



TELECOMMUNICATION
STANDARDIZATION SECTOR
OF ITU

TERMINAL EQUIPMENT AND PROTOCOLS FOR TELEMATIC SERVICES

TELEWRITING TERMINAL EQUIPMENT

ITU-T Recommendation T.150

(Extract from the *Blue Book*)

NOTES

- 1 ITU-T Recommendation T.150 was published in Fascicle VII.5 of the *Blue Book*. This file is an extract from the *Blue Book*. While the presentation and layout of the text might be slightly different from the *Blue Book* version, the contents of the file are identical to the *Blue Book* version and copyright conditions remain unchanged (see below).
- 2 In this Recommendation, the expression “Administration” is used for conciseness to indicate both a telecommunication administration and a recognized operating agency.

© ITU 1988, 1993

All rights reserved. No part of this publication may be reproduced or utilized in any form or by any means, electronic or mechanical, including photocopying and microfilm, without permission in writing from the ITU.

TELEWRITING TERMINAL EQUIPMENT

TABLE OF CONTENTS

This Recommendation consists of four parts, combined in one document

SCOPE

PART 1 – *Fundamental characteristics*

- 1 Introduction
- 2 Definitions
- 3 References
- 4 Presentation functionalities
- 5 Principles of telewriting coding

PART 2 – *Telewriting together with telephony*

- 1 General
- 2 Main characteristics of the basic terminal
- 3 Presentation functionalities of the basic terminal
- 4 Transmission for the basic terminal
- 5 Transmission blocks
- 6 Transmission procedure
- 7 Coding identifier
- 8 Communication control, general requirements
- 9 Communication control commands
- 10 Description of the communication process

PART 3 – *Zone coding*

- 1 General
- 2 Presentation elements
- 3 Zone coding description
- 4 Specification of terms used in coding
- 5 Specification of the coding
- 6 A coding example
- 7 Data structure
- 8 Temporary pen-stop
- 9 Control commands
- 10 Summary code table
- 11 Summary transmission data format
- 12 Zone coding basic terminal

PART 4 – *Differential chain coding*

- 1 General
- 2 Presentation elements
- 3 Description of the coding
- 4 Incremental mode mechanism
- 5 Change of coding parameters
- 6 Coding formats
- 7 Incremental mode coding format
- 8 Displacement mode coding format
- 9 Encoding of the primitives
- 10 Example of differential chain coding

1 Scope

This Recommendation specifies technique-oriented characteristics of telewriting and the application of telewriting in combination with voice communication. Service-oriented requirements are defined in Recommendation F.730. In the development of this Recommendation, compatibility with other telematic services is taken into account. This Recommendation is structured in four parts:

Part 1 – Fundamental characteristics

Part 2 – Telewriting together with telephony

Part 3 – Zone coding

Part 4 – Differential chain coding.

Part 1 - Fundamental characteristics

1 Introduction

1.1 Telewriting is a communication technique that enables the exchange of handwritten information through telecommunication means. The handwritten information may consist of text in handwriting, drawings, diagrams, etc.

1.2 By means of telewriting terminal equipment, the TRACE of the writing instrument as produced at the sending side, is reproduced at the receiving side including the effect of movement.

1.3 In the sending part of the terminal the handwritten input information is converted into a digital signal: the coded representation of the handwritten information. Next, this digital signal is converted into a signal suitable for transmission.

1.4 In the receiving part of the terminal the received signal is converted into a digital signal, corresponding with the coded representation as described in above. From this digital signal, the handwritten information is reproduced.

1.5 The reproduction of the handwritten information can take place on a screen, on paper or both. In this Recommendation, the characteristics of communication through telewriting are defined with respect to the image on a screen (soft copy). Reproduction on paper (hard copy) is considered to be an optional function under local control.

1.6 Storage may take place between the writing (the input process) and the reproduction (the output process). When retrieved from a store, the message will appear on the receiver's screen in the same way as in the case of a direct connection.

1.7 A page of handwritten information (or part of it) could be reproduced as a still picture. This application, however, is not covered in the present text.

- 1.8 Telewriting can be used in various ways:
- as independent communication technique,
 - in combination with voice communication through a telephone network,
 - in the context of teleconferencing,
 - in the context of information retrieval.

2 Definitions

2.1 telewriting image

A collection of telewriting presentation elements, to be displayed together.

Note – The telewriting image can exist in visible form at the output device, or in the form of a coded representation.

2.2 presentation element

Basic graphic element used to construct an image.

Examples of telewriting presentation elements are: trace, closed area, background.

2.3 coding rectangle

Rectangular area representing the coding space in horizontal and vertical direction, available for coding of a telewriting image.

2.4 image area

(previously: text area)

Rectangular part of the display area, to be considered as the image of the coding rectangle.

2.5 background

Presentation element being a rectangular area with the same size as the image area, acting as a reference area on which telewriting foreground information can be presented.

2.6 trace

Presentation element being a curve of an arbitrary shape, starting from a defined position, being completed incrementally and ending at a defined position.

2.7 closed area

Presentation element being an area enclosed within one trace which constitutes a closed line.

2.8 marker

Marked representation of a single position in a telewriting image.

Note – A marker is not a permanent part of a telewriting image, but exists only as long as it is activated.

2.9 attribute

A particular property which applies to a presentation element or to a group of presentation elements.

Examples: line thickness, colour.

3 References

In the text of this Recommendation the following Recommendations/standards are referred to:

- Rec. F.730: Service oriented requirements for telewriting applications.
- Rec. T.101: International interworking for videotex services; Annex C, data syntax II.
- Rec. V.21: 300 bits per second duplex modem standardized for use in the general switched telephone network.
- ISO 9281: Information processing – Identification of picture coding methods.

4 Presentation functionalities

4.1 This section describes a set of presentation functionalities. This set of functionalities is intended as a repertoire of presentation functionalities for telewriting in general. For a specific application a subset may be defined.

4.2 In the description of presentation functionalities, the concept of TRACE is being used. A trace is a curve of an arbitrary shape, starting from a defined position, being completed incrementally and ending at a defined position. Handwritten information is considered to consist of traces.

4.3 Representation of the handwritten information is accomplished by the sequential reconstruction of the individual traces. This implies that the effect of movement is retained during each reproduction.

4.4 Telewriting information is to be displayed on the display area of some output device. The display area is considered to be a two-dimensional surface.

4.5 The display area is subdivided into an image area and a border area; see Figure 1-1/T.150.

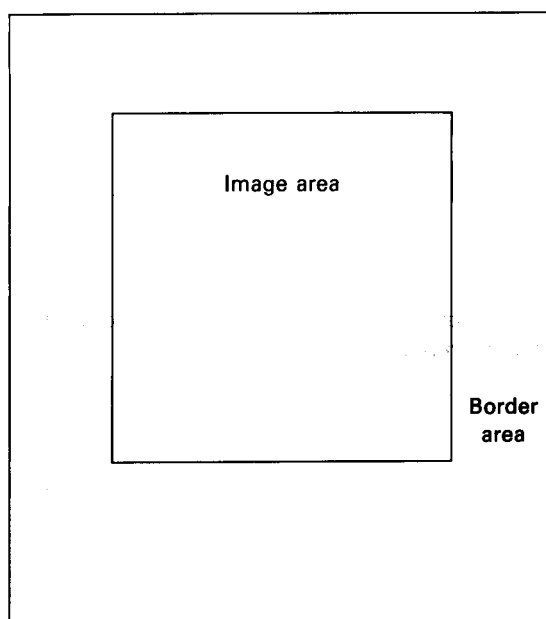


FIGURE 1-1/T.150

Subdivision of display area

4.6 The border area surrounds the image area. External form and dimensions of the border area are not specified. The presence of a border area is not mandatory. It is however inevitable in certain implementations.

4.7 The image area is rectangular. The two shorter edges of the image area have a vertical orientation, the two longer edges have a horizontal orientation. The length ratio of shorter and longer edges is 3:4.

- 4.8 The position of telewriting information on the display area is defined with respect to the edges of the image area.
- 4.9 Information on the display area is composed of presentation elements of three categories:
- foreground,
 - background,
 - border area.
- 4.10 Foreground and background presentation elements are defined in the image area only.
- Border area presentation elements are defined in the border area only. The use of the border area is not defined for telewriting.
- 4.11 Foreground presentation elements include trace, marker and closed area.
- 4.12 The presentation elements have the following characteristics:
- *Trace*: This is the curve as defined in § 2.6 of this part; the essence of the handwritten information is represented by one trace or by any combination of traces; the image area can contain an undefined number of traces at a time.
 - *Marker*: This is a marked representation of a single position; it behaves as if it is overlaid on the foreground; a moving marker does not create a trace; a marker can be switched on and off; one user can generate only one marker at a time. The image area can contain one locally generated marker and one remotely generated marker.
 - *Closed area*: This is the area that is enclosed within a closed trace; this closed trace is the perimeter. A trace is a closed trace if it intersects itself; a trace that is nearly closed can be converted into a closed trace, by the addition of the lacking part of the trace.
 - *Background*: The background is a defined reference area on which foreground information is to be imaged; if the full image area is filled with foreground information, the background is not visible.
 - *Border area* : The border area is independent of the information in the image area.
- In case of a CRT display the border area is the remaining part between image area and edges of the display area.
- In case of a cell-structured display device, the image area may coincide exactly with the display area. In that case no border area remains.
- 4.13 The various presentation elements can have attributes assigned to them as defined in Table 1-1/T.150.

TABLE 1-1/T.150

Attributes of telewriting presentation elements

Presentation element	Attributes
Trace	Line thickness, line texture, colour
Marker	Shape, size, colour
Closed area	Area texture, colour (interaction or area attributes with background attributes to be defined)
Background	Area texture, colour
Border area	Not defined

Note – The concept of colour includes “intensity”.

4.14 Once an image is displayed, subsequent modification of attributes is restricted as follows:

- trace: attributes unchangeable;
- marker: attributes can be changed at any instant;
- closed area: attributes unchangeable;
- background: attributes can be changed at any instant.

4.15 In case of intersection of two traces, the image of the older trace is interrupted as far as it coincides with the newer trace.

4.16 In case of intersection of a trace and a marker, the image of the trace is interrupted as far as it coincides with the marker. After removal of the marker, the image of the original trace is restored.

4.17 With respect to erasure of foreground information, a distinction is made regarding the area in which erasure takes place:

- full image area;
- defined part of the image area;
- individual traces.

4.18 *Erasure of the full image area*

All foreground information in the image area is removed; the background assumes a pre-defined appearance.

4.19 *Erasure of a defined part of the image area*

An area is identified either by means of a closed trace or as a defined square, within which all foreground information is to be removed including the perimeter itself.

4.20 *Erasure of individual traces*

An existing trace is covered by a thicker trace with the same attributes as the background: this type of erasure is processed in the same way as a trace.

4.21 Any modification of background information can take place for the full image area only.

5 Principles of telewriting coding

5.1 Telewriting coding relates to coding of telewriting information in foreground and background and to erasure functions.

5.2 This section contains principles of telewriting coding. In Parts 3 and 4, details of telewriting coding are defined for two methods, namely zone coding and differential chain coding, respectively.

5.3 The coding is defined at the “telewriting coding interface”, TCI. This interface is introduced for ease of reference, but need not exist physically.

5.4 In the sending part of the telewriting terminal, the signal at the TCI contains all data originating from handwritten input, selection of attributes and use of erasure functions.

5.5 The signals at the TCI, both in sending and receiving parts, do not contain data pertaining to transmission or communication functions.

5.6 In the receiving part of the telewriting terminal, the signal at the TCI contains all data required to image the information in accordance with the intentions of the originator.

5.7 The concept of the TCI is illustrated in Figure 1-2/T.150.

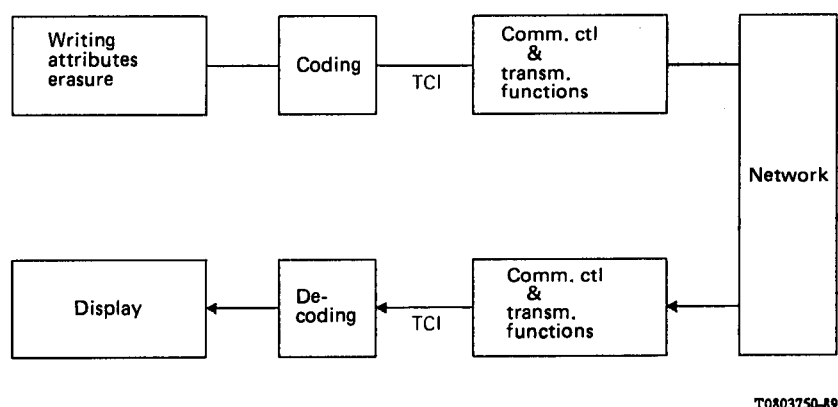


FIGURE 1-2/T.150
Telewriting coding interface, TCI

5.8 The signal at the TCI includes x and y coordinate information regarding telewriting presentation elements.

5.9 The x and y coordinates are related to a unit area of 1×1 . This implies that the respective values of x and y always lie between 0 and 1 (0 included, 1 not included).

5.10 The origin of the coordinate system is in the lower left corner. The x-axis is horizontal, the y-axis is vertical.

5.11 The horizontal size of the telewriting image area corresponds with $x = 1$, the vertical size of this image area corresponds with $y = 0.75$. See Figure 1-3/T.150.

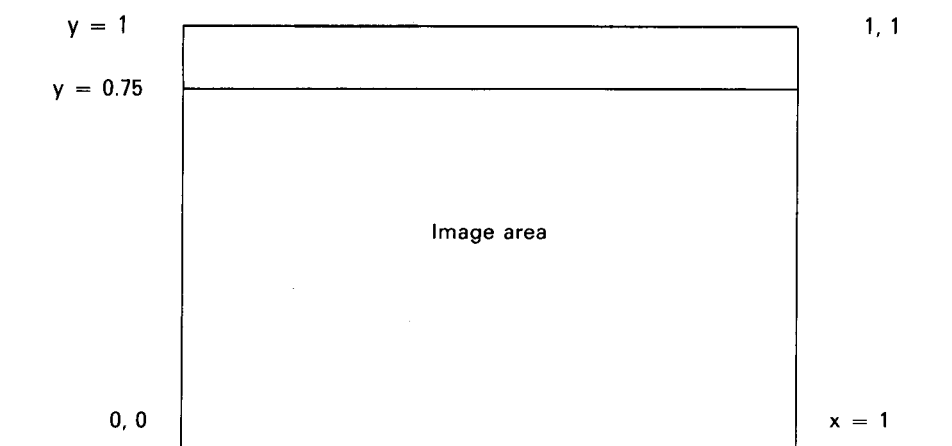


FIGURE 1-3/T.150
Position of image area within unit area

5.12 All coordinates of the telewriting information are quantized relative to a measurement grid in the unit area. The resolution of this grid determines the accuracy.

5.13 The default resolution is 512×512 grid units. The telewriting coding can optionally also accommodate grid resolutions of 1024×1024 and 2048×2048 grid units.

Part 2 - Telewriting together with telephony

1 General

- 1.1 This part of the Recommendation defines the use of telewriting in combination with voice communication through a telephone network (PSTN).
- 1.2 For this application, both sides of the connection must have a combined telephone and telewriting terminal.
- 1.3 The combined telephone and telewriting terminal should, as long as the telewriting transmission function is switched off, behave like a normal telephone set, both for incoming and outgoing calls. In this situation, the full bandwidth is available for transmission of speech signals.
- 1.4 During a telephone conversation, the telewriting transmission function at either side of the connection, may be switched on and off, manually or automatically.
- 1.5 Remark that in this part of the Recommendation “switching on and off” of the telewriting function refers to the telewriting transmission functions. Regardless of this, the telewriting equipment may be used locally, whether or not a telephone connection exists.
- 1.6 By means of the telewriting terminal, the user can generate information. This includes: creation of traces, marker switching on and off, movement of the marker, use of erasure functions.
- 1.7 In this part, distinction is made between “basic terminal” and “enhanced terminal”.
- 1.8 The enhanced terminal is not defined yet, but compared to the basic terminal it is anticipated to have additional capabilities regarding unattended operation, transmission facilities and presentation functionalities.

2 Main characteristics of the basic terminal

- 2.1 In this section, a basic terminal is defined.

In the basic terminal a set of functions is implemented that is to be considered as a minimum requirement; thus a basic level of compatibility is defined.
- 2.2 A basic terminal includes a telephone apparatus, a writing device and a display device. Circuitry to implement control functions may be accommodated in a separate unit or may be included in one of the devices mentioned.
- 2.3 Information generated at either side of the connection will be reproduced on the display devices at both sides of the connection.
- 2.4 Both sides of the connection can contribute, one after another, to the same image.
- 2.5 In the basic terminal, transmission of telewriting signals is accomplished through a sub-channel, segregated from the speech channel. Transmission of speech signals and telewriting signals can take place simultaneously.
- 2.6 Half-duplex transmission is used for conveying the telewriting signals through the sub-channel, i.e. the transmitter is prevented from sending as long as the associated receiver receives telewriting signals from the other side.
- 2.7 The total power level of speech plus telewriting signals should conform to the limits normally applicable to speech transmission and data transmission.
- 2.8 The basic terminal can assume three modes of operation. The characteristics pertinent to each mode, are described in Table 2-1/T.150.

TABLE 2-1/T.150

Modes of operation of the basic terminal

Speech only	The telewriting function remains in the OFF condition.
Speech plus telewriting	The telewriting function can be switched ON after the establishment of a connection. Speech signals and telewriting signals can be sent simultaneously.
Telewriting only	This mode can be switched ON after the establishment of a connection. The sending of speech signals is blocked, the power level of the telewriting signals is increased correspondingly. Reception of speech signals is still possible.

2.9 In this Recommendation, the expression “telewriting ON” is used as a common indication for either “speech plus telewriting” or “telewriting only”.

2.10 A basic terminal may be able to continue transmission and reception of telewriting signals after termination of the human conversation. In this case, the telewriting transmission function will be switched OFF automatically after completion of the telewriting transmission. (Defined in more detail later on.)

2.11 For the coding of telewriting information, two methods are recognized for use at the sending side: tone coding (defined in Part 3) and differential chain coding (defined in Part 4).

At the receiving side, the basic terminal should be able to properly accept telewriting signals coded according to either method.

3 Presentation functionalities of the basic terminal

3.1 The general description of presentation functionalities, as given in Part 1, § 4, applies.

With respect to this general description certain restrictions apply, as defined in the following points.

3.2 The presentation functionalities as described for the basic terminal are to be regarded as default capabilities.

If required, characteristics of terminals with a higher level of sophistication will be described in a section on enhanced terminal.

3.3 The basic terminal employs a monochrome display device. The writing device generates coded representations of monochrome images only.

3.4 The attributes applying to the basic terminal are given in Table 2-2/T.150.

TABLE 2-2/T.150

Attributes applying to the basic terminal

Presentation elements	Attributes
Image size	Horizontal: 512 GU Vertical: 0.75×512 GU Options, the receiver must be able to accept: Horizontal: 1024 and 2048 GU Vertical: 0.75×1024 and 0.75×2048 GU.
Trace	
– thickness	Unit thickness, as used in the output device. Options: $2 \times$ and $3 \times$ unit thickness.
– texture	Solid, no options.
– colour	Monochrome, as used in the output device. The receiver must be able to accept the codes of traces with colours: red, green, blue, yellow, magenta, cyan, white, black. A black trace has the same colour as the background (used for erasure).
Closed area	
– texture	Solid.
– colour	Same as background colour (used only for partial erasure). The receiver must be able to accept the codes of closed areas with colours: red, green, blue, yellow, magenta, cyan, white, black.
Background	
– texture/colour	No information about the background is transmitted. Background can only be imagined as dark screen. This corresponds with colour black.
Border area	Border area is not specified, no information about the border area is transmitted.
Marker	
– shape	PLUS sign; other shapes may be possible depending on terminal implementation.
– size	Not specified.
– colour	Marker colour is not transmitted; on a monochrome device the marker appears in foreground colour; on a colour device the marker may assume a colour under local control.
Full erasure	Black background is restored.
Partial erasure	1) closed area; 2) overwriting with thicker black trace.

GU Grid units

4 Transmission for the basic terminal

4.1 Transmission of the modulated telewriting signal takes place in a small frequency band, segregated from the speech channel. This band is referred to as the sub-channel.

4.2 The centre of the sub-channel is located at 1750 Hz. Details of the implementation are not given here, but the requirements of §§ 4.6 and 4.7 should be met.

- 4.3 The binary telewriting signal is converted into a signal suitable for transmission, by means of frequency shift modulation. Details are the same as those specified in Recommendation V.21 for channel 2 (the high channel).
- 4.4 The modulation rate is 300 Bd, the bit rate is 300 bit/s.
- 4.5 The V.21 requirements for channel 2 are summarized as follows: The nominal mean frequency of the transmission signal is 1750 Hz. The frequency deviation is + or – 100 Hz. Consequently, the nominal characteristic frequencies are 1850 Hz and 1650 Hz respectively. The higher frequency corresponds to a binary 0.
- 4.6 The amount of speech signal power that can reach the local and remote telewriting receivers, should be sufficiently low to avoid errors in the demodulated telewriting signal.
- 4.7 The amount of telewriting signal power that can reach the local and remote telephone receivers (i.e. the loudspeaker part) should be sufficiently low to avoid disturbance of the conversation.
- 4.8 In the mode of operation “telewriting only”, the output power of the telewriting transmitter shall be in accordance with the requirements described in Recommendation V.21.
- 4.9 In the mode of operation “speech plus telewriting”, the modulated Telewriting signal should be attenuated by 4 dB with regard to the level determined by § 4.8. If experience shows that also the power of the speech signal should be adapted, relevant requirements will be included in the next issue of this Recommendation.
- 4.10 In the case of long-distance communication an echo suppressor may be present in the link. This will hamper the “speech plus telewriting” mode. Since, generally, disabling of the echo suppressor cannot be guaranteed to solve the problem, it is recommended to use the “telewriting only” mode, alternating with the “speech only” mode.
- 4.11 The telewriting data as well as communication control commands are structured in 8-bit bytes.

For transmission, each byte is packed in an 11-bit transmission word as defined below.

- 4.12 The structure of each transmission word is as follows:

1 startbit, binary value ZERO

8 bits representing telewriting or control data

1 parity bit

stopbit, binary value ONE.

This structure is illustrated in Figure 2-0/T.150.

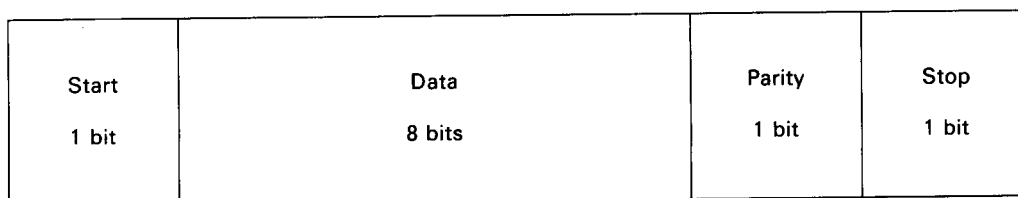


FIGURE 2-0/T.150

Structure of a transmission word

- 4.13 For the value of the parity bit, EVEN parity applies. This Recommendation does not specify any action for the basic terminal in case of reception of an erroneous parity bit.
- 4.14 The transmission words are conveyed in start-stop mode, i.e. the pause following a transmission word until the occurrence of the next transmission word, may in principle have any duration. However, the bits constituting the transmission word should be transmitted as a contiguous sequence at the appropriate bit rate.
- 4.15 In addition to its task of transporting bits, the data send signal may assume one of three possible states:
- MARK signal: a binary ONE condition, with a duration significantly longer than a bit period.
 - SPACE signal: a binary ZERO condition; this condition is not used in the framework of this Recommendation.
 - Carrier OFF: no send signal present.

5 Transmission blocks

5.1 To define the transmission structure, the concept of transmission block is introduced. In the general case, a transmission block contains transmission words and MARK signals. However, also transmission blocks containing MARK signals only may occur.

5.2 The beginning of a transmission block is identified by the occurrence of one out of two defined combinations of MARK signal and carrier OFF condition, referred to as start combination No. 1 and start combination No. 2.

5.3 The start combinations are defined as follows:

- start combination No. 1 carrier OFF during at least 130 ms, followed by MARK signal of 100 ± 20 ms followed by carrier OFF during 100 ± 20 ms followed by MARK signal of 200 ± 20 ms.
- start combination No. 2 carrier OFF during at least 130 ms, followed by MARK signal of 400 ± 20 ms.

See illustration in Figure 2-1/T.150.

The use of these start combinations is defined later.

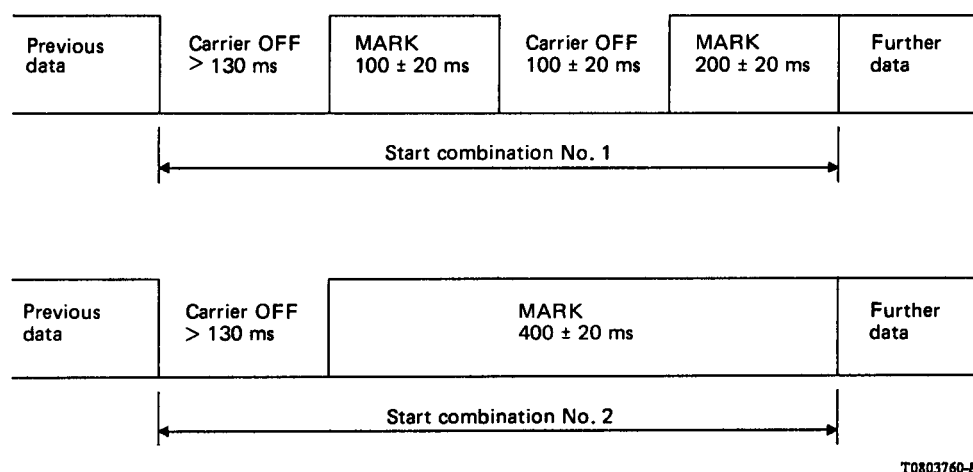


FIGURE 2-1/T.150
Start combinations

5.4 Immediately following the start combination of a transmission block, one of the following signals should be sent:

- a MARK signal
- a single transmission word
- a sequence of transmission words.

Between any two subsequent transmission words, a MARK signal may occur, representing a pause in the writing process.

5.5 Every transmission block is terminated by a MARK signal of 500 ± 20 ms. The MARK signal is to be followed by a carrier OFF condition of at least 130 ms.

5.6 The MARK signals representing pauses may have various durations, determined as follows:

- during PEN DOWN and absence of other telewriting activity, the MARK signal may continue without limitation;
- after PEN UP the terminal will apply a limit of 500 ± 20 ms. Within this limit the telewriting activity may continue without procedural steps. If the limit expires, the carrier will be switched OFF. Thus the transmission block is automatically terminated by the terminal. Sending of further data requires the start of a new transmission block.

- 5.7 The periods between transmission blocks are indicated by carrier OFF conditions.
- 5.8 The formats of transmission blocks are summarized in Figure 2-2/T.150.

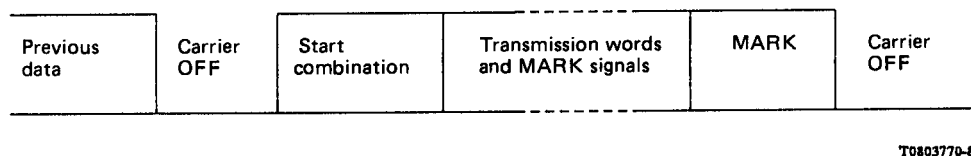


FIGURE 2-2/T.150
Transmission block format, summarized

6 Transmission procedure

6.1 Prior to actually sending telewriting data, the terminal is to decide whether it functions in MASTER mode or in SLAVE mode.

In case of a transmission collision, the master terminal has transmission privilege over slave terminals.

6.2 The terminal decides about the master/slave status by sending the start combination No. 1 and observing the received signal.

6.3 If the terminal, engaged in sending start combination No. 1, detects a received carrier signal at its receiver input (during a carrier OFF interval) it decides to be a slave and it postpones further attempts to send data. See Figure 2-3/T.150.

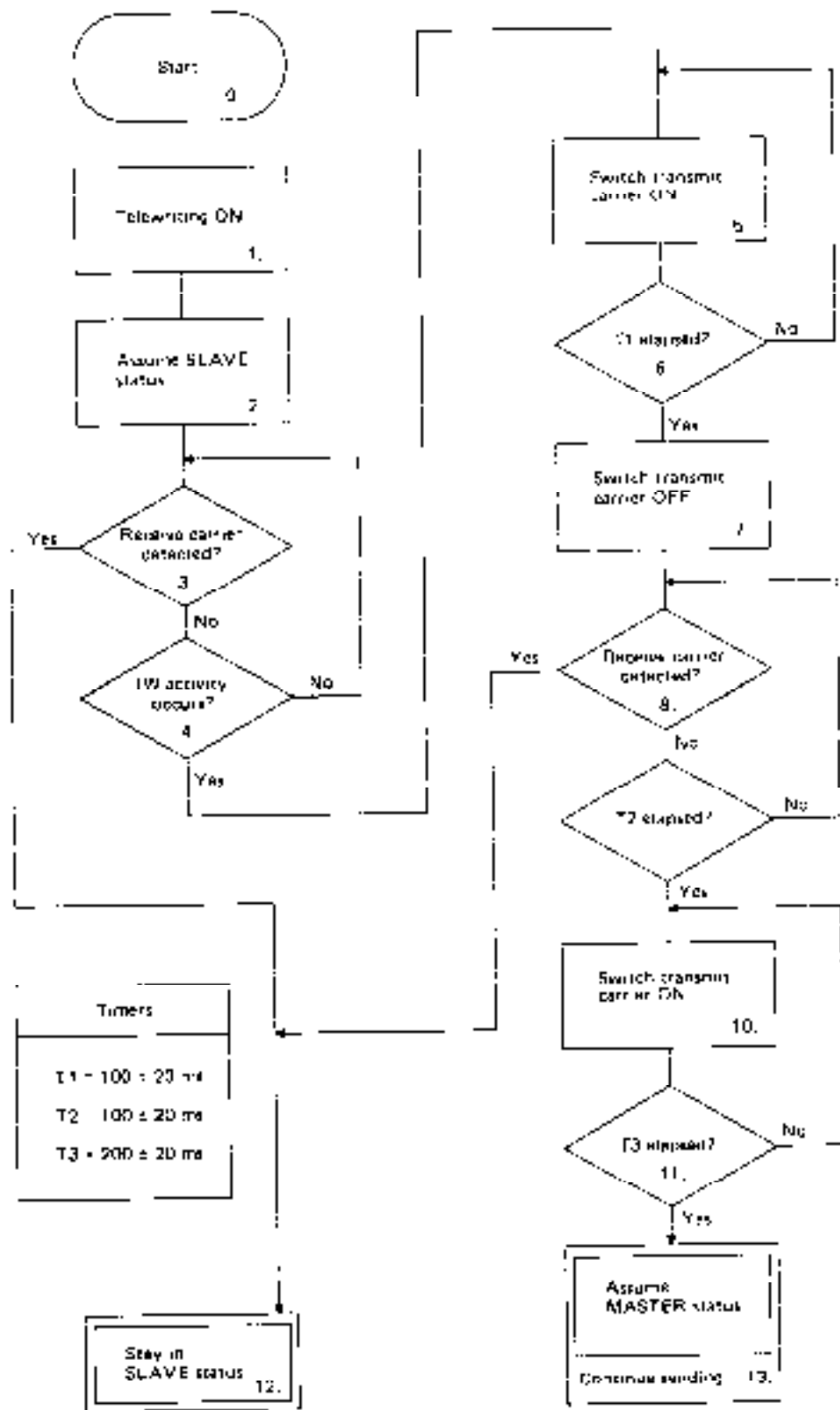
6.4 If the terminal does not detect a received carrier signal during the sending of the start combination, it decides to be a master and continues sending. See Figure 2-3/T.150.

6.5 In the case that only one terminal generates telewriting data, this terminal assumes the master status. The receiving terminal remains in the slave status.

6.6 As a header for the subsequent transmission blocks, a master terminal uses start combination No. 2, a slave terminal uses start combination No. 1. See Figure 2-4/T.150.

6.7 The master/slave status decision in a given terminal remains valid until it is cancelled as follows:

- A master terminal becomes a slave if it is not engaged in sending at the moment that another terminal sends start combination No. 1.
- A slave terminal becomes a master terminal at the moment that it sends a start combination No. 1 and no receive carrier signals are being detected.
- A master status is cancelled by “telewriting OFF”.



T3M03182-45

FIGURE 2-3/T.150
MASTER/SLAVE status decision procedure

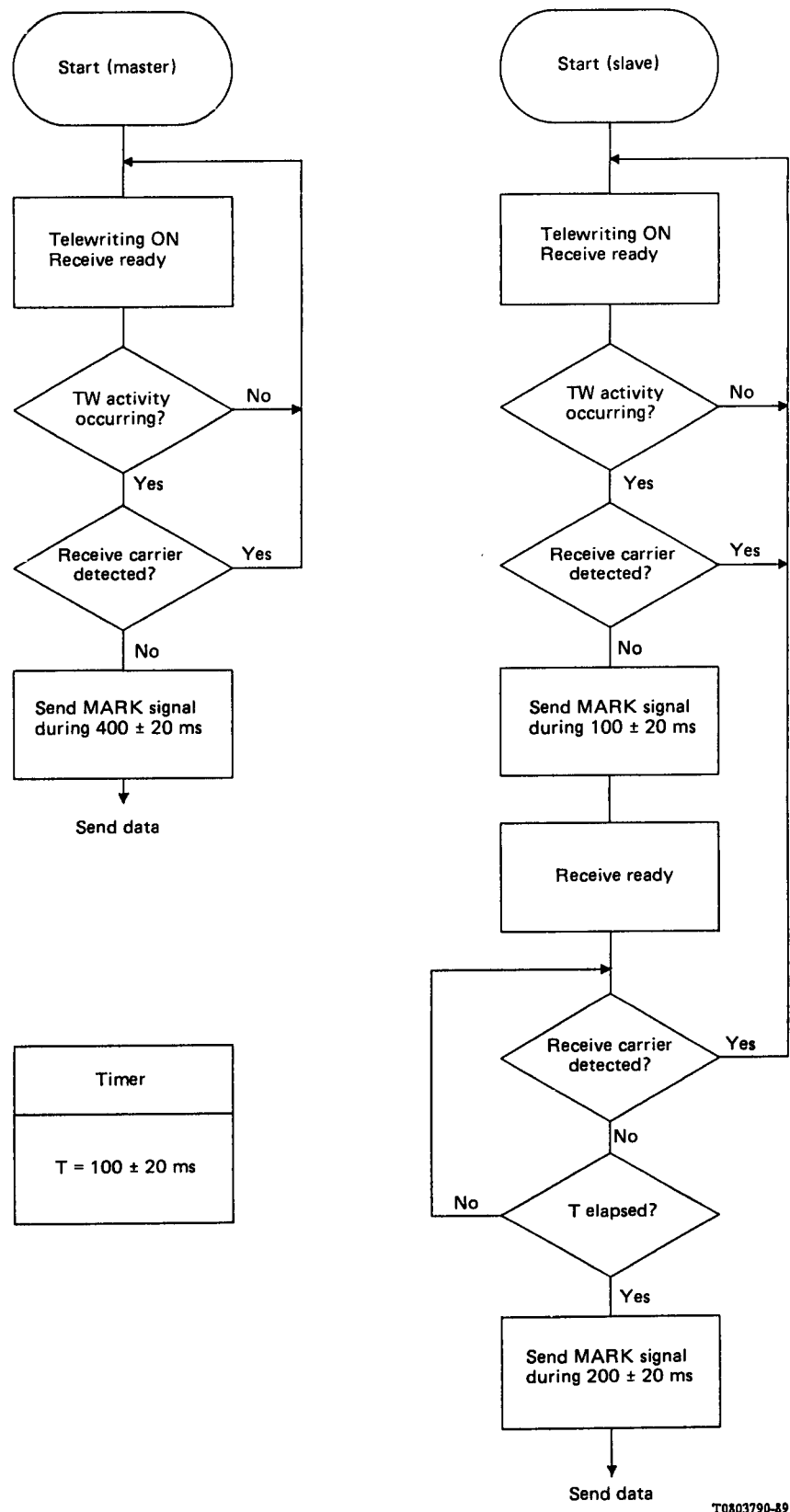


FIGURE 2-4/T.150
Transmission start for master and slave respectively