3.3 BC7321

3.3.1 General Information

The bus controller module BC7321 supports the B&R CAN I/O protocol.

3.3.2 Order Data

Model Number	Short Description	Image
	CAN Bus Controller	
X67BC7321	X67 CAN bus controller, X2X Link supply 3 W, 8 digital channels can be configured as input or output, 24 VDC, 0.5 A, configurable input filter, 2 event counter 20 kHz, LEDs for status display	
	Accessories	

Table 12: BC7321 order data

3.3.3 Technical Data

Product ID	BC7321
General Information	
C-UL-US Listed	In preparation
B&R ID Code	$142E
Module Type	B&R X67 bus controller
Protection	IP67
Mounting Orientation	Any
Power Consumption of Bus Connection	Max. 2.1 W
Operating Temperature	0 °C to +60 °C
Storage Temperature	-25 °C to +85 °C
Number of Inputs/Outputs	8, can be set using software

Table 13: BC7321 technical data

Product ID	BC7321

Electrical Isolation
   Input - Bus
   Input - Input
   Input - Output
	
	Yes
	No
	No

Isolation Voltage between Input and Bus	500 V_{eff}
Module Supply	

Rated Voltage
   Minimum
   Nominal
   Maximum
	
	+18 VDC
	+24 VDC
	+30 VDC

Integrated Protection	Reverse polarity protection

Power Consumption
   Internal
   Sensor Supply
	
	Max. 5.1 W including X2X Link supply
	Max. 12 W [1]

Sensor Supply	
Voltage	Module supply minus voltage drop for short circuit protection
Voltage Drop for Short Circuit Protection at 500 mA	Max. 2 VDC
Total Current	Max. 500 mA
Short Circuit Protection	Yes
Fieldbus	
Type	CAN
Controller	Controller SJA 1000
Processor	16 Bit RISC Processor
Memory	128 KByte
Design	M12 circular plugs (plug on the module)

Electrical Isolation
   CAN - X2X Link
   CAN I/O
	
	No
	Yes

Maximum Distance	1,000 m
Maximum Baud Rate	1 MBit/s
Network Capable	Yes
Bus Termination Resistor	Can be optionally screwed onto the T-connector
Input Characteristics	
Number of Inputs	Max. 8
Design	IEC1131 - Type 1
Wiring	Sink
Status Display	Input status per channel Supply voltage, bus function, I/O function
Input Current at 24 VDC Rated Voltage	Approx. 4 mA

Table 13: BC7321 technical data (cont.)

Product ID	BC7321

Switching Threshold at 24 VDC Rated Voltage
    LOW Range
    HIGH Range
	
	< 5 VDC
	> 15 VDC

Input Filter Hardware
    Channel 1 -4
    Channel 5 -8
	
	< 10 µs
	< 70 µs

Input Filter can be Set using Software
    0
    1
    2
    :
    250
	
	Disabled
	0.1 ms
	0.2 ms
	:
	25 ms

Output Characteristics	
Number of Outputs	Max. 8
Design	FET positive switching
Status Display	Per output
Diagnosis Status	Output monitoring with 10 ms delay

Continuous Current per
    Output
    Module
	
	Max. 0.5 A
	Max. 4 A

Leakage Current when Switched Off	5 µA
Residual Voltage	<0.3 V @ 0.5 A
Short Circuit - Peak Current	<12 A
Switching On after Overload Cutoff	Approx. 10 ms (depends on the module temperature)
Protection	Thermal cutoff Integrated protection for switching inductances Reverse polarity protection

Switching Delay
    Log. 0 - Log. 1
    Log. 1 - Log. 0
	
	< 400 µs
	< 400 µs

Switching Frequency
    Resistive Load
    Inductive Load
	
	Max. 100 Hz
	See Section 6.2.12 "Switching Inductive Loads", on page 75 (with 90 % duty cycle)

Braking Voltage when Switching Off Inductive Loads	50 VDC
Event Counter	
Number of Counters	2
Counter 1	Input 1
Counter 2	Input 3
Signal Form	Square wave pulse
Input Frequency	Max. 50 kHz
Count Frequency	Max. 50 kHz
Counter Size	16-bit

Table 13: BC7321 technical data (cont.)

Chapter 3
B&R X67 Modules

Product ID	BC7321
Gate Measurement	
Gate Measurement on Channel 1	Input 2
Gate Measurement on Channel 2	Input 4
Signal Form	Square wave pulse
Evaluation	Positive edge - Negative edge
Pulse Length	≥20 µs
Length of Pauses Between Pulses	≥100 µs
Internal Counter Frequency	48 MHz, 3 MHz, 187.5 kHz
Counter Size	16-bit
Mechanical Characteristics	

Dimensions
  Width
  Height
  Depth
	53 mm
	85 mm
	42 mm

Weight	Approx. 180 g
Pin Assignments	See Section 3.3.5 "Connection Elements", on page 38

Table 13: BC7321 technical data (cont.)

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

3.3.4 Status LEDs
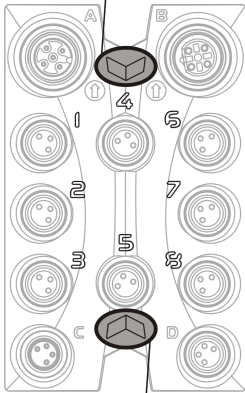
Image	LED	Description		
	Status Display 1	Status display for CAN I/O bus controllers.		
		LED	**Status**	**Description**
		Green	Off	No supply via CAN fieldbus
			Flickering	Baud rate recognition in progress
			Blinking	Preoperational mode
			On	RUN mode
Status Display 1: left: green, right: red		Status display for CAN fieldbus.		
		LED	**Status**	**Description**
		Red	Off	No supply via CAN fieldbus or everything OK
			Flickering	Baud rate recognition in progress
			Single flash	CAN connection reports that the warning limit has been reached
			On	CAN connection reports BusOff status
	1 - 8	Input/output state of the corresponding channel. The LEDs are orange.		
	Status Display 2	Status display for module function.		
		LED	**Status**	**Description**
		Green	Off	Module not supplied
			Single flash	Reset mode
			Blinking	Preoperational mode
			On	RUN mode
Status Display 2: left: green, right: red		Red	Off	Module not supplied or everything is OK
			On	Error or reset state
			Single flash	Warning/error for an I/O channel. Level monitoring for digital outputs has responded.
			Double flash	Supply voltage not in the valid range.

Table 14: BC7321 status LEDs
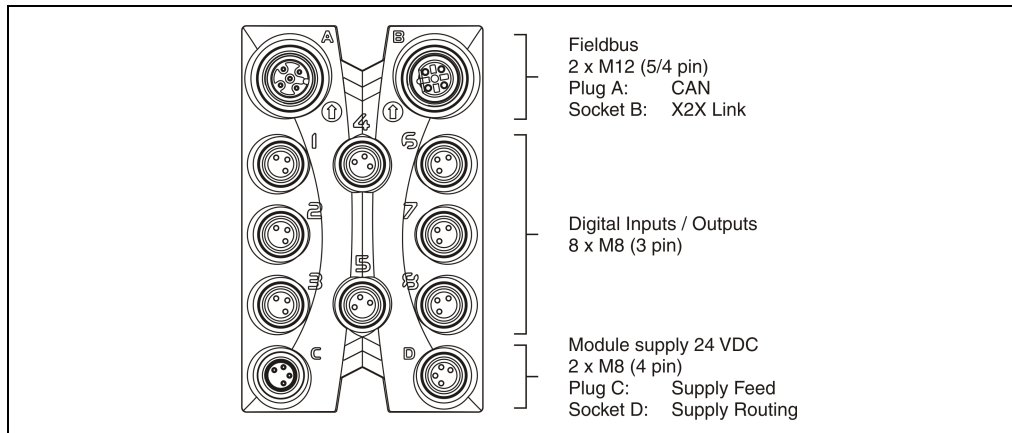
3.3.5 Connection Elements

Figure 11: BC7321 connection elements

3.3.6 CAN Interface

The BC7321module is connected to the CAN fieldbus with prefabricated cables. The connection is made using a circular connector (1 x M12, 5 pin).

Connection	Pin Assignments		
	Pin	CAN [1]	
	1	SHLD	Shield
	2	Not connected	
	3	CAN⊥	CAN Ground
	4	CAN_H	CAN High
	5	CAN_L	CAN Low
	A ... Plug in the module, input		
	Shield connection made via threaded insert in the module.		

Table 15: BC7321 CAN interface

1) Pin assignments apply for bus controllers with a revision ≥B0.

The bus controller is connected to a CAN fieldbus using a T-connector. This allows the bus controller to be exchanged without breaking the fieldbus connection.

The bus termination resistance is housed in a plug and screwed onto the T-connector as needed.

3.3.7 X2X Link

The BC7321 module is connected to the X2X Link with prefabricated cables. The connection is made using a circular connector (1 x M12, 4 pin).
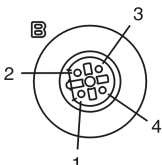
Connection	Pin Assignments	
	Pin	**Designation**
	1	X2X+
	2	X2X
	3	X2X⊥
	4	X2X\
	B ... Socket in the module, output	
	SHLD ...Shield connection made via threaded insert in the module	

Table 16: BC7321 X2X Link

3.3.8 Digital Inputs/Outputs

The digital inputs/outputs are connected using circular connectors (8 x M8, 3 pin).

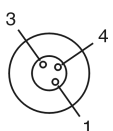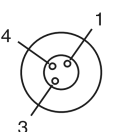| Connection	Pin Assignments	
	Pin	**Designation**
	1	Sensor supply 24 VDC [1]
	3	GND
	4	Input / Output x
	1) Sensor supply is not allowed to take place externally.	

Table 17: BC7321 digital inputs/outputs

3.3.9 Module Supply 24 VDC

The module supply connection is made using circular connectors (2 x M8, 4 pin). The supply feed is connected via plug C. Socket D is used for routing the supply to other modules (see also Section 3.1.3 "Power Supply", on page 32).

The maximum permitted current per supply is 4 A (sum 8 A).
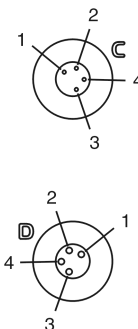
Connection	Pin Assignments		
	Pin	Plug C	Socket D [1)
	1	24 VDC fieldbus	24 VDC I/O
	2	24 VDC I/O	24 VDC I/O
	3	GND	GND
	4	GND	GND
	C ... Plug on the module, supply feed D ... Socket on the module, supply routing		

Table 18: BC7321 module supply 24 VDC

1) Pin assignments apply for bus controllers with a revision ≥B0.

3.3.10 Node Number and Start Baud Rate

Node numbers and start baud rates are configured using both bus controller number switches. The start baud rate is described in the section "Start Baud Rate", on page 42.
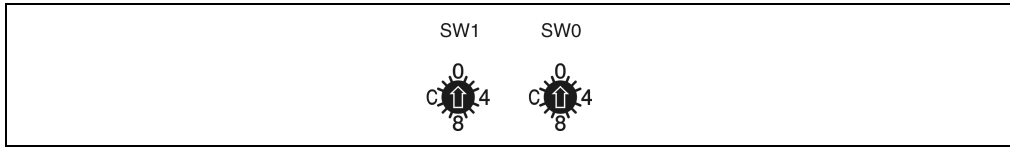

Figure 12: BC7321 number switch

SW1	SW0	Node Number	Start Baud Rate [kBit/s]
$0	$0 [1]	From S-EEPROM	From S-EEPROM
$0	$1 ... $F	1 ... 15	250
$1	$0 ... $F	16 ... 31	250
$2	$0 ... $F	32 ... 47	250
$3	$0 ... $F	48 ... 63	250
$4	$0 [1]	From S-EEPROM	From S-EEPROM
$4	$1 ... $F	1 ... 15	125
$5	$0 ... $F	16 ... 31	125
$6	$0 ... $F	32 ... 47	125
$7	$0 ... $F	48 ... 63	125
$8	$0 [1]	From S-EEPROM	From S-EEPROM
$8	$1 ... $F	1 ... 15	20
$9	$0 ... $F	16 ... 31	20
$A	$0 ... $F	32 ... 47	20
$B	$0 ... $F	48 ... 63	20
$C	$0 [1]	From S-EEPROM	From S-EEPROM
$C	$1 ... $F	1 ... 15	500
$D	$0 ... $F	16 ... 31	500
$E	$0 ... $F	32 ... 47	500
$F	$0 ... $E	48 ... 62	500
$F	$F [1]	1	250

Table 19: BC7321 node numbers and baud rates

[1] A special function is activated using these numbers (see the section "Special Functions" on page 42).

Special Functions

Position of the Number Switch	Special Function
$00, $40, $80, $C0	When one of these numbers is configured, the bus controller uses the operating parameters from the internal S-EEPROM. The S-EEPROM is programmed using the CANIO library.
$FF	The installed firmware from B&R is activated with the number $FF (delivery status). This can be necessary where an incompatible firmware was downloaded during a firmware update and this prevented the download of the correct firmware. The module is booted as in delivery status by configuring the number $FF. This makes it possible to download the correct firmware. Node number 1 on the bus controller and a baud rate of 250 kBit/s are configured using this setting.

Table 20: BC7321 special functions

3.3.11 Automatic Baud Rate Recognition

After booting, the bus controller BC7321 goes into "Listen Only" Mode. That means the bus controller behaves passively on the bus and only listens.

The BC7321 tries to receive valid objects. If an error occurs when receiving, the controller switches to the next baud rate from the search table.

If no objects are received, all baud rates are tested cyclically. This procedure is repeated until valid objects are received.

Start Baud Rate

The bus controller begins the search with this baud rate. The start baud rate can be defined in three different ways:

- Set using the node number switch
- Read from the S-EEPROM (node number = $00)
- The last recognized baud rate is used to begin the search after a software reset (command code 20)

Search Table

The bus controller tests the baud rate according to this table. Beginning with the start baud rate, the baud rate is switched to the next lower value. At the end of the table, the bus controller starts searching from the beginning again.

Baud Rate
1000 kBit/s
500 kBit/s
250 kBit/s
125 kBit/s
50 kBit/s
20 kBit/s
10 kBit/s

Table 21: BC7321 baud rates search table
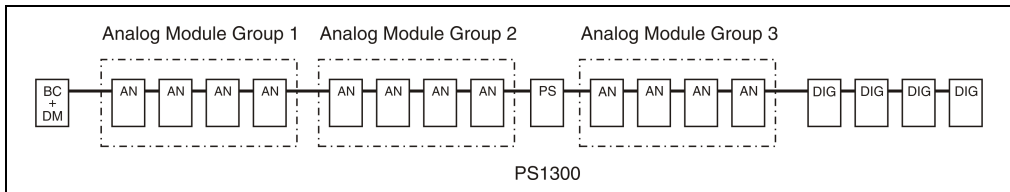
3.3.12 System Configuration

Figure 13: BC7321 system configuration

Up to twelves analog modules can be operated right next to the CAN I/O bus controller These modules are grouped by firmware into three groups, each with four modules.

An analog module group consists of up to four analog modules. Instead of an analog module group **one** digital module can be operated.

A digital mixed module is already integrated in the bus controller. Depending on the number of analog module groups, up to seven further digital modules can be operated by one CAN I/O bus controller.

The bus controller can directly supply three modules. If several modules are used then a PS1300 power supply is required. This power supply can supply a maximum of 15 modules. It should be mounted in the middle of module to be supplied.

Examples for System Configurations

The maximum number of digital modules are shown in the following examples, depending on the number of analog modules and the analog module groups resulting from them.
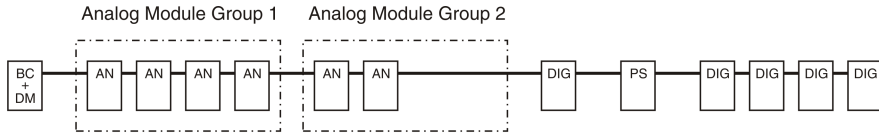
Example 1

Maximal expansion of analog modules.

Example 2

Maximal expansion of digital modules.

Example 3

Mixed Configuration:
- A digital module is operated directly next to the bus controller.
- There are now 5 analog modules. These analog modules are divided into 2 analog module groups.
- Analog Module Group 1: 4 Analog modules
- Analog Module Group 2: 1 Analog module - the remaining places in this group remain free

Example 4

Mixed Configuration:
- Two analog modules are operated directly next to the bus controller. Analog module group 1 is therefore half full.
- A digital module also present.
- There are also three further analog modules. One place in analog module group 2 remains free.

Table 22: BC7321 examples for system configurations
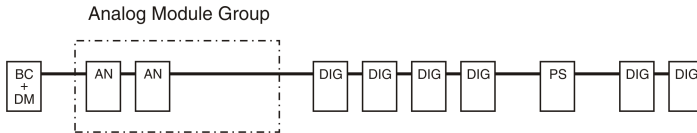
Example 5

Mixed Configuration:

- Six analog modules are operated directly next to the bus controller. These analog modules are divided into 2 analog module groups.
- Analog Module Group 1: 4 analog modules
- Analog Module Group 2: 2 analog modules - the remaining places in this group remain free
- A digital module is operated instead of analog module group 3.

Analog Module Group 1   Analog Module Group 2

```
BC   AN  AN  AN  AN     AN  AN        DIG   PS   DIG DIG DIG DIG
+DM
```

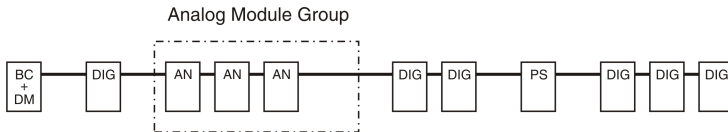**Example 6**

Mixed Configuration:

- Two analog modules are operated directly next to the bus controller. The analog module group is therefore half full.
- Two digital modules are operated instead of analog module groups 2 and 3.

Analog Module Group

```
BC   AN  AN         DIG DIG DIG DIG   PS   DIG DIG
+DM
```

Example 7

Mixed Configuration:

- A digital module is operated directly next to the bus controller.
- There are now 3 analog modules. One place in the analog module group remains free.
- A digital module is operated instead of analog module group 3.

Analog Module Group

```
BC   DIG    AN  AN  AN      DIG DIG   PS   DIG DIG DIG
+DM
```

Example 8

Mixed Configuration:

- Two digital modules are operated directly next to the bus controller.
- There is one analog module. 3 places in the analog module group remain free.
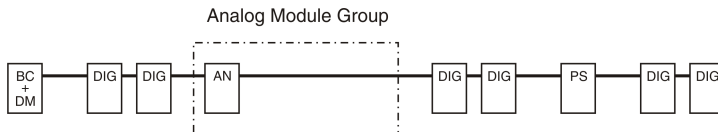
Analog Module Group

```
BC   DIG DIG    AN          DIG DIG   PS   DIG DIG
+DM
```

Table 22: BC7321 examples for system configurations (cont.)

3.3.13 Digital Section

The CAN I/O bus controller is equipped with one digital mixed module. The technical data and the operation of the corresponding digital mixed module DM1321 (see section 6.2 "DM1321", on page 68).