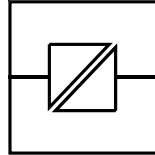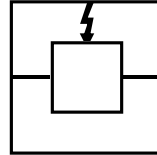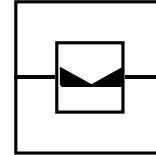# MA-43
# MA-43 H

# INSTALLATION MANUAL
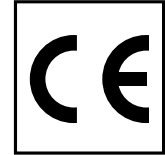
## 6043-2202

| Galvanic Isolation | Transient Protection | Balanced Transmission | CE Approved |



*Addressable modem*

**Wwestermo**®
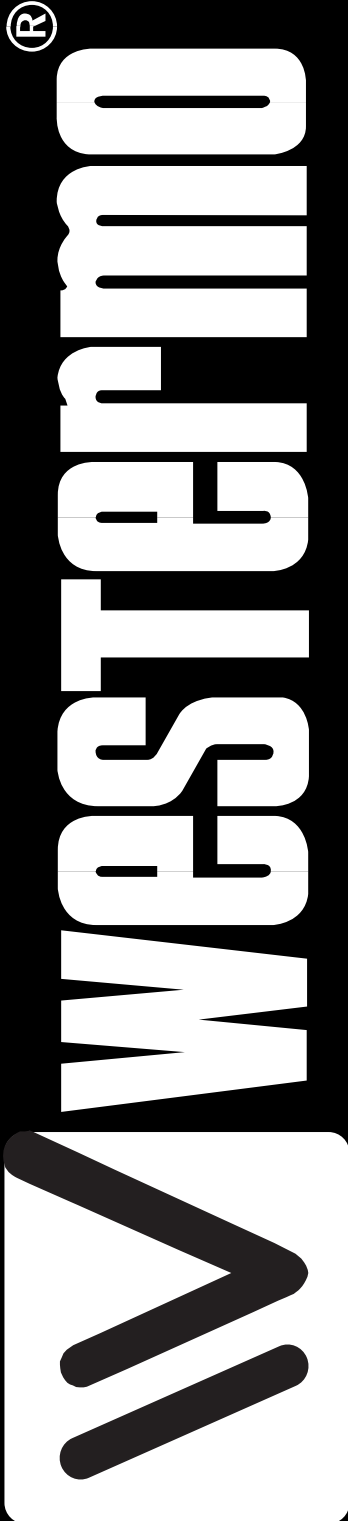
# Specifications

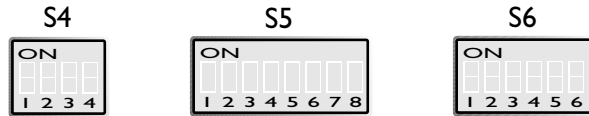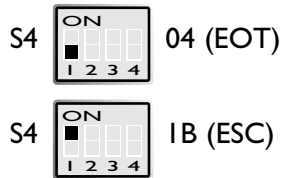| | |
|---|---|
| **Transmission** | Asynchronous, full/half duplex or simplex |
| **Interface 1** | EIA RS-232-C/ITU-T V.24, 25-position D-sub, female |
| **Interface 2** | EIA RS-422-A/RS-485/V.11, 5-position screw block |
| **Transmission rates** | Up to 38.4 kbit/s |
| **Indicators** | Power, RD, TD, DCD, CTS, RTS |
| **Humidity** | 0–95% RH, non-condensing |
| **Overvoltage protection** | **Mains:** Breakdown voltage 440V at 230V AC and 220V at 115V AC<br>**Interface 2:** Breakdown voltage transmitter and receiver 7V<br>Surge capacity 0.6 kW for 1 ms |
| *Transient protection* | |
| **Power/Line** | Yes/Yes |
| **Isolation** | Galvanic isolation with opto-coupler (data transmission) and transformer (supply) |
| *Isolation RMS* | |
| **Data interface** | 1 500 V |
| **Power supply** | 3 000 V |
| | |
| **Power supply** | Switchable 115/230V +15/–10% |
| **Frequency** | 48–62 Hz |
| **Fuse** | 100 mA F 5x20 mm Littlefuse |
| **Power consumption** | 48 mA / 24 mA |
| **Temperature range** | 5–50°C, ambient temperature |
| **Dimensions** | 161x139x53 mm (WxHxD) |
| **Weight** | 0.5 kg |
| **Mounting** | Table top. |

# Switch settings MA-43
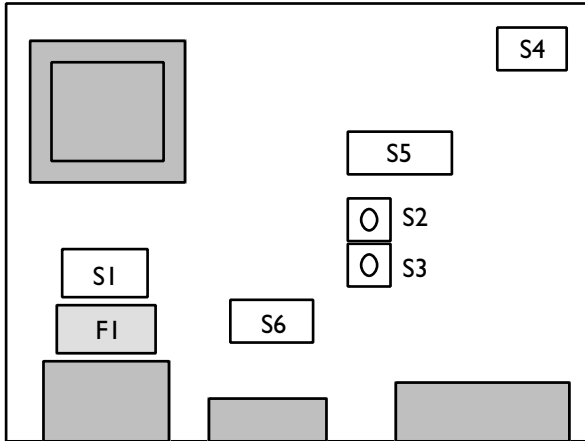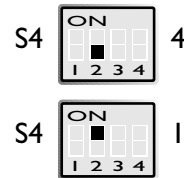
S1      Selection of power supply 115/230V AC

S2, S3   Selection of addresses

S4      Selection of operation

S5      Selection of communication parameters

S6      Selection of 2- or 4-wire communication and termination
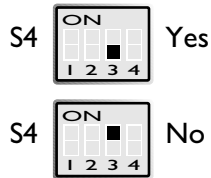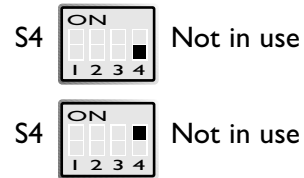
| **Master** **Start character (hex)** | **Master** **Number of start charter** |
|---|---|
| S4   [ON 1 2 3 4]   04 (EOT) | S4   [ON 1 2 3 4]   4 |
| S4   [ON 1 2 3 4]   1B (ESC) | S4   [ON 1 2 3 4]   1 |

| **Master** **Timed address frame** | **Master** **Reserved** |
|---|---|
| S4   [ON 1 2 3 4]   Yes | S4   [ON 1 2 3 4]   Not in use |
| S4   [ON 1 2 3 4]   No | S4   [ON 1 2 3 4]   Not in use |

| **Slave** **Buffered** | **Slave** **Reserved** |
|---|---|
| S4   [ON 1 2 3 4]   Yes | S4   [ON 1 2 3 4]   Not in use |
| S4   [ON 1 2 3 4]   No | S4   [ON 1 2 3 4]   Not in use |
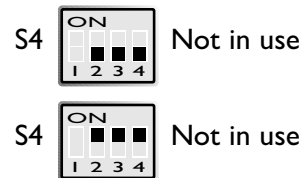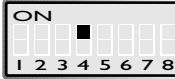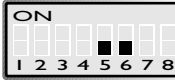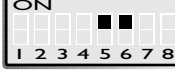
## Bit/s

S5   300

S5   600

S5   1200

S5   2400

S5   4800

S5   9600

S5   19200

S5   38400

## Bits per character

S5   8

S5   7
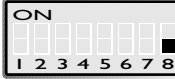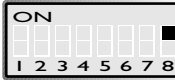
## Parity

S5   Odd

S5   No

S5   Even

S5   No

## Stop bits

S5   2

S5   1

## Flow control

S5   Xon/Xoff

S5   RTS/CTS

## Termination with fail-safe

S6   2-wire

S6   4-wire

S6   No termination

The MA-43 system has to be terminated and have a fail-safe function. Fail-safe forces a three stated line to be in the off state.

## Selection of 2- or 4-wire

S6   2-wire

S6   4-wire

## Factory settings

S4    S5

S6

# General

MA-43 is an addressable short haul modem which can be used in a master/slave system with unintelligent slaves. Unintelligent slaves are devices which cannot recognize any type of addressing.

MA-43 is a flexible product designed to be integrated into many different and complex systems. Any data from single ASCII characters to large binary data files can be transferred through the MA-43. The protocol is flexible so it can fit into many systems. For this reason the addressing protocol is selectable so that data cannot appear as an address to a slave. If just simple character data is going to be exchanged then a simple protocol can be used to save time and complexity. However, if binary data files are going to be transmitted then the contents of the data could be anything. In this case a more complex addressing system has to be used- timed mode. In this mode there has to be a period of no data before and after the addressing, which is a condition that will not occur in binary data file transfer.

Each MA-43 in a network can have different baud rate, parity, stop bits and flow control. This makes it possible to connect different equipment with different flow control and speed to the same bus.

# Protocol

The protocol is an address frame followed by data for the addressed unit. There is no limit for the number of data bytes that can be sent to and from an addressed slave after the address frame. The address frame is made of two parts, a start sequence and an address. The start sequence consists of one or four equal start characters (EOT or ESC) and the address which is just a single character corresponding to the slave address. The address frame is followed by an unlimited number of data characters to the addressed unit. However, the datastream should not include data equal to the start sequence, if this happens a new unit is addr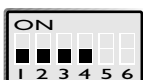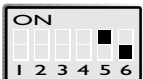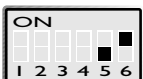essed and the rest of the data is sent to a different unit. The protocol is set in the master MA-43 so all slaves are independent of the chosen protocol.

When a slave receives an address it is compared with its own strapped address. If the address matches all following data received on the bus will be transfered to the RS-232 side. This will be done until another address is received. The addressed slave is the only slave that can transmit data on the bus. When a new address is received the slave will stop the transmitting immediately even if there is still data in the buffer. The bus is fully controlled by the MA-43 so no status signals are required from the terminal equipment.
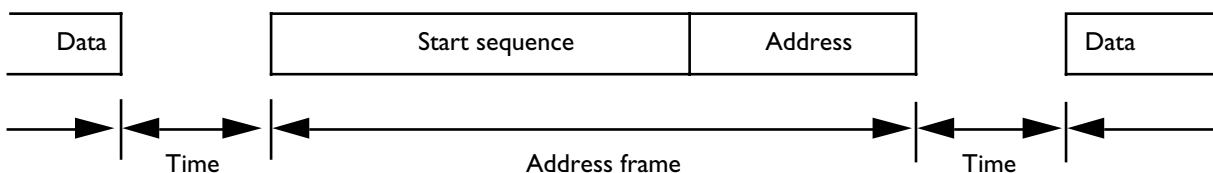


Address frame

# Untimed address frame

The master MA-43 searches for the start sequence and address in the RS-232 data stream. When a valid start sequence is detected the next received character is transmitted as an address to all connected slaves. If there is more than one character in the start sequence, there is a time limit between two subsequent start characters. The time between two start characters has to be less than 10 byte times. When a start sequence is detected the next character is an address. There is no time-limit between the last start character and the address character.

If another character is received instead of a start character, this character and any previously accepted start characters for this address frame search, is transmitted and the MA-43 looks for a new start character.

If the time expire between characters in an address frame, the previously accepted characters for this address frame search are transmitted and the MA-43 looks for a new start character.

| UNTIMED ADDRESS | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| **1 Start character** | Data | Data | | Start | | Address | | Data | |
| **4 Start characters** | Data | Start | T1 | Start | T1 | Start | T1 | Start | Address | Data |

T1 has to be less than 10 byte times
There is no time-limits when only 1 start character is used.
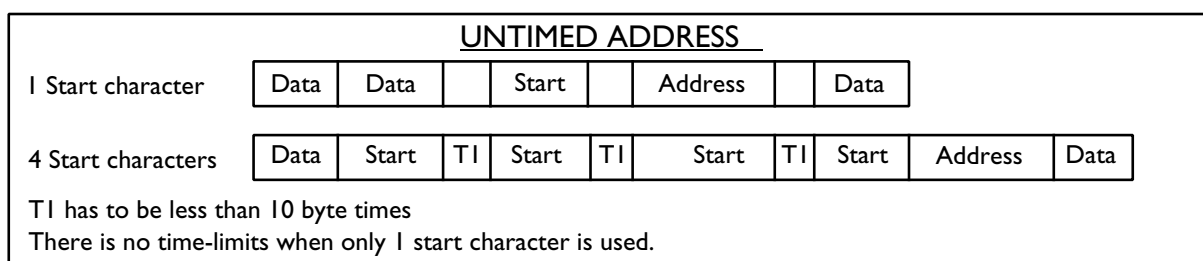
# Timed address frame

This mode uses the same protocol as untimed however in this mode MA-43 requires a quiet period before and after the address frame. A quiet period is a time-period when no character of any kind is sent on the masters RS-232 TD signal. The quiet periods has to be at least 10 byte times.

After 10 byte times quiet since the last character on the RS-232 TD line the MA-43 master waits for a start character. There is also in this mode a time-limit between characters in the startframe. The time-limit between characters is also 10 byte times. In this timed mode the time-limit also concerns the gap between the last start character and the address character. When the address character is received MA-43 requires 10 byte times quiet before the address frame is accepted and the new address can be transmitted to all connected slaves.

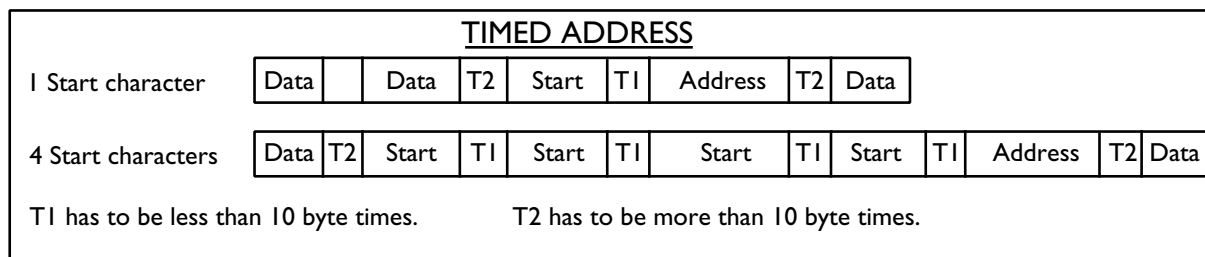If another character is received instead of a start character, this character and any previously accepted start characters for this address frame search are transmitted and 10 new byte times have to pass before the MA-43 looks for a new start character.

If the time expires between characters in an address frame, the previously accepted characters for this address frame search are transmitted and the MA-43 looks for a new start character.

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | | TIMED ADDRESS | | | | | | | |
| 1 Start character | Data | | Data | T2 | Start | T1 | Address | T2 | Data | | | | |
| 4 Start characters | Data | T2 | Start | T1 | Start | T1 | Start | T1 | Start | T1 | Address | T2 | Data |
| T1 has to be less than 10 byte times. | | | | T2 has to be more than 10 byte times. | | | | | | | | | |

# Buffered/Unbuffered

The slaves can be strapped to work with or without buffers. The buffer in the slaves is 24 kbytes. When the slave is working as buffered all data is buffered, even if the slave is not addressed. So if no flow control is used the buffer will overflow and starts to overwrite itself. When unbuffered the slaves only accept data on the RS-232 side as long as they are addressed.

# Flow control

The RS-232 flow control can be done in two different ways, software XON/XOFF or hardware RTS/CTS. This is individually selectable for each connected unit.

The system itself has flow control internally on the RS422/485 bus. The internal flow control is used to transfer the hardware control signals across the network and indicates that the buffer is full.

A MA-43 system can have different baudrates for different connected equipment. Because of this there can be flow control signalling introduced by the MA-43 units. This means for example, that if an XON/XOFF protocol is used the XOFF signal can be sent by either the addressed user equipment or one of the two MA-43s which are involved in the talking, if a buffer is filled up.

# RTS/CTS

The CTS signal is used to control the data stream from a user to a MA-43. CTS is high when the MA-43 is ready to receive characters.

The RTS signal is used to control the data stream from a MA-43 to the user. When the user equipment is ready to receive characters RTS has to be high.

# LED Indicators

MA-43 has 7 LED indicators. The LEDs has the following function.

POWER: Fixed light indicates normal function. If it is flashing the unit is faulty (watchdog).

RD: Indicates RS-232 receiving data. Light off when no data received.

DCD: Lights when this slave is addressed, flashing when master is in test mode.

RTS: Lights when connected unit has RTS in active state.

CTS: Lights when MA-43 is ready to receive data.

TD: Indicates RS-232 transmitting data. Light off when no data transmitted.

RXBUS: Lights when data is received from the bus. This LED is only visible when the box is open.

# 2-Wire system

When a slave has anything to send this will be sent as soon as the slave is addressed. The MA-43 can not follow application protocols, so it is possible to get data collision on the 2-wire bus if the user protocol is not disciplined. i.e the equipment cannot answer polls or commands before the whole message is received from the talking partner.

# Test

Test commands can be sent from a standard terminal with an RS-232 connection. The terminal is connected to the master MA-43 (address 00), which is the only MA-43 that can act on the test commands. To be able to give test commands the MA-43 has to be in the test mode. Test mode can only be entered directly after power up or reset of the master MA-43. To enter the test mode, send an ASCII 0 as the first character to the master MA-43 after power up or reset. The MA-43 then answers with a character string (***** MA-43 TEST MODE ******). During the test phase normal data traffic will be disturbed. The MA-43 will leave testmode with a reset as soon as a start character is sent to the master MA-43.

The following test is available: TEST1.

# Test 1

The test is designed to be used to control an installation. TEST1 first resets all slaves, then all slave addresses are polled. The slaves which recognises their own address answer with a configuration message. 10 slaves will be displayed in ascending order, the user is asked to press a key to continue to see 10 new slaves, only the answering slaves will be displayed. The units will answer with the information seen below. To test the RS-232 hardware the slaves have to be looped back between TD and RD (position 2 and 3 in the 25-pole D-sub). The test can run without TD and RD looped on the slaves, but the RS-232 interface will not be tested.

*Example*

| Address | Baudrate | Flow control | Buffered | Looped |
|---------|----------|--------------|----------|--------|
| 01 | 9600,e,8,1 | RTS/CTS | Buffered | OK |
| 03 | 4800,n,7,1 | XON/XOFF | No | OK |
| 0A | 4800,n,7,1 | XON/XOFF | No | No loop |

# Addresses and commands

All commands and addresses are only accepted through the master MA-43.

| Decimal | Hex | Address/Command |
|---------|-----|-----------------|
| 0 | 00 | Master unit. |
| 1–239 | 01 – EF | Slave units. |
| 240 | F0 | Broadcast. |
| 241–253 | F1 – FD | Reserved. |
| 254 | FE | Reset, resets the whole MA-43 system. |
| 255 | FF | Reserved. |

# Termination

The MA-43 system has to be terminated and have a fail safe. The last units on the bus should have termination switched on. The failsafe circuit ensures that when all transmitters are tristated the line can not float and so cause possible false data readings.

# Address assignment

S2 and S3 is two hexadecimal switches which together determine the unit address. The usable addresses are 0 to 239 (hexadecimal 00 to EF). The addresses 240 to 255 (F0 to FF) are used for commands and cannot be used as slave addresses. S3 is the high part of the hexadecimal address and S2 is the low part. If S3 is in position A and S2 in position 1 the unit will become the address A1. Adress 00 will become master. Only one master is allowed per system.

# Connections

**Line connection**
(5-Position screw-terminal)

| Direction | Connection no. | CCITT V.11 Description |
|---|---|---|
| Receiver | 1 | A' (R+) |
| Receiver | 2 | B' (R-) |
| Transmitter | 3 | A  (T+) |
| Transmitter | 4 | B  (T-) |
|  | 5 | Shield |

The definitions R+/R–, T+/T– can be various between different manufactures.

**Terminal connection (DCE)**
(RS-232-C/V.24, 25-Position D-sub, female)

| Direction | Connection | CCITT V.24 Code | Signal name |
|---|---|---|---|
| I | 2 | 103 | TD/Transmitted data |
| O | 3 | 104 | RD/Received Data |
| I | 4 | 105 | RTS/Request To Send |
| O | 5 | 106 | CTS/Clear To Send |
| O | 6 | 107 | DSR/Data Set Ready |
| – | 7 | 102 | SG/Signal Ground |

**I** = Input   **O** = Output on MA-43
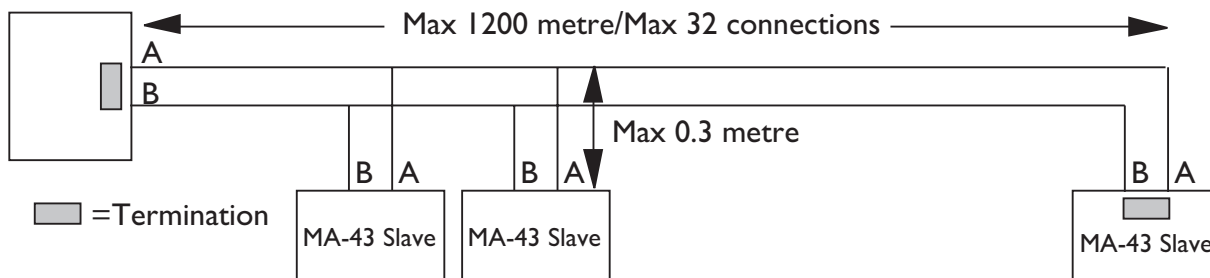
# Transmission range (interface 2)

Use twisted pair cable. Max transmission range 1200 metres.
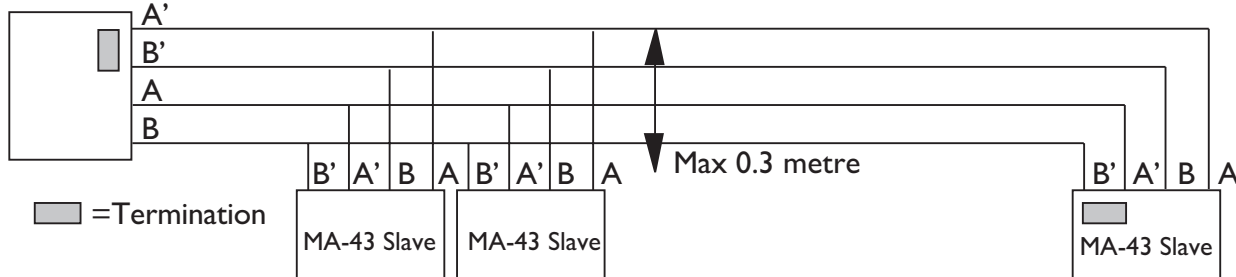(cable specifications 0.3 mm$^2$ and capacitance 42pF/m).
The transmission range will increase if a cable with lower capacitance and larger diameter is used.
Use shielded cable in heavy industrial environments.



**N.B.** R+/R−, T+/T− definitations are not standard, it can help to shift A and B if the unit does not work.

# Switch settings MA-43H

| | |
|---|---|
| **Master**<br>**Start character**<br><br>S4 [ON ▪...] 04 (EOT)<br><br>S4 [ON ▪...] 1B (ESC) | **Master**<br>**Echo**<br><br>S4 [ON .▪..] No echo<br><br>S4 [ON .▪..] Echo |
| **Master**<br>**Mode**<br><br>S4 [ON ..▪.] Hayes<br><br>S4 [ON ..▪.] S4:1 | **Master**<br>**Result codes**<br><br>S4 [ON ...▪] No codes<br><br>S4 [ON ...▪] Result codes |
| **Slave**<br>**Buffered**<br><br>S4 [ON .▪..] Yes<br><br>S4 [ON ▪...] No | **Slave**<br>**Mode**<br><br>S4 [ON .▪..] Hayes<br><br>S4 [ON .▪..] Normal |

Slave S4: 1 and 4 is not used

## Factory settings

S4 [ON ▪.▪.] Master          S4 [ON .▪▪.] Slave

In the MA-43H the timed address mode has been replaced with a Hayes mode.

# Connect MA-43 H

ATDnnn<CR> n is number from 1 to 126 followed by a CR.

Example:
To connect to hex address 30, ATD48<CR>.
To connect to hex address 2, ATD2<CR>.

The modem will reply with CONNECT or NO ANSWER.


# Disconnect MA-43 H

To disconnect, just send +++ and ATH0 or ATH. There has to be a quiet period of 10 byte times before the +++.
10 byte times with 9 600 baud is approximately 10 ms (The time is at least 100/baud-rate). The time between the +signs has to be less than 300 ms. If any other command will be sent after +++ the modem disconnects and answer with ERROR.
The modem will then be ready for a new address.
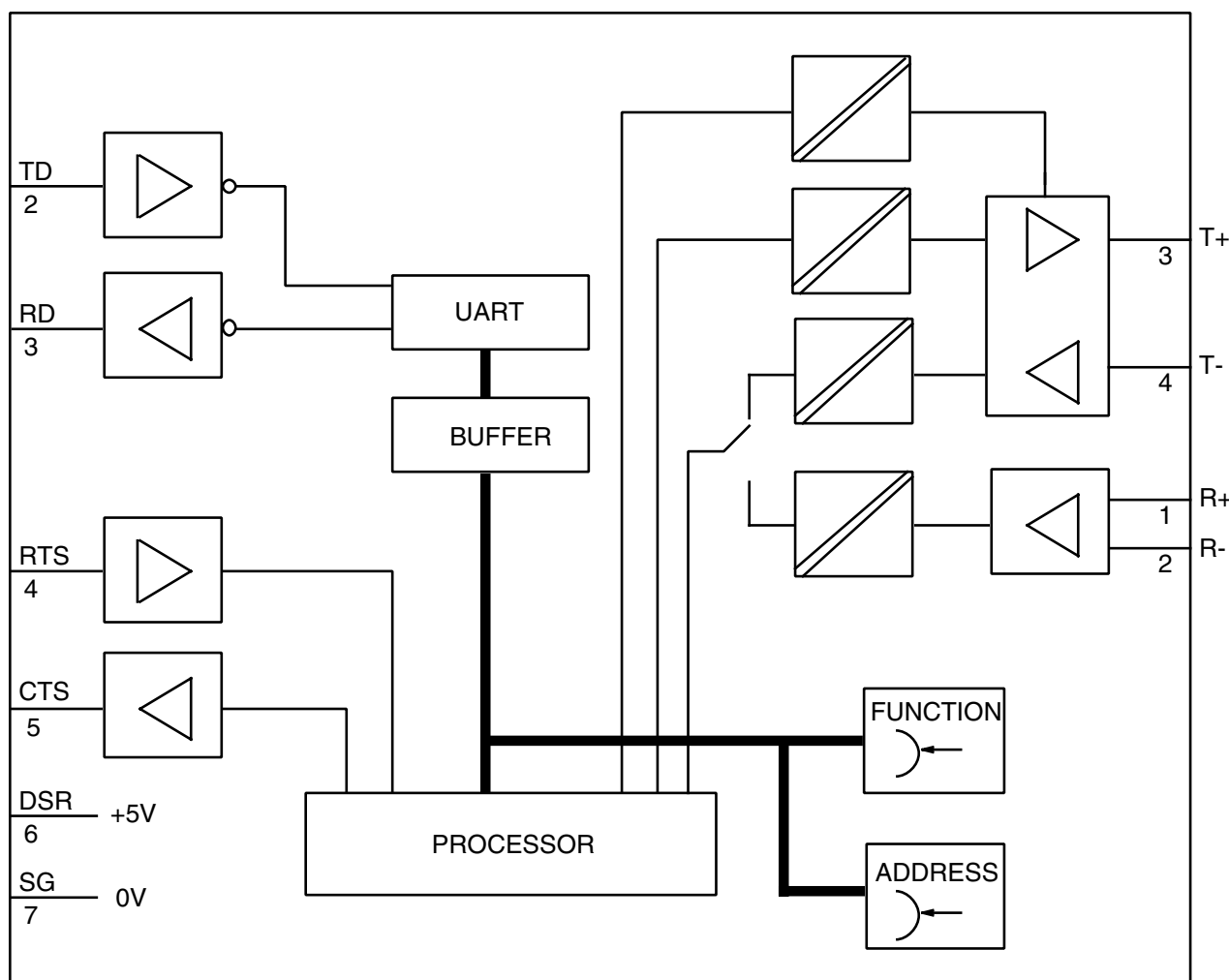
Disconnect sequence:

<quiet>
+++
OK
ATH0<CR>
NO CARRIER

# Block diagram



V24/ RS-232

V.11/ RS-422
RS-485

TD 2

RD 3

UART

BUFFER

RTS 4

CTS 5

DSR 6   +5V

SG 7   0V

PROCESSOR

FUNCTION

ADDRESS

T+ 3

T- 4

R+ 1

R- 2

Westermo Teleindustri AB have distributors in several countries,
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## Subsidiaries