WAGO I/O SYSTEM 750

# Modular I/O System

# MODBUS

# Manual

Technical description,
installation and
configuration

750-138
Version 2.3.1

WAGO®
INNOVATIVE CONNECTIONS

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# Ensure that the following explanations are observed

To assure a quick installation and start up of the units described in this manual ensure that the following information and explanations are carefully read and adhered to.

## Description of the symbols used

The **ATTENTION** symbol refers to

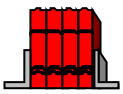
a) incorrect handling which can result in damage or destruction to the hardware or software

b) possible injuries to persons when operating with dangerous peripheral process units.

The **FINGER** symbol describes routines or gives suggestions for the efficient use of the unit and optimisation of the software.


The **FUNCTION** symbol refers to framework conditions which guarantee fault free operation. Ensure that this information is adhered to.

The **QUESTION MARK** is intended to clarify terminology.



The **BOOK** symbol refers to additional literature, manuals data sheets and web addresses.

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# List of contents for register 2

# 1 WAGO-I/O-SYSTEM

## 1.1 Components

The **WAGO-I/O SYSTEM** comprises of various components which allow the creation of modular and user specific fieldbus nodes for various fieldbusses.

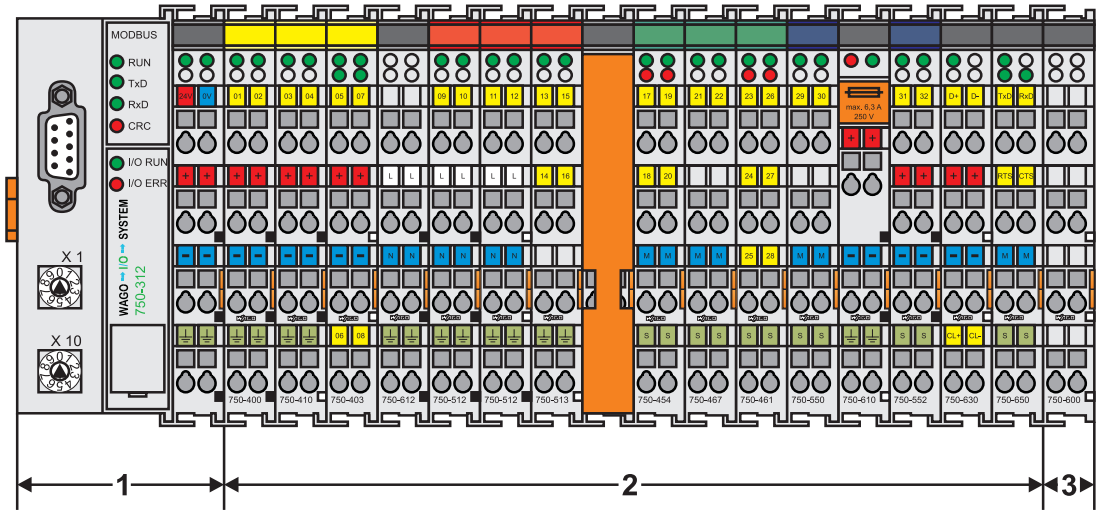



Fig. 1.1: Structure of a fieldbus node with the **WAGO-I/O SYSTEM**

**General:**
In all cases a fieldbus node comprises of a fieldbus coupler (1) or a programmable fieldbus controller (1) as head station, a number of I/O modules (2) and an end module (3), which forms the end of the system.

In the following description the term **Coupler** is used for the fieldbus coupler and the term **Controller** for the programmable fieldbus controller.

**1 – Coupler/Controller:**
With its I/O functions the coupler/controller forms the logic operation between the fieldbus used and the field area. All control tasks necessary for the perfect operation of the I/O are performed by the coupler/controller. The connection to different fieldbus systems is made using the corresponding coupler/controller e.g. for PROFIBUS, INTERBUS, CAN, MODBUS etc. A retrofitting to a different fieldbus system by changing the coupler is possible.

As opposed to the coupler the controller is fitted with additional PLC functions. This permits signal pre-processing, which can considerably reduce the data quantity in the network. In the case of a fieldbus failure the controller can process the control program independently. Alternatively the controller can guide the node into a defined condition. Plant modules become independent testable units due to the controller. In the delivered condition, in other words without the user program, the controller behaves as a coupler.

The user can program the controller in accordance with international standards for controller programming, IEC 1131-3 or the corresponding European standard EN 61131-3, in all five languages, IL, LD, FBD, ST and SFC.

The **WAGO-I/O-*PRO***[1] programming system is used for the following functions:

- Programmer setting
- Controller setting
- Loading the program in the controller
- Simulation
- Test and start-up
- Visualisation during operation
- Software documentation

The programming system runs on an IBM compatible PC (for the system requirement please refer to the **WAGO-I/O-*PRO*** user manual).

**2 – I/O modules**

The input and output of the process data is made at the I/O modules. I/O modules are available for various tasks in accordance with varying requirements. Available are digital and analog input and output modules, I/O modules for angle and path measurement as well as communication modules.

The individual I/O modules are described in detail in the following registers.

**3 - End module**

The node end module is indispensable. It is always fitted as the last module, to guarantee the internal node communication. The end module has no I/O function.

[1] **WAGO-I/O-*PRO*** User manual, English, Order No. 759-120/000-002

## 1.2 Installation

All system components can be snapped directly on a carrier rail in accordance with the European standard EN 50022 (TS 35). Installation is simple and space saving. All modules have the same shape to minimise the project commitment.

It is not necessary to observe the order of analog and digital modules when engaging on the rail. The reliable positioning and connection of the coupler/controllers and the individual I/O modules is made using a tongue and groove system. Due to the automatic locking the individual components are securely seated on the rail after installing.

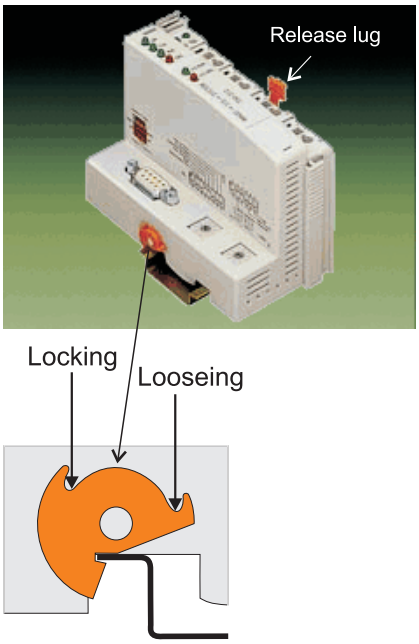



Fig. 1.2: Coupler/controller, locking disk

The coupler/controller must be fixed on the carrier rail with the lateral orange coloured locking disk.

The coupler/controller is removed by releasing the locking disk and pulling the release lug which is also orange coloured.

To fix the coupler/controller apply pressure on the upper groove of the locking disk using a screwdriver.

To remove the coupler/controllers release the locking disk by pressing on the bottom groove.

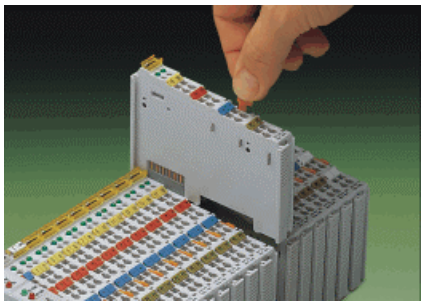


Fig. 1.3: Releasing a I/O module

It is also possible to release an individual I/O module from the unit by pulling an unlocking lug.

Please note that in this manner the power supply to the field level and the data transfer is interrupted. Ensure that an interruption of the PE will not result in a condition which could endanger a person or equipment!

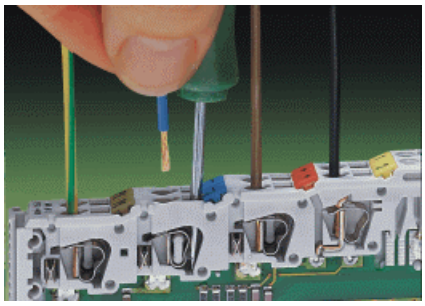


Fig. 1.4: Inserting conductor end

Conductors with a cross section of from 0.08 to 2.5 mm² can be connected using a CAGE CLAMP® to achieve a vibration resistant, fast and maintenance free connection. To actuate the CAGE CLAMP® enter a screw driver or an actuation tool in the opening below the connection. Following this enter the conductor in the corresponding opening. the conductor is clamped securely with the removal of the actuation tool.

The clamping force is automatically adapted to the cross section. The full surface of the cage clamp pressure is applied against the conductor without damaging it. Conductor deformation is compensated for and self-loosening is avoided. The transition point between the conductor and the CAGE CLAMP® is protected against corrosive influences. The connection can be made quickly and is also maintenance free, saving the costs for a periodic checking of terminal connections.

Fig. 1.5: Removing the fuse holder

The power supply modules of the **WAGO-I/O-SYSTEM** are, in part, equipped with a fuse holder. To isolate the following modules from the power supply the fuse holder can be removed. For this insert a screwdriver into one of the slits available on each side and lift the holder.

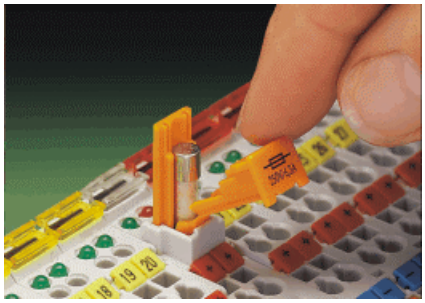


Fig. 1.6: Opening the fuse holder

The fuses can be removed from or inserted into the holder with the fuse holder cover hinged down. Following this close the cover and push the fuse holder back into the original position.

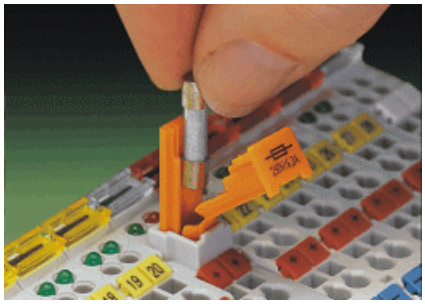


Fig. 1.7: Change fuse

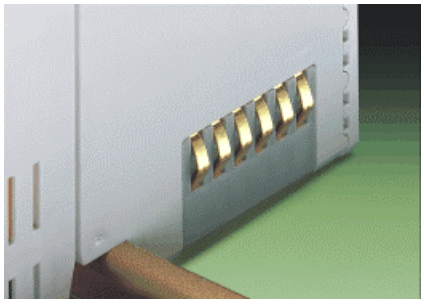


Fig. 1.8: Gold contacts

Do not connect the I/O module to gold spring contacts in order to avoid soiling and scratches!

## 1.3 Methods of decentralisation

By using the coupler or the controller it is possible to realise various methods for the decentralisation of control tasks.

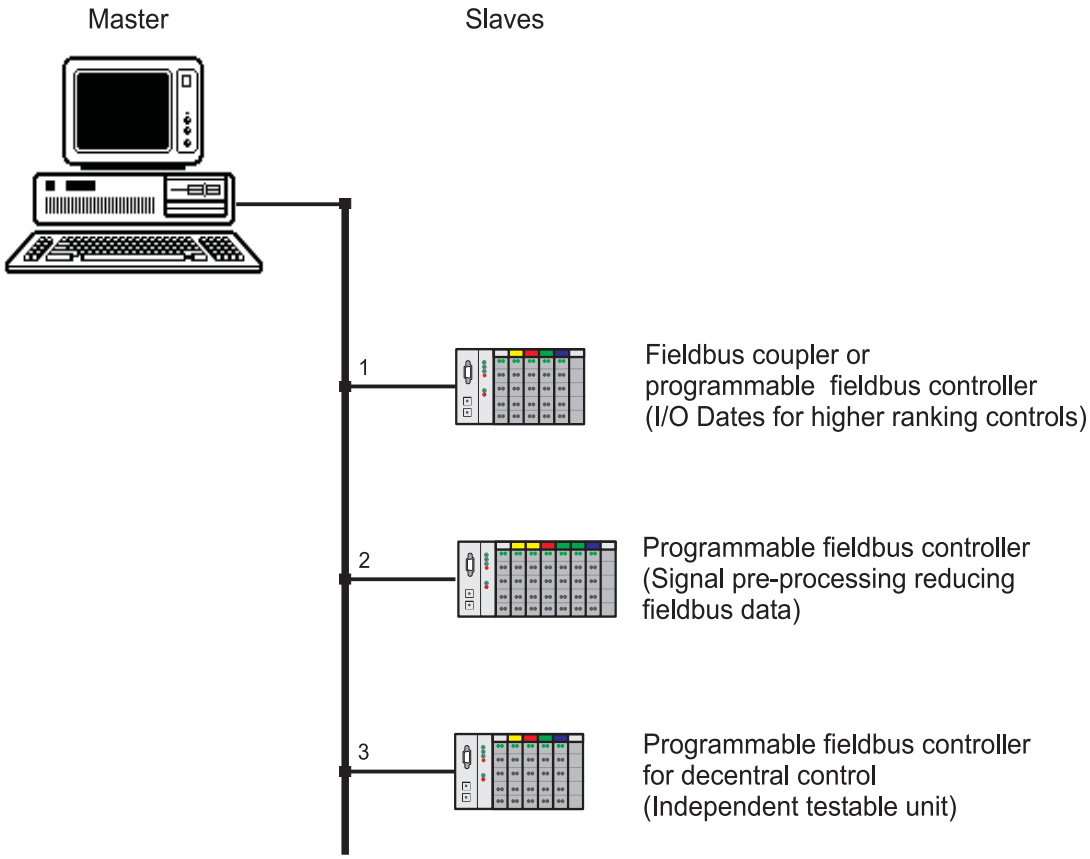



Fig. 1.9: Decentralisation methods

### Central control using a coupler or a controller (1)

The process methods common to date: All input sensor signals are joined in the coupler (Slave) and led to the higher ranking controls (Master) via a bus system. The data generated for signal output in the higher ranking controls reaches the actuators via bus and nodes. The reaction time of the controls is dependent upon the fieldbus.

This principle can be performed in the same manner using the controller.

### Signal pre-processing using controller (2)

Certain control tasks, e.g. impulse generation, delays and counts (e.g. quantity), are taken care of on site. The logic operations required are processed in the controller. The bus system only transmits the results of the logic operations as process data to the higher ranking controls. For signal pre-processing the amount of fieldbus data required is less than that required for a central connection.

## Decentral control with controller (3)

The on site controller controls an assigned function area, e.g. a machine unit or components of a transport system. The unit test can be made independently, i.e. without higher ranking controls.

The higher ranking controls transmit data to the controller via the bus system, e.g. the operating mode, set point values or the current production program (recipe). The controller transmits local operating data to the higher ranking controls, such as operating and control messages, actual values, counter readings etc. The complete linking for actuator triggering is made in the controller, in other words directly on site. This permits a fieldbus independent reaction of the controls.

In the case of a fieldbus failure the control program can be independently further processed and the node put into a defined status.

# 2 MODBUS Coupler/Controller

## 2.1 Hardware

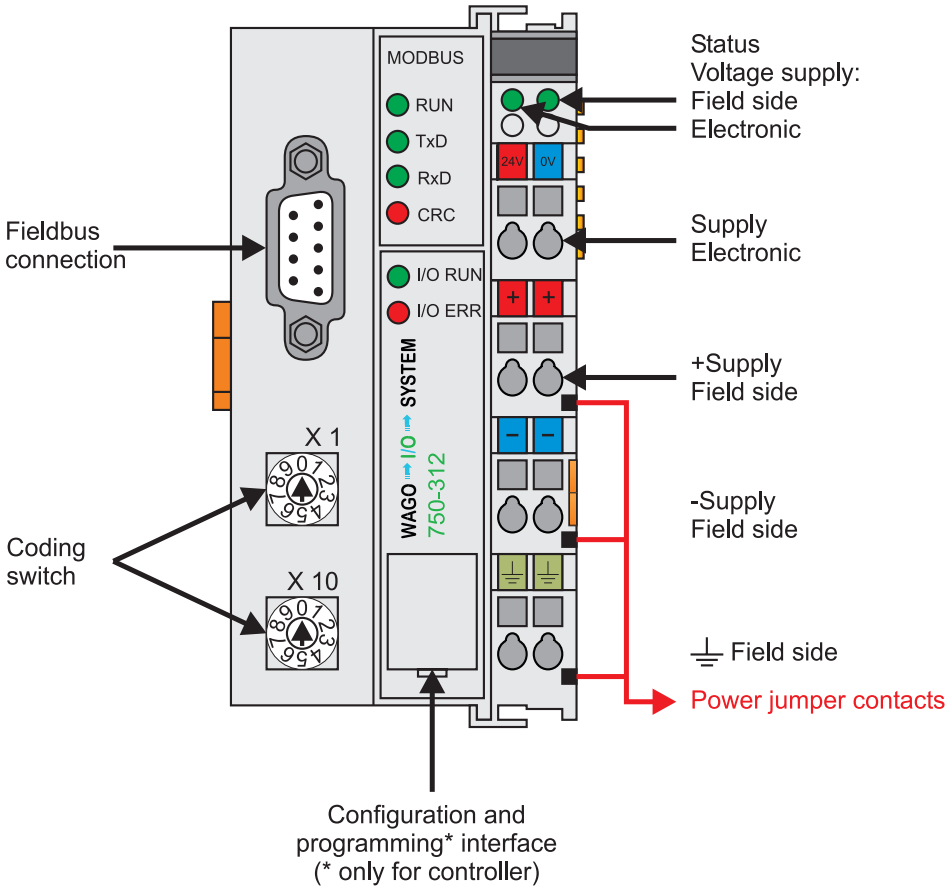



Fig. 2.1: MODBUS coupler/controller

The illustration above applies both to the MODBUS coupler as well as for the MODBUS controller.

Each coupler/controller comprises of two enclosure sections:

left: enclosure for the electronics for bus connection and processing

right: a fixed installed power supply module as connection and distribution for the power supply to the electronics in the coupler/controller enclosure, the assembled I/O modules and the power supply in the field area.

## 2.2 Power supply

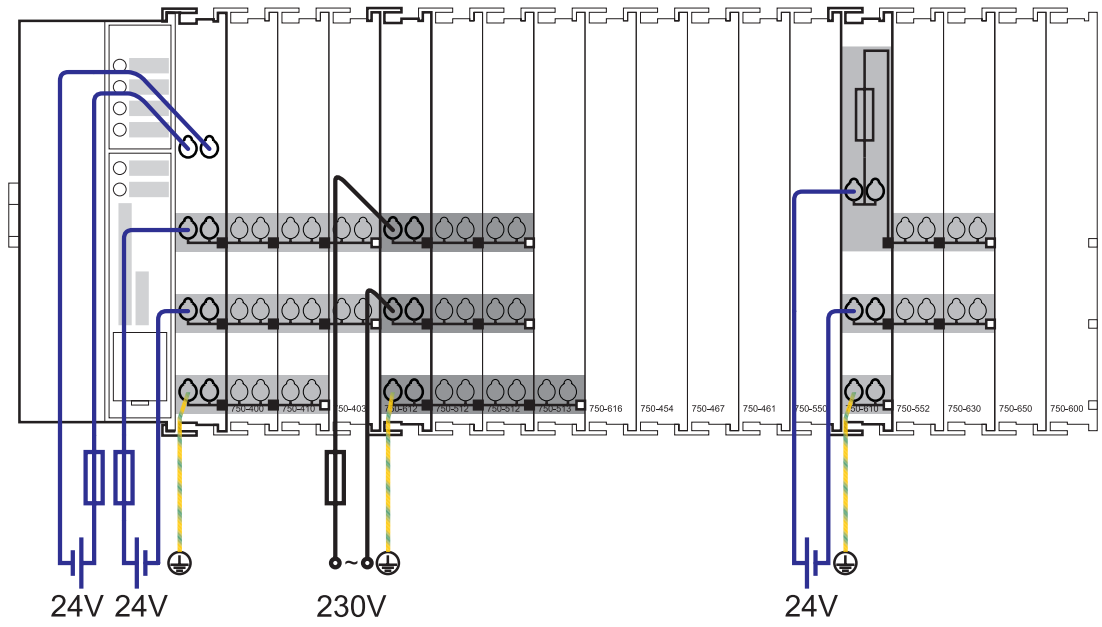



Fig. 2.2: Power supply

The power supply on the field side is electrically isolated from the electronic supply. In this manner sensors and actuators can be supplied and fused by a separate voltage source.

If a non-regulated power supply is used for the 24 V voltage supply of the coupler/controller electronics, it must be ensured that they are supported by a capacitor (200 µF per 1 A load current). To this effect a back-up capacitor module[1] was developed for the **WAGO-I/O SYSTEM**. This module serves for smoothing an unstable 24 V DC voltage supply, in as much as the specified voltage deviation required cannot be maintained. Cause for these fluctuations could be a voltage interruption on the primary side, a secondary side overload or the switching of “non quenched” inductivity and capacities.

**ATTENTION!**
Under no circumstances connect a voltage supply other than 24 V DC on the + and – power supply modules of the coupler/controller. A power supply voltage of max. 230 V AC can only be supplied via the power supply modules 750-609, 750-611 and 750-612!

**ATTENTION!**
Disconnect the PE lead wires prior to undertaking an insulation test, otherwise this will result in incorrect results or destruction of the I/O module.

[1] Back-up capacitor module, Order No. 288-824

## 2.2.1 Electronic supply voltage

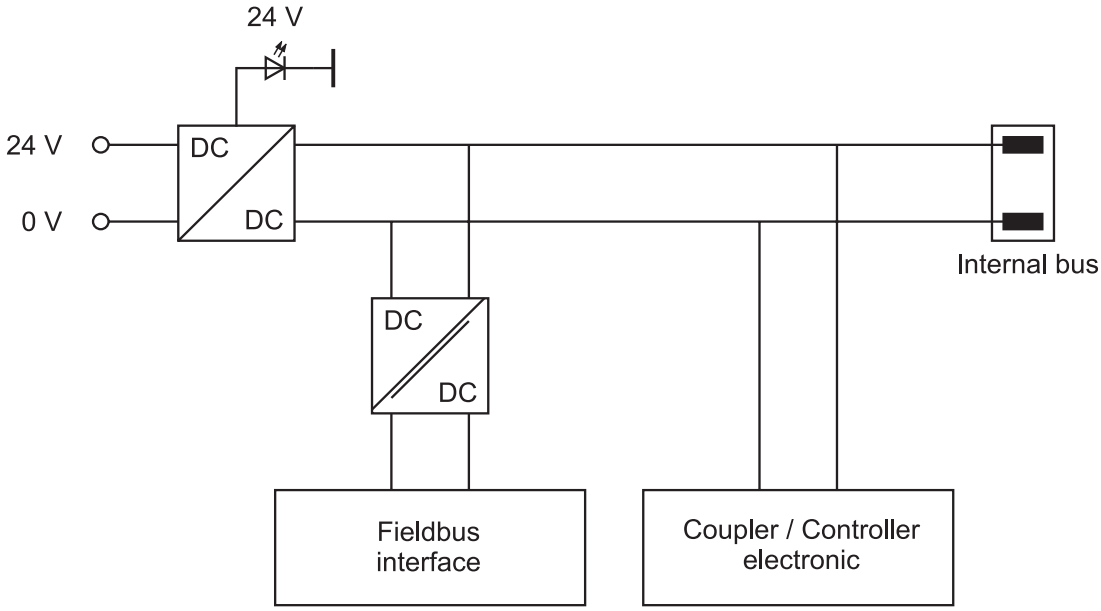



Fig. 2.3: Electronic supply voltage

The electronic supply voltage (24 V DC) is adapted using a voltage regulator and led to the coupler/controller electronics as well as to the internal bus. The electrical isolation of the external fieldbus system is made via a DC/DC converter and via an optocoupler in the fieldbus interface.

The internal bus includes the internal communication between the coupler/controller and the I/O modules as well as the power supply for the I/O modules. The maximum power supply is 1.65 A. If the sum of the internal power consumption of all I/O modules exceeds this value it is necessary to fit additional internal system supply modules[2].

The control electronics in the I/O modules are supplied by snap-fit mounting the I/O modules using the internal bus contacts. A reliable contact is assured by gold plated, self cleaning slide contacts. The removal of a I/O module will cause an interruption of the connection to the following I/O modules. The coupler/controller localises the interruption point and sends a corresponding fault message via the red LED ‘I/O ERR’.

**ATTENTION!**
Removing or inserting the I/O modules with the voltage applied can lead to undefined conditions. For this reason only undertake work on the I/O modules when isolated from the power supply!

[2] Internal system supply modules, order No. 750-613

## 2.2.2 Supply voltage of the field side

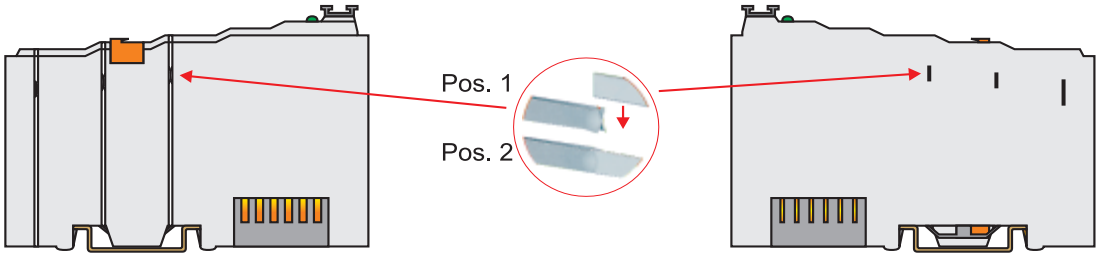



Fig. 2.4: Power contact for the power supply to the field side

The power is supplied to the field side automatically by snap-fitting the individual I/O modules via self-cleaning power contacts (Fig. 2.4). These contacts are arranged on the right hand side of the coupler/controller and the I/O modules, protected against accidental contact, as spring contacts. On the left hand side of the I/O modules are corresponding male contacts as counter pieces. Ensure that the current of the power contacts does not permanently exceed 10 A.

The PE contact is a preceding ground (earth) contact corresponding to the standards which can be used as a protective earth. The contact has a leakage capacity of 125 A.

**Function!**

Please note that some I/O modules do not have any, or only individual power contacts (dependent of the I/O function). This configuration is intended to interrupt the power supply. If a field supply is required for the following I/O modules, it is necessary to use a power supply module. Take note of the individual terminal/module data sheets! The design of some modules does not physically allow assembly them in rows as the grooves for the male contacts are closed at the top.

By fitting an additional power supply module the field supply is always interrupted by the power contacts. From this point a new power supply is made, which can also include a potential change (see Fig. 2.2). This possibility guarantees a high degree of system flexibility.

## 2.3 Station address

The station address is set using both coding switches. The settable address is within the 01 and 99 range. The value 00 is reserved for the programming and configuration mode.

The lower coding switch serves for setting the address tens digit, the upper coding switch for setting the units digit. The address is only read in and saved when switching on. Changes made during operation have no effect.

The following example shows the setting of address 62:


Fig. 2.5: Coding switch

## 2.4 Mode switch

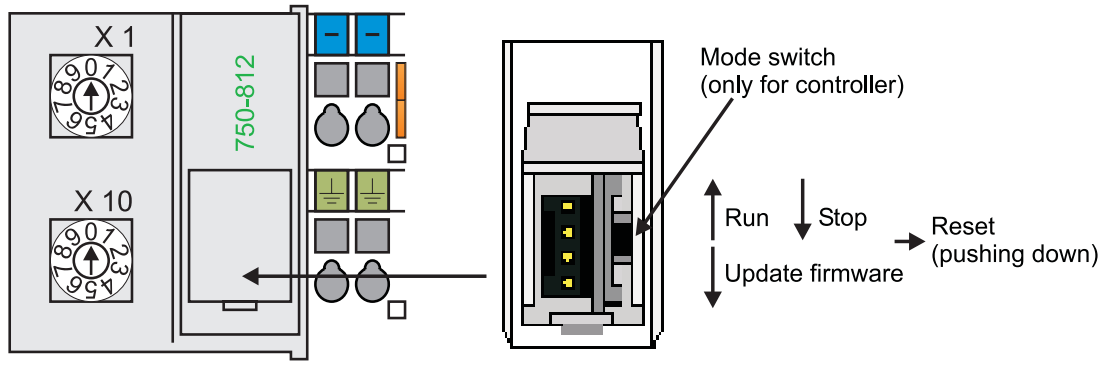



Fig. 2.6: Mode switch

The mode switch is only available in the controller and permits a manual **Run/Stop**-status change.

| Mode switch setting | | Function |
|---|---|---|
| From **Stop** to **Run:** | ⇧ | Activate program processing |
| From **Run** to **Stop:** | ⇩ | Stop program processing |
| **(Bootstrap:)** | ⇩ | To bootstrap the firmware, not required by user |
| **Hardware reset:** | ⇨ | Mode switch e.g. push down with screwdriver<br>All outputs are reset, variables are set to 0 or FALSE or to their initial value.<br>Flags remain in the same status.<br>Reset can be made with both **Stop** as well as **Run**. |

Table 2.1: Mode switch, controller

**Stop** = Program processing stopped
**Run** = Program processing running

**ATTENTION!**
**If when changing over the mode switch from 'Run' to 'Stop' outputs are still activated, these will remain in this status! Switching off on the software side, e.g. by initiators is then ineffective because the program will no longer be processed!**

(A mode change over is made internally at the end of a program cycle'.)

## 2.5 Fieldbus connection

### 2.5.1 RS 485

Coupler : 750-312 and 750-315
Controller: 750-812 and 750-815

One transmission medium for the MODBUS is RS485, whereby, 2 or 4 wire can be used. The following figure shows an example for a 2 wire version:

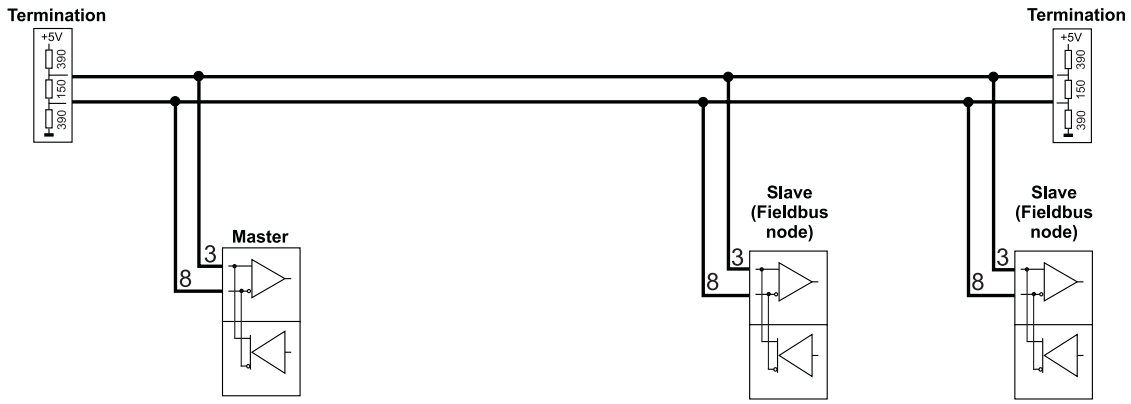



Fig. 2.7: 2 wire connection

As opposed to the above the 4 wire connection offers the advantage that it can use simpler repeaters and converter. The following illustration is a corresponding example:

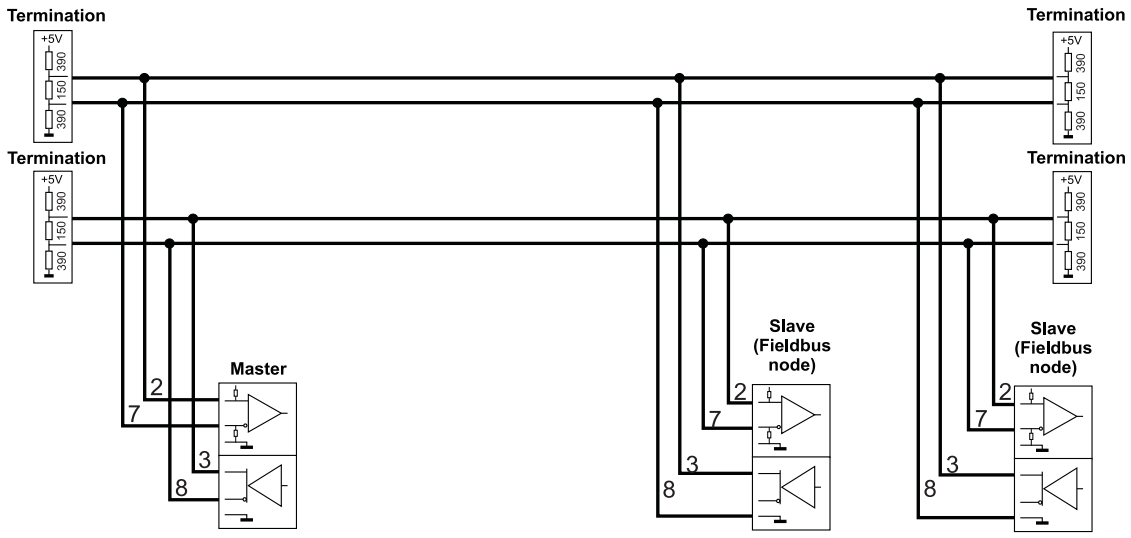



Fig. 2.8: 4 wire connection

Connect the D-SUB connection plug as follows:

| 9 pol. D-SUB | Signal | Direction | Description |
|---|---|---|---|
| **1** | - | | not used |
| **2** | RxD | In | Signal received (4 wire) |
| **3** | TxD (RxD) | Out | Signal transmitted (received) (2 wire) |
| **4** | DE | Out | Repeater control signal |
| **5** | GND | PWR | Signal and supply earth (ground) |
| **6** | Vcc | PWR | Supply voltage, +5V (only for external connections) |
| **7** | RxD inverted | In | Receive signal with inverted level (4 wire) |
| **8** | TxD (RxD) inverted | Out | Send signal with inverted level (receive) (2 wire) |
| **9** | - | | not used |

Table 2.2: Pin assignment for 4 wire connections

The connection point is mechanically lowered so that fitting into a 80 mm deep switch cabinet is possible following the plug-in connection.
The pin assignment is 2 wire operation conforms with the Profibus assignment. Thus the Profibus wiring components can be used.

One application possibility is the connection of a Yokogawa Interface. This PCB supports the MODBUS protocol. The standard setting is the RTU mode (see chapter MODBUS) and 4 wire connections. The pin assignment is as follows:

| 9 pol. D-SUB | Signal | 25 pol. SUB D | Signal | Colour |
|---|---|---|---|---|
| **1** | - | - | - | - |
| **2** | RxD | 14 | SD A | brown |
| **3** | TxD (RxD) | 16 | RD A | red |
| **4** | DE | - | - | - |
| **5** | GND | 25 | SG | yellow/black |
| **6** | Vcc | - | - | - |
| **7** | RxD (inv) | 18 | SD B | black (brown pair) |
| **8** | TxD(RxD) (inv) | 19 | RD B | black (red pair) |
| **9** | - | - | - | - |

Table 2.3: Yokogawa interface pin assignment

### Switches for RS 485

The setting for 2 or 4 wire connections and switching in or out of the corresponding matching resistors is made by switches, covered by the enclosure. To access the switches remove the enclosure from the coupler/controller. A protruding locking device can be found on the bottom of the unit on the two short sides. Push the two short sides apart to permit the enclosure to be pushed past the unit metal plate. Simultaneously press from above on the right hand section of the coupler/controller, which is the supply side.

The enclosure prevents unintentional changes of the settings during later operation. If, however, access to the settings is required in the case of a fault, ensure that the previous settings are marked on a label.

After changing the settings push the enclosure back onto the coupler/controller. Note that it may be necessary to lightly push the wide side of the coupler/controllers to the side when the metal plate does not easily slide into the enclosure. In addition it may be necessary to push the rotary switches into the cut-outs provided.

The switch on the interface printed circuit board for setting 2 and 4 wire connections or for the matching resistors can be found in the following illustration:

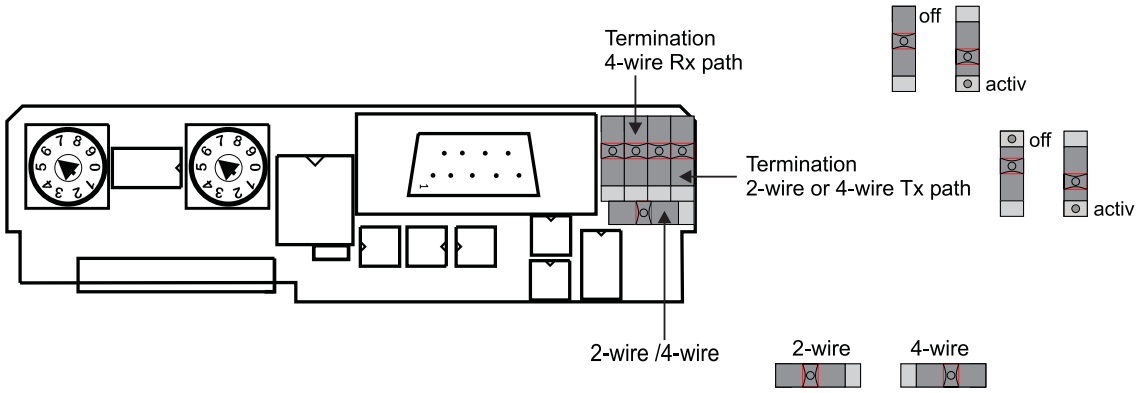



Fig. 2.9: Interface printed circuit board

For 2 wire connections RxD and TxD are short circuited. By the termination, a series circuit comprising of 3 resistors is connected to the bus conductor terminations.

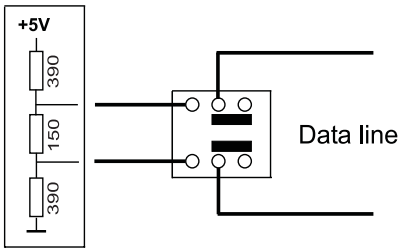



Fig. 2.10: Internal matching resistors and interface switches

The standard setting for the supplied coupler/controller is a 2 wire connection and a switched off matching resistor.

Four wire connections can be terminated as well as the receiver line.

### 2.5.2 RS 232

Coupler : 750-314 and 750-316
Controller: 750-814 and 750-816

The MODBUS can also be operated directly on an RS 232 interface. The D-SUB connection plug is connected in this case as follows:

| 9-pol. D-SUB | Signal | Direction | Description |
|---|---|---|---|
| **1** | - | | not used |
| **2** | TxD | Out | Signal received |
| **3** | RxD | In | Signal transmitted |
| **4** | - | | not used |
| **5** | GND | PWR | Signal and supply earth (ground) |
| **6** | - | | not used |
| **7** | - | | not used |
| **8** | - | | not used |
| **9** | - | | not used |

Table 2.4: RS 232 plug assignment

The pin assignment permits the use of commercially available 9 pole 1:1 sockets/ plug lines for direct connection to a PC.

### Configuration Interface

The configuration interface used for the communication with WAGO-I/O-CHECK or for firmware upload is located behind the cover flap.

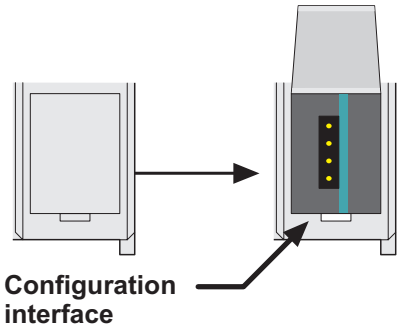



Fig. X-1: Configuration interface g01xx06e

The communication cable (750-920) is connected to the 4-pole header.

**Warning**
The communication cable 750-920 must not be connected or disconnected while the coupler/controller is powered on!

# 3 Technical Data

## 3.1 Dimensions

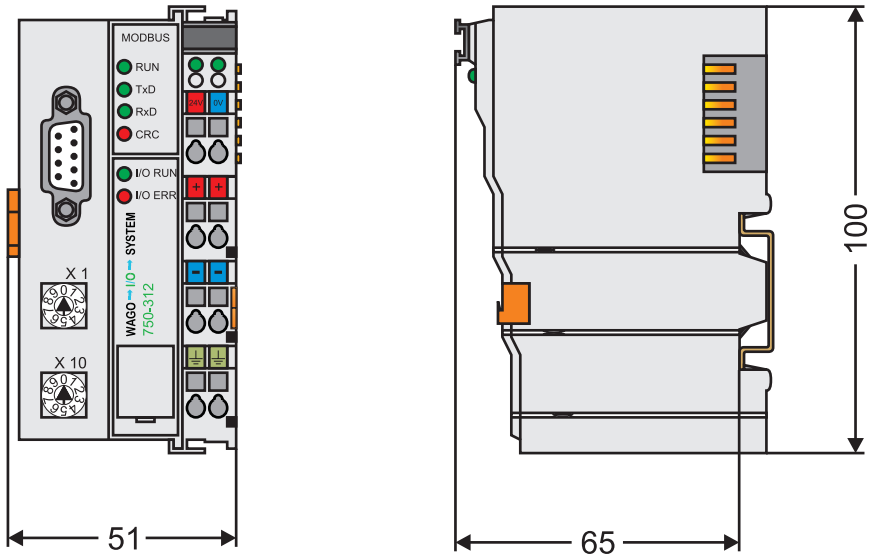



Fig. 3.1: Dimensions of coupler/controller

## 3.2 Coupler

### SYSTEM DATA:

| | 750-312 | 750-315 | 750-314 | 750-316 |
|---|---|---|---|---|
| **Max. number of nodes** | 99 with repeater | | 1 | |
| **Max. number of I/O points** | about 6,000 (depends on master) | | 256 | |
| **Transmission medium** | Shielded Cu cable 2 (4) x 0.25 mm² | | | |
| **Max. length of bus line** | 1,200 m (depends on baud rate/on the | | about 5 m | |
| **Baud rate** | 150-19,200 bauds | 1.2-115.2 kbauds | 150-19,200 bauds | 1.2-115.2 kbauds |
| **Type of transmission** | RS 485 | | RS 232 | |

Table 3.1: System data, coupler

### TECHNICAL DATA:

| | 750-312, 750-314, 750-315, 750-316 |
|---|---|
| **Max. number of I/O modules** | 64 |
| **Digital points per node** | 256 (inputs and outputs) |
| **Analogue points per node** | 128 (inputs and outputs) |
| **Configuration possibility** | DIP switch and decimal coder<br>via PC or PLC device |
| **Bus coupler connection** | 1 x D-Sub 9 |
| **Voltage supply** | 24 V DC (-15%/+20%) |
| **Internal current consumption** | 350 mA |
| **Current supply** | 85 mA typ.<br>580 mA max. |
| **Power jumper contacts** | Blade / spring contact,<br>slide contacts, self-cleaning |
| **Voltage power jumper contacts** | 24 V DC |
| **Current power jumper contacts** | 10 A DC |
| **Max. current supply at intern.** | 1,65 A |
| **Data contacts** | Slide contacts, 2,5µ hart gold-plated<br>self-cleaning |
| **Housing material** | Polycarbonate, polyamide 6.6 |
| **Marking** | Standard marker cards WAGO BR247/278<br>Marking cards 8 x 47 mm |
| **Wire connection** | CAGE CLAMP, 0.08 mm² - 2.5 mm² |
| **Vibrations-/Schockfestigkeit** | IEC 68-2-6 / IEC 68-2-27 |
| **Fitting position** | any |
| **System of protection** | IP 20 |
| **Insulation** | 500 V system/supply |
| **Operating temperature** | 0 °C ... +55 °C |
| **Dimensions in mm** | 51 x 65* x 100 (*from upper edge of DIN 35 rail) |

Table 3.2: Technical data, coupler

## 3.3 Controller

### SYSTEM DATA:

| | 750-812 | 750-815 | 750-814 | 750-816 |
|---|---|---|---|---|
| **Max. number of nodes** | 99 with repeater | | 1 | |
| **Max. number of I/O points** | about 6,000 (depends on master) | | 256 | |
| **Transmission medium** | Shielded Cu cable 2 (4) x 0.25 mm² | | | |
| **Max. length of bus line** | 1,200 m (depends on baud rate/on the | | about 5 m | |
| **Baud rate** | 150-19,200 bauds | 1.2-115.2 kbauds | 150-19,200 bauds | 1.2-115.2 kbauds |
| **Type of transmission** | RS 485 | | RS 232 | |
| **IEC 1131-3 programming** | **WAGO-I/O-*PRO*** IL, LL, FDB, ST, FC | | | |

Table 3.3: System data, controller

### TECHNICAL DATA:

| | 750-812, 750-814, 750-815, 750-816 |
|---|---|
| **Max. number of I/O modules** | 64 |
| **Digital points per node** | 256 (inputs and outputs) |
| **Analogue points per node** | 128 (inputs and outputs) |
| **Configuration possibility** | With function modules and switches |
| **Program memory** | 32 kbytes |
| **Data memory** | 32 kbytes |
| **Residual memory** | 8 kbytes (retain) |
| **I/O fieldbus area** | 256 words in input area and 256 words in output area |
| **I/O modules area** | 256 words for inputs and 256 words for outputs |
| **Cycle time** | < 3 ms for 1,000 statements / 256 I/O |
| **Bus coupler connection** | 1 x D-Sub 9 |
| **Voltage supply** | 24 V DC (-15%/+20%) |
| **Internal current consumption** | 350 mA |
| **Current supply** | 85 mA typ.<br>580 mA max. |
| **Power jumper contacts** | Blade / spring contact,<br>slide contacts, self-cleaning |
| **Voltage power jumper contacts** | 24 V DC |
| **Current power jumper contacts** | 10 A DC |
| **Max. current supply at intern.** | 1.65 A |
| **Data contacts** | Slide contacts, 2.5µ hart gold-plated<br>self-cleaning |
| **Housing material** | Polycarbonate, polyamide 6.6 |
| **Marking** | Standard marker cards WAGO BR247/278<br>Marking cards 8 x 47 mm |
| **Wire connection** | CAGE CLAMP, 0.08 mm² - 2.5 mm² |
| **Resistance to shocks/vibrations** | IEC 68-2-6 / IEC 68-2-27 |
| **Fitting position** | any |
| **System of protection** | IP 20 |
| **Insulation** | 500 V system/supply |
| **Operating temperature** | 0 °C ... +55 °C |
| **Dimensions in mm** | 51 x 65* x 100 (*from upper edge of DIN 35 rail) |

Table 3.4: Technical data, controller

# 4 MODBUS

MODBUS is a master/slave system. The master is a superimposed control unit, e.g. a PC or a PLC device. The MODBUS coupler/controller of the **WAGO-I/O-SYSTEMS** are slave devices.

Bus conflicts do not occur because only one node is sending. The master makes a query for communication. This query can be sent to a specific node or to all nodes as a broadcast message. The nodes receive the query and return a response to the master, depending on the kind of query.

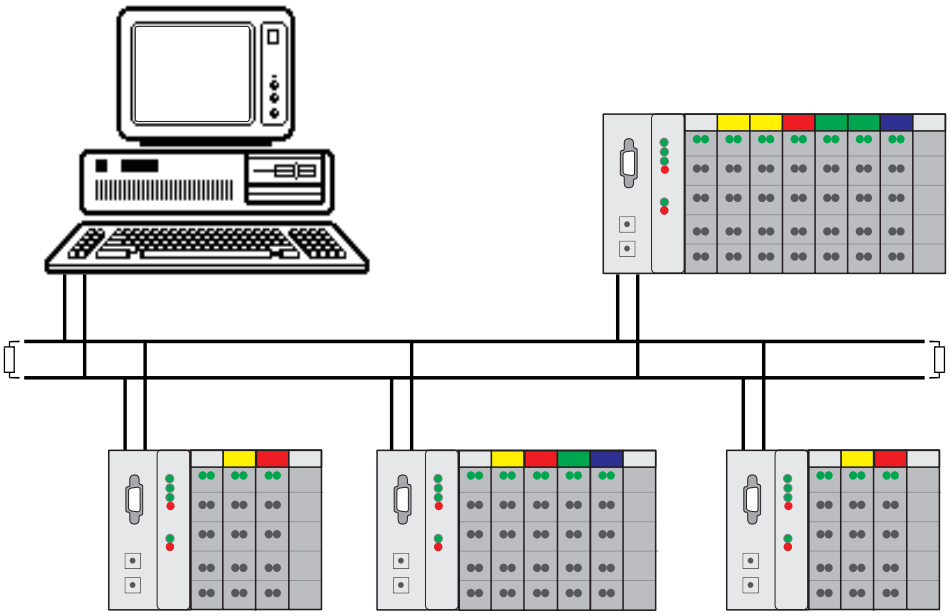


Fig. 4.1: Example of a MODBUS topology

This bus topology is only valid for the variants with the RS 485 interface. With RS 232 it is only possible to have a peer-to-peer connection.

You will find further information on MODBUS in:

Online information on MODBUS: http://www.modicon.com/techpubs/toc7.html

MODBUS tools for PC: http://www.win-tech.com

# 5 Configuration

## 5.1 Coupler

750-312,
750-314,
750-315,
750-316

### 5.1.1 Settings

The factory set coupler configuration can be changed using the DIP switches FR and P. The setting is made prior to start-up. Changes to switch settings during running operation does not affect the configuration. This is only read in when switching on the coupler power supply.

The ‘MODBUS coupler/controller’ chapter describes how to remove the enclosure from the coupler to permit settings to be made.

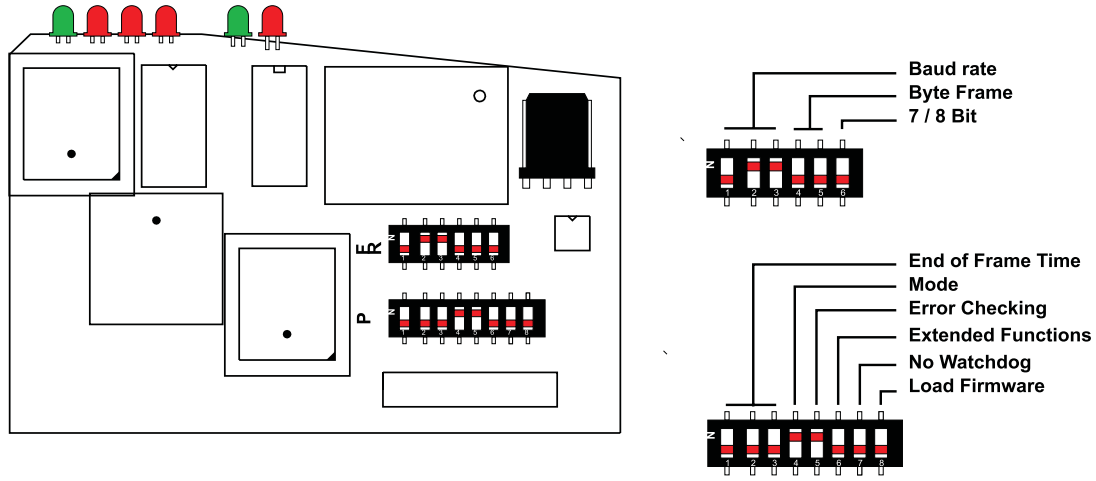



Fig. 5.1: DIP switch arrangement on CPU printed circuit board, coupler

The following is a description of the coupler settings. Here the term ‘Frame’ is frequently used. A ‘Frame’ is a data transmission block.

### 5.1.1.1 Standard settings

The coupler is supplied with the following standard settings:

| Designation | Setting | FR 1 | FR 2 | FR 3 | FR 4 | FR 5 | FR 6 | P1 | P2 | P3 | P4 | P5 | P6 | P7 | P8 | Chapt. |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **Baud rate** | 9600 Bd | off | on | on | | | | | | | | | | | | 5.1.1.2 |
| **Byte Frame** | No Parity, 8 Bit 1 Stop Bit | | | | off | off | off | | | | | | | | | 5.1.1.3 |
| **End of Frame Time** | 3 x Frame Time | | | | | | | off | off | off | | | | | | 5.1.1.4 |
| **Mode** | RTU mode | | | | | | | | | | on | | | | | 5.1.1.5 |
| **Error Check** | to be processed | | | | | | | | | | | on | | | | 5.1.1.6 |
| **Extended Functions** | without | | | | | | | | | | | | off | | | 5.1.1.7 |
| **Watchdog** | switched on | | | | | | | | | | | | | off | | 5.1.1.8 |
| **Update Firmware** | normal operation | | | | | | | | | | | | | | off | 5.1.1.9 |

Table 5.1: Standard settings, coupler

### 5.1.1.2 Baud rate setting

The baud rate is set using DIP switches FR 1 to FR 3.

| Baud rate 750-312/314 | Baud rate 750-315/316 | FR1 | FR2 | FR3 |
|---|---|---|---|---|
| **150 Bd** | **38400 Bd** | off | off | off |
| **300 Bd** | **57600 Bd** | on | off | off |
| **600 Bd** | **115200 Bd** | off | on | off |
| **1200 Bd** | **1200 Bd** | on | on | off |
| **2400 Bd** | **2400 Bd** | off | off | on |
| **4800 Bd** | **4800 Bd** | on | off | on |
| **9600 Bd** | **9600 Bd** | **off** | **on** | **on** |
| **19200 Bd** | **19200 Bd** | on | on | on |

Table 5.2: Baud rates, coupler

The standard setting is 9600 Baud.

### 5.1.1.3 Error detection, length of the character string

A parity bit can additionally be transmitted with each byte. Data transfer faults are detected with the help of the parity bit. A differentiation is made between parity checks for even parity, odd parity and no parity.

For this the number of set bits (=1) are counted in the transmitted data bytes. For example, with the transmission of the character string 1100 0101 the number of set bits is even, namely 4. If the setting of an even parity bit is selected, then in this case it is set to 0, so that the number of set bits still remains even. Analog to this, the odd parity bit 1 would be selected so that the number of set bits will be odd.

This type of error detection is assured with one error, with several errors under certain circumstances this may no longer be assured. If the coupler recognises a parity error, the frame is ignored and a new frame can only be received following a renewed ‘Start of Frame’.

If the slave receives faulty frames, this will not be replied to. The master detects this error in that after the preset time (Time-out) no corresponding frame was received.

In the MODBUS coupler 750-312 a parity bit can be attached to each byte. The data length can be selected for 7 or 8 bit. In addition it is possible to add 1 to 3 stop bits.

| Byte Frame | Data length | Stop Bits | FR4 | FR5 | FR6 |
|---|---|---|---|---|---|
| **No Parity** | **8** | **1** | **off** | **off** | **off** |
| **Even Parity** | 8 | 1 | on | off | off |
| **Odd Parity** | 8 | 1 | off | on | off |
| **No Parity** | 8 | 2 | on | on | off |
| **No Parity** | 7 | 2 | off | off | on |
| **Even Parity** | 7 | 1 | on | off | on |
| **Odd Parity** | 7 | 1 | off | on | on |
| **No Parity** | 7 | 3 | on | on | on |

Table 5.3: Byte Frame, coupler

The standard setting is no parity, 8 bit data length and 1 stop bit.

During transmission in RTU mode the DIP switch FR6 is ignored, as the format is set to 8 bit in this mode.

#### 5.1.1.4 End of Frame Time

The end of frame time is the pause time following a frame, which is required to switch over the repeater in slave. This time must permit gaps during a frame which will not result in a faulty recognition of the end of frame time. The setting of the end of frame time is made with DIP switches P1 to P3.

| End of Frame Time | P1 | P2 | P3 |
|---|---|---|---|
| **3 x Frame Time** | **off** | **off** | **off** |
| **100 ms** | on | off | off |
| **200 ms** | off | on | off |
| **500 ms** | on | on | off |
| **1 s** | off | off | on |
| **1 ms** | on | off | on |
| **10 ms** | off | on | on |
| **50 ms** | on | on | on |

Table 5.4: End of Frame Time, coupler

The standard setting is 3 x frame time. The settings 1 ms, 10 ms and 50 ms are only implemented as from firmware version 2.5 of the MODBUS coupler.

#### 5.1.1.5 ASCII/RTU mode

MODBUS permits two different transmission modes:

ASCII mode: Each byte (8 Bit) is sent as a 2 ASCII characters.

Advantages: Displayable characters are transmitted. The gaps between characters need not be observed, provided they do not exceed 1 second.

RTU mode: Each byte (8 Bit) comprises of two 4 bit hexadecimal characters.

Advantages: As only 1 character has to be transmitted for each byte a higher data throughput is achieved in comparison to the ASCII mode.

The setting is made using DIP switch P4.

| Mode | P4 |
|---|---|
| **ASCII** | off |
| **RTU** | **on** |

Table 5.5: ASCII-/RTU mode, coupler

The standard setting is RTU mode.

### 5.1.1.6 Error Check

A check sum (CRC) is calculated from the frame to be transmitted in the sender (higher ranking controls). This check sum is transmitted in the frame to the receiver (coupler). Once the error check is activated, this check sum is compared with the check sum calculated in the coupler on the basis of the same instruction. An error is signalled by a red LED ‘CRC’.

**ATTENTION:**

Do not set this option during operation!

The error check is set with the DIP switch P5.

| Error Check | P5 |
|---|---|
| **ignored** | off |
| **being processed** | **on** |

Table 5.6: Error Check, coupler

The standard setting is the switched on error check.

### 5.1.1.7 Extended Functions

The register for further internal diagnostic possibilities (extended functions) in the address space of the coupler are not yet available. For this reason do not change the DIP switch P6 standard setting (off).

| Extended Functions | P6 |
|---|---|
| **without** | **off** |
| **available** | on |

Table 5.7: Extended Functions, coupler

In the standard setting, other diagnostic possibilities are switched off.

### 5.1.1.8 Watchdog

The watchdog serves for monitoring the data transfer between the higher ranking controls and the coupler. If no communication has occurred after a default time, the node is set into a secured status, i.e. the digital outputs of the node are set to 0 and the analog outputs are set to the minimum value (e.g. with 4...20 mA to 4 mA).

The watchdog is switched on with DIP switch P7.

| Watchdog | P7 |
|---|---|
| **switched on** | **off** |
| **switched off** | on |

Table 5.8: Watchdog, coupler

The standard setting is with the watchdog switched on.

Selection of the watchdog is described in more detail in chapter 5.3.2.

### 5.1.1.9 Update Firmware

The DIP switch P8 releases the loading of a new firmware. This function has not yet been implemented, for this reason do not change the standard setting (off) of the switch.

**ATTENTION:**
Only switch over the DIP switch P8 to update the firmware. Switching over during operation may lead to a malfunction!

| Update Firmware | P8 |
|---|---|
| **normal operation** | **off** |
| **Update Firmware** | on |

Table 5.9: Update firmware, coupler

The standard setting is normal operation.

## 5.1.2 Data exchange between MODBUS master and I/O modules

The data exchange between the MODBUS master sand coupler is made by bit or byte reading and writing.
In the coupler are 4 different types of process data:

- Input words
- Output words
- Input bits
- Output bits

The addresses of the data words in the process illustration of the inputs and outputs are shown in the next illustration:

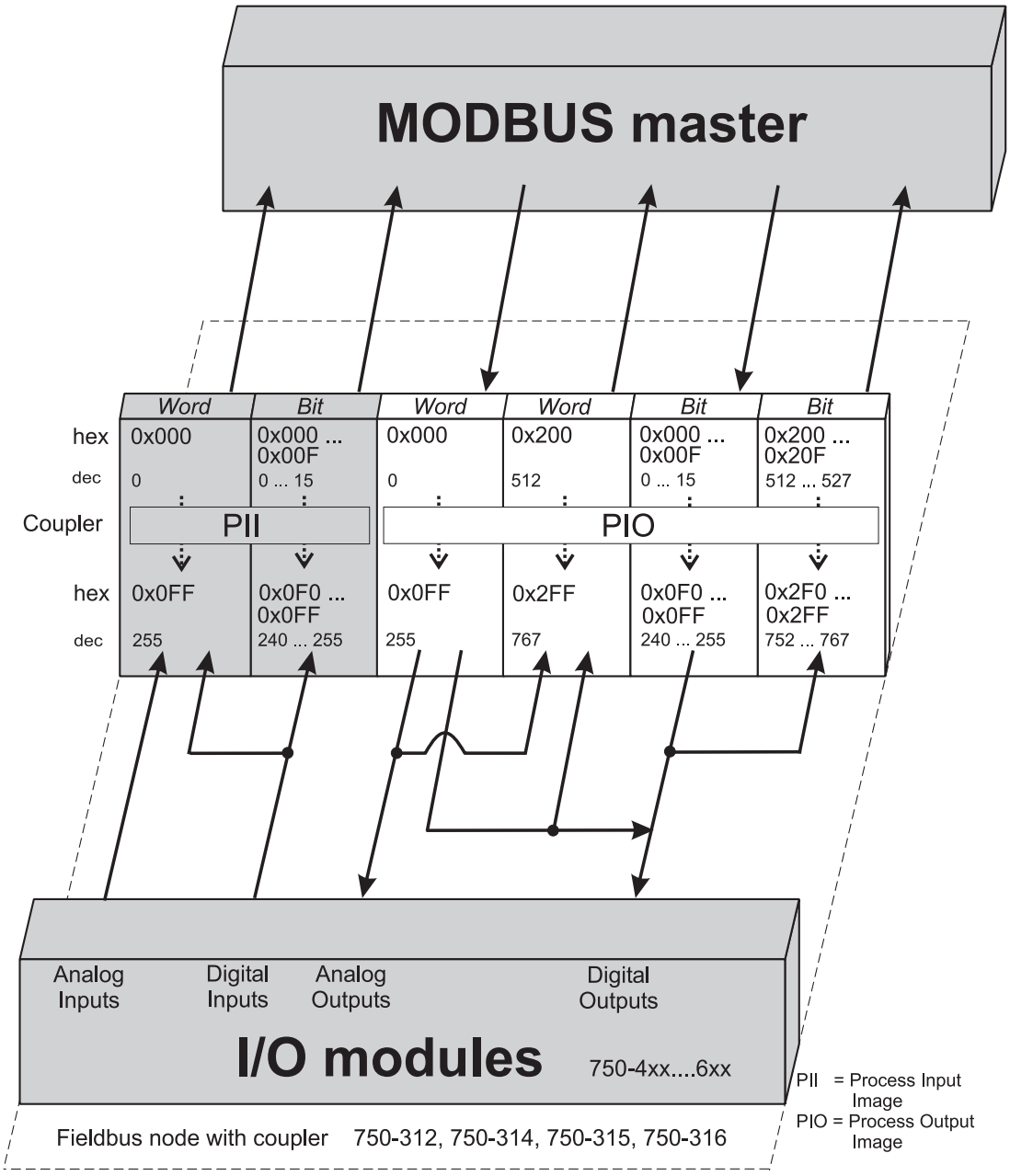



Fig. 5.2: Data exchange between MODBUS master and I/O modules

Access word for word to the digital input and output modules is made in accordance with the following table:

| Digital inputs/ outputs | 8. | 7. | 6. | 5. | 4. | 3. | 2. | 1. | 16. | 15. | 14. | 13. | 12. | 11. | 10. | 9. |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **Process data word** | Bit 15 | Bit 14 | Bit 13 | Bit 12 | Bit 11 | Bit 10 | Bit 9 | Bit 8 | Bit 7 | Bit 6 | Bit 5 | Bit 4 | Bit 3 | Bit 2 | Bit 1 | Bit 0 |
| **Byte** | High-Byte | | | | | | | | Low-Byte | | | | | | | |
| | D1 | | | | | | | | D0 | | | | | | | |

Table 5.10: Allocation of digital inputs/outputs for process data word, coupler

### 5.1.3 Addressing the I/O modules

- The arrangement of the I/O modules in a node is optional.
- The I/O module addressing is based on the attendant coupler.
- Addressing is organised word for word and starts with the word address ‘0’ both for the inputs as well as the outputs.
- The I/O module addressing corresponds to the sequence of their arrangement behind the coupler. Addressing starts with the bus coupler, which can assign one or more words per channel. This is followed by the I/O module addresses which can assign one or two bits per channel. For the number of input and output bits or bytes please refer to the corresponding I/O module data sheets.
- Addressing of I/O modules which are assigned to one or two bits per channel is also made word for word. In other words in each case 16 inputs or outputs are allocated one word. If less channels are present the remaining bits of the word remain free or are reserved for extensions.
- If a node is extended by additional I/O modules for which one or more words are assigned per channel, the I/O module addresses are displaced by one or two bits per channel.

| Data width ≥ 1 Word / channel | Data width = 1 Bit / channel |
|---|---|
| Analog input modules | Digital input modules |
| Analog output modules | Digital output modules |
| Input modules for thermal elements | Digital output modules with diagnosis (2 Bit / channel) |
| Input modules for resistance sensors | Power supply modules with fuse holder / diagnosis |
| Pulse width output modules | Solid State power relay |
| Interface module | Relay output modules |
| Up/down counter | |
| I/O modules for angle and path measurement | |

Table 5.11: I/O module data width

### 5.1.4 Application examples

The following figure is an example for a process input image. The configuration comprises of 10 digital and 8 analog inputs. The process image thus has a data length of 8 words for the analog and 1 word for the digital inputs, i.e. 9 words.

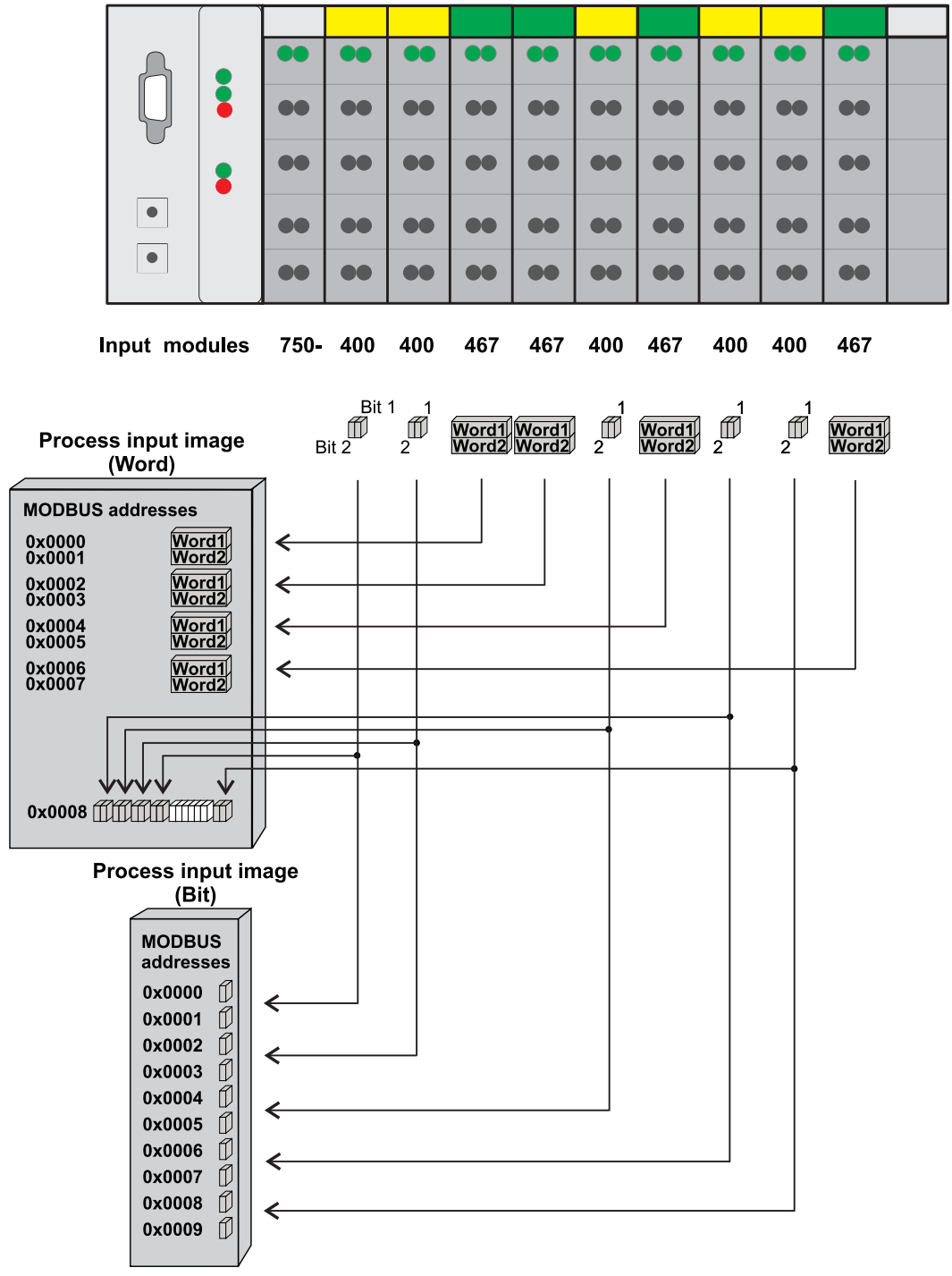



Fig. 5.3: Example for process input image, coupler

The following configuration comprises of 2 digital and 4 analog outputs. This is an example for a process output image. It comprises of 4 words for the analog and one word for the digital outputs.

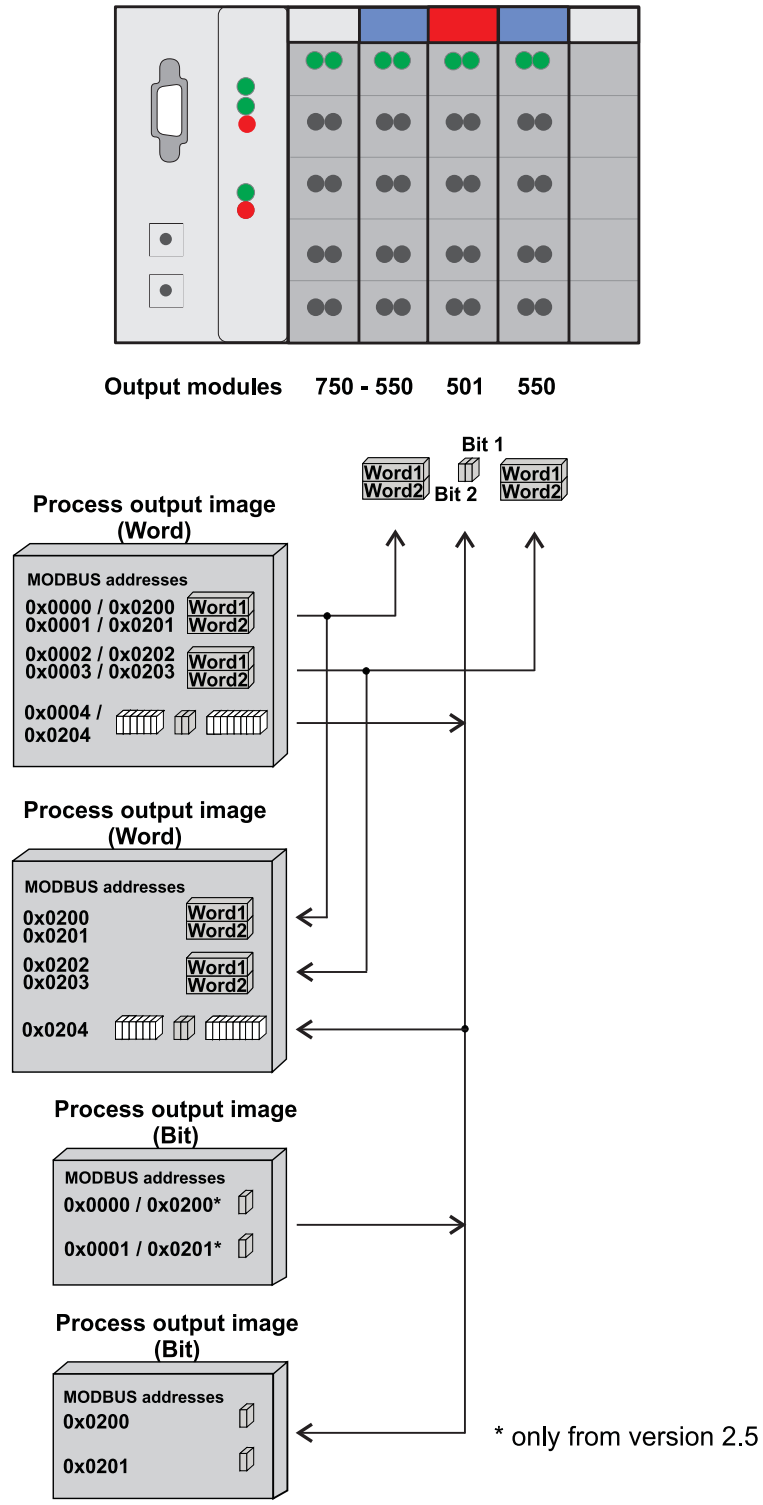



Fig. 5.4: Example for process output image, coupler

## 5.2 Controller

750-812,
750-814,
750-815,
750-816

### 5.2.1 Settings

As opposed to the MODBUS coupler the factory configuration of the controller change is not made by DIP switch, but is changed using a PC. The communication between the controller and PC is described in the ‘Start-up and diagnosis’ chapter.

The controller is set on the software side using the ‘Fieldbus configuration’ function block of the **WAGO-I/O-*PRO*** library. If this module is taken up in the control program, the setting is made automatically even after changing the controller. The settings are taken over into the controller parameter block. If the desired values are not already set, a firmware reset is automatically made in bus operation and the controller restarts with the selected settings.

If the controller is to be set independent of a machine or plant, a program which only comprises of the configuration module can be downloaded and started from the programming system.

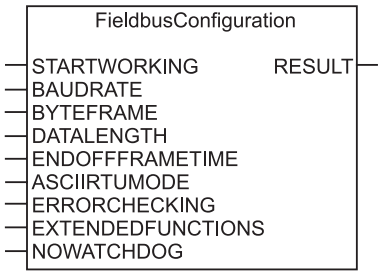



Fig. 5.5: Function block for controller setting

The coupler settings are described as follows. Here the term ‘Frame’ is frequently used. ‘Frame’ is a data transfer record.

#### 5.2.1.1 Standard settings

The controller is delivered with the following standard values:

| Input function block FieldbusConfiguration | Setting | Value | Chapter |
|---|---|---|---|
| **BAUDRATE** | 9600 Bd | 6 | 5.2.1.2 |
| **BYTEFRAME** | No Parity, 8 Bit<br>1 Stop Bit | 0 | 5.2.1.3 |
| **DATALENGTH** | 8 Bit | FALSE | 5.2.1.3 |
| **ENDOFFRAMETIME** | 3 x Frame Time | 0 | 5.2.1.4 |
| **ASCIIRTUMODE** | RTU mode | TRUE | 5.2.1.5 |
| **ERRORCHECKING** | being processed | TRUE | 5.2.1.6 |
| **EXTENDEDFUNCTIONS** | without | FALSE | 5.2.1.7 |
| **NOWATCHDOG** | Watchdog switched on | FALSE | 5.2.1.8 |

Table 5.12: Standard settings, controller

#### 5.2.1.2 Baud rate setting

The following baud rates can be set:

| Baud rate<br>750-812/814 | Baud rate<br>750-815/816 | BAUDRATE<br>Value |
|---|---|---|
| **150 Bd** | **38400 Bd** | 0 |
| **300 Bd** | **57600 Bd** | 1 |
| **600 Bd** | **115200 Bd** | 2 |
| **1200 Bd** | **1200 Bd** | 3 |
| **2400 Bd** | **2400 Bd** | 4 |
| **4800 Bd** | **4800 Bd** | 5 |
| **9600 Bd** | **9600 Bd** | **6** |
| **19200 Bd** | **19200 Bd** | 7 |

Table 5.13: Baud rates, controller

The standard default setting is 9600 Baud.

#### 5.2.1.3 Error detection, length of the character string

A parity bit can additionally be transmitted with each byte. Data transfer faults can be recognised with the help of the parity bit. A differentiation is made between parity checks for even parity, odd parity and no parity.

For this the number of set bits (=1) are counted in the transmitted data bytes. For example, during the transmission of the character string 1100 0101 the number of set bits is even, namely 4. If the setting of an even parity bit is selected, then in this case it is set to 0, so that the number of set bits still remains even. Analog to this, the odd parity bit 1 would be selected so that the number of set bits will be odd.

This type of error detection is assured for one error, for several errors under certain circumstances this error detection may no longer be assured. If the coupler recognises a parity error, the frame is ignored and a new frame can only be received following a renewed ‘Start of Frame’.

If the slave receives faulty frames, these will not be replied to. The master detects this error in that after the preset time (Time-out) no corresponding frame is received.

In the MODBUS coupler 750-812 a parity bit can be attached to each byte. The data length selected can be 7 or 8 bit. In addition it is possible to add 1 to 3 stop bits.

| Byte Frame | Data length | Stop Bits | DATALENGTH<br><br>Value | BYTEFRAME<br><br>Value |
|---|---|---|---|---|
| **No Parity** | **8** | **1** | **FALSE** | **0** |
| **Even Parity** | 8 | 1 | FALSE | 1 |
| **Odd Parity** | 8 | 1 | FALSE | 2 |
| **No Parity** | 8 | 2 | FALSE | 3 |
| **No Parity** | 7 | 2 | TRUE | 0 |
| **Even Parity** | 7 | 1 | TRUE | 1 |
| **Odd Parity** | 7 | 1 | TRUE | 2 |
| **No Parity** | 7 | 3 | TRUE | 3 |

Table 5.14: Byte Frame, Controller

The standard setting is no parity, 8 bit data length and 1 stop bit. This setting is ignored when transferring data in RTU mode, as the format of this mode is set to 8 bit.

#### 5.2.1.4 End of Frame Time

The end of frame time is the pause time following a frame which is required to switch over the repeater in slave. This time must permit gaps during a frame without resulting in a faulty detection of the end of frame time.

The setting of the end of frame time is made with the input *ENDOFFRAMETIME*.

| End of Frame Time | ENDOFFRAMETIME Value |
|---|---|
| **3 x Frame Time** | **0** |
| **100 ms** | 1 |
| **200 ms** | 2 |
| **500 ms** | 3 |
| **1 s** | 4 |
| **1 ms** | 5 |
| **10 ms** | 6 |
| **50 ms** | 7 |

Table 5.15: End of Frame Time, Controller

The standard setting is 3 x frame time.

#### 5.2.1.5 ASCII/RTU mode

MODBUS permits two different transmission modes:

ASCII mode: Each byte (8 Bit) is sent as 2 ASCII characters.

Advantage: Displayable characters are transmitted. The gaps between characters need not be observed, provided they do not exceed 1 second.

RTU mode: Each byte (8 Bit) comprises of two 4 bit hexadecimal characters.

Advantage: As only 1 character has to be transmitted for each byte a higher data throughput is achieved in comparison to the ASCII mode.

The setting is made using input *ASCIIRTUMODE*.

| Mode | ASCIIRTUMODE Value |
|---|---|
| **ASCII** | FALSE |
| **RTU** | **TRUE** |

Table 5.16: ASCII-/RTU mode, controller

The standard setting is RTU mode.

### 5.2.1.6 Error Check

A check sum (CRC) is calculated from the frame to be transmitted in the sender (higher ranking controls). This check sum is transmitted in the frame to the receiver (controller). Once the error check is activated, this check sum is compared with the check sum calculated in the coupler on the basis of the same instruction. An error is signalled by a red LED ‘CRC’.

The setting is made via the input *ERRORCHECKING*.

| **Error Check** | **ERRORCHECKING**<br>**Value** |
|---|---|
| **ignored** | FALSE |
| **being processed** | **TRUE** |

Table 5.17: Error Check, controller

Error Check activated is the standard setting.

### 5.2.1.7 Extended Functions

The registers for further internal diagnostic possibilities (extended functions) in the address space of the coupler are not yet available. For this reason set the attendant input *EXTENDEDFUNCTIONS to* FALSE.

| **Extended Functions** | **EXTENDEDFUNCTIONS**<br>**Value** |
|---|---|
| **without** | **FALSE** |
| **available** | TRUE |

Table 5.18: Extended functions, controller

In the standard setting, other diagnosis possibilities are switched off.

#### 5.2.1.8 Watchdog

The watchdog serves for monitoring the data transfer between the higher ranking controls and the controller. If no communication occurs after a preset time, the controller can be run into a secured status.

The watchdog is switched on via the *NOWATCHDOG* input.

| **Watchdog** | **NOWATCHDOG Value** |
|---|---|
| **switched on** | **FALSE** |
| **switched off** | TRUE |

Table 5.19: Watchdog, controller

Watchdog activated is the standard setting.

The watchdog selection is described is detail in chapter 5.3.2.

## 5.2.2 Data exchange between MODBUS master and controller

The controller mainly comprises of PLC functionality as well the interface to the I/O modules and to the MODBUS. Data is exchanged between the PLC functionality, I/O modules and the MODBUS master. This system operates with two different address formats.

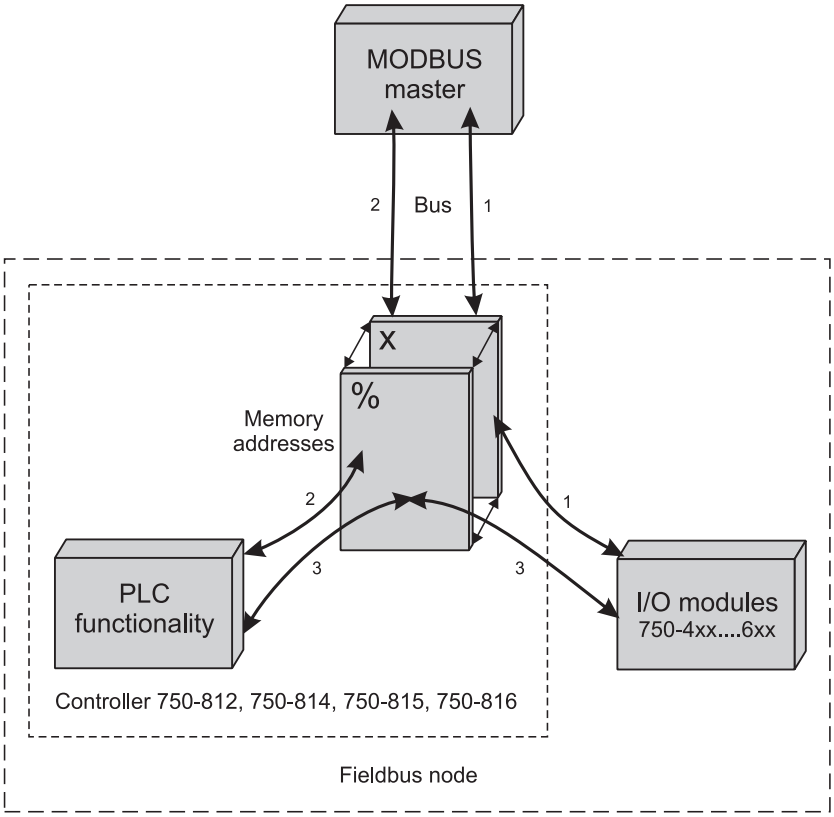



Fig. 5.6: Data exchange between MODBUS master and controller

1 Data exchange between MODBUS master and I/O modules (hexadecimal or decimal display of the addresses, x)

2 Data exchange between the MODBUS master (hexadecimal or decimal display of the address, x) and PLC functionality (absolute addresses, %)

3 Data exchange between I/O modules and PLC functionality (absolute addresses, %)

### 5.2.2.1 Data exchange between MODBUS master and I/O modules

The data exchange between the MODBUS master and the I/O modules is made by reading and writing in bits or bytes.
The controller handles four different types of process data:

- Input words
- Output words
- Input bits
- Output bits

The following figure shows the data word addresses in the process illustration of the inputs and outputs:

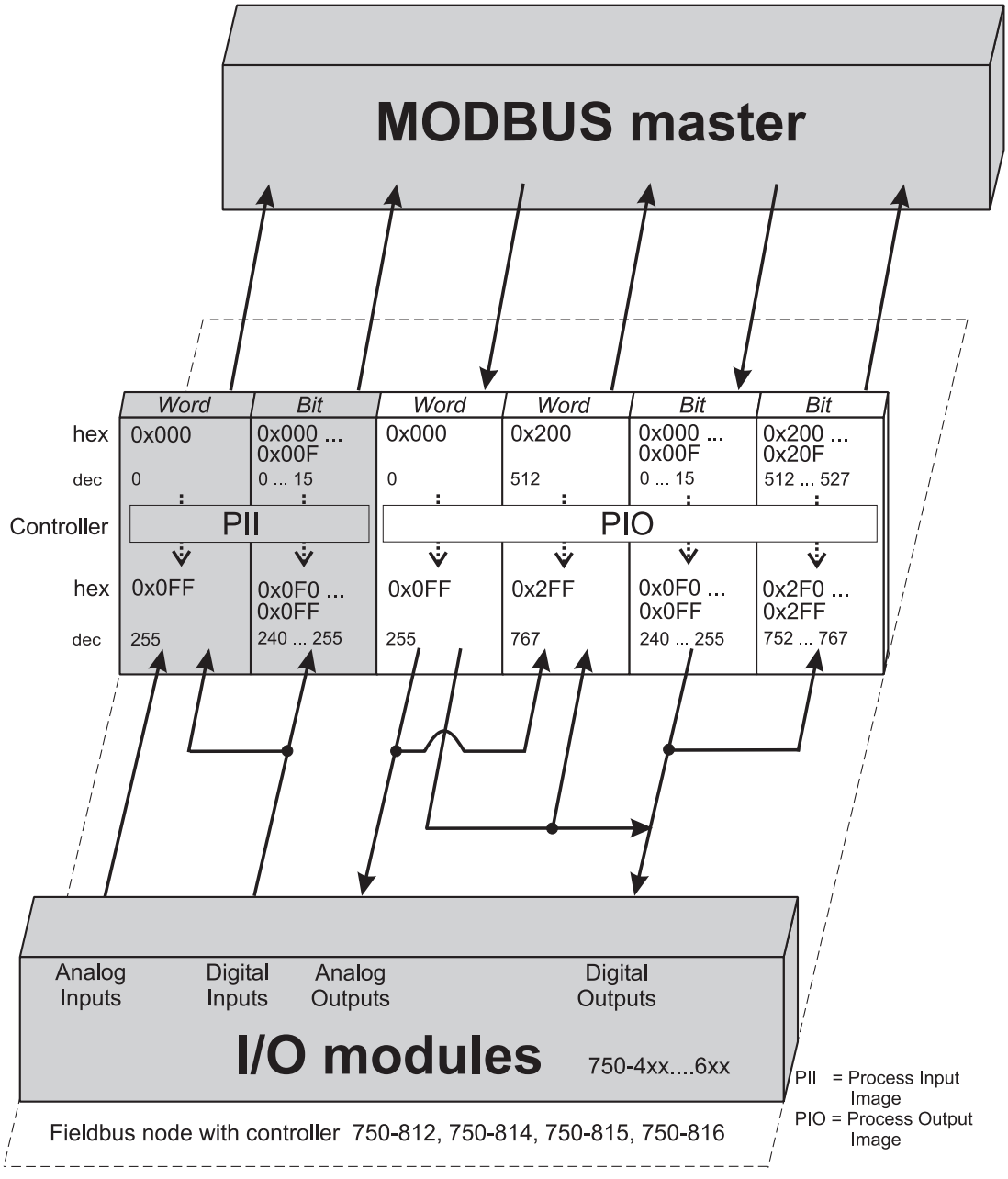



Fig. 5.7: Data exchange between the MODBUS master and I/O modules

The word for word access to the digital input and output modules is made in accordance with the following table:

| **Digital inputs/ outputs** | 16. | 15. | 14. | 13. | 12. | 11. | 10. | 9. | 8. | 7. | 6. | 5. | 4. | 3. | 2. | 1. |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **Process data word** | Bit 15 | Bit 14 | Bit 13 | Bit 12 | Bit 11 | Bit 10 | Bit 9 | Bit 8 | Bit 7 | Bit 6 | Bit 5 | Bit 4 | Bit 3 | Bit 2 | Bit 1 | Bit 0 |
| **Byte** | High-Byte D1 | | | | | | | | Low-Byte D0 | | | | | | | |

Table 5.20: Allocation of digital inputs/outputs to process data word, controller

Function!

### Common access of MODBUS master and PLC functionality to outputs

The process illustration of outputs is described both by the MODBUS master as well as by the PLC functionality, so that the I/O module outputs can be set or reset from both sides. In the case of simultaneity no priority exists. Design the user programs of the MODBUS master and the PLC functionality such that conflicting instructions for simultaneous setting or resetting of outputs is excluded. Applicable in all cases is that the individual instruction of the process illustration processed last will be written over.

### 5.2.2.2 Data exchange between MODBUS master and PLC functionality

The fieldbus data in the MODBUS master and in the PLC functionality have different address formats. The addresses of the MODBUS master are displayed hexadecimal or decimal. The PLC functionality uses absolute addresses.

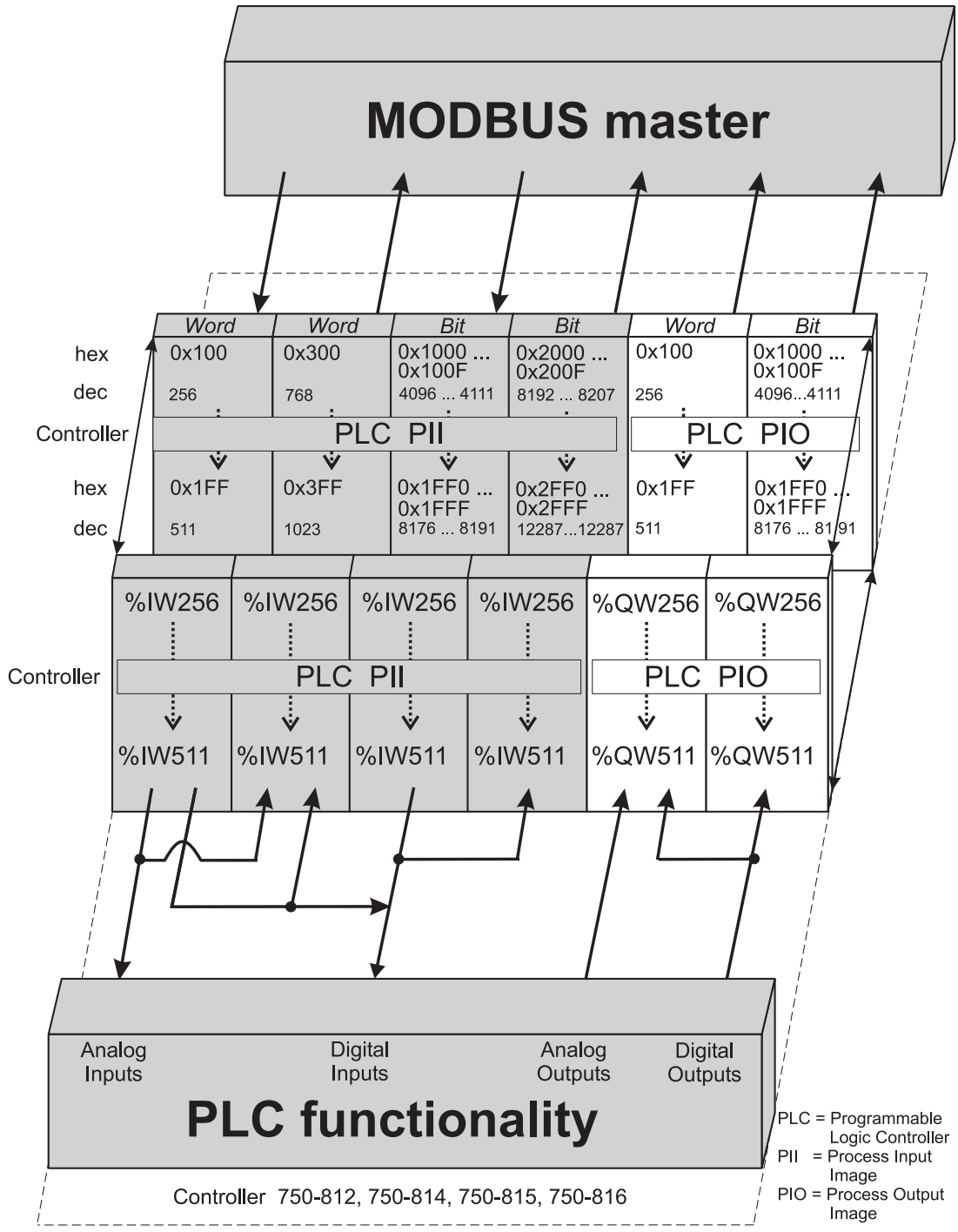



Fig. 5.8: Data exchange between MODBUS master and PLC functionality

### 5.2.2.3 Data exchange between I/O modules and PLC functionality

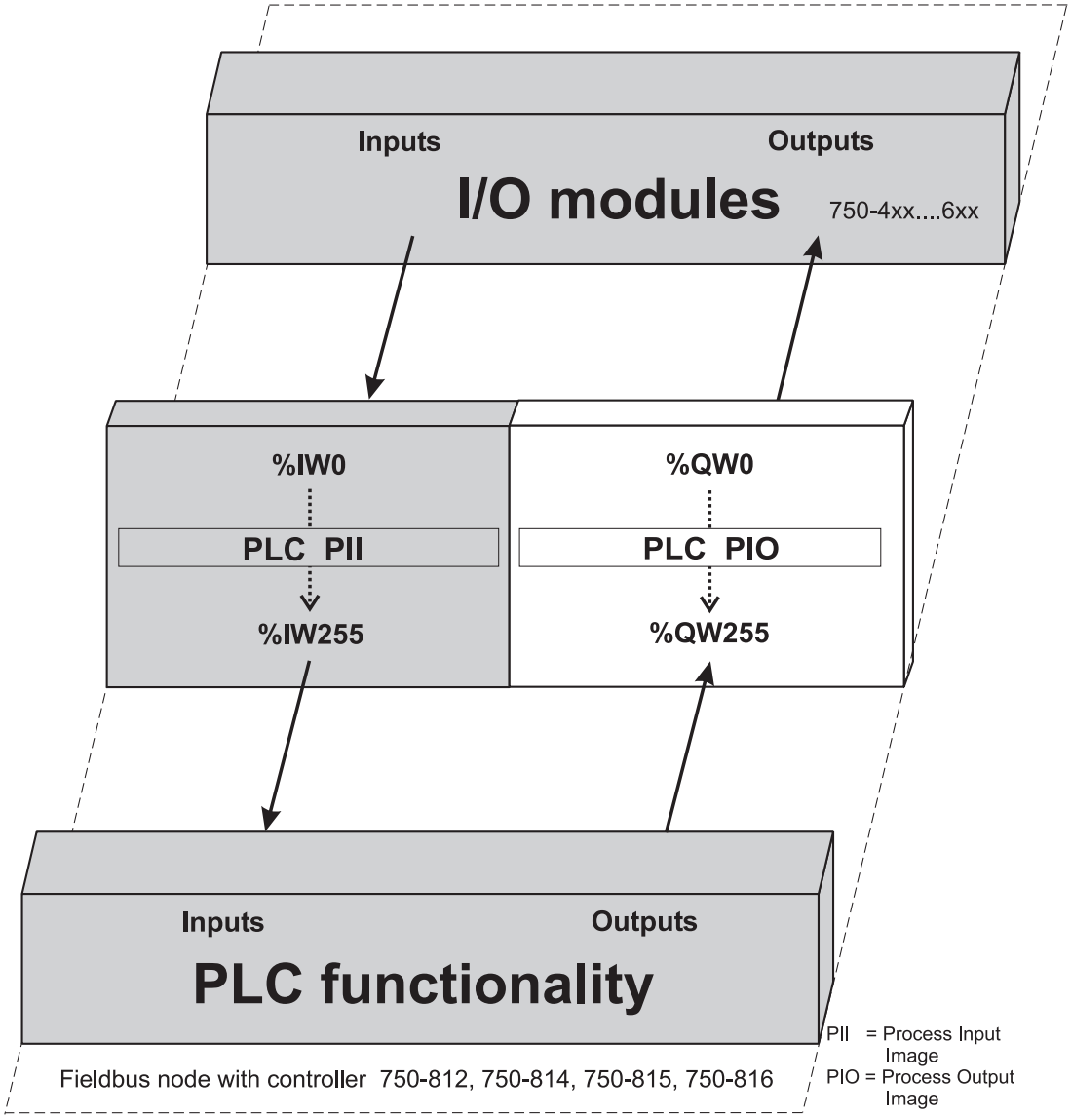



Fig. 5.9: Data exchange between I/O modules and PLC functionality

### 5.2.2.4 Address review

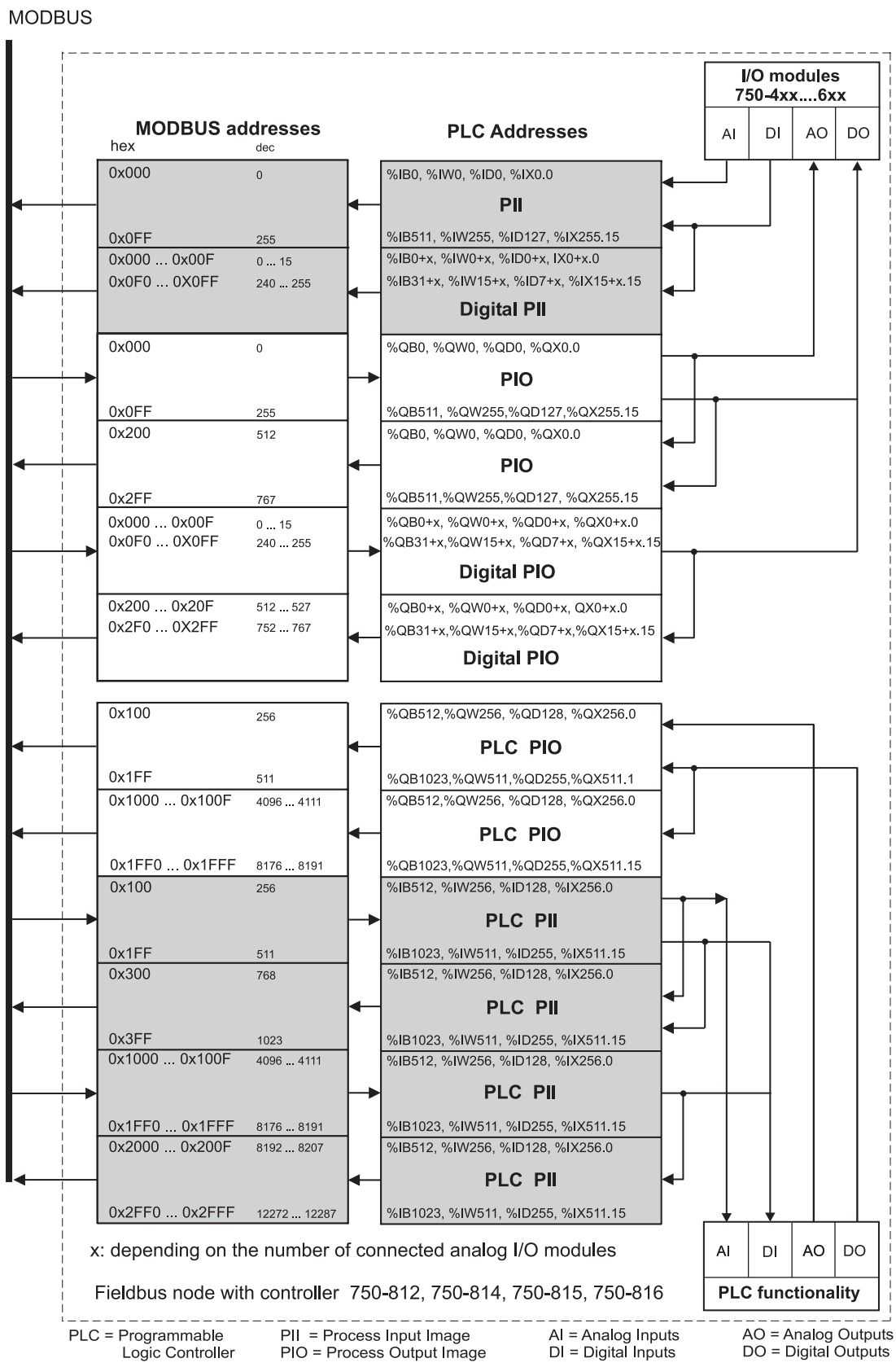



Fig. 5.10: Address review, controller

### 5.2.3 Absolute addresses for inputs, outputs and flags

The direct display of individual memory cells (absolute addresses) in accordance with IEC 1131-3 is made using special character strings in accordance with the following table:

| Position | Character | Designation | Comments |
|---|---|---|---|
| **1** | **%** | Starts absolute address | |
| **2** | I | Input | |
| | Q | Output | |
| | M | Flag | |
| **3** | X* | Single bit | Data width |
| | B | Byte (8 Bits) | |
| | W | Word (16 Bits) | |
| | D | Double word (32 Bits) | |
| **4** | | Address | |
| * The character 'X' for bits can be deleted | | | |

Table 5.21: Absolute addresses

**Funktion!**

Enter the absolute address character strings without blanks!

Address range for I/O module data:

| Data width | Address | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| **Bit** | 0.0 ... 0.15 | | 1.0 ... 1.15 | | ..... | | 254.0 ... 254.15 | | 255.0 ... 255.15 | |
| **Byte** | 0 | 1 | 2 | 3 | ..... | ..... | 508 | 509 | 510 | 511 |
| **Word** | **0** | | **1** | | **.....** | | **254** | | **255** | |
| **DWord** | 0 | | | | ..... | | 127 | | | |

Table 5.22: Address range for the I/O module data

Fieldbus data address range:

| Data width | Address | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| **Bit** | 256.0 ... 256.15 | | 257.0 ... 257.15 | | ..... | | 510.0 ... 510.15 | | 511.0 ... 511.15 | |
| **Byte** | 512 | 513 | 514 | 515 | ..... | ..... | 1020 | 1021 | 1022 | 1023 |
| **Word** | **256** | | **257** | | **.....** | | **510** | | **511** | |
| **DWord** | 128 | | | | ..... | | 255 | | | |

Table 5.23: Address range for fieldbus data

Address range for flags (retain):

| Data width | Address | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| **Bit** | 0.0 ... 0.15 | | 1.0 ... 1.15 | | ..... | | 4094.0 ... 4094.15 | | 4095.0 ... 4095.15 | |
| **Byte** | 0 | 1 | 2 | 3 | ..... | ..... | 8188 | 8189 | 8190 | 8191 |
| **Word** | **0** | | **1** | | **.....** | | **4094** | | **4095** | |
| **DWord** | 0 | | | | ..... | | 2047 | | | |

Table 5.24: Address range for flags

**Address calculation (depending upon the word address):**

Bit address: Word address .0 to .15

Byte address: 1. Byte: 2 x Word address
2. Byte: 2 x Word address + 1

DWord address:
Lower section: Word address (even numbers) / 2
Upper section: Word address (uneven numbers) / 2, rounded off

Example for input absolute addresses:

| %IX14. | 0 | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 | 13 | 14 | 15 | %I15.* | 0 | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 | 13 | 14 | 15 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| %IB28 | | | | | | | | | %IB29 | | | | | | | | %IB30 | | | | | | | | | %IB31 | | | | | | | | |
| **%IW14** | | | | | | | | | | | | | | | | | **%IW15** | | | | | | | | | | | | | | | | |
| %IDW7 | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| * The character 'X' for single bits can be deleted | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |

Table 5.25: Example for input absolute addresses

Example for output absolute addresses:

| %QX5. | 0 | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 | 13 | 14 | 15 | %Q6.* | 0 | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 | 13 | 14 | 15 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| %QB10 | | | | | | | | | %QB11 | | | | | | | | %QB12 | | | | | | | | | %QB13 | | | | | | | | |
| **%QW5** | | | | | | | | | | | | | | | | | **%QW6** | | | | | | | | | | | | | | | | |
| %QDW2 (upper section) | | | | | | | | | | | | | | | | | QDW3 (lower section) | | | | | | | | | | | | | | | | |
| * The character 'X' for single bits can be deleted | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |

Table 5.26: Example for output absolute addresses

Example for flag absolute addresses:

| %MX11. | 0 | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 | 13 | 14 | 15 | %M12.* | 0 | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 | 13 | 14 | 15 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| %MB22 | | | | | | | | | %MB23 | | | | | | | | %MB24 | | | | | | | | | %MB25 | | | | | | | | |
| **%MW11** | | | | | | | | | | | | | | | | | **%MW12** | | | | | | | | | | | | | | | | |
| %MDW5 (upper section) | | | | | | | | | | | | | | | | | %MDW6 (lower section) | | | | | | | | | | | | | | | | |
| * The character 'X' for single bits can be deleted | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |

Table 5.27: Example for flag absolute addresses

### 5.2.4 Addressing the I/O modules

- The arrangement of the I/O modules in a node is optional.
- Addressing of the I/O modules relates to the attendant controller.
- Addressing is organised word for word and starts both for inputs as well as outputs with word address ‘0’.
- The I/O module addressing corresponds to the arrangement order behind the controller. Addressing starts with the I/O module, which occupy one or more words per channel. The I/O module addresses which occupy one or two bits per channel then follow. For the number of input and output bits or bytes please refer to the corresponding I/O module data sheets.
- Addressing of the I/O modules which occupy one or two bits per channel is also made word for word. 16 inputs or outputs each are arranged in one word. If less channels are available the remaining bits of the word remain free or are reserved for extensions.
- If a node is extended by additional I/O modules for which one or more words are assigned per channel, the I/O module addresses are displayed accordingly by one or two bits per channel.

| Data width ≥ 1 word / channel | Data width = 1 Bit / channel |
|---|---|
| Analog input modules | Digital input modules |
| Analog output modules | Digital output modules |
| Input modules for thermal elements | Digital output modules with diagnosis (2 Bit / channel) |
| Input modules for resistance sensors | Power supply module with fuse holder / diagnosis |
| Pulse width output modules | Solid State power relay |
| Interface modules | Relay output modules |
| Up/down counter | |
| I/O modules for angle and path measurement | |

Table 5.28: Data width of I/O modules

### 5.2.5 Application example

The following figure is an example of a process input image. The configuration comprises of 10 digital and 8 analog inputs. The process image thus has a data length of 8 words for the analog and 1 word for the digital inputs, i.e. 9 words in total.

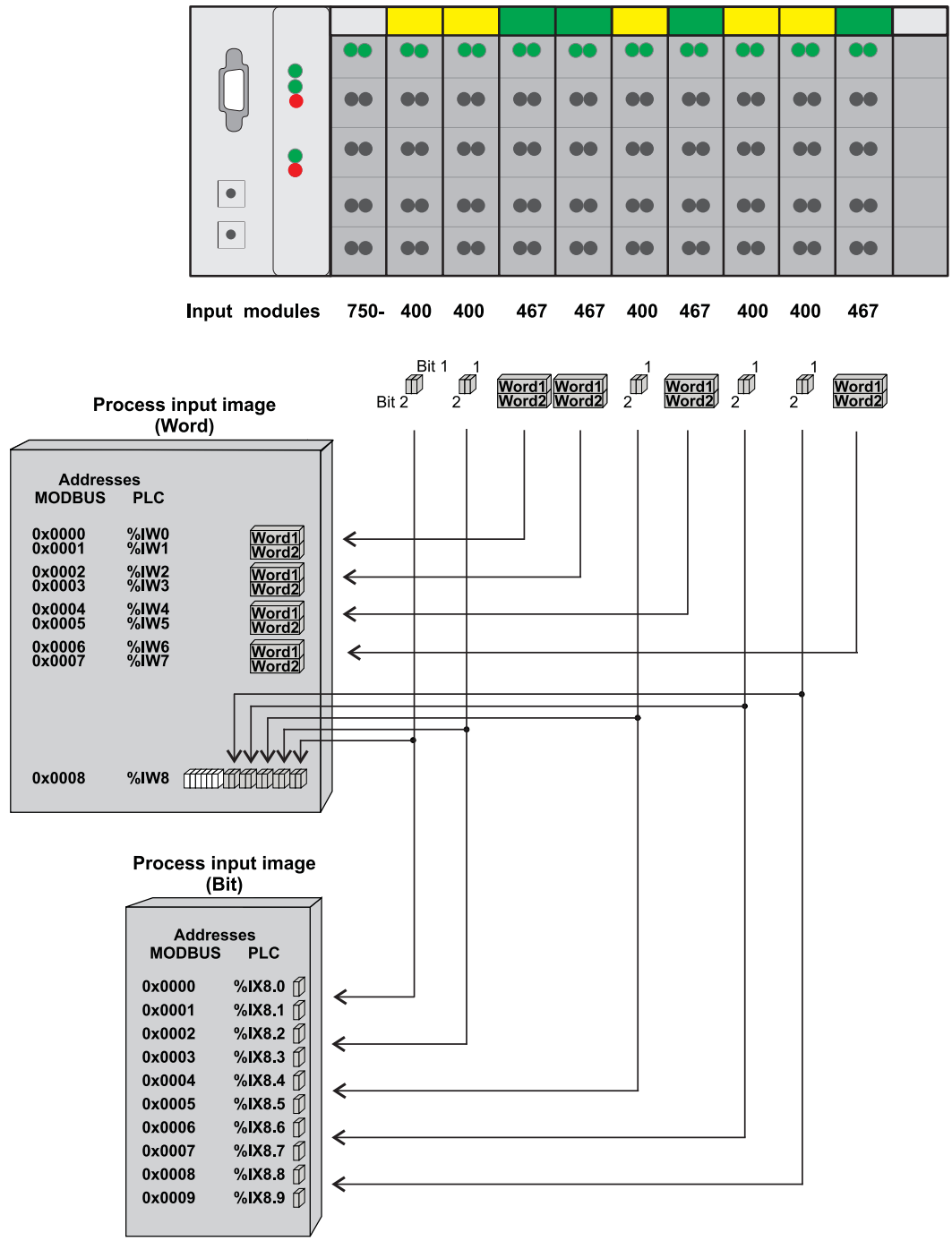



Fig. 5.11: Example for process input image, controller

The following example for the process output image comprises of 2 digital and 4 analog outputs. It comprises of 4 words for the analog and one word for the digital outputs.

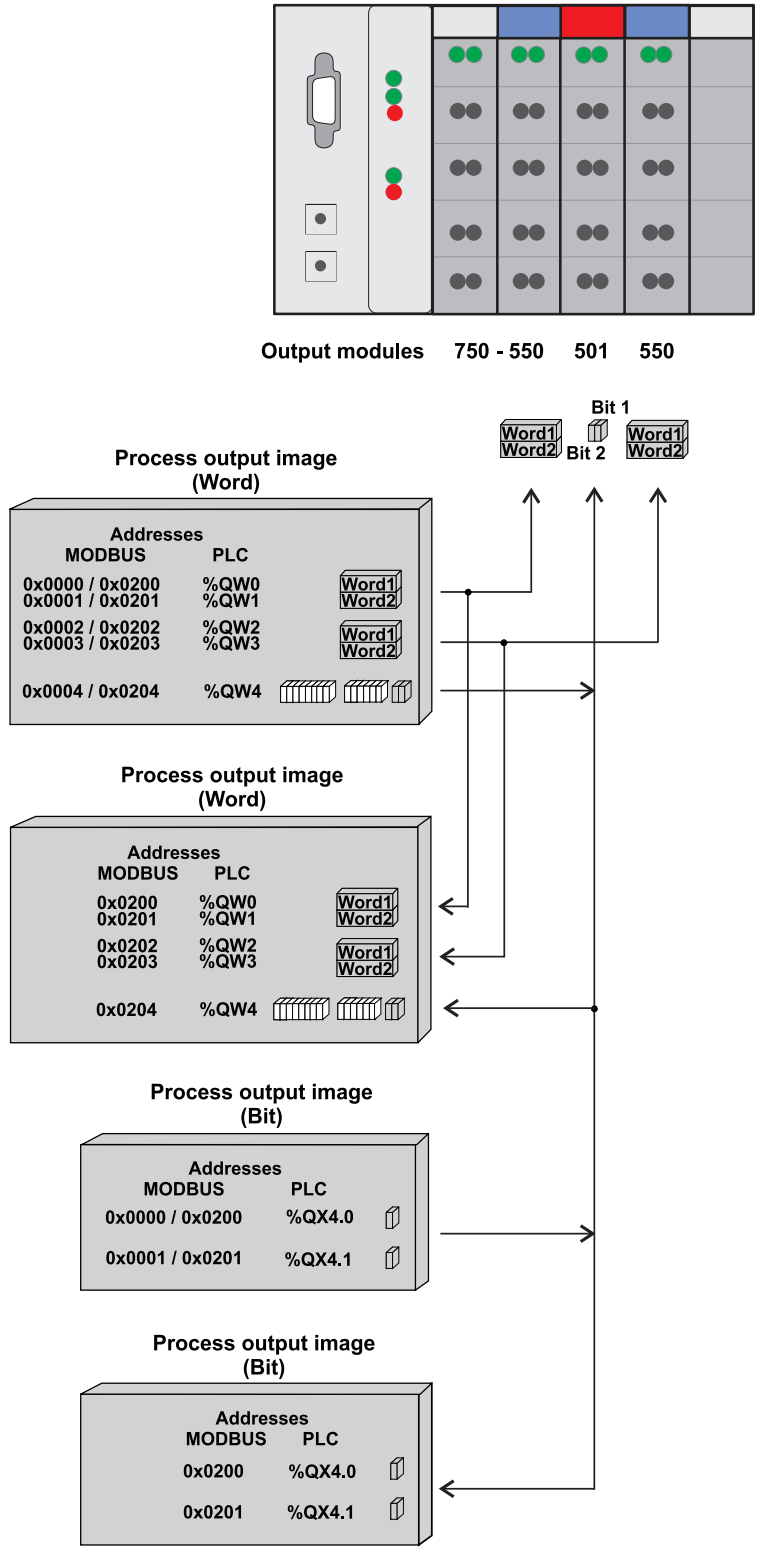



Fig. 5.12: Example for process output image, controller

### 5.2.6 Controller operating system

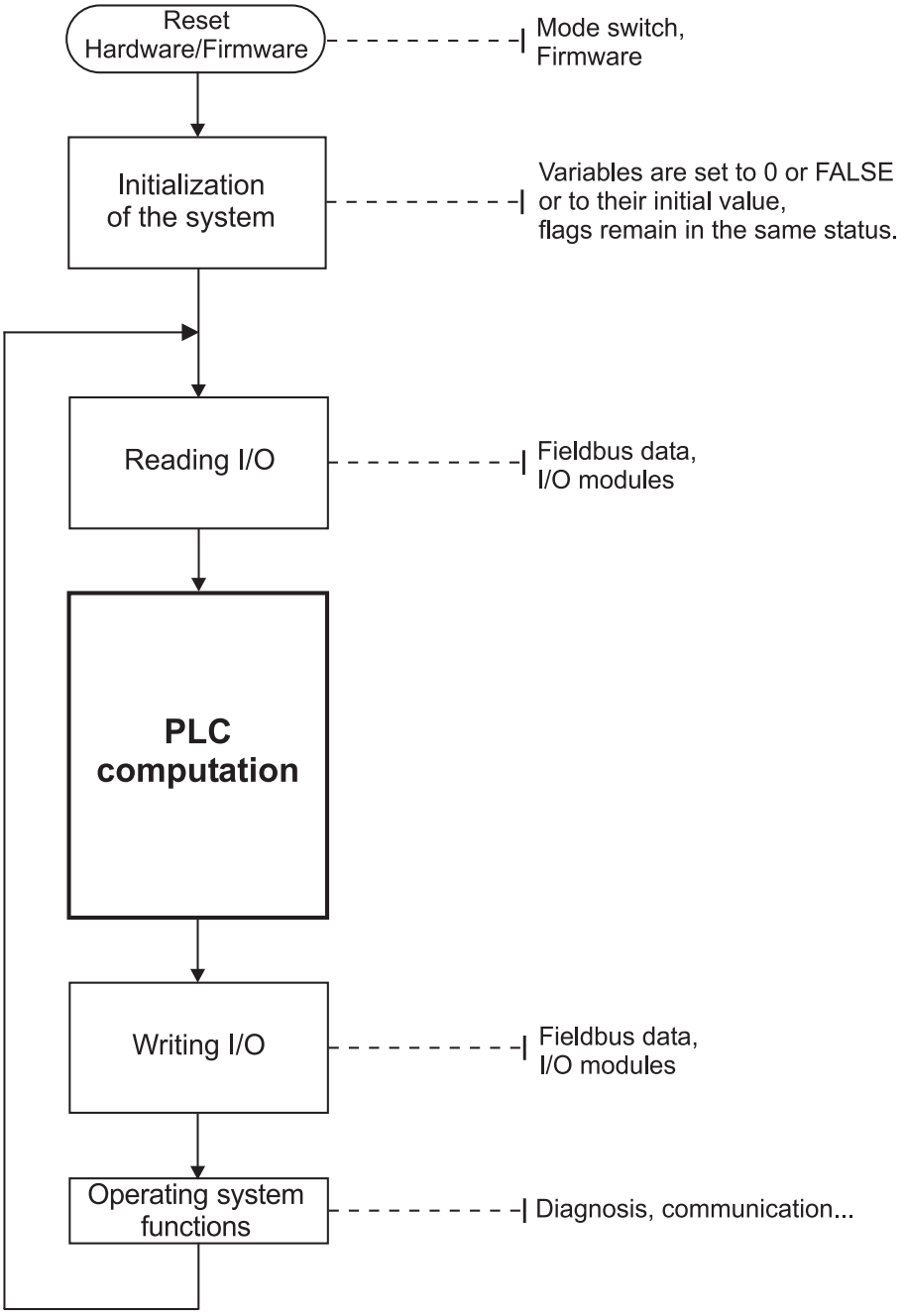



Fig. 5.13: Operating system, controller

## 5.3 Common coupler/controller functions

### 5.3.1 Implemented MODBUS functions

The following table shows the functions which support both the MODBUS coupler as well as the MODBUS controller:

| Function code | Function | Description | |
|---|---|---|---|
| **0x01** | Read Coil Status | Read input bits and output bits as an octet string. | Functions are identical |
| **0x02** | Read Input Status | Read input bit as an octet string. | |
| **0x03** | Read Holding Registers | Read number of input words. | Functions are identical |
| **0x04** | Read Input Registers | Read number of input words. | |
| **0x05** | Force Single Coil | Write output bit. | |
| **0x06** | Preset Single Register | Writes a value in an output word. | |
| **0x0B** | Fetch Comm Event Ctr | Read status word and event counter. | |
| **0x0F** | Force Multiple Coils | Writes a number of output bits. | |
| **0x10** | Preset Multiple Regs | Writes a number of output words. | |

Table 5.29: Implemented functions

### 5.3.1.1 Use of the MODBUS functions

The graphical review shows the MODBUS functions which have access to process illustration data.

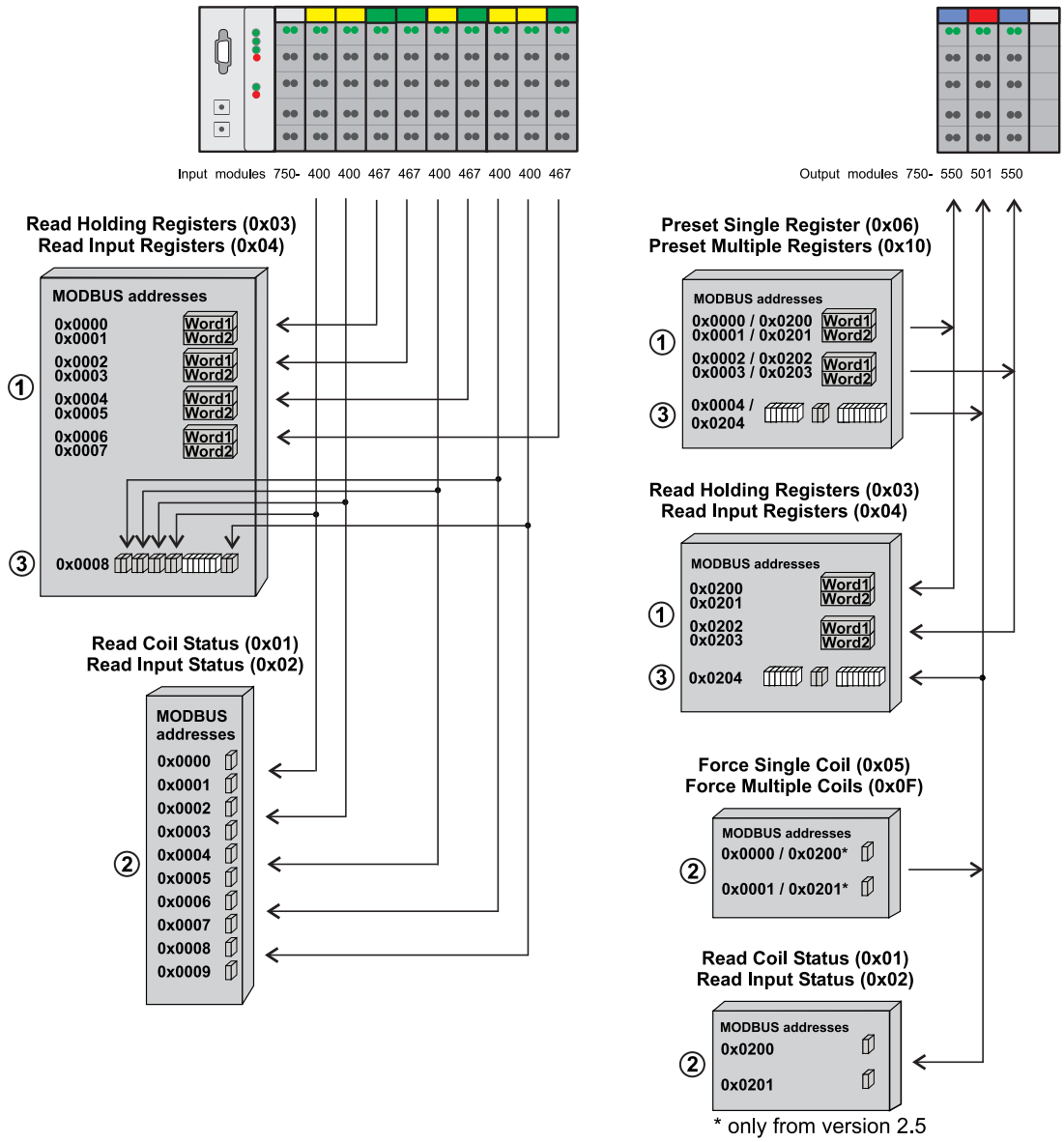



Fig. 5.14: Review of MODBUS functions, e.g. with coupler

It is to be recommended to access the analog signals with register functions ① and binary signals with coil functions ②. If access is also required to reading and writing binary signals with register functions ③, the addresses are displayed as soon as a further analog modules are fitted.

### 5.3.1.2 Read Coil Status (function code 0x01):

This function reads the status of the input and output bits (coils) in slave, whereby broadcast is not supported. With coupler/controller the number of I/O points is limited to 256.

**Inquiry:**

Function!

The Inquiry determines the starting address and the number of bits to be read.
The first point is addressed with 0. With Modicon the addressing starts with 1 (0x01).

The following table shows an example for an inquiry, with which the bits 0 to 7 of the slaves 11 are to be read:

| Field name | Example | RTU | ASCII | |
|---|---|---|---|---|
| **Start of frame** | - | t1-t2-t3 | ":" | 0x3a |
| **Slave address** | 0x0B | 0x0B | "0B" | 0x30, 0x42 |
| **Function code** | 0x01 | 0x01 | "01" | 0x30, 0x31 |
| **Starting address high** | 0x00 | 0x00 | "00" | 0x30, 0x30 |
| **Starting address low** | 0x00 | 0x00 | "00" | 0x30, 0x30 |
| **Number of points high** | 0x00 | 0x00 | "00" | 0x30, 0x30 |
| **Number of points low** | 0x08 | 0x08 | "08" | 0x30, 0x38 |
| **Error Check (LRC / CRC)** | - | 0x3D<br>0x66 | "EC" | 0x45, 0x43 |
| **End of frame** | | t1-t2-t3 | - | 0xD, 0xA |

Table 5.30: Inquiry example, Read Coil Status

**Reply:**

The current values of the interrogated bits are packed in the data field. A 1 corresponds to the ON status and a 0 to the OFF status. The lowest value bit of the first data byte contains the first bit of the inquiry. The others follow in an ascending order. If the number of inputs are not a multiple of 8, the remaining bits of the last data byte are filled with zeroes. If the number of bits interrogated exceed the number of inputs or outputs present in the node, the remaining input bits are set to zero and the outputs contain the last valid value.

| Field name | Example | RTU | ASCII | |
|---|---|---|---|---|
| **Start of frame** | - | t1-t2-t3 | ":" | 0x3A |
| **Slave address** | 0x0B | 0x0B | "0B" | 0x30, 0x42 |
| **Function code** | 0x01 | 0x01 | "01" | 0x30, 0x31 |
| **Byte Count** | 0x01 | 0x01 | "01" | 0x30, 0x31 |
| **Data (point 8...0)** | 0x12 | 0x12 | "12" | 0x31, 0x32 |
| **Error Check (LRC / CRC)** | - | 0xD2<br>0x5D | "E1" | 0x45, 0x31 |
| **End of frame** | - | t1-t2-t3 | - | 0xD, 0xA |

Table 5.31: Reply example, Read Coil Status

The status of the inputs 7 to 0 is shown as byte value 0x12 or binary 0001 0010. Input 7 is the bit having the highest valency of this byte and input 0 the lowest value.
The assignment is thus made from 7 to 0 with OFF-OFF-OFF-ON-OFF-Off-ON-OFF.

| | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| **Bit:** | 0 | 0 | 0 | 1 | 0 | 0 | 1 | 0 |
| **Coil:** | 7 | 6 | 5 | 4 | 3 | 2 | 1 | 0 |

### 5.3.1.3 Read Input Status (function code 0x02):

This function reads the input bits in the slave, whereby broadcast is not supported. With the coupler/controller the number of points is limited to 256.

**Inquiry:**

Function!

The inquiry determines the starting address and the number of bits to be read.
The first point is addressed with 0. With Modicon addressing starts with 1 (0x01).

The following table shows an example of an inquiry with which the bits 0 to 7 of the slaves 11 are to be read:

| Field name | Example | RTU | ASCII | |
|---|---|---|---|---|
| **Start of frame** | - | t1-t2-t3 | ":" | 0x3a |
| **Slave address** | 0x0B | 0x0B | "0B" | 0x30, 0x42 |
| **Function code** | 0x02 | 0x02 | "02" | 0x30, 0x32 |
| **Starting address high** | 0x00 | 0x00 | "00" | 0x30, 0x30 |
| **Starting address low** | 0x00 | 0x00 | "00" | 0x30, 0x30 |
| **Number of points high** | 0x00 | 0x00 | "00" | 0x30, 0x30 |
| **Number of points low** | 0x08 | 0x08 | "08" | 0x30, 0x38 |
| **Error Check (LRC / CRC)** | - | 0x79<br>0x66 | "EC" | 0x45, 0x42 |
| **End of frame** | | t1-t2-t3 | - | 0xD, 0xA |

Table 5.32: Example inquiry, Read Input Status

**Reply:**

The current value of the inquired bit is packed into the data field. A 1 corresponds to the ON status and a 0 the OFF status. The lowest value bit of the first data byte contains the first bit of the inquiry. The other follow in an ascending order. If the number of inputs are not a multiple of 8, the remaining bits of the last data byte are filled with zeroes. If the number of bits interrogated exceed the number of inputs present in the node, the remaining input bits are set to zero.

| Field name | Example | RTU | ASCII | |
|---|---|---|---|---|
| **Start of frame** | - | t1-t2-t3 | ":" | 0x3A |
| **Slave address** | 0x0B | 0x0B | "0B" | 0x30, 0x42 |
| **Function code** | 0x02 | 0x02 | "02" | 0x30, 0x32 |
| **Byte Count** | 0x01 | 0x01 | "01" | 0x30, 0x31 |
| **Data (point 8...0)** | 0x12 | 0x12 | "12" | 0x31, 0x32 |
| **Error Check (LRC / CRC)** | - | 0x22<br>0x5D | "E0" | 0x45, 0x30 |
| **End of frame** | - | t1-t2-t3 | - | 0xD, 0xA |

Table 5.33: Example reply, Read Input Status

The status of the inputs 7 to 0 is shown as a byte value 0x12 or binary 0001 0010. Input 7 is the bit having the highest valency of this byte and input 0 the lowest value.
The assignment is thus made from 7 to 0 with OFF-OFF-OFF-ON-OFF-Off-ON-OFF.

| | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| **Bit:** | 0 | 0 | 0 | 1 | 0 | 0 | 1 | 0 |
| **Coil:** | 7 | 6 | 5 | 4 | 3 | 2 | 1 | 0 |

#### 5.3.1.4 Read Holding Register (function code 0x03)

The binary contents of holding registers are read out in the slave using this function. Broadcast is not supported. The maximum number is limited to 128 registers in one frame.

**Inquiry:**
The inquiry determines the start word address (start register) and the number the register to be read.

**Function!**

The addressing starts with 0. The Modicon address starts with 1 (0x01).

Example for an inquiry of the registers 0 and 1 of slave 11:

| Field name | Example | RTU | ASCII | |
|---|---|---|---|---|
| **Start of frame** | - | t1-t2-t3 | ":" | 0x3a |
| **Slave address** | 0x0B | 0x0B | "0B" | 0x30, 0x42 |
| **Function code** | 0x03 | 0x03 | "03" | 0x30, 0x33 |
| **Starting address high** | 0x00 | 0x00 | "00" | 0x30, 0x30 |
| **Starting address low** | 0x00 | 0x00 | "00" | 0x30, 0x30 |
| **Number of points high** | 0x00 | 0x00 | "00" | 0x30, 0x30 |
| **Number of points low** | 0x02 | 0x02 | "02" | 0x30, 0x32 |
| **Error Check (LRC / CRC)** | - | 0xC4<br>0xA1 | "F0" | 0x46, 0x30 |
| **End of frame** | | t1-t2-t3 | - | 0xD, 0xA |

Table 5.34: Example inquiry, Read Holding Register

**Reply:**
The reply register data is packed as 2 bytes per register. The first byte contains the higher value bits, the second the lower values. A reply to the above inquiry appears as follows:

| Field name | Example | RTU | ASCII | |
|---|---|---|---|---|
| **Start of frame** | - | t1-t2-t3 | ":" | 0x3A |
| **Slave address** | 0x0B | 0x0B | "0B" | 0x30, 0x42 |
| **Function code** | 0x03 | 0x03 | "03" | 0x30, 0x33 |
| **Byte Count** | 0x04 | 0x04 | "04" | 0x30, 0x34 |
| **Data Hi (Register 0)** | 0x3F | 0x3F | "3F" | 0x33, 0x46 |
| **Data Lo (Register 0)** | 0xFB | 0xFB | "FB" | 0x46, 0x42 |
| **Data Hi (Register 1)** | 0x00 | 0x00 | "00" | 0x30, 0x30 |
| **Data Lo (Register 1)** | 0x00 | 0x00 | "00" | 0x30, 0x30 |
| **Error Check (LRC / CRC)** | - | 0x2D<br>0x61 | "B4" | 0x42, 0x34 |
| **End of frame** | - | t1-t2-t3 | - | 0xD, 0xA |

Table 5.35: Example reply, Read Holding Register

The contents of register 0 is displayed hexadecimal by two byte values: 0x3F and 0xFB or 16379 decimal. The contents of register 1 are 0x00 and 0x00 or 0 decimal.

### 5.3.1.5 Read Input Register (Function code 0x04)

This function serves to read a number of input words (also ”input register”). Broadcast is not supported and the maximum number is limited to 128 registers in one frame.

**Inquiry:**

Function!

The inquiry determines the address of the start word (start register) and the number of the register to be read.
Addressing starts with 0. The Modicon address starts with 1 (0x01).

Example for an inquiry of the registers 0 and 1 ofslave 11:

| Field name | Example | RTU | ASCII | |
|---|---|---|---|---|
| **Start of frame** | - | t1-t2-t3 | ”:” | 0x3a |
| **Slave address** | 0x0B | 0x0B | ”0B” | 0x30, 0x42 |
| **Function code** | 0x04 | 0x03 | ”03” | 0x30, 0x33 |
| **Starting address high** | 0x00 | 0x00 | ”00” | 0x30, 0x30 |
| **Starting address low** | 0x00 | 0x00 | ”00” | 0x30, 0x30 |
| **Number of points high** | 0x00 | 0x00 | ”00” | 0x30, 0x30 |
| **Number of points low** | 0x02 | 0x02 | ”02” | 0x30, 0x32 |
| **Error Check (LRC / CRC)** | - | 0xC4<br>0xA1 | ”F0” | 0x46, 0x30 |
| **End of frame** | | t1-t2-t3 | - | 0xD, 0xA |

Table 5.36: Example enquiry, Read Input Register

**Replay:**

The register data of the answer is packed as 2 bytes per register. The first byte has the higher value bits, the second the lower values. A reply to the above inquiry appears as follows:

| Field name | Example | RTU | ASCII | |
|---|---|---|---|---|
| **Start of frame** | - | t1-t2-t3 | ”:” | 0x3A |
| **Slave address** | 0x0B | 0x0B | ”0B” | 0x30, 0x42 |
| **Function code** | 0x04 | 0x03 | ”03” | 0x30, 0x33 |
| **Byte Count** | 0x04 | 0x04 | ”04” | 0x30, 0x34 |
| **Data Hi (Register 0)** | 0x3F | 0x3F | ”3F” | 0x33, 0x46 |
| **Data Lo (Register 0)** | 0xFB | 0xFB | ”FB” | 0x46, 0x42 |
| **Data Hi (Register 1)** | 0x00 | 0x00 | ”00” | 0x30, 0x30 |
| **Data Lo (Register 1)** | 0x00 | 0x00 | ”00” | 0x30, 0x30 |
| **Error Check (LRC / CRC)** | - | 0x2D<br>0x61 | ”B4” | 0x42, 0x34 |
| **End of frame** | - | t1-t2-t3 | - | 0xD, 0xA |

Table 5.37: Example reply, Read Input Register

The contents of register 0 are shown hexadecimal by two byte values: 0x3F and 0xFB or 16379 decimal. The contents of register 1 are 0x00 and 0x00 or 0 decimal.

### 5.3.1.6 Force Single Coil (Function code 0x05):

With the aid of this function a single output bit is written. This function can also be sent as a broadcast, in which case the same bit is set in all slaves. With coupler/controller the number of I/O points is limited to 256.

**Inquiry:**
The required ON or OFF status is specified in the data field of the inquiry. A value of 0xFF00 sets the output bit to 1, a value of 0x00 on 0. Other values are not specified and have no effect on the output condition. In this example the bit 0 is set to 1 in slave 11:

| Field name | Example | RTU | ASCII | |
|---|---|---|---|---|
| **Start of frame** | - | t1-t2-t3 | ":" | 0x3a |
| **Slave address** | 0x0B | 0x0B | "0B" | 0x30, 0x42 |
| **Function code** | 0x05 | 0x05 | "05" | 0x30, 0x35 |
| **Coil address high** | 0x00 | 0x00 | "00" | 0x30, 0x30 |
| **Coil address low** | 0x00 | 0x00 | "00" | 0x30, 0x30 |
| **Force data high** | 0xFF | 0xFF | "FF" | 0x46, 0x46 |
| **Force data low** | 0x00 | 0x00 | "00" | 0x30, 0x30 |
| **Error Check (LRC / CRC)** | - | 0x8C<br>0x90 | "F1" | 0x46, 0x31 |
| **End of frame** | | t1-t2-t3 | - | 0xD, 0xA |

Table 5.38: Example inquiry, Force Single Coil

**Reply:**
The reply is an echo of the inquiry and will be or is returned when the bit is set.

| Field name | Example | RTU | ASCII | |
|---|---|---|---|---|
| **Start of frame** | - | t1-t2-t3 | ":" | 0x3a |
| **Slave address** | 0x0B | 0x0B | "0B" | 0x30, 0x42 |
| **Function code** | 0x05 | 0x05 | "05" | 0x30, 0x35 |
| **Coil address high** | 0x00 | 0x00 | "00" | 0x30, 0x30 |
| **Coil address low** | 0x00 | 0x00 | "00" | 0x30, 0x30 |
| **Force data high** | 0xFF | 0xFF | "FF" | 0x46, 0x46 |
| **Force data low** | 0x00 | 0x00 | "00" | 0x30, 0x30 |
| **Error Check (LRC / CRC)** | - | 0x8C<br>0x90 | "F1" | 0x46, 0x31 |
| **End of frame** | | t1-t2-t3 | - | 0xD, 0xA |

Table 5.39: Example reply, Force Single Coil

### 5.3.1.7 Preset Single Register (Function code 0x06):

This function writes a value in one single output word (also ”Output register”). This function can also be sent as a broadcast, in which case the same output word is set in all slaves.

Function!

**Inquiry:**
Addressing starts with 0. The Modicon address starts with 1 (0x01).
The inquiry determines the address of the first output word to be set.
The value to be set is determined in the inquiry data field.

In the example the register 0 is set in slave 11.

| Field name | Example | RTU | ASCII | |
|---|---|---|---|---|
| **Start of frame** | - | t1-t2-t3 | ”:” | 0x3a |
| **Slave address** | 0x0B | 0x0B | ”0B” | 0x30, 0x42 |
| **Function code** | 0x06 | 0x06 | ”06” | 0x30, 0x36 |
| **Register address high** | 0x00 | 0x00 | ”00” | 0x30, 0x30 |
| **Register address low** | 0x00 | 0x00 | ”00” | 0x30, 0x30 |
| **Preset data high** | 0x12 | 0x12 | ”12” | 0x31, 0x32 |
| **Preset data low** | 0x34 | 0x34 | ”34” | 0x33, 0x34 |
| **Error Check (LRC / CRC)** | - | 0x8C 0x17 | ”A9” | 0x41, 0x39 |
| **End of frame** | | t1-t2-t3 | - | 0xD, 0xA |

Table 5.40: Example inquiry, Preset Single Register

**Reply:**
The reply is an echo of the inquiry and is sent after setting the register.

| Field name | Example | RTU | ASCII | |
|---|---|---|---|---|
| **Start of frame** | - | t1-t2-t3 | ”:” | 0x3a |
| **Slave address** | 0x0B | 0x0B | ”0B” | 0x30, 0x42 |
| **Function code** | 0x06 | 0x06 | ”06” | 0x30, 0x36 |
| **Register address high** | 0x00 | 0x00 | ”00” | 0x30, 0x30 |
| **Register address low** | 0x00 | 0x00 | ”00” | 0x30, 0x30 |
| **Preset data high** | 0x12 | 0x12 | ”12” | 0x31, 0x32 |
| **Preset data low** | 0x34 | 0x34 | ”34” | 0x33, 0x34 |
| **Error Check (LRC / CRC)** | - | 0x8C 0x17 | ”A9” | 0x41, 0x39 |
| **End of frame** | | t1-t2-t3 | - | 0xD, 0xA |

Table 5.41: Example reply, Preset Single Register

### 5.3.1.8 Fetch Comm Event Counter (Function code 0x0B):

This function returns a status word and an event counter from the communication event counter of the slave. With this counter the master can determine whether the slave has treated the slave without a fault.
Following each successful news processing the counter counts up. This counting process is not performed in the case of exception replies, poll commands or counter inquiries.
The event counter can be reset using the diagnosis function (Code 0x08), the restart sub-function communications option (Code 0x01) or clear counters and the diagnosis register (Code 0x0A).

**Inquiry:**
In the example the communication counter of the slave 11 is read:

| Field name | Example | RTU | ASCII | |
|---|---|---|---|---|
| **Start of frame** | - | t1-t2-t3 | ":" | 0x3a |
| **Slave address** | 0x0B | 0x0B | "0B" | 0x30, 0x42 |
| **Function code** | 0x0B | 0x0B | "0B" | 0x30, 0x42 |
| **Error Check (LRC / CRC)** | - | 0x47<br>0x47 | "EA" | 0x45, 0x41 |
| **End of frame** | | t1-t2-t3 | - | 0xD, 0xA |

Table 5.42: Example inquiry, Fetch Comm Event Counter

**Reply:**
The reply contains a 2 byte status word and a 2 byte event counter. The status word only contains zeroes.

The following table shows an example of a reply:

| Field name | Example | RTU | ASCII | |
|---|---|---|---|---|
| **Start of frame** | - | t1-t2-t3 | ":" | 0x3a |
| **Slave address** | 0x0B | 0x0B | "0B" | 0x30, 0x42 |
| **Function code** | 0x0B | 0x0B | "0B" | 0x30, 0x42 |
| **Status high** | 0x00 | 0x00 | "00" | 0x30, 0x30 |
| **Status low** | 0x00 | 0x00 | "00" | 0x31, 0x33 |
| **Event count high** | 0x00 | 0x00 | "00" | 0x30, 0x30 |
| **Event count low** | 0x03 | 0x03 | "03" | 0x30, 0x33 |
| **Error Check (LRC / CRC)** | - | 0xE4<br>0xA0 | "E7" | 0x45, 0x37 |
| **End of frame** | | t1-t2-t3 | - | 0xD, 0xA |

Table 5.43: Example reply, Fetch Comm Event Counter

The event counter shows that 3 (0x03) events were counted.

### 5.3.1.9 Force Multiple Coils (Function code 0x0F):

Using this function a number of output bits are set to 1 or 0. With a broadcast transmission the same bits are set in all activated on slaves. The maximum number is 256 bits.

**Inquiry:**

Function!

The first point is addressed with 0. The Modicon address starts with 1 (0x01).
The inquiry news specifies the bits to be set. The requested 1 or 0 states are determined by the contents of the inquiry data field.
In this example 16 bits are set, starting with the address 0 in slave 11. The inquiry contains 2 bytes with the value 0xA5F0 in other words 1010 0101 1111 0000 binary.

| | | | | | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **Bit:** | 1 | 0 | 1 | 0 | 0 | 1 | 0 | 1 | 1 | 1 | 1 | 1 | 0 | 0 | 0 | 0 | | |
| **Coil:** | 7 | 6 | 5 | 4 | 3 | 2 | 1 | 0 | 15 | 14 | 13 | 12 | 11 | 10 | 9 | 8 | | |

The first byte transmits the 0xA5 to the addresses 7 to 0, whereby 0 is the lowest value bit. The next byte transmits 0xF0 to the addresses 15 to 8, whereby the lowest value bit is 8.

| Field name | Example | RTU | ASCII | |
|---|---|---|---|---|
| **Start of frame** | - | t1-t2-t3 | ":" | 0x3a |
| **Slave address** | 0x0B | 0x0B | "0B" | 0x30, 0x42 |
| **Function code** | 0x0F | 0x0F | "0F" | 0x30, 0x46 |
| **Coil address high** | 0x00 | 0x00 | "00" | 0x30, 0x30 |
| **Coil address low** | 0x00 | 0x00 | "00" | 0x30, 0x30 |
| **Quantity of coils high** | 0x00 | 0x00 | "00" | 0x30, 0x30 |
| **Quantity of coils low** | 0x10 | 0x10 | "10" | 0x31, 0x30 |
| **Byte Counter** | 0x02 | 0x02 | "02" | 0x30, 0x32 |
| **Force data high (coils 7 ... 0)** | 0xA5 | 0xA5 | "A5" | 0x41, 0x35 |
| **Force data low (coils 15 ... 8)** | 0xF0 | 0xF0 | "F0" | 0x46, 0x30 |
| **Error Check (LRC / CRC)** | - | 0xE7<br>0x94 | "3F" | 0x33, 0x46 |
| **End of frame** | | t1-t2-t3 | - | 0xD, 0xA |

Table 5.44: Example inquiry, Force Multiple Coils

**Reply:**

The reply is the address of the slave, the function code, the starting address and the number of set bits.

| Fieldname | Example | RTU | ASCII | |
|---|---|---|---|---|
| **Start of frame** | - | t1-t2-t3 | ":" | 0x3a |
| **Slave address** | 0x0B | 0x0B | "0B" | 0x30, 0x42 |
| **Function code** | 0x0F | 0x0F | "0F" | 0x30, 0x46 |
| **Coil address high** | 0x00 | 0x00 | "00" | 0x30, 0x30 |
| **Coil address low** | 0x00 | 0x00 | "00" | 0x30, 0x30 |
| **Quantity of coils high** | 0x00 | 0x00 | "00" | 0x30, 0x30 |
| **Quantity of coils low** | 0x10 | 0x10 | "10" | 0x31, 0x30 |
| **Error Check (LRC / CRC)** | - | 0x54<br>0xAD | "D6" | 0x44, 0x36 |
| **End of frame** | | t1-t2-t3 | - | 0xD, 0xA |

Table 5.45: Example reply, Force Multiple Coils

### 5.3.1.10 Preset Multiple Registers (Function code 0x10):

This function writes values in a number of output words (also ”Output register”). With a broadcast transmission the values are written in all slaves. The maximum register number per frame is 128.

Function!

**Inquiry:**
The first point is addressed with 0. The Modicon address starts with 1 (0x01).
The inquiry message determines the registers to be set. The data is sent as 2 bytes per register.

The example shows how data is set in the two registers 0 and 1 in slave 11:

| Field name | Example | RTU | ASCII | |
|---|---|---|---|---|
| **Start of frame** | - | t1-t2-t3 | ”:” | 0x3a |
| **Slave address** | 0x0B | 0x0B | ”0B” | 0x30, 0x42 |
| **Function code** | 0x10 | 0x10 | ”10” | 0x31, 0x30 |
| **Starting address high** | 0x00 | 0x00 | ”00” | 0x30, 0x30 |
| **Starting address low** | 0x00 | 0x00 | ”00” | 0x30, 0x30 |
| **Number of register high** | 0x00 | 0x00 | ”00” | 0x30, 0x30 |
| **Number of register low** | 0x02 | 0x02 | ”02” | 0x30, 0x32 |
| **Byte Counter** | 0x04 | 0x04 | ”04” | 0x30, 0x34 |
| **Data high (register 0)** | 0x12 | 0x12 | ”12” | 0x31, 0x32 |
| **Data low (register 0)** | 0x34 | 0x34 | ”34” | 0x33, 0x34 |
| **Data high (register 1)** | 0x56 | 0x56 | ”56” | 0x35, 0x36 |
| **Data low (register 1)** | 0x78 | 0x78 | ”78” | 0x37, 0x38 |
| **Error Check (LRC / CRC)** | - | 0xA9<br>0x43 | ”CB” | 0x43, 0x42 |
| **End of frame** | | t1-t2-t3 | - | 0xD, 0xA |

Table 5.46: Example inquiry, Preset Multiple Registers

**Reply:**
The reply returns the slave address, the function code, the start address and the number of the set register.

| Field name | Example | RTU | ASCII | |
|---|---|---|---|---|
| **Start of frame** | - | t1-t2-t3 | ”:” | 0x3a |
| **Slave address** | 0x0B | 0x0B | ”0B” | 0x30, 0x42 |
| **Function code** | 0x10 | 0x10 | ”10” | 0x31, 0x30 |
| **Starting address high** | 0x00 | 0x00 | ”00” | 0x30, 0x30 |
| **Starting address low** | 0x00 | 0x00 | ”00” | 0x30, 0x30 |
| **Number of register high** | 0x00 | 0x00 | ”00” | 0x30, 0x30 |
| **Number of register low** | 0x02 | 0x02 | ”02” | 0x30, 0x32 |
| **Error Check (LRC / CRC)** | - | 0x41<br>0x62 | ”E3” | 0x45, 0x33 |
| **End of frame** | | t1-t2-t3 | - | 0xD, 0xA |

Table 5.47: Example reply, Preset Multiple Registers

### 5.3.2 Watchdog - Fieldbus failure

Function!

The watchdog serves for monitoring the data transfer between the higher ranking controls and coupler/controller. For this the higher ranking controls cyclically actuate a time function (Time-out) in the coupler/controller. In the case of fault free communication this time cannot reach its end value, because prior to this it is restarted again and again. If this time has elapsed a fieldbus failure has occurred.

The watchdog must be switched on so that it can be activated (see ‘coupler/settings’ or ‘Controller/settings’).

In the coupler/controller special registers are present for the selection and status inquiry of the watchdog by the higher ranking controls (Register addresses 0x1000 to 0x1008).

After switching on the supply voltage the watchdog is not yet activated. First lay down the time-out value (Register 0x1000). The watchdog can be activated by writing a function code in the mask register (0x1001), which is unequal 0. A second activation possibility is to write a value in the toggle register (0x1003) deviating from 0.

Reading the minimum trigger time (Register 0x1004) reveals whether the watchdog fault reaction was activated. If this time value is 0, a fieldbus failure is assumed. The watchdog can be restarted in accordance with the previously mentioned two possibilities or using the register 0x1007.

If the watchdog is started once it can only be stopped by the user for safety reasons via a certain path (register 0x1005 or 0x1008).

## Watchdog register:

The table below shows the registers for the Watchdog/Supervisor function.

| Register address | Designation | Access | Length (word) | Default | Description |
|---|---|---|---|---|---|
| **0 x 1000** | Watchdog/ Supervisor time WD_TIME | read/ write | 1 | pu/co 0x0000 | This register saves the value for time exceeded (Time-out). To be able to start the watchdog default value must have a value which is not equal to zero. The time is set as a multiple of 100 ms, 0x0009 means a time out time of 0.9 s. This value cannot be changed when the watchdog is running. |
| **0 x 1001** | Watchdog/ Supervisor Coding mask, Function code 1...16, WDFCM_1_16 | read/ write | 1 | pu/co 0x0000 | Using this mask the function codes can be set to trigger the watchdog function. The function code can be selected via a '1' to ( = $2^{(\text{Function code-1})}$ + ....)<br>Bit 1001.0 corresponds to function code1,<br>Bit 1001.1 corresponds to function code2...<br>The watchdog function is started if a value is not equal to zero. If only codes from non-supported functions are entered in the mask the watchdog will not start. An existing fault is reset and writing into the process illustration is possible. Also here changes cannot be made while the watchdog is running. |
| **0 x 1002** | Watchdog function Coding mask, Function code 17...32, WD_FCM_17_32 | read/ write | 1 | pu/co 0x0000 | Same function as above, however, with the function codes 17 to 32. These codes are not supported, for this reason the default value of this register should not be changed. It is not possible do modify this value while the watchdog is running. |
| **0 x 1003** | Watchdog trigger, WD_TRIGGER | read/ write | 1 | pu/co 0x0000 | This register is used for an alternative trigger method. The watchdog is triggered by writing different values in this register. Values following each other must differ in size. Writing of a value not equal to zero starts the watchdog. In case of a watchdog fault this register is reset to zero. |
| **0 x 1004** | Minimal actual trigger time, WD_AC_TRG_TIME | read/ write | 1 | pu/co 0xFFFF | Using this value the current watchdog status can be read. If the watchdog is triggered the saved value is compared with the current value. If the current value is smaller than the saved value this is replaced by the current value. The unit is 100 ms/digit. The saved value is changed by writing new values, which does not affect the watchdog. 0x000 is not permissible. |
| **0 x 1005** | Stop watchdog, WD_AC_STOP_MASK | read/ write | 1 | pu/co 0x0000 | The watchdog is stopped if here the value 0xAAAA is written first, followed by 0x5555. The watchdog fault reaction is blocked. A watchdog fault is reset and writing on the process data is possible again. |
| **0 x 1006** | When watchdog is running, WD_RUNNING | read | 1 | pu 0x0000 | Current watchdog status.<br>at 0x0: Watchdog not active,<br>at 0x1: Watchdog active. |
| **0 x 1007** | Restart watchdog, WD_RESTART | read/ write | 1 | pu 0x001 | Writing 0x1 into the register starts the watchdog again. |
| **0 x 1008** | Simplified watchdog stop WD_AC_STOP_SIMPLE | Read/ write | 1 | pu 0x0000 | The watchdog is stopped by writing the value 0x0AA55 or 0X55AA (as from V2.5), if it was already active. The watchdog fault reaction is deactivated. An existing watchdog fault is reset and it is possible to write in the watchdog register again. |

Table 5.48: Watchdog-Register

**pu**: Default value when switching voltage on

**co**: constant value ROM located

In all registers the length is 1, i.e. with each access only one word can be written or read.

**Examples:**

Setting the watchdog for a time overrun of more than 1 s:

1. Write 0x000A (=1000 ms / 100 ms) in the register for time overrun (0x1000).
2. Write 0x0010 (=$2^{(5-1)}$) in the coding mask (register 0x1001) to start the watchdog.
3. Use the function ‘Force Single Coil’ to trigger the watchdog.
4. Read the register of the minimum current trigger time and compare this with zero to check whether a time overrun has occurred.

   Repeat step 3 and Step 4.

Setting a watchdog a time overrun of more than 10 min:

1. Write 0x1770 (=10*60*1000 ms / 100 ms) in the register for time overrun (0x1000).
2. Write 0x0001 in the watchdog trigger register (0x1003) to start the watchdog.
3. Write 0x0001, 0x0000, 0x0001... or a counter value in the watchdog trigger register (0x1003) to trigger the watchdog.
4. Read the register of the minimum current trigger time and compare it with zero to check if a time overrun has occurred.

   Repeat step 3 and Step 4.

**Fieldbus failure on the coupler:**

The evaluation of the watchdog register is made by the coupler firmware. The internal bus is interrupted. The digital outputs are set to 0 and the analog outputs are set to the minimum value (e.g. with 4...20 mA to 4 mA).

**Fieldbus failure on controller:**

The evaluation of the watchdog register is made using the function block ‘FBUS_ERROR_INFORMATION’ in the control program. The internal bus remains in function and the process illustrations are retained. The control program can be further processed independently.

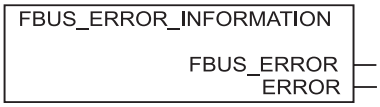



Fig. 5.15:Function block for determining a fieldbus failure

| | |
|---|---|
| ‘FBUS_ERROR’ (BOOL) | = FALSE = no fault |
| | = TRUE = fieldbus failure |
| ‘ERROR’ (WORD) | = 0 = no fault |
| | = 1 = fieldbus failure |

The nodes can set to a safe status in the case of a fieldbus failure using these outputs and a corresponding control program.

### 5.3.3 Configuration function

The following registers can be read, in order to determine the configuration of the connected modules:

| Register address | Designation | Access | Length (word) | Default | Description |
|---|---|---|---|---|---|
| **0 x 1022** | CnfLen. AnalogOut | read | 4++ | pu | Number of I/O bits with the process data words of the outputs |
| **0 x 1023** | CnfLen.AnalogInp | read | 3++ | pu | Number of I/O bits with the process data words of the inputs |
| **0 x 1024** | CnfLen.DigitalOut | read | 2++ | pu | Number of I/O bits with the process data bits of the outputs |
| **0 x 1025** | CnfLen.DigitalInp | read | 1 | pu | Number of I/O bits with the process data bits of the inputs |
| **0 x 1026** | slaveAdr | read | 1 | pu | Current node address. The address is read when switching on the voltage supply. |
| **0 x 1027** | Settings | read | 1 | pu | The current settings are saved here. These are interrogated when switching on the voltage supply.<br>D0-D2: Baud rate<br>D3-D4: Byte Frame<br>D5: Data Length 8/7 Bit<br>D6: Not in use<br>D7: Not in use<br>D8-D10: End of Frame Time<br>D11: RTU/ASCII mode<br>D12: Error Check switched off/switched on<br>D13: Extended Functions switched off/switched on<br>D14: Watchdog switched off/switched on<br>D15: Not in use |

Table 5.49: Configuration function **pu**: Default value when switching voltage on

### 5.3.4 Firmware information

These registers are used to read out information about the coupler or controller firmware.

| Register address | Designation | Access | Length (word) | Default | Description |
|---|---|---|---|---|---|
| **0x2010** | Revison, INFO_REVISION | read | 1 | pu/co - | Firmware version (256* major + minor) e.g.: V2.5 = 0x0205 |
| **0x2011** | Series code, INFO_SERIES | read | 1 | pu/co - | WAGO series number: 750 for WAGO-I/O System |
| **0x2012** | Item number, INFO_ITEM | read | 1 | pu/co - | WAGO order number: 312, 314, 315, 316 for coupler, 812, 814, 815, 816 for controller |
| **0x2013** | Major sub item code, INFO_MAJOR | read | 1 | pu/co - | Extended WAGO order number. Is used for special firmware versions or settings: 0xFFFF for coupler/controller. |
| **0x2014** | Minor sub item code, INFO_MINOR | read | 1 | pu/co - | Extended WAGO order number. Is used for special firmware versions or settings: 0xFFFF for coupler/controller. |
| **0x2020** | Description, INFO_DESCRIPTION | read | 128 | pu/co - | Brief description for this coupler/controller, max. 255 characters. If not available the value 0xFF appears. |
| **0x2021** | Description, INFO_TIME | read | 16 | pu/co - | Details of the manufacture time of the firmware version, max. 31 characters. If not available the value 0xFF appears. |
| **0x2022** | Description, INFO_DATE | read | 16 | pu/co - | Details of manufacture date of the firmware version, max. 31 characters. If not available the value 0xFF appears. |
| **0x2023** | Description, INFO_LOADER_INFO | read | 32 | pu/co - | Details of the company and user of the firmware programming unit, max. 63 characters. If not available the value 0xFF appears. |

Table 5.50: Firmware information **pu**: Default value when switching voltage on, **co**: Constant

### 5.3.5 General registers

The constants saved here can be used to test the communication with the master.

| Register address | Designation | Access | Length (word) | Default | Description |
|---|---|---|---|---|---|
| **0x2000** | Zero, GP_ZERO | read | 1 | pu/co 0x0000 | Constant with zero. |
| **0x2001** | Units, GP_ONES | read | 1 | pu/co 0xFFFF | Constant with units. Is -1 if declared as ”signed int” or MAXVALUE if ”unsigned int”. |
| **0x2002** | 1,2,3,4, GP_1234 | read | 1 | pu/co 0x1234 | Constant value to test whether high and low bytes are changed over (Intel/Motorola format). Should appear in the master as 0 x 1234. If 0 x 3412 appears the high and low byte must be changed over. |
| **0x2003** | Mask1, GP_AAAA | read | 1 | pu/co 0xAAAA | Constant to see if all bits are present. Is used together with register 0 x 2004. |
| **0x2004** | Mask2, GP_5555 | read | 1 | pu/co 0x5555 | Constant to see if all bits are present. Is used together with register 0 x 2003. |
| **0x2005** | Largest positive number, GP_MAX_POS | read | 1 | pu/co 0x7FFF | Constant, to check the arithmetic. |
| **0x2006** | Largest negative number, GP_MAX_NEG | read | 1 | pu/co 0x8000 | Constant, to check the arithmetic. |
| **0x2007** | Largest semi-positive number, GP_HALF_POS | read | 1 | pu/co 0x3FFF | Constant, to check the arithmetic. |
| **0x2008** | Largest semi-negative number, GP_HALF_NEG | read | 1 | pu/co 0x4000 | Constant, to check the arithmetic. |

Table 5.51: General registers **pu**: Default value when switching on voltage ; **co**: constant

# 6 Start-Up and Diagnosis

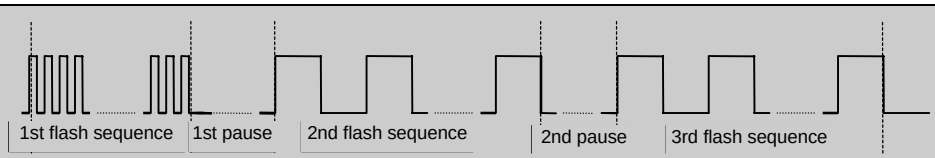
## 6.1 Run-up and error indications

After the supply voltage connection the coupler/controller checks all the functions of its components and the communication interface. The configuration of the I/O modules is then determined. The 'I/O ERR' LED is blinking during the run-up time. The coupler/controller enters then the "fieldbus start" status after the successful run-up. The green "I/O RUN" LED indicates this status. If an error occurs, the red "I/O ERR" goes on blinking in a low frequency. The various types of error are indicated via up to 3 different flash sequences.


Display functions of the 'I/O ERR' LED:

1. Coupler/controller's start-up phase after the supply voltage connection
2. Introduction of the error indication
3. Error code
   (number of flash cycles 2nd flash sequence)
4. Error argument
   (Number of flash cycles 3rd flash sequence)

Fig. 6.1: LED fieldbus start and error indication




| 2nd flash sequence | 3rd flash sequence | Meaning |
|---|---|---|
| Error code | Error argument | |
| 1 | 0 | EEPROM check sum error |
| | 1 | Internal storage overflow for the inline code |
| | 2 | Unknown data type |
| 2 | 0 | Programmed process image assignement is not plausible |
| | N (N>0) | Error in table comparison I/O module N (programmed configuration), passive modules as well as potential supply modules are not taken into account |
| 3 | 0 | I/O module(s) has (have) identified the internal bus command as wrong |
| 4 | 0 | Data error at internal bus or internal bus break at coupler / controller |
| | N (N>0) | Internal bus interrupted after N module |
| 5 | N | Internal bus error in the communication with N module |

Table 6.1: Error diagnosis, nodes

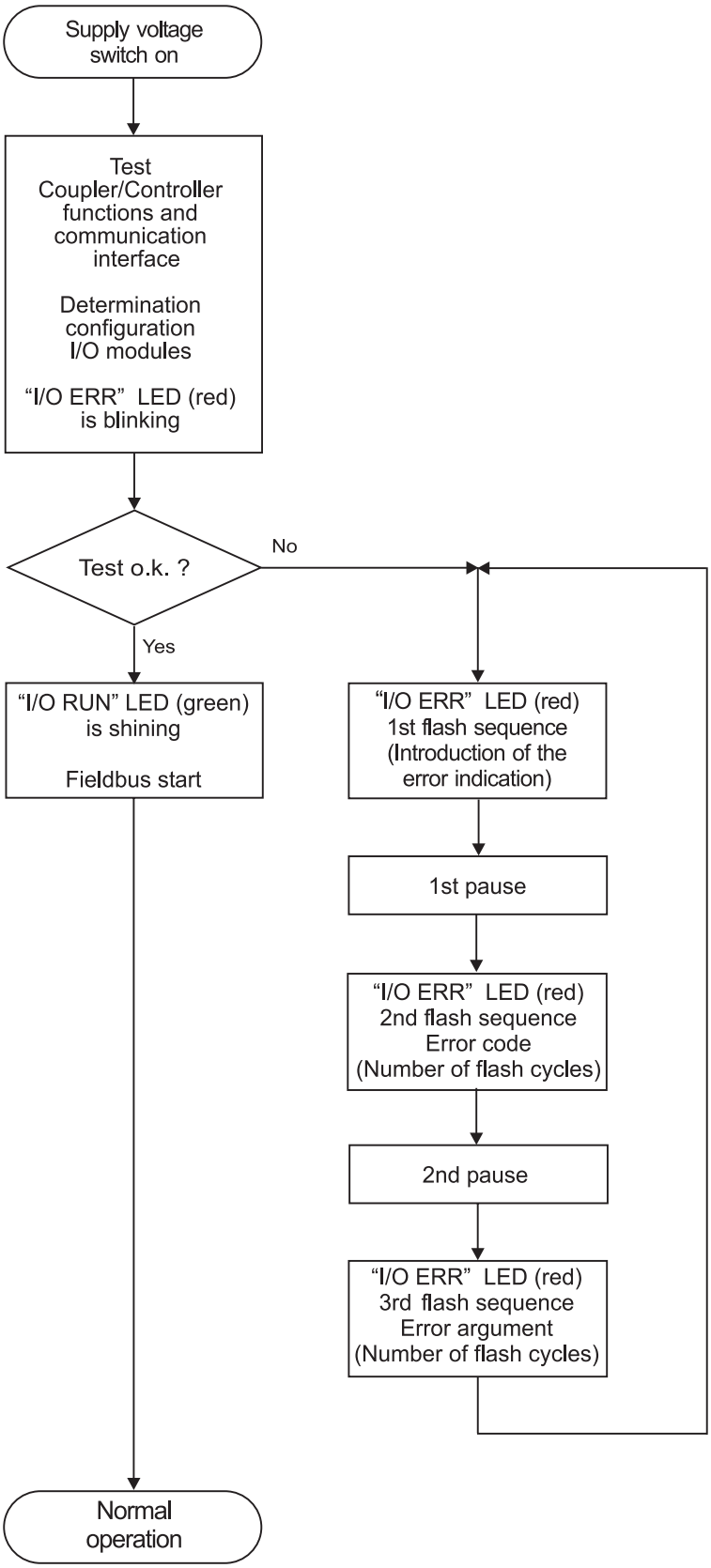



Fig. 6.2: Run-up coupler/controller

## 6.2 MODBUS LED

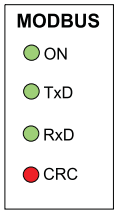



Fig. 6.3: MODBUS LED

The four following LEDs indicate the status of the coupler/controller.

| Status | LED | State | Description |
|---|---|---|---|
| **Node is ready for communication** | ON | shining | The node is working normally. The LED is out for a short time when the receiver receives an incomplete frame or a frame for another node. |
| **Node transmits data** | TXD | blinking | The node transmits a frame. |
| **Node receives data** | RXD | shining | The node receives a frame with own slave-address or broadcast. |
| **Node detects an frame with error code** | CRC | blinking | The received error code differs from the calculated code. The information in the received frames when Error Check is activated. |
| **Only controller:**<br><br>**Flash** | CRC | shining | The user programme is transferred from RAM to Flash |

Table 6.2: : Status and error indication

You have access to the diagnosis functions via the following register too:

| Register address | Name | Access | Length | Default | Description |
|---|---|---|---|---|---|
| **0x1020** | LedErrCode | read | 2++ | pu 0x0000 | See LED description error code |
| **0x1021** | LedErrArg | read | 1 | pu 0x000 | See LED description error code |

Table 6.3: Register for diagnosis functions **pu**: standard value in case of voltage connection

## 6.3 Starting up the controller with WAGO-I/O-*PRO*

The starting-up takes place via a PC. The WAGO communication cable[1] is used to establish the connection between PC (interface: COMx) and controller. The communication parameter for data exchange between controller and PC have to correspond. The following parameter are set in the controller:

- Baud rate: 19200 bauds
- Stop bits: 1
- Parity: even

These parameter are set in **WAGO-I/O-*PRO*** in the window ‘communication parameter’.

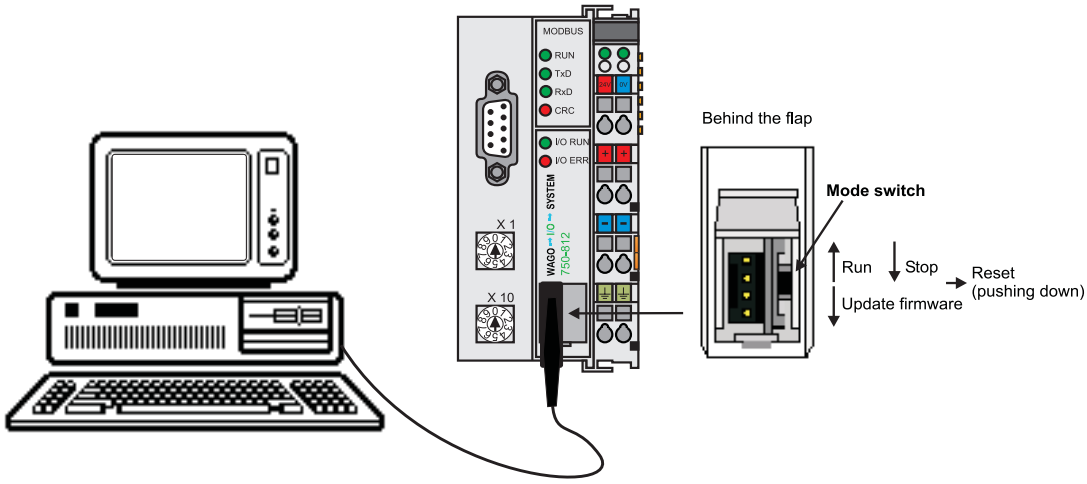



Fig. 6.4: PC and controller, operating mode switch

The **WAGO-I/O-*PRO*** specific test and starting-up functions are explained in the corresponding manual[2]. All the following functions marked with **‘Online’** will be carried out via PC with **WAGO-I/O-*PRO***.

**Function!** **Before you log in, the station address switch must be set to ‘00’! The modified address will be taken over for the controller when you reconnect the supply voltage.**

Before loading the programme, the operating mode switch should be set to **Stop** or the cycle should be stopped with **‘Online’ ‘Stop’**.

[1] Communication cable, Order No. 750-920 (part of the programming tools IEC 1131-3)

[2] **WAGO-I/O-*PRO*** manual, English, Order No. 750-120/000-002

The programme processing can be started in each position of the operating mode switch with **‘Online’ ‘Start’** and be stopped with **‘Online’ ‘Stop’**.

**ATTENTION!**
**In case of ‘Online’ ‘Stop’ or when you set the operating mode switch from run to stop, the outputs (e. g. for motor contactors or valves) which are still set remain set! Switching-off commands coming from the software, e. g. via sensors, are then ineffective because the program is not executed any more !**

(The change in operating mode is taking place internally at the end of the program cycle).

# 7 General Conditions

To ensure the good operation of the **WAGO-I/O-SYSTEM** the following general conditions have to be fulfilled.

## 7.1 Transport and storage conditions

The following declarations concern I/O modules which are transported and stored in the original package.

| Conditions | Allowed values |
|---|---|
| Free fall | ≤ 1m |
| Temperature | -40°C to +70°C |
| Relative humidity | 5 % to 95 % (without condensation) |

Table 7.1: Transport and storage conditions

## 7.2 Climatic conditions

The modules of the **WAGO-I/O-SYSTEM** must **not** be used without taking suitable actions:

- under heavy conditions,
  e.g. very dusty rooms, corroding atmosphere or gases
- in places with a high concentration of ionisation.

| | | |
|---|---|---|
| Working temperature: | 0°C to + 55°C | |
| Relative humidity in operation: | 5 % to 95 % (without condensation) | |
| Mounting: | Horizontal if possible (for a better ventilation) | |
| Resistance to harmful substances: | Tested in accordance with | IEC 68-2-42<br>IEC 68-2-43 |

## 7.3 Mechanical conditions

(given as sinusoidal oscillations)

| Frequency range (Hz) | continuous | sometimes |
|---|---|---|
| 10 ≤ f < 57 | 0.0375 mm amplitude | 0,075 mm amplitude |
| 57 ≤ f < 150 | 0,5 g<br>constant acceleration | 1 g<br>constant acceleration |

Table 7.2: Frequency range

For stronger impulses and oscillations, the acceleration and the amplitude should be reduced by suitable actions.

The following table shows the kind of test for the mechanical conditions.

| Tested for | Test sequence | Remarks |
|---|---|---|
| Oscillations | Test for oscillations acc. to IEC 68, part 2-6 | Type of oscillation:<br>Sweep with a rate of change of 1 octave/minute<br>10 Hz ≤ f < 57 Hz, constant amplitude 0.075mm<br>57 Hz ≤ f < 150 Hz, constant acceleration 1 g<br>Period of oscillation: 10 Sweep per axe in each of the vertical 3 axes |
| Impulses | Test for impulses acc. to IEC 68, part 2-27 | Type of impulse: half sinusoidal<br>Intensity of impulse: 15 g peak value, 11 ms maintenance time<br>Route of impulse: 2 impulses in each of the vertical 3 axes |

Table 7.3: Tests

## 7.4 Class and degree of protection

**Class of protection**
Class of protection acc. to IEC 536 (VDE 0106, part 1):
The ground (earth) connection to the DIN carrier is necessary !

**Degree of protection**
Degree of protection

| | |
|---|---|
| acc. to IEC 529: | IP 20<br>(protection against direct contact with standard probes) |
| Protec. against foreign bodies: | Diameter > 12 mm |
| Protection against water: | No particular protection |

We offer enclosures made of aluminium die-cast, polyester or stainless steel with the IP 65 degree of protection to protect against water infiltration (see **WAGO-I/O-SYSTEM** catalogue).

## 7.5 Specifications and test results

| | | |
|---|---|---|
| Approvals: | UI listed | E175199<br>E198726 |
| | CSA | LR 18677-57<br>(750-xxx/ 1xx-xxx) |
| Ex approvals: | Atex | prEN50021<br>EEX nV II T4 |
| | Ul listed | Class I Div2 ABCD T4A |
| Conformity marking: | CE | |

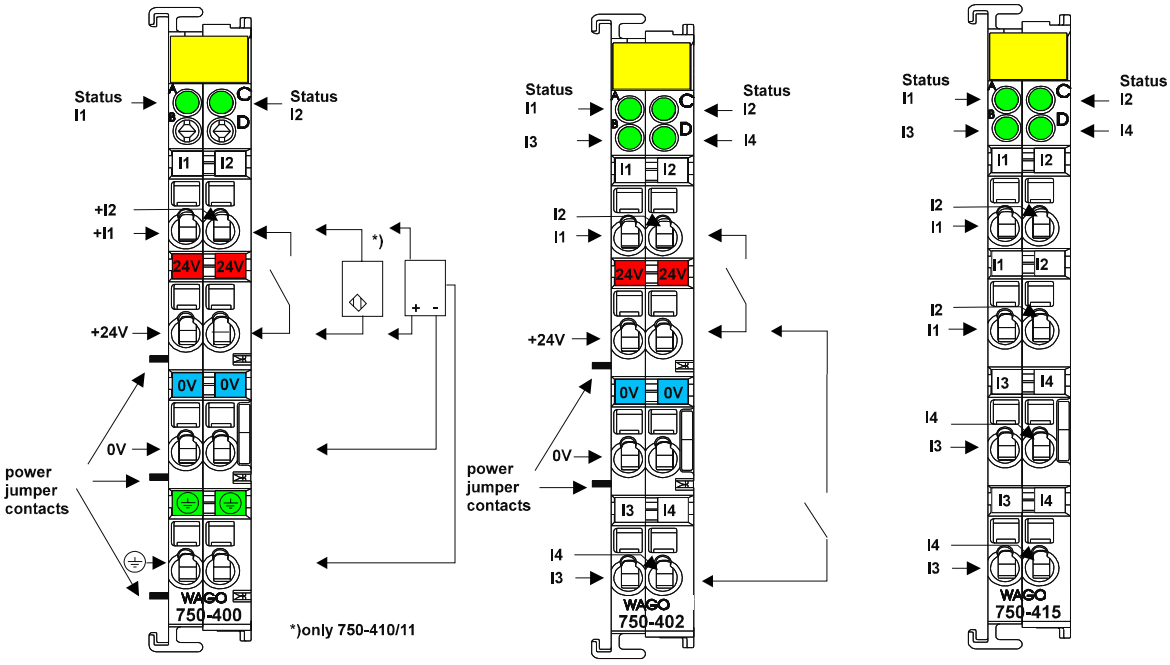
## 7.6 Electromagnetic compatibility

The following requirements for electromagnetic compatibility are fulfilled by all modules of the **WAGO-I/O-SYSTEM** (except for 750-630 and 750-631).

| | | | |
|---|---|---|---|
| **Immunity to interference EN 50082-2 (95)** | | | |
| EN 61000-4-2 | 4 kV/8 kV | (2/4) | B |
| EN 61000-4-3 | 10 V/m 80 % AM | (3) | A |
| EN 61000-4-4 | 2 kV | (3/4) | B |
| EN 61000-4-6 | 10 V/m 80 % AM | (3) | A |
| **Immunity to interference EN 50081-2 (94)** | | | |
| EN 55011 | 30 dBµV/m | (30 m) | A |
| | 37 dBµV/m | | |

Table 7.4: Electromagnetic compatibility

# Digital Inputs (24 V AC/DC, 120 V AC, 230 V AC, 48 V DC)
# PN: 750-400...415




## Technical description

The supply is applied by a series-connected termination to each I/O module for the respective operating voltage. Power connections are made automatically from module to module when snapped onto the DIN rail.

**Attention:**

The lowest power jumper contact is not carried out for some modules (e.g. 4-channel)! A module which needs all contacts (e.g. 2 channel digital) may not be connected to the right hand side of modules which do not have 3 power jumper contacts (e.g. 4 channel modules).

All 2-channel digital inputs are 4-conductor devices allowing the direct connection of 4-conductor sensors with the terminations V+, 0V, ground and signal.

The 4-channel digital inputs are suitable for the direct connection of two 3-conductor sensors (V+, 0V, signal). The power distribution module 750-614 is available for the connection of more sensors to V+ and 0V.

The modules 750-408 and 750-409 are low-side switching.

A 2-wire proximity switch can be connected to the modules 750-410 and 750-411.

RC filters are series-connected to the 5, 24 and 48 V versions for noise rejection and switch debouncing. They are available with time constants of 3.0 ms and 0.2 ms.

The standard numerical assignment for bus operations is from left to right, starting with the LSB. The positions of the different I/O modules in the configured node/station are selectable by the user. A block type configuration is not necessary.

The Input module can be connected to all buscouplers of the WAGO I/O SYSTEM.

# Technical Data:

| Item Number 750- | 400 | 401 | 402 | 403 |
|---|---|---|---|---|
| Number of inputs | 2 | | 4 | |
| Input filter | 3 ms | 0.2 ms | 3 ms | 0.2 ms |
| Nominal voltage | 24V DC (-15%/+20%) | | | |
| Signal voltage (0) | -3V...+5V DC (std. EN 61131 Typ 1) | | | |
| Signal voltage (1) | 15V...30V DC (std. EN 61131 Typ 1) | | | |
| Input current (internal) | 2.5 mA max. | | 5 mA max. | |
| Input current (field side) | 5 mA typ. | | | |
| Isolation | 500 V system/power supply | | | |
| Internal bit width | 2 | | 4 | |
| Configuration | no address or configutation adjustment | | | |
| Operating temperature | 0°C....+55°C | | | |
| Wire connection | CAGE CLAMP; 0.08 to 2.5mm$^2$ | | | |
| Dimensions (mm) WxHxL | 12 x 64* x 100 (*from upper edge of carrier rail) | | | |

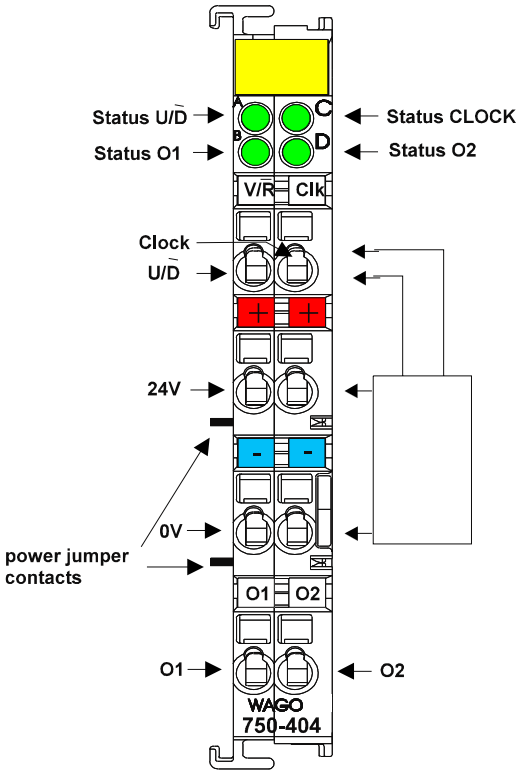
| Item Number 750- | 405 | 406 | 410* | 411* |
|---|---|---|---|---|
| Number of inputs | 2 | | 2 | |
| Input filter | 10 ms | | 3 ms | 0.2 ms |
| Nominal voltage | 230 V AC (-15%/+10%) | 120 V AC (-15%/+10%) | 24V DC (-15%/+20%)) | |
| Signal voltage (0) | 0 V...40 V AC | 0 V..20 V AC | -3 V ... +5 V DC (std. EN 61131 Type 2) | |
| Signal voltage (1) | 79 V...1.1 $U_N$ AC | 79 V...1.1 $U_N$ AC | 11 V ... 30 V DC (std. EN 61131 Type 2) | |
| Input current (internal) | 2 mA | | 2.5 mA max. | |
| Input current (field side) | 6.5 mA typ. | 4.5 mA typ. | 8 mA typ. | |
| Isolation | 4 kV system/power supply | | 500 V system/power supply | |
| Internal bit width | 2 | | | |
| Configuration | no address or configuration adjustment | | | |
| Operating temperature | 0°C....+55°C | | | |
| Wire connection | CAGE CLAMP; 0.08 to 2.5mm$^2$ | | | |
| Dimensions (mm)WxHxL | 12 x 64* x 100 (*from upper edge of the carrier rail) | | | |

*) 2 - wire proximity switch, current without load max. 2 mA

| Item Number 750- | 408 | 409 | 412 | 413 |
|---|---|---|---|---|
| Number of inputs | 4 | | 2 | |
| Input filter | 3 ms | 0,2 ms | 3 ms | 0,2 ms |
| Nominal voltage | 24V DC (-15% / +20%) | | 48 V DC (-15% / +20%) | |
| Signal voltage (0) | 15 V...30 V DC | | -6 V ... +10 V DC | |
| Signal voltage (1) | -3 V...5 V DC | | 34 V ... 60 V DC | |
| Input current (internal) | 10 mA max. | | 5 mA max. | |
| Input current (field side) | 3.5 mA typ. | | | |
| Isolation | 500 V system/power supply | | | |
| Internal bit width | 4 | | 2 | |
| Configuration | no address or configuration adjustment | | | |
| Operating temperature | 0°C....+55°C | | | |
| Wire connection | CAGE CLAMP; 0,08 to 2,5 $mm^2$ | | | |
| Dimensions (mm)WxHxL | 12 x 64* x 100 (*from upper edge of the carrier rail) | | | |

| Item Number 750- | 414 | 415 |
|---|---|---|
| Number of inputs | 4 | 4 |
| Input filter / Conversion time | 0.2 ms | 20 ms |
| Nominal voltage | 5 V DC | 24 V AC/DC (-15%/+20%) |
| Signal voltage (0) | 0...0.8 V DC | -3...+5 V DC 0...+5 V AC |
| Signal voltage (1) | 2.4 V...5 V DC | 11 ... 30 V DC 10 ... 27 V AC |
| Input current (internal) | 5 mA | 10 mA |
| Input current (field side) | 50 µA typ. | 7.5 mA DC 7.6 9.5 mA AC |
| Isolation | 500 V system/power supply | 500V system/power supply 50 V channel/channel |
| Internal bit width | 4 | 4 |
| Configuration | no address or configuration adjustment | |
| Operating temperature | 0°C....+55°C | |
| Wire connection | CAGE CLAMP; 0,08 to 2,5 $mm^2$ | |
| Dimensions (mm)WxHxL | 12 x 64* x 100 (*from upper edge of the carrier rail) | |

# Counter modules
# PN 750-404, 750-404/000-001, 750-404/000-002
# 750-404/000-003, 750-404/000-004
# Up/Down Counter 100 kHz, 750-404




## Technical Description:

Attention! The description that is in the I/O ring binder data pages (88-530/013-600 dated 7/96) is not correct. The bottom contacts are additional outputs.

**Attention:**
The lowest power jumper contact is not carried out for some modules (e.g. 4-channel)! A module which needs all contacts (e.g. 2 channel digital) may not be connected to the right hand side of modules which do not have 3 power jumper contacts (e.g. 4 channel modules).

The described configuration is counter with up/down input.

The following description is preliminary and is applicable to the factory configuration.

The counter module is able to run with all WAGO➟I/O➟SYSTEM bus-couplers (except for the economy type).

# Technical Data:

| Item Number: 750- | 404, 404/000-001<br>404/000-004 | 404/000-002 |
|---|---|---|
| Number of outputs | 2 | |
| Output current | 0.5 A | |
| Number of counter | 1 | |
| Input current (internal) | 70 mA | |
| Nominal voltage | 24 V DC (-15%  +20%) | |
| Signal voltage (0) | -3V.....+5V DC | |
| Signal voltage (1) | +15V...+30V DC | |
| Switching rate | 100 kHz | 10 kHz max. |
| Output current | 5 mA typ. | |
| Counter size | 32 Bit | |
| Isolation | 500 V system/power supply | |
| Bit width | 32 Bit (8 Bit verification; 8 bit not used) | |
| Configuration | none, optional with software parameter | |
| Operating temperature | 0°C....+55°C | |
| Wire connection | CAGE CLAMP; 0.08 to 2.5mm$^2$ | |
| Size (mm)WxHxD | 12 x 64* x 100 (*from upper edge of the carrier rail) | |

## Organization of the in- and output data:

The counter begins processing with pulses at the CLOCK input. The changes from 0 V to 24 V are counted.

The counter counts up, if the input U/D is set at 24 V. With an open circuit input or 0 V the counter counts backwards.

The two bottom contacts each include another output. These outputs are activated through bits in the control byte.

The control byte has the following bits:

| Control Byte | | | | | | | |
|---|---|---|---|---|---|---|---|
| Bit 7 | Bit 6 | Bit 5 | Bit 4 | Bit 3 | Bit 2 | Bit 1 | Bit 0 |
| 0 | x | Set Counter | Block Counter | Output value at output O2 | Output value at output O1 | x | x |

The status byte has the following bits:

| Status Byte | | | | | | | |
|---|---|---|---|---|---|---|---|
| Bit 7 | Bit 6 | Bit 5 | Bit 4 | Bit 3 | Bit 2 | Bit 1 | Bit 0 |
| x | x | Counter is set | Counter is blocked | actual signal at O2 | actual signal at O1 | actual signal at input U/D | actual signal at input CLOCK |

With the control and status-byte the following tasks are possible:

**Set the counter:** Put Bit 5 into the control byte. The counter with the 32 bit value is loaded into output bytes 0-3. As long as the bits are set, the counter can stop and information is stored. The ensuing data of the counter will be conveyed to the status byte.

**Blocking the counter:** Bit 4 is set into the control byte, then the count process is suppressed. Bit 4 in the status byte communicates the suppression of the counter.

**Set the outputs:** Bits 2 and 3 set the additional two outputs of the counter module.

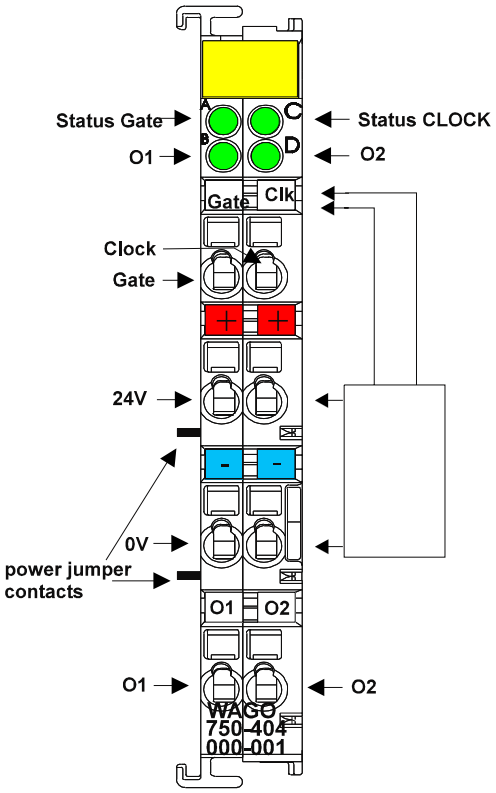
The result of the counter is in binary.

## An example:

The counter is set with “Set Counter” to the value 0x0000.0000
- 0X1X.XXXX, 0x00, 0x00, 0x00, 0x00 are carried over as output value
(carry over the control-byte and the new counter position),
-wait until the input value is 0X1X.XXXX, 0x00, 0x00, 0x00, 0x00
(the status-byte shows the loading feedback) ,
-carry over 0x00, 0x00, 0x00, 0x00, 0x00 as output value (release counter).
Wait for the first and further counting pulse
-the input value is XX00.XXXX, 0x00, 0x00, 0x00, 0x00 (no counting pulse received)
-the input value is XX00.XXXX, 0x00, 0x00, 0x00, 0x01 (1 counting pulse received)
-the input value is XX00.XXXX, 0x00, 0x00, 0x00, 0x02 (2 counting pulses received)
-.....
-the input value is XX00.XXXX, 0xFF, 0xFF, 0xFF, 0xFF (maximum counting position is reached)
-the input value is XX00.XXXX, 0x00, 0x00, 0x00, 0x00 (a further counting pulse causes an overflow)
-the input value is XX00.XXXX, 0x00, 0x00, 0x00  0x01, (a further counting pulse is received)

Notes: 0x23 is a value in hexadecimal form
0101.1001 is a value in binary form
“X” is used if the value at this position is without any significance.

# Counter with enable input 750-404/000-001




## Technical description:

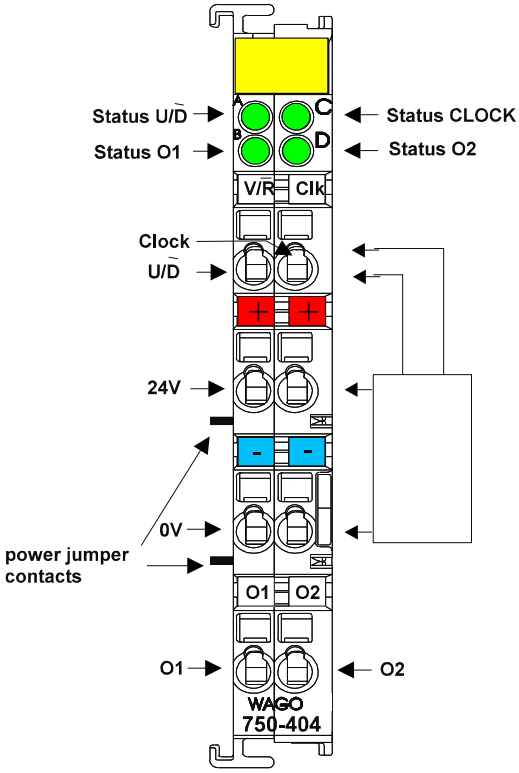
The counter module also can be ordered as counter with enable input (750-404/000-001).

The counter begins processing with pulses at the CLOCK input. The changes from 0 V to 24 V are counted.
The counter counts down if the input U/D is set at 24 V. With an open circuit input or 0 V the counter counts up.

The data format of the module is 4 bytes data and a control/status byte. The module is a 32 Bit counter. The ID Code os 180 (0xB4). The format of input and output data is the same as 750-404.

The counter module is able to run with all WAGO➟I/O➟SYSTEM bus-couplers (except for the economy type).

## Peak Time Counter 750-404/000-002




## Technical data

The counter module also can be ordered as peak time counter with 750-404/000-002.

This description is only intended for hardware version X X X X 0 0 0 1- - - -. The serial number can be found on the right side of the module.

The counter begins processing with pulses at the CLOCK input. The changes from 0 V to 24 V are counted.
The counter counts up if the input U/D is set at 24 V. With an open circuit input or 0 V the counter counts backwards.

The two bottom contacts each include another output. These outputs are activated through bits in the control byte.

The counter module is able to run with all WAGO➟I/O➟SYSTEM bus-couplers (except for the economy type).

## Organization of the in- and output data:

The counter begins processing with pulses at the CLOCK input for a special time span. The time span is predefined as 10 s. The state of the counter is stored in the processs image until the next period. After the recording the counting starts again at 0.

The activation of the counting and the synchronisation with the SPS is made by a handshake in the control and status byte.

The end of thre counting period and thus the new process data is signaled by a toggel bit in the status byte.

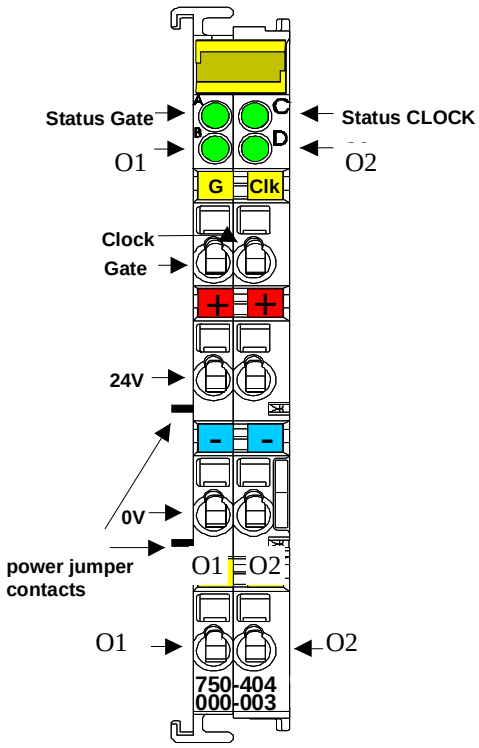
The control byte has the following bits:

| Control Byte | | | | | | | |
|---|---|---|---|---|---|---|---|
| Bit 7 | Bit 6 | Bit 5 | Bit 4 | Bit 3 | Bit 2 | Bit 1 | Bit 0 |
| 0 | 0 | start of the periodic counting | 0 | Output value at output O2 | Output value at output O1 | 0 | 0 |

The status byte has the following bits:

| Status Byte | | | | | | | |
|---|---|---|---|---|---|---|---|
| Bit 7 | Bit 6 | Bit 5 | Bit 4 | Bit 3 | Bit 2 | Bit 1 | Bit 0 |
| 0 | 0 | counting started | 0 | actual signal at O2 | actual signal at O1 | actual signal at input U/D | Toggelbit for end of the record |

# Frequency Counter Module, 750-404/000-003




# Technical Description

The counter module 750-404/000-003 measures the period of the 24 V DC input signal at the CLOCK terminal and converts it into a corresponding frequency value. The measurement is enabled if the GATE terminal is an open circuit input or 0V. To disable processing, the GATE input is to be set to 24 V DC.

The terminals O1 and O2 work as binary outputs. Each output can be activated via specific bits in the CONTROL byte.

The high states of the input and output channels are each indicated by a LED.
To recognize low frequency or near zero frequency signals, the maximum time between two data updates is parameterizable.

# Technical Data:

| Item-No.: 750- | 404/000-003 |
|---|---|
| Supply Voltage | 24V DC (-15%/+20%) |
| Input Voltage (low) | -3V - 5V DC |
| Input Voltage (high) | 15V - 30V DC |
| Input Current | 5mA typ. at 24V DC |
| Min. Pulse Width | 10µs |
| Output Current | 0.5A (short circuit protection) |
| Voltage Drop | 0.6V DC max. at 0.5A |
| **Frequency Range:** | |
| Integration time = 1 period | 0.1 - 100Hz, Resolution 0.001Hz |
| Integration time = 4 periods | 1 - 1,000Hz, Resolution 0.01Hz |
| Integration time = 16 periods | 10 - 10,000Hz, Resolution 0.1Hz (1Hz) |
| **Measuring Error:** | |
| Range 0.1 - 100 Hz | < ± 0.05% |
| Range 1 - 1000Hz | < ± 0.05 % |
| Range 10 - 10000Hz | < ± 0.2 % |
| **Data Format:** | |
| Process Image | 5 Byte In- and Output |
| Internal Bit Width | 8 Bit CONTROL/STATUS + 32 Bit DATA |
| Input Current (internal) | 80mA max. at 5V DC |
| Operating Temperature | 0°C....+55°C |
| Wire Connection | CAGE CLAMP; 0.08 to 2.5mm$^2$ |
| Size (mm) WxHxD | 12 x 64* x 100 (*from upper edge of carrier rail) |

| **Frequency Range:** | |
|---|---|
| Integration time = 1 period | 0.1 - 8,000Hz, Resolution 0.001Hz |
| Integration time = 4 periods | 0.25 - 32,000Hz, Resolution 0.01Hz |
| Integration time = 16 periods | 1 - 100,000Hz, Resolution 0.1Hz (1Hz) |
| **Measuring Error:** | |
| Range 0.1 - 8000Hz | < ± 1% |
| Range 0.25 - 32000Hz | < ± 1.5 % |
| Range 1 - 100000Hz | < ± 1.5 % |

# Functional description

The counter module acquires the time between one or more rising edges of the CLOCK input signal and calculates the frequency of the applied signal.
The calculation and process image update are initiated every 1st, every 4th or every 16th rising edge depending on the integration time selected via the CONTROL byte. The first detection of a rising edge starts the cyclic period measurement and cannot provide a valid frequency value. In this case the module will send $0xFFFFFFFF_H$ for input information. The same input value is returned when a static high or static low signal is applied to the CLOCK input.
If there are no signal changes seen at the CLOCK input, the module can be forced to update the process image after defined parameterizable time spans. In this state the module will send the non valid value $0xFFFFFFFF_H$ too.
The following figures illustrate a process data cycle.

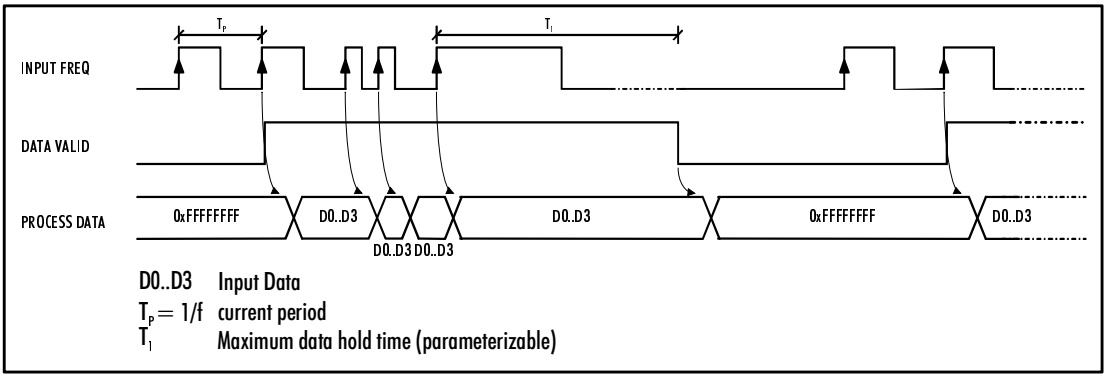



**Figure 2:** Timing diagram for process data update sequence (integration time = 1 period)

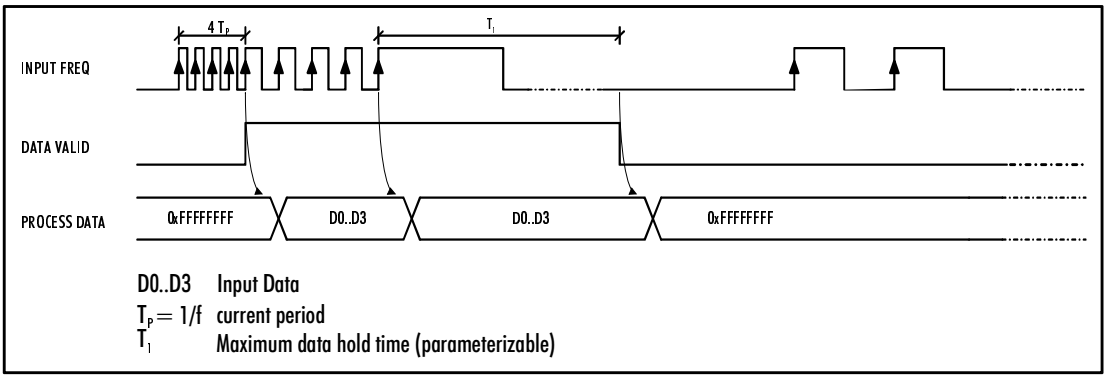



**Figure 3:** Timing diagram for process data update sequence (integration time = 4 periods)

# Structure of CONTROL and STATUS byte

## CONTROL Byte

| b7 | b6 | b5 | b4 | b3 | b2 | b1 | b0 |
|---|---|---|---|---|---|---|---|
| REG_REQ=0 | 0 | 0 | $T_{VD}$ REQ | SET_Q2 | SET_Q1 | RANGE_SEL REQ1 | RANGE_SEL REQ0 |
| REG_REQ=1 | NRD/WR | REG_A5 | REG_A4 | REG_A3 | REG_A2 | REG_A1 | REG_A0 |

| Bit | Description |
|---|---|
| REG_REQ | Access to the register structure is requested, b5...b0 contain the address of the register. |
| REG_A5...A0 | Register address (0-63) |
| $T_{VD}$ REQ | Request to change the maximum time without valid data |
| SET_Q2 | Control Output Q2 (0: Q2 off, 1: Q2 on) |
| SET_Q1 | Control Output Q1 (0: Q1 off, 1: Q1 on) |
| RANGE_SEL REQ1 | Selection of the integration time and the representation of measured frequency value |
| RANGE_SEL REQ0 | Selection of the integration time and the representation of measured frequency value |

## STATUS Byte

| b7 | b6 | b5 | b4 | b3 | b2 | b1 | b0 |
|---|---|---|---|---|---|---|---|
| REG_ACK=0 | 0 | ST_GATE | $T_{VD}$ ACK | ST_Q2 | ST_Q1 | RANGE_SEL ACK1 | RANGE_SEL ACK0 |
| REG_ACK=1 | 0 | REG_A5 | REG_A4 | REG_A3 | REG_A2 | REG_A1 | REG_A0 |

| Bit | Description |
|---|---|
| REG_ACK | Acknowledgment to the register request, b5...b0 contain the address of the register. |
| REG_A5...A0 | Register address (0-63) |
| ST_GATE | State of GATE input (0=enabled, 1=disabled) |
| $T_{VD}$ ACK | Acknowledgment $T_{VD}$ changed |
| ST_A2 | State of output Q2 |
| ST_A1 | State of output Q1 |
| RANGE_SEL ACK1 | Acknowledgment to Range Selection, Frequency values are valid |
| RANGE_SEL ACK0 | Acknowledgment to Range Selection, Frequency values are valid |

## Structure of Input and Output data

The input data contain the CLOCK frequency as a binary value. The representation depends on the RANGE_SEL bits in the CONTROL byte. Even the method of measuring is selected via these bits. The following table illustrates the different modes.

| RANGE_SEL1 | RANGE_SEL0 | Method of measurement | Representation of measuring value |
|---|---|---|---|
| 0 | 0 | Integration over 1 period | Frequency in $^1/_{1000}$ Hz |
| 0 | 1 | Integration over 4 periods | Frequency in $^1/_{100}$ Hz |
| 1 | 0 | Integration over 16 periods | Frequency in $^1/_{10}$ Hz |
| 1 | 1 | Integration over 16 periods | Frequency in Hz |

**Attention:**
When a new frequency range is requested, the application has to wait for valid data until the RANGE_SEL ACK bits contain the new frequency range. The maximum delay can be calculated using the following formula

$$T_{Dmax} = 2 * \frac{\text{number of periods to be integrated}}{\text{actual frequency}}$$

If the gate is enabled the input data contains the last valid frequency value. In this state the application cannot request a new range.

The valid frequency range stretches from 0.1 Hz ($100_D$) up to 10 kHz ($100000_D$).
To recognize static CLOCK signals, a watchdog timer is implemented. The default value for the timer is 10s. The timer resets on every Power On.
The application is able to change the watchdog time during operation by using the CONTROL byte.
This can be initiated by writing the corresponding value into the output bytes OUTPUT_DATA 1 and OUTPUT_DATA 0 before setting the $T_{VD}$ REQ bit in the CONTROL byte.
The success of the parameter transfer is acknowledged by the module via the $T_{VD}$ ACK bit in the STATUS information.

**Attention:**
The range of the watchdog timer stretches from 0 to 16383ms ($0x0000_H$ to $0x3FFF_H$) in steps of 1ms per digit.
Values which raise the permitted range of the watchdog timer are masked with 0x3FFF.
If the maximum possible frequency of the different ranges is raised (see the table with maximum frequency ratings), the module will return the non valid data $0xFFFFFFFF_H$.

## Organization of the in- and output data for ModBus

Output value of the control unit:

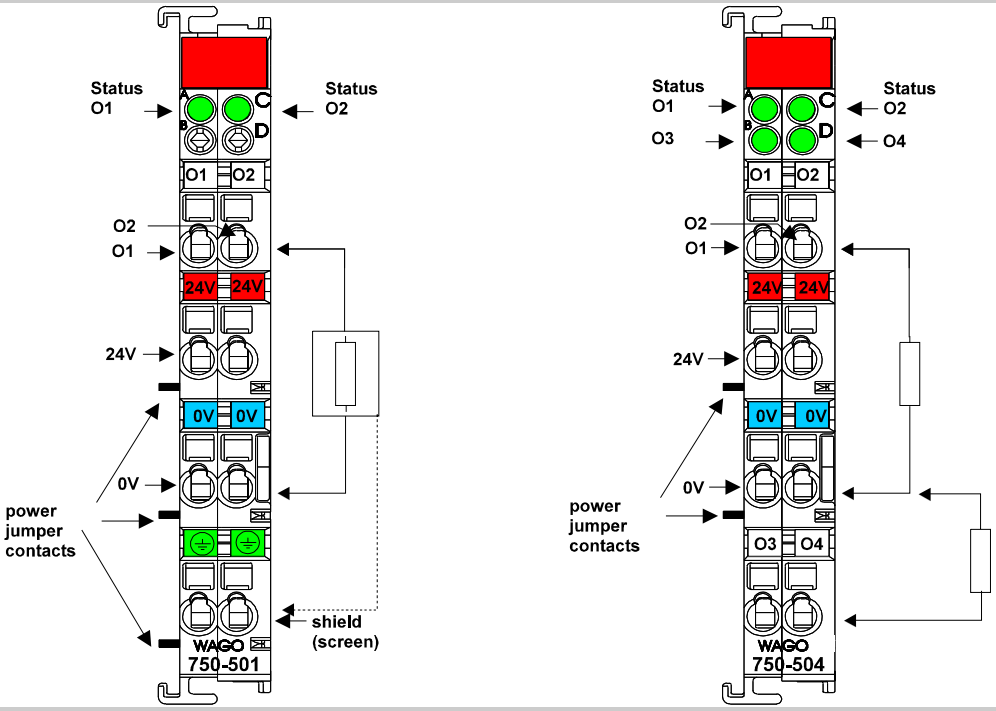
| Byte | Identification | |
|---|---|---|
| D15-D0 | Control Byte | Output Byte 1 |
| D31-D16 | Output Byte 0 | Output Byte 3 |
| D47-D32 | Output Byte 2 | |

Input value of the control unit:

| Byte | Identification | |
|---|---|---|
| D15-D0 | Status Byte | Input Byte 1 |
| D31-D16 | Input Byte 0 | Input Byte 3 |
| D47-D32 | Input Byte 2 | |

The input-bytes 0 to 3 form the 32 bit counter-output. In the output-bytes 0 to 3 the initial value of the counter can be set.

# Digital Outputs (Standard)
# PN 750-501...504, 516, 519




## Technical description:

The power supply is provided by a series-connected supply module for the respective operating voltage. Power connections are made automatically from module to module via the internal P.J.C.s when snapped onto the DIN rail.

**Attention:**

The lowest power jumper contact is not carried out for some modules (e.g. 4-channel)! A module which needs all contacts (e.g. 2 channel digital) may not be connected to the right hand side of modules which do not have 3 power jumper contacts (e.g. 4 channel modules).

For the digital outputs (without diagnostic) four-conductor devices (V+; 0 V; signal; ground) are standard. In case of 12 mm wide 4-channel digital output modules it is not possible to use 4-conductor devices. 4 signal outputs, 2xV+ and 2x0V are provided. All digital outputs are short-circuit protected.

**In case of overloads a supply module with fuse (750-601) must be connected on the line side to protect the output modules.**

The module 750-516 is low-side switching. The indicated output values have been determined for 100% duty cycle. However, in case of the 2 A versions it is possible to operate single channels at higher load currents, however always verify that the total current does not exceed 3.5 A per module. Example: 2x2A (standard); 1x3.0A; 1x0.5A (total current: 3.5 A) The standard numerical assignment for bus operations is from left to right, starting with the LSB. The positions of the different I/O modules in the configured node/station are selectable by the user. A block type configuration is not necessary.The Output module can be connected to all buscouplers of the WAGO➟I/O➟SYSTEM.

# Technical Data:

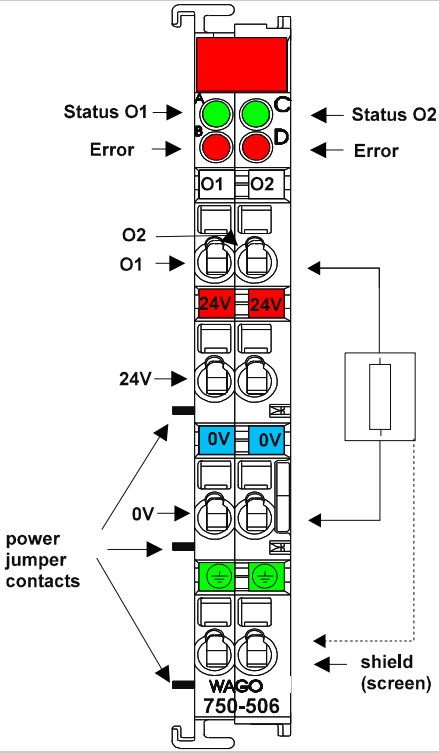
| Item Number 750- | 501 | 502 |
|---|---|---|
| Number of outputs | 2 | |
| Kind of load | resistive, inductive, lamps | |
| Nominal voltage | 24V DC (-15% / +20%) | |
| Output current (DC) | 0,5 A | 2 A |
| Current consumption (internal) | 7 mA | |
| Isolation | 500 V system / power supply | |
| Internal bit width | 2 | |
| Configuration | without address or configuration adjustment | |
| Operating temperature | 0°C....+55°C | |
| Wire connection | CAGE CLAMP; 0,08 to 2,5mm$^2$ | |
| Dimensions (mm)WxHxL | 12 x 64* x 100 (*from upper edge of the carrier rail) | |

| Item Number 750- | 504 | 516*) |
|---|---|---|
| Number of outputs | 4 | |
| Kind of load | resistive, inductive, lamps | |
| Nominal voltage | 24V DC (-15% / +20%) | |
| Output current (DC) | 0,5 A | |
| Current consumption (internal) | 15 mA | |
| Isolation | 500 V system / power supply | |
| Internal bit width | 4 | |
| Configuration | without address or configuration adjustment | |
| Operating temperature | 0°C....+55°C | |
| Wire connection | CAGE CLAMP; 0,08 to 2,5mm$^2$ | |
| Dimensions (mm)WxHxL | 12 x 64* x 100 (*from upper edge of the carrier rail) | |

*) low-side switching

| Item Number 750- | 519 |
|---|---|
| Number of outputs | 4 |
| Kind of load | resistive, inductive, lamps |
| Nominal voltage | 5 V DC |
| Output current (DC) | 20 mA |
| Current consumption (internal) | 16 mA |
| Isolation | 500 V system / power supply |
| Internal bit width | 4 |
| Configuration | without address or configuration adjustment |
| Operating temperature | 0°C....+55°C |
| Wire connection | CAGE CLAMP; 0,08 to 2,5mm$^2$ |
| Dimensions (mm)WxHxL | 12 x 64* x 100 (*from upper edge of the carrier rail) |

# Digital Outputs (Standard with diagnostics)
# PN 750-506




## Technical description:

The power supply is provided by a series-connected supply module for the respective operating voltage. Power connections are made automatically from module to module via the internal P.J.C.s when snapped onto the DIN rail.

**Attention:**

The lowest power jumper contact is not carried out for some modules (e.g. 4-channel)! A module which needs all contacts (e.g. 2 channel digital) may not be connected to the right hand side of modules which do not have 3 power jumper contacts (e.g. 4 channel modules).

Using the digital outputs with diagnostic bit outputs (750-506) allows verification of the I/O channel by the connected bus. Example: a short-circuit at the output or an open circuit will set the appropriate error bit true indicating I/O failure. In this configuration the function module includes 2 digital outputs and 2 separate digital inputs. For the digital outputs with diagnostic four-conductor devices (V+; 0V; signal; ground) are standard. All digital outputs are short-circuit protected.

**In case of overloads a supply module with fuse (750-601) must be connected on the line side to protect the output modules.**

The standard numerical assignment for bus operations is from left to right, starting with the LSB. The positions of the different I/O modules in the configured node/station are selectable by the user. A block type configuration is not necessary. When using I/O modules with diagnostics, the existing inputs must be considered accordingly in the configuration of the Node/station. The Output module can be connected to all buscouplers of the WAGO I/O SYSTEM.

# Technical Data:

| Item Number 750- | 506 |
|---|---|
| Number of outputs | 2 |
| Current consumption (internal) | 15 mA |
| Nominal voltage | 24V DC (-15%/+20%) |
| Kind of load | resistive, inductive, lamps |
| Output current (DC) | 0.5 A |
| Diagnostics | open circuit, overload |
| Current consumption (internal) | 15 mA typ. + load |
| Isolation | 500 V system / power supply |
| Internal bit width | 4 in, 4 out |
| Configuration | without address or configuration adjustment |
| Operating temperature | 0°C....+55°C |
| Wire connection | CAGE CLAMP; 0.08 to 2.5mm$^2$ |
| Dimensions (mm)WxHxL | 12 x 64* x 100 (*from upper edge of carrier rail) |

The output bits control the state of the outputs.

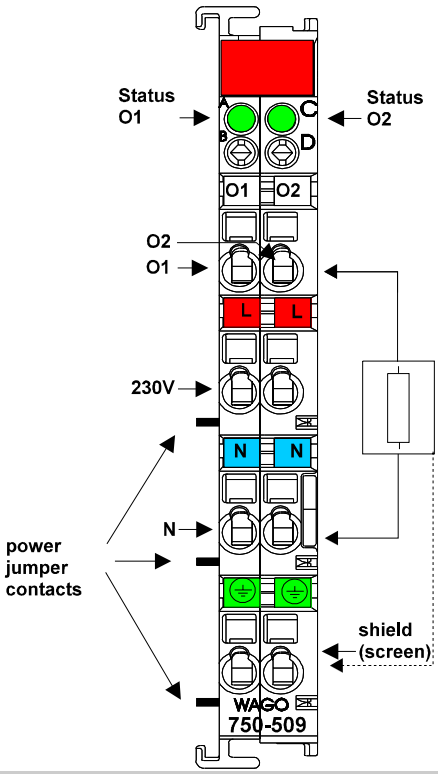
| | Bit 3 | Bit 2 | Bit 1 | Bit 0 |
|---|---|---|---|---|
| function | no function | no function | controls O2 | controls O1 |

The input bits show the state of the outputs.

| | Bit 3 | Bit 2 | Bit 1 | Bit 0 |
|---|---|---|---|---|
| function | diagnostics O2 | diagnostics O2 | diagnostics O1 | diagnostics O1 |
| output follows output bit | 0 | 0 | 0 | 0 |
| no load is connected | 0 | 1 | 0 | 1 |
| short circuit | 1 | 0 | 1 | 0 |
| power supply too low* | 1 | 1 | 1 | 1 |

*The diagnostic bits refer to a hysteresis: If the voltage of the field side is higher than 11V in the falling circle, they are switched on. If the voltage is lower than 15,5 V in the growing circle, they are switched off.

# Digital Outputs (Solid State Relay)
# PN 750-509




## Technical Description

The power supply for the solid state relay module is connected by a series-connected supply module for the respective operating voltage of 230 V. Power connections are made automatically from module to module via the internal P.J.C.s when snapped onto the DIN rail.

**Attention:**

The lowest power jumper contact is not carried out for some modules (e.g. 4-channel)! A module which needs all contacts (e.g. 2 channel digital) may not be connected to the right hand side of modules which do not have 3 power jumper contacts (e.g. 4 channel modules).

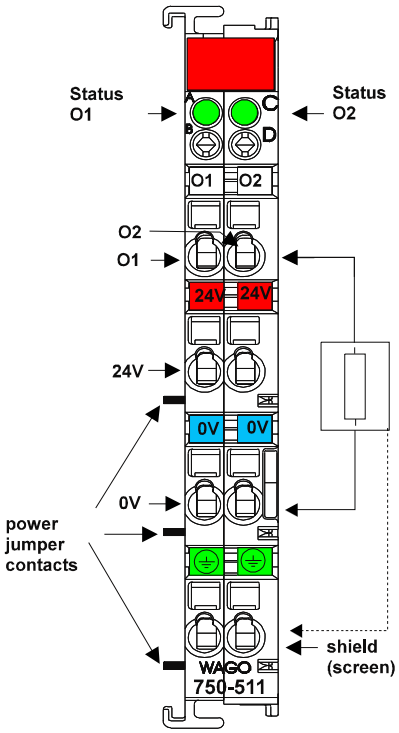
The power supply of the control side is not made via the power jumper contacts but directly from the electronics. The respective output contacts of the switching element are therefore always positioned at the field side. One termination point of these contacts must be directly connected to the power supply. For the digital outputs four-conductor devices (V+; 0V; signal; ground) are standard. All digital outputs are short-circuit protected. **In case of overloads a supply module with fuse (750-609) must be connected on the line side to protect the output modules.**

The standard numerical assignment for Bus operation is from left to right, starting with the LSB. The positions of the different inputs in the configured station are via the user's choice. A block type assembly is not necessary. The Output module can be connected to all buscouplers of the WAGO I/O SYSTEM.

# Technical Data:

| Item Number 750- | 509 |
|---|---|
| Number of outputs | 2 |
| Current consumption (internal) | 10 mA |
| Switching voltage | 0 V...230 V AC/DC |
| Switched current | 300 mA AC max. |
| Speed of operation | 1.65 ms typ., 5 ms max. |
| Volume resistance | 2.1 Ω typ., 3.2 Ω max. |
| Impulse current | 0.5 A (20 s), 1.5 A (0.1 s) |
| Overvoltage protection | >+/- 380 V (suppressor diode) |
| Isolation | 1.5 kV system / power supply |
| Internal bit width | 2 |
| Configuration | without address or configuration adjustment |
| Operating temperature | 0°C....+55°C |
| Wire connection | CAGE CLAMP; 0.08 to 2.5mm$^2$ |
| Dimensions (mm)WxHxL | 12 x 64* x 100 (*from upper edge of the carrier rail) |

# Pulsewidth Module
# PN 750-511




## Technical Description:

This description is for hard and software version X X X X 2 B 0 2- - - - . The part number is displayed on the right side of the module.

The initial pre-programmed base frequency is for 250 Hz. The resolution is 10 Bits and the pulsewidth is modulated.

**Attention:**
The lowest power jumper contact is not carried out for some modules (e.g. 4-channel)! A module which needs all contacts (e.g. 2 channel digital) may not be connected to the right hand side of modules which do not have 3 power jumper contacts (e.g. 4 channel modules).

The following description is preliminary and is applicable to the factory configuration.

The pulsewidth output module 750-511 produces a binary modulated signal of 24 V. The connection of the consuming device should be made via the „O“ and 0 V (common) contacts of the module. The distribution of the 24 V DC is made via the power jumper contacts. If galvanic isolation is desired, a new power feed via a 750-602 is required.

The PWM module can be connected to all buscouplers of the WAGO➡I/O➡SYSTEM (except for the economy type).

# Technical Data:

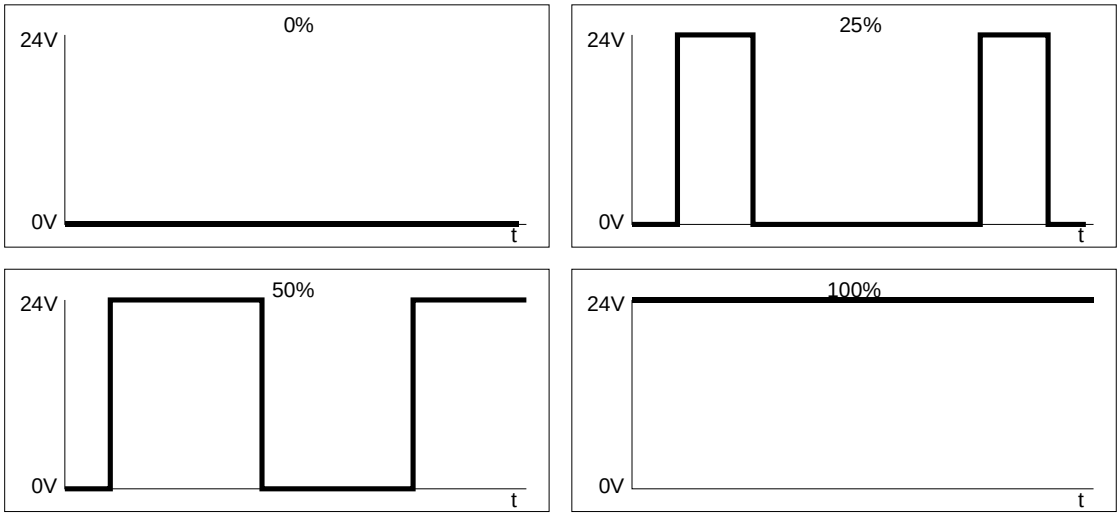
| Part Number 750- | 511 |
|---|---|
| Number of outputs | 2 |
| Current consumption (internal) | 70 mA typical (internal) |
| Nominal voltage | 24V DC (-15% +20%) |
| Load type | ohmic, inductive |
| Output current | 0.1 A, short circuit protected |
| Pulse frequency | 1 Hz...20kHz |
| Duty cycle | 0%...100% ($T_{on}$ > 750 ns, $T_{off}$ > 500 ns) |
| Resolution | 10 Bit max. |
| Isolation | 500 V system/power Supply |
| Configuration | none, optional with software parameter |
| Current Consumption (field side) | 15 mA typ. |
| Internal bit width per channel | 16 Bit Data + 8 Bit Control/Status |
| Operating temperature | 0°C....+55°C |
| Wire connections | CAGE CLAMP; 0.08 to 2.5mm$^2$ |
| Dimension (mm)BxHxT | 12 x 64* x 100 (*from upper edge of the carrier rail) |
| Preset Frequency | 250 Hz Switching Frequency |

## Formation of on/off times

The programming of the on/off times occur with the resolution of 10 bits. The five LSB of the 16 bit value can be zeros or one. The MSB will hold the sign and is preset to the null state.

| Duty Cycle % | Increments | Binary Value | Hex. | Dec. |
|---|---|---|---|---|
| 100 | 1023 | 0111 1111 1111 1111 | 7F FF | 32767 |
| 100 | 1023 | 0111 1111 1111 0000 | 7F E0 | 32752 |
| 50 | 511 | 0011 1111 1111 1111 | 3F FF | 16383 |
| 25 | 255 | 0001 1111 1111 1111 | 1F FF | 8191 |
| 12.5 | 127 | 0000 0001 0000 0000 | 01 00 | 256 |
| 0.1955 | 2 | 0000 0000 0100 0000 | 00 40 | 16 |
| 0.0977 | 1 | 0000 0000 0010 0000 | 00 20 | 32 |
| 0 | 0 | 0000 0000 0001 1111 | 00 1F | 31 |
| 0 | 0 | 0000 0000 0000 0000 | 0 | 0 |

**Table 1:** Value Formation




**Ill. 1:** On/Off time relationships for Table 1.

## Process Image Formation for ModBus

The process image of the 750-511 appears with 6 bytes of input and 6 bytes of output data. The byte allocation for the preset duty cycle has the following modes of formation:
Output values:

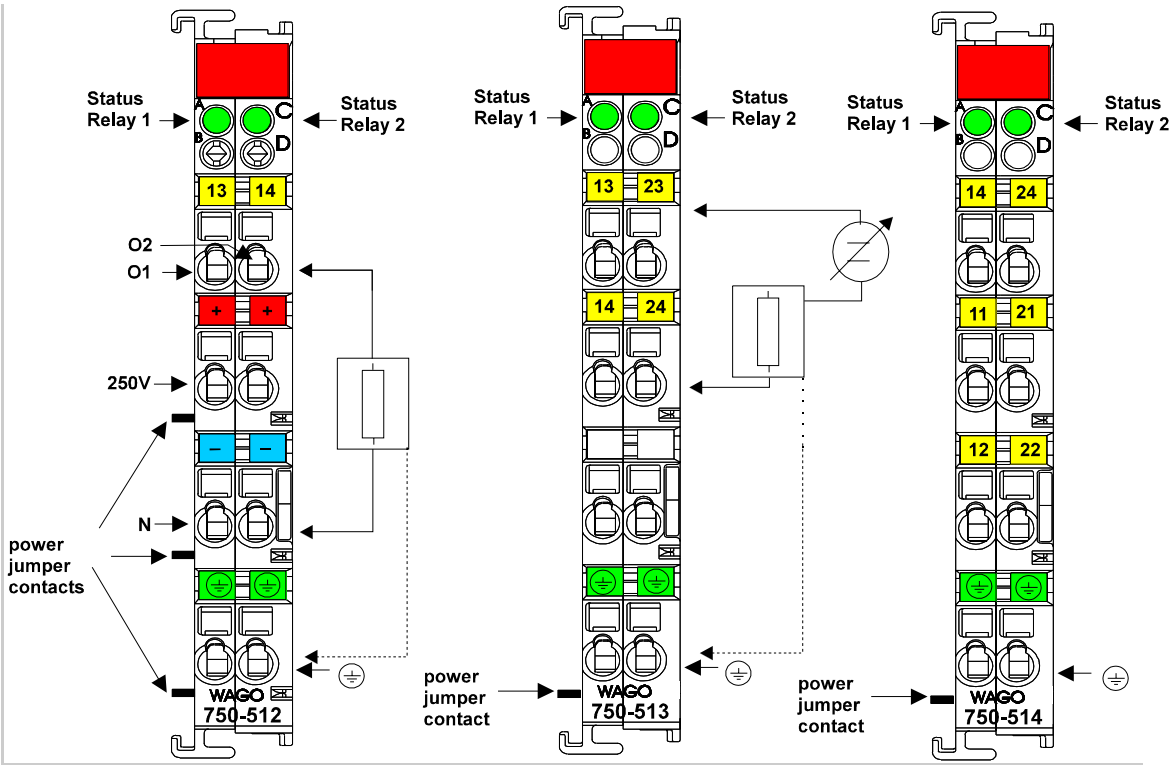
| | Function |
|---|---|
| D0 | Control Byte |
| D1 | Output Byte 1 |
| D2 | Output Byte 0 |
| D3 | reserved |
| D4 | Output Byte 3 |
| D5 | Output Byte 2 |

Input values:

| | Function |
|---|---|
| D0 | Status Byte |
| D1 | Input Byte 1 |
| D2 | Input Byte 0 |
| D3 | reserved |
| D4 | Input Byte 3 |
| D5 | Input Byte 2 |

Out(In)put byte 0 Low Byte
Out(In)put byte 1 High Byte

# Digital Outputs (Relay)
# PN 750-512...514, 517




## Technical description:

The power supply for the relay coils is not made via the power jumper contacts but directly from the electronics. The respective output contacts of the switching element are therefore always positioned at the field side.

**Attention:**

The lowest power jumper contact is not carried out for some modules (e.g. 4-channel)! A module which needs all contacts (e.g. 2 channel digital) may not be connected to the right hand side of modules which do not have 3 power jumper contacts (e.g. 4 channel modules).

**Version 1: non-floating (750-512)**

The power supply is made via a series-connected supply terminal block for the respective operating voltage. Power connections are made automatically from module to module when snapped onto the DIN rail. One termination point of these contacts must be directly connected to the power supply.

**Version 2: isolated outputs (750-513, 750-514)**

These I/O modules are not provided with integrated power jumper contacts. Care should be taken to supply each isolated module with separate power supply connections.

The standard numerical assignment for Bus operation is from left to right, starting with the LSB. The positions of the different inputs in the configured station are via the user's choice. A block type configuration is not necessary. The output module can be connected to all buscouplers of the WAGO➡I/O➡SYSTEM.

# Technical Data:

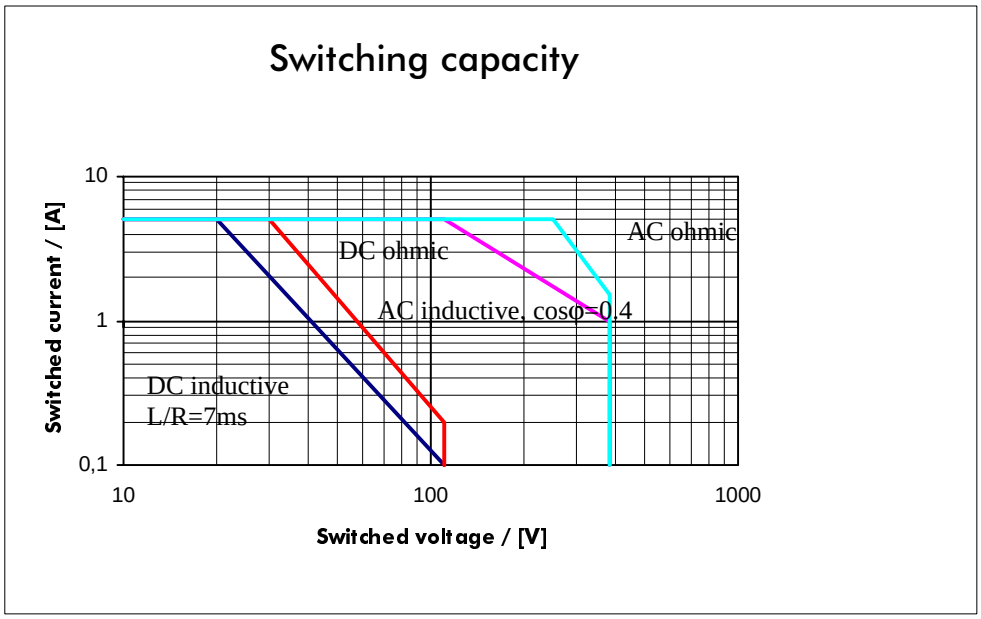
| Item Number 750- | 512 | 513 |
|---|---|---|
| Type of contact | 2 make contacts | |
| Current consumption (internal) | 100 mA max. | |
| Switching voltage | 30 V DC; 250V AC | |
| Switching power | 60 W; 500 VA<br>$\cos \rho_{max}$ =0,4, $L/R_{max}$=7 ms | |
| Switching current | 2 A AC/ DC | |
| Isolation | 4 kV system/power supply | |
| Internal bit width | 2 | |
| Configuration | without address or configuration adjustment | |
| Operating temperature | 0°C....+55°C | |
| Wire connection | CAGE CLAMP; 0.08 to 2.5mm$^2$ | |
| Dimensions (mm)WxHxL | 12 x 64* x 100 (*from upper edge of the carrier rail) | |

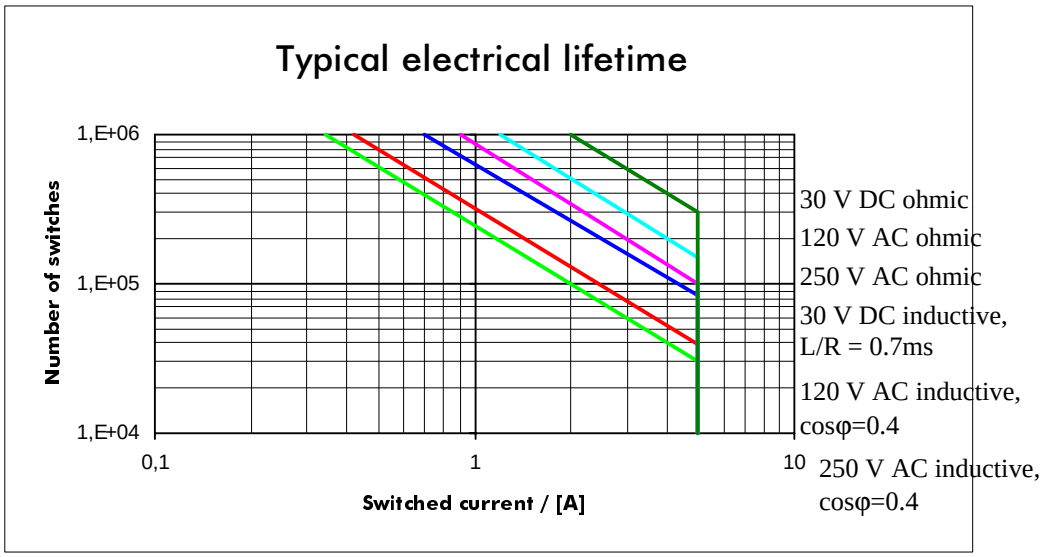
| Item Number 750- | 514 | 517[1)] |
|---|---|---|
| Type of contact | 2 changeover | |
| Current consumption (internal) | 70 mA max. | 80 mA max. |
| Switching voltage | 30 V DC; 125 V AC | 250 V AC |
| Switching power | 30 W; 62.5 VA | 1500 VA* |
| Switching current | 0.5 A AC/ 1 A DC | 1 A AC |
| Isolation | 1.5 kV system/power supply | 4 kV system/ power supply |
| Internal bit width | 2 | |
| Configuration | without address or configuration adjustment | |
| Operating temperature | 0°C....+55°C | |
| Wire connection | CAGE CLAMP; 0.08 to 2.5mm$^2$ | |
| Dimensions (mm)WxHxL | 12 x 64* x 100 (*from upper edge of the carrier rail) | |

*ohmic load

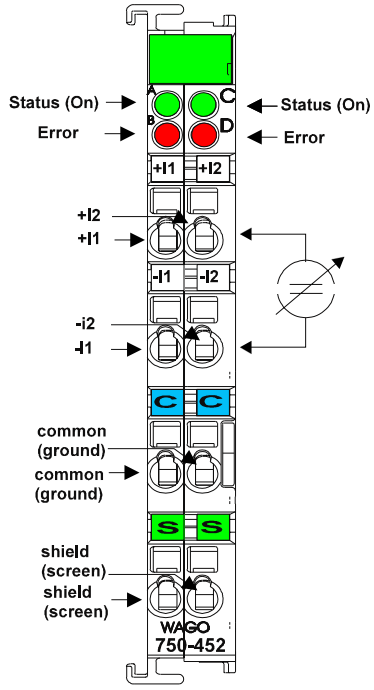
[1)]in design

Relays in the modules 750-512 and 750-513:



# 2 Channel Analog Inputs 0-20 mA / 4-20 mA (Differential Inputs)
# PN 750-452, 454, 750-482, 750-484




## Technical Description

This description is only intended for hardware version X X X X 2 A 0 0 - - - -. The serial number can be found on the right side of the module.

The input channels are differential inputs and they have a common ground potential. The inputs are connected to +I and -I. The shield is connected to „S“. The connection is made automatically when snapped onto the DIN rail.

These I/O modules are not provided with integrated power jumper contacts. The power supply is made by the data contacts with a DC-DC converter. The modules can work self-supporting.

**Attention:**
The lowest power jumper contact is not carried out for some modules (e.g. 4-channel)! A module which needs all contacts (e.g. 2 channel digital) may not be connected to the right hand side of modules which do not have 3 power jumper contacts (e.g. 4 channel modules).

The input module can be connected to all buscouplers of the WAGO I/O SYSTEM (except for the economy type).

# Technical Data:

| Item Number 750- | 452 | 454 | 482 | 484 |
|---|---|---|---|---|
| Number of channels | 2 | | 2 | |
| Nominal voltage | via system voltage | | | |
| Current consumption (internal) | 70 mA | | 70 mA | |
| Voltage | 35 V max. | | | |
| Signal current | 0-20mA | 4-20mA | 0-20mA | 4-20mA |
| Resistance | 50 Ω typ. | | | |
| Resolution | 12 Bit | | | |
| Isolation | 500 V System/Power supply | | | |
| Conversion time | 2 ms typ. | | | |
| Bit width per channel | 16 Bit Data, 8 Bit Control/Status | | | |
| Operating temperature | 0°C....+55°C | | | |
| Configuration | none, optional via software parameter | | | |
| Wire connection | CAGE CLAMP; 0.08 to 2.5mm$^2$ | | | |
| Dimensions (mm)WxHxL | 12 x 64* x 100 (*from upper edge of the carrier rail) | | | |

# The numerical format

All analog values will be shown in a unit numerical format. The resolution is 12 Bits. The following table will explain the numerical format. (750-452, 454). The 3 least significant Bits are not taken into account.

| Input current 0-20 mA | Input current 4-20 mA | Binary Value | Hex. | Dec. |
|---|---|---|---|---|
| 20 | 20 | 0111 1111 1111 1000 | 7F F8 | 32760 |
| 10 | 12 | 0100 0000 0000 0000 | 40 00 | 16384 |
| 5 | 8 | 0010 0000 0000 0000 | 20 00 | 8192 |
| 2.5 | 6 | 0001 0000 0000 0000 | 10 00 | 4096 |
| 0.156 | 4.125 | 0000 0001 0000 0000 | 01 00 | 256 |
| 0.01 | 4.0078 | 0000 0000 0001 0000 | 00 10 | 16 |
| 0.005 | 4.0039 | 0000 0000 0000 1000 | 00 08 | 8 |
| 0 | 4 | 0000 0000 0000 0111 | 00 07 | 7 |
| 0 | 4 | 0000 0000 0000 0000 | 0 | 0 |

# The numerical format for Siemens

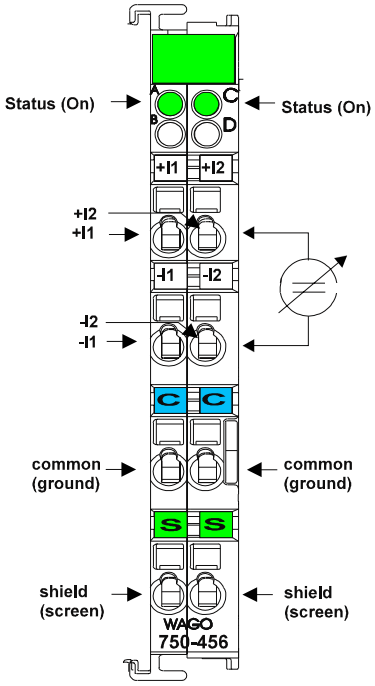
In addition to the full 16 bit indication of the measured value it is possible to use the ‘Siemens format’. The measured value is represented by the most significant 12 Bits. The 3 least significant Bits are reserved for diagnostic and status purposes. (750-482, 484)

| Input current 4-20 mA | Binary value | X : without meaning<br>F : short circuit or<br>F : open circuit<br>Ü : overflow<br>X F Ü | Hex. | Dec. |
|---|---|---|---|---|
| > 20 | 0101 0000 0000 0 | 0 0 1 | 50 01 | 20481 |
| 20 | 0101 0000 0000 0 | 0 0 0 | 50 00 | 20480 |
| 16 | 0100 0000 0000 0 | 0 0 0 | 40 00 | 16384 |
| 12 | 0011 0000 0000 0 | 0 0 0 | 30 00 | 12288 |
| 8 | 0010 0000 0000 0 | 0 0 0 | 20 00 | 8192 |
| 4.0078 | 0001 0000 0000 1 | 0 0 0 | 10 08 | 4104 |
| 4 | 0001 0000 0000 0 | 0 0 0 | 10 00 | 4096 |
| 4 | 0001 0000 0000 0 | 0 1 1 | 10 03 | 4099 |

| Input current 0-20 mA | Binary value | X : without meaning<br>F : short circuit<br>open circuit<br>Ü : overflow<br>X F Ü | Hex. | Dec. |
|---|---|---|---|---|
| > 20 | 0100 0000 0000 0 | 0 0 1 | 40 01 | 16385 |
| 20 | 0100 0000 0000 0 | 0 0 0 | 40 00 | 16384 |
| 10 | 0010 0000 0000 0 | 0 0 0 | 20 00 | 8192 |
| 5 | 0001 0000 0000 0 | 0 0 0 | 10 00 | 4096 |
| 2.5 | 0000 1000 0000 0 | 0 0 0 | 08 00 | 2048 |
| 1.25 | 0000 0100 0000 0 | 0 0 0 | 04 00 | 1024 |
| 0.625 | 0000 0010 0000 0 | 0 0 0 | 02 00 | 512 |
| 0.0976 | 0000 0000 0000 1 | 0 0 0 | 00 08 | 8 |
| 0 | 0000 0000 0000 0 | 0 0 0 | 00 00 | 0 |

**If you have questions about the formatting of this data, please contact WAGO for I/O System technical support.**

# 2 Channel Analog Inputs +/- 10 V (Differential Inputs)
# PN 750-456, 750-456/000-001




## Technical Description

This description is only intended for hardware version X X X X 2 A 0 0 - - - -. The serial number can be found on the right side of the module.

The input channels are differential inputs and they have a common ground potential.

The inputs are connected to +I and -I. The shield is connected to „S“. The connection is made automatically when snapped onto the DIN rail.

These I/O modules are not provided with integrated power jumper contacts. The power supply is made by the data contacts with a DC-DC converter. The modules can work self-supporting.

**Attention:**
The lowest power jumper contact is not carried out for some modules (e.g. 4-channel)! A module which needs all contacts (e.g. 2 channel digital) may not be connected to the right hand side of modules which do not have 3 power jumper contacts (e.g. 4 channel modules).

The input module can be connected to all buscouplers of the WAGO I/O SYSTEM (except for the economy type).

# Technical Data:

| Item Number 750- | 456, 456/000-001 |
|---|---|
| Number of channels | 2 |
| Nominal voltage | via system voltage (DC DC converter) |
| Current consumption (internal) | 65 mA |
| Overvoltage protection | 35 V max. |
| Signal voltage | +/- 10 V |
| Resistance | 570 kΩ |
| Resolution | 12 Bit |
| Isolation | 500 V System/Power supply |
| Conversion time | 2 ms typ. |
| Bit width per channel | 16 Bit Data, 8 Bit Control/Status |
| Operating temperature | 0°C....+55°C |
| Configuration | none, optional via software parameter |
| Wire connection | CAGE CLAMP; 0.08 to 2.5mm$^2$ |
| Dimensions (mm)WxHxL | 12 x 64* x 100 (*from upper edge of the carrier rail) |

Attention:
The value of the input signal should be in a range of 0V to 10V or even no signal.

# The numerical format

All analog values will be shown in a unit numerical format. The resolution is 12 Bits and the 3 LSBs are not taken into account. The following table will explain the numerical format.

| Input voltage ±10V | Binary value | Hex. | Dec. | Status |
|---|---|---|---|---|
| > 10 V | 0111 1111 1111 1111 | 7F FF | 32767 | 42 |
| 10 | 0111 1111 1111 XXXX | 7F FX | 32760 | 0 |
| 5 | 0100 0000 0000 XXXX | 40 0X | 16384 | 0 |
| 2,5 | 0010 0000 0000 XXXX | 20 0X | 8192 | 0 |
| 1,25 | 0001 0000 0000 XXXX | 10 0X | 4096 | 0 |
| 0,0781 | 0000 0001 0000 XXXX | 01 0X | 256 | 0 |
| 0,0049 | 0000 0000 0001 XXXX | 00 1X | 16 | 0 |
| 0 | 0000 0000 0000 XXXX | 00 0X | 0 | 0 |
| -2,5 | 1110 0000 0000 XXXX | E0 0X | 57344 | 0 |
| -5 | 1100 0000 0000 XXXX | C0 0X | 49152 | 0 |
| -7,5 | 1010 0000 0000 XXXX | A0 0X | 40960 | 0 |
| -10 | 1000 0000 0000 XXXX | 80 0X | 32768 | 0 |
| < -10 V | 1000 0000 0000 0000 | 80 00 | 32768 | 41 |

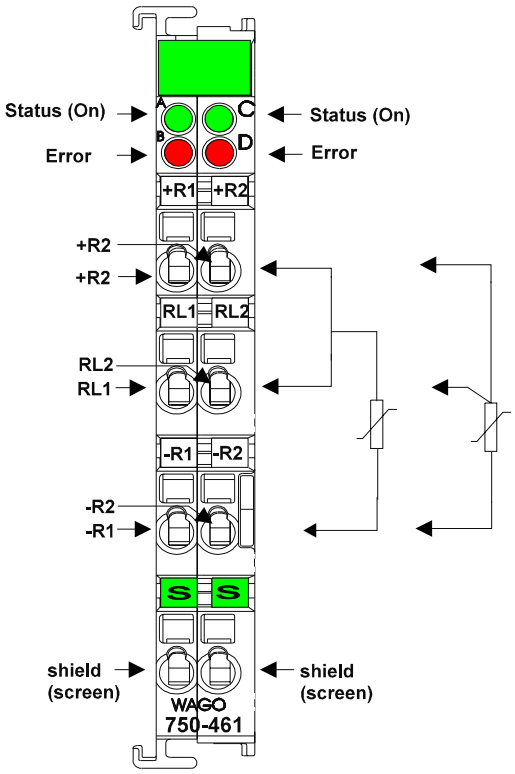
# The numerical format for Siemens

In addition to the full 16 bit indication of the measured value it is possible to use the Siemens format. The measured value is represented by the most significant 12 Bits. The 3 least significant bits are reserved for diagnostic and status purposes. (750-456/000-001).

| Input voltage ±10V | Binary value | X : without meaning<br>F : short circuit<br>or<br>F : open circuit<br>Ü : overflow<br>X F Ü | Hex. | Dec. |
|---|---|---|---|---|
| >10 | 0111 1111 1111 1 | 0 0 1 | 7F F9 | 32761 |
| 10 | 0111 1111 1111 1 | 0 0 0 | 7F F8 | 32760 |
| 5 | 0110 0000 0000 0 | 0 0 0 | 60 00 | 24576 |
| 2,5 | 0101 0000 0000 0 | 0 0 0 | 50 00 | 20480 |
| 1,25 | 0100 1000 0000 0 | 0 0 0 | 48 00 | 18432 |
| 0,0049 | 0100 0000 0000 1 | 0 0 0 | 40 08 | 16392 |
| 0 | 0100 0000 0000 0 | 0 0 0 | 40 00 | 16384 |
| -2,5 | 0011 0000 0000 1 | 0 0 0 | 30 08 | 12296 |
| -5 | 0010 0000 0000 0 | 0 0 0 | 20 00 | 8192 |
| -7,5 | 0001 0000 0000 0 | 0 0 0 | 10 00 | 4096 |
| -10 | 0000 0000 0000 1 | 0 0 0 | 00 00 | 8 |
| <-10 | 0000 0000 0000 0 | 0 0 1 | 00 01 | 1 |

**If you hve questions about the formatting of this data, please contact WAGO for the I/O System technical support.**

# Input for PT 100
# PN 750-461, 750-461/000-002, 750-461/000-003, 750-481




## Technical description:

This description is only intended for hardware version X X X X 3 A 0 2 - - - -. The serial number can be found on the right side of the module.

The described configuration is PT 100. The following description is preliminary and is applicable only to the factory configuration.

The inputs are connected to +I and -I. The shield is connected to „S“. The connection is made automatically when snapped onto the DIN rail.

**Attention:**
The lowest power jumper contact is not carried out for some modules (e.g. 4-channel)! A module which needs all contacts (e.g. 2 channel digital) may not be connected to the right hand side of modules which do not have 3 power jumper contacts (e.g. 4 channel modules).

These I/O modules are not provided with integrated power jumper contacts. The power supply is made by the data contacts with a DC-DC converter. The modules can work self-supporting.
The PT100 module can be connected to all buscouplers of the **WAGO I/O SYSTEM** (except for the economy type).

# Technical Data:

| Item Number 750- | 461, 481, 461/000-002, 461/000-003 |
|---|---|
| Number of inputs | 2 |
| Input current (internal) | 65 mA |
| Voltage supply | via system voltage |
| Sensor types | PT100, PT 200, PT 500, PT1000, Ni100, Ni120, Ni1000 |
| Wire connection | 2-conductor, 3-conductor (presetting) |
| Temperature range | PT: -200°C..+850°C Ni:-60°C...250°C |
| Resolution | 0.1°C over the whole area |
| Isolation DC/DC | 400V system / power supply |
| Measuring current | 0.5mA type |
| | |
| Bit width per channel | 16 bits: data; 8 bits: control/status |
| Configuration | none, optional via software parameter |
| Operating temperature | 0°C....+55°C |
| Wire connection | CAGE CLAMP; 0.08 to 2.5mm$^2$ |
| Dimensions (mm)WxHxL | 12 x 64* x 100 (*from upper edge of the carrier rail) |
| Presetting | 3-conductor PT100 |

The function module 750-461 allows the direct connection of PT- or Ni-resistance sensors. The module is suitable for 2- or 3-wire RTDs. Connection is made according to the above wiring diagram.

Linearization is accomplished over the entire measurement range by a microprocessor. The temperature ranges of the above listed RTD types is available to the user. The temperature ranges of the sensors are represented with a resolution of 1 bit per 0.1° C in one word (16 bits). Resulting from this, 0°C corresponds to the hexadecimal value 0000 and 100°C is 03E8 (dez.1000). Temperatures below 0° are represented in two's complement with a leading '1'.

The function module works in the defined temperature range for the PT100 sensors of -200°C to +850°C. The voltage resolution is represented with 16 bits. An A/D converter and processor converts the voltage value to a numerical value proportional to the temperature of the selected resistance temperature sensor.

A short circuit or an interruption of the RTD wire is transmitted to the bus module and indicated by the red error LED. The green LED identifies that the module is communicating properly with the connected Buscoupler.

# The numerical format

All temperature values will be shown in a unit numerical format. If the mode 'DEFAULT' is selected each bit corresponds to 0.1°C. The possible numerical range refers to the standardized temperature range of the used sensors. The following table will explain the numerical format on a preset PT100. In the third column the numerical format for PT1000 (750-461/000-003) is explained.

| Temperature °C | Voltage (Ohm) | Voltage (Ohm) | Binary Value | Hex. | Dec. |
|---|---|---|---|---|---|
| | >400 | | | | |
| 850 | 390.481 | 1384,998 | 0010 0001 0011 0100 | 2134 | 8500 |
| 100 | 138.506 | 1099,299 | 0000 0011 1110 1000 | 03E8 | 1000 |
| 25.5 | 109.929 | 1000,391 | 0000 0000 1111 1111 | 00FF | 255 |
| 0.1 | 100.039 | 1000 | 0000 0000 0000 0001 | 0001 | 1 |
| 0 | 100 | 999,619 | 0000 0000 0000 0000 | 0000 | 0 |
| -0.1 | 99.970 | 901,929 | 1111 1111 1111 1111 | FFFF | -1 |
| -25.5 | 90.389 | 184,936 | 1111 1111 0000 0001 | FF01 | -255 |
| -200 | 18.192 | | 1111 1000 0011 0000 | F830 | -2000 |
| | <18 | | 1000 0000 0000 0000 | 8000 | -32767 |

Table 1

# The numerical format for 750-461/000-002

All temperature values will be shown in a unit numerical format. Each bit corresponds to 0.1°C. The following table will explain the numerical format for 750-461/000-002.

| Voltage (Ohm) | Binary value | Hex. | Dez. |
|---|---|---|---|
| 10 | 0000 0000 0110 0100 | 00 64 | 100 |
| 100 | 0000 0011 1110 1000 | 03 E8 | 1000 |
| 200 | 0000 0111 1101 0000 | 07 D0 | 2000 |
| 300 | 0000 1011 1011 1000 | 0B B8 | 3000 |
| 400 | 0000 1111 1010 0000 | 0F A0 | 4000 |
| 500 | 0001 0011 1000 1000 | 13 88 | 5000 |
| 1000 | 0010 0111 0001 0000 | 27 10 | 10000 |
| 1200 | 0010 1110 1110 0000 | 2E E0 | 12000 |

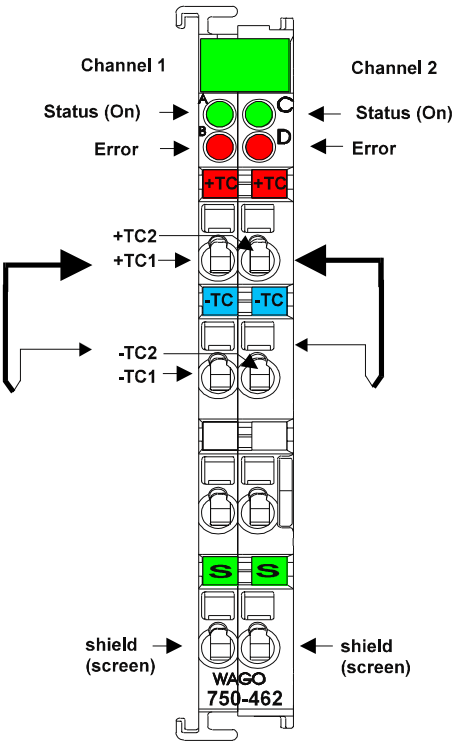
## The numerical format for Siemens

In addition to the full 16 bit indication of the measured value it is possible to use the ‘Siemens format’. The measured value is represented by the most significant 12 Bits. The 4 least significant Bits are reserved for diagnostic and status purposes. (750-481)

| Temp. °C | Ohm | Binary value | X : without meaning<br>F : short circuit or<br>F : open circuit<br>Ü : overflow<br>X F Ü | Hex. | Dec. |
|---|---|---|---|---|---|
| | >400 | 1111 1111 1111 1 | 0 0 1 | FF F9 | 65529 |
| 883 | 400 | 0111 1111 1111 1 | 0 0 0 | 7F F8 | 32866 |
| 560 | 300 | 0110 0000 0000 0 | 0 0 0 | 60 00 | 24576 |
| 266 | 200 | 0100 0000 0000 0 | 0 0 0 | 40 00 | 16384 |
| 0 | 100 | 0010 0000 0000 0 | 0 0 0 | 20 00 | 8192 |
| -125 | 50 | 0001 0000 0000 0 | 0 0 0 | 10 00 | 4096 |
| -185 | 25 | 0000 0101 0000 0 | 0 0 0 | 500 | 1280 |
| -200 | 20 | 0000 0100 0000 0 | 0 0 0 | 400 | 1024 |
| <-200 | 0 | 0000 0000 0000 0 | 0 0 1 | 1 | 1 |

**If you have questions about the formatting of this data, please contact WAGO for I/O System technical support.**

# Input for Thermocouple Modules
# PN 750-462, 750-469, 750-462/000-XXX




## Technical description:

This description is only intended for hardware version X X X X 2 A 0 1 - - - -. The serial number can be found on the right side of the module.

The following description is preliminary and is applicable only to the factory configuration.

The shield is connected to „S“. The connection is made automatically when snapped onto the DIN rail.

These I/O modules are not provided with integrated power jumper contacts. The power supply is made by the data contacts with a DC-DC converter. The modules can work self-supporting.

**Attention:**
The lowest power jumper contact is not carried out for some modules (e.g. 4-channel)! A module which needs all contacts (e.g. 2 channel digital) may not be connected to the right hand side of modules which do not have 3 power jumper contacts (e.g. 4 channel modules).

The thermocouple module can be connected to all buscouplers of the **WAGO I/O SYSTEM** (except for the economy type)**.**

# Technical Data:

| Item Number 750- | 462, 469 |
|---|---|
| Number of inputs | 2 (differential input, max. +/- 3.5V) |
| Voltage supply | via system voltage |
| Sensor types | J, K, B, E, N, R, S, T, U, L, mV Messung |
| Cold junction compensation | on each module |
| Measuring accuracy | <25 µV, typ. 15 µV |
| Resolution | 0.1°C per Bit |
| Isolation DC/DC | 500V system / power supply |
| | |
| Input current (internal) | 65 mA max. |
| Bit width per channel | 16 Bit: data; 8 Bit: control/status*<br>(detection of broken wire 750-469) |
| Configuration | none, optional via software parameter |
| Operating temperature | 0°C....+55°C |
| Connection technique | CAGE CLAMP; 0.08 to 2.5mm$^2$ |
| Dimensions (mm)WxHxL | 12 x 64* x 100 (*from upper edge of the carrier rail) |
| Presetting | -100°C / +1370°C, Typ K |

The function module 750-462 permits the direct connection of thermocouple sensors. The module is suitable for 2 or 3-wire thermocouples. For the 2-wire connection technique, connect the thermocouple wires between TC- and TC+ . For the 3-conductor technique the shield is also connected. The operation of grounded sensors is provided by means of internal electrical isolation.

The function module 750-469 alos detects a broken wire. You can find the PNs for the different sensor types for 750-462 in the following table.

**Warning: Both inputs are referenced to a common potential (not isolated)!**

The linearization is provided over the complete range by a microprocessor. The temperature ranges of the sensors are represented with a resolution of 1 bit per 0.1°C in one word (16 Bit). Thus, 0°C corresponds to the value 0000, and 25.5°C correspond to the value 0 x 00FF. Temperatures below 0°C are represented in two's complement with a leading '1'.

Within the whole range of all thermocouples, the function module works like a 'µV meter'. The voltage resolution is represented with 16 bits. A processor converts the voltage value into a numerical value proportional to the measured temperature of the selected type of thermocouple.

In order to compensate the offset voltage at the clamping point, a cold junction thermocouple compensation calculation is carried out. The circuit contains a temperature measuring sensor at the 'CAGE CLAMP' connection and considers the temperature offset voltage when calculating the measured value.

## Temperature Ranges of the connectable sensors:

| | | | |
|---|---|---|---|
| L | -25°C....+900°C | | |
| K | -100°C...1370°C (Default) | | |
| J | -100°C...+1200°C | 750-462/000-006 | 750-469/000-006 |
| E | -100°C...1000°C | 750-462/000-008 | 750-469/000-008 |
| T | -100°C...+400°C | 750-462/000-002 | 750-469/000-002 |
| N | -100°C...+1300°C | 750-462/000-009 | 750-469/000-009 |
| U | -25°C...+600°C | 750-462/000-011 | 750-469/000-011 |
| B | 600°C...+1800°C | 750-462/000-007 | 750-469/000-007 |
| R | 0°C...+1700°C | 750-462/000-010 | 750-469/000-010 |
| S | 0°C...+1700°C | 750-462/000-001 | 750-469/000-001 |
| mV-Meter | -120 mV...+120 mV | 750-462/000-003 | 750-469/000-003 |

Table 1: Temperature ranges of the connectable sensors
Attention: The range of the mV Meter is 0 to 120mV at the moment!

## LED functions:

green LED: Function

ON: Normal
OFF: Watchdog-Timer Overflow
If the PLC does not transmit processing data for 100 ms the green LED stops lightning.

red LED: Error

ON: Over- or underrange or broken wire (bei 750-469)
OFF: voltage is in the measuring range

## The numerical formats

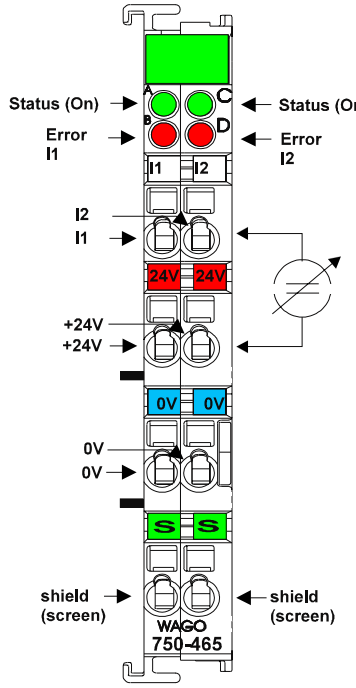
All temperature values are represented in a uniform numerical format. In the default setting (type K) one Bit corresponds to 0.1°C. The output value corresponds to the temperature range of each sensor as defined according to standards. By using a configuration tool, the output formats can be chosen. The linearization can be switched off and the building of the reference temperature can be switched off also. The following table identifies the numerical format on the default range (type K).

| Temp. °C | Voltage (uV) | Binary Value | Hex. | Dec. |
|---|---|---|---|---|
| 850 | 35314 | 0010 0001 0011 0100 | 2134 | 8500 |
| 100 | 4095 | 0000 0011 1110 1000 | 03E8 | 1000 |
| 25,5 | 1021 | 0000 0000 1111 1111 | 00FF | 255 |
| 0,1 | 4 | 0000 0000 0000 0001 | 0001 | 1 |
| 0 | 0 | 0000 0000 0000 0000 | 0000 | 0 |
| -0,1 | -4 | 1111 1111 1111 1111 | FFFF | -1 |
| -25,5 | -986 | 1111 1111 0000 0001 | FF01 | -255 |
| -100 | -3553 | 1111 1100 0001 1000 | FC18 | -1000 |

Table 2: Numerical formats

# 2 Channel Analog Input 0-20 mA / 4- 20 mA single ended

## PN 750-465, 750-466, 750-486, 750-465/000-001




## Technical Description

This description is only intended for hardware version X X X X 2 A 0 1 - - - -. The serial number can be found on the right side of the module.

The input channels are single ended and they have a common ground potential.

The inputs are connected to +I. Via 24 V / 0 V a sensor can be provided directly from the module. Power connections are made automatically from module to module when snapped onto the DIN rail.

The shield is connected to „S“. The connection is made automatically when snapped onto the DIN rail.

**Attention:**
The lowest power jumper contact is not carried out for some modules (e.g. 4-channel)! A module which needs all contacts (e.g. 2 channel digital) may not be connected to the right hand side of modules which do not have 3 power jumper contacts (e.g. 4 channel modules).

The input module can be connected to all buscouplers of the WAGO I/O SYSTEM (except for the economy type).

# Technical Data:

| Item Number 750- | 465<br>465/000-001 | 466<br>486 |
|---|---|---|
| Number of channels | 2 | |
| Nominal voltage | 24 V DC (-15% / +20%) via power jumper contacts | |
| Current consumption (internal) | 75 mA typ. | |
| Overvoltage protection | 35 V max. | |
| Signal current | 0-20mA | 4-20mA |
| Resistance | 50 Ω typ. | |
| Resolution | 12 Bit | |
| Isolation | 500 V system/power supply | |
| Conversion time | 2 ms typ. | |
| Bit width per channel | 16 Bit Data, 8 Bit Control/Status | |
| Operating temperature | 0°C....+55°C | |
| Configuration | none, optional via software parameter | |
| Wire connection | CAGE CLAMP; 0.08 to 2.5mm$^2$ | |
| Dimensions (mm)WxHxL | 12 x 64* x 100 (*from upper edge of the carrier rail) | |

# The numerical format

All analog values will be shown in a unit numerical format. The resolution is 12 Bits. The following table will explain the numerical format. (750-465, 466). The 3 LSBs are not taken into account.

| Input current 0-20mA | Input current 4-20mA | Binary value | Hex. | Dec. | Status | LED |
|---|---|---|---|---|---|---|
| >20,5 | >20,5 | 0111 1111 1111 1111 | 7F FF | 32767 | 42 | on |
| 20 | 20 | 0111 1111 1111 1111 | 7F FF | 32767 | 0 | off |
| 10 | 12 | 0100 0000 0000 0XXX | 40 00 | 16384 | 0 | off |
| 5 | 8 | 0010 0000 0000 0XXX | 20 00 | 8192 | 0 | off |
| 2,5 | 6 | 0001 0000 0000 0XXX | 10 00 | 4096 | 0 | off |
| 0,156 | 4,125 | 0000 0001 0000 0XXX | 01 00 | 256 | 0 | off |
| 0,01 | 4,0078 | 0000 0000 0001 0XXX | 00 10 | 16 | 0 | off |
| 0,005 | 4,0039 | 0000 0000 0000 1XXX | 00 08 | 8 | 0 | off |
| 0 | 4 | 0000 0000 0000 0XXX | 00 00 | 7 | 0 | off |
| 0 | 3,5 - 4 | 0000 0000 0000 0000 | 0 | 0 | 0 | off |
| 0 | 0 - 3,5 | 0000 0000 0000 0000 | 0 | 0 | 41 | on (4 -20 |

# The numerical format for Siemens

In addition to the full 16 bit indication of the measured value it is possible to use the ‘Siemens format’. The measured value is represented by the most significant 12 Bits. The 3 least significant Bits are reserved for diagnostic and status purposes. (750-465/000-001).

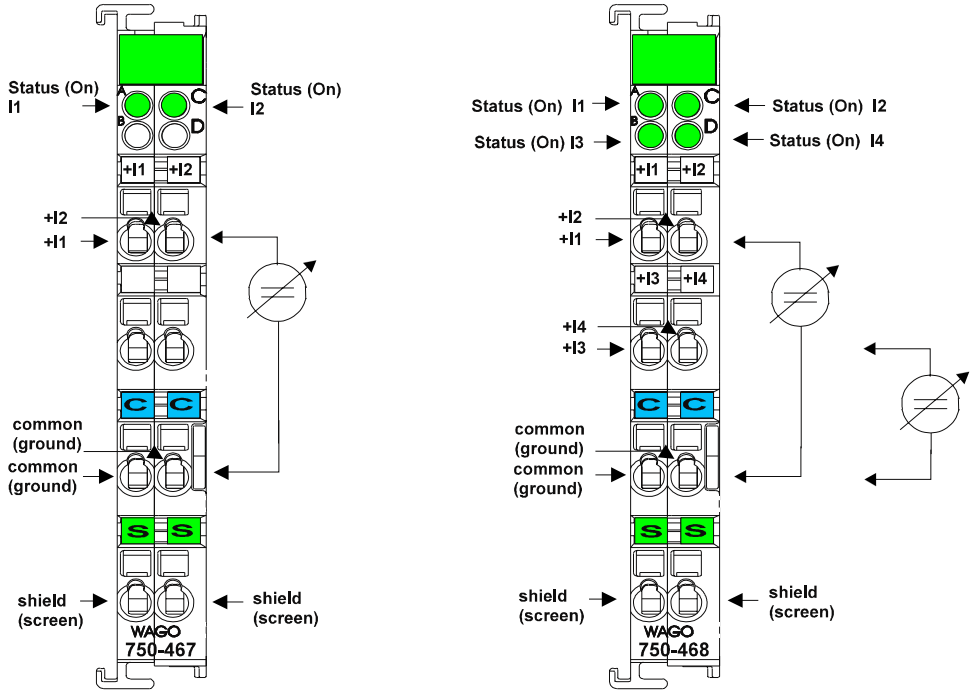
| Input current 0-20mA | Binary value | X : without meaning<br>F : short circuit or<br>F : open circuit<br>Ü : overflow<br>X F Ü | Hex. | Dec. | Status | LED |
|---|---|---|---|---|---|---|
| >20,5 | 0100 0000 0000 0 | 0 0 1 | 4001 | 16385 | 42 | on |
| 20 | 0100 0000 0000 0 | 0 0 0 | 4000 | 16384 | 0 | off |
| 10 | 0010 0000 0000 0 | 0 0 0 | 2000 | 8192 | 0 | off |
| 5 | 0001 0000 0000 0 | 0 0 0 | 1000 | 4096 | 0 | off |
| 2,5 | 0000 1000 0000 0 | 0 0 0 | 0800 | 2048 | 0 | off |
| 1,25 | 0000 0100 0000 0 | 0 0 0 | 0400 | 1024 | 0 | off |
| 0,625 | 0000 0010 0000 0 | 0 0 0 | 0200 | 512 | 0 | off |
| 0,0976 | 0000 0000 0000 1 | 0 0 0 | 0008 | 8 | 0 | off |
| 0 | 0000 0000 0000 0 | 0 0 0 | 0000 | 0 | 0 | off |

750-466/000-200 or 750-486:

| Input current 4-20mA | Binary value | X : without meaning<br>F : short circuit or<br>F : open circuit<br>Ü : overflow<br>X F Ü | Hex. | Dec. | Status | LED |
|---|---|---|---|---|---|---|
| >20,5 | 0101 0000 0000 0 | 0 0 1 | 40 01 | 16385 | 42 | on |
| 20 | 0101 0000 0000 0 | 0 0 0 | 50 00 | 20480 | 0 | off |
| 16 | 0100 0000 0000 0 | 0 0 0 | 40 00 | 16384 | 0 | off |
| 12 | 0011 0000 0000 0 | 0 0 0 | 30 00 | 12288 | 0 | off |
| 8 | 0010 0000 0000 0 | 0 0 0 | 20 00 | 8192 | 0 | off |
| 4,0078 | 0001 0000 0000 1 | 0 0 0 | 1008 | 4104 | 0 | off |
| 4 | 0001 0000 0000 0 | 0 0 0 | 1000 | 4096 | 0 | off |
| <3,5 | 0001 0000 0000 0 | 0 1 1 | 1003 | 4099 | 0 | on |

**If you have questions about the formatting of this data, please contact WAGO for I/O System technical support.**

# 2 / 4 Channel Analog Inputs 0-10 V single ended
# PN 750-467, 468, 487, 488




## Technical Description

This description is only intended for hardware version X X X X 2 A 0 0 - - - -. The serial number can be found on the right side of the module.

The input channels are single ended and they have a common ground potential.

The inputs are connected to +I and M. The shield is connected to „S“. The connection is made automatically when snapped onto the DIN rail.

These I/O modules are not provided with integrated power jumper contacts. The power supply is made by the data contacts with a DC-DC converter. The modules can work self-supporting.

**Attention:**
The lowest power jumper contact is not carried out for some modules (e.g. 4-channel)! A module which needs all contacts (e.g. 2 channel digital) may not be connected to the right hand side of modules which do not have 3 power jumper contacts (e.g. 4 channel modules).

The input module can be connected to all buscouplers of the WAGO I/O SYSTEM (except for the economy type).

# Technical Data:

| Item Number 750- | 467 | 468 | 487 | 488 |
|---|---|---|---|---|
| Number of channels | 2 | 4 | 2 | 4 |
| Nominal voltage | via system voltage (DC DC converter) | | | |
| Current consumption (internal) | 60 mA | 60 mA | 60 mA | 60 mA |
| Overvoltage protection | 35 V max. | | | |
| Signal voltage | 0-10 V | | | |
| Resistance | 133 kΩ typ. | | | |
| Resolution | 12 Bit | | | |
| Isolation | 500 V system/power supply | | | |
| Conversion time | 2 ms typ. | | | |
| Bit width per channel | 16 Bit Data, 8 Bit Control/Status | | | |
| Operating temperature | 0°C....+55°C | | | |
| Configuration | none, optional via software parameter | | | |
| Wire connection | CAGE CLAMP; 0.08 to 2.5mm$^2$ | | | |
| Dimensions (mm)WxHxL | 12 x 64* x 100 (*from upper edge of the carrier rail) | | | |

# The numerical format

All analog values will be shown in a unit numerical format. The resolution is 12 Bits. The following table will explain the numerical format. (750-467, 468). The 3 LSBs are not taken into account.

| Input voltage 0-10V | Binary value | Hex. | Dec. | Status |
|---|---|---|---|---|
| > 10 | 0111 1111 1111 1111 | 7F FF | 32767 | 42 |
| 10 | 0111 1111 1111 1XXX | 7F F8 | 32760 | 0 |
| 5 | 0100 0000 0000 0XXX | 40 00 | 16384 | 0 |
| 2,5 | 0010 0000 0000 0XXX | 20 00 | 8192 | 0 |
| 1,25 | 0001 0000 0000 0XXX | 10 00 | 4096 | 0 |
| 0,0781 | 0000 0001 0000 0XXX | 01 00 | 256 | 0 |
| 0,0049 | 0000 0000 0001 0XXX | 00 10 | 16 | 0 |
| 0,0024 | 0000 0000 0000 1XXX | 00 08 | 8 | 0 |
| 0 | 0000 0000 0000 0XXX | 00 07 | 7 | 0 |
| 0 | 0000 0000 0000 0XXX | 0 | 0 | 0 |

# The numerical format for Siemens

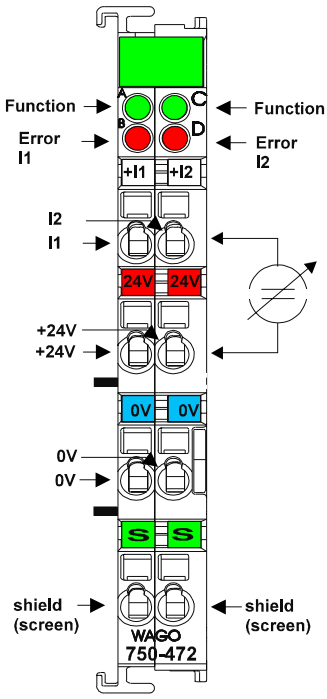
In addition to the full 16 bit indication of the measured value it is possible to use the ‘Siemens format’. The measured value is represented by the most significant 12 Bits. The 3 least significant Bits are reserved for diagnostic and status purposes. (750-487, 488)

| Input voltage 0-10V | Binary value | X : without meaning<br>F : short circuit or<br>F : open circuit<br>Ü : overflow<br>X F Ü | Hex. | Dec. | Status |
|---|---|---|---|---|---|
| >10 | 0101 0000 0000 0 | 0 0 1 | 50 01 | 20481 | 42 |
| 10 | 0101 0000 0000 0 | 0 0 0 | 50 00 | 20480 | 0 |
| 5 | 0011 0000 0000 0 | 0 0 0 | 30 00 | 12288 | 0 |
| 2,5 | 0010 0000 0000 0 | 0 0 0 | 20 00 | 8192 | 0 |
| 1,25 | 0001 1000 0000 0 | 0 0 0 | 18 00 | 6144 | 0 |
| 0,0049 | 0001 0000 0000 1 | 0 0 0 | 10 08 | 4104 | 0 |
| 0 | 0001 0000 0000 0 | 0 0 0 | 10 00 | 4096 | 0 |

**If you have questions about the formatting of this data, please contact WAGO for I/O System technical support.**

# 2 Channel Analog Input 0-20mA / 4-20mA single ended

## PN 750-472, 750-472/000-200, 750-474, 750-474/000-200




## Technical description:

This description is only intended for hardware and software version X X X X 0 2 0 2- - - -. The serial number can be found on the right side of the module.

The input channels are single ended and they have a common ground potential.
The inputs are connected to +I. Via 24 V / 0 V a sensor can be provided directly from the module. Power connections are made automatically from module to module when snapped onto the DIN rail.

The shield is connected to „S“. The connection is made automatically when snapped onto the DIN rail.

**Attention:**
The lowest power jumper contact is not carried out for some modules (e.g. 4-channel)! A module which needs all contacts (e.g. 2-channel digital) may not be connected to the right hand side of modules which do not have 3 power jumper contacts (e.g. 4-channel modules).

The input module can be connected to all buscouplers of the WAGO I/O SYSTEM (except for the economy type).

# Technical Data:

| Item Number 750- | 472<br>472/000-200 | 474<br>474/000-0200 |
|---|---|---|
| Number of channels | 2 | |
| Nominal voltage | 24 V DC (-15% / +20%) via power jumper contacts | |
| Overvoltage protection | 24 V max. | |
| Internal current | 75 mA typ. | |
| Input signal | 0-20mA | 4-20mA |
| Input current | < 38 mA at 24 V | |
| Resistance | 50 Ω | |
| Input voltage | non-linear/overload protection: U=1,2 V DC+160Ω*$I_{mess}$ | |
| Resolution | internal 16 Bit, 15 Bit via fieldbus | |
| Input filter | 50 Hz | |
| Noise rejection at sampling frequency | < -100 dB | |
| Noise rejection below sampling frequency | < -40 dB | |
| Transition frequency | 13 Hz | |
| Isolation | 500 V system/power supply | |
| Conversion time | 80 ms typ. | |
| Bit width per channel | 16Bit: Data; optional 8Bit: Control/Status | |
| Configuration | none, optional via software parameter | |
| Operating temperature | 0°C....+55°C | |
| Wire connection | CAGE CLAMP; 0,08 to 2,5$mm^2$ | |
| Dimensions (mm)WxHxL | 12 x 64* x 100 *from upper edge of the carrier rail | |

## The numerical format

The resolution of 750-472 and 750-474 are 15 Bit.

| Input current 0-20mA | Input current 4-20mA | Binary value | Hex. | Dec. | Status | LED |
|---|---|---|---|---|---|---|
| >20,5 | >20,5 | 0111 1111 1111 1111 | 7F FF | 32767 | 42 | on |
| 20 | 20 | 0111 1111 1111 1111 | 7F FF | 32767 | 0 | off |
| 10 | 12 | 0100 0000 0000 0000 | 40 00 | 16384 | 0 | off |
| 5 | 8 | 0010 0000 0000 0000 | 20 00 | 8192 | 0 | off |
| 2,5 | 6 | 0001 0000 0000 0000 | 10 00 | 4096 | 0 | off |
| 0,156 | 4,125 | 0000 0001 0000 0000 | 01 00 | 256 | 0 | off |
| 0,01 | 4,0078 | 0000 0000 0001 0000 | 00 10 | 16 | 0 | off |
| 0,005 | 4,0039 | 0000 0000 0000 1000 | 00 08 | 8 | 0 | off |
| 0 | 4 | 0000 0000 0000 0000 | 00 00 | 7 | 0 | off |
| 0 | 3,5 - 4 | 0000 0000 0000 0000 | 0 | 0 | 0 | off |
| 0 | 0 - 3,5 | 0000 0000 0000 0000 | 0 | 0 | 41 | on (4-20 |

# The numerical format for Siemens

In addition to the full 16 Bit indication of the measured value it is possible to use the „Siemens format“. The measured value is represented by the most significant 12 Bits. The 3 least significant Bits are reserved for diagnostic and status purpose (750-472/000-200, 750-474/000-200). The numerical format for 750-472/000-200 is equivalent to S5 463, 750-474/000-200 equivalent to S5 460/465.

| Input current 4-20mA | Binary value | X : without meaning<br>F : short circuit or<br>F: open circuit<br>Ü : overflow<br>X F Ü | Hex. | Dec. | Status | LED |
|---|---|---|---|---|---|---|
| 32 | 0111 1111 1111 1 | 0 0 1 | 7F F9 | 32761 | 42 | on |
| 31,99 | 0111 1111 1111 0 | 0 0 0 | 7F F0 | 32752 | 0 | off |
| 20,5 | 0101 0010 0000 0 | 0 0 1 | 52 00 | 20992 | 0 | off |
| 20 | 0101 0000 0000 0 | 0 0 0 | 50 00 | 20480 | 0 | off |
| 16 | 0100 0000 0000 0 | 0 0 0 | 40 00 | 16384 | 0 | off |
| 12 | 0011 0000 0000 0 | 0 0 0 | 30 00 | 12288 | 0 | off |
| 8 | 0010 0000 0000 0 | 0 0 0 | 20 00 | 8192 | 0 | off |
| 4,0078 | 0001 0000 0000 1 | 0 0 0 | 10 08 | 4104 | 0 | off |
| 4 | 0001 0000 0000 0 | 0 0 0 | 10 00 | 4096 | 0 | off |
| 3,5 | 0000 1110 0000 0 | 0 1 1 | 0E 00 | 3584 | 0 | on |
| 0 | 0000 0000 0000 0 | 0 0 0 | 00 00 | 0 | 0 | on |

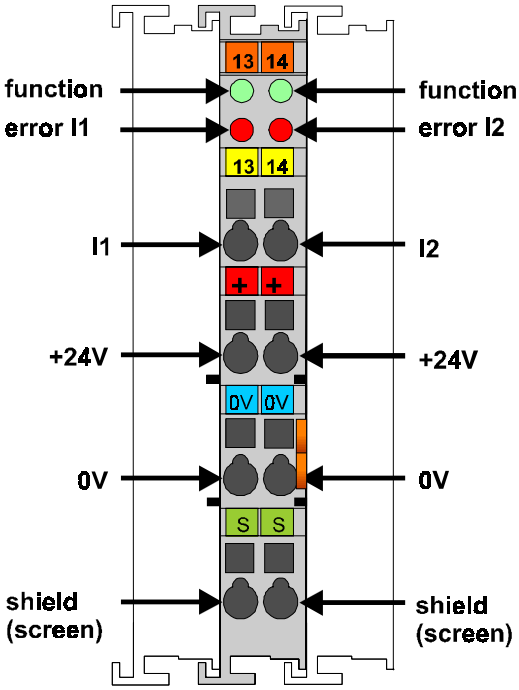
| Input current 0-20mA | Binary value | X : without meaning<br>F : short circuit or<br>F: open circuit<br>Ü : overflow<br>X F Ü | Hex. | Dec. | Status | LED |
|---|---|---|---|---|---|---|
| 30 | 0110 0000 0000 0 | 0 0 1 | 6001 | 24577 | 42 | on |
| 29,98 | 0101 1111 1111 1 | 0 0 0 | 5F F8 | 24568 | 0 | on |
| 20,5 | 0100 0001 1001 1 | 0 0 0 | 41 98 | 16762 | 0 | on |
| 20 | 0100 0000 0000 0 | 0 0 0 | 4000 | 16384 | 0 | off |
| 10 | 0010 0000 0000 0 | 0 0 0 | 2000 | 8192 | 0 | off |
| 5 | 0001 0000 0000 0 | 0 0 0 | 1000 | 4096 | 0 | off |
| 2,5 | 0000 1000 0000 0 | 0 0 0 | 0800 | 2048 | 0 | off |
| 1,25 | 0000 0100 0000 0 | 0 0 0 | 0400 | 1024 | 0 | off |
| 0,625 | 0000 0010 0000 0 | 0 0 0 | 0200 | 512 | 0 | off |
| 0,00976 | 0000 0000 0000 1 | 0 0 0 | 0008 | 8 | 0 | off |
| 0 | 0000 0000 0000 0 | 0 0 0 | 0000 | 0 | 0 | off |

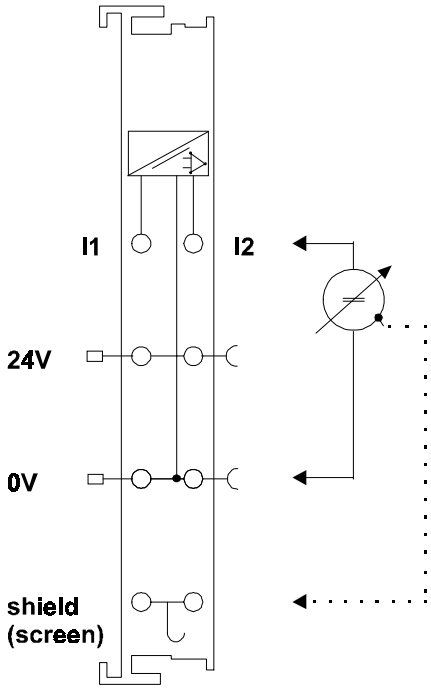
**If you have questions about the formatting of this data, please contact WAGO for I/O System technical support.**

# 2-Channel Analog Input

**± 10 V, 16 Bit, single ended** **750-476**

**0 -10 V, 16 Bit, single ended** **750-478**




## Function clamp and variants

| Item-No. | Description | Identification |
|---|---|---|
| **750-476** | 2-Channel Analog Input<br>± 10 V, single ended | 2 AI ± 10 V DC<br>16 Bit s.e. |
| **750-476/000-200** | 2-Channel Analog Input<br>± 10 V, single ended<br>with status infomation within the data word | 2 AI ± 10 V DC<br>16 Bit s.e.<br>S5-466 |

| | | |
|---|---|---|
| **750-478** | 2-Channel Analog Input<br>0-10 V, single ended | 2 AI 0-10 V DC<br>16 Bit s.e. |
| **750-478/000-200** | 2-Channel Analog Input<br>0-10 V, single ended<br>with status infomation within the data word | 2 AI 0-10 V DC<br>16 Bit s.e.<br>S5-466 |

# Technical description

This description is only intended for hardware and software version
X X X X 0 4 0 1 - - - - .The serial number can be found on the right side of the module.

The input channels are single ended and they have a common ground potential.

The inputs are connected to I and 0V.
The shield is connected to „S“. The connection is made automatically when snapped onto the DIN rail.

**Attention:**
The lowest power jumper contact is not carried out for some modules (e.g. 4-channel)! A module which needs all contacts (e.g. 2-channel digital) may not be connected to the right hand side of modules which do not have 3 power jumper contacts (e.g. 4-channel modules).

The input module can be connected to all buscouplers of the WAGO I/O SYSTEM (except for the economy type).

# Technical Data

| Item Number | 750-476<br>750-476/000-200 | 750-478<br>750-478/000-200 |
|---|---|---|
| Number of channels | 2 | |
| Nominal voltage | via system voltage (DC/DC) | |
| Overvoltage resistance | 24 V max. | |
| Internal current consumption | 75 mA typ. | |
| Input signal | +/- 10 V | 0 - 10 V |
| Input impedance | 130 kΩ typ. | |
| Overvoltage protection | 24 V protected against polarity reversal | |
| Resolution | 15 Bit + sign | |
| Input filter | 50 Hz | |
| Noise rejection at sampling frequency | < -100 dB | |
| Noise rejection below sampling frequency | < -40 dB | |
| Transition frequency | 13 Hz | |
| Isolation | 500 V system/power supply | |
| Wandlungszeit | 80 ms typ. | |
| Bitwidth per channel | 16Bit: Data;<br>optional 8Bit: control/status | |
| Configuration | none, optional via software parameter | |
| Operating temperature | 0°C....+55°C | |
| Wire connection | CAGE CLAMP; 0,08 bis 2,5mm$^2$ | |
| Dimensions (mm)WxHxL | 12 x 64* x 100 * from upper edge of the carrier rail | |

# The numerical format

All analog values will be shown in a unit numerical format. The resolution for 750-476 and 750-478 is 15 Bit plus sign.

**750-476, -478**

| Input voltage | | Value | | | Status | LED |
|---|---|---|---|---|---|---|
| 0-10V | ±10V | Binary | Hex. | Dec. | (hex) | error I (1,2) |
| >11 | >11 | 0111 1111 1111 1111 | 0x7FFF | 32767 | 0x42 | on |
| >10,5 | >10,5 | 0111 1111 1111 1111 | 0x7FFF | 32767 | 0x42 | off |
| 10 | 10 | 0111 1111 1111 1111 | 0x7FFF | 32767 | 0x00 | off |
| 5 | 5 | 0100 0000 0000 0000 | 0x4000 | 16384 | 0x00 | off |
| 2,5 | 2,5 | 0010 0000 0000 0000 | 0x2000 | 8192 | 0x00 | off |
| 1,25 | 1,25 | 0001 0000 0000 0000 | 0x1000 | 4096 | 0x00 | off |
| 0,0781 | 0,0781 | 0000 0001 0000 0000 | 0x0100 | 256 | 0x00 | off |
| 0,049 | 0,049 | 0000 0000 0001 0000 | 0x0010 | 16 | 0x00 | off |
| 0,0003 | 0,0003 | 0000 0000 0000 0001 | 0x0001 | 1 | 0x00 | off |
| 0 | 0 | 0000 0000 0000 0000 | 0x0000 | 0 | 0x00 | off |
| <-0,5 | | 0000 0000 0000 0000 | 0x0000 | 0 | 0x41 | off |
| <-1 | | 0000 0000 0000 0000 | 0x0000 | 0 | 0x41 | on |
| | -5 | 1100 0000 0000 0000 | 0xC000 | 49152 | 0x00 | off |
| | -10 | 1000 0000 0000 0000 | 0x8000 | 32768 | 0x00 | off |
| | <-10,5 | 1000 0000 0000 0000 | 0x8000 | 32768 | 0x41 | off |
| | <-11 | 1000 0000 0000 0000 | 0x8000 | 32768 | 0x41 | on |

# Numerical format with status information

For fieldbus master, which evaluates status information in the data word, e.g. from Siemens, a variant of the function clamp is available.
The format containes the status in Bit B0 .. B2.
The digitalized measuring value is placed at the position Bit B3 .. B15. The numerical format is equivalent to S5 466.

**750-476/000-200**

| Input voltage ±10 V | Value Binary | X E O*) | Hex. | Dec. | Status | LED error I (1,2) |
|---|---|---|---|---|---|---|
| > 11 | 0011 1111 1111 1 | 0 0 1 | 0x3FF9 | 16377 | 0x42 | on |
| > 10,5 | 0011 1111 1111 1 | 0 0 1 | 0x3FF9 | 16377 | 0x42 | off |
| 10 | 0011 1111 1111 1 | 0 0 0 | 0x3FF8 | 16376 | 0x00 | off |
| 5 | 0010 0000 0000 0 | 0 0 0 | 0x2000 | 8192 | 0x00 | off |
| 2,5 | 0001 0000 0000 0 | 0 0 0 | 0x1000 | 4096 | 0x00 | off |
| 1,25 | 0000 1000 0000 0 | 0 0 0 | 0x0800 | 2048 | 0x00 | off |
| 0,0781 | 0000 0000 1000 0 | 0 0 0 | 0x0080 | 128 | 0x00 | off |
| 0,0049 | 0000 0000 0000 1 | 0 0 0 | 0x0008 | 8 | 0x00 | off |
| 0 | 0000 0000 0000 0 | 0 0 0 | 0x0000 | 0 | 0x00 | off |
| -5 | 1110 0000 0000 0 | 0 0 0 | 0xE000 | 57344 | 0x00 | off |
| -10 | 1100 0000 0000 0 | 0 0 0 | 0xC000 | 49152 | 0x00 | off |
| < -10,5 | 1100 0000 0000 0 | 0 0 1 | 0xC001 | 49153 | 0x41 | off |
| < -11 | 1100 0000 0000 0 | 0 0 1 | 0xC001 | 49153 | 0x41 | on |

*) X : without meaning, E : short circuit or open circuit, O : overflow

**750-478/000-200**

| Input voltage 0-10 V | Value Binary | X E O*) | Hex. | Dec. | Status | LED error I (1,2) |
|---|---|---|---|---|---|---|
| > 11 | 0111 1111 1111 1 | 0 0 1 | 0x7FF9 | 32761 | 0x42 | on |
| > 10,5 | 0111 1111 1111 1 | 0 0 1 | 0x7FF9 | 32761 | 0x42 | off |
| 10 | 0111 1111 1111 1 | 0 0 0 | 0x7FF8 | 32760 | 0x00 | off |
| 5 | 0100 0000 0000 0 | 0 0 0 | 0x4000 | 16384 | 0x00 | off |
| 2,5 | 0010 0000 0000 0 | 0 0 0 | 0x2000 | 8192 | 0x00 | off |
| 1,25 | 0001 0000 0000 0 | 0 0 0 | 0x1000 | 4096 | 0x00 | off |
| 0,0781 | 0000 0001 0000 0 | 0 0 0 | 0x0100 | 256 | 0x00 | off |
| 0,049 | 0000 0000 0001 0 | 0 0 0 | 0x0010 | 16 | 0x00 | off |
| 0,024 | 0000 0000 0000 1 | 0 0 0 | 0x0008 | 8 | 0x00 | off |
| 0 | 0000 0000 0000 0 | 0 0 0 | 0x0000 | 0 | 0x00 | off |
| < -0,5 | 0000 0000 0000 0 | 0 0 1 | 0x0001 | 1 | 0x41 | off |
| < -1 | 0000 0000 0000 0 | 0 0 1 | 0x0001 | 1 | 0x41 | on |

*) X : without meaning, E : short circuit or open circuit, O : overflow

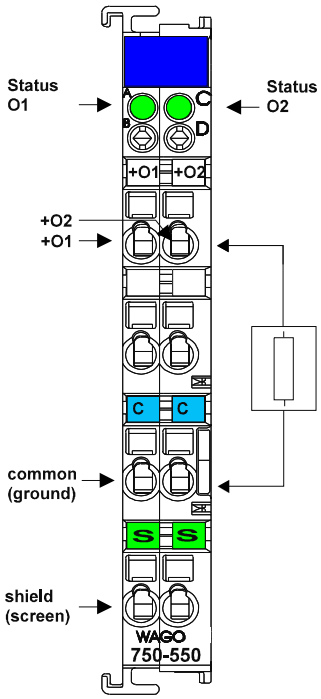
## Status byte

Structure of the status byte:

| **bit** | 7 | 6 | 5 | 4 | 3 | 2 | 1 | 0 |
|---|---|---|---|---|---|---|---|---|
| **meaning** | 0 | ERROR | res. | res. | res. | res. | Overrange | Underrange |

- ERROR error at the input channel.
- Overrange exceed the allowable measuring range.
- Underrange fall below the allowable measuring range.

# 2 Channel Analog Outputs 0-10 V
# PN 750-550, 750-580




## Technical Description

This description is only intended for hardware version X X X X 2 A 0 1 - - - -. The serial number can be found on the right side of the module.

The output signal of 750-550/551 is a 0-10 V signal. Sensors may be connected to „O“ and to the common ground.

The shield is connected to „S“. The connection is made automatically when snapped onto the DIN rail.

These I/O modules are not provided with integrated power jumper contacts. The power supply is made by the data contacts with a DC-DC converter. The modules can work self-supporting.

**Attention:**
The lowest power jumper contact is not carried out for some modules (e.g. 4-channel)! A module which needs all contacts (e.g. 2 channel digital) may not be connected to the right hand side of modules which do not have 3 power jumper contacts (e.g. 4 channel modules).

The output module can be connected to all buscouplers of the **WAGO I/O SYSTEM** (except for the economy type).

## Technical Data:

| | |
|---|---|
| Item Number 750- | 550, 580 |
| Number of channels | 2 |
| Nominal voltage | via system voltage (DC DC converter) |
| Current consumption (internal) | 65 mA |
| Voltage supply | via system voltage (DC-DC) |
| Signal voltage | 0-10 V |
| Resistance | > 5 kΩ |
| Resolution | 12 Bit |
| Isolation | 500 V system/power supply |
| Bit width per channel | 16 Bit Data, 8 Bit Control/Status |
| Operating temperature | 0°C....+55°C |
| Configuration | none, optional via software parameter |
| Wire connection | CAGE CLAMP; 0.08 to 2.5mm$^2$ |
| Dimensions (mm)WxHxL | 12 x 64* x 100 (*from upper edge of the carrier rail) |

## The numerical format

All analog values will be shown in a unit numerical format. The resolution is 12 Bits. The 3 LSBs are not taken into account. The following table will explain the numerical format. (750-550).

| Output voltage 0-10 V | Binary Value | Hex. | Dec. |
|---|---|---|---|
| 10 | 0111 1111 1111 1111 | 7F F8 | 32767 |
| 5 | 0100 0000 0000 0000 | 40 00 | 16384 |
| 2.5 | 0010 0000 0000 0000 | 20 00 | 8192 |
| 1.25 | 0001 0000 0000 0000 | 10 00 | 4096 |
| 0.0781 | 0000 0001 0000 0000 | 01 00 | 256 |
| 0.0049 | 0000 0000 0001 0000 | 00 10 | 16 |
| 0.0024 | 0000 0000 0000 1000 | 00 08 | 8 |
| 0 | 0000 0000 0000 0111 | 00 07 | 7 |
| 0 | 0000 0000 0000 0000 | 0 | 0 |

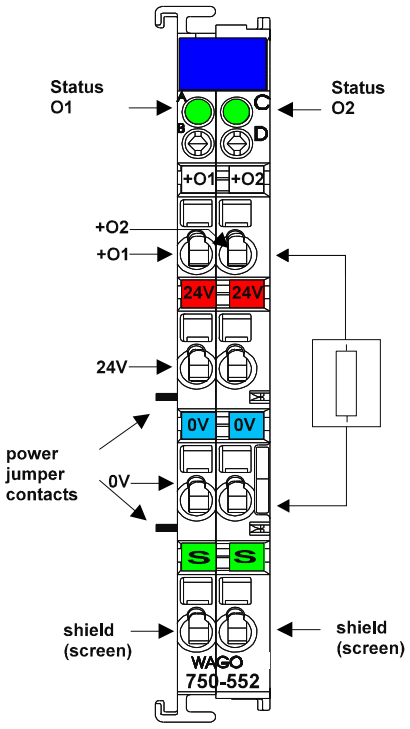
# The numerical format for Siemens

In addition to the full 16 bit indication of the measured value it is possible to use the ‘Siemens format’. The measured value is represented by the most significant 12 Bits. The 3 least significant Bits are reserved for diagnostic and status purposes. (750-580)

| Output voltage 0-10 V | Binary value | Hex. | Dec. |
|---|---|---|---|
| > 10 | 0101 0000 0000 XXXX | 50 01 | 20481 |
| 10 | 0100 0000 0000 XXXX | 40 00 | 16384 |
| 7.5 | 0011 0000 0000 XXXX | 30 00 | 12288 |
| 5 | 0010 0000 0000 XXXX | 20 00 | 8192 |
| 2.5 | 0001 0000 0001 XXXX | 10 08 | 4104 |
| 1.25 | 0000 1000 0000 XXXX | 800 | 2048 |
| 0 | 0000 0000 0000 XXXX | 0 | 0 |

**If you have questions about the formatting of this data, please contact WAGO for I/O System technical support.**

# 2 -Channel Analog Outputs 0-20 mA / 4-20 mA
# PN 750-552, 554, 584




## Technical Description

This description is only intended for hardware version X X X X 2 A 0 1 - - - -. The serial number can be found on the right side of the module.

The output signal of 750-552...555, 584 is a 0-10 mA or 4-20 mA signal. Sensors may be connected to „O“ and to the common ground (0V).
The shield is connected to „S“. The connection is made automatically when snapped onto the DIN rail.
Power connections are made automatically from module to module when snapped onto the DIN rail. For a self-supporting function, the power supply has to be connected by an input module (e.g. 750-602).

**Attention:**
The lowest power jumper contact is not carried out for some modules (e.g. 4-channel)! A module which needs all contacts (e.g. 2 channel digital) may not be connected to the right hand side of modules which do not have 3 power jumper contacts (e.g. 4 channel modules).

The output module can be connected to all buscouplers of the **WAGO I/O SYSTEM** (except for the economy type).

## Technical Data:

| Item Number 750- | 552 | 554 | 584 |
|---|---|---|---|
| Number of channels | 2 | | |
| Current consumption (internal) | 60 mA max. | | |
| Nominal voltage | 24 V DC (-15% /+20%) via power jumper contacts | | |
| Signal current | 0-20mA | 4-20mA | 4-20mA |
| Resistance | <500 Ω | | |
| Resolution | 12 Bit | | |
| Isolation | 500 V system/power supply | | |
| Bit width per channel | 16 Bit Data, 8 Bit Control/Status | | |
| Operating temperature | 0°C....+55°C | | |
| Configuration | none, optional via software parameter | | |
| Wire connection | CAGE CLAMP; 0.08 to 2.5mm$^2$ | | |
| Dimensions (mm)WxHxL | 12 x 64* x 100 (*from upper edge of carrier rail) | | |

## The numerical format

All analog values will be shown in a unit numerical format. The following table will explain the numerical format. (750-552/554). The 3 LSBs are not taken into account.

| Output current 0-20 | Output current 4-20 | Binary Value | Hex. | Dec. |
|---|---|---|---|---|
| 20 | 20 | 0111 1111 1111 1111 | 7F FF | 32767 |
| 10 | 12 | 0100 0000 0000 0000 | 40 00 | 16384 |
| 5 | 8 | 0010 0000 0000 0000 | 20 00 | 8192 |
| 2.5 | 6 | 0001 0000 0000 0000 | 10 00 | 4096 |
| 0.156 | 4.125 | 0000 0001 0000 0000 | 01 00 | 256 |
| 0.01 | 4.0078 | 0000 0000 0001 0000 | 00 10 | 16 |
| 0.005 | 4.0039 | 0000 0000 0000 1000 | 00 08 | 8 |
| 0 | 4 | 0000 0000 0000 0111 | 00 07 | 7 |
| 0 | 4 | 0000 0000 0000 0000 | 0 | 0 |

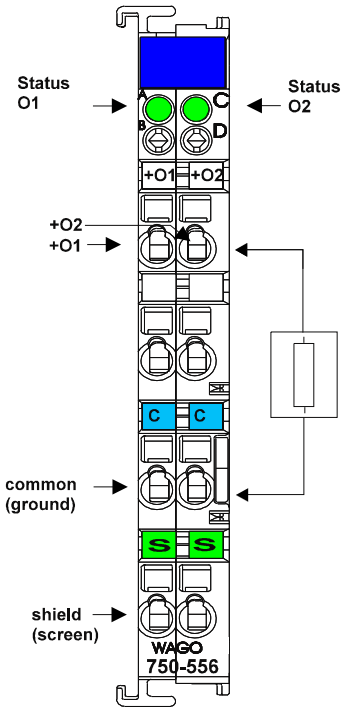
# The numerical format for Siemens

In addition to the full 16 bit indication of the measured value it is possible to use the ‘Siemens format’. The measured value is represented by the most significant 12 Bits. The 4 least significant Bits have no function. (750-584)

| Output current 4-20 mA | Binary value | Hex. | Dec. |
|---|---|---|---|
| 20 | 0100 0000 0000 XXXX | 40 00 | 16384 |
| 16 | 0011 0000 0000 XXXX | 30 00 | 12288 |
| 12 | 0010 0000 0000 XXXX | 20 00 | 8192 |
| 8 | 0001 0000 0000 XXXX | 10 00 | 4096 |
| 4.015 | 0000 0000 0001 XXXX | 00 10 | 16 |
| 4 | 0000 0000 0000 XXXX | 00 00 | 0 |

**If you have questions about the formatting of this data, please contact WAGO for I/O System technical support.**

# 2 Channel Analog Outputs +/- 10 V
# PN 750-556




## Technical Description

This description is only intended for hardware version X X X X 2 A 0 1 - - - -. The serial number can be found on the right side of the module.

The output signal of 750-556 is a +/- 10 V signal. Sensors may be connected to „O“ and to the common ground (0V).

The shield is connected to „S“. The connection is made automatically when snapped onto the DIN rail.
These I/O modules are not provided with integrated power jumper contacts. The power supply is made by the data contacts with a DC-DC converter. The modules can work self-supporting.

**Attention:**
The lowest power jumper contact is not carried out for some modules (e.g. 4-channel)! A module which needs all contacts (e.g. 2 channel digital) may not be connected to the right hand side of modules which do not have 3 power jumper contacts (e.g. 4 channel modules).

The input module can be connected to all buscouplers of the WAGO I/O SYSTEM (except for the economy type).

## Technical Data:

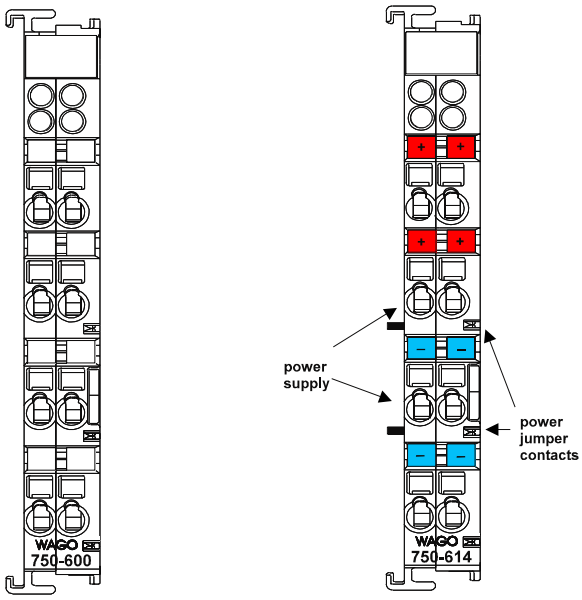
| Item Number 750- | 556 |
|---|---|
| Number of channels | 2 |
| Nominal voltage | via system voltage (DC DC converter) |
| Current consumption (internal) | 65 mA |
| Signal voltage | +/- 10 V |
| Resistance | > 5 kΩ |
| Resolution | 12 Bit |
| Isolation | 500 V System/Power supply |
| Bit width per channel | 16 Bit Data, 8 Bit Control/Status |
| Operating temperature | 0°C....+55°C |
| Configuration | none, optional via software parameter |
| Wire connection | CAGE CLAMP; 0.08 to 2.5mm$^2$ |
| Dimensions (mm)WxHxL | 12 x 64* x 100 (*from upper edge of the carrier rail) |

## The numerical format

All analog values will be shown in a unit numerical format. The resolution is 12 Bits and the 3 LSBs are ignored. The following table will explain the numerical format.

| Input voltage +/- 10 V | Binary Value | Hex. | Dec. |
|---|---|---|---|
| 10 | 0111 1111 1111 1111 | 7F FF | 32767 |
| 5 | 0100 0000 0000 0000 | 40 00 | 16384 |
| 2.5 | 0010 0000 0000 0000 | 20 00 | 8192 |
| 1.25 | 0001 0000 0000 0000 | 10 00 | 4096 |
| 0.0781 | 0000 0001 0000 0000 | 01 00 | 256 |
| 0.0049 | 0000 0000 0001 0000 | 00 10 | 16 |
| 0.0024 | 0000 0000 0000 1111 | 00 0F | 15 |
| 0 | 0000 0000 0000 0000 | 0 | 00 |
| -2.5 | 1110 0000 0000 0000 | E0 00 | 57344 |
| -5 | 1100 0000 0000 0000 | C0 00 | 49152 |
| -7.5 | 1010 0000 0000 0000 | A0 00 | 40960 |
| -10 | 1000 0000 0000 0000 | 80 00 | 32768 |

# End module, Potential multiplication module, Separation module
# PN750-600, 750-614, 750-616, 750-616/030-000




## Technical Description

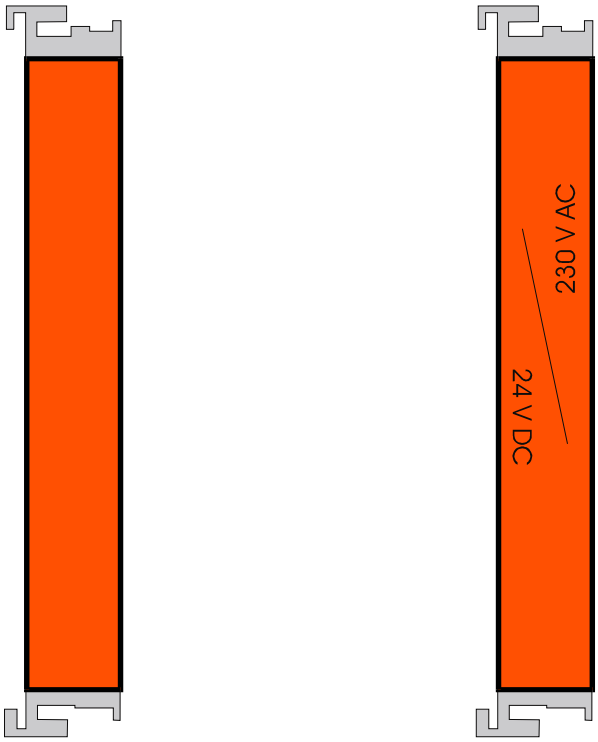
After the fieldbus node is assembled with the correct buscoupler and selected I/O modules, the end module is snapped onto the assembly. It completes the internal data circuit and ensures correct data flow.

The potential multiplication module allows additional + and - voltage connection points (up to 4 additional). This eliminates external terminal blocks.

## Technical Data:

| Item Number 750- | 600 | 614 |
|---|---|---|
| Voltage | - | 24 V - 230 V AC/DC |
| Current on contacts | - | max. 10 mA |
| Operating temperature | 0 °C ... + 55 °C | |
| Wire connection | CAGE CLAMP; 0,08 to 2,5 mm² | |
| Dimensions (mm) WxHxL | 12 x 64 x 100, (from the upper edge of the carrier rail) | |

## Separation module




## Technical description:

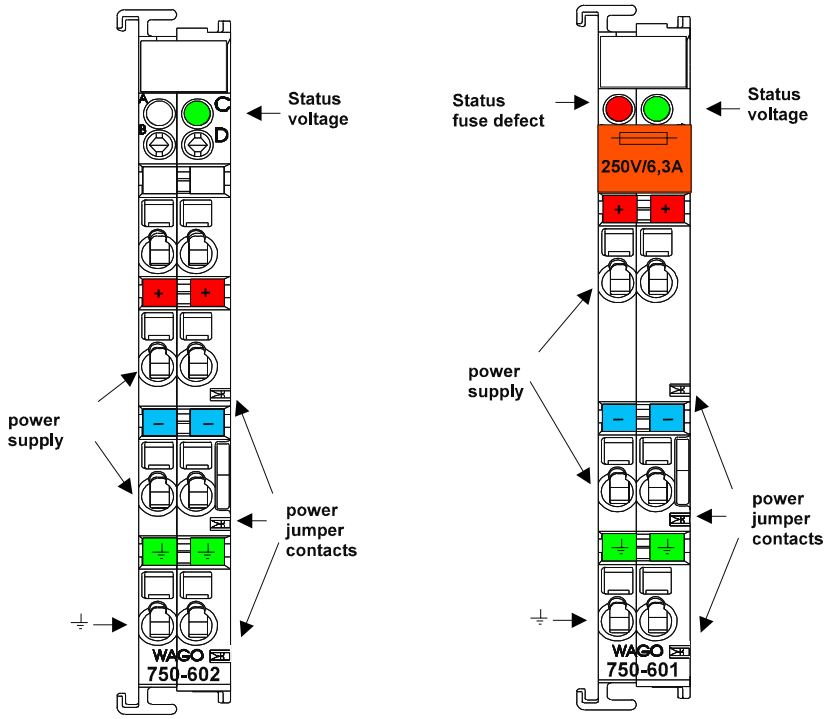
Use of this module allows increased air- and creepage distances between different field voltages within a node.

There are two different types of the separation module. With PN 750-616 you get a module without printing. PN 750-616/030-000 looks like the right one in the above picture.

## Technical Data:

| | |
|---|---|
| Item No. | 750-616, 750-616/030-000 |
| Dimensions (mm) W x H x L | 12 x 64* x 100, (*from the upper edge of the carrier rail) |

# Supply modules
# PN750-601, 602, 609, 610, 611, 612, 613, 615




## Technical Description

The supply module provides I/O module power through the power jumper contacts. Maximum current supply to all connected modules is 10 A. Maximum current supply to the modules with fuse holder is 6.3 A. Should higher currents be necessary, intermediate supply modules may be added in the assembly.
The modules 750-601, 609, 615, 610 and 611 are additionally equipped with a fuse holder. The change of the fuse is very easy by drawing out the fuse holder and changing the fuse. A blown fuse is indicated by a LED.
The modules 750-610 and 611 send information about the status of the supply module to the fieldbus coupler through two input bits.

| Bit1 | Bit2 | Description |
|---|---|---|
| 0 | 0 | voltage < 15 V DC |
| 1 | 0 | fuse blown |
| 0 | 1 | fuse o.k., voltage o.k. |

Using the supply modules you have to look for the allowed voltage. The following table shows the voltage for the supply modules.

The supply module 750-613 supplies the field side and te internal databus system voltage. The internal system voltage can supply 2 A max. If the sum of the internal current consumption exceeds 2 A, an additional supply module must be added.

# Technical Data:

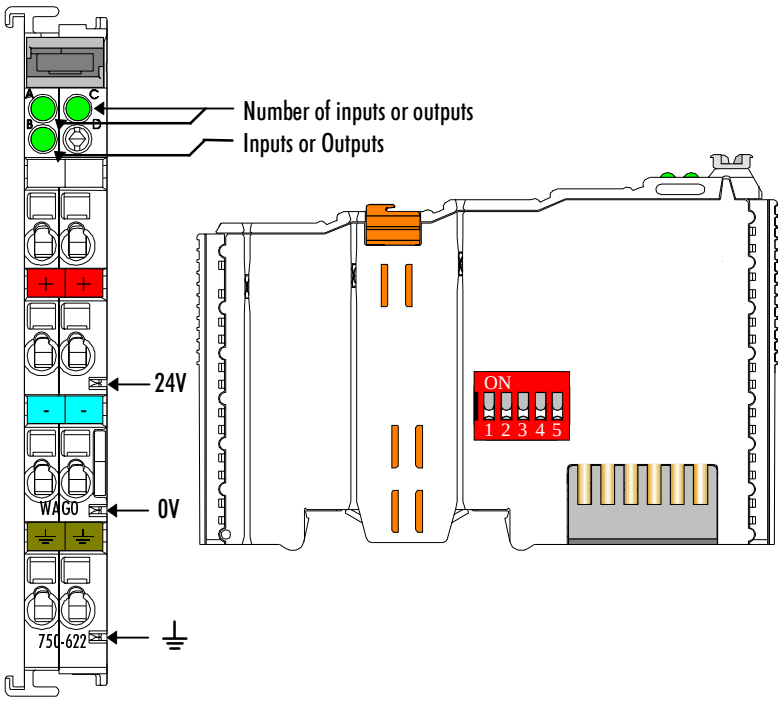
| Item Number 750- | 602 | 612 | 613 |
|---|---|---|---|
| Voltage | 24 V DC | 0 - 230 V AC/DC | 24 V DC (-15%/+20%) |
| Current via contacts | max. 10 A | | |
| Operating temperature | 0 °C ... + 55 °C | | |
| Wire connection | CAGE CLAMP; 0,08 to 2,5 mm² | | |
| Dimensions (mm) W x H x L | 12 x 64 x 100, (from the upper edge of the carrier rail) | | |

internal current 750-613: max. 2 A

| Item Number 750- | 601 | 609 | 615 |
|---|---|---|---|
| Voltage | 24 V DC | 230 V AC | 120 V AC |
| Current via contacts<br>Fuse | max. 6.3 A<br>5 x 20, 6.3 A | | |
| Operating temperature | 0 °C ... + 55 °C | | |
| Wire connection | CAGE CLAMP; 0,08 to 2,5 mm² | | |
| Dimensions (mm) W x H x L | 12 x 64 x 100, (from the upper edge of the carrier rail) | | |

| Item Number 750- | 610 | 611 |
|---|---|---|
| Number of inputs | 2 | |
| Current consumption | 5 mA | |
| Internal bitwidth | 2 | |
| Voltage | 24 V DC | 230 V AC |
| Current via contacts<br>Fuse | max. 6.3 A<br>5 x 20, 6.3 A | |
| Operating temperature | 0 °C ... + 55 °C | |
| Wire connection | CAGE CLAMP; 0,08 to 2,5 mm² | |
| Dimensions (mm) W x H x L | 12 x 64 x 100, (from the upper edge of the carrier rail) | |

# Binary spacer module
# PN 750-622




## Technical description

The binary spacer module reserves bit-addresses in the WAGO buscoupler.
The number of in or outputs can be chosen by two DIP switches. 2, 4, 6 or 8 bits are possible (1, 2, 3 or 4-channel modules). A third DIP Switch chooses inputs or outputs. The kind of configuration is indicated by means of 3 LEDs even if there is no voltage applied.

The binary spacer module works like a supply module. The power supply must be made for the following modules.

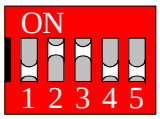
# Technical Data

| Item number 750- | 622 |
|---|---|
| Number of in- or outputs | 2, 4, 6 or 8 |
| Nominal voltage | 5 V DC internal |
| Internal current consumption | 10 mA max. |
| Voltage (field side) | 24 V DC (-15%/+20%) |
| Current via power jumper contacts | 10 A max. |
| Input current (field side) | - |
| Isolation | 500 V system/power supply |
| Internal bit width | 2, 4, 6 oder 8 |
| Configuration | none, optional via software parameter |
| Operating temperature | 0°C....+55°C |
| Wire connection | CAGE CLAMP; 0.08 to 2.5mm$^2$ |
| Dimensions (mm) WxHxL | 12 x 64* x 100 (*from upper edge of the carrier rail) |

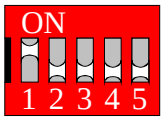
The DIP switches and LEDs are used as follows. When the switch is OFF the LED is also OFF (dark green symbol). When the switch is ON the LED lightens (yellow symbol).


| | | | |
|---|---|---|---|
| X | X | Don't care | |
| OFF | | Inputs |  |
| ON | | Outputs |  |
| OFF | OFF | 2 Bit (1x 2 Bit) |  |
| ON | OFF | 4 Bit (2x 2 Bit) |  |
| OFF | ON | 6 Bit (3x 2 Bit) |  |
| ON | ON | 8 Bit (4x 2 Bit) |  |

**Examples:**

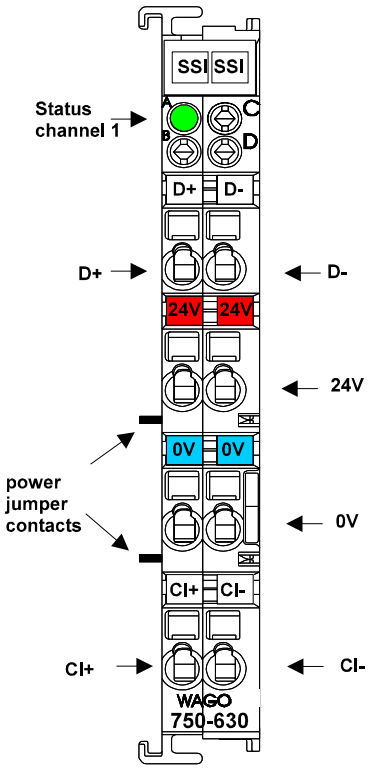



6 binary outputs (3x 2-channel output modules)




4 binary inputs (2x 2-channel input modules)

# SSI Encoder Interface
# PN 750-630, 750-630/000-001, 750-630/000-006




## Technical Description:

This technical description is only valid for hardware and software versions X X X X 2 B 0 2----. The product series number is printed on the right side of the module.

The operational mode of the module is factory preset to discern a 24 bit absolute encoder Graycode signal transmitted at 125kHz.

The following description is preliminary and is applicable to the factory configuration.

**Attention:**
The lowest power jumper contact is not carried out for some modules (e.g. 4-channel)! A module which needs all contacts (e.g. 2 channel digital) may not be connected to the right hand side of modules which do not have 3 power jumper contacts (e.g. 4 channel modules).

The SSI Interface is able to run with all WAGO➟I/O➟SYSTEM bus-couplers (except for the economy type).

# Technical Data:

| Series 750 | 630 | 630/000-001 | 630/000-006 |
|---|---|---|---|
| Encoder connections | Data Input: D+; D-; Clock Output: CI+; CI- | | |
| Current consumption (internal) | 85mA typ. | | |
| Power supply | 24V DC (-15%/+20%) | | |
| Sensor power supply | 24V DC via power jumper contacts | | |
| Baud rate | max. 1 MHz | | |
| Data field width | 32 Bit | | |
| Signal output (clock) | differential RS 422 | | |
| Signal input (positional) | differential RS 422 | | |
| Output data format | Graycode / Dualcode | | |
| Bit width | 32 Bit: Data; 8 Bit: Control/Status | | |
| Configuration | none, optional via software parameter | | |
| Signal isolation | 500 V system/power supply | | |
| Temperature range | 0°C....+55°C | | |
| Wire connection | CAGE CLAMP; 0.08 x 2.5mm$^2$ AWG 28-14 | | |
| Dimensions (mm) WxHxL | 12 x 64* x 100 (*from upper edge of carrier rail) | | |
| Default Configuration | 125 kHz Graycode 24 Bit Data Resolution | 125 kHz Binary 24 Bit Data Resolution | 250 kHz Graycode 24 Bit Data Resolution |

# Terminal Configuration:

| Input | Type | Function |
|---|---|---|
| Signal D+ and Signal D- | Input, RS422 | Positional data from encoder, Graycode. |
| Signal Cl+ and Signal CL- | Output, RS422 | Clock signal output for communications interface. |
| +24 V DC | Input | 24 V DC supply voltage to module, field connection. |
| 0 V DC | Input | 0 V DC supply voltage return to module, field connection. |

The use of this module in conjunction with a SSI encoder provides direct positional information rather than the type of data resultant from incremental type encoders. Absolute encoders are comprised of several data disks which generate a data word which is unique through out the 360 degrees of rotation. The data format is a modified binary pattern in either Graycode or Dualcode.

The resolution of the sensor depends upon the configuration of the sensor and the physical number of revolutions in the motion profile. Since the basis of the encoder is to provide absolute positional information based upon a mechanical configuration limited to one revolution or less. The maximum resolution of this module is 24 bit.

The frequency of the data signal input to the SSI module is maintained at 125 kHz. Listed below are the recommended cable lengths for the various clock signal Baud rates.

| Baud rate | Maximum cable length |
|---|---|
| 100 kHz | 400 meters |
| 200 kHz | 200 meters |
| 300 kHz | 100 meters |
| 400 kHz | 50 meters |

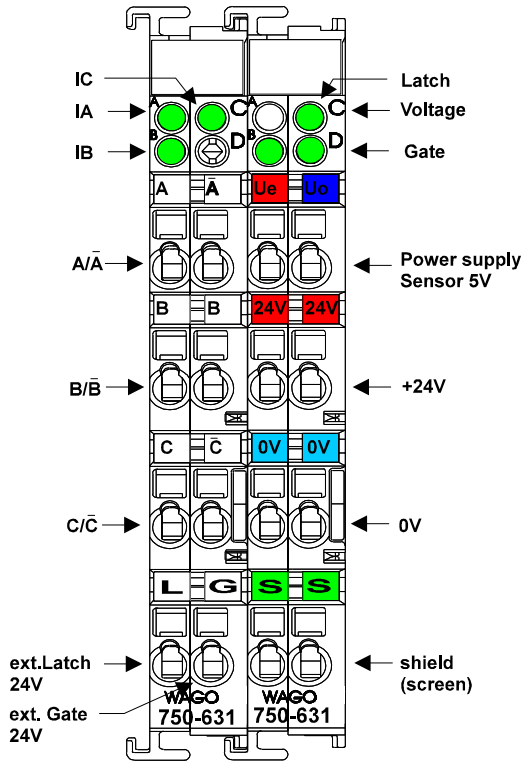
## Organization of the in- and output data for ModBus

The module is seen like an analog input with 2 x 16 Bit input data.

Inputs:

| Word | Data Word Designation | |
|---|---|---|
| D0 (Bit 0-15) | Positional data,<br>Input byte 1 | Positional data,<br>Input byte 0 |
| D1 (Bit 16-31) | Positional data,<br>Input byte 3 | Positional data,<br>Input byte 2 |

# Quadrature Encoder Interface
# PN 750-631, 750-631/000-001




## Technical Description:

This technical description is only valid for hardware and software versions X X X X 2 B 0 1----. The product series number is printed on the right side of the module.

The described operational mode is 4 times or quadrature sampling.

The following description is preliminary and is applicable to the factory configuration.

**Attention:**
The lowest power jumper contact is not carried out for some modules (e.g. 4-channel)! A module which needs all contacts (e.g. 2 channel digital) may not be connected to the right hand side of modules which do not have 3 power jumper contacts (e.g. 4 channel modules).

The Quadrature Encoder Interface is able to run with all WAGO➡I/O➡SYSTEM bus-couplers (except for the economy type).

# Technical Data:

| Series 750- | 631 | 631/000-001 |
|---|---|---|
| Encoder connections | A, A(inv.); B, B(inv.); Index, Index(inv.) | |
| Current consumption (internal) | 25 mA | |
| Sensor supply voltage | 5 V DC | |
| Data word | 16 Bit Binary | |
| Maximum frequency | 1 MHz | |
| Counter modes | 1-2-4 times sampling | |
| Data latch word | 16 Bit | |
| Commands | read, reset, start | |
| Supply voltage | 24 V DC (-15%/+20%) | |
| Current consumption | 85mA Field (without sensor) | |
| Sensor | 0.1 A (without sensor load) | |
| Bit width | 1 x 32 Bit: Data; 8 Bit:Control/Status | |
| Configuration | none, optional via software parameter | |
| Operational temperature | 0°C....+55°C | |
| Wire connection | CAGE CLAMP; 0.08 x 2.5mm$^2$ AWG 28-14 | |
| Dimensions (mm) WxHxL | 24 x 64* x 100 (*from upper edge of the carrier rail) | |
| Default configuration | 4 times sampling | 1 time sampling |

## Operational Characteristics:

The quadrature encoder interface accepts up to two input signals for the counting increment. The index pulse may also be considered should the control configuration require. There is also a Latch and Gate input available on the module for added functionality.

The quadrature encoder provides two signals that are shifted 90 degrees from each other, signals A and B. In order to achieve a better common mode noise rejection ratio, the output signals from the encoder are transmitted via a differential signal. Their complement signals, A(inv.) and B(inv.) are also transmitted. A directional determination may be made by which signal leads. If the A signal leads, the direction is considered to be forward. If the B signal leads, the direction is considered to be reverse. By exchanging the A and A(inv.) the phase relationship will be changed by 180 degrees, thus allowing the direction to be preset via the wiring configuration.
Most quadrature encoders have an Index signal, or Z rev, as well as the incremental signal. This signal provides one pulse per revolution with a duration equal to an incremental pulse.

The inputs to the quadrature encoder module must be supplied from an encoder with Line Driver Outputs for proper operation. The 5 Volt DC output may be used to power the encoder. The 24 Volt DC input supply must be provided from an external power supply.
The Gate and Latch inputs are 24 Volt DC.

Module Inputs and Outputs

| Connection | Type | Function |
|---|---|---|
| Signal A and Signal A(inv.) | Input, TTL | Incremental pulse signals for channel A |
| Signal B and Signal B(inv.) | Input, TTL | Incremental pulse signals for channel B |
| Signal C and Signal C(inv.) | Input, TTL | Index pulse signals |
| Shield | Input | Shield connection for encoder wiring |
| Sensor 0V DC | Output | Supply return for encoder supply |
| Sensor +5V DC | Output | 5 Volt DC supply for encoder |
| +24V DC | Input | 24 Volt DC supply, field connection |
| 0V DC | Input. | Supply return, field connection |
| Gate | Input, 24V DC | 24 Volt DC input for gate signal |
| Latch | Input, 24V DC | 24 Volt DC input for Latch signal |

The Input Gate stops the counter. Only 0 V or an open connection initialize the counter. 24 V stops the counting process.

The input Latch controls the overtaking of the actual counter value into the Latchregister. This input is activated by teh control bit EN_LATEXT („1“). EN_LACT has to be deactivated („0“). The first change from 0 V to 24 V at the Latch input takes the actual counter value into the Latchregister.
The control byte contains the information as listed below.

| Control Byte Configuration | | | | | | | |
|---|---|---|---|---|---|---|---|
| Bit 7 | Bit 6 | Bit 5 | Bit 4 | Bit 3 | Bit 2 | Bit 1 | Bit 0 |
| 0 | x | CFAST_M | x | x | CNT_SET | EN_LATEXT | EN_LATC |
| 0 | x | Operation Mode | x | x | Counter Set | Release Latch | Release Index Pulse |

Please note Bit 7 is a reserved bit and must always be set to 0. It is responsible for register communication which is not decribed in this chapter.

| **Bit** | **Function** |
|---|---|
| CFAST_M | Fast mode operation. Only the counter module function will be operable. All other control bits will be ignored. |
| CNT_SET | The counter module will be preset to a count value with a rising edge. |
| EN_LATEXT | 0=The external latch input is deactivated.<br>1=The module will latch in the counter data on the first rising edge. Other changes have no effect. |
| EN_LACT | 0=Latching data with the Index pulse is deactivated.<br>1=The Index pulse will latch in the counter data on the first rising edge. Other changes have no effect. |

The status byte contains the information as listed below.

| Status Byte Configuration | | | | | | | |
|---|---|---|---|---|---|---|---|
| Bit 7 | Bit 6 | Bit 5 | Bit 4 | Bit 3 | Bit 2 | Bit 1 | Bit 0 |
| 0 | x | x | OVERFLOW | UNDERFLOW | CNTSET_ACC | LATEXT_ VAL | LATC_ VAL |
| 0 | x | x | Counter Overflow | Counter Underflow | Counter Set Acknowledge | External Latch Ack. | Latched Data Set |

| **Bit** | **Function** |
|---|---|
| OVERFLOW | The Overflow bit will be set if the counter value rolls over from 65535 to 0. This bit will automatically be reset if the counter passes through more than one third of the count range, 21845 to 21846, or if an Underflow occurs. |
| UNDERFLOW | The Underflow bit will be set if the counter value rolls back from 65535 to 0. This bit will automatically be reset if the counter passes through more than two thirds of the count range, 43690 to 43689, or if an Overflow occurs. |
| CNTSET_ACC | The Counter Set Acknowledge but is set when a valid counter value is preset to the module. |
| LATEXT_VAL | The Latch External Valid Acknowledge bit is set when a counter value is latched into the module via the Latch input. |
| LACT_VAL | The Latch Index Pulse Valid Acknowledge bit is set when a counter value is latched into the module via the Index pulse. |

It is possible to process and/or check the below listed actions via the control and status bits.

**Extending the 16 bit counting range**: The internal counting range is 16 bits or a maximum value of 65535. Should the application require an extended count range the location-difference-integration method may be employed. This method uses the control system to store the interrogated counter value. Any new interrogated value will have the previously stored counter value subtracted from it. This value will then be added to an accumulated register value. It is assumed that the counter difference of the two interrogated values is smaller than 16 bits therefore overflows need not be considered.

Another method calculates the extended counter range via the underflow and overflow status bits. The interrogated value is either added or subtracted to the accumulation register depending upon the status of the overflow or underflow bits.

**Set Counter Position**: The presetting of the counter is possible via the CNT_SET bit. The desired preset is loaded into the data register and the CNT_SET bit is set from 0 to 1. The CNTSET_ACC bit will be set to 1 when the preset value is loaded into the count register.

**Maintaining the Present Counter Position**: The counter present value may be maintained or latched via the external Latch input. First the external latch must be enabled via the EN_LATEXT bit. Once the input is enabled, the data will be latched into the counter module upon a 0 to 1 transition. Upon completion of the latch process the external latch valid bit LATEXT_VAL will be set to 1.

**Maintaining a Reference Point**: The storage of a present counter value may also accomplished via the Index pulse from the encoder. First the index latch enable bit must be set, EN_LACT, to a value 1. The counter present value will be latched upon the low to high transition of the Index input. Upon completion of the data latch process the Index Latch Valid bit, LACT_VAL will be set to 1.

## Organization of the in- and output data for ModBus

The module is seen like an analog module with 3 x 16 Bit input and output data.

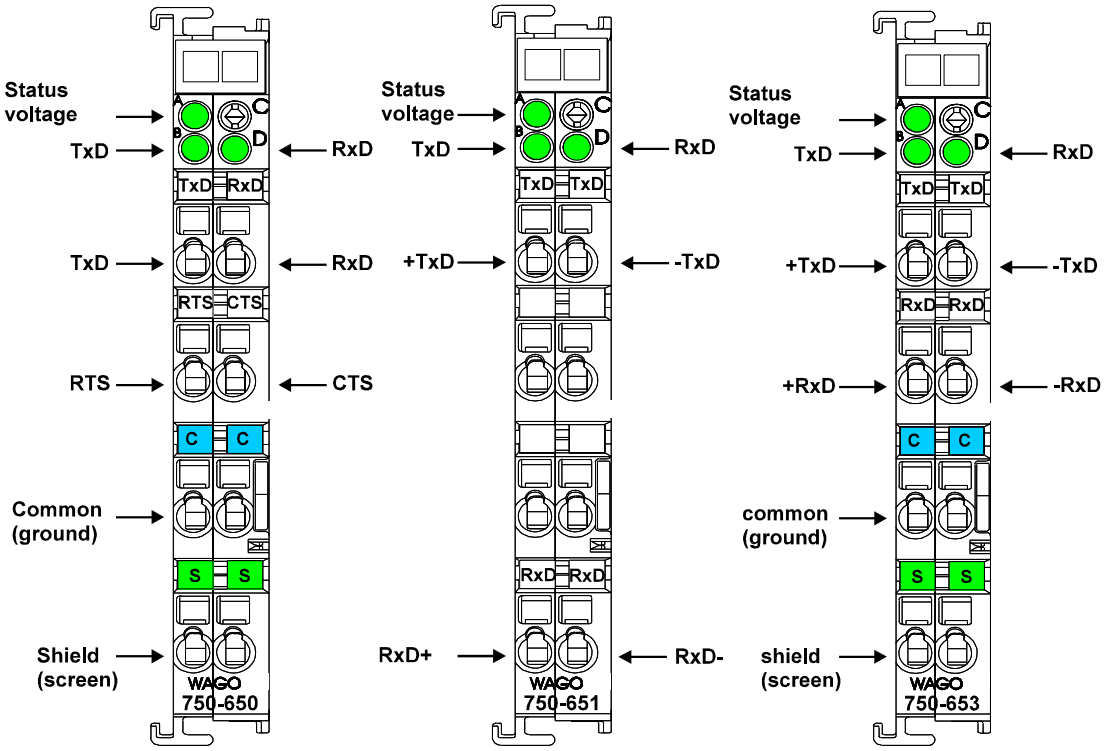
Outputs:

| **Word** | **function** | |
|---|---|---|
| D0 (Bit 0-15) | control byte | set counter-Byte1 |
| D1 (Bit 16-31) | set counter-Byte0 | |
| D2 (Bit 32-47) | | |

Inputs:

| **Word** | **function** | |
|---|---|---|
| D0 (Bit 0-15) | Statusbyte | counter byte 1 |
| D1 (Bit 16-31) | counter byte 0 | |
| D2 (Bit 32-47) | Latch value-Byte1 | Latch value-Byte0 |

# RS232C Interface, TTY Interface -20 mA Current Loop RS485C Interface
# PN 750-650, 750-651, 750-653, 750-650/000-001




## Technical Description:

This technical description is only valid for hardware and software versions X X X X 2 C 0 3----. The product series number is printed on the right side of the module.

The operational mode described below is the presetting.

The following description is preliminary and is applicable to the factory configuration. Many other operational modes are possible (please contact WAGO for the corresponding settings).

**Attention:**
Some modules do not provide all power jumper contacts (e.g. 4-channel)! A module which needs all contacts (e.g. 2 channel digital) cannot be connected to the right hand side of modules which do not have 3 power jumper contacts.

The interface module is able to run with all WAGO I/O SYSTEM buscouplers (except for the economy type).

# Technical Data:

| Series 750- | 650,650/000-001 | 651 | 653 |
|---|---|---|---|
| Transmission channel | 2 (1/1), T x D and R x D, full duplex | | 2, autom. Send/Receive |
| Transmission rate | 1200 - 19200 baud | | |
| Bit skew | < 3 % | - | - |
| Bit transmission | - | 2 x 20 mA passive | acc. to ISO 8482/ DIN 66259 T 4 |
| Resistance | - | < 500 Ω | - |
| Current consumption (internal) | 50 mA max. | | |
| Transmission length | max. 15 m RS 232 cable | max. 1000 m twisted pair | max. 500 m twisted pair |
| Input buffer | 128 bytes | | |
| Output buffer | 16 bytes | | |
| Voltage supply | via internal system supply | | |
| Isolation | 500 V System/Supply | | |
| Bit width internal | 1 x 40 bit, 1 x 8 bit Control/Status | | |
| Configuration | none, parameter configuration with software | | |
| Operating temperature | 0 °C ... + 55 °C | | |
| Wire connection | CAGE CLAMP; 0,08 bis 2,5 mm² | | |
| Dimensions(mm) W x H x L | 12 x 64* x 100 (*from upper edge of the carrier rail) | | |
| Factory preset<br>Baud rate<br>Bit width internal | <br>9600 baud<br>1 x 24 bit in/out, 1 x 8 bit Control/Status | | |

## Description of RS 232:

The interface module is designed to operate with all WAGO I/O fieldbus couplers. The serial interface module allows the connection of RS 232-Interface devices to the WAGO I/O SYSTEM. The RS 232 Interface module can provide gateways within the fieldbus protocol. This allows serial equipment such as printers, barcode readers, and links to local operator interfaces to communicate directly by the fieldbus protocol with the PLC or PC Master.
This module supports no higher level of protocol. Communication is made completely transparent to the fieldbus allowing flexibility in further applications of the serial interface module. The communication protocols are configured at the Master PLC or PC.

The 128 byte input buffer provides for high rates of data transmission. When using lower rates of transmission speed you can collect the received data, with less priority, without loosing data.
The 16 byte output buffer provides for faster transmission of larger data strings.

**FUNCTION**

The data transmission takes place at 9.600 baud (default value). 1 startbit, 8 databits and 1 stopbit will be transmitted. No parity is available. The user controls data via the RTS and CTS signals. These signals are generated in the module depending on the loading status of the buffers. These controls can be deactivated by means of an external jumper. RTS and CTS are to be connected.

For testing purposes the Windows 3.11 terminal emulation can be used. A cable with a 9-pole sub-D socket is required. Pin 5 is connected to input M. Pin 2 is connected to TxD and Pin 3 to RxD. RTS and CTS of the module are connected. A hardwarehandshake between terminal emulation and SPS is not possible though.

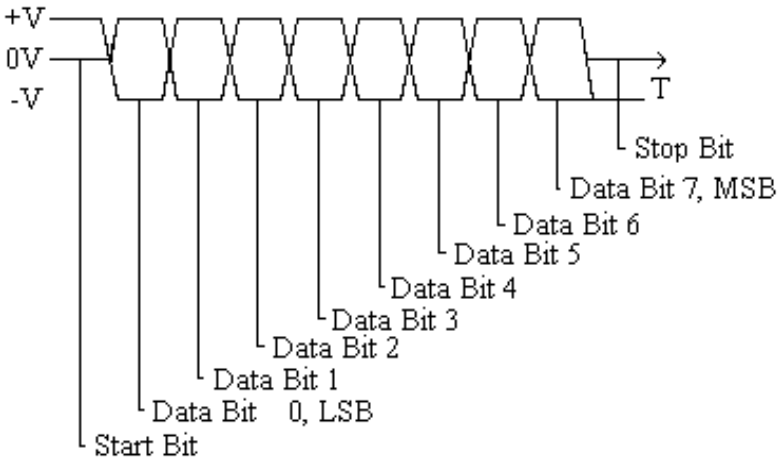



**Figure 2: Data Word Signal**

## Description of TTY:

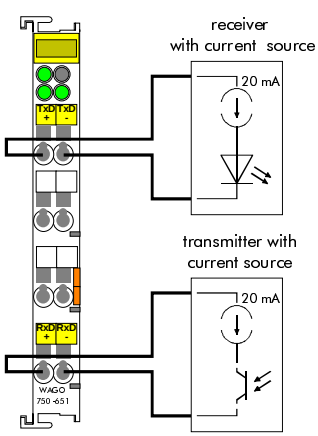
The interface module is designed to operate with all WAGO I/O fieldbus couplers. The TTY interface module allows the connection of TTY-Interface devices to the WAGO I/O SYSTEM. The TTY Interface module can provide gateways within the fieldbus protocol. This allows serial equipment such as printers, barcode readers, and links to local operator interfaces to communicate directly by the fieldbus protocol with the PLC or PC Master.
This module supports no higher level of protocol. Communication is made completely transparent to the fieldbus allowing flexibility in further applications of the serial interface module. The communication protocols are configured at the Master PLC or PC.

The 128 byte input buffer provides for high rates of data transmission. When using lower rates of transmission speed you can collect the received data, with less priority, without loosing data.
The 16 byte output buffer provides for faster transmission of larger data strings.

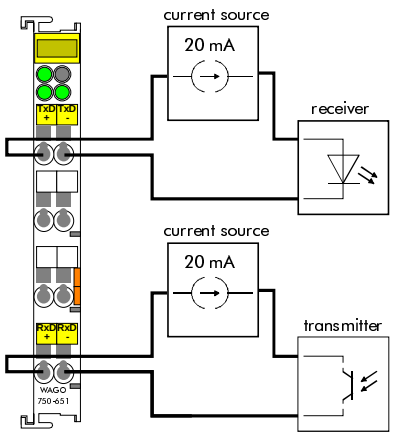
**FUNCTION**

The data transmission takes place at 9600 baud (default value). 1 startbit, 8 databits and 1 stopbit will be transmitted. No parity is available. The drivers are high ohmic. The control of data is made by the user software.

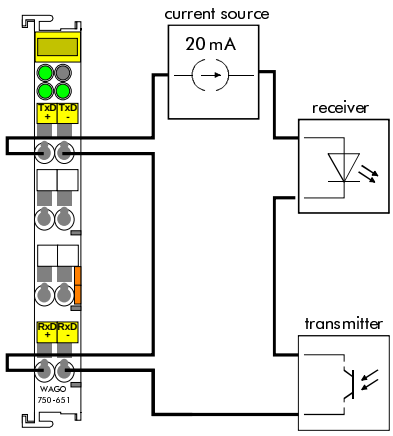
The TTY Interface is passive in sending and receiving , thus having no current sources. For data conversion an active partner is needed or an additional current source has to be connected.




point to point connection
with active partners




point to point connection with passive
partners and additional current sources




bus connection with a current source
and a passive module

## Description of RS 485:

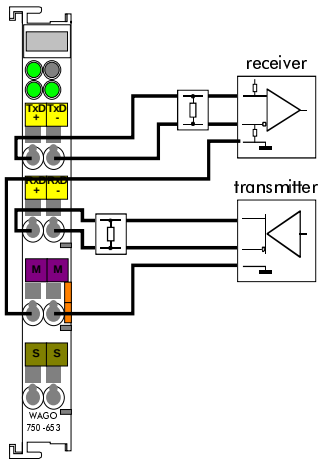
The interface module is designed to operate with all WAGO I/O fieldbus couplers. The serial interface module allows the connection of RS485 or RS488-Interface devices to the WAGO I/O SYSTEM. The RS485/RS488 Interface module can provide gateways within the fieldbus protocol. This allows serial equipment such as printers, barcode readers, and links to local operator interfaces to communicate directly by the fieldbus protocol with the PLC or PC Master.
This module supports no higher level of protocol. Communication is made completely transparent to the fieldbus allowing flexibility in further applications of the serial interface module. The communication protocols are configured at the Master PLC or PC.

The 128 byte input buffer provides for high rates of data transmission. When using lower rates of transmission speed you can collect the received data, with less priority, without loosing data.
The 16 byte output buffer provides for faster transmission of larger data strings.

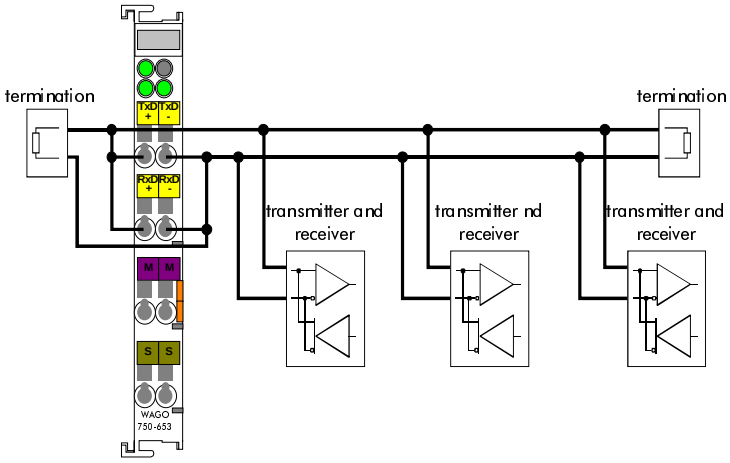
**FUNCTION**

The data transmission takes place at 9,600 baud (default value). 1 startbit, 8 databits and 1 stopbit will be transmitted. No parity is available. The drivers are high ohmic. The control of data is made by the user software.

The interface module can be used for bus connections as well as for point to point connections. With bus connections, *modules that are not connected to the power supply* can also be wired. They do not disturb the bus connection.




point to point connection




bus connection

## Structure of input and output data:

The module is a combined analog input and output module with 2 x 16 bit input and output data. The transfer of the data to be transmitted and the received data is made via up to 3 output and 3 input bytes. One control byte and one status byte are used to control the floating data.
Requests are indicated by a change of a bit. An assigned bit indicates execution by adopting the value of the request bit.

Up to 3 characters which have been received via interface can be stored in the input bytes 0 to 2. The output bytes will contain the characters to be sent.

The control byte consists of the following bits:

| **Control Byte** | | | | | | | |
|---|---|---|---|---|---|---|---|
| Bit 7 | Bit 6 | Bit 5 | Bit 4 | Bit 3 | Bit 2 | Bit 1 | Bit 0 |
| 0 | OL2 | OL1 | OL0 | 0 | IR | RA | TR |
| Con-stant value must always be 0. | Frames available in output area, OL2 is always 0. eg. OL2, OL1, OL0 = 0,1,1 3 characters should be sent and put into the output. | | | Constant value must always be 0. | Initialization request | Reception acknow-ledgement | Trans-mission request |

The status byte consists of the following bits:

| **Status Byte** | | | | | | | |
|---|---|---|---|---|---|---|---|
| Bit 7 | Bit 6 | Bit 5 | Bit 4 | Bit 3 | Bit 2 | Bit 1 | Bit 0 |
| 0 | IL2 | IL1 | IL0 | BUF_F | IA | RR | TA |
| Con-stant value must always be 0. | Frames available in input area, IL2 is always 0. eg. IL2,IL1,IL0 = 0,1,0 2 characters were received and reside in input 0 and input 1. | | | Input buffer is full. | Initialization acknow-ledgement | Reception request | Trans-mission acknow-ledgement |

The PLC is able to control transmission and reception of data by means of the control byte and the status byte.

**Initialization of the module**:

- set IR in the control byte
- transmit/receive functions are blocked
- output/input buffers are erased
- serial interface module will load its configuration data

**Transmitting data**:

- TR≠TA: put characters into output byte 0 to 2
- amount of characters is specified in OL0 to OL2
- TR is inverted and read out
- characters are put into output buffer if TR=TA

**Receiving data**:

- RR≠RA: in input byte 0 to 2 characters are available
- amount of characters is specified in IL0 to IL2
- charactersin IL0 to IL2 are read out
- RA is inverted and read out
- all characters are read when RR=RA

The transmitting and receiving of data can be done simultaneously. The initialization request has prioirity and will stop transmitting and receiving of data immediately.

Message: input buffer full (Bit 3)
Input buffer is full. Data which are received now are lost.

## Examples:

**The module is initialized.**

- The initialization bit in the control byte is set.

| Output byte 0 | Control byte | Output byte 2 | Output byte 1 |
|---|---|---|---|
| 0x00 | 0000.0100 | 0x00 | 0x00 |

- After the initialization has been executed, the status byte will give back 000.0100.

| Input byte 0 | Status byte | Input byte 2 | Input byte 1 | |
|---|---|---|---|---|
| XX | 0XXX.X0XX | XX | XX | Module is still being reset |
| XX | 0XXX.X1XX | XX | XX | Initialization completed |

Sending of the data string “Hello”:

- The first 3 characters and the buffer length of 3 are transmitted.

| Output byte 0 | Control byte | Output byte 2 | Output byte 1 |
|---|---|---|---|
| ‘H’ (0 x 48) | 0011.0000 | ‘l’ (0 x 6C) | ‘e’ (0 x 65) |

- The transmission request bit (TR) is inverted.

| Output byte 0 | Control byte | Output byte 2 | Output byte 1 |
|---|---|---|---|
| ‘H’ | 0011.0001 | ‘l’ | ‘e’ |

- As soon as TR=TA, the rest of the data can be sent.

| Input byte 0 | Status byte | Input byte 2 | Input byte 1 | |
|---|---|---|---|---|
| XX | 0XXX.XXX0 | XX | XX | The data is still being transferred. |
| XX | 0XXX.XXX1 | XX | XX | Data transfer completed. |

- The last 2 characters and the buffer length of 2 are transmitted.

| Output byte 0 | Control byte | Output byte 2 | Output byte 1 |
|---|---|---|---|
| ‘l’ | 0010.0001 | XX | ‘o’ (0 x 6F) |

- The transmission request bit (TR) is inverted.

| Output byte 0 | Control byte | Output byte 2 | Output byte 1 |
|---|---|---|---|
| ‘l’ | 0010.0000 | XX | ‘o’ |

- As soon as TA = TR, the data has been transferred to the output buffer.

| Input byte 0 | Status byte | Input byte 2 | Input byte 1 | |
|---|---|---|---|---|
| XX | 0XXX.XXX1 | XX | XX | The data is still being transferred. |
| XX | 0XXX.XXX0 | XX | XX | Data transfer completed. |

Receiving the character chain “WAGO”

- As soon as RA≠RR, the input bytes contain data.

| Output byte 0 | Control yte | Output byte 2 | Output byte 1 |
|---|---|---|---|
| XX | 0XXX.000X | XX | XX |

| Input byte 0 | Status byte | Input byte 2 | Input byte 1 | |
|---|---|---|---|---|
| XX | 0XXX.0X0X | XX | XX | No received data available. |
| ‘W’ (0 x 57) | 0011.0X1X | ‘G’ (0 x 47) | ‘A’ (0 x 41) | The information is in the input bytes. |

- After the 3 characters have been processed, RA is inverted.

| Output byte 0 | Control byte | Output byte 2 | Output byte 1 |
|---|---|---|---|
| XX | 0XXX.001X | XX | XX |

- If RA≠RR, the receiving of additional characters will continue.

| Input byte 0 | Status byte | Input byte 2 | Input byte 1 | |
|---|---|---|---|---|
| XX | 0XXX.0X1X | XX | XX | No received data available. |
| ‘O’ (0 x 4F) | 0001.0X0X | XX | XX | The information is in the input bytes. |

- After the characters have been processed, RA is inverted.

| Output byte 0 | Control byte | Output byte | Output byte |
|---|---|---|---|
| XX | 0XXX.000X | XX | XX |

Notes:

0 x 23 is a hexadecimal value
0101.1001 is a binary value
An X indicates that this particular value has no importance.
XX indicates that the whole value has no importance.

**Status Indicators:**

The 3 green LEDs have the following function:

| Function | Non-Function |
|---|---|
| Output Status TxD | Input Status RxD |

## Structure of the in and output data for ModBus

The module is a combined input and output module with 2 x 16 bit input and output data.

Outputs:

| Word | Description | |
|---|---|---|
| D0 (bit 0-15) | Output byte0 | Control byte |
| D1(bit16-31) | Output byte2 | Output byte1 |

Inputs:

| Word | Description | |
|---|---|---|
| D0 (bit 0-15) | Input byte0 | Status byte |
| D1(bit16-31) | Input byte2 | Input byte1 |

The RS232 module is also available with a data format of 5 bytes (item-no. 750-650/000-001).

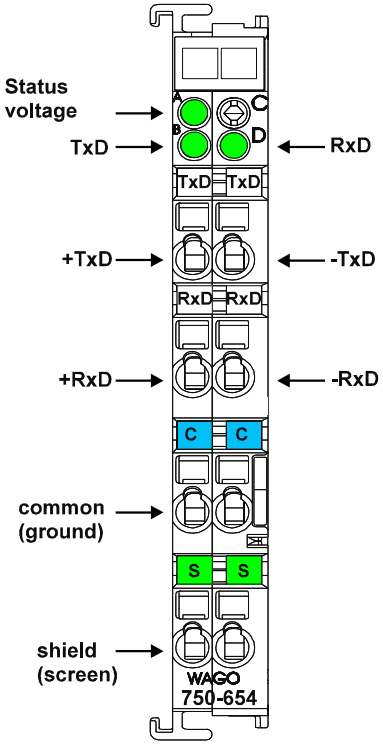
Outputs:

| Word | Description | |
|---|---|---|
| D0 (bit 0-15) | Control byte | Output byte0 |
| D1(bit16-31) | Output byte1 | Output byte2 |
| D2(bit32-47) | Output byte3 | Output byte4 |

Inputs:

| Word | Description | |
|---|---|---|
| D0 (bit 0-15) | Status byte | Input byte0 |
| D1(bit16-31) | Input byte1 | Input byte2 |
| D2(bit32-47) | Input byte3 | Input byte4 |

# Data exchange module
# PN 750-654




## Technical Description

This technical description is only valid for hardware and software versionx X X X X 2 C 0 0 - - - -. The product series number is printed on the right side of the module.

The operational mode described below is for the factory preset mode.

The following description is preliminary and is applicable to the factory configuration. Many other operational modes are possible (please contact WAGO for the corresponding settings.)

**Attention:**
Some modules do not provide all power jumper contacts (e.g. 4-channel)! A module which needs all contacts (e.g. 2-channel digital) cannot be connected to the right hand side of modules which do not have 3 power jumper contacts.

The data exchange module is able to run with all WAGO I/O SYSTEM buscouplers (except for the economy type).

# Technical Data

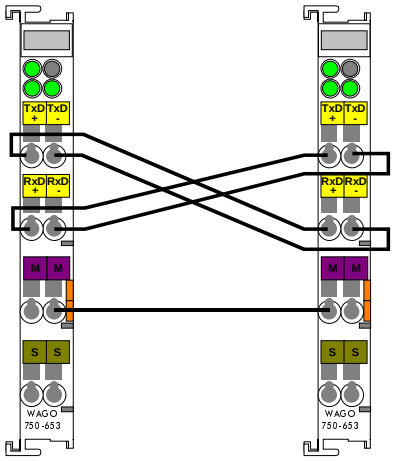
| | |
|---|---|
| Series 750- | 654 |
| Transmission channel | TxD and RxD, full duplex, 2 channel |
| Transmission rate | 62500 Baud |
| Bit transmission | via 2 twisted pair with differential signals |
| Resistance of cable | 120 Ω |
| Current Consumption (internal) | 65 mA max. |
| Transmission length | max. 100 m twisted pair |
| Input buffer | 128 Byte |
| Output buffer | 16 Byte |
| Voltage supply | via internal system |
| Isolation | 500 V System/Supply |
| Bit width internal | 1 x 40 bits, 1 x 8 bits control/status |
| Configuration | none, parameter configuration with software |
| Operating temperature | 0 °C ... + 55 °C |
| Wire connection | CAGE CLAMP; 0.08 to 2.5 mm² |
| Dimensions (mm) W x H x L | 12 x 64* x 100 (*from upper edge of the carrier rail) |
| Factory preset<br>internal bit width | <br>1 x 32 bits in/out, 1 x 8 bits control/status |

## Description of data exchange module

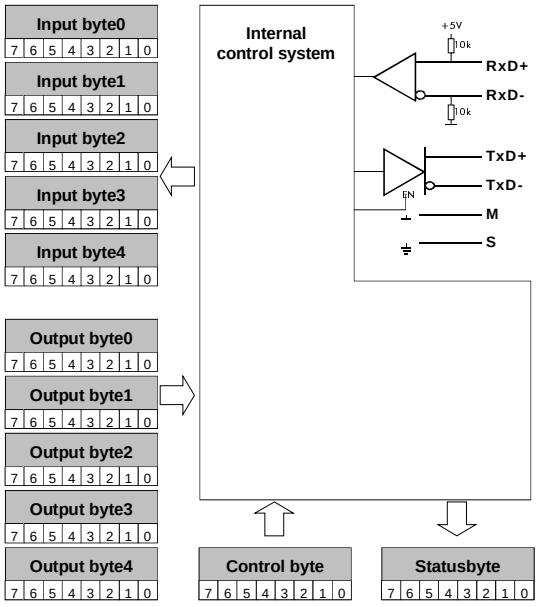
The data exchange module allows the exchange of 4 (5) bytes between different fieldbus systems via multiplexing of a serial connection. The delay which is caused by the multiplexor is < 5ms. The integrated watchdog function switches all outputs to zero if there is no valid information for more than 200 ms via the multiplex connection.

The 128 bytes input buffer provides for high rates of data transmission. When using lower rates of transmission speed you can collect the received data, with less priority, without loosing data.
The 16 byte output buffer provides for faster transmission of larger data strings.

The data exchange module is connected peer-to-peer. For the wiring of the serial multiplex connection the RxD and TxD cables are crossed. The following illustrations show the peer-to-peer connection and the internal structure of the data exchange module.




peer-to-peer connection



## Structure of input and output data:

The module is a combined special function input and output module with 1 x 32 (40) Bit input and output data. The tranfer of the data to be transmitted and the received data is made via up to 5 input and 5 output Bytes. One control byte and one status byte are used to control the floating data.

The control byte consists of the following bits:

| Control byte | | | | | | | |
|---|---|---|---|---|---|---|---|
| Bit 7 | Bit 6 | Bit 5 | Bit 4 | Bit 3 | Bit 2 | Bit 1 | Bit 0 |
| 0 | | | | | | | |
| Constant value always must be 0 | | | | | | | |

The status byte consists of the following bits:

| Status byte | | | | | | | |
|---|---|---|---|---|---|---|---|
| Bit 7 | Bit 6 | Bit 5 | Bit 4 | Bit 3 | Bit 2 | Bit 1 | Bit 0 |
| 0 | | | RCVT1 | RCVT2 | CHK | OVR | PAR |
| Constant value always must be 0. | | | Module is in timeout. All output bits are set to 0 (watchdog). | The receiver is in timeout. | Checksum error. | Buffer overflow | Pariry error or wrong data in a frame. |

The PLC is able to control transmission and reception of data by means of the control byte and the status byte.

**Control of the multiplex connection:** In the process image of the transmitting buscoupler one Bit is set to „1“ for the whole time. As long as this Bit is „1“ in the receiving coupler, further input Bits can be evaluated. If the Bit is „0“ the multiplex connection has been disrupted. The further Bits are also 0 because of the watchdog.

**Control of the multiplex connection with acknowledge:** If the transmitting buscoupler gets an acknowledge from the receiving buscoupler, the received bit must be transfered as an output bit to the process image. The transmission is successful as long as the Bit is „1“.

**Handshake:** If a serial data exchange should be made with the data exchange module, the handshake can be made via „Toggle Bits“. Therefore an input bit and an output bit are reserved. As soon as those bits are different from each other, a request from the opposite module is made. As soon as the request is executed the output bit is toggled.

## Structure of the in- and output data for Profibus (from firmware WH)

The ID 179 (hex: 0xB3), ( Data consistence over 4 Byte) is used.

Outputs

| Byte | Description |
|---|---|
| D0 | Output byte0 |
| D1 | Output byte1 |
| D2 | Output byte2 |
| D3 | Output byte3 |

Inputs

| Byte | Description |
|---|---|
| D0 | Input byte0 |
| D1 | Input byte1 |
| D2 | Input byte2 |
| D3 | Input byte3 |

For the ID 188 (hex.: 0xBC), Data consistence over 6 Byte is used, input and output data are now as follows:

Outputs

| Byte | Description |
|---|---|
| D0 | Control byte |
| D1 | Output byte0 |
| D2 | Output byte1 |
| D3 | Output byte4 |
| D4 | Output byte2 |
| D5 | Output byte3 |

Inputs

| Byte | Description |
|---|---|
| D0 | Statusbyte |
| D1 | Input byte0 |
| D2 | Input byte1 |
| D3 | Input byte4 |
| D4 | Input byte2 |
| D5 | Input byte3 |

For a S7 PLC the function code SFC14 and SFC15 must be used because the data length is more than 4.

**Attention:**
The control byte allows the changing of the registers of the module. It must always be 0 in order to avoid a change in the registers. A wrong mapping can change the function of the module!

## Structure of the in- and output data for InterBus S (from firmware WF)

The module is a combined special function input and output module with 2 x 16 Bit in- and output data.

Input

| Word | Description | |
|---|---|---|
| | High | Low |
| n (Bit0-Bit15) | Input byte0 | Input byte1 |
| n+1 (Bit16-Bit31) | Input byte2 | Input byte3 |

Output

| Word | Description | |
|---|---|---|
| | High | Low |
| n (Bit0-Bit15) | Output byte0 | Output byte1 |
| n+1 (Bit16-Bit31) | Output byte2 | Output byte3 |

**Attention:**
For Interbus S the data is written in Motorola format (high Byte first). In connection with other fieldbus systems the Bytes in the data word are changed.

**Attention:**
The control byte allows the changing of the registers of the module. It must always be 0 in order to avoid a change in the registers. A wrong mapping can change the function of the module!

## Structure of the in- and output data for DeviceNet (from firmware 306V2.2)

The module has 6 Bytes input and output data in the Poll I/O data. Consumed (Tx for the Scanner) and produced (Rx for the Scanner) data size are each 6 Byte more.

Input

| Byte | Description |
|---|---|
| D0 | Control byte |
| D1 | Input byte1 |
| D2 | Input byte0 |
| D3 | Input byte4 |
| D4 | Input byte3 |
| D5 | Input byte2 |

Output

| Byte | Description |
|---|---|
| D0 | Status byte |
| D1 | Input byte1 |
| D2 | Input byte0 |
| D3 | Input byte4 |
| D4 | Input byte3 |
| D5 | Input byte2 |

**Attention:**
The control byte allows the changing of the registers of the module. It must always be 0 in order to avoid a change in the registers. A wrong mapping can change the function of the module!

## Structure of the in- and output data for DeviceNet (from firmware 306V3.0)

The module has 4 Bytes input and output data in the polled I/O data.

Input

| Byte | Description |
|---|---|
| D0 | Input byte0 |
| D1 | Input byte1 |
| D2 | Input byte2 |
| D3 | Input byte3 |

Output

| Byte | Description |
|---|---|
| D0 | Input byte0 |
| D1 | Input byte1 |
| D2 | Input byte2 |
| D3 | Input byte3 |

## Structure of the in- and output data for Modbus (from firmware V2.3)

The module is a combined special function input and output module with 2 x 16 Bit in- and output data.

Input

| Word | Description | |
|---|---|---|
| | **High** | **Low** |
| n (Bit0-Bit15) | Input byte0 | Input byte1 |
| n+1 (Bit16-Bit31) | Input byte2 | Input byte3 |

Output

| Word | Description | |
|---|---|---|
| | **High** | **Low** |
| n (Bit0-Bit15) | Output byte0 | Output byte1 |
| n+1 (Bit16-Bit31) | Output byte2 | Output byte3 |

**Attention:**
For Interbus S the data is written in Motorola format (high Byte first). In connection with other fieldbus systems the Bytes in the data word are changed.

**Attention:**
The control byte allows the changing of the registers of the module. It must always be 0 in order to avoid a change in the registers. A wrong mapping can change the function of the module!

## Structure of the in- and output data for CanOpen (from firmware WI)

The module is in the list with Index 0x2400 (input) and Index 0x2500 (output). The module has 2 subindexes.

**2 Byte special modules, Inputs**

| Idx | SIdx | Name | Type | Attrib. | Default | Description |
|---|---|---|---|---|---|---|
| 2400 | 0 | special 2 byte input | Unsigned8 | ro | none | number of 2 Byte channels |
| | .... | .... | .... | .... | .... | .... |
| | n | Input byte0, Input byte1 | Unsigned16 | ro | none, 0x0 for WD error | 1. and 2. Input byte |
| | n+1 | Input byte2, Input byte3 | Unsigned16 | ro | none, 0x0 for WD error | 3. and 4. Input byte |
| | .... | .... | .... | .... | .... | .... |
| | 0xFF | 0xFF. Special input | Unsigned16 | ro | none | 255. Input channel |

**2 Byte special modules, Outputs**

| Idx | SIdx | Name | Type | Attrib. | Default | Description |
|---|---|---|---|---|---|---|
| 2500 | 0 | special 2 byte output | Unsigned8 | ro | none | number of 2 Byte channels |
| | .... | .... | .... | .... | .... | .... |
| | n | Output byte0, Output byte1 | Unsigned16 | rw | none | 1. and 2. Output byte |
| | n+1 | Output byte2, Output byte3 | Unsigned16 | rw | none | 3. and 4. Output byte |
| | .... | .... | .... | .... | .... | .... |
| | 0xFF | 0xFF. special output | Unsigned16 | rw | none | 255. Outputkanal |

**Attention:**

The control byte allows the changing of the registers of the module. It must always be 0 in order to avoid a change in the registers. A wrong mapping can change the function of the module!

## Structure of the in- and output data for CAL (from firmware WE)

**Mode class 4:**
The data is in the 2 Byte objects #BK_AI2W0_XXX, #BK_AI2W1_XXX and #BK_A02W0_XXX. Each module has 2 values.

Input

| Mux | Content | Description |
|---|---|---|
| n | Input byte0, Input byte1 | 1. and 2. Input byte |
| n+1 | Input byte2, Input byte3 | 3. and 4. Input byte |

Output

| Mux | Content | Description |
|---|---|---|
| n | Output byte0, Output byte1 | 1. and 2. Output byte |
| n+1 | Output byte2, Output byte3 | 3. and 4. Output byte |

**Mode class 0:**
The description of the data is the same as for class 4 mode. The data is put into objects No.1, No.2 and No.3 (read/write 2 Byte analog).

**Attention:**
The control byte allows the changing of the registers of the module. It must always be 0 in order to avoid a change in the registers. A wrong mapping can change the function of the module!

## Structure of the in- and output data for LIGHTBUS (from firmware WD)

Input

| Word | Content | | Description |
|---|---|---|---|
| | High | Low | |
| n | - | Statusbyte | Statusword |
| n+1 | Input byte0 | Input byte1 | 1. and 2. Input byte |
| n+2 | - | Input byte4 | 5.Input byte |
| n+3 | Input byte3 | Input byte2 | 3. and 4. Input byte |

Output

| Word | Content | | Description |
|---|---|---|---|
| | High | Low | |
| n | - | Statusbyte | Statusword |
| n+1 | Output byte0 | Output byte1 | 1. and 2. Output byte |
| n+2 | - | Output byte4 | 5.Output byte |
| n+3 | Output byte3 | Output byte2 | 3. and 4. Output byte |

**Attention:**
The control byte allows the changing of the registers of the module. It must always be 0 in order to avoid a change in the register. A wrong mapping can change the function of the module!

# Ex-1 Application in Explosive Environments

## Ex-1.1 Foreword

Today's development shows that many chemical and petrochemical companies have production plants, production, and process automation machines in operation which use gas-air, vapor-air and dust-air mixtures which can be explosive. For this reason, the electrical components used in such plants and systems must not pose a risk of explosion resulting in injury to persons or damage to property. This is backed by law, directives or regulations, on a national and international scale. WAGO-I/O-SYSTEM 750 (electrical components) is designed for use in zone 2 explosive environments. The following basic explosion protection related terms have been defined.

## Ex-1.2 Protective measures

Primarily, explosion protection describes how to prevent the formation of an explosive atmosphere. For instance by avoiding the use of combustible liquids, reducing the concentration levels, ventilation measures, to name but a few. But there are a large number of applications, which do not allow the implementation of primary protection measures. In such cases, the secondary explosion protection comes into play. Following is a detailed description of such secondary measures.

## Ex-1.3 Classification meeting CENELEC and IEC

The specifications outlined here are valid for use in Europe and are based on the following standards: EN50... of CENELEC (European Committee for Electrotechnical Standardisation). On an international scale, these are reflected by the IEC 60079-... standards of the IEC (International Electrotechnical Commission).

### Ex-1.3.1 Divisions

Explosive environments are areas in which the atmosphere can potentially become explosive. The term explosive means a special mixture of ignitable substances existing in the form of air-borne gases, fumes, mist or dust under atmospheric conditions which, when heated beyond a tolerable temperature or subjected to an electric arc or sparks, can produce explosions. Explosive zones have been created to describe the concentrations level of an explosive atmosphere. This division based on the probability of an explosion occurring is of great importance both for technical safety and feasibility reasons, knowing that the demands placed on electrical components permanently employed in an explosive environment have to be much more stringent than those placed on electrical components that are only rarely and, if at all, for short periods, subject to a dangerous explosive environment.

**Explosive areas resulting from gases, fumes or mist:**

- Zone 0 areas are subject to an explosive atmosphere (> 1000 h /year) continuously or for extended periods.
- Zone 1 areas can expect the occasional occurrence of an explosive atmosphere (> 10 h ≤ 1000 h /year).
- Zone 2 areas can expect the rare or short-term occurrence of an explosive atmosphere (> 0 h ≤ 10 h /year).

**Explosive areas subject to air-borne dust:**

- Zone 20 areas are subject to an explosive atmosphere (> 1000 h /year) continuously or for extended periods.
- Zone 21 areas can expect the occasional occurrence of an explosive atmosphere (> 10 h ≤ 1000 h /year).
- Zone 22 areas can expect the rare or short-term occurrence of an explosive atmosphere (> 0 h ≤ 10 h /year).

## Ex-1.3.2 Explosion protection group

In addition, the electrical components for explosive areas are subdivided into two groups:

Group I: Group I includes electrical components for use in fire-damp endangered mine structures.

Group II: Group II includes electrical components for use in all other explosive environments. The group is further subdivided by pertinent combustible gases in the environment. Subdivision IIA, IIB and IIC takes into account that different materials/substances/gases have various ignition energy characteristic values. For this reason the three sub-groups are assigned representative types of gases:

- IIA – Propane
- IIB – Ethylene
- IIC – Hydrogen

| Minimal ignition energy of representative types of gases | | | | |
|---|---|---|---|---|
| Explosion group | I | IIA | IIB | IIC |
| Gases | Methane | Propane | Ethylene | Hydrogen |
| Ignition energy (µJ) | 280 | 250 | 82 | 16 |

Hydrogen being commonly encountered in chemical plants, frequently the explosion group IIC is requested for maximum safety.

## Ex-1.3.3 Unit categories

Moreover, the areas of use (zones) and the conditions of use (explosion groups) are subdivided into categories for the electrical operating means:

| Unit categories | Explosion group | Area of use |
|---|---|---|
| M1 | I | Fire-damp protection |
| M2 | I | Fire-damp protection |
| 1G | II | Zone 0 Explosive environment by gas, fumes or mist |
| 2G | II | Zone 1 Explosive environment by gas, fumes or mist |
| 3G | II | Zone 2 Explosive environment by gas, fumes or mist |
| 1D | II | Zone 20 Explosive environment by dust |
| 2D | II | Zone 21 Explosive environment by dust |
| 3D | II | Zone 22 Explosive environment by dust |

## Ex-1.3.4 Temperature classes

The maximum surface temperature for electrical components of explosion protection group I is 150 °C (danger due to coal dust deposits) or 450 °C (if there is no danger of coal dust deposit).

In line with the maximum surface temperature for all ignition protection types, the electrical components are subdivided into temperature classes, as far as electrical components of explosion protection group II are concerned. Here the temperatures refer to a surrounding temperature of 40 °C for operation and testing of the electrical components. The lowest ignition temperature of the existing explosive atmosphere must be higher than the maximum surface temperature.

| Temperature classes | Maximum surface temperature | Ignition temperature of the combustible materials |
|---|---|---|
| T1 | 450 °C | > 450 °C |
| T2 | 300 °C | > 300 °C ≤ 450 °C |
| T3 | 200 °C | > 200 °C ≤ 300 °C |
| T4 | 135 °C | > 135 °C ≤ 200 °C |
| T5 | 100 °C | >100 °C ≤ 135 °C |
| T6 | 85°C | > 85 °C ≤ 100 °C |

The following table represents the division and attribution of the materials to the temperature classes and material groups in percent:

| **Temperature classes** | | | | | | |
|---|---|---|---|---|---|---|
| T1 | T2 | T3 | T4 | T5 | T6 | Total* |
| 26.6 % | 42.8 % | 25.5 % | | | | |
| 94.9 % | | | 4.9 % | 0 % | 0.2 % | 432 |
| **Explosion group** | | | | | | |
| IIA | IIB | IIC | | | | Total* |
| 80.2 % | 18.1 % | 0.7 % | | | | 436 |

* Number of classified materials

## Ex-1.3.5 Types of ignition protection

Ignition protection defines the special measures to be taken for electrical components in order to prevent the ignition of surrounding explosive atmospheres. For this reason a differentiation is made between the following types of ignition protection:

| Identifi-cation | CENELEC standard | IEC standard | Explanation | Application |
|---|---|---|---|---|
| EEx o | EN 50 015 | IEC 79-6 | Oil encapsulation | Zone 1 + 2 |
| EEx p | EN 50 016 | IEC 79-2 | Overpressure encapsulation | Zone 1 + 2 |
| EEx q | EN 50 017 | IEC 79-5 | Sand encapsulation | Zone 1 + 2 |
| EEx d | EN 50 018 | IEC 79-1 | Pressure resistant encapsulation | Zone 1 + 2 |
| EEx e | EN 50 019 | IEC 79-7 | Increased safety | Zone 1 + 2 |
| EEx m | EN 50 028 | IEC 79-18 | Cast encapsulation | Zone 1 + 2 |
| EEx i | EN 50 020 (unit)<br>EN 50 039 (system) | IEC 79-11 | Intrinsic safety | Zone 0 + 1 + 2 |
| EEx n | EN 50 021 | IEC 79-15 | Electrical components for zone 2 (see below) | Zone 2 |

Ignition protection “n“ describes exclusively the use of explosion protected electrical components in zone 2. This zone encompasses areas where explosive atmospheres can only be expected to occur rarely or short-term. It represents the transition between the area of zone 1, which requires an explosion protection and safe area in which for instance welding is allowed at any time.

Regulations covering these electrical components are being prepared on a world-wide scale. The standard EN 50 021 allows electrical component manufacturers to obtain certificates from the corresponding authorities for instance KEMA in the Netherlands or the PTB in Germany, certifying that the tested components meet the above mentioned standards draft.

Type “n” ignition protection additionally requires electrical components to be marked , with the following extended identification:

- A – non spark generating (function modules without relay /without switches)
- AC – spark generating, contacts protected by seals (function modules with relays / without switches)
- L – limited energy (function modules with switch)

**Further information**
For more detailed information please refer to the national and/or international standards, directives and regulations!

# Ex-1.4 Classifications meeting the NEC 500

The following classifications according to NEC 500 (National Electric Code) are valid for North America.

## Ex-1.4.1 Divisions

The "Divisions" describe the degree of probability of whatever type of dangerous situation occurring. Here the following assignments apply:

| **Explosion endangered areas due to combustible gases, fumes, mist and dust:** | |
|---|---|
| Division 1 | encompasses areas in which explosive atmospheres are to be expected occasionally (> 10 h ≤ 1000 h /year) as well as continuously and long-term (> 1000 h /year). |
| Division 2 | encompasses areas in which explosive atmospheres can be expected rarely and short-term (>0 h ≤ 10 h /year). |

## Ex-1.4.2 Explosion protection groups

Electrical components for explosion endangered areas are subdivided in three danger categories:

| | |
|---|---|
| Class I (gases and fumes): | Group A (Acetylene)<br>Group B (Hydrogen)<br>Group C (Ethylene)<br>Group D (Methane) |
| Class II (dust): | Group E (Metal dust)<br>Group F (Coal dust)<br>Group G (Flour, starch and cereal dust) |
| Class III (fibers): | No sub-groups |

## Ex-1.4.3 Temperature classes

Electrical components for explosive areas are differentiated by temperature classes:

| Temperature classes | Maximum surface temperature | Ignition temperature of the combustible materials |
|---|---|---|
| T1 | 450 °C | > 450 °C |
| T2 | 300 °C | > 300 °C ≤ 450 °C |
| T2A | 280 °C | > 280 °C ≤ 300 °C |
| T2B | 260 °C | > 260 °C ≤ 280 °C |
| T2C | 230 °C | >230 °C ≤ 260 °C |
| T2D | 215 °C | >215 °C ≤ 230 °C |
| T3 | 200 °C | >200 °C ≤ 215 °C |
| T3A | 180 °C | >180 °C ≤ 200 °C |
| T3B | 165 °C | >165 °C ≤ 180 °C |
| T3C | 160 °C | >160 °C ≤ 165 °C |
| T4 | 135 °C | >135 °C ≤ 160 °C |
| T4A | 120 °C | >120 °C ≤ 135 °C |
| T5 | 100 °C | >100 °C ≤ 120 °C |
| T6 | 85 °C | > 85 °C ≤ 100 °C |

# Ex-1.5 Identification

## Ex-1.5.1 For Europe

According to CENELEC and IEC

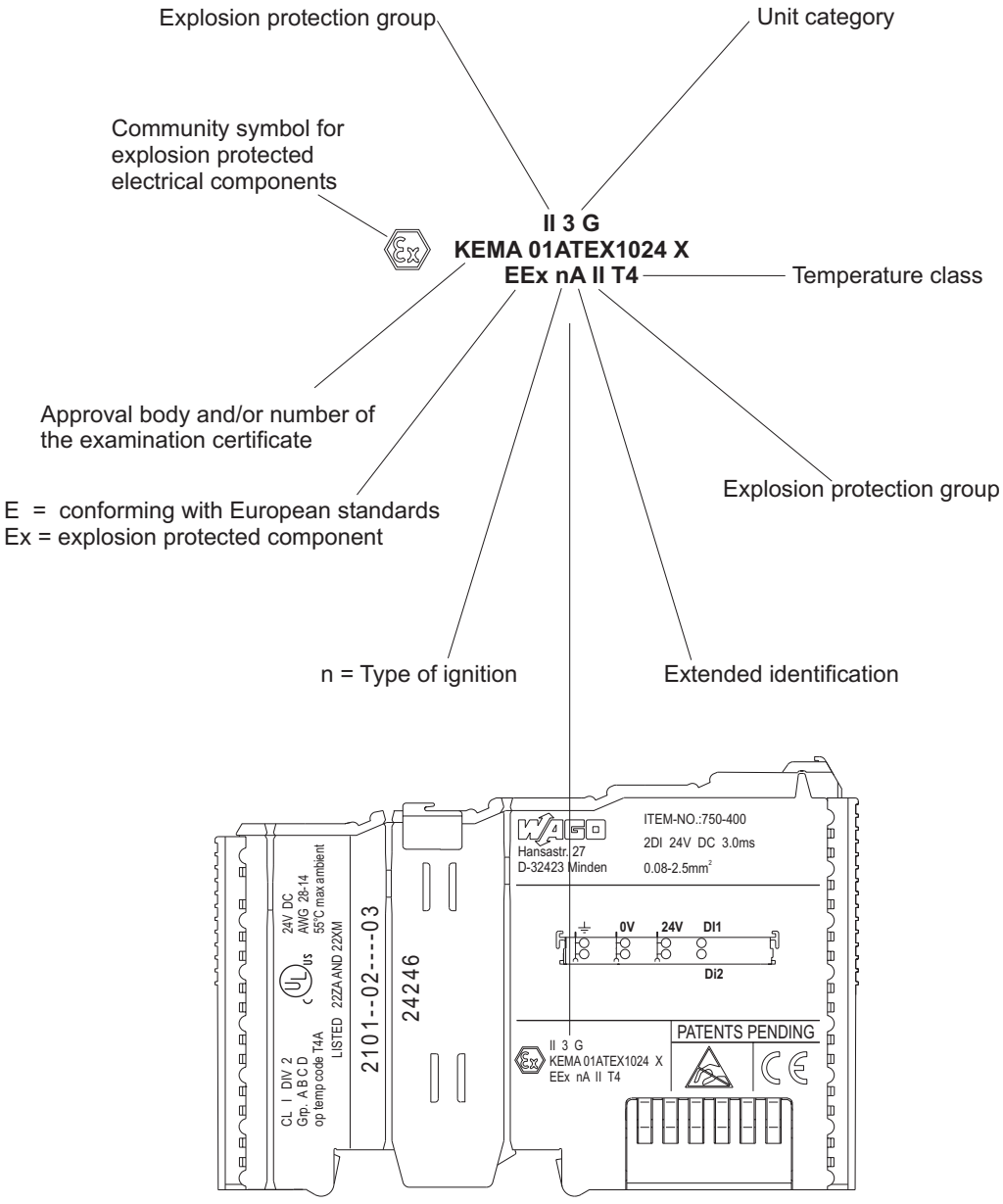



Fig. 1-1: Example for lateral labeling of bus modules
(750-400, 2 channel digital input module 24 V DC)

g01xx03e

## Ex-1.5.2 For America

According to NEC 500

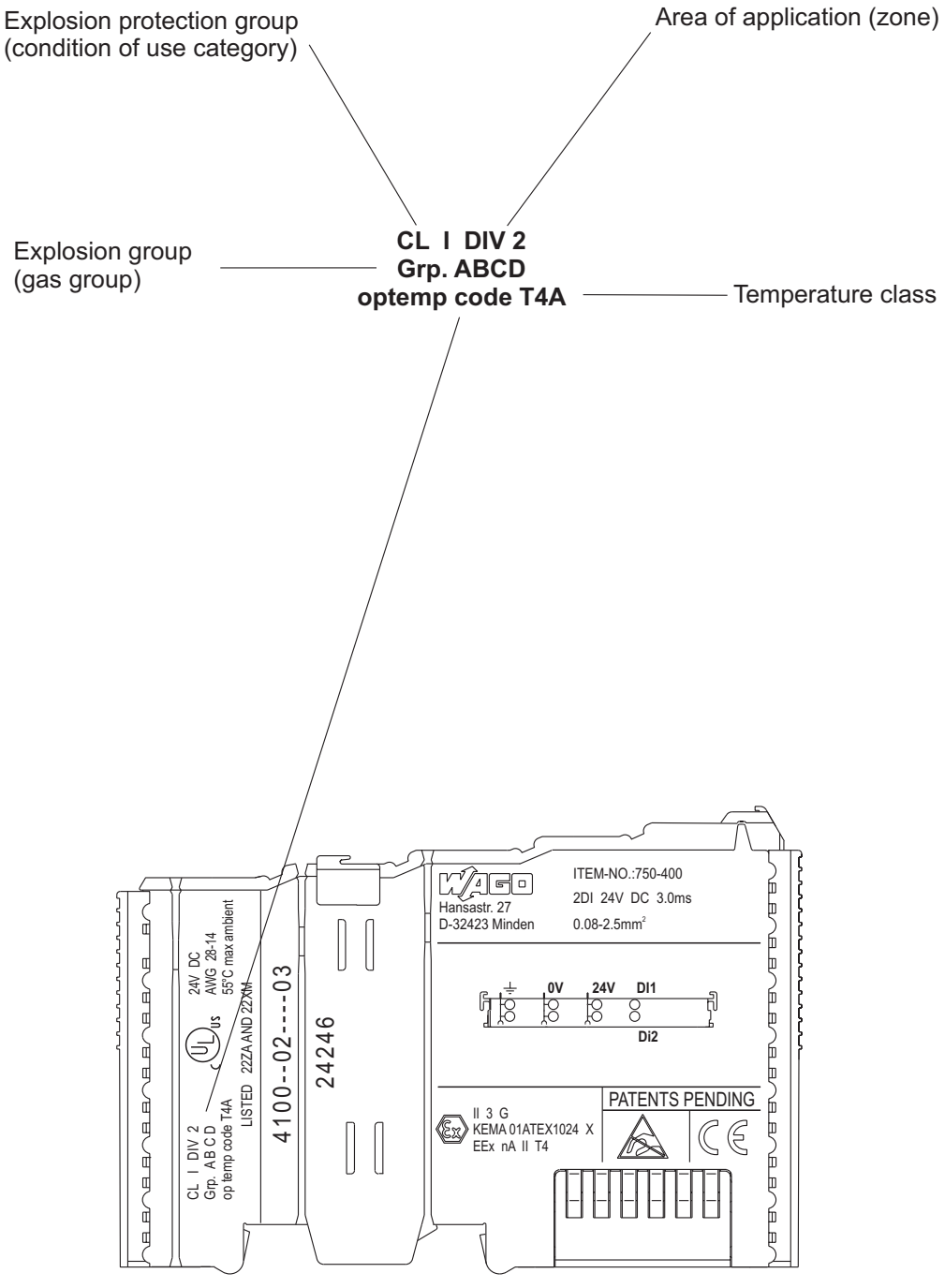



Fig. 1-2: Example for lateral labeling of bus modules
(750-400, 2 channel digital input module 24 V DC)

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## Ex-1.6 Installation regulations

In the **Federal Republic of Germany,** various national regulations for the installation in explosive areas must be taken into consideration. The basis being the ElexV complemented by the installation regulation DIN VDE 0165/2.91. The following are excerpts from additional VDE regulations:

| | |
|---|---|
| DIN VDE 0100 | installation in power plants with rated voltages up to 1000 V |
| DIN VDE 0101 | installation in power plants with rated voltages above 1 kV |
| DIN VDE 0800 | installation and operation in tele-communication plants including information processing equipment |
| DIN VDE 0185 | lightning protection systems |

The **USA** and **Canada** have their own regulations. The following are excerpts from these regulations:

| | |
|---|---|
| NFPA 70 | National Electrical Code Art. 500 Hazardous Locations |
| ANSI/ISA-RP 12.6-1987 | Recommended Practice |
| C22.1 | Canadian Electrical Code |

**Danger**
For the use of WAGO-I/O SYSTEM 750 (electrical operating means) with Ex approval the observance of the following points is mandatory:

- The electrical operating means are exclusively suitable for applications in explosion endangered areas (Europe Group II, Zone 2 or America: Class I, Division 2, Group A, B, C, D) or in non explosion endangered areas!
- Ensure that only approved modules of the electrical operating means will be used. Replacement of components can jeopardize the suitability of the system in explosion endangered zones!
- Only disconnect and/or connect electrical operating means when the voltage supply is isolated or when a non-explosive atmosphere has been ascertained!
- Adhere to the specified data regarding voltage supply and fusing. (See data on the fuse holder)!

**Further Information**
Proof of certification is available on request.

Also take note of the information given on the module technical information sheet.

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