www.westermo.com

AD-01
M-BUS Adapter

Industrial adapter, M-bus, Repeater,
Converter and zone controller

General information

Legal information

The contents of this document are provided “as is”. Except as required by applicable law, no warranties of any kind, either express or implied, including, but not limited to, the implied warranties of merchantability and fitness for a particular purpose, are made in relation to the accuracy and reliability or contents of this document. Westermo reserves the right to revise this document or withdraw it at any time without prior notice.

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Safety and Regulations

Warning signs are provided to prevent personal injury and/or damages to the product.

The following levels are used:

Level of warning	Description	Consequence personal injury	Consequence material damage
WARNING	Indicates a potentially hazardous situation	Possible death or major injury	Major damage to the product
CAUTION	Indicates a potentially hazardous situation	Minor or moderate injury	Moderate damage to the product
NOTICE	Provides information in order to avoid misuse of the product, confusion or misunderstanding	No personal injury	Minor damage to the product
NOTE	Used for highlighting general, but important information	No personal injury	Minor damage to the product

Before installation:
Read this manual completely and gather all information on the product. Make sure that you understand it fully. Check that your application does not exceed the safe operating specifications for this product.

WARNING - SAFETY DURING INSTALLATION

The product must be installed by qualified service personnel and built in to an apparatus cabinet or similar, where access is restricted to service personnel only.

WARNING - HAZARDOUS VOLTAGE

Do not open an energized product. Hazardous voltage may occur when connected to a power supply.

WARNING - PROTECTIVE FUSE

The power supply wiring must be sufficiently fused.

It must be possible to disconnect manually from the power supply. Ensure compliance to national installation regulations.

CAUTION - ELECTROSTATIC DISCHARGE (ESD)

Prevent electrostatic discharge damages to internal electronic parts by discharging your body to a grounding point (e.g. use a wrist strap).

Care recommendations

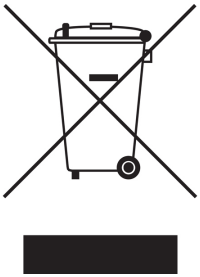
Follow the care recommendations below to maintain full operation of product and to fulfill the warranty obligations:

- Do not drop, knock or shake the product. Rough handling above the specification may cause damage to internal circuit boards.
- Use a dry or slightly water-damp cloth to clean the product. Do not use harsh chemicals, cleaning solvents or strong detergents.
- Do not paint the product. Paint can clog the product and prevent proper operation.

If the product is used in a manner not according to specification, the protection provided by the equipment may be impaired.

If the product is not working properly, contact the place of purchase, nearest Westermo distributor office or Westermo technical support.

Product disposal



This symbol means that the product shall not be treated as unsorted municipal waste when disposing of it. It needs to be handed over to an applicable collection point for recycling electrical and electronic equipment.

By ensuring this product is disposed of correctly, you will help to reduce hazardous substances and prevent potential negative consequences to both environment and human health, which could be caused by inappropriate disposal.

Declaration of Conformity

Hereby, Westermo declares that this product is in compliance with applicable EU directives and UK legislations. The full declaration of conformity and other detailed information is available at **www.westermo.com/support/product-support**.

Agency approvals and standards compliance

Type	Approval / Compliance
EMC	EN 61000-6-1, Immunity residental environment
	EN 61000-6-2, Immunity industrial environments
	EN 61000-6-3, Emission residential environments
	EN 61000-6-4, Emission industrial environments

FCC Part 15.105 Notice:

This equipment has been tested and found to comply with the limits for a Class B digital device, pursuant to Part 15 of the FCC Rules. These limits are designed to provide reasonable protection against harmful interference in a residential installation. This equipment generates, uses and can radiate radio frequency energy and, if not installed and used in accordance with the instructions, may cause harmful interference to radio communications. However, there is no guarantee that interference will not occur in a particular installation. If this equipment does cause harmful interference to radio or television reception, which can be determined by turning the equipment off and on, the user is encouraged to try to correct the interference by one or more of the following measures:

- Reorient or relocate the receiving antenna
- Increase the separation between the equipment and receiver
- Connect the equipment into an outlet on a circuit different from that to which the receiver is connected
- Consult the dealer or an experienced radio/TV technician for help.

Type tests and environmental conditions

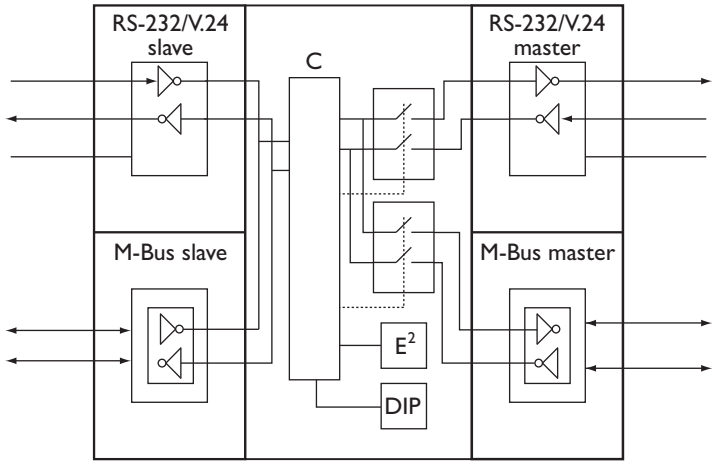
Electromagnetic Compatibility			
Phenomena	**Test**	**Description**	**Level**
ESD	EN 61000-4-2	Enclosure contact	± 4 kV
		Enclosure air	± 8 kV
RF field AM modulated	IEC 61000-4-3	Enclosure	10 V/m 80% AM (1 kHz), 80 - 2700 MHz
Fast transient	EN 61000-4-4	Signal ports	± 1 kV
		Power ports	± 2 kV
Surge	EN 61000-4-5	Signal ports unbalanced	± 1 kV line to earth, ± 1 kV line to line
		Signal ports balanced	± 1 kV line to earth, ± 1 kV line to line
		Power ports	± 2 kV line to earth, ± 2 kV line to line
RF conducted	EN 61000-4-6	Signal ports	10 V 80% AM (1 kHz), 0.15 – 80 MHz
		Power ports	10 V 80% AM (1 kHz), 0.15 – 80 MHz
Radiated emission	CISPR 16-2-3 ANSI 63.4 (FCC part 15)	Enclosure	Class B
Conducted emission	CISPR 16-2-1	AC power ports	Class B
Dielectric strength		Signal port to all other isolated ports	2 kVrms 50 Hz 1min
		Power port to other isolated ports	3 kVrms 50 Hz 1min 2 kVrms 50 Hz 1min (@ rated power < 60V)
Environmental			
Temperature	EN 60068-2-1	Operating	-0 to +50°C
	EN 60068-2-2	Storage & Transport	-25 to +70°C
Humidity	EN 60068-2-30	Operating	5 to 95% relative humidity
		Storage & Transport	5 to 95% relative humidity
Altitude		Operating	2 000 m / 70 kPa
Service life		Operating	10 years
Vibration	IEC 60068-2-6	Operating	7.5 mm, 5 – 8 Hz
			2 g, 8 – 500 Hz
Shock	IEC 60068-2-27	Operating	15 g, 11 ms
Packaging			
Enclosure	UL 94	PC / ABS	Flammability class V-1
Dimension W x H x D			55 x 100 x 128 mm
Weight			0.9 kg
Degree of protection	IEC 529	Enclosure	IP20
Cooling			Convection
Mounting			Horizontal on 35 mm DIN-rail

Description

AD-01 is an industrial adapter for M-bus communication. AD-01 is a very flexible product for building of M-Bus networks. The AD-01 can be configured for a number of applications. It is possible to access the AD-01 and activate/deactivate RS-232 and M-Bus slave port using commands over M-Bus.

- 9-position D-sub connector (RS-232, (M-Bus))
- Data rate from 300 bit/s up to 9600 bit/s
- Automatic data rate detection
- Converter between RS-232 (M-Bus) and M-Bus networks
- Repeater
- Used to interconnect M-Bus and SIOX networks
- Zone controller
- Up to 120 M-bus slaves
- Galvanic isolated
- Designed for hash environments

AD-01 is a flexible product which implements a number of possibilities to extend / control a M-Bus network.



AD-01 includes a micro controller (µC) which handles the data flow through the unit. The main function is activating / deactivating of the two ports, RS-232/V.24 master and M-Bus master which gives possibilities for the unit to work as a zone controller.

Data packets received on the slave side is passed further on the active master ports. Data packets received on active master ports is passed further on both slave ports. AD-01 can be addressed and configured over the slave ports.

AD-01's master ports are active according to factory default. This means that AD-01 can be used as a RS-232 / M-Bus converter without any external configuration.

Interface specifications

Power interface	
Rated voltage	230 V AC ±10%
Rated current	150 mA
Rated frequency	48–62 Hz
Connection	3-position screw terminal

M-Bus interface (slave)	
Electrical specification	M-Bus according to EN1434-3
Data rate	Up to 9600 bit/s
Power consumption	Maximum 2 slave loads
Connection	5-position screw terminal

M-Bus interface (master)	
Electrical specification	M-Bus according to EN1434-3
Data rate	Up to 9600 bit/s
Number of slaves	Up to 120 slave loads
Connection	5-position screw terminal

Serial RS-232/V24 interface (slave)	
Electrical specification	RS-232/V.24
Data rate	Up to 9600 bit/s
Connection	9-position screw terminal (DCE)
	9-position D-sub (DCE)

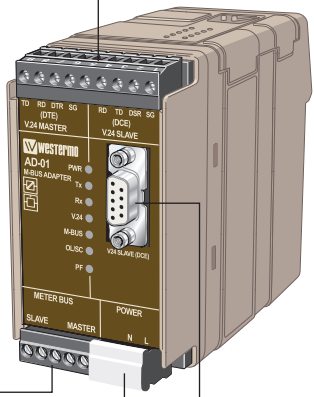
Serial RS-232/V.24 interface (master)	
Electrical specification	RS-232/V.24
Data rate	Up to 9600 bit/s
Connection	9-position screw terminal (DTE)

RS-232/V.24 for M-Bus protocol

Slave		
Screw terminal	**Direction (DCE)**	**Description**
No. 1	–	Signal ground (SG)
No. 2	Out	Data set ready (DSR)*
No. 3	In	Transmit Data (TD)
No. 4	Out	Receive Data (RD)

Master		
Screw terminal	**Direction (DTE)**	**Description**
No. 6	–	Signal ground (SG)
No. 7	Out	Data terminal ready (DTR)*
No. 8	In	Receive Data (RD)
No. 9	Out	Transmit Data (TD)

*) DSR / DTR is always +5 V



METER BUS

Slave		
Screw terminal	**Direction**	**Description**
No. 1	In/Out	M-Bus connection
No. 2	In/Out	M-Bus connection

Master		
Screw terminal	**Direction**	**Desctiption**
No 4	In/Out	M-Bus connection
No 5	In/Out	M-Bus connection

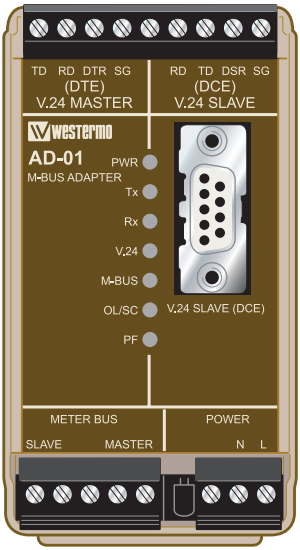
Power

Connection	Description
L	Power 230V AC ±10%
N	Power 230V AC ±10%
⏚	Protective earth

RS-232/V.24

Slave			
Connection	**Direction (DCE)**	**Description**	**D-sub description**
No. 2	Out	Receive data (RD)	
No. 3	In	Transmit data (TD)	
No. 5	–	Signal Ground (SG)	

LED indications

LED	Status	Description	
PWR	LED on	Correct internal power	
	LED off	No internal power	
Tx	LED on	Data received slave interface	
	LED off	No data slave interface	
Rx	LED on	Data received master interface	
	LED off	No data master interface	
V.24	LED on	RS-232/V.24 master port open	
	LED off	RS-232/V.24 master port closed	
M-BUS	LED on	M-Bus master port open	
	LED off	M-Bus master port closed	
OL/SC	LED on	Overload / short-circuit M-Bus master interface	
	LED off	Normal communication M-Bus master interface	
PF*	LED on	Power failure M-Bus slave interface	
	LED off	M-Bus slave interface receives correct power from line	

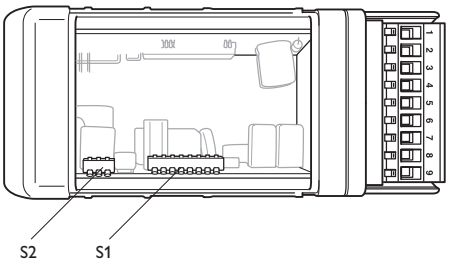
* Observe that if M-Bus slave mode is set to not used, PF led is always inactive.

DIP-switch settings

Before DIP-switch settings:

Prevent damage to internal electronics from electrostatic discharges (ESD) by discharging your body to a grounding point (e.g. use of wrist strap).

NOTE DIP-switch alterations are only effective after a power on.



S1 Primary address

Address bit inactive ('0')

Address bit active ('1')

The units primary address is set up as a 8-bit binary address (0–255)
S1:1 is the least significant bit, S1:8 is the most significant bit.
Observe that only primary addresses 1–250 is allowed to use according to M-Bus standard.

Example, address 103 = "01100111" binary = S1: 4, 5, 8 OFF, others ON,
see table on page xxxx

S2 Data rate functionality

Data rate using protocol

Autobaud

Data rate using protocol means that data rate is set using protocol commands.
Autobaud implies that every incoming packet on slave interfaces is data rate controlled and data rate is set accordingly.

S2 Processor mode

Normal mode

Flash mode

Flash mode implies that an update of the application program is possible using the serial port. See chapter program update.

S2 M-Bus slave mode

M-Bus slave not used

M-Bus slave used

M-Bus slave mode specifies if the M-Bus slave interface is used or not.

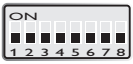
S2 Factory default mode

Normal mode

Reset to factory default

Disconnected power to AD-01.
Set switch to factory default.
Repower AD-01, the unit is now set as factory default.
Disconnect power and set switch to normal mode.

Factory settings



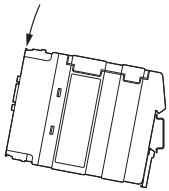
S1

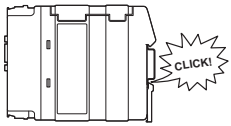
S2

Mounting

This unit should be mounted on 35 mm DIN-rail, which is horizontally mounted inside an apparatus cabinet, or similar.

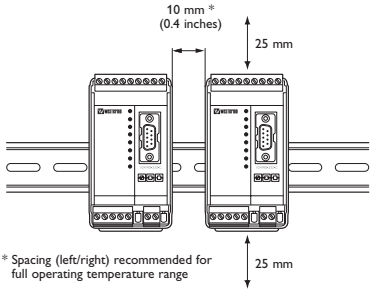
Snap on mounting, see figure.





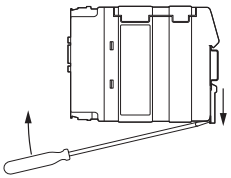
Cooling

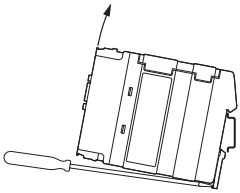
This unit uses convection cooling. To avoid obstructing the airflow around the unit, use the following spacing rules. Minimum spacing 25 mm (1.0 inch) above /below and 10 mm (0.4 inches) left /right the unit. Spacing is recommended for the use of unit in full operating temperature range and service life.



Removal

Press down the black support at the back of the unit using a screwdriver, see figure.





Protocol implementation

Parts of the M-Bus protocol is implemented in the unit. Data packets which are not addressed to the unit are transparently passed further without format or checksum control. Packets addressed to the unit are controlled according to M-Bus standard.

Unit addressing

AD-01 can be addressed over the M-Bus protocol in two ways, by using primary or secondary addressing.

Primary addressing

The primary address is set with switches inside the unit. See page 11, Switch settings / Primary address.

Secondary addressing

The secondary address is based on a unique identification number in every unit. The AD-01 secondary address is according the unit serial number and can in this way easily be identified. The following secondary address parameters is used in AD-01

Parameter	Value
ID number	10000000 + serial number*
Manufacturer	WMO = 5DAF (hex)
Version	Software version
Medium	Bus / system = 0E (hex)

* Example: Unit with serial number 729 has ID number 10000729

Unit configuration

Some of the M-Bus protocol applications are implemented in AD-01. This makes it possible to configure a number of internal parameters. The following applications are implemented.

Initialisation of slave (SND_NKE)

Selection of data rate

(only if data rate using protocol is selected, see page 11, Switch settings / Data rate functionality).

All data rates from 300 bit/s up to 9 600 bit/s can be configured according to M-Bus standard.

Selection of slave

Selection of slave to be able to use secondary addressing. Slave select is performed according to M-Bus standard.

Set up / Read out of master ports setting

Set up or read out of the units master ports setting is made with a specific command sequence.

Set up of master ports

Set up of the master ports is possible using a SND_UD command, CI = 51 (hex) with the following data field.

Data field	DIF = 01 (hex)	VIF = FD (hex)	VIFE = E2 (hex)	VIFE = 00 (hex)	DATA
Description	8-bit integer	Ext. coding	Cont. signal	Write replace	Port setup

The DATA is coded according the following:

Value	Master RS-232 port	Master M-Bus port
00 (hex)	Inactive	Inactive
01 (hex)	Inactive	Active
02 (hex)	Active	Inactive
03 (hex)	Active	Active

Read out of master ports

Read out of the master ports setting is possible using a REQ_UD2 command. AD-01 will respond with a RSP_UD, CI=72 (hex) with the following data field.

Data field	DIF = 01 (hex)	VIF = FD (hex)	VIFE = E2 (hex)	DATA
Description	8-bit integer	Ext. coding	Cont. signal	Port setup

The DATA is coded according the following:

Value	Master RS-232 port	Master M-Bus port
00 (hex)	Inactive	Inactive
01 (hex)	Inactive	Active
02 (hex)	Active	Inactive
03 (hex)	Active	Active

Error indication

AD-01 includes possibilities to alert the supervision system of short-circuit or overload on the M-Bus master interface. Readout of error status can be made using a REQ_UD2 command. AD-01 uses the status field in a RSP_UD answer sequence to alert possible errors.

The coding of the status field is according to the following:

Value status field	Description
00 (hex)	No error
10 (hex)	Overload / short-circuit of M-Bus master interface

Program update

A software update can be made using the 9-position D-sub connection. AD-01 has a micro controller with flash memory which can be reprogrammed.

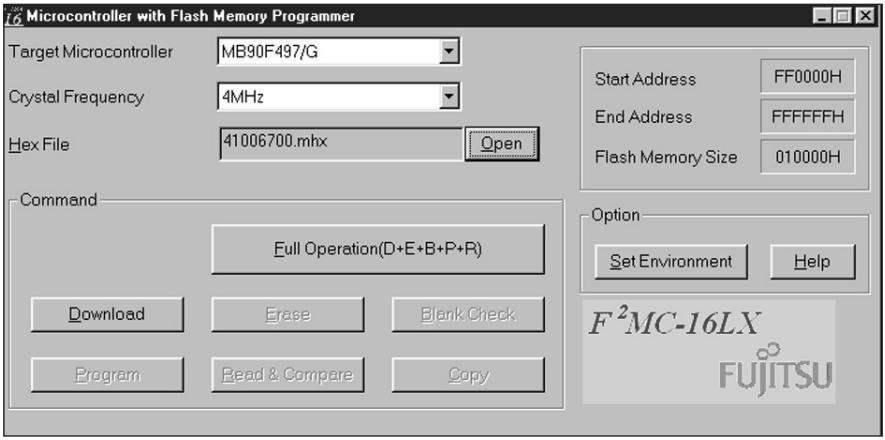
To perform a program update a program file from Westermo and flash software is necessary.

Set up of AD-01 for program update

1. Connect AD-01 to computer serial interface.
   Observe that the connection must be to AD-01 9-position D-sub.
2. Set AD-01 in flash mode, S2:2 OFF, S2:3 ON.
   Observe, power must be removed before switch setting.

Set up of flash program

After installation and start the following window will appear on screen.



1. Choose ”Set Environment” and select serial port.
2. Choose ”Target Microcontroller” as MB90F497/G.
3. Choose ”Crystal Frequency” as 4 MHz.
4. Choose ”Open” and select program file.
5. Choose ”Full Operation”.
6. Control that the programming is completed without errors.
7. Remove power to AD-01
8. Set AD-01 in normal operation, S2:2 ON, S2:3 OFF.
9. Reconnect power to AD-01.

Application example

AD-01 is an industrial adapter for M-Bus communication. AD-01 is a flexible product for building of M-Bus networks. The unit is equipped with two RS-232/V.24 interfaces, one M-Bus master and one M-Bus slave interface. The AD-01 can be configured for a number of applications.

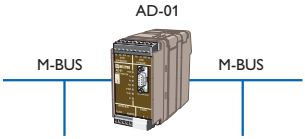
AD-01 as converter RS-232 to M-Bus

AD-01 can be used as a converter between RS-232 and M-Bus. The M-Bus master interface can drive up to 120 slave loads.

Consider the following points.

- AD-01 can be used transparently, no addressing or set up of AD-01 using the M-Bus protocol is necessary.
- The primary address should be set to 0 to avoid addressing of the AD-01 unit.

AD-01 as repeater

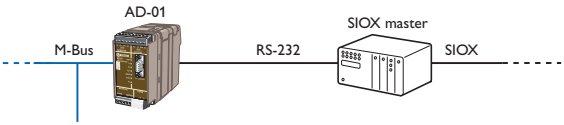


AD-01 can be used as repeater for M-Bus. The M-Bus master interface can extend the network with up to 120 new slave loads.

Consider the following points.

- AD-01 can be used transparently, no addressing or set up of AD-01 using the M-Bus protocol is necessary.
- The primary address should be set to 0 to avoid addressing of the AD-01 unit.

AD-01 and connection to SIOX networks



AD-01 can be used to connect a M-Bus network to a SIOX network.

Consider the following points.

- AD-01 can be used transparently, no addressing or set up of AD-01 using the M-Bus protocol is necessary.
- The primary address should be set to 0 to avoid addressing of the AD-01 unit.
- AD-01 should only be used in datarate using protocol mode since autobaud is not possible when receiving SIOX commands.

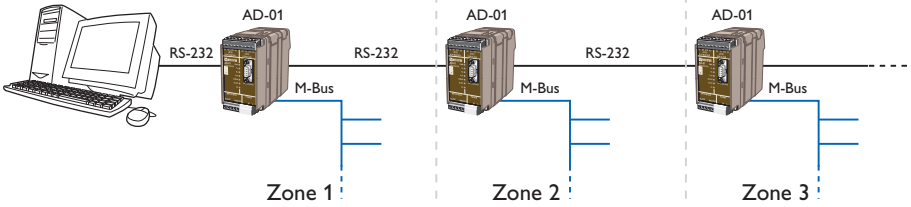
AD-01 to extend a network with a modem link

Two AD-01 units can be used to extend an existing network with any type of modem link.

Consider the following points.

- AD-01 can be used transparently, no addressing or set up of AD-01 using the M-Bus protocol is necessary.
- The primary address should be set to 0 to avoid addressing of the AD-01 unit.
- Observe that if a dial-up modem is used the supervision system needs to send dial commands to the modem. The supervision system must also control that a link is established before sending data over the link.

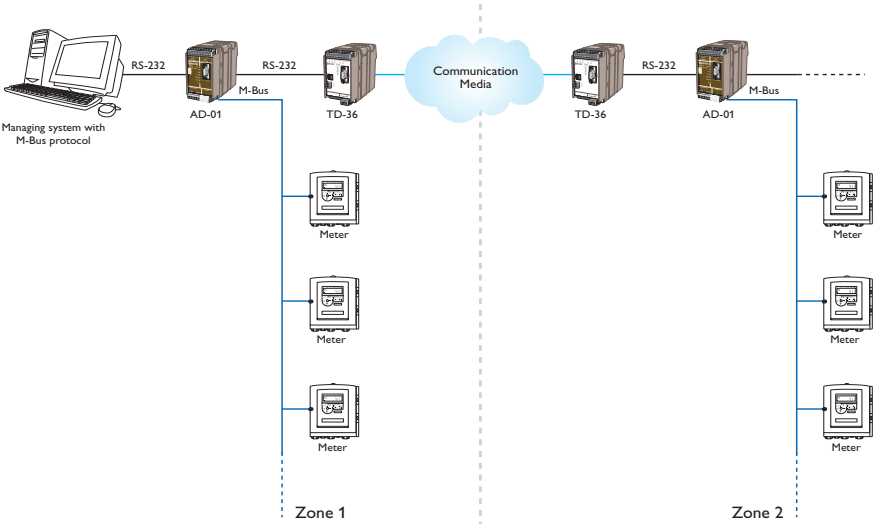
AD-01 as zone controller



AD-01 can be used as zone controller to build larger M-Bus networks.

Consider the following points.

- AD-01 is addressed and set up by the supervision system
- AD-01 can be addressed with primary or secondary address
- If meters with different data rate is used the AD-01 should be set up for autobaud.


RS-232
RS-232
M-Bus
Communication Media
RS-232
M-Bus
Managing system with M-Bus protocol
AD-01
TD-36
TD-36
AD-01
Meter
Meter
Meter
Meter
Meter
Meter
Zone 1
Zone 2

Primary address in binary format

ADDRESS	BINARY
1	00000001
2	00000010
3	00000011
4	00000100
5	00000101
6	00000110
7	00000111
8	00001000
9	00001001
10	00001010
11	00001011
12	00001100
13	00001101
14	00001110
15	00001111
16	00010000
17	00010001
18	00010010
19	00010011
20	00010100
21	00010101
22	00010110
23	00010111
24	00011000
25	00011001
26	00011010
27	00011011
28	00011100
29	00011101
30	00011110
31	00011111
32	00100000
33	00100001
34	00100010
35	00100011
36	00100100
37	00100101
38	00100110
39	00100111
40	00101000
41	00101001
42	00101010
43	00101011
44	00101100
45	00101101
46	00101110
47	00101111
48	00110000
49	00110001
50	00110010
51	00110011
52	00110100
53	00110101
54	00110110
55	00110111
56	00111000
57	00111001
58	00111010
59	00111011
60	00111100
61	00111101
62	00111110
63	00111111
64	01000000
65	01000001
66	01000010
67	01000011
68	01000100
69	01000101
70	01000110

ADDRESS	BINARY
71	01000111
72	01001000
73	01001001
74	01001010
75	01001011
76	01001100
77	01001101
78	01001110
79	01001111
80	01010000
81	01010001
82	01010010
83	01010011
84	01010100
85	01010101
86	01010110
87	01010111
88	01011000
89	01011001
90	01011010
91	01011011
92	01011100
93	01011101
94	01011110
95	01011111
96	01100000
97	01100001
98	01100010
99	01100011
100	01100100
101	01100101
102	01100110
103	01100111
104	01101000
105	01101001
106	01101010
107	01101011
108	01101100
109	01101101
110	01101110
111	01101111
112	01110000
113	01110001
114	01110010
115	01110011
116	01110100
117	01110101
118	01110110
119	01110111
120	01111000
121	01111001
122	01111010
123	01111011
124	01111100
125	01111101
126	01111110
127	01111111
128	10000000
129	10000001
130	10000010
131	10000011
132	10000100
133	10000101
134	10000110
135	10000111
136	10001000
137	10001001
138	10001010
139	10001011
140	10001100

ADDRESS	BINARY
141	10001101
142	10001110
143	10001111
144	10010000
145	10010001
146	10010010
147	10010011
148	10010100
149	10010101
150	10010110
151	10010111
152	10011000
153	10011001
154	10011010
155	10011011
156	10011100
157	10011101
158	10011110
159	10011111
160	10100000
161	10100001
162	10100010
163	10100011
164	10100100
165	10100101
166	10100110
167	10100111
168	10101000
169	10101001
170	10101010
171	10101011
172	10101100
173	10101101
174	10101110
175	10101111
176	10110000
177	10110001
178	10110010
179	10110011
180	10110100
181	10110101
182	10110110
183	10110111
184	10111000
185	10111001
186	10111010
187	10111011
188	10111100
189	10111101
190	10111110
191	10111111
192	11000000
193	11000001
194	11000010
195	11000011
196	11000100
197	11000101
198	11000110
199	11000111
200	11001000
201	11001001
202	11001010
203	11001011
204	11001100
205	11001101
206	11001110
207	11001111
208	11010000
209	11010001
210	11010010

ADDRESS	BINARY
211	11010011
212	11010100
213	11010101
214	11010110
215	11010111
216	11011000
217	11011001
218	11011010
219	11011011
220	11011100
221	11011101
222	11011110
223	11011111
224	11100000
225	11100001
226	11100010
227	11100011
228	11100100
229	11100101
230	11100110
231	11100111
232	11101000
233	11101001
234	11101010
235	11101011
236	11101100
237	11101101
238	11101110
239	11101111
240	11110000
241	11110001
242	11110010
243	11110011
244	11110100
245	11110101
246	11110110
247	11110111
248	11111000
249	11111001
250	11111010
251	11111011
252	11111100
253	11111101
254	11111110
255	11111111

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