

SAT 100

CE-0700

**Dedicated-Line Modem for 1703
User's Guide**

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CE-0700	for versions G21-200-- and higher
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1. Introduction

The CE-0700 Modem was developed and designed as analog leased-line modem for use with the SAT 1703 telecontrol system. It permits the asynchronous transparent data communication via a 2-wire line with

1200 bd	half-duplex according to ITU-T V.23, and
300 bd	full-duplex according to ITU-T V.21

and on a 4-wire line additional

1200bd	full-duplex.
--------	--------------

CE-0700 features a leased line interface with surge voltage protection and a digital interface according to ITU-T V.24 / V.28 (RS 232-C). The modem has to be supplied with power via the SAT 1703 telecontrol system (+5V internal system voltage).

The power supply input of the CE-0700 Modem is neither protected against polarity reversal nor against overvoltage transients. Compliance with EN 50082, EN 55055 standards can be guaranteed only where a SAT 1703 telecontrol component is used to supply the modem with power.

CE-0700's mechanical design was dimensioned for mounting on a TS 35 mounting channel (35mm top-hat rail).

2. Functional Description

2.1. Modulation Method

With the digital data signal of the V.24 / V.28 interface, an analog carrier signal (mid frequency) is frequency-modulated. Since the digital signal can only assume the states 0 or 1, two characteristic frequencies are produced:

upper characteristic frequency: mid frequency + modulation frequency
 lower characteristic frequency: mid frequency – modulation frequency

This special case of a frequency modulation is also called FSK (frequency shift keying) and corresponds to the modulation method for VFT installations. The required modulation frequency is proportional to the baud rate.

The following frequencies can be adjusted:

standard	baud rate	mid frequency	characteristic frequencies	
			lower	upper
V.23	0 – 1200 bd	1700 hz	1300 hz	2100 hz
V.21 Originate	0 – 300 bd	1080 hz	980 hz	1180 hz
V.21 Answer	0 – 300 bd	1750 hz	1650 hz	1850 hz

The above table shows that only one frequency band is available for communication with 1200 bd (V.23). Therefore, the CE-0700 Modem with a 2-wire line can only be used for half-duplex transmission. In the operating mode to V.21 (300 Bd), 2 frequency bands are available, whereby simultaneous transmitting of 2 modulated data signals onto one 2-wire line is made possible. Therefore, in this operating mode, the communication line can also be used for full-duplex transmission. When parameterizing the modems for a transmission line in V.21 mode, however, keep in mind that one modem has to be operated in the “Originate” mode and the other in the “Answer” mode.

If CE-0700 is operated together with VFT installations, frequency deviations ≤ 20 Hz that may result from the individual scales of VFT systems will usually not entail any consequences.

2.2. Transmission Amplifier

The analog output signal of the modulator is amplified as adjusted on the transmission amplifier to either -14 dBm (on a 600-ohms line) or -6 dBm. The output of this amplifier is a current source (high-impedance). Together with the line adaption circuit, it permits a line termination with 600 ohms or with high-impedance. For more detailed information on which impedance setting is required in which operating mode, see the chapter "Operating Modes".

2.3. Local Line Equalizer

Since telecommunication cables have an attenuation characteristic that is proportional to the squareroot of the frequency, the upper characteristic frequency will be attenuated more than the lower characteristic frequency. This effect is also called amplitude distortion and gets more pronounced the longer the cable is. In extreme cases, this may impede the demodulation of the received signal. For this reason, the CE-0700 Modem has a line equalizer on board, that is a reception amplifier that boosts the higher frequencies more than the lower ones and thus compensates, at least partially, the frequency response of the telecommunication cable.

The local line equalizer is dimensioned such that the frequency response of a telecommunication cable having a wire diameter of 0.6 mm and a length of 12 km will be exactly compensated. Therefore, the following rule is valid for parameterizing:

wire diameter of telecom cable = 0,6 mm:

- cable length shorter than 12 km \Rightarrow deactivate local line equalizer
- cable length longer than or equal to 12 km \Rightarrow activate local line equalizer.

wire diameter of telecom cable = 0.8 mm:

- cable length shorter than 18 km \Rightarrow deactivate local line equalizer
- cable length longer than or equal to 18 km \Rightarrow activate local line equalizer.

2.4. Line Adaption Circuit

The line adaption circuit consists essentially of a surge voltage protection, a transformer for electrical isolation and a hybrid with a line balancing network for 2-wire operation.

2.5. Digital Interface

The digital interface of the CE-0700 Modem is designed according to V.24 / V.28 (RS 232-C). The following interface signals are available:

- **TxD:** transmit data (input)
- **RxD:** receive data (output)
- **RTS:** request to send (input)
- **CTS:** clear to send (output)
- **DCD:** data carrier detect (output)
- **DTR:** data terminal ready, used for a redundant modem configuration (input)
- **GND:** signal ground

The specifications "input" and "output" in the above list relate to the modem.

In detail, these interface signals perform the following functions:

- **TxD:** for the transmit data signal, there exists no limitation whatsoever but the set baud rate (0 – 300 bd, or 0 – 1200 bd) which must not be exceeded, however, which may be undershot at random. Every bit of the transmit data signal is transmitted to the remote station in a time-transparent manner.
- **RxD:** the received signal corresponds to the transmit signal of the remote station, delayed by a constant propagation time. Bit errors that may occur by electromagnetic influences on the transmission medium will not be corrected.
- **RTS:** this status signal can be used to activate the modem's transmission section. This function is needed for the "multipoint traffic" mode (see chapter "Operating Modes"). If necessary, the modem can also be parameterized such that the transmission section will always be ON, i.e., that the RTS status line will not be noticed.
- **CTS:** this status line is used to signal to the data terminal device that the modem is ready to send.
- **DCD:** the DCD signal is activated as soon as the receiver of the modem detects a level on the transmission line. The delay between RTS and the output of DCD at the remote station is 20 ms, without taking propagation times on the transmission line into account.
- **DTR:** the DTR signal can be used to switch the V.24 / V.28 interface lines to the "TRI-STATE-MODE". This feature is needed for parallel connection of interfaces in redundant telecontrol configurations. The polarity of the DTR signal's active state can be determined when the modem is parameterized.
- **GND:** reference ground for all interface signals.

2.6. Power Supply and Electrical Isolation

The CE-0700 Modem has to be powered via an internal voltage ($5V \pm 5\%$, power consumption: 0.4W) of the SAT 1703 telecontrol system. The power supply input is neither protected against overvoltage nor against polarity reversal.

The analog line interface is galvanically isolated from the supply voltage and the V.24 / V.28 interface. There exists no electrical isolation between the V.24 / V.28 interface and the supply voltage.

3. Operating Modes

3.1. Point-to-Point Configuration

In point-to-point configuration, two modems (location A, location B) are connected with one another via one pair (2-wire operation) or via two pairs (4-wire operation) of a telecom cable. In such arrangements, the data exchange may take place in two different ways:

- **Half-duplex:** At a given time, data transfer will always be possible in one direction only (i.e., either from location A to location B or vice versa) but never in both directions at the same time. Electrically, in this operating mode, the transmission section required for the respective direction will be activated from the data terminal equipment (DTE) via the RTS status line. Now, data can be transmitted in this direction, and subsequently the DTE will deactivate the modem's transmission section. Now, the DTE at the remote station can activate the transmission section of the modem located at its end and transmit data in the opposite direction.
- **Full-duplex:** In this operating mode, data can be transferred in both directions simultaneously and independently from one another (i.e., also at the same time). In such case, the transmission sections of the two modems will always be active, i.e., the RTS status line will not be needed.

The operating modes that are possible with CE-0700 are listed in the following table:

operating mode	transmission rate	transmission line	line termination (both modems)
half-duplex	1200 bd	2-wire	600 Ω
full-duplex	1200 bd	4-wire	600 Ω
full-duplex	300 bd	2-wire	600 Ω

On a leased line (PTT) the endpoints have to be terminated with 600 Ω.

3.2. Multipoint Configuration

In multipoint configuration, one physical medium (e.g. a pair of a telecommunication cable) is utilized for communication to several substations. This means that modems are needed not only at the ends of a cable but also along the cable duct. In this case, an identified DTE, also designated as master or central station, coordinates the entire communication by cyclically polling the other stations (RTU's) via messages. An RTU will be authorized to send only if it has received a valid call message beforehand, i.e., the multipoint traffic corresponds to the half-duplex operating mode. When parameterizing the modem for multipoint traffic, be sure to keep the following information in mind:

- **Line termination:**

modems at cable ends:	600 ohms
modems along the cable duct (waystations)	high-impedance

The distance between the connection point of the telecom cable in a waystation and the modem should not exceed 30m because otherwise reflexion problems might result due to the required connecting cable. If larger distances need to be bridged, one has to use either a decoupling amplifier for the spur line (only possible for 4-wire operation) or a resistance star (high attenuation!).

- **Line:**

2-wire or 4-wire

- **Transmission rate:**

1200 bd or 300 bd

3.3. Test Mode

For test purposes, the transmission section of the CE-0700 Modem is capable of autonomously generating a QBF text or a 511-bit pseudo random sequence. This test text platters are modulated and available at the line interface with the parameterized transmission rate. At the remote station, the test text plattern can be checked with a bit error measurement device via the modem disposed in that location and the bit error rate can be determined. The test text plattern is generated with the following parameters:

- **Data format:** 8 data bits, even parity, 1 stop bit (8-E-1)
- **QBF:** LFCRLFCRTHE_QUICK_BROWN_FOX_JUMPS_
OVER_THE_LAZY_DOG_1234567890
LF = LINE FEED
CR = CARRIAGE RETURN
_ = blank

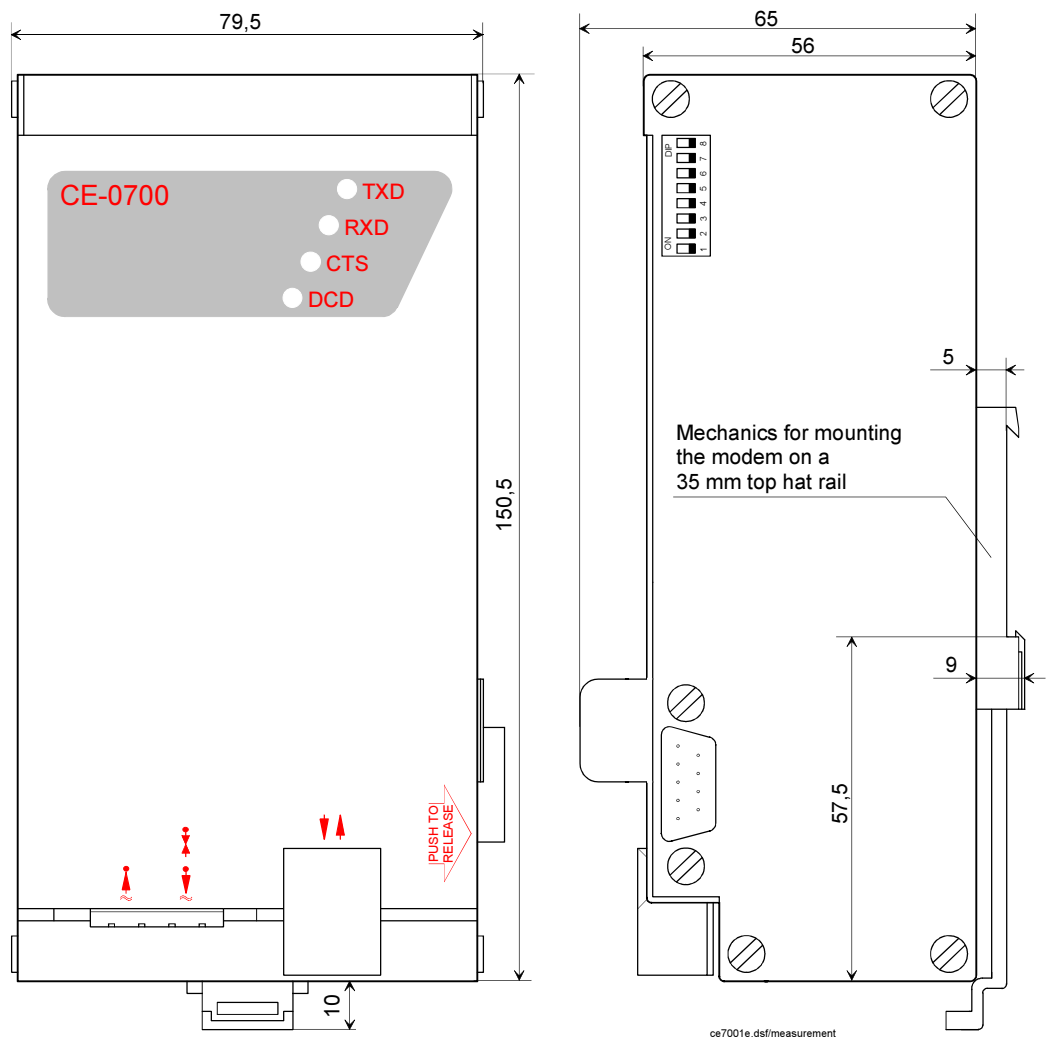
Activation of the test mode and selection of the test text plattern are described in the chapter "Parameterization".

4. Mechanical Design

4.1. Modem Release G21-200-A

The modem's dimensions in millimeters are shown in the following figure:

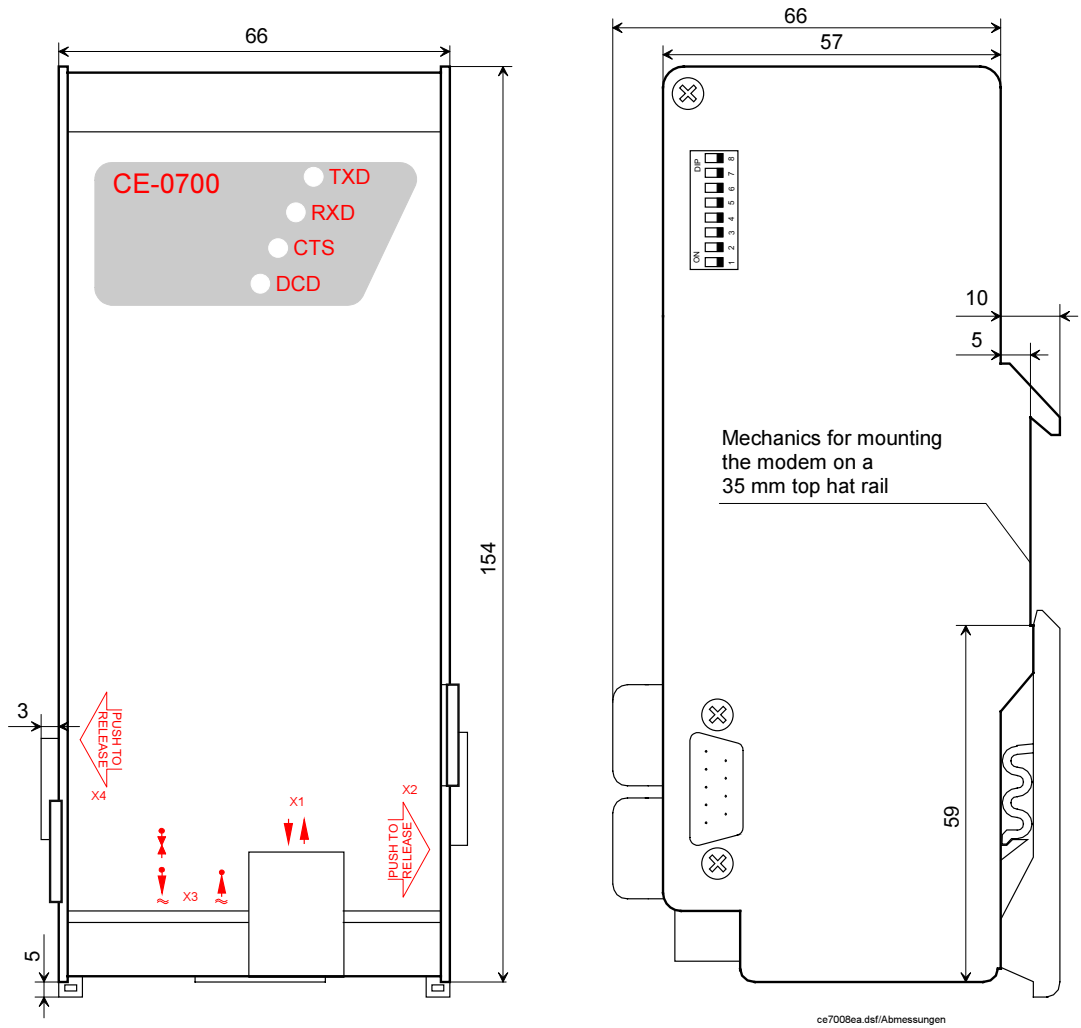
Fig. 4-1
Dimensions
G21-200-A



4.2. Modem Release G21-200-B and higher

The modem's dimensions in millimeters are shown in the following figure:

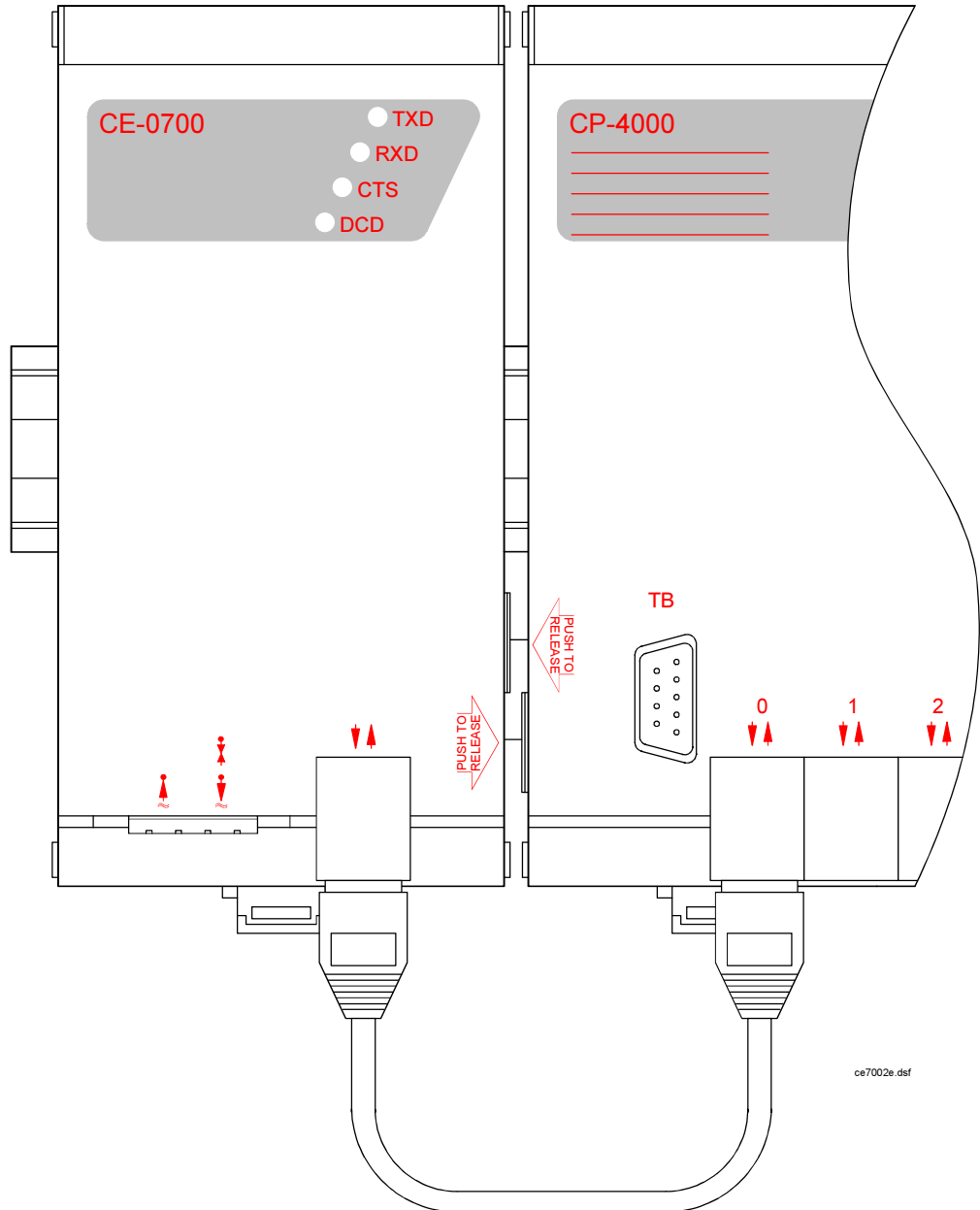
Fig. 4-2
Dimensions
G21-200-B and higher



4.3. Installation guide

CE-0700 is designed to be mounted on a TS35 channel (35mm top-hat rail). To ensure proper functioning of the modem, the top-hat rail must be connected to earth. If the modem is used with AMC 1703, it has to be mounted in accordance with the following drawing:

Fig. 4-3
Information for
mounting



Since modem and AMC are mounted side by side, the connector for the supply of the modem with power can be plugged directly into the related socket on the AMC. For connecting the V.24/V.28 interfaces, a cable with order number

T41-257

is required.

If the CE-0700 Modem is used in combination with other telecontrol components of the SAT 1703 system, the following items should be taken into consideration:

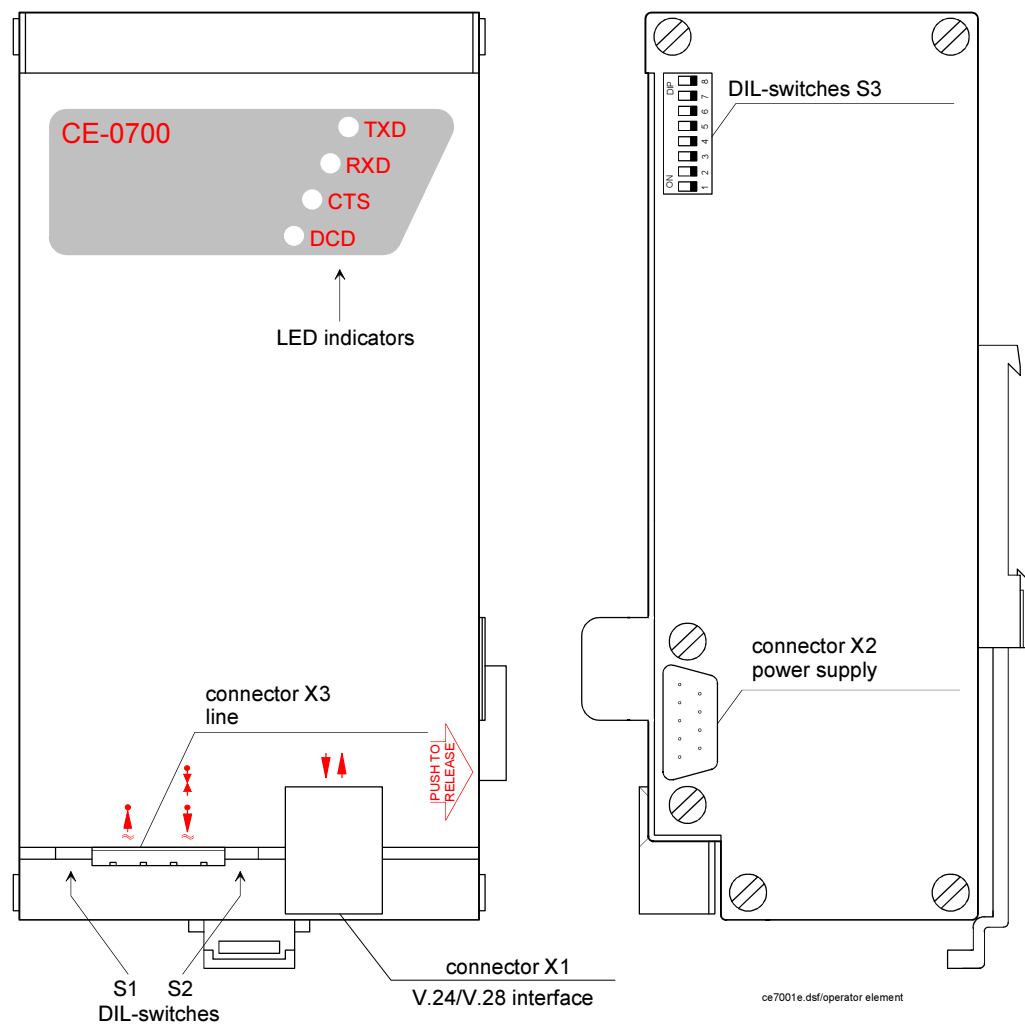
- Cabling of power supply:
 - Use of a cable with braided shield
 - Use of a 9-pole Cannon connector with metal housing or metal-plated plastic housing for the modem
 - Contact the braided shield of the cable with the cable housing
 - Connect the other end of the cable to SAT 1703's in-system supply voltage in accordance with system documentation.
- Cabling of V.24/V.28 interface:
 - Use a STP-Cat 5 cable
 - Connection to the SAT 1703 interface according to system documentation

5. Controls, Indicators, and Interfaces

5.1. Modem Release G21-200-A

All controls, indicators, and interfaces are shown in the following drawing:

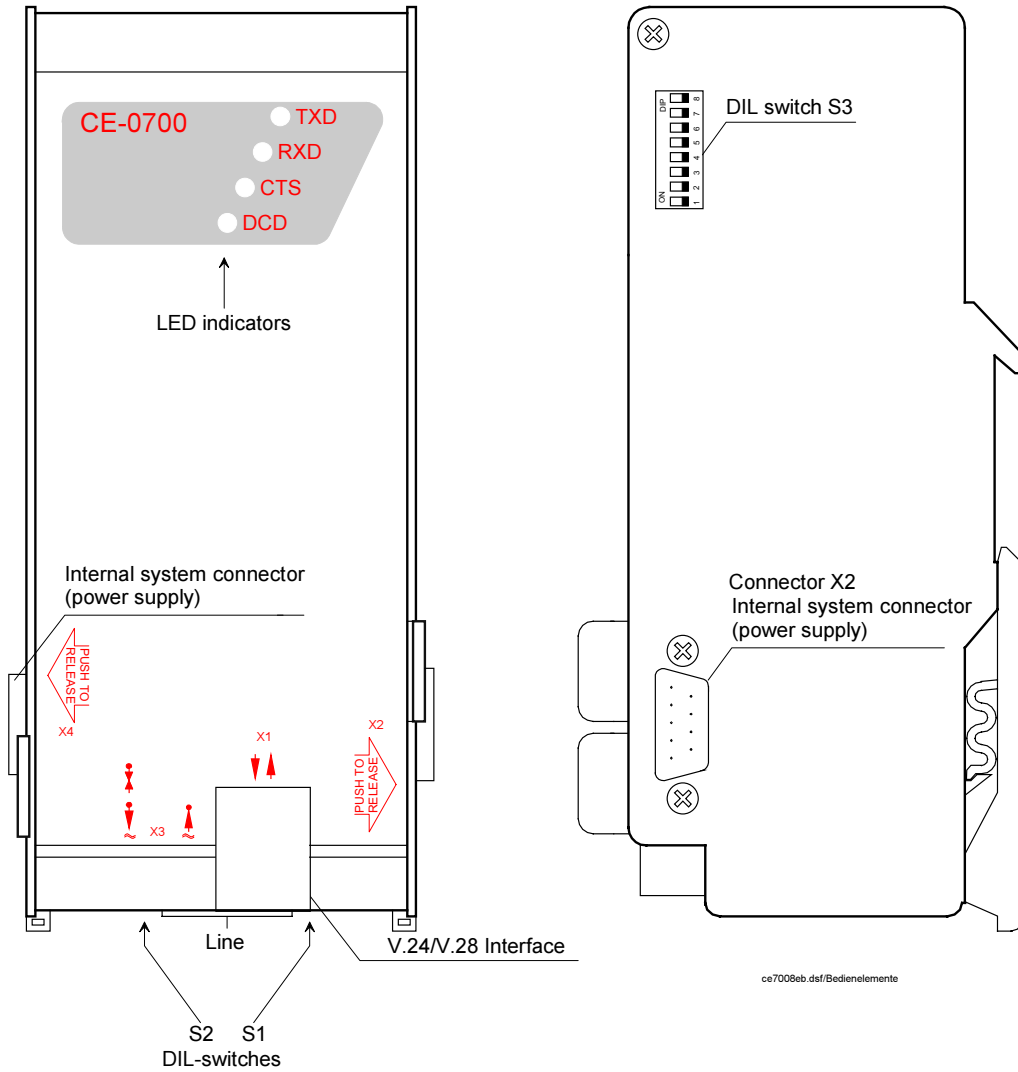
Fig. 5-1
Controls
G21-200-A



5.2. Modem Release G21-200-B and higher

All controls, indicators, and interfaces are shown in the following drawing:

Fig. 5-2
Controls
G21-200-B and higher



ce7008eb.dsf/Bedienelemente

6. Parameterization

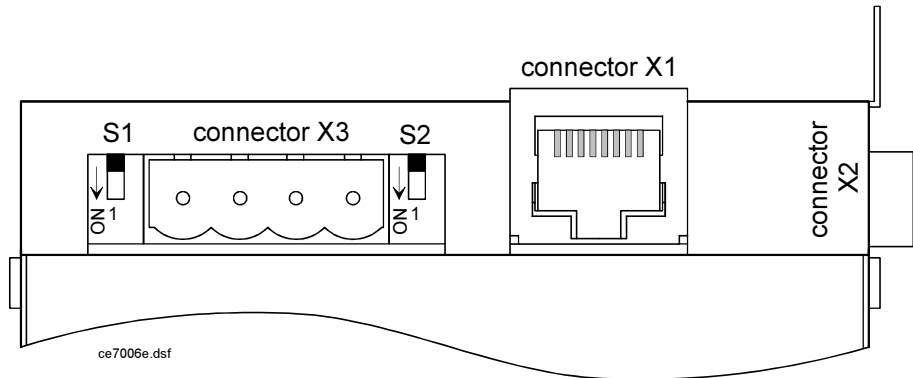
The parameterization of the CE-0700 Modem is carried out fully via the DIL switches shown in the following figures. Information and explanations on the various setting options are contained in the chapter "Functional Description".

If the position of the parameterizing switches is changed while the modem is operating, the new settings will be accepted only after a short interruption of the power supply (RESET).

6.1. Parameterizing Switches S1 and S2

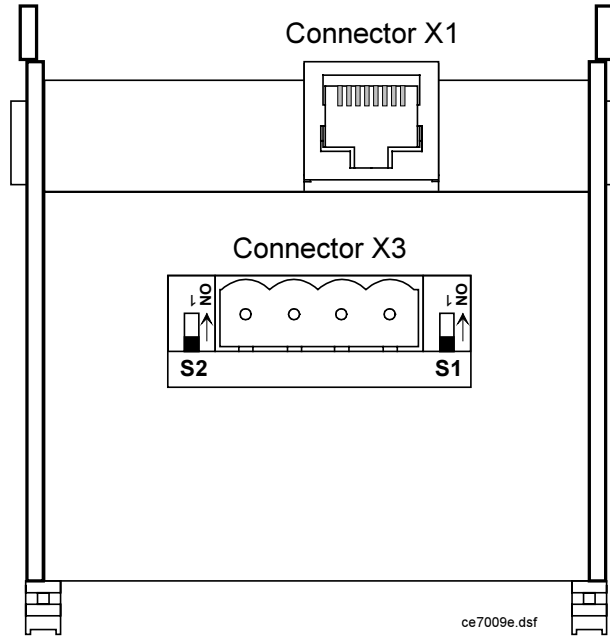
Modem Release G21-200-A:

Fig. 6-1
Switches S1 and S2
G21-200-A



Modem Release G21-200-B and higher:

Fig. 6-2
Switches S1 and S2
G21-200-B and higher

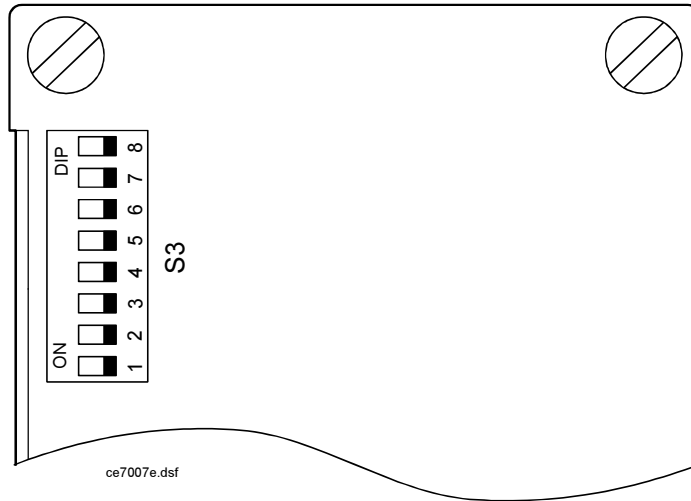


Line Termination	S1	S2
600 Ω	ON	ON
high-impedance	OFF	OFF

A leased line has to be terminated at the endpoints with 600 Ω.

6.2. Parameterizing Switch S3

Fig. 6-3
Switch S3



- S3-1** ON: transmit level –14dBm
OFF: transmit level –6dBm
- S3-2** ON: local line equalizer is active
OFF: local line equalizer is inactive
- S3-3** ON: operation of modem on a 4-wire line
OFF: operation of modem on a 2-wire line

S3-4 and S3-5

standard	baud rate	mid frequency	characteristic frequency		S3-4	S3-5
			lower	upper		
V.21 Originate	0 – 300 bd	1080 hz	980 hz	1180 hz	OFF	OFF
V.21 Answer	0 – 300 bd	1750 hz	1650 hz	1850 hz	ON	OFF
V.23	0 – 1200 bd	1700 hz	1300 hz	2100 hz	OFF	ON

S3-6 The function of the switch S3-6 depends on the position of switches S3-7 and S3-8.

If S3-7 and S3-8 are set to normal operation or to one of the redundancy operation modes, S3-6 is used to define if the RTS (request to send) signal is used or not.

If S3-7 and S3-8 are set to select the test mode, S3-6 is used to select the test text pattern.

RTS Usage:

S3-6 ON: The RTS signal is ignored, the transmitter is permanently ON.
 OFF: The transmitter is controlled (switched) with the RTS signal.

Test Text Selection:

S3-6 ON: 511 pseudo failure sequence
 OFF: QBF

Operating Modes:

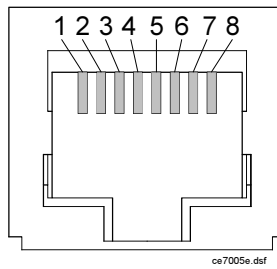
S3-7 and S3-8

Operating mode	S3-7	S3-8
normal operating mode	OFF	OFF
redundancy mode DTR = 0 active	ON	OFF
redundancy mode DTR = 1 active	OFF	ON
test mode (transmitting section generates test text)	ON	ON

7. Connector Pin Assignment

7.1. Connector X1

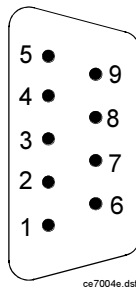
Fig. 7-1
Connector X1



Pin	Signal
1	CTS
2	RTS
3	not used
4	TxD
5	RxD
6	GND
7	DCD
8	DTR

7.2. Connector X2

Fig. 7-2
Connector X2

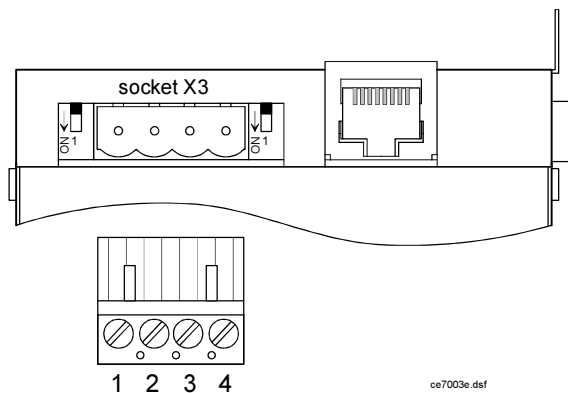


Pin	Signal
1	reserved
2	reserved
3	not connected
4	not connected
5	supply voltage -0V
6	reserved
7	not connected
8	status
9	supply voltage +5V

Pins 1, 2, 3, 4, 6, 7, and 8 are provided for future expansion and must not be connected.

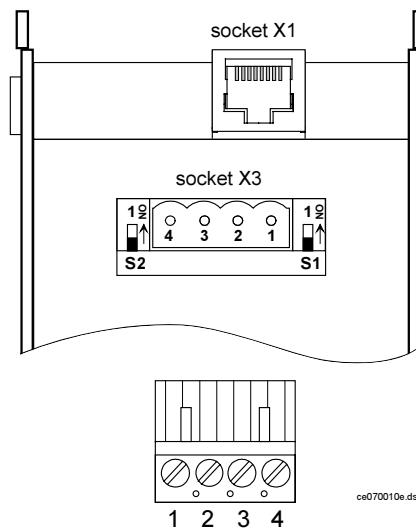
7.3. Connector X3

Fig. 7-3
Pin Assignment X3 for
G21-200-A



Pin	Signal	Signal Direction	
1	incoming LF signal a	•←	
2	incoming LF signal b	•←	
3	outgoing LF signal a / LF a for 2-wire operation	•→	•→←
4	outgoing LF signal b / LF b für 2-wire operation	•→	•→←

Fig. 7-4
Pin Assignment X3 for
G21-200-B and higher



Pin	Signal	Signalrichtung	
1	LF_in+ / LF-in (a): 4 -wire operation	•←≈	
2	LF_in- / LF-in (b): 4 -wire operation	•←≈	
3	LF_out+ / LF-out (a): 4 -wire operation LF-in/out (a): LF a for 2-wire operation	•→≈	•→←≈
4	LF_out- / LF-out (b): 4 -wire operation LF-in/out (b): LF b for 2-wire operation	•→≈	•→←≈

8. Technical Specifications

8.1. Interfaces

LF Interface	Types, Values, Ranges, Settings
modulator / demodulator	to ITU-T V.21 and V.23 (with 75 bd backward channel)
line interfacing	leased line, 2-wire or 4-wire
line termination	600 ohms or high-impedance
transmit level	adjustable -6 dBm or -14 dBm, for a 600 Ω line
activation time of transmitter (RTS to DCD)	16 ms
DCD threshold without local line equalizer with local line equalizer V.21 originate upper char. frequency V.21 answer upper char. frequency V.23 upper char. frequency	-43 dB -53 dB -50 dB -54 dB
required signal to noise ratio (measured with white noise, bandwidth limited at 3,4 kHz) V.21 operation V.23 operation	10 dB 16 dB
typical hop lenght on a telecom cable with 0,6mm wire diameter, under ideal condition V.21 operation V.23 operation	36 km 33 km

Digital Interface	Types, Values, Ranges, Settings
interface design according to ITU-T V.24 / V.28 with the following signals: if the appropriate parameters were set, the interface can be switched to high-impedance (TRI-STATE-MODE) and be deactivated via the DTR status line.	TxD RxD DCD RTS CTS DTR GND

8.2. Power Supply

Supply Voltage	Types, Values, Ranges, Settings
the CE-0700 Modem is supplied with power via an internal 5V voltage of SAT 1703. The supply input is not protected against polarity reversal and overvoltage supply voltage: power consumption:	5V ± 5% < 0.4W

8.3. Mechanical Design

Mechanics	Types, Values, Ranges, Settings
mechanical design of this module	aluminum housing for standardized 35mm top hat rail
Line connection	4-pole screw-type terminal
V.28 connection	RJ-45 socket, shielded, 8-pole
voltage supply	9-pole Cannon plug connector for direct connection with CP-4000
weight	approx. 320g

8.4. Insulation Resistance

Test	Types, Values, Ranges, Settings
dielectric test with sinus voltage between LF line and logic between LF line and chassis ground between LF-outgoing and LF-incoming between logic and chassis ground tested acc. to (standard):	IEC 870-2-1 50Hz/1min 1.5kV 1.5kV 1kV 50V IEC 255-5
dielectric test with impulse voltage between LF line and logic between LF line and chassis ground between LF-outgoing and LF-incoming tested acc. to (standard):	IEC 870-3 1.2/50µs Ri=500R common 3kV common 3kV common 2kV IEC 255-5

8.5. Compliance EN 50082-2

Test	Types, Values, Ranges, Settings
burst resistance between LF line and chassis ground between V.28 line and chassis ground tested acc. to (standard):	IEC 870-2-1 5/50ns, 2.5kHz (Ri=50Ω) 2.0kV link 2.0kV link IEC 1000-4-4
surge resistance between LF line and chassis ground between various LF lines tested acc. to (standard):	IEC 870-2-1 10/700μs, (Ri=40Ω) common 4.0kV normal 2.0kV IEC 1000-4-5
EMC resistance tested acc. to (standard):	IEC 801-3 10V/m test field strength ENV 5020-4
ESD resistance contact discharge air discharge	IEC 1000-4-2 8kV 15kV
test against 50Hz magnetic field tested acc. to (standard):	IEC 870-2-1 30A/m class 3 IEC 1000-4-8
noise immunity against induced HF voltage tested acc. to (standard):	IEC 1000-4-6 10V/m

8.6. Ambient Conditions

- Characteristics to IEC 870-2-2, class B3
- Temperature range extended to -20°C to +70°C

8.7. Noise Radiation

System characteristic to EN 55022, class B

8.8. Reliability

The MTBF of the module is 69 years.

A. Reader's Reactions

We designed and compiled this manual with great care and a high degree of responsibility. It was - and still is - our goal to design it in a way that it will be of greatest possible use at your work.

In order to reach this goal, we also rely on your cooperation - especially where maintenance and care of the manual are concerned.

To make this cooperation easier for you, we added a form to this section. Please make use of it.

We will try to consider your comments already in the next update of the manual.

Thank you very much for your cooperation!

Form for Readers' Reactions

Your comments and suggestions will help us to further improve both the quality and usefulness of this manual. Thank you very much for your efforts!

Please fill in this questionnaire and return it to us; we will send you the next update of this manual free of charge as soon as it is available.

What is your impression of this manual? Do you think it is complete, correct and accurate, well-structured, written in a comprehensible language, etc.?

.....
.....

Which parts, characteristics, aspects are particularly useful?

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.....

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.....
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