## 1.1 DO138

### 1.1.1 General Information

The DO138 digital output module is a screw-in module for the B&R SYSTEM 2003 and for the B&R Power Panel with 8 outputs. Outputs 1 to 4 can also be used limitedly by TPU (see Section 1.1.10 "TPU Operation", on page 5).

### 1.1.2 Order Data

| Model number | Short Description | Image |
|---|---|---|
| 7DO138.70 | 2003 digital output module, 8 outputs 24 VDC, 0.5 A, short circuit protection, thermal overload protection, screw-in module. Order TB712 terminal block separately. |   |
| 7TB712.9 | Terminal block, 12 pin, screw clamps | |
| 7TB712.91 | Terminal block, 12 pin, cage clamps | |
| 7TB712:90-02 | Terminal block, 12 pin, 20 pcs., screw clamps | |
| 7TB712:91-02 | Terminal block, 12 pin, 20 pcs., cage clamps | |
| Terminal block is not included in the delivery. | | |

Table 1: DO138 order data

### 1.1.3 Technical Data

| Description | DO138 |
|---|---|
| **General Information** | |
| C-UL-US Listed | In preparation |
| B&R ID Code | $4C |
| Module Type | B&R 2003 screw-in module |
| Slot | AF101 adapter module, CP interface Power Panel interface (slots 4 - 6) |
| **Static Characteristics** | |
| Number of Outputs | 8 |
| Type | FET positive switching |
| Status Display | None |
| Electrical Isolation<br>Output - PLC<br>Output - Output | <br>No<br>No |

Table 2: DO138 technical data

| Description | DO138 |
|---|---|
| Diagnosis Status<br>Voltage Monitoring<br>Output Monitoring | <br>10.5 V < supply voltage < 30 V<br>Output OK |
| Switching Voltage/Supply<br>Minimum<br>Nominal<br>Maximum | <br>10.5 VDC<br>24 VDC<br>30 VDC |
| Continuous Current per<br>Output<br>Module | <br>Max. 0.5 A<br>Max. 4 A<br><br>To increase the output current, outputs can be switched in parallel |
| Leakage Current when Switched Off | 12 µA |
| Residual Voltage | 0.2 V @ 0.5 A |
| Short Circuit Current | Typ. 4 A |
| Switching On after Overload Cutoff | Automatically within seconds (depends on the module temperature) |
| Power Consumption<br>Internal<br>24 VDC Supply | <br>Max. 0.25 W<br>Max. 1.5 W |
| Protection | Thermal cutoff<br>Integrated protection for switching inductances<br>Reverse polarity protection |
| **Dynamic Characteristics** | |
| Switching Delay<br>Log. 0 - Log. 1<br>Log. 1 - Log. 0 | <br>Max. 450 µs<br>Max. 450 µs |
| Switching Frequency<br>Resistive Load<br>Inductive Load | <br>Max. 100 Hz<br>See Section 1.1.9 "Switching Inductive Loads", on page 5 |
| Braking Voltage when Switching Off Inductive Loads | 47 VDC |
| **Mechanical Characteristics** | |
| Dimensions | B&R 2003 screw-in module |

Table 2: DO138 technical data (cont.)

### 1.1.4 Pin Assignments

| DO138 Pin Assignment | |
|---|---|
| **Pin** | **Assignment** |
| 1 | Output 1 |
| 2 | Output 2 |
| 3 | Output 3 |
| 4 | Output 4 |
| 5 | Output 5 |
| 6 | Output 6 |
| 7 | Output 7 |
| 8 | Output 8 |
| 9 | NC |
| 10 | NC |
| 11 | +12 to +24 VDC |
| 12 | GND |

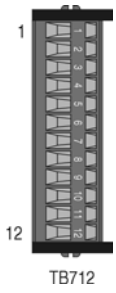


Table 3: DO138 pin assignment



### 1.1.5 Connection Example

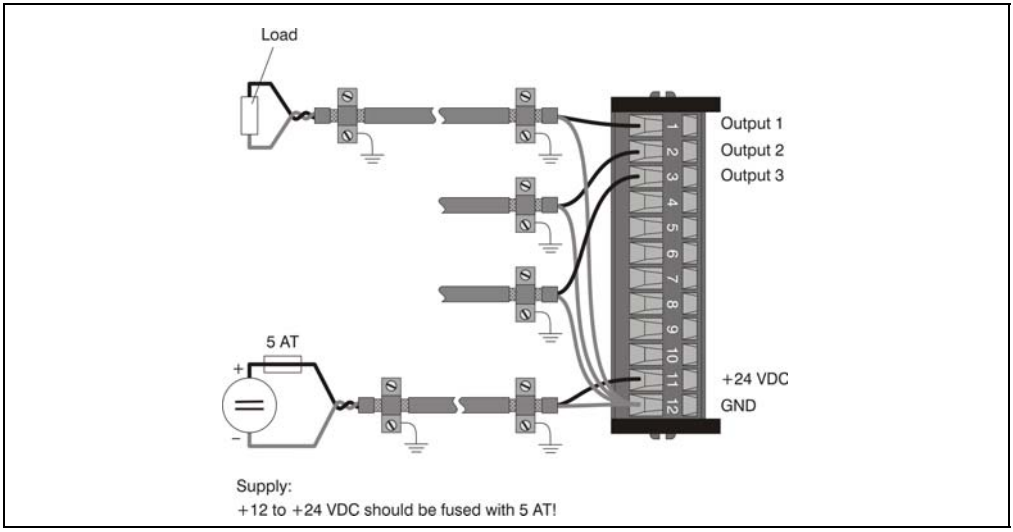


Figure 1: DO138 connection example

### 1.1.6 Output Circuit Diagram

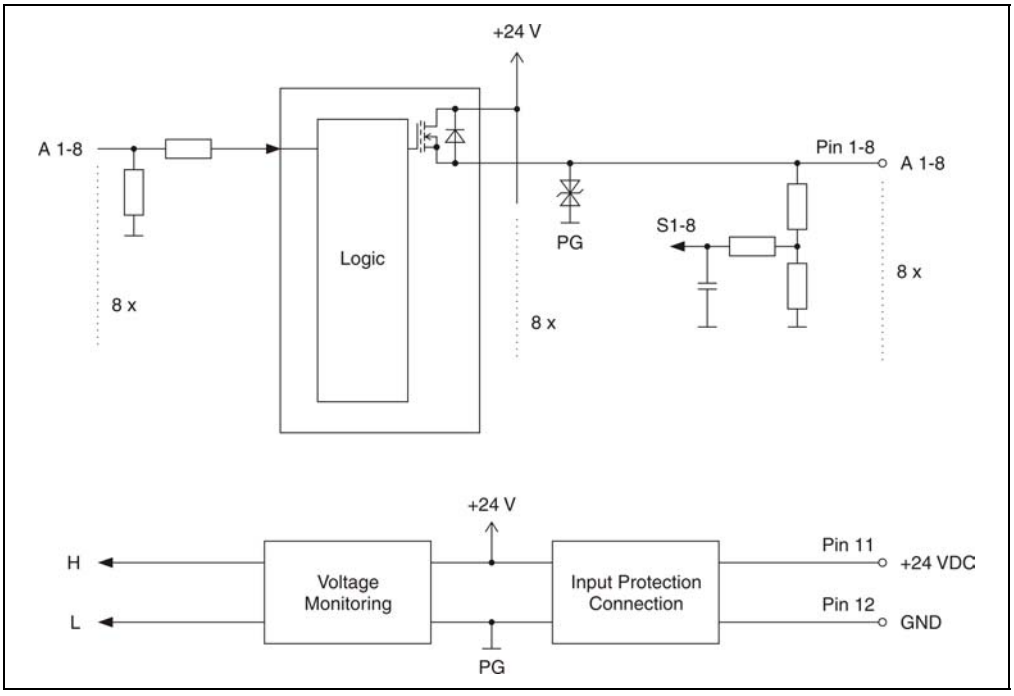


Figure 2: DO138 output circuit diagram

### 1.1.7 Area of Use

The DO138 was designed mainly as a digital add-on module for the Power Panel, but can also be used to increase digital component density on the B&R SYSTEM 2003.

### 1.1.8 Output Monitoring

In a defined cycle (multiple of 250 µs), the output states are compared with the set states. The control for the output driver is used for the set states. This allows monitoring of the outputs controlled by the TPU. If output states have changed during the monitoring cycle, the affected channels are not used in the output monitoring status.

The status can be read using a register. An accumulative bit for output monitoring is created in the module status. Individual channels can be masked and therefore an alarm can be supressed.

### 1.1.9 Switching Inductive Loads

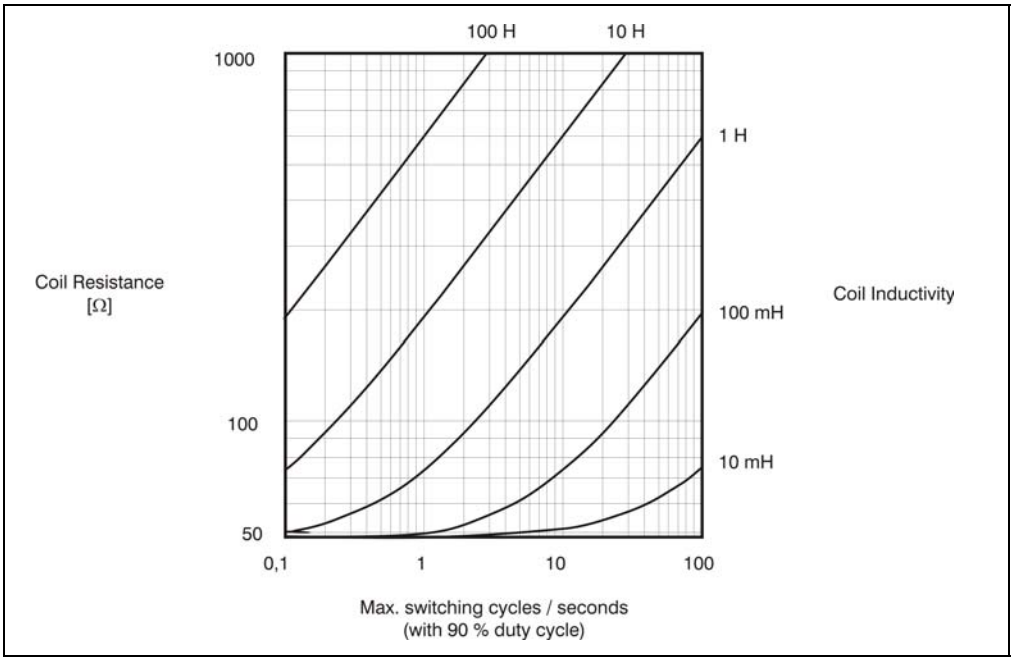


Figure 3: DO138 switching inductive loads

### 1.1.10 TPU Operation

Outputs 1 to 4 can also be used limitedly by TPU

**Remarks**

- TPU functionality is automatically activated for the DO138
- Operation takes place using LTX functions
- TPU functionality is available on slots 1 to 3 when used with a Power Panel
- TPU functionality is available on slots 1 to 4 when used with the B&R SYSTEM 2003
- Maximum switching frequency should be observed

### 1.1.11 Variable Declaration

The variable declaration is valid for the following controllers:

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

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

After booting, the DO138 digital module logically corresponds to an analog module. Communication takes place using shovel instructions from data and configuration words.

Accessing screw-in modules is also explained in the sections "AF101" and "CPU".

The following table provides an overview of the data and configuration words that are used for this module.

| Data Access | VD Data Type | VD Module Type | VD Chan. | R | W | Description |
|---|---|---|---|---|---|---|
| Data Word 0 | UINT | Transp. In | 0 | ● | | Read-back output states |
| | UINT | Transp. Out | 0 | | ● | Output states |
| Configuration Word 8 | UINT | Transp. In | 16 | ● | | Output monitoring for individual channel evaluation |
| | UINT | Transp. Out | 16 | | ● | Definition of group monitoring |
| Configuration Word 9 | UINT | Transp. Out | 18 | | ● | Cycle time for output monitoring |
| Configuration Word 12 | UINT | Transp. In | 24 | ● | | Module status |
| Configuration Word 14 | UINT | Transp. In | 28 | ● | | Module type |
| | UINT | Transp. Out | 28 | | ● | Module configuration |

Table 4: DO138 data and configuration words

### Access using CAN Identifier

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".

Input Data (Read-back Output States)

The read-back output states can be transferred packed or unpacked. CAN objects can only be sent back in packed mode.

| CAN-ID [1] | Slot 1 | | Slot 2 | | Slot 3 | | Slot 4 | |
|---|---|---|---|---|---|---|---|---|
| 542 | ANP 1L | ANP 1H | ANP 2L | ANP 2H | ANP 3L | ANP 3H | ANP 4L | ANP 4H |
| 543 | free | | | | | | | |
| 544 | free | | | | | | | |
| 545 | free | | | | | | | |

Table 5: DO138 input data packed

1) CAN-ID = 542 + (nd - 1) x 16 + (ma - 1) x 4
nd .... Node number of the CAN slaves = 1
ma ... Module address of the AF101 = 1

Four CAN objects can be sent back in unpacked mode.

| Slot | CAN-ID [1] | Word 1 | | Word 2 | Word 3 | Word 4 |
|---|---|---|---|---|---|---|
| 1 | 542 | ANP 1L | ANP 1H | Not used (2 byte objects) | | |
| 2 | 543 | ANP 2L | ANP 2H | Not used (2 byte objects) | | |
| 3 | 544 | ANP 3L | ANP 3H | Not used (2 byte objects) | | |
| 4 | 545 | ANP 4L | ANP 4H | Not used (2 byte objects) | | |

Table 6: DO138 input data unpacked

1) CAN-ID = 542 + (nd - 1) x 16 + (ma - 1) x 4 + (sl - 1)
nd .... Node number of the CAN slaves = 1
ma ... Module address of the AF101 = 1
sl ..... Slot number of the screw-in module on the AF101 (1 - 4)

## Note:

**B&R 2000 users have to exchange the data so that the high data is first (Motorola format)!**

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

Output Data

The output states can be transferred packed or unpacked. CAN objects can only be transferred in packed mode.

| CAN-ID [1] | Slot 1 | | Slot 2 | | Slot 3 | | Slot 4 | |
|---|---|---|---|---|---|---|---|---|
| 1054 | ANP 1L | ANP 1H | ANP 2L | ANP 2H | ANP 3L | ANP 3H | ANP 4L | ANP 4H |
| 1055 | free | | | | | | | |
| 1056 | free | | | | | | | |
| 1057 | free | | | | | | | |

Table 7: DO138 output data packed

1) CAN-ID = 1054 + (nd - 1) x 16 + (ma - 1) x 4
nd .... Node number of the CAN slaves = 1
ma ... Module address of the AF101 = 1

Four CAN objects can be transferred in unpacked mode.

| Slot | CAN-ID [1] | Word 1 | | Word 2 | Word 3 | Word 4 |
|---|---|---|---|---|---|---|
| 1 | 1054 | ANP 1L | ANP 1H | Not used (2 byte objects) | | |
| 2 | 1055 | ANP 2L | ANP 2H | Not used (2 byte objects) | | |
| 3 | 1056 | ANP 3L | ANP 3H | Not used (2 byte objects) | | |
| 4 | 1057 | ANP 4L | ANP 4H | Not used (2 byte objects) | | |

Table 8: DO138 output data unpacked

1) CAN-ID = 1054 + (nd - 1) x 16 + (ma - 1) x 4 + (sl - 1)
nd .... Node number of the CAN slaves = 1
ma ... Module address of the AF101 = 1
sl ..... Slot number of the screw-in module on the AF101 (1 - 4)

## Note:

**B&R 2000 users have to exchange the data so that the high data is first (Motorola format)!**

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

## Description of Data and Configuration Words

Data Word 0 (read)

Read-back output states

| Bit | Description |
|---|---|
| 0 | Output 1 status |
| 1 | Output 2 status |
| 2 | Output 3 status |
| 3 | Output 4 status |
| 4 | Output 5 status |
| 5 | Output 6 status |
| 6 | Output 7 status |
| 7 | Output 8 status |
| 8 - 15 | Not defined, masked out |

Data Word 0 (write)

Output states.

| Bit | Description |
|---|---|
| 0 | Output 1 |
| 1 | Output 2 |
| 2 | Output 3 |
| 3 | Output 4 |
| 4 | Output 5 |
| 5 | Output 6 |
| 6 | Output 7 |
| 7 | Output 8 |
| 8 - 15 | 0 |

Configuration Word 8 (read)

The output states are compared cyclically to the set values by the module. In this way, a short circuit is recognized. The short circuit can be isolated using single channel evaluations.

Configuration word 8 indicates the current status of output monitoring.

| Bit | Description |
|---|---|
| 0 | 0 ... Output 1 OK<br>1 ... Short circuit on output 1 |
| 1 | 0 ... Output 2 OK<br>1 ... Short circuit on output 2 |
| 2 | 0 ... Output 3 OK<br>1 ... Short circuit on output 3 |
| 3 | 0 ... Output 4 OK<br>1 ... Short circuit on output 4 |
| 4 | 0 ... Output 5 OK<br>1 ... Short circuit on output 5 |
| 5 | 0 ... Output 6 OK<br>1 ... Short circuit on output 6 |
| 6 | 0 ... Output 7 OK<br>1 ... Short circuit on output 7 |
| 7 | 0 ... Output 8 OK<br>1 ... Short circuit on output 8 |
| 8 - 15 | 0 |

Configuration Word 8 (write)

Bit 0 in the module status (configuration word 12) indicates that output monitoring has been accessed for one channel. Individual outputs can be deactivated in this group monitoring.

Configuration word 8 (read) indicates the current status of output monitoring (single channel evaluation).

| Bit | Description |
|---|---|
| 0 | 0 ... Output 1 is taken into account in group monitoring<br>1 ... Output 1 is deactivated in group monitoring |
| 1 | 0 ... Output 2 is taken into account in group monitoring<br>1 ... Output 2 is deactivated in group monitoring |
| 2 | 0 ... Output 3 is taken into account in group monitoring<br>1 ... Output 3 is deactivated in group monitoring |
| 3 | 0 ... Output 4 is taken into account in group monitoring<br>1 ... Output 4 is deactivated in group monitoring |
| 4 | 0 ... Output 5 is taken into account in group monitoring<br>1 ... Output 5 is deactivated in group monitoring |
| 5 | 0 ... Output 6 is taken into account in group monitoring<br>1 ... Output 6 is deactivated in group monitoring |
| 6 | 0 ... Output 7 is taken into account in group monitoring<br>1 ... Output 7 is deactivated in group monitoring |
| 7 | 0 ... Output 8 is taken into account in group monitoring<br>1 ... Output 8 is deactivated in group monitoring |
| 8 - 15 | 0 |



Configuration Word 9 (write)

In a defined cycle (multiple of 250 µs), the output states are compared with the set states. The cycle time can be set between 250 µs and 63.75 ms. The standard cycle times is 1.5 ms.

The cycle time should not be set under 1.25 ms. This time takes into account the switching delay for the output driver and the filter time for the read-back output states.

| Bit | Description |
|---|---|
| 0 - 7 | 1 - 255<br>0 is interpreted as 1<br>Standard cycle time ... 1.5 ms |
| 8 - 15 | 0 |

## Configuration Word 12 (read)

Configuration word 12 contains the module status.

| Bit | Description |
|---|---|
| 0 | Group monitoring for the outputs. Individual outputs can be deactivated in this group monitoring (see Section "Configuration Word 8 (write)", on page 11).<br>0 ... Outputs OK<br>1 ... Output monitoring for a channel has been accessed. Single channel evaluation using configuration word 8 (read). |
| 1 - 7 | Not defined, masked out |
| 8 | 0 ... Supply voltage is in the valid range (10.5 V < supply voltage < 30 V)<br>1 ... Supply voltage too low (≤10.5 V) |
| 9 | 0 ... Supply voltage is in the valid range (10.5 V < supply voltage < 30 V)<br>1 ... Supply voltage too high (≥30 V) |
| 10 - 15 | Not defined, masked out |

## Configuration Word 14 (read)

The high byte of configuration word 14 defines the module code.

| Bit | Description |
|---|---|
| 0 - 7 | Not defined, masked out |
| 8 - 15 | Module Code: $4C |

Configuration Word 14 (write)

The module is configured using configuration word 14.

| Bit | Description |
|---|---|
| 0 | The outputs are monitored by the module. The status of this group monitoring is shown by the module status in bit 0 and can be evaluated by the user.<br>If a CAN bus controller is used, an alarm message is automatically generated by the bus controller on one of the digital outputs when an error has been recognized. It corresponds to the alarm message "Open Connection or Sensor Open" (see Appendix B "CAN Bus Controller Error Messages"). The generation of this alarm message can be deactivated by setting bit 0. The bit in the module status is processed further.<br>0 ... Alarm message of group monitoring for outputs is activated (when used with a CAN bus controller)<br>1 ... Alarm message of group monitoring for outputs is deactivated (when used with a CAN bus controller) |
| 1 - 7 | 0 |
| 8 | The supply voltage of the digital outputs to the lower threshold value is monitored by the module. The status is shown by the module status in bit 8 and can be evaluated by the user.<br>If a CAN bus controller is used, an alarm message is automatically generated by the bus controller when the permitted supply voltage range has not been reached. It corresponds to the alarm message "Measurement Range not reached" (see Appendix B "CAN Bus Controller Error Messages"). The generation of this alarm message can be deactivated by setting bit 8. The bit in the module status is processed further.<br>0 ... Supply voltage monitoring alarm message for outputs to the lower threshold value is activated (when used with a CAN bus controller)<br>1 ... Supply voltage monitoring alarm message for outputs to the lower threshold value is deactivated (when used with a CAN bus controller) |
| 9 | The supply voltage of the digital outputs to the upper threshold value is monitored by the module. The status is shown by the module status in bit 9 and can be evaluated by the user.<br>If a CAN bus controller is used, an alarm message is automatically generated by the bus controller when the permitted supply voltage range has been exceeded. It corresponds to the alarm message "Measurement Range Exceeded" (see Appendix B "CAN Bus Controller Error Messages"). The generation of this alarm message can be deactivated by setting bit 9. The bit in the module status is processed further.<br>0 ... Supply voltage monitoring alarm message for outputs to the upper threshold value is activated (when used with a CAN bus controller)<br>1 ... Supply voltage monitoring alarm message for outputs to the upper threshold value is deactivated (when used with a CAN bus controller) |
| 10 - 15 | 0 |