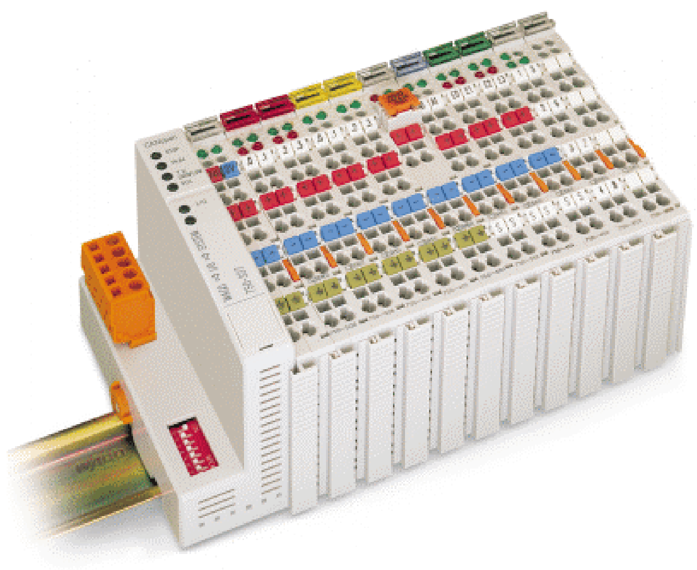
WAGO-I/O-SYSTEM 750

Modular I/O System

CANopen

750-307



Manual

Technical Description,
Installation and
Configuration

Version 1.0.1

INNOVATIVE CONNECTIONS

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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.

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1 Important Notes

This section provides only a summary of the most important safety requirements and notes which will be mentioned in the individual sections. To protect your health and prevent damage to the devices, it is essential to read and carefully follow the safety guidelines.

1.1 Legal Principles

1.1.1 Copyright

This manual including all figures and illustrations contained therein is subject to copyright. Any use of this manual which infringes the copyright provisions stipulated herein, is not permitted. Reproduction, translation and electronic and phototechnical archiving and amendments require the written consent of WAGO Kontakttechnik GmbH & Co. KG, Minden. Non-observance will entail the right of claims for damages.

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All rights developing from the issue of a patent or the legal protection of utility patents are reserved to WAGO Kontakttechnik GmbH & Co. KG. Third-party products are always indicated without any notes concerning patent rights. Thus, the existence of such rights must not be excluded.

1.1.2 Personnel Qualification

The use of the product described in this manual requires special 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 someone who, through technical training, knowledge and experience, demonstrates the ability to meet the relevant specifications and identify potential dangers in the mentioned field of activity.

All personnel must be familiar with the applicable standards.
WAGO Kontakttechnik GmbH & Co. KG declines any liability resulting from

improper action and damage to WAGO products and third party products due to non-observance of the information contained in this manual.

1.1.3 Conforming Use of Series 750

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

The device is designed for IP20 protection class. It is protected against finger touch and solid impurities up to 12.5mm diameter, but not against water penetration. Unless otherwise specified, the device must not be operated in wet and dusty environments.

1.1.4 Technical Condition of the Devices

For each individual application, the components are supplied from the factory with a dedicated hardware and software configuration. Changes in hardware, software and firmware are only admitted within the framework of the possibilities documented in the manuals. All changes to the hardware or software and the non-conforming use of the components entail the exclusion of liability on the part of WAGO Kontakttechnik GmbH & Co. KG.

Please direct any requirements pertaining to a modified and/or new hardware or software configuration directly to WAGO Kontakttechnik GmbH & Co. KG.

1.2 Standards and Regulations for Operating the 750 Series

Please observe the standards and regulations that are relevant to your installation:

- The data and power lines must be connected and installed in compliance with the standards to avoid failures on your installation and eliminate any danger to personnel.
- For installation, startup, maintenance and repair, please observe the accident prevention regulations of your machine (e.g. BGV A 3, "Electrical Installations and Equipment").
- Emergency stop functions and equipment must not be made ineffective. See relevant standards (e.g. DIN EN 418).
- Your installation must be equipped in accordance to the EMC guidelines so that electromagnetic interferences can be eliminated.
- Operating 750 Series components 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 on "WAGO-I/O-SYSTEM 750" → "System Description" → "Technical Data".

- Please observe the safety measures against electrostatic discharge according to DIN EN 61340-5-1/-3. When handling the modules, ensure that the environment (persons, workplace and packing) is well grounded.
- The relevant valid and applicable standards and guidelines concerning the installation of switch cabinets are to be observed.

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 fieldbus 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.

1.5 Font Conventions

italic	Names of paths and files are marked in italic. e.g.: *C:\Programs\WAGO-IO-CHECK*
italic	Menu items are marked in bold italic. e.g.: ***Save***
\	A backslash between two names characterizes the selection of a menu point from a menu. e.g.: ***File \ New***
END	Press buttons 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'	Within ', Nibble separated with dots

1.7 Scope

This manual describes the field bus independent WAGO-I/O-SYSTEM 750 with the fieldbus coupler for CANopen.

Item No.	Component
750-307	Fieldbus Coupler CANopen; 10 kBaud – 1 Mbaud; digital and analog Signals; MCS Fieldbus connection

1.8 Abbreviation

AI	Analog Input

AO	Analog Output
BC	Buscoupler
CAL	CAN Application Layer
CAN	Controller Area Network
COB ID	Communication Object Identifier
DI	Digital Input
DO	Digital Output
EMCY	Emergency Objekt
I/O	Input/Output
ID	Identifier, Identification
Idx	Index
M	Master
NMT	Network Management
PDO	Process Data Object
RO	Read Only
RTR	Remote Transmit Request
RxPDO	Receive PDO
RW	Read/Write
SDO	Service Data Object
S-Idx	Sub-Index
TxPDO	Transmit PDO

2 The WAGO-I/O-SYSTEM 750

2.1 System Description

The WAGO-I/O-SYSTEM 750 is a modular, fieldbus independent I/O system. It is comprised of a fieldbus coupler/controller (1) and connected fieldbus modules (2) for any type of signal. Together, these make up the fieldbus node. The end module (3) completes the node.

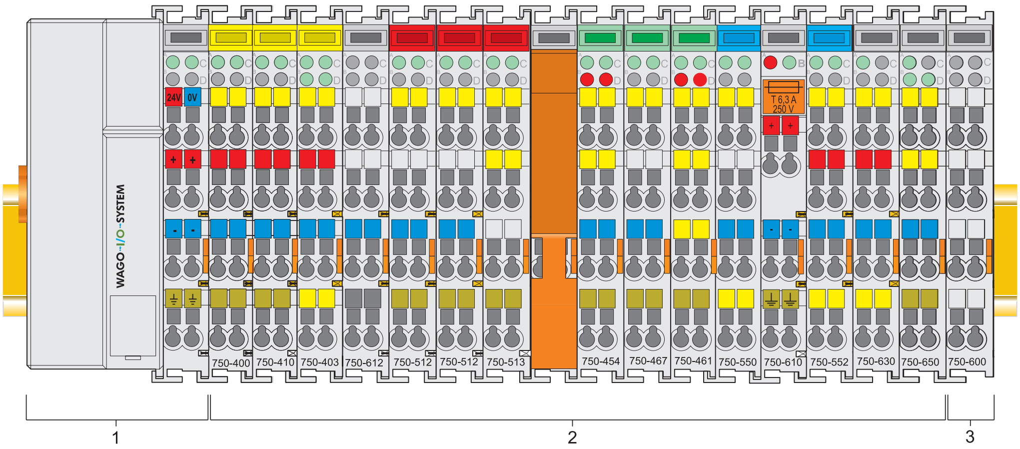


Fig. 2-1: Fieldbus node g0xxx00x

Couplers/controllers for fieldbus systems such as PROFIBUS, INTERBUS, ETHERNET TCP/IP, CAN (CANopen, DeviceNet, CAL), MODBUS, LON and others are available.

The coupler/controller contains the fieldbus interface, electronics and a power supply terminal. The fieldbus interface forms the physical interface to the relevant fieldbus. The electronics process the data of the bus modules and make it available for the fieldbus communication. The 24 V system supply and the 24 V field supply are fed in via the integrated power supply terminal.
The fieldbus coupler communicates via the relevant fieldbus. The programmable fieldbus controller (PFC) enables the implementation of additional PLC functions. Programming is done with the WAGO-I/O-PRO 32 in accordance with IEC 61131-3.

Bus modules for diverse digital and analog I/O functions as well as special functions can be connected to the coupler/controller. The communication between the coupler/controller and the bus modules is carried out via an internal bus.

The WAGO-I/O-SYSTEM 750 has a clear port level with LEDs for status indication, insertable mini WSB markers and pullout group marker carriers. The 3-wire technology supplemented by a ground wire connection allows for direct sensor/actuator wiring.

2.2 Technical Data

Mechanic	
Material	Polycarbonate, Polyamide 6.6
Dimensions W x H* x L * from upper edge of DIN 35 rail - Coupler/Controller (Standard) - Coupler/Controller (ECO) - Coupler/Controller (FireWire) - I/O module, single - I/O module, double - I/O module, fourfold	 - 51 mm x 65 mm x 100 mm - 50 mm x 65 mm x 100 mm - 62 mm x 65 mm x 100 mm - 12 mm x 64 mm x 100 mm - 24 mm x 64 mm x 100 mm - 48 mm x 64 mm x 100 mm
Installation	on DIN 35 with interlock
modular by	double featherkey-dovetail
Mounting position	any position
Marking	marking label type 247 and 248 paper marking label 8 x 47 mm
Connection	
Connection type	CAGE CLAMP®
Wire range	0.08 mm² ... 2.5 mm², AWG 28-14
Stripped length	8 – 9 mm, 9 – 10 mm for components with pluggable wiring (753-xxx)
Contacts	
Power jumpers contacts	blade/spring contact self-cleaning
Current via power contacts$_{max}$	10 A
Voltage drop at I_{max}	< 1 V/64 modules
Data contacts	slide contact, hard gold plated 1.5 µm, self-cleaning
Climatic environmental conditions	
Operating temperature	0 °C ... 55 °C, -20 °C … +60 °C for components with extended temperature range (750-xxx/025-xxx)
Storage temperature	-20 °C ... +85 °C
Relative humidity	5 % to 95 % without condensation
Resistance to harmful substances	acc. to IEC 60068-2-42 and IEC 60068-2-43
Maximum pollutant concentration at relative humidity < 75%	$SO_2 \leq 25$ ppm $H_2S \leq 10$ ppm
Special conditions	Ensure that additional measures for components are taken, which are used in an environment involving: – dust, caustic vapors or gasses – ionization radiation.

Safe electrical isolation	
Air and creepage distance	acc. to IEC 60664-1
Degree of pollution acc. To IEC 61131-2	2
Degree of protection	
Degree of protection	IP 20
Electromagnetic compatibility	

Immunity to interference for industrial areas acc. to EN 61000-6-2 (2001)

Test specification	Test values		Strength class	Evaluation criteria
EN 61000-4-2 ESD	4 kV/8 kV (contact/air)		2/3	B
EN 61000-4-3 electromagnetic fields	10 V/m 80 MHz ... 1 GHz		3	A
EN 61000-4-4 burst	1 kV/2 kV (data/supply)		2/3	B
EN 61000-4-5 surge	Data:	-/- (line/line)		B
		1 kV (line/earth)	2	
	DC supply:	0.5 kV (line/line)	1	B
		0.5 kV (line/earth)	1	
	AC supply:	1 kV (line/line)	2	B
		2 kV (line/earth)	3	
EN 61000-4-6 RF disturbances	10 V/m 80 % AM (0.15 ... 80 MHz)		3	A

Emission of interference for industrial areas acc. to EN 61000-6-4 (2001)

Test specification	Limit values/[QP]*)	Frequency range	Distance
EN 55011 (AC supply, conducted)	79 dB (µV)	150 kHz ... 500 kHz	
	73 dB (µV)	500 kHz ... 30 MHz	
EN 55011 (radiated)	40 dB (µV/m)	30 MHz ... 230 MHz	10 m
	47 dB (µV/m)	230 MHz ... 1 GHz	10 m

Emission of interference for residential areas acc. to EN 61000-6-3 (2001)

Test specification	Limit values/[QP]*)	Frequency range	Distance
EN 55022 (AC supply, conducted)	66 ... 56 dB (µV)	150 kHz ... 500 kHz	
	56 dB (µV)	500 kHz ... 5 MHz	
	60 dB (µV)	5 MHz ... 30 MHz	
EN 55022 (DC supply/data, conducted)	40 ... 30 dB (µA)	150 kHz ... 500 kHz	
	30 dB (µA)	500 kHz ... 30 MHz	
EN 55022 (radiated)	30 dB (µV/m)	30 MHz ... 230 MHz	10 m
	37 dB (µV/m)	230 MHz ... 1 GHz	10 m

Mechanical strength acc. to IEC 61131-2		
Test specification	**Frequency range**	**Limit value**
IEC 60068-2-6 vibration	5 Hz ≤ f < 9 Hz	1.75 mm amplitude (permanent) 3.5 mm amplitude (short term)
	9 Hz ≤ f < 150 Hz	0.5 g (permanent) 1 g (short term)
	Note on vibration test: a) Frequency change: max. 1 octave/minute b) Vibration direction: 3 axes	
IEC 60068-2-27 shock		15 g
	Note on shock test: a) Type of shock: half sine b) Shock duration: 11 ms c) Shock direction: 3x in positive and 3x in negative direction for each of the three mutually perpendicular axes of the test specimen	
IEC 60068-2-32 free fall		1 m (module in original packing)

*) QP: Quasi Peak

Note:
If the technical data of components differ from the values described here, the technical data shown in the manuals of the respective components shall be valid.

For Products of the WAGO-I/O-SYSTEM 750 with ship specific approvals, supplementary guidelines are valid:

Electromagnetic compatibility

Immunity to interference acc. to Germanischer Lloyd (2003)

Test specification	Test values		Strength class	Evaluation criteria
IEC 61000-4-2 ESD	6 kV/8 kV (contact/air)		3/3	B
IEC 61000-4-3 electromagnetic fields	10 V/m 80 MHz ... 2 GHz		3	A
IEC 61000-4-4 burst	1 kV/2 kV (data/supply)		2/3	A
IEC 61000-4-5 surge	AC/DC Supply:	0.5 kV (line/line)	1	A
		1 kV (line/earth)	2	
IEC 61000-4-6 RF disturances	10 V/m 80 % AM (0.15 ... 80 MHz)		3	A
Type test AF disturbances (harmonic waves)	3 V, 2 W		-	A
Type test high voltage	755 V DC 1500 V AC		-	-

Emission of interference acc. to Germanischer Lloyd (2003)

Test specification	Limit values	Frequency range	Distance
Type test (EMC1, conducted) allows for ship bridge control applications	96 ... 50 dB (µV)	10 kHz ... 150 kHz	
	60 ... 50 dB (µV)	150 kHz ... 350 kHz	
	50 dB (µV)	350 kHz ... 30 MHz	
Type test (EMC1, radiated) allows for ship bridge control applications	80 ... 52 dB (µV/m)	150 kHz ... 300 kHz	3 m
	52 ... 34 dB (µV/m)	300 kHz ... 30 MHz	3 m
	54 dB (µV/m)	30 MHz ... 2 GHz	3 m
außer für:	24 dB (µV/m)	156 MHz ... 165 MHz	3 m

Mechanical strength acc. to Germanischer Lloyd (2003)

Test specification	Frequency range	Limit value
IEC 60068-2-6 vibration (category A – D)	2 Hz ≤ f < 25 Hz	± 1.6 mm amplitude (permanent)
	25 Hz ≤ f < 100 Hz	4 g (permanent)
	Note on vibration test: a) Frequency change: max. 1 octave/minute b) Vibration direction: 3 axes	

Range of application	Required specification emission of interference	Required specification immunity to interference
Industrial areas	EN 61000-6-4 (2001)	EN 61000-6-2 (2001)
Residential areas	EN 61000-6-3 (2001)*)	EN 61000-6-1 (2001)

*) The system meets the requirements on emission of interference in residential areas with the fieldbus coupler/controller for:

ETHERNET	750-342/-841/-842/-860
LonWorks	750-319/-819
CANopen	750-337/-837
DeviceNet	750-306/-806
MODBUS	750-312/-314/ -315/ -316 750-812/-814/ -815/ -816

With a special permit, the system can also be implemented with other fieldbus couplers/controllers in residential areas (housing, commercial and business areas, small-scale enterprises). The special permit can be obtained from an authority or inspection office. In Germany, the Federal Office for Post and Telecommunications and its branch offices issues the permit.

It is possible to use other field bus couplers/controllers under certain boundary conditions. Please contact WAGO Kontakttechnik GmbH & Co. KG.

Maximum power dissipation of the components	
Bus modules	0.8 W / bus terminal (total power dissipation, system/field)
Fieldbus coupler/controller	2.0 W / coupler/controller

Warning
The power dissipation of all installed components must not exceed the maximum conductible power of the housing (cabinet).

When dimensioning the housing, care is to be taken that even under high external temperatures, the temperature inside the housing does not exceed the permissible ambient temperature of 55 °C.

Dimensions

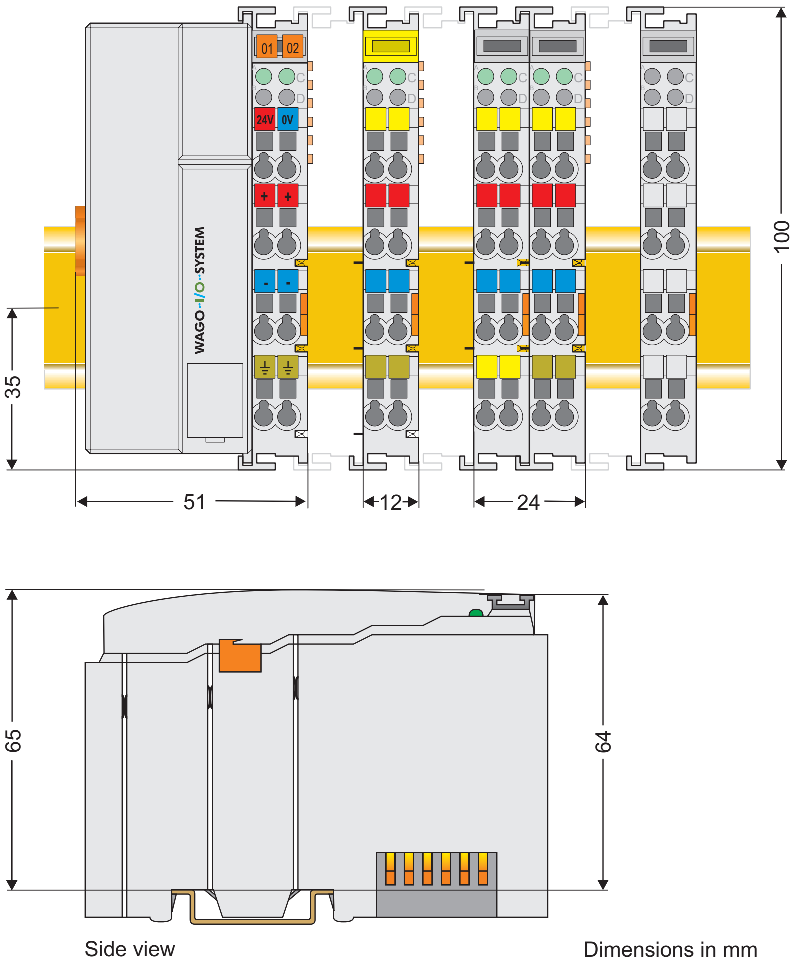


Fig. 2-2: Dimensions g01xx05e

Note:
The illustration shows a standard coupler. For detailed dimensions, please refer to the technical data of the respective coupler/controller.

2.3 Manufacturing Number

The manufacturing number indicates the delivery status directly after production.
This number is part of the lateral marking on the component.
In addition, starting from calender week 43/2000 the manufacturing number is also printed on the cover of the configuration and programming interface of the fieldbus coupler or controller.

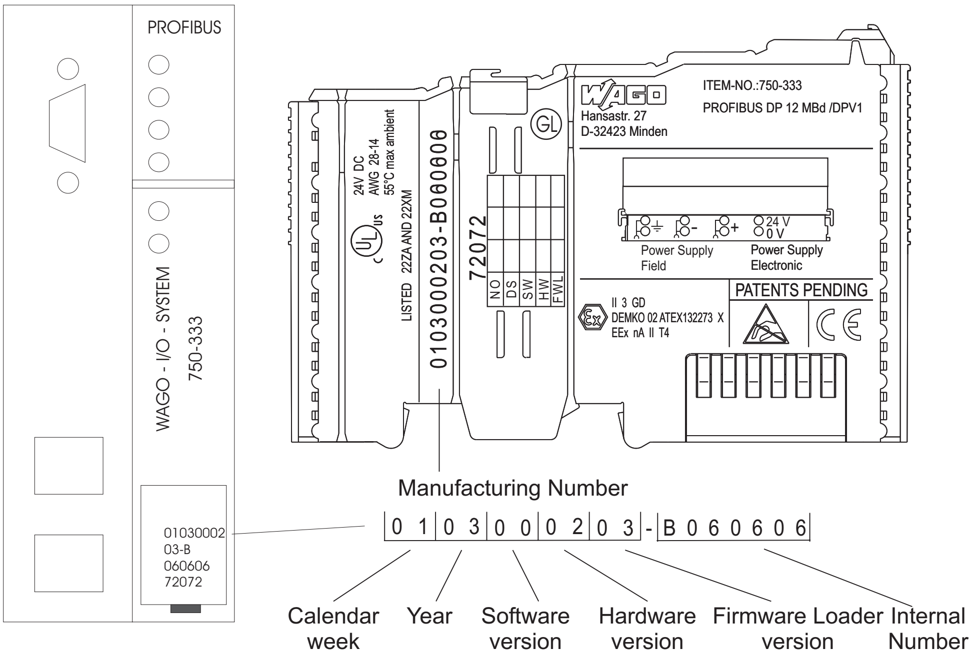


Fig. 2-3: Example: Manufacturing Number of a PROFIBUS fieldbus coupler 750-333

g01xx15e

The manufacturing number consists of the production week and year, the software version (if available), the hardware version of the component, the firmware loader (if available) and further internal information for WAGO Kontakttechnik GmbH.

2.4 Component Update

For the case of an Update of one component, the lateral marking on each component contains a prepared matrix.

This matrix makes columns available for altogether three updates to the entry of the current update data, like production order number (NO; starting from calendar week 13/2004), update date (DS), software version (SW), hardware version (HW) and the firmware loader version (FWL, if available).

Update Matrix

Current Version data for:		1. Update	2. Update	3. Update	
Production Order Number	**NO**				← Only starting from calendar week 13/2004
Datestamp	**DS**				
Software index	**SW**				
Hardware index	**HW**				
Firmware loader index	**FWL**				← Only for coupler/ controller

If the update of a component took place, the current version data are registered into the columns of the matrix.

Additionally with the update of a fieldbus coupler or controller also the cover of the configuration and programming interface of the coupler or controller is printed on with the current manufacturing and production order number.

The original manufacturing data on the housing of the component remain thereby.

2.5 Storage, Assembly and Transport

Wherever possible, the components are to be stored in their original packaging. Likewise, the original packaging provides optimal protection during transport.

When assembling or repacking the components, the contacts must not be soiled or damaged. The components must be stored and transported in appropriate containers/packaging. Thereby, the ESD information is to be regarded.

Statically shielded transport bags with metal coatings are to be used for the transport of open components for which soiling with amine, amide and silicone has been ruled out, e.g. 3M 1900E.

2.6 Mechanical Setup

2.6.1 Installation Position

Along with horizontal and vertical installation, all other installation positions are allowed.

Attention
In the case of vertical assembly, an end stop has to be mounted as an additional safeguard against slipping.

WAGO item 249-116	End stop for DIN 35 rail, 6 mm wide
WAGO item 249-117	End stop for DIN 35 rail, 10 mm wide

2.6.2 Total Expansion

The length of the module assembly (including one end module of 12mm width) that can be connected to the coupler/controller is 780mm. When assembled, the I/O modules have a maximum length of 768mm.

Examples:

- 64 I/O modules of 12mm width can be connected to one coupler/controller.
- 32 I/O modules of 24mm width can be connected to one coupler/controller.

Exception:

The number of connected I/O modules also depends on which type of coupler/controller is used. For example, the maximum number of I/O modules that can be connected to a Profibus coupler/controller is 63 without end module.The maximum total expansion of a node is calculated as follows:

Warning
The maximum total length of a node without coupler/controller must not exceed 780mm. Furthermore, restrictions made on certain types of couplers/controllers must be observed (e.g. for Profibus).

2.6.3 Assembly onto Carrier Rail

2.6.3.1 Carrier rail properties

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

Warning
WAGO supplies standardized carrier rails that are optimal for use with the I/O system. If other carrier rails are used, then a technical inspection and approval of the rail by WAGO Kontakttechnik GmbH should take place.

Carrier rails have different mechanical and electrical properties. For the optimal system setup on a carrier rail, certain guidelines must be observed:

- The material must be non-corrosive.
- Most components have a contact to the carrier rail to ground electromagnetic disturbances. In order to avoid corrosion, this tin-plated carrier rail contact must not form a galvanic cell with the material of the carrier rail which generates a differential voltage above 0.5 V (saline solution of 0.3% at 20°C) .
- The carrier rail must optimally support the EMC measures integrated into the system and the shielding of the bus module connections.
- A sufficiently stable carrier rail should be selected and, if necessary, several mounting points (every 20 cm) should be used in order to prevent bending and twisting (torsion).
- The geometry of the carrier rail must not be altered in order to secure the safe hold of the components. In particular, when shortening or mounting the carrier rail, it must not be crushed or bent.
- The base of the I/O components extends into the profile of the carrier rail. For carrier rails with a height of 7.5 mm, mounting points are to be riveted under the node in the carrier rail (slotted head captive screws or blind rivets).

2.6.3.2 WAGO DIN Rail

WAGO carrier rails meet the electrical and mechanical requirements.

Item Number	Description
210-113 /-112	35 x 7.5; 1 mm; steel yellow chromated; slotted/unslotted
210-114 /-197	35 x 15; 1.5 mm; steel yellow chromated; slotted/unslotted
210-118	35 x 15; 2.3 mm; steel yellow chromated; unslotted
210-198	35 x 15; 2.3 mm; copper; unslotted
210-196	35 x 7.5; 1 mm; aluminum; unslotted

2.6.4 Spacing

The spacing between adjacent components, cable conduits, casing and frame sides must be maintained for the complete field bus node.

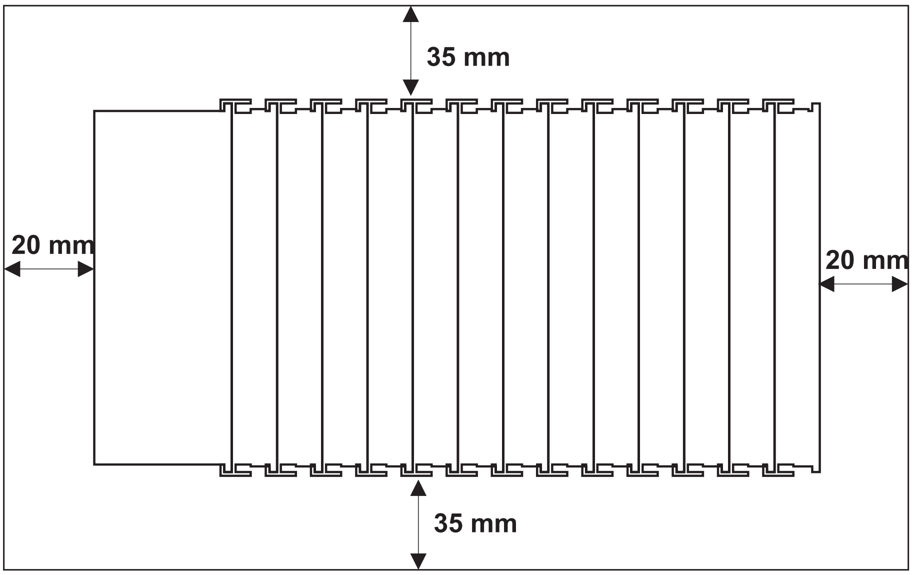


Fig. 2-4: Spacing g01xx13x

The spacing creates room for heat transfer, installation or wiring. The spacing to cable conduits also prevents conducted electromagnetic interferences from influencing the operation.

2.6.5 Plugging and Removal of the Components

Warning
Before work is done on the components, the voltage supply must be turned off.

In order to safeguard the coupler/controller from jamming, it should be fixed onto the carrier rail with the locking disc To do so, push on the upper groove of the locking disc using a screwdriver.

To pull out the fieldbus coupler/controller, release the locking disc by pressing on the bottom groove with a screwdriver and then pulling the orange colored unlocking lug.

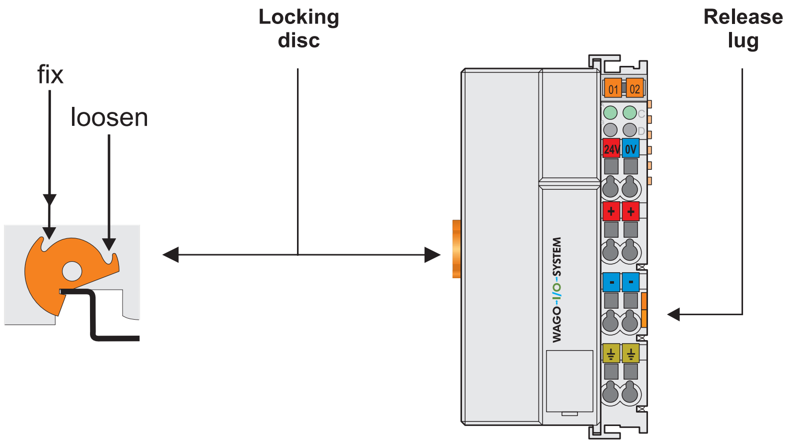


Fig. 2-5: Coupler/Controller and unlocking lug g01xx12e

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

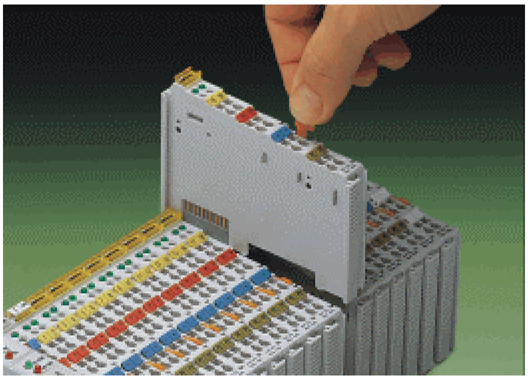


Fig. 2-6: removing bus terminal p0xxx01x

Danger
Ensure that an interruption of the PE will not result in a condition which could endanger a person or equipment!
For planning the ring feeding of the ground wire, please see chapter 2.6.3.

2.6.6 Assembly Sequence

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

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

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

Attention
Always link the bus modules with the coupler/controller, and always plug from above.

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

Always terminate the fieldbus node with an end module (750-600).

2.6.7 Internal Bus/Data Contacts

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

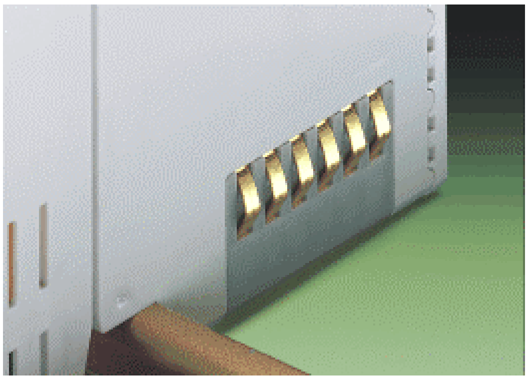


Fig. 2-7: Data contacts p0xxx07x

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

ESD (Electrostatic Discharge)
The modules are equipped with electronic components that may be destroyed by electrostatic discharge. When handling the modules, ensure that the environment (persons, workplace and packing) is well grounded. Avoid touching conductive components, e.g. gold contacts.

2.6.8 Power Contacts

Self-cleaning power contacts , are situated on the side of the components which further conduct the supply voltage for the field side. These contacts come as touchproof spring contacts on the right side of the coupler/controller and the bus module. As fitting counterparts the module has male contacts on the left side.

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

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

Power jumper contacts

Blade	0	0	3	2
Spring	0	3	3	2

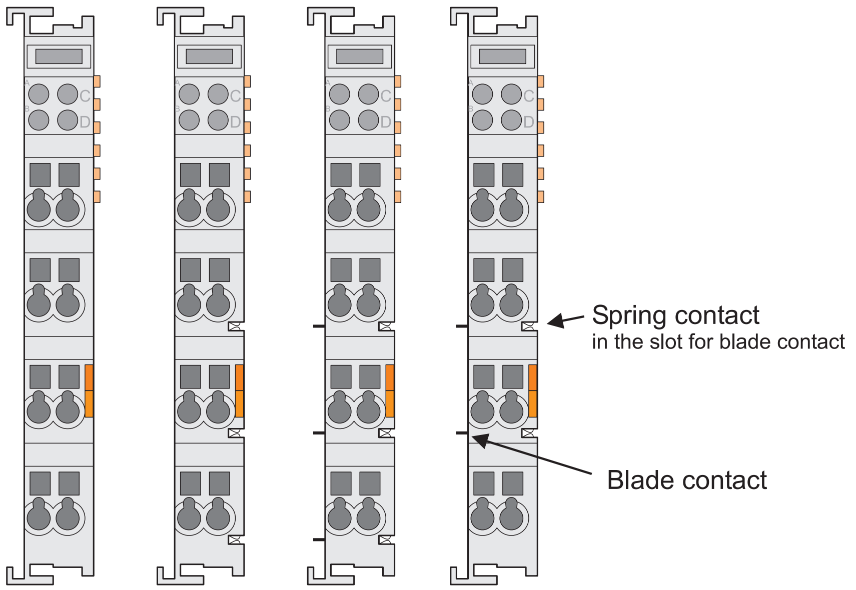


Fig. 2-8: Example for the arrangement of power contacts g0xxx05e

Recommendation
With the WAGO ProServe® Software smartDESIGNER, the assembly of a fieldbus node can be configured. The configuration can be tested via the integrated accuracy check.

2.6.9 Wire connection

All components have CAGE CLAMP® connections.

The WAGO CAGE CLAMP® connection is appropriate for solid, stranded and fine–stranded conductors. Each clamping unit accommodates one conductor.

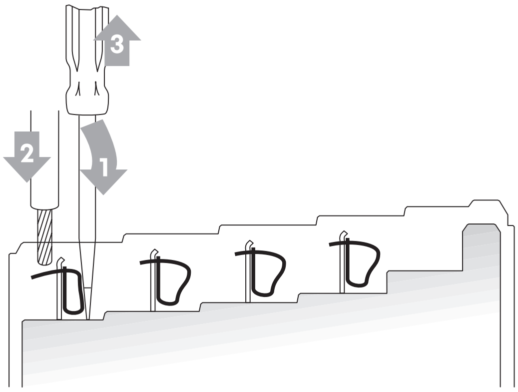


Fig. 2-9: CAGE CLAMP® Connection g0xxx08x

The operating tool is inserted into the opening above the connection. This opens the CAGE CLAMP®. Subsequently the conductor can be inserted into the opening. After removing the operating tool, the conductor is safely clamped.

More than one conductor per connection is not permissible. If several conductors have to be made at one connection point, then they should be made away from the connection point using WAGO Terminal Blocks. The terminal blocks may be jumpered together and a single wire brought back to the I/O module connection point.

Attention
If it is unavoidable to jointly connect 2 conductors, then a ferrule must be used to join the wires together.
Ferrule:

Length	8 mm
Nominal cross section$_{max.}$	1 mm^2 for 2 conductors with 0.5 mm^2 each
WAGO Product	216-103 or products with comparable properties

2.7 Power Supply

2.7.1 Isolation

Within the fieldbus node, there are three electrically isolated potentials.

- Operational voltage for the fieldbus interface.
- Electronics of the couplers/controllers and the bus modules (internal bus).
- All bus modules have an electrical isolation between the electronics (internal bus, logic) and the field electronics. Some digital and analog input modules have each channel electrically isolated, please see catalog.

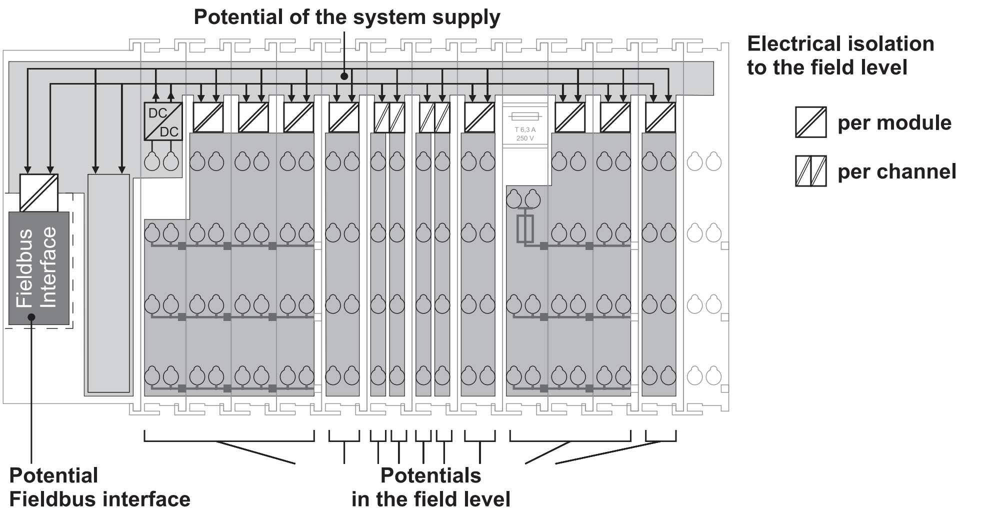


Fig. 2-10: Isolation g0xxx01e

Attention
The ground wire connection must be present in each group. In order that all protective conductor functions are maintained under all circumstances, it is recommended that a ground wire be connected at the beginning and end of a potential group. (ring format, please see chapter "2.8.3"). Thus, if a bus module comes loose from a composite during servicing, then the protective conductor connection is still guaranteed for all connected field devices.

When using a joint power supply unit for the 24 V system supply and the 24 V field supply, the electrical isolation between the internal bus and the field level is eliminated for the potential group.

2.7.2 System Supply

2.7.2.1 Connection

The WAGO-I/O-SYSTEM 750 requires a 24 V direct current system supply (-15% or +20 %). The power supply is provided via the coupler/controller and, if necessary, in addition via the internal system supply modules (750-613). The voltage supply is reverse voltage protected.

Attention
The use of an incorrect supply voltage or frequency can cause severe damage to the component.

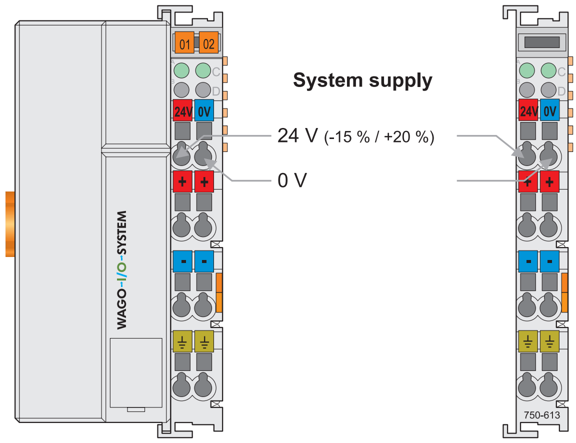


Fig. 2-11: System Supply g0xxx02e

The direct current supplies all internal system components, e.g. coupler/controller electronics, fieldbus interface and bus modules via the internal bus (5 V system voltage). The 5 V system voltage is electrically connected to the 24 V system supply.

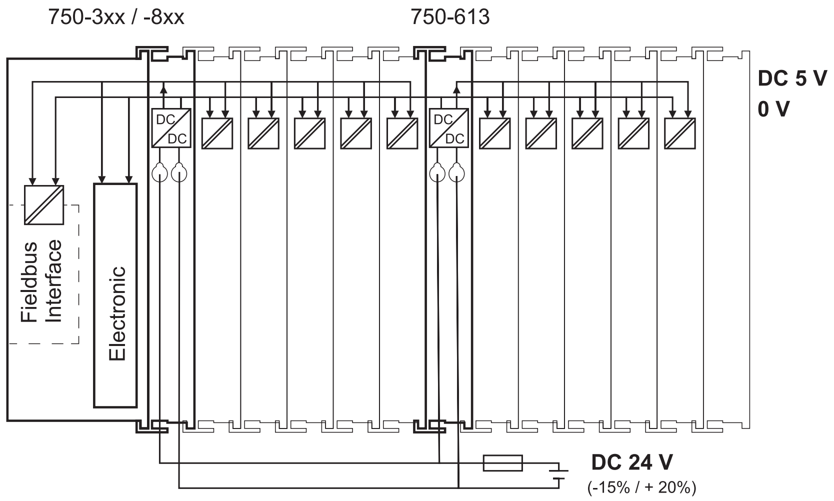


Fig. 2-12: System Voltage g0xxx06e

Attention
Resetting the system by switching on and off the system supply, must take place simultaneously for all supply modules (coupler/controller and 750-613).

2.7.2.2 Alignment

Recommendation
A stable network supply cannot be taken for granted always and everywhere. Therefore, regulated power supply units should be used in order to guarantee the quality of the supply voltage.

The supply capacity of the coupler/controller or the internal system supply module (750-613) can be taken from the technical data of the components.

Internal current consumption*)	Current consumption via system voltage: 5 V for electronics of the bus modules and coupler/controller
Residual current for bus terminals*)	Available current for the bus modules. Provided by the bus power supply unit. See coupler/controller and internal system supply module (750-613)

*) cf. catalogue W4 Volume 3, manuals or Internet

Example

Coupler 750-301:
internal current consumption:350 mA at 5V
residual current for
bus modules: 1650 mA at 5V
sum I(5V) $_{total}$: 2000 mA at 5V

The internal current consumption is indicated in the technical data for each bus terminal. In order to determine the overall requirement, add together the values of all bus modules in the node.

Attention
If the sum of the internal current consumption exceeds the residual current for bus modules, then an internal system supply module (750-613) must be placed before the module where the permissible residual current was exceeded.

Example: A node with a PROFIBUS Coupler 750-333 consists of 20 relay modules (750-517) and 10 digital input modules (750-405).

Current consumption:
20* 90 mA = 1800 mA
10* 2 mA = 20 mA
Sum 1820 mA

The coupler can provide 1650 mA for the bus modules. Consequently, an internal system supply module (750-613), e.g. in the middle of the node, should be added.

Recommendation
With the WAGO ProServe® Software smartDESIGNER, the assembly of a fieldbus node can be configured. The configuration can be tested via the integrated accuracy check.

The maximum input current of the 24 V system supply is 500 mA. The exact electrical consumption ($I_{(24 V)}$) can be determined with the following formulas:

Coupler/Controller

$I(5\ V)_{total}$ =	Sum of all the internal current consumption of the connected bus modules + internal current consumption coupler/controller

750-613

$I(5\ V)_{total}$ =	Sum of all the internal current consumption of the connected bus modules
Input current I(24 V) =	$5\ V / 24\ V * I(5\ V)_{total} / \eta$
	$\eta = 0.87$ (at nominal load)

Note
If the electrical consumption of the power supply point for the 24 V-system supply exceeds 500 mA, then the cause may be an improperly aligned node or a defect.

During the test, all outputs, in particular those of the relay modules, must be active.

2.7.3 Field Supply

2.7.3.1 Connection

Sensors and actuators can be directly connected to the relevant channel of the bus module in 1-/4 conductor connection technology. The bus module supplies power to the sensors and actuators. The input and output drivers of some bus modules require the field side supply voltage.

The coupler/controller provides field side power (DC 24V). In this case it is a passive power supply without protection equipment.
Power supply modules are available for other potentials, e.g. AC 230 V. Likewise, with the aid of the power supply modules, various potentials can be set up. The connections are linked in pairs with a power contact.

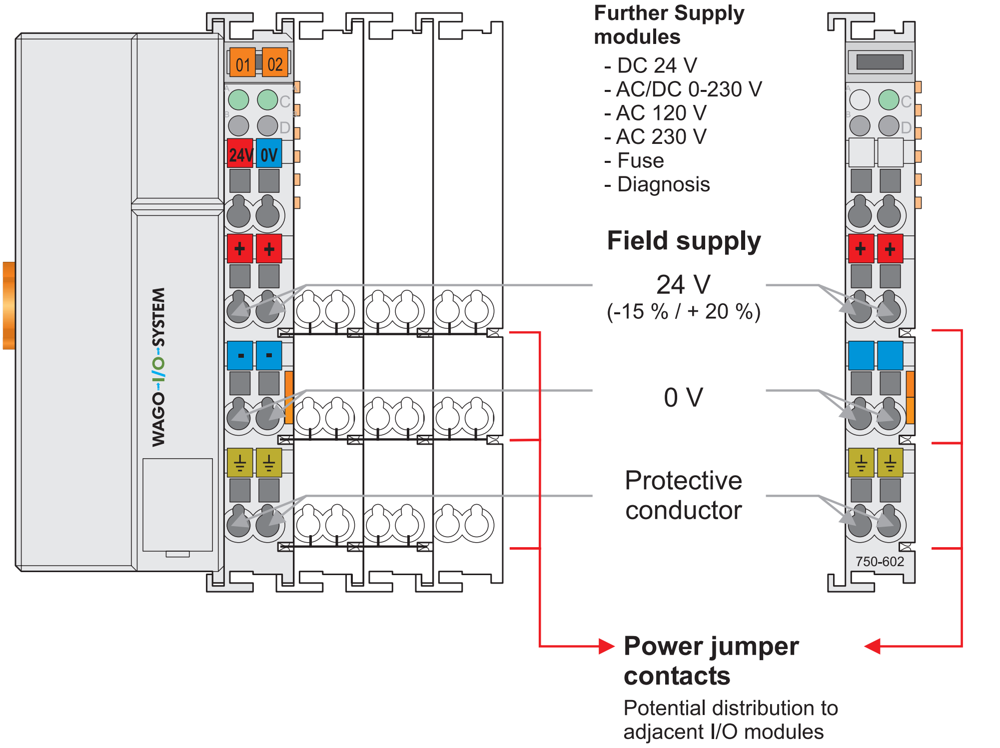


Fig. 2-13: Field Supply (Sensor/Actuator) g0xxx03e

The supply voltage for the field side is automatically passed to the next module via the power jumper contacts when assembling the bus modules .

The current load of the power contacts must not exceed 10 A on a continual basis. The current load capacity between two connection terminals is identical to the load capacity of the connection wires.

By inserting an additional power supply module, the field supply via the power contacts is disrupted. From there a new power supply occurs which may also contain a new voltage potential.

Attention
Some bus modules have no or very few power contacts (depending on the I/O function). Due to this, the passing through of the relevant potential is disrupted. If a field supply is required for subsequent bus modules, then a power supply module must be used.
Note the data sheets of the bus modules.

In the case of a node setup with different potentials, e.g. the alteration from DC 24 V to AC 230V, a spacer module should be used. The optical separation of the potentials acts as a warning to heed caution in the case of wiring and maintenance works. Thus, the results of wiring errors can be prevented.

2.7.3.2 Fusing

Internal fusing of the field supply is possible for various field voltages via an appropriate power supply module.

750-601	24 V DC, Supply/Fuse
750-609	230 V AC, Supply/Fuse
750-615	120 V AC, Supply/Fuse
750-610	24 V DC, Supply/Fuse/Diagnosis
750-611	230 V AC, Supply/Fuse/Diagnosis

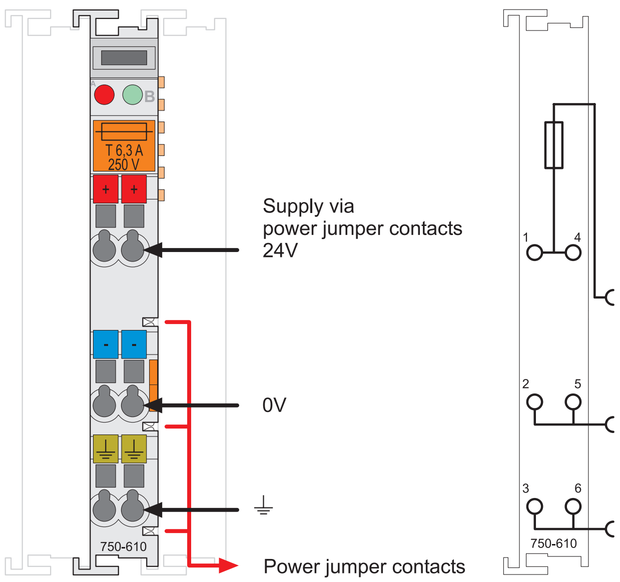


Fig. 2-14: Supply module with fuse carrier (Example 750-610) g0xxx09x

Warning
In the case of power supply modules with fuse holders, only fuses with a maximum dissipation of 1.6 W (IEC 127) must be used.

For UL approved systems only use UL approved fuses.

In order to insert or change a fuse, or to switch off the voltage in succeeding bus modules, the fuse holder may be pulled out. In order to do this, use a screwdriver for example, to reach into one of the slits (one on both sides) and pull out the holder.

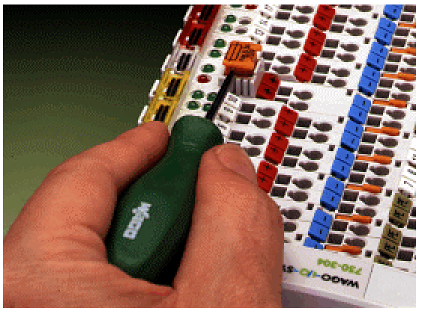


Fig. 2-15: Removing the fuse carrier p0xxx05x

Lifting the cover to the side opens the fuse carrier.

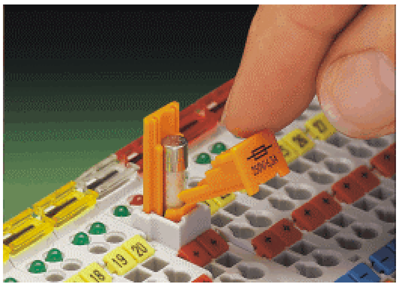


Fig. 2-16: Opening the fuse carrier p0xxx03x

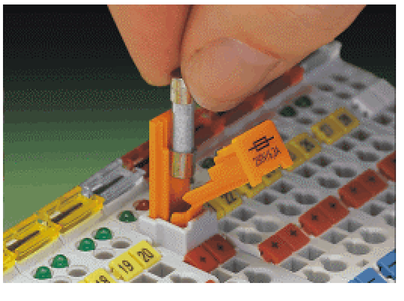


Fig. 2-17: Change fuse p0xxx04x

After changing the fuse, the fuse carrier is pushed back into its original position.

Alternatively, fusing can be done externally. The fuse modules of the WAGO series 281 and 282 are suitable for this purpose.

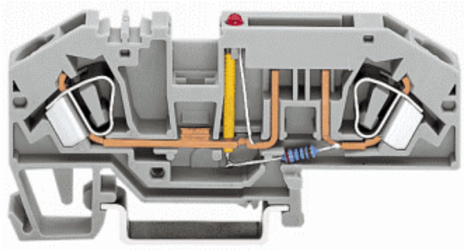


Fig. 2-18: Fuse modules for automotive fuses, Series 282 pf66800x

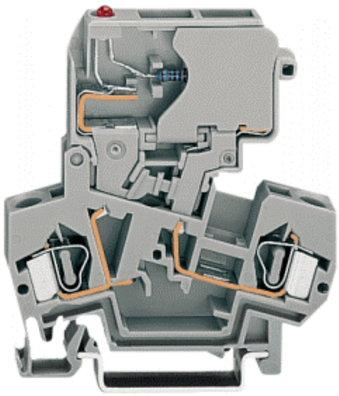


Fig. 2-19: Fuse modules with pivotable fuse carrier, Series 281 pe61100x

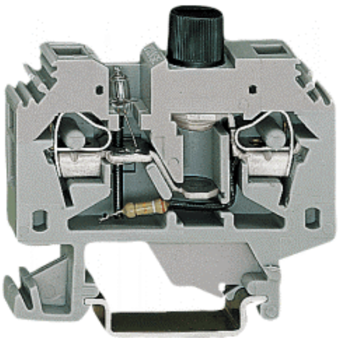


Fig. 2-20: Fuse modules, Series 282 pf12400x

2.7.4 Supplementary power supply regulations

The WAGO-I/O-SYSTEM 750 can also be used in shipbuilding or offshore and onshore areas of work (e.g. working platforms, loading plants). This is demonstrated by complying with the standards of influential classification companies such as Germanischer Lloyd and Lloyds Register.

Filter modules for 24-volt supply are required for the certified operation of the system.

Item No.	Name	Description
750-626	Supply filter	Filter module for system supply and field supply (24 V, 0 V), i.e. for field bus coupler/controller and bus power supply (750-613)
750-624	Supply filter	Filter module for the 24 V- field supply (750-602, 750-601, 750-610)

Therefore, the following power supply concept must be absolutely complied with.

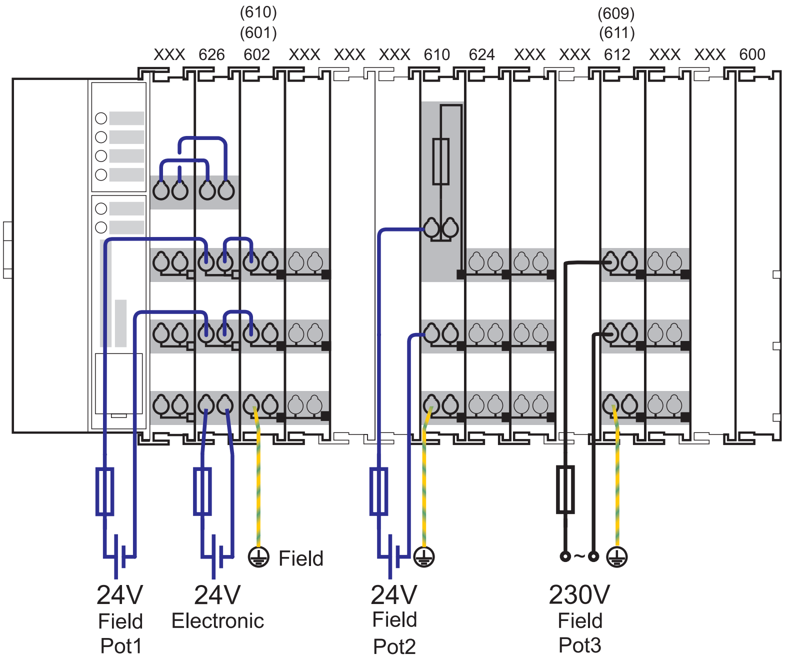


Fig. 2-21: Power supply concept g01xx11e

Note
Another potential power terminal 750-601/602/610 must only be used behind the filter terminal 750-626 if the protective earth conductor is needed on the lower power contact or if a fuse protection is required.

2.7.5 Supply example

Note
The system supply and the field supply should be separated in order to ensure bus operation in the event of a short-circuit on the actuator side.

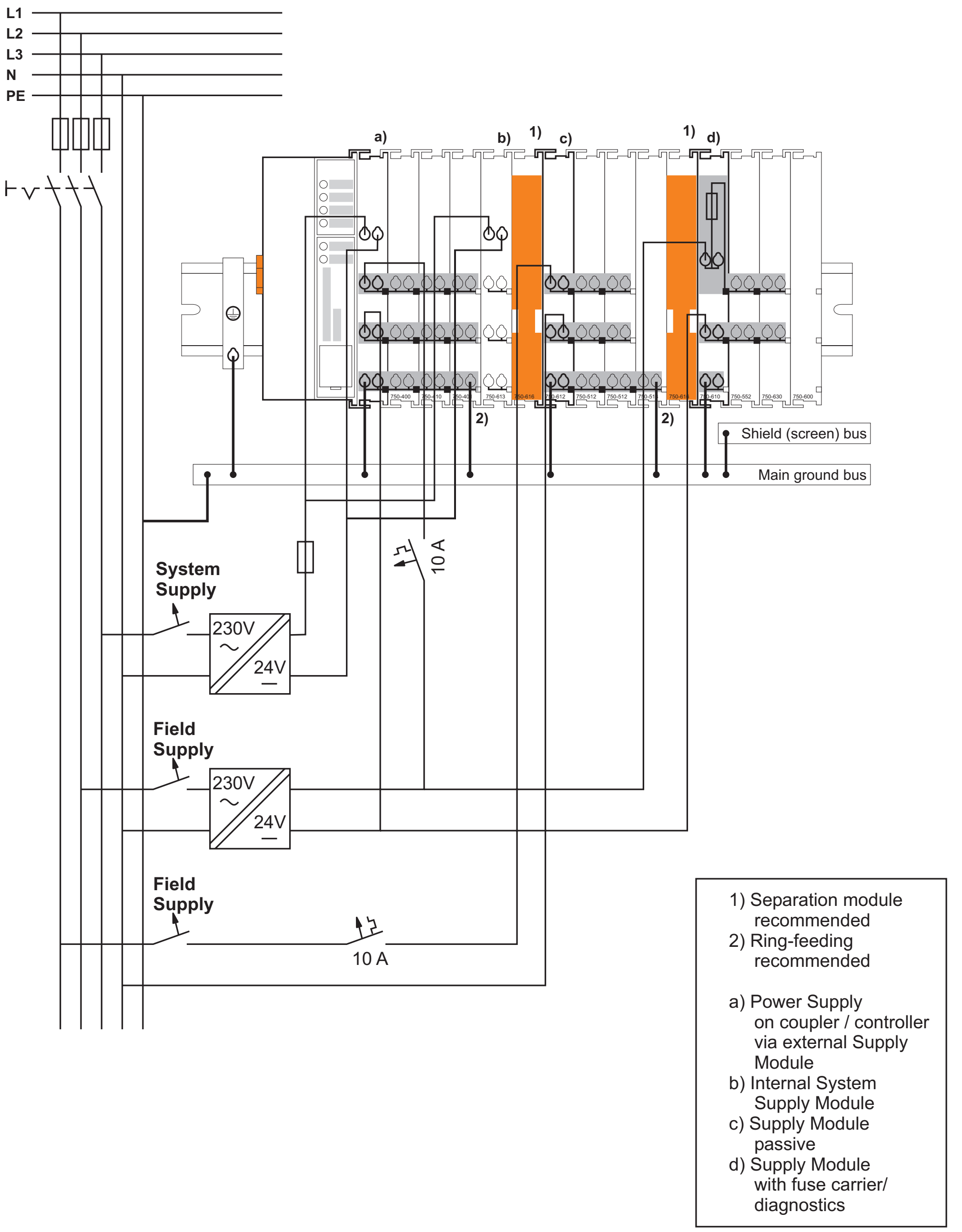


Fig. 2-22: Supply example

g0xxx04e

2.7.6 Power Supply Unit

The WAGO-I/O-SYSTEM 750 requires a 24 V direct current system supply with a maximum deviation of -15% or +20 %.

Recommendation
A stable network supply cannot be taken for granted always and everywhere. Therefore, regulated power supply units should be used in order to guarantee the quality of the supply voltage.

A buffer (200 µF per 1 A current load) should be provided for brief voltage dips. The I/O system buffers for approx 1 ms.

The electrical requirement for the field supply is to be determined individually for each power supply point. Thereby all loads through the field devices and bus modules should be considered. The field supply as well influences the bus modules, as the inputs and outputs of some bus modules require the voltage of the field supply.

Note
The system supply and the field supply should be isolated from the power supplies in order to ensure bus operation in the event of short circuits on the actuator side.

WAGO products Article No.	Description
787-903	Primary switched - mode, DC 24 V, 5 A wide input voltage range AC 85-264 V PFC (Power Factor Correction)
787-904	Primary switched - mode, DC 24 V, 10 A wide input voltage range AC 85-264 V PFC (Power Factor Correction)
787-912	Primary switched - mode, DC 24 V, 2 A wide input voltage range AC 85-264 V PFC (Power Factor Correction)
 288-809 288-810 288-812 288-813	Rail-mounted modules with universal mounting carrier AC 115 V / DC 24 V; 0,5 A AC 230 V / DC 24 V; 0,5 A AC 230 V / DC 24 V; 2 A AC 115 V / DC 24 V; 2 A

2.8 Grounding

2.8.1 Grounding the DIN Rail

2.8.1.1 Framework Assembly

When setting up the framework, the carrier rail must be screwed together with the electrically conducting cabinet or housing frame. The framework or the housing must be grounded. The electronic connection is established via the screw. Thus, the carrier rail is grounded.

Attention
Care must be taken to ensure the flawless electrical connection between the carrier rail and the frame or housing in order to guarantee sufficient grounding.

2.8.1.2 Insulated Assembly

Insulated assembly has been achieved when there is constructively no direct conduction connection between the cabinet frame or machine parts and the carrier rail. Here the earth must be set up via an electrical conductor.

The connected grounding conductor should have a cross section of at least 4 mm^2.

Recommendation
The optimal insulated setup is a metallic assembly plate with grounding connection with an electrical conductive link with the carrier rail.

The separate grounding of the carrier rail can be easily set up with the aid of the WAGO ground wire terminals.

Article No.	Description
283-609	Single-conductor ground (earth) terminal block make an automatic contact to the carrier rail; conductor cross section: 0.2 -16 mm2 Note: Also order the end and intermediate plate (283-320)

2.8.2 Grounding Function

The grounding function increases the resistance against disturbances from electro-magnetic interferences. Some components in the I/O system have a carrier rail contact that dissipates electro-magnetic disturbances to the carrier rail.

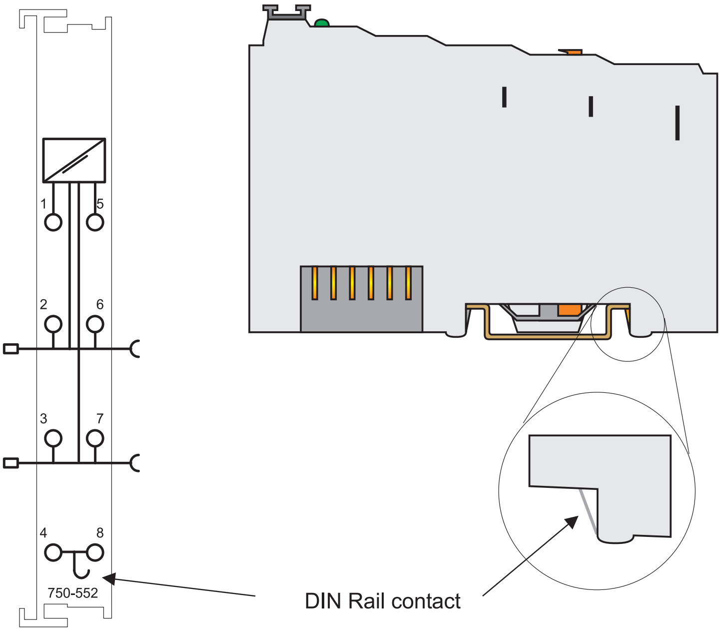


Fig. 2-23: Carrier rail contact g0xxx10e

Attention
Care must be taken to ensure the direct electrical connection between the carrier rail contact and the carrier rail.

The carrier rail must be grounded.

For information on carrier rail properties, please see chapter 2.6.3.2.

2.8.3 Grounding Protection

For the field side, the ground wire is connected to the lowest connection terminals of the power supply module. The ground connection is then connected to the next module via the Power Jumper Contact (PJC). If the bus module has the lower power jumper contact, then the ground wire connection of the field devices can be directly connected to the lower connection terminals of the bus module.

Attention
Should the ground conductor connection of the power jumper contacts within the node become disrupted, e.g. due to a 4-channel bus terminal, the ground connection will need to be re-established.

The ring feeding of the grounding potential will increase the system safety. When one bus module is removed from the group, the grounding connection will remain intact.

The ring feeding method has the grounding conductor connected to the beginning and end of each potential group.

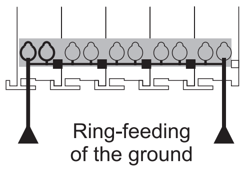


Fig. 2-24: Ring-feeding g0xxx07e

Attention
The regulations relating to the place of assembly as well as the national regulations for maintenance and inspection of the grounding protection must be observed.

2.9 Shielding (Screening)

2.9.1 General

The shielding of the data and signal conductors reduces electromagnetic interferences thereby increasing the signal quality. Measurement errors, data transmission errors and even disturbances caused by overvoltage can be avoided.

Attention
Constant shielding is absolutely required in order to ensure the technical specifications in terms of the measurement accuracy.

The data and signal conductors should be separated from all high-voltage cables.

The cable shield should be potential. With this, incoming disturbances can be easily diverted.

The shielding should be placed over the entrance of the cabinet or housing in order to already repel disturbances at the entrance.

2.9.2 Bus Conductors

The shielding of the bus conductor is described in the relevant assembly guidelines and standards of the bus system.

2.9.3 Signal Conductors

Bus modules for most analog signals along with many of the interface bus modules include a connection for the shield.

Note
For better shield performance, the shield should have previously been placed over a large area. The WAGO shield connection system is suggested for such an application.
This suggestion is especially applicable when the equipment can have even current or high impulse formed currents running through it (for example through atmospheric end loading).

2.9.4 WAGO Shield (Screen) Connecting System

The WAGO Shield Connecting system includes a shield clamping saddle, a collection of rails and a variety of mounting feet. Together these allow many dfferent possibilities. See catalog W4 volume 3 chapter 10.

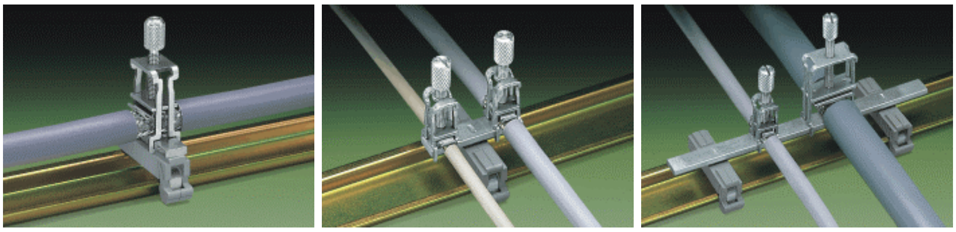


Fig. 2-25: WAGO Shield (Screen) Connecting System p0xxx08x, p0xxx09x, and p0xxx10x

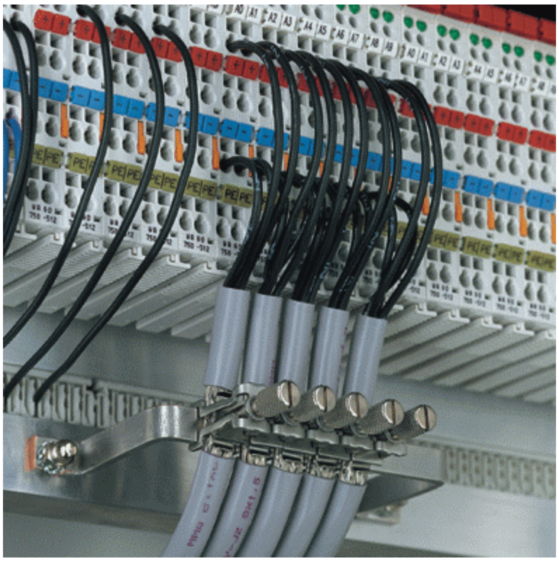


Fig. 2-26: Application of the WAGO Shield (Screen) Connecting System p0xxx11x

2.10 Assembly Guidelines/Standards

DIN 60204,	Electrical equipping of machines
DIN EN 50178	Equipping of high-voltage systems with electronic components (replacement for VDE 0160)
EN 60439	Low voltage – switch box combinations

3 Fieldbus Coupler

3.1 Fieldbus Coupler 750-307

3.1.1 Description

The fieldbus coupler 750-307 displays the peripheral data of all I/O modules in the WAGO-I/O-SYSTEM 750 on CANopen. The data is transmitted with PDOs and SDOs.

In the initialization phase, the bus coupler determines the physical structure of the node and creates a process image from this with all inputs and outputs. This could involve a mixed arrangement of analog (word by word data exchange) and digital (byte by byte data exchange) modules.

The local process image is subdivided into an input and output data area. The process data can be read in via the CANopen bus and further processed in a control system. The process output data is sent via the CANopen bus. The data of the analog modules are mapped into the PDOs according to the order of their position downstream of the bus coupler. The bits of the digital modules are compiled to form bytes and also mapped into PDOs. Should the number of digital I/Os exceed 8 bits, the coupler automatically starts another byte.

The entries in the object directory can be mapped to the 5 Rx PDOs and 5 Tx PDOs as required. The entire input and output data area can be transmitted with the SDOs.

3.1.2 Hardware

3.1.2.1 View

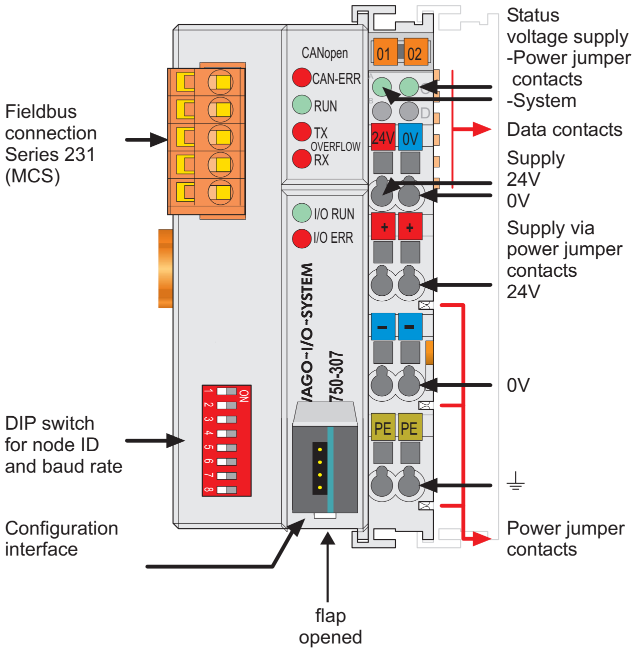


Fig. 3-1: Fieldbus Coupler 750-307 CANopen g030700e

The fieldbus coupler is comprised of:

- Supply module with Internal system supply module for the system supply as well as power jumper contacts for the field supply via I/O module assemblies.
- Fieldbus interface with the bus connection
- DIP switch for baud rate and node ID
- Display elements (LEDs) for status display of the operation, the bus communication, the operating voltages as well as for fault messages and diagnosis
- Configuration Interface
- Electronics for communication with the I/O modules (internal bus) and the fieldbus interface

3.1.2.2 Device supply

The supply is made via terminal bocks with CAGE CLAMP® connection. The device supply is intended both for the system and the field units.

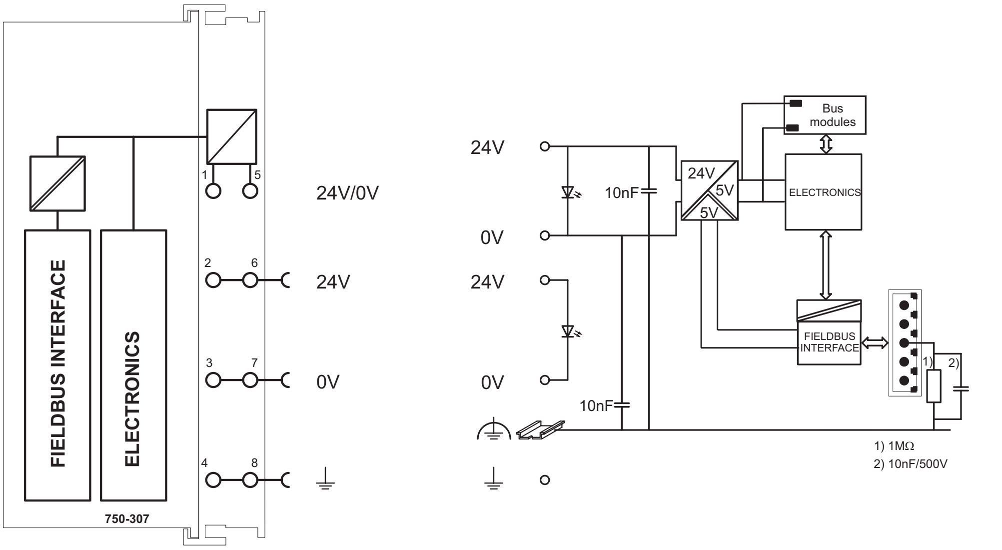


Fig. 3-2: Device Supply g030701e

The integrated internal system supply module generates the necessary voltage to supply the electronics and the connected I/O modules.

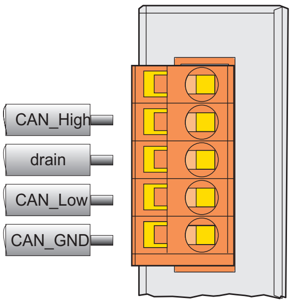
The fieldbus interface is supplied with electrically isolated voltage from the internal system supply module.

3.1.2.3 Fieldbus connection

The CAN interface is designed as an open style connection.

The connection point is lowered in such a way that after a connector is inserted, installation in an 80 mm high switchbox is possible.

The electrical isolation between the fieldbus system and the electronics is made via the DC/DC converter and the optocoupler in the fieldbus.



Pin	Signal	Description
5	CAN_V+	Not used
4	CAN_H	CAN Signal $_{High}$
3	Drain Shield	Shield connection
2	CAN_L	CAN Signal $_{Low}$
1	GND	Ground

Fig. 3-3: Fieldbus connection, MCS g012400x

If a shield exists, it can be connected to drain. The shield is connected via a 1 MΩ resistor to ground (earth) (rail carrier contact). A connection of low impedance between shield and ground (earth) can only be made externally (for example by a supply terminal block). It is recommended to have a central ground (earth) contact for the whole CANbus shield.

3.1.2.4 Display elements

The operating condition of the fieldbus coupler or node is signalled via light diodes (LED).

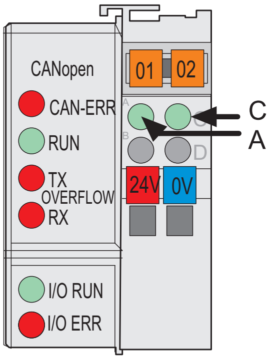


Fig. 3-4: Display elements 750-307 g030702x

LED	Color	Meaning
CAN-ERR	red	The buscoupler / node is in the state STOP, CAN Bus is defected
RUN	green	The buscoupler / node is in the state OPERATIONAL / PRE-OPERATIONAL
Tx-Overflow	red	CAN transmitter buffer is full.
Rx-Overflow	red	CAN receiver buffer is full.
I/O RUN	green	The 'I/O RUN'-LED indicates the operation of the node.
I/O ERR	red	The 'I/O ERR'-LED signals faults encountered.
A	green	Status of the operating voltage system
C	green	Status of the operating voltage – power jumper contacts

More Information
The evaluation of the indicated LED signals is detailed described in the chapter 3.1.7 "LED ".

3.1.2.5 Configuration Interface

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

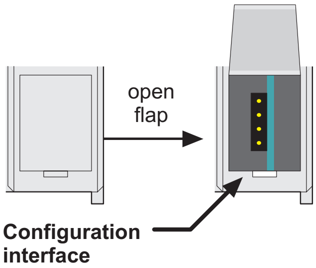


Fig. 3-5: Configuration Interface g01xx06e

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

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

3.1.2.6 Hardware Address (Module ID)

The DIP switch is used both for setting the baud rate of the fieldbus coupler and for setting the module ID. This module ID is necessary for calculating the COB IDs (i.e. of PDO1...4, 1. Server SDO, etc.).

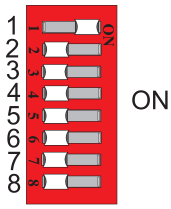


Fig. 3-6: Setting of station (node) address g012440x

The binary significance of the individual DIP switches increases according to the switch number, i.e. the module ID 1 is set by DIP1 = ON, the module ID 8 by DIP4 = ON, etc.

The nodes of the WAGO-I/O-SYSTEM can have module IDs from 1 to 127.

3.1.2.7 Setting the Baud Rate

The bus coupler supports 9 different Baud rates. DIP switches are used to set the baud rate.

The bus coupler changes to the configuration mode using the set module ID = 0 (all DIP switches off) with subsequent power On. The current set baud rate is displayed in this status (starting from Firmware WT). The baud rate display is shown by the top LED group (STOP, RUN, Tx-, Rx-Overflow), whereby STOP = Switch 1,
RUN = Switch 2, Tx-Overflow = Switch 3 and Rx-Overflow = Switch 4. The current set baud rate is displayed by the corresponding LEDs blinking slowly. Now the new baud rate can be set using the DIP switch, by turning the corresponding DIP switches to 'ON'.

The set configuration is saved by turning DIP8 to 'ON'. Following saving, the new baud rate is displayed by the corresponding LEDs having a steady light. Except for the baud rate of 1MBaud, this is displayed by all 4 LEDs blinking/being lit.

Example: 125 kB: Tx-Overflow LED blink / are lit
250 kB: STOP and RUN LED blink / are lit

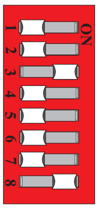


Fig. 3-7: Example: Saving the baud rate 125 kB g012441x

In this status no data exchange via CAN is possible.

Dip	Function	1 MBit	800 kB	500 kB	250 kB	125 kB	100 kB	50 kB	20 kB	10 kB	is displayed by LED
1 (LSB)	Baud rate	0	1	0	1	0	1	0	1	0	CAN-ERR
2	Baud rate	0	0	1	1	0	0	1	1	0	RUN
3	Baud rate	0	0	0	0	1	1	1	1	0	Tx-Overflow
4 (MSB)	Baud rate	0	0	0	0	0	0	0	0	1	Rx-Overflow
5											
6											
7											
8	Acceptance	´off´ -> ´on´ : Accepting the configuration settings									

Once the baud rate setting / baud rate check is completed, switch off the operating voltage knowing that only the DIP value will be used to calculate the IDs which has been set during power ON. When switched off, the desired module ID (=1 as delivered) can be set on the DIP.

Default baud rate: 125 kB

3.1.3 Operating System

Following is the configuration of the master activation and the electrical installation of the fieldbus station.

After switching on the supply voltage, the coupler performs a self test of all functions of its devices, the I/O module and the fieldbus interface. Following this the I/O modules and the present configuration is determined, whereby an external not visible list is generated.

In the event of a fault the coupler changes to the "Stop" condition. The "I/O ERR" LED flashes red. After clearing the fault and cycling power, the coupler changes to the "Fieldbus start" status and the "I/O RUN" LED lights up green.

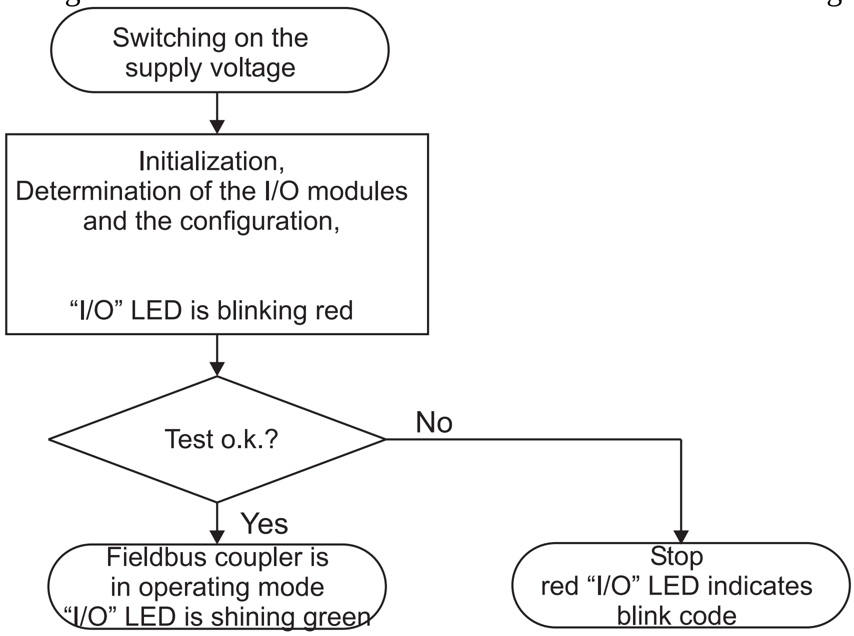


Fig. 3-8: Operating system 750-307 g012x20e

More Information
The evaluation of the indicated LED signals is detailed described in the chapter 3.1.7 "LED ".

3.1.4 Process Image

3.1.4.1 Structure in principle

After powering up, the coupler recognizes all I/O modules plugged into the node which supply or wait for data (data width/bit width > 0). In the nodes analog and digital I/O modules can be mixed.

The coupler produces an internal process image from the data width and the type of I/O module as well as the position of the I/O modules in the node. It is divided into an input and an output data area.

The data of the digital I/O modules is bit orientated, i.e. the data exchange is made bit for bit. The analog I/O modules are all byte orientated I/O modules, i.e. modules where the data exchange is made byte for byte. These I/O modules include for example the counter modules, I/O modules for angle and path measurement as well as the communication modules.

Note
For the number of input and output bits or bytes of the individual I/O modules please refer to the corresponding I/O module description.

The data of the I/O modules is separated for the local input and output process image in the sequence of their position after the coupler in the individual process image.
In the respective I/O area, first of all analog modules are mapped, then all digital modules, even if the order of the connected analog and digital modules does not comply with this order. The digital channels are grouped, each of these groups having a data width of 1 byte. Should the number of digital I/Os exceed 8 bits, the coupler automatically starts another byte.

Note
A process image restructuring may result if a node is changed or extended. In this case the process data addresses also change in comparison with earlier ones. In the event of adding a module, take the process data of all previous modules into account.

More Information
You can find the fieldbus specific process data architecture for all I/O Modules of the WAGO-I/O-SYSTEM 750 and 753 in the chapter „ Process Data Architecture for CANopen“.

3.1.5 Data Exchange

With CANopen, the transmission of data, the triggering of events, the signalling of error states etc. is made using communication objects. Each communication object consists of a CAN telegram, which contains maximally 8 byte utilizable data and it is assigned a unique COB-ID (Communication Object Identifier) in the network.

Parameters for the communication objects as well as parameters and data of the CANopen subscribers are filled in an object directory().

3.1.5.1 Communication Objects

The fieldbus coupler 750-307 supports the following communication objects:

- 5 Tx-PDOs,
  for process data exchange of fieldbus node input data
- 5 Rx-PDOs,
  for process data exchange of fieldbus node output data
- 2 Server SDOs,
  for exchange of configuration data and for information on the state of the node
- Synchronization Object (SYNC),
  for network synchronisation
- Emergency Object (EMCY)
- Network Management Objects
  - Module Control Protocols
  - Error Control Protocols
  - Bootup Protocol

3.1.5.2 Communication Interfaces

For a data exchange, the CANopen fieldbus coupler is equipped with two interfaces:

- the interface to fieldbus (-master) and
- the interface to the I/O modules.

Data exchange takes place between the fieldbus master and the bus modules.

Access from the fieldbus side is fieldbus specific.

3.1.5.3 Memory Areas

The coupler uses a memory space of 256 words (word 0 ... 255) for the physical input and output data.

The division of the memory spaces is identical with all WAGO fieldbus couplers.

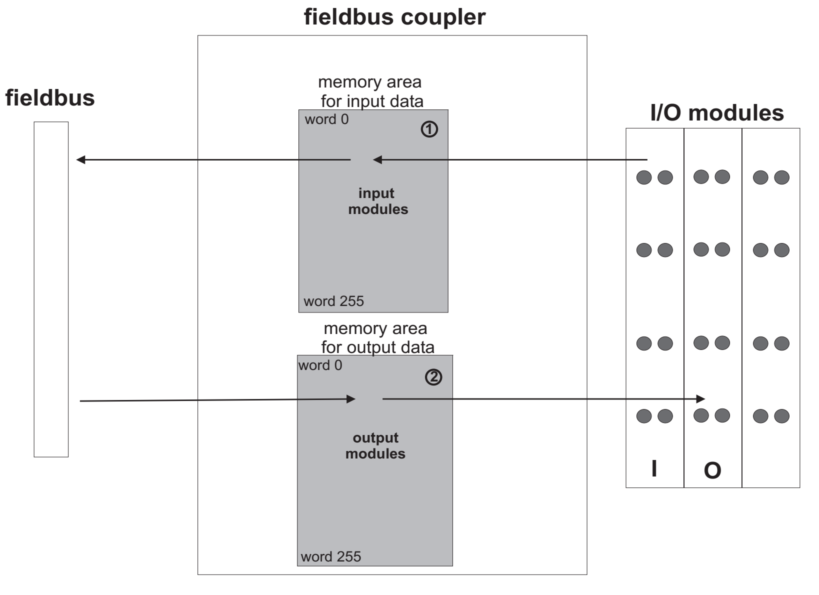


Fig. 3-9: Memory areas and data exchange for a fieldbus coupler g012433e

The coupler process image contains the physical data of the bus modules in a storage area for input data and in a storage area for output data (word 0 ... 255 each).

① The input module data can be read from the fieldbus side.

② In the same manner, writing to the output modules is possible from the fieldbus side.

3.1.5.4 Addressing

Upon switching on the supply voltage, the data is mapped from the process image to an object directory (initialization). A CANopen fieldbus master uses the 16 bit indexes and 8 bit sub-indexes of the object directory in order to address the data via the PDOs or SDOs and for access purposes.
Therefore, the position of the data in the process image has no direct meaning for the CANopen user.

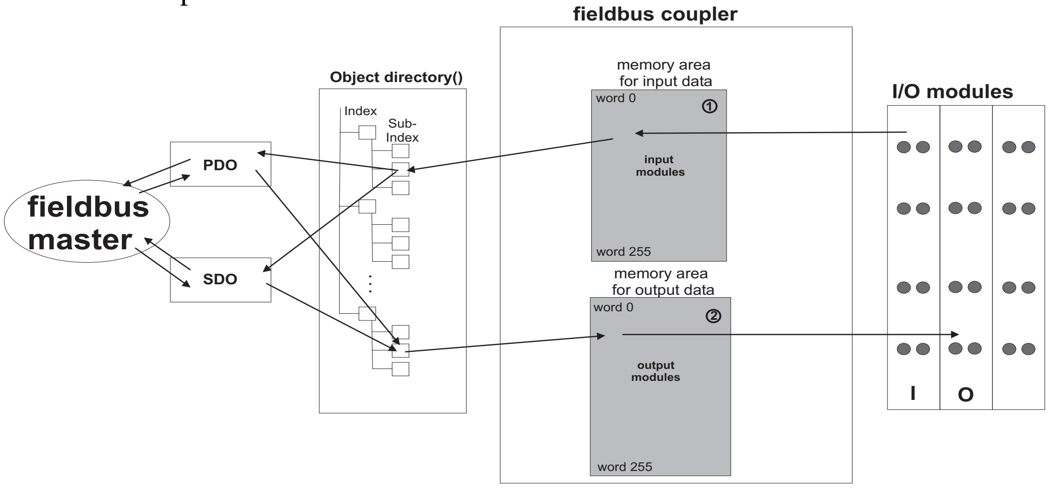


Fig. 3-10: Fieldbus specific data exchange for a CANopen fieldbus coupler g012431e

3.1.5.4.1 Indexing the I/O Module Data

If a customer specific configuration was stored prior to the initialization, and if the currently connected module configuration coincides with the configuration stored before, initialization takes place with this configuration.

Note
For an example for the initialization of the customer specific configuration, please refer to chapter 3.1.6 "Starting up a CANopen Fieldbus Node".

In every other case, when initializing, the object directory is assigned a default configuration according to the device profile DS 401.

The entry into the object directory is then made separately according to data width (1 bit, 1 byte, 2 bytes, 3 bytes, etc...) and input and output.
The physical bus module arrangement within a node is optional.

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

Table 3-1: I/O module data width

Note
For the number of input and output bits or bytes of the individual I/O modules please refer to the corresponding I/O module description.

The digital module data is taken into consideration first.
Knowing that CANopen does not transmit the data bit by bit, the digital module data is grouped to form bytes and assigned to the corresponding index, digital input data to index 0x2000, digital output data to index 0x2100.
The assignment of bus module data of a data width of 1 byte or more is made in relation to the individual indices.

The table reviews the indices of the bus module data.

Data width	input modules	output modules
	Index	
1 Bit digital	0x2000	0x2100
1 Byte specialty modules	0x2200	0x2300
2 Byte specialty modules	0x2400	0x2500
3 Byte specialty modules	0x2600	0x2700
4 Byte specialty modules	0x2800	0x2900
5 Byte specialty modules	0x3000	0x3100
6 Byte specialty modules	0x3200	0x3300
7 Byte specialty modules	0x3400	0x3500
8 Byte specialty modules	0x3600	0x3700

Table 3-2: Indexing the bus module data in the object directory

Each index has a maximum of 256 sub-indexes (sub-index 0-255).

Additionally a part of the data is gemappt in accordance with CANopen profile DS401 into the object directory (). In addition belong:

- maximally 8 digital Input blocks (Index 0x6000)
- maximally 8 digital Output blocks (Index 0x6200)
- maximally 4x 16 bit analog Inputs (Index 0x6401)
- maximally 4x 16 bit analog Outputs (Index 0x6411)

that means i. e. Sub index 1-8 of index 0x6000 correspond to Sub index 1-8 of index 0x2000.

The number of data inputs is quoted in sub-index 0, whereas in the following sub-indices the data is filled in blocks.
The block size depends on the data width of the bus module.

Sub-Index	Contents
0	Number of Data blocks
1	First Data block with the data width of the I/O module
2	Second Data block with the data width of the I/O module
...	...

Table 3-3: Sub-indices of the bus module data in the object directory

Note
For a detailed description of setting the default configuration please refer to chapter **4.3.4.1** "**Initialization**".

Attention
A process image restructuring may result if a node is changed or extended. In this case the process data addresses also change in comparison with earlier ones. In the event of adding modules, take the process data of all previous modules into account.

Example:
The bus module configuration contains :
1) 5 digital 2 channel input modules (i.e. 750-400),
2) one digital 4 channel output module (i.e. 750-504) and
3) two 2 channel analog output modules with output modules having 2 bytes per channel (i.e. 750-552).

To 1) Index the data of the 5 digital 2 channel input modules:

Index:	Sub-Index:	Contents:	Description:
0x2000	0	2	number of dig. 8 Bit input blocks
	1	D4.2 D4.1 D3.2 D3.1 D2.2 D2.1 D1.2 D1.1 *)	1. dig. input block
	2	0 0 0 0 0 0 D5.2 D5.1 *)	2. dig. input block

*) D1.1 = Data bit module 1 channel 1, D1.2 = Data bit module 1channel 2, etc.

To 2) Index the data of the digital 4 channel output module:

Index:	Sub-Index:	Contents:	Description:
0x2100	0	1	number of dig. 8 Bit input blocks
	1	0 0 0 0 D1.4 D1.3 D1.2 D1.1 *)	dig. output block

*) D1.1 = Data bit module 1 channel 1, D1.2 = Data bit module 1 channel 2, etc.

To 3) Index the data of the 2 analog 2 channel output modules:

Index:	Sub-Index:	Contents:	Description:
0x2500	0	4	number of 2 Byte specialty channels
	1	D1.1 *)	1. output channel
	2	D1.2 *)	2. output channel
	3	D2.1 *)	3. output channel
	4	D2.2 *)	4. output channel

*) D1.1 = Data word module 1 channel 1, D1.2 = Data word module 1 channel 2, etc.

3.1.6 Starting up a CANopen Fieldbus Node

This chapter shows the step-by-step procedure for starting up a WAGO CANopen fieldbus node.

Attention
This description is given as an example and is limited to the execution of a local start-up of an individual CANopen fieldbus node.

The procedure contains the following steps:

1. Connecting the PC and Fieldbus Node
2. Checking and setting the Baud Rate
3. Setting the Module ID
4. Changing to the OPERATIONAL Status
5. Application specific Mapping

3.1.6.1 Connecting the PC and Fieldbus Node

Connect the fitted CANopen fieldbus node to the CANopen fieldbus PCB in your PC via a fieldbus cable and start your PC.

3.1.6.2 Checking and setting the Baud Rate

First of all, turn all DIP switches to the “OFF” position (module ID = 0), then apply the supply voltage (DC 24 V power pack) to the fieldbus coupler.

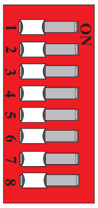


Fig. 3-11: All DIP switches to “OFF” for checking and setting the Baud rate g012442x

Now the currently set Baud rate is checked and displayed by the LED in the top group of LED’s blinking (starting from Firmware WT).

Note
If applying voltage when not all of the DIP switches are in their “OFF” position, the existing setting will be written as a module ID.

Now push the corresponding DIP switches to the desired Baud rate to 'ON', i.e. DIP switch 3 for the Baud rate 125 kB.

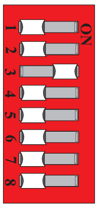


Fig. 3-12: Setting the Baud rate 125 kB g012443x

To be able to store the new setting, push DIP switch 8 also to 'ON'.
Then switch off the coupler supply voltage.

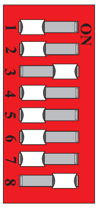


Fig. 3-13: Storing the Baud rate 125 kB g012441x

3.1.6.3 Setting the Module ID

The module ID is set with the supply voltage isolated. For this purpose, push all DIP switches to their “OFF” position again. Then push the DIP switch intended for the desired module ID to “ON”, i.e. DIP switch 1 for the module ID 1.

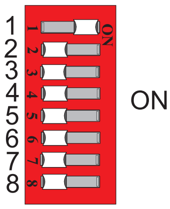


Fig. 3-14: Setting the module ID 1 g012440x

As soon as you switch on the supply voltage, the coupler is in the INITIALIZATION status.
At the same time, the process image is created by means of the connected bus modules and the object directory initialized following the default mapping, if no application specific configuration was stored.
After a fault-free termination of the initialization phase, the coupler automatically changes to the PRE-OPERATIONAL status.
In this status, communication is possible via SDOs, which you can now use to proceed with various settings via your CAN Master software:

- You can set the coupler directly to its OPERATIONAL status or
- select an application specific mapping.

3.1.6.4 Changing to the OPERATIONAL status

You can change the coupler PRE-OPERATIONAL status to the OPERATIONAL status using the **Start_Remote_Node** command from the network management objects. This creates the communication readiness of the fieldbus node for PDOs (see chapter 4.3.3.1.1 "Start Remote Node").

If no further settings are made, the coupler is operational. Communication is possible according to the Default-Mapping (refer to chapter **4.3.4.1.1** "**Default configuration**".

3.1.6.5 Application specific Mapping

An alternative to the use of the default mapping is to define the data to be transmitted by PDOs in an application specific PDO mapping. For this purpose, the coupler has to be in the PRE-OPERATIONAL status, or the coupler has to be set with the NMT Service "**Enter Pre-Operational**" in this status.

Details of how to proceed with an application specific mapping are explained below.

Example:
The 3rd and the 5th 2 byte analog input channel and the first 8 bit digital input group are to be read using the TxPDO 2. For transmission purposes, the CAN identifier 0x432 is to be used. Transmission must be synchronous with each 3rd SYNC object.

The default CAN IDs are used for the SDOs. The setting is made at node 8.

xx... is not evaluated

1. First of all, deactivate the PDO Mapping by zeroing the number of mapping objects in index 0x1A01, sub-index 0 (Transmit PDO Mapping Parameter).

Deactivating PDO mapping:		
	CAN ID	**Data**
Transmit	608	0x2F 01 1A 00 00 xx xx xx
Receive	588	0x60 01 1A 00 xx xx xx xx

2. Enter into the TxPDO mapping parameter structure (Index 0x1A01) the Index, Sub-Index and the Object length of the application object.
   Max. 8 bytes of data can be assigned per PDO.

Writing into the mapping parameter structure:		
Application object	**Index**	**Sub-Index**
3 rd analog input channel	0x2400	3
5 th analog input channel	0x2400	5
1 st digital input group	0x2000	1

The following structure must be reached in the mapping parameters of the 2nd TxPDO in order to ensure the task set:

TxPDO Mapping Parameter Structure, Index 0x1A01			
	Application object		
Sub-Index:	Index:	Sub-Index:	Object length in Bit
0	3		
1	0x2400	3	0x10
2	0x2400	5	0x10
3	0x2000	1	0x08

Note
First of all enter the mapping parameter sub-index 1 ... 8 in the sub-index 0, followed by the number of valid sub-indexes.

These objects are stored with the aid of SDO transmissions:

Mapping 3 rd analog input channel		
	CAN ID	**Data**
Transmit	0x608	0x23 01 1A 01 10 03 00 24 23 0 data bytes invalid 011A Index (Lowbyte first) 01 Sub-index 10 Data width of the analog channel 03 Sub-index, where the 3rd analog channel is in the manufacturer device profile 00 24 Index (Lowbyte first) where the 3rd analog channel is in the manufacturer device profile
Receive	0x588	0x60 01 1A 01 xx xx xx xx 60 OK 011A Index (Lowbyte first) 01 Sub-Index

Mapping 5 th analog input channel		
	CAN ID	**Data**
Transmit	0x608	0x23 01 1A 02 10 05 00 24
Receive	0x588	0x60 01 1A 02 xx xx xx xx

Mapping 1 st digital input group		
	CAN ID	**Data**
Transmit	0x608	0x23 01 1A 03 08 01 00 20
Receive	0x588	0x60 01 1A 03 xx xx xx xx

Number of mapping objects = 3, enter on Sub-Index 0		
	CAN ID	**Data**
Transmit	0x608	0x2F 01 1A 00 03 xx xx xx
Receive	0x588	0x60 01 1A 00 xx xx xx xx

3. To change the communication parameters, now deactivate the PDO you wish to map.
   In the present example, this is the TxPDO2.
   To this effect, write value 0x80000000 into the object having the index 0x1801, sub-index 01 (Transmit PDO Communication Parameter).

Deactivating PDO:		
	CAN ID	**Data**
Transmit	608	0x23 01 18 01 00 00 00 80
Receive	588	0x60 01 18 01 xx xx xx xx

4. Now write into the object with Index 0x1801, Sub-Index 1 to 2 (Transmit PDO Communication Parameter) the communication parameters in the structure.
   Thereby the Transmission Type is 3 (Synchronous transmission with every 3 rd SYNC object).

Enter the Communication Parameter:		
TxPDO Communication Parameter, Index 0x1801		
Sub-Index:	**Value:**	**Meaning:**
0	3	number of supported entries in the record
1	0x432	COB-ID used by PDO
2	3	Transmission Typ

Sub-Index 3: Inhibit Time = 0		
	CAN ID	**Data**
Transmit	0x608	0x2B 01 18 03 00 00 xx xx
Receive	0x588	0x60 01 18 03 xx xx xx xx

Sub-Index 2: Transmission Typ = 3		
	CAN ID	**Data**
Transmit	0x608	0x2F 01 18 02 03 xx xx xx
Receive	0x588	0x60 01 18 02 xx xx xx xx

Sub-Index 1: Change COB-ID = 432 on PDO and PDO from invalid to valid		
	CAN ID	**Data**
Transmit	0x608	0x23 01 18 01 32 04 00 00
Receive	0x588	0x60 01 18 01 xx xx xx xx

5. When you change the fieldbus coupler to OPERATIONAL using **the ”Start Remote Node**" message, the PDOs are activated and the TxPDO object can now be used for data transmission.

3.1.7 LED Display

The coupler possesses several LEDs for on site display of the coupler operating status or the complete node.

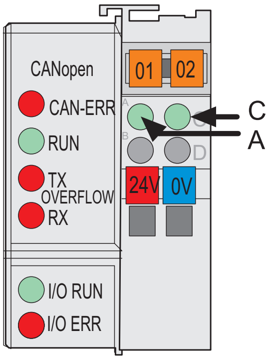


Fig. 3-15: Display elements 750-337 g030702x

The LEDs can be divided into three groups.

The first group = fieldbus contains the LEDs with the denotation CAN-ERR (red), RUN (green), Tx-Overflow (red) and Rx-Overflow (red) signalling the operating status of the communication via CAN.

The second group = internal bus consists of the I/O-RUN LED (green) and the I/O ERR LED (red). The internal bus status and the software exception codes are signalled by these LEDs.

The third group uses green LEDs. They are located on the right-hand side of the coupler power supply. These display the status of the supply voltage.

3.1.7.1 Fieldbus Status

The upper four LED´s (CAN-ERR, RUN, Tx- und Rx-Overflow) signal the operating conditions of the CAN communication.

CAN-ERR	RUN	TX OVERF	RX OVERF	Meaning	Remedy
OFF	OFF	OFF	OFF	No function or self-test	check supply (24V and 0V), wait for self-test
OFF	ON	X	X	Module is in the state PRE-OPERATIONAL or OPERATIONAL	
ON	OFF	X	X	Module is in the STOP state or fatal fieldbus independent error (i.e. a module was removed), incorrect configuration	Check the fieldbus cable, check all other members and remove gradually. Control the baud rate. In case of a fieldbus independent fault: Check the I/O modules, Reset the node, in the case of a configuration fault, check the configuration
X	X	X	ON	CAN receiver buffer is full. Data loss is likely.	Increase the time span between 2 protocols.
X	X	ON	X	CAN transmitter buffer is full. Data loss is likely.	Check the configuration of the bus system. Increase the transmit priority of the module.
ON	SLOW FLASHING	X	X	Module is in the state STOP, Guard Message failed	Change into the state OPERATIONAL and restart Guard message
OFF	SLOW FLASHING	X	X	After Guarding loss module is again in the previous status	Power On , Reset Node or Reset Communication

3.1.7.2 Node Status – Blink Code of the 'I/O ERR'-LED

LED	Color	Meaning
I/O RUN	green	The 'I/O RUN'-LED indicates the node operation.
I/O ERR	red	The 'I/O ERR'-LED signals faults occurring.

The coupler starts after switching on the supply voltage.
The "I/O ERR" LED flashes red.
Following an error free start up the "I/O RUN" LED changes to green steady light.
In the case of a fault the "I/O ERR" LED continues blinking red.

Detailed fault messages are displayed via the 'I/O ERR'-LED with the aid of a blink code. A fault is cyclically displayed with up to 3 blink sequences.

- The first blink sequence (approx. 10 Hz) starts the fault display.
- The second blink sequence (approx. 1 Hz) following a pause. The number of blink pulses indicates the **fault code**.
- The third blink sequence (approx. 1 Hz) follows after a further pause. The number of blink pulses indicates the **fault argument**..

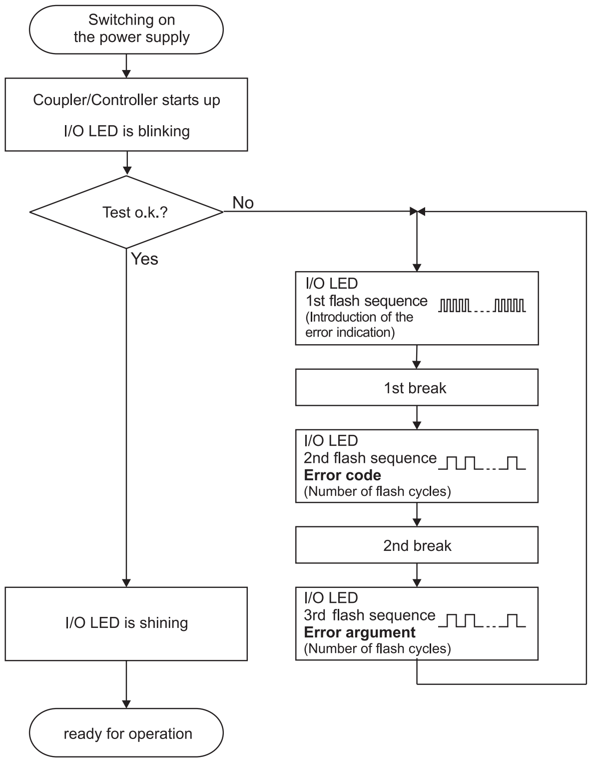


Fig. 3.1.7-16: Signalling the LED's node status via the 'I/O ERR'-LED g012111e

After overcoming a fault, restart the coupler by cycling the power.

I/O RUN	Meaning
green	Data cycle on the internal bus
OFF	No data cycle on the internal bus
I/O ERR	**Meaning**
red	Coupler hardware defective
red blinks	When starting: internal bus is initialized During operation: general internal bus fault
red blinks cyclically	Fault message during internal bus reset and internal fault: The fault message is diplayed via the 'I/O ERR'-LED with the aid of a blink code and evaluated as fault code and fault argument.
OFF	No fault

Fault Message of the 'I/O ERR' LED

1 st blink sequence: Starting the fault display
2 nd blink sequence: Fault code
3 rd blink sequence: Fault argument

Fault code 1: "Hardware and Configuration fault"		
Fault argument	**Fault description**	**Trouble shooting**
-	Checksum error of the parameter data	Turn off the power supply of the node, reduce number of I/O modules and turn the power supply on again.
1	Overflow of the internal buffer memory for the inline code	Turn off the power supply of the node, reduce number of I/O modules and turn the power supply on again. If the error still exists, exchange the bus coupler.
2	I/O module(s) with unsupported data type	Detect faulty I/O module as follows: turn off the power supply. Place the end module in the middle of the fieldbus node. Turn the power supply on again. – If the LED is still blinking, turn off the power supply and place the end module in the middle of the first half of the node (towards the coupler). – If the LED doesn’t blink, turn off the power supply and place the end module in the middle of the second half of the node (away from the coupler). Turn the power supply on again. Repeat this procedure until the faulty I/O module is detected. Replace the faulty I/O module. Ask about a firmware update for the fieldbus coupler.

Fault code 2: -not used-		
Fault argument	**Fault description**	**Trouble shooting**
-	not used	-
Fault code 3: "Internal bus protocol fault"		
Fault argument	**Fault description**	**Trouble shooting**
-	Internal bus communication malfunction; faulty device can’t be detected	If the fieldbus node comprises internal system supply modules (750-613), make sure first that the power supply of these modules is functioning. This is indicated by the status LEDs. If all I/O modules are connected correctly or if the fieldbus node doesn’t comprise 750-613 modules you can detect the faulty I/O module as follows: turn off the power supply of the node. Place the end module in the middle of the fieldbus node. Turn the power supply on again. – If the LED is still blinking, turn off the power supply and place the end module in the middle of the first half of the node (towards the coupler). – If the LED doesn’t blink, turn off the power supply and place the end module in the middle of the second half of the node (away from the coupler). Turn the power supply on again. Repeat this procedure until the faulty I/O module is detected. Replace the faulty I/O module. If there is only one I/O module left but the LED is still blinking, then this I/O module or the coupler is defective. Replace defective com-ponent.

Fault code 4: "Internal bus physical fault"		
Fault argument	**Fault description**	**Trouble shooting**
-	Error in internal bus data communication or interruption of the internal bus at the coupler	Turn off the power supply of the node. Place an I/O module with process data behind the coupler and note the error argument after the power supply is turned on. If no error argument is given by the I/O LED, replace the coupler. Otherwise detect faulty I/O module as follows: turn off the power supply. Place the end module in the middle of the fieldbus node. Turn the power supply on again. – If the LED is still blinking, turn off the power supply and place the end module in the middle of the first half of the node (towards the coupler). – If the LED doesn't blink, turn off the power supply and place the end module in the middle of the second half of the node (away from the coupler). Turn the power supply on again. Repeat this procedure until the faulty I/O module is detected. Replace the faulty I/O module. If there is only one I/O module left but the LED is still blinking, then this I/O module or the coupler is defective. Replace defective component.
n*	Interruption of the internal bus after the nth process data module.	Turn off the power supply of the node, exchange the (n+1)th process data module and turn the power supply on again.
Fault code 5: "Internal bus initialization fault"		
Fault argument	**Fault description**	**Trouble shooting**
n*	Error in register communication during internal bus initialization	Turn off the power supply of the node and replace nth process data module and turn the power supply on again.

* The number of blink pulses (n) indicates the position of the I/O module. I/O modules without data are not counted (e.g. supply module without diagnosis)

Example: the 13th I/O module is removed.	
1.	The "I/O" LED generates a fault display with the first blink sequence (approx. 10 Hz).
2.	The first pause is followed by the second blink sequence (approx. 1 Hz). The "I/O" LED blinks four times and thus signals the fault code 4 (internal bus data fault).
3.	The third blink sequence follows the second pause. The "I/O ERR" LED blinks twelve times. The fault argument 12 means that the internal bus is interrupted after the 12th I/O module.

3.1.7.3 Supply Voltage Status

LED	Color	Meaning
A	green	Status of the operating voltage – system
C	green	Status of the operating voltage – power jumper contacts

There are two green LED’s in the coupler supply section to display the supply voltage. The LED A (left above) indicates the 24 V supply for the coupler. The LED C (right above) signals the supply to the field side, i.e. the power jumper contacts.

3.1.8 Technical Data

System Data	
Number of nodes	110
Transmission medium	shielded Cu cable3 x 0.25 mm^2
Max. length of bus line	30 m ... 100 m (baud rate dependent / cable dependent)
Baud rate	10 kBaud ... 1 MBaud
Fieldbus connection	5-pole male connector, series 231 (MCS) female connector 231-305/010-000 is included
Standards and Regulations (cf. Chapter 2.2)	
EMC CE-Immunity to interference	acc. to EN 50082-2 (96)
EMC CE-Emission of interference	acc. to EN 50081-2 (94)
Approvals (cf. Chapter 2.2)	
$_C$UL$_{US}$ (UL508) $_C$UL$_{US}$ (UL1604)	E175199 E198726 (Class I Div2 ABCD T4A)
KEMA	01ATEX1024 X (II 3 G EEx nA II T4)
Conformity marking	CE
Accessories	
EDS files	Download: www.wago.com
Miniature WSB quick marking system	
Technical Data	
Number of I/O modules	64
Input process image	max. 512 Byte
Output process image	max. 512 Byte
No. of PDO	5 Tx / 5 Rx
No. of SDO	2 Server SDO
Communication profile	DS-301 V3.0
Device profile	DS-401 V1.4
COB ID Distribution	SDO, Standard
Node ID Distribution	DIP Switch
Further CANopen features	NMT Slave, Minimum Boot-up, Variable PDO Mapping, Emergency Message, Life Guarding
Configuration	via PC or PLC
Voltage supply	DC 24 V (-15 % … + 20 %)
Input current $_{max}$	500 mA at 24 V
Efficiency of the power supply	87 %

Internal power consumption	350 mA at 5 V
Total current for I/O modules	1650 mA at 5 V
Isolation	500 V system/field
Voltage via power jumper contacts	DC 24 V (-15 % … + 20 %)
Current via power jumper contacts $_{max}$	DC 10 A
Dimensions (mm) W x H x L	51 x 65* x 100 (*from top edge of mounting rail)
Weight	ca. 195 g

4 CANopen

4.1 Description

CAN (Controller Area Network) was developed in the mid-eighties for data transmission in automobiles. The CAN specification defines the Data Link Layer which is the physical and data backup layer. The message structure is exactly described, however, nothing is said regarding the Application Layer. CAL, in the contrary, describes the Application Layer or the Meaning of the transmitted data. CAL is a general descriptive language for CAN networks and provides a large number of communication services.

CANopen is a networking concept based on the serial bus system CAN. CANopen is defined as a uniform application layer by the DS 301 specifications of the CIA (CAN in automation).

The network management provides a simplified start-up of the network. This network can be extended by the user as desired.

CAN is a Multimaster bus system. In contrast to other fieldbus systems, the modules connected to the bus are not addressed but the messages identified. Whenever the bus is free, the subscribers are allowed to send messages. Bus conflicts are solved in that the messages are assigned a certain priority. This priority is defined by the COB ID (Communication Object Identifier) and is clearly assigned to a communication object. The smaller the assigned identifier, the higher the priority. This also allows communication without the bus master group.

Each bus subscriber is solely decisive as to the point in time of data transmission. However, there is also a possibility to request other bus subscribers to send data. This request is performed via the so-called remote frame.

The CANopen specification (DS 301) defines the technical and functional features used to network distributed field automation devices.

Further information
CAN in Automation (CiA) provides further documents for their members in the Internet under:
can-cia.de

4.2 Network Architecture

4.2.1 Transmission Media

4.2.1.1 Type of Cable

A bus medium forms the basis for the physical connection of CAN.
With CAN, both the bus coupling and the bus medium are specified according to ISO 11898 (CAN High-Speed).

According to the cable specification, the Twisted-Pair medium (shielded cables twisted in pairs) with a wave resistance of 108...132 Ohm is recommended.
Twisted-Pair is low priced, convenient to use and permits simple bus type wiring.

The WAGO CANopen fieldbus nodes are intended for wiring using shielded copper wire (3x0.25 mm²).

Two important points have to be taken into consideration when designing the electrical bus medium:

- the maximum bus length and
- the required conductor cross section.

4.2.1.2 Maximum Bus Length

The length of the bus is mainly limited by the signal running time and must, therefore, be adapted to the Baud rate:

Baud rate	Bus length
1 Mbit/s	30 m
800 kbit/s	50 m
500 kbit/s	100 m
250 kbit/s	250 m
125 kbit/s	500 m
≤ 50 kbit/s	1000 m

Table 4-1: Maximum bus length dependent on the set Baud rate

4.2.1.3 Required Conductor Cross Section

The conductor cross section depends on the conductor length and has to be selected according to the number of nodes connected.

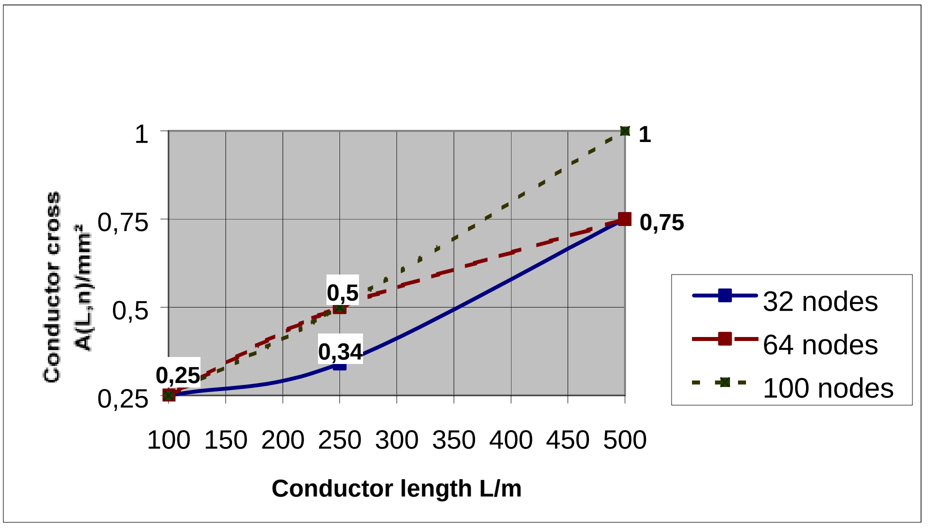


Fig. 4-1: Conductor cross section depending on the conductor length and the number of nodes

4.2.2 Cabling

The connection of a WAGO fieldbus node to the CANopen bus cable is made by the appropriate supplied plug (5-pole plug MCS or 9-pole plug D-SUB).

For cabling with a shielded copper cable (3x0.25 mm²), the plug is assigned with the CAN_High, CAN_Low and CAN_GND connections.
CAN_High and CAN_Low are two physically different bus levels.
CAN_GND is the common reference potential.

The conductor shield of the cable can be routed on the connection drain, which is terminated with 1 MΩ as against the ground or PE (carrier rail contact). A low ohmic connection of the shield to the PE can only be made externally (i.e. by means of a supply module). The aim is for a central PE contact for the entire CANopen bus conductor screening.

Note
WAGO offers the screen connection system (series 790) for an optimum connection between fieldbus cable screening and functional earth.

Each CAN node forms the differential voltage U_{Diff} with: $U_{Diff} = U_{CAN\_High} - U_{CAN\_Low}$. from the bus levels CAN_High and CAN_Low.
The different signal transmission offers the advantage of being immune to common mode interference and ground offset between nodes.

If the bus level is in the recessive status, the voltage between CAN_Low and CAN_GND is 2.5 V and also 2.5°V between CAN_High and CAN_GND. This means that the differential voltage is 0 V.

If the bus level is in the dominant status, the voltage between CAN_Low and CAN_GND is 1.5 V and 3.5°V between CAN_High and CAN_GND.
Then differential voltage is approx. 2 V.

Note

When connecting subscribers, ensure that the data lines are not mixed up.

At its conductor ends, the bus cable must always be connected with a matching resistor of 120 Ohm to avoid reflections and, as a result, transmission problems.
This is also required for very short conductor lengths.

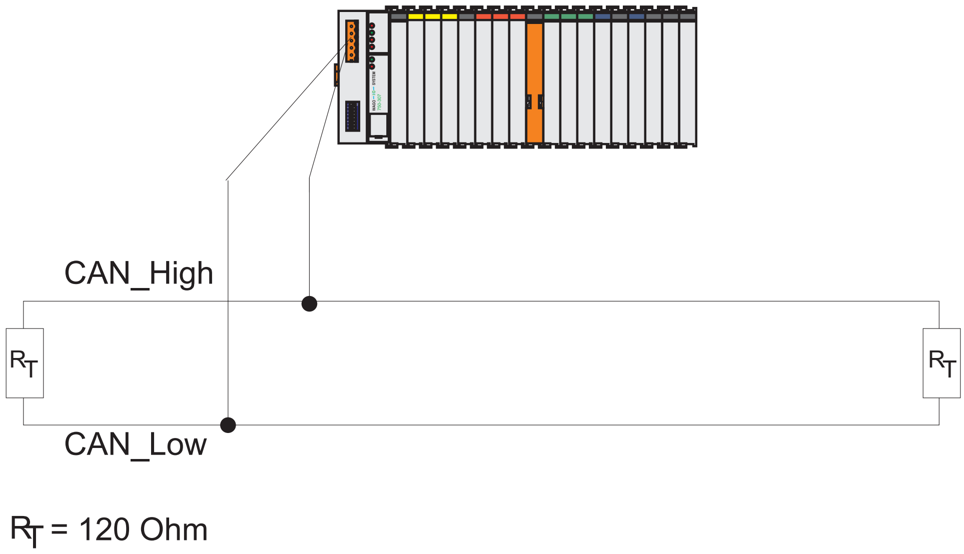


Fig. 4-2: Connection principle of a WAGO fieldbus node to the CAN bus
g012402x

Before starting the buscoupler on the network, the installation should be checked. The physical connection can be checked in the CAN fieldbus with an ohmmeter at any place. You have to remove all connections to other devices except for the terminating resistors.

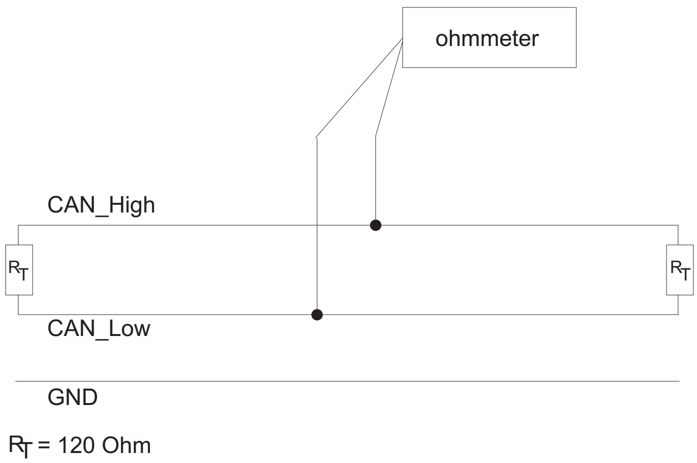


Fig. 4-3: Measuring principle to check the CAN bus prior to wiring g012445e

Measurement	**Value**	**Meaning**
GND and CAN_L	infinite	ok.
	0	Short-circuit between GND and CAN_L
GND and CAN_H	infinite	o.k.
	0	Short-circuit between GND and CAN_H
CAN_L and CAN_H	ca. 60 Ω	o.k., 2 terminal resistors in the bus
	ca. 120 Ω	Only 1 terminal resistor in the bus
	< 50 Ω	More than 2 terminal resistors in the bus

The CAN bus is 2-wire bus and bus error management can detect a cable break or a short-circuit by the asymmetric operation.

Further information
The CiA provides documents regarding specifications, especially cable specifications in the Internet under:

http://www.can-cia.de

4.2.3 Network Topology

To build a simple CANopen network, you need a master (PC with a CANopen fieldbus PCB card), a connection cable and a DC 24 V power pack to ensure the power supply in addition to a CANopen fieldbus node.

The CANopen network is constructed as a line structure with matching resistors (120 Ohm).

In systems having more than two stations, all subscribers are wired in parallel. The maximum length for a conductor branch should not exceed 0.3 m.

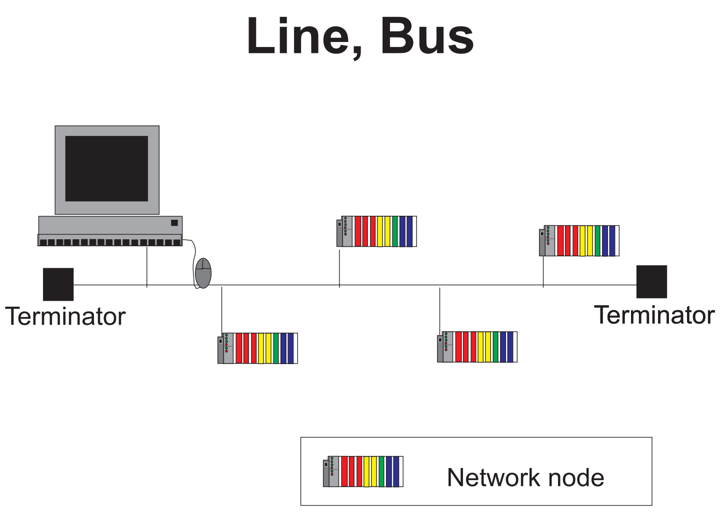


Fig. 4-4: Bus topology of a CANopen network g012430e

All net subscribers communicate at the same Baud rate. The bus structure permits coupling in and out without side effect of stations, or the step-by-step start-up of the system.
Later extensions have no influence on stations already in operation. The system automatically detects when a subscriber fails or is newly added to the net.

Also branches from the line-shaped bus and as such the establishment of hierarchic net structures are possible via router nodes.

Repeaters can be used to increase the maximum possible number of nodes to 110 and to enlarge the network spatial extension (bus length). Although the network spatial extension depends on the transmission rate, CAN can also be used for spatially extended networks. The data rates achievable are of the same order as with other bus systems. However, the maximum possible cable length is reduced per repeater by 20 - 30 m due to the signal delay.

4.2.4 Interface Modules

In a network, all WAGO CANopen fieldbus nodes operate as slaves. The master operation is taken over by a central control system, such as PLC, NC or RC. The connection to fieldbus devices is made via interface modules

Interface modules for programmable logic controls (PLCs) and PC interface PCBs for CANopen are offered by various manufacturers.

4.2.5 Configuration Software

Before a PLC can communicate I/O data with a fieldbus device, the fieldbus controller board has to be configured for each field bus device on the network.

The software for configuring and diagnosing fieldbus networks is delivered with the Interface modules for programmable logic controls (PLCs) or PC interface PCBs for CANopen or it is contained in the used CAN Master-Software (e. g. SyCon of the company Firma Hilscher GmbH).

The needed data to the WAGO CANopen couplers and controllers are made available with the merging of the EDS files (Electrical Data Sheet) in the configuration software.

Note
EDS and Symbol files for the configuration of I/O modules are available for free download on the INTERNET Site:
www.wago.com / Service / Downloads / Software / ELECTRONICC / EDS files for CANopen.

4.3 Network Communication

With CANopen, data transmission, the triggering of events, signalling of error states etc. takes place by means of communication objects. For this purpose, each communication object is assigned a clear COB-ID (Communication Object Identifier) in the network.
The COB ID assignment according to the Device profile DS401 results in accordance with the following table.

10	9	8	7	6	5	4	3	2	1	0
Function code				node identifier (0[= all], 1-127)						

Communication objects		Function code		Resulting COB-ID		Object directory index
		dec	bin	dec	bin	hex
Broadcast messages	NMT Command	0	0000	0		
	Sync message	1	0001	128	80	1005, 1006, 1007
	System time	2	0010	256	100	1012, 1013
Peer-to-Peer messages	Alarm objects	1	0001	129-255	81-FF	1014, 1015
	Tx-PDO1	3	0011	385-511	181-1FF	1800
	Rx-PDO1	4	0100	513-639	201-27F	1400
	Tx-PDO2	5	0101	641-767	281-2FF	1801
	Rx-PDO2	6	0110	769-895	301-37F	1401
	Tx-PDO3	7	0111	897-1023	381-3FF	1802
	Rx-PDO3	8	1000	1025-1151	401-47F	1402
	Tx-PDO4	9	1001	1153-1279	481-4FF	1803
	Rx-PDO4	10	1010	1281-1407	501-57F	1403
	Tx-SDO	11	1011	1409-1535	581-5FF	1200
	Rx-SDO	12	1100	1537-1663	601-67F	1200
	node monitoring	14	1110	1793-1919	701-77F	100C, 100D 1016, 1017

The parameters required for the communication objects as well as the parameters and data of the CANopen subscribers are filled in the object directory.

Type and number of objects supported by the node depend on the individual fieldbus coupler.

In addition to several special objects, i.e. for the network management (NMT), for synchronization (SYNC) or for error messages (EMCY), the communication profile contains the two object types PDO and SDO.

The PDOs (process data objects) are used for the transmission of real time data, and the SDOs (service data objects) permit access to the object directory both for reading and writing.

4.3.1 Communication Objects

4.3.1.1 Process Data Object - PDO

PDOs contain real time data with high priority identifiers. The data telegrams consist of a maximum of 8 bytes and can be interchanged among the individual sub-assemblies, as required. This data exchange can be optionally event controlled or performed in a synchronized manner. The event controlled mode allows the bus load to be drastically reduced permitting a high communication capacity at a low Baud rate. However, the various modes can also be processed as a mix (see chapter 4.3.4.2.16 "Object 0x1400– 0x1404, Receive PDO Communication Parameter").

4.3.1.1.1 PDO Protocol

This protocol is used to transmit data from/to the bus coupler without protocol overhead. PDOs consist only of the CAN identifier and the data field. No further protocol information is contained in a PDO. The contents of the data are defined by the mapping parameters and the transmission type by the communication parameters.

A differentiation is made between RxPDO (receipt PDO) and TxPDO (transmit PDO).

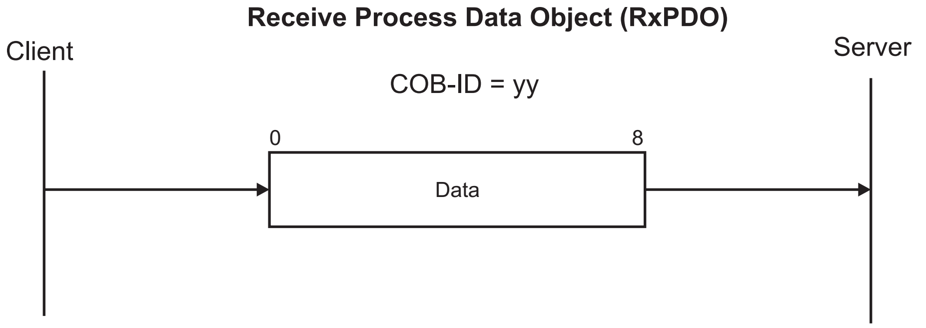


Fig. 4-1: RxPDO g012403x

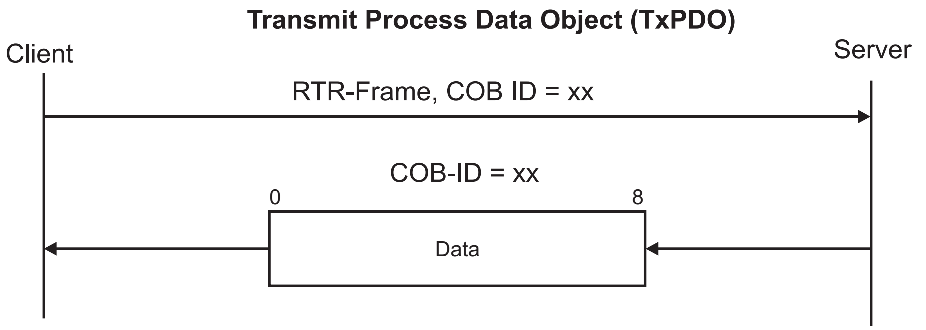


Abb. 4-2: TxPDO g012404x

4.3.1.2 Service Data Object - SDO

The SDOs can be used to read and/or write entries in the object directory. In this manner, a CANopen subscriber can be fully configured. The default SDO is pre-assigned with a low priority identifier. The transmitted data has to be distributed to several messages if it exceeds 4 bytes.

4.3.1.2.1 SDO Protocol

A specific protocol overhead that is indispensable for transmission and contains the command specifier, the index and the sub-index of the entry to be read/written.

4.3.1.2.1.1 General Design

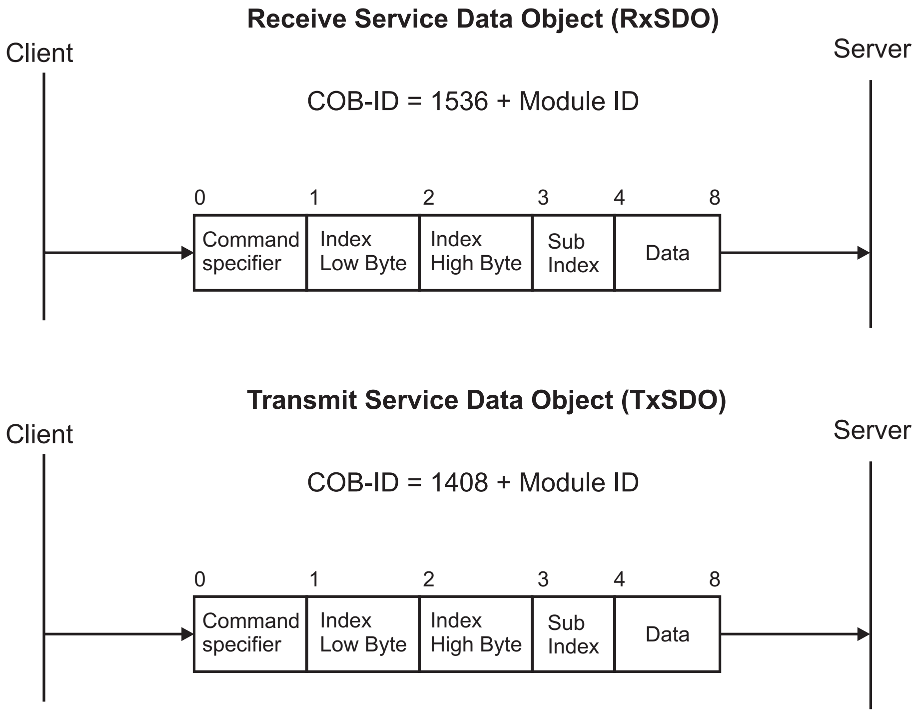


Fig. 4-3: SDO Protokoll g012405x

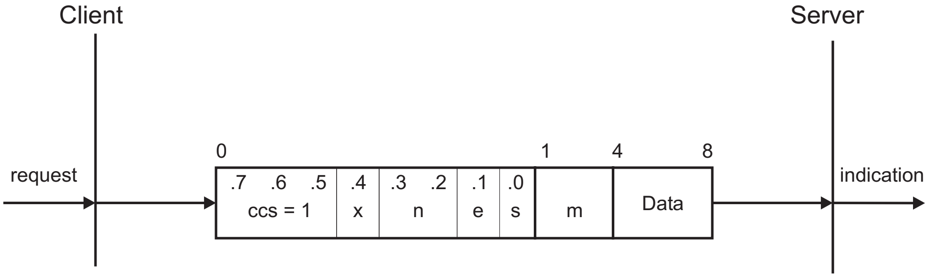
4.3.1.2.1.2 Download SDO Protocol

This protocol is used to write data from the master into the bus coupler.

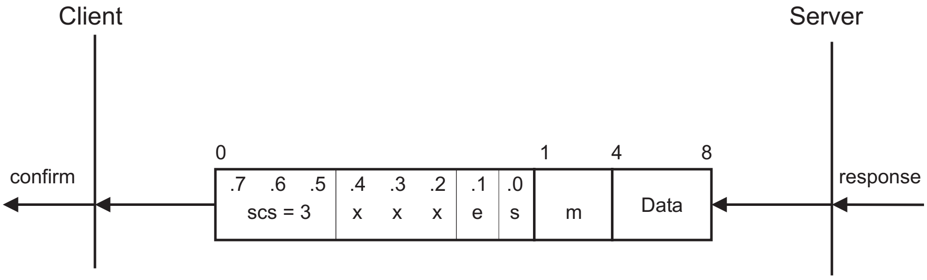
4.3.1.2.1.2.1 Initiate SDO Download

This protocol is used to initiate the data transmission from the master to the bus coupler. When transmitting data of max. 4 bytes, these are also transmitted within the protocol.

Initiate SDO Download



Initiate SDO Download



ccs:	client command specifier	1: initiate download request
scs:	server command specifier	3: initiate download response
n:	only valid if e = 1 and s = 1, otherwise 0.	If n is valid, it displays the number of bytes which do not contain any data. Example: 3 data bytes, e = 1 and s = 1, n = 4 - 3 = 1
e:	transfer type	0: normal transfer, number of the bytes to be written >= 5 byte
		1: expedited transfer, number of the bytes to be written < 5 byte
s:	size indicator	0: data set size is not displayed
		1: data set size is displayed s is always 1
m:	multiplexor	Index and Sub-Index of object directory
		Index, Low Byte : Byte #1
		Index, High Byte: Byte #2
		Sub-Index: Byte #3
d:	data	e = 0, s = 0: d is reserved for further use of CiA
		e = 0, s = 1: d contains the number of bytes for download
		Byte 4 contains the LSB and Byte 7 contains the MSB.
		e = 1: d contains the data
X:		Not used, always 0
reserved:		Reserved for further use of CiA

4.3.1.2.1.2.2 Download SDO Segment

This protocol is used to transmit more than 4 data, i. e. this follows after fully processing the „Initiate SDO Download Protocol" which initiates the data transmissions.

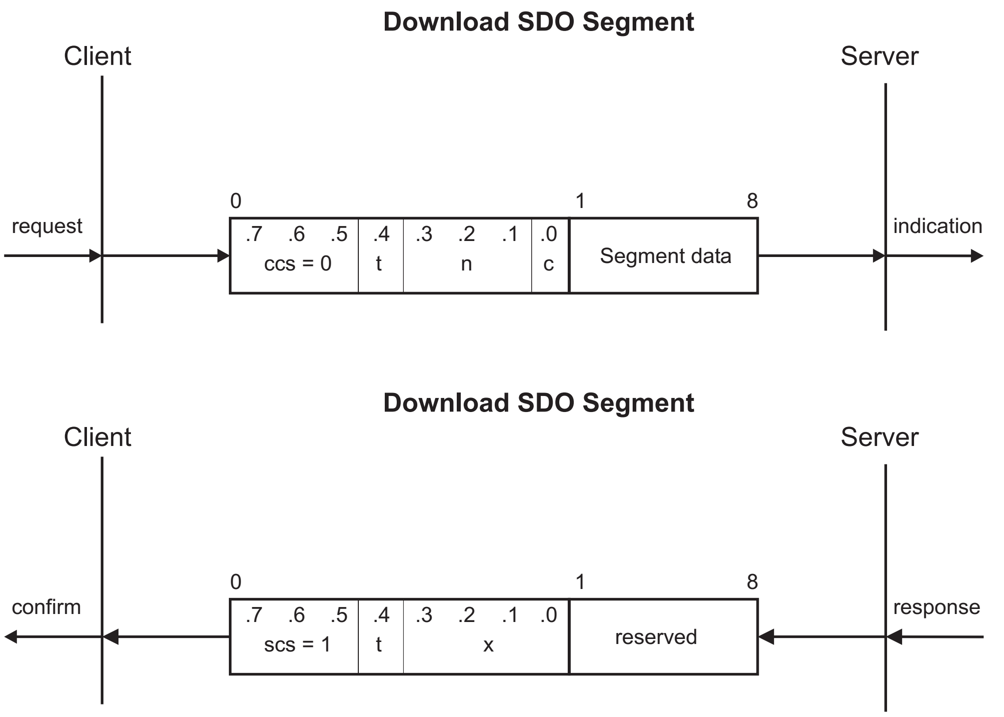


Fig. 4-5: Download SDO Segment g012409x

ccs:	client command specifier	0: download segment request
scs:	server command specifier	1: download segment response
seg-data	Contains the data to be transmitted.	The meaning of the data is determined by the application.
n:		Displays the number of bytes not containing any data. n is 0 if no segment size is displayed.
c:	Indicates whether or not a download is necessary for further data.	0: There is more data to be downloaded.
		1: There is no more data to be downloaded.
t:	Toggle Bit	This bit must be able to toggle for each segment for which a download is made. The first segment zeroes the toggle bit. The toggle bit is identical both for the enquiry and the reply message.
X:		Not used, always 0
reserved:		Reserved for further use of CiA

4.3.1.2.1.3 Upload SDO Protocol

This protocol is used to read data out of the bus coupler.

4.3.1.2.1.3.1 Initiate SDO Upload

The data transmission from the bus coupler to the master is initiated with this protocol. When transmitting data of max. 4 bytes, these are also transmitted within the protocol.

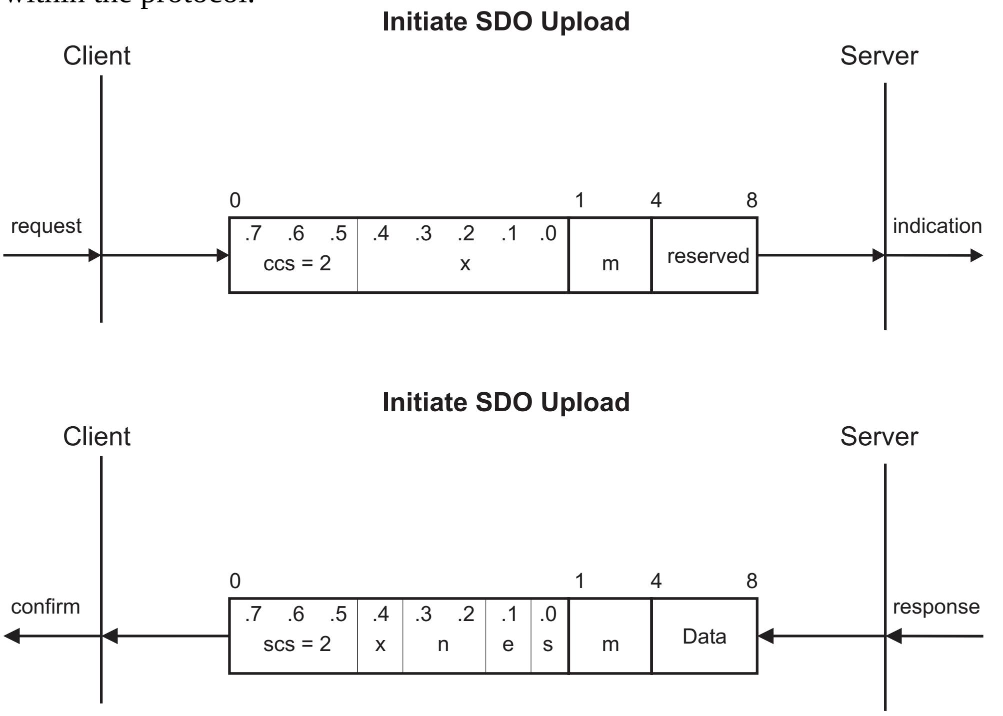


Fig. 4-6: Initiate SDO Upload g012410x

ccs:	Client command specifier	2: initiate upload request
scs:	Server command specifier	2: initiate upload response
n:	is only valid if e = 1 and s = 1, otherwise 0.	If n is valid, it displays the number of bytes in d which do not contain any data. The bytes [8-n, 7] do not contain segment data.
e:	transfer type	0: normal transfer, number of bytes to be written >= 5 bytes
		1: expedited transfer, number of bytes to be written < 5 bytes
s:	size indicator	0: the number of bytes to be transmitted is not displayed
		1: the number of bytes to be transmitted is displayed (depending on the number of bytes)
m:	multiplexor	Index and sub-index of the object directory:
		Index, Low Byte : Byte #1
		Index, High Byte: Byte #2
		Sub-Index: Byte #3

d:	data	e = 0, s = 0: d is reserved for further use of CiA
		e = 0, s = 1: d contains the number of bytes for download
		Byte 4 contains the LSB and Byte 7 contains the MSB.
		e = 1: d contains the data
X:		Not used, always 0
reserved:		Reserved for further use of CiA

4.3.1.2.1.3.2 Upload SDO Segment

This protocol is used if more than 4 data is transmitted, i.e. this follows after fully processing the „Initiate Upload Protocol" which initiates the data transmissions.

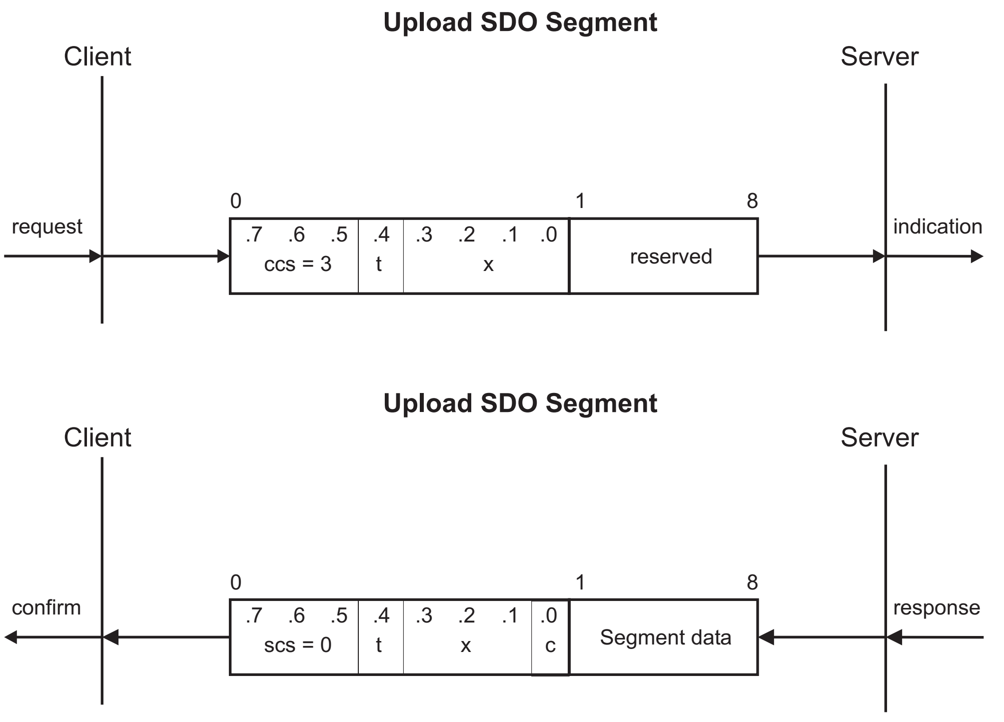


Fig. 4-7: Upload SDO Segment g012411x

ccs:	Client command specifier	3: download segment request
scs:	Server command specifier	0: download segment response
t:	Toggle bit	This bit has to change for each segment for which an upload is made. The toggle bit has to be zeroed for the first segment. The toggle bit is identical both for the enquiry and the reply.
c:	Indicates whether further segments are present for the upload	0: there are more segments to be uploaded
		1:there are no more segments for uploading

seg-data:	Contains the data to be transmitted.	The meaning of the data is determined by the application.
n:		Displays the number of bytes which do not contain data. Bytes [8-n, 7] do not contained data. N is 0 if no segment size is displayed.
X:		Not used, always 0
reserved:		Reserved for further use of CiA

4.3.1.2.1.4 Abort SDO Transfer

This protocol is used in the event of errors occurring during transmission.

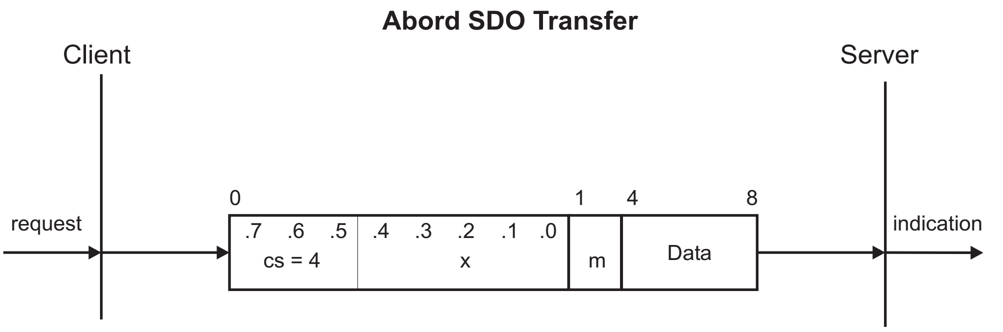


Fig. 4-8: Abort SDO Transfer g012412x

cs:	command specifier	4: abort domain transfer
m:	multiplexor	Index and Sub-Index of Object directory:
X:		Not used, always 0
Data:	4 Byte Error Code	Application specific data about the reasons for the abort.

Supported Abort Domain Transfer Messages

<u>Structure:</u>

Byte	Meaning
0	Command Specifier; 0x80
1	Index
2	
3	SubIdx
4	Additional Code
5	
6	Error Code
7	Error Class

Via Additional Code, Error Code and Error Class the following Errors are coded as UNSIGNED32:

Byte 7	6	Byte 5	Byte 4	Meaning
Additional Code		Error Code	Error Class	
11	00	09	06	Sub Index does not exist
00	00	01	06	Attempt to write a read-only or to read a write only parameter
31	00	09	06	Range Overflow of an Index-Value, Value too high
32	00	09	06	Range Underflow of an Index-Value, Value too low
10	00	07	06	Type Conflict, Data type does not match
12	00	07	06	Data type length too high
13	00	07	06	Data type length too low
41	00	04	06	Data cannot be mapped to PDO
42	00	04	06	PDO length exceeded
40	00	07	06	Incompatibility with other values
00	00	03	05	Toggle bit not alternated
47	00	03	05	General parameter incompatibility reason; Index, SubIdx is mapped in to many PDOs
21	01	00	08	Service Error because of local error
22	00	00	08	Service Error because only one domain transfer is available at the same time

4.3.1.2.2 SDO Examples

The following are 4 SDO examples, the data is being displayed in hexadecimal. These examples show the handling of SDOs on the CAN message level and can be used if the SDO protocol is to be implemented on a CAN card.

A message is subdivided into 4 columns:

1. column	Direction	M->BC = message is sent by the master to the bus coupler. BC->M = message is sent by the bus coupler to the master.
2. column	CAN Identifier	
3. column	Frame Type	D = Data frame R = RTR frame
4. column	Data	Data bytes of the CAN message A maximum of 8 data bytes can be transmitted in a CAN message. The individual bytes are separated by spaces. Entries having the value XX have no meaning, but must be existing. The values should be zeroed for a better understanding. Entries in the reply from the bus coupler having the value DD contain data, which are dependent on the configuration.

4.3.1.2.2.1 Example 1: Read Index 0x1000 Sub-Index 0; Device Type

Index 0x1000 returns 4 bytes. The expedited transfer mode is used for transmission.

Direction	CAN Id	Frame Type	Data byte 0-7
M->BK	0x601	D	0x40 00 10 00 XX XX XX XX
BK->M	0x581	D	0x43 00 10 00 91 01 DD 00

Result:

Data bytes 4 and 5: 91 01 Sequence Low Byte, High Byte rotation:
0x0191 = 401 Device Profile Number

Data bytes 6 and 7: DD 00 Sequence Low Byte, High Byte rotation

4.3.1.2.2.2 Example 2:
Read Index 0x1008 Sub-Index 0; Manufacturer Device Name

Index 0x1008 returns more than 4 bytes. The normal transfer mode is used for transmission in which case 2 messages per mode are transmitted.

Direction	CAN Id	Frame Type	Data byte 0-7
M->BK	0x601	D	0x40 08 10 00 XX XX XX XX
BK->M	0x581	D	0x41 08 10 00 07 00 00 00
M->BK	0x601	D	0x60 XX XX XX XX XX XX XX
BK->M	0x581	D	0x01 37 35 30 2D 33 33 07

Result:

The first reply from the bus coupler informs the master of the number of data to be transmitted (0x00000007 Byte). In the second message, the bus coupler supplies the article number in the ASCII format (hex representation) „750-307“.

4.3.1.2.2.3 Example 3:
Read Index 0x6000 Sub-Index 1; First 8 bit digital input block

The signals of the digital input modules are saved in index 0x6000. 8 bits each are assigned to a group and can be read as from sub index 1. In this example, the input value of the first 8 bit group is read via an SDO message.

Direction	CAN Id	Frame Type	Data byte 0-7
M->BK	0x601	D	0x40 00 60 01 XX XX XX XX
BK->M	0x581	D	0x4F 00 60 01 02 XX XX XX

Result:
In the 5th byte of the CAN message, the bus coupler returns the status of the first group of 8 bits. In this case the 2nd bit is set. Bytes 5-7 are without meaning.

4.3.1.2.2.4 Example 4: Write Index 0x6200 Sub-Index 1; First 8 bit digital output block

The output values of the digital output modules are saved in index 0x6100. 8 bits each are assigned to a group and can be read and written as from sub index 1. In this example, the value 0xFF is written into the outputs of the first 8 bit digital output group.

Direction	CAN Id	Frame Type	Data byte 0-7
M->BK	0x601	D	0x2F 00 62 01 FF XX XX XX
BK->M	0x581	D	0x60 00 62 01 XX XX XX XX

Result:
The outputs of the first 8 bit digital output modules are set.

4.3.1.3 Synchronization Object - SYNC

These objects allow the synchronization of all network subscribers. Corresponding configuration of the PDOs can initiate the network subscribers to process their input data or to update the outputs upon the arrival of a SYNC object.

In this manner cyclical transmission of a SYNC object ensures that all network subscribers will process their process data simultaneously.

4.3.1.3.1 SYNC Protocol

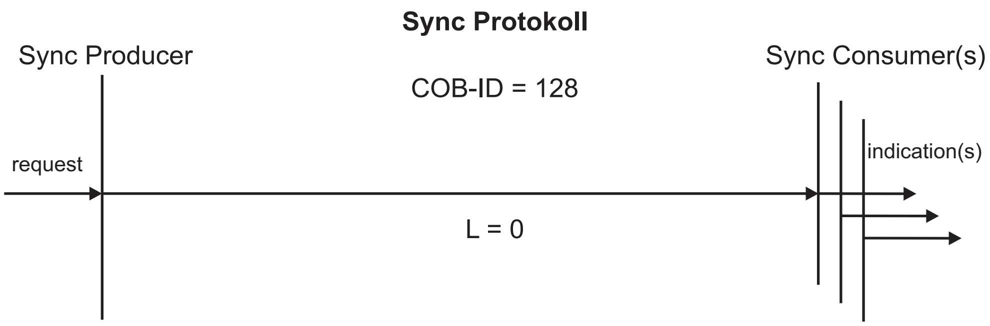


Fig. 4-9: SYNC Protocol g012413x

4.3.1.4 Emergency Object (EMCY)

Emergency objects are triggered by an internal error situation such as i.e. a module is removed during operation, or a module signals an error. The bus coupler then sends an emergency object to all connected devices (Broadcast), to broadcast the error occurred. The informed bus subscribers can then react accordingly by suitable error correction measures.

4.3.1.4.1 EMCY Protocol

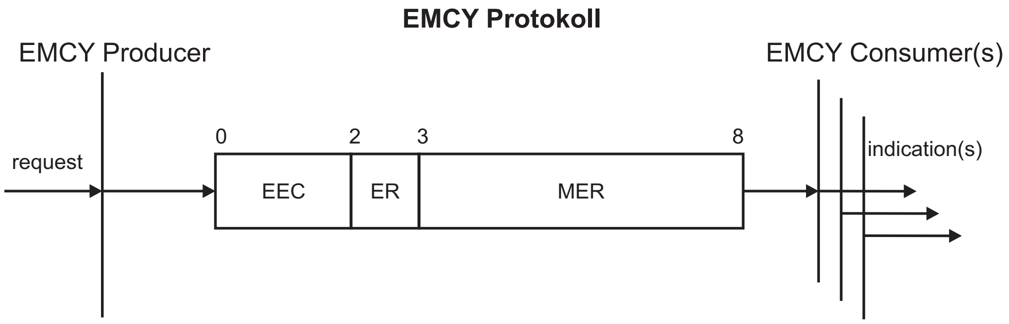


Fig. 4-10: EMCY Protocol g012414x

More Information
A detailed description to the Emergency messages, please refer to chapter **4.3.8** "**Error Message (Emergency)**".

4.3.2 Communication states of a CANopen fieldbus coupler/controller

4.3.2.1 CANopen state diagram

The status diagram described in the following figure shows the individual communication states and possible transitions related to the CAN communication.

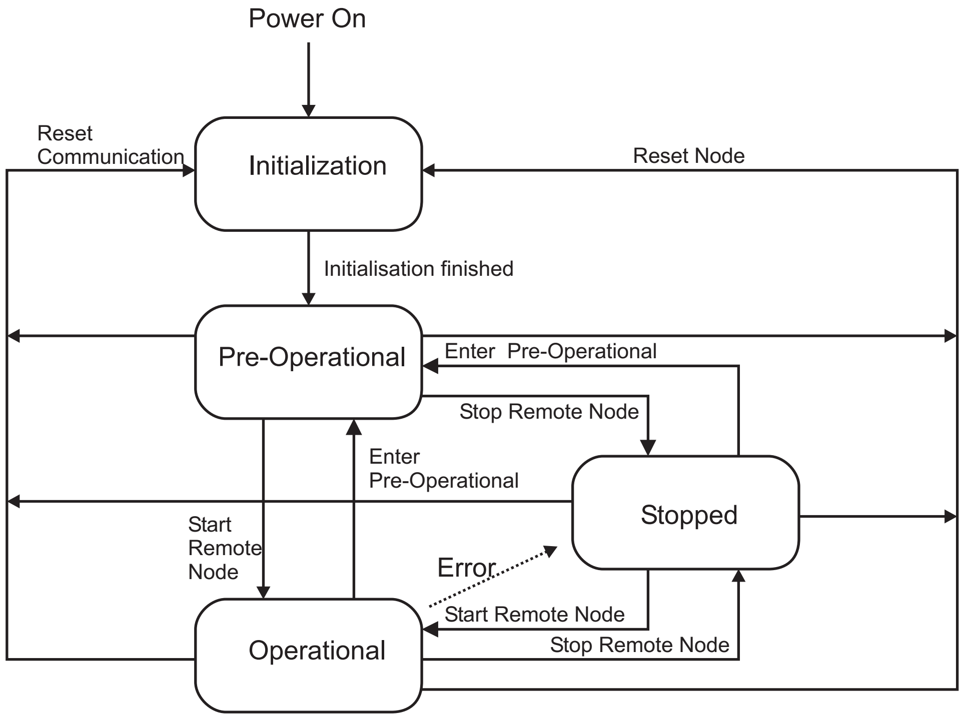


Fig. 4-11: State diagram of the fieldbus coupler/controller g012422x

4.3.2.2 INITIALIZATION

Following a power On or a reset (module ID unequal 0), the bus coupler is automatically in the INITIALIZATION status. In this status, the bus coupler performs a self-check to check all functions of its components and the communication interface. The process image is created on the basis of the connected modules and a possibly stored configuration, and the object directory initialized. If no errors are detected during the initialization phase the bus coupler automatically changes to the pre-operational status. If errors were found, a change to the STOP status takes place.

During initialization, the red I/O ERR LED starts blinking slowly and changes to its higher frequency. If initialization and the change to the pre-operational status have been successfully completed, the green I/O RUN LED is lit and it starts to blink. If errors have occurred (i.e. no end module connected) the I/O ERR LED indicates the error type by a red blinking sequence (see LED status display). In this case, the STOP LED is lit red

4.3.2.3 PRE-OPERATIONAL

In this status, communication can be made via SDOs. Communication via PDOs is not possible. The SDOs allow for reading and writing in the entries of the object directories permitting for instance to re-configure the bus coupler by means of the configuration tool. Mapping, bus coupler parameters, IDs etc. can in this manner be adapted to the required conditions. The newly configured configuration can be saved in flash.

A change from the pre-operational status to the operational status is performed by means of the NMT service Start_Remote_Node.

4.3.2.4 OPERATIONAL

This status allows communication via SDOs and PDOs, it does, however, not allow different configurations. It is, for instance, not allowed to change the COB ID in the presence of a valid PDO. For a detailed description, please refer to the corresponding entries in the object directory.

The change from the operational status to the pre-operational status is performed with the NMT service Enter_Pre_Operational_State.

4.3.2.5 STOPPED

The Stopped status reflects an error status. This is the case if the NMT service Stop_Remote_Node was received or if a fatal internal error has occurred (i.e. module was removed during operation).

This status does not allow communication via SDOs or PDOs. Only the NMT services and the Node Guarding/Heartbeat (if activated) are performed.

You can quit the Stopped status via the NMT services Start_Remote_Node_Indication, Enter_Pre_Operational_State and Reset_Node.

4.3.3 Network Management Objects

4.3.3.1 Module Control Protocols

The NMT master can use these protocols to check the status of the NMT slave. The following states are defined: INITIALIZING, PRE-OPERATIONAL, OPERATIONAL and STOPPED. It is possible to change the status of all nodes with one command or to change the status of each node individually.

4.3.3.1.1 Start Remote Node

This service is used to change the NMT Slave (bus coupler) status to OPERATIONAL.

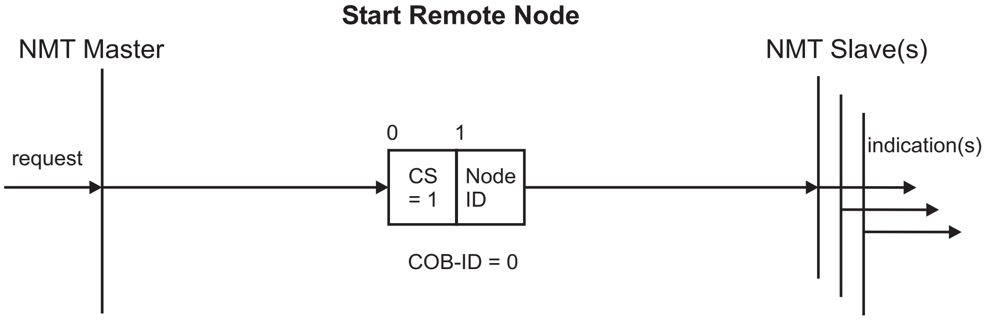


Fig. 4-12: Start Remote Node g012415x

Node ID = 0: The state of all existing nodes is changed to OPERATIONAL.

4.3.3.1.2 Stop Remote Node

This service is used to change the NMT Slave (bus coupler) status to STOPPED.

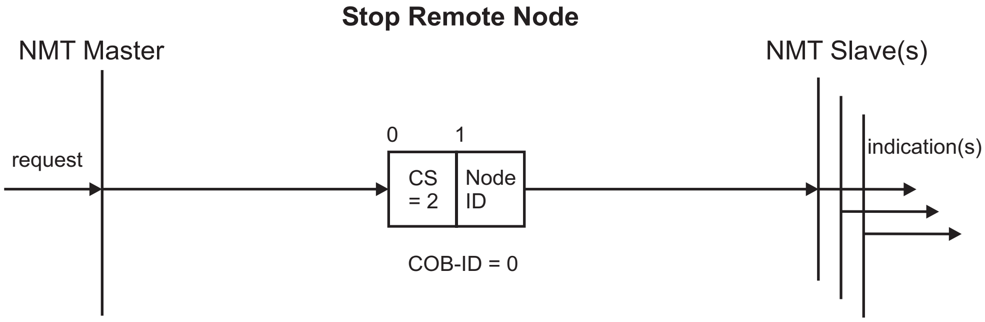


Fig. 4-13: Stop Remote Node g012416x

Node ID = 0: The state of all existing nodes is changed to STOPPED.

4.3.3.1.3 Enter Pre-Operational

This service is used to change the status of the NMT Slave (bus coupler) to PRE-OPERATIONAL.

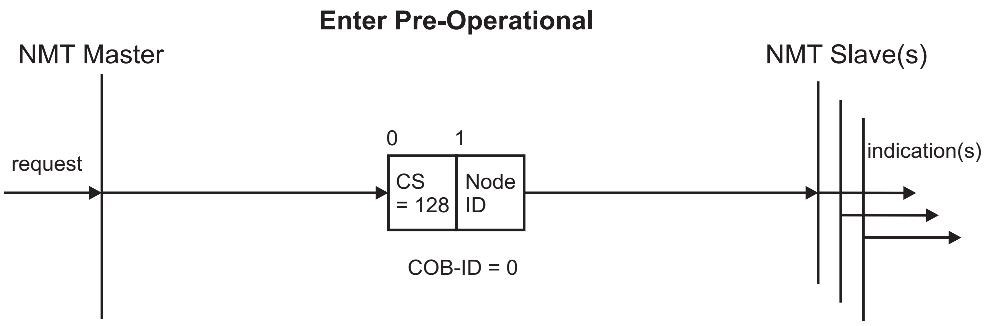


Fig. 4-14: Enter PRE-OPERATIONAL g012417x

Node ID = 0: The state of all existing nodes is changed to PRE-OPERATIONAL.

4.3.3.1.4 Reset Node

In this service a reset is performed with the NMT Slave (bus coupler).

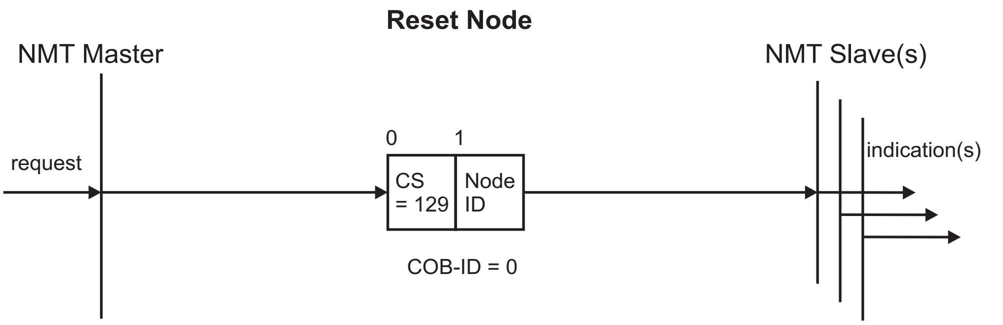


Fig. 4-15: Reset Node g012418x

Node ID = 0: a reset of all existing nodes is performed.

4.3.3.2 Error Control Protocols

These protocols permit the detection of possible errors in the network. In this manner the master can check whether a node is still in the status defined by it or if it has changed to a different status, for instance following a reset.

4.3.3.3 Node Guarding Protocol

By means of Node Guarding, the NMT slave is cyclically requested via an RTR frame to send its current status. Additional toggling of a bit detects whether or not the NMT slave still operates correctly.

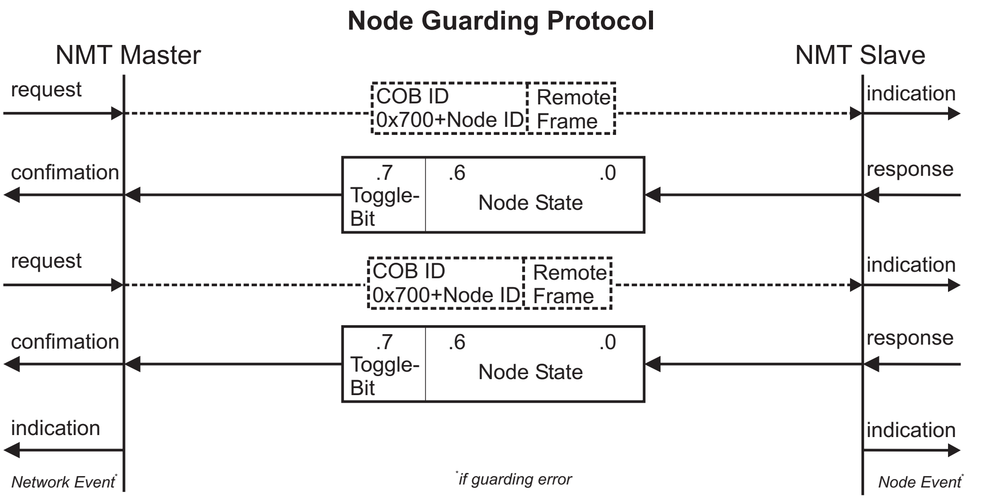


Fig. 4-16: Node Guarding Protocol g012419x

4.3.3.4 Bootup Protocol

This protocol shows that the NMT slave has changed its status from INITIALIZING to PRE-OPERATIONAL. This is performed after a hardware/software reset or following the service reset code.

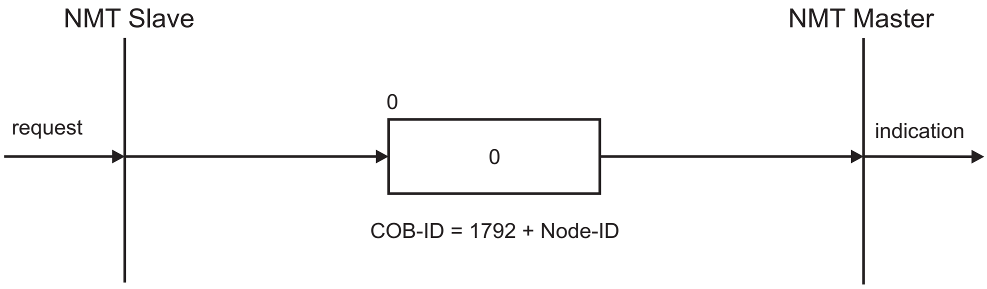


Fig. 4-17: Bootup Protocol g012421x

4.3.4 Object Directory

The object directory is the central point of a CANopen subscriber where all configuration information and data is stored and can be polled. The directory organization is by means of tables and contains three areas of CANopen objects:

- Communication Profile Area (Index 0x1000 – 0x1FFF)
  This profile contains all parameters relevant for CANopen communication. This area is identical for all CANopen subscribers.

- Manufacturer Specific Profile Area (Index 0x2000 – 0x5FFF)
  In this profile, each manufacturer can implement his own company specific objects.

- Standardized Device Profile Area (Index 0x6000 – 0x9FFF)
  This profile contains all objects which are assisted by a certain device profile. The bus coupler assists the device profile DS-401 (Device Profile for Generic I/O Modules)

In the object directory, a logical addressing scheme is used for the access to communication and device parameters, data and functions. Each entry into the directory is identified by a 16 bit index which indicates the row address of the table. A maximum of 65536 entries are permitted.

If an object is composed of several components, the components are identified by means of an 8 bit sub-index. The sub-index indicates the individual column address of the table allowing a maximum of 256 entries.

Each entry consists of:

- an object name describing the object function,
- a data type attribute defining the data type of the entry, and
- an access attribute indicating whether the entry is only read, only write or read and write.

The sub-index 0 indicates the max. number of the following sub-indexes. The data is coded in the following sub-indexes.

Index (hexadecimal)	Object
0x0000	Not used
0x0001 – 0x001F	Static data types
0x0020 – 0x003F	Complex data types
0x0040 – 0x005F	Manufacturer specific data types
0x0060 – 0x007F	Profile specific static data types
0x0080 – 0x009F	Profile specific complex data types
0x00A0 – 0x0FFF	Reserved
0x1000 – 0x1FFF	Communication profile (DS-301)
0x2000 – 0x5FFF	Manufacturer specific parameters
0x6000 – 0x9FFF	Parameters from standardized device profiles
0xA000 – 0xFFFF	Reserved

Table 4-2: Structure of the CANopen object directory

The object directory structure is designed for the worst case. Object entries that cannot be used because of the connected module configuration are deactivated.

4.3.4.1 Initialization

The connected module configuration is determined following power On.

If a customer-specific configuration was saved and if the currently connected module configuration coincides with the one last saved, the object directory with this saved configuration will be initialized.

In every other case, object directory will be assigned a default configuration.

4.3.4.1.1 Default configuration

4.3.4.1.1.1 Initialization Communication Profile Area

All objects of this profile assisted by the bus coupler are initialized according to the default values of DS 301 (CANopen Application Layer and Communication Profile).

Entry of the default mapping parameters:
Pre-assignment of the mapping parameters depends on the device profile used. The bus coupler assists the DS 401 profile, and as such the process described there is used. The first 2 Rx-/TxPDOs are defined as default PDOs.

The pre-assignment of the three remaining PDOs takes place in accordance with the following specified schema, whereby the channels, which are already contained in PDO1/2, are considered again with the pre-assignment. The algorithm starts for this at point a) and ends, if all available PDOs (with max. available PDO length of 64 bits) is full-filled.

a) Assignment of the next PDO with 8 bits digital I/O blocks (if available)
b) Assignment of the next PDO with 8 bits analog I/Os (if available)
c) Assignment of the next PDO with 16 bits analog I/Os (if available)
d) Assignment of the next PDO with 24 bits analog I/Os (if available)
e) Assignment of the next PDO with 32 bits analog I/Os (if available)
f) Assignment of the next PDO with 40 bits analog I/Os (if available)
g) Assignment of the next PDO with 48 bits analog I/Os (if available)
h) Assignment of the next PDO with 56 bits analog I/Os (if available)
i) Assignment of the next PDO with 64 bits analog I/Os (if available)

1. RxPDO:
contains maximum the first 8x8 digital outputs. If no digital outputs exist, the sub index 0 has the default value 0, and this PDO is not used with its default value.

Idx	S-Idx	Description	Default Value
0x1600	0	Number of mapped objects	None, possible values: 0: no digital output block 1..8: 1..8 digital output blocks
	1	1. mapped digital output block	0x6200 01 08
	2	2. mapped digital output block	0x6200 02 08
	:	:	:
	8	8. mapped digital output block	0x6200 08 08

2. RxPDO:
contains max. the 1st to 4th 16 bit analog output. If no 16 bit analog outputs exist, the sub index 0 has the default value 0, and this PDO is not used with its default value.

Idx	S-Idx	Description	Default Value
0x1601	0	Number of mapped objects	None, possible values: 0: no analog output 1..4: 1..4 analog outputs
	1	1. mapped 16 bit analog output	0x6411 01 10
	2	2. mapped 16 bit analog output	0x6411 02 10
	3	3. mapped 16 bit analog output	0x6411 03 10
	4	4. mapped 16 bit analog output	0x6411 04 10

1. TxPDO:
contains maximum the first 8x8 digital inputs. If no digital inputs exist, the sub index 0 has the default value 0, and this PDO is not used with its default value.

Idx	S-Idx	Description	Default Value
0x1A00	0	Number of mapped objects	None, possible values: 0: no digital input block 1..8: 1..8 digital input blocks
	1	1. mapped digital input block	0x6000 01 08
	2	2. mapped digital input block	0x6000 02 08
	:	:	:
	8	8. mapped digital input block	0x6000 08 08

2. TxPDO:
contains maximum the 1st to 4th 16 bit analog input. If no 16 bit analog inputs exist, the sub index 0 has the default value 0, and this PDO is not used with its default value.

Idx	S-Idx	Description	Default Value
0x1A01	0	Number of mapped objects	None, possible values: 0: no analog input 1..4: 1..4 analog inputs
	1	1. mapped 16 bit analog input	0x6401 01 10
	2	2. mapped 16 bit analog input	0x6401 02 10
	3	3. mapped 16 bit analog input	0x6401 03 10
	4	4. mapped 16 bit analog input	0x6401 04 10

Initialization Manufacturer Specific Profile Area
This area is initialized as described in the object directory.

Initialization Standardized Device Profile Area
All supported objects are initialized, as defined in the DS 401 standard.

4.3.4.2 Communication Profile Area

The following table lists all of the bus coupler supported objects of the communication profile.

Idx	Name	Type	Meaning	See on page
0x1000	Device Type	Unsigned32	Device Profile	104
0x1001	Error Register	Unsigned8	Errors are bit coded (DS401)	104
0x1003	Pre-defined Error Field	Array Unsigned32	Storage of the last 20 errors occurred	105
0x1005	COB-ID SYNC message	Unsigned32	COB-ID of the SYNC object	105
0x1006	Communication Cycle Period	Unsigned32	Max. time between 2 SYNC messages	105
0x1008	Manufacturer Device Name	Visible String	Device name	105
0x1009	Manufacturer Hardware Version	Visible String	Hardware version	106
0x100A	Manufacturer Software Version	Visible String	Software version	106
0x100B	Node ID	Unsigned32	Adjusted node ID number	106
0x100C	Guard Time	Unsigned16	Time for "Life Guarding Protocol"	106
0x100D	Life Time Factor	Unsigned8	Life Time Factor	106
0x1010	Store Parameters	Array Unsigned32	Parameter to store the configuration	106
0x1011	Restore default Parameter	Array Unsigned32	Parameter to restore the default configuration	107
0x1014	COB-ID Emergency Object	Unsigned32	COB-ID for the emergency Object	107
0x1200 bis 0x1201	Server SDO Parameter	Record SDO Parameter	Parameter for the Server SDO	107
0x1400 bis 0x1404	Receive PDO Communication Parameter	Record PDO Paramter	Communication parameter for the Receive PDO	108
0x1600 bis 0x1604	Receive PDO Mapping Parameter	Record PDO Mapping	Mapping parameter for the Receive PDO	109
0x1800 bis 0x1804	Transmit PDO Communication Parameter	Record PDO Paramter	Communication parameter for the Transmit PDO	109
0x1A00 bis 0x1A04	Transmit PDO Mapping Parameter	Record PDO Mapping	Mapping parameter for the Transmit PDO	110

4.3.4.2.1 Object 0x1000, Device Type

Idx	S-Idx	Name	Type	Attribut	Default Value
0x1000	0	Device Type	Unsigned32	RO	-

The object indicates the implemented device profile. The CANopen bus coupler has implemented the „Device Profile for Generic I/O Modules" (device profile No. 401). Moreover, in the index 0x1000 the value informs about the type of modules connected.

Design:

MSB			LSB
0000.0000	0000.4321	Device Profile Number 0x01 (High Byte)	Device Profile Number 0x91 (Low Byte)

With Bit 1 = 1, if at least one digital input is connected.
2 = 1, if at least one digital output is connected.
3 = 1, if at least one analog input is connected.
4 = 1, if at least one analog output is connected.

4.3.4.2.2 Object 0x1001, Error Register

Idx	S-Idx	Name	Type	Attribute	Default Value
0x1001	0	Error Register	Unsigned8	RO	-

This register contains internal errors. This register is also part of the emergency message.

Design:

Bit	Meaning
0	General Error
1	Current
2	Voltage
3	Temperature
4	Communication
5	Device profile specific
6	Reserved
7	Manufacturer specific

In the event of an error, bit 0 is always set. Additional bits used specify the error in more detail.

4.3.4.2.3 Object 0x1003, Pre-defined Error Field

Idx	S-Idx	Name	Type	Attribute	Default Value
0x1003	0	Number of Errors	Unsigned8	RW	0
	1	Standard Error Field	Unsigned32	RO	-
	:	:	:	:	:
	20	Standard Error Field	Unsigned32	RO	-

The sub-index 0 contains the errors currently stored in the field. If a new error occurs, it will be entered in sub-index 1, and all errors already existing moved down by one sub-index. A max. of 20 error entries are supported. Should more than 20 errors occur, each time the error contained in sub-index 20 is written over.

Design Standard Error Field:

Bit31 Bit16	Bit15 Bit0
Additional Information	Error code

The additional information corresponds to the first 2 bytes of the additional code of the Emergency telegram. The error code coincides with the error code in the Emergency telegram.

The complete error memory is deleted by writing a „0" in sub-index 0.

4.3.4.2.4 Object 0x1005, COB-ID SYNC message

Idx	S-Idx	Name	Type	Attribute	Default Value
0x1005	0	COB-ID SYNC	Unsigned32	RW	0x00000080

The object defines the COB ID for the synchronization message.

Design:

Bit31 Bit11	Bit10 Bit0
Reserved (always 0)	COB-ID

4.3.4.2.5 Object 0x1006, Communication Cycle Period

Idx	S-Idx	Name	Type	Attribute	Default Value
0x1006	0	Communication Cycle Period	Unsigned32	RW	0

The object defines the max. time in µs for two subsequent SYNC messages. The internal resolution is 2ms. If the value is 0, no SYNC monitoring is performed.

4.3.4.2.6 Object 0x1008, Manufacturer Device Name

Idx	S-Idx	Name	Type	Attribute	Default Value
0x1008	0	Manufacturer Device Name	Visible String	RO	750-307

The object indicates the device name of the bus coupler.

4.3.4.2.7 Object 0x1009, Manufacturer Hardware Version

Idx	S-Idx	Name	Type	Attribute	Default Value
0x1009	0	Manufacturer Hard-ware Version	Visible String	RO	Current HW-Version

The object indicates the current hardware version of the bus coupler.

4.3.4.2.8 Object 0x100A, Manufacturer Software Version

Idx	S-Idx	Name	Type	Attribute	Default Value
0x100A	0	Manufacturer Soft-ware Version	Visible String	RO	Current SW-Version

The object indicates the current software version of the bus coupler.

4.3.4.2.9 Object 0x100B, Node ID

Idx	S-Idx	Name	Type	Attribute	Default Value
0x100B	0	Node ID	Unsigned32	RO	adjusted node ID

The object indicates the adjusted number of the feldbus node.

4.3.4.2.10 Object 0x100C, Guard Time

Idx	S-Idx	Name	Type	Attribute	Default Value
0x100C	0	Guard Time	Unsigned16	RW	0

The object indicates the *Guarding Time* in milli-seconds. An NMT master cyclically interrogates the NMT slave for its status. The time between two interrogations is termed *Guard Time*.

4.3.4.2.11 Object 0x100D, Life Time Factor

Idx	S-Idx	Name	Type	Attribute	Default Value
0x100D	0	Lifetime Factor	Unsigned8	RW	0

The life *Time Factor* is part of the *Node Guarding Protocol*. The NMT slave checks if it was interrogated within the *Node Life Time* (Guardtime multiplied with the life time factor). If not, the slave works on the basis that the NMT master is no longer in its normal operation. It then triggers a *Life Guarding Event*.
If the node life time is zero, no monitoring will take place.

4.3.4.2.12 Object 0x1010, Store Parameters

Idx	S-Idx	Name	Type	Attribute	Default Value
0x1010	0	Max. supported Sub-Index	Unsigned8	RO	1
	1	Store all Parameter	Unsigned32	RW	1

This object allows to permanently store the settings made by the user. For this purpose, the signature „save" (lower case letters ASCII - MSB – 0x65 76 61 73 - LSB) must be written into the index 0x1010 sub index 1. The storing process runs in the background and takes approx. 2-3 seconds. When the storing process is finished, the SDO reply telegram is sent. Communication remains possible during storage by means of SDOs. An error message as a result of a new storage attempt only occurs, when the previous one was not yet finished. It is also not possible to trigger the storage function for as long as „Restore" is active.

As soon as a setting is stored, the Emergency “Changed HW configuration” is not sent any longer if the bus coupler is started up again without changing the module configuration.

Attention
If following the storage of a configuration only the module ID is changed via the DIP switch, the saved configuration is continued to be used. In other words, all module ID specific entries in the object directory (objects that are module ID dependent and have the „rw" attribute) signal with the old values. (i.e. Emergency ID,...)

4.3.4.2.13 Object 0x1011, Restore default Parameters

Idx	S-Idx	Name	Type	Attribute	Default Value
0x1011	0	Max. supported Sub-Index	Unsigned8	RO	4
	1	Set all parameters on default value	Unsigned32	RW	1
	2	-	Unsigned32	RW	0
	3	-	Unsigned32	RW	0

This object allows to reset the user stored parameters to the original default values.

Sub-indexes 2 and 3 are not supported.

The load command is processed in the background and takes approx. 2-3 seconds. When the performance is finished, the SDO reply message is sent. Communication can be continued during performance using SDOs. An error message is only tripped with another attempt to send a load command, if the previous one is not yet completed. It is also not possible to trigger a load command for as long as „Save" is active.

4.3.4.2.13.1 Sub-index 1 - Permanent entry of default parameters

Writing the signature „load" (lower case letters ASCII - MSB 0x64 0x61 0x6F 0x6C LSB) into the index 0x1011 sub-index 1 entails loading of the standard factory settings after the following Power ON and each further Power On (until the next SAVE command is given).

4.3.4.2.14 Object 0x1014, COB-ID Emergency Object

Idx	S-Idx	Name	Type	Attribute	Default Value
0x1014	0	COB ID EMCY	Unsigned32	RW	0x80+Module-ID

The object defines the COB ID for the EMCY message.

Design:

Bit31	Bit 30 Bit11	Bit10 Bit0
0/1 valid/invalid	reserved (always 0)	COB-ID

If a new COB ID is to be entered, set bit 31 to 1 first, because standard DS301 does not allow to change a valid COB ID (Bit31=0).

4.3.4.2.15 Object 0x1200– 0x1201, Server SDO

Idx	S-Idx	Name	Type	Attribute	Default Value
0x1200 to 0x1201	0	Max. supported Entries	Unsigned8	RO	2
	1	COB-ID Client->Server (Rx)	Unsigned32	Idx 0x1200 RO Idx 0x1201 RW	Idx 0x1200 0x600+Module-ID Idx 0x1201 0x80000000
	2	COB-ID Server->Client (Tx)	Unsigned32	Idx 0x1200 RO Idx 0x1201 RW	Idx 0x1200 0x580+Module-ID Idx 0x1201 0x80000000

Access to the entries in the object directory is made via this object.

The default value of the second SDO is not active. Any change to the COB IDs is prohibited in the second SDO, if these are active (Bit 31 = 0).

Design COB-ID:

Bit31 Bit 30	Bit11 Bit10	Bit0
0/1 valid/invalid	reserved (always 0)	COB-ID

4.3.4.2.16 Object 0x1400– 0x1404, Receive PDO Communication Parameter

Idx	S-Idx	Name	Type	Attribute	Default Value
0x1400 to 0x141F	0	Max. supported Entries	Unsigned8	RO	2
	1	COB-ID	Unsigned32	RW	Idx 0x1400 0x200+Module-ID Idx 0x1401 0x300+Module-ID Idx 0x1402 0x400+Module-ID Idx 0x1403 0x500+Module-ID Idx 0x1404-141F 0x80000000
	2	Transmission type	Unsigned8	RW	255

Idx	S-Idx	Name	Type	Attribut	Default Value
0x1400 to 0x1404	0	Max. supported Entries	Unsigned8	RO	2
	1	COB-ID	Unsigned32	RW	Idx 0x1400 0x200+Modul-ID Idx 0x1401 0x300+Modul-ID Idx 0x1402 0x400+Modul ID Idx 0x1403 0x500+Modul-ID Idx 0x1404 0x80000000
	2	Transmission type	Unsigned8	RW	255
	3	Inhibit Time	Unsigned16	RW	No evaluation
	4	CMS Priority Group	Unsigned8	RW	No evaluation

This object is used to set the communication parameters of the RxPDOs. 32 RxPDOs are supported. The default COB IDs of the first four PDOs are pre-assigned according to the DS301 standard. All further PDOs are deactivated. If not all default PDOs are used (i.e. a smaller number of modules is connected), also the default PDOs not used are deactivated.

Design COB-ID:

Bit31	Bit 30	Bit29 Bit11	Bit10 Bit0
0/1 valid/invalid	0/1 RTR allowed / not allowed	reserved (always 0)	COB-ID

If a new COB ID is to be entered, bit 31 must be set to 1 first, because the DS301 standard does not permit to change a valid COB ID (Bit31=0).

A mode can be defined for each PDO for the purpose of data transmission (transmission type in the Index Communication Parameter). As standard, digital and analog inputs are transmitted as ´Change of Value´(COV). The type of transmission depending of the set transmission type is explained in the following table.

Transmission type	PDO transmission						
	cyclic	acyclic	synchronous	asynchronous	RTR only	TxPDO (Inputs)	RxPDO (outputs)
0		X	X			if COV is transmitted with each SYNC	Set outputs after each SYNC as requested by the last PDO received
1 – 240	X		X			Transmission with each x SYNC (x = 1 to 240)	Set outputs **after each SYNC** as requested by the last PDO received
241 – 251	- reserved -						
252			X		X	Data is read-in again with a SYNC, but not sent, request via RTR	Not supported
253				X	X	Request via RTR	COV
254				X		COV [1]	COV
255				X		COV [1]	COV

[1] the data is transmitted at the interval of the set inhibit time

4.3.4.2.17 Object 0x1600– 0x1604, Receive PDO Mapping Parameter

Idx	S-Idx	Name	Type	Attribute	Default Value
0x1600 bis 0x1604	0	Number of mapped Objects	Unsigned8	RW	-
	1 to 8	1.Object to 8.Object	Unsigned32	RW	-

This object is used to define the data, which is to be transmitted by means of the PDO.

Sub-index 0 contains the number of objects valid for the PDO.

Design 1. to 8. Object:

Bit31 Bit16	Bit 15 Bit8	Bit7 Bit0
Index	Sub-Index	Size

Index: Index of the object to be transmitted

Sub-Index: Sub-index of the object to be transmitted

Size: Object size in bits
Due to the fact that max. 8 bytes can be transmitted in a PDO, the sum of the valid object lengths must not exceed 64 (8Byte*8Bit)

4.3.4.2.18 Object 0x1800– 0x1804, Transmit PDO Communication Parameter

Idx	S-Idx	Name	Type	Attribute	Default Value
0x1800 bis 0x1804	0	Max. supported Entries	Unsigned8	RO	5
	1	COB-ID	Unsigned32	RW	Idx 0x1800 0x180+Module-ID Idx 0x1801 0x280+Module-ID Idx 0x1802 0x380+Module-ID Idx 0x1803 0x480h+Module ID Idx 0x1804 0x80000000
	2	Transmission type	Unsigned8	RW	255
	3	Inhibit Time	Unsigned16	RW	No evaluation

This object is used to set the communication parameters of the TxPDOs. 5 TxPDOs are supported. The default COB IDs of the first four PDOs are pre-assigned according to the DS301 standard. All other PDOs are de-activated. If not all default PDOs are used (i.e. a smaller number of modules is connected), also the default PDOs not used are de-activated.

If a new value is to be entered, the COB ID has to be set invalid (Bit 31 = 1), because the DS301 standard does not permit to enter a new time when the COB ID (Bit31=0) is valid.

Attention
An object entry can only be mapped in a **max. of 2 different** PDOs.

4.3.4.2.19 Object 0x1A00 – 0x1A04, Transmit PDO Mapping Parameter

Idx	S-Idx	Name	Type	Attribute	Default Value
0x1A00 to 0x1A04	0	Number of mapped objects	Unsigned8	RW	-
	1 to 8	1.Object to 8.Object	Unsigned32	RW	-

This object is used to define the data, which is transmitted using the PDO.

Sub-index 0 contains the number of objects valid for the PDO.

Design 1. to 8. Object:

Bit31 … Bit16	Bit 15 … Bit8	Bit7 … Bit0
Index	Sub-Index	Size

Index: Index of the object to be transmitted

Sub-Index: Sub-index of the object to be transmitted

Size: Size of the object in bits
Due to the fact that max. 8 bytes in a PDO can be transmitted, the total of valid object lengths must not exceed 64 (8Byte*8Bit)

4.3.4.3 Manufactor Specific Profile Area

The non-standard device profile-specific I/O functionality of special modules and other modules as well as special functions (i.e. spacer module configuration,...) are imaged in the 'Manufacturer Specific Area' profile. The objects defined there provide data word widths of a modularity from 1 to 8 bytes.

The indexes 0x2000 (digital inputs), 0x2100 (digital outputs), 0x2400 (2 byte special module inputs) and 0x2500 (2 byte special module outputs) are mirror imaged by the corresponding indexes of the device profile DS 401 (0x6000, 0x6200, 0x6401, 0x6411). This means for instance: object 0x2000 and object 0x6000 refer to the same memory places in the process image.
The following table shows all objects of the manufacturer profile supported by the bus coupler.

Idx	Name	Type	Meaning	See on page
0x2000	Digital inputs	Array Unsigned8	Data of digital input modules	111
0x2100	Digital outputs	Array Unsigned8	Data of digital output modules	112
0x2200	1 byte special modules, inputs	Array Unsigned8	Data of 1 byte special input modules	112
0x2300	1 byte special modules, outputs	Array Unsigned8	Data of 1 byte special output modules	112
0x2400	2 byte special modules, inputs	Array Unsigned16	Data of 2 byte special input modules	112
0x2500	2 byte special modules, outputs	Array Unsigned16	Data of 2 byte special output modules	112
0x2600	3 byte special modules, inputs	Record	Data of 3 byte special input modules	112
0x2700	3 byte special modules, outputs	Record	Data of 3 byte special output modules	112
0x2800	4 byte special modules, inputs	Record	Data of 4 byte special input modules	113
0x2900	4 byte special modules, outputs	Record	Data of 4 byte special output modules	113
0x3000	5 byte special modules, inputs	Record	Data of 5 byte special input modules	113
0x3100	5 byte special modules, outputs	Record	Data of 5 byte special output modules	113
0x3200	6 byte special modules, inputs	Record	Data of 6 byte special input modules	113
0x3300	6 byte special modules, outputs	Record	Data of 6 byte special output modules	113
0x3400	7 byte special modules, inputs	Record	Data of 7 byte special input modules	113
0x3500	7 byte special modules, outputs	Record	Data of 7 byte special output modules	114
0x3600	8 byte special modules, inputs	Record	Data of 8 byte special input modules	114
0x3700	8 byte special modules, outputs	Record	Data of 8 byte special output modules	114
0x5000	Input PA	Record	Reading of the input process image	111
0x5001	Output PA	Record	Writing the output process image	114

4.3.4.3.1 Object 0x2000, Digital Inputs

Idx	S-Idx	Name	Type	Attribute	Default Value	Meaning
0x2000	0	8-Bit digital input block	Unsigned8	RO	-	Number of digital 8 bit input blocks
	1	1. input block	Unsigned8	RO	-	1. digital input block
	....	....	....	....	....	....
	32	32. input block	Unsigned8	RO	-	32. digital input block

4.3.4.3.2 Object 0x2100, Digital Outputs

Idx	S-Idx	Name	Type	Attribute	Default Value	Meaning
0x2100	0	8-Bit digital output block	Unsigned8	RO	-	Number of digital 8 bit output blocks
	1	1. output block	Unsigned8	RW	0	1. digital output block
	....	....	....	....	....	....
	32	32. output block	Unsigned8	RW	0	32. digital output block

4.3.4.3.3 Object 0x2200, 1 Byte Special Modules, Inputs

Idx	S-Idx	Name	Type	Attribute	Default Value	Meaning
0x2200	0	Special 1 byte input	Unsigned8	RO	-	Number of the 1 byte special channels
	1	1. special input	Unsigned8	RO	-	1. Input channel
	....	....	....	....	....	....
	254	254. special input	Unsigned8	RO	-	254. Input channel

4.3.4.3.4 Object 0x2300, 1 Byte Special Modules, Outputs

Idx	S-Idx	Name	Type	Attribute	Default Value	Meaning
0x2300	0	special 1 byte output	Unsigned8	RO	-	Number of the 1 byte special channels
	1	1. special output	Unsigned8	RW	0	1. Output channel
	....	....	....	....	....	....
	254	254. special output	Unsigned8	RW	0	254. Output channel

4.3.4.3.5 Object 0x2400, 2 Byte Special Modules, Inputs

Idx	S-Idx	Name	Type	Attribute	Default Value	Meaning
0x2400	0	special 2 byte input	Unsigned8	RO	-	Number of the 2 byte special channels
	1	1. special input	Unsigned16	RO	-	1. Input channel
	....	....	....	....	....	....
	254	254. special input	Unsigned16	RO	-	254. Input channel

4.3.4.3.6 Object 0x2500, 2 Byte Special Modules, Outputs

Idx	S-Idx	Name	Type	Attribute	Default Value	Meaning
0x2500	0	special 2 byte output	Unsigned8	RO	-	Number of the 2 byte special channels
	1	1. special output	Unsigned16	RW	0	1. Output channel
	....	....	....	....	....	....
	254	254. special output	Unsigned16	RW	0	254. Output channel

4.3.4.3.7 Object 0x2600, 3 Byte Special Modules, Inputs

Idx	S-Idx	Name	Type	Attribute	Default Value	Meaning
0x2600	0	special 3 byte input	Unsigned8	RO	-	Number of the 3 byte special channels
	1	1. special input	Unsigned24	RO	-	1. Input channel
	....	....	....	....	....	....
	170	170. special input	Unsigned24	RO	-	170. Input channel

4.3.4.3.8 Object 0x2700, 3 Byte Special Modules, Outputs

Idx	S-Idx	Name	Type	Attribute	Default Value	Meaning
0x2700	0	special 3 byte output	Unsigned8	RO	-	Number of the 3 byte special channels
	1	1. special output	Unsigned24	RW	0	1. Output channel
	....	....	....	....	....	....
	170	170. special output	Unsigned24	RW	0	170. Output channel

4.3.4.3.9 Object 0x2800, 4 Byte Special Modules, Inputs

Idx	S-Idx	Name	Type	Attribute	Default Value	Meaning
0x2800	0	special 4 byte input	Unsigned8	RO	-	Number of the 4 byte special channels
	1	1.special input	Unsigned32	RO	-	1. Input channel
	....	....	....	....	....	....
	128	128. special input	Unsigned32	RO	-	128. Input channel

4.3.4.3.10 Object 0x2900, 4 Byte Special Modules, Outputs

Idx	S-Idx	Name	Type	Attribute	Default Value	Meaning
0x2900	0	special 4 byte output	Unsigned8	RO	-	Number of the 4 byte special channels
	1	1. special output	Unsigned32	RW	0	1. Output channel
	....	....	....	....	....	....
	128	128. special output	Unsigned32	RW	0	128. Output channel

4.3.4.3.11 Object 0x3000, 5 Byte Special Modules, Inputs

Idx	S-Idx	Name	Type	Attribute	Default Value	Meaning
0x3000	0	special 5 byte input	Unsigned8	RO	-	Number of the 5 byte special channels
	1	1. special input	Unsigned40	RO	-	1. Input channel
	....	....	....	....	....	....
	102	102. special input	Unsigned40	RO	-	102. Input channel

4.3.4.3.12 Object 0x3100, 5 Byte Special Modules, Outputs

Idx	S-Idx	Name	Type	Attribute	Default Value	Meaning
0x3100	0	special 5 byte output	Unsigned8	RO	-	Number of the 5 byte special channels
	1	1. special output	Unsigned40	RW	0	1. Output channel
	....	....	....	....	....	....
	102	102. special output	Unsigned40	RW	0	102. Output channel

4.3.4.3.13 Object 0x3200, 6 Byte Special Modules, Inputs

Idx	S-Idx	Name	Type	Attribute	Default Value	Meaning
0x3200	0	special 6 byte input	Unsigned8	RO	-	Number of the 6 byte special channels
	1	1. special input	Unsigned48	RO	-	1. Input channel
	....	....	....	....	....	....
	85	85. special input	Unsigned48	RO	-	85. Input channel

4.3.4.3.14 Object 0x3300, 6 Byte Special Modules, Outputs

Idx	S-Idx	Name	Type	Attribute	Default Value	Meaning
0x3300	0	Special 6 byte output	Unsigned8	RO	-	Number of the 6 byte special channels
	1	1. special output	Unsigned48	RW	0	1. Output channel
	....	....	....	....	....	....
	85	85. special output	Unsigned48	RW	0	85. Output channel

4.3.4.3.15 Object 0x3400, 7 Byte Special Modules, Inputs

Idx	S-Idx	Name	Type	Attribute	Default Value	Meaning
0x3400	0	Special 7 byte input	Unsigned8	RO	-	Number of the 7 byte special channels
	1	1. special input	Unsigned56	RO	-	1. Input channel
	....	....	....	....	....	....
	73	73. special input	Unsigned56	RO	-	73. Input channel

4.3.4.3.16 Object 0x3500, 7 Byte Special Modules, Outputs

Idx	S-Idx	Name	Type	Attribute	Default Value	Meaning
0x3500	0	Special 7 byte output	Unsigned8	RO	-	Number of the 7 byte special channels
	1	1. special output	Unsigned56	RW	0	1. Output channel
	....	....	....	....	....	....
	73	73. special output	Unsigned56	RW	0	73. Output channel

4.3.4.3.17 Object 0x3600, 8 Byte Special Modules, Inputs

Idx	S-Idx	Name	Type	Attribute	Default Value	Meaning
0x3600	0	special 8 byte input	Unsigned8	RO	-	Number of the 8 byte special channels
	1	1. special input	Unsigned64	RO	-	1. Input channel
	....	....	....	....	....	....
	64	64. special input	Unsigned64	RO	-	64. Input channel

4.3.4.3.18 Object 0x3700, 8 Byte Special Modules, Outputs

Idx	S-Idx	Name	Type	Attribute	Default Value	Meaning
0x3700	0	Special 8 byte output	Unsigned8	RO	-	Number of the 8 byte special channels
	1	1. special output	Unsigned64	RW	0	1. Output channel
	....	....	....	....	....	....
	64	64. special output	Unsigned64	RW	0	64. Output channel

4.3.4.3.19 Object 0x5000, Read Input Process Image

Idx	S-Idx	Name	Type	Attribute	Default Value	Meaning
0x5000	0	number of input byte	Unsigned16	RO	-	Number of relevant bytes in input PA
	1	input segment 1	Octed_String	RO	-	1. Input PA segment (the bottom 255 bytes of 512 bytes PA)
	2	input segment 2	Octed_String	RO	-	2. Input PA segment (the top 255 bytes of 512 bytes PA. Is only available, if > 255 bytes input data)

Permits reading of the entire input process image as a domain via SDO, allowing access to all input data „as a block“.

Note
The access via SDO being slow, we recommend transmitting time critical data only via PDO.

4.3.4.3.20 Object 0x5001, Write Output Process Image

Idx	S-Idx	Name	Type	Attribute	Default Value	Meaning
0x5001	0	number of output byte	Unsigned16	RO	none	Number of relevant bytes in output PI
	1	input segment 1	Octed_String	RW	none	1. Output PA segment (the bottom 255 bytes of 512 bytes PA)
	2	input segment 2	Octed_String	RW	none	2. Output PA segment (the top 255 bytes of 512 bytes PA. Is only available, if > 255 bytes output data are possible according to the module configuration)

Permits writing of the entire output process image as a domain via SDO „as a block“.

Note
The access via SDO being slow, we recommend transmitting time critical data only via PDO.

4.3.4.4 Standard Device Profile Area – DS 401

The fieldbus coupler supports the standard device profile *Device Profile for Generic I/O Modules*.

The following table shows all objects of the standard profile DS401 supported by the fieldbus coupler.

Idx	Name	Type	Meaning	See on page
0x6000	Read Input 8 Bit	Array Unsigned8	Data of digital input I/O modules	115
0x6200	Write Output 8-Bit	Array Unsigned8	Data of digital output I/O modules	115
0x6401	Read Analog Input 16-Bit	Array Unsigned16	Data of analog input I/O modules (16 bit)	115
0x6411	Write Analog Output 16-Bit	Array Unsigned16	Data of analog output I/O modules (16 bit)	116

4.3.4.4.1 Object 0x6000, Digital Inputs

Idx	S-Idx	Name	Type	Attribute	Default Value
0x6000	0	Number of digital input blocks	Unsigned8	RO	-
	1	1. input block	Unsigned8	RO	-
	2	2. input block	Unsigned8	RO	-
	....	....	....	....	....
	8	8. input block	Unsigned8	RO	-

This object contains the process data of the digital input modules. Sub-index 1 contains the first 8 digital input channels from the left to the right, counted from starting with the bus coupler. Sub-index 2 the next etc.

4.3.4.4.2 Object 0x6200, Digital Outputs

Idx	S-Idx	Name	Type	Attribute	Default Value
0x6200	0	Number of digital output blocks	Unsigned8	RO	-
	1	1. output block	Unsigned8	RW	0
	2	2. output block	Unsigned8	RW	0
	....	....	....	....	....
	8	8. output block	Unsigned8	RW	0

This object contains the process data of the digital output modules. Sub-index 1 contains the first 8 digital output channels from left to right, counting starting from the bus coupler. Sub-index 2 the next etc.

4.3.4.4.3 Object 0x6401, Analog Inputs 16 Bit

Idx	S-Idx	Name	Type	Attribute	Default Value
0x6401	0	Number analog input channels (16Bit)	Unsigned8	RO	-
	1	1. channel	Unsigned16	RO	-
	....	....	....	....	....
	4	4. channel	Unsigned16	RO	-

This object contains the process data of the analog input modules. Sub-index 1 contains the first analog input channel from left to right, counting starting with the bus coupler. Sub-index 2 the second, etc.

4.3.4.4.4 Object 0x6411, Analog Outputs 16 Bit

Idx	S-Idx	Name	Type	Attribute	Default Value
0x6411	0	Number analog input channels (16Bit)	Unsigned8	RO	-
	1	1. channel	Unsigned16	RW	0
	....	....	....	....	....
	4	4. channel	Unsigned16	RW	0

This object contains the process data of the analog output modules. Sub-index 1 contains the first analog output channel from left to right, counting starting with the bus coupler. Sub-index 2 the second, etc.

4.3.5 PDO Transmission

Data transmission with PDOs is only possible in the *Operational* status.

When changing to the *Operational* status, all TxPDOs are transmitted once with the transmission type 254 and 255.

4.3.5.1 Mapping

By PDO mapping you can define the data to be transmitted by means of PDOs.

If no stored customer specific configuration is used and if no other settings are performed, the object directory is assigned with a default configuration according to the device profile DS 401 (refer to chapter 4.3.4.1 “Initialization”).

If the coupler/controller is in the PRE-OPERATIONAL status, its mapping can be modified via SDOs instead, in an application specific manner.

More information
For an example of how to create an application specific mapping configuration, refer to chapter 3.1.6 "Starting up a CANopen Fieldbus Node".

4.3.5.2 Transmit PDO1

The following diagram shows an overview of the relevant objects and their connection for the PDO transmission of digital inputs.

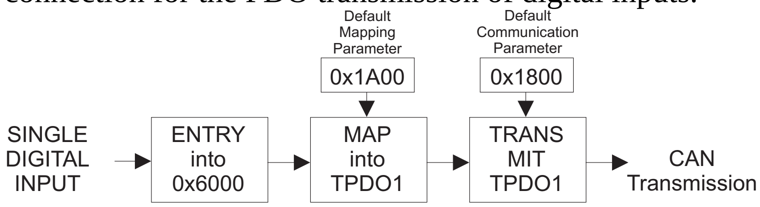


Fig. 4-4: PDO transmission of digital input data g012466x

Index	Object name	Description	See on page:
0x1800	Transmit PDO Communication Parameter	Communication parameters for the Receive PDOs	109
0x1A00	Transmit PDO Mapping Parameter	Mapping parameters for the Transmit PDOs	110
0x6000	Read Input 8 Bit	Data of the digital Inputs	115

4.3.5.3 Receive PDO1

The following diagram shows an overview of the relevant objects and their connection for the PDO transmission of digital outputs.

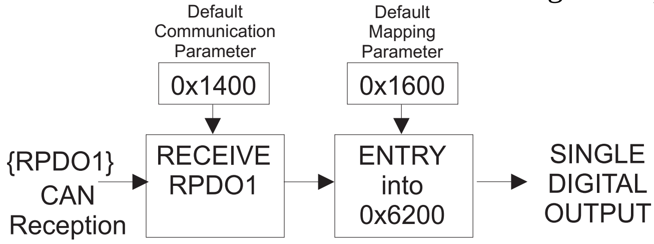


Fig. 4-1: PDO transmission of digital output data g012467x

Index	Object name	Description	See on page:
0x1400	Receive PDO Communication Parameter	Communication parameters for the Receive PDOs	109
0x1600	Transmit PDO Mapping Parameter	Mapping parameters for the Transmit PDOs	109
0x6200	Write Output 8-Bit	Data of the digital Outputs	115

4.3.5.4 Transmit PDO2

The following diagram shows an overview of the relevant objects and their connection for the PDO transmission of analog inputs.

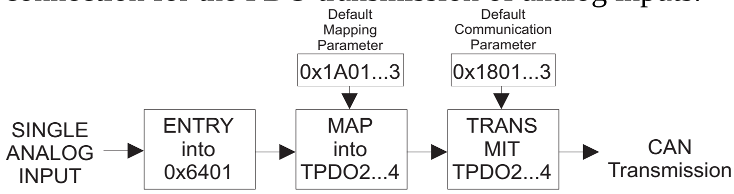


Fig. 4-2: PDO transmission of analog input data g012468x

Index	Object name	Description	See on page:
0x1801...3	Transmit PDO Communication Parameter	Communication parameters for the Receive PDOs	109
0x1A01…3	Transmit PDO Mapping Parameter	Mapping parameters for the Transmit PDOs	110
0x6401	Analogue Input Trigger Selection	Specify the Trigger condition for the 16 bits analog input data	115

4.3.5.5 Receive PDO2

The following diagram shows an overview of the relevant objects and their connection for the PDO transmission of analog outputs.

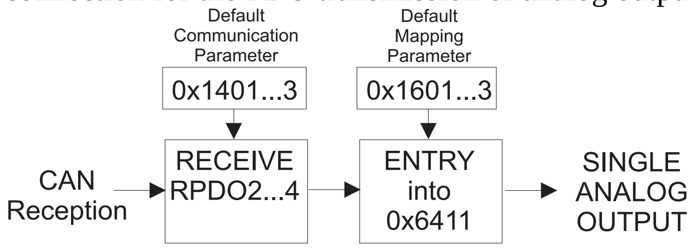


Fig. 4-3: PDO transmission of analog output data g012469x

Index	Object name	Description	See on page:
0x1401…3	Receive PDO Communication Parameter	Communication parameters for the Receive PDOs	109
0x1601…3	Transmit PDO Mapping Parameter	Mapping parameters for the Transmit PDOs	109
0x6411	Write Analogue Output 16-Bit	Data of the analog 16 bit Outputs	116

4.3.6 SYNC Monitoring

If the value of the communication cycle period is unequal to 0, monitoring is made with the first arrival of a SYNC message if the bus coupler is in the *Operational* status.

Failure of SYNC message:

If no SYNC message is received within the monitoring time (communication cycle period), this is signalled by a fast blinking of the 'RUN' LED. In addition, an emergency message (Error Code: 0x8100, Error Register: 0x80, Additional Code: 00 02 00 00 00) is sent. The failure of the SYNC message will be displayed even if the MASTER provokes a status change.
It is only after the repeated receipt of the SYNC message in the *OPERATIONAL* status that the LEDs regain their normal operating status, and another emergency message (Error Code: 0x0000, Error Register: 0x80, Additional Code: 00 02 00 000 0) is sent to show that the SYNC monitoring functions again.

4.3.7 Node Guarding

The Node Guarding starts for the bus coupler when the first remote transmit request message (RTR) is received on the COB ID for the Node Guarding (0x700+Module-ID). If the bus coupler receives no corresponding message, the Node Guarding is not monitored by the bus coupler.

In the default setting, the Node Guarding is deactivated, because a 0 is entered in the corresponding indexes (0x100C = Guard-Time, 0x100D = Life Time Factor).

The NMT master polls the bus coupler at regular intervals. This interval is termed Guard-Time (Index 0x100C). The internal status of the bus coupler is in the reply message.

On the arrival of an RTR request without the Guard Time being set, the Node Guarding is not monitored, nevertheless the bus coupler replies with its internal status.

The states are coded as follows:

State:	Value:	
PRE-OPERATIONAL	127	
OPERATIONAL	5	
STOP	4	

The Life-Time is the product of Guard-Time (Index 0x100C) and Life Time Factor (Index 0x100D).

Failure of Node Guarding:

If no Node Guarding message is received with the life-time, this is shown by a slowly blinking of the 'RUN' LED. In addition, an emergency message (Error Code: 0x8100, Error Register: 0x80, Additional Code: 0x00 01 00 000 0) is sent, the outputs are set to zero (depending on the internal setting of the coupler). The CAN ERR LED is lit and the bus coupler changes to the status STOPPED.
As soon as the Node Guarding protocol is recorded, the CAN ERR LED goes out and the outputs are set on the last values before the Failure of the Node Guarding. Another emergency message (Error Code: 0x0000, Error Register: 0x80, Additional Code: 00 01 00 000 0) is sent to show that the Node Guarding is reactivated, whereby the bus coupler status remain unchanged.
The 'RUN' LED blinks further on as indications that an error arose with the Node Guarding.
The blinking of the LED RUN stops after the next Power On or Reset Node or Reset Communication Telegramm.

4.3.8 Error Message (Emergency)

Emergency messages are always sent in the event of a critical error situation having occurred/overcome in the device, or if important information has to be communicated to other devices.

Structure and meaning of the entries in the emergency object are explained in the table “EMCY-CODE”, they are coded in the bus message in a Lowbyte / Highbyte order.

An emergency object is also sent, after an error is remedied (Error Code = 0x0000, the Error Register and the Additional Code behave as described in the table “EMCY-CODE”).

Following Power On an emergency object is sent if the loaded settings are the default settings. This occurs for two reasons:

- No settings have yet been saved (Index 0x1010).
- The saved setting were discarded by the bus coupler, because modules were connected or disconnected.

EMCY-CODE

Byte:	0 1	2	3 7	
Name	**Error Code**	**Error Register**	**Additional Code**	**Meaning**
	0x0000*	0x00	00 00 00 00 00	Power On Message
	0x5000*	0x80	00 01 00 00 00	Changed hardware configuration after power on or reset Node / communication The fieldbus coupler is be initialized, because no stored configuration is available or the one available does not coincide with the current configuration
	0x5000*	0x80	00 02 00 00 00	Flash errors An error has occurred when saving the configuration in Flash.
	0x8100*	0x80	00 01 00 00 00	The time between two node guarding telegrams is greater than Guard_Time * Life_Time_Faktor.
	0x8100*	0x80	00 02 00 00 00	The time span between two SyncObjects is longer than the communication_Cycle_Period
	0xFF00*	0x80	00 01 00 00 00	Internal bus error, no status change
	0xFF00*	0x80	00 02 EE EE NN	Module error - EE: Error code - NN :Number of current module error

* Byte 0 = Lowbyte und Byte 1 = Highbyte

Example: Error Code 0x8100: Byte 0 = 0x00, Byte 1= 0x81

Example: Error Code 0x8220: Byte 0 = 0x20, Byte 1= 0x82

5 I/O Modules

5.1 Overview

All listed bus modules, in the overview below, are available for modular applications with the WAGO-I/O-SYSTEM 750.
For detailed information on the I/O modules and the module variations, please refer to the manuals for the I/O modules.
You will find these manuals on CD ROM „ELECTRONICC Tools and Docs“ (Item-no.: 0888-0412) or on the web pages:
www.wago.com → Service → Download → Documentation.

More Information
Current information on the modular WAGO-I/O-SYSTEM is available in the Internet under:
www.wago.com

5.1.1 Digital Input Modules

DI DC 5 V	
750-414	4 Channel, DC 5 V, 0.2 ms, 2- to 3-conductor connection, high-side switching
DI DC 5(12) V	
753-434	8 Channel, DC 5(12) V, 0.2 ms, 1-conductor connection, high-side switching
DI DC 24 V	
750-400, 753-400	2 Channel, DC 24 V, 3.0 ms, 2- to 4-conductor connection; high-side switching
750-401, 753-401	2 Channel, DC 24 V, 0.2 ms, 2- to 4-conductor connection; high-side switching
750-410, 753-410	2 Channel, DC 24 V, 3.0 ms, 2- to 4-conductor connection; high-side switching
750-411, 753-411	2 Channel, DC 24 V, 0.2 ms, 2- to 4-conductor connection; high-side switching
750-418, 753-418	2 Channel, DC 24 V, 3.0 ms, 2- to 3-conductor connection; high-side switching; diagnostic
750-419	2 Channel, DC 24 V, 3.0 ms, 2- to 3-conductor connection; high-side switching; diagnostic
750-421, 753-421	2 Channel, DC 24 V, 3.0 ms, 2- to 3-conductor connection; high-side switching; diagnostic
750-402, 753-402	4 Channel, DC 24 V, 3.0 ms, 2- to 3-conductor connection; high-side switching
750-432, 753-432	4 Channel, DC 24 V, 3.0 ms, 2-conductor connection; high-side switching
750-403, 753-403	4 Channel, DC 24 V, 0.2 ms, 2- to 3-conductor connection; high-side switching

750-433, 753-433	4 Channel, DC 24 V, 0.2 ms, 2-conductor connection; high-side switching
750-422, 753-422	4 Channel, DC 24 V, 2- to 3-conductor connection; high-side switching; 10 ms pulse extension
750-408, 753-408	4 Channel, DC 24 V, 3.0 ms, 2- to 3-conductor connection; low-side switching
750-409, 753-409	4 Channel, DC 24 V, 0.2 ms, 2- to 3-conductor connection; low-side switching
750-430, 753-430	8 Channel, DC 24 V, 3.0 ms, 1-conductor connection; high-side switching
750-431, 753-431	8 Channel, DC 24 V, 0.2 ms, 1-conductor connection; high-side switching
750-436	8 Channel, DC 24 V, 3.0 ms, 1-conductor connection; lowside switching
750-437	8 Channel, DC 24 V, 0.2 ms, 1-conductor connection; low-side switching
DI AC/DC 24 V	
750-415, 753-415	4 Channel, AC/DC 24 V, 2-conductor connection
750-423, 753-423	4 Channel, AC/DC 24 V, 2- to 3-conductor connection; with power jumper contacts
DI AC/DC 42 V	
750-428, 753-428	4 Channel, AC/DC 42 V, 2-conductor connection
DI DC 48 V	
750-412, 753-412	2 Channel, DC 48 V, 3.0ms, 2- to 4-conductor connection; high-side switching
DI DC 110 V	
750-427, 753-427	2 Channel, DC 110 V, Configurable high-side or low-side switching
DI AC 120 V	
750-406, 753-406	2 Channel, AC 120 V, 2- to 4-conductor connection; high-side switching
DI AC 120(230) V	
753-440	4 Channel, AC 120(230) V, 2-conductor connection; high-side switching
DI AC 230 V	
750-405, 753-405	2 Channel, AC 230 V, 2- to 4-conductor connection; high-side switching
DI NAMUR	
750-435	1 Channel, NAMUR EEx i, Proximity switch acc. to DIN EN 50227
750-425, 753-425	2 Channel, NAMUR, Proximity switch acc. to DIN EN 50227
750-438	2 Channel, NAMUR EEx i, Proximity switch acc. to DIN EN 50227
DI Intruder Detection	
750-424, 753-424	2 Channel, DC 24 V, Intruder Detection

5.1.2 Digital Output Modules

DO DC 5 V	
750-519	4 Channel, DC 5 V, 20mA, short-circuit-protected; high-side switching
DO DC 12(14) V	
753-534	8 Channel, DC 12(14) V, 1A, short-circuit-protected; high-side switching
DO DC 24 V	
750-501, 753-501	2 Channel, DC 24 V, 0.5 A, short-circuit-protected; high-side switching
750-502, 753-502	2 Channel, DC 24 V, 2.0 A, short-circuit-protected; high-side switching
750-506, 753-506	2 Channel, DC 24 V, 0.5 A, short-circuit-protected; high-side switching; with diagnostics
750-507, 753-507	2 Channel, DC 24 V, 2.0 A, short-circuit-protected; high-side switching; with diagnostics; No longer available, replaced by 750-508
750-508	2 Channel, DC 24 V, 2.0 A, short-circuit-protected; high-side switching; with diagnostics; Replacement for 750-508
750-535	2 Channel, DC 24 V, EEx i, short-circuit-protected; PNP-positive switching
750-504, 753-504	4 Channel, DC 24 V, 0.5 A, short-circuit-protected; high-side switching
750-531, 753-531	4 Channel, DC 24 V, 0.5 A, short-circuit-protected; high-side switching
750-516, 753-516	4 Channel, DC 24 V, 0.5 A, short-circuit-protected; low-side switching
750-530, 753-530	8 Channel, DC 24 V, 0.5 A, short-circuit-protected; high-side switching
750-537	8 Channel, DC 24 V, 0.5 A, short-circuit-protected; high-side switching; with diagnostics
750-536	8 Channel, DC 24 V, 0.5 A, short-circuit-protected; low-side switching
DO AC 120(230) V	
753-540	4 Channel, AC 120(230) V, 0.25 A, short-circuit-protected; high-side switching
DO AC/DC 230 V	
750-509, 753-509	2 Channel Solid State Relay, AC/DC 230 V, 300 mA
750-522	2 Channel Solid State Relay, AC/DC 230 V, 500 mA, 3 A (< 30 s)
DO Relay	
750-523	1 Channel, AC 230 V, AC 16 A, isolated output, 1 make contact, bistable, manual operation
750-514, 753-514	2 Channel, AC 125 V , AC 0.5 A , DC 30 V, DC 1 A, isolated outputs, 2 changeover contacts
750-517, 753-517	2 Channel, AC 230 V, 1 A, isolated outputs, 2 changeover contacts
750-512, 753-512	2 Channel, AC 230 V, DC 30 V, AC/DC 2 A, non-floating, 2 make contacts
750-513, 753-513	2 Channel, AC 230 V, DC 30 V, AC/DC 2 A, isolated outputs, 2 make contacts

5.1.3 Analog Intput Modules

AI 0 - 20 mA	
750-452, 753-452	2 Channel, 0 - 20 mA, Differential Inputs
750-465, 753-465	2 Channel, 0 - 20 mA, single-ended (S.E.)
750-472, 753-472	2-channel, 0 - 20 mA, 16 Bit, single-ended (S.E.)
750-480	2-channel, 0 - 20 mA ,Differential Inputs
750-453, 753-453	4 Channel, 0 - 20 mA, single-ended (S.E.)
AI 4 - 20 mA	
750-454, 753-454	2 Channel, 4 - 20 mA,Differential Inputs
750-474, 753-474	2 Channel, 4 - 20 mA, 16 Bit, single-ended (S.E.)
750-466, 753-466	2 Channel, 4 - 20 mA, single ended (S.E.)
750-485	2 Channel, 4 - 20 mA, EEx i, single ended (S.E.)
750-492, 753-492	2 Channel, 4 - 20 mA, Isolated Differential Inputs
750-455, 753-455	4 Channel, 4 - 20 mA, single ended (S.E.)
AI 0 - 1 A	
750-475, 753-475	2-channel, 0 - 1 A AC/DC ,Differential Inputs
AI 0 - 5 A	
750-475/020-000, 753-475/020-000	2-channel, 0 - 5 A AC/DC ,Differential Inputs
AI 0 - 10 V	
750-467, 753-467	2 Channel, DC 0 - 10 V, single-ended (S.E.)
750-477, 753-477	2 Channel, AC/DC 0 - 10 V,Differential Inputs
750-478, 753-478	2 Channel, DC 0 - 10 V, single-ended (S.E.)
750-459, 753-459	4 Channel, DC 0 - 10 V, single-ended (S.E.)
750-468	4 Channel, DC 0 - 10 V, single-ended (S.E.)
AI DC ± 10 V	
750-456, 753-456	2 Channel, DC ± 10 V,Differential Inputs
750-479, 753-479	2 Channel, DC ± 10 V,Differential Measurement Input
750-476, 753-476	2 Channel, DC ± 10 V, single-ended (S.E.)
750-457, 753-457	4 Channel, DC ± 10 V, single-ended (S.E.)
AI DC 0 - 30 V	
750-483, 753-483	2 Channel, DC 0 -30 V,Differential Measurement Input
AI Resistance Sensors	
750-461, 753-461	2 Channel, Resistance Sensors, PT100 / RTD
750-481/003-000	2 Channel, Resistance Sensors, PT100 / RTD, EEx i
750-460	4 Channel, Resistance Sensors, PT100 / RTD
AI Thermocouples	

750-462	2 Channel, thermocouples with diagnostics Sensor types: J, K, B, E, N, R, S, T, U
750-469, 753-469	2 Channel, thermocouples with diagnostics Sensor types: J, K, B, E, N, R, S, T, U, L
AI Others	
750-491	1 Channel for Resistor Bridges (Strain Gauge)

5.1.4 Analog Output Modules

AO 0 - 20 mA	
750-552, 753-552	2 Channel, 0 - 20 mA
750-585	2 Channel, 0 - 20 mA, EEx i
750-553, 753-553	4 Channel, 0 - 20 mA
AO 4 - 20 mA	
750-554, 753-554	2-channel, 4 - 20 mA
750-554, 753-554	4-channel, 4 - 20 mA
AO DC 0 - 10 V	
750-550, 753-550	2 Channel, DC 0 - 10 V
750-560	2 Channel, DC 0 - 10 V, 10 Bit, 100 mW, 24 V
750-559, 753-559	4 Channel, DC 0 - 10 V
AO DC ± 10 V	
750-556, 753-556	2 Channel, DC ± 10 V
750-557, 753-557	4 Channel, DC ± 10 V

5.1.5 Special Modules

Counter Modules	
750-404, 753-404	Up / Down Counter, DC 24 V, 100 kHz
750-638, 753-638	2 Channel, Up / Down Counter, DC 24 V/ 16Bit / 500 Hz
Frequency Measuring	
750-404/000-003, 753-404/000-003	Frequency Measuring
Pulse Width Module	
750-511	2-channel Pulse Width Module, DC 24 V, short-circuit-protected, high-side switching
Distance and Angle Measurement Modules	
750-630	SSI Transmitter Interface
750-631	Incremental Encor Interface, TTL level squarewave
750-634	Incremental Encor Interface, DC 24 V
750-637	Incremental Encor Interface RS 422, cam outputs
750-635, 753-635	Digital Pulse Interface
Serial Interfaces	
750-650, 753	Serial Interface RS 232 C
750-653, 753	Serial Interface RS 485
750-651	TTY-Serial Interface, 20 mA Current Loop
750-654	Data Exchange Module
DALI / DSI Master Module	
750-641	DALI / DSI Master Module
AS interface Master Module	
750-655	AS interface Master Module
Radio Receiver Module	
750-642	Radio Receiver EnOcean
MP Bus Master Module	
750-643	MP Bus (Multi Point Bus) Master Module
Vibration Monitoring	
750-645	2-Channel Vibration Velocity / Bearing Condition Monitoring VIB I/O
PROFIsafe Modules	
750-660/000-001	8FDI 24V DC PROFIsafe
750-665/000-001	4FDO 0.5A / 4FDI 24V DC PROFIsafe
750-666/000-001	1FDO 10A / 2FDO 0.5A / 2FDI 24V PROFIsafe
RTC Module	
750-640	RTC Module

5.1.6 System Modules

Module Bus Extension	
750-627	Module Bus Extension, End Module
750-628	Module Bus Extension, Coupler Module
DC 24 V Power Supply Modules	
750-602	DC 24 V, passiv
750-601	DC 24 V, max. 6.3 A,without diagnostics, with fuse-holder
750-610	DC 24 V, max. 6.3 A, with diagnostics, with fuse-holder
750-625	DC 24 V, EEx i, with fuse-holder
DC 24 V Power Supply Modules with bus power supply	
750-613	Bus power supply, 24 V DC
AC 120 V Power Supply Modules	
750-615	AC 120 V, max. 6.3 A without diagnostics, with fuse-holder
AC 230 V Power Supply Modules	
750-612	AC/DC 230 V without diagnostics, passiv
750-609	AC 230 V, max. 6.3 A without diagnostics, with fuse-holder
750-611	AC 230 V, max. 6.3 A with diagnostics, with fuse-holder
Filter Modules	
750-624	Filter Module for field side power supply
750-626	Filter Module for system and field side power supply
Field Side Connection Module	
750-603, 753-603	Field Side Connection Module, DC 24 V
750-604, 753-604	Field Side Connection Module, DC 0 V
750-614, 753-614	Field Side Connection Module, AC/DC 0 ... 230 V
Separation Modules	
750-616	Separation Module
750-621	Separation Module with Power Contacts
Binary Spacer Module	
750-622	Binary Spacer Module
End Module	
750-600	End Module, to loop the internal bus

5.2 Process Data Architecture for CANopen Coupler

With some I/O modules, the structure of the process data is fieldbus specific.

In the case of a CANopen coupler, the process image uses a byte structure (without word alignment). The internal mapping method for data greater than one byte conforms to the Intel format.

The following section describes the process image for all of the coupler supported WAGO-I/O-SYSTEM 750 and 753 I/O modules when using a CANopen coupler.

Note
Depending on the specific position of an I/O module in the fieldbus node, the process data of all previous byte or bit-oriented modules must be taken into account to determine its location in the process data map.

In the CANopen object directory the entire input process image can be read over the index 0x5000 and the entire output process image can be written over the index 0x5001.

5.2.1 Digital Input Modules

Digital input modules supply one bit of data per channel to specify the signal state for the corresponding channel. These bits are mapped into the Input Process Image.

When analog input modules are also present in the node, the digital data is always appended after the analog data in the Input Process Image, grouped into bytes. Therefore for each byte one Subindex is occupied.

Some digital modules have an additional diagnostic bit per channel in the Input Process Image. The diagnostic bit is used for detecting faults that occur (e.g., wire breaks and/or short circuits).

1 Channel Digital Input Module with Diagnostics

750-435

Input Process Image							
Bit 7	**Bit 6**	**Bit 5**	**Bit 4**	**Bit 3**	**Bit 2**	**Bit 1**	**Bit 0**
						Diagnostic bit S 1	Data bit DI 1

For the digital inputs the object 0x6000 (also 0x2000 possible) is used.

2 Channel Digital Input Modules

750-400, -401, -405, -406, -410, -411, -412, -427, -438, (and all variations), 753-400, -401, -405, -406, -410, -411, -412, -427

Input Process Image							
Bit 7	**Bit 6**	**Bit 5**	**Bit 4**	**Bit 3**	**Bit 2**	**Bit 1**	**Bit 0**
						Data bit DI 2 Channel 2	Data bit DI 1 Channel 1

For the digital inputs the object 0x6000 (also 0x2000 possible) is used.

2 Channel Digital Input Modules with Diagnostics

750-419, -421, -424, -425, 753-421, -424, -425

Input Process Image							
Bit 7	**Bit 6**	**Bit 5**	**Bit 4**	**Bit 3**	**Bit 2**	**Bit 1**	**Bit 0**
				Diagnostic bit S 2 Channel 2	Diagnostic bit S 1 Channel 1	Data bit DI 2 Channe 2	Data bit DI 1 Channel 1

For the digital inputs the object 0x6000 (also 0x2000 possible) is used.

2 Channel Digital Input Module with Diagnostics and Output Process Data

750-418, 753-418

The 750-418, 753-418 digital input module supplies a diagnostic and acknowledge bit for each input channel. If a fault condition occurs, the diagnostic bit is set. After the fault condition is cleared, an acknowledge bit must be set to re-activate the input. The diagnostic data and input data bit is mapped in the Input Process Image, while the acknowledge bit is in the Output Process Image.

Input Process Image							
Bit 7	**Bit 6**	**Bit 5**	**Bit 4**	**Bit 3**	**Bit 2**	**Bit 1**	**Bit 0**
				Diagnostic bit S 2 Channel 2	Diagnostic bit S 1 Channel 1	Data bit DI 2 Channel 2	Data bit DI 1 Channel 1

For the digital inputs the object 0x6000 (also 0x2000 possible) is used.

Output Process Image							
Bit 7	**Bit 6**	**Bit 5**	**Bit 4**	**Bit 3**	**Bit 2**	**Bit 1**	**Bit 0**
				Acknowl-edgement bit Q 2 Channel 2	Acknowl-edgement bit Q 1 Channel 1	0	0

For the digital outputs the object 0x6200 (also 0x2100 possible) is used.

4 Channel Digital Input Modules

750-402, -403, -408, -409, -414, -415, -422, -423, -428, -432, -433,
753-402, -403, -408, -409, -415, -422, -423, -428, -432, -433, -440

Input Process Image							
Bit 7	**Bit 6**	**Bit 5**	**Bit 4**	**Bit 3**	**Bit 2**	**Bit 1**	**Bit 0**
				Data bit DI 4 Channel 4	Data bit DI 3 Channel 3	Data bit DI 2 Channel 2	Data bit DI 1 Channel 1

For the digital inputs the object 0x6000 (also 0x2000 possible) is used.

8 Channel Digital Input Modules

750-430, -431, -436, -437, 753-430, -431, -434

Input Process Image							
Bit 7	**Bit 6**	**Bit 5**	**Bit 4**	**Bit 3**	**Bit 2**	**Bit 1**	**Bit 0**
Data bit DI 8 Channel 8	Data bit DI 7 Channel 7	Data bit DI 6 Channel 6	Data bit DI 5 Channel 5	Data bit DI 4 Channel 4	Data bit DI 3 Channel 3	Data bit DI 2 Channel 2	Data bit DI 1 Channel 1

For the digital inputs the object 0x6000 (also 0x2000 possible) is used.

5.2.2 Digital Output Modules

Digital output modules use one bit of data per channel to control the output of the corresponding channel. These bits are mapped into the Output Process Image.
When analog output modules are also present in the node, the digital image data is always appended after the analog data in the Output Process Image, grouped into bytes. Therefore for each byte one Subindex is occupied.

1 Channel Digital Output Module with Input Process Data

750-523

Input Process Image							
Bit 7	**Bit 6**	**Bit 5**	**Bit 4**	**Bit 3**	**Bit 2**	**Bit 1**	**Bit 0**
						not used	Status bit „Manual Operation“

For the digital inputs the object 0x6000 (also 0x2000 possible) is used.

Output Process Image							
Bit 7	**Bit 6**	**Bit 5**	**Bit 4**	**Bit 3**	**Bit 2**	**Bit 1**	**Bit 0**
						not used	controls DO 1 Channel 1

For the digital outputs the object 0x6200 (also 0x2100 possible) is used.

2 Channel Digital Output Modules

750-501, -502, -509, -512, -513, -514, -517, -535, (and all variations),
753-501, -502, -509, -512, -513, -514, -517

Ausgangsprozessabbild							
Bit 7	**Bit 6**	**Bit 5**	**Bit 4**	**Bit 3**	**Bit 2**	**Bit 1**	**Bit 0**
						controls DO 2 Channel 2	controls DO 1 Channel 1

For the digital outputs the object 0x6200 (also 0x2100 possible) is used.

2 Channel Digital Input Modules with Diagnostics and Input Process Data

750-507 (-508), -522, 753-507

The 750-507 (-508), -522 and 753-507 digital output modules have a diagnostic bit for each output channel. When an output fault condition occurs (i.e., overload, short circuit, or broken wire), a diagnostic bit is set. The diagnostic data is mapped into the Input Process Image, while the output control bits are in the Output Process Image.

Input Process Image							
Bit 7	**Bit 6**	**Bit 5**	**Bit 4**	**Bit 3**	**Bit 2**	**Bit 1**	**Bit 0**
						Diagnostic bit S 2 Channel 2	Diagnostic bit S 1 Channel 1

For the digital inputs the object 0x6000 (also 0x2000 possible) is used.

Output Process Image							
Bit 7	**Bit 6**	**Bit 5**	**Bit 4**	**Bit 3**	**Bit 2**	**Bit 1**	**Bit 0**
						controls DO 2 Channel 2	controls DO 1 Channel 1

For the digital outputs the object 0x6200 (also 0x2100 possible) is used.

750-506, 753-506

The 750-506, 753-506 digital output module has 2-bits of diagnostic information for each output channel. The 2-bit diagnostic information can then be decoded to determine the exact fault condition of the module (i.e., overload, a short circuit, or a broken wire). The 4-bits of diagnostic data are mapped into the Input Process Image, while the output control bits are in the Output Process Image.

Input Process Image							
Bit 7	**Bit 6**	**Bit 5**	**Bit 4**	**Bit 3**	**Bit 2**	**Bit 1**	**Bit 0**
				Diagnostic bit S 3 Channel 2	Diagnostic bit S 2 Channel 2	Diagnostic bit S 1 Channel 1	Diagnostic bit S 0 Channel 1

For the digital inputs the object 0x6000 (also 0x2000 possible) is used.

Output Process Image							
Bit 7	**Bit 6**	**Bit 5**	**Bit 4**	**Bit 3**	**Bit 2**	**Bit 1**	**Bit 0**
				not used	not used	controls DO 2 Channel 2	controls DO 1 Channel 1

For the digital outputs the object 0x6200 (also 0x2100 possible) is used.

4 Channel Digital Output Modules

750-504, -516, -519, -531, 753-504, -516, -531, -540

Output Process Image							
Bit 7	**Bit 6**	**Bit 5**	**Bit 4**	**Bit 3**	**Bit 2**	**Bit 1**	**Bit 0**
				controls DO 4 Channel 4	controls DO 3 Channel 3	controls DO 2 Channel 2	controls DO 1 Channel 1

For the digital outputs the object 0x6200 (also 0x2100 possible) is used..

4 Channel Digital Output Modules with Diagnostics and Input Process Data

750-532

The 750-532 digital output modules have a diagnostic bit for each output channel. When an output fault condition occurs (i.e., overload, short circuit, or broken wire), a diagnostic bit is set. The diagnostic data is mapped into the Input Process Image, while the output control bits are in the Output Process Image.

Input Process Image							
Bit 7	**Bit 6**	**Bit 5**	**Bit 4**	**Bit 3**	**Bit 2**	**Bit 1**	**Bit 0**
				Diagnostic bit S 3 Channel 4	Diagnostic bit S 2 Channel 3	Diagnostic bit S 1 Channel 2	Diagnostic bit S 0 Channel 1

Diagnostic bit S = '0' no Error
Diagnostic bit S = '1' overload, short circuit, or broken wire

For the digital inputs the object 0x6000 (also 0x2000 possible) is used.

Output Process Image							
Bit 7	**Bit 6**	**Bit 5**	**Bit 4**	**Bit 3**	**Bit 2**	**Bit 1**	**Bit 0**
				controls DO 4 Channel 4	controls DO 3 Channel 3	controls DO 2 Channel 2	controls DO 1 Channel 1

For the digital outputs the object 0x6200 (also 0x2100 possible) is used.

8 Channel Digital Output Modules

750-530, -536, 753-530, -434

Output Process Image							
Bit 7	**Bit 6**	**Bit 5**	**Bit 4**	**Bit 3**	**Bit 2**	**Bit 1**	**Bit 0**
controls DO 8 Channel 8	controls DO 7 Channel 7	controls DO 6 Channel 6	controls DO 5 Channel 5	controls DO 4 Channel 4	controls DO 3 Channel 3	controls DO 2 Channel 2	controls DO 1 Channel 1

For the digital outputs the object 0x6200 (also 0x2100 possible) is used.

8 Channel Digital Output Modules with Diagnostics and Input Process Data

750-537

The 750-537 digital output modules have a diagnostic bit for each output channel. When an output fault condition occurs (i.e., overload, short circuit, or broken wire), a diagnostic bit is set. The diagnostic data is mapped into the Input Process Image, while the output control bits are in the Output Process Image.

Input Process Image							
Bit 7	**Bit 6**	**Bit 5**	**Bit 4**	**Bit 3**	**Bit 2**	**Bit 1**	**Bit 0**
Diagnos-tic bit S 7 Channel 8	Diagnos-tic bit S 6 Channel 7	Diagnos-tic bit S 5 Channel 6	Diagnos-tic bit S 4 Channel 5	Diagnos-tic bit S 3 Channel 4	Diagnos-tic bit S 2 Channel 3	Diagnos-tic bit S 1 Channel 2	Diagnos-tic bit S 0 Channel 1

Diagnostic bit S = '0' no Error
Diagnostic bit S = '1' overload, short circuit, or broken wire

For the digital inputs the object 0x6000 (also 0x2000 possible) is used.

Output Process Image							
Bit 7	**Bit 6**	**Bit 5**	**Bit 4**	**Bit 3**	**Bit 2**	**Bit 1**	**Bit 0**
controls DO 8 Channel 8	controls DO 7 Channel 7	controls DO 6 Channel 6	controls DO 5 Channel 5	controls DO 4 Channel 4	controls DO 3 Channel 3	controls DO 2 Channel 2	controls DO 1 Channel 1

For the digital outputs the object 0x6200 (also 0x2100 possible) is used.

5.2.3 Analog Input Modules

The hardware of an analog input module has 16 bits of measured analog data per channel and 8 bits of control/status. However, the CANopen coupler does not have access to the 8 control/status bits. Therefore, the CANopen coupler can only access the 16 bits of analog data per channel, which are grouped as bytes and mapped in Intel format in the Input Process Image.

When digital input modules are also present in the node, the analog input data is always mapped into the Input Process Image in front of the digital data.

1 Channel Analog Input Module

750-491, (and all variations)

Input Process Image			
Sub-index	**Offset**	**Byte Destination**	**Remark**
n	0	D0	Measured Value U_D
	1	D1	
n+1	2	D2	Measured Value U_{ref}
	3	D3	

These modules present themselves with 2x2 bytes, so that the object 0x6401 (also 0x2400 possible) for 2 Byte Special Modules, Inputs is used. Therefore for each measured value one Subindex is occupied.

2 Channel Analog Input Modules

750-452, -454, -456, -461, -462, -465, -466, -467, -469, -472, -474, -475, -476, -477, -478, -479, -480, -481, -483, -485, -492, (and all variations),
753-452, -454, -456, -461, -465, -466, -467, -469, -472, -474, -475, -476, -477, -478, -479, -483, -492, (and all variations)

Input Process Image			
Sub-index	**Offset**	**Byte Destination**	**Remark**
n	0	D0	Measured Value Channel 1
	1	D1	
n+1	2	D2	Measured Value Channel 2
	3	D3	

These modules present themselves with 2x2 bytes, so that the object 0x6401 (also 0x2400 possible) for 2 Byte Special Modules, Inputs is used. Therefore for each channel one Subindex is occupied.

4 Channel Analog Input Modules

750-453, -455, -457, -459, -460, -468, (and all variations),
753-453, -455, -457, -459

Input Process Image			
Sub-index	Offset	Byte Destination	Remark
n	0	D0	Measured Value Channel 1
	1	D1	
n+1	2	D2	Measured Value Channel 2
	3	D3	
n+2	4	D4	Measured Value Channel 3
	5	D5	
n+3	6	D6	Measured Value Channel 4
	7	D7	

These modules present themselves with 4x2 bytes, so that the object 0x6401 (also 0x2400 possible) for 2 Byte Special Modules, Inputs is used. Therefore for each channel one Subindex is occupied.

5.2.4 Analog Output Modules

The hardware of an analog output module has 16 bits of analog output data per channel and 8 control/status bits. However, the CANopen coupler does not have access to the 8 control/status bits. With CANopen the Status byte is set off as Emergency telegram. Therefore, the CANopen coupler can only supply the 16 bits of analog data per channel, which is grouped as bytes and mapped in Intel format in the Output Process Image.

When digital output modules are also present in the node, the analog output data is always mapped into the Output Process Image in front of the digital data.

2 Channel Analog Output Modules

750-550, -552, -554, -556, -560, -585, (and all variations),
753-550, -552, -554, -556

Output Process Image			
Sub-index	Offset	Byte Destination	Remark
n	0	D0	Output Value Channel 1
	1	D1	
n+1	2	D2	Output Value Channel 2
	3	D3	

These modules present themselves with 2x2 bytes, so that the object 0x6411 (also 0x2500 possible) for 2 Byte Special Modules, Outputs is used. Therefore for each channel one Subindex is occupied.

4 Channel Analog Output Modules

750-553, -555, -557, -559, 753-553, -555, -557, -559

Output Process Image			
Sub-index	**Offset**	**Byte Destination**	**Remark**
n	0	D0	Output Value Channel 1
	1	D1	
n+1	2	D2	Output Value Channel 2
	3	D3	
n+2	4	D4	Output Value Channel 3
	5	D5	
n+3	6	D6	Output Value Channel 4
	7	D7	

These modules present themselves with 4x2 bytes, so that the object 0x6411 (also 0x2500 possible) for 2 Byte Special Modules, Outputs is used. Therefore for each channel one Subindex is occupied.

5.2.5 Specialty Modules

With individual modules beside the data bytes also the control/status byte is mapped in the process image. The control/status byte is required for the bi-directional data exchange of the module with the higher-ranking control system. The control byte is transmitted from the control system to the module and the status byte from the module to the control system.
This allows, for example, setting of a counter with the control byte or displaying of overshooting or undershooting of the range with the status byte.

Further information
For detailed information about the structure of a particular module's control/status byte, please refer to that module's manual. Manuals for each module can be found on the Internet under:
http://www.wago.com.

Counter Modules

750-404, (and all variations except of /000-005),
753-404, (and variations /000-003)

The above Counter Modules have a total of 5 bytes of user data in both the Input and Output Process Image (4 bytes of counter data and 1 byte of control/status). The counter value is supplied as 32 bits. The following tables illustrate the Input and Output Process Image, which has a total of 6 bytes mapped into each image.

Input Process Image			
Sub-index	Offset	Byte Destination	Remark
n	0	S	Status byte
	1	-	not used
	2	D0	Counter Value
	3	D1	
	4	D2	
	5	D3	

These modules present themselves with 1x6 bytes, so that the object 0x3200 for 6 Byte Special Modules, Inputs is used. Therefore for each module one Subindex is occupied.

Output Process Image			
Sub-index	Offset	Byte Destination	Remark
n	0	C	Control byte
	1	-	not used
	2	D0	Counter Setting Value
	3	D1	
	4	D2	
	5	D3	

These modules present themselves with 1x6 bytes, so that the object 0x3300 for 6 Byte Special Modules, Outputs is used. Therefore for each module one Subindex is occupied.

750-404 /000-005

The above Counter Modules have a total of 5 bytes of user data in both the Input and Output Process Image (4 bytes of counter data and 1 byte of control/status). The two counter values are supplied as 16 bits. The following tables illustrate the Input and Output Process Image, which has a total of 6 bytes mapped into each image.

Input Process Image			
Sub-index	Offset	Byte Destination	Remark
n	0	S	Status byte
	1	-	not used
	2	D0	Counter Value of Counter 1
	3	D1	
	4	D2	Counter Value of Counter 2
	5	D3	

These modules present themselves with 1x6 bytes, so that the object 0x3200 for 6 Byte Special Modules, Inputs is used. Therefore for each module one Subindex is occupied.

Output Process Image			
Sub-index	Offset	Byte Destination	Remark
n	0	C	Control byte
	1	-	not used
	2	D0	Counter Setting Value of Counter 1
	3	D1	
	4	D2	Counter Setting Value of Counter 2
	5	D3	

These modules present themselves with 1x6 bytes, so that the object 0x3300 for 6 Byte Special Modules, Outputs is used. Therefore for each module one Subindex is occupied.

750-638, 753-638

The above Counter Modules have a total of 6 bytes of user data in both the Input and Output Process Image (4 bytes of counter data and 2 bytes of control/status). The two counter values are supplied as 16 bits. The following tables illustrate the Input and Output Process Image, which has a total of 6 bytes mapped into each image.

Input Process Image			
Sub-index	Offset	Byte Destination	Remark
n	0	S0	Status byte of Counter 1
	1	D0	Counter Value of Counter 1
	2	D1	
n+1	3	S1	Status byte of Counter 2
	4	D2	Counter Value of Counter 2
	5	D3	

These modules present themselves with 2x3 bytes, so that the object 0x2600 for 3 Byte Special Modules, Inputs is used. Therefore for each channel one Subindex is occupied.

Output Process Image			
Sub-index	Offset	Byte Destination	Remark
n	0	C0	Control byte of Counter 1
	1	D0	Counter Setting Value of Counter 1
	2	D1	
n+1	3	C1	Control byte of Counter 2
	4	D2	Counter Setting Value of Counter 2
	5	D3	

These modules present themselves with 2x3 bytes, so that the object 0x2700 for 3 Byte Special Modules, Outputs is used. Therefore for each channel one Subindex is occupied.

Pulse Width Modules

750-511, (and all variations)

The above Pulse Width modules have a total of 6 bytes of user data in both the Input and Output Process Image (4 bytes of channel data and 2 bytes of control/status). The two channel values are supplied as 16 bits. Each channel has its own control/status byte. The following table illustrates the Input and Output Process Image, which has a total of 6 bytes mapped into each image.

Input and Output Process Image			
Sub-index	**Offset**	**Byte Destination**	**Remark**
n	0	C0/S0	Control/Status byte of Channel 1
	1	D0	Data Value of Channel 1
	2	D1	
n+1	3	C1/S1	Control/Status byte of Channel 2
	4	D2	Data Value of Channel 2
	5	D3	

These modules present themselves with 2x3 bytes, so that the object 0x2600 for 3 Byte Special Modules, Inputs and the object 0x2700 for 3 Byte Special Modules, Inputs are used. Therefore for each channel one Subindex is occupied.

Serial Interface Modules with alternative Data Format

750-650, (and the variations /000-002, -004, -006, -009, -010, -011, -012, -013)
750-651, (and the variations /000-002, -003)
750-653, (and the variations /000-002, -007)

Note:
With the freely parametrizable variations /003 000 of the serial interface modules, the desired operation mode can be set. Dependent on it, the process image of these modules is then the same, as from the appropriate variation.

The above Serial Interface Modules with alternative data format have a total of 4 bytes of user data in both the Input and Output Process Image (3 bytes of serial data and 1 byte of control/status). The following table illustrates the Input and Output Process Image, which have a total of 4 bytes mapped into each image.

Input and Output Process Image			
Sub-index	Offset	Byte Destination	Remark
n	0	C/S	Control/Status byte
	1	D0	Data bytes
n+1	2	D1	
	3	D2	

These modules present themselves with 2x2 bytes, so that the object 0x6401 (also 0x2400 possible) for 2 Byte Special Modules, Inputs and the object 0x6411 (also 0x2500 possible) for 2 Byte Special Modules, Outputs are used. Therefore for each module one Subindex is occupied.

Serial Interface Modules with Standard Data Format

750-650/000-001, -014, -015, -016
750-651/000-001
750-653/000-001, -006

The above Serial Interface Modules with Standard Data Format have a total of 6 bytes of user data in both the Input and Output Process Image (5 bytes of serial data and 1 byte of control/status). The following table illustrates the Input and Output Process Image, which have a total of 6 bytes mapped into each image.

Input and Output Process Image			
Sub-index	Offset	Byte Destination	Remark
n	0	C/S	Control/Status byte
	1	D0	Data bytes
	2	D1	
	3	D2	
	4	D3	
	5	D4	

These modules present themselves with 1x6 bytes, so that the object 0x3200 for 6 Byte Special Modules, Inputs and the object 0x3300 for 6 Byte Special Modules, Outputs are used. Therefore for each module one Subindex is occupied.

Data Exchange Module

750-654, (and the variation /000-001)

The Data Exchange modules have a total of 4 bytes of user data in both the Input and Output Process Image. The following tables illustrate the Input and Output Process Image, which has a total of 4 bytes mapped into each image.

Input and Output Process Image			
Sub-index	Offset	Byte Destination	Remark
n	0	D0	Data bytes
	1	D1	
n+1	2	D2	
	3	D3	

These modules present themselves with 2x2 bytes, so that the object 0x6401 (also 0x2400 possible) for 2 Byte Special Modules, Inputs and the object 0x6411 (also 0x2500 possible) for 2 Byte Special Modules, Outputs are used. Therefore for each module two Subindices are occupied

SSI Transmitter Interface Modules with alternative Data Format

750-630, (and the variations /000-001, -002, -006, -008, -009, -011, -012, -013)

Note:
With the freely parametrizable variations /003 000 of the SSI Transmitter interface modules, the desired operation mode can be set. Dependent on it, the process image of these modules is then the same, as from the appropriate variation.

The above SSI Transmitter Interface modules with alternative data format have a total of 4 bytes of user data in the Input Process Image. The following table illustrates the Input Process Image, which has a total of 4 bytes mapped into the image.

Input Process Image			
Sub-index	Offset	Byte Destination	Remark
n	0	D0	Data bytes
	1	D1	
n+1	2	D2	
	3	D3	

These modules present themselves with 2x2 bytes, so that the object 0x6401 (also 0x2400 possible) for 2 Byte Special Modules, Inputs is used. Therefore for each module two Subindices are occupied

SSI Transmitter Interface modules with Standard Data Format

750-630/000-004, -005, -007

The above SSI Transmitter Interface modules with Standard Data Format have a total of 5 bytes of user data in the Input Process Image (4 bytes of user data and 1 byte of status). The following table illustrates the Input Process Image, which has a total of 6 bytes mapped into the image.

Input Process Image			
Sub-index	Offset	Byte Destination	Remark
n	0	S	Status byte
	1	-	not used
	2	D0	Data bytes
	3	D1	
	4	D2	
	5	D3	

These modules present themselves with 1x6 bytes, so that the object 0x3200 for 6 Byte Special Modules, Inputs is used. Therefore for each module one Subindex is occupied

Incremental Encoder Interface Modules

750-631

The above Incremental Encoder Interface modules have 5 bytes of input data and 3 bytes of output data. The following tables illustrate the Input and Output Process Image, which have 6 bytes mapped into each image.

Input Process Image			
Sub-index	Offset	Byte Destination	Remark
n	0	S	Status byte
	1	D0	Counter word
	2	D1	
	3	-	not used
	4	D2	Latch word
	5	D3	

These modules present themselves with 1x6 bytes, so that the object 0x3200 for 6 Byte Special Modules, Inputs is used. Therefore for each module one Subindex is occupied

Output Process Image			
Sub-index	Offset	Byte Destination	Remark
n	0	C	Control byte
	1	D0	Counter Setting word
	2	D1	
	3	-	not used
	4	-	
	5	-	

These modules present themselves with 1x6 bytes, so that the object 0x3300 for 6 Byte Special Modules, Outputs is used. Therefore for each module one Subindex is occupied

750-634

The above Incremental Encoder Interface module has 5 bytes of input data (6 bytes in cycle duration measurement mode) and 3 bytes of output data. The following tables illustrate the Input and Output Process Image, which has 6 bytes mapped into each image.

Input Process Image			
Sub-index	**Offset**	**Byte Destination**	**Remark**
n	0	S	Status byte
	1	D0	Counter word
	2	D1	
	3	D2*)	(Periodic time)
	4	D3	Latch word
	5	D4	

*) If cycle duration measurement mode is enabled in the control byte, the cycle duration is given as a 24-bit value that is stored in D2 together with D3/D4.

These modules present themselves with 1x6 bytes, so that the object 0x3200 for 6 Byte Special Modules, Inputs is used. Therefore for each module one Subindex is occupied

Output Process Image			
Sub-index	**Offset**	**Byte Destination**	**Remark**
n	0	C	Control byte
	1	D0	Counter Setting word
	2	D1	
	3	-	not used
	4	-	
	5	-	

These modules present themselves with 1x6 bytes, so that the object 0x3300 for 6 Byte Special Modules, Outputs is used. Therefore for each module one Subindex is occupied

750-637

The above Incremental Encoder Interface Module has a total of 6 bytes of user data in both the Input and Output Process Image (4 bytes of encoder data and 2 bytes of control/status). The following table illustrates the Input and Output Process Image, which have 6 bytes mapped into each image.

Input and Output Process Image			
Sub-index	**Offset**	**Byte Destination**	**Remark**
n	0	C0/S0	Control/Status byte of Channel 1
	1	D0	Data Value of Channel 1
	2	D1	
n+1	3	C1/S1	Control/Status byte of Channel 2
	4	D2	Data Value of Channel 2
	5	D3	

These modules present themselves with 2x3 bytes, so that the object 0x2600 for 3 Byte Special Modules, Inputs and the object 0x2700 for 3 Byte Special Modules, Outputs are used. Therefore for each module one Subindex is occupied

750-635, 753-635

The above Digital Pulse Interface module has a total of 4 bytes of user data in both the Input and Output Process Image (3 bytes of module data and 1 byte of control/status). The following table illustrates the Input and Output Process Image, which have 4 bytes mapped into each image.

Input and Output Process Image			
Sub-index	**Offset**	**Byte Destination**	**Remark**
n	0	C0/S0	Control/Status byte
	1	D0	Data Value
	2	D1	
	3	D2	

These modules present themselves with 1x4 bytes, so that the object 0x2800 for 4 Byte Special Modules, Inputs and the object 0x2900 for 4 Byte Special Modules, Outputs are used. Therefore for each module one Subindex is occupied

750-641

The DALI/DSI Master module has a total of 6 bytes of user data in both the Input and Output Process Image (5 bytes of module data and 1 byte of control/status). The following tables illustrate the Input and Output Process Image, which have 6 bytes mapped into each image.

Input Process Image			
Sub-index	**Offset**	**byte Destination**	**Remark**
n	0	S	Status byte
	1	D0	DALI response
	2	D1	DALI address
	3	D2	Message 3
	4	D3	Message 2
	5	D4	Message 1

These modules present themselves with 1x6 bytes, so that the object 0x3200 for 6 byte Special Modules, Inputs is used. Therefore for each module one Subindex is occupied.

Output Process Image			
Sub-index	**Offset**	**byte Destination**	**Remark**
n	0	C	Control byte
	1	D0	DALI command, DSI dimming value
	2	D1	DALI address
	3	D2	Parameter 2
	4	D3	Parameter 1
	5	D4	Command extension

These modules present themselves with 1x6 bytes, so that the object 0x3300 for 6 byte Special Modules, Outputs is used. Therefore for each module one Subindex is occupied.

5.2.6 System Modules

System Modules with Diagnostics

750-610, -611

The 750-610 and 750-611 Supply Modules provide 2 bits of diagnostics in the Input Process Image for monitoring of the internal power supply.

Input Process Image							
Bit 7	**Bit 6**	**Bit 5**	**Bit 4**	**Bit 3**	**Bit 2**	**Bit 1**	**Bit 0**
						Diagnostic bit S 2 Fuse	Diagnostic bit S 1 Voltage

For the digital inputs the object 0x6000 (also 0x2000 possible) is used.

Binary Space Module

750-622

The Binary Space Modules 750-622 behave alternatively like 2 channel digital input modules or output modules and occupy depending upon the selected settings 1, 2, 3 or 4 bits per channel. According to this, 2, 4, 6 or 8 bits are occupied then either in the process input or the process output image.

Input and Output Process Image							
Bit 7	**Bit 6**	**Bit 5**	**Bit 4**	**Bit 3**	**Bit 2**	**Bit 1**	**Bit 0**
(Data bit DI 8)	(Data bit DI 7)	(Data bit DI 6)	(Data bit DI 5)	(Data bit DI 4)	(Data bit DI 3)	Data bit DI 2	Data bit DI 1

For the digital inputs the object 0x6000 (also 0x2000 possible) is used. For the digital outputs the object 0x6200 (also 0x2100 possible) is used.

6 Use in Hazardous Environments

6.1 Foreword

Today's development shows that many chemical and petrochemical companies have production plants, production, and process automation machines in operation which use gas-air, vapor-air and dust-air mixtures which can be explosive. For this reason, the electrical components used in such plants and systems must not pose a risk of explosion resulting in injury to persons or damage to property. This is backed by law, directives or regulations on a national and international scale. WAGO-I/O-SYSTEM 750 (electrical components) is designed for use in zone 2 explosive environments. The following basic explosion protection related terms have been defined.

6.2 Protective measures

Primarily, explosion protection describes how to prevent the formation of an explosive atmosphere. For instance by avoiding the use of combustible liquids, reducing the concentration levels, ventilation measures, to name but a few. But there are a large number of applications, which do not allow the implementation of primary protection measures. In such cases, the secondary explosion protection comes into play. Following is a detailed description of such secondary measures.

6.3 Classification meeting CENELEC and IEC

The specifications outlined here are valid for use in Europe and are based on the following standards: EN50... of CENELEC (European Committee for Electrotechnical Standardization). On an international scale, these are reflected by the IEC 60079-... standards of the IEC (International Electrotechnical Commission).

6.3.1 Divisions

Explosive environments are areas in which the atmosphere can potentially become explosive. The term explosive means a special mixture of ignitable substances existing in the form of air-borne gases, fumes, mist or dust under atmospheric conditions which, when heated beyond a tolerable temperature or subjected to an electric arc or sparks, can produce explosions. Explosive zones have been created to describe the concentrations level of an explosive atmosphere. This division, based on the probability of an explosion occurring, is of great importance both for technical safety and feasibility reasons. Knowing that the demands placed on electrical components permanently employed in an explosive environment have to be much more stringent than those placed on electrical components that are only rarely and, if at all, for short periods, subject to a dangerous explosive environment.

Explosive areas resulting from gases, fumes or mist:

Zone 0 areas are subject to an explosive atmosphere (> 1000 h /year) continuously or for extended periods.

Zone 1 areas can expect the occasional occurrence of an explosive atmosphere (> 10 h ≤ 1000 h /year).

Zone 2 areas can expect the rare or short-term occurrence of an explosive atmosphere (> 0 h ≤ 10 h /year).

Explosive areas subject to air-borne dust:

Zone 20 areas are subject to an explosive atmosphere (> 1000 h /year) continuously or for extended periods.

Zone 21 areas can expect the occasional occurrence of an explosive atmosphere (> 10 h ≤ 1000 h /year).

Zone 22 areas can expect the rare or short-term occurrence of an explosive atmosphere (> 0 h ≤ 10 h /year).

6.3.2 Explosion protection group

In addition, the electrical components for explosive areas are subdivided into two groups:

Group I: Group I includes electrical components for use in fire-damp endangered mine structures.

Group II: Group II includes electrical components for use in all other explosive environments. This group is further subdivided by pertinent combustible gases in the environment.
Subdivision IIA, IIB and IIC takes into account that different materials/substances/gases have various ignition energy characteristic values. For this reason the three sub-groups are assigned representative types of gases:

IIA – Propane
IIB – Ethylene
IIC – Hydrogen

Minimal ignition energy of representative types of gases				
Explosion group	I	IIA	IIB	IIC
Gases	Methane	Propane	Ethylene	Hydrogen
Ignition energy (µJ)	280	250	82	16

Hydrogen being commonly encountered in chemical plants, frequently the explosion group IIC is requested for maximum safety.

6.3.3 Unit categories

Moreover, the areas of use (zones) and the conditions of use (explosion groups) are subdivided into categories for the electrical operating means:

Unit categories	Explosion group	Area of use
M1	I	Fire-damp protection
M2	I	Fire-damp protection
1G	II	Zone 0 Explosive environment by gas, fumes or mist
2G	II	Zone 1 Explosive environment by gas, fumes or mist
3G	II	Zone 2 Explosive environment by gas, fumes or mist
1D	II	Zone 20 Explosive environment by dust
2D	II	Zone 21 Explosive environment by dust
3D	II	Zone 22 Explosive environment by dust

6.3.4 Temperature classes

The maximum surface temperature for electrical components of explosion protection group I is 150 °C (danger due to coal dust deposits) or 450 °C (if there is no danger of coal dust deposit).

In line with the maximum surface temperature for all ignition protection types, the electrical components are subdivided into temperature classes, as far as electrical components of explosion protection group II are concerned. Here the temperatures refer to a surrounding temperature of 40 °C for operation and testing of the electrical components. The lowest ignition temperature of the existing explosive atmosphere must be higher than the maximum surface temperature.

Temperature classes	Maximum surface temperature	Ignition temperature of the combustible materials
T1	450 °C	> 450 °C
T2	300 °C	> 300 °C to 450 °C
T3	200 °C	> 200 °C to 300 °C
T4	135 °C	> 135 °C to 200 °C
T5	100 °C	>100 °C to 135 °C
T6	85°C	> 85 °C to 100 °C

The following table represents the division and attributes of the materials to the temperature classes and material groups in percent:

<table>
<tr><th colspan="7">Temperature classes</th></tr>
<tr><td>T1</td><td>T2</td><td>T3</td><td>T4</td><td>T5</td><td>T6</td><td>Total*</td></tr>
<tr><td>26.6 %</td><td>42.8 %</td><td>25.5 %</td><td rowspan="2">4.9 %</td><td rowspan="2">0 %</td><td rowspan="2">0.2 %</td><td rowspan="2">432</td></tr>
<tr><td colspan="3">94.9 %</td></tr>
<tr><th colspan="7">Explosion group</th></tr>
<tr><td>IIA</td><td>IIB</td><td>IIC</td><td></td><td></td><td></td><td>Total*</td></tr>
<tr><td>85.2 %</td><td>13.8 %</td><td>1.0 %</td><td></td><td></td><td></td><td>501</td></tr>
</table>

* Number of classified materials

6.3.5 Types of ignition protection

Ignition protection defines the special measures to be taken for electrical components in order to prevent the ignition of surrounding explosive atmospheres. For this reason a differentiation is made between the following types of ignition protection:

Identification	**CENELEC standard**	**IEC standard**	**Explanation**	**Application**
EEx o	EN 50 015	IEC 79-6	Oil encapsulation	Zone 1 + 2
EEx p	EN 50 016	IEC 79-2	Overpressure encapsulation	Zone 1 + 2
EEx q	EN 50 017	IEC 79-5	Sand encapsulation	Zone 1 + 2
EEx d	EN 50 018	IEC 79-1	Pressure resistant encapsulation	Zone 1 + 2
EEx e	EN 50 019	IEC 79-7	Increased safety	Zone 1 + 2
EEx m	EN 50 028	IEC 79-18	Cast encapsulation	Zone 1 + 2
EEx i	EN 50 020 (unit) EN 50 039 (system)	IEC 79-11	Intrinsic safety	Zone 0 + 1 + 2
EEx n	EN 50 021	IEC 79-15	Electrical components for zone 2 (see below)	Zone 2

Ignition protection “n" describes exclusively the use of explosion protected electrical components in zone 2. This zone encompasses areas where explosive atmospheres can only be expected to occur rarely or short-term. It represents the transition between the area of zone 1, which requires an explosion protection and safe area in which for instance welding is allowed at any time.

Regulations covering these electrical components are being prepared on a world-wide scale. The standard EN 50 021 allows electrical component manufacturers to obtain certificates from the corresponding authorities for instance KEMA in the Netherlands or the PTB in Germany, certifying that the tested components meet the above mentioned standards draft.

Type “n” ignition protection additionally requires electrical components to be marked with the following extended identification:

A – non spark generating (function modules without relay /without switches)

AC – spark generating, contacts protected by seals (function modules with relays / without switches)

L – limited energy (function modules with switch)

Further information
For more detailed information please refer to the national and/or international standards, directives and regulations!

6.4 Classifications meeting the NEC 500

The following classifications according to NEC 500 (National Electric Code) are valid for North America.

6.4.1 Divisions

The "Divisions" describe the degree of probability of whatever type of dangerous situation occurring. Here the following assignments apply:

Explosion endangered areas due to combustible gases, fumes, mist and dust:	
Division 1	Encompasses areas in which explosive atmospheres are to be expected occasionally (> 10 h ≤ 1000 h /year) as well as continuously and long-term (> 1000 h /year).
Division 2	Encompasses areas in which explosive atmospheres can be expected rarely and short-term (>0 h ≤ 10 h /year).

6.4.2 Explosion protection groups

Electrical components for explosion endangered areas are subdivided in three danger categories:

Class I (gases and fumes):	Group A (Acetylene) Group B (Hydrogen) Group C (Ethylene) Group D (Methane)
Class II (dust):	Group E (Metal dust) Group F (Coal dust) Group G (Flour, starch and cereal dust)
Class III (fibers):	No sub-groups

6.4.3 Temperature classes

Electrical components for explosive areas are differentiated by temperature classes:

Temperature classes	Maximum surface temperature	Ignition temperature of the combustible materials
T1	450 °C	> 450 °C
T2	300 °C	> 300 °C to 450 °C
T2A	280 °C	> 280 °C to 300 °C
T2B	260 °C	> 260 °C to 280 °C
T2C	230 °C	>230 °C to 260 °C
T2D	215 °C	>215 °C to 230 °C
T3	200 °C	>200 °C to 215 °C
T3A	180 °C	>180 °C to 200 °C
T3B	165 °C	>165 °C to 180 °C
T3C	160 °C	>160 °C to 165 °C
T4	135 °C	>135 °C to 160 °C
T4A	120 °C	>120 °C to 135 °C
T5	100 °C	>100 °C to 120 °C
T6	85 °C	> 85 °C to 100 °C

6.5 Identification

6.5.1 For Europe

According to CENELEC and IEC

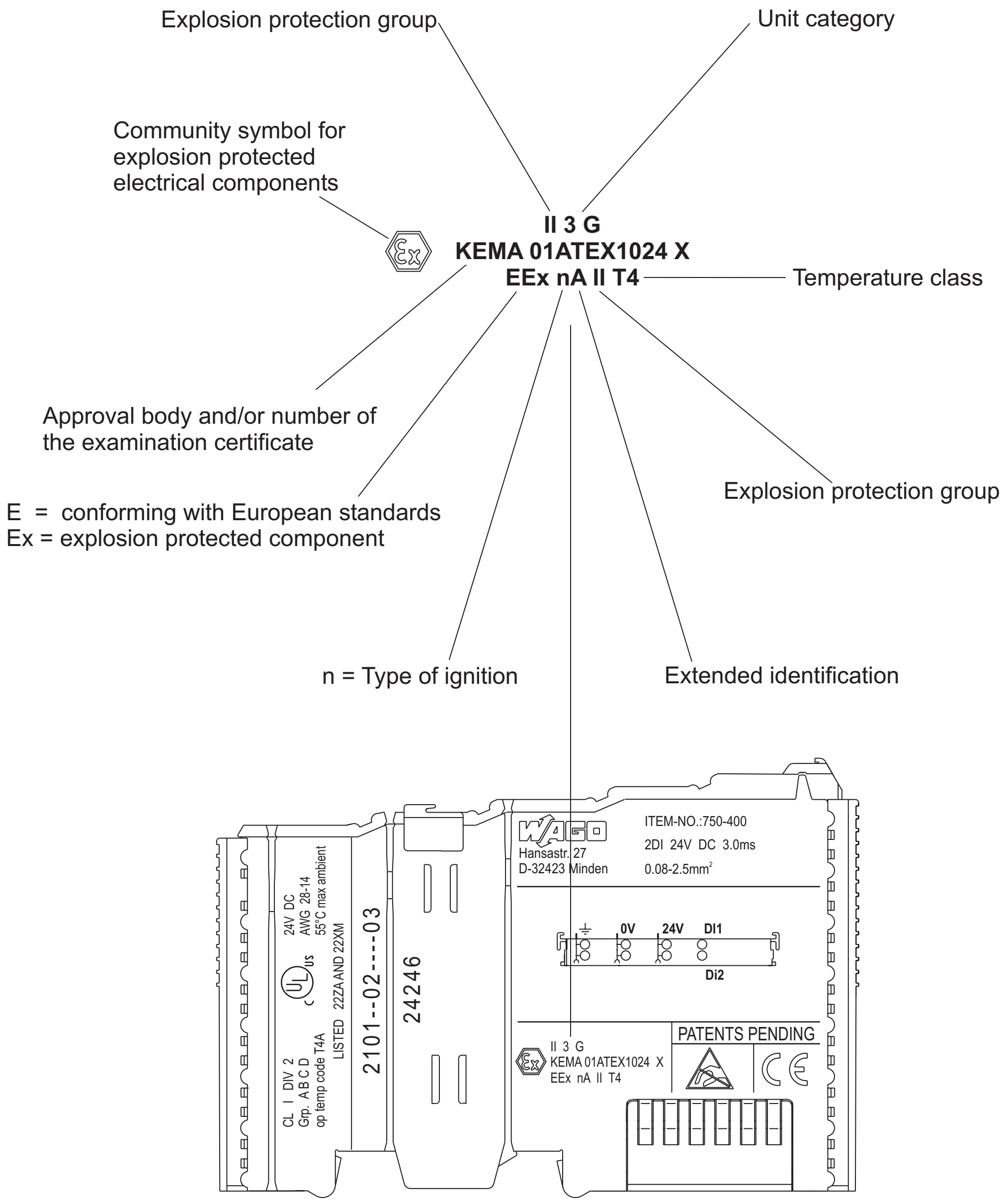


Fig. 6.5.1-1: Example for lateral labeling of bus modules
(750-400, 2 channel digital input module 24 V DC) g01xx03e

6.5.2 For America

According to NEC 500

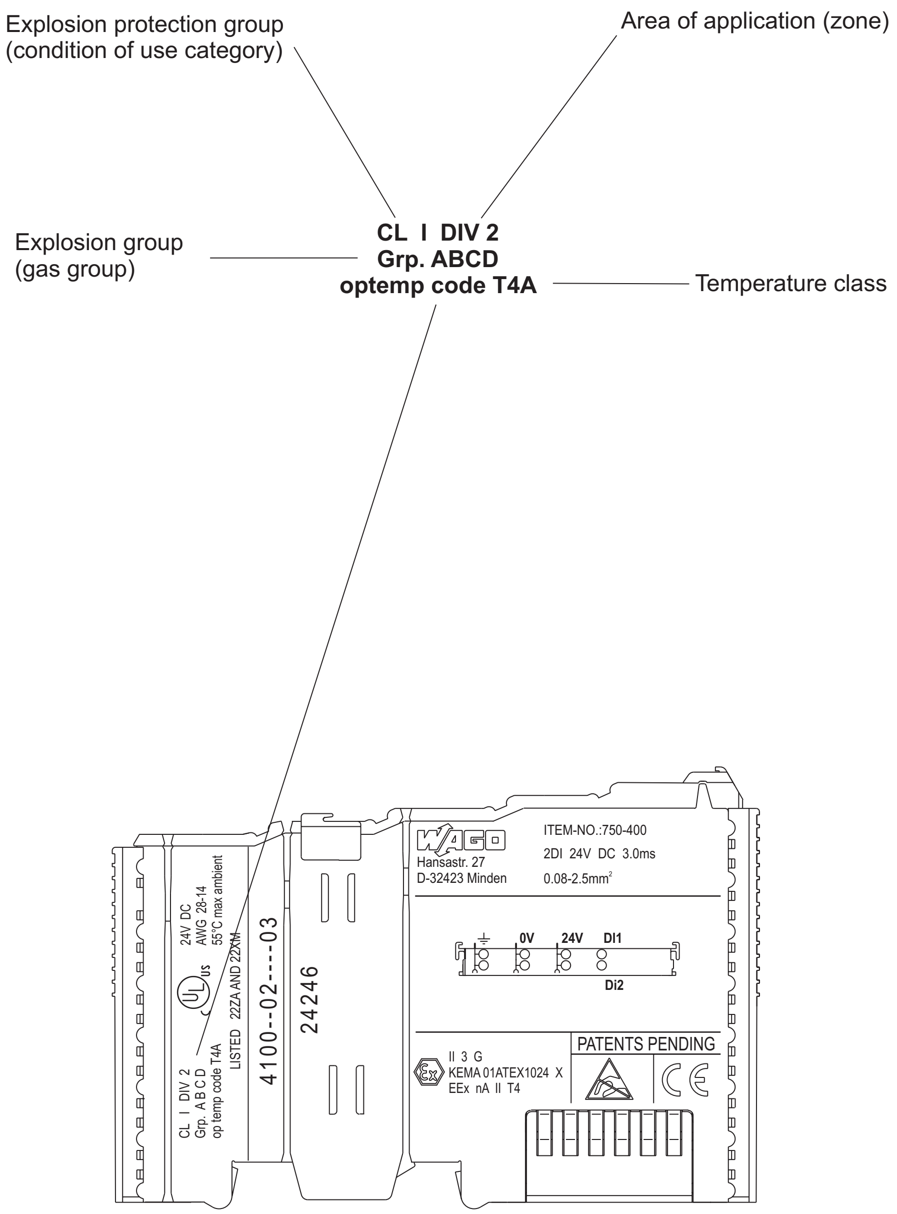


Fig. 6.5.2-1: Example for lateral labeling of bus modules
(750-400, 2 channel digital input module 24 V DC)

g01xx04e

6.6 Installation regulations

In the **Federal Republic of Germany,** various national regulations for the installation in explosive areas must be taken into consideration. The basis being the ElexV complemented by the installation regulation DIN VDE 0165/2.91. The following are excerpts from additional VDE regulations:

DIN VDE 0100	Installation in power plants with rated voltages up to 1000 V
DIN VDE 0101	Installation in power plants with rated voltages above 1 kV
DIN VDE 0800	Installation and operation in 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:

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

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

The fieldbus independent I/O System Modules Type 750-xxx are to be installed in enclosures that provide for the degree of ingress protection of at least IP54.
For use in the presence of combustible dust, the above mentioned modules are to be installed in enclosures that provide for the degree of ingress protection of at least IP64.

The fieldbus independent I/O system may only be installed in hazardous areas (Europe: Group II, Zone 2 or America: Class I, Division 2, Group A, B, C, D) or in non-hazardous areas!

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

Ensure that only approved modules of the electrical operating type will be used. The Substitution or Replacement of modules can jeopardize the suitability of the system in hazardous environments!

Operation of intrinsically safe EEx i modules with direct connection to sensors/actuators in hazardous areas of Zone 0 + 1 and Division 1 type requires the use of a 24 V DC Power Supply EEx i module!

DIP switches and potentiometers are only to be adjusted when the area is know to be non-hazardous.

Further Information
Proof of certification is available on request. Also take note of the information given on the module technical information sheet.

7 Glossary

Bit	Smallest information unit. Its value can either be 1 or 0.
Bitrate	Number of bits transmitted within a time unit.
Bootstrap	Operating mode of the fieldbus coupler. Device expects a firmware upload.
Bus	A structure used to transmit data. There are two types, serial and parallel. A serial bus transmits data bit by bit, whereas a parallel bus transmits many bits at one time.
Byte	Binary Yoked Transfer Element. A byte generally contains 8 bits.
Data bus	see *Bus*.
Fieldbus	System for serial information transmission between devices of automation technology in the process-related field area.
Hardware	Electronic, electrical and mechanic components of a module/subassembly.
Operating system	Software which links the application programs to the hardware.
Segment	Typically, a network is divided up into different physical network segments by way of *routers* or *repeaters*.
Server	Device providing services within a client/server system. The service is requested by the *Client*.
Subnet	A portion of a network that shares the same network address as the other portions. These subnets are distinguished through the subnet mask.

8 Literature list

Further information
CAN in Automation (CiA) provides further documentation for its members in INTERNET.
can-cia.de

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