



## WAGO-I/O-SYSTEM 750

2 AI 4-20 mA 12 Bit S.E. HART

### 750-482

2-Channel-Analog Input Module 4-20 mA HART

V 1.1.0

## General

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Every conceivable measure has been taken to ensure the accuracy and completeness of this documentation. However, as errors can never be fully excluded, we always appreciate any information or suggestions for improving the documentation.

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We wish to point out that the software and hardware terms as well as the trademarks of companies used and/or mentioned in the present manual are generally protected by trademark or patent.

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# 1 Notes about this Documentation

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## Note

### Keep this documentation!

The operating instructions are part of the product and shall be kept for the entire lifetime of the device. They shall be transferred to each subsequent owner or user of the device. Care must also be taken to ensure that any supplement to these instructions are included, if applicable.

---

## 1.1 Validity of this Documentation

This documentation is only applicable to the I/O module 750-482 (2 AI 4-20 mA 12 Bit S.E. HART) of the WAGO-I/O-SYSTEM 750 series.

The I/O module 750-482 shall only be installed and operated according to the instructions in this manual and in the manual for the used fieldbus coupler/controller.

## NOTICE

### Consider power layout of the WAGO-I/O-SYSTEM 750!

In addition to these operating instructions, you will also need the manual for the used fieldbus coupler/controller, which can be downloaded at [www.wago.com](http://www.wago.com). There, you can obtain important information including information on electrical isolation, system power and supply specifications.

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## 1.2 Copyright

This Manual, including all figures and illustrations, is copyright-protected. Any further use of this Manual by third parties that violate pertinent copyright provisions is prohibited. Reproduction, translation, electronic and phototechnical filing/archiving (e.g., photocopying) as well as any amendments require the written consent of WAGO Kontakttechnik GmbH & Co. KG, Minden, Germany. Non-observance will involve the right to assert damage claims.

## 1.3 Symbols

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 **DANGER****Personal Injury!**

Indicates a high-risk, imminently hazardous situation which, if not avoided, will result in death or serious injury.

---

---

 **DANGER****Personal Injury Caused by Electric Current!**

Indicates a high-risk, imminently hazardous situation which, if not avoided, will result in death or serious injury.

---

---

 **WARNING****Personal Injury!**

Indicates a moderate-risk, potentially hazardous situation which, if not avoided, could result in death or serious injury.

---

---

 **CAUTION****Personal Injury!**

Indicates a low-risk, potentially hazardous situation which, if not avoided, may result in minor or moderate injury.

---

---

**NOTICE****Damage to Property!**

Indicates a potentially hazardous situation which, if not avoided, may result in damage to property.

---

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**NOTICE****Damage to Property Caused by Electrostatic Discharge (ESD)!**

Indicates a potentially hazardous situation which, if not avoided, may result in damage to property.

---

---

**Note****Important Note!**

Indicates a potential malfunction which, if not avoided, however, will not result in damage to property.

---



## *Information*

**Additional Information:**

Refers to additional information which is not an integral part of this documentation (e.g., the Internet).

## 1.4 Number Notation

Table 1: Number Notation

Number code	Example	Note
Decimal	100	Normal notation
Hexadecimal	0x64	C notation
Binary	'100' '0110.0100'	In quotation marks, nibble separated with dots (.)

## 1.5 Font Conventions

Table 2: Font Conventions

Font type	Indicates:
<i>italic</i>	Names of paths and data files are marked in italic-type. e.g.: <i>C:\Programme\WAGO-I/O-CHECK</i>
<b>Menu</b>	Menu items are marked in bold letters. e.g.: <b>Save</b>
>	A greater-than sign between two names means the selection of a menu item from a menu. e.g.: <b>File &gt; New</b>
<b>Input</b>	Designation of input or optional fields are marked in bold letters, e.g.: <b>Start of measurement range</b>
“Value”	Input or selective values are marked in inverted commas. e.g.: Enter the value “4 mA” under <b>Start of measurement range</b> .
<b>[Button]</b>	Pushbuttons in dialog boxes are marked with bold letters in square brackets. e.g.: <b>[Input]</b>
<b>[Key]</b>	Keys are marked with bold letters in square brackets. e.g.: <b>[F5]</b>



## 2 Important Notes

This section includes an overall summary of the most important safety requirements and notes that are mentioned in each individual section. To protect your health and prevent damage to devices as well, it is imperative to read and carefully follow the safety guidelines.

### 2.1 Legal Bases

#### 2.1.1 Subject to Changes

WAGO Kontakttechnik GmbH & Co. KG reserves the right to provide for any alterations or modifications that serve to increase the efficiency of technical progress. WAGO Kontakttechnik GmbH & Co. KG owns all rights arising from the granting of patents or from the legal protection of utility patents. Third-party products are always mentioned without any reference to patent rights. Thus, the existence of such rights cannot be excluded.

#### 2.1.2 Personnel Qualifications

All sequences implemented on Series 750 devices may only be carried out by electrical specialists with sufficient knowledge in automation. The specialists must be familiar with the current norms and guidelines for the devices and automated environments.

All changes to the coupler or controller should always be carried out by qualified personnel with sufficient skills in PLC programming.

#### 2.1.3 Use of the 750 Series in Compliance with Underlying Provisions

Couplers, controllers and I/O modules found in the modular WAGO-I/O-SYSTEM 750 receive digital and analog signals from sensors and transmit them to the actuators or higher-level control systems. Using programmable controllers, the signals can also be (pre-)processed.

The components have been developed for use in an environment that meets the IP20 protection class criteria. Protection against finger injury and solid impurities up to 12.5 mm diameter is assured; protection against water damage is not ensured. Unless otherwise specified, operation of the components in wet and dusty environments is prohibited.

Appropriate housing (per 94/9/EG) is required when operating the WAGO-I/O-SYSTEM 750 in hazardous environments. Please note that a prototype test certificate must be obtained that confirms the correct installation of the system in a housing or switch cabinet.

## 2.1.4 Technical Condition of Specified Devices

The components to be supplied Ex Works, are equipped with hardware and software configurations, which meet the individual application requirements. Changes in hardware, software and firmware are permitted exclusively within the framework of the various alternatives that are documented in the specific manuals. WAGO Kontakttechnik GmbH & Co. KG will be exempted from any liability in case of changes in hardware or software as well as to non-compliant usage of components.

Please send your request for modified and new hardware or software configurations directly to WAGO Kontakttechnik GmbH & Co. KG.

## 2.2 Safety Advice (Precautions)

For installing and operating purposes of the relevant device to your system the following safety precautions shall be observed:



### **DANGER**

#### **Do not work on components while energized!**

All power sources to the device shall be switched off prior to performing any installation, repair or maintenance work.

### **DANGER**

#### **Installation only in appropriate housings, cabinets or in electrical operation rooms!**

The WAGO-I/O-SYSTEM 750 and its components are an open system. As such, install the system and its components exclusively in appropriate housings, cabinets or in electrical operation rooms. Allow access to such equipment and fixtures to authorized, qualified staff only by means of specific keys or tools.

### **NOTICE**

#### **Replace defective or damaged devices!**

Replace defective or damaged device/module (e.g., in the event of deformed contacts), since the long-term functionality of fieldbus station involved can no longer be ensured.

### **NOTICE**

#### **Protect the components against materials having seeping and insulating properties!**

The components are not resistant to materials having seeping and insulating properties such as: aerosols, silicones and triglycerides (found in some hand creams). If you cannot exclude that such materials will appear in the component environment, then install the components in an enclosure being resistant to the above-mentioned materials. Clean tools and materials are imperative for handling devices/modules.

### **NOTICE**

#### **Cleaning only with permitted materials!**

Clean soiled contacts using oil-free compressed air or with ethyl alcohol and leather cloths.

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**NOTICE****Do not use any contact spray!**

Do not use any contact spray. The spray may impair contact area functionality in connection with contamination.

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**NOTICE****Do not reverse the polarity of connection lines!**

Avoid reverse polarity of data and power supply lines, as this may damage the devices involved.

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**NOTICE****Avoid electrostatic discharge!**

The devices are equipped with electronic components that you may destroy by electrostatic discharge when you touch. Pay attention while handling the devices to good grounding of the environment (persons, job and packing).

---

### 3 Device Description

The Analog Input Module 750-482 processes analog signals with the norm value of 4 ... 20 mA.

The I/O module also enables digital communication to be carried out with HART-enabled field devices (Highway Addressable Remote Transducer).

The I/O module has two input channels and enables field signals to be received via the HART 1+ and HART 1- and HART 2+ and HART 2- connections. Typically, the current values are measured at these connections, but at the same time the HART signals can also be coupled and decoupled on an alternating voltage basis.

Both channels have a common reference potential and a shield connection (S). The shield connection is fed directly to the carrier rail and contact is made automatically by snapping the module onto the rail.

The channels are not electrically isolated from one another.

Two-conductor transducers, which do not have their own power supply, such as adjustable resistances, pressure, flow and level meters, can be connected directly. The transducers are directly supplied with 24V from the I/O module.

In order to connect the 0V line when using 3-conductor transducers, a 75x-604 or -614 Field Side Connection Module must be plugged in next to the HART I/O module, providing the 0V potential for the field level.

The input signal is electrically isolated and is transmitted with a resolution of 12 bits.

Simple parameterization of the HART I/O module for 6 different operating modes enables the I/O module to be used optimally for 4 different types of application.

Table 3: Types of Application

<b>Types of Application for the HART I/O Module</b>	
1	Programmable fieldbus controllers can communicate with HART devices from IEC61131-3 programs using the "WagoLibHART_0x.lib" PLC library.
2	FDT tool routing to the DTM of the connected HART device is possible with a number of WAGO ETHERNET controllers and the 759-359 ModbusTCP/HART Gateway.
3	Up to 4 HART dynamic variables (PV, SV, TV, QV) can be incorporated in the cyclic process image of the 750-333 PROFIBUS Coupler or 750-833 PROFIBUS Controller by parameterization via GSD (device master data) or WAGO-I/O-CHECK 2.
4	When using the 750-333 PROFIBUS DP/V1 Coupler or 750-833 PROFIBUS Controller and the 759-360 PROFIBUS/HART Gateway DTM, FDT tool routing is possible to the DTM of the connected HART device.

The "ready" state of the respective channel and the internal data communication is indicated by a green function LED.

A red fault LED per channel signals a wire break, a short circuit or that the signal is outside the measuring range.

The meaning of the LEDs are described in the chapter „Display Elements“.

The I/O module receives the 24V voltage supply for the field level from an upstream I/O module or from the fieldbus coupler/controller via the power contacts used as blade contacts. It then provides this potential to subsequent I/O modules via the power contacts used as spring contacts.

---

## Note



### Use potential feed module for Ground (earth)!

The I/O module has no power contacts for PE intake and transfer. Use a potential feed module when a PE feed is needed for the subsequent I/O modules.

---

---

## NOTICE

### Do not exceed maximum current via power contacts!

The maximum current to flow through the power contacts is 10 A. Greater currents can damage the power contacts. When configuring the system, ensure that this current is not exceeded. If exceeded, an additional potential feed module must be used.

---

With consideration of the power jumper contacts, the individual input modules can be arranged in any combination when configuring the fieldbus node. An arrangement in groups within the group of potentials is not necessary.

The HART I/O module can be used with all couplers and controllers of the WAGO-I/O-SYSTEM 750 listed in the following section "Compatibility List".

Table 4: Compatibility List

Bus System	Fieldbus Coupler/ Controller	Item-No.	Hard-ware Version	Soft-ware Version	Max. Number of Modules	Function *)
ETHERNET TCP/IP	Programmable Fieldbus Controllers	750-841	03	07	8	(1), (5)
		750-842	04	12	8	(1), (5)
		750-871	01	01	8	(1), (5)
		750-872	01	01	8	(1), (5)
		750-872/020-000	01	07	8	(1), (5)
		750-873	01	01	8	(1), (5)
CANopen	Programmable Fieldbus Controllers	750-837	07	12	8	(1)
		750-838	02	12	8	(1)
DeviceNet	Programmable Fieldbus Controllers	750-806	04	09	8	(1)
LON	Programmable Fieldbus Controllers	750-819	xx	09	8	(1)
PROFIBUS	Fieldbus Coupler	750-333	12	ab 13	8	(2), (3), (4)
	Programmable Fieldbus Controllers	750-833	12	ab 10	8	(1), (2), (3), (4)
BACnet	Programmable Fieldbus Controllers	750-830	01	01	8	(1)
KNX	Programmable Fieldbus Controllers	750-849	xx	ab 01	8	(1)
Other Fieldbus Coupler/Controller on request.						

+) **Functions:**

(1)	WAGO-I/O-PRO CAA (CoDeSys) PLC library „WagoLibHART_0x.lib“
(2)	Cyclic Profibus communication with HART dynamic variables
(3)	Acyklic Profibus communication with HART Toolrouting FDT/DTM or eddl/SimaticPDM
(4)	PROFIBUS/HART Gateway DTM 759-360
(5)	ModbusTCP/HART Gateway DTM 759-359

### 3.1 View

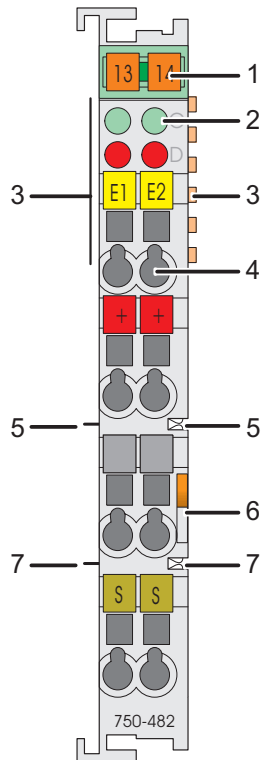


Figure 1: View

Table 5: Legend to the View

No.	Designation	Meaning	Details see chapter
1	---	Group marking carrier (retractable) with additional marking possibility on two miniature WSB markers	---
2	A, B, E, F	Status LEDs	"Device Description" > "Display Elements"
3	---	Data Contacts	"Assembly" > "Inserting and Removing Devices"
4	1, 2, 4, 5, 6, 8	CAGE CLAMP® Connections Inputs HART 1, 2 +/- and Screen	"Connect Devices" > "Connecting a conductor to the CAGE CLAMP®"
5	---	Power Jumper Contacts +24 V	"Device Description" > "Connectors"
6	---	Unlocking Lug	"Assembly" > "Inserting and Removing Devices"
7	---	Power Jumper Contacts 0 V	"Device Description" > "Connectors"



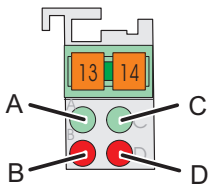
### 3.2 Connectors

Table 6: Connectors

<p>The diagram shows a vertical terminal block with the following connections from top to bottom:         <ul style="list-style-type: none"> <li>Two yellow terminals labeled E1 and E2.</li> <li>Two pairs of terminals for HART 1 and HART 2. Each pair consists of a grey terminal with a '-' sign and a grey terminal with a '+' sign.</li> <li>Two pairs of terminals for 24V power supply, each with a grey terminal and a white terminal.</li> <li>Two pairs of terminals for 0V power supply, each with a grey terminal and a white terminal.</li> <li>Two yellow terminals labeled S.</li> <li>Two grey terminals labeled S.</li> </ul> </p>	<b>Connector</b>	<b>Meaning</b>		
	HART 1 -	HART 2 -	HART 1 -	Sensor 1: Connection HART -
	HART 1 +	HART 2 +	HART 2 -	Sensor 2: Connection HART -
	HART 1 +	HART 2 +	HART 1 +	Sensor 1: Connection HART +
	24 V	24 V	HART 2 +	Sensor 2: Connection HART +
	0 V	0 V	Power Jumper Contacts + 24 V	Field Supply 24 V
	S	S	Power Jumper Contacts 0 V	Field Supply 0 V
Figure 2: Connectors	S	Screen		

### 3.3 Display Elements

Table 7: Display Elements

 <p>Figure 3: Display Elements</p>	<b>A</b>	<b>B</b>	<b>Channel 1 state</b>	<b>Description</b>
	<b>(green) Function HART 1</b>	<b>(red) Error HART 1</b>		
	Don't care	1 x flashing		
	On continuously	Don't care	Ready for operation	Power on completed successfully; internal data bus communication
	Don't care	On	Error	Wire break, short circuit, overload
	<b>C</b>	<b>D</b>	<b>Channel 2 state</b>	<b>Description</b>
	<b>(green) Function HART 2</b>	<b>(red) Error HART 2</b>		
	Don't care	1 x flashing		
	On continuously	Don't care		
	Don't care	On	Error	Wire break, short circuit, overload

### 3.4 Schematic Diagram

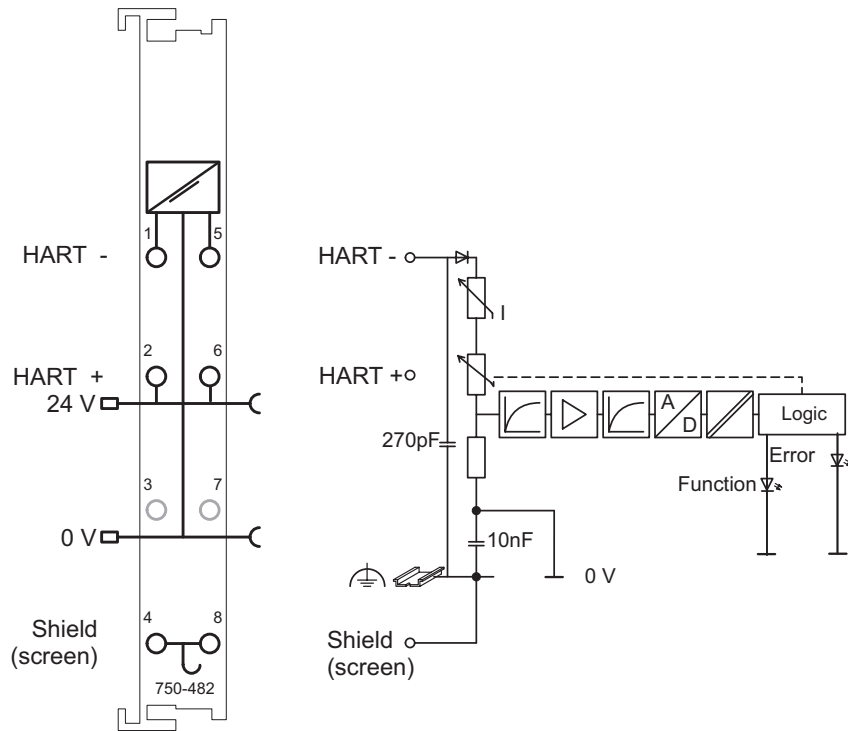


Figure 4: Schematic Diagram

## 3.5 Technical Data

### 3.5.1 Device Data

Table 8: Technical Data - Device

Width	12 mm
High (from upper edge of DIN 35 rail)	64 mm
Length	100 mm
Weight	approx. 55 g

### 3.5.2 Supply

Table 9: Technical Data - Supply

Voltage Supply	via system voltage DC/DC, ~10 mA without sensor supply
Input current	< 65 mA
Input voltage <sub>max.</sub>	24 V
Input voltage drop	( $I_{\text{meas}} < 28 \text{ mA}$ ): not linear, as protected against overload $U = 0.9 \text{ V} + 270 \Omega \times I_{\text{meas}}$
Isolation	500 V system/supply

### 3.5.3 Communication

Table 10: Technical Data - Communication

Data width	2 x 2 bytes data or 2 x 2 bytes data + 2n x 4 bytes data (n = number of dynamic variables) or 2 x 2 bytes data + 6 bytes mailbox
------------	-------------------------------------------------------------------------------------------------------------------------------------------------

### 3.5.4 Inputs

Table 11: Technical Data - Inputs

Number of inputs	2
Signal current	4 mA ... 20 mA
HART input filter	100 Hz
Resolution of the A/D converter	12 Bit
Conversion time (typ.)	20 ms
Measuring error 25°C	0.1 % of final value (non-linearity)
Temperature coefficient	< ±0.01 % / K of full scale value
Line break detection	$I_{\text{meas}} < 3,10 \text{ mA}$
Short circuit detection	$I_{\text{meas}} > 22 \text{ mA}$
Overvoltage protection	30 V, reverse polarity protected
Diagnostics	Wire break, measuring range overflow

Sensor connection	2-conductor
HART devices per channel	1 device (single-drop, no multi-drop)
HART modems per channel	1 modem (no multiplex)

### 3.6 Approvals

The following approvals have been granted to 750-482 I/O modules:

 Conformity Marking

 cUL<sub>US</sub> (UL508)

 cUL<sub>US</sub> (UL1604) (nur Serie 750) Class I Div2 ABCD T4A

### 3.7 EMC Standards

750-482 I/O modules meet the following requirements on emission and immunity of interference:

EMC CE-Immunity to interference acc. to EN 61000-6-2: 2005

EMC CE-Immunity to interference acc. to EN 61000-6-4: 2007

## 4 Assembly

### 4.1 Assembly Sequence

All system components can be snapped directly on a carrier rail in accordance with the European standard EN 50022 (DIN 35).

The reliable positioning and connection is made using a tongue and groove system. Due to the automatic locking, the individual components are securely seated on the rail after installation.

Starting with the coupler/controller, the bus modules are assembled adjacent to each other according to the project design. Errors in the design of the node in terms of the potential groups (connection via the power contacts) are recognized, as the bus modules with power contacts (male contacts) cannot be linked to bus modules with fewer power contacts.

---

#### CAUTION

##### **Risk of injury due to sharp-edged male contacts!**

The male contacts are sharp-edged. Handle the module carefully to prevent injury.

---

#### NOTICE

##### **Connect the I/O modules in the required order!**

Never plug bus modules from the direction of the end terminal. A ground wire power contact, which is inserted into a terminal without contacts, e.g. a 4-channel digital input module, has a decreased air and creepage distance to the neighboring contact in the example DI4.

---

#### NOTICE

##### **Assemble the I/O modules in rows only if the grooves are open!**

Please take into consideration that some bus modules have no or only a few power jumper contacts. The design of some modules does not allow them to be physically assembled in rows, as the grooves for the male contacts are closed at the top.

---

#### Note



##### **Don't forget the bus end module!**

Always plug a bus end module 750-600 onto the end of the fieldbus node! You must always use a bus end module at all fieldbus nodes with the WAGO I/O System 750 fieldbus couplers/controllers to guarantee proper data transfer.

---

## 4.2 Inserting and Removing Devices

### **DANGER**

#### **Use caution when interrupting the PE!**

Make sure that people or equipment are not placed at risk when removing an I/O module and the associated PE interruption. To prevent interruptions, provide ring feeding of the ground conductor, see section "Grounding/Ground Conductor" in manual "System Description WAGO-I/O-SYSTEM 750".

### **NOTICE**

#### **Perform work on devices only if the system is de-energized!**

Working on devices when the system is energized can damage the devices. Therefore, turn off the power supply before working on the devices.

### 4.2.1 Inserting I/O Module

1. Position the I/O module so that the tongue and groove joints to the fieldbus coupler/controller or to the previous or possibly subsequent I/O module are engaged.

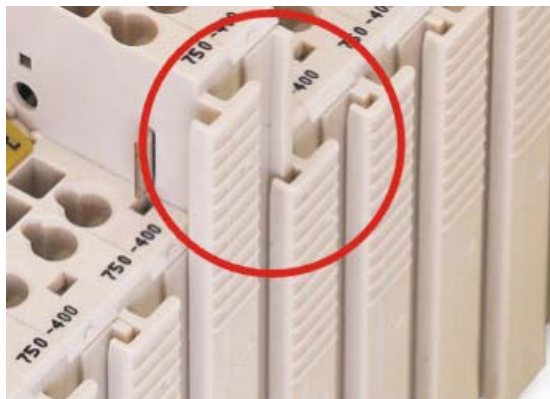


Figure 5: Insert I/O module

2. Press the I/O module into the assembly until the I/O module snaps into the carrier rail.

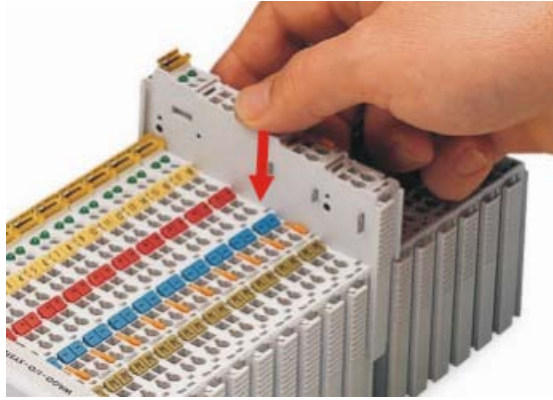


Figure 6: Snap the I/O module into place

With the I/O module snapped in place, the electrical connections for the data contacts and power contacts (if any) to the fieldbus coupler/controller or to the previous or possibly subsequent I/O module are established.

#### 4.2.2 Removing the I/O Module

1. Remove the I/O module from the assembly by pulling the release tab.

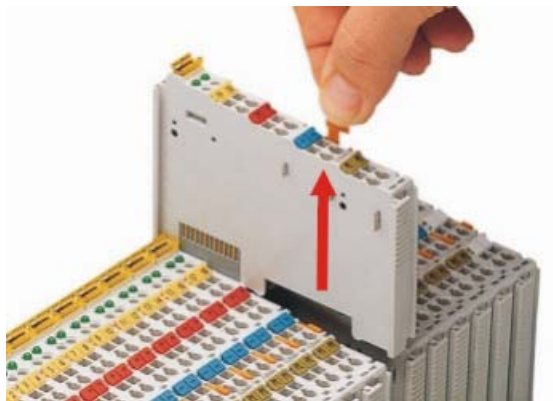


Figure 7: Removing the I/O module

Electrical connections for data or power contacts are disconnected when removing the I/O module.



## 5 Connect Devices

### 5.1 Connecting a conductor to the CAGE CLAMP®

The WAGO CAGE CLAMP® connection is appropriate for solid, stranded and finely stranded conductors.

#### Note



**Only connect one conductor to each CAGE CLAMP® connection!**

Only one conductor may be connected to each CAGE CLAMP® connection.

Do not connect more than one conductor at one single connection!

If more than one conductor must be routed to one connection, these must be connected in an up-circuit wiring assembly, for example using WAGO feed-through terminals.

#### Exception:

If it is unavoidable to jointly connect 2 conductors, then you must use a ferrule to join the wires together. The following ferrules can be used:

Length	8 mm
Nominal cross section <sub>max.</sub>	1 mm <sup>2</sup> for 2 conductors with 0.5 mm <sup>2</sup> each
WAGO Product	216-103 or products with comparable properties.

1. To open the CAGE CLAMP® insert the actuating tool into the opening above the connection.
2. Insert the conductor into the corresponding connection opening.
3. To close the CAGE CLAMP® simply remove the tool - the conductor is then clamped firmly in place.

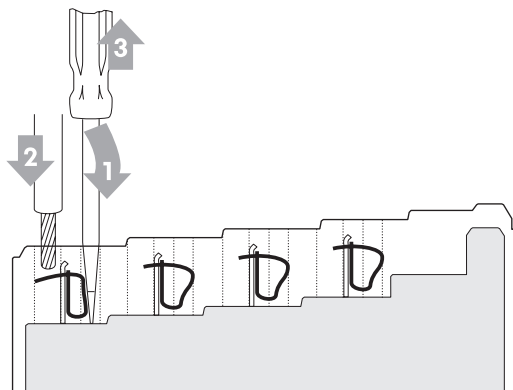


Figure 8: Connecting a conductor to a CAGE CLAMP®

## 5.2 Connection Examples

The example connections of a passive 2- and 3-conductor HART sensor, as well as an active 24VDC and an active 230VAC HART sensor, are shown graphically below.

In summary, the following graphic shows an example of the connection view and the circuit diagrams of the potential feed module 750-614, which is required to connect passive 3-conductor HART sensors as well as active HART sensors, and of the HART I/O module 750-482.

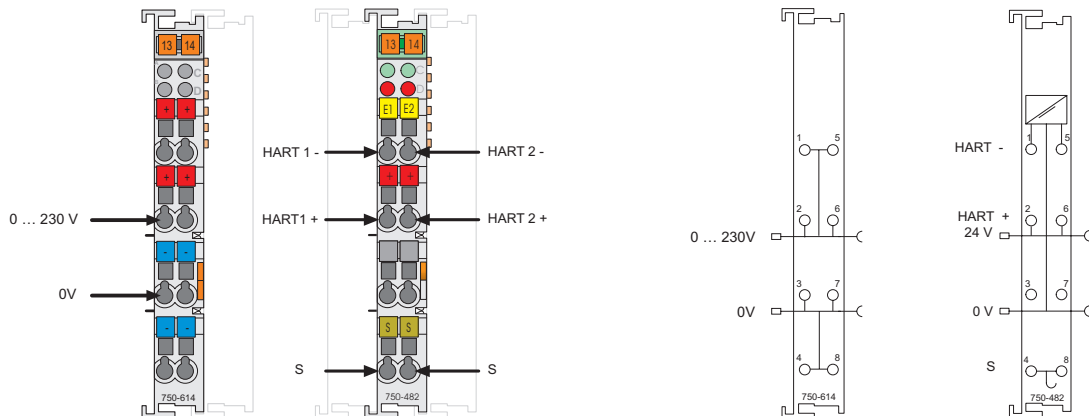


Figure 9: Connection views and circuit diagrams of I/O modules 750-614 and 750-482

### 5.2.1 Connecting Passive HART Sensors

#### 5.2.1.1 Connecting a 2-Conductor HART Sensor

One or two passive 2-conductor HART sensors can be connected directly to the HART + and HART - connections. The passive sensors are supplied with 24VDC directly from the I/O module.

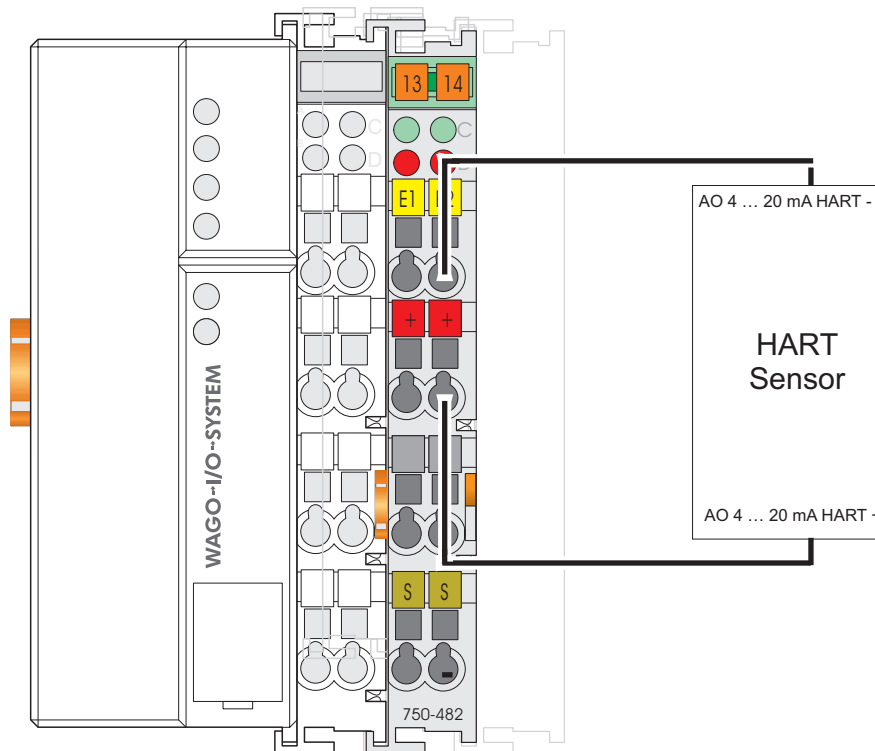


Figure 10: Connecting a passive 2-conductor HART sensor

### 5.2.1.2 Connecting a 3-Conductor HART Sensor

To connect one or two passive 3-conductor HART sensors to the HART module 750-482, a WAGO potential amplification module (item number 750-604 or 750-614) must be connected upstream for the 0V potential.

The HART + and HART - sensors are connected to the HART + and HART - terminal points of the HART module 750-482. The passive sensors are supplied with 24VDC directly from the I/O module.

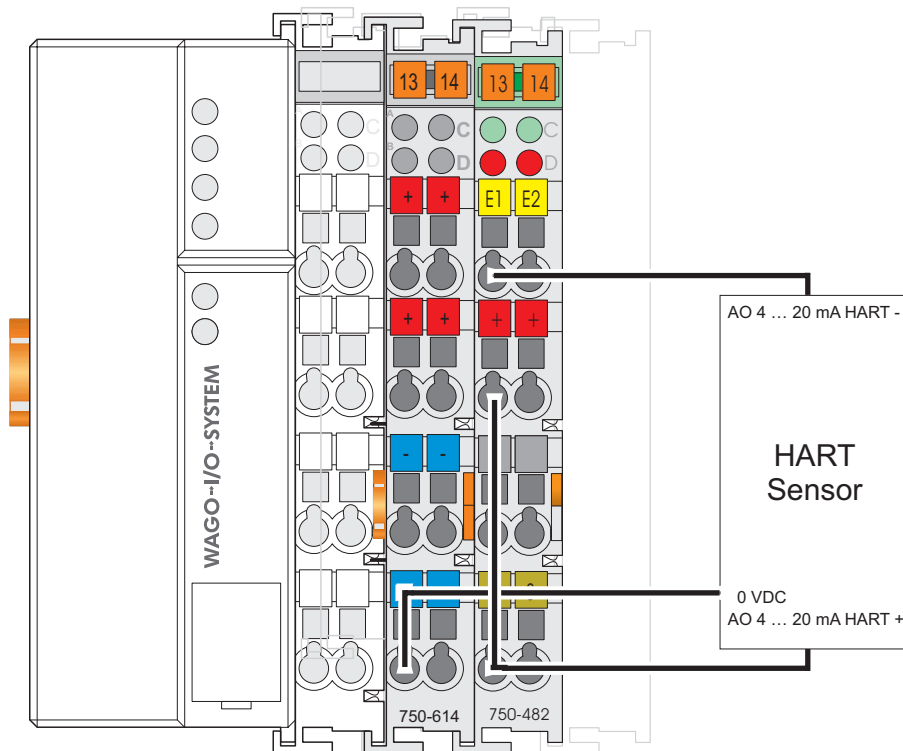


Figure 11: Connecting a passive 3-conductor HART sensor

## 5.2.2 Connecting Active HART Sensors

To connect active HART sensors to the HART module 750-482, a WAGO potential amplification module (item number 750-604 or 750-614) is used, as with the passive 3-conductor HART sensors.

Commensurate with the HART sensor voltage (24VDC or 230VAC), the HART sensors are fed either directly from the potential amplification module with 24VDC or externally with 230VAC. In both cases, the potential amplification module provides the 0V potential for connecting the HART sensors.

The HART + sensor is connected to the HART + terminal point of the HART module 750-482.

### 5.2.2.1 Connecting an Active 24VDC HART Sensor

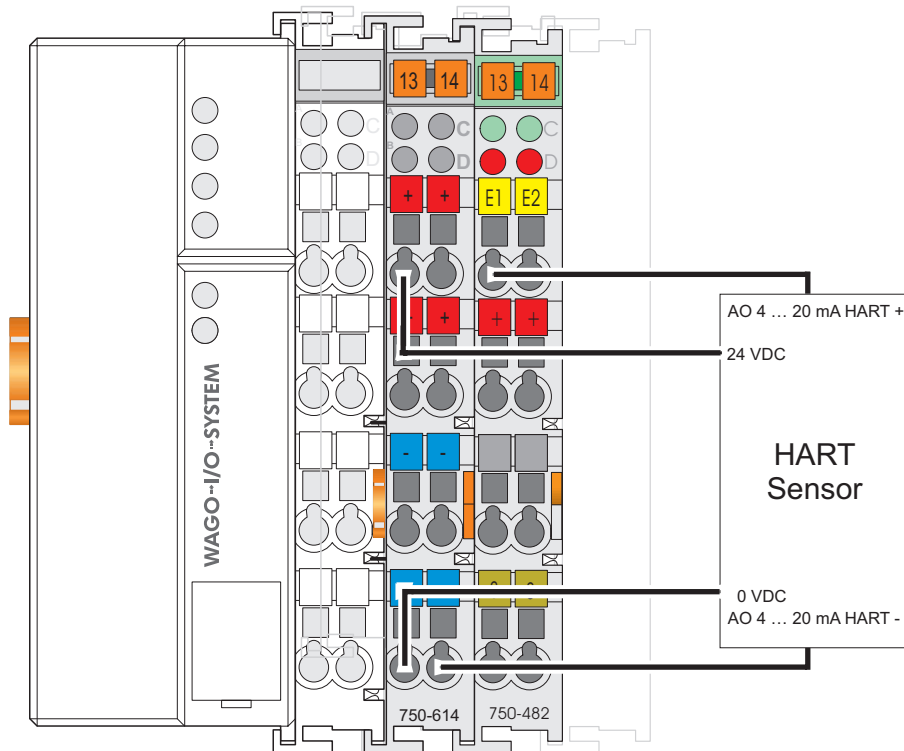


Figure 12: Connecting an active 24VDC HART sensor

### 5.2.2.2 Connecting an active 230VAC HART Sensor

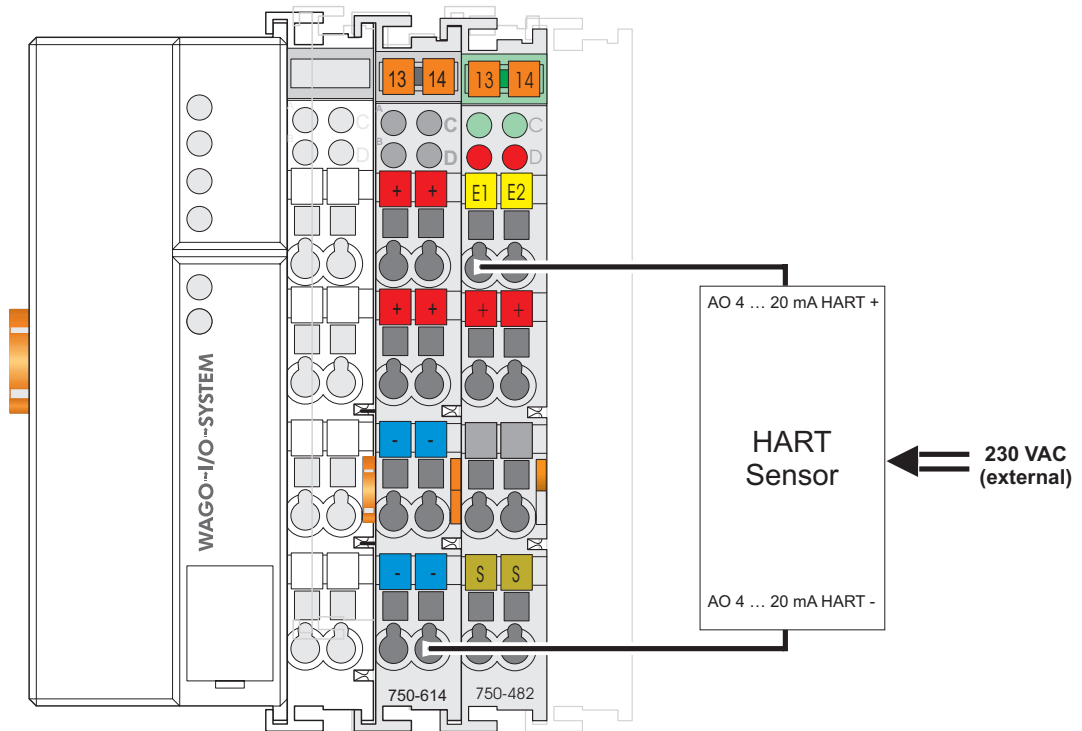


Figure 13: Connecting an active 230VAC HART sensor

## 6 Function Description

HART (Highway Addressable Remote Transducer) is an established variant of digital field communication, which has been introduced as an industry standard and which also enables multivariable field devices to be supported and used in systems with conventional 4 to 20 mA technology. Typical applications are transducers for the measurement of mechanical and electrical variables.

The HART protocol works using the FSK process (Frequency Shift Keying) in accordance with the Bell 202 communications standard. Here, the digital signal, which is made up of the two frequencies 1200 Hz (logic 1) and 2200 Hz (logic 0), is sinusoidally superimposed on the analog current signal. By coding the digital signal with zero mean value, additional information can be transmitted at the same time without affecting the analog signal transmission. This information can come from the field device and be intended for the process control system or for maintenance (e.g., process variable, device status). However, information can also be written to the field device - acyclically - for parameterization or configuration.

Along with the simplex channel for the current signal (analog controller -> field device), the HART protocol therefore also provides a half-duplex channel for two-way communication.

Further advantages of HART are simple construction, maintenance and application as well as flexible data access via up to two operator control units (PC and hand terminal). HART field devices and also HART masters are compatible with 4-20 mA technology. HART field devices can therefore be used with non-HART-compatible masters and vice-versa. This provides the great advantage that the user can upgrade his system with HART modules step-by-step.

In the as-supplied state of the HART I/O module; i.e., in the default operating mode, the HART device can be accessed directly from an IEC61131-3 program via the I/O module. In this case, HART communication is achieved very easily by means of the pre-prepared PLC library "WagoLibHART\_0x.lib", which is provided by WAGO as a free download.

FDT tool routing to the DTM of the connected HART device is possible in default operating mode for connecting the I/O module to various WAGO ETHERNET controllers with the help of the 759-359 ModbusTCP/HART Gateway DTM.

With the simple parameterization of the HART I/O module via GSD (device master data) or WAGO-I/O-CHECK 2, 4 operating modes can be selected specially for using the HART I/O module in PROFIBUS systems, in which up to 4 HART dynamic variables (PV, SV, TV, QV) can be incorporated in the cyclic process image.

When using the PROFIBUS DP/V1 Coupler 750-333 or Controller 7509-833, FDT tool routing to the DTM of the connected HART device is likewise possible in a further operating mode in conjunction with the 759-360 PROFIBUS/HART Gateway DTM.

## Information



### Additional Information about HART Technology

You will find more detailed information on HART technology on the HART Communication Foundation website (HCF user organization) at: [www.hartcomm.org](http://www.hartcomm.org)

## 7 Operating Modes

The HART I/O module can be used with various operating modes depending on connection and parameterization.

Table 12: Overview of Operating Modes

Operating Mode	on Fieldbus Coupler/-Controller	Use
2 AI + 6 bytes mailbox (Default)	all compatible Fieldbus couplers/-controllers (75x-xxx *)	1) with „WagoLibHART_0x.lib“ PLC library
	750-841 ETHERNET TCP/IP Fieldbus controller	2) with ModbusTCP/HART Gateway 759-359
2 AI + 1 HART variable per Channel	PROFIBUS DP/V1 Fieldbus coupler 750-333 or Fieldbus controller 750-833	3) with HART dynamic variables
2 AI + 2 HART variables per Channel		
2 AI + 3 HART variables per Channel		
2 AI + 4 HART variables per Channel		
2 AI + acyclic PROFIBUS services		4) with PROFIBUS/HART Gateway 759-360

\*) see chapter „Compatibility List“

In the as-supplied state, the HART Module is configured in the default operating mode as a 2-channel analog input module for 4 ... 20 mA signals with HART functionality. In this default operating mode the I/O module can be connected to all WAGO couplers and controllers listed in the section "Compatibility List". In this case, HART communication is enabled by a 6-byte mailbox, which is incorporated with the analog values in the cyclic process image.

In addition, five further operating modes can be set up specially for connecting to the PROFIBUS DP/V1 Fieldbus Coupler 750-333 or Fieldbus Controller 750-833.

The section "Description of Operation" following the section on parameterization and a short introduction to the FDT/DTM concept and HART via PROFIBUS, describes the individual operating modes in the appropriate applications in more

detail together with a description of the communications process and brief commissioning instructions in each case.

## 7.1 Setting the Operating Mode Parameters

Depending on the fieldbus used, the HART I/O module can either be parameterized using the "759-302 WAGO-I/O-CHECK 2" commissioning tool for WAGO-I/O-SYSTEM 750 or, for PROFIBUS, using the GSD files (device master data) for PROFIBUS with installation program / Series 750, 752 and 755 (Item No.: 750-910).

Table 13: Setting the Operating Mode Parameters

Fieldbus Coupler/Controller Connection	Parameter setting via:
alle *)	759-302 WAGO-I/O-CHECK
PROFIBUS DP/V1 Fieldbus Coupler 750-333 or Fieldbus Controller 750-833	750-910 GSD (Device Master Data)

\*) see chapter „Compatibility List“

### 7.1.1 Setting Up using WAGO-I/O-CHECK 2

It is only necessary to set the parameters of the HART I/O module using WAGO-I/O-CHECK 2 when the default operating mode (2AI + 6-byte mailbox) has been changed to the "PROFIBUS operating mode" (2 AI + acyclic PROFIBUS services) and is then to be changed back to the default mode. Changing to a "PROFIBUS mode" or between PROFIBUS modes is typically carried out within a PROFIBUS system using GSD in preference.

#### Note



##### Restriction of Settings for PROFIBUS Operating Mode!

This changeover and operation with other than a PROFIBUS Coupler 750-333 or Controller 750-833 is not yet possible at the present time for "PROFIBUS operating modes" (2 AI + 1, 2, 3 or 4 HART variables per channel).

A HART I/O module that has once been set up for HART dynamic variables using GSD files can therefore currently only be operated with a PROFIBUS Coupler 750-333 or Controller 750-833.

It is then possible to restore the default state of the HART I/O module using WAGO-I/O-CHECK 2 and the PROFIBUS Coupler 750 333 or Controller 750-833. When doing so it must be ensured that the parameters of the PROFIBUS Coupler 750-333 or Controller 750-833 are not set using GSD files.



## Information



### Additional Information for the order of WAGO-I/O-CHECK 2

You can order the "WAGO-I/O-CHECK 2" commissioning tool for the WAGO-I/O-SYSTEM 750 from WAGO Kontakttechnik GmbH & Co. KG under the item number 759-302.

1. Connect a 750-920 Communications Cable between your coupler/controller and an available port on your computer.

## NOTICE

### Fieldbus Node must be without power!

The 750-920 Communication Cable shall not be connected or removed when the system is energized; i.e., there shall be no power to the coupler/controller!

2. After installing WAGO-I/O-CHECK 2 via the installation wizard, open it.
3. Go to the "Settings" menu and click "Communication".  
A "Communications settings" dialog box will open.  
In this window under "Connection" select "Serial ports (COM, USB, Bluetooth, ...)" and under "Port" "COM1: Communications port".  
Then confirm this selection by clicking "OK".
4. Switch on the supply voltage to your coupler/controller.
5. When the coupler/controller has booted up click "Identify" on the toolbar.  
The set-up of your fieldbus node will be automatically detected and shown graphically in the node view and also in the navigation bar as a tree structure.
6. Move the mouse pointer to the graphical representation of the HART I/O module or to the I/O module designation "0750-0482" in the tree structure and select "Settings" from the context menu (right mouse button).



Figure 14: WAGO-I/O-CHECK context menu „Settings“

7. In the dialog window that opens for making the settings select the required operating mode and then click "Write".

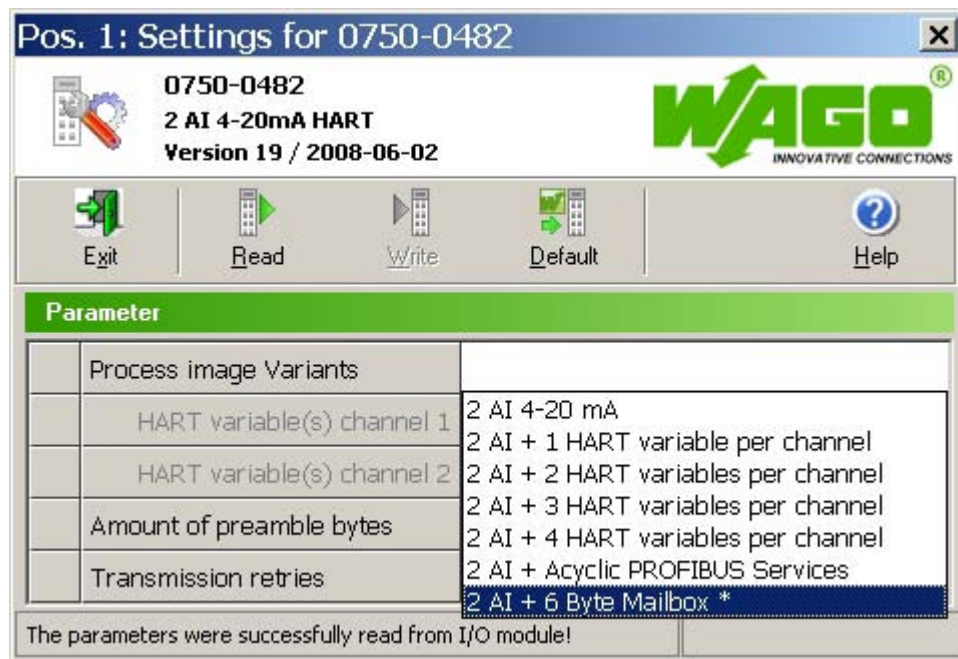


Figure 15: WAGO-I/O-CHECK dialog window „Settings for 0750-0482“

When the parameters have been set successfully, this will be indicated by a message.



Figure 16: WAGO-I/O-CHECK message for successfully parameterizing

## Information



### Additional Information about WAGO-I/O-CHECK

You will find a detailed description of the functions and use of the commissioning tool in the 759-302 "WAGO I/O CHECK 2" manual on the Internet under:  
[www.wago.com](http://www.wago.com)

## 7.1.2 Setting Up via GSD

When connecting to a 750-333 PROFIBUS DP/V1 Fieldbus Coupler or 750-833 Controller, assuming that the HART I/O module is supplied in the default operating mode, the mode must be changed over accordingly. The parameters for the required operating mode can be set using the GSD files.

---

### **Information**



#### **Additional Information for Download the GSD Files**

The GSD files can be downloaded free of charge from the WAGO website at: [www.wago.com](http://www.wago.com) → Service → Documentation → WAGO Software 759 → WAGO-I/O-PRO CoDeSys mit WAGO Targets.

You will find the "Libraries" link in the "Further information" column.

---

Before setting the parameters however, the components of the PROFIBUS system, which define the structure of the input and output process image, must first be configured.

The GSD files for PROFIBUS are read in or installed by the configuration software used. These provide the characteristic device data necessary for configuration, particulars of their communications capability and other information. The size of the process images is then determined by the compiled configuration data.

---

### **Information**



#### **Additional Information on Installing the GSD Files**

Please refer to the documentation for the configuration software which you are using for information on installing the GSD files.

---

The required operating mode for the HART I/O module can be selected and specified right at the configuration stage.

Further data for the HART I/O module can then be specified in a parameterization dialog box corresponding to the selected module.

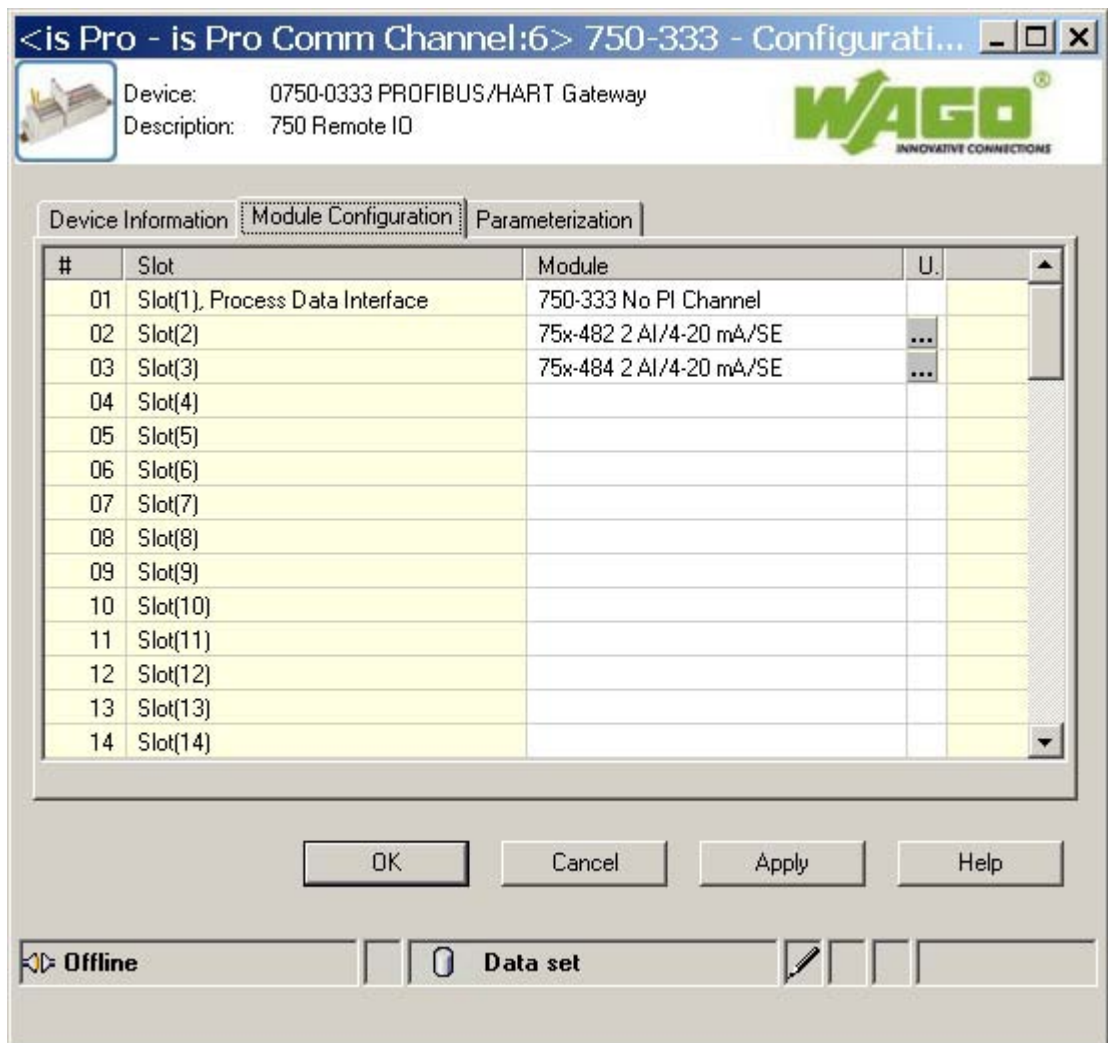


Figure 17: GSD Configuration

To open the parameterization dialog to the selected module, click on the button with three points „...“ in the „UsrPrm“ (User Parameter) column.

Depending on the selected operating mode, various set-up options, which are listed in the following tables, are provided in the dialog box which then opens.

75x-482 2AI/4-20 mA/SE

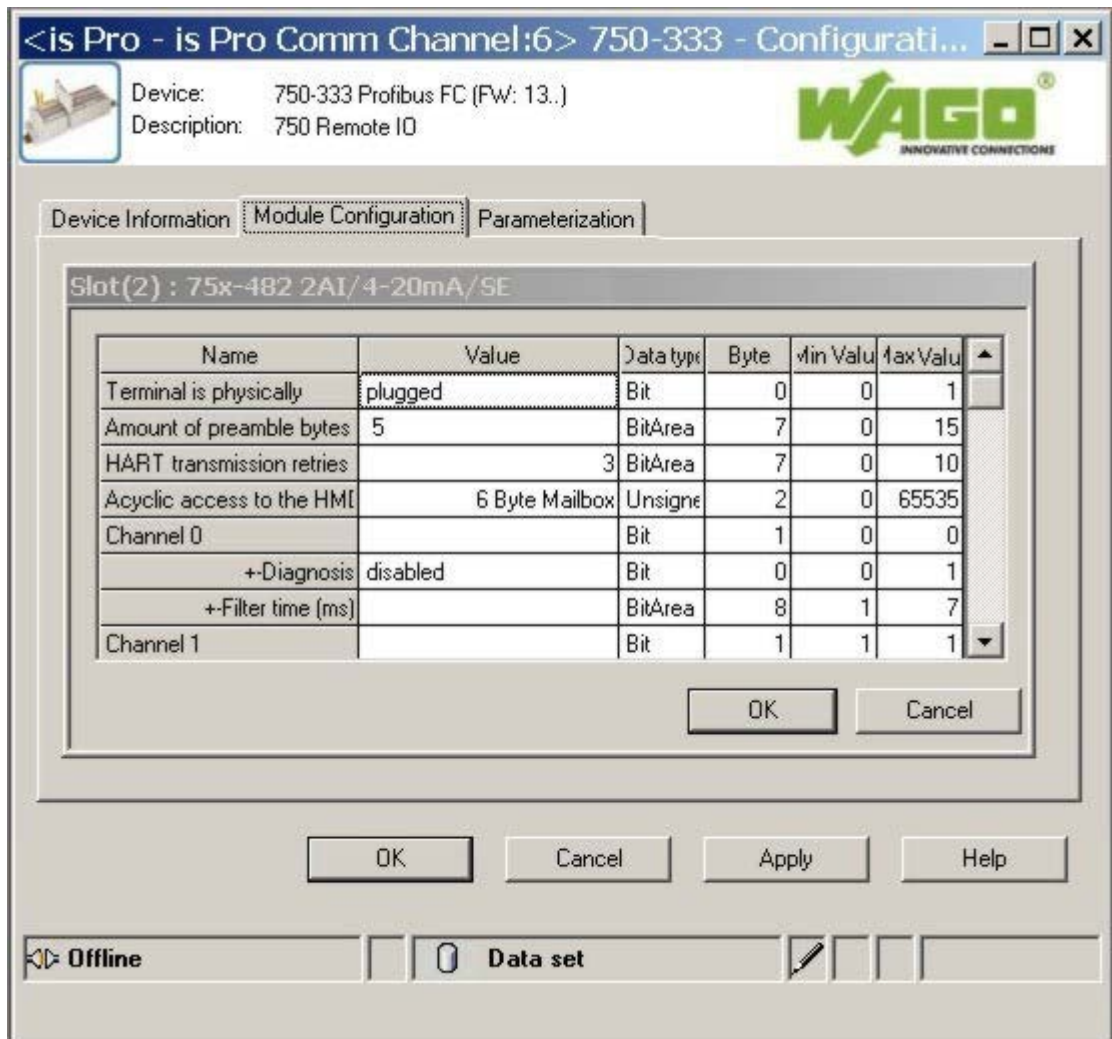


Figure 18: Parameterization dialog for selecting 75x-482 2AI/4-20 mA/SE

**Parameters for all Operating Modes**

Table 14: General Parameter Data

Parameter	Value	Description
Terminal is physically	- plugged *) - unplugged	- I/O module is physically plugged in - I/O module is not physically plugged in
Amount of preamble bytes	5 *) bis 20	Number of preamble bytes. The value must be increased in the event of communications problems.
HART transmission retries	0 *) bis 10	Number of retries for HART telegram transmissions. The value must be increased in the event of communications problems
Channel 0/1 + Diagnosis  + Filter time (ms)	- disabled *)  - enabled  10 ms bis 640 ms	- Diagnostics for Channel 1 / 2 are deactivated - Diagnostics for Channel 1 / 2 are activated  Analog filter time for the input Channel 1/2

\*) Default value

**Selection Parameters for 75x-482 2AI/(1, 2, 3)x2 HV)**

Table 15: Parameter Data for the HART Variables

Parameter	Value	Description
HART-Value Channel 0/1	1x2 HV: - PV *) - SV -TV -QV	1 HART variable Channel 1 / 2; - first variable - second variable - third variable - fourth variable
	2x2 HV: - PV, SV *) - PV, TV - SV, TV - PV, QV - SV, QV - TV, QV	2 HART variables Channel 1 / 2; - first and second variable - first and third variable - second and third variable - first and fourth variable - second and vierte variable - third and fourth variable
	3x2 HV: - PV, SV, TV *) - PV, SV, QV - PV, TV, QV - SV, TV, QV	3 HART variables Channel 1 / 2; - first, second and third variable - first, second and fourth variable - first, third and fourth variable - second, third and fourth variable
	4x2 HV: - PV, SV, TV, QV *)	4 HART variables Channel 1 / 2; - first, second, third and fourth variable

PV	=	first Variable	(Primary Variable),
SV	=	second Variable	(Secondary Variable)
TV	=	third Variable	(Tertiary Variable)
QV	=	fourth Variable	(Quarternary Variable)

\*) Default value

### Selection Parameters for 75x-482 2AI/4-20 mA/SE

Table 16: Parameter Data for acyclic Access

Parameter	Value	Description
Acyclic access to the HMDs	- disabled *)	- Acyclic access to the HMDs (HART Master Devices) is deactivated
	- 12 Byte Mailbox	- 12-byte mailbox for acyclic access activated

\*) Default value

## 7.2 FDT/DTM Concept

FDT is an abbreviation for "Field Device Tool". This is frame application software, which can be used to parameterize, configure and control fieldbus devices separately from the specific communication technologies of the different fieldbusses.

In order to establish communication with the individual devices in an FDT application and from there to be able to access the adjustable device parameters, the application requires an addition in the form of a software component for each field device.

The specific functions and dialogs of a field device for parameterization, diagnosis and maintenance, including the user interface, are reproduced in such a software component, which is referred to as a DTM (Device Type Manager).

Comparable with device driver software, the DTM is supplied with the device by the device manufacturer and installed on the PC by the user. The DTM is subsequently loaded into the FDT frame application from where it is executed.

FDT/DTM is an open concept, which encourages a uniform operating concept within an overall control program in which individual components from different manufacturers can work together.

WAGO provides a simple and convenient FDT frame application in the form of the "759 370 WAGOframe FDT Frame Application" software.

## Information



### Additional Information about *WAGOframe*

Please read the "759 370 *WAGOframe* FDT Frame Application" manual for detailed information on the installation and use of the "759-370 *WAGOframe*" Software. You will find this on the Internet at:

[www.wago.com](http://www.wago.com)

By means of special gateway DTMs, the frame application is additionally provided with further communications functions for connecting the host system to the particular fieldbusses used (e.g., HART, PROFIBUS).

WAGO provides gateway DTMs for PROFIBUS (759-360 Profibus/HART Gateway DTM) and MODBUS TCP (759-359 ModbusTCP/HARTGatewayDTM) for this purpose.

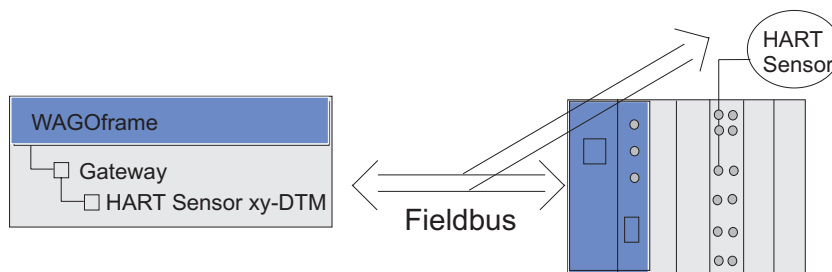


Figure 19: FDT/DTM communication principle

## Information



### Additional Information about the Download of the HARTGatewayDTMs

The gateway DTMs for PROFIBUS (759-360 Profibus/HARTGatewayDTM) and MODBUS TCP (759-359 ModbusTCP/HARTGatewayDTM) are available for downloading free of charge from the Internet at:

[www.wago.com](http://www.wago.com)

## Information



### Additional Information about the FDT Technology

You will find more detailed information on FDT technology on the FDT-Group website at:

[www.fdt-group.org](http://www.fdt-group.org)



## 7.3 HART on PROFIBUS

The PROFIBUS specification provides an open solution especially for incorporating HART in PROFIBUS systems. Here, the HART protocol is taken into account in the specification as a PROFIBUS profile, which is also referred to as "HART on PROFIBUS" for short.

This solution includes the use of the PROFIBUS communications mechanisms without change to the PROFIBUS protocol and services, the PDUs or the state machines and functional characteristics.

The HART client application is integrated within a PROFIBUS master and the HART master within a PROFIBUS slave, the latter serving as a multiplexer and handling the communication with the HART devices.

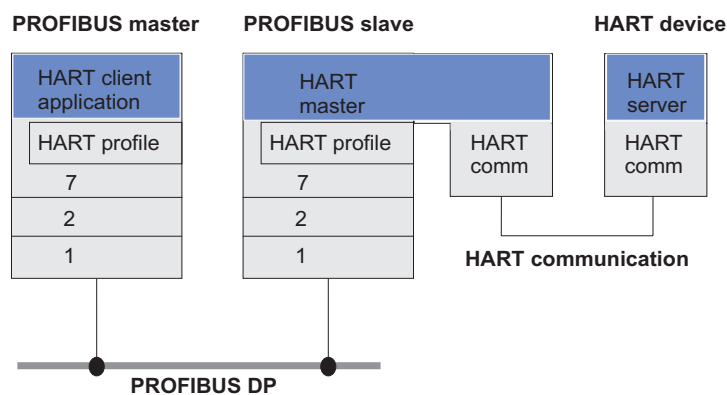


Figure 20: Operation of HART devices via PROFIBUS

## 8 Description of Operation

The principle of operation of the HART I/O module is described in more detail in the following sub-sections with regard to the various types of application and operating modes.

- Application type 1:**  
Operation with PLC library "WagoLibHART\_0x.lib" when connected to any of the 75x-xxx couplers/controllers listed in the section "Compatibility List".  
(Default operating mode 2AI + 6-byte mailbox)
- Application type 2:**  
Operation with the 759-359 Modbus TCP/HART Gateway using FDT/DTM when connected to the 750-841 ETHERNET TCP/IP Controller.  
(Default operating mode 2AI + 6-byte mailbox)
- Application type 3:**  
Operation with HART dynamic variables when connected to the PROFIBUS DP/V1 Coupler 750-333 or Controller 750-833.  
(Operating modes 2AI + 1, 2, 3, 4 HART variables per channel)

- **Application type 4:**  
Operation with the 759-360 PROFIBUS/HART Gateway using FDT/DTM when connected to the PROFIBUS DP/V1 Coupler 750-333 or Controller 750-833.  
(Operating mode 2AI + acyclic PROFIBUS services)

## 8.1 With PLC Library on all compatible 75x-xxx Couplers/Controllers

With the default parameter settings "2AI + 6-byte mailbox", the HART I/O module can be used with all WAGO 75x-xxx couplers/controllers of the WAGO-I/O-SYSTEM with HART functionality, which are listed in the section "Compatibility List".

### Note



#### Consider the maximum number of modules!

Because of the process data capacity of the HART I/O module, please be sure to take into account the corresponding maximum number of modules that can be connected when using a WAGO 75x-xxx coupler/controller. You can find this number in the list in section "Compatibility List".

In the cyclic process image of the coupler/controller, the HART I/O module looks like a 1-channel I/O module whose process values consist of the analog values and a 6-byte mailbox. HART communication can then take place via the mailbox.

### Note



#### Library for HART functionality is necessary!

In order to be able to use the HART functionality, it is necessary to install and incorporate the special WAGO HART library "WagoLibHART\_0x.lib" in the PLC application.

### Information



#### Weitere Information

The library "WagoLibHART\_0x.lib" can be downloaded free of charge from the WAGO website at:

[www.wago.com](http://www.wago.com) → Service → Documentation → WAGO Software 759 → WAGO-I/O-PRO / CoDeSys.

You can find the link to "Libraries" in the column "Additional Information" on the right side.

### 8.1.1 Communication with 75x-xxx via PLC Library

Communication between the 75x-xxx couplers/controllers and the HART I/O module is achieved by means of the library "WagoLibHART\_0x.lib".

This library enables easy access to the 6-byte mailbox of the I/O module and provides the necessary HART commands, which can then be executed locally from the PLC application.

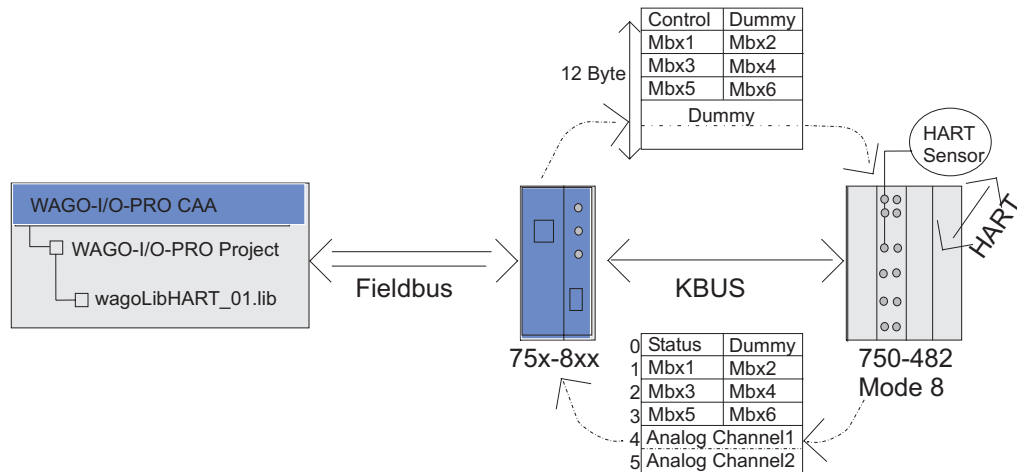


Figure 21: Communication by means of WagoLibHART\_0x.lib using a 75x-8xx Controller as an example

#### Information



#### Additional Information for the Application

You can read a detailed description with a clear application example for the library "WagoLibHART\_0x.lib" with WAGO-I/O-PRO CAA in the appropriate application note, which describes the HART application using this library. You will find this application note on the WAGO website at: [www.wago.com](http://www.wago.com) → Service → Dokumentation → Application notes.

### 8.1.2 Commissioning on a 75x-xxx via PLC Library

This section describes the most important steps for commissioning the HART I/O module on a 75x-xxx coupler/controller using the HART library.

Along with the fitted and wired fieldbus node hardware, which includes the connected coupler/controller, it is necessary to install the following software before carrying out the operations described.

Table 17: Software required for the Commissioning on a 75x-xxx via PLC Library

Pos.	Name	Description	Item-No.:
1	WAGO-I/O-CHECK 2 (optional)	Commissioning tool for the WAGO-I/O-SYSTEM 750	759-302
2	WAGO-I/O-PRO CAA	Programming tool IEC 61131-3; CAA Version 2.3 CoDeSys Automation Alliance	759-333
3	WagoLibHART_0x.lib	WAGO-I/O-PRO Libraries	Download: <a href="http://www.wago.com">www.wago.com</a>

- When the HART I/O module is delivered it is pre-configured for the default operating mode (2 AI + 6-byte mailbox).  
If this should already have been changed; e.g., if the module has been used in a PROFIBUS system, the operating mode must be re-parameterized for the default setting.  
To do this, open WAGO-I/O-CHECK 2, and set the operating mode to "2 AI + 6-byte mailbox".  
For this purpose, proceed as described in the section "Setting the operating mode parameters - Setting up using WAGO-I/O-CHECK 2".

## Note



### Restriction of Settings for PROFIBUS Operating Mode!

This changeover and operation with other than a PROFIBUS Coupler 750-333 or Controller 750-833 is not yet possible at the present time for "PROFIBUS operating modes" (2 AI + 1, 2, 3 or 4 HART variables per channel).

A HART I/O module that has once been set up for HART dynamic variables using GSD files can therefore currently only be operated with a PROFIBUS Coupler 750-333 or Controller 750-833.

It is then possible to restore the default state of the HART I/O module using WAGO-I/O-CHECK 2 and the PROFIBUS Coupler 750 333 or Controller 750-833. When doing so it must be ensured that the parameters of the PROFIBUS Coupler 750-333 or Controller 750-833 are not set using GSD files.

- Next open WAGO-I/O-PRO CAA, select the "Resources" tab and select "Library Manager" from the tree structure.  
Open the appropriate dialog window by double-clicking on it and incorporate the library "WagoLibHART\_0x.lib" for your IEC 61131-3 project.  
You can then access the HART commands directly in your project and also execute these locally from your IEC 61131-3 application.

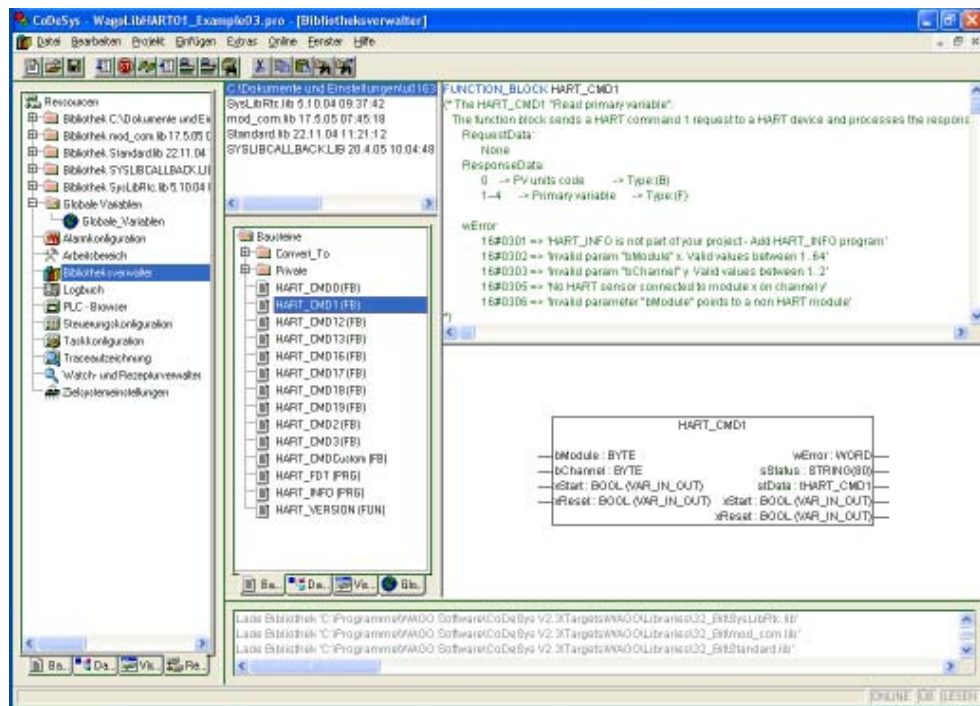


Figure 22: WAGO-I/O-PRO project with incorporated library „WagoLibHART\_0x.lib“

## Information



### Additional Information about WAGO-I/O-PRO CAA

You will find a detailed description of the functions and use of the WAGO-I/O-PRO CAA IEC 61131-3 programming tool in the "759-333 WAGO-I/O-PRO CAA" manual on the Internet at:  
[www.wago.com](http://www.wago.com)

## 8.2 FDT/DTM with the 750-841 ETHERNET Controller

In the default mode "2AI + 6-byte mailbox", when the HART I/O module is connected to a 750 841 WAGO ETHERNET TCP/IP Controller, it is also possible to carry out HART communication by means of the FDT/DTM frame application "WAGOframe".

## Note



### Consider the maximum number of modules!

Because of the process data capacity of the HART I/O module, please be sure to take into account the corresponding maximum number of modules that can be connected when using a WAGO 750-841 ETHERNET Controller. You can find this number in the list in section "Compatibility List".

## Note



### A Boot-Project for HART functionality is necessary!

In order to be able to use the HART functionality, a special boot project for Ethernet controllers must be loaded into the 750 841 ETHERNET Controller. You can download this boot project and more detailed information relating to it on the WAGO website at:

[www.wago.com](http://www.wago.com) → Service → Downloads → AUTOMATION → Application notes, under the number: "A116101".

The device driver "ModbusTCP/HARTGatewayDTM 759 359" is available for the convenient FDT/DTM frame application "*WAGOframe*", which makes it possible to access the DTM of the connected HART device directly from this application.

## Information



### Additional Information about „*WAGOframe*“ and „ModbusTCP/HARTGatewayDTM“

The FDT/DTM frame application "*WAGOframe*" can be ordered under Item No.: 759-370; the free "ModbusTCP/HARTGatewayDTM 759 359" can be downloaded from the WAGO website at:

[www.wago.com](http://www.wago.com) → Service → Downloads → AUTOMATION.

## 8.2.1 Communication on 750-841 via FDT/DTM

The "ModbusTCP/HARTGatewayDTM 759-359" and the DTM for the connected HART sensor are embedded in the *WAGOframe* FDT/DTM frame application.

Communication from the *WAGOframe* FDT/DTM frame application to the connected HART sensor takes place in three phases:

- 1 The DTM of the HART field device first creates a HART telegram. This is received by the WAGO ModbusTCP/HARTGatewayDTM and packed into a Modbus telegram. This is then sent to the 750-841 by means of the Modbus TCP communications DTM.
- 2 The 750-841 Controller acts as a gateway. It receives the Modbus telegram, removes the HART telegram from the Modbus telegram and transfers it via the mailbox, which is incorporated into the process image of the controller. This mailbox data is then used to forward the commands to the HART I/O module by means of the module bus (KBUS).
- 3 The HART I/O module receives the HART telegram via the mailbox and passes it on to the HART field device.

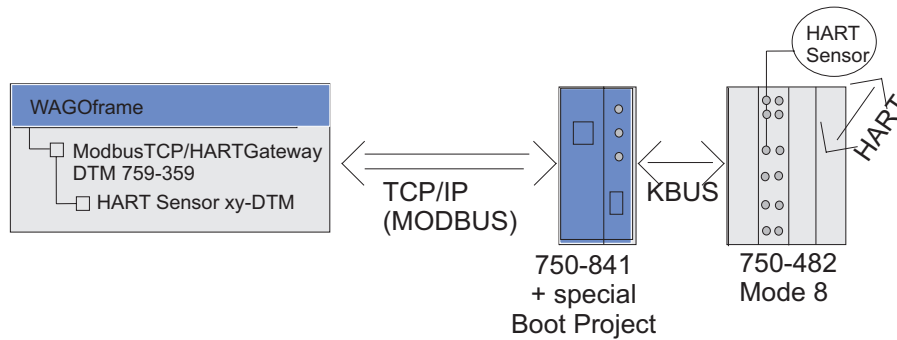


Figure 23: FDT/DTM Communication via MODBUS TCP/IP

## 8.2.2 Commissioning 750-841 via FDT/DTM

This section describes the most important steps for commissioning the HART I/O module on a 750-841 Controller using FDT/DTM.

Along with the fitted and wired fieldbus node hardware, which includes the connected ETHERNET controller, it is necessary to install the following software before carrying out the operations described.

Table 18: Software required for the Commissioning on a 750-841 via FDT/DTM

Pos.	Name	Description	Item-No.:
1	WAGO-I/O-CHECK (optional)	Commissioning tool for the WAGO-I/O-SYSTEM 750	759-302
2	Default.prg	Special boot project for Ethernet controllers, Application note number: "A116101"	Download: <a href="http://www.wago.com">www.wago.com</a>
3	WAGOframe	FDT frame application for parameterization, commissioning and diagnostics of devices with DTM device drivers	759-370
4	WAGO_Modbus_TCP_DTM	DTM for MODBUS/TCP	759-359 Both
5	WAGO_075x-08xx_DTM	DTM for the 75x-8xx controller	Download: <a href="http://www.wago.com">www.wago.com</a>
6	HART device DTM (e.g., Generic HART DTM from ICS GmbH)	DTM for parameterization, commissioning and diagnostics of HART-enabled field devices	Obtainable from HART field device manufacturers

- When the HART I/O module is delivered it is pre-configured for the default operating mode (2 AI + 6-byte mailbox).  
If this should already have been changed; e.g., if the module has been used in a PROFIBUS system, the operating mode must be re-parameterized for the default setting.

To do this, open *WAGO-I/O-CHECK 2*, and set the operating mode to "2 AI + 6-byte mailbox".

For this purpose, proceed as described in the section "Setting the operating mode parameters - Setting up using *WAGO-I/O-CHECK 2*".

## Note



### Restriction of Settings for PROFIBUS Operating Mode!

This changeover and operation with other than a PROFIBUS Coupler 750-333 or Controller 750-833 is not yet possible at the present time for "PROFIBUS operating modes" (2 AI + 1, 2, 3 or 4 HART variables per channel).

A HART I/O module that has once been set up for HART dynamic variables using GSD files can therefore currently only be operated with a PROFIBUS Coupler 750-333 or Controller 750-833.

It is then possible to restore the default state of the HART I/O module using *WAGO-I/O-CHECK 2* and the PROFIBUS Coupler 750 333 or Controller 750-833. When doing so it must be ensured that the parameters of the PROFIBUS Coupler 750-333 or Controller 750-833 are not set using GSD files.

- Set up an FTP connection to the Ethernet controller. The easiest way to do this is using Internet Explorer:

For the address enter:

ftp://<IP> where <IP> is the IP address of the controller.

(Example: ftp://192.168.1.1)

- In the following log-in dialog, enter the user name and password (Default: user name "admin"; password "wago")

You will now see a view of the folder structure for the controller, e.g.:

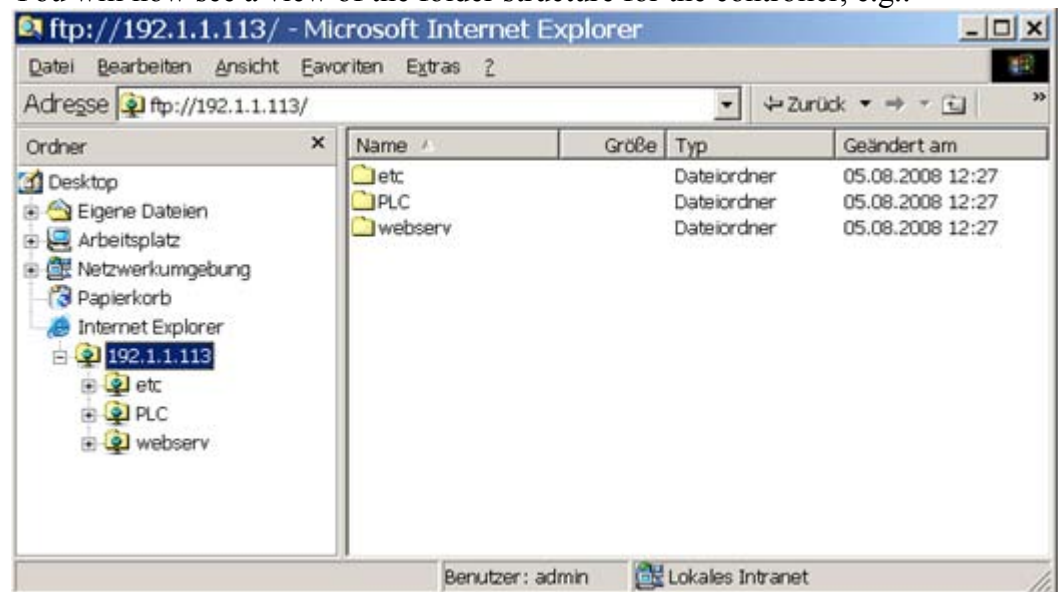


Figure 24: ftp access on a fieldbus controller

- Now switch to the "PLC" directory and here delete the two files "default.prg" and "default.chk".
- Copy the special boot project files, which you have previously downloaded from the WAGO website, into this "PLC" directory.





## Note

### A Boot-Project for HART functionality is necessary!

In order to be able to use the HART functionality, a special boot project for Ethernet controllers must be loaded into the 750 841 ETHERNET Controller. You can download this boot project and more detailed information relating to it on the WAGO website at:

[www.wago.com](http://www.wago.com) → Service → Downloads → AUTOMATION → Application notes, under the number: "A116101".

6. Now move the operating mode switch on your Ethernet controller, which is to be found on the programming and configuration interface, into the upper position.
7. Open the *WAGOframe* in „Expert mode“.
8. Next make sure that the "Device catalog" dialog window is shown on the right-hand side of the screen. This must be activated under "Device catalog" on the "View" menu.  
Click on "Update" in the "Device catalog" dialog window.
9. Open a new project using "New" on the "File" menu.
10. Make sure that the "Network view" dialog window is shown on the left-hand side of the screen. This must be activated under "Network view" on the "View" menu.  
Move the mouse to "Network" in the tree structure and click on "Add..." in the context menu (right mouse button).  
Select "WAGO Modbus TCP" in the dialog which opens and confirm the selection by clicking "OK".  
The entry "MODBUS TCP\_DTM\*" will now be added to the tree structure.
11. Click "Set up connection" on the "Device" menu. The entry "MODBUS TCP\_DTM\*" will now be changed to italics in the tree structure.
12. Move the mouse to "*MODBUS TCP\_DTM*" in the tree structure and click on "Add..." in the context menu (right mouse button).  
Select "075x-08xx ModbusTCP/HART Gateway" in the dialog which opens and confirm the selection by clicking "OK".  
The entry "<ModbusCommChannel:-> 075x-08xx DTM\*" will now be added to the tree structure.
13. Now move the mouse once again to "*MODBUS TCP\_DTM*" in the tree structure and select it by clicking with the left mouse button.  
Next go to "More functions" on the "Device" menu and click on "Device list" on the sub-menu.  
A dialog window with a list of devices will open.  
Select the device with the address "0.0.0.0" by clicking on it and click "Change DTM tag/address...".  
In the new view now enter the "IP address" of your ETHERNET controller in place of the "0.0.0.0".  
Confirm your entry by clicking "OK".  
The IP address which you have entered will now be displayed in the list in the "ModbusTCP\_DTM device list" dialog window.  
Next click on "Check devices".

If all parameters are correctly set, the status of the DTM will now be shown in green.

14. Now move the mouse to `<ModbusCommChannel:-> 075x-08xx DTM*` in the tree structure and click on "Add..." in the context menu (right mouse button).  
Select the HART DTM for your HART field device in the dialog which opens and confirm the selection by clicking "OK".  
A further view will appear in the dialog window in which you can now select the channel to which your HART device is connected. Select "M01\_Ch01" for Channel 1 of the first plugged-in HART module or "M01\_Ch02" for Channel 2.  
Confirm the selection by clicking "OK".  
Depending on the entry "`<M01_Ch01:0>...HART DTM*`" or "`<M01_Ch02:0>...HART DTM*`" will be added in the tree structure.  
If a HART device is connected to both channels, carry out these steps for the first channel and then again in a similar manner for the second channel.
15. Move the mouse once again to `<ModbusCommChannel:-> 075x-08xx DTM*` in the tree structure and select it by clicking with the left mouse button.  
Next go to "Set up connection" on the "Device" menu. The entry "`<ModbusCommChannel:-> 075x-08xx DTM*`" will now be changed to italics in the tree structure.
16. Next go to "More functions" on the "Device" menu and click on "Device list" on the sub-menu.  
A dialog window with a list of devices will open.  
Click on "Update".  
After a while the DTM(s) for the connected HART devices will now also be shown in green.
17. Move the mouse once again to the entry for the channel to which your HART device is connected in the tree structure and select it by clicking with the left mouse button.  
Go to the "Device" menu and click "Set up connection". This entry will then be changed to italics in the tree structure.  
If a HART device is connected to both channels, carry out these steps for the first channel and then again in a similar manner for the second channel.
18. Move the mouse to the entry for the channel to which your HART device is connected in the tree structure and double-click it; a dialog window with the online parameterization will then open. After a short time connection symbols will be displayed after the respective parameters.

## 8.3 With HART Dynamic Variables on PROFIBUS DP/V1 750-333 and 750-833

When connecting to the PROFIBUS DP/V1 Coupler 750-333 or Controller 750-833, there is a choice of four operating modes, "2AI + 1, 2, 3, 4 HART variables per channel", in which the incorporation of one, two, three or four HART variables per channel in the cyclic process image can be set up for the analog values.

Table 19: Operating Mode for PROFIBUS DP/V1

2 AI + 1 HART variable per Channel
2 AI + 2 HART variables per Channel
2 AI + 3 HART variables per Channel
2 AI + 4 HART variables per Channel

### Note



#### Consider the maximum number of modules!

Because of the process data capacity of the HART I/O module, please be sure to take into account the corresponding maximum number of modules that can be connected when using a WAGO PROFIBUS DP/V1 Coupler 750-333 or Controller 750-833. You can find this number in the list in the section "Compatibility List".

With PROFIBUS, it is possible to evaluate and process further information in addition to the actual measured signal, which is output in the main variables. This additional information is then output accordingly by means of the HART dynamic variables.

Some HART field devices (sensors) provide such additional information, an example being a pressure transducer, which depending on the type of measurement also provides such data as the sensor or electronics temperature in the dynamic variables along with the actual process value (e.g., pressure, flow or level).

### Information



#### Additional Information for the Application

You can read a detailed description with a clear application example for the PROFIBUS connection using HART dynamic variables in a superimposed CoDeSys or Siemens controller in the appropriate application note, which describes the use of HART I/O modules on the PROFIBUS DP/V1 coupler. You will find this application note on the WAGO website at:  
[www.wago.com](http://www.wago.com) → Service → Documentation → Application notes.

### 8.3.1 Communication on the 750-333, -833 with Dynamic Variables

The use of the HART I/O module with a WAGO PROFIBUS DP/V1 Coupler 750-333 or Controller 750-833 is described briefly below.

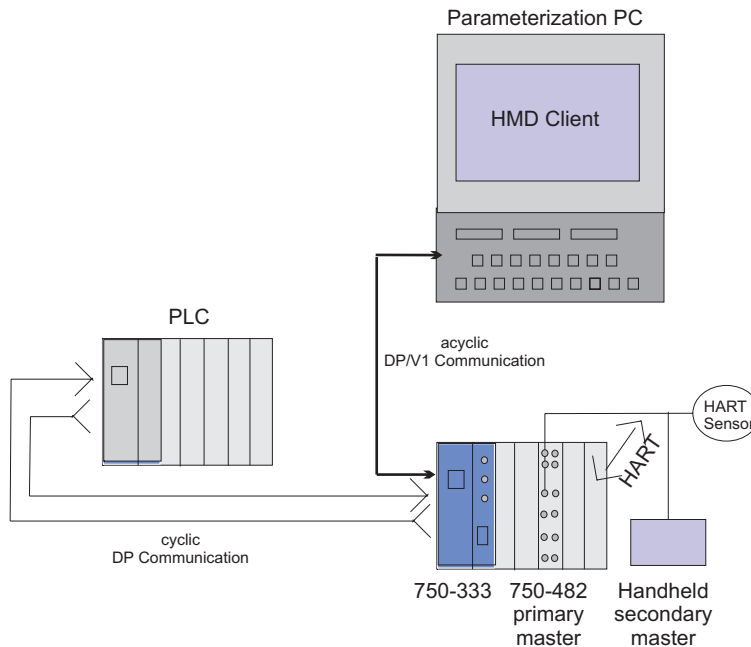


Figure 25: System overview with a PROFIBUS fieldbus coupler/controller

The WAGO fieldbus node with PROFIBUS DP/V1 coupler/controller serves as a data gatherer/distributor for the superimposed controller. The coupler/controller processes the process variables from the HART devices.

Communication on PROFIBUS takes place by means of the acyclic PROFIBUS DP/V1 commands. A prerequisite for the implementation of cyclic communication is the successful start-up of cyclic data traffic.

The final transfer of data between the HART I/O module and the connected sensor then takes place using the HART-on-Profibus protocol.

Parameterization/monitoring of the HART devices can be carried out both using a PC application in the DP/V1 leg and also using a handheld directly in the HART leg. An IEC development tool (e.g., WAGO-I/O-PRO CAA (Item No.: 759-333), the "SIMATIC Manager" or other) is used for the parameterization environment.

### 8.3.2 Commissioning on the 750-333, -833 with Dynamic Variables

This section describes the most important steps for commissioning the HART I/O module on a PROFIBUS DP/V1 fieldbus coupler 750-333 or fieldbus controller 750-833 using the dynamic variables.

Along with the installed and wired fieldbus node hardware, which includes the PROFIBUS DP/V fieldbus coupler/controller, it is necessary to install the following software before carrying out the operations described.

Table 20: Software required for the Commissioning on a 750-333, -833 with Dynamic Variables

Pos.	Name	Description	Item-No.:
1	WAGO-I/O-CHECK 2 (optional)	Commissioning tool for the WAGO-I/O-SYSTEM 750	759-302
2	GSD files for PROFIBUS with installation program / Series 750, 752 und 755	Fieldbus-specific software (e.g., GSD files for PROFIBUS)	750-910 Download: <a href="http://www.wago.com">www.wago.com</a>
3	e.g., WAGO-I/O-PRO CAA (SIMATIC Manager,...)	PLC development environment	759-333

A PROFIBUS Coupler 750-333 or Controller 750-833 is operated on a PROFIBUS master; e.g., on a 750-870 WAGO IPC, an S7 or another PROFIBUS master station.

In this case, WAGO-I/O-PRO CAA (Item No.: 759-333), the "SIMATIC Manager" or other IEC development tools can be used for the configuration software.

The following description of the configuration is by way of example. You will find the exact steps for configuring your PROFIBUS system in the documentation for the software used.

1. As is typical for a PROFIBUS application, set up the required operating mode "2 AI + 1, 2, 3 or 4 HART variables per channel" using the GSD files. You will find more detailed information on this in the section "Setting the Operating Mode Parameters - Setting Up via GSD". Alternatively you can also open WAGO-I/O-CHECK 2 if available. In this case, proceed as described in the section "Setting the Operating Mode Parameters - Setting via WAGO-I/O-CHECK 2".
2. Start your configuration software and create your basic project.
3. When you have selected your PROFIBUS master, open the hardware configurator.
4. Now install the WAGO GSD files.
5. Incorporate the device descriptions for the WAGO-I/O-SYSTEM 750 devices in the device catalog and update them.
6. In the next step, add a "DP master system" and set the station address of the DP master interface.
7. Mark the "DP master system" and open the device catalog in order to connect the WAGO PROFIBUS DP/V1 Coupler 750 333 or Controller 750-833 you are using to the "DP master system". You will find the Coupler 750-333 or Controller 750-833 in the tree structure under:

"PROFIBUS-DP >Other FIELD DEVICES >I/O >WAGO I/O-SYSTEM 750".

8. Change the address to the station address of the WAGO PROFIBUS DP/V1 coupler/controller previously set on the DIP switch.
9. Now expand the device catalog and using "Drag&Drop" add the remaining I/O modules that you have plugged into your fieldbus node on the coupler/controller.

In doing so, you will find a total of five entries for the HART I/O Module corresponding to the operating modes.

You will find a description of the different entries with a list of all the associated parameters in the section "Setting the Operating Mode Parameters - Setting Up via GSD".

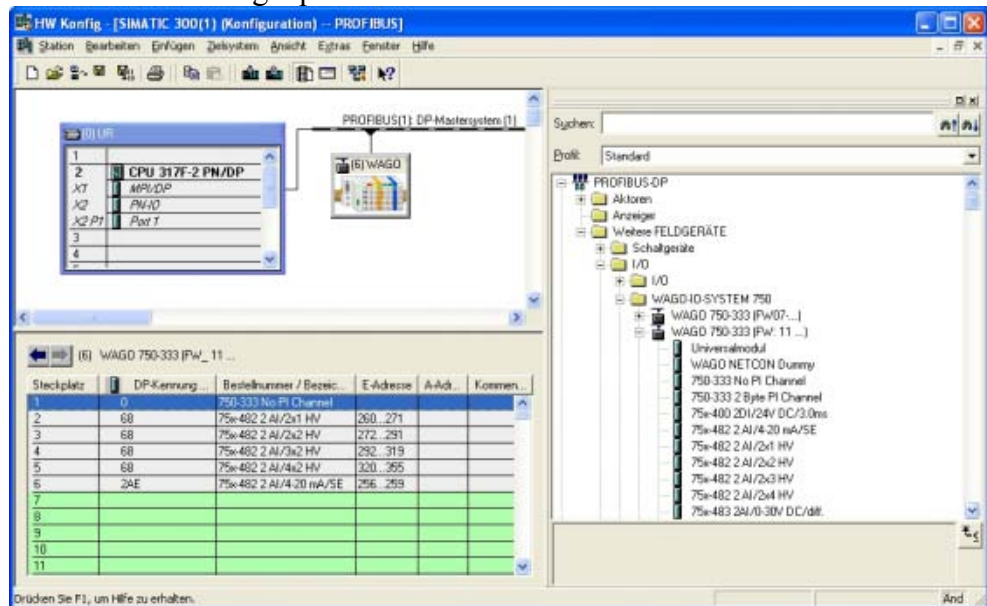


Figure 26: HW Config in STEP7

10. Select the entry corresponding to the required operating mode and incorporate this into your configuration.
11. Double-clicking on a module in the configuration tree structure will open a module-specific parameterizing dialog in which you can set the parameters for the PROFIBUS Coupler 750-333 or Controller 750-833, the HART I/O module and other parameterizable I/O modules.  
Set the required parameter data.
12. Next save and translate the network configuration and transfer the new project to the PLC.

## 8.4 FDT/DTM with the PROFIBUS DP/V1 750-333, 750-833

In the operating mode "2AI + acyclic PROFIBUS services", when the HART I/O module is connected to a PROFIBUS Coupler 750-333 or Controller 750-833, it is also possible to carry out HART communication by means of the FDT/DTM frame application "*WAGOframe*". The device driver "Profibus/HARTGatewayDTM 759 360" is available for using the FDT/DTM frame application "*WAGOframe*", by means of which FDT tool routing from the PROFIBUS DP/V coupler/controller to the DTM of the connected HART device is possible. In this case, HART communication takes place by means of the acyclic PROFIBUS services, which are processed by a 12-byte mailbox.

### Note



#### Consider maximum number of modules!

Because of the process data capacity of the HART I/O module, please be sure to take into account the corresponding maximum number of modules that can be connected when using a WAGO PROFIBUS DP/V1 Coupler 750-333 or Controller 750-833. You can find this number in the list in section "Compatibility List".

### Information



#### Additional Information about "*WAGOframe*" and "Profibus/HARTGatewayDTM"

The FDT/DTM frame application "*WAGOframe*" can be ordered under Item No.: 759-370; the free "759 360 Profibus/HARTGatewayDTM" can be downloaded from the WAGO website at:

[www.wago.com](http://www.wago.com) → Service → Downloads → AUTOMATION.

### 8.4.1 Communication on 750-333, -833 via FDT/DTM

The 759-360 Profibus/HARTGatewayDTM and the DTM for the connected HART sensor are embedded in the *WAGOframe* FDT/DTM frame application.

Communication from the *WAGOframe* FDT/DTM frame application to the connected HART sensor takes place in three phases:

- 1 The DTM of the HART field device first creates a HART telegram. This is received by the WAGO Profibus/HARTGatewayDTM and packed into a Profibus telegram. This is then sent to the 750-333 or 750-833 by means of the Profibus communications DTM.

- 2 The Fieldbus Coupler 750-333 or Controller 750-833 acts as a gateway. The fieldbus coupler/controller receives the Profibus DP/V telegram and transfers it via the mailbox, which is incorporated into the process image of the fieldbus coupler/controller. This mailbox data is then used to forward the commands to the HART I/O module by means of the internal data bus (KBUS).
- 3 The final transfer of data between the HART I/O module and the connected sensor then takes place using the HART-on-Profibus protocol.

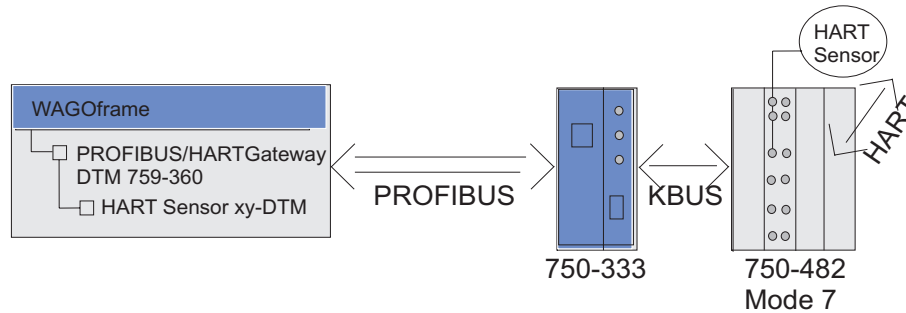


Figure 27: Example of a FDT/DTM Communication via PROFIBUS

## 8.4.2 Commissioning on a 750-333, -833 via FDT/DTM

This section describes the most important steps for commissioning the HART I/O module on a PROFIBUS DP/V1 Fieldbus Coupler 750-333 or Controller 750-833 using FDT/DTM.

Along with the installed and wired fieldbus node hardware, which includes the PROFIBUS DP/V1 Fieldbus Coupler 750-333 or Controller 750-833, it is necessary to install the following software before carrying out the operations described.



Table 21: Software required for the Commissioning on a 750-333, -833 via FDT/DTM

Pos.	Name	Description	Item-No.:
1	WAGO-I/O-CHECK 2 (optional)	Commissioning tool for the WAGO-I/O-SYSTEM 750	759-302
2	GSD files for PROFIBUS with installation program / Series 750, 752 and 755	Fieldbus-specific software (e.g., GSD files for PROFIBUS)	750-910 Download: www.wago.com
3	WAGOframe	FDT frame application for parameterization, commissioning and diagnostics of devices with DTM device drivers	759-370
4	WAGO_Profibus_HART_DTM 759-360	DTM for PROFIBUS	759-360 Both Download:www.wago.com
5	WAGO_075x-08xx_DTM	DTM for the 75x-8xx controller	Obtainable from HART field device manufacturers
6	HART device DTM(e.g., Generic HART DTM from ICS GmbH)	DTM for parameterization, commissioning and diagnostics of HART-enabled field devices	

- As is typical for a PROFIBUS application, set up the operating mode "2 AI + acyclic PROFIBUS services" using the GSD files. You will find more detailed information on this in the section "Setting the Operating Mode Parameters - Setting Up via GSD".  
Alternatively you can also open WAGO-I/O-CHECK 2 if available. In this case, proceed as described in the section "Setting the Operating Mode Parameters - Setting via WAGO-I/O-CHECK 2".
- Open *WAGOframe* in „Expert mode“.
- Next make sure that the "Device catalog" dialog window is shown on the right-hand side of the screen. This must be activated under "Device catalog" on the "View" menu.  
Click on "Update" in the "Device catalog" dialog window.
- Open a new project using "New" on the "File" menu.
- Make sure that the "Network view" dialog window is shown on the left-hand side of the screen. This must be activated under "Network view" on the "View" menu. Now move the mouse to "Network" in the tree structure and click on "Add..." in the context menu (right mouse button).  
Select the device type name for your PROFIBUS master in the dialog which opens and confirm the selection by clicking "OK".  
The name of your PROFIBUS master will now be added in the tree structure.
- Move the mouse to the device type name of your PROFIBUS master in the tree structure and select it by clicking with the left mouse button.  
Next go to the "Device" menu and click "Offline parameterization".  
On the "FDL parameters" tab of the dialog window which opens enter the

baud rate: "12 MBaud" and click on "Set default values".

Confirm your entries by clicking "OK".

7. Click "Set up connection" on the "Device" menu. The device type name of your PROFIBUS master will now be changed to italics in the tree structure.
8. Move the mouse to the device type name of your PROFIBUS master in the tree structure and click on "Add..." in the context menu (right mouse button).

Select "0750-0333 PROFIBUS/HART Gateway" in the dialog which opens and confirm the selection by clicking "OK".

The entry for the PROFIBUS/HART communications DTM will now be added in the tree structure.

9. Move the mouse once again to the device type name of your PROFIBUS master in the tree structure and select it by clicking with the left mouse button.

Next go to "More functions" on the "Device" menu and click on "Device list" on the sub-menu.

A dialog window with a list of devices will open.



Figure 28: Dialog window "Device list"

10. Select the device with the address 126 by clicking on it and click "Change DTM tag/address...".  
Now, instead of the 126, enter the station address, which is physically set by the two rotary decade switches (decimal) on your PROFIBUS coupler/controller, for the "DP slave address" in the new view.  
Confirm your entry by clicking "OK".
11. Use the mouse to select the communications DTM in the tree structure and right click on "Configuration" in the context menu.  
A dialog window opens with three registers: "Device Information," "Module Configuration," and "Parameterization."

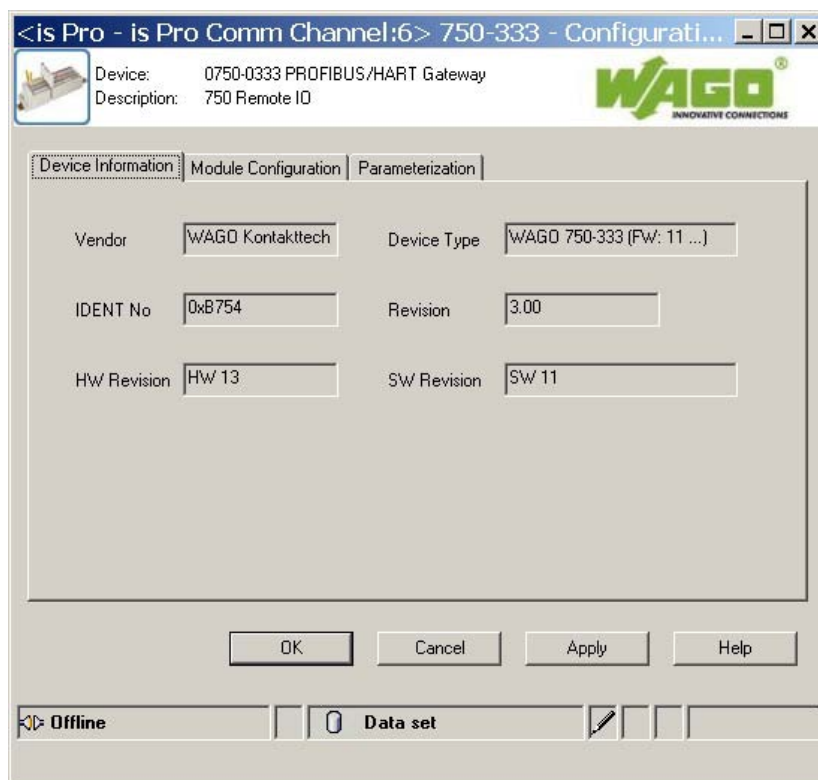


Figure 29: Dialog window 750-333 Configuration, register Device Information

12. Select the register "Module Configuration" and identify for Slot(2) ... Slot(x) which module is physically plugged in to its fieldbus node. Pay attention to all I/O modules that deliver process data in the process image. Slot(1) has been predefined with the fieldbus coupler/controller. For module configuration, a drop down menu of all available I/O modules can be found in the "Module" column. After the node configuration is complete, confirm by clicking "Accept."

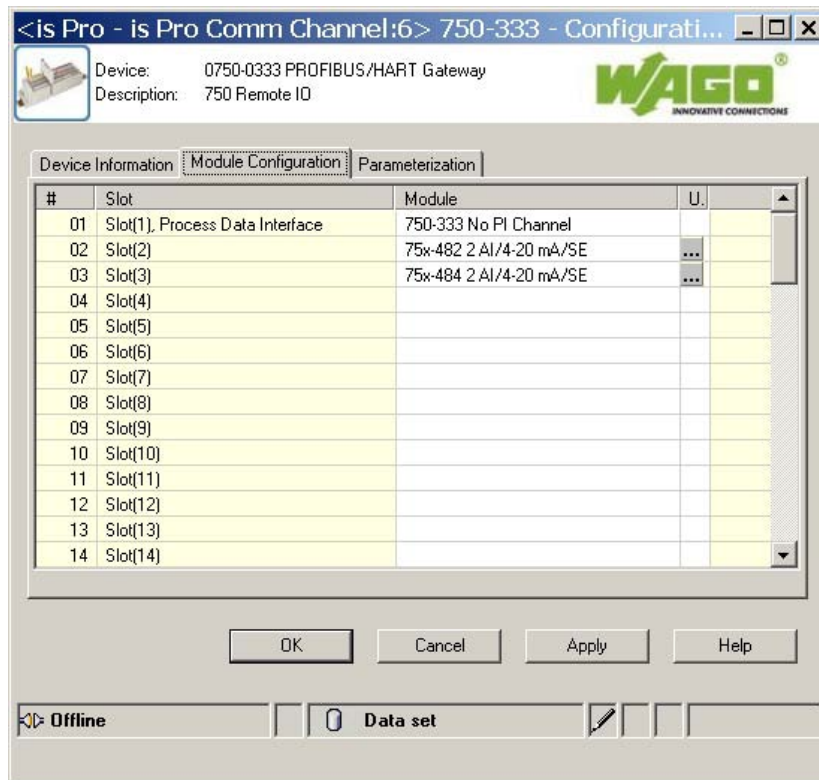


Figure 30: Dialog window 750-333 Configuration, register Module Configuration

13. Select the register "Parameterization" and open a dialog view in which you can make additional parameter changes.  
Confirm the changes made here by clicking "Accept."

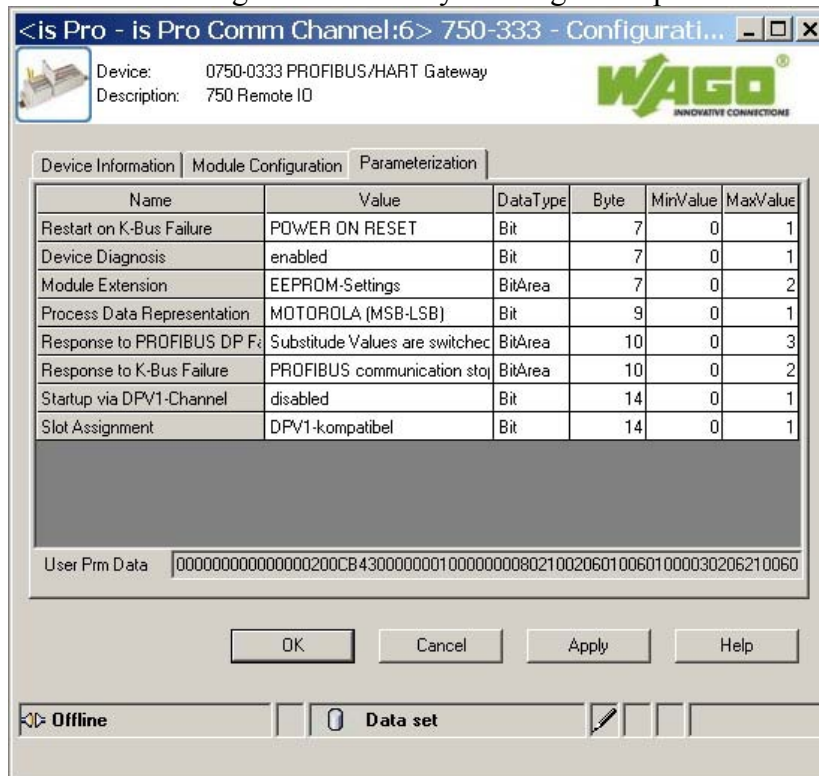


Figure 31: Dialog window 750-333 Configuration, register Parameterization

14. When configuration is completed, close the configuration dialog window.

15. Use the mouse to select the communications DTM in the tree structure and right click on "Offline Parameterization" in the context menu. You will see a dialog window in which you can set the DTM parameters for each module.

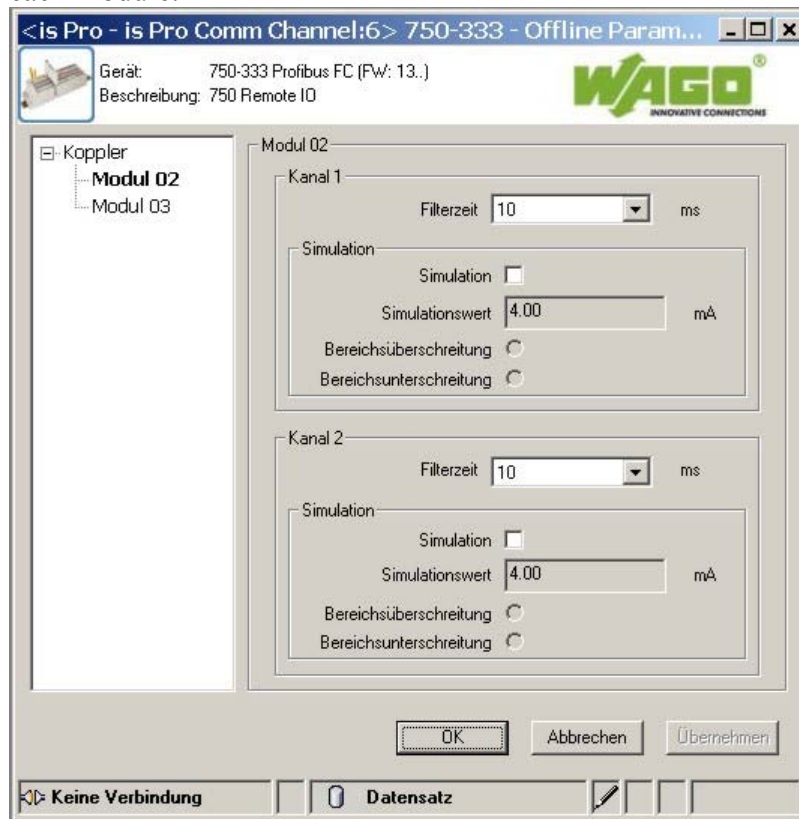


Figure 32: Dialog window DTM parameters

16. Select the desired module from the left side of the tree structure; the displayed module number corresponds to the slot in the structure – module 01 is the bus coupler.

The right side contains the parameterization dialog for this module.

17. Set the desired parameter for each channel separately, such as the analog filter time for the input channel (10 ... 640 ms), the simulation mode activation, and the simulation value setting with the overflow or underflow selection.

When the simulation is activated, the selected simulation value is output as a process value. When selecting an overflow or underflow, the overflow or underflow is overlaid (last 2 bits), as output in the status byte.

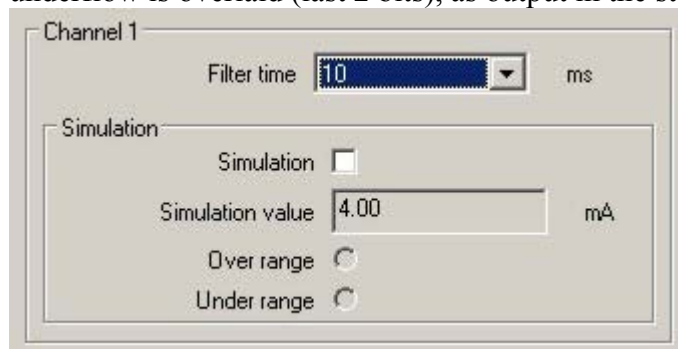


Figure 33: Dialog window detail: setting for channel 1

18. Proceed in the same manner for all additional modules. When parameter settings are complete, confirm by clicking "OK".
19. Move the mouse to the entry for the PROFIBUS/HART communications DTM in the tree structure, select it by clicking with the left mouse button, and then click "Set up connection" on the "Device" menu. The entry for the communications DTM will now be changed to italics in the tree structure. At the same time, the BF LED on your PROFIBUS fieldbus coupler will go off.  
(You can also carry out the following steps using offline parameterization. In this case it will also still be possible to set up a connection retrospectively).
20. Now move the mouse once again to the entry for the communications DTM in the tree structure and right click on "Add..." in the context menu. Select the HART DTM for your HART field device in the dialog which opens and confirm the selection by clicking "OK".  
A further view will appear in the dialog window in which you can now select the channel to which your HART device is connected.

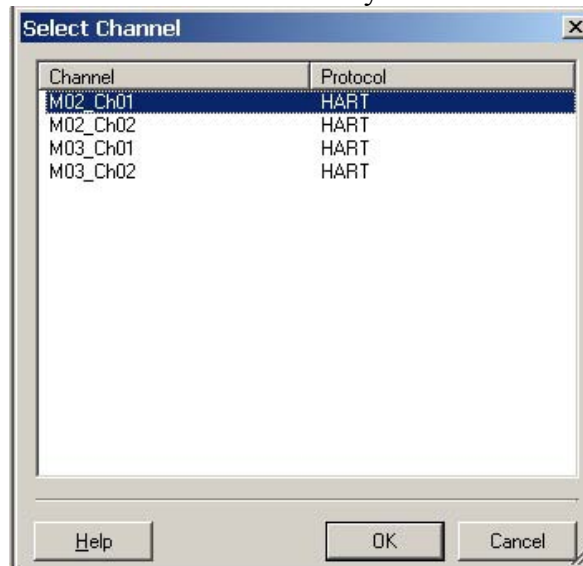


Figure 34: Channel selection dialog window

21. Select "M01\_Ch01" for Channel 1 of the first plugged-in HART module or "M01\_Ch02" for Channel 2.  
Confirm the selection by clicking "OK".  
Depending on the entry "<M01\_Ch01>...HART DTM\*" or "<M01\_Ch01>...HART DTM\*" will be added in the tree structure.  
If a HART device is connected to both channels, carry out these steps for the first channel and then again in a similar manner for the second channel.
22. Move the mouse to the entry for the channel to which your HART device is connected in the tree structure, select it by clicking with the left mouse button, and then click "Set up connection" on the "Device" menu.. This entry will now be changed to italics in the tree structure.  
If a HART device is connected to both channels, carry out these steps for the first channel and then again in a similar manner for the second channel.
23. Move the mouse once again to the entry for the communications DTM in the tree structure and select it by clicking with the left mouse button.  
Next go to "More functions" on the "Device" menu and click on "Device

list" on the sub-menu.

A dialog window with a list of devices will open.

Click on "Update".

After a while the DTM(s) for the connected HART devices will be shown in green.

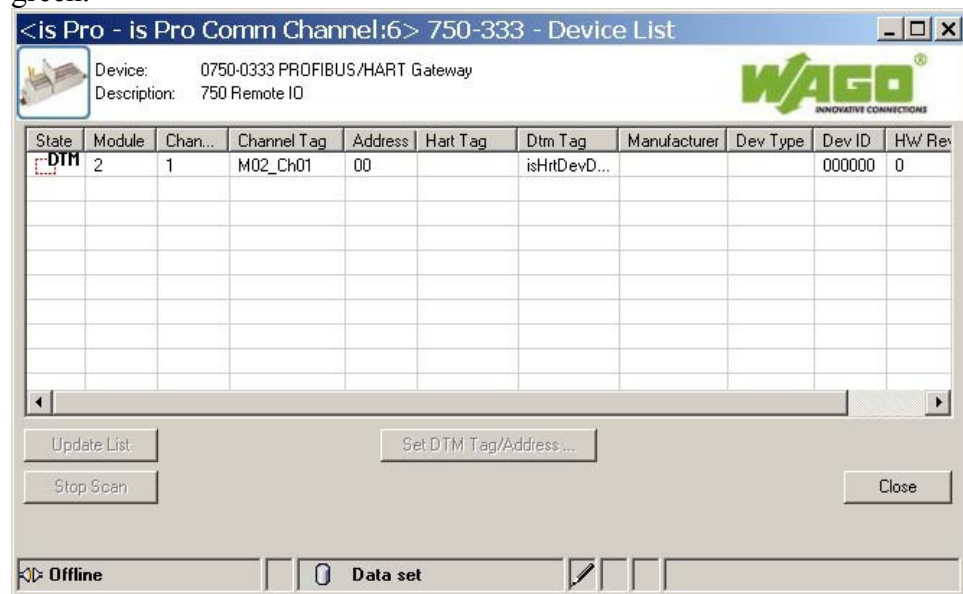


Figure 35: Dialog window Device list, Update

24. Move the mouse to the entry for the channel to which your HART device is connected in the tree structure and double-click it; a dialog window with the online parameterization will then open. After a short time, connection symbols will be displayed after the respective parameters.

## 9 Process Image

The HART I/O Module provides the fieldbus coupler/controller with a different amount of process data depending on the operating mode set.

Some fieldbus systems process status information on the input channel with the help of a status byte.

This status byte can be displayed using the WAGO-I/O-CHECK 2 commissioning tool but processing by the coupler/controller is optional; i.e., access to or evaluation of the status information depends on the respective fieldbus system.

---

### Note



#### **Mapping of the Process Image in the Fieldbus System!**

Mapping the process data of some I/O modules (or their variations) into the process image is specific to the fieldbus coupler/controller used. This information, as well as the specific configuration for relevant control/status bytes is located in the section "Fieldbus-Specific Configuration of Process Data." This section describes the process image of the particular coupler/controller.

---

For pure 4-20 mA analog values the HART module transmits 16-bit measured values and optionally 8 status bits on each channel.

The digitalized measured value is transmitted to the process image of the coupler/controller in a data word (16 bits) as an input byte 0 (low) and input byte 1 (high).

This value is mapped with a resolution of 13 bits on Bit B2 ... B14.

Status information, which can be evaluated in the event of a fault, is contained in the two least significant bits (B0 and B1). If the measurement is above the measuring range, Bit B0 is set = 1, and if the measurement is below the measuring range or if a wire breaks, Bit B0 and B1 are set = 1.

The input voltage range for the measured values of 4 mA to 20 mA is scaled to the numerical range from 0x0000 to 0x7FFD.



Table 22: Process Values for the HART Module

Input Current 4 mA ... 20 mA	Numeric Value				Status Byte Hex.	LED Error AI 1, 2
	Binary Measured Value	*) F O	Hex.	Dec.		
<3	'0000.0000.0000.00	11'	0x0003	3	0x41	on
<4	'0000.0000.0000.00	00'	0x0000	0	0x00	off
4	'0000.0000.0000.00	00'	0x0000	0	0x00	off
6	'0001.0000.0000.00	00'	0x1000	4096	0x00	off
8	'0010.0000.0000.00	00'	0x2000	8192	0x00	off
10	'0011.0000.0000.00	00'	0x3000	12288	0x00	off
12	'0100.0000.0000.00	00'	0x4000	16384	0x00	off
14	'0101.0000.0000.00	00'	0x5000	20480	0x00	off
16	'0110.0000.0000.00	00'	0x6000	24576	0x00	off
18	'0111.0000.0000.00	00'	0x7000	28672	0x00	off
20	'0111.1111.1111.11	00'	0x7FFC	32764	0x00	off
>20	'0111.1111.1111.11	00'	0x7FFC	32764	0x00	off
>22	'0111.1111.1111.11	01'	0x7FFD	32765	0x42	on

\*) Status bits: F = Cable Break, O = Overrun

## 9.1 2 AI 4-20 mA + 6-Byte Mailbox

In the "2AI + 6-byte mailbox" operating mode the HART module provides the fieldbus coupler/controller with a 12-byte input and output process image via one logical channel.

1 control byte (C0) and 1 status byte (S0) are used to monitor the data flow.

The data is mapped in the cyclic process image of the connected coupler/controller. However, the HART commands can then be implemented by the "WagoLibHart\_0x.lib" PLC library. The data is tunneled to the application via a mailbox and decoded by means of the library so that evaluation and processing take place directly at the application level.

The IEC application can be implemented in the connected programmable fieldbus controller (PFC) of the fieldbus node with the WAGO-I/O-PRO programming tool or, if a fieldbus coupler is connected, in the superimposed controller.

Table 23: Input Process Image

Input Process Image		
Offset	Designation of bytes	Remark
0	S0	Status byte
1	Internal Use	used internally
2	MBX_RES	Mailbox response data
3		
4		
5		
6		
7		
8	AI0	Analog input data Channel 1
9		
10	AI1	Analog input data Channel 2
11		

Table 24: Output Process Image

Output Process Image		
Offset	Designation of bytes	Remark
0	C0	Controlbyte
1	Internal Use	used internally
2	MBX_REQ	Mailbox request data
3		
4		
5		
6		
7		
8	-	not used
9		
10		
11		

Tabelle 25: Control byte C0

Control byte C0							
Bit 7	Bit 6	Bit 5	Bit 4	Bit 3	Bit 2	Bit 1	Bit 0
-	-	-	-	-	-	-	-

Tabelle 26: Status byte S0

Statusbyte S0							
Bit 7	Bit 6	Bit 5	Bit 4	Bit 3	Bit 2	Bit 1	Bit 0
-	General fault (Bit 0 or Bit 1 or Bit 3 or Bit 4)	-	Short circuit Channel 2	Cable break Channel 2	-	Short circuit Channel 1	Cable break Channel 1

## 9.2 2 AI 4-20 mA, 1 HART Variable per Channel

With the PROFIBUS DP/V1 Fieldbus Coupler 750-333 or Fieldbus Controller 750-833, when one HART dynamic variable per channel is incorporated (optionally PV, SV, TV, QV), the PROFIBUS telegram has a size of 12 bytes.

Table 27: PROFIBUS Telegram, 1 HART Variable per Channel

PROFIBUS Telegram (1 Variable per Channel)		
Offset	Designation of Bytes	Remark
0	AI0	Analog input data Channel 1
1		
2	HV0_0	1st HART variable Channel 1
3		
4		
5		
6	AI1	Analog input data Channel 2
7		
8	HV1_0	1st HART variable Channel 2
9		
10		
11		

### 9.3 2 AI 4-20 mA, 2 HART Variables per Channel

With the PROFIBUS DP/V1 Fieldbus Coupler 750-333 or Fieldbus Controller 750-833, when two HART dynamic variables per channel are incorporated (optionally PV, SV, TV, QV), the PROFIBUS telegram has a size of 20 bytes.

Table 28: PROFIBUS Telegram, 2 HART Variables per Channel

<b>PROFIBUS Telegram (2 Variables per Channel)</b>		
<b>Offset</b>	<b>Designation of Bytes</b>	<b>Remark</b>
0	AI0	Analog input data Channel 1
1		
2	HV0_0	1st HART variable Channel 1
3		
4		
5	HV0_1	2nd HART variable Channel 1
6		
7		
8		
9	AI1	Analog input data Channel 2
10		
11	HV1_0	1st HART variable Channel 2
12		
13		
14	HV1_1	2nd HART variable Channel 2
15		
16		
17		
18		
19		

## 9.4 2 AI 4-20 mA, 3 HART Variables per Channel

With the PROFIBUS DP/V1 Fieldbus Coupler 750-333 or Fieldbus Controller 750-833, when three HART dynamic variables per channel are incorporated (optionally PV, SV, TV, QV), the PROFIBUS telegram has a size of 28 bytes.

Table 29: PROFIBUS Telegram, 3 HART Variables per Channel

PROFIBUS Telegram (3 Variables per Channel)		
Offset	Designation of Bytes	Remark
0	AI0	Analog input data Channel 1
1		
2	HV0_0	1st HART variable Channel 1
3		
4		
5	HV0_1	2nd HART variable Channel 1
6		
7		
8		
9	HV0_2	3rd HART variable Channel 1
10		
11		
12		
13	AI1	Analog input data Channel 2
14		
15	HV1_0	1st HART variable Channel 2
16		
17		
18		
19	HV1_1	2nd HART variable Channel 2
20		
21		
22		
23	HV1_2	3rd HART variable Channel 2
24		
25		
26		
27		

## **9.5 2 AI 4-20 mA, 4 HART Variables per Channel**

With the PROFIBUS DP/V1 Fieldbus Coupler 750-333 or Fieldbus Controller 750-833, when four HART dynamic variables per channel are incorporated (optionally PV, SV, TV, QV), the PROFIBUS telegram has a size of 36 bytes.

Table 30: PROFIBUS Telegram, 4 HART Variables per Channel

<b>PROFIBUS Telegram (4 Variables per Channel)</b>		
<b>Offset</b>	<b>Designation of Bytes</b>	<b>Remark</b>
0	AI0	Analog input data Channel 1
1		
2	PV0	Primary variable Channel 1
3		
4		
5		
6	SV0	Secondary variable Channel 1
7		
8		
9		
10	TV0	Tertiary variable Channel 1
11		
12		
13		
14	QV0	Quaternary variable Channel 1
15		
16		
17		
18	AI1	Analog input data Channel 2
19		
20	PV1	Primary variable Channel 2
21		
22		
23		
24	SV1	Secondary variable Channel 2
25		
26		
27		
28	TV1	Tertiary variable Channel 2
29		
30		
31		
32	QV1	Quaternary variable Channel 2
33		
34		
35		

## 9.6 AI 4-20 mA + Acyclic PROFIBUS Services

With the PROFIBUS DP/V1 Fieldbus Coupler 750-333 or Fieldbus Controller 750-833, only the two cyclic AI process values are mapped into the process image of the connected coupler in the "2AI + acyclic PROFIBUS services" mode.

HART-via-DPV1-services are passed on using acyclic Profibus services.

Table 31: PROFIBUS Telegram, Acyclic PROFIBUS Services

PROFIBUS Telegram (Acyclic PROFIBUS Services)		
Offset	Designation of Bytes	Remark
0	AI0	Analog input data Channel 1
1		
2	AI1	Analog input data Channel 2
3		

Depending on how the PROFIBUS coupler/controller is parameterized using the GSD, the control and status bytes can also be transmitted via PROFIBUS in addition to the data bytes provided by the HART I/O module.



### Information

#### Additional Information about PROFIBUS DP/V1 750-333 or 750-833

You can read a detailed description of this in the PROFIBUS DP/V1 Fieldbus Coupler 750-333 manual or Fieldbus Controller manual in the section "750-333 Fieldbus Coupler" or "750-833 Fieldbus Controller"/"Configuring and Parameterizing the I/O Modules"/"Analog I/O Modules"/"2 AI Modules".

You will find these manuals on the Internet at:

[www.wago.com](http://www.wago.com) -> Service -> Documentation -> WAGO-I/O-SYSTEM 750 -> Fieldbus Couplers and Programmable Fieldbus Controllers

The status bytes provide status information on the input channels. This can also be displayed using the WAGO-I/O-CHECK 2 commissioning tool.

Table 32: Control byte C0/C1

Control byte C0/C1							
Bit 7	Bit 6	Bit 5	Bit 4	Bit 3	Bit 2	Bit 1	Bit 0
-	-	-	-	-	-	-	-

Table 33: Status byte S0/S1

Status byte S0/S1							
Bit 7	Bit 6	Bit 5	Bit 4	Bit 3	Bit 2	Bit 1	Bit 0
-	General fault (Bit 0 or Bit 1)	-	-	-	-	Short circuit Channel 1, 2	Cable break Channel 1, 2



## 10 Appendix: Information for Hart Library

To enable Hart communication, a HART library must be used which provides the required Hart commands for the selected system.

Prior Wago fieldbus controllers (Codesys) and PROFIBUS systems (via DPV1-to-Hart) are supported.

### 10.1 Codesys Library

For the Wago fieldbus controller, Wago provides a Codesys library that offers a multiplicity of Hart commands that are simple to use from a Codesys program perspective.

The library contains all "Universal Commands" and "Common Practice Commands." This library is constantly being improved and already contains several common "Device Specific Commands."

---

#### Information



##### **Additional information for downloading the library**

The library can be downloaded from the WAGO Internet site at [www.wago.com](http://www.wago.com) → Service → Documentation → (left navigation bar:) WAGO Software 759 → WAGO-I/O-PRO / CoDeSys → (right column, "Additional Information":) Libraries → "WagoLibHART\_03.lib" or by entering the following into the address bar of the web browser:  
[http://www.wago.com/wagoweb/documentation/app\\_note/libraries/WagoLibHART\\_03.lib](http://www.wago.com/wagoweb/documentation/app_note/libraries/WagoLibHART_03.lib)

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#### Information



##### **Additional information about the library and the HART commands**

A detailed description of the library, as well as the implemented HART commands, can be found at: [www.wago.com](http://www.wago.com) → Service → Documentation → (left navigation bar:) Application Notes → General Overview → "A116100" → Documentation (PDF) or by entering the following into the address bar of the web browser:  
[http://www.wago.com/wagoweb/documentation/app\\_note/a1161/a116100d.pdf](http://www.wago.com/wagoweb/documentation/app_note/a1161/a116100d.pdf)

---

### 10.2 PROFIBUS Gateway

When using a PROFIBUS fieldbus coupler/controller, one option is to use a HartToDpv1 gateway, which several manufacturers offer.

## 11 Use in Hazardous Environments

**WAGO-I/O-SYSTEM 750** (electrical components) is designed for use in zone 2 explosive environments.

The following sections include both the identification of components (devices) and the installation regulations to be observed.

### 11.1 Identification

#### 11.1.1 For Europe according to CENELEC and IEC

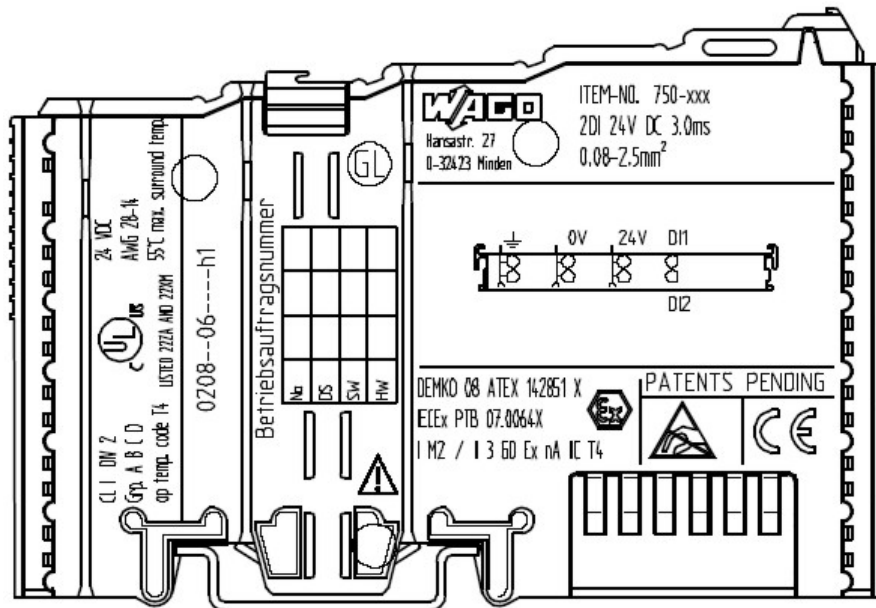


Figure 36: Example for lateral labeling of bus modules

DEMKO 08 ATEX 142851 X  
IECEX PTB 07.0064X  
I M2 / II 3 GD Ex nA IIC T4

Figure 37: Printing on text detail in accordance with CENELEC and IEC

Table 34: Description of Printing on

Printing on Text	Description
DEMKO 08 ATEX 142851 X IECEX PTB 07.0064X	Approval body and/or number of the examination certificate
I M2 / II 3 GD	Explosion protection group and Unit category
Ex nA	Type of ignition and extended identification
IIC	Explosion protection group
T4	Temperature class

### 11.1.2 For America according to NEC 500

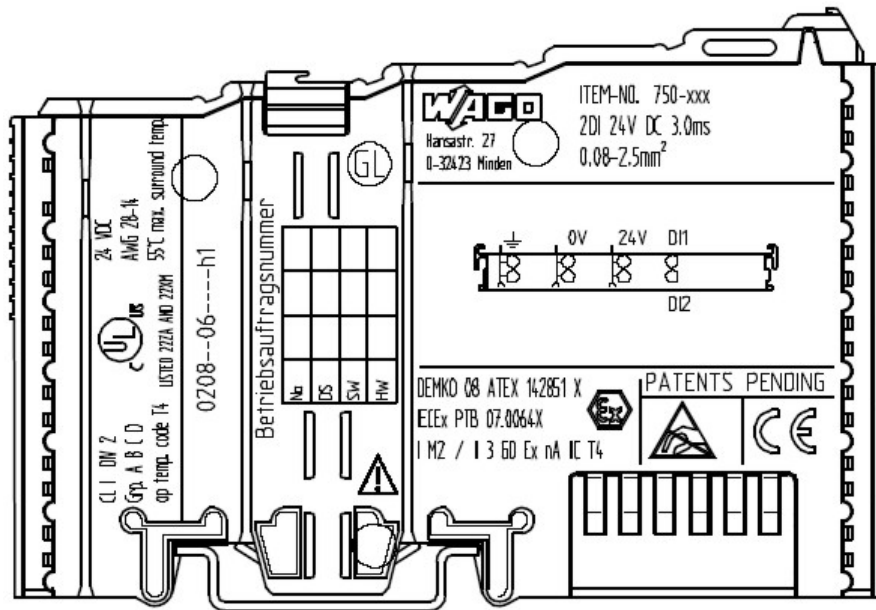


Figure 38: Example for lateral labeling of bus modules



Figure 39: Printing on text detail in accordance with CENELEC and IEC

Table 35: Description of Printing on

Printing on Text	Description
CL 1	Explosion protection group (condition of use category)
DIV 2	Area of application (zone)
Grp. ABCD	Explosion group (gas group)
Optemp code T4	Temperature class

## 11.2 Installation Regulations

In the **Federal Republic of Germany**, various national regulations for the installation in explosive areas must be taken into consideration. The basis for this forms the working reliability regulation, which is the national conversion of the European guideline 99/92/E6. They are complemented by the installation regulation EN 60079-14. The following are excerpts from additional VDE regulations:

Table 36: VDE Installation Regulations in Germany

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 telecommunication 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:

Table 37: Installation Regulations in USA and Canada

NFPA 70	National Electrical Code Art. 500 Hazardous Locations
ANSI/ISA-RP 12.6-1987	Recommended Practice
C22.1	Canadian Electrical Code

### NOTICE

#### Notice the following points

When using the **WAGO-I/O SYSTEM 750** (electrical operation) with Ex approval, the following points are mandatory:

## 11.2.1 ANSI/ISA 12.12.01

This equipment is suitable for use in Class I, Division 2, Groups A, B, C, D or non-hazardous locations only.

---

### NOTICE

#### **Explosion hazard!**

Explosion hazard - substitution of components may impair suitability for Class I, Div. 2.

---

---

### NOTICE

#### **Disconnect device when power is off and only in a non-hazardous area!**

Do not disconnect equipment unless power has been switched off or the area is known to be non-hazardous.

---

When a fuse is provided, the following marking shall be provided:  
"A switch suitable for the location where the equipment is installed shall be provided to remove the power from the fuse".  
The switch need not be integrated in the equipment.

For devices with Ethernet connectors:  
"Only for use in LAN, not for connection to telecommunication circuits".

---

### NOTICE

#### **Use only with antenna module 758-910!**

Use Module 750-642 only with antenna module 758-910.

---

## 11.2.2 TÜV Nord Ex-i applications

For use as category 3 apparatus (in zone 2 or zone 22) the **WAGO-I/O-System 750-\*\*\*** shall be erected in an enclosure that fulfills the requirements of the directive 94/9/EC and the applicable standards (see marking) EN 60079-0, EN 60097-11, EN 60079-15, EN 61241-0 and EN 61241-1.

For use as group I electrical apparatus category M2 the apparatus shall be erected in an enclosure that ensures a sufficient protection according to directive 94/9/EC. A Declaration of Conformity according to annex X of the directive 94/9/EC shall certify the correct installation of the devices named above into an enclosure or a control cabinet.

If interface circuits are operated without the 750-3../....-... fieldbus coupler (DEMKO 08 ATEX 142851 X), measures have to be taken outside of the device that rating voltage is not being exceeded of more than 40 % because of to transient disturbances.

DIP switches, binary switches and potentiometers, connected to the module may only be actuated when explosive atmosphere can be excluded.

### 11.2.3 ATEX and IEC Ex

GROUP I, CATEGORY M2 only with a suitable enclosure according to IEC 60079-0 and IEC 60079-1 required by end-user. When used in Category M2 locations, the modules have to be installed in suitable ATEX Category M2 certified enclosures according to EN 60079-0: 2006 and EN 60079-1: 2007.

The Fieldbus Independent Modules of the **WAGO-I/O-System 750-.../.....-....** have to be installed in a Pollution Degree 2 environment or better in the end use application for use with an IP54 minimum enclosure. Except otherwise specified below. Otherwise the modules have to be installed in an IP64 minimum enclosure.

Modules 750-609 and 750-611 have to be installed in an IP 64 minimum enclosure.

When used in the presence of combustible dust the enclosure shall comply with the relevant requirements of IEC 61241-0:2004 and IEC 61241-1:2004.

Installation, addition, removal or replacement of modules, fieldbus connectors or fuses may only take place when the system supply and the field supply are switched off, or when the area is known to be non-hazardous.

DIP-switches, binary-switches and potentiometers attached to the modules may only be adjusted when the area is known to be non-hazardous.

Module 750-642 has to be used only with antenna module 758-910 with a max. cable length of 2.5 m.

Provide the transient protection device not exceeding 40 % of the rated voltage at the power supply terminal of the apparatus.

Ambient temperature range: -20 °C to +55 °C

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## Information



### Additional Information

Proof of certification is available on request. Also take note of the information given on the module technical information sheet. The Instruction Manual, containing these special conditions for safe use, must be readily available to the user.

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