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IDS-PN

Intelligent Print Mark Detection Sensor
PROFINET

User Manual V2.0

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Table of contents

1 Introduction

This manual contains a description of the IDS and it´s functionality and is suitable not only for machine operators but also for project engineers considering the IDS for their machine designs.

All related documentation and functionality of the IDS are subject to change.

1.1 General functionality

The IDS is based on an integrated optical print mark sensor with optical fiber and micro objective.
It optically detects the print marks on the web located in the corresponding print unit. Therefore the light of a white LED is focused on the web as a round light spot with a diameter of approx.
2 mm (see fig. 1.1, 10 mm print marks).

The reflection of the radiated light generates a current signal which is transformed and evaluated by the integrated sensor electronics (see fig. 1.2, idealized signal). Also an external analog sensor (DS) can be connected for extended tasks of print mark detection.

Figure 1.1:
sensor light spot

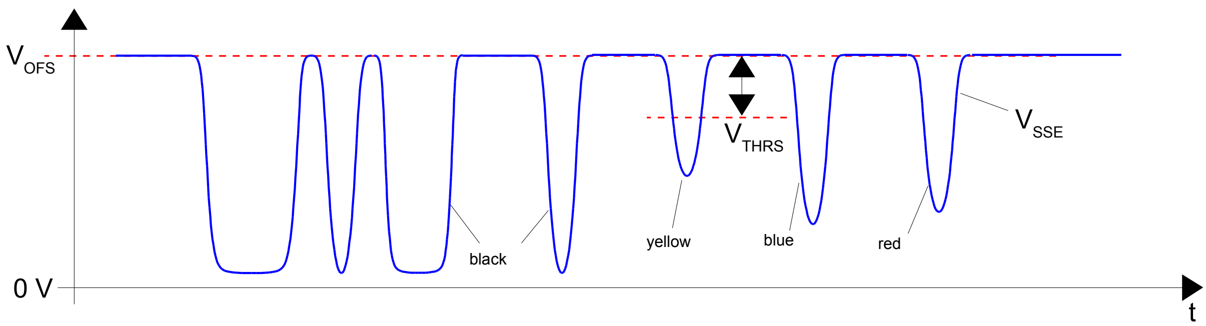


Figure 1.2: Sensor Signal (idealized)

V_{OFS}, V_{THRS} (fig. 1.2) and other parameters for different materials and print marks have to be configured.

All common types of print marks can be detected by the IDS (s. 4.2.2).

Deviations for length- and side-register (accuracy within a few µm) are transmitted via Real Time Ethernet (PROFINET IRT) to the drive system. A variety of data for visualization and diagnosis is available acyclic services of PROFINET (Read/Write Records).

1.2 Terms and Abbreviations

Term / abbreviation	description
AGS	Auto Gate Setting
AM	Analog Monitor
AO	Analog Oscilloscope
BM	Block Mark (print mark type)
C-LS	Controller Life Sign (PROFIdrive)
DB	Double Block (print mark type)
DK	Double Key (print mark type)
DO	Digital Oscilloscope
DO-ID	Drive Object Identification (PROFIdrive)
DO-LS	Device Object Life sign (PROFIdrive)
DPM	Dual-Port-Memory
DS	Detection Sensor for print marks (analog)
DT	Data type
IDS	Intelligent Sensor for print mark detection
IRT	Isochronous Real Time
LR	Length Register (Longitudinal Register)
Master	Master Print Unit
MPM	Master Print Mark
PU	Print Unit
PM	Print Mark
PN	PROFINET
PNU	Parameter Number
Process	Print mark detection and additional real time functions of the IDS
SA	Sensor Adjustment
SPM	Print Mark of the slave PU
Slave	Slave Print Unit
SR	Side Register
Web-Cylinder	Web-Cylinder mode, measuring only the master mark
Web-Web	Web-Web mode, measuring two print marks (master and slave)
Web-Web-2	Web-Web mode with 2 sensors

Table 1: Terms and abbreviations

1.3 System overview IDS-PN

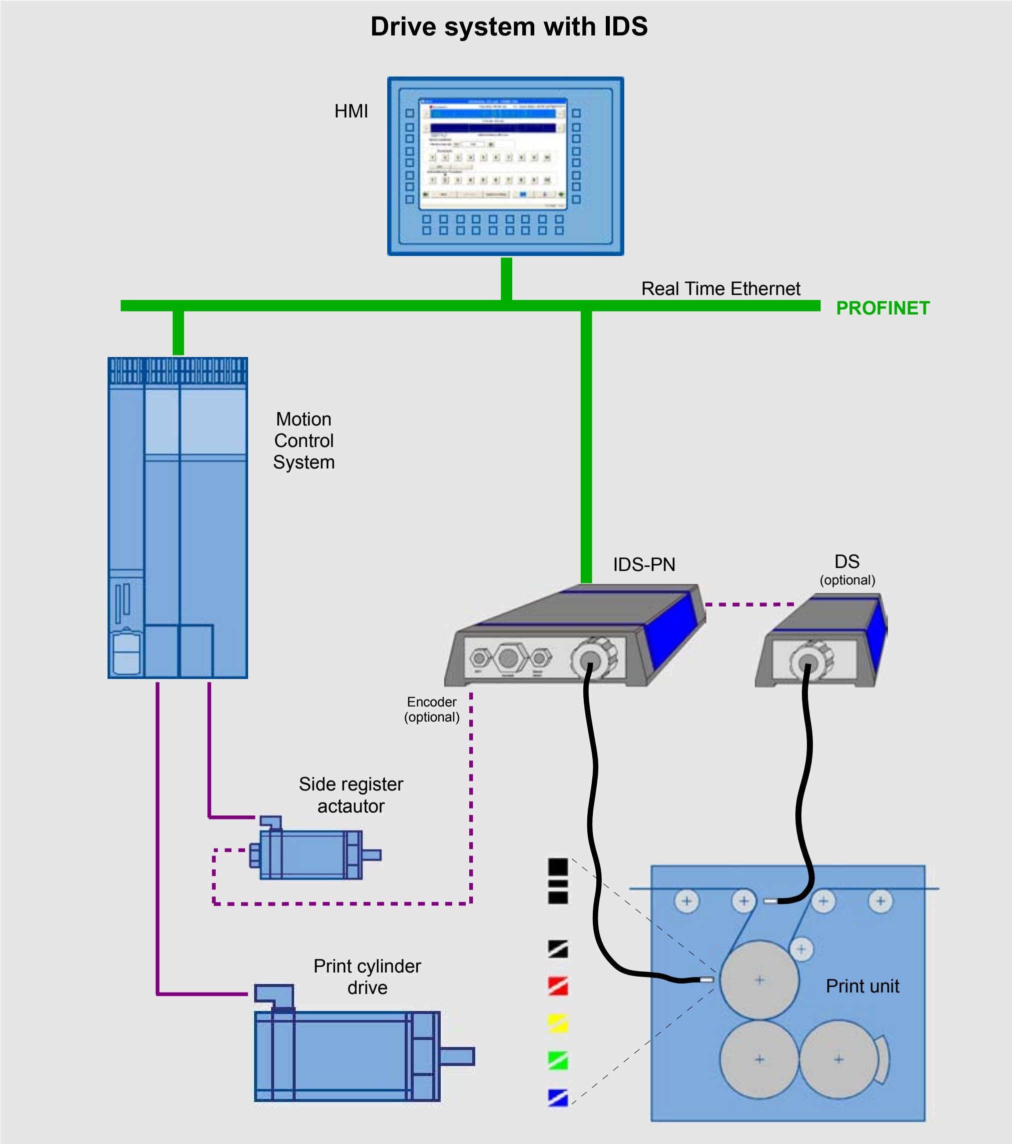


Figure 1.3: System overview IDS-PN

2 Hardware

2.1 General Description

The layout of the hardware components is illustrated in Fig. 2.1. The print mark detection of the IDS consists of the analog sensor unit (light sensor and electronics) and an integrated 32-bit processor system for real time evaluation (internal cycle time 0,5 ms). The selected print marks are detected and evaluated with high precision through FPGA-based logic.

The communication via PROFINET (PN) is realized with a special communication chip netX50 (Hilscher), whose integrated firmware communicates independently after initialization. Through a Dual-Port-Memory (DPM) the communication data is exchanged with the host processor. PROFINET I/O IRT is used as real time communication protocol, which means that cyclic data, such as the print cylinder position, is transmitted with cycle rates between 1 ms and 4 ms (in steps of 0,5 ms).

Acyclic data, such as device configuration or visualization data, is transmitted using the Read/Write Record Service of PROFINET. The parameter interface of the IDS is folly conform to the PROFIdrive [1] specification.

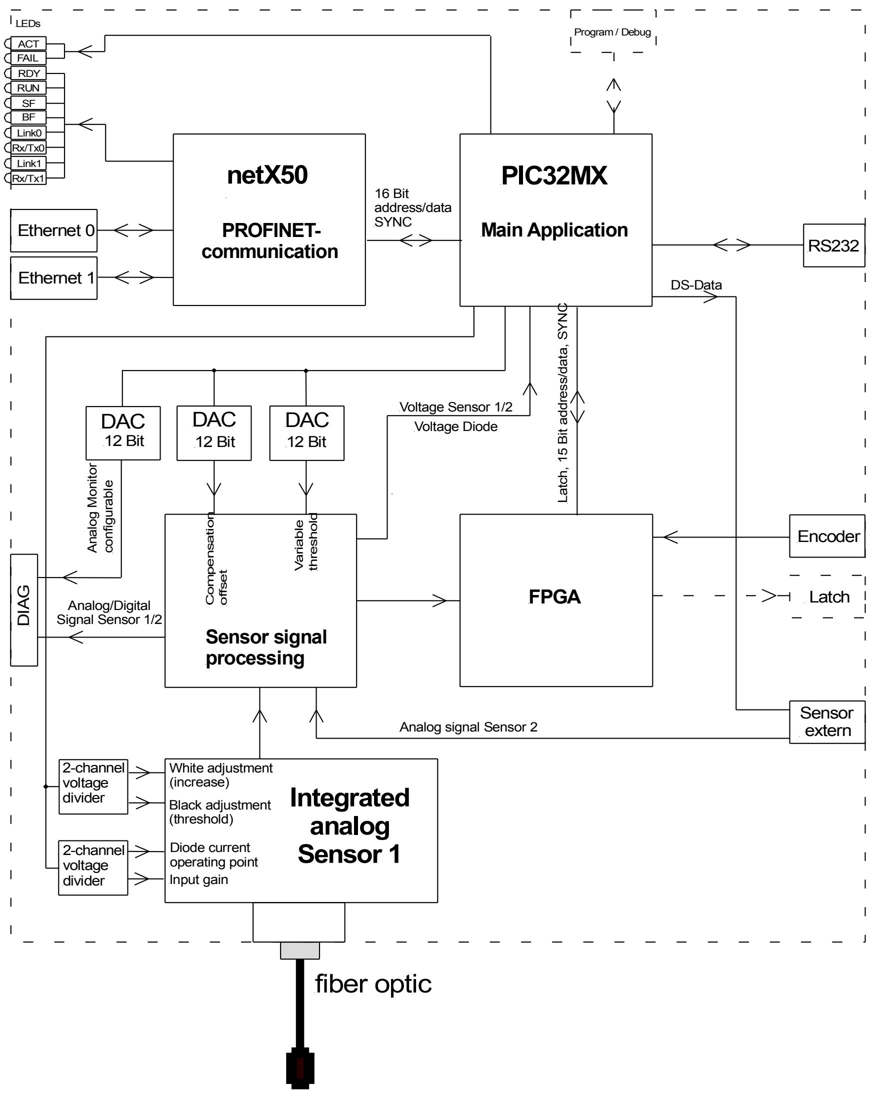
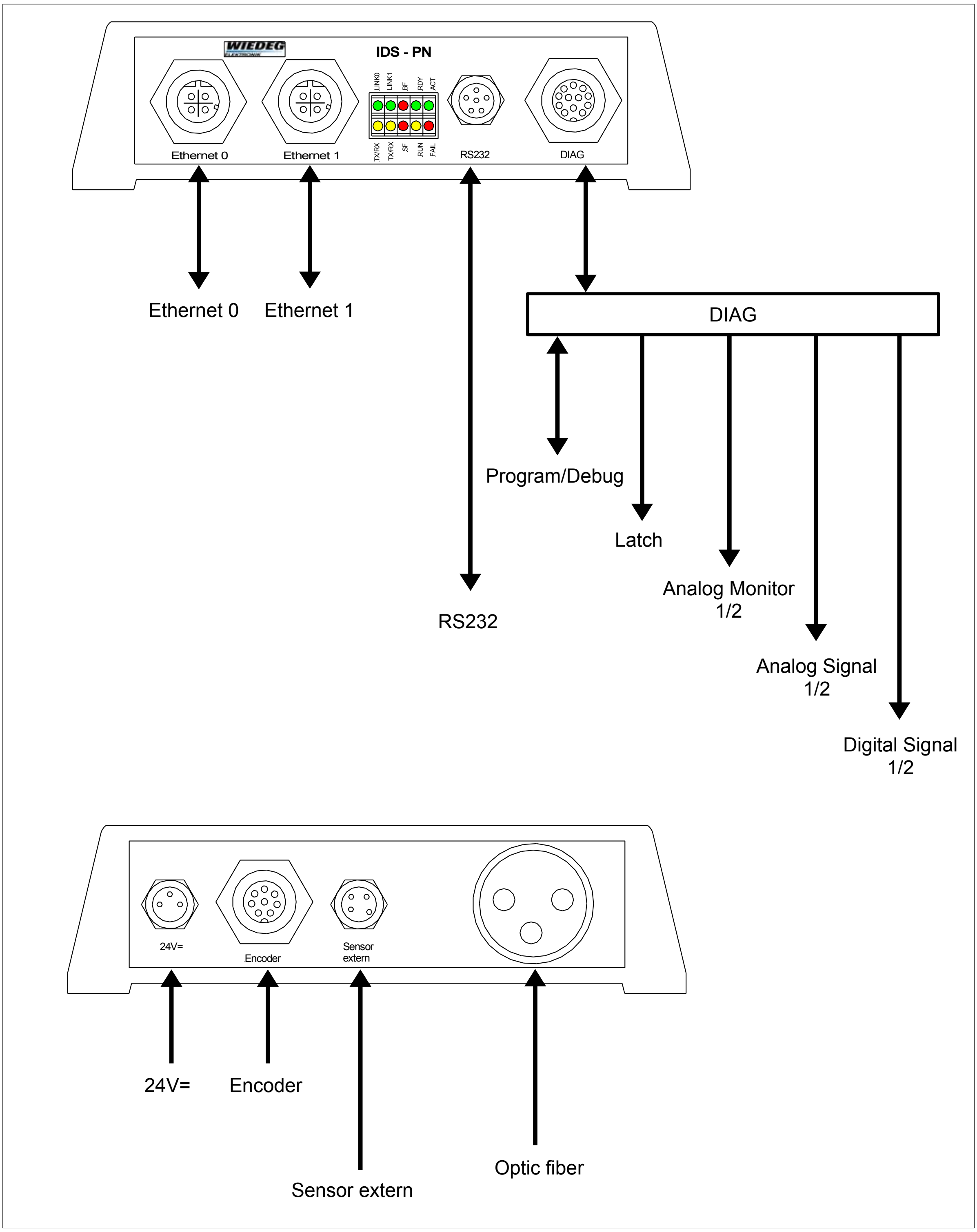


Figure 2.1: Hardware overview IDS-PN

2.2 Interfaces



2.3 Pin assignments

2.3.1 Ethernet 0/1

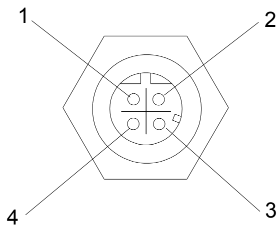
	Pin	Assignment
M12, 4-pin, D-coded, female 	1	Tx +
	2	Rx +
	3	Tx -
	4	Rx -

Table 2: Pin assignment Ethernet

2.3.1.1 Connection cable PROFINET

The connection between I/O Controller (SIMOTION) and IDS-PN has to be established through a standard PROFINET cable (e.g. Phoenix Contact VS-M12MSD-RJ45-933-B). All further IDS-PN have also to be connected by a standard PROFINET cable (e.g. Phoenix Contact SAC-4P-M12MSD).

2.3.2 DIAG

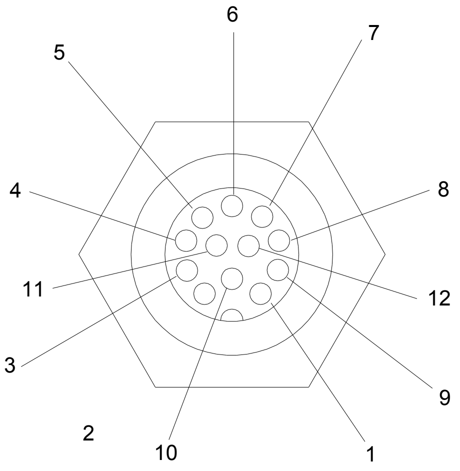
	Pin	Assignment
M12, 12-pin, A-coded, female 	1	PGC (Program/Debug)
	2	/MCLR (Program/Debug)
	3	3V3 (Program/Debug)
	4	Latch
	5	GND
	6	M_SD1, Sensor 1 input signal digital (TTL 5V)
	7	V_A2, Analog Monitor channel 2 (±10V DC)
	8	M_SD2, Sensor 2 input signal digital (TTL 5V)
	9	PGD (Program/Debug)
	10	V_A1, Analog Monitor channel 1 (±10V DC)
	11	M_SSE2, Sensor 2 input signal analog (0...6,6V DC)
	12	M_SSE1, Sensor 1 input signal analog (0...6,6V DC)

Table 3: Pin assignment DIAG

2.3.3 RS232

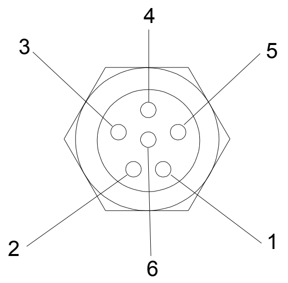
	Pin	Assignment
M8, 6-pin, female 	1	-
	2	RXD
	3	TXD
	4	GND
	5	-
	6	-

Table 4: Pin assignment RS232

2.3.4 24V DC

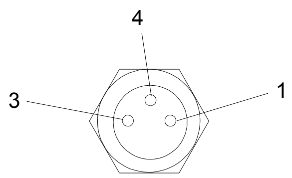
	Pin	Assignment
M8, 3-pin, female 	1	GND
	3	+24V
	4	-

Table 5: Pin assignment 24V DC

2.3.4.1 Power supply IDS

For the 24V DC power supply of the IDS a shielded ready-to-use cable is available:

Notation	Order-No. / Design-No.	Length
IDS B/W 24V DC Cable	6AU1671-0LD00-1AC0 / 1452934	2,0 m

2.3.5 Encoder

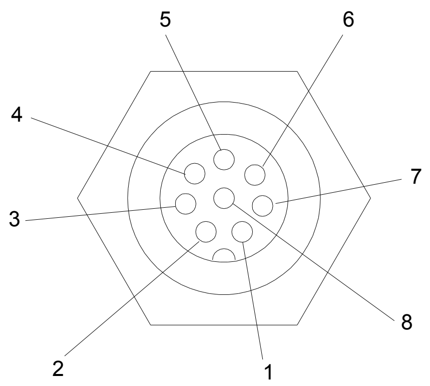
	Pin	Assignment
M12, 8-pin, A-coded, female 	1	GND
	2	GND
	3	+5V output voltage supply
	4	+5V output voltage supply
	5	/UB
	6	UB
	7	/UA
	8	UA

Table 6: Pin assignment Encoder

2.3.6 Sensor extern

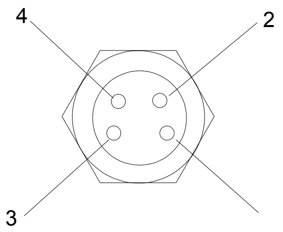
	Pin	Assignment
M8, 4-pin, female 	1	GND
	2	+12V DC output voltage supply
	3	IS, input sensor current signal (analog) max. 30 mA
	4	1-wire Software UART, unidirectional, master, TTL 3,3 V, signal active low, transfer rate 2 kBit/s

Table 7: Pin assignment Sensor extern

2.3.6.1 Connection cable IDS-DS

To connect a second analog sensor (DS) to the IDS-PN two shielded ready-to-use cables of different length are available:

Notation	Order-No. / Design-No.	Length
B/W IDS-DS Cable 0,5m	6AU1671-0KD00-1AA5 / 1452935	0,5 m
B/W IDS-DS Cable 10m	6AU1671-0KD00-1BA0 / 1452936	10,0 m

2.4 Electrical Grounding

At the bottom side of the IDS-PN two aluminum mounting bars are attached to provide an extensive electrical grounding (s. fig. 2.3).

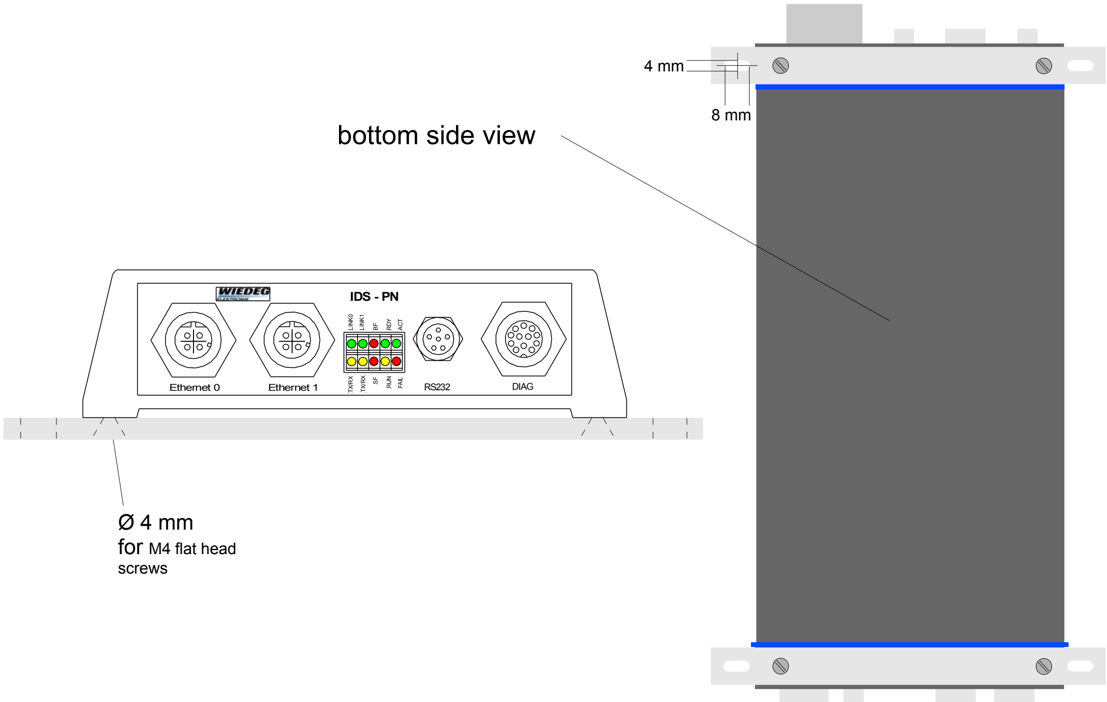


Figure 2.3: Mounting bars IDS-PN

The devices have to be mounted conductive on an extensive electrical grounded surface or grounded by a compensating line (cable cross-section ≥ 10 mm²) as pictured in fig. 2.4.

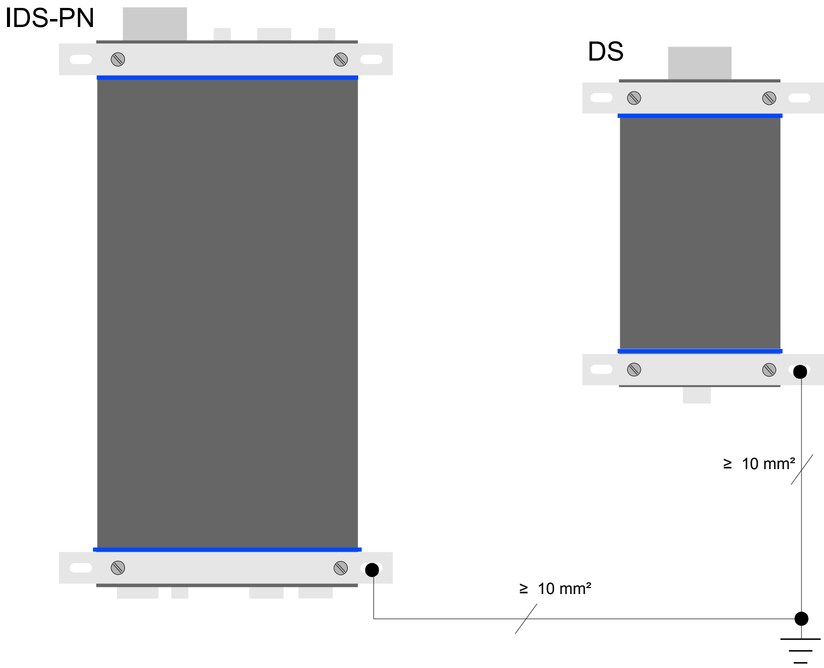


Figure 2.4: Electrical grounding IDS-PN and DS

2.5 Diagnosis LED

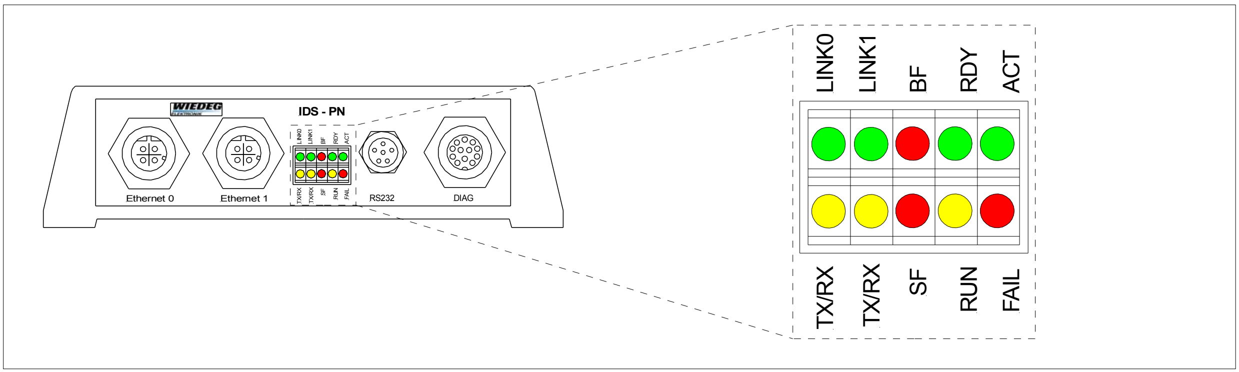


Figure 2.5: Diagnosis LED

The state of the LED ACT (Activity) and FAIL display the current operating mode of the PIC32 Processor resp. it´s Firmware.

ACT (green)	FAIL (red)	Device state
On	On	Firmware (PIC32) started, initializing components
On	Off	Device initialized and ready to operate
Blinking 1)	Off	Cyclic communication and data transfer active
Blinking 1)	Blinking 2)	no C-LS or Timeout I/O data
Off	Blinking 2)	no SYNC-Signal
Off	Off	Reset / Power Off

Table 8: LED ACT/FAIL

1) Frequency f = 1/ T_{DC}
   Examples:
   T_{DC} = 1 ms => f = 1 Hz
   T_{DC} = 4 ms => f = 0,25 Hz
   including T_{DC} = Controller Data Cycle time

2) Frequency: f = 2 Hz

The state of the LED SF and BF are defined through PROFINET and set by the communication chip [4].

SF (red)	Description
On	collective / system error Possible causes: • cable disconnected • wrong port (Controller) • Device used before → Restore Factory Settings and Power-Off to correct • no communication between Controller and Device, possibly configuration error (Controller)
Off	No fault present
Blinking	DCP Signal Service started (LED blinking with 2 Hz for 3 Seconds)

Table 9: LED SF

BF (red)	Description
On	Bus error, not connected
Off	No fault present
Blinking	Connection established, no data transfer with controller

Table 10: LED BF

Tx/Rx 0/1 (yellow)	LINK 0/1 (green)	Description
Flickering	On	Data transfer
-	On	Connected
Off	On	No data transfer
Off	Off	Power off or disconnected

Table 11: LED Tx/Rx

The LED RUN and RDY display the current operating mode of the netX50 communication chip resp. the firmware.

RUN (ge)	description
On	netX in Bootloader Mode, error
Blinking	netX in Bootloader Mode, ready for Firmware Download, f = 1 Hz
Off	Normal operation or Power off

Table 12: LED RUN

RDY (gn)	Description
On	netX OS running, Firmware started
Off	Power off

Table 13: LED RDY

3 I/O-Device

3.1 I/O Data

3.1.1 Controller → IDS

Slot	Subslot	Name	Bytes	Description
1	2	Control word 1	2	S. Table 15
1	2	Control word 2	2	S. Table 16
1	2	Position	4	Print cylinder, rotatory position [mm] (s. 3.1.1.13)
1	2	Speed	4	Print cylinder, speed [mm/s] (s. 3.1.1.13)
1	2	Acceleration	4	Print cylinder, acceleration [mm/s²] (s. 3.1.1.13)
1	2	Correction Offset LR	4	Print cylinder, correction length register [mm] (s. 3.1.1.14)
1	2	Correction Offset SR	4	Print cylinder, correction side register [mm] (s. 3.1.1.14)

Table 14: I/O Data Controller → IDS

3.1.1.1 Bit assignment Control Word 1

All control bits in Control Word 1 are considered to be active 'high'.

Bit	Assignment
0...6	Reserved for PROFIdrive
7	Fault Acknowledge (PROFIdrive)
8...9	Reserved for PROFIdrive
10	Control by PLC (PROFIdrive)
11	Reserved
12	Read DO 1
13	Read DO 2
14	Read AO 1
15	Read AO 2

Table 15: Control Word 1

3.1.1.2 Fault acknowledge

A positive edge of bit “Fault Acknowledge” will delete the fault message buffer and reset the bit “Fault present” in Status Word 1 of the I/O data (s. 3.1.2.3).

- 'low' → 'high': fault acknowledge

3.1.1.3 Control by PLC

This bit is set to 'high' after the connection is fully established and valid setpoint values are transmitted from the Controller to the IDS.

Only if “Control by PLC” is set to 'high' the I/O data will be evaluated in the IDS. Otherwise the last valid data will be kept.

3.1.1.4 Read DO/AO 1/2

The size of data packages of the Analog Oscilloscope (AO) and Digital Oscilloscope (DO) can reach up to 800 bytes.

To achieve data consistency during the Controller´s read access bits 12...15 of Control Word 1 are provided as handshakes.

If bit “Oscilloscope data ready” in Status Word 1 is set to 'high', new data is available from the IDS (s. 3.1.2.4).

The handshake bit in Control Word 1 has to remain 'high' as long as the controller reads the corresponding AO´s/DO´s data package (s. Fig. 3.1).

As soon as one of the handshake-bits in Control Word 1 is set to 'high', “Oscilloscope Data Ready” is reset to 'low'.

Figure 3.1: Application flow read AO/DO data

3.1.1.5 Bit assignment Control Word 2

All control bits in Control Word 2 are considered to be active 'high'.

Bit	Description
0	Initialize PM Detection
1	Manual Gate Setting
2	Gate Enable (only active if bit “Manual Gate Setting” = 'high')
3	reserved
4	AGS Start
5	Sensor Select
6	LR Control (I/O Controller)
7	SR Control (I/O Controller)
8	Manual Adjust SR
9...11	reserved
12...15	C-LS (Sign-Of-Life counter I/O Controller)

Table 16: Control Word 2

3.1.1.6 Control bit “Initialize PM Detection“

If the IDS recognizes a positive edge of bit “Initialize PM Detection”, the detection process is initialized with the actual parameter setting.

- 'low' → 'high': initialize print mark detection

Acyclic writing command identifier 2000 to parameter P1 (commands) has the same effect.

3.1.1.7 Control bits “Manual Gate Setting“ and “Gate Enable“

For special purposes the gate may be set manually and remain set if, for example, only one print mark is detected on the cylinder circumference and only the position is needed.

To activate manual gate setting the bit “Manual Gate Setting” has to be set to 'high'.

- 'low': Normal operation
- 'high': Manual Gate Setting

The control bit “Gate Enable” directly enables/disables the print mark detection.

- 'low': disabled
- 'high': enabled

INFO:
During this operation mode only position and width of the detected print mark are transmitted to the I/O Controller.

Deviation LR and SR are only detected in normal operation mode and set to 0 with Manual Gate Setting being activated.

Half the cylinder circumference is used as display reference position, so that the AO/DO are displayed between 0 and max. position (s. 4.2.10.2).

Offset and Threshold for print mark detection have to be set manually (like “Sensor Automatic” off), because the Gate Setting and all connected functions are overridden in this operation mode.

The following functions are not available with Manual Gate Setting:

- Auto Gate Setting
- Web-Web(-2) (only Web-Cylinder available)
- Mackle Detection
- Sensor Automatic
- Detection of Deviation LR/SR

Only Print Mark Type and Sensor Select are relevant from the Configuration word (P2).

3.1.1.8 Control bit “AGS Start“

Through a rising edge of bit „AGS Start“ the Auto Gate Setting is activated and running.

- 'low' → 'high': AGS start

Bit “AGS Active” is set to 'high' as long as the AGS is running.

Writing command 2012 to parameter P1 also starts the AGS.

3.1.1.9 Control bit “Sensor Select“

Bit “Sensor Select” switches between the integrated print mark sensor (Sensor 1) and the external analog print mark sensor (Sensor 2).

- 'low': Sensor 1
- 'high': Sensor 2

This can be used for switching to backside detection and is also necessary for Web-Web-2.

Switching to Sensor 2 without a DS connected to the IDS will cause an error message.

The control bit and the configuration bit “Sensor Select” (P2) are related in conjunction (OR).

3.1.1.10 Control bits “LR/SR Control”

These bits are set by the I/O Controller if Length and/or Side Register Control is activated.
Currently there is no specific functionality connected, but it could be necessary in the future for certain operation modes.

3.1.1.11 Control bit “Manual Adjust SR“

If the bit “Manual Adjust SR” is set to 'high' during a manual correction of the side register by moving the print cylinder in axial direction, the detection of the print mark width is disabled.

A reset to 'low' initializes the detection again and correction offsets are reset (depending on the measuring mode).

- 'high': disable detection of print mark width
- 'high' → 'low': initialize/start detection of print mark width

3.1.1.12 Sign-Of-Life Counter I/O Controller (C-LS)

The 4-bit C-LS counter within bits 12...15 of Control Word 2 is used as communication watchdog.

A detailed description of the Life-Sign mechanism resides in the PROFIdrive device profile description [1].

3.1.1.13 Rotatory position, speed and acceleration

These values display the actual state of movement of the print cylinder drive and are necessary for the print mark detection, especially gate setting and DO.

> **Reference note:**
> The rotatory position, speed and acceleration have to be the actual values of the specific print cylinder. Print mark detection and all position values refer to the print cylinder only, which is important in Web-Cylinder mode especially.

Generally, position and speed have to be of positive prefix, independent of the drive´s turning direction.

Correction Offsets and acceleration must have prefixes appropriate to the drive direction resp. the web direction.

The rotatory position of the print cylinder is necessary for gate setting and print mark detection, speed and acceleration are mainly used for detecting the print mark width.

> **INFO:**
> Generally positions for the IDS have to reside between 0 and print cylinder circumference, starting with 0 and rising.

3.1.1.14 Correction Offset LR/SR

The correction offsets can be used for (fine) correction of LR/SR (refer to 4.5.1).

The prefixes of the offset are set by the I/O Controller according to the direction of the deviation.

The offsets have to be reset by the I/O Controller only, as the IDS cannot provide this.

3.1.2 IDS → Controller

Slot	Subslot	Name	Bytes	Description
1	2	Status word 1	2	S. Tab. 18
1	2	Status word 2	2	S. Tab. 19
1	2	Deviation LR	4	Deviation length register [mm] (s. 3.1.2.14)
1	2	Deviation SR	4	Deviation side register [mm], axial adjustment way (s. 3.1.2.14)
1	2	MPM Position	4	Position master print mark [mm] (s. 3.1.2.14)
1	2	MPM Width	4	Width master print mark [mm] (s. 3.1.2.14)
1	3	ENC Position	4	Encoder Input Counter (s. 3.1.2.15)

Table 17: I/O data IDS → Controller

3.1.2.1 Bit assignment Status Word 1

All control bits in Status Word 1 are considered to be active 'high'.

Bit	Description
0	Ready to switch on (PROFIdrive)
1	Ready to operate (PROFIdrive)
2	reserved (PROFIdrive)
3	Fault Present
4...8	reserved (PROFIdrive)
9	Control requested / No control requested
10	reserved (PROFIdrive)
11...14	reserved
15	Oscilloscope data ready

Table 18: Status word 1

3.1.2.2 Status bits „Ready to switch on“, „Ready to operate“ and „Control requested“

If the IDS firmware is initialized and running as well as connected to the communication chip, all three status bits are set to 'high' for there is no need too differentiate between these states in the IDS.

The bits “Ready to switch on“ and “Ready to operate“ are only implemented due to PROFIdrive conformity reasons.

3.1.2.3 Status bit “Fault Present“

The status bit “Fault present“ (PROFIdrive) is set to 'high' by the IDS as soon as an error message is written in the fault buffer (refer to 3.2.3.4).

If the control bit “Fault Acknowledge” is set to 'high' by the I/O Controller “Fault Present” will be reset to 'low'.

- 'low': no fault
- 'high': fault present

3.1.2.4 Status bit „Oscilloscope Data Ready“

The status bit is set by the IDS as soon as new oscilloscope data is available (time out elapsed resp. completed turn of the print cylinder).

If at this instant one of the AO/DO data packages is read by the I/O Controller (refer to 3.1.1.4), only the remaining AO/DO data is refreshed. The status bit “Oscilloscope data ready” is not set until the read access is finished see Fig. 3.2).

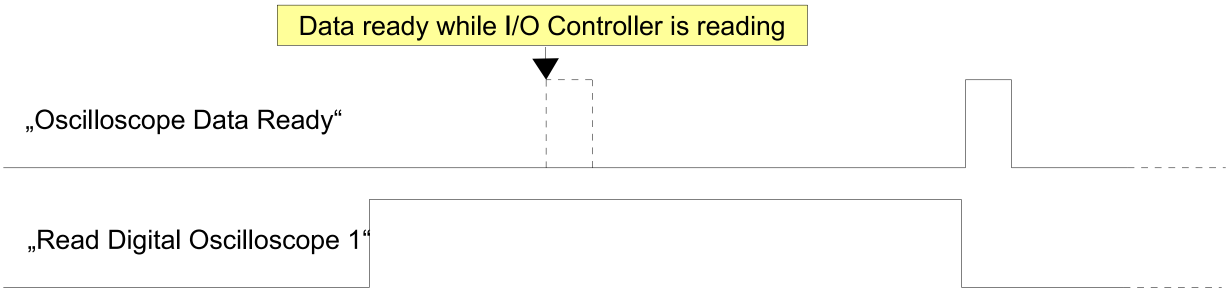


Figure 3.2: Time lapse of “Oscilloscope data ready”

3.1.2.5 Bit assignment Status Word 2

All control bits in Status Word 2 are considered to be active 'high'.

Bit	Description
0...1	reserved
2	Adjustment Finished
3	Travel Measuring Finished
4	Alarm PM Position
5	Alarm PM Width
6	Gate Setting Active
7	AGS Active
8...11	PM Counter
12...15	DO-LS (Sign-Of-Life Counter I/O Device)

Table 19: Status Word 2

3.1.2.6 Status bit “Adjustment Finished”

The status bit “Adjustment Finished” is set to 'high' after a successful adjustment (s. 5.1).

Only at the start of a new adjustment the bit is set to low.

The bit is always set to low after Power Up / Reset.

3.1.2.7 Status bit “Travel Measuring Finished“

The status bit “Travel Measuring Finished” is set to 'high' after successful travel measuring.
It is only affected in operation mode “Sensor Automatic” (refer to 4.2.5).

INFO:
With Sensor Automatic deactivated the status bit always remains 'low'.

3.1.2.8 Status bit “Alarm PM Position“

The Alarm Bit “Alarm PM Position“ is set to 'high' under these conditions:

- no (valid) PM detected within the gate for the last three print cylinder turns, which means
  - PM position not valid (out of gate)
  - no PM detected within the gate
- Too many active signal edges (DO) within the gate
  (only when “Mackle Detection” is activated, refer to 4.2.7)

As soon as a valid PM position and a valid number of active edges are detected within the corresponding gate, the status bit is reset to 'low'.

3.1.2.9 Status bit “Alarm PM Width“

The status bit „Alarm PM Width“ is set to 'high' under these conditions:

- no valid PM width for three print cylinder turns, which means the width exceeds minimum/maximum width limit (refer to 4.2.2)
- “Alarm PM Position” set to 'high' (refer to 3.1.2.8)

As soon as a valid PM width is detected within the corresponding gate and the bit “Alarm PM Position” is 'low', the status bit “Alarm PM Width” also is reset to 'low'.

3.1.2.10 Status bit “Gate Setting Active“

The status bit “Gate Setting Active“ is set to 'high' under these conditions:

- Command “Shift Gate Position” has been sent by the I/O Controller (P1 = 2010)
- Command “Set Gate Position” has been sent by the I/O Controller (P1 = 2011)
  (only Web-Web and Web-Web-2)
- The gate is set automatically after successful AGS (analog to “Shift Gate Position”)

The bit is reset to 'low' if at least three valid PM positions are detected. If no PM are detected at the new gate position the bit remains 'high' until a PM is detected.

3.1.2.11 Status bit “AGS Active“

The status bit “AGS Active” is set to 'high' if the AGS is started by the I/O Controller (refer to 4.4.4).

The bit is reset to 'low' under these conditions:

- AGS block mark detected
- No AGS block mark detected after three print cylinder turns
- Maximum/minimum speed limit exceeded or stand still of the print cylinder

3.1.2.12 PM Counter

The status bits 8...11 contain the 4 least significant bits (LSB) of the IDS´ print mark counter (P217).
Only with a change of the PM counter new values (deviations, etc.) are available from the print mark detection.

3.1.2.13 Sign-Of-Life Counter I/O Device (DO-LS)

The status bits 12...15 contain the DO-LS of the IDS which is used for the communication watchdog of the I/O Controller.

A detailed description of the Life-Sign mechanism resides in the PROFIdrive device profile description [1].

3.1.2.14 Deviation LR/SR, MPM Position and Width

The Deviation LR/SR is calculated of the last detected print mark(s) depending on the measuring mode (refer to 4.2.8). The Deviation SR is equivalent to the axial deviation of the print mark.

MPM Position and Width are of the last detected Master PM.

3.1.2.15 ENC Position

ENC Position results from the detected signal of the Encoder input of the IDS (refer to 2.3.5).
The data format is a signed 32-bit Integer (min./max. Value ± 2.147.483.648).

The value can be used for example as encoder for a side register actuator.

INFO:
The value of ENC Position is refreshed every I/O cycle.

3.2 Parameter Read/Write

3.2.1 Description

The configuration of the IDS is carried out through the acyclic services of PROFINET I/O “Write Record“ and “Read Record“ following the „Base Mode Parameter Access“ of the PROFIdrive Device Profile [1].

The maximum data length for parameter access is 1024 Byte (max. value for data packages of the netX50).

Parameters are not stored permanently in the IDS, except the station name (PROFINET), the counter of operation hours and of course the fault buffer. The IDS has to be configured after start up.

A more detailed description of the acyclic data transfer can be found in the IDS reference manual [3].

3.2.2 Data types

Table 20 contains all supported data types of the IDS.

A detailed description of the single data types is located in the Profile Data Guideline [2] of the PNO (PROFINET Organization).

Code (hex)	Data type according to IEC 61158	Number of bytes
2 (0x02)	Integer8	1
3 (0x03)	Integer16	2
4 (0x04)	Integer32	4
5 (0x05)	Unsigned8	1
6 (0x06)	Unsigned16	2
7 (0x07)	Unsigned32	4
8 (0x08)	Float32	4
65 (0x41)	Byte	1
66 (0x42)	Word	2
67 (0x43)	Double Word	4
10 (0x0A)	OctetString	1
53 (0x35)	TimeDifference with date indication	6

Table 20: IDS supported data types

3.2.3 Parameter Table (compendium)

Table 21 contains the parameters for operation and configuration of the IDS, all of the IDS parameters are described in the IDS-PN Reference Manual [3].

Parameters P1...P46 are used for the configuration of the IDS, parameters above P100 contain the actual values of the processes and are read only.

Parameter						
PNU [11)]	**DT [1)]**	**ID [10)]**	**Description**	**n [2)]**	**Value//unit [3)]**	**AP [4)]**
1	3	DMPE_BEF	Command (4.1)	1	2000	R/W
2	4	DMPE_KFG	Configuration (4.2)	1	0x00000030	R/W
3	3	DMSE_ZYKL	AO/DO detection refresh cycle (3.2.3.2 resp. 3.2.3.3)	1	500 ms	R/W
4	7	NVM_SKFG	Data set selection / fiber optic length [12)] (s.)	1	00000000h	R/W
10	8	DMPE_UDZ	Print cylinder circumference	1	400.000 mm	R/W
11	8	DMPE_ADM	Set point PM distance, Web-Web/Web-Web-2 (4.2.8.3)	1	20.000 mm	R/W
12	8	DMPE_TOB	Gate width (4.4)	1	12.000 mm	R/W
13	8	DMPE_TOW	Gate shift offset (4.4.2)	1	0.000 mm	R/W
14	8	DMPE_TOP	Gate position (4.4.3)	1	0.000 mm	R/W
15	8	DMPE_RVL	Correction offset length register (4.5.2)	1	0.000 mm	R/W
16	8	DMPE_RVS	Correction offset side register (4.5.2)	1	0.000 mm	R/W
17	8	DMPE_SSW	Sensor threshold (4.3.5.1)	1	0.350 V	R/W
18	8	DMPE_SSW2	Sensor 2. threshold(4.3.5.1)	1	0.350 V	R/W
19	8	DMPE_SOF	Sensor offset(4.3.5.1)	1	2.500 V	R/W
20	8	DMPE_SVK	Sensor dead time compensation [$\frac{\mu m}{m/s}$ = µs]	1	0.000 µs	R/W
21	8	DMPE_S2SW	2. Sensor threshold(4.3.5.1)	1	0.350 V	R/W
22	8	DMPE_S2SW2	2. Sensor 2. threshold(4.3.5.1)	1	0.350 V	R/W
23	8	DMPE_S2OF	2. Sensor offset(4.3.5.1)	1	2.500 V	R/W
24	8	DMPE_BB	PM width, block mark (4.2.2.1)	1	3.000 mm	R/W
25	8	DMPE_BKMIN	PM width, key mark, minimum (4.2.2.2)	1	0.000 mm	R/W
26	8	DMPE_BKMAX	PM width, key mark, maximum (4.2.2.2)	1	6.000 mm	R/W
27	8	DMPE_LK	PM edge length, key mark (4.2.2.2)	1	10.000 mm	R/W
28	8	DMPE_BDKMIN	PM width, double key mark, minimum (4.2.2.3)	1	0.000 mm	R/W
29	8	DMPE_BDKMAX	PM width, double key mark, maximum (4.2.2.3)	1	6.000 mm	R/W
30	8	DMPE_BDKMK	Mid-Width of the 1st key mark (double key) (4.2.2.3)	1	3.000 mm	R/W
31	8	DMPE_BDKG	Overall width of the double key mark (4.2.2.3)	1	9.000 mm	R/W

Parameter						
PNU 11)	**DT 1)**	**ID 10)**	**Description**	**n 2)**	**Value//unit 3)**	**AP 4)**
32	8	DMPE_LDK	PM edge length, double key mark (4.2.2.3)	1	10.000 mm	R/W
33	8	DMPE_BDBMIN	PM width, double block mark, minimum (4.2.2.4)	1	7.000 mm	R/W
34	8	DMPE_BDBMAX	PM width, double block mark, maximum (4.2.2.4)	1	13.000 mm	R/W
35	8	DMPE_BDBG	Width of straight mark, double block mark (4.2.2.4)	1	3.000 mm	R/W
36	8	DMPE_BDBS	Width of slant mark, double block mark (4.2.2.4)	1	3.000 mm	R/W
37	8	DMPE_LDB	PM edge length, double block mark (4.2.2.4)	1	10.000 mm	R/W
38	8	DMPE_AAR	Distance between AGS mark and MPM (4.4.4.2)	1	20.000 mm	R/W
39	8	DMPE_AGST	Tolerance AGS detection (4.4.4.2)	1	1.500 mm	R/W
40	8	DMPE_AB1	Width 1. block AGS mark (4.4.4.2)	1	9.000 mm	R/W
41	8	DMPE_AB2	Width 2. block AGS mark (4.4.4.2)	1	3.000 mm	R/W
42	8	DMPE_AB3	Width 3. block AGS mark (4.4.4.2)	1	6.000 mm	R/W
43	8	DMPE_AS1	Width 1. gap AGS mark (4.4.4.2)	1	3.000 mm	R/W
44	8	DMPE_AS2	Width 2. gap AGS mark (4.4.4.2)	1	3.000 mm	R/W
45	8	DMPE_MTS	Travel measuring, min. trigger -voltage (4.2.5)	1	0.200 V	R/W
46	8	DMPE_MUS	Travel measuring, max. web voltage variation (4.2.5)	1	0.200 V	R/W
47	8	DMPE_USAS1	Calibration setpoint voltage (Sensor 1) [V] (s.)	1	2.70 V	R/W
48	8	DMPE_USAS2	Calibration setpoint voltage (Sensor 2) [V] (s.)	1	2.70 V	R/W
122	53	IDS_BZ	Operation hour counter 8)	1	0x000C2F21	R/W
150	7	NVM_SKFG	Actual data set selection / fiber optic length (P4)	1	00000000h	R
200	7	DMPE_KFG	Configuration (P2)	1	0x00000000	R
204	8	DMPE_DMPS	PM set point position	1	234.100 mm	R
205	8	DMPE_DMPI	PM actual position (Web-Cylinder)	1	234.069 mm	R
206	8	DMPE_DMPIR	Master PM actual position (Web-Web/Web-Web-2))	1	0.000 mm	R
207	8	DMPE_DMPIE	Slave PM actual position (Web-Web/Web-Web-2))	1	0.000 mm	R
208	8	DMPE_DMABS	Soll-Abstand EDM zu RDM (BB/BB2)	1	0.000 mm	R
209	8	DMPE_DMABI	Actual distance between MPM and SPM	1	20.123 mm	R
211	8	DMPE_DWRV	Correction offset LR	1	0.010 mm	R
214	8	DMPE_DMPSA	Display set point position (4.2.10)	1	0.000 mm	R
215	8	DMPE_DMPT	Gate position at gate setting Web-Cylinder: MPM, Web-Web(-2): SPM	1	233.000 mm	R
216	8	DMPE_DMPTR	Gate position MPM at gate setting Web-Web(-2)	1	0.000 mm	R
223	8	DMPE_DMBR	PM width maximum value (depends on P2, PM type)	1	6.000 mm	R
224	8	DMPE_DMBM	PM width minimum value (depends on P2, PM type)	1	0.000 mm	R

Parameter						
PNU [11]	**DT [1]**	**ID [10]**	**Description**	**n [2]**	**Value//unit [3]**	**AP [4]**
226	8	DMPE_DMF	Slope factor S, Δb <-> Δs (s. 4.5.4)	1	1.670	R
228	8	DMPE_DSB	PM width, set point value (Web-Cylinder)	1	3.230 mm	R
229	8	DMPE_DIB	PM width, actual value (Web-Cylinder)	1	3.198 mm	R
230	8	DMPE_DIBR	PM width actual value RDM (Web-Web/Web-Web-2)	1	0.000 mm	R
231	8	DMPE_DIBE	PM width actual value EDM (Web-Web/Web-Web-2)	1	0.000 mm	R
232	8	DMPE_DDB	PM width register deviation	1	0.032 mm	R
233	8	DMPE_RVBS	Correction offset SR, axial (s. 4.5.4)	1	0.072 mm	R
234	8	DMPE_RVBO	Correction offset SR	1	0.120 mm	R
257	8	DMPE_POSH	AGS end position of the block mark	1	213.000 mm	R
276	8	DMPE_DMRV	Correction offset LR	1	-0.123 mm	R
278	8	DMPE_SOF	Sensor offset	1	2.5 V	R
279	8	DMPE_SOF2	Sensor 2. offset	1	2.5 V	R
280	8	DMPE_SSW	Sensor threshold	1	0.35 V	R
281	8	DMPE_SSW2	Sensor 2. threshold	1	0.35 V	R
282	8	DMPE_S2OF	2. Sensor offset	1	2.5 V	R
283	8	DMPE_S2OF2	2. Sensor 2. offset	1	2.5 V	R
284	8	DMPE_S2SW	2. Sensor threshold	1	0.35 V	R
285	8	DMPE_S2SW2	2. Sensor 2. threshold	1	0.35 V	R
298	8	DMPE_AGSVM	AGS minimum speed	1	40.05 mm/s	R
305	8	DWIO_RVL	I/O offset register correction LR	1	0.000 mm	R
306	8	DWIO_RVS	I/O offset register correction SR	1	0.000 mm	R
312	8	DMIO_DMPD	I/O register deviation LR	1	0.000 mm	R
600	3	DMSE_DO1	Digital Oscilloscope 1. Sensor	400	s. 3.2.3.2	R
601	3	DMSE_DO2	Digital Oscilloscope 2. Sensor	400	s. 3.2.3.2	R
602	5	DMSE_AO1	Analog Oscilloscope 1. Sensor	800	s. 3.2.3.3	R
603	5	DMSE_AO2	Analog Oscilloscope 2. Sensor	800	s. 3.2.3.3	R
847	8	DMPE_USAS1	Actual calibration setpoint voltage (Sensor 1, P47)	1	2.70 V	R
848	8	DMPE_USAS2	Actual calibration setpoint voltage (Sensor 2, P48)	1	2.70 V	R
944	6	PN_FZ	Fault message counter [8]	1	0	R
947	6	PN_FNR	Fault number [8]	8	-	R
948	53	PN_FST	Fault time [8]	8	-	R

Table 21: IDS Parameter compendium

Footnotes to table 21 see page 29.

Footnotes to table 21:

1) DT: data type according to IEC 61158-5, s. Tab. 20
2) Number of elements, if the specific parameter is an array with more than 1 element
3) P1...P46 are displayed with their default values (start up or after “Reset Factory Settings”), parameters above P100 are displayed with example values.
4) Access permission: R = Read, W = Write
8) Permanent storage in the IDS flash memory (power off / reset)
10) This ID can be used alternative to the PNU when sending commands via Terminal (RS232)
11) PNU: Parameter number

3.2.3.1 Limit values P1...P3, P10...P46

PNU	Minimum [1]	Maximum [1]	PNU	Minimum [1]	Maximum [1]
1	1	32767	28	0.0 mm	10.0 mm
2	-	-	29	0.0 mm	10.0 mm
3	100 ms	10000 ms	30	0.0 mm	10.0 mm
4	-	-	31	0.0 mm	30.0 mm
10	10.0 mm	2000.0 mm	32	0.0 mm	20.0 mm
11	10.0 mm	2000.0 mm	33	0.0 mm	10.0 mm
12	5.0 mm	50.0 mm	34	0.0 mm	30.0 mm
13	-2000.0 mm	2000.0 mm	35	0.0 mm	10.0 mm
14	0.0 mm	2000.0 mm	36	0.0 mm	10.0 mm
15	-2000.0 mm	2000.0 mm	37	0.0 mm	20.0 mm
16	-10.0 mm	10.0 mm	38	5.0 mm	2000.0 mm
17	-5.0 V	5.0 V	39	0.0 mm	3.0 mm
18	-5.0 V	5.0 V	40	0.0 mm	30.0 mm
19	0.0 V	5.0 V	41	0.0 mm	30.0 mm
20	-100.0 µs	100.0 µs	42	0.0 mm	30.0 mm
21	-5.0 V	5.0 V	43	0.0 mm	30.0 mm
22	-5.0 V	5.0 V	44	0.0 mm	30.0 mm
23	0.0 V	5.0 V	45	0.05 V	1.0 V
24	0.0 mm	10.0 mm	46	0.02 V	1.0 V
25	0.0 mm	10.0 mm	47	1.65 V	6.4 V
26	0.0 mm	10.0 mm	48	1.65 V	6.4 V
27	0.0 mm	20.0 mm	-	-	-

Table 22: Parameter limit values

1) Recommended limit values for operator input

3.2.3.2 Digital Oscilloscope (P600, P601)

The Digital Oscilloscope (DO) is an assistance to the operator for the setup of new print jobs or web materials and for the selection of the specific print marks (gate setting).

The DO is detected permanently without any activation necessary. Therefore the logic state of the digitized print mark signal is sampled with T = 0,5 ms and the angle of the positive/negative edge is stored in the data array.

The data packages of the DO are refreshed with a full turn of the print cylinder. At higher speeds new DO data is available with a constant refresh rate (P3, default: 500 ms).

The edge of the master print mark (if detected) is inserted at the appropriate place in the DO.

The DO data consists of a 400 value array (2 bytes per value) which can be read in P600 or P601 (Sensor 2).

INFO:
First and second index are different:
P600.0/P601.0 contains the number of detected edges (index 1 included).
P600.1/P601.1 contains the value +1 or -1 which is the logical state at the beginning of the new data package.

This way the basic signal state 'high' or 'low' can be displayed if print cylinder is in stand still.

The amount of DO data only depends on the number of detected edges, the remaining indexes are set to 0.

Rising/falling edges are stored with positive/negative prefix of the corresponding angle with a maximum resolution of 360° / 32767 = 0,011°.

Reference position for the DO is either the rotatory position 0 or the display set point position (see 4.2.10).

Example DO:

- 1 double key mark, no other edges
- reference is display set point position (P214), P2, Bit 16 = 'high'

Contents of data array (Parameter P600):

P600.0 = 5
P600.1 = -1
P600.2 = +16384
P600.3 = -16561
P600.4 = +16918
P600.5 = -17423
P600.6 = 0
...
P600.399 = 0

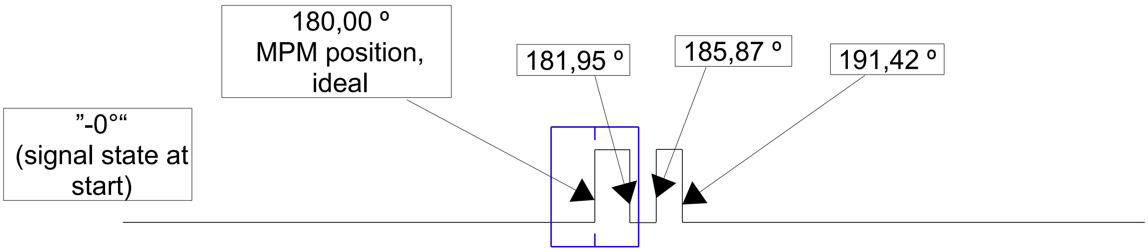


Figure 3.3: Simple DO example

3.2.3.3 Analog Oscilloscope (P602, P603)

The Analog Oscilloscope (AO) is an assistance to the operator for the setup of new print jobs or web materials and for the selection of the specific print marks (gate setting). The AO is detected permanently without any activation necessary.

Data packages of the AO are refreshed with a full turn of the print cylinder. At higher speed new AO data is available with a constant refresh rate (P3, default: 500 ms).

The input signal lies between 0 V and 6,6 V maximum and is converted by a 10 Bit ADC.

Sampled values are stored in an array of 800 bytes (768 samples and 2 bytes for number of values) with 8 bit per value (voltage) which is suitable for a voltage resolution of 25 mV.

Because of the fixed sample rate of 0,5 ms the AO may contain less than 800 values, for example at a speed of 450 m/min 160 values are stored per data package. If the AO contains less than 798 values, the remaining indexes are set to 0.

At a speed of 30 m/min theoretically 2400 values could be stored (cylinder circumference = 600 mm), but the circumference is divided in 798 segments so that the values are covering the whole area.

The AO is readable through P602 resp. P603 (Sensor 2) and uses the same reference value as the DO (s. 4.2.10).

Example of AO display:

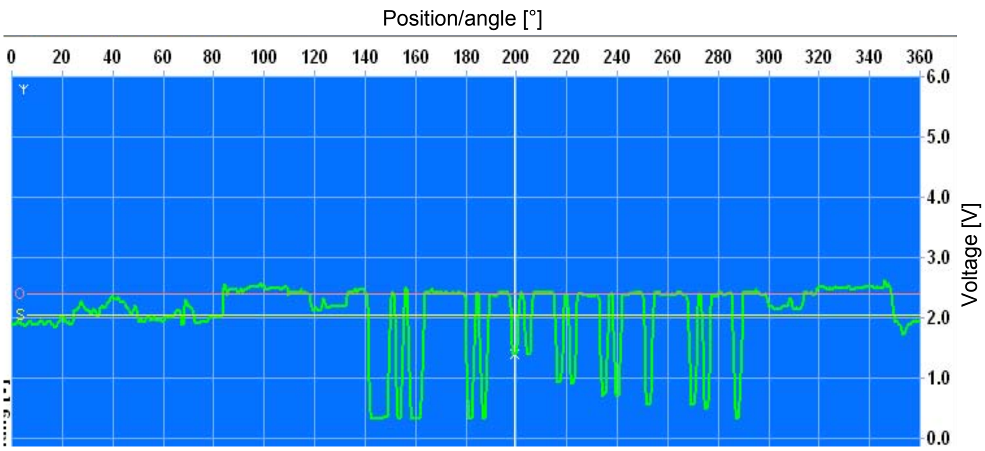


Figure 3.4: Display example AO

3.2.3.4 Fault buffer (P944, P947, P948)

The fault buffer contains up to 8 error messages (3.2.3.5) and is stored in the IDS flash memory protected from power fail or reset.

If more than 8 messages occur without acknowledge, the last message is overwritten, so that the first 7 messages are preserved.

An error message consists of fault number (P947) and the corresponding fault time (P948).

The fault message counter (P944) displays the number of messages and is incremented with each error message.

If one or more error messages are present , the bit “Fault Present” in Status Word 1 of the I/O data is set to 'high'.

The I/O Controller can acknowledge the fault(s) by setting bit “Fault Acknowledge” in Control Word 1 of the I/O data (see 3.1.1.2).

After acknowledge the error messages are erased but the fault message counter remains on it´s actual value so that the number of all occurred errors since first use resp. last reset to factory settings are displayed.

3.2.3.5 Fault buffer error codes

Error code	Description
Processor Exceptions	
0x0004 (4)	Address error (load or command call)
0x0005 (5)	Address error (store)
0x0006 (6)	Bus error (command call)
0x0007 (7)	Bus error (load or store)
0x0008 (8)	System call
0x000A (10)	Reserved instruction
0x000B (11)	Coprocessor unusable
0x000C (12)	Arithmetic overflow
0x000D (13)	Trap (e.g. division by 0)
Communication/ data transmission	
0x0103 (259)	R/W parameter command unknown
0x0104 (260)	R/W parameter command buffer overflow
0x0105 (261)	R/W parameter command system error
0x0106 (262)	I/O data loss of Controller life sign [3)]
0x0107 (263)	I/O data timeout [3)]
0x0108 (264)	I/O data read error netX [3)]
0x0109 (265)	I/O data write error netX [3)]

Error code	Description
Print mark detection / gate setting	
0x0200 (512)	AGS speed limit or standstill
0x0201 (513)	AGS block mark not detected
0x0202 (514)	Sensor 1 Sensor Automatic, error travel measurement
0x0203 (515)	Sensor 2 Sensor Automatic, error travel measurement
0x0204 (516)	Configuration error (P2): PM negative edge selection, predefined by PM type selection
Sensor / input voltage	
0x0300 (768)	Sensor 1 input voltage 0V [1)]
0x0301 (769)	Sensor 2 input voltage 0V [2)]
0x0302 (770)	Sensor 1 error Sensor Adjustment, limit value[4)]
0x0303 (771)	Sensor 2 error Sensor Adjustment, limit value [4)]
Data Memory	
0x0400 (1024)	CRC Error NVM Data load failed [5)]

Table 23: Error messages

1) Sensor 1 calibration error or defective electronics
2) Sensor 2 not connected (though selected), calibration error or defective electronics
3) LED “FAIL” (red) blinking
4) min./max. value of the digital voltage divider exceeded, set point could not be reached
5) Fatal error after CRC check of the NVM data (**N**on **V**olatile **M**emory). All data including Factory Settings (!) are lost, new Sensor Adjustments and, eventually, data recovery by the manufacturer might be necessary

4 Device functions

4.1 Commands (P1)

The I/O Controller transmits commands to the IDS through parameter P1 (1 command per parameter request).

Reference note:
If parameters are written without P1 containing a command, the remaining parameters are written nonetheless, but not taken over in the process.

Command (P1)	Affected parameter	Description
2000	-	Initialize print mark detection, take over all parameters
2001	P2	Take over configuration, e.g. PM type (s. 4.2)
2002	P17...P19	Take over Sensor 1 thresholds and offset (s. 4.3.5)
2003	P21...P23	Take over Sensor 2 thresholds and offset (s. 4.3.5)
2004	P20	Take over dead time compensation [$\frac{\mu m}{m/s}$ = µs]
2005	P24	Take over PM width block mark (s. 4.2.2.1)
2006	P25...P27	Take over key mark parameters (s. 4.2.2.2)
2007	P28...P32	Take over double key mark parameters (s. 4.2.2.3)
2008	P33...P37	Take over double block mark parameters (s. 4.2.2.4)
2009	P12	Take over gate width [mm], < 20 mm
2010	P13	Gate shift (s. 4.4.2)
2011	P14	Set gate position (s. 4.4.3)
2012	-	Start AGS (s. 4.4.4)
2013	P38	Take over distance between AGS mark and MPM [mm], ≥ 20 mm (s. 4.4.4.2)
2014	P40...P44	Take over AGS block mark parameters (s. 4.4.4.2)
2015	P39	Take over tolerance AGS detection [mm] (s. 4.4.4.2)
2016	P11	Take over set point distance between MPM ans SPM [mm], ≥ 20 mm, Web-Web or Web-Web-2 only
2017	P15	Take over correction offset length register [mm]
2018	P16	Take over correction offset side register [mm]
2019	P10	Take over print cylinder circumference [mm]
2020	P2	Change PM type (P2, Bits 4...7) (s. 4.2.1)
2021	P2	Change measuring mode (P2, Bits 12...13) (s. 4.2.1)
2022	-	Take over actual PM position as gate position, “Center Gate” (s. 4.4)

Command (P1)	Affected parameter	Description
2023	-	Take over actual PM width as new set point width
2024	P45,P46	Take over travel measuring limits (s. 4.2.5)
2025	-	Start travel measuring (s. 4.2.5)
2026	P11	Take over actual distance between MPM and SPM as new set point distance
2027	P47	Take over setpoint value for white adjustment (Sensor 1)
2028	P48	Take over setpoint value for white adjustment (Sensor 2)
4000	P3	Initialize signal detection, take over AO/DO refresh cycle (P3)
6004	-	Sensor 1 start automatic white adjustment
6005	-	Sensor 1 start automatic black adjustment
6010	P4	Selection data set fiber optic length, saved permanently [1)]
7004	-	Sensor 2 start automatic white adjustment
7005	-	Sensor 2 start automatic black adjustment
7777	-	DS Reset to Factory Settings (Sensor 2)
8888	-	Reset to Factory Settings
9999	-	Soft Reset

Table 24: IDS commands

1) P4 is only taken over by command 6010

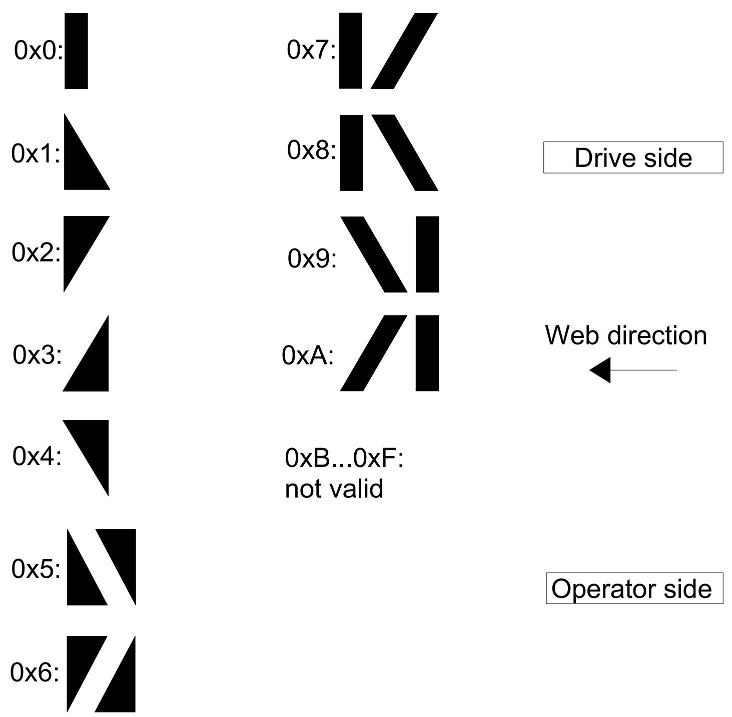
4.2 Configuration (P2)

The print mark detection is enabled for a specific part of the print cylinder, the so called gate. There are several possibilities to set the gate position to the corresponding print mark(s), “Set Gate Position”, “Gate Shift” and “Auto Gate Setting”.

The minimum distance between two print marks or other parts of the print for a proper detection, even at bigger deviations, is 20 mm (basic configuration). Detecting print marks including all additional functions is generally possible for a speed of up to 1000 m/min.

Several operation modes and types of print marks can be selected and have to be configured. Every functionality and it´s general use and/or configuration is described in the following chapters.

4.2.1 Overview

Configuration/operation mode (P2)		
Bit	**Function**	**Description**
0	-	reserved
1	PM active edge (s. 4.2.3)	0: front edge 1: rear edge
2	-	reserved
3	Sensor Select (s. 4.2.4)	0: Sensor 1 (IDS integrated) 1: Sensor 2 (optional, “Sensor extern”)
4...7	PM type (s. 4.2.2)	

Configuration/operation mode (P2)		
Bit	**Function**	**Description**
8	-	reserved
9	Sensor Automatic (s. 4.2.5)	1: on 0: off
10	Deviation limit (s. 4.2.6)	1: on 0: off
11	Mackle detection (s. 4.2.7)	1: on 0: off
12...13	Measuring mode (s. 4.2.8)	0: Web-Cylinder 1: Web-Web 2: Web-Web-2
14	Internal signal gain Sensor 1 (s. 4.2.9)	0: normal amplification $A = A_0$ 1: high amplification $A = 2\ A_0$
15	Internal signal gain Sensor 1 (s. 4.2.9)	0: normal amplification $A = A_0$ 1: high amplification $A = 2\ A_0$
16	AO/DO reference (s. 4.2.10)	0: print cylinder position 0 (0...360°) 1: display set point position P214 (180°)
17...31	-	reserved

Table 25: Configuration P2

4.2.2 Print Mark Type

All common print marks (PM) can be detected by the IDS.

At the setup of the PM type it is very important to think about the web direction and the alignment to the machine in general (operator/drive side). Fig. 4.1 shows these circumstances.

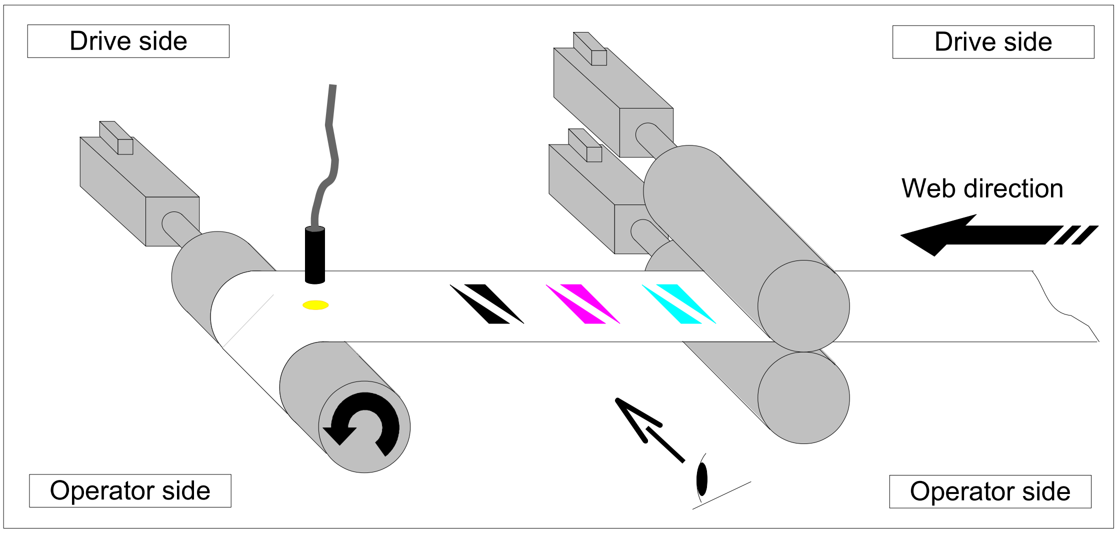


Figure 4.1: Overview PM type alignment

Several parameters (P24...P37) have to be configured to provide a proper measurement.

The minimum and maximum PM width (b_{min}, b_{max}) in web direction are calculated through these parameters for every PM type. They are used for validity control of the detected print marks.

For the side register, the edge length l_k (lateral to the web direction) is necessary to calculate the slope S of the measured print mark. The parameter is not needed for the block mark which is used only without side register.

The slope is calculated as follows:

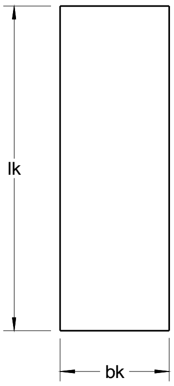
$$S = \frac{lk}{(bmax - bmin)}$$

With the resulting slope the width deviation (Δb) is converted to the lateral deviation (Δs):

$$\Delta s = \Delta b \cdot S$$

The different PM types are described in the following chapters.

4.2.2.1 Block Mark (P24)

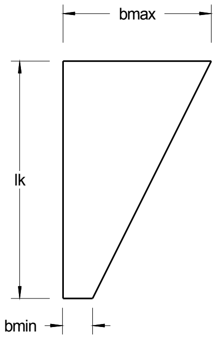


Edge length l_k = 10 mm (not available as parameter)
block mark width b_k = 3 mm

> **Reference note:**
> The block mark is usable only without side register.

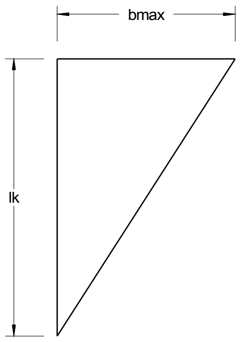
Figure 4.2:
block mark

4.2.2.2 Key Mark (P25...P27)



Edge length l_k
width max. b_{max}
width min. b_{min}

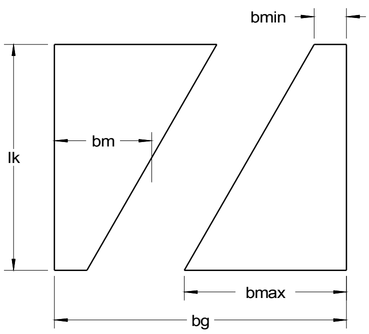
Figure 4.3:
Key Mark



Standard values:
l_k = 10 mm
b_{max} = 6 mm
b_{min} = 0

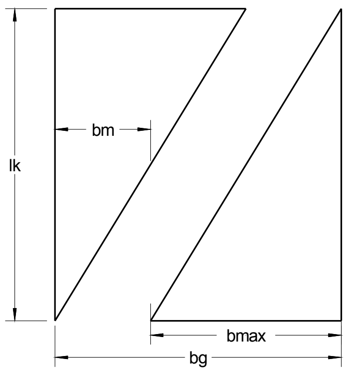
Figure 4.4:
standard Key Mark

4.2.2.3 Double Key Mark (P28...P33)



Edge length l_k
width middle b_m
width overall b_g
width max. b_{max}
width min. b_{min}

Figure 4.6: Double Key Mark

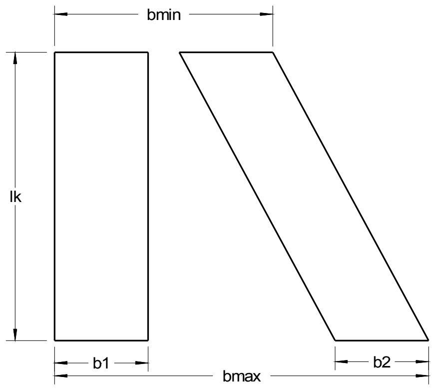


Standard values:
l_k = 10 mm
b_m = 3 mm
b_g = 9 mm
b_{max} = 6 mm
b_{min} = 0

Figure 4.5: Standard
double Key Mark

> **Reference note:**
> Both parts of the Double Key Mark have to be identical in angle and dimension.

4.2.2.4 Double Block Mark (P33...P37)



		Standard values:
Edge length	l_k	l_k = 10 mm
Width straight	b_1	b_1 = 3 mm
Width slant	b_2	b_2 = 3 mm
Width max.	b_{max}	b_{max} = 13 mm
Width min.	b_{min}	b_{min} = 7 mm

Figure 4.7: Double Block Mark

4.2.3 Active edge

Depending on the configured PM type the active edge is automatically preselected.

The active edge can only be set manually with the single Block Mark configured (basic setting: front edge).

For the PM types 0...2 and 5...8 the front, for 3, 4, 9 and 10 the rear edge is selected, which means that always the straight edge is used for detection, so that the length register runs stable even with an unstable side register.

The active edges of the corresponding PM types are displayed in fig. 4.8.

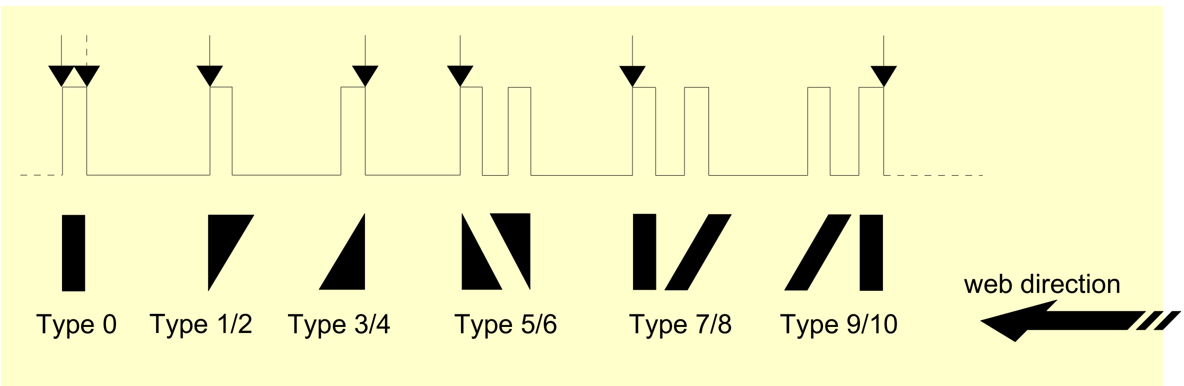


Figure 4.8: Overview edge selection

4.2.4 Sensor Select

- Sensor 1: IDS integrated analog print mark sensor
- Sensor 2: external analog print mark sensor

The IDS provides an interface for an additional print mark detection sensor (DS) for static switching to backside print detection or dynamic switching in Web-Web-2 mode (s. fig. 4.9).

Reference note:
To select measuring mode Web-Web-2 or Sensor 2 for backside detection leads to an error message if the sensor is not connected (Sensor 2, input voltage 0V).

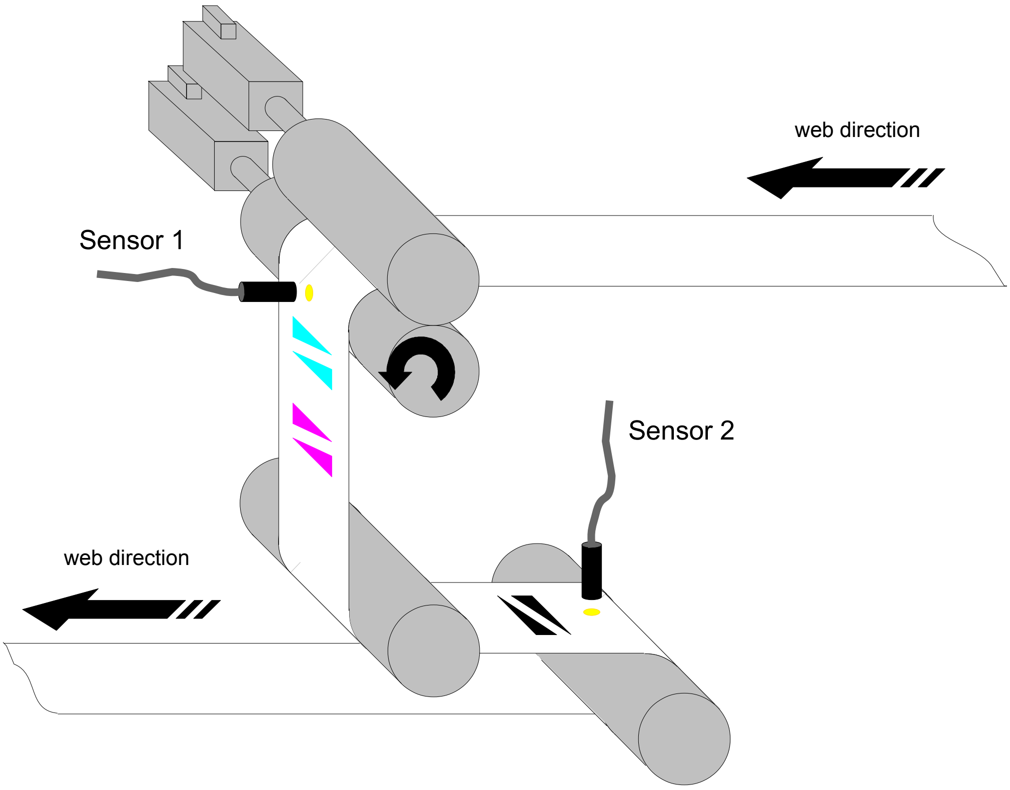


Figure 4.9: Overview Sensor Select

The print mark´s assignment to Sensor 1 or 2, depending on the configuration of “Sensor Select” and the measuring mode is displayed in table 26.

Sensor Select	Print mark	Web-Cylinder	Web-Web	Web-Web-2
Front side	Master	Sensor 1	Sensor 1	Sensor 1
	Slave	-	Sensor 1	Sensor 2
Backside	Master	Sensor 2	Sensor 2	Sensor 2
	Slave	-	Sensor 2	Sensor 1

Table 26: Print mark assignments Sensor 1/2

4.2.5 Sensor Automatic

The threshold of the print marks and the DC offset of the web material are calculated automatically after successful travel measuring. Precondition for a successful travel measuring is that the selected print marks are located within the corresponding gate.

At every gate centering (command 2010, 2022 and/or AGS) the travel measurement is executed for the automatic setting of threshold and offset if “Sensor Automatic” is activated by configuration (P2).

Also the travel measuring can be started by command 2025 without gate setting.

4.2.5.1 Travel measurement

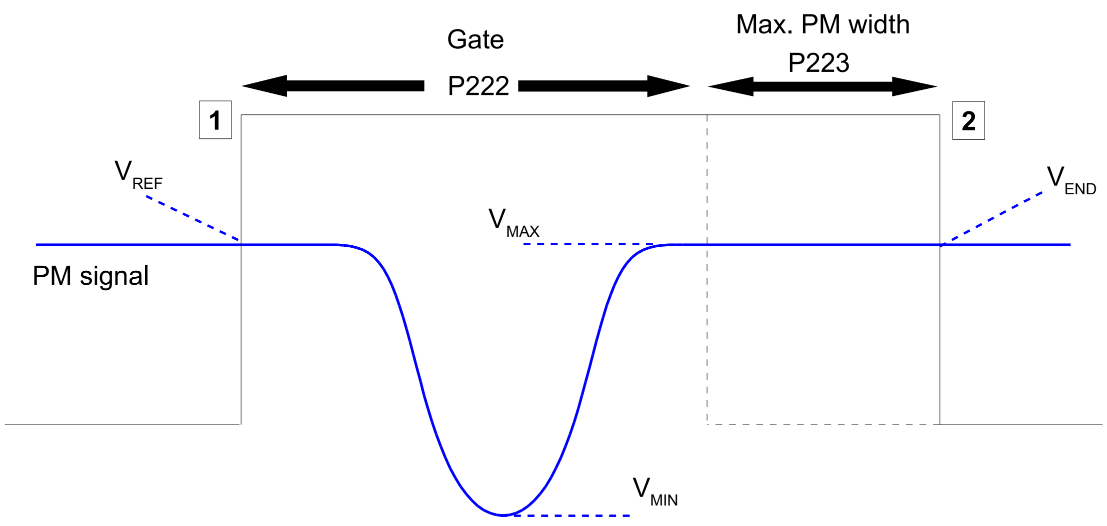


Figure 4.10: Overview travel measuring

During the travel measuring the gate is expanded with the max. PM width to catch the PM even at bigger deviations from center of the gate.

At the gate enable the reference voltage V_{REF} is stored (1).

Within the gate the minimum and maximum voltage V_{MIN} and V_{MAX} are measured.

At the gate disable the voltage at gate end V_{END} is measured and V_{MIN}, V_{MAX} and V_{END} are read and evaluated by the firmware (2).

4.2.5.2 Evaluation

To ensure a correct measurement of a print mark within the gate, which provides a stable PM detection, the limit values minimal trigger voltage ΔV_{MT} (P45) and maximum variation of the web voltage ΔV_{MSU} (P46) are defined for the travel measuring.

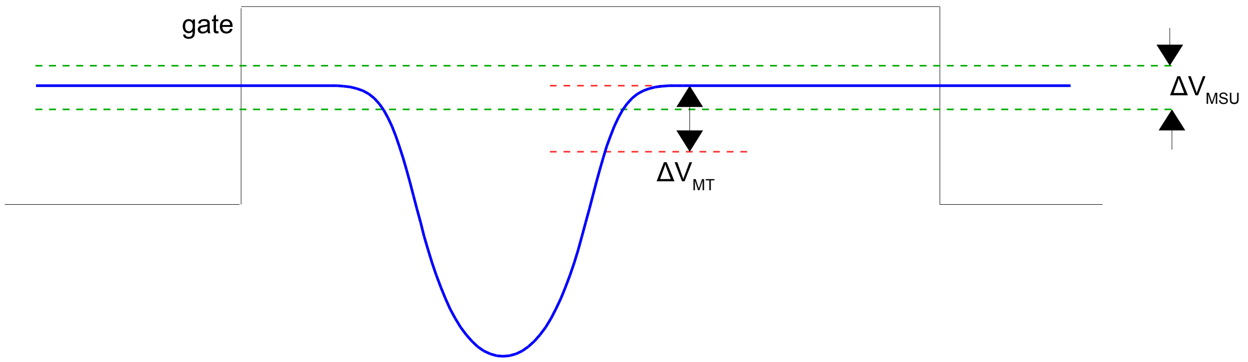


Figure 4.11: Limit values travel measuring

After successful travel measuring the evaluated threshold U_{SW} and offset U_{OFS} are assigned to the corresponding Sensor 1/2 and MPM/SPM in Web-Web(-2) (P278...P285, s. a. 4.3.5.2).

Reference note:
If the travel measuring failed, error 0x0202 (Sensor 1) resp. 0x0203 (Sensor 2) is generated and stored in the fault buffer.

With either condition (1) or (2) the travel measuring failed:

(1) $| V_{REF} - V_{END} | > \Delta V_{MSU}$

Possible cause:
- PM not completely within the gate
- variation of the web voltage too high (limit value!)

(2) $| V_{MAX} - V_{MIN} | < \Delta V_{MT}$

Possible cause:
- No PM within the gate
- PM´s voltage travel too small (limit value!)

Example to (1)

Example to (2)

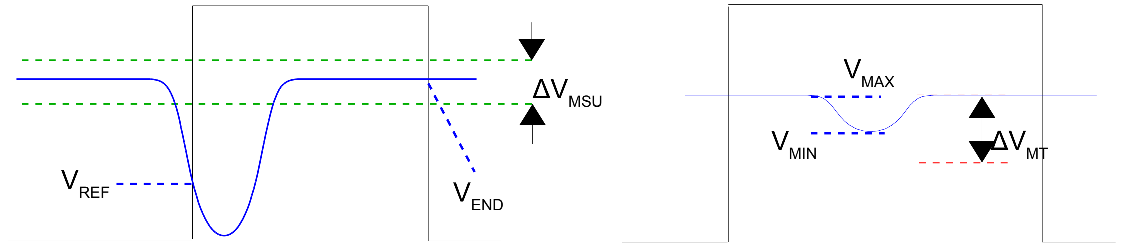


Figure 4.12: Examples of failed travel measuring

4.2.6 Deviation limit

The calculated register deviation (LR) is limited to the actual gate width to prevent bigger outliers.

If such an outlier occurs, an internal counter (P219) is incremented and the deviation is set to 0.

> **Reference note:**
> This function is used mainly in the phase of development, normally such outliers don´t appear.

4.2.7 Mackle detection

This function is implemented mainly as operator support during the print setup, because if bigger register corrections are made during the setup, other parts of the print (i.e. pictures. Text) may be detected temporary within the gate.

Temporary deviations, caused by soiled web or inaccurate print, are detected through the counting of active edges within the gate.

If the limit of permitted active edges (either rising or falling edge, dependent on the actual PM type) is overrun, the PM Alarm is released and the deviation is set to 0.

As soon as a valid number of active edges is detected again, the PM Alarm is reset.

The signal is sampled with a rate of 0,5 ms and the mackle detection is working properly up to a speed of around 300 m/min. Above this speed not all edges might be recognized because of the sample rate.

Example:

Detecting a simple key mark or block mark (PM type 0...4), 3 active edges within the gate, one active edge is permitted only, which means that in this case the PM Alarm is set.

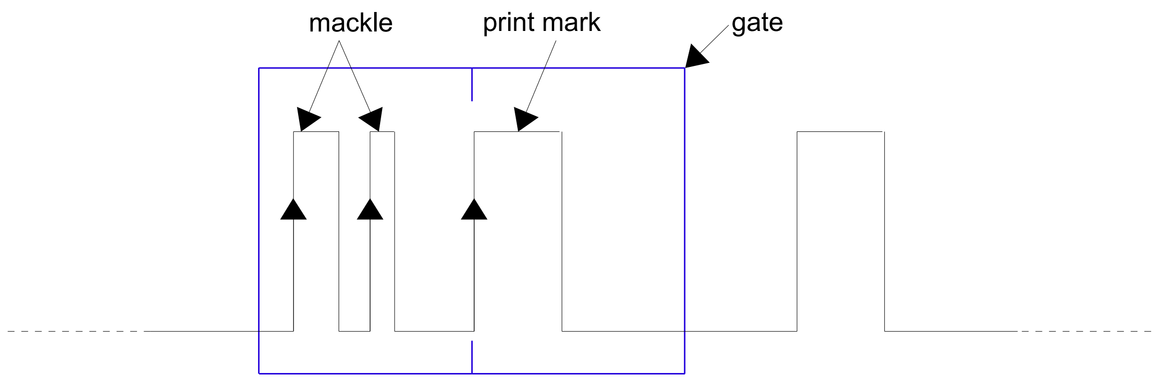


Figure 4.13: Example, Mackle Detection

4.2.8 Measuring mode

4.2.8.1 Definitions

- The master print unit (MPU) is printing the mark that is reference for the register control.
- The MPU is printing master print mark (MPM) and, if applicable, the AGS block mark.
- The slave print unit (SPU) is referenced to the MPU by the register control.
- The SPU is printing the slave print mark (SPM) in Web-Web or Web-Web-2.
- For Web-Cylinder no SPM is necessary.

4.2.8.2 Web-Cylinder mode

- Detection of one MPM per print cylinder circumference
- Length register: Deviation from given set point position
- Side register: Deviation from given set point width

Through AGS or Command “Gate Shift” (P1 = 2010) the gate is centered on the position of the detected MPM (set point value = actual value). Correction offsets are reset to 0.

After command “Set Gate Position” (P1 = 2011) the deviation of the actual value to the new set point position is detected instantly. Correction offsets remain at their actual values.

Taking over the actual position as new set point can be done at any time with the command “Center Gate” (P1 = 2022).

In Web-Cylinder mode the set point for the print mark width is evaluated at every gate setting, where the actual value of the print mark width is taken over as the new set point.

Manual correction of the side register (s. 3.1.1.11) has the same effect.

Taking over the actual width as new set point can be done at any time with the command “Take over PM width” (P1 = 2023).

New set points are always corresponding to the mean value of the first three print mark positions resp. widths.

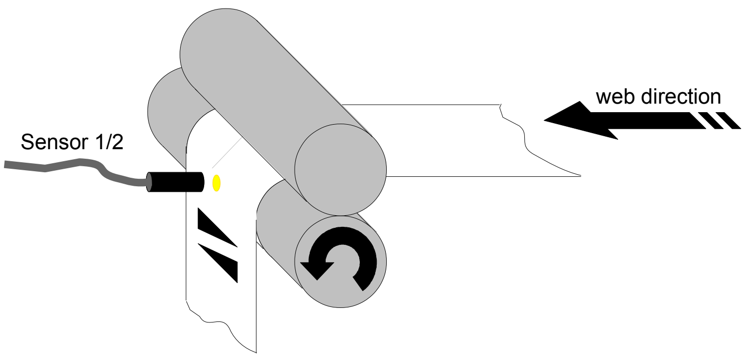


Figure 4.14: Web-Cylinder mode

4.2.8.3 Web-Web mode

- Detection of MPM and SPM, which means two gates are set within one print cylinder circumference
- Deviation from given set point distance between MPM and SPM (P11)
- Deviation between width values of MPM and SPM

Through AGS or Command “Gate Shift” (P1 = 2010), at first, the gate is centered to the position of the detected SPM. The SPM position is defined at this value because the SPM always has the same position regarding to the print cylinder.

Subsequently the gate for the MPM is set in the given distance to the SPM, correction offsets are reset to 0.

Command “Set Gate Position” (P1 = 2011) has the same effect as AGS or “Gate Shift”, only the correction offsets remain at their actual values.

Resetting the correction offsets can always be done with command “Center Gate” (P1 = 2022).

Both gates are enabled in the same turn of the print cylinder, so that, even in Web-Web, deviations are available in each turn.

If in one of the gates no print mark is detected for at least 3 turns, the PM Alarm is set.

Meanwhile, the other PM is not detected any more, which means if for example no (valid) SPM is detected for example, the gate remains at the SPM position until a SPM is detected again.

After gate setting the width of MPM and SPM are compared directly.

Generally Double Key Marks are recommended for Web-Web, because they are detected with the highest accuracy.

Single Key Marks should be used together with “Sensor Automatic” (s. 4.2.5) only, because otherwise the marks are measured slightly different in position and width depending on the colors, which means that the operator has to do some manual corrections.

Reference note:
In Web-Web mode both print marks have to be of the same type and dimensions.

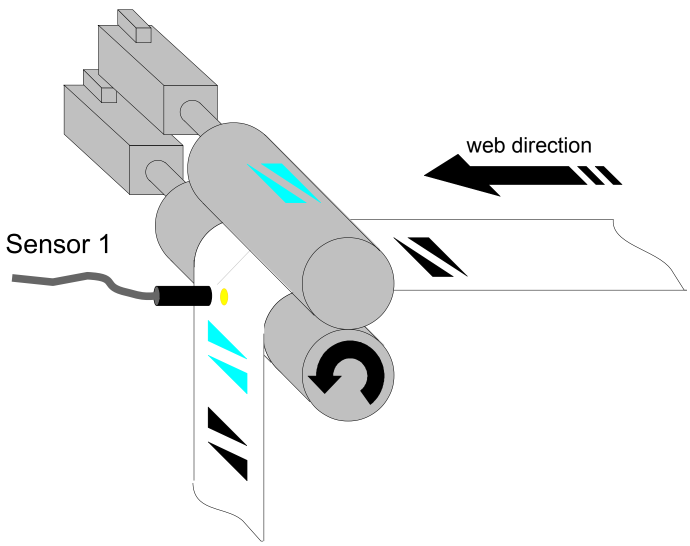


Figure 1: Overview, Web-Web mode, front side

4.2.8.4 Web-Web-2 mode

- IDS with external print mark sensor DS
- Automatic switching between Sensor 1 and 2 during the detection
- otherwise analog to Web-Web (s. 4.2.8.2)

Normally the MPM is detected of the integrated Sensor 1 of the IDS and the SPM is detected of the external Sensor 2, for example if MPM and SPM are not in a straight line on the web (s. fig. 4.15).

In case of Web-Web-2 and back side detection (Sensor Select), the MPM is detected by Sensor 2 and the SPM by Sensor 1 (s. fig. 4.16).

In the field mainly the combination of Web-Web-2 and back side detection is used.

Reference note: In Web-Web-2 mode both print marks have to be of the same type and dimensions.

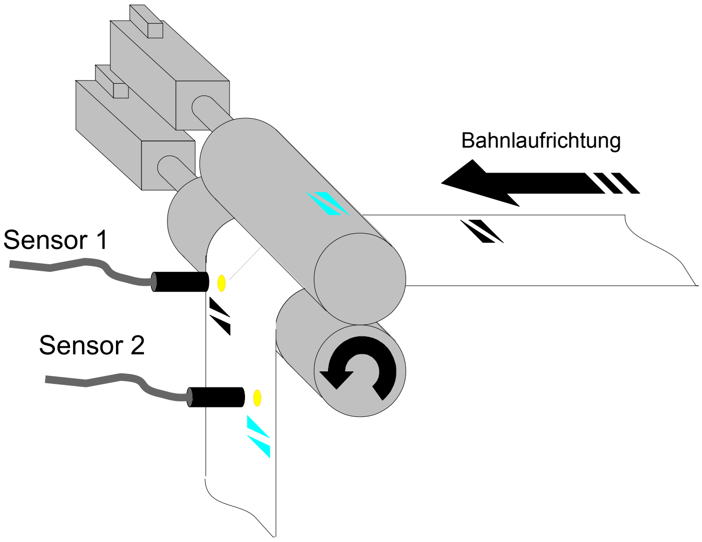


Figure 4.15: Overview Web-Web-2

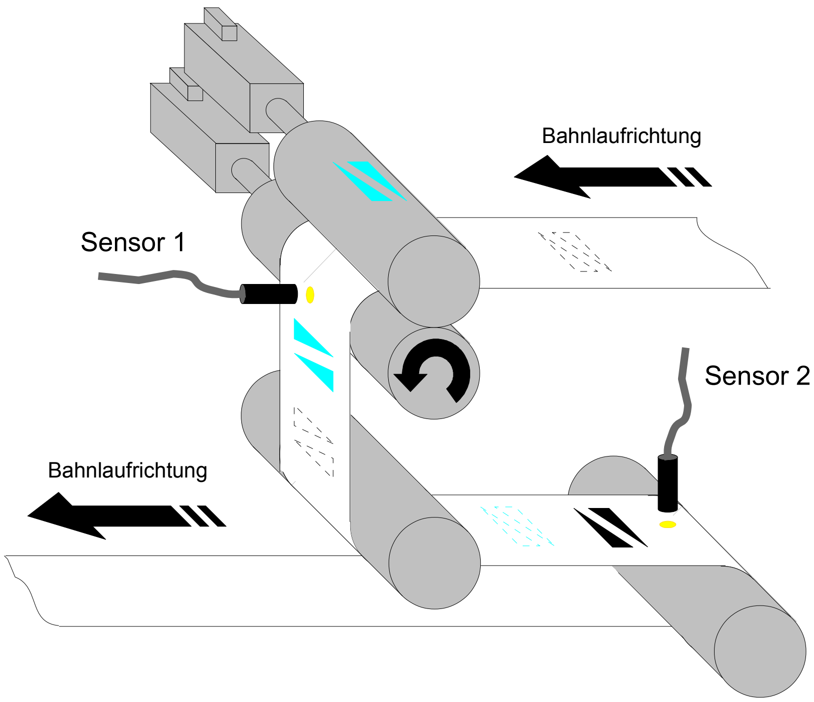


Figure 4.16: Overview Web-Web-2 with back side detection

4.2.9 Signal Gain

In case of weak signals it´s possible to increase the input signal by factor 2 for Sensor 1 and Sensor 2 (separately).

A detailed description is given in chapter “Signal Detection” (s. 4.3).

4.2.10 AO/DO reference

Different references can be selected to display the print mark signal (s. 4.2.1), the display set point position (P214) or the absolute position of the print cylinder (0°).

4.2.10.1 Display Set Point Position

The display set point position (P214) corresponds to the set point position (P204) in Web-Cylinder mode, which includes the register corrections (s. 4.5.3.1).

Web-Cylinder: P214 = P204

In Web-Web(-2) mode the display set point position corresponds to the gate position of the MPM (P216) including the register corrections (P211, s. 4.5.3).

Web-Web(-2): P214 = P216 + P211

4.2.10.2 Signal Illustration

If the display set point position is selected as reference value, the AO/DO will content this value always as 180º, independent of the absolute position on the print cylinder (s. fig. 4.17).

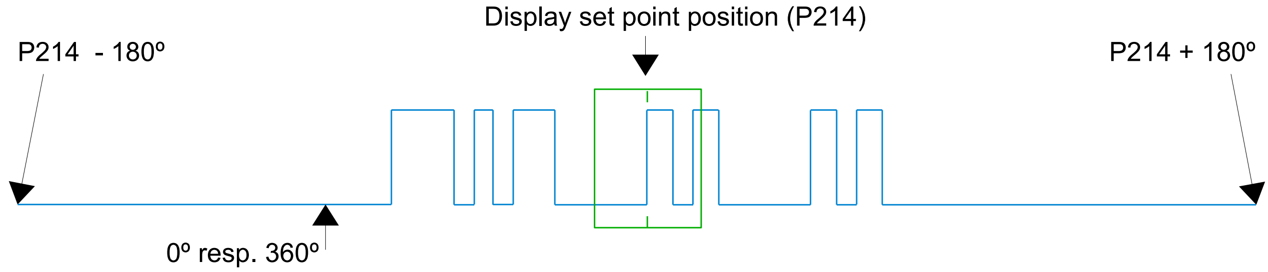


Figure 4.17: P214 as reference value

If the AO/DO is configured to use the absolute position of the print cylinder as reference (0°), the signal display is independent of P214. (s. fig. 4.18). This is the basic setting at system start up.

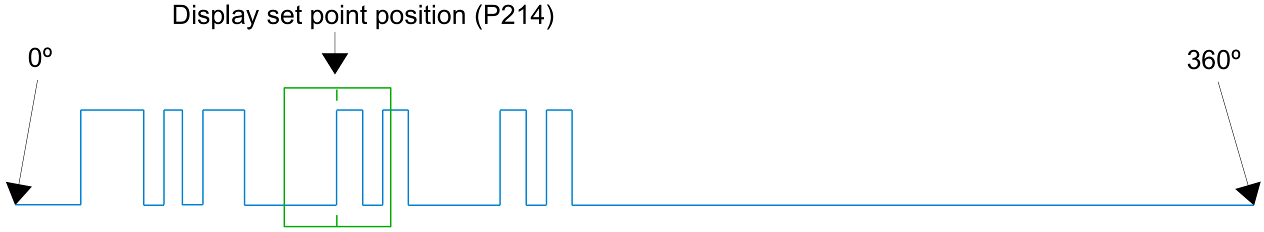


Figure 4.18: Reference value 0º

4.3 Signal Detection

4.3.1 In General

Depending on threshold (V_{THS}) and offset (V_{OFS}) the analog signal of the sensor (V_{SSE}) is sampled and converted into a digital signal, which is evaluated for the detection of the PM position and width.

For enhanced performance (bigger signal slope) V_{SSE} is increased by factor A_0 internally (basic setting).

V_{OFS} is used to compensate the voltage of the material travel, so that only the travel of the print marks can be evaluated.

The voltage values of the AO (V_{AO}) correspond to the value of V_{SSE}.

If the values are set manually, U_{OFS} should correspond to the material´s voltage travel and V_{THS} to half the lowest voltage travel of all (detected) print marks.

Reference note: V_{OFS} has a limit value of max. 5 V DC.

4.3.2 Analog Signal

For further processing the remaining signal (V_A) corresponds to: $V_A = A_0 \cdot (V_{OFS} - V_{SSE})$

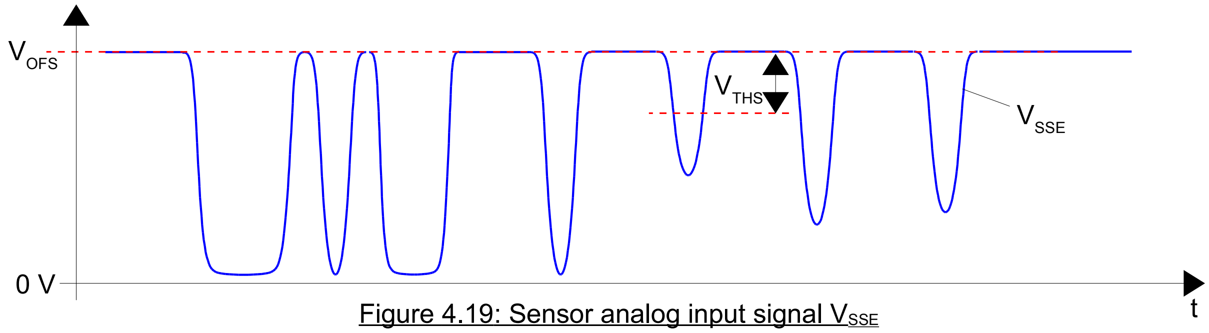


Figure 4.19: Sensor analog input signal V_{SSE}

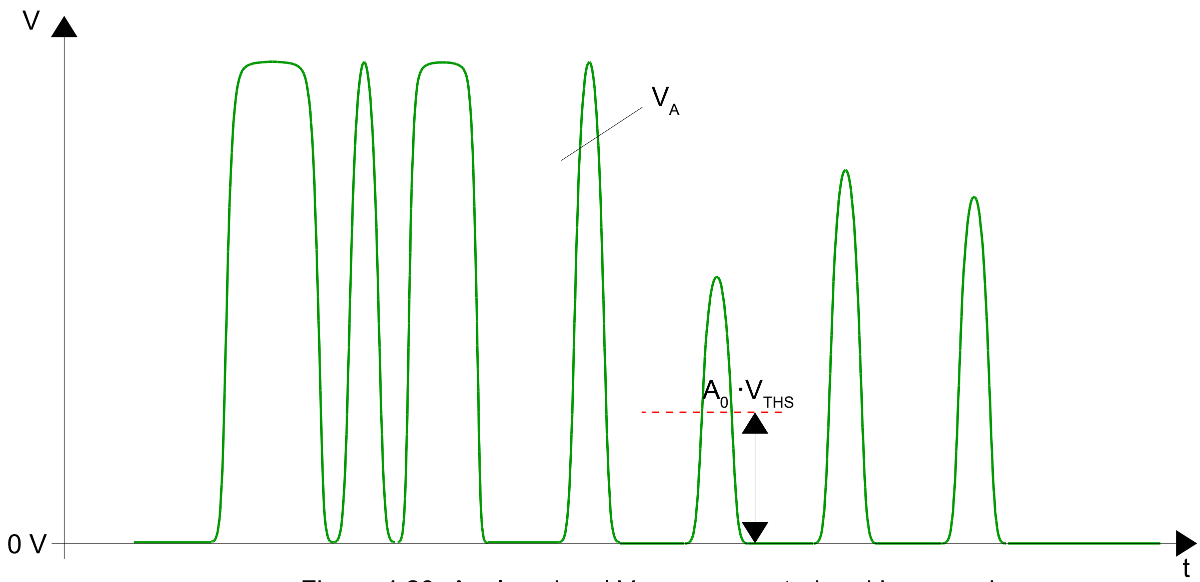


Figure 4.20: Analog signal V_A, compensated and increased

4.3.3 Digital Signal

The resulting digital signal (fig. 4.21), which is sampled from the analog input signal V_A at threshold V_{THS} (s. fig. 4.20), is further processed for the detection of the PM position and width.

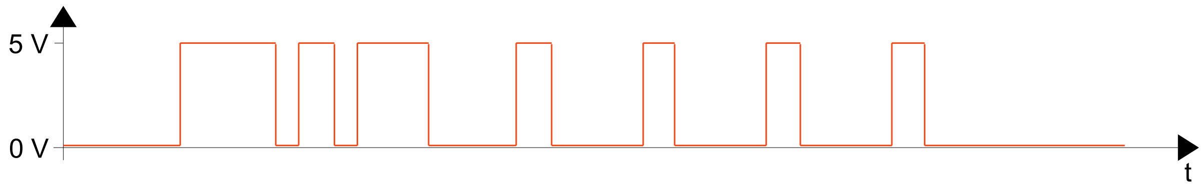


Figure 4.21: Digital signal V_{SD}

4.3.4 Signal Gain

In some cases the micro objective of the sensor can be tilted in relation to the normal above the web to an angle of 12° in order to detect lacquer or finish with a very small voltage travel. Thus the level of the analog input signal U_{SSE} is smaller, because of the light stray illustrated in fig. 4.22.

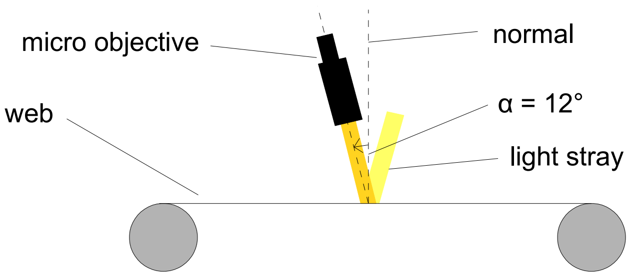


Figure 4.22: Tilted sensor micro objective

The internal gain A_0 can be set to $2 \cdot A_0$ for Sensor 1 and Sensor 2 separately to increase the input signal for better performance (s. 4.2.1).

In this operation mode the voltage values of the AO (V_{AO}) correspond to the value of V_{SSE} multiplied by factor 2:

$$2 \cdot A_0 \quad \Rightarrow \quad V_{AO} = 2 \cdot V_{SSE}$$

Thus the values of threshold V_{THS} and offset V_{OFS} (P17...P19 and P21...P23) can be configured directly corresponding to the AO again.

4.3.4.1 Examples

The resulting values for V_{AO} and the correct setting of threshold and offset are displayed in table 27 depending on different input signals (V_{SSE}) with gain $A = A_0$ and $A = 2 \cdot A_0$.

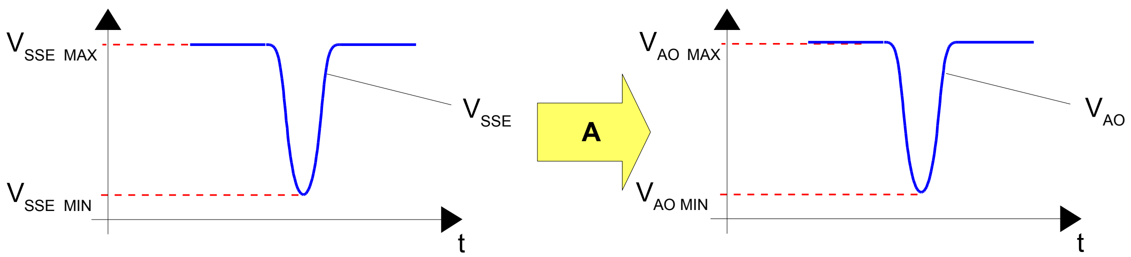


Figure 4.23: Converting V_{SSE} to V_{AO}

$V_{SSE\ MAX}$	$V_{SSE\ MIN}$	A	$V_{AO\ MAX}$	$V_{AO\ MIN}$	V_{OFS}	V_{SW}
2,50 V	1,10 V	A_0	2,50 V	1,10 V	2,50 V	0,70 V
3,60 V	1,80 V	A_0	3,60 V	1,80 V	3,60 V	0,90 V
1,40 V	1,20 V	$2A_0$	2,80 V	2,40 V	2,80 V	0,20 V
0,80 V	0,45 V	$2A_0$	1,60 V	0,90 V	1,60 V	0,35 V

Table 27: Resulting example voltages with $A = A_0$ and $A = 2 \cdot A_0$

4.3.5 Sensor Parameter

4.3.5.1 Threshold/offsets (P17...P19, P21...P23)

There are two sets of parameters for threshold and offset, one for the integrated Sensor 1 (P17...P19) and one for the external Sensor 2 (P21...P23), each with two parameters for the threshold (for Web-Web) and one parameter for the offset.

The values are taken over in the process by command 2002 (Sensor 1) and 2003 (Sensor 2).
The actual values are readable via P278...285 (s. 3.2.3). P279 and P282 are only used for operation mode “Sensor Automatic”.

Reference note:
After takeover by commands 2002/2003 the values of P279/P283 generally correspond to P278/P282.

Only in operation mode Sensor Automatic P279 and P283 are automatically changed after successful travel measuring.

4.3.5.2 Assignments

Depending on the measuring mode and configuration “Sensor Select” in P2 the parameter values are assigned to the corresponding print marks and activated when needed.

In operation mode Web-Web(-2) thresholds and offsets are switched automatically at gate enable for the MPM and SPM.

The assignment of parameters P278...P285 depending on the configuration is displayed in table 28.

Sensor Select	Print mark	Web-Cylinder		Web-Web		Web-Web-2	
		Offset	Threshold	Offset	Threshold	Offset	Threshold
Front side	Master	P278	P280	P278	P280	P278	P280
	Slave	-	-	P279	P281	P282	P284
Back side	Master	P282	P284	P282	P284	P282	P284
	Slave	-	-	P283	P285	P278	P280

Table 28: Assignment of threshold and offset

4.4 Gate Setting

The PM detection is permitted only for a dedicated area of the print cylinder circumference (C_{PC}), the so called “gate”, which is defined through gate width (P12) and gate position (s. fig. 4.24).

The gate width is changed by command 2009 (P1).

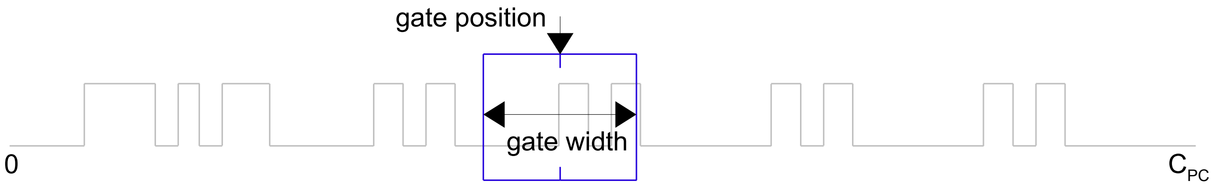


Figure 4.24: Gate

To find the gate position for detection of the dedicated print mark(s) several functions are available (s. 4.4.2 to 4.4.4).

> **Reference note:**
> Register corrections within the I/O data (P305 and P306) have to be reset to 0 before, because otherwise the new found gate position is shifted automatically with P305 resp. the PM width is corrected with P306.

Depending on the measuring mode gate setting may need up to four turns of the print cylinder (AGS not included). The gate setting remains activated (s. 3.1.2.10) and the PM alarm is set(s. 3.1.2.8) if no print mark is detected at the given gate position.

4.4.1 Gate Center

If a gate is centered, the mean value of the first three print mark positions within the given gate position (P215) is taken over as new gate position (fig. 4.25).

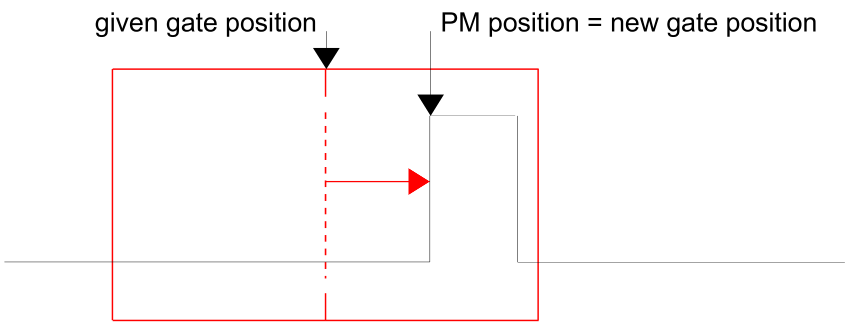


Figure 4.25: Gate Center

In Web-Web(-2) mode the gate is centered to the SPM at first, independent of the type of gate setting and afterwards, the gate position for the MPM (P216) is defined in the set point distance (P11) from the SPM.

After the gate setting the MPM and SPM are detected alternately within one print cylinder circumference.

4.4.2 Gate Shift (P13)

The command “Gate Shift” (P1 = 2010) takes over the given shifting offset in P13 and resets the manual corrections for LR (P276) and SR (P286) to 0.

Based on the actual value of the display set point position (P214, s. 4.2.10.1) the gate is shifted by the amount of P13 to the given gate position (P215).

> **Info:**
> In in Web-Web(-2) the gates are always centered to the SPM first. Therefore the shifting offset is evaluated to shift to a new position of the SPM based on the display set point position.

4.4.2.1 Web-Cylinder

The gate is shifted to the position of the designated MPM.

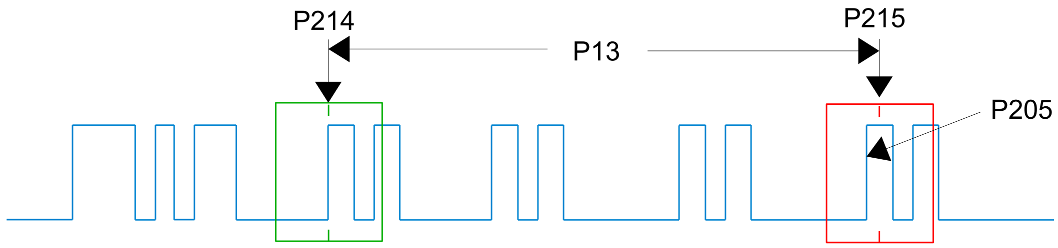


Figure 4.26: Gate Shift Web-Cylinder

After shifting the gate is centered on the actual value of the detected PM (s. fig. 4.27).

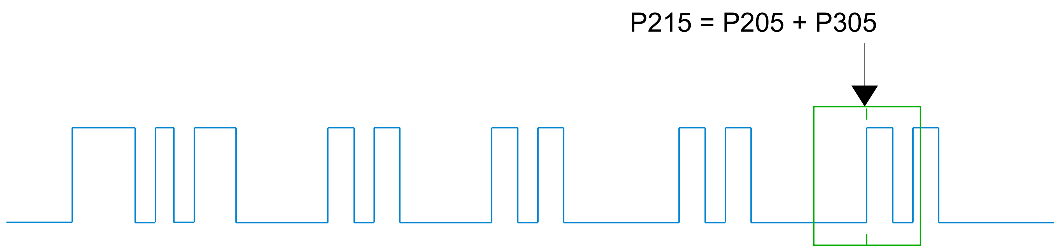


Figure 4.27: Gate Center Web-Cylinder

4.4.2.2 Web-Web

> **Reference note:**
> The following relations for Web-Web are also valid for Web-Web-2.

In Web-Web(-2) mode the gate is centered to the SPM at first and subsequently the gate position for the MPM (P216) is defined in the set point distance (P11) from the SPM.

The offset for Gate Shift (P13) has to correspond to the distance between actual display set point position (P214) and the new gate position of the SPM (s. fig. 4.28).

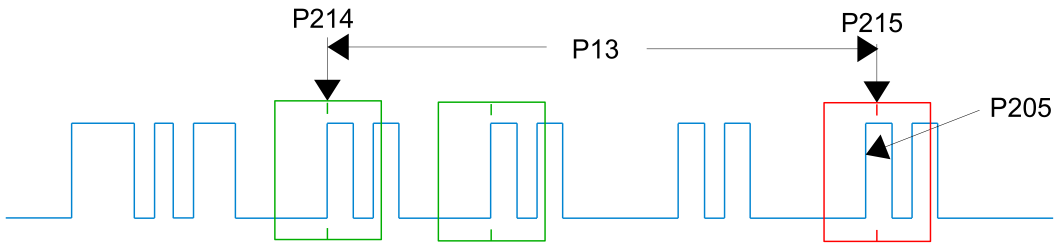


Figure 4.28: Gate Shift Web-Web

The gate for the SPM is centered on the actual value of the detected PM (P205, s. fig. 4.29).

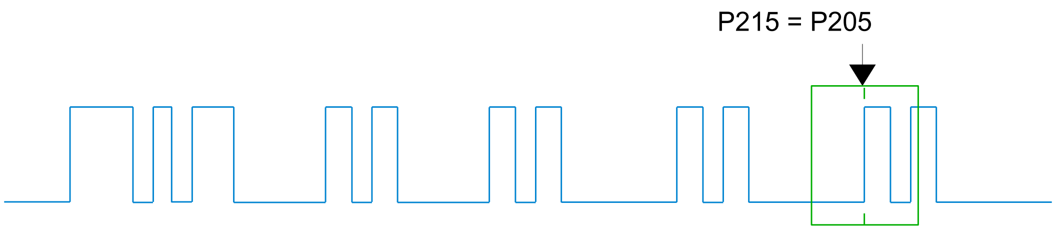


Figure 4.29: Gate Center Web-Web

Subsequently the gate for the MPM is set in the given set point distance (P11, s. fig. 4.30).

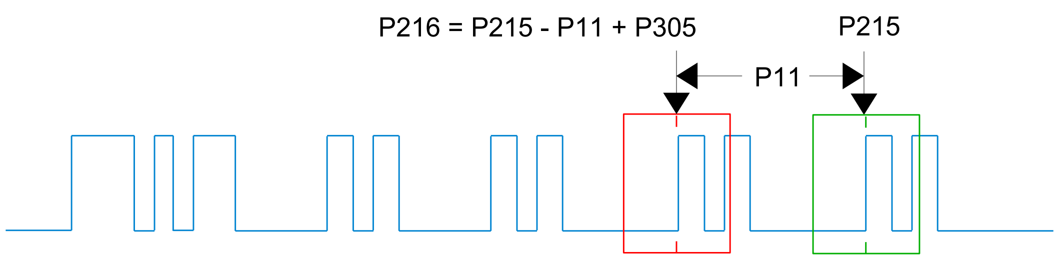


Figure 4.30: Gate setting MPM Web-Web

4.4.3 Set Gate Position (P14)

The command “Set Gate Position” (P1 = 2011) takes over the given gate position in P14.

The value of P14 is taken over as set point position, the LR deviation is available immediately.

In Web-Cylinder mode the LR corrections (P276) are preserved. The detection of the PM width is initialized, because in Web-Cylinder a reference (set point width) is needed first.

In Web-Web(-2) mode the corrections of the LR (P276) and the SR (P234) are preserved, register deviations are available immediately for LR and SR.

4.4.3.1 Web-Cylinder

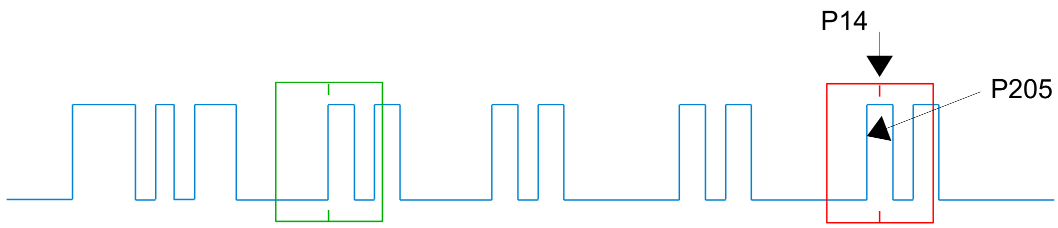


Figure 4.31: Set Gate Position

The given gate position (P14) is taken over as set point position (P204) immediately.

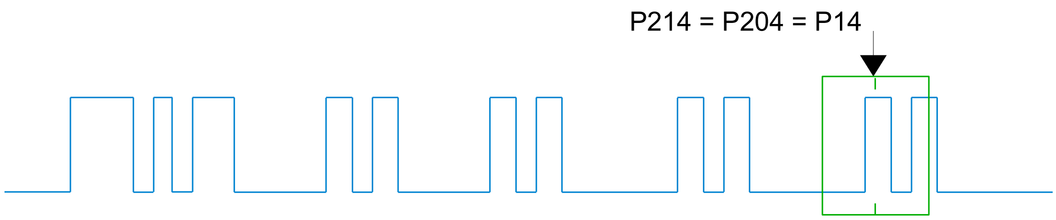


Figure 4.32: Taking over gate position

4.4.3.2 Web-Web

> **Reference note:**
> The following relations for Web-Web are also valid for Web-Web-2.

In Web-Web mode the gate position (P14) is interpreted as SPM position, the gate is centered to the detected actual PM position and the second gate for the MPM is defined in set point distance (P11) subsequently.

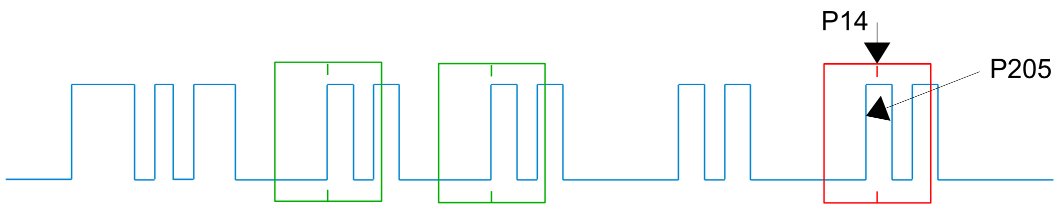


Figure 4.33: Web-Web set gate position

The gate for the SPM is centered on the detected actual PM position (P205).

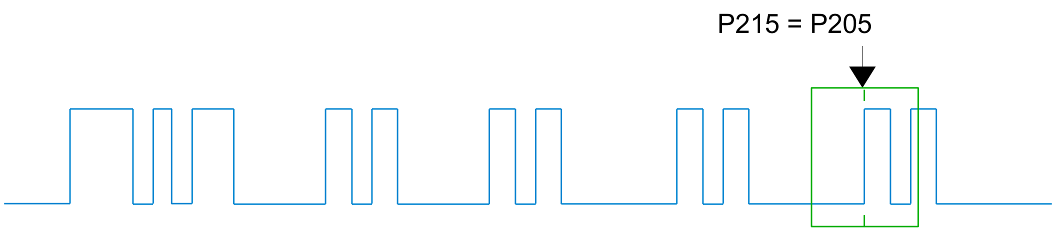


Figure 4.34: Web-Web center gate for SPM

Subsequently the gate for the MPM is set in the configured set point distance (P11).
The correction offsets are preserved and directly evaluated.

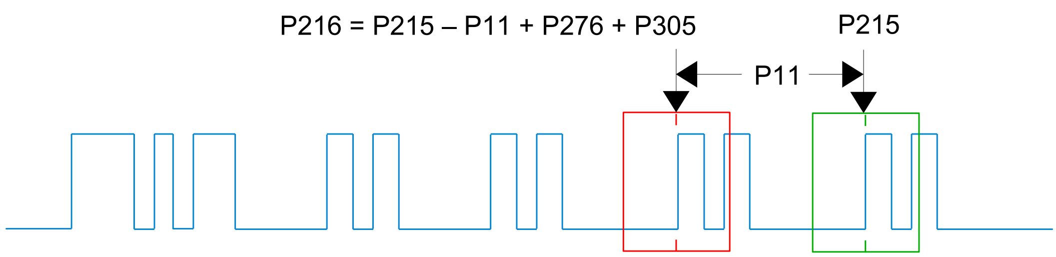


Figure 4.35: Web-Web gate setting MPM

4.4.4 Auto Gate Setting (AGS)

4.4.4.1 Mode of operation

The AGS is activated through the control bit "AGS Start" (s. 3.1.1.8) or command 2012 (P1, s. 4.1).

After the AGS the gate position is set in a configured distance to the AGS block mark set depending on the measuring mode (s. 4.4.4.3).

The maximum speed for the AGS is 1000 m/min. Because the minimum speed (P298) depends on the width of the single marks (P40...P42, s. fig. 4.37) it is calculated at any change on the AGS parameters.

The AGS tolerance limit (P39, s. 4.4.4.2) is also included in the calculations.

$$P298 = (b_{max} + P39) / t_{max}$$

t_{max} : 0,262144 s (20-Bit Counter with f = 4 MHz for PM width)
b_{max} : max. value out of P40, P41 and P42

Example:

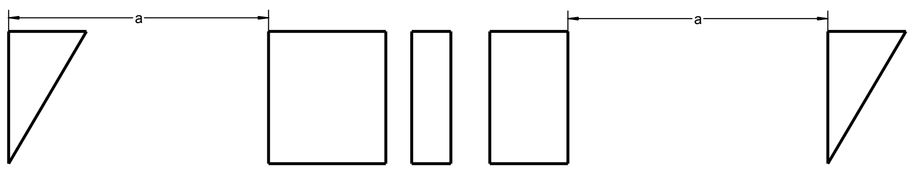
P39 = 1,5 mm and b_{max} = 9 mm lead to a minimum speed of:
P298 = 40,05 mm/s (2,4 m/min).

Reference note:
At invalid speed or stand still the AGS is aborted immediately, error code 0x0200 is generated and stored in the fault buffer.

4.4.4.2 Configuration (P38...P44)

The distance between AGS block mark set and MPM is configured through P38 (basic setting: 20 mm).

For a trouble-free detection even at bigger deviations in the affected print units the distance to other print marks or other parts of the print should be no less than 20 mm (s. fig. 4.36).



a: Distance AGS block mark set to next print mark (active edge)

Minimum value (basic setting): a = 20 mm

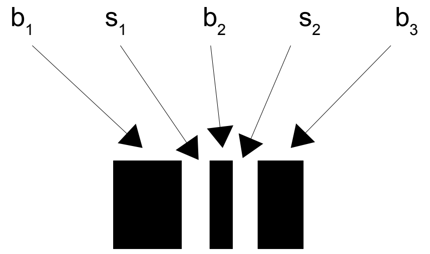
Figure 4.36: Distance AGS block mark set to other print marks

Parameter P39 defines a tolerance range for the detected marks/gaps of the AGS block mark set.

The value of the detected mark/gap has to reside within the corresponding value (P20...P44) including P39 (basic setting 1,5 mm).

Because of threshold and offset eventually being not optimal configured and color-dependent deviations the tolerance range is necessary.

The dimensions of the AGS block mark set is defined through parameters P40...P44 (s. fig. 4.37).



Standard values:

Width 1. block	b_1 = 9 mm (P40)
Width 2. block	b_2 = 3 mm (P41)
Width 3. block	b_3 = 6 mm (P42)
Width 1. gap	s_1 = 3 mm (P43)
Width 2. gap	s_2 = 3 mm (P44)

Figure 4.37: Dimensions of AGS block mark set

4.4.4.3 Application flow

If the set of block marks and the corresponding positions are detected, in Web-Cylinder mode the gate is set in the distance between AGS block mark set (falling edge of the last mark) and the MPM (P38).

In Web-Web(-2) mode the gate is set on the SPM first, which means that the set point distance (P11) is added to P38 (s. fig. 4.38).

The subsequent application flow corresponds to 4.4.2.

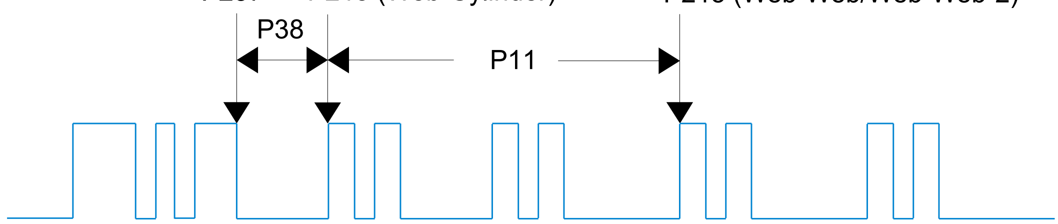


Figure 4.38: Distance AGS block mark set to MPM/SPM

4.5 Register corrections

After the first print setup the print mark(s) maybe in register already, but the colors of the several print units are still not matching like illustrated in fig. 4.39. This could be the case in Web-Web with wrong configured set point distance or incorrect sleeves and in Web-Cylinder after first print setup.

In the examples below a single key mark is detected in Web-Cylinder mode.

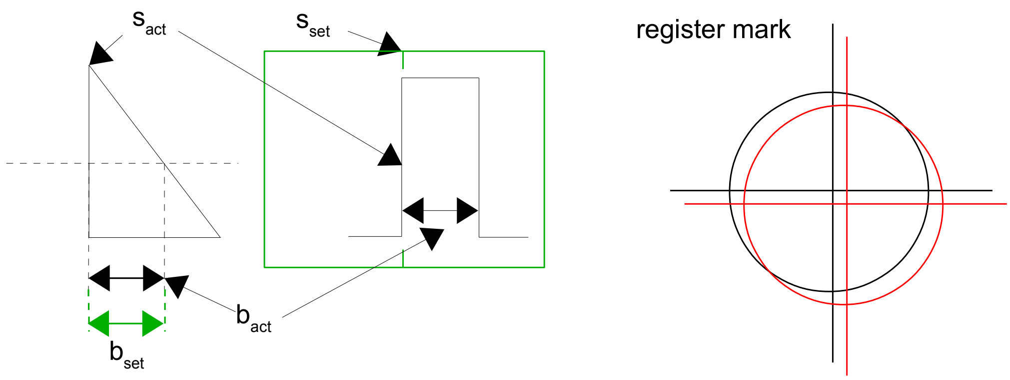


Figure 4.39: Register after first print setup

By the register corrections (Δs_c, Δb_c) the set point values are changed, thus a register deviation (Δs, Δb) is developed (s. fig. 4.40).

$s_{set} = s_{set\ OLD} + \Delta s_c$ | $b_{set} = b_{set\ OLD} + \Delta b_c$

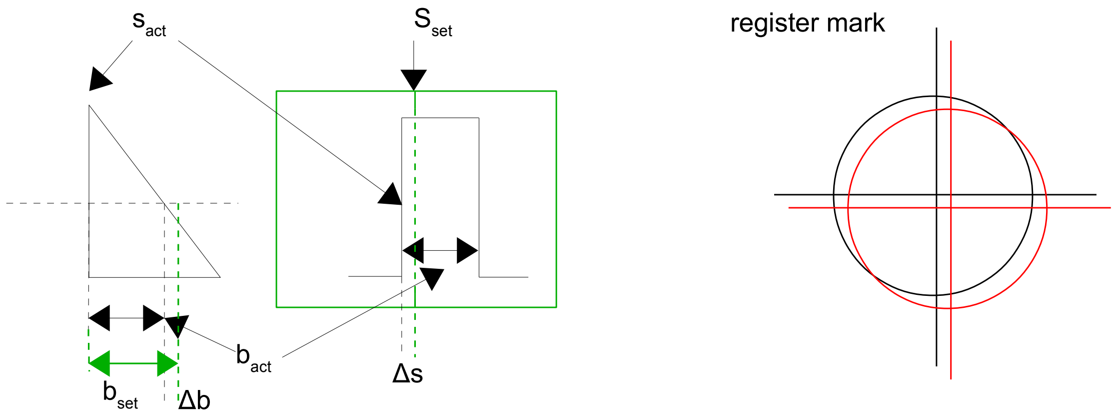


Figure 4.40: Corrections Length and Side Register

Subsequently the register control moves the print in register (s. fig. 4.41).

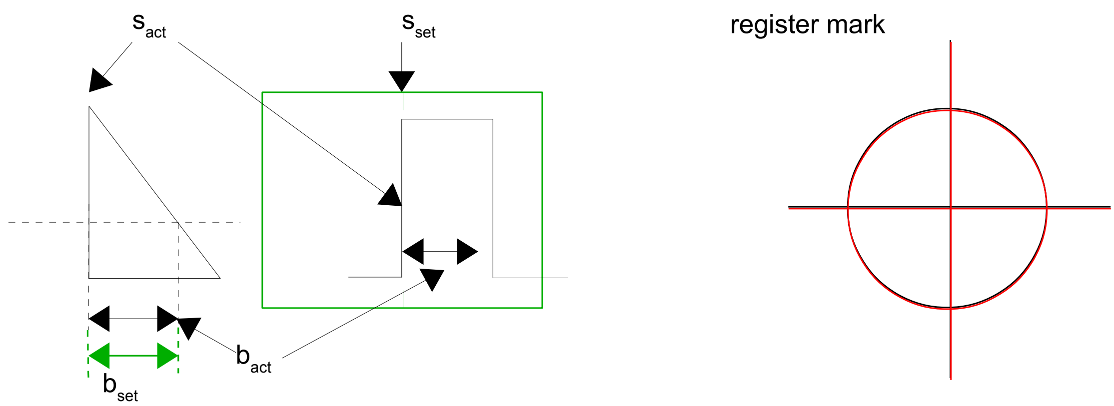


Figure 4.41: Print after register movement

4.5.1 I/O data

Within the cyclic I/O data there are correction offsets for LR (P305) and SR (P306) (s. 3.1.1). These values are superposed directly (s. 4.5.3 resp. 4.5.4), which means the I/O Controller completely has to maintain them.

Reference note:
P305 and P306 can not be set by the IDS, the I/O Controller has to maintain the values.

The SR correction is formatted as axial deviation, which means it is multiplied by the slope factor S (P226), depending on the PM type (s. 4.2.2).

4.5.2 Parameter Write (P15, P16)

Register corrections are also possible via Parameter Write (acyclic data). In this case the corrections are maintained by the IDS only and are deleted eventually depending on the gate setting routine (s. 4.4).

LR corrections are carried out by sending command 2017 (P1) where the value of P15 is added to the internal correction value (P276, s. also 4.5.3) with every received command.

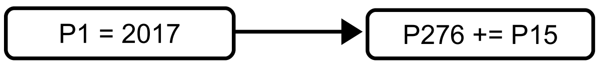


Figure 4.42: LR correction

SR corrections are carried out with by sending command 2018 (P1) where the value of P16 is added to the internal correction value (P234, s. also 4.5.4)) with every received command.

The SR correction gets formatted as axial deviation, which means it is multiplied by the slope factor S (P226) depending on the PM type (s. 4.2.2).

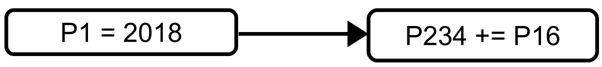


Figure 4.43: SR correction

4.5.3 Length Register

All corrections of the LR are merged in one parameter (P211).

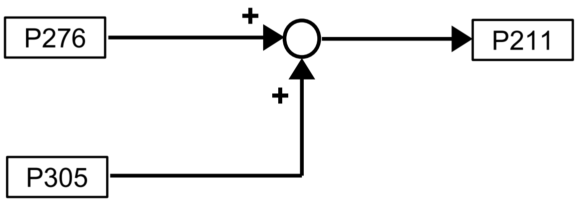


Figure 4.44: LR correction sum

4.5.3.1 Web-Cylinder

The PM set point position (P204) results from the first gate position (P215) and the LR corrections (P211).

Again, the register deviation (P312) results from the difference between set point position (P204) and actual PM position (P205).

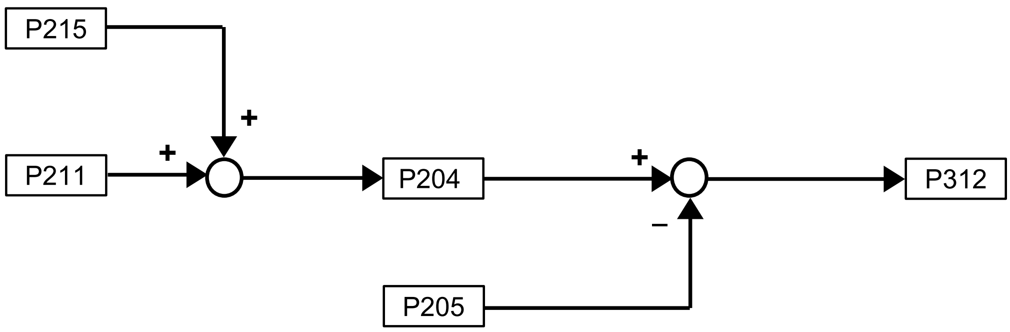


Figure 4.45: LR Web-Cylinder register deviation and corrections

4.5.3.2 Web-Web

Reference note: The following relations for Web-Web are also valid for Web-Web-2.

The register deviation (P312) results from the difference between set point distance (P208) and actual distance between MPM and SPM (P209) including the LR corrections (P211).

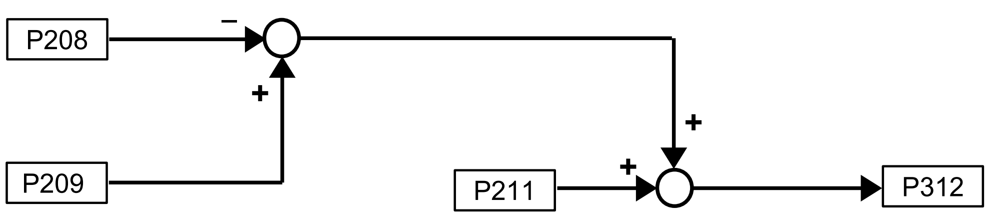


Figure 4.46: LR Web-Web register deviation and corrections

4.5.4 Side Register

The SR correction gets formatted as axial deviation, which means the width deviation (P232) is multiplied by the slope factor S (P226) depending on the PM type (s. 4.2.2).

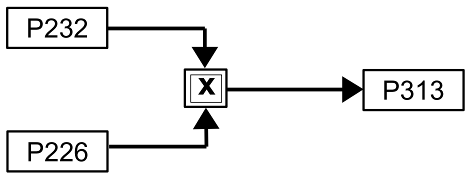


Figure 4.47: Axial register deviation

In analogy to the recent description all corrections divided by slope factor S (P226) are merged into one correction offset (P233).

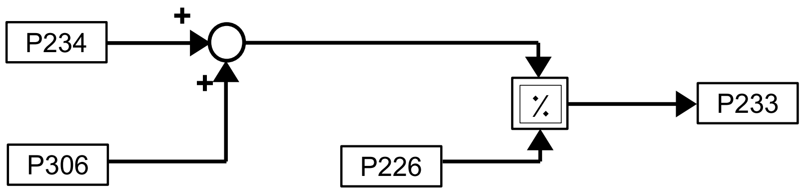


Figure 4.48: SR Correction offset with slope factor

4.5.4.1 Web-Cylinder

The register deviation in Web-Cylinder mode corresponds to the difference between actual PM width (P229) and the set point PM width (P228), corrections included.

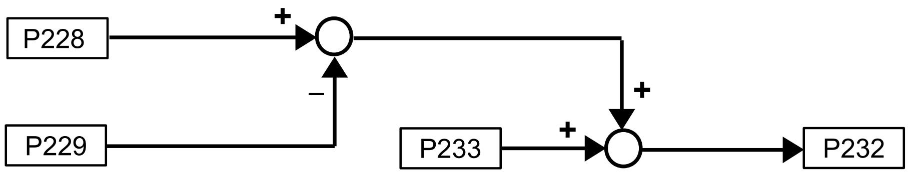


Figure 4.49: SR Web-Cylinder

4.5.4.2 Web-Web

Reference note:
The following relations for Web-Web are also valid for Web-Web-2.

In Web-Web mode the register deviation corresponds to the difference between actual SPM width (P231) and MPM width (P230), corrections included.

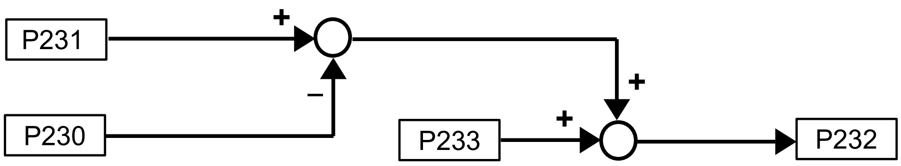


Figure 4.50: SR Web-Web

4.5.4.3 Web-Web, take over actual distance

Reference note:
The following relations for Web-Web are also valid for Web-Web-2.

If the print is in register already, but the actual distance between MPM and SPM (P209) is unequal to the set point distance (P11), e.g. because of wrong configuration or incorrect sleeves, the operator can take over the actual distance as new set point value by command 2026 (P1).

Basic condition for this function is that both print marks are detected at the time.

P11 is overwritten, the LR corrections (P211) are reset to 0.

The gate position of the SPM (P215) remains, resp. equals the actual PM position of the SPM, the gate position of the MPM is set again in the new set point distance: P214 = P215 – P11.

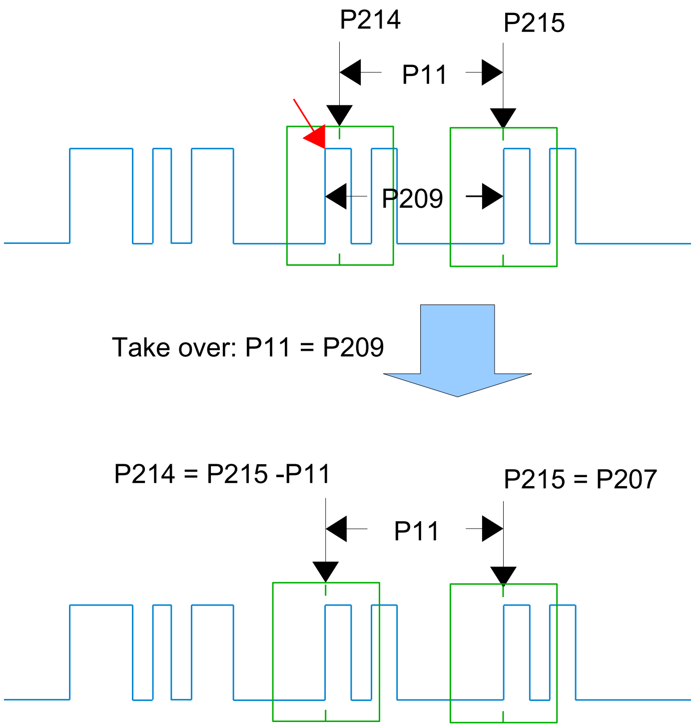


Figure 4.51: Web-Web, take over actual distance

4.6 Commando Interface (RS232)

All parameters available within the acyclic data may also be read and written through the RS232 interface, even if no connection is established between the IDS and an I/O Controller.

In addition, a 2-channel Analog Monitor (s. 2.3.2) is included, where actual values of the process resp. logic states of one ore more bits of a status value can be read out as analog values with a refresh rate of 0,5 ms (s. commands 5001/5002 in 4.6.2 resp. 4.6.3). All parameters with a PNU > 100 are available that way.

Some of the diagnosis functions are only implemented for test and development, there are not explained in the following.

4.6.1 Tera Term

A simple solution for a serial connection to the RS232 interface of the IDS would be the Windows Hyper Terminal (available up to Windows XP). With Windows 7 no Hyper Terminal is delivered, but other programs for serial connections are available in the WWW.

In the following the open source software “Tera Term Pro” V4.70 is described.

At the start up of Tera Term select “Serial“ and the designated COM port.

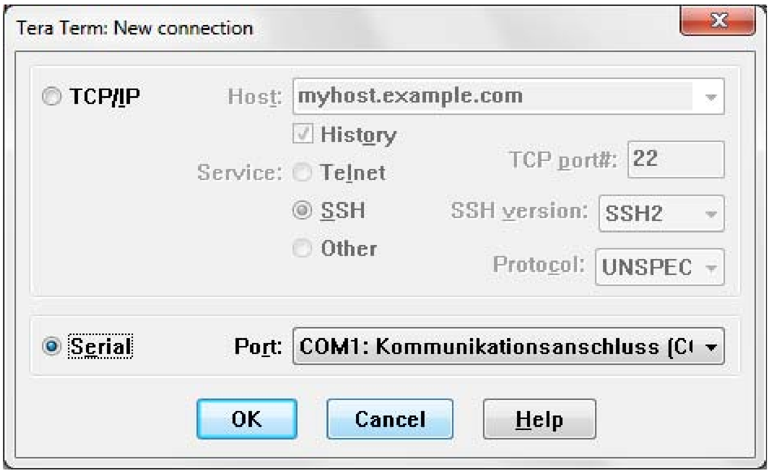


Figure 4.52: Tera Term start window

Within “Menu → Setup“ select “Terminal“ and configure as displayed in fig. 4.53.

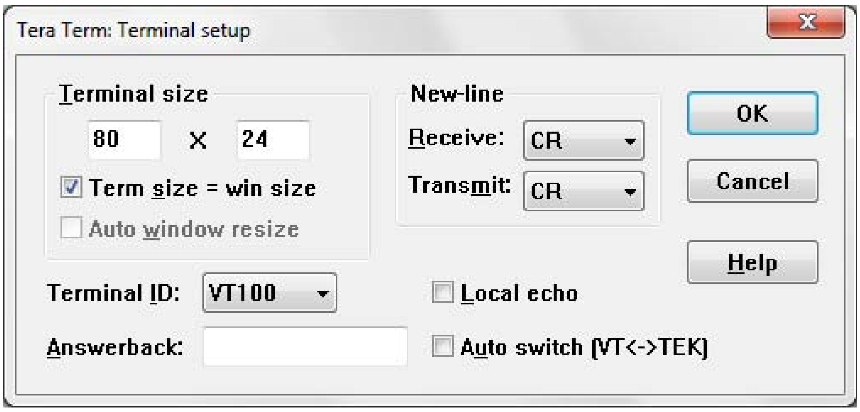


Figure 4.53: Menu → Setup → Terminal

Within “Menu → Setup“ select “Serial Port“ and configure as displayed in fig. 4.54.

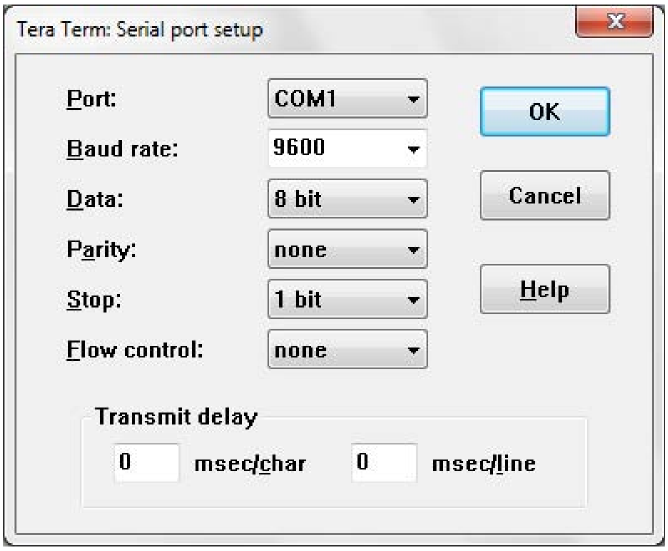


Figure 4.54: Menu → Setup → Serial Port

Switching on the IDS with the connection established should print the output, shown in fig. 4.55, which ends with the IDS prompt „IDS>“.

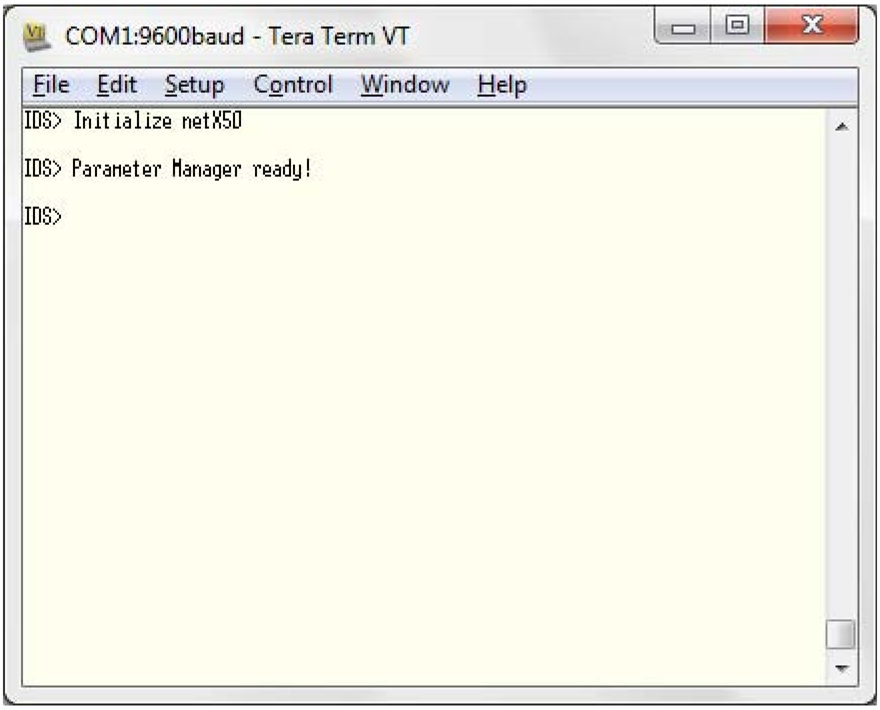


Figure 4.55: Tera Term after IDS start up

Normally a few seconds elapse until „Parameter Manager ready!“ is displayed, due to the initialization of the netX50 communication chip.

Subsequently the IDS is ready for command input.

4.6.2 Commands

Command/Parameter	Description
1000 <ID>	Parameter read (process values, PNU ≥ 100)
1002 <ID>	Parameter read (PNU < 100)
1003 <ID> <value>	Parameter write (PNU < 100)
1004 ID value <Index>	Parameter write (process values, PNU ≥ 100) [1)]
2000	Initialize print mark detection, take over all parameters
2001 <P2>	Take over configuration, e.g. PM type (s. 4.2)
2002 <P19> <P17> <P18>	Take over Sensor 1 thresholds and offset (s. 4.3.5)
2003 <P23> <P21> <P22>	Take over Sensor 2 thresholds and offset (s. 4.3.5)
2004 <P20>	Take over dead time compensation $[\frac{\mu m}{m/s} = \mu s]$
2005 <P24>	Take over PM width block mark (s. 4.2.2.1)
2006 <P25> <P26> <P27>	Take over key mark parameters (s. 4.2.2.2)
2007 <P28> <P29> <P30> <P31> <P32>	Take over double key mark parameters (s. 4.2.2.3)
2008 <P33> <P34> <P35> <P36> <P37>	Take over double block mark parameters (s. 4.2.2.4)
2009 <P12>	Take over gate width [mm], < 20 mm
2010 <P13>	Gate shift (s. 4.4.2)
2011 <P14>	Set gate position (s. 4.4.3)
2012	Start AGS (s. 4.4.4)
2013 <P38>	Take over distance between AGS mark and MPM [mm], ≥ 20 mm
2014 <P40> <P41> <P42> <P43> <P44>	Take over AGS block mark parameters (blocks and gaps have to be ≥ 3 mm)
2015 <P39>	Take over tolerance AGS detection [mm]
2016 <P11>	Take over set point distance between MPM ans SPM [mm], ≥ 20 mm, Web-Web or Web-Web-2 only
2017 <P15>	Take over correction offset length register [mm]
2018 <P16>	Take over correction offset side register [mm]
2019 <P10>	Take over print cylinder circumference [mm]
2020 <value>	Change PM type (P2, Bits 4...7), value between 0 and 10, (s. 4.2.1)
2021 <value>	Change measuring mode (P2, Bits 12...13), value between 0 and 2, (s. 4.2.1)
2022	Take over actual PM position as gate position, “Center gate” (s. 4.4.1)
2023	Take over actual PM width as new set point

Command/Parameter	Description
2024 <P45> <P46>	Take over travel measuring limits (s. 4.2.5)
2025	Start travel measuring (s. 4.2.5)
2026	Take over actual distance between MPM and SPM as new set point distance
4000 <P3>	Initialize signal detection, take over AO/DO refresh cycle (P3)
5001 <channel> <PNU> <reference> <offset>	Analog Monitor display parameter [2)] channel: 1 or 2 PNU: ≥ 100 reference: value referenced to 10 V offset: DC offset with the corresponding unit of the value Example: Input: 5001 1 205 1 123.5 PM position on channel 1 with reference 1mm/10V and offset of 123.5 mm. Value/output: P205 = 124.5 mm => U = +10 V P205 = 123.2 mm => U = -3 V
5002 <channel> <PNU <mask> <logic>	Analog Monitor display logic state (low = 0V, high = 5V) of a parameter´s bit mask [3)] channel: 1 or 2 PNU: ≥ 100 mask: bit(s) included for display logic: logic operation between the bit included in „mask“ 0: OR 1: AND
5003	Read Analog Monitor settings
5004 <channel>	Activate time stamps output on channel 1 or 2 (no AM available on this channel while time stamps activated)
5005	Deactivate time stamps output
5006	Read time stamps settings
5007 <time stamp> <voltage>	Change time stamp voltage, time stamp: 1...7 (process or interrupt routine ID of the IDS)
5008	Start PM analysis
5009	Abort PM analysis
5010	Read PM analysis results

Command/Parameter	Description
5011	Display PM positions recorded in PM analysis
5500	Output Parameter Request on [4)]
5501	Output Parameter Request off [4)]
5502	Output Parameter Response on [4)]
5503	Output Parameter Response off [4)]
5600	Output DO1
5601	Output DO2
5700 <Address> <Number>	Read several bytes out of the netX50 Dual-Port-Memory. Address: 0...3FFF (16 KByte) Number: number of Bytes to read
8000	Read PIC32 Info (Firmware-Version, etc.)
8888	Reset Factory Settings
9000	Read netX50 Info (Firmware-Version, etc.)
9999	Soft-Reset

Table 29: RS232 commands

1) if permitted
2) Data types 2...4, 8
3) Data types 5...7, 10
4) CAUTION: With these outputs activated communication timeouts are possible in the I/O Controller !!!

4.6.3 Command input

Some parameters are also addressable with their ID (small/big letters are not observed).

Attached values of a command are separated by blanks, the left and right part of floating point values are separated by a dot character.

Input	Response	Description

`1000 200`
 	
`1000 dmpe_kfg`
	`10000000h`
	
	`IDS>`
		Read parameter (≥ P100)

`1003 17 0.75`
 	
`1003 dmpe_ssw 0.75`
	`0.75 V`
	
	`IDS>`
		Write parameter (P1...P99)

`2006 5.8 0.2 9.0`	`IDS>`	Change key mark parameters, take over values in the process
`5002 1 200 2 0`	`IDS>`	Analog output logic state, Bit 1, Configuration, channel 1
`5002 1 200 1FF 1`	`IDS>`	Analog output logic state bitmask 1FF, conjunction (AND)
`5001 2 205 0.1 212.0`	`IDS>`	Analog output of actual PM position on channel 2, reference 0.1 mm / 10 V, offset 212.0 mm

`5003`	`Channel Value Value/Mask Offset/Logic`
	`1 201 10000000h none`
	`2 210 1.000mm/10V 0.000mm`
	
	`IDS>`
		Display actual settings of the Analog Monitor

`5600`	`___||___-____-___________||__|___--_`
	
	`IDS>`
		Simple plot of DO1

Table 30: RS232 command input

5 Addendum

5.1 Sensor calibration

5.1.1 General description

The analog sensor has to be calibrated through a so called “Sensor Adjustment” (SA) before use. The sensors are configured ready-to-use for the two standard fiber optics (length 2,5 m and 5 m) and therefore fully operable without further calibration. After the SA the new setting of the digital voltage dividers is saved permanently in the PIC32 flash memory (Sensor 1). The setting for Sensor 2 is saved on the DS itself.

A new SA could be necessary only in rare cases and should only be done by trained personnel.

5.1.2 Configuration for 2,5 m and 5 m fiber optic (P4)

The device is delivered with two preset SA data sets. After changing a fiber optic with another of the same length the voltage remains within a tolerance range of less than 100 mV (voltage on white surface in the sensor gauge).

At first use the 1st data set for 2,5 m is selected, loaded after Power Up / Reset and written in the digital voltage dividers. Using a 5 m fiber optic the 2nd data set has to be selected (s. table 31).

By sending command 6010 the selected data set is taken over and saved permanently in the PIC32´s flash memory, so at the next Power Up / Reset of the device the previously selected data set is loaded. The actual value of the selection is stored in parameter P150 (read only).

Reference note:
After Reset to Factory Settings (command 8888) the original data sets are loaded and the 1st data set for 2,5 m fiber optic is selected automatically.

All user-defined sensor adjustments are overwritten.

Configuration selection data set / fiber optic length (P4)		
Bit	**Notation**	**Assignment**
0	Data Select Sensor 1 (IDS)	**0**: 1st data set for 2,5 m fiber optic selected **1**: 2nd data set for 5 m fiber optic selected
1...3	-	reserved
4	Data Select Sensor 2 (DS) 1)	**0**: 1st data set for 2,5 m fiber optic selected **1**: 2nd data set for 5 m fiber optic selected
17...31		reserved

Table 31: Data set selection

1) Selection for an additional analog sensor DS (Sensor 2), if connected.

5.1.3 Sensor Adjustment

The Sensor Adjustment (SA) is carried out by means of a special sensor gauge an consists of two steps, the white adjustment (Increase) and the black adjustment (Threshold) as displayed in fig. 5.1.

The white adjustment takes place above special barite paper (neutral white matt, less fluorescent).

The standardized color RAL9001 (white semi matt) is similar to the barite paper in the sensor gauge.

For the black adjustment a special non reflecting black foam plastic is used as substrate.

Reference note:
Generally the devices are delivered with SA for the two standard fiber optic lengths of 2,5 and 5 m

A new SA could be necessary only in rare cases and should only be done by trained personnel.

For a new SA with 2,5 or 5 m fiber optic the respective data set selection in parameter P4 has to be considered.

The white adjustment is performed by command 6004 (7004 for Sensor 2) and the black adjustment by command 6005 for Sensor 2), see also 5.1.3.1.

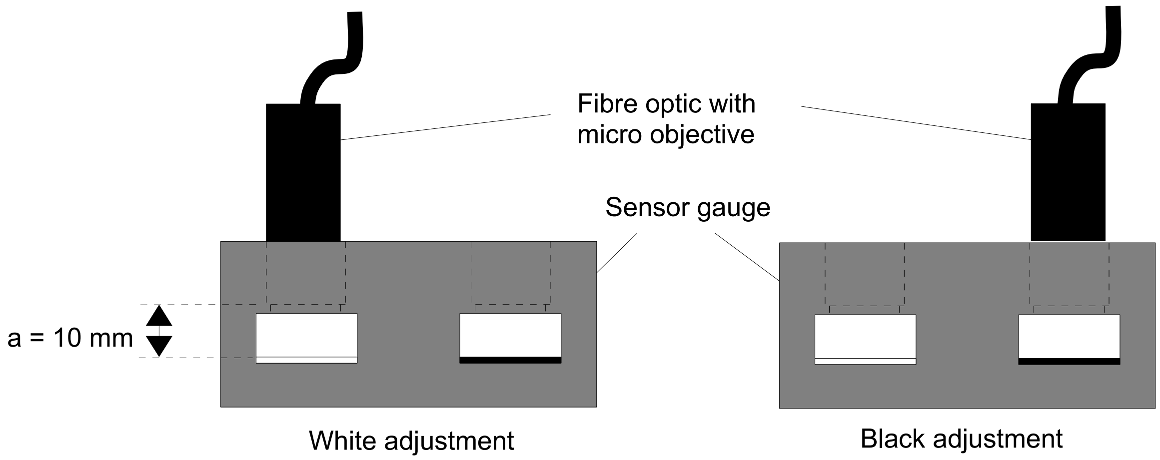


Figure 5.1: Sensor Adjustment overview

The setpoint voltage above the white substrate amounts to 2,7 V an above the black substrate to 100 mV.

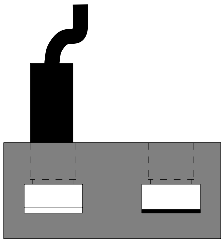
The accuracy of the white adjustment is less than ± 10 mV and of the black adjustment less than ± 5 mV.

5.1.3.1 Sensor Adjustment procedure

A complete SA has to correspond to the following sequence:

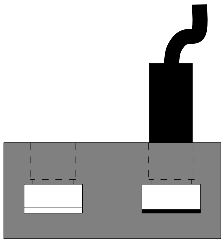
1) Insert the objective above the white substrate up to the limit stop and hold it there.

   Send command 6004 (Sensor 1) for automatic white adjustment



2) Insert the objective above the black substrate up to the limit stop and hold it there.

   Send command 6005 (Sensor 1) for automatic black adjustment



3) Repeat step 1) once

> **Reference note**:
> The procedure for Sensor 2 (DS) is the same as described above, but with command 7004 for white and command 7005 for black adjustment.

5.1.3.2 Set Point Voltage White Adjustment

The set point voltages for white adjustment in the sensor gauge are preset to 2,7 V and do not have to be changed in normal cases.

The automatic white adjustment is suitable for set point values between 1,65 V minimum and 6,4 V maximum (limit values for parameter P47 and P48).

A set point value of 1,75 V for example increases the range of acquisition up to quadruple white level.
If required a set point above 2,7 V increases the voltage travel of colored print marks on very dark material.

> **Reference note**:
> The SA is preset by the manufacturer for the two standard fiber optic lengths.
>
> Changing the set point voltage is only necessary in rare cases and should be done by trained personnel only.

By writing parameter P47 a new set point voltage is given for IDS-PN (Sensor 1) and by writing P48 for the DS (Sensor 2).

The new values are taken over either by sending command 2000 or separately by one of the commands 2027 (P47) or 2028 (P48).

The actual set point voltages are stored in parameter P847 (Sensor 1) and P848 (Sensor 2), both parameters are read only.

5.2 Technical data

5.2.1 In general

Technical data IDS	
Voltage supply	24 V DC ±25%
Rated current	0,35 A
Max. switch on current	1,3 A
Accuracy print mark detection	1,5...3,0 µm (mean absolute deviation)
Maximum speed for PM detection	1000 m/min
Communication interface	PROFINET IRT
Protection class	IP65
CE label	CE
Environment temperature (operation)	0...40 °C (32...104 °F)
Weight (without fiber optic)	850 g

Table 32: General technical data

5.2.2 Interfaces

Name	Characteristics	Description
24V=	24V DC ±25%	Voltage supply
Ethernet 0/1	100 Mbit/s Conformance Class C Ethernet II IEEE 802.3	PROFINET I/O (IRT) 2-Port Switch
Sensor extern	Input: current signal rated value 0...20 mA max. value: 30 mA Output: 12 V DC (sensor supply)	Analog Sensor 2 for backside detection and Web-Web-2
Encoder	Encoder input TTL incremental encoder signal A, /A, B, /B Input Frequency max. 80 kHz Output Current max. 140 mA	Encoder input for side register position
RS232	COM-Interface 9600 Baud 8 data bits 1 stop bit no parity no flow control	Terminal for command input / diagnosis
Analog-Signal 1/2 (DIAG)	0V...6,6V DC output	Sensor 1/2 (intern/external) input signal
Digital-Signal 1/2 (DIAG)	5V TTL output	Sensor 1/2 (intern/external) input signal, sampled (digitized)
Analog-Monitor 1/2 (DIAG)	±10V DC output	2 channels, output values are configurable with the command input terminal
Latch (DIAG)	5V TTL output active low	PM detection latch pulse pulse width 10...30 µs
ICSP (DIAG)	Data in-/output output 3,3 V DC	„In Circuit Serial Programming“ of Microchip Program/Debug Interface

Table 33: Interfaces technical data

5.3 Type label

A type label for identification of the IDS is located on the bottom of the device.

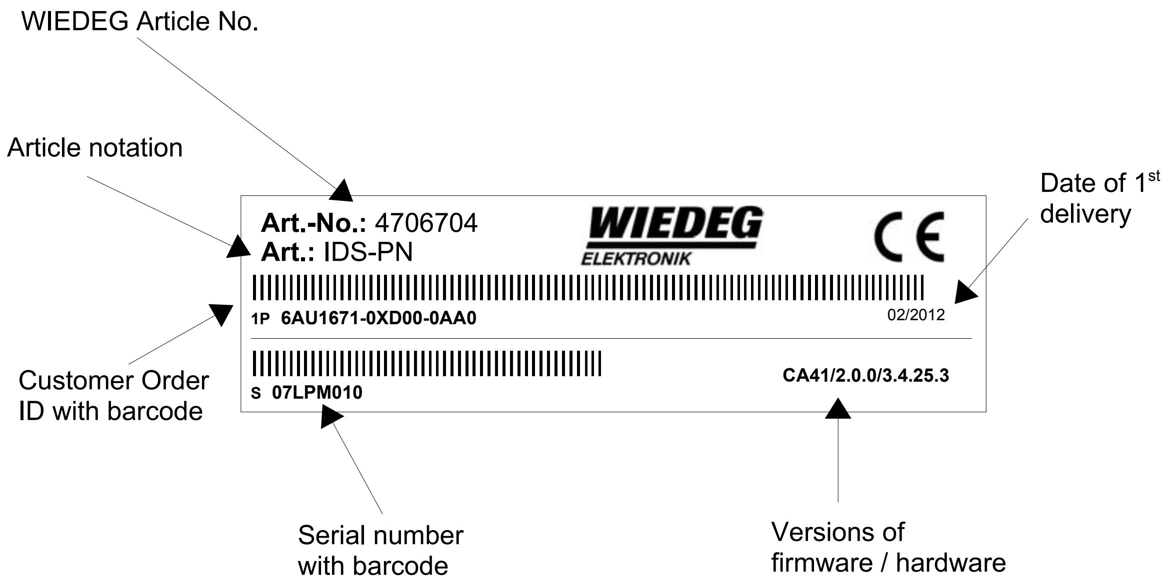


Figure 5.2: DS type label

5.4 Related documents

[1] “Profile-PROFIdrive_3172_V41_May06.pdf“ by the PROFINET user organization (PNO)

[2] “Profile-Guideline-DataTypes_3512_v10_Sep06.pdf“ by the PROFINET user organization (PNO)

[3] “IDS-PN Reference Manual de V2.0.pdf” by WIEDEG GmbH
(at this time only available in german)

[4] „netX LED Description en.pdf“ by Hilscher GmbH

5.5 Declaration of Ex-Protection-Confirmation

WIEDEG
ELEKTRONIK

WD/HO
17.02.12

Declaration of Ex-Protection-Confirmation

For the use in explosion risk areas with grade **zone 2** we declare for our products

IDS-PN Intelligent Print Mark Detection Sensor PROFINET and
DS Print Mark Detection Sensor

ex-protection confirmation according to the ATEX directive (94/9/EG) with the following classification/designation

Device group	II
Device category	3 G
Ignition protection type	[Ex op is]
Explosion group	IIC
Temperature class	T6
Device protection level	Gc
Operational conditions	X

Operational conditions have to be established in order that only fibre optic cables with microobjectives are situated within the explosion risk area. The sensor electronic has to be placed outside of this area.

This declaration is based on our test report with ex-protection classification dated 02/16/2012.

WIEDEG Elektronik GmbH

(G. W. Wiederstein)