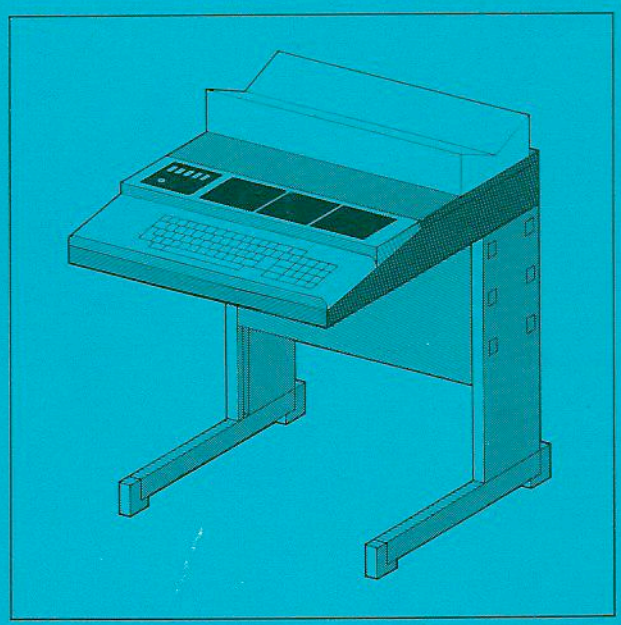
TC 480

Interactive Teleprinter
Reference Manual

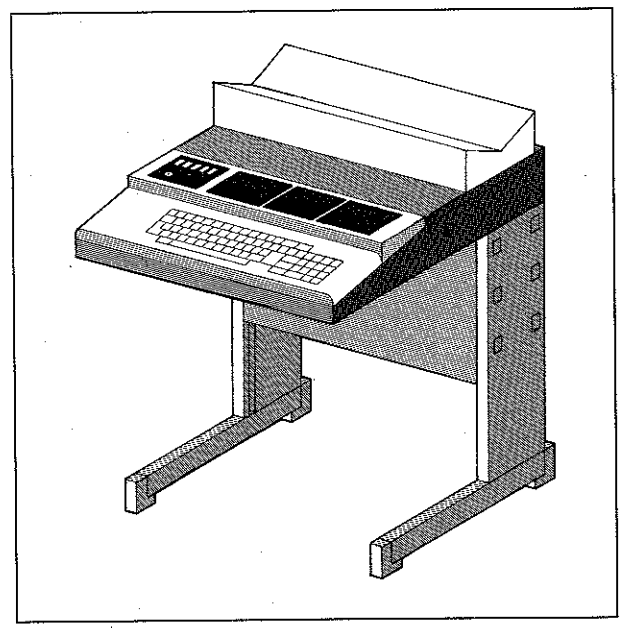


olivetti

GR Code 3943670 F (0)

TC 480

Interactive Teleprinter Reference Manual



olivetti

GR Code 3943670 F (0)

PREFACE

This manual has been written for those who wish to acquire detailed knowledge of the hardware potential of the TC 480 terminal and its operating mode.
A general background knowledge of the teleprocessing environment, in which the product is inserted, is required for the correct interpretation of the manual.

SUMMARY

The manual describes the general characteristics of the TC 480 terminal and its configurations.
A general description of the structure of the terminal is followed by a description of the individual modules of which the system is composed: keyboard, console, display, printer, line interface, tape punch/reader, magnetic cassette unit, minidisk. The operating logic and the technical and functional characteristics are given for each of the above units.

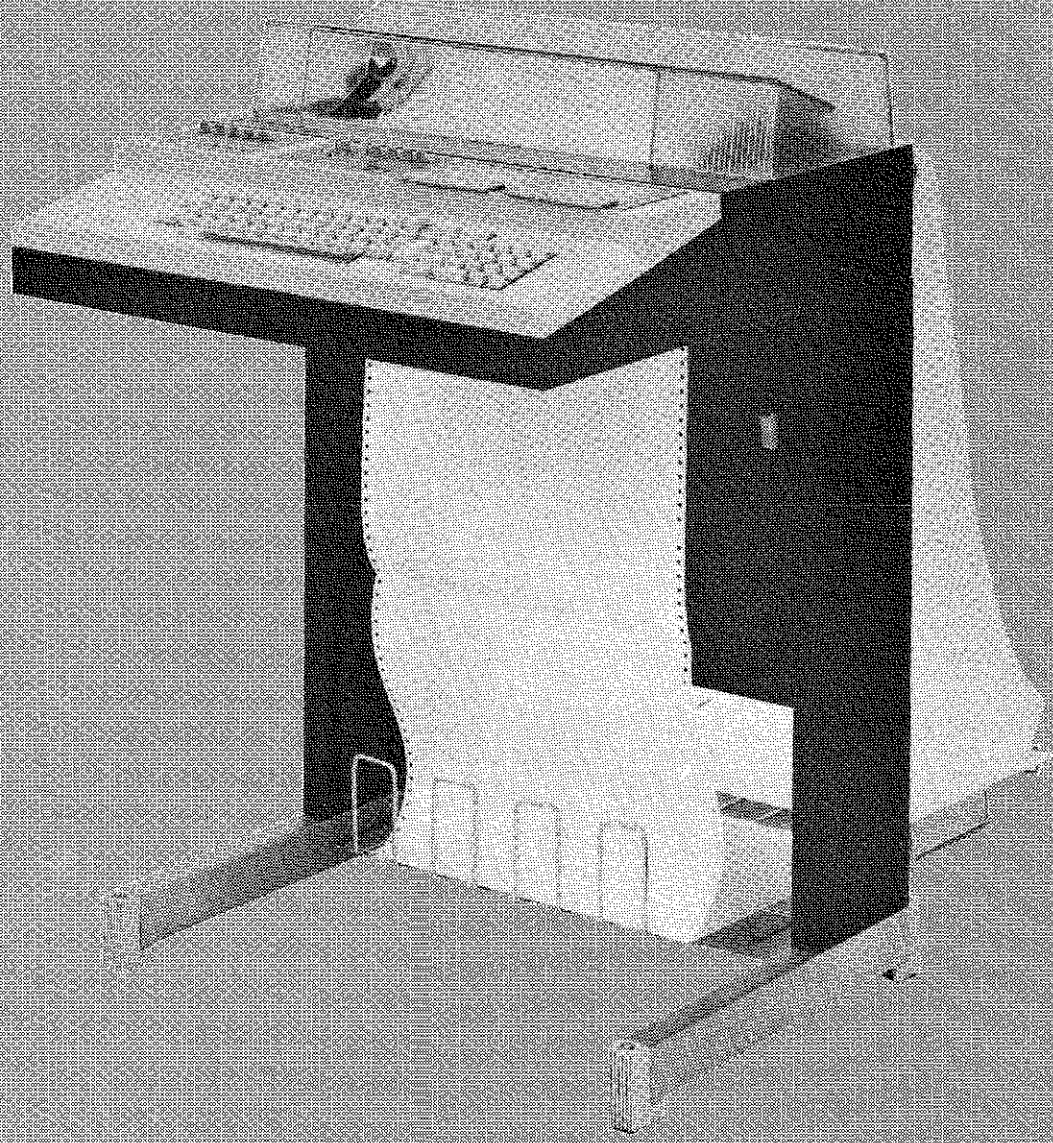
REFERENCES : None

DISTRIBUTION : General (G)

FIRST EDITION: October 1977

PUBLICATION ISSUED BY:
Ing. C. Olivetti & C., S.p.A.
Direzione Marketing-Servizio Documentazione
77, Via Jervis - 10015 Ivrea (Italy)

3943670 F



CONTENTS

INDEX OF THE FIGURES

1. GENERAL CHARACTERISTICS

The TC 480 is a simple interactive terminal using an 8 bit code for data transmission and telecommunications. It has a compact desk size structure with highly integrated and totally electronic logic. The limited amount of moving parts offers greater reliability and silent operation.
The terminal is available in 3 versions:

- TC 481 RO: receive only
- TC 485 KSR: keyboard send/receive
- TC 485 ASR: automatic send/receive

It guarantees compatability with:

- both switched and leased point to point telephone lines with the CCITT/V24 and EIA/RS 232 C interfaces
- both switched and leased point to point telegraph lines. It can operate in single or double current, having local or remote power supply.
- the minicomputers SP 600 and PDP 11 as a machine console
- any external control equipment, by means of a DTL/TTL interface.

The terminal is not programmable and enables direct access to the CPU, without any specific protocol because it is TTY compatible (free running).
This type of access is typical of the time sharing and similar methods and is used when sufficient error protection is provided by the VRC.
The TC 480 is very versatile as many of the features are strap selectable (see Appendix A). Some features can also be programmed on EPROM (Erasable Programmable Read Only Memory - see §5.3.1.). The terminal is provided with diagnostic programs which enable the operator to detect malfunctioning as soon as the machine is switched on, and diagnostic tools for maintenance purposes.

1.1. STRUCTURE OF THE TERMINAL

The basic KSR version has the following characteristics:

- electronic alphanumeric keyboard
- 30 char/s printer, 132 columns with adjustable sprocket device. Printing in local can reach a speed of 48 char/s
- easily replaceable ribbon cartridge
- electronic logic for operation in local and to provide asynchronous transmission/reception on lines operating at 1200 baud in half or full duplex
- console for switched or leased line connections

- 16 character line buffer in addition to the 64 character print buffer
- rear paper support
- CCITT N° 5 alphabet with 11 national variations
- printable character set: 95 ISO and 128 Katakana version
- line modulation speed: 4 selectable from the following 7: 75, 100, 110, 200, 250, 300 and 1200
- VRC error check and printing of the ■ character to indicate that an incorrect character has been received from the line
- number of copies: 1 original and 3 copies
- Break feature
- test mode to check the correct operation of the terminal and of the line
- resident diagnostic programs activated when the terminal is switched on to check the logic and the print functions
- Unattended feature
- Transparent feature

The basic terminal is fitted with a DTL/TTL line interface which permits connection to any external devices compatible with its conventions (chapter 6).
The R.O. version, unlike the KSR version, has no keyboard and has a different console (chapter 10).

1.1.1. Options for line or minicomputer connections

The basic terminal can be connected to telephone or telegraph lines or to the SP 600 and PDP 11 minicomputers using one of the following interfaces:

- TPI 4809 - telephone interface for CCITT V24 and EIA RS 232 C valid for point to point, leased and switched lines (chapter 7)
- TGI 4807 - active point to point telegraph interface (leased lines) (§ 8.1)
- TGW 4812 - neutral point to point telegraph interface (leased lines) (§ 8.3)
- CLI 4808 - 20mA current loop for connection to the SP 600 and PDP 11 console (chap. 9)

A telegraph filter can be inserted on telegraph lines when requested (FIL 4811 option -§8.2)

1.1.2. Input/Output Units

One of the following optional I/O units can be added to convert the TC 485 KSR version to the TC 485 ASR version:

- TP 4881 - 30 char/s 8-channel punch. This external unit is situated on the left of the terminal on a lateral stand called kit 60 (see chapter 11).

- TPR 4882 - 30 char/s 8-channel punch/reader. This external unit is situated on the left of the terminal on a lateral stand called kit 60 (see chapter 11).
- DDC 4883 - dual magnetic cassett unit. Each cassette has an 80K byte capacity making a total of 160 Kbytes. Standard Philips cassettes are used. The unit enables reception/transmission at 120 char/s, has its own console and can be integrated in the basic terminal casing, (see chapter 12).
- MDM 4887 - 8K RAM memory for text editing. This unit can be integrated in the basic terminal casing and has its own console (see chapter 13).
- MDU 4885 - minidisk unit. Both the minidisk and the memory have an 8 Kbyte capacity, making a total of 16 Kbytes. The unit permits reception and transmission at 120 char/s and can be integrated in the terminal casing. It has its own console and comprises the MDM 4887 option (chapter 13).

The TC 481 version can connect only the tape punch TP 4881.

1.1.3. Optional Devices

The terminal can be fitted with the following optional devices:

- NKB 4801 - numeric keyboard for entry of numeric data with or without right hand justification of the numeric fields (§ 3.3).
- HVT 4802 - electronic tabulation (horizontal and vertical) and Answer Back device. The device enables the insertion of 7 horizontal, vertical and form feed tabulation programs each containing 16, 10 and 1 tabulation stops respectively (§ 5.4.1). It also enables the sending of the Answer Back (up to 20 characters- § 6.3), and the definition of the length of the print line (132 characters).
- BEL 4805 - acoustic alarm used to warn the operator (§ 5.3.3).
- FVT 4803 - mechanical tabulation (only vertical). This punched tape loop device enables vertical tabulation and the form feed, and can co-exist with the electronic tabulation (§ 5.3.2).
- MFF 4806 - manual front feed for forms of constant thickness. This option enables simultaneous printing on the form and the journal roll (§5.3.4).
- PFD 4813 - pin feed device. This is an alternative to the sprocket feed device and can handle forms 80 columns wide (§ 5.3.5).
- KEY 4804 - key used by operator to deactivate input units i.e. keyboard, reader, cassette, minidisk (§ 4.1).
- FPC 4810 - fan-fold form support (§ 5.3.6).
- D 415 - copy hold (§ 5.3.6)
- D 427 - lamp (§ 5.3.6)
- KIT 61 - lateral working surface (§ 5.3.6)

1.2. APPLICATIONS

The TC 480 is a general purpose terminal, that is to say, it can be implemented in many varied application sectors and ON LINE environments.
The following is a list of the main sectors:

- terminals connected to the host computer
  - . time sharing
  - . remote job entry
  - . single file inquiry
  - . message switching
  - . data handling
  - . small batch
- terminals used as consoles for:
  - . minicomputers
  - . industry
  - . biomedical
  - . type-setting, etc.
- terminals connected to exchanges or directly to each other
  - . message handling
  - . message switching
- terminals on network systems, e.g.
  - . post office
  - . railways
  - . hotel reservation
  - . police department
  - . service bureau

As a general purpose terminal, the TC 480 is not confined to a specific application field as will be seen from the examples given below. However, its main feature remains that of a simple terminal and that is "to communicate".

- Financial

  The terminal can handle all applications not involving pass books or documents of variable thickness. However, any operation requiring intelligence or rapid store access should be carried out by the host computer (or concentrator). Remote batch operations are handled by means of access to switched networks or leased lines. The terminal uses message switching procedures (as opposed to telegraph techniques using CCITT alphabet N° 2) for stock exchange quotations, invoicing, etc.

- Government

  In this field the terminal performs general operations for the transmission of messages (private networks, ministerial, military, police) and handles information retrieval.

- Transport

  The terminal can be used for all operations in which hard copy is essential, i.e.:

  . control of rolling stock

  . inventory control

  . some types of enquiry

  . general message switching procedures (on switched networks or message switching type)

  . reservation of seats (when travel documents must be issued and the video-printer combination is considered to be too expensive).

- Industry

  The TC 480 is used for general applications, and the sending of messages or data items (mainly the latter). It can normally be associated with private networks, switched networks or with concentrators performing data collection or distribution services (quality control check, production orders, intermediate warehouse control, checking of data on automated production, e.g. chemical, petroleum, steel industries).

- Distribution

  The terminal is used to manage peripheral warehouses in a distribution chain. It can also be configured as an automatic through-put, low-traffic peripheral station.

- Education

  The terminal is used for general applications concerning data and message transmission and enquiry operations.

- Telecommunications

  The terminal provides the N°55 CCITT alphabet as an alternative to the N° 2 CCITT alphabet for specialized low-speed networks (up to 300 baud).

- Time-Sharing

  The terminal is used for scientific-technical applications (KSR version only or version with punch/reader), and for commercial applications (ASR version with magnetic medium for remote batch operations, modulation at 1200 baud on switched networks).

The logic of the TC 480 is realized in both hardware and firmware; the firmware is resident on ROM. The terminal is illustrated in figure 2.1. below.

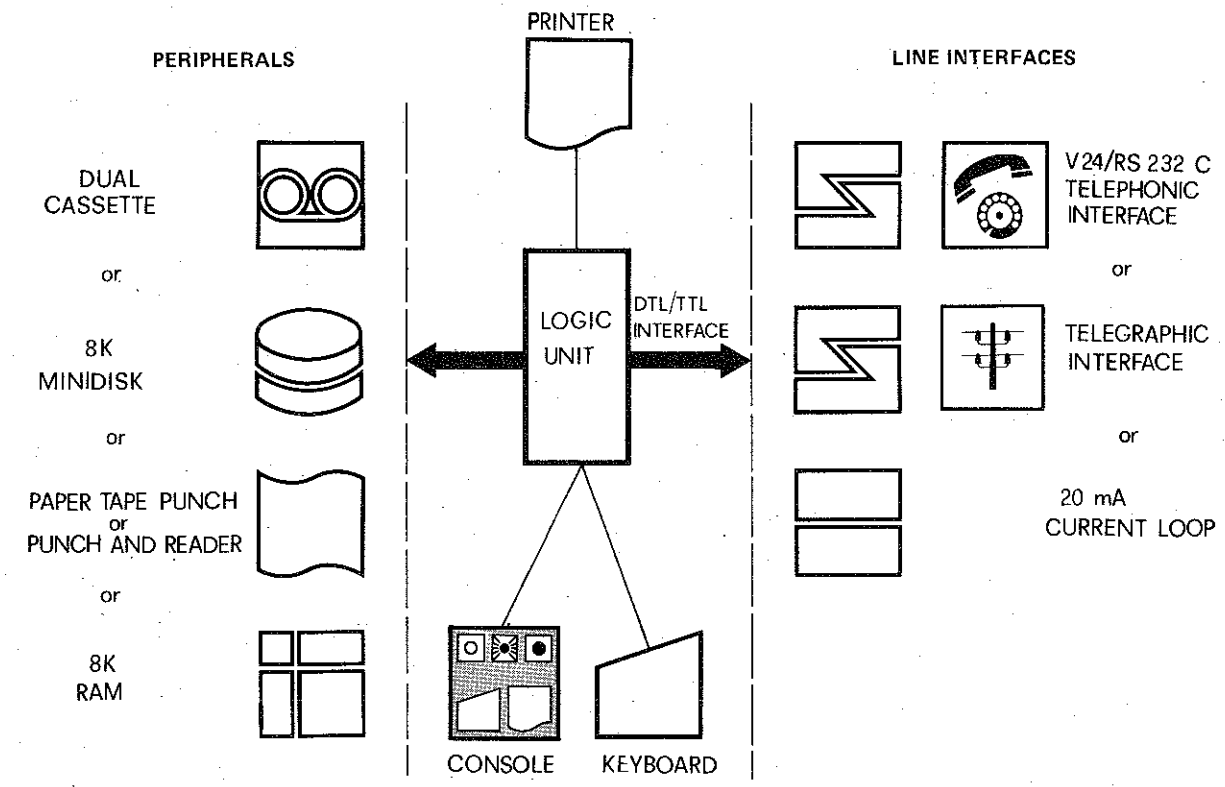


Figure 2.1. - Block diagram of the TC 480

The logic unit consists of a printed circuit board and uses the PPS4 microprocessor with the relevant LSI components.
The PPS4 kit, in addition to the microprocessor, consists of a 4K ROM which contains the microprograms, a 256 byte RAM and the I/O devices for the peripherals connected to the logic unit.
The printer also has a control logic which is composed of another PPS4 kit with its own 2K ROM and 256 byte RAM. The minidisk and cassette units have their own microprocessor.
Reception/transmission is asynchronous, i.e. it is carried out character by character and for this reason the terminal has a control unit to identify characters from the input devices and direct them to the output units.
The input devices on the terminal are:

- keyboard
- magnetic media (cassette, minidisk)

- tape reader
- line

The output devices are:

- printer
- magnetic media (cassette, minidisk)
- tape punch
- line

As the terminal has a single I/O channel, only one of the following I/O peripherals can be connected at one time:

- cassette
- minidisk
- tape punch
- tape punch/reader
- RAM

The flow of data in the terminal varies depending on whether it is operating in HD or FD, whether the punch/reader or a magnetic medium are connected, or whether a printable character is available or not, etc.:

- operation in FD: the terminal can be divided into 2 sections as shown below.

  keyboard ⟶ transmission line

  reception line ⟶ printer

- operation in HD:
  In transmission the characters entered from the keyboard are printed and sent on line simultaneously. In reception the incoming characters are printed (printing at 300 baud maximum = 30 char/s)
- tape punch
  This is associated with the printer, i.e. when the printer prints, the punch punches the tape.
- tape reader
  This can be used in place of the keyboard: when a read command is received, each character read is handled as if it were entered on the keyboard. That is to say, when operating in FD, the character would be sent on line, or in HD, it would be sent on line and printed.
  The punch and reader can operate simultaneously in FD.
- cassette
  Simultaneous input and output is not possible. The cassette is generally used for reception and transmission at 1200 baud.

- keyboard

  The keyboard is disabled when the Answer Back is sent in transmission and when characters are sent directly on line from the peripheral connected to the TC 485.

- minidisk with associated RAM

  This can substitute the tape punch/reader, the only difference being that it does not permit simultaneous I/O operation in full duplex

- the input devices can be deactivated using the relevant key on the console

On the TC 485 fitted with cassette or minidisk, the data entered on the keyboard cannot be sent on line and simultaneously to the cassette, while the data from the line is sent to the cassette

Therefore the flow of data is the following:

keyboard	⟶	line	or
keyboard	⟶	cassette	or
cassette	⟶	line	or
cassette	⟶	printer	or
line	⟶	cassette	

In short, printing is carried out in the circumstances given below:

- the following characters are printed in Local status:

  . those entered via keyboard or those read from one of the I/O units.
  The speed at which they are printed depends on the input device in question (max. 48 char/s)

- the following characters are printed, at a maximum speed of 30 char/s for line speeds of up to 300 baud, in Line status:

  . in HD: the characters entered via keyboard or read from one of the I/O units (line included)

  . in FD: only those characters received from the line.

The terminal uses the following buffers in the RAM to handle the functions described above:

- 64-character print buffer
- 16-character keyboard buffer
- 16-character line input buffer
- 16-character line output buffer
- 32-character punch output buffer
- 288-character (2 blocks) cassette buffer
- 8K (RAM) minidisk buffer

The keyboard buffer stores up to 16 characters entered on the keyboard. The characters are taken from this buffer and sent on line and to the print buffer. The keyboard buffer is

also used to store characters during entry from the numeric keyboard with right hand justification. The input line buffer interfaces the reception line by storing, character by character, the characters coming from the line in asynchronous mode and then directing them to the relevant output devices.

The output line buffer interfaces the transmission line so that characters are transmitted as they are received from the input device.

Refer to the specific chapters in this manual for information on the punch, cassette and minidisk buffers.

Some machine functions can be programmed on an optional EPROM INTEL 1702. Refer to chapter 5 for further information.

Many machine functions can be selected by the insertion of straps during the installation phase. These functions are listed in the summary table in Appendix A and are described in subsequent chapters.

The keyboard is the main interface between the TC 480 and the operator.

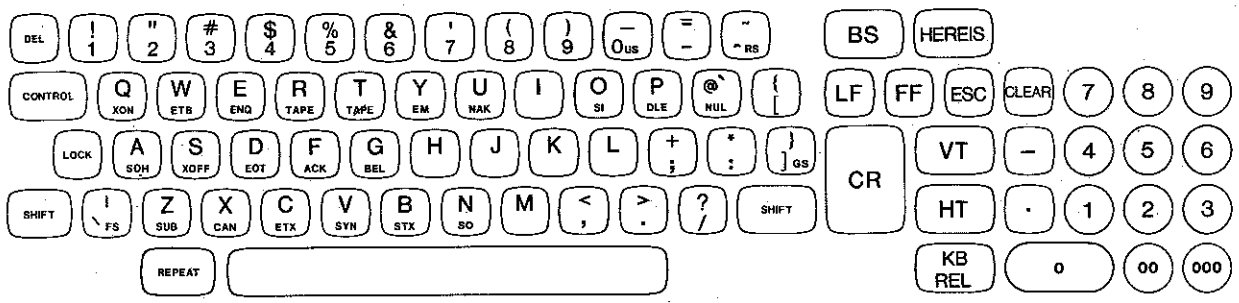


Figure 3.1 - KSR keyboard

It is an electronic capacitive keyboard and is integrated in the terminal models TC 485 (Keyboard Send Receive and Automatic Send Receive) while it is not provided on the TC 481 (Receive Only) version. It can be divided into 3 sections:

- alphanumeric
- function
- numeric (optional)

3.1. ALPHANUMERIC SECTION

This is used to enter:

a) the alphanumeric characters given in columns 2 - 7 of the ISO set, minus the DEL character and plus the SP (Space) character;

b) the special functions given in columns Ø and 1 of the ISO set, minus those functions emitted on the function section of the keyboard.

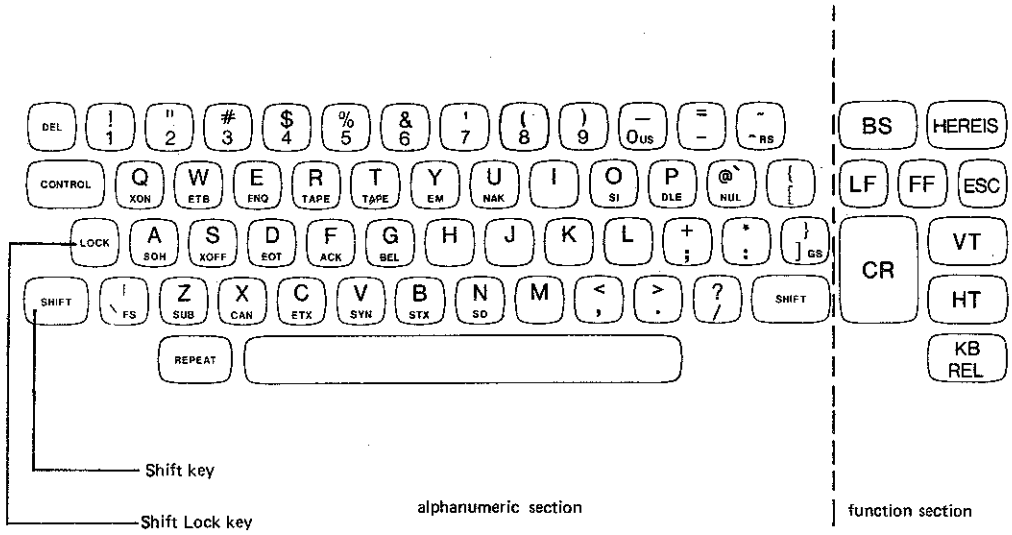


Figure 3.2. - KSR and ASR keyboard

The alphanumeric section has the following keys:

- 47 keys for graphic codes: each key can send 2 or 3 ISO characters depending on the position of the SHIFT, SHIFT LOCK and CONTROL keys
- SP (space) and BS (back space) keys: both send a single character
- SHIFT, SHIFT LOCK and CONTROL keys: these keys are used to modify the codes sent by the above 47 keys
  . the SHIFT key is used to print a character in upper case
  . SHIFT LOCK is used to lock printing in upper case. The light on the left of the key comes on to indicate that the key has been pressed
  . the CONTROL key enables the sending of characters from columns Ø and 1 of the ISO set
  All the codes from columns Ø and 1 are sent for the Italian and ASCII versions. For the other versions, the codes corresponding to the following function keys are not entered: BS, HT, LF, VT, FF, CR, ESC. The codes DC1, DC2, DC3, DC4 correspond to XON, TAPE, XOFF, TAPE keys respectively.
- REPEAT key: when this key is pressed with another key, the code of the latter is automatically repeated. The repetition rate is 14 char/s.

The alphanumeric section generates a total of 128 ISO characters for the Italian and ASCII versions and 121 for the other versions except Japan which has 160 characters.

3.2. FUNCTION SECTION

This section has 9 keys which correspond to the following functions:

- BS - Back Space: moves the print head back one space
- HT - Horizontal Tabulation: moves the print head to the next programmed stop. If no tabulation program exists, the print head advances one space
- LF - Line Feed: causes a line feed on the sprocket. If it is strap selected, a CR is also executed
- VT - Vertical Tabulation: causes vertical tabulation as demanded by the program or the tape loop. If there is no program or loop, VT executes a line feed.
- FF - Form Feed: causes form feed as demanded by the program or the tape loop If no program or loop exists, a line feed is executed
- CR - Carriage Return: moves the print head to the beginning of a new line. Clears the space counter
- ESC - Escape: used in sequence with other characters for supplementary commands which are not in ISO code
  E.g. ESC 1 inserts a horizontal tabulation stop
  ESC A selects tabulation program 1

For more detailed information on the functions of these keys, refer to § 5.4.

- KB REL: requested when the ALARM light starts flashing. It activates the keyboard which was deactivated in the following circumstances:
  . two keys pressed at an interval of less than 20msec
  . pressing of the CONTROL key together with a key on which no check characters are coded
  . reception of a break
  . entering a character after the end-of-line position

  This key also reactivates the numeric keyboard during the entry of characters with right hand justification, if it is deactivated due to:
  . overflow i.e. entry of more than 15 characters with sign
  . pressing a key on the alphanumeric or function keyboard which is not one of those preset to close the numeric field i.e. HT, LF, VT, FF, BS, CR.
- HERE IS: this key releases the Answer Back which establishes the terminal station in data transmission phase (the same sequence sent by the terminal when it re-

ceives ENQ from the line and is programmed to send the Answer Back)

The various national keyboard versions are obtained from the free positions available in ISO code, and are illustrated in appendices B and C.

3.3. NUMERIC KEYBOARD (NKB 4801 option)

The numeric keyboard is optional and can be used:

- to facilitate the entry of numeric characters given in column 3 of the ISO code
- in switched telegraph applications to dial the number of the other party

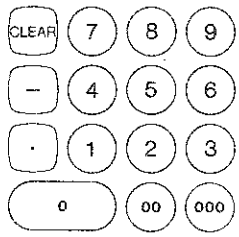


Figure 3.3. - Numeric keyboard

It has the following keys:

- 10 numeric keys
- double or triple zero keys
- minus key
- decimal separator key
- CLEAR key: clears all the entered field when the right hand justification feature is selected. It has the same functions as the KB REL key.

The right hand justification feature is provided for the entry of data on the numeric keyboard. The feature can be used only if:

- the HVT 4802 (Electronic tabulation and Answer Back) option is mounted
- the FØ character is written in position 1C on EPROM. The EPROM forms part of the HVT 4802 option

It is used to right hand justify integers in numeric fields which have a maximum length of 15 characters including the minus sign. Right hand justification is always performed so as to align the units figure.

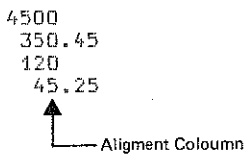


Figure 3.4 - Example of numeric fields with right hand justification

FF must be inserted in position 1C on EPROM to exclude right hand justification. In this case, each character entered on the numeric keyboard is handled as a character entered on the alphanumeric keyboard.
When the feature is used, and the entry of a numeric field is started on the numeric keyboard, the alphanumeric and function sections are deactivated. Only the 6 function keys provided to close the entered field, i.e. BS, HT, LF, VT, FF, CR remain activated.

3.4. KEYBOARD OPERATING LOGIC

The logic of the keyboard control unit is achieved through the functions contained in the basic machine logic. It therefore uses the resources of the PPS4 kit and the basic machine ROM.
At the microprogramming level, keyboard input is logically connected to some signal functions on the console.
The microprogram can also handle the TC 481 (Receive Only) version.
The elements of the basic machine which effect operations on the keyboard are the Keyboard Encoder and the Keyboard Buffer.
The keyboard encoder is an integrated circuit (ROM) which transcodes the position codes, sent by the keys on 8 bits in the corresponding 7 bit ISO codes. The keyboard encoder must correspond to the national keyboard version on which it is mounted.
The keyboard buffer is a 16 character area, contained in the RAM memory of the basic machine.
The characters entered via keyboard and coded by the keyboard encoder are recognized by the microprogram and are handled as follows:

- alphanumeric characters are transferred, but no check is carried out on the units to which they are to be sent (printer, line, I/O units);
- special functions are recognized and the relevant commands are executed;

The various national versions, except for Japan, are obtained by changing the keyboard encoder ROM, without affecting the microprogram.

As the Japanese character set is extended (see appendix B) and as it is coded by setting the keys SI and SO, the control microprogram distinguishes Latin characters from Katakana characters and automatically inserts characters SI and SO. When the terminal is switched on, the keyboard is set to send Latin characters.
The keyboard is deactivated in the following circumstances:

- when two keys are pressed at an interval of less than 20msec
- pressing of the CONTROL key together with a key on which no check characters are coded
- reception of a break
- entering a character after the end-of-line
- if, during the entry of numeric fields with justification, a deactivated key is pressed or if more than 15 numeric characters with sign are entered (overflow)

The ALARM light flashes at the rate of $\frac{1}{2}$ second to indicate that the keyboard has been deactivated. It is reactivated by pressing the KB REL or CLEAR key. As the CLEAR key clears the buffer, it should be used only during the entry of numeric fields with right hand justification.
The keyboard is also temporarily deactivated during the transmission of the Answer Back and during the transmission of characters from the input units.
Right hand justification is achieved in the following way:

- as each character, belonging to the integer part of the numeric field, is entered, a BS character is generated. This back spaces the print head one space and is then sent on line or to the output unit. The decimal separator and the decimal numbers do not generate BS
- the entry must end with one of the function keys BS, HT, LF, VT, FF, CR, which when pressed causes the sending of the keyed character sequence to the printer and on line, or to the output unit. The relevant function is then carried out.
- if the keyboard is deactivated during right hand justification, the KB REL key will reactivate only the numeric section. The CLEAR key, as well as reactivating the entire keyboard, also cancels the characters entered and sends one space for each BS generated to the selected output unit.
- the Answer Back cannot be released until the right hand justification function has been completed.

There are three consoles on the terminal:

- basic machine console
- cassette console
- minidisk console

The consoles for the cassette and minidisk are described in the relevant chapters. The basic machine console is available in 8 versions for the TC 485 model, which vary according to the functions to be carried out by the terminal, and 1 for the TC 481 model (see chapter 10).
The options are as follows:

- Basic console option (this console is used for fixed lines and is a prerequisite for other console options). It comprises:
  - . LOCAL-LINE-BREAK
  - . TEST MODE
  - . ON/OFF light
  - . ALARM light
- Switched line option (this is generally used for switched lines but because it contains the TRANSP/NO TRANSP key it can be used for fixed lines). The console contains all the basic console features, plus:
  - . UNATT-CONN key
  - . TRANSP/NO TRANSP key
  - . ORIGIN key
  - . CONN light
  - . CD light
- Tabulation option
  This requires the addition of a 10 position program selector
- Key option
  This requires the addition of a 2 position key

Figure 4 shows the most complete version of the basic machine console.

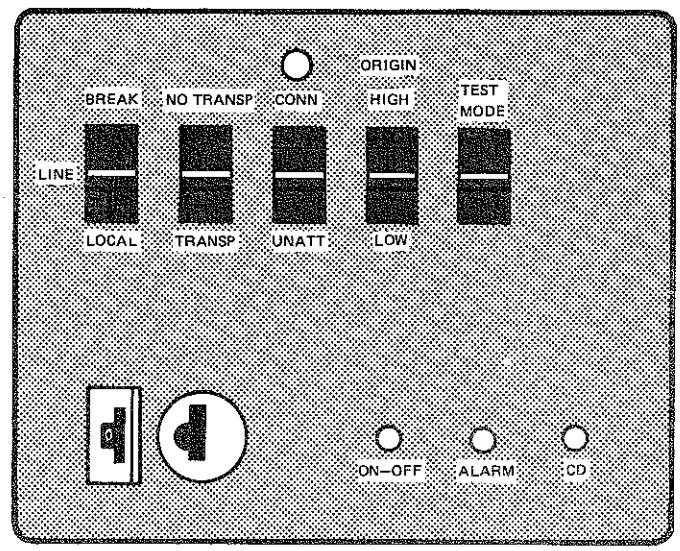


Figure 4.1. - Complete version of the basic machine console

The 8 combinations of the basic machine console are:

Console N°	Basic Console Option	Switched Line Option	Key Option	Tabulation Option
043	X	X	X	X
042	X	X	X	
041	X	X		X
005	X	X		
040	X		X	X
039	X		X	
038	X			X
032	X			

4.1. DESCRIPTION OF THE BASIC MACHINE CONSOLE

a) LOCAL-LINE-BREAK key

This key is two position in the LOCAL and LINE positions and one position for the BREAK position.

It determines whether the machine operates in local or on line. In the latter case, and and when the key is in the BREAK position, a break is sent on line.

b) TEST MODE key

This is a two position key. In the TEST MODE position, the terminal functions in TEST MODE.

Refer to § 7.1.5 for operation in TEST MODE.

c) NO TRANSP-TRANSP key

This is a two position key. In the TRANSP position the machine is made transparent to the data sent or received from the line or a peripheral unit. In the NO TRANSP position, the machine operates normally. Refer to § 7.7 for operation in TRANSPARENT.

d) UNATT-CONN key

This key is two position in the UNATT position and one position in the CONN position. When pushed towards CONN, it starts a line connection procedure. When put in the UNATT position, the machine is automatically connected to the line in order to reply to a call indicated by the Ring Indicator wire in the modem.

Refer to § 7.6.2 for operation in UNATTENDED.

e) ORIGIN key

This is a two position key. When in the HIGH position, on a bichannel modem, it selects the high transmission frequency, and when in LOW, the low transmission frequency.

f) ON/OFF light

This indicates whether the unit is on or off.

g) ALARM light

This indicates several conditions:

- light which flashes every 0.5 seconds indicates:
  - . two keys pressed together (at an interval of 20 msec)
  - . entry on the numeric keyboard not closed (pressing a non-format key after numeric entry with justification)
  - . buffer full
  - . end of line
  - . entry on deactivated keyboard after receiving a Break
- steady light indicates PAPER OUT

h) CONN light

When this comes on, it indicates that the terminal is connected to the line. When the unit is in Local and Unattended mode and a call is being made, this light flashes to request the operator to exit from LOCAL.

i) CD light

Signals that the carrier is on line during reception. This light comes on only when the terminal is connected to the modem. When connecting on telegraph lines (point to point), the light does not come on as there is no carrier on the line. For this reason the console for leased lines has no CD light.

j) Two position key-lock to disable input. When it is in 'open' position, input from the media and keyboard is blocked. The answer back remains activated.
When there is no key, the input units are always activated.

k) Tabulation selector
This has 10 positions. In positions 1-7 it selects the corresponding electronic tabulation program. In positions 8 or 9 it cancels all the tabulation stops in the RAM memory. In position 0 it has no effect.

5.1. GENERAL CHARACTERISTICS

The main characteristics of the basic printer version are:

- print group with a 7 needle head to produce a 7 x (5+4) matrix
- printer speed: up to 30 char/s on line, up to 60 char/s in local
- pitch: 10 char/in (2.54mm)
- characters per line: 132 max.
- line feed: 6 lines/in (4.24mm)
- number of copies: 1 original + 3 copies
- sprocket feed for edge punched, fan-fold continuous forms. Form width varies from 3 in to 14.8 in (76 to 377mm)
- manual adjustment of print head position according to the thickness of the document to be printed
- printable character set: 95 ISO (128 for Latin/Katakana version)
- special ribbon cartridge: contains a 12m nylon ribbon loop

The options and devices available for the basic version are:

- pin feed device (PFD 4813) as an alternative to the sprocket feed device
- manual front feed (MFF 4806)
- 7 vertical and horizontal tabulation programs and form feed on EPROM (HVT 4802)
- vertical tabulation and form feed on tape loop (FVT 4803)
- acoustic alarm (BEL 4805)
- paper support (FPC 4810)
- copy hold (D 415)
- lamp (D 427)

The printer is integrated in the basic machine and consists of:

- print head carriage
- sprocket feed or pin feed device
- ribbon cartridge
- type impact control

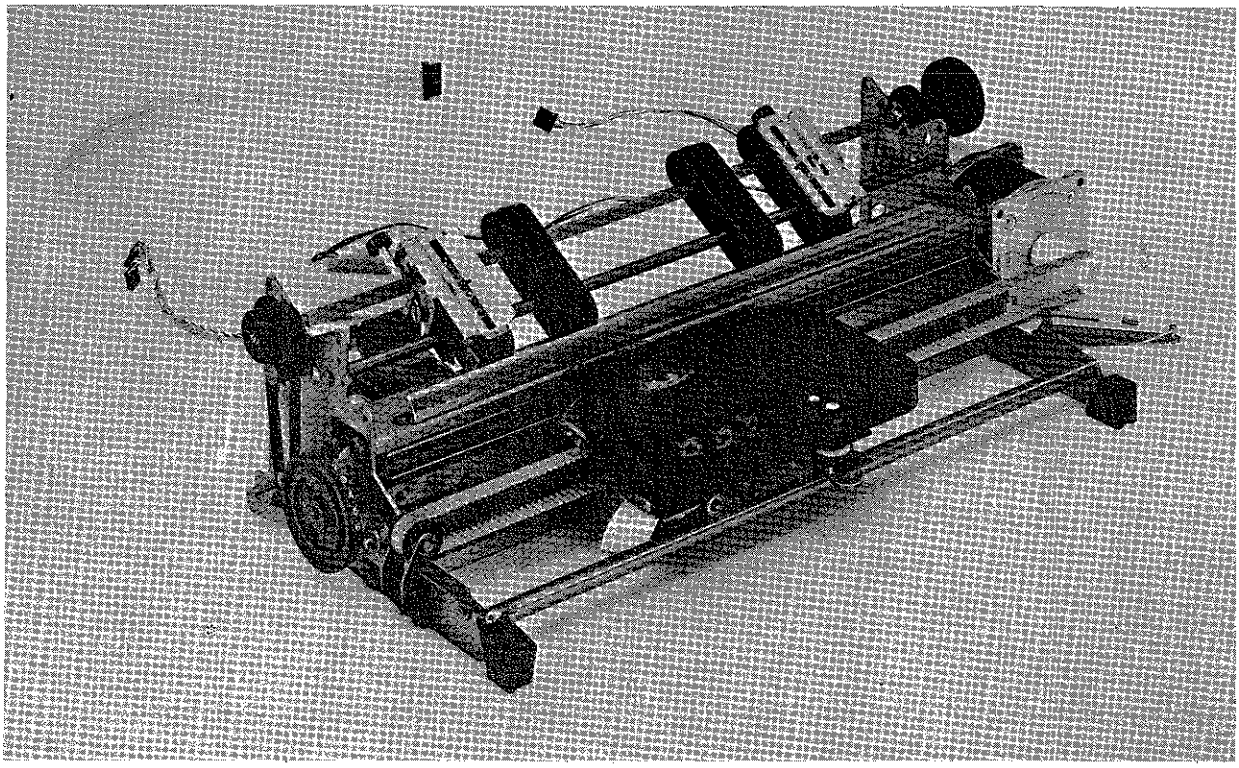


Figure 5.1. - The print group

Edge punched, fan-fold continuous forms are used on the printer. Figure 5.2 indicates the dimensions of the forms.

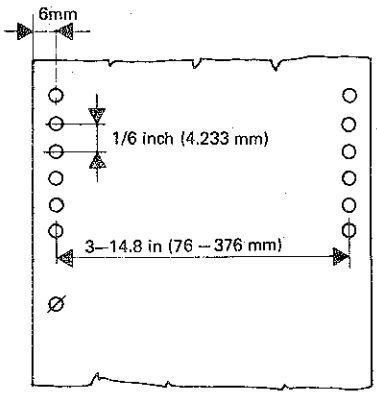


Figure 5.2. - Width of forms

A maximum of 1 original and 3 copies (fan-fold forms) can be printed on self-copy or carbon-backed 60gr/m^2 paper or on 45gr/m^2 paper and 20gr/m^2 carbon paper sheets, making a total weight not exceeding 370gr/m^2.

The printer has three moving elements:

- carriage movement - step-by-step print head transport or back space
  - horizontal tabulation
  - carriage return
- paper transport - line spacing, vertical tabulation and form feed
- type impact control

Printing control is related to the 2 logic levels which control all the integrated peripherals:

- microprogram
- control and actuation hardware

The following hardware/firmware components and the functional aspects are involved in the print phase:

- print carriage movement
- print head and activation of the needles
- transcode microprogram to convert ISO codes into the corresponding print matrix
- hardware/firmware programming of the national version and of the related alphabets
- paper transport

5.2. PHYSICAL STRUCTURE AND PRINT PROCESS

The following paragraphs describe the physical structure of the printer components and their functions.

5.2.1. The print head and matrix

The print head prints characters on the forms which are advanced by the sprocket or the front feed device.
The print head (figure 5.3) is mounted on a carriage. The carriage is moved in both directions by a belt-driven stepping motor. The motor is powered by an actuation logic.
There are two operating speeds: up to 18 char/s and 60 char/s (see § 5.4.6.)
Characters are printed using a 7 needle head. The needles are activated by 7 solenoids (fig. 5.3) and are driven against the impact bar.
The print carriage moves across the paper from left to right. Each character occupies 9 half spaces.
Characters are generated by selectively activating the 7 solenoids.

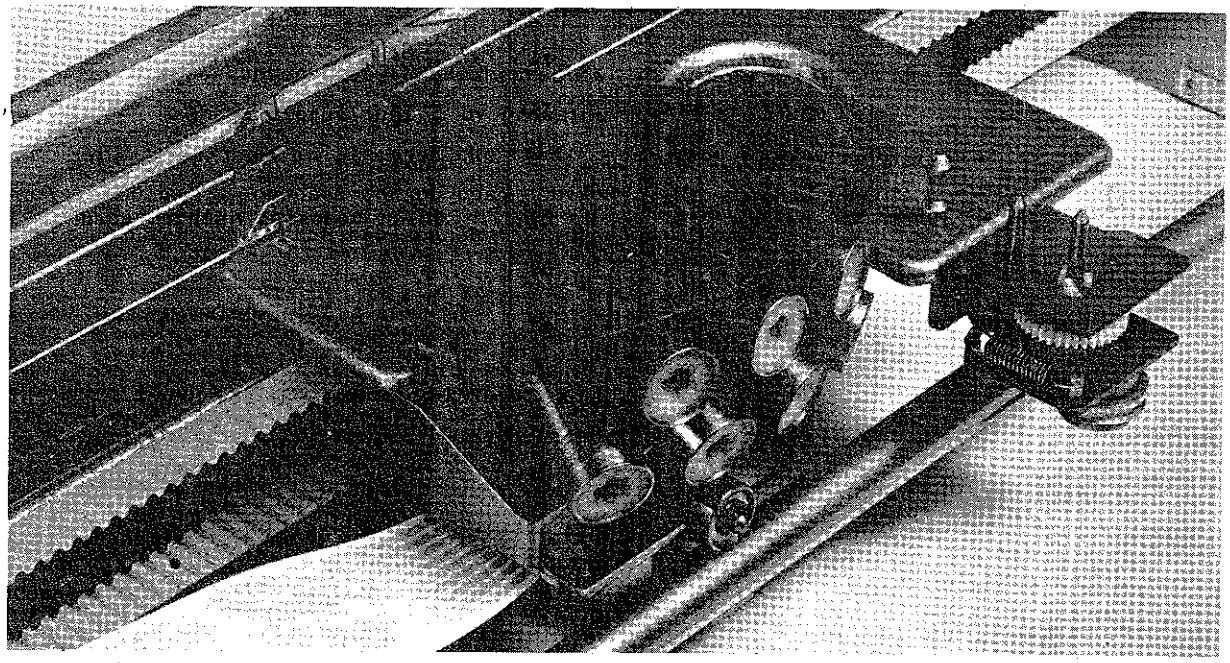


Figure 5.3. - The print head

The pressure of the needles against the ribbon and the paper gives a series of dots which form the character. The series of dots is a 7 x (5+4) matrix formed according to the FONT of OCR characters, ECMA standard N° 0041.
The character sizes are: 2.61 x 1.75mm. The print pitch is 1/10in (2.54mm) (figure 5.4).

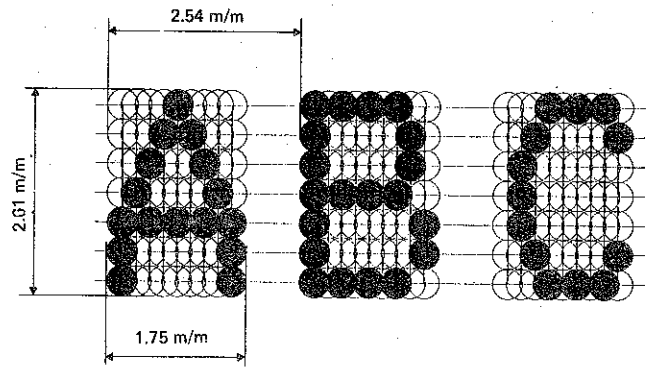


Figure 5.4. - Example of the character structure in accordance with the ECMA standard

The 7 x (5+4) matrix consists of 7 lines, 5 columns and 4 half columns. The latter are used to give a clearer definition to certain characters. However, if the printing of a character begins on a column, then no printing will take place on the adjacent half column or vice-versa.

The exact sequence of solenoid activation is controlled, (for each column or half column), by the microprogram and by a corresponding transcoding table contained in ROM (character generator).
The space between one character and the next is equal to 2 columns or 4 half spaces.
The print line on the main machine is 132 positions long. When the HVT 4802 option (Electronic tabulation and answer back) is inserted, the length of the print line may be lower than 132 characters (see EPROM § 5.4.3).
The horizontal format control (horizontal tabulation) is optional and is carried out by mounting the HVT 4802 option. Sixteen horizontal stops can be inserted for each of the tabulation programs contained in the EPROM of the HVT 4802 option.
With this option, more horizontal tabulation programs can be inserted in the RAM via keyboard or line.

5.2.2. Printable character set

The character set has 95 symbols (96 ISO minus DEL and SP and plus the ▮ character which is 5 x 5 and is printed from the bottom upwards). Japan is an exception as it has a set of 127 symbols plus the ▮ character.
The ROM gives a set of 128 characters. The national versions are illustrated in appendix C and differ only slightly one from the other. The ROM versions available are the following:

Version A:	Italy
	ASCII
	United Kingdom
	France
	Spain
Version B:	Japan
Version C:	Finland
	Sweden
	Norway
	Denmark
	Portugal
	Switzerland
	Germany

The national character set versions are strap selected within each ROM version. The character sets correspond to the national keyboard versions illustrated in Appendix C.
The character set for Japan, illustrated in appendix C, has 127 symbols taken from the JIS standard, plus the incorrect parity character which is represented by the ▮ symbol.
As the terminal operates entirely in 7-bit code, the choice of latin or kana characters for Japan is made using the codes SI and SO respectively.

Codes SI and SO select the latin or kana set as the codes LTRS and CFRS select the letters and figures in a 5-bit ISO code.
The Japanese set does not contain lower case characters and both a latin and kana character correspond to the same code in columns 02 - 05 of the ISO set.
Selection is defined by the last SI or SO code received from the printer control unit.
The latin set is selected when the machine is switched on.
As mentioned in the paragraph describing the keyboard codes, SI and SO are sent automatically.

5.2.3. Paper transport

Paper is fed by a sprocket device with two lateral paper tractors. These are adjusted to the width of the form. The tractors are powered by a stepping motor. There are also two adjustable paper guides mounted on the same shaft.
Line spacing is 1/6in.
To adjust the paper and centre the character on the vertical lines on the form, use the knob on the right hand side of the sprocket (see figure 5.1). The vertical format control (vertical tabulation and FF) is optional and can be electronic or mechanic.
In both cases, tabulation is performed by continuous line feeding (tabulation times are given in § 5.4.6.).
The HVT 4802 option (electronic tabulation and answer back) must be mounted for electronic vertical tabulation operations. Ten vertical tabulation stops and one form feed stop can be inserted for each of the seven programs contained on the EPROM.
Using the HVT 4802 option, more vertical tabulation programs can be inserted in RAM via keyboard or line.
The FVT 4803 option must be mounted for mechanical vertical tabulation. This option is controlled by punched tape loop which is described in § 5.3.2.
The paper out signal is sent by a microswitch set on the 3rd print column and situated about 30mm from the head. The signal is activated 7 line feeds from the end of the paper.
The PDF 4813 option can be mounted instead of the sprocket device. The forms have a fixed width. The option is described in § 5.3.5.

5.2.4. Ribbon cartridge

This is a one-colour nylon loop. It is 12m long and is contained in a special plastic cartridge.
Inside the cartridge there is a reverse cycle device which enables printing on the back of the tape after each complete cycle. This principle is called the Moebious loop.
The tape life is 1.5 million characters.
The tape is always advanced in one direction and is carried out by a mechanism which is moved by the print head carriage, only when the latter is moving from left to right.

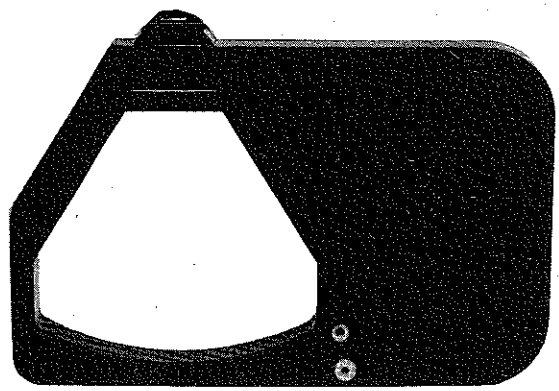


Figure 5.5 - Ribbon cartridge

5.2.5. Type impact control

Type impact is regulated according to the required amount of copies, by a wheel situated on the left of the machine (fig. 5.6). This moves the print head closer to or away from the impact bar. The wheel can be set in 7 positions. The first 6 are print positions and are spaced at 0.07 mm intervals. The 7th is used to move the print head for paper insertion and replacing the cartridge.
Type impact control has no bearing on the print carriage movement and therefore the impact can be adjusted during printing.

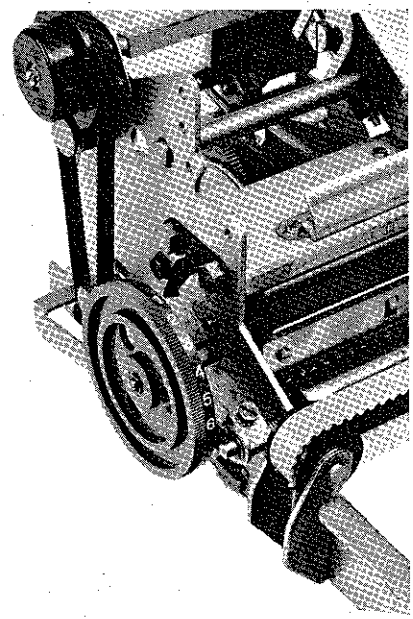


Figure 5.6. - Type impact control

5.3. PRINT OPTIONS

The following options are available for the printer:

- electronic tabulation (HVT 4802)
- mechanical tabulation (FVT 4803)
- acoustic alarm (BEL 4805)
- front feed (MFF 4806)
- pin feed (PFD 4813)
- paper support (PFC 4810)
- copy hold (D 415)
- lamp (D 427)

5.3.1. EPROM, used for Electronic Tabulation and Answer Back

The EPROM INTEL 1702 (Erasable programmable ROM) forms part of the HVT 4802 option. It is mounted on a board which can be inserted on the main board via a connector.
It has a 256 position capacity and is divided as follows:

- first 20 bytes: these are reserved for the Answer Back. The Answer Back procedure is given in §6.3
- position 1B: (in hexadecimal) indicates the length of the print line. The number of columns to be printed must be written in binary. If there are 132, execute FF
- position 1C: indicates whether right hand justification is required for data entered on the numeric keyboard.
  If justification is required, execute FØ; if not, execute FF.
- positon 1D: contains the character (expressed in ISO) which replaces that received from the line with incorrect parity (§6.2)
- position 1E: indicates whether the Answer Back must be sent when ENQ is received from the line.
  To send the Answer Back, execute FØ. It will not be sent if FF is executed (§6.3)
- position 1F: indicates the delay for line turn around generated by the terminal when:
  . a 2 wire connection is used, or
  . in a 4 wire connection, position 1E indicates that the Answer Back is to be sent

  The delay programmed is a multiple of 5 msec, (from 5 to 1280 msec max.).

The formula which gives the value to write in position 1F is:

$$D = 255 - \frac{x}{5}$$

where D is the value to write in position 1F and x is the line turn around time required.

Example:

Execute FF for no delay

Execute CB for a delay of 257

$$D = 255 - \frac{260}{5} = 203 \quad (\text{Hex. CD})$$

- positions 2Ø - 2F: contain, in binary, the columns coinciding with the horizontal tabulation stop in program 1.
  A maximum of 16 stops can be programmed. Those stops which are not used must be filled with FFF

-- positions 36 - 3F: contain, in binary, the number of lines on which vertical tabulation stops have been set in program 1.
  A maximum number of 10 stops can be programmed. Those stops which are not used must be filled with FF

- position 35: contains, in binary, the number of print lines on the form to be used with program 1. This position is called PAGE

- positions 4Ø - FF: contains the horizontal and vertical tabulation stops and the PAGE of programs 2 to 7.

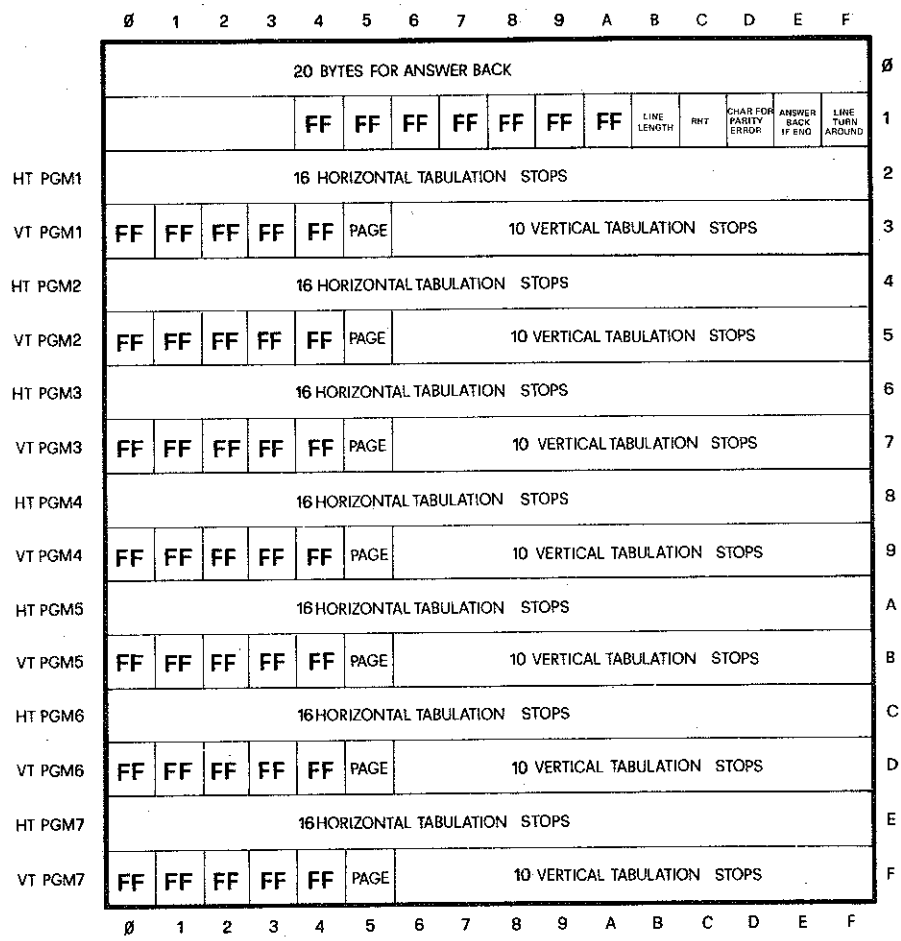


Figure 5.7 - EPROM, used for electronic tabulation and Answer Back

As can be seen from the EPROM contents, the HVT 4802 option is used not only for the electronic tabulation and Answer Back features, but also for other features which will be described later.
We advise the use of the PRO-LOG M900 which is a special device for recording and erasing EPROM. The information required to program EPROM is given in a booklet, code 357001/E.

5.3.2. Tape Loop (FVT 4803)

The punched tape loop device is driven by the same stepping motor which drives the sprocket feed. It consists of a loop feed unit and an optical reader.

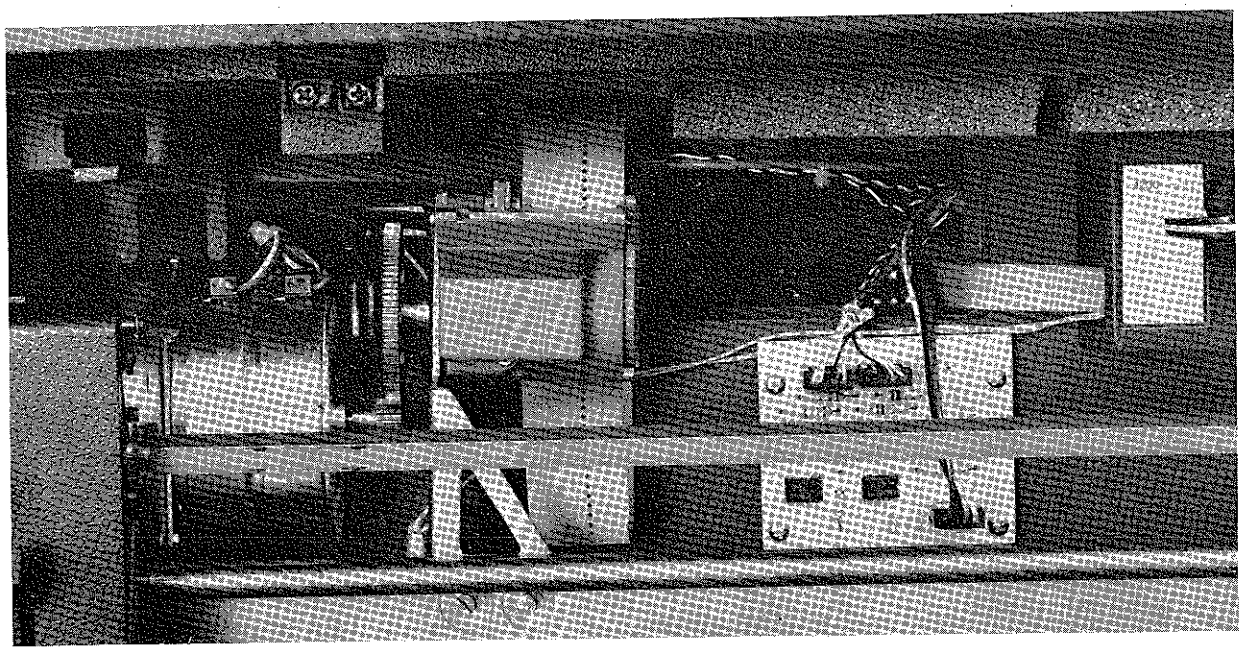


Figure 5.8. - The tape loop device

The punched tape has the same dimensions as that used on the TPR 4882 option. The loop controls the vertical tabulation stops and the form feed. Of the 8 punch tracks, only tracks 5 and 7 are used.
Track 5 stops the vertical skip (vertical tabulation) and track 7 stops skipping at the top of form.
Any holes in the other tracks are ignored.

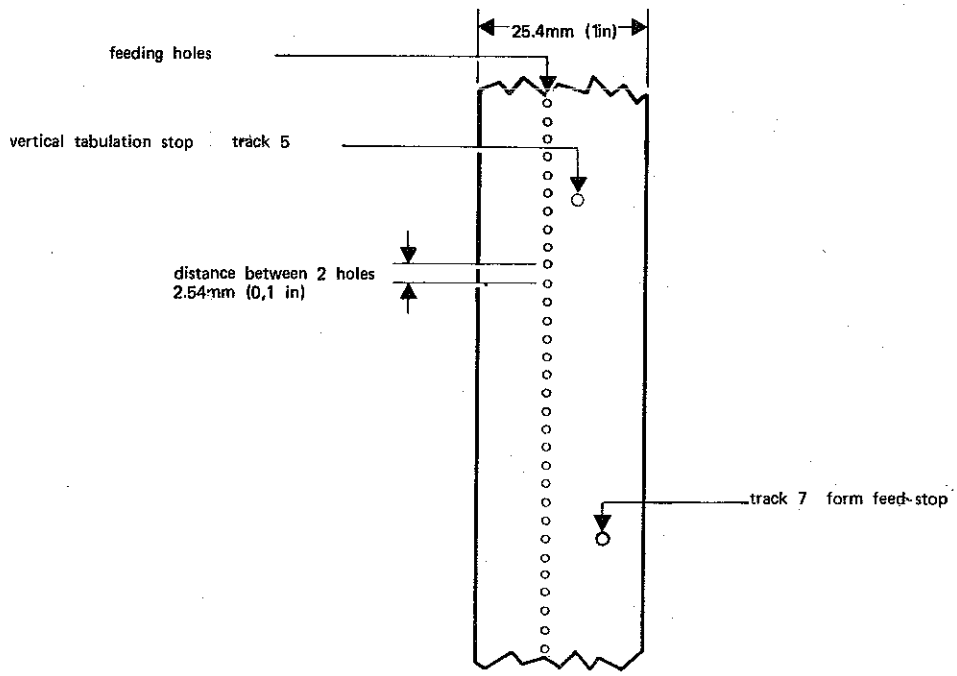


Figure 5.9 - Example of paper tape with stop commands

The loop should be made of Metalized Mylar tape or durable paper tape, e.g. Olivetti code 755542 G.

The terminal punch unit or a similar device is used to punch the loop.

The length of the tape loop can vary from 76.2mm (3in) to 304.8mm (12in) which is the equivalent of 30 and 120 line feeds.

The same sequence of holes is repeated two or more times on the tape loop for those forms having less than 30 line feeds.

5.3.3. Acoustic Alarm (BEL 4805)

This consists of a loud speaker which emits the following signals at 600 HZ:

- continuous, lasting 15 seconds and indicating paper out
- intermittent, lasting 200ms when a BEL character is received and every time the head is 8 spaces from the end of a line
- intermittent, lasting 1 second when Break is received
- intermittent: the alarm has the same frequency as the call signal sent from the exchange when Ring (wire 125 on the V24 interface) is received and the machine is operating in Local and Unattended.

This option is mandatory when the electronic tabulation and answer back option (HVT 4802) is used.

5.3.4. Manual front feed (MFF 4806 option)

This is an optional device for the handling of cards, documents and passbooks of constant thickness. The latter are introduced and aligned by the operator.
The document is inserted between two adjustable paper guides. This device can be mounted on a machine provided with sprocket device.
The open and close roller command is normally done by means of a paper holder lever.
The MFF group can be rotated.
A non standard acoustic hood is mounted on a terminal with front feed device. The hood has an 80mm wide slit for the introduction of documents.

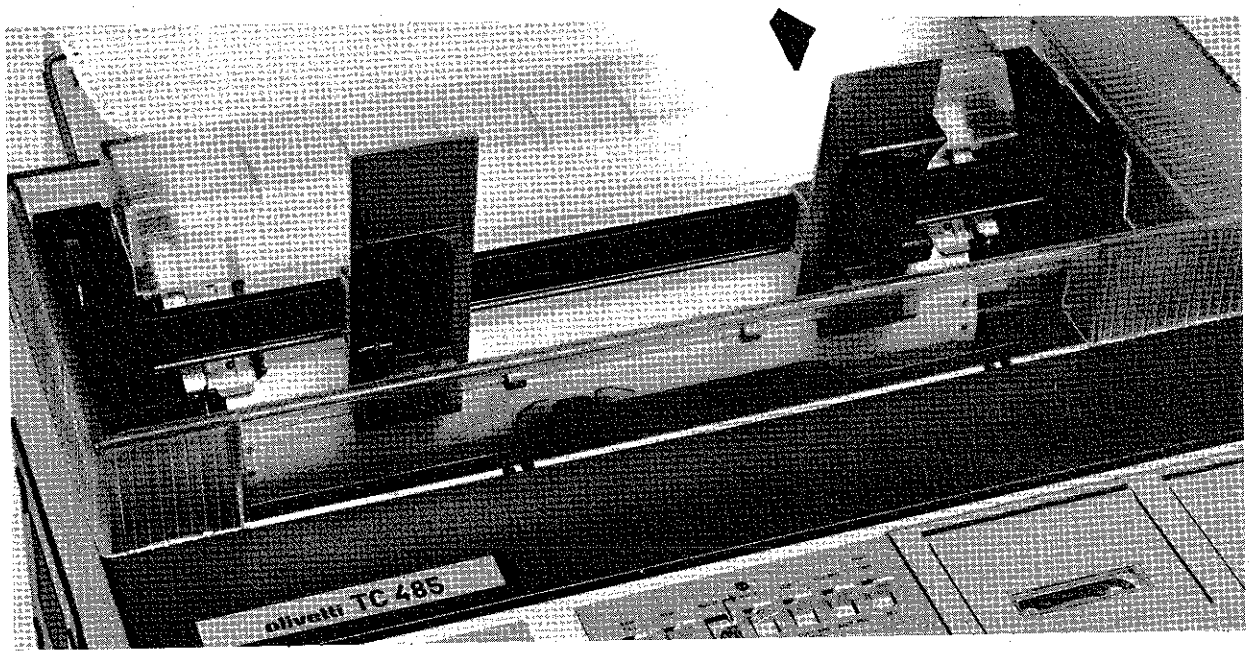


Figure 5.10 - Manual front feed.

5.3.5. Pin Feed (PFD 4813 option)

This device is used for fan-fold forms instead of the sprocket feed.
The differences between the two devices are as follows:

- only 1 pin is used for the module as opposed to 2 to 3 on the sprocket feed
- the pin feed is situated closer to the print line
- the hood is different and is provided with a serrated edge to facilitate the tearing of the paper
- the paper must be run out 62mm after the last print line as opposed to 155mm on the sprocket feed, before the paper can be torn

The mechanics of the pin feed are the same as the sprocket feed with the addition of some of the mechanisms from the manual front feed.
Therefore, if a terminal has the pin feed option, the sprocket and the manual front feed options cannot be mounted.

5.3.6. Other options available for the TC 480

- Fan fold form support (FPC 4810 option)
  This is a tray which contains a pack of fan fold forms. The tray, illustrated in figure 2.1 is situated underneath the terminal.
- Copy hold (D 415)
  This option is similar to those used on teleprinters and facilitates the operator's task. It is situated at the back right hand side of the terminal.
- Lamp (D 427)
  A lamp used to illuminate the work area is available. It is situated at the back left hand side of the terminal.
- Right hand lateral working surface (Kit 61)
  This option is used for resting documents . It is placed on the right hand side of the terminal.
- Acoustic hood
  The following hoods are available:
  . standard hood
  . hood for stand-up operation. This replaces the standard hood.
  . pin feed hood: required when the pin feed device is mounted
  . hood for front feed: required when the manual front feed is mounted

5.4. PRINT LOGIC

5.4.1. Printer control and actuation unit

The logic of the printer controller is achieved through the functions in:

a) basic machine logic

b) printer controller logic

c) printer actuation logic

The basic machine logic and printer controller logic are situated on a board which contains all the actuation circuits of the 2 stepping motors, used for head and paper transport, and the actuation circuits for the print solenoids.
The logic elements of the printer controller are:

a) a microprogrammed PPS4 kit consisting of LSI components and which handles two stepping motors and the print needle solenoids;

b) a ROM, containing the above microprogram and the character generation table (transcoding from ISO code to the 7 x (5+4) dot matrix). Refer to paragraphs 5.2.1. and 5.2.2. for more information on the ROM;

c) a RAM, containing a 64 byte print buffer. This enables the storage of characters each time the printer executes operations of certain duration (e.g. during the carriage return).

The functions carried out by the printer are:

- print and advance one character
- back space (BS)
- carriage return (CR)
- horizontal tabulation (HT)
- line feed (LF)
- vertical tabulation (VT)
- form feed (FF)
- text visibility feature
- print activation and deactivation
- transmit/receive identification characters
- paper out

The logic used to carry out the above functions is described in the following paragraphs.

5.4.2. Printing technique and speed

Characters are printed in asynchronous mode at the rate at which they are received from the peripherals connected to the logic unit. The internal printer logic enables:

- single cycle printing
- continuous printing at 18 char/s
- continuous printing at 60 char/s

The print speed is therefore determined by the combination of the two factors given above i.e. internal logic and the rate at which characters are received from the peripherals. The speed is selected by the printer controller logic and depends on whether the buffer is empty or not. The 64 byte print buffer enables the accumulation of characters coming from the line or from the peripherals during the carriage return, line space and tabulations.
The print buffer has two mechanisms:

a) a filling mechanism which is governed by the rate at which characters are received from the keyboard, line or peripherals

b) an emptying mechanism which empties the buffer at 60 char/s

When the buffer is empty and characters are received at a rate greater than 18 char/s, the extra characters are stored in the buffer. When the buffer contains more than 1 character the print speed is switched to 60 char/s so that the buffer is emptied. The speed is then switched back to 18 char/s or less.
Therefore, the average print speed is governed by the peripherals which transmit characters (e.g. characters received from the line at 300 Baud, are printed at 30 char/s).
The logic described above should make it possible to avoid inserting filling characters (idle or filling) in the message and so prevent the loss of characters.
Paragraph 5.4.6 gives the times required to execute various printer functions. The average and maximum print times of the connected units are given in the relevant chapters.

5.4.3. Functions of the printer

- Text visibility feature

  This gives visibility of the last printed character.
  After printing the last character, the microprogram triggers a strap selectable time delay of 200, 400 or 800 msec. If no character is received during this period, the print head automatically advances 6 spaces. If a character is received within this period, the head does not advance.
  The head is returned to the correct print position before the next character is printed.
  A marker indicates the position at which printing will recommence.
  The text visibility feature cannot be excluded.

- Length of the print line

  The standard length of the print line is 132 characters.
  When EPROM is mounted with the HVT 4802 option, a shorter length can be programmed. This is achieved by inserting the binary characters which indicate the line length in position 1B of the EPROM (see paragraph 5.3.1.).
  The printer logic controls the number of characters printed on the line. The acoustic alarm sounds when the printer is 8 spaces from the end of the line (standard or programmed on EPROM).
  A line overflow causes the following two conditions:

  a) in both local or transmit mode, the keyboard is deactivated and the ALARM light flashes. The keyboard is activated when KB REL or CLEAR is pressed and when a carriage return is performed.

  b) in receive mode, a carriage return and line feed are automatically executed by the terminal and the characters CR and LF are sent to the I/O unit.

- Carriage return

  The carriage return is executed by the microprogram:

  . when a CR is received from any unit connected to the printer

  . automatically when end of line occurs in receive mode

  . when the terminal is switched on, the carriage returns at 18 char/s and is positioned in column 6 (text visibility feature executed)

  The carriage return times are listed in paragraph 5.4.6.

- Line feed

  Line feeding is executed by the microprogram:

  . when an LF is received from any unit connected to the printer

  . automatically when an end of line occurs in receive mode

  . when a VT or FF is received and there are no tabulation options

  The line feed and carriage return are usually two separate functions. However, using straps, the two can be combined to form New Line, and each time the printer receives LF, a line feed and carriage return are automatically executed (CR is not sent to the line).
  The line feed times are listed in paragraph 5.4.6.

- Back space

  This function is carried out when the printer receives BS. It is executed continuously when the REPEAT key is pressed simultaneously.

- Activation and deactivation of printing and carriage advance

  Printing and carriage advance can be:

  a) deactivated: by receiving or transmitting the bicharacter sequence ESC :

  b) activated: by receiving or transmitting the bicharacter sequence ESC ;

  Note that at 1200 baud, the bicharacter ESC ; is ignored and printing remains deactivated. There is a strap which enables printing at 1200 baud for maintenance purposes.

However, if this speed is used in normal operation, some characters would be lost.

- Identification of transmission or reception characters

  Characters are always printed in black. To avoid the use of red and black to distinguish received messages from transmitted messages, a special strap selectable feature inserts the following sequence at the beginning of every transmission:

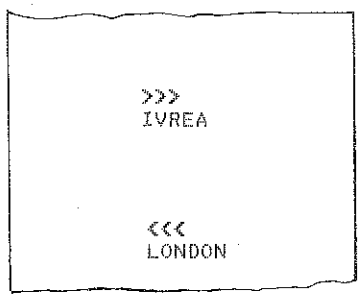
  CR, LF, > , > , > , CR, LF

  and the following sequence at the beginning of every reception:

  CR, LF, < , < , < , CR, LF

  Example of a transmitted message:

  Example of a received message:



- End of paper

  The printer has an end-of-paper microswitch which is situated approx. 7 line feeds before the last print line. When it indicates paper out, the ALARM light comes on and the acoustic alarm (if provided) sounds for 15 seconds. If the printer is connected on line, a break is sent to the other station. If the connection is on switched lines, the printer is automatically disconnected.

  The unit cannot be connected on line if it has no paper.

  Any characters remaining in the print buffer when the paper ends are printed anyway.

- Mechanical tabulation (HVT 4802)

  Mechanical tabulation is obtained by adding the FVT 4803 option, which consists of the electromechanic tape loop device, to the basic machine. It carries out the following functions:

  . vertical tabulation

  . form feed

- Electronic tabulation (HVT 4802)

  Electronic tabulation is obtained using the HVT 4802 option which contains a board on which the EPROM INTEL 1702 is mounted (§5.3.1.) and a tabulation program selector on the console (figure 5.11).

  Electronic tabulation carries out the following functions:

  . horizontal tabulation

  . vertical tabulation

  . form feed

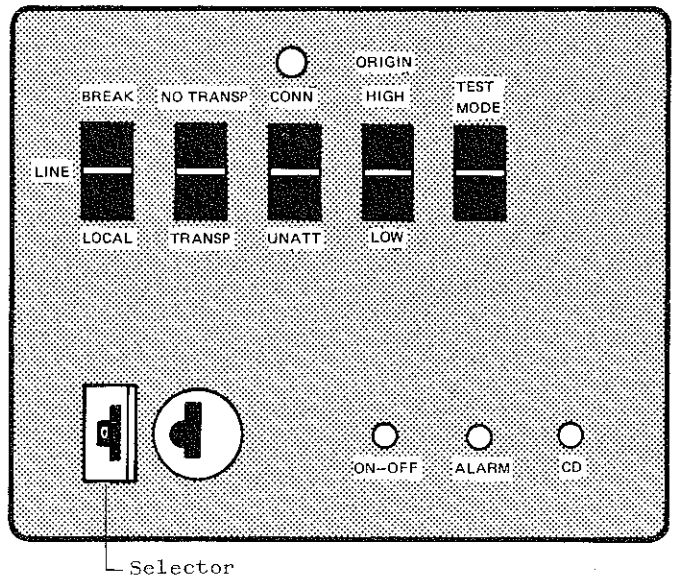


Figure 5.11 - Electronic Tabulation Program Selector

- Electronic tabulation programs

  There is a maximum of 7 fixed tabulation programs.

  Each program contains a maximum of:

  . 16 horizontal tabulation stops per line

  . 10 vertical tabulation stops per form

  . 1 form feed stop

  More horizontal and vertical tabulation programs can be inserted in the volatile RAM using the technique described below.

  Refer to § 5.3.1. for EPROM programming.

- Selection of electronic tabulation programs

  The terminal can execute one tabulation program at a time. The selection is made:

  . by moving the tabulation program selector from position 1 to 7, or

  . via the bicharacter sequence ESC A - ESC G, sent from the line or from the keyboard, where A to G correspond to the programs 1 to 7.

  The program selected from the line or keyboard has priority over that selected by the program selector and remains valid until another program is selected. The selected program is automatically transferred from EPROM to RAM which will therefore contain:

  - all the horizontal tabulation stops required for one line
  - all the vertical tabulation stops required for one form
  - the length of the form expressed in line feeds

The program selector can be set in 10 positions, which are:

Ø: no operation

1 - 7: the corresponding tabulation is selected

8 - 9: all the tabulation stops in the RAM are cancelled. The value indicating the form length is not modified.

- Inserting new electronic tabulation programs

As the insertion of new electronic tabulation programs, in addition to the 7 resident on EPROM, would cause the cancelling and rewriting of EPROM, the terminal uses a special procedure. This consists of the insertion or deletion of tabulation stops in the selected program situated in the RAM.

The tabulation program, obtained in this way, is valid until more stops are inserted or deleted or until another program is selected. Note that a new selection always activates one of the 7 programs which because they are on EPROM have not been altered.

The special procedure is as follows:

. to insert a horizontal tabulation stop, move the print head, using the space bar, to the position at which a stop is to be inserted and send the sequence ESC 1 to the printer

. to cancel a horizontal tabulation stop, move the print head, using the space bar, to the stop to be cancelled and send ESC 2 to the printer.

. to insert a vertical tabulation stop, move the print head, using the line feed key, to the line on which a stop is to be inserted and send ESC 5 to the printer

. to cancel a vertical tabulation stop, move the print head, using the line feed key, to the line on which the stop is to be cancelled and send ESC 6 to the printer

. to cancel all the stops on the terminal:

1) move the tabulation selector to position 8 or 9, or

2) send ESC H to the printer. This function can be executed both in local or on line and causes the cancelling of all the stops on the terminal and the other station.

The bicharacter ESC H does not alter the form length (PAGE) stored in RAM.

The insertion of more tabulation stops, in addition to the 16 horizontal and 10 vertical stops, would cancel the last stops set on the unit.

When the terminal has no tabulation option, no horizontal or vertical tabulation stops can be inserted or cancelled from the line or keyboard using the bicharacters ESC 1, ESC 2, ESC 5, ESC 6.

- Execution of the horizontal tabulation function

When the printer receives an HT

. if there is no electronic tabulation option, the print head advances one space

. if the electronic tabulation option is provided, the print head moves to the right until it reaches the next tabulation stop, (similar to the mechanical tabulation

stops on a typewriter). If there are no stops beyond the print head position,

During horizontal tabulation, the text visibility feature is not taken into consideration.
To calculate the amount of horizontal tabulation characters, there is a character counter. It is cleared every time the unit is switched on and at the beginning of each print line.

- Execution of the vertical tabulation function

When the printer receives VT, the following three conditions may arise:

. the unit has no electronic or mechanic tabulation option so a line feed is executed

. an electronic tabulation program has been selected. Execute the number of line feeds required to reach the next stop. When the maximum number of vertical stops (10) is exceeded, or if there are no more stops on the form, execute the line feeds required to complete the form and go to the first tabulation stop on the next form.

. the unit has the mechanic tabulation option and an electronic vertical tabulation program has not been selected. In this case:

1) there are no vertical stops in one of the 7 tabulation programs on EPROM

2) programs 8 or 9 have been selected

3) the bicharacter ESC H has been used for a cancellation

4) the EPROM, used for tabulation, is not present

Vertical tabulation in this case is controlled by a tape loop and the line feeds required to reach the next hole in column 5 on the loop are executed. If the tape is not inserted, a line feed is executed.

To calculate the amount of vertical tabulation line feeds, there is an electronic line counter. It is cleared every time the unit is switched on and at the beginning of each form.
Note that electronic vertical tabulation has priority over the mechanical vertical tabulation.

- Execution of the form feed function

When the printer receives an FF, the following three conditions may arise:

. if there is no tape loop or electronic tabulation, a line feed is executed

. if the tape is inserted, execute the line feeds required to reach the hole in column 7 on the loop

. if there is no tape loop, but the electronic tabulation is provided, execute the line feeds required to complete the form in accordance with the length programmed on EPROM in the PAGE position (e.g. 35 for program 1, etc.).

The line counter is cleared at the beginning of every form.

If the machine is switched on, when the selector is in position Ø,8,9, the length of the form to be used is that of program 1.
Note that the loop has priority over the electronic tabulation for the form feed function.

5.4.4. Summary of the print functions

A) The functions of the ISO CCITT N°5 characters which involve the printer are described below:

BS - moves the print head back one space

HT - moves the print head to the next programmed stop. If no tabulation program exists, the print head advances one space

LF - causes a paper line feed. If it is strap selected, a CR is also executed, but is not sent on line

VT - causes vertical tabulation as demanded by the program or the tape loop. If there is no program or loop, VT executes a line feed

FF - causes form feed as demanded by the tape loop or by the contents of the PAGE position selected on EPROM. If there is no loop or EPROM, execute a line feed. Clears the line counter.

CR - moves the print head to the beginning of a new line. Clears the character counter

ESC - used in sequence with other characters for supplementary commands which are not in ISO code

Bicharacter sequences:

ESC A - ESC G	selects (not using the selector) the 7 VT and HT program pairs
ESC H	clears the tabulation stops on the machine
ESC :	permanently suppresses both printing and advancing
ESC ;	includes both printing and advancing
ESC 1	sets a horizontal tabulation stop in the position occupied by the print head
ESC 2	if there is a horizontal tabulation stop in the position occupied by the print head, it is cancelled
ESC 5	sets a vertical tabulation stop in the current form position
ESC 6	cancels any vertical tabulation stop which has been set in the current position of the form

Note that all the characters in columns Ø to 1 of the ISO CCITT N°5 set do not cause printing.
The character which follows ESC, in the bicharacter sequences given above, is not printed.
The strap selectable print functions are listed in Appendix A.

5.4.5. Print function times

The standard times for the various printer functions are given below. These times facilitate the understanding of the buffer filling and emptying mechanisms and enable the system engineer to estimate the amount of idle characters to be inserted in the text to be transmitted.

a) Print times

. time required to print one character during non-continuous printing is T_1 = 65 msec

. time required to print a character during continuous printing is Tc = 17 msec

. time required to print n characters during continuous printing at 60 char/s is $Tn = T_1 + (n-1)\ Tc$

E.g. when n = 10 the equation is: 65 + 9x17 = 218 msec

. time required to move the print head for the text visibility feature is 150 msec plus the time delay after the last character is printed, i.e. 200, 400, 800 msec.

b) Horizontal tabulation times

. if the horizontal tabulation is less than 20 characters, the carriage moves at 18 char/s

. if the horizontal tabulation is of 20 or more characters, the time is obtained by adding the following three times:

1) acceleration time = 80 msec

2) rapid shift time (proportional to the columns to be skipped)
(for 132 columns = 225msec)

3) brake time = 145msec

c) Carriage return times

The times vary in accordance with the carriage position:

. if the carriage is in the first 19 columns, the time taken for the carriage return is the same as that required for printing

. if the carriage is beyond the first 19 columns, the time taken for the carriage return is obtained by adding the following three times:

1) acceleration time = 80 msec

2) rapid shift time (proportional to the column reached)
E.g. 132 columns = 225 msec

3) brake time = 145msec

The maximum carriage return time is therefore 450 msec.
The horizontal tabulation and carriage return times are the same.

d) Line feed and vertical tabulation times

- time required to execute 1 line feed is 89 msec
- time required to execute n line feeds is Tn = 89 + (n-1) x 24 msec

  E.g. when n = 10 the equation is Tn = 89 + 9x24 = 305 msec

As already mentioned in chapter 1, the basic machine is fitted with a TTL/DTL interface to which one of the following optional line interfaces can be connected:

- CCITT V24 EIA RS 232 C telephone interface
- telegraph interface
- 20 mA current loop interface

Any other units compatible with the conventions of the TTL/DTL interface can be connected. The necessary procedures are given in paragraph 6.1.
Interface signals are handled by the basic machine microprogram in accordance with the procedure given in paragraph 6.2.

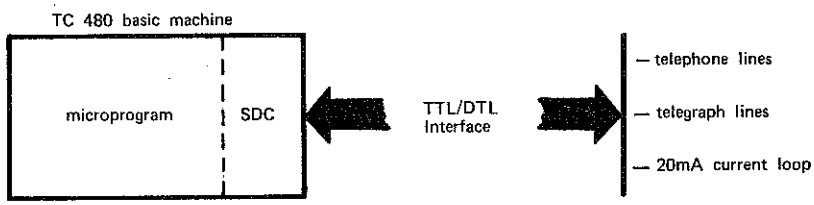


Figure 6.1 - TTL/DTL Interface

6.1. TTL/DTL INTERFACE

This paragraph provides the information necessary to structure the logic for connection to the terminal by means of the DTL/TTL interface.
The exchanged signals of the TTL/DTL interface, their positions, description and their interaction are listed below.
The interface is connected via a 12 x 2 printed circuit board connector with 3.96mm spacing (figure 6.2).

	+5V	24	23	+12V	
		22	21		
	SP600	20	19	CKTRA	Clock transmission
Data carrier detector	L109	18	17	L113	Element timing
		16	15	L125	Calling indicator
		14	13	L122	Back. channel carrier detec.
	-12V	12	11	L106	Ready for sending
		10	9	L104	Received data
Data set ready	L107	8	7	FUSE	Out of service
Transmitted data	L103	6	5	L105	Request to send
Connect data set to line	L108	4	3	L126	Select transmit frequency
	GND	2	1		

Figure 6.2. - DTL/TTL interface connector

The voltages are:

- GND pin 2
- +12V $\pm$ 5% pin 23
- +5V $\pm$ 5% pin 24
- -12V $\pm$ 5% pin 12

The exchange signals are:

- L103 Transmitted data - pin 6
  This signal is generated by the terminal. It is set in OFF during the time intervals between the transmission of 2 successive characters or words. The ON and OFF conditions are maintained for the duration of each individual signal element, e.g. for 3.33ms when operating at 300 baud. This signal can drive 1 TTL; when there is no load, the ON condition is represented by -12V.
- L104 Received data - pin 9
  This signal is an input to the terminal. When transmitting with a half duplex connection, it must be set in OFF until L105 is in the ON condition. If the terminal is used only for transmission, L104 must always be set in OFF. The ON and OFF conditions are maintained for the duration of each individual signal element. The load connected to the line is the input circuit of a CMOS.
- L105 Request to send - pin 5
  This signal is generated by the terminal. It ensures that the modem is able to transmit data. The ON condition causes the data communication equipment to assume the transmit mode, and is maintained while the terminal is connected. It can

drive 1 TTL.

- L106 Ready for sending - pin 11

  The signal on this circuit indicates that the modem is able to transmit data on the data channel. The ON condition is the reply to the ON condition of the L105 signal and indicates that the terminal is ready to transmit data. When L102 goes OFF, signal L106 goes OFF.

  The load connected to the line is the input circuit of a CMOS.

- L108 Connect data set to line - pin 4

  The signal on this circuit controls the switching of the modem to or from the line. The ON condition causes the data communication equipment to connect the modem to the line whereas the OFF condition causes the data communication equipment to remove the modem from the line. This signal can drive 1 TTL.

- L107 Data set ready - pin 8

  This signal indicates whether the modem is ready to operate. The ON condition indicates that the modem is ready to initiate the exchange of data. The OFF condition indicates that the modem is not ready to operate.

  The load connected to the line is the input circuit of a CMOS.

- L109 Data carrier detector - pin 18

  This signal indicates whether the carrier is received within appropriate limits. The ON condition indicates that a carrier has been received; the OFF condition indicates that there is no carrier. Incoming data is controlled using the L109 in the ON condition.

  The load connected to the line is the input circuit of a CMOS.

- L113 Transmitter signal element timing - pin 17

  This signal provides the modem with the signal element timing information. The ON condition is 7/16 of the time of a complete period.

  This signal can drive 1 TTL.

- L125 Calling indicator - pin 15

  This signal indicates whether a calling signal has been received. The ON condition indicates that a calling signal has been received and causes the automatic connection to the line if the terminal is operating in Unattended and is not in local. Position 3 on PONE/7 should be strapped when this signal is used. If however it is not used, it is masked in the OFF condition by strapping position 4 on PONE/7.

  The load connected to the line is the input circuit of a CMOS.

- L126 Select transmit frequency - pin 3

  It is used with bichannel modems. The ON condition selects the higher transmit frequency whereas the OFF condition selects the lower transmit frequency. This signal has the same function as the ORIGIN key on the console.

  It can drive 1 TTL.

- L122 Backward channel received carrier detector - pin 13

  This signal has two meanings which are determined by the state of the SP600 signal. If SP600 is ON, L122 does not perform any function. If it is OFF, L122 indicates that a character from the paper tape reader or cassette has been requested. When L122 is in the OFF condition it indicates that a character has been requested. The TC 485 line microprogram re-examines L122 when the start bit has been transmitted.

  This signal can be masked in the ON condition by strapping position 1 on PONE/7. By strapping position 2, the TC 485 line microprogram is aware of all the variations in the L122 conditions. When SP600 is in the ON condition, position 1 must be strapped.

- SP600 - pin 60

  This signal is used to identify connections to the modem from connections to the minicomputers (PDP11, SP600).

  The ON condition indicates that the terminal is connected to the modem. The OFF condition indicates that the terminal is connected to the minicomputer and enables dialogue with the SP600.

  The load connected to the line is the input circuit of a CMOS.

- FUSE 1 Out of Service - pin 7

  This signal indicates the paper out condition and puts the terminal out of service. The ON condition indicates that the terminal is not out of service

  It can drive 1 TTL.

- CKTRA Transmission clock - pin 19

  This clock is a signal whose frequency is 16 times greater than the L113 signal.

  The load connected to the line is the input circuit of a CMOS.

In all the signals the ON condition is represented by 0V and the OFF condition is represented by +5V.

Pins 1 and 14 on the connector are left free.

Appendix E lists the connections to be made to link 2 TC 485 terminals using a DTL/TTL interface.

6.2. CONTROL OF LINE INPUT/OUTPUT

The way in which the microprogram handles the signals on the DTL/TTL interface is described below. This description applies to the telephone, telegraph and 20mA current loop connections.

Characters are received and transmitted in serial form whilst character handling in the machine is in parallel form. The serial data controller (SDC) from the PPS4 kit is used in the transmission and reception of data.

The character format consists of 10 or 11 bits as follows:

- 1 start bit

- 7 information bits in ISO CCITT N° 5 code
- 1 parity bit
- 1 or 2 stop bits

The parity bit (the 8th bit) and the stop bits are handled by the terminal in accordance with the straps on the basic machine.
The straps indicate:

- parity used: in transmit mode the necessary value of the parity bit is established in the SDC and transmitted immediately following the seven bits of the character. In receive mode the terminal checks, in the SDC, that the character received has the correct value in the parity bit. The VRC is carried out in this way.
- odd or even parity: the strap defines whether odd or even parity is to be used and is only taken into account if the above strap indicates parity used.
- insert 8th bit as 0 or 1: when the parity bit is not used this strap indicates whether the bit following the 7 bit character is to be set to 0 or to 1.
- 1 or 2 stop bits: define whether the terminal must transmit or receive 1 or 2 stop bits. In receive mode, the terminal can accept 1 stop bit at any line speed.

The SDC serializer/deserializer is connected to a clock, constructed in CMOS components and piezoelectric quartz, which makes any of the following transmit/receive speeds available: 75, 100, 110, 150, 200, 300, or 1200 baud.
These seven speeds are not available on one machine. However, the following 4 options may be selected, using a strap, when the machine is installed:

- 75 or 1200 baud
- 100 or 110 baud
- 150 or 200 baud
- 300 (standard) baud

The receive/transmit speed can also be regulated by a knob situated behind the print group (figure 6.3).

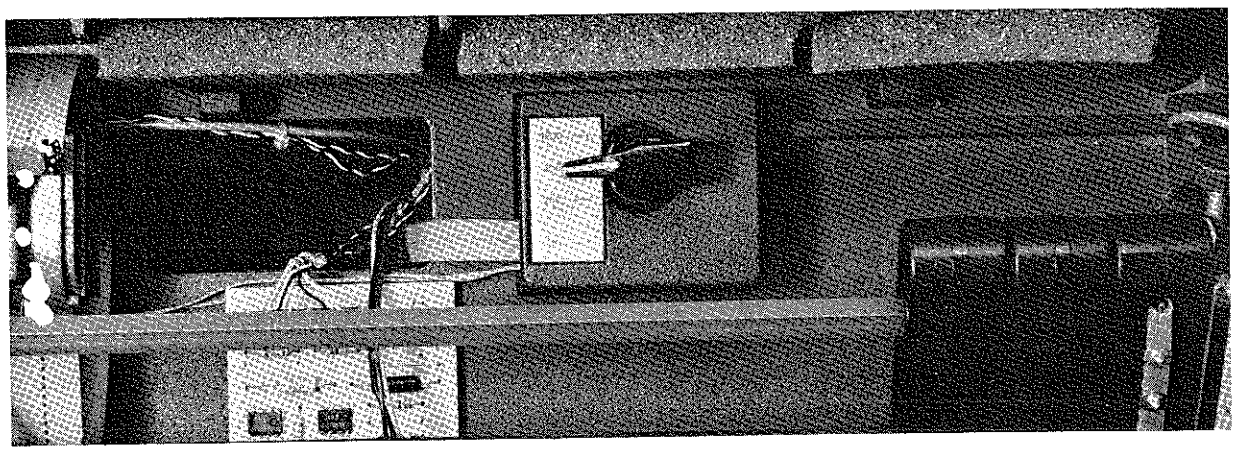


Figure 6.3 - Knob to select the receive/transmit speed

When malfunctioning occurs due to temporary bad line conditions, the operator can change the speed, in agreement with the other station, and thus adapt the terminal to the new conditions.
Associate line distortion is less than 2% and the receive margin is greater than 45%.
There is a protection mechanism against the shortening of the start bit by half a pulse period. If the start bit is shortened, it is not taken into consideration.
In receive mode, when the speed of incoming characters is greater than the terminal transmission speed, the excess characters are enqueued in the line buffer (16 character capacity). When the buffer is full, the machine sends a break to the transmitting party. The characteristics of the break are given in paragraph 7.
The break is also sent when the paper out condition occurs. Transmission/reception is not started if the paper out condition arises. The control logic of the 8th bit and the VRC errors are the following:

- with parity:
  . in receive mode, the machine checks the validity of the data. If the data is recognized as being incorrect, the symbol ▮ is printed (only up to 300 baud) and it is stored on the magnetic medium with bit 8 set to 1 and punched on paper tape as it was received from the line.
    If the electronic tabulation option EPROM exists on the machine, it is possible to insert a character in position 1D. This character replaces that received with incorrect parity. E.g. if an incorrect character is received and the BEL character is inserted in position 1D, instead of printing the symbol ▮ , the terminal will activate the alarm; if ENQ is inserted, and FØ is in the 1E position, the Answer Back is sent.
  . in transmit mode, an incorrect character is sent on line with incorrect parity
- without parity:
  . in receive mode, bit 8 is set to Ø so that an incorrect character will not be recognized by the internal logic
  . in transmit mode, the bit following the 7 character bits is set by the SDC to the value indicated by the condition of the "8th bit strap" and transmitted with the character.

The relationship between the signals on the DTL/TTL interface is as follows. When the machine is switched on, L105 is set in the OFF condition. L126 is set ON or OFF depending on whether the ORIGIN key is in the HIGH or LOW position.
If the terminal is operating in Unattended mode, L126 is forced OFF. When the LOCAL/LINE key is moved from the LOCAL to the LINE position, the terminal is automatically connected to the line if position 2 on PONE/5 has been strapped.
If no strap has been inserted, connection to the line is achieved with the terminal operating in Unattended mode on receipt of L125 (RING INDICATOR) or by pressing the CONNECT key.
When the terminal is connected to the line (CONNECT TO LINE), L108 is set in the ON condition and the line microprogram waits until L107 (DATA SET READY) is set in the ON condition.

L105 (REQUEST TO SEND) is then set in the ON condition and waits until L106 (READY FOR SENDING) is also set in the ON condition. At this point, data can be sent on the line.
The reception of data is controlled by the L109 signal (DATA CARRIER DETECTOR).
As each character is sent on line, the TC 485 line microprogram checks that the conditions for connection are correct. If L106 (READY FOR SENDING) is set in the OFF condition, the line microprogram interrupts transmission.

6.3. ANSWER BACK

The Answer Back is released by the terminal and conforms to the X 32 CCITT standard. It is achieved by using the HVT 4802 option (Electronic tabulation and Answer Back). It consists of 1 to 20 characters on 7 bits in ISO code, programmed on EPROM INTEL in positions ØØ to 13 (hexadecimal). If the parity bit is inserted, the 8th bit must be at Ø if the characters are to be sent with the correct parity.
If there are less than 20 characters, FF should be inserted in the positions which are not used. In this case, the terminal sends only those characters which are programmed.
The Answer Back is used to establish the terminal station and is transmitted:

- in transmit mode, when the operator presses the HERE IS key. If the terminal is operating in half duplex, it is printed as it is transmitted
- in receive mode when ENQ is received from the line and if FØ is inserted in position 1E on the EPROM. It is printed both when the terminal is operating in half duplex and full duplex

When the Answer Back is being sent, all the input units, i.e. keyboard, cassette, etc. are inhibited.

As already mentioned in chapter 1, the basic terminal is equipped with a CCITT V24/EIA RS232 C telephone interface. This is used for connections on:

- switched lines (2 wires): up to 1200 Baud
  - . connection between TC 480 and the other station for alternate data or voice transmission
  - . connection between TC 480 and an intelligent concentrator or a computer for data transmission only

  In this case, the telephone is used only to effect the connection (a typical example is time sharing).
- leased lines (2 or 4 wires)
  - . connection between TC 480 and another station for simultaneous data and voice transmission (up to 300 Baud)
  - . connection between TC 480 and an intelligent concentrator or a computer for data transmission only (up to 1200 Baud)

The connection on switched lines is more advantageous than the connection on leased lines as:

- the user only pays the amount of time the line is actually used
- the terminal can be connected to any other station on the same network

On the TC 480, as for other terminals, the choice of the type of connection (on switched or leased lines) and the parameters relevant to data transmission on telephone lines is determined by the type of applications to be carried out.
To ensure the correct use of these parameters in the TC 480 applications, the following paragraphs contain a description of the TC 480 on line capabilities.
Connection to telephone lines is an alternative to telegraph line and 20mA current loop connections. Appendix A lists all the strap selectable functions available on the TC 480.

7.1. STANDARD TC 480 TRANSMISSION FEATURES

7.1.1. Type of connection

Only point to point on 2 or 4 wires, half or full duplex. The choice of 2 or 4 wires and half or full duplex is indicated by the relevant straps on the basic machine.

7.1.2. Type of transmission

Serial, asynchronous. The character format is: 1 start bit, 7 information bits, 1 parity bit (determined by straps - § 6.2) and 1 or 2 stop bits (determined by strap - § 6.2)

7.1.3. Transmission Speed

There are 7 line speeds: 75, 100, 110, 150, 200, 300, 1200 bauds, which are determined either by strap positions or the speed selector (§6.2).
Transmission speed is the speed at which a character is sent on the line. As transmission is asynchronous, the overall transmission speed is defined by the rate at which characters are sent on line. This rate varies from 0 to the chosen speed.
Lines can be defined as follows for this type of terminal:

- low speed lines: up to 300 baud
- medium speed lines: 1200 baud

7.1.4. Connectable modems

A) the low speed line connections are achieved using a bichannel modem. Bichannel modems were designed for low speed transmission for use of 2 wire switched lines. However, they can also be used on 2 wire leased lines. They operate in the voice band width and provide 2 channels for data transmission:

   - Transmission in full duplex
     One channel is used for transmission and the other for reception. The calling party transmits at low speed and the called party should do the opposite.
     The selection of the channel in transmission may be done by the ORIGIN key or by a strap on the telephone line interface (sets wire 126 Select Frequency at Ø or 1, where 1 = high transmission speed)
   - Transmission in half duplex with supervisory channel
     The high speed channel is usually used for alternate transmission and reception. The other channel, called the supervisory or Backward channel, is used by the receiving party to send commands to the transmitting party. In fact, on TC 480, it is used to send a Break.

   Further information on the bichannel modem can be obtained from the CCITT V21 standard.

B) 1200 baud line connections use medium speed 2 or 4 wire modems

   - 2 wire modems were designed to operate on switched networks. They also operate in the voice bandwidth and provide 2 non simultaneous data transmission channels (one channel at 600 baud or 1200 baud) and a third channel, the backward channel, which normally operates at 75 baud.
     The backward channel is optional and is used by the receiving party to send a Break to the transmitting party. The 600 baud channel is not used on TC 480.
     Further information on 2 wire medium speed modems can be obtained from the CCITT V23 standard.
     Medium speed transmission using 2 wire modems is always in half duplex as there is only one channel available.

- 4 wire modems enable operation in both full and half duplex. Two wires are used for transmission and the other two for reception. In full duplex, transmission and reception are simultaneous, while in half duplex, transmission and reception are alternate.
  (Note that in half duplex, the 4 wires are used to eliminate the modem turn around times).

In short, using medium speed modems the following 3 conditions may occur:

- 2 wire modem with no secondary channel
  In transmission, no data can be received from the other station and likewise the receiving party cannot send signals to the calling party
- 2 wire modem with secondary channel
  In transmission the receiving party can signal line continuity (carrier on the second channel) and can send a break to the transmitting party (disconnects carrier on second channel) using the second channel
- 4 wire modem
  Enables operation in full or half duplex with no turn around time.

7.1.5. Error Handling Procedure

There are 3 types of error checks which are used to suit the type of application and system configuration.

a) Parity check on each character received (VRC). This check is optional (§6.2). When an error occurs, the character received can be handled in 2 alternate ways, depending on the contents of position 1D on EPROM
   - if there is no EPROM or if FØ is in position 1D on EPROM, the character received is stored on the output medium and the symbol ■ is printed for speeds up to 300 baud
   - if a character other than FØ is in position 1D on EPROM, the character received is substituted by that in position 1D. Errors are corrected manually, i.e. the entire message is retransmitted until it is received correctly.

b) Echoplex
   This is used on low speed lines in full duplex only for connections to concentrator or computer. It ensures that characters entered on the keyboard are received error-free by the concentrator or computer. Echoplex is carried out in the following way:
   - the character entered on the keyboard is sent to the concentrator but is not printed. The concentrator receives it and sends it back to the terminal which prints it. The operator can therefore visually check whether the character is correct. The concentrator or computer must be programmed to execute an echoplex application.

c) Test Mode
   This check is used by the other station for connections between one terminal and another or between a terminal and a concentrator or computer.

The reception of a character from the line on a terminal in TEST MODE (TEST MODE key pressed) causes the automatic retransmission on line, and normal handling (e.g. printing or sending to the medium)
The Test Mode function is normally used when the machine is switched on to check the condition of the terminal and the line and for maintenance checks.
During the reception of characters in this mode, operations which are not included in the test function and which involve inputting data from keyboard, magnetic media or paper tape must not be executed. This is because the input units are not inhibited and text confusion could result.

7.2. STRUCTURE OF THE TPI 4809

The physical structure of the option is obtained by inserting a board which adapts the logic levels of the basic machine to the levels of the CCITT V24/EIA 232C interface.

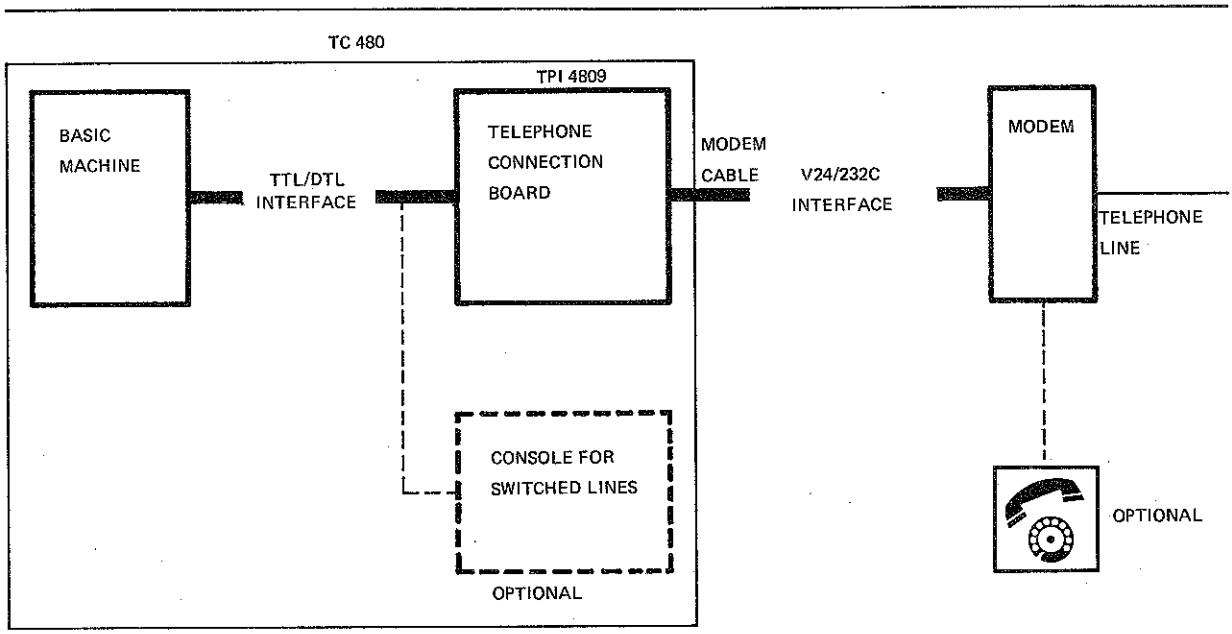


Figure 7.1 - Block diagram of the telephone interface

If the terminal is connected to switched lines, the switched line console must be mounted and a telephone must be provided for connection to the other station.
The CCITT V24/EIA RS 232C interface signals which can be handled by the terminal are listed in Appendix C.
They are handled by the basic machine microprogram in accordance with the procedure given in § 6.2 (I/O handling) and § 7.3 (V24/RS 232C interface handling).

7.3 HANDLING THE V24/RS 232C INTERFACE

The terminal operating techniques depend on whether it is connected to 2 or 4 wire, switched or leased lines, with or without the secondary channel on the modem.
The procedure for the connection of the terminal to the other station on leased lines is given in § 7.5 and that on switched lines is given in § 7.6.
When the terminal receives the DATA SET READY signal (wire 107) 2 conditions may occur:

A) a 4 wire modem, up to 1200 baud, i,e. leased lines (full duplex or half duplex) or a 2 wire modem, bichannel, i.e. up to 300 baud, leased or switched lines, full duplex

In this case, when the terminal is connected, the modem sets the carrier on the main channel (wire 105 Request to Send=ON). The carrier remains on the line throughout the connection. Note that the main channel on bichannel modems is the channel used for transmission by the calling party.
The terminal checks that the carrier is connected during reception (wire 109 CARRIER DETECTOR).
Data can be transmitted at any time, while the carrier must be on the main channel before the terminal can receive.
Note that in the 4 wire half duplex connection, the carrier on the main channel reduces the modem turn around time.

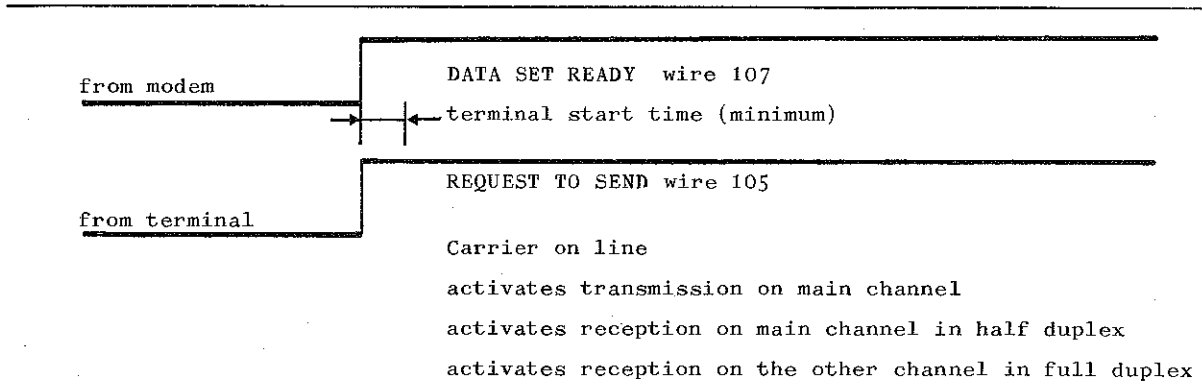


Figure 7.2. - Starting transmission in case A

B) 2 wire modem operating in half duplex at 1200 baud
The line can be switched or leased.
The terminal has 3 main modes:
- wait mode
- transmit mode
- receive mode

As soon as the terminal is connected, it is set in wait mode.
If the terminal must transmit characters, it checks that the carrier is not in reception on the main channel. If it is, the terminal waits until it is disconnected. It then connects the carrier on the main channel (wire 105 Request to Send = ON) waits

48msec and then, if provided with EPROM, releases the delay programmed in position 1F on EPROM (variable from ø to 1s). It is then set in transmit mode. In the meantime, the modem should reply READY FOR SENDING (wire 106) so that the terminal can serialize the characters to be transmitted.

Transmission ends when no characters are transmitted for approx. 1s. This disconnects the carrier on the main channel and the terminal returns to wait mode. When the transmission carrier is on the main channel, the terminal checks whether the carrier is on the second channel.

If the carrier is not on the second channel, the terminal takes this to be a Break signal.

A strap inhibits the check on the second channel, when the latter does not exist on the modem or on the other terminal.

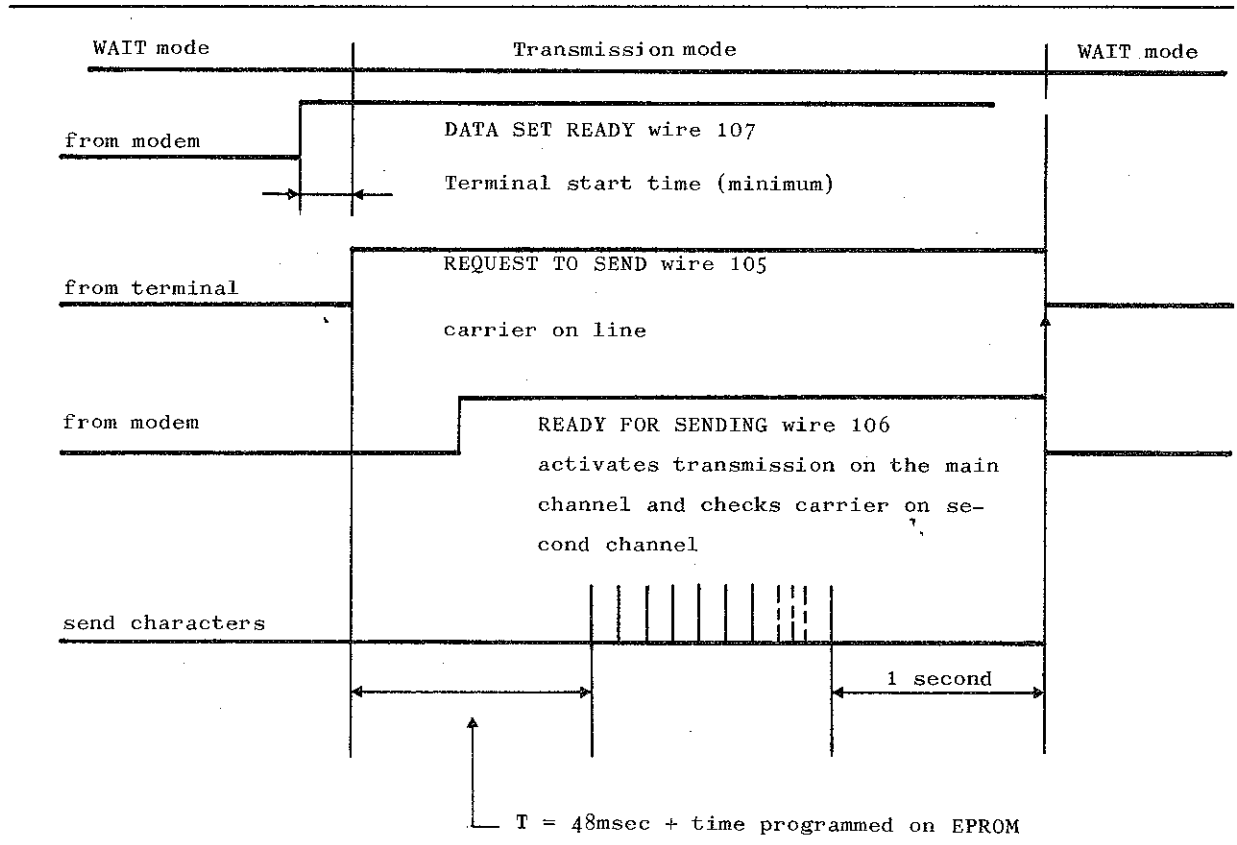


Figure 7.3 - Starting transmission in half duplex with 2 wire modem

When the terminal is not in transmit mode, it can receive characters from the line via wire 109 CARRIER DETECTOR which indicates carrier on line in receive mode.

On reception of this signal, the terminal connects the carrier on the second channel.

In a 2 wire 1200 baud connection, the carrier is continually connected and disconnected on the main channel due to the exchange of messages, whereas in other connections, the carrier remains on the line.

7.4. BREAK SIGNAL

The Break signal is sent by the terminal to the other station in the following circumstances:

- when the BREAK key is pressed
- paper out
- with input/output options: refer to the relevant chapters

The duration of the Break is selected by two straps on the basic machine:

- 280 msec
- 600 msec
- continuous emission until the Break key is released

The Break sent on line by the terminal is handled as follows:

- in a 2 or 4 wire connection with a bichannel modem operating in full duplex, the Break represents a long start (duration determined by straps). It is sent on the transmission channel irrespective of whether the terminal is in transmit or receive mode
- in a 2 wire half duplex connection
  - . in transmit mode, the Break is handled as a normal character, i.e. connects the carrier, sends Break (duration determined by straps) on the data channel and then disconnects the carrier
  - . in receive mode, sends Break disconnecting the carrier on the second channel. If there is no second channel (Supervisor), the Break cannot be sent in receive mode.

The terminal considers the following as Breaks sent by the other station:

- a long start lasting at least 12 to 13 bits on the receive channel

  or
- disconnection of the carrier on the second channel for 2 wire modem with second channel

The reception or transmission of a Break causes the deactivation of the input units (keyboard, cassette, etc.). To reactivate the input functions, press KB REL or request an input operation.

7.5. TELEPHONE CONNECTIONS ON LEASED LINES

Connection to leased lines is achieved using both leased or switched line consoles. When the relevant strap is inserted, the terminal is connected to the line by pressing the LINE key. This causes the sending of the CONNECT TO LINE (wire 108) signal and the reply DATA SET READY (wire 107). When the strap is not inserted, connection to the line (CONNECT TO LINE = ON) is achieved by pressing the CONN key. In this case, the switched line console is required. The line is disconnected by pressing the LOCAL key or by transmitting or receiving EOT, if the relevant strap is on the machine.

Only one of the two channels can be strap selected when bichannel modems are used.
When the terminal is in local, it can be held in alert mode by means of straps. This enables the execution of input operations in local while in alert mode. Characters received from the line are printed while characters entered via keyboard or from the peripheral units are "blocked".
The terminal can recognize any breaks received from the line. Therefore, the CONNECT TO LINE request can be indicated in two ways:

- by sending a break which sounds the buzzer and inhibits the keyboard
- by sending the 2 character sequence DC4 and DC2 followed by a message. The DC4 and DC2 inhibit the input or store operations on the other station, thus avoiding text confusion on the media

In connections on leased 2 wire low speed lines, the telephone can be used to talk to the other station as the data is being transmitted. This is because the transmission of data uses only a small part of the voice band. In this case, the telephone company should supply the appropriate modem.
The TRANSPARENT feature can be achieved on leased lines if the switched line console is mounted. Note that the UNATTENDED feature is not used on leased lines.

7.6. TELEPHONE CONNECTIONS ON SWITCHED LINES

The console for switched lines and the telephone are required for this connection. The console is integrated in the TPI 4809 option, while the telephone is part of the data communication equipment.

7.6.1. Connection Procedure

The terminal must be set in LINE status before it can be connected on the line. As it is provided with the manual call feature, the operator must dial the other party's number (DIAL UP). This call produces a 25Hz signal which allows the telephone selectors to establish the connection between the two telephones.
The following two cases may arise:

a) the other station is not programmed for automatic connection. Therefore, the called party uses the telephone to determine the connection procedure with the calling party e.g. press the DATA key on the modem.
   The modem used by the other station sends the carrier frequency on line for 3 to 4 seconds. When the calling party hears the carrier tone, he must press the DATA key on the modem and the CONN key on the console. This activates the CONNECT TO LINE signal and the modem then sends the DATA SET READY signal.
   From this point onwards, the transmission and reception is effected as for the connection on leased lines.

b) the other station is a TC 480 which can operate in UNATTENDED mode. The intervention of the operator is not required as the 25Hz carrier enables the modem of the other

station to activate the RING INDICATOR (wire 125).
This wire activates the CONNECT TO LINE signal (wire 108) which enables the modem of the other station to send the carrier tone on line. The rest of the procedure is the same as that given for case a).
The RING INDICATOR in Unattended has the same functions as the operator at the other station.
When the connection is made, the CONN light comes on and the terminal is set in receive mode with the CD light on.

7.6.2. Unattended Feature

The TC 480 can only make manual calls, but can reply both manually or automatically to incoming calls.
The terminal is automatically connected to the line to receive a call when it is in Unattended and Line status. The reception of the RING INDICATOR call signal forces the high frequency on wire 126 FREQUENCY SELECT (this is only for bichannel modems to select high frequency in transmission: the called party transmits on channel 2 and the calling party must have the transmission strap on channel 1 or the ORIGIN key in the LOW position).
Note that the frequency select strap has priority over the RING INDICATOR.
When the RING INDICATOR signal is received by the modem with the UNAT key pressed, a 15 sec time out is activated. If the calling party sends the carrier within 15 sec, the connection has been established. The terminal is then able to transmit. If no carrier is sent within 15 sec, the call was made by a terminal with no modem. In this case, once the time out has expired, the terminal is disconnected from the line. This is done to avoid, on terminals in Unattended mode, the blocking of the line due to a CONNECT TO LINE request made by a user without a modem.
In Unattended mode, the terminal also checks whether the other party's carrier has been applied on the line. When there is no transmission for more than 15sec, the terminal is disconnected from the line. This is to prevent blocking the line as the disconnect commands sent by the other station were not recognized.
If, in Unattended, the terminal is in Local, the reception of the RING INDICATOR signal causes the CONN light to flash and the buzzer to sound at the same frequency as the calling tone.

7.6.3. Disconnection Procedure

The terminal is disconnected by pressing the LOCAL key or on reception or transmission of EOT.
It is also disconnected if no characters are transmitted or received within a period of 15 sec when operating in Unattended mode.

7.7. TRANSPARENT FEATURE

This facility requires the console for switched lines and is achieved when the NO TRANSP-TRANSP key is in the TRANSP position.
It is used to transmit programs on line in object code.
In Transparent mode, the microprogram inhibits printing, the recognition of characters used to execute machine functions and the generation and control of the parity character.

The TC 480 can be connected to telegraph lines in the following way:

- to switched telegraph lines using exchanges to connect the TC 480 to any station on the network or to a concentrator. The other station's number is dialled on the numeric keyboard
- to leased telegraph lines to establish the connection between the TC 480 and the other station which may be another terminal, a concentrator or any other device.
  Connection to telegraph lines is an alternative to telephone line and to 20mA current loop connections.

The basic machine microprogram handles both the connection to telegraph lines and the transmission on telephone lines using the same procedure.
Refer to chapter 6 for further information. Note that the maximum speed allowed on telegraph lines is 300 Baud. The following capabilities can therefore be achieved:

- Test mode
- Unattended (with switched line console only)
- Transparent (with switched line console only)
- Echoplex
- Break
- Half or full duplex

Note that:

- as there is no multipoint connection in telegraphy, connections on leased lines are classified as 'point to point'. In telephony, a point to point connection is any connection between two users operating on either leased lines or switched lines
- a terminal may be active or neutral: active means that the voltage is supplied by the terminal whereas neutral means that voltage is supplied by the other station or by the exchange

For further information on telegraph lines refer to the manual 'Telegraph Communication Techniques'.

8.1. POINT TO POINT ACTIVE TELEGRAPH INTERFACE (TGI 4807 OPTION)

The TGI 4807 option is the only one available at present for connections on telegraph lines. It enables the connection of the TC 480 on leased telegraph lines as an actived terminal with double current, or as a neutral terminal with single current.
An optional telegraph filter, FIL 4811, can be mounted on telegraph lines. This option will be described in § 8.2.

8.1.1. Parameters

'Connections are always point to point on 2 or 4 wire leased lines. The choice of 2 or 4 wires is determined by a strap on the basic machine (the same strap is used for telephone lines). Transmission on three wires is possible when using a common return.
The connection may use:

- single current for passive terminals only, or
  double current
- positive or negative polarity on line

The following voltages are used:

for CCITT: ± 48, ± 60V in double current (e.g. ± 48V in France, ± 60V in Italy)
+ 60, + 80, + 120V in single current

for US/UK: ± 48, ± 60V in double current
+ 96, + 120V in single current

Devices which open a circuit or short a circuit are used to modulate a single current circuit. The strap connector on the telegraph board establishes whether open circuit modulation or short circuit modulation is used.
Transmission is serial and asynchronous at 10 or 11 bits, as it is on telephone lines (see § 7.1.2).
The transmission speeds are the same as those quoted for telephone lines (see § 7.1.3), the only difference being that the maximum speed is 300 Baud. The error handling procedure is also the same as that used on telephone lines (see § 7.1.5).

8.1.2. Structure of the interface

The TGI 4807 is achieved by inserting:

- 2 boards to adapt the machine levels (+ 5.0) to telegraph levels (± 48, 60, 80V) and vice-versa. It also electrically separates the logic levels from telegraph levels (insulation is 2000V)
- a transformer which gives the following voltages: ± 48, 60, 80V
- an optional telegraph filter (see § 8.2)

Connection to the telegraph network is achieved by means of a cable which is fitted with one of the following:

- a KUKE plug (red pins), for TC 485 only (CAT 004)
- a 6 pin telephone plug, for TC 485 only (CAT 005)
- no plug (CAT 008)
- a KUKE plug (green pins), for TC 481 only (CAT 002)
- a 6 pin telephone plug, for TC 481 only (CAT 003)

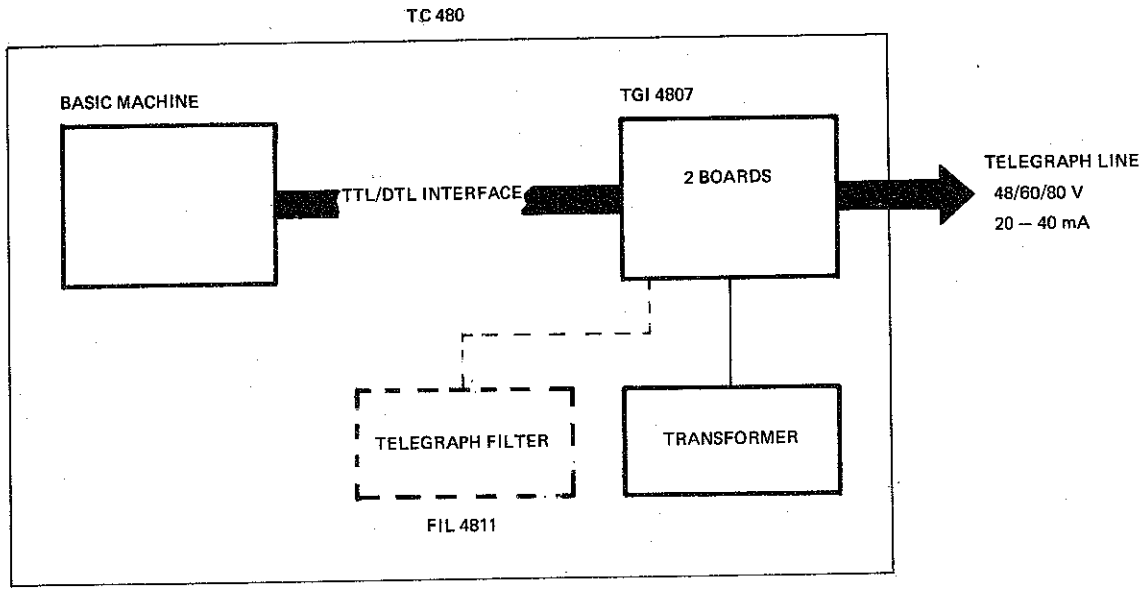


Figure 8.1 - Block diagram of point to point active telegraph interface

8.1.3. Handling the Interface

The microprogram handles both the telegraph and telephone lines using the same procedure. Note that there are no modems on telegraph lines. All the indicator lights and keys which indicate and set the status of the terminal, modem and line are set in the ON position. The microprogram therefore handles only the data. The terminal offers the following capabilities:

- transmission and reception in half duplex or full duplex (strap selectable). In full duplex, the terminal prints only the data received from the line
- alert mode when the terminal is in local: strap selectable
- transmission of break: break is a long start, the duration of which is determined by straps
- recognition of break in reception. This is done in the same way as the recognition of a long start composed of 12 - 13 bits
- deactivation of the input units on reception or transmission of a Break
- connection to the line by pressing LINE and disconnection by pressing LOCAL or by sending or receiving EOT
- Transparent status (only if the switched line console is used)

8.2. TELEGRAPH FILTER (FIL 4811 OPTION)

This device, also known as a psophometric filter, is inserted on the telegraph line in series, to eliminate line distortion. It is housed inside the terminal and is mounted when requested by the owner of the telegraph line.

8.3. POINT TO POINT TELEGRAPH INTERFACE WITH NO VOLTAGE APPLIED (NEUTRAL- TGW 4812 OPTION)

This option will be available shortly.

8.4. TELEGRAPH INTERFACE FOR SWITCHED LINES

This option will be available shortly.

9. MINICOMPUTER CONSOLE (CLI 4808 OPTION)

As already mentioned in chapters 1 and 6, the TC 480 can be connected to the SP 600 and PDP11 using the 20mA current loop interface (CLI 4808 option). The 20mA current loop connection has parameters similar to the telegraph interface and is based on the Teletype standard, now widely used by minicomputer constructors.
As there are no standard specifications, Olivetti has designed the 20mA current loop interface in conformity with standards suggested by the constructors of minicomputers. These standards tend to restrict transmission but offer more possibilities in reception, so as to guarantee adaptability.
The current loop is a single current 4 wire connection with signalling produced by current interruption; the 2 wire connection is achieved by means of external straps.
Its most outstanding features consist in the fact that the power supply for the transmission and reception circuits may be either local or remote and also that the transmission circuit may be closed down in a controlled fashion even though the machine is switched off.
There is also a control circuit for the paper tape reader which operates with a local or remote power supply, as required.
Paragraph 9.2 describes the electrical specifications and the way in which the 20mA interface is connected. In this way, the users can ascertain whether the TC 480 can be profitably connected to minicomputers other than the SP 600 and PDP 11.

9.1. THE STRUCTURE OF THE INTERFACE

The option is inserted between the DTL/TTL interface and the minicomputer and consists of:

- two boards to adapt the machine levels (+5.0V) to telegraph levels of the current loop (24V) and vice-versa. It also electrically separates the logic levels of the machine from the loop levels (insulation is 1500V).
- a transformer for local power supply
- a cable for connection to the minicomputer. This cable is 2 meters long and is fitted with an AMP connector of the MDM type.

The basic microprograms of the TC 480 handle the 20mA current loop interface in the same way as they handle the telegraph and telephone interfaces.
Refer to chapter 6 for more detailed information.

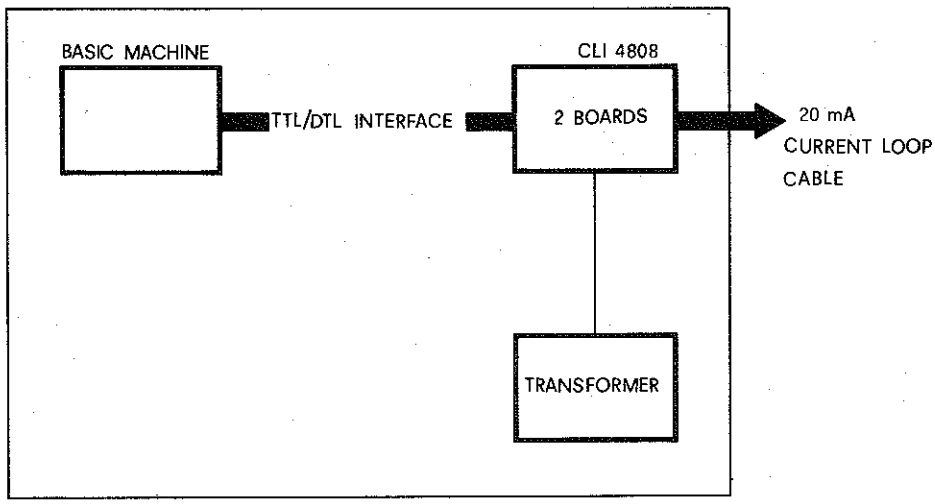


Figure 9.1. - Block diagram of the 20mA current loop interface

9.2. ELECTRICAL SPECIFICATIONS

a) Transmission circuit:

- operation in single current with signalling produced by current interruption
- terminal with local or remote power supply selectable by means of straps
- maximum circulating current: 0.5A (polarity has no significance)
- closing neutral loop even though the machine is switched off
- maximum current available for terminal with local power supply: 100mA
  used: 25mA
- maximum voltage in loop: 100V
  applied: 24V $\pm$ 5%
- maximum current present on the open loop: 100 μA
- insulation between logic and the line: 1500V

b) Reception circuit:

- operation in single current. The line polarity has no significance.
- terminal with local or remote power supply selectable by means of straps
- circulating current on terminal with local power supply : 25mA

- maximum current for terminal with remote power supply: 100mA
- maximum voltage allowed (terminal with local power supply): 100V
  applied: 24V ± 5%
- minimum reception sensitivity: 15mA
- limits of voltage drops across contacts (terminal with remote power supply): 1.2 to 2.7 V
- insulation between logic and the line: 1500 V

c) Reader control circuit

- electrical characteristics as for the reception circuit
- current in the loop = start the reader
  This command can be inverted by means of straps.

The Receive Only version is basically the KSR version without the keyboard and with a different casing and console (figure 10.1).

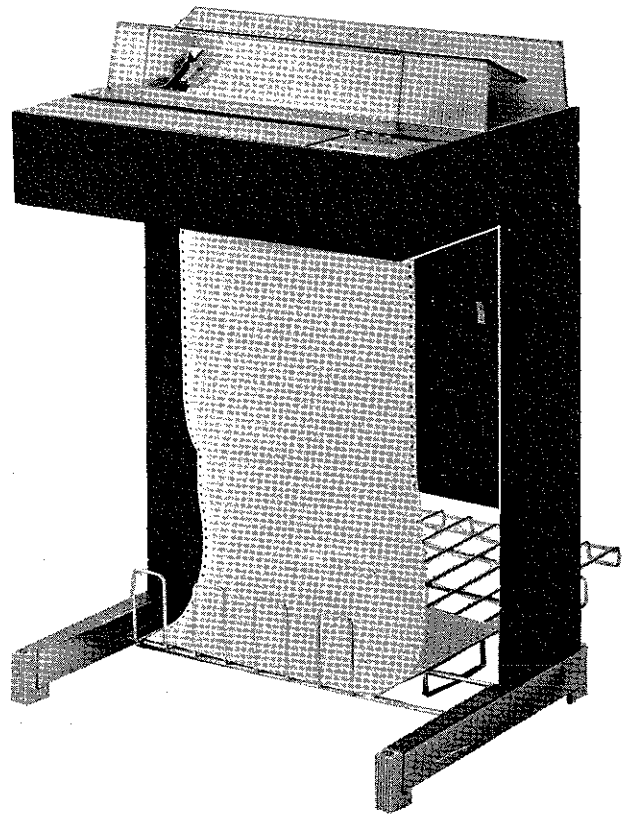


Figure 10.1. - Receive Only terminal

All the options of the KSR version can be connected to the R.O. version except for the numeric keyboard. The only I/O unit which can be connected is the tape punch (TP 4881). The logic boards, including ROM, on the R.O. version have not been modified except for the addition of a strap.
With no input units, the R.O. version of the terminal is only able to print; however, if the tape punch is provided, the characters received from the line can be punched.
The functions carried out by the KSR version vary slightly for the R.O. version:

- connections: the same as the KSR version, i.e. connections can be made to switched or leased lines on telephone or telegraph lines, current loop or via the DTL/TTL interface for connection to special units

The R.O. version uses a different cable to that used by the KSR version for connection to telegraph lines, (paragraph 8.1.2).

- line speed: speeds of a maximum of 300 baud are used
- electronic tabulation: as there is no program selector on the console, programs are selected from the line. The insertion or deletion of tabulation stops is also determined from the line.
- paper transport and carriage functions: these are carried out either from the line or on the console
- Answer Back: this is sent and printed only when ENQ is received and if the FF character is in position 1E in the EPROM
- Unattended: this is a typical application on switched lines
- Test Mode: as for the KSR version
- Local, Echoplex, Transparent, Break: these functions are not used on the R.O. version of the terminal.

The R.O. version has a single console, unlike the KSR version, and is illustrated in figure 10.2.

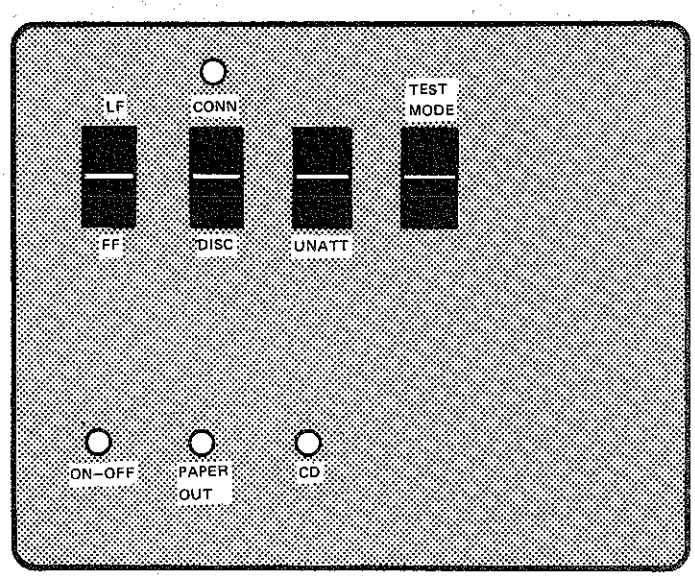


Figure 10.2 - The console of the R.O. version

- CONN-DISCON key: connects and disconnects the line (2 position key)
- UNATT key: sets the answer back device, i.e. the terminal is automatically connected to the line so that it can reply to a call from the other station (2 position key).
- TEST MODE key: enables operation in Test Mode (§7.1.5) (2 position key)
- LF-FF key: this is a 3 position key. The middle position is the rest position, the LF position initiates line feeding until it is released and the FF position initiates feed-

ing to the top of the next form if the tabulation option exists or it executes a line feed if the option does not exist.

- ON/OFF light: indicates whether the terminal is ON or OFF
- PAPER OUT light: remains on when the paper ends
- CONN light: indicates that the terminal is connected to the line
- CD light: indicates the carrier is on the line. When connection is not on telephone lines, this light is always switched off.

11.1. GENERAL CHARACTERISTICS

The two optional units below can be connected to the TC 485:

- TPR 4882 is a tape punch/reader (figure 11.1)
- TP 4881 is a tape punch (figure 11.2)

Both options use 8-bit punched tape and can be installed in field. Only one must be used at a time and replaces the other I/O units on the terminal i.e. cassette, minidisk and RAM

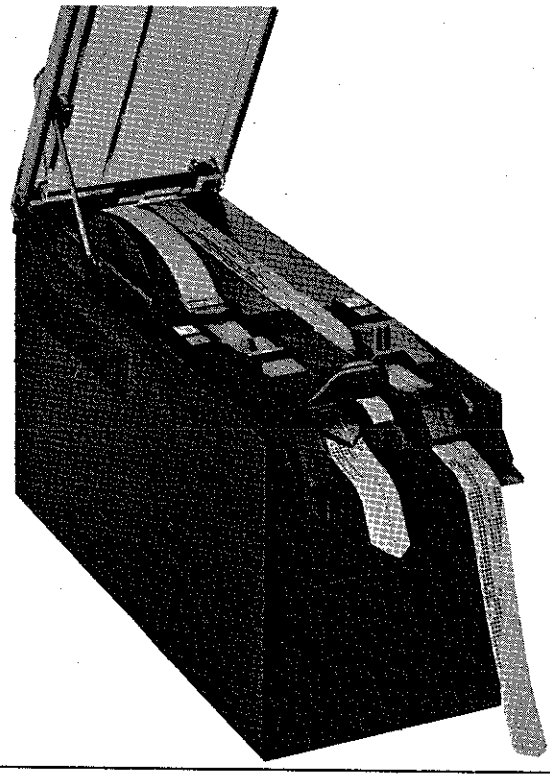


Figure 11.1 - Tape punch /reader

The punch/reader and punch are placed on the left of the terminal on a lateral stand which is known as kit 60. The reader and the punch can be activated simultaneously and thus the paper tape can be duplicated.
On line the punch/reader operates in full duplex so that reading and punching can be carried out together.

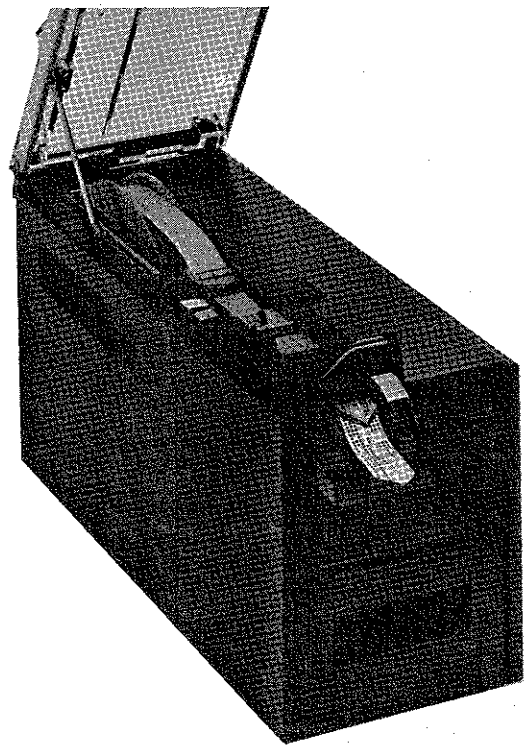


Figure 11.2 - Tape punch

Any reference made to the punch in this chapter is valid for both the PR 4882 and the TPR 4881 options. These units use any paper tape provided that it complies with the standard of Olivetti paper tape (code 55542 G). Mylar tape may also be used.
The maximum operating speed is 30 char/s. Therefore the units are used efficiently at line speeds of up to 300 baud.
The main characteristics of the reader and punch are the following:

- reader: maximum reading speed, 30 char/s (for line speeds of 300 baud max.)
  - . continuous and character by character reading
  - . start/stop determined by the line or console key
  - . incorporated console
- punch: maximum punch speed, 30 char/s (for line speeds of 300 baud max.). The speed varies according to the rate at which characters are received (continuous or if necessary, character by character)
  - · manual backspace: 1 character at a time
  - . connect/disconnect determined by the line or console key
  - . incorporated console

11.2. CHARACTERISTICS OF THE PAPER TAPE

The paper tape has the same characteristics as the 8-bit tapes currently on the market, i.e.:

- width: 1 in (25.4 mm)
- thickness: 0.004 in (0.1 mm)
- external diameter of the spool: 8 in (203 mm)
- internal diameter of the spool: 2 in (50.8 mm)

The punch code used is ISO CCITT N° 5 (7 + 1 bits). It is listed with the national variations in Appendix B.

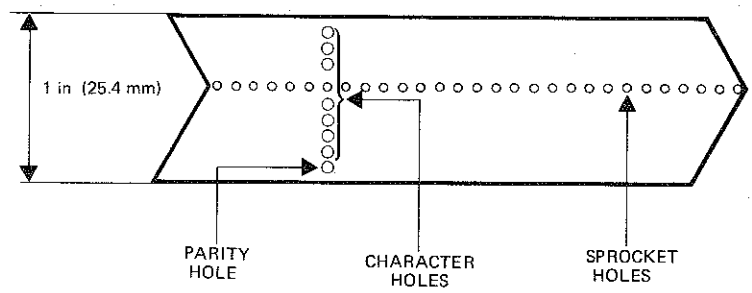


Figure 11.3 - Punched paper tape

11.3. TAPE READER

The tape is driven by a stepping motor and sprocket device. Reading is mechanical and is carried out by a group of 8 sensors which penetrate the holes on the tape.
The supply spool is situated at the rear of the unit.
The reader has the following:

- console with a start/stop continuous reading key with built-in light and a character by character reading key
- manual forward skip wheel (with no reading)
- too taut tape sensor
- end of tape sensor

The way in which the reader operates is described below:

When the reader is switched on, the start/stop light comes on and the tape is read continuously. The reader is started when:

- start/stop key is pressed
- DC1 is received from the line

The paper tape stops when:

- DC3 is received from the line
- DC3 is read on the tape
- the start/stop key is pressed
- a Break is received from the line
- the paper tape ends
- tape is too taut

The starting and stopping of the tape is almost immediate.

When the tape is too taut, the tape is stopped, an acoustic alarm sounds for 1 second and no new read commands can be received. To ammend this condition, the tape must be released and the reader must be started again. The same procedure is carried out when the paper tape comes to an end.
In order to read one character at a time, the character by character key should be pressed once for each character.
The direction of the tape cannot be reversed.
When operating in half duplex, each character read is printed, and if the terminal is in line status, is sent on line.
In full duplex, the characters which are read are sent on line without being printed.
In Transparent status, all the characters are read and the DC3 character, which normally stops the tape, is ignored.
If during transmission a character with incorrect parity is read, it is sent on line with the same parity error.

11.4. TAPE PUNCH

The tape is punched by a set of 8 electromagnets and an electromagnetic driven sprocket for tape transport.
The punch is driven by a motor which, as it is not a stepping motor, requires a certain amount of time to reach its normal operating speed. It has a 32-character buffer which prevents the loss of characters during the switching on phase.
The paper roll is situated at the rear of the unit. The chad box is at the front of the unit and can contain chads from an entire paper roll.
Twenty characters must be run out before the tape can be removed from the punch without loss of information. The tape is removed by pulling it over a V-shaped cutter (20 characters from the punch head) on the front of the unit. In this way, the operator can distinguish the beginning and the end of the tape strip.
The punch has the following:

- console with a punch connect/disconnect key which has a built-in light and a repeat key which punches the last character entered over and over again.

- backspace key. This is used to correct any errors and every time it is pressed, it moves the tape back one space.

- "tape almost out" sensor. This is activated when only 10 metres of tape remain.

The punch is not connected to the terminal and therefore must be started before characters received from the line, keyboard or reader can be punched on the paper tape.
The punch is made available when:

- the connect/disconnect key is pressed

- DC2 is received from the line

The punch is made unavailable when:

- the connect/disconnect key is pressed again

- when DC4 is received (but not punched)

- the "tape almost out" condition occurs

When the punch is disconnected due to the "tape almost out" condition, the alarm sounds for 1 second and, if the terminal is in Line status, a Break is sent to the transmitting station.
In Local status, all the characters entered on the keyboard can be punched. The following command characters are not punched: ENQ (can release Answer Back), EOT and DC1 through DC4. As these commands have no significance in Transparent status, they are punched as if they were ordinary characters.
If characters are received from the line at a speed of more than 30 characters/second (300 baud), the "buffer full" condition may occur. If it does, the terminal sends a Break to the other station indicating that no more data can be received.
The repeat key used with an empty buffer would result in the repetition of the NUL character. The parity bit represents one of the following depending of the straps inserted on the terminal (§ 6.2):

- even parity

- odd parity

- 1

- ø

When a character with incorrect parity is received from the line, and the VRC check is provided, the error is reproduced on the paper tape. In this way, the tape records the data as it was received from the line.

12.1. GENERAL CHARACTERISTICS

The DDC 4883 magnetic cassette unit is a sequential access unit used to store data.
It is an optional input/output unit, installed in field and transforms the TC 485 KSR to TC 485 ASR.
As the TC 480 has a single I/O channel, the cassette unit is an alternative to the other I/O units which can be connected to the terminal.
The cassette unit is inserted in the housing provided for this purpose on the right of the basic machine console.

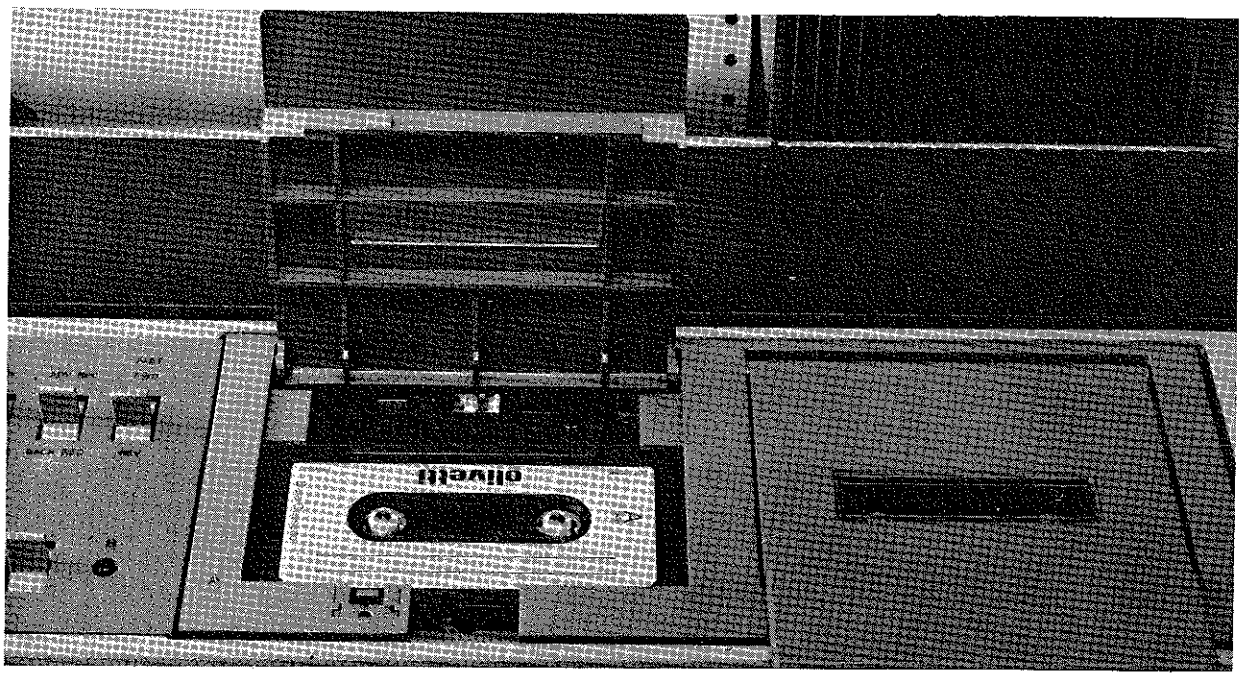


Figure 12.1. - Dual magnetic cassette unit

The main features of the unit are the following:

- 2 drivers
- capacity: about 80K bytes per cassette, making a total of about 160K bytes per unit
- fixed length of blocks: 144 characters
- number of blocks: approx. 560
- standard digital Philips cassette not compatible with ECMA standard
- reception from line: up to 300 baud, data is received and printed simultaneously; at 1200 baud, data is received and not printed
- transmission on line without printing at up to 1200 baud
- speed in local: reading and printing - 60 char/s for an average of 48 char/s.

- spool driven tape as opposed to capstan driven tape
- variable packing density
- serial double frequency recording with non return to zero
- reading check: read after write using CRC
- copy from one cassette to the other, with or without printing

12.2. STRUCTURE

The unit consists of 4 functional blocks (figure 12.2):

- control logic
- 288 character buffer
- cassette group to spool drive the tape
- console

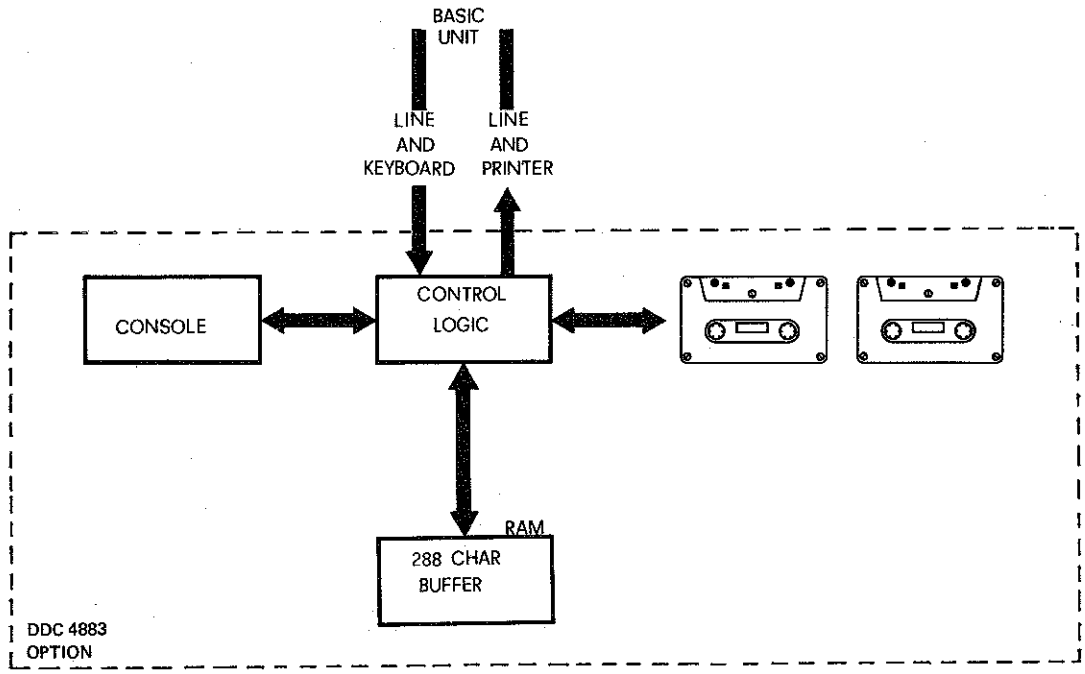


Figure 12.2 - Block diagram of the cassette unit

12.2.1. Control logic

The control logic uses a specific microprogram to handle the exchange of information between the various components of the cassette unit and the terminal. The logic is realized

with MOS-LSI technology and uses a PPS4 kit composed of a microprocessor (CPU), a 6K byte ROM, a 384 position RAM and an SDC to serialize data in write phase and deserialize data in read phase.

12.2.2. The Buffer

The memory buffer consists of 288 bytes which are a part of the specific RAM memory. The remaining part of the memory is reserved for the microprogram. The 288 bytes enable the accumulation of 2 complete information blocks.
The buffer and the microprogram logic, with some constraints, enable the overlapping of the following operations:

- entry via keyboard with recording on cassette, or
- reception from line with recording on cassette, or
- reading from cassette with transmission on line

12.2.3. Cassette Group

The cassette group consists of the spool driving mechanics and an electronic actuation board. It drives the two cassettes independently. The tape is driven by one of the four hubs (the driving hub is defined by the cassette selected and the direction of the tape).

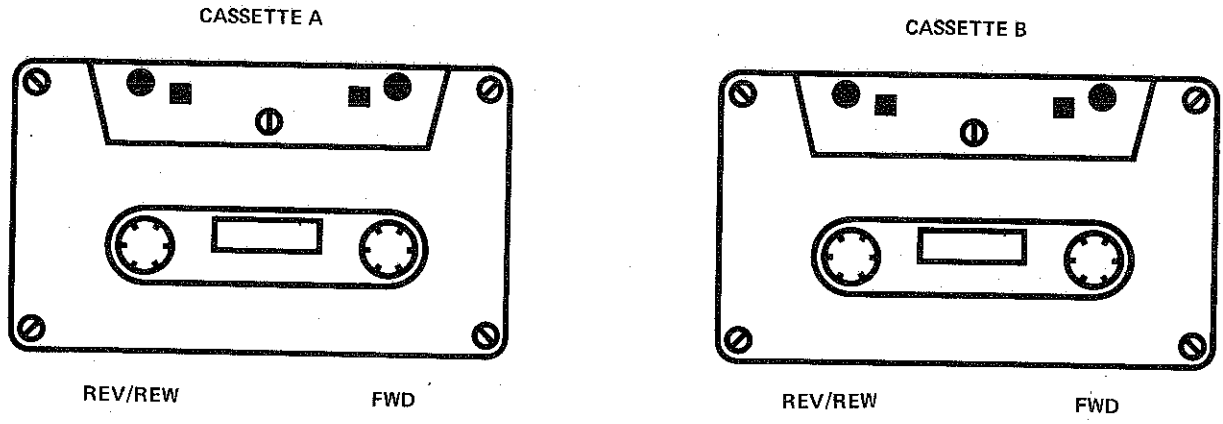


Figure 12.3 - Diagram of the driving spools

The recording frequency is constant (bit time = 300 μsec) but as the tape speed varies as the tape is transferred from the supply to the take up spool, (minimum speed 7.5 ips and maximum speed 18.75 ips) the packing density varies accordingly.
The read/write operation is effected by a "Single-track, Read after Write head which is always in contact with the tape, i.e. the single-track write head is immediately followed by another head which reads the data and checks its validity.
Unlike the standard ECMA cassette, this unit has no 'cassette inserted' or 'side A or B' signals and no EOT/BOT hole indicator.

The beginning and end of tape are indicated by means of a light/photoelectric cell which detects the transparent part of the tape. A write inhibit device, similar to that on the standard ECMA cassettes, is also provided

12.2.4. The Console

The cassette unit console has 8 selection keys and 6 indicator lights (fig. 12.4).

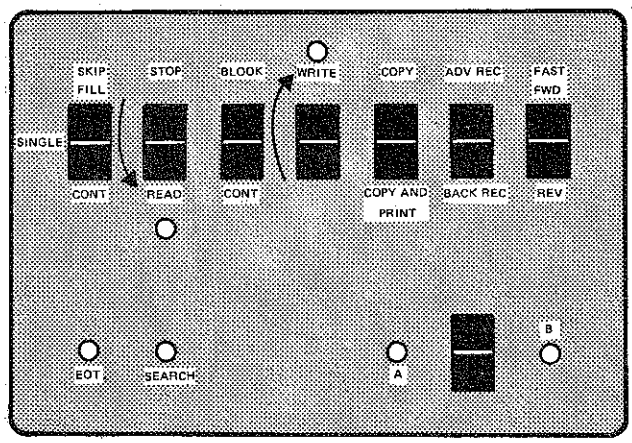


Figure 12.4. - Cassette unit console for the TC 485 version

The functions of the keys and indicator lights are described briefly below. A more detailed description will be given in paragraph 12.4.

The functions of the keys are:

- SINGLE/CONT/SKIP FILL

  This is a 3 position key and starts the read phase on the cassette:

  . in SINGLE it enables the reading of one block

  . in CONT (continue) it enables continuous reading

  . in SKIP FILL it has the same function as when it is in CONT, but does not cause the sending of filling characters to be printed or on line

- READ/STOP

  This is a 2 position key:

  . in READ it carries out reading in accordance with the position of the SINGLE/CONT/SKIP FILL key

  . in STOP it stops any operation on the cassette

- BLOCK/UNBLOCK

  This is a 2 position key and is used in the write phase to determine whether the block must be written in blocked or unblocked mode (see 12.3.2).

- WRITE

  This is a two position key, but only one position is used.

  . in WRITE it prepares the unit for the write phase

- COPY/COPY AND PRINT

  This is a 2 position key:

  . in COPY it copies, without printing, the contents of the selected cassette onto the other cassette

  . in COPY AND PRINT it copies and prints if the terminal is in local, and transmits on line if the terminal is in line

- ADV REC/BACK REC

  This is a 2 position key:

  . in ADV REC it advances one block on the cassette

  . in BACK REC it back spaces one block

- FAST FWD/REW

  This is a 2 position key

  . in FAST FWD it advances the cassette at high speed

  . in REW it rewinds the cassette at high speed

- SELECT cassette A or B

  This is a 2 position key

  . in the upper position, cassette A is selected

  . in the lower position, cassette B is selected

All the operations listed below are carried out on the selected cassette.

The functions of the indicator lights are:

- READ: indicates that the unit is in read status
- WRITE: indicates that the unit is in write status
- SEARCH: indicates that the unit is in search for message, fast forward or rewind states
- EOT: indicates the Leader or Trailer (beginning and end of the tape)

The indicator lights also signal the following error conditions:

- cassette not inserted: EOT light comes on
- end of cassette during read or ADV REC: EOT light comes on
- blank tape (a gap of at least 1 s): EOT light comes on
- persistent read error: the READ light flashes
- persistent write error: the WRITE light flashes
- end of cassette during write phase: EOT light comes on and the WRITE light flashes

12.3. ORGANIZATION OF DATA

12.3.1. Cassette

The unit can read or write Philips digital recording magnetic cassettes. Philips cassettes have neither the side A or B indication nor the BOT/EOT holes which are always provided for the standard ECMA cassettes. The unit can also accept standard ECMA cassettes. However, as the writing procedure does not conform to ECMA standards, the cassettes cannot be read on machines using ECMA standard procedure.
Cassettes with long leaders (e.g. KTRONIC) should not be used.
The Olivetti code for Philips cassettes is: 82200 N and for ECMA cassettes: 82150 P

12.3.2. Recording Format

The cassette is written serially, bit by bit, character by character. Each character is composed of 8 bits.
Writing is in blocks of 144 characters. Both the number of characters per block and the writing time are fixed. Packing is not constant, but varies as the tape is transferred from the supply spool to the take up spool. The tape speed also varies accordingly.
The cassette is recorded on one side only and can contain approx. 560 blocks.
The capacity of a cassette is about 80K bytes (144x560). As there are always 2 drivers, the total capacity of the unit is 160K bytes.
The tape layout is illustrated in figure 12.5 .

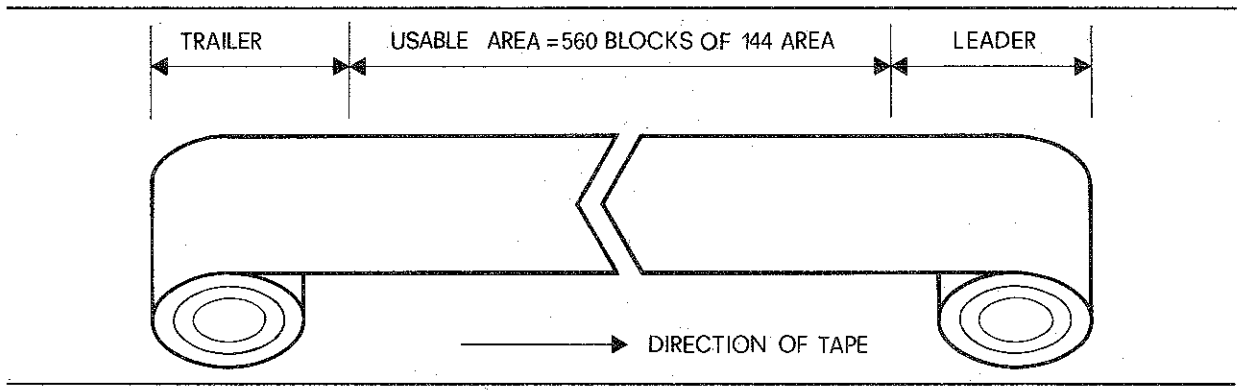


Figure 12.5. - Layout of the tape

The organization of blocks is illustrated in figure 12.6.

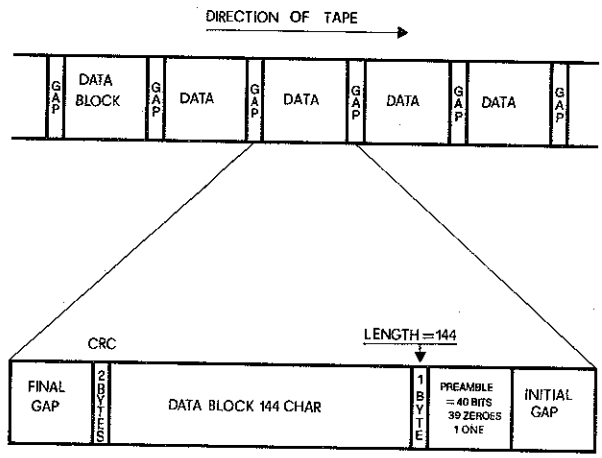


Figure 12.6 - Organization of the block

- Initial gap - this is a pause lasting approx. 96 msec during which the previous tape contents are erased.
  This pause is required to start read/write operations with the motor at normal running speed.
- Preamble - consists of 39 zeroes and 1 one. This is the time taken for the read logic to reach normal operating state.
- Length - consists of 1 byte in which the block length, i.e. 144, is indicated.
- Data - there are 144 8-bit bytes recorded, starting from the least significant bit. Each byte may represent a character is ISO code or a character in object code (transparency option).
- Cyclic Redundancy Check - consists of 2 bytes which represent the remainder of the division of the block (length + data - taken as a single binary number) by the polynomial $X^{16} + X^{15} + X^2 + 1$.
  These bytes are calculated in the block write phase and are written at the end of the block.
- Final gap - this is a pause of about 24 msec during which the previous tape contents are erased. This gap is required to stop the motor completely.

The initial gap, required in order to move beyond the leader, is created by erasing from the beginning of the oxidised area for 300 msec approx.
The preamble, length and CRC are inserted automatically in the write phase.
Note that the GAP, like the data, does not occupy a fixed length on the tape.
The data block can be written in blocked or unblocked mode:

- in blocked mode each block on the cassette corresponds to a print line. The block con-

tains up to 132 characters, the LF, VT or FF character, plus the filling characters (NUL) making a total of 144. The filling characters are inserted automatically.

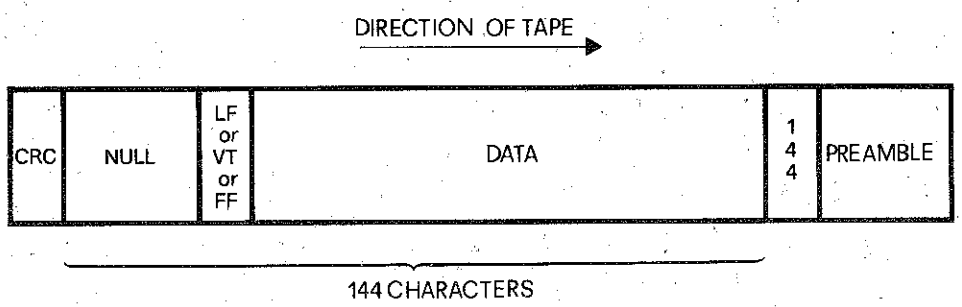


Figure 12.7. - Blocked mode

- in unblocked mode there is no relationship between the blocks on the cassette and the print line. Recording begins when the 144th character is received, irrespective of whether LF/VT or FF has been received.

A comparison between the two modes gives the following results:

- in blocked mode the filling characters take up recording time and cassette space even though they are not inserted by the operator. They vary from 10 (line of 132 characters + CR + LF) to a maximum of 143 for a block containing only LF, i.e. from 8% to 90%.
- unblocked mode gives optimum data packing because there are no filling characters and consequently the speed at which data is transmitted on line is maximized.

Therefore:

- blocked mode should not be used when high packing rates or high transmission speeds are required but it should be used when blocks are to be corrected frequently
- blocked mode must also be used to write a cassette which must then be transmitted to a station with no buffer. After sending CR LF, the station must have time to carry out the carriage return before resuming the transmission of significant characters. This is why filling characters must be sent during the carriage return.

The blocks on the cassettes can be organized in files. As there is no tape mark to define the end of a file, a DC3 or EOT must be written in the last block of the file.

12.4. OPERATION

The capabilities offered by the TC 480 cassette unit are:

a) writing of data blocks on the cassette (WRITE) with:

- entry via keyboard with printing, in local status

- reception from the line (1200 baud) with simultaneous printing (300 baud max.) in line

Writing is always in blocks of 144 characters in blocked or unblocked mode. A single block or several blocks can be written. Writing can also take place in Transparent mode.

b) Reading of data from the cassette with:

- printing in local status
- transmission on line in line status (without printing)

A single block (SINGLE) or several blocks (CONT or SKIP FILL) can be read. Reading can also be effected in Transparent mode.
The tape driving mechanics make simultaneous read/write operations impossible. Therefore, operations on the cassette are always in Half Duplex. If the terminal is set to operate in Full Duplex, there are two operating modes:

- reading from cassette and transmission of data on transmission channel; reception and printing on the other channel
- entry via keyboard and transmission of data on transmission channel; reception, printing and recording on the cassette on the other channel.

When the terminal is in line status, no data can be entered on the cassette via keyboard.

c) Copying of the contents of the selected cassette onto the other cassette. Copying can be carried out:

- with printing (COPY AND PRINT)
- without printing (COPY)

Copying without printing can completely overlap other terminal functions which do not concern the cassette unit.
A blocked cassette can be converted to an unblocked cassette and vice-versa using the copy feature.

d) Tape movement functions

- advance one block without reading (ADV REC)
- back record one block without reading (BACK REC)
- advance the tape at high speed (FAST FWD)
- rewind the tape at high speed (REWIND)

e) Search for a block on the cassette using a search key of 1 - 15 characters:

- in blocked mode, the key must coincide with the beginning of the block
- in unblocked mode the key must coincide either with the beginning of the block or with the characters which follow one of the end of line characters: LF/VT/FF.
  Once the block has been found, it can be transmitted on line or printed, depending on the operating status.

The cassette unit can receive the commands of the specific console keys described previously, either via keyboard (local) or from the line (line) by means of the following sequences:

DC1 (keys CONTROL and XON) - this starts the read phase and has the same function as the READ key

DC2 (keys CONTROL AND TAPE) - prepares the unit for the write phase and has the same function as the WRITE key

DC3 (keys CONTROL AND XOFF) - stops the read phase

DC4 (keys CONTROL and TAPE) - exit from the WRITE status

EOT this has the same functions as DC4 in the write phase and DC3 in the read phase

ESC Ø this has the same functions as the BACK REC key

ESC < this selects cassette A

ESC > this selects cassette B

ESC DLE this has the same functions as the REW key

ESC = this is the beginning of the key character sequence used to search for a message on the cassette

The following characters, sent from the keyboard (local) or from the line (line), enable other operations on the cassette input buffer:

SUB cancels the last character entered on the keyboard or from the line

CAN cancels the print line which is being loaded

Note that the tape movement functions ADV REC and FAST FWD cannot be initiated from the line.

12.4.1. Switching on and diagnostic programs

As the cassette unit is inserted in the TC 485 housing they are both switched on at the same time.
The unit is provided with diagnostic programs which are used to test all the functions of the logic part of the unit.
The sequence of events is the following:

- when the terminal is switched on all the console indicator lights come on
- the diagnostic programs are carried out for approx. 1 second
- all the console indicator lights go off

If one of the lights stays on, the operator is informed that the magnetic cassette unit is not operating correctly. The unit also has a diagnostic status which is used for main-

tenance purposes. This status is entered by pressing the WRITE and READ keys simultaneously as soon as the terminal is switched on.

12.4.2. Selecting the cassette

Before any operation is carried out on the cassette the left (A) or right hand (B) cassette must have been selected:

- by pressing the button on side A to select the left hand cassette and the button on side B for the right hand cassette
- by receiving the ESC< bicharacter sequence from the line or keyboard to select cassette A and the ESC> sequence to select cassette B

To pass from cassette A to cassette B or vice-versa, the relevant cassette must be selected. When cassette A or B has been selected light A or B comes on and stays on until another selection is made. Therefore, from the first selection onwards one of the two lights is always on and one of the two cassettes is always selected.
When the terminal is switched on neither of the two cassettes has been selected and therefore both lights are off.
If an operation is started and no cassette has been selected, the operation is deferred until the selection has been made. In the meantime, lights A and B start flashing. In this case the cassette is selected only via the console.

12.4.3. Writing on the cassette

Characters are entered on the cassette via keyboard, if the terminal is in local, or via line, if the terminal is in line. Each character entered is stored in the cassette buffer until the block is completed.
A block is completed in two ways:

- when an LF/VT/FF character is received in blocked mode
- when the 144th character is received in unblocked mode. In this case, the characters LF/VT/FF in the block indicate the end of the print line and not the end of the block.

When the block is completed it is written on the tape in the following way:

- the tape is started
- the initial gap is created
- the preamble and length (always 144) are written
- the data is written
- the CRC is written
- the final gap is created
- the tape is stopped

The read head checks the validity of the data as it is being written (Read after Write).

The unit is set in Write status either via console, via line or via keyboard:

- via console by pressing the WRITE key
- via line or keyboard with the DC2 character (CONTROL and TAPE keys)

After one of the above events, the unit switches on the WRITE unit and waits for characters from the keyboard or line.
When the block has been entered it is written on the tape and validated by the read after write head. The time taken to write the block is approx. 0.5 seconds. If an error is detected the unit makes another attempt at writing.
If this second attempt is erroneous, the unit exits from the Write status, making the WRITE light flash, and passes to Stand-By status to wait for intervention from the operator or the other station. In the meantime, the cassette buffer continues to accumulate characters received from the line. When the cassette and line buffers are full, (160 characters in addition to the 144 of the erroneous block), the terminal sends a Break to the other station to indicate that the transmission has not been carried out correctly.
The way in which the unit operates in the write phase and the features offered in the various operating states are described below:

a) exit from Write status (end of recording). In Write status, all the blocks sent via keyboard or line to the unit buffer are written on the cassette.
The unit remains in Write until:

- the operator presses STOP, or
- the unit receives DC4 (CONTROL and TAPE keys) or EOT from the keyboard or line

The block which remains in the buffer when the unit exits from Write is still written. If it is shorter than 144 characters it is completed with filling characters (NUL).
As DC3 is the stop character in the read phase it should be inserted in the last recorded block so that, in a subsequent phase, reading is stopped automatically.
Note that characters DC2, DC4 and EOT are not written on the tape.
The unit also exits from Write status when the following 2 anomalies occur:

- persistent write error, i.e. error during second attempt at writing (WRITE light flashes)
- end of cassette during write phase (WRITE light flashes and EOT light comes on)

In these two cases the cassette unit keeps the block which has not been written in the buffer. If the operator performs one of the following operations however, the block is sent to be written:

- replace the cassette
- rewind the cassette
- select the other cassette

Any other function causes the deletion of the buffer contents.

b) checking for errors in the write phase
This check is carried out by comparing the CRC read with that calculated in the read

after write phase. If they differ, an error has occurred and another attempt at writing is made automatically. This involves:

- back recording one block
- deleting the erroneous block
- rewriting the block

In this way the area which caused the error is erased.
The time taken to write a block twice varies from 2.65s to 4.25s depending on the rate at which tape is transferred from the supply to the take up spool.
While the block is being rewritten characters can be sent from the line or the keyboard. These characters are stored in one half of the cassette buffer (144 characters) and in the line buffer (16 characters). This can cause serious problems when data is received at 1200 bps , as 160 characters are received in approx. 1.5s. Therefore the line buffer is always full before the second recording is completed. When this happens, a Break is sent to the station and the terminal is disconnected. The other station must then resume transmission bearing in mind that the cassette unit is in Write status (if the second writing was successful) and that the 160 characters have not been lost (they will be written during the next event which initiates recording). However, some characters were lost during the Break. Note that, when operating at 1200 bps and if the other station is a terminal in Unattended, the transmission is blocked at the first attempt at writing.
If the attempt was not successful, a 5 second time out is started during which the cassette unit does not accept any command from console or line. The purpose of the time out is to give the other station time, when operating at speeds of less than 1200 bps , to fill the line buffer and to send a Break.
The same time out procedure is started if the cassette ends during the Write phase

c) overlapping of reception from the line and writing on the cassette
The magnetic cassette unit buffer enables the overlapping of writing on the cassette with the reception of characters from the keyboard or the line. Overlapping becomes critical in blocked mode as blocks may be formed of one single character, e.g. with 10 consecutive LF characters followed by other normal characters, the unit writes 10 144-character blocks each of which are formed of 1 LF and 143 NUL characters. The writing time is approx. 5s during which the buffer will be filled with other incoming characters. A Break will then be sent. Therefore, the overlap feature should not be used in blocked mode.

d) deletion of the last character entered
The last character entered in the buffer can be deleted by sending the SUB character from the line or via keyboard. Each SUB deletes one character. Deletion is stopped if an LF, VT or FF is encountered when back recording. In this case, when a SUB is received again, it is not acknowledged.

e) deletion of the print line being entered
An entire print line can be deleted in the buffer by sending CAN from the line or key-

board. CAN deletes all the characters up to the preceding LF/VT/FF character. Several CAN codes sent one after the other have the same effect as a single CAN.

f) correction of a block on the cassette
As the cassette unit does not have the Insert feature, the replacement or conversion of a block on the cassette is done only with the Copy feature. (see § 12.4.5.)

g) transparency in Write phase
If the terminal is in Transparent, writing on the cassette is always done in unblocked mode and therefore the codes CAN, SUB, DC4 and EOT are not recognized. All the codes in the ISO set can be written. To exit from Write when in the Transparent status, the operator must press STOP. When STOP is pressed, besides writing a block containing the characters in the buffer at that moment (made up to 144 using NUL characters), a 1s deletion gap is created. This gap replaces the DC3 character, i.e. it indicates the end of the blocks during the read phase.
Note that in Transparent status, the last block does not contain only keyed characters but usually ends with filling characters (NUL).

h) erase
The erase function is used only in Transparent status and requires a special operating sequence which erases a piece of tape for about 1 second. The sequence is the following:

- set the unit in Transparent status
- press WRITE
- press STOP

12.4.4. Reading

The read head reads the contents of the selected cassette block by block. A whole block is first transferred to the buffer character by character and, if the read phase has been completed correctly:

- it is sent to be printed, if the terminal is in local
- it is sent on line, if the terminal is in line

The block has been read when:

- the 144th character is reached, or
- the DC3 character is encountered

No incoming characters are accepted (not even command characters) when the cassette is being read and the keyboard is deactivated.
The only way the other station can communicate is by sending a Break. When this is received the cassette unit terminates reading of the block and stops on the interblock gap interrupting data transmission (some characters are lost).
The read phase can be started in two ways:

- by pressing the READ key, or
- by sending DC1 from the line or keyboard (keys CONTROL and XON)

In both cases the READ light comes on and the unit enters the Read status. If the SINGLE/CONT/SKIP FILL key is in the SINGLE position, only one block is read. If it is in one of the other two positions, the cassette is read continuously.
During the read phase, the block is checked for errors. If the block is erroneous, another attempt at reading is made. If the attempt is not successful, the unit exits from Read making the READ light flash, and waits for intervention from the operator or the other station.
The way in which the unit operates in the read phase and the facilities offered by the various operating states are described below:

a) reading with key in the SINGLE position

A block is read on the cassette and transferred to the printer and/or on line. The READ light then goes off. Note that any filling characters (NUL) in the block are also sent to the printer and/or on line.

b) reading with key in the CONT or SKIP FILL position

In both cases, blocks are read on the cassette and transferred to the printer or sent on line until the unit exits from the Read status. The exit occurs in the following circumstances:

- when STOP is pressed
- when a Break is received from the line
- when DC3 or EOT are recognized in a block
- when a gap lasting minimum 1s is encountered. In this case the EOT light comes on.

When the unit exits from Read, the READ light goes off and the terminal waits for intervention from the operator or the line.
In the first two circumstances given above, reading is stopped by an action made by the operator or the other station; the reading of a block is stopped on the next interblock gap whereas the transmission of characters to the printer or on line is suspended immediately and the remaining characters are stored in the buffer.
If exit from Read was caused by pressing STOP and the unit re-enters this status without having performed any operation, the transmission of data to the printer or on line resumes from the character following that sent before the interruption. If an operation is carried out before re-entry, the buffer contents are deleted and on re-entry the next block on the cassette is read and sent to the printer or on line.
The information given for the STOP key also applies to the Break command, the only difference being that in the latter case some characters are lost.
In the third circumstance, reading of a cassette and transmission of its contents are terminated after a DC3 or EOT character is detected and transmitted. The cassette transport continues operation until an interblock gap is read where the tape is stopped.
The fourth circumstance is typical of the Transparent status in which special codes have no significance and therefore the end of the file is determined by a long gap.
The difference between the Continue and Skip Filling status is that in Skip Filling, the filling characters are not sent on line or to the printer.

If a lot of filling characters are used in the read phase when operating in Skip Filling the transmission speed is greatly reduced.
The maximum transmission speed, during the read phase, is obtained by using cassettes written in unblocked mode, i.e. without filling characters.
As the way in which the cassette is written (in blocked or unblocked mode) is not known in Skip Filling status, all the NUL in the block are taken to be filling characters. Therefore, NUL characters should not be used to represent normal characters as the rest of the block will not be transmitted.
The sequences CONT/STOP/SKIP FILLING and SKIP FILLING/STOP/CONT are not allowed.
Reading ends anomalously when:

- the cassette ends
- the data ends
- there is a persistent read error

When the cassette ends, the READ light goes off and the EOT light comes on.
When the data ends, the READ light goes off and the EOT light comes on.

When a persistent read error occurs, the READ light flashes and the unit waits for intervention from the operator or from the line (e.g. BACK REC or ADV REC).

c) checks carried out in the read phase
The following checks are carried out during the read phase:

- blank tape: if no data is read for 1 second from the beginning of the read phase, the unit exits from Read and no error is flagged. Blank tape is detected when a cassette written in another format or an empty piece of tape is read.
- positioning on data: if when the read is started the head is positioned on data instead of on the interblock gap, an ADV REC is initiated automatically. The next block is then read.
- CRC: during reading of a block, the CRC is recalculated and compared with that read. If the two differ, another attempt is made to read. If the error still persists, the unit exits from READ (end of reading due to persistent error) as described above. The second attempt at reading involves back recording the erroneous block and then re-reading it.
- absence of data: if during the read phase no data is read for more than 4 msec, reading is considered to be erroneous and a second attempt at reading is made (see above)

d) Transparency in read phase
If the terminal is in Transparent status, the reading of the cassette is not affected by any code. Therefore, blocks are transmitted whole. The end of the cassette is determined by a gap of at least 1 second.

12.4.5. Copy Cassette Function

On the cassette unit, the contents of one cassette can be copied onto another. The format of the destination cassette is defined by the BLOCK/UNBLOCK key, irrespective of the format of the source cassette.
Therefore a blocked cassette can be converted to an unblocked cassette and vice-versa using the copy function. In this way, both modes are used to advantage, i.e. editing is facilitated in blocked mode as every block corresponds to a print line, while transmission speeds are improved by converting the cassette to unblocked mode.
The copy function is activated by selecting the cassette from which the data is to be copied and then pressing the COPY or COPY and PRINT key.

- in the COPY position, only the copy function is carried out
- in the COPY and PRINT position, if the terminal is in local, printing is also carried out. If the terminal is in line, only the copy function is carried out

During the copy phase, other functions which do not concern the cassette unit can be overlapped (e.g. entry of data with printing and transmission on line or reception with printing). In this phase the two cassette selection lights flash alternatively to indicate that the cassettes are being copied.
Cassettes can be copied block by block (SINGLE key) or continuously (CONT or SKIP FILL).
The copy phase ends in any of the following circumstances:

- if a DC3 or EOT request/character is recognized in the block to be copied
- if there is no more written data (for at least 1s)
- if Break is received from the line

At the end of the copy phase, the source cassette is selected.
The copy phase also ends when:

- one of the two cassettes ends
- there is a persistent read/write error

The above information also applies in transparent status, the only difference being that the unit does not stop when a DC3 or EOT character is recognized.
Note that when an unblocked cassette is converted to a blocked cassette there is an increase in the number of blocks due to the addition of filling characters.
The copy phase cannot be terminated by pressing STOP or receiving Break, and then re-enter the phase without losing some characters.
As the cassette unit does not have the Insert feature, the following procedure must be followed to replace or correct a block on a cassette:

- copy (even continuously) the source cassette onto the destination cassette until the relevant block is found
- copy and print in Single mode up to the beginning of the block concerned (COPY and PRINT)

- advance the source cassette one block without printing (ADV REC)
- write, via keyboard, the new block on the other cassette
- the copy phase is then resumed

12.4.6. Tape Movement Functions

These functions are those which move the tape without causing the transmission of characters to the printer or on line.

a) back recording one block

This is done in two ways:

- by pressing BACK REC on the console
- by sending the ESCØ bicharacter sequence to the cassette unit from the keyboard or line

To ensure correct positioning of the head on the interblock gap, the tape is back recorded 2 blocks and advanced 1; however, this makes the operation somewhat lengthy. When a Back Record is being executed, no data or commands from the keyboard or console are accepted.

If BACK REC is pressed when the cassette is completely rewound, the function is not carried out.

If the tape is positioned on or at the end of the first block, it is back recorded to the leader.

If the head is not correctly set on an interblock gap, it is positioned on the preceding gap.

b) Advance one block

This is done by pressing the ADV REC key. It cannot be initiated from the line.

If the cassette ends during the advance, the function is terminated and the EOT light comes on.

If ADV REC is pressed when the tape is set after the last block, the function ends:

- when a gap from a previous recording is encountered, or
- when no data is encountered for 1second. The EOT light comes on.

No data or commands received from the keyboard, line or console are accepted during this function. If the read/write head is not correctly positioned on a gap, the tape is advanced to the next gap.

c) Fast Forward

This key advances the selected cassette at high speed. The Search light comes on when this key is pressed. The function cannot be initiated from the line.

It is terminated when:

- the STOP key is pressed

- a Break is received
- the cassette ends

In the first two cases, the tape is stopped on the next interblock gap so that the cassette is ready for subsequent read operations.
If the cassette is initially positioned on the trailer, the fast forward function ends after a 3 second time out.

d) Rewind

The selected cassette is rewound in one of the following ways:

- by pressing the REW key
- by sending the ESC DLE bicharacter sequence to the cassette unit from the keyboard or line

The tape stops when:

- the STOP key is pressed
- a Break is received
- the cassette is completely rewound

In the first two cases, the tape stops on the next gap so that the cassette is correctly positioned for subsequent read operations.
If the cassette is already rewound, the REW key is pressed again and the function ends after a 3 second time out.

12.4.7. Search Function

A cassette can be searched for a message using a 1 to 15 character search key. The message may then be printed or transmitted depending on the operating state.
The search key must coincide with the beginning of a print line. Therefore:

- in blocked mode: it must coincide with the beginning of the block
- in unblocked mode: it must coincide with the beginning of the block or with the characters following LF/VT or FF. The key can be set in any position within the block and interblock gaps can occur within the key.

To start the search, the bicharacter sequence ESC = must be sent to the cassette unit from the keyboard or line followed by a search key and by an LF/VT or FF.

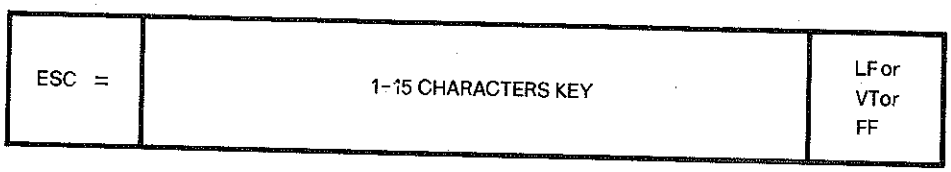


Figure 12.8 - A search key

Once the cassette unit receives the LF/VT or FF character it starts the search and the SEARCH light comes on.
If the search is successful, the cassette is positioned ready to read the block following that which contained the key. The block which now contains the key is in the cassette unit buffer. Therefore, if the search for the message is immediately followed by a read phase, reading begins from the first character in the key.
The read command can be initiated while the search is being carried out. In this case, the read operation is deferred until the search has been carried out. The function is terminated when:

- the block is found, or
- the STOP key is pressed, or
- a Break is received from the line

Other circumstances in which the search phase ends are:

- when the cassette ends
- when there is no more written data (1 second gap)
- when DC3 or EOT are encountered

In these cases, the search is negative, i.e. there is no print line starting with the key after the initial position on the cassette. The SEARCH light therefore starts flashing.
The SEARCH light also flashes if a key longer than 15 characters is entered. (Note that the spaces in the block being searched for can be omitted from the search key).
The search key can be completely erased (using CAN) or only the last character may be erased (using SUB) while it is being entered.
The unit can exit from Search while the key is being entered by pressing the STOP key. The unit then returns to Stand-By status.
In order to set the tape on another file in a multifile cassette, the search for message is programmed not to stop when DC3 or EOT is encountered and the following procedure must be followed:

- set the unit in Transp
- press READ and then STOP (to carry out a trial read)
- set the unit in No Transp
- proceed as normal

13. MINIDISK (MDU 4885 OPTION) AND 8K RAM (MDM 4887 OPTION)

13.1. GENERAL FEATURES

The MDU 4885 minidisk unit is used to store data and for the sophisticated editing of messages. It consists of an 8K RAM and a mechanical driver which enables the reading and writing on an 8K diskette.
The 8K RAM is also available without the mechanical driver and in this case is known as as the MDM 4887 option.
These two input/output options can transform the TC 485 KSR into the TC 485 ASR in field.
As the TC 480 has only one I/O channel, the minidisk or 8K RAM are used instead of other I/O units which can be connected to the terminal.
The minidisk and the 8K RAM are housed in the same casing on the right of the basic machine console and both have their own console.

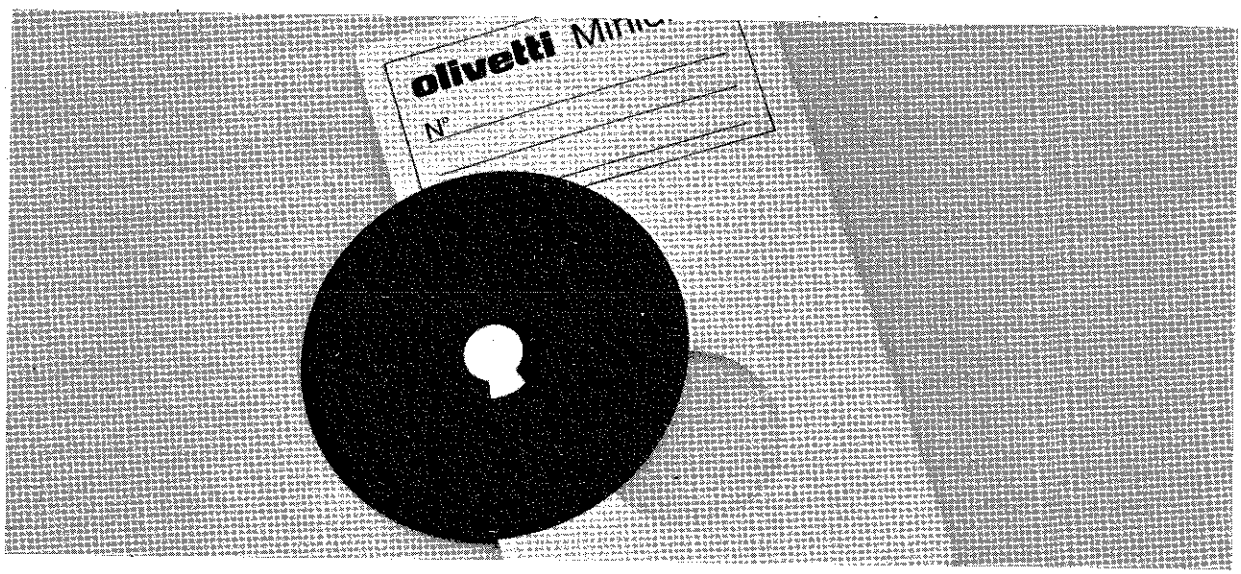


Figure 13.1. - The diskette

The diskette is a mylar-coated, magnetic medium which has a diameter of 65mm. It has a capacity of 8K bytes and is supplied in an envelope from which it is extracted to be read or recorded on the minidisk unit. The diskette code is 0012119Y. The editing capacity of the minidisk is due essentially to the RAM. In fact the operator has access to the memory, but not to the minidisk on which read/write operations can be carried out. The contents can be modified at character, word and line level.
When the operator has compiled the text in the memory (the text may of course be shorter than 8K), the contents of the memory can be transferred onto the diskette simply by pressing the MEM TO DISK key.
Access to the diskette is therefore not random but sequential.

Vice-versa, the contents of the diskette (8K) are transferred to the memory covering the data which was there previously, by pressing the DISK TO MEM key.
The minidisk is used in place of the traditional tape punch/reader giving line speeds of up to 1200 bps as opposed to 300 bps. Obviously the capacity of the minidisk is more limited than that of the tape punch (8K as opposed to more than 100K).

13.2. OPERATING MODES

The minidisk unit has 4 modes, STAND BY, READ, WRITE, and MODIFY, three of which are operating modes (READ, WRITE, MODIFY). Each of the modes has an indicator light on the console.

- STAND BY
  When the terminal is switched on, a diagnostic sequence is sent and all the lights on the console come on. They go off after approximately 0.5 seconds if no anomaly conditions are detected. Moreover, the buffer is cleared and the pointers are initialized.

- READ (transmit message)
  This operating mode, which is conditioned by a message in the memory, is the same as the tape read mode. The characters transmitted are taken sequentially from the memory according to the read pointer and transmission then continues up to the end pointer (these pointers can also be handled by the operator by entering 1 or 2 search masks).

- WRITE (receive message)
  This operating mode is the same as the tape punch mode, the only difference being that data received is not transferred immediately to the external medium, but is stored in the buffer. The transfer to the diskette occurs when the operator sends an explicity command or when the maximum memory capacity is exceeded (8192 characters).
  Any other characters received during the physical transfer of data (transfer rate is 50 usec/bit- total transfer time of 8K and automatic read check is approximately 8.8 seconds), are enqueued in a 352 character buffer from which they are taken, on completion of the transfer, and stored in the memory.

- MODIFY (modify message)
  When operating in modify mode, it is possible to correct a message on the punched tape following the same procedure as that used when the tape punch/reader is connected. The message must have been loaded into the memory before the unit passes to modify status. At this point, the minidisk unit is ready to receive commands which, depending on the position of the Character/Word/Line selectors, enable skipping or cancelling (Cancel selector enabled) of a character, word or line respectively. If the modification is longer or shorter than the length of the line concerned, the operator will adjust to to the new value. The new text of the message is aligned automatically.

14.1. DIAGNOSTIC PROGRAMS

The TC 480 is provided with a series of diagnostic programs which are activated for 0.5s when the terminal is switched on. The devices which indicate any malfunctioning are the acoustic alarm and the Connect light. If there is no fault, the print group performs a slow carriage return.

At the end of the diagnostic programs if the terminal is operating correctly, the CONN light should be off, the alarm must not have sounded and the print group, after the carriage return and the advance for text visibility, should be in position 6.

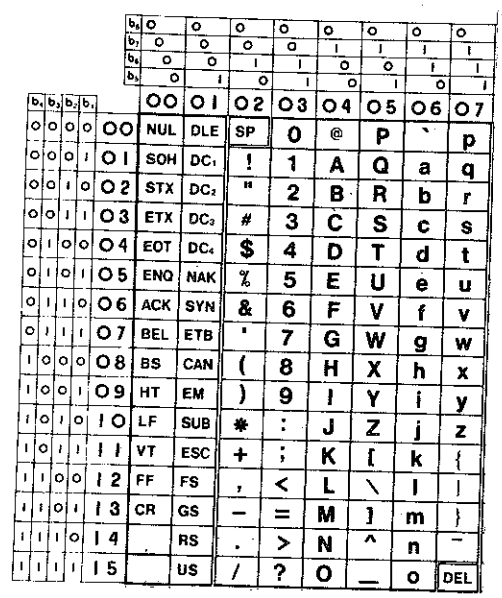
If any of the above conditions is not satisfied, there is a fault on the terminal.

The terminal also has a special hardware diagnostic program which is used for maintenance purposes. In fact it rapidly locates faults on the terminal. This program has a strap which enables printing at 1200 baud and another strap which enables the printing of the graphic set.

Refer to § 12.4.1 for a description of the diagnostic program for the cassette unit, and to § 13.2 for the diagnostic program of the minidisk.

A. LIST OF THE STRAP SELECTABLE FUNCTIONS

	Reference
- On the basic machine for connections to telephone or telegraph lines	
. VRC parity check	6.2
. odd or even parity	6.2
. insertion of the 8th bit to establish correct parity (odd or even)	6.2
. one or two stop bits	6.2
. selection of 4 or the 7 transmission speeds available	6.2
. 2 or 4 wire connection	7.1.1
. alert mode when terminal is in local	7.5
. disconnection of the line when EOT is received or transmitted	7.5
. receive/transmit in full or half duplex	7.1.1
. length of break during transmission	7.4
. automatic connection to the line when the unit exits from local	6.2
- On the telephone line board	
. selection of the transmission channel on the bichannel modem	7.1.4
. selection of high or low frequency	7.1.4
. inhibit carrier check on second channel	7.3
. selection of 108/1 or 108/2	D.
. calling indicator	6.1
. L122 Request character from paper tape reader or cassette	6.1
- On the basic machine for print operations	
. national character set	5.2.2
. text visibility time delay	5.4.3
. printing of > > > and < < <	5.4.3
. automatic New Line (LF + CR)	3.3 and 5.4.3
. printing at 1200 baud for maintenance purposes	5.4.3
. Receive Only version	10

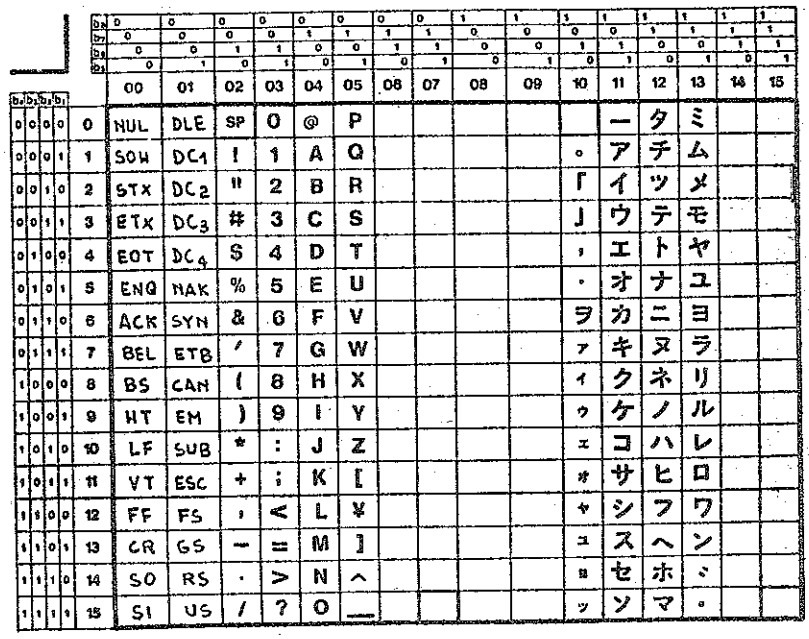


b_4 b_3 b_2 b_1	0 0 0 0	0 0 0 1	0 0 1 0	0 0 1 1	0 1 0 0	0 1 0 1	0 1 1 0	0 1 1 1
	00	01	02	03	04	05	06	07
0 0 0 0	00 NUL	DLE	SP	0	@	P	`	p
0 0 0 1	01 SOH	DC_1	!	1	A	Q	a	q
0 0 1 0	02 STX	DC_2	"	2	B	R	b	r
0 0 1 1	03 ETX	DC_3	#	3	C	S	c	s
0 1 0 0	04 EOT	DC_4	$	4	D	T	d	t
0 1 0 1	05 ENQ	NAK	%	5	E	U	e	u
0 1 1 0	06 ACK	SYN	&	6	F	V	f	v
0 1 1 1	07 BEL	ETB	'	7	G	W	g	w
1 0 0 0	08 BS	CAN	(	8	H	X	h	x
1 0 0 1	09 HT	EM	)	9	I	Y	i	y
1 0 1 0	10 LF	SUB	*	:	J	Z	j	z
1 0 1 1	11 VT	ESC	+	;	K	[	k	{
1 1 0 0	12 FF	FS	,	<	L	\	l	|
1 1 0 1	13 CR	GS	-	=	M	]	m	}
1 1 1 0	14	RS	.	>	N	^	n	~
1 1 1 1	15	US	/	?	O	_	o	DEL

Figure B.1 - ISO-CCITT N° 5 Code Table, USASCII Version

VERSIONE	2-3	2-4	4-0	5-11	5-12	5-13	5-14	6-0	7-11	7-12	7-13	7-14
ITALIA	£	$	§	°	ç	é	^	ù	à	o	è	ì
FRANCIA	£	$	à	°	ç	§	^	`	é	u	è	¨
USA - ASCII	#	$	@	[	\	]	^	`	{	|	}	~
SPAGNA	£	$	§	¡	Ñ	¿	^	`	°	ñ	ç	~
PORTOGALLO	#	$	§	Ã	Ç	Õ	^	`	ã	ç	õ	º
SWITZERLAND	£	$	§	à	ç	e	^	`	ä	ö	ü	é
SWEDEN FINLAND	#	¤	@	Ä	Ö	Å	^	`	ä	ö	å	-
GERMANIA	#	$	§	Ä	Ö	Ü	^	`	ä	ö	ü	ß
U.K	£	$	@	[	\	]	^	`	{	|	}	-
DENMARK NORWAY	£	$	´	Æ	Ø	Å	^	`	æ	ø	å	¨

Figure B.2 - ISO CCITT N° 5 Code Table, National Versions



b_4 b_3 b_2 b_1		00	01	02	03	04	05	06	07	08	09	10	11	12	13	14	15
0 0 0 0	0	NUL	DLE	SP	0	@	P						ー	タ	ミ		
0 0 0 1	1	SOH	DC1	!	1	A	Q					。	ア	チ	ム		
0 0 1 0	2	STX	DC2	"	2	B	R					「	イ	ツ	メ		
0 0 1 1	3	ETX	DC3	#	3	C	S					」	ウ	テ	モ		
0 1 0 0	4	EOT	DC4	$	4	D	T					、	エ	ト	ヤ		
0 1 0 1	5	ENQ	NAK	%	5	E	U					・	オ	ナ	ユ		
0 1 1 0	6	ACK	SYN	&	6	F	V					ヲ	カ	ニ	ヨ		
0 1 1 1	7	BEL	ETB	'	7	G	W					ァ	キ	ヌ	ラ		
1 0 0 0	8	BS	CAN	(	8	H	X					ィ	ク	ネ	リ		
1 0 0 1	9	HT	EM	)	9	I	Y					ゥ	ケ	ノ	ル		
1 0 1 0	10	LF	SUB	*	:	J	Z					ェ	コ	ハ	レ		
1 0 1 1	11	VT	ESC	+	;	K	[					ォ	サ	ヒ	ロ		
1 1 0 0	12	FF	FS	,	<	L	¥					ャ	シ	フ	ワ		
1 1 0 1	13	CR	GS	-	=	M	]					ュ	ス	ヘ	ン		
1 1 1 0	14	SO	RS	.	>	N	^					ョ	セ	ホ	゛		
1 1 1 1	15	SI	US	/	?	O	_					ッ	ソ	マ	゜		

Figure B.3 - Code Table for the Latin-Katakana Version

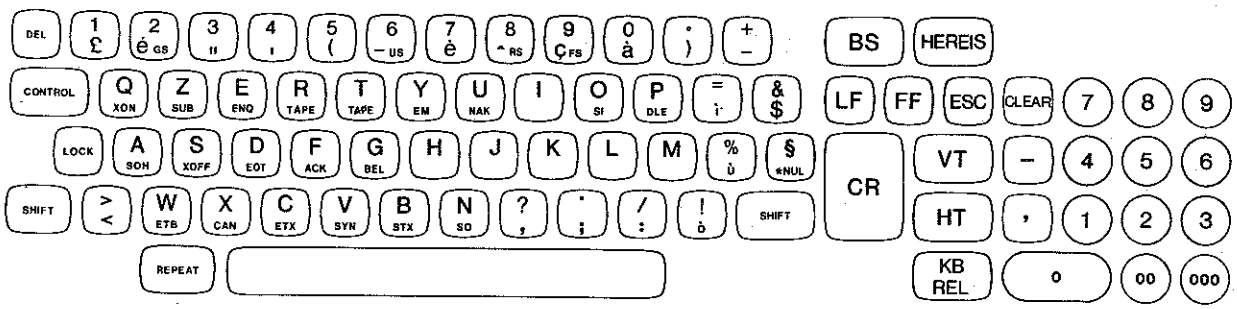


Figure C.1 - Italy national keyboard (TAS 504)

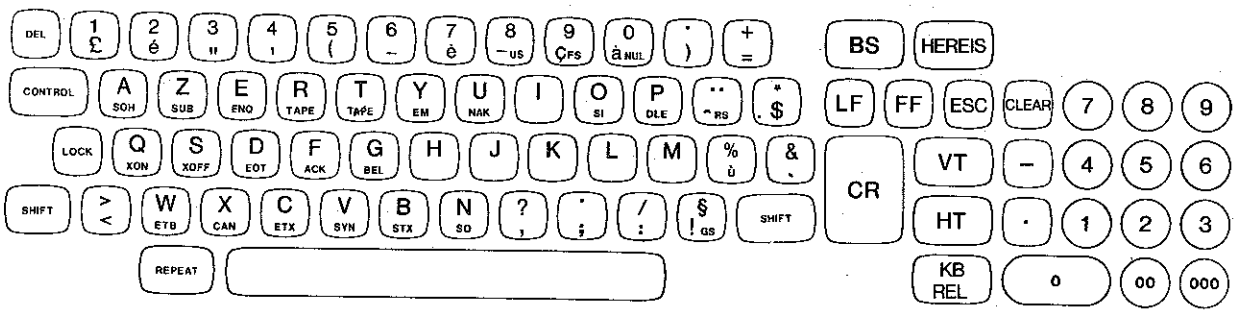


Figure C.2 - France national keyboard (TAS 435)

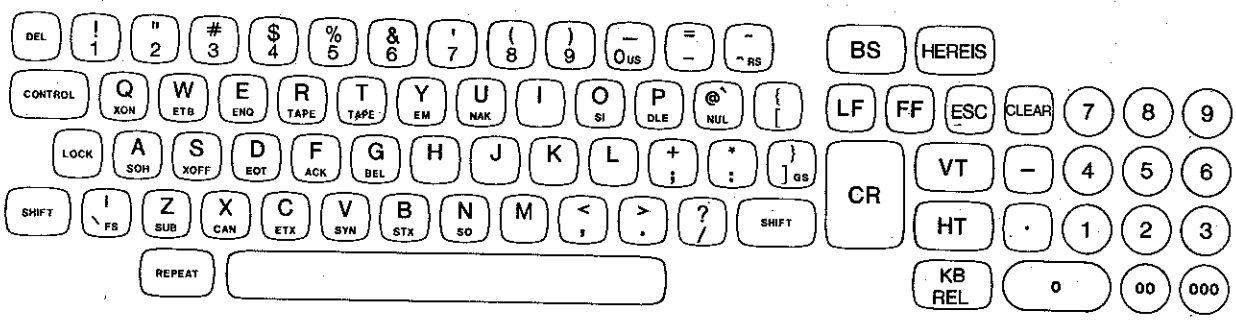


Figure C.3 - ASCII keyboard version (TAS 732)

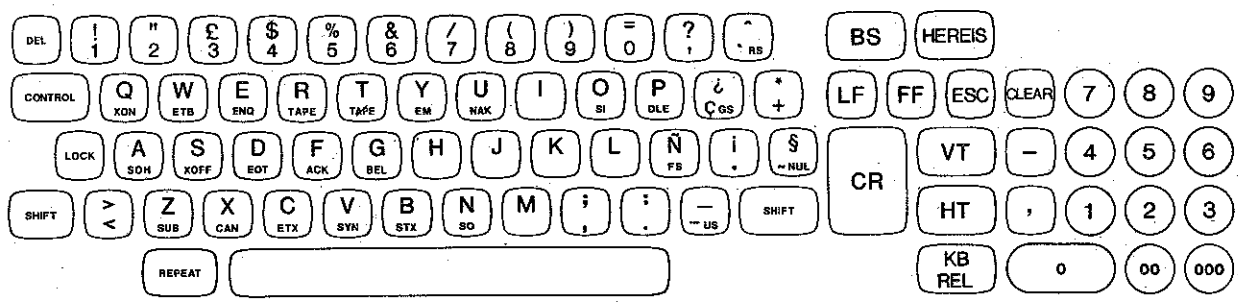


Figure C.4 - Spain national keyboard (TAS 187)

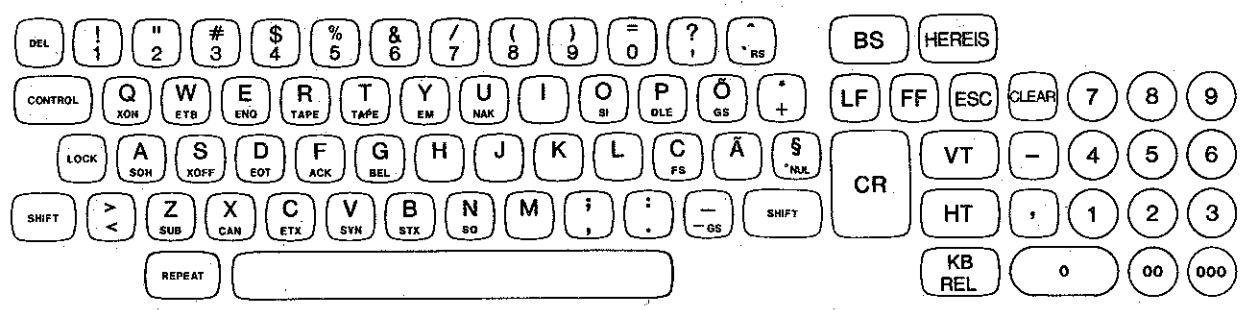


Figure C.5 - Portugal national keyboard (TAS 166)

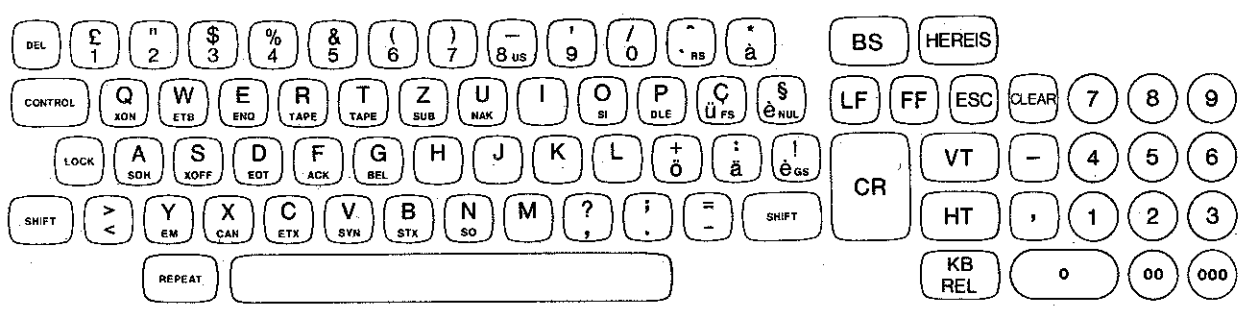


Figure C.6 - Switzerland national keyboard (TAS 687)

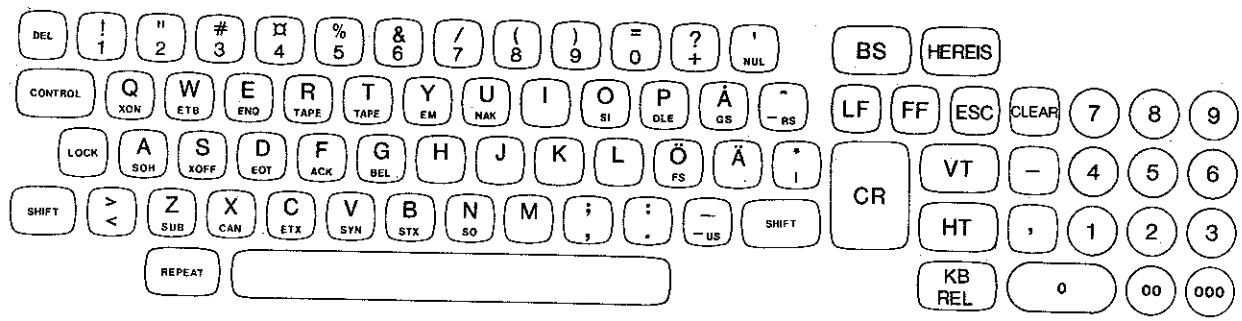


Figure C.7 - Sweden/Finland national keyboard (TAS 684)

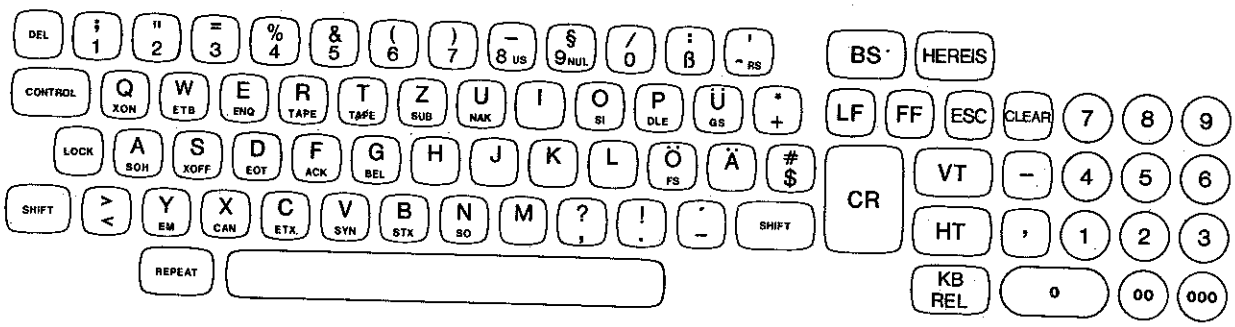


Figure C.8 - German national keyboard (TAS 177)

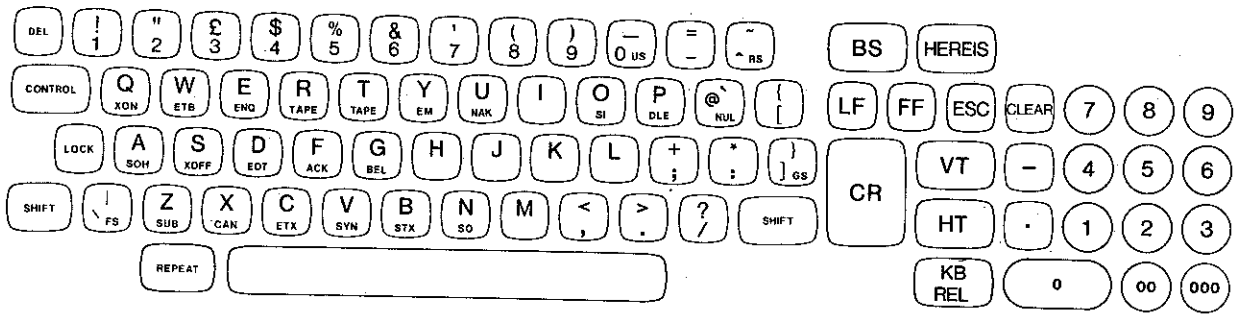


Figure C.9 - U.K national keyboard (TAS 729)

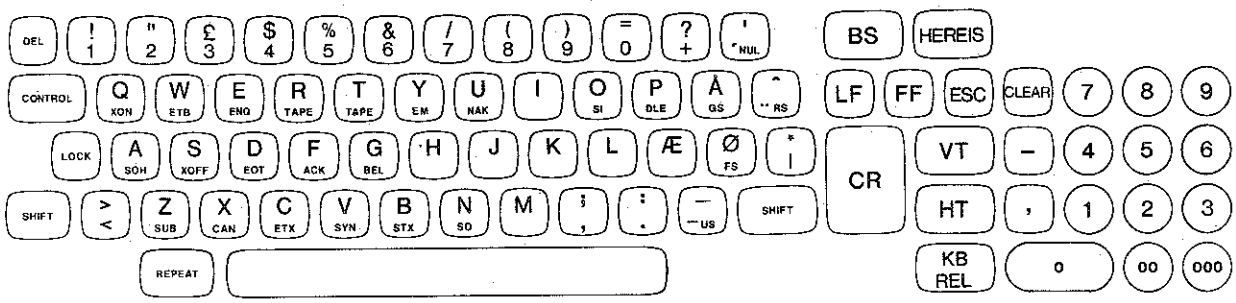


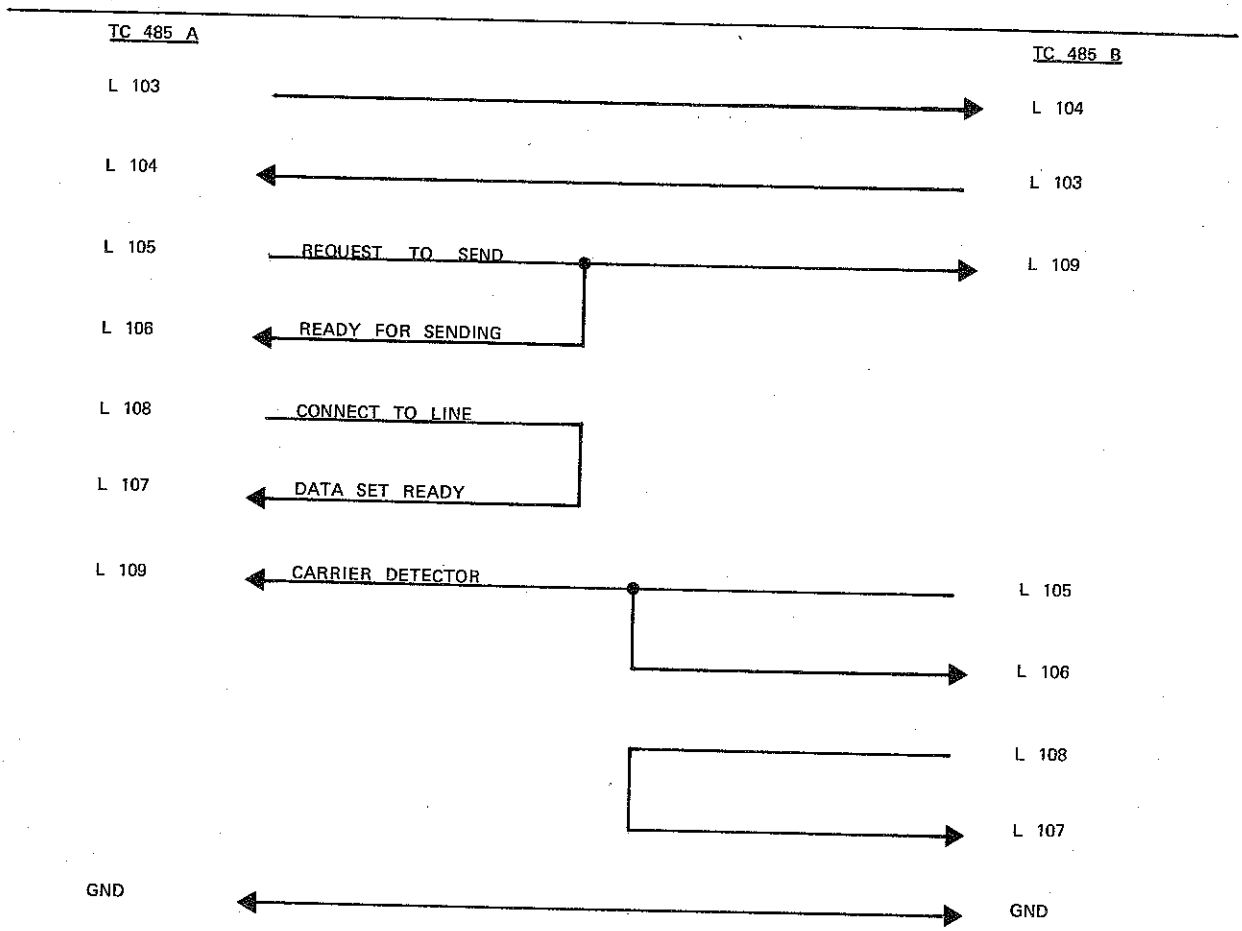
Figure C.10 - Denmark/Norway national keyboard (TAS 411)

D. CCITT V24/EIA RS 232C INTERFACE - SUBSET HANDLED BY TC 480

Direction	Sig. N°	CCITT interface meaning	EIA interface meaning
	101	earth wire	
	102	ground	
→	103	transmitted data	
←	104	received data	
→	105	request to send	
←	106	ready for sending	clear to send
←	107	data set ready	
T →	108/1	connect data set to line *	
E →	108/2		data terminal ready
R M			
M ← O	109	received line signal detector	carrier detector
I → D	113	transmitter signal element	
N E		timing	
A → M	120	transmit backward channel	
L		line signal (connect the carrier on the second channel)	
←	122	backward channel received line detector (carrier recived on second channel)	
←	125	calling indicator	
→	126	select transmit frequency (only for bichannel modems)	

* the selection of 108/1 or 108/2 is done using straps

E. EXAMPLE OF THE CONNECTION BETWEEN 2 TC 485 TERMINALS USING DTL/TTL INTERFACE



PONE/5:

contact 1	voltage always absent	
contact 2	voltage present	automatic connection
contact 3	voltage present	parity required
contact 4	voltage present	even parity
contact 5	voltage absent	1 stop bit
contact 6	voltage present	half duplex

PONE/7:

contact 1	voltage present	set L122 ON
contact 4	voltage present	set L125 OFF

Printed in Italy