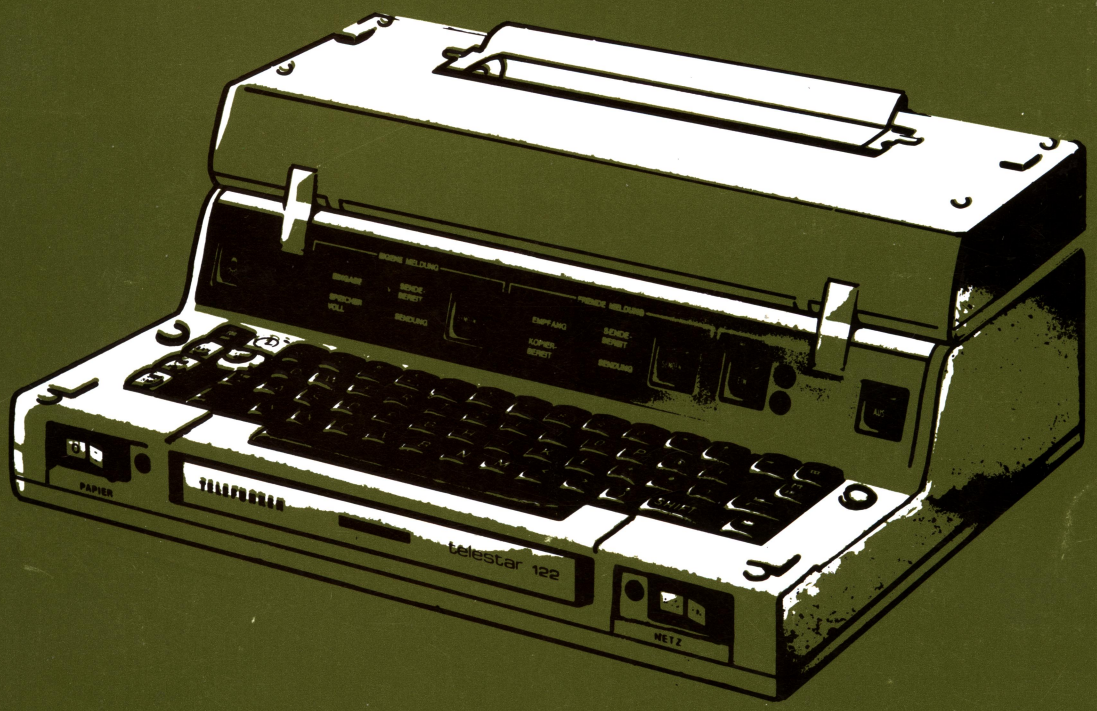
TELESTAR



AEG-TELEFUNKEN

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TELESTAR

AEG-TELEFUNKEN
Nachrichten und Verkehrstechnik AG
Fachbereich Hochfrequenztechnik

Contents

Basic design of the correspondence equipment

TELESTAR

Basic design of the correspondence equipment

The correspondence equipment „TELESTAR" (Telefunken Symbol Transmitter and Receiver) developed by AEG-TELEFUNKEN is a new type of teleprinter which opens up new possibilities for the interchange of written messages through wire or radio links. With regard to its performance, modular design, small dimensions, and flexibility of application due to microprocessor control, the TELESTAR correspondence equipment is an outstanding product of communications engineering.

The components are shown in Fig.1 which determine the communications characteristics of the equipment. The essential technical data and characteristics are:

Correspondence Code:

CCITT No. 2 (teleprinter code) or
CCITT No. 5

① Typing keyboard

For standard correspondence equipment, either:

Teleprinter keyboard for CCITT No. 2 Code, or keyboard for No. 5 Code.

② Microprocessor and separate transmit and receive storages

Equipment functions and correspondence operations are controlled by a microprocessor. This microprocessor control makes it possible, with relatively little effort, to offer the user a multitude of correspondence operations which are matched to one another. For example:

Message error correction, multi-address operation, acknowledgement exchange with quality statement, relay operation, automatic print-out of transmit and receive times, self-test operation.

The microprocessor also contributes to making the correspondence equipment highly adaptable to user requirements. This adaptation which is effected by programming and no longer by modifications of the circuitry, can also be carried out at a later time, i.e. when the correspondence operations of a particular communications system are to be changed.

The equipment is designed to include a message transmit storage and a message receive storage. Storage capacity is 3800 characters each, which amounts to approximately 2.2 standard teleprinter pages.

These two stores allow intermediate storage of a message both at the transmitting and the receiving sides, thus separating the processes

- Typing of the message
- Transmitting and
- Print-out of the message

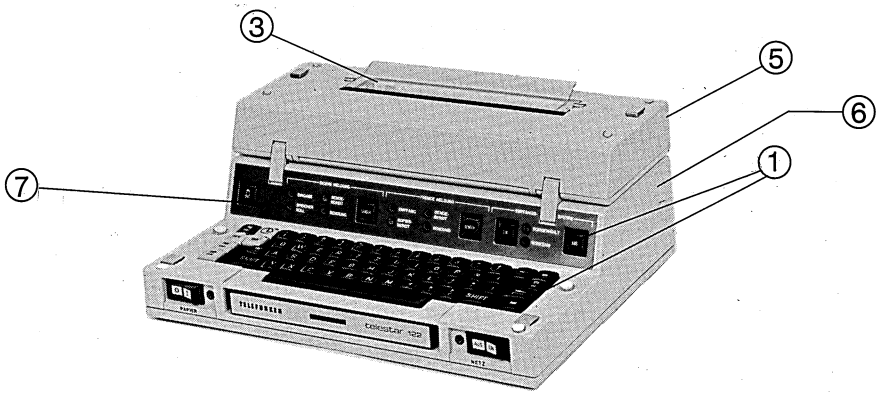
Separation of these processes is a precondition for taking advantage of the highest possible transmission rates.
For example:

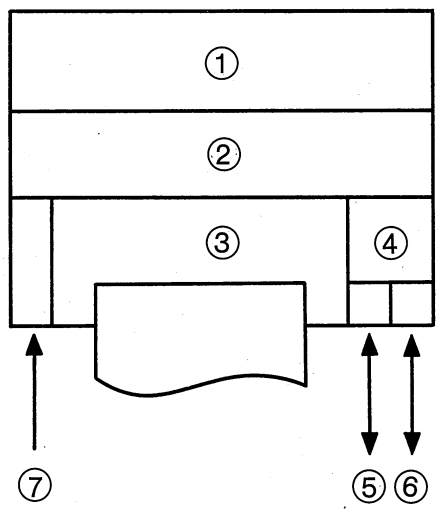
- Typing of a message by hand at a rate of 4 characters per second
- Transmission via UHF radiotelephone at a rate of 109 characters per second (1200 Baud), and
- Print-out of the message at a rate of 35 characters per second.

(please see reverse)

TELESTAR

Basic design of the correspondence equipment





① Typing and function keys, and indicators

② Microprocessor
separate transmit and receive storages with 3800 characters capacity each, corresponding to 2.2 pages of teleprinted text

③ Printer for 69, 72 or 80 characters/line
Effective printing speed: 35 characters/sec

④ Transmit and receive section

⑤ Connection for peripheral devices, such as paper tape unit

⑥ Connection for communications equipment

⑦ Power supply, mains or battery

③ Printer

The effective printing rate of this low-noise printer is 35 characters per second.

The 23 m paper roll can be supplied at a width of 210 mm or 214 mm, the former for the European, the latter for the U. S. standard. Furthermore, the line length can be selected for 69, 72, or 80 characters per line.

The electric typing method on commercial metallized paper was chosen in order to keep the dimensions of the equipment small:

Transmit and receive sections are equipped for the connection of communications equipment and peripherals

④ ⑤ ⑥

TELESTAR is connected to communications channels and peripherals via the interfaces of the transmit and receive sections. For example, the interface with frequency shift keying (FSK) allows direct connection to a UHF radiotelephone, while the interface for peripherals can be used for connection of paper tape units.

⑦ Power supply

The TELESTAR correspondence equipment can be mains or battery operated. Change-over from mains to battery operation, or reverse, is effected by changing the special connecting cables.

Application in the various wire or radio communications systems

TELESTAR

Application in the various wire or radio communications systems

–Application as computer terminal

Due to its modular design and exchangeable electronic interface units, the TELESTAR correspondence equipment can be connected to all communications channels up to 9600 baud. The equipment can be adjusted for transmission rates from 50 baud to 9600 baud. Using an external control signal, it is possible within this range of transmission speeds to switch over from one rate to another.

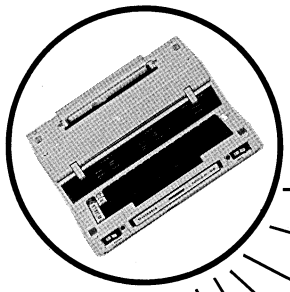
Figure two shows the most important possibilities of connecting available communications channels, and typical transmission speeds for such connections.

TELESTAR can be used for the interchange of written information not only from person to person but also from person to computer. Connection of a computer is either direct or via data transmission equipment. In the case of direct connection, TELESTAR would serve as computer operating equipment; in the case of connection via data transmission equipment, it would serve as a remote data processing unit.

TELESTAR

Application in the various wire or radio communications systems

Application as computer terminal



Wire Communications:

Telex lines
50 baud

Datex Network
up to 200 baud

Dial telephone network via modem
up to 4800 baud

Permanent telephone link via modem
up to 9600 baud

Radio Communications:

UHF/VHF radio equipment
up to 1200 baud

HF radio equipment
up to 200 baud

Computer
up to 9600 baud

Microprocessor control and separate transmit and receive storages of the correspondence equipment provide for

TELESTAR

Microprocessor control and separate transmit and receive storage of the equipment provide for . . .

Figure 3 lists the major communications features of the TELESTAR correspondence equipment that are based on the separation of transmit and receive storage, and on the microprocessor control.
Details are explained in the following illustrations.

TELESTAR

Microprocessor control and separate transmit and receive storages of the correspondence equipment provide for

- Optimum utilization of available transmission channels
- Speed transformation
- Text corrections
- Automatic addressing and text transmission,
  Error detection at receiving station,
  Acknowledgement feed-back to transmitting station
  including print-out of time, transmitting address,
  receiving address and quality statement
- Multi-address operation
- Relay operation
- Repeated print-out of both transmitted
  and received messages
- Self-test operation

Optimum utilization of available transmission channels

TELESTAR

Optimum utilization of available transmission channels.

In Fig. 1 reference was made to the purpose of text storage which allows the off-line transmission of messages.

The principle of this off-line correspondence using transmit and receive storage is:

Typing and storing of the message:

The message intended for another party is typed on a typewriter keyboard. The printer of the equipment prints out immediately each character on paper for simultaneous checking by the operator.

Each typed character is stored in the transmit storage.

Transmitting and receiving of the message:

After completion of the typing operation, the message is sent from the transmit storage of the transmitting station to the receive storage of the receiving station.

Print-out of the message:

The message received at the receiving station is read out and printed out from the receive storage by the printer.

These processes are illustrated in Fig. 4.

The advantages of message storage are:

The processes of typing a message at the transmitting station, and of transmitting and printing it at the receiving end are separated from each other. (Off-line operation).

The duration of a transmission is therefore independent of the typing speed and is practically determined only by the quality of the communications channel used. The time of transmission is freely selectable. The duration of print-out from the receive storage is independent of the transmission rate and depends solely on the printing speed of the printer. Message storage, therefore, means full utilization of the transmission speed of a communications channel when transmitting a message, and full utilization of the printing speed of a printer when printing out an incoming message.

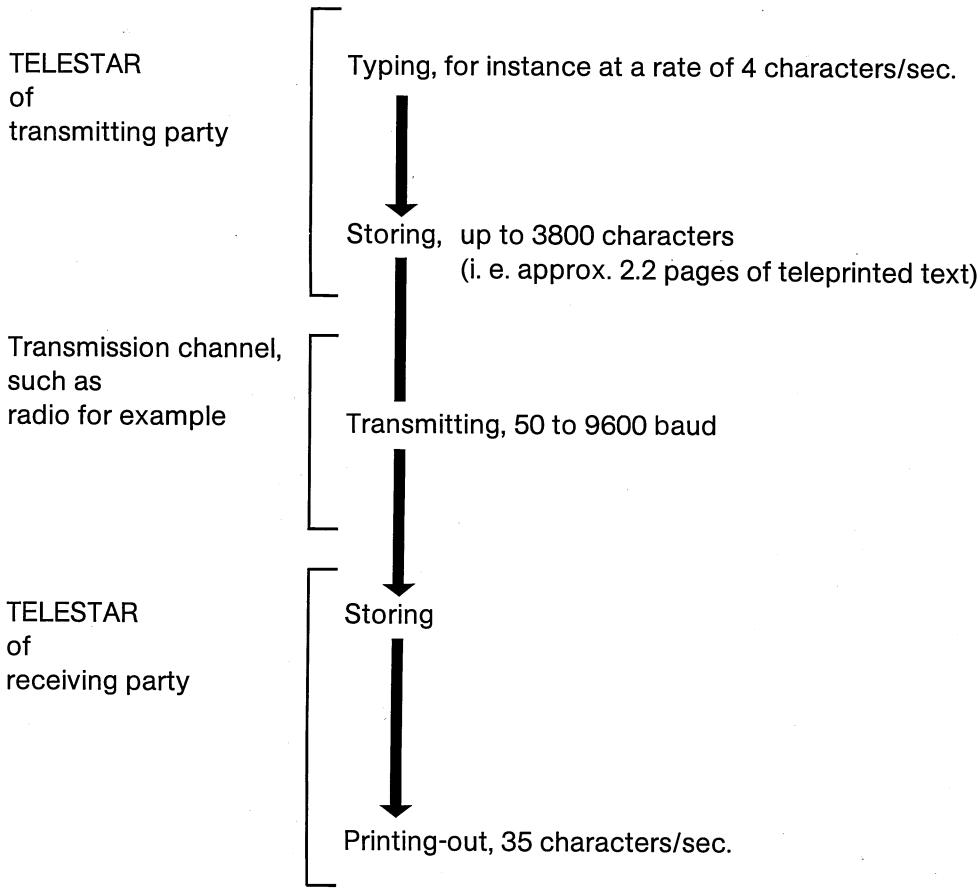
Message exchange with this equipment is restricted to the shortest absolutely necessary period of time. This means under practical conditions short busy periods on the communications channel and low transmission cost.

In addition, the transmit and receive stores render the equipment capable of full duplex operation, which means transmit and receive operations can be carried out simultaneously.

TELESTAR

- Optimum utilization of available transmission channels

  by storing the message in the transmit storage of the transmitting station
  and in the receive storage of the receiving station



Example of utilization of a UHF/VHF radio channel

TELESTAR

Example of utilization of a UHF/VHF radio channel

The example given in Fig. 5 shows the different lengths of time involved in the transmission process. Typing of the message by man takes a multiple of the time required for transmission and print-out.

For this example, it is assumed that the binary code is CCITT Code No. 5, i.e. one character is made up of 7 bits. With 1 start bit, 2 stop bits and 1 bit for error detection (parity bit), 11 bits per character are obtained.

In the case of frequency shift keying, the transmission rate of 1200 baud is the limit for transmission on a UHF/VHF radio channel. In the case of a dedicated telephone line, transmission via appropriate modems could take place at a rate of 9600 baud. In this case, transmission would take less than 2 seconds. The printing speed depends only on the properties of the printer, i.e. it does not depend on the other transmission processes.

For comparative reasons, the transmission time for teleprinting speed is given as well: in this case, off-line operation via punched tape is assumed. During on-line operation, i.e. without intermediate storage, transmission time would, naturally, equal typing time, i.e. approx. 7 minutes.

TELESTAR

- Example of utilization of a UHF/VHF radio channel

1700 character message
(one standard teleprinted page)

Typing of message at a rate of 4 characters/sec.
Storing — 425 sec (approx. 7 min.)

Transmission
at 1200 baud
and 11 bits/sec. — 15.6 sec.

Receiving of message
Storing
Printing-out at 35 characters/sec. — 49 sec.

Comparison:

Transmission
at teleprinter speed

50 baud
7.5 bits/character — 255 sec. (approx. 4.2 min.)

Speed Transformation

TELESTAR

Speed transformation

Separate transmit and receive storage enables transmit and receive operations to be carried out at different speeds. The diagram Fig. 6 illustrates how, with the speed transformation of the stores, a radio communications line having a high transmission speed can be coupled with a low-speed teleprinter data link. For an incoming message of 1700 characters, the radio channel is occupied for only 15.6 seconds. The teleprinting line, on the other hand, in order to transmit this message, is busy for 374 sec. or a little over 6 minutes.

The example illustrated here shows TELESTAR in relay operation. Details concerning relay operation are explained in Figure 12.

TELESTAR

- Speed Transformation

due to storage and read-out of message
at different speeds

Receipt of message by radio at 1200 baud.
For transmissions of 1700 characters per message,
the radio channel is occupied
for only 15.6 seconds.

Storage, print-out

Transmission of the message
via telex lines, for example, at a rate of 50 baud.

Automatic addressing and text transmission

TELESTAR

Automatic addressing and text transmission

Error detection at receiving station
Acknowledgement feed-back to transmitting station

Interaction between TELESTAR stations is not restricted to processes of typing, transmitting and printing-out messages, but includes all other operations required for complete interchange of written messages. These are:

- At the transmitting station:

  Typing of a message with STX start-of-text character and ETX end-of-text character.

  Input of receiving station address

  Transmission of text

  Receipt of acknowledgement including quality statement.

- At the receiving station:

  Receiving, error checking and printing-out of message,
  Transmission of acknowledgement to transmitting station.

As an example Figure 7 shows the communication sequence between two TELESTAR stations for the transmission of a message. During the time intervals T1 to T4, the following information is exchanged:

T1: Inquiry from A to B whether B is ready to receive

T2: If ready to receive, TELESTAR at station B checks the address and, as soon as the address has been identified without error, transmits to TELESTAR at station A the ready to receive signal.

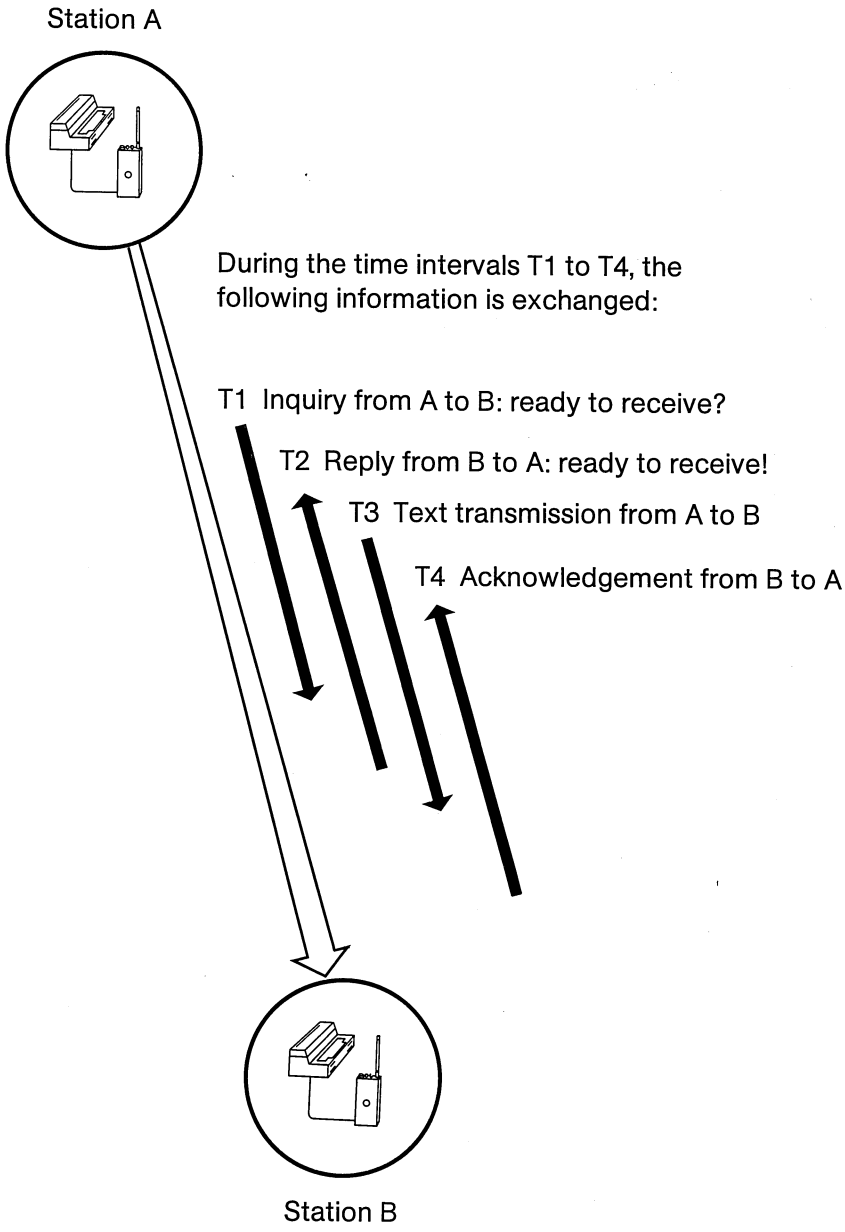
T3: This invitation to transmit initiates the automatic transmission of the text from station A to B. TELESTAR at station B checks the text for errors.

T4: TELESTAR at station B sends to station A an acknowledgement indicating if the message was transmitted with or without errors.

TELESTAR

- Automatic addressing and text transmission,
  Error detection at receiving station
  Acknowledgement feed-back to transmitting station

  Communication sequence between stations A und B
  for the transmission of a message:



Adressing of a message

TELESTAR

Addressing of a message

The addressing procedure and the address structure are shown in Fig. 8.

After completion of text input, i.e. after ETX, the address key is pressed. The address itself is input through the typewriter keyboard. Upon address input completion, the address key is depressed again. The address is now stored and the message ready to be transmitted.

A total of 18 positions are available for the address. The first position contains the types of address, where a distinction is made between:

- single call with acknowledgement
- single call without acknowledgement
- group call, and
- collective call

The following 17 positions can be occupied arbitrarily to order. If 36 alphanumeric characters are used for addressing, the number of individual addresses obtainable with 17 positions

is $36^{17} = 2.8651 \cdot 10^{26}$.

The following example shows how interaction operates in a network with addressing:

The network, such as a radio network, is divided into three groups of 10 TELESTAR stations each.

The group addresses are:

ALPHA, BETA, GAMMA.

The equipment within a group is numbered in numerical order, e.g.: BETA 1, BETA 2, BETA 3, etcetera.

The address for a single call from ALPHA 3 to GAMMA 7 would read:

„E GAMMA 7"

The message would go from ALPHA 3 only to GAMMA 7, and GAMMA 7 would send an acknowledgement to ALPHA 3.

The address for a group call from ALPHA 3 to the GAMMA group would read:

„G GAMMA"

All 10 TELESTAR units within the GAMMA group would receive the same message.

The address for a collective call reads:

„S"

The message would go from ALPHA 3 to all the other 29 stations within the network.

The address itself is in fixed storage in the exchangeable address store which is accommodated either inside the equipment (equipment address) or outside the equipment (location address).

An address store accommodated outside the equipment has the advantage that, when equipment is exchanged for maintenance purposes, for example, the address location is retained.

TELESTAR

- Addressing of a message

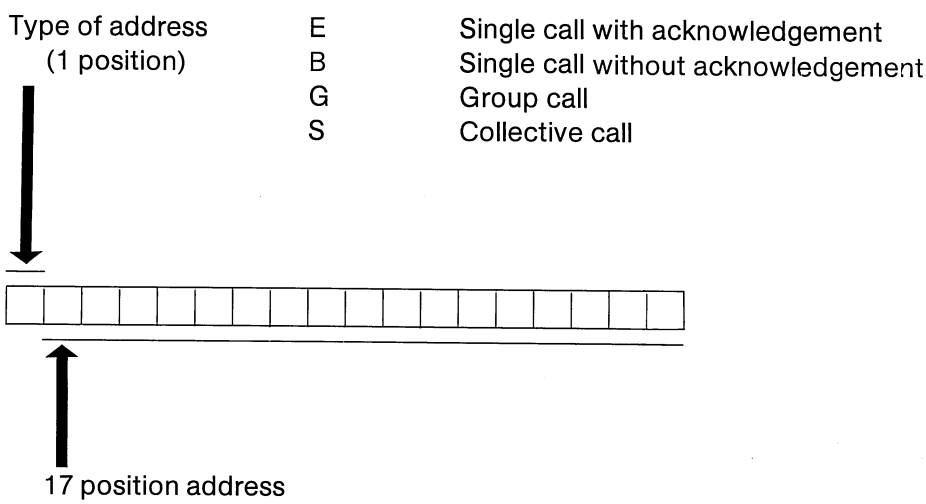
Text input completed

Address input, using address key via typewriting keyboard

Transmission by pressing the transmit key

Automatic transmission of the message,
provided the receiving station is clear
and the address was input correctly.

Address structure:



Receipt of text, error check and acknowledgement feed-back

TELESTAR

Receipt of text, with error check and acknowledgement feed-back

The operational procedure is explained in Fig. 9 when a message is received and acknowledgement therefor transmitted to and printed out at the transmitting station.

As the message is received, each character is checked for compliance with character parity. Furthermore, dead spots such as those experienced when a mobile radio communications set travels through a radio shadow, can be identified. After text end, an additional block parity check is performed.

At the receiving station, each detected error is printed out in the form of a special character. If errors were detected during reception, the acknowledgement sent back to the transmitting station will contain a minus sign, otherwise a plus sign.

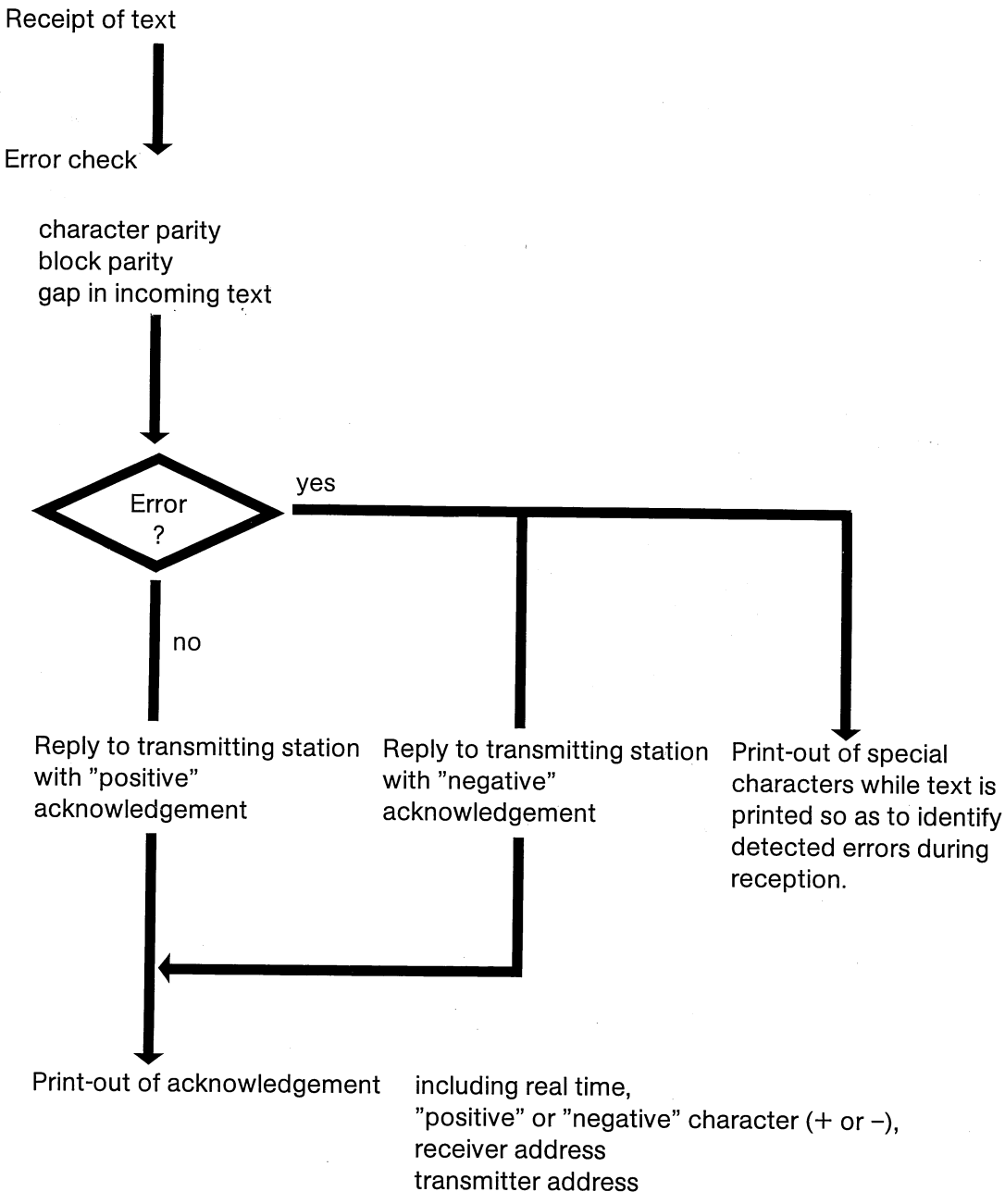
The complete acknowledegement printed out at the transmitting station includes:

- real time,
- plus or minus sign for transmission without/with detected error,
- receiver address, and
- transmitter address.

The time which can be called at any time is generated by a clock built into the TELESTAR equipment. It is automatically printed out for each transmit and receive operation.

TELESTAR

- Receipt of text, error check and acknowledgement feed-back



Multi-address operation

TELESTAR

Multi-address operation

Multi-address operation means transmission to several receiving stations of a message stored in the transmit storage, by addressing the various receiving stations one after the other.

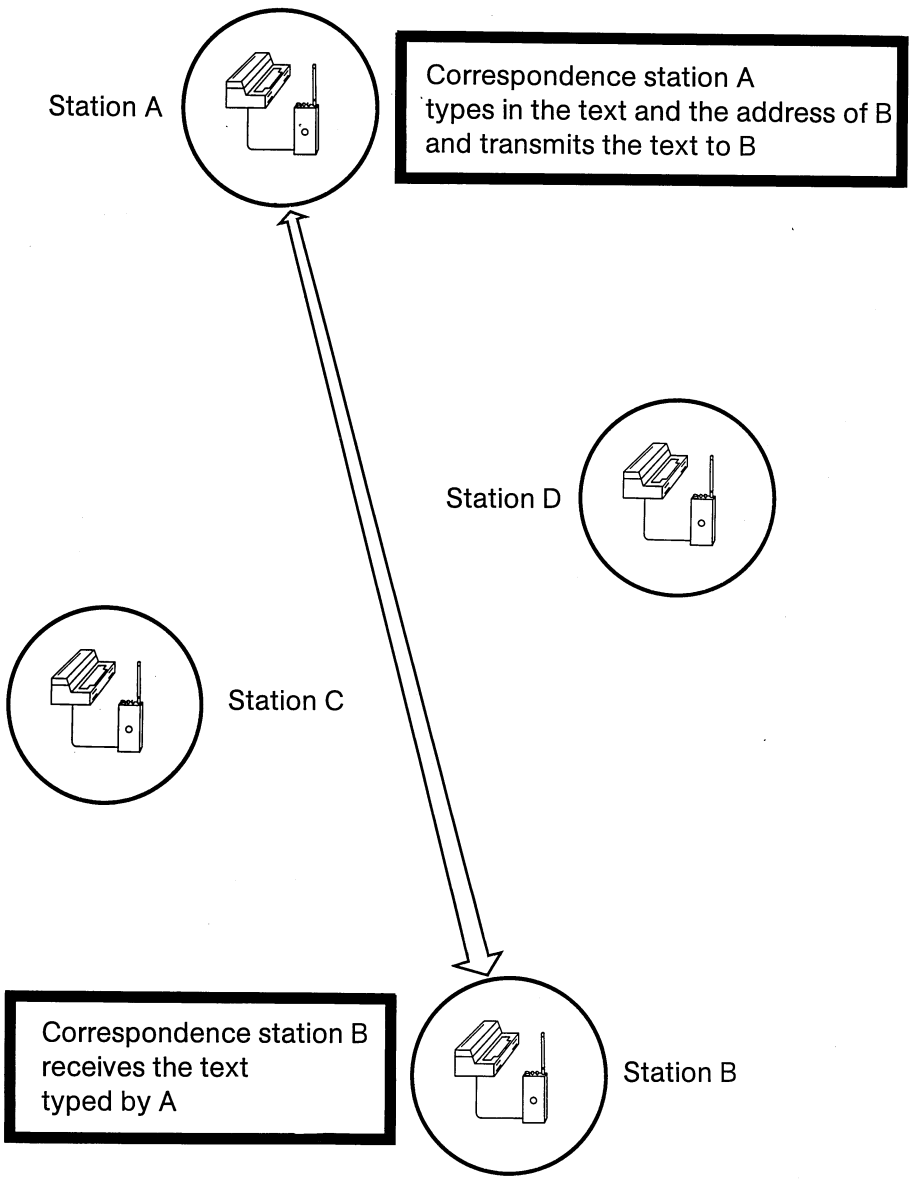
Transmission of a text from station A to station B is illustrated in Fig. 10.

TELESTAR

- Multi-address operation

Transmission to several receiving stations of a text stored in transmit storage by means of addressing the receiving stations one after the other.

Text transmission from station A to station B



Multi-address operation

TELESTAR

Multi-address operation

Figure 11 shows how the message previously sent from station A to station B is now transmitted from station A to station C. The transmission procedure, in chronological order, is:

- Station A
  Address, for example ALPHA 3
  Text input
  Input of station B address, e.g. „E BETA 2"
  Transmission out of transmit storage
  Awaiting acknowledgement from BETA 2

After acknowledgement by BETA 2, input of station C address, e.g. „E GAMMA 7"

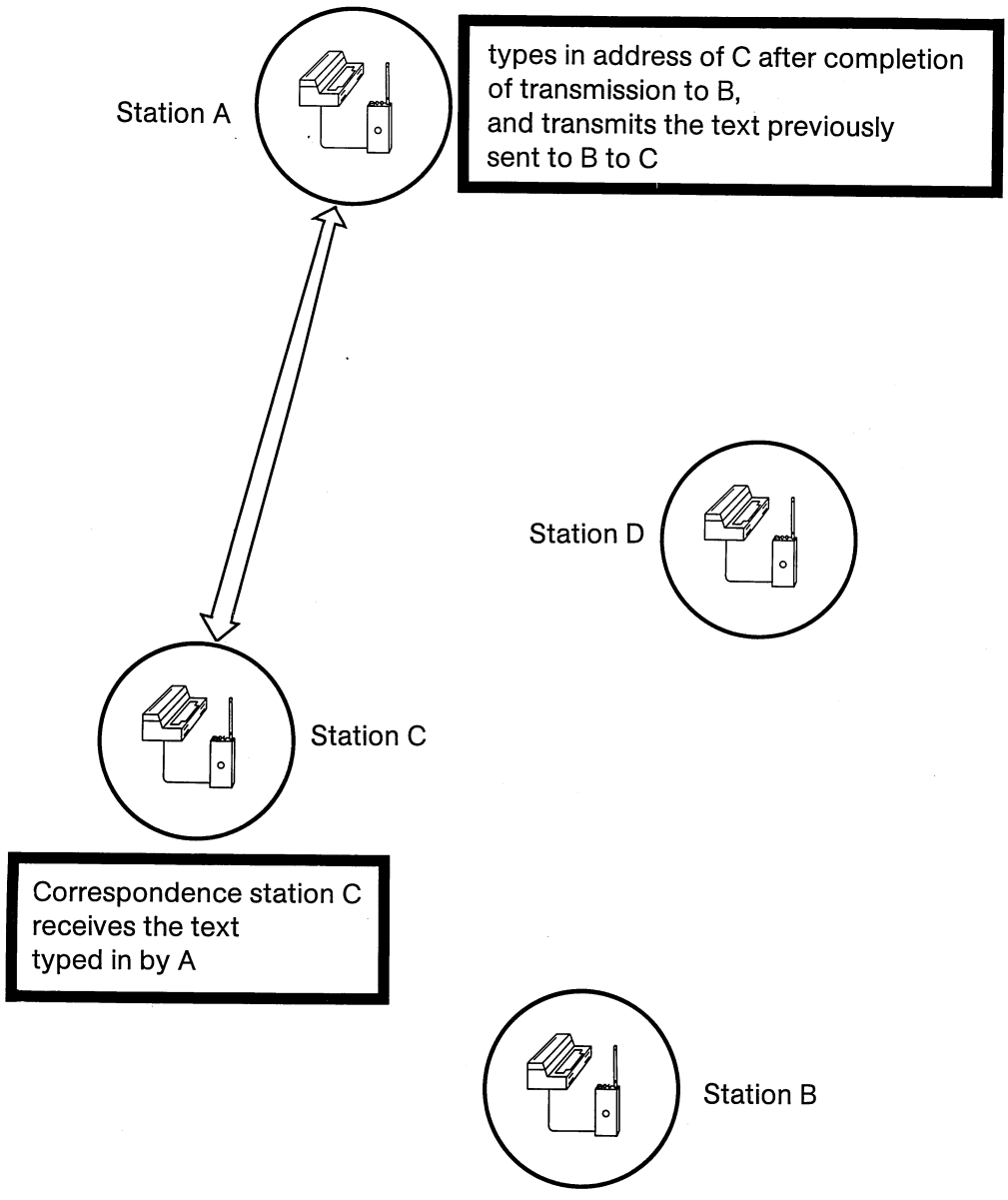
Transmission out of transmit storage
Awaiting acknowledgement from GAMMA 7

- Stations B and C
  Reception of message coming from station A
  Error check
  Feed-back of acknowledgement to station A

TELESTAR

- Multi-address operation

  Text transmission from station A to station C



Relay operation

TELESTAR

Relay operation

Relay operation means transmission of a received message stored in receive storage, to one or several receiving stations, by addressing the receiving stations one after the other.

Figure 12 shows the same basic constellation as Figs. 10 and 11, illustrating the transmission of a message from station B to station C after station B had received it from station A.
The procedure is:

Input of Station C address, e.g. „E DELTA 2"
Transmission out of transmit storage
Awaiting acknowledgement from DELTA 2

The message can, of course, also be retransmitted to the original transmitting station, in which case the procedure would be:

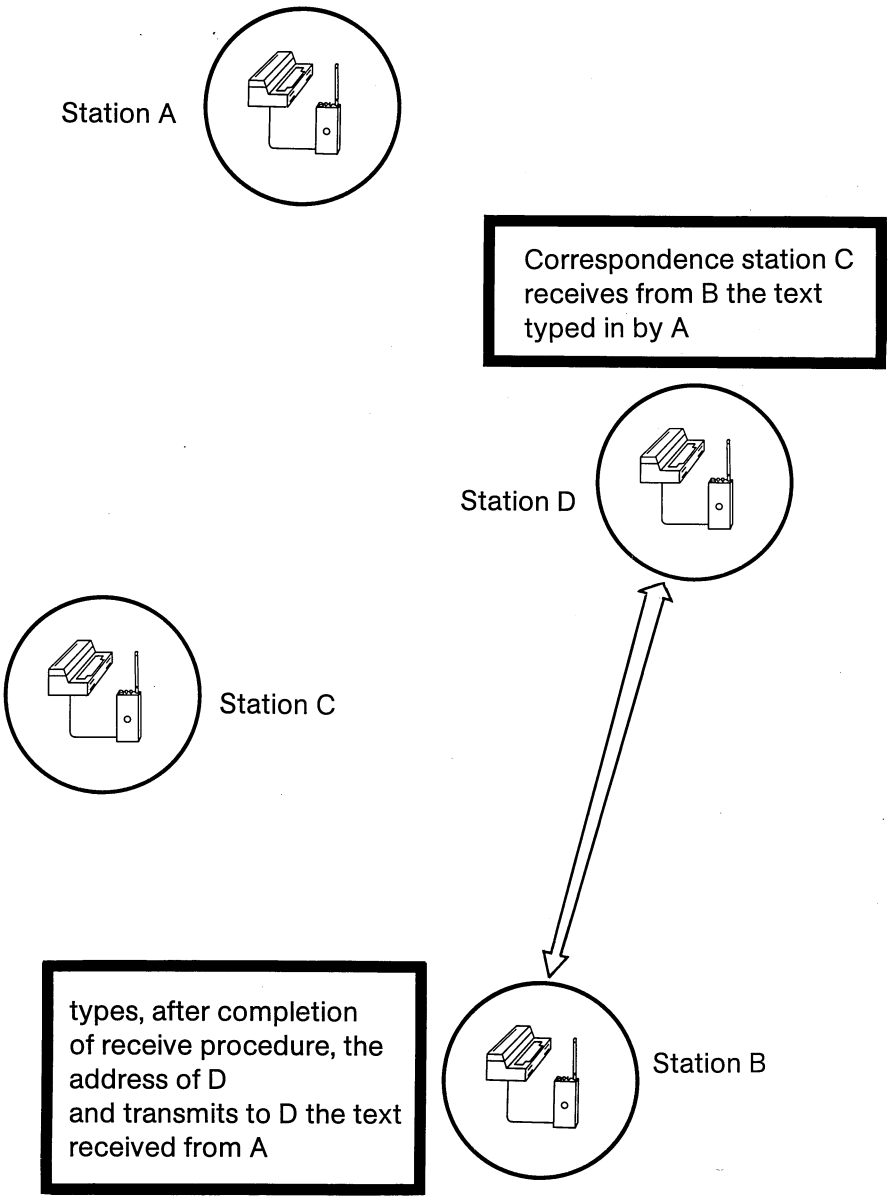
Input of Station A address, i.e. „E ALPHA 3"
Transmission out of receive storage
Awaiting acknowledgement from ALPHA 3.

TELESTAR

- Relay operation

Transmission of a message stored in receive storage,
to one or several receiving stations
by means of inputting receiving station address(es)

Transmission from station B to station C of the text received from station A



Self-test operation

TELESTAR

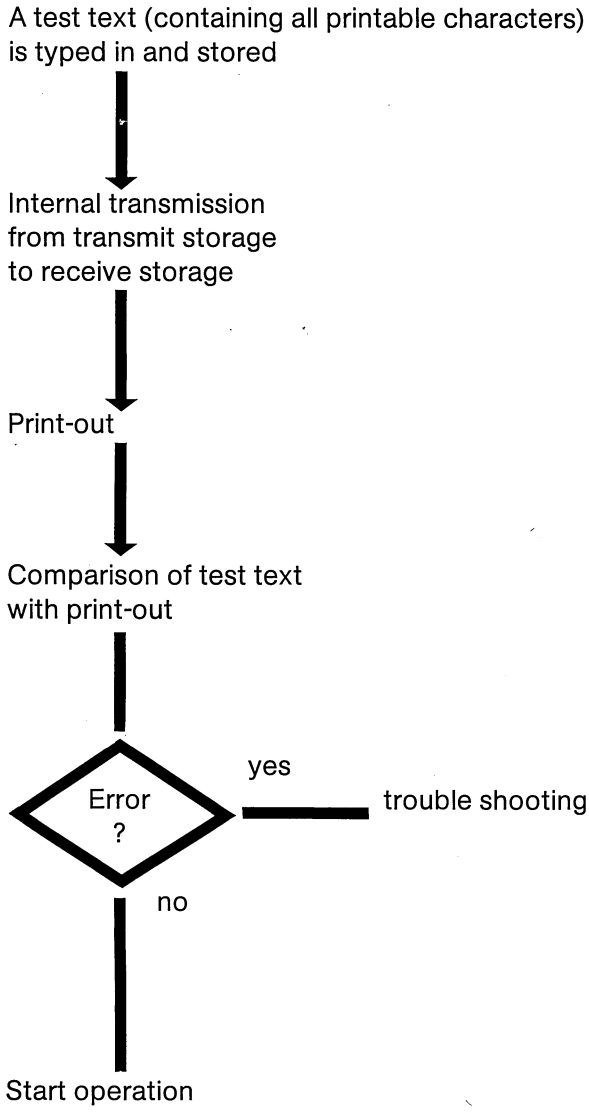
Self-test operation

The built-in separate transmit and receive stores enable the TELESTAR to perform simple self-test operations. Change-over from normal to test operation is effected either by the addition of a test plug or, if the TELESTAR equipment is mounted on a support, by moving the switch accommodated on the support from „Operation" to „Test". Upon initiation of the self-test operation, a test text containing all the printable characters is typed into the equipment. This text is transmitted from transmit storage to receive storage via the test plug or switch and printed out anew by the printer.

If the test text input and output are identical, the equipment is in perfect operating condition.

TELESTAR

Self-test operation



Interfaces

TELESTAR

Interfaces for connecting the correspondence equipment to data communications channels.

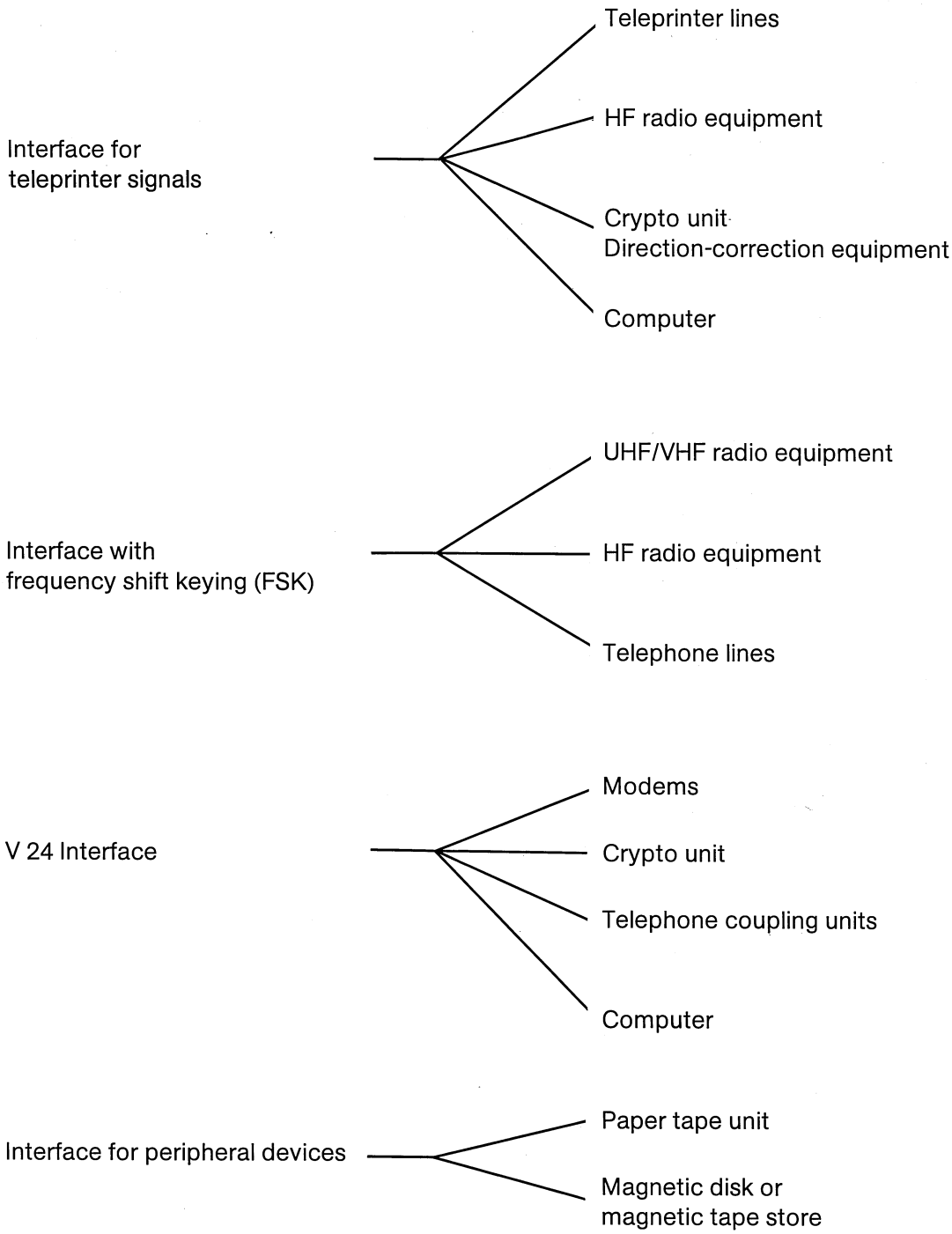
The interfaces for connection of TELESTAR equipment to the various data communications channels or devices and computers, as shown in Fig. 14, can be selected alternatively. Change-over from one interface to another is possible in principle by exchanging the interface board. However, in such a case, it is advisable to check whether or not other function groups have to be adapted to the changed operating situation.

In addition to the interface for a particular data communications channel, TELESTAR is also equipped with an interface for peripherals which, for example, allows operation of tape readers or tape punches.

TELESTAR

Interfaces

for connecting the correspondence equipment
to data communication channels



TELESTAR
for stationary application

TELESTAR

for stationary and mobile operation

Figure 15 lists the features which render TELESTAR suitable not only for stationary operation but also especially for mobile application.

Small dimensions, light weight, low power consumption and high environmental resistance allow the scope of teleprinter-type correspondence to be extended to all those individual cases of application which previously could not, or only partially, be handled by conventional teleprinters.

TELESTAR

for stationary application

TELESTAR operates very quietly

and for mobile application

TELESTAR has the dimensions
of a portable typewriter

(w 373 mm x h 98 mm x d 291 mm)

light weight
(approx. 7.5 kg)

low power consumption
(22 W max. during print-out)

and high environmental stability

For application in tracked vehicles,
TELESTAR is provided with a shock-mount.

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