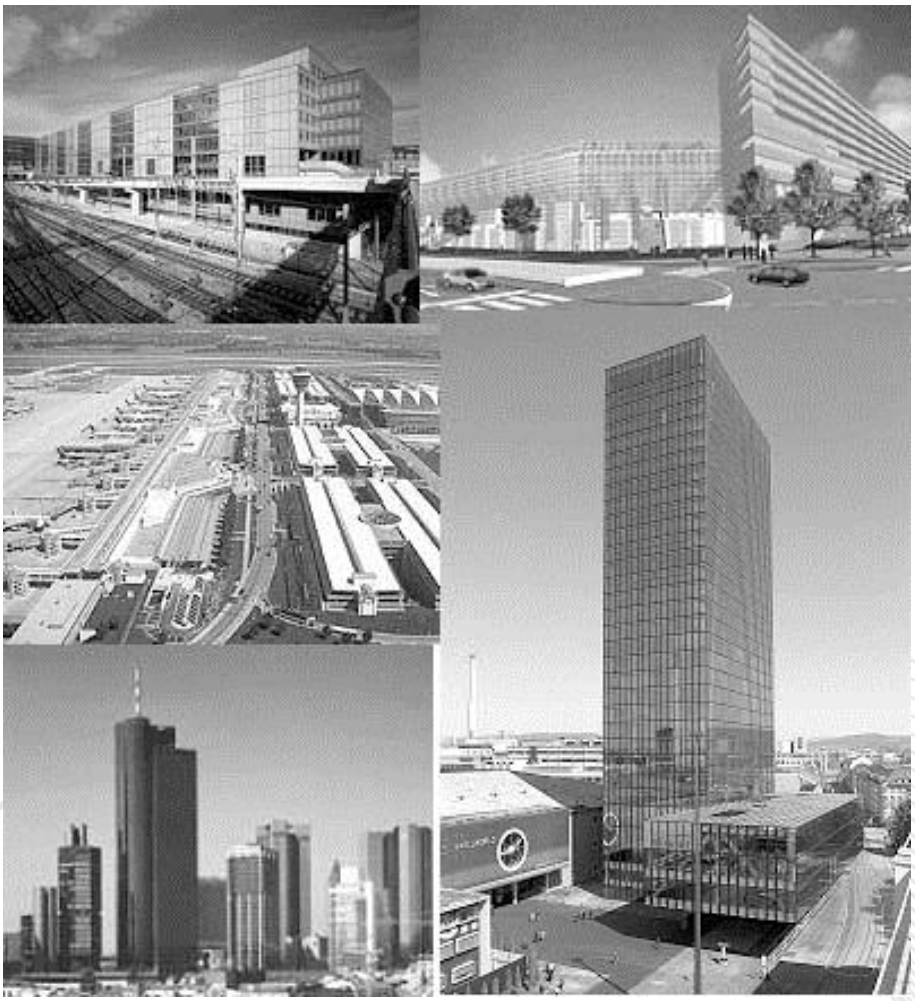
Ambiductor AB
Flow & Energy Analysis Systems

# AMBUS® Planning Folder

4-conductor-installation



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# 1 Presenting Aquametro's AMBUS® products

## 1.1 AMBUS® central units: AMBUS® ZS / Net

The devices in the AMBUS® ZS / FA / Net family are used to manage and evaluate an M-Bus meter network and to supply it with energy at the same time. A 4-core cable is used for this reason of which 2 cores are used each for the M-Bus and for the 15VAC power supply delivered by the central unit.
The interfaces for further data processing are RS-232 and RS-485.
Networks can be extended as desired by using the repeater function.

Available devices:

| M-Bus central units | Number of M-Bus devices* | RS-232 | RS-485 | M-BUS Repeater |
|---|---|---|---|---|
| AMBUS® ZS-5 | 5 * | ✓ | - | - |
| AMBUS® ZS-60 | 60 * | ✓ | ✓ | ✓ |
| AMBUS® ZS-250 | 250 * | ✓ | ✓ | ✓ |
| AMBUS® Net 120 | 120 * | ✓ | ✓ | ✓ |
| AMBUS® Net 250 | 250 * | ✓ | ✓ | ✓ |

* You will find details of the precise number of devices which can be supplied by the power supply in the section on “Determining the maximum number of devices per central unit“.

For more information on AMBUS® central units, please consult the documentation for the devices or our website.

## 1.2 AMBUS® central units: AMBUS® FA / Net LCD

The AMBUS® FA / Net LCD is a easy to use user terminal. It builds up on the functionality of the AMBUS® ZS and offers additional management and reading functions.
It is operated with help of the implemented keyboard and the illuminated high-contrast LCD display AMBUS® FA or directly with help of the integrated LCD display with touch screen of AMBUS® Net LCD respectively.

Available devices:

| Remote reading central units | Number of M-Bus devices* | RS-232 | RS-485 | M-BUS Repeater |
|---|---|---|---|---|
| AMBUS® FA-30 (1) | 30 * | ✓ | ✓ | ✓ |
| AMBUS® Net LCD 120 | 120 * | ✓ | ✓ | ✓ |
| AMBUS® Net LCD 250 | 250 * | ✓ | ✓ | ✓ |

* You will find details of the precise number of devices which can be supplied by the power supply in the section on “Determin-ing the maximum number of devices per central unit“.
(1) Only for CALEC®, AMTRON® N, SAPHIR® N, AMTRON® NW, AMBUS® IS

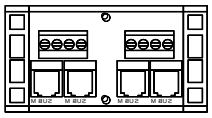
For more information on AMBUS® central units, please consult the documentation for the devices or our website.

## 1.3 Aquametro AMBUS® installation accessories:

To make installation simpler we carry a variety of installation accessories. They are coordinated with our products. It ensures efficient and error-free installation using a 4-pin cable..
The AQUAMETRO AMBUS® installation system is based on the widespread RJ-11 plug system in a 6-pin housing.

**ANS-4/DIN ***

4-fold M-BUS distributor with
4 RJ-11 sockets and 2 x 4-pin terminals.
For mounting on DIN-rail EN550022-35



| Terminal | Signal designation | RJ11-PIN |
|---|---|---|
| 15V~ | Meter supply | 5 |
| M-Bus | M-Bus line | 4 |
| M-Bus | M-Bus line | 3 |
| 15V~ | Meter supply | 2 |

* Matching rail can be supplied

**ANS-4/AP**

4-fold M-BUS distributor, lead-sealable, with
4 RJ-11 sockets and 2 x 4-pin terminals.
For surface mounting.

| Terminal | Signal designation | RJ11-PIN |
|---|---|---|
| 15V~ | Meter supply | 5 |
| M-Bus | M-Bus line | 4 |
| M-Bus | M-Bus line | 3 |
| 15V~ | Meter supply | 2 |

**ANS-1/AP**

M-BUS connection box with 1x RJ-11 socket for surface mounting.

| Terminal | Signal designation | RJ11-PIN |
|---|---|---|
| 5 | Meter supply | 5 |
| 4 | M-Bus line | 4 |
| 3 | M-Bus line | 3 |
| 2 | Meter supply | 2 |

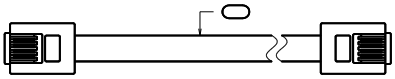
**ANS-1**

Open M-BUS connection box with 1x RJ-11 socket for surface mounting.

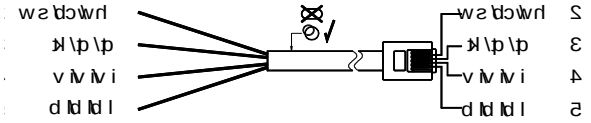
| Terminal | Signal designation | RJ11-PIN |
|---|---|---|
| 5 | Meter supply | 5 (blue) |
| 4 | M-Bus line | 4 (vi) |
| 3 | M-Bus line | 3 (tq) |
| 2 | Meter supply | 2(white) |

**Connecting cables**

**RJ-11 Oval cable**
M-Bus connecting cable with RJ-11 plug on both ends.

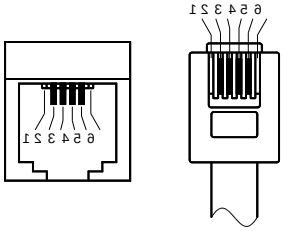


**RJ-11 Round cable**
M-Bus connecting cable with RJ-11 plug and open end to connect to terminal blocks.



**Pin assignment (6/4-pin) for socket and plug:**

| RJ11-PIN | Signal designation |
|---|---|
| 5 | Meter supply |
| 4 | M-Bus line |
| 3 | M-Bus line |
| 2 | Meter supply |



## 1.4 M-Bus measuring instruments

**Compact Heat Meter**
AMTRON® N AMTRON® E AMTRON® S
AMTRON® C AMTRON® S compact
ULTRASONIC ULTRASONIC E

**Wall-Mounted Heat Calculators**
CALEC® ST CALEC® ST - Flowprocessor
CALEC® light
CALEC® MB 2P / 3P / 2S / 4S

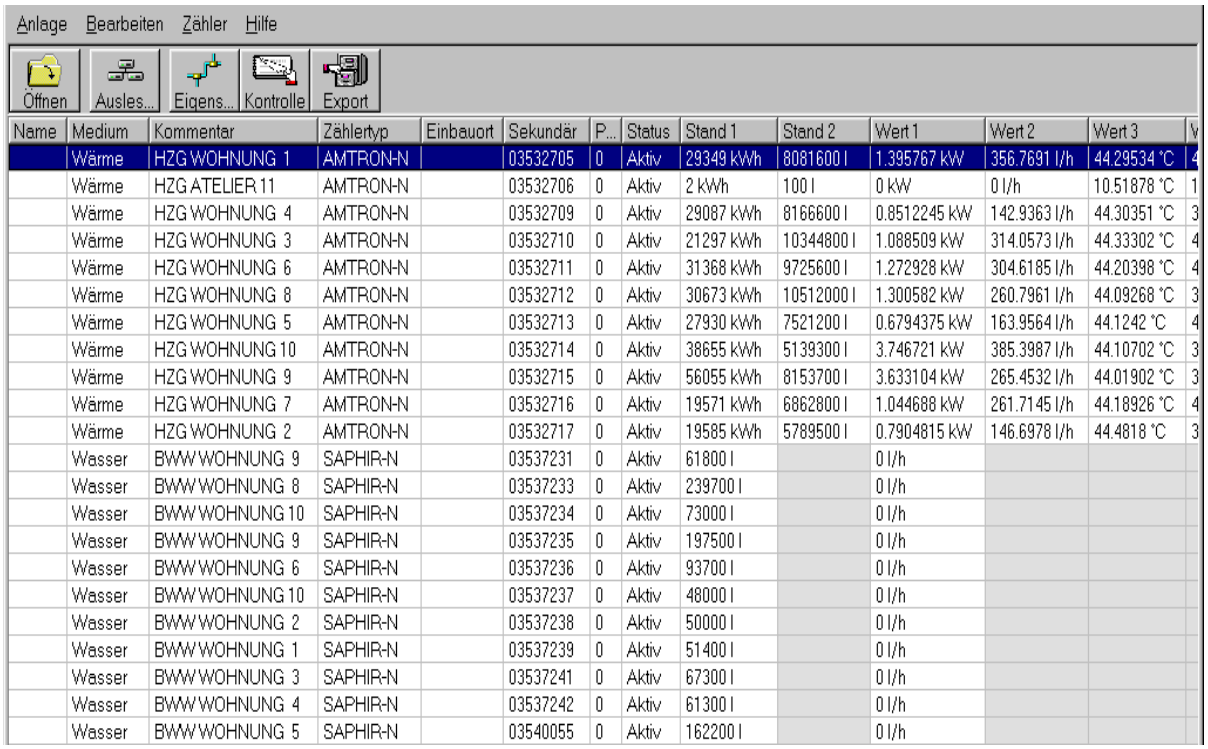
**Cold/Hot Water Meter**
SAPHIR N SAPHIR E (Scampy) Cosmos-Electronic

## 1.5 M-Bus interfaces

AMBUS® IS AMBUS® IS-2 pulse collector for rail and surface mounting

## 1.6 M-Bus software

AMBUS® Data, M-Bus software for system management, reading, protocolling of meter data, cyclic saving of metering point data in MS-ACCESS/EXCEL format.




| Name | Medium | Kommentar | Zählertyp | Einbauort | Sekundär | P... | Status | Stand 1 | Stand 2 | Wert 1 | Wert 2 | Wert 3 | V |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | Wärme | HZG WOHNUNG 1 | AMTRON-N | | 03532705 | 0 | Aktiv | 29349 kWh | 8081600 l | 1.395767 kW | 356.7691 l/h | 44.29534 °C | 4 |
| | Wärme | HZG ATELIER 11 | AMTRON-N | | 03532706 | 0 | Aktiv | 2 kWh | 100 l | 0 kW | 0 l/h | 10.51878 °C | 1 |
| | Wärme | HZG WOHNUNG 4 | AMTRON-N | | 03532709 | 0 | Aktiv | 29087 kWh | 8166600 l | 0.8512245 kW | 142.9363 l/h | 44.30351 °C | 3 |
| | Wärme | HZG WOHNUNG 3 | AMTRON-N | | 03532710 | 0 | Aktiv | 21297 kWh | 10344800 l | 1.088509 kW | 314.0573 l/h | 44.33302 °C | 4 |
| | Wärme | HZG WOHNUNG 6 | AMTRON-N | | 03532711 | 0 | Aktiv | 31368 kWh | 9725600 l | 1.272928 kW | 304.6185 l/h | 44.20398 °C | 4 |
| | Wärme | HZG WOHNUNG 8 | AMTRON-N | | 03532712 | 0 | Aktiv | 30673 kWh | 10512000 l | 1.300582 kW | 260.7961 l/h | 44.09268 °C | 3 |
| | Wärme | HZG WOHNUNG 5 | AMTRON-N | | 03532713 | 0 | Aktiv | 27930 kWh | 7521200 l | 0.6794375 kW | 163.9564 l/h | 44.1242 °C | 4 |
| | Wärme | HZG WOHNUNG 10 | AMTRON-N | | 03532714 | 0 | Aktiv | 38655 kWh | 5139300 l | 3.746721 kW | 385.3987 l/h | 44.10702 °C | 3 |
| | Wärme | HZG WOHNUNG 9 | AMTRON-N | | 03532715 | 0 | Aktiv | 56055 kWh | 8153700 l | 3.633104 kW | 265.4532 l/h | 44.01902 °C | 3 |
| | Wärme | HZG WOHNUNG 7 | AMTRON-N | | 03532716 | 0 | Aktiv | 19571 kWh | 6862800 l | 1.044688 kW | 261.7145 l/h | 44.18926 °C | 4 |
| | Wärme | HZG WOHNUNG 2 | AMTRON-N | | 03532717 | 0 | Aktiv | 19585 kWh | 5789500 l | 0.7904815 kW | 146.6978 l/h | 44.4818 °C | 3 |
| | Wasser | BWW WOHNUNG 9 | SAPHIR-N | | 03537231 | 0 | Aktiv | 61800 l | | 0 l/h | | | |
| | Wasser | BWW WOHNUNG 8 | SAPHIR-N | | 03537233 | 0 | Aktiv | 239700 l | | 0 l/h | | | |
| | Wasser | BWW WOHNUNG 10 | SAPHIR-N | | 03537234 | 0 | Aktiv | 73000 l | | 0 l/h | | | |
| | Wasser | BWW WOHNUNG 9 | SAPHIR-N | | 03537235 | 0 | Aktiv | 197500 l | | 0 l/h | | | |
| | Wasser | BWW WOHNUNG 6 | SAPHIR-N | | 03537236 | 0 | Aktiv | 93700 l | | 0 l/h | | | |
| | Wasser | BWW WOHNUNG 10 | SAPHIR-N | | 03537237 | 0 | Aktiv | 48000 l | | 0 l/h | | | |
| | Wasser | BWW WOHNUNG 2 | SAPHIR-N | | 03537238 | 0 | Aktiv | 50000 l | | 0 l/h | | | |
| | Wasser | BWW WOHNUNG 1 | SAPHIR-N | | 03537239 | 0 | Aktiv | 51400 l | | 0 l/h | | | |
| | Wasser | BWW WOHNUNG 3 | SAPHIR-N | | 03537241 | 0 | Aktiv | 67300 l | | 0 l/h | | | |
| | Wasser | BWW WOHNUNG 4 | SAPHIR-N | | 03537242 | 0 | Aktiv | 61300 l | | 0 l/h | | | |
| | Wasser | BWW WOHNUNG 5 | SAPHIR-N | | 03540055 | 0 | Aktiv | 162200 l | | 0 l/h | | | |

# 2 Planning folder

The next sections give you more detailed information about planning an AMBUS® system.

## 2.1 Notes on network topology in 4-core cabling (Remote supply of meters)

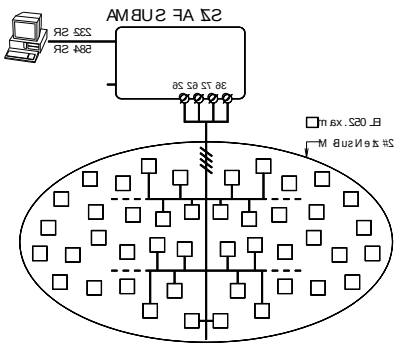
When you determine the topology and the type of cable, you should pay particular attention to the maximum current load and the expected voltage drop on the lines.

The voltage drop between the central unit and an end node should not exceed 5 VAC.

Excessive voltage drop can be reduced in these ways:
split the main cable up into several parallel cables (this is where the largest currents flow, 3 cables are available).
increase the cable cross-section.
use a star-shaped network instead of an interlinked one (never ring-shaped).

**Standard M-Bus networks**

Simple M-Bus network:

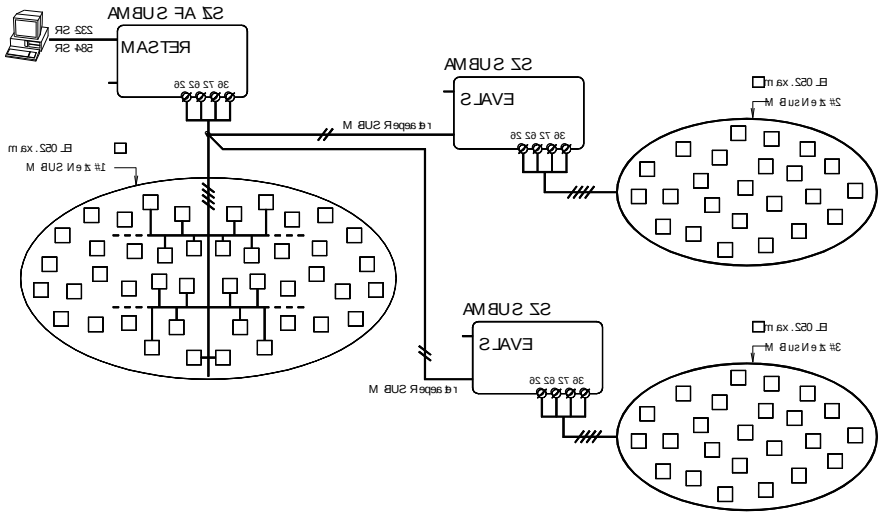


**Extended M-Bus networks**

Extend parallel M-Bus networks by only one subnet.
Serial extension by multi-stage interlacing of the slave central units is not allowed.

M-Bus network extended in parallel, with one subnet:

1 AMBUS® central unit as Master.
2 AMBUS® central units as Slaves.



## 2.2 Cabling (4-core)

An M-Bus network is installed using 4-core unshielded cable.
Bus lines and high power lines must be laid separately.

**Main line cross-sections should always be generously dimensioned; use parallel lines if necessary!**
When selecting the cable and its cross-section, take account of the network topology, and the number and local positioning of the M-Bus devices.
Recommended cable types are: telephone cable, 2x2x0.8mm, installation wire: 1x4x1.5mm² and 2.5mm².

## 2.3 Determining voltage drops

Draw a schematic diagram of the M-Bus system.

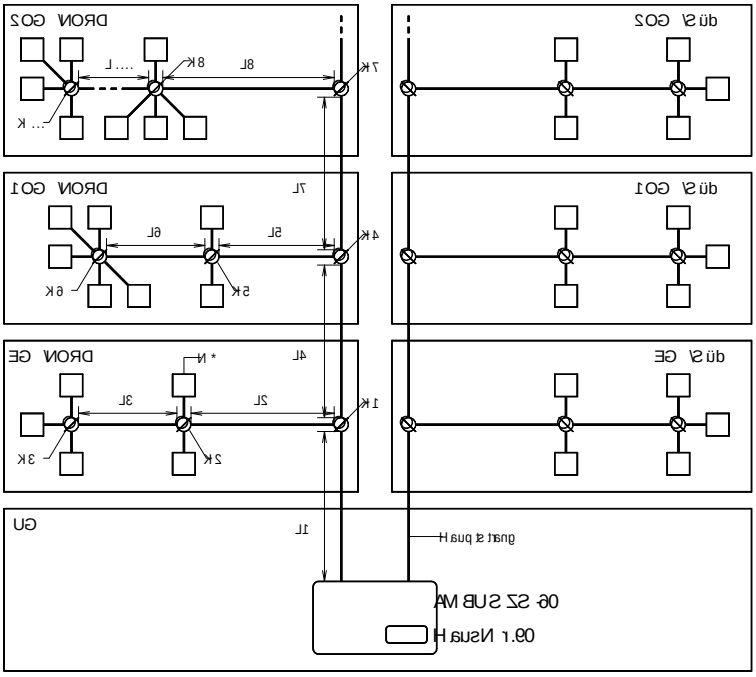
Mark all the node points (K...).

Determine the lengths of the various line sections (L...) and note them.

(e.g. using the construction plans).

For each node, determine the sum of the supply load unit* (LE) for all connected M-Bus devices.

*For details on determining the supply load, see the section on “Determining the maximum number of devices per central unit“



Starting with the end notes, add up and note down the supply load units (LE) to which the relevant line section is subjected.

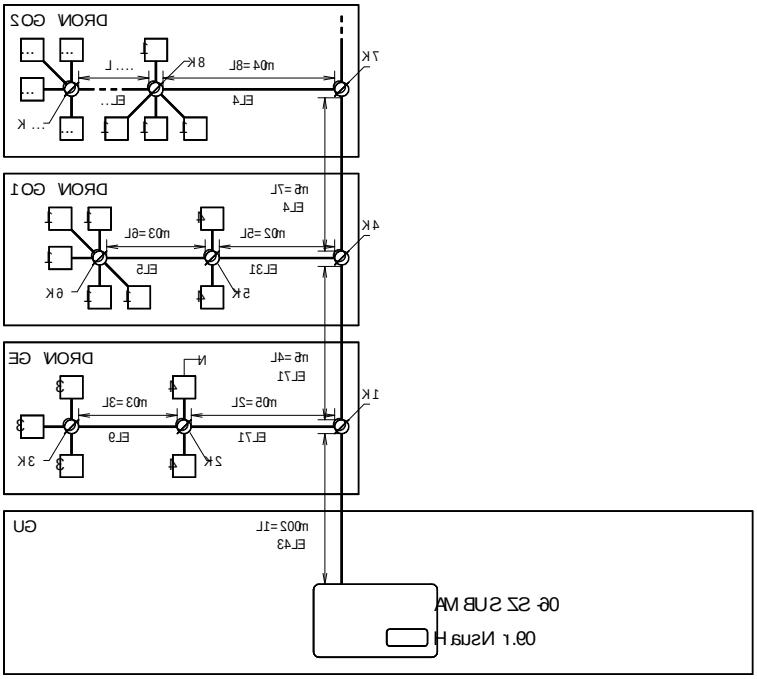
Starting from the central unit,
determine the voltage drop over each line section.

The cable cross-section of the line section determines the cable constant that you should use.
(See the table below for values).

Determine the partial voltage drop for the line sections.

Determine the total voltage drop from the central unit to the end node by adding the various partial voltage drops.

Example:



Partial voltage drop: = (Total load units x cable constant x length of line section) / 1000

| | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| $\Delta U_{L1}$ = (34LE | x | 0.47 | X | 200m) | / 1000 | = 3.20V | | (cable: 1.5mm²) |
| $\Delta U_{L2}$ = (17LE | x | 0.47 | X | 50m) | / 1000 | = 0.40V | | (cable: 1.5mm²) |
| $\Delta U_{L3}$ = (9LE | x | 1.35 | X | 30m) | / 1000 | = 0.37V | | (cable: 0.8mm) |

**Node 3**: $\Delta U_{K3}$ = $\Delta U_{L1} + \Delta U_{L2} + \Delta U_{L3}$ = **3.97V** OK (limit 5VAC)

| | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| $\Delta U_{L1}$ = (34LE | x | 0.47 | X | 200m) | / 1000 | = 3.20V | | (cable: 1.5mm²) |
| $\Delta U_{L4}$ = (17LE | x | 0.47 | X | 5m) | / 1000 | = 0.04V | | (cable: 1.5mm²) |
| $\Delta U_{L7}$ = (4LE | x | 0.47 | X | 5m) | / 1000 | = 0.01V | | (cable: 1.5mm²) |
| $\Delta U_{L8}$ = (4LE | x | 1.35 | X | 40m) | / 1000 | = 0.22V | | (cable: 0.8mm) |

**Node 8**: $\Delta U_{K8}$ = $\Delta U_{L1} + \Delta U_{L2} + \Delta U_{L3}$ = **3.47V** OK (limit 5VAC)

**Notes:**
If the tolerable voltage drop is exceeded at a node:
either increase the cross-section, split up the line or change the network topology.
(Recommendation: keep the voltage drop low over the main lines)

**Guidance values for cable resistances and the resultant voltage drop:**

| Cable type: | Resistance of cable (forward and reverse conductors) | Voltage drop ΔU/LE per supply/load unit | Cable constant* KB |
|---|---|---|---|
| Telephone cable, 2x2x0.8mm | typ.75Ω / 1000m | 1.35V/1000m | 1.35 |
| Installation wire, 1.5mm² | typ.26Ω / 1000m | 0.47V/1000m | 0.47 |
| Installation wire, 2.5mm² | typ.16Ω / 1000m | 0.29V/1000m | 0.29 |

*Cable constant KB = cable resistance x 18mA

## 2.4 Determining the maximum number of devices per central unit

**Rule of thumb:**

1. For each device type, multiply the **number** by the corresponding **load unit, LE**.
2. Add these **sub-totals** up to obtain the **"total load units".**
3. Select the appropriate central unit as per the table in section 6, meter supply and M-Bus output. (The calculated "total load units" must not be larger than the figure shown in the table.)

**Example:**

Calculation for the M-Bus load

| | | | |
|---|---|---|---|
| 29 SAPHIR N | =29 x 1 | = | **29** |
| 20 AMTRON® N | =20 x 1 | = | **20** |
| 5 AMTRON® NW | =5 x 1 | = | **5** |
| 1 CALEC® MB* | =1 x 1 | = | **1** |

(*Supplied locally with 230V)

"Total M-Bus load units": 29+20+5+1=**55**

Calculation for the supply load

| | | | |
|---|---|---|---|
| 29 SAPHIR N | =29 x 1 | = | **29** |
| 20 AMTRON® N | =20 x 1.1 | = | **22** |
| 5 AMTRON® NW | =5 x 1.6 | = | **8** |
| 1 CALEC® MB* | =1 x 0 | = | **0** |

"Total supply load units": 29+22+8+0=**59**

The AMBUS® ZS-**60** is suitable for this example.

**Load units for the various M-Bus devices:**

| M-Bus device: | M-Bus load unit | Supply/load unit | |
|---|---|---|---|
| | | Supply from central unit | Local supply |
| SAPHIR E (Scampy) | **1** | **0** | Battery |
| SAPHIR N | | **1** | - |
| AMTRON® N | **1** | **1.1** | - |
| AMTRON® E | **1** | **0** | Battery |
| ULTRASONIC E | **1** | **0** | Battery / Network |
| AMTRON® C | **1.5** | **0** | Battery |
| AMTRON® S | **1.2** | **0** | Battery |
| AMTRON® S compact | **1.2** | **0** | Battery |
| AMBUS® IS | **1** | **1.3** | - |
| AMBUS® IS2 | **1** | **0** | Battery |
| CALEC® light | **1** | **3** | |
| CALEC® MB | **1** | **4** | 0 |
| CALEC® ST | **1** | **1.6** | 0 |
| M-Bus power meter | **1** | - | - |
| M-Bus battery devices | **1** | - | Battery |

**Power range for the various M-Bus central units:**

| M-Bus central units | Maximum number of M-Bus load units | Maximum number of supply/load units |
|---|---|---|
| AMBUS® ZS-5 | 20 | 5 |
| AMBUS® ZS-60 | 60 | 60 |
| AMBUS® ZS-250 | 250 | 250 |
| AMBUS® FA-30 | 30 | 30 |
| AMBUS® Net-120 | 120 | 120 |
| AMBUS® Net-250 | 250 | 250 |
| AMBUS® Net LCD –120 | 120 | 120 |
| AMBUS® Net LCD –250 | 250 | 250 |

# 3 Example of M-Bus planning documentation

## 3.1 Objective and purpose

This planning documentation defines how the installation and connections for the M-Bus for energy measurement should be implemented, and which components should be used for this purpose.
This should make sure that:

- the installation is carried out uniformly throughout the entire project
- bus participants can communicate without problems
- intended options and extensions can easily be implemented at a later stage.

## 3.2 Description of M-Bus

Bus name: M-Bus (Standard: EN 1434-3)
Network topology: Star-shaped main lines, meter connection with free topology
Special features: Two-core cables are used for certain zones:

## 3.3 Definition of terms

| | |
|---|---|
| **M-Bus main line:** | Connection between the M-Bus central unit and the various house connection points. |
| **M-Bus connection line:** | Connection between the house connection point and the handover point. |
| **M-Bus riser line:** | Connection between the handover point as far as the last floor connection |
| **M-Bus floor network:** | Fine distribution of the M-Bus on the floor. Starting from the base point in the riser zone area, the M-Bus components (meters) are developed with free topology. Separate connection boxes in the immediate vicinity of the meters are fitted for this purpose. |
| **House connection point** | Point where the M-Bus main line is introduced into a building. |
| **Handover point:** | Central node of a building. Operates as a repeater, and supplies the M-Bus devices with energy. Basis for the riser lines. |
| **Base point:** | Point where a floor network is connected to the riser line. |
| **End box:** | Point at which an M-Bus device is connected to the floor network. |
| **M-Bus central unit:** | Device to operate and manage an M-Bus meter network. Comprises the function blocks for communication, energy supply and (optionally) simple data visualisation. |

## 3.4 Cables

| Line section: | M-Bus data line: | Additional supply, 15VAC: |
|---|---|---|
| M-Bus main line: | TT 4 L 1 x 4 x 1.5 or 2.5mm$^2$ | - |
| M-Bus connection line: | TT 4 L 1 x 4 x 1.5 or 2.5mm$^2$ | - |
| M-Bus riser line: | TT 4 L 1 x 4 x 1.5 or 2.5mm$^2$ | |
| M-Bus storey network: | U72 1 x 4 x 0.8mm without shielding<br>or<br>J-Y (ST) 2 x 2 x 0.8 mm | |

## 3.5 Components

Boxes for base points and separate connection boxes in the floor network:

- M-Bus distributor AMBUS® ANS-4/DIN for DIN rail mounting. Aquametro No. 81644
- M-Bus distributor AMBUS® ANS-4/AP for surface mounting, lead-sealable. Aquametro No. 81643
- Rail for AMBUS® ANS-4 DIN. Aquametro No. 19565

Boxes for individual separate meters:

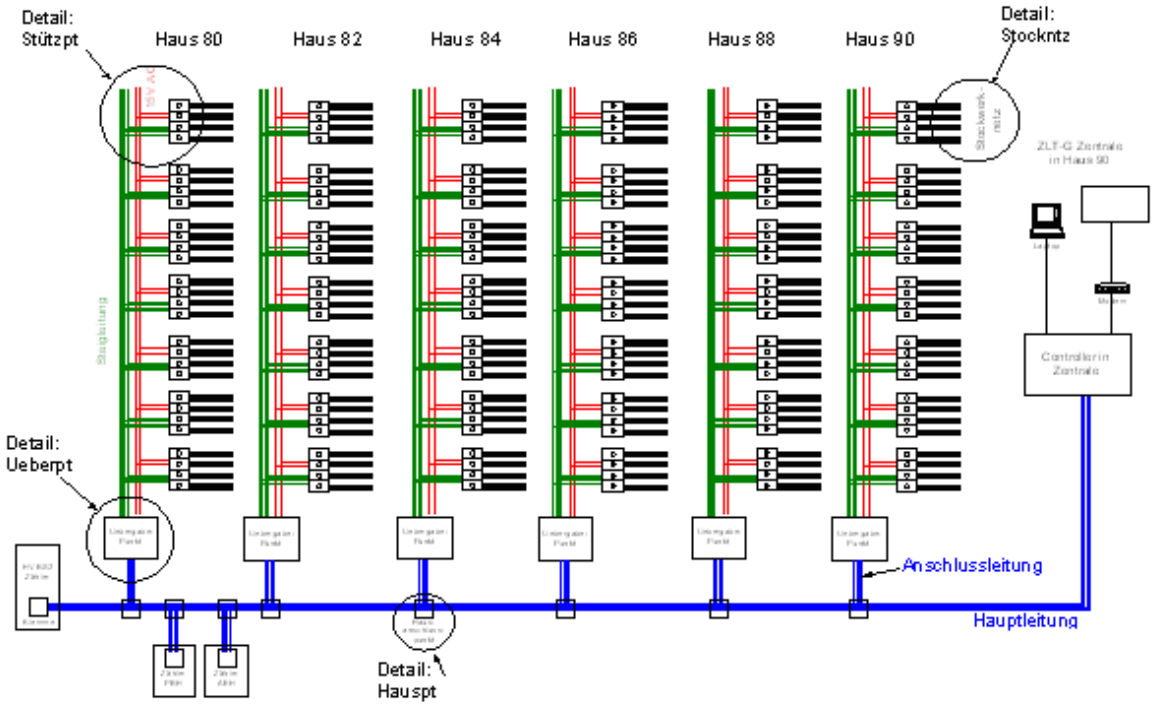
- Single connection box, RJ11 AMBUS® ANS1/AP. Aquametro No. 80006
- Single connection point, RJ11 AMBUS® ANS1/open. Aquametro No. 81585

Terminals for M-Bus house connection point (branch from main line):

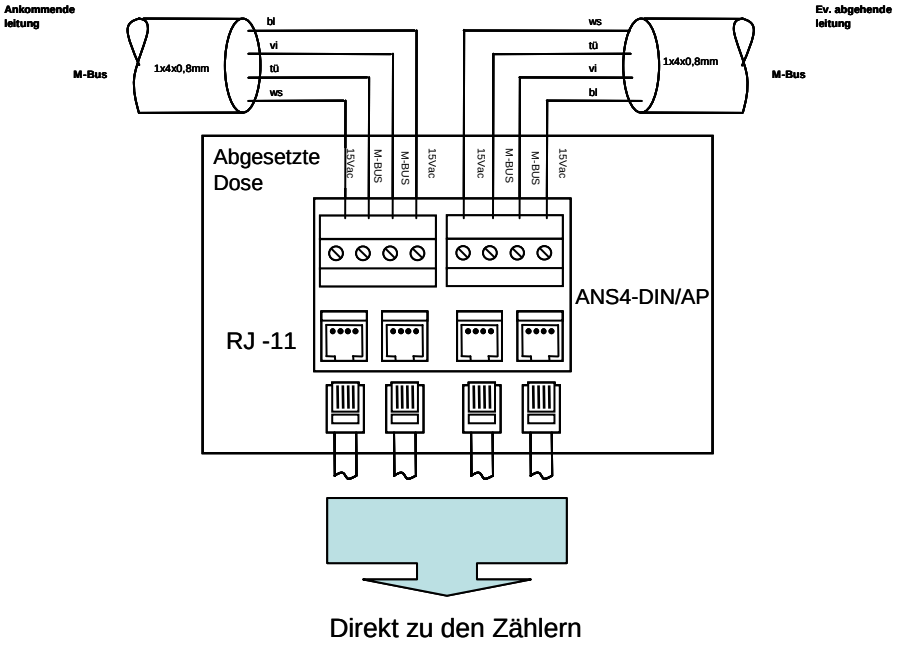
- 4-pin 4-conductor through terminals for cross-section 0.8 ... 2.5mm$^2$ screw or spring terminals

# 4 Topology of the M-Bus network

Basic scheme:

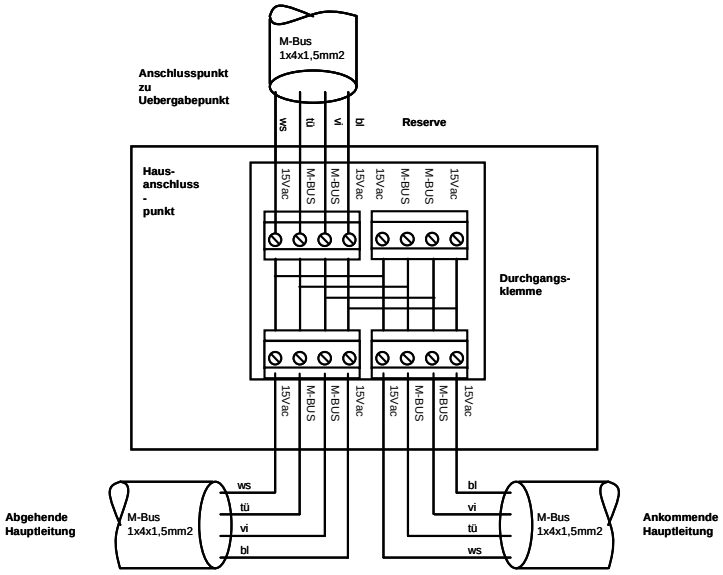


Concept of floor network:




## 4.1 House connection point

At this point the main line is connected to introduce the M-Bus into another building.
The house connection point is installed using a terminal.

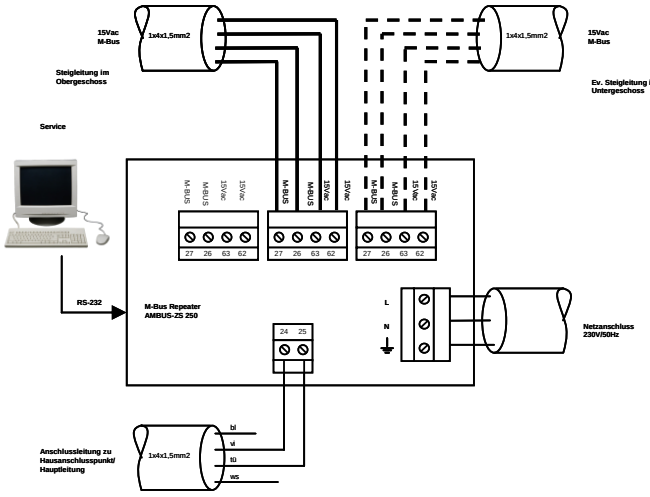



Using this installation type, various objectives are met:

- Defined branch into the building
- Tightly screwed connection of the M-Bus main and connection line (secure connection)
- No multiple assignment of terminals
- Easy separation of the building for maintenance and extension work

## 4.2 Handover Point

The handover point is the central M-Bus node of a building.
An AMBUS® central unit carries out this function. It operates as an M-Bus repeater and supplies the M-Bus devices with energy. The riser lines are connected to this central unit.



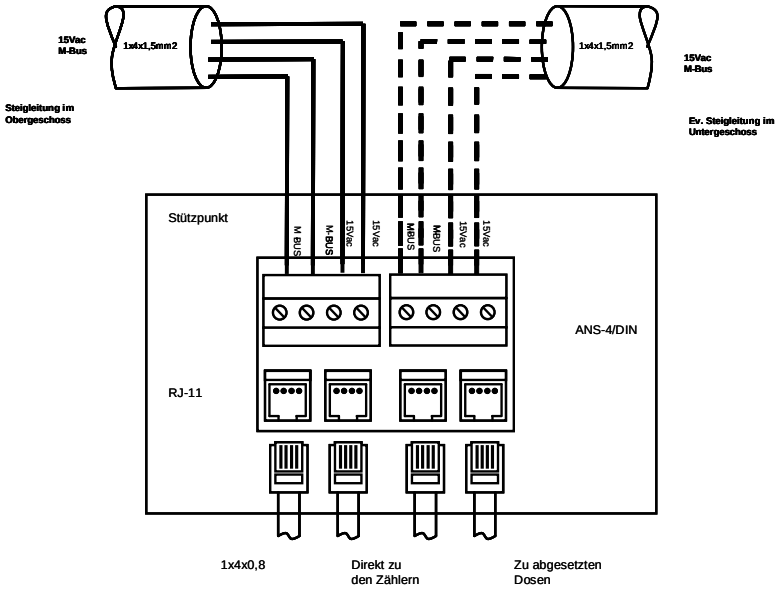

Using this installation type, various objectives are met:

- Defined branch into the building
- Tightly screwed connection of the M-Bus main and connection line (secure connection)
- No multiple assignment of terminals
- Easy separation of the building for maintenance and extension work

## 4.3 Base point

At the base point on every floor in the riser zone area, the M-Bus riser line runs over into the M-Bus floor network for meters or M-Bus components.
This connection is implemented using a fourfold socket outlet type ANS 4.

Due to the maxium current load of a single socket, a maximum of 20 M-Bus load units can be connected per slot in the base point. By consistent allocation to all four RJ-11 socket outlets a capacity overload can be avoided.

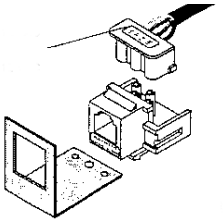


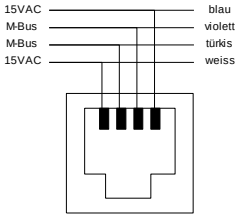

Using this installation type, various objectives are met:

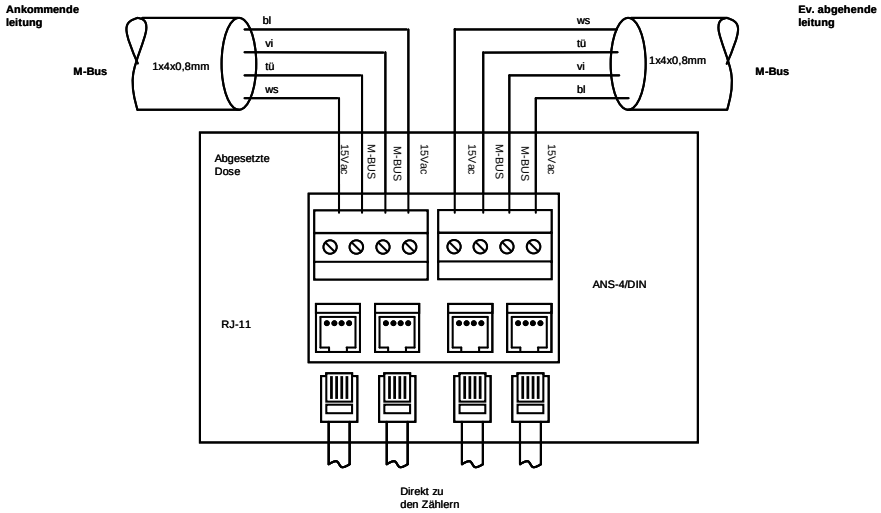
- Defined transition from M-Bus to the floor network
- Screwable connection of the floor network (thereby easy error localization)

## 4.4 End box (meter connection)

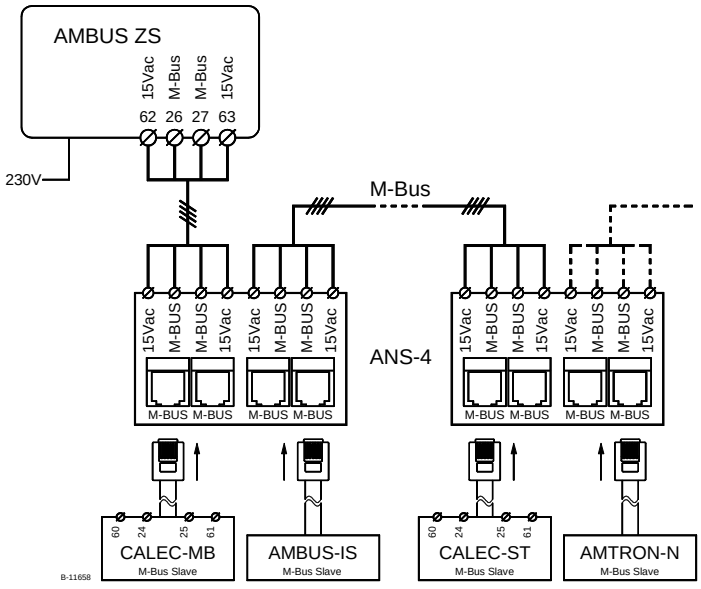
For the development of the meter points within the floor network, type ANS 4 or ANS 1sockets are installed in immediate vicinity of the M-Bus devices The prefabricated RJ-11 connecting cables of the meters are plugged in there.
vices. The prefabricated RJ-11 connecting cables of the meters are plugged in there.

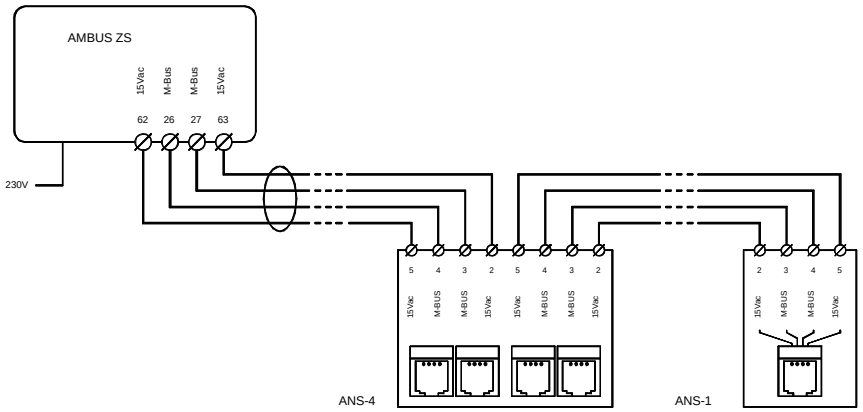




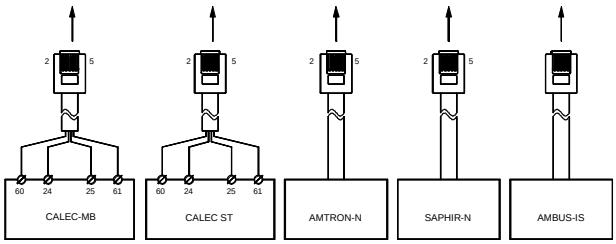




# 5 Examples of how to use distributor and connection boxes






M-Bus Installation mit AQUAMETRO Installationszubehör




M-Bus Geräte z.B: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