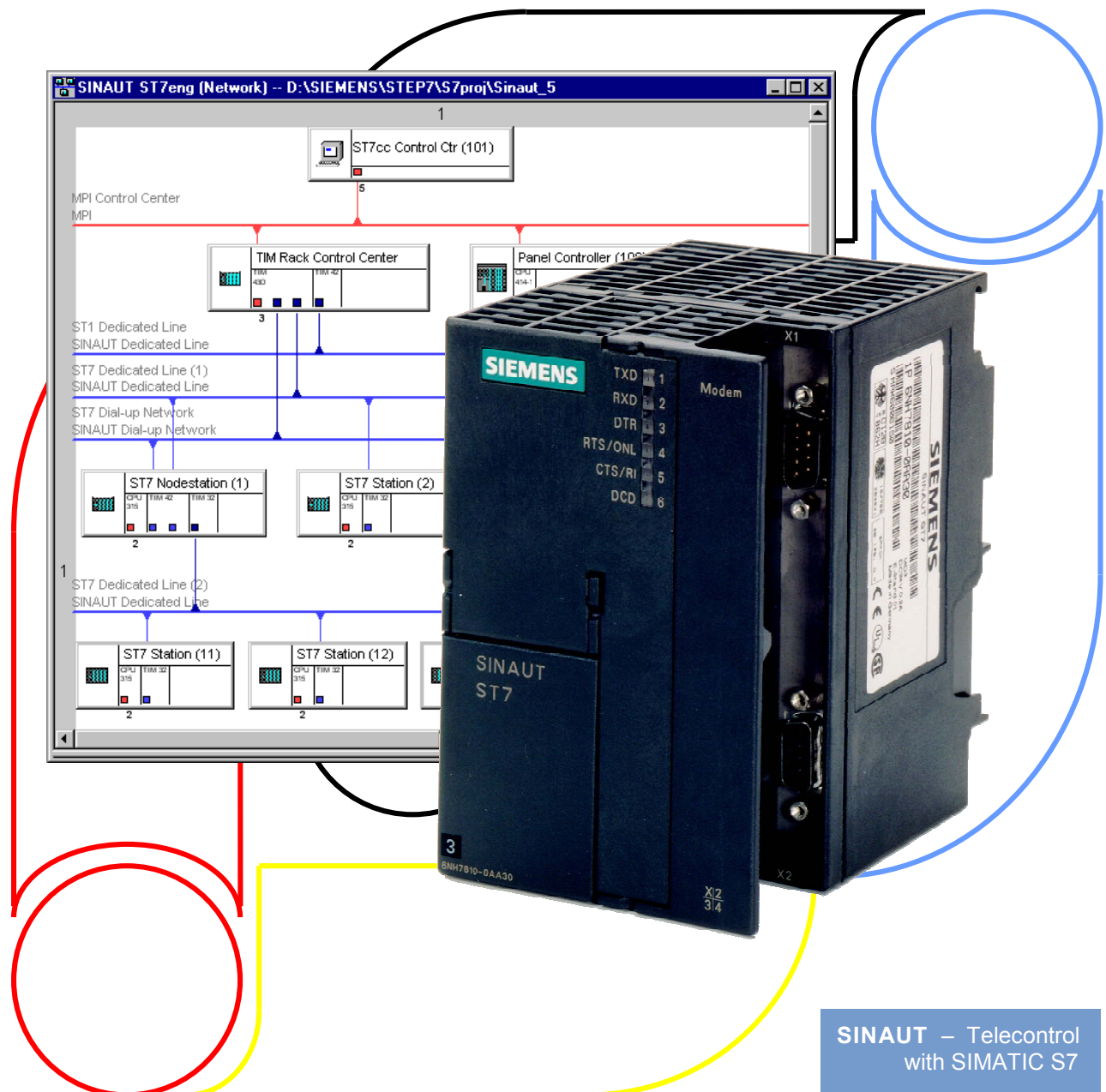


## SINAUT ST7 Dedicated Line Modem MD2

Operating Instructions

Edition 07/2002



**SINAUT – Telecontrol  
with SIMATIC S7**

**SIEMENS**

# SINAUT ST7

## Dedicated Line Modem MD2

Operating Instructions

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Installation 2

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Problem Report 10

# SINAUT® Documentation

Certified Siemens Quality for Software and Training  
according to DIN ISO 9001, Reg. No. 2160-01

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It is possible that there are operable functions in the device that are  
not described in this documentation. However, no claims can be made  
for these functions for new delivery or in cases of servicing.

We have checked the contents of this manual for agreement with the  
hardware and software described. Deviations, however, cannot be  
entirely precluded. The information in this manual is reviewed regularly  
and any necessary corrections included in subsequent editions.  
Suggestions for improvement are welcome.

Technical data subject to change.

# Preface

## Notes

This documentation uses the following conventions for pointing out information of special importance:

### Note

This symbol draws your attention to information on the product, handling the product, or to a particular part of the documentation.



### Important

This symbol draws your attention to particularly important information on the product, handling the product, or to a particular part of the documentation.

## Notes of Warning

The following notes are used in the documentation for various levels of warning:



### Danger

This symbol indicates that death, severe personal injury or substantial property damage **will** result if proper precautions are not taken.



### Warning

This symbol indicates that death, severe personal injury or substantial property damage **can** result if proper precautions are not taken.



### Caution

This symbol indicates that minor personal injury or property damage **can** result if proper precautions are not taken.



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To  
Siemens AG  
  
I&S OCW TI  
  
D-76181 Karlsruhe, Germany

**Suggestions**

**Corrections**

Correspondence to:

SINAUT ST7

Dedicated Line Modem MD2

Operating Instructions

Sender

Name:

Address of your company/office

Street: \_\_\_\_\_

ZIP: \_\_\_\_\_ City: \_\_\_\_\_

Tel: \_\_\_\_\_ / \_\_\_\_\_

Fax: \_\_\_\_\_ / \_\_\_\_\_

E-mail: \_\_\_\_\_

Order no.: 6NH7811-0AA22

Edition: 07/2002

If you notice typographical errors in this document please use this form to inform us. We would also be grateful for your suggestions and criticisms.

**Suggestions and/or corrections**



# 1

## Overview

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## 1.1 Areas of Application

The MD2 modem (see Fig. 1-1) is an FSK dedicated line modem for half-duplex data transmission via a 2-wire or duplex data transmission via a 4-wire multi-point dedicated line. The MD2 can also be used as a repeater on a 2-wire and 4-wire dedicated line.

It was developed as a component of the SINAUT ST7 station control system but can also be used as a normal dedicated line modem independent from this system. Due to its design and its electrical properties, the MD2 is suited for use in industrial applications.



Fig. 1-1 SINAUT MD2 Modem

## 1.2 Main Features

The MD2 modem has the following features:

- SIMATIC S7-300 design (see Fig. 1-1)
- Can be mounted on a S7-300 mounting rail or a 35 mm standard rail (using the optional adapter 6NH7760-0AA)
- 24 V DC power supply connection, power consumption 100 mA
- RS232 port (9-pin sub-D plug) and RS485 port (9-pin sub-D socket)
- Potential insulation between power supply and RS232/RS485 interface
- Choice of 4 different transmission speeds: 1200, 2400, 9600 or 19200 bps
- It is possible to use baud rates lower than 1200 bps in several operating modes (compared to 1200 bps no range extension can be achieved with lower baud rates)
- Choice of 4-wire full-duplex or 2-wire half-duplex transmission mode
- Integrated double transformer for two 2-wire lines
- Send level can be switched from -6 to 0 dB
- Tapping capable
- Parallel connection of several MD2s to one data terminal (DTE, data terminal equipment), for example to connect a star network
- Integrated repeater function (by connecting two MD2s) for range multiplication
- Conversion from 2-wire to 4-wire or from 4-wire to 2-wire is possible in repeater mode
- Switched optocoupler output with RTS signal for switching connected radio equipment on and off
- RS485 interface for 2-wire half-duplex with automatic direction recognition
- Automatic refresh of received data before transfer to the DTE
- Certified for telecom leased lines using 1200 and 2400 bps. This only applies to purely analog telecom leased lines. For telecom leased lines using analog/digital conversion, only 1200 bps can be used (see section 1.5)

### 1.3 Compatibility to SINAUT ST1 Modems

In certain operating modes the MD2 modem is compatible to the dedicated line modems that are used for SINAUT ST1. This compatibility is ensured in two ways:

1. You can build a new SINAUT station into an existing ST1 network and use the MD2 modem to exchange data with an existing ST1 dedicated line modem as the partner.
2. You can use the MD2 modem as a replacement for a defective ST1 dedicated line modem.

The following table provides a compatibility matrix of the MD2 modem in connection with the dedicated line modems used in the SINAUT ST1 system.

Table 1-1 Compatibility matrix of the MD2 modem and SINAUT ST1 dedicated line modems

Operating Mode of the MD2	SINAUT ST1 Dedicated Line Modem		
	LGM 1200H1	MD100	MD124
1200 bps hx (2-wire)	X	X	X
1200 bps dx (4-wire)	-	X	X
2400 bps hx (2-wire)	-	-	X
2400 bps dx (4-wire)	-	-	X
9600 bps hx (2-wire)	-	-	-
9600 bps dx (4-wire)	-	-	-
19200 bps hx (2-wire)	-	-	X
19200 bps dx (4-wire)	-	-	X

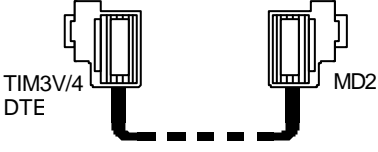
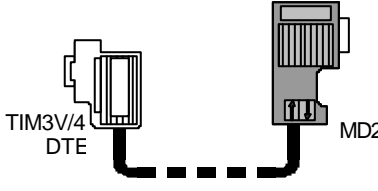
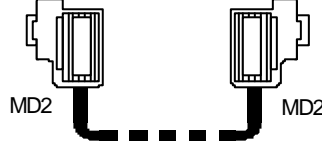
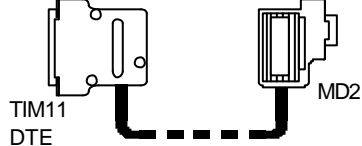
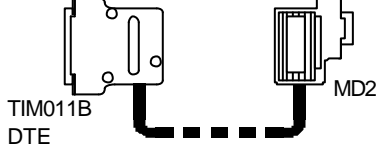
**Note**

When the MD2 is connected to a DTE in the control center via the RS485 interface, it is not compatible to the MD100 or LGM 1200H1 modem.

## 1.4 Standard Cables

The following standard cables are available for the RS232 and RS485 interfaces.

Table 1-2 Standard cable for the MD2 modem

Order no.	Description	Diagram
6NH7701-4AL	Cable for connecting the MD2 modem (RS232) with a TIM3V/TIM4 (RS232) or an other terminal (DTE) with an identically configured 9-pin RS232 interface. Cable length 1.5 m	
6NH7701-4DL	Cable for connecting the MD2 modem (RS485) with a TIM3V/TIM4 (RS485) or an other terminal (DTE) with an identically configured 9-pin RS485 interface. Cable length 1.5 m	
6NH7701-1CB	Cable for connecting two MD2 modems (RS232) to form a repeater. Cable length 0.3 m	
6NH1701-7AN	Cable for connecting the MD2 modem (RS232) with a TIM11 (RS232) or an other terminal (DTE) with an identically configured 25-pin RS232 interface (socket) and slide lock. Cable length 2.5 m	
6NH1701-7BK	Cable for connecting the MD2 modem (RS232) with a TIM011B (RS232) or an other terminal (DTE) with an identically configured 25-pin RS232 interface (socket) and screw lock. Cable length 1.0 m	

Tables 2-5 to 2-9 in Chapter 2, *Mounting and Installation*, show the configuration of the cables listed above.



## 1.5 Certification and CE Labeling

### 1.5.1 Certification Provisions

The MD2 modem is certified for use across Europe for connection to analog 2-wire or 4-wire leased lines.

<b>CETECOM ICT Services GmbH</b>	
<b>CE 0682 X</b>	
<b>EG-ZULASSUNGSBESTÄTIGUNG</b> Confirmation of Administrative EC-Approval	
EC-Type examination certificate:	<b>Registration number: D810411L      Date: 09.11.1999</b>
Product checks:	<b>Contract on product checks</b>
- Test laboratory:	<b>CETECOM ICT Services GmbH, D-66117 Saarbrücken</b>
- Contract number:	<b>3-2128/99</b>
Declaration of conformity:	<b>Dated: 03.11.1999</b>
Product designation:	<b>Modemplatine MD2 T89620-E3322-A100-B0</b>
Product manufacturer:	<b>Siemens AG ATD TD6 Frauenauracherstraße 98 D-91056 Erlangen</b>
Confirmation:	<b>The administrative approval according to § 12 of the ordinance concerning the conformity assessment, marking, type approval, placing on the market and operation of radio equipment not intended for connection to a public telecommunications network, and of telecommunications equipment (Telecommunications Type Approval Ordinance) of 20. August 1997 is confirmed herewith.</b>
Saarbrücken, den 09.11.99 CETECOM ICT Services GmbH  Hans-Jürgen Lennerz	
	
<small>CETECOM ICT Services GmbH, Untertürkheimer Str. 6-10, D-66117 Saarbrücken, Germany</small>	

**CETECOM ICT Services GmbH****EU-Kennnummer 0682**

EC identification number

beliehen nach der Beleihungs- und Akkreditierungsverordnung vom 10. Dezember 1997  
als Benannte Stelle der Bundesrepublik Deutschland, vertreten durch die  
recognised in accordance with the Recognition and Accreditation Ordinance of December 10, 1997  
as Notified Body for the Federal Republic of Germany, represented by



**Regulierungsbehörde für  
Telekommunikation und Post**

**EG-BAUMUSTERPRÜFBESCHEINIGUNG  
EC TYPE-EXAMINATION CERTIFICATE**

**Registriernummer:** D810411L  
Registration No.:

**Bescheinigungsinhaber:** Siemens AG  
Certificate Holder:  
ATD TD6  
Frauenaaracherstraße 98  
D-91056 Erlangen

**Produktbezeichnung:** Modemplatine MD2 T89620-E3322-A100-B0  
Product Designation:

**Produktbeschreibung:** Modem-device integrated in the system SINAUT ST7 for access to 2-/4-  
Product Description: wire analogue leased lines (A2O/A4O and A2S/A4S)

**ProduktHersteller:** Siemens AG  
Product Manufacturer:  
ATD TD6  
Frauenaaracherstraße 98  
D-91056 Erlangen

**Vorschriften:** CTR 15 as specified in Commission Decision 97/486/EC  
Specifications: CTR 17 as specified in Commission Decision 97/487/EC

**Prüfergebnis:** Das geprüfte Baumuster ist konform zu den genannten Vorschriften.  
Examination Result: The examined type meets the requirements of the above mentioned specifications

Diese Bescheinigung ist erstellt in Übereinstimmung mit der Telekommunikationszulassungsverordnung vom 20. August 1997 und gilt nur in Verbindung mit der nachfolgenden Anzahl von Anlagen.  
The certificate is issued in accordance with the Telecommunications Approval Ordinance from August 20, 1997 and is only valid in conjunction with the following number of annexes

**Anzahl der Anlagen:** 1  
Number of annexes:

Saarbrücken, 09.11.99  
Ort, Ausstellungsdatum  
Place, Date of Issue

Unterszeichnet von / Signed by Hans-Jürgen Lennerz  
Benannte Stelle / Notified Body



CETECOM ICT Services GmbH, Untertürkheimer Straße 6-10, D-66117 Saarbrücken, Germany

## 1.5.2 Notes about CE Labeling

### Product Description

Product Description	Order No.	EMC	TCE
MD2	6NH7810-0AA20	**	1

### EC Guidelines EMC 89/336/EEC

The product described above complies with the requirements of the EC Directive 89/336/EEC "Electromagnetic Compatibility" and the Harmonized European Standards (EN) published in this connection.

### EC Guidelines TCE 1999/5/EEC

The product described above complies with the requirements of the EC Directive 1999/5/EC "Directive of the European Parliament and Council Governing Radio and Telecommunication Equipment and the Mutual Recognition of their Conformity".



In accordance with the EC directive described above, the EC conformity declarations are kept available at the following address:

Siemens Aktiengesellschaft  
 Industrial Solutions & Services  
 I&S IS 6 E D  
 P.O. Box 3249  
 D-91050 Erlangen  
 Germany

### Operating Areas

The product fulfills the following requirements:

	Requirement	
	Interference emission	Interference immunity
Equipment in non-protected environment	-	EN 60870-2-1 : 1996
Industry	* EN 55022 (A) : 1998	-
Residential	** EN 55022 (B) : 1998	-

	CTR / TBR 15	Analog 2-wire leased lines
	CTR / TBR 17	Analog 4-wire leased lines

### Observe Installation Guidelines

The product complies with the requirements when the product information and the installation guidelines described in the product documentation are observed during installation and operation.

## Mounting and Installation

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## 2.1 Design of the MD2 Modem

### Introduction

This section provides a description of the design of the MD2 modem with its connections, display elements and setting switches.

#### 2.1.1 Front View of an MD2 with Closed Front Doors

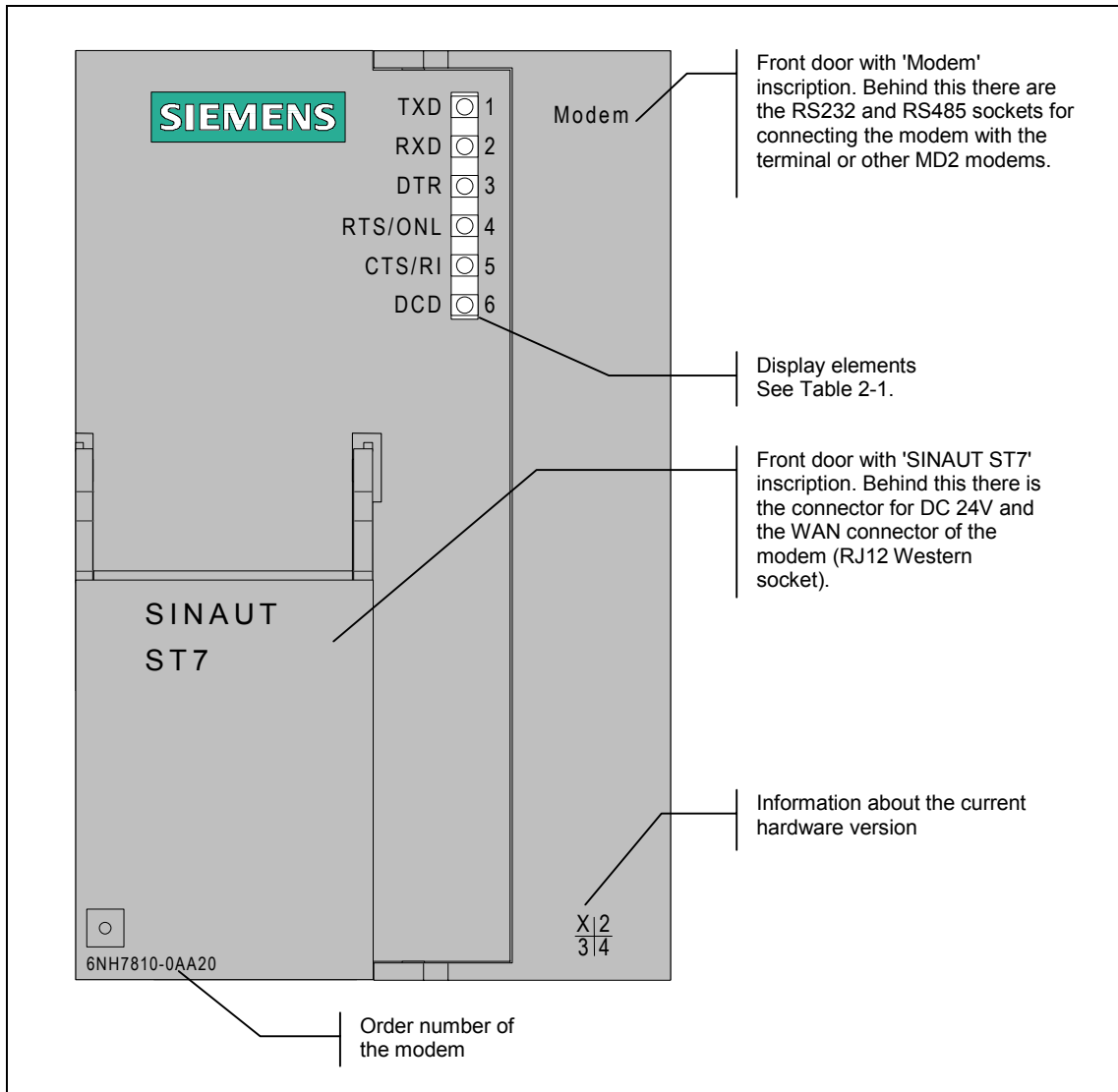


Fig. 2-1 Front view of the MD2 modem with closed front doors

## 2.1.2 LED Display of the MD2

The following table is a summary of the meaning and the activity of the six LEDs on the front of the modem.

Table 2-1 Meaning and activity of the six LEDs on the MD2 front

LED no.	Inscription	Description
1	TXD	Transmit Data The LED blinks in rhythm with the data flow that is sent to the modem by the terminal via the RS232 or RS485 interface.
2	RXD	Receive Data The LED blinks in rhythm with the data flow that is sent from the modem to the terminal via the RS232 or RS485 interface.
3	DTR	Data Terminal Ready Shows the status of the DTR signal of the connected terminal. The terminal signals it is ready to send and receive as soon as the LED lights continuously.
4	RTS / ONL	Request to Send (RTS) Shows the status of the RTS signal of the connected terminal. When a terminal wants to activate the transmitter of the modem, it sets its RTS signal to 1. The RTS LED remains lit on the MD2 modem as long as the RTS is set to 1. The LED goes out as soon as the terminal recalls the RTS signal.
5	CTS / RI	Clear to Send (CTS) When the transmitter of the modem is activated through the RTS signal, the modem reports to the terminal that it is ready to send by setting its CTS signal to 1. The CTS LED remains lit on the MD2 modem as long as the CTS is set to 1. The LED goes out as soon as the terminal recalls the RTS signal and thereby deactivates the transmitter of the modem.
6	DCD	Data Carrier Detect The DCD LED goes on as soon as the MD2 modem detects a sufficiently high data carrier signal through its receive channel. It goes out when this received level is no longer detected.

The inscriptions ONL and RI are not relevant for the MD2.

### 2.1.3 Front View of an MD2 with Removed Front Doors

The following illustration shows a front view of the MD2 modem with the doors removed so that the connectors inside are visible.

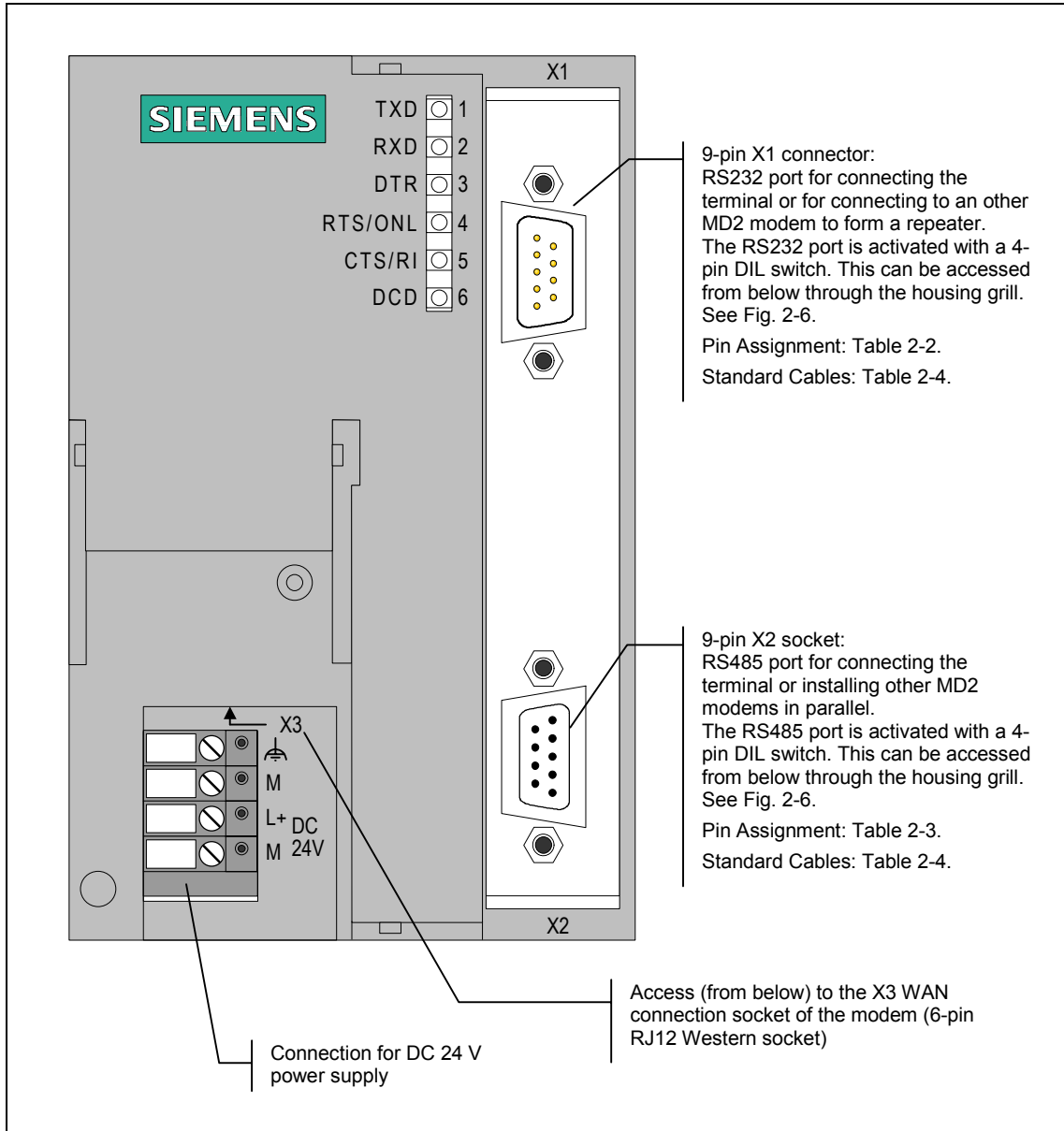


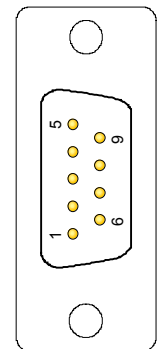
Fig. 2-2 Front view of the MD2 modem with removed front doors

### 2.1.4 Pin Assignments for the RS232 and RS485 Ports

The X1 connector is a 9-pin Sub-D miniature socket (male). The following table lists the pin assignments. Used as an RS232 interface the pin assignment corresponds to a standard PC port.

The RS232 port is activated with a 4-pin DIL switch which can be accessed from below through the housing grill. The corresponding settings on the DIL switch can be seen in Fig. 2-6.

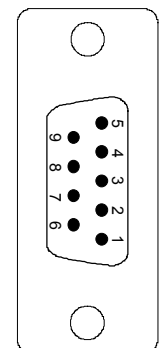
Table 2-2 Pin assignments on X1 RS232 socket

Diagram	Pin no.	Signal name	Signal direction	Comments
	1	DCD	Output	
	2	RXD	Output	
	3	TXD	Input	
	4	DTR	Input	
	5	GND		
	6	DSR	Output	
	7	RTS	Input	
	8	CTS	Output	
	9	RI / T	Output	

The RS485 port is a 9-pin Sub-D miniature socket (female). The following table lists the pin assignments.

The RS485 port and terminating resistor can be activated with a 4-pin DIL switch which can be accessed from below through the housing grill. The corresponding settings on the DIL switch can be seen in Fig. 2-6.

Table 2-3 Pin assignments on the X2 RS485 socket

Diagram	Pin no.	Signal name	Signal direction	Comments
	1			
	2			
	3	Data B	bi-directional	
	4			
	5	M5	-	0 V for bus termination in the plug *)
	6	P5	-	5 V for bus termination in the plug *)
	7			
	8	Data A	bi-directional	
	9			

\*) It is recommended to activate the terminating resistor for the RS485 bus in the plug and not in the modem itself. The recommended RS485 setting in the modem is shown in Fig. 2-6.

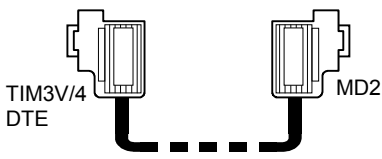
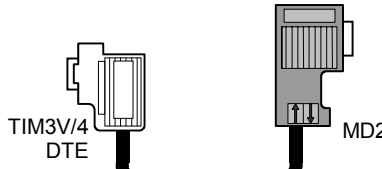
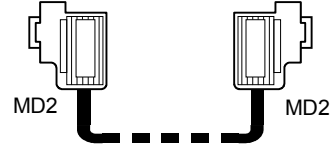
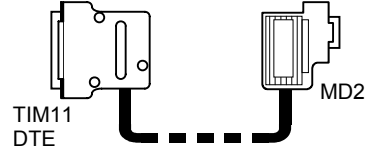
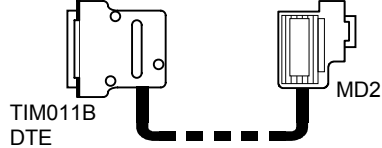


### 2.1.5 Standard Cables for the RS232 and RS485 Ports

The TIM module, one or more MD2 modems or an other terminal with an appropriate interface can be connected to the 9-pin X1 RS232 socket or X2 RS485 socket.

The following standard cables are available for X1 or X2 connections.

Table 2-4 Standard cables for the RS232 and RS485 ports

Order no.	Description	Diagram
6NH7701-4AL	Cable for connecting the MD2 modem (RS232) with a TIM3V/TIM4 (RS232) or an other terminal (DTE) with an identically configured 9-pin RS232 interface. Cable length 1.5 m	
6NH7701-4DL	Cable for connecting the MD2 modem (RS485) with a TIM3V/TIM4 (RS485) or an other terminal (DTE) with an identically configured 9-pin RS485 interface. Cable length 1.5 m	
6NH7701-1CB	Cable for connecting two MD2 modems (RS232) to form a repeater. Cable length 0.3 m	
6NH1701-7AN	Cable for connecting the MD2 modem (RS232) with a TIM11 (RS232) or an other terminal (DTE) with an identically configured 25-pin RS232 interface (socket) and slide lock. Cable length 2.5 m	
6NH1701-7BK	Cable for connecting the MD2 modem (RS232) with a TIM011B (RS232) or an other terminal (DTE) with an identically configured 25-pin RS232 interface (socket) and screw lock. Cable length 1.0 m	

The following tables show you how the cables mentioned above are configured.

Table 2-5 Configuration of standard cable 6NH7701-4AL

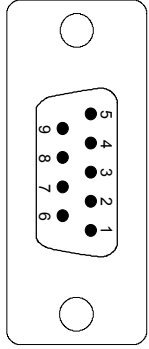
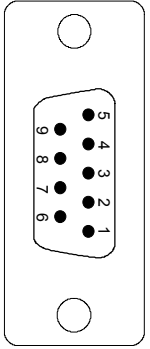
DTE/TIM3V/TIM4 (RS232)	Pin no.	Connection	Pin no.	MD2 Modem (RS232)
 <p>Sub-D socket 9-pin</p>	Housing shell		Housing shell	 <p>Sub-D socket 9-pin</p>
	1	DCD	1	
	2	RXD	2	
	3	TXD	3	
	4	DTR	4	
	5	GND	5	
	6	DSR	6	
	7	RTS	7	
	8	CTS	8	
9	RI / T	9		

Table 2-6 Configuration of standard cable 6NH7701-4DL

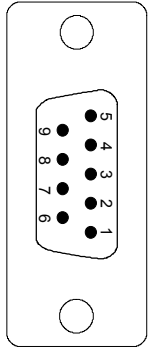
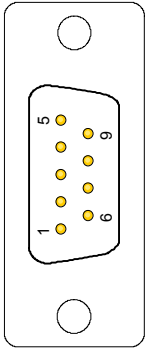
DTE/TIM3V/TIM4 (RS485)	Pin no.	Connection	Pin no.	Modem MD2 (RS485)
 <p>Sub-D socket 9-pin</p>	Housing shell		Housing shell	 <p>Sub-D plug 9-pin</p>
	1			
	2	Data B	A1 (8)	
	3	Data A	B1 (3)	
	4			
	5			
	6			
	7			
	8			
9				

Table 2-7 Configuration of standard cable 6NH7701-1CB

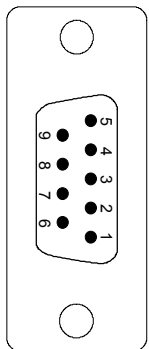
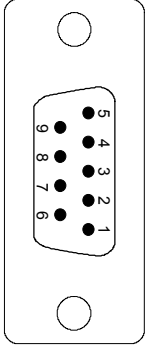
Modem MD2 (RS232)	Pin no.	Connection	Pin no.	Modem MD2 (RS232)
 <p>Sub-D socket 9-pin</p>	Housing shell		Housing shell	 <p>Sub-D socket 9-pin</p>
	9		9	
	2	RXD	RXD	
	3	TXD	TXD	
	4	GND	GND	
	5			
	6			
	7	RTS	RTS	
	8	DCD	DCD	
1				

Table 2-8 Configuration of Standard Cable 6NH1701-7AN

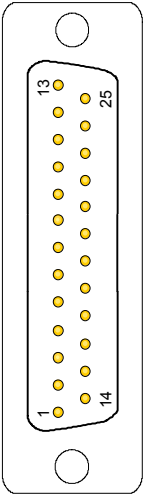
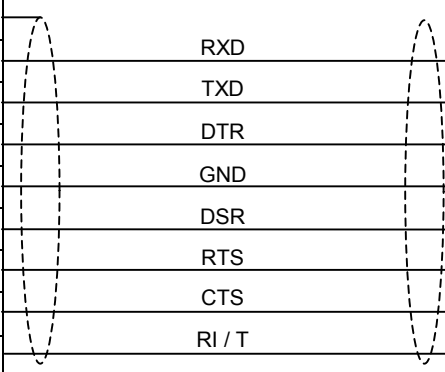
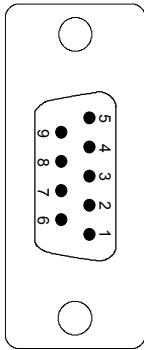
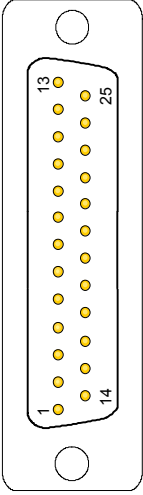
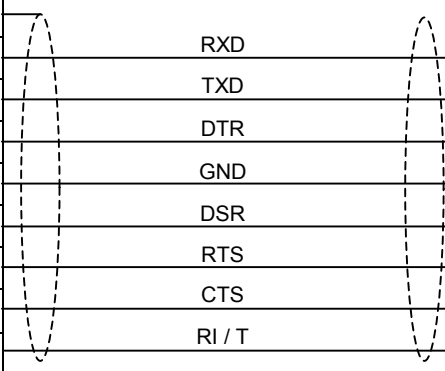
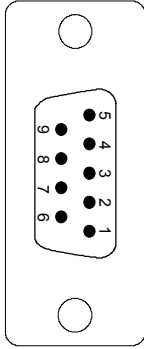
DTE/TIM11 (RS232)	Pin no.	Connection	Pin no.	MD3 Modem (RS232)	
 <p>Sub-D Plug 25-pin</p>	1		1	 <p>Sub-D socket 9-pin</p>	
	3		RXD		2
	2		TXD		3
	18		DTR		4
	7		GND		5
	6		DSR		6
	4		RTS		7
	8		CTS		8
	22		RI / T		9

Table 2-9 Configuration of Standard Cable 6NH1701-7BK

DTE/TIM011B (RS232)	Pin no.	Connection	Pin no.	MD3 Modem (RS232)	
 <p>Sub-D Plug 25-pin</p>	1		1	 <p>Sub-D socket 9-pin</p>	
	3		RXD		2
	2		TXD		3
	20		DTR		4
	7		GND		5
	6		DSR		6
	4		RTS		7
	5		CTS		8
	22		RI / T		9

### 2.1.6 View of the MD2 Modem from Above

The following illustration shows the MD2 modem viewed from above. It shows the positions of the 5-pin and 10-pin DIL switches accessible from above.

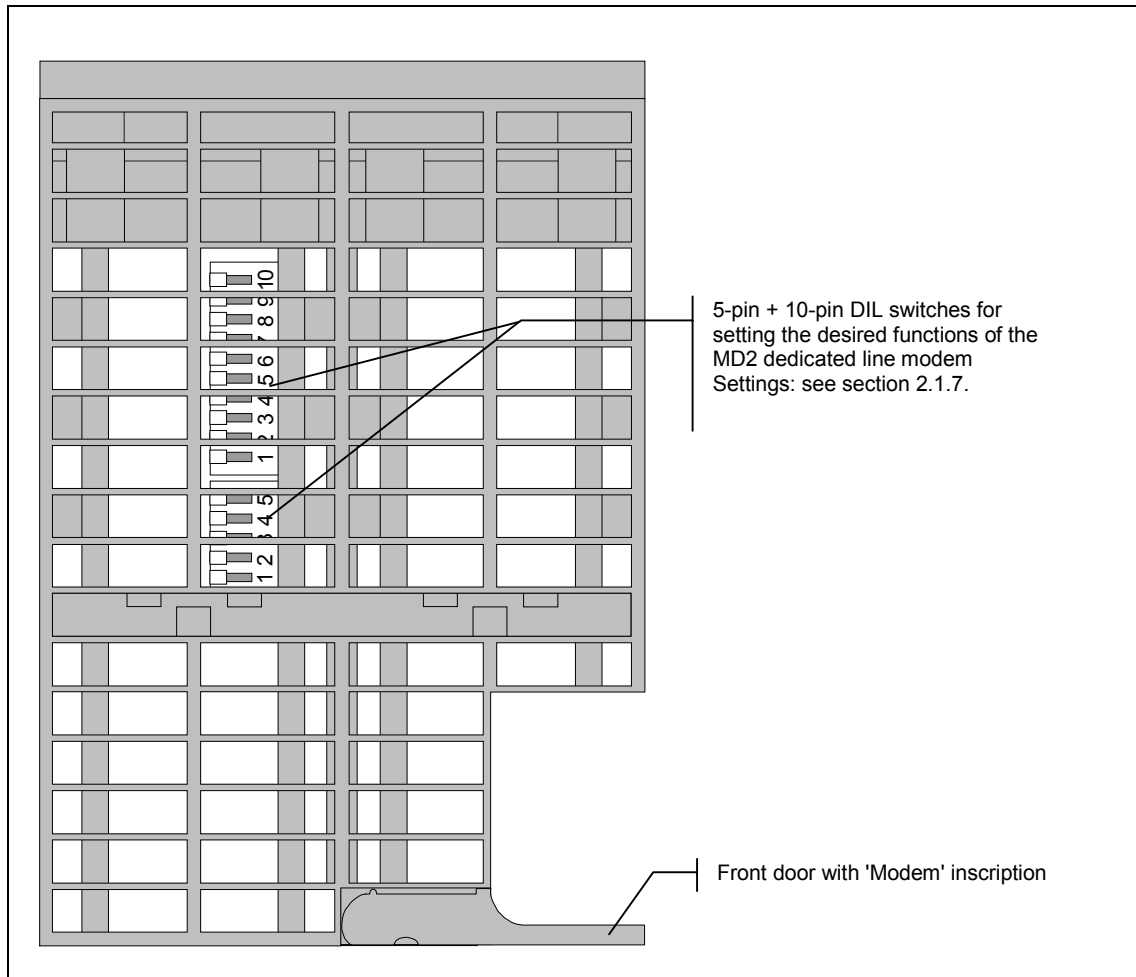


Fig. 2-3 View of the MD2 modem from above

### 2.1.7 Settings for the DIL Switches Accessible from Above

The MD2 modem features a 5-pin and a 10-pin DIL switch (see Fig. 2-3). Both switches are located directly on top of the housing grill. The 5-pin DIL switch is used to specify settings for the dedicated line, the 10-pin DIL switch is used to set the operating mode and the character recognition.

The DIL switches have the following individual functions:

- 5-pin DIL switch
  - Send level -6 dB or 0 dB
  - 2-wire or 4-wire mode
  - One channel or two channel for 2-wire mode
  - Baud rate 1200, 2400, 9600 or 19200

- 10-pin DIL switch
  - Operating mode
  - Character recognition
  - Control signal set to RTS
  - Squelch ON or OFF
  - Reset test receive

The following illustration is a summary of the possible settings.

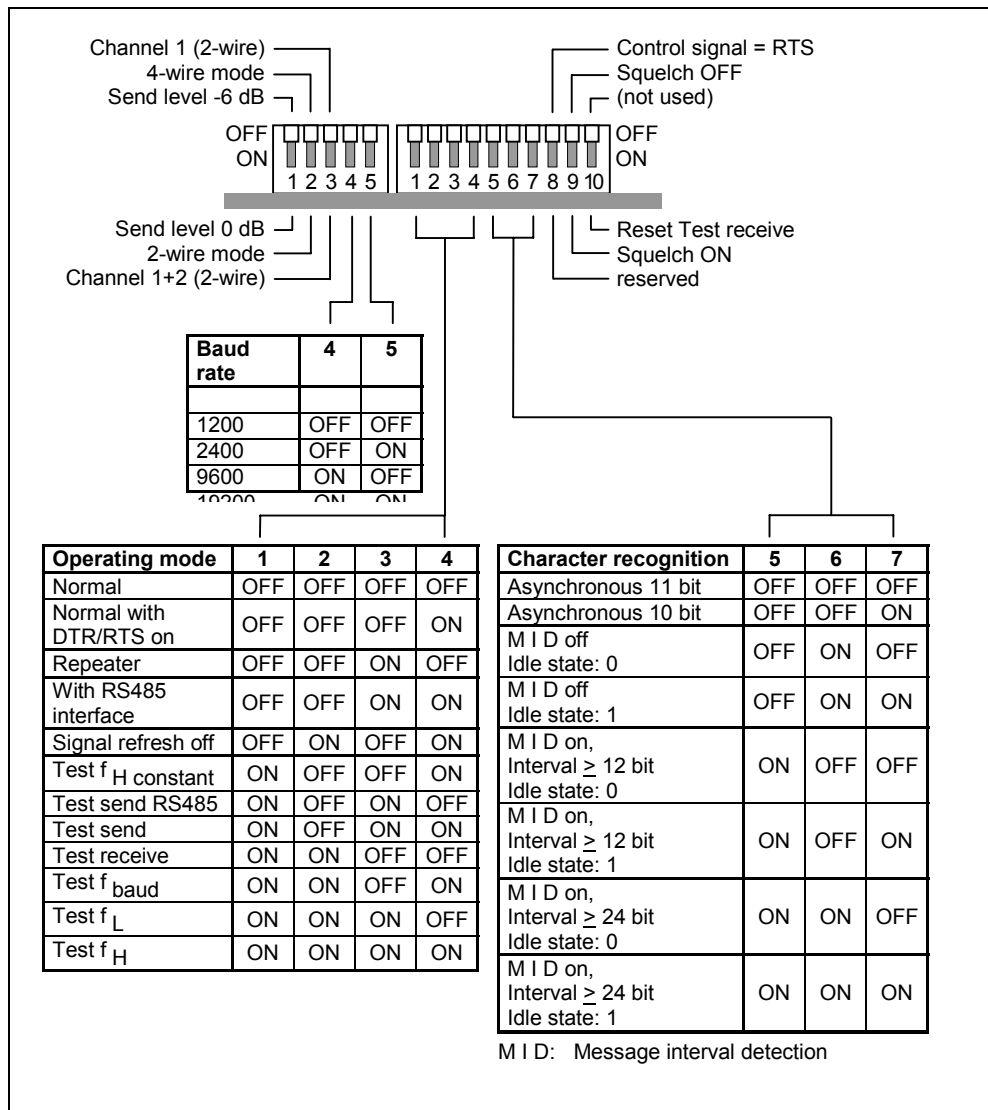


Fig. 2-4 Various settings for the DIL switches accessible from above

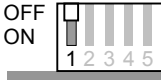
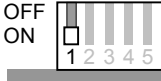

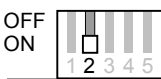

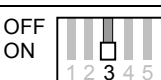




The following sections provide more information for individually configuring these default settings.

## Setting the Dedicated Line Properties

Specific settings must be made for the dedicated line connected to the MD2 modem. The settings are for the send level, 2-wire or 4-wire operating mode, two channel operation for 2-wire dedicated lines and the baud rate. The dedicated line settings are made with the 5-pin DIL switch. The procedure is as follows:

Switch off the power supply of the modem and make the desired settings using the DIL switch. When the power is switched on the selected settings become active.

Table 2-10 Settings on the 5-pin DIL switch

Setting on DIL Switch	Meaning
	<p>Send level -6 dB *)</p> <p>For details about maximum transmission range see 2-22.</p>
	<p>Send level 0 dB *)</p> <p>This can be used to increase the transmission range without a repeater. For details about maximum transmission range see 2-22.</p>
	<p>4-wire mode</p> <p>This setting is required when the send and receive direction each use a separate pair of cores. In this mode the position of switch 3 has no relevance.</p>
	<p>2-wire mode</p> <p>This setting is required when a common pair of cores is used for the send and receive direction. In this mode the position of switch 3 is relevant. This is then used to set whether only one 2-wire line is connected (channel 1) or whether two 2-wire lines are connected (channel 1+2), for example, in a control center when the communication to the stations is made via two separate 2-wire connections ('small star network').</p>
	<p>Channel 1 (2-wire)</p> <p>In the 2-wire mode only channel 1 is used, in other words, only <u>one</u> 2-wire line is connected to the modem (see also switch 2).</p>
	<p>Channel 1+2 (2-wire)</p> <p>In the 2-wire mode channels 1+2 are used, in other words, <u>two</u> separate 2-wire lines are connected to the modem (see also switch 2).</p>
	<p>Baud rate 1200 bps (see also Note)</p> <p>At this speed the modem is compatible to SINAUT ST1 modems MD100, MD124 and LGM 1200H1.</p>
	<p>Baud rate 2400 bps (see also Note)</p> <p>At this speed the modem is compatible to SINAUT ST1 modem MD124.</p>
	<p>Baud rate 9600 bps</p>
	<p>Baud rate 19200 bps</p> <p>At this speed the modem is compatible to SINAUT ST1 modem MD124.</p>

\*) Normally these levels are not allowed on Telecom leased lines. In connection with switch S10 of the 10pin DIL switch (see page 2-15) a reduced level of -9 dB (standard for leased lines) can be set instead of 0 dB or instead of -6 dB the level can be reduced to -15 dB.

**Note**

The 1200 and 2400 bps transmission speed is suitable for lines with band widths limited to the normal voice frequency band (300 Hz – 3400 Hz). This is typically the case for leased lines from public telephone companies. A corresponding certification from the German Telekom is available for the MD2 modem. It is entitled, 'Connection to a transmission line with analog connection points (2-wire) and 3.1 kHz effective band width (300 Hz – 3400 Hz)'. See Chapter 1.5.

**Setting the Operating Mode**

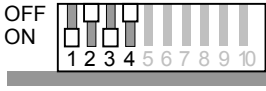
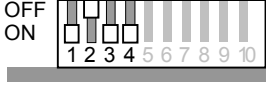

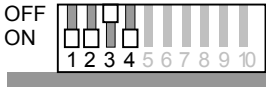
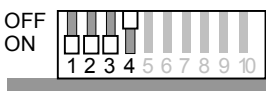
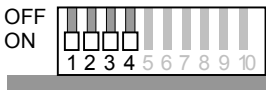
In addition to the settings for the dedicated line, the operating mode of the modem needs to be specified. This involves setting the operating mode for an RS232 or RS485 interface, the repeater mode or a test mode to help in the installation. The operating modes are set on switches 1 to 4 of the 10-pin DIL switch.

The procedure is as follows:

Switch off the power supply of the modem and make the desired settings using the DIL switch. When the power is switched on the selected operating mode settings become active.

Table 2-11 Settings on the 10-pin DIL switch (operating mode)

Setting on DIL Switch	Meaning
	<p><b>Normal operating mode</b></p> <p>This mode must be selected when the MD2 is connected through its RS232 interface to a terminal.</p>
	<p><b>Normal operating mode with DTR/RTS on</b></p> <p>Set this operating mode if you want to connect the MD2 via the RS232 interface to a terminal that does not have control signals (DTR and RTS). This operating mode is only suitable for 4-wire lines in a point-to-point network configuration.</p>
	<p><b>Repeater</b></p> <p>This mode must be selected when two MD2s are connected to function as a repeater.</p>
	<p><b>with RS485 interface</b></p> <p>This mode must be selected when the MD2 is connected through its RS485 interface to a terminal or another MD2.</p>
	<p><b>Signal refresh off</b></p> <p>In this operating mode the receive signal is not refreshed. In this case the RS485 interface cannot be used.</p> <p>Using this operating mode allows data to be sent with &lt; 1200 bps.</p>
	<p><b>Test mode: Test f<sub>H</sub> constant</b></p> <p>In this test mode the upper keying frequency is continuously present at the modem transmitter output.</p>

Setting on DIL Switch	Meaning
	<p><b>Test mode: Test send RS485</b></p> <p>In this test mode a short message (2 bytes) is continuously present in asynchronous 11-bit format at the modem transmitter output and the RS485 port.</p>
	<p><b>Test mode: Test send</b></p> <p>In this test mode a short message (2 bytes) is continuously present in asynchronous 11-bit format at the modem transmitter output.</p>
	<p><b>Test mode: Test receive</b></p> <p>You can use this test mode together with test modes "Test Send RS485" and "Test Send" to check the transmission line or the receiver section of the modem.</p>
	<p><b>Test mode: Test f<sub>baud</sub></b></p> <p>In this test mode the lower and the upper keying frequencies are, continuously changing according to the transmission speed, present at the modem transmitter output.</p> <p>This corresponds to the binary sequence 01010101... .</p>
	<p><b>Test mode: Test f<sub>L</sub></b></p> <p>In this test mode the lower keying frequency is continuously present at the modem transmitter output.</p>
	<p><b>Test mode: Test f<sub>H</sub></b></p> <p>In this test mode the upper keying frequency is continuously present at the modem transmitter output.</p>

**Note**

Details about the individual operating modes are available in Chapter 4 *Operating Modes and Character Recognition*.

**Setting the Character Recognition**


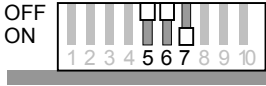


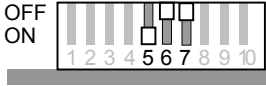
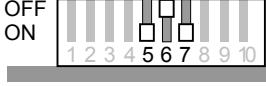


The character recognition is set on switches 5 to 7 of the 10-pin DIL switch.

The procedure is as follows:

Switch off the power supply of the modem and make the desired settings using the DIL switch. When the power is switched on the selected settings for the character recognition become active.



Table 2-12 Settings on the 10-pin DIL switch (character recognition)

Setting on DIL Switch	Meaning
	<p><b>Character recognition asynchronous 11 bit :</b></p> <p>This Character recognition mode must be set if the transmitted message consists of a series of asynchronous characters, 11-bit each (1 start bit, 8 data bits, 1 parity bit, 1 stop bit).</p> <p>This is the standard setting for sending SINAUT ST1 or SINAUT ST7 messages. In this case message format FT 1.2, based on 11-bit asynchronous characters, is normally used for transmitting over dedicated lines.</p>
	<p><b>Character recognition asynchronous 10 bit :</b></p> <p>This Character recognition mode must be set if the transmitted message consists of a series of asynchronous characters, 10-bit each (1 start bit, 8 data bits, 1 stop bit).</p> <p>This setting is required for transmitting SINAUT ST7 messages over dedicated lines with the optional FT 2 message format. This format is based on 10-bit asynchronous characters.</p>
	<p><b>MID off, idle state 0 :</b></p> <p>This Character recognition mode must be set if the transmitted message consists of a series of any synchronous or asynchronous characters. Message intervals are not detected. The FSK transmitter has to be switched off at the end of a message. The MD2 then gives 0 signal to the DTE.</p>
	<p><b>MID off, idle state 1 :</b></p> <p>This Character recognition mode must be set if the transmitted message consists of a series of any synchronous or asynchronous characters. Message intervals are not recognized. The FSK transmitter has to be switched off at the end of a message. The MD2 then gives 1 signal to the DTE.</p>
	<p><b>MID on (interval ≥ 12 bit), idle state 0 :</b></p> <p>This Character recognition mode must be set if the transmitted message consists of a series of any synchronous or asynchronous characters. If the receive signal is in the idle state (= 0 signal) for at least 12 bits long, a message interval is recognized.</p>
	<p><b>MID on (interval ≥ 12 bit), idle state 1 :</b></p> <p>This Character recognition mode must be set if the transmitted message consists of a series of any synchronous or asynchronous characters. If the receive signal is in the idle state (= 1 signal) for at least 12 bits long, a message interval is recognized.</p>
	<p><b>MID on (interval ≥ 24 bit), idle state 0 :</b></p> <p>This Character recognition mode must be set if the transmitted message consists of a series of any synchronous or asynchronous characters. If the receive signal is in the idle state (= 0 signal) for at least 24 bits long, a message interval is recognized.</p>
	<p><b>MID on (interval ≥ 24 bit), idle state 1 :</b></p> <p>This Character recognition mode must be set if the transmitted message consists of a series of any synchronous or asynchronous characters. If the receive signal is in the idle state (= 1 signal) for at least 24 bits long, a message interval is recognized.</p>







**Note**

Details about the individual character formats are available in Chapter 4 *Operating Modes and Character Recognition*.

## Other Settings

Switched 8 to 10 on the 10-pin DIL switch are used to set the control output (see section 2.1.11), the squelch function and the reset for the test modes.

Table 2-13 Settings on the 10-pin DIL switch (other functions)

Setting on DIL Switch	Meaning
 <p>OFF ON</p>	<p><b>Control output switches with RTS</b></p> <p>A floating optical relay is provided on pins 1 and 6 of the RJ12 Western plug. This is active as long as the terminal keeps sending the RTS signal (transmitter on) to the MD2 modem. This control signal can be used to switch on a radio device when the MD2 modem is used together with a radio system.</p>
 <p>OFF ON</p>	<p><b>Reserved</b></p>
 <p>OFF ON</p>	<p><b>Squelch off</b></p> <p>This is a <u>compulsory</u> setting for the MD2 in connection with a TIM.</p>
 <p>OFF ON</p>	<p><b>Squelch on</b></p> <p>This is a prohibited setting for the MD2 in connection with a TIM.</p>
 <p>OFF ON</p>	<p><b>Reset "Test receive" off / normal send level</b></p> <p>This switch has two different functions depending on the selected operating mode:</p> <p>In "Test receive" mode this switch setting has no function.</p> <p>In all other operating modes the send level for modem operation on normal dedicated lines is set to 0dB or -6dB depending on the setting of switch S1 (5-pin DIL switch).</p>
 <p>OFF ON</p>	<p><b>Reset "Test receive" on / reduced send level</b></p> <p>This switch has two different functions depending on the selected operating mode:</p> <p>In "Test receive" mode the test mode can be reset.</p> <p>In all other operating modes the send level for modem operation on telecom leased lines is reduced. The send level is set to -9dB or to -15dB depending on the setting of switch S1 (5-pin DIL switch).</p>

### Note

Details about the control output, squelch function and resetting 'Test receive' are available in Chapter 4 *Operating Modes and Character Recognition*.

### Factory Default Settings for DIL Switches

The MD2 modem is delivered with all DIL switches set in the OFF position. This corresponds to the following default setting:

- Send level –6 dB
- 4-wire mode
- Channel 1 ON (fixed setting for 4-wire mode)
- Baud rate 1200 bps
- Normal operating mode
- A message consists of a string of 11-bit asynchronous characters.
- Control output switches with RTS (only relevant for connection to radio)

With the factory default settings the switches appear as shown in the following illustration.

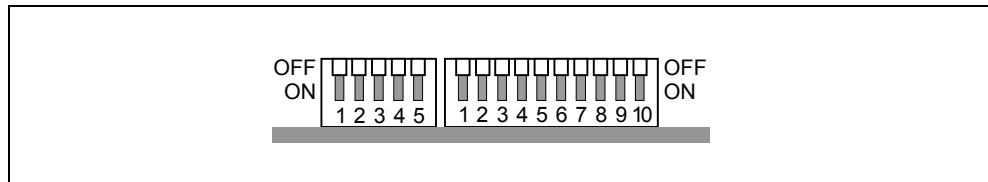


Fig. 2-5 Factory default settings for DIL switches

### 2.1.8 View of the MD2 Modem from Below

The following illustration shows the MD2 modem from below with the X3 RJ12 Western socket, the DIL switch for activating the RS232 or RS485 interface as well as the DIL switch for activating the terminating resistors at the WAN end.

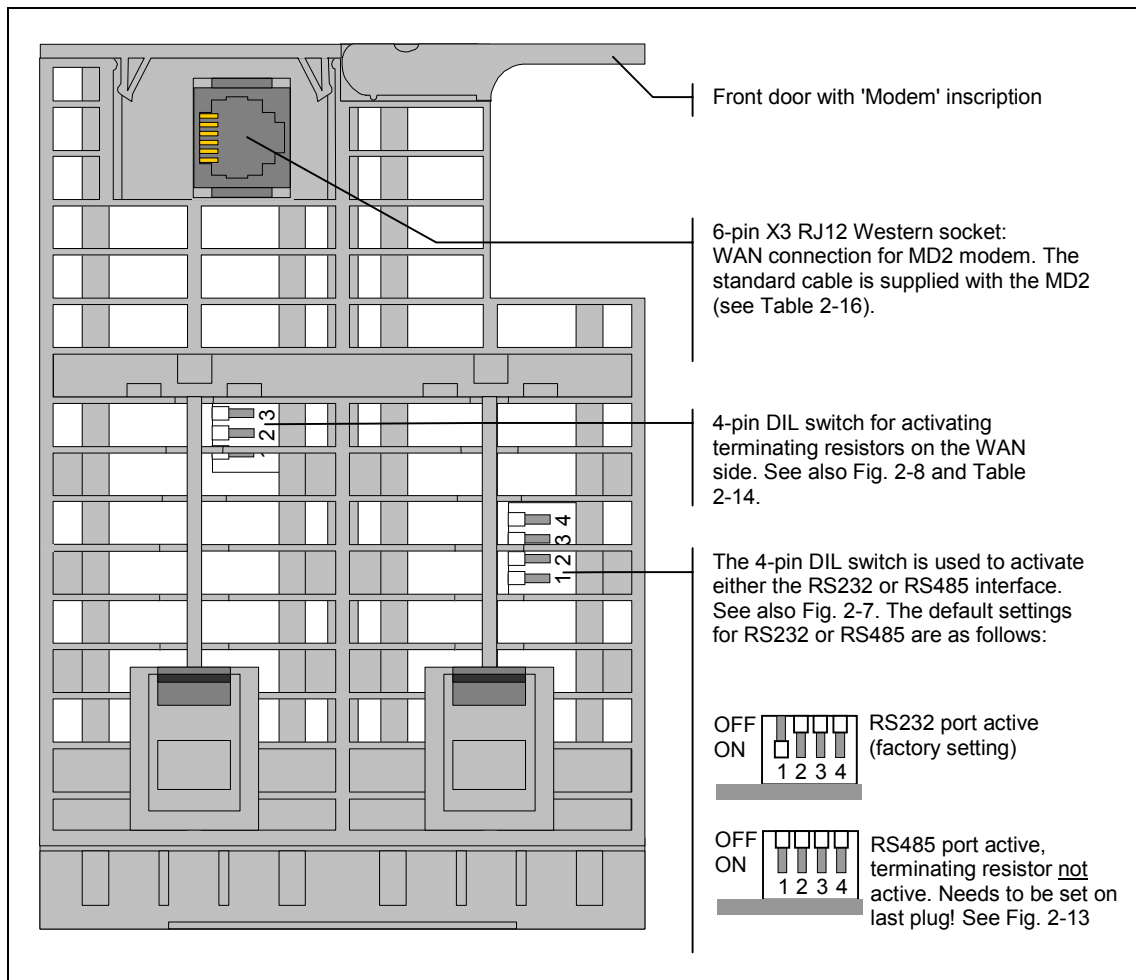


Fig. 2-6 View of the MD2 modem from below

### 2.1.9 DIL Switch for Activating the RS232 or RS485 Port

A 4-pin DIL switch can be accessed from the bottom of the modem housing (see Fig. 2-6). The DIL switch is used to activate either the RS232 or RS485 interface. The terminating resistor for the line is also switched on here for the RS485 mode (see Fig. 2-13). The following illustration shows a summary of the settings possible, Fig. 2-6 lists the default settings.

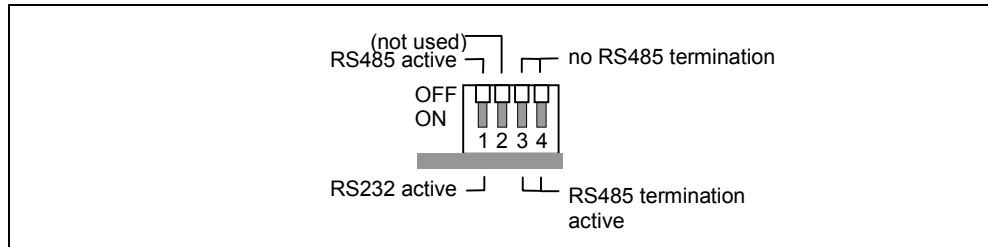


Fig. 2-7 Various settings on 4-pin DIL switch for activating RS232/RS485

### 2.1.10 DIL Switch for Activating Terminating Resistors (WAN)

Another 4-pin DIL switch can be accessed from the bottom of the MD2 housing. This is used for activating the terminating resistors at the WAN end (see Fig. 2-6 for the location of the DIL switch). Fig. 2-8 is a summary of the various settings, Table 2-14 lists the respective default settings.

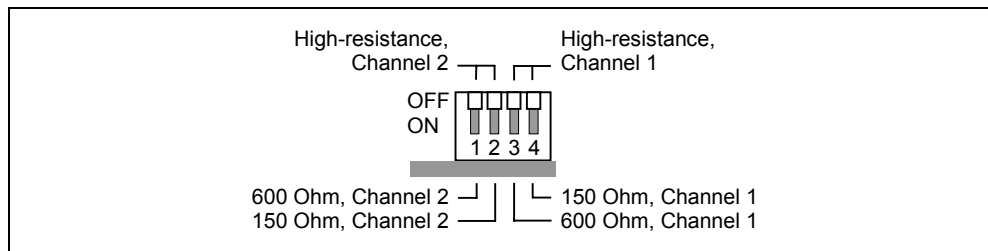
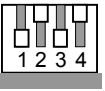
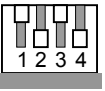
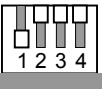
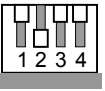
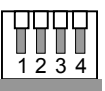


Fig. 2-8 Various settings for terminating resistors at the WAN end

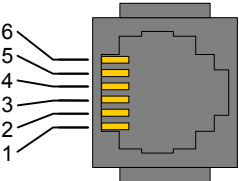
Table 2-14 Default settings for terminating resistors at the WAN end

Type of Connection	Baud rate	Setting on DIL Switch	Note
Terminal Point 2-wire (channel 1), 2 x 2-wire (channel 1+2), 4-wire	1200 bps 2400 bps	OFF ON 	The MD2 is located at the beginning or end of a 2-wire or 4-wire line and is set to a transmission speed of 1200 or 2400 bps (see also Table 2-10).
	9600 bps 19200 bps	OFF ON 	Terminal point as above but with transmission speed set to 9600 or 19200 bps (see also Table 2-10).
Tapping Point 2-wire (channel 1)	1200 bps 2400 bps	OFF ON 	The MD2 is <u>not</u> located at the beginning or end of a 2-wire line; it taps into this 2-wire line somewhere along the way with high resistance. The transmission speed is set to 1200 or 2400 bps (see also Table 2-10).
	9600 bps 19200 bps	OFF ON 	Tapping point as above but with transmission speed set to 9600 or 19200 bps (see also Table 2-10).
Tapping Point 4-wire	1200 bps 2400 bps 9600 bps 19200 bps	OFF ON 	The MD2 is <u>not</u> located at the beginning or end of a 4-wire line; it taps into this 4-wire line somewhere along the way with high resistance.

### 2.1.11 Pin Assignments on the RJ12 Western Socket

The X3 connector on the MD2 modem is a 6-pin RJ12 Western connector (socket). The following table lists the pin assignments.

Table 2-15 Pin assignments on the X3 RJ12 Western socket for the MD2 modem

Diagram	Pin no.	Signal Name	Signal Direction	Comments
	5	a1	Input or bi-directional (channel 1)	With 2-wire: Input and output channel 1
	2	b1		With 4-wire: Input
	4	a2	Output or bi-directional (channel 2)	With 2-wire: Input and output channel 2
	3	b2		With 4-wire: Output
	1	a RTS	Output	Output optical relay
	6	b RTS		

The RTS signal can be output via the floating optical relay on pins 1 and 6 of the RJ12 connector.

The following is the technical data for this output:

- max. connection voltage = 60V AC/DC
- $R_{ON}$  max = 3 Ohm
- $I_{max}$  = 400 mA

A suppression circuit is not provided for the output.

The following diagram is a wiring example for the use of the optical relay on the RJ12 port: when the RTS signal is active the optical relay connects signal ground and PTT input of a radio device.

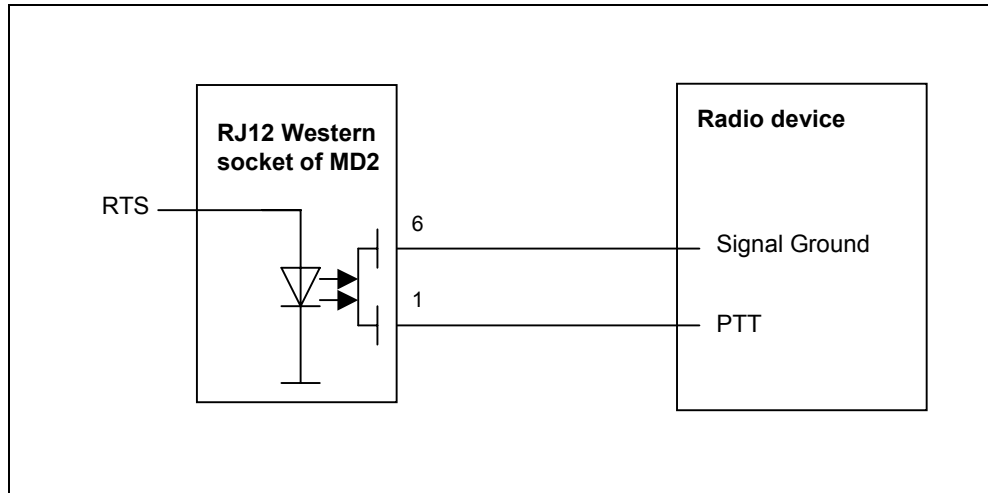


Fig. 2-9 Wiring example for the optical relay on the RJ12 port

### 2.1.12 Standard Cable for the RJ12 Port

A 6NH7700-2AR60 cable is delivered with each MD2 modem. This enables the MD2 modem to be connected with an LTOP overvoltage protection module. The actual connection to the dedicated line is made through screw terminals on the LTOP overvoltage protection module.

A spare connection cable can also be ordered by specifying the part number listed below.

Table 2-16 Standard cable for the MD2 modem

Order no.	Description	Diagram
6NH7700-2AR60	Cable with 2 x RJ12 Western plugs for connecting the MD2 modem (RJ12) to an LTOP overvoltage protection module (RJ12). The cable can also be used for an MD2 that is integrated in a TIM. Cable length 6 m	

The pin assignment on both RJ12 plugs are identical and correspond to the assignment listed in Table 2-15.

#### Note

When inserting the cable it is best to hold it directly below the RJ12 plug. The insertion is then considerably easier than when holding the cable by the RJ12 plug. Make sure that the RJ12 plug clearly clicks when it is inserted!

## 2.2 Connecting an MD2 to DTE, LTOP and Dedicated Line

The following diagrams show various possibilities for connecting the MD2 modem to a DTE (e.g. TIM) or other MD2 modems as well as to the dedicated line via an LTOP.

For detailed information about connecting, switching and configuring LTOPs, refer to section 2.3 *LTOP Line Transformer with Overvoltage Protection*.

### 2.2.1 Connecting an MD2 with a DTE via the RS232 Port

Only one MD2 modem can be connected to a data terminal equipment (e.g. TIM) through the RS232 interface. The following illustrations show various terminal and tapping point configurations.

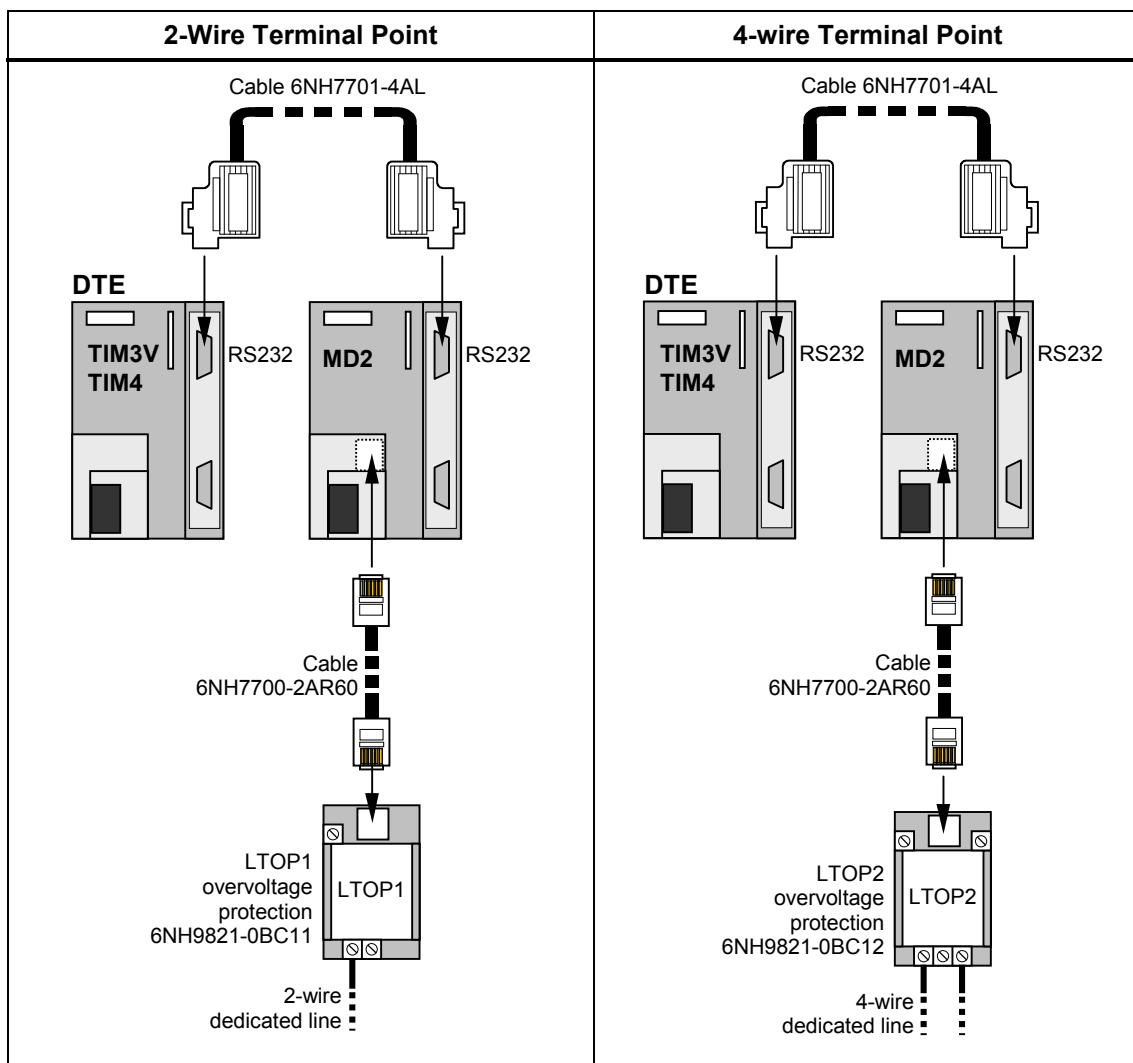


Fig. 2-10 Connection of an MD2 with a DTE via RS232, configuration as 2-wire and 4-wire terminal points



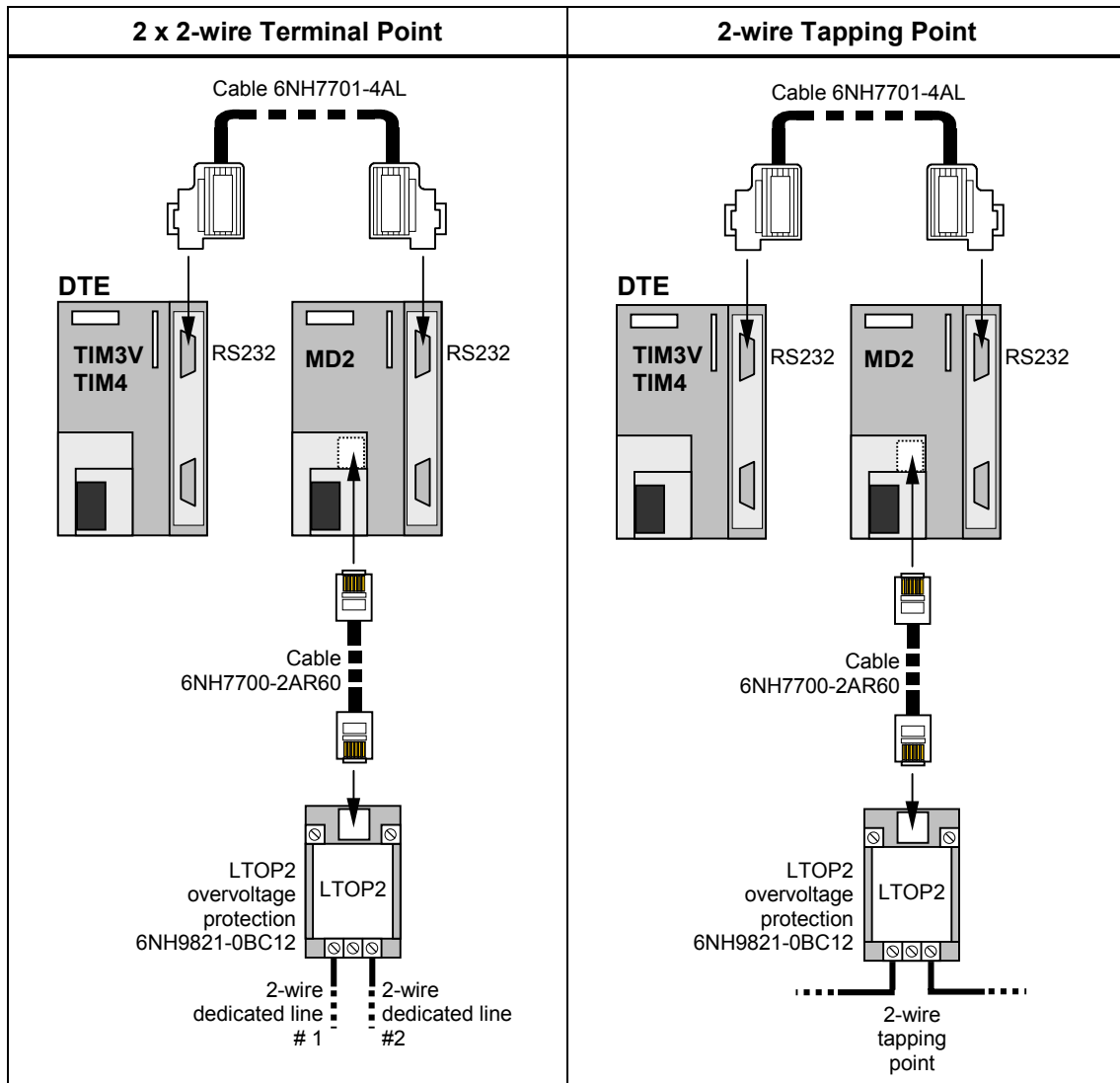


Fig. 2-11 Connection of an MD2 with a DTE (e.g. TIM) via RS232, configuration as 2 x 2-wire terminal point and 2-wire tapping point

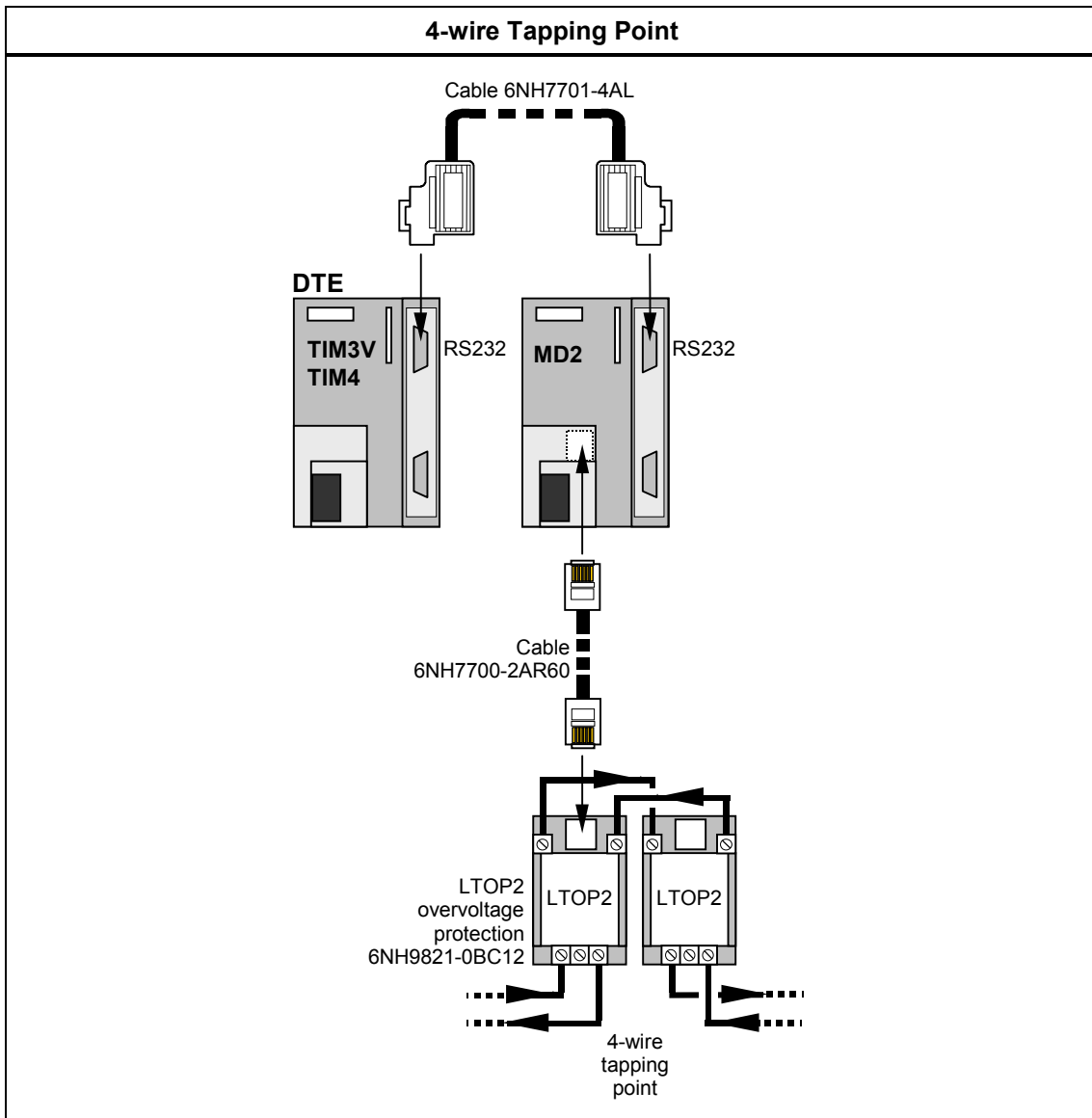


Fig. 2-12 Connection of an MD2 with a DTE (e.g. TIM) via RS232, configuration as 4-wire tapping point

## 2.2.2 Connecting Several MD2s with a DTE via the RS485 Port

Several MD2 modems can be connected to a data terminal equipment (e.g. TIM) through the RS485 interface. This type of connection is needed when several dedicated lines come together at one DTE, in other words, when the connection involves a star-shaped network. The following diagram shows an example of such a configuration using standard components.

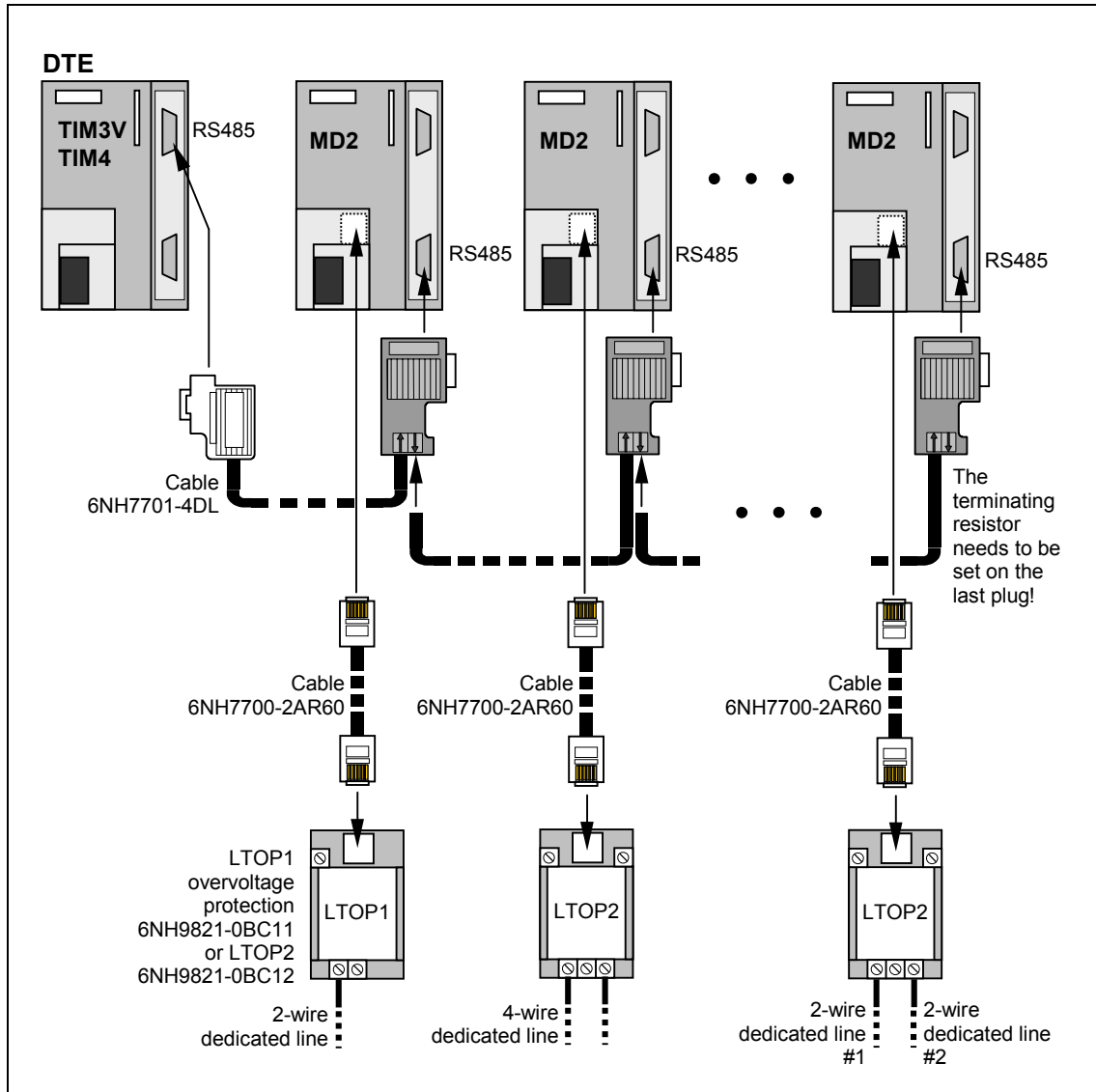


Fig. 2-13 Connecting several MD2s with a DTE (e.g. TIM) via RS485, star-shaped junction of several dedicated lines

Standard cable 6NH7701-4DL is used for connecting the DTE (e.g. TIM) to the first MD2. There is no prefabricated cable for the connection to the next modems. However, one can be built using standard components from the SIMATIC S7 product catalog. The same components can be used as those for making an MPI connection. 6XV1830-0AH10 is recommended for the cable, and 6ES7972-0BA12-0XA0 for the plug. The RS485 terminating resistor for the line can be switched on this plug if required.

The table on the next page shows how several MD2s can be connected in parallel using the various cable sections.

**Important**

Do not forget to activate the terminating resistor for the RS485 bus with the slide-switch on the last plug (see Fig. 2-13)!

The connection to the dedicated line is made through overvoltage protection modules LTOP1 or LTOP2. The diagram shows the various connections possible for 1 x 2-wire, 1x 4-wire or 2 x 2-wire terminal point for each MD2 modem. The 5-pin DIL switch accessible from above on the modem is used to make the appropriate setting for the type of terminal point (see Table 2-10).

**RS485 Operation of the MD2**

When connecting several MD2s in parallel through the RS485 interface, the following should be taken into consideration in making the settings on the MD2 modem:

- 1) The MD2 modem must be set to the "Interface with RS485" operating mode using the 10-pin DIL switch (see Fig. Fig. 2-4).
- 2) The RS485 interface must also be activated with the 4-pin DIL switch accessible from below (see Fig. 2-6).
- 3) If the DTE connected to the MD2 modem is a SINAUT ST7 TIM, follow the instructions in the SINAUT ST7 Manual, Chapter 5.1.4.

**Important**

If the MD2 is operated via its RS485 interface there is no communication possible with the MD100 modem, that otherwise is compatible. The compatibility is only valid if the RS232 interface of the MD2 is used.

Table 2-17 Configuration of standard cable 6NH7701-4DL (from DTE to first MD2 modem)

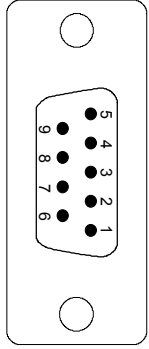
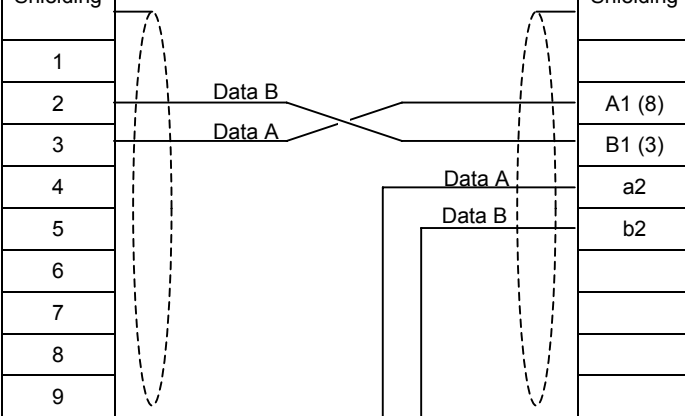
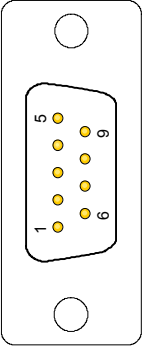
DTE/TIM3V/TIM4 (RS485)	Pin no.	Connection	Pin no.	Modem MD2 (RS485)
 <p>Sub-D socket 9-pin</p>	Shielding		Shielding	 <p>Sub-D plug 9-pin</p>
	1			
	2			
	3			
	4			
	5			
	6			
	7			
	8			
9				

Table 2-18 Connection to the second MD2 modem

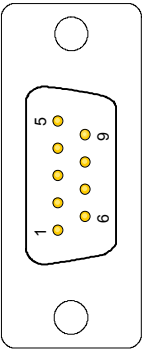
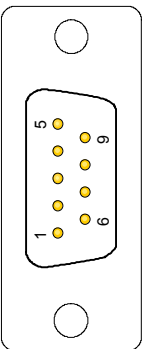
	Pin no.	Modem MD2 (RS485)
<p>Connection</p>	Shielding	 <p>Sub-D plug 9-pin</p>
	Data A	
	Data B	
	A1 (8)	
	B1 (3)	
	a2	
	b2	

Table 2-19 Connection to the third MD2 modem etc.

	Pin no.	Modem MD2 (RS485)
<p>Connection</p>	Shielding	 <p>Sub-D plug 9-pin</p>
	Data A	
	Data B	
	A1 (8)	
	B1 (3)	
	a2	
	b2	

### 2.2.3 Connecting Two MD2s to Function as a Repeater

Two MD2 modems can be connected to function as a repeater when the distances being bridged are too long (2-wire or 4-wire repeater). The repeater amplifies the signal and regenerates the individual characters. Table 2-22 provides information for calculating the distances that can be bridged depending on the baud rate and number of tapping stations.

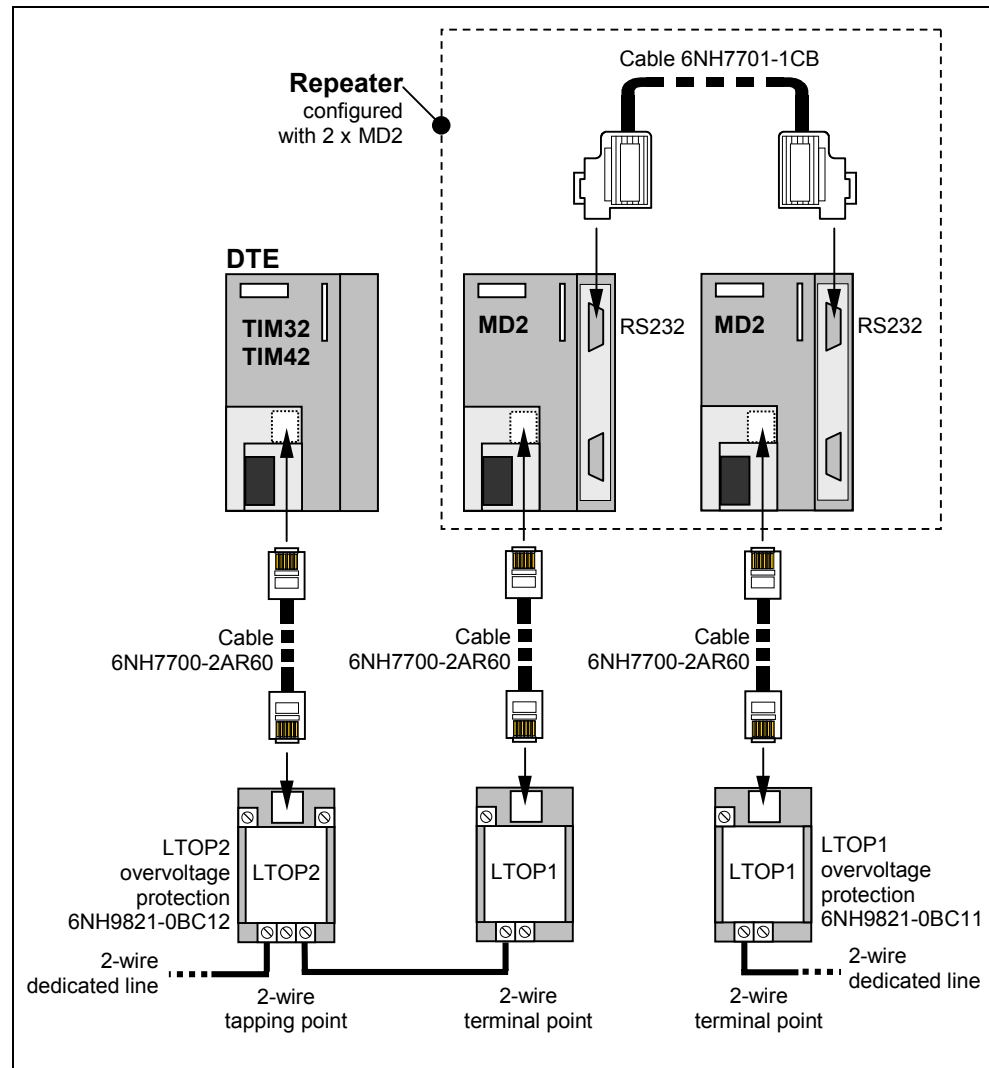


Fig. 2-14 Two MD2s as a 2-wire repeater combined with a 2-wire tapping of a DTE (e.g. TIM32 or TIM42)

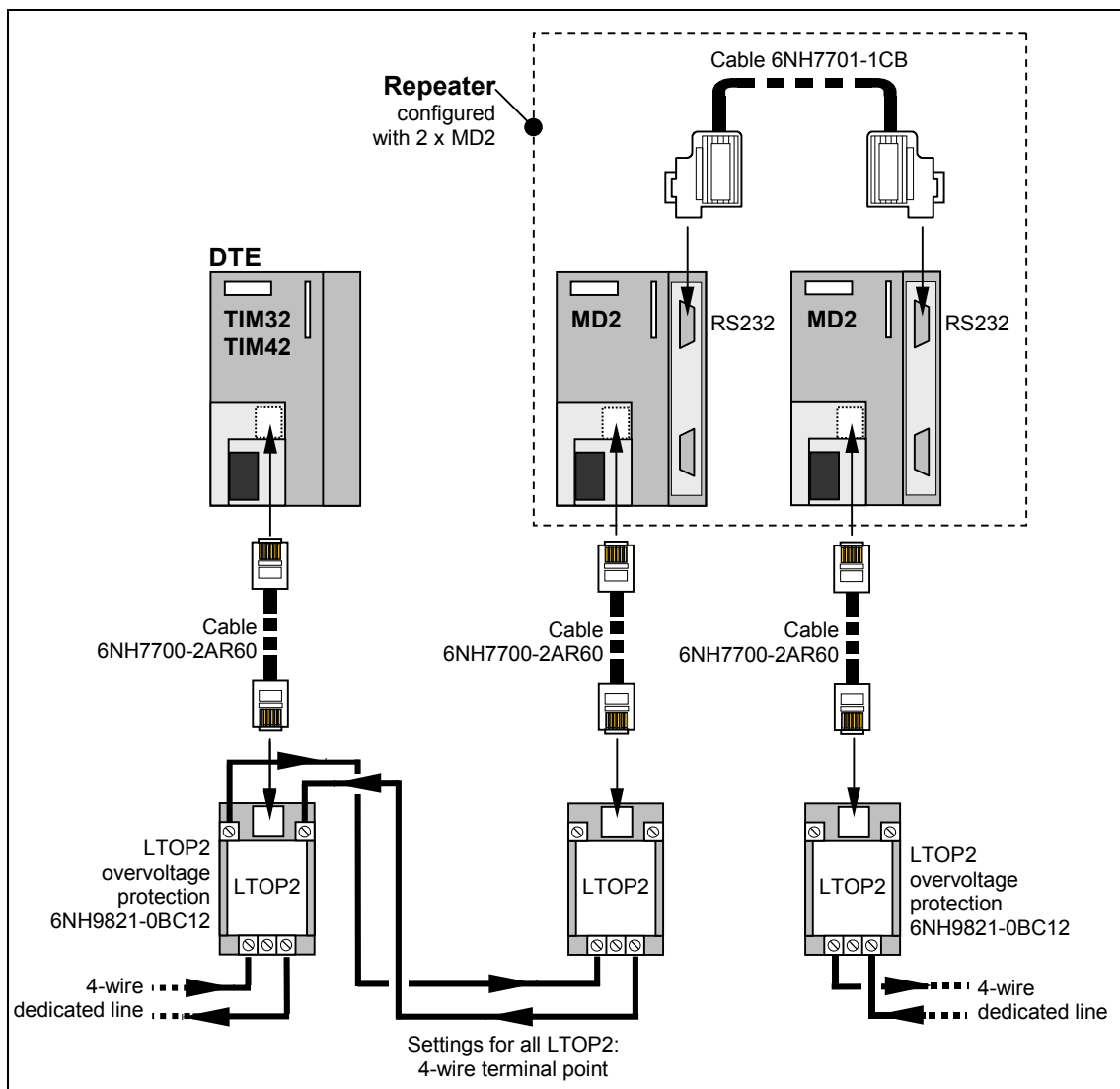


Fig. 2-15 Two MD2s as a 4-wire repeater combined with a DTE at the same spot (e.g. TIM32 or TIM42)

In most cases a repeater is placed at the location of a DTE (e.g. an ST7 station which includes a TIM with an integrate MD2 modem). This is why these diagrams also show how to connect a DTE (e.g. a TIM32 or TIM42) into the 2-wire or 4-wire line at this repeater location in addition to showing the connection of two MD2s as a repeater.

## 2.2.4 Transmission Speeds and Frequencies of the MD2 Modem

Table 2-20 Transmission speeds and frequencies of the MD2 modem

Transmission speed (bps)	Mid-frequency (Hz)	Frequency deviation $\Delta f$ (Hz)	Lower keying frequency (Hz)	Upper keying frequency (Hz)
1200	1 700	400	1 300	2 100
2400	2 850	450	2400	3 300
9600 / 19200	27 200	6 400	20 800	33 600

## 2.2.5 Signal Loss Values

Table 2-21 Signal loss values depending on transmission speed and core diameter

Transmission speed (bps)	Loss per km (dB) for core diameter (mm)					Loss per LTOP (dB)	Insertion loss per tapping point (dB)
	0.6	0.8	0.9	1.2	1.4		
Line termination with Z = 600 Ohm							
1200	1.5	1.15	0.9	0.65	0.55	0.4	0.4
2400	1.85	1.4	1.1	0.75	0.6	0.4	0.2
Line termination with Z = 150 Ohm							
9600 / 19200	4.3	3.2	2.6	1.8	1.5	2.0	0.2

The values listed in Table 2-21 are approximate values for non-coil-loaded telecommunication lines of type 2 x 2 x A J-Y(St)Y (A = core diameter in mm).

## 2.2.6 Maximum Range (km)

Table 2-22 Maximum range depending on transmission speed and core diameter

Transmission speed (bps)	Maximum range (km)			
	Send level -6 dB *)		Send level 0 dB *)	
	with LTOP	without LTOP	with LTOP	without LTOP
Core diameter 0.6 mm				
1200	21.4 – NTP x 0.8	22 – NTP x 0.3	25.4 – NTP x 0.8	26 – NTP x 0.3
2400	17.4 – NTP x 0.6	17.8 – NTP x 0.2	20.6 – NTP x 0.6	21 – NTP x 0.2
9600 / 19200	6.7 – NTP x 1.0	7.6 – NTP x 0.1	8.1 – NTP x 1.0	9 – NTP x 0.1
Core diameter 0.8 mm				
1200	28 – NTP x 1.1	28.7 – NTP x 0.4	33.2 – NTP x 1.1	33.9 – NTP x 0.4
2400	23 – NTP x 0.8	23.5 – NTP x 0.2	27.2 – NTP x 0.8	27.8 – NTP x 0.2
9600 / 19200	9.0 – NTP x 1.4	10.3 – NTP x 0.1	10.9 – NTP x 1.4	12.1 – NTP x 0.1
Core diameter 0.9 mm				
1200	35.7 – NTP x 1.4	36.6 – NTP x 0.5	42.4 – NTP x 1.4	43.3 – NTP x 0.5
2400	29.2 – NTP x 1.0	30 – NTP x 0.2	34.7 – NTP x 1.0	35.4 – NTP x 0.2
9600 / 19200	11.1 – NTP x 1.7	12.6 – NTP x 0.1	13.4 – NTP x 1.7	15 – NTP x 0.1
Core diameter 1.2 mm				
1200	49.5 – NTP x 1.9	50.7 – NTP x 0.7	58.7 – NTP x 1.9	60 – NTP x 0.7
2400	42.9 – NTP x 1.4	44 – NTP x 0.3	50.9 – NTP x 1.4	52 – NTP x 0.3
9600 / 19200	16.1 – NTP x 2.4	18.3 – NTP x 0.2	19.4 – NTP x 2.4	21.6 – NTP x 0.2
Core diameter 1.4 mm				
1200	58.5 – NTP x 2.2	60 – NTP x 0.8	69.4 – NTP x 2.2	70.9 – NTP x 0.8
2400	53.6 – NTP x 1.7	55 – NTP x 0.4	63.6 – NTP x 1.7	65 – NTP x 0.4
9600 / 19200	19.3 – NTP x 2.9	22 – NTP x 0.2	23.3 – NTP x 2.9	26 – NTP x 0.2

NTP = number of tapping points

\*) not permitted on telecom leased lines. Set send level to -9 dB.



The values listed in Table 2-22 are approximate values and are based on the data in Table 2-21.

A level reserve of 4 dB was included in the calculation of the maximum range. This is to compensate for deviations in cable properties that experience has shown to occur in actual operation, and thus always ensure that sufficient signal level is available for undisturbed data transmission. To calculate the values listed in the table the following formula was used:

$$S_{\max} = \frac{[N_{\min}] + N_{\text{Send}} - N_{\text{Res}} - 2 \times A_{\text{LTOP}}}{A_{\text{Cable}}} - NTP \times \frac{A_{\text{Insert}} + 2 \times A_{\text{LTOP}}}{A_{\text{Cable}}}$$

Legend:

- $A_{\text{Cable}}$  Loss (Attenuation) per km of the used cable [in dB]
- $A_{\text{Insert}}$  Insertion loss per tapping point [in dB]
- $A_{\text{LTOP}}$  Loss per LTOP [in dB]
- $NTP$  Number of tapping points
- $N_{\min}$  Minimum receive level [in dB]  
(-43 dB for MD2, enter only absolute value in formula)
- $N_{\text{Send}}$  Send level [in dB]  
(normally -6 dB or 0 dB)
- $N_{\text{Res}}$  Level reserve [in dB]  
(4 dB was calculated in Table 2-22)
- $S_{\max}$  Maximum range [in km]

Calculation example:

For core diameter 0.8 mm, at 2400 bps, with LTOPs and send level -6 dB

$$S_{\max} = \frac{[-43] + (-6) - 4 - 2 \times 0,4}{1,4} - NTP \times \frac{0,2 + 2 \times 0,4}{1,4}$$

$$S_{\max} = \frac{43 - 6 - 4 - 0,8}{1,4} - NTP \times \frac{0,2 + 0,8}{1,4}$$

$$S_{\max} = \frac{32,2}{1,4} - NTP \times \frac{1,0}{1,4} \longrightarrow S_{\max} = 23 - NTP \times 0,8$$

Using the above formula the user can make his own calculations if the data of the cable actually used are known.

There is no need to calculate the maximum range for telecom leased lines. The telecom is responsible for providing a sufficient signal level. Recommended cable quality for telecom leased lines:

Analog fixed line connections, type M.1020 or M.1025.

## 2.2.7 Determination of the receive level

To determine the receive level the MD2 modem at the beginning of the dedicated line must be set to the test operating mode "Test  $f_{H \text{ constant}}$ " (see Table 2-13, page 2-15). This modem will then continuously send the upper keying frequency of the selected baud rate (see Table 2-20) on the dedicated line. After this the level available at the other end of the dedicated line can be checked there. If this dedicated line is a line with several tapping points, then all of these tapping points must be included in the line (incl. LTOPs) to achieve a correct measurement.

### Note

For level measurements it is important to ensure that the line termination is set to 150 Ohm (for 9600 / 19200 bps) or 600 Ohm (for 1200 / 2400 bps) at a terminal point or 6 kOhm at a tapping point. It is also important to carry out the measurement without grounding since the dedicated line operates with a symmetrical signal.

The MD2 modem can receive data up to a minimum level of  $-43$  dB. What level is actually available at the receiving end must be verified with an appropriate measuring device. If this is not available, the level still may be determined with adequate precision using a normal voltage measuring device. For this purpose the following table summarizes the level values and the assigned voltage values ( $U_{\text{rms}}$  AC voltage).

Table 2-23 Comparison of level and voltage values

Level	Voltage value (AC)	Level	Voltage value (AC)	Level	Voltage value (AC)
+10 dB	2,45 V	-10 dB	245 mV	-25 dB	43,5 mV
0 dB	775 mV	-12 dB	195 mV	-30 dB	24,5 mV
-3 dB	552 mV	-15 dB	137 mV	-35 dB	13,7 mV
-6 dB	389 mV	-18 dB	97,8 mV	-40 dB	7,8 mV
-9 dB	274 mV	-20 dB	77,7 mV	-43 dB	5,5 mV

## 2.3 LTOP Line Transformer with Overvoltage Protection

### Introduction

Dedicated lines are highly susceptible to the coupling-in and carry-over of external potentials. Coupling-in of external potentials may be inductive or capacitive, e.g. as the result of lightning. Direct galvanic coupling is also possible as a result of insulation faults.

The LTOP (Line Transformer with Overvoltage Protection) limits interference voltage and overvoltage to a non-critical level. The floating transformer provides electrical isolation in addition, thus preventing potential carry-over onto other sections of the line.

### 2.3.1 Design

#### Protective Mechanism

The protective mechanism consists of a combination of components whose functions supplement one another (see Figs. 2-16 and 2-17):

- Overtension suppressors filled with inert gas as coarse protection (G1, G2)
- Inductors which limit rises in current (L1, L2)
- Metal oxide varistor as fine protection (voltage-dependent resistance; R1)
- Transformer for electric decoupling (T1)
- Suppressor diode to limit the secondary voltage of the transformer (V1)

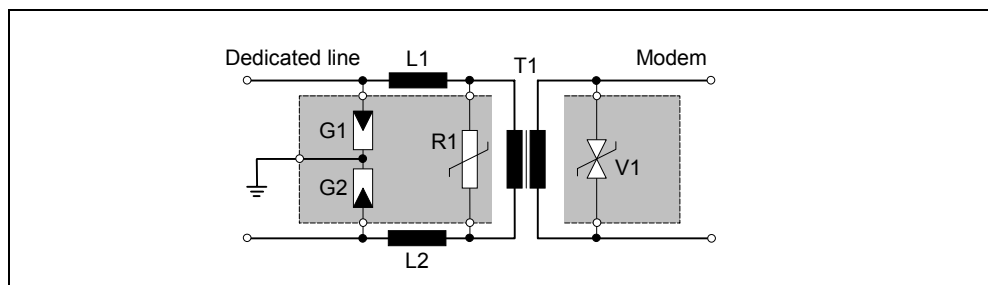


Fig. 2-16 Circuit diagram of an LTOP unit

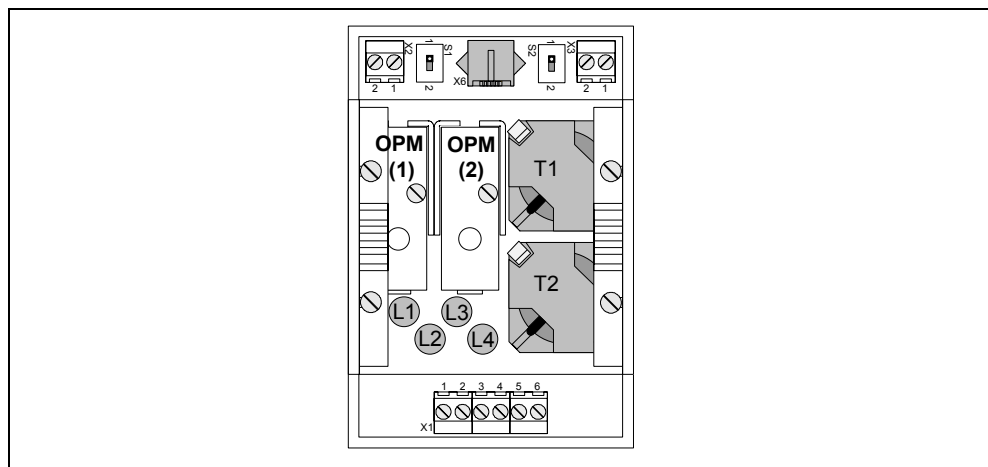


Fig. 2-17 Location of circuit elements in an LTOP2 (viewed from above)

**Note**

The protective elements in the OPM (Overvoltage Protection Module) undergo high stress during discharge processes and progressively deteriorate. Therefore it is recommended to replace the OPMs every one year. To be on the safe side within regions with frequent thunderstorms this period should be reduced to about 6 months.

**LTOP Models**

Either one LTOP unit (= LTOP1) or two LTOP units (= LTOP2) is accommodated in a single housing. The following figures show the design of both LTOP versions with their connectors and adjustment switches.

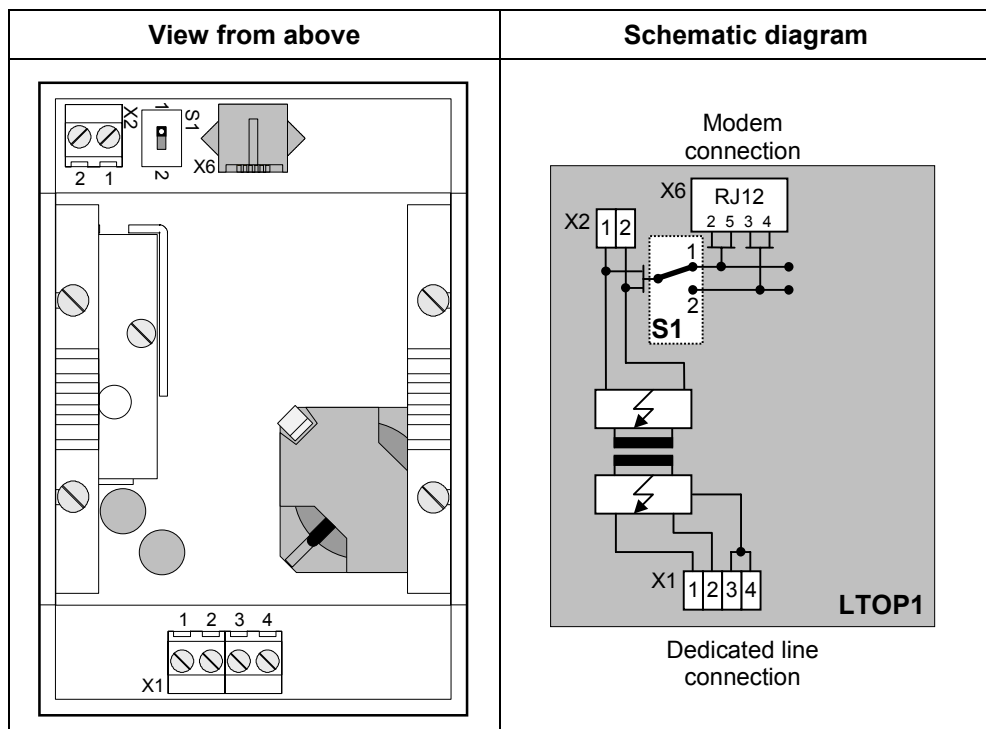


Fig. 2-18 LTOP1

**Legend:**

- X1** Dedicated line (screw terminals 1, 2, 5, 6)  
Ground (screw terminals 3, 4)
- X2** Modem connection 2-wire through screw terminal
- X2 + X3** Modem connection 4-wire through screw terminal
- X6** 2-Wire/4-wire modem connection via RJ12 Western connector; for direct connection of the SINAUT ST7 MD2 modem via the standard interconnecting cable (RJ12 – RJ12) which is supplied with this modem.
- S1 + S2** Adjustment switches

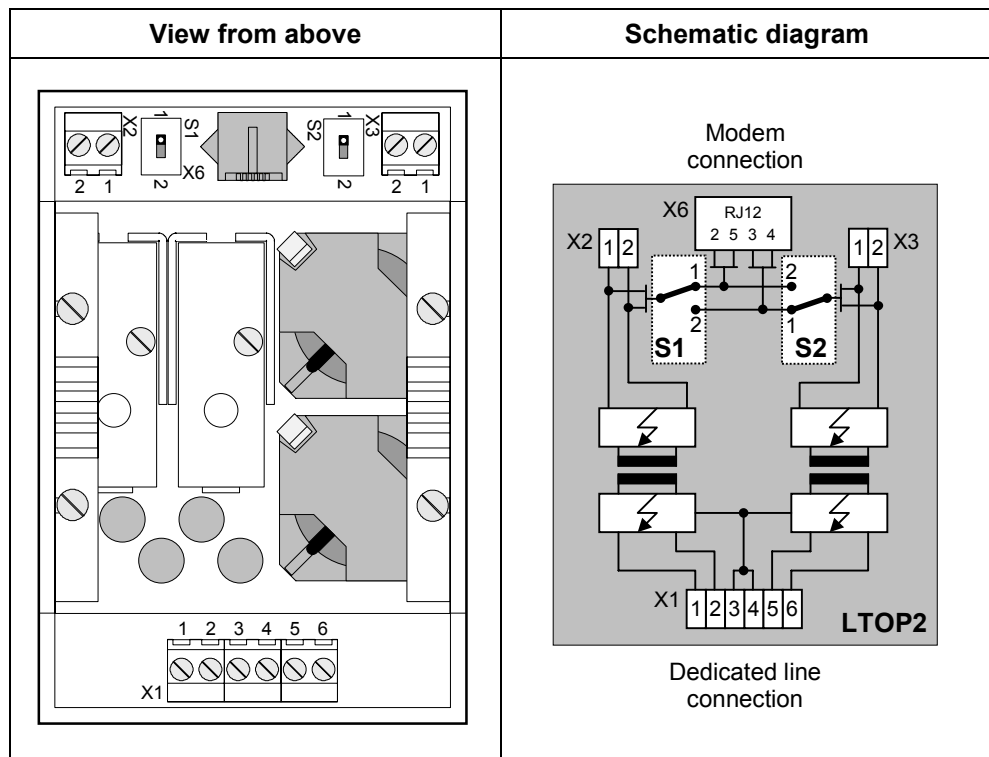


Fig. 2-19 LTOP2

### 2.3.2 Connecting the MD2 Modem

The following diagrams show connections of the dedicated line modem MD2. The connection to LTOP1 or LTOP2 is made via the standard cable supplied with the modem. This cable has RJ12 Western plugs at both ends.

Please take care that the modem MD2 has the correct line termination setting:

- At terminal point and 1200 or 2400 bps: 600 Ohm
- At terminal point and 19200 bps: 150 Ohm
- At tapping point: high-resistance.

For more detailed information refer to section 2.1.10 *DIL Switch for Activating Terminating Resistors*.



**Important**

Please take care that the switches S1 and S2 are in the correct position 1 or 2 as shown in the following figures!

Connection at a 2-wire Terminal Point

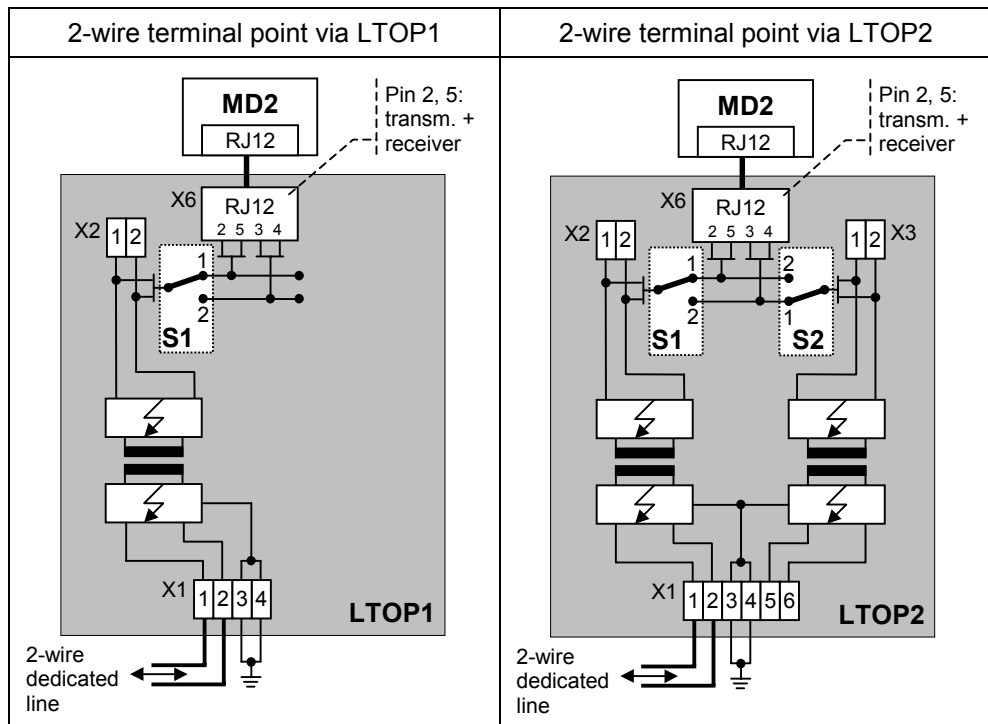


Fig. 2-20 Connection of the MD2 to LTOP1 or LTOP2 at a 2-wire terminal point

Connection at a 4-wire or 2 x 2-wire Terminal Point

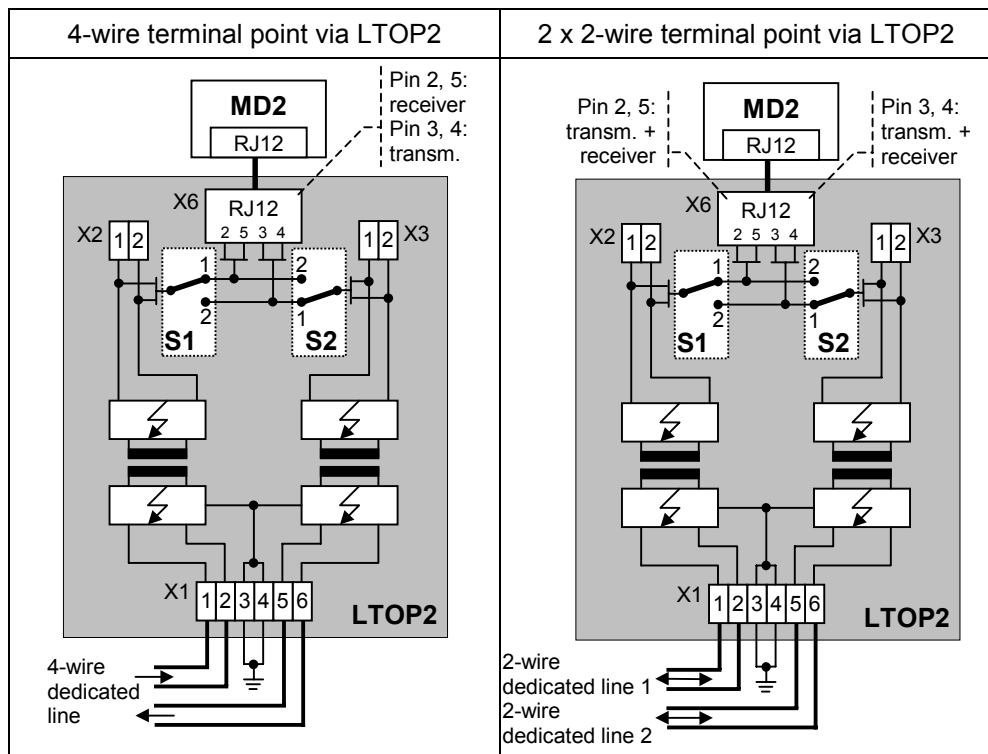


Fig. 2-21 Connection of the MD2 to an LTOP2 at a 4-wire or 2 x 2-wire terminal point

### Connection at a 2-wire Tapping Point

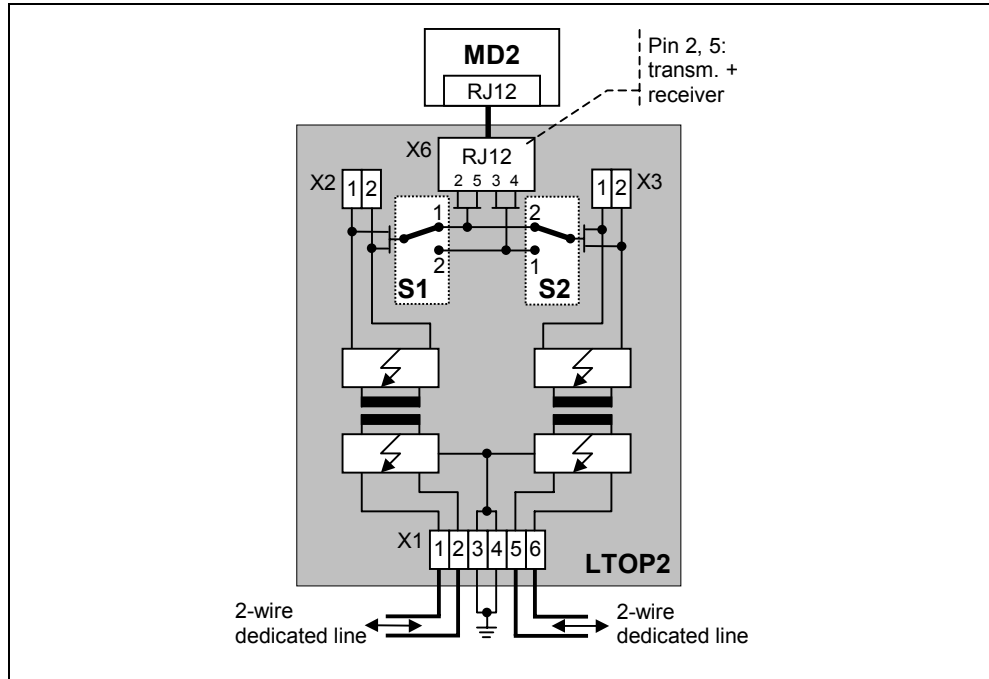


Fig. 2-22 Connection of the MD2 to an LTOP2 at a 2-wire tapping point

### Connection at a 4-wire Tapping Point

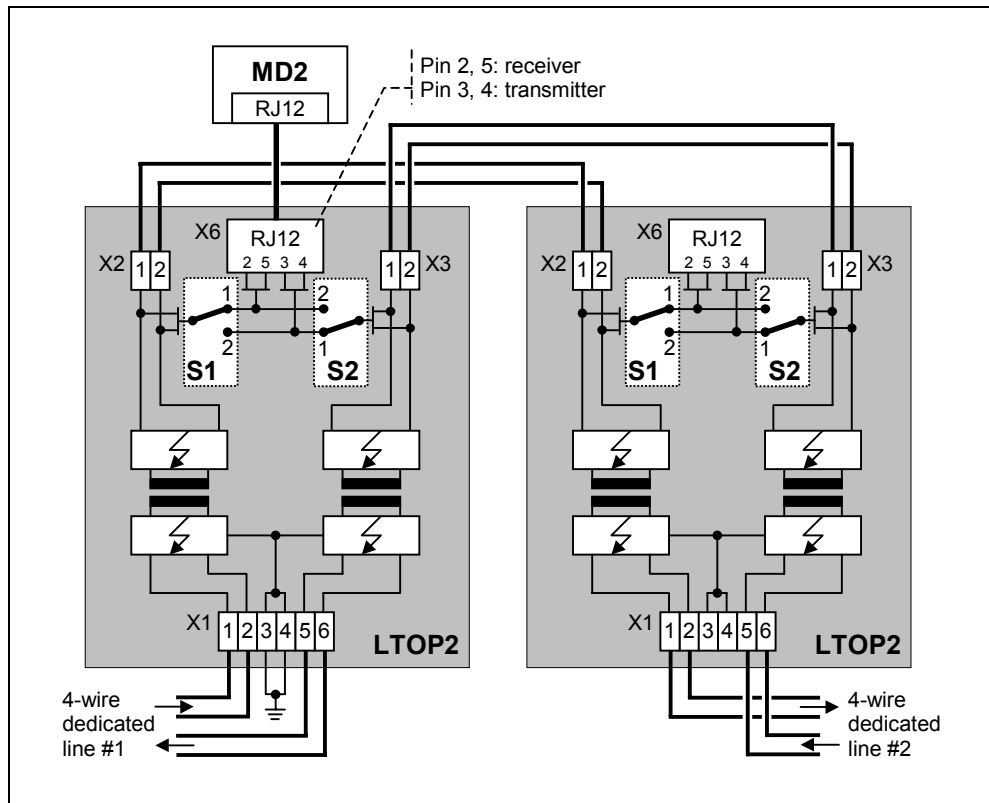


Fig. 2-23 Connection of the MD2 to two LTOP2s at a 4-wire tapping point

## 2.4 Mounting

### Introduction

The modem can be mounted on a SIMATIC S7-300 mounting rail or on a standard 35 mm mounting rail using a 6NH7760-0AA adapter (to be ordered separately).

You can mount and operate the modem horizontally or vertically.



#### Important

Before the modem is mounted on the S7-300 or standard mounting rail, all of the DIL switches on the modem should be set to the positions required for operation. These switches are usually not easy to access when mounted.

### 2.4.1 Mounting on an S7-300 Mounting Rail



#### Important

If the MD2 is mounted together with other S7-300 modules, note the fact that this modem does not have an S7-300 backplane bus. For this reason an S7-300 SM, FM or CP module that communicates with the S7-CPU via this backplane bus may not be placed to the right of the modem!

### Procedural Steps for Installation

To mount the modem on a S7-300 mounting rail, carry out the steps in the order listed below:

1. Switch off the power supply to which the modem is to be connected.
2. Hang the modem on the mounting rail and swing it down.
3. Screw the modem tight.
4. Connect the modem to the power supply (see also 2.4.4).
5. Insert the supplied cable for the modem into the X3 RJ12 Western socket located above the power supply socket on the modem (see Fig. 2-2 and Fig. 2-6). The release clip of the RJ12 Western plug must be on the right side when inserted.

#### Note

When inserting the cable it is best to hold it directly below the RJ12 plug. The insertion is then considerably easier than when holding the cable by the RJ12 plug. Make sure that the RJ12 plug clearly clicks when it is inserted!



6. To connect the modem to the terminal equipment, the 9-pin Sub-D plug of the modem cable should be inserted into the X1 socket (RS232 interface) or X2 socket (RS485 interface) of the modem and screwed tight.

**Note**

Standard cable 6NH7701-4AL for the RS232 connection of the modem to a TIM3 or TIM4 module is inserted 'upside down', in other words, the cable leads upward. The cable is also inserted from above on the TIM3/TIM4.

7. If other modems are to be mounted into the rack, follow the procedures described above for each one.
8. When all of the modems are mounted the power supply can be switched on. The modem starts up but will first show activity on its LEDs when the terminal equipment addresses it.

### 2.4.2 Mounting on a Standard 35mm Mounting Rail

Mounting the modem on a standard 35mm mounting rail requires the optional 6NH7760-0AA adapter. See illustration below.

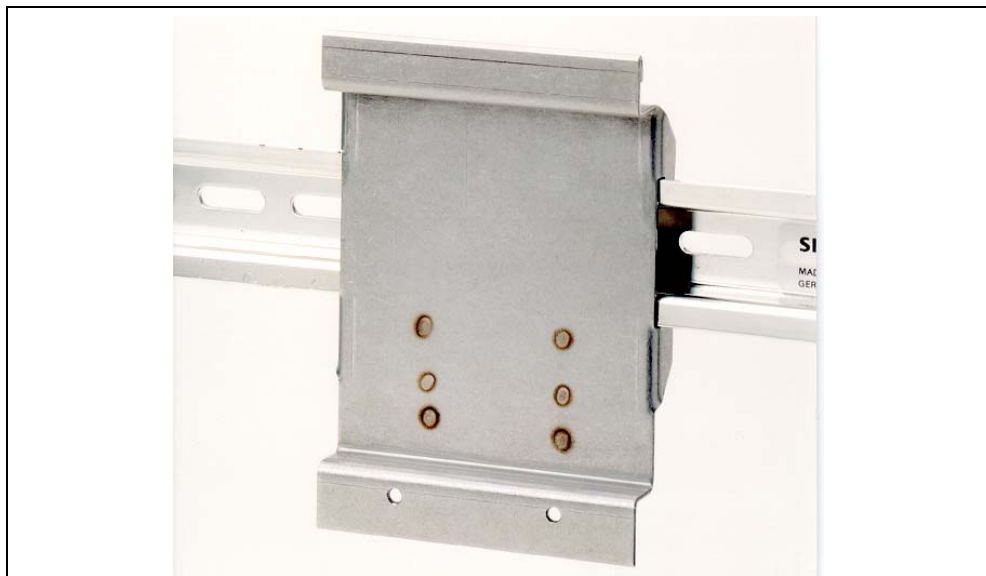


Fig. 2-24 Adapter for mounting on a standard 35mm mounting rail

Hang the modem on the adapter, similar to the way it is mounted on an S7-300 rail. Screw the modem tight on the adapter. Now the modem is ready for mounting on the standard rail and can be clipped into place.

The remaining steps for mounting are similar to those described in section 2.4.1 *Mounting on an S7-300 Mounting Rail*.

### 2.4.3 Horizontal and Vertical Mounting

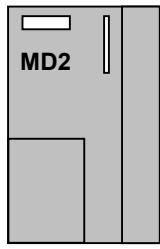
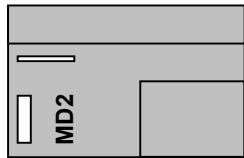
#### Horizontal and Vertical Assembly

You can mount and operate a SINAUT modem horizontally or vertically.

#### Permissible Ambient Temperature

The SINAUT modems do not deviate from the temperature range specified for other SIMATIC S7-300 components:

Table 2-24 Permissible ambient temperature for the MD2 modem

Installation Position	Permissible Ambient Temperature
 <p>Horizontal</p>	0 to 60 °C
 <p>Vertical</p>	0 to 40 °C

#### Assembly Dimensions of the MD2 Modem

Table 2-25 Assembly dimensions of the MD2 modem

Module	Module width	Module height	Max. depth req.
MD2 modem module	80 mm	125 mm	120 mm or 180 mm with open front plate

## 2.4.4 Connecting to the Power Supply



### Warning

Connecting the modem module to live current can cause damage to it. Only connect the modem to the power supply when it is not under current.



### Warning

The power for the device (DC 24 V) must be generated as safe, electrically isolated low voltage. This means that the power must be SELV (Safety Extra Low Voltage) or PELV (Protective Extra Low Voltage) in conformity with DIN VDE 0100 Part 410 (IEC 60364-4-41).

## Cabling

For wiring the power supply use flexible cables with a diameter of 0.25 ... 0.75 mm<sup>2</sup>. A core sleeve is not necessary if you are wiring only one cable per connection.

## Wiring

To wire the power supply module to a SINAUT modem, carry out the following steps:

1. Open the front door of the power supply and the modem.
2. Connect the power supply cables to the modem: M and L+
3. Close the front doors.



### Important

To avoid ground loops you should not connect the shielding of the modem.

### Connection Diagram

Use the following diagram for connecting one or more modems and a TIM3 or TIM4. The same connection scheme applies for all of these modules.

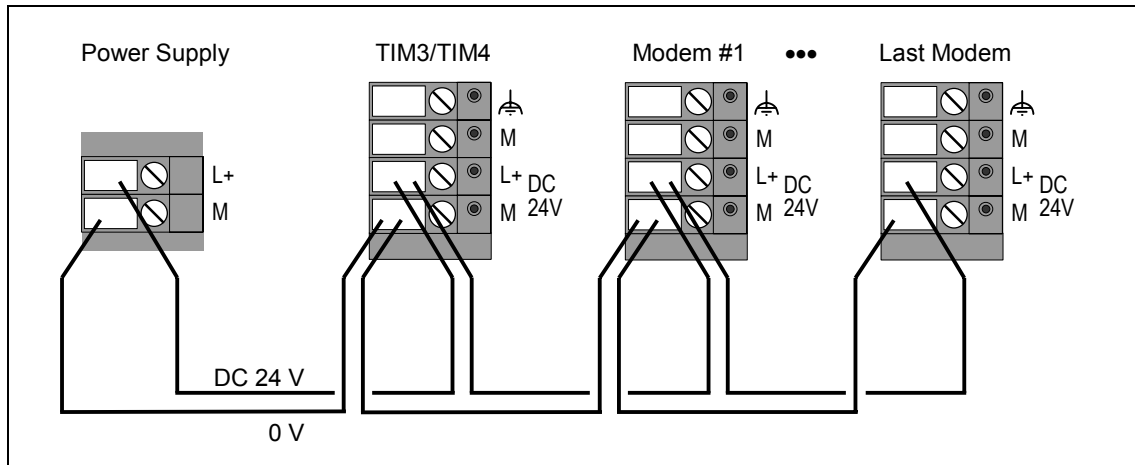


Fig. 2-25 Connecting to the power supply



# 3

## Instructions for Operation with SINAUT ST1

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3.2	Connecting the MD2 to a TIM11 and TIM011B.....	3-3
3.2.1	Modem Settings .....	3-4
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3.2.3	Avoiding Problems When Exchanging Modems .....	3-6

## 3.1 Compatibility to SINAUT ST1 Modems

### Introduction

In certain operating modes the MD2 modem is compatible to the dedicated line modems that are used for SINAUT ST1. This compatibility is ensured in two ways:

1. You can build a new SINAUT ST1 station into an existing network and use the MD2 modem to exchange data with an existing ST1 dedicated line modem as the partner.
2. You can use the MD2 modem as a replacement for a defective ST1 dedicated line modem.

#### Note

A new SINAUT ST1 station might also be a SINAUT ST7 device with an MD2 operating as an ST1 station.

For most applications it is possible to connect the MD2 modem to a SINAUT ST1 device without any special considerations having to be made. You simply need to set the properties for the dedicated line, the operating mode and the character format on the DIL switches of the modem.

In the following you will find detailed information about connecting the MD2 to a SINAUT ST1 device.

### Compatibility Matrix

The following table provides a compatibility matrix of the MD2 modem in connection with the dedicated line modems used in the SINAUT ST1 system.

Table 3-1 Compatibility matrix of the MD2 modem and SINAUT ST1 dedicated line modems

Operating Mode of the MD2	SINAUT ST1 Dedicated Line Modem		
	LGM 1200H1	MD100	MD124
1200 bps hx (2-wire)	X <sup>1)</sup> 3)	X <sup>1)</sup> 3)	X
1200 bps dx (4-wire)	-	X <sup>1)</sup> 3)	X
2400 bps hx (2-wire)	-	-	X <sup>2)</sup>
2400 bps dx (4-wire)	-	-	X <sup>2)</sup>
9600 bps hx (2-wire)	-	-	-
9600 bps dx (4-wire)	-	-	-

1) Only in the "Normal" MD2 operating mode.

2) The baud rate 2400VF must be set for a MD124 with hardware version ≤ 3.


3) The MD2 at the opposite end must not be connected to the DTE via the RS485 interface.

## 3.2 Connecting the MD2 to a TIM11 and TIM011B

### Standard Cable

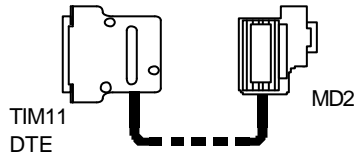
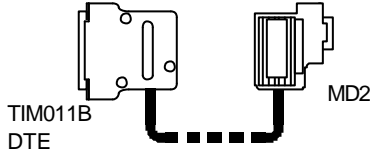
Cable 6NH7700-2AR60 is delivered with the MD2 modem (see following table). This enables the MD2 modem to be connected with an LTOP overvoltage protection module.

Table 3-2 Standard cable for the RJ12 port of the MD2 modem

Order no.	Description	Diagram
6NH7700-2AR60	Cable with 2 x RJ12 plugs for connecting the MD2 modem (RJ12) to a LTOP overvoltage protection module (RJ12).  Cable length 6 m	 The diagram shows a cable with two RJ12 connectors at each end. The connectors are labeled 'RJ12'.

There are two standard cables for connecting the MD2 to the SINAUT ST1 modules TIM11 and TIM011B (see following table). These are not included with the MD2; both must be ordered separately.

Table 3-3 Standard cables for the SINAUT ST1 modules TIM11 and TIM011B

Order no.	Description	Diagram
6NH1701-7AN	Cable for connecting the MD2 modem (RS232) with a TIM11 (RS232) or an other terminal (DTE) with an identically configured 25-pin RS232 interface (socket) and slide lock. Cable length 2.5 m	 The diagram shows a cable connecting a 25-pin RS232 socket on the left, labeled 'TIM11 DTE', to a 25-pin RS232 connector on the right, labeled 'MD2'.
6NH1701-7BK	Cable for connecting the MD2 modem (RS232) with a TIM011B (RS232) or an other terminal (DTE) with an identically configured 25-pin RS232 interface (socket) and screw lock. Cable length 1.0 m	 The diagram shows a cable connecting a 25-pin RS232 socket on the left, labeled 'TIM011B DTE', to a 25-pin RS232 connector on the right, labeled 'MD2'.

The section 'Standard Cables for the RS232 Port' in Chapter 2 provides a description of this cable's configuration.

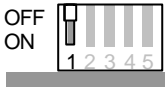
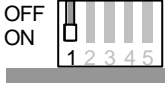
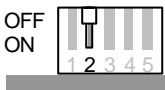
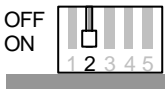
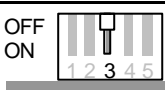





### 3.2.1 Modem Settings

#### Setting the Dedicated Line Properties

A few settings must be made on the DIL switches in order to operate the MD2 modem with a SINAUT ST1 device. The following table lists the settings for the dedicated line properties.

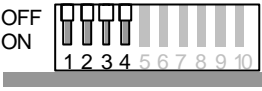
Table 3-4 Settings on the 5-pin DIL switch

Setting on DIL Switch	Meaning
	<p>Send level -6 dB.</p> <p>Detailed information about the distances that can be bridged is available in Chapter 6 <i>Technical Data</i></p>
	<p>Send level 0 dB</p> <p>This can be used to increase the transmission distance without a repeater. Detailed information about the distances that can be bridged is available in Chapter 6 <i>Technical Data</i></p>
	<p>4-wire mode</p> <p>This setting is required when the send and receive direction each use a separate pair of cores. In this mode the position of switch 3 has no relevance.</p>
	<p>2-wire mode</p> <p>This setting is required when a common pair of cores is used for the send and receive direction. In this mode the position of switch 3 is relevant. This is then used to set whether only one 2-wire line is connected (channel 1) or whether two 2-wire lines are connected (channel 1+2), for example, in a control center when the communication to the stations is made via two separate 2-wire connections ('small star network').</p>
	<p>Channel 1 (2-wire)</p> <p>In the 2-wire mode only channel 1 is used, in other words, only <u>one</u> 2-wire line is connected to the modem (see also switch 2).</p>
	<p>Channel 1+2 (2-wire)</p> <p>In the 2-wire mode channels 1+2 are used, in other words, <u>two</u> separate 2-wire lines are connected to the modem (see also switch 2).</p>
	<p>Baud rate 1200 bps (see also Note)</p> <p>At this speed the modem is compatible to SINAUT ST1 modems MD100, MD124 and LGM 1200H1.</p>
	<p>Baud rate 2400 bps (see also Note)</p> <p>At this speed the modem is compatible to SINAUT ST1 modem MD124.</p>

## Setting the Operating Mode

In addition to the settings for the dedicated line, the operating mode of the modem needs to be specified. The "Normal" operating mode is usually used for the SINAUT ST1 system.


Table 3-5 Settings on the 10-pin DIL switch (operating modes)

Setting on DIL Switch	Meaning
 <p>OFF ON</p> <p>1 2 3 4 5 6 7 8 9 10</p>	<p>Normal operating mode</p> <p>This mode must be selected when the MD2 is connected through its RS232 interface to a terminal.</p>

## Setting the Character Recognition

The character recognition is set on switches 5 to 7 of the 10-pin DIL switch.



Table 3-6 Settings on the 10-pin DIL switch (character format)

Setting on DIL Switch	Meaning
 <p>OFF ON</p> <p>1 2 3 4 5 6 7 8 9 10</p>	<p>Character recognition asynchronous 11 bit :</p> <p>In this mode a message consists of a series of asynchronous characters, 11-bit each (1 start bit, 8 data bits, 1 parity bit, 1 stop bit).</p> <p>This is the standard setting for sending SINAUT ST1 or SINAUT ST7 messages. In this case message format FT 1.2, based on 11-bit asynchronous characters, is normally used for transmitting over dedicated lines.</p>

### 3.2.2 Configuration Required for TIM11 and TIM011B

If the MD2 modem is connected to the TIM11 or TIM011B, it is necessary to enter the parameters for the TIM module listed below in the SINAUT ST1 startup program.

Table 3-7 Configuration Required for TIM11 and TIM011B

Operating Mode of the MD2	Baud rate on the MD2	Basic Parameters for TIM11 or TIM011B				
		MTYP	BAUD	DUPL	SINT	SZEI
1200 bps	OFF ON 	1	1200	1)	0	0
2400 bps	OFF ON 	1	2400	1)	0	0

1) Both half-duplex (DUPL = 0) and full-duplex operating mode (DUPL = 1) can be set.

### 3.2.3 Avoiding Problems When Exchanging Modems

Note the following points when using the MD2 to replace a defective SINAUT ST1 dedicated line modem:

- Set the dedicated line properties, operating mode and the character recognition on both DIL switches before beginning operation.
- Use the cable supplied with the MD2 for connecting the MD2 to the LTOP.
- If the MD2 is used in a network together with an MD124 at baud rate 2400 bps and the MD124 is hardware version  $\leq 3$ , the MD124 has to be set to baud rate 2400VF.

# Operating Modes and Character Recognition

# 4

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## **Introduction**

A variety of operating modes and character formats can be set on the MD2 modem to optimally adapt the modem to the various requirements of the data terminal equipment (DTE) to which it is to be connected.

Setting the operating mode is essentially the selection of the type of interface to be used, the RS232 or RS485 port through which the modem connects to the DTE. In addition to the operating mode, the transmission rate is usually set, which, like the type of interface, is determined by the DTE.

The MD2 modem offers the basic baud rates 1200, 2400, 9600 and 19200 bps. The MD2 uses a signal refresh logic to regenerate the received transmission signal based on the baud rate set and thereby ensures error-free transmission of data.

The MD2 modem also features an operating mode for using baud rates less than 1200 bps. This operating mode, "Signal refresh off", turns off the signal refresh logic permitting the modem to operate "transparently".

The various operating modes of the MD2 modem are described in detail in the following section, 4.1 *MD2 Operating Modes*.

Setting the character recognition on the MD2 determines the type of asynchronous data format to be used for transmission. The signal refresh logic also plays a role here. This needs to be repeatedly re-synchronized during transmission of a data block. The character recognition setting determines the point in time in which the signal refresh logic is re-synchronized. This attribute enables operation of the MD2 modem at baud rates of 300 and 600 bps.

A detailed description of the character recognition and its properties is available in section 4.2 *Character Recognition of the MD2*.

## 4.1 MD2 Operating Modes

### Overview

The MD2 modem uses a variety of operating modes which on the one hand enables it to be optimally adapted to the connected data terminal equipment (DTE) and on the other hand increases its maximum transmission range (through the repeater operating mode). Test operating modes are also available to carry out function tests of the MD2 or measure the line quality.

The MD2 modem provides the following operating modes:

- Normal
- Normal with DTR/RTS on
- Repeater
- RS485 port
- Signal refresh off
- Test operating mode Test  $f_L$
- Test operating mode Test  $f_H$
- Test operating mode Test  $f_{\text{baud}}$
- Test operating mode Test  $f_{H \text{ constant}}$
- Test operating mode Test send
- Test operating mode Test send RS485
- Test operating mode Test receive

The setting for the operating mode is made on switches 1 to 4 of the 10-pin DIL switch which can be accessed from above through the housing grid.

The following table provides an overview of the operating modes to be used in conjunction with the various types of transmission, network configurations and character recognition methods.

Table 4-1 Overview of various operating modes and network configurations

Operating mode	Transmission type			Connection possible			Character recognition possible
	4-wire full-duplex	4-wire half-duplex	2-wire half-duplex	Point-to-point	Multidrop network	Star network	
Normal	x	x	x	x	x	x	All
Normal, with DTR/RTS on	x	x	-	x	-	-	Everything except "MID off"
Repeater	x	x	x	x	x	x	All
RS485 port	-	-	x	x	x	x	Everything except "MID off"
Signal refresh	x	x	x	x	x	x	Not applicable

**Note**

The test operating modes are not included in Table 4-1 because it is not possible to create a network configuration with them in which data can be exchanged. Their only purpose is for testing or checking the functions of the modem.

The following sections contain detailed descriptions of the functions and applications of the individual MD2 operating modes. A few examples of the various network configurations and the corresponding settings on the MD2 modem are available in Chapter 5 *Network Configurations*.

### 4.1.1 "Normal" Operating Mode

The "Normal" operating mode is the standard mode for connecting a DTE to the modem via the RS232 interface. Standard cable 6NH7701-4DL, is used for connecting the DTE to the MD2 modem in this case. The data transmission via the modem is controlled by the DTE through the control signals of the RS232 interface.

The following network configurations can be built using this operating mode:

- Point-to-point connection
- Multidrop network
- Star network

The "Normal" operating mode can be used together with all of the available character recognition methods and transmission types (see Table 4-1).

The following illustration shows the setting on the 10-pin DIL switch of the MD2 for the "Normal" operating mode.

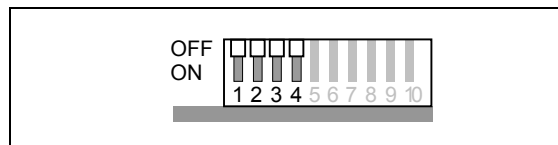


Fig. 4-1 DIL switch setting for the "Normal" operating mode

### 4.1.2 "Normal" with DTR/RTS on" Operating Mode

Similar to the "Normal" operating mode, the "Normal" with DTR/RTS on" mode is used to connect a DTE via the RS232 interface. Standard cable 6NH7701-4DL, is also used for connecting the DTE to the modem. However, this operating mode allows the connection of data terminal equipment in which the RS232 control signals DTR and RTS are not available and there is no support for RTS/CTS handshaking.

Only a point-to-point connection in 4-wire full-duplex or 4-wire half-duplex transmission mode is possible. It is not possible to build a multidrop network.

The "MID off" character recognition cannot be used (see Table 4-1).

The following illustration shows the setting on the 10-pin DIL switch of the MD2 for the "Normal with DTR/RTS on" operating mode.

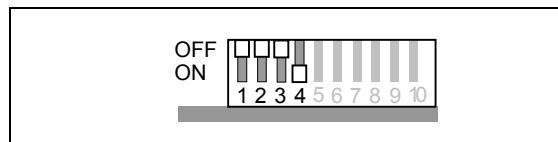


Fig. 4-2 DIL switch setting for the "Normal with DTR/RTS on" operating mode



### 4.1.3 "Repeater" Operating Mode

The "Repeater" operating mode is used to build repeaters. Two MD2 modems are needed to form a repeater. They are connected to one another via the RS232 interface by the standard cable 6NH7701-1CB. Both modems must be set to the "Repeater" operating mode.

The repeater is used to increase the range for data transmission between terminal points. The repeater regenerates the received signal so after the repeater the maximum range for data transmission for the baud rate set is available once again. The repeater can be located anywhere on the dedicated line. There is no limit to the number of repeaters that can be used in a network configuration. It is possible to use repeaters in point-to-point, multidrop and star networks (see sections 5.1.8 and 5.1.9).

#### Note

Note that the message running time on the transmission line is increased by 4 bits per repeater.

The "Repeater" operating mode can be used together with all of the available character recognition methods and transmission types (see Table 4-1).

The following illustration shows the setting on the 10-pin DIL switch of the MD2 for the "Repeater" operating mode.

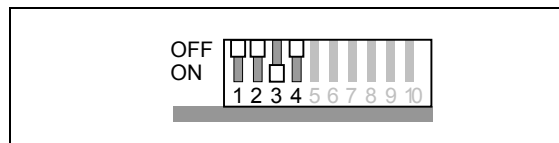


Fig. 4-3 DIL switch setting for the "Repeater" operating mode

#### 4.1.4 "With RS485 Interface" Operating Mode

The operating mode "With RS485 interface" must be set when the DTE is connected to the MD2 modem via the RS485 interface. In this case the RS232 interface of the modem is switched to passive.

Any number of MD2 modems can be connected with each other via the RS485 interface because the RS485 interface is multi-point capable. It is therefore possible to build a star network. A point-to-point connection or a multidrop network can be connected to each modem.

The "With RS485 interface" operating mode can only be used with the transmission type "2-wire half-duplex" but with all available character recognition methods except for "MID off" (see Table 4-1).

**Note**  
Note that the message running time is increased by 13 bits for each RS485 bus segment.

**Note**  
The minimum message intervals must be adhered to (more information about this is available in section 4.2).

The following illustration shows the setting on the 10-pin DIL switch of the MD2 for the "With RS485 interface" operating mode.

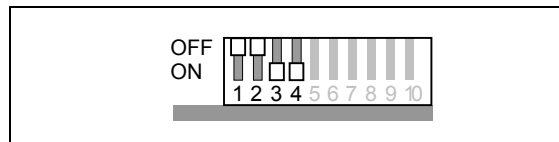


Fig. 4-4 DIL switch setting for the "With RS485 interface" operating mode

#### 4.1.5 "Signal refresh off" Operating Mode

The "Signal refresh off" operating mode is essentially the same as the "Normal" operating mode except that here the refresh and synchronization logic is switched off. In this case the RS485 interface cannot be used.

**Note**

The refresh and synchronization logic ensures that the sampling of the signal received from the WAN interface is synchronized and then refreshed.

The "Signal refresh off" operating mode is designed for operation with transmission speeds less than that which is set. Any transmission speed can be selected in this case. The MD2 modem operates "transparently" in this operating mode. The message running time through the modem is reduced to 1 bit.

**Note**

Note that not refreshing the received signal can result in interpretation errors. This, in turn, can result in transmission errors. This is caused by character distortions of up to 40% measured on the bit length of the transmission speed (baud rate) set on the modem. Setting a lower transmission speed on the DTE correspondingly reduces the character distortion. The character distortion (in percent) can be calculated with the following formula:

$$\text{Character distortion} \leq 40\% \cdot \frac{\text{DTE baud rate}}{\text{Modem baud rate}}$$

Example: A modem baud rate of 1200 bps and a DTE baud rate of 120 bit/s results in a character distortion of less than 4%.

Point-to-point, multidrop and star networks can be built with the "Signal refresh off" operating mode. The setting for the character recognition method is irrelevant. All transmission types are possible (see Table 4-1).

The following illustration shows the setting on the 10-pin DIL switch of the MD2 for the "Signal refresh off" operating mode.

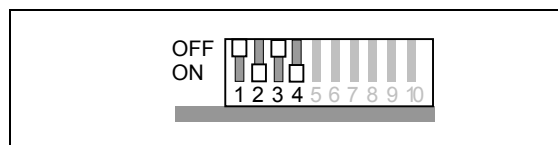


Fig. 4-5 DIL switch setting for the "Signal refresh off" operating mode

### 4.1.6 Test Operating Modes

The MD2 modem features several test operating modes to help in the installation and testing of the modem's functions. The following test operating modes are offered:

- Test operating mode Test  $f_L$
- Test operating mode Test  $f_H$
- Test operating mode Test  $f_{baud}$
- Test operating mode Test  $f_H$  constant
- Test operating mode Test send
- Test operating mode Test send RS485
- Test operating mode Test receive

Table 4-2 Summary of the test operating modes

	Test operating mode at sending site	(Test) operating mode at receiving site	Suitable for
1	Test $f_L$	Normal	Verification whether sufficient receive level is available (only for the lower keying frequency)
2	Test $f_H$	Normal	Verification whether sufficient receive level is available (only for the upper keying frequency)
3	Test $f_{baud}$	Normal	Verification whether sufficient receive level is available (for the lower and upper keying frequency simultaneously)
4	Test send	Test receive	Testing the function of the receiving modem (detection of a sequence of characters)
5	Test send RS485	Test receive	Like 4, however for a star shaped dedicated line network.
6	Test $f_H$ constant	Normal	For level measurement only. Appropriate measuring device required.

For the test variants 1 to 5 the test result can be read from the LEDs on the receiving MD2. Except for the modems themselves no other devices are required here.

Only for test variant 6, that is used for level measurement, an appropriate measuring device is needed. However, in most cases a normal voltage measuring device will be sufficient.

For the correct execution of a test it is required that all of the modems, that are provided for the ultimate layout, are connected to the telecontrol line and are correctly configured (baud rate, 2-wire/4-wire, terminating resistor, RS232/RS485 port, operating mode, etc.). There are several possible causes, if the test result is negative. Some notes to this can be found below under *Possible Error Causes*.

All options for the dedicated line properties can be selected but the character recognition method must be set to either "Asynchronous 10" or "Asynchronous 11".

**Note**

The test operating modes are not suitable for continuous operation since data transmission between two DTEs is not possible using these modes.

The following pages contain detailed descriptions of the individual test operating modes and some examples of their application.

**Possible Error Causes**

There are several causes, if the result of a level measurement or function test is negativ. Some of the possible causes are:

- Wrong configuration of one or more MD2 modems that are connected to the dedicated line network.  
Remedy: Set the DIL switches, that can be accessed on the MD2 from above and from below, correctly (baud rate, 2-wire/4-wire, terminating resistor, RS232/RS485 port, operating mode, etc.).
- Attenuation to high.  
For the maximum distance that can be covered: see chapter 2, section 2.2.6 *Maximum range*.  
Remedy:
  - Reduction of the transmissionspeed and/or
  - Insertion of a repeater at the appropriate point in the dedicated line.
- Cable breakage.
- Wrong core pair:  
At the beginning of the line the modem was connected to core pair x, at the other end to core pair y.
- Wrong cores:  
2 cores from different core pairs are used:  
one core from core pair x, one core from core pair y.  
Note: Maybe the interchange of the cores has not been made at the beginning or end of the cable but took place somewhere in the line in a cable junction box.
- Cable damage:  
Cable isolation defective, earth fault, water penetration, etc.
- Crosstalk in the cable.
- etc.

### Test Operating Mode "Test $f_L$ "

The test operating mode "Test  $f_L$ " can be used to determine the quality of a 2-wire or 4-wire dedicated line by measuring the attenuation characteristics in relation to the baud rate.

Fig. 4-6 shows one possible test configuration for a point-to-point connection with 2-wire half-duplex. This could also be a multidrop or star network. Any other network type using 4-wire full-duplex could also be tested.

In Fig. 4-6 the MD2 on the left is a 2-wire terminal point and is set to test operating mode "Test  $f_L$ ". The MD2 on the right is also a 2-wire terminal point but its operating mode is set to "Normal".

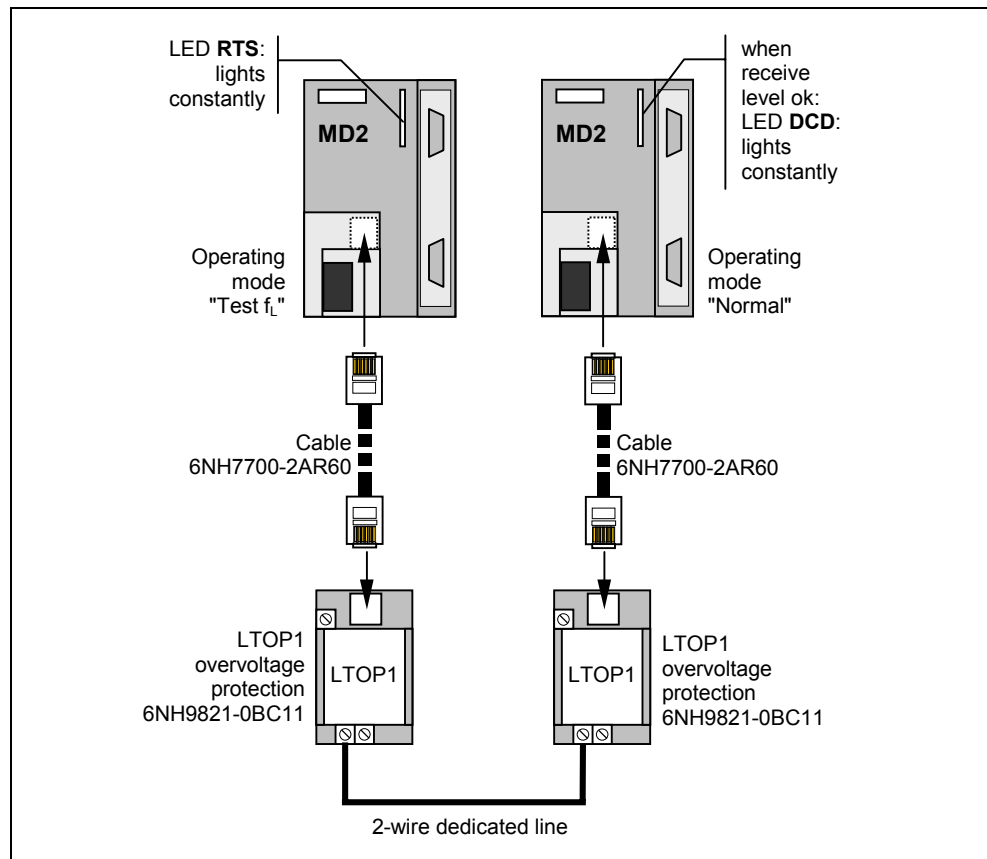


Fig. 4-6 Test configuration for operating mode "Test  $f_L$ "

In the test operating mode "Test  $f_L$ " the MD2 modem continuously outputs the lower keying frequency to the WAN port and thus to the 2-wire dedicated line. The selected operating mode is signaled by the constantly lit "RTS" LED. All other LEDs stay off.

If this lower keying frequency is now correctly received by the opposite MD2, that MD2 will signalize this by its "DCD" LED that is constantly on. If the "DCD" LED stays off or flashes irregularly; then this indicates an incorrect data reception. For possible causes: see section *Possible Error Causes*.

The following illustration shows the setting on the 10-pin DIL switch of the MD2 for the "Test  $f_L$ " operating mode.

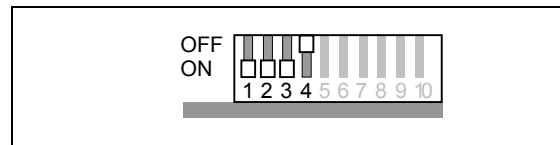


Fig. 4-7 DIL switch setting for the "Test  $f_L$ " operating mode

#### Note

In order to obtain a complete overview of the quality of the 2-wire or 4-wire dedicated line, you should carry out tests in both the "Test  $f_L$ " and the "Test  $f_H$ " operating modes. This way it is sure that both keying frequencies for the selected baud rate are received at the opposite end of the dedicated line being tested, thereby ensuring error-free data transmission.

#### Hinweis

Test operating mode "Test  $f_L$ " is not suitable for measuring the level over the dedicated line. Use operating mode "Test  $f_{H \text{ constant}}$ " for making exact measurements of the level.

### Test Operating Mode "Test $f_H$ "

Similar to "Test  $f_L$ ", the "Test  $f_H$ " operating mode can be used to determine the quality of a 2-wire or 4-wire dedicated line by measuring the attenuation characteristics in relation to the baud rate.

Fig. 4-8 shows one possible test configuration for a point-to-point connection with 2-wire half-duplex. This could also be a multidrop or star network. Any other network type using 4-wire full-duplex could also be tested.

In Fig. 4-8 the MD2 on the left is a 2-wire terminal point and is set to test operating mode "Test  $f_H$ ". The MD2 on the right is also a 2-wire terminal point but its operating mode is set to "Normal".

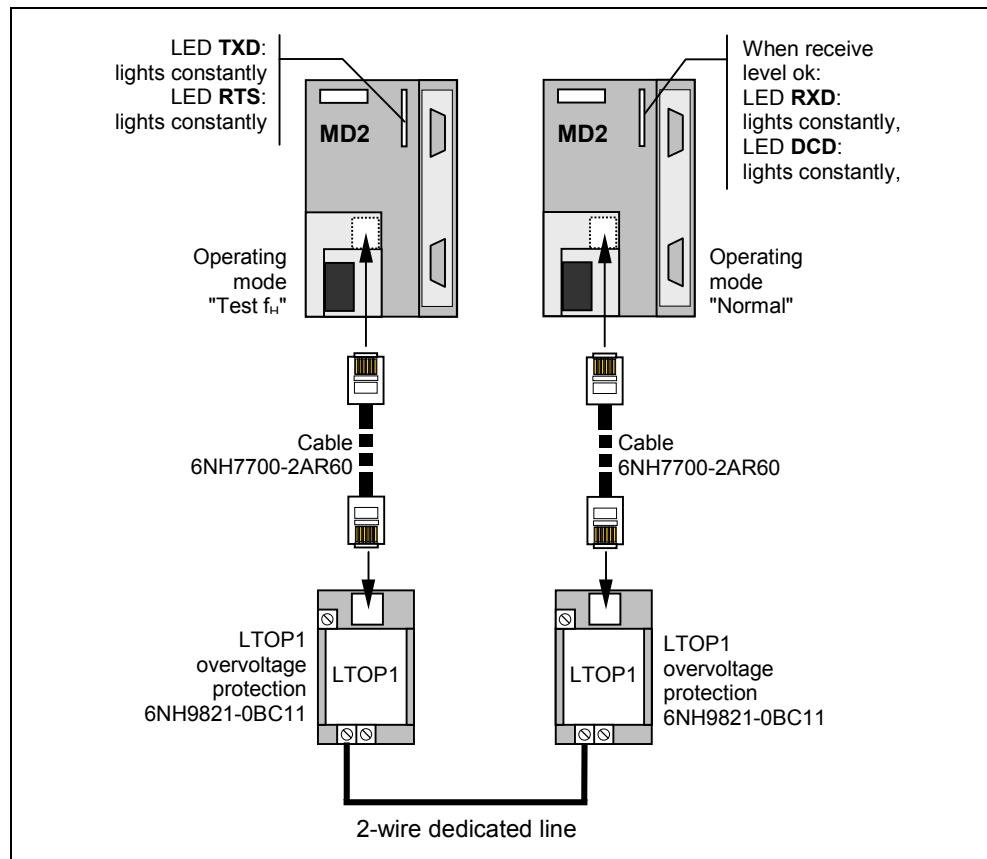


Fig. 4-8 Test configuration for operating mode "Test  $f_H$ "

In the test operating mode "Test  $f_H$ " the MD2 modem continuously outputs the upper keying frequency to the WAN port and thus to the 2-wire dedicated line. The selected operating mode is signaled by the constantly lit "TXD" and "RTS" LEDs. All other LEDs stay off.

If this upper keying frequency is now correctly received by the opposite MD2, that MD2 will signalize this by its "RXD" and "DCD" LEDs that both are constantly on. If the "RXD" and "DCD" LEDs stay off or flash irregularly; then this indicates an incorrect data reception. For possible causes: see section *Possible Error Causes*.



**Note**

The modem does not continuously output the upper keying frequency to the WAN port. The lower frequency is also output for the period of 1 bit length every 63 bits.

The reason for this is that with continuous output of the upper keying frequency the refresh logic cannot guarantee that the "RxD" LED of the receiving modem will light continuously.

The following illustration shows the setting on the 10-pin DIL switch of the MD2 for the "Test  $f_H$ " operating mode.

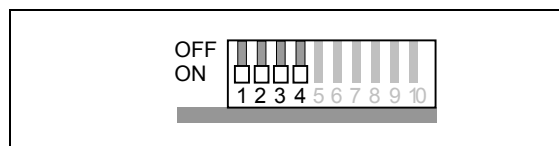


Fig. 4-9 DIL switch setting for the "Test  $f_H$ " operating mode

**Note**

In order to obtain a complete overview of the quality of the 2-wire or 4-wire dedicated line, you should carry out tests in both the "Test  $f_H$ " and the "Test  $f_L$ " operating modes. This way it is sure that both keying frequencies for the selected baud rate are received at the opposite end of the dedicated line being tested, thereby ensuring error-free data transmission.

**Note**

Test operating mode "Test  $f_H$ " is not suitable for measuring the level over the dedicated line. Use operating mode "Test  $f_{H \text{ constant}}$ " for making exact measurements of the level.

### Test Operating Mode "Test $f_{baud}$ "

Test operating mode "Test  $f_{baud}$ " is a combination of the "Test  $f_L$ " and "Test  $f_H$ " operating modes. This test operating mode can be used to determine the quality of a 2-wire or 4-wire dedicated line by measuring the attenuation characteristics in relation to the baud rate.

Fig. 4-10 shows one possible test configuration for a point-to-point connection with 2-wire half-duplex. This could also be a multidrop or star network. Any other network type using 4-wire full-duplex could also be tested.

In Fig. 4-10 the MD2 on the left is a 2-wire terminal point and is set to test operating mode "Test  $f_{baud}$ ". The MD2 on the right is also a 2-wire terminal point but its operating mode is set to "Normal".

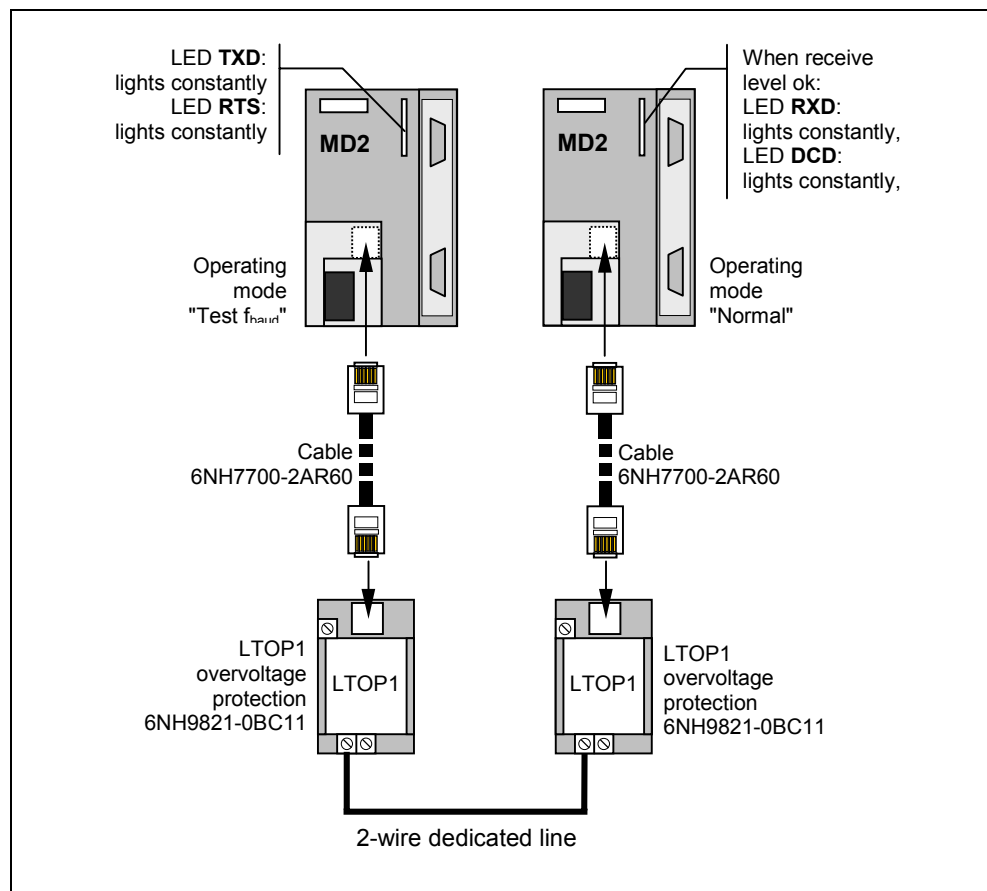


Fig. 4-10 Test configuration for operating mode "Test  $f_{baud}$ "

In the "Test  $f_{baud}$ " test operating mode the MD2 modem continuously changes between the upper and lower keying frequency in synchronization with the transmission speed on the WAN port and thus on the 2-wire dedicated line. The selected operating mode is signaled by the constantly lit "TXD" and "RTS" LEDs. All other LEDs stay off.

If both keying frequencies are now correctly received by the opposite MD2, that MD2 will signalize this by its "RXD" and "DCD" LEDs that both are constantly on. If the "RXD" and "DCD" LEDs stay off or flash irregularly; then this indicates an incorrect data reception. For possible causes: see section *Possible Error Causes*.

The following illustration shows the setting on the 10-pin DIL switch of the MD2 for the "Test  $f_{\text{baud}}$ " operating mode.

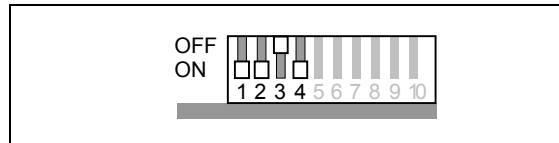


Fig. 4-11 DIL switch setting for the "Test  $f_{\text{baud}}$ " operating mode

**Note**

Test operating mode "Test  $f_{\text{baud}}$ " is not suitable for measuring the level over the dedicated line. Use operating mode "Test  $f_{\text{H constant}}$ " for making exact measurements of the level.

### Test Operating Mode "Test $f_{H \text{ constant}}$ "

Test operating mode "Test  $f_{H \text{ constant}}$ " can be used to perform level measurements (see below *Determination of the Receive Level*). In this scenario the modem continuously outputs the upper keying frequency of the selected baud rate to the WAN port. The operating mode is signaled by the continuously lit "RTS" and "TxD" LEDs.

The following illustration shows the setting on the 10-pin DIL switch of the MD2 for the "Test  $f_{H \text{ constant}}$ " operating mode.

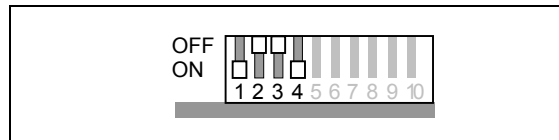


Fig. 4-12 DIL switch setting for the "Test  $f_{H \text{ constant}}$ " operating mode

### Determination of the Receive Level

The MD2 modem at the beginning of the dedicated line must be set to the test operating mode "Test  $f_{H \text{ constant}}$ " (all other test operating modes are not suitable for a correct level measurement). After this the level available at the other end of the dedicated line can be checked there. If this dedicated line is a line with several tapping points, then all of these tapping points must be included in the line (incl. LTOPs) to achieve a correct measurement.

#### Note

For level measurements it is important to ensure that the line termination is set to 150 Ohm (for 9600 / 19200 bps) or 600 Ohm (for 1200 / 2400 bps) at a terminal point or 6 kOhm at a tapping point. It is also important to carry out the measurement without grounding since the dedicated line operates with a symmetrical signal.

The MD2 modem can receive data up to a minimum level of  $-43$  dB. What level is actually available at the receiving end must be verified with an oscilloscope or level meter. If this is not available, the level still may be determined with adequate precision using a normal voltage measuring device. For this purpose the following table summarizes the level values and the assigned (approximate) voltage values ( $U_{\text{rms}}$  AC voltage).

Table 4-3 Comparison of level and voltage values

Level	Voltage value (AC)	Level	Voltage value (AC)	Level	Voltage value (AC)
+10 dB	2,45 V	-10 dB	245 mV	-25 dB	43,5 mV
0 dB	775 mV	-12 dB	195 mV	-30 dB	24,5 mV
-3 dB	552 mV	-15 dB	137 mV	-35 dB	13,7 mV
-6 dB	389 mV	-18 dB	97,8 mV	-40 dB	7,8 mV
-9 dB	274 mV	-20 dB	77,7 mV	-43 dB	5,5 mV

### Test Operating Mode "Test send"

Similar to the operating modes described previously, the "Test send" test operating mode can be used to determine the quality of a 2-wire or 4-wire dedicated line by measuring the attenuation characteristics in relation to the baud rate. In this mode, however, character strings are sent to check the general functions of the modem during data transmission. The "Test send" test operating mode should be used together with the "Test receive" mode.

Fig. 4-13 shows one possible test configuration for a point-to-point connection with 2-wire half-duplex. This could also be a multidrop or star network. Any other network type using 4-wire full-duplex could also be tested.

In Fig. 4-13 the MD2 on the left is a 2-wire terminal point and is set to test operating mode "Test send". The MD2 on the right is also a 2-wire terminal point but its operating mode is set to "Test receive".

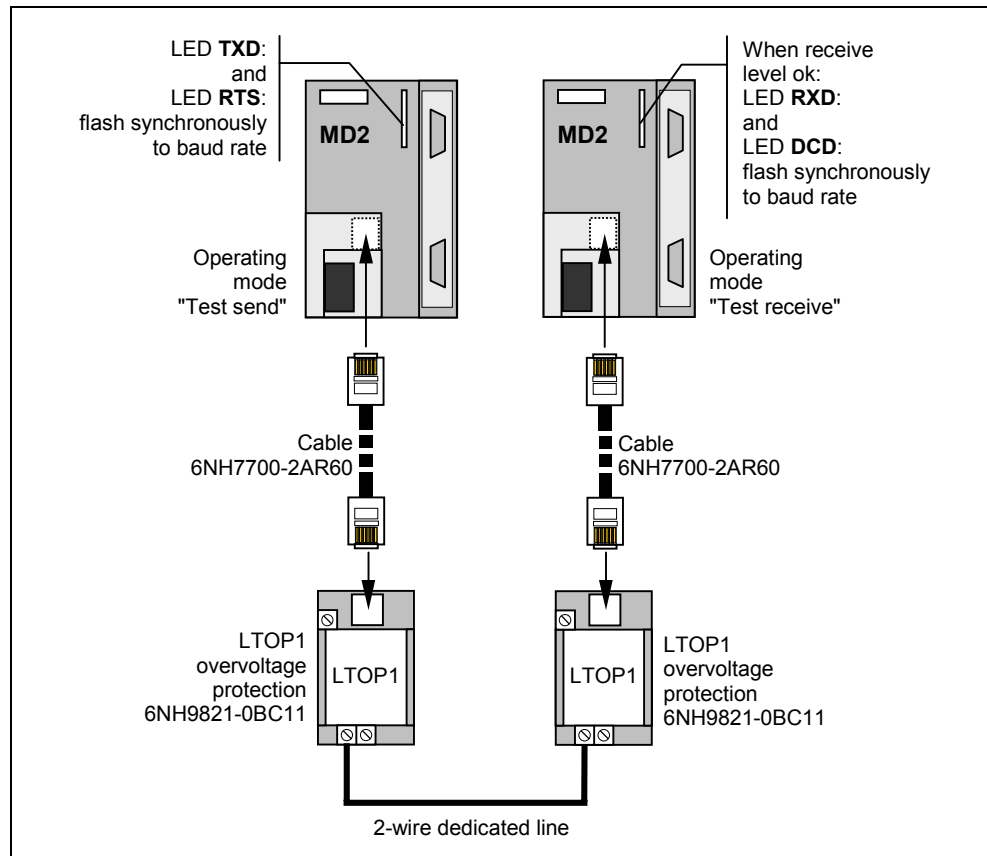


Fig. 4-13 Test configuration for operating mode "Test send"

In the "Test send" test operating mode the MD2 modem continuously outputs a short message with a character string in asynchronous 11-bit format to the WAN port and thus to the 2-wire dedicated line.

The test operating mode "Test send" is signaled by the "TXD" and "RTS" LEDs that both flash synchronously to the selected baud rate (please consider: as of 2400 bps any flashing can hardly be recognized). All other LEDs stay of.

If the short message is now correctly received by the opposite MD2, that MD2 will signalize this by its "RXD" and "DCD" LEDs that both are flashing synchronous to the selected baud rate. If the "RXD" and "DCD" LEDs stay off or if the "DTR" and "CTS" LEDs are continuously lit ; then this indicates an incorrect data reception or the reception of single errors in the received character string. Further notes to this: see section *Test Operating Mode "Test receive"*. For possible causes: see section *Possible Error Causes*.

The following illustration shows the setting on the 10-pin DIL switch of the MD2 for the "Test send" operating mode.

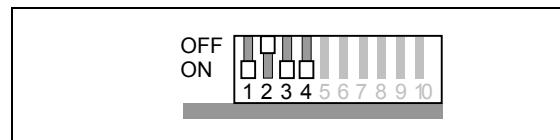


Fig. 4-14 DIL switch setting for the "Test send" operating mode

### Test Operating Mode "Test send RS485"

The "Test send RS485" test operating mode has the same function as the "Test send" mode. However, in addition to the sending of a short message over the WAN interface it is also sent over the RS485 interface. The "Test send RS485" test operating mode should also be used together with the "Test receive" mode.

Fig. 4-15 shows one possible test configuration for a star network with point-to-point connection with 2-wire half-duplex. This could also be a multidrop network. Any other network type using 4-wire full-duplex could also be tested.

In Fig. 4-15 the MD2 modems on the left and the middle are 2-wire terminal points in a star network. The MD2 on the left is set to "Test send RS485" test operating mode, the one in the middle is set to "With RS485 interface". The MD2 on the right is also a 2-wire terminal point but its operating mode is set to "Test receive".

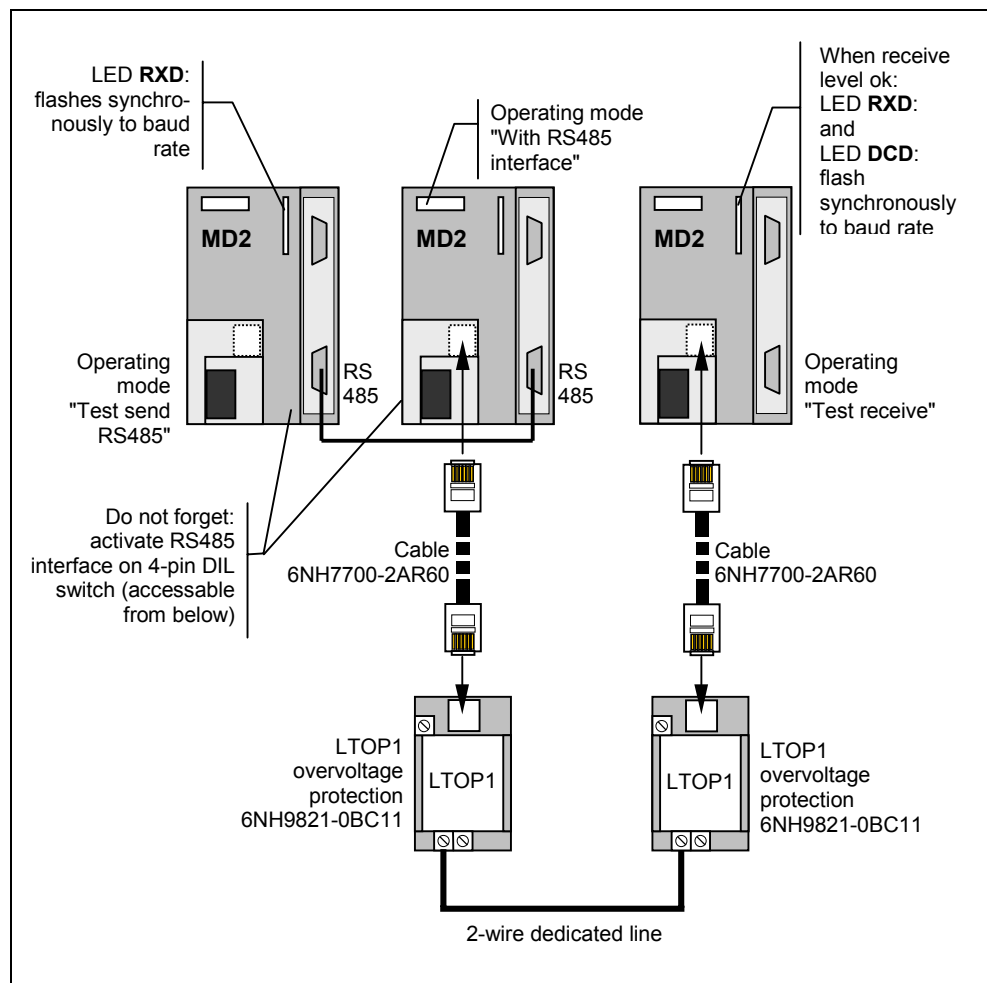


Fig. 4-15 Test configuration for operating mode "Test send RS485"

In the "Test send RS485" test operating mode the MD2 modem continuously outputs a short message with a character string in asynchronous 11-bit format to the WAN port and the RS485 interface.

The test operating mode "Test send RS485" is signaled by the "RXD" LED that flashes synchronously to the selected baud rate (please consider: as of 2400 bps any flashing can hardly be recognized). All other LEDs stay of.

If the short message is now correctly received by the opposite MD2, that MD2 will signalize this by its "RXD" and "DCD" LEDs that both are flashing synchronous to the selected baud rate. If the "RXD" and "DCD" LEDs stay off or if the "DTR" and "CTS" LEDs are continuously lit ; then this indicates an incorrect data reception or the reception of single errors in the received character string. Further notes to this: see section *Test Operating Mode "Test receive"*. For possible causes: see section *Possible Error Causes*.

The following illustration shows the setting on the 10-pin DIL switch of the MD2 for the "Test send RS485" operating mode.

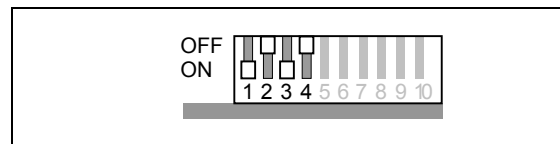


Fig. 4-16 DIL switch setting for the "Test send RS485" operating mode



### Test Operating Mode "Test receive"

The "Test receive" test operating mode is used together with one of the test modes "Test Send" or "Test Send RS485" (see previous sections).

The following illustration shows the setting on the 10-pin DIL switch of the MD2 for the "Test receive" operating mode.

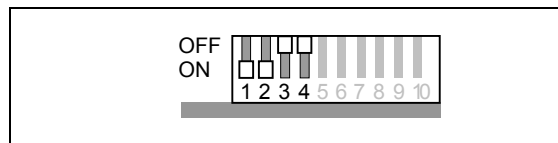


Fig. 4-17 DIL switch setting for the "Test receive" operating mode

At the modem that has been set to this operating mode "Test receive", the result of the test can be indicated as follows:

1. Indication: Both LEDs "TXD" and "RTS" flash synchronously to the selected baud rate. All other LEDs are off.  
Meaning: The MD2 receives the test character string correctly.
2. Indication: Both LEDs "TXD" and "RTS" flash synchronously to the selected baud rate. In addition the "DTR" and "CTS" LEDs are continuously on.  
Meaning: A character string is being received but an error has been detected. The continuous lighting of the "DTR" and "CTS" LEDs is activated upon the first detected error and then stored. The stored error can be reset via DIL switch 10 (see Fig. 4-18).
3. Indication: Only the LEDs "DTR" und "CTS" are continuously on. All other LEDs are off.  
Meaning: There is no character string being received or it is not at all understood. "Test receive" can be reactivated at any time via DIL switch 10 (see Fig. 4-18).

	<p>Execution of the reset: Set DIL switch 10 to the ON position and then back to OFF. Result: The "DTR" and "CTS" LEDs will go off, "Test receive" is restarted. If these LEDs go on again, a new error has been detected in the received character string and is stored.</p>
--	---

Fig. 4-18 Reset "Test receive"

## 4.2 Character Recognition of the MD2

### Introduction

Setting the character recognition on the MD2 determines the point in time for the re-synchronization of the signal refresh logic. The signal refresh logic of the MD2 ensures that the received signals are regenerated. The correct synchronization of the signal refresh logic ensures error-free data transmission for the selected baud rate. In this regard it is important that the modem recognizes the beginning and end of a character or a complete data block (message). The MD2 modem essentially operates with two mechanisms:

- Asynchronous character recognition
- Message interval recognition

These two mechanisms are briefly described in the following.

### Asynchronous Character Recognition

The mechanism for asynchronous character recognition is based on the transmission of standard asynchronous characters which begin with a start bit, followed by 8 data bits with or without parity and end with one or more stop bits.

The signal refresh logic of the MD2 is re-synchronized with every start bit. The character recognition methods which operate according to this mechanism are "Asynchronous 11 bit" and "Asynchronous 10 bit".

### Message Interval Recognition

The mechanism for message interval recognition is based on the detection of the intervals between two messages. Depending on the setting for character recognition, the intervals must be either 12 or 24 bits long at a minimum to detect a message interval. When the MD2 recognizes a message interval, the signal refresh logic switches off and is only synchronized again when the next start bit is received. The synchronization of the signal refresh logic therefore only occurs once for every message or data block.

The "MID on" character recognition methods available on the MD2 operate according to message interval detection.

### 4.2.1 Character Recognition "Asynchronous 11 Bit"

The "Asynchronous 11 bit" character recognition is designed to transmit data streams consisting of standard 11-bit asynchronous characters:

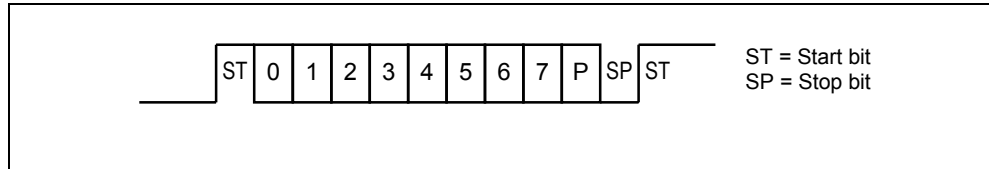


Fig. 4-19 Standard 11-Bit Asynchronous Characters

The "Asynchronous 11 bit" character recognition can be used in combination with all operating modes of the MD2 modem. Four baud rates can be used: 1200, 2400, 9600 and 19200 baud.

The following illustration shows the setting on the 10-pin DIL switch of the MD2 for "Asynchronous 11 bit" character recognition.

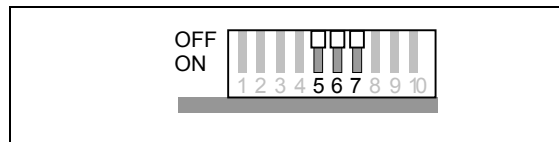


Fig. 4-20 DIL switch setting for the "Asynchronous 11 bit" character recognition

### 4.2.2 Character Recognition "Asynchronous 10 Bit"

The "Asynchronous 10 bit" character recognition is designed to transmit data streams consisting of standard 10-bit asynchronous characters:

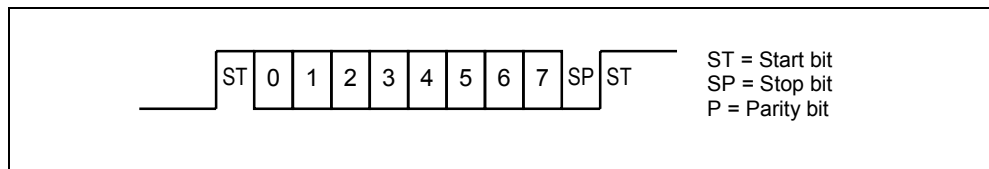


Fig. 4-21 Standard 10-Bit Asynchronous Characters

The "Asynchronous 10 bit" character recognition can be used in combination with all operating modes of the MD2 modem. Four baud rates can be used: 1200, 2400, 9600 and 19200 baud.

The following illustration shows the setting on the 10-pin DIL switch of the MD2 for "Asynchronous 10 bit" character recognition.

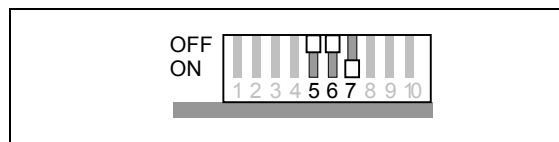


Fig. 4-22 DIL switch setting for the "Asynchronous 10 bit" character recognition

### 4.2.3 "MID on" Character Recognition

The "MID on" character recognition (MID = Message Interval Detection) is designed to transmit a data stream consisting of characters of any format. This type of character recognition is especially suited to transmit data streams which are available from the DTE at only half or a quarter of the baud rate set on the modem. This means that data can be transmitted at 300 or 600 bps when the modem's baud rate is set to 1200 bps.

Another characteristic of the "MID on" character recognition is that the idle state of the data signal on the WAN line can be set to either "0" or "1". The MD2 detects intervals between two messages by the idle state of the data signal. These intervals must last at least 12 or 24 bits long.

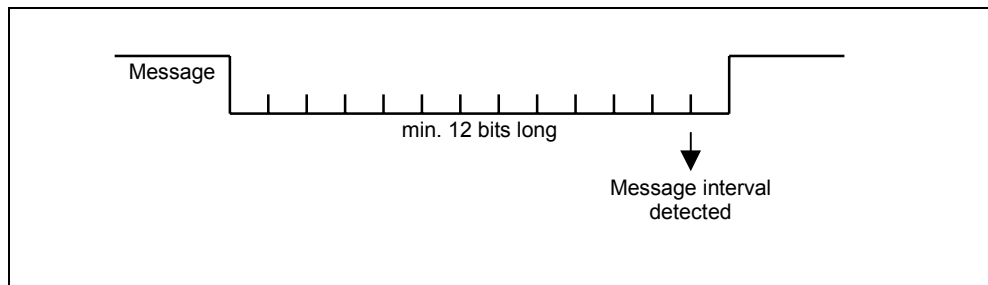


Fig. 4-23 Example of message interval detection using "MID on (interval ≥ 12) idle state 0"

The following table summarizes the various characteristics of "MID on" character recognition.

Table 4-4 Summary of the characteristics of the "MID on" character recognition

Character recognition	Settings on the 10-pin DIL switch	Length of message interval	Idle state of the data signal	Possible baud rates (in baud)
MID on (interval ≥ 12) idle state 0	OFF ON	≥ 12 bits long	0	600, 1200, 2400, 4800, 9600, 19200
MID on (interval ≥ 12) idle state 1	OFF ON		1	
MID on (interval ≥ 24) idle state 0	OFF ON	≥ 24 bits long	0	300, 600, 1200, 2400, 4800, 9600, 19200
MID on (interval ≥ 24) idle state 1	OFF ON		1	

#### 4.2.4 "MID off" Character Recognition

Similar to "MID on" character recognition "MID off" character recognition is designed to transmit data streams consisting of any format. This type of character recognition is especially suited to transmit data streams which are available from the DTE at less than the baud rate set on the modem. The baud rate set on the modem must be an even multiple of the baud rate set on the DTE. The DTE can therefore be operated at baud rates 600, 300, 150, 75, etc..

Message interval detection is switched off if "MID off" character recognition is selected. However, in order for the receiving modem to still be able to detect the end of a message, the sending modem needs to switch off its transmitter after the final character of a message. This is accomplished by withdrawing the RTS signal on the sending modem. The following illustration shows this mechanism from the viewpoint of the sending modem.

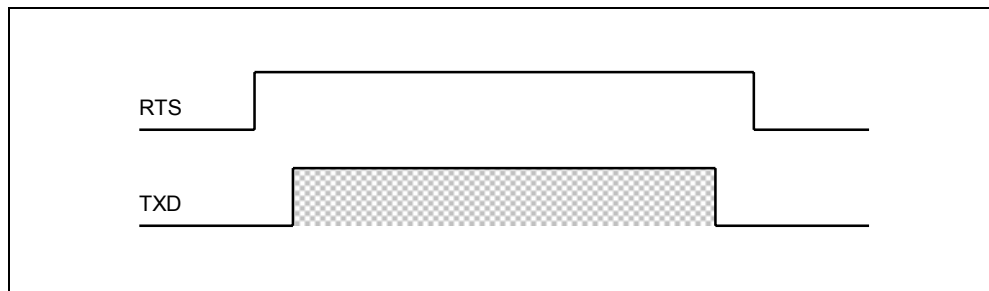


Fig. 4-24 RTS and TxD signals

The method described above means that "MID off" character recognition can only be used in combination with the "Normal" operating mode.

Another characteristic of "MID off" character recognition is that the idle state of the data signal on the WAN line can be set to either "0" or "1". However, this property has no effect on the data transmission.

The following table summarizes the various characteristics of the "MID off" character recognition.

Table 4-5 Summary of the characteristics of "MID off" character recognition

Character recognition	Settings on the 10-pin DIL switch	Length of message interval	Idle state of the data signal	Possible baud rates (in baud)
MID off idle state 0	OFF ON 	unlimited	0	....., 75, 150, 300, 600, 1200, 2400, 4800, 9600, 19200
MID off idle state 1	OFF ON 		1	

## Network Configurations

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## Introduction

The MD2 modem can be used to build a variety of network configurations. These include the following types of networks:

- Point-to-point
- Multidrop line
- Star network
- Repeater

In the following sections these network configurations are described with graphic examples and the corresponding DIL switch settings on the individual modems are explained along with the switch settings on the LTOP overvoltage protection modules.

## 5.1 Network Configurations with RS232

The following table provides an overview of the network configurations that can be built using the RS232 interface.

Table 5-1 Overview of network configurations with RS232

<b>Network Configuration</b>	<b>Modem Operating Mode</b>	<b>Transmission Type</b>	<b>Section</b>
Point-to-point	Normal	4-wire full-duplex	5.1.1
Point-to-point	Normal	2-wire half-duplex	5.1.2
Multidrop line	Normal	4-wire full-duplex	5.1.3
Multidrop line	Normal	2-wire half-duplex	5.1.4
Star network via integrated two-way transformer	Normal	2-wire half-duplex	5.1.5
Star network via external multiple transformer	Normal	2-wire half-duplex	5.1.6
Star network via external multiple transformer	Normal	4-wire full-duplex	5.1.7
Repeater	Repeater	4-wire full-duplex	5.1.8
Repeater	Repeater	2-wire half-duplex	5.1.9

### 5.1.1 Point-to-Point, 4-wire Full-duplex

#### Overview

Fig. 5-1 shows a configuration for a **point-to-point, 4-wire full-duplex** network. Both MD2 modems represent 4-wire terminal points and are set to the "Normal" operating mode.

All available baud rates and character recognition methods can be used in this configuration.

The DIL switch settings on the MD2 modem and the switch settings on the LTOP2 are the same at both terminal points (see Table 5-2).

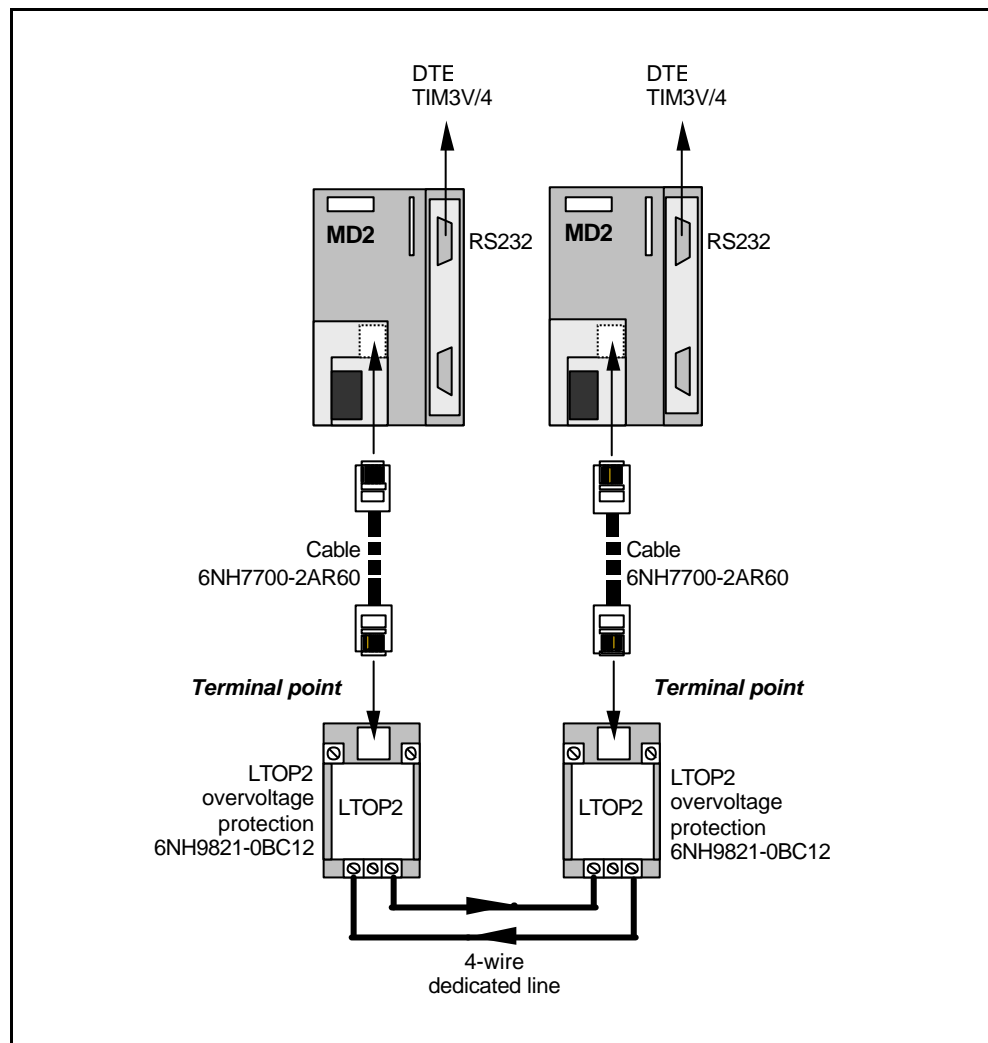


Fig. 5-1 Network configuration: point-to-point, 4-wire full-duplex network



Table 5-2 Settings for both 4-wire terminal points

Settings on the DIL switches accessible from above (see Fig. 2-3 and 2-4)			
5-pin and 10-pin DIL switch		Meaning	
		4-wire operation channel 1 "Normal" operating mode The baud rate must be selected with switches 4 and 5 on the 5-pin DIL switch and the character recognition with switches 5 to 7 on the 10-pin DIL switch.	
Settings on the DIL switch accessible from below (termination resistors)			
Type of connection	Baud rate	Setting on DIL switch	Note
Terminal Point 4-wire	1200 bps 2400 bps		The MD2 is located at the beginning or end of a 4-wire line and is set to a transmission speed of 1200 or 2400 bps. (see Fig. 2-6)
	9600 bps 19200 bps		Terminal point as above but with transmission speed set to 9600 or 19200 bps. (see Fig. 2-6)
Settings on the DIL switch accessible from below (port)			
Interface type	Setting on DIL switch		Note
RS232 interface			Activation of the RS232 interface (see Fig. 2-6)
Settings on the LTOP2 switches			
Switch	Switch position	Note	
Switch S1		Receive channel (pins 2 and 5) activated (see Fig. 2-18)	
Switch S2		Send channel (pins 3 and 4) activated (see Fig. 2-18)	

## 5.1.2 Point-to-Point, 2-wire Half-duplex

### Overview

Fig. 5-2 shows a configuration for a **point-to-point, 2-wire half-duplex** network. Both MD2 modems represent 2-wire terminal points and are set to the "Normal" operating mode.

All available baud rates and character recognition methods can be used in this configuration.

The DIL switch settings on the MD2 modem and the switch settings on the LTOP1 are the same at both terminal points (see Table 5-3).

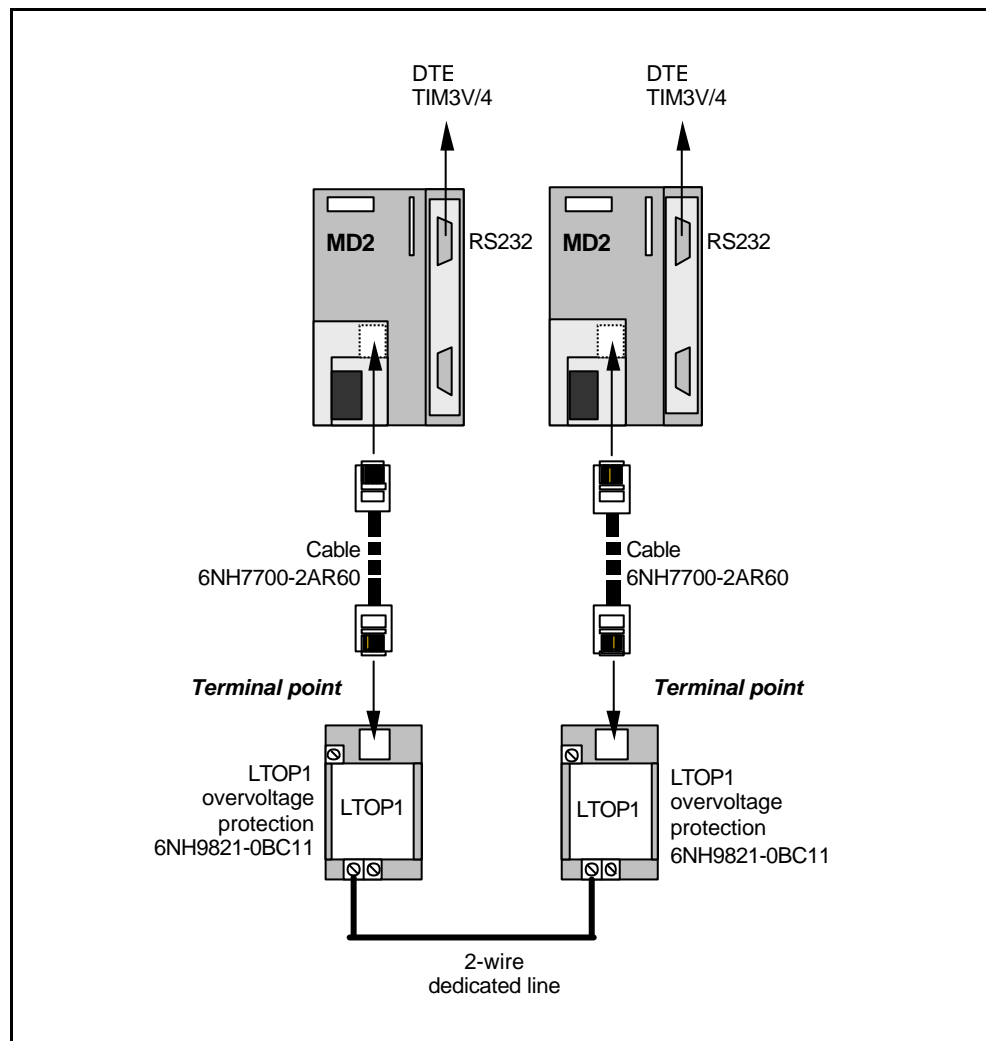


Fig. 5-2 Network configuration: point-to-point, 2-wire half-duplex

Table 5-3 Settings for both 2-wire terminal points

Settings on the DIL switches accessible from above (see Fig. 2-3 and 2-4)			
5-pin and 10-pin DIL switch		Meaning	
		2-wire operation channel 1 "Normal" operating mode The baud rate must be selected with switches 4 and 5 on the 5-pin DIL switch and the character recognition with switches 5 to 7 on the 10-pin DIL switch.	
Settings on the DIL switch accessible from below (termination resistors)			
Type of connection	Baud rate	Setting on DIL switch	Note
Terminal Point 2-wire	1200 bps 2400 bps		The MD2 is located at the beginning or end of a 2-wire line and is set to a transmission speed of 1200 or 2400 bps. (see Fig. 2-6)
	9600 bps 19200 bps		Terminal point as above but with transmission speed set to 9600 or 19200 bps. (see Fig. 2-6)
Settings on the DIL switch accessible from below (port)			
Interface type	Setting on DIL switch		Note
RS232 interface			Activation of the RS232 interface (see Fig. 2-6)
Settings on the LTOP1 switch			
Switch	Switch position	Note	
Switch S1		2-wire channel (pins 2 and 5) activated (see Fig. 2-18)	

### 5.1.3 Multidrop Line, 4-wire Full-duplex

#### Overview

Fig. 5-3 shows a configuration for a **multidrop line, 4-wire full-duplex**. The MD2 modems on the outer left and right represent 4-wire terminal points, the MD2 modem in the middle is a 4-wire tapping point. All three modems are set to the "Normal" operating mode.

All available baud rates and character recognition methods can be used in this configuration.

The DIL switch settings on the MD2 modem and the switch settings on the LTOP2 are the same at both terminal points (see Table 5-4). The tapping point requires other switch settings on the MD2 and LTOP2 (see Table 5-5).

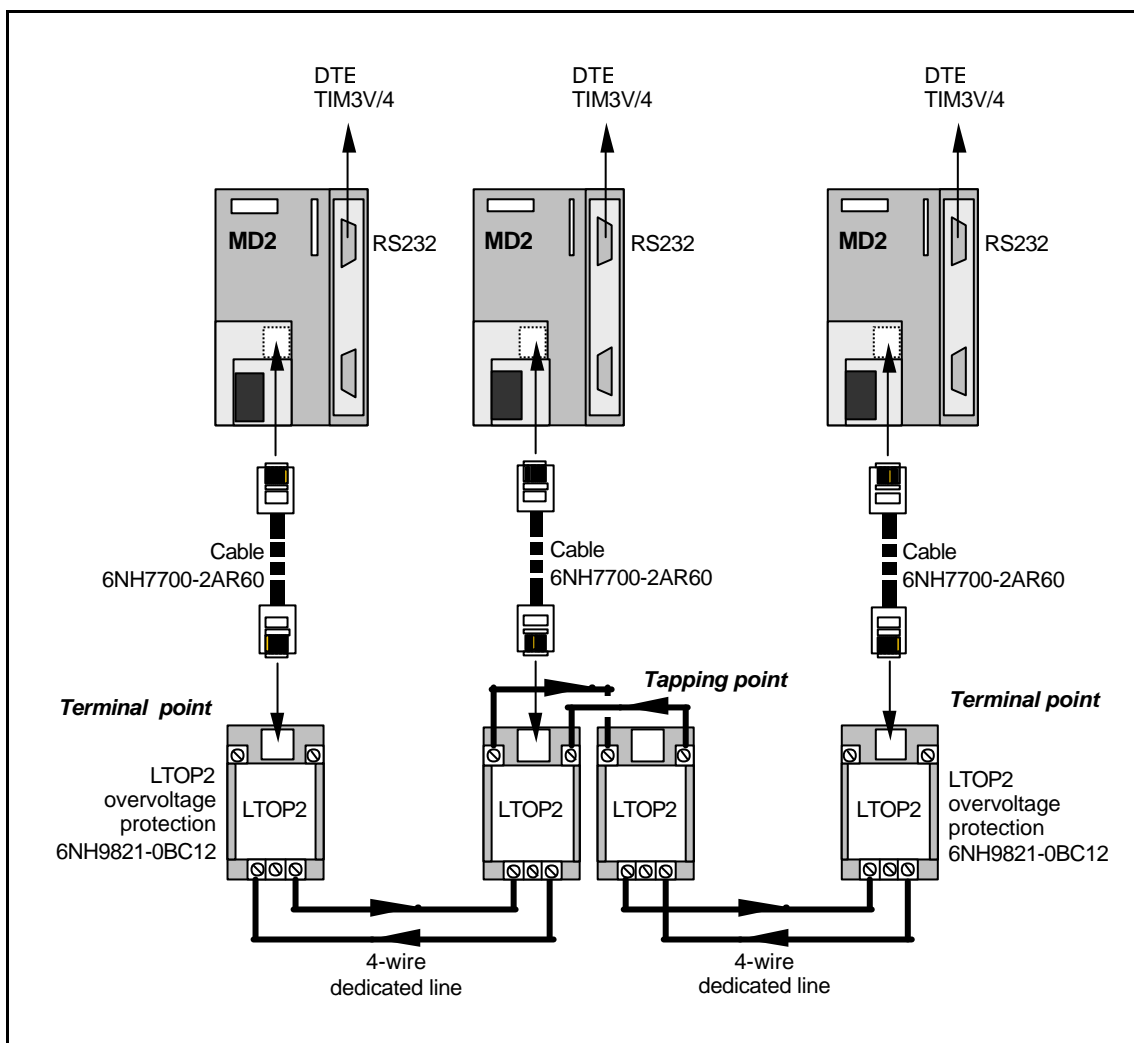


Fig. 5-3 Network configuration: multidrop line, 4-wire full-duplex

Fig. 5-3 illustrates only one tapping point. Each additional tapping point is identical to this and the settings on the MD2 and both LTOPs are the same.

Table 5-4 Settings for both 4-wire terminal points

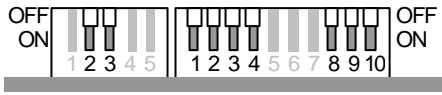
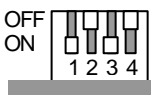
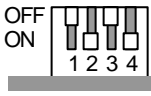
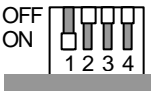


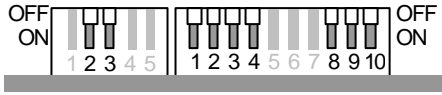
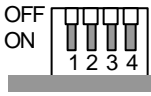
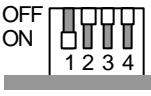


Settings on the DIL switches accessible from above (see Fig. 2-3 and 2-4)			
5-pin and 10-pin DIL switch		Meaning	
		4-wire operation channel 1 "Normal" operating mode The baud rate must be selected with switches 4 and 5 on the 5-pin DIL switch and the character recognition with switches 5 to 7 on the 10-pin DIL switch.	
Settings on the DIL switch accessible from below (termination resistors)			
Type of connection	Baud rate	Setting on DIL switch	Note
Terminal Point 4-wire	1200 bps 2400 bps		The MD2 is located at the beginning or end of a 4-wire line and is set to a transmission speed of 1200 or 2400 bps. (see Fig. 2-6)
	9600 bps 19200 bps		Terminal point as above but with transmission speed set to 9600 or 19200 bps. (see Fig. 2-6)
Settings on the DIL switch accessible from below (port)			
Interface type	Setting on DIL switch		Note
RS232 interface			Activation of the RS232 interface (see Fig. 2-6)
Settings on the LTOP2 switches			
Switch	Switch position	Note	
Switch S1		Receive channel (pins 2 and 5) activated (see Fig. 2-18)	
Switch S2		Send channel (pins 3 and 4) activated (see Fig. 2-18)	

Table 5-5 Settings for the 4-wire tapping point

Settings on the DIL switches accessible from above (see Fig. 2-3 and 2-4)			
5-pin and 10-pin DIL switch		Meaning	
		4-wire operation channel 1 "Normal" operating mode The baud rate must be selected with switches 4 and 5 on the 5-pin DIL switch and the character recognition with switches 5 to 7 on the 10-pin DIL switch.	
Settings on the DIL switch accessible from below (termination resistors)			
Type of connection	Baud rate	Setting on DIL switch	Note
Tapping point 4-wire	1200 bps 2400 bps 9600 bps 19200 bps		The MD2 is <u>not</u> located at the beginning or end of a 4-wire line; it taps into this 4-wire line somewhere along the way with high resistance. (see Fig. 2-6)
Settings on the DIL switch accessible from below (port)			
Interface type	Setting on DIL switch		Note
RS232 interface			Activation of the RS232 interface (see Fig. 2-6)
Settings on the switches of both LTOP2s			
Switch	Switch position	Note	
Switch S1		Receive channel (pins 2 and 5) activated (see Fig. 2-18)	
Switch S2		Send channel (pins 3 and 4) activated (see Fig. 2-18)	

### 5.1.4 Multidrop Line, 2-wire Half-duplex

#### Overview

Fig. 5-4 shows the configuration for a **multidrop line, 2-wire half-duplex**. The MD2 modems on the outer left and right represent 2-wire terminal points, the MD2 modem in the middle is a 2-wire tapping point. All three modems are set to the "Normal" operating mode.

All available baud rates and character recognition methods can be used in this configuration.

The DIL switch settings on the MD2 modem and the switch settings on the LTOP1 are the same at both terminal points (see Table 5-6). The tapping point requires other switch settings on the MD2 and LTOP2 (see Table 5-7).

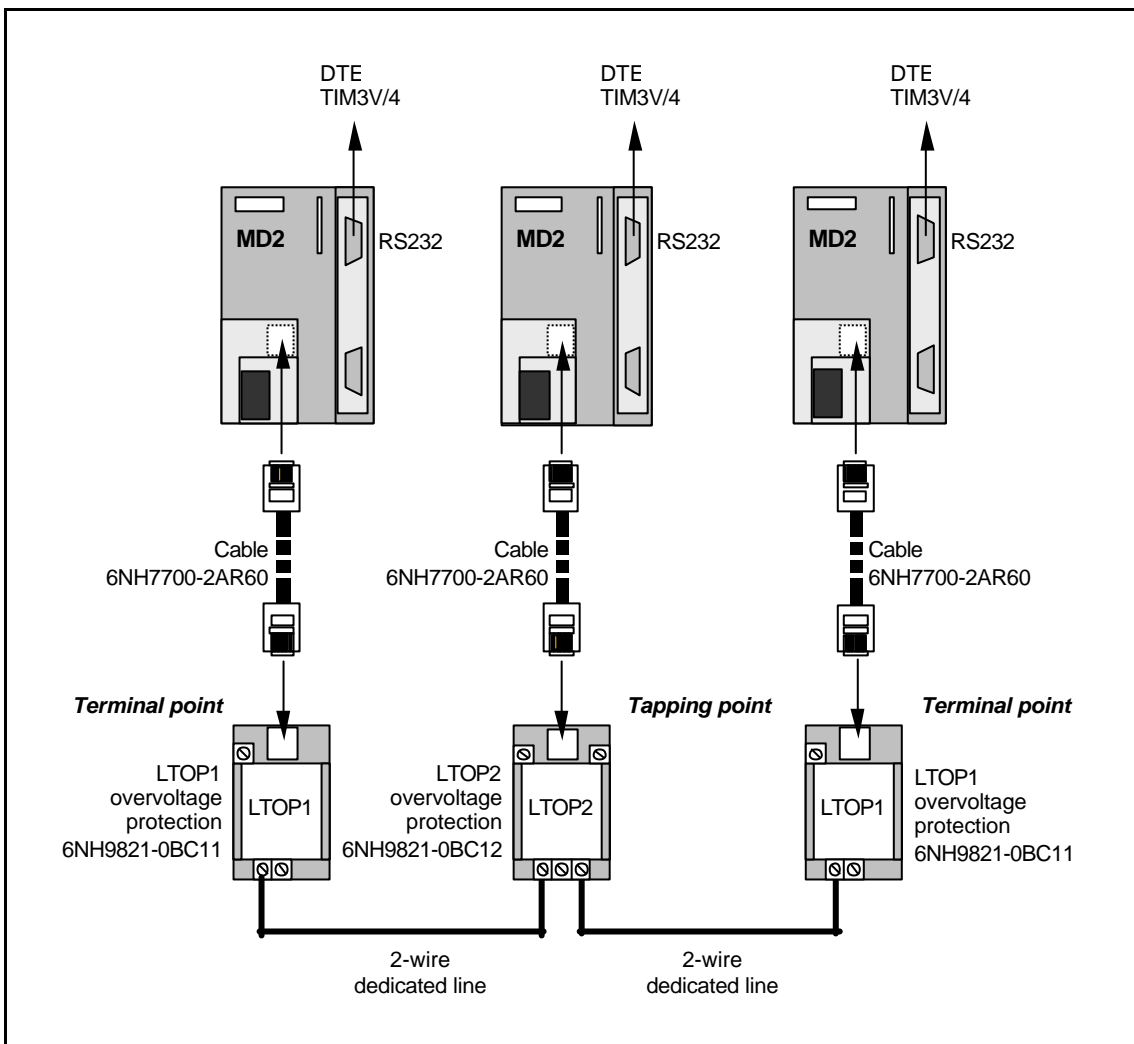


Fig. 5-4 Network configuration: multidrop line, 2-wire half-duplex

Fig. 5-4 illustrates only one tapping point. Each additional tapping point is identical to this and the settings on the MD2 and both LTOPs are the same.

Table 5-6 Settings for both 2-wire terminal points

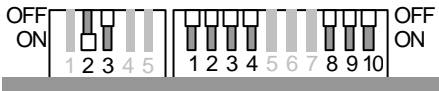
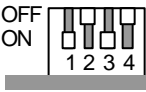

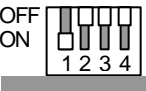

Settings on the DIL switches accessible from above (see Fig. 2-3 and 2-4)			
5-pin and 10-pin DIL switch		Meaning	
		2-wire operation channel 1 "Normal" operating mode The baud rate must be selected with switches 4 and 5 on the 5-pin DIL switch and the character recognition with switches 5 to 7 on the 10-pin DIL switch.	
Settings on the DIL switch accessible from below (termination resistors)			
Type of connection	Baud rate	Setting on DIL switch	Note
Terminal Point 2-wire	1200 bps 2400 bps		The MD2 is located at the beginning or end of a 2-wire line and is set to a transmission speed of 1200 or 2400 bps. (see Fig. 2-6)
	9600 bps 19200 bps		Terminal point as above but with transmission speed set to 9600 or 19200 bps. (see Fig. 2-6)
Settings on the DIL switch accessible from below (port)			
Interface type	Setting on DIL switch		Note
RS232 interface			Activation of the RS232 interface (see Fig. 2-6)
Settings on the LTOP1 switch			
Switch	Switch position	Note	
Switch S1		2-wire channel (pins 2 and 5) activated (see Fig. 2-18)	



Table 5-7 Settings for the 2-wire tapping point

Settings on the DIL switches accessible from above (see Fig. 2-3 and 2-4)			
5-pin and 10-pin DIL switch		Meaning	
		2-wire operation channel 1 "Normal" operating mode The baud rate must be selected with switches 4 and 5 on the 5-pin DIL switch and the character recognition with switches 5 to 7 on the 10-pin DIL switch.	
Settings on the DIL switch accessible from below (termination resistors)			
Type of connection	Baud rate	Setting on DIL switch	Note
Tapping point 2-wire	1200 bps 2400 bps		The MD2 is <u>not</u> located at the beginning or end of a 2-wire line; it taps into this 2-wire line somewhere along the way with high resistance. The transmission speed is set to 1200 or 2400 bps. (see Fig. 2-6)
	9600 bps 19200 bps		Tapping point as above but with transmission speed set to 9600 or 19200 bps. (see Fig. 2-6)
Settings on the DIL switch accessible from below (port)			
Interface type	Setting on DIL switch		Note
RS232 interface			Activation of the RS232 interface (see Fig. 2-6)
Settings on the LTOP2 switches			
Switch	Switch position	Note	
Switch S1		2-wire channel (pins 2 and 5) activated (see Fig. 2-18)	
Switch S2		2-wire channel (pins 2 and 5) activated (see Fig. 2-18)	

### 5.1.5 Star Network via the MD2-internal Two-way Transformer, 2-wire Half-duplex

#### Overview

Fig. 5-5 shows a configuration for a **star network, 2-wire half-duplex**. The MD2 modem on the left represents a 2 x 2-wire terminal point which uses the two-way transformer integrated in the MD2 to connect a small star network consisting of two 2-wire dedicated lines: the first 2-wire dedicated line is a multidrop line, the second 2-wire dedicated line is a point-to-point connection. The MD2 on the right is a 2-wire tapping point, the MD2 modem in the middle is a 2-wire terminal point. All three modems are set to the "Normal" operating mode.

All available baud rates and character recognition methods can be used in this configuration.

Note that the DIL switch settings on all three modems are different due to their location in the star network: one is a 2 x 2-wire terminal point (see Table 5-8), one is a 2-wire terminal point (see Table 5-9) and the last one is a 2-wire tapping point (see Table 5-10).

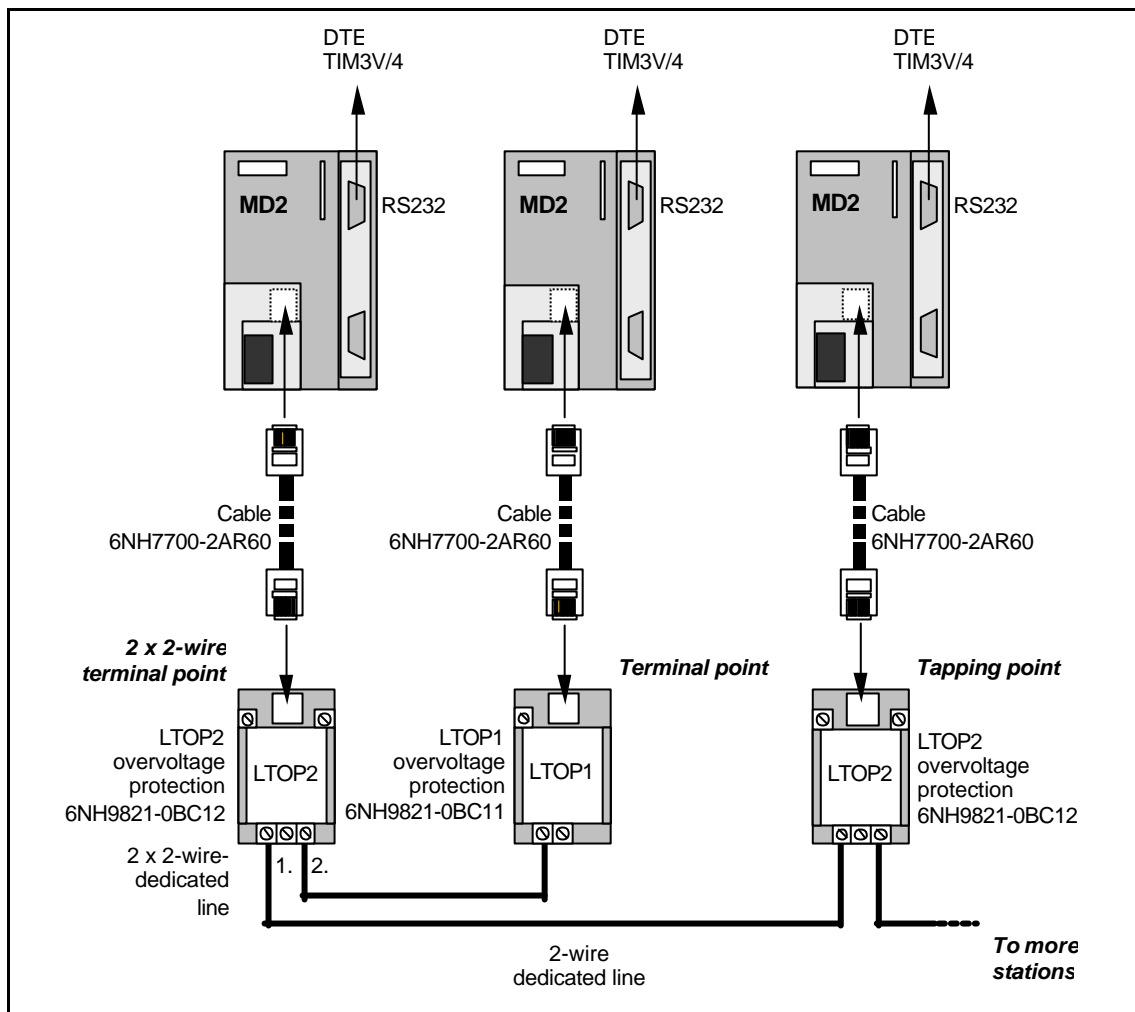


Fig. 5-5 Network configuration: star network via the MD2-internal two-way transformer, 2-wire half-duplex

Table 5-8 Settings for the 2 x 2-wire terminal point

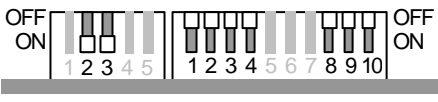
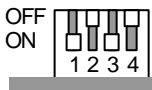
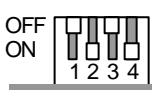
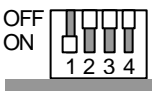


Settings on the DIL switches accessible from above (see Fig. 2-3 and 2-4)			
5-pin and 10-pin DIL switch		Meaning	
		2-wire operation channels 1+2 "Normal" operating mode The baud rate must be selected with switches 4 and 5 on the 5-pin DIL switch and the character recognition with switches 5 to 7 on the 10-pin DIL switch.	
Settings on the DIL switch accessible from below (termination resistors)			
Type of connection	Baud rate	Setting on DIL switch	Note
Terminal Point 2 x 2-wire	1200 bps 2400 bps		The MD2 is located at the beginning or end of a 2-wire line and is set to a transmission speed of 1200 or 2400 bps. (see Fig. 2-6)
	9600 bps 19200 bps		Terminal point as above but with transmission speed set to 9600 or 19200 bps. (see Fig. 2-6)
Settings on the DIL switch accessible from below (port)			
Interface type	Setting on DIL switch		Note
RS232 interface			Activation of the RS232 interface (see Fig. 2-6)
Settings on the LTOP2 switches			
Switch	Switch position	Note	
Switch S1		First 2-wire channel (pins 2 and 5) activated (see Fig. 2-18)	
Switch S2		Second 2-wire channel (pins 3 and 4) activated (see Fig. 2-18)	

Table 5-9 Settings for the 2-wire terminal point

Settings on the DIL switches accessible from above (see Fig. 2-3 and 2-4)			
5-pin and 10-pin DIL switch		Meaning	
		2-wire operation channel 1 "Normal" operating mode The baud rate must be selected with switches 4 and 5 on the 5-pin DIL switch and the character recognition with switches 5 to 7 on the 10-pin DIL switch.	
Settings on the DIL switch accessible from below (termination resistors)			
Type of connection	Baud rate	Setting on DIL switch	Note
Terminal Point 2-wire	1200 bps 2400 bps		The MD2 is located at the beginning or end of a 2-wire line and is set to a transmission speed of 1200 or 2400 bps. (see Fig. 2-6)
	9600 bps 19200 bps		Terminal point as above but with transmission speed set to 9600 or 19200 bps. (see Fig. 2-6)
Settings on the DIL switch accessible from below (port)			
Interface type	Setting on DIL switch		Note
RS232 interface			Activation of the RS232 interface (see Fig. 2-6)
Settings on the LTOP1 switch			
Switch	Switch position	Note	
Switch S1		2-wire channel (pins 2 and 5) activated (see Fig. 2-18)	

Table 5-10 Settings for the 2-wire tapping point

Settings on the DIL switches accessible from above (see Fig. 2-3 and 2-4)			
5-pin and 10-pin DIL switch		Meaning	
		2-wire operation channel 1 "Normal" operating mode The baud rate must be selected with switches 4 and 5 on the 5-pin DIL switch and the character recognition with switches 5 to 7 on the 10-pin DIL switch.	
Settings on the DIL switch accessible from below (termination resistors)			
Type of connection	Baud rate	Setting on DIL switch	Note
Tapping point 2-wire	1200 bps 2400 bps		The MD2 is <u>not</u> located at the beginning or end of a 2-wire line; it taps into this 2-wire line somewhere along the way with high resistance. The transmission speed is set to 1200 or 2400 bps. (see Fig. 2-6)
	9600 bps 19200 bps		Tapping point as above but with transmission speed set to 9600 or 19200 bps. (see Fig. 2-6)
Settings on the DIL switch accessible from below (port)			
Interface type	Setting on DIL switch		Note
RS232 interface			Activation of the RS232 interface (see Fig. 2-6)
Settings on the LTOP2 switches			
Switch	Switch position		Note
Switch S1			2-wire channel (pins 2 and 5) activated (see Fig. 2-18)
Switch S2			2-wire channel (pins 2 and 5) activated (see Fig. 2-18)

### 5.1.6 Star Network via an External Multiple Transformer, 2-wire Half-duplex

#### Overview

Fig. 5-6 shows a configuration for a **star network, 2-wire half-duplex**. The MD2 modem on the left represents a 2-wire terminal point to which a multiple transformer (in this example a 4-way transformer) is connected to connect a star network consisting of up to four 2-wire dedicated lines. In Fig. 5-6 only two dedicated lines are shown: the first 2-wire dedicated line is a multidrop line, the second 2-wire dedicated line is a point-to-point connection. The MD2 on the right is a 2-wire tapping point, the MD2 modem in the middle is a 2-wire terminal point. All three modems are set to the "Normal" operating mode.

All available baud rates and character recognition methods can be used in this configuration. However, the 4-way transformer 6NH9812-4GA shown in Fig. 5-6 is only suitable for 1200 or 2400 bps.

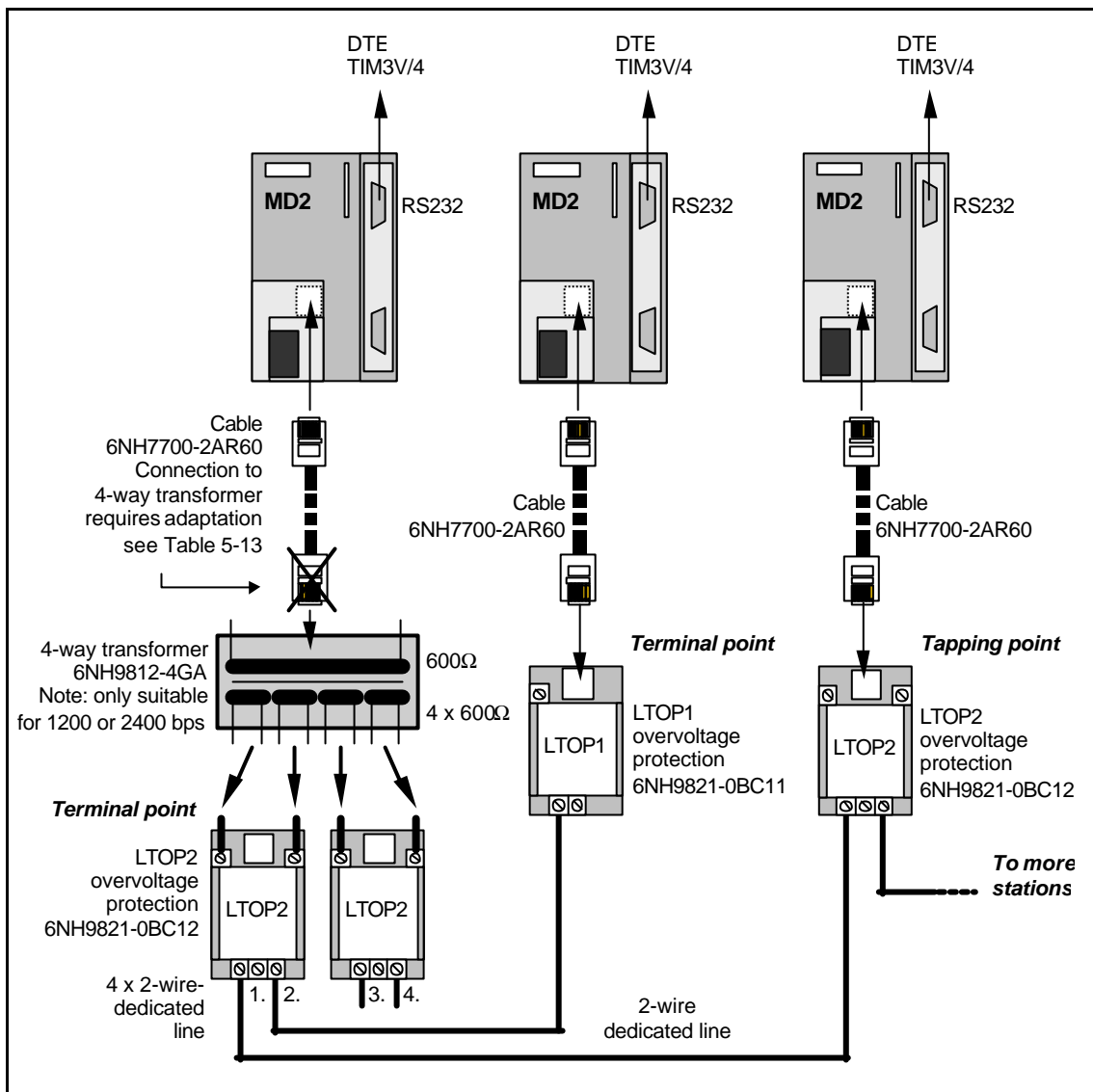


Fig. 5-6 Network configuration: star network via an external multiple transformer, 2-wire half-duplex

Note that the DIL switch settings on the modems are different due to their location in the star network: two are 2-wire terminal points (see Table 5-11) and one is a 2-wire tapping point (see Table 5-12).

Table 5-11 Settings for both 2-wire terminal points

Settings on the DIL switches accessible from above (see Fig. 2-3 and 2-4)			
5-pin and 10-pin DIL switch		Meaning	
		2-wire operation channel 1 "Normal" operating mode The baud rate must be selected with switches 4 and 5 on the 5-pin DIL switch and the character recognition with switches 5 to 7 on the 10-pin DIL switch.	
Settings on the DIL switch accessible from below (termination resistors)			
Type of connection	Baud rate	Setting on DIL switch	Note
Terminal Point 2-wire	1200 bps 2400 bps		The MD2 is located at the beginning or end of a 2-wire line and is set to a transmission speed of 1200 or 2400 bps. (see Fig. 2-6)
	9600 bps 19200 bps		Terminal point as above but with transmission speed set to 9600 or 19200 bps. (see Fig. 2-6)
Settings on the DIL switch accessible from below (port)			
Interface type	Setting on DIL switch		Note
RS232 interface			Activation of the RS232 interface (see Fig. 2-6)
Settings on the LTOP2 Switches (both LTOP2s at the multiple transformer)			
Switch	Switch position	Note	
Switch S1		First 2-wire channel (pins 2 and 5) activated (see Fig. 2-18)	
Switch S2		Second 2-wire channel (pins 3 and 4) activated (see Fig. 2-18)	
Settings on the LTOP1 Switch (LTOP1 at modem in the middle)			
Switch	Switch position	Note	
Switch S1		2-wire channel (pins 2 and 5) activated (see Fig. 2-18)	

Table 5-12 Settings for the 2-wire tapping point

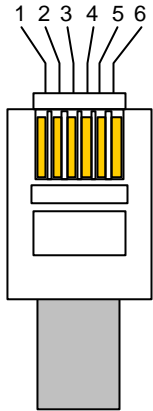
Settings on the DIL switches accessible from above (see Fig. 2-3 and 2-4)			
5-pin and 10-pin DIL switch		Meaning	
		2-wire operation channel 1 "Normal" operating mode The baud rate must be selected with switches 4 and 5 on the 5-pin DIL switch and the character recognition with switches 5 to 7 on the 10-pin DIL switch.	
Settings on the DIL switch accessible from below (termination resistors)			
Type of connection	Baud rate	Setting on DIL switch	Note
Tapping point 2-wire	1200 bps 2400 bps		The MD2 is <u>not</u> located at the beginning or end of a 2-wire line; it taps into this 2-wire line somewhere along the way with high resistance. The transmission speed is set to 1200 or 2400 bps. (see Fig. 2-6)
	9600 bps 19200 bps		Tapping point as above but with transmission speed set to 9600 or 19200 bps. (see Fig. 2-6)
Settings on the DIL switch accessible from below (port)			
Interface type	Setting on DIL switch		Note
RS232 interface			Activation of the RS232 interface (see Fig. 2-6)
Settings on the LTOP2 switches			
Switch	Switch position	Note	
Switch S1		2-wire channel (pins 2 and 5) activated (see Fig. 2-18)	
Switch S2		2-wire channel (pins 2 and 5) activated (see Fig. 2-18)	



### Wiring Adaptation for the Multiple Transformer

When the MD2 modem is connected to a multiple transformer using cable 6NH7700-2AR60 the wiring needs to be adapted. To do this cut the Western connector at the multiple transformer's end and solder the wires directly on the multiple transformer. The following table shows the wiring configuration for the connection to the multiple transformer.

Table 5-13 Pin assignment of the RJ12 Western connector for cable 6NH7700-2AR60

Diagram	Pin no.	Signal Name	Signal Direction	Comments
	5	a1	bi-directional	Connection of the multiple transformer for the first 2-wire channel
	2	b1		
	4	a2	bi-directional	Connection of the multiple transformer for the second 2-wire channel <sup>1)</sup>
	3	b2		
	1	-	-	-
	6	-	-	-

1) Two 4-way transformers can be connected to the MD2, this means that a total of eight 2-wire dedicated lines can be connected. The MD2 then has to be configured as a 2 x 2-wire terminal point.

### 5.1.7 Star Network via an External Multiple Transformer, 4-wire Full-duplex

#### Overview

Fig. 5-7 shows a configuration for a **star network, 4-wire full-duplex**. The MD2 modem on the left represents a 4-wire terminal point to which two multiple transformers (in this example these are two 4-way transformers) are connected. The left multiple transformer provides 4 channels for the receiving direction, the right one 4 channels for the sending direction. Multidrop lines or point-to-point connections can be connected via the available four 4-wire lines.

The modem is set to the "Normal" operating mode. Table 5-14 shows all the settings necessary on the MD2 modem and the LTOP2s.

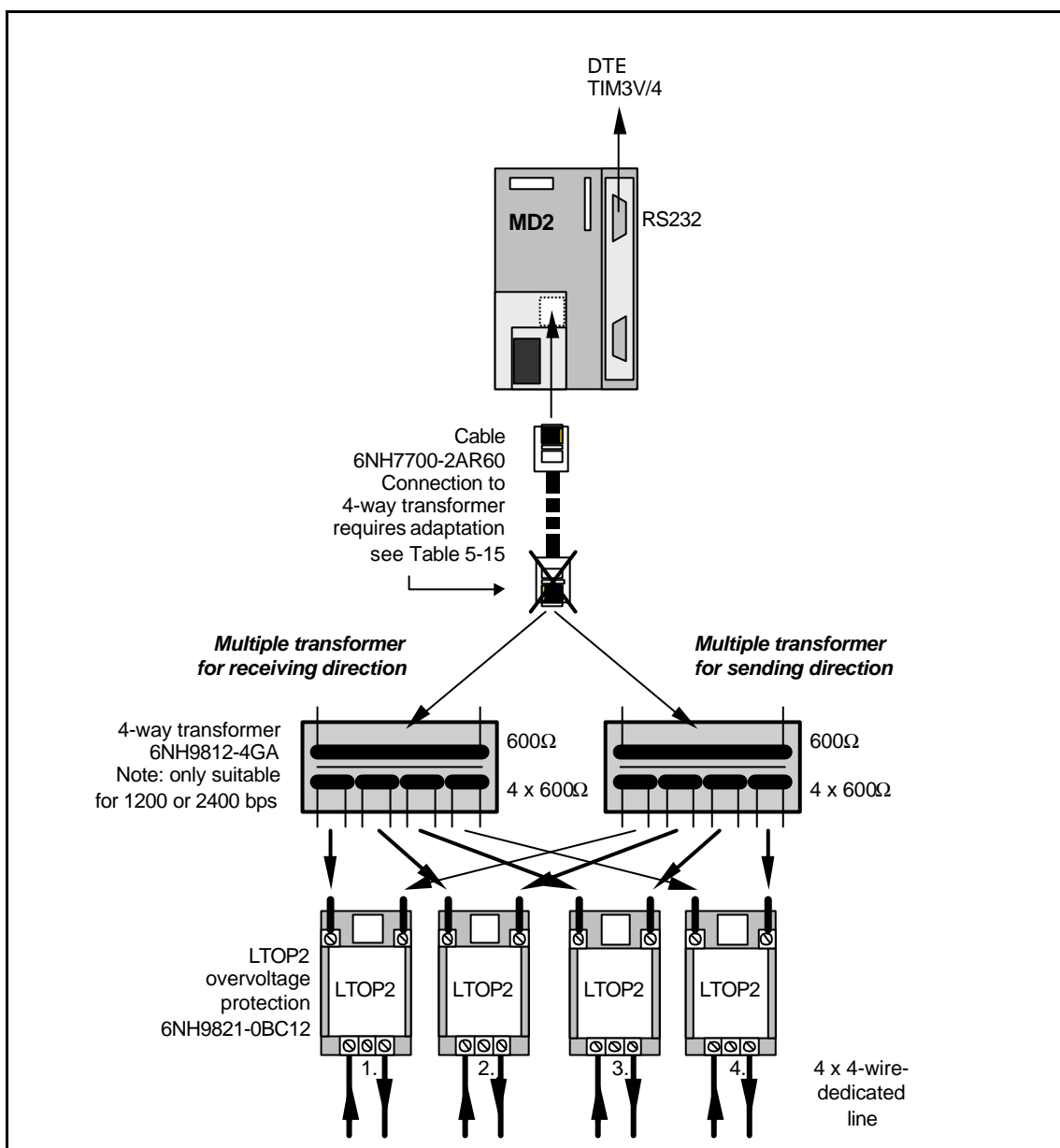


Fig. 5-7 Network configuration: star network via an external multiple transformer, 4-wire full-duplex

All available baud rates and character recognition methods can be used in this configuration. However, the 4-way transformer 6NH9812-4GA shown in Fig. 5-7 is only suitable for 1200 or 2400 bps.

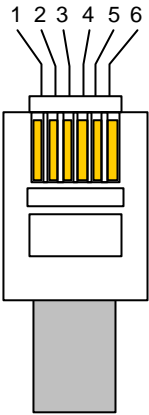
Table 5-14 Settings for the 4-wire terminal point

Settings on the DIL switches accessible from above (see Fig. 2-3 and 2-4)			
<b>5-pin and 10-pin DIL switch</b>		<b>Meaning</b>	
		4-wire operation channel 1 "Normal" operating mode The baud rate must be selected with switches 4 and 5 on the 5-pin DIL switch and the character recognition with switches 5 to 7 on the 10-pin DIL switch.	
Settings on the DIL switch accessible from below (termination resistors)			
Type of connection	Baud rate	Setting on DIL switch	Note
Terminal Point 4-wire	1200 bps 2400 bps		The MD2 is located at the beginning or end of a 4-wire line and is set to a transmission speed of 1200 or 2400 bps. (see Fig. 2-6)
	9600 bps 19200 bps		Terminal point as above but with transmission speed set to 9600 or 19200 bps. (see Fig. 2-6)
Settings on the DIL switch accessible from below (port)			
Interface type	Setting on DIL switch		Note
RS232 interface			Activation of the RS232 interface (see Fig. 2-6)
Settings on the LTOP2 switches			
Switch	Switch position	Note	
Switch S1		Receive channel (pins 2 and 5) activated (see Fig. 2-18)	
Switch S2		Send channel (pins 3 and 4) activated (see Fig. 2-18)	

### Wiring Adaptation for the Multiple Transformer

When the MD2 modem is connected to a multiple transformer using cable 6NH7700-2AR60 the wiring needs to be adapted. To do this cut the Western connector at the multiple transformer's end and solder the wires directly on the multiple transformer. The following table shows the wiring configuration for the connection to the multiple transformer.

Table 5-15 Pin assignment of the RJ12 Western connector for cable 6NH7700-2AR60

Diagram	Pin no.	Signal Name	Signal Direction	Comments
	5	a1	Input	Connection of the multiple transformer for the receiving direction
	2	b1		
	4	a2	Output	Connection of the multiple transformer for the sending direction
	3	b2		
	1	-	-	-
	6	-	-	-

### 5.1.8 Repeater, 4-wire Full-duplex

#### Overview

Fig. 5-8 shows a configuration for a **multidrop line with an intermediate 4-wire repeater, 4-wire full-duplex and**. The MD2 modem on the left represents a 4-wire terminal point, the MD2 modem on the right is a 4-wire tapping point. Both modems are set to the "Normal" operating mode. Both MD2 modems in the middle form a 4-wire repeater and are set to the "Repeater" operating mode.

All available baud rates and character recognition methods can be used in this configuration.

Note that the DIL switch settings for the modems are different due to their location in the multidrop line: one is a 4-wire terminal point (see Table 5-16), an other one is a 4-wire tapping point (see Table 5-17) and two are 4-wire repeaters (see Table 5-18). The two repeater modems have the same DIL switch settings.

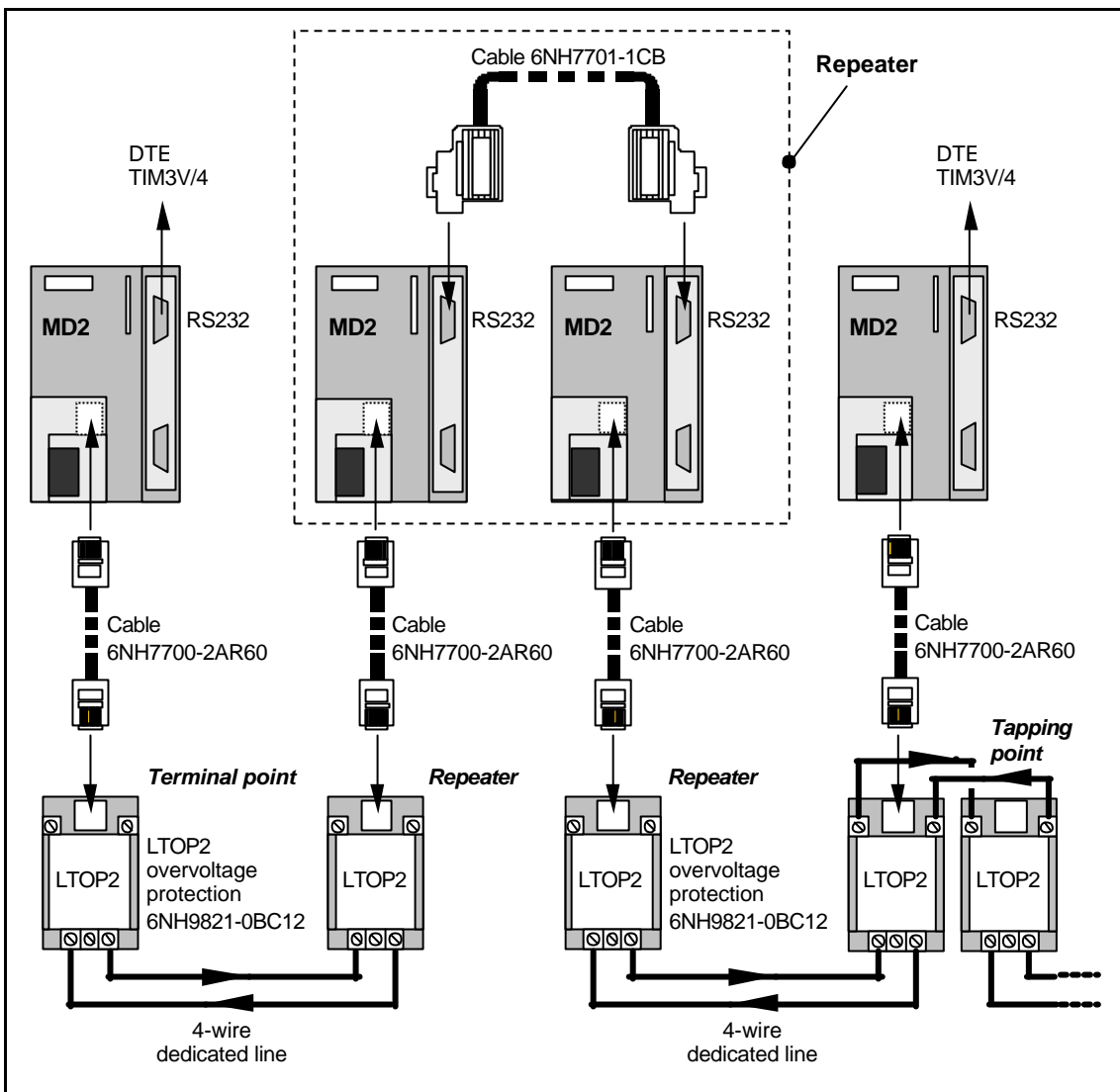


Fig. 5-8 Network configuration: repeater, 4-wire full-duplex

Table 5-16 Settings for the 4-wire terminal point

Settings on the DIL switches accessible from above (see Fig. 2-3 and 2-4)			
5-pin and 10-pin DIL switch		Meaning	
		4-wire operation channel 1 "Normal" operating mode The baud rate must be selected with switches 4 and 5 on the 5-pin DIL switch and the character recognition with switches 5 to 7 on the 10-pin DIL switch.	
Settings on the DIL switch accessible from below (termination resistors)			
Type of connection	Baud rate	Setting on DIL switch	Note
Terminal Point 4-wire	1200 bps 2400 bps		The MD2 is located at the beginning or end of a 4-wire line and is set to a transmission speed of 1200 or 2400 bps. (see Fig. 2-6)
	9600 bps 19200 bps		Terminal point as above but with transmission speed set to 9600 or 19200 bps. (see Fig. 2-6)
Settings on the DIL switch accessible from below (port)			
Interface type	Setting on DIL switch		Note
RS232 interface			Activation of the RS232 interface (see Fig. 2-6)
Settings on the LTOP2 switches			
Switch	Switch position	Note	
Switch S1		Receive channel (pins 2 and 5) activated (see Fig. 2-18)	
Switch S2		Send channel (pins 3 and 4) activated (see Fig. 2-18)	

Table 5-17 Settings for the 4-wire tapping point

Settings on the DIL switches accessible from above (see Fig. 2-3 and 2-4)			
5-pin and 10-pin DIL switch		Meaning	
		4-wire operation channel 1 "Normal" operating mode The baud rate must be selected with switches 4 and 5 on the 5-pin DIL switch and the character recognition with switches 5 to 7 on the 10-pin DIL switch.	
Settings on the DIL switch accessible from below (termination resistors)			
Type of connection	Baud rate	Setting on DIL switch	Note
Tapping point 4-wire	1200 bps 2400 bps 9600 bps 19200 bps		The MD2 is <u>not</u> located at the beginning or end of a 4-wire line; it taps into this 4-wire line somewhere along the way with high resistance. (see Fig. 2-6)
Settings on the DIL switch accessible from below (port)			
Interface type	Setting on DIL switch		Note
RS232 interface			Activation of the RS232 interface (see Fig. 2-6)
Settings on the switches of both LTOP2s			
Switch	Switch position		Note
Switch S1			Receive channel (pins 2 and 5) activated (see Fig. 2-18)
Switch S2			Send channel (pins 3 and 4) activated (see Fig. 2-18)

Table 5-18 Settings for both 4-wire repeaters

Settings on the DIL switches accessible from above (see Fig. 2-3 and 2-4)			
5-pin and 10-pin DIL switch		Meaning	
		4-wire operation channel 1 "Repeater" operating mode The baud rate must be selected with switches 4 and 5 on the 5-pin DIL switch and the character recognition with switches 5 to 7 on the 10-pin DIL switch.	
Settings on the DIL switch accessible from below (termination resistors)			
Type of connection	Baud rate	Setting on DIL switch	Note
Repeater 4-wire	1200 bps 2400 bps		The MD2 is connected as a repeater on a 4-wire line and is set to a transmission speed of 1200 or 2400 bps. (see Fig. 2-6)
	9600 bps 19200 bps		Repeater as above but with transmission speed set to 9600 or 19200 bps. (see Fig. 2-6)
Settings on the DIL switch accessible from below (port)			
Interface type	Setting on DIL switch		Note
RS232 interface			Activation of the RS232 interface (see Fig. 2-6)
Settings on the LTOP2 switches			
Switch	Switch position	Note	
Switch S1		Receive channel (pins 2 and 5) activated (see Fig. 2-18)	
Switch S2		Send channel (pins 3 and 4) activated (see Fig. 2-18)	



### 5.1.9 Repeater, 2-wire Half-duplex

#### Overview

Fig. 5-9 shows a configuration for a **multidrop line with an intermediate 2-wire repeater, 2-wire half-duplex**. The MD2 modem on the left represents a 2-wire terminal point, the MD2 modem on the right is a 2-wire tapping point. Both modems are set to the "Normal" operating mode. Both MD2 modems in the middle form a 2-wire repeater and are set to the "Repeater" operating mode.

All available baud rates and character recognition methods can be used in this configuration.

Note that the DIL switch settings for the modems are different due to their location in the multidrop line: one is a 2-wire terminal point (see Table 5-19), one is a 2-wire tapping point (see Table 5-20) and two are 2-wire repeaters (see Table 5-21). The two repeater modems have the same DIL switch settings.

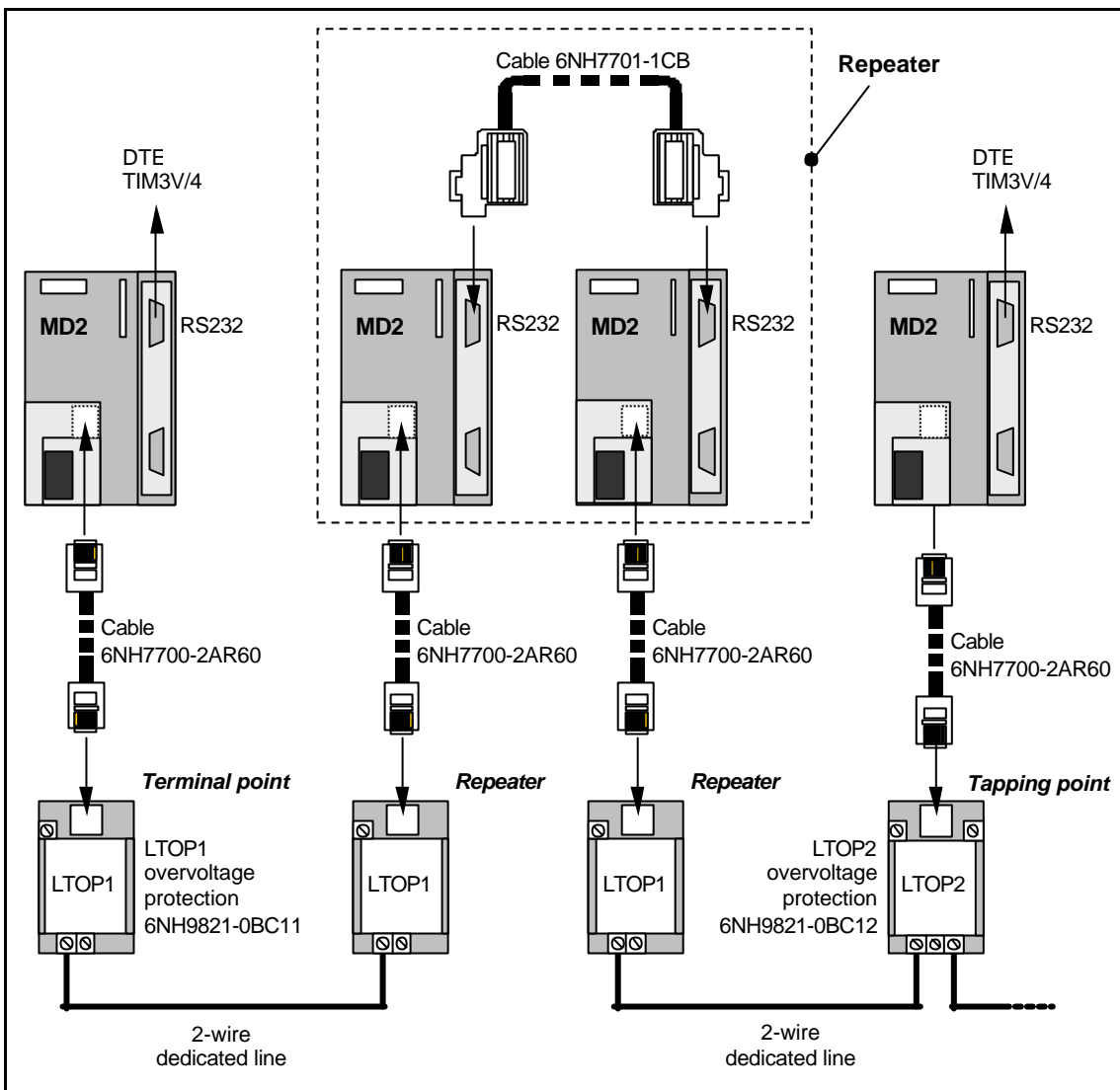


Fig. 5-9 Network configuration: repeater, 2-wire half-duplex

Table 5-19 Settings for the 2-wire terminal point

Settings on the DIL switches accessible from above (see Fig. 2-3 and 2-4)			
5-pin and 10-pin DIL switch		Meaning	
		2-wire operation channel 1 "Normal" operating mode The baud rate must be selected with switches 4 and 5 on the 5-pin DIL switch and the character recognition with switches 5 to 7 on the 10-pin DIL switch.	
Settings on the DIL switch accessible from below (termination resistors)			
Type of connection	Baud rate	Setting on DIL switch	Note
Terminal Point 2-wire	1200 bps 2400 bps		The MD2 is located at the beginning or end of a 2-wire line and is set to a transmission speed of 1200 or 2400 bps. (see Fig. 2-6)
	9600 bps 19200 bps		Terminal point as above but with transmission speed set to 9600 or 19200 bps. (see Fig. 2-6)
Settings on the DIL switch accessible from below (port)			
Interface type	Setting on DIL switch		Note
RS232 interface			Activation of the RS232 interface (see Fig. 2-6)
Settings on the LTOP1 switch			
Switch	Switch position	Note	
Switch S1		2-wire channel (pins 2 and 5) activated (see Fig. 2-18)	

Table 5-20 Settings for the 2-wire tapping point

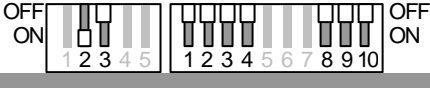

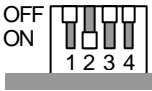
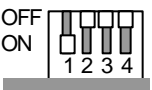


Settings on the DIL switches accessible from above (see Fig. 2-3 and 2-4)			
5-pin and 10-pin DIL switch		Meaning	
		2-wire operation channel 1 "Normal" operating mode The baud rate must be selected with switches 4 and 5 on the 5-pin DIL switch and the character recognition with switches 5 to 7 on the 10-pin DIL switch.	
Settings on the DIL switch accessible from below (termination resistors)			
Type of connection	Baud rate	Setting on DIL switch	Note
Tapping point 2-wire	1200 bps 2400 bps		The MD2 is <u>not</u> located at the beginning or end of a 2-wire line; it taps into this 2-wire line somewhere along the way with high resistance. The transmission speed is set to 1200 or 2400 bps. (see Fig. 2-6)
	9600 bps 19200 bps		Tapping point as above but with transmission speed set to 9600 or 19200 bps. (see Fig. 2-6)
Settings on the DIL switch accessible from below (port)			
Interface type	Setting on DIL switch		Note
RS232 interface			Activation of the RS232 interface (see Fig. 2-6)
Settings on the LTOP2 switches			
Switch	Switch position		Note
Switch S1			2-wire channel (pins 2 and 5) activated (see Fig. 2-18)
Switch S2			2-wire channel (pins 2 and 5) activated (see Fig. 2-18)

Table 5-21 Settings for both 2-wire repeaters

Settings on the DIL switches accessible from above (see Fig. 2-3 and 2-4)			
5-pin and 10-pin DIL switch		Meaning	
		2-wire operation channel 1 "Repeater" operating mode The baud rate must be selected with switches 4 and 5 on the 5-pin DIL switch and the character recognition with switches 5 to 7 on the 10-pin DIL switch.	
Settings on the DIL switch accessible from below (termination resistors)			
Type of connection	Baud rate	Setting on DIL switch	Note
Repeater 2-wire	1200 bps 2400 bps		The MD2 is connected as a repeater on a 2-wire line and is set to a transmission speed of 1200 or 2400 bps. (see Fig. 2-6)
	9600 bps 19200 bps		Repeater as above but with transmission speed set to 9600 or 19200 bps. (see Fig. 2-6)
Settings on the DIL switch accessible from below (port)			
Interface type	Setting on DIL switch		Note
RS232 interface			Activation of the RS232 interface (see Fig. 2-6)
Settings on the LTOP1 switch			
Switch	Switch position	Note	
Switch S1		2-wire channel (pins 2 and 5) activated (see Fig. 2-18)	

## 5.2 Network Configurations with RS485

The following table provides an overview of the network configurations that can be built using the RS485 interface.

### Note

Only half-duplex operating modes can be used in network configurations with the RS485 interface.

Table 5-22 Overview of network configurations with RS485

Network Configuration	Modem Operating Mode	Transmission Type	Section
Point-to-point	with RS485 interface	2-wire half-duplex	5.2.1
Point-to-point with fiber optic section	with RS485 interface	2-wire half-duplex	5.2.2
Multidrop line	with RS485 interface	2-wire half-duplex	5.2.3
Multidrop line with fiber optic section	with RS485 interface	2-wire half-duplex	5.2.4
Star network	with RS485 interface	2-wire half-duplex	5.2.5
Repeater	with RS485 interface	2-wire half-duplex	5.2.6

### 5.2.1 Point-to-Point, 2-Wire Half-duplex (RS485 Interface)

Fig. 5-10 shows a configuration for a **point-to-point, 2-wire half-duplex** network. Both MD2 modems represent 2-wire terminal points and are set to the "With RS485 interface" operating mode.

All available baud rates and character recognition methods except for "MID off" can be used in this configuration.

The DIL switch settings on the MD2 modem and the switch settings on the LTOP1 are the same at both terminal points (see Table 5-23).

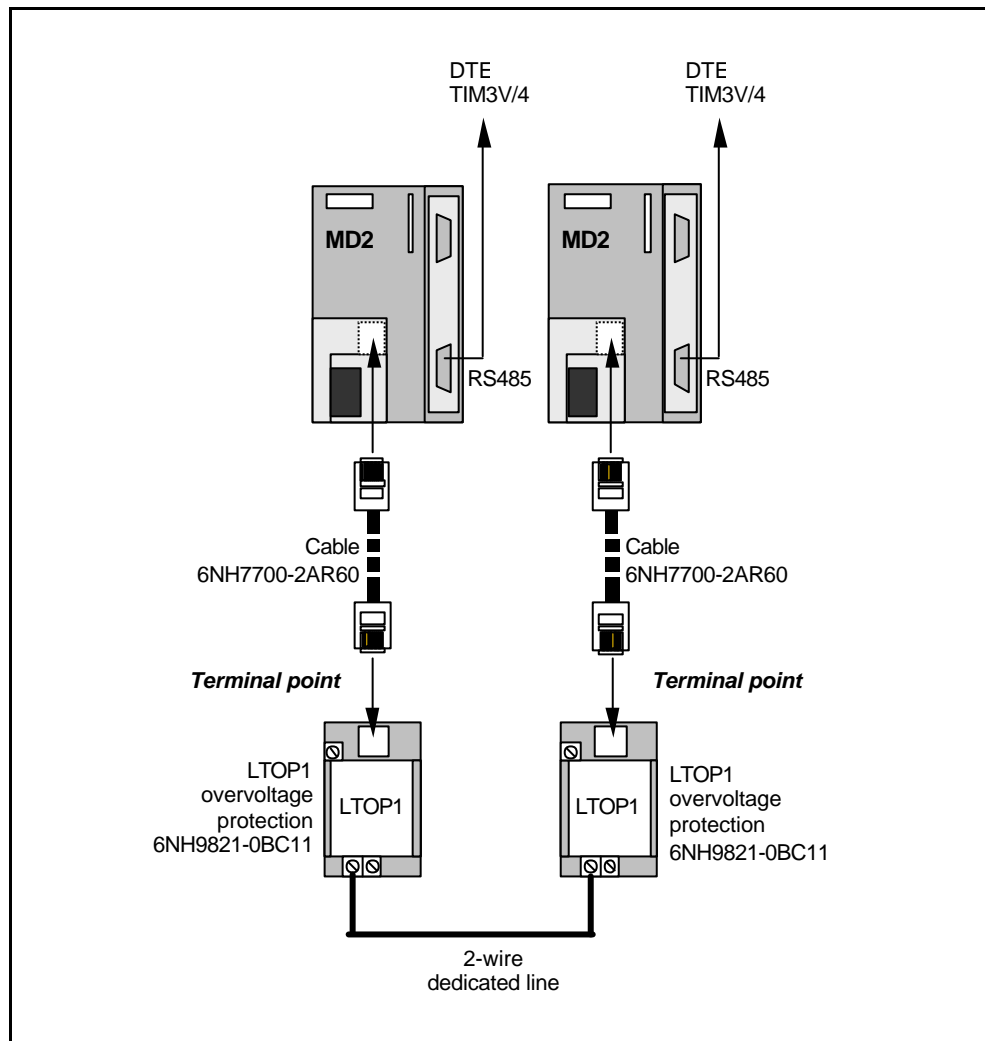


Fig. 5-10 Network configuration: Point-to-point, 2-wire half-duplex (RS485 interface)

Table 5-23 Settings for both 2-wire terminal points

Settings on the DIL switches accessible from above (see Fig. 2-3 and 2-4)			
5-pin and 10-pin DIL switch		Meaning	
		2-wire operation channel 1 "With RS485 interface" operating mode The baud rate must be selected with switches 4 and 5 on the 5-pin DIL switch and the character recognition with switches 5 to 7 on the 10-pin DIL switch.	
Settings on the DIL switch accessible from below (termination resistors)			
Type of connection	Baud rate	Setting on DIL switch	Note
Terminal Point 2-wire	1200 bps 2400 bps		The MD2 is located at the beginning or end of a 2-wire line and is set to a transmission speed of 1200 or 2400 bps. (see Fig. 2-6)
	9600 bps 19200 bps		Terminal point as above but with transmission speed set to 9600 or 19200 bps. (see Fig. 2-6)
Settings on the DIL switch accessible from below (port)			
Interface type	Setting on DIL switch		Note
RS485 interface			Activation of the RS485 interface (see Fig. 2-6)
Settings on the LTOP1 switch			
Switch	Switch position	Note	
Switch S1		2-wire channel (pins 2 and 5) activated (see Fig. 2-18)	

### 5.2.2 Point-to-Point with Fiber Optic Section, 2-wire Half-duplex (RS485 Interface)

Fig. 5-11 shows a configuration for a **point-to-point connection with fiber optic section, 2-wire half-duplex**. Both MD2 modems represent 2-wire terminal points and are set to the "With RS485 interface" operating mode. In addition a fiber optic section is connected through the RS485 interface of one of the MD2 modems.

All available baud rates and character recognition methods except for "MID off" can be used in this configuration.

The DIL switch settings on the MD2 modem and the switch settings on the LTOP1 are the same at both terminal points (see Table 5-24).

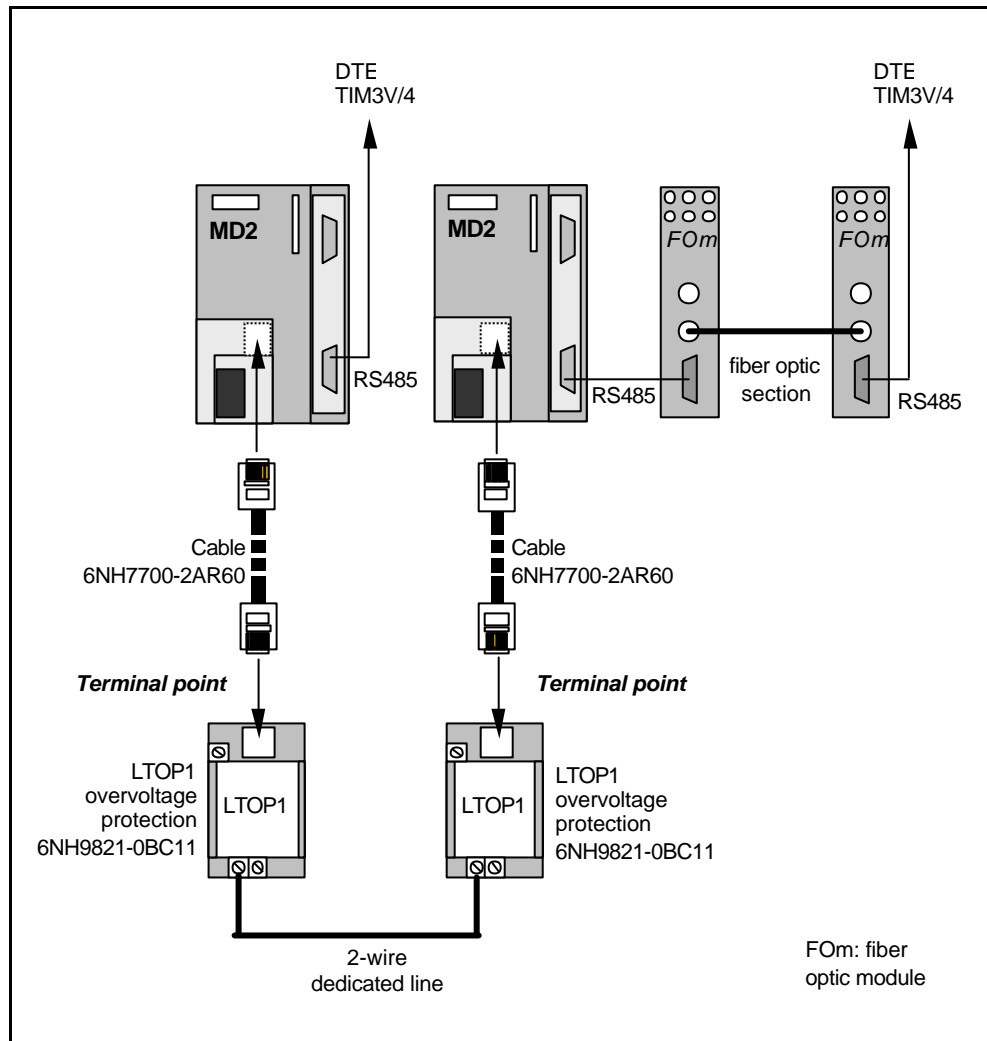


Fig. 5-11 Network configuration:  
Point-to-point with fiber optic section, 2-wire half-duplex (RS485 interface)



Table 5-24 Settings for both 2-wire terminal points

Settings on the DIL switches accessible from above (see Fig. 2-3 and 2-4)			
5-pin and 10-pin DIL switch		Meaning	
		2-wire operation channel 1 "With RS485 interface" operating mode The baud rate must be selected with switches 4 and 5 on the 5-pin DIL switch and the character recognition with switches 5 to 7 on the 10-pin DIL switch.	
Settings on the DIL switch accessible from below (termination resistors)			
Type of connection	Baud rate	Setting on DIL switch	Note
Terminal Point 2-wire	1200 bps 2400 bps		The MD2 is located at the beginning or end of a 2-wire line and is set to a transmission speed of 1200 or 2400 bps. (see Fig. 2-6)
	9600 bps 19200 bps		Terminal point as above but with transmission speed set to 9600 or 19200 bps. (see Fig. 2-6)
Settings on the DIL switch accessible from below (port)			
Interface type	Setting on DIL switch		Note
RS485 interface			Activation of the RS485 interface (see Fig. 2-6)
Settings on the LTOP1 switch			
Switch	Switch position	Note	
Switch S1		2-wire channel (pins 2 and 5) activated (see Fig. 2-18)	

### 5.2.3 Multidrop Line, 2-Wire Half-duplex (RS485 Interface)

Fig. 5-12 shows a configuration for a **multidrop line, 2-wire half-duplex**. The MD2 modems on the outer left and right represent 2-wire terminal points, the MD2 modem in the middle is a 2-wire tapping point. All three modems are set to the "With RS485 interface" operating mode.

All available baud rates and character recognition methods except for "MID off" can be used in this configuration.

The DIL switch settings on the MD2 modem and the switch settings on the LTOP1 are the same at both terminal points (see Table 5-25). The tapping point requires other switch settings on the MD2 and LTOP2 (see Table 5-26).

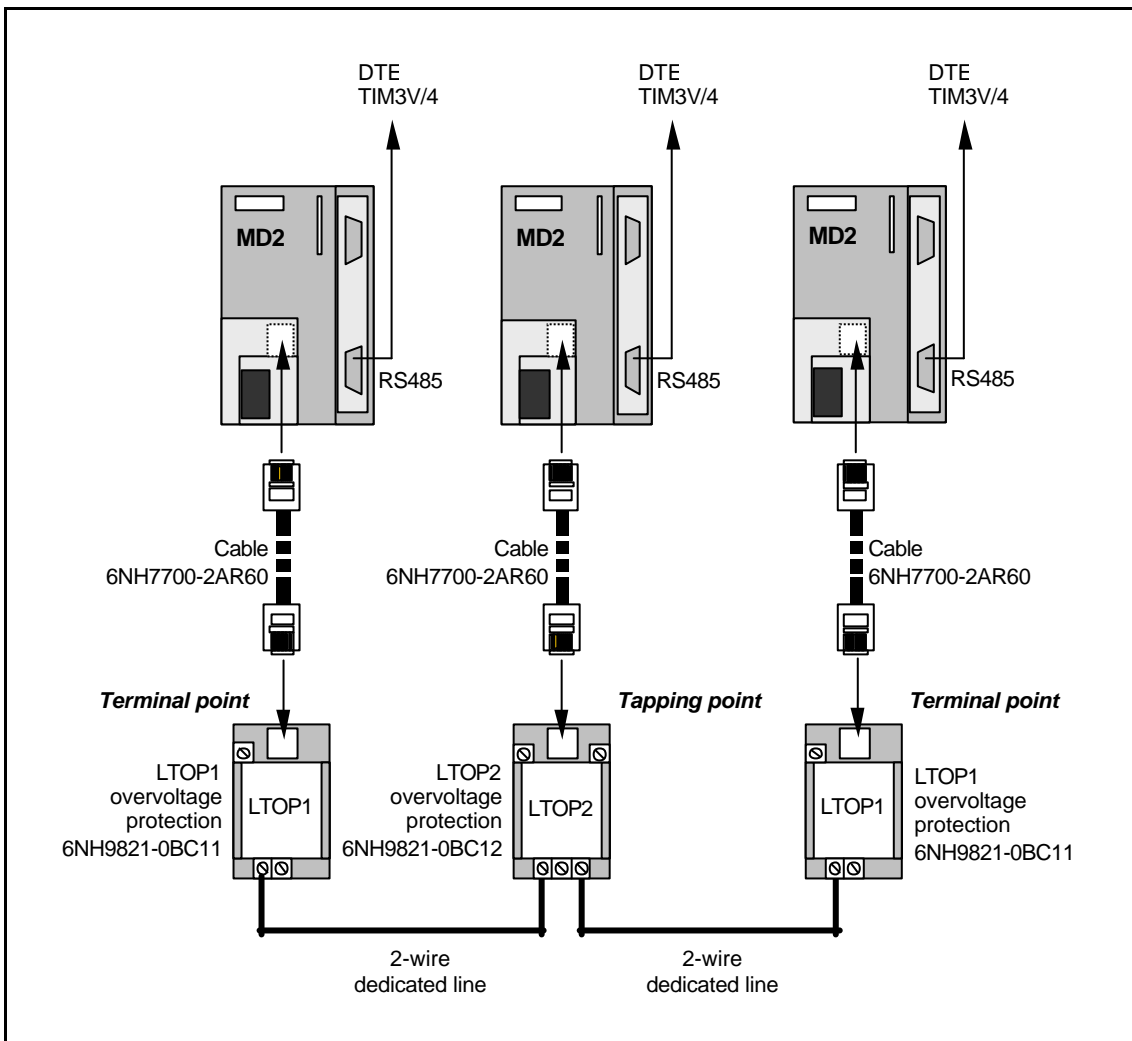


Fig. 5-12 Network configuration: Multidrop line, 2-wire half-duplex (RS485 interface)

Table 5-25 Settings for both 2-wire terminal points

Settings on the DIL switches accessible from above (see Fig. 2-3 and 2-4)			
5-pin and 10-pin DIL switch		Meaning	
		2-wire operation channel 1 "With RS485 interface" operating mode The baud rate must be selected with switches 4 and 5 on the 5-pin DIL switch and the character recognition with switches 5 to 7 on the 10-pin DIL switch.	
Settings on the DIL switch accessible from below (termination resistors)			
Type of connection	Baud rate	Setting on DIL switch	Note
Terminal Point 2-wire	1200 bps 2400 bps		The MD2 is located at the beginning or end of a 2-wire line and is set to a transmission speed of 1200 or 2400 bps. (see Fig. 2-6)
	9600 bps 19200 bps		Terminal point as above but with transmission speed set to 9600 or 19200 bps. (see Fig. 2-6)
Settings on the DIL switch accessible from below (port)			
Interface type	Setting on DIL switch		Note
RS485 interface			Activation of the RS485 interface (see Fig. 2-6)
Settings on the LTOP1 switch			
Switch	Switch position	Note	
Switch S1		2-wire channel (pins 2 and 5) activated (see Fig. 2-18)	

Table 5-26 Settings for the 2-wire tapping point

Settings on the DIL switches accessible from above (see Fig. 2-3 and 2-4)			
5-pin and 10-pin DIL switch		Meaning	
		2-wire operation channel 1 "With RS485 interface" operating mode The baud rate must be selected with switches 4 and 5 on the 5-pin DIL switch and the character recognition with switches 5 to 7 on the 10-pin DIL switch.	
Settings on the DIL switch accessible from below (termination resistors)			
Type of connection	Baud rate	Setting on DIL switch	Note
Tapping point 2-wire	1200 bps 2400 bps		The MD2 is <u>not</u> located at the beginning or end of a 2-wire line; it taps into this 2-wire line somewhere along the way with high resistance. The transmission speed is set to 1200 or 2400 bps. (see Fig. 2-6)
	9600 bps 19200 bps		Tapping point as above but with transmission speed set to 9600 or 19200 bps. (see Fig. 2-6)
Settings on the DIL switch accessible from below (port)			
Interface type	Setting on DIL switch		Note
RS485 interface			Activation of the RS485 interface (see Fig. 2-6)
Settings on the LTOP2 switches			
Switch	Switch position	Note	
Switch S1		2-wire channel (pins 2 and 5) activated (see Fig. 2-18)	
Switch S2		2-wire channel (pins 2 and 5) activated (see Fig. 2-18)	

### 5.2.4 Multidrop Line with Fiber Optic Section, 2-wire Half-duplex (RS485 Interface)

#### Overview

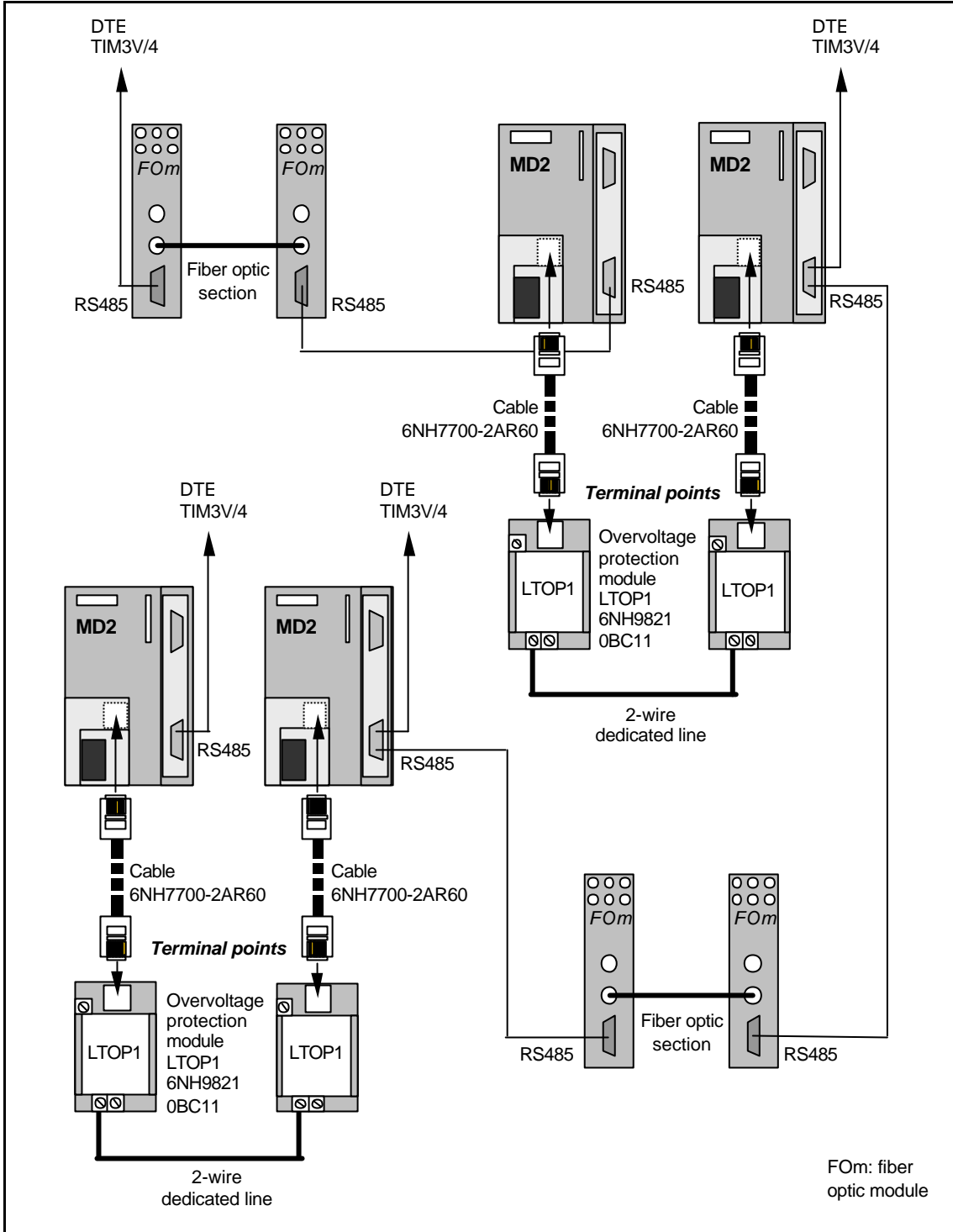



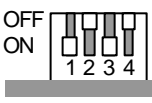
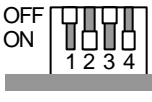
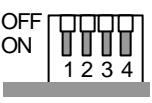

Fig. 5-13 Network configuration:  
Multidrop line with fiber optic section, 2-wire half-duplex (RS485 interface)

Fig. 5-13 shows a configuration for **multidrop line with fiber optic sections, 2-wire half-duplex**. All four MD2 modems represent 2-wire terminal points and are set to the "With RS485 interface" operating mode. The multidrop line includes two fiber optic sections that are connected through the RS485 interface of the MD2 modems.

All available baud rates and character recognition methods except for "MID off" can be used in this configuration.

The DIL switch settings on the MD2 modem and the switch settings on the LTOP1 are the same at all terminal points (see Table 5-27).

Table 5-27 Settings for each 2-wire terminal point

Settings on the DIL switches accessible from above (see Fig. 2-3 and 2-4)			
5-pin and 10-pin DIL switch		Meaning	
		2-wire operation channel 1 "With RS485 interface" operating mode The baud rate must be selected with switches 4 and 5 on the 5-pin DIL switch and the character recognition with switches 5 to 7 on the 10-pin DIL switch.	
Settings on the DIL switch accessible from below (termination resistors)			
Type of connection	Baud rate	Setting on DIL switch	Note
Terminal Point 2-wire	1200 bps 2400 bps		The MD2 is located at the beginning or end of a 2-wire line and is set to a transmission speed of 1200 or 2400 bps. (see Fig. 2-6)
	9600 bps 19200 bps		Terminal point as above but with transmission speed set to 9600 or 19200 bps. (see Fig. 2-6)
Settings on the DIL switch accessible from below (port)			
Interface type	Setting on DIL switch		Note
RS485 interface			Activation of the RS485 interface (see Fig. 2-6)
Settings on the LTOP1 switch			
Switch	Switch position	Note	
Switch S1		2-wire channel (pins 2 and 5) activated (see Fig. 2-18)	

### 5.2.5 Star Network, 2-Wire Half-duplex (RS485 Interface)

#### Overview

Fig. 5-14 shows a configuration for a **star network, 2-wire half-duplex**. Parallel connection of several MD2 modems enable the connection of a star network to one single DTE. All three MD2 modems represent terminal points but in this example one is a 2-wire, one is a 4-wire and the other is a 2 x 2-wire terminal point. Each modem is set to the "With RS485 interface" operating mode.

All available baud rates and character recognition methods except for "MID off" can be used in this configuration.

The settings on each modem is different due to the different terminal types they represent (see Table 5-28, Table 5-29 and Table 5-30).

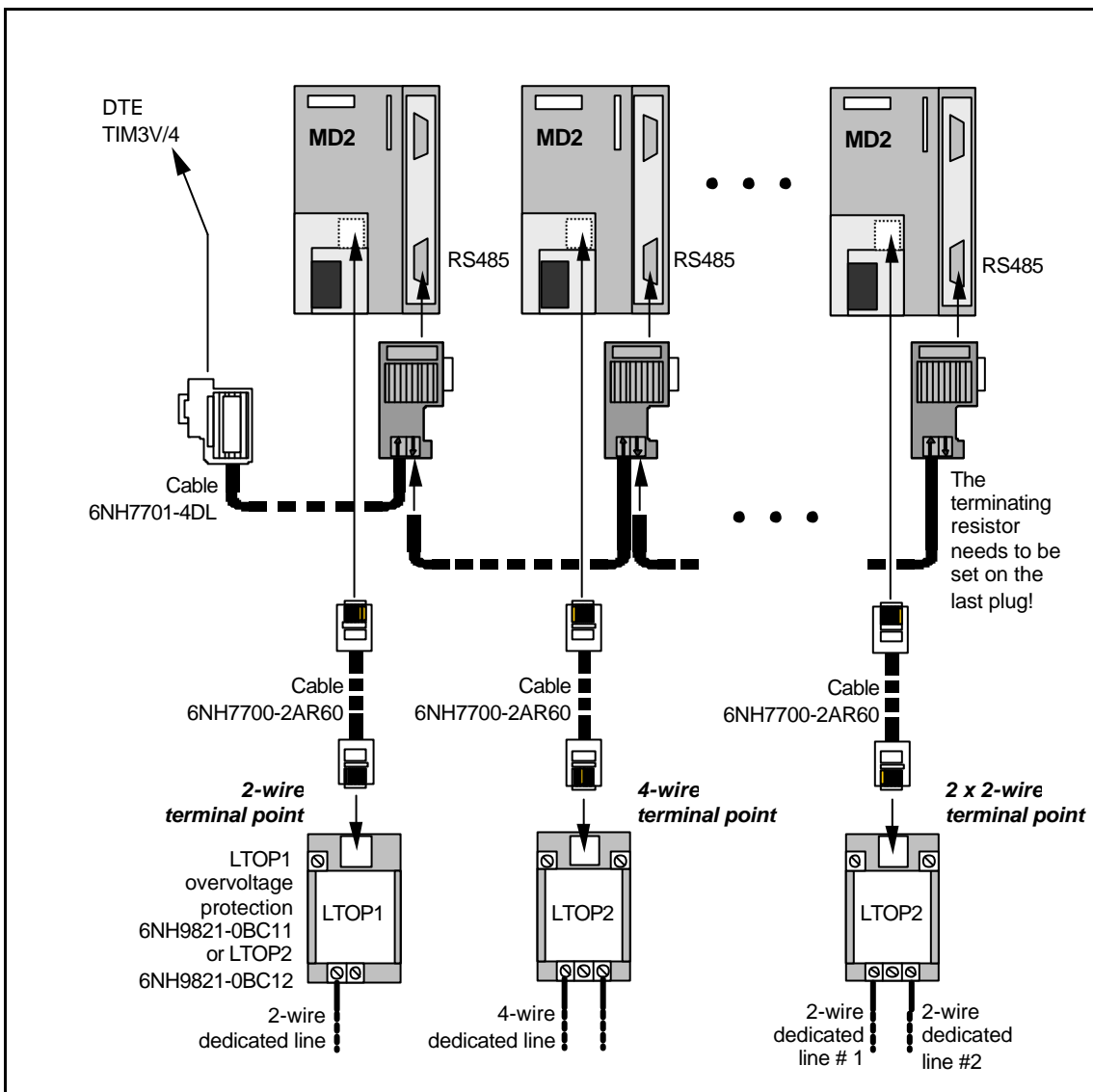


Fig. 5-14 Network configuration: Star network, 2-wire half-duplex (RS485 interface)

Table 5-28 Settings for the 2-wire terminal point

Settings on the DIL switches accessible from above (see Fig. 2-3 and 2-4)			
5-pin and 10-pin DIL switch		Meaning	
		2-wire operation channel 1 "With RS485 interface" operating mode The baud rate must be selected with switches 4 and 5 on the 5-pin DIL switch and the character recognition with switches 5 to 7 on the 10-pin DIL switch.	
Settings on the DIL switch accessible from below (termination resistors)			
Type of connection	Baud rate	Setting on DIL switch	Note
Terminal Point 2-wire	1200 bps 2400 bps		The MD2 is located at the beginning or end of a 2-wire line and is set to a transmission speed of 1200 or 2400 bps. (see Fig. 2-6)
	9600 bps 19200 bps		Terminal point as above but with transmission speed set to 9600 or 19200 bps. (see Fig. 2-6)
Settings on the DIL switch accessible from below (port)			
Interface type	Setting on DIL switch		Note
RS485 interface			Activation of the RS485 interface (see Fig. 2-6)
Settings on the LTOP1 switch			
Switch	Switch position	Note	
Switch S1		2-wire channel (pins 2 and 5) activated (see Fig. 2-18)	



Table 5-29 Settings for the 4-wire terminal point


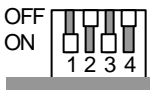
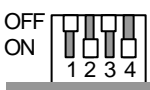
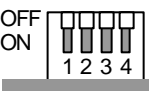


Settings on the DIL switches accessible from above (see Fig. 2-3 and 2-4)			
5-pin and 10-pin DIL switch		Meaning	
		4-wire operation channel 1 "With RS485 interface" operating mode The baud rate must be selected with switches 4 and 5 on the 5-pin DIL switch and the character recognition with switches 5 to 7 on the 10-pin DIL switch.	
Settings on the DIL switch accessible from below (termination resistors)			
Type of connection	Baud rate	Setting on DIL switch	Note
Terminal Point 4-wire	1200 bps 2400 bps		The MD2 is located at the beginning or end of a 4-wire line and is set to a transmission speed of 1200 or 2400 bps. (see Fig. 2-6)
	9600 bps 19200 bps		Terminal point as above but with transmission speed set to 9600 or 19200 bps. (see Fig. 2-6)
Settings on the DIL switch accessible from below (port)			
Interface type	Setting on DIL switch		Note
RS485 interface			Activation of the RS485 interface (see Fig. 2-6)
Settings on the LTOP2 switches			
Switch	Switch position	Note	
Switch S1		Receive channel (pins 2 and 5) activated (see Fig. 2-18)	
Switch S2		Send channel (pins 3 and 4) activated (see Fig. 2-18)	

Table 5-30 Settings for the 2 x 2-wire terminal point

Settings on the DIL switches accessible from above (see Fig. 2-3 and 2-4)			
5-pin and 10-pin DIL switch		Meaning	
		2-wire operation channels 1+2 "With RS485 interface" operating mode The baud rate must be selected with switches 4 and 5 on the 5-pin DIL switch and the character recognition with switches 5 to 7 on the 10-pin DIL switch.	
Settings on the DIL switch accessible from below (termination resistors)			
Type of connection	Baud rate	Setting on DIL switch	Note
Terminal Point 2 x 2-wire	1200 bps 2400 bps		The MD2 is located at the beginning or end of a 2-wire line and is set to a transmission speed of 1200 or 2400 bps. (see Fig. 2-6)
	9600 bps 19200 bps		Terminal point as above but with transmission speed set to 9600 or 19200 bps. (see Fig. 2-6)
Settings on the DIL switch accessible from below (port)			
Interface type	Setting on DIL switch		Note
RS485 interface			Activation of the RS485 interface (see Fig. 2-6)
Settings on the LTOP2 switches			
Switch	Switch position	Note	
Switch S1		First 2-wire channel (pins 2 and 5) activated (see Fig. 2-18)	
Switch S2		Second 2-wire channel (pins 3 and 4) activated (see Fig. 2-18)	

## 5.2.6 Repeater, 2-Wire Half-duplex (RS485 Interface)

### Overview

Fig. 5-15 shows a configuration for a **multidrop line with intermediate 2-wire repeater, 2-wire half-duplex**. The MD2 modem on the left represents a 2-wire terminal point, the MD2 modem on the right is a 2-wire tapping point. Both modems are set to the "With RS485 interface" operating mode. Both MD2 modems in the middle form a 2-wire repeater and are set to the "Repeater" operating mode.

All available baud rates and character recognition methods except for "MID off" can be used in this configuration.

Note that the DIL switch settings for the modems are different due to their location in the multidrop line: one is a 2-wire terminal point (see Table 5-31), one is a 2-wire tapping point (see Table 5-32) and two are 2-wire repeaters (see Table 5-33). The two repeater modems have the same DIL switch settings.

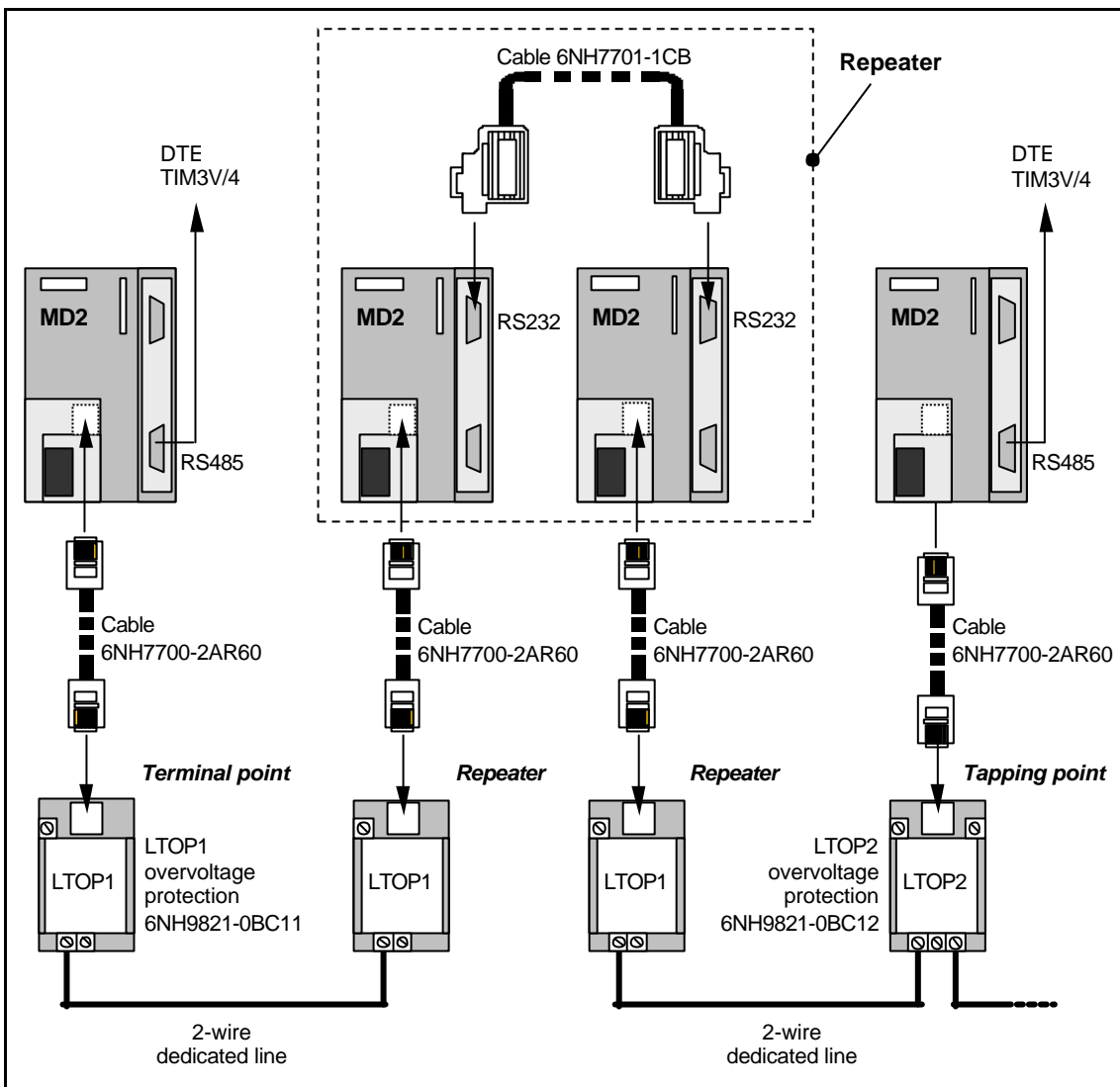


Fig. 5-15 Network configuration: Repeater, 2-wire half-duplex (RS485 interface)

Table 5-31 Settings for the 2-wire terminal point

Settings on the DIL switches accessible from above (see Fig. 2-3 and 2-4)			
5-pin and 10-pin DIL switch		Meaning	
		2-wire operation channel 1 "With RS485 interface" operating mode The baud rate must be selected with switches 4 and 5 on the 5-pin DIL switch and the character recognition with switches 5 to 7 on the 10-pin DIL switch.	
Settings on the DIL switch accessible from below (termination resistors)			
Type of connection	Baud rate	Setting on DIL switch	Note
Terminal Point 2-wire	1200 bps 2400 bps		The MD2 is located at the beginning or end of a 2-wire line and is set to a transmission speed of 1200 or 2400 bps. (see Fig. 2-6)
	9600 bps 19200 bps		Terminal point as above but with transmission speed set to 9600 or 19200 bps. (see Fig. 2-6)
Settings on the DIL switch accessible from below (port)			
Interface type	Setting on DIL switch		Note
RS485 interface			Activation of the RS485 interface (see Fig. 2-6)
Settings on the LTOP1 switch			
Switch	Switch position	Note	
Switch S1		2-wire channel (pins 2 and 5) activated (see Fig. 2-18)	

Table 5-32 Settings for the 2-wire tapping point

Settings on the DIL switches accessible from above (see Fig. 2-3 and 2-4)			
5-pin and 10-pin DIL switch		Meaning	
		2-wire operation channel 1 "With RS485 interface" operating mode The baud rate must be selected with switches 4 and 5 on the 5-pin DIL switch and the character recognition with switches 5 to 7 on the 10-pin DIL switch.	
Settings on the DIL switch accessible from below (termination resistors)			
Type of connection	Baud rate	Setting on DIL switch	Note
Tapping point 2-wire	1200 bps 2400 bps		The MD2 is <u>not</u> located at the beginning or end of a 2-wire line; it taps into this 2-wire line somewhere along the way with high resistance. The transmission speed is set to 1200 or 2400 bps. (see Fig. 2-6)
	9600 bps 19200 bps		Tapping point as above but with transmission speed set to 9600 or 19200 bps. (see Fig. 2-6)
Settings on the DIL switch accessible from below (port)			
Interface type	Setting on DIL switch		Note
RS485 interface			Activation of the RS485 interface (see Fig. 2-6)
Settings on the LTOP2 switches			
Switch	Switch position	Note	
Switch S1		2-wire channel (pins 2 and 5) activated (see Fig. 2-18)	
Switch S2		2-wire channel (pins 2 and 5) activated (see Fig. 2-18)	

Table 5-33 Settings for a 2-wire repeaters

Settings on the DIL switches accessible from above (see Fig. 2-3 and 2-4)			
5-pin and 10-pin DIL switch		Meaning	
		2-wire operation channel 1 "Repeater" operating mode The baud rate must be selected with switches 4 and 5 on the 5-pin DIL switch and the character recognition with switches 5 to 7 on the 10-pin DIL switch.	
Settings on the DIL switch accessible from below (termination resistors)			
Type of connection	Baud rate	Setting on DIL switch	Note
Repeater 2-wire	1200 bps 2400 bps		The MD2 is connected as a repeater on a 2-wire line and is set to a transmission speed of 1200 or 2400 bps. (see Fig. 2-6)
	9600 bps 19200 bps		Repeater as above but with transmission speed set to 9600 or 19200 bps. (see Fig. 2-6)
Settings on the DIL switch accessible from below (port)			
Interface type	Setting on DIL switch		Note
RS232 interface			Activation of the RS232 interface (see Fig. 2-6)
Settings on the LTOP1 switch			
Switch	Switch position	Note	
Switch S1		2-wire channel (pins 2 and 5) activated (see Fig. 2-18)	

### 5.3 Network Configurations for DTE without RTS/CTS

The MD2 operating mode "Normal with DTR/RTS on" can be used in network configurations with data terminal equipment (e.g. SIMATIC CPs) that cannot control the MD2 through the RTS and CTS control signals. Only a point-to-point connection in 4-wire full-duplex transmission mode is possible with this operating mode. The following table provides an overview.

Table 5-34 Overview of network configurations for DTE without RTS/CTS

<b>Network Configuration</b>	<b>Modem Operating Mode</b>	<b>Transmission Type</b>	<b>Section</b>
Point-to-point	Normal with DTR/RTS on	4-wire full-duplex	5.3.1
Point-to-point with repeater	Normal with DTR/RTS on	4-wire full-duplex	5.3.2

### 5.3.1 Point-to-Point, 4-wire Full-duplex

#### Overview

Fig. 5-16 shows a configuration for a **point-to-point, 4-wire full-duplex** network. Both MD2 modems represent 4-wire terminal points and are set to the "Normal with DTR/RTS on" operating mode.

All available baud rates and character recognition methods except for "MID off" can be used in this configuration.

The DIL switch settings on the MD2 modem and the switch settings on the LTOP2 are the same at both terminal points (see Table 5-35).

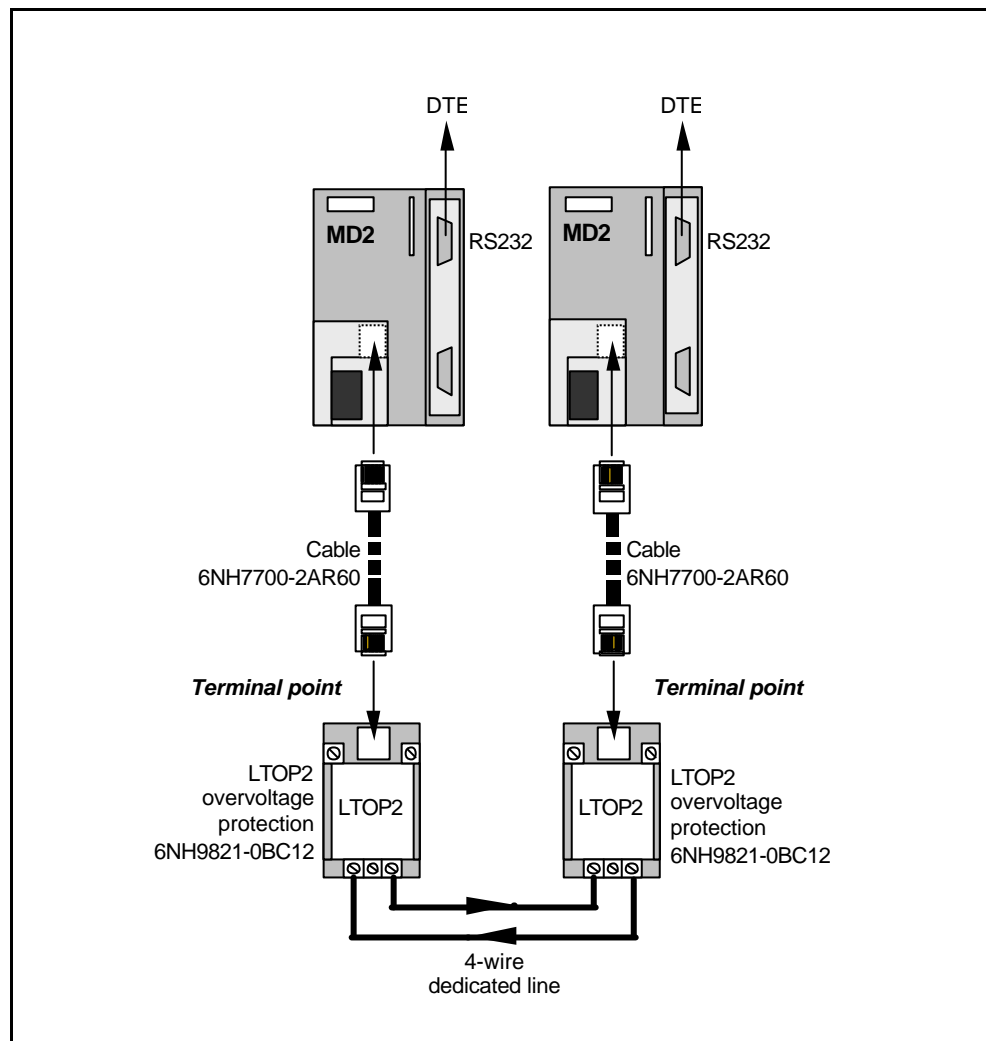


Fig. 5-16 Network configuration: point-to-point, 4-wire full-duplex



Table 5-35 Settings for both 4-wire terminal points

Settings on the DIL switches accessible from above (see Fig. 2-3 and 2-4)			
5-pin and 10-pin DIL switch		Meaning	
		4-wire operation channel 1 "Normal with DTR/RTS on" operating mode The baud rate must be selected with switches 4 and 5 on the 5-pin DIL switch and the character recognition with switches 5 to 7 on the 10-pin DIL switch.	
Settings on the DIL switch accessible from below (termination resistors)			
Type of connection	Baud rate	Setting on DIL switch	Note
Terminal Point 4-wire	1200 bps 2400 bps		The MD2 is located at the beginning or end of a 4-wire line and is set to a transmission speed of 1200 or 2400 bps. (see Fig. 2-6)
	9600 bps 19200 bps		Terminal point as above but with transmission speed set to 9600 or 19200 bps. (see Fig. 2-6)
Settings on the DIL switch accessible from below (port)			
Interface type	Setting on DIL switch		Note
RS232 interface			Activation of the RS232 interface (see Fig. 2-6)
Settings on the LTOP2 switches			
Switch	Switch position	Note	
Switch S1		Receive channel (pins 2 and 5) activated (see Fig. 2-18)	
Switch S2		Send channel (pins 3 and 4) activated (see Fig. 2-18)	

### 5.3.2 Point-to-Point with Repeater, 4-wire Full-duplex

#### Overview

Fig. 5-17 shows a configuration for a **point-to-point connection with an intermediate 4-wire repeater, 4-wire full-duplex**. The MD2 modems on the outer left and right represent 4-wire terminal points. Both modems are set to the "Normal with DTR/RTS on" operating mode. Both MD2 modems in the middle form a 4-wire repeater and are set to the "Repeater" operating mode.

All available baud rates and character recognition methods except for "MID off" can be used in this configuration.

Note that the DIL switch settings for the modems are different due to their location in the multidrop line: two are 4-wire terminal points (see Table 5-36), two are 4-wire repeaters (see Table 5-37).

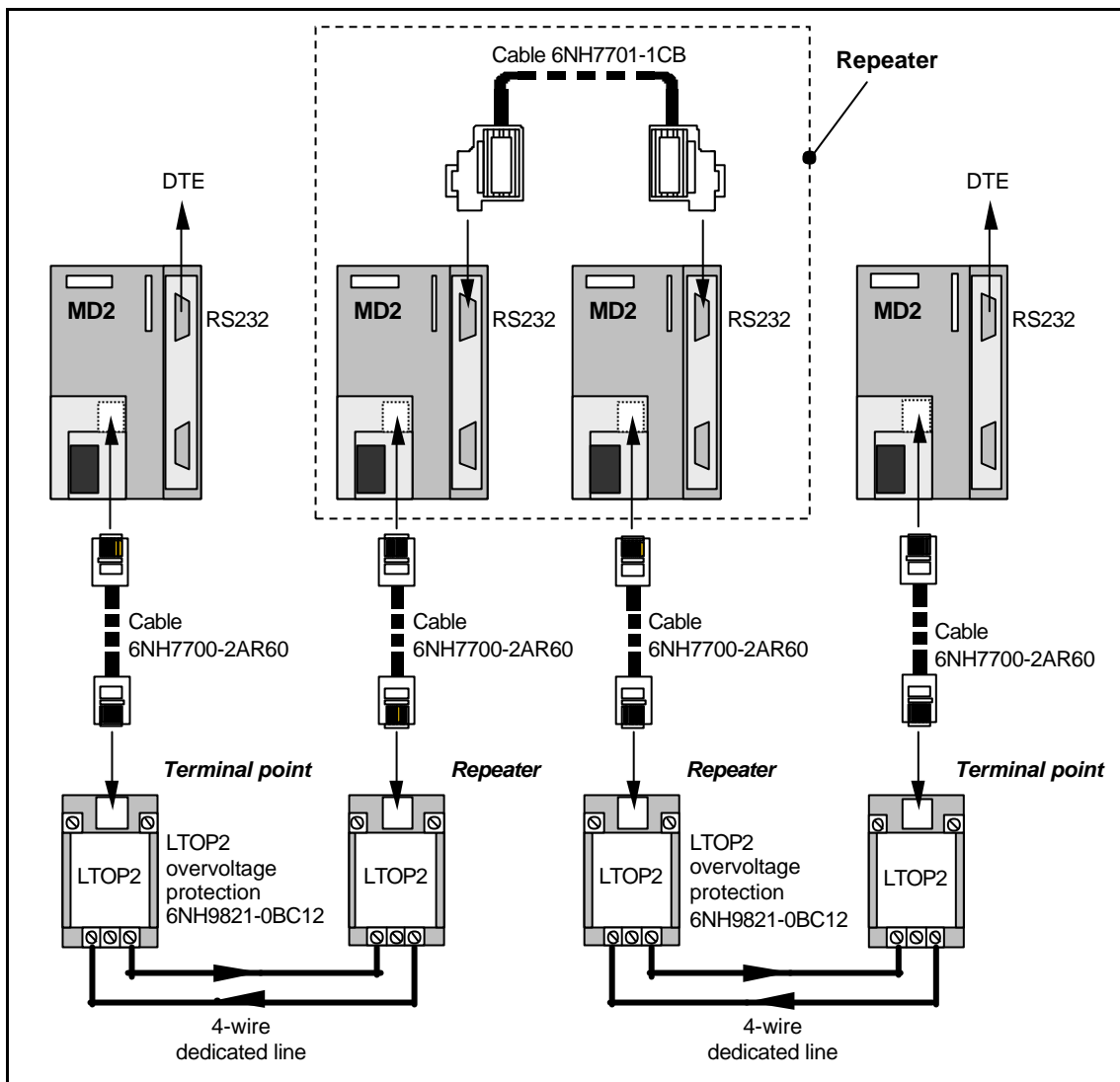
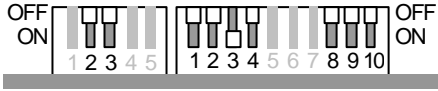
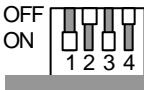
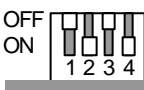





Fig. 5-17 Network configuration: Point-to-point with repeater, 4-wire full-duplex

Table 5-36 Settings for both 4-wire terminal points

Settings on the DIL switches accessible from above (see Fig. 2-3 and 2-4)			
5-pin and 10-pin DIL switch		Meaning	
		4-wire operation channel 1 "Normal with DTR/RTS on" operating mode The baud rate must be selected with switches 4 and 5 on the 5-pin DIL switch and the character recognition with switches 5 to 7 on the 10-pin DIL switch.	
Settings on the DIL switch accessible from below (termination resistors)			
Type of connection	Baud rate	Setting on DIL switch	Note
Terminal Point 4-wire	1200 bps 2400 bps		The MD2 is located at the beginning or end of a 4-wire line and is set to a transmission speed of 1200 or 2400 bps. (see Fig. 2-6)
	9600 bps 19200 bps		Terminal point as above but with transmission speed set to 9600 or 19200 bps. (see Fig. 2-6)
Settings on the DIL switch accessible from below (port)			
Interface type	Setting on DIL switch		Note
RS232 interface			Activation of the RS232 interface (see Fig. 2-6)
Settings on the LTOP2 switches			
Switch	Switch position	Note	
Switch S1		Receive channel (pins 2 and 5) activated (see Fig. 2-18)	
Switch S2		Send channel (pins 3 and 4) activated (see Fig. 2-18)	

Table 5-37 Settings for both 4-wire repeaters

Settings on the DIL switches accessible from above (see Fig. 2-3 and 2-4)			
5-pin and 10-pin DIL switch		Meaning	
		4-wire operation channel 1 "Repeater" operating mode The baud rate must be selected with switches 4 and 5 on the 5-pin DIL switch and the character recognition with switches 5 to 7 on the 10-pin DIL switch.	
Settings on the DIL switch accessible from below (termination resistors)			
Type of connection	Baud rate	Setting on DIL switch	Note
Repeater 4-wire	1200 bps 2400 bps		The MD2 is connected as a repeater on a 4-wire line and is set to a transmission speed of 1200 or 2400 bps. (see Fig. 2-6)
	9600 bps 19200 bps		Repeater as above but with transmission speed set to 9600 or 19200 bps. (see Fig. 2-6)
Settings on the DIL switch accessible from below (port)			
Interface type	Setting on DIL switch		Note
RS232 interface			Activation of the RS232 interface (see Fig. 2-6)
Settings on the LTOP2 switches			
Switch	Switch position	Note	
Switch S1		Receive channel (pins 2 and 5) activated (see Fig. 2-18)	
Switch S2		Send channel (pins 3 and 4) activated (see Fig. 2-18)	



# Technical Data

# 6

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## 6.2 Technical Data

### 6.2.1 DTE interfaces

#### RS232 interface

Connector:	9-pin sub-D plug
Pin assignment:	According to ITU-T recommendation V.24 (RS232)
Signal level:	According to ITU-T recommendation V.28
Clear to send:	RTS and CTS signals
Response time:	8 x bit periods 4 x bit periods at 9600 baud
Hangover time:	3 x bit periods with squelch off 6 x bit periods with squelch on

#### RS485 interface

Connector:	9-pin sub-D socket
Pin assignment:	According to RS485
Signal level:	According to RS485

#### "With RS485 Interface" operating mode

Refresh delay:	RS485 input signal
Time required:	9.5 x bit periods



## 6.2.2 FSK Line Interface

Modulation method: Binary continuous phase  
FSK frequency modulation

### FSK transmitter

Output impedance  
 at 1200 and 2400 bps: 600  $\Omega$   
 at 9600 and 19200 bps: 150  $\Omega$   
 Send level: -7..-6.0dB at 300  $\Omega$   
 -7..-5.5dB at 75  $\Omega$   
 can be switched to 0  $\pm$ 1 dB at 300/75  $\Omega$

### FSK receiver

Input impedance: min. 6 k $\Omega$   
 Reception level range: 0 .. -43..-45 dB  
 Terminating resistor  
 for 1200 and 2400 bps: 600  $\Omega$   $\pm$ 1%  
 for 9600 and 19200 bps: 150  $\Omega$   $\pm$ 1%  
 for tapping point: > 6 k $\Omega$   
 Reception level monitor: DCD signal  
 Response threshold: -43..-45 dB  
 Response time: 6.5 x bit periods  
 4.5 x bit periods at 9600 baud  
 Hangover time: 5..7 x bit periods  
 2.5..3.5 x bit periods at 9600 baud  
 Delay demodulation FSK signal: 1 x bit period  
 Refresh delay RxD signal: 2 x bit periods  
 Refresh delay for  
 "Repeater" operating mode: 6 x bit periods

### Miscellaneous

Impulse voltage resistance between  
 the power supply circuit, both  
 FSK transmission line circuits  
 and the optocoupler output: U<sub>1,2/50</sub> = 2.5 kV acc. to DIN VDE 0804

Transmission path: Uncoiled or lightly coiled  
 2-wire or 4-wire dedicated line

Transmission speed: 1200, 2400, 9600, 19200 bps,  
 switchable

RTS output: Floating optorelay output  
 max. connection voltage: 60V AC/DC  
 max. allowed constant current: 400mA  
 max.R<sub>on</sub>: 3  $\Omega$

### 6.2.3 Frequencies, Attenuation and Maximum Range

#### Transmission Speeds and Frequencies

Table 6-1 Transmission speeds and frequencies on the dedicated line

Transmission speed (bps)	Mid-frequency (Hz)	Frequency deviation $\Delta f$ (Hz)	Lower keying frequency (Hz)	Upper keying frequency (Hz)
1200	1 700	400	1 300	2 100
2400	2 850	450	2400	3 300
9600 / 19200	27 200	6 400	20 800	33 600

#### Attenuation Values

Tabelle 6-2 Attenuation in relation to the transmission speed for non-coil-loaded telecommunication lines of type 2 x 2 x A J-Y(St)Y (A = core diameter in mm).

Transmission speed (bps)	Loss per km (dB) for core diameter (mm)					Loss per LTOP (dB)	Insertion loss per tapping point (dB)
	0.6	0.8	0.9	1.2	1.4		
Line termination with Z = 600 Ohm							
1200	1.5	1.15	0.9	0.65	0.55	0.4	0.4
2400	1.85	1.4	1.1	0.75	0.6	0.4	0.2
Line termination with Z = 150 Ohm							
9600 / 19200	4.3	3.2	2.6	1.8	1.5	2.0	0.2

## Maximum Range (km)

Table 6-3 Maximum range in relation to the transmission speed with 4dB level reserve.  
Standard values for non-coil-loaded telecommunication lines of type  
2 x 2 x A J-Y(St)Y (A = core diameter in mm).

Transmission speed (bps)	Maximum range (km)			
	Send level -6 dB *)		Send level 0 dB *)	
	with LTOP	without LTOP	with LTOP	without LTOP
<b>Core diameter 0.6 mm</b>				
1200	21.4 – NTP x 0.8	22 – NTP x 0.3	25.4 – NTP x 0.8	26 – NTP x 0.3
2400	17.4 – NTP x 0.6	17.8 – NTP x 0.2	20.6 – NTP x 0.6	21 – NTP x 0.2
9600 / 19200	6.7 – NTP x 1.0	7.6 – NTP x 0.1	8.1 – NTP x 1.0	9 – NTP x 0.1
<b>Core diameter 0.8 mm</b>				
1200	28 – NTP x 1.1	28.7 – NTP x 0.4	33.2 – NTP x 1.1	33.9 – NTP x 0.4
2400	23 – NTP x 0.8	23.5 – NTP x 0.2	27.2 – NTP x 0.8	27.8 – NTP x 0.2
9600 / 19200	9.0 – NTP x 1.4	10.3 – NTP x 0.1	10.9 – NTP x 1.4	12.1 – NTP x 0.1
<b>Core diameter 0.9 mm</b>				
1200	35.7 – NTP x 1.4	36.6 – NTP x 0.5	42.4 – NTP x 1.4	43.3 – NTP x 0.5
2400	29.2 – NTP x 1.0	30 – NTP x 0.2	34.7 – NTP x 1.0	35.4 – NTP x 0.2
9600 / 19200	11.1 – NTP x 1.7	12.6 – NTP x 0.1	13.4 – NTP x 1.7	15 – NTP x 0.1
<b>Core diameter 1.2 mm</b>				
1200	49.5 – NTP x 1.9	50.7 – NTP x 0.7	58.7 – NTP x 1.9	60 – NTP x 0.7
2400	42.9 – NTP x 1.4	44 – NTP x 0.3	50.9 – NTP x 1.4	52 – NTP x 0.3
9600 / 19200	16.1 – NTP x 2.4	18.3 – NTP x 0.2	19.4 – NTP x 2.4	21.6 – NTP x 0.2
<b>Core diameter 1.4 mm</b>				
1200	58.5 – NTP x 2.2	60 – NTP x 0.8	69.4 – NTP x 2.2	70.9 – NTP x 0.8
2400	53.6 – NTP x 1.7	55 – NTP x 0.4	63.6 – NTP x 1.7	65 – NTP x 0.4
9600 / 19200	19.3 – NTP x 2.9	22 – NTP x 0.2	23.3 – NTP x 2.9	26 – NTP x 0.2

NTP = number of tapping points

\*) not permitted on telecom leased lines. Set send level to -9 dB.

## 6.2.4 General Data

### Power supply

Nominal:	DC 24 V
Permitted range:	18 .. 32 V
Ripple $U_{SS}$ :	max. 3.6 V
Power consumption:	Typically 100 mA
Polarization protection:	Yes

### Mechanical Data

Housing dimensions (H x W x D):	125 x 80 x 120 mm
Weight:	Approx. 0.3 kg
Mounting:	Can be snapped on a S7-300 mounting rail or using adapter 6NH7760-0AA on a 35 mm standard rail acc. to DIN 46 277
Line cross section (screw terminals):	0.25 .. 0.75 mm <sup>2</sup> (including core end ferrules)

### Ambient

Temperature	
Operation:	0 .. +60°C
Storage/Transport:	-40 .. +70°C
Humidity:	Max. 95%, no condensation
Protection type:	IP 20 acc. to DIN 40050
Air pressure	
Operation:	Up to 2 000 m at msl
Storage/Transport:	Up to 3 500 m at msl
CE Label	
Interference immunity:	Conform to EN 60870-2-1 : 1996
Emitted interference:	Conform to EN 55022 : 1998 (radio interference level B)



# Problem Report

## SINAUT ST1 / ST7 / ST7cc

K \_ \_ \_ \_ (Servicenumber given by I&S OCW TI Hotline)  
 E \_ \_ \_ \_ (Servicenumber given by I&S IS6 ECS)

<b>To</b> <b>SIEMENS AG</b> I&S OCW TI Attn. Ms. Ksiondz Siemensallee 84 76181 Karlsruhe Germany  Tel. +49 (0)721 / 595 - 5204 Fax. +49 (0)721 / 595 - 5244 E-mail: <b>Hotline.ST@khe.siemens.de</b>	<b>From</b>      Tel. Fax. E-mail:	<b>Entry remark</b>     Response: .....  Done: .....
--	--	---

When hardware is clearly at fault, please send the device to:  
**Siemens AG, I&S IS6-ECS, Retourenstelle, Attn. Ms. Stenzel,**  
**Fraunauracher Str. 98, 91056 Erlangen, Germany**

Forwarded on .....	for information	for processing
<input type="checkbox"/> to Karlsruhe I&S OCW TI, Mr./Ms.: .....	<input type="checkbox"/>	<input type="checkbox"/>
<input type="checkbox"/> to Erlangen I&S IS6 ECS, Mr./Ms.: .....	<input type="checkbox"/>	<input type="checkbox"/>

1. **Keyword :** .....

2. **Project :** .....

3. **Contact at Siemens AG (Sales):**

Name: ..... Dept.: ..... City: .....

4. **Contact at customer**

Company: ..... Dept.: .....

Name: ..... Tel.: ..... Fax: .....

Street: ..... ZIP: ..... City: .....

E-mail: .....

5. **Brief description of plant** (for example: Dial-up network with 10 stations)

.....  
 .....

6. **Description of problem:**

Occurs :  always  sporadically  reproducible

The error has occurred since: ..... observed by: .....

Problem already discussed with: ..... on: .....

7. **Attachments:**

Network configuration .....  Archived project .....  other attachments

..... Dept., City, Date ..... Processed by

To be completed by the person who processes the problem report: Keyword 1: ..... Keyword 2: .....
---







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Tel: ++49 / 721 / 595-4466  
Fax: ++49 / 721 / 595-5244

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without notice (07/2002)