

X20 System Register Descriptions User's Manual

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Model number: **MAX20REGISTER-ENG**

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Chapter 1 • General information

1. Manual history

| Version | Date | Comment |
|---------|------------|----------------|
| 1.00 | March 2007 | First version. |

Table 1: Manual history

2. Introduction

This manual describes the registers used to configure the X20 System modules. It also contains the following information:

- Variable assignment in Automation Studio (X2X master, CANIO, etc.)
- Data points with respect to the type of fieldbus used (CANopen, DeviceNet, etc.)
- Descriptions of module functions
- B&R ID code

Chapter 2 • Bus receivers / transmitters

1. Overview

| Module | Description |
|-----------|--|
| X20BR9300 | X20 bus receiver (X2X Link) with feed for internal I/O supply, and X2X Link bus supply |
| X20BT9100 | X20 bus transmitter (X2X Link) |

Table 2: Overview of bus receivers and bus transmitters

2. X20BR9300

2.1 Register overview

| Register | Name | Data type | Length | Read | | Write | |
|----------|------------------|-----------|--------|--------|---------|--------|---------|
| | | | | Cyclic | Acyclic | Cyclic | Acyclic |
| 0 | ModuleStatus | USINT | 1 | ● | ● | | |
| 2 | BusSupplyCurrent | USINT | 1 | ● | ● | | |
| 4 | BusSupplyVoltage | USINT | 1 | ● | ● | | |

Table 3: Register overview - BR9300

2.2 Variable assignment in Automation Studio (X2X master)

| Name | Data type | Length | Read | | Write | |
|---------------|-----------|--------|--------|---------|--------|---------|
| | | | Cyclic | Acyclic | Cyclic | Acyclic |
| StatusInput01 | BOOL | 1 | ● | | | |
| StatusInput02 | BOOL | 1 | ● | | | |
| SupplyCurrent | USINT | 1 | ● | | | |
| SupplyVoltage | USINT | 1 | ● | | | |

Table 4: Variable assignment in Automation Studio (X2X master) - BR9300

2.3 Variable assignment in Automation Studio (CANIO)

| Name | Data type | Length | Read | | Write | |
|---------------|-----------|--------|--------|---------|--------|---------|
| | | | Cyclic | Acyclic | Cyclic | Acyclic |
| StatusInput01 | BOOL | 1 | ● | | | |
| StatusInput02 | BOOL | 1 | ● | | | |
| SupplyCurrent | UINT | 1 | ● | | | |
| SupplyVoltage | UINT | 1 | ● | | | |

Table 5: Variable assignment in Automation Studio (CANIO) - BR9300

2.4 CANopen data points

| Register | Name | Data type | Length | Read | | Write | |
|----------|------------------|-----------|--------|------|-----|-------|-----|
| | | | | PDO | SDO | PDO | SDO |
| 0 | ModuleStatus | UINT | 1 | ● | ● | | |
| 2 | BusSupplyCurrent | UINT | 1 | ● | ● | | |
| 4 | BusSupplyVoltage | UINT | 1 | ● | ● | | |

Table 6: CANopen data points - BR9300

2.5 DeviceNet data points

| Register | Name | Data type | Length | Read | | Write | |
|----------|------------------|-----------|--------|--------|---------|--------|---------|
| | | | | Cyclic | Acyclic | Cyclic | Acyclic |
| 0 | ModuleStatus | USINT | 1 | ● | ● | | |
| 2 | BusSupplyCurrent | USINT | 1 | ● | ● | | |
| 4 | BusSupplyVoltage | USINT | 1 | ● | ● | | |

Table 7: DeviceNet data points - BR9300

2.6 Modbus/TCP data points

| Register | Name | Data type | Length | Read | | Write | |
|----------|------------------|-----------|--------|--------|---------|--------|---------|
| | | | | Cyclic | Acyclic | Cyclic | Acyclic |
| 0 | ModuleStatus | UINT | 1 | ● | ● | | |
| 2 | BusSupplyCurrent | UINT | 1 | ● | ● | | |
| 4 | BusSupplyVoltage | UINT | 1 | ● | ● | | |

Table 8: Modbus/TCP data points - BR9300

2.7 Module status

The following module states are monitored:

- Bus supply current
- Bus supply voltage
- 24 VDC I/O supply voltage

Bus supply current

A bus supply current of >2.3 A is displayed as a warning.

Bus supply voltage

A bus supply voltage of <4.7 V is displayed as a warning.

24 VDC I/O supply voltage

An I/O supply voltage of <20.4 V is displayed as a warning.

2.8 Register: ModuleStatus

| Bit | Description |
|-------|--|
| 0 | 0 ... No error 1 ... Bus supply warning - overcurrent (>2.3 A) or undercurrent (<4.7 V) |
| 1 | 0 |
| 2 | 0 ... I/O supply above the warning level of 20.4 V 1 ... I/O supply below the warning level of 20.4 V |
| 3 - x | 0 |

2.9 Register: StatusInput01

| BOOL | Description |
|------|--|
| x | 0 ... No error 1 ... Bus supply warning - overcurrent (>2.3 A) or undercurrent (<4.7 V) |

2.10 Register: StatusInput02

| BOOL | Description |
|------|--|
| x | 0 ... I/O supply above the warning level of 20.4 V 1 ... I/O supply below the warning level of 20.4 V |

2.11 Register: BusSupplyCurrent, SupplyCurrent

The bus supply current is measured with a resolution of 0.1 A.

2.12 Register: BusSupplyVoltage, SupplyVoltage

The bus supply voltage is measured with a resolution of 0.1 V.

2.13 B&R ID code

Code for module identification (\$1BC1).

2.14 Minimum cycle time

The minimum cycle time is the minimum time needed for the bus cycle to be shut down without a communication error occurring. It should be noted that very fast cycles have reduced the idle time needed for handling monitoring, diagnostics and acyclic commands.

| Minimum cycle time |
|------------------------|
| $\geq 100 \mu\text{s}$ |

Table 9: Minimum cycle time - BR9300

2.15 Minimum I/O update time

The minimum I/O update time refers to the minimum time it takes for the bus cycle to shut down, so that in each cycle an I/O update takes place.

| Minimum I/O update time |
|-------------------------|
| 2 ms |

Table 10: Minimum I/O update time - BR9300

3. X20BT9100

3.1 Register overview

| Register | Name | Data type | Length | Read | | Write | |
|----------|------------------|-----------|--------|--------|---------|--------|---------|
| | | | | Cyclic | Acyclic | Cyclic | Acyclic |
| 0 | ModuleStatus | USINT | 1 | ● | ● | | |
| 2 | BusSupplyCurrent | USINT | 1 | ● | ● | | |
| 4 | BusSupplyVoltage | USINT | 1 | ● | ● | | |

Table 11: Register overview - BT9100

3.2 Variable assignment in Automation Studio (X2X master)

| Name | Data type | Length | Read | | Write | |
|---------------|-----------|--------|--------|---------|--------|---------|
| | | | Cyclic | Acyclic | Cyclic | Acyclic |
| StatusInput01 | BOOL | 1 | ● | | | |
| StatusInput02 | BOOL | 1 | ● | | | |
| SupplyVoltage | USINT | 1 | ● | | | |

Table 12: Variable assignment in Automation Studio (X2X master) - BT9100

3.3 Variable assignment in Automation Studio (CANIO)

| Name | Data type | Length | Read | | Write | |
|---------------|-----------|--------|--------|---------|--------|---------|
| | | | Cyclic | Acyclic | Cyclic | Acyclic |
| StatusInput01 | BOOL | 1 | ● | | | |
| StatusInput02 | BOOL | 1 | ● | | | |
| SupplyVoltage | UINT | 1 | ● | | | |

Table 13: Variable assignment in Automation Studio (CANIO) - BT9100

3.4 CANopen data points

| Register | Name | Data type | Length | Read | | Write | |
|----------|------------------|-----------|--------|------|-----|-------|-----|
| | | | | PDO | SDO | PDO | SDO |
| 0 | ModuleStatus | UINT | 1 | ● | ● | | |
| 2 | BusSupplyCurrent | UINT | 1 | ● | ● | | |
| 4 | BusSupplyVoltage | UINT | 1 | ● | ● | | |

Table 14: CANopen data points - BT9100

3.5 DeviceNet data points

| Register | Name | Data type | Length | Read | | Write | |
|----------|------------------|-----------|--------|--------|---------|--------|---------|
| | | | | Cyclic | Acyclic | Cyclic | Acyclic |
| 0 | ModuleStatus | USINT | 1 | ● | ● | | |
| 2 | BusSupplyCurrent | USINT | 1 | ● | ● | | |
| 4 | BusSupplyVoltage | USINT | 1 | ● | ● | | |

Table 15: DeviceNet data points - BT9100

3.6 Modbus/TCP data points

| Register | Name | Data type | Length | Read | | Write | |
|----------|------------------|-----------|--------|--------|---------|--------|---------|
| | | | | Cyclic | Acyclic | Cyclic | Acyclic |
| 0 | ModuleStatus | UINT | 1 | ● | ● | | |
| 2 | BusSupplyCurrent | UINT | 1 | ● | ● | | |
| 4 | BusSupplyVoltage | UINT | 1 | ● | ● | | |

Table 16: Modbus/TCP data points - BT9100

3.7 Module status

The following module states are monitored:

- Bus supply voltage
- 24 VDC I/O supply voltage

Bus supply voltage

A bus supply voltage of <4.7 V is displayed as a warning.

24 VDC I/O supply voltage

An I/O supply voltage of <20.4 V is displayed as a warning.

3.8 Register: ModuleStatus

| Bit | Description |
|-------|--|
| 0 | 0 ... No error 1 ... Bus supply warning - undervoltage (<4.7 V) |
| 1 | 0 |
| 2 | 0 ... I/O supply above the warning level of 20.4 V 1 ... I/O supply below the warning level of 20.4 V |
| 3 - x | 0 |

3.9 Register: StatusInput01

| BOOL | Description |
|------|--|
| x | 0 ... No error 1 ... Bus supply warning - undervoltage (<4.7 V) |

3.10 Register: StatusInput02

| BOOL | Description |
|------|--|
| x | 0 ... I/O supply above the warning level of 20.4 V 1 ... I/O supply below the warning level of 20.4 V |

3.11 Register: BusSupplyVoltage, SupplyVoltage

The bus supply voltage is measured with a resolution of 0.1 V.

3.12 B&R ID code

Code for module identification (\$1BC2).

3.13 Minimum cycle time

The minimum cycle time is the minimum time needed for the bus cycle to be shut down without a communication error occurring. It should be noted that very fast cycles have reduced the idle time needed for handling monitoring, diagnostics and acyclic commands.

| Minimum cycle time |
|------------------------|
| $\geq 100 \mu\text{s}$ |

Table 17: Minimum cycle time - BT9100

3.14 Minimum I/O update time

The minimum I/O update time refers to the minimum time it takes for the bus cycle to shut down, so that in each cycle an I/O update takes place.

| Minimum I/O update time |
|-------------------------|
| 2 ms |

Table 18: Minimum I/O update time - BT9100

Chapter 3 • Supply modules

1. Overview

| Supply modules | Description |
|----------------|--|
| X20PS2100 | X20 supply module for internal I/O supply |
| X20PS2110 | X20 supply module for internal I/O supply, integrated microfuse |
| X20PS3300 | X20 supply module for internal I/O supply, X2X link supply |
| X20PS3310 | X20 supply module for internal I/O supply, X2X Link bus supply, integrated microfuse |
| X20PS9400 | X20 supply module for bus controller and internal I/O supply, X2X link bus supply |

Table 19: Overview of supply modules

2. X20PS2100

2.1 Register overview

| Register | Name | Data type | Length | Read | | Write | |
|----------|------------------|-----------|--------|--------|---------|--------|---------|
| | | | | Cyclic | Acyclic | Cyclic | Acyclic |
| 0 | ModuleStatus | USINT | 1 | ● | ● | | |
| 2 | BusSupplyCurrent | USINT | 1 | ● | ● | | |
| 4 | BusSupplyVoltage | USINT | 1 | ● | ● | | |

Table 20: Register overview - PS2100

2.2 Variable assignment in Automation Studio (X2X master)

| Name | Data type | Length | Read | | Write | |
|---------------|-----------|--------|--------|---------|--------|---------|
| | | | Cyclic | Acyclic | Cyclic | Acyclic |
| StatusInput01 | BOOL | 1 | ● | | | |
| StatusInput02 | BOOL | 1 | ● | | | |
| SupplyVoltage | USINT | 1 | ● | | | |

Table 21: Variable assignment in Automation Studio (X2X master) - PS2100

2.3 Variable assignment in Automation Studio (CANIO)

| Name | Data type | Length | Read | | Write | |
|---------------|-----------|--------|--------|---------|--------|---------|
| | | | Cyclic | Acyclic | Cyclic | Acyclic |
| StatusInput01 | BOOL | 1 | ● | | | |
| StatusInput02 | BOOL | 1 | ● | | | |
| SupplyVoltage | UINT | 1 | ● | | | |

Table 22: Variable assignment in Automation Studio (CANIO) - PS2100

2.4 CANopen data points

| Register | Name | Data type | Length | Read | | Write | |
|----------|------------------|-----------|--------|------|-----|-------|-----|
| | | | | PDO | SDO | PDO | SDO |
| 0 | ModuleStatus | UINT | 1 | ● | ● | | |
| 2 | BusSupplyCurrent | UINT | 1 | ● | ● | | |
| 4 | BusSupplyVoltage | UINT | 1 | ● | ● | | |

Table 23: CANopen data points - PS2100

2.5 DeviceNet data points

| Register | Name | Data type | Length | Read | | Write | |
|----------|------------------|-----------|--------|--------|---------|--------|---------|
| | | | | Cyclic | Acyclic | Cyclic | Acyclic |
| 0 | ModuleStatus | USINT | 1 | ● | ● | | |
| 2 | BusSupplyCurrent | USINT | 1 | ● | ● | | |
| 4 | BusSupplyVoltage | USINT | 1 | ● | ● | | |

Table 24: DeviceNet data points - PS2100

2.6 Modbus/TCP data points

| Register | Name | Data type | Length | Read | | Write | |
|----------|------------------|-----------|--------|--------|---------|--------|---------|
| | | | | Cyclic | Acyclic | Cyclic | Acyclic |
| 0 | ModuleStatus | UINT | 1 | ● | ● | | |
| 2 | BusSupplyCurrent | UINT | 1 | ● | ● | | |
| 4 | BusSupplyVoltage | UINT | 1 | ● | ● | | |

Table 25: Modbus/TCP data points - PS2100

2.7 Module status

The following module states are monitored:

- Bus supply voltage
- 24 VDC I/O supply voltage

Bus supply voltage

A bus supply voltage of <4.7 V is displayed as a warning.

24 VDC I/O supply voltage

An I/O supply voltage of <20.4 V is displayed as a warning.

2.8 Register: ModuleStatus

| Bit | Description |
|-------|--|
| 0 | 0 ... No error 1 ... Bus supply warning - undervoltage (<4.7 V) |
| 1 | 0 |
| 2 | 0 ... I/O supply above the warning level of 20.4 V 1 ... I/O supply below the warning level of 20.4 V |
| 3 - x | 0 |

2.9 Register: StatusInput01

| BOOL | Description |
|------|--|
| x | 0 ... No error 1 ... Bus supply warning - undervoltage (<4.7 V) |

2.10 Register: StatusInput02

| BOOL | Description |
|------|--|
| x | 0 ... I/O supply above the warning level of 20.4 V 1 ... I/O supply below the warning level of 20.4 V |

2.11 Register: BusSupplyVoltage, SupplyVoltage

The bus supply voltage is measured with a resolution of 0.1 V.

2.12 B&R ID code

Code for module identification (\$1BBF).

2.13 Minimum cycle time

The minimum cycle time is the minimum time needed for the bus cycle to be shut down without a communication error occurring. It should be noted that very fast cycles have reduced the idle time needed for handling monitoring, diagnostics and acyclic commands.

| Minimum cycle time |
|------------------------|
| $\geq 100 \mu\text{s}$ |

Table 26: Minimum cycle time - PS2100

2.14 Minimum I/O update time

The minimum I/O update time refers to the minimum time it takes for the bus cycle to shut down, so that in each cycle an I/O update takes place.

| Minimum I/O update time |
|-------------------------|
| 2 ms |

Table 27: Minimum I/O update time - PS2100

3. X20PS2110

3.1 Register overview

| Register | Name | Data type | Length | Read | | Write | |
|----------|------------------|-----------|--------|--------|---------|--------|---------|
| | | | | Cyclic | Acyclic | Cyclic | Acyclic |
| 0 | ModuleStatus | USINT | 1 | ● | ● | | |
| 2 | BusSupplyCurrent | USINT | 1 | ● | ● | | |
| 4 | BusSupplyVoltage | USINT | 1 | ● | ● | | |

Table 28: Register overview - PS2110

3.2 Variable assignment in Automation Studio (X2X master)

| Name | Data type | Length | Read | | Write | |
|---------------|-----------|--------|--------|---------|--------|---------|
| | | | Cyclic | Acyclic | Cyclic | Acyclic |
| StatusInput01 | BOOL | 1 | ● | | | |
| StatusInput02 | BOOL | 1 | ● | | | |
| SupplyVoltage | USINT | 1 | ● | | | |

Table 29: Variable assignment in Automation Studio (X2X master) - PS2110

3.3 Variable assignment in Automation Studio (CANIO)

| Name | Data type | Length | Read | | Write | |
|---------------|-----------|--------|--------|---------|--------|---------|
| | | | Cyclic | Acyclic | Cyclic | Acyclic |
| StatusInput01 | BOOL | 1 | ● | | | |
| StatusInput02 | BOOL | 1 | ● | | | |
| SupplyVoltage | UINT | 1 | ● | | | |

Table 30: Variable assignment in Automation Studio (CANIO) - PS2110

3.4 CANopen data points

| Register | Name | Data type | Length | Read | | Write | |
|----------|------------------|-----------|--------|------|-----|-------|-----|
| | | | | PDO | SDO | PDO | SDO |
| 0 | ModuleStatus | UINT | 1 | ● | ● | | |
| 2 | BusSupplyCurrent | UINT | 1 | ● | ● | | |
| 4 | BusSupplyVoltage | UINT | 1 | ● | ● | | |

Table 31: CANopen data points - PS2110

3.5 DeviceNet data points

| Register | Name | Data type | Length | Read | | Write | |
|----------|------------------|-----------|--------|--------|---------|--------|---------|
| | | | | Cyclic | Acyclic | Cyclic | Acyclic |
| 0 | ModuleStatus | USINT | 1 | ● | ● | | |
| 2 | BusSupplyCurrent | USINT | 1 | ● | ● | | |
| 4 | BusSupplyVoltage | USINT | 1 | ● | ● | | |

Table 32: DeviceNet data points - PS2110

3.6 Modbus/TCP data points

| Register | Name | Data type | Length | Read | | Write | |
|----------|------------------|-----------|--------|--------|---------|--------|---------|
| | | | | Cyclic | Acyclic | Cyclic | Acyclic |
| 0 | ModuleStatus | UINT | 1 | ● | ● | | |
| 2 | BusSupplyCurrent | UINT | 1 | ● | ● | | |
| 4 | BusSupplyVoltage | UINT | 1 | ● | ● | | |

Table 33: Modbus/TCP data points - PS2110

3.7 Module status

The following module states are monitored:

- Bus supply voltage
- 24 VDC I/O supply voltage

Bus supply voltage

A bus supply voltage of <4.7 V is displayed as a warning.

24 VDC I/O supply voltage

An I/O supply voltage of <20.4 V is displayed as a warning.

3.8 Register: ModuleStatus

| Bit | Description |
|-------|---|
| 0 | 0 ... No error 1 ... Bus supply warning - undervoltage (<4.7 V) |
| 1 | 0 |
| 2 | 0 ... I/O supply above the warning level of 20.4 V 1 ... I/O supply below the warning level of 20.4 V or faulty fuse |
| 3 - x | 0 |

3.9 Register: StatusInput01

| BOOL | Description |
|------|--|
| x | 0 ... No error 1 ... Bus supply warning - undervoltage (<4.7 V) |

3.10 Register: StatusInput02

| BOOL | Description |
|------|---|
| x | 0 ... I/O supply above the warning level of 20.4 V 1 ... I/O supply below the warning level of 20.4 V or faulty fuse |

3.11 Register: BusSupplyVoltage, SupplyVoltage

The bus supply voltage is measured with a resolution of 0.1 V.

3.12 B&R ID code

Code for module identification (\$2016).

3.13 Minimum cycle time

The minimum cycle time is the minimum time needed for the bus cycle to be shut down without a communication error occurring. It should be noted that very fast cycles have reduced the idle time needed for handling monitoring, diagnostics and acyclic commands.

| Minimum cycle time |
|------------------------|
| $\geq 100 \mu\text{s}$ |

Table 34: Minimum cycle time - PS2110

3.14 Minimum I/O update time

The minimum I/O update time refers to the minimum time it takes for the bus cycle to shut down, so that in each cycle an I/O update takes place.

| Minimum I/O update time |
|-------------------------|
| 2 ms |

Table 35: Minimum I/O update time - PS2110

4. X20PS3300

4.1 Register overview

| Register | Name | Data type | Length | Read | | Write | |
|----------|------------------|-----------|--------|--------|---------|--------|---------|
| | | | | Cyclic | Acyclic | Cyclic | Acyclic |
| 0 | ModuleStatus | USINT | 1 | ● | ● | | |
| 2 | BusSupplyCurrent | USINT | 1 | ● | ● | | |
| 4 | BusSupplyVoltage | USINT | 1 | ● | ● | | |

Table 36: Register overview - PS3300

4.2 Variable assignment in Automation Studio (X2X master)

| Name | Data type | Length | Read | | Write | |
|---------------|-----------|--------|--------|---------|--------|---------|
| | | | Cyclic | Acyclic | Cyclic | Acyclic |
| StatusInput01 | BOOL | 1 | ● | | | |
| StatusInput02 | BOOL | 1 | ● | | | |
| SupplyCurrent | USINT | 1 | ● | | | |
| SupplyVoltage | USINT | 1 | ● | | | |

Table 37: Variable assignment in Automation Studio (X2X master) - PS3300

4.3 Variable assignment in Automation Studio (CANIO)

| Name | Data type | Length | Read | | Write | |
|---------------|-----------|--------|--------|---------|--------|---------|
| | | | Cyclic | Acyclic | Cyclic | Acyclic |
| StatusInput01 | BOOL | 1 | ● | | | |
| StatusInput02 | BOOL | 1 | ● | | | |
| SupplyCurrent | UINT | 1 | ● | | | |
| SupplyVoltage | UINT | 1 | ● | | | |

Table 38: Variable assignment in Automation Studio (CANIO) - PS3300

4.4 CANopen data points

| Register | Name | Data type | Length | Read | | Write | |
|----------|------------------|-----------|--------|------|-----|-------|-----|
| | | | | PDO | SDO | PDO | SDO |
| 0 | ModuleStatus | UINT | 1 | ● | ● | | |
| 2 | BusSupplyCurrent | UINT | 1 | ● | ● | | |
| 4 | BusSupplyVoltage | UINT | 1 | ● | ● | | |

Table 39: CANopen data points - PS3300

4.5 DeviceNet data points

| Register | Name | Data type | Length | Read | | Write | |
|----------|------------------|-----------|--------|--------|---------|--------|---------|
| | | | | Cyclic | Acyclic | Cyclic | Acyclic |
| 0 | ModuleStatus | USINT | 1 | ● | ● | | |
| 2 | BusSupplyCurrent | USINT | 1 | ● | ● | | |
| 4 | BusSupplyVoltage | USINT | 1 | ● | ● | | |

Table 40: DeviceNet data points - PS3300

4.6 Modbus/TCP data points

| Register | Name | Data type | Length | Read | | Write | |
|----------|------------------|-----------|--------|--------|---------|--------|---------|
| | | | | Cyclic | Acyclic | Cyclic | Acyclic |
| 0 | ModuleStatus | USINT | 1 | ● | ● | | |
| 2 | BusSupplyCurrent | USINT | 1 | ● | ● | | |
| 4 | BusSupplyVoltage | USINT | 1 | ● | ● | | |

Table 41: Modbus/TCP data points - PS3300

4.7 Module status

The following module states are monitored:

- Bus supply current
- Bus supply voltage
- 24 VDC I/O supply voltage

Bus supply current

A bus supply current of >2.3 A is displayed as a warning.

Bus supply voltage

A bus supply voltage of <4.7 V is displayed as a warning.

24 VDC I/O supply voltage

An I/O supply voltage of <20.4 V is displayed as a warning.

4.8 Register: ModuleStatus

| Bit | Description |
|-------|--|
| 0 | 0 ... No error 1 ... Bus supply warning - overcurrent (>2.3 A) or undercurrent (<4.7 V) |
| 1 | 0 |
| 2 | 0 ... I/O supply above the warning level of 20.4 V 1 ... I/O supply below the warning level of 20.4 V |
| 3 - x | 0 |

4.9 Register: StatusInput01

| BOOL | Description |
|------|--|
| x | 0 ... No error 1 ... Bus supply warning - overcurrent (>2.3 A) or undercurrent (<4.7 V) |

4.10 Register: StatusInput02

| BOOL | Description |
|------|--|
| x | 0 ... I/O supply above the warning level of 20.4 V 1 ... I/O supply below the warning level of 20.4 V |

4.11 Register: BusSupplyCurrent, SupplyCurrent

The bus supply current is measured with a resolution of 0.1 A.

4.12 Register: BusSupplyVoltage, SupplyVoltage

The bus supply voltage is measured with a resolution of 0.1 V.

4.13 B&R ID code

Code for module identification (\$1BC0).

4.14 Minimum cycle time

The minimum cycle time is the minimum time needed for the bus cycle to be shut down without a communication error occurring. It should be noted that very fast cycles have reduced the idle time needed for handling monitoring, diagnostics and acyclic commands.

| Minimum cycle time |
|--------------------|
| ≥100 µs |

Table 42: Minimum cycle time - PS3300

4.15 Minimum I/O update time

The minimum I/O update time refers to the minimum time it takes for the bus cycle to shut down, so that in each cycle an I/O update takes place.

| Minimum I/O update time |
|-------------------------|
| 2 ms |

Table 43: Minimum I/O update time - PS3300

5. X20PS3310

5.1 Register overview

| Register | Name | Data type | Length | Read | | Write | |
|----------|------------------|-----------|--------|--------|---------|--------|---------|
| | | | | Cyclic | Acyclic | Cyclic | Acyclic |
| 0 | ModuleStatus | USINT | 1 | ● | ● | | |
| 2 | BusSupplyCurrent | USINT | 1 | ● | ● | | |
| 4 | BusSupplyVoltage | USINT | 1 | ● | ● | | |

Table 44: Register overview - PS3310

5.2 Variable assignment in Automation Studio (X2X master)

| Name | Data type | Length | Read | | Write | |
|---------------|-----------|--------|--------|---------|--------|---------|
| | | | Cyclic | Acyclic | Cyclic | Acyclic |
| StatusInput01 | BOOL | 1 | ● | | | |
| StatusInput02 | BOOL | 1 | ● | | | |
| SupplyCurrent | USINT | 1 | ● | | | |
| SupplyVoltage | USINT | 1 | ● | | | |

Table 45: Variable assignment in Automation Studio (X2X master) - PS3310

5.3 Variable assignment in Automation Studio (CANIO)

| Name | Data type | Length | Read | | Write | |
|---------------|-----------|--------|--------|---------|--------|---------|
| | | | Cyclic | Acyclic | Cyclic | Acyclic |
| StatusInput01 | BOOL | 1 | ● | | | |
| StatusInput02 | BOOL | 1 | ● | | | |
| SupplyCurrent | UINT | 1 | ● | | | |
| SupplyVoltage | UINT | 1 | ● | | | |

Table 46: Variable assignment in Automation Studio (CANIO) - PS3310

5.4 CANopen data points

| Register | Name | Data type | Length | Read | | Write | |
|----------|------------------|-----------|--------|------|-----|-------|-----|
| | | | | PDO | SDO | PDO | SDO |
| 0 | ModuleStatus | UINT | 1 | ● | ● | | |
| 2 | BusSupplyCurrent | UINT | 1 | ● | ● | | |
| 4 | BusSupplyVoltage | UINT | 1 | ● | ● | | |

Table 47: CANopen data points - PS3310

5.5 DeviceNet data points

| Register | Name | Data type | Length | Read | | Write | |
|----------|------------------|-----------|--------|--------|---------|--------|---------|
| | | | | Cyclic | Acyclic | Cyclic | Acyclic |
| 0 | ModuleStatus | USINT | 1 | ● | ● | | |
| 2 | BusSupplyCurrent | USINT | 1 | ● | ● | | |
| 4 | BusSupplyVoltage | USINT | 1 | ● | ● | | |

Table 48: DeviceNet data points - PS3310

5.6 Modbus/TCP data points

| Register | Name | Data type | Length | Read | | Write | |
|----------|------------------|-----------|--------|--------|---------|--------|---------|
| | | | | Cyclic | Acyclic | Cyclic | Acyclic |
| 0 | ModuleStatus | USINT | 1 | ● | ● | | |
| 2 | BusSupplyCurrent | USINT | 1 | ● | ● | | |
| 4 | BusSupplyVoltage | USINT | 1 | ● | ● | | |

Table 49: Modbus/TCP data points - PS3310

5.7 Module status

The following module states are monitored:

- Bus supply current
- Bus supply voltage
- 24 VDC I/O supply voltage

Bus supply current

A bus supply current of >2.3 A is displayed as a warning.

Bus supply voltage

A bus supply voltage of <4.7 V is displayed as a warning.

24 VDC I/O supply voltage

An I/O supply voltage of <20.4 V is displayed as a warning.

5.8 Register: ModuleStatus

| Bit | Description |
|-------|--|
| 0 | 0 ... No error 1 ... Bus supply warning - overcurrent (>2.3 A) or undercurrent (<4.7 V) |
| 1 | 0 |
| 2 | 0 ... I/O supply above the warning level of 20.4 V 1 ... I/O supply below the warning level of 20.4 V |
| 3 - x | 0 |

5.9 Register: StatusInput01

| BOOL | Description |
|------|--|
| x | 0 ... No error 1 ... Bus supply warning - overcurrent (>2.3 A) or undercurrent (<4.7 V) |

5.10 Register: StatusInput02

| BOOL | Description |
|------|--|
| x | 0 ... I/O supply above the warning level of 20.4 V 1 ... I/O supply below the warning level of 20.4 V |

5.11 Register: BusSupplyCurrent, SupplyCurrent

The bus supply current is measured with a resolution of 0.1 A.

5.12 Register: BusSupplyVoltage, SupplyVoltage

The bus supply voltage is measured with a resolution of 0.1 V.

5.13 B&R ID code

Code for module identification (\$2017).

5.14 Minimum cycle time

The minimum cycle time is the minimum time needed for the bus cycle to be shut down without a communication error occurring. It should be noted that very fast cycles have reduced the idle time needed for handling monitoring, diagnostics and acyclic commands.

| Minimum cycle time |
|--------------------|
| ≥100 µs |

Table 50: Minimum cycle time - PS3310

5.15 Minimum I/O update time

The minimum I/O update time refers to the minimum time it takes for the bus cycle to shut down, so that in each cycle an I/O update takes place.

| Minimum I/O update time |
|-------------------------|
| 2 ms |

Table 51: Minimum I/O update time - PS3310

6. X20PS9400

6.1 Register overview

| Register | Name | Data type | Length | Read | | Write | |
|----------|------------------|-----------|--------|--------|---------|--------|---------|
| | | | | Cyclic | Acyclic | Cyclic | Acyclic |
| 0 | ModuleStatus | USINT | 1 | ● | ● | | |
| 2 | BusSupplyCurrent | USINT | 1 | ● | ● | | |
| 4 | BusSupplyVoltage | USINT | 1 | ● | ● | | |

Table 52: Register overview - PS9400

6.2 Variable assignment in Automation Studio (X2X master)

| Name | Data type | Length | Read | | Write | |
|---------------|-----------|--------|--------|---------|--------|---------|
| | | | Cyclic | Acyclic | Cyclic | Acyclic |
| StatusInput01 | BOOL | 1 | ● | | | |
| StatusInput02 | BOOL | 1 | ● | | | |
| SupplyCurrent | USINT | 1 | ● | | | |
| SupplyVoltage | USINT | 1 | ● | | | |

Table 53: Variable assignment in Automation Studio (X2X master) - PS9400

6.3 Variable assignment in Automation Studio (CANIO)

| Name | Data type | Length | Read | | Write | |
|---------------|-----------|--------|--------|---------|--------|---------|
| | | | Cyclic | Acyclic | Cyclic | Acyclic |
| StatusInput01 | BOOL | 1 | ● | | | |
| StatusInput02 | BOOL | 1 | ● | | | |
| SupplyCurrent | UINT | 1 | ● | | | |
| SupplyVoltage | UINT | 1 | ● | | | |

Table 54: Variable assignment in Automation Studio (CANIO) - PS9400

6.4 CANopen data points

| Register | Name | Data type | Length | Read | | Write | |
|----------|------------------|-----------|--------|------|-----|-------|-----|
| | | | | PDO | SDO | PDO | SDO |
| 0 | ModuleStatus | UINT | 1 | ● | ● | | |
| 2 | BusSupplyCurrent | UINT | 1 | ● | ● | | |
| 4 | BusSupplyVoltage | UINT | 1 | ● | ● | | |

Table 55: CANopen data points - PS9400

6.5 DeviceNet data points

| Register | Name | Data type | Length | Read | | Write | |
|----------|------------------|-----------|--------|--------|---------|--------|---------|
| | | | | Cyclic | Acyclic | Cyclic | Acyclic |
| 0 | ModuleStatus | USINT | 1 | ● | ● | | |
| 2 | BusSupplyCurrent | USINT | 1 | ● | ● | | |
| 4 | BusSupplyVoltage | USINT | 1 | ● | ● | | |

Table 56: DeviceNet data points - PS9400

6.6 Modbus/TCP data points

| Register | Name | Data type | Length | Read | | Write | |
|----------|------------------|-----------|--------|--------|---------|--------|---------|
| | | | | Cyclic | Acyclic | Cyclic | Acyclic |
| 0 | ModuleStatus | USINT | 1 | ● | ● | | |
| 2 | BusSupplyCurrent | USINT | 1 | ● | ● | | |
| 4 | BusSupplyVoltage | USINT | 1 | ● | ● | | |

Table 57: Modbus/TCP data points - PS9400

6.7 Module status

The following module states are monitored:

- Bus supply current
- Bus supply voltage
- 24 VDC I/O supply voltage

Bus supply current

A bus supply current of >2.3 A is displayed as a warning.

Bus supply voltage

A bus supply voltage of <4.7 V is displayed as a warning.

24 VDC I/O supply voltage

An I/O supply voltage of <20.4 V is displayed as a warning.

6.8 Register: ModuleStatus

| Bit | Description |
|-------|--|
| 0 | 0 ... No error 1 ... Bus supply warning - overcurrent (>2.3 A) or undercurrent (<4.7 V) |
| 1 | 0 |
| 2 | 0 ... I/O supply above the warning level of 20.4 V 1 ... I/O supply below the warning level of 20.4 V |
| 3 - x | 0 |

6.9 Register: StatusInput01

| BOOL | Description |
|------|--|
| x | 0 ... No error 1 ... Bus supply warning - overcurrent (>2.3 A) or undercurrent (<4.7 V) |

6.10 Register: StatusInput02

| BOOL | Description |
|------|--|
| x | 0 ... I/O supply above the warning level of 20.4 V 1 ... I/O supply below the warning level of 20.4 V |

6.11 Register: BusSupplyCurrent, SupplyCurrent

The bus supply current is measured with a resolution of 0.1 A.

6.12 Register: BusSupplyVoltage, SupplyVoltage

The bus supply voltage is measured with a resolution of 0.1 V.

6.13 B&R ID code

Code for module identification (\$1F8C).

6.14 Minimum cycle time

The minimum cycle time is the minimum time needed for the bus cycle to be shut down without a communication error occurring. It should be noted that very fast cycles have reduced the idle time needed for handling monitoring, diagnostics and acyclic commands.

| Minimum cycle time |
|--------------------|
| ≥100 μs |

Table 58: Minimum cycle time - PS9400

6.15 Minimum I/O update time

The minimum I/O update time refers to the minimum time it takes for the bus cycle to shut down, so that in each cycle an I/O update takes place.

| Minimum I/O update time |
|-------------------------|
| 2 ms |

Table 59: Minimum I/O update time - PS9400

Chapter 4 • Digital input modules

1. Overview

| Digital input modules | Description |
|-----------------------|---|
| X20DI2371 | X20 digital input module, 2 inputs, 24 VDC, sink, configurable input filters, 3-wire connections |
| X20DI2372 | X20 digital input module, 2 inputs, 24 VDC, source, configurable input filters, 3-wire connections |
| X20DI2377 | X20 digital input module, 2 inputs, 24 VDC, sink, configurable input filters, 2 event counters 50 kHz |
| X20DI4371 | X20 digital input module, 4 inputs, 24 VDC, sink, configurable input filters, 3-wire connections |
| X20DI4372 | X20 digital input module, 4 inputs, 24 VDC, source, configurable input filters, 3-wire connections |
| X20DI4760 | X20 digital input module, 4 NAMUR inputs, 8.05 VDC |
| X20DI6371 | X20 digital input module, 6 inputs, 24 VDC, sink, configurable input filters, 2-wire connections |
| X20DI6372 | X20 digital input module, 6 inputs, 24 VDC, source, configurable input filters, 2-wire connections |
| X20DI9371 | X20 digital input module, 12 inputs, 24 VDC, sink, configurable input filters, 1-wire connections |
| X20DI9372 | X20 digital input module, 12 inputs, 24 VDC, source, configurable input filters, 1-wire connections |

Table 60: Overview of digital input modules

2. X20DI2371

2.1 Register overview

| Register | Name | Data type | Length | Read | | Write | |
|----------|----------------------|-----------|--------|--------|---------|--------|---------|
| | | | | Cyclic | Acyclic | Cyclic | Acyclic |
| 0 | DigitalInput 1 - 2 | USINT | 1 | ● | ● | | |
| 18 | InputFilter [0.2 ms] | USINT | 1 | | ● | | ● |

Table 61: Register overview - DI2371

2.2 Variable assignment in Automation Studio (X2X master)

| Name | Data type | Length | Read | | Write | |
|----------------|-----------|--------|--------|---------|--------|---------|
| | | | Cyclic | Acyclic | Cyclic | Acyclic |
| DigitalInput01 | BOOL | 1 | ● | | | |
| DigitalInput02 | BOOL | 1 | ● | | | |

Table 62: Variable assignment in Automation Studio (X2X master) - DI2371

2.3 Variable assignment in Automation Studio (CANIO)

| Name | Data type | Length | Read | | Write | |
|----------------|-----------|--------|--------|---------|--------|---------|
| | | | Cyclic | Acyclic | Cyclic | Acyclic |
| DigitalInput01 | BOOL | 1 | ● | | | |
| DigitalInput02 | BOOL | 1 | ● | | | |

Table 63: Variable assignment in Automation Studio (CANIO) - DI2371

2.4 CANopen data points

| Register | Name | Data type | Length | Read | | Write | |
|----------|----------------------|-----------|--------|------|-----|-------|-----|
| | | | | PDO | SDO | PDO | SDO |
| 0 | DigitalInput 1 - 2 | USINT | 1 | ● | ● | | |
| 18 | InputFilter [0.2 ms] | USINT | 1 | | ● | | ● |

Table 64: CANopen data points - DI2371

2.5 DeviceNet data points

| Register | Name | Data type | Length | Read | | Write | |
|----------|----------------------|-----------|--------|--------|---------|--------|---------|
| | | | | Cyclic | Acyclic | Cyclic | Acyclic |
| 0 | DigitalInput 1 - 2 | USINT | 1 | ● | ● | | |
| 18 | InputFilter [0.2 ms] | USINT | 1 | | ● | | ● |

Table 65: DeviceNet data points - DI2371

2.6 Modbus/TCP data points

| Register | Name | Data type | Length | Read | | Write | |
|----------|----------------------|-----------|--------|--------|---------|--------|---------|
| | | | | Cyclic | Acyclic | Cyclic | Acyclic |
| 0 | DigitalInput 1 - 2 | USINT | 1 | ● | ● | | |
| 18 | InputFilter [0.2 ms] | USINT | 1 | | ● | | ● |

Table 66: Modbus/TCP data points - DI2371

Unfiltered

The input status is registered with a fixed offset with respect to the network cycle and is transferred in the same cycle.

Filtered

The filtered status is registered with a fixed offset with respect to the network cycle and is transferred in the same cycle. Filtering takes place asynchronous to the network in a 200 µs grid with a network-related jitter of up to 50 µs.

2.7 Register: DigitalInput 1 - 2

| Bit | Description |
|-----|--------------------------------|
| 0 | Input status - digital input 1 |
| 1 | Input status - digital input 2 |

2.8 Register: DigitalInput01 - DigitalInput02

| BOOL | Description |
|------|--------------------------------------|
| x | 0/1 ... Input status - digital input |

2.9 Register: InputFilter

The filter value can be configured for all digital inputs.

| Value | Filter |
|-------|---|
| 0 | No SW filter |
| 2 | 0.2 ms |
| 4 | 0.4 ms |
| : | : |
| 250 | 25 ms - higher values are limited to this value |

Table 67: Input filters - DI2371

2.10 B&R ID code

Code for module identification (\$1B8D).

2.11 Minimum cycle time

The minimum cycle time is the minimum time needed for the bus cycle to be shut down without a communication error occurring. It should be noted that very fast cycles have reduced the idle time needed for handling monitoring, diagnostics and acyclic commands.

| Minimum cycle time | |
|---------------------------------|---------|
| Without filtering ¹⁾ | ≥100 µs |

Table 68: Minimum cycle time - DI2371

1) At cycle times of <150 µs, filtering is deactivated

2.12 Minimum I/O update time

The minimum I/O update time refers to the minimum time it takes for the bus cycle to shut down, so that in each cycle an I/O update takes place.

| Minimum I/O update time | |
|-------------------------|---------|
| Without filtering | ≥100 µs |
| With filtering | ≥200 µs |

Table 69: Minimum I/O update time - DI2371

3. X20DI2372

3.1 Register overview

| Register | Name | Data type | Length | Read | | Write | |
|----------|----------------------|-----------|--------|--------|---------|--------|---------|
| | | | | Cyclic | Acyclic | Cyclic | Acyclic |
| 0 | DigitalInput 1 - 2 | USINT | 1 | ● | ● | | |
| 18 | InputFilter [0.2 ms] | USINT | 1 | | ● | | ● |

Table 70: Register overview - DI2372

3.2 Variable assignment in Automation Studio (X2X master)

| Name | Data type | Length | Read | | Write | |
|----------------|-----------|--------|--------|---------|--------|---------|
| | | | Cyclic | Acyclic | Cyclic | Acyclic |
| DigitalInput01 | BOOL | 1 | ● | | | |
| DigitalInput02 | BOOL | 1 | ● | | | |

Table 71: Variable assignment in Automation Studio (X2X master) - DI2372

3.3 Variable assignment in Automation Studio (CANIO)

| Name | Data type | Length | Read | | Write | |
|----------------|-----------|--------|--------|---------|--------|---------|
| | | | Cyclic | Acyclic | Cyclic | Acyclic |
| DigitalInput01 | BOOL | 1 | ● | | | |
| DigitalInput02 | BOOL | 1 | ● | | | |

Table 72: Variable assignment in Automation Studio (CANIO) - DI2371

3.4 CANopen data points

| Register | Name | Data type | Length | Read | | Write | |
|----------|----------------------|-----------|--------|------|-----|-------|-----|
| | | | | PDO | SDO | PDO | SDO |
| 0 | DigitalInput 1 - 2 | USINT | 1 | ● | ● | | |
| 18 | InputFilter [0.2 ms] | USINT | 1 | | ● | | ● |

Table 73: CANopen data points - DI2372

3.5 DeviceNet data points

| Register | Name | Data type | Length | Read | | Write | |
|----------|----------------------|-----------|--------|--------|---------|--------|---------|
| | | | | Cyclic | Acyclic | Cyclic | Acyclic |
| 0 | DigitalInput 1 - 2 | USINT | 1 | ● | ● | | |
| 18 | InputFilter [0.2 ms] | USINT | 1 | | ● | | ● |

Table 74: DeviceNet data points - DI2372

3.6 Modbus/TCP data points

| Register | Name | Data type | Length | Read | | Write | |
|----------|----------------------|-----------|--------|--------|---------|--------|---------|
| | | | | Cyclic | Acyclic | Cyclic | Acyclic |
| 0 | DigitalInput 1 - 2 | USINT | 1 | ● | ● | | |
| 18 | InputFilter [0.2 ms] | USINT | 1 | | ● | | ● |

Table 75: Modbus/TCP data points - DI2372

Unfiltered

The input status is registered with a fixed offset with respect to the network cycle and is transferred in the same cycle.

Filtered

The filtered status is registered with a fixed offset with respect to the network cycle and is transferred in the same cycle. Filtering takes place asynchronous to the network in a 200 µs grid with a network-related jitter of up to 50 µs.

3.7 Register: DigitalInput 1 - 2

| Bit | Description |
|-----|--------------------------------|
| 0 | Input status - digital input 1 |
| 1 | Input status - digital input 2 |

3.8 Register: DigitalInput01 - DigitalInput02

| BOOL | Description |
|------|--------------------------------------|
| x | 0/1 ... Input status - digital input |

3.9 Register: InputFilter

The filter value can be configured for all digital inputs.

| Value | Filter |
|-------|---|
| 0 | No SW filter |
| 2 | 0.2 ms |
| 4 | 0.4 ms |
| : | : |
| 250 | 25 ms - higher values are limited to this value |

Table 76: Input filters - DI2372

3.10 B&R ID code

Code for module identification (\$22A7).

3.11 Minimum cycle time

The minimum cycle time is the minimum time needed for the bus cycle to be shut down without a communication error occurring. It should be noted that very fast cycles have reduced the idle time needed for handling monitoring, diagnostics and acyclic commands.

| Minimum cycle time | |
|---------------------------------|---------|
| Without filtering ¹⁾ | ≥100 µs |

Table 77: Minimum cycle time - DI2372

1) At cycle times of <150 µs, filtering is deactivated

3.12 Minimum I/O update time

The minimum I/O update time refers to the minimum time it takes for the bus cycle to shut down, so that in each cycle an I/O update takes place.

| Minimum I/O update time | |
|-------------------------|---------|
| Without filtering | ≥100 µs |
| With filtering | ≥200 µs |

Table 78: Minimum I/O update time - DI2372

4. X20DI2377

4.1 Register overview

| Register | Name | Data type | Length | Read | | Write | |
|----------|--------------------------------------|-----------|--------|--------|---------|--------|---------|
| | | | | Cyclic | Acyclic | Cyclic | Acyclic |
| 0 | DigitalInput 1 - 2 | USINT | 1 | ● | ● | | |
| 4 | Counter01 | UINT | 2 | ● | ● | | |
| 6 | Counter02 | UINT | 2 | ● | ● | | |
| 18 | InputFilter [0.2 ms] | USINT | 1 | | ● | | ● |
| 20 | ConfigurationCounter01 | USINT | 1 | | ● | ● | ● |
| 22 | ConfigurationCounter02 | USINT | 1 | | ● | ● | ● |
| 26 | PositiveEdgeInputLatch ¹⁾ | USINT | 1 | ● | ● | | |
| 28 | AcknowledgeInputLatch ¹⁾ | USINT | 1 | | ● | ● | ● |

Table 79: Register overview - DI2377

1) Only with function model 1

4.2 Variable assignment in Automation Studio (X2X master)

| Name | Data type | Length | Read | | Write | |
|--------------------------------------|-----------|--------|--------|---------|--------|---------|
| | | | Cyclic | Acyclic | Cyclic | Acyclic |
| DigitalInput01 | BOOL | 1 | ● | | | |
| DigitalInput02 | BOOL | 1 | ● | | | |
| Counter01 | UINT | 2 | ● | | | |
| Counter02 | UINT | 2 | ● | | | |
| ResetCounter01 | BOOL | 1 | | | ● | |
| ResetCounter02 | BOOL | 1 | | | ● | |
| DigitalInput01Latch ¹⁾ | BOOL | 1 | ● | | | |
| DigitalInput02Latch ¹⁾ | BOOL | 1 | ● | | | |
| DigitalInput01LatchAck ¹⁾ | BOOL | 1 | | | ● | |
| DigitalInput02LatchAck ¹⁾ | BOOL | 1 | | | ● | |

Table 80: Variable assignment in Automation Studio (X2X master) - DI2377

1) Only with function model 1

4.3 Variable assignment in Automation Studio (CANIO)

| Name | Data type | Length | Read | | Write | |
|----------------|-----------|--------|--------|---------|--------|---------|
| | | | Cyclic | Acyclic | Cyclic | Acyclic |
| Counter01 | UINT | 2 | ● | | | |
| Counter02 | UINT | 2 | ● | | | |
| ResetCounter01 | BOOL | 1 | | | | ● |
| ResetCounter02 | BOOL | 1 | | | | ● |

Table 81: Variable assignment in Automation Studio (CANIO) - DI2377

4.4 CANopen data points

| Register | Name | Data type | Length | Read | | Write | |
|----------|------------------------|-----------|--------|------|-----|-------|-----|
| | | | | PDO | SDO | PDO | SDO |
| 0 | DigitalInput 1 - 2 | USINT | 1 | | ● | | |
| 4 | Counter01 | UINT | 2 | ● | ● | | |
| 6 | Counter02 | UINT | 2 | ● | ● | | |
| 18 | InputFilter [0.2 ms] | USINT | 1 | | ● | | ● |
| 20 | ConfigurationCounter01 | USINT | 1 | | ● | | ● |
| 22 | ConfigurationCounter02 | USINT | 1 | | ● | | ● |
| 26 | PositiveEdgeInputLatch | USINT | 1 | | ● | | |
| 28 | AcknowledgeInputLatch | USINT | 1 | | ● | | ● |

Table 82: CANopen data points - DI2377

4.5 DeviceNet data points

| Register | Name | Data type | Length | Read | | Write | |
|----------|------------------------|-----------|--------|--------|---------|--------|---------|
| | | | | Cyclic | Acyclic | Cyclic | Acyclic |
| 0 | DigitalInput 1 - 2 | USINT | 1 | | ● | | |
| 4 | Counter01 | UINT | 2 | ● | ● | | |
| 6 | Counter02 | UINT | 2 | ● | ● | | |
| 18 | InputFilter [0.2 ms] | USINT | 1 | | ● | | ● |
| 20 | ConfigurationCounter01 | USINT | 1 | | ● | | ● |
| 22 | ConfigurationCounter02 | USINT | 1 | | ● | | ● |
| 26 | PositiveEdgeInputLatch | USINT | 1 | | ● | | |
| 28 | AcknowledgeInputLatch | USINT | 1 | | ● | | ● |

Table 83: DeviceNet data points - DI2377

4.6 Modbus/TCP data points

| Register | Name | Data type | Length | Read | | Write | |
|----------|------------------------|-----------|--------|--------|---------|--------|---------|
| | | | | Cyclic | Acyclic | Cyclic | Acyclic |
| 0 | DigitalInput 1 - 2 | USINT | 1 | | ● | | |
| 4 | Counter01 | UINT | 2 | ● | ● | | |
| 6 | Counter02 | UINT | 2 | ● | ● | | |
| 18 | InputFilter [0.2 ms] | USINT | 1 | | ● | | ● |
| 20 | ConfigurationCounter01 | USINT | 1 | | ● | | ● |
| 22 | ConfigurationCounter02 | USINT | 1 | | ● | | ● |
| 26 | PositiveEdgeInputLatch | USINT | 1 | | ● | | |
| 28 | AcknowledgeInputLatch | USINT | 1 | | ● | | ● |

Table 84: Modbus/TCP data points - DI2377

4.7 Digital inputs

Unfiltered

The input status is registered with a fixed offset with respect to the network cycle and is transferred in the same cycle.

Filtered

The filtered status is registered with a fixed offset with respect to the network cycle and is transferred in the same cycle. Filtering takes place asynchronous to the network in a 200 µs grid with a network-related jitter of up to 50 µs.

4.8 Register: DigitalInput 1 - 2

| Bit | Description |
|-----|--------------------------------|
| 0 | Input status - digital input 1 |
| 1 | Input status - digital input 2 |

4.9 Register: DigitalInput01 - DigitalInput02

| BOOL | Description |
|------|--------------------------------------|
| x | 0/1 ... Input status - digital input |

4.10 Register: Counter01 - Counter02

Event counter or gate measurement (16-bit counter value) depending on operating mode.

4.11 Register: ResetCounter01 - ResetCounter02

| BOOL | Description |
|------|---|
| x | 0 ... No influence on the counter 1 ... Delete counter |

4.12 Input filter

The filter value can be configured for all digital inputs.

| Value | Filter |
|-------|---|
| 0 | No SW filter |
| 2 | 0.2 ms |
| 4 | 0.4 ms |
| : | : |
| 250 | 25 ms - higher values are limited to this value |

Table 85: Input filters - DI2377

4.13 Counter operation

The following operation modes can be selected:

- Event counter operation
- Gate measurement

Event counter operation

The falling edges are registered on the counter input.

The counter status is registered with a fixed offset with respect to the network cycle and is transferred in the same cycle.

Gate measurement

Information:

Only one of the counter channels at a time can be used for gate measurement.

The time of rising to falling edges for the gate input is registered using an internal frequency. The result is checked for overflow (\$FFFF) and corrected with the adjustable prescaler.

The recovery time between measurements must be >100 µs.

The measurement result is transferred with the falling edge to the result memory.

4.14 Register: ConfigurationCounter01 - ConfigurationCounter02

| Bit | Description |
|-------|---|
| 0 - 3 | 0000 ... Counter frequency= 48 MHz (only with gate measurement) 0001 ... Counter frequency= 3 MHz (only with gate measurement) 0010 ... Counter frequency= 187.5 kHz (only with gate measurement) 0011 ... Counter frequency= 24 MHz (only with gate measurement) 0100 ... Counter frequency= 12 MHz (only with gate measurement) 0101 ... Counter frequency= 6 MHz (only with gate measurement) 0110 ... Counter frequency= 1.5 MHz (only with gate measurement) 0111 ... Counter frequency= 750 kHz (only with gate measurement) 1000 ... Counter frequency= 375 kHz (only with gate measurement) |
| 4 | 0 |
| 5 | 0 ... No influence on the counter 1 ... Delete counter |
| 6 - 7 | 00 ... Event counter measurement 01 ... Gate measurement |

4.15 Positive edge input latch

Using this function, the positive edges of the input signal can be latched with a resolution of 200 μ s. With the "Acknowledge input latch" function, the input latch is either reset or prevented from latching.

It works in the same way as a dominant reset RS flip-flop.

| | | | | | |
|--|--|----------|----------|----------|---------------|
| | | R | S | Q | Status |
| | | 0 | 0 | x | Do not change |
| | | 0 | 1 | 1 | Set |
| | | 1 | 0 | 0 | Reset |
| | | 1 | 1 | 0 | Reset |

Table 86: Functioning principle of positive edge input latch - DI2377

4.16 Register: InputLatchPositiveEdge

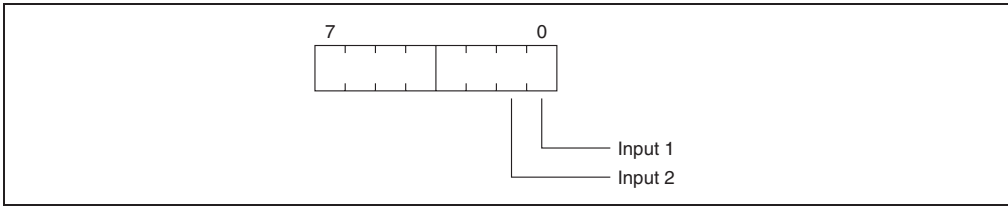


Figure 1: InputLatchPositiveEdge register - DI2377

4.17 Register: DigitalInput01Latch - DigitalInput02Latch

| BOOL | Description |
|------|--------------------------------------|
| x | 0/1 ... Latch status - digital input |

4.18 Input latch acknowledgement

This function is used to reset the input latches channel by channel.

4.19 Register: AcknowledgeInputLatch

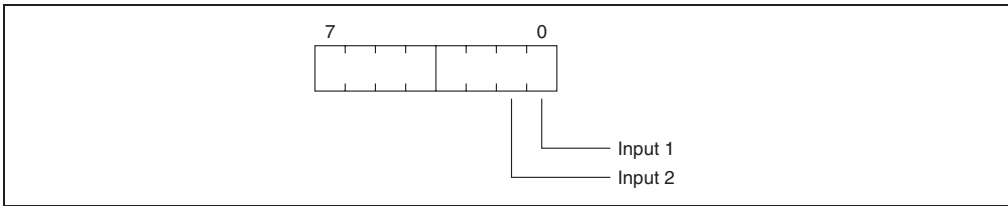


Figure 2: AcknowledgeInputLatch register - DI2377

4.20 Register: DigitalInput01LatchAck - DigitalInput02LatchAck

| BOOL | Description |
|------|---|
| x | 0 ... No influence on the latch status 1 ... Resets the latch status |

4.21 Function models

A function model describes the registers for the module (memory model) which are available for the application. Only these registers are processed on the module during each cycle and cyclically transferred using the bus. The cycle time can be minimized by selecting the correct function model.

Function model 0: counter module (default)

| Function model 0 | | | | | | | |
|------------------|------------------------|-----------|--------|--------|---------|--------|---------|
| Register | Name | Data type | Length | Read | | Write | |
| | | | | Cyclic | Acyclic | Cyclic | Acyclic |
| 0 | DigitalInput 1 - 2 | USINT | 1 | ● | ● | | |
| 4 | Counter01 | UINT | 2 | ● | ● | | |
| 6 | Counter02 | UINT | 2 | ● | ● | | |
| 18 | InputFilter [0.2 ms] | USINT | 1 | | ● | | ● |
| 20 | ConfigurationCounter01 | USINT | 1 | | ● | ● | ● |
| 22 | ConfigurationCounter02 | USINT | 1 | | ● | ● | ● |

Table 87: Function model 0: counter module (default) - DI2377

Function model 1: counter module with input latch

| Function model 1 | | | | | | | |
|------------------|------------------------|-----------|--------|--------|---------|--------|---------|
| Register | Name | Data type | Length | Read | | Write | |
| | | | | Cyclic | Acyclic | Cyclic | Acyclic |
| 0 | DigitalInput 1 - 2 | USINT | 1 | ● | ● | | |
| 4 | Counter01 | UINT | 2 | ● | ● | | |
| 6 | Counter02 | UINT | 2 | ● | ● | | |
| 18 | InputFilter [0.2 ms] | USINT | 1 | | ● | | ● |
| 20 | ConfigurationCounter01 | USINT | 1 | | ● | ● | ● |
| 22 | ConfigurationCounter02 | USINT | 1 | | ● | ● | ● |
| 26 | PositiveEdgeInputLatch | USINT | 1 | ● | ● | | |
| 28 | AcknowledgeInputLatch | USINT | 1 | | ● | ● | ● |

Table 88: Function model 1: counter module with input latch - DI2377

4.22 Function models - used where?

| Name | Automation Studio | CANopen | DeviceNet | Modbus/TCP | CAN I/O |
|---|-------------------|---------|-----------|------------|---------|
| Function model 0: counter module (default) | • | • | • | • | • |
| Function model 1: counter module with input latch | • | | | • | |

Table 89: Function models - DI2377

4.23 B&R ID code

Code for module identification (\$1B8E).

4.24 Minimum cycle time

The minimum cycle time is the minimum time needed for the bus cycle to be shut down without a communication error occurring. It should be noted that very fast cycles have reduced the idle time needed for handling monitoring, diagnostics and acyclic commands.

| Minimum cycle time | |
|---------------------------------|------------------------|
| Without filtering ¹⁾ | $\geq 100 \mu\text{s}$ |

Table 90: Minimum cycle time - DI2377

1) At cycle times of $< 150 \mu\text{s}$, filtering is deactivated

4.25 Minimum I/O update time

The minimum I/O update time refers to the minimum time it takes for the bus cycle to shut down, so that in each cycle an I/O update takes place.

| Minimum I/O update time | |
|-------------------------|------------------------|
| Without filtering | $\geq 100 \mu\text{s}$ |
| With filtering | $\geq 200 \mu\text{s}$ |

Table 91: Minimum I/O update time - DI2377

5. X20DI4371

5.1 Register overview

| Register | Name | Data type | Length | Read | | Write | |
|----------|----------------------|-----------|--------|--------|---------|--------|---------|
| | | | | Cyclic | Acyclic | Cyclic | Acyclic |
| 0 | DigitalInput 1 - 4 | USINT | 1 | ● | ● | | |
| 18 | InputFilter [0.2 ms] | USINT | 1 | | ● | | ● |

Table 92: Register overview - DI4371

5.2 Variable assignment in Automation Studio (X2X master)

| Name | Data type | Length | Read | | Write | |
|----------------|-----------|--------|--------|---------|--------|---------|
| | | | Cyclic | Acyclic | Cyclic | Acyclic |
| DigitalInput01 | BOOL | 1 | ● | | | |
| DigitalInput02 | BOOL | 1 | ● | | | |
| DigitalInput03 | BOOL | 1 | ● | | | |
| DigitalInput04 | BOOL | 1 | ● | | | |

Table 93: Variable assignment in Automation Studio (X2X master) - DI4371

5.3 Variable assignment in Automation Studio (CANIO)

| Name | Data type | Length | Read | | Write | |
|----------------|-----------|--------|--------|---------|--------|---------|
| | | | Cyclic | Acyclic | Cyclic | Acyclic |
| DigitalInput01 | BOOL | 1 | ● | | | |
| DigitalInput02 | BOOL | 1 | ● | | | |
| DigitalInput03 | BOOL | 1 | ● | | | |
| DigitalInput04 | BOOL | 1 | ● | | | |

Table 94: Variable assignment in Automation Studio (CANIO) - DI4371

5.4 CANopen data points

| Register | Name | Data type | Length | Read | | Write | |
|----------|----------------------|-----------|--------|------|-----|-------|-----|
| | | | | PDO | SDO | PDO | SDO |
| 0 | DigitalInput 1 - 4 | USINT | 1 | ● | ● | | |
| 18 | InputFilter [0.2 ms] | USINT | 1 | | ● | | ● |

Table 95: CANopen data points - DI4371

5.5 DeviceNet data points

| Register | Name | Data type | Length | Read | | Write | |
|----------|----------------------|-----------|--------|--------|---------|--------|---------|
| | | | | Cyclic | Acyclic | Cyclic | Acyclic |
| 0 | DigitalInput 1 - 4 | USINT | 1 | ● | ● | | |
| 18 | InputFilter [0.2 ms] | USINT | 1 | | ● | | ● |

Table 96: DeviceNet data points - DI4371

5.6 Modbus/TCP data points

| Register | Name | Data type | Length | Read | | Write | |
|----------|----------------------|-----------|--------|--------|---------|--------|---------|
| | | | | Cyclic | Acyclic | Cyclic | Acyclic |
| 0 | DigitalInput 1 - 4 | USINT | 1 | ● | ● | | |
| 18 | InputFilter [0.2 ms] | USINT | 1 | | ● | | ● |

Table 97: Modbus/TCP data points - DI4371

Unfiltered

The input status is registered with a fixed offset with respect to the network cycle and is transferred in the same cycle.

Filtered

The filtered status is registered with a fixed offset with respect to the network cycle and is transferred in the same cycle. Filtering takes place asynchronous to the network in a 200 µs grid with a network-related jitter of up to 50 µs.

5.7 Register: DigitalInput 1 - 4

| Bit | Description |
|-----|--------------------------------|
| 0 | Input status - digital input 1 |
| 1 | Input status - digital input 2 |
| 2 | Input status - digital input 3 |
| 3 | Input status - digital input 4 |

5.8 Register: DigitalInput01 - DigitalInput04

| BOOL | Description |
|------|--------------------------------------|
| x | 0/1 ... Input status - digital input |

5.9 Register: InputFilter

The filter value can be configured for all digital inputs.

| Value | Filter |
|-------|---|
| 0 | No SW filter |
| 2 | 0.2 ms |
| 4 | 0.4 ms |
| : | : |
| 250 | 25 ms - higher values are limited to this value |

Table 98: Input filters - DI4371

5.10 B&R ID code

Code for module identification (\$1B92).

5.11 Minimum cycle time

The minimum cycle time is the minimum time needed for the bus cycle to be shut down without a communication error occurring. It should be noted that very fast cycles have reduced the idle time needed for handling monitoring, diagnostics and acyclic commands.

| Minimum cycle time | |
|---------------------------------|---------|
| Without filtering ¹⁾ | ≥100 µs |

Table 99: Minimum cycle time - DI4371

1) At cycle times of <150 µs, filtering is deactivated

5.12 Minimum I/O update time

The minimum I/O update time refers to the minimum time it takes for the bus cycle to shut down, so that in each cycle an I/O update takes place.

| Minimum I/O update time | |
|-------------------------|---------|
| Without filtering | ≥100 µs |
| With filtering | ≥200 µs |

Table 100: Minimum I/O update time - DI4371

6. X20DI4372

6.1 Register overview

| Register | Name | Data type | Length | Read | | Write | |
|----------|----------------------|-----------|--------|--------|---------|--------|---------|
| | | | | Cyclic | Acyclic | Cyclic | Acyclic |
| 0 | DigitalInput 1 - 4 | USINT | 1 | ● | ● | | |
| 18 | InputFilter [0.2 ms] | USINT | 1 | | ● | | ● |

Table 101: Register overview - DI4372

6.2 Variable assignment in Automation Studio (X2X master)

| Name | Data type | Length | Read | | Write | |
|----------------|-----------|--------|--------|---------|--------|---------|
| | | | Cyclic | Acyclic | Cyclic | Acyclic |
| DigitalInput01 | BOOL | 1 | ● | | | |
| DigitalInput02 | BOOL | 1 | ● | | | |
| DigitalInput03 | BOOL | 1 | ● | | | |
| DigitalInput04 | BOOL | 1 | ● | | | |

Table 102: Variable assignment in Automation Studio (X2X master) - DI4372

6.3 Variable assignment in Automation Studio (CANIO)

| Name | Data type | Length | Read | | Write | |
|----------------|-----------|--------|--------|---------|--------|---------|
| | | | Cyclic | Acyclic | Cyclic | Acyclic |
| DigitalInput01 | BOOL | 1 | ● | | | |
| DigitalInput02 | BOOL | 1 | ● | | | |
| DigitalInput03 | BOOL | 1 | ● | | | |
| DigitalInput04 | BOOL | 1 | ● | | | |

Table 103: Variable assignment in Automation Studio (CANIO) - DI4372

6.4 CANopen data points

| Register | Name | Data type | Length | Read | | Write | |
|----------|----------------------|-----------|--------|------|-----|-------|-----|
| | | | | PDO | SDO | PDO | SDO |
| 0 | DigitalInput 1 - 4 | USINT | 1 | ● | ● | | |
| 18 | InputFilter [0.2 ms] | USINT | 1 | | ● | | ● |

Table 104: CANopen data points - DI4372

6.5 DeviceNet data points

| Register | Name | Data type | Length | Read | | Write | |
|----------|----------------------|-----------|--------|--------|---------|--------|---------|
| | | | | Cyclic | Acyclic | Cyclic | Acyclic |
| 0 | DigitalInput 1 - 4 | USINT | 1 | ● | ● | | |
| 18 | InputFilter [0.2 ms] | USINT | 1 | | ● | | ● |

Table 105: DeviceNet data points - DI4372

6.6 Modbus/TCP data points

| Register | Name | Data type | Length | Read | | Write | |
|----------|----------------------|-----------|--------|--------|---------|--------|---------|
| | | | | Cyclic | Acyclic | Cyclic | Acyclic |
| 0 | DigitalInput 1 - 4 | USINT | 1 | ● | ● | | |
| 18 | InputFilter [0.2 ms] | USINT | 1 | | ● | | ● |

Table 106: Modbus/TCP data points - DI4372

Unfiltered

The input status is registered with a fixed offset with respect to the network cycle and is transferred in the same cycle.

Filtered

The filtered status is registered with a fixed offset with respect to the network cycle and is transferred in the same cycle. Filtering takes place asynchronous to the network in a 200 µs grid with a network-related jitter of up to 50 µs.

6.7 Register: DigitalInput 1 - 4

| Bit | Description |
|-----|--------------------------------|
| 0 | Input status - digital input 1 |
| 1 | Input status - digital input 2 |
| 2 | Input status - digital input 3 |
| 3 | Input status - digital input 4 |

6.8 Register: DigitalInput01 - DigitalInput04

| BOOL | Description |
|------|--------------------------------------|
| x | 0/1 ... Input status - digital input |

6.9 Register: InputFilter

The filter value can be configured for all digital inputs.

| Value | Filter |
|-------|---|
| 0 | No SW filter |
| 2 | 0.2 ms |
| 4 | 0.4 ms |
| : | : |
| 250 | 25 ms - higher values are limited to this value |

Table 107: Input filters - DI4372

6.10 B&R ID code

Code for module identification (\$22A8).

6.11 Minimum cycle time

The minimum cycle time is the minimum time needed for the bus cycle to be shut down without a communication error occurring. It should be noted that very fast cycles have reduced the idle time needed for handling monitoring, diagnostics and acyclic commands.

| Minimum cycle time | |
|---------------------------------|---------|
| Without filtering ¹⁾ | ≥100 µs |

Table 108: Minimum cycle time - DI4372

1) At cycle times of <150 µs, filtering is deactivated

6.12 Minimum I/O update time

The minimum I/O update time refers to the minimum time it takes for the bus cycle to shut down, so that in each cycle an I/O update takes place.

| Minimum I/O update time | |
|-------------------------|---------|
| Without filtering | ≥100 µs |
| With filtering | ≥200 µs |

Table 109: Minimum I/O update time - DI4372

7. X20DI4760

7.1 Register overview

| Register | Name | Data type | Length | Read | | Write | |
|----------|----------------------------------|-----------|--------|--------|---------|--------|---------|
| | | | | Cyclic | Acyclic | Cyclic | Acyclic |
| 0 | DigitalInput 1 - 4 | USINT | 1 | ● | ● | | |
| 4 | Pos. edge counter DigitalInput 1 | USINT | 1 | ● | ● | | |
| 6 | Pos. edge counter DigitalInput 2 | USINT | 1 | ● | ● | | |
| 8 | Pos. edge counter DigitalInput 3 | USINT | 1 | ● | ● | | |
| 10 | Pos. edge counter DigitalInput 4 | USINT | 1 | ● | ● | | |
| 12 | Current - channel 1 | SINT | 1 | | ● | | |
| 13 | Current - channel 2 | SINT | 1 | | ● | | |
| 14 | Current - channel 3 | SINT | 1 | | ● | | |
| 15 | Current - channel 4 | SINT | 1 | | ● | | |
| 30 | Channel status 1 - 4 | USINT | 1 | ● | ● | | |

Table 110: Register overview - DI4760

7.2 Variable assignment in Automation Studio (X2X master)

| Name | Data type | Length | Read | | Write | |
|----------------|-----------|--------|--------|---------|--------|---------|
| | | | Cyclic | Acyclic | Cyclic | Acyclic |
| DigitalInput01 | BOOL | 1 | ● | | | |
| DigitalInput02 | BOOL | 1 | ● | | | |
| DigitalInput03 | BOOL | 1 | ● | | | |
| DigitalInput04 | BOOL | 1 | ● | | | |

Table 111: Variable assignment in Automation Studio (X2X master) - DI4760

7.3 Variable assignment in Automation Studio (CANIO)

| Name | Data type | Length | Read | | Write | |
|----------------|-----------|--------|--------|---------|--------|---------|
| | | | Cyclic | Acyclic | Cyclic | Acyclic |
| DigitalInput01 | BOOL | 1 | ● | | | |
| DigitalInput02 | BOOL | 1 | ● | | | |
| DigitalInput03 | BOOL | 1 | ● | | | |
| DigitalInput04 | BOOL | 1 | ● | | | |

Table 112: Variable assignment in Automation Studio (CANIO) - DI4760

7.4 CANopen data points

| Register | Name | Data type | Length | Read | | Write | |
|----------|----------------------------------|-----------|--------|------|-----|-------|-----|
| | | | | PDO | SDO | PDO | SDO |
| 0 | DigitalInput 1 - 4 | USINT | 1 | ● | ● | | |
| 4 | Pos. edge counter DigitalInput 1 | USINT | 1 | | ● | | |
| 6 | Pos. edge counter DigitalInput 2 | USINT | 1 | | ● | | |
| 8 | Pos. edge counter DigitalInput 3 | USINT | 1 | | ● | | |
| 10 | Pos. edge counter DigitalInput 4 | USINT | 1 | | ● | | |
| 12 | Current - channel 1 | SINT | 1 | | ● | | |
| 13 | Current - channel 2 | SINT | 1 | | ● | | |
| 14 | Current - channel 3 | SINT | 1 | | ● | | |
| 15 | Current - channel 4 | SINT | 1 | | ● | | |
| 30 | Channel status 1 - 4 | USINT | 1 | | ● | | |

Table 113: CANopen data points - DI4760

7.5 DeviceNet data points

| Register | Name | Data type | Length | Read | | Write | |
|----------|----------------------------------|-----------|--------|--------|---------|--------|---------|
| | | | | Cyclic | Acyclic | Cyclic | Acyclic |
| 0 | DigitalInput 1 - 4 | USINT | 1 | ● | ● | | |
| 4 | Pos. edge counter DigitalInput 1 | USINT | 1 | | ● | | |
| 6 | Pos. edge counter DigitalInput 2 | USINT | 1 | | ● | | |
| 8 | Pos. edge counter DigitalInput 3 | USINT | 1 | | ● | | |
| 10 | Pos. edge counter DigitalInput 4 | USINT | 1 | | ● | | |
| 12 | Current - channel 1 | SINT | 1 | | ● | | |
| 13 | Current - channel 2 | SINT | 1 | | ● | | |
| 14 | Current - channel 3 | SINT | 1 | | ● | | |
| 15 | Current - channel 4 | SINT | 1 | | ● | | |
| 30 | Channel status 1 - 4 | USINT | 1 | | ● | | |

Table 114: DeviceNet data points - DI4760

7.6 Modbus/TCP data points

| Register | Name | Data type | Length | Read | | Write | |
|----------|----------------------------------|-----------|--------|--------|---------|--------|---------|
| | | | | Cyclic | Acyclic | Cyclic | Acyclic |
| 0 | DigitalInput 1 - 4 | USINT | 1 | ● | ● | | |
| 4 | Pos. edge counter DigitalInput 1 | USINT | 1 | | ● | | |
| 6 | Pos. edge counter DigitalInput 2 | USINT | 1 | | ● | | |
| 8 | Pos. edge counter DigitalInput 3 | USINT | 1 | | ● | | |
| 10 | Pos. edge counter DigitalInput 4 | USINT | 1 | | ● | | |
| 12 | Current - channel 1 | SINT | 1 | | ● | | |
| 13 | Current - channel 2 | SINT | 1 | | ● | | |
| 14 | Current - channel 3 | SINT | 1 | | ● | | |
| 15 | Current - channel 4 | SINT | 1 | | ● | | |
| 30 | Channel status 1 - 4 | USINT | 1 | | ● | | |

Table 115: Modbus/TCP data points - DI4760

7.7 Register: DigitalInput 1 - 4

| Bit | Description |
|-----|--------------------------------|
| 0 | Input status - digital input 1 |
| 1 | Input status - digital input 2 |
| 2 | Input status - digital input 3 |
| 3 | Input status - digital input 4 |

7.8 Register: DigitalInput01 - DigitalInput04

| BOOL | Description |
|------|--------------------------------------|
| x | 0/1 ... Input status - digital input |

7.9 Register: ChannelStatus 1 - 4

| Bit | Description |
|-----|----------------------|
| 0 | Channel 1 overload |
| 1 | Channel 2 overload |
| 2 | Channel 3 overload |
| 3 | Channel 4 overload |
| 4 | Channel 1 wire break |
| 5 | Channel 2 wire break |
| 6 | Channel 3 wire break |
| 7 | Channel 4 wire break |

7.10 B&R ID code

Code for module identification (\$2105).

7.11 Minimum cycle time

The minimum cycle time is the minimum time needed for the bus cycle to be shut down without a communication error occurring. It should be noted that very fast cycles have reduced the idle time needed for handling monitoring, diagnostics and acyclic commands.

| Minimum cycle time | |
|-----------------------|------------------------|
| Any type of operation | $\geq 100 \mu\text{s}$ |

Table 116: Minimum cycle time - DI4760

7.12 Minimum I/O update time

The minimum I/O update time refers to the minimum time it takes for the bus cycle to shut down, so that in each cycle an I/O update takes place.

| Minimum I/O update time | |
|-------------------------|------------------------|
| Any type of operation | $\geq 500 \mu\text{s}$ |

Table 117: Minimum I/O update time - DI4760

8. X20DI6371

8.1 Register overview

| Register | Name | Data type | Length | Read | | Write | |
|----------|----------------------|-----------|--------|--------|---------|--------|---------|
| | | | | Cyclic | Acyclic | Cyclic | Acyclic |
| 0 | DigitalInput 1 - 6 | USINT | 1 | ● | ● | | |
| 18 | InputFilter [0.2 ms] | USINT | 1 | | ● | | ● |

Table 118: Register overview - DI6371

8.2 Variable assignment in Automation Studio (X2X master)

| Name | Data type | Length | Read | | Write | |
|----------------|-----------|--------|--------|---------|--------|---------|
| | | | Cyclic | Acyclic | Cyclic | Acyclic |
| DigitalInput01 | BOOL | 1 | ● | | | |
| DigitalInput02 | BOOL | 1 | ● | | | |
| DigitalInput03 | BOOL | 1 | ● | | | |
| DigitalInput04 | BOOL | 1 | ● | | | |
| DigitalInput05 | BOOL | 1 | ● | | | |
| DigitalInput06 | BOOL | 1 | ● | | | |

Table 119: Variable assignment in Automation Studio (X2X master) - DI6371

8.3 Variable assignment in Automation Studio (CANIO)

| Name | Data type | Length | Read | | Write | |
|----------------|-----------|--------|--------|---------|--------|---------|
| | | | Cyclic | Acyclic | Cyclic | Acyclic |
| DigitalInput01 | BOOL | 1 | ● | | | |
| DigitalInput02 | BOOL | 1 | ● | | | |
| DigitalInput03 | BOOL | 1 | ● | | | |
| DigitalInput04 | BOOL | 1 | ● | | | |
| DigitalInput05 | BOOL | 1 | ● | | | |
| DigitalInput06 | BOOL | 1 | ● | | | |

Table 120: Variable assignment in Automation Studio (CANIO) - DI6371

8.4 CANopen data points

| Register | Name | Data type | Length | Read | | Write | |
|----------|----------------------|-----------|--------|------|-----|-------|-----|
| | | | | PDO | SDO | PDO | SDO |
| 0 | DigitalInput 1 - 6 | USINT | 1 | ● | ● | | |
| 18 | InputFilter [0.2 ms] | USINT | 1 | | ● | | ● |

Table 121: CANopen data points - DI6371

8.5 DeviceNet data points

| Register | Name | Data type | Length | Read | | Write | |
|----------|----------------------|-----------|--------|--------|---------|--------|---------|
| | | | | Cyclic | Acyclic | Cyclic | Acyclic |
| 0 | DigitalInput 1 - 6 | USINT | 1 | ● | ● | | |
| 18 | InputFilter [0.2 ms] | USINT | 1 | | ● | | ● |

Table 122: DeviceNet data points - DI6371

8.6 Modbus/TCP data points

| Register | Name | Data type | Length | Read | | Write | |
|----------|----------------------|-----------|--------|--------|---------|--------|---------|
| | | | | Cyclic | Acyclic | Cyclic | Acyclic |
| 0 | DigitalInput 1 - 6 | USINT | 1 | ● | ● | | |
| 18 | InputFilter [0.2 ms] | USINT | 1 | | ● | | ● |

Table 123: Modbus/TCP data points - DI6371

Unfiltered

The input status is registered with a fixed offset with respect to the network cycle and is transferred in the same cycle.

Filtered

The filtered status is registered with a fixed offset with respect to the network cycle and is transferred in the same cycle. Filtering takes place asynchronous to the network in a 200 µs grid with a network-related jitter of up to 50 µs.

8.7 Register: DigitalInput 1 - 6

| Bit | Description |
|-----|--------------------------------|
| 0 | Input status - digital input 1 |
| 1 | Input status - digital input 2 |
| 2 | Input status - digital input 3 |
| 3 | Input status - digital input 4 |
| 4 | Input status - digital input 5 |
| 5 | Input status - digital input 6 |

8.8 Register: DigitalInput01 - DigitalInput06

| BOOL | Description |
|------|--------------------------------------|
| x | 0/1 ... Input status - digital input |

8.9 Register: InputFilter

The filter value can be configured for all digital inputs.

| Value | Filter |
|-------|---|
| 0 | No SW filter |
| 2 | 0.2 ms |
| 4 | 0.4 ms |
| : | : |
| 250 | 25 ms - higher values are limited to this value |

Table 124: Input filters - DI6371

8.10 B&R ID code

Code for module identification (\$1B93).

8.11 Minimum cycle time

The minimum cycle time is the minimum time needed for the bus cycle to be shut down without a communication error occurring. It should be noted that very fast cycles have reduced the idle time needed for handling monitoring, diagnostics and acyclic commands.

| Minimum cycle time | |
|---------------------------------|---------|
| Without filtering ¹⁾ | ≥100 µs |

Table 125: Minimum cycle time - DI6371

1) At cycle times of <150 µs, filtering is deactivated

8.12 Minimum I/O update time

The minimum I/O update time refers to the minimum time it takes for the bus cycle to shut down, so that in each cycle an I/O update takes place.

| Minimum I/O update time | |
|-------------------------|------------------------|
| Without filtering | $\geq 100 \mu\text{s}$ |
| With filtering | $\geq 200 \mu\text{s}$ |

Table 126: Minimum I/O update time - DI6371

9. X20DI6372

9.1 Register overview

| Register | Name | Data type | Length | Read | | Write | |
|----------|----------------------|-----------|--------|--------|---------|--------|---------|
| | | | | Cyclic | Acyclic | Cyclic | Acyclic |
| 0 | DigitalInput 1 - 6 | USINT | 1 | ● | ● | | |
| 18 | InputFilter [0.2 ms] | USINT | 1 | | ● | | ● |

Table 127: Register overview - DI6372

9.2 Variable assignment in Automation Studio (X2X master)

| Name | Data type | Length | Read | | Write | |
|----------------|-----------|--------|--------|---------|--------|---------|
| | | | Cyclic | Acyclic | Cyclic | Acyclic |
| DigitalInput01 | BOOL | 1 | ● | | | |
| DigitalInput02 | BOOL | 1 | ● | | | |
| DigitalInput03 | BOOL | 1 | ● | | | |
| DigitalInput04 | BOOL | 1 | ● | | | |
| DigitalInput05 | BOOL | 1 | ● | | | |
| DigitalInput06 | BOOL | 1 | ● | | | |

Table 128: Variable assignment in Automation Studio (X2X master) - DI6372

9.3 Variable assignment in Automation Studio (CANIO)

| Name | Data type | Length | Read | | Write | |
|----------------|-----------|--------|--------|---------|--------|---------|
| | | | Cyclic | Acyclic | Cyclic | Acyclic |
| DigitalInput01 | BOOL | 1 | ● | | | |
| DigitalInput02 | BOOL | 1 | ● | | | |
| DigitalInput03 | BOOL | 1 | ● | | | |
| DigitalInput04 | BOOL | 1 | ● | | | |
| DigitalInput05 | BOOL | 1 | ● | | | |
| DigitalInput06 | BOOL | 1 | ● | | | |

Table 129: Variable assignment in Automation Studio (CANIO) - DI6372

9.4 CANopen data points

| Register | Name | Data type | Length | Read | | Write | |
|----------|----------------------|-----------|--------|------|-----|-------|-----|
| | | | | PDO | SDO | PDO | SDO |
| 0 | DigitalInput 1 - 6 | USINT | 1 | ● | ● | | |
| 18 | InputFilter [0.2 ms] | USINT | 1 | | ● | | ● |

Table 130: CANopen data points - DI6372

9.5 DeviceNet data points

| Register | Name | Data type | Length | Read | | Write | |
|----------|----------------------|-----------|--------|--------|---------|--------|---------|
| | | | | Cyclic | Acyclic | Cyclic | Acyclic |
| 0 | DigitalInput 1 - 6 | USINT | 1 | ● | ● | | |
| 18 | InputFilter [0.2 ms] | USINT | 1 | | ● | | ● |

Table 131: DeviceNet data points - DI6372

9.6 Modbus/TCP data points

| Register | Name | Data type | Length | Read | | Write | |
|----------|----------------------|-----------|--------|--------|---------|--------|---------|
| | | | | Cyclic | Acyclic | Cyclic | Acyclic |
| 0 | DigitalInput 1 - 6 | USINT | 1 | ● | ● | | |
| 18 | InputFilter [0.2 ms] | USINT | 1 | | ● | | ● |

Table 132: Modbus/TCP data points - DI6372

Unfiltered

The input status is registered with a fixed offset with respect to the network cycle and is transferred in the same cycle.

Filtered

The filtered status is registered with a fixed offset with respect to the network cycle and is transferred in the same cycle. Filtering takes place asynchronous to the network in a 200 µs grid with a network-related jitter of up to 50 µs.

9.7 Register: DigitalInput 1 - 6

| Bit | Description |
|-----|--------------------------------|
| 0 | Input status - digital input 1 |
| 1 | Input status - digital input 2 |
| 2 | Input status - digital input 3 |
| 3 | Input status - digital input 4 |
| 4 | Input status - digital input 5 |
| 5 | Input status - digital input 6 |

9.8 Register: DigitalInput01 - DigitalInput06

| BOOL | Description |
|------|--------------------------------------|
| x | 0/1 ... Input status - digital input |

9.9 Register: InputFilter

The filter value can be configured for all digital inputs.

| Value | Filter |
|-------|---|
| 0 | No SW filter |
| 2 | 0.2 ms |
| 4 | 0.4 ms |
| : | : |
| 250 | 25 ms - higher values are limited to this value |

Table 133: Input filters - DI6372

9.10 B&R ID code

Code for module identification (\$1B94).

9.11 Minimum cycle time

The minimum cycle time is the minimum time needed for the bus cycle to be shut down without a communication error occurring. It should be noted that very fast cycles have reduced the idle time needed for handling monitoring, diagnostics and acyclic commands.

| Minimum cycle time | |
|---------------------------------|---------|
| Without filtering ¹⁾ | ≥100 µs |

Table 134: Minimum cycle time - DI6372

1) At cycle times of <150 µs, filtering is deactivated

9.12 Minimum I/O update time

The minimum I/O update time refers to the minimum time it takes for the bus cycle to shut down, so that in each cycle an I/O update takes place.

| Minimum I/O update time | |
|-------------------------|------------------------|
| Without filtering | $\geq 100 \mu\text{s}$ |
| With filtering | $\geq 200 \mu\text{s}$ |

Table 135: Minimum I/O update time - DI6372

10. X20DI9371

10.1 Register overview

| Register | Name | Data type | Length | Read | | Write | |
|----------|----------------------|-----------|--------|--------|---------|--------|---------|
| | | | | Cyclic | Acyclic | Cyclic | Acyclic |
| 0 | DigitalInput 1 - 8 | USINT | 1 | ● | ● | | |
| 1 | DigitalInput 9 - 12 | USINT | 1 | ● | ● | | |
| 18 | InputFilter [0.2 ms] | USINT | 1 | | ● | | ● |

Table 136: Register overview - DI9371

10.2 Variable assignment in Automation Studio (X2X master)

| Name | Data type | Length | Read | | Write | |
|----------------|-----------|--------|--------|---------|--------|---------|
| | | | Cyclic | Acyclic | Cyclic | Acyclic |
| DigitalInput01 | BOOL | 1 | ● | | | |
| DigitalInput02 | BOOL | 1 | ● | | | |
| DigitalInput03 | BOOL | 1 | ● | | | |
| DigitalInput04 | BOOL | 1 | ● | | | |
| DigitalInput05 | BOOL | 1 | ● | | | |
| DigitalInput06 | BOOL | 1 | ● | | | |
| DigitalInput07 | BOOL | 1 | ● | | | |
| DigitalInput08 | BOOL | 1 | ● | | | |
| DigitalInput09 | BOOL | 1 | ● | | | |
| DigitalInput10 | BOOL | 1 | ● | | | |
| DigitalInput11 | BOOL | 1 | ● | | | |
| DigitalInput12 | BOOL | 1 | ● | | | |

Table 137: Variable assignment in Automation Studio (X2X master) - DI9371

10.3 Variable assignment in Automation Studio (CANIO)

| Name | Data type | Length | Read | | Write | |
|----------------|-----------|--------|--------|---------|--------|---------|
| | | | Cyclic | Acyclic | Cyclic | Acyclic |
| DigitalInput01 | BOOL | 1 | ● | | | |
| DigitalInput02 | BOOL | 1 | ● | | | |
| DigitalInput03 | BOOL | 1 | ● | | | |
| DigitalInput04 | BOOL | 1 | ● | | | |
| DigitalInput05 | BOOL | 1 | ● | | | |
| DigitalInput06 | BOOL | 1 | ● | | | |
| DigitalInput07 | BOOL | 1 | ● | | | |
| DigitalInput08 | BOOL | 1 | ● | | | |
| DigitalInput09 | BOOL | 1 | ● | | | |
| DigitalInput10 | BOOL | 1 | ● | | | |
| DigitalInput11 | BOOL | 1 | ● | | | |
| DigitalInput12 | BOOL | 1 | ● | | | |

Table 138: Variable assignment in Automation Studio (CANIO) - DI9371

10.4 CANopen data points

| Register | Name | Data type | Length | Read | | Write | |
|----------|----------------------|-----------|--------|------|-----|-------|-----|
| | | | | PDO | SDO | PDO | SDO |
| 0 | DigitalInput 1 - 8 | USINT | 1 | ● | ● | | |
| 1 | DigitalInput 9 - 12 | USINT | 1 | ● | ● | | |
| 18 | InputFilter [0.2 ms] | USINT | 1 | | ● | | ● |

Table 139: CANopen data points - DI9371

10.5 DeviceNet data points

| Register | Name | Data type | Length | Read | | Write | |
|----------|----------------------|-----------|--------|--------|---------|--------|---------|
| | | | | Cyclic | Acyclic | Cyclic | Acyclic |
| 0 | DigitalInput 1 - 8 | USINT | 1 | ● | ● | | |
| 1 | DigitalInput 9 - 12 | USINT | 1 | ● | ● | | |
| 18 | InputFilter [0.2 ms] | USINT | 1 | | ● | | ● |

Table 140: DeviceNet data points - DI9371

10.6 Modbus/TCP data points

| Register | Name | Data type | Length | Read | | Write | |
|----------|----------------------|-----------|--------|--------|---------|--------|---------|
| | | | | Cyclic | Acyclic | Cyclic | Acyclic |
| 0 | DigitalInput 1 - 8 | USINT | 1 | ● | ● | | |
| 1 | DigitalInput 9 - 12 | USINT | 1 | ● | ● | | |
| 18 | InputFilter [0.2 ms] | USINT | 1 | | ● | | ● |

Table 141: Modbus/TCP data points - DI9371

Unfiltered

The input status is registered with a fixed offset with respect to the network cycle and is transferred in the same cycle.

Filtered

The filtered status is registered with a fixed offset with respect to the network cycle and is transferred in the same cycle. Filtering takes place asynchronous to the network in a 200 µs grid with a network-related jitter of up to 50 µs.

10.7 Register: DigitalInput 1 - 8

| Bit | Description |
|-----|--------------------------------|
| 0 | Input status - digital input 1 |
| 1 | Input status - digital input 2 |
| 2 | Input status - digital input 3 |
| 3 | Input status - digital input 4 |
| 4 | Input status - digital input 5 |
| 5 | Input status - digital input 6 |
| 6 | Input status - digital input 7 |
| 7 | Input status - digital input 8 |

10.8 Register: DigitalInput 9 - 12

| Bit | Description |
|-----|---------------------------------|
| 0 | Input status - digital input 9 |
| 1 | Input status - digital input 10 |
| 2 | Input status - digital input 11 |
| 3 | Input status - digital input 12 |

10.9 Register: DigitalInput01 - DigitalInput12

| BOOL | Description |
|------|--------------------------------------|
| x | 0/1 ... Input status - digital input |

10.10 Register: InputFilter

The filter value can be configured for all digital inputs.

| Value | Filter |
|-------|---|
| 0 | No SW filter |
| 2 | 0.2 ms |
| 4 | 0.4 ms |
| : | : |
| 250 | 25 ms - higher values are limited to this value |

Table 142: Input filters - DI9371

10.11 B&R ID code

Code for module identification (\$1B95).

10.12 Minimum cycle time

The minimum cycle time is the minimum time needed for the bus cycle to be shut down without a communication error occurring. It should be noted that very fast cycles have reduced the idle time needed for handling monitoring, diagnostics and acyclic commands.

| Minimum cycle time | |
|---------------------------------|---------|
| Without filtering ¹⁾ | ≥100 µs |

Table 143: Minimum cycle time - DI9371

1) At cycle times of <150 µs, filtering is deactivated

10.13 Minimum I/O update time

The minimum I/O update time refers to the minimum time it takes for the bus cycle to shut down, so that in each cycle an I/O update takes place.

| Minimum I/O update time | |
|-------------------------|---------|
| Without filtering | ≥100 µs |
| With filtering | ≥200 µs |

Table 144: Minimum I/O update time - DI9371

11. X20DI9372

11.1 Register overview

| Register | Name | Data type | Length | Read | | Write | |
|----------|----------------------|-----------|--------|--------|---------|--------|---------|
| | | | | Cyclic | Acyclic | Cyclic | Acyclic |
| 0 | DigitalInput 1 - 8 | USINT | 1 | ● | ● | | |
| 1 | DigitalInput 9 - 12 | USINT | 1 | ● | ● | | |
| 18 | InputFilter [0.2 ms] | USINT | 1 | | ● | | ● |

Table 145: Register overview - DI9372

11.2 Variable assignment in Automation Studio (X2X master)

| Name | Data type | Length | Read | | Write | |
|----------------|-----------|--------|--------|---------|--------|---------|
| | | | Cyclic | Acyclic | Cyclic | Acyclic |
| DigitalInput01 | BOOL | 1 | ● | | | |
| DigitalInput02 | BOOL | 1 | ● | | | |
| DigitalInput03 | BOOL | 1 | ● | | | |
| DigitalInput04 | BOOL | 1 | ● | | | |
| DigitalInput05 | BOOL | 1 | ● | | | |
| DigitalInput06 | BOOL | 1 | ● | | | |
| DigitalInput07 | BOOL | 1 | ● | | | |
| DigitalInput08 | BOOL | 1 | ● | | | |
| DigitalInput09 | BOOL | 1 | ● | | | |
| DigitalInput10 | BOOL | 1 | ● | | | |
| DigitalInput11 | BOOL | 1 | ● | | | |
| DigitalInput12 | BOOL | 1 | ● | | | |

Table 146: Variable assignment in Automation Studio (X2X master) - DI9372

11.3 Variable assignment in Automation Studio (CANIO)

| Name | Data type | Length | Read | | Write | |
|----------------|-----------|--------|--------|---------|--------|---------|
| | | | Cyclic | Acyclic | Cyclic | Acyclic |
| DigitalInput01 | BOOL | 1 | ● | | | |
| DigitalInput02 | BOOL | 1 | ● | | | |
| DigitalInput03 | BOOL | 1 | ● | | | |
| DigitalInput04 | BOOL | 1 | ● | | | |
| DigitalInput05 | BOOL | 1 | ● | | | |
| DigitalInput06 | BOOL | 1 | ● | | | |
| DigitalInput07 | BOOL | 1 | ● | | | |
| DigitalInput08 | BOOL | 1 | ● | | | |
| DigitalInput09 | BOOL | 1 | ● | | | |
| DigitalInput10 | BOOL | 1 | ● | | | |
| DigitalInput11 | BOOL | 1 | ● | | | |
| DigitalInput12 | BOOL | 1 | ● | | | |

Table 147: Variable assignment in Automation Studio (CANIO) - DI9372

11.4 CANopen data points

| Register | Name | Data type | Length | Read | | Write | |
|----------|----------------------|-----------|--------|------|-----|-------|-----|
| | | | | PDO | SDO | PDO | SDO |
| 0 | DigitalInput 1 - 8 | USINT | 1 | ● | ● | | |
| 1 | DigitalInput 9 - 12 | USINT | 1 | ● | ● | | |
| 18 | InputFilter [0.2 ms] | USINT | 1 | | ● | | ● |

Table 148: CANopen data points - DI9372

11.5 DeviceNet data points

| Register | Name | Data type | Length | Read | | Write | |
|----------|----------------------|-----------|--------|--------|---------|--------|---------|
| | | | | Cyclic | Acyclic | Cyclic | Acyclic |
| 0 | DigitalInput 1 - 8 | USINT | 1 | ● | ● | | |
| 1 | DigitalInput 9 - 12 | USINT | 1 | ● | ● | | |
| 18 | InputFilter [0.2 ms] | USINT | 1 | | ● | | ● |

Table 149: DeviceNet data points - DI9372

11.6 Modbus/TCP data points

| Register | Name | Data type | Length | Read | | Write | |
|----------|----------------------|-----------|--------|--------|---------|--------|---------|
| | | | | Cyclic | Acyclic | Cyclic | Acyclic |
| 0 | DigitalInput 1 - 8 | USINT | 1 | ● | ● | | |
| 1 | DigitalInput 9 - 12 | USINT | 1 | ● | ● | | |
| 18 | InputFilter [0.2 ms] | USINT | 1 | | ● | | ● |

Table 150: Modbus/TCP data points - DI9372

Unfiltered

The input status is registered with a fixed offset with respect to the network cycle and is transferred in the same cycle.

Filtered

The filtered status is registered with a fixed offset with respect to the network cycle and is transferred in the same cycle. Filtering takes place asynchronous to the network in a 200 µs grid with a network-related jitter of up to 50 µs.

11.7 Register: DigitalInput 1 - 8

| Bit | Description |
|-----|--------------------------------|
| 0 | Input status - digital input 1 |
| 1 | Input status - digital input 2 |
| 2 | Input status - digital input 3 |
| 3 | Input status - digital input 4 |
| 4 | Input status - digital input 5 |
| 5 | Input status - digital input 6 |
| 6 | Input status - digital input 7 |
| 7 | Input status - digital input 8 |

11.8 Register: DigitalInput 9 - 12

| Bit | Description |
|-----|---------------------------------|
| 0 | Input status - digital input 9 |
| 1 | Input status - digital input 10 |
| 2 | Input status - digital input 11 |
| 3 | Input status - digital input 12 |

11.9 Register: DigitalInput01 - DigitalInput12

| BOOL | Description |
|------|--------------------------------------|
| x | 0/1 ... Input status - digital input |

11.10 Register: InputFilter

The filter value can be configured for all digital inputs.

| Value | Filter |
|-------|---|
| 0 | No SW filter |
| 2 | 0.2 ms |
| 4 | 0.4 ms |
| : | : |
| 250 | 25 ms - higher values are limited to this value |

Table 151: Input filters - DI9372

11.11 B&R ID code

Code for module identification (\$1D28).

11.12 Minimum cycle time

The minimum cycle time is the minimum time needed for the bus cycle to be shut down without a communication error occurring. It should be noted that very fast cycles have reduced the idle time needed for handling monitoring, diagnostics and acyclic commands.

| Minimum cycle time | |
|---------------------------------|---------|
| Without filtering ¹⁾ | ≥100 µs |

Table 152: Minimum cycle time - DI9372

1) At cycle times of <150 µs, filtering is deactivated

11.13 Minimum I/O update time

The minimum I/O update time refers to the minimum time it takes for the bus cycle to shut down, so that in each cycle an I/O update takes place.

| Minimum I/O update time | |
|-------------------------|---------|
| Without filtering | ≥100 µs |
| With filtering | ≥200 µs |

Table 153: Minimum I/O update time - DI9372

Chapter 5 • Digital output modules

1. Overview

| Digital output modules | Description |
|------------------------|--|
| X2ODO2321 | X20 digital output module, 2 outputs, 24 VDC, 0.5 A, sink, 3-line connections |
| X2ODO2322 | X20 digital output module, 2 outputs, 24 VDC, 0.5 A, source, 3-line connections |
| X2ODO2649 | X20 digital output module, 2 relays, change-over contacts, 230 VAC / 5 A, 30 VDC / 5 A |
| X2ODO4321 | X20 digital output module, 4 outputs, 24 VDC, 0.5 A, sink, 3-line connections |
| X2ODO4322 | X20 digital output module, 4 outputs, 24 VDC, 0.5 A, source, 3-line connections |
| X2ODO4331 | X20 digital output module, 4 outputs, 24 VDC, 2.0 A, sink, 3-line connections |
| X2ODO4332 | X20 digital output module, 4 outputs, 24 VDC, 2.0 A, source, 3-line connections |
| X2ODO4529 | X20 digital output module, 4 relays, change-over contacts, 115 VAC / 0.5 A, 30 VDC / 1 A |
| X2ODO6321 | X20 digital output module, 6 outputs, 24 VDC, 0.5 A, sink, 2-line connections |
| X2ODO6322 | X20 digital output module, 6 outputs, 24 VDC, 0.5 A, source, 2-line connections |
| X2ODO6529 | X20 digital output module, 6 relays, N.O. contacts, 115 VAC / 0.5 A, 30 VDC / 1 A |
| X2ODO8331 | X20 digital output module, 8 outputs, 24 VDC, 2.0 A, sink, feed directly on module, 1-wire connections |
| X2ODO8332 | X20 digital output module, 8 outputs, 24 VDC, 2.0 A, source, feed directly on module, 1-wire connections |
| X2ODO9321 | X20 digital output module, 12 outputs, 24 VDC, 0.5 A, sink, 1-line connections |
| X2ODO9322 | X20 digital output module, 12 outputs, 24 VDC, 0.5 A, source, 1-line connections |

Table 154: Overview of digital output modules

2. X2DO2321

2.1 Register overview

| Register | Name | Data type | Length | Read | | Write | |
|----------|---------------------------|-----------|--------|--------|---------|--------|---------|
| | | | | Cyclic | Acyclic | Cyclic | Acyclic |
| 2 | DigitalOutput 1 - 2 | USINT | 1 | | | ● | ● |
| 30 | StatusDigitalOutput 1 - 2 | USINT | 1 | ● | ● | | |

Table 155: Register overview - DO2321

2.2 Variable assignment in Automation Studio (X2X master)

| Name | Data type | Length | Read | | Write | |
|-----------------------|-----------|--------|--------|---------|--------|---------|
| | | | Cyclic | Acyclic | Cyclic | Acyclic |
| DigitalOutput01 | BOOL | 1 | | | ● | |
| DigitalOutput02 | BOOL | 1 | | | ● | |
| StatusDigitalOutput01 | BOOL | 1 | ● | | | |
| StatusDigitalOutput02 | BOOL | 1 | ● | | | |

Table 156: Variable assignment in Automation Studio (X2X master) - DO2321

2.3 Variable assignment in Automation Studio (CANIO)

| Name | Data type | Length | Read | | Write | |
|-----------------------|-----------|--------|--------|---------|--------|---------|
| | | | Cyclic | Acyclic | Cyclic | Acyclic |
| DigitalOutput01 | BOOL | 1 | | | ● | |
| DigitalOutput02 | BOOL | 1 | | | ● | |
| StatusDigitalOutput01 | BOOL | 1 | | ● | | |
| StatusDigitalOutput02 | BOOL | 1 | | ● | | |

Table 157: Variable assignment in Automation Studio (CANIO) - DO2321

2.4 CANopen data points

| Register | Name | Data type | Length | Read | | Write | |
|----------|---------------------------|-----------|--------|------|-----|-------|-----|
| | | | | PDO | SDO | PDO | SDO |
| 2 | DigitalOutput 1 - 2 | USINT | 1 | | | ● | ● |
| 30 | StatusDigitalOutput 1 - 2 | USINT | 1 | | ● | | |

Table 158: CANopen data points - DO2321

2.5 DeviceNet data points

| Register | Name | Data type | Length | Read | | Write | |
|----------|---------------------------|-----------|--------|--------|---------|--------|---------|
| | | | | Cyclic | Acyclic | Cyclic | Acyclic |
| 2 | DigitalOutput 1 - 2 | USINT | 1 | | | ● | ● |
| 30 | StatusDigitalOutput 1 - 2 | USINT | 1 | ● | ● | | |

Table 159: DeviceNet data points - DO2321

2.6 Modbus/TCP data points

| Register | Name | Data type | Length | Read | | Write | |
|----------|---------------------------|-----------|--------|--------|---------|--------|---------|
| | | | | Cyclic | Acyclic | Cyclic | Acyclic |
| 2 | DigitalOutput 1 - 2 | USINT | 1 | | | ● | ● |
| 30 | StatusDigitalOutput 1 - 2 | USINT | 1 | | ● | | |

Table 160: Modbus/TCP data points - DO2321

2.7 Digital outputs

The output status is transferred to the output channels using a fixed offset to the network cycle.

2.8 Register: DigitalOutput 1 - 2

| Bit | Description |
|-----|--|
| 0 | 0 ... Digital output 1 reset 1 ... Digital output 1 set |
| 1 | 0 ... Digital output 2 reset 1 ... Digital output 2 set |

2.9 Register: DigitalOutput01 - DigitalOutput02

| BOOL | Description |
|------|--|
| x | 0 ... Digital output channel reset 1 ... Digital output channel set |

2.10 Output monitoring status

The output states for the outputs are compared to the set values on the module. The control for the output driver is used for the set states.

A change in the output status resets the monitoring for this output. The status of each individual channel can be read. A change in monitoring status triggers an error message.

| Monitoring status | Description |
|-------------------|---|
| 0 | Digital output channel: No error |
| 1 | Digital output channel: Short circuit or overload |

Table 161: Monitoring status - DO2321

2.11 Register: StatusDigitalOutput 1 - 2

| Bit | Description |
|-----|---|
| 0 | 0 ... Channel 1: No error 1 ... Channel 1: Short circuit or overload |
| 1 | 0 ... Channel 2: No error 1 ... Channel 2: Short circuit or overload |

2.12 Register: StatusDigitalOutput01 - StatusDigitalOutput02

| BOOL | Description |
|------|---|
| x | 0 ... Digital output channel: No error 1 ... Digital output channel: Short circuit or overload |

2.13 B&R ID code

Code for module identification (\$22B3).

2.14 Minimum cycle time

The minimum cycle time is the minimum time needed for the bus cycle to be shut down without a communication error occurring. It should be noted that very fast cycles have reduced the idle time needed for handling monitoring, diagnostics and acyclic commands.

| Minimum cycle time |
|--------------------|
| ≥100 µs |

Table 162: Minimum cycle time - DO2321

2.15 Minimum I/O update time

The minimum I/O update time refers to the minimum time it takes for the bus cycle to shut down, so that in each cycle an I/O update takes place.

| Minimum I/O update time |
|---------------------------------|
| Equal to the minimum cycle time |

Table 163: Minimum I/O update time - DO2321

3. X2DO2322

3.1 Register overview

| Register | Name | Data type | Length | Read | | Write | |
|----------|---------------------------|-----------|--------|--------|---------|--------|---------|
| | | | | Cyclic | Acyclic | Cyclic | Acyclic |
| 2 | DigitalOutput 1 - 2 | USINT | 1 | | | ● | ● |
| 30 | StatusDigitalOutput 1 - 2 | USINT | 1 | ● | ● | | |

Table 164: Register overview - DO2322

3.2 Variable assignment in Automation Studio (X2X master)

| Name | Data type | Length | Read | | Write | |
|-----------------------|-----------|--------|--------|---------|--------|---------|
| | | | Cyclic | Acyclic | Cyclic | Acyclic |
| DigitalOutput01 | BOOL | 1 | | | ● | |
| DigitalOutput02 | BOOL | 1 | | | ● | |
| StatusDigitalOutput01 | BOOL | 1 | ● | | | |
| StatusDigitalOutput02 | BOOL | 1 | ● | | | |

Table 165: Variable assignment in Automation Studio (X2X master) - DO2322

3.3 Variable assignment in Automation Studio (CANIO)

| Name | Data type | Length | Read | | Write | |
|-----------------------|-----------|--------|--------|---------|--------|---------|
| | | | Cyclic | Acyclic | Cyclic | Acyclic |
| DigitalOutput01 | BOOL | 1 | | | ● | |
| DigitalOutput02 | BOOL | 1 | | | ● | |
| StatusDigitalOutput01 | BOOL | 1 | | ● | | |
| StatusDigitalOutput02 | BOOL | 1 | | ● | | |

Table 166: Variable assignment in Automation Studio (CANIO) - DO2322

3.4 CANopen data points

| Register | Name | Data type | Length | Read | | Write | |
|----------|---------------------------|-----------|--------|------|-----|-------|-----|
| | | | | PDO | SDO | PDO | SDO |
| 2 | DigitalOutput 1 - 2 | USINT | 1 | | | ● | ● |
| 30 | StatusDigitalOutput 1 - 2 | USINT | 1 | | ● | | |

Table 167: CANopen data points - DO2322

3.5 DeviceNet data points

| Register | Name | Data type | Length | Read | | Write | |
|----------|---------------------------|-----------|--------|--------|---------|--------|---------|
| | | | | Cyclic | Acyclic | Cyclic | Acyclic |
| 2 | DigitalOutput 1 - 2 | USINT | 1 | | | ● | ● |
| 30 | StatusDigitalOutput 1 - 2 | USINT | 1 | ● | ● | | |

Table 168: DeviceNet data points - DO2322

3.6 Modbus/TCP data points

| Register | Name | Data type | Length | Read | | Write | |
|----------|---------------------------|-----------|--------|--------|---------|--------|---------|
| | | | | Cyclic | Acyclic | Cyclic | Acyclic |
| 2 | DigitalOutput 1 - 2 | USINT | 1 | | | ● | ● |
| 30 | StatusDigitalOutput 1 - 2 | USINT | 1 | | ● | | |

Table 169: Modbus/TCP data points - DO2322

3.7 Digital outputs

The output status is transferred to the output channels using a fixed offset to the network cycle.

3.8 Register: DigitalOutput 1 - 2

| Bit | Description |
|-----|--|
| 0 | 0 ... Digital output 1 reset 1 ... Digital output 1 set |
| 1 | 0 ... Digital output 2 reset 1 ... Digital output 2 set |

3.9 Register: DigitalOutput01 - DigitalOutput02

| BOOL | Description |
|------|--|
| x | 0 ... Digital output channel reset 1 ... Digital output channel set |

3.10 Output monitoring status

The output states for the outputs are compared to the set values on the module. The control for the output driver is used for the set states.

A change in the output status resets the monitoring for this output. The status of each individual channel can be read. A change in monitoring status triggers an error message.

| Monitoring status | Description |
|-------------------|---|
| 0 | Digital output channel: No error |
| 1 | Digital output channel: Short circuit or overload |

Table 170: Monitoring status - DO2322

3.11 Register: StatusDigitalOutput 1 - 2

| Bit | Description |
|-----|---|
| 0 | 0 ... Channel 1: No error 1 ... Channel 1: Short circuit or overload |
| 1 | 0 ... Channel 2: No error 1 ... Channel 2: Short circuit or overload |

3.12 Register: StatusDigitalOutput01 - StatusDigitalOutput02

| BOOL | Description |
|------|---|
| x | 0 ... Digital output channel: No error 1 ... Digital output channel: Short circuit or overload |

3.13 B&R ID code

Code for module identification (\$1B96).

3.14 Minimum cycle time

The minimum cycle time is the minimum time needed for the bus cycle to be shut down without a communication error occurring. It should be noted that very fast cycles have reduced the idle time needed for handling monitoring, diagnostics and acyclic commands.

| Minimum cycle time |
|--------------------|
| ≥100 µs |

Table 171: Minimum cycle time - DO2322

3.15 Minimum I/O update time

The minimum I/O update time refers to the minimum time it takes for the bus cycle to shut down, so that in each cycle an I/O update takes place.

| Minimum I/O update time |
|---------------------------------|
| Equal to the minimum cycle time |

Table 172: Minimum I/O update time - DO2322

4. X2ODO2649

4.1 Register overview

| Register | Name | Data type | Length | Read | | Write | |
|----------|---------------------|-----------|--------|--------|---------|--------|---------|
| | | | | Cyclic | Acyclic | Cyclic | Acyclic |
| 2 | DigitalOutput 1 - 2 | USINT | 1 | | | ● | ● |

Table 173: Register overview - DO2649

4.2 Variable assignment in Automation Studio (X2X master)

| Name | Data type | Length | Read | | Write | |
|-----------------|-----------|--------|--------|---------|--------|---------|
| | | | Cyclic | Acyclic | Cyclic | Acyclic |
| DigitalOutput01 | BOOL | 1 | | | ● | |
| DigitalOutput02 | BOOL | 1 | | | ● | |

Table 174: Variable assignment in Automation Studio (X2X master) - DO2649

4.3 Variable assignment in Automation Studio (CANIO)

| Name | Data type | Length | Read | | Write | |
|-----------------|-----------|--------|--------|---------|--------|---------|
| | | | Cyclic | Acyclic | Cyclic | Acyclic |
| DigitalOutput01 | BOOL | 1 | | | ● | |
| DigitalOutput02 | BOOL | 1 | | | ● | |

Table 175: Variable assignment in Automation Studio (CANIO) - DO2649

4.4 CANopen data points

| Register | Name | Data type | Length | Read | | Write | |
|----------|---------------------|-----------|--------|------|-----|-------|-----|
| | | | | PDO | SDO | PDO | SDO |
| 2 | DigitalOutput 1 - 2 | USINT | 1 | | | ● | ● |

Table 176: CANopen data points - DO2649

4.5 DeviceNet data points

| Register | Name | Data type | Length | Read | | Write | |
|----------|---------------------|-----------|--------|--------|---------|--------|---------|
| | | | | Cyclic | Acyclic | Cyclic | Acyclic |
| 2 | DigitalOutput 1 - 2 | USINT | 1 | | | ● | ● |

Table 177: DeviceNet data points - DO2649

4.6 Modbus/TCP data points

| Register | Name | Data type | Length | Read | | Write | |
|----------|---------------------|-----------|--------|--------|---------|--------|---------|
| | | | | Cyclic | Acyclic | Cyclic | Acyclic |
| 2 | DigitalOutput 1 - 2 | USINT | 1 | | | ● | ● |

Table 178: Modbus/TCP data points - DO2649

4.7 Digital outputs

The output status is transferred to the output channels using a fixed offset to the network cycle.

4.8 Register: DigitalOutput 1 - 2

| Bit | Description |
|-----|--|
| 0 | 0 ... Digital output 1 reset 1 ... Digital output 1 set |
| 1 | 0 ... Digital output 2 reset 1 ... Digital output 2 set |

4.9 Register: DigitalOutput01 - DigitalOutput02

| BOOL | Description |
|------|--|
| x | 0 ... Digital output channel reset 1 ... Digital output channel set |

4.10 B&R ID code

Code for module identification (\$20DA).

4.11 Minimum cycle time

The minimum cycle time is the minimum time needed for the bus cycle to be shut down without a communication error occurring. It should be noted that very fast cycles have reduced the idle time needed for handling monitoring, diagnostics and acyclic commands.

| Minimum cycle time |
|--------------------|
| ≥100 µs |

Table 179: Minimum cycle time - DO2649

4.12 Minimum I/O update time

The minimum I/O update time refers to the minimum time it takes for the bus cycle to shut down, so that in each cycle an I/O update takes place.

| Minimum I/O update time |
|---------------------------------|
| Equal to the minimum cycle time |

Table 180: Minimum I/O update time - DO2649

5. X20DO4321

5.1 Register overview

| Register | Name | Data type | Length | Read | | Write | |
|----------|---------------------------|-----------|--------|--------|---------|--------|---------|
| | | | | Cyclic | Acyclic | Cyclic | Acyclic |
| 2 | DigitalOutput 1 - 4 | USINT | 1 | | | ● | ● |
| 30 | StatusDigitalOutput 1 - 4 | USINT | 1 | ● | ● | | |

Table 181: Register overview - DO4321

5.2 Variable assignment in Automation Studio (X2X master)

| Name | Data type | Length | Read | | Write | |
|-----------------------|-----------|--------|--------|---------|--------|---------|
| | | | Cyclic | Acyclic | Cyclic | Acyclic |
| DigitalOutput01 | BOOL | 1 | | | ● | |
| DigitalOutput02 | BOOL | 1 | | | ● | |
| DigitalOutput03 | BOOL | 1 | | | ● | |
| DigitalOutput04 | BOOL | 1 | | | ● | |
| StatusDigitalOutput01 | BOOL | 1 | ● | | | |
| StatusDigitalOutput02 | BOOL | 1 | ● | | | |
| StatusDigitalOutput03 | BOOL | 1 | ● | | | |
| StatusDigitalOutput04 | BOOL | 1 | ● | | | |

Table 182: Variable assignment in Automation Studio (X2X master) - DO4321

5.3 Variable assignment in Automation Studio (CANIO)

| Name | Data type | Length | Read | | Write | |
|-----------------------|-----------|--------|--------|---------|--------|---------|
| | | | Cyclic | Acyclic | Cyclic | Acyclic |
| DigitalOutput01 | BOOL | 1 | | | ● | |
| DigitalOutput02 | BOOL | 1 | | | ● | |
| DigitalOutput03 | BOOL | 1 | | | ● | |
| DigitalOutput04 | BOOL | 1 | | | ● | |
| StatusDigitalOutput01 | BOOL | 1 | | ● | | |
| StatusDigitalOutput02 | BOOL | 1 | | ● | | |
| StatusDigitalOutput03 | BOOL | 1 | | ● | | |
| StatusDigitalOutput04 | BOOL | 1 | | ● | | |

Table 183: Variable assignment in Automation Studio (CANIO) - DO4321

5.4 CANopen data points

| Register | Name | Data type | Length | Read | | Write | |
|----------|---------------------------|-----------|--------|------|-----|-------|-----|
| | | | | PDO | SDO | PDO | SDO |
| 2 | DigitalOutput 1 - 4 | USINT | 1 | | | ● | ● |
| 30 | StatusDigitalOutput 1 - 4 | USINT | 1 | | ● | | |

Table 184: CANopen data points - DO4321

5.5 DeviceNet data points

| Register | Name | Data type | Length | Read | | Write | |
|----------|---------------------------|-----------|--------|--------|---------|--------|---------|
| | | | | Cyclic | Acyclic | Cyclic | Acyclic |
| 2 | DigitalOutput 1 - 4 | USINT | 1 | | | ● | ● |
| 30 | StatusDigitalOutput 1 - 4 | USINT | 1 | ● | ● | | |

Table 185: DeviceNet data points - DO4321

5.6 Modbus/TCP data points

| Register | Name | Data type | Length | Read | | Write | |
|----------|---------------------------|-----------|--------|--------|---------|--------|---------|
| | | | | Cyclic | Acyclic | Cyclic | Acyclic |
| 2 | DigitalOutput 1 - 4 | USINT | 1 | | | ● | ● |
| 30 | StatusDigitalOutput 1 - 4 | USINT | 1 | | ● | | |

Table 186: Modbus/TCP data points - DO4321

5.7 Digital outputs

The output status is transferred to the output channels using a fixed offset to the network cycle.

5.8 Register: DigitalOutput 1 - 4

| Bit | Description |
|-----|--|
| 0 | 0 ... Digital output 1 reset 1 ... Digital output 1 set |
| 1 | 0 ... Digital output 2 reset 1 ... Digital output 2 set |
| 2 | 0 ... Digital output 3 reset 1 ... Digital output 3 set |
| 3 | 0 ... Digital output 4 reset 1 ... Digital output 4 set |

5.9 Register: DigitalOutput01 - DigitalOutput04

| BOOL | Description |
|------|--|
| x | 0 ... Digital output channel reset 1 ... Digital output channel set |

5.10 Output monitoring status

The output states for the outputs are compared to the set values on the module. The control for the output driver is used for the set states.

A change in the output status resets the monitoring for this output. The status of each individual channel can be read. A change in monitoring status triggers an error message.

| Monitoring status | Description |
|-------------------|---|
| 0 | Digital output channel: No error |
| 1 | Digital output channel: Short circuit or overload |

Table 187: Monitoring status - DO4321

5.11 Register: StatusDigitalOutput 1 - 4

| Bit | Description |
|-----|---|
| 0 | 0 ... Channel 1: No error 1 ... Channel 1: Short circuit or overload |
| 1 | 0 ... Channel 2: No error 1 ... Channel 2: Short circuit or overload |
| 2 | 0 ... Channel 3: No error 1 ... Channel 3: Short circuit or overload |
| 3 | 0 ... Channel 4: No error 1 ... Channel 4: Short circuit or overload |

5.12 Register: StatusDigitalOutput01 - StatusDigitalOutput04

| BOOL | Description |
|------|---|
| x | 0 ... Digital output channel: No error 1 ... Digital output channel: Short circuit or overload |

5.13 B&R ID code

Code for module identification (\$22B4).

5.14 Minimum cycle time

The minimum cycle time is the minimum time needed for the bus cycle to be shut down without a communication error occurring. It should be noted that very fast cycles have reduced the idle time needed for handling monitoring, diagnostics and acyclic commands.

| Minimum cycle time |
|--------------------|
| ≥100 µs |

Table 188: Minimum cycle time - DO4321

5.15 Minimum I/O update time

The minimum I/O update time refers to the minimum time it takes for the bus cycle to shut down, so that in each cycle an I/O update takes place.

| Minimum I/O update time |
|---------------------------------|
| Equal to the minimum cycle time |

Table 189: Minimum I/O update time - DO4321

6. X20DO4322

6.1 Register overview

| Register | Name | Data type | Length | Read | | Write | |
|----------|---------------------------|-----------|--------|--------|---------|--------|---------|
| | | | | Cyclic | Acyclic | Cyclic | Acyclic |
| 2 | DigitalOutput 1 - 4 | USINT | 1 | | | ● | ● |
| 30 | StatusDigitalOutput 1 - 4 | USINT | 1 | ● | ● | | |

Table 190: Register overview - DO4322

6.2 Variable assignment in Automation Studio (X2X master)

| Name | Data type | Length | Read | | Write | |
|-----------------------|-----------|--------|--------|---------|--------|---------|
| | | | Cyclic | Acyclic | Cyclic | Acyclic |
| DigitalOutput01 | BOOL | 1 | | | ● | |
| DigitalOutput02 | BOOL | 1 | | | ● | |
| DigitalOutput03 | BOOL | 1 | | | ● | |
| DigitalOutput04 | BOOL | 1 | | | ● | |
| StatusDigitalOutput01 | BOOL | 1 | ● | | | |
| StatusDigitalOutput02 | BOOL | 1 | ● | | | |
| StatusDigitalOutput03 | BOOL | 1 | ● | | | |
| StatusDigitalOutput04 | BOOL | 1 | ● | | | |

Table 191: Variable assignment in Automation Studio (X2X master) - DO4322

6.3 Variable assignment in Automation Studio (CANIO)

| Name | Data type | Length | Read | | Write | |
|-----------------------|-----------|--------|--------|---------|--------|---------|
| | | | Cyclic | Acyclic | Cyclic | Acyclic |
| DigitalOutput01 | BOOL | 1 | | | ● | |
| DigitalOutput02 | BOOL | 1 | | | ● | |
| DigitalOutput03 | BOOL | 1 | | | ● | |
| DigitalOutput04 | BOOL | 1 | | | ● | |
| StatusDigitalOutput01 | BOOL | 1 | | ● | | |
| StatusDigitalOutput02 | BOOL | 1 | | ● | | |
| StatusDigitalOutput03 | BOOL | 1 | | ● | | |
| StatusDigitalOutput04 | BOOL | 1 | | ● | | |

Table 192: Variable assignment in Automation Studio (CANIO) - DO4322

6.4 CANopen data points

| Register | Name | Data type | Length | Read | | Write | |
|----------|---------------------------|-----------|--------|------|-----|-------|-----|
| | | | | PDO | SDO | PDO | SDO |
| 2 | DigitalOutput 1 - 4 | USINT | 1 | | | ● | ● |
| 30 | StatusDigitalOutput 1 - 4 | USINT | 1 | | ● | | |

Table 193: CANopen data points - DO4322

6.5 DeviceNet data points

| Register | Name | Data type | Length | Read | | Write | |
|----------|---------------------------|-----------|--------|--------|---------|--------|---------|
| | | | | Cyclic | Acyclic | Cyclic | Acyclic |
| 2 | DigitalOutput 1 - 4 | USINT | 1 | | | ● | ● |
| 30 | StatusDigitalOutput 1 - 4 | USINT | 1 | ● | ● | | |

Table 194: DeviceNet data points - DO4322

6.6 Modbus/TCP data points

| Register | Name | Data type | Length | Read | | Write | |
|----------|---------------------------|-----------|--------|--------|---------|--------|---------|
| | | | | Cyclic | Acyclic | Cyclic | Acyclic |
| 2 | DigitalOutput 1 - 4 | USINT | 1 | | | ● | ● |
| 30 | StatusDigitalOutput 1 - 4 | USINT | 1 | | ● | | |

Table 195: Modbus/TCP data points - DO4322

6.7 Digital outputs

The output status is transferred to the output channels using a fixed offset to the network cycle.

6.8 Register: DigitalOutput 1 - 4

| Bit | Description |
|-----|--|
| 0 | 0 ... Digital output 1 reset 1 ... Digital output 1 set |
| 1 | 0 ... Digital output 2 reset 1 ... Digital output 2 set |
| 2 | 0 ... Digital output 3 reset 1 ... Digital output 3 set |
| 3 | 0 ... Digital output 4 reset 1 ... Digital output 4 set |

6.9 Register: DigitalOutput01 - DigitalOutput04

| BOOL | Description |
|------|--|
| x | 0 ... Digital output channel reset 1 ... Digital output channel set |

6.10 Output monitoring status

The output states for the outputs are compared to the set values on the module. The control for the output driver is used for the set states.

A change in the output status resets the monitoring for this output. The status of each individual channel can be read. A change in monitoring status triggers an error message.

| Monitoring status | Description |
|-------------------|---|
| 0 | Digital output channel: No error |
| 1 | Digital output channel: Short circuit or overload |

Table 196: Monitoring status - DO4322

6.11 Register: StatusDigitalOutput 1 - 4

| Bit | Description |
|-----|---|
| 0 | 0 ... Channel 1: No error 1 ... Channel 1: Short circuit or overload |
| 1 | 0 ... Channel 2: No error 1 ... Channel 2: Short circuit or overload |
| 2 | 0 ... Channel 3: No error 1 ... Channel 3: Short circuit or overload |
| 3 | 0 ... Channel 4: No error 1 ... Channel 4: Short circuit or overload |

6.12 Register: StatusDigitalOutput01 - StatusDigitalOutput04

| BOOL | Description |
|------|---|
| x | 0 ... Digital output channel: No error 1 ... Digital output channel: Short circuit or overload |

6.13 B&R ID code

Code for module identification (\$1B97).

6.14 Minimum cycle time

The minimum cycle time is the minimum time needed for the bus cycle to be shut down without a communication error occurring. It should be noted that very fast cycles have reduced the idle time needed for handling monitoring, diagnostics and acyclic commands.

| Minimum cycle time |
|--------------------|
| ≥100 µs |

Table 197: Minimum cycle time - DO4322

6.15 Minimum I/O update time

The minimum I/O update time refers to the minimum time it takes for the bus cycle to shut down, so that in each cycle an I/O update takes place.

| Minimum I/O update time |
|---------------------------------|
| Equal to the minimum cycle time |

Table 198: Minimum I/O update time - DO4322

7. X20DO4331

7.1 Register overview

| Register | Name | Data type | Length | Read | | Write | |
|----------|---------------------------|-----------|--------|--------|---------|--------|---------|
| | | | | Cyclic | Acyclic | Cyclic | Acyclic |
| 2 | DigitalOutput 1 - 4 | USINT | 1 | | | ● | ● |
| 30 | StatusDigitalOutput 1 - 4 | USINT | 1 | ● | ● | | |

Table 199: Register overview - DO4331

7.2 Variable assignment in Automation Studio (X2X master)

| Name | Data type | Length | Read | | Write | |
|-----------------------|-----------|--------|--------|---------|--------|---------|
| | | | Cyclic | Acyclic | Cyclic | Acyclic |
| DigitalOutput01 | BOOL | 1 | | | ● | |
| DigitalOutput02 | BOOL | 1 | | | ● | |
| DigitalOutput03 | BOOL | 1 | | | ● | |
| DigitalOutput04 | BOOL | 1 | | | ● | |
| StatusDigitalOutput01 | BOOL | 1 | ● | | | |
| StatusDigitalOutput02 | BOOL | 1 | ● | | | |
| StatusDigitalOutput03 | BOOL | 1 | ● | | | |
| StatusDigitalOutput04 | BOOL | 1 | ● | | | |

Table 200: Variable assignment in Automation Studio (X2X master) - DO4331

7.3 Variable assignment in Automation Studio (CANIO)

| Name | Data type | Length | Read | | Write | |
|-----------------------|-----------|--------|--------|---------|--------|---------|
| | | | Cyclic | Acyclic | Cyclic | Acyclic |
| DigitalOutput01 | BOOL | 1 | | | ● | |
| DigitalOutput02 | BOOL | 1 | | | ● | |
| DigitalOutput03 | BOOL | 1 | | | ● | |
| DigitalOutput04 | BOOL | 1 | | | ● | |
| StatusDigitalOutput01 | BOOL | 1 | | ● | | |
| StatusDigitalOutput02 | BOOL | 1 | | ● | | |
| StatusDigitalOutput03 | BOOL | 1 | | ● | | |
| StatusDigitalOutput04 | BOOL | 1 | | ● | | |

Table 201: Variable assignment in Automation Studio (CANIO) - DO4331

7.4 CANopen data points

| Register | Name | Data type | Length | Read | | Write | |
|----------|---------------------------|-----------|--------|------|-----|-------|-----|
| | | | | PDO | SDO | PDO | SDO |
| 2 | DigitalOutput 1 - 4 | USINT | 1 | | | ● | ● |
| 30 | StatusDigitalOutput 1 - 4 | USINT | 1 | | ● | | |

Table 202: CANopen data points - DO4331

7.5 DeviceNet data points

| Register | Name | Data type | Length | Read | | Write | |
|----------|---------------------------|-----------|--------|--------|---------|--------|---------|
| | | | | Cyclic | Acyclic | Cyclic | Acyclic |
| 2 | DigitalOutput 1 - 4 | USINT | 1 | | | ● | ● |
| 30 | StatusDigitalOutput 1 - 4 | USINT | 1 | ● | ● | | |

Table 203: DeviceNet data points - DO4331

7.6 Modbus/TCP data points

| Register | Name | Data type | Length | Read | | Write | |
|----------|---------------------------|-----------|--------|--------|---------|--------|---------|
| | | | | Cyclic | Acyclic | Cyclic | Acyclic |
| 2 | DigitalOutput 1 - 4 | USINT | 1 | | | ● | ● |
| 30 | StatusDigitalOutput 1 - 4 | USINT | 1 | | ● | | |

Table 204: Modbus/TCP data points - DO4331

7.7 Digital outputs

The output status is transferred to the output channels using a fixed offset to the network cycle.

7.8 Register: DigitalOutput 1 - 4

| Bit | Description |
|-----|--|
| 0 | 0 ... Digital output 1 reset 1 ... Digital output 1 set |
| 1 | 0 ... Digital output 2 reset 1 ... Digital output 2 set |
| 2 | 0 ... Digital output 3 reset 1 ... Digital output 3 set |
| 3 | 0 ... Digital output 4 reset 1 ... Digital output 4 set |

7.9 Register: DigitalOutput01 - DigitalOutput04

| BOOL | Description |
|------|--|
| x | 0 ... Digital output channel reset 1 ... Digital output channel set |

7.10 Output monitoring status

The output states for the outputs are compared to the set values on the module. The control for the output driver is used for the set states.

A change in the output status resets the monitoring for this output. The status of each individual channel can be read. A change in monitoring status triggers an error message.

| Monitoring status | Description |
|-------------------|---|
| 0 | Digital output channel: No error |
| 1 | Digital output channel: Short circuit or overload |

Table 205: Monitoring status - DO4331

7.11 Register: StatusDigitalOutput 1 - 4

| Bit | Description |
|-----|---|
| 0 | 0 ... Channel 1: No error 1 ... Channel 1: Short circuit or overload |
| 1 | 0 ... Channel 2: No error 1 ... Channel 2: Short circuit or overload |
| 2 | 0 ... Channel 3: No error 1 ... Channel 3: Short circuit or overload |
| 3 | 0 ... Channel 4: No error 1 ... Channel 4: Short circuit or overload |

7.12 Register: StatusDigitalOutput01 - StatusDigitalOutput04

| BOOL | Description |
|------|---|
| x | 0 ... Digital output channel: No error 1 ... Digital output channel: Short circuit or overload |

7.13 B&R ID code

Code for module identification (\$22B5).

7.14 Minimum cycle time

The minimum cycle time is the minimum time needed for the bus cycle to be shut down without a communication error occurring. It should be noted that very fast cycles have reduced the idle time needed for handling monitoring, diagnostics and acyclic commands.

| Minimum cycle time |
|--------------------|
| ≥100 µs |

Table 206: Minimum cycle time - DO4331

7.15 Minimum I/O update time

The minimum I/O update time refers to the minimum time it takes for the bus cycle to shut down, so that in each cycle an I/O update takes place.

| Minimum I/O update time |
|---------------------------------|
| Equal to the minimum cycle time |

Table 207: Minimum I/O update time - DO4331

8. X20DO4332

8.1 Register overview

| Register | Name | Data type | Length | Read | | Write | |
|----------|---------------------------|-----------|--------|--------|---------|--------|---------|
| | | | | Cyclic | Acyclic | Cyclic | Acyclic |
| 2 | DigitalOutput 1 - 4 | USINT | 1 | | | ● | ● |
| 30 | StatusDigitalOutput 1 - 4 | USINT | 1 | ● | ● | | |

Table 208: Register overview - DO4332

8.2 Variable assignment in Automation Studio (X2X master)

| Name | Data type | Length | Read | | Write | |
|-----------------------|-----------|--------|--------|---------|--------|---------|
| | | | Cyclic | Acyclic | Cyclic | Acyclic |
| DigitalOutput01 | BOOL | 1 | | | ● | |
| DigitalOutput02 | BOOL | 1 | | | ● | |
| DigitalOutput03 | BOOL | 1 | | | ● | |
| DigitalOutput04 | BOOL | 1 | | | ● | |
| StatusDigitalOutput01 | BOOL | 1 | ● | | | |
| StatusDigitalOutput02 | BOOL | 1 | ● | | | |
| StatusDigitalOutput03 | BOOL | 1 | ● | | | |
| StatusDigitalOutput04 | BOOL | 1 | ● | | | |

Table 209: Variable assignment in Automation Studio (X2X master) - DO4332

8.3 Variable assignment in Automation Studio (CANIO)

| Name | Data type | Length | Read | | Write | |
|-----------------------|-----------|--------|--------|---------|--------|---------|
| | | | Cyclic | Acyclic | Cyclic | Acyclic |
| DigitalOutput01 | BOOL | 1 | | | ● | |
| DigitalOutput02 | BOOL | 1 | | | ● | |
| DigitalOutput03 | BOOL | 1 | | | ● | |
| DigitalOutput04 | BOOL | 1 | | | ● | |
| StatusDigitalOutput01 | BOOL | 1 | | ● | | |
| StatusDigitalOutput02 | BOOL | 1 | | ● | | |
| StatusDigitalOutput03 | BOOL | 1 | | ● | | |
| StatusDigitalOutput04 | BOOL | 1 | | ● | | |

Table 210: Variable assignment in Automation Studio (CANIO) - DO4332

8.4 CANopen data points

| Register | Name | Data type | Length | Read | | Write | |
|----------|---------------------------|-----------|--------|------|-----|-------|-----|
| | | | | PDO | SDO | PDO | SDO |
| 2 | DigitalOutput 1 - 4 | USINT | 1 | | | ● | ● |
| 30 | StatusDigitalOutput 1 - 4 | USINT | 1 | | ● | | |

Table 211: CANopen data points - DO4332

8.5 DeviceNet data points

| Register | Name | Data type | Length | Read | | Write | |
|----------|---------------------------|-----------|--------|--------|---------|--------|---------|
| | | | | Cyclic | Acyclic | Cyclic | Acyclic |
| 2 | DigitalOutput 1 - 4 | USINT | 1 | | | ● | ● |
| 30 | StatusDigitalOutput 1 - 4 | USINT | 1 | ● | ● | | |

Table 212: DeviceNet data points - DO4332

8.6 Modbus/TCP data points

| Register | Name | Data type | Length | Read | | Write | |
|----------|---------------------------|-----------|--------|--------|---------|--------|---------|
| | | | | Cyclic | Acyclic | Cyclic | Acyclic |
| 2 | DigitalOutput 1 - 4 | USINT | 1 | | | ● | ● |
| 30 | StatusDigitalOutput 1 - 4 | USINT | 1 | | ● | | |

Table 213: Modbus/TCP data points - DO4332

8.7 Digital outputs

The output status is transferred to the output channels using a fixed offset to the network cycle.

8.8 Register: DigitalOutput 1 - 4

| Bit | Description |
|-----|--|
| 0 | 0 ... Digital output 1 reset 1 ... Digital output 1 set |
| 1 | 0 ... Digital output 2 reset 1 ... Digital output 2 set |
| 2 | 0 ... Digital output 3 reset 1 ... Digital output 3 set |
| 3 | 0 ... Digital output 4 reset 1 ... Digital output 4 set |

8.9 Register: DigitalOutput01 - DigitalOutput04

| BOOL | Description |
|------|--|
| x | 0 ... Digital output channel reset 1 ... Digital output channel set |

8.10 Output monitoring status

The output states for the outputs are compared to the set values on the module. The control for the output driver is used for the set states.

A change in the output status resets the monitoring for this output. The status of each individual channel can be read. A change in monitoring status triggers an error message.

| Monitoring status | Description |
|-------------------|---|
| 0 | Digital output channel: No error |
| 1 | Digital output channel: Short circuit or overload |

Table 214: Monitoring status - DO4332

8.11 Register: StatusDigitalOutput 1 - 4

| Bit | Description |
|-----|---|
| 0 | 0 ... Channel 1: No error 1 ... Channel 1: Short circuit or overload |
| 1 | 0 ... Channel 2: No error 1 ... Channel 2: Short circuit or overload |
| 2 | 0 ... Channel 3: No error 1 ... Channel 3: Short circuit or overload |
| 3 | 0 ... Channel 4: No error 1 ... Channel 4: Short circuit or overload |

8.12 Register: StatusDigitalOutput01 - StatusDigitalOutput04

| BOOL | Description |
|------|---|
| x | 0 ... Digital output channel: No error 1 ... Digital output channel: Short circuit or overload |

8.13 B&R ID code

Code for module identification (\$1B9C).

8.14 Minimum cycle time

The minimum cycle time is the minimum time needed for the bus cycle to be shut down without a communication error occurring. It should be noted that very fast cycles have reduced the idle time needed for handling monitoring, diagnostics and acyclic commands.

| Minimum cycle time |
|--------------------|
| ≥100 µs |

Table 215: Minimum cycle time - DO4332

8.15 Minimum I/O update time

The minimum I/O update time refers to the minimum time it takes for the bus cycle to shut down, so that in each cycle an I/O update takes place.

| Minimum I/O update time |
|---------------------------------|
| Equal to the minimum cycle time |

Table 216: Minimum I/O update time - DO4332

9. X2DO4529

9.1 Register overview

| Register | Name | Data type | Length | Read | | Write | |
|----------|---------------------|-----------|--------|--------|---------|--------|---------|
| | | | | Cyclic | Acyclic | Cyclic | Acyclic |
| 2 | DigitalOutput 1 - 4 | USINT | 1 | | | ● | ● |

Table 217: Register overview - DO4529

9.2 Variable assignment in Automation Studio (X2X master)

| Name | Data type | Length | Read | | Write | |
|-----------------|-----------|--------|--------|---------|--------|---------|
| | | | Cyclic | Acyclic | Cyclic | Acyclic |
| DigitalOutput01 | BOOL | 1 | | | ● | |
| DigitalOutput02 | BOOL | 1 | | | ● | |
| DigitalOutput03 | BOOL | 1 | | | ● | |
| DigitalOutput04 | BOOL | 1 | | | ● | |

Table 218: Variable assignment in Automation Studio (X2X master) - DO4529

9.3 Variable assignment in Automation Studio (CANIO)

| Name | Data type | Length | Read | | Write | |
|-----------------|-----------|--------|--------|---------|--------|---------|
| | | | Cyclic | Acyclic | Cyclic | Acyclic |
| DigitalOutput01 | BOOL | 1 | | | ● | |
| DigitalOutput02 | BOOL | 1 | | | ● | |
| DigitalOutput03 | BOOL | 1 | | | ● | |
| DigitalOutput04 | BOOL | 1 | | | ● | |

Table 219: Variable assignment in Automation Studio (CANIO) - DO4529

9.4 CANopen data points

| Register | Name | Data type | Length | Read | | Write | |
|----------|---------------------|-----------|--------|------|-----|-------|-----|
| | | | | PDO | SDO | PDO | SDO |
| 2 | DigitalOutput 1 - 4 | USINT | 1 | | | ● | ● |

Table 220: CANopen data points - DO4529

9.5 DeviceNet data points

| Register | Name | Data type | Length | Read | | Write | |
|----------|---------------------|-----------|--------|--------|---------|--------|---------|
| | | | | Cyclic | Acyclic | Cyclic | Acyclic |
| 2 | DigitalOutput 1 - 4 | USINT | 1 | | | ● | ● |

Table 221: DeviceNet data points - DO4529

9.6 Modbus/TCP data points

| Register | Name | Data type | Length | Read | | Write | |
|----------|---------------------|-----------|--------|--------|---------|--------|---------|
| | | | | Cyclic | Acyclic | Cyclic | Acyclic |
| 2 | DigitalOutput 1 - 4 | USINT | 1 | | | ● | ● |

Table 222: Modbus/TCP data points - DO4529

9.7 Digital outputs

The output status is transferred to the output channels using a fixed offset to the network cycle.

9.8 Register: DigitalOutput 1 - 4

| Bit | Description |
|-----|--|
| 0 | 0 ... Digital output 1 reset 1 ... Digital output 1 set |
| 1 | 0 ... Digital output 2 reset 1 ... Digital output 2 set |
| 2 | 0 ... Digital output 3 reset 1 ... Digital output 3 set |
| 3 | 0 ... Digital output 4 reset 1 ... Digital output 4 set |

9.9 Register: DigitalOutput01 - DigitalOutput04

| BOOL | Description |
|------|--|
| x | 0 ... Digital output channel reset 1 ... Digital output channel set |

9.10 B&R ID code

Code for module identification (\$20D9).

9.11 Minimum cycle time

The minimum cycle time is the minimum time needed for the bus cycle to be shut down without a communication error occurring. It should be noted that very fast cycles have reduced the idle time needed for handling monitoring, diagnostics and acyclic commands.

| Minimum cycle time |
|------------------------|
| $\geq 100 \mu\text{s}$ |

Table 223: Minimum cycle time - DO4529

9.12 Minimum I/O update time

The minimum I/O update time refers to the minimum time it takes for the bus cycle to shut down, so that in each cycle an I/O update takes place.

| Minimum I/O update time |
|---------------------------------|
| Equal to the minimum cycle time |

Table 224: Minimum I/O update time - DO4529

10. X2DO6321

10.1 Register overview

| Register | Name | Data type | Length | Read | | Write | |
|----------|---------------------------|-----------|--------|--------|---------|--------|---------|
| | | | | Cyclic | Acyclic | Cyclic | Acyclic |
| 2 | DigitalOutput 1 - 6 | USINT | 1 | | | ● | ● |
| 30 | StatusDigitalOutput 1 - 6 | USINT | 1 | ● | ● | | |

Table 225: Register overview - DO6321

10.2 Variable assignment in Automation Studio (X2X master)

| Name | Data type | Length | Read | | Write | |
|-----------------------|-----------|--------|--------|---------|--------|---------|
| | | | Cyclic | Acyclic | Cyclic | Acyclic |
| DigitalOutput01 | BOOL | 1 | | | ● | |
| DigitalOutput02 | BOOL | 1 | | | ● | |
| DigitalOutput03 | BOOL | 1 | | | ● | |
| DigitalOutput04 | BOOL | 1 | | | ● | |
| DigitalOutput05 | BOOL | 1 | | | ● | |
| DigitalOutput06 | BOOL | 1 | | | ● | |
| StatusDigitalOutput01 | BOOL | 1 | ● | | | |
| StatusDigitalOutput02 | BOOL | 1 | ● | | | |
| StatusDigitalOutput03 | BOOL | 1 | ● | | | |
| StatusDigitalOutput04 | BOOL | 1 | ● | | | |
| StatusDigitalOutput05 | BOOL | 1 | ● | | | |
| StatusDigitalOutput06 | BOOL | 1 | ● | | | |

Table 226: Variable assignment in Automation Studio (X2X master) - DO6321

10.3 Variable assignment in Automation Studio (CANIO)

| Name | Data type | Length | Read | | Write | |
|-----------------------|-----------|--------|--------|---------|--------|---------|
| | | | Cyclic | Acyclic | Cyclic | Acyclic |
| DigitalOutput01 | BOOL | 1 | | | ● | |
| DigitalOutput02 | BOOL | 1 | | | ● | |
| DigitalOutput03 | BOOL | 1 | | | ● | |
| DigitalOutput04 | BOOL | 1 | | | ● | |
| DigitalOutput05 | BOOL | 1 | | | ● | |
| DigitalOutput06 | BOOL | 1 | | | ● | |
| StatusDigitalOutput01 | BOOL | 1 | | ● | | |
| StatusDigitalOutput02 | BOOL | 1 | | ● | | |
| StatusDigitalOutput03 | BOOL | 1 | | ● | | |
| StatusDigitalOutput04 | BOOL | 1 | | ● | | |
| StatusDigitalOutput05 | BOOL | 1 | | ● | | |
| StatusDigitalOutput06 | BOOL | 1 | | ● | | |

Table 227: Variable assignment in Automation Studio (CANIO) - DO6321

10.4 CANopen data points

| Register | Name | Data type | Length | Read | | Write | |
|----------|---------------------------|-----------|--------|------|-----|-------|-----|
| | | | | PDO | SDO | PDO | SDO |
| 2 | DigitalOutput 1 - 6 | USINT | 1 | | | ● | ● |
| 30 | StatusDigitalOutput 1 - 6 | USINT | 1 | | ● | | |

Table 228: CANopen data points - DO6321

10.5 DeviceNet data points

| Register | Name | Data type | Length | Read | | Write | |
|----------|---------------------------|-----------|--------|--------|---------|--------|---------|
| | | | | Cyclic | Acyclic | Cyclic | Acyclic |
| 2 | DigitalOutput 1 - 6 | USINT | 1 | | | ● | ● |
| 30 | StatusDigitalOutput 1 - 6 | USINT | 1 | ● | ● | | |

Table 229: DeviceNet data points - DO6321

10.6 Modbus/TCP data points

| Register | Name | Data type | Length | Read | | Write | |
|----------|---------------------------|-----------|--------|--------|---------|--------|---------|
| | | | | Cyclic | Acyclic | Cyclic | Acyclic |
| 2 | DigitalOutput 1 - 6 | USINT | 1 | | | ● | ● |
| 30 | StatusDigitalOutput 1 - 6 | USINT | 1 | | ● | | |

Table 230: Modbus/TCP data points - DO6321

10.7 Digital outputs

The output status is transferred to the output channels using a fixed offset to the network cycle.

10.8 Register: DigitalOutput 1 - 6

| Bit | Description |
|-----|--|
| 0 | 0 ... Digital output 1 reset 1 ... Digital output 1 set |
| 1 | 0 ... Digital output 2 reset 1 ... Digital output 2 set |
| 2 | 0 ... Digital output 3 reset 1 ... Digital output 3 set |
| 3 | 0 ... Digital output 4 reset 1 ... Digital output 4 set |
| 4 | 0 ... Digital output 5 reset 1 ... Digital output 5 set |
| 5 | 0 ... Digital output 6 reset 1 ... Digital output 6 set |

10.9 Register: DigitalOutput01 - DigitalOutput06

| BOOL | Description |
|------|--|
| x | 0 ... Digital output channel reset 1 ... Digital output channel set |

10.10 Output monitoring status

The output states for the outputs are compared to the set values on the module. The control for the output driver is used for the set states.

A change in the output status resets the monitoring for this output. The status of each individual channel can be read. A change in monitoring status triggers an error message.

| Monitoring status | Description |
|-------------------|---|
| 0 | Digital output channel: No error |
| 1 | Digital output channel: Short circuit or overload |

Table 231: Monitoring status - DO6321

10.11 Register: StatusDigitalOutput 1 - 6

| Bit | Description |
|-----|---|
| 0 | 0 ... Channel 1: No error 1 ... Channel 1: Short circuit or overload |
| 1 | 0 ... Channel 2: No error 1 ... Channel 2: Short circuit or overload |
| 2 | 0 ... Channel 3: No error 1 ... Channel 3: Short circuit or overload |
| 3 | 0 ... Channel 4: No error 1 ... Channel 4: Short circuit or overload |
| 4 | 0 ... Channel 5: No error 1 ... Channel 5: Short circuit or overload |
| 5 | 0 ... Channel 6: No error 1 ... Channel 6: Short circuit or overload |

10.12 Register: StatusDigitalOutput01 - StatusDigitalOutput06

| BOOL | Description |
|------|---|
| x | 0 ... Digital output channel: No error 1 ... Digital output channel: Short circuit or overload |

10.13 B&R ID code

Code for module identification (\$1B99).

10.14 Minimum cycle time

The minimum cycle time is the minimum time needed for the bus cycle to be shut down without a communication error occurring. It should be noted that very fast cycles have reduced the idle time needed for handling monitoring, diagnostics and acyclic commands.

| Minimum cycle time |
|--------------------|
| ≥100 µs |

Table 232: Minimum cycle time - DO6321

10.15 Minimum I/O update time

The minimum I/O update time refers to the minimum time it takes for the bus cycle to shut down, so that in each cycle an I/O update takes place.

| Minimum I/O update time |
|---------------------------------|
| Equal to the minimum cycle time |

Table 233: Minimum I/O update time - DO6321

11. X2DO6322

11.1 Register overview

| Register | Name | Data type | Length | Read | | Write | |
|----------|---------------------------|-----------|--------|--------|---------|--------|---------|
| | | | | Cyclic | Acyclic | Cyclic | Acyclic |
| 2 | DigitalOutput 1 - 6 | USINT | 1 | | | ● | ● |
| 30 | StatusDigitalOutput 1 - 6 | USINT | 1 | ● | ● | | |

Table 234: Register overview - DO6322

11.2 Variable assignment in Automation Studio (X2X master)

| Name | Data type | Length | Read | | Write | |
|-----------------------|-----------|--------|--------|---------|--------|---------|
| | | | Cyclic | Acyclic | Cyclic | Acyclic |
| DigitalOutput01 | BOOL | 1 | | | ● | |
| DigitalOutput02 | BOOL | 1 | | | ● | |
| DigitalOutput03 | BOOL | 1 | | | ● | |
| DigitalOutput04 | BOOL | 1 | | | ● | |
| DigitalOutput05 | BOOL | 1 | | | ● | |
| DigitalOutput06 | BOOL | 1 | | | ● | |
| StatusDigitalOutput01 | BOOL | 1 | ● | | | |
| StatusDigitalOutput02 | BOOL | 1 | ● | | | |
| StatusDigitalOutput03 | BOOL | 1 | ● | | | |
| StatusDigitalOutput04 | BOOL | 1 | ● | | | |
| StatusDigitalOutput05 | BOOL | 1 | ● | | | |
| StatusDigitalOutput06 | BOOL | 1 | ● | | | |

Table 235: Variable assignment in Automation Studio (X2X master) - DO6322

11.3 Variable assignment in Automation Studio (CANIO)

| Name | Data type | Length | Read | | Write | |
|-----------------------|-----------|--------|--------|---------|--------|---------|
| | | | Cyclic | Acyclic | Cyclic | Acyclic |
| DigitalOutput01 | BOOL | 1 | | | ● | |
| DigitalOutput02 | BOOL | 1 | | | ● | |
| DigitalOutput03 | BOOL | 1 | | | ● | |
| DigitalOutput04 | BOOL | 1 | | | ● | |
| DigitalOutput05 | BOOL | 1 | | | ● | |
| DigitalOutput06 | BOOL | 1 | | | ● | |
| StatusDigitalOutput01 | BOOL | 1 | | ● | | |
| StatusDigitalOutput02 | BOOL | 1 | | ● | | |
| StatusDigitalOutput03 | BOOL | 1 | | ● | | |
| StatusDigitalOutput04 | BOOL | 1 | | ● | | |
| StatusDigitalOutput05 | BOOL | 1 | | ● | | |
| StatusDigitalOutput06 | BOOL | 1 | | ● | | |

Table 236: Variable assignment in Automation Studio (CANIO) - DO6322

11.4 CANopen data points

| Register | Name | Data type | Length | Read | | Write | |
|----------|---------------------------|-----------|--------|------|-----|-------|-----|
| | | | | PDO | SDO | PDO | SDO |
| 2 | DigitalOutput 1 - 6 | USINT | 1 | | | ● | ● |
| 30 | StatusDigitalOutput 1 - 6 | USINT | 1 | | ● | | |

Table 237: CANopen data points - DO6322

11.5 DeviceNet data points

| Register | Name | Data type | Length | Read | | Write | |
|----------|---------------------------|-----------|--------|--------|---------|--------|---------|
| | | | | Cyclic | Acyclic | Cyclic | Acyclic |
| 2 | DigitalOutput 1 - 6 | USINT | 1 | | | ● | ● |
| 30 | StatusDigitalOutput 1 - 6 | USINT | 1 | ● | ● | | |

Table 238: DeviceNet data points - DO6322

11.6 Modbus/TCP data points

| Register | Name | Data type | Length | Read | | Write | |
|----------|---------------------------|-----------|--------|--------|---------|--------|---------|
| | | | | Cyclic | Acyclic | Cyclic | Acyclic |
| 2 | DigitalOutput 1 - 6 | USINT | 1 | | | ● | ● |
| 30 | StatusDigitalOutput 1 - 6 | USINT | 1 | | ● | | |

Table 239: Modbus/TCP data points - DO6322

11.7 Digital outputs

The output status is transferred to the output channels using a fixed offset to the network cycle.

11.8 Register: DigitalOutput 1 - 6

| Bit | Description |
|-----|--|
| 0 | 0 ... Digital output 1 reset 1 ... Digital output 1 set |
| 1 | 0 ... Digital output 2 reset 1 ... Digital output 2 set |
| 2 | 0 ... Digital output 3 reset 1 ... Digital output 3 set |
| 3 | 0 ... Digital output 4 reset 1 ... Digital output 4 set |
| 4 | 0 ... Digital output 5 reset 1 ... Digital output 5 set |
| 5 | 0 ... Digital output 6 reset 1 ... Digital output 6 set |

11.9 Register: DigitalOutput01 - DigitalOutput06

| BOOL | Description |
|------|--|
| x | 0 ... Digital output channel reset 1 ... Digital output channel set |

11.10 Output monitoring status

The output states for the outputs are compared to the set values on the module. The control for the output driver is used for the set states.

A change in the output status resets the monitoring for this output. The status of each individual channel can be read. A change in monitoring status triggers an error message.

| Monitoring status | Description |
|-------------------|---|
| 0 | Digital output channel: No error |
| 1 | Digital output channel: Short circuit or overload |

Table 240: Monitoring status - DO6322

11.11 Register: StatusDigitalOutput 1 - 6

| Bit | Description |
|-----|---|
| 0 | 0 ... Channel 1: No error 1 ... Channel 1: Short circuit or overload |
| 1 | 0 ... Channel 2: No error 1 ... Channel 2: Short circuit or overload |
| 2 | 0 ... Channel 3: No error 1 ... Channel 3: Short circuit or overload |
| 3 | 0 ... Channel 4: No error 1 ... Channel 4: Short circuit or overload |
| 4 | 0 ... Channel 5: No error 1 ... Channel 5: Short circuit or overload |
| 5 | 0 ... Channel 6: No error 1 ... Channel 6: Short circuit or overload |

11.12 Register: StatusDigitalOutput01 - StatusDigitalOutput06

| BOOL | Description |
|------|---|
| x | 0 ... Digital output channel: No error 1 ... Digital output channel: Short circuit or overload |

11.13 B&R ID code

Code for module identification (\$1B98).

11.14 Minimum cycle time

The minimum cycle time is the minimum time needed for the bus cycle to be shut down without a communication error occurring. It should be noted that very fast cycles have reduced the idle time needed for handling monitoring, diagnostics and acyclic commands.

| Minimum cycle time |
|------------------------|
| $\geq 100 \mu\text{s}$ |

Table 241: Minimum cycle time - DO6322

11.15 Minimum I/O update time

The minimum I/O update time refers to the minimum time it takes for the bus cycle to shut down, so that in each cycle an I/O update takes place.

| Minimum I/O update time |
|---------------------------------|
| Equal to the minimum cycle time |

Table 242: Minimum I/O update time - DO6322

12. X2DO6529

12.1 Register overview

| Register | Name | Data type | Length | Read | | Write | |
|----------|---------------------|-----------|--------|--------|---------|--------|---------|
| | | | | Cyclic | Acyclic | Cyclic | Acyclic |
| 2 | DigitalOutput 1 - 6 | USINT | 1 | | | ● | ● |

Table 243: Register overview - DO6529

12.2 Variable assignment in Automation Studio (X2X master)

| Name | Data type | Length | Read | | Write | |
|-----------------|-----------|--------|--------|---------|--------|---------|
| | | | Cyclic | Acyclic | Cyclic | Acyclic |
| DigitalOutput01 | BOOL | 1 | | | ● | |
| DigitalOutput02 | BOOL | 1 | | | ● | |
| DigitalOutput03 | BOOL | 1 | | | ● | |
| DigitalOutput04 | BOOL | 1 | | | ● | |
| DigitalOutput05 | BOOL | 1 | | | ● | |
| DigitalOutput06 | BOOL | 1 | | | ● | |

Table 244: Variable assignment in Automation Studio (X2X master) - DO6529

12.3 Variable assignment in Automation Studio (CANIO)

| Name | Data type | Length | Read | | Write | |
|-----------------|-----------|--------|--------|---------|--------|---------|
| | | | Cyclic | Acyclic | Cyclic | Acyclic |
| DigitalOutput01 | BOOL | 1 | | | ● | |
| DigitalOutput02 | BOOL | 1 | | | ● | |
| DigitalOutput03 | BOOL | 1 | | | ● | |
| DigitalOutput04 | BOOL | 1 | | | ● | |
| DigitalOutput05 | BOOL | 1 | | | ● | |
| DigitalOutput06 | BOOL | 1 | | | ● | |

Table 245: Variable assignment in Automation Studio (CANIO) - DO6529

12.4 CANopen data points

| Register | Name | Data type | Length | Read | | Write | |
|----------|---------------------|-----------|--------|------|-----|-------|-----|
| | | | | PDO | SDO | PDO | SDO |
| 2 | DigitalOutput 1 - 6 | USINT | 1 | | | ● | ● |

Table 246: CANopen data points - DO6529

12.5 DeviceNet data points

| Register | Name | Data type | Length | Read | | Write | |
|----------|---------------------|-----------|--------|--------|---------|--------|---------|
| | | | | Cyclic | Acyclic | Cyclic | Acyclic |
| 2 | DigitalOutput 1 - 6 | USINT | 1 | | | ● | ● |

Table 247: DeviceNet data points - DO6529

12.6 Modbus/TCP data points

| Register | Name | Data type | Length | Read | | Write | |
|----------|---------------------|-----------|--------|--------|---------|--------|---------|
| | | | | Cyclic | Acyclic | Cyclic | Acyclic |
| 2 | DigitalOutput 1 - 6 | USINT | 1 | | | ● | ● |

Table 248: Modbus/TCP data points - DO6529

12.7 Digital outputs

The output status is transferred to the output channels using a fixed offset to the network cycle.

12.8 Register: DigitalOutput 1 - 6

| Bit | Description |
|-----|--|
| 0 | 0 ... Digital output 1 reset 1 ... Digital output 1 set |
| 1 | 0 ... Digital output 2 reset 1 ... Digital output 2 set |
| 2 | 0 ... Digital output 3 reset 1 ... Digital output 3 set |
| 3 | 0 ... Digital output 4 reset 1 ... Digital output 4 set |
| 4 | 0 ... Digital output 5 reset 1 ... Digital output 5 set |
| 5 | 0 ... Digital output 6 reset 1 ... Digital output 6 set |

12.9 Register: DigitalOutput01 - DigitalOutput06

| BOOL | Description |
|------|--|
| x | 0 ... Digital output channel reset 1 ... Digital output channel set |

12.10 B&R ID code

Code for module identification (§2019).

12.11 Minimum cycle time

The minimum cycle time is the minimum time needed for the bus cycle to be shut down without a communication error occurring. It should be noted that very fast cycles have reduced the idle time needed for handling monitoring, diagnostics and acyclic commands.

| Minimum cycle time |
|--------------------|
| ≥100 µs |

Table 249: Minimum cycle time - DO6529

12.12 Minimum I/O update time

The minimum I/O update time refers to the minimum time it takes for the bus cycle to shut down, so that in each cycle an I/O update takes place.

| Minimum I/O update time |
|---------------------------------|
| Equal to the minimum cycle time |

Table 250: Minimum I/O update time - DO6529

13. X20DO8331

13.1 Register overview

| Register | Name | Data type | Length | Read | | Write | |
|----------|--|-----------|--------|--------|---------|--------|---------|
| | | | | Cyclic | Acyclic | Cyclic | Acyclic |
| 2 | DigitalOutput 1 - 8 | USINT | 1 | | | ● | ● |
| 4 | DigitalOutputDelayed 1 - 8 ¹⁾ | USINT | 1 | | | ● | ● |
| 6 | DigitalOutputSwitchingMask 1 - 8 ¹⁾ | USINT | 1 | | | ● | ● |
| 8 | DelayTime ¹⁾ | USINT | 1 | | | ● | ● |
| 30 | StatusDigitalOutput 1 - 8 | USINT | 1 | ● | ● | | |
| 8196 | OperatingLimitStatus | USINT | 1 | ● | | | |

Table 251: Register overview - DO8331

1) Only with function model 1

13.2 Variable assignment in Automation Studio (X2X master)

| Name | Data type | Length | Read | | Write | |
|--|-----------|--------|--------|---------|--------|---------|
| | | | Cyclic | Acyclic | Cyclic | Acyclic |
| DigitalOutput01 | BOOL | 1 | | | ● | |
| DigitalOutput02 | BOOL | 1 | | | ● | |
| DigitalOutput03 | BOOL | 1 | | | ● | |
| DigitalOutput04 | BOOL | 1 | | | ● | |
| DigitalOutput05 | BOOL | 1 | | | ● | |
| DigitalOutput06 | BOOL | 1 | | | ● | |
| DigitalOutput07 | BOOL | 1 | | | ● | |
| DigitalOutput08 | BOOL | 1 | | | ● | |
| StatusDigitalOutput01 | BOOL | 1 | ● | | | |
| StatusDigitalOutput02 | BOOL | 1 | ● | | | |
| StatusDigitalOutput03 | BOOL | 1 | ● | | | |
| StatusDigitalOutput04 | BOOL | 1 | ● | | | |
| StatusDigitalOutput05 | BOOL | 1 | ● | | | |
| StatusDigitalOutput06 | BOOL | 1 | ● | | | |
| StatusDigitalOutput07 | BOOL | 1 | ● | | | |
| StatusDigitalOutput08 | BOOL | 1 | ● | | | |
| PowerSupply01 | BOOL | 1 | ● | | | |
| OutputDelayTime ¹⁾ | USINT | 1 | | | ● | |
| DigitalOutput01DelayEnable ¹⁾ | BOOL | 1 | | | ● | |
| DigitalOutput02DelayEnable ¹⁾ | BOOL | 1 | | | ● | |
| DigitalOutput03DelayEnable ¹⁾ | BOOL | 1 | | | ● | |
| DigitalOutput04DelayEnable ¹⁾ | BOOL | 1 | | | ● | |
| DigitalOutput05DelayEnable ¹⁾ | BOOL | 1 | | | ● | |
| DigitalOutput06DelayEnable ¹⁾ | BOOL | 1 | | | ● | |
| DigitalOutput07DelayEnable ¹⁾ | BOOL | 1 | | | ● | |
| DigitalOutput08DelayEnable ¹⁾ | BOOL | 1 | | | ● | |
| DigitalOutput01Delayed ¹⁾ | BOOL | 1 | | | ● | |
| DigitalOutput02Delayed ¹⁾ | BOOL | 1 | | | ● | |
| DigitalOutput03Delayed ¹⁾ | BOOL | 1 | | | ● | |
| DigitalOutput04Delayed ¹⁾ | BOOL | 1 | | | ● | |

Table 252: Variable assignment in Automation Studio (X2X master) - DO8331

| Name | Data type | Length | Read | | Write | |
|--------------------------------------|-----------|--------|--------|---------|--------|---------|
| | | | Cyclic | Acyclic | Cyclic | Acyclic |
| DigitalOutput05Delayed ¹⁾ | BOOL | 1 | | | ● | |
| DigitalOutput06Delayed ¹⁾ | BOOL | 1 | | | ● | |
| DigitalOutput07Delayed ¹⁾ | BOOL | 1 | | | ● | |
| DigitalOutput08Delayed ¹⁾ | BOOL | 1 | | | ● | |

Table 252: Variable assignment in Automation Studio (X2X master) - DO8331

1) Only with function model 1

13.3 Variable assignment in Automation Studio (CANIO)

| Name | Data type | Length | Read | | Write | |
|-----------------------|-----------|--------|--------|---------|--------|---------|
| | | | Cyclic | Acyclic | Cyclic | Acyclic |
| DigitalOutput01 | BOOL | 1 | | | ● | |
| DigitalOutput02 | BOOL | 1 | | | ● | |
| DigitalOutput03 | BOOL | 1 | | | ● | |
| DigitalOutput04 | BOOL | 1 | | | ● | |
| DigitalOutput05 | BOOL | 1 | | | ● | |
| DigitalOutput06 | BOOL | 1 | | | ● | |
| DigitalOutput07 | BOOL | 1 | | | ● | |
| DigitalOutput08 | BOOL | 1 | | | ● | |
| StatusDigitalOutput01 | BOOL | 1 | | ● | | |
| StatusDigitalOutput02 | BOOL | 1 | | ● | | |
| StatusDigitalOutput03 | BOOL | 1 | | ● | | |
| StatusDigitalOutput04 | BOOL | 1 | | ● | | |
| StatusDigitalOutput05 | BOOL | 1 | | ● | | |
| StatusDigitalOutput06 | BOOL | 1 | | ● | | |
| StatusDigitalOutput07 | BOOL | 1 | | ● | | |
| StatusDigitalOutput08 | BOOL | 1 | | ● | | |
| PowerSupply01 | BOOL | 1 | | ● | | |

Table 253: Variable assignment in Automation Studio (CANIO) - DO8331

13.4 CANopen data points

| Register | Name | Data type | Length | Read | | Write | |
|----------|---------------------------|-----------|--------|------|-----|-------|-----|
| | | | | PDO | SDO | PDO | SDO |
| 2 | DigitalOutput 1 - 8 | USINT | 1 | | | ● | ● |
| 30 | StatusDigitalOutput 1 - 8 | USINT | 1 | | ● | | |

Table 254: CANopen data points - DO8331

13.5 DeviceNet data points

| Register | Name | Data type | Length | Read | | Write | |
|----------|---------------------------|-----------|--------|--------|---------|--------|---------|
| | | | | Cyclic | Acyclic | Cyclic | Acyclic |
| 2 | DigitalOutput 1 - 8 | USINT | 1 | | | ● | ● |
| 30 | StatusDigitalOutput 1 - 8 | USINT | 1 | ● | ● | | |

Table 255: DeviceNet data points - DO8331

13.6 Modbus/TCP data points

| Register | Name | Data type | Length | Read | | Write | |
|----------|---------------------------|-----------|--------|--------|---------|--------|---------|
| | | | | Cyclic | Acyclic | Cyclic | Acyclic |
| 2 | DigitalOutput 1 - 8 | USINT | 1 | | | ● | ● |
| 30 | StatusDigitalOutput 1 - 8 | USINT | 1 | | ● | | |

Table 256: Modbus/TCP data points - DO8331

13.7 Digital outputs

The output status is transferred to the output channels using a fixed offset to the network cycle.

13.8 Register: DigitalOutput 1 - 8

| Bit | Description |
|-----|--|
| 0 | 0 ... Digital output 1 reset 1 ... Digital output 1 set |
| 1 | 0 ... Digital output 2 reset 1 ... Digital output 2 set |
| 2 | 0 ... Digital output 3 reset 1 ... Digital output 3 set |
| 3 | 0 ... Digital output 4 reset 1 ... Digital output 4 set |
| 4 | 0 ... Digital output 5 reset 1 ... Digital output 5 set |
| 5 | 0 ... Digital output 6 reset 1 ... Digital output 6 set |
| 6 | 0 ... Digital output 7 reset 1 ... Digital output 7 set |
| 7 | 0 ... Digital output 8 reset 1 ... Digital output 8 set |

13.9 Register: DigitalOutput01 - DigitalOutput08

| BOOL | Description |
|------|--|
| x | 0 ... Digital output channel reset 1 ... Digital output channel set |

13.10 Output monitoring status

The output states for the outputs are compared to the set values on the module. The control for the output driver is used for the set states.

A change in the output status resets the monitoring for this output. The status of each individual channel can be read. A change in monitoring status triggers an error message.

| Monitoring status | Description |
|-------------------|---|
| 0 | Digital output channel: No error |
| 1 | Digital output channel: Short circuit or overload |

Table 257: Monitoring status - DO8331

13.11 Register: StatusDigitalOutput 1 - 8

| Bit | Description |
|-----|---|
| 0 | 0 ... Channel 1: No error 1 ... Channel 1: Short circuit or overload |
| 1 | 0 ... Channel 2: No error 1 ... Channel 2: Short circuit or overload |
| 2 | 0 ... Channel 3: No error 1 ... Channel 3: Short circuit or overload |
| 3 | 0 ... Channel 4: No error 1 ... Channel 4: Short circuit or overload |
| 4 | 0 ... Channel 5: No error 1 ... Channel 5: Short circuit or overload |
| 5 | 0 ... Channel 6: No error 1 ... Channel 6: Short circuit or overload |
| 6 | 0 ... Channel 7: No error 1 ... Channel 7: Short circuit or overload |
| 7 | 0 ... Channel 8: No error 1 ... Channel 8: Short circuit or overload |

13.12 Register: StatusDigitalOutput01 - StatusDigitalOutput08

| BOOL | Description |
|------|---|
| x | 0 ... Digital output channel: No error 1 ... Digital output channel: Short circuit or overload |

13.13 Operating limit monitoring

The module's output supply is monitored. An I/O supply voltage of <20.4 V is displayed as a warning.

13.14 Register: OperatingLimitStatus

| Bit | Description |
|-------|--|
| 0 - 1 | 0 |
| 2 | 0 ... I/O supply above the warning level of 20.4 V 1 ... I/O supply below the warning level of 20.4 V |
| 3 - 7 | 0 |

13.15 Register: PowerSupply01

| BOOL | Description |
|------|--|
| x | 0 ... I/O supply above the warning level of 20.4 V 1 ... I/O supply below the warning level of 20.4 V |

13.16 Additional function - switch digital outputs w/ delay using switching mask

In function model 1 the digital outputs can be operated with a timer on a 100 µs basis and with your choice of switching mask. After the delay time has expired, the digital outputs are adjusted according to the switching mask and the delayed output pattern.

Procedure:

The delay time is changed or set to 0:

Output status = status is taken from register 2

After delay time has expired:

Output status = (register 2 AND INV(register 6)) OR (register 4 AND register 6)

Register 2 = Register: DigitalOutput 1 - 8 or Register: DigitalOutput01 - DigitalOutput08

Register 4 = Register: DigitalOutputDelayed 1 - 8 or
Register: DigitalOutput01Delayed - DigitalOutput08Delayed

Register 6 = Register: DigitalOutputSwitchingMask 1 - 8 or
Register: DigitalOutput01DelayEnable - DigitalOutput08DelayEnable

13.17 Register: DigitalOutputDelayed 1 - 8

| Bit | Description |
|-----|--|
| 0 | 0 ... Digital output 1 reset 1 ... Digital output 1 set |
| 1 | 0 ... Digital output 2 reset 1 ... Digital output 2 set |
| 2 | 0 ... Digital output 3 reset 1 ... Digital output 3 set |
| 3 | 0 ... Digital output 4 reset 1 ... Digital output 4 set |
| 4 | 0 ... Digital output 5 reset 1 ... Digital output 5 set |
| 5 | 0 ... Digital output 6 reset 1 ... Digital output 6 set |
| 6 | 0 ... Digital output 7 reset 1 ... Digital output 7 set |
| 7 | 0 ... Digital output 8 reset 1 ... Digital output 8 set |

13.18 Register: DigitalOutput01Delayed - DigitalOutput08Delayed

| BOOL | Description |
|------|--|
| x | 0 ... Digital output channel reset 1 ... Digital output channel set |

13.19 Register: DigitalOutputSwitchingMask 1 - 8

| Bit | Description |
|-----|---|
| 0 | 0 ... Digital output 1 remains unchanged 1 ... Digital output 1 is toggled |
| 1 | 0 ... Digital output 2 remains unchanged 1 ... Digital output 2 is toggled |
| 2 | 0 ... Digital output 3 remains unchanged 1 ... Digital output 3 is toggled |
| 3 | 0 ... Digital output 4 remains unchanged 1 ... Digital output 4 is toggled |
| 4 | 0 ... Digital output 5 remains unchanged 1 ... Digital output 5 is toggled |
| 5 | 0 ... Digital output 6 remains unchanged 1 ... Digital output 6 is toggled |
| 6 | 0 ... Digital output 7 remains unchanged 1 ... Digital output 7 is toggled |
| 7 | 0 ... Digital output 8 remains unchanged 1 ... Digital output 8 is toggled |

13.20 Register: DigitalOutput01DelayEnable - DigitalOutput08DelayEnable

| BOOL | Description |
|------|---|
| x | 0 ... Digital output remains unchanged 1 ... Digital output is toggled |

13.21 Register: DelayTime, OutputDelayTime

After the delay time has expired (100 µs base), the digital outputs are adjusted according to the switching mask (register 6) and the delayed output pattern (register 4).

Register 6 = Register: DigitalOutputSwitchingMask 1 - 8 or
Register: DigitalOutput01DelayEnable - DigitalOutput08DelayEnable

Register 4 = Register: DigitalOutputDelayed 1 - 8 or
Register: DigitalOutput01Delayed - DigitalOutput08Delayed

| Value | Delay time |
|-------|-----------------|
| 0 | Delay activated |
| 1 | 0.1 ms |
| 2 | 0.2 ms |
| : | : |
| 250 | 25 ms |

13.22 Function models

A function model describes the registers for the module (memory model) which are available for the application. Only these registers are processed on the module during each cycle and cyclically transferred using the bus. The cycle time can be minimized by selecting the correct function model.

13.22.1 Function model 0: digital outputs (default)

| Function model 0 | | | | | | | |
|------------------|---------------------------|-----------|--------|--------|---------|--------|---------|
| Register | Name | Data type | Length | Read | | Write | |
| | | | | Cyclic | Acyclic | Cyclic | Acyclic |
| 2 | DigitalOutput 1 - 8 | USINT | 1 | | | ● | ● |
| 30 | StatusDigitalOutput 1 - 8 | USINT | 1 | ● | ● | | |
| 8196 | OperatingLimitStatus | USINT | 1 | ● | | | |

Table 258: Function model 0: digital outputs (default) - DO8331

13.22.2 Function model 1: digital outputs with toggle function

| Function model 1 | | | | | | | |
|------------------|----------------------------------|-----------|--------|--------|---------|--------|---------|
| Register | Name | Data type | Length | Read | | Write | |
| | | | | Cyclic | Acyclic | Cyclic | Acyclic |
| 2 | DigitalOutput 1 - 8 | USINT | 1 | | | ● | ● |
| 4 | DigitalOutputDelayed 1 - 8 | USINT | 1 | | | ● | ● |
| 6 | DigitalOutputSwitchingMask 1 - 8 | USINT | 1 | | | ● | ● |
| 8 | DelayTime | USINT | 1 | | | ● | ● |
| 30 | StatusDigitalOutput 1 - 8 | USINT | 1 | ● | ● | | |
| 8196 | OperatingLimitStatus | USINT | 1 | ● | | | |

Table 259: Function model 1: digital outputs with toggle function - DO8331

13.23 Function models - used where?

| Name | Automation Studio | CANopen | DeviceNet | Modbus/TCP | CAN I/O |
|--|-------------------|---------|-----------|------------|---------|
| Function model 0: digital output module (default) | ● | ● | ● | ● | ● |
| Function model 1: digital output module with toggle function | ● | | | ● | |

Table 260: Function models - DO8331

13.24 B&R ID code

Code for module identification (\$22EB).

13.25 Minimum cycle time

The minimum cycle time is the minimum time needed for the bus cycle to be shut down without a communication error occurring. It should be noted that very fast cycles have reduced the idle time needed for handling monitoring, diagnostics and acyclic commands.

| Minimum cycle time | |
|--------------------|------------------------|
| Function model 0 | $\geq 100 \mu\text{s}$ |
| Function model 1 | $\geq 150 \mu\text{s}$ |

Table 261: Minimum cycle time - DO8331

13.25.1 Minimum I/O update time

The minimum I/O update time refers to the minimum time it takes for the bus cycle to shut down, so that in each cycle an I/O update takes place.

| Minimum I/O update time | |
|-------------------------|---------------------------------|
| Function model 0 | Equal to the minimum cycle time |
| Function model 1 | Equal to the minimum cycle time |

Table 262: Minimum I/O update time - DO8331

14. X20DO8332

14.1 Register overview

| Register | Name | Data type | Length | Read | | Write | |
|----------|--|-----------|--------|--------|---------|--------|---------|
| | | | | Cyclic | Acyclic | Cyclic | Acyclic |
| 2 | DigitalOutput 1 - 8 | USINT | 1 | | | ● | ● |
| 4 | DigitalOutputDelayed 1 - 8 ¹⁾ | USINT | 1 | | | ● | ● |
| 6 | DigitalOutputSwitchingMask 1 - 8 ¹⁾ | USINT | 1 | | | ● | ● |
| 8 | DelayTime ¹⁾ | USINT | 1 | | | ● | ● |
| 30 | StatusDigitalOutput 1 - 8 | USINT | 1 | ● | ● | | |
| 8196 | OperatingLimitStatus | USINT | 1 | ● | | | |

Table 263: Register overview - DO8332

1) Only with function model 1

14.2 Variable assignment in Automation Studio (X2X master)

| Name | Data type | Length | Read | | Write | |
|--|-----------|--------|--------|---------|--------|---------|
| | | | Cyclic | Acyclic | Cyclic | Acyclic |
| DigitalOutput01 | BOOL | 1 | | | ● | |
| DigitalOutput02 | BOOL | 1 | | | ● | |
| DigitalOutput03 | BOOL | 1 | | | ● | |
| DigitalOutput04 | BOOL | 1 | | | ● | |
| DigitalOutput05 | BOOL | 1 | | | ● | |
| DigitalOutput06 | BOOL | 1 | | | ● | |
| DigitalOutput07 | BOOL | 1 | | | ● | |
| DigitalOutput08 | BOOL | 1 | | | ● | |
| StatusDigitalOutput01 | BOOL | 1 | ● | | | |
| StatusDigitalOutput02 | BOOL | 1 | ● | | | |
| StatusDigitalOutput03 | BOOL | 1 | ● | | | |
| StatusDigitalOutput04 | BOOL | 1 | ● | | | |
| StatusDigitalOutput05 | BOOL | 1 | ● | | | |
| StatusDigitalOutput06 | BOOL | 1 | ● | | | |
| StatusDigitalOutput07 | BOOL | 1 | ● | | | |
| StatusDigitalOutput08 | BOOL | 1 | ● | | | |
| PowerSupply01 | BOOL | 1 | ● | | | |
| OutputDelayTime ¹⁾ | USINT | 1 | | | ● | |
| DigitalOutput01DelayEnable ¹⁾ | BOOL | 1 | | | ● | |
| DigitalOutput02DelayEnable ¹⁾ | BOOL | 1 | | | ● | |
| DigitalOutput03DelayEnable ¹⁾ | BOOL | 1 | | | ● | |
| DigitalOutput04DelayEnable ¹⁾ | BOOL | 1 | | | ● | |
| DigitalOutput05DelayEnable ¹⁾ | BOOL | 1 | | | ● | |
| DigitalOutput06DelayEnable ¹⁾ | BOOL | 1 | | | ● | |
| DigitalOutput07DelayEnable ¹⁾ | BOOL | 1 | | | ● | |
| DigitalOutput08DelayEnable ¹⁾ | BOOL | 1 | | | ● | |
| DigitalOutput01Delayed ¹⁾ | BOOL | 1 | | | ● | |
| DigitalOutput02Delayed ¹⁾ | BOOL | 1 | | | ● | |
| DigitalOutput03Delayed ¹⁾ | BOOL | 1 | | | ● | |
| DigitalOutput04Delayed ¹⁾ | BOOL | 1 | | | ● | |
| DigitalOutput05Delayed ¹⁾ | BOOL | 1 | | | ● | |
| DigitalOutput06Delayed ¹⁾ | BOOL | 1 | | | ● | |
| DigitalOutput07Delayed ¹⁾ | BOOL | 1 | | | ● | |
| DigitalOutput08Delayed ¹⁾ | BOOL | 1 | | | ● | |

Table 264: Variable assignment in Automation Studio (X2X master) - DO8332

1) Only with function model 1

14.3 Variable assignment in Automation Studio (CANIO)

| Name | Data type | Length | Read | | Write | |
|-----------------------|-----------|--------|--------|---------|--------|---------|
| | | | Cyclic | Acyclic | Cyclic | Acyclic |
| DigitalOutput01 | BOOL | 1 | | | ● | |
| DigitalOutput02 | BOOL | 1 | | | ● | |
| DigitalOutput03 | BOOL | 1 | | | ● | |
| DigitalOutput04 | BOOL | 1 | | | ● | |
| DigitalOutput05 | BOOL | 1 | | | ● | |
| DigitalOutput06 | BOOL | 1 | | | ● | |
| DigitalOutput07 | BOOL | 1 | | | ● | |
| DigitalOutput08 | BOOL | 1 | | | ● | |
| StatusDigitalOutput01 | BOOL | 1 | | ● | | |
| StatusDigitalOutput02 | BOOL | 1 | | ● | | |
| StatusDigitalOutput03 | BOOL | 1 | | ● | | |
| StatusDigitalOutput04 | BOOL | 1 | | ● | | |
| StatusDigitalOutput05 | BOOL | 1 | | ● | | |
| StatusDigitalOutput06 | BOOL | 1 | | ● | | |
| StatusDigitalOutput07 | BOOL | 1 | | ● | | |
| StatusDigitalOutput08 | BOOL | 1 | | ● | | |
| PowerSupply01 | BOOL | 1 | | ● | | |

Table 265: Variable assignment in Automation Studio (CANIO) - DO8332

14.4 CANopen data points

| Register | Name | Data type | Length | Read | | Write | |
|----------|---------------------------|-----------|--------|------|-----|-------|-----|
| | | | | PDO | SDO | PDO | SDO |
| 2 | DigitalOutput 1 - 8 | USINT | 1 | | | ● | ● |
| 30 | StatusDigitalOutput 1 - 8 | USINT | 1 | | ● | | |

Table 266: CANopen data points - DO8332

14.5 DeviceNet data points

| Register | Name | Data type | Length | Read | | Write | |
|----------|---------------------------|-----------|--------|--------|---------|--------|---------|
| | | | | Cyclic | Acyclic | Cyclic | Acyclic |
| 2 | DigitalOutput 1 - 8 | USINT | 1 | | | ● | ● |
| 30 | StatusDigitalOutput 1 - 8 | USINT | 1 | ● | ● | | |

Table 267: DeviceNet data points - DO8332

14.6 Modbus/TCP data points

| Register | Name | Data type | Length | Read | | Write | |
|----------|---------------------------|-----------|--------|--------|---------|--------|---------|
| | | | | Cyclic | Acyclic | Cyclic | Acyclic |
| 2 | DigitalOutput 1 - 8 | USINT | 1 | | | ● | ● |
| 30 | StatusDigitalOutput 1 - 8 | USINT | 1 | | ● | | |

Table 268: Modbus/TCP data points - DO8331

14.7 Digital outputs

The output status is transferred to the output channels using a fixed offset to the network cycle.

14.8 Register: DigitalOutput 1 - 8

| Bit | Description |
|-----|--|
| 0 | 0 ... Digital output 1 reset 1 ... Digital output 1 set |
| 1 | 0 ... Digital output 2 reset 1 ... Digital output 2 set |
| 2 | 0 ... Digital output 3 reset 1 ... Digital output 3 set |
| 3 | 0 ... Digital output 4 reset 1 ... Digital output 4 set |
| 4 | 0 ... Digital output 5 reset 1 ... Digital output 5 set |
| 5 | 0 ... Digital output 6 reset 1 ... Digital output 6 set |
| 6 | 0 ... Digital output 7 reset 1 ... Digital output 7 set |
| 7 | 0 ... Digital output 8 reset 1 ... Digital output 8 set |

14.9 Register: DigitalOutput01 - DigitalOutput08

| BOOL | Description |
|------|--|
| x | 0 ... Digital output channel reset 1 ... Digital output channel set |

14.10 Output monitoring status

The output states for the outputs are compared to the set values on the module. The control for the output driver is used for the set states.

A change in the output status resets the monitoring for this output. The status of each individual channel can be read. A change in monitoring status triggers an error message.

| Monitoring status | Description |
|-------------------|---|
| 0 | Digital output channel: No error |
| 1 | Digital output channel: Short circuit or overload |

Table 269: Monitoring status - DO8332

14.11 Register: StatusDigitalOutput 1 - 8

| Bit | Description |
|-----|---|
| 0 | 0 ... Channel 1: No error 1 ... Channel 1: Short circuit or overload |
| 1 | 0 ... Channel 2: No error 1 ... Channel 2: Short circuit or overload |
| 2 | 0 ... Channel 3: No error 1 ... Channel 3: Short circuit or overload |
| 3 | 0 ... Channel 4: No error 1 ... Channel 4: Short circuit or overload |
| 4 | 0 ... Channel 5: No error 1 ... Channel 5: Short circuit or overload |
| 5 | 0 ... Channel 6: No error 1 ... Channel 6: Short circuit or overload |
| 6 | 0 ... Channel 7: No error 1 ... Channel 7: Short circuit or overload |
| 7 | 0 ... Channel 8: No error 1 ... Channel 8: Short circuit or overload |

14.12 Register: StatusDigitalOutput01 - StatusDigitalOutput08

| BOOL | Description |
|------|---|
| x | 0 ... Digital output channel: No error 1 ... Digital output channel: Short circuit or overload |

14.13 Operating limit monitoring

The module's output supply is monitored. An I/O supply voltage of <20.4 V is displayed as a warning.

14.14 Register: OperatingLimitStatus

| Bit | Description |
|-------|--|
| 0 - 1 | 0 |
| 2 | 0 ... I/O supply above the warning level of 20.4 V 1 ... I/O supply below the warning level of 20.4 V |
| 3 - 7 | 0 |

14.15 Register: PowerSupply01

| BOOL | Description |
|------|--|
| x | 0 ... I/O supply above the warning level of 20.4 V 1 ... I/O supply below the warning level of 20.4 V |

14.16 Additional function - switch digital outputs with delay using switching mask

In function model 1 the digital outputs can be operated with a timer on a 100 µs basis and with your choice of switching mask. After the delay time has expired, the digital outputs are adjusted according to the switching mask and the delayed output pattern.

Procedure:

The delay time is changed or set to 0:

Output status = status is taken from register 2

After delay time has expired:

Output status = (register 2 AND INV(register 6)) OR (register 4 AND register 6)

Register 2 = Register: DigitalOutput 1 - 8 or
Register: DigitalOutput01 - DigitalOutput08

Register 4 = Register: DigitalOutputDelayed 1 - 8 or
Register: DigitalOutput01Delayed - DigitalOutput08Delayed

Register 6 = Register: DigitalOutputSwitchingMask 1 - 8 or
Register: DigitalOutput01DelayEnable - DigitalOutput08DelayEnable

14.17 Register: DigitalOutputDelayed 1 - 8

| Bit | Description |
|-----|--|
| 0 | 0 ... Digital output 1 reset 1 ... Digital output 1 set |
| 1 | 0 ... Digital output 2 reset 1 ... Digital output 2 set |
| 2 | 0 ... Digital output 3 reset 1 ... Digital output 3 set |
| 3 | 0 ... Digital output 4 reset 1 ... Digital output 4 set |
| 4 | 0 ... Digital output 5 reset 1 ... Digital output 5 set |
| 5 | 0 ... Digital output 6 reset 1 ... Digital output 6 set |
| 6 | 0 ... Digital output 7 reset 1 ... Digital output 7 set |
| 7 | 0 ... Digital output 8 reset 1 ... Digital output 8 set |

14.18 Register: DigitalOutput01Delayed - DigitalOutput08Delayed

| BOOL | Description |
|------|--|
| x | 0 ... Digital output channel reset 1 ... Digital output channel set |

14.19 Register: DigitalOutputSwitchingMask 1 - 8

| Bit | Description |
|-----|---|
| 0 | 0 ... Digital output 1 remains unchanged 1 ... Digital output 1 is toggled |
| 1 | 0 ... Digital output 2 remains unchanged 1 ... Digital output 2 is toggled |
| 2 | 0 ... Digital output 3 remains unchanged 1 ... Digital output 3 is toggled |
| 3 | 0 ... Digital output 4 remains unchanged 1 ... Digital output 4 is toggled |
| 4 | 0 ... Digital output 5 remains unchanged 1 ... Digital output 5 is toggled |
| 5 | 0 ... Digital output 6 remains unchanged 1 ... Digital output 6 is toggled |
| 6 | 0 ... Digital output 7 remains unchanged 1 ... Digital output 7 is toggled |
| 7 | 0 ... Digital output 8 remains unchanged 1 ... Digital output 8 is toggled |

14.20 Register: DigitalOutput01DelayEnable - DigitalOutput08DelayEnable

| BOOL | Description |
|------|---|
| x | 0 ... Digital output remains unchanged 1 ... Digital output is toggled |

14.21 Register: DelayTime, OutputDelayTime

After the delay time has expired (100 µs base), the digital outputs are adjusted according to the switching mask (register 6) and the delayed output pattern (register 4).

Register 6 = Register: DigitalOutputSwitchingMask 1 - 8 or
Register: DigitalOutput01DelayEnable - DigitalOutput08DelayEnable

Register 4 = Register: DigitalOutputDelayed 1 - 8 or
Register: DigitalOutput01Delayed - DigitalOutput08Delayed

| Value | Delay time |
|-------|-----------------|
| 0 | Delay activated |
| 1 | 0.1 ms |
| 2 | 0.2 ms |
| : | : |
| 250 | 25 ms |

14.22 Function models

A function model describes the registers for the module (memory model) which are available for the application. Only these registers are processed on the module during each cycle and cyclically transferred using the bus. The cycle time can be minimized by selecting the correct function model.

14.22.1 Function model 0: digital outputs (default)

| Function model 0 | | | | | | | |
|------------------|---------------------------|-----------|--------|--------|---------|--------|---------|
| Register | Name | Data type | Length | Read | | Write | |
| | | | | Cyclic | Acyclic | Cyclic | Acyclic |
| 2 | DigitalOutput 1 - 8 | USINT | 1 | | | ● | ● |
| 30 | StatusDigitalOutput 1 - 8 | USINT | 1 | ● | ● | | |
| 8196 | OperatingLimitStatus | USINT | 1 | ● | | | |

Table 270: Function model 0: digital outputs (default) - DO8332

14.22.2 Function model 1: digital outputs with toggle function

| Function model 1 | | | | | | | |
|------------------|----------------------------------|-----------|--------|--------|---------|--------|---------|
| Register | Name | Data type | Length | Read | | Write | |
| | | | | Cyclic | Acyclic | Cyclic | Acyclic |
| 2 | DigitalOutput 1 - 8 | USINT | 1 | | | ● | ● |
| 4 | DigitalOutputDelayed 1 - 8 | USINT | 1 | | | ● | ● |
| 6 | DigitalOutputSwitchingMask 1 - 8 | USINT | 1 | | | ● | ● |
| 8 | DelayTime | USINT | 1 | | | ● | ● |
| 30 | StatusDigitalOutput 1 - 8 | USINT | 1 | ● | ● | | |
| 8196 | OperatingLimitStatus | USINT | 1 | ● | | | |

Table 271: Function model 1: digital outputs with toggle function - DO8332

14.23 Function models - used where?

| Name | Automation Studio | CANopen | DeviceNet | Modbus/TCP | CAN I/O |
|--|-------------------|---------|-----------|------------|---------|
| Function model 0: digital output module (default) | ● | ● | ● | ● | ● |
| Function model 1: digital output module with toggle function | ● | | | ● | |

Table 272: Function models - DO8332

14.24 B&R ID code

Code for module identification (\$1B9D).

14.25 Minimum cycle time

The minimum cycle time is the minimum time needed for the bus cycle to be shut down without a communication error occurring. It should be noted that very fast cycles have reduced the idle time needed for handling monitoring, diagnostics and acyclic commands.

| Minimum cycle time | |
|--------------------|------------------------|
| Function model 0 | $\geq 100 \mu\text{s}$ |
| Function model 1 | $\geq 150 \mu\text{s}$ |

Table 273: Minimum cycle time - DO8332

14.26 Minimum I/O update time

The minimum I/O update time refers to the minimum time it takes for the bus cycle to shut down, so that in each cycle an I/O update takes place.

| Minimum I/O update time | |
|-------------------------|---------------------------------|
| Function model 0 | Equal to the minimum cycle time |
| Function model 1 | Equal to the minimum cycle time |

Table 274: Minimum I/O update time - DO8332

15. X20DO9321

15.1 Register overview

| Register | Name | Data type | Length | Read | | Write | |
|----------|----------------------------|-----------|--------|--------|---------|--------|---------|
| | | | | Cyclic | Acyclic | Cyclic | Acyclic |
| 2 | DigitalOutput 1 - 8 | USINT | 1 | | | ● | ● |
| 3 | DigitalOutput 9 - 12 | USINT | 1 | | | ● | ● |
| 30 | StatusDigitalOutput 1 - 8 | USINT | 1 | ● | ● | | |
| 31 | StatusDigitalOutput 9 - 12 | USINT | 1 | ● | ● | | |

Table 275: Register overview - DO9321

15.2 Variable assignment in Automation Studio (X2X master)

| Name | Data type | Length | Read | | Write | |
|-----------------------|-----------|--------|--------|---------|--------|---------|
| | | | Cyclic | Acyclic | Cyclic | Acyclic |
| DigitalOutput01 | BOOL | 1 | | | ● | |
| DigitalOutput02 | BOOL | 1 | | | ● | |
| DigitalOutput03 | BOOL | 1 | | | ● | |
| DigitalOutput04 | BOOL | 1 | | | ● | |
| DigitalOutput05 | BOOL | 1 | | | ● | |
| DigitalOutput06 | BOOL | 1 | | | ● | |
| DigitalOutput07 | BOOL | 1 | | | ● | |
| DigitalOutput08 | BOOL | 1 | | | ● | |
| DigitalOutput09 | BOOL | 1 | | | ● | |
| DigitalOutput10 | BOOL | 1 | | | ● | |
| DigitalOutput11 | BOOL | 1 | | | ● | |
| DigitalOutput12 | BOOL | 1 | | | ● | |
| StatusDigitalOutput01 | BOOL | 1 | ● | | | |
| StatusDigitalOutput02 | BOOL | 1 | ● | | | |
| StatusDigitalOutput03 | BOOL | 1 | ● | | | |
| StatusDigitalOutput04 | BOOL | 1 | ● | | | |
| StatusDigitalOutput05 | BOOL | 1 | ● | | | |
| StatusDigitalOutput06 | BOOL | 1 | ● | | | |
| StatusDigitalOutput07 | BOOL | 1 | ● | | | |
| StatusDigitalOutput08 | BOOL | 1 | ● | | | |
| StatusDigitalOutput09 | BOOL | 1 | ● | | | |
| StatusDigitalOutput10 | BOOL | 1 | ● | | | |
| StatusDigitalOutput11 | BOOL | 1 | ● | | | |
| StatusDigitalOutput12 | BOOL | 1 | ● | | | |

Table 276: Variable assignment in Automation Studio (X2X master) - DO9321

15.3 Variable assignment in Automation Studio (CANIO)

| Name | Data type | Length | Read | | Write | |
|-----------------------|-----------|--------|--------|---------|--------|---------|
| | | | Cyclic | Acyclic | Cyclic | Acyclic |
| DigitalOutput01 | BOOL | 1 | | | ● | |
| DigitalOutput02 | BOOL | 1 | | | ● | |
| DigitalOutput03 | BOOL | 1 | | | ● | |
| DigitalOutput04 | BOOL | 1 | | | ● | |
| DigitalOutput05 | BOOL | 1 | | | ● | |
| DigitalOutput06 | BOOL | 1 | | | ● | |
| DigitalOutput07 | BOOL | 1 | | | ● | |
| DigitalOutput08 | BOOL | 1 | | | ● | |
| DigitalOutput09 | BOOL | 1 | | | ● | |
| DigitalOutput10 | BOOL | 1 | | | ● | |
| DigitalOutput11 | BOOL | 1 | | | ● | |
| DigitalOutput12 | BOOL | 1 | | | ● | |
| StatusDigitalOutput01 | BOOL | 1 | | ● | | |
| StatusDigitalOutput02 | BOOL | 1 | | ● | | |
| StatusDigitalOutput03 | BOOL | 1 | | ● | | |
| StatusDigitalOutput04 | BOOL | 1 | | ● | | |
| StatusDigitalOutput05 | BOOL | 1 | | ● | | |
| StatusDigitalOutput06 | BOOL | 1 | | ● | | |
| StatusDigitalOutput07 | BOOL | 1 | | ● | | |
| StatusDigitalOutput08 | BOOL | 1 | | ● | | |
| StatusDigitalOutput09 | BOOL | 1 | | ● | | |
| StatusDigitalOutput10 | BOOL | 1 | | ● | | |
| StatusDigitalOutput11 | BOOL | 1 | | ● | | |
| StatusDigitalOutput12 | BOOL | 1 | | ● | | |

Table 277: Variable assignment in Automation Studio (CANIO) - DO9321

15.4 CANopen data points

| Register | Name | Data type | Length | Read | | Write | |
|----------|----------------------------|-----------|--------|------|-----|-------|-----|
| | | | | PDO | SDO | PDO | SDO |
| 2 | DigitalOutput 1 - 8 | USINT | 1 | | | ● | ● |
| 3 | DigitalOutput 9 - 12 | USINT | 1 | | | ● | ● |
| 30 | StatusDigitalOutput 1 - 8 | USINT | 1 | | ● | | |
| 31 | StatusDigitalOutput 9 - 12 | USINT | 1 | | ● | | |

Table 278: CANopen data points - DO9321

15.5 DeviceNet data points

| Register | Name | Data type | Length | Read | | Write | |
|----------|----------------------------|-----------|--------|--------|---------|--------|---------|
| | | | | Cyclic | Acyclic | Cyclic | Acyclic |
| 2 | DigitalOutput 1 - 8 | USINT | 1 | | | ● | ● |
| 3 | DigitalOutput 9 - 12 | USINT | 1 | | | ● | ● |
| 30 | StatusDigitalOutput 1 - 8 | USINT | 1 | ● | ● | | |
| 31 | StatusDigitalOutput 9 - 12 | USINT | 1 | ● | ● | | |

Table 279: DeviceNet data points - DO9321

15.6 Modbus/TCP data points

| Register | Name | Data type | Length | Read | | Write | |
|----------|----------------------------|-----------|--------|--------|---------|--------|---------|
| | | | | Cyclic | Acyclic | Cyclic | Acyclic |
| 2 | DigitalOutput 1 - 8 | USINT | 1 | | | ● | ● |
| 3 | DigitalOutput 9 - 12 | USINT | 1 | | | ● | ● |
| 30 | StatusDigitalOutput 1 - 8 | USINT | 1 | | ● | | |
| 31 | StatusDigitalOutput 9 - 12 | USINT | 1 | | ● | | |

Table 280: Modbus/TCP data points - DO9321

15.7 Digital outputs

The output status is transferred to the output channels using a fixed offset to the network cycle.

15.8 Register: DigitalOutput 1 - 8

| Bit | Description |
|-----|--|
| 0 | 0 ... Digital output 1 reset 1 ... Digital output 1 set |
| 1 | 0 ... Digital output 2 reset 1 ... Digital output 2 set |
| 2 | 0 ... Digital output 3 reset 1 ... Digital output 3 set |
| 3 | 0 ... Digital output 4 reset 1 ... Digital output 4 set |
| 4 | 0 ... Digital output 5 reset 1 ... Digital output 5 set |
| 5 | 0 ... Digital output 6 reset 1 ... Digital output 6 set |
| 6 | 0 ... Digital output 7 reset 1 ... Digital output 7 set |
| 7 | 0 ... Digital output 8 reset 1 ... Digital output 8 set |

15.9 Register: DigitalOutput 9 - 12

| Bit | Description |
|-----|--|
| 0 | 0 ... Digital output 9 reset 1 ... Digital output 9 set |
| 1 | 0 ... Digital output 10 reset 1 ... Digital output 10 set |
| 2 | 0 ... Digital output 11 reset 1 ... Digital output 11 set |
| 3 | 0 ... Digital output 12 reset 1 ... Digital output 12 set |

15.10 Register: DigitalOutput01 - DigitalOutput12

| BOOL | Description |
|------|--|
| x | 0 ... Digital output channel reset 1 ... Digital output channel set |

15.11 Output monitoring status

The output states for the outputs are compared to the set values on the module. The control for the output driver is used for the set states.

A change in the output status resets the monitoring for this output. The status of each individual channel can be read. A change in monitoring status triggers an error message.

| Monitoring status | Description |
|-------------------|---|
| 0 | Digital output channel: No error |
| 1 | Digital output channel: Short circuit or overload |

Table 281: Monitoring status - DO9321

15.12 Register: StatusDigitalOutput 1 - 8

| Bit | Description |
|-----|---|
| 0 | 0 ... Channel 1: No error 1 ... Channel 1: Short circuit or overload |
| 1 | 0 ... Channel 2: No error 1 ... Channel 2: Short circuit or overload |
| 2 | 0 ... Channel 3: No error 1 ... Channel 3: Short circuit or overload |
| 3 | 0 ... Channel 4: No error 1 ... Channel 4: Short circuit or overload |
| 4 | 0 ... Channel 5: No error 1 ... Channel 5: Short circuit or overload |
| 5 | 0 ... Channel 6: No error 1 ... Channel 6: Short circuit or overload |
| 6 | 0 ... Channel 7: No error 1 ... Channel 7: Short circuit or overload |
| 7 | 0 ... Channel 8: No error 1 ... Channel 8: Short circuit or overload |

15.13 Register: StatusDigitalOutput 9 - 12

| Bit | Description |
|-----|---|
| 0 | 0 ... Channel 9: No error 1 ... Channel 9: Short circuit or overload |
| 1 | 0 ... Channel 10: No error 1 ... Channel 10: Short circuit or overload |
| 2 | 0 ... Channel 11: No error 1 ... Channel 11: Short circuit or overload |
| 3 | 0 ... Channel 12: No error 1 ... Channel 12: Short circuit or overload |

15.14 Register: StatusDigitalOutput01 - StatusDigitalOutput12

| BOOL | Description |
|------|---|
| x | 0 ... Digital output channel: No error 1 ... Digital output channel: Short circuit or overload |

15.15 B&R ID code

Code for module identification (\$1B9B).

15.16 Minimum cycle time

The minimum cycle time is the minimum time needed for the bus cycle to be shut down without a communication error occurring. It should be noted that very fast cycles have reduced the idle time needed for handling monitoring, diagnostics and acyclic commands.

| Minimum cycle time |
|------------------------|
| $\geq 100 \mu\text{s}$ |

Table 282: Minimum cycle time - DO9321

15.17 Minimum I/O update time

The minimum I/O update time refers to the minimum time it takes for the bus cycle to shut down, so that in each cycle an I/O update takes place.

| Minimum I/O update time |
|---------------------------------|
| Equal to the minimum cycle time |

Table 283: Minimum I/O update time - DO9321

16. X2ODO9322

16.1 Register overview

| Register | Name | Data type | Length | Read | | Write | |
|----------|----------------------------|-----------|--------|--------|---------|--------|---------|
| | | | | Cyclic | Acyclic | Cyclic | Acyclic |
| 2 | DigitalOutput 1 - 8 | USINT | 1 | | | ● | ● |
| 3 | DigitalOutput 9 - 12 | USINT | 1 | | | ● | ● |
| 30 | StatusDigitalOutput 1 - 8 | USINT | 1 | ● | ● | | |
| 31 | StatusDigitalOutput 9 - 12 | USINT | 1 | ● | ● | | |

Table 284: Register overview - DO9322

16.2 Variable assignment in Automation Studio (X2X master)

| Name | Data type | Length | Read | | Write | |
|-----------------------|-----------|--------|--------|---------|--------|---------|
| | | | Cyclic | Acyclic | Cyclic | Acyclic |
| DigitalOutput01 | BOOL | 1 | | | ● | |
| DigitalOutput02 | BOOL | 1 | | | ● | |
| DigitalOutput03 | BOOL | 1 | | | ● | |
| DigitalOutput04 | BOOL | 1 | | | ● | |
| DigitalOutput05 | BOOL | 1 | | | ● | |
| DigitalOutput06 | BOOL | 1 | | | ● | |
| DigitalOutput07 | BOOL | 1 | | | ● | |
| DigitalOutput08 | BOOL | 1 | | | ● | |
| DigitalOutput09 | BOOL | 1 | | | ● | |
| DigitalOutput10 | BOOL | 1 | | | ● | |
| DigitalOutput11 | BOOL | 1 | | | ● | |
| DigitalOutput12 | BOOL | 1 | | | ● | |
| StatusDigitalOutput01 | BOOL | 1 | ● | | | |
| StatusDigitalOutput02 | BOOL | 1 | ● | | | |
| StatusDigitalOutput03 | BOOL | 1 | ● | | | |
| StatusDigitalOutput04 | BOOL | 1 | ● | | | |
| StatusDigitalOutput05 | BOOL | 1 | ● | | | |
| StatusDigitalOutput06 | BOOL | 1 | ● | | | |
| StatusDigitalOutput07 | BOOL | 1 | ● | | | |
| StatusDigitalOutput08 | BOOL | 1 | ● | | | |
| StatusDigitalOutput09 | BOOL | 1 | ● | | | |
| StatusDigitalOutput10 | BOOL | 1 | ● | | | |
| StatusDigitalOutput11 | BOOL | 1 | ● | | | |
| StatusDigitalOutput12 | BOOL | 1 | ● | | | |

Table 285: Variable assignment in Automation Studio (X2X master) - DO9322

16.3 Variable assignment in Automation Studio (CANIO)

| Name | Data type | Length | Read | | Write | |
|-----------------------|-----------|--------|--------|---------|--------|---------|
| | | | Cyclic | Acyclic | Cyclic | Acyclic |
| DigitalOutput01 | BOOL | 1 | | | ● | |
| DigitalOutput02 | BOOL | 1 | | | ● | |
| DigitalOutput03 | BOOL | 1 | | | ● | |
| DigitalOutput04 | BOOL | 1 | | | ● | |
| DigitalOutput05 | BOOL | 1 | | | ● | |
| DigitalOutput06 | BOOL | 1 | | | ● | |
| DigitalOutput07 | BOOL | 1 | | | ● | |
| DigitalOutput08 | BOOL | 1 | | | ● | |
| DigitalOutput09 | BOOL | 1 | | | ● | |
| DigitalOutput10 | BOOL | 1 | | | ● | |
| DigitalOutput11 | BOOL | 1 | | | ● | |
| DigitalOutput12 | BOOL | 1 | | | ● | |
| StatusDigitalOutput01 | BOOL | 1 | | ● | | |
| StatusDigitalOutput02 | BOOL | 1 | | ● | | |
| StatusDigitalOutput03 | BOOL | 1 | | ● | | |
| StatusDigitalOutput04 | BOOL | 1 | | ● | | |
| StatusDigitalOutput05 | BOOL | 1 | | ● | | |
| StatusDigitalOutput06 | BOOL | 1 | | ● | | |
| StatusDigitalOutput07 | BOOL | 1 | | ● | | |
| StatusDigitalOutput08 | BOOL | 1 | | ● | | |
| StatusDigitalOutput09 | BOOL | 1 | | ● | | |
| StatusDigitalOutput10 | BOOL | 1 | | ● | | |
| StatusDigitalOutput11 | BOOL | 1 | | ● | | |
| StatusDigitalOutput12 | BOOL | 1 | | ● | | |

Table 286: Variable assignment in Automation Studio (CANIO) - DO9322

16.4 CANopen data points

| Register | Name | Data type | Length | Read | | Write | |
|----------|----------------------------|-----------|--------|------|-----|-------|-----|
| | | | | PDO | SDO | PDO | SDO |
| 2 | DigitalOutput 1 - 8 | USINT | 1 | | | ● | ● |
| 3 | DigitalOutput 9 - 12 | USINT | 1 | | | ● | ● |
| 30 | StatusDigitalOutput 1 - 8 | USINT | 1 | | ● | | |
| 31 | StatusDigitalOutput 9 - 12 | USINT | 1 | | ● | | |

Table 287: CANopen data points - DO9322

16.5 DeviceNet data points

| Register | Name | Data type | Length | Read | | Write | |
|----------|----------------------------|-----------|--------|--------|---------|--------|---------|
| | | | | Cyclic | Acyclic | Cyclic | Acyclic |
| 2 | DigitalOutput 1 - 8 | USINT | 1 | | | ● | ● |
| 3 | DigitalOutput 9 - 12 | USINT | 1 | | | ● | ● |
| 30 | StatusDigitalOutput 1 - 8 | USINT | 1 | ● | ● | | |
| 31 | StatusDigitalOutput 9 - 12 | USINT | 1 | ● | ● | | |

Table 288: DeviceNet data points - DO9322

16.6 Modbus/TCP data points

| Register | Name | Data type | Length | Read | | Write | |
|----------|----------------------------|-----------|--------|--------|---------|--------|---------|
| | | | | Cyclic | Acyclic | Cyclic | Acyclic |
| 2 | DigitalOutput 1 - 8 | USINT | 1 | | | ● | ● |
| 3 | DigitalOutput 9 - 12 | USINT | 1 | | | ● | ● |
| 30 | StatusDigitalOutput 1 - 8 | USINT | 1 | | ● | | |
| 31 | StatusDigitalOutput 9 - 12 | USINT | 1 | | ● | | |

Table 289: Modbus/TCP data points - DO9322

16.7 Digital outputs

The output status is transferred to the output channels using a fixed offset to the network cycle.

16.8 Register: DigitalOutput 1 - 8

| Bit | Description |
|-----|--|
| 0 | 0 ... Digital output 1 reset 1 ... Digital output 1 set |
| 1 | 0 ... Digital output 2 reset 1 ... Digital output 2 set |
| 2 | 0 ... Digital output 3 reset 1 ... Digital output 3 set |
| 3 | 0 ... Digital output 4 reset 1 ... Digital output 4 set |
| 4 | 0 ... Digital output 5 reset 1 ... Digital output 5 set |
| 5 | 0 ... Digital output 6 reset 1 ... Digital output 6 set |
| 6 | 0 ... Digital output 7 reset 1 ... Digital output 7 set |
| 7 | 0 ... Digital output 8 reset 1 ... Digital output 8 set |

16.9 Register: DigitalOutput 9 - 12

| Bit | Description |
|-----|--|
| 0 | 0 ... Digital output 9 reset 1 ... Digital output 9 set |
| 1 | 0 ... Digital output 10 reset 1 ... Digital output 10 set |
| 2 | 0 ... Digital output 11 reset 1 ... Digital output 11 set |
| 3 | 0 ... Digital output 12 reset 1 ... Digital output 12 set |

16.10 Register: DigitalOutput01 - DigitalOutput12

| BOOL | Description |
|------|--|
| x | 0 ... Digital output channel reset 1 ... Digital output channel set |

16.11 Output monitoring status

The output states for the outputs are compared to the set values on the module. The control for the output driver is used for the set states.

A change in the output status resets the monitoring for this output. The status of each individual channel can be read. A change in monitoring status triggers an error message.

| Monitoring status | Description |
|-------------------|---|
| 0 | Digital output channel: No error |
| 1 | Digital output channel: Short circuit or overload |

Table 290: Monitoring status - DO9322

16.12 Register: StatusDigitalOutput 1 - 8

| Bit | Description |
|-----|---|
| 0 | 0 ... Channel 1: No error 1 ... Channel 1: Short circuit or overload |
| 1 | 0 ... Channel 2: No error 1 ... Channel 2: Short circuit or overload |
| 2 | 0 ... Channel 3: No error 1 ... Channel 3: Short circuit or overload |
| 3 | 0 ... Channel 4: No error 1 ... Channel 4: Short circuit or overload |
| 4 | 0 ... Channel 5: No error 1 ... Channel 5: Short circuit or overload |
| 5 | 0 ... Channel 6: No error 1 ... Channel 6: Short circuit or overload |
| 6 | 0 ... Channel 7: No error 1 ... Channel 7: Short circuit or overload |
| 7 | 0 ... Channel 8: No error 1 ... Channel 8: Short circuit or overload |

16.13 Register: StatusDigitalOutput 9 - 12

| Bit | Description |
|-----|---|
| 0 | 0 ... Channel 9: No error 1 ... Channel 9: Short circuit or overload |
| 1 | 0 ... Channel 10: No error 1 ... Channel 10: Short circuit or overload |
| 2 | 0 ... Channel 11: No error 1 ... Channel 11: Short circuit or overload |
| 3 | 0 ... Channel 12: No error 1 ... Channel 12: Short circuit or overload |

16.14 Register: StatusDigitalOutput01 - StatusDigitalOutput12

| BOOL | Description |
|------|---|
| x | 0 ... Digital output channel: No error 1 ... Digital output channel: Short circuit or overload |

16.15 B&R ID code

Code for module identification (\$1B9A).

16.16 Minimum cycle time

The minimum cycle time is the minimum time needed for the bus cycle to be shut down without a communication error occurring. It should be noted that very fast cycles have reduced the idle time needed for handling monitoring, diagnostics and acyclic commands.

| Minimum cycle time |
|------------------------|
| $\geq 100 \mu\text{s}$ |

Table 291: Minimum cycle time - DO9322

16.17 Minimum I/O update time

The minimum I/O update time refers to the minimum time it takes for the bus cycle to shut down, so that in each cycle an I/O update takes place.

| Minimum I/O update time |
|---------------------------------|
| Equal to the minimum cycle time |

Table 292: Minimum I/O update time - DO9322

Chapter 7 • Analog input modules

1. Overview

| Analog input modules | Description |
|----------------------|--|
| X20AI2622 | X20 analog input module, 2 inputs, $\pm 10\text{ V} / 0$ to 20 mA, 12-bit resolution, configurable input filters |
| X20AI4622 | X20 analog input module, 4 inputs, $\pm 10\text{ V} / 0$ to 20 mA, 12-bit resolution, configurable input filters |

Table 293: Overview of analog input modules

2. X20AI2622

2.1 Register overview

| Register | Name | Data type | Length | Read | | Write | |
|----------|---------------|-----------|--------|--------|---------|--------|---------|
| | | | | Cyclic | Acyclic | Cyclic | Acyclic |
| 0 | AnalogInput01 | INT | 2 | ● | ● | | |
| 2 | AnalogInput02 | INT | 2 | ● | ● | | |
| 16 | InputFilter | USINT | 1 | | ● | ● | ● |
| 18 | ChannelType | USINT | 1 | | ● | ● | ● |
| 30 | StatusInput01 | USINT | 1 | ● | ● | | |

Table 294: Register overview - AI2622

2.2 Variable assignment in Automation Studio (X2X master)

| Name | Data type | Length | Read | | Write | |
|---------------|-----------|--------|--------|---------|--------|---------|
| | | | Cyclic | Acyclic | Cyclic | Acyclic |
| AnalogInput01 | INT | 2 | ● | | | |
| AnalogInput02 | INT | 2 | ● | | | |
| StatusInput01 | USINT | 1 | ● | | | |

Table 295: Variable assignment in Automation Studio (X2X master) - AI2622

2.3 Variable assignment in Automation Studio (CANIO)

| Name | Data type | Length | Read | | Write | |
|---------------|-----------|--------|--------|---------|--------|---------|
| | | | Cyclic | Acyclic | Cyclic | Acyclic |
| AnalogInput01 | INT | 2 | ● | | | |
| AnalogInput02 | INT | 2 | ● | | | |
| StatusInput01 | USINT | 1 | | ● | | |

Table 296: Variable assignment in Automation Studio (CANIO) - AI2622

2.4 CANopen data points

| Register | Name | Data type | Length | Read | | Write | |
|----------|---------------|-----------|--------|------|-----|-------|-----|
| | | | | PDO | SDO | PDO | SDO |
| 0 | AnalogInput01 | INT | 2 | ● | ● | | |
| 2 | AnalogInput02 | INT | 2 | ● | ● | | |
| 16 | InputFilter | USINT | 1 | | ● | | ● |
| 18 | ChannelType | USINT | 1 | | ● | | ● |
| 30 | StatusInput01 | USINT | 1 | | ● | | |

Table 297: CANopen data points - AI2622

2.5 DeviceNet data points

| Register | Name | Data type | Length | Read | | Write | |
|----------|---------------|-----------|--------|--------|---------|--------|---------|
| | | | | Cyclic | Acyclic | Cyclic | Acyclic |
| 0 | AnalogInput01 | INT | 2 | ● | ● | | |
| 2 | AnalogInput02 | INT | 2 | ● | ● | | |
| 16 | InputFilter | USINT | 1 | | ● | | ● |
| 18 | ChannelType | USINT | 1 | | ● | | ● |
| 30 | StatusInput01 | USINT | 1 | ● | ● | | |

Table 298: DeviceNet data points - AI2622

2.6 Modbus/TCP data points

| Register | Name | Data type | Length | Read | | Write | |
|----------|---------------|-----------|--------|--------|---------|--------|---------|
| | | | | Cyclic | Acyclic | Cyclic | Acyclic |
| 0 | AnalogInput01 | INT | 2 | ● | ● | | |
| 2 | AnalogInput02 | INT | 2 | ● | ● | | |
| 16 | InputFilter | USINT | 1 | | ● | | ● |
| 18 | ChannelType | USINT | 1 | | ● | | ● |
| 30 | StatusInput01 | USINT | 1 | ● | ● | | |

Table 299: Modbus/TCP data points - AI2622

2.7 Analog inputs

The input status is registered with a fixed offset with respect to the network cycle and is transferred in the same cycle.

2.8 Register: AnalogInput01 - AnalogInput02

Analog input value with respect to operating mode:

| Input signal | Digital value |
|-----------------------------------|------------------|
| Voltage signal -10 VDC to +10 VDC | -32768 to +32767 |
| Current signal 0 mA to 20 mA | 0 to +32767 |

2.9 Input filter

The module is equipped with a configurable input filter. The minimum cycle time must be >500 µs. Filtering is deactivated for shorter cycle times.

If the input filter is active, then the channels are scanned in ms cycles. The time offset between the channels is 200 µs. The conversion takes place asynchronously to the network cycle.

2.9.1 Input ramp limitation

Input ramp limitation can only take place when a filter is used. Input ramp limitation is executed before filtering takes place.

The amount of the change in the input value is checked to make sure the specified limits are not exceeded. If the values are exceeded, the adjusted input value is equal to the old value \pm the limit value.

Adjustable limit values:

| Code | Limit value |
|------|---|
| 0 | The input value is used without limitation. |
| 1 | \$3FFF = 16383 |
| 2 | \$1FFF = 8191 |
| 3 | \$0FFF = 4095 |
| 4 | \$07FF = 2047 |
| 5 | \$03FF = 1023 |
| 6 | \$01FF = 511 |
| 7 | \$00FF = 255 |

Table 300: Input ramp limit values - AI2622

The input ramp limitation is well suited for suppressing disturbances (spikes). The following examples show the function of the input ramp limitation based on an input jump and a disturbance.

Example 1: The input value makes a jump from 8,000 to 17,000. The diagram displays the adjusted input value for the following settings:

Input ramp limitation = 4 = \$07FF = 2047

Filter level = 2

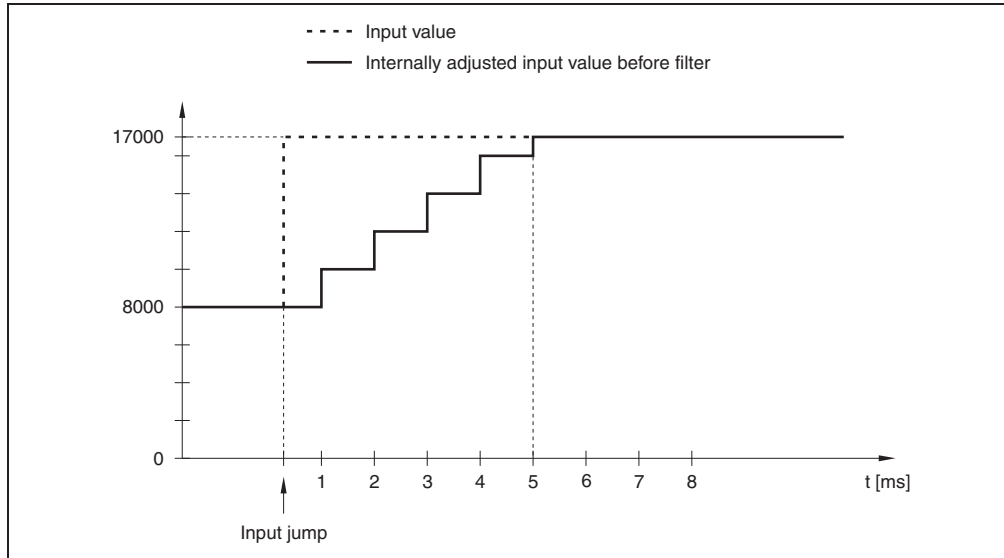


Figure 3: Input value adjusted for input jump - AI2622

Example 2: A disturbance is imposed on the input value. The diagram shows the adjusted input value with the following settings:

Input ramp limitation = 4 = \$07FF = 2047

Filter level = 2

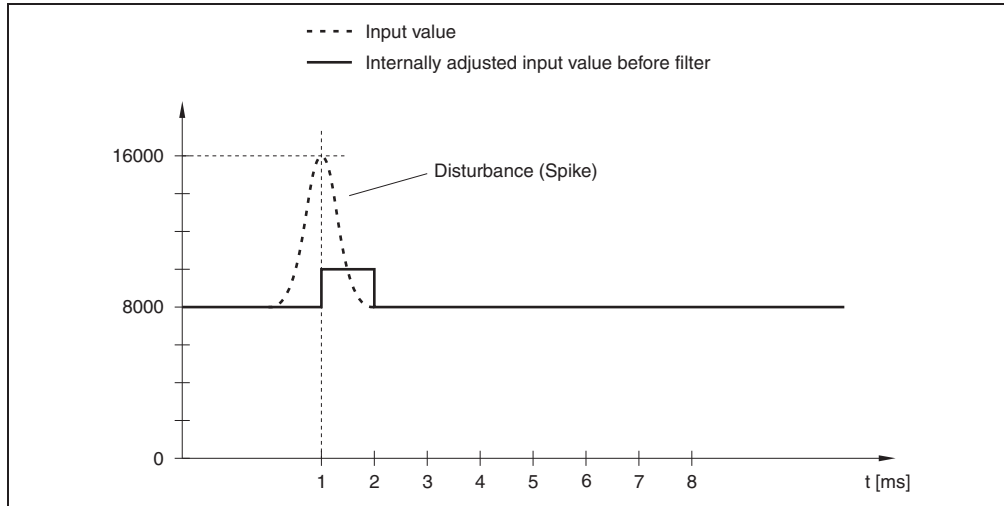


Figure 4: Input value adjusted for disturbance - AI2622

2.9.2 Filter level

The input value is evaluated according to the filter level. An input ramp limitation can then be applied using this evaluation.

Formula for the evaluation of the input value:

$$\text{Value}_{\text{new}} = \text{Value}_{\text{old}} - \frac{\text{Value}_{\text{new}}}{\text{FilterLevel}} + \frac{\text{InputValue}}{\text{FilterLevel}}$$

Adjustable filter levels:

| Code | Filter level |
|------|---------------------|
| 0 | Filter switched off |
| 1 | Filter level 2 |
| 2 | Filter level 4 |
| 3 | Filter level 8 |
| 4 | Filter level 16 |
| 5 | Filter level 32 |
| 6 | Filter level 64 |
| 7 | Filter level 128 |

Table 301: Adjustable filter levels - AI2622

The following examples show the function of the input ramp limitation based on an input jump and a disturbance.

Example 1: The input value makes a jump from 8,000 to 16,000. The diagram displays the evaluated value with the following settings:

Input ramp limitation = 0

Filter level = 2 or 4

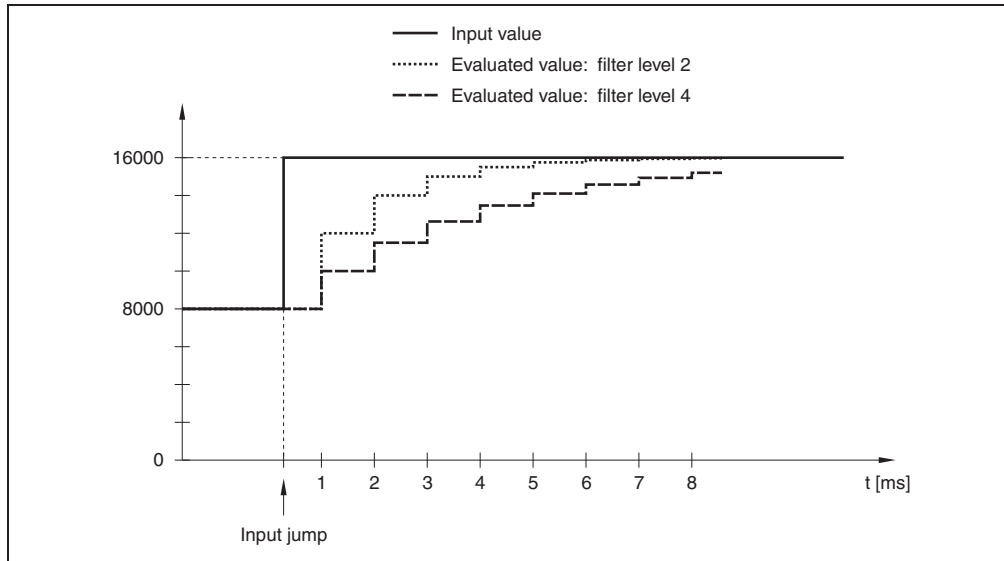


Figure 5: Evaluated value during input jump - AI2622

Example 2: A disturbance is imposed on the input value. The diagram shows the evaluated value with the following settings:

Input ramp limitation = 0

Filter level = 2 or 4

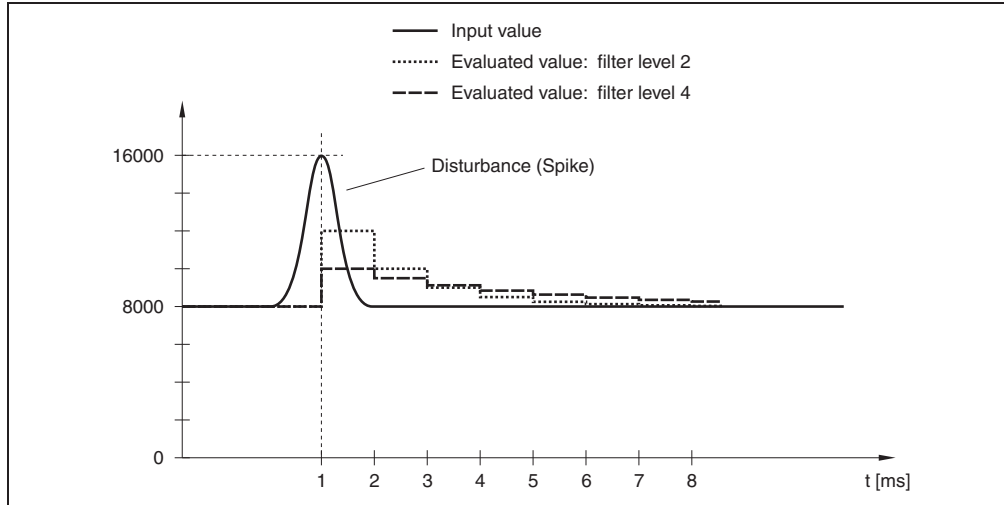


Figure 6: Evaluated value during disturbance - AI2622

2.10 Register: InputFilter

| Bit | Description |
|-------|---|
| 0 - 2 | The filter level is defined using these bits. 000 ... Filter switched off 001 ... Filter level 2 010 ... Filter level 4 011 ... Filter level 8 100 ... Filter level 16 101 ... Filter level 32 110 ... Filter level 64 111 ... Filter level 128 |
| 3 | 0 |
| 4 - 6 | The input ramp limit is defined using these bits. 000 ... The input value is used without limitation 001 ... Limit value = \$3FFF = 16383 010 ... Limit value = \$1FFF = 8191 011 ... Limit value = \$0FFF = 4095 100 ... Limit value = \$07FF = 2047 101 ... Limit value = \$03FF = 1023 110 ... Limit value = \$01FF = 511 111 ... Limit value = \$00FF = 255 |
| 7 | 0 |

2.11 Channel type

Each channel is capable of either current or voltage signals.

The type of signal is determined by the connection terminals used. Since current and voltage require different adjustment values, it is also necessary to configure the desired type of input signal.

| Code | Input signal |
|------|--------------------------|
| 0 | Voltage signal (default) |
| 1 | Current signal |

Table 302: Channel type - AI2622

2.12 Register: ChannelType

| Bit | Description |
|-------|--|
| 0 | 0 ... Channel 1: Voltage signal 1 ... Channel 1: Current signal |
| 1 | 0 ... Channel 2: Voltage signal 1 ... Channel 2: Current signal |
| 2 - 7 | 0 |

2.13 Input status

The module's inputs are monitored. A change in monitoring status triggers an error message.

| Code | Voltage signal | Current signal |
|------|-------------------------|---|
| 0 | No error | No error |
| 1 | Below lower limit value | The input value has a lower limit of \$0000. Underflow monitoring is therefore not necessary. |
| 2 | Above upper limit value | Above upper limit value |
| 3 | Wire break | - |

Table 303: Input status - AI2622

2.14 Register: StatusInput01

| Bit | Voltage signal description | Current signal description |
|-------|--|---|
| 0 - 1 | Channel 1: 00 ... No error 01 ... Below lower limit value 10 ... Above upper limit value 11 ... Wire break | Channel 1: 00 ... No error 10 ... Above upper limit value |
| 2 - 3 | Channel 2: 00 ... No error 01 ... Below lower limit value 10 ... Above upper limit value 11 ... Wire break | Channel 2: 00 ... No error 10 ... Above upper limit value |
| 4 - 7 | 0 | 0 |

In addition to the status info, the error type also sets the analog value as follows:

| Error type | Digital value for error |
|-------------------------|-------------------------|
| Wire break | +32767 (0x7FFF) |
| Above upper limit value | +32767 (0x7FFF) |
| Below lower limit value | -32767 (0x8001) |
| Invalid value | -32768 (0x8000) |

2.15 B&R ID code

Code for module identification (\$1B9E).

2.16 Minimum cycle time

The minimum cycle time is the minimum time needed for the bus cycle to be shut down without a communication error occurring. It should be noted that very fast cycles have reduced the idle time needed for handling monitoring, diagnostics and acyclic commands.

| Minimum cycle time | |
|--------------------------|-------------------------|
| Inputs without filtering | $\geq 100\ \mu\text{s}$ |
| Inputs with filtering | $> 500\ \mu\text{s}$ |

Table 304: Minimum cycle time - AI2622

2.17 Minimum I/O update time

The minimum I/O update time refers to the minimum time it takes for the bus cycle to shut down, so that in each cycle an I/O update takes place.

| Minimum I/O update time | |
|--------------------------|----------------------------------|
| Inputs without filtering | 300 μs for all inputs |
| Inputs with filtering | $\geq 1\ \text{ms}$ |

Table 305: Minimum I/O update time - AI2622

3. X20AI4622

3.1 Register overview

| Register | Name | Data type | Length | Read | | Write | |
|----------|---------------|-----------|--------|--------|---------|--------|---------|
| | | | | Cyclic | Acyclic | Cyclic | Acyclic |
| 0 | AnalogInput01 | INT | 2 | ● | ● | | |
| 2 | AnalogInput02 | INT | 2 | ● | ● | | |
| 4 | AnalogInput03 | INT | 2 | ● | ● | | |
| 6 | AnalogInput04 | INT | 2 | ● | ● | | |
| 16 | InputFilter | USINT | 1 | | ● | ● | ● |
| 18 | ChannelType | USINT | 1 | | ● | ● | ● |
| 30 | StatusInput01 | USINT | 1 | ● | ● | | |

Table 306: Register overview - AI4622

3.2 Variable assignment in Automation Studio (X2X master)

| Name | Data type | Length | Read | | Write | |
|---------------|-----------|--------|--------|---------|--------|---------|
| | | | Cyclic | Acyclic | Cyclic | Acyclic |
| AnalogInput01 | INT | 2 | ● | | | |
| AnalogInput02 | INT | 2 | ● | | | |
| AnalogInput03 | INT | 2 | ● | | | |
| AnalogInput04 | INT | 2 | ● | | | |
| StatusInput01 | USINT | 1 | ● | | | |

Table 307: Variable assignment in Automation Studio (X2X master) - AI4622

3.3 Variable assignment in Automation Studio (CANIO)

| Name | Data type | Length | Read | | Write | |
|---------------|-----------|--------|--------|---------|--------|---------|
| | | | Cyclic | Acyclic | Cyclic | Acyclic |
| AnalogInput01 | INT | 2 | ● | | | |
| AnalogInput02 | INT | 2 | ● | | | |
| AnalogInput03 | INT | 2 | ● | | | |
| AnalogInput04 | INT | 2 | ● | | | |
| StatusInput01 | USINT | 1 | | ● | | |

Table 308: Variable assignment in Automation Studio (CANIO) - AI4622

3.4 CANopen data points

| Register | Name | Data type | Length | Read | | Write | |
|----------|---------------|-----------|--------|------|-----|-------|-----|
| | | | | PDO | SDO | PDO | SDO |
| 0 | AnalogInput01 | INT | 2 | ● | ● | | |
| 2 | AnalogInput02 | INT | 2 | ● | ● | | |
| 4 | AnalogInput03 | INT | 2 | ● | ● | | |
| 6 | AnalogInput04 | INT | 2 | ● | ● | | |
| 16 | InputFilter | USINT | 1 | | ● | | ● |
| 18 | ChannelType | USINT | 1 | | ● | | ● |
| 30 | StatusInput01 | USINT | 1 | | ● | | |

Table 309: CANopen data points - AI4622

3.5 DeviceNet data points

| Register | Name | Data type | Length | Read | | Write | |
|----------|---------------|-----------|--------|--------|---------|--------|---------|
| | | | | Cyclic | Acyclic | Cyclic | Acyclic |
| 0 | AnalogInput01 | INT | 2 | ● | ● | | |
| 2 | AnalogInput02 | INT | 2 | ● | ● | | |
| 4 | AnalogInput03 | INT | 2 | ● | ● | | |
| 6 | AnalogInput04 | INT | 2 | ● | ● | | |
| 16 | InputFilter | USINT | 1 | | ● | | ● |
| 18 | ChannelType | USINT | 1 | | ● | | ● |
| 30 | StatusInput01 | USINT | 1 | ● | ● | | |

Table 310: DeviceNet data points - AI4622

3.6 Modbus/TCP data points

| Register | Name | Data type | Length | Read | | Write | |
|----------|---------------|-----------|--------|--------|---------|--------|---------|
| | | | | Cyclic | Acyclic | Cyclic | Acyclic |
| 0 | AnalogInput01 | INT | 2 | ● | ● | | |
| 2 | AnalogInput02 | INT | 2 | ● | ● | | |
| 4 | AnalogInput03 | INT | 2 | ● | ● | | |
| 6 | AnalogInput04 | INT | 2 | ● | ● | | |
| 16 | InputFilter | USINT | 1 | | ● | | ● |
| 18 | ChannelType | USINT | 1 | | ● | | ● |
| 30 | StatusInput01 | USINT | 1 | ● | ● | | |

Table 311: Modbus/TCP data points - AI4622

3.7 Analog inputs

The input status is registered with a fixed offset with respect to the network cycle and is transferred in the same cycle.

3.8 Register: AnalogInput01 - AnalogInput04

Analog input value with respect to operating mode:

| Input signal | Digital value |
|-----------------------------------|------------------|
| Voltage signal -10 VDC to +10 VDC | -32768 to +32767 |
| Current signal 0 mA to 20 mA | 0 to +32767 |

3.9 Input filter

The module is equipped with a configurable input filter. The minimum cycle time must be $>500\ \mu\text{s}$. Filtering is deactivated for shorter cycle times.

If the input filter is active, then the channels are scanned in ms cycles. The time offset between the channels is $200\ \mu\text{s}$. The conversion takes place asynchronously to the network cycle.

3.9.1 Input ramp limitation

Input ramp limitation can only take place when a filter is used. Input ramp limitation is executed before filtering takes place.

The difference of the change in the input value is checked to make sure the specified limits are not exceeded. If the values are exceeded, the adjusted input value is equal to the old value \pm the limit value.

Adjustable limit values:

| Code | Limit value |
|------|---|
| 0 | The input value is used without limitation. |
| 1 | \$3FFF = 16383 |
| 2 | \$1FFF = 8191 |
| 3 | \$0FFF = 4095 |
| 4 | \$07FF = 2047 |
| 5 | \$03FF = 1023 |
| 6 | \$01FF = 511 |
| 7 | \$00FF = 255 |

Table 312: Input ramp limit values - AI4622

The input ramp limitation is well suited for suppressing disturbances (spikes). The following examples show the function of the input ramp limitation based on an input jump and a disturbance.

Example 1: The input value makes a jump from 8,000 to 17,000. The diagram displays the adjusted input value for the following settings:

Input ramp limitation = 4 = \$07FF = 2047

Filter level = 2

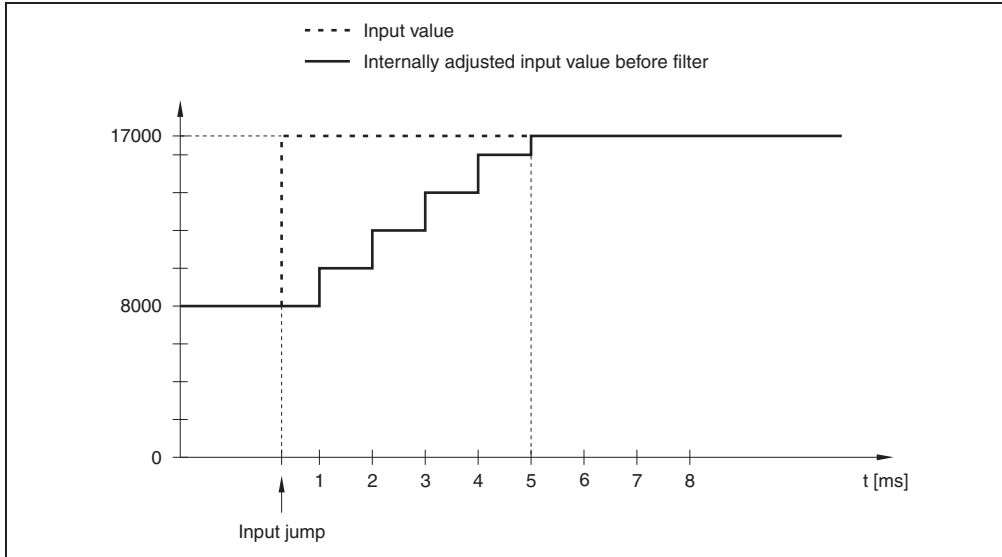


Figure 7: Input value adjusted for input jump - AI4622

Example 2: A disturbance is imposed on the input value. The diagram shows the adjusted input value with the following settings:

Input ramp limitation = 4 = \$07FF = 2047

Filter level = 2

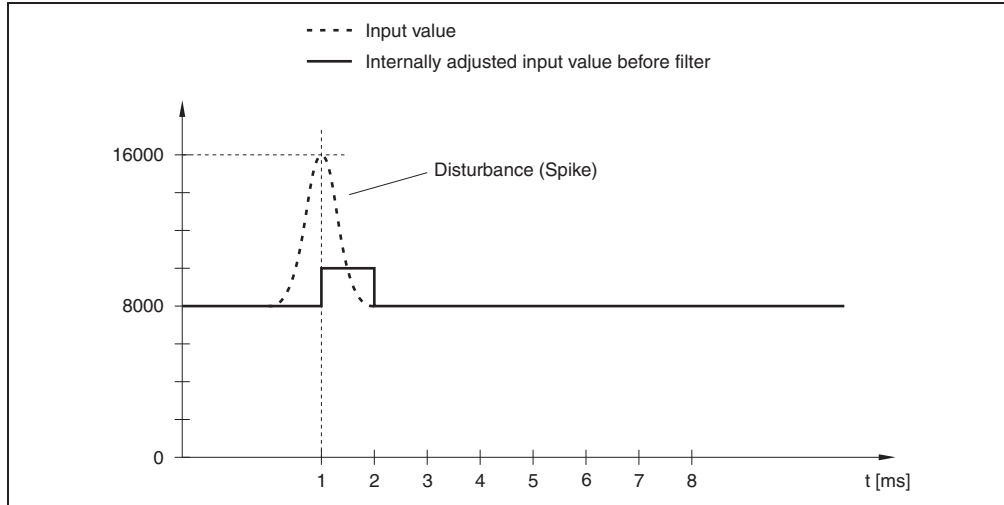


Figure 8: Input value adjusted for disturbance - AI4622

3.9.2 Filter level

Depending on the filter level, the input value is more strongly or less strongly evaluated. The evaluation is then made for a possible input ramp limitation.

Formula for the evaluation of the input value:

$$\text{Value}_{\text{new}} = \text{Value}_{\text{old}} - \frac{\text{Value}_{\text{old}}}{\text{FilterLevel}} + \frac{\text{InputValue}}{\text{FilterLevel}}$$

Adjustable filter levels:

| Code | Filter level |
|------|---------------------|
| 0 | Filter switched off |
| 1 | Filter level 2 |
| 2 | Filter level 4 |
| 3 | Filter level 8 |
| 4 | Filter level 16 |
| 5 | Filter level 32 |
| 6 | Filter level 64 |
| 7 | Filter level 128 |

Table 313: Adjustable filter levels - AI4622

The following examples show the function of the input ramp limitation based on an input jump and a disturbance.

Example 1: The input value makes a jump from 8,000 to 16,000. The diagram displays the evaluated value with the following settings:

Input ramp limitation = 0

Filter level = 2 or 4

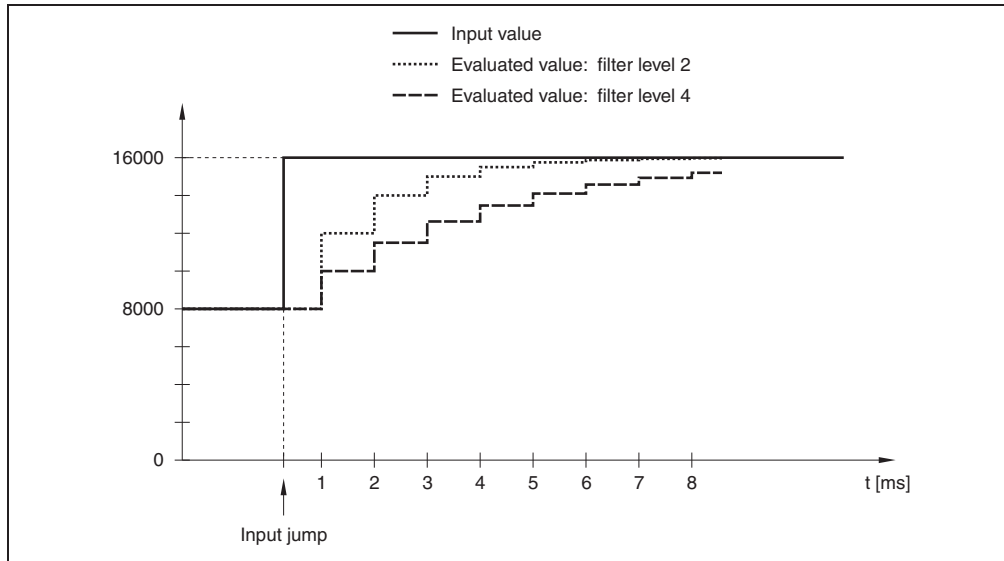


Figure 9: Evaluated value during input jump - AI4622

Example 2: A disturbance is imposed on the input value. The diagram shows the evaluated value with the following settings:

Input ramp limitation = 0

Filter level = 2 or 4

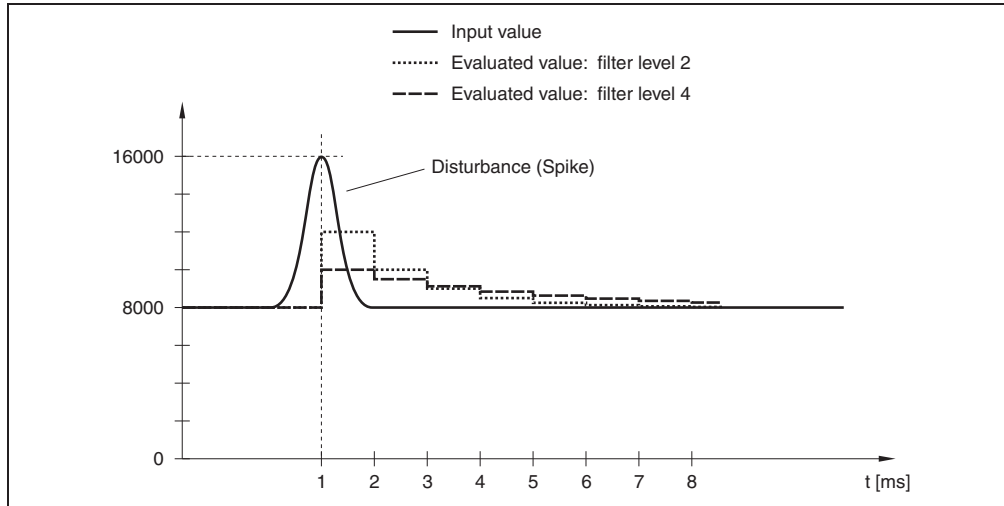


Figure 10: Evaluated value during disturbance - AI4622

3.10 Register: InputFilter

| Bit | Description |
|-------|---|
| 0 - 2 | The filter level is defined using these bits. 000 ... Filter switched off 001 ... Filter level 2 010 ... Filter level 4 011 ... Filter level 8 100 ... Filter level 16 101 ... Filter level 32 110 ... Filter level 64 111 ... Filter level 128 |
| 3 | 0 |
| 4 - 6 | The input ramp limit is defined using these bits. 000 ... The input value is used without limitation 001 ... Limit value = \$3FFF = 16383 010 ... Limit value = \$1FFF = 8191 011 ... Limit value = \$0FFF = 4095 100 ... Limit value = \$07FF = 2047 101 ... Limit value = \$03FF = 1023 110 ... Limit value = \$01FF = 511 111 ... Limit value = \$00FF = 255 |
| 7 | 0 |

3.11 Channel type

Each channel is capable of either current or voltage signals.

The type of signal is determined by the connection terminals used. Since current and voltage require different adjustment values, it is also necessary to configure the desired type of input signal.

| Code | Input signal |
|------|--------------------------|
| 0 | Voltage signal (default) |
| 1 | Current signal |

Table 314: Channel type - AI4622

3.12 Register: ChannelType

| Bit | Description |
|-------|--|
| 0 | 0 ... Channel 1: Voltage signal 1 ... Channel 1: Current signal |
| 1 | 0 ... Channel 2: Voltage signal 1 ... Channel 2: Current signal |
| 2 | 0 ... Channel 3: Voltage signal 1 ... Channel 3: Current signal |
| 3 | 0 ... Channel 4: Voltage signal 1 ... Channel 4: Current signal |
| 4 - 7 | 0 |

3.13 Input status

The module's inputs are monitored. A change in monitoring status triggers an error message.

| Code | Voltage signal | Current signal |
|------|-------------------------|--|
| 0 | No error | No error |
| 1 | Below lower limit value | The input value has a lower limit of \$0000. Underflow monitoring is therefore not necessary. |
| 2 | Above upper limit value | Above upper limit value |
| 3 | Wire break | - |

Table 315: Input status - AI4622

3.14 Register: StatusInput01

| Bit | Voltage signal description | Current signal description |
|-------|--|---|
| 0 - 1 | Channel 1: 00 ... No error 01 ... Below lower limit value 10 ... Above upper limit value 11 ... Wire break | Channel 1: 00 ... No error 10 ... Above upper limit value |
| 2 - 3 | Channel 2: 00 ... No error 01 ... Below lower limit value 10 ... Above upper limit value 11 ... Wire break | Channel 2: 00 ... No error 10 ... Above upper limit value |
| 4 - 5 | Channel 3: 00 ... No error 01 ... Below lower limit value 10 ... Above upper limit value 11 ... Wire break | Channel 3: 00 ... No error 10 ... Above upper limit value |
| 6 - 7 | Channel 4: 00 ... No error 01 ... Below lower limit value 10 ... Above upper limit value 11 ... Wire break | Channel 4: 00 ... No error 10 ... Above upper limit value |

In addition to the status info, the error type also sets the analog value as follows:

| Error type | Digital value for error |
|-------------------------|-------------------------|
| Wire break | +32767 (0x7FFF) |
| Above upper limit value | +32767 (0x7FFF) |
| Below lower limit value | -32767 (0x8001) |
| Invalid value | -32768 (0x8000) |

3.15 B&R ID code

Code for module identification (\$1BAA).

3.16 Minimum cycle time

The minimum cycle time is the minimum time needed for the bus cycle to be shut down without a communication error occurring. It should be noted that very fast cycles have reduced the idle time needed for handling monitoring, diagnostics and acyclic commands.

| Minimum cycle time | |
|--------------------------|-------------------------|
| Inputs without filtering | $\geq 100\ \mu\text{s}$ |
| Inputs with filtering | $> 500\ \mu\text{s}$ |

Table 316: Minimum cycle time - AI4622

3.17 Minimum I/O update time

The minimum I/O update time refers to the minimum time it takes for the bus cycle to shut down, so that in each cycle an I/O update takes place.

| Minimum I/O update time | |
|--------------------------|----------------------------------|
| Inputs without filtering | 300 μs for all inputs |
| Inputs with filtering | $\geq 1\ \text{ms}$ |

Table 317: Minimum I/O update time - AI4622

Chapter 8 • Analog output modules

1. Overview

| Analog output modules | Description |
|-----------------------|--|
| X20AO2622 | X20 analog output module, 2 outputs, $\pm 10\text{ V} / 0$ to 20 mA, 12-bit resolution |
| X20AO2632 | X20 analog output module, 2 outputs, $\pm 10\text{ V} / 0$ to 20 mA, 16-bit resolution |
| X20AO4622 | X20 analog output module, 4 outputs, $\pm 10\text{ V} / 0$ to 20 mA, 12-bit resolution |
| X20AO4632 | X20 analog output module, 4 outputs, $\pm 10\text{ V} / 0$ to 20 mA, 16-bit resolution |

Table 318: Overview of analog output modules

2. X2AO2622

2.1 Register overview

| Register | Name | Data type | Length | Read | | Write | |
|----------|----------------|-----------|--------|--------|---------|--------|---------|
| | | | | Cyclic | Acyclic | Cyclic | Acyclic |
| 0 | AnalogOutput01 | INT | 2 | | | ● | ● |
| 2 | AnalogOutput02 | INT | 2 | | | ● | ● |
| 18 | ChannelType | USINT | 1 | | ● | ● | ● |

Table 319: Register overview - AO2622

2.2 Variable assignment in Automation Studio (X2X master)

| Name | Data type | Length | Read | | Write | |
|----------------|-----------|--------|--------|---------|--------|---------|
| | | | Cyclic | Acyclic | Cyclic | Acyclic |
| AnalogOutput01 | INT | 2 | | | ● | |
| AnalogOutput02 | INT | 2 | | | ● | |

Table 320: Variable assignment in Automation Studio (X2X master) - AO2622

2.3 Variable assignment in Automation Studio (CANIO)

| Name | Data type | Length | Read | | Write | |
|----------------|-----------|--------|--------|---------|--------|---------|
| | | | Cyclic | Acyclic | Cyclic | Acyclic |
| AnalogOutput01 | INT | 2 | | | ● | |
| AnalogOutput02 | INT | 2 | | | ● | |

Table 321: Variable assignment in Automation Studio (CANIO) - AO2622

2.4 CANopen data points

| Register | Name | Data type | Length | Read | | Write | |
|----------|----------------|-----------|--------|------|-----|-------|-----|
| | | | | PDO | SDO | PDO | SDO |
| 0 | AnalogOutput01 | INT | 2 | | | ● | ● |
| 2 | AnalogOutput02 | INT | 2 | | | ● | ● |
| 18 | ChannelType | USINT | 1 | | ● | | ● |

Table 322: CANopen data points - AO2622

2.5 DeviceNet data points

| Register | Name | Data type | Length | Read | | Write | |
|----------|----------------|-----------|--------|--------|---------|--------|---------|
| | | | | Cyclic | Acyclic | Cyclic | Acyclic |
| 0 | AnalogOutput01 | INT | 2 | | | ● | ● |
| 2 | AnalogOutput02 | INT | 2 | | | ● | ● |
| 18 | ChannelType | USINT | 1 | | ● | | ● |

Table 323: DeviceNet data points - AO2622

2.6 Modbus/TCP data points

| Register | Name | Data type | Length | Read | | Write | |
|----------|----------------|-----------|--------|--------|---------|--------|---------|
| | | | | Cyclic | Acyclic | Cyclic | Acyclic |
| 0 | AnalogOutput01 | INT | 2 | | | ● | ● |
| 2 | AnalogOutput02 | INT | 2 | | | ● | ● |
| 18 | ChannelType | USINT | 1 | | ● | | ● |

Table 324: Modbus/TCP data points - AO2622

2.7 Analog outputs

Each channel can be configured for either current or voltage signals. The type of signal is also determined by the connection terminals used.

2.8 Register: AnalogOutput01 - AnalogOutput02

Analog output value with respect to operating mode:

| Digital value | Output signal |
|------------------|-----------------------------------|
| -32768 to +32767 | Voltage signal -10 VDC to +10 VDC |
| 0 to +32767 | Current signal 0 mA to 20 mA |

2.9 Channel type

Each channel is capable of either current or voltage signals.

The type of signal is determined by the connection terminals used. Since current and voltage require different adjustment values, it is also necessary to configure the desired type of output signal.

| Code | Output signal |
|------|--------------------------|
| 0 | Voltage signal (default) |
| 1 | Current signal |

Table 325: Channel type - AO2622

2.10 Register: ChannelType

| Bit | Description |
|-------|--|
| 0 | 0 ... Channel 1: Voltage signal 1 ... Channel 1: Current signal |
| 1 | 0 ... Channel 2: Voltage signal 1 ... Channel 2: Current signal |
| 2 - 7 | 0 |

2.11 Function models

A function model describes the registers for the module (memory model) which are available for the application. Only these registers are processed on the module during each cycle and cyclically transferred using the bus. The cycle time can be minimized by selecting the correct function model.

Function model 0: Jitter-free I/O (default)

The output of corrected values occurs in the next cycle with a minimum cycle of $\geq 300 \mu\text{s}$. This minimizes jitter.

Function model 1: Fast reaction I/O

The output of corrected values occurs in the same cycle with a minimum cycle of $\geq 300 \mu\text{s}$.

Comparison of the two function models

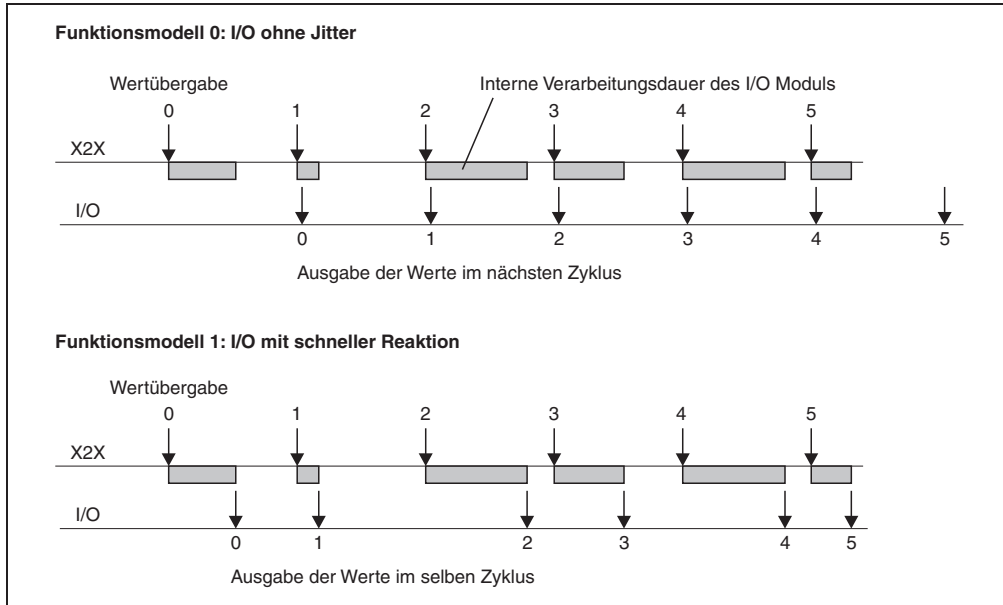


Figure 11: Function model comparison - AO2622

The registers used are identical for all function models:

| Function models 0 and 1 | | | | | | | |
|-------------------------|----------------|-----------|--------|--------|---------|--------|---------|
| Register | Name | Data type | Length | Read | | Write | |
| | | | | Cyclic | Acyclic | Cyclic | Acyclic |
| 0 | AnalogOutput01 | INT | 2 | | | ● | ● |
| 2 | AnalogOutput02 | INT | 2 | | | ● | ● |
| 18 | ChannelType | USINT | 1 | | ● | ● | ● |

Table 326: Function models 0 and 1 - AO2622

2.12 Function models - used where?

| Name | Automation Studio | CANopen | DeviceNet | Modbus/TCP | CAN I/O |
|---|-------------------|---------|-----------|------------|---------|
| Function model 0: Jitter-free I/O (default) | ● | ● | ● | ● | ● |
| Function model 1: I/O with fast reaction | ● | | | ● | |

Table 327: Function models - AO2622

2.13 B&R ID code

Code for module identification (\$1BA2).

2.14 Minimum cycle time

The minimum cycle time is the minimum time needed for the bus cycle to be shut down without a communication error occurring. It should be noted that very fast cycles have reduced the idle time needed for handling monitoring, diagnostics and acyclic commands.

| Minimum cycle time | |
|--------------------|---------|
| Minimum cycle time | ≥250 μs |

Table 328: Minimum cycle time - AO2622

2.15 Minimum I/O update time

The minimum I/O update time refers to the minimum time it takes for the bus cycle to shut down, so that in each cycle an I/O update takes place.

| Minimum I/O update time | |
|-------------------------|---------|
| For all outputs | <300 μs |

Table 329: Minimum I/O update time - AO2622

3. X20AO2632

3.1 Register overview

| Register | Name | Data type | Length | Read | | Write | |
|----------|----------------|-----------|--------|--------|---------|--------|---------|
| | | | | Cyclic | Acyclic | Cyclic | Acyclic |
| 2 | AnalogOutput01 | INT | 2 | | | ● | ● |
| 4 | AnalogOutput02 | INT | 2 | | | ● | ● |
| 0 | ChannelType | UINT | 2 | | | | ● |

Table 330: Register overview - AO2632

3.2 Variable assignment in Automation Studio (X2X master)

| Name | Data type | Length | Read | | Write | |
|----------------|-----------|--------|--------|---------|--------|---------|
| | | | Cyclic | Acyclic | Cyclic | Acyclic |
| AnalogOutput01 | INT | 2 | | | ● | |
| AnalogOutput02 | INT | 2 | | | ● | |

Table 331: Variable assignment in Automation Studio (X2X master) - AO2632

3.3 Variable assignment in Automation Studio (CANIO)

| Name | Data type | Length | Read | | Write | |
|----------------|-----------|--------|--------|---------|--------|---------|
| | | | Cyclic | Acyclic | Cyclic | Acyclic |
| AnalogOutput01 | INT | 2 | | | ● | |
| AnalogOutput02 | INT | 2 | | | ● | |

Table 332: Variable assignment in Automation Studio (CANIO) - AO2632

3.4 CANopen data points

| Register | Name | Data type | Length | Read | | Write | |
|----------|----------------|-----------|--------|------|-----|-------|-----|
| | | | | PDO | SDO | PDO | SDO |
| 2 | AnalogOutput01 | INT | 2 | | | ● | ● |
| 4 | AnalogOutput02 | INT | 2 | | | ● | ● |
| 0 | ChannelType | UINT | 2 | | | | ● |

Table 333: CANopen data points - AO2632

3.5 DeviceNet data points

| Register | Name | Data type | Length | Read | | Write | |
|----------|----------------|-----------|--------|--------|---------|--------|---------|
| | | | | Cyclic | Acyclic | Cyclic | Acyclic |
| 2 | AnalogOutput01 | INT | 2 | | | ● | ● |
| 4 | AnalogOutput02 | INT | 2 | | | ● | ● |
| 0 | ChannelType | UINT | 2 | | | | ● |

Table 334: DeviceNet data points - AO2632

3.6 Modbus/TCP data points

| Register | Name | Data type | Length | Read | | Write | |
|----------|----------------|-----------|--------|--------|---------|--------|---------|
| | | | | Cyclic | Acyclic | Cyclic | Acyclic |
| 2 | AnalogOutput01 | INT | 2 | | | ● | ● |
| 4 | AnalogOutput02 | INT | 2 | | | ● | ● |
| 0 | ChannelType | UINT | 2 | | | | ● |

Table 335: Modbus/TCP data points - AO2632

3.7 Analog outputs

Each channel can be configured for either current or voltage signals. The type of signal is also determined by the connection terminals used.

3.8 Register: AnalogOutput01 - AnalogOutput02

Analog output value with respect to operating mode:

| Digital value | Output signal |
|------------------|-----------------------------------|
| -32768 to +32767 | Voltage signal -10 VDC to +10 VDC |
| 0 to +32767 | Current signal 0 mA to 20 mA |

3.9 Channel type

Each channel is capable of either current or voltage signals.

The type of signal is determined by the connection terminals used. Since current and voltage require different adjustment values, it is also necessary to configure the desired type of output signal.

| Code | Output signal |
|------|--------------------------|
| 0 | Voltage signal (default) |
| 1 | Current signal |

Table 336: Channel type - AO2632

3.10 Register: ChannelType

| Bit | Description |
|---------|--|
| 0 - 7 | 0 |
| 8 | 0 ... Channel 1: Voltage signal 1 ... Channel 1: Current signal |
| 9 | 0 ... Channel 2: Voltage signal 1 ... Channel 2: Current signal |
| 10 - 15 | 0 |

3.11 B&R ID code

Code for module identification (\$1BA4).

3.12 Minimum cycle time

The minimum cycle time is the minimum time needed for the bus cycle to be shut down without a communication error occurring. It should be noted that very fast cycles have reduced the idle time needed for handling monitoring, diagnostics and acyclic commands.

| Minimum cycle time | |
|--------------------|------------------------|
| Minimum cycle time | $\geq 200 \mu\text{s}$ |

Table 337: Minimum cycle time - AO2632

3.13 Minimum I/O update time

The minimum I/O update time refers to the minimum time it takes for the bus cycle to shut down, so that in each cycle an I/O update takes place.

| Minimum I/O update time | |
|-------------------------|------------------------|
| For all outputs | $\geq 200 \mu\text{s}$ |

Table 338: Minimum I/O update time - AO2632

4. X2AO4622

4.1 Register overview

| Register | Name | Data type | Length | Read | | Write | |
|----------|----------------|-----------|--------|--------|---------|--------|---------|
| | | | | Cyclic | Acyclic | Cyclic | Acyclic |
| 0 | AnalogOutput01 | INT | 2 | | | ● | ● |
| 2 | AnalogOutput02 | INT | 2 | | | ● | ● |
| 4 | AnalogOutput03 | INT | 2 | | | ● | ● |
| 6 | AnalogOutput04 | INT | 2 | | | ● | ● |
| 18 | ChannelType | USINT | 1 | | ● | ● | ● |

Table 339: Register overview - AO4622

4.2 Variable assignment in Automation Studio (X2X master)

| Name | Data type | Length | Read | | Write | |
|----------------|-----------|--------|--------|---------|--------|---------|
| | | | Cyclic | Acyclic | Cyclic | Acyclic |
| AnalogOutput01 | INT | 2 | | | ● | |
| AnalogOutput02 | INT | 2 | | | ● | |
| AnalogOutput03 | INT | 2 | | | ● | |
| AnalogOutput04 | INT | 2 | | | ● | |

Table 340: Variable assignment in Automation Studio (X2X master) - AO4622

4.3 Variable assignment in Automation Studio (CANIO)

| Name | Data type | Length | Read | | Write | |
|----------------|-----------|--------|--------|---------|--------|---------|
| | | | Cyclic | Acyclic | Cyclic | Acyclic |
| AnalogOutput01 | INT | 2 | | | ● | |
| AnalogOutput02 | INT | 2 | | | ● | |
| AnalogOutput03 | INT | 2 | | | ● | |
| AnalogOutput04 | INT | 2 | | | ● | |

Table 341: Variable assignment in Automation Studio (CANIO) - AO4622

4.4 CANopen data points

| Register | Name | Data type | Length | Read | | Write | |
|----------|----------------|-----------|--------|------|-----|-------|-----|
| | | | | PDO | SDO | PDO | SDO |
| 0 | AnalogOutput01 | INT | 2 | | | ● | ● |
| 2 | AnalogOutput02 | INT | 2 | | | ● | ● |
| 4 | AnalogOutput03 | INT | 2 | | | ● | ● |
| 6 | AnalogOutput04 | INT | 2 | | | ● | ● |
| 18 | ChannelType | USINT | 1 | | ● | | ● |

Table 342: CANopen data points - AO4622

4.5 DeviceNet data points

| Register | Name | Data type | Length | Read | | Write | |
|----------|----------------|-----------|--------|--------|---------|--------|---------|
| | | | | Cyclic | Acyclic | Cyclic | Acyclic |
| 0 | AnalogOutput01 | INT | 2 | | | ● | ● |
| 2 | AnalogOutput02 | INT | 2 | | | ● | ● |
| 4 | AnalogOutput03 | INT | 2 | | | ● | ● |
| 6 | AnalogOutput04 | INT | 2 | | | ● | ● |
| 18 | ChannelType | USINT | 1 | | ● | | ● |

Table 343: DeviceNet data points - AO4622

4.6 Modbus/TCP data points

| Register | Name | Data type | Length | Read | | Write | |
|----------|----------------|-----------|--------|--------|---------|--------|---------|
| | | | | Cyclic | Acyclic | Cyclic | Acyclic |
| 0 | AnalogOutput01 | INT | 2 | | | ● | ● |
| 2 | AnalogOutput02 | INT | 2 | | | ● | ● |
| 4 | AnalogOutput03 | INT | 2 | | | ● | ● |
| 6 | AnalogOutput04 | INT | 2 | | | ● | ● |
| 18 | ChannelType | USINT | 1 | | ● | | ● |

Table 344: Modbus/TCP data points - AO4622

4.7 Analog outputs

Each channel can be configured for either current or voltage signals. The type of signal is also determined by the connection terminals used.

4.8 Register: AnalogOutput01 - AnalogOutput04

Analog output value with respect to operating mode:

| Digital value | Output signal |
|------------------|-----------------------------------|
| -32768 to +32767 | Voltage signal -10 VDC to +10 VDC |
| 0 to +32767 | Current signal 0 mA to 20 mA |

4.9 Channel type

Each channel is capable of either current or voltage signals.

The type of signal is determined by the connection terminals used. Since current and voltage require different adjustment values, it is also necessary to configure the desired type of output signal.

| Code | Output signal |
|------|--------------------------|
| 0 | Voltage signal (default) |
| 1 | Current signal |

Table 345: Channel type - AO4622

4.10 Register: ChannelType

| Bit | Description |
|-------|--|
| 0 | 0 ... Channel 1: Voltage signal 1 ... Channel 1: Current signal |
| 1 | 0 ... Channel 2: Voltage signal 1 ... Channel 2: Current signal |
| 2 | 0 ... Channel 3: Voltage signal 1 ... Channel 3: Current signal |
| 3 | 0 ... Channel 4: Voltage signal 1 ... Channel 4: Current signal |
| 4 - 7 | 0 |

4.11 Function models

A function model describes the registers for the module (memory model) which are available for the application. Only these registers are processed on the module during each cycle and cyclically transferred using the bus. The cycle time can be minimized by selecting the correct function model.

Function model 0: Jitter-free I/O (default)

The output of corrected values occurs in the next cycle with a minimum cycle of $\geq 400 \mu\text{s}$. This minimizes jitter.

Function model 1: Fast reaction I/O

The output of corrected values occurs in the same cycle with a minimum cycle of $\geq 400 \mu\text{s}$.

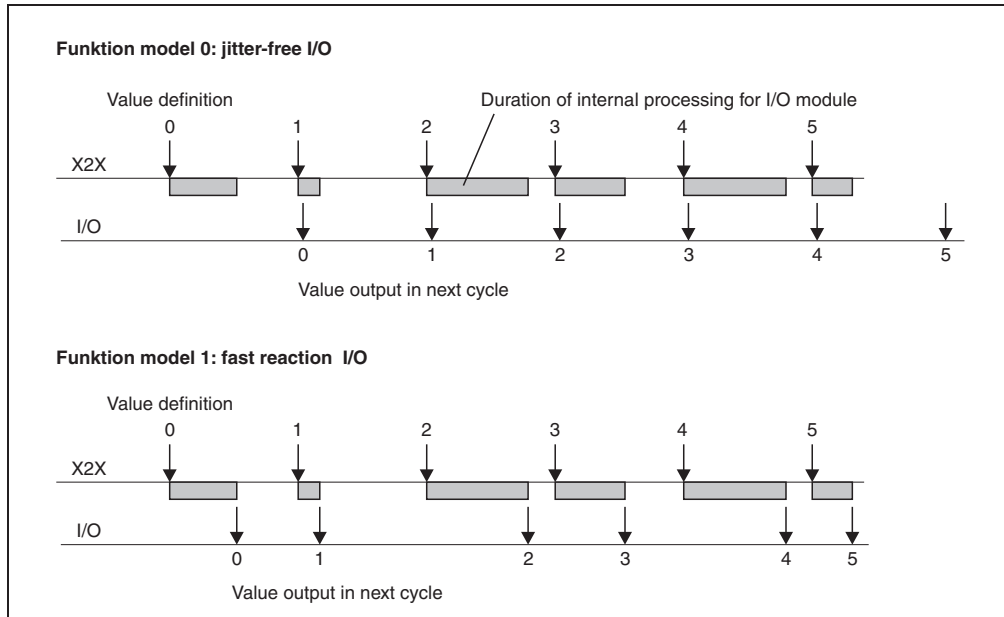
Comparison of the two function models

Figure 12: Function model comparison - AO4622

The registers used are identical for all function models:

| Function models 0 and 1 | | | | | | | |
|-------------------------|----------------|-----------|--------|--------|---------|--------|---------|
| Register | Name | Data type | Length | Read | | Write | |
| | | | | Cyclic | Acyclic | Cyclic | Acyclic |
| 0 | AnalogOutput01 | INT | 2 | | | ● | ● |
| 2 | AnalogOutput02 | INT | 2 | | | ● | ● |
| 4 | AnalogOutput03 | INT | 2 | | | ● | ● |
| 6 | AnalogOutput04 | INT | 2 | | | ● | ● |
| 18 | ChannelType | USINT | 1 | | ● | ● | ● |

Table 346: Function models 0 and 1 - AO4622

4.12 Function models - used where?

| Name | Automation Studio | CANopen | DeviceNet | Modbus/TCP | CAN I/O |
|---|-------------------|---------|-----------|------------|---------|
| Function model 0: Jitter-free I/O (default) | ● | ● | ● | ● | ● |
| Function model 1: I/O with fast reaction | ● | | | ● | |

Table 347: Function models - AO4622

4.13 B&R ID code

Code for module identification (\$1BA3).

4.14 Minimum cycle time

The minimum cycle time is the minimum time needed for the bus cycle to be shut down without a communication error occurring. It should be noted that very fast cycles have reduced the idle time needed for handling monitoring, diagnostics and acyclic commands.

| Minimum cycle time | |
|--------------------|---------|
| Minimum cycle time | ≥250 µs |

Table 348: Minimum cycle time - AO4622

4.15 Minimum I/O update time

The minimum I/O update time refers to the minimum time it takes for the bus cycle to shut down, so that in each cycle an I/O update takes place.

| Minimum I/O update time | |
|-------------------------|---------|
| For all outputs | <400 µs |

Table 349: Minimum I/O update time - AO4622

5. X20AO4632

5.1 Register overview

| Register | Name | Data type | Length | Read | | Write | |
|----------|----------------|-----------|--------|--------|---------|--------|---------|
| | | | | Cyclic | Acyclic | Cyclic | Acyclic |
| 2 | AnalogOutput01 | INT | 2 | | | ● | ● |
| 4 | AnalogOutput02 | INT | 2 | | | ● | ● |
| 6 | AnalogOutput03 | INT | 2 | | | ● | ● |
| 8 | AnalogOutput04 | INT | 2 | | | ● | ● |
| 0 | ChannelType | UINT | 2 | | | | ● |

Table 350: Register overview - AO4632

5.2 Variable assignment in Automation Studio (X2X master)

| Name | Data type | Length | Read | | Write | |
|----------------|-----------|--------|--------|---------|--------|---------|
| | | | Cyclic | Acyclic | Cyclic | Acyclic |
| AnalogOutput01 | INT | 2 | | | ● | |
| AnalogOutput02 | INT | 2 | | | ● | |
| AnalogOutput03 | INT | 2 | | | ● | |
| AnalogOutput04 | INT | 2 | | | ● | |

Table 351: Variable assignment in Automation Studio (X2X master) - AO4632

5.3 Variable assignment in Automation Studio (CANIO)

| Name | Data type | Length | Read | | Write | |
|----------------|-----------|--------|--------|---------|--------|---------|
| | | | Cyclic | Acyclic | Cyclic | Acyclic |
| AnalogOutput01 | INT | 2 | | | ● | |
| AnalogOutput02 | INT | 2 | | | ● | |
| AnalogOutput03 | INT | 2 | | | ● | |
| AnalogOutput04 | INT | 2 | | | ● | |

Table 352: Variable assignment in Automation Studio (CANIO) - AO4632

5.4 CANopen data points

| Register | Name | Data type | Length | Read | | Write | |
|----------|----------------|-----------|--------|------|-----|-------|-----|
| | | | | PDO | SDO | PDO | SDO |
| 2 | AnalogOutput01 | INT | 2 | | | ● | ● |
| 4 | AnalogOutput02 | INT | 2 | | | ● | ● |
| 6 | AnalogOutput03 | INT | 2 | | | ● | ● |
| 8 | AnalogOutput04 | INT | 2 | | | ● | ● |
| 0 | ChannelType | UINT | 2 | | | | ● |

Table 353: CANopen data points - AO4632

5.5 DeviceNet data points

| Register | Name | Data type | Length | Read | | Write | |
|----------|----------------|-----------|--------|--------|---------|--------|---------|
| | | | | Cyclic | Acyclic | Cyclic | Acyclic |
| 2 | AnalogOutput01 | INT | 2 | | | ● | ● |
| 4 | AnalogOutput02 | INT | 2 | | | ● | ● |
| 6 | AnalogOutput03 | INT | 2 | | | ● | ● |
| 8 | AnalogOutput04 | INT | 2 | | | ● | ● |
| 0 | ChannelType | UINT | 2 | | | | ● |

Table 354: DeviceNet data points - AO4632

5.6 Modbus/TCP data points

| Register | Name | Data type | Length | Read | | Write | |
|----------|----------------|-----------|--------|--------|---------|--------|---------|
| | | | | Cyclic | Acyclic | Cyclic | Acyclic |
| 2 | AnalogOutput01 | INT | 2 | | | ● | ● |
| 4 | AnalogOutput02 | INT | 2 | | | ● | ● |
| 6 | AnalogOutput03 | INT | 2 | | | ● | ● |
| 8 | AnalogOutput04 | INT | 2 | | | ● | ● |
| 0 | ChannelType | UINT | 2 | | | | ● |

Table 355: Modbus/TCP data points - AO4632

5.7 Analog outputs

Each channel can be configured for either current or voltage signals. The type of signal is also determined by the connection terminals used.

5.8 Register: AnalogOutput01 - AnalogOutput04

Analog output value with respect to operating mode:

| Digital value | Output signal |
|------------------|-----------------------------------|
| -32768 to +32767 | Voltage signal -10 VDC to +10 VDC |
| 0 to +32767 | Current signal 0 mA to 20 mA |

5.9 Channel type

Each channel is capable of either current or voltage signals.

The type of signal is determined by the connection terminals used. Since current and voltage require different adjustment values, it is also necessary to configure the desired type of output signal.

| Code | Output signal |
|------|--------------------------|
| 0 | Voltage signal (default) |
| 1 | Current signal |

Table 356: Channel type - AO4632

5.10 Register: ChannelType

| Bit | Description |
|---------|--|
| 0 - 7 | 0 |
| 8 | 0 ... Channel 1: Voltage signal 1 ... Channel 1: Current signal |
| 9 | 0 ... Channel 2: Voltage signal 1 ... Channel 2: Current signal |
| 10 | 0 ... Channel 3: Voltage signal 1 ... Channel 3: Current signal |
| 11 | 0 ... Channel 4: Voltage signal 1 ... Channel 4: Current signal |
| 12 - 15 | 0 |

5.11 B&R ID code

Code for module identification (\$1BA5).

5.12 Minimum cycle time

The minimum cycle time is the minimum time needed for the bus cycle to be shut down without a communication error occurring. It should be noted that very fast cycles have reduced the idle time needed for handling monitoring, diagnostics and acyclic commands.

| Minimum cycle time | |
|--------------------|------------------------|
| Minimum cycle time | $\geq 200 \mu\text{s}$ |

Table 357: Minimum cycle time - AO4632

5.13 Minimum I/O update time

The minimum I/O update time refers to the minimum time it takes for the bus cycle to shut down, so that in each cycle an I/O update takes place.

| Minimum I/O update time | |
|-------------------------|------------------------|
| For all outputs | $\geq 200 \mu\text{s}$ |

Table 358: Minimum I/O update time - AO4632

Chapter 9 • Temperature modules

1. Overview

| Temperature modules | Description |
|---------------------|--|
| X20AT2222 | X20 temperature input module, 2 inputs for resistance measurement, PT100, PT1000, resolution 0.1 K, 3-line connections |
| X20AT2402 | X20 temperature input module, 2 thermocouple inputs, type J,K,N,S, resolution 0.1 K |
| X20AT4222 | X20 temperature input module, 4 inputs for resistance measurement, PT100, PT1000, resolution 0.1 K, 3-line connections |
| X20AT6402 | X20 temperature input module, 6 thermocouple inputs, type J,K,N,S, resolution 0.1 K |

Table 359: Overview of temperature modules

2. X20AT2222

2.1 Register overview

| Register | Name | Data type | Length | Read | | Write | |
|----------|----------------------------|-----------|--------|--------|---------|--------|---------|
| | | | | Cyclic | Acyclic | Cyclic | Acyclic |
| 0 | Temperature01 / Resistor01 | INT/UINT | 2 | ● | ● | | |
| 2 | Temperature02 / Resistor02 | INT/UINT | 2 | ● | ● | | |
| 16 | InputFilter | USINT | 1 | | ● | ● | ● |
| 18 | SensorType | USINT | 1 | | ● | ● | ● |
| 28 | IOCyclicCounter | USINT | 1 | ● | ● | | |
| 30 | StatusInput01 | USINT | 1 | ● | ● | | |

Table 360: Register overview - AT2222

2.2 Variable assignment in Automation Studio (X2X master)

| Name | Data type | Length | Read | | Write | |
|----------------------------|-----------|--------|--------|---------|--------|---------|
| | | | Cyclic | Acyclic | Cyclic | Acyclic |
| Temperature01 / Resistor01 | INT/UINT | 2 | ● | | | |
| Temperature02 / Resistor02 | INT/UINT | 2 | ● | | | |
| IOCyclicCounter | USINT | 1 | ● | | | |
| StatusInput01 | USINT | 1 | ● | | | |

Table 361: Variable assignment in Automation Studio (X2X master) - AT2222

2.3 Variable assignment in Automation Studio (CANIO)

| Name | Data type | Length | Read | | Write | |
|----------------------------|-----------|--------|--------|---------|--------|---------|
| | | | Cyclic | Acyclic | Cyclic | Acyclic |
| Temperature01 / Resistor01 | INT/UINT | 2 | ● | | | |
| Temperature02 / Resistor02 | INT/UINT | 2 | ● | | | |
| IOCyclicCounter | USINT | 1 | | ● | | |
| StatusInput01 | USINT | 1 | | ● | | |

Table 362: Variable assignment in Automation Studio (CANIO) - AT2222

2.4 CANopen data points

| Register | Name | Data type | Length | Read | | Write | |
|----------|----------------------------|-----------|--------|------|-----|-------|-----|
| | | | | PDO | SDO | PDO | SDO |
| 0 | Temperature01 / Resistor01 | INT/UINT | 2 | ● | ● | | |
| 2 | Temperature02 / Resistor02 | INT/UINT | 2 | ● | ● | | |
| 16 | InputFilter | USINT | 1 | | ● | | ● |
| 18 | SensorType | USINT | 1 | | ● | | ● |
| 28 | IOCyclicCounter | USINT | 1 | | ● | | |
| 30 | StatusInput01 | USINT | 1 | | ● | | |

Table 363: CANopen data points - AT2222

2.5 DeviceNet data points

| Register | Name | Data type | Length | Read | | Write | |
|----------|----------------------------|-----------|--------|--------|---------|--------|---------|
| | | | | Cyclic | Acyclic | Cyclic | Acyclic |
| 0 | Temperature01 / Resistor01 | INT/UINT | 2 | ● | ● | | |
| 2 | Temperature02 / Resistor02 | INT/UINT | 2 | ● | ● | | |
| 16 | InputFilter | USINT | 1 | | ● | | ● |
| 18 | SensorType | USINT | 1 | | ● | | ● |
| 28 | IOCyclicCounter | USINT | 1 | | ● | | |
| 30 | StatusInput01 | USINT | 1 | ● | ● | | |

Table 364: DeviceNet data points - AT2222

2.6 Modbus/TCP data points

| Register | Name | Data type | Length | Read | | Write | |
|----------|----------------------------|-----------|--------|--------|---------|--------|---------|
| | | | | Cyclic | Acyclic | Cyclic | Acyclic |
| 0 | Temperature01 / Resistor01 | INT/UINT | 2 | ● | ● | | |
| 2 | Temperature02 / Resistor02 | INT/UINT | 2 | ● | ● | | |
| 16 | InputFilter | USINT | 1 | | ● | | ● |
| 18 | SensorType | USINT | 1 | | ● | | ● |
| 28 | IOCyclicCounter | USINT | 1 | | ● | | |
| 30 | StatusInput01 | USINT | 1 | | ● | | |

Table 365: Modbus/TCP data points - AT2222

2.7 Analog inputs

The converted analog values are output by the module in the registers. Different resistance or temperature measurements will result in different value ranges and data types.

2.8 Register: Temperature01 - Temperature02, Resistor01 - Resistor02

Analog input value with respect to operating mode:

| Input signal | Digital value |
|---|---|
| Sensor type PT100 | -2000 to +8500 (for -200.0°C to +850.0°C) |
| Sensor type PT1000 | -2000 to +8500 (for -200.0°C to +850.0°C) |
| Resistance measurement 0.1 Ω to 4500 Ω | 1 to 45000 (resolution 0.1 Ω) |
| Resistance measurement 0.05 Ω to 2250 Ω | 1 to 45000 (resolution 0.05 Ω) |

The following should be taken into consideration to ensure that the user always has a defined output value:

- Up to the first conversion, \$8000 is output.
- After switching the sensor type, \$8000 is output until the first conversion.
- If the input is not switched on, \$8000 is output.

2.9 Timing setting

The timing setting for data acquisition is made using the converter hardware. All switched on inputs are converted during each conversion cycle.

2.10 Conversion time

The conversion time for the channels depends on their use. For the formulas listed in the table, 'n' corresponds to the number of channels that are switched on.

| Channel uses | Conversion time |
|--|---|
| 1 channel | $1 \cdot \text{FilterTime}$ |
| n channels with the same sensor type | $n \cdot (20\text{ms} + \text{FilterTime})$ |
| n channels with different sensor types | $n \cdot (20\text{ms} + 2 \cdot \text{FilterTime})$ |

Table 366: Conversion time calculation - AT2222

2.11 Reduced refresh time

If an input is not necessary, it can be switched off, thereby reducing the refresh time. Inputs can also be only temporarily switched off.

The time saved is equal to:

$$\text{TimeSavings} = 2 \cdot 20\text{ms} + \text{FilterTime}$$

The filter time is the conversion time for the remaining channels.

Examples

The inputs are filtered using a 60 Hz filter.

| | Example 1 | Example 2 |
|--------------------|-----------|-----------|
| Switched on inputs | 1 | 1 - 2 |
| Conversion time | 16.7 ms | 73.4 ms |

Table 367: Example conversion time calculations - AT2222

2.12 Input filter

The filter time for all analog inputs is defined using the input filter parameter.

| Value | Filter | Filter time | Digital converter resolution |
|-------|---------|-------------|------------------------------|
| 0 | 15 Hz | 66.7 ms | 16-bit |
| 1 | 25 Hz | 40 ms | 16-bit |
| 2 | 30 Hz | 33.3 ms | 16-bit |
| 3 | 50 Hz | 20 ms | 16-bit |
| 4 | 60 Hz | 16.7 ms | 16-bit |
| 5 | 100 Hz | 10 ms | 16-bit |
| 6 | 500 Hz | 2 ms | 16-bit |
| 7 | 1000 Hz | 1 ms | 16-bit |

Table 368: Input filters - AT2222

2.13 Register: InputFilter

| Value | Description |
|-------|-------------|
| 0 - 7 | Filter time |

2.14 Sensor type and channel deactivation

The module is designed for temperature and resistance measurement. The sensor type must be specified because of the different adjustment values for temperature and resistance.

The default setting for all channels is ON. To save time, individual channels can be switched off (see section "Reduced refresh time" on page 227).

| Code | Input signal |
|------|---|
| 0 | Reserved |
| 1 | Reserved |
| 2 | Sensor type PT100 |
| 3 | Sensor type PT1000 |
| 4 | Reserved |
| 5 | Resistance measurement 0.1 Ω to 4500 Ω |
| 6 | Resistance measurement 0.05 Ω to 2250 Ω |
| 7 | Channel turned off |

Table 369: Setting the sensor type and channel deactivation - AT2222

2.15 Register: SensorType

| Bit | Description |
|-------|--|
| 0 - 3 | Channel 1: 0000 ...Reserved 0001 ...Reserved 0010 ...Sensor type PT100 0011 ...Sensor type PT1000 0100 ...Reserved 0101 ...Resistance measurement 0.1 Ω to 4500 Ω 0110 ...Resistance measurement 0.05 Ω to 2250 Ω 0111 ...Channel turned off |
| 4 - 7 | Channel 2: 0000 ...Reserved 0001 ...Reserved 0010 ...Sensor type PT100 0011 ...Sensor type PT1000 0100 ...Reserved 0101 ...Resistance measurement 0.1 Ω to 4500 Ω 0110 ...Resistance measurement 0.05 Ω to 2250 Ω 0111 ...Channel turned off |

2.16 Input status

The module's inputs are monitored. A change in monitoring status triggers an error message.

| Code | Channel x |
|------|-------------------------|
| 0 | No error |
| 1 | Below lower limit value |
| 2 | Above upper limit value |
| 3 | Wire break |

Table 370: Input status - AT2222

2.17 Register: StatusInput01

| Bit | Description |
|-------|--|
| 0 - 1 | Channel 1: 00 ... No error 01 ... Below lower limit value 10 ... Above upper limit value 11 ... Wire break |
| 2 - 3 | Channel 2: 00 ... No error 01 ... Below lower limit value 10 ... Above upper limit value 11 ... Wire break |
| 4 - 7 | 0 |

In addition to the status info, the error type also sets the analog value as follows:

| Error type | Temperature measurement Digital value for error | Resistance measurement Digital value for error |
|-------------------------|--|---|
| Wire break | +32767 (0x7FFF) | 65535 (0xFFFF) |
| Above upper limit value | +32767 (0x7FFF) | 65535 (0xFFFF) |
| Below lower limit value | -32767 (0x8001) | 0 (0x0000) |
| Invalid value | -32768 (0x8000) | 65535 (0xFFFF) |

2.18 IOcyclicCounter

The cyclic counter increases after all input data have been updated.

2.19 Register: IOcyclicCounter

| Value | Description |
|---------|-------------------|
| 0 - 255 | Repeating counter |

2.20 Function models

A function model describes the registers for the module (memory model) which are available for the application. Only these registers are processed on the module during each cycle and cyclically transferred using the bus. The cycle time can be minimized by selecting the correct function model.

Selection of connection type

For this module, the connection type is selected using function models 0 and 1.

| Function model | Connection type |
|----------------|-----------------------------|
| 0 | 3-line connection (default) |
| 1 | 2-line connection |

Table 371: Selection of connection type using function models - AT2222

The registers used are identical for all function models:

| Function models 0 and 1 | | | | | | | |
|-------------------------|----------------------------|-----------|--------|--------|---------|--------|---------|
| Register | Name | Data type | Length | Read | | Write | |
| | | | | Cyclic | Acyclic | Cyclic | Acyclic |
| 0 | Temperature01 / Resistor01 | INT/UINT | 2 | ● | ● | | |
| 2 | Temperature02 / Resistor02 | INT/UINT | 2 | ● | ● | | |
| 16 | InputFilter | USINT | 1 | | ● | ● | ● |
| 18 | SensorType | USINT | 1 | | ● | ● | ● |
| 28 | IOcyclicCounter | USINT | 1 | ● | ● | | |
| 30 | StatusInput01 | USINT | 1 | ● | ● | | |

Table 372: Function models 0 and 1 - AT2222

2.21 Function models - used where?

| Name | Automation Studio | CANopen | DeviceNet | Modbus/TCP | CAN I/O |
|---|-------------------|---------|-----------|------------|---------|
| Function model 0: 3-line connection (default) | ● | ● | ● | ● | ● |
| Function model 1: 2-line connection | ● | | | ● | |

Table 373: Function models - AT2222

2.22 B&R ID code

Code for module identification (\$1BA6).

2.23 Minimum cycle time

The minimum cycle time is the minimum time needed for the bus cycle to be shut down without a communication error occurring. It should be noted that very fast cycles have reduced the idle time needed for handling monitoring, diagnostics and acyclic commands.

| Minimum cycle time | |
|------------------------|------------------------|
| In each operating mode | $\geq 100 \mu\text{s}$ |

Table 374: Minimum cycle time - AT2222

2.24 Minimum I/O update time

The minimum I/O update time refers to the minimum time it takes for the bus cycle to shut down, so that in each cycle an I/O update takes place.

| Minimum I/O update time | |
|-------------------------|---|
| 1 input | Corresponds to the filter time |
| 2 inputs | $2 \cdot (20\text{ms} + \text{FilterTime})$ |

Table 375: Minimum I/O update time - AT4222

3. X20AT2402

3.1 Register overview

| Register | Name | Data type | Length | Read | | Write | |
|----------|---|-----------|--------|--------|---------|--------|---------|
| | | | | Cyclic | Acyclic | Cyclic | Acyclic |
| 0 | Temperature01 | INT | 2 | ● | ● | | |
| 2 | Temperature02 | INT | 2 | ● | ● | | |
| 12 | TerminalTemperature01 ¹⁾ | INT | 2 | | ● | | |
| | ExternalCompensationTemperature ²⁾ | | | | | ● | ● |
| 14 | TerminalTemperature02 | INT | 2 | | ● | | |
| 24 | InputFilter | USINT | 1 | | ● | ● | ● |
| 26 | SensorType | USINT | 1 | | ● | ● | ● |
| 27 | ChannelDeactivation | USINT | 1 | | ● | ● | ● |
| 28 | IOCyclicCounter | USINT | 1 | ● | ● | | |
| 30 | StatusInput01 | USINT | 1 | ● | ● | | |

Table 376: Register overview - AT2402

1) Only with function model 0: TerminalTemperature01

2) Only with function model 1: ExternalCompensationTemperature

3.2 Variable assignment in Automation Studio (X2X master)

| Name | Data type | Length | Read | | Write | |
|---|-----------|--------|--------|---------|--------|---------|
| | | | Cyclic | Acyclic | Cyclic | Acyclic |
| Temperature01 | INT | 2 | ● | | | |
| Temperature02 | INT | 2 | ● | | | |
| ExternalCompensationTemperature ¹⁾ | INT | 2 | | | ● | |
| IOCyclicCounter | USINT | 1 | ● | | | |
| StatusInput01 | USINT | 1 | ● | | | |
| CompensationTemperature ²⁾ | INT | 2 | | ● | | |

Table 377: Variable assignment in Automation Studio (X2X master) - AT2402

1) Only with function model 1: ExternalCompensationTemperature

2) Data point can only be read using the library

3.3 Variable assignment in Automation Studio (CANIO)

| Name | Data type | Length | Read | | Write | |
|-----------------|-----------|--------|--------|---------|--------|---------|
| | | | Cyclic | Acyclic | Cyclic | Acyclic |
| Temperature01 | INT | 2 | ● | | | |
| Temperature02 | INT | 2 | ● | | | |
| IOCyclicCounter | USINT | 1 | | ● | | |
| StatusInput01 | USINT | 1 | | ● | | |

Table 378: Variable assignment in Automation Studio (CANIO) - AT2402

3.4 CANopen data points

| Register | Name | Data type | Length | Read | | Write | |
|----------|-----------------------|-----------|--------|------|-----|-------|-----|
| | | | | PDO | SDO | PDO | SDO |
| 0 | Temperature01 | INT | 2 | ● | ● | | |
| 2 | Temperature02 | INT | 2 | ● | ● | | |
| 12 | TerminalTemperature01 | INT | 2 | | ● | | |
| 14 | TerminalTemperature02 | INT | 2 | | ● | | |
| 24 | InputFilter | USINT | 1 | | ● | | ● |
| 26 | SensorType | USINT | 1 | | ● | | ● |
| 27 | ChannelDeactivation | USINT | 1 | | ● | | ● |
| 28 | IOCyclicCounter | USINT | 1 | | ● | | |
| 30 | StatusInput01 | USINT | 1 | | ● | | |

Table 379: CANopen data points - AT2402

3.5 DeviceNet data points

| Register | Name | Data type | Length | Read | | Write | |
|----------|-----------------------|-----------|--------|--------|---------|--------|---------|
| | | | | Cyclic | Acyclic | Cyclic | Acyclic |
| 0 | Temperature01 | INT | 2 | ● | ● | | |
| 2 | Temperature02 | INT | 2 | ● | ● | | |
| 12 | TerminalTemperature01 | INT | 2 | | ● | | |
| 14 | TerminalTemperature02 | INT | 2 | | ● | | |
| 24 | InputFilter | USINT | 1 | | ● | | ● |
| 26 | SensorType | USINT | 1 | | ● | | ● |
| 27 | ChannelDeactivation | USINT | 1 | | ● | | ● |
| 28 | IOCyclicCounter | USINT | 1 | | ● | | |
| 30 | StatusInput01 | USINT | 1 | ● | ● | | |

Table 380: DeviceNet data points - AT2402

3.6 Modbus/TCP data points

| Register | Name | Data type | Length | Read | | Write | |
|----------|-----------------------|-----------|--------|--------|---------|--------|---------|
| | | | | Cyclic | Acyclic | Cyclic | Acyclic |
| 0 | Temperature01 | INT | 2 | ● | ● | | |
| 2 | Temperature02 | INT | 2 | ● | ● | | |
| 12 | TerminalTemperature01 | INT | 2 | | ● | | |
| 14 | TerminalTemperature02 | INT | 2 | | ● | | |
| 24 | InputFilter | USINT | 1 | | ● | | ● |
| 26 | SensorType | USINT | 1 | | ● | | ● |
| 27 | ChannelDeactivation | USINT | 1 | | ● | | ● |
| 28 | IOCyclicCounter | USINT | 1 | | ● | | |
| 30 | StatusInput01 | USINT | 1 | | ● | | |

Table 381: Modbus/TCP data points - AT2402

3.7 Analog inputs

The converted analog values are output by the module in the registers. The sensor type configured will affect the value ranges.

3.8 Register: Temperature01 - Temperature02

Analog input value with respect to sensor type:

| Input signal | Digital value |
|---|---|
| Type J (FeCuNi) | -2100 to +12000 (for -210.0°C to +1200.0°C) |
| Type K (NiCrNi) | -2700 to +13720 (for -270.0°C to +1372.0°C) |
| Type N (NiCrSi) | -2700 to +13000 (for -270.0°C to +1300.0°C) |
| Type S (PtRhPt) | -500 to +17680 (for -50.0°C to +1768.0°C) |
| Raw value without linearization and terminal temperature compensation Resolution 1.0625 μ V for a measurement range of ± 35 mV | -32768 to +32767 |
| Raw value without linearization and terminal temperature compensation Resolution 2.125 μ V for a measurement range of ± 70 mV | -32768 to +32767 |

The following should be taken into consideration to ensure that the user always has a defined output value:

- Up to the first conversion, \$8000 is output.
- After switching the sensor type, \$8000 is output until the first conversion.
- If the input is not switched on, \$8000 is output.

3.9 Raw value measurement

If a sensor type other than J, K, N or S is used, the terminal temperature must be measured on at least one input. Based on this value, the user must perform a terminal temperature compensation.

3.10 Timing setting

The timing setting for data acquisition is made using the converter hardware. All switched on inputs are converted during each conversion cycle. A terminal temperature measurement also takes place (not in function model 1).

If an input is not necessary, it can be switched off, thereby reducing the refresh time. Inputs can also be only temporarily switched off. The measurement of the terminal temperature is switched off in function model 1.

3.11 Conversion time

The conversion time depends on the number of channels and on the function model. For the formulas listed in the table, 'n' corresponds to the number of channels that are switched on.

| Function model | Conversion time |
|----------------------|--|
| Model 0 - n channels | $(n + 1) \cdot (2 \cdot \text{FilterTime} + 200\mu\text{s})$ |
| Model 1 - n channels | $n \cdot (2 \cdot \text{FilterTime} + 200\mu\text{s})$ |
| Model 1 - 1 channel | Corresponds to the filter time |

Table 382: Conversion time calculation - AT2402

Examples

The inputs are filtered using a 50 Hz filter.

| | Example 1 | | Example 2 | |
|--|------------------|------------------|------------------|------------------|
| | Function model 0 | Function model 1 | Function model 0 | Function model 1 |
| Switched on inputs | 1 | 1 | 1 - 2 | 1 - 2 |
| Conversion time | 40.2 ms | 20 ms | 80.4 ms | 80.4 ms |
| Conversion time for the terminal temperature | 40.2 ms | - | 40.2 ms | - |
| Total conversion time | 80.4 ms | 20 ms | 120.6 ms | 80.4 ms |

Table 383: Example conversion time calculations - AT2402

3.12 Compensation temperature

The module's compensation temperatures can be read.

3.13 Register: TerminalTemperature01 - TerminalTemperature02, CompensationTemperature

Analog input value:

| Input signal | Digital value |
|-----------------------------------|---------------------------------------|
| Compensation temperature (PT1000) | -250 to +850 (for -25.0°C to +85.0°C) |

3.14 Setting the external compensation temperature

For each module you can set the compensation temperature used for measurement correction.

3.15 Register: ExternalCompensationTemperature

Output value:

| Description | Digital value |
|---------------------------------|---------------------------------------|
| ExternalCompensationTemperature | -250 to +850 (for -25.0°C to +85.0°C) |

3.16 Input filter

The filter time for all analog inputs is defined using the input filter parameter.

| Value | Filter | Filter time | Digital converter resolution |
|-------|---------|-------------|------------------------------|
| 0 | 15 Hz | 66.7 ms | 16-bit |
| 1 | 25 Hz | 40 ms | 16-bit |
| 2 | 30 Hz | 33.3 ms | 16-bit |
| 3 | 50 Hz | 20 ms | 16-bit |
| 4 | 60 Hz | 16.7 ms | 16-bit |
| 5 | 100 Hz | 10 ms | 16-bit |
| 6 | 500 Hz | 2 ms | 16-bit |
| 7 | 1000 Hz | 1 ms | 16-bit |

Table 384: Input filter - AT2402

3.17 Register: InputFilter

| Value | Description |
|-------|-------------|
| 0 - 7 | Filter time |

3.18 Sensor type

The module is designed for various sensor types. The sensor type must be specified because of the different adjustment values.

| Code | Input signal |
|------|---|
| 0 | Conversion switched off |
| 1 | Sensor type J |
| 2 | Sensor type K |
| 3 | Sensor type S |
| 4 | Sensor type N |
| 5 | Conversion switched off |
| 6 | Raw value without linearization and terminal temperature compensation Resolution 1.0625 μ V for a measurement range of ± 35 mV |
| 7 | Raw value without linearization and terminal temperature compensation Resolution 2.125 μ V for a measurement range of ± 70 mV |

Table 385: Setting the sensor type - AT2402

3.19 Register: SensorType

| Bit | Description |
|-------|--|
| 0 - 2 | Defines sensor: 000 ... Sensor switched off 001 ... Sensor type J 010 ... Sensor type K 011 ... Sensor type S 100 ... Sensor type N 101 ... Sensor switched off 110 ... Raw value without linearization and terminal temperature compensation Resolution 1.0625 μ V for a measurement range of ± 35 mV 111 ... Raw value without linearization and terminal temperature compensation Resolution 2.125 μ V for a measurement range of ± 70 mV |
| 3 - 7 | 0 |

3.20 Channel deactivation

The default setting for all channels is ON. To save time, individual channels can be switched off (see section "Conversion time" on page 235).

| Code | Description |
|------|-------------------------|
| 0 | Channel x: Switched off |
| 1 | Channel x: Switched on |

Table 386: Channel deactivation - AT2402

3.21 Register: ChannelDeactivation

| Bit | Description |
|-------|-------------------------------------|
| 0 | Channel 1: 0 ... Off 1 ... On |
| 1 | Channel 2: 0 ... Off 1 ... On |
| 2 - 7 | 0 |

3.22 Input status

The module's inputs are monitored. A change in monitoring status triggers an error message.

| Code | Channel x |
|------|-------------------------|
| 0 | No error |
| 1 | Below lower limit value |
| 2 | Above upper limit value |
| 3 | Wire break |

Table 387: Input status - AT2402

3.23 Register: StatusInput01

| Bit | Description |
|-------|--|
| 0 - 1 | Channel 1: 00 ... No error 01 ... Below lower limit value 10 ... Above upper limit value 11 ... Wire break |
| 2 - 3 | Channel 2: 00 ... No error 01 ... Below lower limit value 10 ... Above upper limit value 11 ... Wire break |
| 4 - 7 | 0 |

In addition to the status info, the error type also sets the analog value as follows:

| Error type | Digital value for error |
|-------------------------|-------------------------|
| Wire break | +32767 (0x7FFF) |
| Above upper limit value | +32767 (0x7FFF) |
| Below lower limit value | -32767 (0x8001) |
| Invalid value | -32768 (0x8000) |

3.24 IOcyclicCounter

The cyclic counter increases after all input data have been updated.

3.24.1 Register: IOcyclicCounter

| Value | Description |
|---------|-------------------|
| 0 - 255 | Repeating counter |

3.25 Function models

A function model describes the registers for the module (memory model) which are available for the application. Only these registers are processed on the module during each cycle and cyclically transferred using the bus. The cycle time can be minimized by selecting the correct function model.

3.25.1 Selection of terminal temperature compensation

For this module, the terminal temperature compensation is selected using function models 0 and 1.

| Function model | Terminal temperature compensation |
|----------------|---|
| 0 | Internal compensation temperature (default) |
| 1 | ExternalCompensationTemperature |

Table 388: Selection of compensation type using function models - AT2402

3.25.2 Function models - Internal compensation temperature (default)

| Function model 0 | | | | | | | |
|------------------|---------------------|-----------|--------|--------|---------|--------|---------|
| Register | Name | Data type | Length | Read | | Write | |
| | | | | Cyclic | Acyclic | Cyclic | Acyclic |
| 0 | Temperature01 | INT | 2 | ● | ● | | |
| 2 | Temperature02 | INT | 2 | ● | ● | | |
| 24 | InputFilter | USINT | 1 | | ● | ● | ● |
| 26 | SensorType | USINT | 1 | | ● | ● | ● |
| 27 | ChannelDeactivation | USINT | 1 | | ● | ● | ● |
| 28 | IOCyclicCounter | USINT | 1 | ● | ● | | |
| 30 | StatusInput01 | USINT | 1 | ● | ● | | |

Table 389: Function model 0: Internal compensation temperature (default) - AT2402

3.25.3 Function models - External compensation temperature

| Function model 1 | | | | | | | |
|------------------|---------------------------------|-----------|--------|--------|---------|--------|---------|
| Register | Name | Data type | Length | Read | | Write | |
| | | | | Cyclic | Acyclic | Cyclic | Acyclic |
| 0 | Temperature01 | INT | 2 | ● | ● | | |
| 2 | Temperature02 | INT | 2 | ● | ● | | |
| 12 | ExternalCompensationTemperature | INT | 2 | | | ● | ● |
| 24 | InputFilter | USINT | 1 | | ● | ● | ● |
| 26 | SensorType | USINT | 1 | | ● | ● | ● |
| 27 | ChannelDeactivation | USINT | 1 | | ● | ● | ● |
| 28 | IOCyclicCounter | USINT | 1 | ● | ● | | |
| 30 | StatusInput01 | USINT | 1 | ● | ● | | |

Table 390: Function model 0: External compensation temperature - AT2402

3.26 Function models - used where?

| Name | Automation Studio | CANopen | DeviceNet | Modbus/TCP | CAN I/O |
|---|-------------------|---------|-----------|------------|---------|
| Function model 0: Internal compensation temperature (default) | ● | ● | ● | ● | ● |
| Function model 1: External compensation temperature | ● | | | ● | |

Table 391: Function models - AT2402

3.27 B&R ID code

Code for module identification (\$1BA8).

3.28 Minimum cycle time

The minimum cycle time is the minimum time needed for the bus cycle to be shut down without a communication error occurring. It should be noted that very fast cycles have reduced the idle time needed for handling monitoring, diagnostics and acyclic commands.

| Minimum cycle time | |
|---|------------------------|
| In each operating mode and function model | $\geq 150 \mu\text{s}$ |

Table 392: Minimum cycle time - AT2402

3.29 Minimum I/O update time

The minimum I/O update time refers to the minimum time it takes for the bus cycle to shut down, so that in each cycle an I/O update takes place.

For the formulas listed in the table, 'n' corresponds to the number of channels that are switched on.

| Minimum I/O update time - function model 0 | |
|--|--|
| n inputs | $(n + 1) \cdot (\text{FilterTime} + 200\mu\text{s})$ |

Table 393: Minimum I/O update time (function model 0) - AT2402

| Minimum I/O update time - function model 1 | |
|--|--|
| 1 input | Corresponds to the filter time |
| n inputs | $n \cdot (\text{FilterTime} + 200\mu\text{s})$ |

Table 394: Minimum I/O update time (function model 1) - AT2402

4. X20AT4222

4.1 Register overview

| Register | Name | Data type | Length | Read | | Write | |
|----------|----------------------------|-----------|--------|--------|---------|--------|---------|
| | | | | Cyclic | Acyclic | Cyclic | Acyclic |
| 0 | Temperature01 / Resistor01 | INT/UINT | 2 | ● | ● | | |
| 2 | Temperature02 / Resistor02 | INT/UINT | 2 | ● | ● | | |
| 4 | Temperature03 / Resistor03 | INT/UINT | 2 | ● | ● | | |
| 6 | Temperature04 / Resistor04 | INT/UINT | 2 | ● | ● | | |
| 16 | InputFilter | USINT | 1 | | ● | ● | ● |
| 18 | SensorType | UINT | 2 | | ● | ● | ● |
| 28 | IOCyclicCounter | USINT | 1 | ● | ● | | |
| 30 | StatusInput01 | USINT | 1 | ● | ● | | |

Table 395: Register overview - AT4222

4.2 Variable assignment in Automation Studio (X2X master)

| Name | Data type | Length | Read | | Write | |
|----------------------------|-----------|--------|--------|---------|--------|---------|
| | | | Cyclic | Acyclic | Cyclic | Acyclic |
| Temperature01 / Resistor01 | INT/UINT | 2 | ● | | | |
| Temperature02 / Resistor02 | INT/UINT | 2 | ● | | | |
| Temperature03 / Resistor03 | INT/UINT | 2 | ● | | | |
| Temperature04 / Resistor04 | INT/UINT | 2 | ● | | | |
| IOCyclicCounter | USINT | 1 | ● | | | |
| StatusInput01 | USINT | 1 | ● | | | |

Table 396: Variable assignment in Automation Studio (X2X master) - AT4222

4.3 Variable assignment in Automation Studio (CANIO)

| Name | Data type | Length | Read | | Write | |
|----------------------------|-----------|--------|--------|---------|--------|---------|
| | | | Cyclic | Acyclic | Cyclic | Acyclic |
| Temperature01 / Resistor01 | INT/UINT | 2 | ● | | | |
| Temperature02 / Resistor02 | INT/UINT | 2 | ● | | | |
| Temperature03 / Resistor03 | INT/UINT | 2 | ● | | | |
| Temperature04 / Resistor04 | INT/UINT | 2 | ● | | | |
| IOCyclicCounter | USINT | 1 | | ● | | |
| StatusInput01 | USINT | 1 | | ● | | |

Table 397: Variable assignment in Automation Studio (CANIO) - AT4222

4.4 CANopen data points

| Register | Name | Data type | Length | Read | | Write | |
|----------|----------------------------|-----------|--------|------|-----|-------|-----|
| | | | | PDO | SDO | PDO | SDO |
| 0 | Temperature01 / Resistor01 | INT/UINT | 2 | ● | ● | | |
| 2 | Temperature02 / Resistor02 | INT/UINT | 2 | ● | ● | | |
| 4 | Temperature03 / Resistor03 | INT/UINT | 2 | ● | ● | | |
| 6 | Temperature04 / Resistor04 | INT/UINT | 2 | ● | ● | | |
| 16 | InputFilter | USINT | 1 | | ● | | ● |
| 18 | SensorType | UINT | 2 | | ● | | ● |
| 28 | IOCyclicCounter | USINT | 1 | | ● | | |
| 30 | StatusInput01 | USINT | 1 | | ● | | |

Table 398: CANopen data points - AT4222

4.5 DeviceNet data points

| Register | Name | Data type | Length | Read | | Write | |
|----------|----------------------------|-----------|--------|--------|---------|--------|---------|
| | | | | Cyclic | Acyclic | Cyclic | Acyclic |
| 0 | Temperature01 / Resistor01 | INT/UINT | 2 | ● | ● | | |
| 2 | Temperature02 / Resistor02 | INT/UINT | 2 | ● | ● | | |
| 4 | Temperature03 / Resistor03 | INT/UINT | 2 | ● | ● | | |
| 6 | Temperature04 / Resistor04 | INT/UINT | 2 | ● | ● | | |
| 16 | InputFilter | USINT | 1 | | ● | | ● |
| 18 | SensorType | UINT | 2 | | ● | | ● |
| 28 | IOCyclicCounter | USINT | 1 | | ● | | |
| 30 | StatusInput01 | USINT | 1 | ● | ● | | |

Table 399: DeviceNet data points - AT4222

4.6 Modbus/TCP data points

| Register | Name | Data type | Length | Read | | Write | |
|----------|----------------------------|-----------|--------|--------|---------|--------|---------|
| | | | | Cyclic | Acyclic | Cyclic | Acyclic |
| 0 | Temperature01 / Resistor01 | INT/UINT | 2 | ● | ● | | |
| 2 | Temperature02 / Resistor02 | INT/UINT | 2 | ● | ● | | |
| 4 | Temperature03 / Resistor03 | INT/UINT | 2 | ● | ● | | |
| 6 | Temperature04 / Resistor04 | INT/UINT | 2 | ● | ● | | |
| 16 | InputFilter | USINT | 1 | | ● | ● | ● |
| 18 | SensorType | UINT | 2 | | ● | ● | ● |
| 28 | IOCyclicCounter | USINT | 1 | | ● | | |
| 30 | StatusInput01 | USINT | 1 | | ● | | |

Table 400: Modbus/TCP data points - AT4222

4.7 Analog inputs

The converted analog values are output by the module in the registers. Different resistance or temperature measurements will result in different value ranges and data types.

4.8 Register: Temperature01 - Temperature04, Resistor01 - Resistor04

Analog input value with respect to operating mode:

| Input signal | Digital value |
|---|---|
| Sensor type PT100 | -2000 to +8500 (for -200.0°C to +850.0°C) |
| Sensor type PT1000 | -2000 to +8500 (for -200.0°C to +850.0°C) |
| Resistance measurement 0.1 Ω to 4500 Ω | 1 to 45000 (resolution 0.1 Ω) |
| Resistance measurement 0.05 Ω to 2250 Ω | 1 to 45000 (resolution 0.05 Ω) |

The following should be taken into consideration to ensure that the user always has a defined output value:

- Up to the first conversion, \$8000 is output.
- After switching the sensor type, \$8000 is output until the first conversion.
- If the input is not switched on, \$8000 is output.

4.9 Timing setting

The timing setting for data acquisition is made using the converter hardware. All switched on inputs are converted during each conversion cycle.

4.10 Conversion time

The conversion time for the channels depends on their use. For the formulas listed in the table, 'n' corresponds to the number of channels that are switched on.

| Channel uses | Conversion time |
|--|---|
| 1 channel | $1 \cdot \text{FilterTime}$ |
| n channels with the same sensor type | $n \cdot (20\text{ms} + \text{FilterTime})$ |
| n channels with different sensor types | $n \cdot (20\text{ms} + 2 \cdot \text{FilterTime})$ |

Table 401: Conversion time calculation - AT4222

4.11 Reduced refresh time

If an input is not necessary, it can be switched off, thereby reducing the refresh time. Inputs can also be only temporarily switched off.

Calculating the time saved

The amount of time saved can be calculated with the following formula. And 'n' corresponds to the number of inputs that are switched off.

$$\text{TimeSavings} = n \cdot (20\text{ms} + \text{FilterTime})$$

Examples

The inputs are filtered using a 60 Hz filter.

| | Example 1 | Example 2 | Example 3 |
|--------------------|-----------|-----------|-----------|
| Switched on inputs | 1 | 1, 3 | 1 - 4 |
| Conversion time | 16.7 ms | 73.4 ms | 146.8 ms |

Table 402: Example conversion time calculations - AT4222

4.12 Input filter

The filter time for all analog inputs is defined using the input filter parameter.

| Value | Filter | Filter time | Digital converter resolution |
|-------|---------|-------------|------------------------------|
| 0 | 15 Hz | 66.7 ms | 16-bit |
| 1 | 25 Hz | 40 ms | 16-bit |
| 2 | 30 Hz | 33.3 ms | 16-bit |
| 3 | 50 Hz | 20 ms | 16-bit |
| 4 | 60 Hz | 16.7 ms | 16-bit |
| 5 | 100 Hz | 10 ms | 16-bit |
| 6 | 500 Hz | 2 ms | 16-bit |
| 7 | 1000 Hz | 1 ms | 16-bit |

Table 403: Input filters - AT4222

4.13 Register: InputFilter

| Value | Description |
|-------|-------------|
| 0 - 7 | Filter time |

4.14 Sensor type and channel deactivation

The module is designed for temperature and resistance measurement. The sensor type must be specified because of the different adjustment values for temperature and resistance.

The default setting for all channels is ON. To save time, individual channels can be switched off (see section "Reduced refresh time" on page 245).

| Code | Input signal |
|------|---|
| 0 | Reserved |
| 1 | Reserved |
| 2 | Sensor type PT100 |
| 3 | Sensor type PT1000 |
| 4 | Reserved |
| 5 | Resistance measurement 0.1 Ω to 4500 Ω |
| 6 | Resistance measurement 0.05 Ω to 2250 Ω |
| 7 | Channel turned off |

Table 404: Setting the sensor type and channel deactivation - AT4222

4.15 Register: SensorType

| Bit | Description |
|---------|--|
| 0 - 3 | Channel 1: 0000 ...Reserved 0001 ...Reserved 0010 ...Sensor type PT100 0011 ...Sensor type PT1000 0100 ...Reserved 0101 ...Resistance measurement 0.1 Ω to 4500 Ω 0110 ...Resistance measurement 0.05 Ω to 2250 Ω 0111 ...Channel turned off |
| 4 - 7 | Channel 2: 0000 ...Reserved 0001 ...Reserved 0010 ...Sensor type PT100 0011 ...Sensor type PT1000 0100 ...Reserved 0101 ...Resistance measurement 0.1 Ω to 4500 Ω 0110 ...Resistance measurement 0.05 Ω to 2250 Ω 0111 ...Channel turned off |
| 8 - 11 | Channel 3: 0000 ...Reserved 0001 ...Reserved 0010 ...Sensor type PT100 0011 ...Sensor type PT1000 0100 ...Reserved 0101 ...Resistance measurement 0.1 Ω to 4500 Ω 0110 ...Resistance measurement 0.05 Ω to 2250 Ω 0111 ...Input switched off |
| 12 - 15 | Channel 4: 0000 ...Reserved 0001 ...Reserved 0010 ...Sensor type PT100 0011 ...Sensor type PT1000 0100 ...Reserved 0101 ...Resistance measurement 0.1 Ω to 4500 Ω 0110 ...Resistance measurement 0.05 Ω to 2250 Ω 0111 ...Input switched off |

4.16 Input status

The module's inputs are monitored. A change in monitoring status triggers an error message.

| Code | Channel x |
|------|-------------------------|
| 0 | No error |
| 1 | Below lower limit value |
| 2 | Above upper limit value |
| 3 | Wire break |

Table 405: Input status - AT4222

4.17 Register: StatusInput01

| Bit | Description |
|-------|--|
| 0 - 1 | Channel 1: 00 ... No error 01 ... Below lower limit value 10 ... Above upper limit value 11 ... Wire break |
| 2 - 3 | Channel 2: 00 ... No error 01 ... Below lower limit value 10 ... Above upper limit value 11 ... Wire break |
| 4 - 5 | Channel 3: 00 ... No error 01 ... Below lower limit value 10 ... Above upper limit value 11 ... Wire break |
| 6 - 7 | Channel 4: 00 ... No error 01 ... Below lower limit value 10 ... Above upper limit value 11 ... Wire break |

In addition to the status info, the error type also sets the analog value as follows:

| Error type | Temperature measurement Digital value for error | Resistance measurement Digital value for error |
|-------------------------|--|---|
| Wire break | +32767 (0x7FFF) | 65535 (0xFFFF) |
| Above upper limit value | +32767 (0x7FFF) | 65535 (0xFFFF) |
| Below lower limit value | -32767 (0x8001) | 0 (0x0000) |
| Invalid value | -32768 (0x8000) | 65535 (0xFFFF) |

4.18 IOcyclicCounter

The cyclic counter increases after all input data have been updated.

4.19 Register: IOcyclicCounter

| Value | Description |
|---------|-------------------|
| 0 - 255 | Repeating counter |

4.20 Function models

A function model describes the registers for the module (memory model) which are available for the application. Only these registers are processed on the module during each cycle and cyclically transferred using the bus. The cycle time can be minimized by selecting the correct function model.

4.20.1 Selection of connection type

For this module, the connection type is selected using function models 0 and 1.

| Function model | Connection type |
|----------------|-----------------------------|
| 0 | 3-line connection (default) |
| 1 | 2-line connection |

Table 406: Selection of connection type using function models - AT4222

4.20.2 The registers used are identical for all function models:

| Function models 0 and 1 | | | | | | | |
|-------------------------|----------------------------|-----------|--------|--------|---------|--------|---------|
| Register | Name | Data type | Length | Read | | Write | |
| | | | | Cyclic | Acyclic | Cyclic | Acyclic |
| 0 | Temperature01 / Resistor01 | INT/UINT | 2 | ● | ● | | |
| 2 | Temperature02 / Resistor02 | INT/UINT | 2 | ● | ● | | |
| 4 | Temperature03 / Resistor03 | INT/UINT | 2 | ● | ● | | |
| 6 | Temperature04 / Resistor04 | INT/UINT | 2 | ● | ● | | |
| 16 | Input filter | USINT | 1 | | ● | ● | ● |
| 18 | SensorType | UINT | 2 | | ● | ● | ● |
| 28 | IOcyclicCounter | USINT | 1 | ● | ● | | |
| 30 | StatusInput01 | USINT | 1 | ● | ● | | |

Table 407: Function models 0 and 1 - AT4222

4.21 Function models - used where?

| Name | Automation Studio | CANopen | DeviceNet | Modbus/TCP | CAN I/O |
|---|-------------------|---------|-----------|------------|---------|
| Function model 0: 3-line connection (default) | • | • | • | • | • |
| Function model 1: 2-line connection | • | | | • | |

Table 408: Function models - AT4222

4.22 B&R ID code

Code for module identification (\$1BA7).

4.23 Minimum cycle time

The minimum cycle time is the minimum time needed for the bus cycle to be shut down without a communication error occurring. It should be noted that very fast cycles have reduced the idle time needed for handling monitoring, diagnostics and acyclic commands.

| Minimum cycle time | |
|------------------------|------------------------|
| In each operating mode | $\geq 100 \mu\text{s}$ |

Table 409: Minimum cycle time - AT4222

4.24 Minimum I/O update time

The minimum I/O update time refers to the minimum time it takes for the bus cycle to shut down, so that in each cycle an I/O update takes place.

| Minimum I/O update time | |
|-------------------------|---|
| 1 input | Corresponds to the filter time |
| n inputs | $n \cdot (20\text{ms} + \text{FilterTime})$ |

Table 410: Minimum I/O update time - AT4222

5. X20AT6402

5.1 Register overview

| Register | Name | Data type | Length | Read | | Write | |
|----------|---|-----------|--------|--------|---------|--------|---------|
| | | | | Cyclic | Acyclic | Cyclic | Acyclic |
| 0 | Temperature01 | INT | 2 | ● | ● | | |
| 2 | Temperature02 | INT | 2 | ● | ● | | |
| 4 | Temperature03 | INT | 2 | ● | ● | | |
| 6 | Temperature04 | INT | 2 | ● | ● | | |
| 8 | Temperature05 | INT | 2 | ● | ● | | |
| 10 | Temperature06 | INT | 2 | ● | ● | | |
| 12 | TerminalTemperature01 ¹⁾ | INT | 2 | | ● | | |
| | ExternalCompensationTemperature ²⁾ | | | | | ● | ● |
| 14 | TerminalTemperature02 | INT | 2 | | ● | | |
| 16 | TerminalTemperature03 | INT | 2 | | ● | | |
| 18 | TerminalTemperature04 | INT | 2 | | ● | | |
| 20 | TerminalTemperature05 | INT | 2 | | ● | | |
| 22 | TerminalTemperature06 | INT | 2 | | ● | | |
| 24 | InputFilter | USINT | 1 | | ● | ● | ● |
| 26 | SensorType | USINT | 1 | | ● | ● | ● |
| 27 | ChannelDeactivation | USINT | 1 | | ● | ● | ● |
| 28 | IOCyclicCounter | USINT | 1 | ● | ● | | |
| 30 | StatusInput01 | USINT | 1 | ● | ● | | |
| 31 | StatusInput02 | USINT | 1 | ● | ● | | |

Table 411: Register overview - AT6402

1) Only with function model 0: TerminalTemperature01

2) Only with function model 1: ExternalCompensationTemperature

5.2 Variable assignment in Automation Studio (X2X master)

| Name | Data type | Length | Read | | Write | |
|---|-----------|--------|--------|---------|--------|---------|
| | | | Cyclic | Acyclic | Cyclic | Acyclic |
| Temperature01 | INT | 2 | ● | | | |
| Temperature02 | INT | 2 | ● | | | |
| Temperature03 | INT | 2 | ● | | | |
| Temperature04 | INT | 2 | ● | | | |
| Temperature05 | INT | 2 | ● | | | |
| Temperature06 | INT | 2 | ● | | | |
| ExternalCompensationTemperature ¹⁾ | INT | 2 | | | ● | |
| IOCyclicCounter | USINT | 1 | ● | | | |
| StatusInput01 | USINT | 1 | ● | | | |
| StatusInput02 | USINT | 1 | ● | | | |
| CompensationTemperature ²⁾ | INT | 2 | | ● | | |

Table 412: Variable assignment in Automation Studio (X2X master) - AT6402

1) Only with function model 1: ExternalCompensationTemperature

2) Data point can only be read using the library

5.3 Variable assignment in Automation Studio (CANIO)

| Name | Data type | Length | Read | | Write | |
|-----------------|-----------|--------|--------|---------|--------|---------|
| | | | Cyclic | Acyclic | Cyclic | Acyclic |
| Temperature01 | INT | 2 | ● | | | |
| Temperature02 | INT | 2 | ● | | | |
| Temperature03 | INT | 2 | ● | | | |
| Temperature04 | INT | 2 | ● | | | |
| Temperature05 | INT | 2 | ● | | | |
| Temperature06 | INT | 2 | ● | | | |
| IOCyclicCounter | USINT | 1 | | ● | | |
| StatusInput01 | USINT | 1 | | ● | | |
| StatusInput02 | USINT | 1 | | ● | | |

Table 413: Variable assignment in Automation Studio (CANIO) - AT6402

5.4 CANopen data points

| Register | Name | Data type | Length | Read | | Write | |
|----------|-----------------------|-----------|--------|------|-----|-------|-----|
| | | | | PDO | SDO | PDO | SDO |
| 0 | Temperature01 | INT | 2 | ● | ● | | |
| 2 | Temperature02 | INT | 2 | ● | ● | | |
| 4 | Temperature03 | INT | 2 | ● | ● | | |
| 6 | Temperature04 | INT | 2 | ● | ● | | |
| 8 | Temperature05 | INT | 2 | ● | ● | | |
| 10 | Temperature06 | INT | 2 | ● | ● | | |
| 12 | TerminalTemperature01 | INT | 2 | | ● | | |
| 14 | TerminalTemperature02 | INT | 2 | | ● | | |
| 16 | TerminalTemperature03 | INT | 2 | | ● | | |
| 18 | TerminalTemperature04 | INT | 2 | | ● | | |
| 20 | TerminalTemperature05 | INT | 2 | | ● | | |
| 22 | TerminalTemperature06 | INT | 2 | | ● | | |
| 24 | InputFilter | USINT | 1 | | ● | | ● |
| 26 | SensorType | USINT | 1 | | ● | | ● |
| 27 | ChannelDeactivation | USINT | 1 | | ● | | ● |
| 28 | IOCyclicCounter | USINT | 1 | | ● | | |
| 30 | StatusInput01 | USINT | 1 | | ● | | |
| 31 | StatusInput02 | USINT | 1 | | ● | | |

Table 414: CANopen data points - AT6402

5.5 DeviceNet data points

| Register | Name | Data type | Length | Read | | Write | |
|----------|-----------------------|-----------|--------|--------|---------|--------|---------|
| | | | | Cyclic | Acyclic | Cyclic | Acyclic |
| 0 | Temperature01 | INT | 2 | ● | ● | | |
| 2 | Temperature02 | INT | 2 | ● | ● | | |
| 4 | Temperature03 | INT | 2 | ● | ● | | |
| 6 | Temperature04 | INT | 2 | ● | ● | | |
| 8 | Temperature05 | INT | 2 | ● | ● | | |
| 10 | Temperature06 | INT | 2 | ● | ● | | |
| 12 | TerminalTemperature01 | INT | 2 | | ● | | |
| 14 | TerminalTemperature02 | INT | 2 | | ● | | |
| 16 | TerminalTemperature03 | INT | 2 | | ● | | |
| 18 | TerminalTemperature04 | INT | 2 | | ● | | |
| 20 | TerminalTemperature05 | INT | 2 | | ● | | |
| 22 | TerminalTemperature06 | INT | 2 | | ● | | |
| 24 | InputFilter | USINT | 1 | | ● | | ● |
| 26 | SensorType | USINT | 1 | | ● | | ● |
| 27 | ChannelDeactivation | USINT | 1 | | ● | | ● |
| 28 | IOCyclicCounter | USINT | 1 | | ● | | |
| 30 | StatusInput01 | USINT | 1 | ● | ● | | |
| 31 | StatusInput02 | USINT | 1 | ● | ● | | |

Table 415: DeviceNet data points - AT6402

5.6 Modbus/TCP data points

| Register | Name | Data type | Length | Read | | Write | |
|----------|-----------------------|-----------|--------|--------|---------|--------|---------|
| | | | | Cyclic | Acyclic | Cyclic | Acyclic |
| 0 | Temperature01 | INT | 2 | ● | ● | | |
| 2 | Temperature02 | INT | 2 | ● | ● | | |
| 4 | Temperature03 | INT | 2 | ● | ● | | |
| 6 | Temperature04 | INT | 2 | ● | ● | | |
| 8 | Temperature05 | INT | 2 | ● | ● | | |
| 10 | Temperature06 | INT | 2 | ● | ● | | |
| 12 | TerminalTemperature01 | INT | 2 | | ● | | |
| 14 | TerminalTemperature02 | INT | 2 | | ● | | |
| 16 | TerminalTemperature03 | INT | 2 | | ● | | |
| 18 | TerminalTemperature04 | INT | 2 | | ● | | |
| 20 | TerminalTemperature05 | INT | 2 | | ● | | |
| 22 | TerminalTemperature06 | INT | 2 | | ● | | |
| 24 | InputFilter | USINT | 1 | | ● | | ● |
| 26 | SensorType | USINT | 1 | | ● | | ● |
| 27 | ChannelDeactivation | USINT | 1 | | ● | | ● |
| 28 | IOCyclicCounter | USINT | 1 | | ● | | |
| 30 | StatusInput01 | USINT | 1 | | ● | | |
| 31 | StatusInput02 | USINT | 1 | | ● | | |

Table 416: Modbus/TCP data points - AT6402

5.7 Analog inputs

The converted analog values are output by the module in the registers. The sensor type configured will affect the value ranges.

5.8 Register: Temperature01 - Temperature06

Analog input value with respect to sensor type:

| Input signal | Digital value |
|---|---|
| Type J (FeCuNi) | -2100 to +12000 (for -210.0°C to +1200.0°C) |
| Type K (NiCrNi) | -2700 to +13720 (for -270.0°C to +1372.0°C) |
| Type N (NiCrSi) | -2700 to +13000 (for -270.0°C to +1300.0°C) |
| Type S (PtRhPt) | -500 to +17680 (for -50.0°C to +1768.0°C) |
| Raw value without linearization and terminal temperature compensation Resolution 1.0625 μ V for a measurement range of ± 35 mV | -32768 to +32767 |
| Raw value without linearization and terminal temperature compensation Resolution 2.125 μ V for a measurement range of ± 70 mV | -32768 to +32767 |

The following should be taken into consideration to ensure that the user always has a defined output value:

- Up to the first conversion, \$8000 is output.
- After switching the sensor type, \$8000 is output until the first conversion.
- If the input is not switched on, \$8000 is output.

5.9 Raw value measurement

If a sensor type other than J, K, N or S is used, the terminal temperature must be measured on at least one input. Based on this value, the user must perform a terminal temperature compensation.

5.10 Timing setting

The timing setting for data acquisition is made using the converter hardware. All switched on inputs are converted during each conversion cycle. A terminal temperature measurement also takes place (not in function model 1).

If an input is not necessary, it can be switched off, thereby reducing the refresh time. Inputs can also be only temporarily switched off. The measurement of the terminal temperature is switched off in function model 1.

5.11 Conversion time

The conversion time depends on the number of channels and on the function model. For the formulas listed in the table, 'n' corresponds to the number of channels that are switched on.

| Function model | Conversion time |
|----------------------|--|
| Model 0 - n channels | $(n + 1) \cdot (2 \cdot \text{FilterTime} + 200\mu\text{s})$ |
| Model 1 - n channels | $n \cdot (2 \cdot \text{FilterTime} + 200\mu\text{s})$ |
| Model 1 - 1 channel | Corresponds to the filter time |

Table 417: Conversion time calculation - AT6402

Examples

The inputs are filtered using a 50 Hz filter.

| | Example 1 | | Example 2 | |
|--|------------------|------------------|------------------|------------------|
| | Function model 0 | Function model 1 | Function model 0 | Function model 1 |
| Switched on inputs | 1 | 1 | 1 - 6 | 1 - 6 |
| Conversion time | 40.2 ms | 20 ms | 241.2 ms | 241.2 ms |
| Conversion time for the terminal temperature | 40.2 ms | - | 40.2 ms | - |
| Total conversion time | 80.4 ms | 20 ms | 281.4 ms | 241.2 ms |

Table 418: Example conversion time calculations - AT6402

5.12 Compensation temperature

The module's compensation temperatures can be read.

5.13 Register: TerminalTemperature01 - TerminalTemperature06, CompensationTemperature

Analog input value:

| Input signal | Digital value |
|-----------------------------------|---------------------------------------|
| Compensation temperature (PT1000) | -250 to +850 (for -25.0°C to +85.0°C) |

5.14 Setting the external compensation temperature

For each module you can set the compensation temperature used for measurement correction.

5.15 Register: ExternalCompensationTemperature

Output value:

| Description | Digital value |
|---------------------------------|---------------------------------------|
| ExternalCompensationTemperature | -250 to +850 (for -25.0°C to +85.0°C) |

5.16 Input filter

The filter time for all analog inputs is defined using the input filter parameter.

| Value | Filter | Filter time | Digital converter resolution |
|-------|---------|-------------|------------------------------|
| 0 | 15 Hz | 66.7 ms | 16-bit |
| 1 | 25 Hz | 40 ms | 16-bit |
| 2 | 30 Hz | 33.3 ms | 16-bit |
| 3 | 50 Hz | 20 ms | 16-bit |
| 4 | 60 Hz | 16.7 ms | 16-bit |
| 5 | 100 Hz | 10 ms | 16-bit |
| 6 | 500 Hz | 2 ms | 16-bit |
| 7 | 1000 Hz | 1 ms | 16-bit |

Table 419: Input filter - AT6402

5.17 Register: InputFilter

| Value | Description |
|-------|-------------|
| 0 - 7 | Filter time |

5.18 Sensor type

The module is designed for various sensor types. The sensor type must be specified because of the different adjustment values.

| Code | Input signal |
|------|---|
| 0 | Conversion switched off |
| 1 | Sensor type J |
| 2 | Sensor type K |
| 3 | Sensor type S |
| 4 | Sensor type N |
| 5 | Conversion switched off |
| 6 | Raw value without linearization and terminal temperature compensation Resolution 1.0625 μ V for a measurement range of ± 35 mV |
| 7 | Raw value without linearization and terminal temperature compensation Resolution 2.125 μ V for a measurement range of ± 70 mV |

Table 420: Setting the sensor type - AT6402

5.19 Register: SensorType

| Bit | Description |
|-------|--|
| 0 - 2 | Defines sensor: 000 ... Sensor switched off 001 ... Sensor type J 010 ... Sensor type K 011 ... Sensor type S 100 ... Sensor type N 101 ... Sensor switched off 110 ... Raw value without linearization and terminal temperature compensation Resolution 1.0625 μ V for a measurement range of ± 35 mV 111 ... Raw value without linearization and terminal temperature compensation Resolution 2.125 μ V for a measurement range of ± 70 mV |
| 3 - 7 | 0 |

5.20 Channel deactivation

The default setting for all channels is ON. To save time, individual channels can be switched off (see section "Conversion time" on page 257).

| Code | Description |
|------|-------------------------|
| 0 | Channel x: Switched off |
| 1 | Channel x: Switched on |

Table 421: Channel deactivation - AT6402

5.21 Register: ChannelDeactivation

| Bit | Description |
|-------|-------------------------------------|
| 0 | Channel 1: 0 ... Off 1 ... On |
| 1 | Channel 2: 0 ... Off 1 ... On |
| 2 | Channel 3: 0 ... Off 1 ... On |
| 3 | Channel 4: 0 ... Off 1 ... On |
| 4 | Channel 5: 0 ... Off 1 ... On |
| 5 | Channel 6: 0 ... Off 1 ... On |
| 6 - 7 | 0 |

5.22 Input status

The module's inputs are monitored. A change in monitoring status triggers an error message.

| Code | Channel x |
|------|-------------------------|
| 0 | No error |
| 1 | Below lower limit value |
| 2 | Above upper limit value |
| 3 | Wire break |

Table 422: Input status - AT6402

5.23 Register: StatusInput01

| Bit | Description |
|-------|--|
| 0 - 1 | Channel 1: 00 ... No error 01 ... Below lower limit value 10 ... Above upper limit value 11 ... Wire break |
| 2 - 3 | Channel 2: 00 ... No error 01 ... Below lower limit value 10 ... Above upper limit value 11 ... Wire break |
| 4 - 5 | Channel 3: 00 ... No error 01 ... Below lower limit value 10 ... Above upper limit value 11 ... Wire break |
| 6 - 7 | Channel 4: 00 ... No error 01 ... Below lower limit value 10 ... Above upper limit value 11 ... Wire break |

5.24 Register: StatusInput02

| Bit | Description |
|-------|--|
| 0 - 1 | Channel 5: 00 ... No error 01 ... Below lower limit value 10 ... Above upper limit value 11 ... Wire break |
| 2 - 3 | Channel 6: 00 ... No error 01 ... Below lower limit value 10 ... Above upper limit value 11 ... Wire break |
| 4 - 7 | 0 |

In addition to the status info, the error type also sets the analog value as follows:

| Error type | Digital value for error |
|-------------------------|-------------------------|
| Wire break | +32767 (0x7FFF) |
| Above upper limit value | +32767 (0x7FFF) |
| Below lower limit value | -32767 (0x8001) |
| Invalid value | -32768 (0x8000) |

5.25 IOcyclicCounter

The cyclic counter increases after all input data have been updated.

5.26 Register: IOcyclicCounter

| Value | Description |
|---------|-------------------|
| 0 - 255 | Repeating counter |

5.27 Function models

A function model describes the registers for the module (memory model) which are available for the application. Only these registers are processed on the module during each cycle and cyclically transferred using the bus. The cycle time can be minimized by selecting the correct function model.

5.27.1 Selection of terminal temperature compensation

For this module, the terminal temperature compensation is selected using function models 0 and 1.

| Function model | Terminal temperature compensation |
|----------------|---|
| 0 | Internal compensation temperature (default) |
| 1 | ExternalCompensationTemperature |

Table 423: Selection of compensation type using function models - AT6402

5.27.2 Function models - Internal compensation temperature (default)

| Function model 0 | | | | | | | |
|------------------|---------------------|-----------|--------|--------|---------|--------|---------|
| Register | Name | Data type | Length | Read | | Write | |
| | | | | Cyclic | Acyclic | Cyclic | Acyclic |
| 0 | Temperature01 | INT | 2 | ● | ● | | |
| 2 | Temperature02 | INT | 2 | ● | ● | | |
| 4 | Temperature03 | INT | 2 | ● | ● | | |
| 6 | Temperature04 | INT | 2 | ● | ● | | |
| 8 | Temperature05 | INT | 2 | ● | ● | | |
| 10 | Temperature06 | INT | 2 | ● | ● | | |
| 24 | InputFilter | USINT | 1 | | ● | ● | ● |
| 26 | SensorType | USINT | 1 | | ● | ● | ● |
| 27 | ChannelDeactivation | USINT | 1 | | ● | ● | ● |
| 28 | IOCyclicCounter | USINT | 1 | ● | ● | | |
| 30 | StatusInput01 | USINT | 1 | ● | ● | | |
| 31 | StatusInput02 | USINT | 1 | ● | ● | | |

Table 424: Function model 0: Internal compensation temperature (default) - AT6402

5.27.3 Function models - External compensation temperature

| Function model 1 | | | | | | | |
|------------------|---------------------------------|-----------|--------|--------|---------|--------|---------|
| Register | Name | Data type | Length | Read | | Write | |
| | | | | Cyclic | Acyclic | Cyclic | Acyclic |
| 0 | Temperature01 | INT | 2 | ● | ● | | |
| 2 | Temperature02 | INT | 2 | ● | ● | | |
| 4 | Temperature03 | INT | 2 | ● | ● | | |
| 6 | Temperature04 | INT | 2 | ● | ● | | |
| 8 | Temperature05 | INT | 2 | ● | ● | | |
| 10 | Temperature06 | INT | 2 | ● | ● | | |
| 12 | ExternalCompensationTemperature | INT | 2 | | | ● | ● |
| 24 | InputFilter | USINT | 1 | | ● | ● | ● |
| 26 | SensorType | USINT | 1 | | ● | ● | ● |
| 27 | ChannelDeactivation | USINT | 1 | | ● | ● | ● |
| 28 | IOCyclicCounter | USINT | 1 | ● | ● | | |
| 30 | StatusInput01 | USINT | 1 | ● | ● | | |
| 31 | StatusInput02 | USINT | 1 | ● | ● | | |

Table 425: Function model 0: External compensation temperature - AT6402

5.28 Function models - used where?

| Name | Automation Studio | CANopen | DeviceNet | Modbus/TCP | CAN I/O |
|---|-------------------|---------|-----------|------------|---------|
| Function model 0: Internal compensation temperature (default) | • | • | • | • | • |
| Function model 1: External compensation temperature | • | | | • | |

Table 426: Function models - AT6402

5.29 B&R ID code

Code for module identification (\$1BA9).

5.30 Minimum cycle time

The minimum cycle time is the minimum time needed for the bus cycle to be shut down without a communication error occurring. It should be noted that very fast cycles have reduced the idle time needed for handling monitoring, diagnostics and acyclic commands.

| Minimum cycle time | |
|---|------------------------|
| In each operating mode and function model | $\geq 150 \mu\text{s}$ |

Table 427: Minimum cycle time - AT6402

5.31 Minimum I/O update time

The minimum I/O update time refers to the minimum time it takes for the bus cycle to shut down, so that in each cycle an I/O update takes place.

For the formulas listed in the table, 'n' corresponds to the number of channels that are switched on.

| Minimum I/O update time - function model 0 | |
|--|--|
| n inputs | $(n + 1) \cdot (\text{FilterTime} + 200\mu\text{s})$ |

Table 428: Minimum I/O update time (function model 0) - AT6402

| Minimum I/O update time - function model 1 | |
|--|--|
| 1 input | Corresponds to the filter time |
| n inputs | $n \cdot (\text{FilterTime} + 200\mu\text{s})$ |

Table 429: Minimum I/O update time (function model 1) - AT6402

Chapter 11 • Other modules

1. Overview

| Other modules | Description |
|---------------|--|
| X20PS4951 | X20 supply module for potentiometers, 4 x ±10 V potentiometer supply |

Table 430: Overview of other modules

2. X20PS4951

2.1 Register overview

| Register | Name | Data type | Length | Read | | Write | |
|----------|--------------------|-----------|--------|--------|---------|--------|---------|
| | | | | Cyclic | Acyclic | Cyclic | Acyclic |
| 0 | SupplyStatus 1 - 4 | USINT | 1 | ● | ● | | |

Table 431: Register overview - PS4951

2.2 Variable assignment in Automation Studio (X2X master)

| Name | Data type | Length | Read | | Write | |
|----------------|-----------|--------|--------|---------|--------|---------|
| | | | Cyclic | Acyclic | Cyclic | Acyclic |
| OpenLine01 | BOOL | 1 | ● | | | |
| OpenLine02 | BOOL | 1 | ● | | | |
| OpenLine03 | BOOL | 1 | ● | | | |
| OpenLine04 | BOOL | 1 | ● | | | |
| ShortCircuit01 | BOOL | 1 | ● | | | |
| ShortCircuit02 | BOOL | 1 | ● | | | |
| ShortCircuit03 | BOOL | 1 | ● | | | |
| ShortCircuit04 | BOOL | 1 | ● | | | |

Table 432: Variable assignment in Automation Studio (X2X master) - PS4951

2.3 Variable assignment in Automation Studio (CANIO)

| Name | Data type | Length | Read | | Write | |
|----------------|-----------|--------|--------|---------|--------|---------|
| | | | Cyclic | Acyclic | Cyclic | Acyclic |
| OpenLine01 | BOOL | 1 | ● | | | |
| OpenLine02 | BOOL | 1 | ● | | | |
| OpenLine03 | BOOL | 1 | ● | | | |
| OpenLine04 | BOOL | 1 | ● | | | |
| ShortCircuit01 | BOOL | 1 | ● | | | |
| ShortCircuit02 | BOOL | 1 | ● | | | |
| ShortCircuit03 | BOOL | 1 | ● | | | |
| ShortCircuit04 | BOOL | 1 | ● | | | |

Table 433: Variable assignment in Automation Studio (CANIO) - PS4951

2.4 CANopen data points

| Register | Name | Data type | Length | Read | | Write | |
|----------|--------------------|-----------|--------|------|-----|-------|-----|
| | | | | PDO | SDO | PDO | SDO |
| 0 | SupplyStatus 1 - 4 | USINT | 1 | ● | ● | | |

Table 434: CANopen data points - PS4951

2.5 DeviceNet data points

| Register | Name | Data type | Length | Read | | Write | |
|----------|--------------------|-----------|--------|--------|---------|--------|---------|
| | | | | Cyclic | Acyclic | Cyclic | Acyclic |
| 0 | SupplyStatus 1 - 4 | USINT | 1 | ● | ● | | |

Table 435: DeviceNet data points - PS4951

2.6 Modbus/TCP data points

| Register | Name | Data type | Length | Read | | Write | |
|----------|--------------------|-----------|--------|--------|---------|--------|---------|
| | | | | Cyclic | Acyclic | Cyclic | Acyclic |
| 0 | SupplyStatus 1 - 4 | USINT | 1 | ● | ● | | |

Table 436: Modbus/TCP data points - PS4951

2.7 Register: SupplyStatus 1 - 4

| Bit | Description |
|-----|----------------------|
| 0 | Channel 1 overload |
| 1 | Channel 2 overload |
| 2 | Channel 3 overload |
| 3 | Channel 4 overload |
| 4 | Channel 1 wire break |
| 5 | Channel 2 wire break |
| 6 | Channel 3 wire break |
| 7 | Channel 4 wire break |

2.8 Register: OpenLine01 - OpenLine04

| BOOL | Description |
|------|---|
| x | 0 ... No open connection on channel 1 ... Open connection on channel |

2.9 Register: ShortCircuit01 - ShortCircuit04

| BOOL | Description |
|------|---|
| x | 0 ... No short circuit on channel 1 ... Short circuit on channel |

2.10 B&R ID code

Code for module identification (\$1F43).

2.11 Minimum cycle time

The minimum cycle time is the minimum time needed for the bus cycle to be shut down without a communication error occurring. It should be noted that very fast cycles have reduced the idle time needed for handling monitoring, diagnostics and acyclic commands.

| Minimum cycle time | |
|-----------------------|------------------------|
| Any type of operation | $\geq 100 \mu\text{s}$ |

Table 437: Minimum cycle time - PS4951

2.12 Minimum I/O update time

The minimum I/O update time refers to the minimum time it takes for the bus cycle to shut down, so that in each cycle an I/O update takes place.

| Minimum I/O update time | |
|-------------------------|---------------------|
| Any type of operation | $\geq 1 \text{ ms}$ |

Table 438: Minimum I/O update time - PS4951

Chapter 12 • Counter modules

1. Overview

| Counter modules | Description |
|-----------------|---|
| X20DC1196 | X20 digital counter module, 1 channel ABR, 5 V, 250 kHz input freq., 4x evaluation |
| X20DC1198 | X20 digital counter module, 1 channel SSI, 5 V, 1 MBit/s, 32-bit |
| X20DC1396 | X20 digital counter module, 1 channel ABR, 24 V, 100 kHz input freq., 4x evaluation |
| X20DC1398 | X20 digital counter module, 1 channel SSI, 24 V, 125 MBit/s, 32-bit |
| X20DC2396 | X20 digital counter module, 2 channel ABR, 24 V, 100 kHz input freq., 4x evaluation |
| X20DC2398 | X20 digital counter module, 2 channel SSI, 24 V, 125 MBit/s, 32-bit |

Table 439: Overview - counter modules

2. X20DC1196

2.1 Register overview

| Register | Name | Data type | Length | Read | | Write | |
|----------|--|-----------|--------|--------|---------|--------|---------|
| | | | | Cyclic | Acyclic | Cyclic | Acyclic |
| 2080 | Encoder01 ¹⁾ | INT | 2 | ● | ● | | |
| 2080 | Encoder01_32-bit ²⁾ | DINT | 4 | ● | ● | | |
| 264 | DigitalInput 1 - 2 | USINT | 1 | ● | ● | | |
| 2116 | ReferenceModeEncoder01 | USINT | 1 | | | ● | ● |
| 2118 | StatusInput01 | USINT | 1 | ● | ● | | |
| 40 | PowerSupply 1 - 2 | USINT | 1 | ● | ● | | |
| 4104 | Cf0_EdgeDetectFalling | USINT | 1 | | | ● | ● |
| 4106 | Cf0_EdgeDetectRising | USINT | 1 | | | ● | ● |
| 2064 | Cf0_PresetABR01_1 ¹⁾ | INT | 2 | | | ● | ● |
| 2064 | Cf0_PresetABR01_1_32-bit ²⁾ | DINT | 4 | | | ● | ● |
| 512 | ConfigOutput24 | UINT | 2 | | | ● | ● |
| 522 | ConfigOutput26 | USINT | 1 | | | ● | ● |
| 520 | ConfigOutput27 | USINT | 1 | | | ● | ● |

Table 440: Register overview - DC1196

1) Only with function model 0

2) Only with function model 1

2.2 Variable assignment in Automation Studio (X2X master)

| Name | Data type | Length | Read | | Write | |
|-------------------------|-----------|--------|--------|---------|--------|---------|
| | | | Cyclic | Acyclic | Cyclic | Acyclic |
| Encoder01 ¹⁾ | INT | 2 | ● | | | |
| Encoder01 ²⁾ | DINT | 4 | ● | | | |
| DigitalInput01 | BOOL | 1 | ● | | | |
| DigitalInput02 | BOOL | 1 | ● | | | |
| ReferenceModeEncoder01 | BOOL | 1 | | | ● | |
| StatusInput01 | BOOL | 1 | ● | | | |
| PowerSupply01 | BOOL | 1 | ● | | | |
| PowerSupply02 | BOOL | 1 | ● | | | |

Table 441: Variable assignment in Automation Studio (X2X master) - DC1196

1) Only with function model 0

2) Only with function model 1

2.3 Variable assignment in Automation Studio (CANIO)

| Name | Data type | Length | Read | | Write | |
|------------------------|-----------|--------|--------|---------|--------|---------|
| | | | Cyclic | Acyclic | Cyclic | Acyclic |
| Encoder01 | INT | 2 | ● | | | |
| DigitalInput01 | BOOL | 1 | ● | | | |
| DigitalInput02 | BOOL | 1 | ● | | | |
| ReferenceModeEncoder01 | BOOL | 1 | | | ● | |
| StatusInput01 | BOOL | 1 | ● | | | |
| PowerSupply01 | BOOL | 1 | ● | | | |
| PowerSupply02 | BOOL | 1 | ● | | | |

Table 442: Variable assignment in Automation Studio (CANIO) - DC1196

2.4 CANopen data points

| Register | Name | Data type | Length | Read | | Write | |
|----------|------------------------|-----------|--------|------|-----|-------|-----|
| | | | | PDO | SDO | PDO | SDO |
| 2080 | Encoder01 | INT | 2 | ● | ● | | |
| 264 | DigitalInput 1 - 2 | USINT | 1 | ● | ● | | |
| 2116 | ReferenceModeEncoder01 | USINT | 1 | | | ● | ● |
| 2118 | StatusInput01 | USINT | 1 | ● | ● | | |
| 40 | PowerSupply 1 - 2 | USINT | 1 | ● | ● | | |
| 4104 | Cf0_EdgeDetectFalling | USINT | 1 | | | | ● |
| 4106 | Cfo_EdgeDetectRising | USINT | 1 | | | | ● |
| 2064 | Cf0_PresetABR01_1 | INT | 2 | | | | ● |
| 512 | ConfigOutput24 | UINT | 2 | | | | ● |
| 522 | ConfigOutput26 | USINT | 1 | | | | ● |
| 520 | ConfigOutput27 | USINT | 1 | | | | ● |

Table 443: CANopen data points - DC1196

2.5 DeviceNet data points

| Register | Name | Data type | Length | Read | | Write | |
|----------|------------------------|-----------|--------|--------|---------|--------|---------|
| | | | | Cyclic | Acyclic | Cyclic | Acyclic |
| 2080 | Encoder01 | INT | 2 | ● | ● | | |
| 264 | DigitalInput 1 - 2 | USINT | 1 | ● | ● | | |
| 2116 | ReferenceModeEncoder01 | USINT | 1 | | | ● | ● |
| 2118 | StatusInput01 | USINT | 1 | ● | ● | | |
| 40 | PowerSupply 1 - 2 | USINT | 1 | ● | ● | | |
| 4104 | Cf0_EdgeDetectFalling | USINT | 1 | | | | ● |
| 4106 | Cfo_EdgeDetectRising | USINT | 1 | | | | ● |
| 2064 | Cf0_PresetABR01_1 | INT | 2 | | | | ● |
| 512 | ConfigOutput24 | UINT | 2 | | | | ● |
| 522 | ConfigOutput26 | USINT | 1 | | | | ● |
| 520 | ConfigOutput27 | USINT | 1 | | | | ● |

Table 444: DeviceNet data points - DC1196

2.6 Modbus/TCP data points

| Register | Name | Data type | Length | Read | | Write | |
|----------|--|-----------|--------|--------|---------|-----------------|---------|
| | | | | Cyclic | Acyclic | Cyclic | Acyclic |
| 2080 | Encoder01 ¹⁾ | INT | 2 | ● | ● | | |
| 2080 | Encoder01_32-bit ²⁾ | DINT | 4 | ● | ● | | |
| 264 | DigitalInput 1 - 2 | USINT | 1 | ● | ● | | |
| 2116 | ReferenceModeEncoder01 | USINT | 1 | | | ● | ● |
| 2118 | StatusInput01 | USINT | 1 | ● | ● | | |
| 40 | PowerSupply 1 - 2 | USINT | 1 | ● | ● | | |
| 4104 | Cf0_EdgeDetectFalling | USINT | 1 | | | ● ³⁾ | ● |
| 4106 | Cfo_EdgeDetectRising | USINT | 1 | | | ● ³⁾ | ● |
| 2064 | Cf0_PresetABR01_1 ¹⁾ | INT | 2 | | | ● ³⁾ | ● |
| 2064 | Cf0_PresetABR01_1_32-bit ²⁾ | DINT | 4 | | | ● ³⁾ | ● |
| 512 | ConfigOutput24 | UINT | 2 | | | ● ³⁾ | ● |
| 522 | ConfigOutput26 | USINT | 1 | | | ● ³⁾ | ● |
| 520 | ConfigOutput27 | USINT | 1 | | | ● ³⁾ | ● |

Table 445: Modbus/TCP data points - DC1196

1) Only with function model 0

2) Only with function model 1

3) With the default configuration, these registers are not located in the area for cyclic output data. However, using a special function (Modbus/TCP User's Manual) these registers can also be applied cyclically.

2.7 Cyclic encoder registers

2.7.1 Register: Encoder01

The encoder is represented by a 16-bit value.

| Data type | Description |
|-------------------|--|
| INT ¹⁾ | -32768 - 32767 ... Encoder counter value |

1) Only with function model 0

2.7.2 Register: Encoder01_32Bit

The encoder is represented by a 32-bit value.

| Data type | Description |
|--------------------|--|
| DINT ¹⁾ | -2147483648 - 2147483647 ... Encoder counter value |

1) Only with function model 1

2.7.3 Register: DigitalInput 1 - 2

| Bit | Description |
|-----|--|
| 0 | Input status - encoder signal A |
| 1 | Input status - encoder signal B |
| 2 | Input status - encoder reference impulse |
| 4 | Input status - digital input 1 |
| 5 | Input status - digital input 2 |

2.7.4 Register: DigitalInput01 - DigitalInput02

| BOOL | Description |
|------|--------------------------------------|
| x | 0/1 ... Input status - digital input |

2.7.5 Register: ReferenceModeEncoder01

This register determines the reference mode.

| Bit | Description |
|-------|--|
| 0 - 1 | 00 ... Referencing OFF 01 ... One-time reference (single shot) 11 ... Continuous referencing |
| 2 - 5 | 0000 ... Bits permanently set = 0 |
| 6 - 7 | 00 ... Referencing OFF 11 ... Bits permanently set = 1 |

Table 446: Reference mode - DC1196

This results in the following values:

%00000000 = \$00 = Referencing OFF

%11000001 = \$C1 = One-time reference (single shot)

When starting over after the referencing process is complete, the value \$00 must be written. Then wait until the StatusInput01 also takes on the value \$00
Only then can the value \$C1 be written.

%11000011 = \$C3 = Continuous referencing

Referencing occurs at every reference pulse.

It is important to know how the optional reference enable (see section 2.8.4 "Referencing with reference enable input" on page 277) is configured.

2.7.6 Register: StatusInput01

This register contains information regarding whether the referencing process is off, active, or complete.

| Bit | Description |
|-------|---|
| 0 - 1 | 00 ... Always 0 |
| 2 | 0/1 ... Bit is always 1 after the first reference impulse |
| 3 | 0/1 ... Toggle after each completed reference |
| 4 | 0/1 ... Bit is always 1 after the first reference impulse |
| 5 - 7 | xxx ... Free-running counter, increased with each reference impulse |

Table 447: Encoder status information - DC1196

Examples of possible values:

%00000000 = \$00 = Referencing off or already in progress

%00111100 = \$3C = first reference complete, reference value applied in register
Encoder01

%xxx11100 = \$xB = Bits 5 - 7 are changed sequentially with each reference impulse

%xxx1x100 = \$xx = Bits changed continuously with the setting continuous referencing.
With every reference impulse, the reference value is applied to register
Encoder01

It is important to know how the optional reference enable (see section 2.8.4 "Referencing with reference enable input" on page 277) is configured.

2.7.7 Register: PowerSupply 1 - 2

This register shows the status of the integrated encoder supplies.

| Bit | Description |
|-----|--|
| 0 | 0 ... 24 VDC encoder supply voltage OK 1 ... 24 VDC encoder supply voltage faulty |
| 1 | 0 ... 5 VDC encoder supply voltage OK 1 ... 5 VDC encoder supply voltage faulty |

2.7.8 Register: PowerSupply01

| BOOL | Description |
|------|--|
| x | 0 ... 24 VDC encoder supply voltage OK 1 ... 24 VDC encoder supply voltage faulty |

2.7.9 Register: PowerSupply02

| BOOL | Description |
|------|--|
| x | 0 ... 5 VDC encoder supply voltage OK 1 ... 5 VDC encoder supply voltage faulty |

2.8 Encoder configuration register for cyclical operation

2.8.1 Reference pulse - positive edge

The following registers must be configured by setting the listed values one time using a non-cyclic write command so that the reference process is completed on the positive edge of the reference pulse.

Register: CfO_EdgeDetectFalling

| USINT | Description |
|-------|------------------------------|
| \$00 | \$00 ... Configuration value |

Register: CfO_EdgeDetectRising

| USINT | Description |
|-------|------------------------------|
| \$04 | \$04 ... Configuration value |

Register: ConfigOutput24

| UINT | Description |
|--------|--------------------------------|
| \$1012 | \$1012 ... Configuration value |

2.8.2 Reference pulse - negative edge (default configuration)

The following registers must be configured by setting the listed values one time using a non-cyclic write command so that the reference process is completed on the negative edge of the reference pulse.

Register: CfO_EdgeDetectFalling

| USINT | Description |
|-------|--|
| \$04 | \$04 ... Configuration value (default) |

Register: CfO_EdgeDetectRising

| USINT | Description |
|-------|--|
| \$00 | \$00 ... Configuration value (default) |

Register: ConfigOutput24

| UINT | Description |
|--------|--|
| \$1002 | \$1002 ... Configuration value (default) |

2.8.3 Preset home position

This register allows you to apply a preset home position using a one-time non-cyclic write command (default = 0). The value set here is applied to the counter value upon completion of the referencing process.

Register: CfO_PresetABR01_1

| Data type | Description |
|-------------------|----------------------------------|
| INT ¹⁾ | -32768 - 32767 ... Home position |

1) Only with function model 0

Register: CfO_PresetABR01_1_32Bit

| Data type | Description |
|--------------------|--|
| DINT ¹⁾ | -2147483648 - 2147483647 ... Home position |

1) Only with function model 1

2.8.4 Referencing with reference enable input

Regardless of the referencing mode, it is possible to prevent the home position from being taken over when the corresponding reference input voltage level occurs (DigitalInput01 / DigitalInput 1 - 2 bit 4). The desired setting can be configured using a one-time non-cyclic write command.

Register: ConfigOutput27

| USINT | Description |
|-------|--|
| \$x0 | \$00 ... Reference enable input OFF (default) \$10 ... Reference enable input activated |

Register: ConfigOutput26

The voltage level to activate reference enable (DigitalInput01 / DigitalInput 1 - 2 bit 4) is configured with this register.

| USINT | Description |
|-------|---|
| \$x0 | \$00 ... Reference enable is active at 0 VDC \$10 ... Reference enable is active at 24 VDC |

2.8.5 Function models

A function model describes the registers for the module (memory model) which are available for the application. Only these registers are processed on the module during each cycle and cyclically transferred using the bus.

Function model 0 with 16-bit encoder counter value (default)

| Register | Name | Data type | Length | Read | | Write | |
|----------|------------------------|-----------|--------|--------|---------|--------|---------|
| | | | | Cyclic | Acyclic | Cyclic | Acyclic |
| 2080 | Encoder01 | INT | 2 | ● | ● | | |
| 264 | DigitalInput 1 - 2 | USINT | 1 | ● | ● | | |
| 2116 | ReferenceModeEncoder01 | USINT | 1 | | | ● | ● |
| 2118 | StatusInput01 | USINT | 1 | ● | ● | | |
| 40 | PowerSupply 1 - 2 | USINT | 1 | ● | ● | | |
| 4104 | Cf0_EdgeDetectFalling | USINT | 1 | | | ● | ● |
| 4106 | Cf0_EdgeDetectRising | USINT | 1 | | | ● | ● |
| 2064 | Cf0_PresetABR01_1 | INT | 2 | | | ● | ● |
| 512 | ConfigOutput24 | UINT | 2 | | | ● | ● |
| 522 | ConfigOutput26 | USINT | 1 | | | ● | ● |
| 520 | ConfigOutput27 | USINT | 1 | | | ● | ● |

Table 448: Function model 0 with 16-bit encoder - DC1196

Function model 1 with 32-bit encoder counter value

| Register | Name | Data type | Length | Read | | Write | |
|----------|-------------------------|-----------|--------|--------|---------|--------|---------|
| | | | | Cyclic | Acyclic | Cyclic | Acyclic |
| 2080 | Encoder01_32Bit | DINT | 4 | ● | ● | | |
| 264 | DigitalInput 1 - 2 | USINT | 1 | ● | ● | | |
| 2116 | ReferenceModeEncoder01 | USINT | 1 | | | ● | ● |
| 2118 | StatusInput01 | USINT | 1 | ● | ● | | |
| 40 | PowerSupply 1 - 2 | USINT | 1 | ● | ● | | |
| 4104 | Cf0_EdgeDetectFalling | USINT | 1 | | | ● | ● |
| 4106 | Cfo_EdgeDetectRising | USINT | 1 | | | ● | ● |
| 2064 | Cf0_PresetABR01_1_32Bit | DINT | 4 | | | ● | ● |
| 512 | ConfigOutput24 | UINT | 2 | | | ● | ● |
| 522 | ConfigOutput26 | USINT | 1 | | | ● | ● |
| 520 | ConfigOutput27 | USINT | 1 | | | ● | ● |

Table 449: Function model 1 with 32-bit encoder - DC1196

2.8.6 Function models - used where?

| Name | Automation Studio | CANopen | DeviceNet | Modbus/TCP | CAN I/O |
|---|-------------------|---------|-----------|------------|---------|
| Function model 0 with 16-bit encoder data (default) | ● | ● | ● | ● | ● |
| Function model 1 with 32-bit encoder data | ● | | | ● | |

Table 450: Function models - DC1196

2.9 B&R ID code

Code for module identification (\$1BAF).

2.10 Minimum cycle time

The minimum cycle time is the minimum time needed for the bus cycle to be shut down without a communication error occurring. It should be noted that very fast cycles have reduced the idle time needed for handling monitoring, diagnostics and acyclic commands.

| Minimum cycle time |
|--------------------|
| ≥128 µs |

Table 451: Minimum cycle time - DC1196

2.11 Maximum cycle time

The maximum cycle time is the maximum time the bus cycle can take to start without internal counter overruns causing module errors.

| Minimum cycle time |
|--------------------|
| <16 ms |

Table 452: Maximum cycle time - DC1196

2.12 Minimum I/O update time

The minimum I/O update time refers to the minimum time it takes for the bus cycle to shut down, so that in each cycle an I/O update takes place.

| Minimum I/O update time |
|-------------------------|
| ≥128 μs |

Table 453: Minimum I/O update time - DC1196

3. X20DC1198

3.1 Register overview

| Register | Name | Data type | Length | Read | | Write | |
|----------|--------------------|-----------|--------|--------|---------|--------|---------|
| | | | | Cyclic | Acyclic | Cyclic | Acyclic |
| 7184 | Encoder01 | UDINT | 4 | ● | ● | | |
| 264 | DigitalInput 1 - 2 | USINT | 1 | ● | ● | | |
| 40 | PowerSupply 1 - 2 | USINT | 1 | ● | ● | | |
| 7176 | ConfigOutput14 | UINT | 2 | | | ● | ● |

Table 454: Register overview - DC1198

3.2 Variable assignment in Automation Studio (X2X master)

| Name | Data type | Length | Read | | Write | |
|----------------|-----------|--------|--------|---------|--------|---------|
| | | | Cyclic | Acyclic | Cyclic | Acyclic |
| Encoder01 | UDINT | 4 | ● | | | |
| DigitalInput01 | BOOL | 1 | ● | | | |
| DigitalInput02 | BOOL | 1 | ● | | | |
| PowerSupply01 | BOOL | 1 | ● | | | |
| PowerSupply02 | BOOL | 1 | ● | | | |

Table 455: Variable assignment in Automation Studio (X2X master) - DC1198

3.3 Variable assignment in Automation Studio (CANIO)

| Name | Data type | Length | Read | | Write | |
|----------------|-----------|--------|--------|---------|--------|---------|
| | | | Cyclic | Acyclic | Cyclic | Acyclic |
| Encoder01 | UDINT | 4 | ● | | | |
| DigitalInput01 | BOOL | 1 | ● | | | |
| DigitalInput02 | BOOL | 1 | ● | | | |
| PowerSupply01 | BOOL | 1 | ● | | | |
| PowerSupply02 | BOOL | 1 | ● | | | |

Table 456: Variable assignment in Automation Studio (CANIO) - DC1198

3.4 CANopen data points

| Register | Name | Data type | Length | Read | | Write | |
|----------|--------------------|-----------|--------|------|-----|-------|-----|
| | | | | PDO | SDO | PDO | SDO |
| 7184 | Encoder01 | UDINT | 4 | ● | ● | | |
| 264 | DigitalInput 1 - 2 | USINT | 1 | ● | ● | | |
| 40 | PowerSupply 1 - 2 | USINT | 1 | ● | ● | | |
| 7176 | ConfigOutput14 | UINT | 2 | | | | ● |

Table 457: CANopen data points - DC1198

3.5 DeviceNet data points

| Register | Name | Data type | Length | Read | | Write | |
|----------|--------------------|-----------|--------|--------|---------|--------|---------|
| | | | | Cyclic | Acyclic | Cyclic | Acyclic |
| 7184 | Encoder01 | UDINT | 4 | ● | ● | | |
| 264 | DigitalInput 1 - 2 | USINT | 1 | ● | ● | | |
| 40 | PowerSupply 1 - 2 | USINT | 1 | ● | ● | | |
| 7176 | ConfigOutput14 | UINT | 2 | | | | ● |

Table 458: DeviceNet data points - DC1198

3.6 Modbus/TCP data points

| Register | Name | Data type | Length | Read | | Write | |
|----------|--------------------|-----------|--------|--------|---------|-----------------|---------|
| | | | | Cyclic | Acyclic | Cyclic | Acyclic |
| 7184 | Encoder01 | UDINT | 4 | ● | ● | | |
| 264 | DigitalInput 1 - 2 | USINT | 1 | ● | ● | | |
| 40 | PowerSupply 1 - 2 | USINT | 1 | ● | ● | | |
| 7176 | ConfigOutput14 | UINT | 2 | | | ● ¹⁾ | ● |

Table 459: Modbus/TCP data points - DC1198

1) With the default configuration, these registers are not located in the area for cyclic output data. However, using a special function (Modbus/TCP User's Manual) these registers can also be applied cyclically.

3.7 SSI encoder cyclic register

3.7.1 Register: Encoder01

The SSI encoder value is displayed as a 32-bit position value. The SSI position value is generated synchronously with the X2X cycle.

| Data type | Description |
|-----------|---|
| DINT | -2147483648 - 2147483647 ... SSI position |

3.7.2 Register: DigitalInput 1 - 2

| Bit | Description |
|-----|--------------------------------|
| 4 | Input status - digital input 1 |
| 5 | Input status - digital input 2 |

3.7.3 Register: DigitalInput01 - DigitalInput02

| BOOL | Description |
|------|--------------------------------------|
| x | 0/1 ... Input status - digital input |

3.7.4 Register: PowerSupply 1 - 2

This register shows the status of the integrated encoder supplies.

| Bit | Description |
|-----|--|
| 0 | 0 ... 24 VDC encoder supply voltage OK 1 ... 24 VDC encoder supply voltage faulty |
| 1 | 0 ... 5 VDC encoder supply voltage OK 1 ... 5 VDC encoder supply voltage faulty |

3.7.5 Register: PowerSupply01

| BOOL | Description |
|------|--|
| x | 0 ... 24 VDC encoder supply voltage OK 1 ... 24 VDC encoder supply voltage faulty |

3.7.6 Register: PowerSupply02

| BOOL | Description |
|------|--|
| x | 0 ... 5 VDC encoder supply voltage OK 1 ... 5 VDC encoder supply voltage faulty |

3.8 SSI encoder configuration register for cyclical operation

3.8.1 Register: ConfigOutput14

This configuration register is used to set the coding, the clock rate and the number of bits. Default = 0. This must be set once using a non-cyclic write command.

| Bit | Description |
|--------|---|
| 0 - 5 | Number of bits valid for SSI value |
| 6 - 7 | Clock rate: 00: 1 MHz 01: 500 kHz 10: 250 kHz 11: 125 kHz |
| 8 - 13 | Total number of bits in SSI, including leading zeros |
| 14 | 0 ... Reserved |
| 15 | 0 ... Binary coding 1 ... Gray coding |

3.9 B&R ID code

Code for module identification (\$1BB0)

3.10 Minimum cycle time

The minimum cycle time is the minimum time needed for the bus cycle to be shut down without a communication error occurring. It should be noted that very fast cycles have reduced the idle time needed for handling monitoring, diagnostics and acyclic commands.

| Minimum cycle time |
|--------------------|
| ≥128 µs |

Table 460: Minimum cycle time - DC1198

3.11 Maximum cycle time

The maximum cycle time is the maximum time the bus cycle can take to start without internal counter overruns causing module errors.

| Minimum cycle time |
|--------------------|
| <16 ms |

Table 461: Maximum cycle time - DC1198

3.12 Minimum I/O update time

The minimum I/O update time refers to the minimum time it takes for the bus cycle to shut down, so that in each cycle an I/O update takes place.

| Minimum I/O update time |
|-------------------------|
| ≥128 μs |

Table 462: Minimum I/O update time - DC1198

4. X20DC1396

4.1 Register overview

| Register | Name | Data type | Length | Read | | Write | |
|----------|---------------------------------------|-----------|--------|--------|---------|--------|---------|
| | | | | Cyclic | Acyclic | Cyclic | Acyclic |
| 2080 | Encoder01 ¹⁾ | INT | 2 | ● | ● | | |
| 2080 | Encoder01_32Bit ²⁾ | DINT | 4 | ● | ● | | |
| 264 | DigitalInput 1 | USINT | 1 | ● | ● | | |
| 2116 | ReferenceModeEncoder01 | USINT | 1 | | | ● | ● |
| 2118 | StatusInput01 | USINT | 1 | ● | ● | | |
| 40 | PowerSupply 1 | USINT | 1 | ● | ● | | |
| 4104 | Cf0_EdgeDetectFalling | USINT | 1 | | | ● | ● |
| 4106 | Cf0_EdgeDetectRising | USINT | 1 | | | ● | ● |
| 2064 | Cf0_PresetABR01_1 ¹⁾ | INT | 2 | | | ● | ● |
| 2064 | Cf0_PresetABR01_1_32Bit ²⁾ | DINT | 4 | | | ● | ● |
| 512 | ConfigOutput24 | UINT | 2 | | | ● | ● |
| 522 | ConfigOutput26 | USINT | 1 | | | ● | ● |
| 520 | ConfigOutput27 | USINT | 1 | | | ● | ● |

Table 463: Register overview - DC1396

1) Only with function model 0

2) Only with function model 1

4.2 Variable assignment in Automation Studio (X2X master)

| Name | Data type | Length | Read | | Write | |
|-------------------------|-----------|--------|--------|---------|--------|---------|
| | | | Cyclic | Acyclic | Cyclic | Acyclic |
| Encoder01 ¹⁾ | INT | 2 | ● | | | |
| Encoder01 ²⁾ | DINT | 4 | ● | | | |
| DigitalInput01 | BOOL | 1 | ● | | | |
| ReferenceModeEncoder01 | BOOL | 1 | | | ● | |
| StatusInput01 | BOOL | 1 | ● | | | |
| PowerSupply01 | BOOL | 1 | ● | | | |

Table 464: Variable assignment in Automation Studio (X2X master) - DC1396

1) Only with function model 0

2) Only with function model 1

4.3 Variable assignment in Automation Studio (CANIO)

| Name | Data type | Length | Read | | Write | |
|------------------------|-----------|--------|--------|---------|--------|---------|
| | | | Cyclic | Acyclic | Cyclic | Acyclic |
| Encoder01 | INT | 2 | ● | | | |
| DigitalInput01 | BOOL | 1 | ● | | | |
| ReferenceModeEncoder01 | BOOL | 1 | | | ● | |
| StatusInput01 | BOOL | 1 | ● | | | |
| PowerSupply01 | BOOL | 1 | ● | | | |

Table 465: Variable assignment in Automation Studio (CANIO) - DC1396

4.4 CANopen data points

| Register | Name | Data type | Length | Read | | Write | |
|----------|------------------------|-----------|--------|------|-----|-------|-----|
| | | | | PDO | SDO | PDO | SDO |
| 2080 | Encoder01 | INT | 2 | ● | ● | | |
| 264 | DigitalInput 1 | USINT | 1 | ● | ● | | |
| 2116 | ReferenceModeEncoder01 | USINT | 1 | | | ● | ● |
| 2118 | StatusInput01 | USINT | 1 | ● | ● | | |
| 40 | PowerSupply 1 | USINT | 1 | ● | ● | | |
| 4104 | Cf0_EdgeDetectFalling | USINT | 1 | | | | ● |
| 4106 | Cfo_EdgeDetectRising | USINT | 1 | | | | ● |
| 2064 | Cf0_PresetABR01_1 | INT | 2 | | | | ● |
| 512 | ConfigOutput24 | UINT | 2 | | | | ● |
| 522 | ConfigOutput26 | USINT | 1 | | | | ● |
| 520 | ConfigOutput27 | USINT | 1 | | | | ● |

Table 466: CANopen data points - DC1396

4.5 DeviceNet data points

| Register | Name | Data type | Length | Read | | Write | |
|----------|------------------------|-----------|--------|--------|---------|--------|---------|
| | | | | Cyclic | Acyclic | Cyclic | Acyclic |
| 2080 | Encoder01 | INT | 2 | ● | ● | | |
| 264 | DigitalInput 1 | USINT | 1 | ● | ● | | |
| 2116 | ReferenceModeEncoder01 | USINT | 1 | | | ● | ● |
| 2118 | StatusInput01 | USINT | 1 | ● | ● | | |
| 40 | PowerSupply 1 | USINT | 1 | ● | ● | | |
| 4104 | Cf0_EdgeDetectFalling | USINT | 1 | | | | ● |
| 4106 | Cf0_EdgeDetectRising | USINT | 1 | | | | ● |
| 2064 | Cf0_PresetABR01_1 | INT | 2 | | | | ● |
| 512 | ConfigOutput24 | UINT | 2 | | | | ● |
| 522 | ConfigOutput26 | USINT | 1 | | | | ● |
| 520 | ConfigOutput27 | USINT | 1 | | | | ● |

Table 467: DeviceNet data points - DC1396

4.6 Modbus/TCP data points

| Register | Name | Data type | Length | Read | | Write | |
|----------|---------------------------------------|-----------|--------|--------|---------|-----------------|---------|
| | | | | Cyclic | Acyclic | Cyclic | Acyclic |
| 2080 | Encoder01 ¹⁾ | INT | 2 | ● | ● | | |
| 2080 | Encoder01_32Bit ²⁾ | DINT | 4 | ● | ● | | |
| 264 | DigitalInput 1 | USINT | 1 | ● | ● | | |
| 2116 | ReferenceModeEncoder01 | USINT | 1 | | | ● | ● |
| 2118 | StatusInput01 | USINT | 1 | ● | ● | | |
| 40 | PowerSupply 1 | USINT | 1 | ● | ● | | |
| 4104 | Cf0_EdgeDetectFalling | USINT | 1 | | | ● ³⁾ | ● |
| 4106 | Cf0_EdgeDetectRising | USINT | 1 | | | ● ³⁾ | ● |
| 2064 | Cf0_PresetABR01_1 ¹⁾ | INT | 2 | | | ● ³⁾ | ● |
| 2064 | Cf0_PresetABR01_1_32Bit ²⁾ | DINT | 4 | | | ● ³⁾ | ● |
| 512 | ConfigOutput24 | UINT | 2 | | | ● ³⁾ | ● |
| 522 | ConfigOutput26 | USINT | 1 | | | ● ³⁾ | ● |
| 520 | ConfigOutput27 | USINT | 1 | | | ● ³⁾ | ● |

Table 468: Modbus/TCP data points - DC1396

1) Only with function model 0

2) Only with function model 1

3) With the default configuration, these registers are not located in the area for cyclic output data. However, using a special function (Modbus/TCP User's Manual) these registers can also be applied cyclically.

4.7 Cyclic encoder registers

4.7.1 Register: Encoder01

The encoder is represented by a 16-bit value.

| Data type | Description |
|-------------------|--|
| INT ¹⁾ | -32768 - 32767 ... Encoder counter value |

1) Only with function model 0

4.7.2 Register: Encoder01_32Bit

The encoder is represented by a 32-bit value.

| Data type | Description |
|--------------------|--|
| DINT ¹⁾ | -2147483648 - 2147483647 ... Encoder counter value |

1) Only with function model 1

4.7.3 Register: DigitalInput 1

| Bit | Description |
|-----|--|
| 0 | Input status - encoder signal A |
| 1 | Input status - encoder signal B |
| 2 | Input status - encoder reference impulse |
| 3 | Input status - digital input 1 |

4.7.4 Register: DigitalInput01

| BOOL | Description |
|------|--------------------------------------|
| x | 0/1 ... Input status - digital input |

4.7.5 Register: ReferenceModeEncoder01

This register determines the reference mode.

| Bit | Description |
|-------|--|
| 0 - 1 | 00 ... Referencing OFF 01 ... One-time reference (single shot) 11 ... Continuous referencing |
| 2 - 5 | 0000 ... Bits permanently set = 0 |
| 6 - 7 | 00 ... Referencing OFF 11 ... Bits permanently set = 1 |

Table 469: Reference mode - DC1396

This results in the following values:

%00000000 = \$00 = Referencing OFF

%11000001 = \$C1 = One-time reference (single shot)

When starting over after the referencing process is complete, the value \$00 must be written. Then wait until the StatusInput01 also takes on the value \$00
Only then can the value \$C1 be written.

%11000011 = \$C3 = Continuous referencing

Referencing occurs at every reference pulse.

It is important to know how the optional reference enable (see section 4.8.4 "Referencing with reference enable input" on page 291) is configured.

4.7.6 Register: StatusInput01

This register contains information regarding whether the referencing process is off, active, or complete.

| Bit | Description |
|-------|---|
| 0 - 1 | 00 ... Always 0 |
| 2 | 0/1 ... Bit is always 1 after the first reference impulse |
| 3 | 0/1 ... Toggle after each completed reference |
| 4 | 0/1 ... Bit is always 1 after the first reference impulse |
| 5 - 7 | xxx ... Free-running counter, increased with each reference impulse |

Table 470: Encoder status information - DC1396

Examples of possible values:

%00000000 = \$00 = Referencing off or already in progress

%00111100 = \$3C = First reference complete, reference value applied in register Encoder01

%xxx11100 = \$xB = Bits 5 - 7 are changed sequentially with each reference impulse

%xxx1x100 = \$xx = Bits changed continuously with the setting continuous referencing. With every reference impulse, the reference value is applied to register Encoder01

It is important to know how the optional reference enable (see section 4.8.4 "Referencing with reference enable input" on page 291) is configured.

4.7.7 Register: PowerSupply 1

This register shows the status of the integrated encoder supplies.

| Bit | Description |
|-----|--|
| 0 | 0 ... 24 VDC encoder supply voltage OK 1 ... 24 VDC encoder supply voltage faulty |

4.7.8 Register: PowerSupply01

| BOOL | Description |
|------|--|
| x | 0 ... 24 VDC encoder supply voltage OK 1 ... 24 VDC encoder supply voltage faulty |

4.8 Encoder configuration register for cyclical operation

4.8.1 Reference pulse - positive edge

The following registers must be configured by setting the listed values one time using a non-cyclic write command so that the reference process is completed on the positive edge of the reference pulse.

Register: CfO_EdgeDetectFalling

| USINT | Description |
|-------|------------------------------|
| \$00 | \$00 ... Configuration value |

Register: CfO_EdgeDetectRising

| USINT | Description |
|-------|------------------------------|
| \$04 | \$04 ... Configuration value |

Register: ConfigOutput24

| UINT | Description |
|--------|--------------------------------|
| \$1012 | \$1012 ... Configuration value |

4.8.2 Reference pulse - negative edge (default configuration)

The following registers must be configured by setting the listed values one time using a non-cyclic write command so that the reference process is completed on the negative edge of the reference pulse.

Register: CfO_EdgeDetectFalling

| USINT | Description |
|-------|--|
| \$04 | \$04 ... Configuration value (default) |

Register: CfO_EdgeDetectRising

| USINT | Description |
|-------|--|
| \$00 | \$00 ... Configuration value (default) |

Register: ConfigOutput24

| UINT | Description |
|--------|--|
| \$1002 | \$1002 ... Configuration value (default) |

4.8.3 Preset home position

This register allows you to apply a preset home position using a one-time non-cyclic write command (default = 0). The value set here is applied to the counter value upon completion of the referencing process.

Register: CfO_PresetABR01_1

| Data type | Description |
|-------------------|----------------------------------|
| INT ¹⁾ | -32768 - 32767 ... Home position |

1) Only with function model 0

Register: CfO_PresetABR01_1_32Bit

| Data type | Description |
|--------------------|--|
| DINT ¹⁾ | -2147483648 - 2147483647 ... Home position |

1) Only with function model 1

4.8.4 Referencing with reference enable input

Regardless of the referencing mode, it is possible to prevent the home position from being taken over when the corresponding reference input voltage level occurs (DigitalInput01 / DigitalInput 1 bit 3). The desired setting can be configured using a one-time non-cyclic write command.

Register: ConfigOutput27

| USINT | Description |
|-------|--|
| \$0x | \$00 ... Reference enable input OFF (default) \$08 ... Reference enable input activated |

Register: ConfigOutput26

The voltage level to activate reference enable (DigitalInput01 / DigitalInput 1 bit 3) is configured with this register.

| USINT | Description |
|-------|---|
| \$0x | \$00 ... Reference enable is active at 0 VDC \$08 ... Reference enable is active at 24 VDC |

4.8.5 Function models

A function model describes the registers for the module (memory model) which are available for the application. Only these registers are processed on the module during each cycle and cyclically transferred using the bus.

Function model 0 with 16-bit encoder counter value (default)

| Register | Name | Data type | Length | Read | | Write | |
|----------|------------------------|-----------|--------|--------|---------|--------|---------|
| | | | | Cyclic | Acyclic | Cyclic | Acyclic |
| 2080 | Encoder01 | INT | 2 | ● | ● | | |
| 264 | DigitalInput 1 | USINT | 1 | ● | ● | | |
| 2116 | ReferenceModeEncoder01 | USINT | 1 | | | ● | ● |
| 2118 | StatusInput01 | USINT | 1 | ● | ● | | |
| 40 | PowerSupply 1 | USINT | 1 | ● | ● | | |
| 4104 | Cf0_EdgeDetectFalling | USINT | 1 | | | ● | ● |
| 4106 | Cf0_EdgeDetectRising | USINT | 1 | | | ● | ● |
| 2064 | Cf0_PresetABR01_1 | INT | 2 | | | ● | ● |
| 512 | ConfigOutput24 | UINT | 2 | | | ● | ● |
| 522 | ConfigOutput26 | USINT | 1 | | | ● | ● |
| 520 | ConfigOutput27 | USINT | 1 | | | ● | ● |

Table 471: Function model 0 with 16-bit encoder - DC1396

Function model 1 with 32-bit encoder counter value

| Register | Name | Data type | Length | Read | | Write | |
|----------|-------------------------|-----------|--------|--------|---------|--------|---------|
| | | | | Cyclic | Acyclic | Cyclic | Acyclic |
| 2080 | Encoder01_32Bit | DINT | 4 | ● | ● | | |
| 264 | DigitalInput 1 | USINT | 1 | ● | ● | | |
| 2116 | ReferenceModeEncoder01 | USINT | 1 | | | ● | ● |
| 2118 | StatusInput01 | USINT | 1 | ● | ● | | |
| 40 | PowerSupply 1 | USINT | 1 | ● | ● | | |
| 4104 | Cf0_EdgeDetectFalling | USINT | 1 | | | ● | ● |
| 4106 | Cfo_EdgeDetectRising | USINT | 1 | | | ● | ● |
| 2064 | Cf0_PresetABR01_1_32Bit | DINT | 4 | | | ● | ● |
| 512 | ConfigOutput24 | UINT | 2 | | | ● | ● |
| 522 | ConfigOutput26 | USINT | 1 | | | ● | ● |
| 520 | ConfigOutput27 | USINT | 1 | | | ● | ● |

Table 472: Function model 1 with 32-bit encoder - DC1396

4.8.6 Function models - used where?

| Name | Automation Studio | CANopen | DeviceNet | Modbus/TCP | CAN I/O |
|---|-------------------|---------|-----------|------------|---------|
| Function model 0 with 16-bit encoder data (default) | ● | ● | ● | ● | ● |
| Function model 1 with 32-bit encoder data | ● | | | ● | |

Table 473: Function models - DC1396

4.9 B&R ID code

Code for module identification (\$1BAC).

4.10 Minimum cycle time

The minimum cycle time is the minimum time needed for the bus cycle to be shut down without a communication error occurring. It should be noted that very fast cycles have reduced the idle time needed for handling monitoring, diagnostics and acyclic commands.

| Minimum cycle time |
|--------------------|
| ≥128 μs |

Table 474: Minimum cycle time - DC1396

4.11 Maximum cycle time

The maximum cycle time is the maximum time the bus cycle can take to start without internal counter overruns causing module errors.

| Minimum cycle time |
|--------------------|
| <16 ms |

Table 475: Maximum cycle time - DC1396

4.12 Minimum I/O update time

The minimum I/O update time refers to the minimum time it takes for the bus cycle to shut down, so that in each cycle an I/O update takes place.

| Minimum I/O update time |
|-------------------------|
| ≥128 μs |

Table 476: Minimum I/O update time - DC1396

5. X20DC1398

5.1 Register overview

| Register | Name | Data type | Length | Read | | Write | |
|----------|----------------|-----------|--------|--------|---------|--------|---------|
| | | | | Cyclic | Acyclic | Cyclic | Acyclic |
| 7184 | Encoder01 | UDINT | 4 | ● | ● | | |
| 264 | DigitalInput 1 | USINT | 1 | ● | ● | | |
| 40 | PowerSupply 1 | USINT | 1 | ● | ● | | |
| 7176 | ConfigOutput14 | UINT | 2 | | | ● | ● |

Table 477: Register overview - DC1398

5.2 Variable assignment in Automation Studio (X2X master)

| Name | Data type | Length | Read | | Write | |
|----------------|-----------|--------|--------|---------|--------|---------|
| | | | Cyclic | Acyclic | Cyclic | Acyclic |
| Encoder01 | UDINT | 4 | ● | | | |
| DigitalInput01 | BOOL | 1 | ● | | | |
| PowerSupply01 | BOOL | 1 | ● | | | |

Table 478: Variable assignment in Automation Studio (X2X master) - DC1398

5.3 Variable assignment in Automation Studio (CANIO)

| Name | Data type | Length | Read | | Write | |
|----------------|-----------|--------|--------|---------|--------|---------|
| | | | Cyclic | Acyclic | Cyclic | Acyclic |
| Encoder01 | UDINT | 4 | ● | | | |
| DigitalInput01 | BOOL | 1 | ● | | | |
| PowerSupply01 | BOOL | 1 | ● | | | |

Table 479: Variable assignment in Automation Studio (CANIO) - DC1398

5.4 CANopen data points

| Register | Name | Data type | Length | Read | | Write | |
|----------|----------------|-----------|--------|------|-----|-------|-----|
| | | | | PDO | SDO | PDO | SDO |
| 7184 | Encoder01 | UDINT | 4 | ● | ● | | |
| 264 | DigitalInput 1 | USINT | 1 | ● | ● | | |
| 40 | PowerSupply 1 | USINT | 1 | ● | ● | | |
| 7176 | ConfigOutput14 | UINT | 2 | | | | ● |

Table 480: CANopen data points - DC1398

5.5 DeviceNet data points

| Register | Name | Data type | Length | Read | | Write | |
|----------|----------------|-----------|--------|--------|---------|--------|---------|
| | | | | Cyclic | Acyclic | Cyclic | Acyclic |
| 7184 | Encoder01 | UDINT | 4 | ● | ● | | |
| 264 | DigitalInput 1 | USINT | 1 | ● | ● | | |
| 40 | PowerSupply 1 | USINT | 1 | ● | ● | | |
| 7176 | ConfigOutput14 | UINT | 2 | | | | ● |

Table 481: DeviceNet data points - DC1398

5.6 Modbus/TCP data points

| Register | Name | Data type | Length | Read | | Write | |
|----------|----------------|-----------|--------|--------|---------|-----------------|---------|
| | | | | Cyclic | Acyclic | Cyclic | Acyclic |
| 7184 | Encoder01 | UDINT | 4 | ● | ● | | |
| 264 | DigitalInput 1 | USINT | 1 | ● | ● | | |
| 40 | PowerSupply 1 | USINT | 1 | ● | ● | | |
| 7176 | ConfigOutput14 | UINT | 2 | | | ● ¹⁾ | ● |

Table 482: Modbus/TCP data points - DC1398

1) With the default configuration, these registers are not located in the area for cyclic output data. However, using a special function (Modbus/TCP User's Manual) these registers can also be applied cyclically.

5.7 SSI encoder cyclic register

5.7.1 Register: Encoder01

The SSI encoder value is displayed as a 32-bit position value. The SSI position value is generated synchronously with the X2X cycle.

| Data type | Description |
|-----------|---|
| DINT | -2147483648 - 2147483647 ... SSI position |

5.7.2 Register: DigitalInput 1

| Bit | Description |
|-----|--------------------------------|
| 3 | Input status - digital input 1 |

5.7.3 Register: DigitalInput01

| BOOL | Description |
|------|--------------------------------------|
| x | 0/1 ... Input status - digital input |

5.7.4 Register: PowerSupply 1

This register shows the status of the integrated encoder supplies.

| Bit | Description |
|-------|--------------------------------------|
| 0 ... | 24 VDC encoder supply voltage OK |
| 1 ... | 24 VDC encoder supply voltage faulty |

5.7.5 Register: PowerSupply01

| BOOL | Description |
|------|--|
| x | 0 ... 24 VDC encoder supply voltage OK |
| | 1 ... 24 VDC encoder supply voltage faulty |

5.8 SSI encoder configuration register for cyclical operation

5.8.1 Register: ConfigOutput14

This configuration register is used to set the coding, the clock rate and the number of bits. Default = 0. This must be set once using a non-cyclic write command.

| Bit | Description |
|--------|--|
| 0 - 5 | Number of bits valid for SSI value |
| 6 - 7 | Clock rate: 11: 125 kHz |
| 8 - 13 | Total number of bits in SSI, including leading zeros |
| 14 | 0 ... Reserved |
| 15 | 0 ... Binary coding 1 ... Gray coding |

5.9 B&R ID code

Code for module identification (\$1BAE).

5.10 Minimum cycle time

The minimum cycle time is the minimum time needed for the bus cycle to be shut down without a communication error occurring. It should be noted that very fast cycles have reduced the idle time needed for handling monitoring, diagnostics and acyclic commands.

| Minimum cycle time |
|--------------------|
| ≥128 µs |

Table 483: Minimum cycle time - DC1398

5.11 Maximum cycle time

The maximum cycle time is the maximum time the bus cycle can take to start without internal counter overruns causing module errors.

| Minimum cycle time |
|--------------------|
| <16 ms |

Table 484: Maximum cycle time - DC1398

5.12 Minimum I/O update time

The minimum I/O update time refers to the minimum time it takes for the bus cycle to shut down, so that in each cycle an I/O update takes place.

| Minimum I/O update time |
|-------------------------|
| $\geq 128 \mu\text{s}$ |

Table 485: Minimum I/O update time - DC1398

6. X20DC2396

6.1 Register overview

| Register | Name | Data type | Length | Read | | Write | |
|----------|---------------------------------------|-----------|--------|--------|---------|--------|---------|
| | | | | Cyclic | Acyclic | Cyclic | Acyclic |
| 2080 | Encoder01 ¹⁾ | INT | 2 | ● | ● | | |
| 2080 | Encoder01_32Bit ²⁾ | DINT | 4 | ● | ● | | |
| 2592 | Encoder02 ¹⁾ | INT | 2 | ● | ● | | |
| 2592 | Encoder02_32Bit ²⁾ | DINT | 4 | ● | ● | | |
| 264 | DigitalInput 1 - 2 | USINT | 1 | ● | ● | | |
| 2116 | ReferenceModeEncoder01 | USINT | 1 | | | ● | ● |
| 2628 | ReferenceModeEncoder02 | USINT | 1 | | | ● | ● |
| 2118 | StatusInput01 | USINT | 1 | ● | ● | | |
| 2630 | StatusInput02 | USINT | 1 | ● | ● | | |
| 40 | PowerSupply 1 | USINT | 1 | ● | ● | | |
| 4104 | Cf0_EdgeDetectFalling | USINT | 1 | | | ● | ● |
| 4106 | Cf0_EdgeDetectRising | USINT | 1 | | | ● | ● |
| 2064 | Cf0_PresetABR01 ¹⁾ | INT | 2 | | | ● | ● |
| 2064 | Cf0_PresetABR01_1_32Bit ²⁾ | DINT | 4 | | | ● | ● |
| 2576 | Cf0_PresetABR02 ¹⁾ | INT | 2 | | | ● | ● |
| 2576 | Cf0_PresetABR02_1_32Bit ²⁾ | DINT | 4 | | | ● | ● |
| 512 | ConfigOutput24 | UINT | 2 | | | ● | ● |
| 522 | ConfigOutput26 | USINT | 1 | | | ● | ● |
| 520 | ConfigOutput27 | USINT | 1 | | | ● | ● |
| 544 | ConfigOutput32 | UINT | 2 | | | ● | ● |
| 554 | ConfigOutput34 | USINT | 1 | | | ● | ● |
| 552 | ConfigOutput35 | USINT | 1 | | | ● | ● |

Table 486: Register overview - DC2396

1) Only with function model 0

2) Only with function model 1

6.2 Variable assignment in Automation Studio (X2X master)

| Name | Data type | Length | Read | | Write | |
|-------------------------|-----------|--------|--------|---------|--------|---------|
| | | | Cyclic | Acyclic | Cyclic | Acyclic |
| Encoder01 ¹⁾ | INT | 2 | ● | | | |
| Encoder01 ²⁾ | DINT | 4 | ● | | | |
| Encoder02 ¹⁾ | INT | 2 | ● | | | |
| Encoder02 ²⁾ | DINT | 4 | ● | | | |
| DigitalInput01 | BOOL | 1 | ● | | | |
| DigitalInput02 | BOOL | 1 | ● | | | |
| ReferenceModeEncoder01 | BOOL | 1 | | | ● | |
| ReferenceModeEncoder02 | BOOL | 1 | | | ● | |
| StatusInput01 | BOOL | 1 | ● | | | |
| StatusInput02 | BOOL | 1 | ● | | | |
| PowerSupply01 | BOOL | 1 | ● | | | |

Table 487: Variable assignment in Automation Studio (X2X master) - DC2396

1) Only with function model 0

2) Only with function model 1

6.3 Variable assignment in Automation Studio (CANIO)

| Name | Data type | Length | Read | | Write | |
|------------------------|-----------|--------|--------|---------|--------|---------|
| | | | Cyclic | Acyclic | Cyclic | Acyclic |
| Encoder01 | INT | 2 | ● | | | |
| Encoder02 | INT | 2 | ● | | | |
| DigitalInput01 | BOOL | 1 | ● | | | |
| DigitalInput02 | BOOL | 1 | ● | | | |
| ReferenceModeEncoder01 | BOOL | 1 | | | ● | |
| ReferenceModeEncoder02 | BOOL | 1 | | | ● | |
| StatusInput01 | BOOL | 1 | ● | | | |
| StatusInput02 | BOOL | 1 | ● | | | |
| PowerSupply01 | BOOL | 1 | ● | | | |

Table 488: Variable assignment in Automation Studio (CANIO) - DC2396

6.4 CANopen data points

| Register | Name | Data type | Length | Read | | Write | |
|----------|------------------------|-----------|--------|------|-----|-------|-----|
| | | | | PDO | SDO | PDO | SDO |
| 2080 | Encoder01 | INT | 2 | ● | ● | | |
| 2592 | Encoder02 | INT | 2 | ● | ● | | |
| 264 | DigitalInput 1 - 2 | USINT | 1 | ● | ● | | |
| 2116 | ReferenceModeEncoder01 | USINT | 1 | | | ● | ● |
| 2628 | ReferenceModeEncoder02 | USINT | 1 | | | ● | ● |
| 2118 | StatusInput01 | USINT | 1 | ● | ● | | |
| 2630 | StatusInput02 | USINT | 1 | ● | ● | | |
| 40 | PowerSupply 1 | USINT | 1 | ● | ● | | |
| 4104 | Cf0_EdgeDetectFalling | USINT | 1 | | | | ● |
| 4106 | Cf0_EdgeDetectRising | USINT | 1 | | | | ● |
| 2064 | Cf0_PresetABR01_1 | INT | 2 | | | | ● |
| 2576 | Cf0_PresetABR02_1 | INT | 2 | | | | ● |
| 512 | ConfigOutput24 | UINT | 2 | | | | ● |
| 522 | ConfigOutput26 | USINT | 1 | | | | ● |
| 520 | ConfigOutput27 | USINT | 1 | | | | ● |
| 544 | ConfigOutput32 | UINT | 2 | | | ● | ● |
| 554 | ConfigOutput34 | USINT | 1 | | | ● | ● |
| 552 | ConfigOutput35 | USINT | 1 | | | ● | ● |

Table 489: CANopen data points - DC2396

6.5 DeviceNet data points

| Register | Name | Data type | Length | Read | | Write | |
|----------|------------------------|-----------|--------|--------|---------|--------|---------|
| | | | | Cyclic | Acyclic | Cyclic | Acyclic |
| 2080 | Encoder01 | INT | 2 | ● | ● | | |
| 2592 | Encoder02 | INT | 2 | ● | ● | | |
| 264 | DigitalInput 1 - 2 | USINT | 1 | ● | ● | | |
| 2116 | ReferenceModeEncoder01 | USINT | 1 | | | ● | ● |
| 2628 | ReferenceModeEncoder02 | USINT | 1 | | | ● | ● |
| 2118 | StatusInput01 | USINT | 1 | ● | ● | | |
| 2630 | StatusInput02 | USINT | 1 | ● | ● | | |
| 40 | PowerSupply 1 | USINT | 1 | ● | ● | | |
| 4104 | Cf0_EdgeDetectFalling | USINT | 1 | | | | ● |
| 4106 | Cf0_EdgeDetectRising | USINT | 1 | | | | ● |
| 2064 | Cf0_PresetABR01_1 | INT | 2 | | | | ● |

Table 490: DeviceNet data points - DC2396

| Register | Name | Data type | Length | Read | | Write | |
|----------|-------------------|-----------|--------|--------|---------|--------|---------|
| | | | | Cyclic | Acyclic | Cyclic | Acyclic |
| 2576 | Cf0_PresetABR02_1 | INT | 2 | | | | ● |
| 512 | ConfigOutput24 | UINT | 2 | | | | ● |
| 522 | ConfigOutput26 | USINT | 1 | | | | ● |
| 520 | ConfigOutput27 | USINT | 1 | | | | ● |
| 544 | ConfigOutput32 | UINT | 2 | | | ● | ● |
| 554 | ConfigOutput34 | USINT | 1 | | | ● | ● |
| 552 | ConfigOutput35 | USINT | 1 | | | ● | ● |

Table 490: DeviceNet data points - DC2396

6.6 Modbus/TCP data points

| Register | Name | Data type | Length | Read | | Write | |
|----------|---------------------------------------|-----------|--------|--------|---------|-----------------|---------|
| | | | | Cyclic | Acyclic | Cyclic | Acyclic |
| 2080 | Encoder01 ¹⁾ | INT | 2 | ● | ● | | |
| 2080 | Encoder01_32Bit ²⁾ | DINT | 4 | ● | ● | | |
| 2592 | Encoder02 ¹⁾ | INT | 2 | ● | ● | | |
| 2592 | Encoder02_32Bit ²⁾ | DINT | 4 | ● | ● | | |
| 264 | DigitalInput 1 - 2 | USINT | 1 | ● | ● | | |
| 2116 | ReferenceModeEncoder01 | USINT | 1 | | | ● | ● |
| 2628 | ReferenceModeEncoder02 | USINT | 1 | | | ● | ● |
| 2118 | StatusInput01 | USINT | 1 | ● | ● | | |
| 2630 | StatusInput02 | USINT | 1 | ● | ● | | |
| 40 | PowerSupply 1 | USINT | 1 | ● | ● | | |
| 4104 | Cf0_EdgeDetectFalling | USINT | 1 | | | ● ³⁾ | ● |
| 4106 | Cf0_EdgeDetectRising | USINT | 1 | | | ● ³⁾ | ● |
| 2064 | Cf0_PresetABR01_1 ¹⁾ | INT | 2 | | | ● ³⁾ | ● |
| 2064 | Cf0_PresetABR01_1_32Bit ²⁾ | DINT | 4 | | | ● ³⁾ | ● |
| 2576 | Cf0_PresetABR02_1 ¹⁾ | INT | 2 | | | ● ³⁾ | ● |
| 2576 | Cf0_PresetABR02_1_32Bit ²⁾ | DINT | 4 | | | ● ³⁾ | ● |
| 512 | ConfigOutput24 | UINT | 2 | | | ● ³⁾ | ● |
| 522 | ConfigOutput26 | USINT | 1 | | | ● ³⁾ | ● |

Table 491: Modbus/TCP data points - DC2396

| Register | Name | Data type | Length | Read | | Write | |
|----------|----------------|-----------|--------|--------|---------|-----------------|---------|
| | | | | Cyclic | Acyclic | Cyclic | Acyclic |
| 520 | ConfigOutput27 | USINT | 1 | | | ● ³⁾ | ● |
| 544 | ConfigOutput32 | UINT | 2 | | | ● ³⁾ | ● |
| 554 | ConfigOutput34 | USINT | 1 | | | ● ³⁾ | ● |
| 552 | ConfigOutput35 | USINT | 1 | | | ● ³⁾ | ● |

Table 491: Modbus/TCP data points - DC2396

1) Only with function model 0

2) Only with function model 1

3) With the default configuration, these registers are not located in the area for cyclic output data. However, using a special function (Modbus/TCP User's Manual) these registers can also be applied cyclically.

6.7 Cyclic encoder registers

6.7.1 Register: Encoder01, Encoder02

The encoders are represented by 16-bit values.

| Data type | Description |
|-------------------|--|
| INT ¹⁾ | -32768 - 32767 ... Encoder counter value |

1) Only with function model 0

6.7.2 Register: Encoder01_32Bit, Encoder02_32Bit

The encoders are represented by 32-bit values.

| Data type | Description |
|--------------------|--|
| DINT ¹⁾ | -2147483648 - 2147483647 ... Encoder counter value |

1) Only with function model 1

6.7.3 Register: DigitalInput 1 - 2

| Bit | Description |
|-----|--|
| 0 | Input status - Encoder01 signal A |
| 1 | Input status - Encoder01 signal B |
| 2 | Input status - Encoder01 reference pulse |
| 3 | Input status - digital input 1 |
| 4 | Input status - Encoder02 signal A |
| 5 | Input status - Encoder02 signal B |
| 6 | Input status - Encoder02 reference pulse |
| 7 | Input status - digital input 2 |

6.7.4 Register: DigitalInput01 - DigitalInput02

| BOOL | Description |
|------|--------------------------------------|
| x | 0/1 ... Input status - digital input |

6.7.5 Register: ReferenceModeEncoder01, ReferenceModeEncoder02

ReferenceModeEncoder01:

This register determines the reference mode for Encoder01.

ReferenceModeEncoder02:

This register determines the reference mode for Encoder02.

| Bit | Description |
|-------|--|
| 0 - 1 | 00 ... Referencing OFF 01 ... One-time reference (single shot) 11 ... Continuous referencing |
| 2 - 5 | 0000 ... Bits permanently set = 0 |
| 6 - 7 | 00 ... Referencing OFF 11 ... Bits permanently set = 1 |

Table 492: Reference mode - DC2396

This results in the following values:

%00000000 = \$00 = Referencing OFF

%11000001 = \$C1 = One-time reference (single shot)

When starting over after the referencing process is complete, the value \$00 must be written. Then wait until the StatusInput01 also takes on the value \$00
Only then can the value \$C1 be written.

%11000011 = \$C3 = Continuous referencing

Referencing occurs at every reference pulse.

It is important to know how the optional reference enable (see section 6.9.4 "Referencing with reference enable input" on page 309) is configured.

6.7.6 Register: StatusInput01, StatusInput02

StatusInput01:

This register contains information regarding whether the referencing process is off, active, or complete for Encoder01.

StatusInput02:

This register contains information regarding whether the referencing process is off, active, or complete for Encoder02.

| Bit | Description |
|-------|---|
| 0 - 1 | 00 ... Always 0 |
| 2 | 0/1 ... Bit is always 1 after the first reference impulse |
| 3 | 0/1 ... Toggle after each completed reference |
| 4 | 0/1 ... Bit is always 1 after the first reference impulse |
| 5 - 7 | xxx ... Free-running counter, increased with each reference impulse |

Table 493: Encoder status information - DC2396

Examples of possible values:

%00000000 = \$00 = Referencing off or already in progress

%00111100 = \$3C = first reference complete, reference value applied in register Encoder01

%xxx11100 = \$xB = Bits 5 - 7 are changed sequentially with each reference impulse

%xxx1x100 = \$xx = Bits changed continuously with the setting continuous referencing. With every reference impulse, the reference value is applied to register Encoder01

It is important to know how the optional reference enable (see section 6.9.4 "Referencing with reference enable input" on page 309) is configured.

6.7.7 Register: PowerSupply 1

This register shows the status of the integrated encoder supplies.

| Bit | Description |
|-----|--|
| 0 | 0 ... 24 VDC encoder supply voltage OK 1 ... 24 VDC encoder supply voltage faulty |

6.7.8 Register: PowerSupply01

| BOOL | Description |
|------|--|
| x | 0 ... 24 VDC encoder supply voltage OK 1 ... 24 VDC encoder supply voltage faulty |

6.8 Encoder01 configuration register for cyclical operation

6.8.1 Reference pulse - positive edge

The following registers must be configured by setting the listed values one time using a non-cyclic write command so that the reference process is completed on the positive edge of the reference pulse.

Register: CfO_EdgeDetectFalling

| USINT | Description |
|-------|--|
| \$x0 | \$x0 ... Configuration value x defined by settings for Encoder02 Default: \$00 |

Register: CfO_EdgeDetectRising

| USINT | Description |
|-------|--|
| \$x4 | \$x4 ... Configuration value x defined by settings for Encoder02 Default: \$44 |

Register: ConfigOutput24

| UINT | Description |
|--------|--------------------------------|
| \$1012 | \$1012 ... Configuration value |

6.8.2 Reference pulse - negative edge (default configuration)

The following registers must be configured by setting the listed values one time using a non-cyclic write command so that the reference process is completed on the negative edge of the reference pulse.

Register: CfO_EdgeDetectFalling

| USINT | Description |
|-------|--|
| \$x4 | \$x4 ... Configuration value x defined by settings for Encoder02 Default: \$44 |

Register: CfO_EdgeDetectRising

| USINT | Description |
|-------|--|
| \$x0 | \$x0 ... Configuration value x defined by settings for Encoder02 Default: \$00 |

Register: ConfigOutput24

| UINT | Description |
|--------|--|
| \$1002 | \$1002 ... Configuration value (default) |

6.8.3 Preset home position

This register allows you to apply a preset home position using a one-time non-cyclic write command (default = 0). The value set here is applied to the counter value upon completion of the referencing process.

Register: CfO_PresetABR01_1

| Data type | Description |
|-------------------|----------------------------------|
| INT ¹⁾ | -32768 - 32767 ... Home position |

1) Only with function model 0

Register: CfO_PresetABR01_1_32Bit

| Data type | Description |
|--------------------|--|
| DINT ¹⁾ | -2147483648 - 2147483647 ... Home position |

1) Only with function model 1

6.8.4 Referencing with reference enable input

Regardless of the referencing mode, it is possible to prevent the home position from being taken over when the corresponding reference input voltage level occurs (DigitalInput01 / DigitalInput 1 bit 3). The desired setting can be configured using a one-time non-cyclic write command.

Register: ConfigOutput27

| USINT | Description |
|-------|--|
| \$0x | \$00 ... Reference enable input OFF (default) \$08 ... Reference enable input activated |

Register: ConfigOutput26

The voltage level to activate reference enable (DigitalInput01 / DigitalInput 1 bit 3) is configured with this register.

| USINT | Description |
|-------|---|
| \$0x | \$00 ... Reference enable is active at 0 VDC \$08 ... Reference enable is active at 24 VDC |

6.9 Encoder02 configuration register for cyclical operation

6.9.1 Reference pulse - positive edge

The following registers must be configured by setting the listed values one time using a non-cyclic write command so that the reference process is completed on the positive edge of the reference pulse.

Register: CfO_EdgeDetectFalling

| USINT | Description |
|-------|--|
| \$0x | \$0x ... Configuration value x defined by settings for Encoder01 Default: \$00 |

Register: CfO_EdgeDetectRising

| USINT | Description |
|-------|--|
| \$4x | \$4x ... Configuration value x defined by settings for Encoder01 Default: \$44 |

Register: ConfigOutput32

| UINT | Description |
|--------|--------------------------------|
| \$1016 | \$1016 ... Configuration value |

6.9.2 Reference pulse - negative edge

The following registers must be configured by setting the listed values one time using a non-cyclic write command so that the reference process is completed on the negative edge of the reference pulse.

Register: CfO_EdgeDetectFalling

| USINT | Description |
|-------|--|
| \$4x | \$4x ... Configuration value x defined by settings for Encoder01 Default: \$44 |

Register: CfO_EdgeDetectRising

| USINT | Description |
|-------|--|
| \$0x | \$0x ... Configuration value x defined by settings for Encoder01 Default: \$00 |

Register: ConfigOutput32

| UINT | Description |
|--------|--|
| \$1006 | \$1006 ... Configuration value (default) |

6.9.3 Preset home position

This register allows you to apply a preset home position using a one-time non-cyclic write command (default = 0). The value set here is applied to the counter value upon completion of the referencing process.

Register: CfO_PresetABR02_1

| Data type | Description |
|-------------------|----------------------------------|
| INT ¹⁾ | -32768 - 32767 ... Home position |

1) Only with function model 0

Register: CfO_PresetABR02_1

| Data type | Description |
|--------------------|--|
| DINT ¹⁾ | -2147483648 - 2147483647 ... Home position |

1) Only with function model 1

6.9.4 Referencing with reference enable input

Regardless of the referencing mode, it is possible to prevent the home position from being taken over when the corresponding reference input voltage level occurs (DigitalInput02 / DigitalInput 1 bit 7). The desired setting can be configured using a one-time non-cyclic write command.

Register: ConfigOutput35

| USINT | Description |
|-------|--|
| \$x0 | \$00 ... Reference enable input OFF (default) \$80 ... Reference enable input activated |

Register: ConfigOutput34

The voltage level to activate reference enable (DigitalInput02 / DigitalInput 1 bit 7) is configured with this register.

| USINT | Description |
|-------|---|
| \$x0 | \$00 ... Reference enable is active at 0 VDC \$80 ... Reference enable is active at 24 VDC |

6.9.5 Function models

A function model describes the registers for the module (memory model) which are available for the application. Only these registers are processed on the module during each cycle and cyclically transferred using the bus.

Function model 0 with 16-bit encoder counter value (default)

| Register | Name | Data type | Length | Read | | Write | |
|----------|------------------------|-----------|--------|--------|---------|--------|---------|
| | | | | Cyclic | Acyclic | Cyclic | Acyclic |
| 2080 | Encoder01 | INT | 2 | ● | ● | | |
| 2592 | Encoder02 | INT | 2 | ● | ● | | |
| 264 | DigitalInput 1 - 2 | USINT | 1 | ● | ● | | |
| 2116 | ReferenceModeEncoder01 | USINT | 1 | | | ● | ● |
| 2628 | ReferenceModeEncoder02 | USINT | 1 | | | ● | ● |
| 2118 | StatusInput01 | USINT | 1 | ● | ● | | |
| 2630 | StatusInput02 | USINT | 1 | ● | ● | | |
| 40 | PowerSupply 1 | USINT | 1 | ● | ● | | |
| 4104 | Cf0_EdgeDetectFalling | USINT | 1 | | | ● | ● |
| 4106 | Cfo_EdgeDetectRising | USINT | 1 | | | ● | ● |
| 2064 | Cf0_PresetABR01_1 | INT | 2 | | | ● | ● |
| 2576 | Cf0_PresetABR02_1 | INT | 2 | | | ● | ● |
| 512 | ConfigOutput24 | UINT | 2 | | | ● | ● |
| 522 | ConfigOutput26 | USINT | 1 | | | ● | ● |
| 520 | ConfigOutput27 | USINT | 1 | | | ● | ● |
| 544 | ConfigOutput32 | UINT | 2 | | | ● | ● |
| 554 | ConfigOutput34 | USINT | 1 | | | ● | ● |
| 552 | ConfigOutput35 | USINT | 1 | | | ● | ● |

Table 494: Function model 0 with 16-bit encoder - DC2396

Function model 1 with 32-bit encoder counter value

| Register | Name | Data type | Length | Read | | Write | |
|----------|-------------------------|-----------|--------|--------|---------|--------|---------|
| | | | | Cyclic | Acyclic | Cyclic | Acyclic |
| 2080 | Encoder01_32Bit | DINT | 4 | ● | ● | | |
| 2592 | Encoder02_32Bit | DINT | 4 | ● | ● | | |
| 264 | DigitalInput 1 - 2 | USINT | 1 | ● | ● | | |
| 2116 | ReferenceModeEncoder01 | USINT | 1 | | | ● | ● |
| 2628 | ReferenceModeEncoder02 | USINT | 1 | | | ● | ● |
| 2118 | StatusInput01 | USINT | 1 | ● | ● | | |
| 2630 | StatusInput02 | USINT | 1 | ● | ● | | |
| 40 | PowerSupply 1 | USINT | 1 | ● | ● | | |
| 4104 | Cf0_EdgeDetectFalling | USINT | 1 | | | ● | ● |
| 4106 | Cf0_EdgeDetectRising | USINT | 1 | | | ● | ● |
| 2064 | Cf0_PresetABR01_1_32Bit | DINT | 4 | | | ● | ● |
| 2576 | Cf0_PresetABR02_1_32Bit | DINT | 4 | | | ● | ● |
| 512 | ConfigOutput24 | UINT | 2 | | | ● | ● |
| 522 | ConfigOutput26 | USINT | 1 | | | ● | ● |
| 520 | ConfigOutput27 | USINT | 1 | | | ● | ● |
| 544 | ConfigOutput32 | UINT | 2 | | | ● | ● |
| 554 | ConfigOutput34 | USINT | 1 | | | ● | ● |
| 552 | ConfigOutput35 | USINT | 1 | | | ● | ● |

Table 495: Function model 1 with 32-bit encoder - DC2396

6.9.6 Function models - used where?

| Name | Automation Studio | CANopen | DeviceNet | Modbus/TCP | CAN I/O |
|---|-------------------|---------|-----------|------------|---------|
| Function model 0 with 16-bit encoder data (default) | ● | ● | ● | ● | ● |
| Function model 1 with 32-bit encoder data | ● | | | ● | |

Table 496: Function models - DC2396

6.10 B&R ID code

Code for module identification (\$1BAB).

6.11 Minimum cycle time

The minimum cycle time is the minimum time needed for the bus cycle to be shut down without a communication error occurring. It should be noted that very fast cycles have reduced the idle time needed for handling monitoring, diagnostics and acyclic commands.

| Minimum cycle time |
|--------------------|
| ≥128 µs |

Table 497: Minimum cycle time - DC2396

6.12 Maximum cycle time

The maximum cycle time is the maximum time the bus cycle can take to start without internal counter overruns causing module errors.

| Minimum cycle time |
|--------------------|
| <16 ms |

Table 498: Maximum cycle time - DC2396

6.13 Minimum I/O update time

The minimum I/O update time refers to the minimum time it takes for the bus cycle to shut down, so that in each cycle an I/O update takes place.

| Minimum I/O update time |
|-------------------------|
| ≥128 µs |

Table 499: Minimum I/O update time - DC2396

7. X20DC2398

7.1 Register overview

| Register | Name | Data type | Length | Read | | Write | |
|----------|--------------------|-----------|--------|--------|---------|--------|---------|
| | | | | Cyclic | Acyclic | Cyclic | Acyclic |
| 7184 | Encoder01 | UDINT | 4 | ● | ● | | |
| 7440 | Encoder02 | UDINT | 4 | ● | ● | | |
| 264 | DigitalInput 1 - 2 | USINT | 1 | ● | ● | | |
| 40 | PowerSupply 1 | USINT | 1 | ● | ● | | |
| 7176 | ConfigOutput15 | UINT | 2 | | | ● | ● |
| 7432 | ConfigOutput16 | UINT | 2 | | | ● | ● |

Table 500: Register overview - DC2398

7.2 Variable assignment in Automation Studio (X2X master)

| Name | Data type | Length | Read | | Write | |
|----------------|-----------|--------|--------|---------|--------|---------|
| | | | Cyclic | Acyclic | Cyclic | Acyclic |
| Encoder01 | UDINT | 4 | ● | | | |
| Encoder02 | UDINT | 4 | ● | | | |
| DigitalInput01 | BOOL | 1 | ● | | | |
| DigitalInput02 | BOOL | 1 | ● | | | |
| PowerSupply01 | BOOL | 1 | ● | | | |

Table 501: Variable assignment in Automation Studio (X2X master) - DC2398

7.3 Variable assignment in Automation Studio (CANIO)

| Name | Data type | Length | Read | | Write | |
|----------------|-----------|--------|--------|---------|--------|---------|
| | | | Cyclic | Acyclic | Cyclic | Acyclic |
| Encoder01 | UDINT | 4 | ● | | | |
| Encoder02 | UDINT | 4 | ● | | | |
| DigitalInput01 | BOOL | 1 | ● | | | |
| DigitalInput02 | BOOL | 1 | ● | | | |
| PowerSupply01 | BOOL | 1 | ● | | | |

Table 502: Variable assignment in Automation Studio (CANIO) - DC2398

7.4 CANopen data points

| Register | Name | Data type | Length | Read | | Write | |
|----------|--------------------|-----------|--------|------|-----|-------|-----|
| | | | | PDO | SDO | PDO | SDO |
| 7184 | Encoder01 | UDINT | 4 | ● | ● | | |
| 7440 | Encoder02 | UDINT | 4 | ● | ● | | |
| 264 | DigitalInput 1 - 2 | USINT | 1 | ● | ● | | |
| 40 | PowerSupply 1 | USINT | 1 | ● | ● | | |
| 7176 | ConfigOutput15 | UINT | 2 | | | | ● |
| 7432 | ConfigOutput16 | UINT | 2 | | | | ● |

Table 503: CANopen data points - DC2398

7.5 DeviceNet data points

| Register | Name | Data type | Length | Read | | Write | |
|----------|--------------------|-----------|--------|--------|---------|--------|---------|
| | | | | Cyclic | Acyclic | Cyclic | Acyclic |
| 7184 | Encoder01 | UDINT | 4 | ● | ● | | |
| 7440 | Encoder02 | UDINT | 4 | ● | ● | | |
| 264 | DigitalInput 1 - 2 | USINT | 1 | ● | ● | | |
| 40 | PowerSupply 1 | USINT | 1 | ● | ● | | |
| 7176 | ConfigOutput15 | UINT | 2 | | | | ● |
| 7432 | ConfigOutput16 | UINT | 2 | | | | ● |

Table 504: DeviceNet data points - DC2398

7.6 Modbus/TCP data points

| Register | Name | Data type | Length | Read | | Write | |
|----------|--------------------|-----------|--------|--------|---------|-----------------|---------|
| | | | | Cyclic | Acyclic | Cyclic | Acyclic |
| 7184 | Encoder01 | UDINT | 4 | ● | ● | | |
| 7440 | Encoder02 | UDINT | 4 | ● | ● | | |
| 264 | DigitalInput 1 - 2 | USINT | 1 | ● | ● | | |
| 40 | PowerSupply 1 | USINT | 1 | ● | ● | | |
| 7176 | ConfigOutput15 | UINT | 2 | | | ● ¹⁾ | ● |
| 7432 | ConfigOutput16 | UINT | 2 | | | ● ¹⁾ | ● |

Table 505: Modbus/TCP data points - DC2398

1) With the default configuration, these registers are not located in the area for cyclic output data. However, using a special function (Modbus/TCP User's Manual) these registers can also be applied cyclically.

7.7 SSI encoder cyclic register

7.7.1 Register: Encoder01, Encoder02

The two SSI encoder values are displayed as 32-bit position values. The SSI position values are generated synchronously with the X2X cycle.

| Data type | Description |
|-----------|--|
| DINT | -2147483648 - 2147483647 ... SSI positions |

7.7.2 Register: DigitalInput 1 - 2

| Bit | Description |
|-----|--------------------------------|
| 3 | Input status - digital input 1 |
| 7 | Input status - digital input 2 |

7.7.3 Register: DigitalInput01 - DigitalInput02

| BOOL | Description |
|------|--------------------------------------|
| x | 0/1 ... Input status - digital input |

7.7.4 Register: PowerSupply 1

This register shows the status of the integrated encoder supplies.

| Bit | Description |
|-----|--|
| 0 | 0 ... 24 VDC encoder supply voltage OK 1 ... 24 VDC encoder supply voltage faulty |

7.7.5 Register: PowerSupply01

| BOOL | Description |
|------|--|
| x | 0 ... 24 VDC encoder supply voltage OK 1 ... 24 VDC encoder supply voltage faulty |

7.8 SSI encoder configuration register for cyclical operation

7.8.1 Register: ConfigOutput15, ConfigOutput16

ConfigOutput15: Configuration register for SSI Encoder01

ConfigOutput16: Configuration register for SSI Encoder02

These configuration registers are used to set the coding, the clock rate and the number of bits. Default = 0. This must be set once using a non-cyclic write command.

| Bit | Description |
|--------|--|
| 0 - 5 | Number of bits valid for SSI value |
| 6 - 7 | Clock rate: 11: 125 kHz |
| 8 - 13 | Total number of bits in SSI, including leading zeros |
| 14 | 0 ... Reserved |
| 15 | 0 ... Binary coding 1 ... Gray coding |

7.9 B&R ID code

Code for module identification (\$1BAD).

7.10 Minimum cycle time

The minimum cycle time is the minimum time needed for the bus cycle to be shut down without a communication error occurring. It should be noted that very fast cycles have reduced the idle time needed for handling monitoring, diagnostics and acyclic commands.

| Minimum cycle time |
|------------------------|
| $\geq 128 \mu\text{s}$ |

Table 506: Minimum cycle time - DC2398

7.11 Maximum cycle time

The maximum cycle time is the maximum time the bus cycle can take to start without internal counter overruns causing module errors.

| Minimum cycle time |
|--------------------|
| <16 ms |

Table 507: Maximum cycle time - DC2398

7.12 Minimum I/O update time

The minimum I/O update time refers to the minimum time it takes for the bus cycle to shut down, so that in each cycle an I/O update takes place.

| Minimum I/O update time |
|-------------------------|
| ≥128 μs |

Table 508: Minimum I/O update time - DC2398

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