Technical Description

Wireless Automation

Manual

Planning, Installation and Commissioning Guidelines

Power and productivity
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Planning Installation and Commissioning Guidelines
Technical description

Please note the following

Target group

This description is intended for the use of trained specialists in electrical installation and control and automation engineering, who are familiar with the applicable national standards.

Safety requirements

The responsible staff must ensure that the application or use of the products described satisfy all the requirements for safety, including all the relevant laws, regulations, guidelines and standards.

Planning Installation and Commissioning Guidelines
Technical description

Content

continuation...

Contents (...continuation)

Planning Installation and Commissioning Guidelines
Technical description

Introduction

This guideline is intended for the engineering, planning and commissioning of ABB´s Wireless Automation system. It also includes all details for the operation and use of the wireless devices. For the basic infrastructure devices a short list of steps for fast commissioning is given at the end of each chapter. In the appendix a detailed checklist including all steps from planning to commissioning of a system with wireless devices is provided.

Detailed data sheets are not included in this guideline, you can find them on the system CD or download them from the internet (www.abb.com/plc “wireless automation devices”, “download”)

ABB´s Concept - Wireless Interface for Sensors and Actuators

ABB´s Wireless Interface for Sensors and Actuators is the new standard for industrial automation set by ABB. It consists of two wireless technologies to enable devices like sensors and actuators to be connected fully wireless (see figure next page):

- Wireless communication (Wireless-COM),
- Wireless power supply (Wireless-POWER).

ABB supports a growing range of innovative IP67 products for the machine and device level:

- The Wireless Proximity Switch (WPS) consist of a low power sensor head (WSIN/WSIF) and a communication module called WSIX (Wireless Sensor Interface for proximity switches). The wireless proximity switches, in contrast to conventional proximity switches, do not require any cable connection between sensor and machine control system due to using both Wireless technologies.
- The Wireless Sensor Pad (WSP) is a communication module shaped as a sensor distribution box. It allows several sensors heads to be connected to one communication module. It also uses both Wireless technologies and therefore does not require any cable connection between sensors and machine control and enables the use of reed switches.
- The Wireless Input/Output Pad (WIOP) is a sensor actor distribution box which communicates via Wireless-COM, but is supplied with 24V conventional power supply in order to enable the connection of outputs/actuators (which are typically more centralized) and other third party sensors/inputs to a system with ABB´s Concept.

These wireless devices communicate via radio communication to an Wireless I/O module (WDIO). The WDIO receives the Wireless-COM signals via a pair of antennas and connects to a control system/PLC by a choice of field busses via the ABB FieldBusPlug FBP. Communication takes place in the 2.4 GHz band. It can also map signals to other Wireless Automation devices without a fieldbus connection or controller (cable replacement). Up to three WDIO can be operated in one cell without noticeable performance change, which would support e. g. up to 360 wireless proximity switches or 39 pads (up to 624 IO points).

The general advantages of ABB´s Wireless automation devices are:

- high flexibilty in use
- reduced engineering
- short commissioning times
- higher reliability and availability of the machinery
- fast and cost effective retrofit
- new applications, not possible with wired devices

ABB´s Concept Wireless-COM: Industrial wireless realtime communication

ABB´s Concept was designed especially for the requirements in the machine and device level in factory automation and therefore has a total performance figure which is by several orders of magnitude higher than with other wireless standards. Wireless-COM contains unique technologies to fulfill the requirements of factory automation:

- Realtime (2ms cycle time on air interface)
  - 20 ms typ. overall latency including fieldbus interfaces
  - 7ms typ. latency in mapping mode (in- to output reaction time)
- Highest reliability (practically guaranteed worst case response times -> realtime)
- Highest node density (~ 300 in a cell without noticeable communication degradation)
- A practically unlimited number of nodes in a factory (cellular approach)

Wireless-POWER: Wireless power supply via an electromagnetic field

The electromagnetic field used for the power transfer is typically produced by two pairs of primary loops to supply a volume of 1 m x 1 m x 1 m up to 3 m x 3 m x 3 m, which can be enlarged modularly.
A maximum cell size of 6 m x 6 m x 3 m is possible for one cell – several cells can be adjacent to each other modularly. The Primary loop cable WPC is connected to the Wireless Power Units (WPU) which controls the 120 kHz current to a constant value.

Also other configurations are possible e. g. spot and line configurations.

Wireless Automation function and device overview
Right side: Infrastructure components, power supply and data communication
Left side: Communication modules and sensor/actor interfaces (field devices)

1. Primary loops

With the help of primary loops a weak electromagnetic field is generated, which supplies some or all the devices of a machine or manufacturing cell with wireless power. This is the principle of a transformer without core. The same principle (but with modulation) is used e.g. since decades for anti-theft devices in warehouses. The following principles are for standard setups of primary loops for supply of larger volumes.

In many applications, especially in retrofits, often simpler arrangements e.g. with only one primary loop (ringshaped or linear) is already sufficient to supply a problem area. Basically around each primary loop conductor a field is created which, depending on the set current, provides sufficient field lines density up to a maximum distance of e.g. 30 cm distance of the conductor. Compacted by closing the primary loop conductor into a loop, the field lines inside the loop are further concentrated, so that inside the loop much greater distances are possible, as is described in the following chapters.

For other, simpler arrangements applies: Magnetic fields can be thought of as a flux (river), symbolized by the field lines (which are closed, however), meaning the flux/river flows in a circle around the current-carrying conductor. The density of the field lines at a location corresponding to a field strength H, determined directly by the flowing current I and the closeness/distance r to the current-carrying conductor parts: $H = I / (2 \varpi r)$ with the unit A / m.

If the current flows, for example large metal objects will move the magnetic field locally or weaken it, but because the current is giving the total flux/flow, it must be even strengthened in another place. This can be illustrated by a large stone in a small river: In some placces the river flux will be weakened, but the water has to flow around the stone correspondingly faster... clearly focused "energy". For testing of field strengths, there is the field strength indicator WPI100 for fast display on site.

The max. settable current is low enough that accord. German Berufsgenossenschaft working directly at the loops is possible.

1.1 Geometry of the primary loops

The top view to the primary loops, shown on the left-hand side of figure 1.2, shows the standard configuration for larger volumes. If shielded by larger metallic objects is possible, two pairs of loops are recommended.

Maximum permitted sizes of the primary loops (inductivity :

- Edge length s_a between 1 m and 3 m
- Edge length s_c between 1 m and 6 m

The following boundary condition is to be kept:

- $s_c \geq s_a$

Procedure:

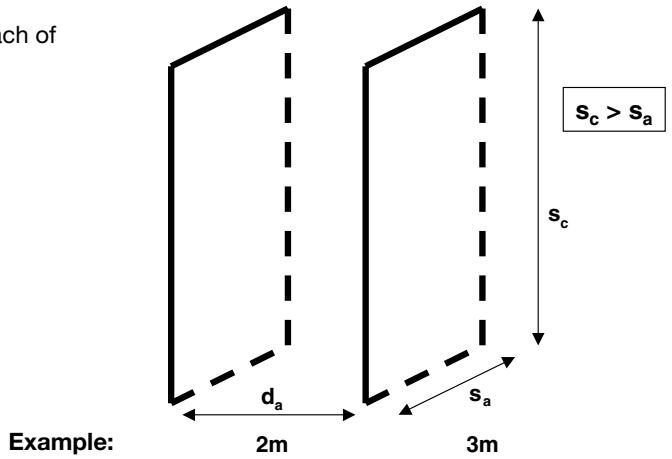
- Set up 4 two-dimensional primary loops (2 pairs) around the part of the machine containing wireless devices in a way that always the two opposite primary loops roughly have the same size and geometry.
- Set up the primary loops rectangular to each other.
  - Max. tolerance: ± 8°.
- Set up the lop pairs symmetrically, permitted distance of the two primary loops of one pair to each other:
  - 2/3 of the shortest edge length of one primary loop (± 10%).
- The individual primary loops must cross each other with 1/6 (tolerance max. ± 20%) of their length (refer to fig. 1.3). This way, a square outline is evenly supplied with sufficient magnetic field strength.

Important:

Position the primary loops in a way that their electromagnetic field is not shielded by large metal surfaces or short cicuit loops, in e. g. the support structure (refer to fig. 1.6).

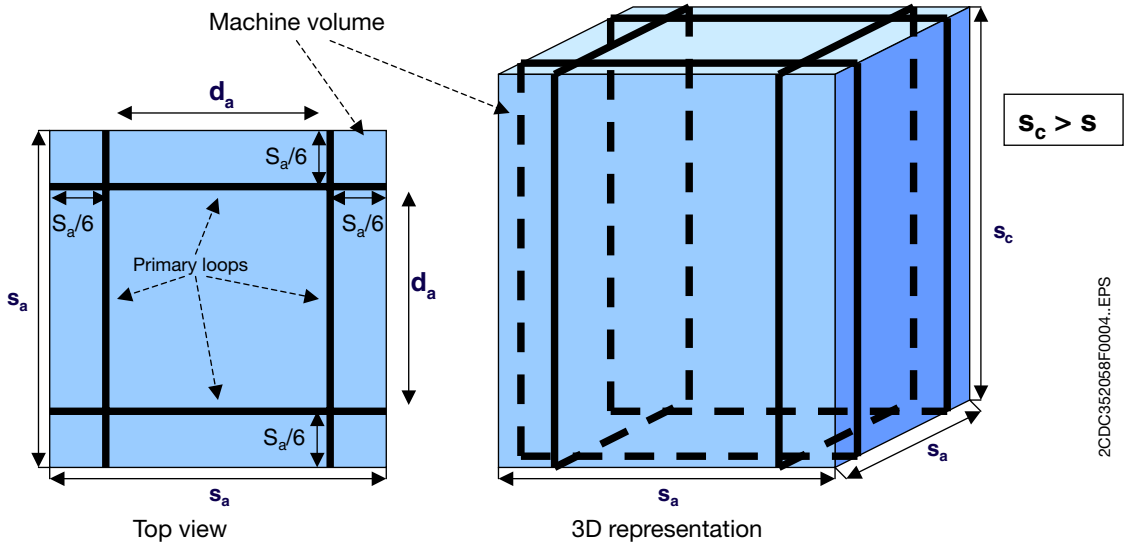
1.2 Arrangement variants for the primary loops

Design constraint valid for each of the two coil pairs



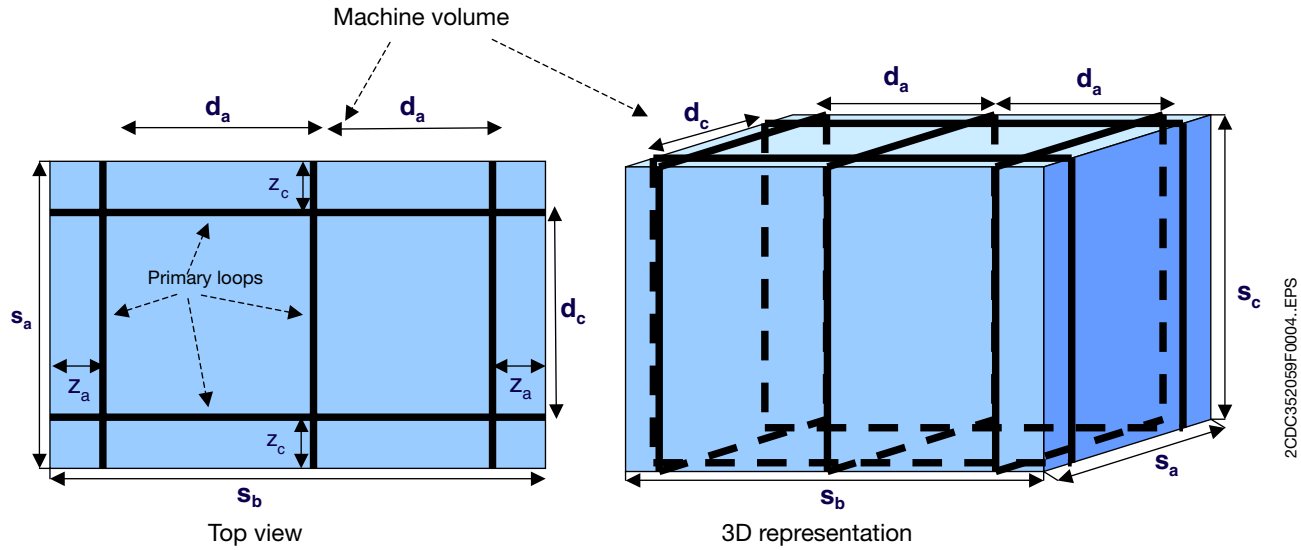
The smallest side s_a of one loop determines the distance d_a to the next parallel loop: $d_a \sim 2/3 \times s_a$

Fig. 1.1: Dimensioning principle for loop pairs



1. The smallest side s_a of one loop determines the distance d_a to the next parallel loop: $d_a \sim 2/3 \times s_a$
2. The following constraint is valid: Overlapping “distance” of a coil from cell border: $s_a/6$

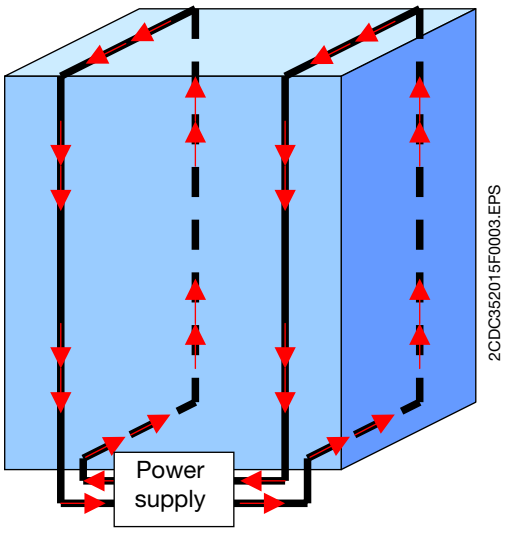
Fig. 1.2: Arrangement of primary loops for machines with nearly square outline the height of which is greater than the length of one of the edges.



1. The smallest side s_a, s_c of one loop determines the distance d_a , d_c to the next parallel loop:
   $d_a \sim$ (4-) 5/6 x s_a ($s_a < s_c < s_b$ is assumed)
2. The following constraint is valid:
   Overlapping “distance” of a coil from cell border z_a, z_c approximately 1/6 of the smallest side s_a, s_c of this loop

Fig. 1.3: Arrangement of primary loops for machines with rectangular outline

- The primary loop cables are marked in regular spacings with arrows on the outer insulation. These arrows all have to point towards the same direction when installing a pair of primary loops and further primary loops arranged in parallel (refer to fig. 1.6).



(Principle representation: For reasons of clarity only one pair of primary loops is represented).

Fig. 1.4: Arrows on the outer insulation of the primary loop cables:
If the arrows point towards the same direction, the primary loop pairs and further primary loops arranged in parallel are installed correctly.

1.3 Distances to primary loops, safety aspects

- Persons with cardiac pacemakers have to observe minimum clearances to the primary loops. Refer to the explanations below and fig. 1.5.
- Some cardiac pacemakers may be particularly sensitive to high frequency electromagnetic fields.
- The primary loops generate an electromagnetic field the field strength of which depends on the set current. The strongest electromagnetic field is right next to the primary loop cable.
- The required current depends on the edge length of a primary loop. For rectangular primary loops the short edge is the relevant length.

- We recommand to observe a distance of 30 cm for the head and backbone at continuous working positions

Measures

- Marking for Pace Maker Carriers:

  If the machine/installation does not have a fence around it to determine this distance (for minimum distances please refer to the following table and fig. 1.5), a black-yellow line has to be attached to the floor in order to make the distance clear.
  In this case, suitable labelings have to be installed in the line of the distance.
  The Engineering Package WEP100.01xx (1SAF900091R01xx.ZIP) contains an example for this.

- The values given in the following table are theoretical values intended for the planning of a machine/installation with wireless devices. During commissioning and acceptance these values have to be verified by corresponding measurements and, if necessary, the distances have to be corrected.

For more detailed information, please refer to the expert's report of the „Berufsgenossenschaft der Feinmechanik und Eletrotechnik BGFE“ (in the category: certificates or reports)

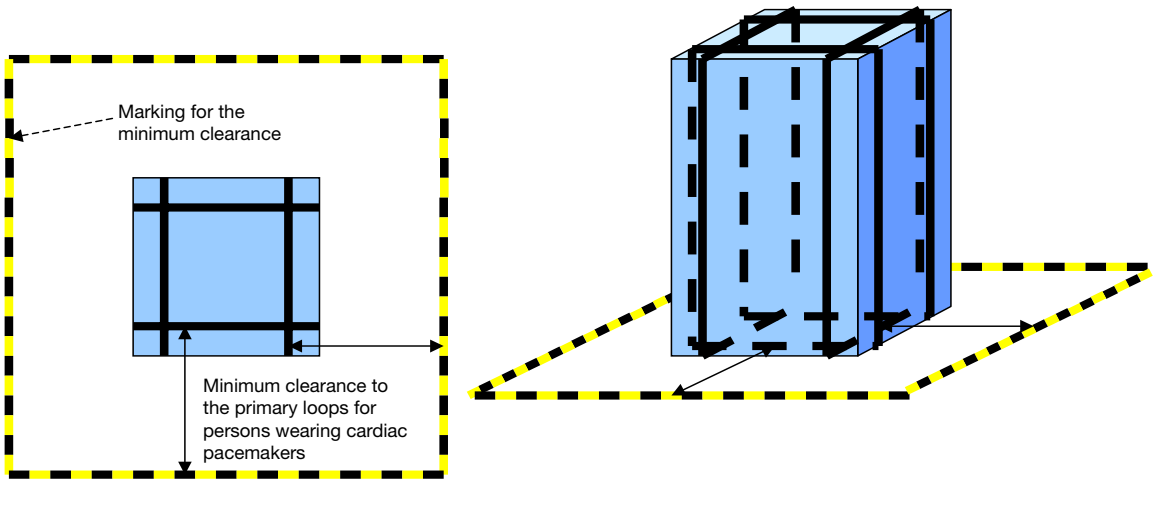


Fig. 1.5: Minimum clearances to primary loops for persons wearing cardiac pacemakers (principle representation)

Long edge of the primary loop (one winding): 1200 – 6000 mm		
Short edge of the primary loop [mm]	Current [A]	[1]) Distance for cardiac pacemakers [mm]
1000 - 1200	8.0	[2]) 800
1200 - 1400	10.0	1000
1400 - 1600	12.0	1300
1600 - 1800	13.0	1400
1800 - 2000	15.0	1600
2000 - 2200	16.0	1700
2200 - 2400	18.0	1900
2400 - 2600	20.0	2100
2600 - 2800	22.0	2300
2800 - 3000	24.0	2500

[1]) Distance for cardiac pacemakers = Minimum clearance from the primary loop area to be observed by persons wearing cardiac pacemakers.

[2]) This value is also valid for smaller primary loops with two windings.

1.4 Distances of primary loops to metal constructions

a Distance of primary loops to metal surfaces or metal gratings min.. 30 mm. Consequently, the same distance is valid for primary loops standing vertically on metal platforms, steel-reinforced industrial floors, etc. Especially for large steel objects a distance of > 100 mm is recommended to keep losses/heating low.

b Large metal surfaces (e.g. larger than approx. 50 % of the primary loop area) surrounding the primary loop arrangement (including machine fencings made of metal) should have a minimum clearance of 200 mm (for small primary loops) up to 500 mm (for large primary loops) to the entire primary loop area in order not to burden the power supply too much. This distance is the overlapping in fig. 1.2.

c Inside of ring constructions (see figure) with continuous electric connections the electromagnetic field induces currents which can attenuate the energy field of the primary loops. In order to avoid an attenuation of the electromagnetic field, the electric conductivity of those ring constructions has to be interrupted, e.g. by inserting an isolating plastic part, unless the distance to the loops or potentional sensor positions is large enough (see b and fig. 1.9)

d In order to avoid inadmissible contact voltages at those interrupted ring constructions in the immediate neighborhood of a primary loop, the area of the ring construction must have a minimum clearance of 30 mm to the nearest primary loop area, if the relevant area is not larger than 9 m² (see fig. 1.5). For larger primary loops up to 18 m² this distance has to be increased linearly up to 120 mm.

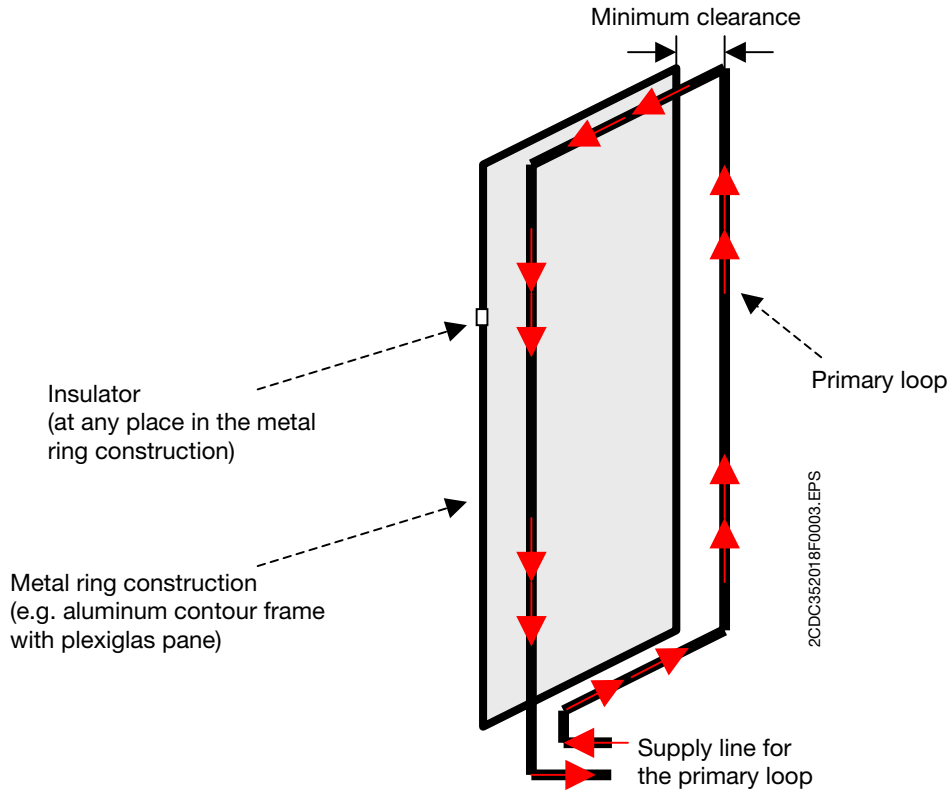


Fig. 1.6: Minimum clearance of the primary loops to metal ring constructions (e. g. aluminum contour frame with plexiglas pane)

1.5 Installation of the primary loop cables

Normally, the primary loops are made of only one winding/turn of the primary loop cable. Only for small primary loops two windings/turns of the primary loop cable may be necessary (see table in chapter 4) in order to stay within the inductivity range of WPU100. The windings can be installed without any distance to each other.

Using more than one turn can lead to unacceptable high field strength for working plces directly near the primary loop conductor
(if the sum current is larger than 24A).

- The primary loop cables can be laid open or in armored plastic conduits, plastic cable ducts (open or closed types), etc.

- The primary loop cable parts of the loop itself must not be laid in armored steel conduits or similar electrically conductive materials. This increase losses especially with steel. Aluminium might be acceptable over parts of a loop.
- For the installation of the primary loops glas fibre reinforced plastic conduits may be used conveniently due to their self supporting property at large lenght

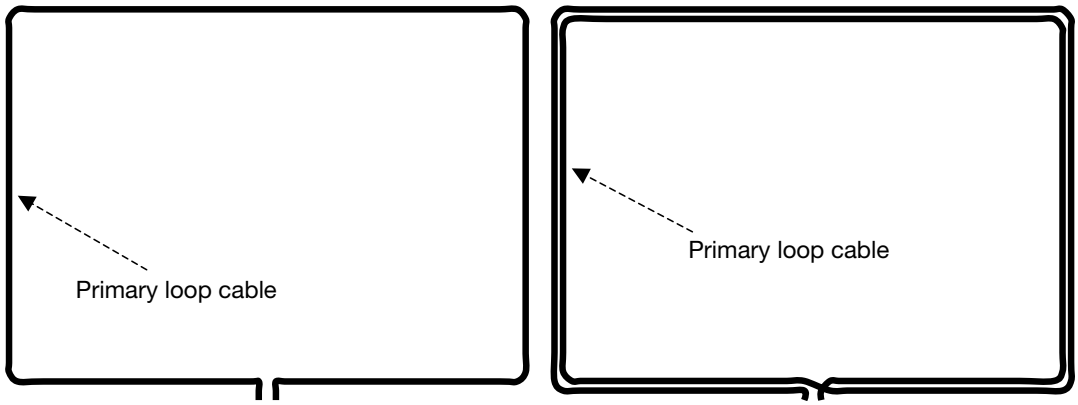


Fig. 1.7: Normally, the primary loop cable is laid in one winding, as shown on the left.
Two windings are only necessary for small primary loops
(1000 mm x 1000 mm to 1000 mm x 1200 mm).

1.6 Installation of the supply line for the primary loops

- The supply lines for a primary loop must be twisted with each other or held closely together in any other way (e.g. by cable ties, heat shrinkable tubes, etc.) over the entire distance to the power supply.

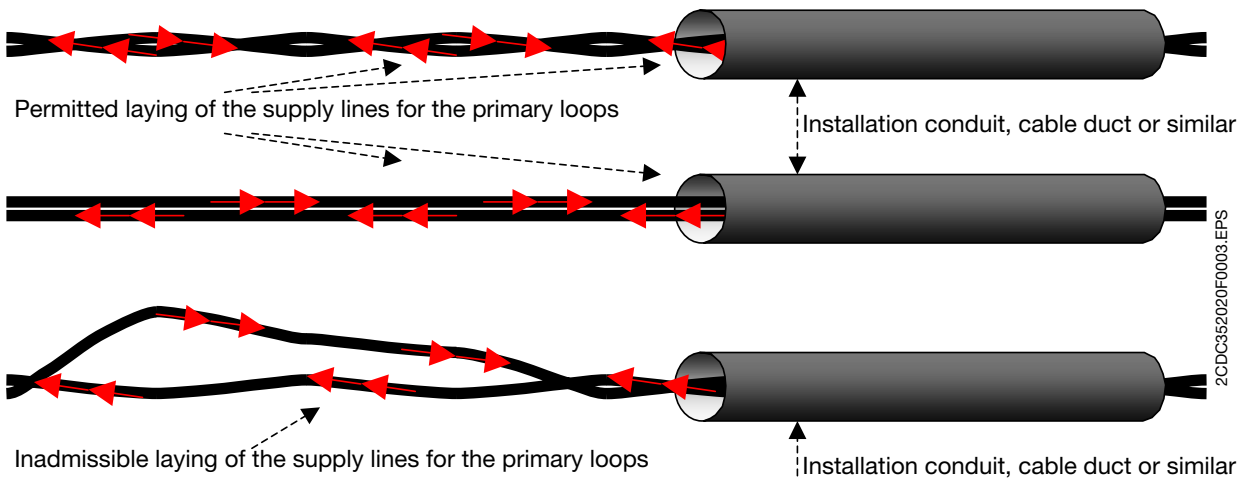


Fig. 1.8: Laying of the supply lines for a primary loop

- The total length of all supply lines for one pair of primary loops can be max. 8 m.
- The line length required for one primary loop can be calculated as follows:
  line length = circumference x number of windings + 2 x supply line length.
- Due to double insulation the supply lines can also be laid open.
- For higher stability the supply lines for a primary loop (twisted with each other or held closely together in any other way) can be laid in armored plastic or steel conduits or similar materials.

1.7 Electrically conductive ring construction inside the machine

- Electrically conductive ring constructions inside a machine running in parallel to one of the primary loop pairs lead to an attenuation of the electromagnetic field in their neighborhood. If wireless powered devices should be operated there, these ring constructions have to be electrically interrupted, e. g. by the use of plastic parts.
- For seperated mounting of a sensorhead and its wireless communication module WSIX, the sensorcable with bracket WSC100 exists in different configurations and cable length, so that ABB´s sensor heads can also be used in such shielded spots.

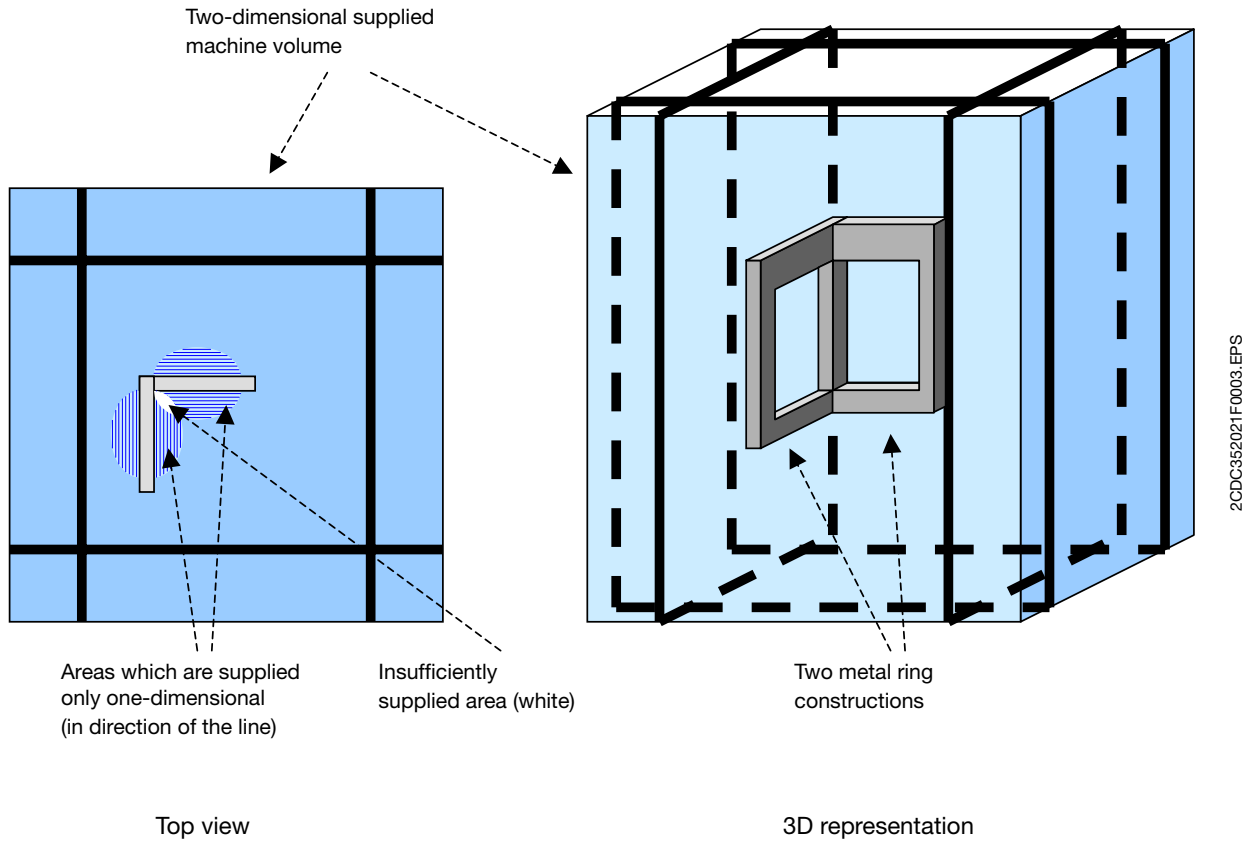


Fig. 1.9: Attenuation of the magnetic field by electrically conductive ring constructions (example)

- If any of the ring constructions mentioned above cannot be electrically interrupted by inserting insulating plastic parts, one dimension of the electromagnetic field will be attenuated as shown in fig. 1.9. If wireless devices shall be used in this area, the second dimension of the electromagnetic field around the place of installation must not be shielded or attenuated in any other way.

2. Wireless Sensor/Actuator Interfaces (Field devices)

The Wireless Sensor / Actuator Interfaces communicates via the ABB´s wireless communication technology to an WDIO Input/Output Module (“Basestation”), which connects via a FieldBusPlug to a fieldbus of choice (PROFIBUS®, DeviceNet™, Modbus…).

Each wireless Wireless Automation device receives during configuration

- an address depending on the configuration type of the WDIO used and
- the Cell-ID of the WDIO.

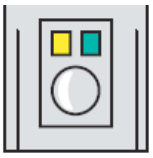
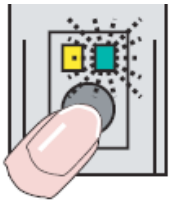
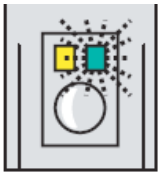
The Cell-ID address or range identifier determines to which WDIO (Basestation) the device is connected.

The Wireless Automation sensor / actuator interface products all have a common user interface consisting of a push button and one green LED for diagnosis/status information.

2.1 Configuration, Service and Deletion of Devices

The push button is used for configuration, winking and diagnosis commands. A green LED is always used to signal the status of the device

To check correct power supply (and communication) the push button can be pressed. On configured devices (with error free communication) the green LED blinks after release of push button. WIthout communication the LED blinks only as long as the button is pressed. Without beeing configured the device will have the green LED on permanently, if correctly powered.

	LED signal, push button	**Reason, Case**
	Green LED on:	Not configured (device is powered but has not yet been configured/addressed or has been reset to factory status)
	No LED on	If device is powered: The device is configured
	Green LED flashing when push button pressed	If the blinking /green LED stops when releasing the button: The device is configured but has no communication to its basestation:! If the green LED continues blinking when releasing the button: The device is in the Wink mode and has communication to the in/output module (Basestation)
	Green LED flashing no push button pressed	If the green LED blinks slowly (switch is/was not pressed): The device is in the Wink mode ordered from the input/output module (Basestation) Fast irregular blinking, (with possibly blink breaks of 1 second, WIOP/WSP only): The Device has no communication: - Communication problem (range, interference), - Device is not configured in this basestation (wrong Cell ID !)

Configuration of wireless devices

Wireless devices can be configured only if they are brand new (factory status) or their configuration has been deleted before. This un-configured status is indicated by a green LED, if the device is powered.

In order to perform the configuration, the input/output module must be switched into the CFG configuration mode (see chapter 3.2) and should display a free (blinking) address for this device type. Then simply the push button of the wireless device has to be pressed once to configure it with this address to this basestation (more precise this Cell-ID).

When the button is released the green LED will be off, the next free device address will be displayed at the input/output module (after it has received three valid telegrams from the configured device).

Deleting the configuration of wireless devices

- Normally devices should be deleted (set back to factory status) from the respective input/output module with the matching Cell-ID, because only then the device is also deleted from the configuration of this input/output module.
- Alternatively, by pressing the push button of Wireless Automation devices for more than 15 seconds, its configuration can be deleted. This is called an “unconditional delete” as it also works without the matching input/output module (Cell-ID) present.

The device is not deleted from the configuration of the input/output module.

This function is useful if you have a device without the input/output module with the correct Cell-ID available

2.2 WSIX Communication module

The communication module is screwed like the socket of a sensor cable on one of the sensor heads or wired to it or to a contact via a cable (WSC100, max. 3 m length).

The wireless proximity switch built in this way can, whether it is configured or not, detect metal objects, as soon as it is powered sufficiently by a magnetic field (can be checked with WPI100 indicator).

The recognition of a metal object by the sensor head is indicated by the yellow LED on the top side of the communication module.

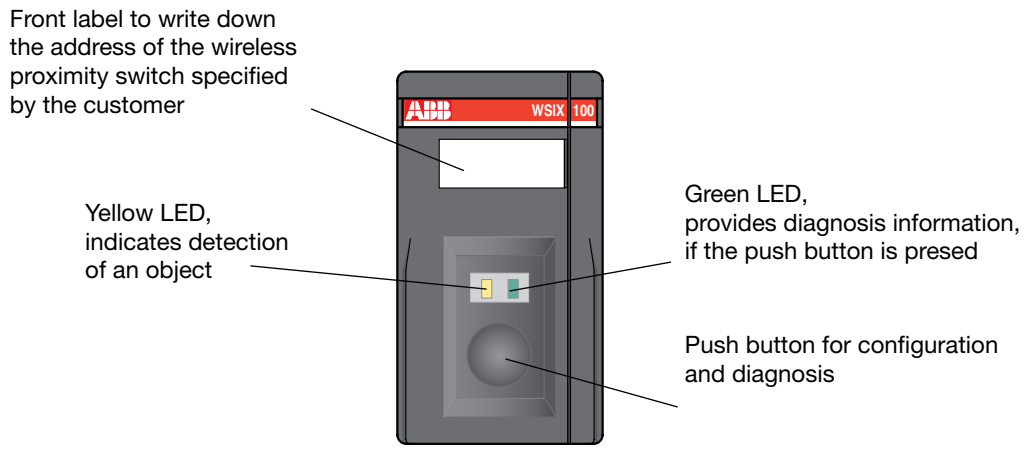


Fig. 2.1: WSIX100, indicators and oparating elements on the front side

2.2.1 Installation of communication modules

In order to avoid interferences and shading effects, minimum clearances have to be considered for the communication module.

- Minimum clearance to metal parts: refer to fig. 2.2.
- Minimum clearance between communication modules: refer to fig. 2.3.

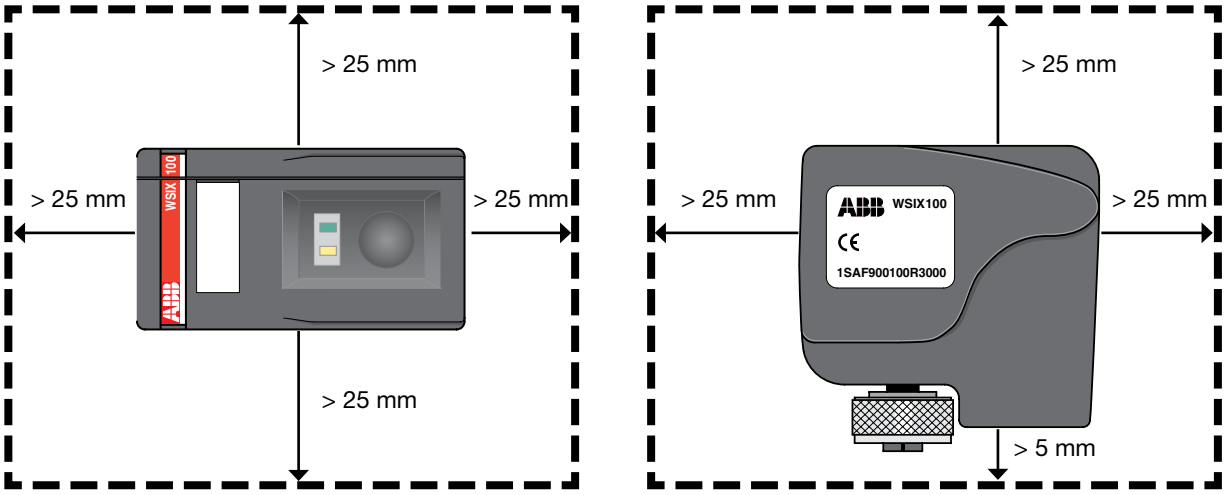


Fig. 2.2: Minimum clearances of the communication module to metal parts

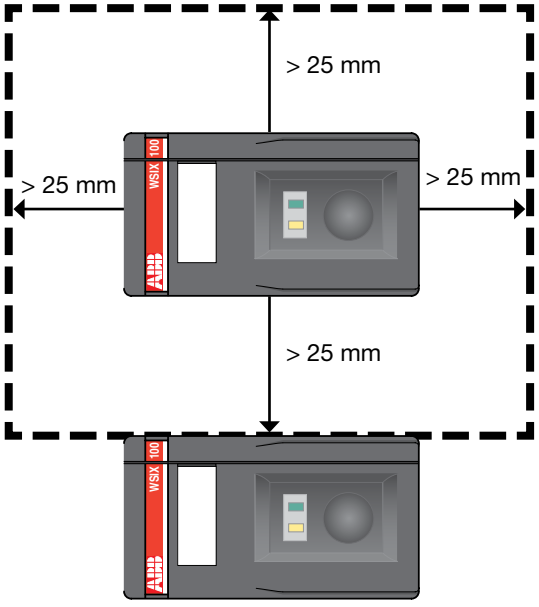


Fig. 2.3: Minimum clearance between two communication modules

Furthermore, the communication modules must have a minimum clearance of 25 mm to primary loop cables in order not to expose them to too strong electromagnetic fields.

The mentioned minimum clearances only guarantee reliable energy supply, if the rotating electromagnetic field can reach the wireless device in at least one direction, i.e. if the wireless device is not shielded by metal parts or electrically conductive ring constructions.

Tighten the nut with 0.7 Nm (tighten manually as strong as possible, than add ¼ turn, e. g. with a pliers).

In case of space restrictions at the sensor head mounting position, the WSIX communication module can be mounted with the WSC100 bracket and a short extension cable (see accessories).

2.2.2 Switching Frequency and Latency

The devices communicate with the WDIO (base station) via the air interface.

Signal detection:
WSP and WIOP have adjustable filter time constants, the WSIX has practically no delay (< 1 ms)

Due to this communication and the following processing in the input module and fieldbus connection (FieldBusPlug), certain delays occur.

Principle

1st event is transmitted (sampling is done at 1kHz)

2nd event is stored, to be transmitted as soon as 1st transmission is finished.
Each input is blocked for 5 ms after a first event (bouncing protection without delay)

3rd event -> error message ERR2 (event lost, but last status transmitted)

Wireless Automation Air Interface Latency as such:

2 - 15 ms (typ.< 4ms)

Overall Latency incl. fieldbus (sensor head -> signal available at fieldbus):

typical ~	13 ms
99,9% of the events	18 ms
max. (worst case)	30 ms

(for single events in case of heavy disturbance)
Independant of number of sensors used or their amount of events.

Min. Pulsewidth

for signal ~20 ms (otherwise events may be lost on the fieldbus interface)

-> corresponds to **typ. switching frequency of 25 Hz**
(worst case: min. switching frequency of 15 Hz)

BUT:
restrictions to ≤ 5 events / s per input of WSIX or WSP devices in places with small field strength.

Typical timing patterns can be seen below:

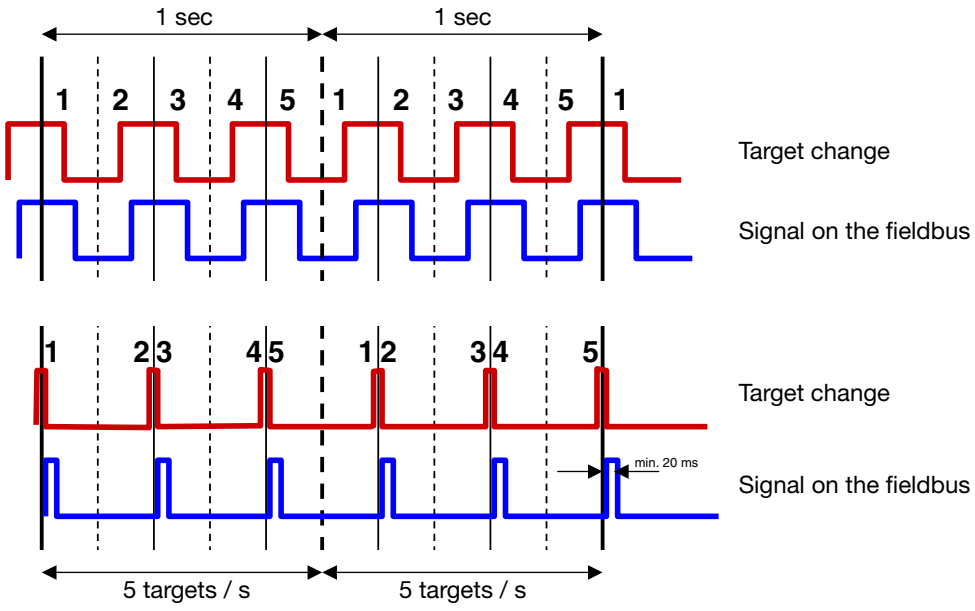


Fig. 2.4: Timing pattern

2.3 WSP Wireless Sensor Pad

The wireless sensor pad WSP is a sensor distribution box, enabling several sensor heads to be attached to one wireless communication device. The sensor pad receives its energy for the sensor functions and radio communication also from an electromagnetic field.

The sensor pad has to use the low power WSIN/WSIF-sensor-heads or passive switches (e. g. reed contacts) connected via short cables. Two sensor heads can be connected to each M12 sockets. The WSIN/WSIF low power sensor heads operate with 3 V only, and therefore use a different pinning in order to avoid destruction when unintentionally connected to a standard 24 V sensor input.

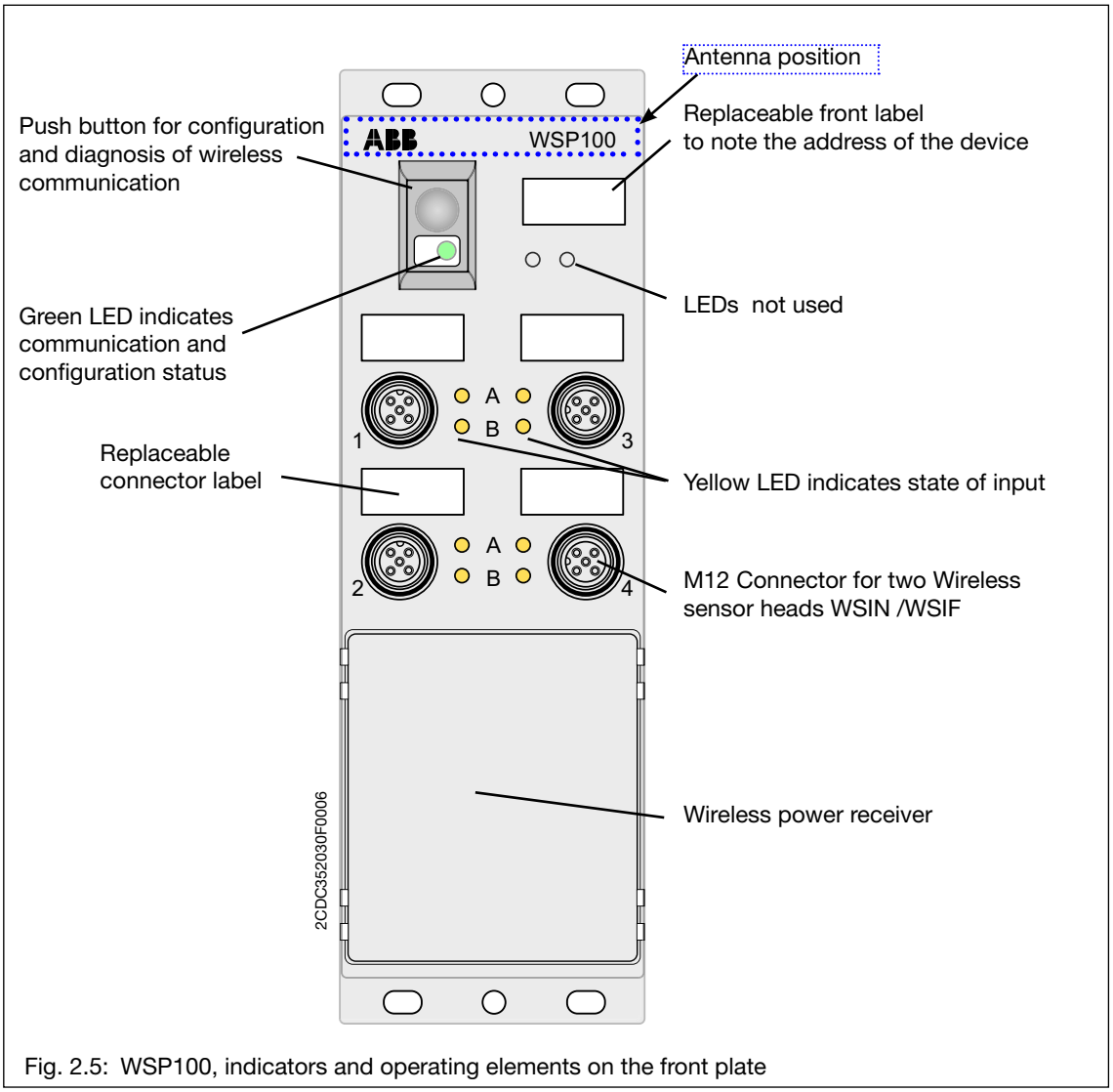
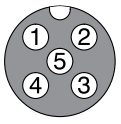


Fig. 2.5: WSP100, indicators and operating elements on the front plate

Input M12



1 = IN B
2 = + 3 V
3 = GND (0 V)
4 = IN A
5 = earth

Pinning deviates from standard sensor connectors to avoid destruction by wrong wiring.

Pinning corresponds to WSIN/WSIF-sensor-heads.

In order to avoid interferences and shading effects, minimum clearances have to be consideredfor the sensor pad.

Wireless power supply:

Minimum clearance of 50 mm to metal and especially steel parts have to be observed for the power receiver (block type structure on pad).

It can be mounted on a metal plate, nevertheless the power margin is higher the smaller such a metal plate is. A wireless power receiver needs a certain free volume around to take magnetic power from. The size of this volume is determined by the receiver size.

The minimum clearance between two WSP100 or to a neighboring WSIX communication module should be at least 100 mm.

The mentioned minimum clearances only guarantee reliable energy supply, if the rotating electromagnetic field can reach the wireless device in at least one direction, i. e. if the wireless devices is not shielded by metal parts or electrically conductive ring constructions.

Wireless power supply:

For the undisturbed communication by a radiowave propagation, a free space of at least 25 mm from the antenna position (see Figure 2.5) to other larger metallic obstacles should be observed to achieve full communication range.

Furthermore, the communication modules must have a minimum clearance of 25 mm to primary loop cables in order not to expose them to too strong electromagnetic fields.

Switching Frequency and Latency

The timing is similar to the WSIX communication module (see chapter 2.2.2). Nevertheless due to the total higher power available, a trade off regarding switching frequency between the different inputs is possible. A total value of 40 events per second under worst case conditions can be shared between the inputs, resulting in 5 events/second per input (assuming WSP100-8I with 8 inputs).

2.4 WIOP Wireless Input/Output Pad

The wireless input/output pads collect 24 V inputs and outputs like standard bus distribution boxes and uses a standard 24 V power supply.
The pads use different connection concepts and housing width:

	Module width [mm]	Connector In-/Output	Connector Power supply
• WIOP100 – 8DI8DC	60	M12	7/8 Zoll
• WIOP208 - 8DC	30	M8	M12

The actuator voltage is fed separately to enable flexible emergency stop concepts. Both devices have failsafe mode and input filter which can be configured both (determined by SET parameters of WDIO at the time of configuration/addressing, cannot be changed on-line.

2.4.1 WIOP100 – 8DI8DC (8 Inputs, 8 In-/Outputs, M12)

The two 7/8" power feeding connectors allow also a comfortable looping through of the power wiring from pad to pad. The WIOP100 – 8DI8DC has 8 digital inputs and 8 configurable inputs/outputs which can be both, input or output, depending on the use on the fieldbus/PLC.

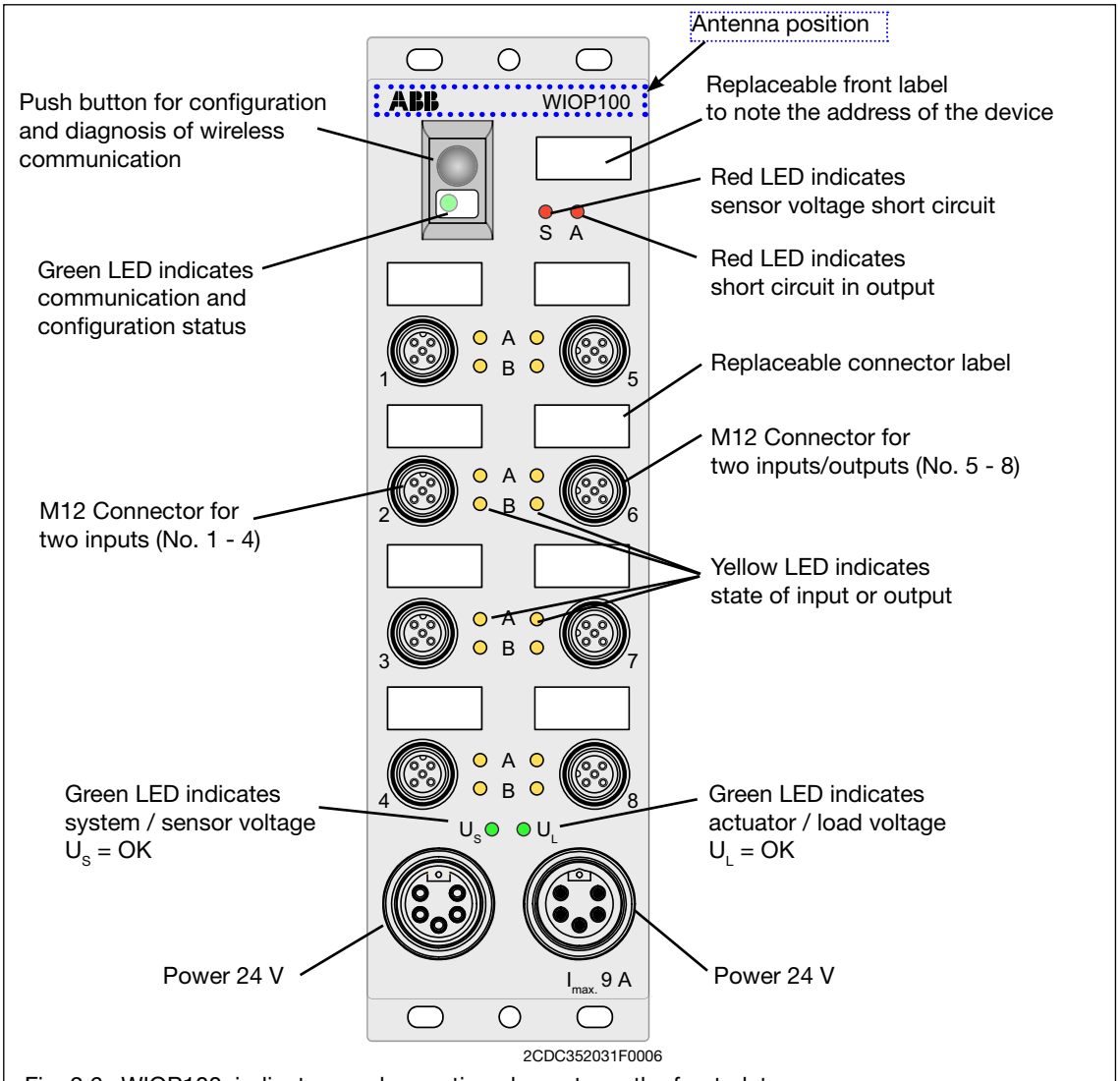
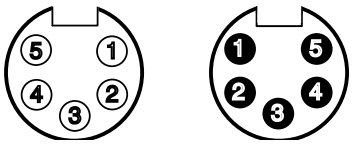


Fig. 2.6: WIOP100, indicators and operating elements on the front plate

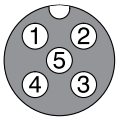
WIOP100 Power supply 7/8"



female **male**

1 = GND (0 V)
2 = GND (0 V
3 = Earth
4 = + 24 V system / sensors U_S
5 = + 24 V actuators / load U_L

WIOP100 Input/Output M12



1 = + 24 V
2 = Signal B
3 = GND (0 V)
4 = Signal A
5 = Earth

- Minimum clearance around the antenna position of 25 mm to larger metal objects is recommended.
- Check 24V supply, fuse with max. 10 A fuse medium slow
- Reverse polarity protection - see information

Reverse polarity protection

The reverse polarity protection does only work, when the supply voltage for the actuators is fused (10 A, mT) and a short circuit is switched off after 10 – 100 ms.

Attention!
A power supply with current control/limit or a wrong fuse results in the case of reversed polarity in the destruction of the modul.

2.4.2 WIOP208 – 8DC (8 In-/Outputs, M8)

The WIOP208 – 8DC has 8 digital configurable in-/outputs, which can be either only inputs or also outputs, depending on their use in the process image of the controller (readable output).

In contrary to WIOP100, the WIOP208 uses only the first input-Byte, in RUN-mode the bits are shown in the upper row of the WDIO100 Display.

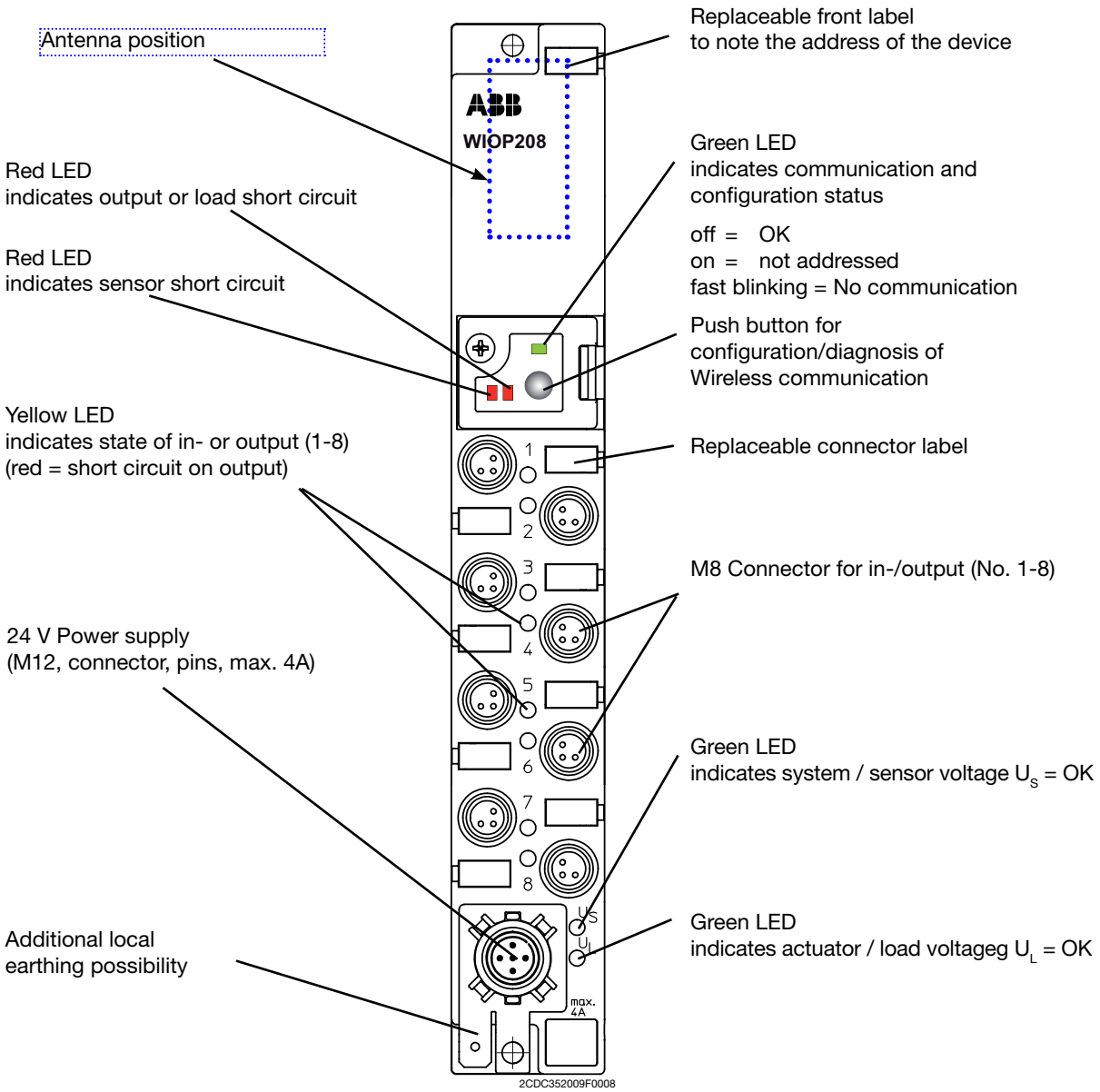
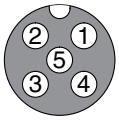


Fig. 2.7: WIOP208, indicators and operating elements on the front plate

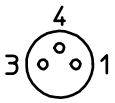
WIOP208 Power supply M12 (pin assignment)



male

1 = + 24 V Actuators / Load U_L
2 = + 24 V System / Sensors U_S
3 = GND (0 V)
4 = GND (0 V)
5 = Earthing

WIOP208 Input/Output M8



female

1 = +24 V Sensor supply
3 = GND (0 V)
4 = Input/Output

- Minimum clearance around the antenna position of 25 mm to larger metal objects is recommended.
- Check 24V supply, fuse with max. 5 A fuse medium slow

2.5 WSIN/WSIF Sensor Head

Wireless proximity switches consist of a communication module (WSIX or WSP) and a sensor head which can be selected from a range of different designs and properties depending on the application.

2.5.1 Sensor head properties

The sensor heads operate as inductive proximity switches and therefore have standardized properties and operating conditions. This allows an easy application without any problems.

- They exclusively detect metal objects.
- They have an exactly defined detection range.
- They work reliable and without any impairment by light, noises, non-conducting dust
- and fluids such as oil.
- They detect precisely without any adjustment.
- They substantially work according to standardized detection characteristic curves.

2.5.2 Functional principle of the sensor heads

The fundamental component of the sensor heads is a resonating circuit with an open coil. When a metal object comes close, the oscillation is attenuated until it is completely interrupted according to the further decrease of the distance. This effect is evaluated by a subsequent trigger stage and converted into a binary output signal.

Like a conventional proximity switch, the sensor itself is not supervised for function, cut wire or short circuit. The sensor is optimized for low energy consumption (e. g. 3 V operation voltage). To avoid exchange/destruction by standard sensors/cables the supply voltage is fed via Pin 2 (Pin 1 is not existing).

For space critical locations or protection, the sensorhead can be mounted seperat from the communication unit (WSIX or WSP) via a short cable: WSC holder and extension cables for the WSIX or standard 4 pole (due to differing pinning) sensor cables: up to a maximum length of 3 m (not close over longer stretches to a primary loop cable).

2.5.3 Switching distance of the sensor heads

The most important and distinguishing characteristic of the sensor heads is their switching distance. The switching distance depends on the dimensions and the electronic circuitry of the sensor head as well as on the size and chemical consistency of the actuator (target).

The actuator can be moved in axial as well as in radial direction towards the sensitive part of the sensor head.

Nominal switching distance s_n

Like conventional inductive proximity switches, the sensor heads are categorized according to their nominal switching distance (rated switching distance according to EN 60947-2-5). This value does neither consider any manufacturing tolerances nor any kind of environmental influences such as the ambient temperature.

Standard measuring plate

Switching distances are determined using a 1 mm thick square smooth standard measuring plate made of ST37 steel. The edge length of the plate is the higher value of the active sensor face's inner circle diameter and the triple nominal switching distance. The standard measuring plate determined this way is the optimum actuator for the sensor head.

Example WSIF020-M12N: inner circle diameter = 12 mm; 3 x nom. switching distance = 6 mm. The resulting edge length of the standard measuring plate is 12 mm.

Example WSIN080-M18N: inner circle diameter = 18 mm; 3 x nom. switching distance = 24 mm. The resulting edge length of the standard measuring plate is 24 mm.

Real switching distance s_r

The real switching distance of a single sensor head considers the manufacturing tolerances and is determined at ambient temperatures of (23 ± 5) °C. It can be up to 10 % above or below the nominal switching distance.

Effective switching distance s_u

The effective switching distance considers ambient temperatures in the range of –25 °C to +70 °C and is further 10 % above or below the real switching distance, i.e. between 81 % and 121 % of the nominal switching distance.

Reliable switching distance s_a

The reliable switching distance is between 0 % and 81 % of the nominal switching distance and is recommended for the use of the sensor head under determined conditions.

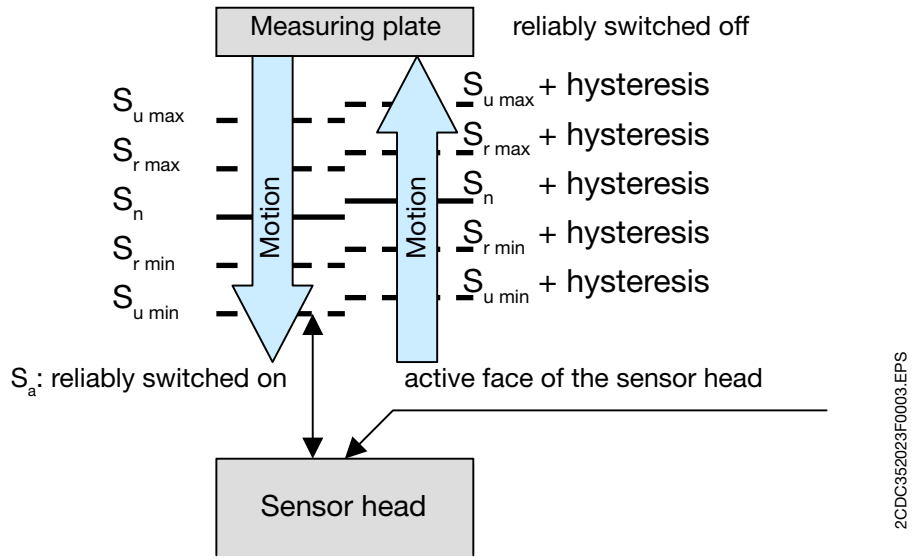


Fig. 2.8: Different switching distances

Repeat accuracy R

The repeat accuracy specifies the variation of the real switching distance over a period of eight hours at an ambient temperature of (23 ± 5) °C.

Hysteresis H

In order to avoid bouncing of the output signals the sensor head's switching point for an approaching actuator differs by a hysteresis from the switching point for a receding actuator. The hysteresis is determined at an ambient temperature of (23 ± 5) °C and specified relative to the real switching distance.

Reliably switched off

A sensor head is switched off reliably, if the distance between the active sensor face and the measuring plate is at least three times the nominal switching distance.

Radially moved actuator

Depending on the axial distance to the active sensor face, a radial motion of the actuator results in an other switching distance than an axial motion. This is shown in the standardized pick-up characteristic curve for inductive proximity switches which is also valid for sensor heads.

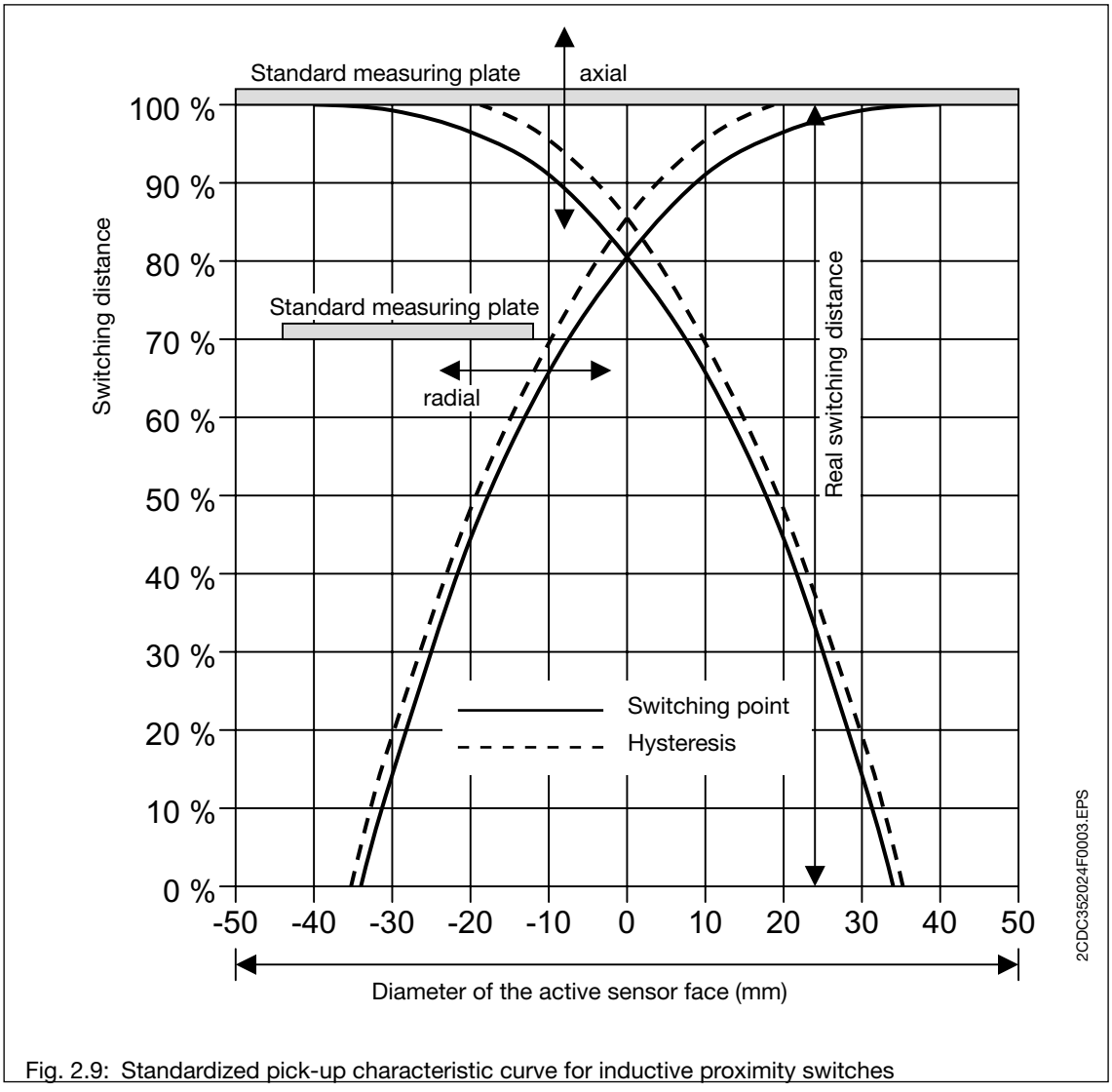


Fig. 2.9: Standardized pick-up characteristic curve for inductive proximity switches

Derating factor

The derating factor which is normally smaller than 1 specifies how much the switching distance reduces if actuators made of stainless steel, aluminum or copper are used.

2.5.4 Flush mounting and non flush mounting

The product range of wireless proximity switches includes flush mountable as well as non flush mountable sensor heads. Flush mountable sensor heads can be mounted in the machine in a way that they are particularly well protected against mechanical damages. Compared with that, the non flush mountable sensor heads have a significant higher switching distance. However, their plastic cap has to stand out of the metal environment as shown in the figure.

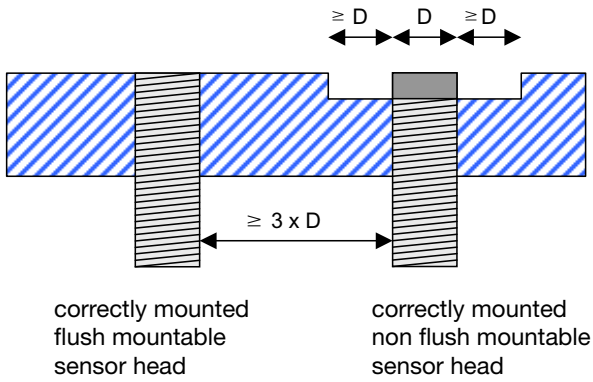


Fig. 2.10: Correct mounting of flush and non flush mountable sensor heads in metal materials

2.5.5 Mutual influence

In order to avoid mutual influences, sensor heads of the same type have to be mounted as shown in the figure, considering the minimum clearances.

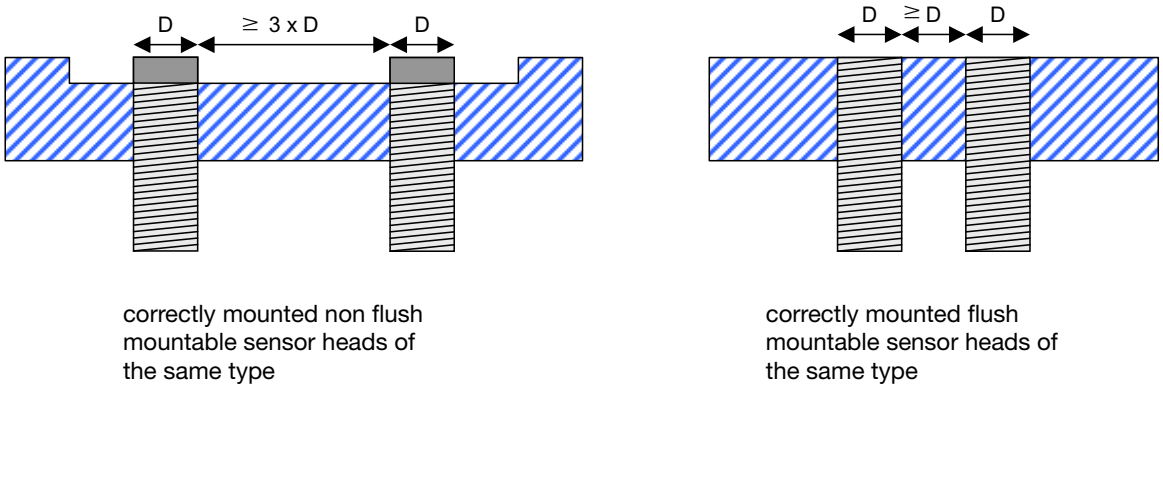


Fig. 2.11: Correct mounting of sensor heads of the same type considering the minimum clearances

3. Input/Output module WDIO

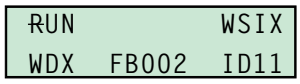
The input/output module WDIO provides connection between the wireless devices and the machine control via an ABB FieldBusPlug. It can alternatively also map signals from one Wireless Automation device to others (cable replacement) without a bus connection or controller.

3.1 Functions of the input/output module

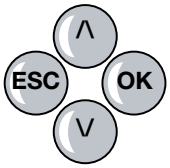
The following functionality is offered by the input/output module

- choice between the modes:
  - RUN: Operation
  - CFG: Configuration of wireless devices and mappings
  - DEL: Delete the configuration of wireless devices and mappings
  - SET: Settings
- Individual display of the information to configured wireless devices in operation
- Triggering of the WINK mode for a selected device for clear allocation during operation
- Acknowledgement of error messages during operation
- Adding further wireless devices and mappings (configuration, parametrisation)
- Deletion of configured wireless devices and mappings
- Setting of a password for prevention of unauthorized changes at the input/output module
- Setting of an cell-ID address for the input/output module
- Setting of a field bus address
- Setting of other parameters (faile-safe behavior, filters, ...)

The input module is operated via four membrane switches. It displays the data on a LCD display in two lines with sixteen characters each:



Type FB-Address Cell-ID



The four membrane switches have the following basic functionality:

- Λ or V Scroll up and downward through the offered number ranges or options
- OK Confirm a selection, store and change to the next menu option one level down
- ESC Leave a selection without storing and change to the next menu option one level higher
- ESC and OK Changes from RUN mode in one of the other modes

In order to prepare the input module for operation, connect an antenna cable to each of the two coaxial sockets on the top side. Both antenna cables must be connected to antennas from the product assortment of the wireless devices.

For the connection of the input module to a fieldbus, connect a FieldBusPlug from the ABB FBP system to the FBP socket on the left side of the device (Modbus RTU and TCP, PROFIBUS® DP, DeviceNet™, CANopen®). The WDIO is fully functional without an FBP and will show e. g. sensor or input signals and can map them to outputs of a WIOP (direct cable replacement see fig. 3.1).

Power supply is done via the screw-type terminals at the bottom side of the device.

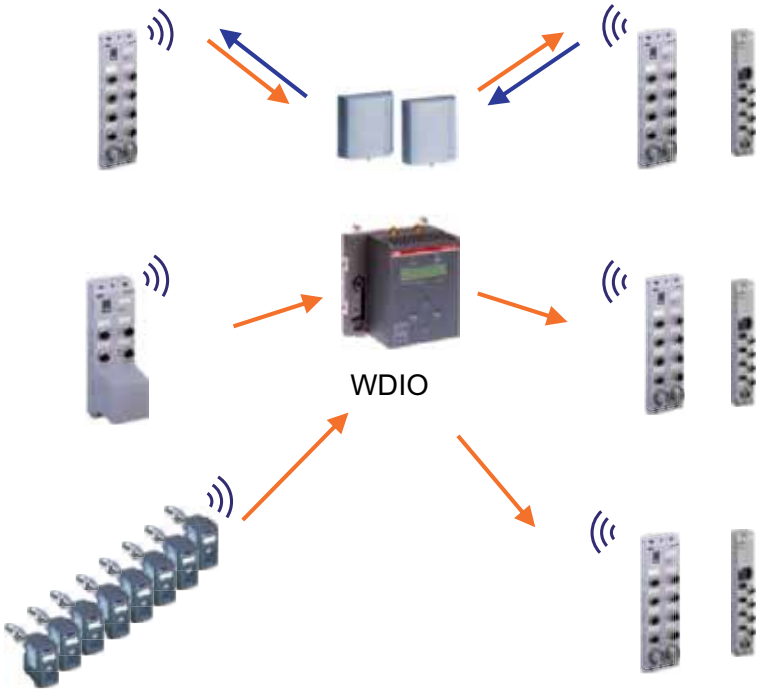


Fig. 3.1: WDI0100, Overview of mapping mode

3.2 Display and user menu overview

This chapter gives an overview of the menu structure and explains the main display informations.

The following shows the main operation modes RUN, CFG, DEL, SET and explains typical display contents. The picture on the next page show the main menues and explains reactions.

At the first start-up of the device a Device Type for the WDIO has to be chosen:

Operation Type set	Wireless Devices	Proximity Switches (WSIX)	+	Wireless Pads (WIOP, WSP)
• WDI	Inputs	120		-
• WDX	mixed	56	+	7
• WDP	Pads	-		13

The main operation mode is “RUN”, which can be left for configuration (CFG) or deletion of devices (DEL) and for parameter setting (SET).

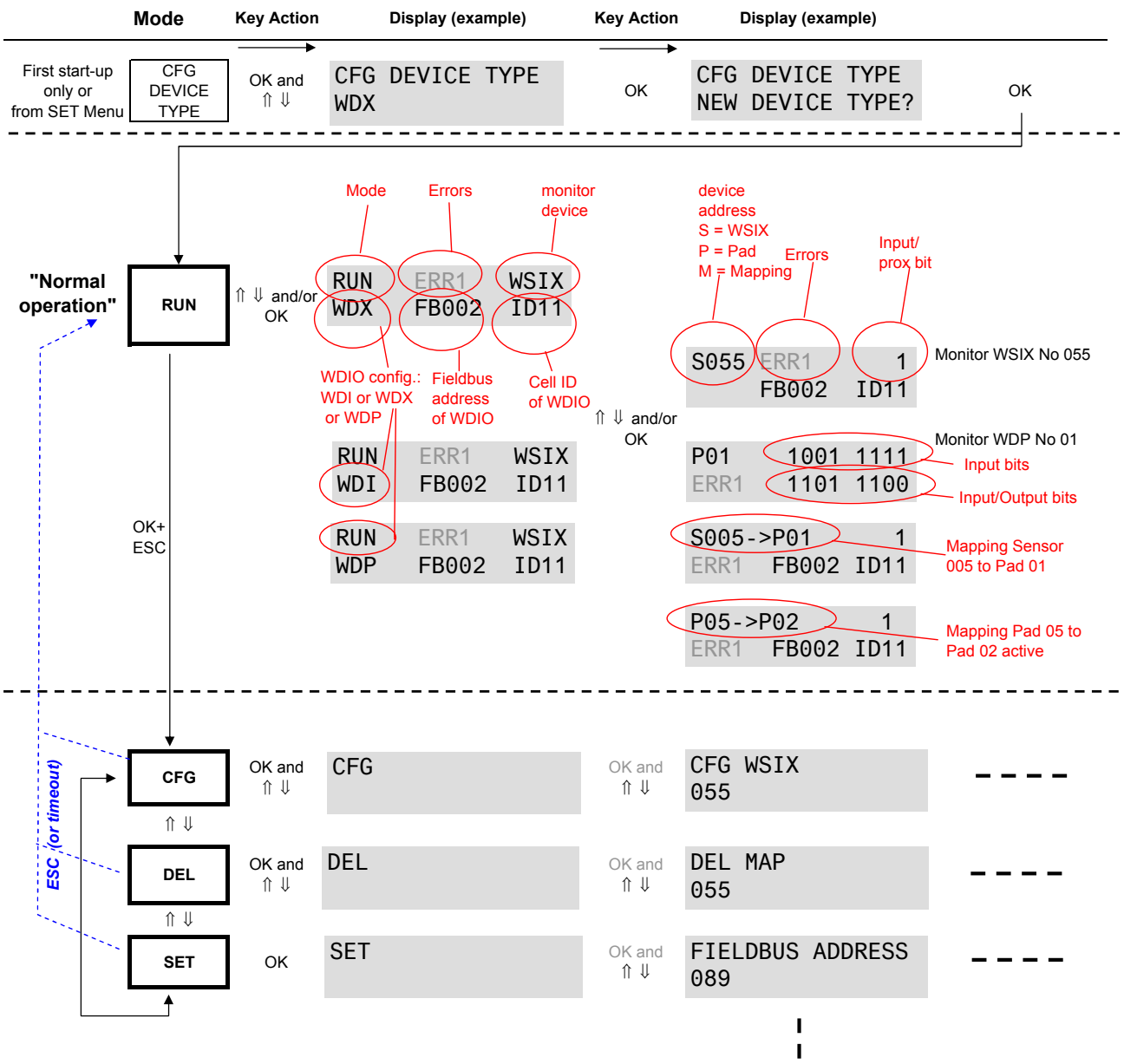
The mapping option allows in the WDX and WDP operation types the mapping of signals of one Wireless Automation device to another (e.g. a sensor input to a WIOP output):
- WSIX are mapped in groups of eight
- max. 4 mappings are possible to configure (-> max 32 IO-points))
- a further status pad (WIOP) can be configured to show status informations on outputs

A more detailed description of the different submenus can be found in the following chapters

- chapter 3.4 (RUN Mode),
- chapter 3.6 (CFG Mode)
- chapter 3.7 (DEL Mode)
- chapter 3.8 (SET Mode)

The display returns to the next higher menu point, when ESC is pressed or after a time out.

WDIO Display Structure (Overview)

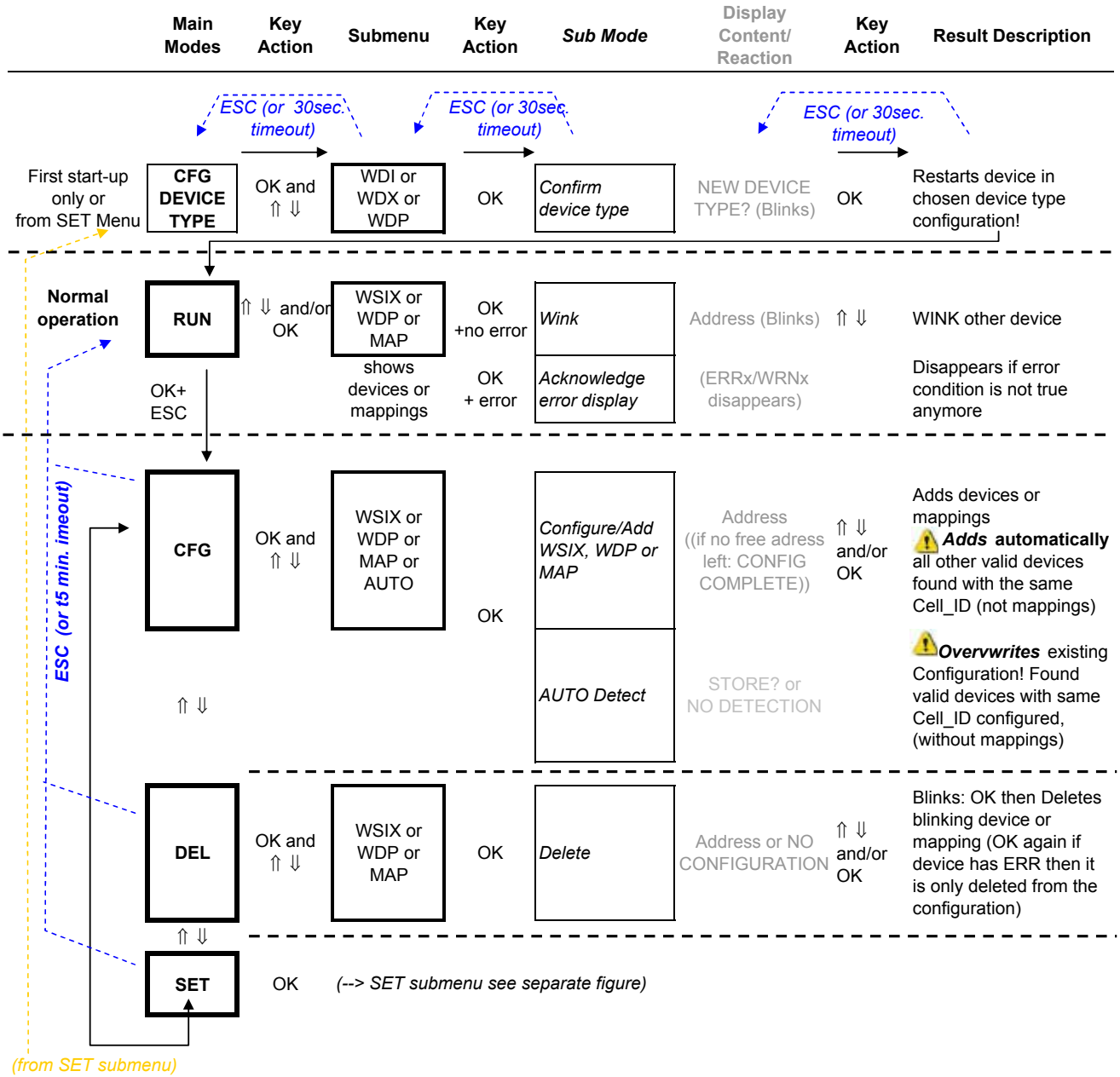


WDIO Basic Menue Structure (Overview)

The WDIO display keeps error (ERRx WARNy) displayed and stored for each device , also if the error condition is not true anymore, until acknowledged by pressing the OK button at the WDIO for this device.

This is to inform the operator/service person also about short time errors.
The diagnosis bits on the bus for this device directly follows the actual state of the device, e.g. is set to valid=1 again if the communication has been OK for 3 Telegramms).

For more details of these errors see error table and timing in chapter “3.12 Errorhandling”.



Main Modes	Key Action	Submenu	Key Action	*Sub Mode*	Display Content/ Reaction	Key Action	Result Description
			ESC (or 30sec. timeout)	*ESC (or 30sec. timeout)*		*ESC (or 30sec. timeout)*	
SET	OK	*FIELDBUS ADDRESS*	OK	Change address: ⇑ ⇓ and OK per digit	Address (3 digits)		Address Set!
		⇑ ⇓					
		CELL ID	OK	Change Cell ID: ⇑ ⇓ and OK per digit	Cell ID (3 digits)		Cell ID Set!
		⇑ ⇓					
		PASSWORD	OK	Change User Password: ⇑ ⇓ and OK per digit	Password (3 digits)		PasswordSet!
		⇑ ⇓					
		SET DEFAULTS	OK	Delete set parameters	Delete ...	OK	Asks for confirmation (of Cell ID, Fieldbus address if not "0"; Configuration), then Restarts device
		⇑ ⇓					
		CFG LOCAL / FB	OK and ⇑ ⇓	Change configuration mode	LOCAL or FIELDBUS	OK	New Mode set!
		⇑ ⇓					
		CFG PARAMETERS	OK	Display Fieldbus Parameters	Parameters: Number, Name, Format, Value	OK	Change Format: HEX, BIN, DEC
		⇑ ⇓					
		MASTER PASSWORD	OK	Enter Password: ⇑ ⇓ and OK per digit	Password (8 digits)		
		⇑ ⇓					
		JUMP ON ERROR	OK and ⇑ ⇓	Change error jump mode:	YES or NO (Blinks)	OK	New Mode set!
		⇑ ⇓					
		NODE HOURS CTR (counter)	OK	RESET	RESET?	OK	Counter is reset!
		⇑ ⇓					
		DATA INVALID CTR (counter)	OK	RESET	RESET?	OK	Counter is reset!
		⇑ ⇓					
CFG . Dev. Type		*CFG DEVICE TYPE*	OK	*(see CFG DEVICE TYPE on top)*			!! (all parameters are reset: Cell ID, Fieldbbus address) !!
		⇑ ⇓					
		WDP ERROR ACK (Acknowledge)	OK and ⇑ ⇓	Change error acknowledge mode:	AUTO ACK or WDIO100 ACK (blinks)	⇑ ⇓ and/or OK	Asks for confirmation, New Mode set!
		⇑ ⇓					
		FAILSAFE MODE	OK and ⇑ ⇓	Change failsafe mode:	ZERO or KEEP (blinks)	⇑ ⇓ and/or OK	Asks for confirmation, New Mode set!
		⇑ ⇓					
		ANTENNA SWITCH	OK and ⇑ ⇓	Change antenna switching:	ON or OFF (blinks)	⇑ ⇓ and/or OK	Asks for confirmation, New Mode set!
		⇑ ⇓					
		FILTER TIME	OK and ⇑ ⇓	Change filter time:	1, 5 or 25ms (blinks)	⇑ ⇓ and/or OK	Asks for confirmation, New Mode set!

3.3 Switching on the module

The module is switched on by supplying the supply voltage (+24 V) to the screw-type terminals. The device then performs a self-test. If the device is switched on for the first time, or after a reset, first the operation type (WDI, WDX, or WDP) has to be chosen.
If devices have been already configured, the WDIO waits for messages from each configured device (for max. 45 seconds, and then goes to RUN-mode and shows error messages). If valid telegramms have been received from all configured devices, the WDIO goes to RUN mode after approximately five seconds

3.4 RUN Mode Operation

The RUN-mode is the normal continuous operation mode of the input module.

In this mode of operation

- the display shows the data and conditions of the wireless devices configured in the system.
- the device type has to be selected first (/\ \/ and **OK**).
- it is possible to change between the devices configured in the system with the keys /\ and \/.
- the error message of a Wireless Automation device can be acknowledged with **OK**.
- by pressing **OK** an error-free device can be triggered to provide the WINK-mode, so that its green LED blinks.
- by simultaneous pressing of the keys **ESC** and **OK**, the mode can be changed to configure devices or set parameters.

Error Messages

If the input/output module does have an connection error to at least one of the wireless devices configured, the display indicates the data of this device. If several devices are incorrect, then the device with the lowest number is indicated. All disturbed devices stand successively at the beginning of the internal list of the input/output module, so that with /\ and \/ the display can be scrolled.

Error messages are acknowledged individually for each device with one single **OK**. After acknowledgement, the **Err** remains displayed with the address if the device is not error-free again.

WINK-Mode

For the clear allocation of the address number indicated in the display to one in the field installed wireless device the WINK-mode exists.

As long as a device without disturbance is displayed, this device's wink-mode can be triggered by pressing **OK** so that its green LED blinks. At the same time the device number in the display of the input module blinks. If an Error message is shown it has to be acknowledged first by pressing OK.

The WINK-mode ends automatically after 60 seconds or as soon as it is started for another device. Likewise the WINK-mode can be triggered by pressing of the membrane switch on a wireless device (if there is no ERR message from this device on the WDIO display).

3.5 Password inquiry

If a password (001... 999) had been assigned to the input/output module, then this is queried after each change out of the RUN-mode, before the first change of the settings of the input module can be done. After 30 seconds without input, the password inquiry will be left automatically.

Procedure	Display content	Operator options	Description
Password Enquiry			
Input	PASSWORD CHECK **000**	Λ or V	Increase or decrease of the selected number (blinkt)
		ESC	leave the password inquiry
		OK	change to the next number; Confirmation of password after the last number
After successful password entry, the module releases the desired menu. If a wrong number is entered, the password inquiry is repeated.			

3.6 CFG Mode Configuration of wireless devices and mappings

By simultaneousles pressing **ESC** and **OK**, one changes from the RUN mode into the CFG mode.

As long as less than the max. number of devices or mappings are configured, in this mode of operation further devices or mappings can be added to the existing system. Differentiated is between: WSIX (Sensors), WDP (Distribution boxes: "Pads") and MAP (Mappings).

The CFG mode is left by **ESC** or terminated automatically by the input module, if none of its four keys has been operated within 5 minutes. In all submenues the input module changes after 30 seconds without manipulation of a key into the mode, which is reached also by **ESC**.

If in the CFG mode, an input/output module automatically seizes all configured devices in its reception range, which carry its Cell-ID. They are added to the configuration. If the CFG mode "auto detect" is used, the so far stored configuration is overwritten (-> only found devices are stored, all other are deleted ! In this way, when exchanging the input/output module, a very fast recognition of all the wireless devices installed in a machine by the new module is possible, and can be stored as valid configuration. Mappings cannot be automatically restored as they are only known to the WDIO).

For configuration of a mapping, first the mapping numer can be chosen (max. 4 possible),

- then the two mapping partners are chosen
  (**G** symbolises a sensor group of 8 WSIX, **P** a pad /distribution box)

- then a possible mapping direction can be chosen (see arrows in Display).

- to store press "**OK**" when the correct mapping is blinking.

3.7 DEL Mode Delete configured Wireless Automation devices or mappings

By simultaneously pressing **ESC** and **OK** from within the RUN mode, the CFG mode is reached. From there the DEL mode is reached via V.

As long as in the input module wireless devices and mappings are configured, they can be deleted from the existing configuration in the WDIO in this mode of operation. Furthermore also the wireless connected device is set back to factory status (if it is reachable...otherwise an error message is asking for further confirmation).

If the communication to a configured device is disturbed or the device is just not there (**ERR**), it can be nevertheless deleted from the configuration of the input module with a further confirmation. Then the device itself is not set back to factory status and keeps its adress and Cell_ID.

The DEL mode is again left by ESC or terminated automatically by the input module, if none of its four keys has been operated within 5 minutes. In all submenues, the input module changes after 30 seconds without manipulation of a key into the mode, which is reached also by **ESC**

Deleting mapped devices deletes also the mapping. Deletion of a mapping does not delete the devices.

3.8 SET Mode System settings

By simultaneously pressing of **ESC** and **OK** from the RUN mode, the CFG mode is reached. From there the SET mode is reached via V.

Setting of the FIELDBUS ADDRESS for the input/output module

The module communicates over a FieldBusPlug and a fieldbus with a machine control.

The system menus permits addresses between 0 and 255. Which address ranges are actually available for the integration into a field bus structure, depends on the installed field bus and the already existing field bus participants.

The address „000“ is preset, which is invalid with PROFIBUS® in general. The FieldBusPlug uses its previous field bus address automatically in this case!

Cell-ID

Setting of the range identification

During comissioning, each module needs an individual Cell-ID range identification between 1 and 59. This Cell-ID range identification guarantees that also in large installations with more than 120 wireless devices (i.e. also more than one input/output module) the devices communicate reliably with their assigned input/output module. The Cell-ID determines the frequency hopping sequence.

To minimize interference between several closely located Wireless Automation System within a 10 m radius, the following rule for defining Cell-IDs should be observed :

- The upper digit of the Cell-IDs must all be different.
- The lower digit of the Cell-IDs must all be different

Not more than six Wireless Automation cells must be installed ‚close‘ to each other (within a 15 m radius). Examples for Cell-IDs: 06, 11, 22, 33, 44, 55 or 05, 16, 27, 38, 49 or 09, 18, 27, 36, 45.

In the case of repeated use of a Cell-ID range identification (i.e. already more than 60 input/output modules are installed) the distance, between the devices and the pair of antennas of the not assigned input/output module with the same Cell-ID - range identification, should amount to at least 40 m (depending on antenna orientation)

For parallel WLANs with time critical telegrams, it is recommended to use Cell-Ids out of the 10 - 49 range (ensures a large frequency-hopping distance).
A delay of up to 2 ms for a WLAN telegramm may occur eventually, otherwise of up to 4 ms.

PASSWORD

Setting of a password

For each input/output module a password can be set between 001 and 999, in order to prevent the change of system settings and system parameters by unauthorized persons.

If the password “000” is chosen in the following dialogue, then the system is not protected by a password.

SET DEFAULTS

Reset all parameters of the input/output module to factory settings

With this menu option the input module is set back to the factory settings:

- Field bus address: 000
- Cell-ID range identification: 01
- Password: 000
- No configuration
- No device configured
- Filter 1 ms
- JUMP ON ERROR on
- FALE SAFE zero
- ANTENNA SWITCH on
- AUTO ACK on

CFG LOCAL FB

Change of the reference for the configuration between local and field bus

After the commissioning is finished, its configuration can be stored in the machine control (e.g. PLC). With each restart, the module gets this configuration downloaded via the fieldbus. In this way, it is guaranteed, that the machine control and the input/output module work with the same information, even if the module was exchanged. The exact proceeding for this procedure depends on the used field bus and therefore has to be looked up in the relevant documentation.

If this downloading of the configuration via the field bus should be prevented, "Local" has to be used and is the recommanded mode during commissioning. Otherwise, with each startup (e.g. applying 24V) the local configuration might be overwritten by the controller.

CFG PARAMETERS

Display of the field bus parameters for the configuration

The field bus parameters contain in the first parameter set the Cell-ID - range identification of the module (CELL ID). The further eight (CFG 01... CFG 08) show for 16 sensors numbers each, whether these are configured or not.

The display can change between hexadecimal, binary and decimal representation.
In the binary representation 16 sensors each, from right to the left ascending, are indicated as ”1” for configured” and as “0” for “not configured”.

If the input/output module is connected via a field bus, which does not permit upload of the field bus parameters into the machine control, but however in reverse direction, then the field bus parameters can be manually copied from this display and be entered manually into the control program (see 3.11.2).

MASTER PASSWORD

Setting of the master password

In the set main menue, input of an eight-digit master-password is offered as last menu option.

This option can be used only by system specialists of ABB. It serves to allow system access again, if the set three-digit user-password has been forgotten by the user.

The setting is handled according to the same principle as with the setting of the user-password.

JUMP ON ERROR

This SET parameter determines if the WDIO display should jump in the RUN mode to the devices display and show its specific error message

NODE HOURS CTR

The node hours counter counts the hours of the operation of the WDIO multiplied by the configured number of devices. The counter can be reset here.

DATA INVALID CTR (counter)

The data invalid counter counts the amount of err1 + err2 messages indicating communication or event lost errors. The counter can be reset here.

CFG DEVICE TYPE

At the first start-up of the WDIO a device type has to be chosen:

Device Type	Wireless Devices	Proximity Switches	+	Wireless Pads (WIOP, WSP)
WDI	Inputs	120		-
WDX	mixed	56	+	7
WDP	Pads	-		13

WDP ERROR ACK (Acknowledge)

The WDIO is normally preset to “AUTO ACK”, the wireless pads with outputs resume normal operation if the communication has been OK for at least three telegrams (=1,5 sec.).

If the parameter is set to “WDIO100 ACK” error acknowledge, an communication error ERR1 or event lost ERR2 immediately set the pad into the fail safe mode. In order to resume normal operation after the error reason has been solved the error has to be acknowledge on the WDIO100 display by pressing “OK”.

The WDIO Display anyway keeps all Errors displayed and stored for a device , also if the error condition is not true anymore ,until acknowledged by pressing the OK button at the WDIO.

This is to enable the operator/service person also to catch short time communication errors or have a defined static output status after errors: The outputs remain in the chosen failsafe state (see FAILSAFE MODE) until the “OK” button is pressed, input signals are always active on the bus if three correct telegrams have been received again.

The respective valid bit on the bus for this device then is also not “1” again, until the acknowledgement has been done on the WDIO “OK” button.

ERR1 Communication has been lost (Timeout: no communication within 500ms)).

ERR2 Event lost :
- event could not be transmitted within 15ms (7 retries) or
- too many events to transmit, e. g. if more than 2 events occur within 10-15ms)

For more details of these errors see error table and timing in chapter “3.11.3 Errorhandling”.

If the setting is changed to AUTO acknowledge, then ERR2 (event lost = event overflow) messages are not stored in the display anymore as they are typically less critical errors not directly related to a communication problem (e.g. triggered by contact bouncing).

FAILSAFE MODE

The failsafe mode is important for devices with outputs. In case of an communication error both the WDIO and the device with outputs (e.g. WIOP) changes to the failsafe mode, regardless if the fieldbus or the wireless communication is interrupted.

Two possible reactions of the output mode can be set: KEEP or ZERO. In the KEEP mode, the WIOP keeps the last state of all outputs until three valid telegrams have been received. In the ZERO Mode the outputs are all reset to Zero (Preset).

The inputs on the fieldbus always keep the last correct received state.

After the communication is error free again, the ouputs resume operation automatically or only after confirmation on the WDIO100 “OK” key - in dependence of the WDP ERROR ACK setting (see above).

This setting is only transmitted once to a pad during configuration of this pad. Later changes will not affect the pad! It has to be ensured, that all pads have the same fail safe mode!

ANTENNA SWITCH

ABB´s Wireless Automation concept uses antenna switching (preset = ON) in order to combat shading and multipath effects through reflections (fading) to the most possible degree, as several frequency bands can be faded ("no received field strength") at the same time in industrial environement.

“ON” means Antenna ANT1 and ANT2 connectors switch receiving and sending function every 2 ms.

Nevertheles for special applications (e. g. using a booster/amplifier on TX to increase range) this can be switched OFF.
Then the ANT1 connector on the WDIO is continuously receiving (Rx) and ANT2 is continuously sending (Tx) .

FILTER TIME

For the wireless input pads a filter timing can be set: 1 ms, 5 ms, 25 ms (Preset is 1 ms).

Furthermore all inputs have a blank time of 5 ms while a first event is processed, in order to avoid unnecessary event lost error messages (ERR2) by contat bouncing.

This setting is only transmitted once to a pad during the configuration of this pad.
Later changes at the WDIO will not affect the pad!

For change the device must be deleted from the WDIO and again configured!

3.9 Antennas and antenna cables

Communication between the input/output module and the configured wireless devices is performed via a pair of antennas where one antenna has right-handed and one has left-handed circular polarization. The antennas are labeled beside the socket for the antenna cable with the letter „R“ for right-handed circular polarization and/or „L“ for left handed circular polarization. Both antennas are working alternating as transmitting and receiving antennas. Each antenna is connected to the input module by a separate up to 5 m long coaxial cable. One pair of antennas should be mounted with a distance of approx. 0.5 m to each other.

In order to obtain as good as possible connection between the antennas and the wireless devices, the antennas should be mounted above the machine or manufacturing cell in a way that they can cover all configured wireless devices with their main radiation direction, similar to a spotlight (see fig. 3.2), but are not directed towards each other.

It is not necessary to have direct line-of-sight connection to the antennas for all wireless devices. Reflexions on more far away obstacles, floor or ceiling lead to an improvement in range and coverage in typical industrial environment. The antennas should not be pointed directly on a nearby large metal object (compare the spotlight - most energy would be reflected in the opposite direction. The distance between the antennas and devices in an industrial environment with large obstacles should be between 0.5 m and 5 m. Typical range is 10-15 m, longer ranges are possible but with a detoriation in statistical long term reliability of the link.

If several pairs of WAT-antennas are mounted in an installation, they should not be positioned opposite each other and with same inclination or only with a minimum distance of 5 m.

For more information see technical description "WAT100 Antenna".

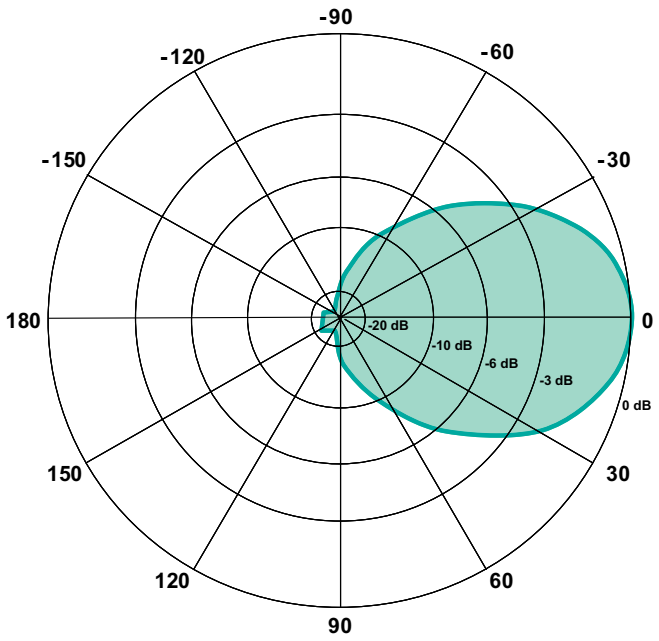


Fig. 3.2: Antenna Radiation Pattern of WAT100 Antenna (horizontal and vertical):

In many applications a larger range can be achieved but not guaranteed in industrial environment

Observe the directional pattern of the Antennas.

3.10 Field Bus Integration

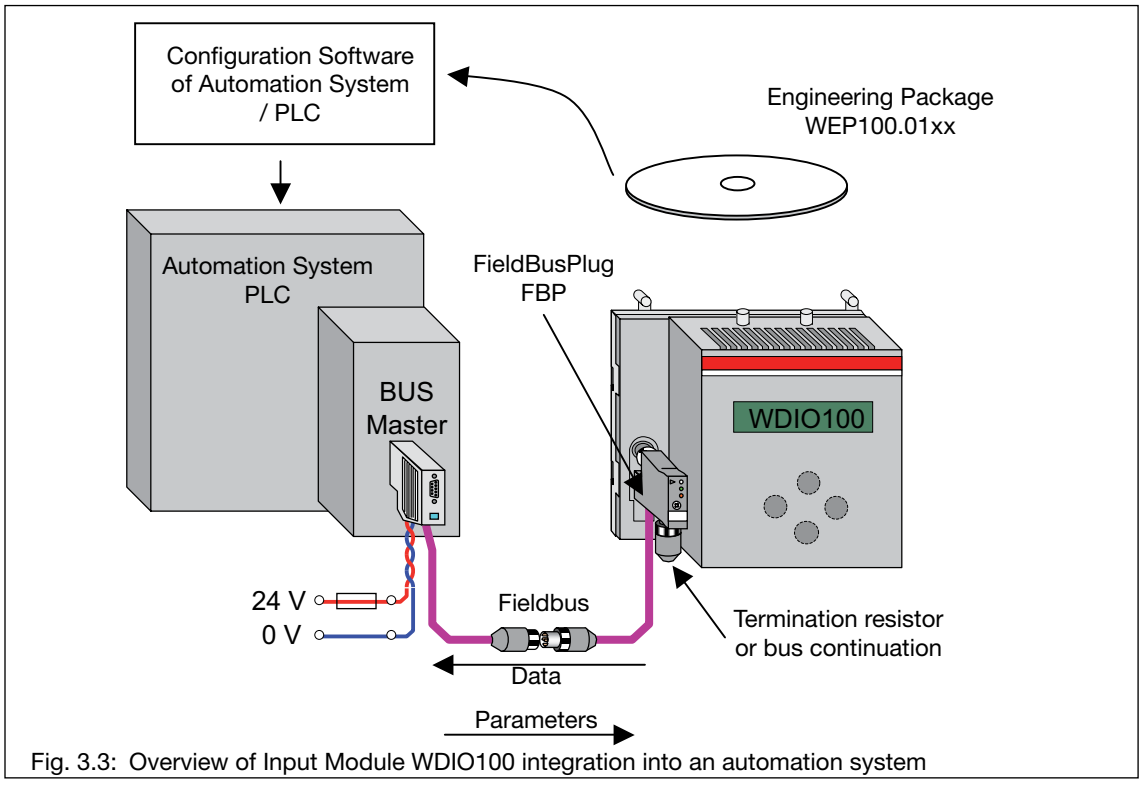


Fig. 3.3: Overview of Input Module WDIO100 integration into an automation system

The data sent via field bus from the WDIO100 to the PLC are organized as WORD (16Bit, see picture below). The structure is the same for every field bus used (PROFIBUS®, DeviceNet™...).

The WDIO100 provides the I/O information and a data valid or status information of the configured devices via the field bus.

For this set of data, 16 input-words and up to 7 output-words (depending on WDIO device type) are used on the fieldbus.

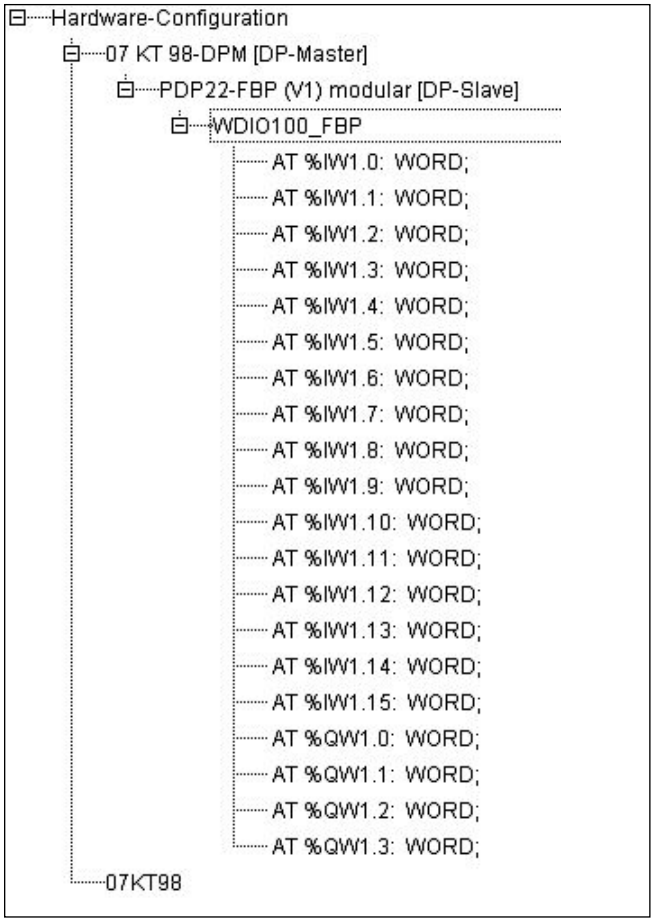


Fig. 3.3:
Example overview of WDIO100-WDX data structure and its integration via the FieldBusPlug PDP22-FBP into an ABB PLC 07KT98 with a PROFIBUS® master

3.11 WDIO100 data structure at the PLC

The data structure can be seen in the following table, dependent on the chosen device tpye.

3.11.1 Data of the Wireless Automation devices

For each wireless device two kinds of information are exchanged via the fieldbus:

- The data bit(s) contains the input/output information.
- The “Valid”-bit gives the automation system / PLC the possibility to check, if this data information is “valid”. The “DataValid”-Bit should be normally 1 and is set to “0” as long as at least one of the two conditions below is pending.
  - The input/output module WDIO has not received a telegram within the last 600 ms from this device (missing “I´am alive signal” of this communication module).
  - The “Event Lost”-bit in the device telegram was set. This happens:
    - if too many changes occur, to be transmitted correctly (more than two within ~20 ms). Example: One change is transmitted, which may take up to 20 ms, a second change during that time will be stored and processed if the first transmission has been finished successfully.
    - if an event cannot be transmitted with 8 retransmitts

WSP and WIOP devices are handled both in a similar way as WDP (wireless digital pad) and have an additional status bit (see chapter 3.12).
For a WSP the 8 input bits are provided in the low byte of the input data range for a WDP.
The WIOP additionally uses the output data range (8 bits = 1 byte).

Table: WDIO data structure and mapping

Payload Data

	WDI: 120 WSIX		WDX: 56WSIX + 7WDP		WDP: 13WDP	
Input data						
Word	high byte	low byte	high byte	low byte	high byte	low byte
0	Input 15..0		Input 15..0		Input 15..0	WDP 0
1	Valid 15..0		Valid 15..0		Input 15..0	WDP 1
2	Input 31..16		Input 31..16		Input 15..0	WDP 2
3	Valid 31..16		Valid 31..16		Input 15..0	WDP 3
4	Input 47..32		Input 47..32		Input 15..0	WDP 4
5	Valid 47..32		Valid 47..32		Input 15..0	WDP 5
6	Input 63..47		spare	Input 55..48	Input 15..0	WDP 6
7	Valid 63..47		Status BS	Valid 55..48	Input 15..0	WDP 7
8	Input 79..64		Input 15..0	WDP 0	Input 15..0	WDP 8
9	Valid 79..64		Input 15..0	WDP 1	Input 15..0	WDP 9
10	Input 95..80		Input 15..0	WDP 2	Input 15..0	WDP 10
11	Valid 95..80		Input 15..0	WDP 3	Input 15..0	WDP 11
12	Input 111..96		Input 15..0	WDP 4	Input 15..0	WDP 12
13	Valid 111..96		Input 15..0	WDP 5	Valid WDP 12..0	
14	spare	Input 119..112	Input 15..0	WDP 6	Status WDP 12..0	
15	Status BS	Valid 119..112	Status WDP 6..0	Valid WDP 6..0	Status BS	
Output data						
Word			high byte	low byte	high byte	low byte
0			Out 7..0 WDP1	Out 7..0 WDP0	Out 7..0 WDP1	Out 7..0 WDP0
1			Out 7..0 WDP3	Out 7..0 WDP2	Out 7..0 WDP3	Out 7..0 WDP2
2			Out 7..0 WDP5	Out 7..0 WDP4	Out 7..0 WDP5	Out 7..0 WDP4
3			spare	Out 7..0 WDP6	Out 7..0 WDP7	Out 7..0 WDP6
4					Out 7..0 WDP9	Out 7..0 WDP8
5					Out 7..0 WDP11	Out 7..0 WDP10
6					spare	Out 7..0 WDP12
7						

Table_WDIO data structure-mapping.pdf

Status BS:	bit n .... bit 3	bit 2	bit 1	bit 0
	reserved	Parameter fault	Fieldbus enable	System ready

Status BS.pdf

Meaning of the status bits of the WDIO

“SystemReady”-Bit (bit 0)

- “1” If all “Valid”-Bits of **all** configured devices in the local configuration of the WDIO100 are “1”.
- “0” If at least one on the “Valid”-Bits of the configured device is “0”

”Fieldbus Enable”-Bit (bit 1)

Set via the SET-Menu of the WDIO100, item “CFG LOCAL / FB” to choose which configuration is used after start-up:

- “1” the option is set to FIELDBUS (preconfigured!), to indicate that the parameters sent by the PLC will be stored at the WDIO100 if they are valid.
- “0” the option is set to LOCAL, to indicate to the PLC that the parameters, that are downloaded to the WDIO100 at start-up will not be used.
  - The bit is also set to “0”, in case the WDIO100 is in SET, DEL or CFG Mode, to indicate the PLC that Parameters are blocked during this time. This function is to prevent local changes to be overwritten by the PLC.

“ParameterFault”-Bit (bit 2)

- “1” to indicate the PLC a Parameter Error in case the Parameters are not stored because of the “FieldbusWriteEnable”-Bit or if a Parameter is out of range:
  - A range check of the parameter value is done for the Cell-ID (1-59) and for the last configuration word (<=255) because this word is only half full.
  - The bit is also set to “1”, if there was a something wrong in the field bus telegram (Package number or Parameter number does not match).
- “0” if valid parameters from the PLC are stored as local configuration.

3.11.2 Parameter to be downloaded to the WDIO100

At each start-up of a field bus node or of the whole system, Block-parameters are downloaded to the WDIO100 field bus slave. This ensures a simple exchange of the WDIO without loosing the configuration/settings made.

They are only used if the WDIO Parameter “CFG LOCAL / FB” is set to the “FIELDBUS” (which is the default setting).

During commissioning of an application this parameter should be set to LOCAL, otherwise the configuration is deleted at the next startup (unless the configuration has been entered or uploaded as fieldbus parameters in the PLC).

The parameters according to the table below (except the counter values) should be entered manually in the PLC after an application is finished or uploaded from the WDIO device if the bus master and PLC supports this functionality.

The parameters contain the Cell-ID, one bit per possible wireless device and some other parameters needed for the correct function of the system. The bit will be “1” if a device is configured, “0” if not used in this configuration.

	WDI: 120 WSIX			WDX: 56WSIX + 7WDP		WDP: 13WDP	
	Default values: 0						
Parameter Data	Para. No.	Name	Meaning	Name	Meaning	Name	Meaning
	1	Cell ID	Cell ID	Cell ID	Cell ID	Cell ID	Cell ID
	2	Config0	WSIX 15..0	Config0	WSIX 15..0	Config0	WDP 12..0
	3	Config1	WSIX 31..16	Config1	WSIX 31..16	Antenna switching	0=ON, 1=OFF
	4	Config2	WSIX 47..32	Config2	WSIX 47..32	Error Ack	0=Auto Ack, 1=WDIO100 Ack
	5	Config3	WSIX 63..47	Config3	WSIX 55..47	Failsafe Mode	0=Zero 1=Keep
	6	Config4	WSIX 79..64	Config4	WDP 6..0	Filter Time	0=1ms 1=5ms 2=25ms
	7	Config5	WSIX 95..80	Antenna switching	0=ON, 1=OFF	Node hours	*(read only)*
	8	Config6	WSIX 111..96	Error Ack	0=Auto Ack, 1=WDIO100 Ack	Invalid Counter	*(read only)*
	9	Config7	WSIX 119..112	Failsafe Mode	0=Failsafe Zero 1=Failsafe Keep		
	10	Antenna switching	0=ON, 1=OFF	Filter Time	0=1ms 1=5ms 2=25ms		
	11	Node hours	*(read only)*	Node hours	*(read only)*		
	12	Invalid Counter	*(read only)*	Invalid Counter	*(read only)*		

Table_WDIO-Parameter_1-12.pdf

3.12 Diagnosis and Error handling and timing

The WDIO Display keeps warnings and errors (ERRx WARNy) displayed and stored for each device, also if the condition is not true anymore, until acknowledged by pressing the OK button for this device.

This is to inform the operator/service person also about short time errors. The diagnosis bits on the bus for this device directly follows the actual state of the device, e.g. the devices valid bit is set to valid=1 again, if the communication has been OK for 3 Telegramms.

The error messages can be bulk cleared from the PLC side by:

- starting up the device again (via 24 V power), or
- sending the cell-ID as parameter again to the device, this leads to a reset of the device.

It takes then 5 seconds for the new SYSTEM CHECK in both cases, where the WDIO waits for 10 valid telegrams for each configured device (timeout is 40 seconds: then the timeout devices have an ERR1 message).

For Outputs the “WDP ERROR ACK” parameter can be changed to “WDIO100 ACK”, so that the system stays in failsafe mode after ERR1 or ERR2, in order to have a defined static output status after communication errors: The outputs remain in the chosen failsafe state until the “OK” button is pressed. Input signals are always active on the bus if three correct telegrams have been received.

The respective valid bit on the bus for this device then is also not “1” again, until the acknowledgement has been done on the WDIO100 “OK” button.

The event lost ERR2 only leads to a short invalid pulse of the respective valid and system status bits on the bus of 100 ms. Therefore the “WDIO100 ACK” setting of the parameter “WDP ERROR ACK” helps to detect correct application timing.

There are two main groups of diagnosis messages as can be seen from the Error -Table. The timing in dependence of the Setting and Error cases can be seen from the error timing table.

ERR1/ ERR2/ ERR3 Messages

ERR1 Communication has been lost (Timeout, has highest priority).

ERR2 Event lost :
- event could not be transmitted within 15 ms (7 retries);
- too many events to transmit, e. g. if more than 2 events occur within 10-15 ms.

Only these two errors do affect the valid bit, only ERR1 signals a real communication error.

ERR3 Parameter download error, occurs only during addressing/configuration of a wireless device via the WDIO if the download of the needed parameters (e.g. filter time) has failed. This message cannot be acknowledged, the device has to be deleted at the WDIO and has to be configured again.

WARN4 ….WARN7 Messages

Diagnosis messages from the pads lead to warnings (see error-table), which lead to a “0” of the status bit of the device, but do not affect the system ready bit (as the communication is OK).

WSIX devices:

- valid bit to indicate communication/data is valid
- (System ready bit for all configured devices in total)

WDP devices :

- valid bit to indicate the communication/data is valid
- status bit to indicate the device status (function AND data communication OK)
- (System ready bit for all configured devices in total)

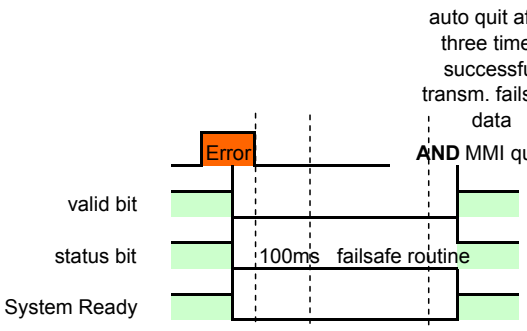
Priority	Error case / display	Error case description		Reaction of WDIO	Reaction mode outputs (WIOP)	Bus		
						valid bit	status bit	system ready
	-	No Error				1	1	1
1	**ERR1**	**Communication timeout (or internal errors)** General device: 500ms from WIOP after output change: 20ms	Failsafe mode keep	The WDIO tries to send the last successful transmitted outputs to the WIOP. After three successful attempts, the system goes out of the failsafemode in dependence of the set error acknowledge mode: Auto or WDIO acknowledgement	Keep outputs	0	0	0
			Failsafe mode zero	The WDIO tries to send a output command with output data "Zero" to the WIOP. After three successful attempts, the system goes out of the failsafe mode in dependence of the set acknowledgement mode: Auto or WDIO acknowledgement	Outputs are zero	0	0	0
2	**ERR2**	**Event lost**: Is set if: - an event could not be transmitte within 7 retransmitts (15ms). - a third event for an in- or output is registered , during a first transmission isn't successfully finished. A second event is always stored for later processing.	Auto ACK	WDIO accepts new output data. Valid bit is for one cycle only zero		(O)	1	0
			WDIO ACK	WDIO doesn't accept new output data until the error is acknowledged on the WDIO with OK		0	1	0
no	**ERR3**	**Parameter download failed**: After the configuration of a pad ("WDP"), the WDIO transmits failsafe mode and filter time parameter to the Pad. If any of these parameter downloads failed, the Pad shows this error "ERR3" in the display.	No error clearing possible!	Error indication in display (user should delete this device on the WDIO configuration and configure it again)		1	1	1
3	**WARN4**	**Actorvoltage over current** (short circuit)		the status bit is zero until the error cause is removed.		1	0	1
4	**WARN5**	**Sensor over current** (short circuit)		the status bit is zero until the error cause is removed.		1	0	1
5	**WARN6**	**Actor under voltage**		the status bit is zero until the error cause is removed.		1	0	1
6	**WARN7**	**Sensor under voltage**		the status bit is zero until the error cause is removed.		1	0	1

WDIO error indication Bus/ PLC

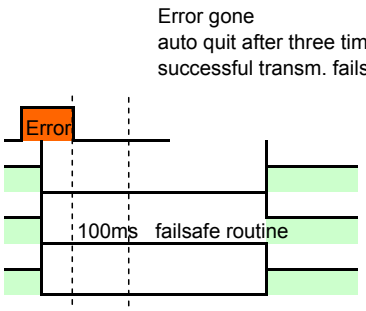
ERR1

DL timeout
UL timeout
WIOP internal fault

MMI Quit

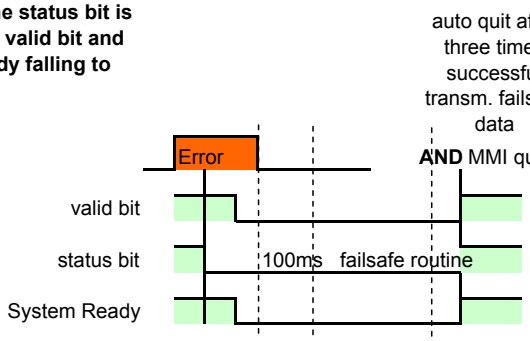


Auto Quit

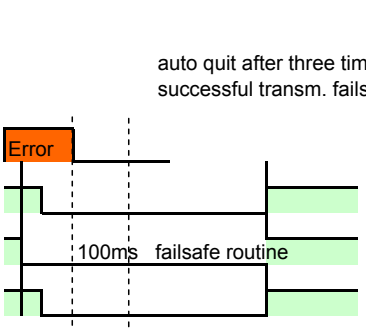


A failure of the system/sensor power causes an UL timeout. In this case the status bit is zero before valid bit and system ready falling to zero.

MMI Quit



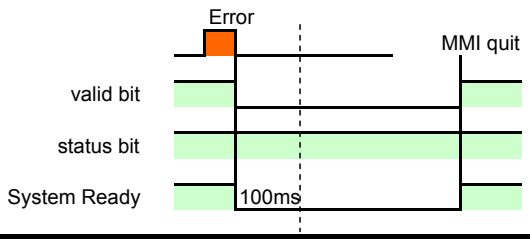
Auto Quit



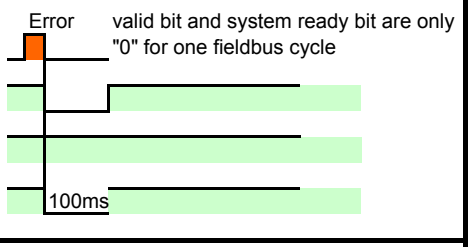
ERR2

UL event lost
DL event lost

MMI Quit

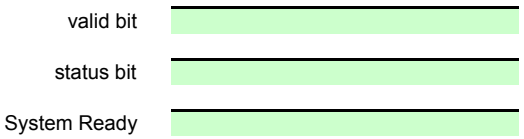


Auto Quit



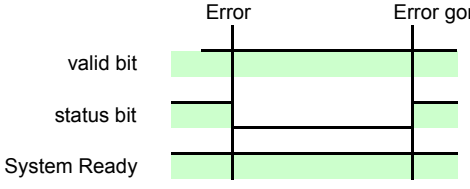
ERR3

Parameter transfer to device failed



WARN4 - WARN7

Actor/Sensor overcurrent
Actor/Sensor undervoltage



3.13 Quick-Start of Communication

Assumption: The power supply for the wireless input / output devices is connected and already commissioned (compare chapter 4.4 for the Wireless Power Supply).

Installation

- Mount Input/Output Module WDIO100
- Mount antennas
- Install and connect antenna cables
- Connect Input Module to 24 V DC
- Plug-in FieldBusPlug at WDIO100
- Ensure Supply of FieldBusPlug (has to be supplied separately via the 5 pole cable!)
- Connect field devices WSIX/WSP/WIOP and e. g. sensor
- Switch on the power supply for the wireless input / output devices (e.g. the magnetic power supplies WPU100).

Settings of Input Module WDIO100

- Select configuration type of WDIO (e. g. WDX=56WSXI+7 pads possible)
- Set parameters in SET Menu (press ESC + OK; use /\ and \/ buttons and OK to chose)
  - Set a suited field-bus-address on the WDIO
  - Set Cell-ID, set the desired ID-number for this Cell / WDIO (1 ….59)
  - Set “CFG LOCAL/FB” to LOCAL (device uses locally stored configuration, otherwise configuration data is read from Block parameters on fieldbus at start-up which may be "0" if not yet configured in controller))

Configuration of Devices

- CFG-Menu: Configure a device in the CFG Menu (depends on configuration type chosen e.g. WDX) (WISX = Sensor; WDP = WIOP/WSP)
  - Select a device address
  - Press Button at a selected device to receive this address (and the Cell-ID)
- RUN-Mode:
  Check device function in the respective submenu (use /\ and \/ buttons and OK to chose)
  e. g. by triggering a sensor.
- WINK – Mode:
  Press button on wireless field device, observe address appearing in the WDIO display.

Configuration of a Mapping (optional)

CFG-Menu: Minimum two devices have to be configured (e.g.: 1 WSIX, 1 WDP/WIOP).

- Chose a mapping adresse (only free addresses are shown),
- Chose the mapping partners to be connected, chose the connection direction

Check the correct device function (e.g. trigger a Sensor -> WIOP Output is set)

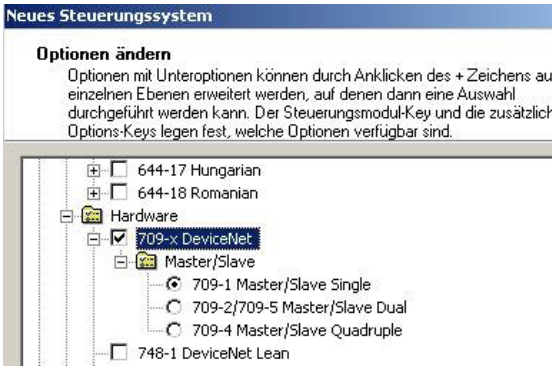
Configuration of connection to a controller, PLC

- Copy the ABB*.gsd or the matching WDIO100*.eds files for the chosen FieldBusPlug into the subdirectory of the host/PLC software. The files can e.g. be obtained from the FieldBusPlug pages of ABB (e.g. Zip files for PROFIBUS® PBE91-FBP, DeviceNet™ DNE91-FBP, CANopen® COE91-FBP).
- Start the host/PLC software, (or actualize the directory to choose the file from in the host software)
- Map the wireless input module into the field bus network (assign field bus address)
- In the host/PLC software, select the WDIO100 as the I/O for that node and set I/O addresses

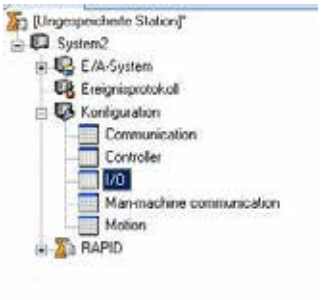
Configuration of connection to an IRC 5 Robot controller with help of RobotStudio

A signal configuration file of the Robot (EIO, CFG needs to be created (or available).

1. The Robot system must have a filedbus option DeviceNet™ Master/Slave Single.



2. Connect the robot control in RobotStudio and double-click in the controller view under configuration on "I/O".

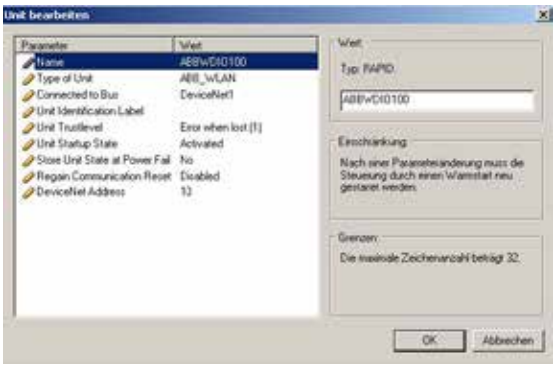


3. Right-click on "Unit Type" and in the context-menü "Add Unit Type". By this a template (Driver) for a physcal IO Unit is generated.

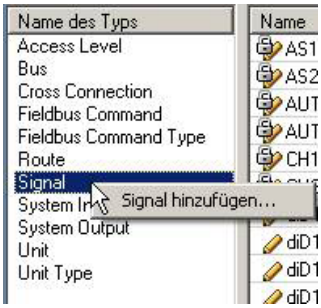
4. Enter in the opening window the data from the correct EDS file (depends on your configuration type set at starting up the WDIO100 e.g. WDP, WDX, or WDI). Here, note that decimal values must be entered, i.e. the hex values from the EDS file must first be converted. The name is arbitrary. After pressing the OK button, the robot system will now request a reboot. Do NOT do yet the reboot now.

5. A new unit based on the new unit types needs to be produced. The new unit represents the actual EA unit and uses the new unit type as a driver. To do this right-click on "Unit" and choose "Add Unit" option.

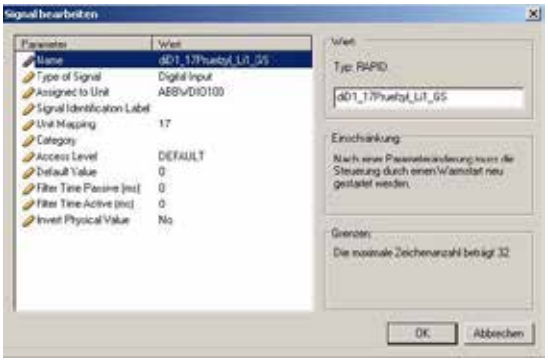
6. The name is arbitrary. After pressing the OK button, the robot system will now request a reboot. Do NOT do yet the reboot now.



7. Now, digital input and output signals based on the new unit need to be created. For this right-click the entry "signal" and in the context menu, select "Add Signal".



8. Create the digital signal. After pressing the OK button, the robot system will now request a reboot. Now this can be performed.



4. Power Supply

- For primary loop pairs up to a size of 3 m x 4.5 m one power supply per loop pair is required.
  For larger loops up to 3 m x 6 m one power supply per loop is required.
  The power supplies are installed near the primary loops outside the control cabinets.
- The power supplies are installed in the proximity of the primary loops, outside of cabinets with a maximum wiring length (twisted primary loop cable) between power supply and each primary loop of 5 m.
- A space of 200 mm has to be kept above and below each power supply in order to guarantee sufficient air circulation and heat dissipation (see V6, 'Power Supply WPU100').
- All power supplies of a setup (and adjacent setups) have to be connected one after the other by a synchronization cable.
- For synchronization one power supply is set to master mode and all other power supplies connected via synchronization cables are set to slave mode.
- All power supplies of one setup have to be switched on/off via one switch.
- To obtain a rotating electromagnetic field, all slave devices for primary loops which are turned by 90° against the primary loops of the master device (=0° !) have to be set to a phase of 90°.
- At all other Slave-devices and at the Master, a phase of 0° has to be selected.
- For designe with more than two WPU100 units, the WPU100-24M has to be used.
  The WPU100-24M enables modular cells or parallel loops with different power supplies and can cope with higher magnatic coupling factors

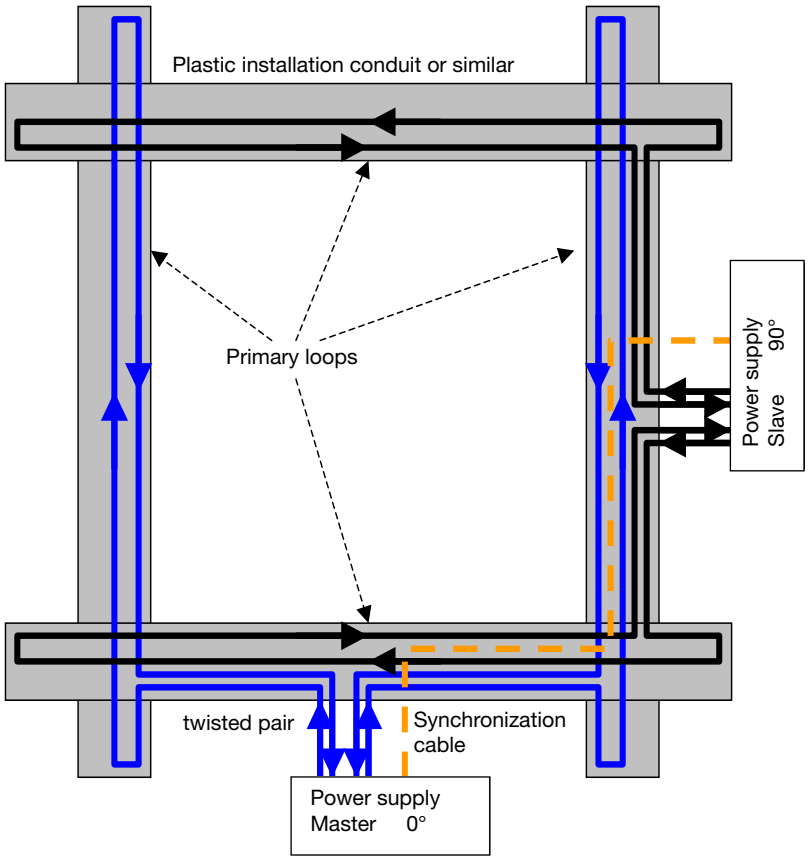


Fig. 4.1: Interconnection of two power supplies using a synchronization cable, connection of the primary loops and operating mode settings, schematic top view diagram

4.1 Electrical connections

All electrical connections and settings of DIL switches are under the cover plate underneath the heat sink area.

This cover plate can be removed after loosening of the six fixing screws.

All cables are brought into the housing by PG glands through the bottom surface.

- OThe device only fulfills the IP 65 degree of protection, if the cover plate is mounted, the fixing screws and all PG glands are firmly bolted (unused also covered).
- For fulfilment of the VDE regulations, an external protective grounding must be additionally connected from the cabinet common connection point to the mains.

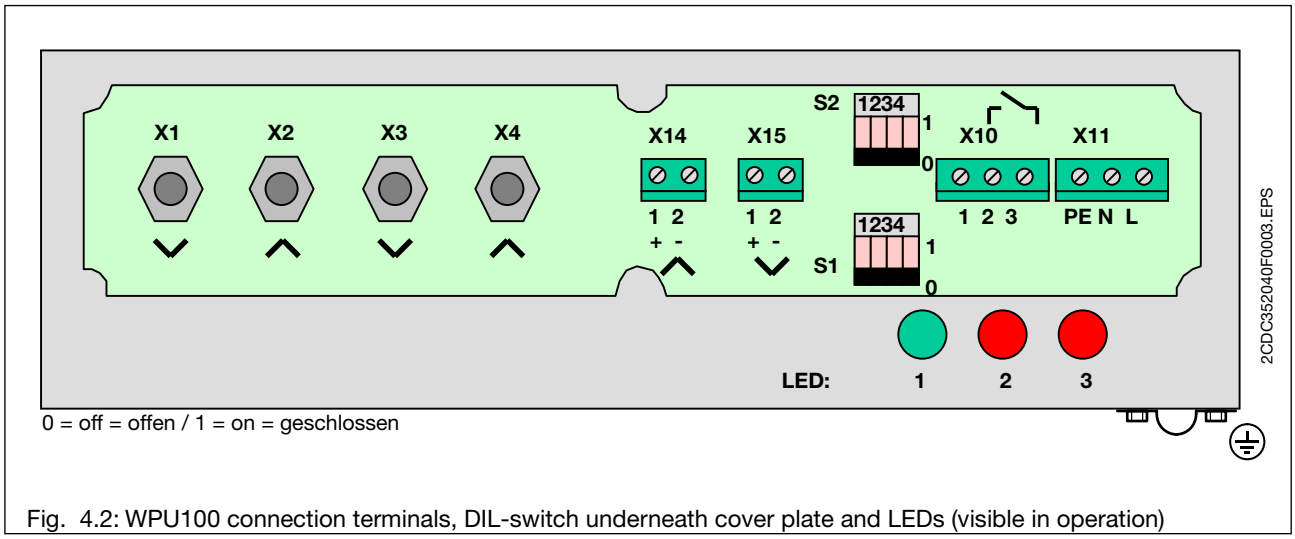


Fig. 4.2: WPU100 connection terminals, DIL-switch underneath cover plate and LEDs (visible in operation)

Allocation

Connection terminals

X1	Primary Loop 1 >
X2	Primary Loop 1 <
X3	Primary Loop 2 > or contact-bridge to X4 (included in scope of delivery)
X4	Primary Loop 2 < or contact-bridge to X3 (included in scope of delivery)
X14.1	Sync-Input +
X14.2	Sync-Input -
X15.1	Sync-Output +
X15.2	Sync-Output -
X10.2	"Field OK"-Output (potential-free contact)
X10.3	"Field OK"-Output (potential-free contact)
X11.L	Main Supply L
X11.N	Main Supply N
X11.PE	Main Supply PE

DIL-Switches

S1	Current setting
S2	Setting for synchronisation

LEDs

LED1, green	Operation
LED2, red	Disturbance of power supply
LED3, red	Disturbance of synchronisation

- The sync-connections are a non-isolated functional DC-voltage (FELV).
- The sync-connections may be connected via plastic-sheated cable to the sync connections of other power supplies WPU100.
- The 2nd PE-connection (at the housing) has to be connected in a star type configuration to the common connection point / cabinet.
- In installations with a residual-current circuit breaker a type B-switch has to be used.
- In typical machine constructions, and a primary loop arrangement according to the rules of chapter 1, a power consumption of the WPU power supply units of 5 - 15 W/m³ of supplied/surrounded machine volume occurs (2D-supply with rotating magnetic field assumed).
  The losses are determined mainly by the proximity of the primary loops to conducting larger objects (metall, especially steel) and the adjusted current.

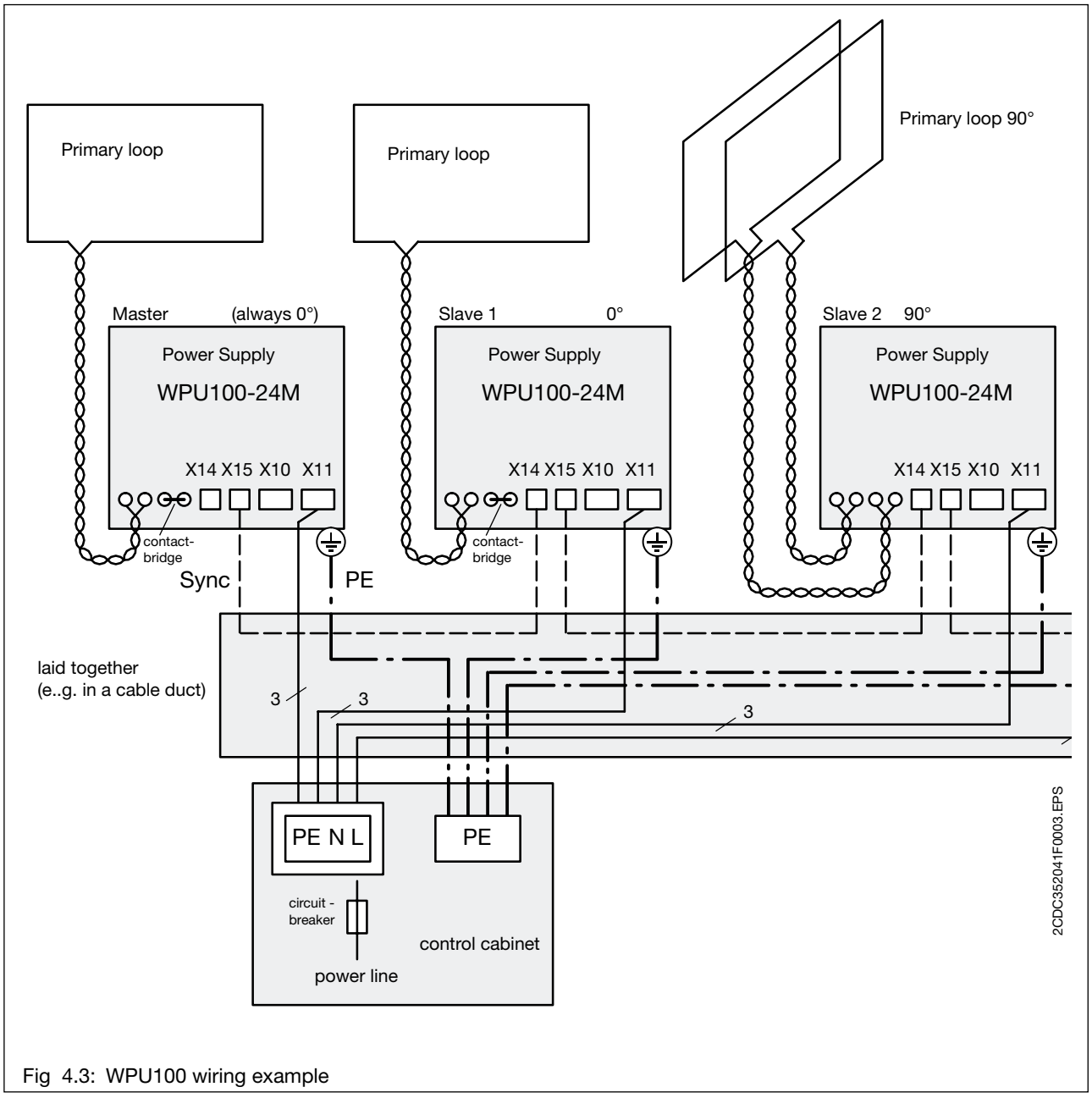


Fig 4.3: WPU100 wiring example

4.2 Primary loop sizes and current values

Primary loops which are connected to the same primary supply, should have the same side-length.

The current value which has to be chosen for the power supply is defined by the short side of a primary loop, in very small setups additionally by the number of turns (1 or 2).

The values are listed in the following table.

Long side of the primary loop [mm]	Number of **primary loops** per power supply	Number of **turns** per primary loop	**Short side** of the primary loop [mm]										
			1000	1200	1400	1600	1800	2000	2200	2400	2600	2800	3000
			Current value [A]										
1000	1-2	**2**	4										
1200	1-2	**2**	4	5									
	2	1	8	10									
1400	1-2	**2**	4										
	1	**2**		5	6								
	2	1	8	10	12								
1600	1	**2**	4	5	6	6							
	2	1	8	10	12	13							
1800	1	**2**	4	5	6	6	7						
	2	1	8	10	12	13	15						
2000	2	1	8	10	12	13							
	1-2	1					15	16					
2200	2	1	8	10	12	13							
	1-2	1					15	16	18				
2400	2	1	8	10	12								
	1-2	1				13	15	16	18	20			
2600	2	1	8	10									
	1-2	1			12	13	15	16	18	20	22		
2800	1-2	1		10	12	13	15	16	18	20	22	24	
3000	1-2	1	8	10	12	13	15	16	18	20	22	24	24
3100 - 4500	1-2	1	8	10	12	13	15	16	18	20	22	24	24
4500 - 6000	**1**	1	8	10	12	13	15	16	18	20	22	24	24
Minimum distance for pacemaker carriers [mm]			800	1000	1300	1400	1600	1700	1900	2100	2300	2500	2500

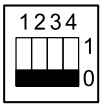
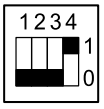
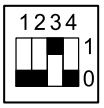
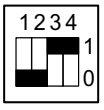
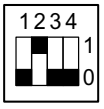
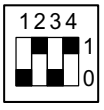
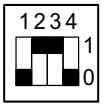
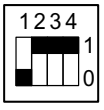
Table: Dependence of primary loop size, turns and current value to be set.

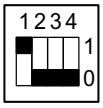
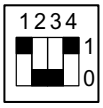
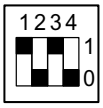
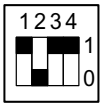
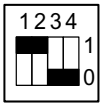
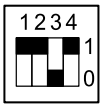
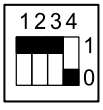
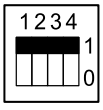
2CDC352062F0204.EPS

The feeding to the primary loops should be max. 5m (twisted part of the primary loop cable).

Too high current values, particularly with several turns, may lead to not allowed high field strength for humans, especially pace maker carriers.

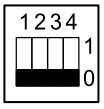
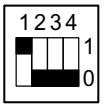
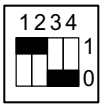
The current values are set at DIL-switch S1 as followed

Current value [A]	DIL-switch S1	
0	0000	
4	0001	
5	0010	
6	0011	
8	0100	
10	0101	
12	0110	
13	0111	

Current value [A]	DIL-switch S1	
15	1000	
16	1001	
18	1010	
20	1011	
22	1100	
24	1101	
unused	1110	
unused	1111	

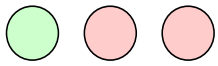
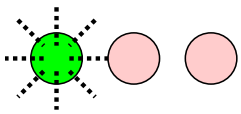
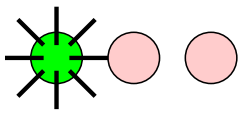
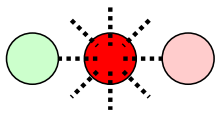
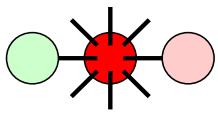
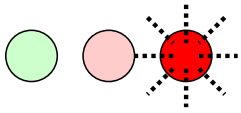
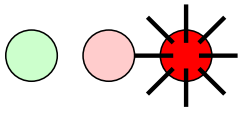
0 = off = open / 1 = on = closed

The synchronisation is set at DIL-switch S2 as followed:

Synchronisation	DIL-switch S2	
Master (= 0° !)	0000	
Slave - 0°	1000	
Slave - 90°	1100	
All other settings are not allowed		

0 = off = open / 1 = on = closed

4.3 Power Supply LED Signals

LED signal	Explanation	Recommended Action
	All LEDs off: Power Supply is switched off (no mains supply!)	
	The left LED blinks green: After switching on, the power supply is in the Start-mode (for approx. 20 - 30 sec.).	
	The left LED is green: Power Supply is in normal operation mode.	
	The LED in the middle blinks red: Disturbance due to one of the following: • Over-temperature • Instability of control • Difference in internal current measurements These errors turn off the power supply	• Switch Device off and on again. If the error occurs again: - -> Exchange Device
	The LED in the middle is red: Disturbance due to one of the following: • Cut cable in the primary loop(s) • Short-circuit in the primary loop(s) • Set current can not be achieved • High coupling between two loops/devices: Device switches off	• Check primary loops regarding cut cables or short-circuits, eliminate fault. • Check geometry / symmetry of primary loops according to the installation guidelines
	The right LED blinks red: Disturbance due to one of the following • Wrong setting of DIL-switch S1 (Current)	• Check and correct setting of DIL-switch S1
	The right LED is red: Sync-error due to one of the following: • Cable cut, short circuit, wrong polarity, mistaken in-/output connection via sync-cable • All devices connected via sync-wire are slaves • Several Masters present	• Check the synchronisation-cables and correct possible errors • Check the DIL-switch S2 of all devices regarding correct Master/Slave setting with respect to the wiring.
With each the specified disturbances, and without power, the contact of the malfunction signal output opens.		

4.4 Comissioning

The commissioning of the power supply of one setup or a machine is carried out in the following steps:

- Connect the primary loops to the power supplies.
- Connect the sync-cables, starting at the master device, one after the other to the Slave devices, by connecting the output of one device with the following input.
- Chose “Master” operation mode at the first device, “Slave” at all other devices and choose a phase value (0°/90°) matching the orientation in relation to the “Master” primary loop.
- Choose the appropriate current value matching the size of the connected primary loop(s) for each power supply.
- Connect the alarm/error-output with a suited alarm-input of the control system.
- Connect all power supplies of the setup, so that they can be switched with one main switch.
- Connect the external PE-connections of the power supplies (star configuration).
- Tighten all the glands.
- Mount the cover on the terminal board.
- Switch on the mains voltage.
- The operation LEDs of the connected power supplies start to blink green.

The power supplies are in normal operation if their green LEDs are continuously on (after ~20-30 seconds).

The housing, especially the heat sinks, of the power supplies heat up considerably in operation.

5. Abbreviations

WSIX	**W**ireless **S**ensor **I**nterface to pro**x**, communication module of wireless proximity switch
WIOP	**W**ireless **IO P**ad, wireless IO distribution box
WSP	**W**ireless **S**ensor **P**ad, wireless sensor distribution box (with wireless power supply)
WDP	**W**ireless **D**igital **P**ad, wireless device type for WDIO
WDIO	**W**ireless **D**evice **I**nput **O**uput module, basestation which communicates to the wireless devices in a machine/the field, and transmits the signals via a fieldbus to a PLC/control system
WSIN	**W**ireless **S**ensor **I**nductive **N**on-Flush, sensor head
WSIF	**W**ireless **S**ensor **I**nductive **F**lush, sensor head
ABB´s Concept	Wireless Interface for Sensors and Actuators, a new de facto standard set by ABB, targeted especially at the demanding requirements in factory automation (highest reliability, high node density, low latency, low power /wireless power)
Wireless-COM	ABB´s Wireless Automation **com**munication protocol
Wireless-POWER	ABB´s **wireless power** supply via magnetic fields
ICNIRP	**I**nternational **c**ommission for **n**on **i**onization **r**adiation **p**rotection
Cell-ID	WDIO address identifier, serving to identify to which basestation a wireless device belongs

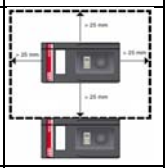
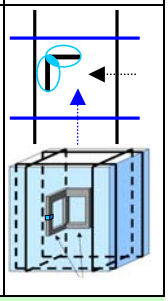
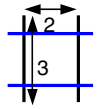
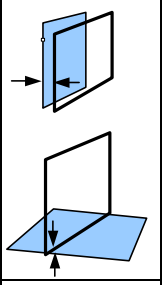
Appendix

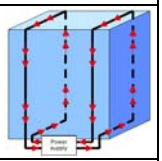
A Checklist

B WDIO100 - Basic Menu Structure (Overview)

A Checklist

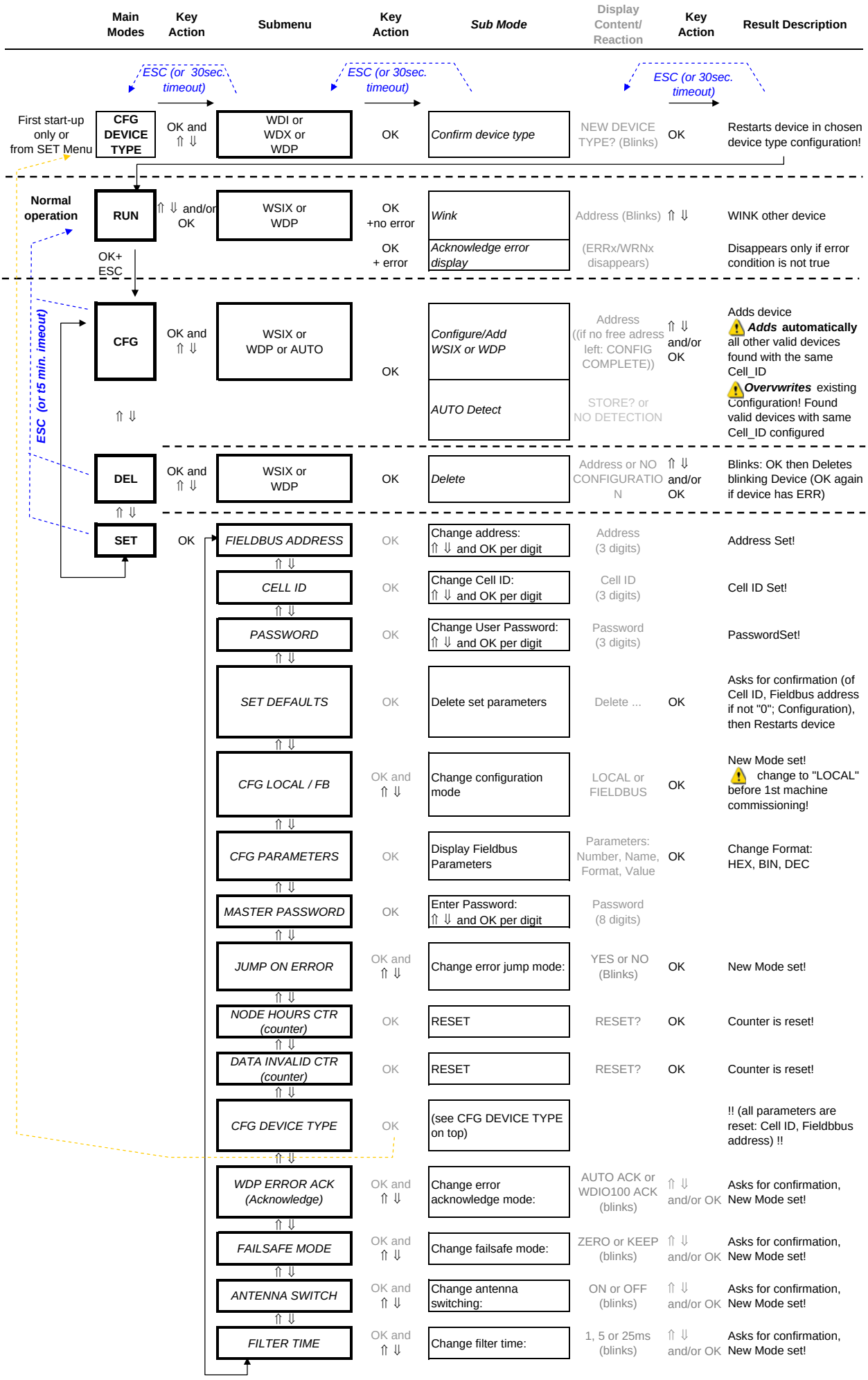
This list contains all important steps for the planning, installation and commissioning of a system with wireless proximity switches WPS. It additionally contains hints and references to the relevant chapters in the handbook.

Phase	✔	Point to be Checked	Further Details	Remark Hints	Drawing
1. Planning					
1.1 Sensor Related					
1.1.1		Get an overview of location and type of sensors		Choose WPS sensorhead type to be used	
1.1.2		Distance to neighbouring WPS Sensors and to metal objects	See "Planning and Installation Guidelines" Chapter 2.9	Should be >2.5cm, otherwise wireless communication and power supply will be affected.	
1.1.3		Shielding: Distance of sensor position relative to large metal parts or short circuit loops in the application	See "Planning and Installation Guidelines" Chapter 1.7	! WPS will not work if both magnetic field directions setup by the primary loops are shielded by metall objects or short circuit loops : - 1D Shielding (in one direction of the magnetic field) is tolerable - 2D shielding is not tolerable: -> If short circuit loops are shielded: Interrupt at least one loop with an isolating section - >if large metal plates are shielding: Check if sensor can be moved to another location	
1.2 Power Supply Related					
1.2.1		Plan primary loops: Size, distance, number	See "Planning and Installation Guidelines" Chapter 1.2	- Use at least two pairs of primary loops to create a rotating field. - Distance of parallel loops: ~ 2/3 of smallest width of a loop. - The two primary loop pairs have to be orthogonal to	
1.2.2		Check details of planned application: Distance of metal objects near loops (large short circuit loops, metal parts)	See "Planning and Installation Guidelines" Chapter 1.4	- Interrupt large short circuit loops, also if outside of the primary loops but close to the loops - Avoid large metal obstacles parallel to the two coil planes (try to keep a distance of 1/6 of the loop size to parallel large metal objects). - Keep the loop coils away from metal objects by at min. 3 cm, recommended are >> 10 cm (especially from magnetic steel objects; if the steel is magnetic can be checked with a permanent magnet).	
1.2.3		Check details of the applications surrounding		same as above: metal floor, walls, poles belonging to other structures (machines, building) close to the coils	
1.2.4		Chose amount and placement of power supplies WPU100		Two loops can be connected per supply. Mounting: Observe a distance for free airflow of 20 cm above the supplies. Placing the supplies close to the coils shortens the loop wires needed, which reduces losses.	
1.2.5		Select the mechanical support for primary loops		Plastic tubes/conduits are recommended ! Metal tubes/conduits or metal cable ducts are not allowed for the loop itself.	
1.2.6		Calculate length and amount of primary loop cables needed		The primary loop wire is available in lengths from 10-28m in steps of 1m (readily configured with ring cable lugs)	
1.2.7		Plan primary loop routing	See "Planning and Installation Guidelines" Chapter 1.6	Do not route other electrical wiring in loop ducts or directly in parallel (>15cm f. fieldbus wires; cross vertical). Plan for twisted loop wire, from the loop to the power supplies WPU	
1.2.8		Calculate current to be used	See "Planning and Installation Guidelines" Chapter 4.2	See the table in chapter 4.2 "Primary loop sizes and current values" Document chosen current value!	
1.2.9		Plan safety distance for pace maker carriers in your application (marking and sign)	See "Planning and Installation Guidelines" Chapter 1.3	See the table in chapter 1.3 Mark pacemaker warning line on floor (e.g. in yellow-black colour), put a danger sign in high of the line and document place and distance.	

Phase	✔	Point to be Checked	Further Details	Remark Hints	Drawing
1.3 Communication Related					
1.3.1		Decide on mounting position for input module WDI100		IP20: Typically in a cabinet, (access needed only for commissioning and trouble shooting), distance to planned antenna max. 5m antenna cable length	
1.3.2		Decide on field bus to be used / select suited FieldBusPlug		The WDI100 input module may be connected to different field busses by choosing the matching ABB FieldBusPlug	
1.3.3		Decide on amount of input modules		One WDI100 Input module supports up to 120 sensors, max. up to 3 WDI are allowed in one application	
1.3.4		Decide on antenna position		The antenna should be able to "see" most WPS sensors (70° viewing angle of antenna) Several WDI: The antennas shouldn´t face each other directly (if distance < 5m)	
1.4 Order Components					
2. Mechanical Mounting					
2.1		Mounting of power supplies		four M8 threads on backside	
2.2		Mounting of mechanical coil support (mechanical part)		Support structure, fixtures for coil wire - plastic tubes/conduits (e.g. mounted on aluminium support structures/profiles) - or use glass fibre reinforced tubes/conduits which are self-supporting and can carry the wire inside)	
2.3		Mounting of sensors/sensor Heads			
3. Electrical installation					
3.1 Power Supply Related					
3.1.1		Mounting of mechanical primary loop support (electricians part)		Install cable into e.g. plastic tubes/conduits, glasfiber reinforced tubes are self-supporting due to their mechanical strength, - keep a distance to metal objects (reduces losses) - keep other wires separate (if running parallel by at least 15cm)	
3.1.2		Mounting of cable ducts/channel(s) for power supply wiring		for primary loop wire going to the loop (twisted!), grid connection, 2nd PE, sync-wire	
3.1.3		Installation of primary loops	See "Planning and Installation Guidelines" Chapter 1.2	carefully observe loop direction (arrow on cable), connect to power supply; parallel loops have to have the same orientation of current/arrows. Observe arrows also when connecting to power supply.	
3.1.4		Installation of sync wire(s)		twisted pair wire (if shielded do not connect shields !), connect output to input of next device	
3.1.5		Installation of grid connection and PE		-Joint connection to <u>one</u> switch/fuse for all supplies of one setup (4/6A at 230/120V per supply) - 2nd PE connection necessary!	
3.2 Communication Related					
3.2.1		Mount Input Module WDI100		DIN rail with 13mm height (break mounting hoods on base plate for smaller DIN-rails or use mounting hoods (4M4 screws)??	
3.2.2		Mount antennas		Distance of 0.5m to each other, use L and R polarized ones, max. distance to a sensor 5m.	
3.2.3		Mount and connect antenna cables			
3.2.4		Connect Input Module to 24 V DC		(max. 0.8A)	
3.2.5		Plug-in FieldBusPlug at WDI100			
3.2.6		Install and ensure supply of FieldBusPlug	see FieldBusPlug technical documentation	The FieldBusPlug needs 24 V feeding via the bus wire, typically coming from the PLC.	

Phase	✔	Point to be Checked	Further Details	Remark Hints	Drawing
4. Commissioning					
4.1 Power Supply					
4.1.1		Choose Master/Slave setting		Chose "Master" operation mode at the first device, "Slave" at all other devices	
4.1.2		Set phase angle to 0/90°		Choose a phase value (0°/90°) matching the orientation in relation to the "Master" primary loop (=0°).	
4.1.3		Set current chosen during planning (DIP-switch S1)	See "Planning and Installation Guidelines" Chapter 4.2	Set the appropriate current value matching the size of the connected primary loop(s) for each power supply.	
4.1.4		Document chosen current value and associated pace maker distance in application documentation	See "Planning and Installation Guidelines" Chapter 1.3 / 4.2		
4.1.5		Optional: Connect alarm output		Connect to an input of the control system/ PLC. Contact opens in case of malfunction of power supply	
4.1.6		Tighten all PG "Threads" , Put caps on unused ones		To achieve IP65 class	
4.1.7		Switch-on the main switch / fuse		The operation LEDs of the power supplies start to blink green. After ~15 sec. constantly green (check manual if red LED are on/blinking)	
4.1.8		Check correct function		Use a sensor w. communication module to check power (orange LED if triggered + green LED if unconfigured) **!** The communication module needs up to 8 sec. to start-up or stop operation.	
4.1.9		Mount the cover			
4.2 Configure PLC/FBP					
4.2.1		- Copy the *.gsd -file for the fieldbus plug into the GSD subdirectory of the host software	See "Technical Description for (FBP) FieldBusPlug"	The *.gsd file contains a description of the node, I/O and diagnostic data for the PLC (and is a readable text file). It can be found on the Documentation CD	
4.2.2		Start the host software, (or actualize the directory to choose the *.gsd File from)			
4.2.3		- Map the wireless input module into the fieldbus		by assigning the node address in the host software	
4.2.4		- In the host software, select the WDI100 as the I/O for that node and set I/O addresses		by turning on the auto address feature or manually address with the auto addressing turned off	
4.3 Settings of Input Module WDI100 (SET Menue)					
4.3.1		Set field bus address on WDI	See "Planning and Installation Guidelines" Chapter 3.8 FIELDBUS ADDR	- Leave RUN Mode: hold ESC and press OK at the same time - Select the SET Mode on the WDI100 panel (with Λ or V buttons) - Select FIELDBUS ADDR, set fieldbus address for the WDI100/FBP to the same address that was selected in the controller or PLC - FieldBusPlug LED(s) change Red -> Green: communication OK	
4.3.2		Set Cell-ID, set the desired ID-number for this Cell (1-60)	See "Planning and Installation Guidelines" Chapter 3.8 CELL-ID	Make sure to not have double Cell-IDs in a radius of ~16m !!	
4.3.3		Set "FIELDBUS ADDR" to LOCAL	See "Planning and Installation Guidelines" Chapter 3.8 CFG LOCAL / FB	Locally stored configuration is used instead of getting configuration for the sensors and CELL-ID from the field-bus/PLC. (May overwrite your local setting otherwise!)	
4.4 Configure Sensors					
4.4.1		Configure sensors in the (CFG Menu)	See "Planning and Installation Guidelines" p. 24	- Go to CFG Mode (press ESC and OK simultaneously from RUN mode), select CFG, (press OK to enter CFG mode) - Choose sensor address (1-120) (to be given to a certain sensor, only free addresses are available) Assign address: I. Press OK (address blinks), II. Press membrane switch on unconfigured sensor (green LED = on), it will receive selected address and Cell-ID. - The next free address is blinking on the WDI100: Press another sensor's membrane switch to assign this address, ...	
4.4.2		Check correct sensor function (RUN Menu)		- Choose the sensor to be triggered with Λ V (in RUN mode of WDI) - Trigger the sensor head with a metal object -Observe status change in RUN mode on WDI display - Check Wink function by pressing OK in the RUN mode or by pressing a membrane switch of a sensor WSIX	

B WDIO Basic Menu Structure (Overview)



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