

WAGO → I/O → **SYSTEM 750**

**Fieldbus Independent
I/O Modules**

**Incremental Encoder Interfaces
750-631 (/xxx-xxx)**



Manual

Version 1.1.1

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WAGO Kontakttechnik GmbH & Co. KG

Hansastraße 27
D-32423 Minden

Phone: +49 (0) 571/8 87 – 0
Fax: +49 (0) 571/8 87 – 1 69
E-Mail: info@wago.com
Web: <http://www.wago.com>

Technical Support

Phone: +49 (0) 571/8 87 – 5 55
Fax: +49 (0) 571/8 87 – 85 55
E-Mail: support@wago.com

Every conceivable measure has been taken to ensure the correctness and completeness of this documentation. However, as errors can never be fully excluded, we would appreciate any information or ideas at any time.

E-Mail: documentation@wago.com

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 trademark or patent protected.

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1 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.

1.1 Legal Bases

1.1.1 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.

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.

1.1.2 Personnel Qualifications

The use of the product described in this Manual requires special personnel qualifications, as shown in the following table:

Activity	Electrical specialist	Instructed personnel*)	Specialists**) having qualifications in PLC programming
Assembly	X	X	
Commissioning	X		X
Programming			X
Maintenance	X	X	
Troubleshooting	X		
Disassembly	X	X	

*) Instructed persons have been trained by qualified personnel or electrical specialists.

**) A specialist is a person, who – thanks to technical training – has the qualification, knowledge and expertise to meet the required specifications of this work and to identify any potential hazardous situation in the above listed fields of activity.

All responsible persons have to familiarize themselves with the underlying legal standards to be applied. WAGO Kontakttechnik GmbH & Co. KG does not assume any liability whatsoever resulting from improper handling and damage incurred to both WAGO's own and third-party products by disregarding detailed information in this Manual.

1.1.3 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.

1.1.4 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.

1.2 Standards and Guidelines for Operating the 750 Series

Please adhere to the standards and guidelines required for the use of your system:

- The data and power lines shall be connected and installed in compliance with the standards required to avoid failures on your system and to substantially minimize any imminently hazardous situations resulting in personal injury.
- For assembly, start-up, maintenance and troubleshooting, adhere to the specific accident prevention provisions which apply to your system (e.g. BGV A 3, "Electrical Installations and Equipment").
- Emergency stop functions and equipment shall not be made ineffective. See relevant standards (e.g. DIN EN 418).
- The equipment of your system shall be conform to EMC guidelines so that any electromagnetic interferences will be eliminated.
- Operating 750 Series components in home applications without further measures is permitted only if they meet the emission limits (emissions of interference) in compliance with EN 61000-6-3. You will find the detailed information in section "WAGO-I/O-SYSTEM 750" → "System Description" → "Technical Data".
- Please observe the safety precautions against electrostatic discharge in accordance with DIN EN 61340-5-1/-3. When handling the modules, please ensure that environmental factors (persons, working place and packaging) are well grounded.
- The valid standards and guidelines applicable for the installation of switch cabinets shall be adhered to.

1.3 Symbols



Danger

Always observe this information to protect persons from injury.



Warning

Always observe this information to prevent damage to the device.



Attention

Marginal conditions that must always be observed to ensure smooth and efficient operation.



ESD (Electrostatic Discharge)

Warning of damage to the components through electrostatic discharge. Observe the precautionary measure for handling components at risk of electrostatic discharge.



Note

Make important notes that are to be complied with so that a trouble-free and efficient device operation can be guaranteed.



Additional Information

References to additional literature, manuals, data sheets and internet pages.

1.4 Safety Information

When connecting the device to your installation and during operation, the following safety notes must be observed:



Danger

The WAGO-I/O-SYSTEM 750 and its components are an open system. It must only be assembled in housings, cabinets or in electrical operation rooms. Access is only permitted via a key or tool to authorized qualified personnel.



Danger

All power sources to the device must always be switched off before carrying out any installation, repair or maintenance work.



Warning

Replace defective or damaged device/module (e.g. in the event of deformed contacts), as the functionality of field bus station in question can no longer be ensured on a long-term basis.



Warning

The components are not resistant against materials having seeping and insulating properties. Belonging to this group of materials is: e.g. aerosols, silicones, triglycerides (found in some hand creams). If it cannot be ruled out that these materials appear in the component environment, then the components must be installed in an enclosure that is resistant against the above mentioned materials. Clean tools and materials are generally required to operate the device/module.



Warning

Soiled contacts must be cleaned using oil-free compressed air or with ethyl alcohol and leather cloths.



Warning

Do not use contact sprays, which could possibly impair the functioning of the contact area.



Warning

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



ESD (Electrostatic Discharge)

The devices are equipped with electronic components that may be destroyed by electrostatic discharge when touched.



Warning

For components with ETHERNET/RJ-45 connectors:
Only for use in LAN, not for connection to telecommunication circuits.

1.5 Font Conventions

- italic* Names of paths and data files are marked in italic-type.
e.g.: *C:\Programs\WAGO-IO-CHECK*
- italic* Menu items are marked in italic-type, bold letters.
e.g.: ***Save***
- \ A backslash between two names characterizes the selection of a menu point from a menu.
e.g.: ***File \ New***
- END Pushbuttons are marked as bold with small capitals
e.g.: **ENTER**
- < > Keys are marked bold within angle brackets
e.g.: **<F5>**
- Courier The print font for program codes is Courier.
e.g.: END_VAR

1.6 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 (.)

1.7 Scope

This manual describes the Digital Input Module **750-631 Incremental Encoder Interface** of the modular WAGO-I/O-SYSTEM 750.

Handling, assembly and start-up are described in the manual of the Fieldbus Coupler. Therefore this documentation is valid only in the connection with the appropriate manual.

2 I/O Modules

2.1 Special Modules

2.1.1 Overview Incremental Encoder Interfaces 750-631 (/xxx-xxx)

I/O module	750-631	750-631/ 000-001	750-631/ 000-004	750-631/ 000-010	750-631/ 000-011
Function	Incremental encoder interface	Incremental encoder interface, single report	Incremental encoder interface, RS422	Incremental encoder interface	Incremental encoder interface, single report
Sensor input	differential	differential	differential	single ended, differential	single ended, differential
Digital input	Latch, gate	Latch, gate	Latch, gate, ext. error	Latch, gate, ext. error	Latch, gate, ext. error
sensor supply voltage	DC 5 V	DC 5 V	DC 5 V (RS422)	DC 5 V ... 24 V	DC 5 V ... 24 V
Report	4-fold	single	4-fold	4-fold	single
Data width	32 bit	32 bit	32 bit	32 bit	32 bit
Remark	No longer available	No longer available			

2.1.2 750-631(750-631/000-001) [Incremental Encoder Interface]

2.1.2.1 Variations

Item-No.	Designation	Description
750-631	Increment.Enc.	Incremental Encoder Interface, 4-fold report
750-631/000-001	Increment.Enc./single report	Incremental Encoder Interface, single report

2.1.2.2 View

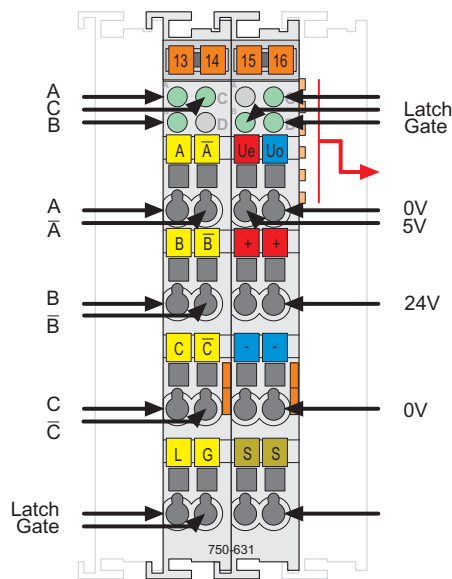


Fig. 2.1.2-2: View

g063100e

2.1.2.3 Description

This module is an interface for the connection of any incremental encoder.

The transmitter can be directly supplied from the Ue and U0 terminations of the module.

The shield (screen) is directly connected to the carrier rail.

A 16 bit counter with quadrature encoder interface as well as a 16 bit latch for the zero impulse can be read, set, or enabled. The count of the counter will be transmitted fast and interference-free over the fieldbus to the PC, PLC, or NC. A counter lock-out is possible using input Gate.

Individual green status LEDs indicate the operating status of the module and the signal status of the A, B and C as well as latch and gate inputs.

Any configuration of the specialty modules is possible when designing the fieldbus node. Grouping of module types is not necessary.



Attention

This module has no power contacts. For field supply to downstream I/O modules, a supply module will be needed.

The module 750-631 and its variations can be used with all couplers/controllers of the WAGO-I/O-SYSTEM 750 (except for the economy types 750-320, -323, -324 and -327).

This description is valid for the XXXX2B1A... and XXXX2B1B... hardware and software versions. The version is specified in the manufacturing number, which is part of the lateral marking on the module.

2.1.2.4 Display Elements

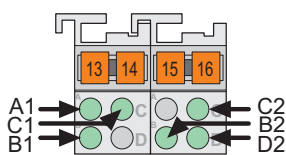


Fig. 2.1.2-2: Display Elements
g063102x

LED	Channel	State	Function
A1	A	off	Signal (0)
		green	Signal (1)
B1	B	off	Signal (0)
		green	Signal (1)
C1	C	off	Signal (0)
		green	Signal (1)
B2	Latch	off	Signal (0)
		green	Signal (1)
C2	Function	off	No operational readiness or the internal data bus communication is interrupted
		green	Operational readiness and trouble-free internal data bus communication
D2	Gate	off	Signal (0)
		green	Signal (1)

2.1.2.5 Schematic Diagram

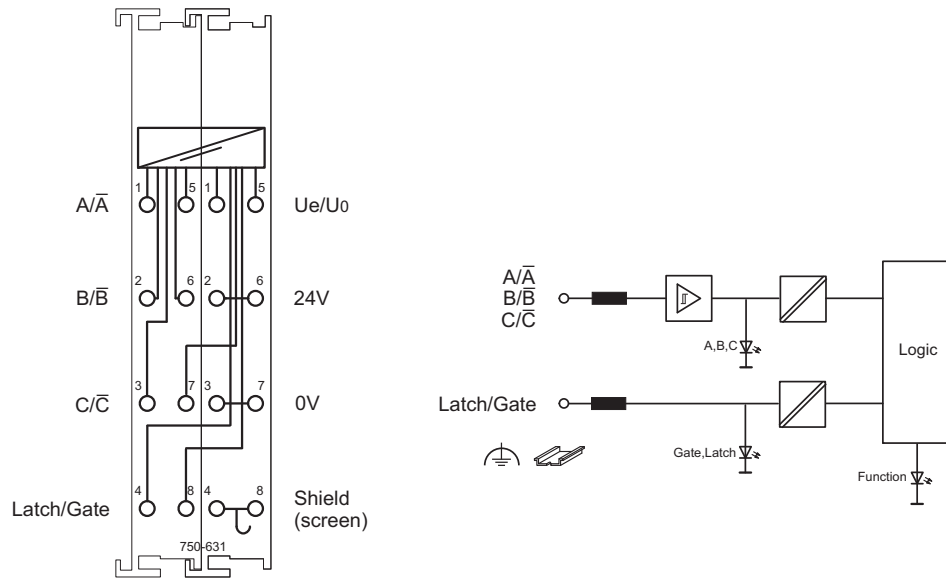


Fig. 2.1.2-1: Schematic Diagram

g063101e

2.1.2.6 Technical Data

Module Specific Data		
Sensor connection		A, /A, B, /B, C, /C (/A, /B, /C are inversed)
Current consumption (internal)		25 mA
Signal voltage A, B, C, /A, /B, /C		(0) $U \leq 2.0 \text{ V}$ (1) $U \geq 5.0 \text{ V}$
Signal voltage Latch, Gate		(0) $U \leq 2.0 \text{ V}$ (1) $U \geq 11.0 \text{ V}$
Sensor power supply		DC 5 V
Sensor output current _{max.}		200 mA
Counter		16 bits binary
Operating frequency		470 kHz
Quadrature decoder		4-fold report (750-631), single report (750-631/000-001)
Zero impulse latch		16 bits
Commands		read, set, enable
Voltage supply		DC 24 V (-15 % ... +20 %)
Current consumption _{typ.}		6 mA without sensor
Internal bit width		1 x 32 bits 1 x 8 bits control/status 1 x 8 bits reserved
Isolation		500 V (System/Supply)
Dimensions W x H* x L * from upper edge of 35 DIN rail		24 mm x 64 mm x 100 mm
Weight		ca. 105 g
Approvals		
	cUL _{US} (UL508)	
	cUL _{US} (ANSI/ISA 12.12.01)	Class I Div2 ABCD T4
	Conformity Marking	
Standards and Guidelines		
EMC CE-Emission of interference		acc. to EN 61000-6-4: 2007
EMC CE-Immunity to interference		acc. to EN 61000-6-2: 2005



More Information

Detailed references to the approvals are listed in the document "Overview Approvals WAGO-I/O-SYSTEM 750", which you can find on the CD ROM ELECTRONICC Tools and Docs (Item-No.: 0888-0412)
or in the internet under: <http://www.wago.com> → Documentation → WAGO-I/O-SYSTEM 750 → System Description

2.1.2.7 Functional Description

The incremental encoder interface is used to evaluate two 90° phase-shifted track signals delivered by digital encoders. If required, the signals generated by the index track can also be processed. Control via two 24 V signals is optional.

Typically, incremental encoders provide two signals of the encoder track, both 90° offset. These signals are labeled A and B. To improve the common mode rejection ratio, both signals are transmitted as differential signals. In addition to the A signal, the complement signal /A is also transmitted. The difference between the input signals is performed by the incremental encoder interface.

By exchanging A and /A the phase position will turn from A to B, thus allowing the desired counting direction to be preset via the wiring configuration.

Most incremental encoders have an index track in addition to the two track signals. This index track generates a single pulse per encoder revolution. This pulse can be used to determine the absolute encoder position within a revolution. Through the appropriate initialization, the current counter value is transmitted to a latch register using the index pulse. Since the index pulse has the same duration as a track signal, the latch process should always be performed in the same rotational direction.

The encoder is supplied with 5 V derived from the terminations Ue and U0. This voltage is generated from an external 24 V power supply. The inputs 0 V and U0 are connected internally.

The latch input controls the overtaking of the actual counter value into the latch register. This input is activated by the control bit EN_LATEXT ("1"). EN_LACT has to be deactivated ("0"). After activation, the first edge transition from 0 V to 24 V at the latch input takes the actual counter value into the latch register. The control bit EN_LATEXT must be deleted and reset, so that the counter value can be stored again.

The gate input stops the counter. Only 0 V or an open connection initializes the counter. 24 V stops the counting process.

The latch and gate inputs are 24 V.

Overview of Inputs and Outputs:

In-/Output	Type	Function
Signal A and Signal /A	Input, TTL	Incremental pulse signals for channel A
Signal B and Signal /B	Input, TTL	Incremental pulse signals for channel B
Signal C and Signal /C	Input, TTL	Track signal for the index channel of the sensor
Shield	Input	Shield connection for encoder wiring
Sensor 0 V	Output, Vers.	Ground for sensor signals and supply
Sensor +5 V	Output, Vers.	5 V supply for encoder
+24 V	Input, Vers.	24 V supply voltage for the sensor and data processing
0 V	Input, Vers.	Ground for the 24 V supply voltage, internally connected to sensor V0
Gate	Input, 24 V	24 V input for gate signal
Latch	Input, 24 V	24 V input for Latch signal

2.1.2.8 Process Image

Using the I/O module 750-631, a 6 byte input and output process image can be transferred to the fieldbus coupler / controller via one logical channel. The data sent and received is stored in 2 output bytes (D0, D1) and 4 input bytes (D0, D1, D3, D4). The output bytes D2 ... D4 and the input byte D2 are reserved and without function. One control byte (C0) and one status byte (S0) are used to control the data flow.



Attention

The representation of the process data of some I/O modules or their variations in the process image depends on the fieldbus coupler/-controller used. Please take this information as well as the particular design of the respective control/status bytes from the section "Fieldbus Specific Design of the Process Data" included in the description concerning the process image of the corresponding coupler/controller.

Input data		Output data	
S0	Status byte	C0	Control byte
D0	Counter value byte 0 (LSB)	D0	Setpoint value byte 0 (LSB)
D1	Counter value byte 1 (MSB)	D1	Setpoint value byte 1 (MSB)
D2	reserved	D2	reserved
D3	Latched value byte 0 (LSB)	D3	reserved
D4	Latched value byte 1 (MSB)	D4	reserved

Control byte C0							
Bit 7	Bit 6	Bit 5	Bit 4	Bit 3	Bit 2	Bit 1	Bit 0
0	0	0	0	0	CNT_ SET	EN_ LATEXT	EN_ LATC

EN_
LATC The counter is set with a rising edge of CNT_SET to the value that is specified via the process data.

EN_
LATEXT The external latch input is activated. With the first external latch pulse after validity of the EN_LATEXT bit, the counter value is stored in the latch register. The following pulses have no influence on the latch register when the bit is set.

CNT_
SET The zero point latch (C input) is activated. With the first external latch pulse after the validity of the EN_LATC bit, the counter value is stored in the latch register (this has priority over EN_LATEXT). The following pulses have no influence on the latch register when the bit is set.

0 reserved

Status byte S0							
Bit 7	Bit 6	Bit 5	Bit 4	Bit 3	Bit 2	Bit 1	Bit 0
0	0	0	OVER- FLOW	UNDER- FLOW	CNTSET _ACK	LA- TEXT_ VAL	LATC_ VAL

LATC_VAL A zero point latch has occurred. The data D3, D4 in the process image corresponds to the latched counter value when the bit is set. To reactivate the latch input, EN_LATC must first be cancelled and then the bit must be set again.

LATEXT_
VAL An external latch pulse has occurred. The data D3, D4 in the process image corresponds to the latched counter value when the bit is set. To reactivate the latch input, EN_LATEXT must first be cancelled and then the bit must be set again.

CNTSET_
ACK The data for setting the counter has been accepted from the module.

UNDER-
FLOW This bit is set if an underflow (0 to 65535) of the 16-bit counter occurs. It is reset when the counter drops below two thirds of the measurement range (43690 to 43689) or as soon as an overflow occurs.

OVER-
FLOW This bit is set if an overflow (65535 to 0) of the 16-bit counter occurs. It is reset if the counter exceeds a third of the measurement range (21845 to 21846) or as soon as an underflow occurs.

0 reserved

The following tasks can be performed or checked via the control and status byte:

Extending the counter above 16 bits:

The internal counter has a width of 16 bits. Should the application require an extended range for the location values, the extended counter range may be calculated within the control system using the location-difference-integration method. This method uses the control system to store the last location value (counter value). Any new location value will have the previously stored counter value subtracted from it. Using the sign bit, this difference will be completed with the desired number of extension bits and then be added to the accumulated location value. It is assumed that the counter difference of the two counter queries is smaller than (16-1) bits therefore counter overflows need not be considered.

Another method calculates the counter extension separately by adding the bit OVERFLOW (status bit 4) or subtracting the bit UNDERFLOW (status bit 3) once, each time the counter value is read. Between two counter queries, the counter value should not be increased or decreased by more than $1/3 \times 0xFFFF$. Due to the separate calculation of the counter extension, this procedure allows for calculation using smaller data widths.

Setting the counter value:

Presetting the counter value is possible via the CNT_SET bit (control bit 2). The new counter value is transferred in the load value. When the CNT_SET bit is set from "0" to "1", the counter is loaded with the load value. The CNTSET_ACC bit (status bit 2) is set to "1" when the loading is completed

Maintaining the present counter value:

The present counter value may be maintained or latched via the external latch input. To do so, the EN_LATEXT bit (control bit 1) is set in the control word. Upon transition from "0" to "1", the latch value will contain the counter value at the time of the edge transition. Upon completion of the latch process the LATEXT_VAL bit (status bit 1) will be set to "1". Calculating the extended latch value is done as shown above.

Maintaining a reference point:

The storage of a present counter value may also be accomplished via the index pulse from the encoder. Releasing is done when the EN_LATC bit (control bit 0) is set to "1". The storage of the counter value is completed when LATC_VAL = 1 (status bit 0).

2.1.3 750-631/000-004 [Incremental Enc./ RS422]

Incremental Encoder Interface RS 422

2.1.3.1 View

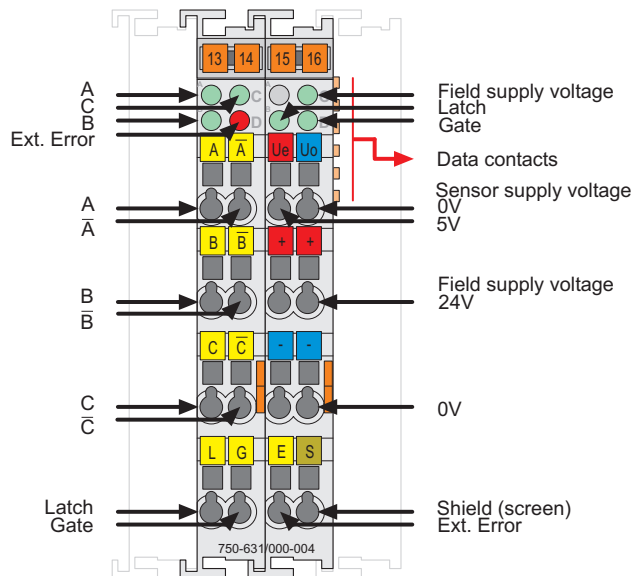


Fig. 2.1.3-1: View

g063140e

2.1.3.2 Description

This module is an interface for the connection of any incremental encoder.

The transmitter can be directly supplied from the Ue and U0 terminations of the module.

The shield (screen) is directly connected to the carrier rail.

A 16 bit counter with quadrature encoder interface as well as a 16 bit latch for the zero impulse can be read, set, or enabled. The count of the counter will be transmitted fast and interference-free over the fieldbus to the PC, PLC, or NC. A counter lock-out is possible using input Gate.

Individual green status LEDs indicate the operating status of the module and the signal status of the A, B and C as well as latch and gate inputs.

Any configuration of the specialty modules is possible when designing the fieldbus node. Grouping of module types is not necessary.



Attention

This module has no power contacts. For field supply to downstream I/O modules, a supply module will be needed.

The module 750-631 and its variations can be used with all couplers/controllers of the WAGO-I/O-SYSTEM 750 (except for the economy types 750-320, -323, -324 and -327).

This description is valid for the XXXX3E08... hardware and software versions. The version is specified in the manufacturing number, which is part of the lateral marking on the module.

2.1.3.3 Display Elements

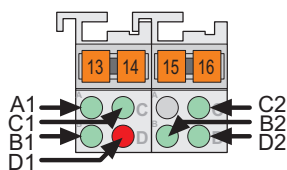


Fig. 2.1.3-2: Display Elements
g063142x

LED	Channel	State	Function
A1 green	A	off	$U_A = 0 \text{ V}$, $U_{/A} = 5 \text{ V}$
		on	$U_A = 5 \text{ V}$, $U_{/A} = 0 \text{ V}$
B1 green	B	off	$U_B = 0 \text{ V}$, $U_{/B} = 5 \text{ V}$
		on	$U_B = 5 \text{ V}$, $U_{/B} = 0 \text{ V}$
C1 green	C	off	$U_C = 0 \text{ V}$, $U_{/C} = 5 \text{ V}$
		on	$U_C = 5 \text{ V}$, $U_{/C} = 0 \text{ V}$
D1 red	Ext. Error	off	$U \geq 5.0 \text{ V}$ or open connection
		on	$U < 0.5 \text{ V}$
B2 green	Latch	off	$U \leq 5.0 \text{ V}$
		on	$U \geq 15.0 \text{ V}$
C2 green	Field supply	off	24 V field supply voltage missing
		on	24 V field supply voltage ok
D2 green	Gate	off	$U \leq 5.0 \text{ V}$
		on	$U \geq 15.0 \text{ V}$

2.1.3.4 Schematic Diagram

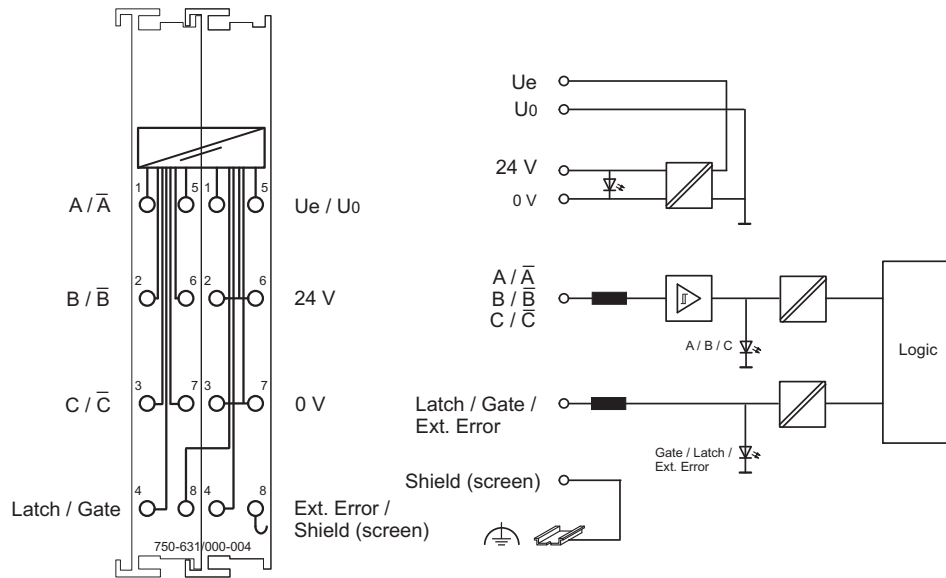


Fig. 2.1.3-2: Schematic Diagram

g063141e

2.1.3.5 Technical Data

Module Specific Data	
Sensor connection	A, /A, B, /B, C, /C (/A, /B, /C are inversed)
Signal voltage A, B, C, /A, /B, /C	(0) $U_{ABC} = 0 \text{ V}$, $U_{/A/B/C} = 5 \text{ V}$ (1) $U_{ABC} = 5 \text{ V}$, $U_{/A/B/C} = 0 \text{ V}$
Signal voltage Latch, Gate	(0) $U \leq 5.0 \text{ V}$ (1) $U \geq 15.0 \text{ V}$
Signal voltage Ext. Error	(0) $U \geq 5.0 \text{ V}$ or open connection (1) $U < 0.5 \text{ V}$
Sensor power supply	DC 5 V
Sensor output current $_{\text{max.}}$	200 mA
Counter	16 bits binary
Operating frequency	1 MHz
Quadrature decoder	4-fold report
Zero impulse latch	16 bits
Commands	read, set, enable
Voltage supply	DC 24 V (-15 % ... +20 %)
Current consumption (internal)	25 mA
Current consumption (field) $_{\text{typ.}}$	10 mA without sensor
Internal bit width	1 x 32 bits 1 x 8 bits control/status 1 x 8 bits reserved
Isolation	500 V (System/Supply)
Dimensions W x H* x L * from upper edge of 35 DIN rail	24 mm x 64 mm x 100 mm
Weight	ca. 105 g

Approvals (cf. Chapter 2.2 of the Coupler/Controller Manual)		
	cUL _{US} (UL508)	
	cUL _{US} ANSI/ISA 12.12.01	Class I Div2 ABCD T4A
	DEKRA	II 3 G Ex nA II T4
	Conformity Marking	
Standards and Guidelines		
EMC CE-Emission of interference	acc. to EN 61000-6-4: 2007	
EMC CE-Immunity to interference	acc. to EN 61000-6-2: 2005	
ATEX-Guideline	acc. to EN 61079-0: 2006 and acc. to EN 61079-15: 2005	



More Information

Detailed references to the approvals are listed in the document "Overview Approvals WAGO-I/O-SYSTEM 750", which you can find on the CD ROM ELECTRONICC Tools and Docs (Item-No.: 0888-0412)

or in the internet under: <http://www.wago.com> → Documentation → WAGO-I/O-SYSTEM 750 → System Description

2.1.3.6 Functional Description

The incremental encoder interface is used to evaluate two 90° phase-shifted track signals delivered by digital encoders. If required, the signals generated by the index track can also be processed. Control via two 24V signals is optional.

Typically, incremental encoders provide two signals of the encoder track, both 90° offset. These signals are labelled A and B. To improve the common mode rejection ratio, both signals are transmitted as differential signals. In addition to the A signal, the complement signal /A is also transmitted. The difference between the input signals is performed by the incremental encoder interface.

By exchanging A and /A the phase position will turn from A to B, thus allowing the desired counting direction to be preset via the wiring configuration.

Most incremental encoders have an index track in addition to the two track signals. This index track generates a single pulse per encoder revolution. This pulse can be used to determine the absolute encoder position within a revolution. Through the appropriate initialization, the current counter value is transmitted to a latch register using the index pulse. Since the index pulse has the same duration as a track signal, the latch process should always be performed in the same rotational direction.

If the rotary transducer is equipped with a monitoring electronics with NPN alarm output, then this output can be connected to the external error input. The input is switching negatively, i.e., 0V is logically mapped to 1.

With connector versions A and D, the 5V supply for the sensor can be tapped off at the outputs Ue and U0. This supply voltage is generated from 24V to be provided externally. The inputs 0V and U0 are connected internally.

The latch input controls the overtaking of the actual counter value into the latch register. This input is activated by the control bit EN_LATEXT ("1"). EN_LACT has to be deactivated ("0"). After activation, the first edge transition from 0V to 24V at the latch input takes the actual counter value into the latch register. The control bit EN_LATEXT must be deleted and reset, so that the counter value can be stored again.

The gate input stops the counter. Only 0V or an open connection initializes the counter. 24V stops the counting process.

The latch and gate inputs are 24V.

Overview of Inputs and Outputs:

In-/Output	Type	Function
Signal A and Signal /A	Input, RS 422	Incremental pulse signals for channel A
Signal B and Signal /B	Input, RS 422	Incremental pulse signals for channel B
Signal C and Signal /C	Input, RS 422	Track signal for the index channel of the sensor
Shield	Input	Shield connection for encoder wiring
Sensor 0 V (U_0)	Output, power supply	Ground for sensor signals and supply
Sensor +5 V (U_e)	Output, power supply	5 V supply for encoder
+24 V	Input, power supply	24 V supply voltage for the sensor and data processing
0 V	Input, power supply	Ground for the 24 V supply voltage, internally connected to sensor U_0
Gate	Input, 24 V	24 V input for gate signal
Latch	Input, 24 V	24 V input for Latch signal
Ext. Error	Input, low-side switching	Input for alarm output of sensor

2.1.3.7 Process Image

Using the I/O module 750-631/000-004, a 6 byte input and output process image can be transferred to the fieldbus coupler / controller via one logical channel. The data sent and received is stored in 2 output bytes (D0, D1) and 5 input bytes (D0 ... D4). The output bytes D2 ... D4 are reserved and without function. One control byte (C0) and one status byte (S0) are used to control the data flow.

**Attention**

The representation of the process data of some I/O modules or their variations in the process image depends on the fieldbus coupler/-controller used. Please take this information as well as the particular design of the respective control/status bytes from the section "Fieldbus Specific Design of the Process Data" included in the description concerning the process image of the corresponding coupler/controller.

Input data		Output data	
S0	Status byte	C0	Control byte
D0	Counter value byte 0 (LSB)	D0	Setpoint value byte 0 (LSB)
D1	Counter value byte 1 (MSB)	D1	Setpoint value byte 1 (MSB)
D2	DIG_INPUT	D2	reserved
D3	Latched value byte 0 (LSB)	D3	reserved
D4	Latched value byte 1 (MSB)	D4	reserved

Data byte D2 (DIG_INPUT)							
Bit 7	Bit 6	Bit 5	Bit 4	Bit 3	Bit 2	Bit 1	Bit 0
X	X	Signal Input A, /A	Signal Input B, /B	Signal Input C, /C	Signal Input Ext. Error	Signal Input Latch	Signal Input Gate

Signal (0): $U \leq 5.0 \text{ V}$
Input Gate (1): $U \geq 15.0 \text{ V}$
Signal (0): $U \leq 5.0 \text{ V}$
Input Latch (1): $U \geq 15.0 \text{ V}$
Signal (0): $U \geq 5.0 \text{ V}$ or open connection
Input (1): $U < 0.5 \text{ V}$
Ext. Error
Signal (0): $U_C = 0 \text{ V}$, $U_{/C} = 5 \text{ V}$
Input C, /C (1): $U_C = 5 \text{ V}$, $U_{/C} = 0 \text{ V}$
Signal (0): $U_B = 0 \text{ V}$, $U_{/B} = 5 \text{ V}$
Input B, /B (1): $U_B = 5 \text{ V}$, $U_{/B} = 0 \text{ V}$
Signal (0): $U_A = 0 \text{ V}$, $U_{/A} = 5 \text{ V}$
Input A, /A (1): $U_A = 5 \text{ V}$, $U_{/A} = 0 \text{ V}$
X reserved

Control byte C0							
Bit 7	Bit 6	Bit 5	Bit 4	Bit 3	Bit 2	Bit 1	Bit 0
0	0	0	0	0	CNT_SET	EN_LATEXT	EN_LATC

EN_LATC The counter is set with a rising edge of CNT_SET to the value that is specified via the process data.
EN_LATEXT The external latch input is activated. With the first external latch pulse after validity of the EN_LATEXT bit, the counter value is stored in the latch register. The following pulses have no influence on the latch register when the bit is set.
CNT_SET The zero point latch (C input) is activated. With the first external latch pulse after the validity of the EN_LATC bit, the counter value is stored in the latch register (this has priority over EN_LATEXT). The following pulses have no influence on the latch register when the bit is set.
0 reserved

Status byte S0							
Bit 7	Bit 6	Bit 5	Bit 4	Bit 3	Bit 2	Bit 1	Bit 0
0	0	0	OVER- FLOW	UNDER- FLOW	CNTSET _ACK	LA- TEXT_ VAL	LATC_ VAL

LATC_VAL	A zero point latch has occurred. The data D3, D4 in the process image corresponds to the latched counter value when the bit is set. To reactivate the latch input, EN_LATC must first be cancelled and then the bit must be set again.
LATEXT_VAL	An external latch pulse has occurred. The data D3, D4 in the process image corresponds to the latched counter value when the bit is set. To reactivate the latch input, EN_LATEXT must first be cancelled and then the bit must be set again.
CNTSET_ACK	The data for setting the counter has been accepted from the module.
UNDER-FLOW	This bit is set if an underflow (0 to 65535) of the 16-bit counter occurs. It is reset when the counter drops below two thirds of the measurement range (43690 to 43689) or as soon as an overflow occurs.
OVER-FLOW	This bit is set if an overflow (65535 to 0) of the 16-bit counter occurs. It is reset if the counter exceeds a third of the measurement range (21845 to 21846) or as soon as an underflow occurs.
0	reserved

The following tasks can be performed or checked via the control and status byte:

Extending the counter above 16 bits:

The internal counter has a width of 16 bits. Should the application require an extended range for the location values, the extended counter range may be calculated within the control system using the location-difference-integration method. This method uses the control system to store the last location value (counter value). Any new location value will have the previously stored counter value subtracted from it. Using the sign bit, this difference will be completed with the desired number of extension bits and then be added to the accumulated location value. It is assumed that the counter difference of the two counter queries is smaller than (16-1) bits therefore counter overflows need not be considered.

Another method calculates the counter extension separately by adding the bit OVERFLOW (status bit 4) or subtracting the bit UNDERFLOW (status bit 3) once, each time the counter value is read. Between two counter queries, the counter value should not be increased or decreased by more than $1/3 \times 0xFFFF$. Due to the separate calculation of the counter extension, this procedure allows for calculation using smaller data widths.

Setting the counter value:

Presetting the counter value is possible via the CNT_SET bit (control bit 2). The new counter value is transferred in the load value. When the CNT_SET bit is set from "0" to "1", the counter is loaded with the load value. The CNTSET_ACC bit (status bit 2) is set to "1" when the loading is completed

Maintaining the present counter value:

The present counter value may be maintained or latched via the external latch input. To do so, the EN_LATEXT bit (control bit 1) is set in the control word. Upon transition from "0" to "1", the latch value will contain the counter value at the time of the edge transition. Upon completion of the latch process the LATEXT_VAL bit (status bit 1) will be set to "1". Calculating the extended latch value is done as shown above.

Maintaining a reference point:

The storage of a present counter value may also be accomplished via the index pulse from the encoder. Releasing is done when the EN_LATC bit (control bit 0) is set to "1". The storage of the counter value is completed when LATC_VAL = 1 (status bit 0).

2.1.4 750-631/000-010, 750-631/000-011 [Incremental Encoder Interface]

Incremental Encoder Interface

2.1.4.1 Variations

Item-No.	Designation	Description
750-631/000-010	Increment.Enc.	Incremental Encoder Interface, 4-fold report
750-631/000-011	Increment.Enc./single report	Incremental Encoder Interface, single report

2.1.4.2 View

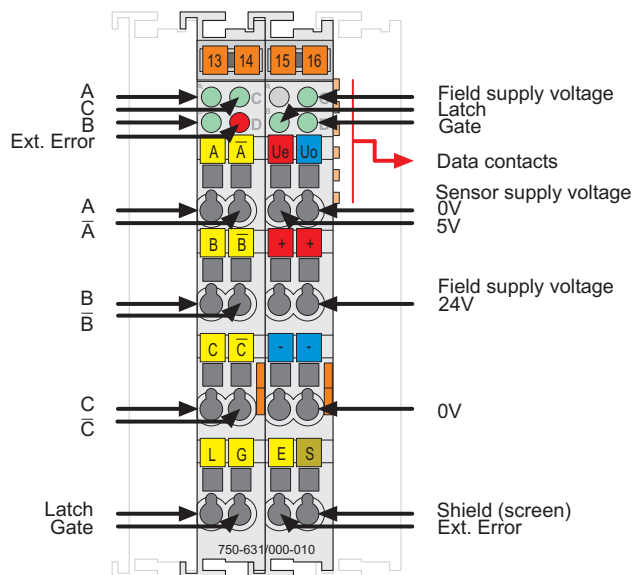


Fig. 2.1.4-1: View

g0631a0e

2.1.4.3 Description

This module is an interface for the connection of following incremental encoder:

- A) Incremental encoder with RS422 output,
- B) Incremental encoder with 24 V push-pull output,
- C) Incremental encoder with non-equivalent 24 V push-pull output,
- D) Incremental encoder with 5 V push-pull output.

The directly connected to the Ue and U0 terminations of the module, the power supply for 24 V transmitter can be connected to the 24 V field supply connectors.

The shield (screen) is directly connected to the carrier rail.

A 16 bit counter with quadrature encoder interface as well as a 16 bit latch for the zero impulse can be read, set, or enabled. The count of the counter will be transmitted fast and interference-free over the fieldbus to the PC, PLC, or NC.

A counter lock-out is possible using input Gate.

Individual green status LEDs indicate the operating status of the module and the signal status of the A, B and C as well as latch and gate inputs and power supply.

A red LED indicates the status of the input for an external error.

Any configuration of the specialty modules is possible when designing the fieldbus node. Grouping of module types is not necessary.



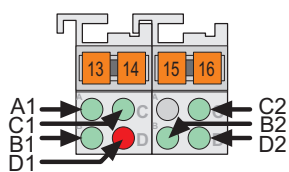
Attention

This module has no power contacts. For field supply to downstream I/O modules, a supply module will be needed.

The module 750-631 and its variations can be used with all couplers/controllers of the WAGO-I/O-SYSTEM 750 (except for the economy types 750-320, -323, -324 and -327).

This description is valid for the XXXX3E08... hardware and software versions. The version is specified in the manufacturing number, which is part of the lateral marking on the module.

2.1.4.4 Display Elements

Fig. 2.1.4-2: Display Elements
g063142x

LED	Channel	State	Function
A1 green	A	off	Signal voltage (0), (see technical data)
		on	Signal voltage (1), (see technical data)
B1 green	B	off	Signal voltage (0), (see technical data)
		on	Signal voltage (1), (see technical data)
C1 green	C	off	Signal voltage (0), (see technical data)
		on	Signal voltage (1), (see technical data)
D1 red	Ext. Error	off	$U \geq 5.0 \text{ V}$ or open connection
		on	$U < 0.5 \text{ V}$
B2 green	Latch	off	$U \leq 5.0 \text{ V}$
		on	$U \geq 15.0 \text{ V}$
C2 green	Field supply	off	24 V field supply voltage missing
		on	24 V field supply voltage ok
D2 green	Gate	off	$U \leq 5.0 \text{ V}$
		on	$U \geq 15.0 \text{ V}$

2.1.4.5 Schematic Diagram

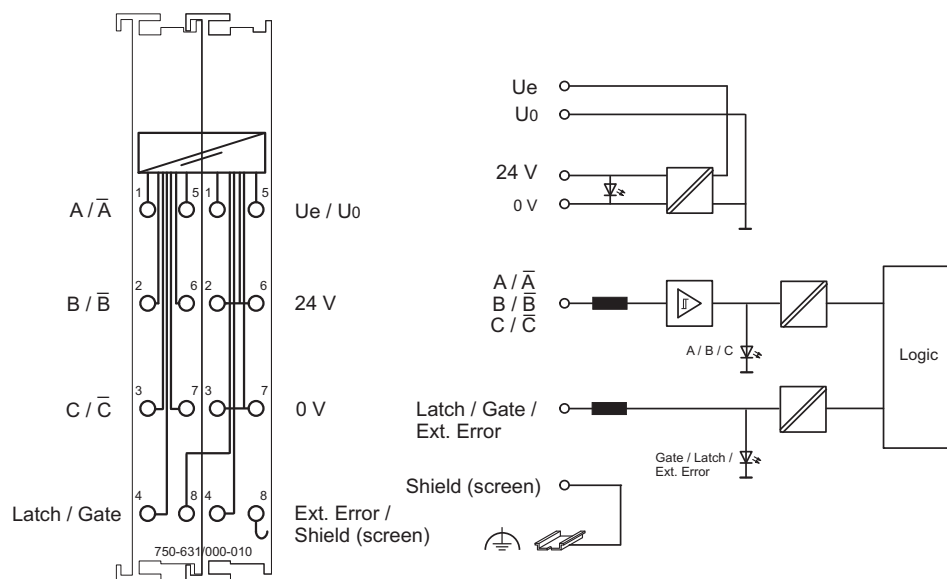


Fig. 2.1.4-2: Schematic Diagram

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2.1.4.6 Technical Data

Module Specific Data		
Sensor connection	Variation A	Incremental encoder with RS422 output
	Variation B	Incremental encoder with 24 V push-pull output
	Variation C	Incremental encoder with non-equivalent 24 V push-pull output
	Variation D	Incremental encoder with 5 V push-pull output
Signal voltage A, B, C, /A, /B, /C	Variation A	(0): $U_{A, B, C} = 0 \text{ V}$, $U_{/A, /B, /C} = 5 \text{ V}$ (1): $U_{A, B, C} = 5 \text{ V}$, $U_{/A, /B, /C} = 0 \text{ V}$
	Variation B	(0): $U_{A, B, C} \leq 5 \text{ V}$ (1): $U_{A, B, C} \geq 15 \text{ V}$
	Variation C	(0): $U_{A, B, C} = 0 \text{ V}$, $U_{/A, /B, /C} = 5 \text{ V}$ (1): $U_{A, B, C} = 5 \text{ V}$, $U_{/A, /B, /C} = 0 \text{ V}$
	Variation D	(0): $U_{A, B, C} \leq 5 \text{ V}$ (1): $U_{A, B, C} \geq 15 \text{ V}$
Signal voltage Latch, Gate		(0) $U \leq 5.0 \text{ V}$ (1) $U \geq 15.0 \text{ V}$
Signal voltage Ext. Error		(0) $U \geq 5.0 \text{ V}$ or open connection (1) $U < 0.5 \text{ V}$
Sensor power supply		DC 5 V
Sensor output current _{max.}		200 mA
Counter		16 bits binary
Operating frequency		1 MHz
Quadrature decoder		4-fold report (750-631/000-010), single report (750-631/000-011)
Zero impulse latch		16 bits
Commands		read, set, enable
Voltage supply		DC 24 V (-15 % ... +20 %)
Current consumption (internal)		50 mA
Current consumption (field) _{typ.}		10 mA without sensor
Internal bit width		1 x 32 bits 1 x 8 bits control/status 1 x 8 bits reserved
Isolation		500 V (System/Supply)
Dimensions W x H* x L * from upper edge of 35 DIN rail		24 mm x 64 mm x 100 mm
Weight		ca. 105 g

Approvals		
	cUL _{US} (UL508)	
	cUL _{US} ANSI/ISA 12.12.01	Class I Div2 ABCD T4
	DEKRA	II 3 G Ex nA II T4
	Conformity Marking	
Standards and Guidelines		
EMC CE-Emission of interference	acc. to EN 61000-6-4: 2007	
EMC CE-Immunity to interference	acc. to EN 61000-6-2: 2005	
ATEX-Guideline	acc. to EN 61079-0: 2006 and acc. to EN 61079-15: 2005	



More Information

Detailed references to the approvals are listed in the document "Overview Approvals WAGO-I/O-SYSTEM 750", which you can find on the CD ROM ELECTRONICC Tools and Docs (Item-No.: 0888-0412)
 or in the internet under: <http://www.wago.com> → Documentation → WAGO-I/O-SYSTEM 750 → System Description

2.1.4.7 Functional Description

The incremental encoder interface is used to evaluate two 90° phase-shifted track signals delivered by digital encoders with 5 V ... 24 V output. If required, the signals generated by the index track can also be processed. Control via two 24V signals is optional.

Typically, incremental encoders provide two signals of the encoder track, both 90° offset. These signals are labelled A and B.

In the case of connector versions A and C, the signals are transmitted as differential signals for an improved common mode rejection. Besides signal A, the inverted level /A is also transmitted. The difference of the input signals is formed in the incremental encoder interface.

By exchanging A and /A the phase position will turn from A to B, thus allowing the desired counting direction to be preset via the wiring configuration.

Connector versions B and D are also known as S.E. (single ended). The potentials of the track signals relate to the common earth connection. In comparison to the complementary evaluation of the track signals, the susceptibility is higher because common-mode interferences are not suppressed.

Most incremental encoders have an index track in addition to the two track signals. This index track generates a single pulse per encoder revolution. This pulse can be used to determine the absolute encoder position within a revolution. Through the appropriate initialization, the current counter value is transmitted to a latch register using the index pulse. Since the index pulse has the same duration as a track signal, the latch process should always be performed in the same rotational direction.

If the rotary transducer is equipped with a monitoring electronics with NPN alarm output, then this output can be connected to the external error [input](#). The input is switching negatively, i.e., 0V is logically mapped to 1.

With connector versions A and D, the 5V supply for the sensor can be tapped off at the outputs Ue and U0. This supply voltage is generated from 24V to be provided externally. The inputs 0V and U0 are connected internally.

The latch input controls the overtaking of the actual counter value into the latch register. This input is activated by the control bit EN_LATEXT ("1"). EN_LACT has to be deactivated ("0"). After activation, the first edge transition from 0V to 24V at the latch input takes the actual counter value into the latch register. The control bit EN_LATEXT must be deleted and reset, so that the counter value can be stored again.

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

The latch and gate inputs are 24V.

Overview of Inputs and Outputs:

In-/Output	Type	Function
Signal A and Signal /A	Input	Incremental pulse signals for channel A
Signal B and Signal /B	Input	Incremental pulse signals for channel B
Signal C and Signal /C	Input	Track signal for the index channel of the sensor
Shield	Input	Shield connection for encoder wiring
Sensor 0 V (U_0)	Output, power supply	Ground for sensor signals and supply
Sensor +5 V (U_e)	Output, power supply	5 V supply for encoder
+24 V	Input, power supply	24 V supply voltage for the sensor and data processing
0 V	Input, power supply	Ground for the 24 V supply voltage, internally connected to sensor U_0
Gate	Input, 24 V	24 V input for gate signal
Latch	Input, 24 V	24 V input for Latch signal
Ext. Error	Input, low-side switching	Input for alarm output of sensor

2.1.4.8 Process Image

Using the I/O module 750-631/000-010 or 750-631/000-011, a 6 byte input and output process image can be transferred to the fieldbus coupler / controller via one logical channel. The data sent and received is stored in 2 output bytes (D0, D1) and 5 input bytes (D0 ... D4). The output bytes D2 ... D4 are reserved and without function. One control byte (C0) and one status byte (S0) are used to control the data flow.



Attention

The representation of the process data of some I/O modules or their variations in the process image depends on the fieldbus coupler/-controller used. Please take this information as well as the particular design of the respective control/status bytes from the section "Fieldbus Specific Design of the Process Data" included in the description concerning the process image of the corresponding coupler/controller.

Input data		Output data	
S0	Status byte	C0	Control byte
D0	Counter value byte 0 (LSB)	D0	Setpoint value byte 0 (LSB)
D1	Counter value byte 1 (MSB)	D1	Setpoint value byte 1 (MSB)
D2	DIG_INPUT	D2	reserved
D3	Latched value byte 0 (LSB)	D3	reserved
D4	Latched value byte 1 (MSB)	D4	reserved

Data byte D2 (DIG_INPUT)							
Bit 7	Bit 6	Bit 5	Bit 4	Bit 3	Bit 2	Bit 1	Bit 0
X	X	Signal Input A, /A	Signal Input B, /B	Signal Input C, /C	Signal Input Ext. Error	Signal Input Latch	Signal Input Gate

Signal (0): $U \leq 5.0 \text{ V}$
Input Gate (1): $U \geq 15.0 \text{ V}$
Signal (0): $U \leq 5.0 \text{ V}$
Input Latch (1): $U \geq 15.0 \text{ V}$
Signal (0): $U \geq 5.0 \text{ V}$ or open connection
Input (1): $U < 0.5 \text{ V}$
Ext. Error
Signal (0): Signal voltage (0), (see technical data)
Input C, /C (1): Signal voltage (1), (see technical data)
Signal (0): Signal voltage (0), (see technical data)
Input B, /B (1): Signal voltage (1), (see technical data)
Signal (0): Signal voltage (0), (see technical data)
Input A, /A (1): Signal voltage (1), (see technical data)
X reserved

Control byte C0							
Bit 7	Bit 6	Bit 5	Bit 4	Bit 3	Bit 2	Bit 1	Bit 0
0	0	0	0	0	CNT_SET	EN_LATEXT	EN_LATC

EN_LATC The counter is set with a rising edge of CNT_SET to the value that is specified via the process data.
EN_LATEXT The external latch input is activated. With the first external latch pulse after validity of the EN_LATEXT bit, the counter value is stored in the latch register. The following pulses have no influence on the latch register when the bit is set.
CNT_SET The zero point latch (C input) is activated. With the first external latch pulse after the validity of the EN_LATC bit, the counter value is stored in the latch register (this has priority over EN_LATEXT). The following pulses have no influence on the latch register when the bit is set.
0 reserved

Status byte S0							
Bit 7	Bit 6	Bit 5	Bit 4	Bit 3	Bit 2	Bit 1	Bit 0
0	0	0	OVER- FLOW	UNDER- FLOW	CNTSET _ACK	LA- TEXT_ VAL	LATC_ VAL

LATC_VAL	A zero point latch has occurred. The data D3, D4 in the process image corresponds to the latched counter value when the bit is set. To reactivate the latch input, EN_LATC must first be cancelled and then the bit must be set again.
LATEXT_VAL	An external latch pulse has occurred. The data D3, D4 in the process image corresponds to the latched counter value when the bit is set. To reactivate the latch input, EN_LATEXT must first be cancelled and then the bit must be set again.
CNTSET_ACK	The data for setting the counter has been accepted from the module.
UNDER-FLOW	This bit is set if an underflow (0 to 65535) of the 16-bit counter occurs. It is reset when the counter drops below two thirds of the measurement range (43690 to 43689) or as soon as an overflow occurs.
OVER-FLOW	This bit is set if an overflow (65535 to 0) of the 16-bit counter occurs. It is reset if the counter exceeds a third of the measurement range (21845 to 21846) or as soon as an underflow occurs.
0	reserved

The following tasks can be performed or checked via the control and status byte:

Extending the counter above 16 bits:

The internal counter has a width of 16 bits. Should the application require an extended range for the location values, the extended counter range may be calculated within the control system using the location-difference-integration method. This method uses the control system to store the last location value (counter value). Any new location value will have the previously stored counter value subtracted from it. Using the sign bit, this difference will be completed with the desired number of extension bits and then be added to the accumulated location value. It is assumed that the counter difference of the two counter queries is smaller than (16-1) bits therefore counter overflows need not be considered.

Another method calculates the counter extension separately by adding the bit OVERFLOW (status bit 4) or subtracting the bit UNDERFLOW (status bit 3) once, each time the counter value is read. Between two counter queries, the counter value should not be increased or decreased by more than $1/3 \times 0xFFFF$. Due to the separate calculation of the counter extension, this procedure allows for calculation using smaller data widths.

Setting the counter value:

Presetting the counter value is possible via the CNT_SET bit (control bit 2). The new counter value is transferred in the load value. When the CNT_SET bit is set from "0" to "1", the counter is loaded with the load value. The CNTSET_ACC bit (status bit 2) is set to "1" when the loading is completed.

Maintaining the present counter value:

The present counter value may be maintained or latched via the external latch input. To do so, the EN_LATEXT bit (control bit 1) is set in the control word. Upon transition from "0" to "1", the latch value will contain the counter value at the time of the edge transition. Upon completion of the latch process the LATEXT_VAL bit (status bit 1) will be set to "1". Calculating the extended latch value is done as shown above.

Maintaining a reference point:

The storage of a present counter value may also be accomplished via the index pulse from the encoder. Releasing is done when the EN_LATC bit (control bit 0) is set to "1". The storage of the counter value is completed when LATC_VAL = 1 (status bit 0).

2.1.4.9 Connection Variations

2.1.4.9.1 Incremental Encoder with RS422 Output (Variation A)

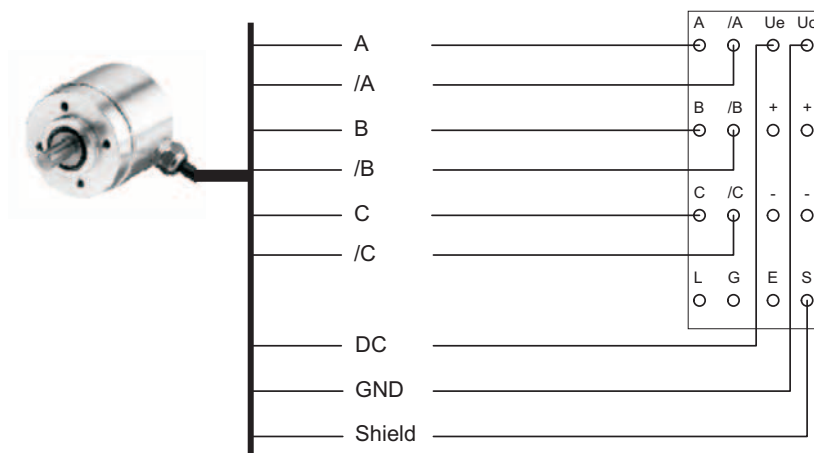


Abb. 2.1.4-3: Incremental encoder with RS422 output

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2.1.4.9.2 Incremental Encoder with 24 V Push-Pull Output (Variation B)

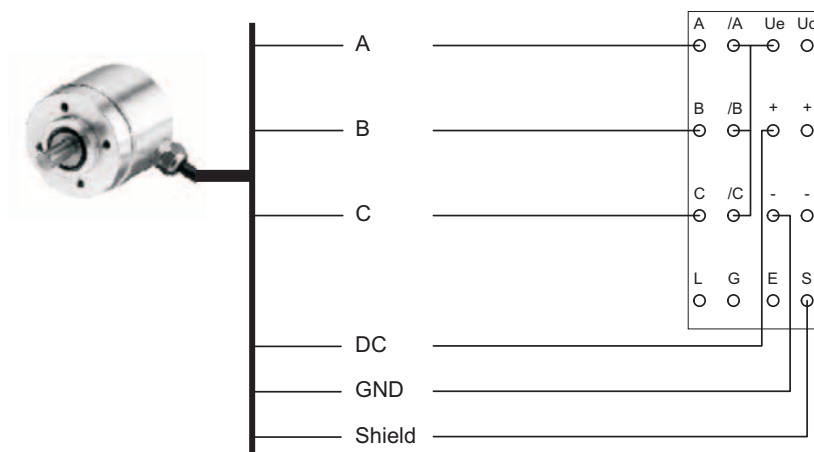


Abb. 2.1.4-4: Incremental encoder with 24 V push-pull output

g0631a4e

2.1.4.9.3 Incremental Encoder with non-equivalent 24 V Push-Pull Output
(Variation C)

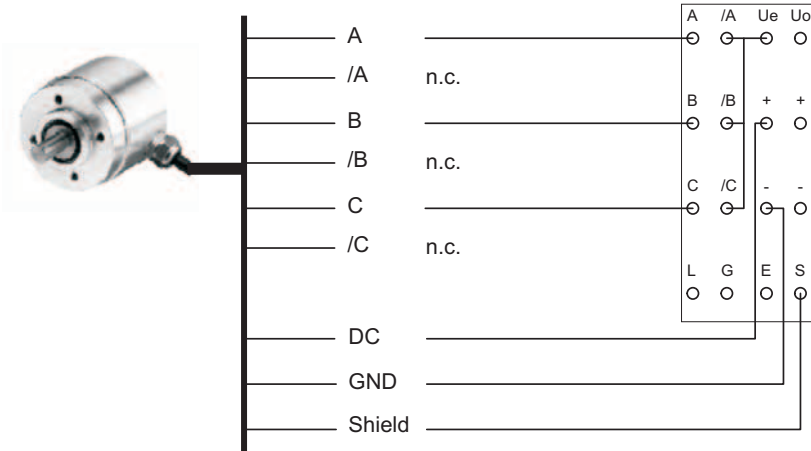


Abb. 2.1.4-5: Incremental encoder with non-equivalent 24 V push-pull output g0631a5e

2.1.4.9.4 Incremental Encoder with 5 V Push-Pull Output (Variation D)

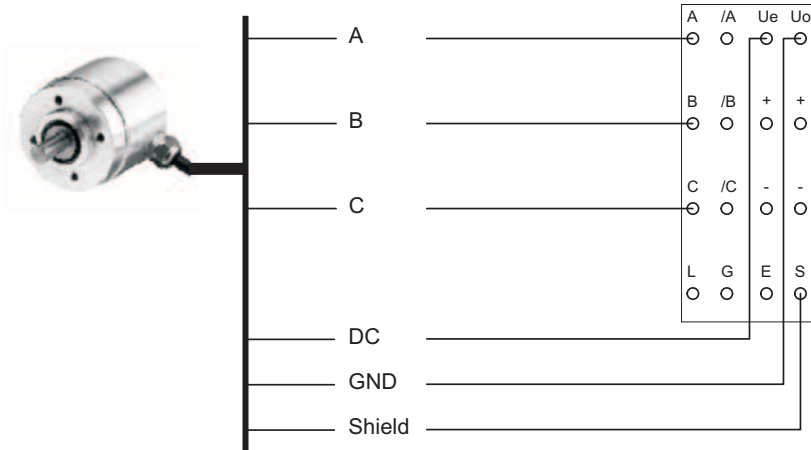


Abb. 2.1.4-6: Incremental encoder with 5 V push-pull output g0631a6e

3 Use in Hazardous Environments

The **WAGO-I/O-SYSTEM 750** (electrical equipment) is designed for use in Zone 2 hazardous areas.

The following sections include both the general identification of components (devices) and the installation regulations to be observed. The individual subsections of the "Installation Regulations" section must be taken into account if the I/O module has the required approval or is subject to the range of application of the ATEX directive.

3.1 Marking Configuration Examples

3.1.1 Marking for Europe according to CENELEC and IEC

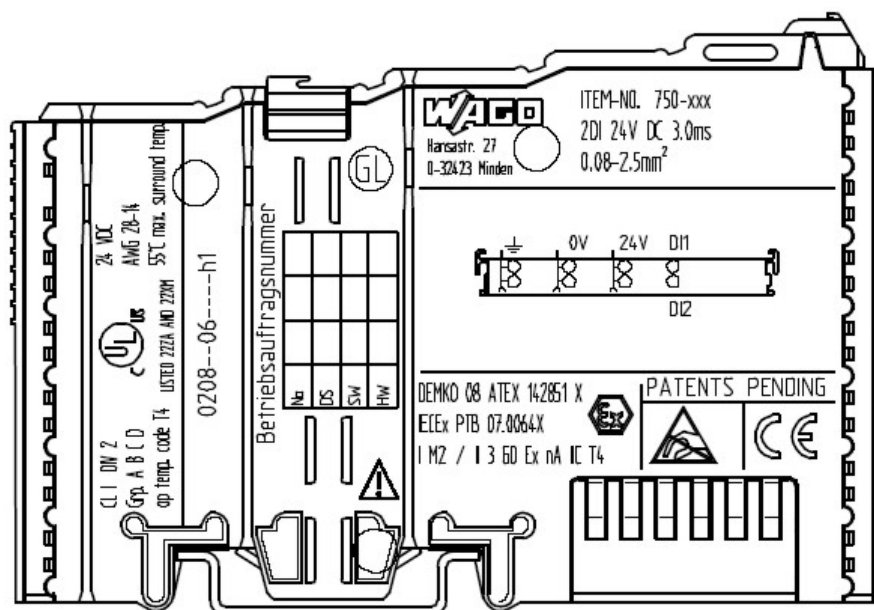


Figure 1: Side marking example for ATEX and IEC Ex approved I/O modules according to CENELEC and IEC

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



Figure 2: Printing Text detail – Marking example for ATEX and IEC Ex approved I/O modules according to CENELEC and IEC

Table 1: Description of marking example for ATEX and IEC Ex approved I/O modules according to CENELEC and IEC

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

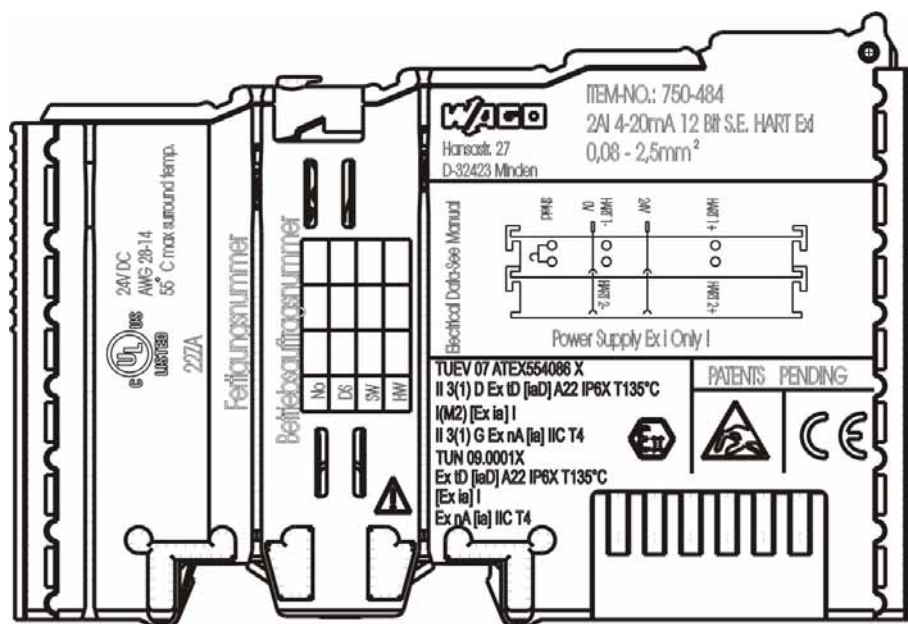


Figure 3: Side marking example for Ex i and IEC Ex i approved I/O modules according to CENELEC and IEC

TUEV 07 ATEX554086 X
II 3(1) D Ex tD [iaD] A22 IP6X T135°C
I(M2) [Ex ia] I
II 3(1) G Ex nA [ia] IIC T4
TUN 09.0001X
Ex tD [iaD] A22 IP6X T135°C
[Ex ia] I
Ex nA [ia] IIC T4



Figure 4: Text detail – Marking example for Ex i and IEC Ex i approved I/O modules according to CENELEC and IEC

Table 2: Description of marking example for Ex i and IEC Ex i approved I/O modules according to CENELEC and IEC

Inscription text	Description
TÜV 07 ATEX 554086 X TUN 09.0001X	Approving authority or certificate numbers
Dust	
II	Device group: All except mining
3(1)D	Device category: Zone 22 device (Zone 20 subunit)
Ex	Explosion protection mark
tD	Protection by enclosure
[iaD]	Approved in accordance with "Dust intrinsic safety" standard
A22	Surface temperature determined according to Procedure A, use in Zone 22
IP6X	Dust-tight (totally protected against dust)
T 135°C	Max. surface temp. of the enclosure (no dust bin)
Mining	
I	Device group: Mining
(M2)	Device category: High degree of safety
[Ex ia]	Explosion protection: Mark with category of type of protection intrinsic safety: Even safe when two errors occur
I	Device group: Mining
Gases	
II	Device group: All except mining
3(1)G	Device category: Zone 2 device (Zone 0 subunit)
Ex	Explosion protection mark
nA	Type of protection: Non-sparking operating equipment
[ia]	Category of type of protection intrinsic safety: Even safe when two errors occur
IIC	Explosion Group
T4	Temperature class: Max. surface temperature 135°C

3.1.2 Marking for America according to NEC 500

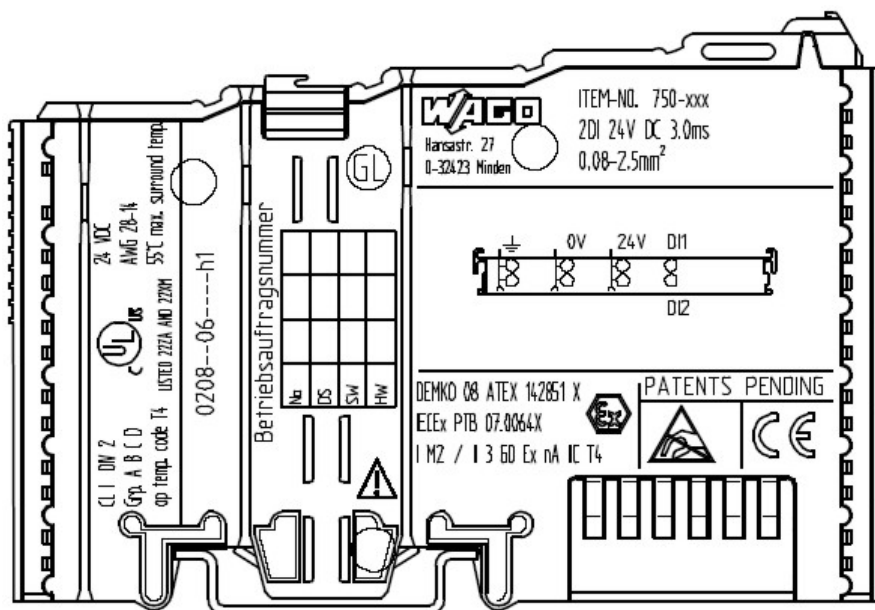


Figure 5: Side marking example for I/O modules according to NEC 500

CL 1 DIV 2
Grp. A B C D
op temp. code T4



LISTED 222A AND 220M

Figure 6: Text detail – Marking example for I/O modules according to NEC 500

Table 3: Description of marking example for I/O modules according to NEC 500

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

3.2 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 4: 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 5: 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:

3.2.1 Special Conditions for Safe Operation of the ATEX and IEC Ex (acc. DEMKO 08 ATEX 142851X and IECEx PTB 07.0064)

The fieldbus-independent I/O modules of the WAGO-I/O-SYSTEM 750-.../...-... must be installed in an environment with degree of pollution 2 or better. In the final application, the I/O modules must be mounted in an enclosure with IP 54 degree of protection at a minimum with the following exceptions:

- I/O modules 750-440, 750-609 and 750-611 must be installed in an IP 64 minimum enclosure.
- I/O module 750-540 must be installed in an IP 64 minimum enclosure for 230 V AC applications.
- I/O module 750-440 may be used up to max. 120 V AC.

When used in the presence of combustible dust, all devices and the enclosure shall be fully tested and assessed in compliance with the requirements of IEC 61241-0:2004 and IEC 61241-1:2004.

When used in mining applications the equipment shall be installed in a suitable enclosure according to EN 60079-0:2006 and EN 60079-1:2007.

I/O modules fieldbus plugs or fuses may only be installed, added, removed or replaced when the system and field supply is switched off or the area exhibits no explosive atmosphere.

DIP switches, coding switches and potentiometers that are connected to the I/O module may only be operated if an explosive atmosphere can be ruled out.

I/O module 750-642 may only be used in conjunction with antenna 758-910 with a max. cable length of 2.5 m.

To exceed the rated voltage no more than 40%, the supply connections must have transient protection.

The permissible ambient temperature range is 0 °C to +55 °C.

3.2.2 Special conditions for safe use (ATEX Certificate TÜV 07 ATEX 554086 X)

1. For use as Gc- or Dc-apparatus (in zone 2 or 22) the field bus independent I/O modules WAGO-I/O-SYSTEM 750-*** shall be erected in an enclosure that fulfils the requirements of the applicable standards (see the marking) EN 60079-0, EN 60079-11, EN 60079-15, EN 61241-0 and EN 61241-1. For use as group I, electrical apparatus M2, the apparatus shall be erected in an enclosure that ensures a sufficient protection according to EN 60079-0 and EN 60079-1 and the degree of protection IP64. The compliance of these requirements and the correct installation into an enclosure or a control cabinet of the devices shall be certified by an ExNB.
2. If the interface circuits are operated without the field bus coupler station type 750-3../...-... (DEMKO 08 ATEX 142851 X), measures must be taken outside of the device so that the rating voltage is not being exceeded of more than 40% because of transient disturbances.
3. DIP-switches, binary-switches and potentiometers, connected to the module may only be actuated when explosive atmosphere can be excluded.
4. The connecting and disconnecting of the non-intrinsically safe circuits is only permitted during installation, for maintenance or for repair purposes. The temporal coincidence of explosion hazardous atmosphere and installation, maintenance resp. repair purposes shall be excluded.
5. For the types 750-606, 750-625/000-001, 750-487/003-000, 750-484 the following shall be considered: The interface circuits shall be limited to overvoltage category I/II/III (non mains/mains circuits) as defined in IEC 60664-1.
6. For the type 750-601 the following shall be considered: Do not remove or replace the fuse when the apparatus is energized.
7. The ambient temperature range is: $0^{\circ}\text{C} \leq T_a \leq +55^{\circ}\text{C}$ (for extended details please note certificate).

8. The following warnings shall be placed nearby the unit:



WARNING

Do not remove or replace fuse when energized!

If the module is energized do not remove or replace the fuse.



WARNING

Do not separate when energized!

Do not separate the module when energized!



WARNING

Separate only in a non-hazardous area!

Separate the module only in a non-hazardous area!

3.2.3 Special conditions for safe use (IEC-Ex Certificate TUN 09.0001 X)

1. For use as Dc- or Gc-apparatus (in zone 2 or 22) the fieldbus independent I/O modules WAGO-I/O-SYSTEM 750-*** shall be erected in an enclosure that fulfils the requirements of the applicable standards (see the marking) IEC 60079-0, IEC 60079-11, IEC 60079-15, IEC 61241-0 and IEC 61241-1. For use as group I, electrical apparatus M2, the apparatus shall be erected in an enclosure that ensures a sufficient protection according to IEC 60079-0 and IEC 60079-1 and the degree of protection IP64. The compliance of these requirements and the correct installation into an enclosure or a control cabinet of the devices shall be certified by an ExCB.
2. Measures have to be taken outside of the device that the rating voltage is not being exceeded of more than 40% because of transient disturbances.
3. DIP-switches, binary-switches and potentiometers, connected to the module may only be actuated when explosive atmosphere can be excluded.
4. The connecting and disconnecting of the non-intrinsically safe circuits is only permitted during installation, for maintenance or for repair purposes. The temporal coincidence of explosion hazardous atmosphere and installation, maintenance resp. repair purposes shall be excluded.
5. For the types 750-606, 750-625/000-001, 750-487/003-000, 750-484 the following shall be considered: The interface circuits shall be limited to overvoltage category I/II/III (non mains/mains circuits) as defined in IEC 60664-1.
6. For the type 750-601 the following shall be considered: Do not remove or replace the fuse when the apparatus is energized.
7. The ambient temperature range is: $0^{\circ}\text{C} \leq T_a \leq +55^{\circ}\text{C}$ (for extended details please note certificate).

8. The following warnings shall be placed nearby the unit:



WARNING

Do not remove or replace fuse when energized!

If the module is energized do not remove or replace the fuse.



WARNING

Do not separate when energized!

Do not separate the module when energized!



WARNING

Separate only in a non-hazardous area!

Separate the module only in a non-hazardous area!

3.2.4 Special conditions for safe use (ATEX Certificate DEKRA 11ATEX0203 X)

1. The components shall be installed in a suitable enclosure providing a degree of protection of at least IP54 according to EN 60529, taking into account the environmental conditions under which the equipment will be used.
2. When the temperature under rated conditions exceeds 70 °C at the cable or conduit entry point, or 80 °C at the branching point of the conductors, the temperature specification of the selected cable shall be in compliance with the actual measured temperature values.
3. Provisions shall be made to prevent the rated voltages from being exceeded by transient disturbances of more than 40 %.
4. Components may only be removed or inserted when the system supply and the field supply are switched off, or when the location is known to be non-hazardous.
5. Fieldbus connectors may only be disconnected or connected when the system supply is switched off, or when the location is known to be non-hazardous.
6. The fuses, present in the system modules 750-6xx may only be replaced when the supply is switched off, or when the location is known to be non-hazardous.
7. Address selectors and ID switches may only be adjusted when the system supply is switched off, or when the location is known to be non-hazardous.
8. The ambient temperature range is: $0^{\circ}\text{C} \leq T_a \leq +55^{\circ}\text{C}$.

3.2.5 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.

This equipment is to be fitted within tool-secured enclosures only.



WARNING

Explosion hazard!

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



WARNING

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 near each operator accessible connector and fuse holder." When a fuse is provided, the following information shall be provided: "A switch suitable for the location where the equipment is installed shall be provided to remove the power from the fuse."

For devices with Ethernet connectors:

"Only for use in LAN, not for connection to telecommunication circuits".



WARNING

Use only with antenna module 758-910!

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

For Couplers/Controllers and Economy bus modules only: "The configuration Interface Service connector is for temporary connection only. Do not connect or disconnect unless the area is known to be nonhazardous. Connection or disconnection in an explosive atmosphere could result in an explosion.



WARNING

Devices containing fuses must not be fitted into circuits subject to over loads!

Devices containing fuses must not be fitted into circuits subject to over loads, e.g. motor circuits!



WARNING

Do not connect or disconnect SD-Card unless the area known to be free of ignitable concentrations of flammable gases or vapors!

Do not connect or disconnect SD-Card while circuit is live unless the area is known to be free of ignitable concentrations of flammable gases or vapors.



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.



WAGO Kontakttechnik GmbH & Co. KG
Postfach 2880 • D-32385 Minden
Hansastraße 27 • D-32423 Minden
Phone: 05 71/8 87 – 0
Fax: 05 71/8 87 – 1 69
E-Mail: info@wago.com

Internet: <http://www.wago.com>
