

POWERLINK

User's manual

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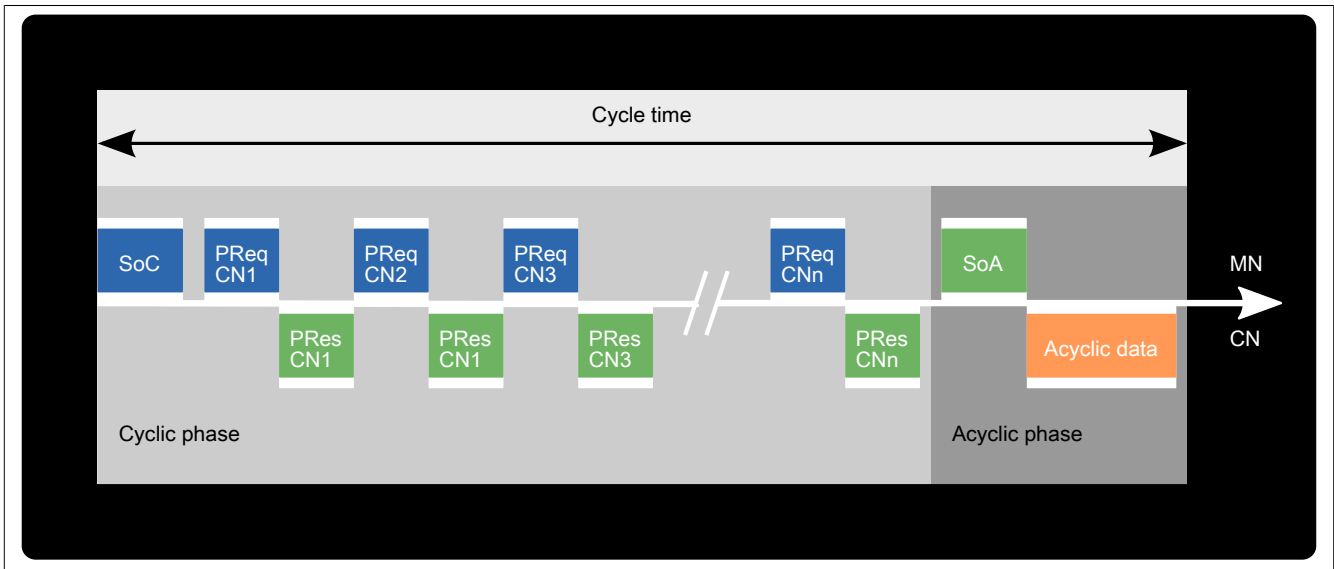
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1 General information

POWERLINK is an Ethernet-based, real-time capable fieldbus. POWERLINK extends the IEEE 802.3 Ethernet standard by a deterministic access method and also defines a CANopen-compatible fieldbus interface. POWERLINK distinguishes between process and service data in the same way as CANopen. Process data (PDO) is exchanged cyclically in the cyclic phase, while service data (SDO) is transferred acyclically. Service data objects are transmitted in the acyclic phases of POWERLINK using a connection-oriented protocol (see figure). The cyclic transfer of data in PDOs is enabled by "mapping".



For additional information, see www.br-automation.com/en/technologies/powerlink.

2 Bus controller

B&R bus controllers for POWERLINK make it possible to connect X2X Link I/O nodes to a POWERLINK network.

2.1 X20 - Order data

Order number	Short description	Figure
	Bus controllers	
X20BC0083	X20 bus controller, 1 POWERLINK interface, integrated 2-port hub, 2x RJ45, order bus base, power supply module and terminal block separately!	
	Expandable bus controllers	
X20BC1083	X20 bus controller, 1 POWERLINK interface, integrated 2-port hub, supports expansion with X20 interface modules, 2x RJ45, order bus base, power supply module and terminal block separately!	
X20BC8083	X20 bus controller, 1 POWERLINK interface, integrated 2-port hub, supports X20 expansion Hub modules, 2x RJ45, order bus base, power supply module and terminal block separately!	
X20BC8084	X20 bus controller, 1 POWERLINK interface, 1x link selector for POWERLINK cable redundancy, supports expansion with active X20 hub modules, 2x RJ45, order bus base, power supply module and terminal block separately!	
	Required accessories	
	System modules for bus controllers	
X20BB80	X20 bus base, for X20 base module (BC, HB, etc.) and X20 power supply module, X20 end cover plates (left and right) X20AC0SL1/X20AC0SR1 included	
X20PS9400	X20 power supply module, for bus controller and internal I/O power supply X2X Link power supply	
X20PS9402	X20 power supply module, for bus controller and internal I/O power supply, X2X Link supply, supply not galvanically isolated	
	System modules for expandable bus controllers	
X20BB81	X20 bus base, for X20 base module (BC, HB, etc.) and X20 power supply module, with one expansion slot for X20 add-on module (IF, HB, etc.), X20 end cover plates (left and right) X20AC0SL1/X20AC0SR1 included	
X20BB82	X20 bus base, for X20 base module (BC, HB, etc.) and X20 power supply module, with 2 expansion slots for 2 X20 add-on modules (IF, HB, etc.), X20 end cover plates (left and right) X20AC0SL1/X20AC0SR1 included	
	Terminal blocks	
X20TB12	X20 terminal block, 12-pin, 24 VDC keyed	
	Optional accessories	
	System modules for X20 redundancy systems	
X20HB2885	X20 hub expansion module, integrated active 2-port hub, 2x RJ45	
X20HB2886	X20 hub expansion module, integrated active 2-port hub, 2x fiber optic connections	
	System modules for expandable bus controllers	
X20IF1091-1	X20 interface module, for expandable bus controller, 1 X2X Link master interface, electrically isolated, order 1x terminal block TB704 separately!	
	System modules for the X20 hub system	
X20HB1881	X20 hub expansion module, integrated 1-port hub, for multimode fiber optic cables	
X20HB1882	X20 hub expansion module, integrated 1-port hub, for monomode fiber optic cables	
X20HB2880	X20 hub expansion module, integrated 2-port hub, 2x RJ45	
X20HB2881	X20 hub expansion module, integrated 2-port hub, for fiber optic cables	
	X20 interface module communication	
X20IF1041-1	X20 interface module, for DTM configuration, 1 CANopen master interface, electrically isolated, order 1x terminal block TB2105 separately!	
X20IF1043-1	X20 interface module, for DTM configuration, 1 CANopen slave interface, electrically isolated, order 1x terminal block TB2105 separately!	
X20IF1051-1	X20 interface module, for DTM configuration, 1 DeviceNet scanner (master) interface, electrically isolated, order 1x terminal block TB2105 separately!	

Table 1: X20BC0083, X20BC1083, X20BC8083, X20BC8084 - Order data

Order number	Short description	Figure
X20IF1053-1	X20 interface module, for DTM configuration, 1 DeviceNet adapter (slave) interface, electrically isolated, order 1x terminal block TB2105 separately!	
X20IF1061-1	X20 interface module, for DTM configuration, 1 PROFIBUS DP V0/V1 master interface, electrically isolated	
X20IF1063-1	X20 interface module, for DTM configuration, 1 PROFIBUS DP V1 slave interface, electrically isolated	
X20IF10A1-1	X20 interface module, for DTM configuration, 1 ASi master interface, electrically isolated, order 1x terminal block TB704 separately!	
X20IF10D1-1	X20 interface module, for DTM configuration, 1 EtherNet/IP scanner (master) interface, electrically isolated	
X20IF10D3-1	X20 interface module, for DTM configuration, 1 EtherNet/IP adapter (slave) interface, electrically isolated	
X20IF10E1-1	X20 interface module, for DTM configuration, 1 PROFINET IO controller (master) interface, electrically isolated	
X20IF10E3-1	X20 interface module, for DTM configuration, 1 PROFINET IO device (slave) interface module, electrically isolated	
X20IF10G1-1	X20 interface module for DTM configuration, 1 EtherCAT master interface, electrically isolated	
X20IF10G3-1	X20 interface module for DTM configuration, 1 EtherCAT slave interface, electrically isolated	

Table 1: X20BC0083, X20BC1083, X20BC8083, X20BC8084 - Order data

2.2 X67 - Order data

Order number	Short description	Figure
	Bus controller modules	
X67BC81RT.L12	X67 bus controller, 2 POWERLINK interfaces, X2X Link power supply 15 W, reACTION Technology module, 2 digital inputs, 24 VDC, <1 µs, 3 digital channels, 5 VDC, <1 µs, configurable as inputs or outputs, 2 digital channels, 24 VDC, 0.4 A, <1 µs, configurable as inputs or outputs, 2 analog inputs ±10 V, 5 µs, 200 kHz sampling frequency, 13-bit converter resolution including sign, configurable input filter, 1 analog output ±10 V, 2.5 µs, 13-bit converter resolution including sign, M12 connectors, high-density module	
X67BC8321-1	X67 bus controller, 1 POWERLINK interface, X2X Link power supply 3 W, 8 digital channels configurable as inputs or outputs, 24 VDC, 0.5 A, configurable input filter, 2 event counters 50 kHz	
X67BC8321.L12	X67 bus controller, 1 POWERLINK interface, X2X Link power supply 15 W, 16 digital channels configurable as inputs or outputs, 24 VDC, 0.5 A, configurable input filter, 2 event counters 50 kHz, M12 connectors, high-density module	
X67BC8331	X67 bus controller, 1 POWERLINK interface, X2X Link power supply 3 W, 8 digital channels configurable as inputs or outputs, 24 VDC, 2 A, configurable input filter	
X67BC8513.L12	X67 bus controller, 1 POWERLINK interface, X2X Link power supply 15 W, 12 digital channels configurable as inputs or outputs, 24 VDC, 0.5 A, configurable input filter, 1 event counters 50 kHz, 1 analog input 0 to 20 mA, 12-bit, M12 connectors, high-density module	

Table 2: X67BC81RT.L12, X67BC8321-1, X67BC8321.L12, X67BC8331, X67BC8513.L12 - Order data

2.3 X20 - Technical data

Order number	X20BC0083	X20BC1083	X20BC8083	X20BC8084
Short description				
Bus controller	POWERLINK (V1/V2) controlled node	POWERLINK (V1/V2) controlled node with up to 2 slots for interface modules	POWERLINK (V1/V2) controlled node with up to 2 slots for hub expansion modules	POWERLINK (V1/V2) controlled node with compact link selector
General information				
B&R ID code	0x1F1E	0x2268	0x2673	0x2674
Status indicators	Module status, bus function			
Diagnostics				
Module status	Yes, using LED status indicator and software			
Bus function	Yes, using LED status indicator and software			
Support				
Dynamic node allocation (DNA)	Yes			
Power consumption				
Bus	2 W			
Additional power dissipation caused by actuators (resistive) [W]	-			
Certifications				
CE	Yes			
UKCA	Yes			
ATEX	Zone 2, II 3G Ex nA nC IIA T5 Gc IP20, Ta (see X20 user's manual) FTZÚ 09 ATEX 0083X			
UL	cULus E115267 Industrial control equipment			
HazLoc	cCSAus 244665 Process control equipment for hazardous locations Class I, Division 2, Groups ABCD, T5			
DNV	Temperature: B (0 to 55°C) Humidity: B (up to 100%) Vibration: B (4 g) EMC: B (bridge and open deck)			
LR	ENV1			
KR	Yes			
ABS	Yes			
BV	EC33B Temperature: 5 - 55°C Vibration: 4 g EMC: Bridge and open deck			
EAC	Yes			
KC	Yes			
Interfaces				
Fieldbus	POWERLINK (V1/V2) controlled node			
Type	Type 2 ¹⁾			
Variant	2x shielded RJ45 (hub)			2x shielded RJ45
Line length	Max. 100 m between 2 stations (segment length)			
Transfer rate	100 Mbit/s			
Transfer				
Physical layer	100BASE-TX			
Half-duplex	Yes			
Full-duplex	No			
Autonegotiation	Yes			
Auto-MDI/MDIX	Yes			
Hub propagation delay	0.96 to 1 µs			
Min. cycle time ²⁾				
Fieldbus	200 µs			
X2X Link	200 µs			
Synchronization between bus systems possible	Yes			
Cyclic data				
Input data	-	Max. 1488 bytes	-	-
Output data	-	Max. 1488 bytes	-	-
Electrical properties				
Electrical isolation	POWERLINK isolated from bus and I/O			
Operating conditions				
Mounting orientation				
Horizontal	Yes			
Vertical	Yes			
Installation elevation above sea level				
0 to 2000 m	No limitation			
>2000 m	Reduction of ambient temperature by 0.5°C per 100 m			

Table 3: X20BC0083, X20BC1083, X20BC8083, X20BC8084 - Technical data

Bus controller

Order number	X20BC0083	X20BC1083	X20BC8083	X20BC8084
Degree of protection per EN 60529	IP20			
Ambient conditions				
Temperature				
Operation				
Horizontal mounting orientation	-25 to 60°C			
Vertical mounting orientation	-25 to 50°C			
Derating	-			
Storage	-40 to 85°C			
Transport	-40 to 85°C			
Relative humidity				
Operation	5 to 95%, non-condensing			
Storage	5 to 95%, non-condensing			
Transport	5 to 95%, non-condensing			
Mechanical properties				
Note	Order 1x terminal block X20TB12 separately. Order 1x power supply module X20PS9400 or X20PS9402 separately. Order 1x bus base X20BB80 separately.	Order 1x terminal block X20TB12 separately. Order 1x power supply module X20PS9400 or X20PS9402 separately. Order 1x bus base X20BB81 or X20BB82 separately.	Order 1x terminal block X20TB12 separately. Order 1x power supply module X20PS9400 or X20PS9402 separately. Order 1x bus base X20BB8x separately.	Order 1x terminal block X20TB12 separately. Order 1x power supply module X20PS9400 or X20PS9402 separately. Order 1x bus base X20BB80 or X20BB82 separately.
Pitch ³⁾	37.5 ^{+0.2} mm	-		
Pitch ⁴⁾				
X20BB80	-	37.5 ^{+0.2} mm		
X20BB81	-	62.5 ^{+0.2} mm		-
X20BB82	-	87.5 ^{+0.2} mm		

Table 3: X20BC0083, X20BC1083, X20BC8083, X20BC8084 - Technical data

- 1) For additional information, see section "Communication / POWERLINK / General information / Hardware - CN" in Automation Help.
- 2) The minimum cycle time specifies how far the bus cycle can be reduced without communication errors occurring.
- 3) Pitch is based on the width of bus base X20BB80. In addition, power supply module X20PS9400 or X20PS9402 is always required for the bus controller.
- 4) Pitch is based on the width of bus base X20BB81 or X20BB82. Up to 2 interface modules and 1 power supply module X20PS9400 or X20PS9402 are always required for the bus controller.

2.4 X67 - Technical data

Order number	X67BC81RT.L12	X67BC8321-1	X67BC8321.L12	X67BC8331	X67BC8513.L12
Short description					
Bus controller	POWERLINK (V1/V2) controlled node				
General information					
Inputs/Outputs	4 digital inputs, 2 digital channels, configurable as inputs or outputs using software, 2 analog inputs, 1 analog output, 1 ABR input, also usable as 5 V differential inputs/outputs, inputs with special function	8 digital channels, configurable as inputs or outputs using software, inputs with additional functions	16 digital channels, configurable as inputs or outputs using software, inputs with additional functions	8 digital channels, configurable as inputs or outputs using software, inputs with additional functions	12 digital channels (configurable as inputs or outputs using the software, inputs with additional functions), 1 analog channel
Insulation voltage between channel and bus	500 V _{eff}				
Nominal voltage	24 VDC				
B&R ID code					
Bus controller	0xE2DC	0x1E37	0xA90E	0xA7A5	0xB3AC
Internal I/O module	0xE2DF	0x1311	0x1A1D	0x1311	0xB3CD
Sensor/Actuator power supply	-	0.5 A summation current			
Status indicators	I/O function per channel, supply voltage, bus function				
Diagnostics					
Outputs	Yes, using LED status indicator and software				
I/O power supply	Yes, using LED status indicator and software				
Support					
Dynamic node allocation (DNA)	Yes				
reACTION-capable I/O channels	Yes	-			
Connection type					
Fieldbus	M12, D-coded				
X2X Link	M12, B-coded				
Inputs/Outputs	M12, 5-pin, A-coded	8x M8, 3-pin	8x M12, A-coded	8x M8, 3-pin	8x M12, A-coded
Encoder	M12, 12-pin, A-coded	-			
I/O power supply	M8, 4-pin				
Power output	15 W X2X Link power supply for I/O modules	3 W X2X Link power supply for I/O modules	15 W X2X Link power supply for I/O modules	3 W X2X Link power supply for I/O modules	15 W X2X Link power supply for I/O modules
Power consumption					
Fieldbus	4.6 W	3.5 W	4.2 W	3.5 W	2.5 W
Internal I/O	6 W	2.5 W		3.8 W	0.6 W
X2X Link power supply	19.6 W at maximum power output for connected I/O modules	4.2 W at maximum power output for connected I/O modules	24.3 W at maximum power output for connected I/O modules	4.2 W at maximum power output for connected I/O modules	17.25 W at maximum power output for connected I/O modules
Application memory					
Type	16 Mbit flash memory	-			
Data retention	20 years at 55°C	-			
Guaranteed erase/write cycles	100,000	-			
Certifications					
CE	Yes				
UKCA	Yes				
ATEX	Zone 2, II 3G Ex nA IIA T5 Gc IP67, Ta = 0 - Max. 60°C TÜV 05 ATEX 7201X				
UL	cULus E115267 Industrial control equipment				
HazLoc	cCSAus 244665 Process control equipment for hazardous locations Class I, Division 2, Groups ABCD, T5				
EAC	Yes				
KC	-	Yes			
Interfaces					
Fieldbus	POWERLINK (V1/V2) controlled node				
Type	-	Type 2 ¹⁾			
Variant	2x M12 circular connector (hub), 2x female connector on module	M12 interface (female connector on module)	2x M12 interface (hub), 2x female connector on module	M12 interface (female connector on module)	2x M12 interface (hub), 2x female connector on module
Line length	Max. 100 m between 2 stations (segment length)				
Transfer rate	100 Mbit/s				

Table 4: X67BC81RT.L12, X67BC8321-1, X67BC8321.L12, X67BC8331, X67BC8513.L12 - Technical data

Bus controller

Order number	X67BC81RT.L12	X67BC8321-1	X67BC8321.L12	X67BC8331	X67BC8513.L12
Transfer					
Physical layer	100BASE-TX				
Half-duplex	Yes				
Full-duplex	No				
Autonegotiation	Yes				
Auto-MDI/MDIX	Yes				
Hub propagation delay	0.96 to 1 µs	-	0.96 to 1 µs	-	0.96 to 1 µs
Min. cycle time ²⁾					
Fieldbus	200 µs				
X2X Link	200 µs				
Synchronization between bus systems possible	Yes				
Encoder power supply connector 8					
5 VDC	Module-internal, max. 0.3 A summation current	-			
24 VDC	Module-internal, max. 0.5 A summation current	-			
I/O power supply					
Nominal voltage	24 VDC				
Voltage range	18 to 30 VDC				
Integrated protection	Reverse polarity protection				
Power consumption					
Sensor/Actuator power supply	Max. 12 W ³⁾				
Sensor/Actuator power supply					
Voltage	I/O power supply minus voltage drop for short-circuit protection				
Voltage drop for short-circuit protection at 0.5 A	Max. 2 VDC				
Summation current	Max. 0.5 A				
Short-circuit proof	Yes				
Digital inputs					
Input characteristics per EN 61131-2	-	Type 1			
Input voltage	-	18 to 30 VDC			
Input current at 24 VDC	-	Typ. 4 mA			
Input circuit	-	Sink			
Input filter					
Hardware	-	≤10 µs (channels 1 to 4) / ≤70 µs (channels 5 to 8)	≤10 µs (channels 1 to 4) / ≤70 µs (channels 5 to 16)	≤10 µs (channels 1 to 4) / ≤70 µs (channels 5 to 8)	≤10 µs (channels 1 to 4) / ≤70 µs (channels 5 to 12)
Software	-	Default 0 ms, configurable between 0 and 25 ms in 0.2 ms intervals			
Input resistance	-	Typ. 6 kΩ			
Additional functions	-	50 kHz event counting, gate measurement		-	50 kHz event counting, gate measurement
Switching threshold					
Low	-	<5 VDC			
High	-	>15 VDC			
ABR incremental encoder					
Quantity	1	-			
Encoder inputs	DI 5 to DI 7, 5 V, symmetrical DI 1 to DI 4 and DI 8 to DI 9, 24 V, asymmetrical	-			
Counter size	32-bit	-			
Input frequency	DI 1 to DI 7: 250 kHz DI 8 and DI 9: 100 kHz	-			
Evaluation	4x	-			
Encoder power supply	5 V: Module-internal, max. 0.3 A 24 V: Module-internal, max. 0.5 A	-			
Overload characteristics of encoder power supply	Short-circuit proof, overload-proof	-			
Digital inputs 5 VDC					
Nominal voltage	5 VDC	-			
Input circuit	Differential	-			
Insulation voltage between encoder and bus	500 V _{eff}	-			

Table 4: X67BC81RT.L12, X67BC8321-1, X67BC8321.L12, X67BC8331, X67BC8513.L12 - Technical data

Order number	X67BC81RT.L12	X67BC8321-1	X67BC8321.L12	X67BC8331	X67BC8513.L12
Input filter					
Hardware	No input filter		-		
Software	Default 200 ns, configurable between 200 ns and 5 ms in 20 ns intervals		-		
Digital inputs 24 VDC					
Nominal voltage	24 VDC		-		
Input characteristics per EN 61131-2	Type 1 ⁴⁾		-		
Input circuit	Sink		-		
Input voltage	24 VDC -15/+20%		-		
Input filter					
Hardware	≤50 ns		-		
Software	Default 200 ns, configurable between 200 ns and 5 ms in 20 ns intervals		-		
Input current at 24 VDC					
Channel 1 and 2	Typ. 9 mA		-		
Channel 3 and 4	Typ. 3 mA		-		
Channel 8 and 9	Typ. 1 mA		-		
Input resistance					
Channel 1 and 2	Typ. 3 kΩ		-		
Channel 3 and 4	Typ. 8 kΩ		-		
Channel 8 and 9	Typ. 40 kΩ		-		
Sensor power supply	0.5 A summation current		-		
Switching threshold					
Low	<5 VDC		-		
High	<15 VDC		-		
Insulation voltage between channel and bus	500 V _{eff}		-		
Event counters					
Quantity	-	2	-	-	1
Signal form	-	Square wave pulse	-	-	Square wave pulse
Evaluation	-	Each negative edge, cyclic counter	-	-	Each negative edge, cyclic counter
Input frequency	-	Max. 50 kHz	-	-	Max. 50 kHz
Counter 1	-	Input 1	-	-	Input 1
Counter 2	-	Input 3	-	-	-
Counter frequency	-	Max. 50 kHz	-	-	Max. 50 kHz
Counter size	-	16-bit	-	-	16-bit
Gate measurement					
Quantity	-	1	-	-	1
Signal form	-	Square wave pulse	-	-	Square wave pulse
Evaluation	-	Positive edge - Negative edge	-	-	Positive edge - Negative edge
Counter frequency					
Internal	-	48 MHz, 3 MHz, 187.5 kHz	-	-	48 MHz, 3 MHz, 187.5 kHz
Counter size	-	16-bit	-	-	16-bit
Length of pause between pulses	-	≥100 μs	-	-	≥100 μs
Pulse length	-	≥20 μs	-	-	≥20 μs
Supported inputs	-	Input 2 or input 4	-	-	Input 2
Analog inputs					
Input	±10 V		-		0 to 20 mA
Input type	Single-ended		-		Differential input
Digital converter resolution	12-bit		-		12-bit
Conversion time	5 μs for both inputs		-		200 μs
Output format	INT		-		INT
Output format					
Current		-			0x0000 - 0x7FFF / 1 LSB = 0x0008 = 4.883 μA
Load		-			<300 Ω
Input protection	Protection against wiring with supply voltage		-		Protection against wiring with supply voltage
Open-circuit detection	Yes, using software		-		
Reverse polarity protection	Yes		-		
Permissible input signal	±30 V		-		Max. ±30 mA
Output of digital value during overload					
Undershoot	0x8001		-		0x0000
Overshoot	0x7FFF		-		0x7FFF

Table 4: X67BC81RT.L12, X67BC8321-1, X67BC8321.L12, X67BC8331, X67BC8513.L12 - Technical data

Bus controller

Order number	X67BC81RT.L12	X67BC8321-1	X67BC8321.L12	X67BC8331	X67BC8513.L12
Conversion procedure	Successive approximation	-			Successive approximation
Max. error					
Gain	0.1% ⁵⁾		-		0.1% ⁶⁾
Offset	0.05% ⁷⁾		-		0.05% ⁸⁾
Max. drift at 25°C					
Gain	0.01%/°C ⁵⁾		-		
Offset	0.0075% / °C ⁷⁾		-		
Max. gain drift		-			0.013 %/°C ⁶⁾
Max. offset drift		-			0.02 %/°C ⁸⁾
Common-mode rejection					
DC		-			>50 dB
50 Hz		-			>50 dB
Common-mode range		-			±2 V
Crosstalk between channels	-70 dB		-		>70 dB
Nonlinearity	<0.0062% ⁷⁾		-		<0.1% ⁸⁾
Insulation voltage between channel and bus	500 V _{eff} , 1 min	-			
Insulation voltage between input and bus		-			500 V _{eff}
Voltage drop at 20 mA		-			Typ. 4.5 V
Input filter					
Cutoff frequency		-			1 kHz
Slope		-			40 dB
Digital outputs					
Variant	-	Current-sourcing FET			
Switching voltage	-	I/O power supply minus residual voltage			
Nominal output current	-	0.5 A		2 A	0.5 A
Total nominal current	-	4 A	8 A		
Output circuit	-	Source			
Output protection	-	Thermal shutdown in the event of overcurrent or short circuit, integrated protection for switching inductive loads, reverse polarity protection of the output power supply			
Diagnostic status	-	Output monitoring with 10 ms delay			
Leakage current when the output is switched off	-	5 µA			
Switching on after overload shutdown	-	Approx. 10 ms (depends on the module temperature)			
R _{DS(on)}		-			150 mΩ
Residual voltage	-	<0.3 V at 0.5 A nominal current		<0.5 V at 2 A nominal current	<0.3 V at 0.5 A nominal current
Peak short-circuit current	-	<12 A		<21 A	<12 A
Switching delay					
0 → 1	-	<400 µs		<250 µs	<400 µs
1 → 0	-	<400 µs		<270 µs	<400 µs
Switching frequency					
Resistive load	-	Max. 100 Hz			
Inductive load	-	See section "Switching inductive loads".			
Braking voltage when switching off inductive loads	-	50 VDC			
Digital outputs 5 VDC					
Output protection	Short-circuit protection	-			
Variant	Differential	-			
Nominal voltage	5 VDC	-			
Output current	Max. 65 mA ⁹⁾	-			
Diagnostic status	Output monitoring	-			
Switching frequency	Max. 500 kHz	-			
Digital outputs 24 VDC					
Nominal voltage	24 VDC	-			
Nominal output current	0.4 A	-			
Variant	Push/Pull	-			
Output protection	Thermal shutdown in the event of overcurrent or short circuit	-			
Braking voltage when switching off inductive loads	50 VDC	-			
Diagnostic status	Overload monitoring	-			
Switch-on in the event of overload shutdown or short-circuit shutdown	Approx. 25 ms	-			
Peak short-circuit current	<1 A	-			
Switching voltage	24 VDC (-15/+20%)	-			
Switching frequency					
Resistive load	Max. 100 kHz	-			
Inductive load	Max. 100 kHz	-			

Table 4: X67BC81RT.L12, X67BC8321-1, X67BC8321.L12, X67BC8331, X67BC8513.L12 - Technical data

Order number	X67BC81RT.L12	X67BC8321-1	X67BC8321.L12	X67BC8331	X67BC8513.L12
Switching delay					
0 → 1	<1 µs		-		
1 → 0	<1 µs		-		
Insulation voltage between channel and bus	500 V _{eff}		-		
Analog outputs					
Output	±10 V		-		
Digital converter resolution	12-bit		-		
Conversion time	2 µs		-		
Settling time on output change over entire range	2.5 µs		-		
Switch on/off behavior	Internal enable relay for startup		-		
Max. error					
Gain	0.15% ⁵⁾		-		
Offset	0.05% ⁷⁾		-		
Output protection	Short-circuit proof		-		
Output format	Example: INT 0x8001 - 0x7FFF / 1 LSB = 0x0010 = 4.882 mV		-		
Load per channel	Max. ±10 mA, load ≥1 kΩ		-		
Output filter	First-order low-pass filter / cutoff frequency 2.5 kHz		-		
Max. gain drift	0.012%/°C ⁵⁾		-		
Max. offset drift	0.001%/°C ⁷⁾		-		
Error caused by load change	Max. 0.01%, from 10 MΩ → 1 kΩ, resistive		-		
Nonlinearity	<0.15% ⁷⁾		-		
Insulation voltage between channel and bus	500 V _{eff} , 1 min		-		
Output response when the power supply is switched on/off	An enable relay is switched on at a defined value ≠ 0, default setting = 10 kΩ to GND		-		
Short-circuit proof					
Current limiting	±40 mA		-		
To actuator or I/O power supply	Yes		-		
To GND	Yes		-		
Max. error at 25°C and 10 kΩ load					
Gain	0.15%		-		
Offset	0.05%		-		
Electrical properties					
Electrical isolation	Bus isolated from POWERLINK and channel Channel not isolated from channel				
Operating conditions					
Mounting orientation					
Any	Yes				
Installation elevation above sea level					
0 to 2000 m	No limitation				
>2000 m	Reduction of ambient temperature by 0.5°C per 100 m				
Degree of protection per EN 60529	IP67				
Ambient conditions					
Temperature					
Operation	-25 to 60°C				
Derating	-		See section "Derating".		-
Storage	-40 to 85°C				
Transport	-40 to 85°C				
Mechanical properties					
Dimensions					
Width	53 mm				
Height	155 mm	85 mm	155 mm	85 mm	155 mm
Depth	42 mm				
Weight	320 g	195 g	350 g	200 g	360 g
Torque for connections					
M8	Max. 0.4 Nm				
M12	Max. 0.6 Nm				

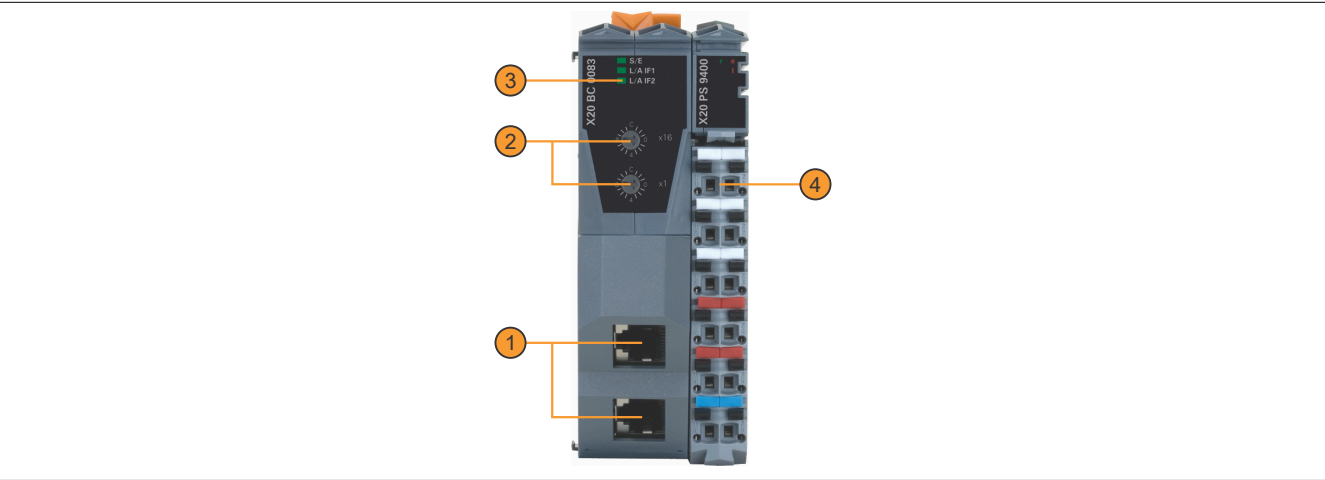
Table 4: X67BC81RT.L12, X67BC8321-1, X67BC8321.L12, X67BC8331, X67BC8513.L12 - Technical data

- For additional information, see section "Communication / POWERLINK / General information / Hardware - CN" in Automation Help.
- The minimum cycle time specifies how far the bus cycle can be reduced without communication errors occurring.
- The power consumption of the sensors and actuators connected to the module is not permitted to exceed 12 W.
- Only channels 1 to 4
- Based on the current output value.

- 6) Based on the current measured value.
- 7) Based on the total output value.
- 8) Based on the entire measurement range.
- 9) For differential output voltage depending on the output current, see section "Differential output"

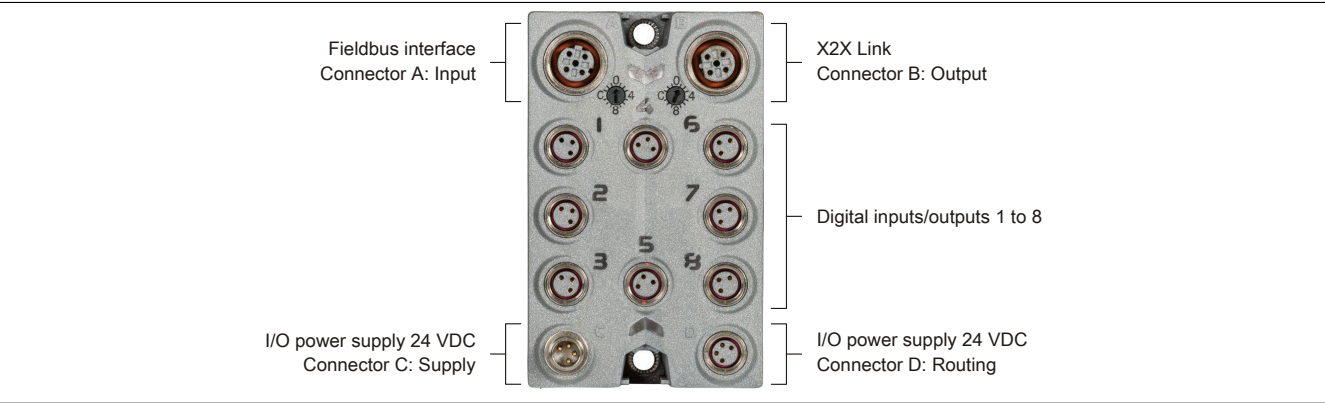
2.5 Operating and connection elements

X20

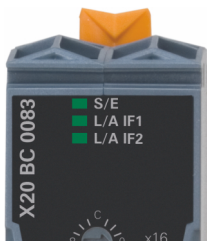
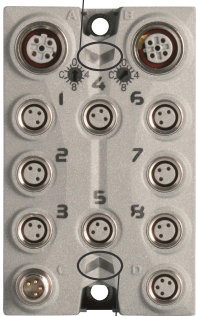


1	POWERLINK connection with 2x RJ45 for simple wiring	2	Node number switches
3	LED status indicators	4	Terminal block for bus controller and I/O supply

X67



2.5.1 LED status indicators

Figure	LED	Color	Status	Description
X20 	S/E ¹⁾	Green/Red		LED states are described in section "LED "S/E" (status/error LED)" on page 15.
	L/A IFx	Green	On Blinking	Link established to the remote station A link to the remote station has been established and there is activity on bus.
X67 Status indicator 1: Left: Green, Right: Red  Status indicator 2: Left: Green, Right: Red				

1) The Status/Error LED "S/E" is a green/red dual LED.

2.5.1.1 LED "S/E" (status/error LED)

This LED is a green/red dual LED and indicates the state of the POWERLINK interface. The LED states have a different meaning depending on the operating mode of the POWERLINK interface.

2.5.1.1.1 Ethernet mode

In this mode, the interface is operated as an Ethernet interface.

LED "S/E"		Description
Green	Red	
On	Off	The interface is operated as an Ethernet interface.

Table: LED "S/E": Interface in Ethernet mode

2.5.1.1.2 POWERLINK V1 mode

LED "S/E"		Current state of the POWERLINK node
Green	Red	
On	Off	The POWERLINK node is running with no errors.
Off	On	A system error occurred. The type of error can be read using the PLC logbook. An irreparable problem has occurred. The system can no longer properly carry out its tasks. This state can only be changed by resetting the module.
Blinking alternately		The POWERLINK managing node has failed. This error code can only occur when operated as a controlled node. This means that the set node number lies within the range 0x01 - 0xFD.
Off	Blinking	System stop. The red blinking LED indicates an error code (see "System stop error codes" on page 17).
Off	Off	The interface is either not active or one of the following states or errors is present: - The device is switched off. - The device is in the startup phase. - The interface or device is not configured correctly in Automation Studio. - The interface or device is defective.

Table 5: LED "S/E": POWERLINK V1 mode

2.5.1.1.3 POWERLINK V2 mode

Error message

LED "S/E"		Description
Green	Red	
Off	On	The interface is in error mode (failed Ethernet frames, increased number of collisions on the network, etc.). Note: Several red blinking signals are displayed immediately after the device is switched on. These are not errors, however.
Blinking	On	If an error occurs in the following modes, then the green LED blinks over the red LED: - PRE_OPERATIONAL_1 - PRE_OPERATIONAL_2 - READY_TO_OPERATE

Table: LED "S/E" - Error message (interface in POWERLINK mode)

Interface status

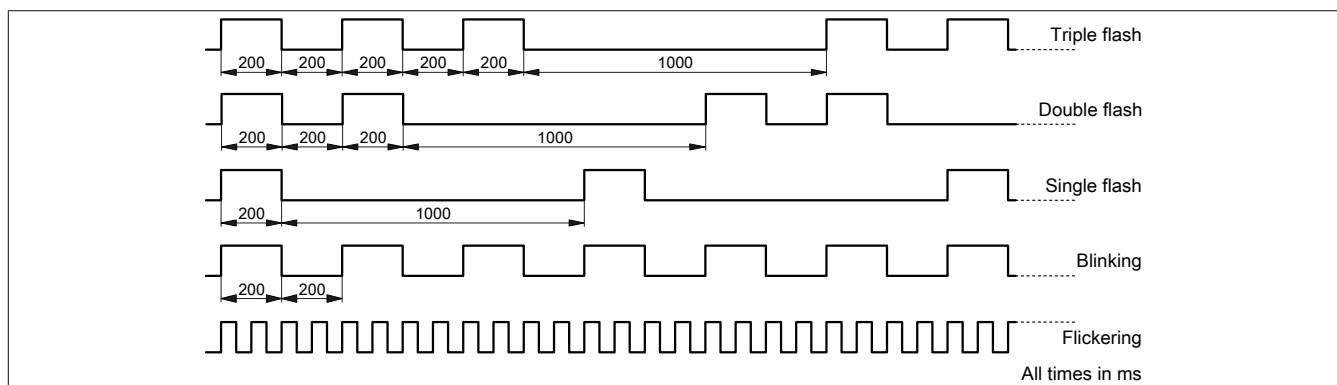
LED "S/E"		Description
Green	Red	
Off	Off	Mode: NOT_ACTIVE The interface is either in mode NOT_ACTIVE or one of the following modes or errors is present: - The device is switched off. - The device is in the startup phase. - The interface or device is not configured correctly in Automation Studio. - The interface or device is defective. Managing node (MN) The network is monitored for POWERLINK frames. If a frame is not received within the configured time window (timeout), the interface immediately enters mode PRE_OPERATIONAL_1. If POWERLINK communication is detected before the time has elapsed, however, the MN is not started. Controlled node (CN) The network is monitored for POWERLINK frames. If a frame is not received within the configured time window (timeout), the interface immediately enters mode BASIC_ETHERNET. If POWERLINK communication is detected before this time expires, however, the interface immediately enters mode PRE_OPERATIONAL_1.
Flickering (approx. 10 Hz)	Off	Mode: BASIC_ETHERNET The interface is in mode BASIC_ETHERNET. The interface is operated in Ethernet mode. Managing node (MN) This mode can only be exited by resetting the controller. Controlled node (CN) If POWERLINK communication is detected during this mode, the interface enters mode PRE_OPERATIONAL_1.
Single flash (approx. 1 Hz)	Off	Mode: PRE_OPERATIONAL_1 The interface is in mode PRE_OPERATIONAL_1. Managing node (MN) The MN is in "reduced cycle" mode. The CNs are configured in this mode. Cyclic communication is not yet taking place. Controlled node (CN) The CN can be configured by the MN in this mode. The CN waits until it receives an SoC frame and then switches to mode PRE_OPERATIONAL_2.
	On	Controlled node (CN) If the red LED lights up in this mode, this means that the MN has failed.
Double flash (approx. 1 Hz)	Off	Mode: PRE_OPERATIONAL_2 The interface is in mode PRE_OPERATIONAL_2. Managing node (MN) The MN starts cyclic communication (cyclic input data is not yet evaluated). The CNs are configured in this mode. Controlled node (CN) The CN can be configured by the MN in this mode. A command then switches the mode to READY_TO_OPERATE.
	On	Controlled node (CN) If the red LED lights up in this mode, this means that the MN has failed.

Table: LED "S/E" - Interface state (interface in POWERLINK mode)

LED "S/E"		Description
Green	Red	
Triple flash (approx. 1 Hz)	Off	Mode: READY_TO_OPERATE The interface is in mode READY_TO_OPERATE. Managing node (MN) Cyclic and asynchronous communication. Received PDO data is ignored. Controlled node (CN) The configuration of the CN is completed. Normal cyclic and asynchronous communication. The transmitted PDO data corresponds to the PDO mapping. However, cyclic data is not yet evaluated.
	On	Controlled node (CN) If the red LED lights up in this mode, this means that the MN has failed.
On	Off	Mode: OPERATIONAL The interface is in mode OPERATIONAL. PDO mapping is active and cyclic data is evaluated.
Blinking (approx. 2.5 Hz)	Off	Mode: STOPPED The interface is in mode STOPPED. Managing node (MN) This mode does not occur for the MN. Controlled node (CN) Output data is not being output, and no input data is being provided. This mode can only be reached and exited by a corresponding command from the MN.
	On	

Table: LED "S/E" - Interface state (interface in POWERLINK mode)

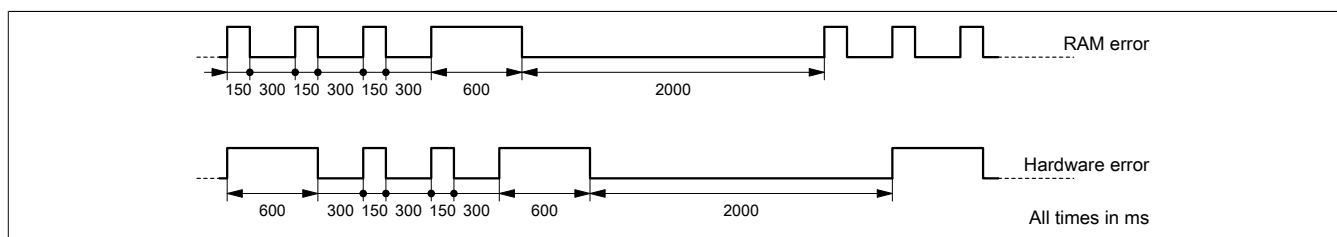
Blink times



2.5.1.1.4 System stop error codes

A system stop error can occur due to incorrect configuration or defective hardware.

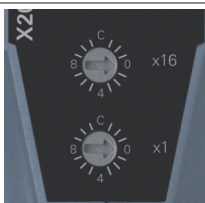
The error code is indicated by LED "S/E" blinking red. The blinking signal of the error code consists of 4 switch-on phases with short (150 ms) or long (600 ms) duration. The error code is repeated every 2 seconds.



Error	Error description
RAM error	The device is defective and must be replaced.
Hardware error	The device or a system component is defective and must be replaced.

2.6 POWERLINK node number

X20



X67



The node number for the POWERLINK node is set using the two number switches.

Switch position	Description
0x00	Only permitted when operating the POWERLINK node in DNA mode.
0x01 - 0xEF	Node number of the POWERLINK node. Operation as a controlled node (CN).
0xF0 - 0xFF	Reserved, switch position not permitted.

2.7 Dynamic node allocation (DNA)

Most POWERLINK bus controllers have the ability to dynamically assign node numbers. This has the following advantages:

- No setting of the node number switch
- Easier installation
- Reduced error sources

For information regarding configuration as well as an example, see Automation Help → Communication → POWERLINK → General information → Dynamic node allocation (DNA)

2.8 Behavior in the event of module failure

If an I/O module connected to the bus controller fails, the following states occur:

- **Module data:** The data of the I/O module is frozen to the last valid value. It is updated again as soon as the module is available again.
- **StaleData:** Set to "1" as soon as no data has been transmitted from the module for at least one cycle. Switches back to "0" as soon as new data is available from the module.
- **ModuleOK:** Only set to "0" if the bus controller has reset the module internally. This can be delayed up to a few milliseconds.

For high-speed evaluation of the I/O module state, bit StaleData and bit ModuleOK must both be observed.

3 Object directory

3.1 General information

POWERLINK specifies a CANopen-compatible object dictionary that can be used to access all communication and application objects. An object is identified by a 16-bit index and 8-bit subindex in the object dictionary.

Each object has an object type that specifies whether the object is a variable, array or structure. Individual elements of an array or structure are mapped using up to 254 subobjects, which are only permitted to contain variables. In addition, attributes such as name, access rights, cyclic communication (PDO mapping) and value can be assigned to objects and subobjects.

3.2 Object dictionary areas

The POWERLINK specification divides the address space into different areas. These areas are listed in the following table.

Index	Area
0x0000	Unused
0x0001 - 0x001F	Static data types
0x0020 - 0x003F	Complex data types
0x0040 - 0x005F	Vendor-specific complex data types
0x0060 - 0x007F	Device profile-specific static data types
0x0080 - 0x009F	Device profile-specific complex data types
0x00A0 - 0x03FF	Reserved
0x0400 - 0x041F	POWERLINK-specific static data types
0x0420 - 0x04FF	POWERLINK-specific complex data types
0x0500 - 0x0FFF	Reserved
0x1000 - 0x1FFF	Area for the POWERLINK communication profile
0x2000 - 0x5FFF	Area for vendor-specific profiles
0x6000 - 0x9FFF	Area for standardized device profiles
0xA000 - 0xBFFF	Area for standardized interface profiles
0xC000 - 0xFFFF	Reserved

3.3 Communication objects

Objects responsible for configuring the POWERLINK network are referred to as communication objects. They are defined in the "Ethernet POWERLINK communication profile specification (DS301)"¹⁾ and located in the 0x1000 to 0x1FFF area of the object dictionary.

The following tables list the communication objects supported by B&R POWERLINK bus controllers. The DS301 specification contains a description of the objects themselves.

3.3.1 Communication objects 0x1000 to 0x1403

Index	Name	Access	Default value	Comment
Subindex				
0x1000	NMT_DeviceType_U32	Constant	0x000F0191	DS401 device profile with digital and analog inputs/outputs
0x1001	ERR_ErrorRegister_U8	Read only	0	
0x1003	ERR_History_ADOM			
	0x00 NumberOfEntries	Read/Write	0	
	0x01 - 0xFE ErrorEntry_DOM	Read only		
0x1006	NMT_CycleLen_U32	Read/Write	1000	
0x1008	NMT_ManufactDevName_VS	Constant		Product name (e.g. X20BC0083)
0x1009	NMT_ManufactHwVers_VS	Constant		e.g. V01.00
0x100A	NMT_ManufactSwVers_VS	Constant		e.g. V01.00
0x1010	NMT_StoreParam_REC			
	0x00 NumberOfEntries	Constant	3	
	0x01 AllParam_U32	Read/Write	0x00000001	Saves by writing "save"
	0x02 CommunicationParam_U32	Read/Write	0x00000001	Saves by writing "save"
	0x03 ApplicationParam_U32	Read/Write	0x00000000	Not supported
0x1011	NMT_RestoreDefParam_REC			
	0x00 NumberOfEntries	Constant	3	
	0x01 AllParam_U32	Read/Write	0x00000001	Resets by writing "load"
	0x02 CommunicationParam_U32	Read/Write	0x00000001	Resets by writing "load"
	0x03 ApplicationParam_U32	Read/Write	0x00000000	Not supported
0x1018	NMT_IdentityObject_REC			
	0x00 NumberOfEntries	Constant	4	
	0x01 VendorId_U32	Constant	0x100006C	CANopen vendor ID for B&R
	0x02 ProductCode_U32	Constant		Hardware ID of the product (e.g. 0x1F1E)
	0x03 RevisionNo_U32	Constant		
	0x04 SerialNo_U32	Constant		
0x1020	CFM_VerifyConfiguration_REC			
	0x00 NumberOfEntries	Constant	2	
	0x01 ConfDate_U32	Read/Write	0	
	0x02 ConfTime_U32	Read/Write	0	
0x1030	NMT_InterfaceGroup_0h_REC			
	0x00 NumberOfEntries	Constant	9	
	0x01 InterfaceIndex_U16	Read only	0	
	0x02 InterfaceDescription_VSTR	Constant		e.g. BR_X20BC0083_1
	0x03 InterfaceType_U8	Constant	6	6 → Ethernet CSMA/CD
	0x04 InterfaceMtu_U16	Constant	1500	
	0x05 InterfacePhysAddress_OSTR	Constant		MAC address: "xx:xx:xx:xx:xx:xx"
	0x06 InterfaceName_VSTR	Read only	"IF1"	
	0x07 InterfaceOperStatus_U8	Read only	1	0 = Down, 1 = Up
	0x08 InterfaceAdminState_U8	Read/Write	1	0 = Down, 1 = Up
	0x09 Valid_BOOL	Read/Write	TRUE	
0x1050	NMT_RelativeLatencyDiff_AU32			
	0x00 NumberOfEntries	Read only	254	
	0x01 - 0xFE RelativeLatencyDiff	Read only	0	
0x1101	DIA_NMTTelegCount_REC			
	0x00 NumberOfEntries	Constant	8	
	0x01 IsochrCyc_U32	Read only	0	
	0x02 IsochrRx_U32	Read only	0	
	0x03 IsochrTx_U32	Read only	0	
	0x04 AsyncRx_U32	Read only	0	
	0x05 AsyncTx_U32	Read only	0	
	0x06 SdoRx_U32	Read only	0	
	0x07 SdoTx_U32	Read only	0	
	0x08 Status_U32	Read only	0	

¹⁾ Ethernet POWERLINK communication profile specification DS301 V1.1.0, 2009, see also www.br-automation.com/en/technologies/powerlink.

Index	Name	Access	Default value	Comment
Subindex				
0x1102	DIA_ERRStatistics_REC			
0x00	NumberOfEntries	Constant	7	
0x01	HistoryEntryWrite_U32	Read only	0	
0x02	EmergencyQueueWrite_U32	Read only	0	
0x03	EmergencyQueueOverflow_U32	Read only	0	
0x04	StatusEntryChanged_U32	Read only	0	
0x05	StaticErrorBitFieldChanged_U32	Read only	0	
0x06	ExceptionResetEdgePos_U32	Read only	0	
0x07	ExceptionNewEdge_U32	Read only	0	
0x1400 - 0x1403	PDO_RxCommParam_xxxh_REC			
0x00	NumberOfEntries	Constant	2	
0x01	NodeID_U8	Read/Write	0	
0x02	MappingVersion_U8	Read/Write	0	

3.3.2 Communication objects 0x1600 to 0x1C0C

Index	Name	Access	Default value	Comment
Subindex				
0x1600	PDO_RxMappParam_00h_AU64			Default Rx mapping (DS401)
0x00	NumberOfEntries	Read/Write	20	
0x01	ObjectMapping	Read/Write	0x0008000000016200	Offset 0x0000: 8-bit → 0x6200 / 0x01
0x02	ObjectMapping	Read/Write	0x00080008000026200	Offset 0x0008: 8-bit → 0x6200 / 0x02
0x03	ObjectMapping	Read/Write	0x0008001000036200	Offset 0x0010: 8-bit → 0x6200 / 0x03
0x04	ObjectMapping	Read/Write	0x0008001800046200	Offset 0x0018: 8-bit → 0x6200 / 0x04
0x05	ObjectMapping	Read/Write	0x0008002000056200	Offset 0x0020: 8-bit → 0x6200 / 0x05
0x06	ObjectMapping	Read/Write	0x0008002800066200	Offset 0x0028: 8-bit → 0x6200 / 0x06
0x07	ObjectMapping	Read/Write	0x0008003000076200	Offset 0x0030: 8-bit → 0x6200 / 0x07
0x08	ObjectMapping	Read/Write	0x0008003800086200	Offset 0x0038: 8-bit → 0x6200 / 0x08
0x09	ObjectMapping	Read/Write	0x0010004000016411	Offset 0x0040: 16-bit → 0x6411 / 0x01
0x0A	ObjectMapping	Read/Write	0x0010005000026411	Offset 0x0050: 16-bit → 0x6411 / 0x02
0x0B	ObjectMapping	Read/Write	0x0010006000036411	Offset 0x0060: 16-bit → 0x6411 / 0x03
0x0C	ObjectMapping	Read/Write	0x0010007000046411	Offset 0x0070: 16-bit → 0x6411 / 0x04
0x0D	ObjectMapping	Read/Write	0x0010008000056411	Offset 0x0080: 16-bit → 0x6411 / 0x05
0x0E	ObjectMapping	Read/Write	0x0010009000066411	Offset 0x0090: 16-bit → 0x6411 / 0x06
0x0F	ObjectMapping	Read/Write	0x001000A000076411	Offset 0x00A0: 16-bit → 0x6411 / 0x07
0x10	ObjectMapping	Read/Write	0x001000B000086411	Offset 0x00B0: 16-bit → 0x6411 / 0x08
0x11	ObjectMapping	Read/Write	0x001000C000096411	Offset 0x00C0: 16-bit → 0x6411 / 0x09
0x12	ObjectMapping	Read/Write	0x001000D0000A6411	Offset 0x00D0: 16-bit → 0x6411 / 0x0A
0x13	ObjectMapping	Read/Write	0x001000E0000B6411	Offset 0x00E0: 16-bit → 0x6411 / 0x0B
0x14	ObjectMapping	Read/Write	0x001000F0000C6411	Offset 0x00F0: 16-bit → 0x6411 / 0x0C
0x15 - 0xFE	ObjectMapping	Read/Write	0	No mapping defined
0x1601 - 0x1603	PDO_RxMappParam_xxxh_AU64			
0x00	NumberOfEntries	Read/Write	0	
0x01 - 0xFE	ObjectMapping	Read/Write	0	No mapping defined
0x1800				
0x00	NumberOfEntries	Constant	2	
0x01	NodeID_U8	Read/Write	0	
0x02	MappingVersion_U8	Read/Write	0	
0x1A00	PDO_TxMappParam_00h_AU64			Default Tx mapping (DS401)
0x00	NumberOfEntries	Read/Write	0	
0x01	ObjectMapping	Read/Write	0x0008000000016000	0x6000 / 0x01: 8-bit → Offset 0x0000
0x02	ObjectMapping	Read/Write	0x00080008000026000	0x6000 / 0x02: 8-bit → Offset 0x0008
0x03	ObjectMapping	Read/Write	0x0008001000036000	0x6000 / 0x03: 8-bit → Offset 0x0010
0x04	ObjectMapping	Read/Write	0x0008001800046000	0x6000 / 0x04: 8-bit → Offset 0x0018
0x05	ObjectMapping	Read/Write	0x0008002000056000	0x6000 / 0x05: 8-bit → Offset 0x0020
0x06	ObjectMapping	Read/Write	0x0008002800066000	0x6000 / 0x06: 8-bit → Offset 0x0028
0x07	ObjectMapping	Read/Write	0x0008003000076000	0x6000 / 0x07: 8-bit → Offset 0x0030
0x08	ObjectMapping	Read/Write	0x0008003800086000	0x6000 / 0x08: 8-bit → Offset 0x0038
0x09	ObjectMapping	Read/Write	0x0010004000016401	0x6401 / 0x01: 16-bit → Offset 0x0040
0x0A	ObjectMapping	Read/Write	0x0010005000026401	0x6401 / 0x02: 16-bit → Offset 0x0050
0x0B	ObjectMapping	Read/Write	0x0010006000036401	0x6401 / 0x03: 16-bit → Offset 0x0060
0x0C	ObjectMapping	Read/Write	0x0010007000046401	0x6401 / 0x04: 16-bit → Offset 0x0070
0x0D	ObjectMapping	Read/Write	0x0010008000056401	0x6401 / 0x05: 16-bit → Offset 0x0080
0x0E	ObjectMapping	Read/Write	0x0010009000066401	0x6401 / 0x06: 16-bit → Offset 0x0090
0x0F	ObjectMapping	Read/Write	0x001000A000076401	0x6401 / 0x07: 16-bit → Offset 0x00A0
0x10	ObjectMapping	Read/Write	0x001000B000086401	0x6401 / 0x08: 16-bit → Offset 0x00B0
0x11	ObjectMapping	Read/Write	0x001000C000096401	0x6401 / 0x09: 16-bit → Offset 0x00C0
0x12	ObjectMapping	Read/Write	0x001000D0000A6401	0x6401 / 0x0A: 16-bit → Offset 0x00D0
0x13	ObjectMapping	Read/Write	0x001000E0000B6401	0x6401 / 0x0B: 16-bit → Offset 0x00E0
0x14	ObjectMapping	Read/Write	0x001000F0000C6401	0x6401 / 0x0C: 16-bit → Offset 0x00F0
0x15 - 0xFE	ObjectMapping	Read/Write	0	No mapping defined

Index	Name	Access	Default value	Comment
Subindex				
0x1C0A	DLL_CNCCollision_REC			
0x00	NumberOfEntries	Constant	3	
0x01	CumulativeCnt_U32	Read/Write	0	
0x02	ThresholdCnt_U32	Read only	0	
0x03	Threshold_U32	Read/Write	15	
0x1C0B	DLL_CNLossSoC_REC			
0x00	NumberOfEntries	Constant	3	
0x01	CumulativeCnt_U32	Read/Write	0	
0x02	ThresholdCnt_U32	Read only	0	
0x03	Threshold_U32	Read/Write	15	
0x1C0C	DLL_CNLossSoA_REC			
0x00	NumberOfEntries	Constant	3	
0x01	CumulativeCnt_U32	Read/Write	0	
0x02	ThresholdCnt_U32	Read only	0	
0x03	Threshold_U32	Read/Write	15	

3.3.3 Communication objects 0x1C0D to 0x1F0E

Index	Name	Access	Default value	Comment
Subindex				
0x1C0D	DLL_CNLossPReq_REC			
0x00	NumberOfEntries	Constant	3	
0x01	CumulativeCnt_U32	Read/Write	0	
0x02	ThresholdCnt_U32	Read only	0	
0x03	Threshold_U32	Read/Write	15	
0x1C0F	DLL_CNCRCErrror_REC			
0x00	NumberOfEntries	Constant	3	
0x01	CumulativeCnt_U32	Read/Write	0	
0x02	ThresholdCnt_U32	Read only	0	
0x03	Threshold_U32	Read/Write	15	
0x1C10	DLL_CNLossOfLinkCum_U32	Read/Write	0	
0x1C14	DLL_LossOfSocTolerance_U32	Read/Write	100000	
0x1E40	NWL_IpAddrTable_0h_REC			
0x00	NumberOfEntries	Constant	5	
0x01	IfIndex_U16	Read/Write	0	
0x02	Addr_IPAD	Read/Write	192.168.100.x	x = Node number
0x03	NetMask_IPAD	Read/Write	255.255.255.0	
0x04	ReasmMaxSize_U16	Read only	0	Not supported
0x05	DefaultGateway_IPAD	Read/Write	192168100254	
0x1E4A	NWL_IpGroup_REC			
0x00	NumberOfEntries	Constant	3	
0x01	Forwarding_BOOL	Read/Write	FALSE	Not supported
0x02	DefaultTTL_U16	Read/Write	64	Not supported
0x03	ForwardDatagrams_U32	Read only	0	
0x1F50	PDL_DownloadProgData_ADOM			
0x00	NumberOfEntries	Constant	1	
01	Program	Read/Write		Bus controller firmware
0x1F51	PDL_ProgCtrl_AU8			
0x00	NumberOfEntries	Constant	1	
0x01	ProgCtrl	Read/Write	1	Value must always be 1
0x1F52	PDL_LocVerApplSw_REC			
0x00	NumberOfEntries	Constant	2	
0x01	ApplSwDate_U32	Read/Write	0	
0x02	ApplSwTime_U32	Read/Write	0	
0x1F81	NMT_NodeAssignment_AU32			
0x00	NumberOfEntries	Read/Write	254	
0x01 - 0xFE	NodeAssignment	Read/Write	0	
0x1F82	NMT_FeatureFlags_U32	Constant	0x00048247	Supported: Isochronous, SDO/UDP, SDO / ASnd, dynamic mapping, multiplexed, SDO multiple read/write, PRes chaining
0x1F83	NMT_EPLVersion_U8	Constant	0x20	POWERLINK V2.0
0x1F8C	NMT_CurrNMTState_U8	Read/Write	0001 1100 (binary)	NMT_CS_NOT_ACTIVE
0x1F8D	NMT_PResPayloadLimitList_AU16			
0x00	NumberOfEntriesNumberOfEntries	Constant	254	
0x01 - 0xFE	NumberOfEntries	Read/Write	0	
0x1F93	NMT_EPLNodeID_REC			
0x00	NumberOfEntries	Constant	2	
0x01	NodeID_U8	Read only	1 to 239	Corresponds to the node number switch
0x02	NodeIDByHW_BOOL	Read only	TRUE	

Index	Name	Access	Default value	Comment
Subindex				
0x1F98	NMT_CycleTiming_REC			
0x00	NumberOfEntries	Constant	8	
0x01	IsochrTxMaxPayload_U16	Read only	1490	
0x02	IsochrRxMaxPayload_U16	Read only	1490	
0x03	PResMaxLatency_U32	Constant	2000	
0x04	PReqActPayload_U16	Read/Write	256	
0x05	PReqActPayload_U16	Read/Write	256	
0x06	ASndMaxLatency_U32	Constant	2000	
0x07	MultiplCycleCnt_U8	Read/Write	0	
0x08	AsyncMTUSize_U16	Read/Write	1500	
0x1F99	NMT_CNBasicEthernetTimeout_U32	Read/Write	5000000	
0x1F9A	NMT_HostName_VSTR	Read/Write		e.g. "EPL_102" (node number 102)
0x1F9B	NMT_MultiplCycleAssign_AU8			
0x00	NumberOfEntries	Constant	254	
0x01 - 0xFE	CycleNo	Read/Write	0	
0x1F9E	NMT_ResetCmd_U8	Read/Write	0xFF	

3.4 Device profile

B&R POWERLINK bus controllers support the CANopen device profile for generic I/O modules (DS401). According to the POWERLINK specification, range 0x6000 to 0x9FFF area is reserved for standardized device profiles in the object dictionary.

The following table lists the application objects supported by B&R POWERLINK bus controllers in accordance with DS401. The DS401 specification from CiA (CAN in Automation)¹⁾ contains a description of the objects themselves.

3.4.1 Application objects

Index	Name	Access	Default value	Comment
Subindex				
0x6000	IO_DigitalInput_AU8			Digital inputs
0x00	NumberOfEntries	Read only	254	
0x01 - 0xFE	DigitalInput	Read only		
0x6200	IO_DigitalOutput_AU8			Digital outputs
0x00	NumberOfEntries	Read only	254	
0x01 - 0xFE	DigitalOutput	Read/Write		SDO access reads/writes force values
0x6400	IO_AnalogueInput_AI8			Analog inputs (8-bit)
0x00	NumberOfEntries	Read only	254	
0x01 - 0xFE	AnalogueInput	Read only		For channels with more than 8 bits, only the 8 high-order bits are displayed here.
0x6401	IO_AnalogueInput_AI16			Analog inputs (16-bit)
0x00	NumberOfEntries	Read only	254	
0x01 - 0xFE	AnalogueInput	Read only		For channels with more than 16 bits, only the 16 high-order bits are displayed here.
0x6402	IO_AnalogueInput_AI32			Analog inputs (32-bit)
0x00	NumberOfEntries	Read only	254	
0x01 - 0xFE	AnalogueInput	Read only		
0x6410	IO_AnalogueOutput_AI8			Analog outputs (8-bit)
0x00	NumberOfEntries	Read only	254	
0x01 - 0xFE	AnalogueOutput	Read/Write		For channels with more than 8 bits, only the 8 high-order bits are displayed here. SDO access reads/writes force values
0x6411	IO_AnalogueOutput_AI16			Analog outputs (16-bit)
0x00	NumberOfEntries	Read only	254	
0x01 - 0xFE	AnalogueOutput	Read/Write		For channels with more than 16 bits, only the 16 high-order bits are displayed here. SDO access reads/writes force values
0x6412	IO_AnalogueOutput_AI32			Analog outputs (32-bit)
0x00	NumberOfEntries	Read only	254	
0x01 - 0xFE	AnalogueOutput	Read/Write		SDO access reads/writes force values
0x6423	IO_AnalogueInputIrqEnable_BOOL	Read/Write	TRUE	No function, only included for compatibility

¹⁾ CAN in Automation: DS401 V3.0 CANopen device profile for generic I/O modules, www.can-cia.org

3.5 Device profile for B&R bus controllers

In addition to the device profile for generic I/O modules (DS401) included in the previous section, a vendor-specific profile has been defined for bus controllers that is better adapted to the needs of a modular I/O system and offers extended configuration options. The range 0x2000 to 0x5FFF is reserved in the object dictionary for vendor-specific profiles.

The following tables list the vendor-specific application objects supported by B&R POWERLINK bus controllers.

3.5.1 Application objects 0x2000 to 0x2011

Index	Name	Access	Default value	Comment
Subindex				
0x2000	"X2X_CycleConfig_REC"			
0x00	"NumberOfEntries"	Constant	14	
0x01	"X2X_CycleMode_U8"	Read/Write	1	Uses X2X_CycleTimeUs_U32
0x02	"X2X_CycleFactor_S8"	Read/Write	1	
0x03	"X2X_CycleTimeUs_U32"	Read/Write	1000	X2X Link cycle time in µs
0x04	"X2X_SyncMode_U8"	Read/Write	0	Synchronizes X2X to the SoC frame
0x05	"X2X_SyncShiftUs_S32"	Read/Write	0	X2X runs without offset to POWERLINK
0x06	"X2X_SyncOutSize_U16"	Read/Write	400	
0x07	"X2X_SyncInSize_U16"	Read/Write	400	
0x08	"X2X_AsyncSize_U16"	Read/Write	100	
0x09	"X2X_PhysicalSlots_U8"	Read/Write	253	
0x0A	"X2X_StartupDelayUs_U32"	Read/Write	1500000	
0x0B	"X2X_CfgModeUploadDisable_BOOL"	Read/Write	FALSE	
0x0C	"X2X_ResponseMinUs_U16"	Read/Write	0xFFFF	
0x0D	"X2X_ResponseMaxUs_U16"	Read/Write	0	
0x0E	"X2X_ResponseAverageUs_U16"	Read/Write	0	
0x2001	"X2X_OutputConfig_REC"			
0x00	"NumberOfEntries"	Constant	9	
0x01	"X2X_OutputControl_U8"	Read/Write	0	
0x02	"X2X_OutputOffDelayUs_U32"	Read/Write	0	
0x03	"X2X_OutputForceTimeUs_U32"	Read/Write	0	
0x04	"X2X_ModuleErrorReaction_U8"	Read/Write	0	
0x05	"X2X_PollReady0_Limit_U8"	Read/Write	10	
0x06	"X2X_PollReady0_InhibitTimeMs_U16"	Read/Write	1000	
0x07	"X2X_LocalNetTime_BOOL"	Read/Write	0	
0x08	"X2X_StreamControl_U32"	Read/Write	0	
0x09	"X2X_StreamData_DOM"	Write only		
0x2005	"X2X_IoDataBasic_REC"			
0x00	"NumberOfEntries"	Constant	4	
0x01	"X2X_InputBasic_DOM"	Read only		
0x02	"X2X_OutputBasic_DOM"	Write only		
0x03	"X2X_OutputBasicWatchdogMs_U16"	Read/Write	500	
0x04	"X2X_OutputBasicLocked_BOOL"	Read/Write	FALSE	
0x2011	"DIA_StatisticErrorCount_REC"	Constant	32	
0x00	"NumberOfEntries"	Read/Write	0	
0x01	"DIA_Total_U32"	Read/Write	0	
0x02	"DIA_EthRxLost_U32"	Read/Write	0	
0x03	"DIA_EthRxOversize_U32"	Read/Write	0	
0x04	"DIA_EthRxCrcError_U32"	Read/Write	0	
0x05	"DIA_EthRxOverflow_U32"	Read/Write	0	
0x06	"DIA_EthTxCollision_U32"	Read/Write	0	
0x07	Reserved			
0x08 - 0x0F	"DIA_PhyXLinkLoss_U32"	Read/Write	0	
0x10	"DIA_XlkCycleCount_U32"	Read/Write	0	
0x11	"DIA_XlkBreakCount_U32"	Read/Write	0	
0x12	"DIA_XlkSyncErrorCount_U32"	Read/Write	0	
0x13	"DIA_XlkSyncBusyErrorCount_U32"	Read/Write	0	
0x14	"DIA_XlkSyncNoRxErrorCount_U32"	Read/Write	0	
0x15	"DIA_XlkSyncFormatErrorCount_U32"	Read/Write	0	
0x16	"DIA_XlkSyncPendingErrorCount_U32"	Read/Write	0	
0x17	"DIA_XlkAsyncErrorCount_U32"	Read/Write	0	
0x18	"DIA_XlkAsyncBusyErrorCount_U32"	Read/Write	0	
0x19	"DIA_XlkAsyncNoRxErrorCount_U32"	Read/Write	0	
0x1A	"DIA_XlkAsyncFormatErrorCount_U32"	Read/Write	0	
0x1B	"DIA_XlkAsyncPendingErrorCount_U32"	Read/Write	0	
0x1C	"DIA_XlkModuleLostWhileOperational_U32"	Read/Write	0	
0x1D	"DIA_XlkModuleNewWhileOperational_U32"	Read/Write	0	
0x1E - 0x20	Reserved			

3.5.2 Application objects 0x20A0 to 0x20FF

Index	Name	Access	Default value	Comment
Subindex				
0x20A0	"MOD_CfgCount_U8"	Read/Write	253	
0x20A1	"MOD_SlotCount_U8"	Read only		
0x20A2	"MOD_ActCount_U8"	Read only		
0x20A8	NMT_ChildIdentData_ADOM			
0x00	NumberOfEntries	Read only	1	
0x01 - 0xFE	NMT_ChildIdentData_ADOM	Read only		
0x20A9	PDL_DownloadChildProgData_ADOM			
0x00	NumberOfEntries	Read only	1	
0x01 - 0xFE	PDL_DownloadChildProgData_ADOM	Write only		
0x20B0	"MOD_NetworkStatus_AU64"			
0x00	"NumberOfEntries"	Constant	32	
0x01 - 0x20	"NetworkStatus"	Read only		The status of the first module in the group is located in the low-order byte.
0x20B1	"IO_MultiScan_DOM"	Read only		
0x20F0	"BC_InfoGeneral"			
0x00	"NumberOfEntries"	Constant	29	
0x01	"BC_BootFpgaVersion_U16"	Read only		
0x02	"BC_BootFirmwareVersion_U16"	Read only		
0x03	"BC_UpgradeFpgaVersion_U16"	Read only		
0x04	"BC_UpgradeFirmwareVersion_U16"	Read only		
0x05	Reserved			
0x06	"BC_NodeNumber_U8"	Read only		
0x07 - 0x0D	Reserved			
0x0E	"BC_IoCycleCount_U8"	Read only		
0x0F - 0x10	Reserved	Read only		
0x11	"BC_PhysicalPorts_U8"	Read only		
0x12	"BC_PhysicalLink_U8"	Read only		
0x13 - 0x14	Reserved	Read/Write	0	
0x15	"BC_UserDataWriteEnable_U32"	Read/Write		
0x16	"BC_UserData_DOM"	Read/Write		
0x17	"BC_UserDataCountdown_U16"	Read only	0	
0x18	"BC_RedundancyNetworkFlags_U8"	Read only		Only on bus controllers with cable redundancy
0x19	"BC_RedundancyNetworkIndex_U8"	Read/Write		Only on bus controllers with cable redundancy
0x1A	"BC_RedundancyTxMode_U8"	Read/Write		Only on bus controllers with cable redundancy
0x1B	Reserved			
0x1C	"BC_PhyExist_U32"	Read only		
0x1D	"BC_PhyLinked_U32"	Read only		

3.5.3 Application objects 0x21xx to 0x27xx

Index	Name	Access	Default value	Comment
Subindex				
0x21xx	"MOD_Config_xxx_REC"			
0x00	"NumberOfEntries"	Constant	254	
0x01	"MOD_ChildCfgIndex_U16"	Read/Write	0	
0x02	"MOD_ChildCfgCount_U8"	Read/Write	0	
0x03	"MOD_ChildActCount_U8"	Read only	0	
0x04	"MOD_CfgMode_U8"	Read/Write	0	Loads configuration from the I/O module
0x05	"MOD_RequestedHardwareId_U16"	Read/Write	0	Hardware ID verification disabled
0x06	"MOD_RequestedVendorId_U16"	Read/Write	0	Vendor ID verification disabled
0x07	"MOD_HardwareId_U16"	Read only		
0x08	"MOD_VendorId_U16"	Read only		
0x09	Reserved			
0x0A	"MOD_Status_U16"	Read/Write		
0x0B	"MOD_NetworkStatus_U8"	Read only		
0x0C	"MOD_BlockMask_U8"	Read only		
0x0D	"MOD_BootCount_U8"	Read/Write		
0x0E	"MOD_LastError_U8"	Read/Write		
0x0F - 0x10	Reserved			
0x11	"MOD_FirmwareVersion_U16"	Read only		
0x12	"MOD_HardwareVariant_U16"	Read only		
0x13	"MOD_SerialNo_U32"	Read only		
0x14	"MOD_PhysicalSlotNumber_U8"	Read only		
0x15	"MOD_NodeSwitch_U8"	Read only		
0x16	"MOD_RequestedSerialNo_U32"	Read/Write		
0x17	"MOD_ModuleErrorReaction_U8"	Read/Write		
0x18 - 0x1D	Reserved			
0x1E	"MOD_InputImage1_DOM"	Read only		
0x1F	"MOD_InputImage2_DOM"	Read only		
0x20	"MOD_OutputImage_DOM"	Write only		
0x21	"MOD_AsyncRead_U64"	Read/Write		
0x22	"MOD_AsyncWrite_U64"	Write only		
0x23	"MOD_Firmware_DOM"	Write only		
0x24 - 0x31	Reserved			
0x32	"MOD_FirmwareChannel_U16"	Write only	2	
0x33 - 0x59	Reserved			
0x5A	"MOD_CfgFunctionMode_U8"	Read/Write	0	Function model of the I/O module
0x5B	"MOD_CfgEntryCount_U8"	Read/Write	0	Number of configuration registers being used
0x5C - 0x63	Reserved			
0x64 - 0xC7	"MOD_CfgEntry_xx_U64"	Read/Write	0	Configuration registers 00 to 99
0x22xx	MOD_DataIn_xxx_AU8			
0x00	NumberOfEntries	Constant	254	Byte access to input register
0x01 - 0xFE	DataIn			
0x23xx	MOD_DataIn_xxx_AU16			
0x00	NumberOfEntries	Constant	254	Word access to input register
0x01 - 0xFE	DataIn			
0x24xx	MOD_DataIn_xxx_AU32			
0x00	NumberOfEntries	Constant	254	DWord access to input register
0x01 - 0xFE	DataIn			
0x25xx	MOD_DataOut_xxx_AU8			
0x00	NumberOfEntries	Constant	254	Byte access to output register
0x01 - 0xFE	DataOut			
0x26xx	MOD_DataOut_xxx_AU16			
0x00	NumberOfEntries	Constant	254	Word access to output register
0x01 - 0xFE	DataOut			
0x27xx	MOD_DataOut_xxx_AU32			
0x00	NumberOfEntries	Constant	254	DWord access to output register
0x01 - 0xFE	DataOut			

4 Description of B&R device objects

4.1 X2X_CycleConfig_REC

Object 0x2000

This object specifies the parameters for the X2X Link cycle configuration.

Index	0x2000
Name	X2X_CycleConfig_REC
Data type	X2X_CycleConfig_TYPE
Object type	RECORD

NumberOfEntries

Subindex	0x00
Name	NumberOfEntries
Range of values	14
Data type	-
Default value	14
Access rights	Constant
PDO mapping	No

X2X_CycleMode_U8

Subindex	0x01
Name	X2X_CycleMode_U8
Data type	UNSIGNED8
Range of values	0 to 1
Default value	1
Access rights	Read/Write
PDO mapping	No

X2X_CycleMode_U8 defines whether the X2X cycle should be defined or automatically adjusted to the POWERLINK cycle.

Value	Description
0	The X2X cycle length is derived from the POWERLINK cycle NMT_CycleLen_U32 (0x1006, see section " Communication objects 0x1000 to 0x1403 " on page 20) and the factor X2X_CycleFactor_S8.
1	The X2X cycle length is defined in X2X_CycleTimeUs_U32.

X2X_CycleFactor_S8

Subindex	0x02
Name	X2X_CycleFactor_S8
Data type	SIGNED8
Range of values	-128 to -1 or 1 to 127
Default value	1
Access rights	Read/Write
PDO mapping	No

If X2X_CycleMode_U8 has the value 0, this subobject specifies the factor used to calculate the X2X cycle length from the POWERLINK cycle length (NMT_CycleLen_U32) (0x1006, see section "[Communication objects 0x1000 to 0x1403](#)" on page 20).

Value	Description
-n	n POWERLINK cycles result in 1 X2X cycle (X2X Link running slower than POWERLINK).
+n	1 POWERLINK cycle results in n X2X cycles (X2X Link running faster than POWERLINK)

X2X_CycleTimeUs_U32

Subindex	0x03
Name	X2X_CycleTimeUs_U32
Data type	UNSIGNED32
Range of values	0 to 32000
Default value	1000
Access rights	Read/Write
PDO mapping	No

If X2X_CycleMode_U8 has the value 1, this subobject specifies the X2X cycle length in microseconds.

X2X_SyncMode_U8

Subindex	0x04
Name	X2X_SyncMode_U8
Data type	UNSIGNED8
Range of values	0 to 1
Default value	0
Access rights	Read/Write
PDO mapping	No

X2X_SyncMode_U8 defines the moment when X2X Link is synchronized with POWERLINK.

Value	Description
0	X2X Link is synchronized to the POWERLINK network's "Start of Cyclic" frame.
1	X2X Link is synchronized to the POWERLINK network's "Poll request".

Synchronizing X2X Link to the poll request achieves a faster reaction for inputs and outputs.

X2X Link networks behind different bus controllers are no longer synchronous with one another, however. Since the moment the poll request is made is not clearly defined, adding/removing stations can shift the moment of synchronization.

X2X_SyncShiftUs_S32

Subindex	0x05
Name	X2X_SyncShiftUs_S32
Data type	SIGNED32
Range of values	-2,147,483,648 to 2147483647
Default value	0
Access rights	Read/Write
PDO mapping	No

X2X_SyncShiftUs_S32 defines the phase shift between POWERLINK and X2X Link in microseconds. The value 0 means that the synchronous X2X output frame is transmitted at the same time as the POWERLINK SoC frame.

X2X_SyncOutSize_U16

Subindex	0x06
Name	X2X_SyncOutSize_U16
Data type	UNSIGNED16
Range of values	10 to 1490
Default value	400
Access rights	Read/Write
PDO mapping	No

X2X_SyncOutSize_U16 defines the length of the synchronous X2X output frame.

Information:

X2X_SyncInSize_U16 and **X2X_SyncOutSize_U16** must have the same value!

X2X_SyncInSize_U16

Subindex	0x07
Name	X2X_SyncInSize_U16
Data type	UNSIGNED16
Range of values	10 to 1490
Default value	400
Access rights	Read/Write
PDO mapping	No

X2X_SyncInSize_U16 defines the length of the synchronous X2X input frame.

Information:

X2X_SyncInSize_U16 and **X2X_SyncOutSize_U16** must have the same value!

X2X_AsyncSize_U16

Subindex	0x08
Name	X2X_AsyncSize_U16
Data type	UNSIGNED16
Range of values	20 to 800
Default value	100
Access rights	Read/Write
PDO mapping	No

X2X_AsyncSize_U16 defines the length of the asynchronous X2X frame.

X2X_PhysicalSlots_U8

Subindex	0x09
Name	X2X_PhysicalSlots_U8
Data type	UNSIGNED8
Range of values	0 to 255
Default value	253
Access rights	Read/Write
PDO mapping	No

X2X_PhysicalSlots_U8 defines how many physical slots are started by the X2X master.

X2X_StartupDelayUs_U32

Subindex	0x0A
Name	X2X_StartupDelayUs_U32
Data type	UNSIGNED32
Range of values	0 to 4294967295
Default value	1500000
Access rights	Read/Write
PDO mapping	No

The bus controller can only be switched to the OPERATIONAL state when the X2X Link network has completely finished booting. Booting the X2X Link network is considered completely finished when no new I/O modules are registered during the period X2X_StartupDelayUs_U32.

Example

Increasing this value:

10 I/O modules are connected to a bus controller. The power supply for the last 2 modules is always switched on 5 seconds after the power supply for the other modules has been switched on. By default, the bus controller would wait an additional 1.5 seconds after the eighth module is initialized. During this time, the ninth and tenth modules are still not powered, however. In order for the bus controller to also wait for the last 2 modules, the value of X2X_StartupDelayUs_U32 must be set to at least 5 seconds.

X2X_CfgModeUploadDisable_BOOL

Subindex	0x0B
Name	X2X_CfgModeUploadDisable_BOOL
Data type	BOOLEAN
Range of values	TRUE, FALSE
Default value	FALSE
Access rights	Read/Write
PDO mapping	No

The automatic startup of X2X modules can be disabled for the entire X2X Link network using X2X_CfgModeUploadDisable_BOOL. If the value is set to FALSE, then modules where MOD_CfgMode_U8 = 0 are started automatically.

X2X_ResponseMinUs_U16

Subindex	0x0C
Name	X2X_ResponseMinUs_U16
Data type	UNSIGNED16
Range of values	0 to 65535
Default value	65535
Access rights	Read/Write
PDO mapping	No

The minimum response time in microseconds on the X2X Link network can be read using X2X_ResponseMinUs_U16. A write operation resets this value back to 65,535.

X2X_ResponseMaxUs_U16

Subindex	0x0D
Name	X2X_ResponseMaxUs_U16
Data type	UNSIGNED16
Range of values	0 to 65535
Default value	0
Access rights	Read/Write
PDO mapping	No

The maximum response time in microseconds on the X2X Link network can be read using X2X_ResponseMaxUs_U16. A write operation resets this value back to 0.

X2X_ResponseAverageUs_U16

Subindex	0x0E
Name	X2X_ResponseAverageUs_U16
Data type	UNSIGNED16
Range of values	0 to 65535
Default value	0
Access rights	Read/Write
PDO mapping	No

The average response time in microseconds on the X2X Link network can be read using X2X_ResponseAverageUs_U16. The last 8 cycles are taken into account. A write operation resets [X2X_ResponseMinUs_U16](#) and [X2X_ResponseMaxUs_U16](#).

4.2 X2X_OutputConfig_REC**Object 0x2001**

This object specifies the X2X Link output parameters.

Index	0x2001
Name	X2X_OutputConfig_REC
Data type	X2X_OutputConfig_TYPE
Object type	RECORD

NumberOfEntries

Subindex	0x00
Name	NumberOfEntries
Data type	
Range of values	9
Default value	9
Access rights	Constant
PDO mapping	No

X2X_OutputControl_U8

Subindex	0x01
Name	X2X_OutputControl_U8
Data type	UNSIGNED8
Range of values	0 to 1
Default value	0
Access rights	Read/Write
PDO mapping	No

X2X_OutputControl_U8 defines which values are output on the X2X Link network if the bus controller on the POWERLINK network is not in the NMT_CS_OPERATIONAL state.

Value	Description
0	Resets the outputs to 0
1	Sets the outputs to preconfigured default values

X2X_OutputOffDelayUs_U32

Subindex	0x02
Name	X2X_OutputOffDelayUs_U32
Data type	UNSIGNED32
Range of values	0 to 4294967295
Default value	0
Access rights	Read/Write
PDO mapping	No

After the connection to the POWERLINK MN is lost, the outputs on the X2X Link network are reset to their default values. X2X_OutputOffDelayUs_U32 defines the time span (in microseconds) after which this reset takes place.

X2X_OutputForceTimeUs_U32

Subindex	0x03
Name	X2X_OutputForceTimeUs_U32
Data type	UNSIGNED32
Range of values	0 to 4294967295
Default value	0
Access rights	Read/Write
PDO mapping	No

Setting X2X_OutputForceTimeUs_U32 to a value greater than 0 forces permanent values on the outputs on the X2X Link network. The bus controller decrements this parameter down to 0.

X2X_ModuleErrorReaction_U8

Subindex	0x04
Name	X2X_ModuleErrorReaction_U8
Data type	UNSIGNED8
Range of values	0 to 255
Default value	0
Access rights	Read/Write
PDO mapping	No

X2X_ModuleErrorReaction_U8 defines the behavior of the bus controller if there is a faulty module configuration on the X2X Link network.

Bit	Description
0	If set, does not switch to READY_TO_OPERATE mode if a configured module on the X2X Link network is missing.
1	If set, does not switch to READY_TO_OPERATE mode if a configured module on the X2X Link network does not correspond to the one that is actually connected.
2	If set, switches back from OPERATIONAL to PRE_OPERATIONAL_1 mode in the event of a module error.

X2X_PollReady0_Limit_U8

Subindex	0x05
Name	X2X_PollReady0_Limit_U8
Data type	UNSIGNED8
Range of values	0 to 255
Default value	10
Access rights	Read/Write
PDO mapping	No

The outputs are reset to default values after receiving more than the number of PReq frames whose ReadyFlag is not set than is configured in X2X_PollReady0_Limit_U8. This applies at least for the time span set in [X2X_PollReady0_InhibitTimeMs_U16](#). Setting this to 0 disables the check for PReq ReadyFlags.

X2X_PollReady0_InhibitTimeMs_U16

Subindex	0x06
Name	X2X_PollReady0_InhibitTimeMs_U16
Data type	UNSIGNED16
Range of values	0 to 65535
Default value	1000
Access rights	Read/Write
PDO mapping	No

X2X_PollReady0_InhibitTimeMs_U16 specifies the time span (in milliseconds) in which PReq frames with an enabled ReadyFlag must be received by the bus controller until the transferred values are switched through to the outputs.

X2X_LocalNetTime_BOOL

Subindex	0x07
Name	X2X_LocalNetTime_BOOL
Data type	BOOLEAN
Range of values	TRUE, FALSE
Default value	FALSE
Access rights	Read/Write
PDO mapping	No

X2X_LocalNetTime_BOOL defines whether the bus controller should locally generate the NetTime for X2X NetTime synchronization. This can be used, for example, to operate NetTime-dependent modules (e.g. X20DS1319) in basic Ethernet mode or behind a POWERLINK master that doesn't support RelativeTime in the SoC frame.

X2X_StreamControl_U32

Subindex	0x08
Name	X2X_StreamControl_U32
Data type	UNSIGNED32
Range of values	0 to 4294967295
Default value	-
Access rights	Read/Write
PDO mapping	No

X2X_StreamControl_U32 is used to configure the X2X_StreamData_DOM stream object.

Information:

This object is reserved for B&R.

Bit	Description
0 - 15	Client index
16 - 23	Client subindex
24 - 31	Client node ID

The node ID / index / subindex specify the destination to which the received data is sent back to the client via SDO/UDP. If all bits are set to 0, streaming is disabled.

X2X_StreamData_DOM

Subindex	0x09
Name	X2X_StreamData_DOM
Data type	DOMAIN
Range of values	-
Default value	-
Access rights	Read only
PDO mapping	No

The streaming data object (transmitted data) is written to X2X_StreamData_DOM.

Information:

This object is reserved for B&R.

4.3 X2X_IoDataBasic_REC

Object 0x2005

This object is used to access I/O data in basic Ethernet mode.

Index	0x2005
Name	X2X_IoDataBasic_REC
Data type	X2X_IoDataBasic_TYPE
Object type	RECORD

NumberOfEntries

Subindex	0x00
Name	NumberOfEntries
Data type	
Range of values	4
Default value	4
Access rights	Constant
PDO mapping	No

X2X_InputBasic_DOM

Subindex	0x01
Name	X2X_InputBasic_DOM
Data type	DOMAIN
Range of values	-
Default value	-
Access rights	Read only
PDO mapping	No

A complete input data frame is read using X2X_InputBasic_DOM. The data in this object corresponds to the payload data of a PRes frame from the bus controller.

Information:

This function is only available in basic Ethernet mode.

X2X_OutputBasic_DOM

Subindex	0x02
Name	X2X_OutputBasic_DOM
Data type	DOMAIN
Range of values	-
Default value	-
Access rights	Write only
PDO mapping	No

A complete output data frame is written using X2X_OutputBasic_DOM. The data in this object corresponds to the payload data of a PReq frame for the bus controller.

Information:

This function is only available in basic Ethernet mode.

X2X_OutputBasicWatchdogMs_U16

Subindex	0x03
Name	X2X_OutputBasicWatchdogMs_U16
Data type	UNSIGNED16
Range of values	0 to 65535
Default value	500
Access rights	Read/Write
PDO mapping	No

X2X_OutputBasicWatchdogMs_U16 defines the time span (in milliseconds) after which the outputs the outputs are reset to default values in basic Ethernet mode. The watchdog is reset to the value configured here by writing to [X2X_OutputBasic_DOM](#).

X2X_OutputBasicLocked_BOOL

Subindex	0x04
Name	X2X_OutputBasicLocked_BOOL
Data type	BOOLEAN
Range of values	TRUE, FALSE
Default value	FALSE
Access rights	Read/Write
PDO mapping	No

This flag is set to TRUE if the watchdog configured in [X2X_OutputBasicWatchdogMs_U16](#) expires. The outputs are then fixed to default values and have to be unlocked by writing 0 to this subobject.

4.4 DIA_StatisticErrorCount_REC**Object 0x2011**

This object is used to read statistical error values.

Index	0x2011
Name	DIA_StatisticErrorCount_REC
Data type	DIA_StatisticErrorCount_TYPE
Object type	RECORD

NumberOfEntries

Subindex	0x00
Name	NumberOfEntries
Data type	
Range of values	32
Default value	32
Access rights	Constant
PDO mapping	No

DIA_Total_U32

Subindex	0x01
Name	DIA_Total_U32
Data type	UNSIGNED32
Range of values	0 to 4294967295
Default value	0
Access rights	Read/Write
PDO mapping	No

DIA_Total_U32 contains the total of all counters listed here (without [DIA_XlkCycleCount_U32](#)). Writing the value 0 to this object resets all counters to 0.

DIA_EthRxLost_U32

Subindex	0x02
Name	DIA_EthRxLost_U32
Data type	UNSIGNED32
Range of values	0 to 4294967295
Default value	0
Access rights	Read/Write
PDO mapping	No

DIA_EthRxLost_U32 specifies the number of received frames lost due to performance problems on the bus controller.

DIA_EthRxOversize_U32

Subindex	0x03
Name	DIA_EthRxOversize_U32
Data type	UNSIGNED32
Range of values	0 to 4294967295
Default value	0
Access rights	Read/Write
PDO mapping	No

DIA_EthRxOversize_U32 specifies the number of oversized frames received (jumbo frames >1500 bytes).

DIA_EthRxCrcError_U32

Subindex	0x04
Name	DIA_EthRxCrcError_U32
Data type	UNSIGNED32
Range of values	0 to 4294967295
Default value	0
Access rights	Read/Write
PDO mapping	No

DIA_EthRxCrcError_U32 specifies the number of frames received with a fault checksum (CRC).

DIA_EthRxOverflow_U32

Subindex	0x05
Name	DIA_EthRxOverflow_U32
Data type	UNSIGNED32
Range of values	0 to 4294967295
Default value	0
Access rights	Read/Write
PDO mapping	No

DIA_EthRxOverflow_U32 specifies the number of received frames lost due to performance problems on the bus controller.

DIA_EthTxCollision_U32

Subindex	0x06
Name	DIA_EthTxCollision_U32
Data type	UNSIGNED32
Range of values	0 to 4294967295
Default value	0
Access rights	Read/Write
PDO mapping	No

DIA_EthTxCollision_U32 specifies the number of collisions that occurred during transmission.

DIA_PhyXLinkLoss_U32

Subindex	0x08 - 0x0F
Name	DIA_PhyXLinkLoss_U32
Data type	UNSIGNED32
Range of values	0 to 4294967295
Default value	0
Access rights	Read/Write
PDO mapping	No

DIA_PhyXLinkLoss_U32 specifies how often the link to an Ethernet interface was lost. The assignment of PhyX to the subindexes is listed in the following table.

Subindex	Physical interface
0x08	Phy7
0x09	Phy8
0x0A - 0x0F	Phy1 to Phy6

DIA_XlkCycleCount_U32

Subindex	0x10
Name	DIA_XlkCycleCount_U32
Data type	UNSIGNED32
Range of values	0 to 4294967295
Default value	0
Access rights	Read/Write
PDO mapping	No

DIA_XlkCycleCount_U32 specifies the number of X2X Link cycles carried out.

DIA_XlkBreakCount_U32

Subindex	0x11
Name	DIA_XlkBreakCount_U32
Data type	UNSIGNED32
Range of values	0 to 4294967295
Default value	0
Access rights	Read/Write
PDO mapping	No

DIA_XlkCycleCount_U32 specifies the number of X2X Link cycles with a set break flag.

DIA_XlkSyncErrorCount_U32

Subindex	0x12
Name	DIA_XlkSyncErrorCount_U32
Data type	UNSIGNED32
Range of values	0 to 4294967295
Default value	0
Access rights	Read/Write
PDO mapping	No

DIA_XlkSyncErrorCount_U32 specifies the number of sync errors on the X2X Link network.

DIA_XlkSyncBusyErrorCount_U32

Subindex	0x13
Name	DIA_XlkSyncBusyErrorCount_U32
Data type	UNSIGNED32
Range of values	0 to 4294967295
Default value	0
Access rights	Read/Write
PDO mapping	No

DIA_XlkSyncBusyErrorCount_U32 specifies the number of bus timing errors from sync frames on the X2X Link network.

DIA_XlkSyncNoRxErrorCount_U32

Subindex	0x14
Name	DIA_XlkSyncNoRxErrorCount_U32
Data type	UNSIGNED32
Range of values	0 to 4294967295
Default value	0
Access rights	Read/Write
PDO mapping	No

DIA_XlkSyncNoRxErrorCount_U32 specifies the number of frame timing errors from sync frames on the X2X Link network.

DIA_XlkSyncFormatErrorCount_U32

Subindex	0x15
Name	DIA_XlkSyncFormatErrorCount_U32
Data type	UNSIGNED32
Range of values	0 to 4294967295
Default value	0
Access rights	Read/Write
PDO mapping	No

DIA_XlkSyncFormatErrorCount_U32 specifies the number of CRC errors from sync frames on the X2X Link network.

DIA_XlkSyncPendingErrorCount_U32

Subindex	0x16
Name	DIA_XlkSyncPendingErrorCount_U32
Data type	UNSIGNED32
Range of values	0 to 4294967295
Default value	0
Access rights	Read/Write
PDO mapping	No

DIA_XlkSyncPendingErrorCount_U32 specifies the number of cases in which a sync frame could not be sent on the X2X Link network because another frame was being received.

DIA_XlkAsyncErrorCount_U32

Subindex	0x17
Name	DIA_XlkAsyncErrorCount_U32
Data type	UNSIGNED32
Range of values	0 to 4294967295
Default value	0
Access rights	Read/Write
PDO mapping	No

DIA_XlkAsyncErrorCount_U32 specifies the number of errors from async frames on the X2X Link network.

DIA_XlkAsyncBusyErrorCount_U32

Subindex	0x18
Name	DIA_XlkAsyncBusyErrorCount_U32
Data type	UNSIGNED32
Range of values	0 to 4294967295
Default value	0
Access rights	Read/Write
PDO mapping	No

DIA_XlkAsyncBusyErrorCount_U32 specifies the number of bus timing errors from async frames on the X2X Link network.

DIA_XlkAsyncNoRxErrorCount_U32

Subindex	0x19
Name	DIA_XlkAsyncNoRxErrorCount_U32
Data type	UNSIGNED32
Range of values	0 to 4294967295
Default value	0
Access rights	Read/Write
PDO mapping	No

DIA_XlkAsyncNoRxErrorCount_U32 specifies the number of frame timing errors from async frames on the X2X Link network.

DIA_XlkAsyncFormatErrorCount_U32

Subindex	0x1A
Name	DIA_XlkAsyncFormatErrorCount_U32
Data type	UNSIGNED32
Range of values	0 to 4294967295
Default value	0
Access rights	Read/Write
PDO mapping	No

DIA_XlkAsyncFormatErrorCount_U32 specifies the number of CRC errors from async frames on the X2X Link network.

DIA_XlkAsyncPendingErrorCount_U32

Subindex	0x1B
Name	DIA_XlkAsyncPendingErrorCount_U32
Data type	UNSIGNED32
Range of values	0 to 4294967295
Default value	0
Access rights	Read/Write
PDO mapping	No

DIA_XlkAsyncPendingErrorCount_U32 specifies the number of cases in which an async frame could not be sent on the X2X Link network because another frame was being received.

DIA_XlkModuleLostWhileOperational_U32

Subindex	0x1C
Name	DIA_XlkModuleLostWhileOperational_U32
Data type	UNSIGNED32
Range of values	0 to 4294967295
Default value	0
Access rights	Read/Write
PDO mapping	No

The DIA_XlkModuleLostWhileOperational_U32 counter specifies how often a module was removed from the bus during operation.

DIA_XlkModuleNewWhileOperational_U32

Subindex	0x1D
Name	DIA_XlkModuleNewWhileOperational_U32
Data type	UNSIGNED32
Range of values	0 to 4294967295
Default value	0
Access rights	Read/Write
PDO mapping	No

The DIA_XlkModuleNewWhileOperational_U32 counter specifies how often a new module was detected on the bus during operation.

4.5 MOD_CfgCount_U8

Object 0x20A0

Subindex	0x20A0
Name	MOD_CfgCount_U8
Data type	UNSIGNED8
Range of values	0 to 255
Default value	253
Object type	VAR
Access rights	Read/Write
PDO mapping	No

MOD_CfgCount_U8 specifies the number of configured I/O modules. The X2X Link master starts up to the number of modules specified here.

4.6 MOD_SlotCount_U8

Object 0x20A1

Subindex	0x20A1
Name	MOD_SlotCount_U8
Data type	UNSIGNED8
Range of values	0 to 255
Default value	-
Object type	VAR
Access rights	Read only
PDO mapping	No

MOD_SlotCount_U8 specifies the number of physical slots found. Empty X2X slots are also counted.

4.7 MOD_ActCount_U8

Object 0x20A2

Subindex	0x20A2
Name	MOD_ActCount_U8
Data type	UNSIGNED8
Range of values	0 to 255
Default value	-
Object type	VAR
Access rights	Read only
PDO mapping	No

MOD_ActCount_U8 specifies the number of active modules on the X2X Link network.

4.8 NMT_ChildIdentData_ADOM

Object 0x20A8

This object returns the identification data of the connected I/O modules according to the definition in EPSG DSP 311.

Index	0x20A0
Name	NMT_ChildIdentData_ADOM
Data type	DOMAIN
Object type	ARRAY

NumberOfEntries

Subindex	0x00
Name	NumberOfEntries
Data type	-
Range of values	1 to 253
Default value	1
Access rights	Read only
PDO mapping	No

NMT_ChildIdentData_ADOM

Subindex	0x01 to 0xFE
Name	NMT_ChildIdentData_ADOM
Data type	-
Range of values	DOMAIN
Default value	-
Access rights	Read only
PDO mapping	No

The subindexes refer to the respective I/O module (e.g. subindex 1 = first I/O module).

Each subindex contains 6 UINT32 entries.

- VendorID: Vendor ID, corresponds to 0x0100006C
- ProductCode: Corresponds to the module's hardware ID
- RevisionNo: Corresponds to the hardware variant of the module
- SerialNo: Corresponds to the module's serial number
- ApplSwdata: "0" - Value not supported by module
- ApplSwTime: Module's firmware version

Empty slots return "0" for all element entries.

4.9 PDL_DownloadChildProgData_ADOM**Object 0x20A9**

This object corresponds to the firmware object according to the definition in EPSG DSP 311.

Index	0x20A9
Name	PDL_DownloadChildProgData_ADOM
Data type	DOMAIN
Object type	ARRAY

NumberOfEntries

Subindex	0x00
Name	NumberOfEntries
Data type	-
Range of values	1 to 253
Default value	1
Access rights	Read only
PDO mapping	No

PDL_DownloadChildProgData_ADOM

Subindex	0x01 to 0xFE
Name	PDL_DownloadChildProgData_ADOM
Data type	-
Range of values	DOMAIN
Default value	-
Access rights	Write only
PDO mapping	No

PDL_DownloadChildProgData_ADOM can be used for updating the firmware on I/O modules. The subindexes refer to the respective I/O module (e.g. subindex 1 = first I/O module).

4.10 MOD_NetworkStatus_AU64

Object 0x20B0

This object can be used to read the network status bytes in groups of 8 modules.

Index	0x20B0
Name	MOD_NetworkStatus_AU64
Data type	UNSIGNED64
Object type	ARRAY

NumberOfEntries

Subindex	0x00
Name	NumberOfEntries
Data type	
Range of values	32
Default value	32
Access rights	Constant
PDO mapping	No

NetworkStatus

Subindex	0x01 - 0x20
Name	NetworkStatus
Data type	UNSIGNED64
Range of values	0 to 255 per module
Default value	-
Access rights	Read only
PDO mapping	TPDO

Each subindex encodes the network status of up to 8 X2X Link modules. The first module in the group of eight is located at the least significant byte.

4.11 IO_MultiScan_DOM

Object 0x20B1

Subindex	0x20B1
Name	IO_MultiScan_DOM
Data type	DOMAIN
Range of values	-
Default value	-
Object type	VAR
Access rights	Read only
PDO mapping	TPDO

IO_MultiScan_DOM can be used to map multiple X2X Link cycles into one PRes frame. If a transmit mapping of 20 bytes is created, for example, and IO_MultiScan_DOM also mapped with 20 bytes, then 2 X2X Link cycles will be transferred in each PRes frame. If the IO_MultiScan_DOM object is mapped twice with 20 bytes each, then a total of 3 X2X Link cycles is transferred.

This function is used if X2X Link is working with a lower (faster) cycle time than POWERLINK and all I/O data should still be transferred to the PLC. If X2X Link is running at 1 ms and POWERLINK at 5 ms, for example, all 5 X2X Link cycles would be transferred in each POWERLINK PRes frame.

4.12 BC_InfoGeneral

Object 0x20F0

Internal bus controller information.

Index	0x20F0
Name	BC_Internal_REC
Data type	BC_Internal_TYPE
Object type	RECORD

NumberOfEntries

Subindex	0x00
Name	NumberOfEntries
Data type	
Range of values	29
Default value	29
Access rights	Constant
PDO mapping	No

BC_BootFpgaVersion_U16

Subindex	0x01
Name	BC_BootFpgaVersion_U16
Data type	UNSIGNED16
Range of values	0 to 65535
Default value	-
Access rights	Read only
PDO mapping	No

BC_BootFpgaVersion_U16 is used to read the FPGA version of bootable flash memory.

BC_BootFirmwareVersion_U16

Subindex	0x02
Name	BC_BootFirmwareVersion_U16
Data type	UNSIGNED16
Range of values	0 to 65535
Default value	-
Access rights	Read only
PDO mapping	No

BC_BootFirmwareVersion_U16 is used to read the firmware version of bootable flash memory.

BC_UpgradeFpgaVersion_U16

Subindex	0x03
Name	BC_UpgradeFpgaVersion_U16
Data type	UNSIGNED16
Range of values	0 to 65535
Default value	-
Access rights	Read only
PDO mapping	No

BC_UpgradeFpgaVersion_U16 is used to read the FPGA version of upgrade flash memory.

BC_UpgradeFirmwareVersion_U16

Subindex	0x04
Name	BC_UpgradeFirmwareVersion_U16
Data type	UNSIGNED16
Range of values	0 to 65535
Default value	-
Access rights	Read only
PDO mapping	No

BC_UpgradeFirmwareVersion_U16 is used to read the firmware version of upgrade flash memory.

BC_NodeNumber_U8

Subindex	0x06
Name	BC_NodeNumber_U8
Data type	UNSIGNED8
Range of values	0 to 255
Default value	-
Access rights	Read only
PDO mapping	No

BC_NodeNumber_U8 shows the current setting of the node number switch.

BC_IoCycleCount_U8

Subindex	0x0E
Name	BC_IoCycleCount_U8
Data type	UNSIGNED8
Range of values	0 to 255
Default value	-
Access rights	Read only
PDO mapping	TPDO

BC_IoCycleCount_U8 contains the last cycle counter received on the X2X Link network.

BC_PhysicalPorts_U8

Subindex	0x11
Name	BC_PhysicalPorts_U8
Data type	UNSIGNED8
Range of values	0 to 255
Default value	-
Access rights	Read only
PDO mapping	No

BC_PhysicalPorts_U8 indicates which physical Ethernet interfaces exist on the device. Bit 0 stands for IF1, bit 1 for IF2, etc.

BC_PhysicalLink_U8

Subindex	0x12
Name	BC_PhysicalLink_U8
Data type	UNSIGNED8
Range of values	0 to 255
Default value	-
Access rights	Read only
PDO mapping	No

BC_PhysicalLink_U8 indicates the link status of the physical Ethernet interfaces. Bit 0 stands for IF1, bit 1 for IF2, etc.

BC_UserDataWriteEnable_U32

Subindex	0x15
Name	BC_UserDataWriteEnable_U32
Data type	UNSIGNED32
Range of values	0 to 4294967295
Default value	-
Access rights	Read/Write
PDO mapping	No

BC_UserDataWriteEnable_U32 enables write access to BC_UserData_DOM. The value 0x65766173 must be written for this. This value is reset to 0 after writing to [BC_UserData_DOM](#).

BC_UserData_DOM

Subindex	0x16
Name	BC_UserData_DOM
Data type	DOMAIN
Range of values	-
Default value	-
Access rights	Read/Write
PDO mapping	No

User-specific data up to 1024 bytes can be written to BC_UserData_DOM.

Please note the following when writing user-specific data:

- Write 0x65766173 to [BC_UserDataWriteEnable_U32](#) to enable (an abort code will be returned otherwise).
- Data is stored directly in flash memory; old data is deleted.
- It can take up to 2 seconds until the write operation is confirmed (SDO command layer ACK).
- Data is only deleted explicitly; this data remains even during firmware updates.
- Reading is permitted anytime.
- All data is set to 0 if the power supply is interrupted during the write phase.
- After the data is written, this object is locked for 0.5 s per byte. After writing 50 bytes to an object, for example, the object cannot be written to for 25 s (this protects the flash memory from excessive write operations).

The following abort codes can be returned after a read operation:

Value	Description
0x08000021	No memory buffer for reading available or write operation currently active
0x08000000	No data available or data invalid

The following abort codes can be returned after a write operation:

Value	Description
0x08000021	Object locked due to earlier write operation (flash locking)
0x08000000	Write operation disabled (see " BC_UserDataWriteEnable_U32 " on page 42)

BC_UserDataCountdown_U16

Subindex	0x17
Name	BC_UserDataCountdown_U16
Data type	UNSIGNED16
Range of values	0 to 65535
Default value	-
Access rights	Read only
PDO mapping	No

BC_UserDataCountdown_U16 counts the number of seconds until new user-specific data is permitted to be written.

BC_RedundancyNetworkFlags_U8

Subindex	0x18
Name	BC_RedundancyNetworkFlags_U8
Data type	UNSIGNED8
Range of values	0 to 255
Default value	-
Access rights	Read only
PDO mapping	No

BC_RedundancyNetworkFlags_U8 indicates the available networks.

Bit	Description
0	First network determined
1	Second network determined

Information:

This object is only used on POWERLINK bus controllers with a cable redundancy system (X20BC8084).

BC_RedundancyNetworkIndex_U8

Subindex	0x19
Name	BC_RedundancyNetworkIndex_U8
Data type	UNSIGNED8
Range of values	0 to 255
Default value	-
Access rights	Read/Write
PDO mapping	No

BC_RedundancyNetworkIndex_U8 indicates the network to which the bus controller is currently connected. A write operation can be carried out to force a certain network to be used. This only works if valid network traffic is determined on the selected interface.

Information:

This object is only used on POWERLINK bus controllers with a cable redundancy system (X20BC8084).

BC_RedundancyTxMode_U8

Subindex	0x1A
Name	BC_RedundancyTxMode_U8
Data type	UNSIGNED8
Range of values	0 to 255
Default value	-
Access rights	Read/Write
PDO mapping	No

BC_RedundancyTxMode_U8 specifies whether transmission should take place only on the selected interface (value 0) or both interfaces simultaneously (value 1).

Information:

This object is only used on POWERLINK bus controllers with a cable redundancy system (X20BC8084).

BC_PhyExist_U32

Subindex	0x1C
Name	BC_PhyExist_U32
Data type	UNSIGNED32
Range of values	0 to 4294967295
Default value	-
Access rights	Read only
PDO mapping	No

BC_PhyExist_U32 uses bits to specify whether a certain physical interface exists. Bit 0 corresponds to interface 0, bit 1 to interface 1, etc.

BC_PhyLinked_U32

Subindex	0x1D
Name	BC_PhyLinked_U32
Data type	UNSIGNED32
Range of values	0 to 4294967295
Default value	-
Access rights	Read only
PDO mapping	No

BC_PhyLinked_U32 uses bits to specify whether a link to a physical interface exists. Bit 0 corresponds to interface 0, bit 1 to interface 1, etc.

4.13 MOD_Config_xxx_REC**Object 21xx**

These objects can be used to configure the individual modules on the X2X Link network. Object 0x2100 represents the power supply module (e.g. X20PS9400), object 0x2101 the first I/O module in the X2X Link network, object 0x2102 the second I/O module, etc.

Index	0x2100 - 0x21FE
Name	MOD_Config_xxx_REC
Data type	MOD_Config_xxx_TYPE
Object type	RECORD

NumberOfEntries

Subindex	0x00
Name	NumberOfEntries
Data type	
Range of values	254
Default value	254
Access rights	Constant
PDO mapping	No

MOD_ChildCfgIndex_U16

Subindex	0x01
Name	MOD_ChildCfgIndex_U16
Data type	UNSIGNED16
Range of values	0 or 0x2101 to 0x21FE
Default value	0
Access rights	Read/Write
PDO mapping	No

This subindex is reserved for future expansions.

MOD_ChildCfgIndex_U16 specifies the index for the first submodule. The value 0 specifies that no submodules exist for this module.

MOD_ChildCfgCount_U8

Subindex	0x02
Name	MOD_ChildCfgCount_U8
Data type	UNSIGNED8
Range of values	0 to 255
Default value	0
Access rights	Read/Write
PDO mapping	No

This subindex is reserved for future expansions.

MOD_ChildCfgCount_U8 specifies the number of configured submodules.

MOD_ChildActCount_U8

Subindex	0x03
Name	MOD_ChildActCount_U8
Data type	UNSIGNED8
Range of values	0 to 255
Default value	0
Access rights	Read only
PDO mapping	No

This subindex is reserved for future expansions.

MOD_ChildActCount_U8 specifies the number of active submodules.

MOD_CfgMode_U8

Subindex	0x04
Name	MOD_CfgMode_U8
Data type	UNSIGNED8
Range of values	0 to 255
Default value	0
Access rights	Read/Write
PDO mapping	No

MOD_CfgMode_U8 can be used to determine how the X2X Link modules are configured.

Value	Description:
0	Loads the register information from the I/O modules and configures all cyclic registers (except if X2X_CfgModeUploadDisable_BOOL is set to TRUE)
1	Takes the register configuration from the managing node (via MOD_CfgEntry_xx_U64)
2	Disables the I/O module
3	Combination of 0 and 1: Loads the register information and then adds configuration parameters from MOD_CfgEntry_xx_U64 .

MOD_RequestedHardwareId_U16

Subindex	0x05
Name	MOD_RequestedHardwareId_U16
Data type	UNSIGNED16
Range of values	0 to 65535
Default value	0
Access rights	Read/Write
PDO mapping	No

MOD_RequestedHardwareId_U16 specifies the hardware ID of the module expected in this slot. If the connected modules does not have the specified ID, it will not be enabled.

Value	Description
0	Disables ID verification for the module
1 - 65534	Expected hardware ID
65535	Dummy module

MOD_RequestedVendorId_U16

Subindex	0x06
Name	MOD_RequestedVendorId_U16
Data type	UNSIGNED16
Range of values	0 to 65535
Default value	0
Access rights	Read/Write
PDO mapping	No

MOD_RequestedVendorId_U16 specifies the vendor ID of the module expected in this slot. If the connected modules does not have the specified ID, it will not be enabled.

Value	Description
0	Disables ID verification for the module
1 - 65,535	Expected vendor ID

MOD_HardwareId_U16

Subindex	0x07
Name	MOD_HardwareId_U16
Data type	UNSIGNED16
Range of values	0 to 65535
Default value	-
Access rights	Read only
PDO mapping	No

MOD_HardwareId_U16 specifies the hardware ID of the I/O module. 0 is output here if no module is connected.

MOD_VendorId_U16

Subindex	0x08
Name	MOD_VendorId_U16
Data type	UNSIGNED16
Range of values	0 to 65535
Default value	-
Access rights	Read only
PDO mapping	No

MOD_VendorId_U16 specifies the vendor ID of the I/O module. 0 is output here if no module is connected.

MOD_Status_U16

Subindex	0x0A
Name	MOD_Status_U16
Data type	UNSIGNED16
Range of values	0 to 65535
Default value	-
Access rights	Read/Write
PDO mapping	No

MOD_Status_U16 describes the current status of the I/O module. The following values can be read:

Value	Status
0	Module not connected
0x42 ("B")	OS loader test
0x43 ("C")	Configuration
0x44 ("D")	Firmware download active
0x4E ("N")	Slot found but boot procedure could not be started due to missing I/O power supply or unconnected module
0x50 ("P")	PRE_OPERATIONAL mode
0x52 ("R")	RUN mode: Module active
0x53 ("S")	Synchronization
0x55 ("U")	IDs uploading
0xE0	Firmware update required (no valid firmware on module)
0xE1	Firmware update required (invalid file loaded for this module)
0xE2	GO command failed, incorrect function mode configured
0xE3	Faulty register configuration, configured register doesn't exist
0xE4	Error reading configuration flash memory on ASIC-only modules
0xE5	X2X frame too small
0xE6	Module with incorrect ID (MOD_HardwareId_U16 <> MOD_RequestedHardwareId_U16)

The following values can be written:

Value	Status
0x44 ("D")	Puts the module into the firmware download status (for manual firmware download via streaming channel)
0x63 ("c")	Closes the firmware download channel
0x64 ("d")	Returns abort code 0x08000021 (for compatibility reasons)
0x72 ("r")	Resets the I/O module

The controlled node is permitted to refuse a command with abort code 0x08000021 if it is not allowed in the current state.

MOD_NetworkStatus_U8

Subindex	0x0B
Name	MOD_NetworkStatus_U8
Data type	UNSIGNED8
Range of values	0 to 255
Default value	-
Access rights	Read only
PDO mapping	TPDO

MOD_NetworkStatus_U8 specifies the module's current status.

Bit	Status
0	X2X supply voltage OK
1	Reserved
2	X2X network OK
3	Data valid (0 = OK, 1 = Data not refreshed since module was removed from bus, for example)

MOD_BlockMask_U8

Subindex	0x0C
Name	MOD_BlockMask_U8
Data type	UNSIGNED8
Range of values	0 to 255
Default value	-
Access rights	Read only
PDO mapping	No

MOD_BlockMask_U8 contains information about the module's firmware blocks (e.g. "Valid block mask" for PSOC modules).

MOD_BootCount_U8

Subindex	0x0D
Name	MOD_BootCount_U8
Data type	UNSIGNED8
Range of values	0 to 255
Default value	-
Access rights	Read/Write
PDO mapping	No

MOD_BootCount_U8 counts the module's boot cycles. The counter is incremented after successful startup and when the connection to the module is lost. An even number means that the module is inactive; an odd number means that the module is active and a hardware ID exists.

MOD_LastError_U8

Subindex	0x0E
Name	MOD_LastError_U8
Data type	UNSIGNED8
Range of values	0 to 255
Default value	-
Access rights	Read/Write
PDO mapping	No

MOD_LastError_U8 can be used to read an error code that specifies the reason for the module's last restart.

MOD_FirmwareVersion_U16

Subindex	0x11
Name	MOD_FirmwareVersion_U16
Data type	UNSIGNED16
Range of values	0 to 65535
Default value	-
Access rights	Read only
PDO mapping	No

MOD_FirmwareVersion_U16 specifies the version of the module's firmware.

MOD_HardwareVariant_U16

Subindex	0x12
Name	MOD_HardwareVariant_U16
Data type	UNSIGNED16
Range of values	0 to 65535
Default value	-
Access rights	Read only
PDO mapping	No

MOD_HardwareVariant_U16 specifies the X2X Link module's hardware variant.

MOD_SerialNo_U32

Subindex	0x13
Name	MOD_SerialNo_U32
Data type	UNSIGNED32
Range of values	0 to 4294967295
Default value	-
Access rights	Read only
PDO mapping	No

MOD_SerialNo_U32 specifies the last 7 digits of the X2X Link module's serial number.

MOD_PhysicalSlotNumber_U8

Subindex	0x14
Name	MOD_PhysicalSlotNumber_U8
Data type	UNSIGNED8
Range of values	0 to 255
Default value	-
Access rights	Read only
PDO mapping	No

MOD_PhysicalSlotNumber_U8 specifies the X2X Link module's physical slot number. If X2X modules with node number switches are being used, then it is possible for the physical node number to be different from the logical node number.

MOD_NodeSwitch_U8

Subindex	0x15
Name	MOD_NodeSwitch_U8
Data type	UNSIGNED8
Range of values	0 to 255
Default value	-
Access rights	Read only
PDO mapping	No

MOD_NodeSwitch_U8 contains the setting for the node number switch (0 if the module does not have node number switches).

MOD_RequestedSerialNo_U32

Subindex	0x16
Name	MOD_RequestedSerialNo_U32
Data type	UNSIGNED32
Range of values	0 to 4294967295
Default value	-
Access rights	Read/Write
PDO mapping	No

MOD_RequestedSerialNo_U32 specifies the module's expected serial number. A module with a different serial number will not be enabled. Value 0 means that verification of the serial number is disabled.

MOD_ModuleErrorReaction_U8

Subindex	0x17
Name	MOD_ModuleErrorReaction_U8
Data type	UNSIGNED8
Range of values	0 to 255
Default value	-
Access rights	Read/Write
PDO mapping	No

MOD_ModuleErrorReaction_U8 can be used to determine the behavior of the bus controller when there is an error on the X2X Link module.

Bit	Status
0	Does not switch to READY_TO_OPERATE mode if this module is missing
1	Does not switch to READY_TO_OPERATE mode if this module is not the expected module
2	Switches to PRE_OPERATIONAL_1 mode if an error occurs on this module and the bus controller was in OPERATIONAL mode beforehand.

MOD_InputImage1_DOM

Subindex	0x1E
Name	MOD_InputImage1_DOM
Data type	DOMAIN
Range of values	-
Default value	-
Access rights	Read only
PDO mapping	TPDO

All cyclic input data including the connected X2X Link modules' network status bytes is transferred in MOD_InputImage1_DOM. This object is usually mapped to TPDO.

MOD_InputImage2_DOM

Subindex	0x1F
Name	MOD_InputImage2_DOM
Data type	DOMAIN
Range of values	-
Default value	-
Access rights	Read only
PDO mapping	TPDO

All cyclic input data without the connected X2X Link modules' network status bytes is transferred in MOD_InputImage2_DOM. This object is usually mapped to TPDO.

MOD_OutputImage_DOM

Subindex	0x20
Name	MOD_OutputImage_DOM
Data type	DOMAIN
Range of values	-
Default value	-
Access rights	Write only
PDO mapping	RPDO

All connected X2X Link modules' cyclic output data can be written to MOD_OutputImage_DOM. This object is usually mapped to RPDO.

Information:

SDO access to this object is not supported!

MOD_AsyncRead_U64

Subindex	0x21
Name	MOD_AsyncRead_U64
Data type	UNSIGNED64
Range of values	See format of configuration entries in "MOD_CfgEntry_xx_U64" in Section "MOD_Config_xxh_REC".
Default value	-
Access rights	Read/Write
PDO mapping	No

MOD_AsyncRead_U64 can be used to asynchronously read a register on the X2X Link module. The request is written to the object for this. The requested value can then be read by the object.

MOD_AsyncWrite_U64

Subindex	0x22
Name	MOD_AsyncWrite_U64
Data type	UNSIGNED64
Range of values	See format of configuration entries in "MOD_CfgEntry_xx_U64" in Section "MOD_Config_xxh_REC".
Default value	-
Access rights	Write only
PDO mapping	No

MOD_AsyncWrite_U64 can be used to asynchronously write to a register on the X2X Link module.

MOD_Firmware_DOM

Subindex	0x23
Name	MOD_Firmware_DOM
Data type	DOMAIN
Range of values	-
Default value	-
Access rights	Write only
PDO mapping	No

MOD_Firmware_DOM can be used to write the firmware to an X2X Link module.

MOD_FirmwareChannel_U16

Subindex	0x32
Name	MOD_FirmwareChannel_U16
Data type	UNSIGNED16
Range of values	0 to 65535
Default value	2
Access rights	Read/Write
PDO mapping	No

Downloads to MOD_Firmware_DOM are transferred via the X2X Link module's channel specified in MOD_FirmwareChannel_U16.

The least significant byte specifies the channel; the most significant byte defines whether the module should first switch to PRE_OPERATIONAL mode (value 0) or remain in the current module mode (value 1).

MOD_CfgFunctionMode_U8

Subindex	0x5A
Name	MOD_CfgFunctionMode_U8
Data type	UNSIGNED8
Range of values	0 to 255
Default value	0
Access rights	Read/Write
PDO mapping	No

MOD_CfgFunctionMode_U8 defines the function model.

MOD_CfgEntryCount_U8

Subindex	0x5B
Name	MOD_CfgEntryCount_U8
Data type	UNSIGNED8
Range of values	0 to 100
Default value	0
Access rights	Read/Write
PDO mapping	No

MOD_CfgEntryCount_U8 defines the number of configuration entries in MOD_CfgEntry_xx_U64.

MOD_CfgEntry_xx_U64

Subindex	0x64 - 0xC7
Name	MOD_CfgEntry_xx_U64
Data type	UNSIGNED64
Range of values	See format of the configuration entries
Default value	0
Access rights	Read/Write
PDO mapping	No

MOD_CfgEntry_xx_U64 contains the register configuration for the X2X Link module. Up to 100 configuration entries are possible.

Format of configuration entries

Bit	Description
0 - 15	Register or parameter number (the upper 8 bits contain the register bank)
16 - 23	Size in bytes (0: Register not being used)
24 - 27	Type: • 0: Dynamic cyclic input register • 1: Dynamic cyclic output register • 2: Static cyclic input register • 3: Static cyclic output register • 5: Acyclic output register • 6: Reserved • 7: Set parameters
28 - 29	Element size
30 - 31	Flags: Reserved
32 - 63	Value: • Type = 1: Default value for output if no valid data is available • Type = 3: Default value for output if no valid data is available • Type = 5: Writes the initialization value before the module is enabled • Type = 7: Parameter value that should be set before starting the module

Maximum number of configuration entries

The bus controller automatically creates a list of configuration entries for each connected I/O module. This includes the following for each module:

- All cyclic registers of the I/O module
- All additional registers used internally by the function model for the I/O module configuration

This can cause an internal configuration memory overflow when using several computationally intensive I/O modules (e.g. X20DC4395).

Information:

The total number of all configuration entries on the bus controller is not permitted to exceed 2024.

5 Configuration examples

This chapter includes typical examples for configuring and using a B&R POWERLINK bus controller.

The following hardware combination is used:

Bus controller	X20BC0083
Power supply module	X20PS9402
12-channel digital input module	X20DI9371
12-channel digital output module	X20DO9322

5.1 Resetting the bus controller

The NMT_Restore_DefParam_REC object is used to reset a POWERLINK bus controller to its default values (0x1011, see "[Communication objects 0x1000 to 0x1403](#)" on page 20). A write operation to subindex 0x01 (AllParam_U32) deletes the entire bus controller configuration.

Step	Command	Object	Value	Description
1	SDOWrite	0x1011 / 0x01	0x64616F6C	Write "load" to NMT_RestoreDefParam_REC / AllParam_U32
2	NMTResetNode			Restart station

5.2 Saving the configuration

To save the current bus controller configuration, an unambiguous configuration timestamp should first be set in the CFM_VerifyConfiguration_REC object. This timestamp can be used when restarting the station by the managing node to determine whether the current configuration already exists or whether it needs to be written first.

The save procedure itself is triggered by a write operation to NMT_StoreParam_REC (see "[Communication objects 0x1000 to 0x1403](#)" on page 20).

Step	Command	Object	Value	Description
1	SDOWrite	0x1020 / 0x01	ConfDate	Number of days since 1984-01-01
2	SDOWrite	0x1020 / 0x02	ConfTime	Number of milliseconds since midnight
3	SDOWrite	0x1010 / 0x01	0x65766173	Write "save" to NMT_StoreParam_REC / AllParam_U32

5.3 Configuring the bus controller in accordance with DS401

If a B&R POWERLINK bus controller should be operated in accordance with the DS401 profile, then it should be reset first as described in section 4.1. At a minimum, the cycle time and mapping must then be defined.

In order to carry out PDO mapping, the number of mapping parameters is first set to 0. The objects specified in DS401 are then entered in the mapping table. Finally, the mapping is enabled by setting the actual number of mapping parameters.

Step	Command	Object	Value	Description
1	SDOWrite	0x1006h	Cycle time in µs	Set cycle time using NMT_CycleLen_U32
Rx mapping				
2	SDOWrite	0x1600 / 0x00	0x00	Sets number of mapping parameters to 0
3	SDOWrite	0x1600 / 0x01	0x00080000000016200	Map first digital output register
4	SDOWrite	0x1600 / 0x00	0x01	Enables mapping with one entry
Tx mapping				
5	SDOWrite	0x1A00 / 0x00	0x00	Sets number of mapping parameters to 0
6	SDOWrite	0x1A00 / 0x01	0x00080000000016000	Map first digital input register
7	SDOWrite	0x1A00 / 0x00	0x01	Enables mapping with one entry
Starts station				
8	NMTResetConfiguration			Enables configuration
9	NMTEnableReadyToOperate			Prepares station for startup
10	NMTStartNode			Starts station

5.4 Configuring the bus controller in accordance with the B&R device profile

Compared to the DS401 profile, the B&R bus controller device profile offers extended configuration options. It makes sense to put together the device configuration for the bus controller and the X2X Link modules using Automation Studio V4.4 or later.

Automation Studio can be downloaded at no cost from the B&R website (www.br-automation.com). The evaluation license is permitted to be used to create complete configurations for fieldbus bus controllers at no cost.

The objects in the vendor-specific range (0x2000 to 0x5FFF) of the generated XDC file ¹⁾ are particularly interesting.

Step	Command	Object	Value	Description
1	SDOWrite	0x1006	Cycle time in µs	Set cycle time using NMT_CycleLen_U32
X2X Link configuration				
2	SDOWrite	0x2000 / 0x01	1	Sets the X2X Link cycle time explicitly
3	SDOWrite	0x2000 / 0x03	X2X cycle time in µs	X2X Link cycle time value
4	SDOWrite	0x2000 / 0x04	0	Synchronize X2X with POWERLINK to the SoC frame
5	SDOWrite	0x2000 / 0x06	94	X2X output sync frame length
6	SDOWrite	0x2000 / 0x07	94	X2X input sync frame length
7	SDOWrite	0x2000 / 0x08	159	X2X async frame length
8	SDOWrite	0x2000 / 0x09	33	Maximum number of physical slots
9	SDOWrite	0x2000 / 0x0B	1	Disables automatic register configuration
10	SDOWrite	0x20A0	3	Number of actual X2X Link modules
X20PS9402 configuration				
11	SDOWrite	0x2100 / 0x04	1	Enables manual register configuration
12	SDOWrite	0x2100 / 0x05	0xA389	ID code of the expected hardware (X20PS9402)
13	SDOWrite	0x2100 / 0x5A	0	Sets the function model
14	SDOWrite	0x2100 / 0x5B	1	Number of registers to be configured
15	SDOWrite	0x2100 / 0x64	0x0000000002010001	Register configuration 2
X20DI9371 configuration				
16	SDOWrite	0x2101 / 0x04	1	Enables manual register configuration
17	SDOWrite	0x2101 / 0x05	0x1B95	ID code of the expected hardware (X20DI9371)
18	SDOWrite	0x2101 / 0x5A	0	Sets the function model
19	SDOWrite	0x2101 / 0x5B	3	Number of registers to be configured
20	SDOWrite	0x2101 / 0x64	0x0000000002010001	Register configuration
21	SDOWrite	0x2101 / 0x65	0x0000000002010002	Register configuration
22	SDOWrite	0x2101 / 0x66	0x00000000A05010012	Register configuration
X20DO9322 configuration				
23	SDOWrite	0x2102 / 0x04	1	Enables manual register configuration
24	SDOWrite	0x2102 / 0x05	0x1B9A	ID code of the expected hardware (X20DO9322)
25	SDOWrite	0x2102 / 0x5A	0	Sets the function model
26	SDOWrite	0x2102 / 0x5B	4	Number of registers to be configured
27	SDOWrite	0x2102 / 0x65	0x0000000003010000	Register configuration
27	SDOWrite	0x2102 / 0x66	0x0000000003010001	Register configuration
27	SDOWrite	0x2102 / 0x67	0x0000000002010001	Register configuration
27	SDOWrite	0x2102 / 0x68	0x0000000002010002	Register configuration
Rx mapping				
28	SDOWrite	0x1600 / 0x00	0x00	Sets number of mapping parameters to 0
29	SDOWrite	0x1600 / 0x01	0x0010000000202102	Maps output image of DO module
30	SDOWrite	0x1600 / 0x00	0x01	Enables mapping with one entry
Tx mapping				
31	SDOWrite	0x1A00 / 0x00	0x00	Sets number of mapping parameters to 0
32	SDOWrite	0x1A00 / 0x01	0x00100000001E2100	Maps input image of PS module
33	SDOWrite	0x1A00 / 0x02	0x00180010001E2101	Maps input image of DI module
34	SDOWrite	0x1A00 / 0x03	0x00180028001E2102	Maps input image of DO module
35	SDOWrite	0x1A00 / 0x00	0x03	Enables mapping with three entries
Starts station				
36	NMTResetConfiguration			Enables configuration
37	NMTEnableReadyToOperate			Prepares station for startup
38	NMTStartNode			Starts station

¹⁾ Ethernet POWERLINK XML Device Description DS311 V1.0.0, 2009, see also www.br-automation.com/en/technologies/powerlink.