diagnostic bits

Byte	Bit	Diagnostic messagee	Meaning
Inputs			
0 - 3	0	OoR (Out of Range) Measurement value range error	Indicates an exceed or undercut of the value ranges. The permissible measurement value limits are exceeded, it is thus possible that no valid measurement value can be detected.
	1	WB (Wire Break)	Display of a wire break in the signal line for the operation mode. Only in current measurement 4 to 20 mA.
	2	OUFL (Over-/Underflow)	The measured value exceeds the measurement range and the module can not detect these values.
	3 - 7	reserved	

Note
In the current measurement ranges , the module switches automatically to the voltage measurement after 300 ms if I > 40.0 mA. For the 300 ms, a current of max. 500 mA is accepted. After this, a periodical switching to current measurement is done. If the current falls again to the permissible range, the module switches permanently back to current measurement. During this procedure, the transmitted value is always the measurement range end value. Please observe the module’s maximum input voltage!

6.6.4 Module parameters (per channel)

Table 6-28: Module parameters

A *Standard parameter value*

Parameter name	Value
Range	0 = 0..10V/0..20mA **A** 1 = -10..+10V/4..20mA
Value representation	0 = Integer (15bit + sign) **A** 1 = 12bit (left-justified)
Diagnostic	0 = release **A** 1 = block
Channel	0 = activate **A** 1 = deactivate
Operation mode	0 = voltage **A** 1 = current
Number representation	00 = standard **A** 01 = NE43 10 = extended range

Note

Concerning the „number representation“, please observe the tables for measurement value representation on the following pages.

6.6.5 Measurement value representation

Standard value representation

- 16-bit-representation

-10 … 10 V	bipolar	diagnostic message	dec.	hex.
voltage value U_M = (dec. value × 3.052 × 10^{-4}) V				
> 10.1000 V		at ↑DIA OoR (Out of Range) ON	32767	7FFF
≤ 10.0500 V		at ↓ DIA OoR (Out of Range) OFF	32767	7FFF
10.0000 V	nominal range		32767	7FFF
9.9997 V			32766	7FFE
…			…	…
5.0002 V			16384	4000
…			…	…
0.000305 V			1	0001
0.000000 V			0	0000
-0.000305 V			-1	FFFF
…			…	…
-5.0000 V			-16384	C000
…			…	…
-9.9997 V			-32767	8001
≤ -10.0000 V			-32768	8000
≥ -10.0500 V		at ↑ DIA OoR (Out of Range) OFF	-32768	8000
< -10.1000 V		at ↓ DIA OoR (Out of Range) ON	-32768	8000

0 … 10 V	unipolar	diagnostic message	dec.	hex.
voltage value U_M = (dec. value × 3.052 × 10^{-4}) V				
> 10.1000 V		at ↑ DIA OoR (Out of Range) ON	32767	7FFF
≤ 10.0500 V		at ↓ DIA OoR (Out of Range) OFF	32767	7FFF
10.0000 V	nominal range		32767	7FFF
9.9997 V			32766	7FFE
…			…	…
5.0002 V			16384	4000
…			…	…
0.000305 V			1	0001
≤ 0.000000 V			0	0000
≥ -0.0500 V		at ↑ DIA OoR (Out of Range) OFF	0	0000
< -0.1000 V		at ↓ DIA OoR (Out of Range) ON	0	0000

0 … 20 mA	**unipolar**	**diagnostic message**	**dec.**	**hex.**
current value I_M = (dec. value × 6.104 × 10^{-4}) mA				
> 20.2000 mA		at ↑DIA OoR (Out of Range) ON	32767	7FFF
≤ 20.1000 mA		at ↓ DIA OoR (Out of Range) OFF	32767	7FFF
20.0000 mA	nominal range		32767	7FFF
19.9994 mA			32766	7FFE
…			…	…
10.0003 mA			16384	4000
…			…	…
0.0006104 mA			1	0001
≤ 0.0000 mA			0	0000
≥ -0.1 mA		at ↑DIA OoR (Out of Range) OFF	0	0000
< -0.2 mA		at ↓ DIA OoR (Out of Range) ON	0	0000

4 … 20 mA	**unipolar**	**diagnostic message**	**dec.**	**hex.**
current value I_M = ((dec. value × 4.883 × 10^{-4}) + 4) mA				
> 20.2000 mA		at ↑ DIA OoR (Out of Range) ON	32767	7FFF
≤ 20.1000 mA		at ↓ DIA OoR (Out of Range) OFF	32767	7FFF
20.0000 mA	nominal range		32767	7FFF
19.9995 mA			32766	7FFE
…			…	…
12.00024 mA			16384	4000
…			…	…
4.0004883 mA			1	0001
≤ 4.0000 mA			0	0000
≥ 3.7000 mA		at ↑ DIA OoR (Out of Range) OFF	0	0000
< 3.6000 mA		at ↓ DIA OoR (Out of Range) ON	0	0000
≥ 3.0000 mA		at ↑DIA WB (Wire Break) OFF	0	0000
< 2.9000 mA		at ↓ DIA WB (Wire Break) ON	0	0000

- 12-bit-representation (left-justified)

Note

In the values representation "12-bit-representation (left-justified)", the diagnostic data are transmitted with bits 0 to 3 of the channel's process data.

-10 ... 10 V	bipolar	diagnostic message	dec.	hex.
voltage value U_M = (dec. value / 16 × 4.885 × 10^{-3}) V				
> 10.1000 V		at ↑DIA OoR (Out of Range) ON	2047 × 16	7FF×
≤ 10.0500 V		at ↓ DIA OoR (Out of Range) OFF	2047 × 16	7FF×
10.0000 V	nominal range		2047 × 16	7FF×
9.9951 V			2046 × 16	7FE×
...			...	...
5.00244 V			1024 × 16	400×
...			...	...
0.00488 V			1 × 16	001×
0.000000 V			0	000×
-0.000488 V			-1 × 16	FFF×
...			...	...
-5.0000 V			-1024 × 16	C00×
...			...	...
-9.99511 V			-2047 × 16	801×
≤ -10.0000 V			-2048 × 16	800×
≥ -10.0500 V		at ↑DIA OoR (Out of Range) OFF	-2048 × 16	800×
< -10.1000 V		at ↓ DIA OoR (Out of Range) ON	-2048 × 16	800×

0 ... 10 V	unipolar	diagnostic message	dec.	hex.
voltage value U_M = (dec. value / 16 × 2.442 × 10^{-3}) V				
> 10.1000 V		at ↑ DIA OoR (Out of Range) ON	4095 × 16	FFF×
≤ 10.0500 V		at ↓ DIA OoR (Out of Range) OFF	4095 × 16	FFF×
10.0000 V	nominal range		4095 × 16	FFF×
9.9976 V			4094 × 16	FFE×
...			...	...
5.0012 V			2048 × 16	800×
...			...	...
0.00244 V			1 × 16	001×
≤ 0.0000 V			0	000×
≥ -0.0500 V		at ↑DIA OoR (Out of Range) OFF	0	000×
< -0.1000 V		at ↓ DIA OoR (Out of Range) ON	0	000×

0 … 20 mA	unipolar	diagnostic message	dec.	hex.
current value I_M = (dec. value / 16 × 4.884 × 10^{-3}) mA				
> 20.2000 mA		at ↑DIA OoR (Out of Range) ON	4095 × 16	FFF×
≤ 20.1000 mA		at ↓ DIA OoR (Out of Range) OFF	4095 × 16	FFF×
≥ 20.0000 mA	nominal range		4095 × 16	FFF×
19.9951 mA			4094 × 16	FFE×
…			…	…
10.0024 mA			2048 × 16	800×
…			…	…
0.00488 mA			1 × 16	001×
≤ 0.0000 mA			0	000×

4 … 20 mA	unipolar	diagnostic message	dec.	hex.
current value I_M = ((dec. value / 16 × 3.907 × 10^{-3}) + 4) mA				
> 20.2000 mA		at ↑DIA OoR (Out of Range) ON	4095 × 16	FFF×
≤ 20.1000 mA		at ↓ DIA OoR (Out of Range) OFF	4095 × 16	FFF×
≥ 20.0000 mA	nominal range		4095 × 16	FFF×
19.9961 mA			4094 × 16	FFE×
…			…	…
12.0020 mA			2048 × 16	800×
…			…	…
4.0039 mA			1 × 16	001×
≤ 4.0000 mA			0	000×
≥ 3.7000 mA		at ↑DIA OoR (Out of Range) OFF	0	000×
< 3.6000 mA		at ↓ DIA OoR (Out of Range) ON	0	000×
≥ 3.0000 mA		at ↑DIA WB (Wire Break) OFF	0	000×
< 2.9000 mA		at ↓ DIA WB (Wire Break) ON	0	000×

Extended Range - value representation

- 16-bit-representation

-10 … 10 V	bipolar	diagnostic message	dec.	hex.
voltage value U_M = (dec. value × 3.617 × 10^{-4}) V				
≥ 11.851490 V	overflow		32767	7FFF
≥ 11.758773 V		at ↑DIA OoR (Out of Range) ON	32512	7F00
11.7584 V	out of range		32511	7EFF
≤ 11.603010 V		at ↓ DIA OoR (Out of Range) OFF	32080	7D50
10.000305 V			27649	6C01
10.000000 V	nominal range		27648	6C00
…			…	…
5.0000 V			13824	3600
…			…	…
0.0003617 V			1	0001
0.000000 V			0	0000
-0.0003617 V			-1	FFFF
…			…	…
-5.000000 V			-13824	CA00
…			…	…
-10.000000V			-27648	9400
-10.000362 V	out of range		-27649	93FF
≥ -11.60301 V		at ↑ DIA OoR (Out of Range) OFF	-32080	82B0
-11.758897 V			-32511	8100
-11.759259 V	underflow	at ↓ DIA OoR (Out of Range) ON	-32512	80FF
≤ -11.851851 V			-32768	8000

0 … 10 V	bipolar	diagnostic message	dec.	hex.
voltage value U_M = (dec. value × 3.617 × 10^{-4}) V				
≥ 11.851490 V	overflow		32767	7FFF
≥ 11.758773 V		at ↑ DIA OoR (Out of Range) ON	32512	7F00
11.7584 V	out of range		32511	7EFF
≤ 11.603010 V		at ↓ DIA OoR (Out of Range) OFF	32080	7D50
10.000305 V			27649	6C01
10.000000 V	nominal range		27648	6C00
…			…	…
5.0000 V			13824	3600
…			…	…
0.000361 V			1	0001
0.000000 V			0	0000
< 0.000000 V			0	0000
≥ -0.050 V	out of range	at ↑ DIA OUFL (Over-/Under-flow) OFF	0	0000
< -0.100 V		at ↓ DIA OUFL (Over-/Underflow) ON	0	0000

0 … 20 mA	bipolar	diagnostic message	dec.	hex.
current value I_M = (dec. value × 7.234 × 10^{-4}) mA				
≥ 23.70298 mA	overflow		32767	7FFF
≥ 23.5185 mA		at ↑ DIA OoR (Out of Range) ON	32512	7F00
23.517795 mA	out of range		32511	7EFF
≤ 23.2060 mA		at ↓ DIA OoR (Out of Range) OFF	32080	7D50
20.000723 mA			27649	6C01
20.000000 mA	nominal range		27648	6C00
…			…	…
10.0000 mA			13824	3600
…			…	…
0.0007234 mA			1	0001
0.000000 mA			0	0000

4 … 20 mA	bipolar	diagnostic message	dec.	hex.
current value I_M = ((dec. value × 5.787 × 10^{-4}) + 4) mA				
≥ 22.96238 mA	overflow		32767	7FFF
≥ 22.81481 mA		at ↑ DIA OoR (Out of Range) ON	32512	7F00
22.814236 mA	out of range		32511	7EFF
≤ 22.56482 mA		at ↓ DIA OoR (Out of Range) OFF	32080	7D50
20.000579 mA			27649	6C01
20.000000 mA	nominal range		27648	6C00
…			…	…
12.0000 mA			13824	3600
…			…	…
4.0005787 mA			1	0001
4.000000 mA			0	0000
3.999421 mA	out of range		-1	FFFF
≥ 1.30324 mA		at ↑ DIA OoR (Out of Range) OFF	-4672	EDC0
1.185185			-4864	ED00
≤ 1.184606 mA	underflow	at ↓ DIA OoR (Out of Range) ON	-4865	ECFF
≤ 0.0000 mA			-6912	E500

- 12-bit-representation (left-justified)

The "12-bit-representation (left-justified)" in process automation corresponds to the 16-bit representation in which the lower 4 bits of the analog value are overwritten with diagnostic data.

-10 ... 10 V	bipolar	diagnostic message	dec.	hex.
voltage value U_M = (dec. value / 16 × 5.787 × 10^{-3}) V				
≥ 11.8460 V	overflow		2047 × 16	7FF0
≥ 11.7592 V		at ↑ DIA OoR (Out of Range) ON	2032 × 16	7F00
11.7535 V	out of range		2031 × 16	7EF0
≤ 11.6030 V		at ↓ DIA OoR (Out of Range) OFF	2005 × 16	7D50
10.0058 V			1729 × 16	6C10
10.000000 V	nominal range		1728 × 16	6C00
...			...	...
5.0000 V			864 × 16	3600
...			...	...
0.000578 V			1 × 16	0010
0.000000 V			0	0000
-0.000578 V			-1 × 16	FFF0
...			...	...
-5.000000 V			-864 × 16	CA00
...			...	...
-10.000000V			-1728 × 16	9400
-10.0058 V	out of range		-1729 × 16	93F0
≥ -11.6030 V		at ↑ DIA OoR (Out of Range) OFF	-2005 × 16	82B0
-11.7592 V			-2032 × 16	8100
-11.7650 V	underflow	at ↓ DIA OoR (Out of Range) ON	-2033 × 16	80F0
≤ -11.8518 V			-2048 × 16	8000

0 ... 10 V	bipolar	diagnostic message	dec.	hex.
voltage value U_M = (dec. value / 16 × 5.787 × 10^{-3}) V				
≥ 11.8460 V	overflow		2047 × 16	7FF0
≥ 11.7592 V		at ↑ DIA OoR (Out of Range) ON	2032 × 16	7F00
11.7535 V	out of range		2031 × 16	7EF0
≤ 11.6030 V		at ↓ DIA OoR (Out of Range) OFF	2005 × 16	7D50
10.0058 V			1729 × 16	6C10
10.000000 V	nominal range		1728 × 16	6C00
...			...	...
5.0000 V			864 × 16	3600
...			...	...
0.000578 V			1 × 16	0010
0.00000 V			0	0000
≥ -0.050 V	underflow	at ↑ DIA OUFL (Over-/Under-flow) OFF	0	0000
< -0.100 V		at ↓ DIA OUFL (Over-/Underflow) ON	0	0000

0 ... 20 mA	bipolar	diagnostic message	dec.	hex.
current value I_M = (dec. value / 16 × 0.01157) mA				
≥ 23.6921 mA	overflow		2047 × 16	7FF0
≥ 23.5185 mA		at ↑ DIA OoR (Out of Range) ON	2032 × 16	7F00
23.5069 mA	out of range		2031 × 16	7EF0
≤ 23.2060 mA		at ↓ DIA OoR (Out of Range) OFF	2005 × 16	7D50
20.0116 mA			1729 × 16	6C10
20.000000 mA	nominal range		1728 × 16	6C00
...			...	...
10.0000 mA			864 × 16	3600
...			...	...
0.01157 mA			1 × 16	0010
≤ 0.0000 mA			0	0000
≥ -0.1 mA	underflow	at ↑ DIA OUFL (Over-/Under-flow) OFF	0	0000
< -0.2 mA		at ↓ DIA OUFL (Over-/Underflow) ON	0	0000

4 … 20 mA	bipolar	diagnostic message	dec.	hex.
current value I_M = ((dec. value / 16 × 9.259 × 10^{-3}) + 4) mA				
≥ 22.9537 mA	overflow		2047 × 16	7FF0
≥ 22.8148 mA		at ↑ DIA OoR (Out of Range) ON	2032 × 16	7F00
22.8056 mA	out of range		2031 × 16	7EF0
≤ 22.5648 mA		at ↓ DIA OoR (Out of Range) OFF	2005 × 16	7D50
20.0093 mA			1729 × 16	6C10
20.000000 mA	nominal range		1728 × 16	6C00
…			…	…
12.0000 mA			864 × 16	3600
…			…	…
4.00925 mA			1 × 16	0010
4,0000 mA			0	0000
3.9907 mA	out of range		-1 × 16	FFF0
≥ 1.2963 mA		at ↑ DIA OoR (Out of Range) OFF	-292 × 16	EDC0
1.1851 mA			-304 × 16	ED00
≤ 1.1759 mA	underflow	at ↓ DIA OoR (Out of Range) ON	-305 × 16	ECF0
≤ 0.000 mA			-432 × 16	E500

Value representation process automation (NE 43)

- 16-bit-representation

The hexadecimal value transmitted by the module has to be interpreted as decimal value, which corresponds, if multiplied with a defined factor, to the analog value.

-10 ... 10 V	bipolar	diagnostic message	dec.	hex.
voltage value U_M = (dec. value × 0.001) V				
≥ 11.000 V	overflow		11000	2AF8
≤ 10.999 V			10999	2AF7
≥ 10.500 V	out of range	at ↑ DIA OoR (Out of Range) ON	10500	2904
≤ 10.250 V		at ↓ DIA OoR (Out of Range) OFF	10250	280A
10.001 V			10001	2711
10.000 V	nominal range		10000	2710
...			...	...
5.000 V			5000	1388
...			...	...
0.001 V			1	0001
0.000 V			0	0000
-0.001 V			-1	FFFF
...			...	...
-5.0000 V			-5000	EC78
...			...	...
-10.000 V			-10000	D8F0
- 10.001 V	out of range		-10001	D8EF
-10.250 V		at ↑ DIA OoR (Out of Range) OFF	-10250	D7F6
-10.500 V		at ↓ DIA OoR (Out of Range) ON	-10500	D6FC
-10.501 V	underflow		-10501	D6FB
-10.999 V			-10999	D509
≤ -11.000 V			-11000	D508

0 … 10 V	unipolar	diagnostic message	dec.	hex.
voltage value U_M = (dec. value × 0.001) V				
≥ 11.000 V	overflow		11000	2AF8
≤ 10.999 V			10999	2AF7
≥ 10.500 V	out of range	at ↑ DIA OoR (Out of Range) ON	10500	2904
≤ 10.250 V		at ↓ DIA OoR (Out of Range) OFF	10250	280A
10.001 V			10001	2711
10.000 V	nominal range		10000	2710
…			…	…
5.000 V			5000	1388
…			…	…
0.001 V			1	0001
0.000 V			0	0000
≥ - 0.05 V	underflow	at ↑ DIA OoR (Out of Range) OFF	0	0000
< -0.10 V		at ↓ DIA OoR (Out of Range) ON	0	0000

0 … 20 mA	unipolar	diagnostic message	dec.	hex.
current value I_M = (dec. value × 0.001) mA				
≥ 22.000 mA	overflow	at ↑ DIA OUFL (Over-/Under-flow) ON	22000	55F0
≤ 21.999 mA		at ↓ DIA OUFL (Over-/ Underflow) OFF	21999	55EF
21.001 mA			21001	5209
≥ 21.000 mA	out of range	at ↑DIA OoR (Out of Range) ON	21000	5208
≤ 20.500 mA		at ↓ DIA OoR (Out of Range) OFF	20500	5014
20.001 mA			20001	4E21
20.000 mA	nominal range		20000	4E20
…			…	…
10.000 mA			10000	2712
…			…	…
0.001 mA			1	0001
0.0000 mA			0	0000

4 … 20 mA	unipolar	diagnostic message	dec.	hex.
current value I_M = (dec. value × 0.001) mA				
≥ 22.000 mA	overflow	at ↑ DIA OUFL (Over-/Under-flow) ON	22000	55F0
≤ 21.999 mA		at ↓ DIA OUFL (Over-/ Underflow) OFF	21999	55EF
21.001 mA			21001	5209
≥ 21.000 mA	out of range	at ↑ DIA OoR (Out of Range) ON	21000	5208
≤ 20.500 mA		at ↓ DIA OoR (Out of Range) OFF	20500	5014
20.001 mA			20001	4E21
20.000 mA	nominal range		20000	4E20
…			…	…
12.000 mA			12000	2EE0
…			…	…
4.001 mA			4001	0FA1
4.000 mA			4000	0FA0
3.999 mA	out of range		3999	0F9F
≥ 3.800 mA		at ↑ DIA OoR (Out of Range) OFF	3800	0ED8
3.600 mA		at ↓ DIA OoR (Out of Range) ON	3600	0E10
3.599 mA	underflow		3599	0E0F
≥ 2.001 mA		at ↑ DIA WB (Wire Break) OFF	2001	07D1
≤ 2.000 mA		at ↓ DIA WB (Wire Break) ON	2000	07D0
0.000 mA			0000	0000

- 12-bit-representation (left-justified)

The "12-bit-representation (left-justified)" in process automation corresponds to the 16-bit-representation in which the lower 4 bits of the analog value are overwritten with diagnostic data.

-10 ... 10 V	bipolar	diagnostic message	dec.	hex.
voltage value U_M = (dec. value × 0.001) V				
≥ 11.008 V	overflow		11008	2B0×
≤ 10.992 V			10992	2AF×
10.512 V		at ↑ DIA OoR (Out of Range) ON	10512	291×
≥ 10.496 V	out of range		10496	290×
≤ 10.256 V		at ↓ DIA OoR (Out of Range) OFF	10256	281×
10.016 V			10016	272×
10.000 V	nominal range		10000	271×
...				
4.992 V			4992	138×
...			...	...
0.016 V			16	001×
0.0000 V			0	000×
-0.016 V			-16	FFF×
...			...	...
-4.992 V			-4992	EC8×
...			...	...
-10.000 V			-10000	D8F×
- 10.016 V	out of range		-10016	D8E×
-10.256 V		at ↑ DIA OoR (Out of Range) OFF	-10256	D7F×
-10.496 V			-10496	D70×
-10.512 V	underflow	at ↓ DIA OoR (Out of Range) ON	-10512	D6F×
-10.992 V			-10992	D51×
≤ -11.008 V			-11008	D50×

0 … 10 V	bipolar	diagnostic message	dec.	hex.
voltage value U_M = (dec. value × 0.001) V				
≥ 11.008 V	overflow		11008	2B0×
≤ 10.992 V			10992	2AF×
10.512 V		at ↑ DIA OoR (Out of Range) ON	10512	291×
≥ 10.496 V	out of range		10496	290×
≤ 10.256 V		at ↓ DIA OoR (Out of Range) OFF	10256	281×
10.016 V			10016	272×
10.000 V	nominal range		10000	271×
…				
4.992 V			4992	138×
…			…	…
0.016 V			16	001×
≤ 0.0000 V			0	000×
≥ -0.05 V	underflow	at ↑ DIA OoR (Out of Range) OFF	0	000×
< -0.1 V		at ↓ DIA OoR (Out of Range) ON	0	000×

0 … 20 mA	unipolar	diagnostic message	dec.	hex.
current value I_M = (dec. value / 16 × 0.001) mA				
≥ 22.000 mA	overflow	at ↑ DIA OUFL (Over-/Under-flow) ON	22000	55F×
≤ 21.984 mA		at ↓ DIA OUFL (Over-/Underflow) OFF	21984	55E×
21.024 mA			21024	522×
≥ 21.008 mA	out of range	at ↑ DIA OoR (Out of Range) ON	21008	521×
≤ 20.496 mA		at ↓ DIA OoR (Out of Range) OFF	20496	501×
20.016 mA			20016	4E3×
20.000m A	nominal range		20000	4E2×
…			…	…
10.000 mA			10000	271×
…			…	…
0.016 mA			16	001×
0.0000 mA			0	000×

4 … 20 mA	unipolar	diagnostic message	dec.	hex.
current value I_M = (dec. value / 16 × 0.001) mA				
≥ 22.000 mA	overflow	at ↑ DIA OUFL (Over-/Under-flow) ON	22000	55F×
≤ 21.984 mA		at ↓ DIA OUFL (Over-/Underflow) OFF	21984	55E×
≥ 21.008 mA	out of range	at ↑ DIA OoR (Out of Range) ON	21008	521×
≤ 20.992 mA			20496	5010
≤ 20.496 mA		at ↓ DIA OoR (Out of Range) OFF		
20.016 mA			20016	4E3×
20.000m A	nominal range		20000	4E2×
…			…	…
12.000 mA			12000	2EE×
…			…	…
4.016 mA			4016	0FB×
4.000 mA			4000	0FA×
3.984 mA	out of range		3984	0F9×
≥ 3.792 mA		at ↑ DIA OoR (Out of Range) OFF	3792	0ED×
< 3.600 mA		at ↓ DIA OoR (Out of Range) ON	3600	0E1×
3.584 mA	underflow		3584	0E0×
≥ 2.001 mA		at ↑ DIA WB (Wire Break) OFF	2001	07D×
< 2.000 mA		at ↓ ΔIA WB (Wire Break) ON	2000	07D×
0.000 mA			0000	000×

6.6.6 Base Modules/ pin assignment

- BL67-B-4M12

Figure 6-6: BL67-B-4M12

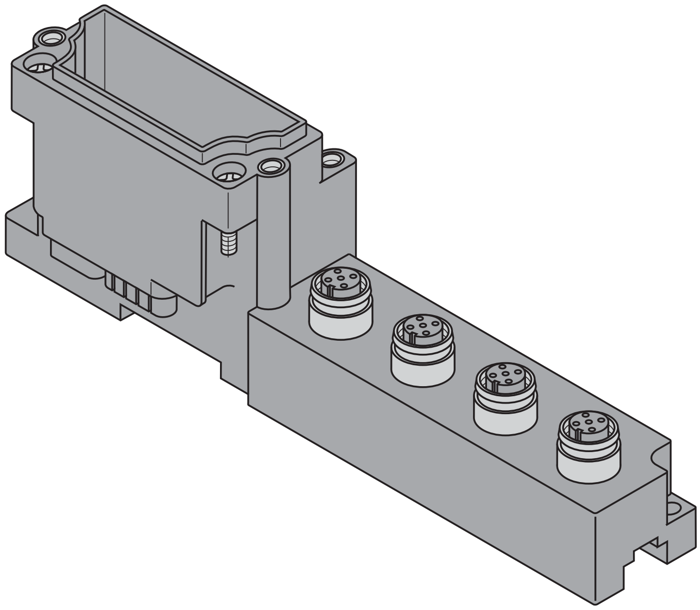
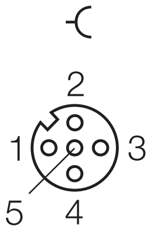


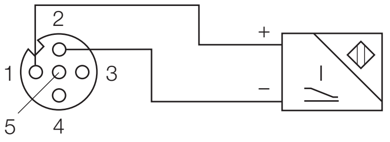
Table 6-29: Pin assignment BL67-4AI-V/I with BL67-B-4M12



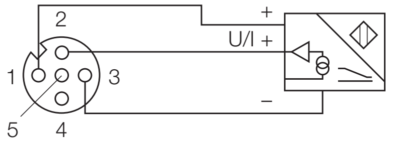
1 = V_{SENS}
2 = AI +
3 = GND
4 = AI –
5 = PE

Figure 6-7: Wiring diagrams BL67-4AI-V/I

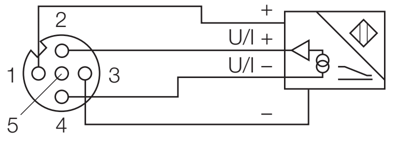
2-wire sensor with power supply via base module:



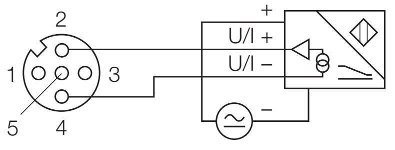
3-wire sensor with power supply via base module:



4-wire sensor with power supply via base module:



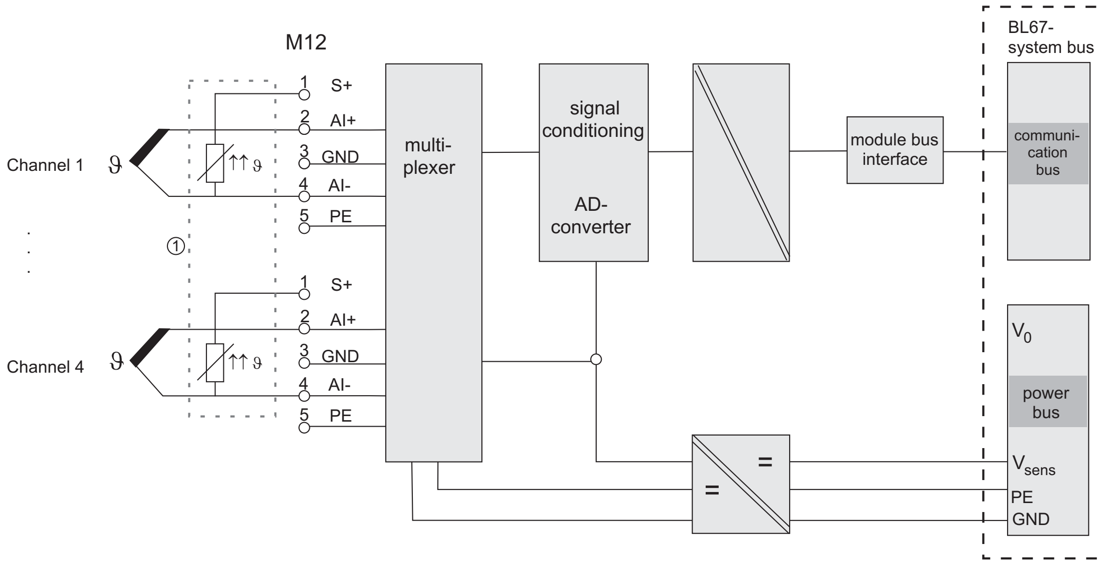
4-wire sensor with external power supply:



6.7 BL67-4AI-TC, thermocouple

Figure 6-8: BL67-4AI-TC

Figure 6-9: Block diagram



① cold junction compensation r esistance (Pt1000) in male connector

Technical data

Table 6-30: Technical data

Designation	BL67-4AI-TC
Number of channels	4
Nominal voltage from supply terminal U_L	24 V DC
Nominal current from supply terminal I_L	< 30 mA
Nominal current from module bus I_{MB}	≤ 50 mA
Power loss of the module, typical	< 1 W
Input resistance	> 7 MΩ
Potential isolation	electronic to field
Sensors	gemäß DIN IEC 584, Klasse 1, 2, 3
Temperature ranges	
Type B	100 to 1820 °C
Type C	0 to 2315 (15 bit + sign) 0 to 2047 (12 bit)
Type E	-270 to 1000 °C
Type G	0 to 2315 (15 bit + sign) 0 to 2047 (12 bit)
Type J	-210 to 1200 °C
Type K	-270 to 1370 °C
Type N	-270 to 1300 °C
Type R	-50 to 1760 °C
Type S	-50 to 1760°C
Type T	-270 to 400 °C
Voltage measurment (resolution)	
± 50 mV	< 2 µV
± 100 mV	< 4 µV
± 500 mV	< 20 µV
Measurement value representation	16 bit Signed Integer/ 12 bit Full Range, left justified
Basic error (nominal value at 23 °C)	see table, page 6-59
Crosstalk suppression	70 Hz
Repeat accuracy	0.05 % from end value
Temperature coefficient	≤ 150 ppm/°C from end value

Basic error and repeat accuracies

Table 6-31: Basic error - nominal ranges **A**

Thermo element	nominal range for basic error at 23 °C 0.2 % from end value	Repeat accuracy / % from positive end value
Type B	750 … 1820 °C	0.05
Type C	0 … 2315 °C (15 bit + sign) 0 … 2047°C (12 bit)	0.05
Type G	0 … 2315 °C (15 bit + sign) 0 … 2047 °C (12 bit)	0.05
Type E	-200. ..1000 °C	0.05
Type J	-210 ..1200 °C	0.05
Type K	-200 …1370 °C	0.05
Type N	-200 …1300 °C	0.05
Type R	750 …1760 °C	0.05
Type S	750 …1540 °C	0.05
Type T	-200.…400 °C	0.05
Voltage measurment	all measurement ranges	0.05

A For temperatures outside the defined measurement range, higher deviations for basic error and repeat accuracy are possible.

6.7.1 Diagnostic/ status messages

Diagnosis/ status via LEDs

Table 6-32: Diagnosis via LED

LED	Display	Meaning	Remedy
D	Red, flashing, 0.5 Hz	Diagnostics pending	-
	Red	Module bus communication failure or field voltage U_L not connected	Check if more than two ad-joining electronic modules have been pulled. This applies to modules located between this module and the gateway.
	Off	No error messages or diagnostics	–
0 to 3	Green	Channel activated normal operation	
	Green, flashing, 0.5 Hz	Channel diagnostics pending	
	Off	Channel deactivated	

This module has the following diagnostic data available **per channel**:

Bit 7	Bit 6	Bit 5	Bit 4	Bit 3	Bit 2	Bit 1	Bit 0
HW error	x	x	x	CMV_ OoR	No Pt1000	WB	OoR

- Measurement value range error "Out of Range"
  OoR
  Indicates an exceed or undercut of the value ranges.
  The permissible measurement value limits are exceeded, it is thus possible that no valid measurement value can be detected.

- "Wire Break"
  WB
  Display of a wire break in the signal line for the operation mode.
  – in temperature measurement
  – in resistance measurement

- "No Pt1000-sensor found":
  No PT1000
  The Pt1000-sensor for the respective channel in the base module is defective
  → the Pt1000-sensor of the other channel is taken as cold junction.
  → A cold junction temperature of 23°C is presumed.

- "Common Mode voltage out of range"
  CMV_OoR
  The difference in potential between the measuring voltages is too high.
  What is actually monitored is the potential difference of the measuring voltages of a group of sensors: channel 0/1 resp. channel 2/3.
  Remedy:
  – Check the insulation of the sensors.
  – Check the difference in potential between non-insulated sensors
  – If the sensors are not insulated, use channels of different sensor groups (e.g. channel 1 and channel 3).

- "Hardware failure"
  HW Error
  Shows common errors of the module hardware.
  The return analog value in case of an error is "0".

6.7.2 Module parameters (per channel)

Table 6-33: Module parameters

***A**default settings*

Parameter name	Value
Mains suppression	50 Hz **A**
	60 Hz
Value representation	Integer (15Bit + sign) **A**
	12Bit (left-justified)
Diagnostic	release **A**
	block
Channel	activate**A**
	deactivate
Element	type K, -270…1370°C **A** type B, +100…1820°C type E, -270…1000°C type J, -210…1200°C type N, -270…1300°C type R, -50…1760°C type S, -50…1540°C type T, -270…400°C +/-50mV +/-100mV +/-500mV +/-1000mV

6.7.3 Base modules/ pin assignment

- BL67-B-4M12

Abbildung 6-10: BL67-B-4M12

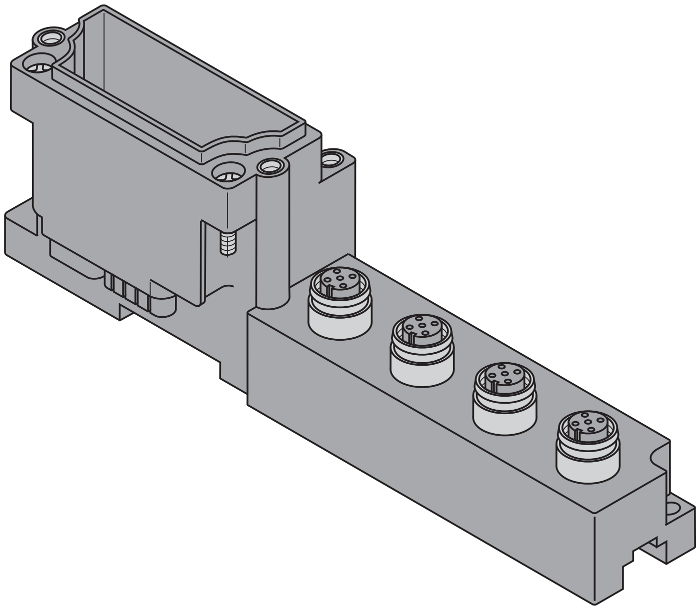
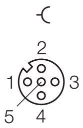


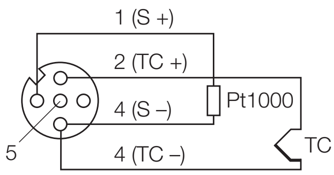
Table 6-34: Pin assignement BL67-4AI-TC



1 = S +
2 = TC +
3 = GND
4 = TC – / S –
5 = PE

S = PT1000-sensor for cold junction compensation
TC = thermo element

Table 6-35: Wiring diagram BL67-4AI-TC



Matching connector with Pt1000 sensor for cold junction compensation: BL67-WAS5-THERMO

Industrial Automation

6.7.4 Measurement value representation

Temperature measurment

- 16 bit representation
  The measured temperature is multiplied by 10.
  example:
  10.1 °C → 101 → 0x0065
- 12 bit representation
  The value representation depends on the measuring unit (°C or °F).
  Celsius:
  The measured temperature is shifted 4 bit to the left.
  example (°C):
  10.1 °C → 10 → (0x000A <<4) → 0x00A0
  Fahrenheit
  The measured temperature is devided by 2 and shifted 4 bit to the left.
  example (°F):
  10.1 °C → 5 → (0x0005 <<4) → 0x0050

Example of a value representation (thermoelement Typ K)

Measurement [°C]	15 Bit + sign		12 Bit [°C]		12 Bit (°F)	
	dec.	hex.	dec.	hex.	dec.	hex.
-270	-2700	F574	-4320	EF20	-2160	F790
-269.9	-2699	F575	-4320	EF30	-2144	F7A0
-269	-2690	F57E	-4304	EF30	-2144	F7A0
-200	-2000	F830	-3200	F380	-1600	F9C0
-100	-1000	FC18	-1600	F9C0	-800	FCE0
-50	-500	FE0C	-800	FCE0	-400	FE70
-1	-10	FFF6	-16	FFF0	0	0000
0.1	-1	FFFF	0	0000	0	0000
0	0	0000	0	0000	0	0000
0.1	1	0001	0	0000	0	0000
1	10	000A	16	0010	0	0000
500	5000	1388	8000	1F40	4000	0FA0
1000	10000	2710	16000	3E80	8000	1F40
1500	15000	3A98	24000	5DC0	12000	2EE0
1819	18190	470E	29104	71B0	14544	38D0
1819.9	18199	4717	29104	71B0	14544	38D0
1820	18200	4718	29120	71C0	14560	38E0

Note

In 12 bit representation, the module's diagnostic data are mapped into bit 0 - 3 of the input data.

Voltage measurement

Measurement [mV]				15 Bit + sign		12 Bit	
50	**100**	**500**	**1000**	**dec.**	**hex.**	**dec.**	**hex.**
-50	-100	-500	-1000	-31768	8000	-32768	8000
-49.998	-99.997	-499.985	-999.969	-32767	8001	-32767	8001
-49.976	-99.951	-499.756	-999.512	-32752	8010	-32752	8010
-0.024	-0.049	-0.244	-0.488	-16	FFF0	-16	FFF0
-0.002	-0.003	-0.015	-0.031	-1	FFFF	0	0000
0	0	0	0	0	0000	0	0000
0.002	0.003	0.015	0.031	1	0001	0	0000
0.024	0.049	0.244	0.488	16	0010	16	0010
49.951	99.902	499.512	999.023	32736	7FE0	32736	7FE0
49.997	99.994	499.969	999.939	32766	7FFE	32752	7FF0
49.998	99.997	499.985	999.969	32767	7FFF	32752	7FF0

Note

In 12 bit representation, the module's diagnostic data are mapped into bit 0 - 3 of the input data.

7 Digital Output Modules

7.1 Overview

Digital output modules (DO) receive output values from the gateway via the internal module bus. The modules convert these values and transwith the corresponding high or low level signals for each channel to the field level via the base modules.

The outputs are rated according to EN 61 131-2 Type 2.

The output supply (V_O) is tapped from the internal voltage supply bus.
This voltage is supplied by the gateway or a Power Feeding module. Both contain a short circuit detection for the output supply voltage.

An output short circuit is thus also detected in the gateway or in the Power Feeding module.

The module bus electronic of the digital output modules are galvanically isolated from the field level via an optocoupler.

Warnung

After a short circuit or an overload, the output modules switch on automatically, as soon as the error has been eliminated.

LED status indicators

Channel statuses are indicated by LEDs. Error signals from the I/O level are indicated by each module via the "D" LED. The corresponding diagnostic information is transwithted to the gateway via diagnostic bits.

Attention

An external suppressor should be planned for inductive loads.

7.1.1 Module overview

Table 7-1: Module overview

Module	No. of channels	Output current, nominal
BL67-4DO-0.5A-P	4	0.5 A
BL67-4DO-2A-P	4	2 A
BL67-4DO-4A-P	4	4 A
BL67-8DO-0.5A-P	8	0.5 A
BL67-16DO-0.1A-P	16	0.1 A
BL67-4DO-2A-N	4	2 A
BL67-8DO-0.5A-N	8	0.5 A
Module	**Galvanically isolated**	**Positive switching (sinking)**
BL67-4DO-0.5A-P	✓	✓
BL67-4DO-2A-P	✓	✓
BL67-4DO-24A-P	✓	✓
BL67-8DO-0.5A-P	✓	✓
BL67-16DO-0.1A-P	✓	✓
BL67-4DO-2A-N	✓	-
BL67-8DO-0.5A-N	✓	-

7.2 BL67-4DO-0.5A-P

Figure 7-1: BL67-4DO-0.5A

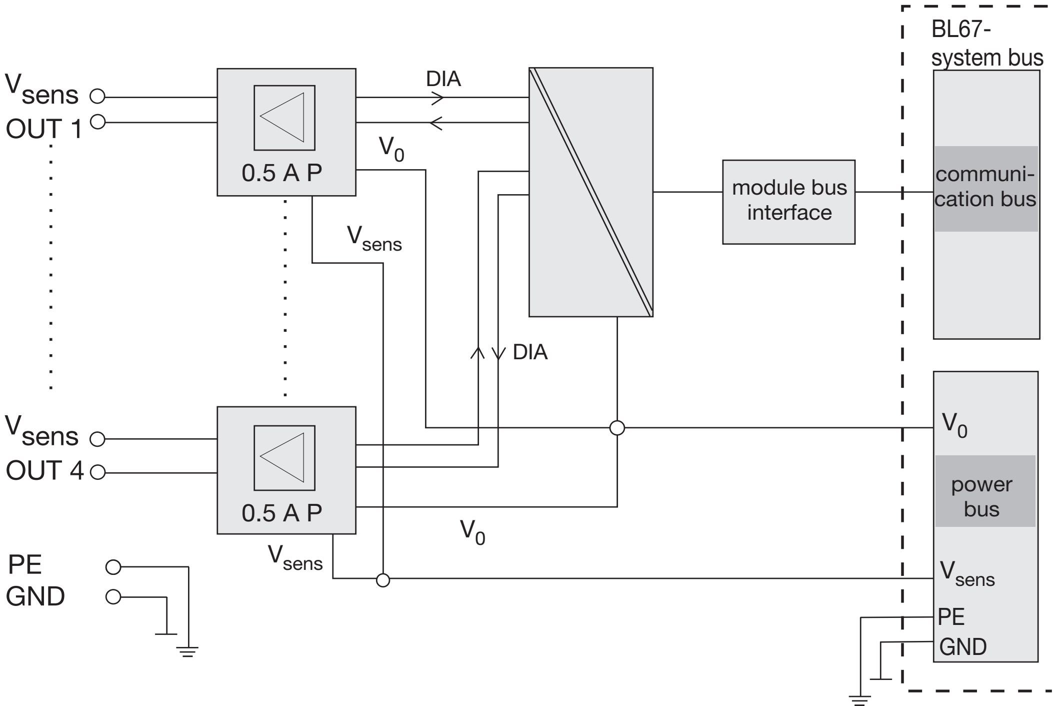


Figure 7-2: Block diagram

7.2.1 Technical data

Table 7-2: Technical data

Designation	BL67-4DO-0.5A-P
Number of channels	4
Nominal voltage from supply terminal	24 V DC
Load voltage V_O	24 VDC
Voltage range	18 to 30 VDC
Nominal current from 5 V DC (module bus) I_{MB}	≤ 30 mA
Nominal current from supply terminal (field) I_L	< 100 mA (when load current = 0)
Power loss of the module, typical	< 1.5 W
Output voltage, High level (loaded)	min. L+ (-1 V)
Output current I_A	
High level I_A (nominal)	0.5 A
High level I_{AMAX}	0.6 A (according to IEC 6 1131-2)
Synchronization factor	100 %
Switching-off characteristic K_A	
I_{OUT} > 1.5 A	< 4 ms
1.0 A < I_{OUT} < 1.5 A	< 10 s
0.6 A < I_{OUT} > 1.0 A	min. 10 s/ max. 60 s
Delay at signal change and resistive load	
From low to high level	3 ms
From high to low level	3 ms
Load impedance range	48 Ω to 1 kΩ
Switch-on resistance R_{on}	max. 190 mΩ
Resistive, inductive and lamp loads can be connected.	
Load impedance, resistive R_{LO}	48 Ω
Lamp load R_{LL}	3 W
Switching frequency	
Resistive load	200 Hz
Inductive load	2 Hz
Lamp load	20 Hz

Isolation voltage	
U_{TMB} (module bus/ field)	max. 2500 V DC
U_{FE} (field/ functional earth)	max. 1000 V DC
Short-circuit proof	Yes, according to EN 61 131-2

Note
The parallel switching of outputs is possible with the synchronous switching of the channels. In this case, the maximum output current can be increased up to 2 A, depending on the number of the parallel switched outputs.

7.2.2 Diagnostic/ status messages

Diagnosis/ status via LEDs

Table 7-3: Diagnosis/ status via LEDs

LED	Display	Meaning	Remedy
D	Red, flashing, 0.5 Hz	Diagnostics pending	-
	Red	Module bus communication failure	Check if more than two ad-joining electronic modules have been pulled. This applies to modules located between this module and the gateway.
	Off	No error messages or diagnostics	-
0 to 3	Green	Status of channel x = „1“	-
	Red	Short circuit/ Overload Channel x	Eliminate the cause for the short circuit or the overload → After cooling the module switches on autmatically.
	Off	Status of channel x = „0“	-

Diagnosis via software

Table 7-4: Diagnosis

Diagnosis	
Overload or short-circuit	The channel is switched off automatically. For the for switching-off characteristics of the outputs see Table 7-2: Technical data.

7.2.3 Module parameters

None

7.2.4 Base modules/ pin assignment

- BL67-B-4M8

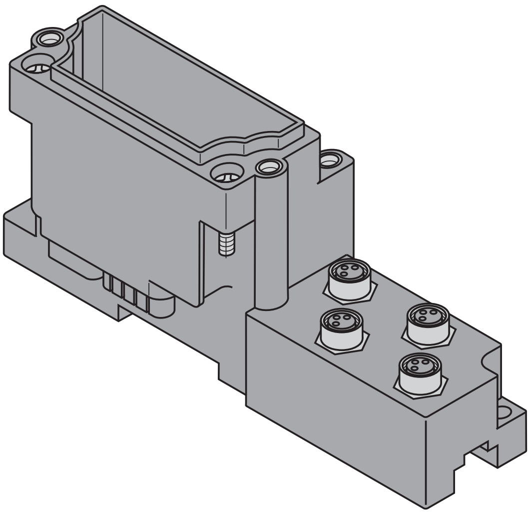


Figure 7-3: BL67-B-4M8

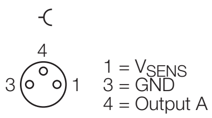


Figure 7-4: Pin assignment BL67-4DO-0.5A-P with BL67-B-4M8

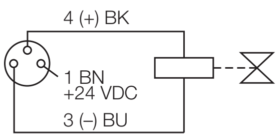


Figure 7-5: Wiring diagram BL67-4DO-0.5A-P with BL67-B-4M8

- BL67-B-2M12/ BL6 7-B-2M12-P (paired)

Figure 7-6: BL67-B-2M12/ BL67-B-2M12-P

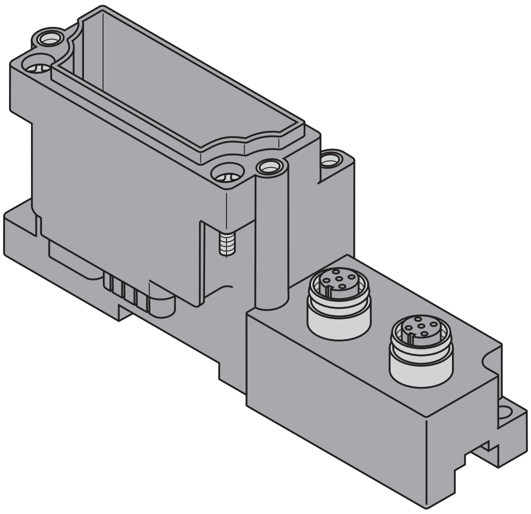


Figure 7-7: Pin assignment BL67-4DO-0.5A-P with BL67-B-2M12/ BL67-B-2M12-P

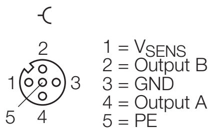
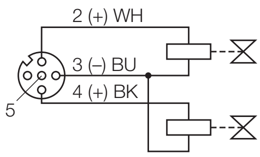
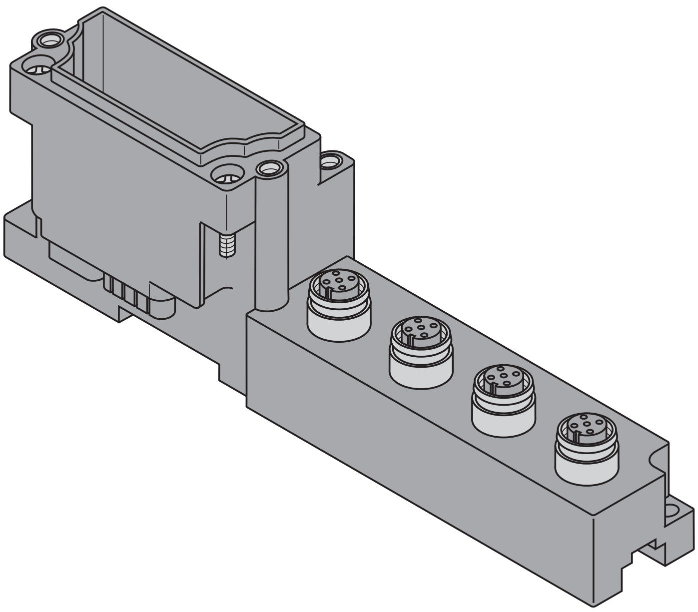


Figure 7-8: Wiring diagram BL67-4DO-0.5A-P with BL67-B-2M12/ BL67-B-2M12-P



- BL67-B-4M12

Figure 7-9: BL67-B-4M12



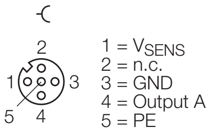


Figure 7-10: Pin assignment BL67-4DO-0.5A-P with BL67-B-4M12

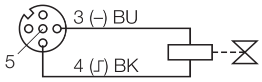


Figure 7-11: Wiring diagram BL67-4DO-0.5A-P with BL67-B-4M12

- BL67-B-1M23

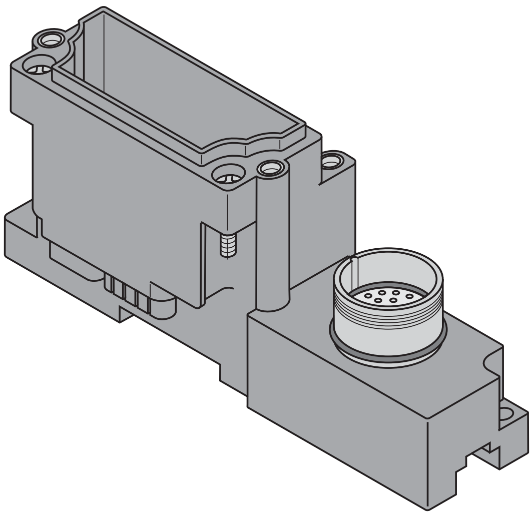


Figure 7-12: BL67-B-1M23

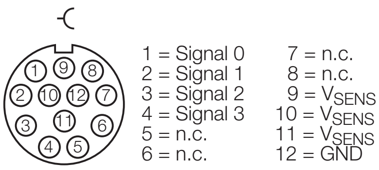


Figure 7-13: Pin assignment BL67-4DO-0.5A-P with BL67-B-1M23

7.2.5 Signal assignment

Table 7-5: Signal assigment with BL67-B-4M8

	Byte	Bit 7	Bit 6	Bit 5	Bit 4	Bit 3	Bit 2	Bit 1	Bit 0
Out	m	-	-	-	-	C3P4	C2P4	C1P4	C0P4

Table 7-6: Signal assigment with BL67-B-2M12

	Byte	Bit 7	Bit 6	Bit 5	Bit 4	Bit 3	Bit 2	Bit 1	Bit 0
Out	m	-	-	-	-	C1P2	C0P2	C1P4	C0P4

Table 7-7: Signal assigment with BL67-B-2M12-P

	Byte	Bit 7	Bit 6	Bit 5	Bit 4	Bit 3	Bit 2	Bit 1	Bit 0
Out	m	-	-	-	-	C1P2	C1P4	C0P2	C0P4

Table 7-8: Signal assigment with BL67-B-4M12

	Byte	Bit 7	Bit 6	Bit 5	Bit 4	Bit 3	Bit 2	Bit 1	Bit 0
Out	m	-	-	-	-	C3P4	C2P4	C1P4	C0P4

Table 7-9: Signal assigment with BL67-B-1M23

	Byte	Bit 7	Bit 6	Bit 5	Bit 4	Bit 3	Bit 2	Bit 1	Bit 0
Out	m	-	-	-	-	C0P4	C0P3	C0P2	C0P1

m = process data offset of the output data depending on station configuration and the corresponding fieldbus.

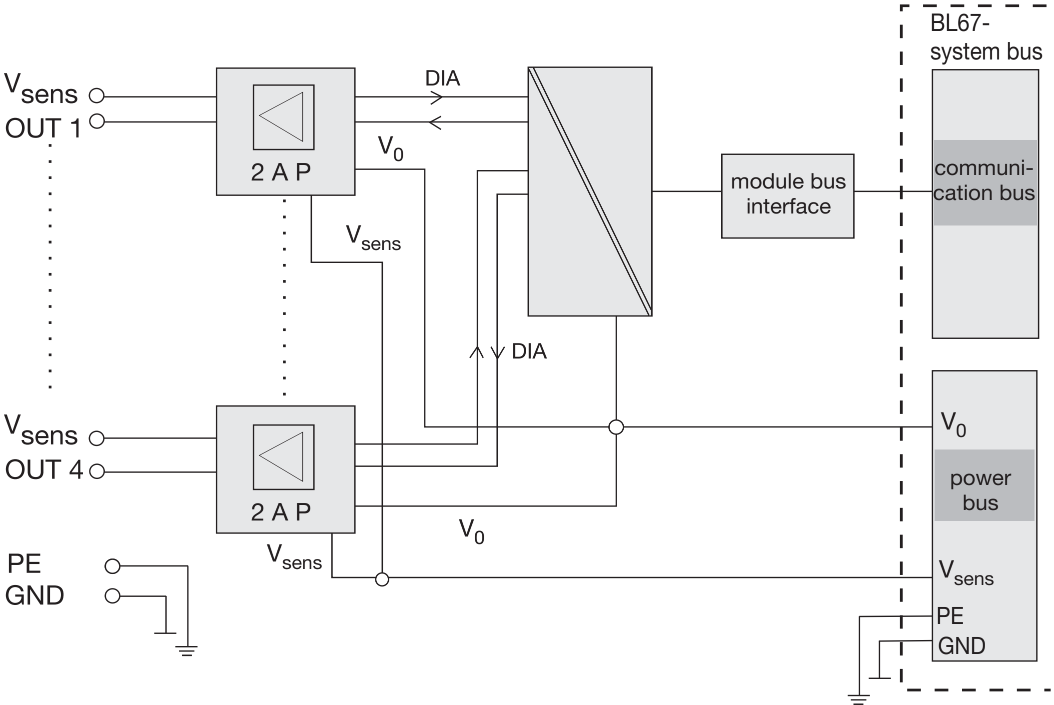
C… = slot no.

P… = pin no.

7.3 BL67-4DO-2A-P

Figure 7-14: BL67-4DO-2A-P

Figure 7-15: Block diagram



7.3.1 Technical data

Table 7-10: Technical data

Designation	BL67-4DO-2A-P
Number of channels	4
Nominal voltage from supply terminal	24 V DC
Load voltage V_O	24 V DC
Voltage range	18 to 30 V DC
Nominal current from 5 V DC (module bus) I_{MB}	≤ 30 mA
Nominal current from supply terminal (field) I_L	< 100 mA (when load current = 0)

Power loss of the module, typical	< 1.5 W
Output voltage, High level (loaded)	min. L+ (-1 V)
Output current I_A	
High level I_A (nominal)	2 A
High level I_{AMAX}	max. 2.4 A (according to IEC 61131-2)
Synchronization factor	100 %
Switching-off characteristic K_A	
I_{OUT} > 6 A	< 4 ms
4 A < I_{OUT} < 6 A	< 10 s
2.2 A < I_{OUT} < 4 A	min. 10 s/ max. 60 s
Delay at signal change and resistive load	
From low to high level	3 ms
From high to low level	3 ms
Load impedance range	12 Ω to 1 kΩ
Switch-on resistance R_{ON}	max. 50 mΩ
Resistive, inductive and lamp loads can be connected.	
Load impedance, resistive R_{LO}	12 Ω
Lamp load R_{LL}	10 W
Switching frequency	
Resistive load	200 Hz
Inductive load	2 Hz
Lamp load	20 Hz
Isolation voltage	
U_{TMB} (module bus/ field)	max. 2500 V DC
U_{FE} (field/ functional earth)	max. 1000 V DC
Short-circuit proof	Yes, according to EN 61 131-2

Note
The parallel switching of outputs is possible with the synchronous switching of the channels. In this case, the maximum output current can be increased up to 8 A, depending on the number of the outputs switched in paralell.

7.3.2 Diagnostic/ status messages

Diagnosis/ status via LEDs

Table 7-11: Diagnosis/ status via LEDs

LED	Display	Meaning	Remedy
D	Red, flashing, 0.5 Hz	Diagnostics pending	-
	Red	Module bus communication failure	Check if more than two ad-joining electronic modules have been pulled. This applies to modules located between this module and the gateway.
	Off	No error messages or diagnostics	-
0 to 3	Green	Status of channel x = „1“	-
	Red	Short circuit/ Overload Channel x	Eliminate the cause for the short circuit or the overload → After cooling the module switches on autmatically.
	Off	Status of channel x = „0“	-

Diagnosis via software

Table 7-12: Diagnosis

Diagnosis	
Overload or short-circuit	The channel is switched off automatically. For the for switching-off characteristics of the outputs see Table 7-2: Technical data.

7.3.3 Module parameters

None

7.3.4 Base modules/ pin assignment

- BL67-B-4M8

Figure 7-16:
BL67-B-4M8

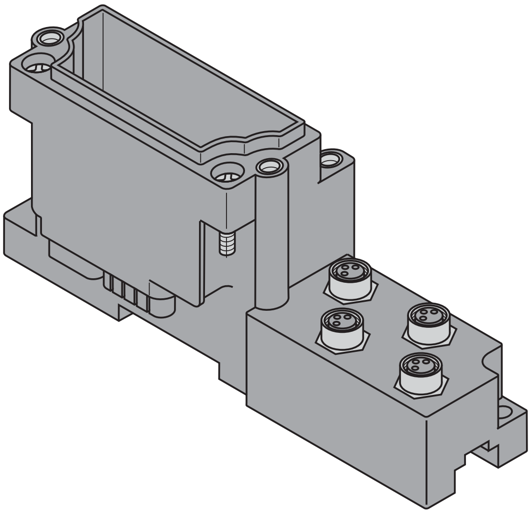


Figure 7-17:
Pin assignment
BL67-4DO-2A-P
with BL67-B-4M8

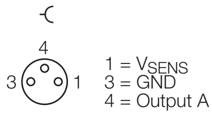
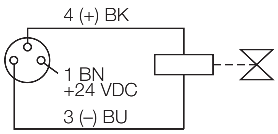


Figure 7-18:
Wiring diagram
BL67-4DO-2A-P
with BL67-B-4M8



- BL67-B-2M12/ BL6 7-B-2M12-P (paired)

Figure 7-19:
BL67-B-2M12/
BL67-B-2M12-P

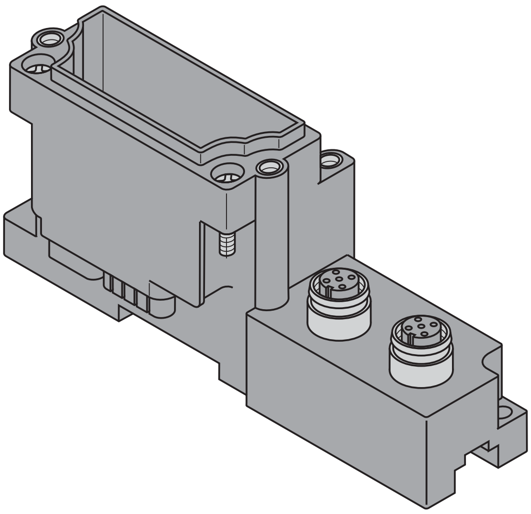


Figure 7-20: Pin assignment BL67-4DO-2A-P with BL67-B-2M12/ BL67-B-2M12-P

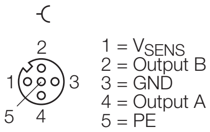
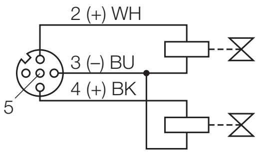


Figure 7-21: Wiring diagram BL67-4DO-2A-P with BL67-B-2M12/ BL67-B-2M12-P



- BL67-B-4M12

Figure 7-22: BL67-B-4M12

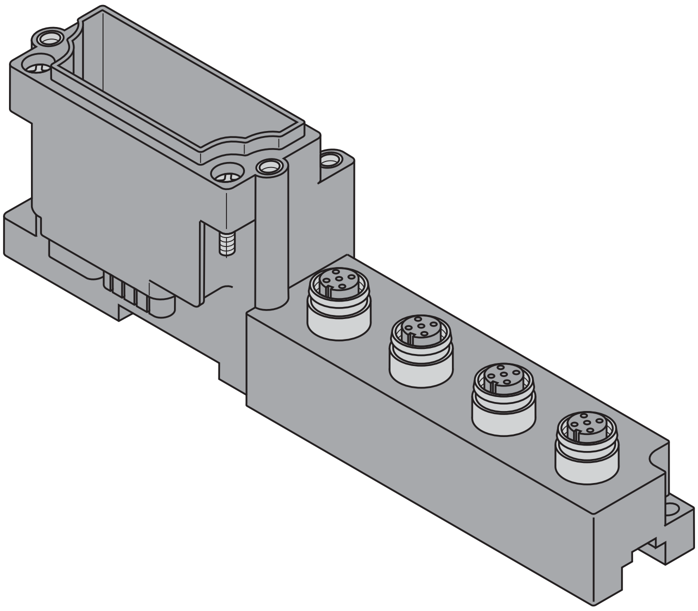


Figure 7-23: Pin assignment BL67-4DO-2A-P with BL67-B-4M12

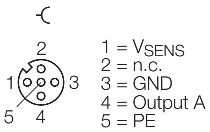
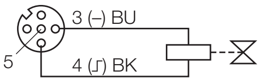


Figure 7-24: Wiring diagram BL67-4DO-2A-P with BL67-B-4M12



- BL67-B-1M23

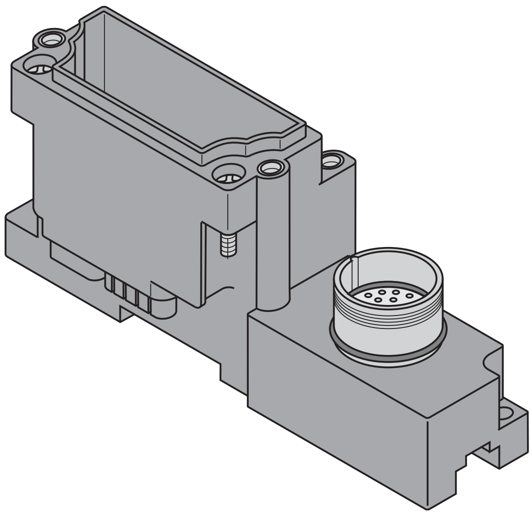


Figure 7-25:
BL67-B-1M23

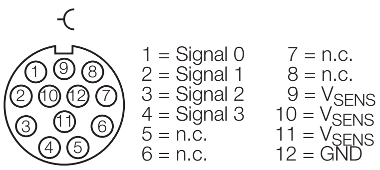


Figure 7-26:
Pin assignment
BL67-4DO-2A-P
with BL67-B-1M23

7.3.5 Signal assignment

Table 7-13: Signal assignment with BL67-B-4M8

	Byte	Bit 7	Bit 6	Bit 5	Bit 4	Bit 3	Bit 2	Bit 1	Bit 0
Out	m	-	-	-	-	C3P4	C2P4	C1P4	C0P4

Table 7-14: Signal assignment with BL67-B-2M12

	Byte	Bit 7	Bit 6	Bit 5	Bit 4	Bit 3	Bit 2	Bit 1	Bit 0
Out	m	-	-	-	-	C1P2	C0P2	C1P4	C0P4

Table 7-15: Signal assignment with BL67-B-2M12-P

	Byte	Bit 7	Bit 6	Bit 5	Bit 4	Bit 3	Bit 2	Bit 1	Bit 0
Out	m	-	-	-	-	C1P2	C1P4	C0P2	C0P4

Table 7-16: Signal assignment with BL67-B-4M12

	Byte	Bit 7	Bit 6	Bit 5	Bit 4	Bit 3	Bit 2	Bit 1	Bit 0
Out	m	-	-	-	-	C3P4	C2P4	C1P4	C0P4

Table 7-17: Signal assignment with BL67-B-1M23

	Byte	Bit 7	Bit 6	Bit 5	Bit 4	Bit 3	Bit 2	Bit 1	Bit 0
Out	m	-	-	-	-	C0P4	C0P3	C0P2	C0P1

m = process data offset of the output data depending on station configuration and the corresponding fieldbus.

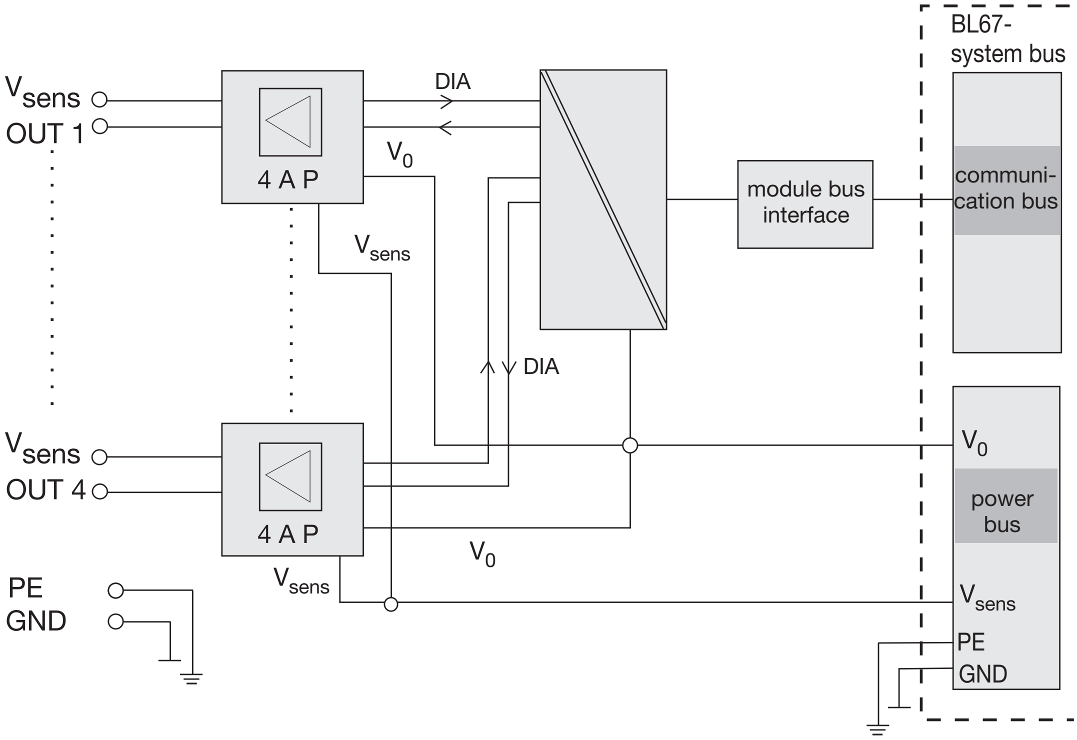
C… = slot no.

P… = pin no.

7.4 BL67- 4DO-4A-P

Figure 7-27:
BL67-4DO-4A-P

Figure 7-28:
Block diagram



7.4.1 Technical data

Table 7-18: Technical data

Designation	BL67-4DO-4A-P
Number of channels	4
Nominal voltage from supply terminal	24 V DC
Load voltage V_O	24 V DC
Voltage range	18 to 30 V DC
Nominal current from 5 V DC (module bus) I_{MB}	≤ 30 mA
Nominal current from supply terminal (field) I_L	< 100 mA (when load current = 0)
Power loss of the module, typical	< 1.5 W
Output voltage, High level (loaded)	min. L+ (-1 V)
Output current I_A	
High level I_A (nominal)	4 A
High level I_{AMAX}	max. 4.8 A (according to IEC 61131-2)
Synchronization factor	100 %
Switching-off characteristic K_A	
I_{OUT} > 12 A	< 8 ms
8 A < I_{OUT} < 12 A	< 10 s
4.4 A < I_{OUT} < 8 A	min. 10 s/ max. 60 s
Delay at signal change and resistive load	
From low to high level	3 ms
From high to low level	3 ms
Load impedance range	6 Ω to 1 kΩ
Switch-on resistance R_{ON}	max. 50 mΩ
Resistive, inductive and lamp loads can be connected.	
Load impedance, resistive R_{LO}	6 Ω
Lamp load R_{LL}	10 W
Switching frequency	
Resistive load	200 Hz
Inductive load	2 Hz
Lamp load	20 Hz

Isolation voltage	
U_{TMB} (module bus/ field)	max. 2500 V DC
U_{FE} (field/ functional earth)	max. 1000 V DC
Short-circuit proof	Yes, according to EN 61 131-2

Note
The parallel switching of outputs is possible with the synchronous switching of the channels. In this case, the maximum output current can be increased up to 10 A, depending on the number of the outputs switched in parallel.

7.4.2 Diagnostic/ status messages

Diagnosis/ status via LEDs

Table 7-19: Diagnosis/ status via LEDs

LED	Display	Meaning	Remedy
D	Red, flashing, 0.5 Hz	Diagnostics pending	-
	Red	Module bus communication failure	Check if more than two ad-joining electronic modules have been pulled. This applies to modules located between this module and the gateway.
	Off	No error messages or diagnostics	-
0 to 3	Green	Status of channel x = „1“	-
	Red	Short circuit/ Overload Channel x	Eliminate the cause for the short circuit or the overload → After cooling the module switches on autmatically.
	Off	Status of channel x = „0“	-

Diagnosis via software

Table 7-20: Diagnosis

Diagnosis	
Overload or short-circuit	The channel is switched off automatically. For switching-off characteristics of the outputs see Table 7-2: Technical data.

7.4.3 Module parameters

None

7.4.4 Base modules/ pin assignment

- BL67-B-4M8

Figure 7-29: BL67-B-4M8

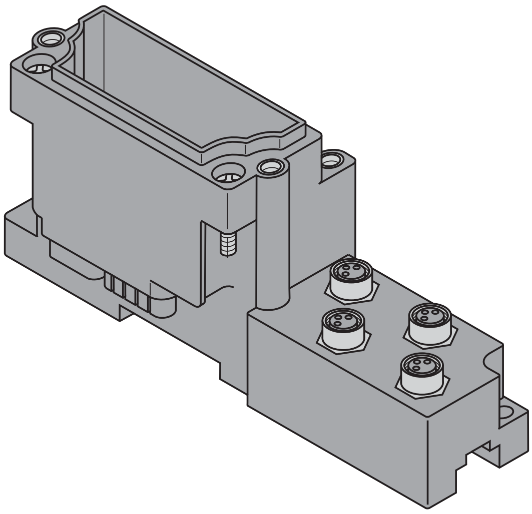


Figure 7-30: Pin assignment BL67-4DO-4A-P with BL67-B-4M8

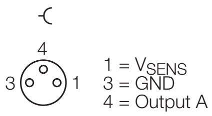
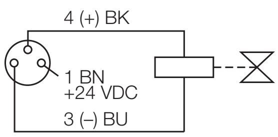


Figure 7-31: Wiring diagram BL67-4DO-4A-P with BL67-B-4M8



- BL67-B-2M12/ BL6 7-B-2M12-P (paired)

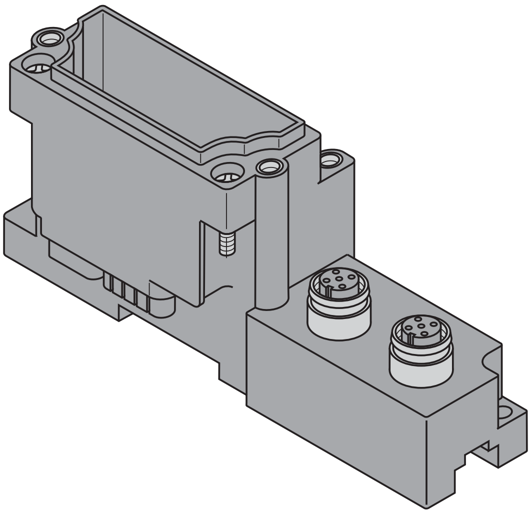


Figure 7-32: BL67-B-2M12/ BL67-B-2M12-P

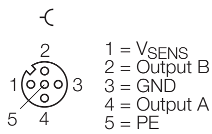


Figure 7-33: Pin assignment BL67-4DO-4A-P with BL67-B-2M12/ BL67-B-2M12-P

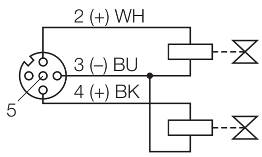


Figure 7-34: Wiring diagram BL67-4DO-4A-P with BL67-B-2M12/ BL67-B-2M12-P

- BL67-B-4M12

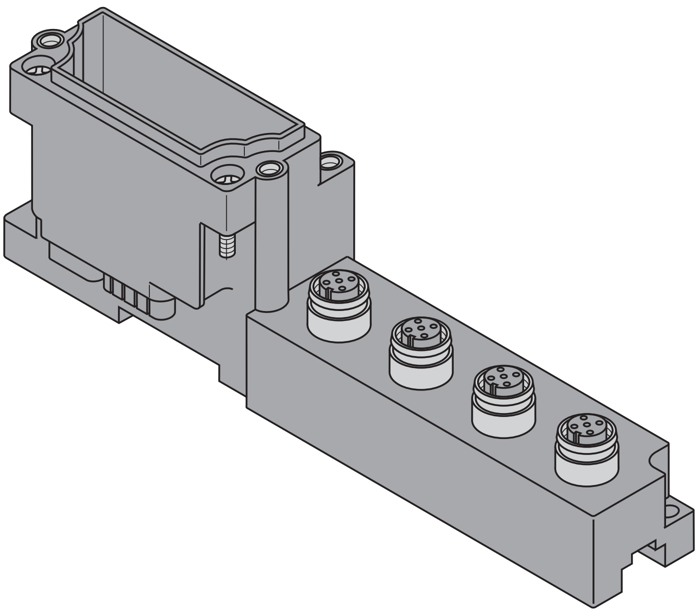


Figure 7-35: BL67-B-4M12

Figure 7-36:
Pin assignment
BL67-4DO-4A-P
with BL67-B-4M12

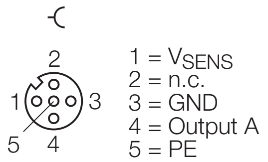
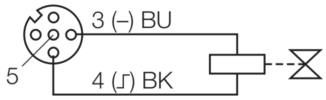


Figure 7-37:
Wiring diagram
BL67-4DO-4A-P
with BL67-B-4M12



- BL67-B-1M23

Figure 7-38:
BL67-B-1M23

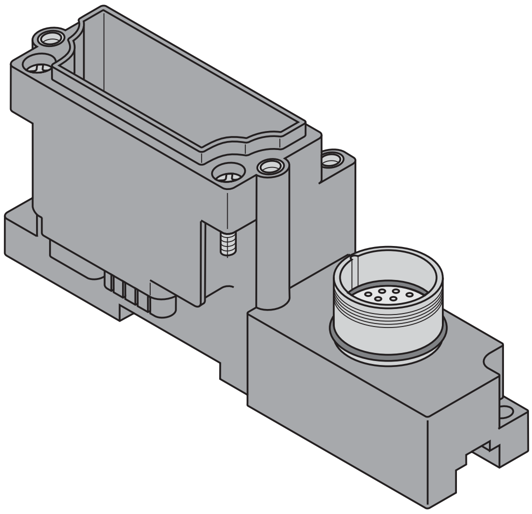
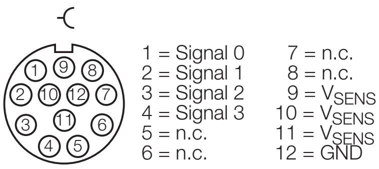


Figure 7-39:
Pin assignment
BL67-4DO-4A-P
with BL67-B-1M23



7.4.5 Signal assignment

Table 7-21: Signal assigment with BL67-B-4M8

	Byte	Bit 7	Bit 6	Bit 5	Bit 4	Bit 3	Bit 2	Bit 1	Bit 0
Out	m	-	-	-	-	C3P4	C2P4	C1P4	C0P4

Table 7-22: Signal assigment with BL67-B-2M12

	Byte	Bit 7	Bit 6	Bit 5	Bit 4	Bit 3	Bit 2	Bit 1	Bit 0
Out	m	-	-	-	-	C1P2	C0P2	C1P4	C0P4

Table 7-23: Signal assigment with BL67-B-2M12-P

	Byte	Bit 7	Bit 6	Bit 5	Bit 4	Bit 3	Bit 2	Bit 1	Bit 0
Out	m	-	-	-	-	C1P2	C1P4	C0P2	C0P4

Table 7-24: Signal assigment with BL67-B-4M12

	Byte	Bit 7	Bit 6	Bit 5	Bit 4	Bit 3	Bit 2	Bit 1	Bit 0
Out	m	-	-	-	-	C3P4	C2P4	C1P4	C0P4

Table 7-25: Signal assigment with BL67-B-1M23

	Byte	Bit 7	Bit 6	Bit 5	Bit 4	Bit 3	Bit 2	Bit 1	Bit 0
Out	m	-	-	-	-	C0P4	C0P3	C0P2	C0P1

m = process data offset of the output data depending on station configuration and the corresponding fieldbus.

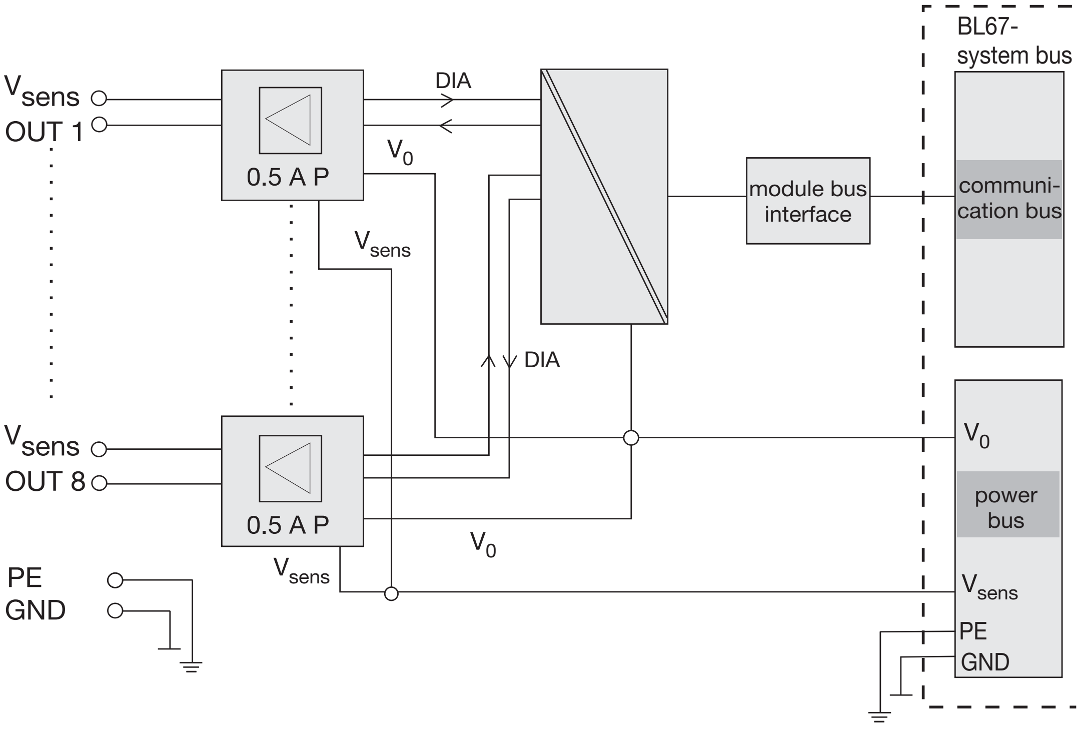
C… = slot no.

P… = pin no.

7.5 BL67-8DO-0.5A-P

Figure 7-40: BL67-8DO-0.5A

Figure 7-41: Block diagram



Turck Industrial Automation

7.5.1 Technical data

Table 7-26: Technical data

Designation	BL67-8DO-0.5A-P
Number of channels	8
Nominal voltage from supply terminal	24 V DC
Load voltage V_O	24 V DC
Voltage range	18 to 30 V DC
Nominal current from 5 V DC (module bus) I_{MB}	≤ 30 mA
Nominal current from supply terminal I_L	< 100 mA (when load current = 0)
Power loss of the module, typical	< 1.5 W
Output voltage, High level (loaded)	min. L+ (-1 V)
Output current I_A	
High level I_A (nominal)	0.5 A
High level I_{AMAX}	0.6 A (according to IEC 61131-2)
Synchronization factor	100 %
Switching-off characteristic K_A	
I_{OUT} > 1.5 A	< 4 ms
1.0 A < I_{OUT} < 1.5 A	10 s
0.6 A < I_{OUT} > 1.0 A	min. 10 s/ max. 60 s
Delay at signal change and resistive load	
From low to high level	3 ms
From high to low level	3 ms
Load impedance range	48 Ω to 1 kΩ
Switch-on resistance R_{ON}	max. 190 mΩ
Resistive, inductive and lamp loads can be connected.	
Load impedance, resistive R_{LO}	48 Ω
Lamp load R_{LL}	3 W
Switching frequency	
Resistive load	200 Hz
Inductive load	2 Hz
Lamp load	20 Hz

Isolation voltage	
U_{TMB} (module bus/ field)	max. 2500 V DC
U_{FE} (field/ functional earth)	max. 1000 V DC
Short-circuit proof	Yes, according to EN 61 131-2

Note
The parallel switching of outputs is possible with the synchronous switching of the channels. In this case, the maximum output current can be increased up to 4 A, depending on the number of the parallel switched outputs.

7.5.2 Diagnostic/ status messages

Diagnosis/ status via LEDs

Table 7-27: Diagnosis/ status via LEDs

LED	Display	Meaning	Remedy
D	Red, flashing, 0.5 Hz	Diagnostics pending	-
	Red	Module bus communication failure	Check if more than two ad-joining electronic modules have been pulled. This applies to modules located between this module and the gateway.
	Off	No error messages or diagnostics	-
0 to 7	Green	Status of channel x = „1“	-
	Red	Short circuit/ Overload Channel x	Eliminate the cause for the short circuit or the overload → After cooling the module switches on autmatically.
	Off	Status of channel x = „0“	-

Diagnosis via software

Table 7-28: Diagnosis

Diagnosis	
Overload or short-circuit	The channel is switched off automatically. For the for switching-off characteristics of the outputs see Table 7-2: Technical data.

7.5.3 Module parameters

None

7.5.4 Base modules/ pin assignment

- BL67-B-8M8

Figure 7-42: BL67-B-8M8

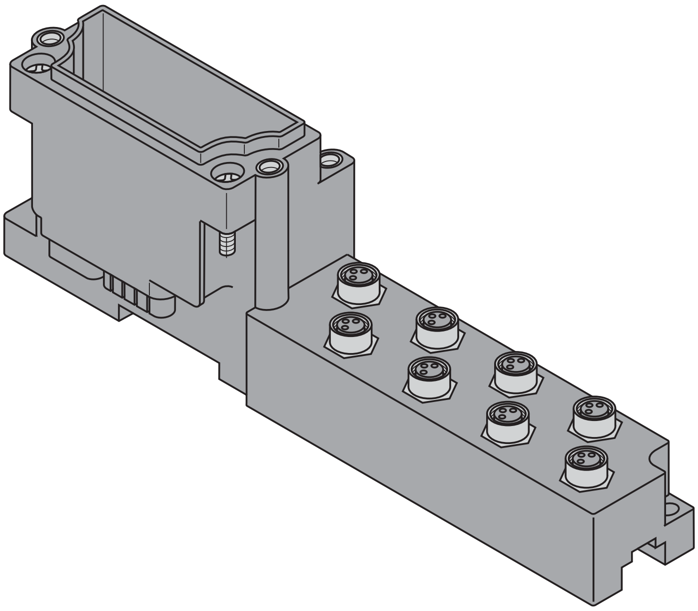


Figure 7-43: Pin assignment BL67-8DO-0.5A-P with BL67-B-8M8

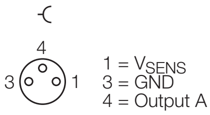
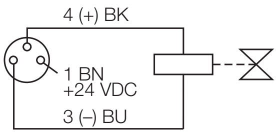


Figure 7-44: Wiring diagram BL67-8DO-0.5A-P with BL67-B-8M8



- BL67-B-4M12/ BL67-B-4M12-P

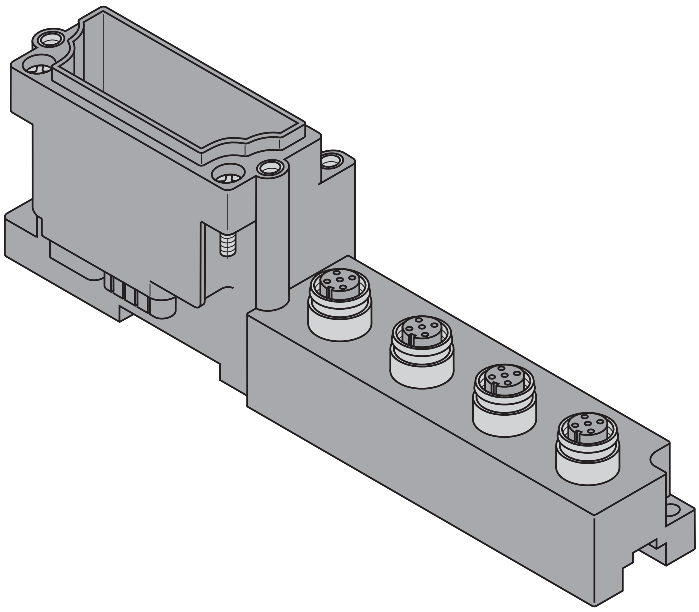


Figure 7-45: BL67-B-4M12/ BL67-B-4M12-P

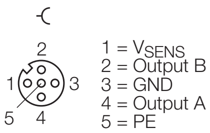


Figure 7-46: Pin assignment BL67-8DO-0.5A-P with BL67-B-4M12

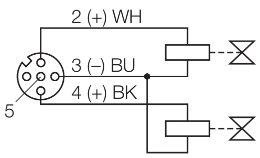


Figure 7-47: Wiring diagram BL67-8DO-0.5A-P with BL67-B-4M12

- BL67-B-1M23

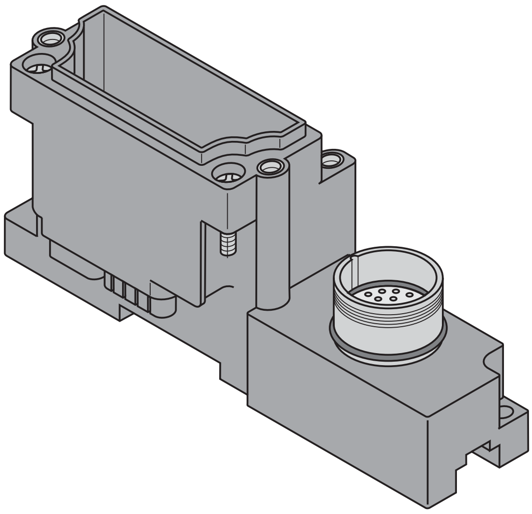
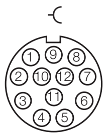


Figure 7-48: BL67-B-1M23

Figure 7-49: Pin assignment BL67-8DO-0.5A-P with BL67-B-1M23



1 = Signal 0
2 = Signal 1
3 = Signal 2
4 = Signal 3
5 = Signal 4
6 = Signal 5
7 = Signal 6
8 = Signal 7
9 = V_{SENS}
10 = V_{SENS}
11 = V_{SENS}
12 = GND

7.5.5 Signal assignment

Table 7-29: Signal assignment with BL67-B-8M8

	Byte	Bit 7	Bit 6	Bit 5	Bit 4	Bit 3	Bit 2	Bit 1	Bit 0
Out	m	C7P4	C6P4	C5P4	C4P4	C3P4	C2P4	C1P4	C0P4

Table 7-30: Signal assignment with BL67-B-4M12

	Byte	Bit 7	Bit 6	Bit 5	Bit 4	Bit 3	Bit 2	Bit 1	Bit 0
Out	m	C3P2	C2P2	C1P2	C0P2	C3P4	C2P4	C1P4	C0P4

Table 7-31: Signal assignment with BL67-B-4M12-P

	Byte	Bit 7	Bit 6	Bit 5	Bit 4	Bit 3	Bit 2	Bit 1	Bit 0
Out	m	C3P2	C3P4	C2P2	C2P4	C1P2	C1P4	C0P2	C0P4

Table 7-32: Signal assignment with BL67-B-1M23

	Byte	Bit 7	Bit 6	Bit 5	Bit 4	Bit 3	Bit 2	Bit 1	Bit 0
Out	m	C0P8	C0P7	C0P6	C0P5	C0P4	C0P3	C0P2	C0P1

m = process data offset of the output data depending on station configuration and the corresponding fieldbus.

C… = slot no.

P… = pin no.

7.6 BL67-16DO-0.1A-P

Figure 7-50: BL67-16DO-0.1A-P

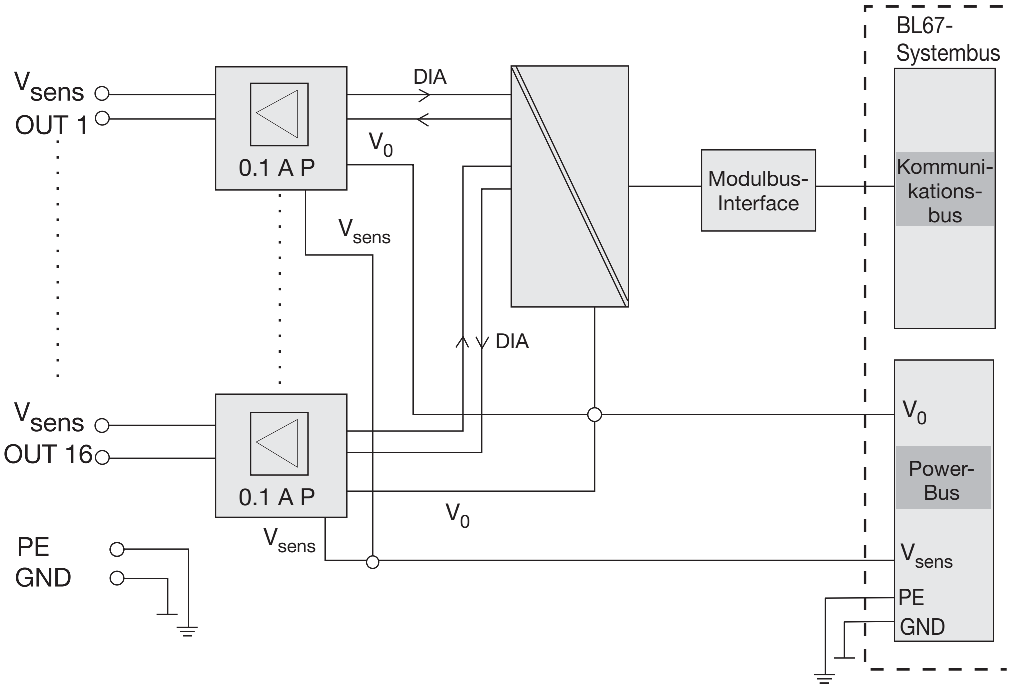


Figure 7-51: block diagram

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7.6.1 Technical data

Table 7-33: Technical data

Designation	BL67-16DO-0.1A-P
Number of channels	16
Nominal voltage from supply terminal	24 V DC
Load voltage V_O	24 V DC
Voltage range	18 to 30 V DC
Nominal current from 5 V DC (module bus) I_{MB}	≤ 30 mA
Nominal current from supply terminal I_L	< 100 mA (when load current = 0)
Power loss of the module, typical	< 1.5 W
Output voltage, High level (loaded)	min. L+ (-1 V)
Output current I_A	
High level I_A (nominal)	0.1 A
High level I_{AMAX}	0.12 A (according to IEC 61131-2)
Synchronization factor	100 %
Delay at signal change and resistive load	
From low to high level	3 ms
From high to low level	3 ms
Load impedance range	250 Ω to 10 kΩ
Switch-on resistance R_{ON}	max. 2 Ω
Resistive and inductive loads can be connected.	
Load impedance, resistive R_{LO}	250 Ω
Switching frequency	
Resistive load	200 Hz
Inductive load	2 Hz
Isolation voltage	
U_{TMB} (module bus/ field)	max. 2500 V DC
U_{FE} (field/ functional earth)	max. 1000 V DC
Short-circuit proof	Yes, according to EN 61 131-2

7.6.2 Diagnostic/ status messages

Diagnosis/ status via LEDs

Table 7-34: Diagnosis/ status via LEDs

LED	Display	Meaning	Remedy
D	Red, flashing, 0.5 Hz	Diagnostics pending	-
	Red	Module bus communication failure	Check if more than two adjoining electronic modules have been pulled. This applies to modules located between this module and the gateway.
	Off	No error messages or diagnostics	-
0 to 7	Green	Status of channels x/y = „1“ (see below: „Attention“)	-
	Red	Diagnosis at channels x/y	Eliminate the cause for the short circuit or the overload (see page 7-34 Diagnosis via software) → After cooling the module switches on autmatically.

> **Attention**
>
> In this module, each channel LED indicates the status of two outputs:
>
> – LED 0 = status of channels 0/1
> – …
> – LED 7 = status of channels 14/15.
>
> The red LED, indicating a channel diagnosis, is dominant.

Diagnosis via software

Table 7-35: Diagnosis

Diagnosis	
Channel diagnosis	Short-circuit or/and open circuit (depending on the parameterization, see Table 7-36:): – byte 0, bit 0 to 7 = channel 0 to 7 – byte 1, bit 0 to 7 = channel 8 to 15

7.6.3 Module parameters

Table 7-36: Module parameters

A *default-settings*

Parameter name	Value	Description
Short-circuit current	0 to 12 **A**	current above which a short-circuit diagnosis is generated: „Value“ × 10 mA.
Open circuit current	0 **A** to 12	current below which an open circuit diagnosis is generated: „Value“ × 10 mA
short-circuit detection	deactivate	
	activate **A**	
open circuit detection	deactivate **A**	
	activate	

7.6.4 Base modules/ pin assignment

- BL67-B-1M23-19

Figure 7-52: BL67-B-1M23-19

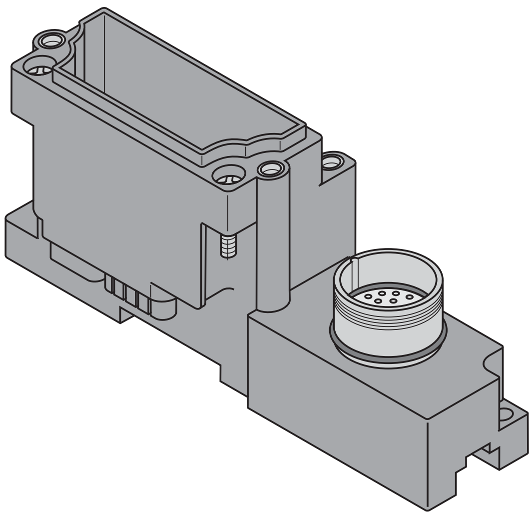
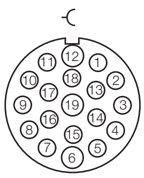


Figure 7-53: Pin assignment BL67-16DO-0.1A-P with BL67-B-1M23-19



Signal assignment

Table 7-37: Signal assignment with BL67-B-1M23-19

	Byte	Bit 7	Bit 6	Bit 5	Bit 4	Bit 3	Bit 2	Bit 1	Bit 0
Out	m	C0P14	C0P3	C0P8	C0P16	C0P4	C0P5	C0P7	C0P15
	m + 1	C0P18	C0P1	C0P10	C0P11	C0P13	C0P2	C0P9	C0P17

m = process data offset of the output data depending on station configuration and the corresponding fieldbus.

C… = slot no.

P… = pin no.

7.7 BL67-4DO-2A-N

Figure 7-54: BL67-4DO-2A-N

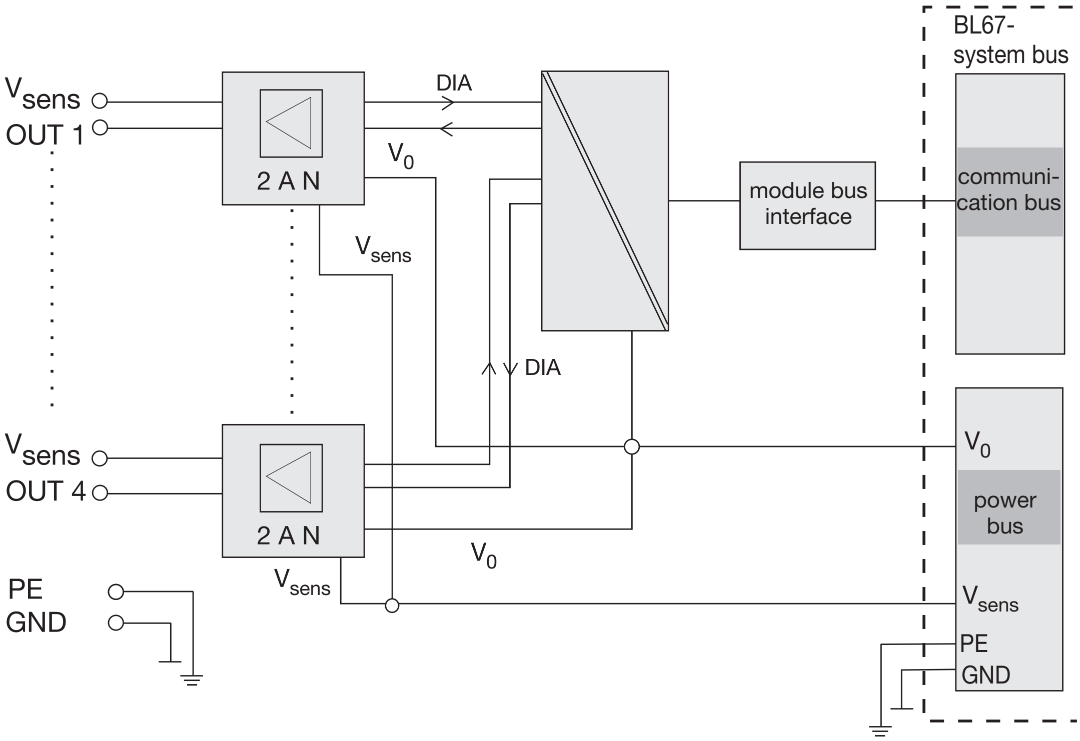


Figure 7-55: Block diagram

7.7.1 Technical data

Table 7-38: Technical data

Designation	BL67-4DO-2A-N
Number of channels	4
Nominal voltage from supply terminal	24 V DC
Load voltage V_O	24 V DC
Voltage range	18 to 30 V DC
Nominal current from 5 V DC (module bus) I_{MB}	≤ 30 mA
Nominal current from supply terminal (field) I_L	< 100 mA (when load current = 0)
Power loss of the module, typical	< 1.5 W
Output voltage, High level (loaded)	min. L+ (-1 V)
Output current I_A	
High level I_A (nominal)	2 A
High level I_{AMAX}	max. 3.6 A (according to IEC 61131-2)
Synchronization factor	100 %
Switching-off characteristic K_A	
I_{OUT} > 6 A	< 4 ms
4 A < I_{OUT} < 6 A	< 10 s
2.4 A < I_{OUT} < 4 A	min. 10 s/ max. 60 s
Delay at signal change and resistive load	
From low to high level	3 ms
From high to low level	3 ms
Load impedance range	12 Ω to 1 kΩ
Switch-on resistance R_{ON}	max. 400 mΩ
Resistive, inductive and lamp loads can be connected.	
Load impedance, resistive R_{LO}	12 Ω
Lamp load R_{LL}	6 W
Switching frequency	
Resistive load	200 Hz
Inductive load	2 Hz
Lamp load	20 Hz

Isolation voltage	
U_{TMB} (module bus/ field)	max. 2500 V DC
U_{FE} (field/ functional earth)	max. 1000 V DC
Short-circuit proof	Yes, according to EN 61 131-2

Note
The parallel switching of outputs is possible with the synchronous switching of the channels. In this case, the maximum output current can be increased up to 8 A, depending on the number of the parallel switched outputs.

7.7.2 Diagnostic/ status messages

Diagnosis/ status via LEDs

Table 7-39: Diagnosis/ status via LEDs

LED	Display	Meaning	Remedy
D	Red, flashing, 0.5 Hz	Diagnostics pending	-
	Red	Module bus communication failure	Check if more than two ad-joining electronic modules have been pulled. This applies to modules located between this module and the gateway.
	Off	No error messages or diagnostics	-
0 to 3	Green	Status of channel x = „1“	-
	Red	Short circuit/ Overload Channel x	Eliminate the cause for the short circuit or the overload → After cooling the module switches on autmatically.
	Off	Status of channel x = „0“	-

Diagnosis via software

Table 7-40: Diagnosis

Diagnosis	
Overload or short-circuit	The channel is switched off automatically. For the for switching-off characteristics of the outputs see Table 7-2: Technical data.

7.7.3 Module parameters

None

7.7.4 Base modules/ pin assignment

- BL67-B-4M8

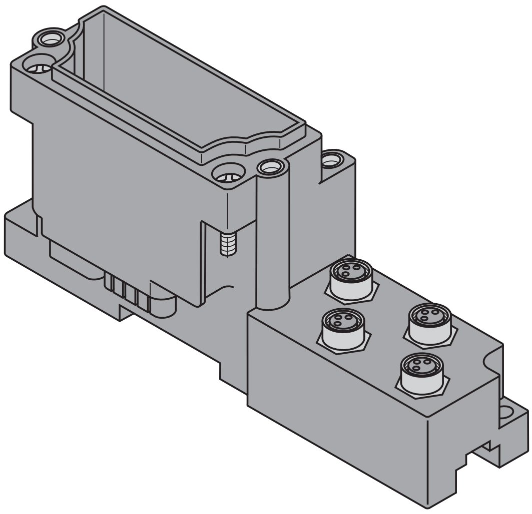


Figure 7-56: BL67-B-4M8

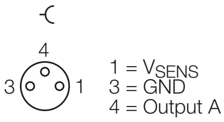


Figure 7-57: Pin assignment BL67-4DO-2A-N with BL67-B-4M8

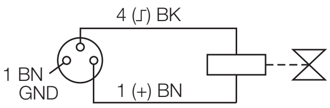


Figure 7-58: Wiring diagram BL67-4DO-2A-N with BL67-B-4M8

■ BL67-B-2M12/ BL6 7-B-2M12-P (paired)

Figure 7-59:
BL67-B-2M12/
BL67-B-2M12-P

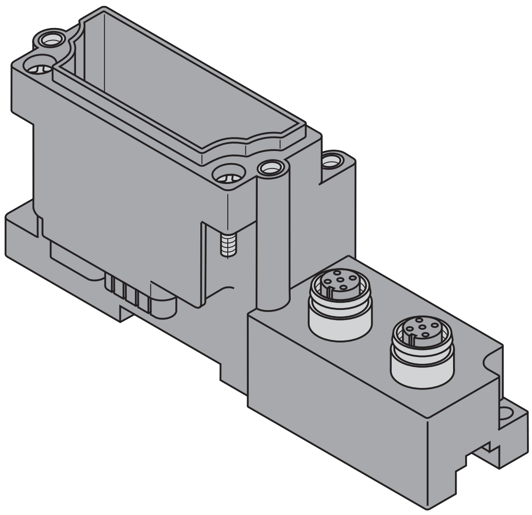


Figure 7-60:
Pin assignment
BL67-4DO-2A-N
with BL67-B-2M12/
BL67-B-2M12-P

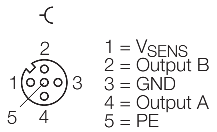
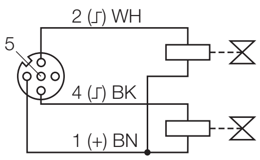


Figure 7-61:
Wiring diagram
BL67-4DO-2A-N
with BL67-B-2M12/
BL67-B-2M12-P



■ BL67-B-4M12

Figure 7-62:
BL67-B-4M12

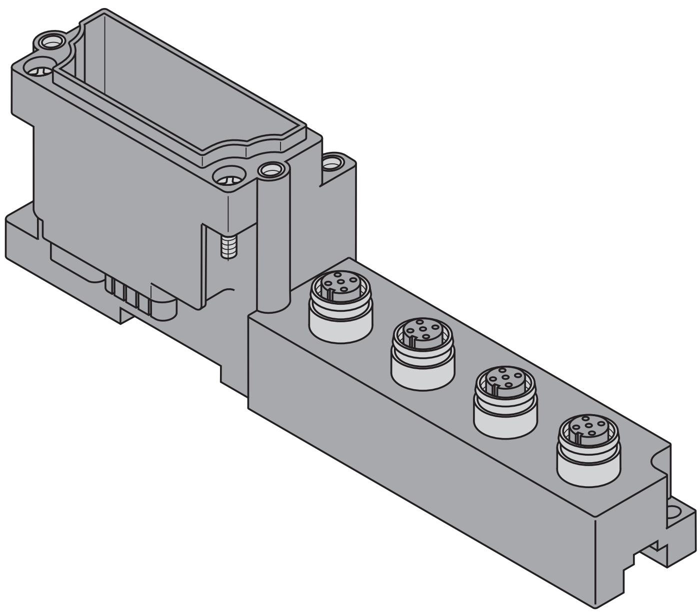


Figure 7-63:
Pin assignment
BL67-4DO-2A-N
with BL67-B-4M12

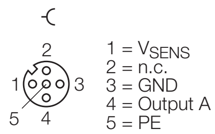
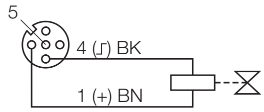


Figure 7-64:
Wiring diagram
BL67-4DO-2A-N
with BL67-B-4M12



- BL67-B-1M23

Figure 7-65:
BL67-B-1M23

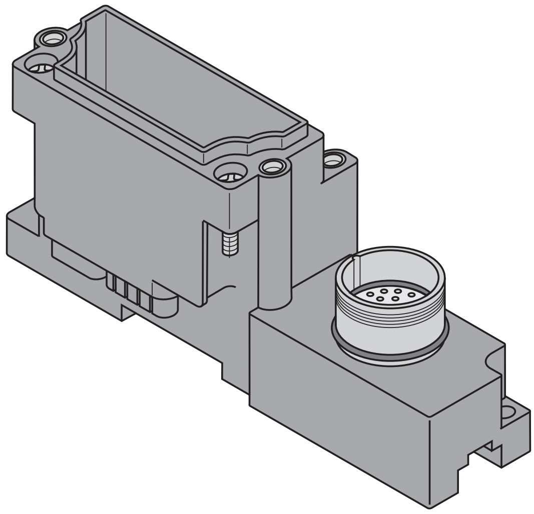
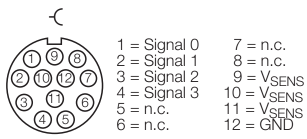


Figure 7-66:
Pin assignment
BL67-4DO-2A-N
with BL67-B-1M23



7.7.5 Signal assignment

Table 7-41: Signal assignment with BL67-B-4M8

	Byte	Bit 7	Bit 6	Bit 5	Bit 4	Bit 3	Bit 2	Bit 1	Bit 0
Out	m	-	-	-	-	C3P4	C2P4	C1P4	C0P4

Table 7-42: Signal assignment with BL67-B-2M12

	Byte	Bit 7	Bit 6	Bit 5	Bit 4	Bit 3	Bit 2	Bit 1	Bit 0
Out	m	-	-	-	-	C1P2	C0P2	C1P4	C0P4

Table 7-43: Signal assignment with BL67-B-2M12-P

	Byte	Bit 7	Bit 6	Bit 5	Bit 4	Bit 3	Bit 2	Bit 1	Bit 0
Out	m	-	-	-	-	C1P2	C1P4	C0P2	C0P4

Table 7-44: Signal assignment with BL67-B-4M12

	Byte	Bit 7	Bit 6	Bit 5	Bit 4	Bit 3	Bit 2	Bit 1	Bit 0
Out	m	-	-	-	-	C3P4	C2P4	C1P4	C0P4

Table 7-45: Signal assignment with BL67-B-1M23

	Byte	Bit 7	Bit 6	Bit 5	Bit 4	Bit 3	Bit 2	Bit 1	Bit 0
Out	m	-	-	-	-	C0P4	C0P3	C0P2	C0P1

m = process data offset of the output data depending on station configuration and the corresponding fieldbus.

C… = slot no.

P… = pin no.

7.8 BL67-8DO-0.5A-N

Figure 7-67: BL67-8DO-0.5A-N

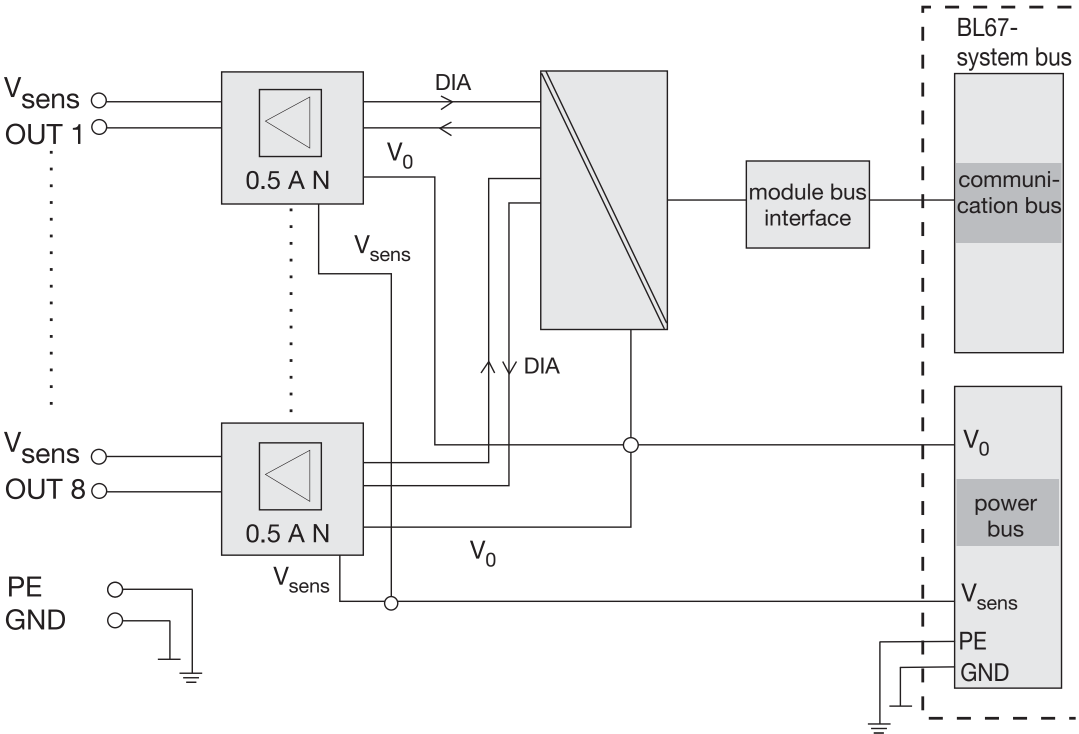


Figure 7-68: Block diagram

7.8.1 Technical data

Table 7-46: Technical data

Designation	BL67-8DO-0.5A-N
Number of channels	8
Nominal voltage from supply terminal	24 V DC
Load voltage V_O	24 V DC
Voltage range	18 to 30 V DC
Nominal current from 5 V DC (module bus) I_{MB}	≤ 30 mA
Nominal current from supply terminal I_L	< 100 mA (when load current = 0)
Power loss of the module, typical	< 1.5 W
Output voltage, High level (loaded)	min. L+ (-1 V)
Output current I_A	
High level I_A (nominal)	0.5 A
High level I_{AMAX}	0.6 A (according to IEC 61131-2)
Synchronization factor	100 %
Switching-off characteristic K_A	
I_{OUT} > 1.5 A	< 4 ms
1.0 A < I_{OUT} < 1.5 A	10 s
0.6 A < I_{OUT} > 1.0 A	min. 10 s/ max. 60 s
Delay at signal change and resistive load	
From low to high level	3 ms
From high to low level	3 ms
Load impedance range	48 Ω to 1 kΩ
Switch-on resistance R_{ON}	max. 800 mΩ
Resistive, inductive and lamp loads can be connected.	
Load impedance, resistive R_{LO}	48 Ω
Lamp load R_{LL}	3 W
Switching frequency	
Resistive load	200 Hz
Inductive load	2 Hz
Lamp load	20 Hz

Isolation voltage	
U_{TMB} (module bus/ field)	max. 2500 V DC
U_{FE} (field/ functional earth)	max. 1000 V DC
Short-circuit proof	Yes, according to EN 61 131-2

Note
The parallel switching of outputs is possible with the synchronous switching of the channels. In this case, the maximum output current can be increased up to 4 A, depending on the number of the parallel switched outputs.

7.8.2 Diagnostic/ status messages

Diagnosis/ status via LEDs

Table 7-47: Diagnosis/ status via LEDs

LED	Display	Meaning	Remedy
D	Red, flashing, 0.5 Hz	Diagnostics pending	-
	Red	Module bus communication failure	Check if more than two ad-joining electronic modules have been pulled. This applies to modules located between this module and the gateway.
	Off	No error messages or diagnostics	-
0 to 7	Green	Status of channel x = „1“	-
	Red	Short circuit/ Overload Channel x	Eliminate the cause for the short circuit or the overload → After cooling the module switches on autmatically.
	Off	Status of channel x = „0“	-

Diagnosis via software

Table 7-48: Diagnosis

Diagnosis	
Overload or short-circuit	The channel is switched off automatically. For the for switching-off characteristics of the outputs see Table 7-2:.

7.8.3 Module parameters

None

7.8.4 Base modules/ pin assignment

- BL67-B-8M8

Figure 7-69: BL67-B-8M8

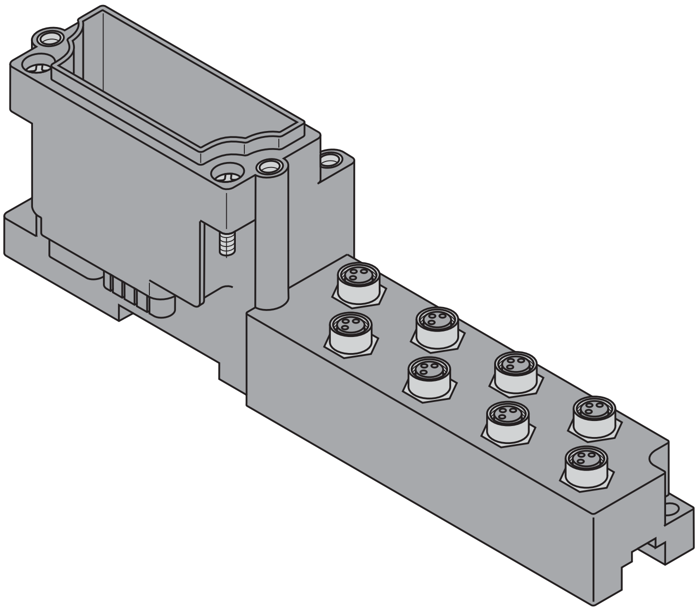


Figure 7-70: Pin assignment BL67-8DO-0.5A-N with BL67-B-8M8

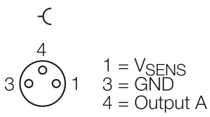
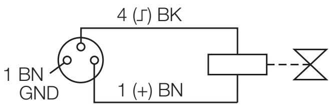


Figure 7-71: Wiring diagram BL67-8DO-0.5A-N with BL67-B-8M8



- BL67-B-4M12/ BL67-B-4M12-P

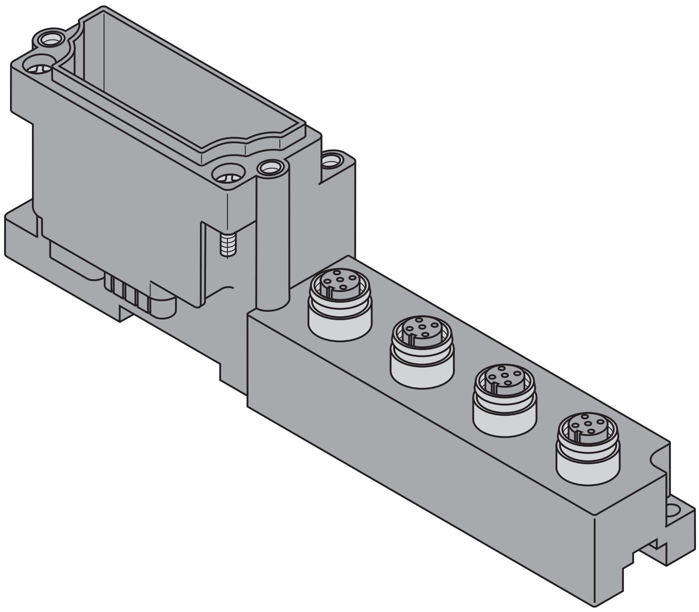


Figure 7-72: BL67-B-4M12/ BL67-B-4M12-P

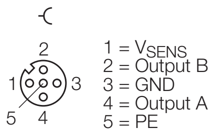


Figure 7-73: Pin assignment BL67-8DO-0.5A-N with BL67-B-4M12

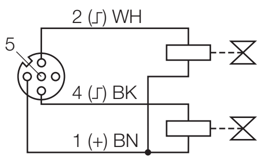


Figure 7-74: Wiring diagram BL67-8DO-0.5A-N with BL67-B-4M12

- BL67-B-1M23

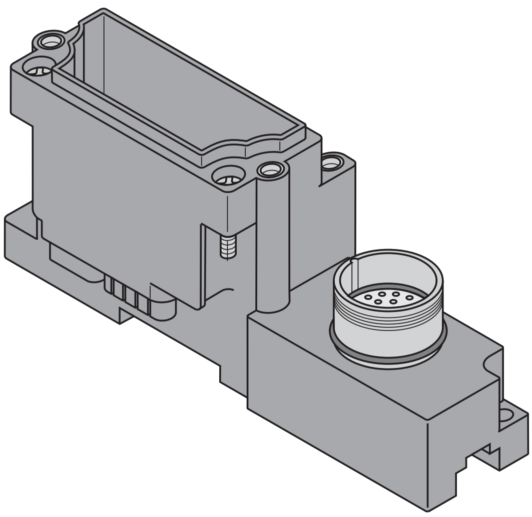
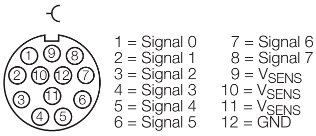


Figure 7-75: BL67-B-1M23

Figure 7-76: Pin assignment BL67-8DO-0.5A-N with BL67-B-1M23



7.8.5 Signal assignment

Table 7-49: Signal assignment with BL67-B-8M8

	Byte	Bit 7	Bit 6	Bit 5	Bit 4	Bit 3	Bit 2	Bit 1	Bit 0
Out	m	C7P4	C6P4	C5P4	C4P4	C3P4	C2P4	C1P4	C0P4

Table 7-50: Signal assignment with BL67-B-4M12

	Byte	Bit 7	Bit 6	Bit 5	Bit 4	Bit 3	Bit 2	Bit 1	Bit 0
Out	m	C3P2	C2P2	C1P2	C0P2	C3P4	C2P4	C1P4	C0P4

Table 7-51: Signal assignment with BL67-B-4M12-P

	Byte	Bit 7	Bit 6	Bit 5	Bit 4	Bit 3	Bit 2	Bit 1	Bit 0
Out	m	C3P2	C3P4	C2P2	C2P4	C1P2	C1P4	C0P2	C0P4

Table 7-52: Signal assignment with BL67-B-1M23

	Byte	Bit 7	Bit 6	Bit 5	Bit 4	Bit 3	Bit 2	Bit 1	Bit 0
Out	m	C0P8	C0P7	C0P6	C0P5	C0P4	C0P3	C0P2	C0P1

m = process data offset of the output data depending on station configuration and the corresponding fieldbus.

C… = slot no.

P… = pin no.

8 Analog Output Modules

8.1 Overview

Analog output modules (AO) receive output values from the gateway via the internal module bus. The modules convert these values and transmit the corresponding signals for each channel to the field level via the base modules.

The output supply (V_O) is tapped from the internal voltage supply bus.
This voltage is supplied by the gateway or a Power Feeding module. Both contain a short circuit detection for the output supply voltage.

An output short circuit is thus also detected in the gateway or in the Power Feeding module.

The module bus electronic of the analog input modules are galvanically isolated from the module bus and provide reverse polarity protection.

The modules are short-circuit proof.

Supported signal ranges

- BL67-2AO-I:
  0 to 20 mA,
  4 to 20 mA
- BL67-2AO-V/BL67-4AO-V:
  0 to 10 V DC
  -10 to 10 V DC

LED status indicators

Error signals from the I/O level are indicated by each module via the "D" LED. The corresponding diagnostic information is transmitted to the gateway via diagnostic bits.

8.1.1 Resolution of analog value representations

In the bipolar mode the digitalized analog values are represented as a two's complement. The 16 bit or the 12 bit representation (left justified) can be chosen by setting the respective module parameter.

Note
A detailed description of the 16 bit/12 bit representation for the analog values can be found in the "appendix", page 15-1.

8.1.2 Module overview

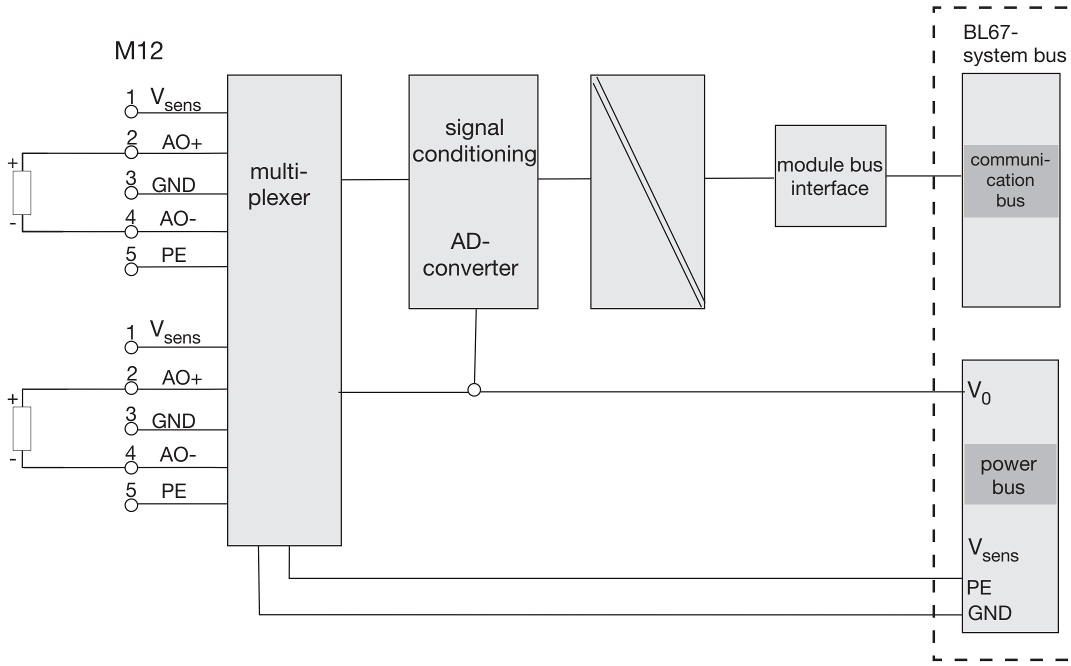
Table 8-1: Module overview

Module	Number of channels	Short-circuit proof
BL67-2AO-I	2	✓
BL20-2AO-V	2	✓
BL67-4AO-V	4	✓

8.2 BL67-2AO-I, 0/4...20mA

Figure 8-1: BL67-2AO-I

Figure 8-2: Block diagram



8.2.1 Technical data

Table 8-2: Technical data

Designation	BL67-2AO-I
Number of channels	2
Nominal voltage from supply terminal	24 V DC
Load voltage U_L	24 VDC
voltage range	18 to 30 VDC
Nominal current from 5 V DC (module bus) I_{MB}	≤ 40 mA
Nominal current from supply terminal I_L	≤ 50 mA
Power loss of the module, typical P_{MAX}	< 1 W
Output current I_A	0/4 to 20 mA
Burden resistance	
Resistive load R_{LO}	< 450 Ω
Inductive load R_{Lk}	< 1 mH
Transmission frequency f_T	< 200 Hz
Basic error at 23 °C / 73.4 °F	0.2 %
Temperature coefficient	≤ 150 ppm/°C of end value
Settling time (maximum)	
Resistive load	0.1 ms
Inductive Load	0.5 ms
Isolation voltage	
U_{TMB} (module bus/ field)	min. 500 V_{rms}
U_{Fe} (field/ functional earth)	min. 50 V_{AC}
channel/channel	no
channel/field supply	no
channel/system supply	500 V_{rms}
Measurement value representation	16 Bit Signed Integer / 12 Bit Full Range left-justified
I_{SENS} (output supply from V_O)	≤ 250 mA per channel; short-circuit protection in gateway or Power Feeding module

Note

Negative values are automatically displayed as 0 mA or 4 mA, depending on the configured measurement range.

8.2.2 Diagnostic/ status messages

Diagnosis/ status via LEDs

Table 8-3: Diagnosis/ status via LEDs

LED	Display	Meaning	Remedy
D	Red	Module bus communication failure	Check if more than two ad-joining electronic modules have been pulled. This applies to modules located between this module and the gateway.
	Off	No error messages or diagnostics	–

8.2.3 Module parameters (per channel)

The module provides 4 byte parameter data (1 byte per channel)

Table 8-4: Module parameters

***A** default-settings*

Parameter name	Value
Current mode Kx	0 = 0…20mA **A** 1 = 4…20mA
Value representation Kx	0 = integer (15bit + sign) A 1 = 12bit (left-justified)
Channel Kx	0 = activate A 1 = deactivate
Substitute value Ax	The substitute value will be transmitted if the respective parameters of the gateway have been set to „output substitute value“.
Number representation	00 = Standard **A** 01 = NE 43 10 = Extended Range

Note
Concerning the „number representation“, please observe the tables for measurement value representation on the following pages.

8.2.4 Measurement value representation

Standard value representation

- 16-bit-representation

dec.	hex.	0...20 mA	4...20 mA
		dec. value= 1638.35 [1/mA] × current value [mA]	dec. value= 2047.94 [1/mA] × (current value [mA] - 4 mA)
32767	7FFF	20.0000 mA	20.0000 mA
32766	7FFE	19.9994 mA	19.9995 mA
...	...	...	...
16384	4000	10.0003 mA	12.00024 mA
...	...	...	...
1	0001	0.0006103 mA	4.0004883 mA
0	0000	0.000000 mA	4.000000 mA
-1	FFFF	0.000000 mA	4.000000 mA
...	...	...	...
-16384	C000	0.000000 mA	4.000000 mA
...	...	...	...
-32767	8001	0.000000 mA	4.000000 mA
-32768	8000	0.000000 mA	4.000000 mA

- 12-bit-representation (left-justified)

dec.	hex.	0...20 mA	4...20 mA
		dec. value= 204.75 [1/mA] × current value [mA] × 16	dec. value= (255.9 [1/mA] × (current value [mA] - 4 mA)) × 16
4095 × 16	FFF×	20.0000 mA	20.0000 mA
4094 × 16	FFEx	19.995117 mA	19.99609 mA
...	...	...	...
2048 × 16	800x	10.0024 mA	12.0020 mA
...	...	...	...
1 × 16	001x	0.004883 mA	4.00391 mA
0	000x	0.000000 mA	4.000000 mA

Extended Range - value representation

- 16-bit-representation

dec.	hex.		0...20 mA
dec. value= 1382.4 [1/mA] × current value [mA]			
32767	7FFF		23.7030 mA
32752	7FF0		23.692 mA
32512	7F00		23.518 mA
32511	7EFF	out of range	23.517 mA
32496	7EF0		23.507 mA
27664	6C10		20.0116 mA
27649	6C01		20.0007 mA
27648	6C00	nominal range	20 mA
16	0010		11.574 µA
1	0001		0.7234 µA
0	0000		0.0000 mA
-1	FFFF		0.0000 mA
-16	FFF0		0.0000 mA
-6912	E500		0.0000 mA
-27648	9400		0.0000 mA
-27649	93FF		0.0000 mA
-27664	93F0		0.0000 mA
-32512	8100		0.0000 mA
-32513	80FF		0.0000 mA
-32752	80F0		0.0000 mA
-32768	8000		0.0000 mA

dec.	hex.		4...20 mA
dec. value= 1382.4 [1/mA] × current value [mA]			
32767	7FFF		22.9624 mA
32752	7FF0		22.9537 mA
32512	7F00		22.8148 mA
32511	7EFF	out of range	22.8142 mA
32496	7EF0		22.8056 mA
27664	6C10		20.0093 mA
27649	6C01		20.0006 mA
27648	6C00	nominal range	20.0000 mA
16	0010		4.009259 mA
1	0001		4.000578 mA
0	0000		4.0000 mA
-1	FFFF	out of range	3.99942 mA
-16	FFF0		3.99075 mA
-6912	E500		0.0000 mA
-27648	9400		0.0000 mA
-27649	93FF		0.0000 mA
-27664	93F0		0.0000 mA
-32512	8100		0.0000 mA
-32513	80FF		0.0000 mA
-32752	80F0		0.0000 mA
-32768	8000		0.0000 mA

- 12-bit-representation (left-justified)
  The representation of the 12 bit values is similar to that of the 16 bit values. Only the bits Bit 0-3 are set to "0".

Value representation for process automation (NE 43)

The hexadecimal value, transmitted from the module has to be interpreted as decimal value which, multiplied by a certain factor, corresponds to the analog measurement value.

Example:

Process value	
– dec.	15020
– hex.	3AAC
Output current	15.02 mA

- 16-bit-representation

dec.	hex.		0...20 mA
dec. value= 1000 [1/mA] × current value [mA]			
65535	FFFF		22.000 mA
≥ 22001	55F1		22.000 mA
22000	55F0	out of range	22.000 mA
21001	5209		21.001 mA
21000	5208		21.000 mA
20001	4E21		20.001 mA
20000	4E20	nominal range	20.000 mA
8000	1F40		8.000 mA
4000	0FA0		4.000 mA
2	0002		0.002 mA
1	0001		0.001 mA
0	0000		0.000 mA

dec.	hex.		4...20 mA
dec. value= 1000 [1/mA] × current value [mA]			
65535	FFFF		22.000 mA
22001	55F1		22.001 mA
22000	55F0	out of range	22.000 mA
21001	5209		21.001 mA
21000	5208		21.000 mA
20001	4E21		20.001 mA
20000	4E20	nominal range	20.000 mA
8000	1F40		8.000 mA
4000	0FA0		4.000 mA
3999	0F9F	out of range	3.999 mA
3800	0ED8		3.800 mA
3600	0E10		3.600 mA
3599	0E0F		3.599 mA
2000	07D0		2.000 mA
1999	07CF		1.999 mA
1	0001		0.001 mA
0	0000		0.000 mA

- 12-bit-representation (left-justified)
  The representation of the 12 bit values is similar to that of the 16 bit values. Only the bits Bit 0-3 are set to "0".

8.2.5 Base modules/ pin assignment

- BL67-B-2M12

Figure 8-3: BL67-B-2M12

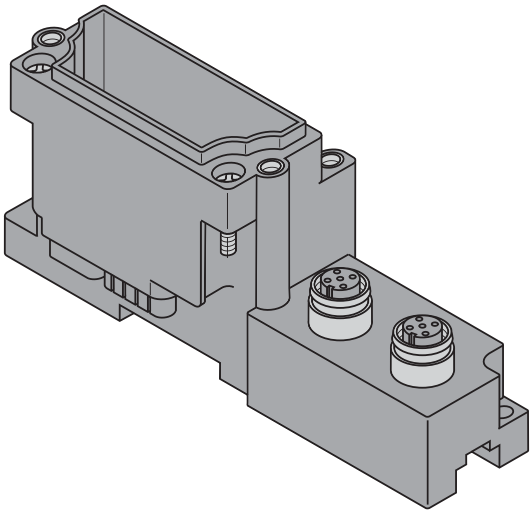
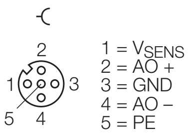


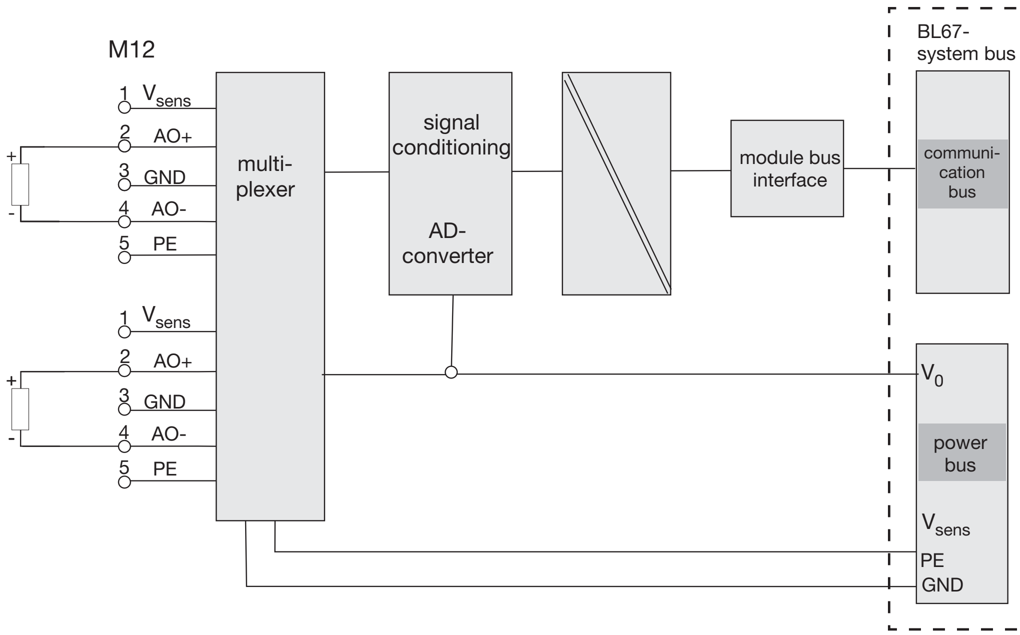
Figure 8-4: Pin assignment BL67-2AO-I with BL67-B2M12



8.3 BL67-2AO-V, -10/0...+10V DC

Figure 8-5: BL67-2AO-V

Figure 8-6: Block diagram



8.3.1 Technical data

Table 8-5: Technical data

Designation	BL67-2AO-V
Number of channels	2
Nominal voltage from supply terminal	24 V DC
Load voltage U_L	24 V DC
voltage range	18 to 30 V DC
Nominal current from 5 V DC (module bus) I_{MB}	≤ 60 mA

Nominal current from supply terminal I_L	≤ 50 mA
Power loss of the module, typical P_{MAX}	< 1 W
Output voltage U_A	-10/0 to 10 V DC
Burden resistance	
Resistive load R_{LO}	> 1 kΩ
Capacitive load R_{Lk}	< 1 µF
Short-circuit current I_K	≤ 40 mA
Transmission frequency f_T	< 100 Hz
Offset error	≤ 0.1 %
Basic error at 23 °C / 73.4 °F	0.2 %
Repeat accuracy	0.05 %
Output ripple	0.02 %
Temperature coefficient	≤ 300 ppm/°C of end value
Settling time (maximum)	
Resistive load	0.1 ms
Inductive load	0.5 ms
Isolation voltage	
U_{TMB} (module bus/ field)	min. 500 V_{rms}
U_{Fe} (field/ functional earth)	min. 50 V_{AC}
channel/channel	no
channel/field supply	no
channel/system supply	500 V_{rms}
Measurement value representation	16 Bit Signed Integer / 12 Bit Full Range left-justified
I_{SENS} (output supply from V_O)	≤ 250 mA per channel; short-circuit protection in gateway or Power Feeding module

Note

Negative values are automatically displayed as 0 V, in a configured measurement range of 0 to 10 V.

8.3.2 Diagnostic/ status messages

Diagnosis/ status via LEDs

Table 8-6: Diagnosis/ status via LEDs

LED	Display	Meaning	Remedy
DIA	Red	Module bus communication failure	Check if more than two ad-joining electronic modules have been pulled. This applies to modules located between this module and the gateway.
	Off	No error messages or diagnostics	–

8.3.3 Module parameters (per channel)

Table 8-7: Module parameters

A*default-settings*

Parameter name	Value
Channel	activate **A**
	deactivate
Value representation	integer (15bit + sign) **A**
	12bit (left-justified)
Voltage mode	0 … +10 V **A**
	-10 … +10 V
Substitute value A	The substitute value will be transmitted if the respective parameters of the gateway have been set to „output substitute value“.

8.3.4 Base modules/ pin assignment

- BL67-B-2M12

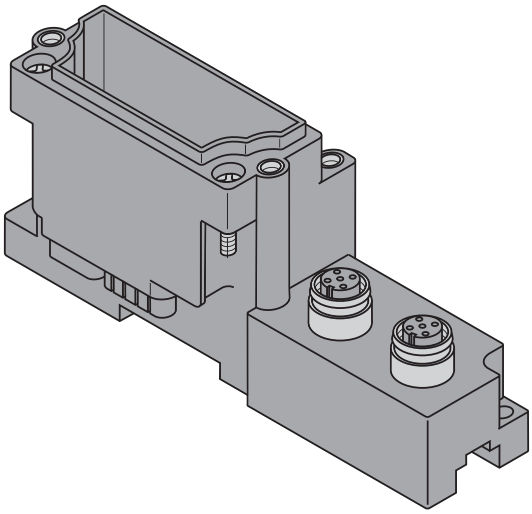


Figure 8-7: BL67-B-2M12

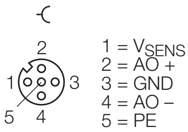


Figure 8-8: Pin assignment BL67-2AO-I with BL67-B2M12

8.3.5 Measurement value representation

16-bit-representation

- Voltage values from 0 to 10 V DC

  The value range
  0 V to 10 V
  is displayed as follows:
  0000$_{hex}$ **to 7FFF**$_{hex}$ (decimal: 0 to 32767)

- Voltage values from -10 to 10 V DC

  The value range
  -10 V to -3.052 10^{-4} **V**
  is displayed as follows:
  8000$_{hex}$ **to FFFF**$_{hex}$ (decimal:-32768 to -1)

12 bit representation (left-justified)

- Voltage values from 0 to 10 V DC

  The value range
  0 V to 10 V
  is displayed as follows:
  000(0)$_{hex}$ **to FFF(0)**$_{hex}$ (decimal: 0 to 4095)

- Voltage values from -10 to 10 V DC

  The value range
  0 V to 10 V
  is displayed as follows:
  000(0)$_{hex}$ **to 7FF(0)**$_{hex}$ (decimal: 0 to 2047)

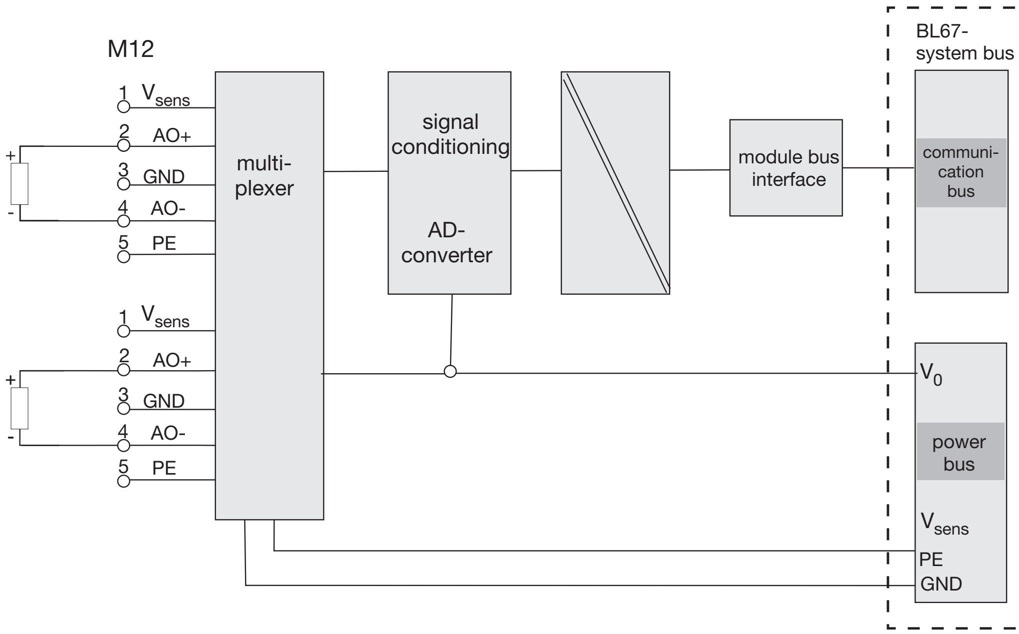
  The value range
  -10 V to -0,0049 V
  is displayed as follows:
  800(0)$_{hex}$ **to FFF(0)**$_{hex}$ (decimal: -2048 to -1)

Note
A detailed description of the 16 bit/12 bit representation for the analog values can be found in the "appendix", page 15-1.

8.4 BL67-4AO-V, -10/0...+10V DC

Figure 8-9: BL67-4AO-V

Figure 8-10: Block diagram



8.4.1 Technical data

Table 8-8: Technical data

Designation	BL67-4AO-V
Number of channels	4
Nominal voltage from supply terminal	24 V DC
Load voltage U_L	24 V DC
voltage range	18 to 30 V DC
Nominal current from 5 V DC (module bus) I_{MB}	≤ 50 mA
Nominal current from supply terminal I_L	≤ 50 mA
Power loss of the module, typical P_{MAX}	< 1 W
Output voltage U_A	-10/0 to 10 V DC
Burden resistance	
Resistive load R_{LO}	> 1 kΩ
Capacitive load R_{Lk}	< 1 µF
Short-circuit current I_K	≤ 40 mA
Transmission frequency f_T	< 100 Hz
Offset error	≤ 0.1 %
Basic error at 23 °C / 73.4 °F	0.2 %
Repeat accuracy	0.05 %
Output ripple	0.02 %
Temperature coefficient	≤ 300 ppm/°C of end value
Settling time (maximum)	
Resistive load	0.5 ms
Inductive load	2.0 ms
kapacitive load	2.0 ms
Common mode error	min. 90 dB
Differental mode error	min. 70 dB
Crosstalk (channel to channel)	min. -50 dB
Isolation voltage	
U_{TMB} (module bus/ field)	min. 500 V DC
U_{Fe} (field/ functional earth)	min. 500 V DC
Resolution of A/D-converter	16 Bit

Note
Negative values are automatically displayed as 0 V, in a configured measurement range of 0 to 10 V.

8.4.2 Diagnostic/ status messages

Diagnosis/ status via LEDs

Table 8-9: Diagnosis/ status via LEDs

LED	Display	Meaning	Remedy
DIA	Red	Module bus communication failure	Check if more than two ad-joining electronic modules have been pulled. This applies to modules located between this module and the gateway.
	Off	No error messages or diagnostics	–
0 bis 4	Green	Channek inactive	-
	Green flashing, 0,5 Hz	Underflow diagnostics	-
	Green flashing, 4 Hz	Overflow diagnostics	-
	Off	Chanenl x inactive	

Diagnosis via software

The module sends the following diagnostic data per channel:

Table 8-10: Diagnosis

Byte	Bit	Diagnosis	Meaning
0 - 3	0	**OoR** Measurement value range error	Threwhold values see Measurement value representation.
	1 + 2	reserved	
	3	**OUFL** Over-/ Underflow	
	4 - 7	reserved	

8.4.3 Module parameters (per channel)

The module provides 8 byte parameter data. One byte is assigned to each channel.

Note
Please read page 8-20 ff. for detailed information about the parameter settings (Standard, Extended Range, PA (NE 43)).

Table 8-11: Module parameters

A *default-settings*

Parameter	Settings
Operation mode Kx	– voltage -10 … 10 V DC standard **A** – voltage 0 … 10 V DC standard – voltage -10 … 10 V DC PA (NE 43) – voltage 0 … 10 V DC PA (NE 43) – voltage -10 … 10 V DC Extended Range – voltage 0 … 10 V DC Extended Range – deaktivieren
Value representation	– Integer (15 bit + sign) **A** – 12 bit (left-justified)
Diagnostics Kx	– release **A** – block
Behaviour on module bus error Ax	– output substitute value **A** – hold current value
Substitute value Ax	Substitute value = “0“ **A** The substitute value will be transmitted if the respective parameters of the gateway have been set to "output substitute value" or if the module does not communicate with the gateway.

8.4.4 Measurement value representation

Standard value representation

- 16-bit-representation

	dec.	hex.	bipolar	-10…10 V
				dec. value= 3276.7 [1/V] × voltage value [V]
100.00 %	32767	7FFF	nominal range	10.0000 V
99.99695 %	32766	7FFE		9.9997 V
	…	…		…
50.00153 %	16384	4000		5.0002 V
	…	…		…
0.00305 %	1	0001		0.000305 V
0.00000 %	0	0000		0.000000 V
-0.00305 %	-1	FFFF		-0.000305 V
	…	…		…
-50.00000 %	-16384	C000		-5.0000 V
	…	…		…
-99.99695 %	-32767	8001		-9.9997 V
-100.00 %	-32768	8000		- 10.0000 V

	dec.	hex.	unipolar	0…10 V
dec. value= 3276.7 [1/V] × voltage value [V]				
100.00 %	32767	7FFF	nominal range	10.0000 V
99.99695 %	32766	7FFE		9.9997 V
	…	…		…
50.00153 %	16384	4000		5.0002 V
	…	…		…
0.00305 %	1	0001		0.000305 V
0.00000 %	0	0000		0.000000 V
-0.00305 %	-1	FFFF	DIA **OoR** ON at FFFF to 8000	0.000000 V
	…	…		…
-50.00000 %	-16384	C000		0.000000 V
	…	…		…
-99.99695 %	-32767	8001		0.000000 V
-100.00 %	-32768	8000		0.000000 V

- 12 Bit (left-justified)

	dec.	hex.	bipolar	-10…10 V
dec. value= 204.7 [1/V] × voltage value [V] × 16				
100.00 %	2047 × 16	7FF×	nominal range	10.0000 V
99.96 %	2046 × 16	7FEx		9.9951 V
	…	…		…
0.0049 %	1 × 16	001x		0.004885 V
0.00000 %	0	000x		0.000000 V
-0.0049 %	-1 × 16	FFF×		-0.004883 V
	…	…		…
-99.95 %	-2047 × 16	801x		-9.9951 V
-100.00 %	-2048 × 16	800x		- 10.0000 V

	dec.	hex.	unipolar	0...10 V
dec. value= 409.5 [1/V] × voltage value [V] × 16				
100.00 %	4095 × 16	FFF×	nominal range	10.0000 V
99.9756 %	4094 × 16	FFEx		9.9997 V
	...	...		...
50.0122%	2048 × 16	800x		5.0002 V
	...	...		...
0.0244 %	1 × 16	001x		0.000305 V
0.00000 %	0	000x		0.000000 V

Extended Range - value representation

- 16-bit-representation

	dec.	hex.	bipolar	-10...10 V
dec. value= 2764.8 [1/V] × voltage value [V]				
118.525 %	32767	7FFF	DIA **OoR** ON at 7F00 to 7FFF	11.851 V
118.461 %	32752	7FF0		11.846 V
	32512	7F00		11.759 V
117.589 %	32511	7EFF	out of range	11.760 V
117.535 %	32496	7EF0		11.75 V
100.058%	27664	6C10		10.0058 V
≥100.004 %	27649	6C01		10.0004 V
100.000 %	27648	6C00	nominal range	10 V
0.05787 %	16	0010		5.787 mV
0.003617 %	1	0001		361.7 µV
0.000 %	0	0000		0 V
-0.00362 %	-1	FFFF		-361.7 µV
-0.05787 %	-16	FFF0		- 5.787 mV V
-25.000 %	-6912	E500		-2.5 V
-100.000 %	-27648	9400		-10 V
≤ -100.004 %	-27649	93FF	out of range	-10.0004 V
-100.058 %	-27664	93F0		-10.0058 V
-117.593 %	-32512	8100		-11.759 V
	-32513	80FF	DIA **OoR** ON at 80FF to 8000	11.760 V
-118.461 %	-32752	80F0		-11.846 V
-118.519 %	-32768	800		-11.852 V

	dec.	hex.	unipolar	0...10 V
dec. value= 2764.8 [1/V] × voltage value [V]				
118.525 %	32767	7FFF	DIA **OoR** ON at 7F00 to 7FFF	11.851 V
118.461 %	32752	7FF0		11.846 V
	32512	7F00		11.760 V
117.589 %	32511	7EFF	out of range	11.759 V
117.535 %	32496	7EF0		11.75 V
100.058%	27664	6C10		10.0058 V
≥100.004 %	27649	6C01		10.0004 V
100.000 %	27648	6C00	nominal range	10 V
0.05787 %	16	0010		5.787 mV
0.003617 %	1	0001		361.7 µV
0.000 %	0	0000		0.00 V
-0.00362 %	-1	FFFF	DIA **OoR** ON at FFFF to 8000	0.00 V
-0.05787 %	-16	FFF0		0.00 V
-25.000 %	-6912	E500		0.00 V
-100.000 %	-27648	9400		0.00 V
≤ -100.004 %	-27649	93FF		0.00 V
-100.058 %	-27664	93F0		0.00 V
-117.593 %	-32512	8100		0.00 V
	-32513	80FF		0.00 V
-118.461 %	-32752	80F0		0.00 V
-118.519 %	-32768	8000		0.00 V

- 12 Bit (left-justified)
  The representation of the 12 bit values is similar to that of the 16 bit values. Only the bits Bit 0-3 are set to "0".

Value representation (NE 43)

- 16-bit-representation

	dec.	hex.	bipolar	-10...10 V
dec. value= 1000 [1/V] × voltage value [V]				
	37767	7FFF	DIA **OUFL** ON at 2AF9 to 7FFF	11.000 V
> 110. 00 %	> 11000	2AF8		11.000 V
110.00 %	11000	2AF8	DIA **OoR** ON at 2905 to 7FFF	11.000 V
105.01 %	10501	2905		10.501 V
105.00 %	10500	2904	out of range	10.500 V
100.01 %	10001	2711		10.001 V
100.000 %	10000	2710	nominal range	10.000 V
40.00 %	4000	0FA0		4.000 V
0.01 %	1	0001		0.001 V
0.000 %	0	0000		0 V
-0.01 %	-1	FFFF		-0.001 V
-40.00 %	-4000	F060		-4.000 V
-100.00 %	-10000	D8F0		-10.000 V
≤-100.01 %	-10001	D8EF	out of range	-10.001 V
-105.00 %	-10500	D6FC		-10.500 V
-105.01 %	-10501	D6FB	DIA **OoR** ON at D6FB to 8000	-10.501 V
-110.00 %%	-11000	D508		-11.000 V
> -110.00 %	< -11000	D508	DIA **OUFL** ON at D507 to 8000	-11.00 0 V
	-32768	8000		-11.000 V

	dec.	hex.	bipolar	0...10 V
dec. value= 1000 [1/V] × voltage value [V]				
	65535	FFFF	DIA **OUFL** ON at 2AF9 to FFFF	11.000 V
> 110. 00 %	> 11000	2AF8		11.000 V
110.00 %	11000	2AF8	DIA **OoR** ON at 2905 to 7FFF	11.000 V
105.01 %	10501	2905		10.501 V
105.00 %	10500	2904	out of range	10.500 V
100.01 %	10001	2711		10.001 V
100.000 %	10000	2710	nominal range	10.000 V
40.00 %	4000	0FA0		4.000 V
20.00 %	2000	07D0		2.000 V
0.01 %	1	0001		0.001 V
0.000 %	0	0000		0 V

- 12 Bit (left-justified)
  The representation of the 12 bit values is similar to that of the 16 bit values. Only the bits Bit 0-3 are set to "0".

8.4.5 Base modules/ pin assignment

- BL67-B-4M12

Figure 8-11: BL67-B-4M12

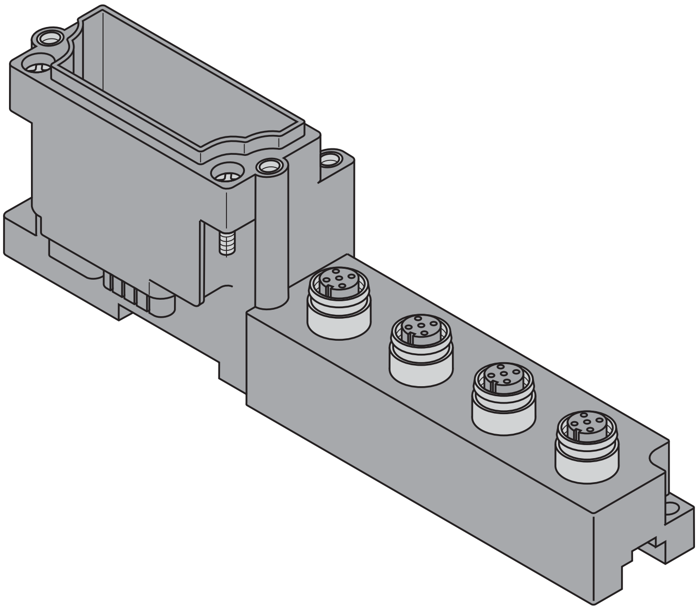
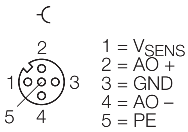


Table 8-12: Pin assignemtn BL67-4AO-V with BL67-B-4M12



- BL67-2M12-8/ BL67-2M12-8-P

Figure 8-12: BL67-B-2M12-8/ BL67-B-2M12-8-P

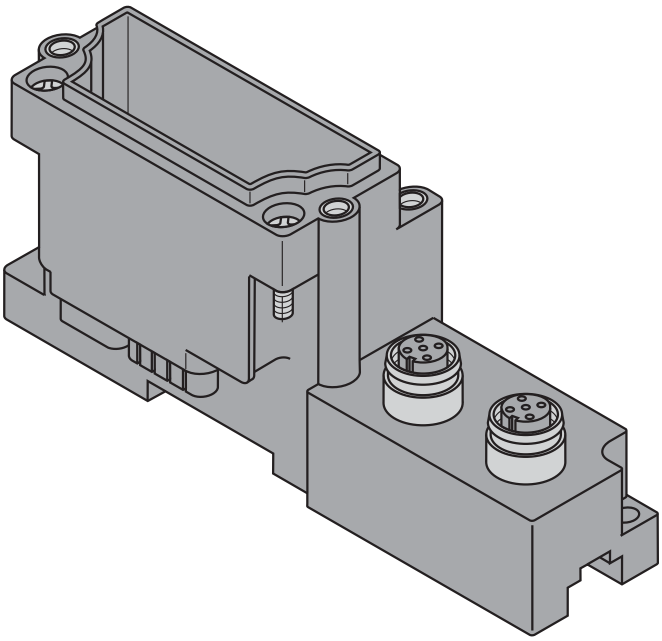
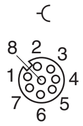


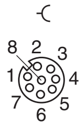
Table 8-13:
Pin assignment
BL67-4AO-V with
BL67-B-2M12-8

Slot 0



1 = AO 0 –
2 = AO 2 –
3 = AO 0 +
4 = AO 2 +
5 = V_{SENS}
6 = GND
7 = n.c.
8 = PE

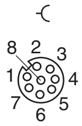
Slot 1



1 = AO 1 –
2 = AO 3 –
3 = AO 1 +
4 = AO 3 +
5 = V_{SENS}
6 = GND
7 = n.c.
8 = PE

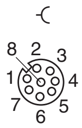
Table 8-14:
Pin assignment
BL67-4AO-V with
BL67-B-2M12-8-P

Slot 0



1 = AO 0 –
2 = AO 1 –
3 = AO 0 +
4 = AO 1 +
5 = V_{SENS}
6 = GND
7 = n.c.
8 = PE

Slot 1



1 = AO 2 –
2 = AO 3 –
3 = AO 2 +
4 = AO 3 +
5 = V_{SENS}
6 = GND
7 = n.c.
8 = PE

9 Digital Combi Modules

9.1 Overview

The modules provide optically isolated in- and outputs according to IEC 61131 Type 1.

The inputs detect electrical high- and low-level values through the base module connections and transmit the corresponding digital value to the gateway and the outputs receive output values from the gateway via the internal module bus. The modules convert these values and transmit the corresponding high or low level signals for each channel to the field level via the base modules.

The sensor supply (V_{sens}) and the output supply (V_O) are tapped from the internal voltage supply bus. They are short circuit proof (100 mA) and supplied be the module.

Short circuit detection is realized in the module.

Danger
In case of a short circuit or an overload, the digital combi modules may switch on automatically after the removal of the short circuit or the overload.

Danger
Switching-off the outputs should not be a normal application!

Do not use the module for safety-related applications.
A failure of the output voltage may cause an output supply trough the inputs.

LED status indicators

Error signals from the I/O-level are indicated as channel diagnostics via the channel-LEDs or as group diagnostics by each module via the "D" LED. The corresponding diagnostic information is transmitted to the gateway via diagnostic bits.

Attention
An external suppressor should be planned for inductive loads.

9.1.1 Module overview

Table 9-1: Module overview

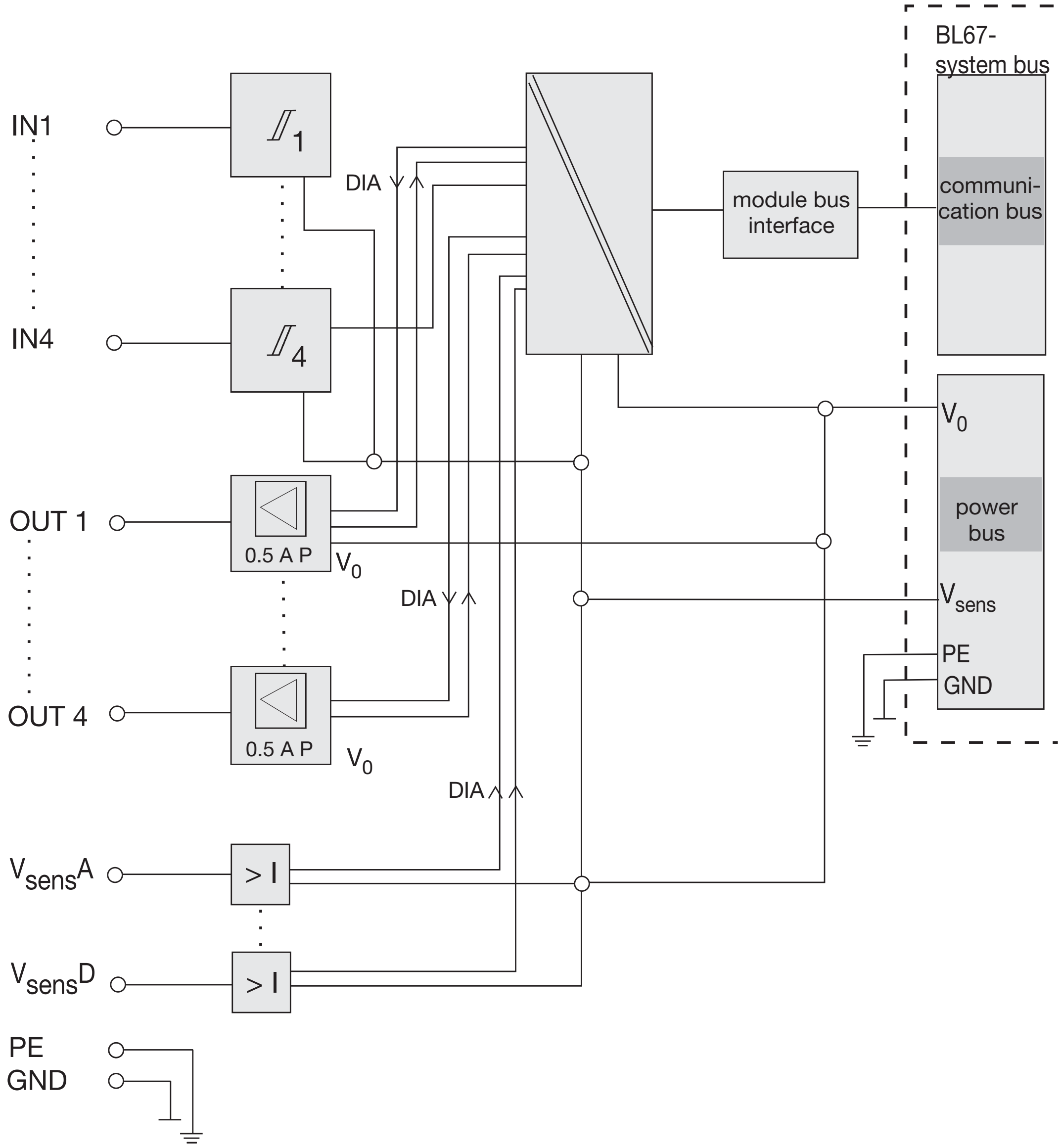
Module	No. of channels	Positive switching (sinking)
BL67-4DI4DO-PD	4	✓
BL67-8XSG-PD	8	✓
BL67-8XSG-P	8	✓

9.2 BL67-4DI4DO-PD

The module provides one in- and one output at each M12-connector.

Figure 9-1: BL67-4DI/4DO-PD

Figure 9-2:
Block diagram



9.2.1 Technical data

Table 9-2: Technical data

Designation	BL67-4DI4DO-PD
Nominal voltage from supply terminal	24 VDC
Nominal current from 5 VDC (module bus) I_{MB}	≤ 30 mA
Nominal current from supply terminal (field) I_L	≤ 100 mA (when load current = 0)
Power loss of the module, typical	< 1.5 W
Inputs	4
Input voltage at nominal value 24 VDC	
– low level	< 4.5 V
– high level	> 7 V (max. 30 V)
Input current I_{in}	
– low level	< 1.5 mA
– high level	2.1 mA < I_{in} < 3.7 mA
Outputs	4
Load voltage V_O	24 VDC
– voltage range	18 to 30 VDC
Output voltage, high level (loaded)	min. L+ (-1 V)
Output current I_A	
– high level I_A (nominal value)	0.5 A
– high level I_{AMAX}	0.6 A (according to IEC 61 131-2)
Simultaneity factor	100 %
Switching-off characteristic K_A	
– I_{OUT} > 1.5 A	< 4 ms
– 1.0 A < I_{OUT} < 1.5 A	< 10 s
– 0.6 A < I_{OUT} < 1.0 A	min. 10 s/ max. 60 s
Output delay at signal change and ohmic load	
– low- to high level	3 ms
– high- to low level	3 ms
Load impedance range	48 Ω to 1 kΩ
Switch-on resistance R_{ON}	max. 800 mΩ
Resistive, inductive and lamp loads can be connected.	
Load impedance, resistive R_{LO}	48 Ω
Lamp load R_{LL}	3 W

Switching frequency	
– Resistive load	200 Hz
– Inductive load	2 Hz
– Lamp load	20 Hz
Isolation voltage	
U_{TMB} (module bus/ field)	max. 2500 V DC
U_{FE} (field/ functional earth)	max. 1000 V DC
Short-circuit proof	Yes, according to EN 61 131-2

Note

The parallel switching of outputs is possible with the synchronous switching of the channels. In this case, the maximum output current can be increased up to 2 A, depending on the number of the parallel switched outputs.

9.2.2 Diagnostic/ status messages

Diagnosis/ status via LEDs

Table 9-3: Diagnosis/ status via LEDs

LED	Display	Meaning	Remedy
D	Red, flashing, 0.5 Hz	Diagnostics pending	-
	Red	Module bus communication failure	Check if more than two ad-joining electronic modules have been pulled. This applies to modules located between this module and the gateway.
	Red	Error in field supply (LEDs V_I and V_O at Power Feeding module are „off“)	Check the power supply for the inputs (V_{sens}) and the outputs (V_O).
	Off	No error messages or diagnostics	-
0 to 7	Green	– LEDs 0 to 3: Status of the input – LEDs 4 to 7: Status of the output	-
	Red, flashing, 2 Hz	LED 0 to 3: Short circuit in sensor supply	Eliminate the cause for the short circuit or the overload.
	Red	LED 0 to 7: Short circuit at output x	Eliminate the cause for the short circuit or the overload.
	Off	Status of in- or output at channels x = 0	-

Diagnosis via software

Table 9-4: Diagnosis

Diagnosis	
Overcurrent/ short circuit sensor x	Short circuit or overcurrent at sensor supply A, B, C or D (see Table 9-10:).
Overcurrent/ short circuit K x	Short circuit or overload at output x. The channel is switched-off automatically. For the for switching-off characteristics of the outputs (see Table 9-2:).

9.2.3 Module parameters

The parameters can be set for each channel.

Table 9-5: Module parameters

A default setting

Parameter name	Value	Meaning
digital input x	0	normal **A**
	1	inverted
input filter x	0	deactivate **A**
	1	activate
output on overcurrent x	0	automatic recovery **A**
	1	controlled recovery: The output is manually switched-off and on again.

9.2.4 Base modules/ pin assignment

- BL67-B-8M8

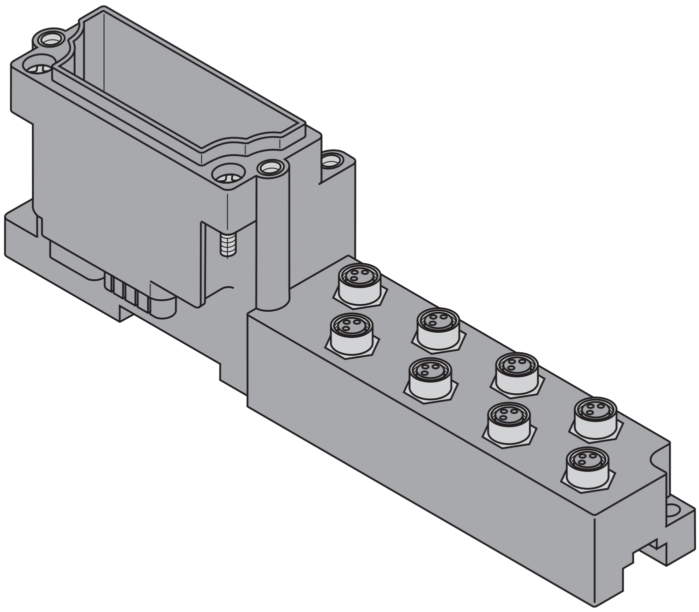


Figure 9-3: BL67-B-8M8

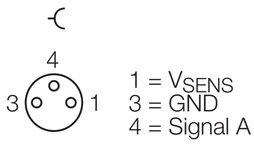


Figure 9-4: Pin assignment BL67-4DI4DO-PD with BL67-B-8M8

Figure 9-5: Wiring diagram BL67-4DI4DO-PD with BL67-B-8M8

- BL67-B-4M12/ BL67-B-4M12-P (paired)

Figure 9-6: BL67-B-4M12/ BL67-B-4M12-P

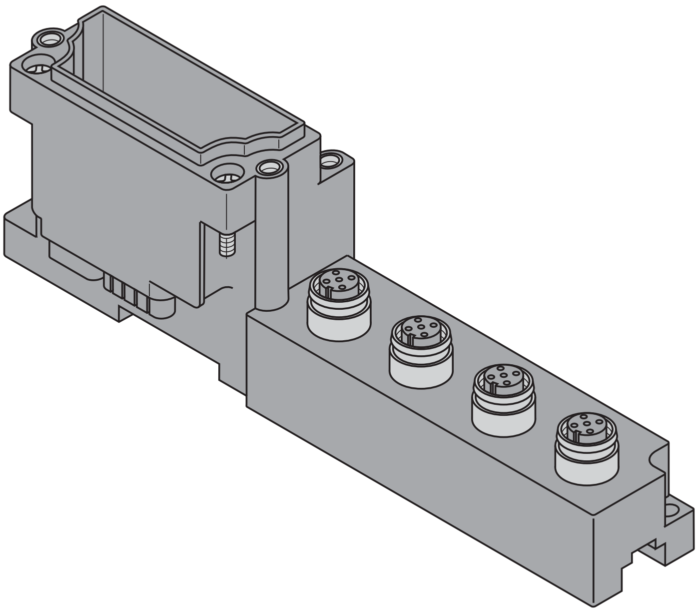


Figure 9-7: Pin assignment BL67-4DI4DO-PD with BL67-B-4M12/ BL67-B-4M12-P

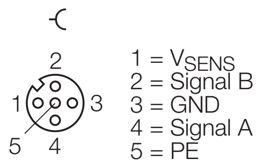
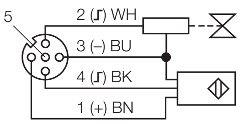
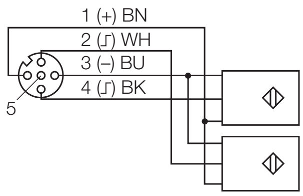


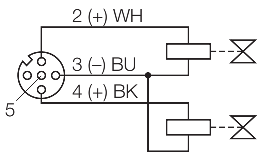
Figure 9-8: Wiring diagrams BL67-4DI4DO-PD with BL67-B-4M12/ BL67-B-4M12-P



Inputs (Connector 0 und 1):



Outputs (Connector 2 und 3):



9.2.5 Signal assignment

Table 9-6: Signal assignment-with BL67-B-8M8

	Byte	Bit 7	Bit 6	Bit 5	Bit 4	Bit 3	Bit 2	Bit 1	Bit 0
In	n	-	-	-	-	C3P4	C2P4	C1P4	C0P4
Out	m	-	-	-	-	C7P4	C6p4	C5P4	C4P4

Table 9-7: Signal assignment-with BL67-B-4M12

	Byte	Bit 7	Bit 6	Bit 5	Bit 4	Bit 3	Bit 2	Bit 1	Bit 0
In	n					C3P4	C2P4	C1P4	C0P4
Out	m					C3P2	C2P2	C1P2	C0P2

Table 9-8: Signal assignment-with BL67-B-4M12-P

	Byte	Bit 7	Bit 6	Bit 5	Bit 4	Bit 3	Bit 2	Bit 1	Bit 0
In	n					C1P2	C1P4	C0P4	C0P4
Out	m					C3P2	C3P4	C2P4	C2P4

Table 9-9: Signal assignment-with BL67-B-1M23-(VI)

	Byte	Bit 7	Bit 6	Bit 5	Bit 4	Bit 3	Bit 2	Bit 1	Bit 0
In	n					C0P4	C0P3	C0P2	C0P1
Out	m					C0P8	C0P7	C0P6	C0P5

n = process data offset of the input data depending on station configuration and the corresponding fieldbus.

m = process data offset of the output data depending on station configuration and the corresponding fieldbus.

C… = slot no.

P… = pin no.

Sensor supply

Table 9-10: Sensor supply

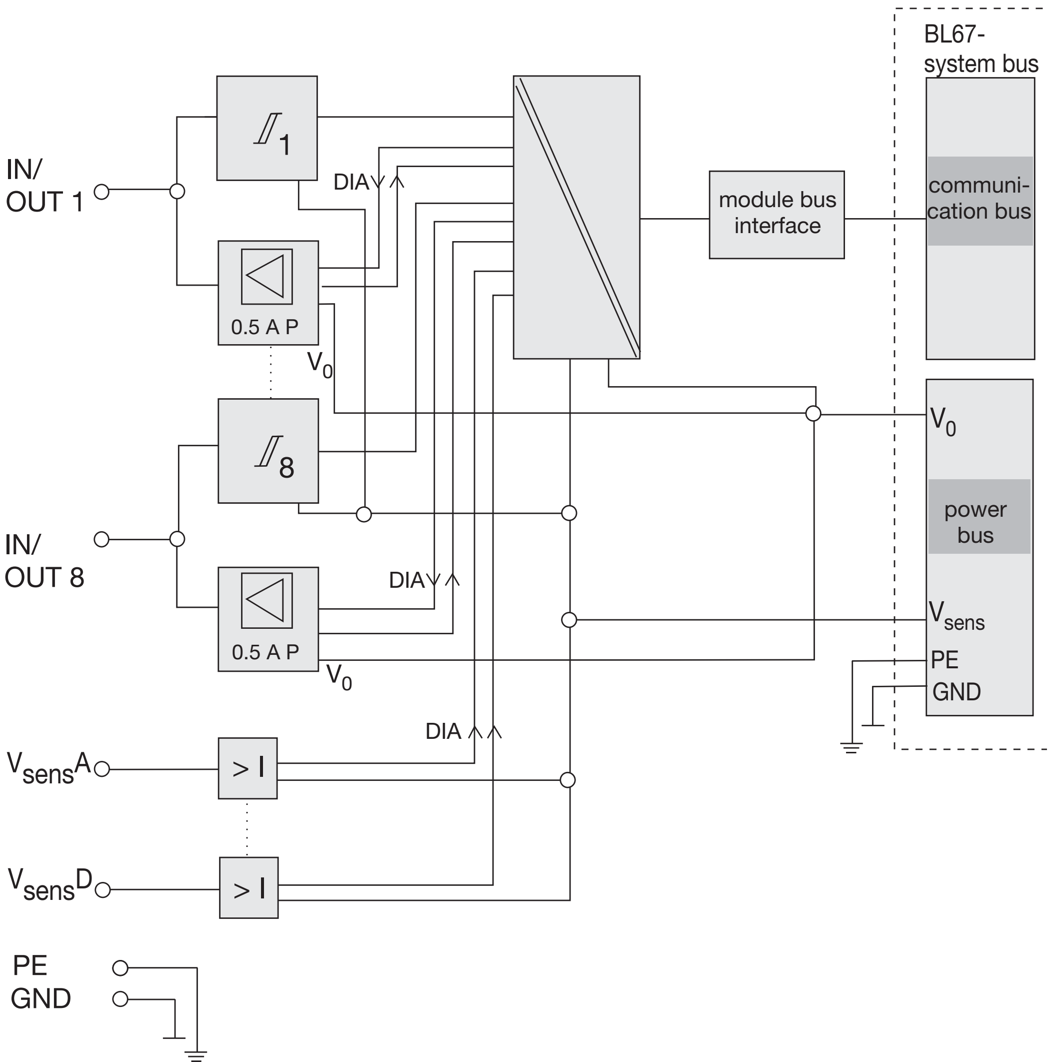
V_{sens}	A	B	C	D
BL67-B-8M8	C0P1/ C1P1	C2P1/ C3P1	C4P1/ C5P1	C6P1/ C7P1
BL67-B-4M12	C0P1	C1P1	C2P1	C3P1
BL67-B-4M12-P	C0P1	C1P1	C2P1	C3P1
BL67-B-1M23-VI	C0P9	C0P10	C0P11	-

9.3 BL67-8XSG-PD

The module provides 8 channels which can be configured according to application-specific needs. A maximum of 8 2-/3-wire-pnp-sensors or 8 DC-actuators can be connected to the module.

Figure 9-9: BL67-8XSG-PD

Figure 9-10: Block diagram



9.3.1 Technical data

Table 9-11: Technical data

Designation	BL67-8XSG-PD
Nominal voltage from supply terminal	24 VDC
Nominal current from 5 VDC (module bus) I_{MB}	≤ 30 mA
Nominal current from supply terminal (field) I_L	≤ 100 mA (at load current = 0)
Power loss of the module, typical	< 1.5 W
Inputs	8
Input voltage at nominal value 24 VDC	
– low level	< 4.5 V
– high level	> 7 V (max. 30 V)
Input current I_{in}	
– low level	< 1.5 mA
– high level	2.1 mA < I_{in} < 3.7 mA
Outputs	8
Load voltage V_O	24 VDC
– voltage range	18 to 30 VDC
Output voltage, high level (loaded)	min. L+ (-1 V)
Output current I_A	
– high level I_A (nominal value)	0.5 A
– high level I_{AMAX}	0.6 A (according to IEC 6 1131-2)
Simultaneity factor	100%
Switching-off characteristic K_A	
– I_{OUT} > 1.5 A	< 4 ms
– 1.0 A < I_{OUT} < 1.5 A	< 10 s
– 0.6 A < I_{OUT} < 1.0 A	min. 10 s/ max. 60 s
Output delay at signal change and ohmic load	
– low- to high level	3 ms
– high- to low level	3 ms
Load impedance range	48 Ω to 1 kΩ
Switch-on resistance R_{ON}	max. 190 mΩ
Resistive, inductive and lamp loads can be connected.	

Load impedance, resistive R_{LO}	48 Ω
Lamp load R_{LL}	3 W
Switching frequency	
– Resistive load	200 Hz
– Inductive load	2 Hz
– Lamp load	20 Hz
Isolation voltage	
U_{TMB} (module bus/ field)	max. 2500 V DC
U_{FE} (field/ functional earth)	max. 1000 V DC
Short-circuit proof	Yes, according to EN 61 131-2

Note
The parallel switching of outputs is possible with the synchronous switching of the channels.
In this case, the maximum output current can be increased up to 2A,
depending on the number of the parallel switched outputs.

9.3.2 Diagnostic/ status messages

Diagnosis/ status via LEDs

Table 9-12: Diagnosis/ status via LEDs

LED	Display	Meaning	Remedy
D	Red, flashing, 0.5 Hz	Diagnostics pending	-
	Red	Module bus communication failure	Check if more than two ad-joining electronic modules have been pulled. This applies to modules located between this module and the gateway.
	Red	Error in field supply (LEDs V_I and V_O at Power Feeding module are „off“)	Check the power supply for the inputs (V_{sens}) and the outputs (V_O).
	Off	No error messages or diagnostics	-
0 to 7	Green	Status of the input or the output at channel x = 1	-
	Red, flashing, 2 Hz	LED 0 to 3: Short circuit in sensor supply	Eliminate the cause for the short circuit or the overload.
	Red	LED 4 to 7: Short circuit at output x	Eliminate the cause for the short circuit or the overload.
	Off	Status of in- or output at channels x = 0	-

Diagnosis via software

Table 9-13: Diagnosis

Diagnosis	
Overcurrent/ short circuit sensor x	Short circuit or overcurrent at sensor supply A, B, C or D (see Table 9-19:).
Overcurrent/ short circuit K x	Short circuit or overload at output x. The channel is switched-off automatically. For the for switching-off characteristics of the outputs (see Table 9-11:).

9.3.3 Module parameters

he parameters can be set for each channel.

Table 9-14: Module parameters

A *default setting*

Parameter name	Value	Meaning
digital input x	0	normal **A**
	1	inverted
input filter x	0	deactivate **A**
	1	activate
output x	0	deactivate **A**
	1	activate
output on overcurrent x	0	automatic recovery **A**
	1	controlled recovery: The output is manually switched-off and on again.

9.3.4 Base modules/ pin assignment

- BL67-B-8M8

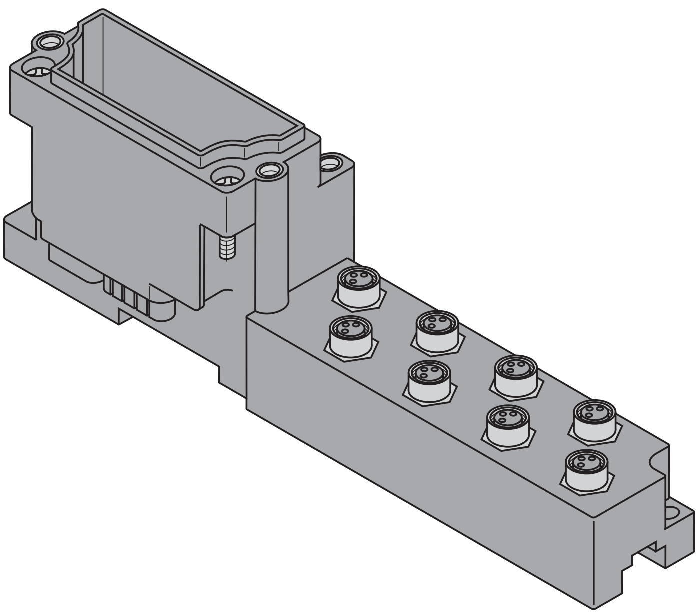


Figure 9-11: BL67-B-8M8

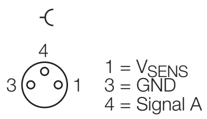


Figure 9-12: Pin assignment BL67-8XSG-PD with BL67-B-8M8

Figure 9-13: Wiring diagram BL67-8XSG-PD with BL67-B-8M8

- BL67-B-4M12/ BL67-B-4M12-P (paired)

Figure 9-14: BL67-B-4M12/ BL67-B-4M12-P

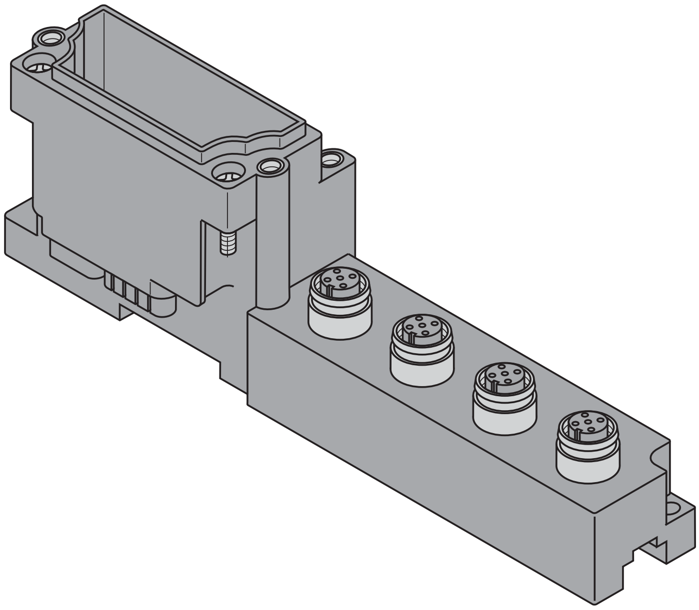


Figure 9-15: Pin assignment BL67-8XSG-PD with BL67-B-4M12/ BL67-B-4M12-P

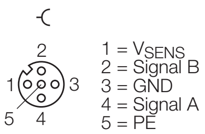
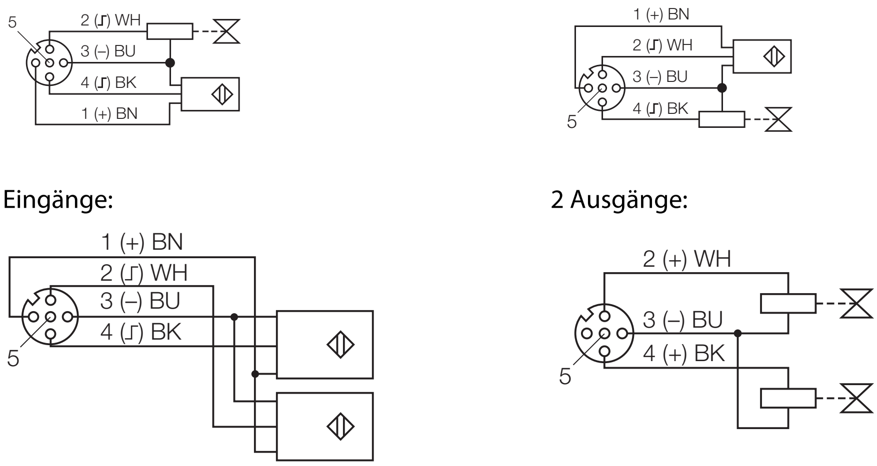


Figure 9-16: Wiring diagrams BL67-8XSG-PD with BL67-B-4M12/ BL67-B-4M12-P



- BL67-B-1M23-VI
  Channel related diagnostics is not possible with this base module. 4A current limited power supply to the sensor via gateway or power feeding module.

Figure 9-17: BL67-B-1M23-VI

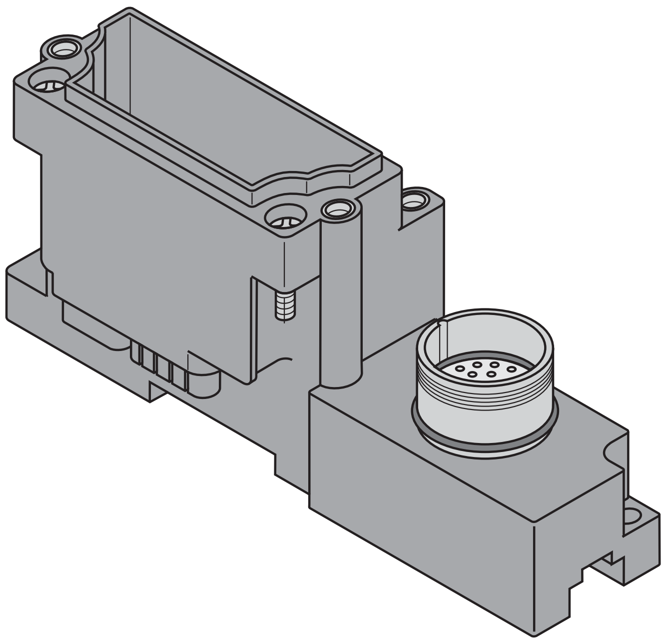
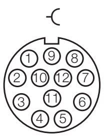


Figure 9-18: Pin assignment BL67-8XSG-PD with BL67-B-1M23-VI



- BL67-B-1M23
  Channel related diagnostics is restricted with this base module. The sensor supply is electronically current limited to 3 × 100mA (pin 9, 10, 11).

Figure 9-19: BL67-B-1M23

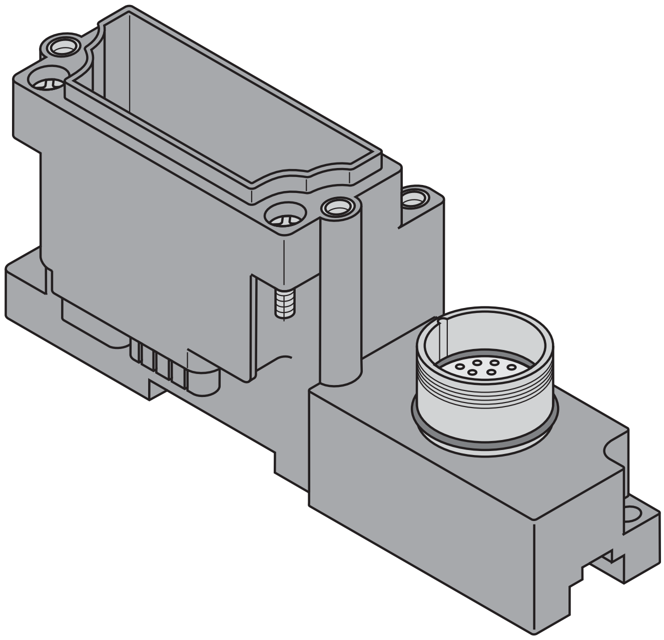
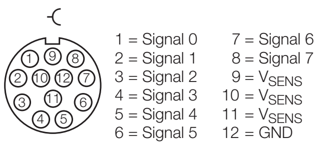


Figure 9-20: Pin assignment BL67-8XSG-PD with BL67-B-1M23



Industrial Automation

9.3.5 Signal assignment

Table 9-15: Signal assignmen with BL67-B-8M8

Daten	Byte	Bit 7	Bit 6	Bit 5	Bit 4	Bit 3	Bit 2	Bit 1	Bit 0
In	n	C7P4	C6P4	C5P4	C4P4	C3P4	C2P4	C1P4	C0P4
Out	m	C7P4	C6P4	C5P4	C4P4	C3P4	C2P4	C1P4	C0P4

Table 9-16: Signal assignmen with BL67-B-4M12

Daten	Byte	Bit 7	Bit 6	Bit 5	Bit 4	Bit 3	Bit 2	Bit 1	Bit 0
In	n	C3P2	C2P2	C1P2	C0P2	C3P4	C2P4	C1P4	C0P4
Out	m	C3P2	C2P2	C1P2	C0P2	C3P4	C2P4	C1P4	C0P4

Table 9-17: Signal assignmen with BL67-B-4M12-P

	Byte	Bit 7	Bit 6	Bit 5	Bit 4	Bit 3	Bit 2	Bit 1	Bit 0
In	n	C3P2	C3P4	C2P2	C2P4	C1P2	C1P4	C0P2	C0P4
Out	m	C3P2	C3P4	C2P2	C2P4	C1P2	C1P4	C0P2	C0P4

Table 9-18: Signal assignmen with BL67-B-1M23(-VI)

	Byte	Bit 7	Bit 6	Bit 5	Bit 4	Bit 3	Bit 2	Bit 1	Bit 0
In	n	C0P8	C0P7	C0P6	C0P5	C0P4	C0P3	C0P2	C0P1
Out	m	C0P8	C0P7	C0P6	C0P5	C0P4	C0P3	C0P2	C0P1

n = process data offset of the input data depending on station configuration and the corresponding fieldbus.

m = process data offset of the output data depending on station configuration and the corresponding fieldbus.

C… = slot no.

P… = pin no.

9.3.6 Sensor supply

Table 9-19: Sensor supply

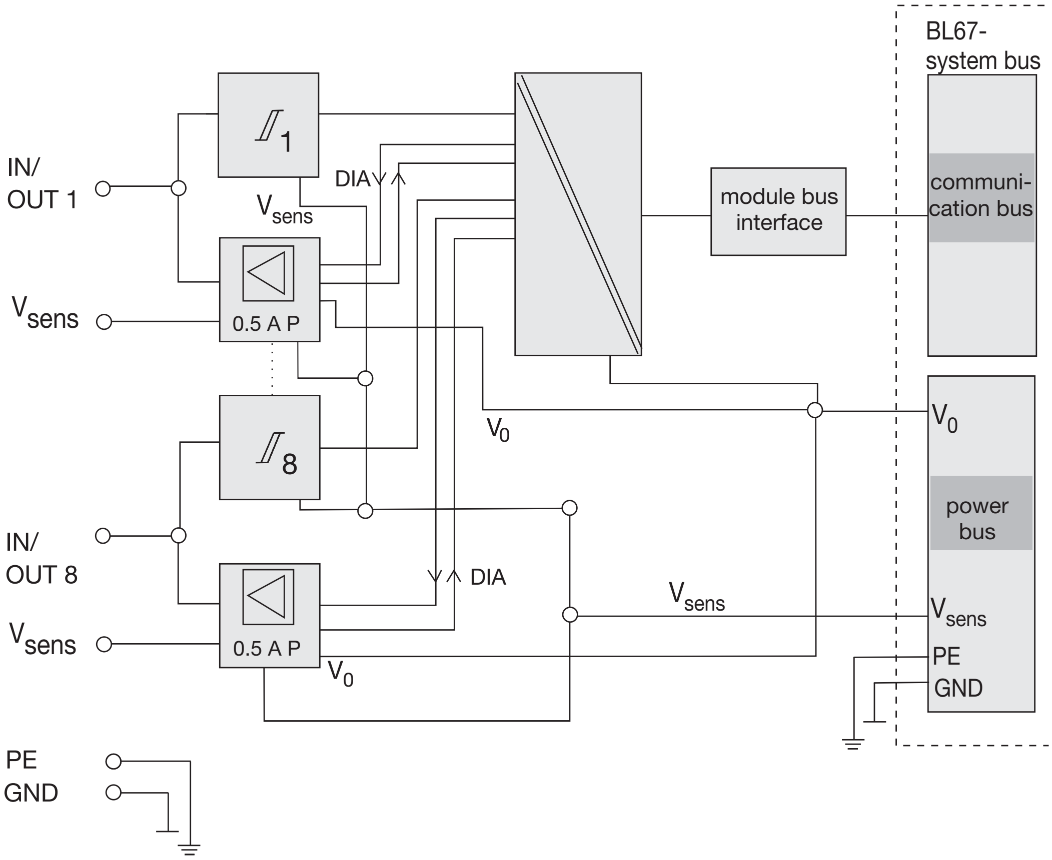
V_{sens}	A	B	C	D
BL67-B-8M8	C0P1/ C1P1	C2P1/ C3P1	C4P1/ C5P1	C6P1/ C7P1
BL67-B-4M12	C0P1	C1P1	C2P1	C3P1
BL67-B-4M12-P	C0P1	C1P1	C2P1	C3P1
BL67-B-1M23(-VI)	C0P9	C0P10	C0P11	-

9.4 BL67-8XSG-P

The module provides 8 channels which can be configured according to application-specific needs. A maximum of 8 2-/3-wire-pnp-sensors or 8 DC-actuators can be connected to the module.

Figure 9-21: BL67-8XSG-P

Figure 9-22: Block diagram



9.4.1 Technical data

Table 9-20: Technical data

Designation	BL67-8XSG-P
Nominal voltage from supply terminal	24 VDC
Nominal current from 5 VDC (module bus) I_{MB}	≤ 30 mA
Nominal current from supply terminal (field) I_L	≤ 100 mA (at load current = 0)
Power loss of the module, typical	< 1.5 W
Inputs	8
Input voltage at nominal value 24 VDC	
– low level	< 4.5 V
– high level	> 7 V (max. 30 V)
Input current I_{in}	
– low level	< 1.5 mA
– high level	2.1 mA < I_{in} < 3.7 mA
Outputs	8
Load voltage V_O	24 VDC
– voltage range	18 to 30 VDC
Output voltage, high level (loaded)	min. L+ (-1 V)
Output current I_A	
– high level I_A (nominal value)	0.5 A
– high level I_{AMAX}	0.6 A (according to IEC 6 1131-2)
Simultaneity factor	100%
Switching-off characteristic K_A	
– I_{OUT} > 1.5 A	< 4 ms
– 1.0 A < I_{OUT} < 1.5 A	< 10 s
– 0.6 A < I_{OUT} < 1.0 A	min. 10 s/ max. 60 s
Output delay at signal change and ohmic load	
– low- to high level	3 ms
– high- to low level	3 ms
Load impedance range	48 Ω to 1 kΩ
Switch-on resistance R_{ON}	max. 190 mΩ
Resistive, inductive and lamp loads can be connected.	
Load impedance, resistive R_{LO}	48 Ω
Lamp load R_{LL}	3 W

Switching frequency	
– Resistive load	200 Hz
– Inductive load	2 Hz
– Lamp load	20 Hz
Isolation voltage	
U_{TMB} (module bus/ field)	max. 2500 V DC
U_{FE} (field/ functional earth)	max. 1000 V DC
Short-circuit proof	Yes, according to EN 61 131-2

Note
The parallel switching of outputs is possible with the synchronous switching of the channels. In this case, the maximum output current can be increased up to 2A, depending on the number of the parallel switched outputs.

9.4.2 Diagnostic/ status messages

Diagnosis/ status via LEDs

Table 9-21: Diagnosis/ status via LEDs

LED	Display	Meaning	Remedy
D	Red, flashing, 0.5 Hz	Diagnostics pending	-
	Red	Module bus communication failure	Check if more than two ad-joining electronic modules have been pulled. This applies to modules located between this module and the gateway.
	Red	Error in field supply (LEDs V_I and V_O at Power Feeding module are „off“)	Check the power supply for the inputs (V_{sens}) and the outputs (V_O).
	Off	No error messages or diagnostics	-
0 to 7	Green	– Status of the input or the output at channel x = 1	-
	Red	LED 0 to 7: Short circuit at output x	Eliminate the cause for the short circuit or the overload.
	Off	Status of in- or output at channels x = 0	-

Diagnosis via software

Table 9-22: Diagnosis

Diagnosis	
Overload or short-circuit	The channel is switched off automatically. For the for switching-off characteristics of the outputs see Table 9-2: Technical data.

9.4.3 Module parameters

The parameters can be set for each channel.

Table 9-23: Module parameters

***A** default setting*

Parameter name	Value	Meaning
digital input x	0	normal **A**
	1	inverted
input filter x	0	deactivate **A**
	1	activate
output x	0	deactivate **A**
	1	activate
output on overcurrent x	0	automatic recovery **A**
	1	controlled recovery: The output is manually switched-off and on again.

9.4.4 Base modules/ pin assignment

- BL67-B-8M8

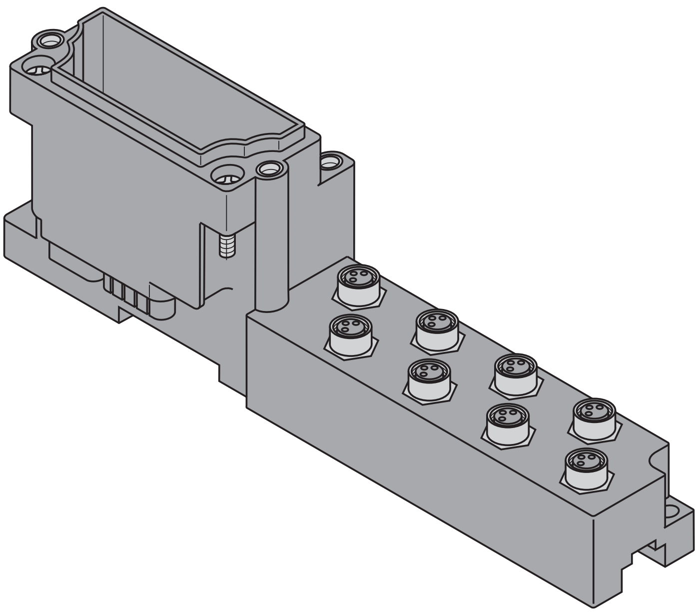


Figure 9-23: BL67-B-8M8

Figure 9-24:
Pin assignment
BL67-8XSG-P with
BL67-B-8M8

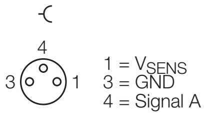
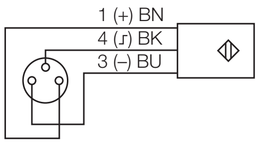
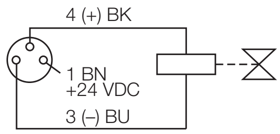


Figure 9-25:
Wiring diagram
BL67-8XSG-P with
BL67-B-8M8

Inputs:



outputs:



- BL67-B-4M12/ BL67-B-4M12-P (paired)

Figure 9-26:
BL67-B-4M12/
BL67-B-4M12-P

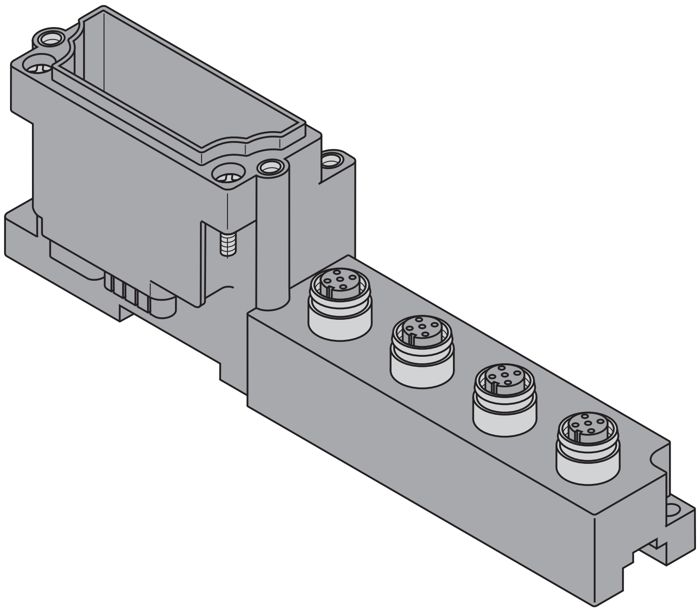


Figure 9-27:
Pin assignment
BL67-8XSG-P with
BL67-B-4M12/
BL67-B-4M12-P

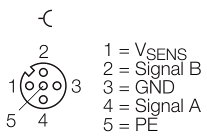
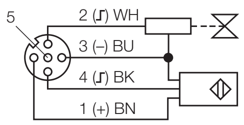
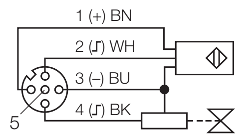
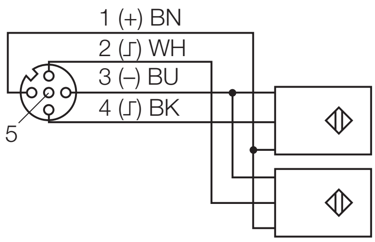


Figure 9-28: Wiring diagrams BL67-8XSG-P with BL67-B-4M12/ BL67-B-4M12-P

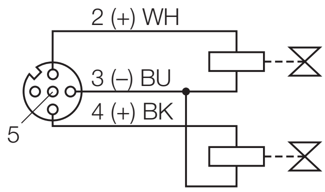




2 Eingänge:



2 Ausgänge:



- BL67-B-1M23

Figure 9-29: BL67-B-1M23

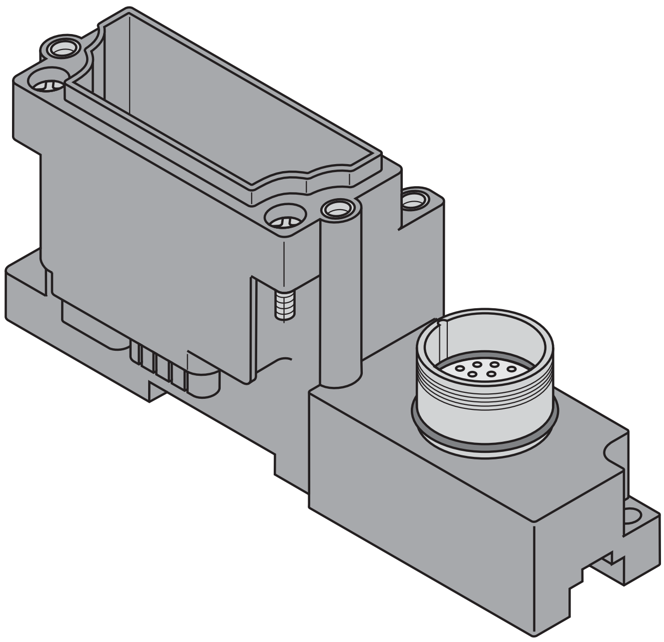
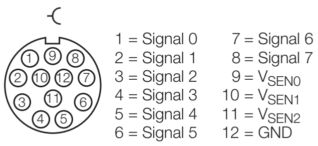


Figure 9-30: Pinbelegung BL67-8XSG-P mit BL67-B-1M23



9.4.5 Signal assignment

Table 9-24: Signal assignment with BL67-B-8M8

Daten	Byte	Bit 7	Bit 6	Bit 5	Bit 4	Bit 3	Bit 2	Bit 1	Bit 0
In	n	C7P4	C6P4	C5P4	C4P4	C3P4	C2P4	C1P4	C0P4
Out	m	C7P4	C6P4	C5P4	C4P4	C3P4	C2P4	C1P4	C0P4

Table 9-25: Signal assignment with BL67-B-4M12

Daten	Byte	Bit 7	Bit 6	Bit 5	Bit 4	Bit 3	Bit 2	Bit 1	Bit 0
In	n	C3P2	C2P2	C1P2	C0P2	C3P4	C2P4	C1P4	C0P4
Out	m	C3P2	C2P2	C1P2	C0P2	C3P4	C2P4	C1P4	C0P4

Table 9-26: Signal assignment with BL67-B-4M12-P

Daten	Byte	Bit 7	Bit 6	Bit 5	Bit 4	Bit 3	Bit 2	Bit 1	Bit 0
In	n	C3P2	C3P4	C2P2	C2P4	C1P2	C1P4	C0P2	C0P4
Out	m	C3P2	C3P4	C2P2	C2P4	C1P2	C1P4	C0P2	C0P4

Table 9-27: Signal assignment with BL67-B-1M23

Daten	Byte	Bit 7	Bit 6	Bit 5	Bit 4	Bit 3	Bit 2	Bit 1	Bit 0
In	n	C0P8	C0P7	C0P6	C0P5	C0P4	C0P3	C0P2	C0P1
Out	m	C0P8	C0P7	C0P6	C0P5	C0P4	C0P3	C0P2	C0P1

n = process data offset of the input data depending on station configuration and the corresponding fieldbus.

m = process data offset of the output data depending on station configuration and the corresponding fieldbus.

C… = slot no.

P… = pin no.

9.4.6 Sensor supply

Table 9-28: Sensor supply

V_{sens}	A	B	C	D
BL67-B-8M8	C0P1/ C1P1	C2P1/ C3P1	C4P1/ C5P1	C6P1/ C7P1
BL67-B-4M12	C0P1	C1P1	C2P1	C3P1
BL67-B-4M12-P	C0P1	C1P1	C2P1	C3P1
BL67-B-1M23	C0P9	C0P10	C0P11	-

10 Analog Combi Modules

10.1 BL67-4AI4AO-V/I, voltage/ current measurement

Figure 10-1:
BL67-4AI4AO-V/I

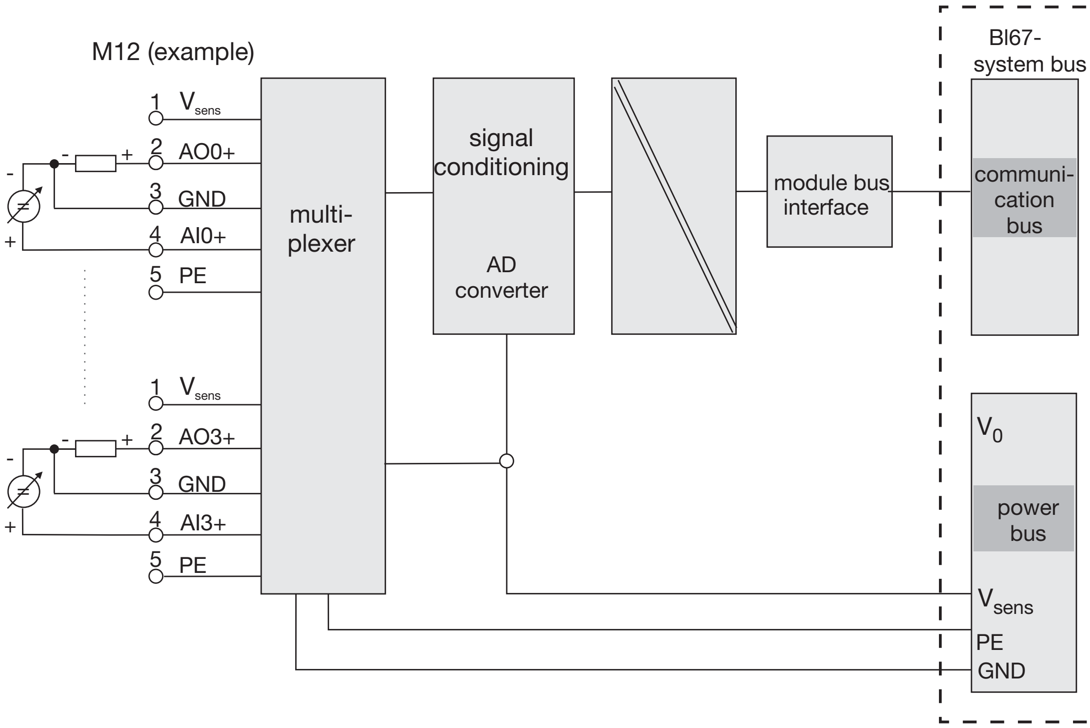


Figure 10-2:
Block diagramm

10.1.1 Technical data

Table 10-1: Technical data

Designation	BL67-4AI4AO-V/I
Number of channels	4/4
Nominal voltage from supply terminal	24 V DC
voltage range	18 to 30 VDC
Nominal current from 5 V DC (module bus) I_{MB}	≤ 50 mA
Nominal current from supply terminal I_L	≤ 50 mA
Power loss of the module, typical P_{MAX}	< 1 W
Input signal for current measurement	
Input resistance (burden)	< 125 Ω
Input current (range, which can be evalutated by the AD converter)	0 to 20 mA 4 to 20 mA
Input current (maximum - if > 20,2 mA, a "measurement value range error" is reported)	50 mA
Limit frequency (-3 dB)	20 Hz
Input signal for voltage measurement	
Input resistance (burden)	> 98.5 kΩ
Input voltage (range, which can be evalutated by the AD converter)	-10 to 10 V DC 0 to 10 V DC
Input voltage (maximum - if the deviation is > 1 % of the value range "measurement value range error" is reported)	35 V DC
Limit frequency (-3 dB)	20 Hz
Accuracy of input signal	
Basic error at 23 °C / 73.4 °F	< 0,3 %
Temperature coefficient	≤ 300 ppm/°C of end value
Output signal for voltage measurement	
Output voltage U_A	-10/0 to 10V DC
Burden resistance	
– ohmic load R_{LO}	> 1 kΩ
– capacitive load R_{Lk}	< 1 µF

Short-ciruit current I_K	≤ 40 mA
Transmission frequency f_T	< 100 Hz
Basic error at 23 °C / 73.4 °F	0,3 %
Repeat accuracy	0,05 %
Output ripple	0,02 %
Temperature coefficient	≤ 300 ppm/°C of end value
Settling time (maximum)	
– ohmic load	max. 0.5 ms
– inductive load	max. 2.0 ms
– capacitive Last	max. 2.0 ms
Common Mode Error	min. 90 dB
Differental Mode Error	min. 70 dB
Crosstalk	min. -50 dB
Isolation voltages	
U_{TMB} (module bus/ field)	min. 500 V DC
U_{PE} (field/ PE)	min. 500 V DC
Resolution of A/D-converter	16 Bit

10.1.2 Diagnostic/ status messages

Diagnosis/ status via LEDs

Table 10-2: Diagnosis/ status via LEDs

LED	Display	Meaning	Remedy
D	Red, flashing, 0.5 Hz	Pending diagnostic message	-
	Red	Module bus communication failure	Check if more than two ad-joining electronic modules have been pulled. This applies to modules located between this module and the gateway.
	Off	No error messages or diagnostics	–
0 to 4	Green	Channel x active	-
	Green, flashing,0.5 Hz	Underflow	-
	Green, flashing 4 Hz	Overflow	-
	Off	Channel x inactive	

Diagnosis via software

The module sends the following diagnostic messages per channel:

Table 10-3: Diagnosis

Byte	Bit	Diagnosis	Meaning
Inputs			
0 - 3	0	**OoR** Measurement value range error	Thresholds see Measurement value representation of inputs, page 10-8. Note: A wire break diagnosis is only possible in the operation mode 4 to 20 mA.
	1	**WB** wire break	
	2	reserviert	
	3	**OUFL** Over-/ Underflow	
	4 - 7	reserved	
Ouputs			
0 - 3	0	**OoR** Measurement value range error	Thresholds see Measurement value representation of outputs, page 10-21.
	1 + 2	reserved	
	3	**OUFL** Over-/ Underflow	
	4 - 7	reserved	

10.1.3 Module parameters (per channel)

The module provides 8 byte parameter data. One byte is assigned to each channel.

Note
Please read page 10-21 ff. for detailed information about the parameter settings (Standard, Extended Range, PA (NE 43)).

Table 10-4: Module parameters

A *default-settings*
B *for in- and outputs*
C *only for inputs*

Parameter	Settings
Operation mode Kx	– voltage -10 … 10 V DC standard **A, B** – voltage 0 … 10 V DC standard **B** – voltage -10 … 10 V DC PA (NE 43) **B** – voltage 0 … 10 V DC PA (NE 43) **B** – voltage -10 … 10 V DC Extended Range **B** – voltage 0 … 10 V DC Extended Range **B** – current 0 … 20 mA standard **A, C** – current 4 … 20 mA standard **C** – current 0 … 20 mA PA (NE 43) **C** – current 4 … 20 mA PA (NE 43) **C** – current 0 … 20 mA Extended Range **C** – current 4 … 20 mA Extended Range **C** – deactivate
Value representation	– Integer (15 bit + sign) **A** – 12 bit (left-justified)
Diagnostics	– release **A** – block
Behaviour on module bus error Ax	– output substitute value **A** – hold current value
Substitute value Ax	Substitute value = “0“ **A** The substitute value will be transmitted if the respective parameters of the gateway have been set to "output substitute value" or if the module does not communicate with the gateway.

10.1.4 Measurement value representation of inputs

Standard value representation

- 16-bit-representation

-10…10 V	bipolar	diagnostic message	dec.	hex.
voltage value U_M = (dec. value × 3.052 × 10^{-4}) V				
> 10.1000 V		if ↑DIA **OoR** ON	32767	7FFF
≤ 10.0500 V		if ↓ DIA **OoR** OFF	32767	7FFF
10.0000 V	nominal range		32767	7FFF
9.9997 V			32766	7FFE
…			…	…
5.0002 V			16384	4000
…			…	…
0.000305 V			1	0001
0.000000 V			0	0000
-0.000305 V			-1	FFFF
…			…	…
-5.0000 V			-16384	C000
…			…	…
-9.9997 V			-32767	8001
≤ - 10.0000 V			-32768	8000
≥ -10.0500 V		if ↑DIA **OoR** OFF	-32768	8000
< -10.1000 V		if ↓ DIA **OoR** ON	-32768	8000

0…10 V	unipolar	diagnostic message	dec.	hex.
voltage value U_M = (dec. value × 3.052 × 10^{-4}) V				
> 10.1000 V		if ↑DIA **OoR** ON	32767	7FFF
≤ 10.0500 V		if ↓ DIA **OoR** OFF	32767	7FFF
10.0000 V	nominal range		32767	7FFF
9.9997 V			32766	7FFE
…			…	…
5.0002 V			16384	4000
…			…	…
0.000305 V			1	0001
≤ 0.000000 V			0	0000
≥ -0.0500 V		if ↑DIA **OoR** OFF	0	0000
< -0.1000 V		if ↓ DIA **OoR** ON	0	0000

0...20 mA	unipolar	diagnostic message	dec.	hex.
current value I_M = (dec. value × 6.104 × 10^{-4}) mA				
> 20.2000 mA		if ↑DIA **OoR** ON	32767	7FFF
≤ 20.1000 mA		if ↓ DIA **OoR** OFF	32767	7FFF
20.0000 mA	nominal range		32767	7FFF
19.9994 mA			32766	7FFE
...			...	...
10.0003 mA			16384	4000
...			...	...
0.0006103 mA			1	0001
≤ 0.0000 mA			0	0000
≥ -0.1 mA		if ↑DIA **OoR** OFF	0	0000
< -0.2 mA	underflow	if ↓ DIA **OoR** ON	0	0000

4...20 mA	unipolar	diagnostic message	dec.	hex.
current value I_M = ((dec. value × 4.883 × 10^{-4}) + 4) mA				
> 20.2000 mA		if ↑DIA **OoR** ON	32767	7FFF
≤ 20.1000 mA		if ↓ DIA **OoR** OFF	32767	7FFF
20.0000 mA	nominal range		32767	7FFF
19.9995 mA			32766	7FFE
...			...	...
12.00024 mA			16384	4000
...			...	...
4.0004883 mA			1	0001
≤ 4.0000 mA			0	0000
≥ 3.7000 mA		if ↑DIA **OoR** OFF	0	0000
< 3.6000 mA		if ↓ DIA **OoR** ON	0	0000
≥ 3.0000 mA		if ↑DIA **WB** OFF	0	0000
< 2.9000 mA		if ↓ DIA **WB** ON	0	0000

- 12-Bit-representation (left-justified)

> **Note**
> In the values representation 12-Bit (left-justified), the diagnostic data are transmitted with bits 0 to 3 of the channel's process data.

-10...10 V	bipolar	diagnostic message	dec.	hex.
voltage value U_M = (dec. value / 16 × 4.885 × 10^{-3}) V				
> 10.1000 V		if ↑DIA **OoR** ON	2047 × 16	7FF×
≤ 10.0500 V		if ↓ DIA **OoR** OFF	2047 × 16	7FF×
10.0000 V			2047 × 16	7FF×
9.9951 V			2046 × 16	7FE×
...			...	...
5.00244 V			1024 × 16	400×
...			...	...
0.00488 V	nominal range		1 × 16	001×
0.000000 V			0	000×
-0.000488 V			-1 × 16	FFF×
...			...	...
-5.0000 V			-1024 × 16	C00×
...			...	...
-9.99511 V			-2047 × 16	801×
≤ - 10.0000 V			2048 × 16	800×
≥ -10.0500 V		if ↑DIA **OoR** OFF	2048 × 16	800×
< -10.1000 V		if ↓ DIA **OoR** ON	2048 × 16	800×

0...10 V	unipolar	diagnostic message	dec.	hex.
voltage value U_M = (dec. value / 16 × 2.442 × 10^{-3}) V				
> 10.1000 V		if ↑DIA **OoR** ON	4095 × 16	FFF×
≤ 10.0500 V		if ↓ DIA **OoR** OFF	4095 × 16	FFF×
10.0000 V			4095 × 16	FFF×
9.9976 V			4094 × 16	FFE×
...			...	...
5.0012 V	nominal range		2048 × 16	800×
...			...	...
0.00244 V			1 × 16	001×
≤ 0.0000 V			0	000×
≥ -0.0500 V	underflow	if ↑DIA **OoR** OFF	0	000×
< -0.1000 V		if ↓ DIA **OoR** ON	0	000×

0...20 mA	unipolar	diagnostic message	dec.	hex.
current value I_M = (dec. value / 16 × 4.884 × 10^{-3}) mA				
> 20.2000 mA		if ↑DIA **OoR** ON	4095 × 16	FFF×
≤ 20.1000 mA		if ↓ DIA **OoR** OFF	4095 × 16	FFF×
≥ 20.0000 mA	nominal range		4095 × 16	FFF×
19.9951 mA			4094 × 16	FFE×
...			...	...
10.0024 mA			2048 × 16	800×
...			...	...
0.00488 mA			1 × 16	001×
≤ 0.0000 mA			0	000×
≥ -0.1 mA		if ↑DIA **OoR** OFF	0	000×
< -0.2 mA		if ↓ DIA **OoR** ON	0	000×

4...20 mA	unipolar	diagnostic message	dec.	hex.
current value I_M = ((dec. value / 16 × 3.907 × 10^{-3}) + 4) mA				
> 20.2000 mA		if ↑DIA **OoR** ON	4095 × 16	FFF×
≤ 20.1000 mA		if ↓ DIA **OoR** OFF	4095 × 16	FFF×
≥ 20.0000 mA	nominal range		4095 × 16	FFF×
19.9961 mA			4094 × 16	FFE×
...			...	...
12.0019 mA			2048 × 16	800×
...			...	...
4.0039 mA			1 × 16	001×
≤ 4.0000 mA			0	000×
≥ 3.7000 mA		if ↑DIA **OoR** OFF	0	000×
< 3.6000 mA		if ↓ DIA **OoR** ON	0	000×
≥ 3.0000 mA		if ↑DIA **WB** OFF	0	000×
< 2.9000 mA		if ↓ DIA **WB** ON	0	000×

Extended Range - value representation

- 16-bit-representation

-10...10 V	bipolar	diagnostic message	dec.	hex.
voltage value U_M = (dec. value $\times$ 3.617 $\times$ 10^{-4}) V				
≥ 11.851490 V	overflow		32767	7FFF
≥ 11.758773 V		if ↑DIA **OoR** ON	32512	7F00
11.758411 V	out of range		32511	7EFF
≤ 11.603010 V		if ↓ DIA **OoR** OFF	32080	7D50
10.000305 V			27649	6C01
10.000000 V	nominal range		27648	6C00
...			...	...
5.0000 V			13824	3600
...			...	...
0.0003617 V			1	0001
0.000000 V			0	0000
-0.0003617 V			-1	FFFF
...			...	...
-5.000000 V			-13824	CA00
...			...	...
-10.000000V			-27648	9400
-10.000362 V	out of range		-27649	93FF
≥ -11.60301 V		if ↑DIA **OoR** OFF	-32080	82B0
-11.758897 V			-32511	8100
-11.759259 V	underflow	if ↓ DIA **OoR** ON	-32512	80FF
≤ -11.851851 V			-32768	8000

0...10 V	bipolar	diagnostic message	dec.	hex.
voltage value U_M = (dec. value × 3.617 × 10^{-4}) V				
≥ 11.851 V	overflow		32767	7FFF
≥ 11.758773 V		if ↑DIA **OoR** ON	32512	7F00
11.758411 V	out of range		32511	7EFF
≤ 11.603010 V		if ↓ DIA **OoR** OFF	32080	7D50
10.000305 V			27649	6C01
10.000000 V	nominal range		27648	6C00
...			...	...
4.999793 V			13824	3600
...			...	...
0.000361 V			1	0001
0.000000 V			0	0000
< 0.000000 V			0	0000
≥ -0.050 V	underflow	if ↑DIA **OUFL** OFF	0	0000
< -0.100 V		if ↓ DIA **OUFL** ON	0	0000

0...20 mA	bipolar	diagnostic message	dec.	hex.
current value I_M = (dec. value × 7.234 × 10^{-4}) mA				
≥ 23.70298 mA	overflow		32767	7FFF
≥ 23.51852 mA		if ↑DIA **OoR** ON	32512	7F00
23.518518 mA			32512	7F00
23.517795 mA	out of range		32511	7EFF
≤ 23.2060 mA		if ↓ DIA **OoR** OFF	32080	7D50
20.00723 mA			27649	6C01
20.000000 mA	nominal range		27648	6C00
...			...	...
10.0000 mA			13824	3600
...			...	...
0.0007234 mA			1	0001
0.000000 mA			0	0000
≥ -0.1 mA	underflow	if ↑DIA **OoR** OFF	0	000×
< -0.2 mA		if ↓ DIA **OoR** ON	0	000×

4…20 mA	bipolar	diagnostic message	dec.	hex.
current value I_M = ((dec. value × 5.787 × 10^{-4}) + 4) mA				
≥ 22.96238 mA	overflow		32767	7FFF
≥ 22.81481 mA		if ↑DIA **OoR** ON	32512	7F00
22.814236 mA	out of range		32511	7EFF
≤ 2256482 mA		if ↓ DIA **OoR** OFF	32080	7D50
20.00579 mA			27649	6C01
20.000000 mA	nominal range		27648	6C00
…			…	…
12.0000 mA			13824	3600
…			…	…
4.005787 mA			1	0001
4.000000 mA			0	0000
3.999421 mA	out of range		-1	FFFF
≥ 1.303241 mA		if ↑DIA **OoR** OFF	-4222	EEBA
1.185185 mA			-4864	ED00
≤ 1.184606 mA	underflow	if ↓ DIA **OoR** ON	-4865	ECFF
≤ 0.0000 mA			-32768	E500

- 12 bit representation
  The representation of the 12 bit values corresponds to that of the 16 bit values Only bits 0 to 3 are set to "0". Diagnostic data are **not** mapped to the process data.

-10...10 V	bipolar	diagnostic message	dec.	hex.
voltage value U_M = (dec. value / 16 × 5.787 × 10^{-3}) V				
≥ 11.8460 V	overflow		2047 × 16	7FF0
≥ 11.7592 V		if ↑DIA **OoR** ON	2032 × 16	7F00
11.7535 V	out of range		2031 × 16	7EF0
≤ 11.6030 V		if ↓ DIA **OoR** OFF	2005 × 16	7D50
10.0058 V			1729 × 16	6C10
10.000000 V	nominal range		1728 × 16	6C00
...			...	...
5.0000 V			864 × 16	3600
...			...	...
0.000578 V			1 × 16	0010
0.000000 V			0	0000
-0.000578 V			-1 × 16	FFF0
...			...	...
-5.000000 V			-864 × 16	CA00
...			...	...
-10.000000V			-1728 × 16	9400
-10.0058 V	out of range		-1729 × 16	93F0
≥ -11.6030 V		if ↑DIA **OoR** OFF	-2005 × 16	82B0
-11.7592 V			-2032 × 16	8100
-11.7650 V	underflow	if ↓ DIA **OoR** ON	-2033 × 16	80F0
≤ -11.8518 V			-2048 × 16	8000

0...10 V	bipolar	diagnostic message	dec.	hex.
voltage value U_M = (dec. value / 16 × 5.787 × 10^{-3}) V				
≥ 11.8460 V	overflow		2047 × 16	7FF0
≥ 11.7592 V		if ↑DIA **OoR** ON	2032 × 16	7F00
11.7535 V	out of range		2031 × 16	7EF0
≤ 11.6030 V		if ↓ DIA **OoR** OFF	2005 × 16	7D50
10.0058 V			1729 × 16	6C10
10.000000 V	nominal range		1728 × 16	6C00
...			...	...
5.0000 V			864 × 16	3600
...			...	...
0.000578 V			1 × 16	0010
0.00000 V			0	0000
< 0.00000 V	underflow		0	0000
≥ -0.050 V		if ↑DIA **OUFL** OFF	0	0000
< -0.100 V		if ↓ DIA **OUFL** ON	0	0000

0...20 mA	bipolar	diagnostic message	dec.	hex.
current value I_M = (dec. value / 16 × 0.01157) mA				
≥ 23.6921 mA	overflow		2047 × 16	7FF0
≥ 23.51852 mA		if ↑DIA **OoR** ON	2032 × 16	7F00
23.5069 mA	out of range		2031 × 16	7EF0
≤ 23.2060 mA		if ↓ DIA **OoR** OFF	2005 × 16	7D50
20.0116 mA			1729 × 16	6C10
20.000000 mA	nominal range		1728 × 16	6C00
...			...	...
10.0000 mA			864 × 16	3600
...			...	...
0.01157 mA			1 × 16	0010
≤ 0.0000 mA			0	0000
≥ -0.1 mA	out of range	if ↑DIA **OUFL** OFF	0	0000
< -0.2 mA		if ↓ DIA **OUFL** ON	0	0000

4...20 mA	bipolar	diagnostic message	dec.	hex.
current value I_M = ((dec. value / 16 × 9.259 × 10^{-3}) + 4) mA				
≥ 22.9537 mA	overflow		2047 × 16	7FF0
≥ 22.8148 mA		if ↑DIA **OoR** ON	2032 × 16	7F00
22.8056 mA	out of range		2031 × 16	7EF0
≤ 22.5648 mA		if ↓ DIA **OoR** OFF	2005 × 16	7D50
20.0093 mA			1729 × 16	6C10
20.000000 mA	nominal range		1728 × 16	6C00
...			...	...
12.0000 mA			864 × 16	3600
...			...	...
4.00925 mA			1 × 16	0010
4,0000 mA			0	0000
3.9907 mA	out of range		-1 × 16	FFF0
≥ 1.2963 mA		if ↑DIA **OoR** OFF	-292 × 16	EDC0
1.1851 mA			-304 × 16	ED00
≤ 1.1759 mA	underflow	if ↓ DIA **OoR** ON	-305 × 16	ECF0
≤ 0.000 mA			-432 × 16	E500

Value representation NE 43

- 16 Bit-respresentation

The hexadecimal value transmitted by the module has to be interpreted as adecimal value, which corresponds, if multiplied with a defined factor, to the analog value.

-10...10 V	bipolar	diagnostic message	dec.	hex.
voltage value U_M = (dec. value × 0.001) V				
≥ 11.000 V	overflow	if ↑DIA **OUFL** ON	11000	2AF8
≤ 10.999 V		if ↓ DIA **OUFL** OFF	10999	2AF7
10.501 V			10501	2905
≥ 10.500 V	out of range	if ↑DIA **OoR** ON	10500	2904
≤ 10.250 V		if ↓ DIA **OoR** OFF	10250	280A
10.001 V			10001	2711
...	nominal range		...	...
5.000 V			5000	1388
...			...	...
0.001 V			1	0001
0.0000 V			0	0000
-0.0001 V			-1	FFFF
...			...	...
-5.0000 V			-5000	EC78
...			...	...
-10.000 V			-10000	D8F0
- 10.001 V	out of range		-10001	D8EF
-10.250 V		if ↑DIA **OoR** OFF	-10250	D7F6
-10.500 V		if ↓ DIA **OoR** ON	-10500	D6FC
-10.501 V	underflow		-10501	D6FB
-10.999 V		if ↑DIA **OUFL** OFF		
≤ -11.000 V		if ↓ DIA **OUFL** ON	-11000	D508

0...10 V	unipolar	diagnostic message	dec.	hex.
voltage value U_M = (dec. value × 0.001) V				
≥ 11.000 V	overflow	if ↑DIA **OUFL** ON	11000	2AF8
≤ 10.999 V		if ↓ DIA **OUFL** OFF	10999	2AF7
10.501 V			10501	2905
≥ 10.500 V	out of range	if ↑DIA **OoR** ON	10500	2904
≤ 10.250 V		if ↓ DIA **OoR** OFF	10250	280A
10.001 V			10001	2711
10.000 V	nominal range		10000	2710
...			...	...
5.000 V			5000	1388
...			...	...
0.001 V			1	0001
0.000 V			0	0000
≥ - 0.05 V	underflow	if ↑ DIA **OUFL** OFF	0	0000
< -0.10 V		if ↓ DIA **OUFL** ON	0	0000

0...20 mA	unipolar	diagnostic message	dec.	hex.
current value I_M = (dec. value × 0.001) mA				
≥ 22.000 mA	overflow	if ↑DIA **OUFL** ON	22000	55F0
≤ 21.999 mA		if ↓ DIA **OUFL** OFF	21999	55EF
21.001 mA			21001	5209
≥ 21.000 mA	out of range	if ↑DIA **OoR** ON	21000	5208
≤ 20.500 mA		if ↓ DIA **OoR** OFF	20500	5014
20.001 mA			20001	4E21
20.000m A	nominal range		20000	4E20
...			...	...
10.000 mA			10000	2712
...			...	...
0.001 mA			1	0001
0.0000 mA			0	0000
≥ -0.1 mA		if ↑DIA **OUFL** OFF	0	0000
< -0.2 mA		if ↓ DIA **OUFL** ON	0	0000

4...20 mA	unipolar	diagnostic message	dec.	hex.
current value I_M = (dec. value × 0.001) mA				
≥ 22.000 mA	overflow	if ↑DIA **OUFL** ON	22000	55F0
≤ 21.999 mA		if ↓ DIA **OUFL** OFF	21999	55EF
21.001 mA			21001	5209
≥ 21.000 mA	out of range	if ↑DIA **OoR** ON	21000	5208
≤ 20.500 mA		if ↓ DIA **OoR** OFF	20500	5014
20.001 mA			20001	4E21
20.000m A	nominal range		20000	4E20
...			...	...
12.000 mA			12000	2EE0
...			...	...
4.001 mA			4001	0FA1
4.000 mA			4000	0FA0
3.999 mA	out of range		3999	0F9F
≥ 3.800 mA		if ↑DIA **OoR** OFF	3800	0ED8
3.600 mA		if ↓ DIA **OoR** ON	3600	0E10
3.599 mA	underflow		3599	0E0F
≥ 2.001 mA		if ↑DIA **WB** OFF	2001	07D1
≤ 2.000 mA		if ↓ DIA **WB** ON	2000	07D0
0.000 mA			0000	0000

- 12-Bit-representation (left-justified)
  The representation 12-Bit (left-justified) in process automation corresponds to the 16-bit-representation in which the lower 4 bits of the analog value are overwritten with diagnostic data.

-10...10 V	bipolar	diagnostic message	dec.	hex.
voltage value U_M = (dec. value × 0.001) V				
≥ 11.008 V	overflow	if ↑DIA **OUFL** ON	11008	2B00
≤ 10.992 V		if ↓ DIA **OUFL** OFF	10992	2AF0
10.512 V		if ↑DIA **OoR** ON	10512	2910
≥ 10.496 V	out of range		10496	2900
≤ 10.256 V		if ↓ DIA **OoR** OFF	10256	2810
10.016 V			10016	2720
10.000 V	nominal range		10000	2710
...				
4.992 V			4992	1380
...			...	...
0.016 V			16	0010
0.0000 V			0	0000
-0.016 V			-16	FFF0
...			...	...
-4.992 V			-5000	EC80
...			...	...
-10.000 V			-10000	D8F0
- 10.016 V	out of range		-10016	D8E0
-10.256 V		if ↑DIA **OoR** OFF	-10250	D7F0
-10.496 V			-10496	D700
-10.512 V	underflow	if ↓ DIA **OoR** ON	-10512	D6F0
-10.992 V		if ↑DIA **OUFL** OFF	-10992	D510
≤ -11.008 V		if ↓ DIA **OUFL** ON	-11000	D500

0...10 V	bipolar	diagnostic message	dec.	hex.
voltage value U_M = (dec. value × 0.001) V				
≥ 11.008 V	overflow	if ↑DIA **OUFL** ON	11008	2B00
≤ 10.992 V		if ↓ DIA **OUFL** OFF	10992	2AF0
10.512 V		if ↑DIA **OoR** ON	10512	2910
≥ 10.496 V	out of range		10496	2900
≤ 10.256 V		if ↓ DIA **OoR** OFF	10256	2810
10.016 V			10016	2720
10.000 V	nominal range		10000	2710
...				
4.992 V			4992	1380
...			...	...
0.016 V			16	0010
≤ 0.0000 V			0	0000
≥ -0.05 V		if ↑DIA **OUFL** OFF	0	0000
< -0.1 V		if ↓ DIA **OUFL** ON	0	0000

0…20 mA	unipolar	diagnostic message	dec.	hex.
current value I_M = (dec. value / 16 × 0.001) mA				
≥ 22.000 mA	overflow	if ↑DIA **OUFL** ON	22000	55F0
≤ 21.984 mA		if ↓ DIA **OUFL** OFF	21984	55E0
21.024 mA			21024	5220
≥ 21.008 mA	out of range	if ↑DIA **OoR** ON	21008	5210
≤ 20.496 mA		if ↓ DIA **OoR** OFF	20496	5010
20.016 mA			20016	4E30
20.000m A	nominal range		20000	4E20
…			…	…
10.000 mA			10000	2710
…			…	…
0.016 mA			16	0010
0.0000 mA			0	0000
≥ -0.1 mA		if ↑DIA **OUFL** OFF	0	0000
< -0.2 mA		if ↓ DIA **OUFL** ON	0	0000

4…20 mA	unipolar	diagnostic message	dec.	hex.
current value I_M = (dec. value / 16 × 0.001) V				
≥ 22.000 mA	overflow	if ↑DIA **OUFL** ON	22000	55F0
≤ 21.984 mA		if ↓ DIA **OUFL** OFF	21984	55E0
21.024 mA			21024	5220
≥ 21.008 mA	out of range	if ↑DIA **OoR** ON	21008	5210
≤ 20.496 mA		if ↓ DIA **OoR** OFF	20496	5010
20.016 mA			20016	4E30
20.000m A	nominal range		20000	4E20
…			…	…
12.000 mA			12000	2EE0
…			…	…
4.016 mA			4016	0FB0
4.000 mA			4000	0FA0
3.984 mA	out of range		3984	0F90
≥ 3.792 mA		if ↑DIA **OoR** OFF	3792	0ED0
< 3.600 mA		if ↓ DIA **OoR** ON	3600	0E10
3.584 mA	underflow		3584	0E00
≥ 2.496 mA		if ↑DIA **WB** OFF	2496	09C0
< 2.000 mA		if ↓ DIA **WB** ON	2000	07D0
0.000 mA			0000	0000

10.1.5 Measurement value representation of outputs

Standard value representation (voltage)

- 16-bit-representation

	dec.	hex.	bipolar	-10…10 V
dec. value= 3276.7 [1/V] × voltage value [V]				
100.00 %	32767	7FFF	nominal range	10.0000 V
99.99695 %	32766	7FFE		9.9997 V
	…	…		…
50.00153 %	16384	4000		5.0002 V
	…	…		…
0.00305 %	1	0001		0.000305 V
0.00000 %	0	0000		0.000000 V
-0.00305 %	-1	FFFF		-0.000305 V
	…	…		…
-50.00000 %	-16384	C000		-5.0000 V
	…	…		…
-99.99695 %	-32767	8001		-9.9997 V
-100.00 %	-32768	8000		- 10.0000 V

	dec.	hex.	unipolar	0…10 V
dec. value= 3276.7 [1/V] × voltage value [V]				
100.00 %	32767	7FFF	nominal range	10.0000 V
99.99695 %	32766	7FFE		9.9997 V
	…	…		…
50.00153 %	16384	4000		5.0002 V
	…	…		…
0.00305 %	1	0001		0.000305 V
0.00000 %	0	0000		0.000000 V
-0.00305 %	-1	FFFF	DIA **OoR** ON at FFFF to 8000	0.000000 V
	…	…		…
-50.00000 %	-16384	C000		0.000000 V
	…	…		…
-99.99695 %	-32767	8001		0.000000 V
-100.00 %	-32768	8000		0.000000 V

- 12-Bit-representation (left-justified)

	dec.	hex.	bipolar	-10…10 V
dec. value= 204.7 [1/V] × voltage value [V] × 16				
100.00 %	2047 × 16	7FF×	nominal range	10.0000 V
99.96 %	2046 × 16	7FEx		9.9951 V
	…	…		…
0.0049 %	1 × 16	001x		0.004885 V
0.00000 %	0	000x		0.000000 V
-0.0049 %	-1 × 16	FFF×		-0.004883 V
	…	…		…
-99.95 %	-2047 × 16	801x		-9.9951 V
-100.00 %	-2048 × 16	800x		- 10.0000 V

	dec.	hex.	unipolar	0…10 V
dec. value= 409.5 [1/V] × voltage value [V] × 16				
100.00 %	4095 × 16	FFF×	nominal range	10.0000 V
99.9756 %	4094 × 16	FFEx		9.9997 V
	…	…		…
50.0122%	2048 × 16	800x		5.0002 V
	…	…		…
0.0244 %	1 × 16	001x		0.000305 V
0.00000 %	0	000x		0.000000 V

Extended Range - value representation (voltage)

- 16-bit-representation

	dec.	hex.	bipolar	-10…10 V
dec. value= 2764.8 [1/V] × voltage value [V]				
118.525 %	32767	7FFF	DIA **OoR** ON at 7F00 to 7FFF	11.851 V
118.461 %	32752	7FF0		11.846 V
	32512	7F00		11.759 V
117.589 %	32511	7EFF	out of range	11.760 V
117.535 %	32496	7EF0		11.75 V
100.058%	27664	6C10		10.0058 V
≥100.004 %	27649	6C01		10.0004 V
100.000 %	27648	6C00	nominal range	10 V
0.05787 %	16	0010		5.787 mV
0.003617 %	1	0001		361.7 µV
0.000 %	0	0000		0 V
-0.00362 %	-1	FFFF		-361.7 µV
-0.05787 %	-16	FFF0		- 5.787 mV V
-25.000 %	-6912	E500		-2.5 V
-100.000 %	-27648	9400		-10 V
≤ -100.004 %	-27649	93FF	out of range	-10.0004 V
-100.058 %	-27664	93F0		-10.0058 V
-117.593 %	-32512	8100		-11.759 V
	-32513	80FF	DIA **OoR** ON at 80FF to 8000	11.760 V
-118.461 %	-32752	80F0		-11.846 V
-118.519 %	-32768	800		-11.852 V

	dec.	hex.	unipolar	0…10 V
dec. value= 2764.8 [1/V] × voltage value [V]				
118.525 %	32767	7FFF	DIA **OoR** ON at 7F00 to 7FFF	11.851 V
118.461 %	32752	7FF0		11.846 V
	32512	7F00		11.760 V
117.589 %	32511	7EFF	out of range	11.759 V
117.535 %	32496	7EF0		11.75 V
100.058%	27664	6C10		10.0058 V
≥100.004 %	27649	6C01		10.0004 V
100.000 %	27648	6C00	nominal range	10 V
0.05787 %	16	0010		5.787 mV
0.003617 %	1	0001		361.7 μV
0.000 %	0	0000		0.00 V
-0.00362 %	-1	FFFF	DIA **OUFL** ON at FFFF to 8000	0.00 V
-0.05787 %	-16	FFF0		0.00 V
-25.000 %	-6912	E500		0.00 V
-100.000 %	-27648	9400		0.00 V
≤ -100.004 %	-27649	93FF		0.00 V
-100.058 %	-27664	93F0		0.00 V
-117.593 %	-32512	8100		0.00 V
	-32513	80FF		0.00 V
-118.461 %	-32752	80F0		0.00 V
-118.519 %	-32768	8000		0.00 V

- 12-Bit-representation (left-justified)
  The representation of the 12 bit values is similar to that of the 16 bit values. Only the bits Bit 0-3 are set to "0".

Value representation (NE 43) (voltage)

- 16-bit-representation

	dec.	hex.	bipolar	-10…10 V
dec. value= 1000 [1/V] × voltage value [V]				
	37767	7FFF	DIA **OUFL** ON at 2AF9 to 7FFF	11.000 V
> 110. 00 %	> 11000	2AF8		11.000 V
110.00 %	11000	2AF8	DIA **OoR** ON at 2905 to 7FFF	11.000 V
105.01 %	10501	2905		10.501 V
105.00 %	10500	2904	out of range	10.500 V
100.01 %	10001	2711		10.001 V
100.000 %	10000	2710	nominal range	10.000 V
40.00 %	4000	0FA0		4.000 V
0.01 %	1	0001		0.001 V
0.000 %	0	0000		0 V
-0.01 %	-1	FFFF		-0.001 V
-40.00 %	-4000	F060		-4.000 V
-100.00 %	-10000	D8F0		-10.000 V
≤-100.01 %	-10001	D8EF	out of range	-10.001 V
-105.00 %	-10500	D6FC		-10.500 V
-105.01 %	-10501	D6FB	DIA **OoR** ON at D6FB to 8000	-10.501 V
-110.00 %%	-11000	D508		-11.000 V
> -110.00 %	< -11000	D508	DIA **OUFL** ON at D507 to 8000	-11.00 0 V
	-32768	8000		-11.000 V

	dec.	hex.	bipolar	0…10 V
dec. value= 1000 [1/V] × voltage value [V]				
	65535	FFFF	DIA **OUFL** ON at 2AF9 to FFFF	11.000 V
> 110. 00 %	> 11000	2AF8		11.000 V
110.00 %	11000	2AF8	DIA **OoR** ON at 2905 to 7FFF	11.000 V
105.01 %	10501	2905		10.501 V
105.00 %	10500	2904	out of range	10.500 V
100.01 %	10001	2711		10.001 V
100.000 %	10000	2710	nominal range	10.000 V
40.00 %	4000	0FA0		4.000 V
20.00 %	2000	07D0		2.000 V
0.01 %	1	0001		0.001 V
0.000 %	0	0000		0 V

- 12-Bit-representation (left-justified)
  The representation of the 12 bit values is similar to that of the 16 bit values. Only the bits Bit 0-3 are set to "0".

10.1.6 Base modules/ pin assignment

- BL67-B-4M12

Figure 10-3: BL67-B-4M12

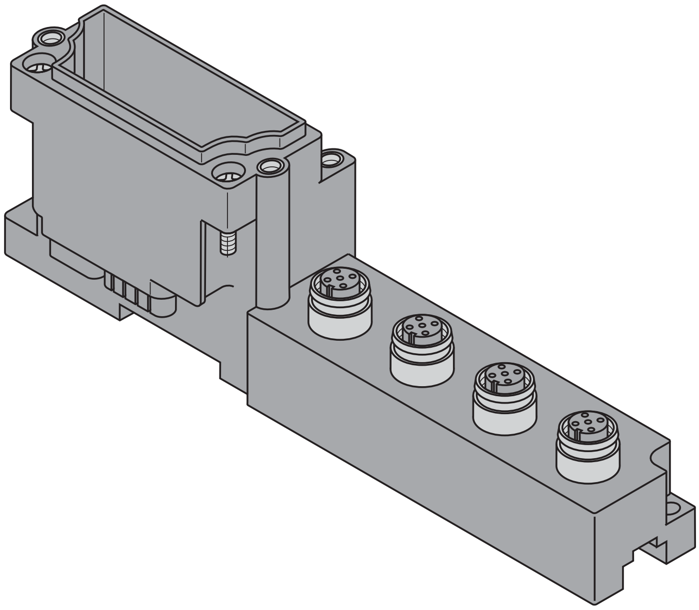
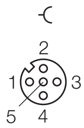


Table 10-5: Pin assignemtn BL67-4AI4AO-V/I with BL67-B-4M12



1 = V_{SENS}
2 = AO +
3 = GND
4 = AI +
5 = PE

- BL67-B-2M12-8/ BL67-B_2M12-8-P

Figure 10-4: BL67-B-2M12-8/ BL67-B-2M12-8-P

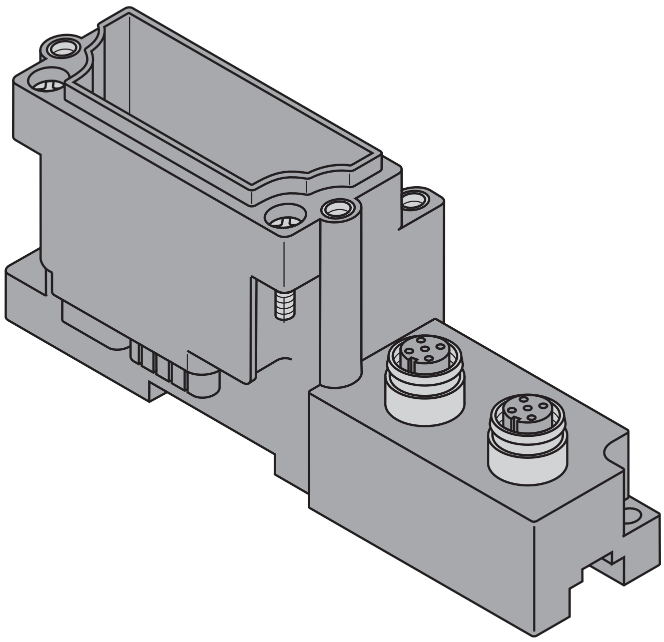
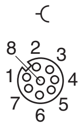


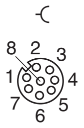
Table 10-6: Pin assignment BL67-4AI4AO-V/I with BL67-B-2M12-8

Slot 0



1 = AI 0 + 5 = V_{SENS}
2 = AI 2 + 6 = $V_{SENS}0$
3 = AO 0 + 7 = GND
4 = AO 2 + 8 = PE

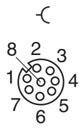
Slot 1



1 = AI 1 + 5 = V_{SENS}
2 = AI 3 + 6 = $V_{SENS}1$
3 = AO 1 + 7 = GND
4 = AO 3 + 8 = PE

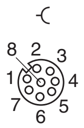
Table 10-7: Pin assignment BL67-4AI4AO-V/I with BL67-B-2M12-8-P

Slot 0



1 = AI 0 + 5 = V_{SENS}
2 = AI 1 + 6 = $V_{SENS}0$
3 = AO 0 + 7 = GND
4 = AO 1 + 8 = PE

Slot 1



1 = AI 2 + 5 = V_{SENS}
2 = AI 3 + 6 = $V_{SENS}1$
3 = AO 2 + 7 = GND
4 = AO 3 + 8 = PE

- BL67-B-8M8

Figure 10-5: BL67-B-8M8

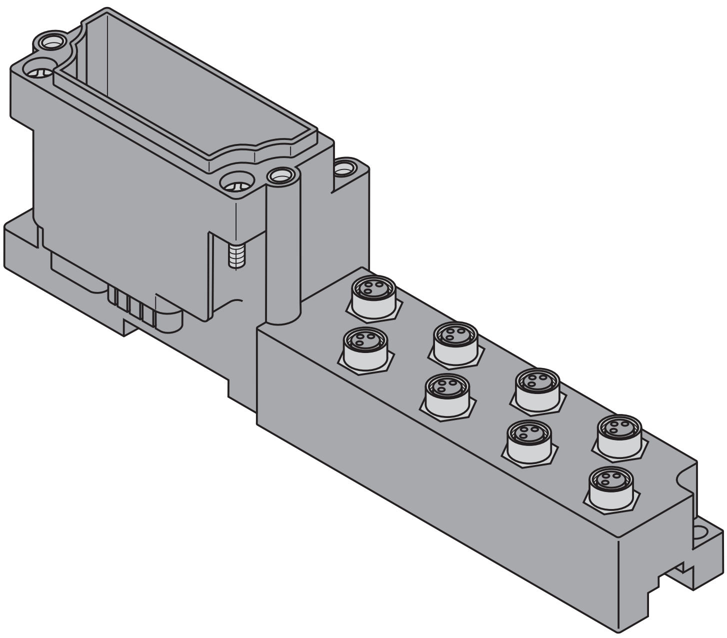


Table 10-8: Pin assignment BL67-4AI4AO-V/I with BL67-B-8M8

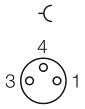
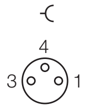
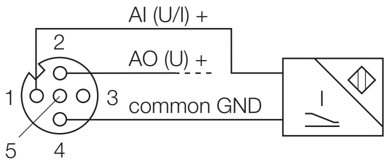
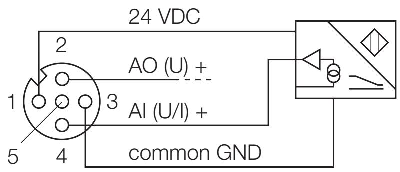
Connector 0 - 3	Connector 4 - 7
 1 = V_{SENS} 3 = GND 4 = AI +	 1 = V_{SENS} 3 = GND 4 = AO +

Figure 10-6: Connection options for BL67-4AI4AO-VI with M12

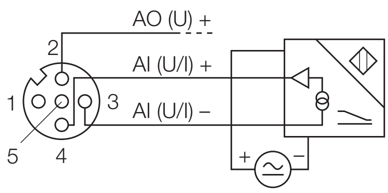
2-wire-connection of the analog input:



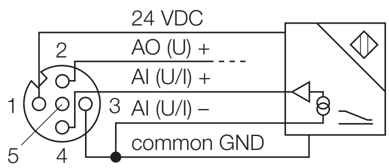
3-wire-connection of the analog input:



3-wire-connection of the analog input with separate power supply:



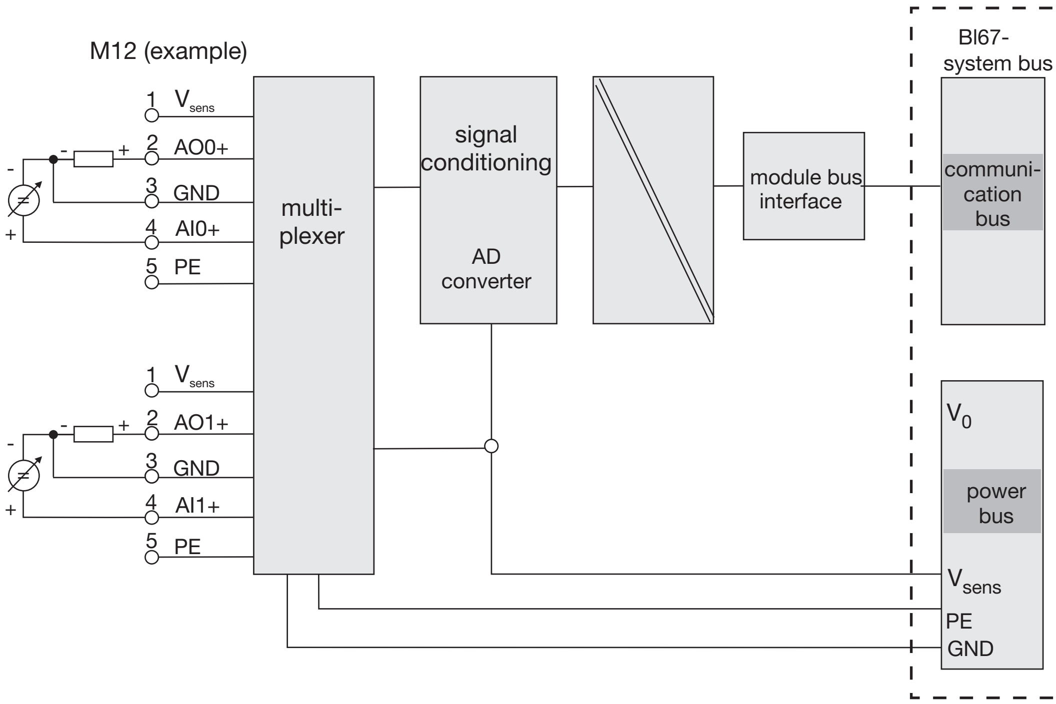
3-wire-connection of the analog input (4-wire-sensor with external brdge):



10.2 BL67-2AI2AO-V/I, voltage/ current measurement

Figure 10-7:
BL67-2AI2AO-V/I

Figure 10-8:
Block diagramm



10.2.1 Technical data

Table 10-9: Technical data

Designation	BL67-2AI2AO-V/I
Number of channels	2/2
Nominal voltage from supply terminal	24 V DC
voltage range	18 to 30 VDC
Nominal current from 5 V DC (module bus) I_{MB}	≤ 50 mA
Nominal current from supply terminal I_L	≤ 50 mA
Power loss of the module, typical P_{MAX}	< 1 W
Input signal for current measurement	
Input resistance (burden)	< 125 Ω
Input current (range, which can be evalutated by the AD converter)	0 to 20 mA 4 to 20 mA
Input current (maximum - if > 20,2 mA, a "measurement value range error" is reported)	50 mA
Limit frequency (-3 dB)	20 Hz
Input signal for voltage measurement	
Input resistance (burden)	> 98.5 kΩ
Input voltage (range, which can be evalutated by the AD converter)	-10 to 10 V DC 0 to 10 V DC
Input voltage (maximum - if the deviation is > 1 % of the value range "measurement value range error" is reported)	35 V DC
Limit frequency (-3 dB)	20 Hz
Accuracy of input signal	
Basic error at 23 °C / 73.4 °F	< 0,3 %
Temperature coefficient	≤ 300 ppm/°C of end value
Output signal for voltage measurement	
Output voltage U_A	-10/0 to 10V DC
Burden resistance	
– ohmic load R_{LO}	> 1 kΩ
– capacitive load R_{Lk}	< 1 µF
Short-ciruit current I_K	≤ 40 mA
Transmission frequency f_T	< 100 Hz

Basic error at 23 °C / 73.4 °F	0,3 %
Repeat accuracy	0,05 %
Output ripple	0,02 %
Temperature coefficient	≤ 300 ppm/°C of end value
Settling time (maximum)	
– ohmic load	max. 0.5 ms
– inductive load	max. 2.0 ms
– capacitive Last	max. 2.0 ms
Common Mode Error	min. 90 dB
Differental Mode Error	min. 70 dB
Crosstalk	min. - 50 dB
Isolation voltages	
U_{TMB} (module bus/ field)	min. 500 V DC
U_{PE} (field/ PE)	min. 500 V DC
Resolution of A/D-converter	16 Bit

10.2.2 Diagnostic/ status messages

Diagnosis/ status via LEDs

Table 10-10: Diagnosis/ status via LEDs

LED	Display	Meaning	Remedy
D	Red, flashing, 0.5 Hz	Pending diagnostic message	-
	Red	Module bus communication failure	Check if more than two ad-joining electronic modules have been pulled. This applies to modules located between this module and the gateway.
	Off	No error messages or diagnostics	–
0 to 1	Green	Channel x active	-
	Green, flashing, 0.5 Hz	Underflow	-
	Green, flashing 4 Hz	Overflow	-
	Off	Channel x inactive	

Diagnostic meassages via software

The module sends the following diagnostic messages per channel:

Table 10-11: Diagnosis

Byte	Bit	Diagnostic message	Meaning
Inputs			
0 - 1	0	**OoR** Measurement value range error	Thresholds see Measurement value representation of inputs (see Measurement value representation of inputs for module BL67-4AI4AO-VI, page 10-8) Note: A wire break diagnosis is only possible in the operation mode 4 to 20 mA.
	1	**WB** wire break	
	2	reserviert	
	3	**OUFL** Over-/ Underflow	
	4 - 7	reserved	
Ouputs			
0 - 1	0	**OoR** Measurement value range error	Thresholds see Measurement value representation of outputs (see Measurement value representation of outputs for module BL67-4AI4AO-VI, page 10-21)
	1 + 2	reserved	
	3	**OUFL** Over-/ Underflow	
	4 - 7	reserved	

10.2.3 Module parameters (per channel)

The module provides 8 byte parameter data. One byte is assigned to each channel.

Note

Please read page 10-21 ff. for detailed information about the parameter settings (Standard, Extended Range, PA (NE 43)).

Table 10-12: Module parameters

A *default-settings*
B *for in- and outputs*
C *only for inputs*

Parameter	Settings
Operation mode Kx	– voltage -10 … 10 V DC standard **A, B** – voltage 0 … 10 V DC standard **B** – voltage -10 … 10 V DC PA (NE 43) **B** – voltage 0 … 10 V DC PA (NE 43) **B** – voltage -10 … 10 V DC Extended Range **B** – voltage 0 … 10 V DC Extended Range **B** – current 0 … 20 mA standard **A, C** – current 4 … 20 mA standard **C** – current 0 … 20 mA PA (NE 43) **C** – current 4 … 20 mA PA (NE 43) **C** – current 0 … 20 mA Extended Range **C** – current 4 … 20 mA Extended Range **C** – deactivate
Value representation	– Integer (15 bit + sign) **A** – 12 bit (left-justified)
Diagnostics	– release **A** – block
Behaviour on module bus error Ax	– output substitute value **A** – hold current value
Substitute value Ax	Substitute value = “0“ **A** The substitute value will be transmitted if the respective parameters of the gateway have been set to "output substitute value" or if the module does not communicate with the gateway.

10.2.4 Measurement value representation of inputs

see Measurement value representation of inputs, page 10-8

see Measurement value representation of outputs, page 10-21

10.2.5 Base modules/ pin assignment

- BL67-B-2M12-8/ BL67-B-2M12-8-P

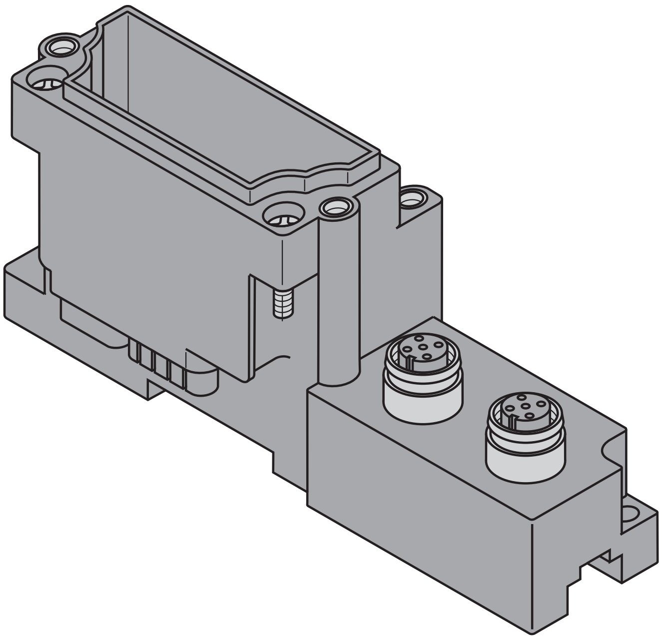
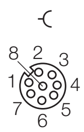


Figure 10-9: BL67-B-2M12-8/ BL67-B-2M12-8-P

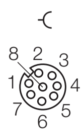
Table 10-13: Pin assignment BL67-2AI2AO-V/I with BL67-B-2M12-8

Slot 0



1 = AI 0 –	5 = V_{SENS}
2 = AO 0 –	6 = V_{SENS}
3 = AI 0 +	7 = GND
4 = AO 0 +	8 = PE

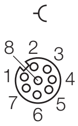
Slot 1



1 = AI 1 –	5 = V_{SENS}
2 = AO 1 –	6 = V_{SENS}
3 = AI 1 +	7 = GND
4 = AO 1 +	8 = PE

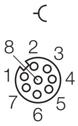
Table 10-14: Pin assignment BL67-2AI2AO-V/I with BL67-B-2M12-8-P

Slot 0



1 = AI 0 –	5 = V_{SENS}
2 = AI 1 –	6 = V_{SENS}
3 = AI 0 +	7 = GND
4 = AI 1 +	8 = PE

Slot 1



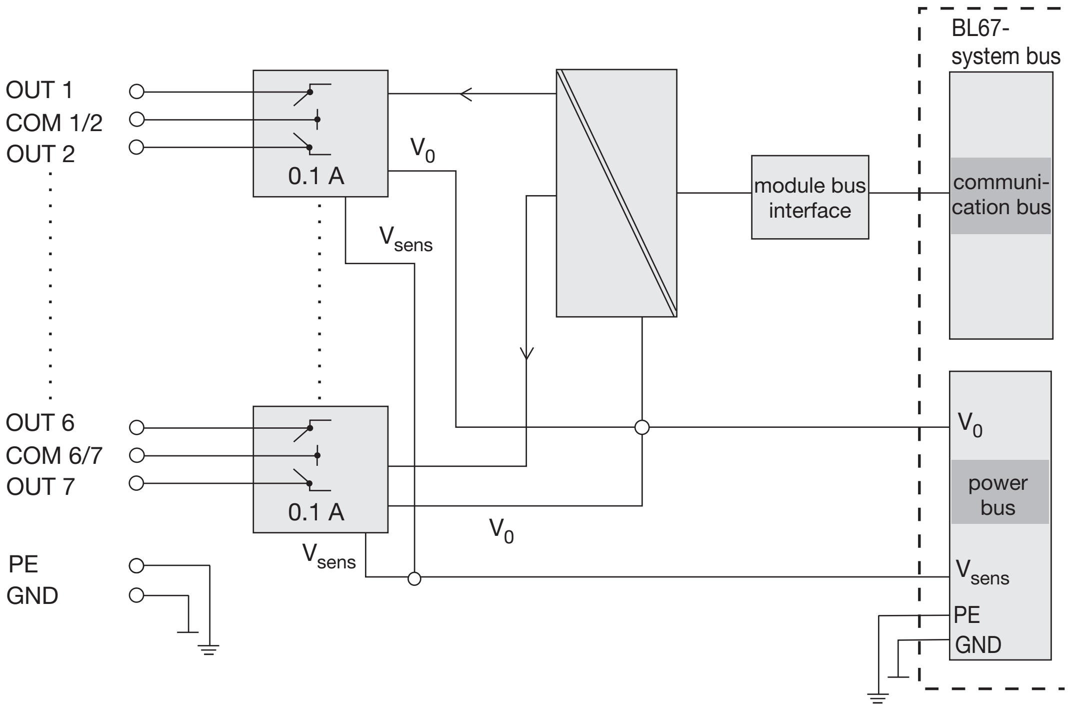
1 = AO 0 –	5 = V_{SENS}
2 = AO 1 –	6 = V_{SENS}
3 = AO 0 +	7 = GND
4 = AO 1 +	8 = PE

11 Relay modules

11.1 BL67-8DO-R-NO

Figure 11-1: BL67-8DO-R-NO

Figure 11-2: Block diagram



11.1.1 Technical data

Table 11-1: Techncal data

Designation	BL67-8DO-R-NO
Number of channels	8, normally open
Nominal voltage from supply terminal	24 V DC
Load voltage V_O	24 V DC
Voltage range	18 bis 30 VDC
Nominal current consumption from 5 V DC (module bus) I_{MB}	≤ 50 mA
Nominal current consumption from supply terminal I_L	-
Power loss of the module, typical	typ. < 2 W
Switching resistor	< 31 Ω
Switch-on resistor R_{on}	max. 25 Ω
Output current I_A per channel	
at 25 °C	100 mA
at 55 °C	50 mA
Load type	ohmic, TTL logic
Switching frequency, resistive	< 200 Hz
Simultaneity factor	100 %
Isolation voltages	
Module bus /fied	1500 V AC
Relay/ relay (contact group/ contanct group)	300 V DC
Contact/contact (open contact)	50 V DC

11.1.2 Diagnostic/ status messages

Diagnosis/ status via LEDs

Table 12: Diagnosis/ status via LEDs

LED	Display	Meaning	Remedy
D	Red, flashing, 0.5 Hz	Diagnostics pending	-
	Red	Module bus communication failure	Check if more than two ad-joining electronic modules have been pulled. This applies to modules located between this module and the gateway.
	Off	No error messages or diagnostics	-
0 to 7	Green	Status of channel x = 1	-
	Off	Status of channels x = 0	-

Diagnosis via software

none

11.1.3 Modul parameters

none

11.1.4 Base moduled/ pin assignment

- BL67-B-4M12-P

Figure 11-3: BL67-B-4M12-P

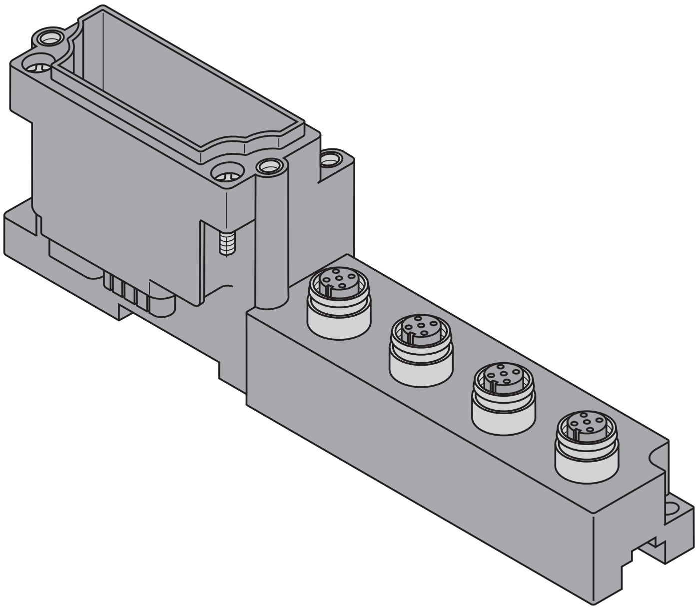


Figure 11-4: Pin assignment

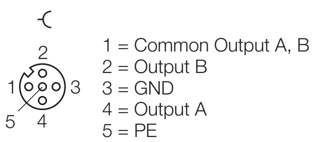
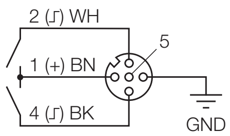
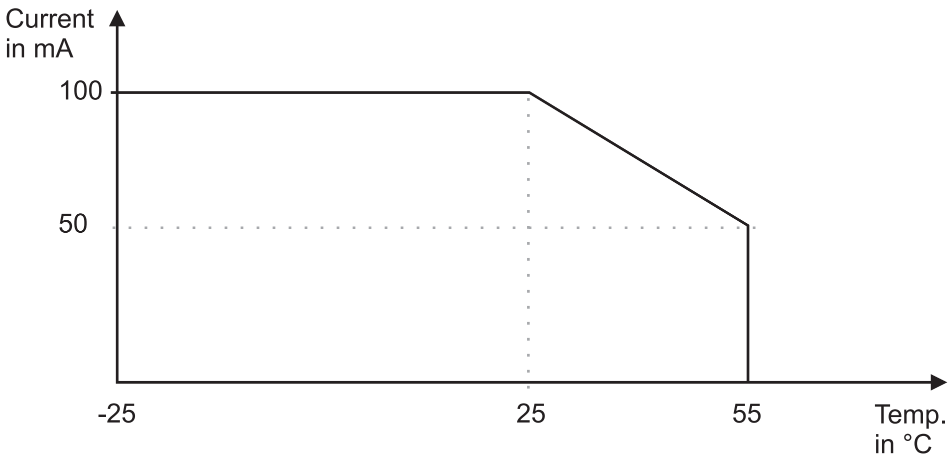


Figure 11-5: Wiring diagram



11.1.5 Derating

Figure 11-6: Derating of the PhotoMOS-Relays



11.1.6 Signal assignment

Table 11-1: Signal assignment with BL67-B-4M12-P

	Byte	Bit 7	Bit 6	Bit 5	Bit 4	Bit 3	Bit 2	Bit 1	Bit 0
Out	m	C3P2	C3P4	C2P2	C2P4	C1P2	C1P4	C0P2	C0P4

m = process data offset of the output data depending on station configuration and the corresponding fieldbus.

C… = slot no.

P… = pin no.

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12 Technology Modules

12.1 BL67-1RS232

The module BL67-1RS232 transmits serial data through the BL67 system via a RS232 interface and enables the connection of different devices (printer/ scanner/ bar code reader), which as well provide a serial RS232 interface.

12.1.1 Data transfer method

The serial data transfer is flexible. An operational data transfer method can be set by the module's parameters.

The data transfer can be parameterized as follows:

- Data rate: 300 Bit/s to 115200 Bit/s.
- Data bits: 7 or 8 data bits in one data frame
- Parity: none, odd or even
- Stop bits: 1 or 2 Bit.

Note
The data flow control can be realized via a hardware handshake (RTS/CTS) or a software handshake (XON/XOFF).

12.1.2 Data exchange

For the data exchange with a field device, the module provides a 64-byte transmit-buffer and a 128-byte receive-buffer. This is a hardware-restriction. The data telegrams which have to be sent or received can be larger.

The data transfer from the PLC into the transmit-buffer of the module or from the receive-buffer of the module to the PLC is realized via a 8-byte transmission channel in the process input or process output data.
To ensure the error-free data transmission, 2 byte of each data package are used to display status-, control- and diagnosis information. The amount of user data is therefore reduced to 6 byte within a data package.

12.1.3 Process data

With PROFIBUS, PROFINET and CANopen, the position of the I/O data of this module within the process data of the whole station is determined by the hardware configuration tool of the fieldbus master.

With DeviceNet™, EtherNet/IP™ and Modbus TCP a detailed mapping table can be created with the TURCK configuration tool I/O-ASSISTANT.

Process input data (PDin)

The incoming data are stored in the receive-buffer of the BL67-1RS232 module, segmented and transferred to the PLC via the module bus and the gateway.

The transmission is realized in a 8-byte format, structured as follows:

- 6 byte user data
- 1 byte diagnostic data
- 1 status byte, used to guarantee error free data-transmission.

Process image - input data

	Byte	Byte in DP	Bit 7	Bit 6	Bit 5	Bit 4	Bit 3	Bit 2	Bit 1	Bit 0
Statusbyte	n	n + 7	STAT	TX_CNT_ACK		RX_CNT		RX_BYTE_CNT		
Diagnosis	n + 1	n + 6	Buf Ovfl	Frame Err	HndSh Err	HW Faliure	Prm Err	reserved		
User data	n + 2	n + 5	Data byte 0							
	n + 3	n + 4	Data byte 1							
	n + 4	n + 3	Data byte 2							
	n + 5	n + 2	Data byte 3							
	n + 6	n + 1	Data byte 4							
	n + 7	n + 0	Data byte 5							

n = process data offset of the input data depending on station configuration and the corresponding fieldbus

Note

A software function block is available for simple handling of the serial interfaces (RS232, RS485 and RS422). Such a function block is available for the CoDeSys programmable BL67 gateway and for the S7 PLC systems.

The actual sequence of the data of the RSxxx modules in the process data of the higher-level control system may vary from that shown here.

The sequence in PROFIBUS systems is generally the reverse (byte 0 complies with byte 7 etc.).

Meaning of the data bits

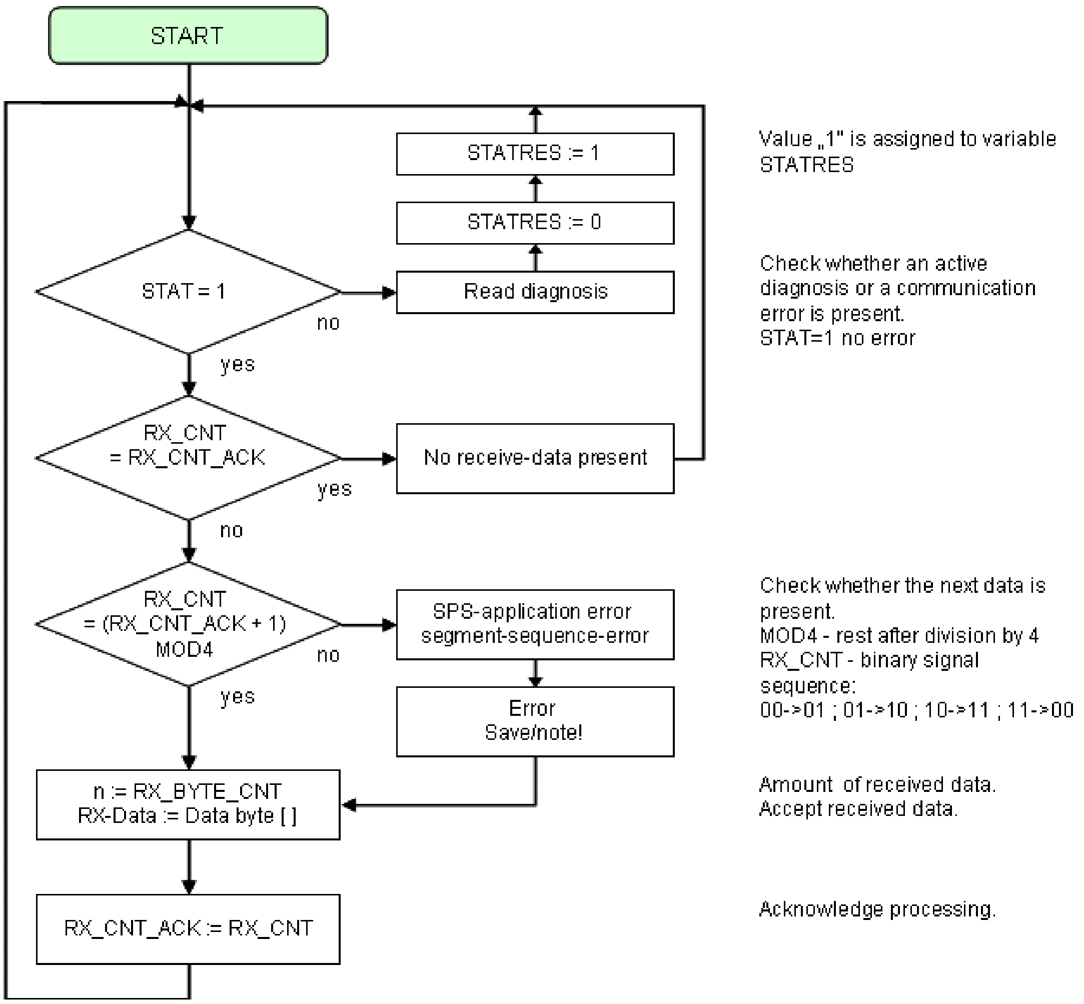
Table 12-1: Meaning of the data bits (process input)

Designation	Value	Meaning
BufOvfl; FrameErr; HndShErr; HwFailure; PrmErr	0 - 255	Diagnostic information (correspond to the diagnostic information in the diagnosis telegram, see Diagnosis via software, page 12-12).
STAT	0-1	1: The communication with the data terminal equipment (DTE) is error free 0: The communication with the data terminal equipment (DTE) is disturbed. A diagnosis message is generated if the parameter "Diagnostics" is set to "0/ release". The diagnostic data show the cause of the communication disturbance. The user has to set back this bit in the process output data by using< STATRES.

TX_CNT_ACK	0-3	The value TX_CNT_ACK is a copy of the value TX_CNT. TX_CNT has been transmitted together with the last data segment of the process output data. TX_CNT_ACK is an acknowledge for the successful transmission of the data segment with TX_CNT.
RX_CNT	0-3	This value is transferred together with every data segment. The RX_CNT values are sequential: 00->01->10->11->00… (decimal: 0->1->2->3->0…) Errors in this sequence show the loss of data segments.
RX_BYTE_CNT	0-7	Number of the valid bytes in this data segment.

Schematic diagram of the receive sequence

Figure 12-1: Schematic diagram of the receive sequence



PLC output data

The data received from the PLC are loaded into the transmit- buffer of the BL67-1RS232 module.

The fieldbus specific transmission for PROFIBUS-DP is realized in a 8-byte format which is structured as follows:

- 6 byte user data
- 1 byte containing signals to flush the transmit- and receive buffer.
- 1 control byte, used to guarantee error free data-transmission.

Process image - output data

	Byte	Byte in DP	Bit 7	Bit 6	Bit 5	Bit 4	Bit 3	Bit 2	Bit 1	Bit 0
Control byte	m	m + 7	STAT RES	RX_CNT_ACK		TCX_CNT		TX_BYTE_CNT		
Communication	m + 1	m + 6	reserved						RXBUF FLUSH	TXBUF FLUSH
User data	m + 2	m + 5	Data byte 0							
	m + 3	m + 4	Data byte 1							
	m + 4	m + 3	Data byte 2							
	m + 5	m + 2	Data byte 3							
	m + 6	m + 1	Data byte 4							
	m + 7	m + 0	Data byte 5							

m = process data offset of the output data depending on station configuration and the corresponding fieldbus

Note

A software function block is available for simple handling of the serial interfaces (RS232, RS485 and RS422). Such a function block is available for the CoDeSys programmable BL67 gateway and for the S7 PLC systems.

The actual sequence of the data of the RSxxx modules in the process data of the higher-level control system may vary from that shown here.

The sequence in PROFIBUS systems is generally the reverse (byte 0 complies with byte 7 etc.).

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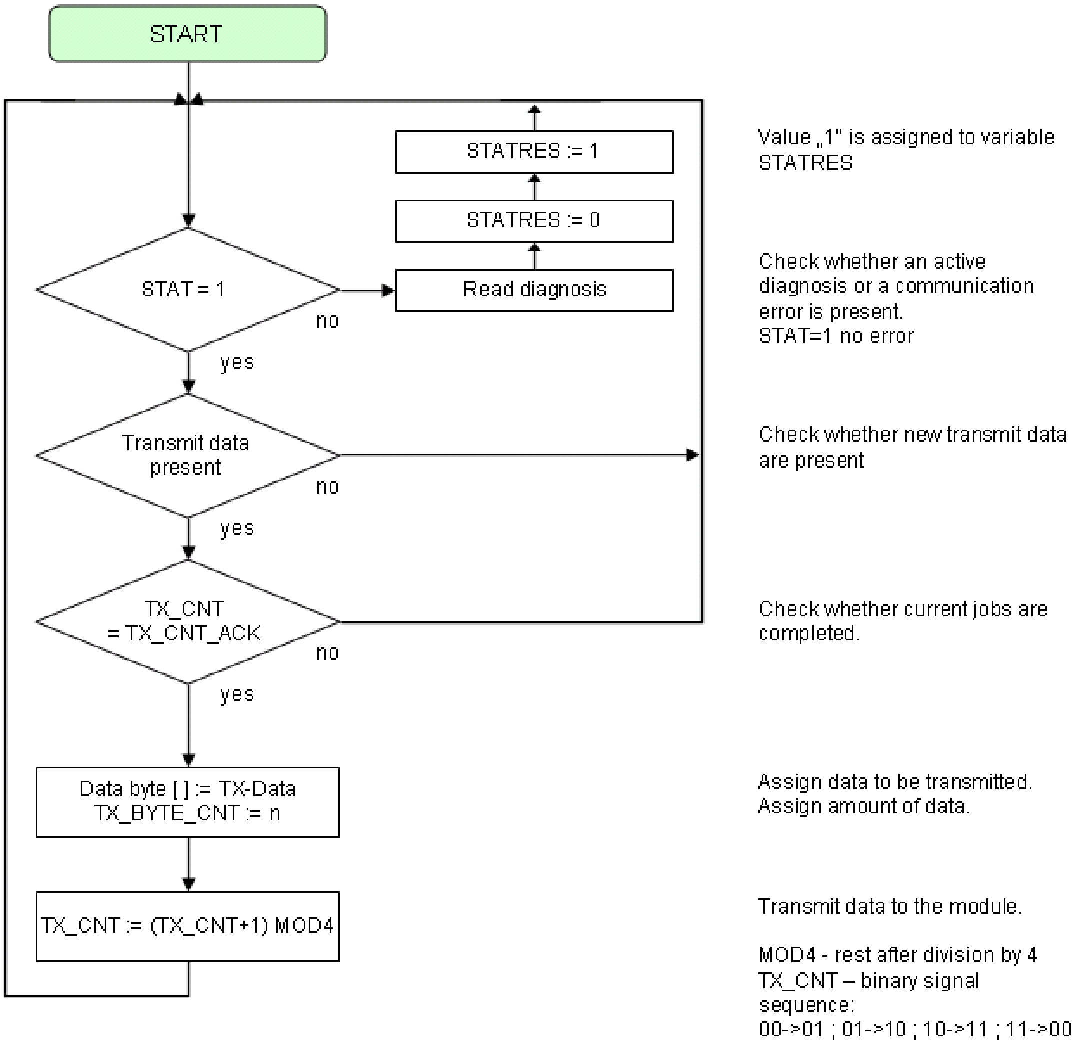
Meaning of the data bits

Table 12-2: Meaning of the data bits (process output)

Designation	Value	Meaning
RXBUF FLUSH	0 - 1	This bit is used to flush the receive-buffer. If STATRES = 1: The command RXBUF FLUSH = 1 is ignored. If STATRES = 0: RXBUF FLUSH = 1 causes the flushing of the receive-buffer.
TXBUF FLUSH	0-1	This bit is used to flush the transmit-buffer. If STATRES = 1: The command TXBUF FLUSH = 1 is ignored. If STATRES = 0: TXBUF FLUSH = 1 causes the flushing of the transmit-buffer.
STATRES	0-1	This bit is set to reset the STAT bit in the process input data. With the change from 1 to 0 the STAT bit is reset (from 0 to 1). If this bit is 0, all changes in TX_BYTE_CNT, TX_CNT and RX_CNT_ACK are ignored. Flushing the transmit-/ receive-buffer with RXBUF FLUSH/ TXBUF FLUSH is possible. If this bit is 1 or with the change from 0 to 1, the flushing of the transmit-/ receive-buffer with RXBUF FLUSH/ TXBUF FLUSH is not possible.
RX_CNT_ACK	0-3	The value RX_CNT_ACK is a copy of the value RX_CNT. TX_CNT has been transmitted together with the last data segment of the process input data. TX_CNT_ACK is an acknowledge for the successful transmission of the data segment with RX_CNT.
TX_CNT	0-3	This value is transferred together with every data segment. The TX_CNT values are sequential: 00->01->10->11->00… (decimal: 0->1->2->3->0…) Errors in this sequence show the loss of data segments.
TX_BYTE_CNT	0 - 7	Number of the valid user data in this data segment. In PROFIBUS-DP, the data segments contain a maximum number of 6 bytes of user data.

Schematic diagram of the transmit sequence

Figure 12-2: Schematic diagram of the transmit sequence



12.1.4 Technical data

Figure 12-3: BL67-1RS232

Figure 12-4: Block diagram

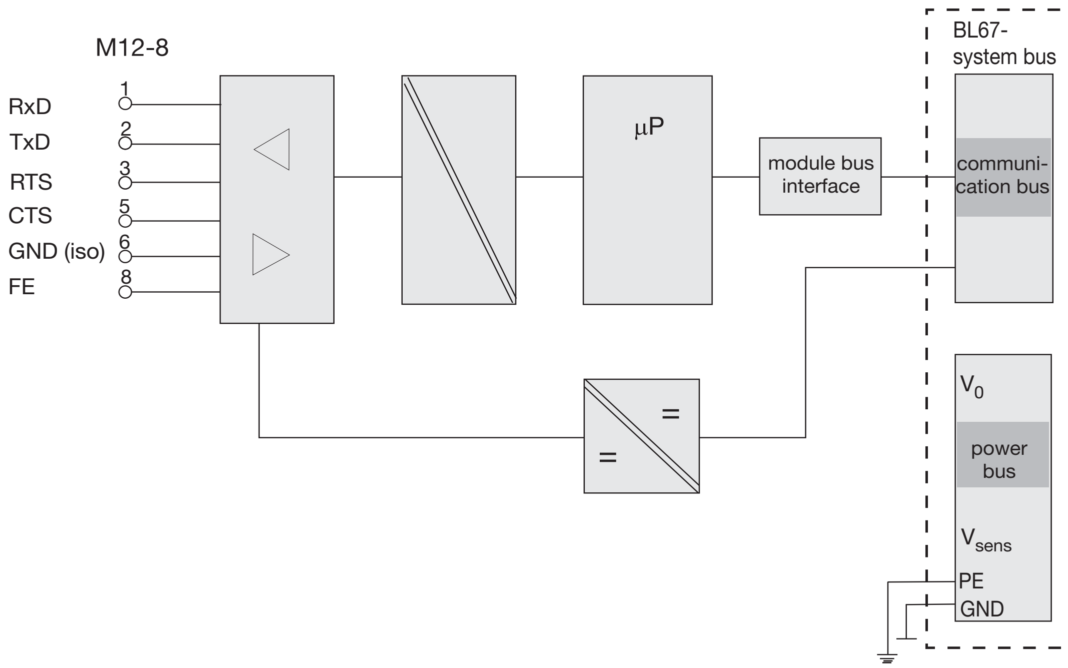


Table 12-3: Technical Data

Designation	BL67-1RS232
Number of channels	1
Voltage supply	via module bus
Voltage from module bus U_{MB}	5 VDC
voltage range	4.75 to 5.25 VDC
Field supply	24 DC
voltage range	18 to 30 VDC
Nominal current from supply terminal I_L	≤ 50 mA
Nominal current from module bus I_{MB}	≤ 140 mA
Memory	128 Byte receive 64 Byte transmit
In/- Outputs	
transmission level active (U_{RS1})	-15 to -3 VDC
transmission level inactive (U_{RS0})	3 to 15 VDC
transmission channels	2 (1/1) TxD and RxD, full-duplex
transmission rate	300 to 115200 Baud (defined by parameters) Data, Parity, Stop (default: 9600 Baud, 7 Bit, impair, 2 stop-bits)
RS232 cable length	max. 15 m
Flow Control	Software-Handshake (Xon/ Xoff) Hardware-Handshake (RTS/ CTS)
Diagnostic data can be written into the process image (depending on the parameterization)	
Isolation voltage	
U_{TMB} (module bus /RS232)	max. 1000 VDC
U_{Field} (Field voltage/ RS232	max. 1000 VDC

12.1.5 Diagnostic/ status messages

Diagnosis/ status via LEDs

Table 12-4: Diagnosis/ status via LEDs

LED	Display	Meaning	Remedy
D	Red	Module bus communication failure	Check if more than two ad-joining electronic modules have been pulled. This applies to modules located between this module and the gateway.
	Off	No error messages or diagnostics	–
TxD	Green	Data actually sent	-
	Off	No data sent actually	-
RxD	Green	Data actually received	-
	Off	No data actually received	-
RTS	Green	The RS232 module stopped the data transfer from the communication partner.	-
	Off	The RS232 module enabled the data transfer from the communication partner.	-
CTS	Green	The communication partner stopped the data transfer from the RS232 module.	-
	Off	The communication partner enabled the data transfer from the RS232 module.	-

Diagnosis via software

The module has the following diagnostic data available.

Table 12-5: Diagnosis

Diagnostic message	
Buffer Overflow	Overflow of the receive-buffer (RX-buffer).
Frame error	The module has to be parameterized for adaptation to the data structure of the data terminal equipment (DTE). A frame error occurs in case of inconsequent parameterization (number of data bits, stop bits, method of parity,…).
Data flow control error	The DTE connected t the module does not react to XOFF or RTS handshake. The internal receive-buffer may overflow (buffer-overflow = 1).
Hardware failure	The module has to be replaced (e.g. error in EEPROM or UART)
Parameterization error	The parameter settings can not be supported.

12.1.6 Module parameters

Table 12-6: Module parameters

A *default-settings*

Parameter name	Value	
Diagnostic	release	Diagnosis activated/ diagnosis deactivated: This item only concerns the field bus specific diagnostic messages not the diagnosis mapped into the process input data of the module
	block **A**	
Disable ReducedCtrl	1	Constant setting: The diagnosis messages are set in Byte 6 of the process input data (independent of "diagnostic"). Byte 6 of the process output data contains two bits which may set to flush the transmit- or the receive-buffer. Byte 7 contains the status- or the control-byte. Bytes 0 to 5 contain the user data.

Table 12-6: Module parameters

Parameter name	Value	
Data rate	300 Bit/s 600 Bit/s 1200 Bit/s 2400 Bit/s 4800 Bit/s 9600 Bit/s **A** 14400 Bit/s 19200 Bit/s 28800 Bit/s 38400 Bit/s 57600 Bit/s 115200 Bit/s	
Data flow control	none **A**	The data flow control has been deactivated.
	XON/XOFF	Software-Handshake (XON/XOFF) activated.
	RTS/CTS	Hardware-Handshake (RTS/CTS) activated.
Data bits	7 **A**	The number of data bits is 7.
	8	The number of data bits is 8.
Parity	none	-
	odd **A**	The number of the bits set (data bits and parity bit) is odd.
	even	The number of the bits set (data bits and parity bit) is even.
stop bits	1	Number of stop bits is 1.
	2 **A**	Number of stop bits is 2.
XON character	0 – 255	XON-character (17 **A**) This character is used to start the data transfer of the data terminal device (DTE) when the software-handshake is activated
XOFF character	0 – 255	XOFF-sign (19 **A**) This character is used to stop the data transfer of the data terminal device (DTE) when the software-handshake is activated

12.1.7 Base modules/ pin assignment

- BL67-B-1M12/ BL67-B-1M12-8

Figure 12-5: BL67-B-1M12-8/ BL67-B-1M12

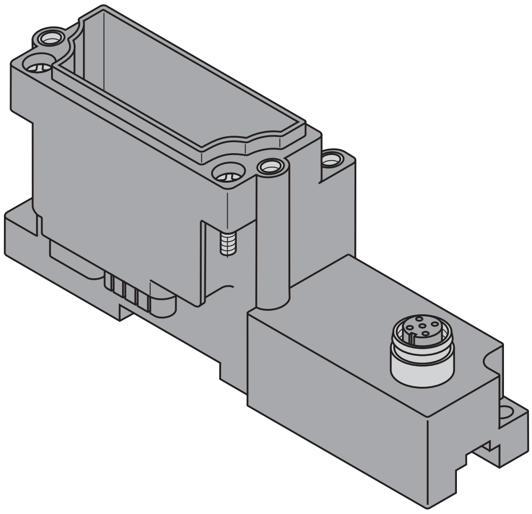
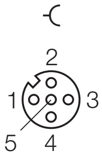
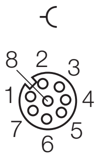


Figure 12-6: Pin assignment BL67-1RS232 with BL67-B-1M12



1 = n.c.
2 = TxD
3 = GND_{ISO}
4 = RxD
5 = Schirm

Figure 12-7: Pin assignment BL67-1RS232 with BL67-B-1M12-8



1 = RxD	5 = GND_{ISO}
2 = TxD	6 = n.c.
3 = RTS	7 = n.c.
4 = CTS	8 = Schirm

- BL67-B-1M23/ BL67-B-1M23-VI

Figure 12-8: BL67-B-1M23/ BL67-B-1M23-VI

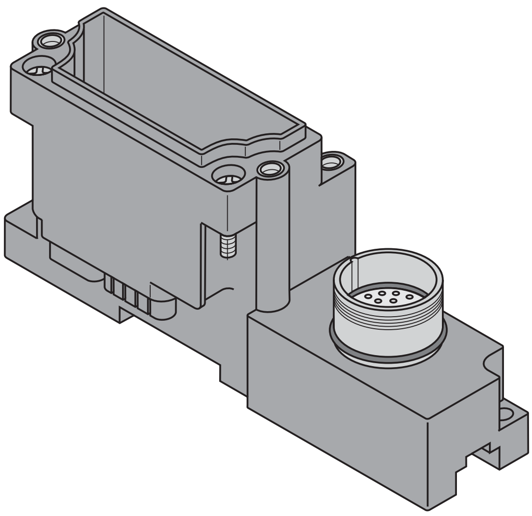
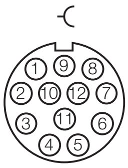
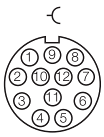


Figure 12-9:
Pin assignment
BL67-1RS232 with
BL67-B-1M23



1 = RxD	7 = n.c.
2 = TxD	8 = Schirm
3 = RTS	9 = n.c.
4 = CTS	10 = n.c.
5 = GND (iso)	11 = n.c.
6 = n.c.	12 = n.c.

Figure 12-10:
Pin assignment
BL67-1RS232 with
BL67-1M23-VI



1 = RxD	7 = n.c.
2 = TxD	8 = Schirm
3 = RTS	9 = V_{SENS}
4 = CTS	10 = V_{SENS}
5 = GND (iso)	11 = V_{SENS}
6 = n.c.	12 = GND

12.2 BL67-1RS485/422

The module BL67-1RS485/422 allows the transfer of serial data streams via the RS485/422 interface and therefore enables various devices to be connected, such as printers, scanners or bar code readers that use the RS485/422 interface for communication. The interface transfers the data received from the device to the PLC or transfers data to be sent from the PLC to the device.

12.2.1 Transmission procedure

The BL67-1RS485/422 module allows the flexible transfer of serial data. The RS422 connection mode supports two wire simplex or four wire full-duplex transmission. The RS485 connection supports two wire half-duplex transmission.

The parameters of the module can be configured by the user to set up a functional transmission procedure as required.

The following transfer parameters can be configured:

- Bit transmission rate: 300 bit/s to 115200 bit/s.
- Data bits: 7 or 8 user data bits in a data frame.
- Parity: none, even or odd.
- Stop bits: 1 or 2 bits.

The data flow control can be implemented in RS422 operation with a software handshake (XON/XOFF) routine.

12.2.2 Data exchange

The module provides a 64 byte transmit buffer and a 128 byte receive buffer for data exchange with the field device.This is a hardware-restriction. The data telegrams which have to be sent or received can be larger.

The data transfer from the PLC into the transmit-buffer of the module or from the receive-buffer of the module to the PLC is realized via a 8-byte transmission channel in the process input or process output data.
To ensure the error-free data transmission, 2 byte of each data package are used to display status-, control- and diagnosis information. The amount of user data is therefore reduced to 6 byte within a data package.

12.2.3 Process data

With PROFIBUS, PROFINET and CANopen, the position of the I/O data of this module within the process data of the whole station is determined by the hardware configuration tool of the fieldbus master.

With DeviceNet™, EtherNet/IP™ and Modbus TCP a detailed mapping table can be created with the TURCK configuration tool I/O-ASSISTANT.

Process input data (PDin)

The incoming data are stored in the receive-buffer of the BL67-1RS232 module, segmented and transferred to the PLC via the module bus and the gateway.

The transmission is realized in a 8-byte format, structured as follows:

- 6 byte user data
- 1 byte diagnostic data
- 1 status byte, used to guarantee error free data-transmission.

Process image - input data

	Byte	Byte in DP	Bit 7	Bit 6	Bit 5	Bit 4	Bit 3	Bit 2	Bit 1	Bit 0
Statusbyte	n	n + 7	STAT	TX_CNT_ACK		RX_CNT		RX_BYTE_CNT		
Diagnosis	n + 1	n + 6	Buf Ovfl	Frame Err	HndSh Err	HW Faliure	Prm Err	reserved		
User data	n + 2	n + 5	Data byte 0							
	n + 3	n + 4	Data byte 1							
	n + 4	n + 3	Data byte 2							
	n + 5	n + 2	Data byte 3							
	n + 6	n + 1	Data byte 4							
	n + 7	n + 0	Data byte 5							

n = process data offset of the input data depending on station configuration and the corresponding fieldbus

Note

A software function block is available for simple handling of the serial interfaces (RS232, RS485 and RS422). Such a function block is available for the CoDeSys programmable BL67 gateway and for the S7 PLC systems.

The actual sequence of the data of the RSxxx modules in the process data of the higher-level control system may vary from that shown here.

The sequence in PROFIBUS systems is generally the reverse (byte 0 complies with byte 7 etc.).

Meaning of the data bits

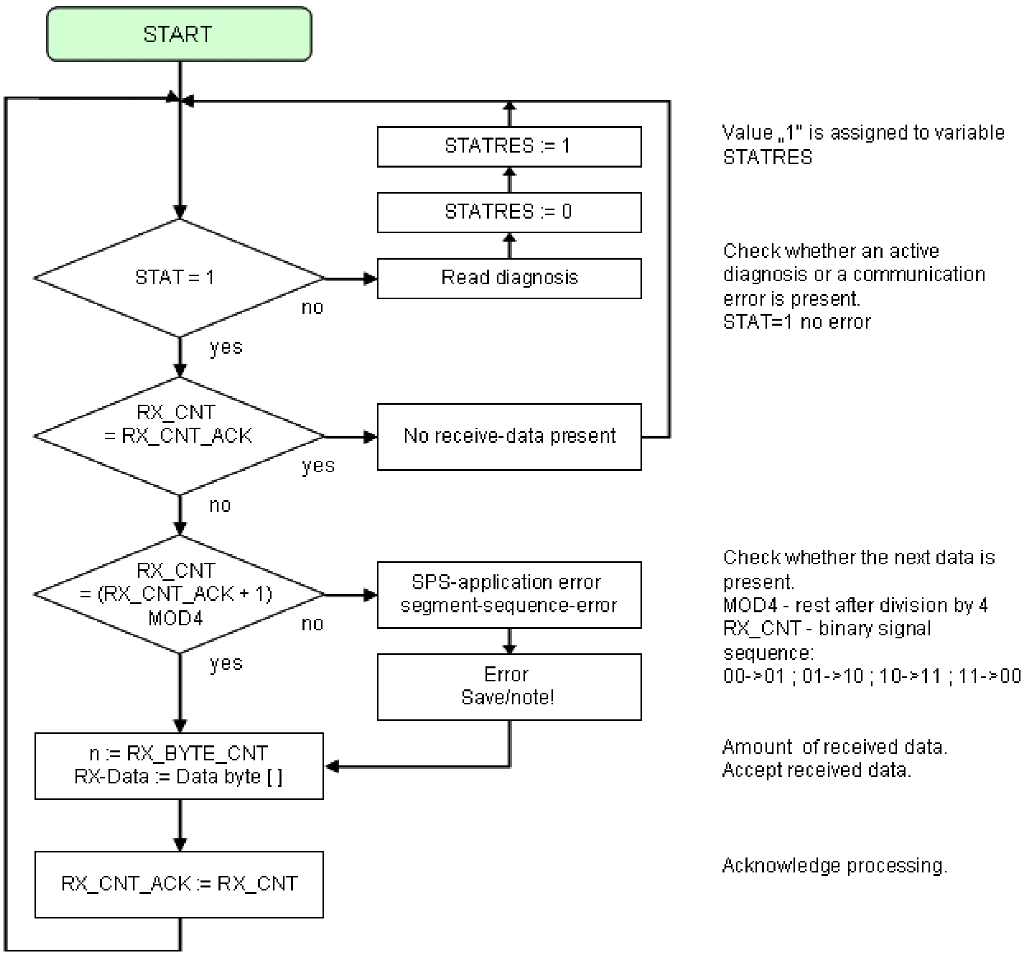
Table 12-7: Meaning of the data bits (process input)

Designation	Value	Meaning
BufOvfl; FrameErr; HndShErr; HwFailure; PrmErr	0 - 255	Diagnostic information (correspond to the diagnostic information in the diagnosis telegram). These diagnostics are always displayed and independent to the setting of the parameter "Diagnostics".
STAT	0-1	1: The communication with the data terminal equipment (DTE) is error free 0: The communication with the data terminal equipment (DTE) is disturbed. A diagnosis message is generated if the parameter "Diagnostics" is set to "0/ release". The diagnostic data show the cause of the communication disturbance. The user has to set back this bit in the process output data by using STATRES.

TX_CNT_ACK	0-3	The value TX_CNT_ACK is a copy of the value TX_CNT. TX_CNT has been transmitted together with the last data segment of the process output data. TX_CNT_ACK is an acknowledge for the successful transmission of the data segment with TX_CNT.
RX_CNT	0-3	This value is transferred together with every data segment. The RX_CNT values are sequential: 00->01->10->11->00… (decimal: 0->1->2->3->0…) Errors in this sequence show the loss of data segments.
RX_BYTE_CNT	0-7	Number of the valid bytes in this data segment.

Schematic diagram of the receive sequence

Figure 12-11: Schematic diagram of the receive sequence



PLC output data

The data received from the PLC are loaded into the transmit- buffer of the BL67-1RS485/422 module.

The fieldbus specific transmission for PROFIBUS-DP is realized in a 8-byte format which is structured as follows:

- 6 byte user data
- 1 byte containing signals to flush the transmit- and receive buffer.
- 1 control byte, used to guarantee error free data-transmission.1 control byte, used to guarantee error free data-transmission.

Process image - output data

	Byte	Byte in DP	Bit 7	Bit 6	Bit 5	Bit 4	Bit 3	Bit 2	Bit 1	Bit 0
Control byte	m	m + 7	STAT RES	RX_CNT_ACK		TCX_CNT		TX_BYTE_CNT		
Communication	m + 1	m + 6	reserved						RXBUF FLUSH	TXBUF FLUSH
User data	m + 2	m + 5	Data byte 0							
	m + 3	m + 4	Data byte 1							
	m + 4	m + 3	Data byte 2							
	m + 5	m + 2	Data byte 3							
	m + 6	m + 1	Data byte 4							
	m + 7	m + 0	Data byte 5							

m = process data offset of the output data depending on station configuration and the corresponding fieldbus

Note

A software function block is available for simple handling of the serial interfaces (RS232, RS485 and RS422). Such a function block is available for the CoDeSys programmable BL67 gateway and for the S7 PLC systems.

The actual sequence of the data of the RSxxx modules in the process data of the higher-level control system may vary from that shown here.

The sequence in PROFIBUS systems is generally the reverse (byte 0 complies with byte 7 etc.).

Meaning of the data bits

Table 12-8: Meaning of the data bits (process output)

Designation	Value	Meaning
RXBUF FLUSH	0 - 1	This bit is used to flush the receive-buffer. If STATRES = 1: The command RXBUF FLUSH = 1 is ignored. If STATRES = 0: RXBUF FLUSH = 1 causes the flushing of the receive-buffer.
TXBUF FLUSH	0-1	This bit is used to flush the transmit-buffer. If STATRES = 1: The command TXBUF FLUSH = 1 is ignored. If STATRES = 0: TXBUF FLUSH = 1 causes the flushing of the transmit-buffer.
STATRES	0-1	This bit is set to reset the STAT bit in the process input data. With the change from 1 to 0 the STAT bit is reset (from 0 to 1). If this bit is 0, all changes in TX_BYTE_CNT, TX_CNT and RX_CNT_ACK are ignored. Flushing the transmit-/ receive-buffer with RXBUF FLUSH/ TXBUF FLUSH is possible. If this bit is 1 or with the change from 0 to 1, the flushing of the transmit-/ receive-buffer with RXBUF FLUSH/ TXBUF FLUSH is not possible.
RX_CNT_ACK	0-3	The value RX_CNT_ACK is a copy of the value RX_CNT. TX_CNT has been transmitted together with the last data segment of the process input data. TX_CNT_ACK is an acknowledge for the successful transmission of the data segment with RX_CNT.
TX_CNT	0-3	This value is transferred together with every data segment. The TX_CNT values are sequential: 00->01->10->11->00… (decimal: 0->1->2->3->0…) Errors in this sequence show the loss of data segments.
TX_BYTE_CNT	0 - 7	Number of the valid user data in this data segment. In PROFIBUS-DP, the data segments contain a maximum number of 6 bytes of user data.

Schematic diagram of the transmit sequence

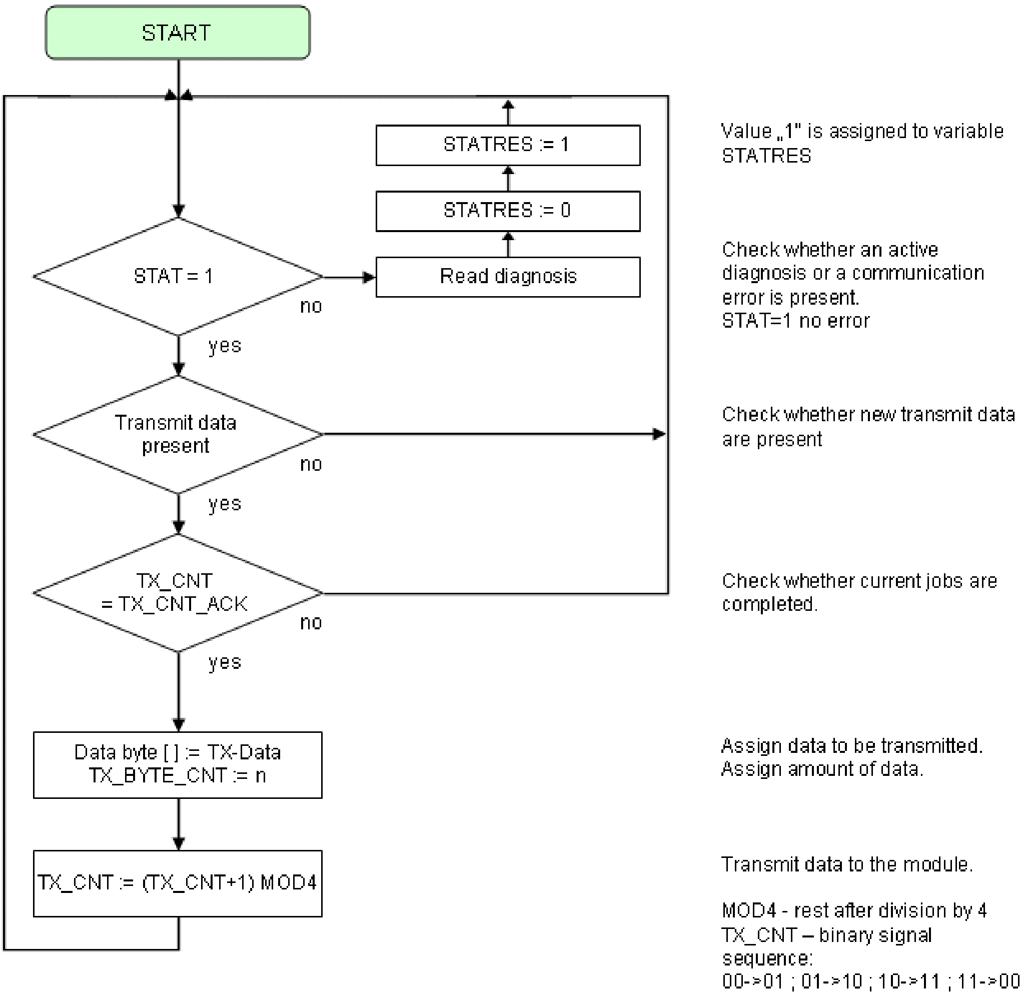


Figure 12-12: Schematic diagram of the transmit sequence

12.2.4 Technical data

Figure 12-13: BL67-1RS485/422

Figure 12-14: Block diagram BL67-1RS485/422

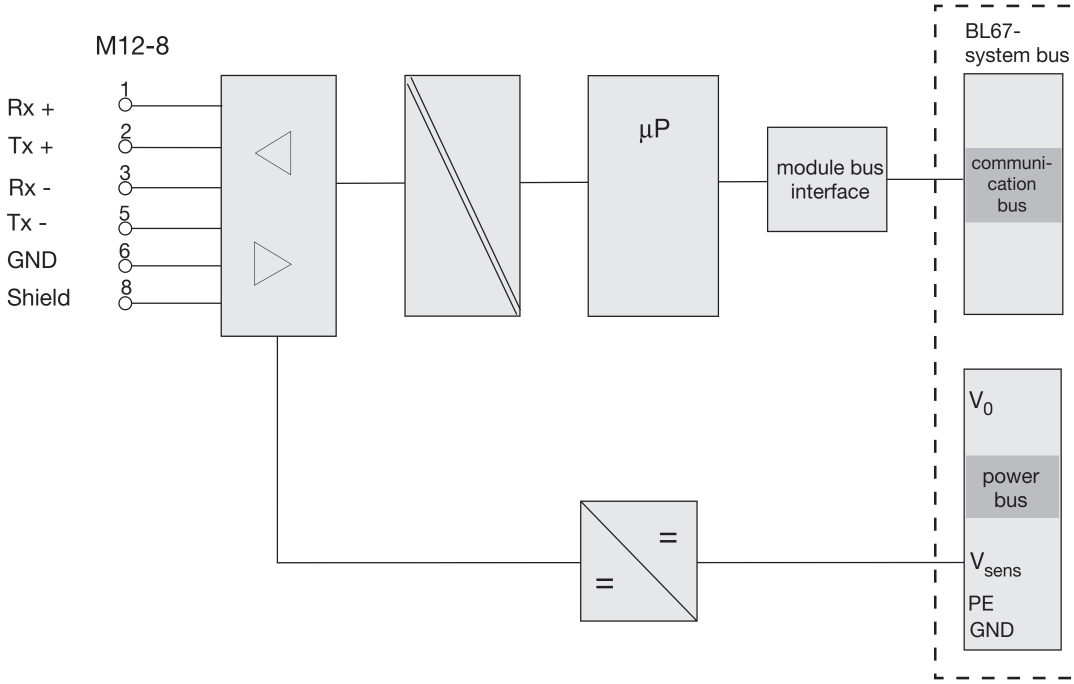


Table 12-9: Technical data BL67-1RS485/422

Designation	BL67-1RS485/422
Number of RS485/422-interfaces	1
Nominal voltage via supply terminal	18 to VDC
Nominal current from supply terminal (field) I_L	25 mA
Voltage from module bus	4.75 to 5.25 VDC
Nominal current consumption from 5 VDC (module bus) I_{MB}	60 mA
transmission channels	RxD, TxD
Data buffer	
Receive buffer	128 byte
Transmit buffer	64 byte
RS422 connection type	Two wire simplex or four wire full-duplex
RS485 connection type	Two wire half-duplex
Bit transmission rate	max. 115200 Bit/s (parameterizable)
U_{RS1} (active)	> 500 mV
U_{RS0} (inactive)	0 to 200 mV
U_{GLRS} (common mode)	-7 to 12 mV
RS485/422 cable length	max. 30 m
Cable impedance	120 Ω
Bus terminating resistors	120 Ω (external)

Isolation voltage	
U_{TMB} (module bus/ field voltage/ RS485)	max. 1000 VDC
U_{Field} (field voltage/ RS485)	0 V

12.2.5 Diagnostic/ status messages

Diagnosis/ status via LEDs

Table 12-10: Diagnosis/ status via LEDs

LED	Display	Meaning	Remedy
D	Red	Module bus communication failure	Check if more than two ad-joining electronic modules have been pulled. This applies to modules located between this module and the gateway.
	Red flashing, 0.5 Hz	Diagnosis pending	-
	Off	No error messages or diagnostics	–
TxD	Green	Data actually sent	-
	Off	No data sent actually	-
RxD	Green	Data actually received	-
	Off	No data actually received	-

Diagnosis via software

The module has the following diagnostic data available.

Table 12-11: Diagnosis

Diagnostic message	
Buffer Overflow	Overflow of the receive-buffer (RX-buffer).
Frame error	The module has to be parameterized for adaptation to the data structure of the data terminal equipment (DTE). A frame error occurs in case of inconsequent parameterization (number of data bits, stop bits, method of parity,…).
Data flow control error	The DTE connected t the module does not react to XOFF or RTS handshake. The internal receive-buffer may overflow (buffer-overflow = 1).
Hardware failure	The module has to be replaced (e.g. error in EEPROM or UART)
Parameterization error	The parameter settings can not be supported.

12.2.6 Module parameters

Table 12-12: Module parameters

A *default-settings*

Parameter name	Value	
Diagnostic	release	Diagnosis activated/ diagnosis deactivated: This item only concerns the field bus specific diagnostic messages not the diagnosis mapped into the process input data of the module
	block **A**	
Disable ReducedCtrl	1	Constant setting: The diagnosis messages are set in Byte 6 of the process input data (independent of "diagnostic"). Byte 6 of the process output data contains two bits which may set to flush the transmit- or the receive-buffer. Byte 7 contains the status- or the control-byte. Bytes 0 to 5 contain the user data.
Data rate	300 Bit/s 600 Bit/s 1200 Bit/s 2400 Bit/s 4800 Bit/s 9600 Bit/s **A** 14400 Bit/s 19200 Bit/s 28800 Bit/s 38400 Bit/s 57600 Bit/s 115200 Bit/s	
Data bits	7 **A**	The number of data bits is 7.
	8	The number of data bits is 8.
Parity	none	-
	odd **A**	The number of the bits set (data bits and parity bit) is odd.
	even	The number of the bits set (data bits and parity bit) is even.
Stop bits	1	Number of stop bits is 1.
	2 **A**	Number of stop bits is 2.

12.2.7 Base modules/ pin assignment

- BL67-B-1M12/ BL67-B-1M12-8

Figure 12-15: BL67-B-1M12-8/ BL67-B-1M12

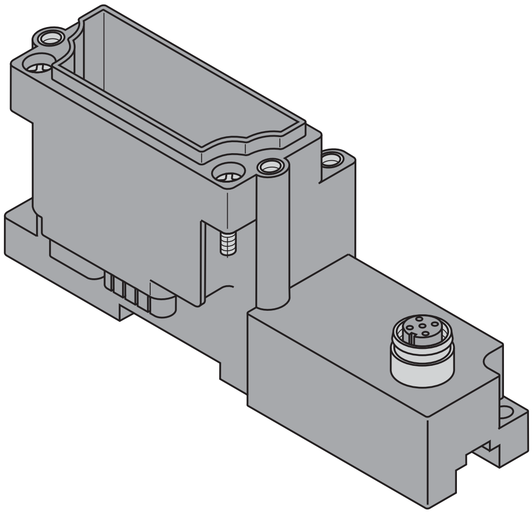


Figure 12-16: Pin assignment BL67-1RS485/422 with BL67-B-1M12

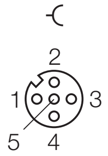
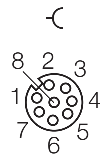


Figure 12-17: Pin assignment BL67-1RS485/422 with BL67-B-1M12-8



- BL67-B-1M23/ BL67-B-1M23-VI

Figure 12-18: BL67-B-1M23/ BL67-B-1M23-VI

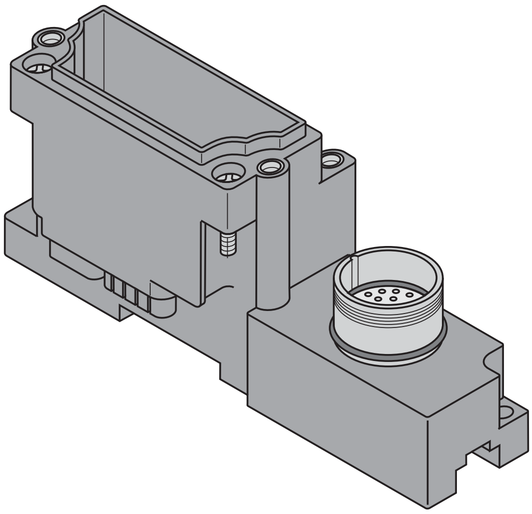
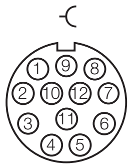
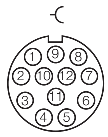


Figure 12-19:
Pin assignment
BL67-1RS485/422
with
BL67-B-1M23



1 = Rx +	7 = n.c.
2 = Tx +	8 = shield
3 = Tx –	9 = n.c.
4 = n.c.	10 = n.c.
5 = Rx –	11 = Tx –
6 = GND (iso)	12 = n.c.

Figure 12-20:
Pin assignment
BL67-1RS485/422
with
BL67-B-1M23-VI



1 = Rx +	7 = n.c.
2 = Tx +	8 = Schirm
3 = Tx –	9 = V_{SENS}
4 = n.c.	10 = V_{SENS}
5 = Rx –	11 = V_{SENS}
6 = GND (iso)	12 = GND

12.3 BL67-1SSI

The BL67-1SSI module is used for connecting SSI encoders with a maximum word length of 32 bits and a maximum bit transmission rate of 1Mbit/s. It provides a 24 VDC (500 mA) power supply.

In order to read SSI encoder data, the module outputs a clock signal with which the encoder value can be read via the signal input. The clock signal and the signal input are based on the RS422 protocol.

12.3.1 Transmission procedure

The BL67-1SSI module enables the SSI data to be transferred according to the requirements of the application. The parameters of the module can be configured by the user to set up a functional transmission procedure as required.

- Gray code or binary code data transmission is possible.
- Bit transmission rates from 62.5 Kbit/s to 1 Mbit/s are possible.

The SSI encoder value can be represented in a data frame with between 1 to 32 bits. Bits can be deactivated at both the LSB and MSB side of the frame. At the MSB side this is done by a masking operation, which causes invalid bits to be set to 0. At the LSB side, the invalid bits are removed by shifting the entire data frame to the right. The missing bits on the MSB side are filled with zeros.

12.3.2 Data exchange

The process output data is transmitted from the PLC to the BL67-1SSI module, whilst the process input data is transferred from the module to the PLC.

The process output data is used for writing the registers and requesting data from them. It is possible to stop the communication with the SSI encoder and activate or deactivate comparison operations.

The process input data is used for reading the contents of the registers inside the modules. In this case, the SSI encoder value is part of the register. The writing of these registers can be controlled. The results of different comparison operations can be supplied, and the communication status with the SSI encoder can also be displayed. Status messages that were generated by the connected SSI encoder can be passed to the PLC as process input data.

The diagnostics messages are also embedded in the process input data.

The parameter and diagnostics interface allows acyclic data to be transferred in addition to this cyclic data. The parameters for the data transmission on the SSI module, such as bit transmission rate, telegram length etc. are set via the parameter interface. The diagnostics interface supplies the higher level system with error messages, such as parameter errors.

Process data

With PROFIBUS, PROFINET and CANopen, the position of the I/O data of this module within the process data of the whole station is determined by the hardware configuration tool of the fieldbus master.

With DeviceNet™, EtherNet/IP™ and Modbus TCP a detailed mapping table can be created with the TURCK configuration tool I/O-ASSISTANT.

Industrial Automation

Process input data (PDin)

The field input data is transferred from the connected field device to the BL67-1SSI module.

The process input data is the data that is transferred to the PLC from the BL67-1SS1 via a gateway.

This is transferred in an 8 byte format as follows:

- 4 bytes are used for representing the data that was read from the register with the address stated at REG_RD_ADR.
- When necessary, 1 byte represents the register address of the read data and an acknowledgement that the read operation was successful.
- 1 byte can be used to transfer status messages of the SSI encoder. This byte also contains an acknowledgement that the write operation to the register was successful and indication of an active write operation.
- 1 byte contains the results of comparison operations with the SSI encoder value.
- 1 byte contains messages concerning the communication status between the BL67-1SSI module and the SSI encoder, as well as other results of comparison operations.

The following table describes the structure of the 8 x 8 bits of the process input data.

STS (or ERR) contains non-retentive status information, i.e. the bit concerned indicates the actual status.

FLAG describes a retentive flag that is set in the event of a particular event. The bit concerned retains the value until it is reset.

Process image - input data

	Byte	Byte in DP	Bit 7	Bit 6	Bit 5	Bit 4	Bit 3	Bit 2	Bit 1	Bit 0
Status bytes	n	n + 7	STS STOP	X	X	ERR PARA	STS UFLW	STS OFLW	ERR SSI	SSI DIAG
	n + 1	n + 6	STS_UP	STS_DN	REL CMP2	FLAG CMP2	STS CMP2	REL CMP1	FLAG CMP1	STS CMP1
	n + 2	n + 5	REG_WR_ACEPT	REG_WR_AKN	X	X	SSI_STS3	SSI_STS2	SSI_STS1	SSI_STS0
Communication	n + 3	n + 4	REG_RD_ABORT	X	REG_RD_AR					
User data	n + 4	n + 3	REG_RD_DATA, Byte 0							
	n + 5	n + 2	REG_RD_DATA, Byte 1							
	n + 6	n + 1	REG_RD_DATA, Byte 2							
	n + 7	n + 0	REG_RD_DATA, Byte 3							

Meaning of the data bits

Table 12-13: Meaning of the data bits (process input)

Designation	Value	Meaning
STS_STOP	0	The SSI encoder is read cyclically.
	1	Communication with the SSI encoder is stopped as STOP = 1 (process output) or ERR_PARA = 1.
ERR_PARA	0	The parameter set of the module has been accepted.
	1	Operation of the module is not possible with the present parameter set.
STS_UFLW	0	A comparison of the register contents has produced the following result: (REG_SSI_POS) ≥ (REG_LOWER_LIMIT)
	1	A comparison of the register contents has produced the following result: (REG_SSI_POS) < (REG_LOWER_LIMIT)
STS_OFLW	0	A comparison of the register contents has produced the following result: (REG_SSI_POS) ≤ (REG_UPPER_LIMIT)
	1	A comparison of the register contents has produced the following result: (REG_SSI_POS) > (REG_UPPER_LIMIT)
ERR_SSI	0	SSI encoder signal present.
	1	SSI encoder signal faulty. (e.g. due to a cable break).
SSI_DIAG	0	No enabled status signal is active (SSI_STSx = 0).
	1	At least one enabled status signal is active (SSI_STSx = 1).
STS_UP (LED UP)	0	The SSI encoder values are decremented or the values are constant.
	1	The SSI encoder values are incremented.
STS_DN (LED DN)	0	The SSI encoder values are incremented or the values are constant.
	1	The SSI encoder values are decremented.
REL_CMP2	0	A comparison of the register contents has produced the following result: (REG_SSI_POS) < (REG_CMP2)
	1	A comparison of the register contents has produced the following result: (REG_SSI_POS) ≥ (REG_CMP2)
FLAG_CMP2	0	Default status, i.e. the register contents have not yet matched (REG_SSI_POS) = (REG_CMP2) since the last reset.
	1	The contents of the registers match (REG_SSI_POS) = (REG_CMP2). This marker must be reset with CLR_CMP2 = 1 in the process output data.

Table 12-13: Meaning of the data bits (process input)

Designation	Value	Meaning
STS_CMP2	0	A comparison of the register contents has produced the following result: (REG_SSI_POS) ≠ (REG_CMP2)
	1	A comparison of the register contents has produced the following result: (REG_ SSI_POS) = (REG_CMP2)
REL_CMP1	0	A comparison of the register contents has produced the following result: (REG_SSI_POS) < (REG_CMP1)
	1	A comparison of the register contents has produced the following result: (REG_ SSI_POS) ≥ (REG_CMP1)
FLAG_CMP1	0	Default status, i.e. the register contents have not yet matched (REG_SSI_POS) = (REG_CMP1) since the last reset.
	1	The contents of the registers match: (REG_SSI_POS) = (REG_CMP1). This marker must be reset when CLR_CMP1 = 1 in the process output data.
STS_CMP1	0	A comparison of the register contents has produced the following result: (REG_SSI_POS) ≠ (REG_CMP1)
	1	A comparison of the register contents has produced the following result: (REG_ SSI_POS) = (REG_CMP1)
REG_WR_ACEPT	0	The writing of user data for process output to the register with the address stated at REG_WR_ADR in the process output data could not be executed.
	1	The writing of user process output data to the register with the address stated at REG_WR_ADR in the process output data was successfully completed.
REG_WR_AKN	0	No modification of the data in the register bank by process output, i.e. REG_WR = 0. A write job would be accepted with the next telegram of process output data. (handshake for data transmission to the register.)
	1	A modification of the register contents by a process output was initiated, i.e. REG_WR = 1. A write job would not be accepted with the next telegram of process output data.

Table 12-13: Meaning of the data bits (process input)

Designation	Value	Meaning
SSI_STS3	0	These four bits transfer the status bits of the SSI encoder with the status messages of the SSI module. With some SSI encoders, the status bits are transferred together with the position value.
	1	
SSI_STS2	0	
	1	
SSI_STS1	0	
	1	
SSI_STS0	0	
	1	
REG_RD_ABORT	0	The reading of the register stated at REG_RD_ADR was accepted and executed. The content of the register is located in the user data range (REG_RD_DATA Bytes 0-3).
	1	The reading of the register stated at REG_RD_ADR was not accepted.The user data range (REG_RD_DATA Bytes 0-3) is zero.
REG_RD_ADR	0… 63	The reading of the register stated at REG_RD_ADR was not accepted.The user data range (REG_RD_DATA Bytes 0-3) is zero.
REG_RD_DATA	0… 2^{32}-1	Content of the register to be read if REG_RD_ABORT = 0. If REG_RD_ABORT = 1, then REG_RD_DATA = 0.

Process output data (PDout)

The field output data is transferred from the BL67-1SSI module to the connected field device.

The process output data is the data that is output from the PLC to the BL67-1SSI module via a gateway.

This is transferred in an 8 byte format as follows:

- 4 bytes are used for representing the data that is to be written to the register with the address specified at REG_WR_DATA.
- 1 byte contains the register address for the data that is to be read with the next response telegram.
- 1 byte contains the register address of the data to be written to bytes 0 to 3 of this telegram and a write request.
- 1 byte is used for controlling the comparison operations.
- 1 byte contains a Stop bit for interrupting communication with the encoder

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Process image - output data

	Byte	Byte in DP	Bit 7	Bit 6	Bit 5	Bit 4	Bit 3	Bit 2	Bit 1	Bit 0
Control byte	m	m + 7	STOP	X						
	m + 1	m + 6	X	X	X	CLR_ CMP2	EN_ CMP2	X	CLR_ CMP1	EN_ CMP1
	m + 2	m + 5	REG_ WR	X	REG WR ADR					
Communication	m + 3	m + 4	X	REG_RD_ADR						
Data bytes	m + 4	m + 3	REG_WR_DATA, Byte 0							
	m + 5	m + 2	REG_WR_DATA, Byte 1							
	m + 6	m + 1	REG_WR_DATA, Byte 2							
	m + 6	m + 0	REG_WR_DATA, Byte 3							

Meaning of the data bytes

Table 12-14: Meaning of the data bits (process output)

Designation	Value	Meaning
STOP	0	Request to read the SSI encoder cyclically
	1	Request to interrupt communication with the encoder
CLR_CMP2	0	Default status, i.e. no reset of FLAG_CMP2 active.
	1	Reset of FLAG_CMP2 active
EN_CMP2	0	Default status, i.e. the data bits REL_CMP2, STS_CMP2 and FLAG_CMP2 always have the value 0, irrespective of the actual SSI encoder value.
	1	Comparison active, i.e. the data bits REL_CMP2,STS_CMP2 and FLAG_CMP2 have a value based on the result of the comparison with the SSI encoder value.
CLR_CMP1	0	Default status, i.e. reset of FLAG_CMP1 not active.
	1	Reset of FLAG_CMP1 active
EN_CMP1	0	Default status, i.e. the data bits REL_CMP1, STS_CMP1 and FLAG_CMP1 always have the value 0, irrespective of the actual SSI encoder value.
	1	Comparison active, i.e. the data bits REL_CMP1, STS_CMP1 and FLAG_CMP1 have a value based on the result of the comparison with the SSI encoder value.

REG_WR	0…63	Default status, i.e. there is no request to overwrite the content of the register with the address stated at REG_WR_ADR with REG_WR_DATA. Bit REG_WR_AKN is reset (0) if necessary.
	1	Request to overwrite the content of the register with the address stated at REG_WR_ADR with REG_WR_DATA.
REG_RD_ADR	0…63	Address of the register to be read. If the read operation is successful (REG_RD_ABORT = 0), the user data is located in REG_RD_DATA of the process input data (bytes 4 – 7).
REG_WR_ADR	0…63	Address of the register to be written with REG_WR_DATA.
REG_WR_DATA	0… 2^{32}-1	Value to be written to the register with the address stated at REG_WR_ADR.

12.3.3 Internal registers - read and write operations

The SSI module is provided with a universal register interface that enables access to up to 64 registers. These are accessed via the process data.

For write access, it must be ensured beforehand that the register write interface is in the default status and that a write access operation is therefore not currently active. This is ensured if REG_WR = 0 in the process output data, and is confirmed in the process input data with REG_WR_AKN = 0. Write access is then possible. The following values must be transferred with the process output data for this:

- REG_WR_ADR = Register address,
- REG_WR_DATA = Value to be written (32 bit)
- REG_WR = 1 (write command)

The SSI module acknowledges the processing of the write command via the process input data by signalling REG_WR_AKN = 1. REG_WR_ACEPT = 1 in the process input data confi$_{rms}$ whether the write operation to the register was successfully completed. If the register could not be written (no access authorization, out of value range,…), this is indicated by REG_WR_ACEPT = 0. The write operation must then be terminated by REG_WR = 0 in order to resume the default state.

The address specified at REG_RD_ADR of the process output data is used for read access. The read register content is entered in REG_RD_DATA (bytes 4-7) if the address at REG_RD_ADR was accepted in the process input data and if REG_RD_ABORT = 0 confi$_{rms}$ that the register was read error-free. REG_RD_ABORT = 1 indicates that the register could not be read. REG_RD_ADR in the process input data then contains the address that could not be accessed successfully. The user data is then set to ZERO.

12.3.4 Register access and meaning

Table 12-15: Register access and meaning

Designation		Description	Default (HEX)
REG_SSI_POS		Actual binary SSI encoder value	
REG_MAGIC_NO	1	Magic number (0xaa55cc33)	
REG_HW_VER	2	Hardware version	
REG_SW_VER	3	Software version	
REG_SF	4	Special Function register	
REG	5	Reserve	
	...		
REG_WR_ADR	14	Pointer register OUT	
PREG_RD_ADR	15	Pointer register IN	
REG_DIAG1	16	Diagnostics data	
REG	17	Reserve	
	...		
REG_PARA1	20	Parameter data	0 x 19 01 00 00
REG	21	Reserve	
	...		
REG_GRAY_POS	32	32 Actual Gray-coded SSI encoder value.	
REG_SSI_FRAME	33	33 Complete frame read from SSI encoder.	
REG_CMP1	34	Comparison value 1	0 x 00 00 00 00
REG_CMP2	35	Comparison value 2	0 x 00 00 00 00
REG	36	Reserve	
	...		
REG_LOWER_LIMIT	484	Lower limit	0 x 00 00 00 00
REG_UPPER_LIMIT	49	Upper limit	0 x FF FF FF FF
REG_OFFSET	50	Offset value	0 x 00 00 00 00
REG_SSI_MASK	51	Selection of the SSI encoder diagnostics transferred to the diagnostics interfaces	0 x 00 00 00 00
	52 to 63	Reserve	

Table 12-16: Designation of the interfaces

Designation		Interfaces				
		Process output	Storage in module	Process input	Parameter	Diagnosis
REG_SSI_POS	0			RD		
REG_MAGIC_NO	1			RD		
REG_HW_VER	2			RD		
REG_SW_VER	3			RD		
REG_SF	4	WR	volatile	RD		
REG_WR_ADR	14			RD		
REG_RD_ADR	15			RD		
REG_DIAG1	16			RD		RD
REG_PARA1	20	WR	non volatile	RD	WR	
REG_GRAY_POS	32			RD		
REG_SSI_FRAME	33			RD		
REG_CMP1	34	WR	volatile	RD		
REG_CMP2	35	WR	volatile	RD		
REG_LOWER_LIMIT	48	WR	non volatile	RD		
REG_UPPER_LIMIT	49	WR	non volatile	RD		
REG_OFFSET	50	WR	non volatile	RD		
REG_SSI_MASK	51	WR	non volatile	RD		

Note

The non volatile registers can be written maximum 100.000 times.

12.3.5 Comparison value 1, Comparison value 2

The recorded encoder position can be compared with two loadable values. The character "x” below stands for "1” or "2”. The register contents are loaded into the register REG_CMPx using in a write operation. The comparison functions are activated by setting bit EN_CMPx = 1 in the process output data. The results of the continuous comparison operations are displayed in the process input data via STS_CMPx, REL_CMPx and FLAG_CMPx. Bit REL_CMPx indicates as the actual status message the relation of the actual value (register content of REG_SSI_POS) to the comparison value (register content of REG_CMPx). Bit STS_CMPx is non-retentive and indicates whether the current actual value (REG_SSI_POS) and the comparison value (REG_CMPx) match. FLAG_CMPx is also used as a marker to indicate that the status (REG_SSI_POS = REG_CMPx) is present or lost. This bit must be reset by the application via the process output data using CLR_CMPx = 1. If the comparator is inactive (EN_CMPx = 0), the signals from STS_CMPx, REL_CMPx and FLAG_CMPx are always zero.

Table 12-17: Comparator enable

A *The value Z0 of this flag is 1 as soon as the comparison values match. The value stays 1 until it is reset.*

Process input data		**Process output data**
	REL_CMPx = 0 STS_CMPx = 0 FLAG_CMPx = 0	
Process input data		**Process output data**
(REG_SSI_POS) < (REG_CMPx)		
	REL_CMPx = 1 STS_CMPx =0 FLAG_CMPx = Z0 **A**	Reset the Flag FLAG_CMPx with CLR_CMPx = 1
(REG_SSI_POS) > (REG_CMPx)		
	REL_CMPx = 1 STS_CMPx =0 F LAG_CMPx = Z0 **A**	Reset the Flag FLAG_CMPx with CLR_CMPx = 1
(REG_SSI_POS) = (REG_CMPx)		
	REL_CMPx = 1 STS_CMPx = 1 FLAG_CMPx = 1	Resetting the FLAG_CMPx not possible, as long as equality exists.

12.3.6 Lower limit, upper limit

The recorded encoder position can be compared with up to two loadable limit values. The upper limit value must be entered in the REG_UPPER_LIMIT register and the lower limit value in REG_LOWER_LIMIT. Writing these registers with values that are different to the default values will activate the monitoring of the limits, and bits STS_OFLW and STS_UFLW will be enabled in the process input data. The diagnostics function will indicate the presence of values above or below the default values.

"Encoder value overflow” and "Encoder value underflow” signals will also indicate this via the acyclic diagnostics interface.

The limit values are set by default to the maximum and minimum value.

Table 12-18: Overflow of the encoder values

Register access	Process input data	Diagnostics
REG_UPPER_LIMIT at default-value FFFFFFFFh	STS_OFLW = 0	Value: 0
Register content of REG_UPPER_LIMIT less than FFFFFFFFh	(REG_SSI_POS) ≤ (REG_UPPER_LIMIT)	Value: 0
	STS_OFLW = 0	
	(REG_SSI_POS) > (REG_UPPER_LIMIT)	Value: 1 Text: Encoder value overflow
	STS_OFLW = 1	

Table 12-19: Underflow of the encoder values

Register access	Process input data	Diagnostics
REG_LOWER_LIMIT at default-value 00000000h	STS_UFLW = 0	Value: 0
Register content of REG_LOWER_LIMIT greater than 0	(REG_SSI_POS) ≥ (REG_LOWER_LIMIT)	Value: 0
	STS_UFLW = 0	
	(REG_SSI_POS) < (REG_LOWER_LIMIT)	Value: 1 Text: Encoder value underflow
	→ STS_UFLW = 1	

12.3.7 Offset function / load value

This function is activated by writing the REG_OFFSET register with a value <> 0. The content of the register is then subtracted from the SSI encoder value and stored in REG_SSI_POS. All limit values, such as lower limit, upper limit, comparison value 1, comparison value 2 then refer to the newly calculated value (REG_SSI_POS).

The calculation is thus:

(REG_SSI_POS) = SSI encoder - (REG_OFFSET)

This function can be deactivated by writing the REG_OFFSET with zero.

12.3.8 Status messages of the SSI encoder

Some SSI encoders not only transfer the position value in the data frame that they transfer to the module but also supply additional status messages. It is useful to include these status messages in the application in order to analyze the measured value.

Writing the REG_SSI_MASK register allows up to four individual bits to be taken from the data frame of the SSI encoder and transferred to the SSI_STSx bits of the process input data. It is also possible to output the "SSI encoder group diagnostics message" with an acyclic diagnostics operation when a status message is initiated.

Table 12-20: Masking with REG_SSI_MASK

Process input data	REG_SSI_MASK							
	Byte	Bit 7	Bit 6	B5	B4	B3	B2	B1
SSI_STS0	0	EN_D0_RMS0	EN_D0_DS	X	SSI_FRAME_BIT_SEL0			
SSI_STS1	1	EN_D1_RMS1	EN_D1_DS	X	SSI_FRAME_BIT_SEL1			
SSI_STS2	2	EN_D2_RMS2	EN_D2_DS	X	SSI_FRAME_BIT_SEL2			
SSI_STS3	3	EN_D3_RMS3	EN_D3_DS	X	SSI_FRAME_BIT_SEL3			

Table 12-21: Description of the diagnosis messages

A*default*

Designation	Value	Description
EN_Dx_RMSx	0 **A**	The transfer of the SSI status messages to the process input data is not activated
	1	The transfer of the SSI status messages to the process input data is activated
EN_ Dx_DS	0 **A**	The evaluation of the SSI status messages for bit 0 of the diagnostics is not activated
	1	The evaluation of the SSI status messages for bit 0 of the diagnostics is activated.
SSI_FRAME_BIT_ SEL	0-31	Definition of the selected bits in the frame of the SSI encoder to be evaluated or copied. Default:0

The following applies to bit 0 (SSI group diagnostics) of the diagnostics interface and SSI_DIAG of the process input data:

(SSI_STS0 & EN_D0_DS) || (SSI_STS1 & EN_D1_DS) || (SSI_STS2 & EN_D2_DS) || (SSI_STS3 & EN_D3_DS)

12.3.9 Resetting the register bank

If register REG_SF is written with the signature:

"ld20" = 0 x 6C643230,
all default values of the retentive registers (incl. parameter registers) are reset.

If register REG_SF is written with the signature:

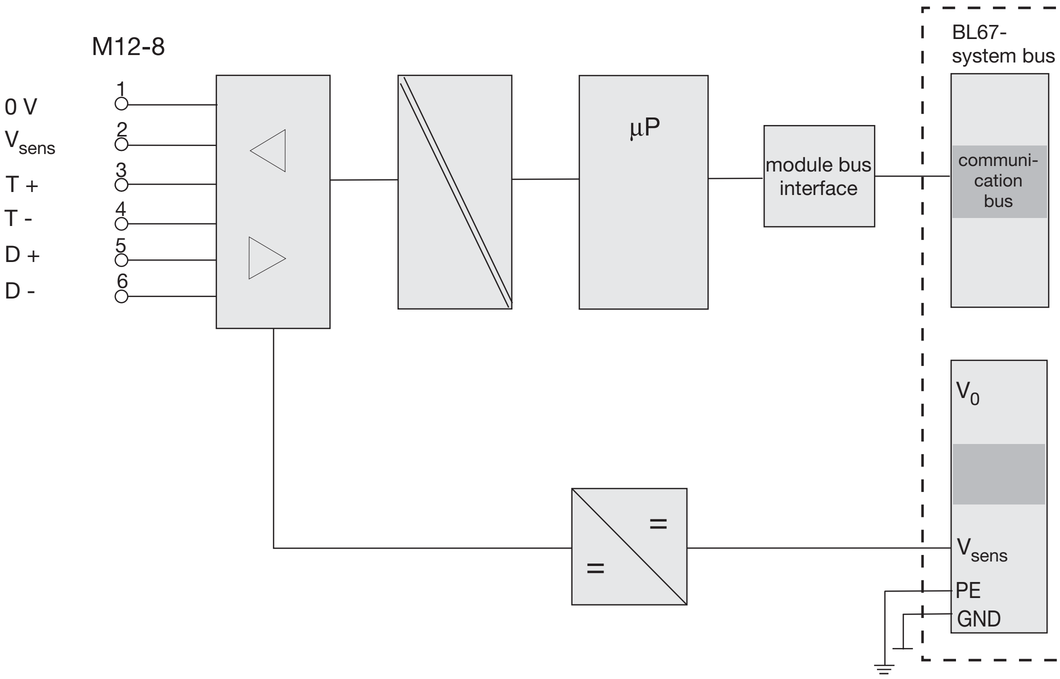
"ld48" = 0 x 6C643438
all default values of the retentive registers except the parameter registers are reset.

Note
Overwritten values are lost.

12.3.10 Technica data

Figure 12-21: BL67-1SSI

Figure 12-22: BL67-1SSI



The module is provided with two RS422 interfaces that form one SSI interface. One RS422 interface works as the clock generator for reading the data, which is then received on the other RS422 interface.

Table 12-22: Technical data BL67-1SSI

Designation	BL67-1SSI
Number of serial interfaces	1
Encoder voltage	24 VDC (-15% / +20%)
Encoder current	500 mA (not short-circuit proof)
U_{RS1} (active)	> 500 mV
U_{RS0} (inactive)	0 to 200 mV
U_{GLRS} (common mode)	-7 to 12 mV
Clock output type	RS422
Signal input type	RS422
RS422 cable length	max. 30 m
Nominal voltage from supply terminal	24 VDC
Nominal current from supply voltage (field) I_L	25 mA (without encoder current)
Nominal current consumption at 5 VDC (module bus) I_{MB}	50 mA
Power loss of the module	< 1 W
U_{TMB} (module bus/ field voltage)	1000 VDC
U_{FE} (field voltage/ functional earth)	1000 VDC
U_{Field} (field voltage/ IOs)	0 V

12.3.11 Diagnostic/ status messages

Diagnosis/ status via LEDs

Table 12-23: Diagnosis/ status via LEDs

LED	Display	Meaning	Remedy
D	Red	Module bus communication failure	Check if more than two ad-joining electronic modules have been pulled. This applies to modules located between this module and the gateway.
	Red flashing 0.5 Hz	Diagnosis pending	-
	Off	No error messages or diagnostics	–
UP	Green	Direction of movement upwards	–
	Off	No upwards direction of movement	–
DN	Green	Direction of movement downwards	–
	Off	No downwards direction of movement	–

Diagnosis via software

The module has the following diagnostic data available.

Table 12-24: Diagnosis

Diagnostic message	
SSI group diagnostics	Status messages of the SSI encoder present.
Open circuit	SSI encoder signal faulty (e.g. due to a cable break).
Sensor value overflow	SSI encoder value above upper limit. Overflow occurred.
sensor value underflow	SSI encoder value below lower limit. Underflow occurred.
Parameter error	Operation of the module is not possible with the present parameter set.

12.3.12 Module parameters

Table 12-25: Module parameters

A *default-settings*

Parameter name	Value	Description
sensor idle data cable test	Activate **A**	ZERO test of data cable.
	Deactivate	After the last valid bit, a ZERO test of the data cable is not carried out.
invalid bits (LSB)	"0" to "15"	Number of invalid bits on the LSB side of the position value supplied by the SSI encoder. The meaningful word width of the position value transferred to the module bus master is as follows: SSI_FRAME_LEN - INVALID_BITS_MSB - INVALID_BITS_LSB. The invalid bits on the LSB side are removed by shifting the position value to the right, starting with the LSB. (Default 0 Bit = 0x 0). INVALID_BITS_MSB + INVALID_BITS_LSB must always be less than SSI_FRAME_LEN.
invalid bits (MSB)	"0" to "7"	Number of invalid bits on the MSB side of the position value supplied by the SSI encoder. The meaningful word width of the position value transferred to the module bus master is as follows: SSI_FRAME_LEN - INVALID_BITS_MSB - INVALID_BITS_LSB. The invalid bits on the MSB side are zeroed by masking the position value. INVALID_BITS_MSB + INVALID_BITS_LSB must always be less than SSI_FRAME_LEN. Default: 0 = 0hex
Data rate	1000000 Bit/s 500000 Bit/s **A** 250000 Bit/s 125000 Bit/s 100000 Bit/s 83000 Bit/s 71000 Bit/s 62500 Bit/s	
Data frame bits	1 to 32	Number of bits of the SSI data frame. SSI_FRAME_LEN must always be greater than INVALID_BITS. Default: 25 = 19 hex

Table 12-25: Module parameters	Parameter name	Value	Description
	Data format	Binary coded	SSI encoder sends data in binary code
		GRAY coded	SSI encoder sends data in Gray code

Number of data frame bits:

INVALID_BITS_MSB: Number of invalid bits (MSB)
INVALID_BITS_LSB: Number of invalid bits (LSB)
INVALID_BITS: INVALID_BITS_MSB + INVALID_BITS_LSB

12.3.13 Base modules/ pin assignment

- BL67-B-1M12-8

Figure 12-23: BL67-B-1M12-8

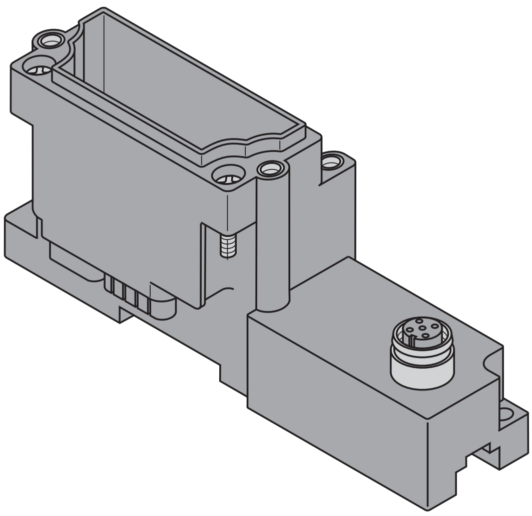
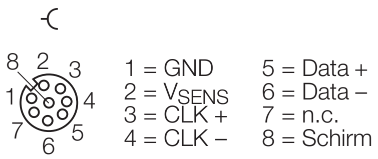


Figure 12-24: Pin assignment BL67-1SSI with BL67-B-1M12-8



- BL67-B-1M23

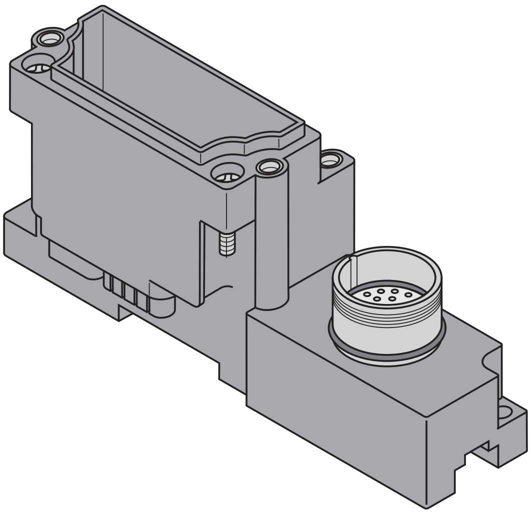
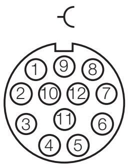


Figure 12-25: BL67-B-1M23



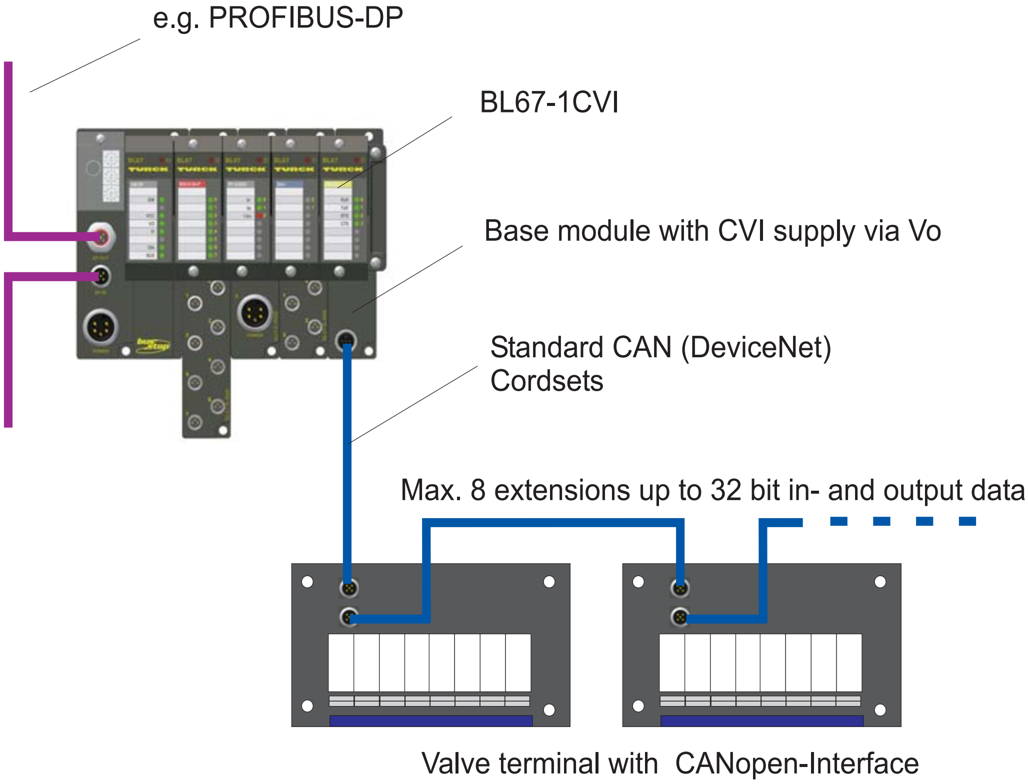
1 = GND	7 = n.c.
2 = V_{SENS}	8 = Schirm
3 = CLK +	9 = n.c.
4 = CLK –	10 = n.c.
5 = Data +	11 = n.c.
6 = Data –	12 = n.c.

Figure 12-26: Pin assignment BL67-1SSI with BL67-B-1M23

12.4 BL67-1CVI

The module BL67-1CVI is an interface to the CAN-Bus. It serves to connect simple digital CANopen device (e.g. valve terminals of different manufacturers) to a BL67-System.

Figure 12-27: Example for connecting valve terminals to BL67-1CVI



12.4.1 Technical data

Figure 12-28: BL67-1CVI

Figure 12-29: Block diagram BL67-1CVI

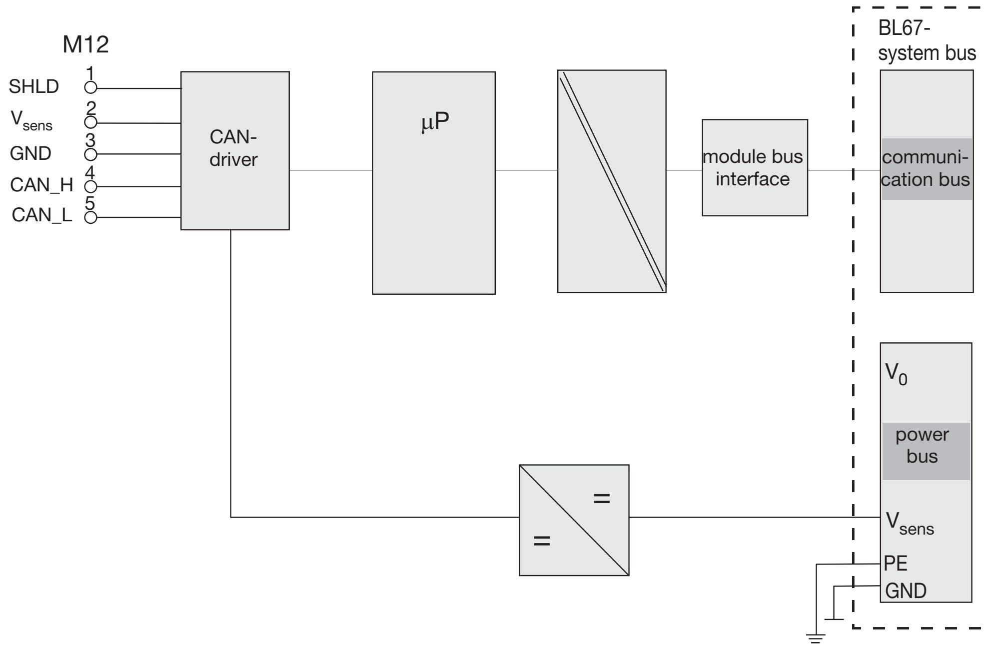


*Table 12-26: Technical data^*

Designation	BL67-1CVI
Number of channels	1
Nominal voltage from supply terminal	24 V DC
Load voltage V_O	24 V DC
Voltage range	18 to 30 VDC
Nominal current consumption at 5 VDC (module bus) I_{MB}	≤ 30 mA
Nominal current from supply voltage (field) I_L	< 100 mA (at load current = 0)
Power loss of the module, typical	< 1.5 W
CAN	
U_{RS1} (active)	min. 500 mV
U_{RS1} (inactive)	max. 200 mV
U_{GLRS} (common mode)	-7 to 12 V
Power supply (valve electronic)	
Output current	
High level I_A (nominal value)	0.5 A
High-level I_{AMAX}	0.6 A (acc. to IEC 6 1131-2)
Switch-on resistance R_{ON}	190 mΩ
Simultaneity factor	100%
Switch-off characteristic K_A	
I_{OUT} > 1.5 A	< 4 ms
1.0 A < I_{OUT} ≤ 1.5 A	< 10 s
0.6 A < I_{OUT} ≤ 1.0 A	min. 10 s/ max. 60 s
Power supply (valves)	
Output current	
High level I_A (nominal value)	1 A
High-level I_{AMAX}	1.2 A (acc. to IEC 6 1131-2)
Switch-on resistance R_{ON}	95 mΩ
Simultaneity factor	100%
Switch-off characteristic K_A	
I_{OUT} > 3 A	< 4 ms
2 A < I_{OUT} ≤ 3 A	< 10 s
1.2 A < I_{OUT} ≤ 2 A	min. 10 s/ max. 60 s

Isolation voltage	
U_{TMB} (module bus/ field/ CAN)	max. 1000 V DC
U_{Feld} (field/ CAN)	0 V DC
U_{Feld} (Supply valve electronic/ CAN)	0 V DC
U_{Feld} (supply valves/ CAN)	0 V DC
Short-circuit proof	yes, acc. to EN 61 131-2

12.4.2 Process data

The process data of the CVI-module mirror the data of the connected CANopen-nodes depending on their parameterization (see Table 12-32: Configuration possibilities for the CANopen-nodes).
The process data begin with the data of the node with the lowest address, followed by the data of all other modules in chronological order.This applies to both, in- and output data.

Note
The input data of not connected or disturbed CANopen-nodes are assumed as "0".

12.4.3 Diagnostic/ status messages

Diagnosis/ status via LEDs

Table 12-27: Diagnosis/ status via LEDs

LED	Display	Meaning	Remedy
D	Red	Module bus communication failure	Check if more than two ad-joining electronic modules have been pulled. This applies to modules located between this module and the gateway.
	Red, flashing, 0.5 Hz	Diagnosis pending	
	Off	No error messages or diagnostics	-
BUS	Orange (+ **Error** = Red)	Not all configured CANopen-nodes are online and in Operational mode.	Please check the connected CANopen-nodes.
	Green	All configured CANopen-nodes are online and in Operational mode.	

Error	Red	Communication between interface and other bus nodes disturbed: - CAN BusOff - Heartbeat- error - Guarding- error - Transmit-Timeout	Control the CAN-communication between the nodes
	Off	Communication between CVI and other bus nodes OK	
VE	Green	Valve electronic power supply is switched on.	
	Red	Over load / short-circuit in valve electronic power supply	Eliminate the cause for the short-circuit or the overload
	Off	Valve electronic power supply is switched off.	
VC	Green	Valve power supply is switched on.	
	Red	Over load / short-circuit in valve power supply	Eliminate the cause for the short-circuit or the overload
	Off	Valve power supply is switched off.	

Diagnosis via software

The module has the following diagnostic data available.

Table 12-28: Diagnosis data

Name	Description
DiagNode x	Diagnostic messages of the respective node (see Table 12-29 Diagnosis data of the CANopen-nodes)
DiagCVI	Global diagnostic messages of the CVI-module (see Table 12-30 Global diagnosis of the CVI-module)

Table 12-29: Diagnosis data of the CANopen-nodes

Name	Description
Emergencies transmitted since module start	The emergency messages may already be eliminated. The diagnosis is deleted 10s after eliminating **all** communication and application errors of **all** nodes.
Node transmitted emergencies	Node sent emergency messages.
Communication error transmitted since module start/ Guard Time	The communication errors may already be eliminated. The diagnosis is deleted 10s after eliminating **all** communication and application errors of **all** nodes.
Communication error/Guard Time timeout	Communication error, for example Guard-Time elapsed

Table 12-30: Global diagnosis of the CVI-module

Name	Description
Emergencies transmitted since module start	The emergency messages may already be eliminated. The diagnosis is deleted 10s after eliminating **all** communication and application errors of **all** nodes.
Node address not within permissible range (1-8)	This error is only deleted after a module-restart.
Overcurrent VC	Overcurrent at the valve power supply.
Overcurrent VE	Overcurrent at the valve electronic power supply.

12.4.4 Module parameters

Table 12-31: Module parameters

Parameter name	Description
Configuration Node x	Configuration of the connected node (see Table 12-32:)
Guarding time [n*0.1s]	Setting the Guard-Time in steps of 100 ms (value 0 to 255); default 3 = 300 ms
Life time factor	Factor which defines how often a node is allowed not to answer a request or to exceed the Guard-Time (values 0 to 255); default = 3
Configuration	Different configuration settings (see Table 12-32:)

Table 12-32: Configuration possibilities for the CANopen-nodes

Bit	Parameter name	Description
0	**Node x** 0 = inactive/ not connected **A** 1 = active	
1	**Guarding** 0 = inactive **A** 1 = active	
2 to 4	**Input bits** 000 = 0 bit **A** 001 = 4 bit 010 = 8 bit 011 = 12 bit 100 = 16 bit 101 = 24 bit 110 = 32 bit 111 = reserved	Length of the node's input data.
5 to 7	**Output bits** 000 = 0 bit **A** 001 = 4 bit 010 = 8 bit 011 = 12 bit 100 = 16 bit 101 = 24 bit 110 = 32 bit 111 = reserved	Length of the node's output data.

Table 12-33: Configuration possibilities for CANopen

Bit	Parameter name	Description
0 to 2	**Data rate** 000 = 1000k 001 = reserved 010 = 500k 011 = 250k 100 = 125k **A** 101 = 50k 110 = 20k 111 = 10k	Baudrate for CANopen
3	**Terminating resistor** 0 = no terminating resistor A 1 = terminating resistor active	Activation of the bus terminating resistor
4 to 7	reserved	

12.4.5 Base modules/ pin assignment

- BL67-B-1M12

Figure 12-30: BL67-B-1M12

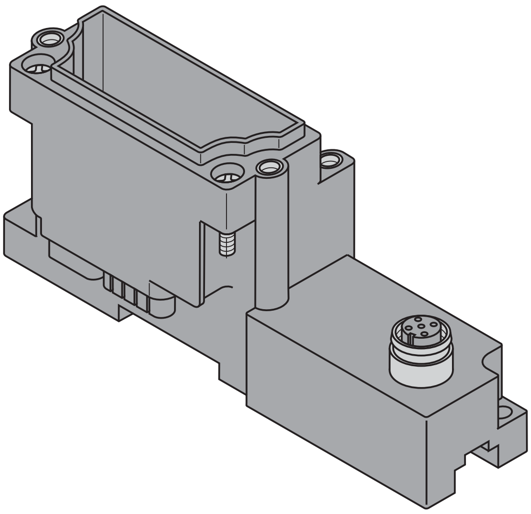
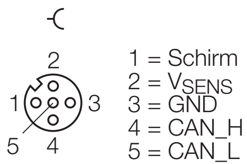


Figure 12-31: Pin assignment BL67-1CVI with BL67-B-1M12



12.4.6 Important notes for using the CVI module

In order to guarantee a trouble-free communication between the valve interface and the connected CANopen nodes, please follow these notes during the start-up of BL67-1CVI:

1. When connecting the CANopen nodes to the CVI module, all regulations concerning the installation of a CANopen network have to be considered, above all, the rules for terminating a CANopen network.
   If the CVI module is the first or the last node in the network, the terminating resistor has to be activated via a module parameter.
2. The BL67-system as well as the CANopen nodes have to be supplied meeting the demands for voltage supply.
3. Please set the CANopen station addresses at the nodes. The first node in the CANopen subnet receives address "1".
4. Please set identical baudrates at the CVI module and each CANopen node. With different baudrate-setting, the CVI module and the connected CANopen nodes can not communicate.
5. Please parameterize the connected CANopen nodes according to the application. Activate present nodes and deactivate inactive nodes, activate/ deactivate the guarding and set the length of in- and output data for every active node.
6. If the LEDs of the CVI module and the CANopen nodes switch to green, the system runs without problems.

12.5 BL67-1CNT/ENC

The BL67-1CNT/ENC allows the connection of encoders as well as signal- and direction inputs, whereas the output of the direction is optional.

The module provides a 24 V power supply of connected encoders.

The counter can be used as input module for RS422-outputs as well as digital input with a parameterizable threshold for push-pull-outputs (single ended) (0 to 30 V) (see parameter Encoder signal).

- RS422-input:
  - signal evaluation between A, B, Z and /A, /B, /Z
  - power supply of 5 V-encoders has to be realized externally
- push-pull-input (single ended)
  (digital input with parameterizable threshold):
  - signal evaluation between A, B, Z and GND.
    The inputs /A, /B and /Z are internally connected to GND.
  - push-pull-inputs (0 to 30 V)
  - threshold freely parameterization (1 to 18 VDC)

Additionally, the module provides 4 digital outputs and 4 digital inputs, whereas the channels DI0 and DO0 and DI1 and DO1 respectively are connected to the same contact (DIO0 and DIO1).

The digital inputs can be used as counter release.

Operation modes

Counting

- encoder
- pulse and direction

Measurement

- frequency measurement / revolution measurement
- period duration measurement

12.5.1 Getting Started

The following section shows the general procedure for reading the count value:

1 short parameterization (if necessary):

- If no external encoder power supply is used, the supply can be realized using output DO3 of the module.
  To realize this, the parameter "function DO3" (byte 1, bit 2) has to be set to "1 = Encoder power supply" (see Parameters of the counter module, page 12-74).
- If no external encoder power supply is used, the input DI3 of the module can be used as encoder-GND.
  To realize this, the parameter "function DI3" (byte 1, bit 1) has to be set to "1 = Encoder GND" (see Parameters of the counter module, page 12-74).

2 counter release:

- The count process is released by setting the process output bit "GATE" from 0 → 1 (see Process output/ control interface Byte 0, Bit 1, page 12-80).
  → The counter is activated and the count process starts.

3 read out the counter value

- The counter value can be read out from bytes 4 to 7 "REG_RD_DATA" of the Process input/ status interface (see page 12-80).

Note

For further information about the functions of BL67-1CNT/ENC (parameterization, process image, internal registers etc.), please read the following pages.

12.5.2 Count mode

After the release signal, the counter module counts from the load value continuously between the upper and lower limit.

The release is activated by the rising edge from 0 → 1 of the control bit Gate in the Process output/ control interface.

- If the counter counts up and reaches the upper count limit, it will jump to the lower count limit when another counter signal is received, and will continue to count without signal loss from this point.
- If the counter counts down and reaches the lower count limit, it will jump to the upper count limit when another counter signal is received, and will continue to count without signal loss from this point.

Limit values of count mode

The limit values have to be defined via the registers no. 36 REG_LOWER_LIMIT and no. 40 REG_UPPER_LIMIT in the module's Register bank of the module (page 12-84).

Maximum count ranges:

- The upper count limit is +2 147 483 647 (2^{31}-1) = 0×7FFFFFFF
- The lower count limit is-2 147 483 648 (-2^{31}) = 0×80000000

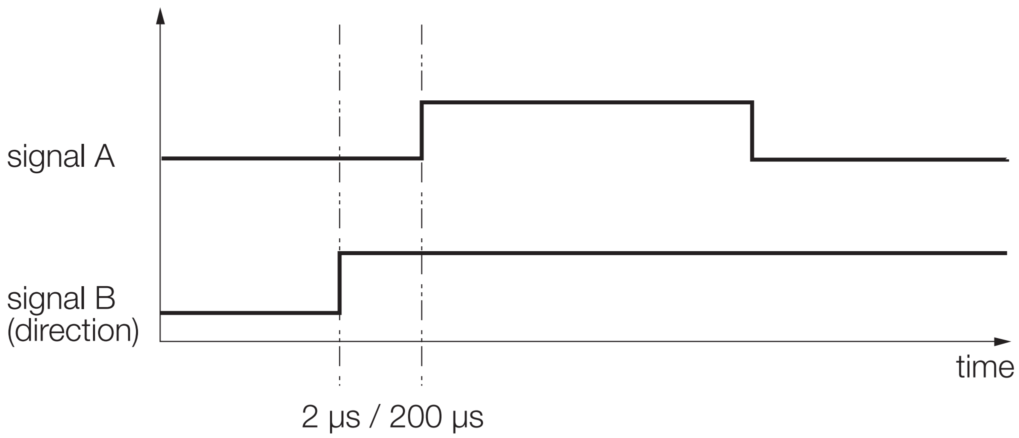
Signal evaluation A, B, Z

- Pulse and direction, single
- Pulse and direction, double
- Encoder, single
- Encoder, double
- Encoder, quadruple

Time between direction signal (B) and counter signal (A)

On pulse generators with a direction signal, it must be ensured that there is a gap of at least 2 µs/ 200 µs between the direction signal (B) and the counter signal (A), depending on the input filter configured.

Figure 12-32: Time between direction signal and counter signal



12.5.3 Measurement mode

General

The measurement operation has not to be started. It is done automatically, at the same time as the counting operation. Depending on the parameterization (parameter byte 3, bit 5, Measurement mode), either a frequency or a period duration count is executed.

Exception:
If, for the synchronization of the module, the parameter Sync. with Z is set to *periodical*, then the parameter Measurement mode has to be set to frequency measurement in order to activate frequency measurement.

The activation of the measurement operation is done via the setting of the internal software release or, if the digital input is parameterized as hardware-gate (HW-gate), via the setting of both, the hardware- **and** the software-release.

Frequency measurement

Definition

In this operating mode the module counts the pulses received within a specified integration time.

The integration time can be set by using the register communication via register no. 60 REG_MEASURE_TIME. It can be set in steps of 10 ms to between 10 ms and (2^{32} -1) × 10 ms.

Preconditions

- Parameter Measurement mode = 0
- Register no. 52 REG_SCALE_MUL = 1
- Register no. 56 REG_SCALE_DIV = 1
- Register no. 60 REG_MEASURE_TIME → Integration time, depends on the application

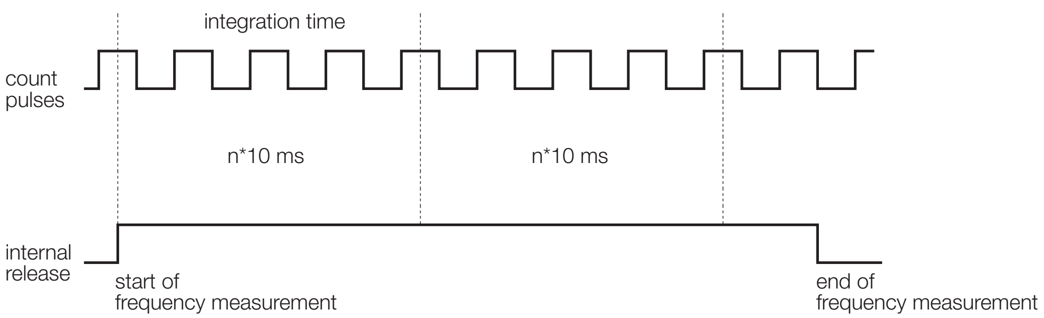
The value of the measured frequency is displayed with the unit 10^{-3} Hz.

The measured frequency value can be read out from register no. 48 REG_MEASURED_ VALUE and, if parameterized, from the Process input/ status interface (bytes 8 to 11)..

Note
The value displayed in bytes 8 to 11of the feedback interface (process output) is defined via parameter REG_AUX_ADR (parameter byte 14).
Here, enter the register no. of the value to be monitored (see Register bank of the module, page 12-84).

The displayed value cannot be updated until the integration time has elapsed.

Figure 12-33: Frequency measurement with release function



Period duration measurement

Definition

In this operating mode the counter module measures the precise time between two rising edges of the counter signal in µs.

Preconditions

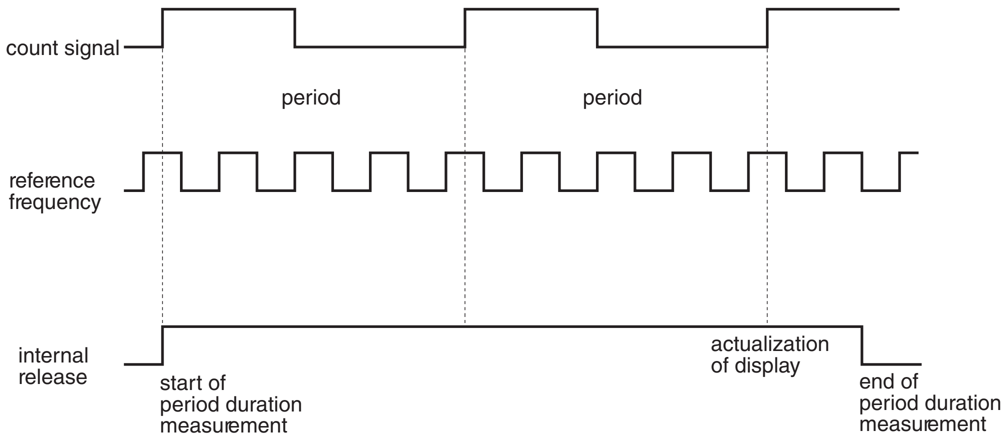
- Parameter Measurement mode = 1
- Register no. 52 REG_SCALE_MUL = 1
- Register no. 56 REG_SCALE_DIV = 1

The period duration value can be read out from register no. 48 REG_MEASURED_ VALUE and, if parameterized, from the Process input/ status interface (bytes 8 to 11).

Note

The value displayed in bytes 8 to 11of the feedback interface (process output) is defined via parameter REG_AUX_ADR (parameter byte 14).
Here, enter the register no. of the value to be monitored (see Register bank of the module, page 12-84).

Figure 12-34: Period duration measurement; no. of periods = 2



Revolutions measurement

The revolutions measurement is not executed directly.

In the operation mode frequency measurement (see parameter Measurement mode), the no. of revolutions (n) in 1/min can be calculated on the basis of the frequency (f).

The following applies:

- The frequency (f) is provided by the module.
- The conversion to the no. of revolutions is done **internally by the module** using the following formula in consideration of the encoder's resolution (pulses/revolution):

$$n = f \times \frac{\text{multiplier}}{\text{divisor}} = f \times \frac{60}{1000 \times \text{pulses}}$$

- The multiplier and the divisor are module registers, which have to be written according to the formula mentioned above.
  Multiplier:REG_SCALE_MUL; Reg. no. 52 (page 12-84)
  Divisor: REG_SCALE_DIV; Reg. no. 56 (page 12-85)
- Register REG_MEASURED_VALUE contains the revolutions speed.

Preconditions

- Parameter Measurement mode = 0
- Register no. 52 REG_SCALE_MUL ≠ 1
- Register no. 56 REG_SCALE_DIV ≠ 1

Revolutions speed in higher resolution

In order to display a higher-resolved revolutions speed, e.g. 10^{-3}/min, the multiplier has to be multiplied with e.g. 10^3.

$$n = f \times \frac{multiplier \times 1000}{divisor}$$

12.5.4 Functions and explanations

Software-gate and hardware-gate

A release signal is required in order to start counting/measuring.

The counter module controls the starting and stopping of the counting/measuring operation by means of so-called "gates". A software gate and a hardware gate are provided for implementing this control both via the software (process output/control interface) and via a physical output:

- Software-gate:
  The release is initiated via a rising edge from 0 → 1 of the control bit Gate in the Process output/ control interface.
  Resetting this control bit 1 → 0 stops the measurement.
  It is always necessary to release the counter via the software-gate. If not, the operation will not be started.
  If the release is to be initiated only via the software-gate, the parameter Gate function has to be set in parameter byte 3, bits 0 to 2 (see Parameters of the counter module, page 12-74).
  Additionally, the counter release can be controlled via a hardware-gate (see below).
- Hardware-gate:
  The release is initiated via a high-signal (depends on the set threshold) at input Z or via a 24 V-signal at one of the digital inputs DI0 to DI3.
  The release is initiated with a rising edge 0 → 1 at the input an reset with a falling edge 1 → 0.

  The parameterization of the digital inputs DI0 to DI3 as hardware-gate is also done via the parameter Gate function, parameter byte 3, bits 0 to 2 (see Parameters of the counter module, page 12-74).

  A release via the hardware-gate is thus only possible if, at the same time, the control bit "Gate" in the control interface is set to 1 (software-gate, see above).

Synchronization

Synchronization must be configured before operating the counter module (see parameter Synchronization with Z). A rising edge of a reference signal at input Z is used to set the counter to the load value.

Single and **periodical** synchronization can be chosen:

The following te$_{rms}$ have to be considered:

- The count operation has been started with the software release.
- The control bit for the release of the synchronization (SYNC_REQ) has to be set.
- During the synchronization no period duration measurement is done.
- In single synchronization, the period duration measurement starts automatically after the synchronization.

Note

In periodical synchronization, a period duration measurement is not possible.
In this case frequency measurement has to be used!

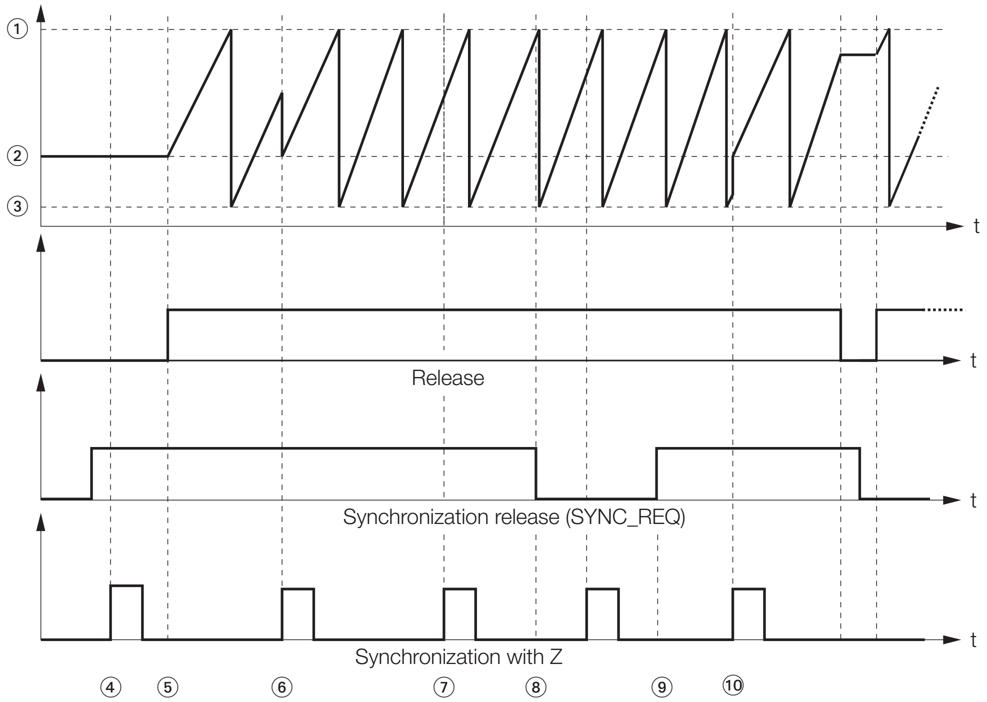
- Single synchronization:
  - Active, if parameter byte "synchronization with Z": byte 1, bit 5 = **0**.
  - In single synchronization the synchronization with the load value only takes place once with the **first** 0 → 1 rising edge at the digital input, *after* setting the release-bit.

Note

A synchronization with Z during frequency measurement may lead to undefined values for the time of the synchronization process.

In single synchronization, a reset and a following setting of the control bit SYNC_REQ initiates a new synchronization process. This process is started with the next rising edge 0 → 1 at the digital input.

Figure 12-35: Single synchronization



1 upper count limit

2 uoad value

3 lower count limit

4 no synchronization without release

5 release set

6 single synchronization

7 no 2. synchronization

8 stop synchronization

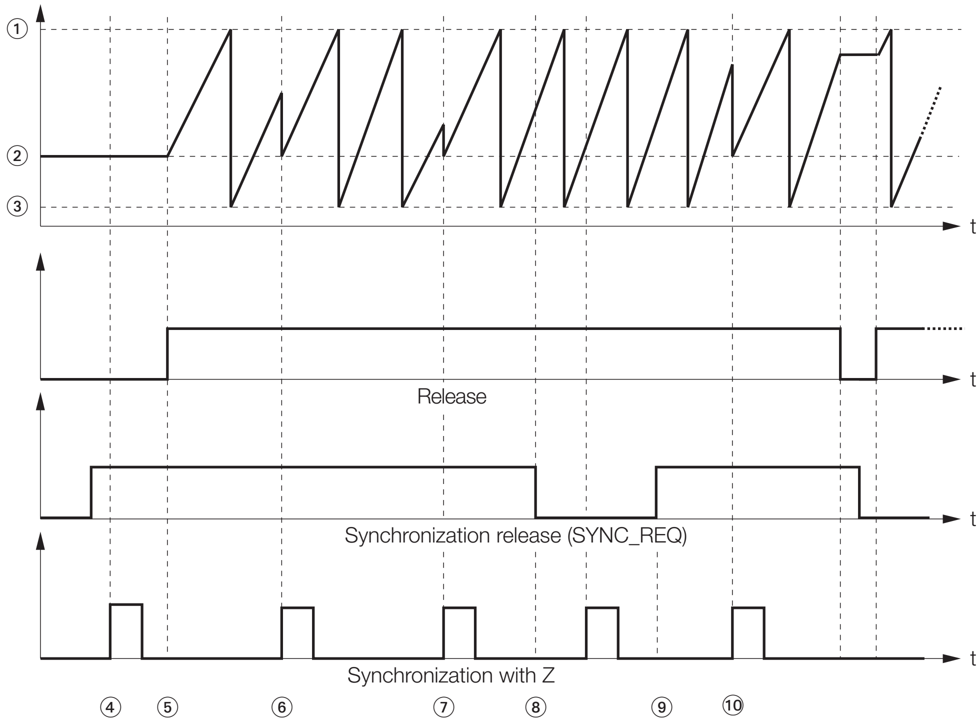
9 start synchronization

10 single synchronization after new release

- Periodical synchronization:
  – active, if parameter byte "synchronization with Z": byte 1, bit 5 = **1**.

In periodical synchronization, the synchronization with the load value is done with the **first** and **every following** 0 → 1 rising edge at input Z, after setting the release bit.

Figure 12-36: Periodical synchronization



1 upper count limit
2 load value
3 lower count limit
4 no synchronization without release
5 release set
6 1. synchronization
7 2. synchronization
8 stop synchronization
9 start synchronization
10 1. synchronization after new release

The following applies:

- The status bit SYNC_AKN is set after successful synchronization. This bit can only be reset by a new setting of the bit SYNC_REQ.

The signal of a bounce-free switch or the zero position of an encoder can be used as reference signal.

Behavior of the digital inputs DI0 to DI3

The digital input can be operated using different sensors (pnp-switch or push-pull-contact).

The input signal can be inverted.

The status-bits DI0 to DI3 display the level of the digital input.

The following functions can be selected for the digital inputs:

- Digital input
- Hardware-gate (see parameter Gate function)
- Encoder GND (see parameter Function DI3).

Behavior of the digital outputs DO0 toDO3

The module provides "real"   digital outputs with overload detection (see Diagnostic messages via software).

The following functions can be selected for the digital outputs:

- Digital output
  The digital outputs are controlled via a flag in the Process data of the module, page 12-78.
- Encoder power supply (see parameter Function DO3)

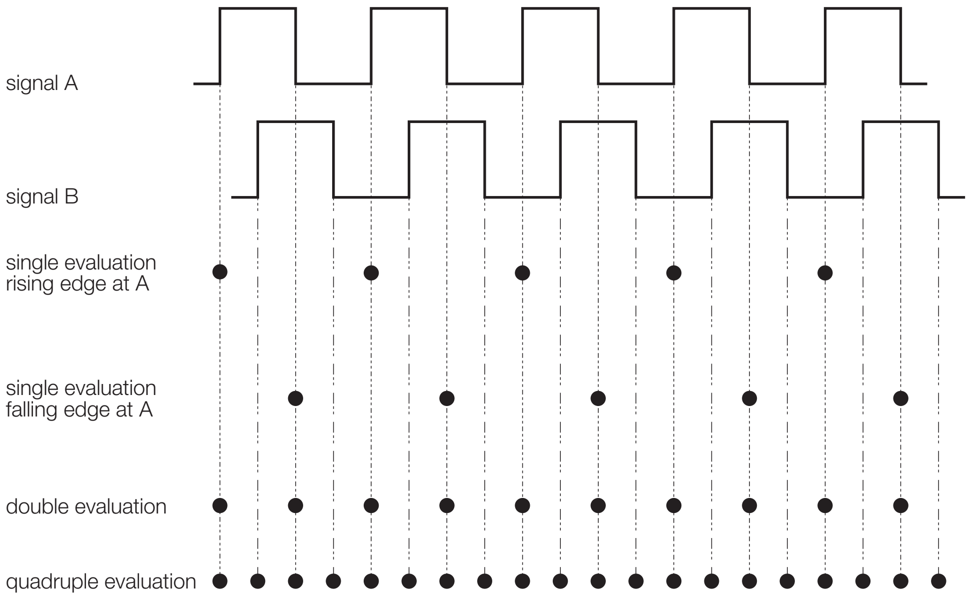
Signal-evaluation options for encoders

The setting of the evaluation options is done in the BL67 counter module. The following settings are possible:

- single
- double
- fourfold

The parameterization of the evaluation is done in parameter-byte 0, bits 2 and 3, parameter "Signal evaluation", see page 12-74.

Figure 12-37: Evaluation options for the counter module



Scan points with different evaluations

The set configuration determines how the counter status is incremented or decremented according to the rising and falling edges of signals A and B. The following evaluations are possible:

- Single evaluation:
  - only the rising edge of signal A is evaluated
    or
  - only the falling edge of signal A is evaluated.
- Double evaluation:
  Both the rising and falling edge of signal A are evaluated.
- Fourfold evaluation:
  Both the rising and falling edge of signal A and B are evaluated.

Pulse and direction

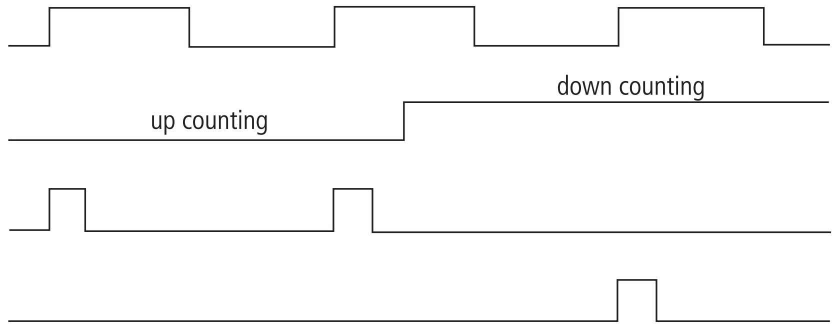
Input A receives the counter signal and input B the direction signal.

A signal at input A can either increment or decrement the counter status depending on the state of input B.

The count direction or respectively the direction signal is parameterized in byte1,bit 0 of the process input data (see the module's Process input/ status interface).

Note
The signal at A and B can be inverted.

Figure 12-38: Changing the counter status on counter signal and direction signal



Load value

Load value in preparation

The counter module can be assigned with a load value in preparation. This value can either be set via the connected controller (see Register bank of the module, register no. 40 "REG_LOAD_VALUE") or via the I/O-ASSISTANT software.

The preconditions for loading the load value are the following:

- a completed synchronization with Z
- a module reset

If the parameterized load value exceeds the parameterized count limits of the module, the respective count limit is loaded.

The following values can be changed using the load function during operation by means of the respective registers (see Register bank of the module):

- count value (REG_COUNTER_VALUE, register no. 32)
- lower limit (REG_LOWER_LIMIT, register no. 36)
- upper limit (REG_UPPER_LIMIT, register no. 40)
- load value (REG_LOAD_VALUE, register no. 44)
- set digital outputs
- read digital inputs

Load counter directly

The counter can be loaded directly.

In this case, the load value is directly written into the counter-value-register (register no. 0 "REG_CNT_POS", see Register bank of the module) and accepted immediately from the module as the new counter value.

If the parameterized load value exceeds the parameterized count limits of the module, the respective count limit is loaded.

12.5.5 Reset of status bits

The reset of the status bits is initiated with a rising edge 0 $\rightarrow$ 1 at RES_STS (byte 1, bit 0) of the module’s control interface Process output/ control interface.

Status bits:
STS_ZC, STS_UFLW, STS_OFLW

12.5.6 Error acknowledgement

Error messages as "overload at output" (DIA_DOx) or "parameterization error" (ERR_PARA) automatically cause a diagnostic message.
They do not have to be acknowledged. The reset of the diagnosis is done automatically after the deletion of the error.

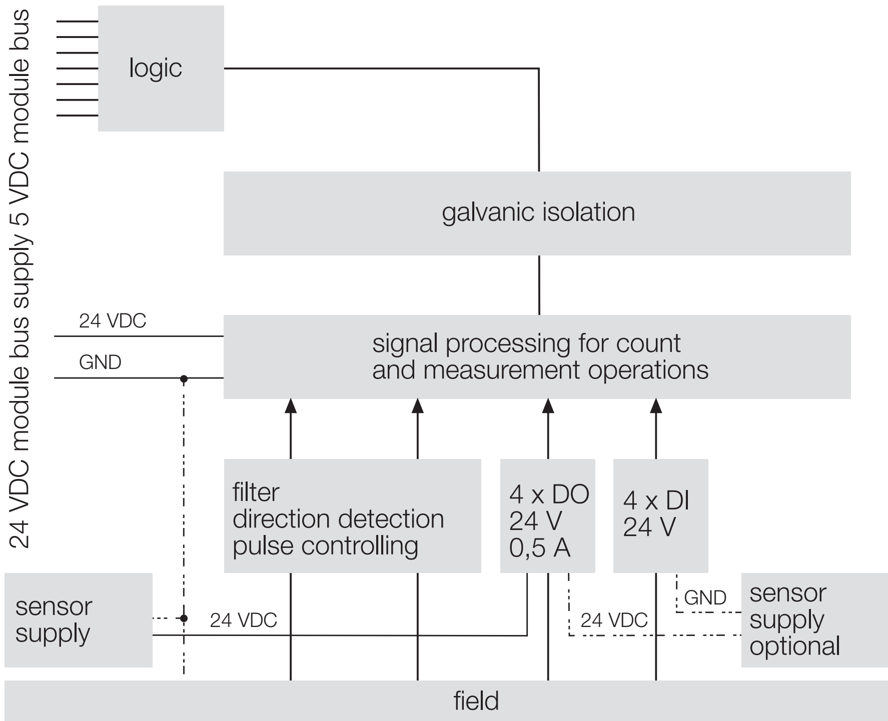
The reset of a "ERR_PARA"-diagnostic message is done immediately after the deletion of the error, a "DIA_DOx"-diagnostic message is reset with delay, depending on the severity of the overload.

12.5.7 Technical properties

Figure 12-39: BL67-1CNT/ENC

Block diagram

Figure 12-40: block diagram



Technical data

Table 12-34: Technical data

Designation	BL67-1CNT/ENC
Number of channels	1
Nominal voltage from supply terminal	24 VDC
Nominal current from supply terminal I_L	< 50 mA (if load current = 0)
Nominal current consumption from module bus	50 mA
Power loss of the module, typical	< 1.5 W
Sensor supply	
Output voltage of the DOs	24 VDC
Output current	≤ 0.5 A, short-circuit proof
Digital inputs for counter signals A, B Z	
Differential inputs	RS422 with 150 Ω terminating resistors
– max. input voltage	acc. to RS422
Digital input with parameterizable threshold	
– max. input voltage	0 to 30 VDC
U_{SE} (switching threshold)	1 to 18 V
U_{HSE} (hysteresis)	1 to 4 V

Input current	
– Low-level I_L	-0.06 to 1.1 mA
– High-level I_H	0.02 mA to 2.5 mA
Minimum pulse width (maximum counter frequency)	
Depends on the parameterized Input filter (A,B):	
– at 500 kHz	≥ 2 µs
– at 50 kHz	≥ 20 µs
– at 5 kHz	≥ 200 µs
Digital inputs DI0, DI1, DI2, DI3	
Input current	≤ 5 mA
Switching threshold EIN	≥ 7 V
Switching threshold AUS	≤ 5 V
Digital output DO0, DO1, DO2, DO3	
R_{ON} switch-on resistance	< 110 mΩ
Output current I_A	
– High-level I_A (nominal value)	0.5 A
– High-level I_{AMAX}	0.6 A (acc. to IEC 6 1131-2)
Switch-off characteristic K_A	
– I_{OUT} > 1,5 A	< 0.8 s
– 1,0 A < I_{OUT} > 1,5 A	< 3 s
– 0,6 A < I_{OUT} > 1,0 A	min. 3 s/ max. 10 s
Synchronization factor	100 %

Switching frequency	
– ohmic load	100 Hz
– inductive load	2 Hz
– lamp load	≤ 10 Hz
Lamp load R_{LL}	≤ 10 W
Short-circuit proof	yes
Isolation voltages	
U_{TMB} (module bus/ IOs)	1000 VDC
U_{Feld} (field/IOs)	0 VDC
U_{FE} (module bus or field/ FE)	100 VDC
Measurement ranges	
frequency measurement	250 kHz
single	max. 250 kHz
double	max. 250 kHz
fourfold	max. 125 kHz
Period duration measurement	400 ns to 858,9 s
Counter modes	
Signal evaluation A, B, Z	– pulse and direction – encoder, single – encoder, double – encoder, fourfold
Counter mode	– Continuous count – Periodical count (if Synchronization with Z is parameterized as *periodical*)
Synchronization	single periodical
Counter limits	
upper count limit	0×8000 0000 to 0×7FFF FFFF Can be freely chosen, whereas the upper count limit must always be higher than the lower count limit.
lower count limit	

Diagnostic-/ and status messages

Table 12-35: LED-Anzeigen

LED	Display	Meaning	Remedy
DIA	Red, flashing, 0,5 Hz	Diagnosis pending	
	Red	Module bus communication failure	Check if more than two adjoining electronics modules have been pulled.Check the power supply to the module bus.
	OFF	No error message or diagnosis	–
A/ Z	Green	Input A active	-
	Red	Input Z active	
	Red and Green	Inputs A and Z active	
	OFF	Inputs A and Z not active	
B	Green	Input B active or direction input set for down counting	-
	OFF	Input B not active	-
DIO0/DIO1	Green	Channel active	-
	Red	Overload at output x	-
	OFF	Channel not active	
DO2/DO3	Green	Output active	
	Red	Overload at output x	
	OFF	Output not active	
DI2/DI3	Green	Input active	-
	OFF	Input not active	-

Diagnostic messages via software

The module has the following diagnostic data available:

Byte	Byte in DP	Bit 7	Bit 6	Bit 5	Bit 4	Bit 3	Bit 2	Bit 1	Bit 0
0	7	ERR_ PARA	X	X	X	X	X	STS_ OLFW	STS_ ULFW
1	6	X	X	X	X	DIA_ DO3	DIA_ DO2	DIA_ DO1	DIA_ DO0
2	5	X							
…	…								
7	0								

Table 12-36: Diagnostics of the BL67-1CNT/ENC

Diagnostic message	Value	Meaning
STS_OFLW	0	No overflow
	1	Counter value exceeded upper limit of counter range.
STS_UFLW	0	No underflow
	1	Counter value exceeded lower limit of counter range.
DIA_DOx	0	Output OK
	1	Short circuit or overload at output x
ERR_PARA	0	The last parameter change is valid.
	0	The last parameter change is invalid.

Base modules

- BL67-B-1M12-8

Figure 12-41: BL67-B-1M12-8

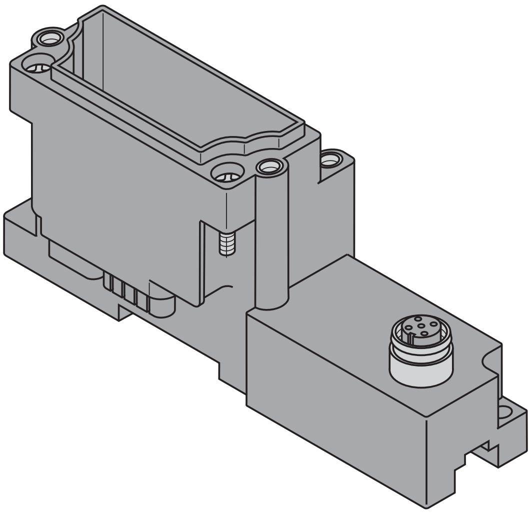
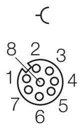


Figure 12-42: Pin assignment BL67-1CNT/ENC with BL67-B-1M12-8



1 = Di 3 / GND	5 = B
2 = DO 3 / Venc	6 = $\overline{B}$
3 = A	7 = Z
4 = $\overline{A}$	8 = $\overline{Z}$

- BL67-B-1M23

Figure 12-43: BL67-B-1M23

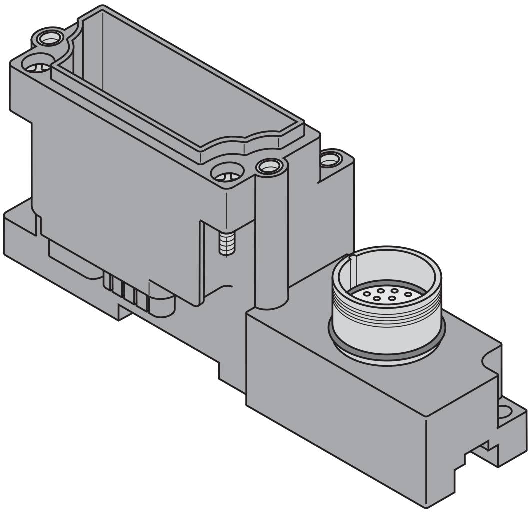
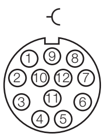
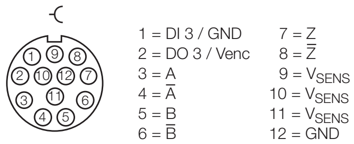


Figure 12-44: Pin assignment BL67-1CNT/ENC with BL67-B-1M23



1 = DI 3 / GND	7 = Z
2 = DO 3 / Venc	8 = $\overline{Z}$
3 = A	9 = DIO 0
4 = $\overline{A}$	10 = DIO 1
5 = B	11 = DO 2
6 = $\overline{B}$	12 = GND

Figure 12-45: Pin assignment BL67-1CNT/ENC with BL67-B-1M23-VI



12.5.8 Parameters of the counter module

Byte	Byte in DP	Bit 7	Bit 6	Bit 5	Bit 4	Bit 3	Bit 2	Bit 1	Bit 0
0	15	Input A	Input B	X	Count direction	Signal evaluation (A,B)		Input filter (A, B)	
1	14	Input Z	X	Sync. with Z	X	Enc. signal	Function DO3	Function DI3	PullUp Z
2	13	Threshold of inputs A, B and Z							
3	12	X	X	Meas.-ment mode	Count mode	Gate	Gate function		
4	11	X							
…									
13	2								
14	1	REG_AUX_ADR							
15	0	X							

X = reserved

Sync. = synchronization

Table 12-37: Parameters of BL67-1CNT/ENC

A *default-settings*

Parameter name	Value	Meaning
Input A	0 = normal **A**	Signal A not inverted
	1 = inverted	Signal A inverted
Input B	0 = normal **A**	Signal B not inverted
	1 = inverted	Signal B inverted
Count direction	0 = up **A**	Counter counts up (edge A before B)
	1 = down	Counter counts down (edge B before A)

Table 12-37: Parameters of BL67-1CNT/ENC

Parameter name	Value	Meaning
Signal evaluation (A,B)	00 = 1 x: rising edge at A	Single signal evaluation at rising edge at signal A
	01 = 1 x: falling edge at A	Single signal evaluation at falling edge at signal A
	10 = 2 x: both edges at A **A**	Double signal evaluation at rising and falling edge at signal A
	11 = 4 x: both edges at A and B	Fourfold evaluation at rising and falling edge at signal A and B (only incremental encoders)
Input filter (A,B)	00 = 500 kHz **A**	Setting the input filter for Signal A and B
	01 = 50 kHz	
	10 = 5 kHz	
	11 = reserved	
Input Z	0 = normal **A**	Signal Z not inverted
	1 = inverted	Signal Z inverted
Synchronization with Z	0 = single **A**	If a signal is pending at Z and if, at the same time, the bit SYNC_REQ = 1 (see control interface: byte 1, bit 6), then the counter is synchronized once with the load value.
	1 = periodical	If a signal is pending at Z and if, at the same time, the bit SYNC_REQ = 1 (see control interface: byte 1, bit 6), then the counter is synchronized periodically with the load value.
Encoder signal	0 = Push-pull input **A**	Push-pull input (single ended): Signal evaluation between A, B, Z and GND. The inputs /A, /B and /Z are internally connected to GND.
	1 = RS422-input	RS422-input: Signal evaluation between A, B, Z and /A, /B, /Z
Function DO3	0 = output **A**	The output is used as digital output.
	1 = encoder power supply	The output is used as power supply for the connected encoder.
Function DI3	0 = input **A**	The input is used as digital input.
	1 = encoder-GND	The input is used as encoder-GND.

Table 12-37: Parameters of BL67-1CNT/ENC

Parameter name	Value	Meaning
PullUp Z	0 = off **A**	The PullUp-resistance for input Z is switched off.
	1 = on	The PullUp-resistance for input Z is switched on.
Threshold input A, B, Z	0000 = 1V 0001 = 1.5 V 0010 = 2 V 0011 = 2.5 V 0100 = 3 V 0101 = 4 V 0110 = 5 V 0111 = 6 V 1000 = 7 V 1001 = 8 V 1010 = 9 V 1011 = 10 V **A** 1100 = 12 V 1101 = 14 V 1110 = 16 V 1111 = 18 V	Setting the threshold value for the inputs A, B and Z.
Count mode	0 = encoder **A**	Operation mode for the connection of an incremental encoder.
	1 = pulse and direction	Operation mode for the connection of a counter with pulse- and direction-input.
Measurement mode	0 = frequency measurement **A**	Setting the measurement mode
	1 = period duration measurement	
Gate	0 = normal **A**	Gate not inverted
	1 = inverted	Gate inverted
Gate function	000 = Counter permanently inactive	Selection of the hardware-gate or activation of the software-gate.
	100 = DI3 is HW-gate	
	001 = DI0 is HW-gate	
	010 = DI1 is HW-gate	
	011 = DI2 is HW-gate	
	101 = Z is gate	
	110 = only SW-gate **A**	
	111 = reserved	

Table 12-37: Parameters of BL67-1CNT/ENC

Parameter name	Value	Meaning
REG_AUX_ADR	0 to 127 default: 48	Definition of the register number from the register interface (REG_PARA; REG_COUNTER_VALUE, REG_LOWER_LIMIT etc., see from page 12-84), whose content should be mapped into byte 8 - 11 of the process input data (see page 12-78).

12.5.9 Process data of the module

Process input/ status interface

	Byte	Byte in DP	Bit 7	Bit 6	Bit 5	Bit 4	Bit 3	Bit 2	Bit 1	Bit 0
Status bytes	0	11	X	A	B	Z	DI3	DI2	DI1	DI0
	1	10	ERR_ PARA	SYNC_ AKN	X	X	X	X	X	Count direction
	2	9	REG_ WR_ ACEPT	REG_ WR_ AKN	X	X	X	STS_ ZC	STS_ OFLW	STS_ UFLW
Communication	3	8	REG_ RD_ ABORT	REG_ACT_RD_ADR						
User data	4	7	REG_RD_DATA, Byte 0							
	5	6	REG_RD_DATA, Byte 1							
	6	5	REG_RD_DATA, Byte 2							
	7	4	REG_RD_DATA, Byte 3							
	8	3	AUX_RD_DATA, Byte 0							
	9	2	AUX_RD_DATA, Byte 1							
	10	1	AUX_RD_DATA, Byte 2							
	11	0	AUX_RD_DATA, Byte 3							

X = reserved

Table 12-38: Process input data of the module

Bit	Value	Meaning
DI0 to DI3	0	Digital input DIx = 0
	1	Digital input DIx = 1
A, B, Z	0	Digital input A, B or Z = 0
	1	Digital input A, B or Z = 1
Count direction	0	up
	1	down
SYNC_AKN	0	Encoder not synchronized.
	1	Encoder not synchronized with zero-position.
ERR_PARA	0	The last change in parameters is valid.
	1	Faulty/ inconsistent parameter data.

Table 12-38: Process input data of the module

Bit	Value	Meaning
STS_UFLW	0	No underflow
	1	Counter value below lower limit of counter range
STS_OFLW	0	No overflow
	1	Counter value exceeded upper limit of counter range.
STS_ZC	0	No zero crossing
	1	Counter value crossed zero value
REG_WR_AKN	0	No change in the in the registers → No command for data change in the registers by the process output. A write access (REG_WR) to the register bank is only possible when this bit was previously zero; handshake for data transfer to the registers.
	1	Register contents updated → A change in the register contents has been instructed by one process output.
REG_WR_ACCEPT	0	REG_WR_ADR error → During REG_WR = 1 the register addressed in REG_WR_ADR in the control interface could **not** successfully be written with user data.
	1	REG_WR_ADR valid → During REG_WR = 1 the register addressed in REG_WR_ADR in the control interface could successfully be written with user data.
REG_ACT_RD_ADR	0 to 127	Address of the actually read input register.
REG_RD_ABORT	0	REG_RD_ADR valid → Reading the register defined in REG_RD_ADR accepted and carried out. The register content is shown in the user data area (REG_RD_DATA, byte 0-3).
	1	REG_RD_ADR error → Reading the register defined in REG_RD_ADR **not** accepted. The value in the user data area (REG_RD_DATA, Byte 0-3) is zero.
REG_RD_DATA	0 to 2^{32}-1	Content of the register selected by REG_RD_ADR. If RD_ABORT = 0, if not REG_RD_DATA = 0.
AUX_RD_DATA	0 to 2^{32}-1	Content of the register which has been defined via parameter byte 14 (see Parameters of the counter module).

Process output/ control interface

	Byte	Byte in DP	Bit 7	Bit 6	Bit 5	Bit 4	Bit 3	Bit 2	Bit 1	Bit 0
Control bytes	0	7	DO3	DO2	DO1	DO0	X	X	X	GATE
	1	6	X	SYNC_REQ	X	X	X	X	X	RES_STS
communication	2	5	REG_WR	REG_WR_ADR						
	3	4	REG_RD_ADR							
User data	4	3	REG_WR_DATA, Byte 0							
	5	2	REG_WR_DATA, Byte 1							
	6	1	REG_WR_DATA, Byte 2							
	7	0	REG_WR_DATA, Byte 3							

X = reserviert

Table 12-39: Process output data of the module

Bit	Value	Meaning
GATE	0	Counter inactive
	1	Counter active, depending on parameter Gate function
DO0 to DO3	0	Digital output DOx = 0
	1	Digital output DOx = 1
RES_STS	0	inactive
	1	During the change from 0 to 1 the counter status bits (STS_UFLW and STS_OFLW) are reset.
SYNC_REQ	0	No synchronization
	1	Synchronization request → The bit SYNC_AKN of the status interface is reset.
REG_WR_ADR	0 to 127	Address of the register which has to be written with REG_WR_DATA.
REG_WR	0	Initial state
	1	Write register → Command to overwrite the content of register of the address REG_WR_ADR with REG_WR_DATA.
REG_RD_ADR	0 to 127	Address of the register which has to be read. If RD_ABORT = 0, the user data can be found in REG_RD_DATA in the status interface (bytes 4-7).

Table 12-39: Process output data of the module

Bit	Value	Meaning
REG_WR_DATA	0 to 2^{32}-1	Value, which has to be written to the register defined via REG_WR_ADR.

12.5.10 Internal registers - read and write

This module is provided with a universal register interface that enables access to up to 128 registers.

The write access is done via the process data. For write access, it must be ensured beforehand that the register write interface is in the default status and that a write access operation is therefore not currently active.

This is ensured if REG_WR = 0 in the process output data, and is confirmed in the process input data with REG_WR_AKN = 0.

Write access is then possible. Therefore, following values must be transferred with the process output:

- REG_WR_ADR = Register address,
- REG_WR_DATA = Value to be written (32 bit)
- REG_WR = 1 (write command)

The SSI module acknowledges the processing of the write command via the process input data by signalling REG_WR_AKN = 1.

REG_WR_ACEPT = 1 in the process input data $confi_{rms}$ whether the write operation to the register was successfully completed. If the register could not be written (no access authorization, out of value range,…), this is indicated by REG_WR_ACEPT = 0. The write operation must then be terminated by REG_WR = 0 in order to resume the default state.

The address specified at REG_RD_ADR of the process output data is used for read access. The read register content is entered in REG_RD_DATA (bytes 4-7) if the address at REG_RD_ADR was accepted in the process input data and if REG_RD_ABORT = 0 $confi_{rms}$ that the register was read error-free. REG_RD_ABORT = 1 indicates that the register could not be read. REG_RD_ADR in the process input data then contains the address that could not be accessed successfully. The user data is then set to ZERO.

12.5.11 Schematic diagram of the read sequence

The following diagram shows the general procedure for the read operation:

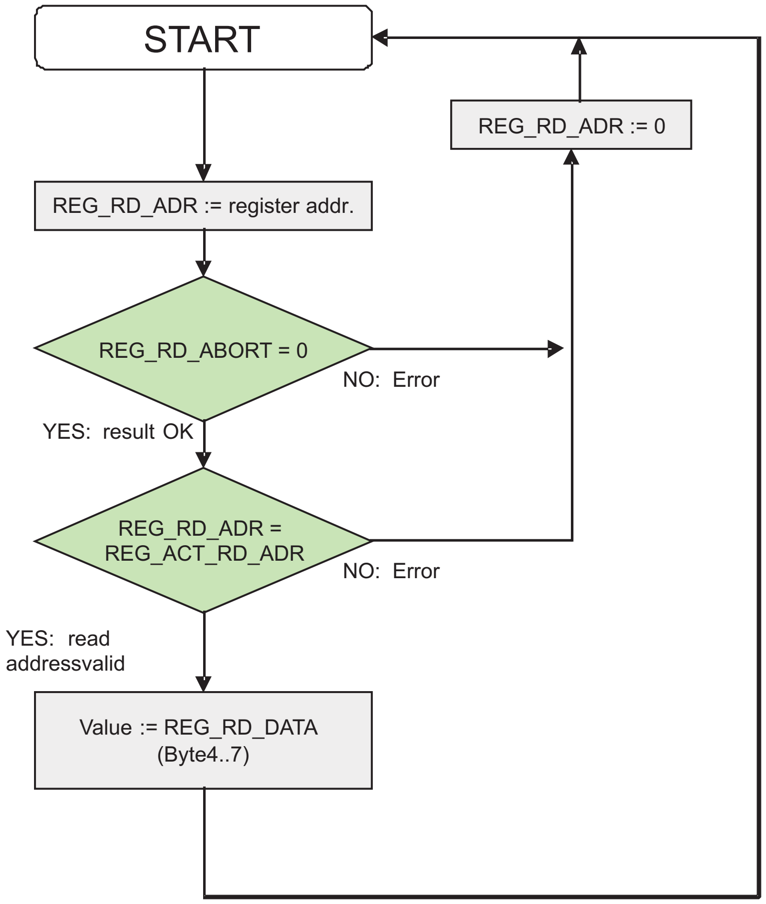


Figure 12-46: Schematic diagram, read operation

12.5.12 Schematic diagram of the write sequence

The following diagram shows the general procedure for the write operation:

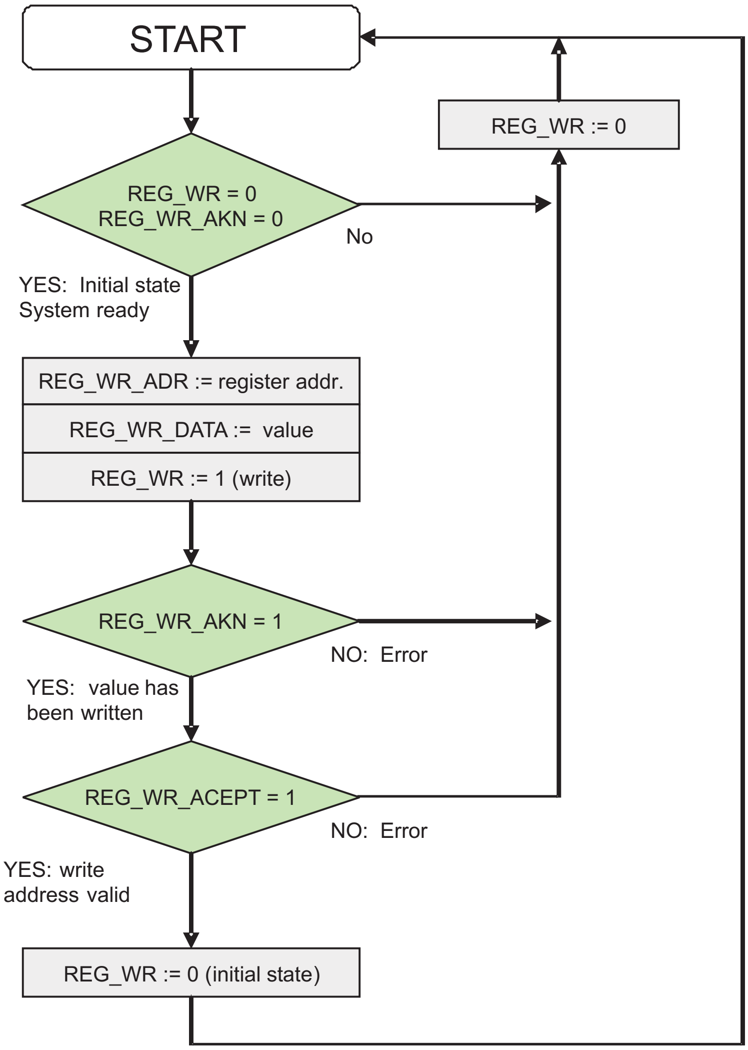


Figure 12-47: Schematic diagram, write operation

12.5.13 Register bank of the module

Register description and register access

Table 12-40: Register description

Designation	No.	Description	Default (HEX)
REG_CNT_POS	0		
REG_MAGIC_NO	1	Magic number (0xaa55cc33)	Internal use
REG_HW_VER	2	Hardware-version	
REG_SW_VER	3	Firmware-version	
REG_SF	4	Special function register	
REG_IF_VER	5	Version of the register-interface	
	…	reserved	
REG_DIAG1	16	Diagnostics data	
	…	reserved	
REG_PARA1	20	Parameter data 1	0×06 0B 00 08
	…	reserved	
REG_PARA4	23	Parameter data 4	0× 00 30 00 00
	…	reserved	
REG_COUNTER_ VALUE	32	Actual counter value	
reserviert	…		
REG_LOWER_LIMIT	36	Lower count limit	0×80 00 00 00
	…	reserved	
REG_UPPER_LIMIT	40	Upper count limit	0×7F FF FF FF
	…	reserved	0×0000 0000
REG_LOAD_VALUE	44	Load value	0
	…	reserved	
REG_MEASURED_ VALUE	48	Measured value of the frequency, period duration or rotation speed measurement.	
	…	reserved	
REG_SCALE_MUL	52	Multiplier for the frequency- or period duration measurement	1
	…	reserved	

Table 12-40: Register description

Designation	No.	Description	Default (HEX)
REG_SCALE_DIV	56	Divisor for the frequency- or period duration measurement	1
	…	reserviert	
REG_MEASURE_TIME	60	Time out for period duration measurement/ gate time for frequency measurement	100

Table 12-41: Access to the registers

Designation	Nr.	Process output	Storage in module	Process input	Parameter	Diagnostics
		Access to the interfaces RD = read WR = write				
REG_CNT_POS	0			RD		
REG_MAGIC_NO	1			RD		
REG_HW_VER	2			RD		
REG_SW_VER	3			RD		
REG_SF	4			RD		
REG_IF_VER	5			RD		
REG_DIAG1	16			RD		RD
REG_PARA1	20	WR	non volatile	RD	WR	
REG_PARA4	23	WR	non volatile	RD	WR	
REG_COUNTER_VALUE	32	WR		RD		
REG_LOWER_LIMIT	36	WR	non volatile	RD		
REG_UPPER_LIMIT	40	WR	non volatile	RD		
REG_LOAD_VALUE	44	WR	non volatile	RD		
REG_MEASURED_VALUE	48			RD		
REG_SCALE_MUL	52	WR	non volatile	RD		
REG_SCALE_DIV	56	WR	non volatile	RD		

Table 12-41: Access to the registers

Designation		Access to the interfaces RD = read WR = write				
	Nr.	Process output	Storage in module	Process input	Paramete r	Diagnosti cs
REG_MEASURE_TIME	60	WR	non volatile	RD		

Note
The non volatile registers can be written maximum 100.000 times.

Special function register/ resetting the der register bank

If the Special Function Register REG_SF is written with

LD20 = 0×4C443230

or

ld20 = 0×6C643230 ,

the default values are written back to all non volatile registers (**including parameter registers**, Reg. 20 to 23).

If the Special Function Register REG_SF is written with

LD48 = 0x4C443230

or

ld48 = 0×6C643438

the default values are written back to all non volatile registers **except for the parameter registers** (Reg. 20 to 23).

Note
Values that have been overwritten get lost.

12.6 *BL ident*® - BL67-2RFID-S/BL670-2RFID-A

The description of the RFID-technology modules can be found in separate manuals.

The complete *BL ident*®-documentation is part of the *BL ident*®-CD:

Ident-no.	Type	Document-no.
1545052	BLIDENT-CD	D101659

13 Mounting and dismounting

13.1 Mechanical mounting

13.1.1 General mounting rules

- BL67 is designed to be mounted on a mounting plate or on mounting rails directly at the machine.
- A vertical as well as a horizontal mounting of the stations is possible.
- The complete BL67 system is secured to the mounting rail by means of two end brackets. One at each end of the station.
- The gateway is the first electronic component on a BL67 station.
- The electronic modules are mounted subsequently in the order required.
- Potential isolation can be achieved by mounting a Power Feeding module (power distribution) before mounting the next module.
- Power Feeding modules can be mounted between the rest of the modules as required.
- An end plate is mounted at the end of each BL67station to protect the module bus contacts and to guarantee the protection class IP 67.

13.2 Building up a BL67 station

Note
The BL67-station should be assembled completely before mounting it on a mounting plate or a mounting rail.

13.2.1 Mounting a gateway

The gateway is the first module of a BL67-station.

The electronic modules are mounted on the right side of the gateway.

13.2.2 Mounting a base module

1. The module bus contacts of the first base module have to be inserted from above into the module bus contacts of the gateway.
2. Tighten the screws of the inserted base module.
3. All other base modules of the station are mounted identically. Their module bus contacts have to fit into the contacts of the respective left-hand base module.

Attention
To guarantee the protection class IP67, the screws at the base modules have to be firmly tightened.
Furthermore the seals at the left module bus contacts of the base modules must not be damaged or slipped due to wrong transport, storage or similar.

13.2.3 Mounting the electronic modules

Please observe:

1 The correct base module must have been previously mounted onto the mounting rail.

2 Electronic modules are fitted onto the previously mounted and wired base modules.

Note

Before plugging the electronic modules, it is advisable to blowclean the station with compressed air. This prevents dust and grains of dirt from contaminating the contacts, which can negatively influence the communication on the station.

Method:

1 Press the electronic module squarely onto the base module and tighten the two screws on the top of the electronic module.

Attention

To guarantee the protection class IP67, the screws at the base modules have to be firmly tightened.

Furthermore the seal at the lower side of the electronic module housing must not be damaged or slipped due to wrong transport, storage or similar.

13.2.4 Prevention of false mounting

A mechanical coding element prevents an electronic module from being mounted onto the wrong base module – for example, following a defect in an electronic module. The coding element consists of two pieces and is supplied with every electronic module.

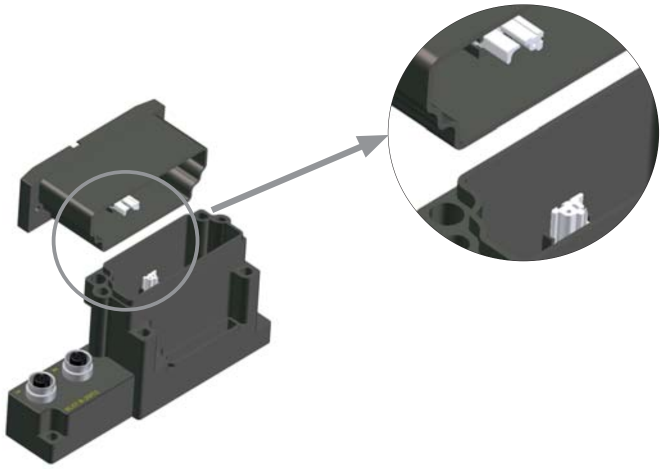
The complete coding element is mounted on the underside of each electronic module. When mounting the electronic module for the first time, the lower part of the coding element is automatically inserted into the recess provided in the base module.

Note

When plugging electronic modules for the first time, an initial resistance must be overcome. This is because the lower part of the coding element has to be pressed into the base module.

Should the electronic module be pulled, one half of the coding element remains in the base module, the other half remains in the electronic module. It is now possible to mount a new electronic module only when its coding matches that of the base module.

Figure 13-1: Coding element



When replacing an electronic module (plugging a new electronic module), remove and dispose of the lower part of the coding element (that part destined for the base module). The original lower part of the coding element, which remains in the base module, cannot be removed.

Note

When all modules are mounted, the supply to the module bus should be applied to check if the station communication functions correctly (no false mounting, no empty slots, etc.). The field voltage should be applied only when the correct functioning of the station has been established.

13.2.5 End plate

The end plate is mounted onto the last base module of a station. It is fixed with two screws and serves to protect the module bus contacts and to guarantee the protection class IP67.

Method:

1 Insert the end plate into the last base module of the station so that the module bus contacts of the base module are covered by the end plate.

2 Tighten both screws of the end plate.

Attention

Without the end plate, the protection class IP67 can not be guaranteed.

Furthermore the seal at the end plate must not be damaged or slipped due to wrong transport, storage or similar.

13.2.6 Mounting of BL67 directly on the mounting plate

The BL67 stations can be mounted directly onto a pre-drilled galvanized mounting plate. The mounting plate has to be connected to protective earth (PE).

- Fasten the station on the mounting plate by screws through the holes in the base modules and in the gateway.

13.2.7 FE connection

The station is connected to functional earth by the FE connection at the upper right drilling of the gateway.

Note

If the mounting plate is not connected to ground, the station has to be grounded via a separate ground terminal at the FE contact of the gateway.

13.2.8 Mounting the BL67-stations on a mounting rail

The mounting rails used for BL67 should be mounted onto a galvanized mounting plate with a minimum thickness of 2 mm / 0.08 inch.

This allows a reference potential for protective earth (PE) and functional earth (FE) to be created.

Please allow for a maximum distance of 150 mm / 5.91 inch between mounting holes, when mounting non pre-drilled mounting rails.

1. Insert a screwdriver into the opening provided in the locking mechanism at the top of the gateway and of the base modules and open the locking mechanism of all modules in the station.
2. Tilt the top of the station towards you, position the lower groove provided on the rear of the gateway and each base module onto the lower edge of the mounting rail.
3. Tilt the top of the base module away from you and towards the mounting rail and close the locking mechanism at the every module.
4. The station is mounted on the mounting rail.

13.2.9 Mounting end brackets

BL67 stations must be fixed securely onto the mounting rail using two end brackets.

Method:

- Clip the end bracket onto the mounting rail. If necessary, loosen the screw beforehand.
- Slide one end bracket up to the gateway and one up to the last module in the station and tighten the screws.

13.3 Dismounting a BL67-station

Note
The complete station should be dismounted from the mounting plate or the mounting rail before disassembling it.

13.3.1 Dismounting from the mounting plate

The BL67 stations are dismounted from the mounting plate by loosening all screws at the station.

13.3.2 Dismounting from the mounting rail

Please observe the following basic rules when dismounting:

Dismounting of a single component:

- The gateway can only be dismounted from a station after all the base modules located on its right are dismounted.
- Individual base modules can only be removed from a station when all base modules located to its right have been dismounted.

Danger
Before dismounting a base module, the supply voltage to the relevant power distribution modules must be switched off. All wires must be disconnected.

Dismounting an entire BL67 station in chronological order:

- Switch off the power to the distribution modules.
- Pull the electronic modules.
- Disconnect wiring.
- Loosen/remove end brackets.
- Dismount base modules.
- Dismount gateway.

13.3.3 Dismounting electronic modules

Method:

- Loosen the screws at the front of the electronic modules and pull the electronic module away from the base module.

13.3.4 Dismounting the end brackets

- Loosen the screws at the end brackets and pull them away from the mounting rail.

13.3.5 Dismounting base modules

Danger
The supply voltage to the relevant power distribution modules must be switched off before dismounting a base module.

Please observe:

- Base modules can only be dismounted from the right.
- If one base module in the middle of the station has to be changed, all other base modules on the right have to be dismounted from the mounting rail as well.

Method:

- Disconnect the wiring from the base module.
- Loosen the two screws at the front of the base modules.
- Insert a screwdriver into the opening provided in the locking mechanism at the top of the base module to be changed and of all base modules on its right.
- Pull the base modules away from the mounting rail.

13.3.6 Dismounting the gateway

Danger
The supply voltage to the gateway must be disconnected before dismounting the gateway. The connection to the field bus must also be disconnected.

Please observe:

- All base modules on the mounting rail must be dismounted.

Method:

- Open the locking hook at the top of the gateway by inserting a screwdriver into the opening of the locking mechanism.
- Pull the gateway away from the mounting rail.

13.3.7 Plugging and pulling electronic modules

BL67 enables the pulling and plugging of electronic modules without having to disconnect the field wiring. The BL67 station remains in operation if an electronic module is pulled. The voltage and current supplies as well as the protective earth connections are not interrupted.

Attention
If the electronic modules are plugged or pulled under load with the field and system supplies remaining connected, arc discharges may be caused.

14 Module labeling

14.1 General notes

All electrical and electronic components for BL67 stations are supplied with labels to guarantee clear identification. In addition, Turck offers marking and labeling materials which enable individual and application specific labeling of each component.

Fundamentally, the differences are as follows:

14.1.1 Colors

Each electronic module can be recognized immediately by the colored lid imprint (top and bottom).

Color identification of BL67 modules

Table 14-1: Color identification of modules

Gateway (GW)	grey
Power Feeding modules 24 VDC (PF)	grey
Digital input modules (DI)	white
Analog input modules (AI)	blue
Digital output modules (DO)	red
Analog output modules (AO)	green
Technology modules (e.g. RS232)	yellow

14.2 Designations/ ident-no.

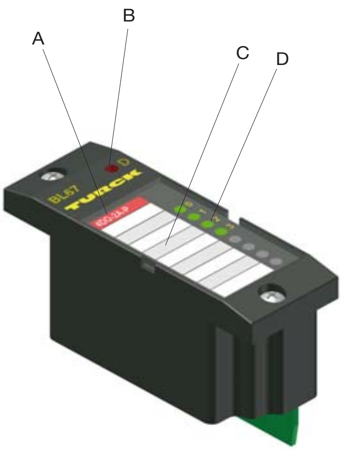
The designation is imprinted on the top of the electronic modules.

Each module is clearly identified by a Indent-number. The Indent-number as well as further module-specific details (pin assignment of the base modules, etc.) can be found on a label attached to the side of the respective module.

Figure 14-1: Module label

Figure 14-2: Designation

A *module designation*
B *diagnosis-LED*
C *label for application specific use*
D *channel-LEDs*



14.3 Channel numbering

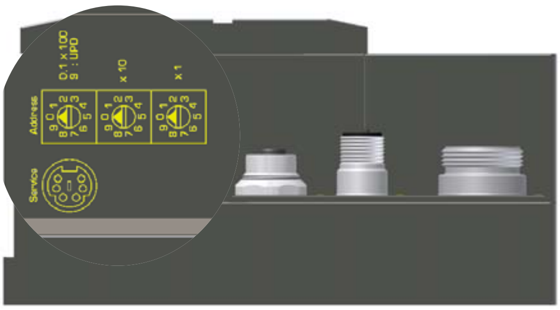
All base module connectors are numbered.

Figure 14-3: Channel numbering

14.4 Labeling of the rotary coding switches

The labeling of the rotary coding switches for setting the field bus addresses can be found on the gateway side next to the protection cover.

Figure 14-4: Gateway labeling



14.5 Labels

Each electronic module is supplied with a label to enable application-specific identification. Labels are available as accessories.

15 Appendix

15.1 Nominal current consumption and power loss of the modules

Note
The nominal current consumption of the modules from the 24 V DC system supply at the gateway or the Power Feeding module are different for each bus system.
Please read the relevant sections in the "Appendix" of the respective gateway manual.

15.1.1 Nominal current consumption from the module bus (5 V DC) I_{MB}

Table 15-1: Current consumption from the module bus

Module	Supply	Current consumption from the module bus
Gateway	1500 mA	
Power supply modules		
BL67-PF-24VDC		≤ 30 mA
Digital input modules		
BL67-4DI-P		≤ 30 mA
BL67-8DI-P		≤ 30 mA
BL67-4DI-PD		≤ 30 mA
BL67-8DI-PD		≤ 30 mA
BL67-4DI-N		≤ 30 mA
BL67-8DI-N		≤ 30 mA
BL67-16DI-P		≤ 30 mA
Analog input modules		
BL67-2AI-I		≤ 35 mA
BL67-1AI-V		≤ 35 mA
BL67-2AI-PT		≤ 45 mA
BL67-2AI-TC		≤ 35 mA
BL67-4AI-V/I		≤ 35 mA
BL67-4AI-TC		≤ 50 mA
Digital output modules		
BL67-4DO-0.5A-P		≤ 30 mA
BL67-4DO-2A-P		≤ 30 mA
BL67-4DO-4A-P		≤ 30 mA
BL67-8DO-0.5A-P		≤ 30 mA

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Table 15-1: Current consumption from the module bus

Module	Supply	Current consumption from the module bus
BL67-16DO-0.1A-P		≤ 30 mA
BL67-4DO-2A-N		≤ 30 mA
BL67-8DO-0.5A-N		≤ 30 mA
Analog output module		
BL67-2AO-I		≤ 40 mA
BL67-2AO-V		≤ 60 mA
BL67-4AO-V		≤ 50 mA
Relay modules		
BL67-8DO-R-NO		≤ 30 mA
Digital combi modules		
BL67-4DI4DO-PD		≤ 30 mA
BL67-8XSG-PD		≤ 30 mA
BL67-8XSG-P		≤ 30 mA
Analog combi modules		
BL67-4AI4AO-V/I		≤ 50 mA
BL67-2AI2AO-V/I		≤ 50 mA
Technology modules		
BL67-1RS232		≤ 140 mA
BL67-1RS485/422		≤ 60 mA
BL67-1SSI		≤ 50 mA
BL67-1CVI		≤ 30 mA
BL67-1CNT/ENC		< 50 mA

15.1.2 Nominal current consumption from supply terminal (field) I_L

Table 16: Current consumption from supply terminal

Module	Supply	Nominal current consumption from supply terminal	
		from V_{sens} **A**	from V_o **B**
Gateway	-	-	-
Power supply modules			
BL67-PF-24VDC	10 A		
Digital input modules			
BL67-4DI-P		≤ 40 mA	
BL67-8DI-P		≤ 40 mA	
BL67-4DI-PD		≤ 100 mA	
BL67-8DI-PD		≤ 100 mA	
BL67-4DI-N		≤ 1 mA	
BL67-8DI-N		≤ 1 mA	
BL67-16DI-P		≤ 3 mA	
Analog input modules			
BL67-2AI-I		≤ 12 mA	
BL67-2AI-V		≤ 12 mA	
BL67-2AI-PT		≤ 45 mA	
BL67-2AI-TC		≤ 30 mA	
BL67-4AI-V/I		≤ 12 mA	
BL67-4AI-TC		≤ 30 mA	
Digital output modules			
BL67-4DO-0.5A-P			< 100 mA **C**
BL67-4DO-2A-P			< 100 mA **C**
BL67-4DO-4A-P			< 100 mA **C**
BL67-8DO-0.5A-P			< 100 mA **C**
BL67-16DO-0.1A-P			< 100 mA **C**
BL67-4DO-2A-N			< 100 mA **C**
BL67-8DO-0.5A-N			< 100 mA **C**
Analog output modules			
BL67-2AO-I			≤ 50 mA
BL67-2AO-V			≤ 50 mA

A *limited by internal short circuit protection (4 A)*

B *sum of current consumptions must not exceed 10 A*

C *at load current = 0*

Table 16: Current consumption from supply terminal

Module	**Supply**	**Nominal current consumption from supply terminal**	
		from V_{sens} **A**	from V_o **B**
BL67-4AO-V			≤ 50 mA
Relay modules			
BL67-8DO-R-NO			-
Digital combi modules			
BL67-4DI4DO-PD		≤ 100 mA (from V_{sens} and V_o)	
BL67-8XSG-PD		≤ 100 mA (from V_{sens} and V_o)	
BL67-8XSG-P		≤ 100 mA (from V_{sens} and V_o)	
Analog camobi module			
BL67-4AI4AO-V/I			≤ 50 mA
BL67-2AI2AO-V/I			≤ 50 mA
Technology modules			
BL67-1RS232		≤ 50 mA	
BL67-1RS485/422		≤ 25 mA	
BL67-1SSI		≤ 25 mA	
BL67-1CVI		< 100 mA **C**	
BL67-1CNT/ENC		< 100 mA **C**	

15.1.3 Maximum Power Loss of the Modules

Table 15-1: Power loss

Module	max. power loss, typical (P_{max})
Gateway	-
Power supply modules	
BL67-PF-24VDC	-
Digital input modules	
BL67-4DI-P	< 250 mW
BL67-8DI-P	< 250 mW
BL67-4DI-PD	< 1.5 W
BL67-8DI-PD	< 1.5 W
BL67-4DI-N	< 1.3 W
BL67-8DI-N	< 1.3 W
BL67-16DI-P	< 100 mW
Analog input modules	
BL67-2AI-I	< 1 W
BL67-2AI-V	< 1 W
BL67-2AI-PT	< 1 W
BL67-2AI-TC	< 1 W
BL67-4AI-V/I	< 1 W
BL67-4AI-TC	< 1 W
Digital output modules	
BL67-4DO-0.5A-P	< 1.5 W
BL67-4DO-2A-P	< 1.5 W
BL67-4DO-4A-P	< 1,5 W
BL67-8DO-0.5A-P	< 1.5 W
BL67-16DO-0.1A-P	< 1.5 W
BL67-4DO-2A-N	< 1.5 W
BL67-8DO-0.5A-N	< 1.5 W
Analog output modules	
BL67-2AO-I	< 1 W
BL67-2AO-V	< 1 W
BL67-4AO-V	< 1 W

Table 15-1: Power loss

Module	max. power loss, typical (P_{max})
Relay modules	
BL67-8DO-R-NO	< 2 W
Digital combi modules	
BL67-4DI4DO-PD	< 1.5 W
BL67-8XSG-PD	< 1.5 W
BL67-8XSG-P	< 1,5 W
Analog combi modules	
BL67-4AI4AO-V/I	< 1 W
BL67-2AI2AO-V/I	< 1 W
Technology modules	
BL67-1RS232	< 1 W
BL67-1RS485/422	< 1 W
BL67-1SSI	< 1 W
BL67-1CVI	< 1.5 W
BL67-1CNT/ENC	< 1,5 W

15.2 Analog Value Representation (Analog Input Modules)

The analog values can either be represented with16 bit or 12 bit. The two's-complement representation allows the representation of positive as well as negative values.

16 bit representation

The 16 bit representation is realized as a two's-complement. 2 byte of process data are completely occupied:

Figure 15-1: 16 bit representation

analog value	16 bit representation															
byte	byte 1								byte 0							
bit	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
meaning	+ -	measurement value														

12 bit representation

In the voltage measurement/ output and in the temperature measurement, the value is represented as a two's-complement. In the current measurement/ output and in the resistance measurement, the value is represented as a dual number. The 12 bit value is left-justified and occupies bit 15 to 4 of the process data:

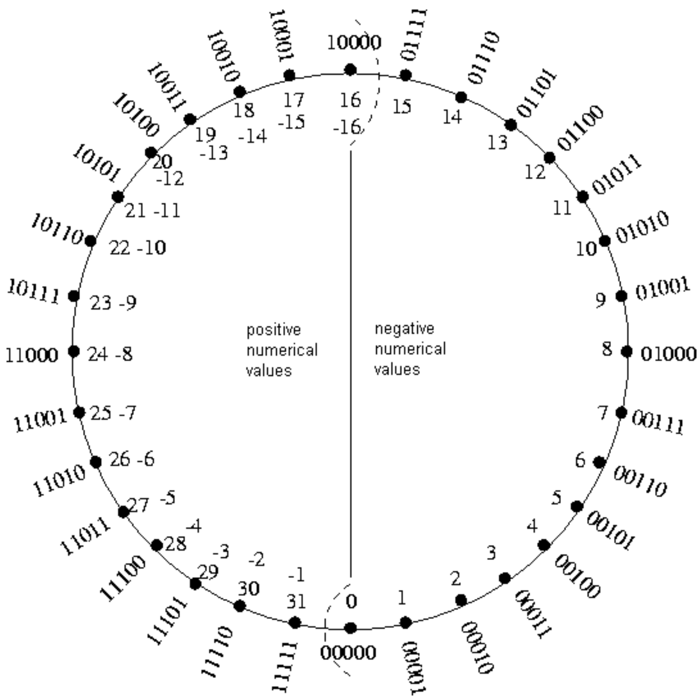
Figure 15-2: 12 bit representation

analog value	12 bit representation															
byte	byte 1								byte 0							
bit	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
meaning	measurement value (without sign)												diagnostic data			

The diagnosis information is integrated in the process input data and occupies 4 bit (right-justified).

The figure shows a 5-digit binary code in the outer circuit. The inner circuit shows the respective dual number, if the binary code is interpreted as binary number (positive numerical values) and as two's complement.

Figure 15-3: Binary code as binary number and two's complement



15.2.1 Equations for 16 bit representation

Current values from 0 to 20 mA

Before using the equation below, the hexadecimal or binary value has to be converted into a decimal value.

The value range

0 mA to 20 mA

is displayed as follows:

0000_{hex} to $7FFF_{hex}$ (decimal: 0 to 32767)

The hexadecimal/binary value can easily be converted into a decimal value, because all numbers belong to the positive range of the two's complement (→ page 15-9).

The current value can now be calculated by means of the following equation:

$$current\ value = \frac{decimalvalue}{1638,35}\ mA = 6,1 \times 10^4 \times decimal\ value$$

Current values from 4 to 20 mA

Before using the equation below, the hexadecimal or binary value has to be converted into a decimal value.

The value range

4 mA to 20 mA

is displayed as follows:

0000_{hex} to $7FFF_{hex}$ (decimal: 0 to 32767)

The hexadecimal/binary value can easily be converted into a decimal value, because all numbers belong to the positive range of the two’s complement (→ page 13-4).

The current value can now be calculated by means of the following equation:

$current\ value = 4{,}88 \times 10^{-4} \times decimal\ value + 4\ mA$

Temperature- and resistance values (BL67-2AI-PT)

Before using the equation below, the hexadecimal or binary value has to be converted into a decimal value.

The hexadecimal/binary values for the negative value range cannot easily be converted into decimal values, because the values are coded as two’s complement (→ page 15-9).

All numerical values from 0000_{hex} to $7FFF_{hex}$ represent **positive** values when coded as two’s complement. Values in this range can easily be converted into decimal values. This is also relevant for binary numbers in which the most significant bit (bit 16) is “0“.

All numerical values from 8000_{hex} to $FFFF_{hex}$ represent **negative** values when coded as two’s complement. This is also relevant for binary numbers in which the most significant bit (bit 16) is “1“.

The conversion into a decimal number is shown in the following.

Example of the conversion of negative numerical values:

The following parameterization is used in the example:

"PT100, -200…150°C"

The temperature is thus calculated with the factor 0.01 (see below).

The example explains the general procedure to convert a hexadecimal or binary number coded as two’s complement to a decimal number.

The hexadecimal value should be „**B344**“.

1 The binary value is:

B344 ↔ **1011.0011.0100.0100**

2 Invert the binary number:

1011.0011.0100.0100 → **0100.1100.1011.1011**

3 Add a “1“to the inverted binary number:

0100.1100.1011.1011
0000.0000.0000.0001
0100.1100.1011.1100

4 Convert the binary number into a decimal number:

0100110010111100 ↔ **19644**

5 The temperature value is calculated as follows:

temperature value = *0,01 °C* × *decimal value* = *0,01 °C* × *(-19644)* = *-19,44 °C*

The temperature values can now be calculated according to the parameterization.

- For the parameterization
  "PT100, -200…850°C"
  "NI100, -60…250°C"
  "PT200, -200…850°C"
  "PT500, -200…850°C"
  "PT1000, -200…850°C"
  "NI1000, -60…250°C"

  use the equation:

  temperature value = **0.1 °C** × *decimal value*

The value range

-200 °C to -0.1°C

is displayed as follows:

F830$_{hex}$ **to FFFF**$_{hex}$ (decimal: -2000 to -1)

The value range

0 °C to 850°C

is displayed as follows:

0000$_{hex}$ **to 2134**$_{hex}$ (decimal: 0 to 8500)

- For the parameterization
  "PT100, -200…150°C"
  "NI100, -60…150°C"
  "PT200, -200…150°C"
  "PT500, -200…150°C"
  "PT1000, -200…150°C"
  "NI1000, -60…150°C"

  use the equation:

  temperature value = **0,01 °C** × *decimal value*

The value range

-200 °C to -0,01°C

is displayed as follows:

B1E0$_{hex}$ **to FFFF**$_{hex}$ (decimal: -20000 to -1)

The value range

0 °C to 150°C

is displayed as follows:

0000$_{hex}$ **to 3A98**$_{hex}$ (decimal: 0 to 15000)

For representation of resistance values only positive numbers (hexadecimal/binary) are used. The positive values can easily be converted into decimal ones.

The value range

0 to 100 Ω;

0 to 200 Ω;

0 to 200 Ω;

0 to 1000 Ω

is displayed as follows:

0000$_{hex}$ **to 7FFF**$_{hex}$ (decimal: 0 to 32767)

The resistance values can now be calculated according to the parameterization.

The following equations are valid:

- "resistance, 0…100 Ohm":
  resistance value = 0,00305 Ω × *decimal value*
- "resistance, 0…200 Ohm":
  resistance value = 0,00613 Ω × *decimal value*
- „resistance, 0…400 Ohm":
  resistance value = 0,01221 Ω × *decimal value*
- „resistance, 0…1000 Ohm":
  resistance value = 0,03052 Ω × *decimal value*

Temperature- and voltage values (BL67-2AI-TC)

Before using the equation below, the hexadecimal or binary value has to be converted into a decimal value.

The hexadecimal/binary values for the negative value range cannot easily be converted into decimal values, because the values are coded as two's complement (→ page 13-4).

All numerical values from 0000_{hex} to $7FFF_{hex}$ represent **positive** values when coded as two's complement. Values in this range can easily be converted into decimal values. This is also relevant for binary numbers in which the most significant bit (no. 16) is "0".

All values from 8000_{hex} to $FFFF_{hex}$ represent **negative** values when coded as two's complement. This is also relevant for binary numbers in which the most significant bit (no. 16) is "1".

Please see → Example of the conversion of negative numerical values:, page 15-11.

The temperature and voltage values can now be calculated according to the parameterization.

- For the parameterization
  "Typ K, -270…1370°C"
  "Typ B, +100…1820°C"
  "Typ E, -270…1000°C"
  "Typ J, -210…1200°C"
  "Typ N, -270…1300°C"
  "Typ R, -50…1760°C"
  "Typ S, -50…1540°C"
  "Typ T, -270…400°C"

  use the equation.

  $$\textit{temperature value} = \mathbf{0{,}01\ ^\circ C} \times \textit{decimal value}$$

The value range
-270 °C to -0.1°C
is displayed as follows:
$F574_{hex}$ to $FFFF_{hex}$ (decimal: -2700 to -1)

The value range
0 °C to 1820°C
is displayed as follows:
0000_{hex} to 4718_{hex} (decimal: 0 to 18200)

The value range
-50 mV to -0,002 mV;
-100 mV to -0,003 mV;
-500 mV to -0,015 mV;
-1000 mV to -0,031 mV

is displayed as follows:
8000_{hex} to $FFFF_{hex}$ (decimal: -32768 to -1)

The value range
0 mV to 50 mV;
0 mV to 100 mV;
0 mV to 500 mV;
0 mV to 1000 mV;

is displayed as follows:
0000$_{hex}$ **to7FFF**$_{hex}$ (decimal: 0 to 32767)

- For the parameterization "+/-50mV":
  voltage value = 0,001526 mV × decimal value
- For the parameterization "+/-100mV":
  voltage value = 0,003052 mV × decimal value
- For the parameterization "+/-500mV":
  voltage value = 0,015259 mV × decimal value
- For the parameterization "+/-1000mV":
  voltage value = 0,030519 mV × decimal value

Voltage values from 0 to 10 V DC

Before using the equation below, the hexadecimal or binary value has to be converted into a decimal value. The hexadecimal/binary value can easily be converted into a decimal value, because all numbers belong to the positive range of the two's complement
(→ page 13-4).

The value range

0 V DC to 10 V DC

is displayed as follows:

0000$_{hex}$ **to 7FFF**$_{hex}$ (decimal: 0 to 32767)

The voltage values can now be calculated by means of the following equation:

voltage value = $3{,}05185\ mV \times 10^{-4} \times$ *decimal value*

Voltage values from -10 to 10 V DC

Before using the equation below, the hexadecimal or binary value has to be converted into a decimal value.

The hexadecimal/binary values for the negative value range cannot easily be converted into decimal values, because the values are coded as two's complement (→ page 13-4).

All numerical values from 0000$_{hex}$ to 7FFF$_{hex}$ represent **positive** values when coded as two's complement. Values in this range can easily be converted into **decimal** values. This is also relevant for binary numbers in which the most significant bit (no. 16) is "0".

All numerical values from 8000$_{hex}$ to FFFF$_{hex}$ represent **negative** values when coded as two's complement. This is also relevant for binary numbers in which the most significant bit (no. 16) is "1".

Please see → Example of the conversion of negative numerical values:, page 15-11.

The value range

-10 V to -3.052 10^{-4} V

is displayed as follows:

8000$_{hex}$ **to FFFF**$_{hex}$ (decimal:-32768 to -1)

The value range

0 V to 10 V

is displayed as follows:

0000$_{hex}$ **to 7FFF**$_{hex}$ (decimal: 0 to 32767)

$$\text{voltage value} = 3{,}05185\ mV \times 10^{-4} \times \text{decimal value}$$

15.2.2 Equations for 12 bit representation

Attention

The 12 bit representation is „left-justified“. The value is transmitted with 16 bit. The last 4 digits of the binary number or respectively the last digit position of the hexadecimal value are used as diagnostic bits!

Note

Before using the following equations, the hexadecimal or binary value always has to be converted into a decimal value.
The value is contained in the 3 more significant digit positions of the hexadecimal number or in the 12 more significant bits of the binary number.

Note

In the 12 Bit representation only the 3 more significant digit positions of the hexadecimal number or the 12 more significant bits of the binary number are used for the calculation of the decimal value.

Current values from 0 to 20 mA

The value range

0 mA to 20 mA

is displayed as follows:

000$_{hex}$ **to FFF**$_{hex}$ (decimal: 0 to 4095)

The current values can now be calculated by means of the following equation:

$$\text{current value} = 4{,}88\ mA \times 10^{-3} \times \text{decimal value}$$

Current values from 4 to 20 mA

The value range

4 mA to 20 mA

is displayed as follows:

000$_{hex}$ **to FFF**$_{hex}$ (decimal: 0 to 4095)

The current values can now be calculated by means of the following equation:

$current\ value = 3{,}91\ mA \times 10^{-3} \times decimal\ value$

Temperature and resistance values (BL67-2AI-PT)

The hexadecimal/binary values for the negative value range cannot easily be converted into decimal values, because the values are coded as two's complement (→ page 13-4).

All numerical values from 000$_{hex}$ to 7FF$_{hex}$ represent **positive** values when coded as two's complement. Values in this range can easily be converted into **decimal** values. This is also relevant for binary numbers in which the most significant bit (no. 16) is "0".

All numerical values from 800$_{hex}$ to FFF$_{hex}$ represent **negative** values when coded as two's complement. This is also relevant for binary numbers in which the most significant bit (no. 16) is "1".

Please see → Example of the conversion of negative numerical values:, page 15-11.

The temperature values can now be calculated depending on the parameterization.

- For the parameterization:
  "PT100, -200…850°C"
  "NI100, -60…250°C"
  "PT200, -200…850°C"
  "PT500, -200…850°C"
  "PT1000, -200…850°C"
  "NI1000, -60…250°C

  use the following equation:

  $temperature\ value = 0{,}5\ °C \times decimal\ value$

The value range

-200 °C to -0.5°C

is displayed as follows:

E70$_{hex}$ **to FFF**$_{hex}$ (decimal: -400 to -1)

The value range

0 °C to 850°C

is displayed as follows:

000$_{hex}$ **to 6A4**$_{hex}$ (decimal: 0 to 1700)

- For the parameterization:
  "PT100, -200…150°C"
  "NI100, -60…150°C"
  "PT200, -200…150°C"
  "PT500, -200…150°C"
  "PT1000, -200…150°C"
  "NI1000, -60…150°C"

  use the following equation:

  temperature value = 0,1 °C × decimal value

The value range

-200 °C to -0.1°C

is displayed as follows:

830$_{hex}$ **to FFF**$_{hex}$ (decimal: -2000 to -1)

The value range

0 °C to 150°C

is displayed as follows:

000$_{hex}$ **to 5DC**$_{hex}$ (decimal: 0 to 1500)

Note

In the 12 Bit representation only the 3 more significant digit positions of the hexadecimal number or the 12 more significant bits of the binary number are used for the calculation of the decimal value.

The temperature values can now be calculated depending on the parameterization.

The value range

0 Ω to 100 Ω;
0 Ω to 200 Ω;
0 Ω to 400 Ω;
0 Ω to 1000 ΩW;

is displayed as follows:

000$_{hex}$ **to FFF**$_{hex}$ (decimal: 0 to 4095)

The following equations are valid:

- "resistance, 0…100 Ohm":
  resistance value = 0,02442 Ω × decimal value
- "resistance, 0…200 Ohm":
  resistance value = 0,04884 Ω × decimal value
- "resistance, 0…200 Ohm":
  resistance value = 0,09768 Ω × decimal value
- "resistance, 0…1000 Ohm":
  resistance value = 0,2442 Ω × decimal value

Temperature- and voltage values (BL67-2AI-TC)

All numerical values from 000_{hex} to $7FF_{hex}$ represent **positive** values when coded as two's complement. Values in this range can easily be converted into **decimal** values. This is also relevant for binary numbers in which the most significant bit (no. 16) is "0".

All numerical values from 800_{hex} to FFF_{hex} represent **negative** values when coded as two's complement. This is also relevant for binary numbers in which the most significant bit (no. 16) is "1".

Please see → Example of the conversion of negative numerical values:, page 15-11.

Note

In the 12 Bit representation only the 3 more significant digit positions of the hexadecimal number or the 12 more significant bits of the binary number are used for the calculation of the decimal value.

The temperature values can now be calculated depending on the parameterization.

- For the parameterization
  "Typ K, -270…1370°C"
  "Typ B, +100…1820°C"
  "Typ E, -270…1000°C"
  "Typ J, -210…1200°C"
  "Typ N, -270…1300°C"
  "Typ R, -50…1760°C"
  "Typ S, -50…1540°C"
  "Typ T, -270…400°C"

  use the following equation:

  temperature value = 1 °C × decimal value

The value range

-270 °C to 1820°C

is displayed as follows:

$EF2_{hex}$ to $71C_{hex}$ (decimal: -270 to 1820)

- For the parameterization "+/-50mV":
  voltage value = 0,02443 mV × decimal value
- For the parameterization "+/-100mV":
  voltage value = 0,04885 mV × decimal value
- For the parameterization "+/-500mV":
  voltage value = 0,24430 mV × decimal value
- For the parameterization "+/-1000mV":
  voltage value = 0,48852 mV × decimal value

The value range

-50 mV to -0,024mV;

-100 mV to -0,049mV;

-500 mV to -0,244mV;

-1000 mV to -0,489mV;

is displayed as follows:

800$_{hex}$ **to FFF**$_{hex}$ (decimal: -2048 to -1)

The value range

0 mV to 50 mV;

0 mV to 100 mV;

0 mV to 500 mV;

0 mV to 1000 mV;

is displayed as follows:

000$_{hex}$ **to 7FF**$_{hex}$ (decimal: 0 to 2047)

Voltage values from 0 to 10 V DC

Note

In the 12 Bit representation only the 3 more significant digit positions of the hexadecimal number or the 12 more significant bits of the binary number are used for the calculation of the decimal value.

The voltage values can now be calculated by means of the following equation:

$$voltage\ value = 0{,}002442 \times decimal\ value$$

The value range

0 V to 10 V

is displayed as follows:

000$_{hex}$ **to FFF**$_{hex}$ (decimal: 0 to 4095)

Voltage values from -10 to 10 V DC

All numerical values from 000$_{hex}$ to 7FF$_{hex}$ represent **positive** values when coded as two’s complement. Values in this range can easily be converted into **decimal** values. This is also relevant for binary numbers in which the most significant bit (no. 16) is “0“.

All numerical values from 800$_{hex}$ to FFF$_{hex}$ represent **negative** values when coded as two’s complement. This is also relevant for binary numbers in which the most significant bit (no. 16) is “1“.

Note

In the 12 Bit representation only the 3 more significant digit positions of the hexadecimal number or the 12 more significant bits of the binary number are used for the calculation of the decimal value.

For **positive** voltage values (0 to 10 V DC) use:

voltage value = 0,004885 × decimal value

The value range

0 V to 10 V

is displayed as follows:

000$_{hex}$ **to 7FF**$_{hex}$ (decimal: 0 to 2047)

For **negative** voltage values (-10 to 10 V DC) use:

voltage value = 0,004883 × decimal value

The value range

-10 V to -0,0049 V

is displayed as follows:

800$_{hex}$ **to FFF**$_{hex}$ (decimal: -2048 to -1)

15.3 Analog Value Representation (Analog Output Modules)

In the bipolar mode the digitalized analog values are represented as a two's complement. The 16 bit or the 12 bit representation (left justified) can be chosen by setting the respective module parameter.

15.3.1 Equations for 16 bit representation

Current values from 0 to 20 mA

The decimal values can be converted into current values from 0 mA to 20 mA by means of the following equation:

$$\textit{decimal value} = 1638{,}35 \, \frac{1}{mA} \times \textit{current value}$$

The value range

0 mA to 20 mA

is displayed as follows:

0000_{hex} to $7FFF_{hex}$ (decimal: 0 to 32767)

The decimal values can easily be converted into a hexadecimal value, because all possible values belong to the positive value range of the two's complement (→ page 15-9).

Current values from 4 to 20 mA

The decimal values can be converted into current values from 4 mA to 20 mA by means of the following equation:

$$\textit{decimal value} = 2047{,}9375 \, \frac{1}{mA} \times \textit{current value} - 8191{,}75$$

The value range

4 mA to 20 mA

is displayed as follows:

0000_{hex} to $7FFF_{hex}$ (decimal: 0 to 32767)

The decimal values can easily be converted into a hexadecimal value, because all possible values belong to the positive value range of the two's complement (→ page 15-9).

Voltage values from 0 to 10 V DC

The decimal values can be converted into voltage values from 0 to 10 V DC by means of the following equation:

$$\textit{decimal value} = 3276{,}7 \, \frac{1}{V} \times \textit{voltage value}$$

The value range

0 V to 10 V

is displayed as follows:

0000_{hex} to $7FFF_{hex}$ (decimal: 0 to 32767)

The decimal values can easily be converted into a hexadecimal value, because all possible values belong to the positive value range of the two's complement (→ page 15-9).

Voltage values from -10 to 10 V DC

The decimal values can be converted into voltage values from -10 to 10 V DC by means of the following equation:

For **positive** voltage values (0 to 10 V DC) use:

$$decimal\ value = 3276{,}7\ \frac{1}{V} \times voltage\ value$$

The value range

0 V to 10 V

is displayed as follows:

0000_{hex} to $7FFF_{hex}$ (decimal: 0 to 32767)

For **negative** voltage values (-10 to 0 V DC) use:

$$decimal\ value = 3276{,}8\ \frac{1}{V} \times voltage\ value$$

The value range

-10 V to -3.052 10^{-4} V

is displayed as follows:

8000_{hex} to $FFFF_{hex}$ (decimal:-32768 to -1)

Conversion of the decimal values into hexadecimal/ binary values

The decimal value can easily be converted into hexadecimal or binary values. The two's complement (→ page 15-9) for the 16 bit values corresponds to the dual numbers in the positive range.

The conversion of negative decimal values into hexadecimal values is more complicated, because the values have to be coded as a two's complement.

The following example explains the method of conversion:

The 4-digit hexadecimal number for the voltage value **-6V** is searched:

$$decimal\ value = 3276{,}8\ \frac{1}{V} \times (-6\ V) = -19660{,}8$$

Some calculators can be used to convert negative decimal values directly in a hexadecimal value coded as two's complement.

Without such a calculator, convert the value as follows:

1 Convert the amount of the negative decimal value to a binary number:

$|-19600, 8| = 19660{,}8 \Leftrightarrow$ 100.1100.1100.1100

2 Fill the 16 bit of the binary number with "0":

100.1100.1100.1100 ⇔ 0100.1100.1100.1100

3 Invert the 16-digit binary number:

0100.1100.1100.1100 ⇒ 1011.0011.0011.0011

4 Add “1“ to this inverted number:

1011.0011.0011.0011
0000.0000.0000.0001
1011.0011.0011.0100

5 The number is now coded as a two’s complement and can be converted into a hexadecimal number.

1011.0011.0011.0100 ⇒ B334

6 The result is:

-6 V ⇒ 19660,8 ⇒ B334

15.3.2 Equations for 12 bit representation

Attention
The 12 bit representation is „left-justified“. The value is transmitted with 16 bit. The last 4 digits of the binary number or the last digit position of the hexadecimal value are always “0“.

Current values from 0 to 20 mA

The decimal values can be converted into current values from 0 to 20 mA by means of the following equation:

$$\textit{decimal value} = 204{,}75\,\frac{1}{mA} \times \textit{current value}$$

The value range

0 mA to 20 mA

is displayed as follows:

000_{hex} to FFF_{hex} (decimal: 0 to 4095)

Note
As the numbers are represented left-justified, a “0“ has to be added to the 3-digit hexadecimal value or the number has to move one digit to the left.

$XXX_{hex} \Rightarrow XXX0_{hex}$

The 12-digit binary number has to be filled with 4 digits of “0“ or has to move 4 digits to the left:

XXXX.XXXX.XXXX ⇒ XXXX.XXXX.XXXX.0000

Current values from 4 to 20 mA

The decimal values can be converted into current values from 4 to 20 mA by means of the following equation:

$$decimal\ value = 255{,}9375\ \frac{1}{mA} \times current\ value - 1023{,}75$$

The value range

4 mA to 20 mA

is displayed as follows:

000$_{hex}$ **to FFF**$_{hex}$ (decimal: 0 to 4095)

Voltage values from 0 to 10 V DC

The decimal values can be converted into voltage values from 0 to 10 V DC by means of the following equation:

$$decimal\ value = 255{,}9375\ \frac{1}{mA} \times current\ value - 1023{,}75$$

The value range

0 V to 10 V

is displayed as follows:

000$_{hex}$ **to FFF**$_{hex}$ (decimal: 0 to 4095)

Voltage values from -10 to 10 V DC

The decimal values can be converted into voltage values from -10 to 10 V DC by means of the following equation:

For **positive** voltage values (0 to 10 V DC) use:

$$decimal\ value = 409{,}5\ \frac{1}{V} \times voltage\ value$$

The value range

0 V to 10 V

is displayed as follows:

000$_{hex}$ **to 7FF**$_{hex}$ (decimal: 0 to 2047)

For **negative** voltage values (-10 to 0 V DC) use:

$$decimal\ value = 204{,}8\ \frac{1}{V} \times voltage\ value$$

The value range

-10 V to -0,0049 V

is displayed as follows:

800$_{hex}$ **to FFF**$_{hex}$ (decimal: -2048 to -1)

Positive decimal values can easily be converted into hexadecimal values. The two's complement (→ page 15-9) corresponds to the 12 bit values in the positive range of the binary numbers.

Note
As the numbers are represented left-justified, a "0" has to be added to the 3-digit hexadecimal value or the number has to move one digit to the left (→ page 15-23).

Conversion of the negative decimal values into hexadecimal/ binary value

The conversion of negative decimal values into hexadecimal values is more complicated, because the values have to be coded as a two's complement.

The following example explains the method of conversion:

The 4-digit hexadecimal number for the voltage value **-6V** is searched:

$$\textit{decimal value} = 204{,}8\ \frac{1}{V} \times (-6V) = -1228{,}8$$

Some calculators can be used to convert negative decimal values directly in a hexadecimal value coded as two's complement.

Without such a calculator, convert the value as follows:

1 Convert the amount of the negative decimal value to a binary number:
|1228, 8| = 1228,8 → 100.1100.1100

Fill the 12 bit of the binary number with "0":

100.1100.1100 ⇒ 0100.1100.1100

2 Invert the 12-digit binary number:

0100.1100.1100 ⇒ 1011.0011.0011

3 Add "1" to this inverted number:

1011.0011.0011
0000.0000.0001
1011.0011.0100

4 The number is now coded as a two's complement and can be converted into a hexadecimal number.

1011.0011.0100 ⇒ B34

5 As the number is represented as 16 bit left-justified, the hexadecimal value has to be completed with a "0" and the binary value with 4 "0".

B34 ⇒ B340
(1011.0011.0100 ⇒ 1011.0011.0100.0000)

6 The result is:

- 6 V ⇒ -1228.8 ⇒ B340

15.4 Ident codes of the BL67-modules

Each module modul is identified by the gateway with the help of a module-specific ident code.

Table 15-2: Module ident codes

Module	Ident code
Digital input modules	
BL67-4DI-P	0×410030××
BL67-8DI-P	0×610040××
BL67-4DI-PD	0×015630××
BL67-8DI-PD	0×015640××
BL67-4DI-N	0×420030××
BL67-8DI-N	0×620040××
Analog input modules	
BL67-2AI-I	0×225570××
BL67-2AI-V	0×235570××
BL67-2AI-PT	0×215770××
BL67-2AI-TC	0×215570××
BL67-4AI-V/I	0×417790××
BL67-4AI-TC	0×427790××
Digital output modules	
BL67-4DO-0.5A-P	0×413003××
BL67-4DO-2A-P	0×433003××
BL67-4DO-4A-P	0×453003××
BL67-8DO-0.5A-P	0×614004××
BL67-16DO-0.1A-P	0×805505××
BL67-4DO-2A-N	0×443003××
BL67-8DO-0.5A-N	0×624004××
Analog output modules	
BL67-2AO-I	0×220807××
BL67-2AO-V	0×210807××
BL67-4AO-V	0×427A09××
Relay modules	
BL67-8DO-R-NO	0×62004××

Table 15-2: Module ident codes

Module	Ident code
Digital combi modules	
BL67-4DI4DO-PD	0×015633××
BL67-8XSG-PD	0×015744××
BL67-8XSG-P	0×025744××
Analog combi modules	
BL67-4AI4AO-VI/	0×419B99××
BL67-2AI2AO-V/I	0×217977××
Technology modules	
BL67-1RS232	0×014799××
BL67-1RS485/422	0×024799××
BL67-1SSI	0×044799××
BL67-1CVI	0×018B99×× (0×242224××) **A**
BL67-1CNT/ENC	0×019BA9××
Power supply modules	
BL67-PF-24VDC	0×063000××

A *Default ID of the module → Only transmitted in case of non-connected field voltage during module start.*

16 Glossary

A

Acknowledge

Acknowledgment of a signal received.

Active metal component

Conductor or conducting component that is electrically live during operation.

Address

Identification number of, e.g. a memory position, a system or a module within a network.

Addressing

Allocation or setting of an address, e. g. for a module in a network.

Analog

Infinitely variable value, e. g. voltage. The value of an analog signal can take on any value, within certain limits.

Attribute

Attributes represent the data that a device makes available via the DeviceNet fieldbus (e. g. status of an object, serial number of the device, process data).

Automation device

A device connected to a technical process with inputs and outputs for control. Programmable logic controllers (PLC) are a special group of automation devices.

B

Baud

Baud is a measure for the transmission speed of data. 1 Baud corresponds to the transmission of one bit per second (Bit/s).

Baud rate

Unit of measurement for data transmission speeds in Bit/s.

Bidirectional

Working in both directions.

Bit Strobe

A Bit Strobe I/O connection is a connection between a DeviceNet client and an undetermined number of servers, these being queried by commands sent by the client.

Bonding strap

Flexible conductor, normally braided, that joins inactive components, e. g. the door of a switch gear cabinet to the cabinet main body.

Bus

Bus system for data exchange, e. g. between CPU, memory and I/O levels. A bus can consist of several parallel cables for data transmission, addressing, control and power supply.

Bus cycle time

Time required for a master to serve all slaves or stations in a bus system, i. e. reading inputs and writing outputs.

Bus line

Smallest unit connected to a bus, consisting of a PLC, a coupling element for modules on the bus and a module.

Bus system

All units which communicate with one another via a bus.

C

Capacitive coupling

Electrical capacitive couplings occur between cables with different potentials. Typical sources of interference are, e. g. parallel-routed signal cables, contactors and electrostatic discharges.

Coding elements

Two-piece element for the unambiguous assignment of electronic and base modules.

Configuration

Systematic arrangement of the I/O modules of a station.

Control interface

The control interface is the interface from the BL67's internal module bus to the counter module. The commands and signals directed to the counter module are converted by the BL67 gateway from the respective type of communication applicable to the fieldbus in to the module-specific bits and bytes.

COS

Change of State Connections are event controlled connections. This means the DeviceNet devices generate messages as soon as a change of state takes place.

CPU

Central Processing Unit. Central unit for electronic data processing, the processing core of the PC.

Cyclic

Messages are triggered time-controlled in Cyclic I/O connections by means of a time generator.

D

Digital

A value (e. g. a voltage) which can adopt only certain statuses within a finite set, mostly defined as 0 and 1.

DIN

German acronym for German Industrial Standard.

E

EDS

Electronic Device Data Sheet which contains standardized DeviceNet station descriptions. They simplify the planning of the DeviceNet nodes.

EIA

Electronic Industries Association – association of electrical companies in the United States.

Electrical components

All objects that produce, convert, transmit, distribute or utilize electrical power (e. g. conductors, cable, machines, control devices).

EMC

Electromagnetic compatibility – the ability of an electrical part to operate in a specific environment without fault and without exerting a negative influence on its environment.

EN

German acronym for European Standard.

ESD

Electrostatic Discharge.

F

Field power supply

Voltage supply for devices in the field as well as the signal voltage.

Fieldbus

Data network on sensor/actuator level. A fieldbus connects the equipment on the field level. Characteristics of a fieldbus are a high transmission security and real-time behavior.

Force Mode

Software mode which enables the user to set his plant to a required state by forcing certain variables on the input and output modules.

G

GND

Abbreviation of ground (potential „0“).

Ground

Expression used in electrical engineering to describe an area whose electrical potential is equal to zero at any given point. In neutral grounding devices, the potential is not necessarily zero, and one speaks of the ground reference.

Ground connection

One or more components that have a good and direct contact to earth.

Ground reference

Potential of ground in a neutral grounding device. Unlike earth whose potential is always zero, it may have a potential other than zero.

H

Hexadecimal

System of representing numbers in base 16 with the digits 0 … 9, and further with the letters A, B, C, D, E and F.

Hysteresis

A sensor can get caught up at a certain point, and then “waver“ at this position. This condition results in the counter content fluctuating around a given value. Should a reference value be within this fluctuating range, then the relevant output would be turned on and off in rhythm with the fluctuating signal.

I

I/O

Input/output.

Impedance

Total effective resistance that a component or circuit has for an alternating current at a specific frequency.

Inactive metal components

Conductive components that cannot be touched and are electrically isolated from active metal components by insulation, but can adopt voltage in the event of a fault.

Inductive coupling

Magnetic inductive couplings occur between two cables through which an electrical current is flowing. The magnetic effect caused by the electrical currents induces an interference voltage. Typical sources of interference are for example, transformers, motors, parallel-routed network and HF signal cables.

Intelligent modules

Intelligent modules are modules with an internal memory, able to transmit certain commands (e. g. substitute values and others).

L

Load value

Predefined value for the counter module with which the count process begins.

Lightning protection

All measures taken to protect a system from damage due to overvoltages caused by lightning strike.

Low impedance connection

Connection with a low AC impedance.

LSB

Least Significant Bit

M

Mass

All interconnected inactive components that do not take on a dangerous touch potential in the case of a fault.

Master

Station in a bus system that controls the communication between the other stations.

Master/slave mode

Mode of operation in which a station acting as a master controls the communication between other stations in a bus system.

Module bus

The module bus is the internal bus in a BL67 station. The BL67 modules communicate with the gateway via the module bus which is independent of the fieldbus.

MSB

Most Significant Bit

Multi-master mode

Operating mode in which all stations in a system communicate with equal rights via the bus.

N

Namur

German acronym for an association concerned with standardizing measurement and control engineering. Namur initiators are special versions of the two-wire initiators. Namur initiators are characterized by their high immunity to interference and operating reliability, due to their special construction (low internal resistance, few components and compact design).

O

Overhead

System administration time required by the system for each transmission cycle.

P

PLC

Programmable Logic Controller.

Potential compensation

The alignment of electrical levels of electrical components and external conductive components by means of an electrical connection.

Potential free

Galvanic isolation of the reference potentials in I/O modules of the control and load circuits.

Potential linked

Electrical connection of the reference potentials in I/O modules of the control and load circuits.

Protective earth

Electrical conductor for protection against dangerous shock currents. Generally represented by PE (protective earth).

R

Radiation coupling

A radiation coupling appears when an electromagnetic wave hits a conductive structure. Voltages and currents are induced by the collision. Typical sources of interference are e. g. sparking gaps (spark plugs, commutators from electric motors) and transmitters (e. g., radio), that are operated near to conducting structures.

Reaction time

The time required in a bus system between a reading operation being sent and the receipt of an answer. It is the time required by an input module to change a signal at its input until the signal is sent to the bus system.

Reference potential

Potential from which all voltages of connected circuits are viewed and/or measured.

Repeater

Amplifier for signals transmitted via a bus.

Root-connecting

Creating a new potential group using a power distribution module. This allows sensors and loads to be supplied individually.

RS 485

Serial interface in accordance with EIA standards, for fast data transmission via multiple transmitters.

S

Serial

Type of information transmission, by which data is transmitted bit by bit via a cable.

Setting parameters

Setting parameters of individual stations on the bus and their modules in the configuration software of the master.

Shield

Conductive screen of cables, enclosures and cabinets.

Shielding

Description of all measures and devices used to join installation components to the shield.

Short-circuit proof

Characteristic of electrical components. A short-circuit proof part withstands thermal and dynamic loads which can occur at its place of installation due to a short circuit.

Station

A functional unit or I/O components consisting of a number of elements.

T

Terminating resistance

Resistor on both ends of a bus cable used to prevent interfering signal reflections and which provides bus cable matching. Terminating resistors must always be the last component at the end of a bus segment.

To ground

Connection of a conductive component with the grounding connection via a grounding installation.

Topology

Geometrical structure of a network or the circuitry arrangement.

U

UART

Universal Asynchronous Receiver/Transmitter. UART is a logic circuit which is used to convert an asynchronous serial data sequence to a parallel bit sequence or vice versa.

Unidirectional

Working in one direction.

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Industrial
Automation

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