2004-12-16
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MANUAL

Line **S**plitter **R**epeater with Modem

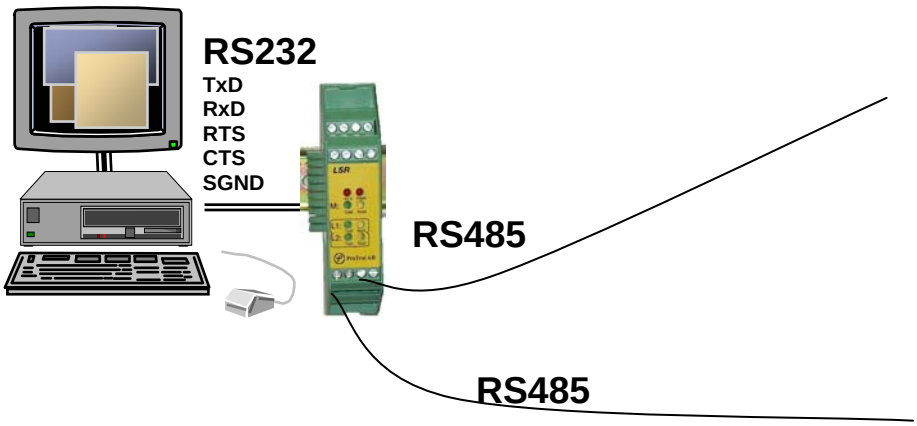
The LSRwM is a combined Line Splitter and Repeater with 2 slave RS485 modems. Data flow direction is controlled by RTS/CTS handshake or the on board MCU.

Table of Contents

1. Introduction

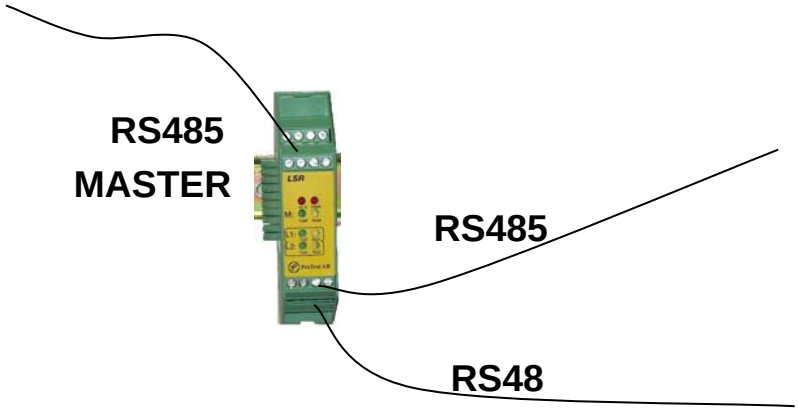
The LSR is internally divided into 4 separate, galvanic separated, systems. Each communication port has a separate power supply distributed through 3 DC/DC-converters. The extension bus and micro controller unit (MCU) have a galvanic isolation to each communication port.
The configuration for different operation modes (Line Splitter, Repeater, Master Line RS232 or RS485, 2- or 4-wire, extended operation, converter between 2- and 4-wire system etc) is done by jumpers and (instead of jumpers) selection of the right driver IC-circuit (location U1 and U5) inserted in IC-sockets. See *Figur 7*.
Applications example:

Line Splitter with RS232 to 2 x RS485 (2- or 4-wire)



Note: In 4-wire operation the master RS232 does not require the handshake signals.

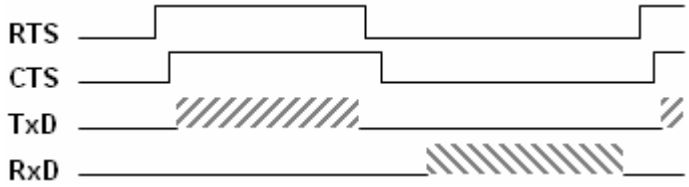
Repeater RS485 to 2 x RS485 (2- or 4-wire)



Line Splitter or Repeater with 4, 6 or 8 x slave line RS485

2. Master communication line connected to a computer RS232 port

When the LSR is controlled from an RS232 communication port (normally a computer) it can operate in 2- or 4-wire configuration. 2-wire configuration requires half duplex communication which in this case means that a line can only have one sending driver at a time. In a polled system this is normally performed by letting the master com. port RTS-signal be set to a high level when a data transmission should be carried out. After the RTS is set high, the transmitting port should wait for the CTS-signal to go high before any data transmission is carried out. When the last character in the message is sent, the RTS-signal should go low again to allow the addressee to be the "owner" of the line. See in the *Figur 1* below how the port signals change with time in a typical poll sequence.

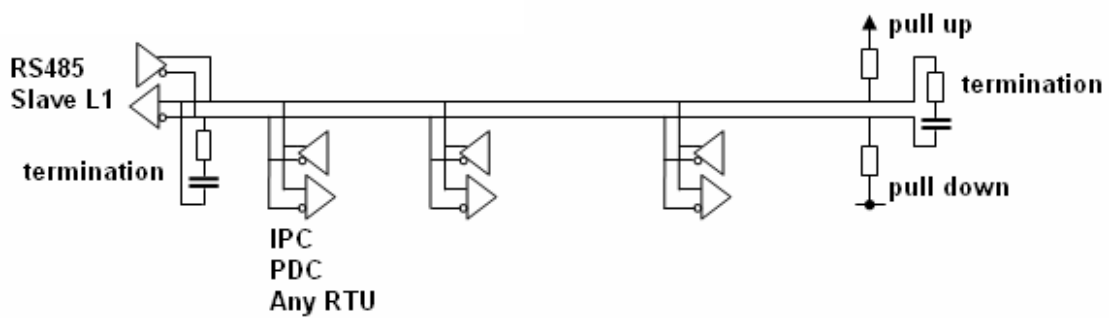


Figur 1 RTS and CTS-signal in a polled system.

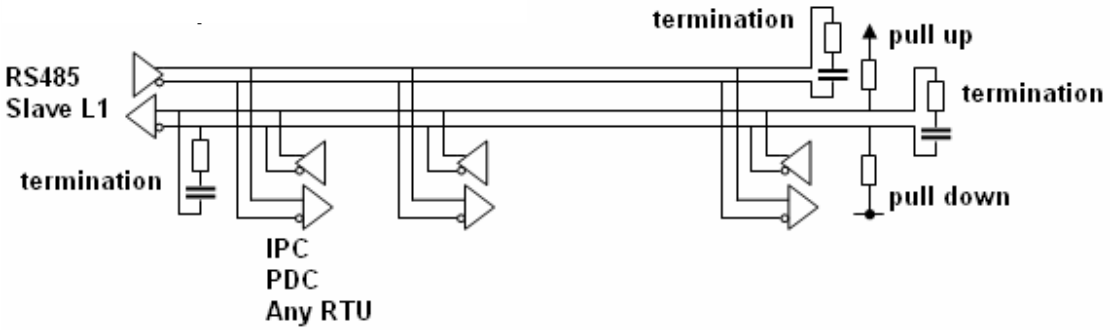
Selection of datarate [bps] is not requested. The LSR automatically adapt to the rate data speed on the line. Observe that the LSR is transparent and the data rate needs to be the same on both sides of the unit. (Notice that max data rate is 9600ps).
If the data communication disappears for about 2 sec, the LSR will restart to try calculating a possible new data rate.

2- or 4-wire communication

Below are 2 examples showing a 2-wire and a 4-wire communication. Note: For clarity, the primary over voltage protection is omitted.



Figur 2 2-wire half duplex communication

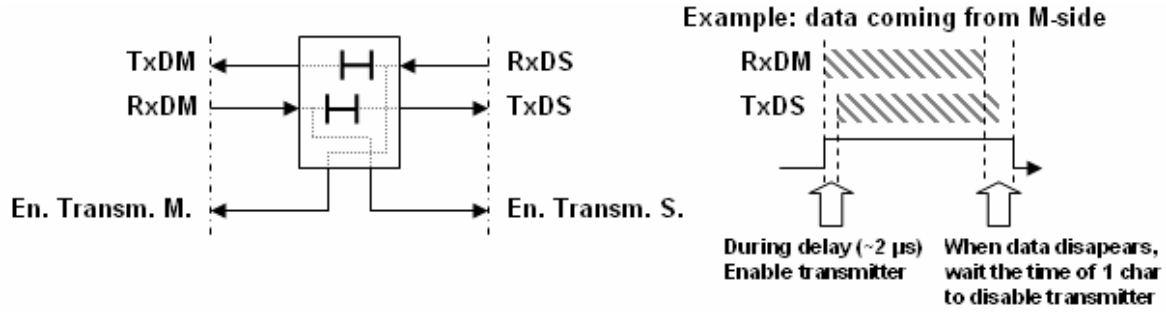


Figur 3 4-wire "full duplex" communication

As can be seen in the 2-wire communication, all transmitters are competing regarding "owning" the line. In the 4-wire communication, the polling master (here Slave L1) do not have to remove the RTS (driver enable) when expecting an answer from a remote terminal unit as opposed to a 2-wire system. Compared to the 2-wire topology, the 4-wire makes it possible to transmit and receive data simultaneously (full duplex).

3. Repeater functionality

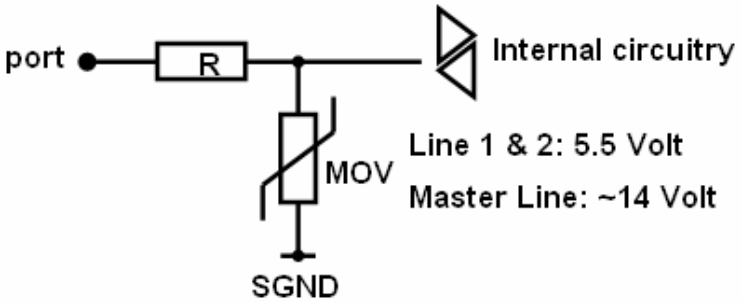
Setting up the LSR as a 4-wire repeater is simple as the data "direction" is always known. In a 2-wire topology the repeater do not know if the data should be transported to the RTU or from the RTU. In the LSR this problem is solved by a MCU who always listen to the data traffic. While waiting for data "traffic" the MCU disable all transmitters and enable all receivers. As soon as the MCU recognizes data coming from either the RTU side or the MASTER side, it enables the "opposite" transmitter before the data stream is retransmitted on the "opposite" side (from where the data comes). See timing in the *Figur 4* below.



Figur 4 Timing in a 2-wire topology

4. Over voltage protection

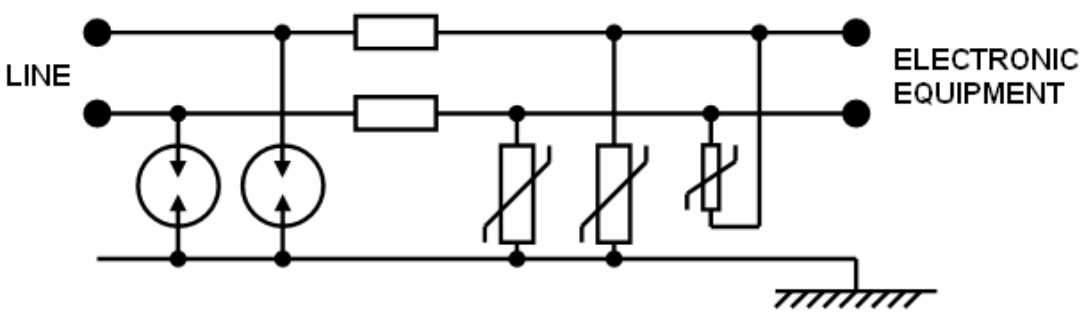
All communication ports are over voltage protected to avoid damage of the driver circuitry. Communication wires exposed to possible over voltages should also have a primary protection against over voltages (as for example Protrol OVP-RS485, see the part "Primary over voltage protection" below) to save electronic equipments / communication ports. As a thumb rule, there is no requirement for an additional primary protection as long as the communication is located within a building.



Figur 5 Over voltage protection

5. Primary over voltage protection

The primary protection will protect electronic devices from dangerous high voltages with respect to ground (common mode) by Metal Oxide Varistors (MOV) and gas discharge tubes (arrestor) and between pairs by a low voltage MOV. Combining discharge tubes and varistors enables the protection to respond quickly as well as having a high discharge current capacity (typically ~10 kA). The Protrol OVP-RS485 will allow common mode voltages up to consumer levels (230 VAC/350 VDC) to ground before it is activated. This allows the pilot wires to have a reasonable acceptance towards common mode voltages. As the LSR is isolated the com. Ports will withstand and "float" with up to 230 VAC common mode voltage (to ground).



Figur 6 Protrol primary ***O****ver* ***V****oltage* ***P****rotection, OVP-RS485*

6. Basic Line jumpers

Figur 7 Jumper position

How should the RS485 modem be terminated?
The pull-up and pull-down resistors connected to pin 2 on **J8, J9, J11** and **J13** should be connected to avoid an undefined state on the communication wire. This is of importance when there is no transmitter “owning” the line as for example in a half-duplex situation when the “owner” is changing all the time. When a “owner” leaves the line to someone else there is normally a short time where the line is “floating” and having an undefined state.

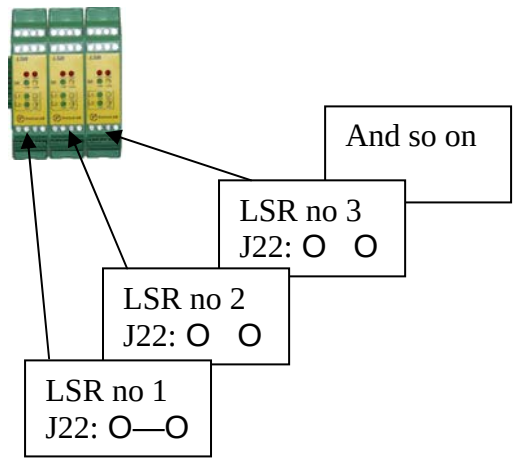
2-wire connection

1 modem + every tenth of the connected modems should be terminated (example for Line 1, **J11** and **J13 1 - 2.)** As a thumb rule one can set the corresponding jumpers in the master modem and the most remote modem.
The BUS-TERMINATION **J6** and **J10** should be connected on the most remote modem and on the corresponding termination at the master modem.

The jumpers are accessible when the printed circuit card is removed from the sealing.

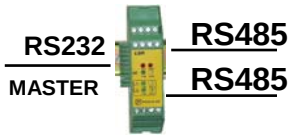
Jumper	Function
J1	Spare
J2	Spare
J3	Spare
J4	Handshake from master RS232 or MCU
J5	Handshake from master RS232 or MCU
J6	Termination RS485 Line 2
J7	2- or 4-wire RS485 Line 1
J8	Pull up and pull down RS485 Line 2
J9	Pull up and pull down RS485 Line 2
J10	Termination RS485 Line 1
J11	Pull up and pull down RS485 Line 1
J12	Termination RS485 Master Line
J13	Pull up and pull down RS485 Line 1
J14	2- or 4-wire RS485 Line 1
J15	2- or 4-wire RS485 Master Line
J16	2- or 4-wire RS485 Line 1
J17	2- or 4-wire RS485 Line 1
J18	2- or 4-wire RS485 Line 1
J19	2- or 4-wire RS485 Line 1
J20	2- or 4-wire RS485 Master Line
J21	2- or 4-wire RS485 Master Line
J22	Removed at the LSR module no 2 or higher when used as line splitter *)
J23	Spare

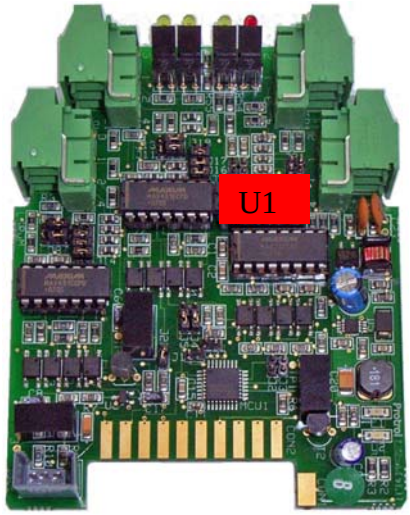
*)



Jumper settings example for LSR as:

RS232 RTS/CTS-control Line Splitter





Figur 8 *Remove U1 on the printed circuit card*

Circuit U5 inserted
Circuit U1 removed

J4: O O—O (Handshake from internal MCU)
J5: O O—O (-"-)

J22: O—O

Jumpers for RS232 Master Line

2-wire
J20: O O J21: O O
J15: O O

4-wire
J20: O O J21: O O
J15: O O

Termination
J12: O O

Jumpers for RS485 Line 1, 2-wire

2-wire
J16: O—O J17: O—O
J7: O—O

Pull up & pull down
J13: O 1 J11: O 1
O 2 O 2
O 3 O 3

Termination
J10: O—O

4-wire
J16: O O J17: O O
J7: O O

J13: pull up 1-2: TX+, 2-3: RX+
J11: pull dn 1-2: TX-, 2-3: RX-

Jumpers for RS485 Line 2, 2-wire

2-wire
J18: O—O J19: O—O
J14: O—O

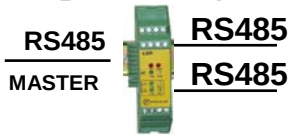
Pull up & pull down
J8: O 1 J9 : O 1
O 2 O 2
O 3 O 3

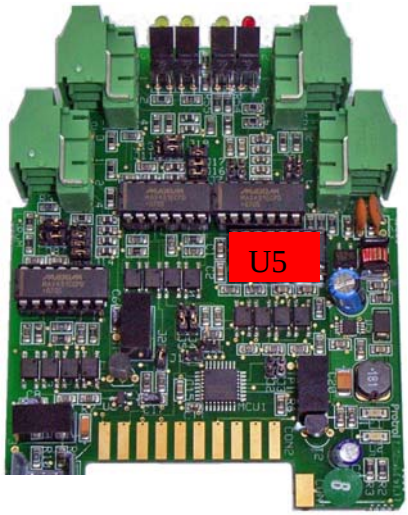
Termination
J6: O—O

4-wire
J18: O O J19: O O
J14: O O

J8: pull up 1-2: TX+, 2-3: RX+
J9: pull dn 1-2: TX-, 2-3: RX-

Jumper settings for RS485 Repeater





Circuit U1 inserted
Circuit U5 removed

2-wire:
J4: O O—O (Handshake from internal MCU)
J5: O O—O (-"-)
4-wire:
J4: O O—O (MCU enables both Transmitter and Receiver)
J5: O O—O (-"-)

Figur 9 Remove U5 on the printed circuit card

J22: O—O

Jumpers for RS485 Master Line, 2-wire

2-wire
J20: O—O J21: O—O
J15: O—O

4-wire
J20: O O J21: O O
J15: O O

Termination
J12: O—O

Jumpers for RS485 Line 1, 2-wire

2-wire
J16: O—O J17: O—O
J7: O—O

4-wire
J16: O O J17: O O
J7: O O

Pull up & pull down
J13: O 1 J11: O 1
O 2 O 2
O 3 O 3

J13: pull up 1-2: TX+, 2-3: RX+
J11: pull dn 1-2: TX-, 2-3: RX-

Termination
J10: O—O

Jumpers for RS485 Line 2, 2-wire

2-wire
J18: O—O J19: O—O
J14: O—O

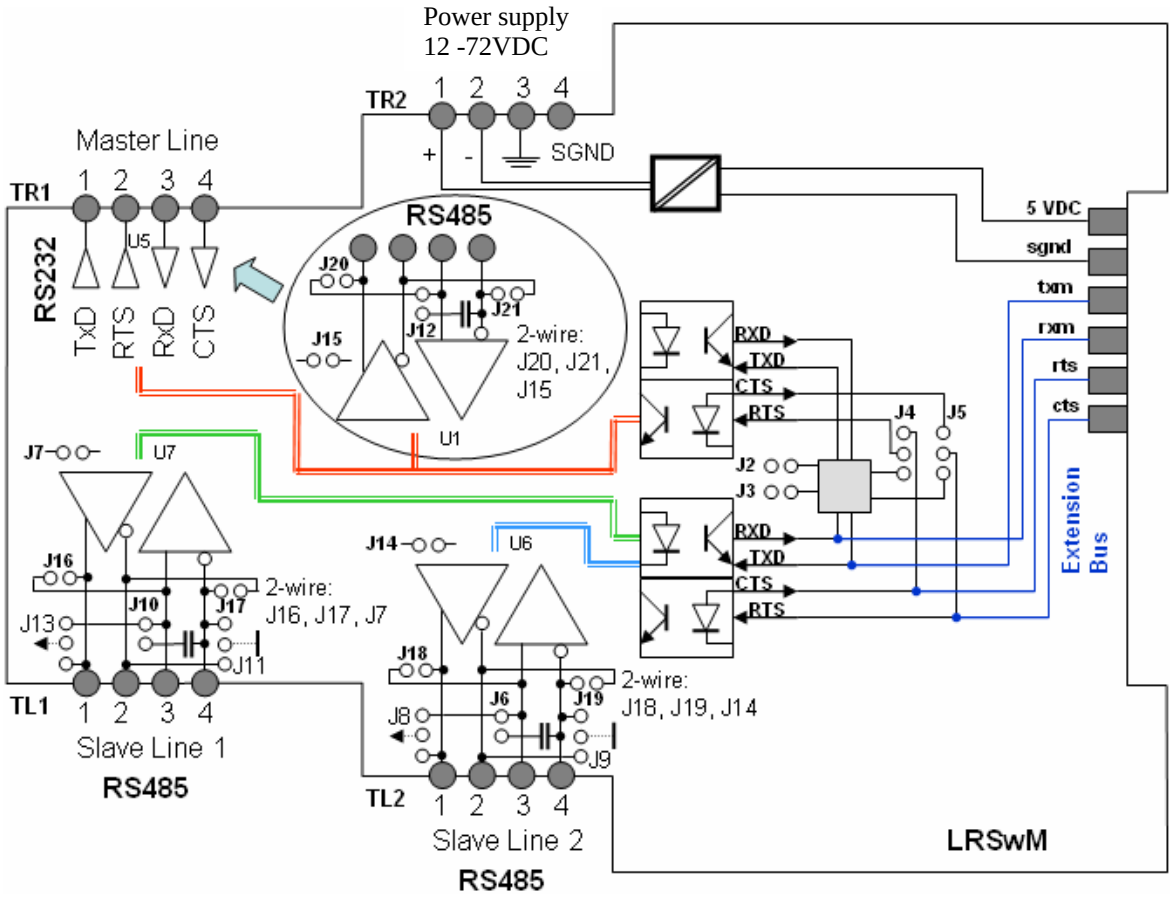
4-wire
J18: O O J19: O O
J14: O O

Pull up & pull down
J8: O 1 J9 : O 1
O 2 O 2
O 3 O 3

J8: pull up 1-2: TX+, 2-3: RX+
J9: pull dn 1-2: TX-, 2-3: RX-

Termination
J6: O—O

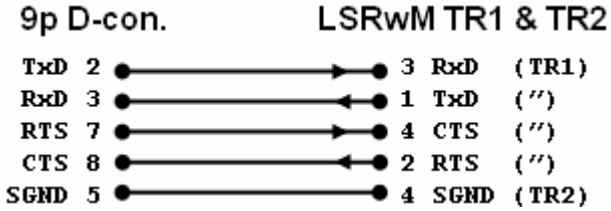
7. Block diagram



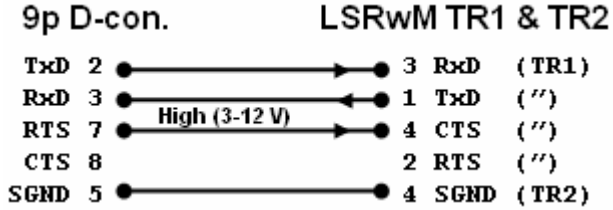
Figur 10Functional overview

Connecting to a Master Line RS232 port:

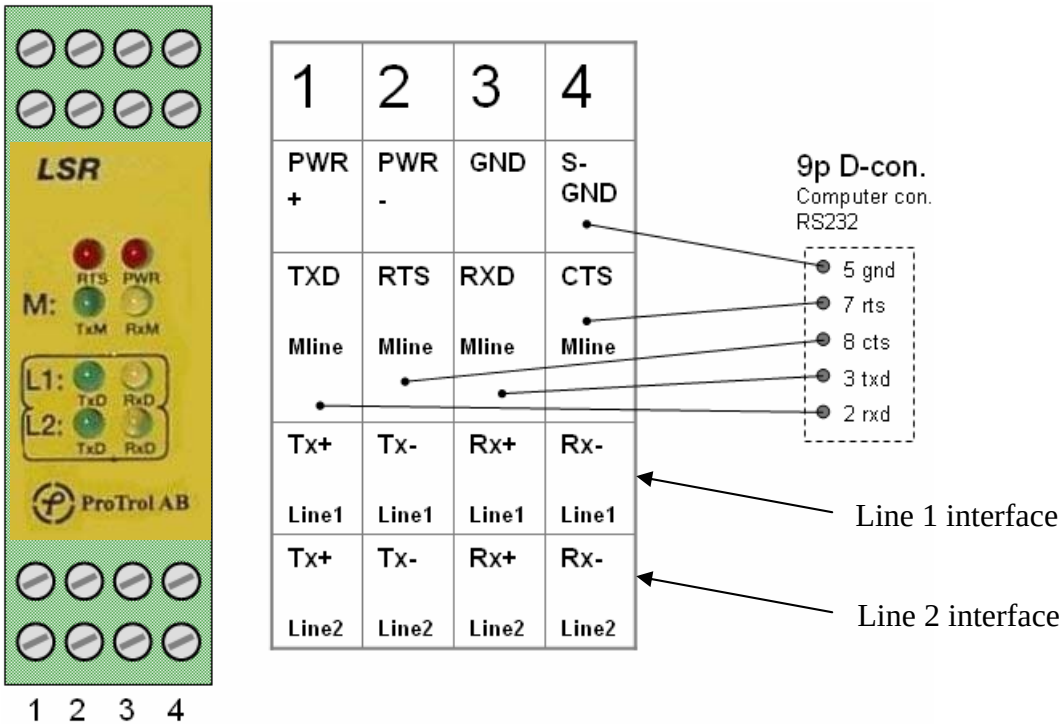
2-wire, half duplex communication



4-wire, full duplex communication



8. Front board and terminal description

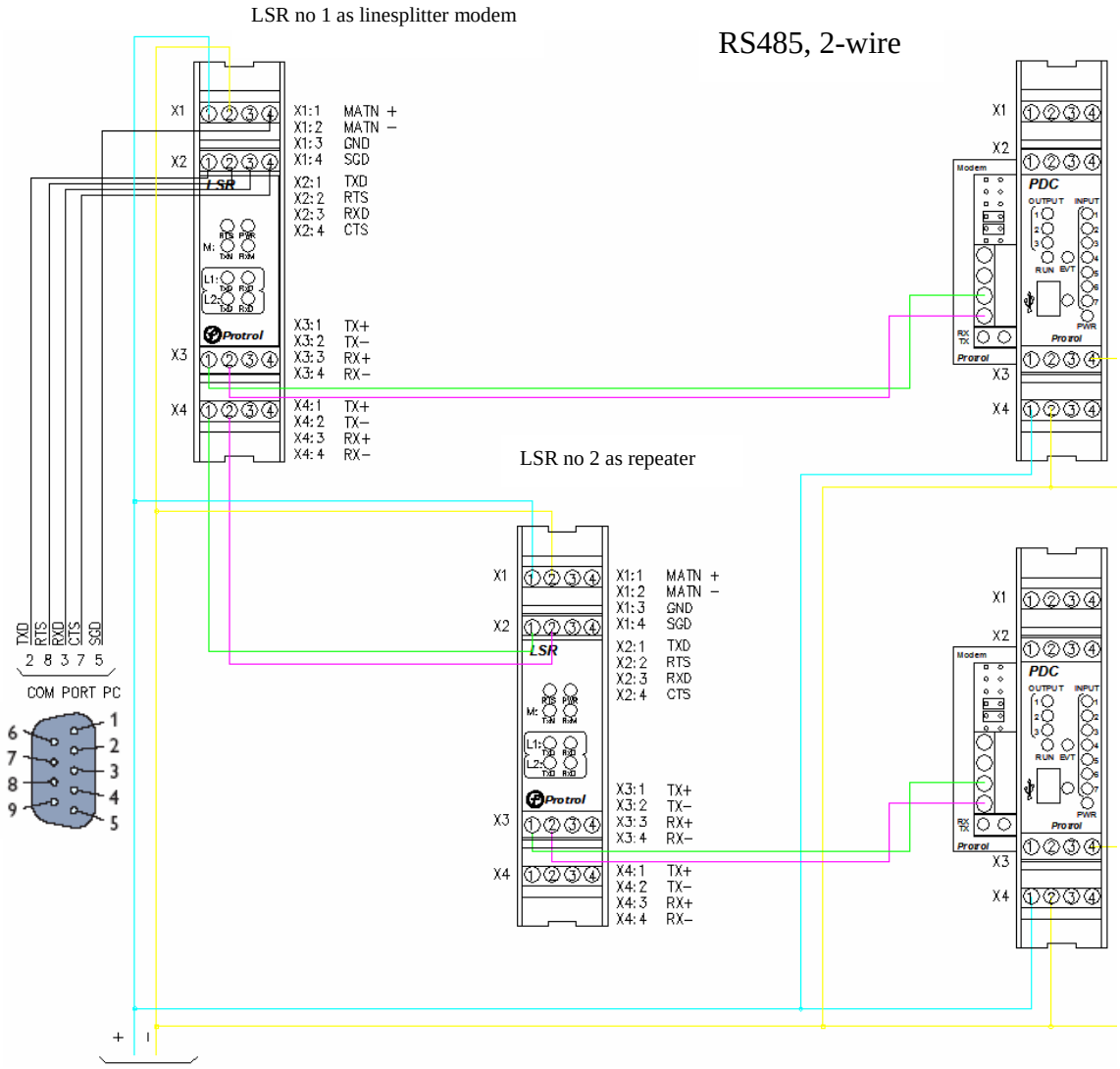


Figur 11 Front board and terminal description

PWR	LED on	Power on and internal MCU ok
RTS	LED on	RTS is set high
M: TxM	LED on	Transmitting data Master Line
M: RxM	LED on	Receiving data Master Line
L1 or L2: TxM	LED on	Transmitting data Line 1 or Line 2
L1 or L2: RxM	LED on	Receiving data Line 1 or Line 2

Figur 12 LED indicators

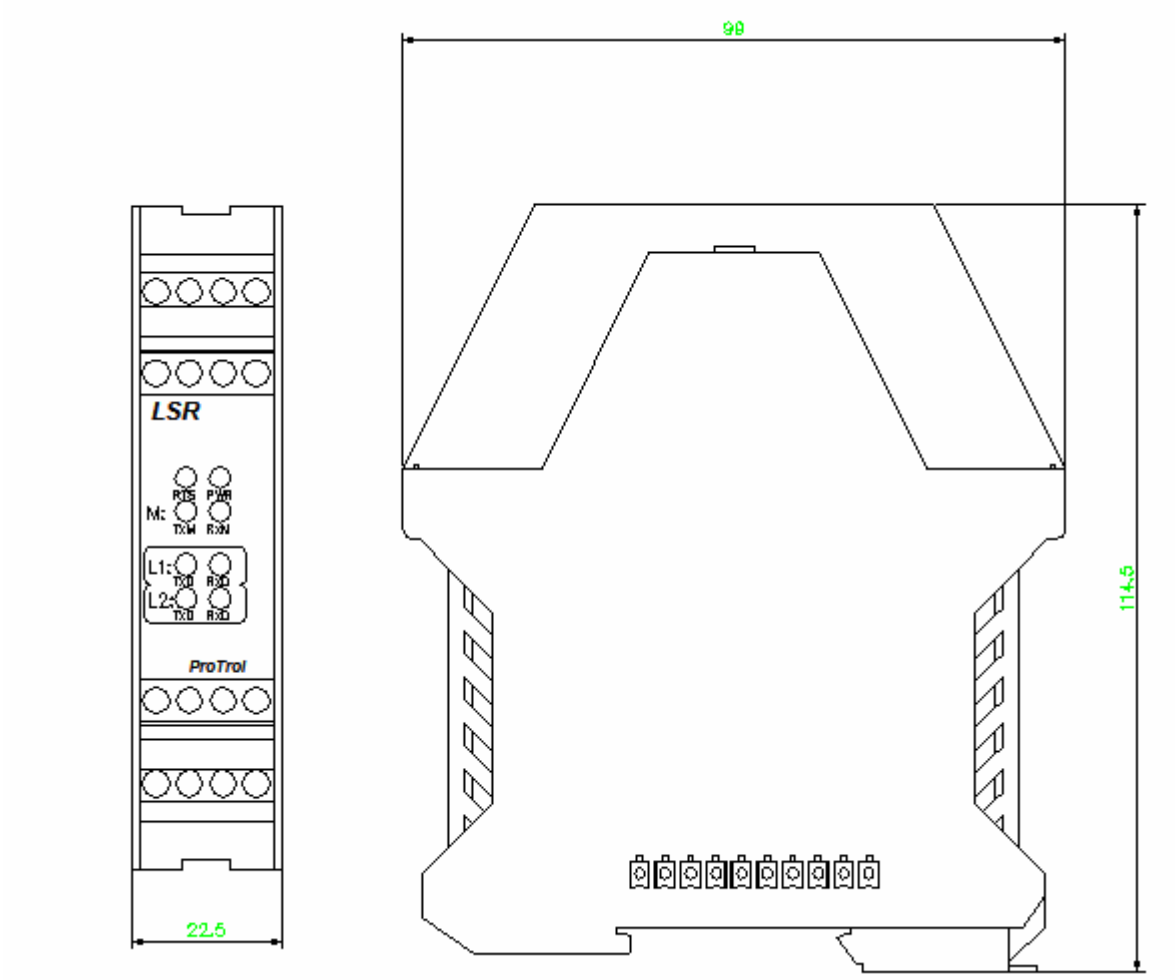
9. Example wiring diagram



Figur 13Connection example with one LSR as modem/linesplitter and LSR no 2 as Repeater

10. General Technical Information

Operating temperature	-40 -+ 60 C	
Power supply	12 – 72VDC	
Tot power consumption	20 mA at 24VDC	
CE-approval	EN61000-4-x	
	EN61000-6-4, Class B	
Communication interface	2, RS485	
	RS232	
Data rate	min 300 – max 9600 bps	Automatic detected



Figur 14DIN-rail mounting

Dimension (W x H x D) [mm]	22,5 x 114,5 x 99	
Weight [g]	130	
Mounting	DIN-rail	Snap on mounting
Degree of protection	IP20	