

Chapter 3 • Embedded controller

1. General information

The Embedded Controller is a stand-alone CPU for switching cabinet installation.

The **EC2x** module offers interchangeable application memory in the form of a CompactFlash card¹⁾ as well as a separate backup battery for the module.

It is equipped with five application interfaces:

- One RS232 interface (IF1) for programming and configuring using B&R AutomationStudio™
- One CAN interface (IF2) for connecting to a CAN network
- One Profibus DP interface (IF3) for connecting to a Profibus network (only **EC21**)
- One X2X Link interface (IF4)
- One Ethernet interface (IF6) for connecting to an Ethernet network.

In addition, a maximum of three digital inputs / outputs are provided.

The digital inputs and outputs can be configured individually as input or output. Additional functions such as a counter function with direction switching (stepper motor) or period and gate measurement are integrated.

The **EC20** module is also available as version with ARNC0 software.

1) Application memory must be ordered separately.

2. The compact system on the DIN rail

Standalone CPUs have to be compact, highly efficient, and able to communicate with other devices. The embedded controller does all this and more. Its wide range of interfaces means all communication requirements can be met. Outstanding performance with its compact size and integrated digital I/O mean the embedded controller can be used in a wide range of applications.

3. The most important data

Name	EC20		EC21
	7EC020.60-2	7EC020.61-2	7EC021.60-1
Module type	Standalone CPU		
Installation	Directly or on standard mounting rail TS35		
Processor	x86 Intel-compatible		
ARNC0	✓	—	—
Clock frequency	100 MHz		
DRAM	32 MB	32 MB	16 MB
SRAM	32 KB (battery-buffered)		
Fastest task class	1 ms		
Communication interfaces			
Ethernet 10/100 Mbps	✓	✓	✓
RS232	✓	✓	✓
CAN	✓	✓	✓
X2X Link	✓	✓	✓
Profibus DP	—	—	✓
Integrated I/O	3 digital mixed channels at 24 VDC, 0.5 A, can be individually selected as input or output		
Special functions for dig. inputs	Event counter, ABR incremental encoder, gate measurement, period measurement		

Table 4: Embedded Controller - The most important data

Ethernet is increasingly becoming the standard communication medium used in automation. B&R provides all System Generation 4 CPUs with 10/100 Mbps Ethernet onboard.

4. EC20

4.1 Order data

Model number	Short description	Figure
7EC020.60-2	Embedded Controller, x86 100 MHz Intel compatible, 32 MB DRAM, 32 KB SRAM, removable application memory (CompactFlash), 1 CAN interface, 1 X2X Link Master interface, 1 Ethernet interface 100 Base-T, 1 RS232 interface, 3 DM, 24 VDC, 0.5 A. Application memory must be ordered separately! Terminal blocks 0TB708 and 0TB704 must be ordered separately!	
7EC020.61-2	Embedded Controller, ARNC0, x86 100 MHz Intel compatible, 32 MB DRAM, 32 KB SRAM, removable application memory (CompactFlash), 1 CAN interface, 1 X2X Link Master interface, 1 Ethernet interface 100 Base-T, 1 RS232 interface, 3 DM, 24 VDC, 0.5 A. Application memory must be ordered separately! Terminal blocks 0TB708 and 0TB704 must be ordered separately!	
Program memory		
5CFCRD.0032-02	CompactFlash 32 MB ATA/IDE SanDisk	
5CFCRD.0064-03	CompactFlash 64 MB ATA/IDE SiliconSystems	
5CFCRD.0128-03	CompactFlash 128 MB ATA/IDE SiliconSystems	
5CFCRD.0256-03	CompactFlash 256 MB ATA/IDE SiliconSystems	
5CFCRD.0512-03	CompactFlash 512 MB ATA/IDE SiliconSystems	
5CFCRD.1024-03	CompactFlash 1024 MB ATA/IDE SiliconSystems	
5CFCRD.2048-03	CompactFlash 2048 MB ATA/IDE SiliconSystems	
5CFCRD.4096-03	CompactFlash 4096 MB ATA/IDE SiliconSystems	
5CFCRD.8192-03	CompactFlash 8192 MB ATA/IDE SiliconSystems	
Required accessories		
0TB708.91	Accessory terminal block, 8-pin cage clamps, 1.5 mm²	
0TB708.91-02	Accessory terminal block, 20 pcs. 8-pin cage clamps, 1.5 mm²	
0TB704.9	Accessory terminal block, 4-pin, screw clamp, 1.5 mm²	
0TB704.91	Accessory terminal block, 4-pin, cage clamps, 2.5 mm²	
Optional accessories		
0G0001.00-090	Cable PC <-> PLC/PW, RS232, online cable	
7AC911.9	Bus connector, CAN	
0AC912.9	Bus adapter, CAN, 1 CAN interface	
0AC913.92	Bus adapter, CAN, 2 CAN interfaces, including 30 cm connection cable (DSUB connector)	
Notes		
Application memory and TB704 / TB708 terminal blocks must be ordered separately!		

Table 5: 7EC021.60-1 - Order data

4.2 Technical data

Product ID	EC20
General information	
Module type	Embedded controller
Power consumption	<6 W
ARNC0 7EC020.60-2 7EC020.61-2	No Yes
Certification	CE, C-UL-US, GOST-R
CPU	
Processor clock	100 MHz
SRAM	32 KB
DRAM	32 MB
Operating system	AC140 (Version E2.82 or higher)
Application interface IF1	
Interface type	RS232, electrically isolated
Design	9-pin DSUB connector
Maximum transfer rate	115.2 kBit/s to 19.2 kBit/s at 15 m
Display	232 LED
Application interface IF2	
Interface type	CAN, electrically isolated
Design	9-pin DSUB connector
Maximum transfer rate	50 kBit/s at 1000 m to 500 kBit/s at 60 m
Display	CAN LED
Network-capable	Yes
Bus termination resistor	Externally wired
Application interface IF5 ¹⁾	
Interface type	X2X Link Master, electrically isolated
Design	4-pin connector
Max. distance	100 m
Display	X2X LED
Network-capable	Yes (network topology: line)

Table 6: 7EC021.60-1 - Technical data

Product ID	EC20
Application interface IF6	
Interface type	Ethernet IEEE802.3, electrically isolated
Design	RJ45 socket
Max. distance	100 m
Transfer rate	10/100 MBit/s
Display	ACT LED
Network-capable	Yes
Inputs/Outputs	
Connection, module-side	8-pin connector
Configuration of the digital inputs/outputs	Can be configured individually as input or output
Digital inputs ²⁾	
Number of inputs	Max. 3
Wiring	Sink
Electrical isolation Input - PLC Input - Input	Yes No
Input voltage (nom./max.)	24 VDC / 30 VDC
Input delay	<5 µs
Event counter	
Signal form	Square wave pulse
Input frequency	Max. 100 kHz
Pulse length	Min. 5 µs
Counter size	32-bit
Inputs	Counter on input 1
Incremental encoder	
Signal form	Square wave pulse
Evaluation	4x
Input frequency	Max. 20 kHz
Counter size	16-bit
Inputs	A/B on input 1/2, reference pulse on input 3
Gate measurement	
Signal form	Square wave pulse
Input frequency	Max. 100 kHz
Counter frequency (internal / external)	31.25 kHz or 4 MHz / max. 100 kHz
Period measurement	
Signal form	Square wave pulse
Input frequency	Max. 100 kHz
Counter frequency (internal / external)	31.25 kHz or 4 MHz / max. 100 kHz

Table 6: 7EC021.60-1 - Technical data (Forts.)

Product ID	EC20
Digital outputs	
Number of outputs	Max. 3
Type	High-side transistor outputs, readable
Electrical isolation	
Output - PLC	Yes
Output - Output	No
Rated voltage	24 VDC
Rated current	500 mA
Switching delay	Typ. 250 µs
Switching frequency (resistive load)	Max. 100 Hz
Output protection	Cutoff for overcurrent or short circuit
Operational conditions	
Operating temperature	0°C to +50°C
Relative humidity	5% to 95%, non-condensing
Storage and transport conditions	
Storage/transport temperature	-25°C to +55°C / -25°C to +70°C
Relative humidity	
Storage	5% to 95%, non-condensing
Transport	95% at +40°C
Mechanical characteristics	
Dimensions in mm (W x H x D)	43 x 122 x 110
Protection type	IP20
Comment	Backup battery included in delivery

Table 6: 7EC021.60-1 - Technical data (Forts.)

- 1) Application memory must be ordered separately.
- 2) Shielded cables must be used for inputs 1 - 3.

4.3 Additional technical data

Product ID	EC20
Application interface IF1	
Max. distance	15 m at 19.2 kBit/s
Maximum transfer rate	115.2 kBit/sec
Application interface IF2	
Max. distance	1000 m
Maximum transfer rate	
Bus lengths up to 60 m	500 kBit/s
Bus lengths up to 200 m	250 kBit/s
Bus lengths up to 1000 m	50 kBit/s

Table 7: 7EC021.60-1 - Additional technical data

Product ID	EC20
Application interface IF4	
Internal bus supply	No
Digital inputs	
Switching threshold LOW HIGH	< 5 V > 15 V
Input current at rated voltage	Approx. 4.2 mA
Modulation compared to ground potential	Max. ±30 V
Incremental encoder	
Encoder monitoring	No
Counter frequency	Max. 80 kHz
Reference frequency	Max. 20 kHz
Distance between edges	Min. 5 µs
Gate measurement	
Pulse length	Min. 5 µs
Period measurement	
Pulse length	Min. 5 µs
Digital outputs	
Switching voltage (min. /nom. /max.)	18 VDC / 24 VDC / 30 VDC
Switching delay	Max. 500 µs (typ. 250 µs)
Continuous short circuit current at 24 V	Typ. 4 A
Comment	Backup battery is included in the delivery
General information	
B&R ID code 7EC020.60-2 7EC020.61-2	\$8825 \$8826

Table 7: 7EC021.60-1 - Additional technical data (Forts.)

4.4 Indications

Figure	LED	Name	Color	Description
	❶	Status (RUN)	Red	ERROR/RESET
			Red with orange blinking	Load/unload and start BOOT AR
			Red/green blinking (1 Hz)	Startup of BOOT or CF - AR
			Orange	SERVICE/DIAG/BOOT mode
			Green	RUN
			Green with orange blinking	RUN - BATTERY LOW
	❷	RS232 (232)	Orange blinking	Data transfer to application interface IF1 (RS232)
	❸	Ethernet (ACT)	Orange	Ethernet LINK (IF6)
			Orange blinking	Ethernet ACTIVE (IF6)
	❹	CAN1 (CAN)	Orange	Data transfer on application interface IF2 (CAN)
	❺	X2X	Orange	Data transfer on application interface IF4 (X2X)

Table 8: 7EC021.60-1 - Indicators

4.5 Sets CAN node number (IF2) and operating mode

The CAN node number and the operating mode of the EC20 can be set using two HEX code switches:

Figure	Code switch	Description
	❶	CAN node number 16s position (high)
	❷	CAN node number 1s position (low)

Table 9: 7EC021.60-1 - Sets CAN node number (IF2) and operating mode

Switch position	Operating mode	Description
\$00	Boot	In this switch position, the default B&R Automation Runtime™(AR) is started and the runtime system can be installed using the online interface (B&R Automation Studio™). User Flash is deleted after the download begins.
\$01-\$FE	Run	RUN mode, valid CAN node number.
\$FF	Diagnostics	The CPU boots in Diagnostics mode. Program sections in User RAM and User FlashPROM are not initialized. After Diagnostics mode, the CPU always boots with a warm restart.

Table 10: 7EC021.60-1 - Operating modes

The CAN node number change takes effect the next time the EC20 is switched on.

4.6 Ethernet station number setting (IF6)

The Ethernet station number can be set with software (B&R Automation Studio™).

4.7 Reset button

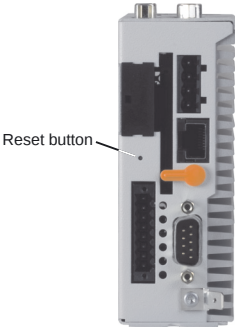
Figure	Description
 Reset button View from below	The reset button can be pressed with any small pointed object (e.g. paper clip). Pressing the reset button triggers a hardware reset, which means: • All application programs are stopped. • All outputs are set to zero. The EC20 then goes into SERVICE mode.

Table 11: 7EC021.60-1 - Reset button

4.8 Application memory slot (CompactFlash)

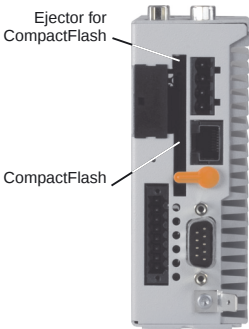
Figure	Description
 Ejector for CompactFlash CompactFlash View from below	Application memory is required to operate the EC20. The application memory is CompactFlash. It is not included with the delivery of the EC20, instead it must be ordered as an accessory. The CompactFlash memory card is inserted in the slot underneath the EC20 and is removed by pressing the ejector. The CompactFlash memory card can be secured using a safety clip.

Table 12: 7EC021.60-1 - Reset button

4.9 Backup battery

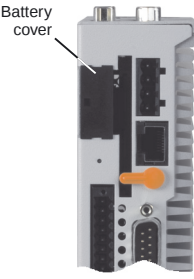
Figure	Code switch	Description
		The EC20 is equipped with a lithium battery. The lithium battery is placed in a separate compartment on the bottom of the module and protected by a cover.
	Backup battery data	
	Lithium battery	3 V / 950 mAh
	Model number	0AC201.9
	Short description	Lithium batteries, 5 pcs., 3 V / 950 mAh, button cell
	Storage temperature	-20 to +60°C
	Storage time	Max. 3 years at 30°C
	Relative humidity	0 to 95%, non-condensing

Table 13: 7EC021.60-1 - Backup battery

4.9.1 Data / real-time buffering

The following areas are buffered:

- Remanent variables
- User RAM
- System RAM
- Real-time clock

4.9.2 Battery monitoring

The battery voltage is checked cyclically. The cyclic load test of the battery does not considerably shorten the battery life, instead it gives an early warning of weakened buffer capacity.

The status information, "Battery OK" is available from the system library function "BatteryInfo."

4.9.3 Battery change interval

The battery should be changed every 4 years. Change intervals are recommended by B&R and refer to average life span and operating conditions. It is not the maximum buffer duration.

Information:

Data stored in the EC20 RAM will be lost if the battery is changed with the PLC switched off! The battery can be changed with power applied, but this is not allowed in all countries!

4.10 Input / output register

4.10.1 Digital in r/- (16-bit)



Bit	Value	Description
0		Logical status of digital I/O 1
1		Logical status of digital I/O 2
2		Logical status of digital I/O 3
3 - 15		Reserved

4.10.2 Digital out r/w (16-bit)



All reserved bits must be written with 0.

Bit	Value	Description
0	0	Digital output 1 is inactive
	1	Digital output 1 is active
1	0	Digital output 2 is inactive
	1	Digital output 2 is active
2	0	Digital output 3 is inactive
	1	Digital output 3 is active
3 - 15		Reserved

4.10.3 Counter (32-bit) r/(w)

In addition to the typical counter modes, this counter has a "Stepper motor counter mode" (see Configuration register bits 4-6).

In stepper motor counter mode, the count direction is set using digital I/O 2 (0...increment, 1...decrement), and the counter clock is on digital I/O 1. Only one clock edge is used for counting (can be configured with bit 3 of the counter configuration register).

4.10.4 Counter configuration (16-bit) r/w

15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
0	0	0	0	0	0								0		0

All reserved bits must be written with 0.

Bit	Value	Description
0		Reserved
1	0	AB(R) counter mode: R input disabled
	1	AB(R) counter mode: R input enabled
2		Reserved
3	0	Measurement starts at increasing edge
	1	Measurement starts at decreasing edge
4 - 6	000	No counter operation
	001	AB(R) counter mode
	010	Event counter mode
	011	Period measurement mode
	100	Stepper motor counter mode
	101	Gate measurement mode
	110	Not allowed
	111	Not allowed
7 - 8	00	Counter frequency 4MHz
	01	External counter frequency
	10	Counter frequency 31.25 kHz
	11	Not allowed
9	0	Counter overflow recognition disabled / Reset counter overflow bit
	1	Overflow recognition of the continuous counter is enabled (value limited to \$FFFF)
10 - 14		Reserved
15	0	Time / counter reset
	1	Time / counter enabled (ATTENTION: Only set bit after counter configuration is complete)

4.10.5 Status (16-bit) r/-

15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0

Bit	Value	Description
0 - 8		Reserved
9	0	Period or gate measurement within the counter range 0 - \$FFFF (only valid if bit 9 is set in the counter configuration word).
	1	Counter overflow during period or gate measurement. Acknowledge by resetting bit 9 of the counter configuration word.
10 - 14		Reserved
15	0	Output supply voltage monitoring 24 VDC - OK
	1	Output supply voltage monitoring 24VDC - Error

4.11 Wiring

4.11.1 Overview



Figure 3: 7EC021.60-1 - Overview of connections (view from front)

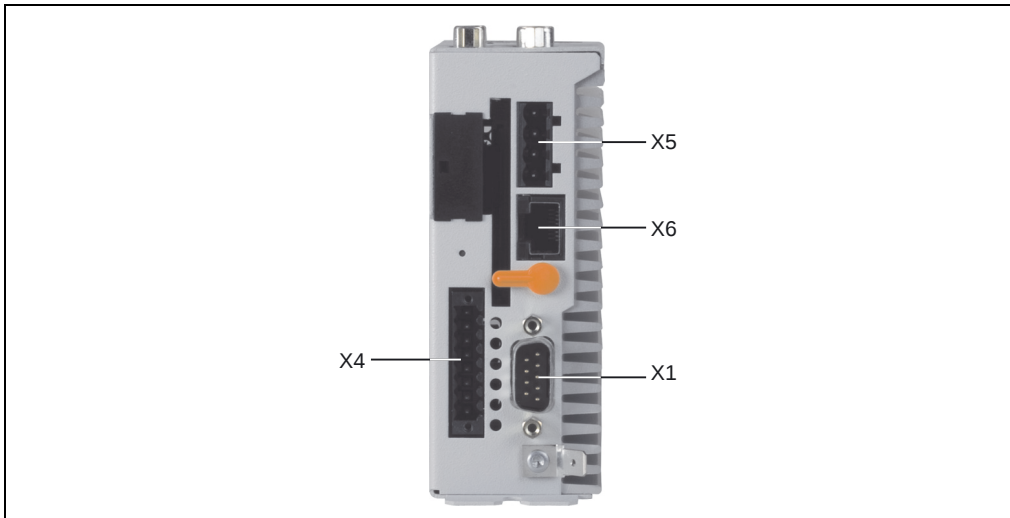


Figure 4: 7EC021.60-1 - Overview of connections (view from below)

4.11.2 Application interface IF1 (RS232)

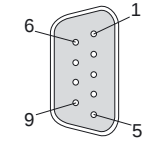
X1	Pin	Name	Function
 9-pin DSUB connector	1	DCD	Data Carrier Detect
	2	RXD	Receive signal
	3	TXD	Transmit signal
	4	DTR	Data Terminal Ready
	5	GND	Ground
	6	DSR	Data Set Ready
	7	RTS	Request To Send
	8	CTS	Clear To Send
	9	RIIN	Ring indicator

Table 14: 7EC021.60-1 - Pin assignments IF1 (RS232)

4.11.3 Application interface IF2 (CAN)

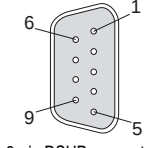
X2	Pin	Name	Function
 9-pin DSUB connector	1	---	---
	2	CAN_L	CAN low
	3	CAN_GND	CAN 0 V
	4	---	---
	5		---
	6		---
	7	CAN_H	CAN high
	8	---	---
	9	---	---

Table 15: 7EC021.60-1 - Pin assignments - IF2 (CAN)

There must be a terminating resistor (120 Ω , 0.25 W) between CAN_H and CAN_L at the beginning and end of the CAN bus.

4.11.4 IF4 connector (inputs/outputs)

X4	Pin	Name	Function in the mode:		
			Incremental counter	Period/gate measurement	Stepper motor counter
 0TB708.91	1	GND	GND (Digital I/O)		
	2	+24 VDC	Supply +24V (Digital I/O)		
	3	Digital I/O 1	A	Counter input	
	4	Digital I/O 2	B	---	Counting direction
	5	Digital I/O 3	R	External clock	---
	6	Shield	Shield		
	7	+24 VDC	+24V supply (module)		
	8	GND	GND (module)		

Table 16: 7EC021.60-1 - Pin assignments IF4 (inputs/outputs)

4.11.5 Application interface IF5 (X2X)

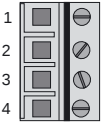
X5	Pin	Name	Function
 0TB704.9	1	X2X	X2X data
	2	X2X _L	X2X ground
	3	X2X _I	X2X data inverted
	4	SHLD	Shield

Table 17: 7EC021.60-1 - Application interface IF5 (X2X)

4.11.6 Application interface IF6 (Ethernet)

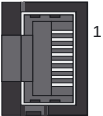
X6	Pin	Name	Function
 1	1	RXD	Receive signal
	2	RXD _I	Receive signal inverted
	3	TXD	Transmit signal
	4	Termination	Termination
	5	Termination	Termination
	6	TXD _I	Transmit signal inverted
	7	Termination	Termination
	8	Termination	Termination

Table 18: 7EC021.60-1 - Pin assignments IF6 (Ethernet)

5. EC21

5.1 Order data

Model number	Short description	Figure
7EC021.60-1	Embedded Controller, x86 100 MHz Intel compatible, 16 MB DRAM, 32 KB SRAM, removable application memory (CompactFlash), 1 CAN interface, 1 Profibus DP slave interface, 1 X2X Link master interface, 1 Ethernet interface 100 Base-T, 1 RS232 interface, 3 DM, 24 VDC, 0.5 A. Application memory must be ordered separately! Terminal blocks 0TB708 and 0TB704 must be ordered separately!	
7EC021.61-2	Embedded Controller, ARNC0, x86 100 MHz Intel compatible, 16 MB DRAM, 32 KB SRAM, removable application memory (CompactFlash), 1 CAN interface, 1 Profibus DP slave interface, 1 X2X Link master interface, 1 Ethernet interface 100 Base-T, 1 RS232 interface, 3 DM, 24 VDC, 0.5 A. Application memory must be ordered separately! Terminal blocks 0TB708 and 0TB704 must be ordered separately!	
Program memory		
5CFCRD.0032-02	CompactFlash 32 MB ATA/IDE SanDisk	
5CFCRD.0064-03	CompactFlash 64 MB ATA/IDE SiliconSystems	
5CFCRD.0128-03	CompactFlash 128 MB ATA/IDE SiliconSystems	
5CFCRD.0256-03	CompactFlash 256 MB ATA/IDE SiliconSystems	
5CFCRD.0512-03	CompactFlash 512 MB ATA/IDE SiliconSystems	
5CFCRD.1024-03	CompactFlash 1024 MB ATA/IDE SiliconSystems	
5CFCRD.2048-03	CompactFlash 2048 MB ATA/IDE SiliconSystems	
5CFCRD.4096-03	CompactFlash 4096 MB ATA/IDE SiliconSystems	
5CFCRD.8192-03	CompactFlash 8192 MB ATA/IDE SiliconSystems	
Required accessories		
0TB708.91	Accessory terminal block, 8-pin cage clamps, 1.5 mm²	
0TB708.91-02	Accessory terminal block, 20 pcs. 8-pin cage clamps, 1.5 mm²	
0TB704.9	Accessory terminal block, 4-pin, screw clamp, 1.5 mm²	
0TB704.91	Accessory terminal block, 4-pin, cage clamps, 2.5 mm²	
Optional accessories		
0G0001.00-090	Cable PC <=> PLC/PW, RS232, online cable	
7AC911.9	Bus connector, CAN	
0AC912.9	Bus adapter, CAN, 1 CAN interface	
0AC913.92	Bus adapter, CAN, 2 CAN interfaces, including 30 cm connection cable (DSUB connector)	
Notes		
Application memory and TB704 / TB708 terminal blocks must be ordered separately!		

Table 19: 7EC021.60-1 - Order data

5.2 Technical data

Product ID	EC21
General information	
Module type	Embedded controller
Power consumption	<6 W
ARNC0 7EC021.60-1 7EC021.61-2	No Yes
Certification	CE, C-UL-US, GOST-R
CPU	
Processor clock	100 MHz
SRAM	32 KB
DRAM (7EC021.60-1 / 7EC021.61-2)	16 MB / 32 MB
Operating system	AC140 (Version E2.82 or higher)
Application interface IF1	
Interface type	RS232, electrically isolated
Design	9-pin DSUB connector
Maximum transfer rate	115.2 kBit/s to 19.2 kBit/s at 15 m
Display	232 LED
Application interface IF2	
Interface type	CAN, electrically isolated
Design	9-pin DSUB connector
Maximum transfer rate	50 kBit/s at 1000 m to 500 kBit/s at 60 m
Display	CAN LED
Network-capable	Yes
Bus termination resistor	Externally wired
Application interface IF3	
Interface type	RS485, electrically isolated
Transfer protocol	Profibus DP
Design	9-pin DSUB socket
Maximum transfer rate	187.5 kBit/s at 1000 m to 12 MBit/s at 100 m
Indicators	PB LED
Network-capable	Yes
Bus termination resistor	External T-connector

Table 20: 7EC021.60-1 - Technical data

Embedded controller • EC21

Product ID	EC21
Application interface IF5 ¹⁾	
Interface type	X2X Link Master, electrically isolated
Design	4-pin connector
Max. distance	100 m
Display	X2X LED
Network-capable	Yes (network topology: line)
Application interface IF6	
Interface type	Ethernet IEEE802.3, electrically isolated
Design	RJ45 socket
Max. distance	100 m
Transfer rate	10/100 MBit/s
Display	ACT LED
Network-capable	Yes
Inputs/Outputs	
Connection, module-side	8-pin connector
Configuration of the digital inputs/outputs	Can be configured individually as input or output
Digital inputs ²⁾	
Number of inputs	Max. 3
Wiring	Sink
Electrical isolation	
Input - PLC	Yes
Input - Input	No
Input voltage (nom./max.)	24 VDC / 30 VDC
Input delay	<5 µs
Event counter	
Signal form	Square wave pulse
Input frequency	Max. 100 kHz
Pulse length	Min. 5 µs
Counter size	32-bit
Inputs	Counter on input 1
Incremental encoder	
Signal form	Square wave pulse
Evaluation	4x
Input frequency	Max. 20 kHz
Counter size	16-bit
Inputs	A/B on input 1/2, reference pulse on input 3

Table 20: 7EC021.60-1 - Technical data (Forts.)

Product ID	EC21
Gate measurement	
Signal form	Square wave pulse
Input frequency	Max. 100 kHz
Counter frequency (internal / external)	31.25 kHz or 4 MHz / max. 100 kHz
Period measurement	
Signal form	Square wave pulse
Input frequency	Max. 100 kHz
Counter frequency (internal / external)	31.25 kHz or 4 MHz / max. 100 kHz
Digital outputs	
Number of outputs	Max. 3
Type	High-side transistor outputs, readable
Electrical isolation Output - PLC Output - Output	Yes No
Rated voltage	24 VDC
Rated current	500 mA
Switching delay	Typ. 250 µs
Switching frequency (resistive load)	Max. 100 Hz
Output protection	Cutoff for overcurrent or short circuit
Operational conditions	
Operating temperature	0°C to +50°C
Relative humidity	5% to 95%, non-condensing
Storage and transport conditions	
Storage/transport temperature	-25°C to +55°C / -25°C to +70°C
Relative humidity Storage Transport	5% to 95%, non-condensing 95% at +40°C
Mechanical characteristics	
Dimensions in mm (W x H x D)	43 x 122 x 110
Protection type	IP20
Comment	Backup battery included in delivery

Table 20: 7EC021.60-1 - Technical data (Forts.)

- 1) Application memory must be ordered separately.
- 2) Shielded cables must be used for inputs 1 - 3.

5.3 Additional technical data

Product ID	EC21
Application interface IF1	
Max. distance	15 m at 19.2 kBit/s
Maximum transfer rate	115.2 kBit/sec
Application interface IF2	
Max. distance	1000 m
Maximum transfer rate	
Bus lengths up to 60 m	500 kBit/s
Bus lengths up to 200 m	250 kBit/s
Bus lengths up to 1000 m	50 kBit/s
Application interface IF3	
Controller	ASIC SPC3
RAM	1.5 KB
Max. distance	1000 m
Maximum transfer rate	
Bus lengths up to 100 m	12 MBit/s
Bus lengths up to 200 m	1.5 MBit/s
Bus lengths up to 400 m	500 kBit/s
Bus lengths up to 1000 m	187.5 kBit/s
Application interface IF4	
Internal bus supply	No
Digital inputs	
Switching threshold	
LOW	< 5 V
HIGH	> 15 V
Input current at rated voltage	Approx. 4.2 mA
Modulation compared to ground potential	Max. ±30 V
Incremental encoder	
Encoder monitoring	No
Counter frequency	Max. 80 kHz
Reference frequency	Max. 20 kHz
Distance between edges	Min. 5 µs
Gate measurement	
Pulse length	Min. 5 µs
Period measurement	
Pulse length	Min. 5 µs

Table 21: 7EC021.60-1 - Additional technical data

Product ID	EC21
Digital outputs	
Switching voltage (min. /nom. /max.)	18 VDC / 24 VDC / 30 VDC
Switching delay	Max. 500 µs (typ. 250 µs)
Continuous short circuit current at 24 V	Typ. 4 A
Comment	Backup battery is included in the delivery
General information	
B&R ID code	
7EC021.60-1	\$7306
7EC021.61-2	\$A077

Table 21: 7EC021.60-1 - Additional technical data (Forts.)

5.4 Indications

Figure	LED	Name	Color	Description
	❶	Status (RUN)	Red	ERROR/RESET
			Red with orange blinking	Load/unload and start BOOT AR
			Red/green blinking (1 Hz)	Startup of BOOT or CF - AR
			Orange	SERVICE/DIAG/BOOT mode
			Green	RUN
			Green with orange blinking	RUN - BATTERY LOW
	❷	RS232 (232)	Orange blinking	Data transfer to application interface IF1 (RS232)
	❸	Profibus (PB)	Orange	Data transfer on application interface IF3 (Profibus)
	❹	Ethernet (ACT)	Orange	Ethernet LINK (IF6)
			Orange blinking	Ethernet ACTIVE (IF6)
	❺	CAN1 (CAN)	Orange	Data transfer on application interface IF2 (CAN)
	❻	X2X	Orange	Data transfer on application interface IF4 (X2X)

Table 22: 7EC021.60-1 - Indicators

5.5 Sets CAN node number (IF2) and operating mode

The CAN node number and the operating mode of the EC21 can be set using two HEX code switches:

Figure	Code switch	Description
	❶	CAN node number 16s position (high)
	❷	CAN node number 1s position (low)

Table 23: 7EC021.60-1 - Sets CAN node number (IF2) and operating mode

Switch position	Operating mode	Description
\$00	Boot	In this switch position, the default B&R Automation Runtime™(AR) is started and the runtime system can be installed using the online interface (B&R Automation Studio™). User Flash is deleted after the download begins.
\$01-\$FE	Run	RUN mode, valid CAN node number.
\$FF	Diagnostics	The CPU boots in Diagnostics mode. Program sections in User RAM and User FlashPROM are not initialized. After Diagnostics mode, the CPU always boots with a warm restart.

Table 24: 7EC021.60-1 - Operating modes

The CAN node number change takes effect the next time the EC21 is switched on.

5.6 Profibus station number setting (IF3)

The Profibus station number can be set using two HEX code switches:

Figure	Code switch	Description
	❶	Profibus station number 16s position (high)
	❷	Profibus station number 1s position (low)

Table 25: 7EC021.60-1 - Setting the Profibus station number

The Profibus station number change takes effect the next time the EC21 is switched on.

The AsL2Dp library is used for communication between the master and slave.

5.7 Ethernet station number setting (IF6)

The Ethernet station number can be set with software (B&R Automation Studio™).

5.8 Reset button

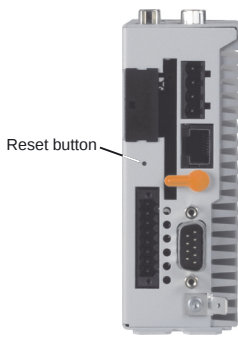
Figure	Description
	The reset button can be pressed with any small pointed object (e.g. paper clip). Pressing the reset button triggers a hardware reset, which means: • All application programs are stopped. • All outputs are set to zero. The EC21 then goes into SERVICE mode.

Table 26: 7EC021.60-1 - Reset button

5.9 Application memory slot (CompactFlash)

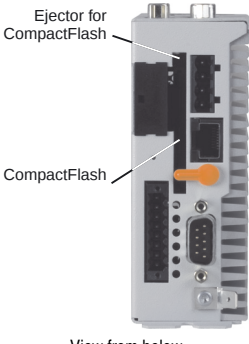
Figure	Description
 View from below	Program memory is required to operate the EC21. The application memory is CompactFlash. It is not included with the delivery of the EC21, instead it must be ordered as an accessory. The CompactFlash memory card is inserted in the slot underneath the EC21 and is removed by pressing the ejector. The CompactFlash memory card can be secured using a safety clip.

Table 27: 7EC021.60-1 - Reset button

5.10 Backup battery

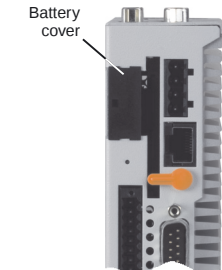
Figure	Code switch	Description
 View from below		The EC21 is equipped with a lithium battery. The lithium battery is placed in a separate compartment on the bottom of the module and protected by a cover.
	Backup battery data	
	Lithium battery	3 V / 950 mAh
	Model number	0AC201.9
	Short description	Lithium batteries, 5 pcs., 3 V / 950 mAh, button cell
	Storage temperature	-20 to +60°C
	Storage time	Max. 3 years at 30°C
	Relative humidity	0 to 95%, non-condensing

Table 28: 7EC021.60-1 - Backup battery

5.10.1 Data / real-time buffering

The following areas are buffered:

- Remanent variables
- User RAM
- System RAM
- Real-time clock

5.10.2 Battery monitoring

The battery voltage is checked cyclically. The cyclic load test of the battery does not considerably shorten the battery life, instead it gives an early warning of weakened buffer capacity.

The status information, "Battery OK" is available from the system library function "BatteryInfo."

5.10.3 Battery change interval

The battery should be changed every 4 years. Change intervals are recommended by B&R and refer to average life span and operating conditions. It is not the maximum buffer duration.

Information:

Data stored in the EC21 RAM will be lost if the battery is changed with the PLC switched off! The battery can be changed with power applied, but this is not allowed in all countries!

5.11 Input / output register

5.11.1 Digital in r/- (16-bit)



Bit	Value	Description
0		Logical status of digital I/O 1
1		Logical status of digital I/O 2
2		Logical status of digital I/O 3
3 - 15		Reserved

5.11.2 Digital out r/w (16-bit)

15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
0	0	0	0	0	0	0	0	0	0	0	0	0	0		

All reserved bits must be written with 0.

Bit	Value	Description
0	0	Digital output 1 is inactive
	1	Digital output 1 is active
1	0	Digital output 2 is inactive
	1	Digital output 2 is active
2	0	Digital output 3 is inactive
	1	Digital output 3 is active
3 - 15		Reserved

5.11.3 Counter (32-bit) r/(w)

In addition to the typical counter modes, this counter has a "Stepper motor counter mode" (see Configuration register bits 4-6).

In stepper motor counter mode, the count direction is set using digital I/O 2 (0...increment, 1...decrement), and the counter clock is on digital I/O 1. Only one clock edge is used for counting (can be configured with bit 3 of the counter configuration register).

5.11.4 Counter configuration (16-bit) r/w

15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
	0	0	0	0	0								0		0

All reserved bits must be written with 0.

Bit	Value	Description
0		Reserved
1	0	AB(R) counter mode: R input disabled
	1	AB(R) counter mode: R input enabled
2		Reserved
3	0	Measurement starts at increasing edge
	1	Measurement starts at decreasing edge
4 - 6	000	No counter operation
	001	AB(R) counter mode
	010	Event counter mode
	011	Period measurement mode
	100	Stepper motor counter mode
	101	Gate measurement mode
	110	Not allowed
	111	Not allowed
7 - 8	00	Counter frequency 4MHz
	01	External counter frequency
	10	Counter frequency 31.25 kHz
	11	Not allowed
9	0	Counter overflow recognition disabled / Reset counter overflow bit
	1	Overflow recognition of the continuous counter is enabled (value limited to \$FFFF)
10 - 14		Reserved
15	0	Time / counter reset
	1	Time / counter enabled (ATTENTION: Only set bit after counter configuration is complete)

5.11.5 Status (16-bit) r/-

15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0

Bit	Value	Description
0 - 8		Reserved
9	0	Period or gate measurement within the counter range 0 - \$FFFF (only valid if bit 9 is set in the counter configuration word).
	1	Counter overflow during period or gate measurement. Acknowledge by resetting bit 9 of the counter configuration word.
10 - 14		Reserved
15	0	Output supply voltage monitoring 24 VDC - OK
	1	Output supply voltage monitoring 24VDC - Error

5.12 Wiring

5.12.1 Overview

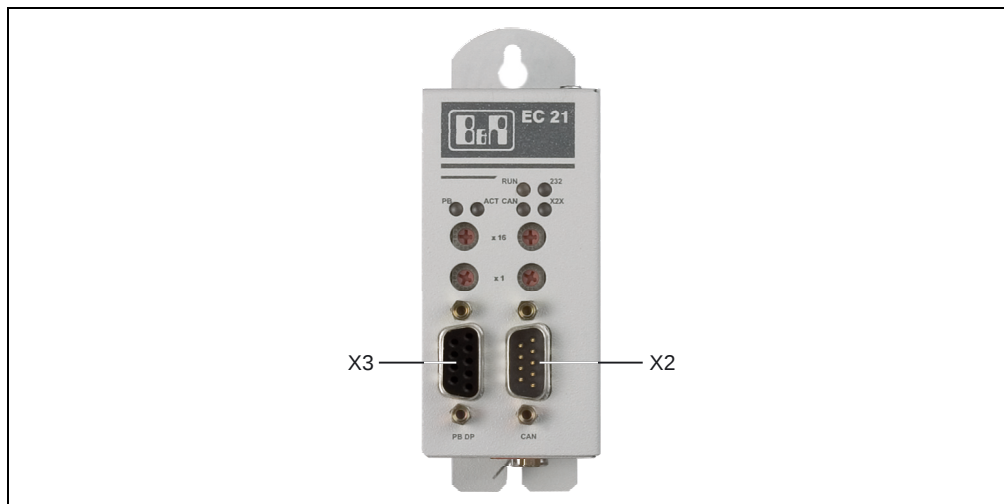


Figure 5: 7EC021.60-1 - Overview of connections (view from front)

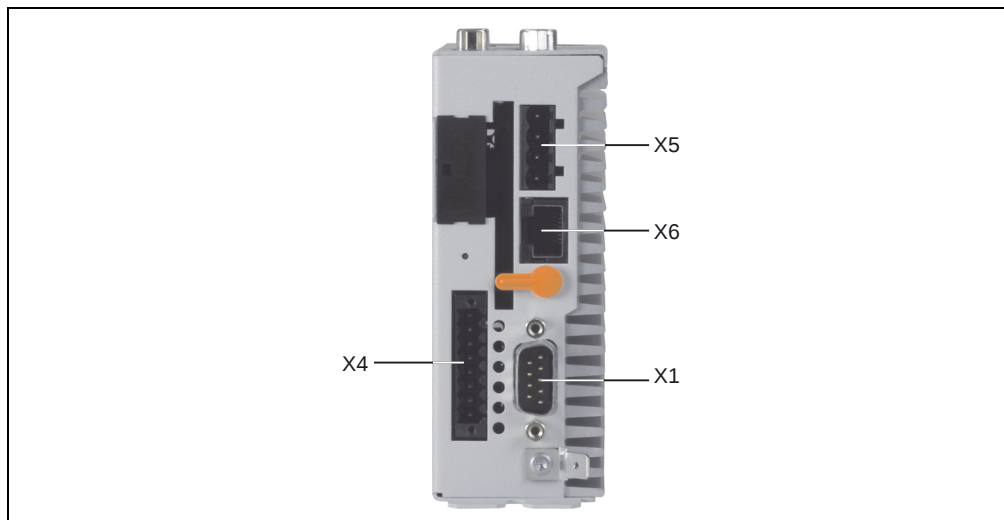


Figure 6: 7EC021.60-1 - Overview of connections (view from below)

5.12.2 Application interface IF1 (RS232)

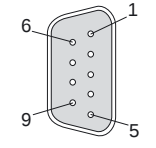
X1	Pin	Name	Function
 9-pin DSUB connector	1	DCD	Data Carrier Detect
	2	RXD	Receive signal
	3	TXD	Transmit signal
	4	DTR	Data Terminal Ready
	5	GND	Ground
	6	DSR	Data Set Ready
	7	RTS	Request To Send
	8	CTS	Clear To Send
	9	RIIN	Ring indicator

Table 29: 7EC021.60-1 - Pin assignments IF1 (RS232)

5.12.3 Application interface IF2 (CAN)

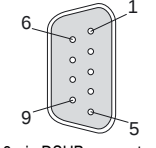
X2	Pin	Name	Function
 9-pin DSUB connector	1	---	---
	2	CAN_L	CAN low
	3	CAN_GND	CAN 0 V
	4	---	---
	5		---
	6		---
	7	CAN_H	CAN high
	8	---	---
	9	---	---

Table 30: 7EC021.60-1 - Pin assignments - IF2 (CAN)

There must be a terminating resistor (120 Ω , 0.25 W) between CAN_H and CAN_L at the beginning and end of the CAN bus.

5.12.4 Application interface IF3 (Profibus)

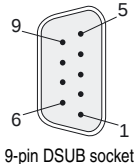
X3	Pin	Name	Function
 9-pin DSUB socket	1	---	---
	2	---	---
	3	DATA	Data
	4	CNTRL	Transmit enable
	5	Profibus_GND	Profibus GND (electrically isolated)
	6	+5V / 50mA	+5 V supply / 50 mA (electrically isolated)
	7	---	---
	8	DATA\	Data\
	9	CNTRL\	Transmit enable\

Table 31: 7EC021.60-1 - pin assignments IF3 (Profibus)

5.12.5 IF4 connector (inputs/outputs)

X4	Pin	Name	Function in the mode:		
			Incremental counter	Period/gate measurement	Stepper motor counter
 0TB708.91	1	GND	GND (Digital I/O)		
	2	+24 VDC	Supply +24V (Digital I/O)		
	3	Digital I/O 1	A	Counter input	
	4	Digital I/O 2	B	---	Counting direction
	5	Digital I/O 3	R	External clock	---
	6	Shield	Shield		
	7	+24 VDC	+24V supply (module)		
	8	GND	GND (module)		

Table 32: 7EC021.60-1 - Pin assignments IF4 (inputs/outputs)

5.12.6 Application interface IF5 (X2X)

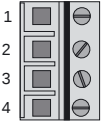
X5	Pin	Name	Function
 0TB704.9	1	X2X	X2X data
	2	X2X.L	X2X ground
	3	X2X\	X2X data inverted
	4	SHLD	Shield

Table 33: 7EC021.60-1 - Application interface IF5 (X2X)

5.12.7 Application interface IF6 (Ethernet)

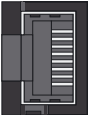
X6	Pin	Name	Function
	1	RXD	Receive signal
	2	RXD\	Receive signal inverted
	3	TXD	Transmit signal
	4	Termination	Termination
	5	Termination	Termination
	6	TXD\	Transmit signal inverted
	7	Termination	Termination
	8	Termination	Termination

Table 34: 7EC021.60-1 - Pin assignments IF6 (Ethernet)

