1. DO435

1.1 Order data

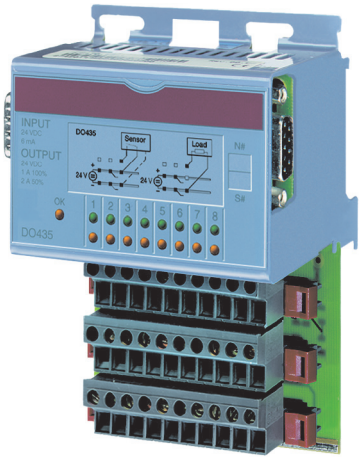
Model number	Short description	Figure
7DO435.7	2003 digital output module, 8 FET outputs 24 VDC, 2 A, outputs can be optionally used as inputs. Order terminal blocks separately!	
7TB710.9	Terminal block, 10-pin, screw clamps	
7TB710.91	Terminal block, 10-pin, cage clamps	
Terminal blocks are not included in the delivery.		

Table 1: DO435 - Order data

1.2 Technical data

Product ID	DO435
General information	
C-UL-US listed	Yes
B&R ID code	$EB
Module type	B&R 2003 I/O module, single-width
Number CP430, EX270 CP470, CP770, CP474, CP476, CP774, EX470, EX770 EX477, EX777	 4 8
Voltage monitoring (LED: U OK)	Yes Supply voltage >18 V
Power consumption	Max. 0.5 W
Outputs	
Number of outputs	Max. 8
Type	FET

Table 2: DO435 - Technical data

Product ID	DO435
Switching voltage/supply Minimum Rated Maximum	 18 VDC 24 VDC 30 VDC
Continuous current per Output Module	 Max. 2 A Max. 8 A
Simultaneousness at 1 A at 2 A	 100 % 50 % (note derating curve on page 10)
Residual voltage	Max. 1 V at 2 A
Protection Short circuit protection Overload protection	 Yes Yes
Short circuit current at 24 V	Approx. 20 A until switched off
Braking voltage when switching off inductive loads	Approx. 46 V
Switching delay log. 0 - log. 1 log. 1 - log. 0	Approx. 200 µs Typ. 50 µs / max. 250 µs Typ. 170 µs / max. 250 µs
Maximum switching frequency Resistive load Inductive load	 100 Hz See section 1.8 "Switching inductive loads" on page 9
Electrical isolation	Output - PLC

Table 2: DO435 - Technical data (cont.)

With this module, each channel can be used either as an input or output. All outputs must first be declared as such. Each time the module is turned on, all channels are configured as inputs.

Controller / Access	Declaration	
	Automatic	By user
CPU for the PLC 2003	●	
Remote Slaves		●
CAN Slaves	●	
Access using CAN Identifiers		●

Table 3: DO435 - Input/output configuration

1.3 Technical Data for the Inputs

Name	DO435
Number of Inputs	Max. 8
Wiring	Sink
Input voltage Minimum Rated Maximum	 18 VDC 24 VDC 30 VDC
Switching threshold Low High	 <5 V >15 V
Input delay	Max. 1 ms (at 18 - 30 V)
Input current at nominal voltage	Approx. 6 mA
Electrical isolation	Input - PLC

Table 4: DO435 - Technical data for the inputs

1.4 Status LEDs

The green/orange status LEDs 1 - 8 show the logical state of the corresponding input/output. The LED U-OK (orange) indicates that the supply voltage is present. The LED is lit starting with a supply voltage of approx. 18 VDC.

1.5 Input/output circuit diagram

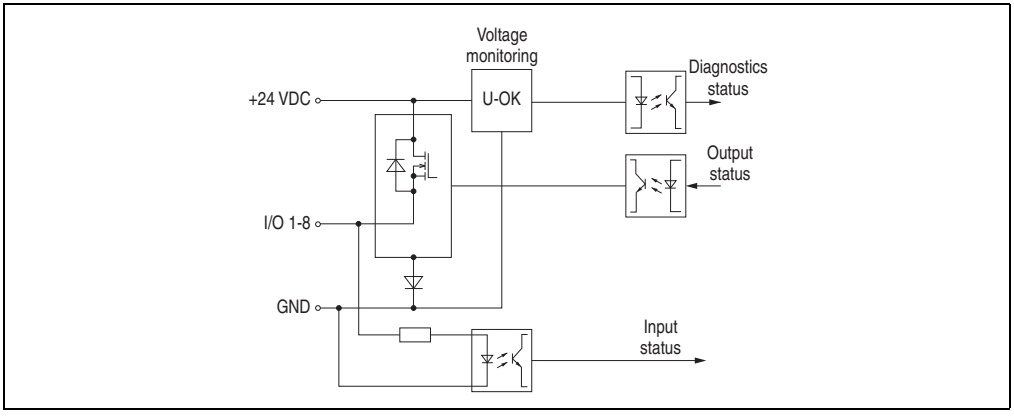


Figure 1: DO435 - Input/output circuit diagram

1.6 Legend strips

A legend sheet can be slid into the front of the module from above. The module circuit is shown on the back. The outputs/inputs can be labeled on the front.

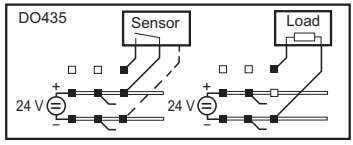


Figure 2: DO435 - Legend strips

1.7 Connections

1.7.1 Output circuit

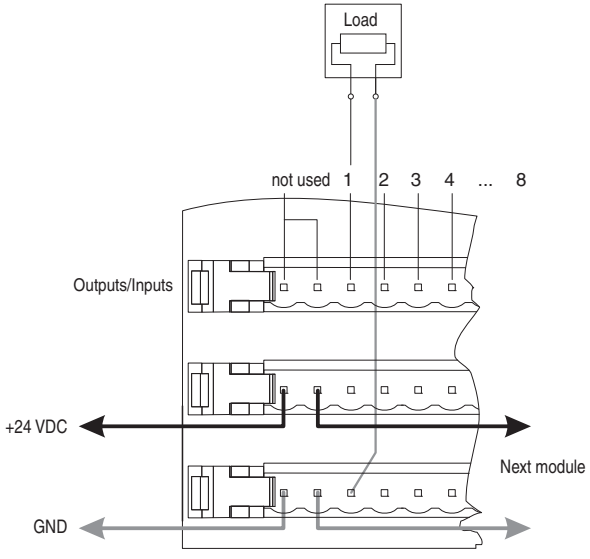


Figure 3: DO435 - Output wiring

1.7.2 Output wiring for safety purposes: E-stop, stop category 0

An appropriate upstream safety switch must be used in safety-related applications in order to achieve category 4 shutdown according to EN 954-1.

Caution!

The upstream safety switch must be category 4 according to EN 954-1. It must meet the technical requirements for the intended use. These include, for example, switching power, environmental conditions, etc.

Caution!

Only the described wiring will ensure that the E-stop safety function securely shuts off the outputs according to category 4, EN 954-1.

If the status of the secure outputs is checked with a control element, it is important that a 24 VDC current is not fed into the module if the control element malfunctions.

Caution!

A short circuit between the digital output and the 24 V supply can result in the 24 V supply being fed back into the module's internal supply voltage.
As a result, the safety function can no longer be guaranteed, which means that none of the module channels can be shutdown using the upstream safe switching device.

To prevent this error from occurring, one of the wiring methods listed in EN ISO 13849-2:2003, appendix D.5.2, table D.5 must be used for all the digital output channels to rule out short circuit errors.

The wiring can take place through the following examples:

1) Directly connect the actuators up to category 4 according to EN 954-1

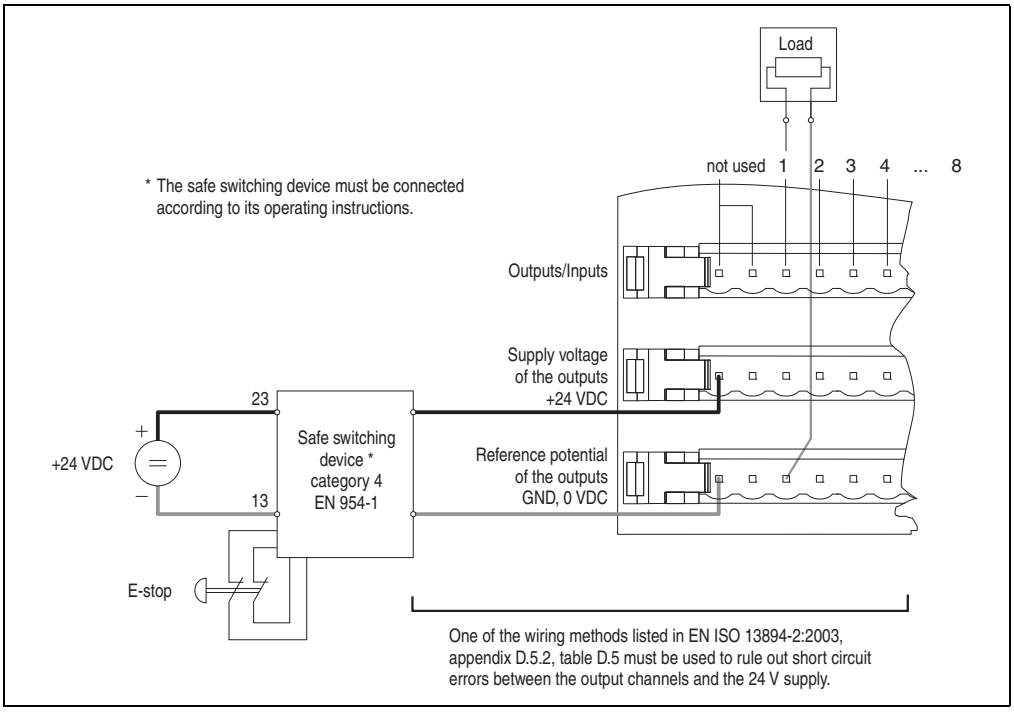


Figure 4: DO435 - Output wiring by directly connecting the actuators

Caution!

Only properly functioning actuators can be connected using this wiring method!

2) Wiring using contactors up to category 4 according to EN 954-1

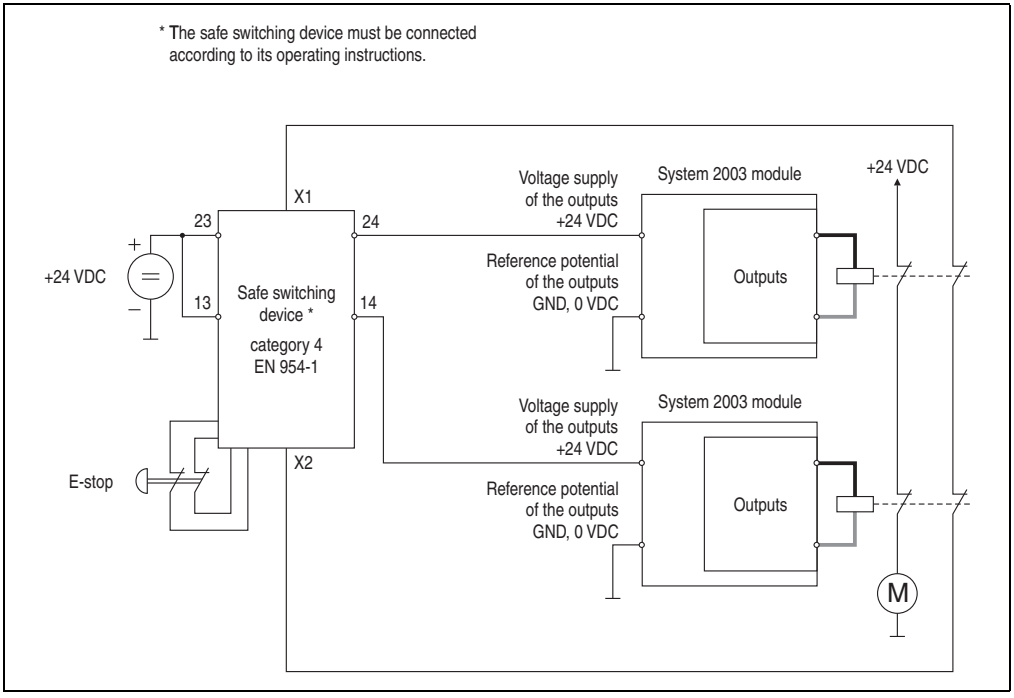


Figure 5: DO435 - Output wiring by wiring with contactors

- 2-channel execution necessary to avoid contactor error (contactor is faulty, e. g. contacts sticking).
- Evaluation of feedback contacts in order to prevent a restart in case of error.

1.7.3 Input circuit

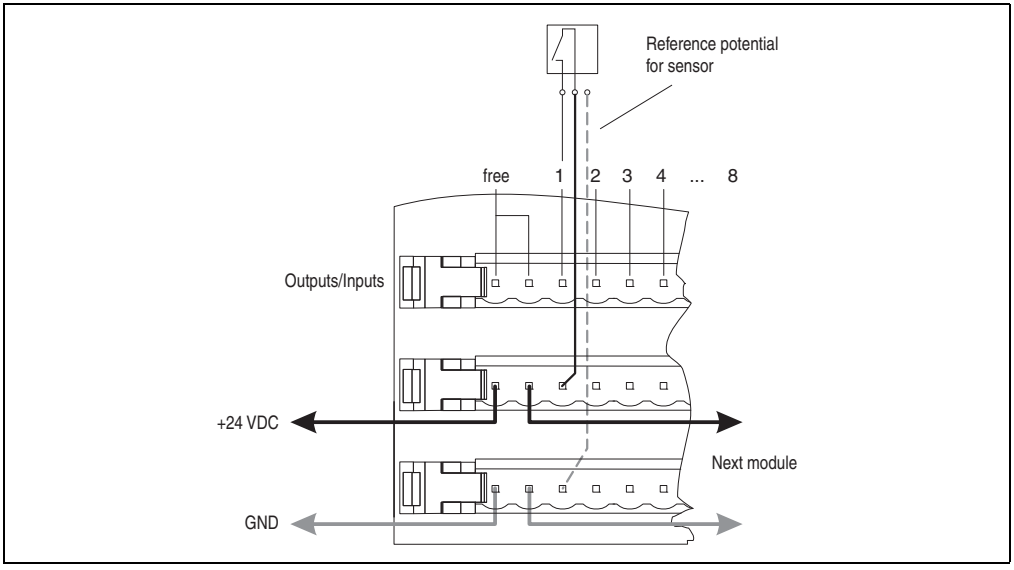


Figure 6: DO435 - Input Circuit

1.8 Switching inductive loads

Transistors are suitable for switching inductive loads off quickly and safely. Inverse diodes are not necessary on inductive loads. It should be noted that the maximum switching frequency at a given inductance is limited by a set braking voltage of 46 V. The maximum switching frequency decreases as the inductance increases.

The maximum switching frequency in relation to a given inductance can be seen from the following diagram.

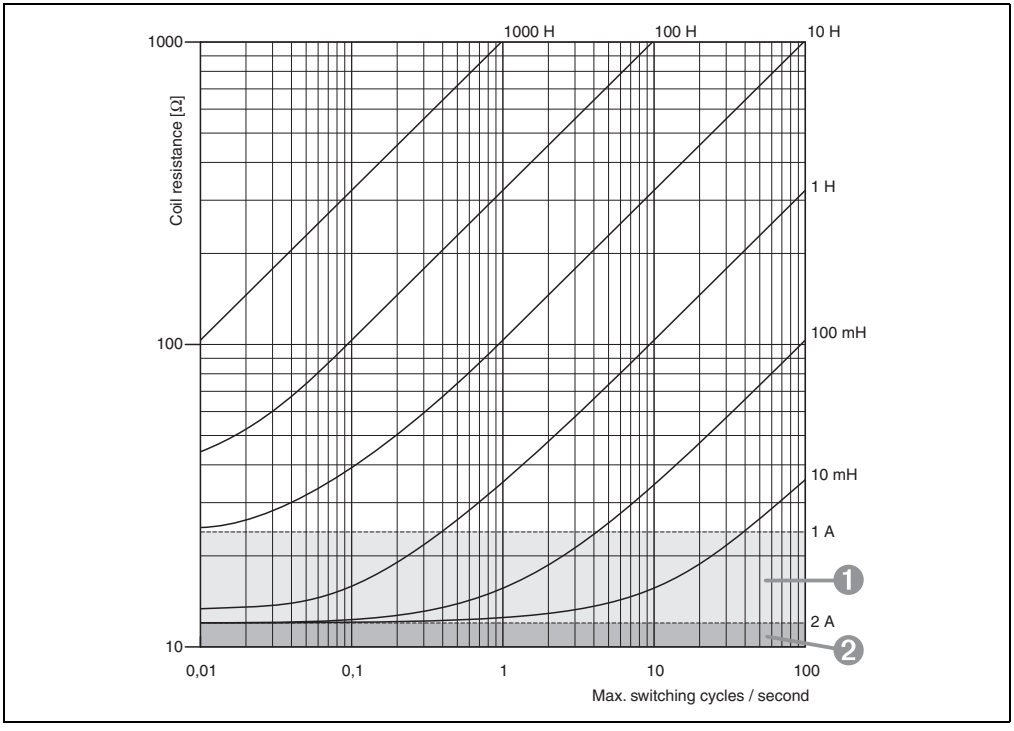


Figure 7: DO435 - Switching inductive loads

❶ ... Observe derating curve
❷ ... Invalid Range (thermal cut off)

1.8.1 Derating Curve

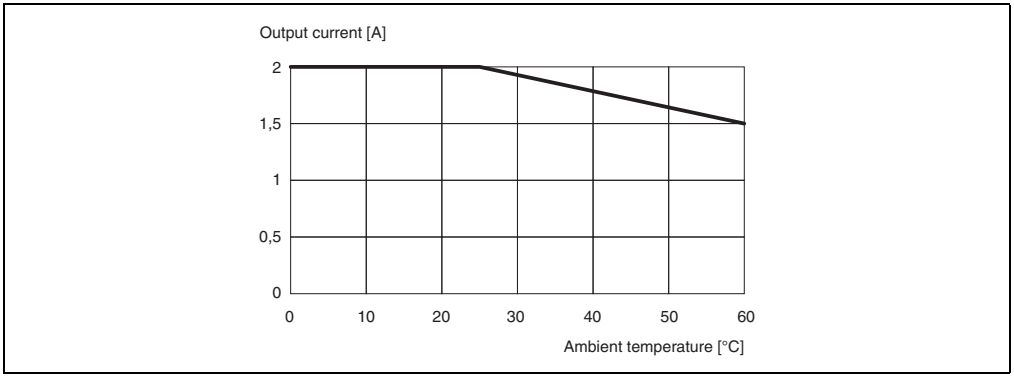


Figure 8: DO435 - Derating curve

1.9 Variable declaration

The variable declaration is valid for the following controllers:

- CPU for the PLC 2003
- Remote I/O bus controllers
- CAN bus controller

B&R Automation Studio Support: See B&R Automation Studio Help starting with V 1.40

Information:

After the module is turned on, all channels are configured as inputs. Output channels must first be declared as such. Please refer to the overview in the technical data and the examples in Chapter 4 "Module Addressing".

1.9.1 Variable declaration with PLC 2003 CPU and remote slaves

Function	Variable declaration				
	Scope	Data type	Length	Module type	Channel
Single digital input (channel x)	tc_global	BOOL	1	Digit. In	1 ... 8
Single digital output (channel x)	tc_global	BOOL	1	Digit. Out	1 ... 8
Module status	tc_global	USINT	1	Status In	0

Table 5: DO435 - Variable declaration using the CPU and remote slaves

1.9.2 Variable declaration with CAN slaves

Function	Variable declaration				
	Scope	Data type	Length	Module type	Channel
Single digital input (channel x)	tc_global	BOOL	1	Digit. In	1 ... 8
Single digital output (channel x)	tc_global	BOOL	1	Digit. Out	1 ... 8

Table 6: DO435 - Variable Declaration with CAN Slaves

Module status

The module status for CAN slaves can only be read using command codes. The command codes are explained in Chapter 5 "CAN Bus Controller Functions", section "Command Codes and Parameters". An example is provided in Chapter 4 "Module Addressing".

1.10 Access using CAN identifiers

Access via CAN identifiers is used if the slave is being controlled by a device from another manufacturer. Access via CAN identifiers is described in an example in Chapter 4 "Module Addressing". The transfer modes are explained in Chapter 5, "CAN Bus Controller Functions".

1.10.1 Digital inputs

A maximum of eight digital I/O modules can be run in the packed mode.

CAN ID 1)	Byte 1	Byte 2	Byte 3	Byte 4	Byte 5	Byte 6	Byte 7	Byte 8
286	Module 1	Module 2	Module 3	Module 4	Module 5	Module 6	Module 7	Module 8

Table 7: DO435 - Access via CAN identifiers, digital inputs, packed

1) CAN ID = 286 + (nn - 1) x 4
nn ... Node number of the CAN slave = 1

A maximum of four digital I/O modules can be run in unpacked mode.

Module	CAN ID 1)	Bytes
1	286	Inputs 1 - 8
2	287	Inputs 1 - 8
3	288	Inputs 1 - 8
4	289	Inputs 1 - 8

Table 8: DO435 - Access via CAN identifiers, digital inputs, unpacked

1) CAN ID = 286 + (nn - 1) x 4 + (ma - 1)
nn ... Node number of the CAN slave = 1
ma ... Module address of digital I/O modules = 1 - 4

1.11 Digital outputs

Information:

All channels are declared as inputs as their default. The redefining of an output signal is explained in Chapter 5, "CAN Bus Controller Functions". An example is provided in Chapter 4 "Module Addressing".

A maximum of eight digital I/O modules can be run in the packed mode.

CAN ID [1]	Byte 1	Byte 2	Byte 3	Byte 4	Byte 5	Byte 6	Byte 7	Byte 8
414	Module 1	Module 2	Module 3	Module 4	Module 5	Module 6	Module 7	Module 8

Table 9: DO435 - Access via CAN identifiers, digital outputs, packed

1) CAN ID = 414 + (nn - 1) x 4
nn ... Node number of the CAN slave = 1

A maximum of four digital I/O modules can be run in unpacked mode.

Module	CAN ID [1]	Bytes
1	414	Outputs 1 - 8
2	415	Outputs 1 - 8
3	416	Outputs 1 - 8
4	417	Outputs 1 - 8

Table 10: DO435 - Access via CAN identifiers, digital outputs, unpacked

1) CAN ID = 414 + (nn - 1) x 4 + (ma - 1)
nn ... Node number of the CAN slave = 1
ma ... Module address of digital I/O modules = 1 - 4

For more information on ID allocation, see Chapter 5, "CAN Bus Controller Functions".

1.12 Module status

The evaluation of the module status is described in an example in Chapter 4 "Module Addressing".

Bit	Description
0 - 4	Module code = $0B
5	x ... Not defined, masked out
6	Digital module = 0
7	0 ... No module voltage or module voltage too low 1 ... Module voltage OK