HAEHNE

Amplifier Busbox Profibus

Special Features

- Amplifier with Profibus interface
- User friendly commissioning via GSD file on www.haehne.de
- Transmission rate up to 12 Mbit/s
- 16 bit resolution

Busbox P2

Single channel amplifier for one or two strain gauge sensors in an aluminum enclosure suitable for field mounting.

Protection class IP67
Weight 175 g

Busbox PS2

Single channel amplifier with one strain gauge sensors connection in an aluminum enclosure suitable for DIN rail mounting. Amplification of 2 strain gauge sensors possible.

Protection class IP20
Weight 175 g

Option
- Option F (Ex-protection): Use with safety barriers

Busbox PEZ

Dual channel amplifier for two strain gauge sensors.

Consisting of two PS2 with wiring to the terminal block in high-quality stainless steel enclosures suitable for aggressive surroundings, e. g. in rolling mills.
Each web tension sensor at each roll end is assigned to its individual amplifier, which is connected to the Profibus with its own individual address for transmitting the measured force value.

Protection class IP67

The Busboxes are used whenever full bridge strain gauge sensors are to be connected to the Profibus DP.
The primary field of application is web tension measurement.
It is possible to connect either each sensor separately to one Busbox and transmit the measurement value of each sensor onto the Bus or connect two sensors to one Busbox to get the average value.

The Profibus amplifier consists of an analog and a digital module. It can power one or two sensors and process the measuring signals. The measurement values are converted into digital signals, averaged and transmitted to the interfaces module every 3 milliseconds. The interface module converts the signal to the appropriate data format for transmission to the bus.

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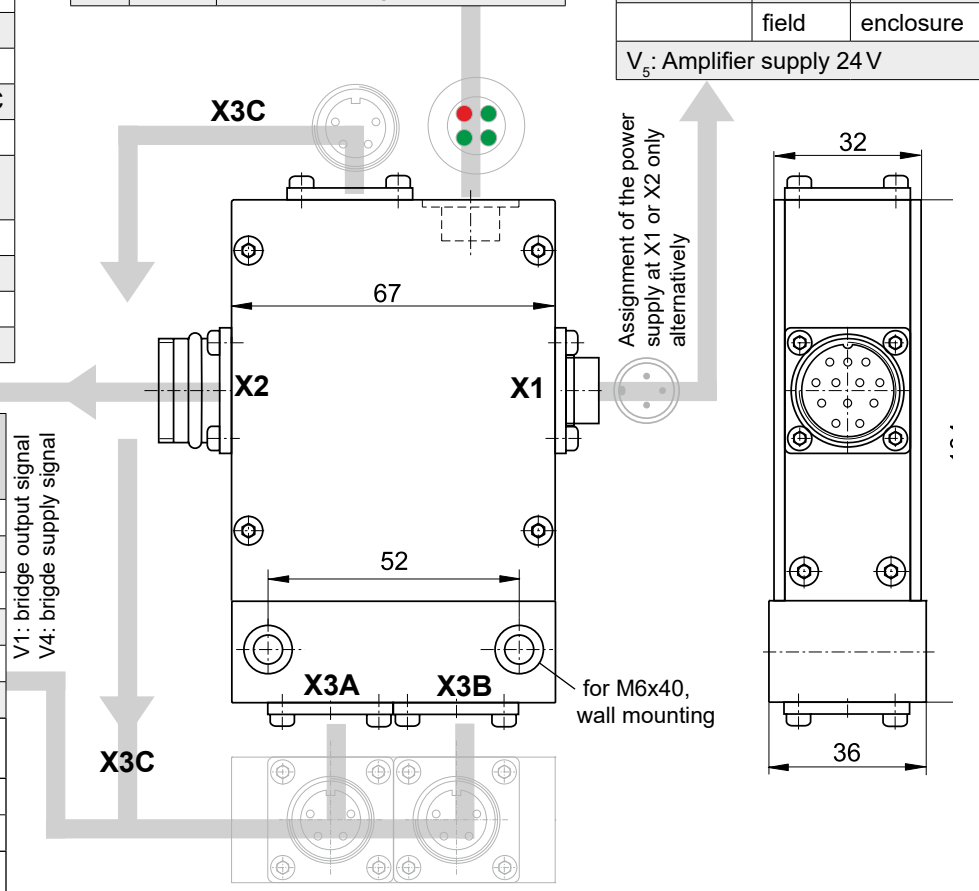
Busbox P2

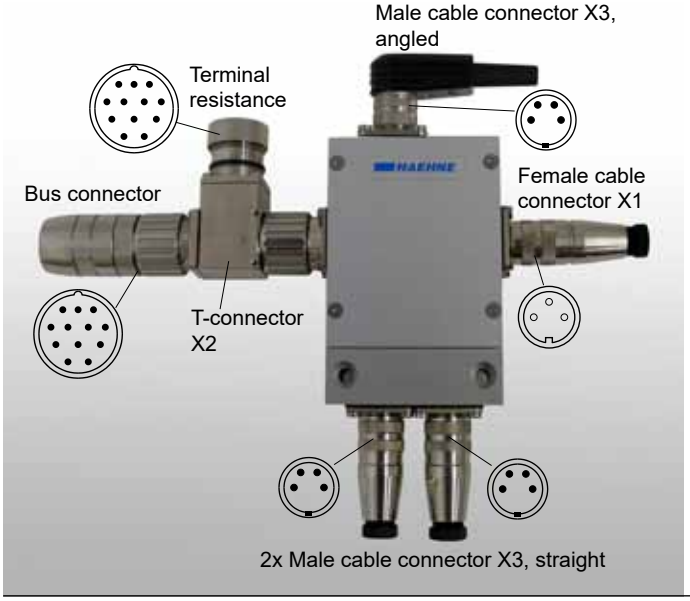
Profibus DP (Female flange connector)		
lead color	pin no.	function
	1	GNDI
green	2	line A
	3	n. c.
red	4	line B
	5	n. c.
	6	VCCI
black	7	+24 VDC
blue	8	0 V
green/ yellow	9	PE
	10	n. c.
	11	n. c.
	12	RTS
	enclosure	PE

LED Configuration LED display		
U_L	green	Power supply is on
Sa	green	Slave address changed
BA	green	Profibus data exchange
F	red	Incorrect configuration

Power supply X1 (Male flange connector)		
lead color	pin no.	function
white	1	+24 V (V_5+)
brown	2	GND (V_5-)
green	3	PE
	field	enclosure
V_5: Amplifier supply 24 V		

Sensor connection		Female flange connector
lead color	pin-Nr.	X3A/B/C
white	1	$+V_1$
brown	2	$-V_4$
green	3	$-V_1$
yellow	4	$+V_4$
	field	enclosure
For sensors with plug connection S1, S2, N2:		
1 white	2 blue	
3 black	4 brown	
Wire assignment before 08/2005: Only for PUR cable without explosion protection (outer sheath black):		
1 white	2 brown	
3 blue	4 black	





Scope of supply P2
- Electronic unit designed into an aluminum enclosure
- GSD file
- 2 Male cable connector (X3), straight
- 1 Protection cover (X3C)

Additionally available
- Female cable connector (X1), straight
- Female cable connector, (X1), angled
- Male cable connector (X3), angled
- T-connector (X2)
- Bus connector
- Terminal resistor

Connecting examples

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Busbox PS2

Sensor connection		Female flange connector
lead color	pin-no.	**X3A/B/C**
white	1	$+V_1$
brown	2	$-V_4$
green	3	$-V_1$
yellow	4	$+V_4$
	field	enclosure
V1: bridge output signal V4: brigde supply signal		
For sensors with plug connection S1, S2, N1, N2:		
1 white	2 blue	
3 black	4 brown	

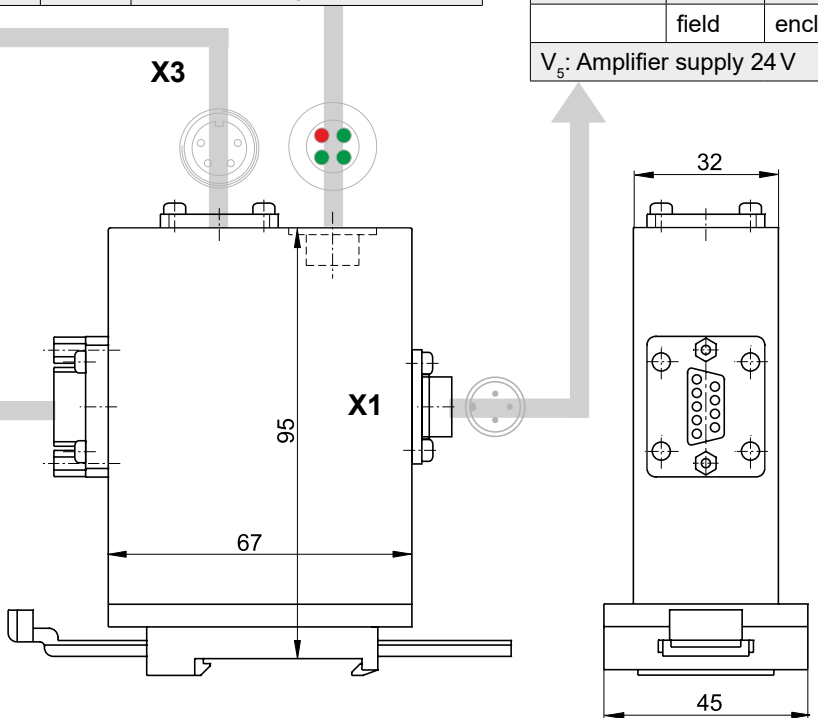
LED Configuration
LED display

F Sa
U_L BA

U_L	green	Power supply is on
Sa	green	Slave adress changed
BA	green	Profibus data exchange
F	red	Incorrect configuration

Power supply X1 (Male flange connector)		
lead color	pin-no.	function
white	1	+24 V (V_5+)
brown	2	GND (V_5-)
green	3	PE
	field	enclosure
V_5: Amplifier supply 24 V		

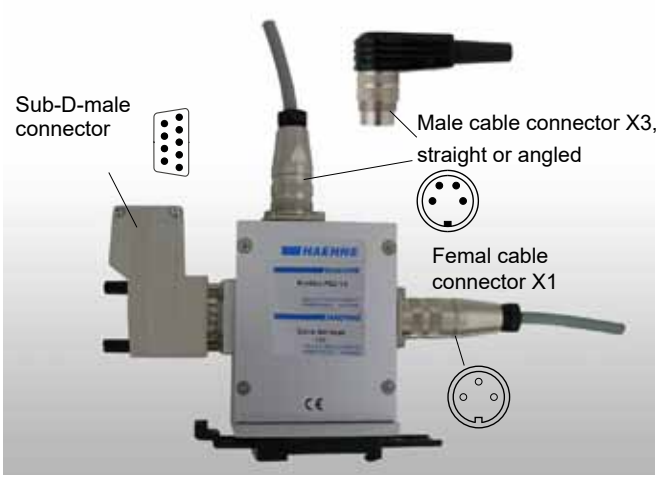
Profibus DP-connection (Sub-D-male connector)	
pin-no.	function
1	n. c.
2	n. c.
3	linie B (red)
4	RTS
5	DGND
6	VP / VCCI
7	n. c.
8	linie A (green)
9	n. c.



Clip for mounting on DIN rail,
35 mm as DIN EN 50022

Scope of supply PS2
- Electronic unit designed into an aluminum enclosure
- GSD file
- Male cable connector (X3), straight
- Female cable connector (X1), straight
- DIN rail clip

Additionally available
- Profibus Sub D-male connector
- Male cable connector (X3), angled
- Female cable connector (X1), angled



Connecting example

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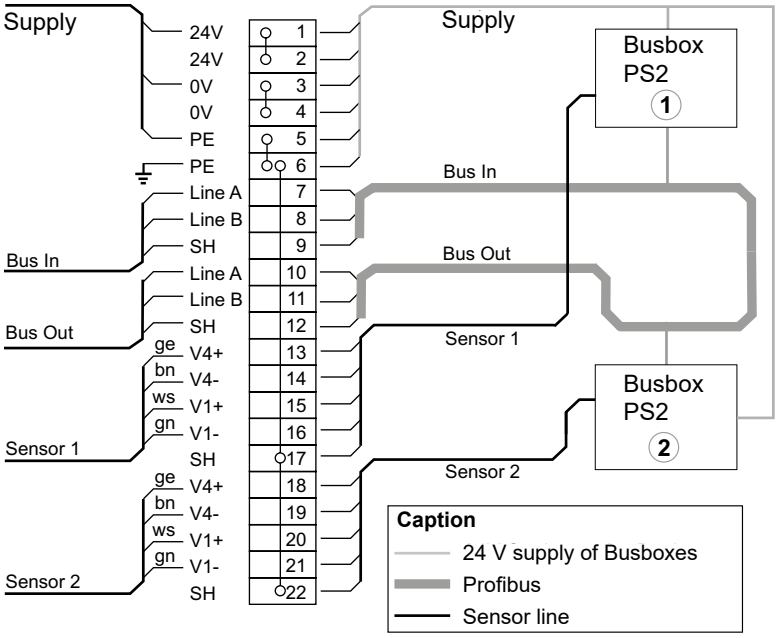
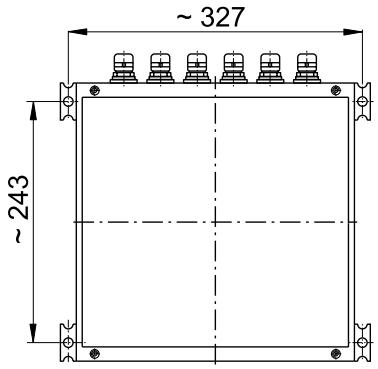
Busbox PEZ

Shield of supply voltage cable and sensor cable have to be connected with the enclosure within the EMC cable gland.

Terminal diagram



Schematic structure



Enclosure dimensions
300 x 300 x 161 mm

Other enclosures on request

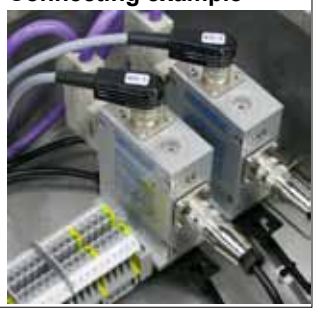
Sealing enclosure: VMQ / PUR
Sealing screw connection: CR / NBR
Protection class IP67

If further participants follow the Busbox unit, the terminal resistors of the SUB-D-plugs at both Busboxes must be switched to „OFF“.
If the Busbox unit is the last Bus participant, the terminal resistor of the SUB-D-plug of this Busbox must be switched to „ON“.

Scope of supply PEZ

- 2-channel-amplifier for two sensors built into a stainless steel enclosure, wired to the terminal blocks
- 2 Busboxes PS2
- GSD file on www.haehne.de

Connecting example



Technical Data for all Busboxes Profibus

Power supply V_5 each Busbox	20,5…30 V, typ. 50 mA
Supply voltage, each sensor	4,5 V / max. 18 mA
Signal	-160 % …0 … +160 % ≙ 8000…0000…7FFF
Nominal temperature range	+10…+60 °C
Operational temperature range	0…+60 °C

Profibus DP	
Participant-ID	00E7 hex (Data defined in GSD file “ HAEH00E7.GSD“)
Data width	1 word
Resolution	16 bit

Ordering data

Please consider with the order:	Version Busbox	Nominal rating of the sensor
The amplification of the Busbox is pre-setted and in particular correlation with the nominal rating of the *HAEHNE* sensor.	-1,5	1,5 mV/V
	-1,0	1,0 mV/V
	-0,75	0,75 mV/V
	-0,5	0,5 mV/V

Order example for a bus box: **P2-1,5**
Version
Type

Ordering example for option F:

Indicate the total resistance from measuring chain for option F (e. g. 500 Ohm):

PS2-F500-1,5

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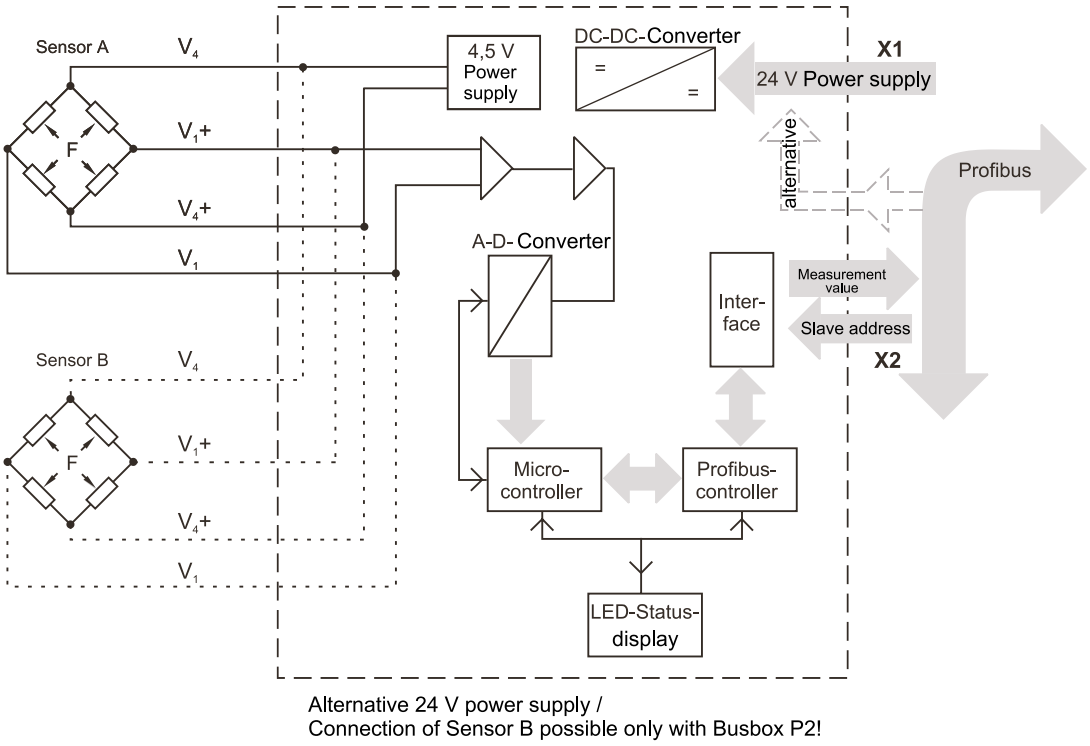
Design and Data Transmission

The analog part supplies power to the sensors and processes the analog signals. After converting with 16 bit resolution the force values are transmitted to the Profibus in the corresponding format.
(see: Technical Information "Profibus DP")



Alternative 24 V power supply /
Connection of Sensor B possible only with Busbox P2!

Circuit Variants

When measuring web tension at both roll ends there are two possibilities for analyzing the forces:

1. Transmission of average force value

Both sensor cables are connected separately to the amplifier unit. Connecting the strain gauge bridge in parallel leads to an average of voltage values proportionally to the force. The uneven force distribution on both bearing sides are thereby accounted force. The average force value is processed and transmitted to the bus master.

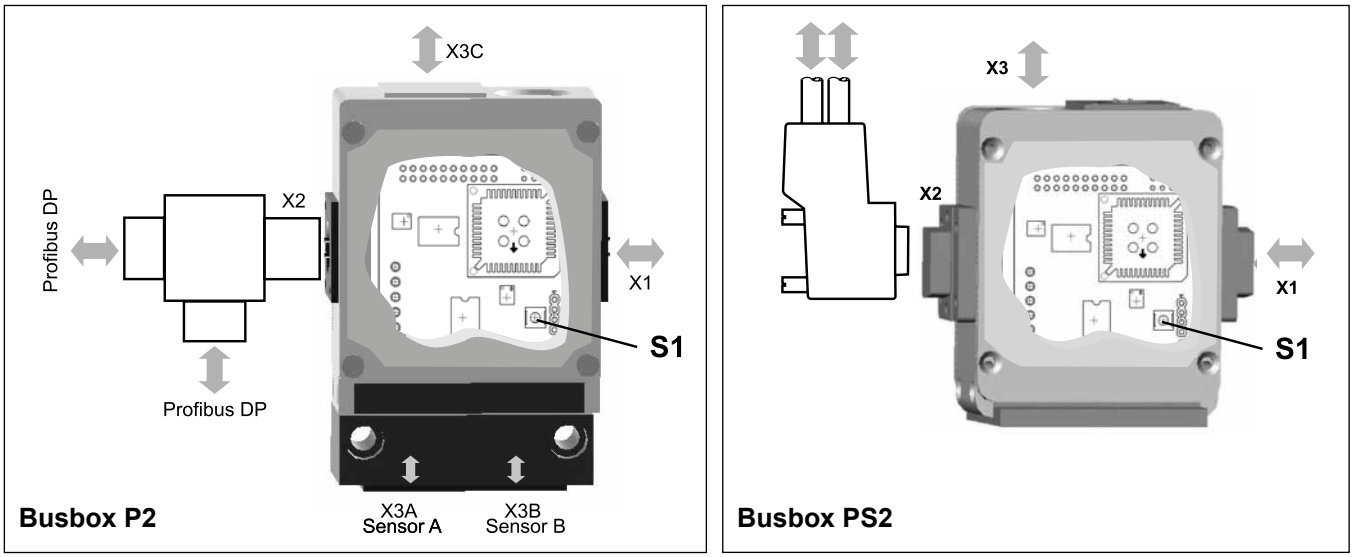
The complete measuring roll is therefore one participant in the Profibus system.

In order to test the sensor separately the plugs X3A and X3B can be alternatively disconnected. Also under running conditions (however, not under close loop conditions). For evenly running web in the middle of the measuring roll the single measurement values should vary very little from each other.

2. Separate transmission of sensor force values

Here each force sensor is connected separately to an amplifier unit. The average value is then calculated with special programs in the bus master. The solution requires more hardware (one additional amplifier unit for each measuring roll) however, it allows a continuous control of each bearing side without manual intervention and also the calculation of different values.

At the beginning and at the end of a segment terminal resistors must be connected, in order to guarantee a physically clean signal level. These are already integrated (Busbox PS2) and controlled by switches or be attached to the bus end with a quick disconnect T-connector (same as Busbox P2).



Remove the cover of the Busbox as seen in the pictures above (plug is to the left of the Busbox). Push the switch S1 for min. 8 seconds under operating conditions in order to reset the slave address to address 126. Subsequently, any slave address (1-125) can be assigned to the Busbox.

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Design and Data Transmission

The analog processed and digitally converted signals are transmitted to the Profibus. The measuring range is ± 160 % of nominal force for sensors with a nominal sensitivity of 1,5 mV/V. If the measurement direction has a vertical component, e.g. the roll weight, then force values are transmitted without acting web forces.

The Busmaster receives the calibrated sensor force values. In order to determine the web tension force correctly the tara value (roll weight portion) and the web geometry have to be accounted for.

Measurement Data Transmission

Presentation in 16-bit-register as complement of two

Measurement value based on F_{nom}	Measurement value of bridge output signal V_1 [mV] Sensor and Busbox with: 1,5 [mV/V]	1 [mV/V]	0,75 [mV/V]	0,5 [mV/V]	hex	dez (unsigned)	dez (signed)	MSB 15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	LSB 0
+ 150 %	10,125	6,75	5,0625	3,375	7800	30720	30720	0	1	1	1	1	0	0	0	0	0	0	0	0	0	0	0
+ 100 %	6,75	4,5	3,375	2,25	5000	20480	20480	0	1	0	1	0	0	0	0	0	0	0	0	0	0	0	0
+ 50 %	3,375	2,25	1,6875	1,125	2800	10240	10240	0	0	1	0	1	0	0	0	0	0	0	0	0	0	0	0
0 %	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
- 50 %	-3,375	-2,25	-1,6875	-1,125	D800	55296	-10240	1	1	0	1	1	0	0	0	0	0	0	0	0	0	0	0
- 100 %	-6,75	-4,5	-3,375	-2,25	B000	45056	-20480	1	0	1	1	0	0	0	0	0	0	0	0	0	0	0	0
- 150 %	-10,125	-6,75	-5,0625	-3,375	8800	34816	-30720	1	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0

Other measurement values can be calculated with following formulas:

The following applies to positive measurement values:

$$A = 20480 \cdot \frac{F_M}{F_{nom}}$$

The following applies to negative measurement values:

$$A = 65536 - 20480 \cdot \frac{F_M}{F_{nom}}$$

A:	Measuring value in decimal
$\mathbf{F_{nom}}$:	Nominal force of sensor
$\mathbf{F_M}$:	Measuring force
$\mathbf{C_{nom}}$:	Nominal rating
$\mathbf{U_M}$:	Sensor output voltage

The entire measuring range of ± 160 % is resolved in 2^{16} = 65536 steps.
0 to 100 % corresponds to 20480 steps.

The equation applies only für adapted measuring systems,
i. e. nominal rating of sensor ≙ nominal rating of Busbox.

Exceptation: e. g. compression force sensor DK4; in this case the 1,5 mV/V Busbox is used for 1,25 mV/V sensor nominal rating. Therefore a correction factor ($\frac{1,25}{1,5} = 0,833\overline{3}$) must be used.

The measurement force can be measured either directly with an appropriately calibrated sensor or be determined with the sensor output signal. The following formula applies:

$$\frac{F_M}{F_{nom}} = \frac{U_M}{C_{nom} \cdot 4,5\ V}$$

Example 1:

Sensor: BZH-K01R20k
Nominal rating sensor: 1,5 mV/V
Nominal force sensor: 20 kN

Profibus amplifier: P2-1,5
(The amplification is adapted to 1,5 mV/V sensors)

A force of 16,2 kN is applied to the sensor

$$A = 20480 \cdot \frac{16,2\ kN}{20\ kN} = 16588,8$$

$$\Rightarrow 16589_{dez} \triangleq 40CD_{hex}$$

Example 2:

Sensor: BZH-K03R200kN
Nominal rating sensor: 1,0 mV/V
Nominal force sensor: 200 kN

Profibus amplifier: P2-1,0
(The amplification is adapted to 1,0 mV/V sensors)

A force of -95 kN is applied to the sensor

$$A = 65536 - 20480 \cdot \frac{95\ kN}{200\ kN} = 55808$$

$$\Rightarrow 55808_{dez} \triangleq DA00_{hex}$$

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Profibus DP

Technical Information

Special Features

- Topology: Line structure
- Mono or Multimaster operation possible
- Transmission rates up to 12 MBit/s
- User friendly installation with supplied GSD file

Application

The Profibus DP was specifically developed for the communication between automation systems and decentralized equipment on the field level.
It is possible to design Mono or Multimaster systems. Monomaster systems consist of one DP Master class 1 and up to 125 slaves. This configuration leads to the shortest bus cycle times because of the strict master slave access mode.
In case of the Multimaster system several masters are present in the bus. These can form independent subsystems consisting of one master and the associated slaves. Another possibility of the Multimaster system allows additional masters to be used as additional design and diagnostic systems. The Profibus is standardized according to DIN 19245. The standardization on the European level has been made in accordance with CENELEC in the standard EN 50 170.

Bus Structure

The topology of a Profibus DP segment is a straight line structure. Because of the high tact frequency on the bus no short branches are allowed. However, with the use of repeaters to couple several segments, other topologies can be realized.

Transmission Media

The physical transmission media can be either fiber optics or twisted bus cables. The electrical interface is specified according to RS485. The participants are either connected via a terminal or a connecting plug.
A maximum of 32 units including the masters can be connected to one bus segment. It is possible to connect separate bus segments with a repeater. The largest number of participants connecting several bus segments depends on the performance of the master and is limited according to EN50170 to a maximum of 126 participants. The maximum cable length of one segment depends on the selected transmission speed. For very time critical applications transmission rates of 12 Mbit/s are possible. In the case of fiber optics the largest distance between two participants is 9 miles, the maximum transmission rate is 1,5 MBit/s.
The longest length of the segment in case of fiber optical transmission depends on the transmission rate.

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Data Communication

For the communication between participants it is necessary to ensure that the data exchange between complex automation systems can be accomplished in a defined time grid with sufficient length of time. On the other hand one must ensure that a real time data exchange between a complex automation system and the associated simple slave is accomplished with a minimum of effort. Because of these conflicting demands, a toking pass procedure was introduced between bus masters and master slaves sub systems. Each master receives cyclically for a limited time the access rights (Token) for the slaves. In this limited time the master can access in the master slave mode the slaves. The maximum token cycle time can be adjusted as a parameter.

Connection and Installation of HAEHNE Profibus DP Electronic Systems

Connection of the Profibus DP Cable

The incoming and outgoing Profibus cables are connected to a 12 pin cable plug with inserted pins.
(as shown on the picture below).

After completed assembly both cable plugs are placed onto the receptacles of the T-piece. The direction of the connection is immaterial. The last participant at the end of the bus receives a closing plug with adapted terminal resistance instead of an outgoing bus cable. With the exception of the first and the last participant on the bus which have the plugs with terminal resistance, each participant can be disconnected at the T piece under normal operating conditions. This enables the easy exchange of an participant and in this case a sensor.
In order to achieve the highest system availability the bus topology should be designed in such a way that one adapted resistance load is at the master.

Important: Between electrically conducting equipment parts a potential equalization line with sufficient cross section has to be provided!

Calibration

The web tension measurement systems are all factory calibrated. In order to ensure the correct measurement it is necessary to observe the instructions for mounting the sensor and take into account the web geometry as well as the roll weight.

Connection of HAEHNE Profibus Systems to the Computer and Installation

The power supply of HAEHNE Profibus systems can be accomplished via the bus cable. If the bus cable contains no cable for the power supply external power supply with the 3 pin plug at the system is possible.
The commissioning of the system begins after the following steps have been executed:
The cable connection to the Profibus participants has been made and the potential equalization line to all conducting equipment parts have been installed and power is applied. The commissioning of the systems should be made step by step by connecting the slave units one after the other to the bus. A data medium with the GSD file is part of the scope of supply. This file contains all systems data for the configuration of the bus system. Depending on the configuration software in use the GSD file can be incorporated in the systems configurator. In that case the configuration occurs largely automatic.

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Amplifier Busbox Profibus

Installation Assignation

Notes regarding the installation of Profibus Busboxes with Siemens Step 7

Working with GSD Files

All the properties of a DP slave are saved in a device database (*.GSD) file. Step 7 requires a *.GSD file for every DP slave in order that the DP slave can be selected in the module catalog. The manufacturer supplies a *.GSD file for non-Siemens devices that are DP slaves.

Installing a *.GSD File

If a DP slave does not appear in the „Hardware Catalog“ window, you must install the corresponding *.GSD file supplied by HAEHNE:

1. Select the menu command *Options > Install New *.GSD Files*
2. In the dialog box that appears, open the drive/directory containing the corresponding *.GSD
   Result: The DP slave is entered in the „Hardware Catalog“ window under „PROFIBUS-DP\Other Field Devices“ and is then available to be used for configuring.

Changing the Profibus Address of HAEHNE Busboxes (up to Step 7 V 5.4)

DP slaves connected to a Profibus subnet must also have a unique Profibus address. The HAEHNE DP slaves support the function „Set_Slave_Add“ (for example, ET 200C), therefore you can assign the address with STEP 7. Before that, the Bus communication between Master/Slave must be stopped.

In the Simatic Manager and in Configuring Hardware you can assign a new Profibus address using the menu command *PLC>PROFIBUS>Assign Profibus Address*.

Tip: If you are not entirely certain of the current address assignment, you should connect the DP slaves to the PG/PC one by one and re-address them.

If requested HAEHNE delivers the Busboxes also with the desired Profibus address.

The function “Assign address” may no longer be available in higher versions. We recommend the use of SIMATIC PDM or similar software.

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