WAGO-I/O-SYSTEM 750

Manual

750-631(/xxx-xxx)

Incremental Encoder Interface

Version 1.2.0

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 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.

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 protected by trademark or patent.

Table of Contents

1 Notes about this Documentation

Note

Always retain this documentation!
This documentation is part of the product. Therefore, retain the documentation during the entire service life of the product. Pass on the documentation to any subsequent user. In addition, ensure that any supplement to this documentation is included, if necessary.

1.1 Validity of this Documentation

This documentation is only applicable to the I/O module 750-631 (Incremental Encoder Interface) and the variants listed in the table below.

Table 1: Variants

Item Number/Variant	Designation
750-631	Incremental Encoder Interface **No longer available!**
750-631/000-001	Incremental Encoder Interface/Single evaluation **No longer available!**
750-631/000-004	Incremental Encoder Interface/RS-422
750-631/000-010	Incremental Encoder Interface/5 … 24 VDC
750-631/000-011	Incremental Encoder Interface/5 … 24 VDC; Single evaluation

Note

Documentation Validity for Variants
Unless otherwise indicated, the information given in this documentation applies to listed variants.

The I/O module 750-631 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. There, you can obtain important information including information on electrical isolation, system power and supply specifications.

1.2 Copyright

1.3 Symbols

⚠ 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.

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 2: 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 3: Font Conventions

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

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 WAGO-I/O-SYSTEM 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 WAGO-I/O-SYSTEM 750 in Compliance with Underlying Provisions

Fieldbus couplers, fieldbus 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 actuators or higher-level control systems. Using programmable controllers, the signals can also be (pre-) processed.

The devices 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 devices in wet and dusty environments is prohibited.

Operating the WAGO-I/O-SYSTEM 750 devices in home applications without further measures is only permitted if they meet the emission limits (emissions of interference) according to EN 61000-6-3. You will find the relevant information in the section “Device Description” > “Standards and Guidelines” in the manual for the used fieldbus coupler/controller.

Appropriate housing (per 2014/34/EU) 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 devices to be supplied ex works are equipped with hardware and software configurations, which meet the individual application requirements. 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 devices.

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

DANGER

Install the device 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 device/module 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

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

NOTICE

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

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.

NOTICE

Avoid electrostatic discharge!
The devices are equipped with electronic components that may be destroyed by electrostatic discharge when touched. Please observe the safety precautions against electrostatic discharge per DIN EN 61340-5-1/-3. When handling the devices, please ensure that environmental factors (personnel, work space and packaging) are properly grounded.

3 Device Description 750-631, 750-631/000-001

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

The transmitter can be directly supplied from the U_e and U_0 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.

The signal status for inputs A, B and C, Latch and Gate and the operating status of the I/O module are each indicated by a dedicated green status LED.

The meaning of the LEDs is described in the “Display Elements” section.

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

Note

Use a supply module!
Use a supply module for field-side power supply of downstream I/O modules.

The field voltage and the system voltage are electrically isolated from each other.

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

3.1 View

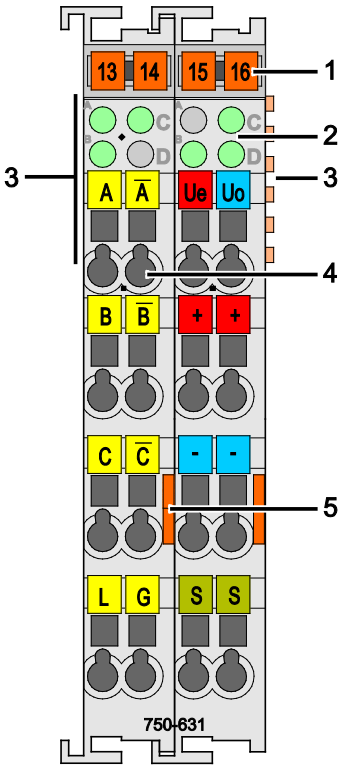

Figure 1: View

Table 4: Legend for Figure “View”

Pos.	Description	Details See Section
1	Marking possibility with Mini-WSB	---
2	Status LEDs	“Device Description” > “Display Elements”
3	Data contacts	“Device Description” > “Connectors”
4	CAGE CLAMP® connectors	“Device Description” > “Connectors”
5	Release tab	“Mounting” > ”Inserting and Removing Devices”

3.2 Connectors

3.2.1 Data Contacts/Internal Bus

Communication between the fieldbus coupler/controller and the I/O modules as well as the system supply of the I/O modules is carried out via the internal bus. It is comprised of 6 data contacts, which are available as self-cleaning gold spring contacts.

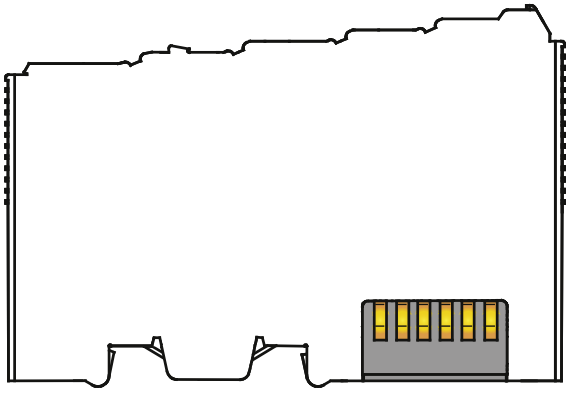

Figure 2: Data Contacts

NOTICE

Do not place the I/O modules on the gold spring contacts!
Do not place the I/O modules on the gold spring contacts in order to avoid soiling or scratching!

NOTICE

Ensure that the environment is well grounded!
The devices are equipped with electronic components that may be destroyed by electrostatic discharge. When handling the devices, ensure that the environment (persons, workplace and packing) is well grounded. Avoid touching conductive components, e.g. data contacts.

3.2.2 Power Jumper Contacts/Field Supply

The I/O module 750-631 has no power jumper contacts.

3.2.3 CAGE CLAMP® Connectors

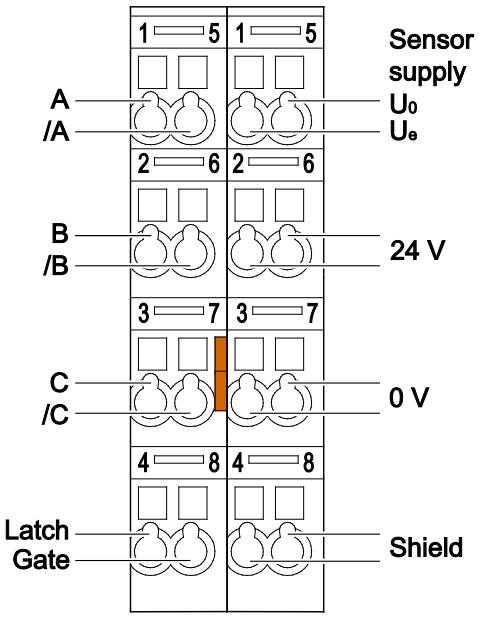

Figure 3: CAGE CLAMP® Connectors

Table 5: Legend for "CAGE CLAMP® Connectors Figure

Designation	Connection	Function
A	1, left	Encoder connection
B	2, left	
C	3, left	
/A	5, left	
/B	6, left	
/C	7, left	
Latch	4, left	Latch input
Gate	8, left	Gate input
Ue	1, right	Sensor supply 5 V
U_0	5, right	Sensor supply 0 V
24 V	2, right	Field supply
	6, right	
0 V	3, right	
	7, right	
Shield	4, right	Shield connection (DIN rail)
	8, right	

3.3 Display Elements

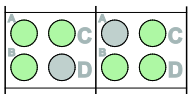

Figure 4: Display Elements

Table 6: Legend for the “Display Elements” Figure

Designation	LED	State	Function
A	A, left	Off	Signal voltage (0)
		Green	Signal voltage (1)
B	B, left	Off	Signal voltage (0)
		Green	Signal voltage (1)
C	C, left	Off	Signal voltage (0)
		Green	Signal voltage (1)
Latch	B, rechts	Off	Signal voltage (0)
		Green	Signal voltage (1)
Function	C, right	Off	Not ready for operation or no or disturbed internal bus communication
		Green	Ready for operation and undisturbed internal bus communication
Gate	D, right	Off	Signal voltage (0)
		Green	Signal voltage (1)

3.4 Operating Elements

The I/O module 750-631 has no operating elements.

3.5 Schematic Diagram

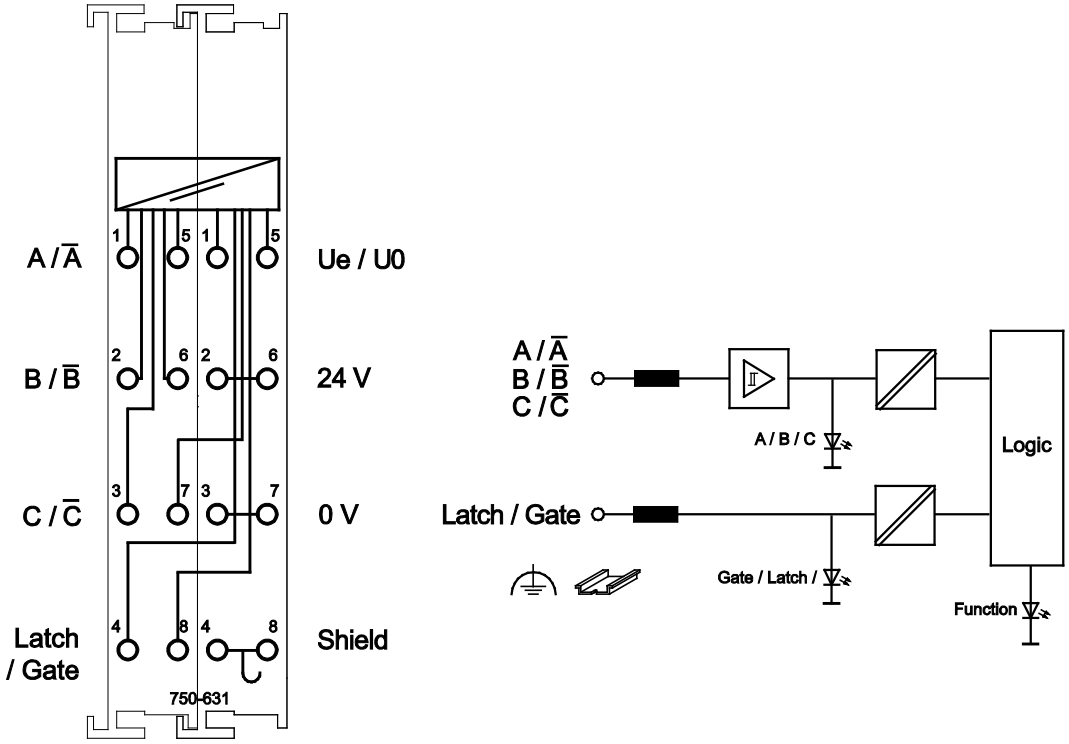

Figure 5: Schematic Diagram

3.6 Technical Data

3.6.1 Device Data

Table 7: Technical Data — Device

Width	24 mm
Height (from upper-edge of DIN rail)	64 mm
Depth	100 mm
Weight	ca. 105 g

3.6.2 Power Supply

Table 8: Technical Data — Power Supply

Power supply	Via CAGE CLAMP® connections
	24 VDC (−15 % … +20 %)
Current consumption max. (24 VDC)	6 mA (without encoder)
Current consumption (internal)	25 mA
Encoder output current$_{max.}$	200 mA
Encoder operating voltage	5 VDC
Isolation	500 V System / Power Supply

3.6.3 Communication

Table 9: Technical Data — Communication

Data width, internal (internal data bus)	1 x 32 bit Data 1 x 8 bit control/status 1 x 8 bit reserved

3.6.4 Inputs/Outputs

Table 10: Technical Data — Inputs/Outputs

Encoder connection	A, /A, B, /B, C, /C (/A, /B, /C are inverted)
Zero impulse latch	16 Bit
Commands	Reading, setting, activating
Counter	16 bit binär
Limit frequency	470 kHz

3.6.5 Digital Inputs (Latch, Gate, Ext. Error)

Table 11: Technical Data — Digital Inputs (Latch, Gate, Ext. Error)

Input voltage Latch, Gate	(0) U ≤ 2,0 V
	(1) U ≤ 11,0 V

3.6.6 Quadrature Inputs (A, /A, B, /B, C, /C))

Table 12: Technical Data — Quadrature Inputs (A, /A, B, /B, C, /C)

Input voltage A, /A, B, /B, C, /C	(0) U ≤ 2,0 V
	(1) U ≥ 5,0 V

3.6.7 Quadrature Decoder

Table 13: Technical Data — Quadrature Decoder

Evaluation	
750-631	4 x
750-631/000-001	1 x

3.6.8 Climatic Environmental Conditions

Table 14: Technical Data – Climatic Environmental Conditions

Operating temperature range	0 °C … 55 °C
Storage temperature range	−25 °C … +85 °C
Relative humidity without condensation	Max. 95 %
Resistance to harmful substances	Acc. to IEC 60068-2-42 and IEC 60068-2-43
Maximum pollutant concentration at relative humidity < 75 %	SO_2 ≤ 25 ppm H_2S ≤ 10 ppm
Special conditions	Ensure that additional measures for components are taken, which are used in an environment involving: – dust, caustic vapors or gases – ionizing radiation

4 Functional description 750-631, 750-631/000-001

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 U_e and U_0. This voltage is generated from an external 24 V power supply. The inputs 0 V and U_0 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 and open connection initialize the counter. 24 V stops the counting process.

The latch and gate inputs are 24 V.

Table 15: Overview of Inputs and Outputs 750-631, /000-001

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, supply	Ground for sensor signals and supply
Sensor + 5 V	Output, supply	5 V supply for encoder
+ 24 V	Input, supply	24 V supply voltage for the sensor and data processing
0 V	Input, supply	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

5 Process Image 750-631, 750-631/000-001

Note

Mapping of process data in the process image of fieldbus systems
The representation of the I/O modules' process data 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 fieldbus coupler/controller used.

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 … 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.

Table 16: Process Image 750-631, 750-631/000-001

Process Image			
Input		**Output**	
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

5.1 Control / Status byte

Table 17: Control byte 750-631, 750-631/000-001

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_LATEX). The following pulses have no influence on the latch register when the bit is set.
0	reserved

Table 18: Status byte 750-631, 750-631/000-001

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.
UNDERFLOW	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.
OVERFLOW	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 x 0xFFFF. Due to the separate calculation of the counter extension, this procedure allows for calculation using smaller data width.

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).

6 Device Description 750-631/000-004

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

The transmitter can be directly supplied from the U_e and U_0 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

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

The meaning of the LEDs is described in the “Display Elements” section.

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

Note

Use a supply module!
Use a supply module for field-side power supply of downstream I/O modules.

The field voltage and the system voltage are electrically isolated from each other.

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

6.1 View

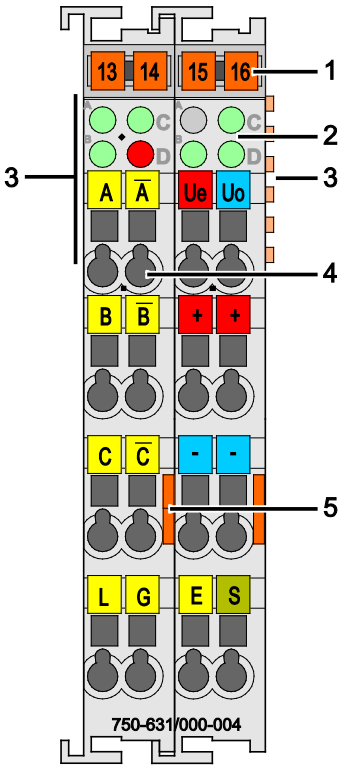

Figure 6: View

Table 19: Legend for Figure “View”

Pos.	Description	Details See Section
1	Marking possibility with Mini-WSB	---
2	Status LEDs	“Device Description” > “Display Elements”
3	Data contacts	“Device Description” > “Connectors”
4	CAGE CLAMP® connectors	“Device Description” > “Connectors”
5	Release tab	“Mounting” > ”Inserting and Removing Devices”

6.2 Connectors

6.2.1 Data Contacts/Internal Bus

Communication between the fieldbus coupler/controller and the I/O modules as well as the system supply of the I/O modules is carried out via the internal bus. It is comprised of 6 data contacts, which are available as self-cleaning gold spring contacts.

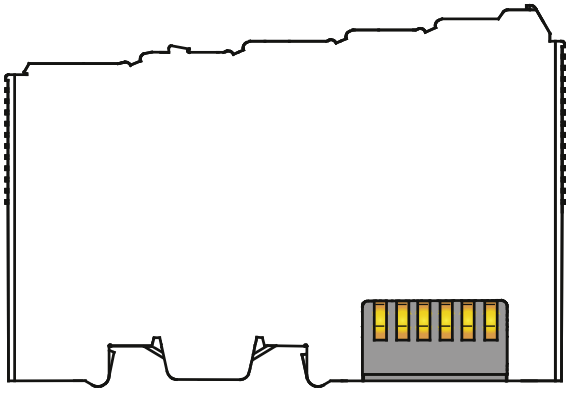

Figure 7: Data Contacts

NOTICE

Do not place the I/O modules on the gold spring contacts!
Do not place the I/O modules on the gold spring contacts in order to avoid soiling or scratching!

NOTICE

Ensure that the environment is well grounded!
The devices are equipped with electronic components that may be destroyed by electrostatic discharge. When handling the devices, ensure that the environment (persons, workplace and packing) is well grounded. Avoid touching conductive components, e.g. data contacts.

6.2.2 Power Jumper Contacts/Field Supply

The I/O module 750-631 has no power jumper contacts.

6.2.3 CAGE CLAMP® Connectors

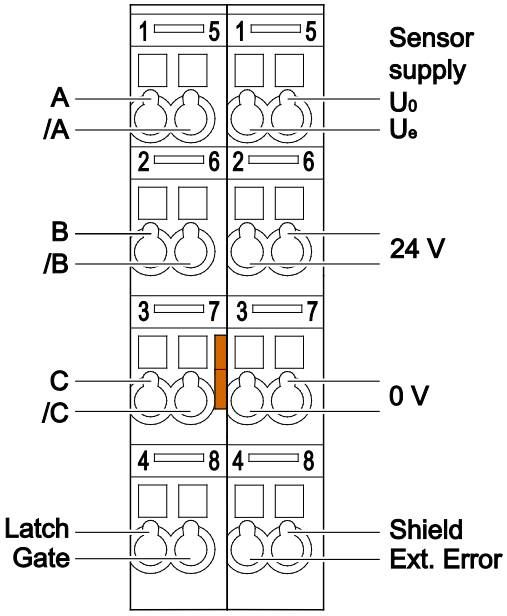

Figure 8: CAGE CLAMP® Connectors

Table 20: Legend for "CAGE CLAMP® Connectors

Designation	Connection	Function
A	1, left	Sensor connection
B	2, left	
C	3, left	
/A	5, left	
/B	6, left	
/C	7, left	
Latch	4, left	Latch input
Gate	8, left	Gate input
U_e	1, right	Sensor supply 5 V
U_0	5, right	Sensor supply 0 V
24 V	2, right	Field supply
	6, right	
0 V	3, right	
	7, right	
Ext. Error	4, right	Input for ext. Error (U < 0,5 V)
Shield	8, right	Shield connection (DIN rail)

6.3 Display Elements

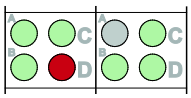

Figure 9: Display Elements

Table 21: Legend for the “Display Elements” Figure

Designation	LED	State	Function
A	A, left	Off	U_A = 0 V, $U_{/A}$ = 5 V
		Green	U_A = 5 V, $U_{/A}$ = 0 V
B	B, left	Off	U_B = 0 V, $U_{/B}$ = 5 V
		Green	U_B = 5 V, $U_{/B}$ = 0 V
C	C, left	Off	U_C = 0 V, $U_{/C}$ = 5 V
		Green	U_C = 5 V, $U_{/C}$ = 0 V
Ext. Error	D, left	Off	U ≥ 5,0 V or open connection
		Red	U < 0,5 V
Latch	B, right	Off	U ≤ 5,0 V
		Green	U ≤ 15,0 V
Field supply	C, right	Off	24 V Field supply voltage missing
		Green	24 V Field supply voltage ok
Gate	D, right	Off	U ≤ 5,0 V
		Green	U ≤ 15,0 V

6.4 Operating Elements

The I/O module 750-631 has no operating elements.

6.5 Schematic Diagram

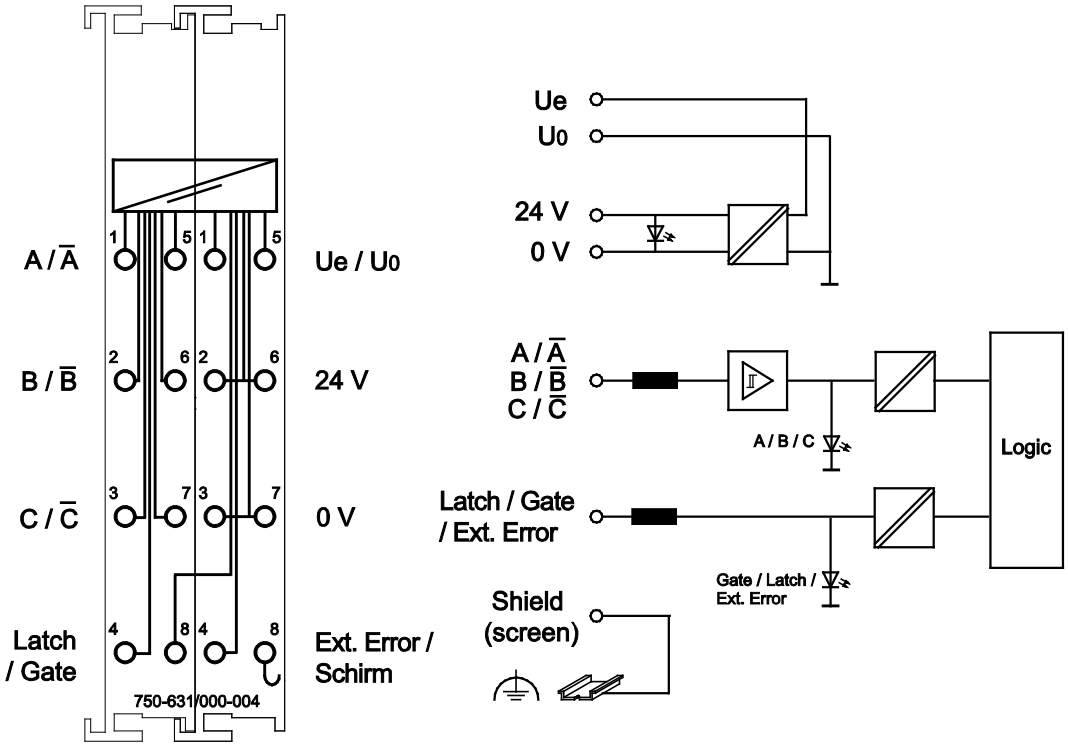

Figure 10: Schematic Diagram

6.6 Technical Data

6.6.1 Device Data

Table 22: Technical Data — Device

Width	24 mm
Height (from upper-edge of DIN rail)	64 mm
Depth	100 mm
Weight	ca. 105 g

6.6.2 Power Supply

Table 23: Technical Data — Power Supply

Power supply	Via CAGE CLAMP® connections
	24 VDC (−15 % … +20 %)
Current consumption max. (24 VDC)	10 mA (without encoder)
Current consumption (internal)	50 mA
Encoder output current$_{max.}$	200 mA
Encoder operating voltage	5 VDC

6.6.3 Communication

Table 24: Technical Data — Communication

Data width, internal (internal data bus)	1 x 32 bit Data 1 x 8 bit control/status 1 x 8 bit reserved

6.6.4 Inputs/Outputs

Table 25: Technical Data — Inputs/Outputs

Encoder connection	A, /A, B, /B, C, /C (RS-422-Inputs, /A, /B, /C are inverted)
Zero impulse latch	16 Bit
Commands	Reading, setting, activating
Counter	16 Bit binär
Limit frequency	1 MHz

6.6.5 Digital Inputs (Latch, Gate, Ext. Error)

Table 26: Technical Data — Digital Inputs (Latch, Gate, Ext. Error)

Input voltage Latch, Gate	(0) U ≤ 5,0 V
	(1) U ≥ 15,0 V
Input voltage Ext. Error	(0) U ≥ 5,0 V or open connection
	(1) U ≤ 0,5 V

6.6.6 Quadrature Inputs (A, /A, B, /B, C, /C))

Table 27: Technical Data — Quadrature Inputs (A, /A, B, /B, C, /C)

Input voltage A, /A, B, /B, C, /C	(0) $U_{A, B, C}$ = 0 V, $U_{/A, /B, /C}$ = 5 V
	(1) $U_{A, B, C}$ = 5 V, $U_{/A, /B, /C}$ = 0 V

6.6.7 Quadrature Decoder

Table 28: Technical Data — Quadrature Decoder

Evaluation	
750-631/000-004	4-fach

6.6.8 Climatic Environmental Conditions

Table 29: Technical Data – Climatic Environmental Conditions

Operating temperature range	0 °C … 55 °C
Storage temperature range	−25 °C … +85 °C
Relative humidity without condensation	Max. 95 %
Resistance to harmful substances	Acc. to IEC 60068-2-42 and IEC 60068-2-43
Maximum pollutant concentration at relative humidity < 75 %	SO_2 ≤ 25 ppm H_2S ≤ 10 ppm
Special conditions	Ensure that additional measures for components are taken, which are used in an environment involving: – dust, caustic vapors or gases – ionizing radiation

7 Funktionsbeschreibung 750-631/000-004

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.

The encoder is supplied with 5 V derived from the terminations U_e and U_0. This voltage is generated from an external 24 V power supply. The inputs 0 V and U_0 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 and open connection initialize the counter. 24 V stops the counting process.

The latch and gate inputs are 24 V.

Table 30: Function Description – In-/Output 750-631/000-004

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	Output, Power supply	Ground for sensor signals and supply
Sensor + 5 V	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

8 Process Image 750-631/000-004

Note

Mapping of process data in the process image of fieldbus systems
The representation of the I/O modules' process data 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 fieldbus coupler/controller used.

Using the I/O module, 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

Tabelle 31: Process Image 750-631/000-004, /000-010, /000-011

Process Image			
Input		**Output**	
S0	Status byte S0	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

Table 32: Data byte 750-631/000-004

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. Fehler	Signal Input Latch	Signal Input Gate

Signal	(0) U ≤ 5,0 V
Input Gate	(1) U ≥ 15,0 V
Signal	(0) U ≤ 5,0 V
Input Latch	(1) U ≥ 15,0 V
Signal	(0) U ≥ 5,0 V or open connection
Input Ext. Error	(1) U < 0,5 V
Signal	(0) U_C = 0 V, $U_{/C}$ = 5 V
Input C, /C	(1) U_C = 5 V, $U_{/C}$ = 0 V
Signal	(0) U_B = 0 V, $U_{/B}$ = 5 V
Input B, /B	(1) U_B = 5 V, $U_{/B}$ = 0 V
Signal	(0) U_A = 0 V, $U_{/C}$ = 5 V
Input A, /A	(1) U_A = 5 V, $U_{/C}$ = 0 V
x	reserved

8.1 Control-/ Status byte

Table 33: Control byte 750-631/000-004, /000-010, /000-011

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_LATEX). The following pulses have no influence on the latch register when the bit is set.
0	Reserved

Table 34: Status byte 750-631/000-004, /000-010, /000-011

Status byte S0							
Bit 7	**Bit 6**	**Bit 5**	**Bit 4**	**Bit 3**	**Bit 2**	**Bit 1**	**Bit 0**
x	x	EXT_ ERROR	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
UNDERFLOW	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.
OVERFLOW	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
EXT_ERROR	An external error occurred and was determined via the input for ext. error or input is open.
x	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 x 0xFFFF. Due to the separate calculation of the counter extension, this procedure allows for calculation using smaller data width.

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).

9 Device Description 750-631/000-010, /000-011

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 U_e and U_0 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.

The signal status for inputs A, B and C, Latch and Gate and the operating status of the I/O module are each indicated by a dedicated green status LED.

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

The meaning of the LEDs is described in the “Display Elements” section.

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

Note

Use a supply module!
Use a supply module for field-side power supply of downstream I/O modules.

The field voltage and the system voltage are electrically isolated from each other.

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

9.1 View

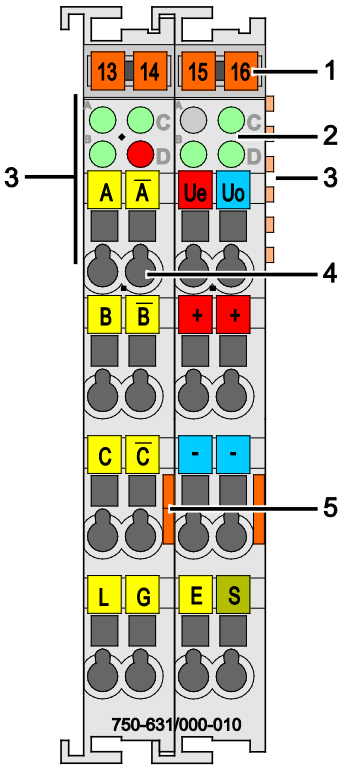

Figure 11: View

Table 35: Legend for Figure “View”

Pos.	Description	Details See Section
1	Marking possibility with Mini-WSB	---
2	Status LEDs	“Device Description” > “Display Elements”
3	Data contacts	“Device Description” > “Connectors”
4	CAGE CLAMP® connectors	“Device Description” > “Connectors”
5	Release tab	“Mounting” > ”Inserting and Removing Devices”

9.2 Connectors

9.2.1 Data Contacts/Internal Bus

Communication between the fieldbus coupler/controller and the I/O modules as well as the system supply of the I/O modules is carried out via the internal bus. It is comprised of 6 data contacts, which are available as self-cleaning gold spring contacts.

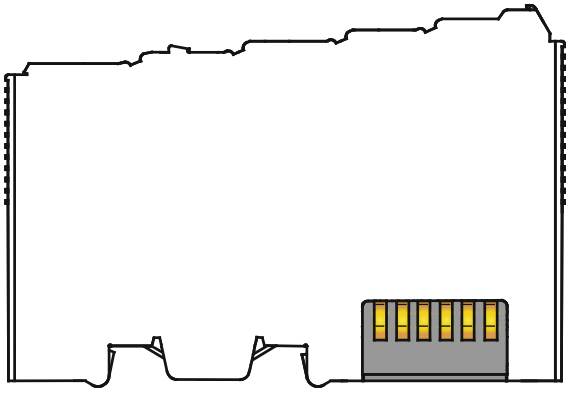

Figure 12: Data Contacts

NOTICE

Do not place the I/O modules on the gold spring contacts!
Do not place the I/O modules on the gold spring contacts in order to avoid soiling or scratching!

NOTICE

Ensure that the environment is well grounded!
The devices are equipped with electronic components that may be destroyed by electrostatic discharge. When handling the devices, ensure that the environment (persons, workplace and packing) is well grounded. Avoid touching conductive components, e.g. data contacts.

9.2.2 Power Jumper Contacts/Field Supply

The I/O module 750-631 has no power jumper contacts.

9.2.3 CAGE CLAMP® Connectors

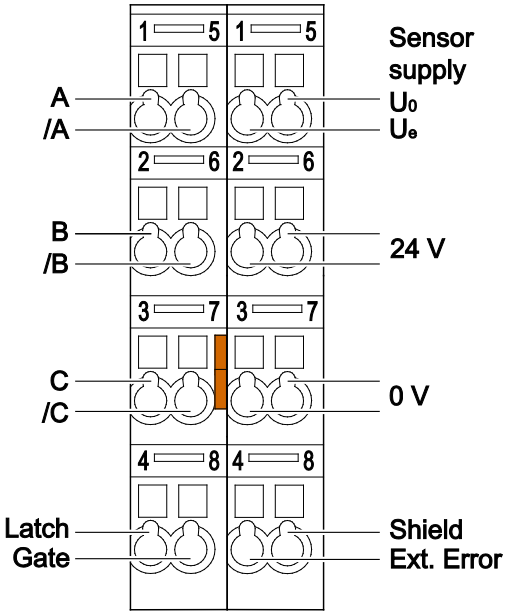

Figure 13: CAGE CLAMP® Connectors

Table 36: Legend for "CAGE CLAMP® Connectors

Designation	Connection	Function
A	1, left	Sensor connection
B	2, left	
C	3, left	
/A	5, left	
/B	6, left	
/C	7, left	
Latch	4, left	Latch input
Gate	8, left	Gate input
U_e	1, right	Sensor supply 5 V
U_0	5, right	Sensor supply 0 V
24 V	2, right	Field supply
	6, right	
0 V	3, right	
	7, right	
Ext. Error	4, right	Input for ext. Error (U < 0,5 V)
Shield	8, right	Shield connection (DIN rail)

9.3 Display Elements

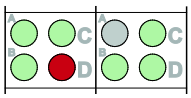

Figure 14: Display Elements

Table 37: Legend for the “Display Elements” Figure

Designation	LED	State	Function
A	A, left	Off	Signal voltage (0)
		Green	Signal voltage (1)
B	B, left	Off	Signal voltage (0)
		Green	Signal voltage (1)
C	C, left	Off	Signal voltage (0)
		Green	Signal voltage (1)
Ext. Error	D, left	Off	U ≥ 5,0 V or open connection
		Red	U < 0,5 V
Latch	B, right	Off	U ≤ 5,0 V
		Green	U ≥ 15,0 V
Field supply	C, right	Off	24 V Field supply not available
		Green	24 V Field supply available
Gate	D, right	Off	U ≤ 5,0 V
		Green	U ≥ 15,0 V

9.4 Operating Elements

The I/O module 750-631 has no operating elements.

9.5 Schematic Diagram

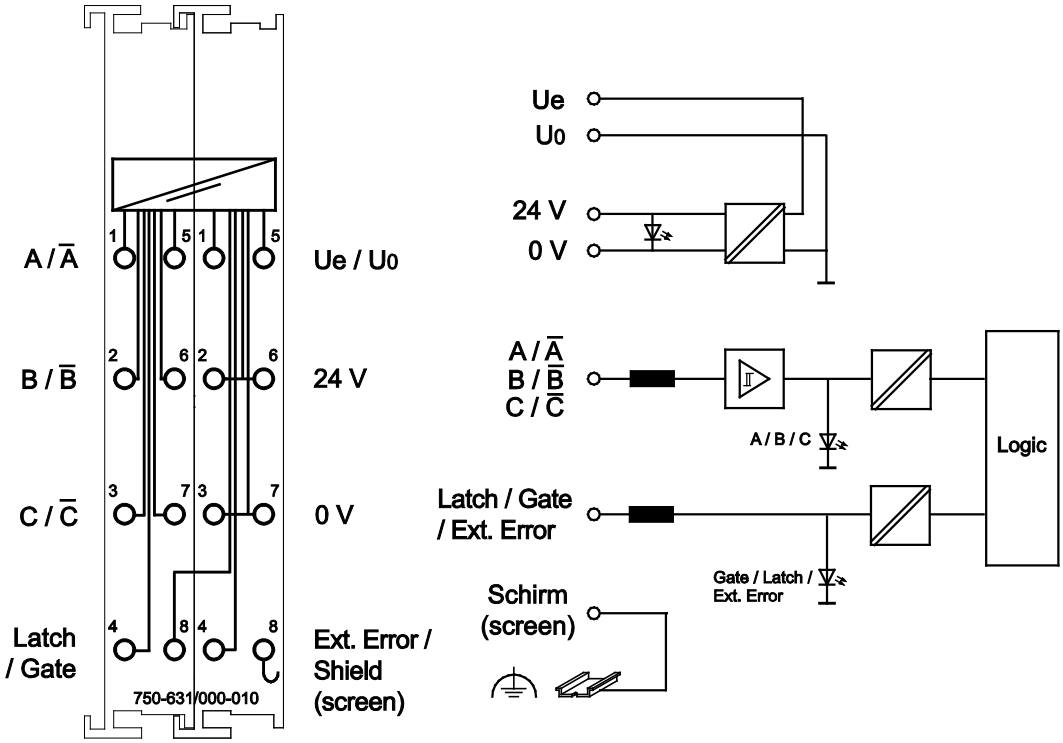

Figure 15: Schematic Diagram

9.6 Technical Data

9.6.1 Device Data

Table 38: Technical Data — Device

Width	24 mm
Height (from upper-edge of DIN rail)	64 mm
Depth	100 mm
Weight	ca. 105 g

9.6.2 Power Supply

Table 39: Technical Data — Power Supply

Power supply	Via CAGE CLAMP® connections
	24 VDC (−15 % … +20 %)
Current consumption max. (24 VDC)	10 mA (without encoder)
Current consumption (internal)	50 mA
Encoder output current$_{max.}$	200 mA
Encoder operating voltage	5 VDC

9.6.3 Communication

Table 40: Technical Data — Communication

Data width, internal (internal data bus)	1 x 32 bit Data 1 x 8 bit control/status 1 x 8 bit reserved

9.6.4 Inputs/Outputs

Table 41: Technical Data — Inputs/Outputs

Encoder connection	Variant A	Incremental encoder with RS422 output
	Variant B	Incremental encoder with 24 V push-pull output
	Variant C	Incremental encoder with non-equivalent 24 V push-pull output
	Variant D	Incremental encoder with 5 V push-pull output
Zero impulse latch		16 Bit
Commands		Reading, setting, activating
Counter		16 Bit binär
Limit frequency		1 MHz

9.6.5 Digital Inputs (Latch, Gate, Ext. Error)

Table 42: Technical Data — Digital Inputs (Latch, Gate, Ext. Error)

Input voltage Latch, Gate	(0) U ≤ 5,0 V
	(1) U ≥ 15,0 V
Input voltage Ext. Error	(0) U ≥ 5,0 V or open connection
	(1) U ≤ 0,5 V

9.6.6 Quadrature Inputs (A, /A, B, /B, C, /C, D, /D)

Table 6: Technical Data — Quadrature Inputs (A, /A, B, /B, C, /C, D, /D)

Variant A	(0) $U_{A, B, C}$ = 0 V, $U_{/A, /B, /C}$ = 5 V
	(1) $U_{A, B, C}$ = 5 V, $U_{/A, /B, /C}$ = 0 V
Variant B	(0) $U_{A, B, C}$ ≤ 5 V
	(1) $U_{A, B, C}$ ≥ 15 V
Variant C	(0) $U_{A, B, C}$ ≤ 5 V
	(1) $U_{A, B, C}$ ≥ 15 V
Variant D	(0) $U_{A, B, C}$ ≤ 0,5 V
	(1) $U_{A, B, C}$ ≥ 3,5 V

9.6.7 Quadrature Decoder

Table 7: Technical Data — Quadrature Decoder

Evaluation	
750-631/000-010	4 x
750-631/000-011	1 x

9.6.8 Climatic Environmental Conditions

Table 43: Technical Data – Climatic Environmental Conditions

Operating temperature range	0 °C … 55 °C
Storage temperature range	−25 °C … +85 °C
Relative humidity without condensation	Max. 95 %
Resistance to harmful substances	Acc. to IEC 60068-2-42 and IEC 60068-2-43
Maximum pollutant concentration at relative humidity < 75 %	SO_2 ≤ 25 ppm H_2S ≤ 10 ppm
Special conditions	Ensure that additional measures for components are taken, which are used in an environment involving: – dust, caustic vapors or gases – ionizing radiation

10 Functional Description 750-631/000-010, /000-011

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.

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 U_e and U_0. This supply voltage is generated from 24V to be provided externally. The inputs 0V and U_0 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 and open connection initialize the counter. 24 V stops the counting process.

The latch and gate inputs are 24 V.

Table 44: Overview of Inputs and Outputs 750-631/000-010, /000-011

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

11 Process Image 750-631/000-010, /000-011

Note

Mapping of process data in the process image of fieldbus systems
The representation of the I/O modules' process data 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 fieldbus coupler/controller used.

Using the I/O module, 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

Tabelle 45: Process Image 750-631/000-004, /000-010, /000-011

Process Image			
Input		**Output**	
S0	Status byte S0	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

11.1 Data byte

Table 46: Data byte 750-631/000-010, /000-011

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 ≤ 5,0 V	
Input Gate	(1) U ≥ 15,0 V	
Signal	(0) U ≤ 5,0 V	
Input Latch	(1) U ≥ 15,0 V	
Signal	(0) U ≥ 5,0 V or open connection	
Input Ext. Fehler	(1) U < 0,5 V	
Signal	(0) Signal voltage	(see Chapter „Device Description “ >„Technical Data“)
Input C, /C	(1) Signal voltage	(see Chapter „Device Description “ >„Technical Data“)
Signal	(0) Signal voltage	(see Chapter „Device Description “ >„Technical Data“)
Input B, /B	(1) Signal voltage	(see Chapter „Device Description “ >„Technical Data“)
Signal	(0) Signal voltage	(see Chapter „Device Description “ >„Technical Data“)
Input A, /A	(1) Signal voltage	(see Chapter „Device Description “ >„Technical Data“)
x	reserved	

11.2 Control-/ Status byte

Table 47: Control byte 750-631/000-004, /000-010, /000-011

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_LATEX). The following pulses have no influence on the latch register when the bit is set.
0	Reserved

Table 48: Status byte 750-631/000-004, /000-010, /000-011

Status byte S0							
Bit 7	**Bit 6**	**Bit 5**	**Bit 4**	**Bit 3**	**Bit 2**	**Bit 1**	**Bit 0**
x	x	EXT_ ERROR	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
UNDERFLOW	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.
OVERFLOW	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
EXT_ERROR	An external error occurred and was determined via the input for ext. error or input is open.
x	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 x 0xFFFF. Due to the separate calculation of the counter extension, this procedure allows for calculation using smaller data width.

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).

11.3 Connection Examples

11.3.1 Incremental Encoder with RS422 Output (Variation A)

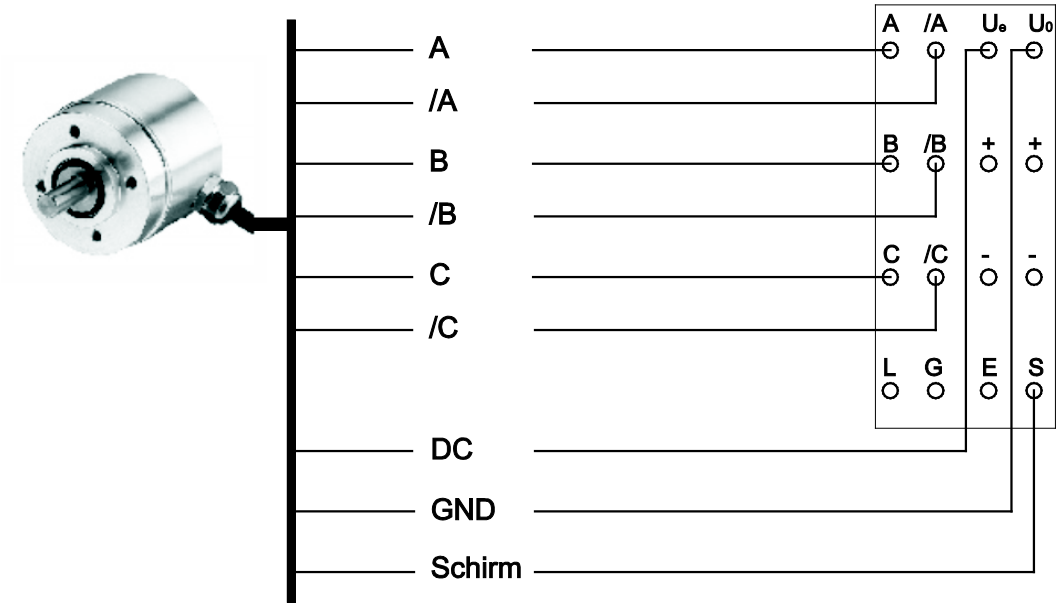

Figure 16: Incremental encoder with RS422 Output

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

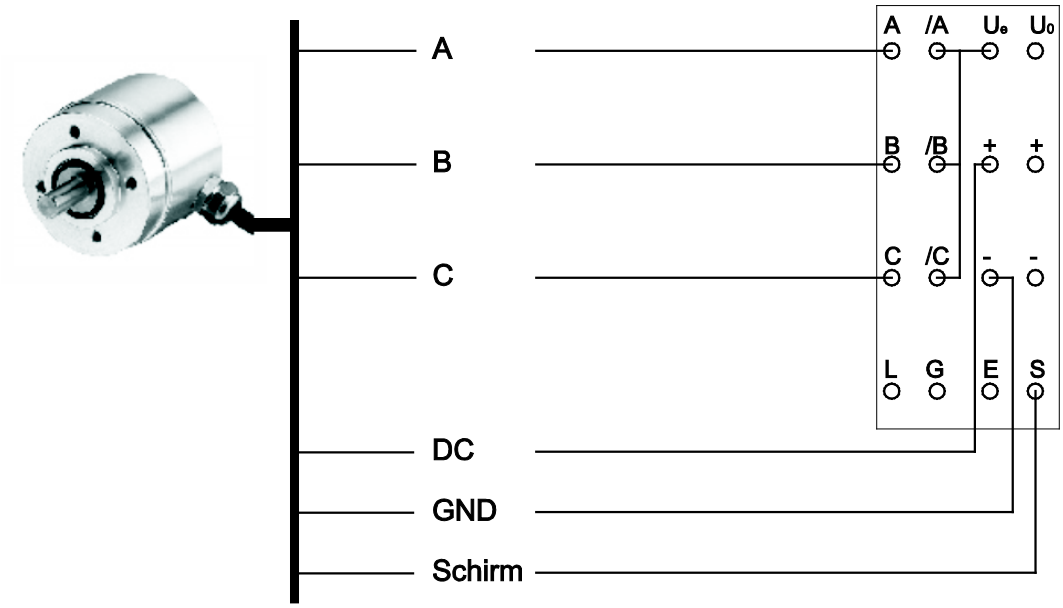

Figure 17: Incremental Encoder with 24 V Push-Pull Output (Variation B)

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

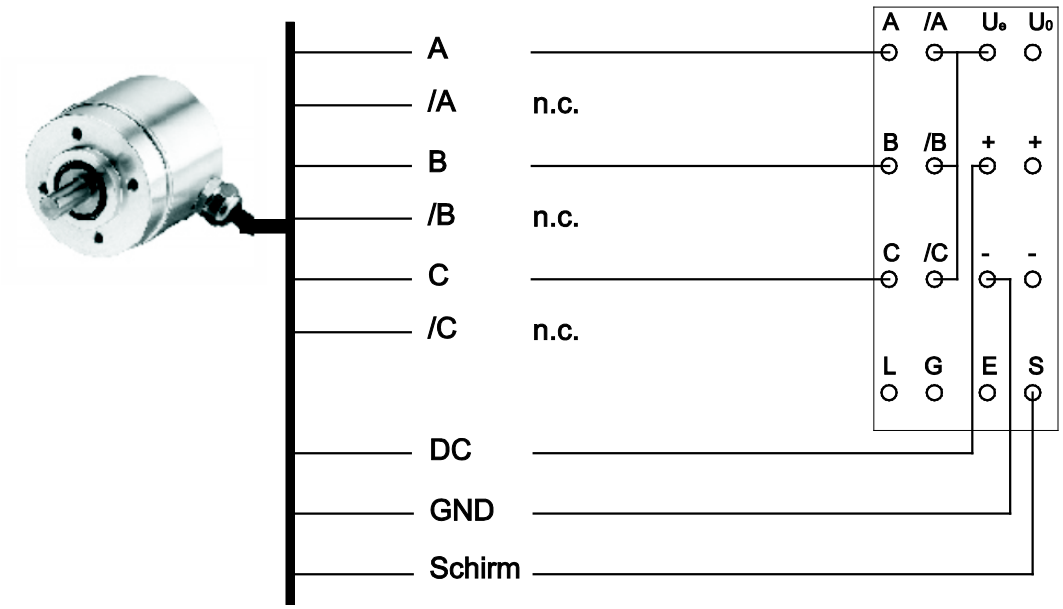

Figure 18: Incremental Encoder with non-equivalent 24 V Push-Pull Output (Variation C)

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

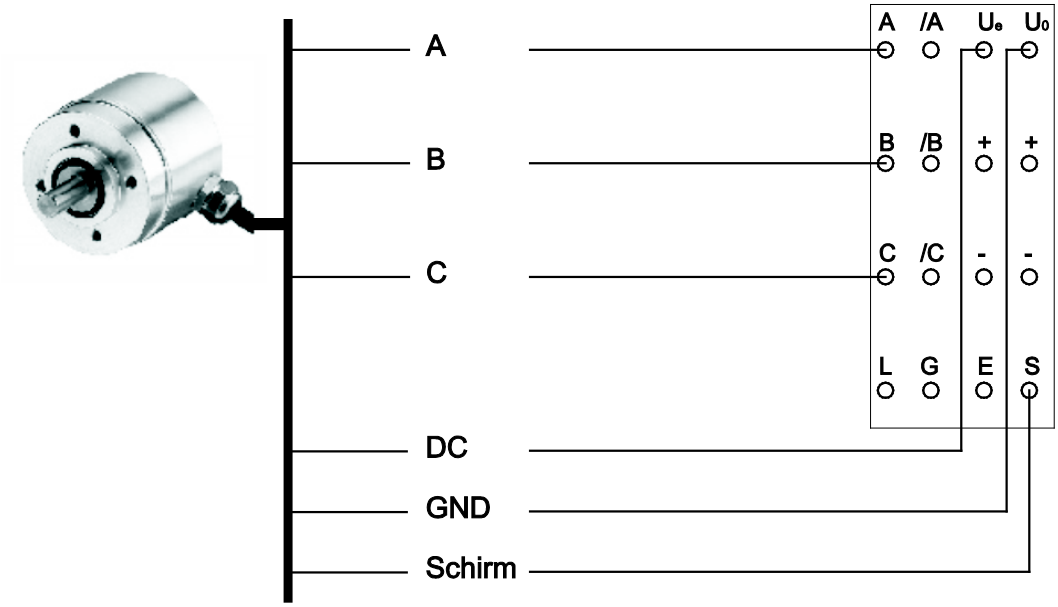

Figure 19: Incremental Encoder with 5 V Push-Pull Output (Variation D)

12 Standards and Approvals

12.1 Approvals

The following approvals have been granted to the basic version and all variants of 750-631 I/O modules:

Information

More information about approvals.
Detailed references to the approvals are listed in the document “Overview Approvals **WAGO-I/O-SYSTEM 750**”, which you can find via the internet under: www.wago.com > SERVICES > DOWNLOADS > Additional documentation and information on automation products > WAGO-I/O-SYSTEM 750 > System Description.

CE Conformity Marking

cULus cULus UL508

The following approvals have been granted to the variation 750-631/0000-0004:

Korea Certification MSIP-REM-W43-DAM750

12.1.1 Ex Approvals

The following Ex approvals have been granted to the variations 750-631/000-004, /000-010, /000-011:

DEKRA 11 ATEX 0203 X
II 3 G Ex nA II T4 Gc

cULus cULus ANSI/ISA 12.12.01
Class I, Div2 ABCD T4

12.2 Standards and Guidelines

All variations of 750-631 I/O modules meet the following requirements on emission and immunity of interference:

EMC CE-Immunity to interference	EN 61000-6-2
EMC CE-Emission of interference	EN 61000-6-4

13 Mounting

13.1 Mounting Sequence

Fieldbus couplers/controllers and I/O modules of the WAGO-I/O-SYSTEM 750 are 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 devices are securely seated on the rail after installation.

Starting with the fieldbus coupler/controller, the I/O modules are mounted 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 I/O modules with power contacts (blade contacts) cannot be linked to I/O modules with fewer power contacts.

⚠ CAUTION

Risk of injury due to sharp-edged blade contacts!
The blade contacts are sharp-edged. Handle the I/O module carefully to prevent injury.

NOTICE

Insert I/O modules only from the proper direction!
All I/O modules feature grooves for power jumper contacts on the right side. For some I/O modules, the grooves are closed on the top. Therefore, I/O modules featuring a power jumper contact on the left side cannot be snapped from the top. This mechanical coding helps to avoid configuration errors, which may destroy the I/O modules. Therefore, insert I/O modules only from the right and from 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 WAGO-I/O-SYSTEM 750 fieldbus couplers/controllers to guarantee proper data transfer.

13.2 Inserting and Removing Devices

NOTICE

Perform work on devices only if they are de-energized!
Working on energized devices can damage them. Therefore, turn off the power supply before working on the devices.

13.2.1 Inserting the 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.

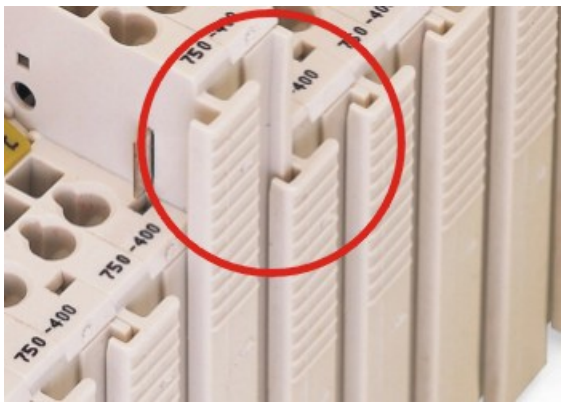

Figure 20: Insert I/O Module (Example)

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

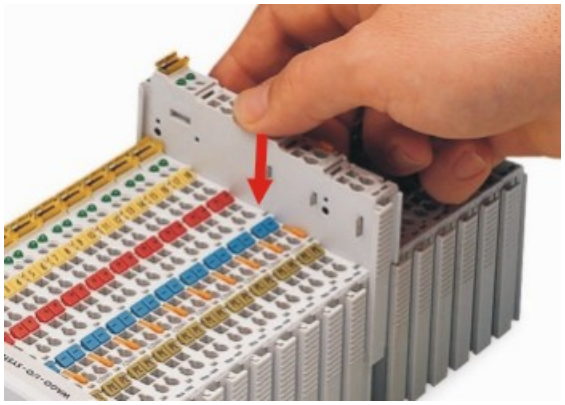

Figure 21: Snap the I/O Module into Place (Example)

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

13.2.2 Removing the I/O Module

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

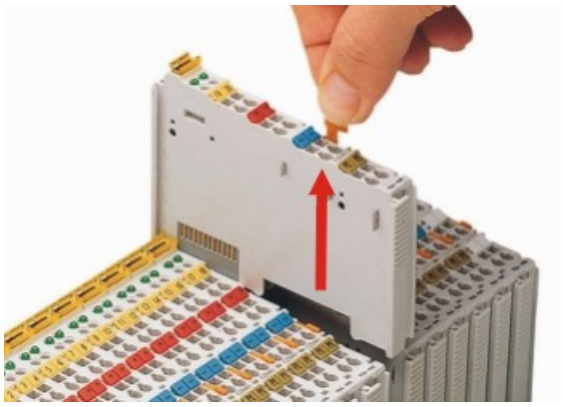

Figure 22: Removing the I/O Module (Example)

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

14 Connect Devices

Note

Use shielded signal lines!
Only use shielded signal lines for analog signals and I/O modules which are equipped with shield clamps. Only then can you ensure that the accuracy and interference immunity specified for the respective I/O module can be achieved even in the presence of interference acting on the signal cable.

14.1 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®!
Only one conductor may be connected to each CAGE CLAMP®.
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.

1. For opening the CAGE CLAMP® insert the actuating tool into the opening above the connection.
2. Insert the conductor into the corresponding connection opening.
3. For closing the CAGE CLAMP® simply remove the tool. The conductor is now clamped firmly in place.

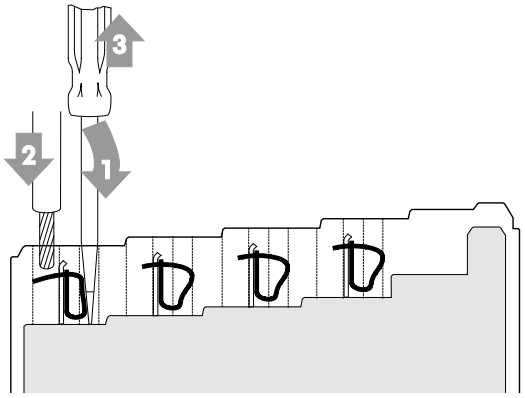

Figure 23: Connecting a Conductor to a CAGE CLAMP®

15 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.

15.1 Marking Configuration Examples

15.1.1 Marking for Europe According to ATEX and IEC-Ex

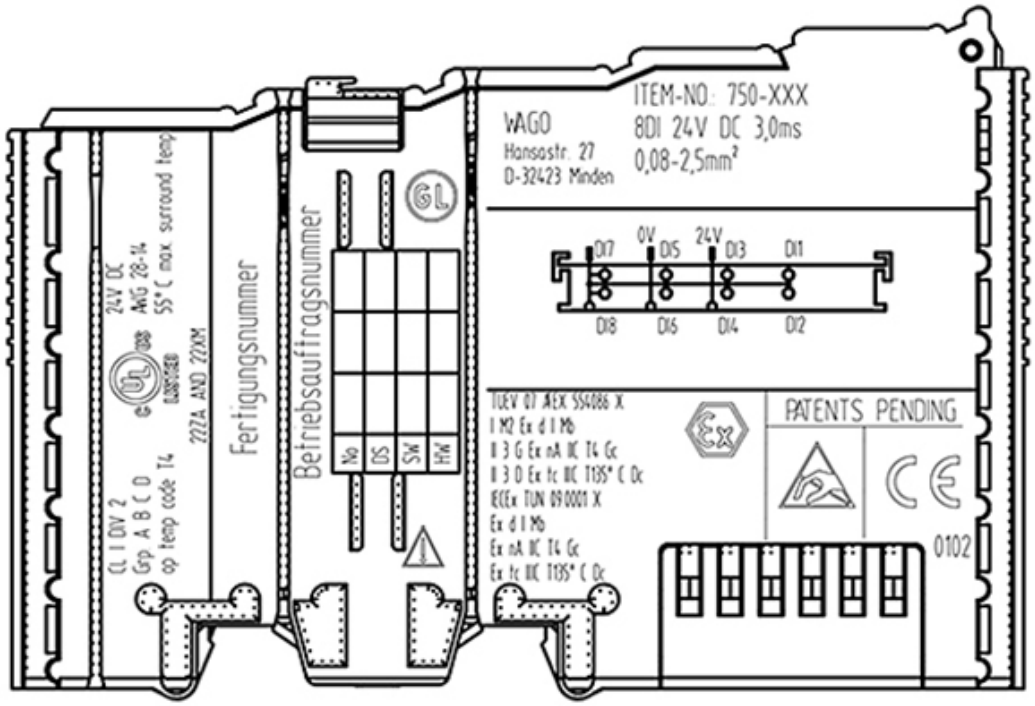

Figure 24: Side Marking Example for Approved I/O Modules According to ATEX and IECEx

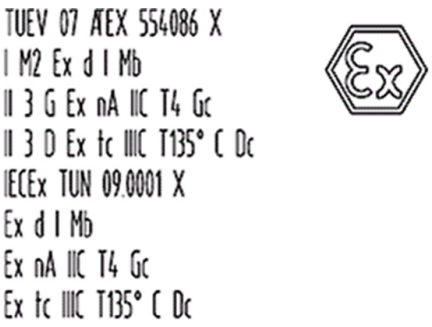

Figure 25: Text Detail – Marking Example for Approved I/O Modules According to ATEX and IECEx.

Table 49: Description of Marking Example for Approved I/O Modules According to ATEX and IECEx

Marking	Description
TÜV 07 ATEX 554086 X IECEx TUN 09.0001 X	Approving authority and certificate numbers
Dust	
II	Equipment group: All except mining
3D	Category 3 (Zone 22)
Ex	Explosion protection mark
tc Dc	Type of protection and equipment protection level (EPL):protection by enclosure
IIIC	Explosion group of dust
T 135°C	Max. surface temperature of the enclosure (without a dust layer)
Mining	
I	Equipment group: Mining
M2	Category: High level of protection
Ex	Explosion protection mark
d Mb	Type of protection and equipment protection level (EPL): Flameproof enclosure
I	Explosion group for electrical equipment for mines susceptible to firedamp
Gases	
II	Equipment group: All except mining
3G	Category 3 (Zone 2)
Ex	Explosion protection mark
nA Gc	Type of protection and equipment protection level (EPL): Non-sparking equipment
nC Gc	Type of protection and equipment protection level (EPL): Sparking apparatus with protected contacts. A device which is so constructed that the external atmosphere cannot gain access to the interior
IIC	Explosion group of gas and vapours
T4	Temperature class: Max. surface temperature 135°C

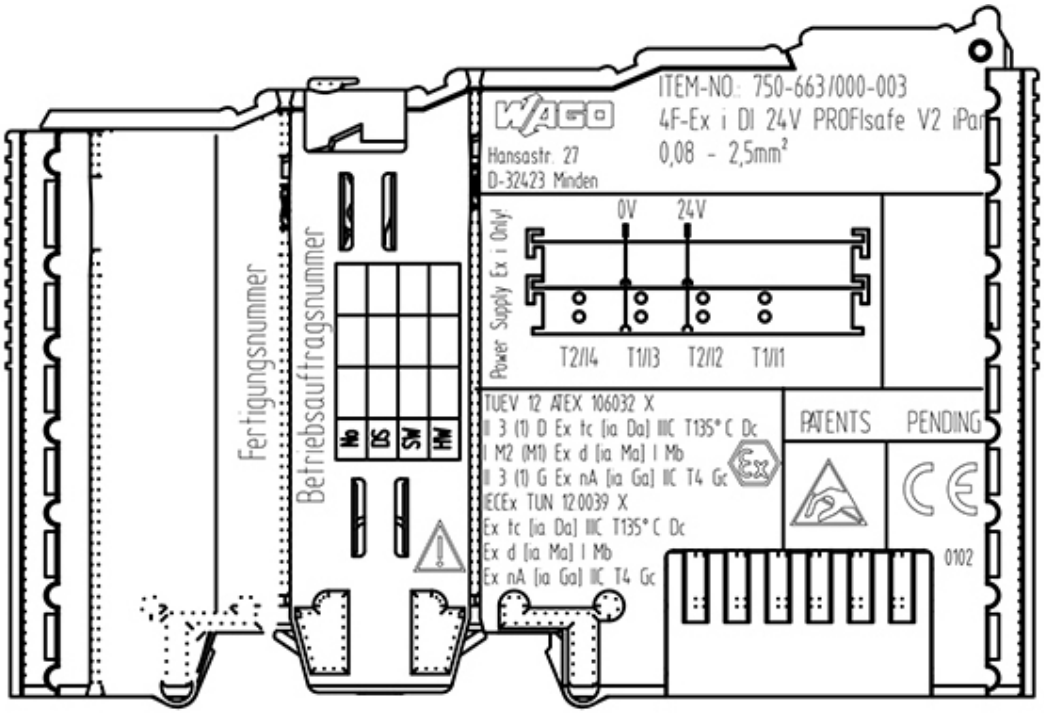

Figure 26: Side Marking Example for Approved Ex i I/O Modules According to ATEX and IECEx.

TUEV 12 ATEX 106032 X
II 3 (1) D Ex tc [ia Da] IIIC T135° C Dc
I M2 (M1) Ex d [ia Ma] I Mb
II 3 (1) G Ex nA [ia Ga] IIC T4 Gc
IECEx TUN 12.0039 X
Ex tc [ia Da] IIIC T135° C Dc
Ex d [ia Ma] I Mb
Ex nA [ia Ga] IIC T4 Gc

Figure 27: Text Detail – Marking Example for Approved Ex i I/O Modules According to ATEX and IECEx.

Table 50: Description of Marking Example for Approved Ex i I/O Modules According to ATEX and IECEx

Marking	Description
TÜV 07 ATEX 554086 X IECEx TUN 09.0001X TÜV 12 ATEX 106032 X IECEx TUN 12.0039 X	Approving authority and certificate numbers
Dust	
II	Equipment group: All except mining
3(1)D	Category 3 (Zone 22) equipment containing a safety device for a category 1 (Zone 20) equipment
3(2)D	Category 3 (Zone 22) equipment containing a safety device for a category 2 (Zone 21) equipment
Ex	Explosion protection mark
tc Dc	Type of protection and equipment protection level (EPL): protection by enclosure
[ia Da]	Type of protection and equipment protection level (EPL): associated apparatus with intrinsic safety circuits for use in Zone 20
[ib Db]	Type of protection and equipment protection level (EPL): associated apparatus with intrinsic safety circuits for use in Zone 21
IIIC	Explosion group of dust
T 135°C	Max. surface temperature of the enclosure (without a dust layer)
Mining	
I	Equipment Group: Mining
M2 (M1)	Category: High level of protection with electrical circuits which present a very high level of protection
Ex d Mb	Explosion protection mark with Type of protection and equipment protection level (EPL): Flameproof enclosure
[ia Ma]	Type of protection and equipment protection level (EPL): associated apparatus with intrinsic safety electrical circuits
I	Explosion group for electrical equipment for mines susceptible to firedamp

Table 50: Description of Marking Example for Approved Ex i I/O Modules According to ATEX and IECEx

Gases	
II	Equipment group: All except mining
3(1)G	Category 3 (Zone 2) equipment containing a safety device for a category 1 (Zone 0) equipment
3(2)G	Category 3 (Zone 2) equipment containing a safety device for a category 2 (Zone 1) equipment
Ex	Explosion protection mark
nA Gc	Type of protection and equipment protection level (EPL): Non-sparking equipment
[ia Ga]	Type of protection and equipment protection level (EPL): associated apparatus with intrinsic safety circuits for use in Zone 0
[ia Gb]	Type of protection and equipment protection level (EPL): associated apparatus with intrinsic safety circuits for use in Zone 1
IIC	Explosion group of gas and vapours
T4	Temperature class: Max. surface temperature 135°C

15.1.2 Marking for America According to NEC 500

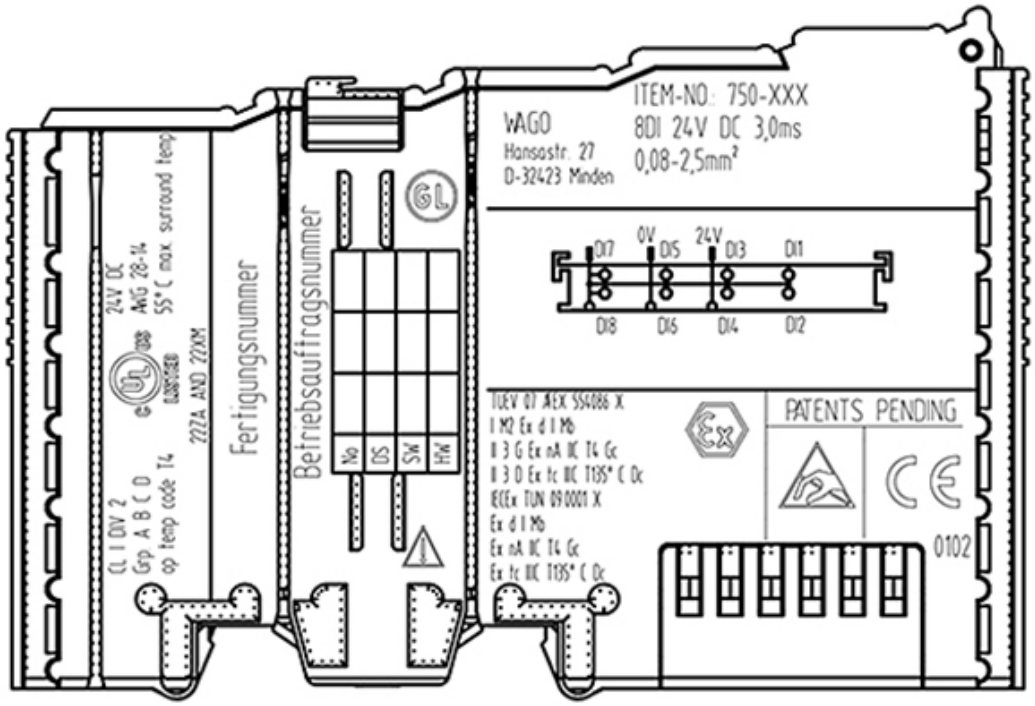

Figure 28: Side Marking Example for I/O Modules According to NEC 500

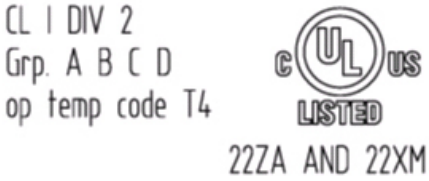

Figure 29: Text Detail – Marking Example for Approved I/O Modules According to NEC 500

Table 51: Description of Marking Example for Approved I/O Modules According to NEC 500

Marking	Description
CL I	Explosion protection group (condition of use category)
DIV 2	Area of application
Grp. ABCD	Explosion group (gas group)
Op temp code T4	Temperature class

15.2 Installation Regulations

For the installation and operation of electrical equipment in hazardous areas, the valid national and international rules and regulations which are applicable at the installation location must be carefully followed.

15.2.1 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 and EN 60079-31.
   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. 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.
   This is although and in particular valid for the interfaces “Memory-Card”, “USB”, “Fieldbus connection”, “Configuration and programming interface”, “antenna socket”, “D-Sub”, “DVI-port” and the “Ethernet interface”. These interfaces are not energy limited or intrinsically safe circuits. An operating of those circuits is in the behalf of the operator.
5. For the types 750-606, 750-625/000-001, 750-487/003-000, 750-484 and 750-633 the following shall be considered: The Interface circuits shall be limited to overvoltage category I/II/III (non mains/mains circuits) as defined in EN 60664-1.
6. For replaceable fuses the following shall be considered: Do not remove or replace the fuse when the apparatus is energized.
7. The following warnings shall be placed nearby the unit:
   WARNING – DO NOT REMOVE OR REPLACE FUSE WHEN ENERGIZED
   WARNING – DO NOT SEPARATE WHEN ENERGIZED
   WARNING – SEPARATE ONLY IN A NON-HAZARDOUS AREA

15.2.2 Special Conditions for Safe Use (ATEX Certificate TÜV 12 ATEX 106032 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-*** Ex i 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 and EN 60079-31.
   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. 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. 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.
4. For the type the following shall be considered: The Interface circuits shall be limited to overvoltage category I/II (non mains/mains circuits) as defined in EN 60664-1.

15.2.3 Special Conditions for Safe Use (IEC-Ex Certificate TUN 09.0001 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) IEC 60079-0, IEC 60079-11, IEC 60079-15 and IEC 60079-31.
   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.
   This is although and in particular valid for the interfaces “Memory-Card”, “USB”, “Fieldbus connection”, “Configuration and programming interface”, “antenna socket”, “D-Sub”, “DVI-port” and the “Ethernet interface”. These interfaces are not energy limited or intrinsically safe circuits. An operating of those circuits is in the behalf of the operator.
5. For the types 750-606, 750-625/000-001, 750-487/003-000, 750-484 and 750-633 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 replaceable fuses the following shall be considered: Do not remove or replace the fuse when the apparatus is energized.
7. The following warnings shall be placed nearby the unit:
   WARNING – DO NOT REMOVE OR REPLACE FUSE WHEN ENERGIZED
   WARNING – DO NOT SEPARATE WHEN ENERGIZED
   WARNING – SEPARATE ONLY IN A NON-HAZARDOUS AREA

15.2.4 Special Conditions for Safe Use (IEC-Ex Certificate IECEx TUN 12.0039 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-*** Ex i 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 60079-31.
   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. 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.
4. For the type the following shall be considered: The Interface circuits shall be limited to overvoltage category I/II (non mains/mains circuits) as defined in IEC 60664-1.

15.2.5 Special Conditions for Safe Use According to ANSI/ISA 12.12.01

A. “This equipment is suitable for use in Class I, Division 2, Groups A, B, C, D or non-hazardous locations only.”
B. “This equipment is to be fitted within tool-secured enclosures only.”
C. “WARNING Explosion hazard - substitution of components may impair suitability for Class I, Div. 2.”
D. “WARNING – Do not disconnect equipment unless power has been switched off or the area is known to be non-hazardous” has to be placed near each operator accessible connector and fuse holder.
E. 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.”
F. For devices with EtherCAT/Ethernet connectors “Only for use in LAN, not for connection to telecommunication circuits.”
G. “WARNING - Use Module 750-642 only with antenna module 758-910.”
H. For Couplers/Controllers and Economy bus modules only: The instructions shall contain the following: “The configuration interface Service connector is for temporary connection only. Do not connect or disconnect unless the area is known to be non-hazardous. Connection or disconnection in an explosive atmosphere could result in an explosion.”
I. Modules containing fuses only: “WARNING - Devices containing fuses must not be fitted into circuits subject to over loads, e.g. motor circuits.”
J. Modules containing SD card reader sockets only: “WARNING - 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 operating and assembly instructions.
The manual, containing these special conditions for safe use, must be readily available to the user.

List of Figures

List of Tables

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