Profibus Amplifier Busbox P2G

Scope of Supply

- Electronic unit designed into an aluminium enclosure
- GSD-file on www.haehne.de
- Dummy plug

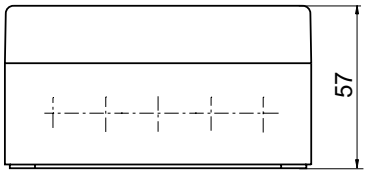
Variants

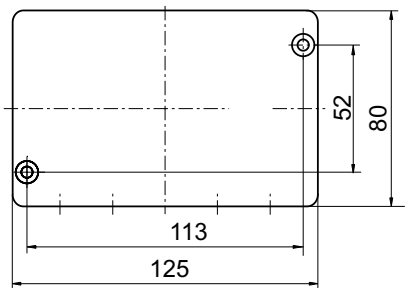
Option M: Potted amplifier modul

Option Z: Connection for 2 sensors

Special Features

- Amplifier with Profibus Interface
- Designed for one a strain gauge sensor
- User friendly comissioning via GSD file
- Transmission range up to 12 Mbit/s
- 16 Bit resolution
- Potted version for rotating machine elements available





The Busbox P2G is used whenever strain gauge sensors are to be connected to the Profibus DP. The primary application field is web tension measurement. A Busbox is assigned to each sensor, the addresses are assigned accordingly and the appropriate value is transferred to the bus.

The electronic module consists of on analog and a digital PCB. It can power one sensor and process the measuring signals. The measurement values are converted into digital signals, averaged and transmitted to the interfaces module every 3 ms. The interface module converts the signal to the appropriate data format for transmission on the bus.

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Busbox P2G

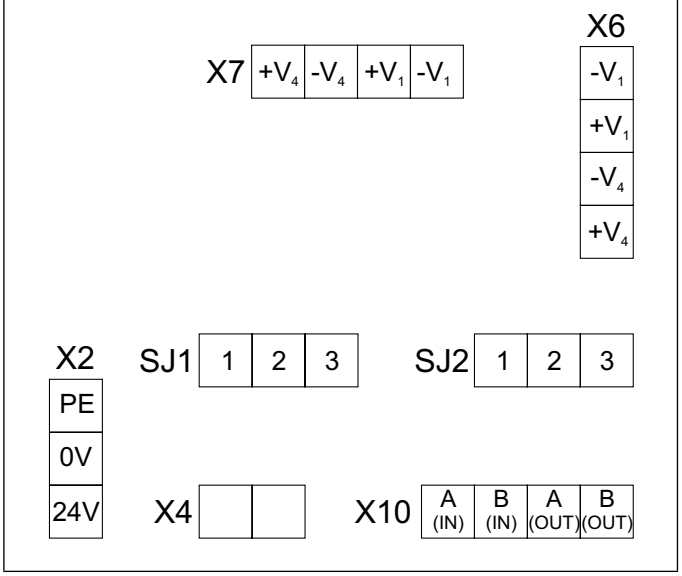
HAEHNE

Technical Data

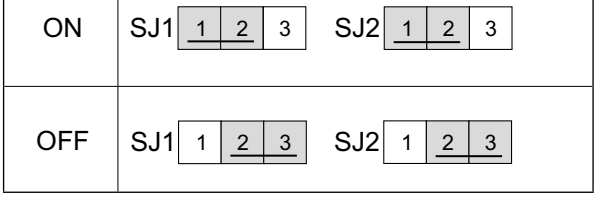
Power supply V_5	20,5…30 V, max 150 mA
Sensor voltage (Sensor A + B)	4,5 V / 18 mA
Signal	-10,8 mV…0 mV…+10,8 mV ≙ 8000…0000…7FFF
Standard protection	IP66
Nominal temperature range	+10…+60 °C (50... 140°F)
Operational temperature range	0…+60 °C (32... 140°F)

Profibus DP	
Participant-ID	00E7 hex (Data standardized in GSD-file “HAEH00E7.GSD“)
Data width	1 word
Resolution	16 bit
Weight	~ 700 g (approx. 5 lbs)

PCB



Terminatingresistor



Reset

The contact between the two solder terminals for the reset can be done with a screwdriver. After 8 sec. contact time the slave address is reset to 126.

Sensor Connection X6/X7	
$-V_1$	green
$+V_1$	white
$-V_4$	brown
$+V_4$	yellow

Profibus DP-Connection X10	
A (IN) green	A (OUT) green
B (IN) red	B (OUT) red

Please consider with the order:
The amplification of the Busbox is preset and corresponds to the nominal rating of the *HAEHNE* sensors. Other nominal ratings on request.

Version P2G	Nominal Rating *HAEHNE*-Sensor
-1,5	1,5 mV/V
-1,25	1,25 mV/V
-1,0	1,0 mV/V
-0,75	0,75 mV/V
-0,5	0,5 mV/V

Ordering Example:
P2G-M-1,5
- 1,5 — Version
- M — Option
- P2G — Enclosure
- P2G — Type

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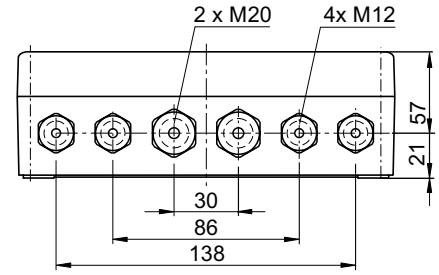
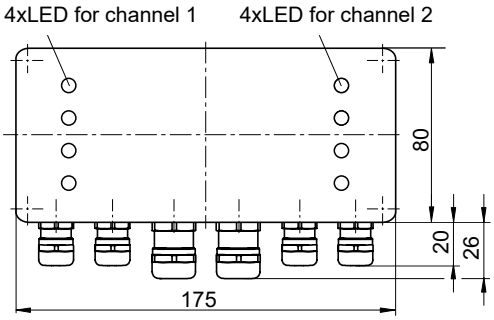
Profibus-Amplifier Busbox P2GM-2

Scope of Supply

- Amplifier with Profibus Interface in aluminium field enclosure
- GSD-file on www.haehne.de
- Dummy plug





Special Features

- Two independent measuring amplifiers with Profibus Interface
- Two separate slave addresses
- Designed for two to four strain gauge sensors
- User friendly commissioning via GSD file
- Transmission range up to 12 Mbit/s
- 16 Bit resolution
- Potted version for rotating machine elements

The Busbox P2G is used whenever strain gauge sensors are to be connected to the Profibus DP. The primary application field is web tension measurement. Each sensor is assigned a channel (1 or 2) and the single value is assigned to the bus. Possible are four sensors depending on the internal resistance.
The electronic module consists of on analog and a digital PCB.
It can power the sensors and process the measuring signals. The measurement values are converted into digital signals, averaged and transmitted to the interfaces module every 3 ms. The interface module converts the signal to the appropriate data format for transmission on the bus.

Please consider with the order:
The amplification of the Busbox is preset and corresponds to the nominal rating of the *HAEHNE* sensors. Other nominal rating on request.

Version P2GM-2	Nominal Rating *HAEHNE*-Sensor
-1,5	1,5 mV/V
-1,25	1,25 mV/V
-1,0	1,0 mV/V
-0,75	0,75 mV/V
-0,5	0,5 mV/V

Ordering Example:
P2GM-2-1,5
- Version
- Channels
- Enclosure
- Type

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Busbox P2GM-2

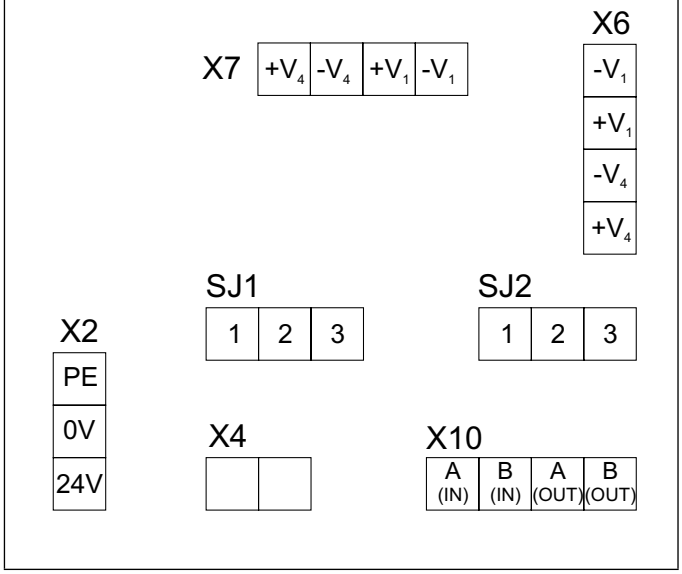
HAEHNE

Technical Data

Power supply V_5	20,5…30 V, typ. 100 mA
Sensor voltage (Sensor A + B)	4,5 V / 18 mA
Signal	-10,8 mV…0 mV…+10,8 mV ≙ 8000…0000…7FFF
Standard protection	IP66
Nominal temperature range	+10…+60 °C (50... 140°F)
Operational temperature range	0…+60 °C (32... 140°F)

Profibus DP	
Participant-ID	00E7 hex (Data standardized in GSD-file “HAEH00E7.GSD“)
Data width	1 word
Resolution	16 bit
Weight	~ 700 g (approx. 5 lbs)

PCB channel 1 and 2



Terminatingresistor channel 1 and 2

ON	SJ1	1 2 3
	SJ2	1 2 3
OFF	SJ1	1 2 3
	SJ2	1 2 3

Reset channel 1 and 2

X4 Reset

The contact between the two solder terminals for the reset can be done with a screwdriver. After 8 sec. contact time the slave address is reset to 126. For the reset of channel 2 will proceed with X4.2 exactly.

Profibus DP Connection X10 Channel 1			Profibus DP Connection X10 Channel 2	
A_1 (IN) green	A_1 (OUT) green	connected internally	A_2 (IN) green	A_2 (OUT) green
B_1 (IN) red	B_1 (OUT) red		B_2 (IN) red	B_2 (OUT) red

Sensor Connection	X6.1 / X7.1 X6.2 / X7.2	For sensors with plug connection S1, S2, N2:
white	$+V_1$	white
brown	$-V_4$	blue
green	$-V_1$	black
yellow	$+V_4$	brown
V_1: Signal voltage V_4: Supply voltage		

LED-Configuration				
●	**U_L**	green	Power supply	●
●	**Sa**	green	Slave adress changed	●
●	**BA**	green	Profibus data exchange	●
●	**F**	red	Incorrect configuration	●

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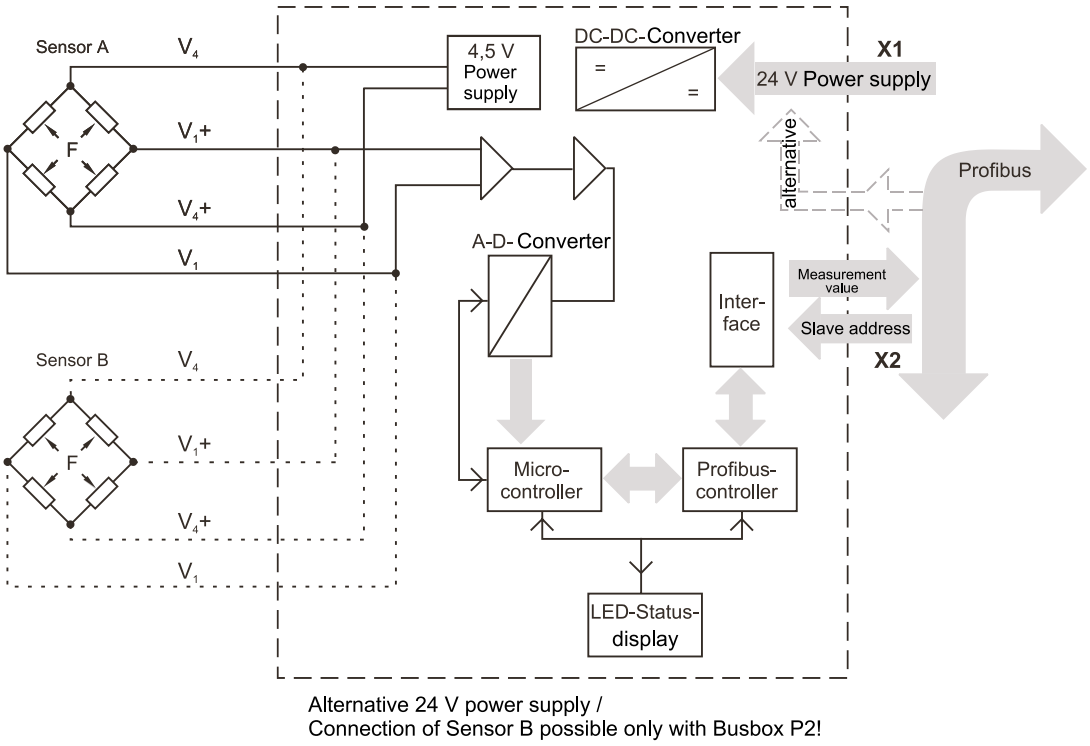
Design and Data Transmission

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.

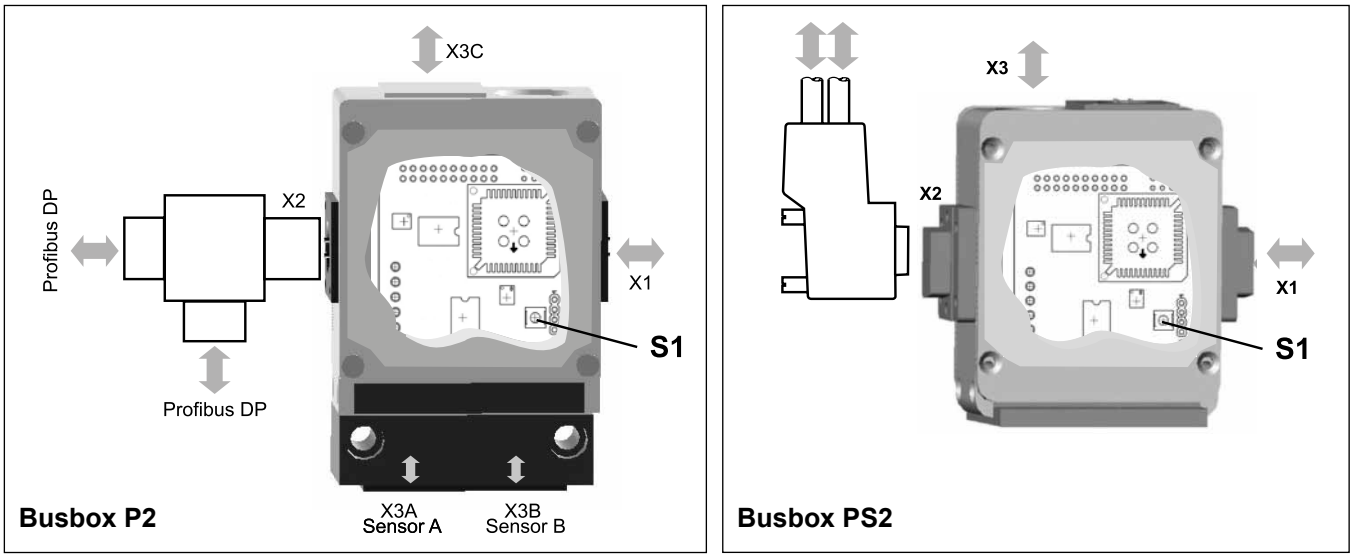
The complete measuring roll is therefore one participant in the Profibus system.

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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