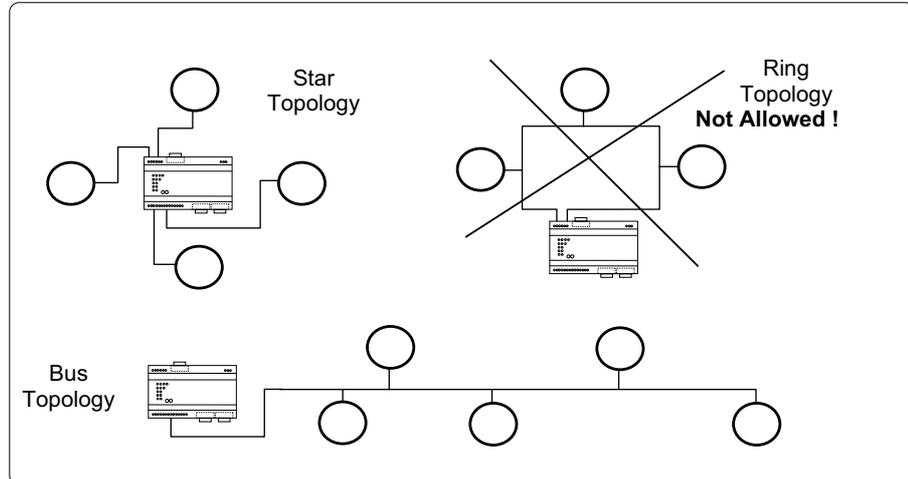


M-BUS WIRING GUIDELINES

M-BUS NETWORK TOPOLOGY

The topology of the M-Bus network is (almost) arbitrary. Only the ring topology as shown beneath should be avoided. In general the length of the cables should be minimised.



Usually a mixture between star and bus topology should be used.

M-BUS CABLE

The M-Bus uses two wire cables which are going from the M-Bus Master / Repeater to each M-Bus device (bus structure). The M-Bus is **polarity independent** and needs no line termination resistors at the end of the cables.

Any cable type may be used as long as the cable is suitable for 42 V / 500 mA. Shielding is not necessary and not recommended since the capacity of the cable should be minimized.

In most cases a standard telephone cable is used which is a twisted pair wire with a diameter of 0.8 mm each (2 x 0.8 mm). This type of cable should be used for the main wiring. For the wiring to the meters from the main wiring (last 1 .. 5 m to the meter) a cable with smaller diameter may be used.

The maximum distance between a slave and the repeater is 350 m. This distance applies for the standard configuration having Baud rates between 300 and 2400 Baud, and a maximum of 250 slaves. The maximum distance can be increased by limiting the Baud rate and using fewer slaves (see below theoretical calculations and the table below), but the bus voltage at no point in a segment fall below 24V, because of the remote powering of the slaves. In the standard configuration the total cable length should not exceed 1000 m, in order to meet the requirement of a maximum cable capacitance of 180 nF.

The table below illustrates typical relation between the number of M-bus meters and the distances using the JYStY cable.

Device	Max. No of Unit Loads	Max Distance To the Slaves Baud Rate = 2400			
		3 Meters	20 Meters	60 Meters	120 Meters
M-P120	120	3000m	3000m	1800m	750m
M-PW60	60	4000m	3500m	1200m	
M-W60					
M810-60					
M-PW20	20	4000m	3000m		
M810-20					
M810-5	5	4000m			
M-PW3	3	4000m			

NOTE: In normal installations the cable length should be limited to 1000m. If baud rate is set to 9600 the distances will be significantly shorter.

Recommended M-Bus Cable (telephone cable):

Cable Type: 2 x 0.8 mm (JYStY N*2*0.8 mm)
 Cable Resistance: 75 Ohm / km
 Cable Capacity: 50 nF / km

Table Characteristics for typical CAT5e (ANSI/TIA/EIA-568-A):-

Cable Type: CAT5e Solid Copper Wire AWG24
 Max Cable Current per Conductor: 0.577 Amp
 Cable Resistance: <188 Ohm / km
 Cable Capacity: 52 nF / km

Although it is possible to use CAT5e UTP cable, this will shorten the maximum allowed cable distances due to higher resistance. For max. of 60 M-bus devices the max segment resistance is 175 kOhms, therefore the maximum theoretical distance using CAT5e would be around 930 meters. In practice using CAT5 cable it is practical to limit the segment length to mximum of 305m for up to 60 devices due to differences in CAT5 cable electrical characteristics. This is the total cable length including spurs etc.

**THEORETICAL MAXIMUM
 CABLE LENGTH IN M-BUS
 NETWORKS**

The question for the maximum possible cable length in M-Bus networks is not easy to answer since several parameters are critical. However, an example calculation is shown here to give an estimation.

Cable Type: 2 x 0.8 mm (JYStY N*2*0.8 mm)
 Cable Resistance: 75 Ohm / km
 Cable Capacity: 50 nF / km

Capacity of one M-Bus Device: 1 nF
 Current of one M-Bus Device: 1.5 mA

The limiting parameters in M-Bus networks are mainly the cable resistance and the cable capacity plus the capacity of the devices (= bus capacity).

The cable resistance causes, depending on the bus current, a bus voltage drop. The maximum bus voltage drop may not be more than 16 V .. 18 V since the minimum bus voltage at any device must not be lower than 24 V (40 V – 24 V = 16 V).

$$R = U / I$$

$$U_{max} = 16V$$

$$I = N * 1.5mA$$

$$R = 16 / (1.5 * N) \text{ Ohm}$$

where

R = Cable Resistance

U = Voltage Drop over Cable Length

I = Bus Current

N = Number of Connected M-Bus Devices

The cable resistance, therefore, limits the maximum possible cable length from the M-Bus Master / Repeater to the device with the largest distance away from it (largest cable segment). The table beneath shows theoretical maximum cable segment lengths:

Number of M-Bus Devices	Max Segment Resistance	Max. Cable Segment Length (75kOhm / km)
1	10.7 kOhm	142 km
10	1.1 kOhm	14.7 km
50	213 Ohm	2.8 km
100	106 Ohm	1.4km
150	71 Ohm	0.95 km
200	53 Ohm	0.71 km
250	43 Ohm	0.57 km

NOTE: The given maximum cable segment length takes into account only the bus resistance and not the bus capacity. Therefore, some of the cable lengths in the table may not be possible in reality. At the end of the chapter is a table with real example configurations.

NOTE: The M-bus segments can be extended using M-MEX10/MEX11/MEX12 M-Bus Extender Modules.

The cable capacity plus the capacity of the M-Bus devices (= bus capacity) is responsible for sloppy signal edges. Therefore, the bus capacity limits the maximum data transfer rate of the M-Bus. The table beneath gives an estimation of the bus capacity / baudrate relationship.

Baudrate	Max. Bus Capacity	Example Configuration
2400 baud	300 nF	50 Devices + 5km Cable ($50 * 1\text{nF} + 5\text{km} * 50\text{nF}$) 250 Devices + 1km Cable ($250 * 1\text{nF} + 1\text{km} * 50\text{nF}$)
9600 baud	100 nF	1 Device + 2 km Cable ($1 * 1\text{nF} + 2\text{km} * 50\text{nF}$) 50 Devices + 1km Cable ($50 * 1\text{nF} + 1\text{km} * 50\text{nF}$) 80 Devices + 400m Cable ($80 * 1\text{nF} + 0.4\text{km} * 50\text{nF}$)

NOTE: The mentioned example configurations are taking into account only the bus capacity but not the bus resistance. Therefore, some of the cable lengths in the table may not be possible in reality. At the end of the chapter is a table with real example configurations.