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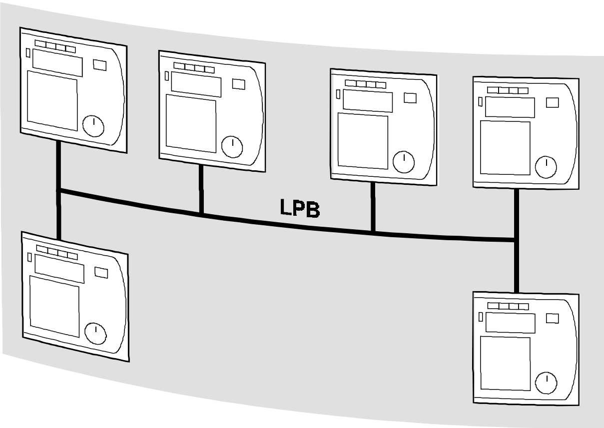

Local Process Bus LPB

Basic Engineering Data

The Local Process Bus (LPB) is used for the exchange of process-specific data required by heating controllers. It can also be used for the supervision of plant.

Use

Data exchange

The LPB is employed in heating plants for the exchange of process and operating data. For more information, refer to data sheet 2030, “Basic System Data”.

Devices with LPB capability

Devices with LPB capability can be connected to the LPB. Only a few very straightforward engineering guidelines must be observed when integrating the devices into a system.

Design

Bus cable

⚠

In its simplest form, the LPB consists of a twisted two-core bus cable.
When using a bus cable with several wires, the following rules must be observed:
- The two wires for the LPB must be twisted
- When running several wires parallel to increase the cross-sectional area of the wires, it must be noted that line capacitance will also increase, thereby reducing the maximum extension of the system

The best protection against interference is achieved with a screened two-core cable (refer to data sheet 2034, ”Installation of Heating Plant in Compliance with EMC Directives", under "Selection of signal and bus cable”).

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Bus power supply	In smaller plants with a maximum of 16 devices connected to the bus, the bus is powered by the devices (distributed bus power supply). In larger plants, a central bus power supply is required (PNE1.0). Also refer to “Engineering notes”.
Galvanic separation	Normally, the bus connection terminals on the LPB devices are not galvanically separated from the devices` electronics.

Technical data

Physical Layer to ISO/OSI	Voltage level and character transmission are in compliance with NF C 46621.
Data Link Layer to ISO/OSI	Bus access procedure, telegram makeup, telegram transmission and data protection are in compliance with NF C 46 622.
Application Layer to ISO/OSI	Conforming to specific Landis & Staefa standards.
Open-circuit voltage of bus	15.5 V ±10 % (with no load)
Signal level	< 7 V: logic ‘1’ > 9 V: logic ’0’
Polarity	Not interchangeable
Cable	Two-core, twisted Cable capacitance: ≤ 100 pF / m at 800 Hz (greater values require a proportional reduction of the permissible total cable length, refer to “Engineering notes”) Cross-sectional area, resistance and length: refer to “Engineering notes”
⚠	The best protection against interference is achieved with screened two-core cables. The best results are obtained with cables protected by a tight braid, followed by cables protected by a foil. Vapour-plated screening is unsuited.
Bus topology	Line, tree, star, or their combinations Note: for lightning protection reasons, it is not advisable to use the ring topology
Character transmission	NRZ coding, 8 data bit, odd parity, 1 stop bit
Baud rate	4,800 Baud
Telegram length	Max. 32 characters
Transmission capacity	Approx. 10 telegrams per second on average
Bus access procedure	CSMA / CA (multiple access with collision avoidance)
Address range	1..240, can be assigned to 15 groups / segments each with 16 devices
Number of users	With the distributed bus power supply: max. 16 With the central bus power supply: refer to “Engineering notes”

Mode of operation of data transmission

CSMA / CA procedure

With the LPB, the CSMA / CA (Carrier Sense Multiple Access / Collision Avoidance) procedure is used. When employing this procedure, each bus user is at the same level in terms of data transmission, and there is no communication master (contrary to the master / slave principle). Data are exchanged directly between the bus users (peer-to-peer communication).
If several bus users want to deliver a message at the same time, special measures are taken to prevent data collisions on the bus. In that case, the telegram of one sender is transmitted correctly. The other senders stop their transmission and make another transmission attempt after a certain waiting time has elapsed.

Response times

The CSMA / CA procedure affords short response times, provided the available transmission capacity of the bus is within the permissible limits. The loading on the bus is dependent on the number of bus users connected (refer to “Engineering notes”).

Engineering notes

Connection of LPB devices

The LPB devices can be connected to the bus at any location provided the permissible cable lengths and the maximum extension of the network are observed. Also, the correct polarity of the terminals MB(-) and DB(+) must be ensured.

Distributed bus power supply

In smaller plants, the bus can be powered by the interconnected LPB devices. In that case, a central bus power supply is not required.

- A system consisting of **up to 16 devices** can be operated without a central bus power supply
- The connected LPB devices must be capable of supporting the function of the distributed bus power supply (refer to the relevant data sheets)
- When using products of other manufacture (e.g. BatiBUS products of other manufacture), a central bus power supply is mandatory

When designing an interconnected system, the following guidelines must be observed:

Limitation R (cable resistance)	Required cross-sectional area of cable	**1.5 mm^2**
	Max. cable length between the remotest devices	- **250 m** per connected device - But **max. 1000 m**
Limitation C (cable capacitance)	Max. total cable capacitance (sum of all branches)	- **25 nF** per connected device - But max.140 nF
	Total cable length (sum of all branches) at 100 pF / m cable capacitance *)	- **250 m** per connected device - But **max. 1400 m**

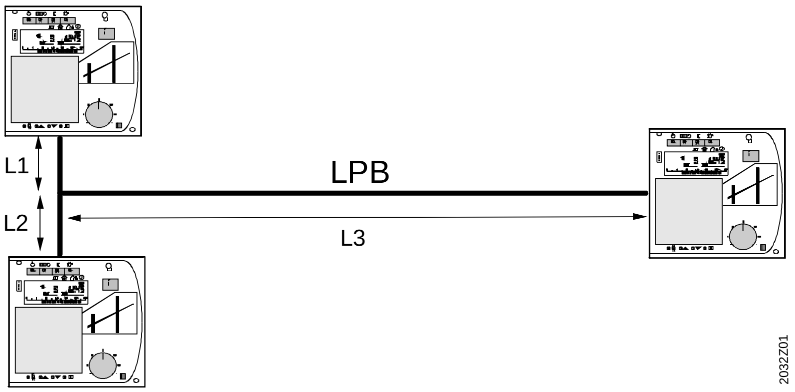
*) Greater cable capacitances require a proportional reduction of the permissible total cable length

$$L' = \frac{L \times 100\ pF/m}{\text{eff. capacitance per unit length}}$$

Topology with the distributed bus power supply

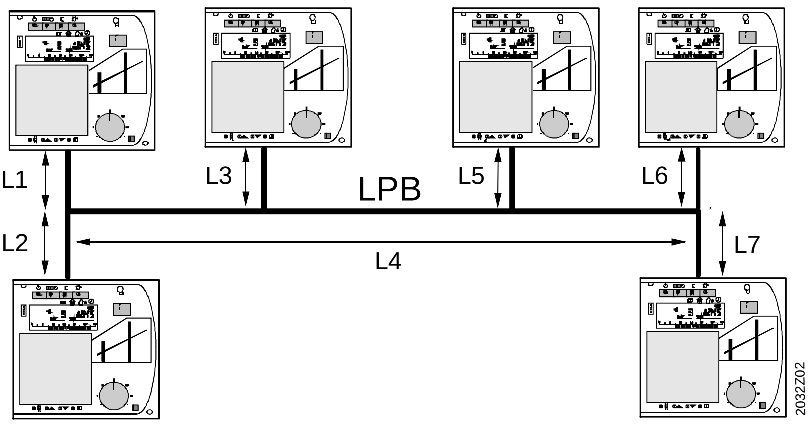
Example 1

- LPB system with 3 connected devices
- Cable capacitance 100 pF / m
- Max. cable length between the remotest devices: 3 x 250 m
  e.g. L1 + L2 + L3 ≤ 750 m (limitation R)
- Total cable length: 3 x 250 m
  L1 + L2 + L3 ≤ 750 m (limitation C)



Example 2

- LPB system with 6 connected devices
- Cable capacitance 125 pF / m
- Max. cable length between the remotest devices: 1000 m
  e.g. L2 + L4 + L7 ≤ 1000 m (limitation R)
- Total cable length: 1120 m in place of 1400 m due to greater cable capacitance:
  L1 + L2 +...+ L7 ≤ 1120 m (limitation C)



Central bus power supply

If more than 16 LPB devices or devices of other manufacture are connected, a central bus power supply (PNE1.0) is required. A maximum of 40 devices can be connected if the LPB is used with a central bus power supply, but the engineering guidelines with regard to bus transmission capacity must be observed.

For information about the PNE, refer to page 13.

Guidelines for bus extensions:
- Ohmic cable resistance between the bus power supply and a device: **<12 Ω**
- Total cable capacitance of all bus cables: **<250 nF**

		Cross-sectional area of cable				
		0.8 mm dia.	0.75 mm²	1.0 mm²	1.5 mm²	2.5 mm²
Limitation R (cable resistance)	Max. distance between bus power supply and device	160 m	230 m	310 m	460 m	600 m
	Max. distance between the remotest devices	320 m	460 m	620 m	920 m	1200 m
Limitation C (cable capacitance)	Total cable length (sum of all branches) at 100 pF / m cable capacitance *)	2500 m	2500 m	2500 m	2500 m	2500 m

*) Greater cable capacitances require a proportional reduction of the permissible total cable length

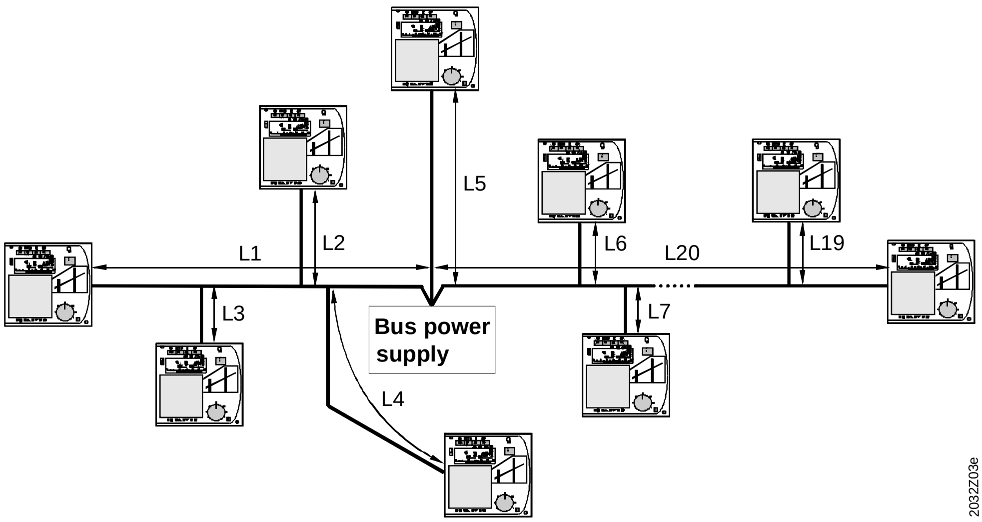
$$L' = \frac{\textbf{L x 100 pF/m}}{\textbf{eff. capacitance per unit length}}$$

Whenever possible, the bus power supply should be located near the centre of the bus network to allow maximum extension.

Topology example with central bus power supply

- LPB system with 20 devices
- Cross-sectional area of cable 1.5 mm²
- Cable capacitance 100 pF / m
- Max. cable length between bus power supply and device:
  e.g. L20 ≤ 460 m (limitation R)
- Max. cable length between the remotest devices:
  e.g. L1 + L20 ≤ 920 m (limitation R)
- Total cable length:
  L1 + L2 + ... + L20 ≤ 2500 m (limitation C)

Example

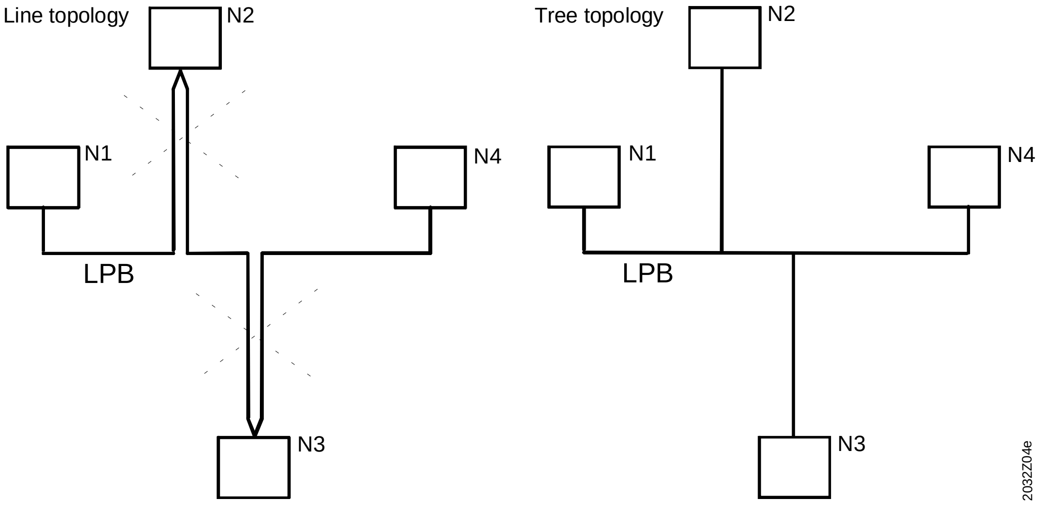


Connecting the bus cable

The bus cable is connected directly to the terminals of the LPB devices marked MB(-) and DB(+).

In the case of T-branches, it is recommended to use a conduit box.

If the bus cable is run along cables of the AC 230 V mains network, it must be isolated against mains voltage in compliance with local regulations (SELV to EN 60730). This kind of cabling should be avoided wherever possible since large loads on the AC 230 V network can cause interference on the bus line (refer to data sheet 2034, “Installation of Heating Plant in Compliance with EMC Directives”, under “Cabling”).
When wiring a plant, it is recommended to use the tree topology (single arms with loop-back at the end of the arm). In terms of plant size, this topology affords much greater plant extensions than the line topology (refer to data sheet 2034, “Installation of Heating Plant in Compliance with EMC Directives“, under “Cabling“).



Lightning protection

The local regulations for lightning protection must be observed (also refer to data sheet 2034, “Installation of Heating Plant in Compliance with EMC Directives”, under “Bus connections between buildings”).
Wherever a bus cable enters or leaves a building, the proper installation of a surge protector against lightning effects is mandatory.

⚠ Restrictions

The proposed surge protector does not offer protection against

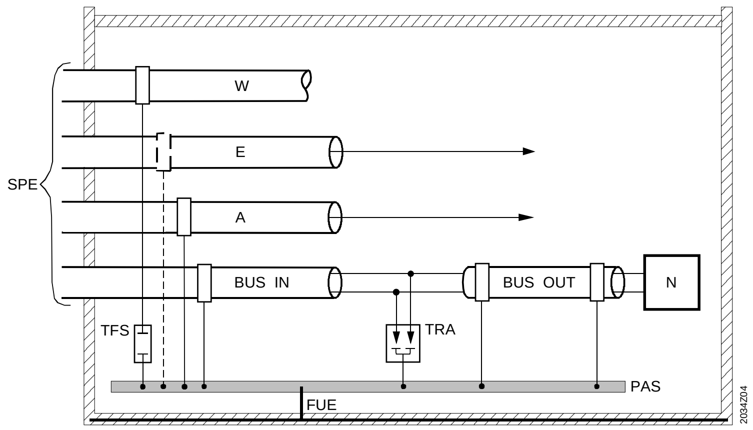
- constant overvoltages (mains voltage) and
- surges affecting the terminal units via the building installation (water pipes or mains connection).

Regulations for installation

Full-scale surge protection is based on a three-stage concept: gas surge protector – ZNR - suppression diode.

- The protective function is ensured only if the installation is properly executed
- The bus cable should enter the building where the mains cable enters (single-point entry)
- The potential equalization rail = building ground is to be fitted very close to the bus cable entry
- The surge protector is to be mounted on a DIN rail which is to be connected to the potential equalization rail using a short piece of copper (20 x 2 mm) to ensure good conductance
- ⚠ The surge discharge current flows via the fixing of the surge protector to the DIN rail. Without this connection, there will be no protection!
- The unprotected bus cable must be connected to terminals 1 and 2 marked “IN”
- The protected bus output to the controller must be connected to terminals 3 and 4 marked “OUT”

- At the point of entry to the building, the cable screen must be connected to the potential equalization rail while ensuring good conductivity
- In normal circumstances, a TN-S network with separate protective and neutral conductors is now used. With buildings located in the same area, potential equalization is provided by the earth conductor
- Armoured mains supply lines must be properly connected to the potential equalization rail where the supply lines enter the building
- In the case of long distance connections, potential equalization from one building to another is no longer ensured. If that is the case, only one side of the cable screen is to be earthed



Potential equalization and surge protection at the point of entry to the building (cellar)

N	Controller
W	Water pipe
E	Power cable
A	Antenna cable
SPE	Single-point entry
TFS	Separating spark gap
FUE	Foundation earth
PAS	Potential equalization rail
TRA	Surge protector
BUS IN	Unprotected
BUS OUT	Protected

Surge protector

Approved components

Every bus cable and the devices to be protected necessitate protective elements that are matched to the specific requirements. For this reason, only the following approved components may be used for **protecting the LPB**:

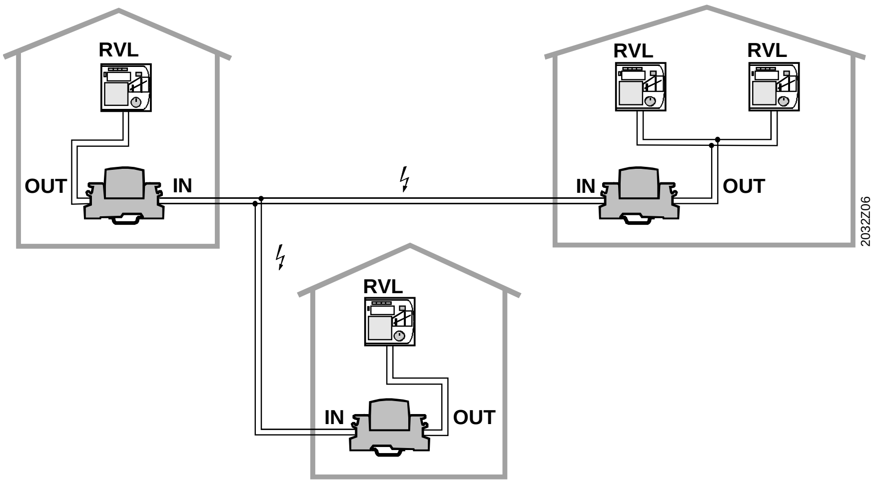
Component	Type reference (Phoenix)	Part number
Basic unit	UFBK BE	27 83 09 5
Plug-in unit	UFBK-M 2-PE 48AC-ST	28 17 06 8

Source: PHOENIX CONTACT

Lightning protection
Engineering the LPB

The surge protector produces an additional capacitance of 2.3 nF on the LPB.
This means:
=> Reduction of the maximum rate of transmission
=> Reduction of the total cable length
=> Reduction of the maximum number of terminal units
This aspect must be considered when engineering the plant.

Example: 2 surge protectors reduce the total cable length by about 50 m at the same rate of transmission and using the same number of terminal units, or 10 surge protectors each with 2.3 nF reduce the cable length by 250 m.



Transmission capacity

The usable transmission capacity of the LPB is about 600 telegrams per minute on average. Each device connected to the LPB generates a certain amount of data traffic on the bus. The resulting total data draffic must be within the permissible limits.

Engineering aid: to simplify the calculations, a bus loading figure “E” is defined for each device (refer to the relevant data sheets).
A device having a value of E = 1 produces an average bus loading of 2 telegrams per minute.
The total of E-values of all devices connected may not exceed the value of 300.

Commissioning notes

Wiring

Before connecting the controllers, it must be made certain that the wiring is correct. False wiring is much more difficult to detect when several devices have already been connected.

When connecting the devices, it must be made absolutely certain that the bus polarity MB(-) and DB(+) is correct.

In the case of large plants, it is recommended to keep a record of the cable lengths and of the measured line resistances.

Bus address

When commissioning the plant, LPB address assignments are made, which are part of the configuration process (refer to data sheet 2030, “Basic System Data”).

The bus address is set in the form of a **segment no.** and a **device no.** The address can be set either via the device operation (devices with a display) or via coding switches (refer to the relevant data sheets).

– Segment no.: 0..14 — The plant is divided into a maximum of 15 segments; segments 1…14 are of equal value; from an application point of view, segment 0 has a special meaning (refer to data sheet 2030)

– Device no.: 0; 1..16 — A maximum of 16 devices carrying device nos. 1…16 can be installed per segment; device no. 0 means "No bus address" and the device cannot communicate on the LPB (autonomous operation)

Having 15 segments each with 16 devices means that the LPB has an address capacity of 240 addresses.
When delivered, all devices have segment no. 0 and device no. 0, which means that they will operate autonomously.

When commissioning the plant, it must be ensured that every address in the system is assigned only once. Address collisions and potentially faulty behaviour are not checked by the system.

Bus power supply variant

The type of LPB bus power supply (distributed or central) can be configured, either via the device operation (devices with a display) or by means of hardware plugs (refer to the relevant data sheet).

The setting parameter / plug with which the type of LPB bus power supply can be configured has the positions AUTOMATIC and OFF. The device is supplied in the AUTOMATIC position, in which case the LPB can be powered as soon as a valid bus address has been assigned. In the OFF position, the distributed bus power supply of the device is always switched off.

In smaller plants with less than 16 devices and with no central bus power supply, the AUTOMATIC position is required.

⚠ When using the central bus power supply, the OFF position is mandatory!

If, in that case, the devices are operated in the AUTOMATIC mode, overcurrents can occur on the bus for short periods of time in large plants with a large number of bus users. Landis & Staefa will not assume any responsibility for damage resulting from such improper use.

Commissioning with distributed bus power supply

1. Switch on all devices. The devices are delivered with no valid bus address (segment no. 0 / device no. 0). In that case, the devices are not capable of communicating and cannot power the bus (autonomous operation).
2. Set the bus address on the **first** device and check whether the distributed bus power supply is set to AUTOMATIC. Then, the device switches on its bus power supply.
   Note: after switching on the mains voltage on the device, it may take up to 30 seconds for the bus power supply to be switched on. Also refer to “Power-up behaviour”.
3. Check the bus function on the device:
   After setting a valid bus address, the LCD segment BUS of the device should be continuously displayed or, in the case of devices with no display, the green LPB LED should flash. In that case, the bus is powered and the device can communicate.
   - If there is no BUS display or the LPB LED is not flashing, there is a wiring error (e.g. a short-circuit, refer to “Fault tracing”), or
   - The bus does not receive sufficient power, which means that additional devices must be put into operation to ensure an adequate bus power supply
   - The device has no valid bus address.
4. Put another device into operation. First, measure the bus voltage across terminals DB(+) and MB(-) (> DC +9.5 V, observe the polarity!).
   - When the voltage is negative, the bus connections have been mixed up
   - When the bus voltage is too low, there is a wiring error (e.g. short-circuit or bus connection in the system mixed up), or the bus does not yet receive sufficient power

   Then, set the bus address and check whether the distributed bus power supply is in the AUTOMATIC mode. In that case, the device can also power the bus.
   Then, check the bus function on the device (refer to item 3 above) and measure the bus voltage in the event of failure.
5. Put the remaining devices into operation (same as item 4). After commissioning all devices, the bus voltage should be a minimum of DC 9.5 V and, on all devices, the LCD segment BUS will appear, or the LPB LED will flash.

BUS status display (on the device)

The LPB LED and the LCD segment BUS are useful aids when tracing faults.

	No bus address set: S0 / G0 and bus level <9 V	No bus address set: S0 / G0 and bus level >9 V	Valid bus address set: Sx / Gy and bus level <9 V	Valid bus address set: Sx / Gy and bus level >9 V
LED	OFF	ON steady	OFF	**FLASHES ***
BUS segment on LCD	OFF	OFF	OFF + fault message on the display	**ON** steady

*Double flashing: locally distributed bus power supply is switched on

*Single flashing: locally distributed bus power supply is switched off,
or the device is powered via the bus,
or the bus uses a central power supply

Fault tracing

Most faults can be pinpointed in a straightforward manner with the help of a multimeter and the BUS status indication on the device.

- Throughout the system, the bus voltage does not reach 9.5 V:
  - Possibility of a wiring error: e.g. a short-circuit
  - Possibility of a wrong bus connection (mixed up) on one or several devices
    Note: if, in the system, one or several devices have been connected to the LPB with their wrong polarity, the resulting bus voltage will be in the range -17 V ... + 17 V. In that case, the bus voltage is the result of an unstable equilibrium and also dependent on the ambient conditions (e.g. the temperature). Often, however, the bus voltage “tips” in the vicinity of +15.5 V or -15.5 V. It is also possible that the bus power supplies offset one another so that the bus voltage is in the vicinity of 0 V. Due to external effects, such as self-heating of the devices, the unstable equilibrium and thus the bus voltage may considerably vary. This behaviour makes fault tracing more difficult. Each time a bus connection with incorrect polarity has been rectified, the resulting bus voltage must be measured. In the case of a bus power supply with incorrect polarity, a constant bus current can be recorded (even in the idle state).
- Bus voltage is too low only at certain devices:
  - Possibly too small cross-sectional area of the cable or cables too long; check ohmic resistance of the cable
- Bus voltage is sufficiently high throughout the LPB system, but certain devices cannot communicate:
  - Possibly too small cross-sectional area of the cable or cables too long; check ohmic resistance of the cable
  - Bus connection may have been mixed up on these devices; check bus voltage across the connection terminals (see above)
  - Devices may have no valid bus address yet
  - Total cable capacitance may be too great (due to the extension of the system or unsuited type of cable). In that case, the bus must be operated with a central bus power supply

1. The LPB devices and the central bus power supply must be switched off.
2. Switch on the central bus power supply (PNE1.0) and connect the LPB by means of a Phoenix MSTB2 connector. When connecting the bus cable, make certain that the polarity is correct!
   Then, measure the LPB voltage across the terminals of the bus power supply. This voltage must be a minimum of DC +13.5 V. If it is too low, there is probably a wiring error.
3. When the bus voltage has reached a certain level, the mains voltage of the LPB devices may be switched on. The devices are delivered with no valid bus address (segment no. 0 / device no. 0) and cannot communicate (autonomous operation).
4. Put the first device into operation. First, the bus voltage across the device's terminals DB(+) and MB(-) must be checked (> DC +9.5 V, observe the polarity!).
   When the bus voltage is sufficiently high, **first** set the distributed bus power supply to **OFF** and **then** set the bus address.

   Then, check the bus function on the device:
   After setting a valid bus address, the LCD segment BUS of the device should be continuously displayed or, in the case of devices with no display, the green LPB LED will flash. In that case, the bus is powered and the device can communicate.

   If there is no BUS display or the LPB LED is not flashing, there is an error (refer to “Fault tracing”).
5. Put the remaining devices into operation (same as item 4). After commissioning all devices, the bus voltage should be a minimum of DC 9.5 V and, on all devices, the LCD segment BUS will appear or the LPB LED will flash.

Fault tracing

With the help of a multimeter and the BUS status indication on the device (refer to “Commissioning with distributed bus power supply”), most faults can be pinpointed in a fairly straightforward manner.

- Throughout the system, the bus voltage does not reach 9.5 V:
  - Wiring error: e.g. a short-circuit
- Bus voltage is too low only at certain devices:
  - Possibly too small cross-sectional area of the cable or cables too long; check ohmic resistance of the cable between bus power supply and device (<12 Ω**)**
- Bus voltage is sufficiently high throughout the LPB system, but certain devices cannot communicate:
  - Possibly too small cross-sectional area of the cable or cables too long; check ohmic resistance of the cable between bus power supply and device
  - Bus connection may have been mixed up on these devices; check bus voltage across the connection terminals
  - Devices may have no valid bus address yet
  - Total cable capacitance may be too great (due to extension of the system or unsuited type of cable)

Power-up behaviour

When, after a power failure, mains voltage is restored, it takes a certain time for communication on the LPB to be resumed. The behaviour with the distributed and the central bus power supply are partly different.

Behaviour with the **distributed** bus power supply

1. After switching on the plant, it takes 5 to 30 seconds for the distributed bus power supply to built up. Then, on all devices, the LCD segment BUS will appear or the LPB LED will flash.
2. The LPB devices start communicating on the LPB no earlier than 5 seconds after switching on the mains voltage. It should be noted, however, that during the next 25

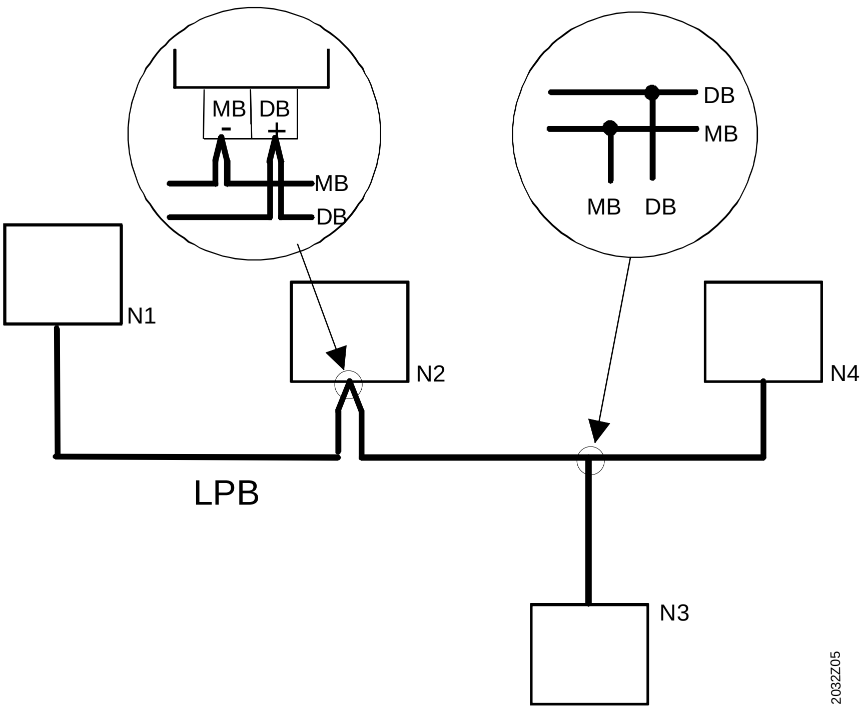
seconds, process data cannot be exchanged via the bus. After a maximum of one minute after power-up, the bus is in a stable state, allowing normal data traffic.

Behaviour with the **central** bus power supply

1. After switching on the central bus power supply, it takes a maximum of 3 seconds for the bus voltage to built up. Then, on all devices, the LCD segment BUS will appear or the LPB LED will flash.
2. Then, the behaviour is the same as with the distributed bus power supply.

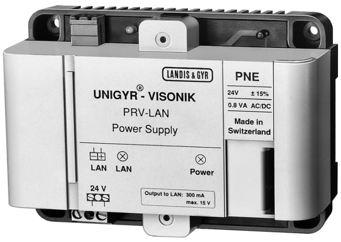
Connection diagram

Example



N1..N4 LPB devices

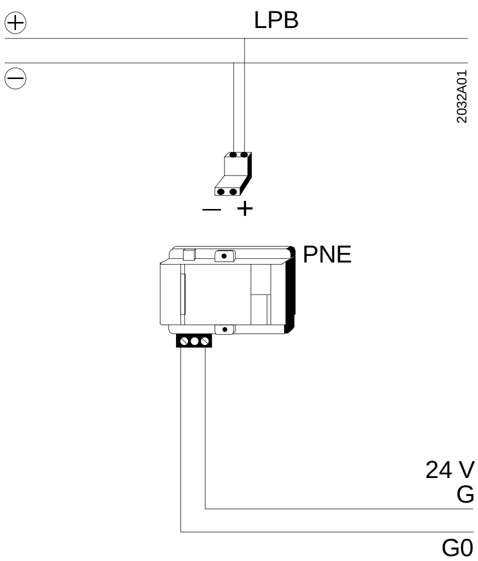
Technical data PNE



Operating voltage	AC / DC 24 ± 15 %
Frequency	50...60 Hz
Output to LPB	300 mA (max. 15 V)
Typical power consumption	0.8 VA
Maximum power consumption	5 VA
Ambient temperature	
Operation	0..40 °C
Storage and transport	-20..70 °C
Weight	180 g

Connector | Phoenix MSTB 2

Connection diagram PNE



Dimensions PNE